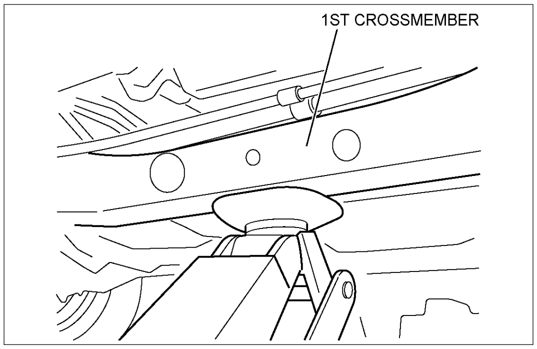
ISUZU
KB P190
MY 2007
WORKSHOP
REPAIR MANUAL
MAIN INDEX

ISUZU

CONTENTS

LIFTING POINT; FRONT

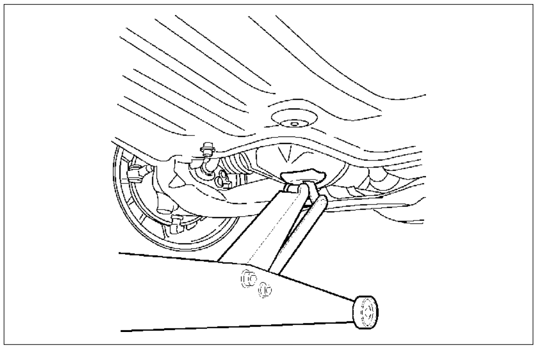
4×2 model



RUW50ASH000101

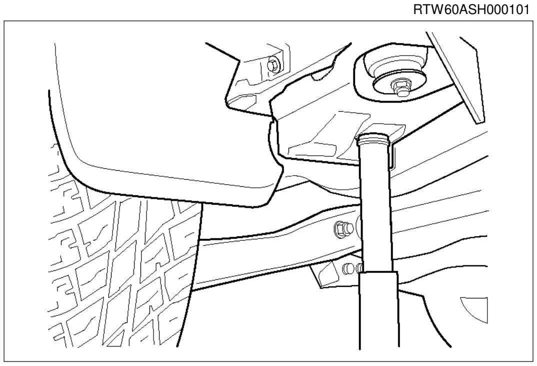
- When using floor jack, lift the center of 1st cross member.

4×4 model


RTW60ASH000101

- When using floor jack, lift the center of front axle case.

SUPPORTABLE POINT; FRONT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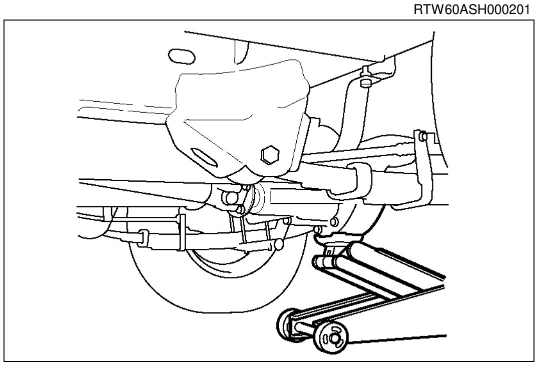
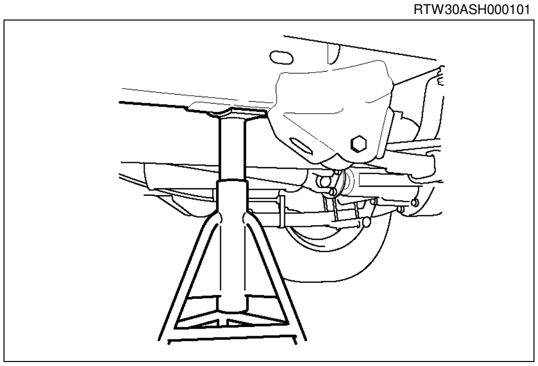
- Position the chassis stands at the bottom of the frame side member, backward of front wheel.

LIFTING POINT; REAR


RTW30ASH000101

- When using floor jack, lift the center of rear axle case.

SUPPORTABLE POINT; REAR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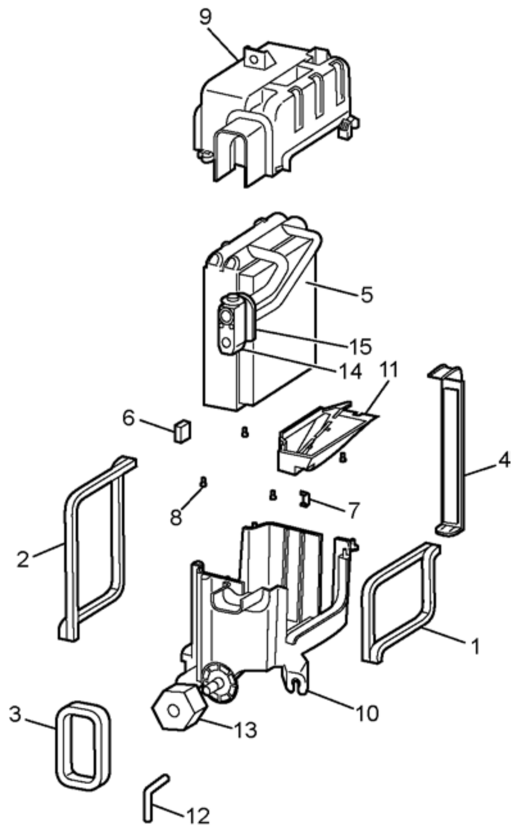
- Position the chassis stands at the bottom of the frame side member, forward of the rear wheel.

DISASSEMBLY AND REASSEMBLY



This illustration is based on RHD model

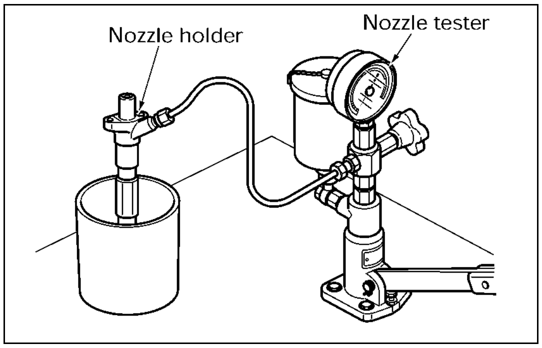
RTW710MF000901

Disassembly Steps

1. Packing cooler outlet
2. Packing cooler inlet
3. Seal FOD cooler
4. Filter cover assembly
5. Air filter
6. Electronic thermostat
7. Clip heater
8. Attaching screws
9. Case : cooler upper
10. Case : cooler lower
11. Insulator : case lower
12. Drain hose
13. Packing drain
14. Evaporator assembly W/Expansion valve
15. Grommet : A/C pipe

Reassembly Steps

15. Grommet : A/C pipe
14. Evaporator assembly W/Expansion valve
13. Packing drain
12. Drain hose
11. Insulator : case lower
10. Case : cooler lower
9. Case : cooler upper
8. Attaching screws
7. Clip heater
▲ 6. Electronic thermostat
5. Air filter
4. Filter cover assembly
3. Seal FOD cooler
2. Packing cooler inlet
1. Packing cooler outlet



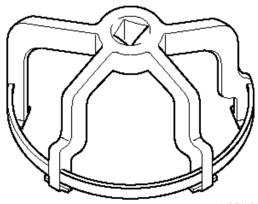
040MV030.tif

4. Set the nozzle holder to the nozzle tester and check first nozzle opening pressure, spray condition, seat oil tightness and each part for oil leaks.
5. When replacing the nozzle, replace the nozzle, lift piece, pins and spacer as a set with the nozzle service kit.

CAUTION:

Pre-lift will not be as specified if only the nozzle is replaced.

SPECIAL TOOLS

ILLUSTRATION	TOOL NUMBER	TOOL NAME
 140RW009	5-8840-2602-0 (J-39765)	Remover: fuel pump retainer ring

SECTION 6D

ENGINE ELECTRICAL

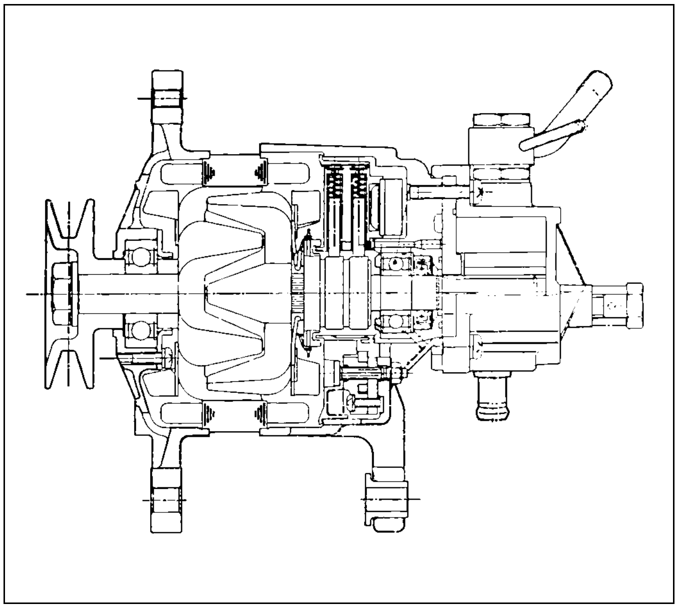
TABLE OF CONTENTS

MAIN DATA AND SPECIFICATIONS

Item		Description	
		60A	80A
Generator			
Type		AC generator with IC regulator and vacuum pump	
		Hitachi LR160-503E	Hitachi LR180-513B
Voltage	V	12	
Drive and rotation		V-belt, clockwise viewed from the drive pulley	
Ground polarity		Negative	
Maximum output	A	60	80
Engine speed ratio	to 1	1.788	
Maximum speed	rpm	11,000	
Weight with vacuum pump	kg(lb)	5.8(12.8)	6.4(14.1)
Vacuum Pump			
Delivery volume	cm^3/rev	50	
Exhaust Characteristic		-66.7 kPa (-500 mmHg) bulid up time 21 seconds or less at 1,000 rpm	
		7 seconds or less at 5,000 rpm	
Maximum vacuum		-90.7 kPa (-680 mmHg) or more	
Starter Motor			
Type		Solenoid controlled	
		Hitachi S13-555	
Rated voltage	V	12	
Rated output	kW	2.3	
Load characteristics			
Terminal voltage	V	8.76	
Load current	A	300	
Weight	kg(lb)	4.7 (10.4)	

GENERAL DESCRIPTION

GENERATOR



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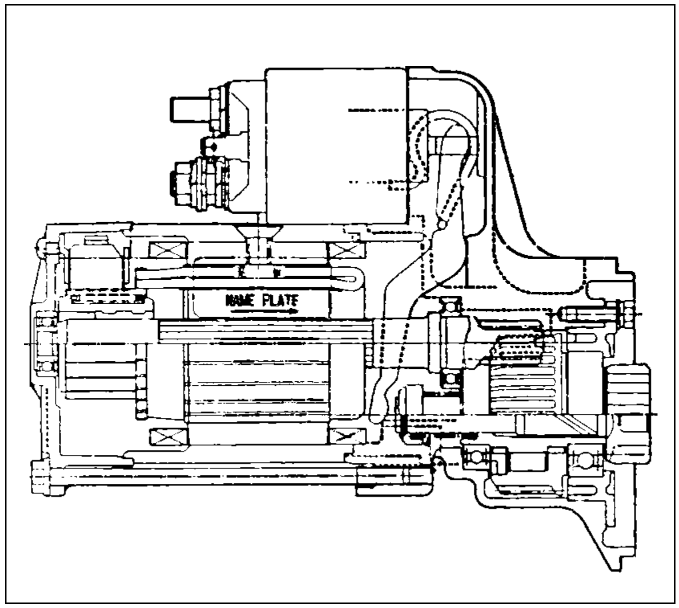
STARTER MOTOR



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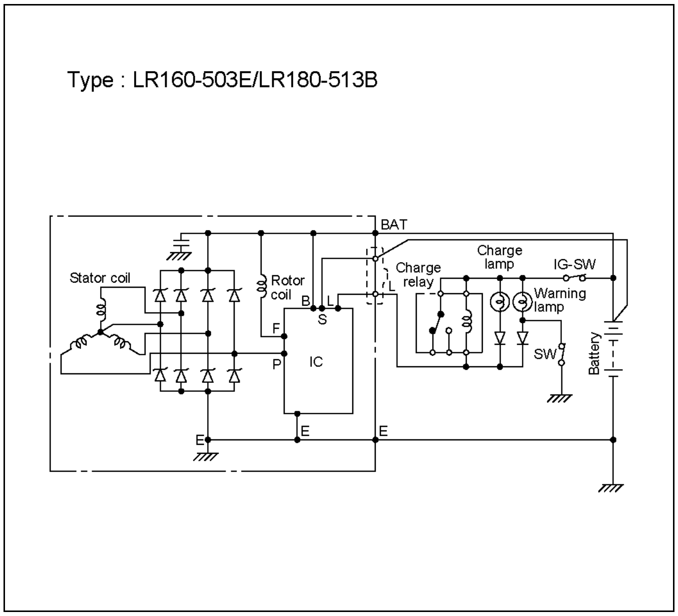
The basic charging system is the IC integral regulator charging system. The internal components are connected electrically as shown in charging circuit diagram.
The generator features a solid state regulator that is mounted inside the generator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The generator voltage setting cannot be adjusted.
The starter motor circuit is composed of a 4-pole 4-brush type direct current series motor. The starter motor circuit utilizes negative ground polarity.

CHARGING CIRCUIT DIAGRAM



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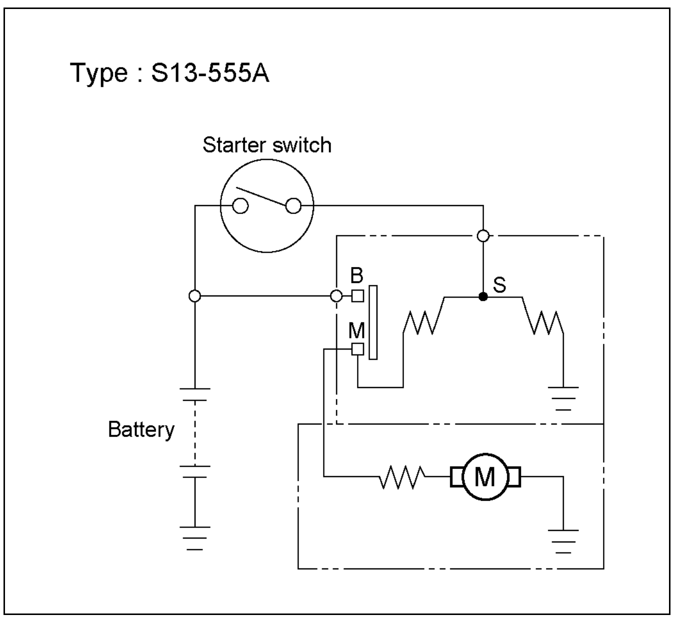
STARTING CIRCUIT DIAGRAM



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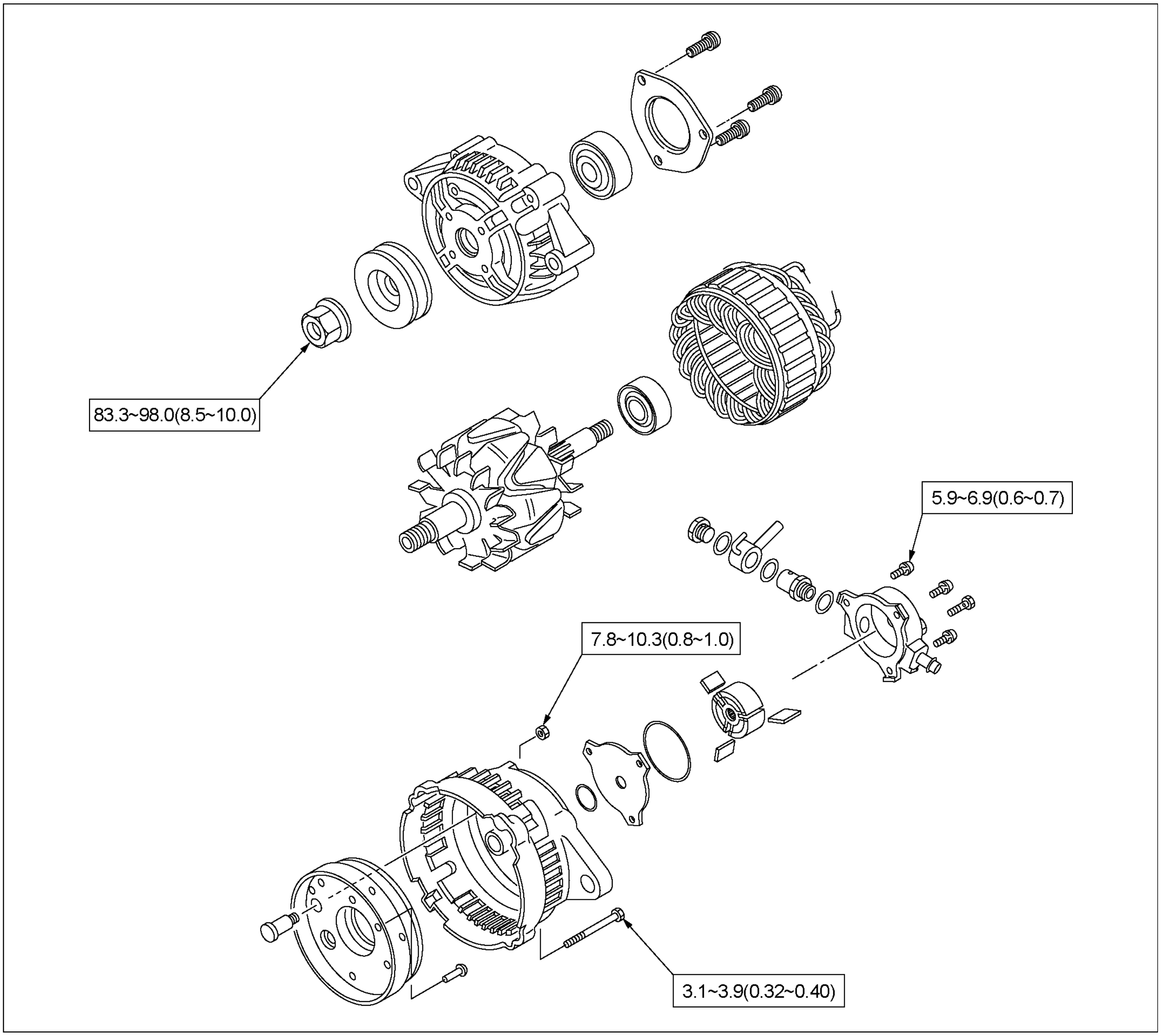
TORQUE SPECIFICATIONS

GENERATOR

N·m (kg·m/lb·ft)



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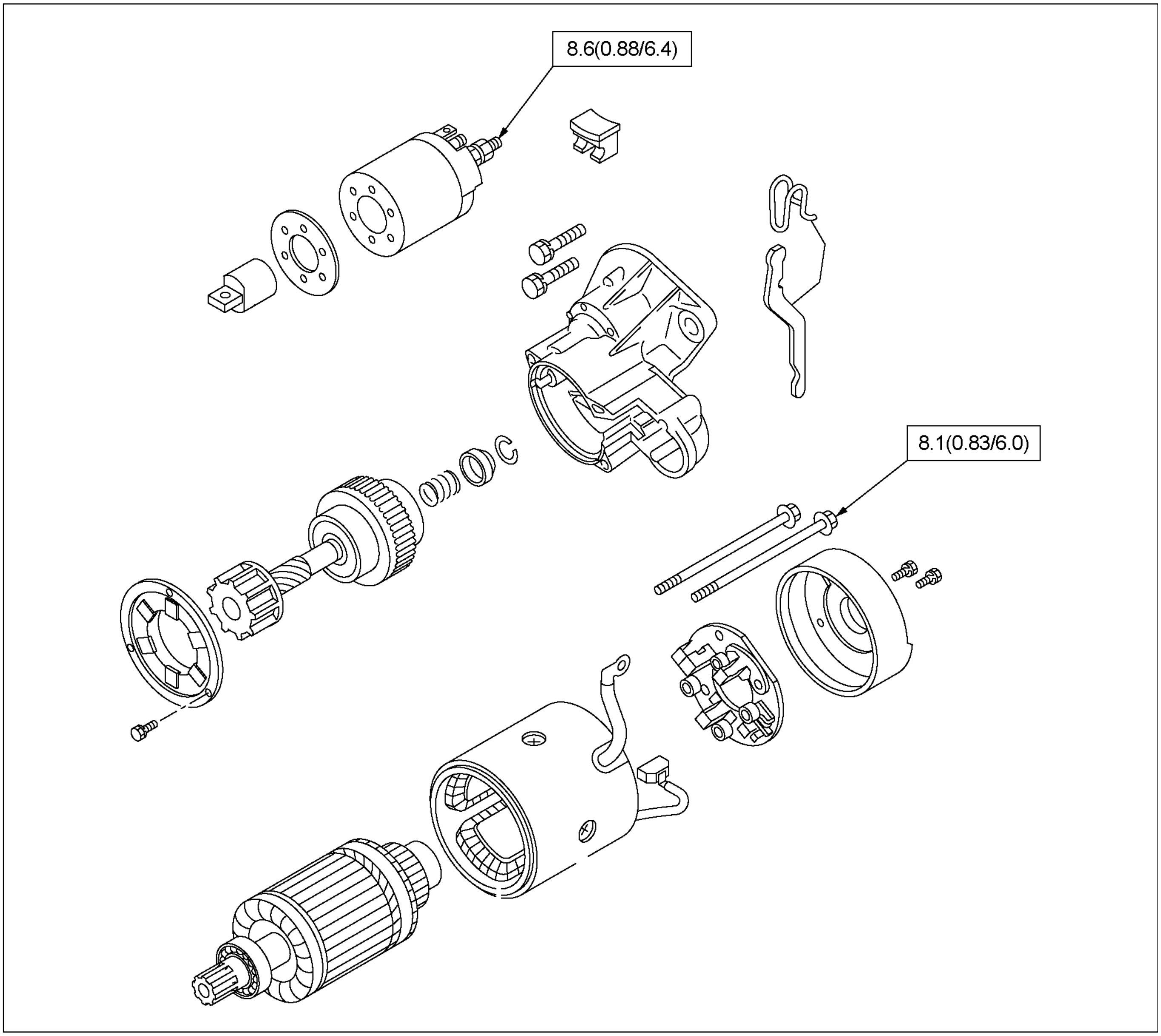
STARTER MOTOR

N·m (kg·m/lb·ft)



RTW46DLF000301

GENERATOR

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

P1010002

Important Operations-Removal

Cooling Fan Belt

1. Disconnect the battery cables at the battery terminals.
2. Loosen and remove the fan belt adjusting plate bolts.
3. Remove the fan belt from the generator drive pulley.

Generator

1. Remove the vacuum pump hose.
2. Remove the generator bolt and the generator from the bracket.

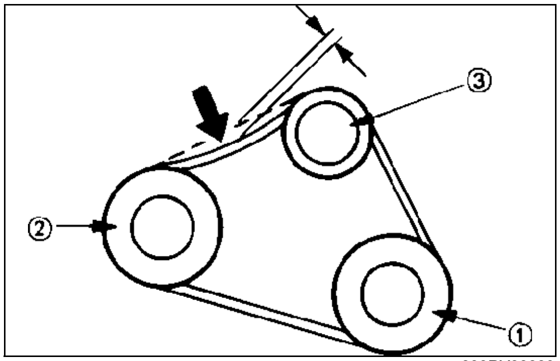
Important Operations-Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

Generator

1. Install the generator to the bracket.
2. Tighten the generator bolt to the specified torque.
3. Install the vacuum pump hose.

Generator Bolt Torque	N·m (kg·m/lb·ft)
40 (4.1/30)	



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Cooling Fan Drive Belt

1. Hold the generator toward the engine.
2. Install the fan belt to the three pulleys.
   1 Crankshaft pulley
   2 Generator pulley
   3 Cooling fan drive pulley
3. Adjust the fan belt tension
   Fan belt tension is adjusted by moving the generator. Depress the drive belt mid-portion with a 98N (10 kg/22 lb) force.

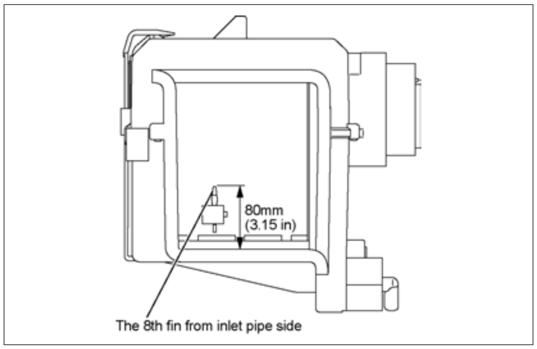
Cooling Fan Drive Belt Deflection mm (in)

New belt	4 - 7 (0.16 - 0.28)
Reuse belt	6 - 9 (0.24 - 0.35)

4. Tighten the adjusting plate bolts to the specified torque.

Adjusting Plate Bolt	N·m (kg·m/lb·ft)
19 (1.9/14)	

5. Reconnect the battery cable to the battery.



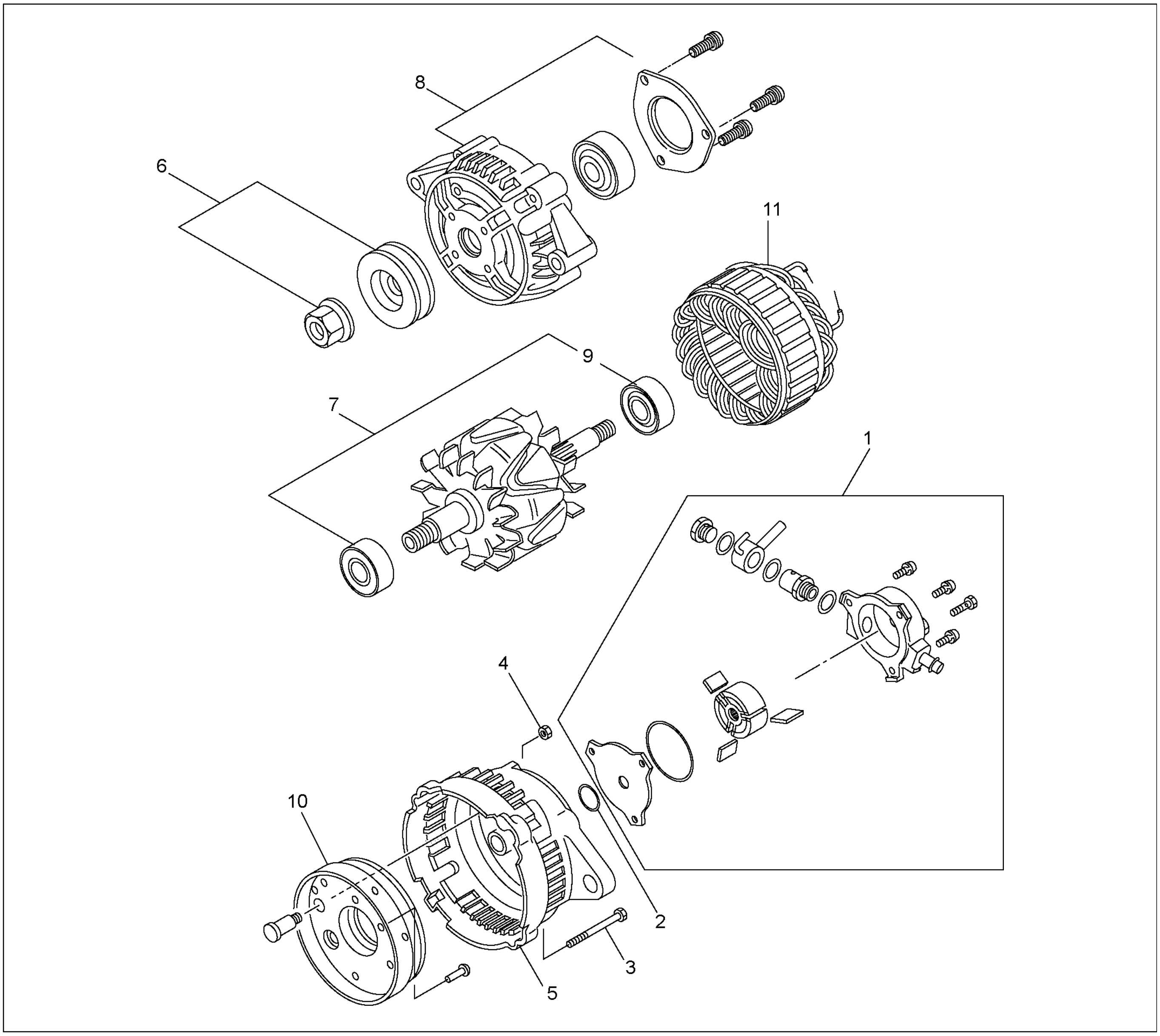
This illustration is based on RHD model

Important Operation -Reassembly

6. Electronic Thermostat

1) Install the electronic thermostat to the evaporator core specified position with the clip.
2) Sensor part must not interfere with the evaporator core.

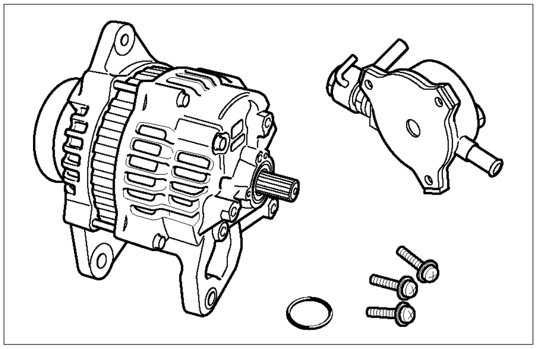
DISASSEMBLY



RTW46DLF000401

Disassembly Step

1. Vacuum pump
2. O-ring
3. Through bolt
4. B Terminal nut
5. Rear cover
6. Pulley
7. Rotor assembly
8. Front cover assembly
9. Rear rotor bearing
10. Rectifier assembly
11. Stator assembly
12. Rotor assembly



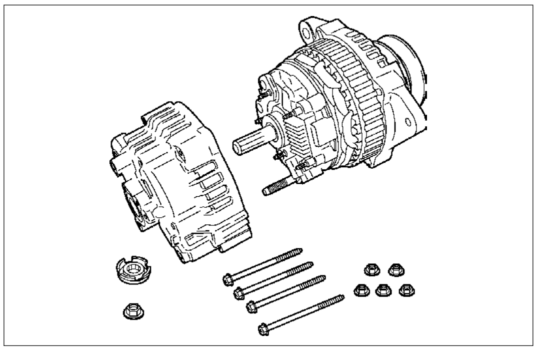
RTW46DSH000101

Important Operations

1. Vacuum Pump

1. Loosen the vacuum pump fixing screws.
2. Support the vacuum pump O-ring.
3. Carefully remove the O-ring.

2. Cover



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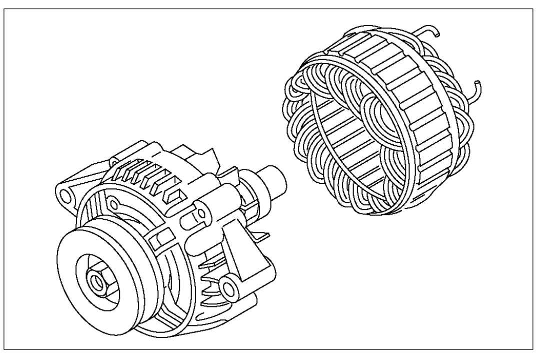
3. Through Bolt

1. Remove the M5 through bolt.
2. Separate the front and rear sides of the vacuum pump.
3. Insert the tips of 2 ordinary screwdrivers into the space between the front cover and the stator core. Remove the front cover and rotor together with the rear cover and stator.

If removal is difficult, push the rear cover to the side and lightly tap the end of the shaft with a plastic hammer to loosen it.

- The front cover oil seal must be replaced with a new one when the front cover is removed.
- Take care not to damage the stator core with the screwdriver tips.



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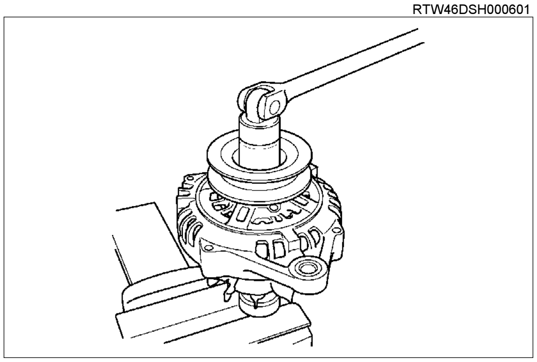

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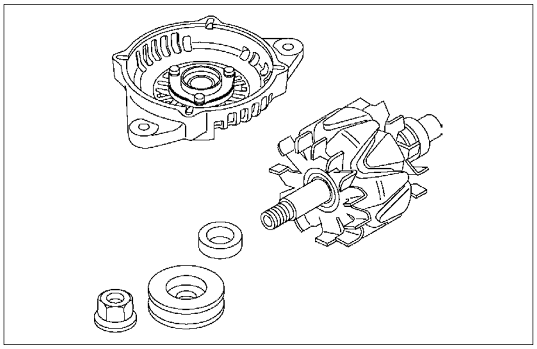
4. Pulley

1. Carefully clamp the rotor assembly in a vise.
2. Loosen the pulley nut.
3. Remove the pulley and the front cover from the rotor.



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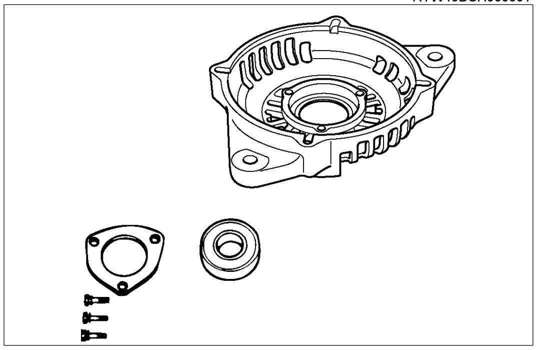
7. Rotor Assembly

1. Remove the rotor from front cover assembly.

Remove the front cover stator and rectifier.



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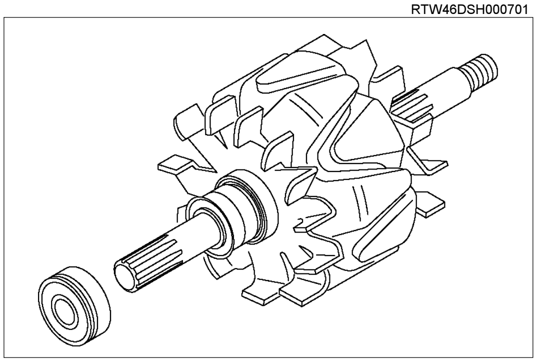
8. Front Cover Assembly

1. Remove the front cover bearing retainer screws.
2. Remove the bearing.



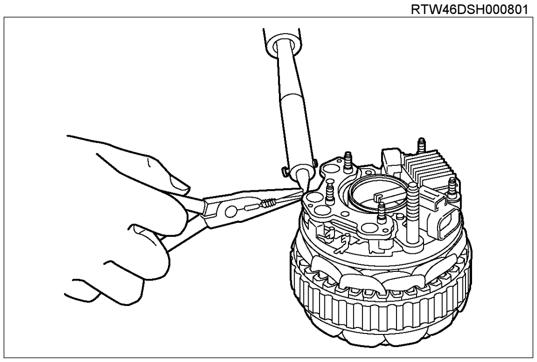
RTW46DSH000801

9. Rear rotor bearing

- Re-use improper parts.

10. Rectifier

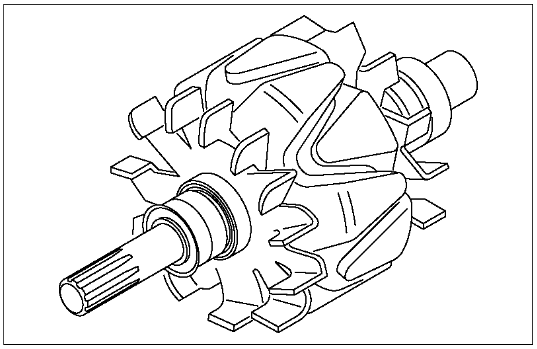
1. Disconnect the stator coil leads between each rectifier by melting the solder connection.
   Hold the lead wire between the solder and the rectifier with a pair of long nose pliers.
   This will prevent heat transfer and resultant damage to the rectifier.



RTW46DSH000401

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.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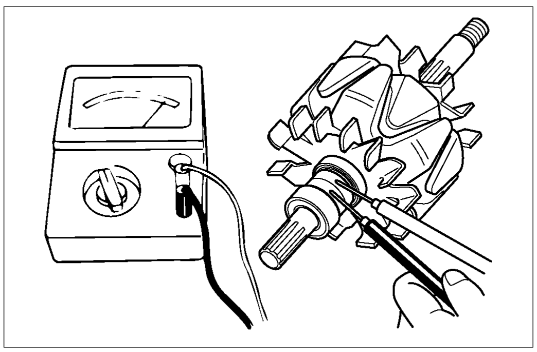
ROTOR ASSEMBLY

1. Inspect the slip ring faces for dirt and pitting.
   Wipe away any dirt with a clean cloth soaked in alcohol.
2. Measure the slip ring diameter.

Slip Ring Diameter mm (in)

Standard	Limit
31.6 (1.245)	30.6 (1.183)

If the slip ring diameter is less than the specified limit, the slip rings must be replaced.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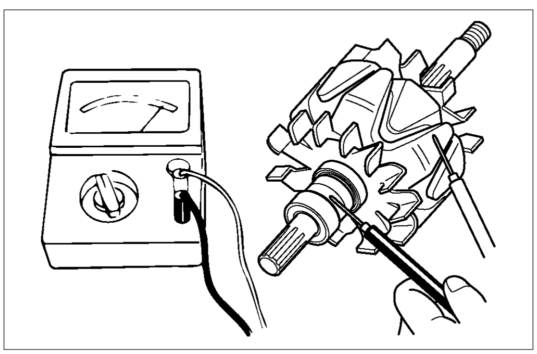
3. Measure the rotor coil resistance.

Rotor Coil Resistance at 20°C (68°F) ohms

Standard	3.8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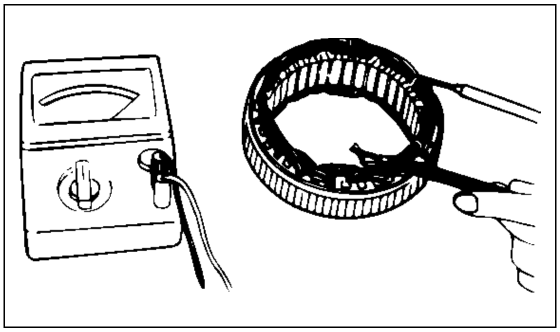
4. Check for continuity between the slip rings and the rotor core or shaft.
   If there is continuity, the entire rotor assmbly must be replaced.

STATOR COIL ASSEMBLY



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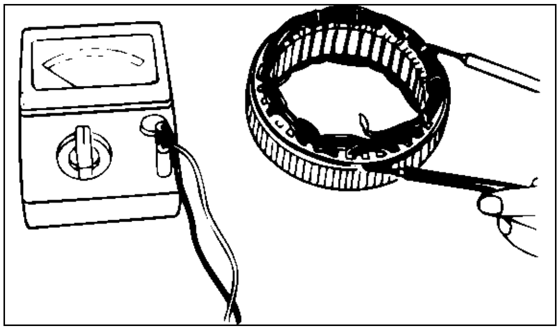
1. Check for continuity across the stator coils.
   If there is no continuity, the stator coils must be replaced.

Resistance Between The Terminal “N” and the Coil Ends (Reference) ohms

Standard	0.1



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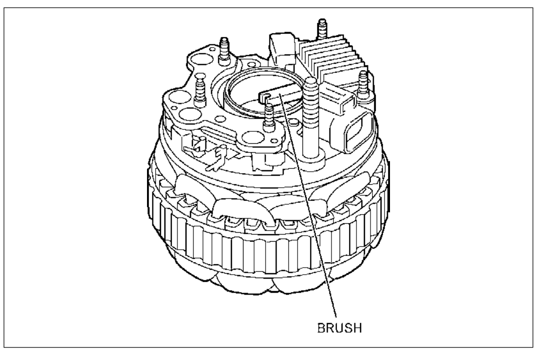
2. Check for continuity between each stator coils and the stator core.
   If there is continuity, the stator coils must be replaced.

BRUSH



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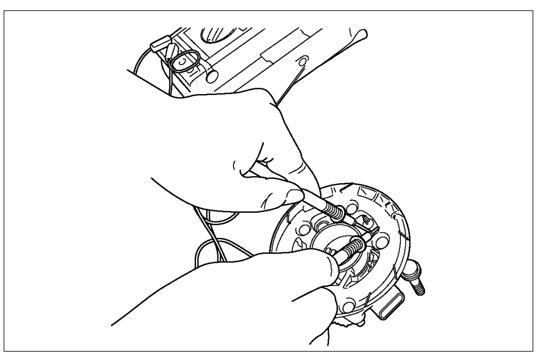
Measure the length of the brush. If abrasion has reduced the brush length to less than 6.5 mm, the brush must be replaced with a new one.

A wear line is inscribed in the brush. If the line is not visible, the brush must be replaced.

Brush Length (Reference) mm (in)

Standard	Limit
25 (1.0)	6.5 (0.25)

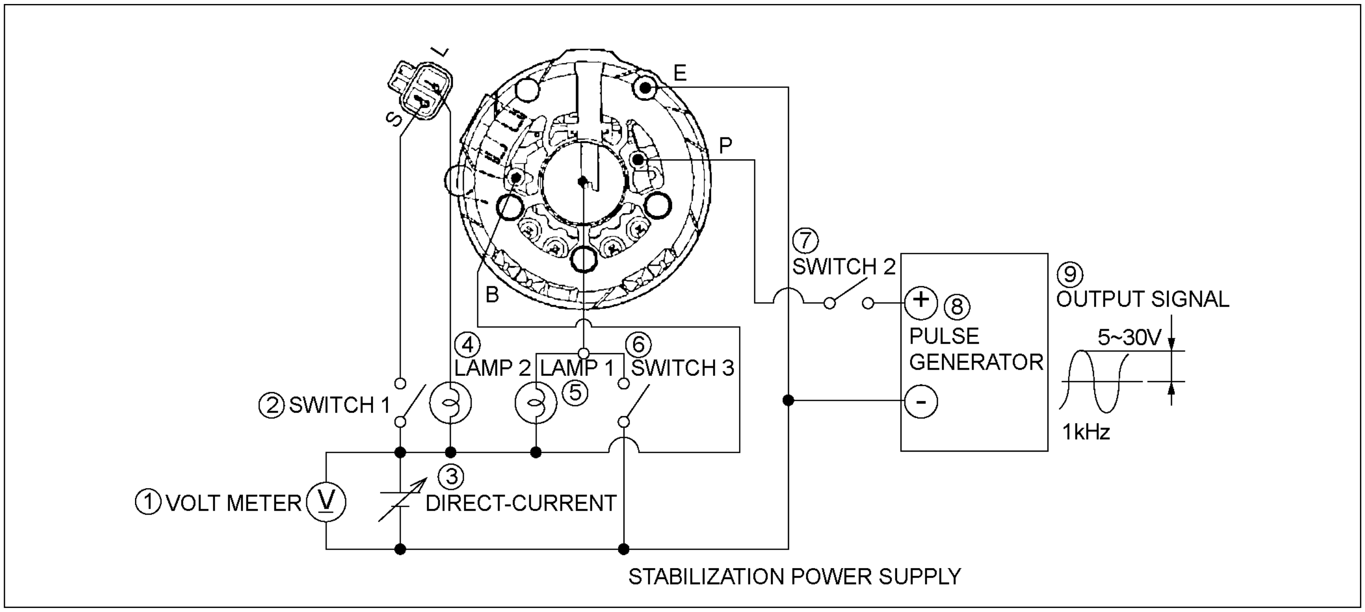
Rectifier



RTW46DSH001201

Tester wire						
E U, V, and WN	⊕	⊖		BAT U, V, and WN	⊕	⊖
⊕	-----	Conductivity		⊕	-----	No conductivity
⊖	No conductivity	-----		⊖	Conductivity	-----
Negative side diode check				Positive side diode check		

RECTIFIER ASSEMBLY



RTW46DSF000301

1. Voltmeter
2. Switch 1
3. DC regulated power supply
4. Lamp 2
5. Lamp 1
6. Switch 3
7. Switch 2
8. Pulse generator
9. Output signal

Test circuit

Refer to the judgment criteria shown in the Table below. Carefully check Items 1~5. If all the items are OK, the IC regulator is normal.

Circuit components

1	DC regulated power supply	0~20 volts variable with output of 1 ampere or more
2	Lamps (2)	12 volts, 1.4~3.4 watts
3	Switches (3)	-----
4	DC voltmeter	0~30 volts, 0.5 grade
5	Pulse generator (Oscillator)	5~30 volt output at a frequency of 1kHz

Judgment criteria

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Switch 1</th><th rowspan="2">Switch 2</th><th rowspan="2">Switch 3</th><th rowspan="2">Voltmeter reading</th><th colspan="2">Lamp condition</th><th rowspan="2">Remarks</th></tr>
<tr><th>Lamp 1</th><th>Lamp 2</th></tr>
<tr><td>1</td><td>ON</td><td>OFF</td><td>OFF</td><td rowspan="2">12V</td><td>On (dim)</td><td>ON</td><td>Initial excitation check</td></tr>
<tr><td>2</td><td>ON</td><td>ON</td><td>OFF</td><td>On or flashing</td><td rowspan="2">OFF</td><td>Full excitation check</td></tr>
<tr><td>3</td><td>ON</td><td>ON</td><td>OFF</td><td>16V</td><td>Off or on (dim)</td><td>Lamp 1 off or dimly lit when the voltmeter shows less than 12 volts or 16 volts</td></tr>
<tr><td>4</td><td>OFF</td><td>ON</td><td>OFF</td><td>12V</td><td>On or flashing</td><td rowspan="2">ON</td><td>Stator and brush separation check</td></tr>
<tr><td>5</td><td>ON</td><td>ON</td><td>ON</td><td>18V</td><td>On</td><td>Excess voltage check</td></tr>
</table>

Oil seal

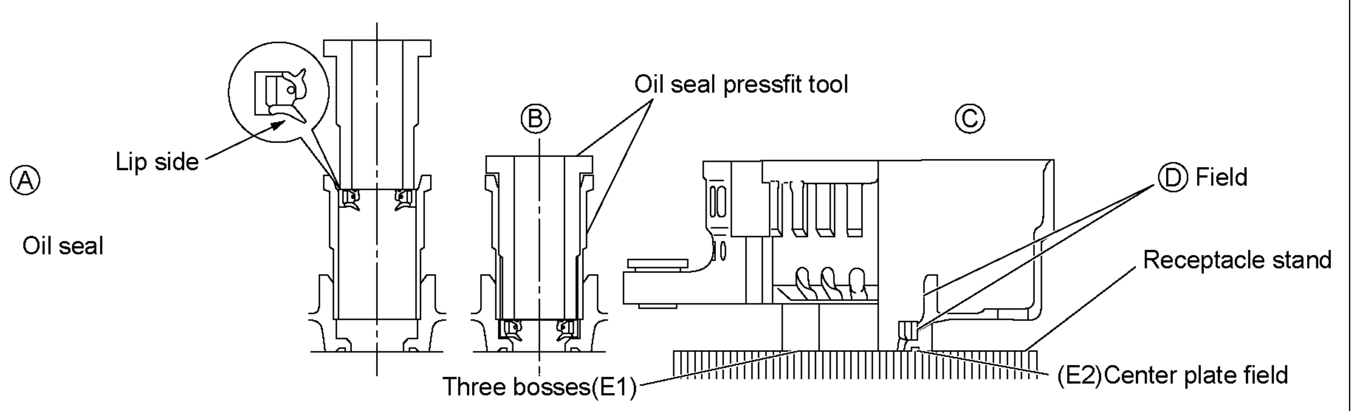
The oil seal must be replaced with a new one whenever the alternator is disassembled.

Oil Seal Replacement

1. Push the old oil seal from the rear bracket outside holes.
2. Use the insertion tool to press the new oil seal into place. Follow the procedure shown in Figures A, B, C and D.
   - Position the oil seal beneath the shaft and the guide lip.
   - Position the cradle against the rear cover bosses (3 points) so that the E1 and E2 surfaces fit into the cradle. Take care not to damage the E1 and E2 surfaces.
   - After completing the procedure, carefully check the oil seal seating. Be absolutely sure that the seal is evenly inserted (no warp) and level with the surrounding surfaces.

Caution

- **Be sure that no foreign material enters the space between the oil seal and the rotor shaft surfaces during the installation procedure.**
- **Take care not to damage the D surface.**
- **Under no circumstances may the original oil seal be reused.**
- **The oil seal must be perfectly flat after being pressed into place. If the oil seal is tilted, there will be oil leakage.**



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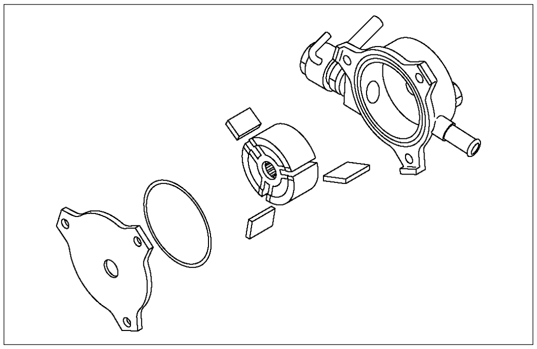


RTW46DSH000901

Vacuum Pump

Vacuum Pump Disassembly

1. Remove the center plate from the vacuum pump housing.
2. Remove the vacuum pump rotor and the vanes from the housing.

Inspection

Vacuum Pump Housing and Center Plate

Inspect the vacuum pump housing and the center plate for excessive wear, abrasion, and scoring.

If any of these conditions are present, the vacuum pump housing and center plate must be replaced.

Vane

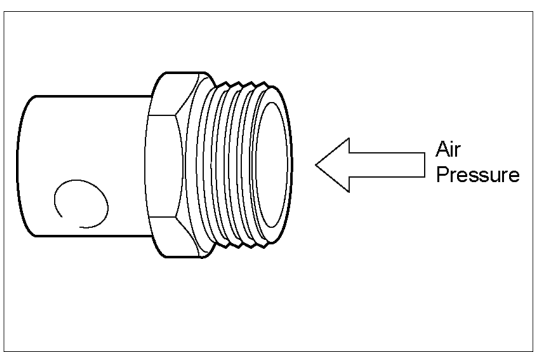
Inspect the vanes for excessive wear and damage.

Replace all four vanes if either of these conditions are present.

Never replace only one vane.

Rotor

1. Inspect the rotor for excessive wear, abrasion, and scoring.
   Pay particular attention to the internal spline.
   Replace the rotor if any of these conditions are present.
2. Inspect the generator rotor shaft splines for backlash.
   Replace the rotor if backlash is present.



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Check Value

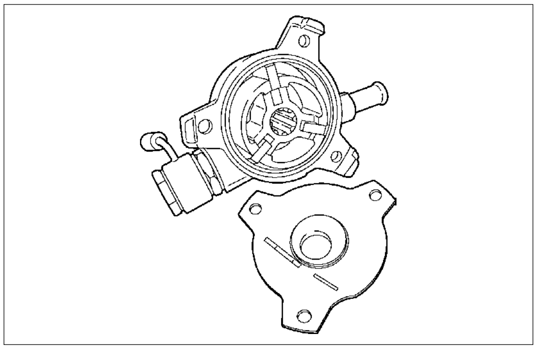
1. Carefully force the valve from the "B" side as shown in the illustration.
   The valve must move smoothly.
   If it does not, the check valve must be replaced.
2. Apply compressed air to the "A" side.

Air Pressure	kPa (kg/cm^2/psi)
98 - 490 (1-5/14 – 71)	

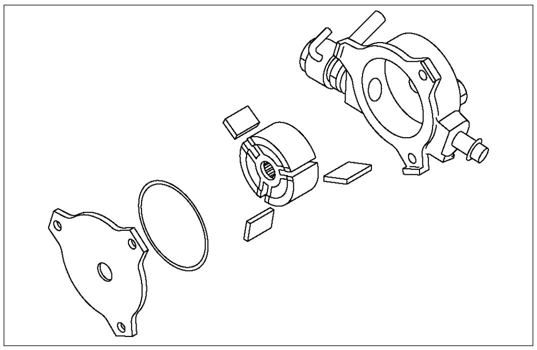
Check for air leakage from the check valve.

If there is air leakage, the valve must be replaced.

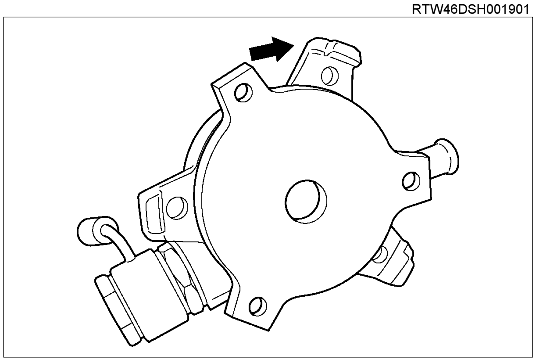
Vacuum Pump Reassembly


RTW46DSH001801

1. Install the vanes to the rotor slits.
   The rounded side of the vanes must be facing the rotor housing.

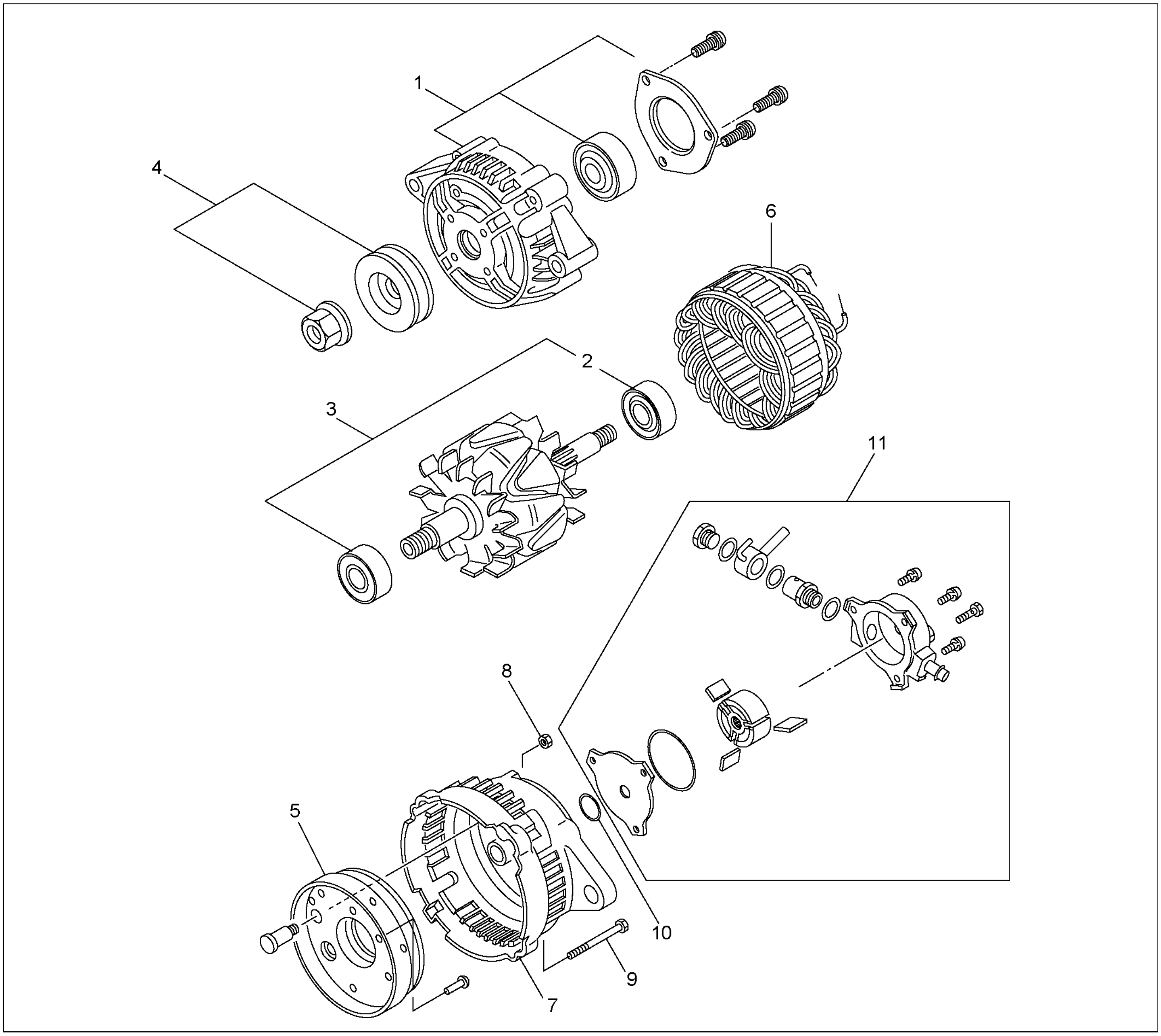

RTW46DSH001901

2. Install the rotor with the concave side facing the center plate.


RTW46DSH002001

3. Install the center plate to the rotor housing.
   Be sure to use a new O-ring.

REASSEMBLY



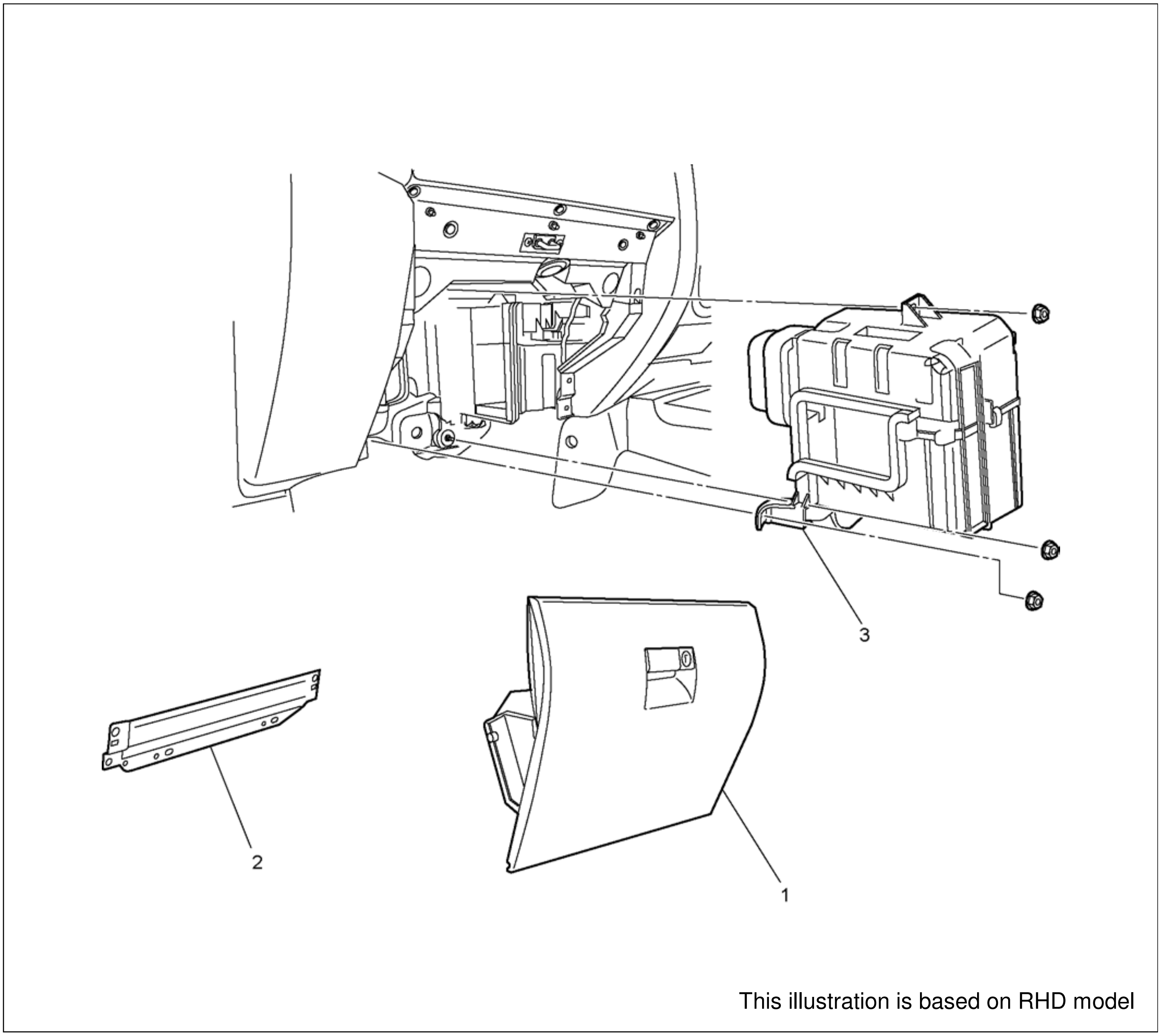
RTW46DLF000501

Reassembly Step

1. Front cover
2. Rear rotor bearing
3. Rotor Assembly
4. Pulley
5. Rectifier Assembly
6. Stator Assembly
7. Rear cover
8. B Terminal nuts
9. Through bolt
10. O-ring
11. Vacuum pump

DUCT (WITHOUT A/C)

REMOVAL AND INSTALLATION



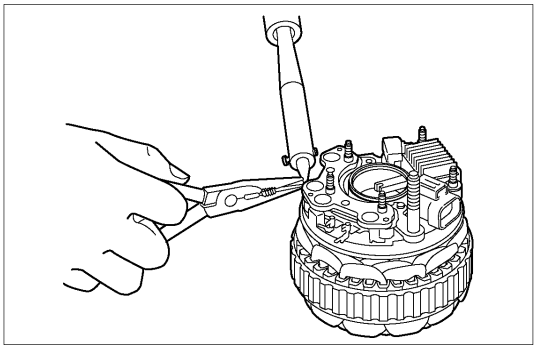
RTW710LF003901

Removal Steps

1. Glove box
2. Passenger lower bracket
3. Evaporator assembly

Installation Steps

3. Evaporator assembly
2. Passenger lower bracket
1. Glove box


RTW46DSH000401

Important Operations

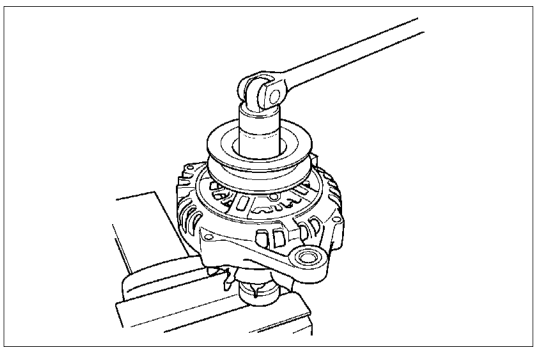
2. Rear rotor bearing

- Re-use improper parts.

5. Rectifier

6. Stator

Use a pair of long-nose plier to connect the stator coil leads and the rectifier leads.
Finish the work as quickly as possible to prevent the rectifier from heat transferred by the soldering.

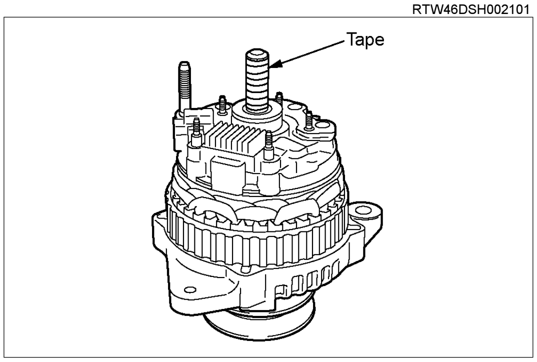

RTW46DSH002101

3. Rotor Assembly

4. Pulley Assembly

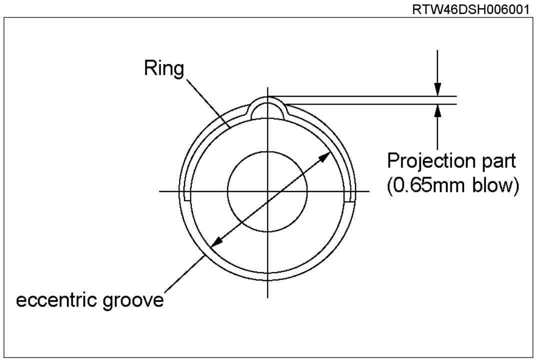
Clamp the rotor in a vise and install the pulley nut.

Pulley Nut Torque	N·m (kg·m/lb·ft)
	83.3 ~ 98.0 (8.5 ~ 10.0 / 61 ~ 72)



RTW46DSH006001

Remove the tape from the splines.

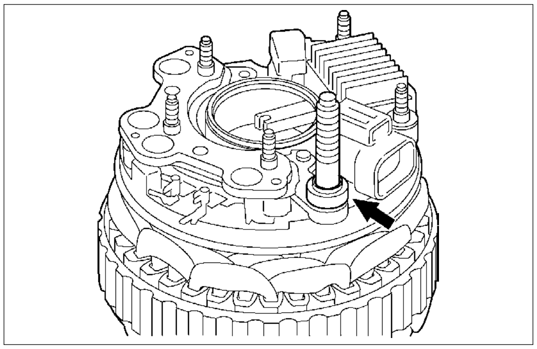


RTW46DSH004901

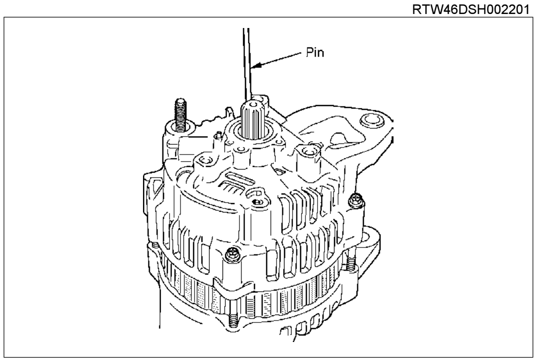
The rear ball bearing is pressed into the wheel eccentric groove. The bearing ring projects from the groove.

During installation, rotate the bearing to the point of minimum bearing ring projection.

Inspect the rear cover bearing box and replace it if it is damaged.


RTW46DSH002201

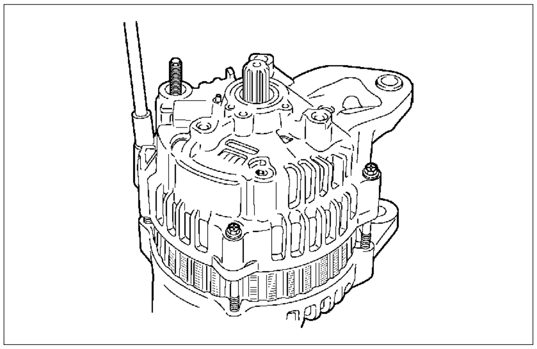
NOTE: Be sure to attach a cooler to B terminal.



RTW46DSH005301

Insert the pin from the outside of the rear cover. Press the brushes into the brush holder. Complete the assembly procedure.

Remove the pin after completion of the assembly procedure.


RTW06DSH000201

9. Through Bolt

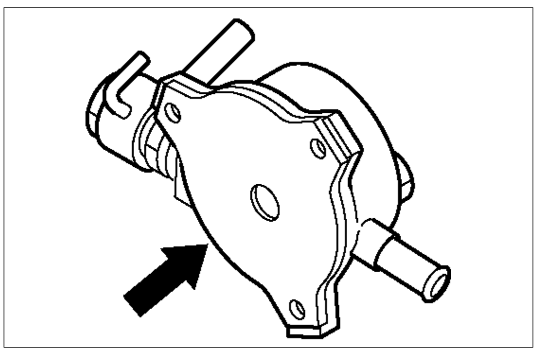
1. Place a pilot bar into the through bolt hole to align the front cover and the rear cover.
2. Install the through bolts and tighten them to the specified torque.

Through Bolt Torque	N·m (kg·m/lb·ft)
3.1 ~ 3.9 (0.32 ~ 0.41 / 2.6 ~ 3.5)	

11. Vaccum Pump

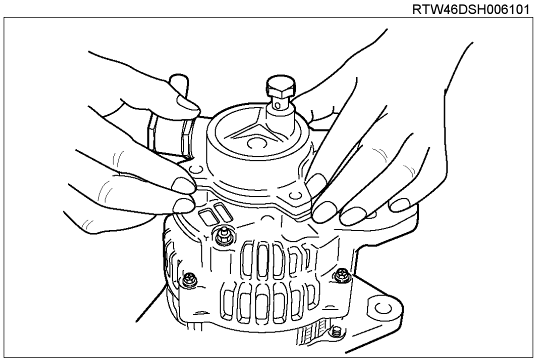
To install the generator -

1. Note the direction of the arrow on the vacuum pump.
2. Look forward from the base of the arrow to locate the 3 generator fixing points.
3. Twist the fixing points down and to the left to align them with the middle of the center plate and the rotor.


RTW46DSH006101

Install vanes into slits in rotor.

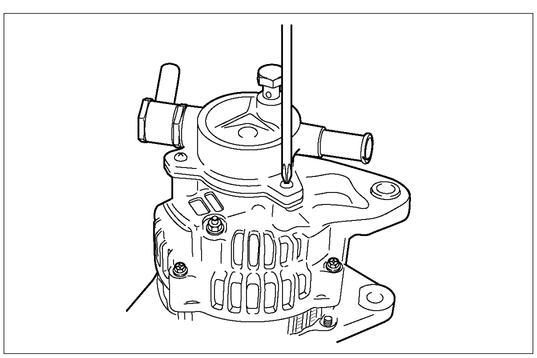
The vanes should be installed with the chamfered side facing outward.


RTW46DSH002401

Install the vacuum pump housing.

Make sure that the O-ring is not projecting beyond the slots of the center plate.

Take care so that no scratching takes place on the vane resulted by contact with the housing.


RTW46DSH002501

Install the housing in the generator and fix it with the three bolts.

Supply engine oil (5cc or so) from the oil port and check that the generator pulley can be turned smoothly with your hand.

Generator Housing Bolt Torque	N·m (kg·m/lb·ft)
5.9 ~ 6.9 (0.6 ~ 0.7 / 5.2 ~ 6.1)	

STARTER MOTOR

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Important Operations - Removal

Starter Motor

1. Disconnect the battery cable and the ground cable at the battery terminals.
2. Disconnect the magnetic switch cable at the terminal bolts.
3. Disconnect the battery cable at the starter motor and the ground cable at the cylinder body.
4. Remove the starter motor from the engine.

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

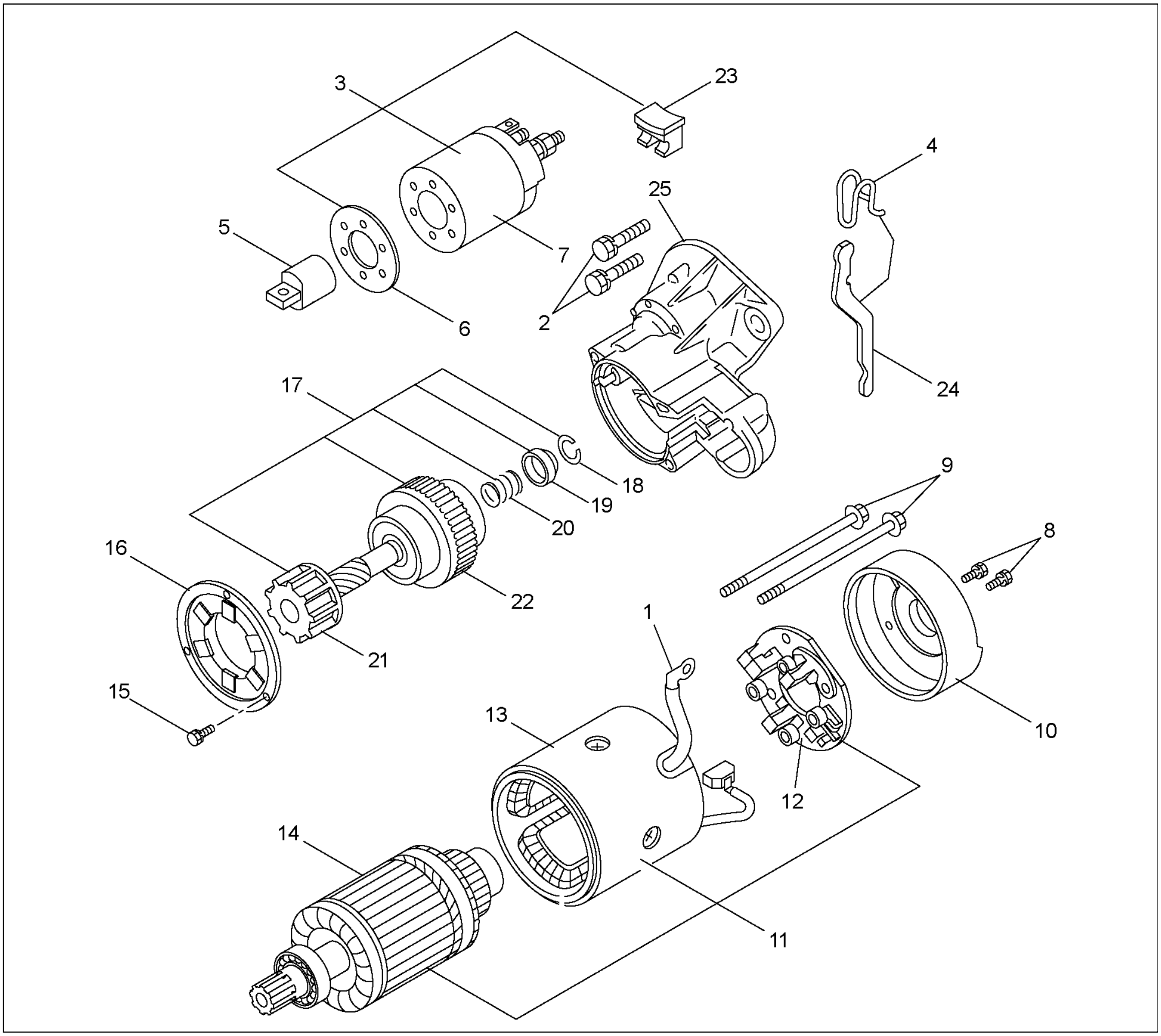
Starter Motor

1. Install the starter motor to the rear plate.
2. Tighten the starter motor bolts to the specified torque.

Starter Motor Bolt Torque	N·m (kg·m/lb·ft)
85 (8.7/63)	

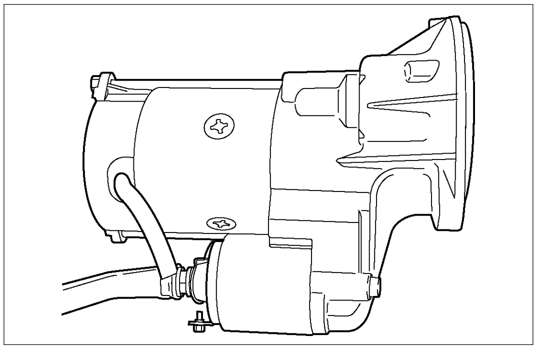
3. Reconnect the battery cable at the starter motor and the ground cable at the cylinder body.
4. Reconnect the battery cable and the ground cable at the battery terminals.

DISASSEMBLY



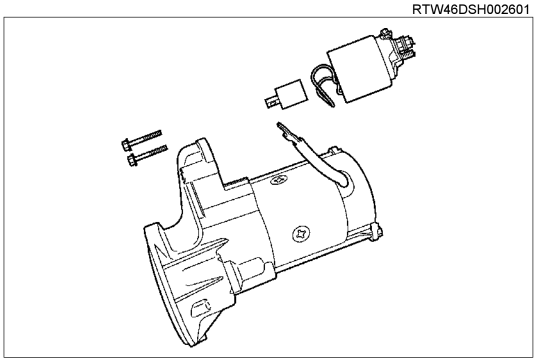
Disassembly Step

1. Lead wire
2. Bolt
3. Magnetic switch assembly
4. Torsion spring
5. Plunger
6. Dust cover
7. Magnetic switch
8. Screw
9. Through bolt
10. Rear cover
11. Motor assembly
12. Brush holder
13. Yoke
14. Armature
15. Bolt
16. Bearing retainer
17. Pinion assembly
18. Pinion stopper clip
19. Pinion stopper
20. Return spring
21. Pinion shaft
22. Clutch
23. Dust cover
24. Shift lever
25. Gear case

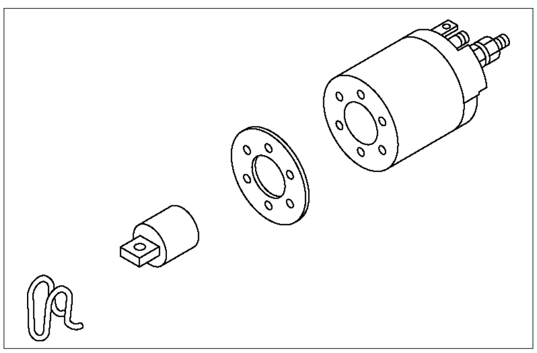

RTW46DSH002601

Important Operations

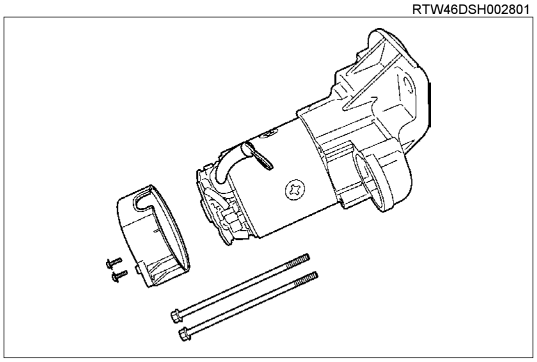
1. Lead Wire
Disconnect the lead wire at the magnetic switch.


RTW46DSH002701

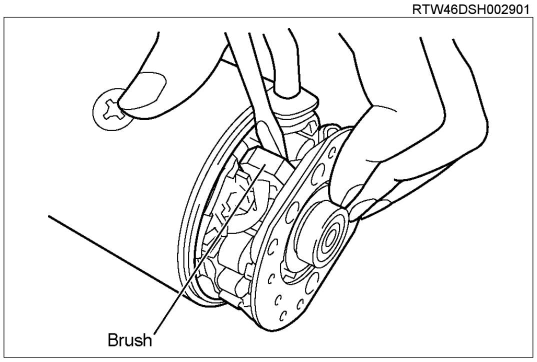
3. Magnetic Switch Assembly
Remove the magnetic switch bolts, then remove the switch from the shift lever.


RTW46DSH002801

Remove the torsion spring from the magnetic switch.

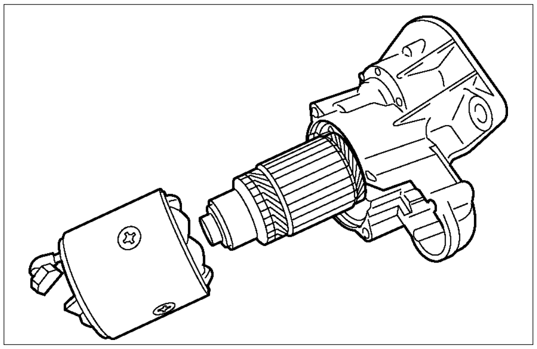

RTW46DSH002901

8. Through Bolt
9. Screw
10. Rear Cover
Remove the through bolts, then remove the rear cover.



RTW46DSH003001

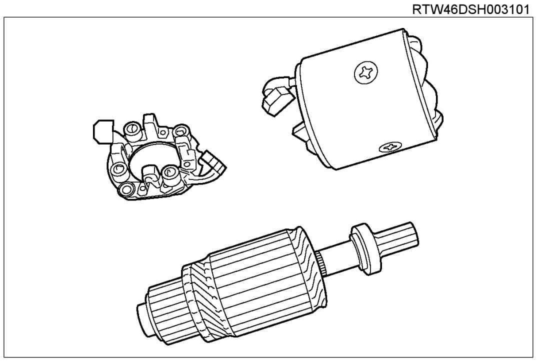
11. Motor Assembly
Remove the four brushes from the brush holders.



RTW46DSH003101

Remove the yoke along with the armature and the brush holder from the gear case.

Remove the brushes and commutator carefully so as not to allow them in contact with the adjacent parts.



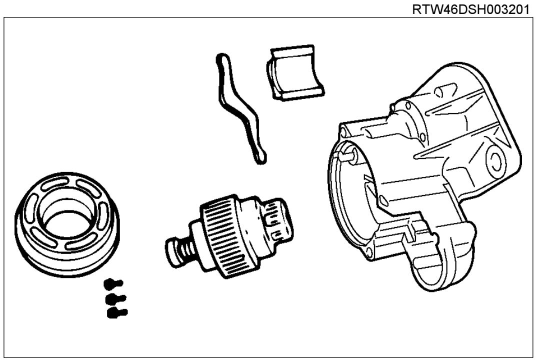
RTW46DSH003201

12. Brush Holder

13. Yoke

14. Armature

Remove the brush holder and pull out the armature assembly free from the yoke.



RTW46DSH003301

16. Bearing Retainer

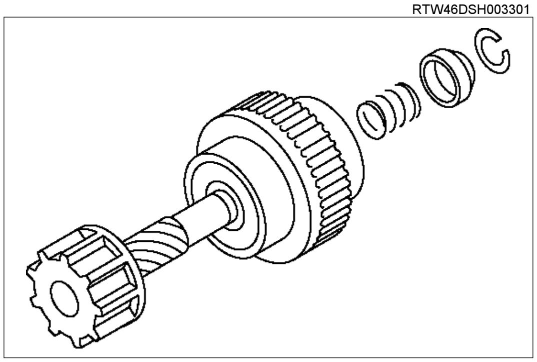
17. Pinion Assembly

23. Dust Cover

24. Shift Lever

25. Gear Case

1. Remove the bearing retainer.
2. Remove the pinion from the gear case.

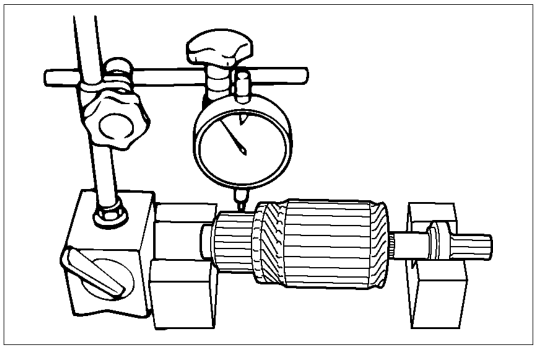


RTW46DSH003401

3. Use a screwdriver to remove the stopper clip. Then disassemble the pinion assembly.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.



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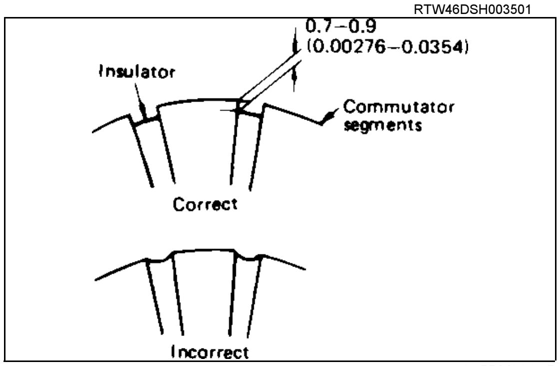


065RY00025

ARMATURE

1. Measure the commutator run-out.
   Replace the commutator if the measured run-out exceeds the specified limit.

Commutator Run-Out mm (in)

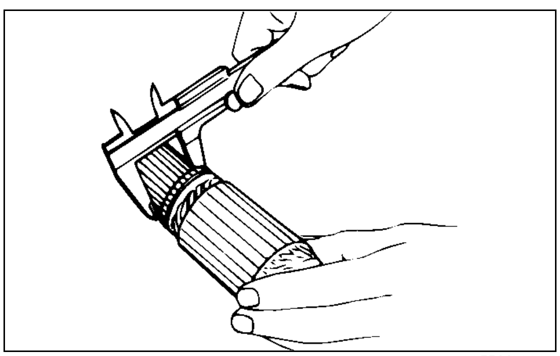
Standard	Limit
0.05 (0.002)	0.2 (0.008)

2. Check the commutator mica segments for excessive wear.
3. Measure the mica segment depth.

Mica Segment Depth mm (in)

Standard	Limit
0.5 ~ 0.8 (0.020 ~ 0.030)	0.2 (0.008)

If the mica segment depth is less than the standard but more than the limit, the commutator may be reground.
If the mica segment depth is less than the limit, the commutator must be replaced.



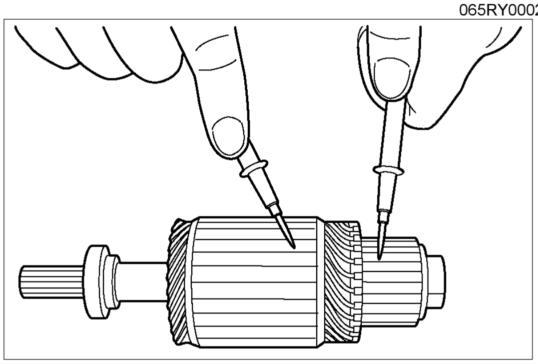
065RY00026

4. Measure the commutator outside diameter.

Commutator Outside Diameter mm (in)

Standard	Limit
36.5 (1.44)	35.5 (1.40)

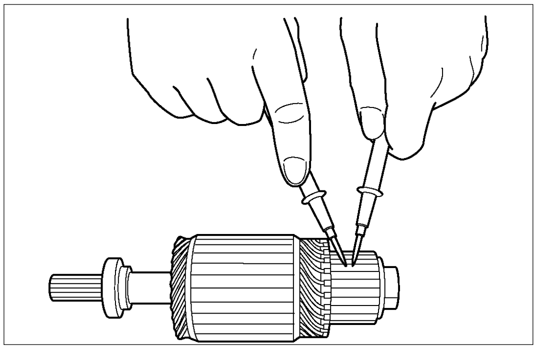
If the measured outside diameter is less than the specified limit, the commutator must be replaced.



RTW46DSH003601

5. Use a circuit tester to check the armature for grounding.
   1 Hold one probe of the circuit tester against the commutator segment.
   2 Hold the other circuit tester probe against the armature core.

   If the circuit tester indicates continuity, the armature is grounded.
   The armature must be replaced.

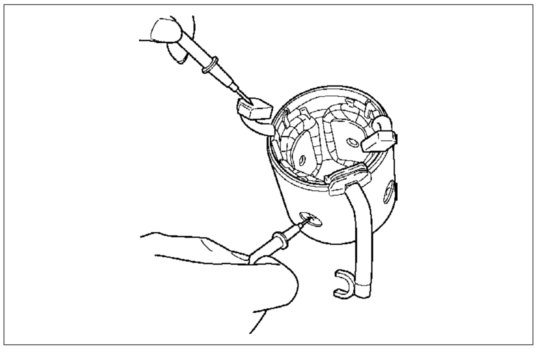


RTW46DSH003701

6. Use the circuit tester to check the armature for continuity.
   1 Hold the circuit tester probes against two commutator segments.
   2 Repear Step 1 at different segments of the armature core.

   There should be continuity between all segments of the commutator.
   If there is not, the armature must be replaced.

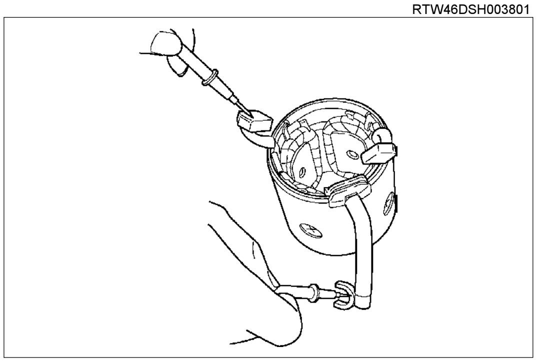
YOKE



RTW46DSH003801

1. Use a circuit tester to check the field winding ground.
   1 Hold one circuit tester probe against the field winding end or brush.
   2 Hold the other circuit tester probe against the bare surface of the yoke body.

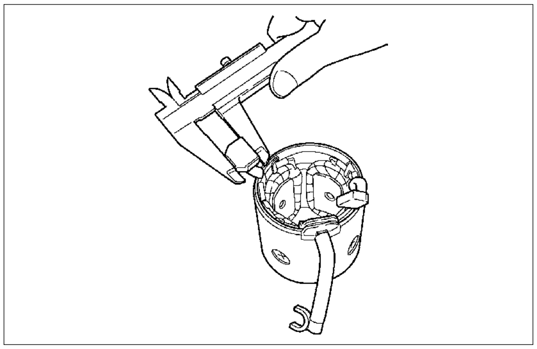
   There should be no continuity.
   If there is continuity, the field coil is grounded.
   The yoke must be replaced.



RTW46DSH003901

2. Use the circuit tester to check the field winding continuity.
   1 Hold one circuit tester probe against the “M” terminal lead wire.
   2 Hold the other circuit tester probe against the field winding brush.

   There should be continuity.
   If there is no continuity, the yoke must be replaced.

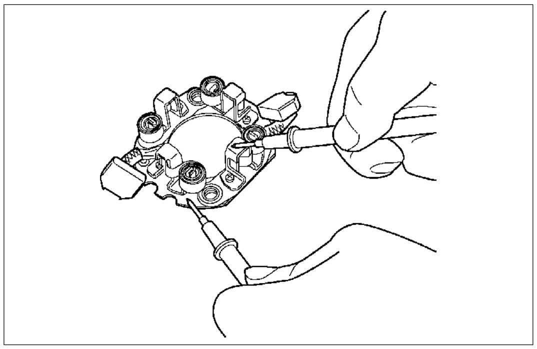

RTW46DSH004001

BRUSH AND BRUSH HOLDER

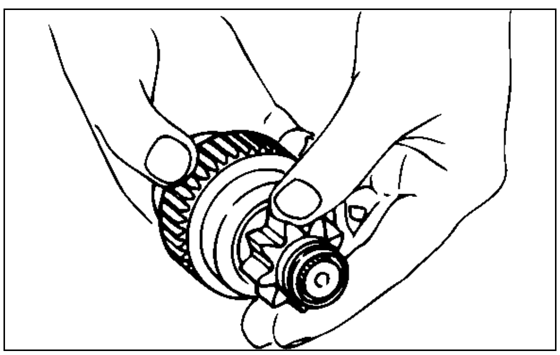
1. Use a vernier caliper to measure the brush length (four brushes).
   Replace the brushes as a set if one or more of the brush lengths is less than the specified limit.

Brush Length mm (in)

Standard	Limit
15 (0.59)	12 (0.47)

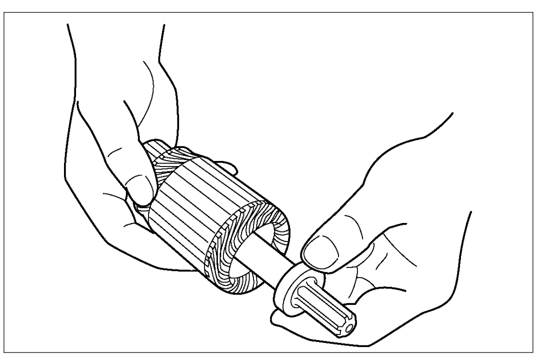

RTW46DSH004101

2. Use a circuit tester to check the brush holder insulation.
   Touch one probe to the holder plate and the other probe to the positive brush holder.
   There should be no continuity.
3. Inspect the brushes for excessive wear.
   If the negative brushes have excessive wear, the entire brush holder assembly must be replaced.
   If the positive brushes have excessive wear, the entire yoke must be replaced.


065RY00035

OVERRUNNING CLUTCH

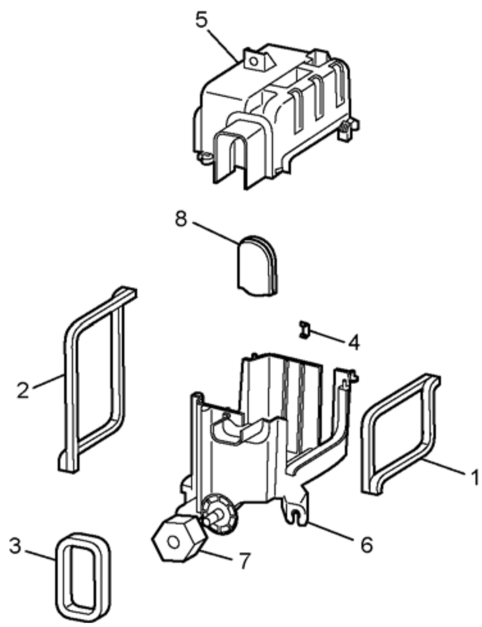
1. Inspect the overrunning clutch gear teeth for excessive wear and damage.
   Replace the overrunning clutch if necessary.
2. Rotate the pinion clockwise.
   It should turn smoothly.
3. Try to rotate the pinion in the opposite direction.
   The pinion should lock.


RTW46DSH004401

BEARING

Inspect the bearings for excessive wear and damage.
Replace the bearings if necessary.

DISASSEMBLY AND REASSEMBLY



RTW710MF001001

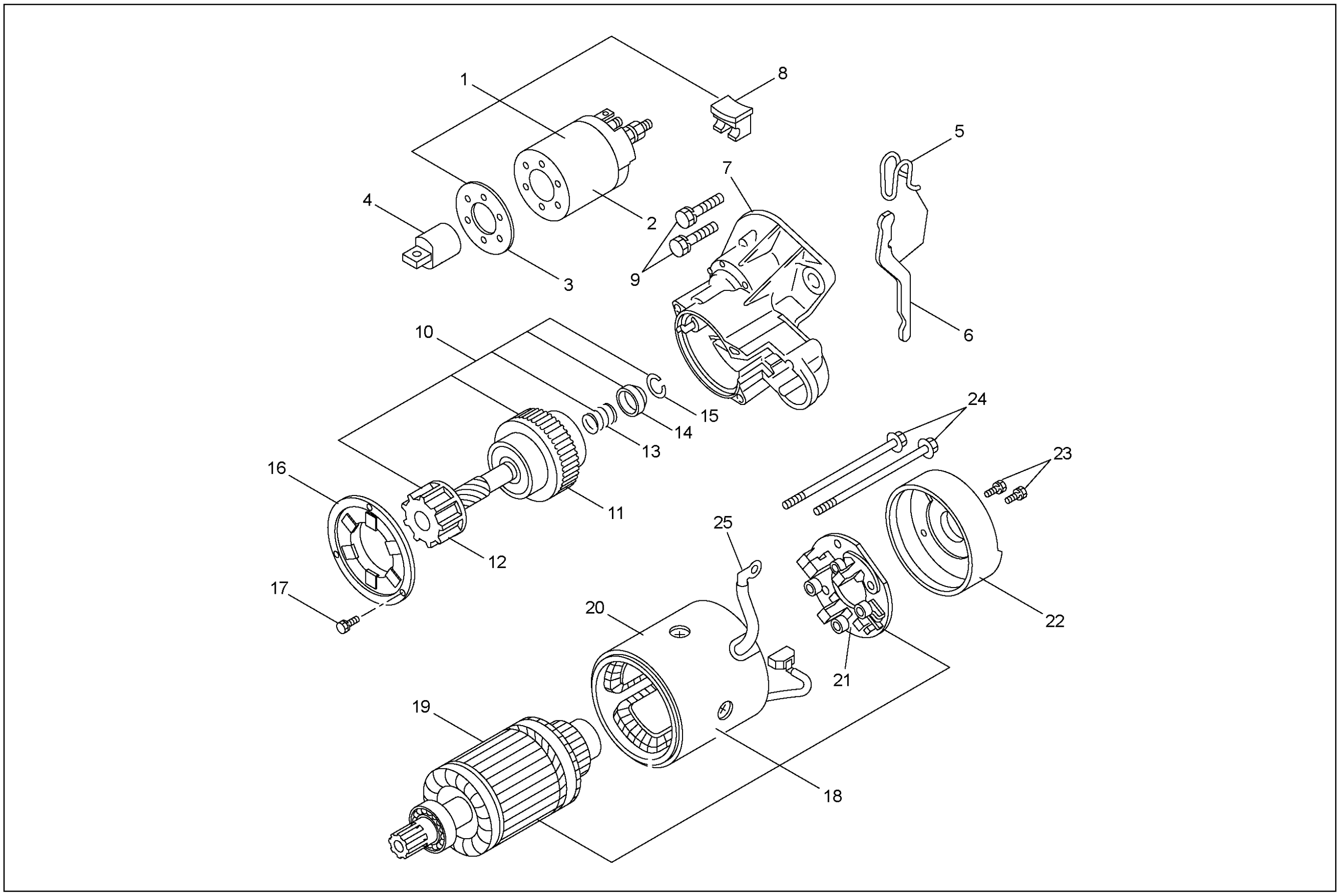
Disassembly Steps

1. Packing cooler outlet
2. Packing cooler inlet
3. Seal FOD cooler
4. Clip heater
5. Case : cooler upper
6. Case : cooler lower
7. Packing drain
8. Grommet

Reassembly Steps

8. Grommet
7. Packing drain
6. Case : cooler lower
5. Case : cooler upper
4. Clip heater
3. Seal FOD cooler
2. Packing cooler inlet
1. Packing cooler outlet

REASSEMBLY

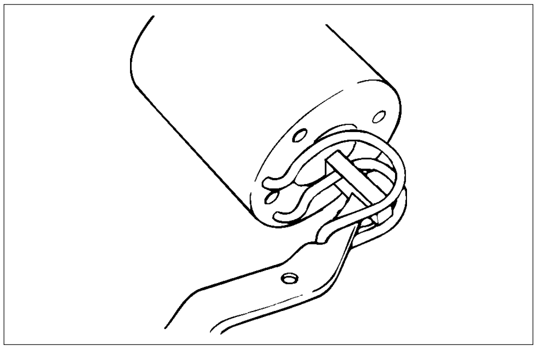


RTW46DLF000601

Reassembly Steps

1. Magnetic switch assembly
2. Magnetic switch
3. Dust cover
4. Plunger
5. Torsion spring
6. Shift lever
7. Gear case
8. Dust cover
9. Bolt
10. Pinion assembly
11. Clutch
12. Pinion shaft
13. Rerurn spring
14. Pinion stopper
15. Pinion stopper clip
16. Bearing retainer
17. Bolt
18. Motor assembly
19. Armature
20. Yoke
21. Brush holder
22. Rear cover
23. Screw
24. Through bolt
25. Lead wire

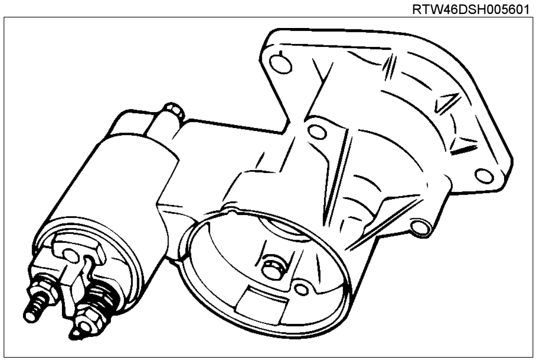
Important Operations



RTW46DSH005601

1. Magnetic Switch Assembly

1. Attach the torsion spring to the hole in the magnetic switch as illustrated.
2. Insert the shift lever into the plunger hole of the magnetic switch.



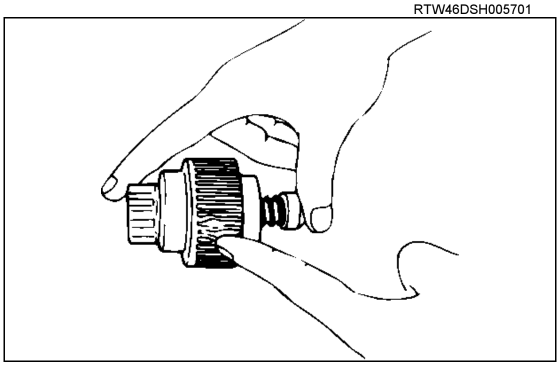
RTW46DSH005701

7. Gear Case

3,8. Dust Cover

1. Install the magnetic switch assembly in the gear case.
2. Install the dust cover.

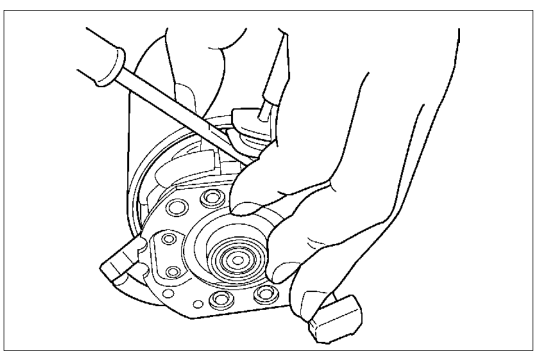
Dust Cover Bolt Torque	N·m (kg·m/lb·ft)
8 (0.8/5.4)	



065RY00041

10. Pinion Assembly

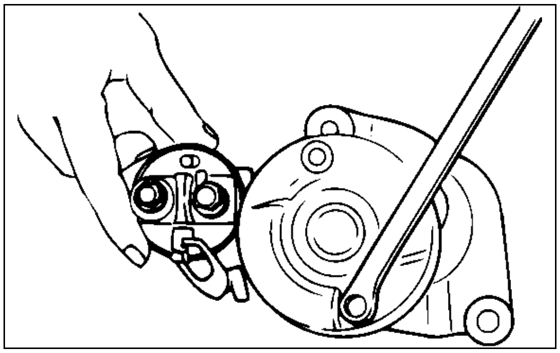
Apply a coat of grease to the reduction gear and install the pinion assembly to the armature shaft.



RTW46DSH004501

21. Brush Holders

1. Install the brushes into the brush holder with raising the spring end of the brush spring.
   Take care not to damage the commutator face.
2. Install the brush holder with aligning the peripheries of the yoke and the brush holder.

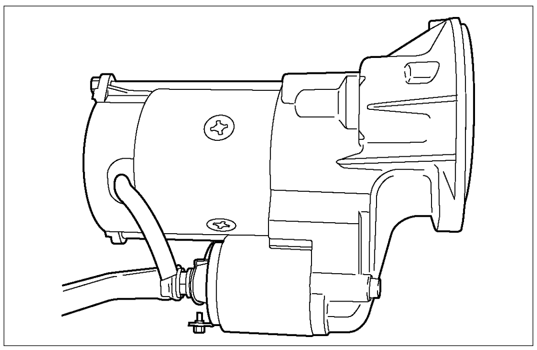


065RY00044

24. Through Bolt

Install the through bolts in the rear cover and tighten them to the specified torque.

Through Bolt Torque	N·m (kg·m/lb·ft)
8.1 (0.83/6.00)	

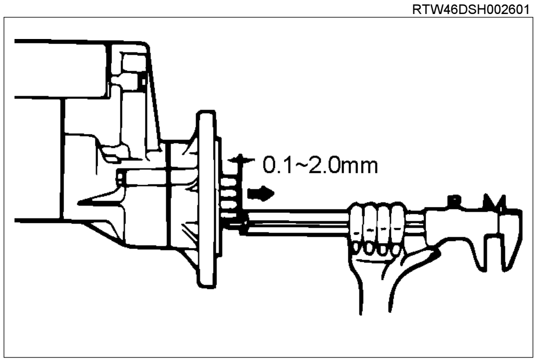


RTW46DSH002601

25. Lead Wire

Connect the lead wire in the magnetic switch and tighten the terminal nut to the specified torque.

Lead Wire Terminal Nut Torque	N·m (kg·m/lb·ft)
8.6 (0.88/6.40)	



RTW46DSH005801

Inspection After Assembly

Use a vernier caliper to measure the pinion shaft thrust play.

The pinion shaft thrust play is equal to the pinion shaft end and pinion stopper clearance.

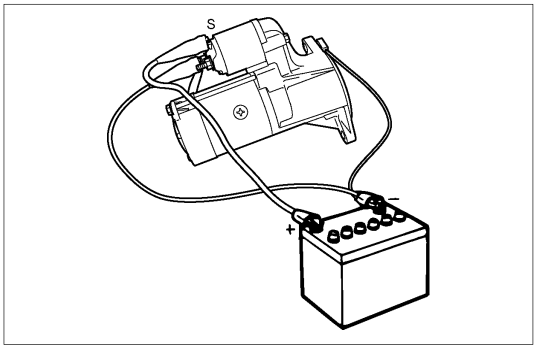
Pinion Shaft Thrust Play	mm (in)
0.1 – 2.0 (0.004 – 0.078)	

MAGNETIC SWITCH

The following tests must be performed with the starter motor fully assembled.

The yoke lead wire must be disconnected from the "M" terminal.

To prevent coil burning, complete each test as quickly as possible (within three to five seconds).

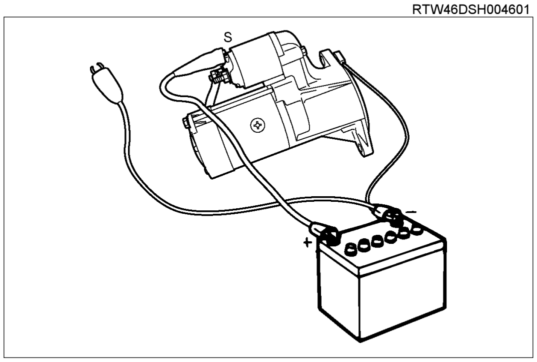


RTW46DSH004601

Temporarily connect the solenoid switch between the clutch and the housing and run the following test. Complete each test within three to five seconds.

1. **Pull-in Test**

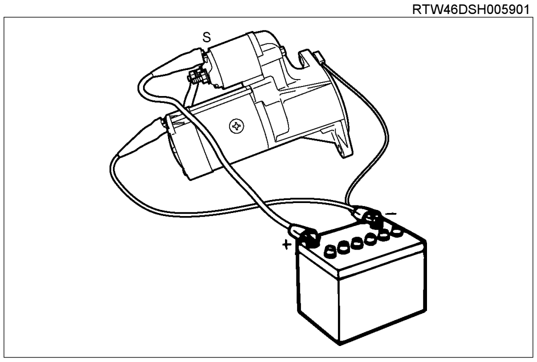
   Connect the battery negative terminal with the solenoid switch body and the M terminal. When current is applied to the S terminal from the battery positive terminal, the pinion should flutter.



RTW46DSH005901

2. **Hold-in Maintenance Test**

   Disconnect the lead at the M terminal. The pinion should continue to flutter.



RTW46DSH004701

3. **Return Test**

   Disconnect the battery positive lead at the S terminal.

   The pinion should return to its home position.

PRE-HEATING SYSTEM

INSPECTION AND REPAIR

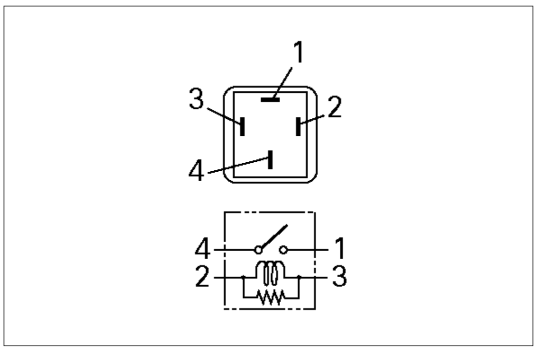
Make the necessary adjustments, repairs, and part replacement if excessive wear of damage is discovered during inspection.

VISUAL CHECK

Check the main fuses and glow indicator for damage.
Replace the part(s) if required.

GLOW RELAY

The glow relay is located in the relay box the engine compartment.

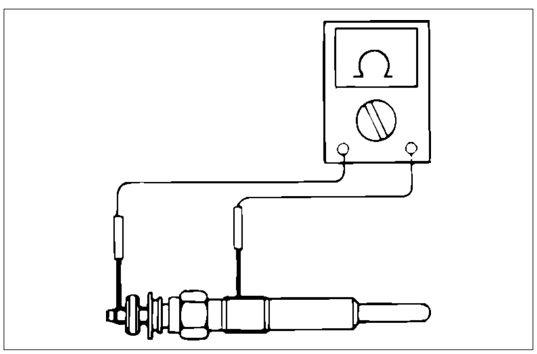


825R300046

Use an ohmmeter to measure the resistance between terminals No.2 and No.3.
If the measured value is outside the specified range, the glow relay must be replaced.

Glow Relay Resistance	Ohms
94 – 114	

GLOW PLUG



LNW21KSH001401

Use a circuit tester to test the glow plugs for continuity.

Glow Plug Resistance (Reference)	Ohms
Approximately 0.9	

EGR SYSTEM 4JA1T (L)

Refer to 6F-9. (EGR system diagram)

SECTION 6E

ENGINE CONTROL SYSTEM (4JH1)

TABLE OF CONTENTS

Specifications

Temperature vs Resistance

Engine Coolant Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
120	248	120
110	230	160
100	212	200
90	194	260
80	176	350
70	158	470
60	140	640
50	122	880
40	104	1250
30	86	1800
20	68	2650
10	50	4000
0	32	6180
-10	14	9810
-20	-4	16000
-30	-22	27000

Intake Air Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
100	212	190
90	194	240
80	176	320
70	158	430
60	140	590
50	122	810
40	104	1150
30	86	1650
25	77	2000
20	68	2430
10	50	3660
0	32	5650
-10	14	8970
-20	-4	14700

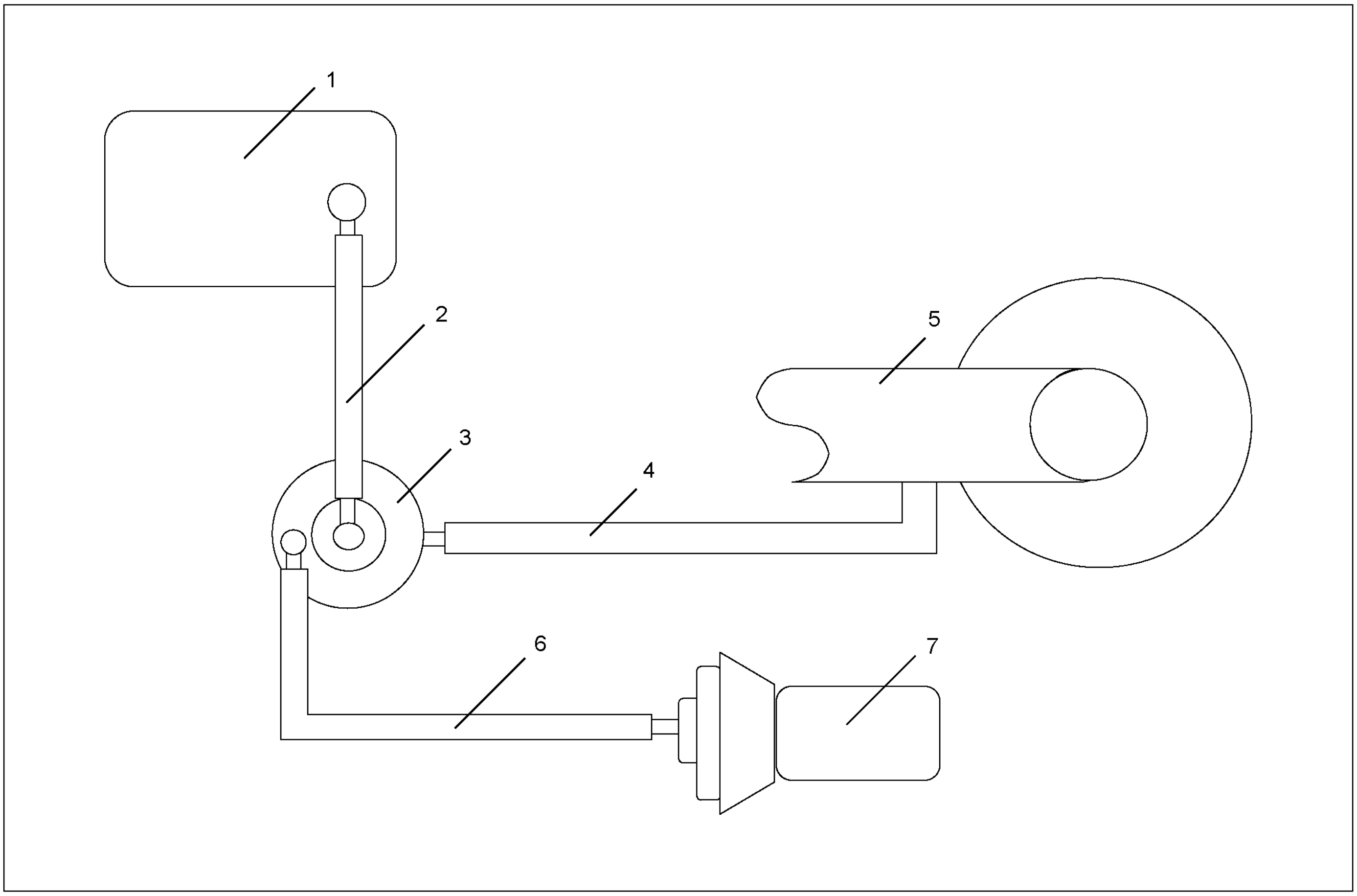
Altitude vs Barometric Pressure

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)
Determine your altitude by contacting a local weather station or by using another reference source.		
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-98
610	2000	90-98
305	1000	94-102
0	0 Sea Level	96-104
-305	-1000	101-105

Schematic And Routing Diagrams

Vacuum Hose Routing Diagram

Normal Altitude Spec



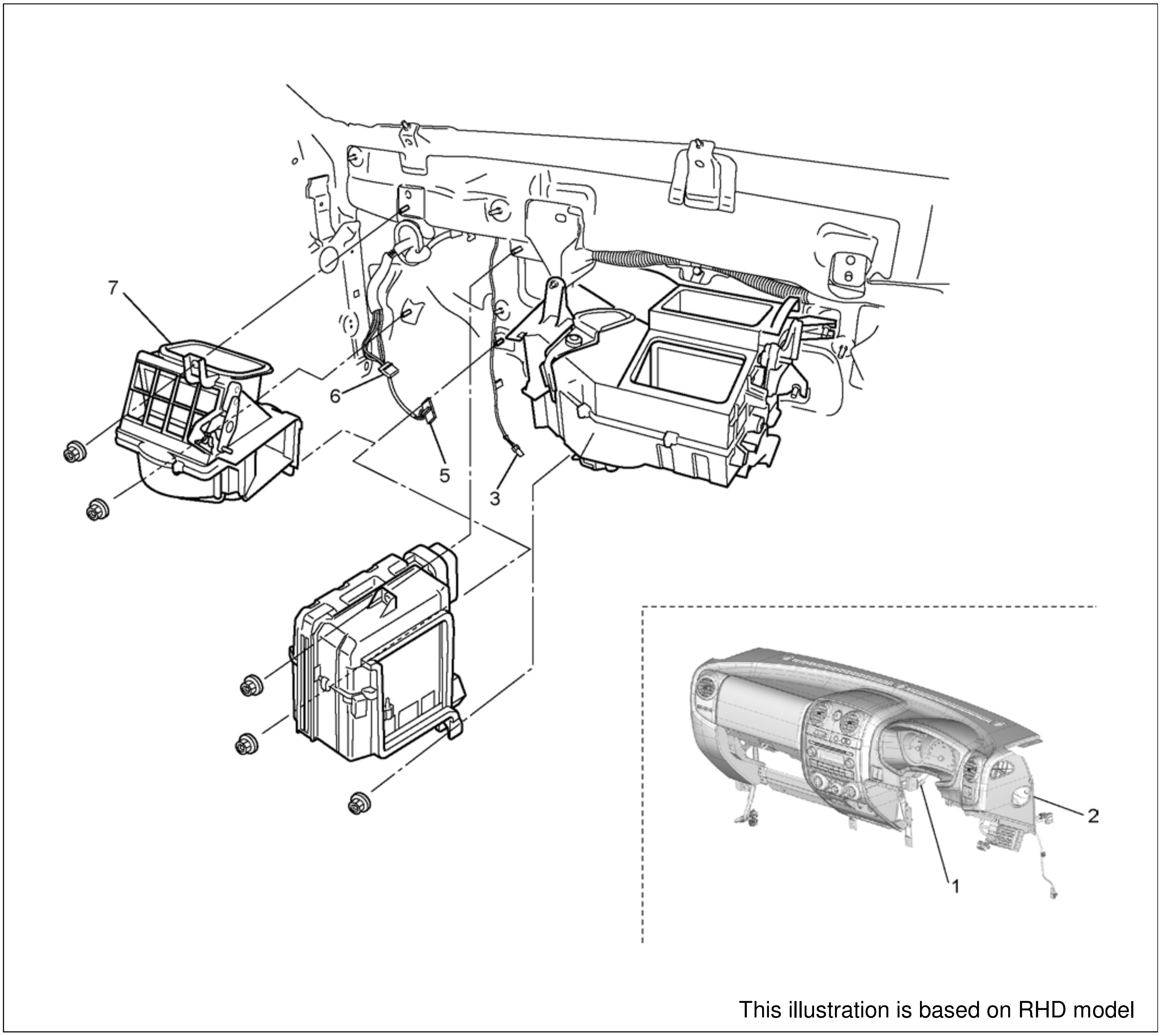
RTW66EMF001001

Legend

1. Vacuum Pump
2. Blue Stripe Vacuum Hose
3. EGR Solenoid Valve
4. White Stripe Vacuum Hose
5. Intake Duct
6. Yellow Stripe Vacuum Hose
7. EGR Valve

BLOWER UNIT ASSEMBLY

REMOVAL AND INSTALLATION



RTW710LF001801

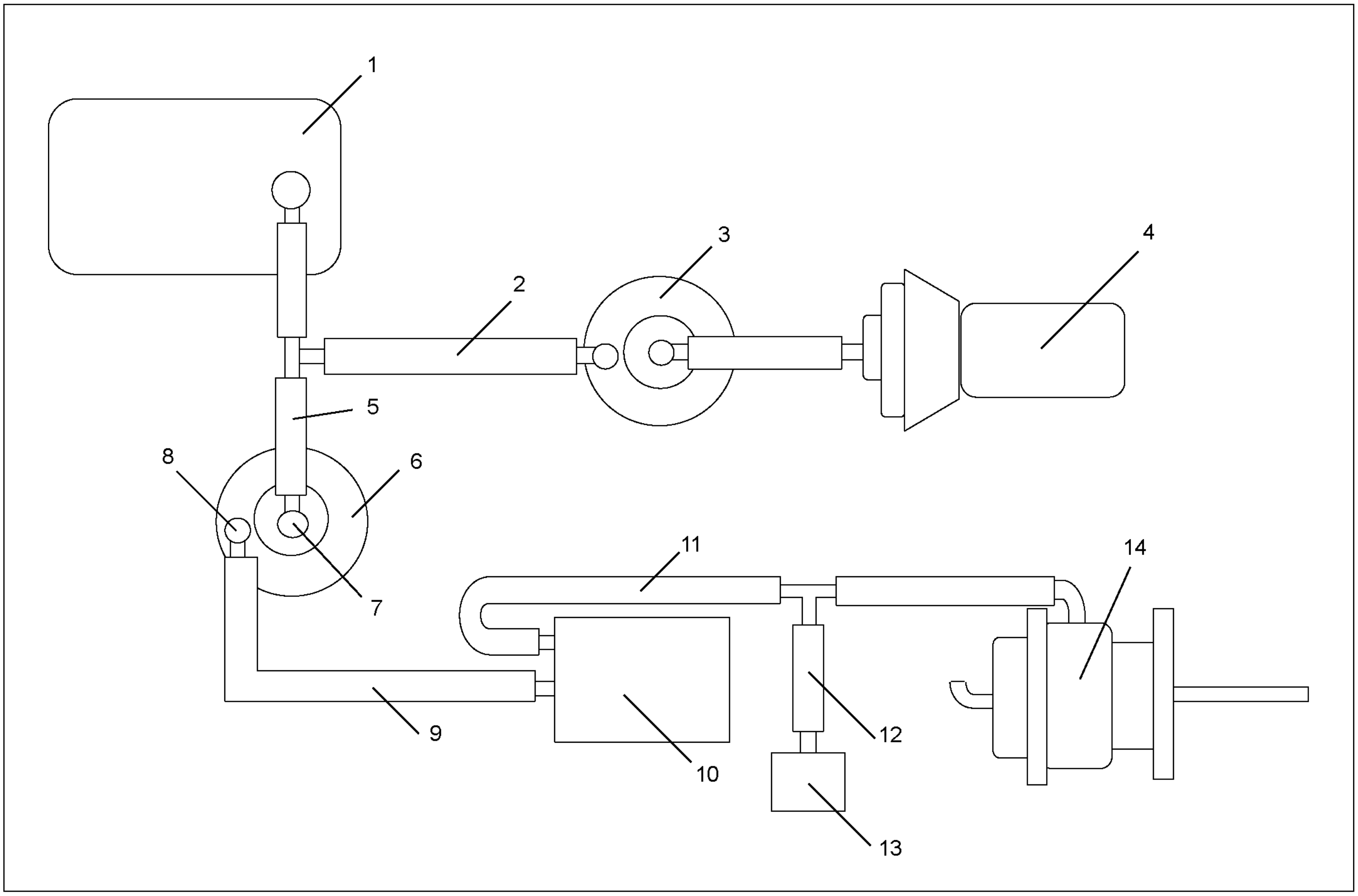
Removal Steps

1. Control cable
▲ 2. Instrument panel assembly and cross beam
3. Electronic thermostat connector
▲ 4. Evaporator or duct
5. Resistor connector
6. Blower motor connector
7. Blower unit assembly or intake box assembly

Installation Steps

7. Blower unit assembly or intake box assembly
6. Blower motor connector
5. Resistor connector
4. Evaporator or duct
3. Electronic thermostat connector
▲ 2. Instrument panel assembly and cross beam
1. Control cable

High Altitude Spec



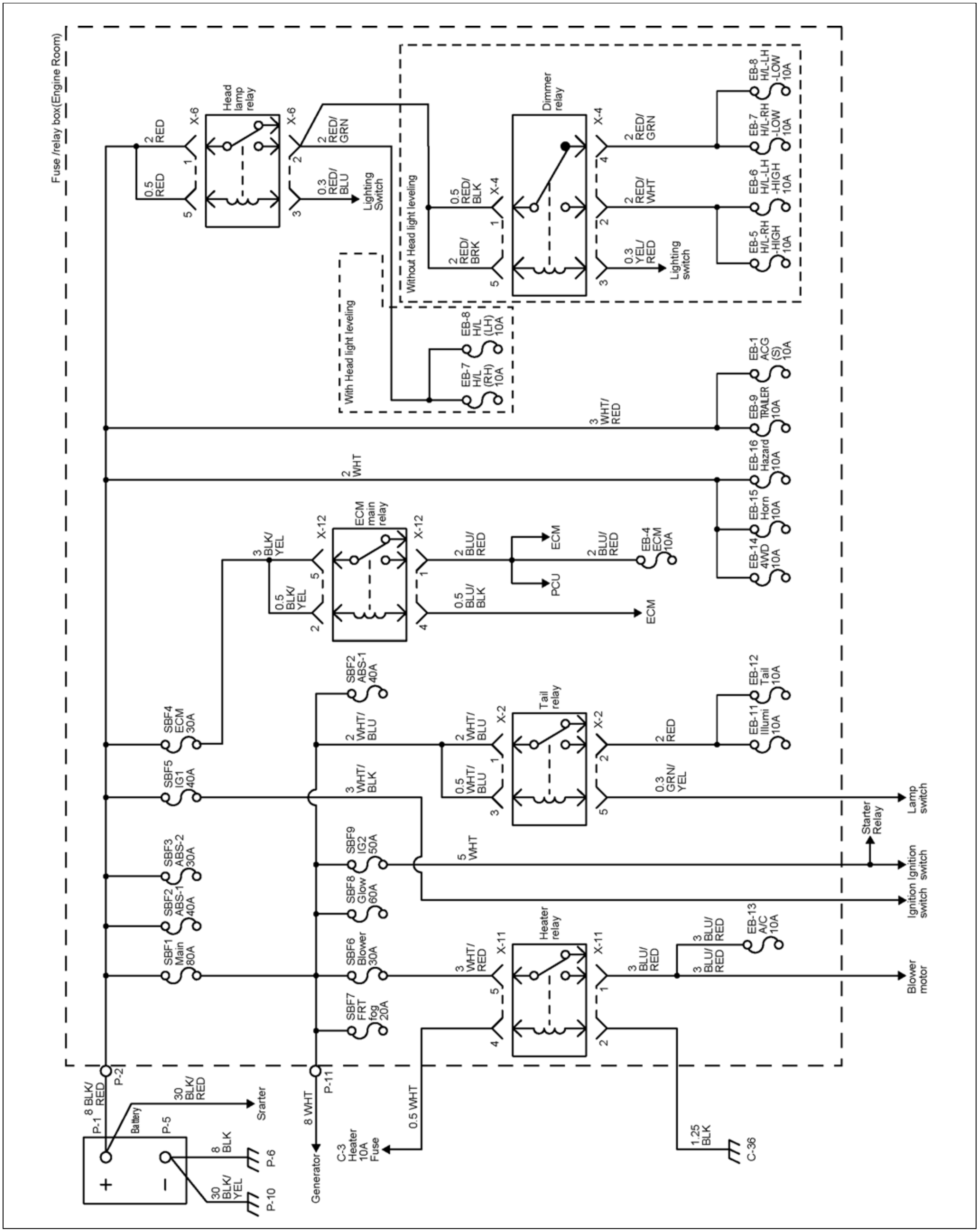
RTW66EMF001101

Legend

1. Vacuum Pump
2. White Stripe Vacuum Hose
3. EGR Solenoid Valve
4. EGR Valve
5. White Stripe Vacuum Hose
6. Vacuum Regulating Valve
7. Port S
8. Port Z
9. Blue Stripe Vacuum Hose
10. Turbocharger Solenoid Valve
11. White Stripe Vacuum Hose
12. Yellow Stripe Vacuum Hose
13. Vacuum Pressure Sensor
14. Turbocharger

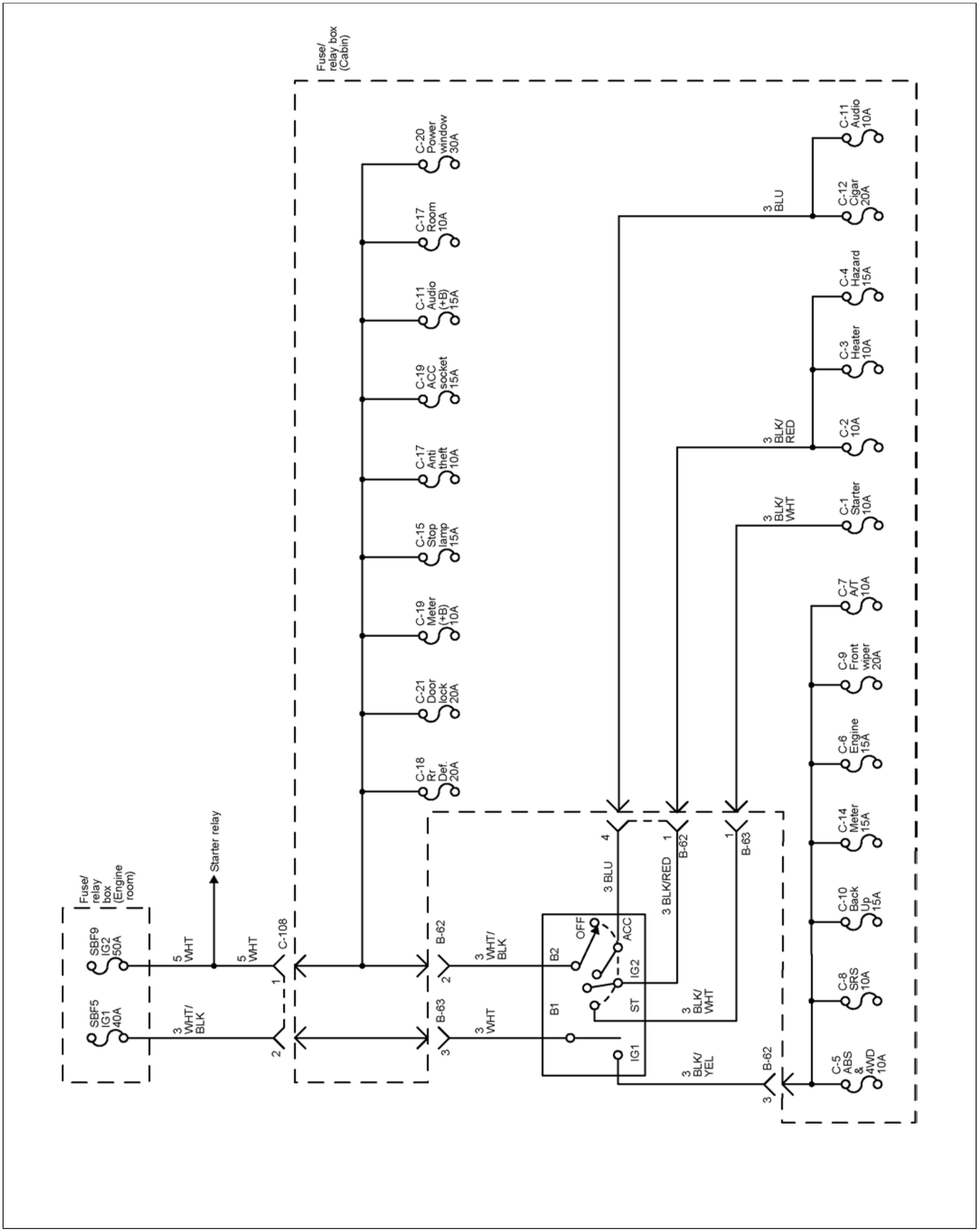
Engine Controls Schematics

Power Distribution (1)



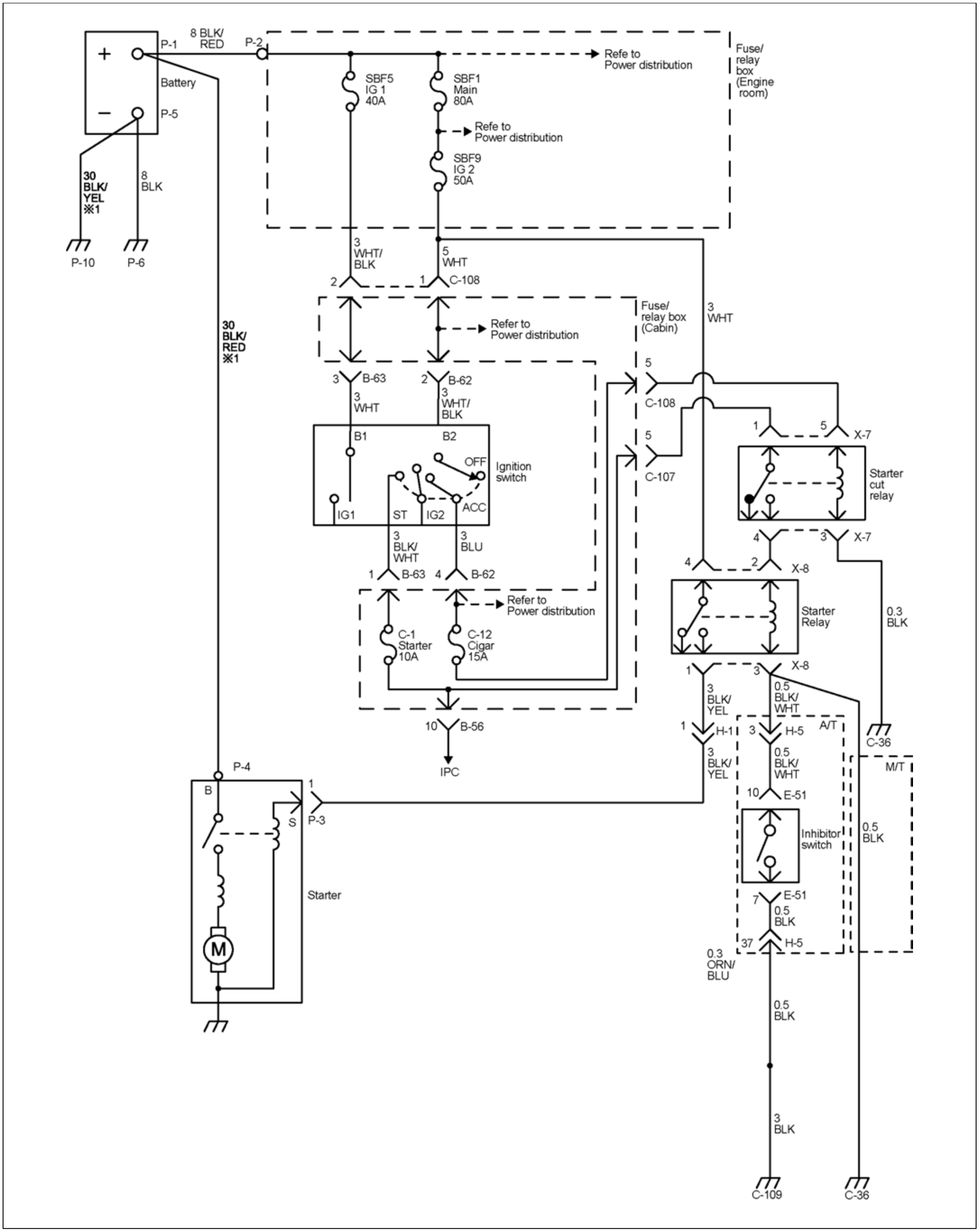
RTW76EXF002501

Power Distribution (2)



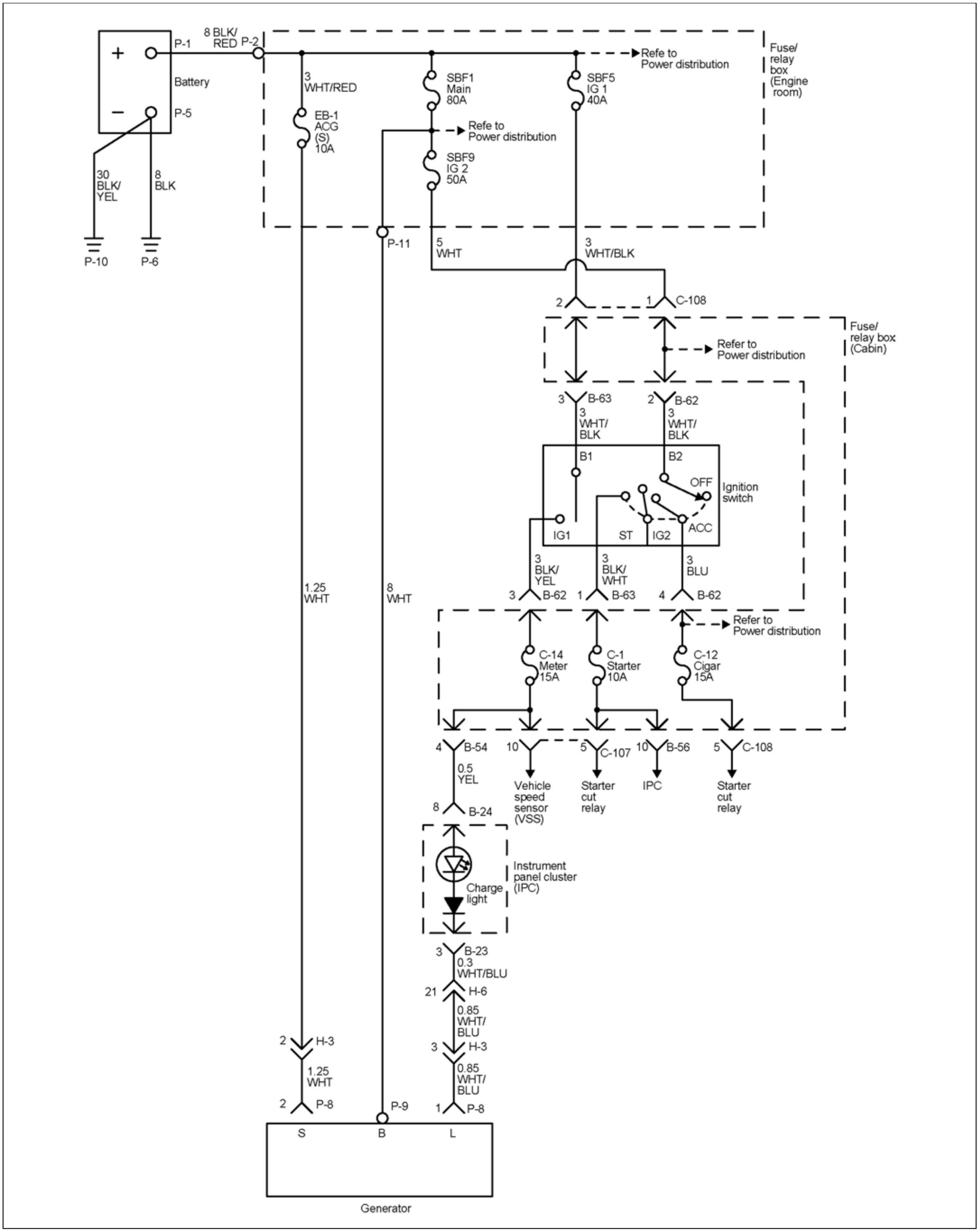
RTW76EXF002601

Starting System



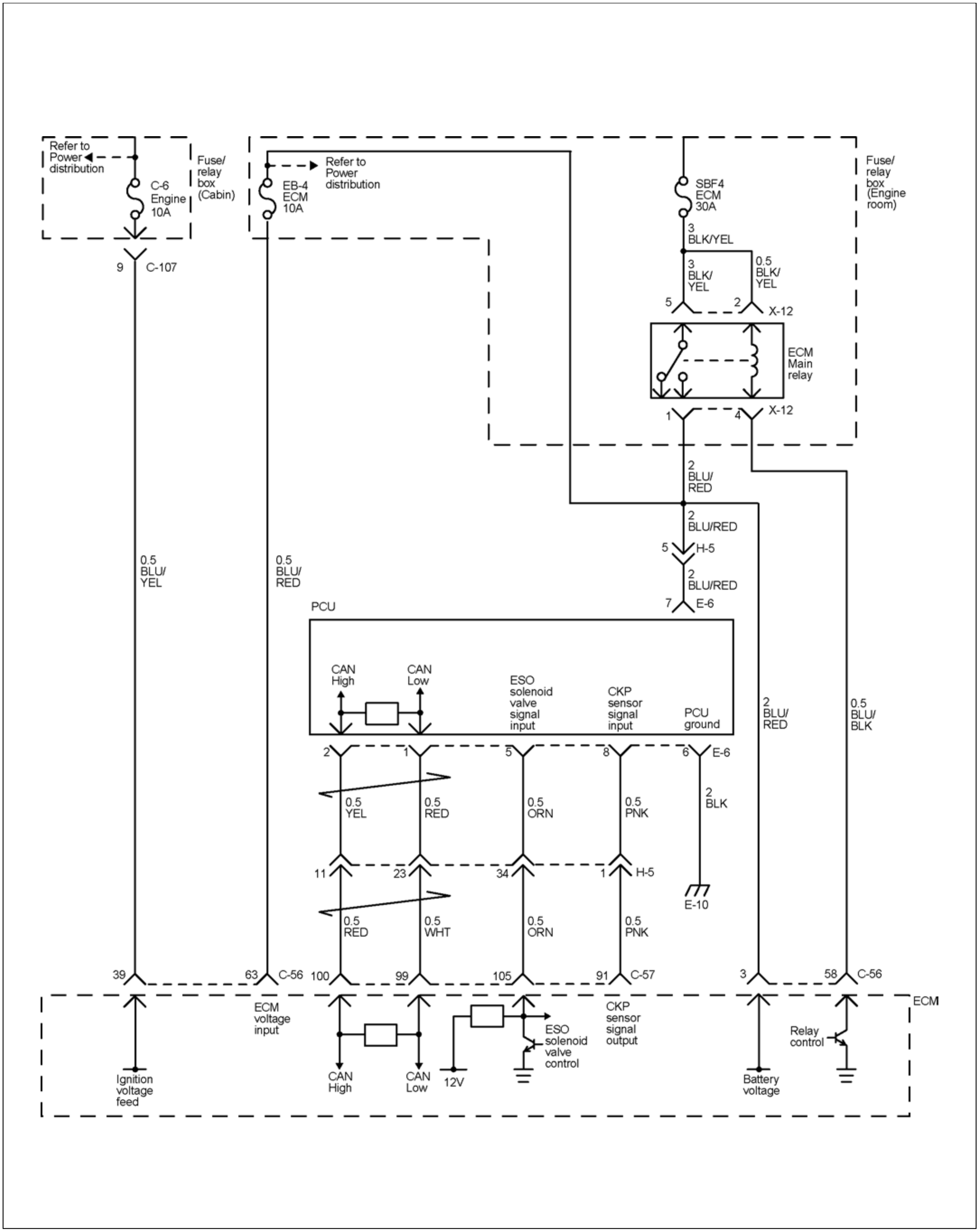
RTW76EXF002701

Charging System



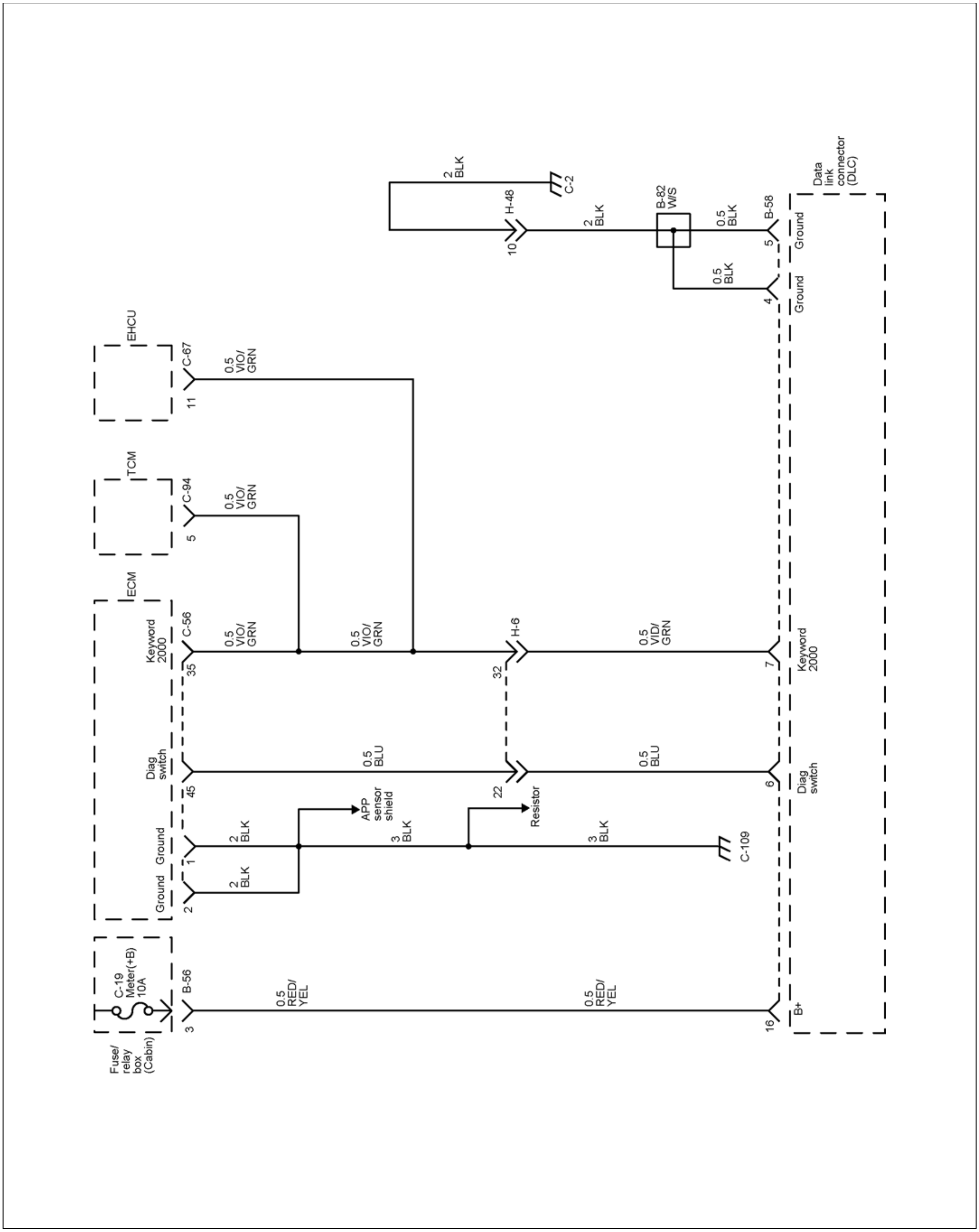
RTW76EXF002801

ECM Power and PCU



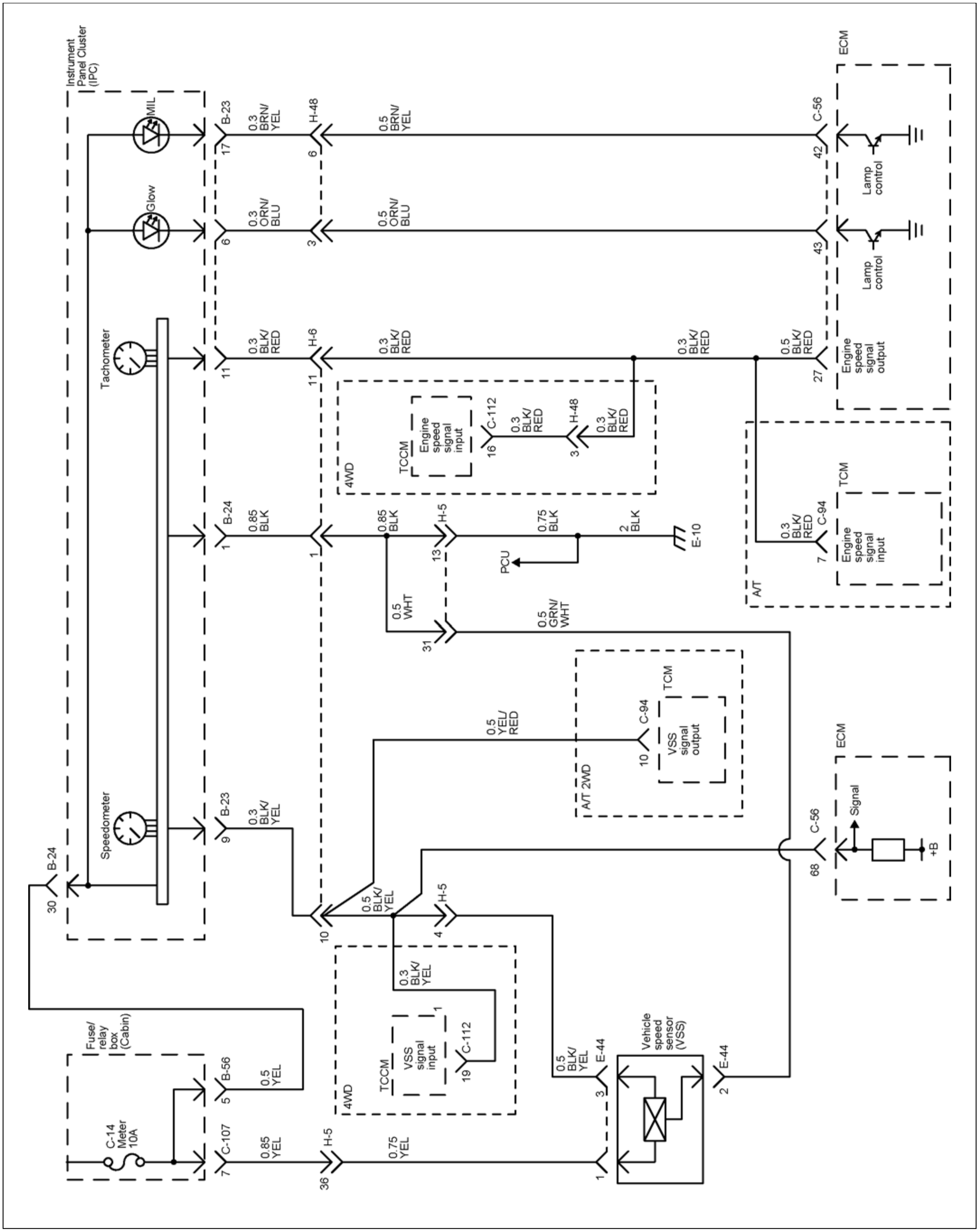
RTW76EXF002901

ECM Ground and DLC



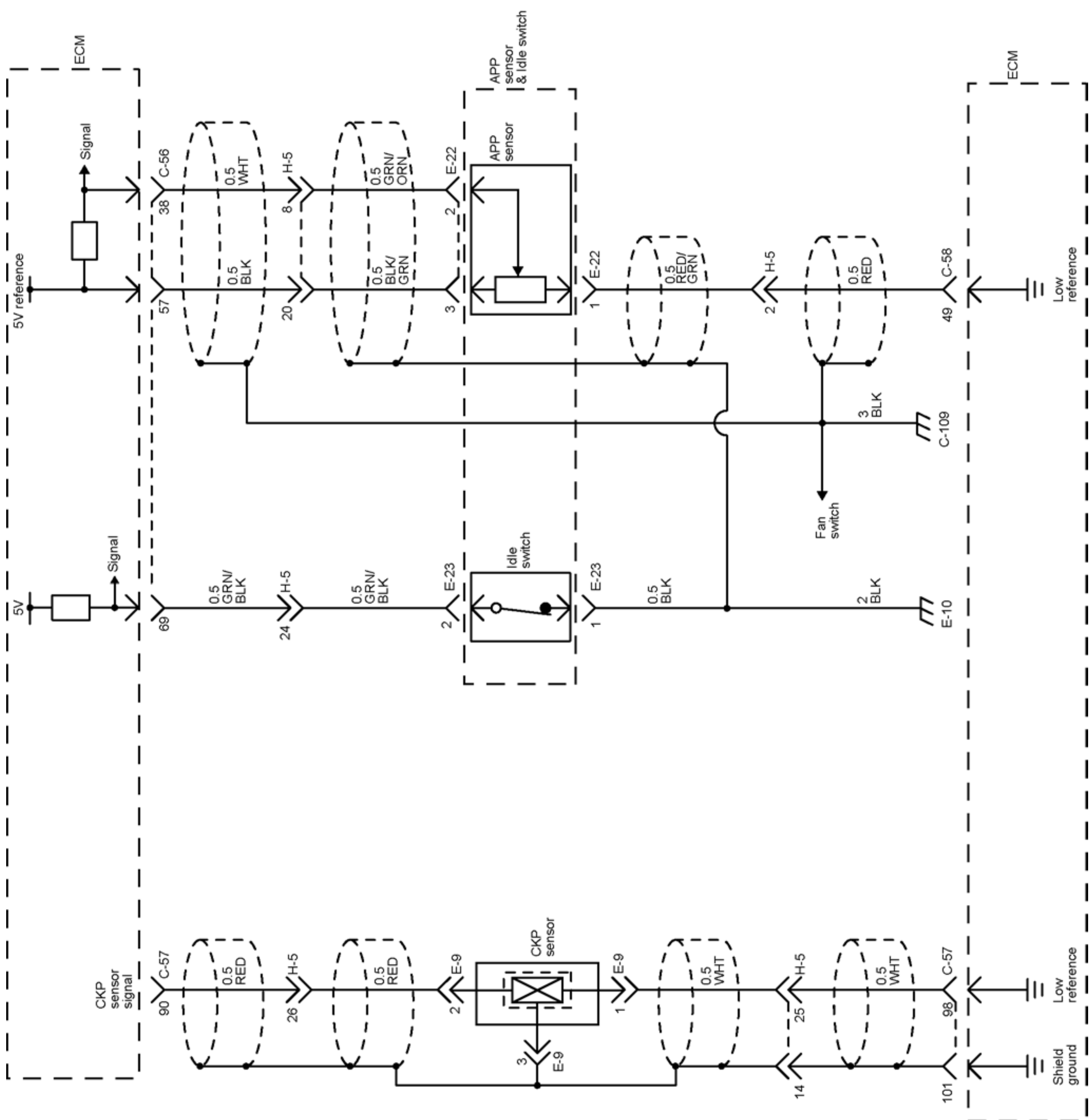
RTW76EXF003001

Gauges and Warning Lamps



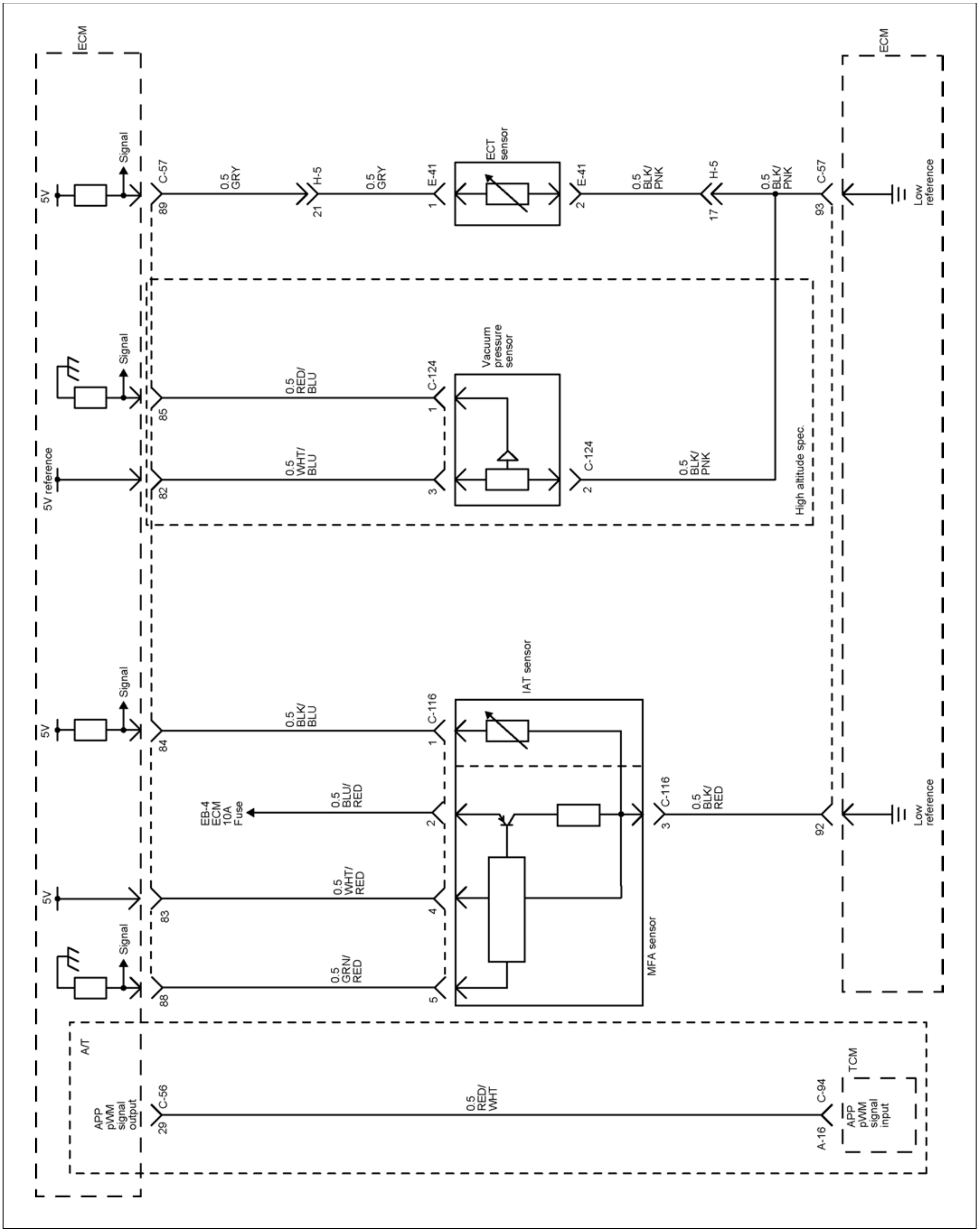
RTW76EXF003101

A/C & Neutral Switch Resister, CKP Sensor, APP Sensor and Idle Switch



RTW76EXF003201

MAF & IAT, Vacuum Pressure and ECT Sensors



RTW76EXF003301

Important Operations - Removal

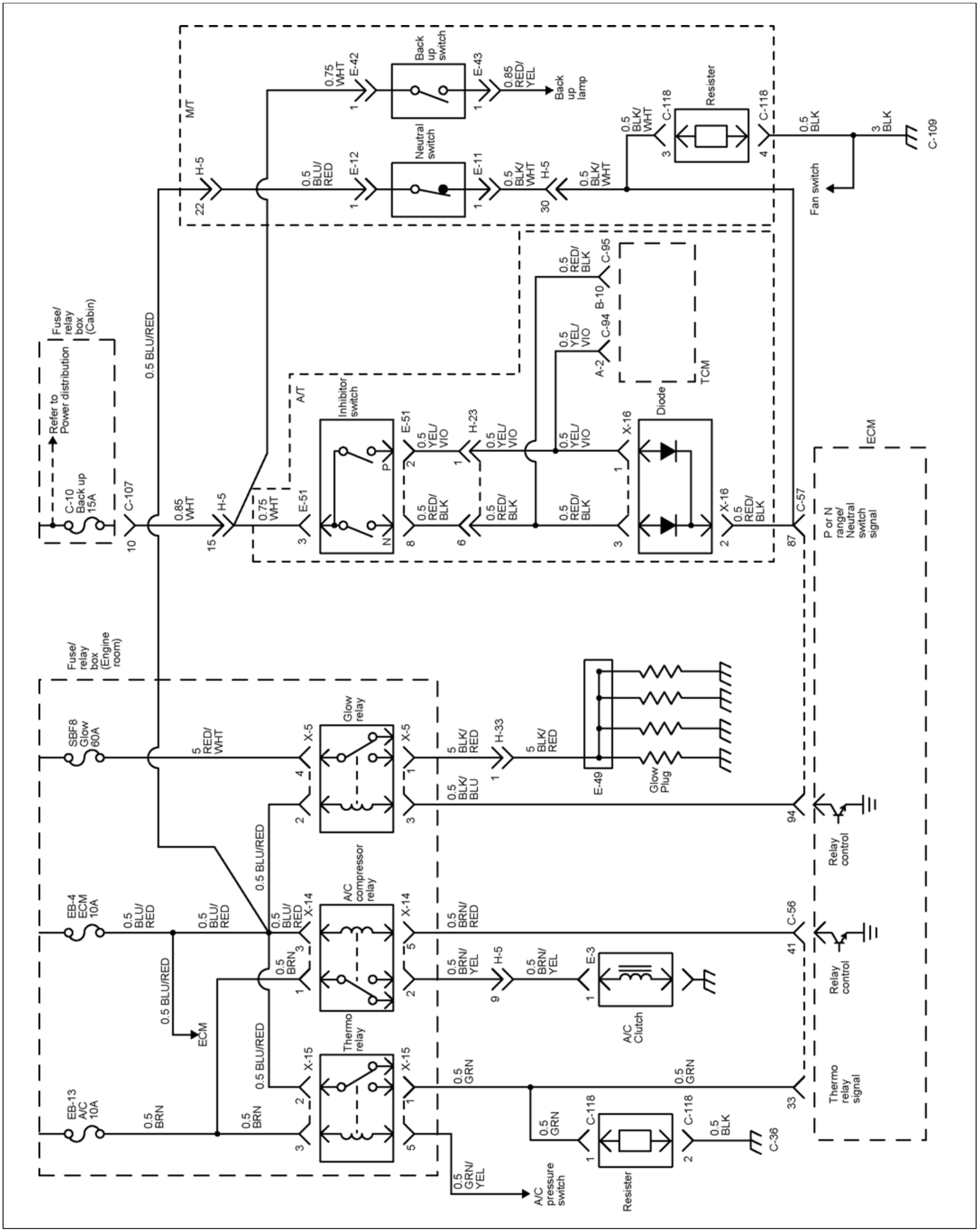
2. Instrument Panel Assembly and Cross Beam
Refer to SECTION 10 “INSTRUMENT PANEL”.

4. Evaporator or Duct
Refer to “EVAPORATOR” or “DUCT” in this section.

Important Operation - Installation

2. Instrument Panel Assembly and Cross Beam
Adjust the heater control cables.
Refer to “CONTOROL LEVER ASSEMBLY” in this section.

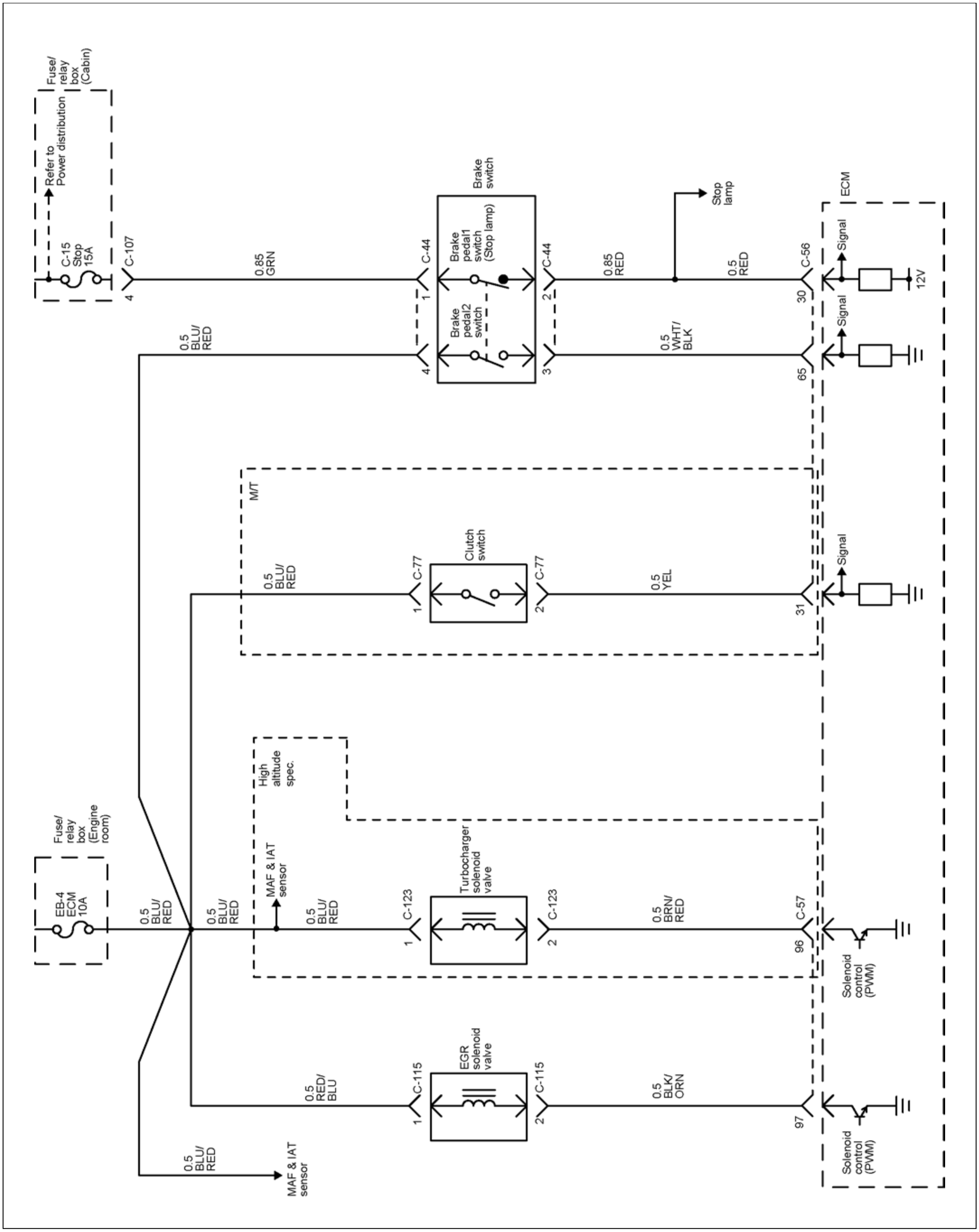
A/C Control System, Glow Control System, Inhibitor Switch (A/T) and Neutral Switch (M/T)



RTW76EXF003401

BACK TO CHAPTER INDEX

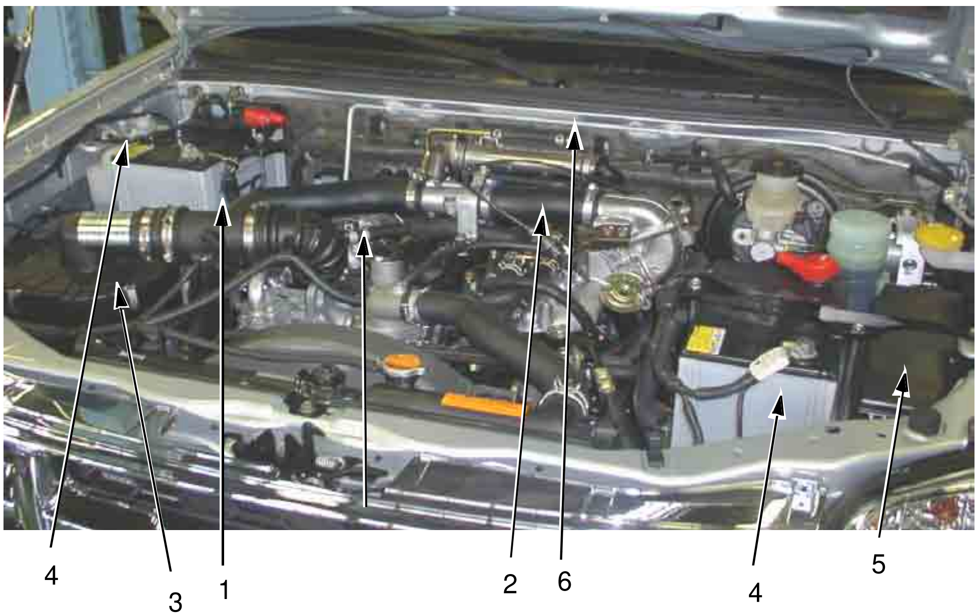
EGR Solenoid Valve, Turbocharger Solenoid Valve, Clutch Switch and Stop Light Switch



RTW76EXF003501

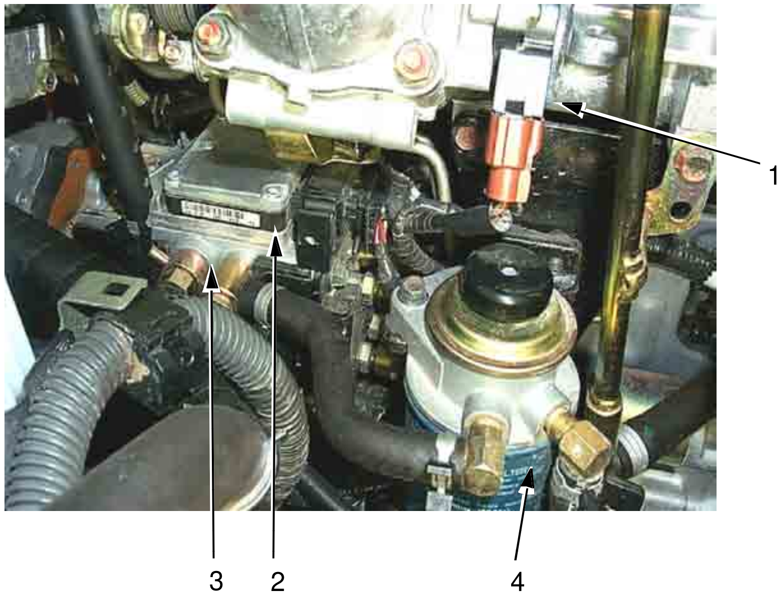
Component Locator

Engine Controls Component Views



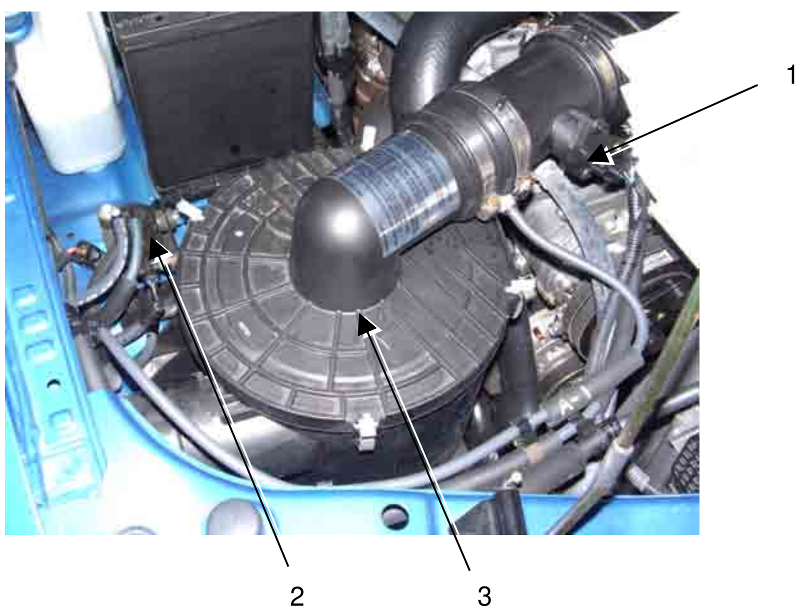
Legend

1. Mass Air Flow (MAF) & Intake Air Temperature (IAT) Sensor Assembly
2. Throttle Cable
3. Air Cleaner Case
4. Battery
5. Relay & Fuse Box
6. EGR Cooler (Euro3) / EGR Pipe (Except Euro3)



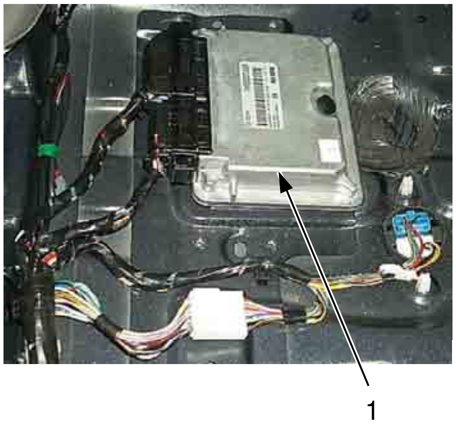
Legend

1. Accelerator Pedal Position (APP) Sensor & Idle Switch
2. Fuel Iinjection Pump Control Unit (PCU)
3. Fuel Injection Pump Assembly
4. Fuel Filter (Except Euro 3)



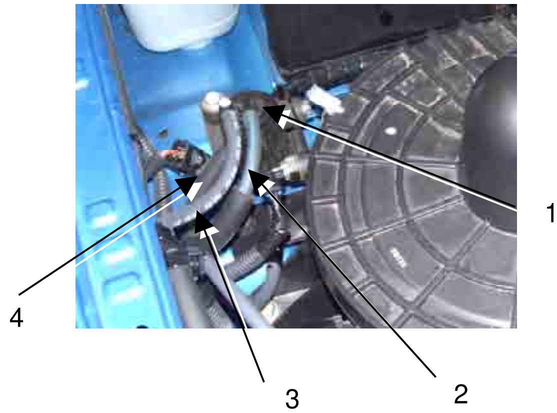
Legend

1. Mass Air Flow (MAF) & Intake Air Temperature (IAT) Sensor
2. EGR Solenoid Valve
3. Air Cleaner Case



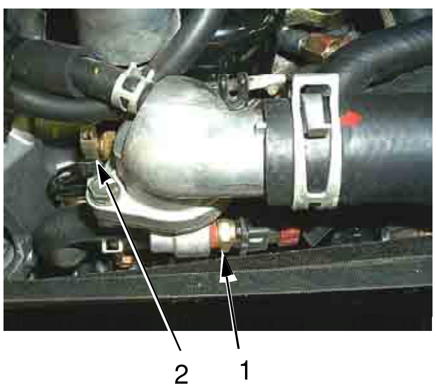
Legend

1. Engine Control Module (ECM)



Legend

1. EGR Solenoid Valve
2. To Vacuum Pump
3. To EGR Valve
4. To Intake Duct



Legend

1. Engine Coolant Temperature (ECT) Sensor
2. Thermo Unit for Water Temperature Gauge

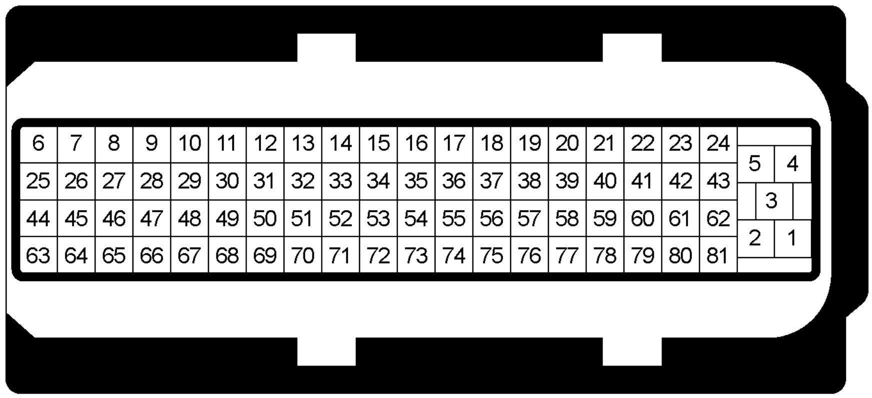
Legend

1. Crankshaft Position (CKP) Sensor
2. Clutch Housing

Legend

1. Vehicle Speed Sensor (VSS)

Engine Control Module (ECM) Connector End Views

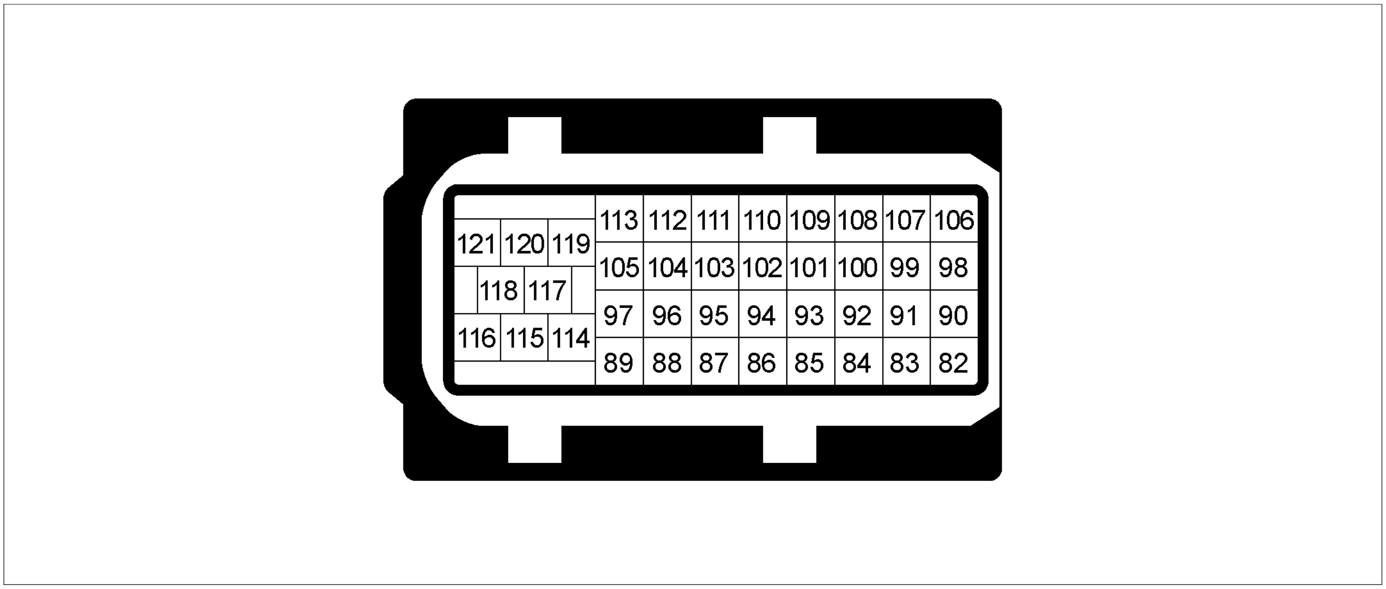


RTW66ESF000301

Connector No.		C-56
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 - 5) J-35616-64A (Pin 6 - 81)
Pin	Wire Color	Pin Function
1	BLK	ECM Ground
2	BLK	ECM Ground
3	BLU/RED	ECM Battery Voltage
4	—	Not Used
5	—	Not Used
6 – 24	—	Not Used
25	—	Not Used
26	—	Not Used
27	BLK/RED	Engine Speed Signal Output to Tachometer and TCM (A/T Only)
28	—	Not Used
29	RED/WHT	APP PWM Signal Output (A/T Only)
30	RED	Brake Pedal 1 Switch (Stop Lamp Pedal Switch) Signal
31	YEL	Clutch Pedal Switch (M/T Only)
32	—	Not Used
33	GRN	Thermo Relay Signal Input
34	—	Not Used
35	WHT	Keyword 2000
36	—	Not Used
37	—	Not Used
38	WHT	APP Sensor Signal
39	BLU/YEL	Ignition Voltage Feed
40	—	Not Used
41	BRN/RED	A/C Compressor Relay Control

Connector No.		C-56
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 - 5) J-35616-64A (Pin 6 - 81)
Pin	Wire Color	Pin Function
42	BRN/YEL	MIL Control
43	ORN/BLU	Glow Indicator Lamp Control
44	—	Not Used
45	BLU	Diag Request Switch
46	—	Not Used
47	—	Not Used
48	—	Not Used
49	RED	APP Sensor Low Reference
50	—	Not Used
51	—	Not Used
52	—	Not Used
53	—	Not Used
54	—	Not Used
55	—	Not Used
56	—	Not Used
57	BLK	APP Sensor 5 Volts reference
58	BLU/BLK	ECM Main Relay Control
59	—	Not Used
60	—	Not Used
61	—	Not Used
62	—	Not Used
63	BLU/RED	ECM Voltage Feed via ECM Fuse
64	—	Not Used
65	WHT/BLK	Brake Pedal 2 Switch Signal
66	—	Not Used

Connector No.		C-56
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 - 5) J-35616-64A (Pin 6 - 81)
Pin	Wire Color	Pin Function
67	—	Not Used
68	BLU/WHT	VSS Signal
69	GRN/BLK	Idle Switch Signal
70	—	Not Used
71	—	Not Used
72	—	Not Used
73	—	Not Used
77	—	Not Used
78	—	Not Used
79	—	Not Used
80	—	Not Used
81	—	Not Used



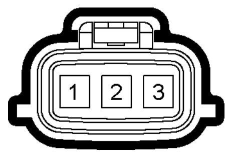
RTW66ESF000401

Connector No.		C-57
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
82	WHT/BLU	Vacuum Pressure Sensor 5 Volts Reference (High Altitude Only)
83	WHT/RED	MAF Sensor 5 Volts Reference
84	BLK/BLU	IAT Sensor Signal
85	RED/BLU	Vacuum Pressure Sensor Signal (High Altitude Only)
86	—	Not Used
87	BLK/WHT	Neutral Switch Input (M/T)
	RED/BLK	P & N Position Switch Input (A/T)
88	GRN/RED	MAF Sensor Signal
89	GRY	ECT Sensor Signal
90	RED	CKP Sensor Signal
91	PNK	CKP Sensor Signal Output
92	BLK/RED	MAF Sensor & IAT Sensor Low Reference
93	BLK/PNK	ECT Sensor & Vacuum Pressure Sensor (High Altitude Only) Low Reference
94	BLK/BLU	Glow Relay Control
95	—	Not Used
96	BRN/RED	Turbocharger Solenoid Valve Control (High Altitude Only)
97	BLK/ORN	EGR Solenoid Valve Control
98	WHT	CKP Sensor Low Reference
99	RED	CAN Low Signal
100	WHT	CAN High Signal
101	BLK	CKP Sensor Shield Ground
102	—	Not Used

Connector No.		C-57
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
102	—	Not Used
103	—	Not Used
105	ORN	Engine Shutoff (ESO) Solenoid Valve Control Signal Output
106 - 121	—	Not Used

Engine Control Connector End Views

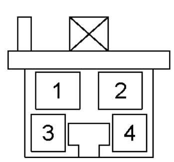
Accelerator Pedal Position (APP) Sensor



RTW66ESH000301

Connector No.		E-22
Connector Color		Brown
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	RED/GRN	APP Sensor Low Reference
2	GRN/ORN	APP Sensor Signal
3	BLK/GRN	APP Sensor 5 Volts Reference

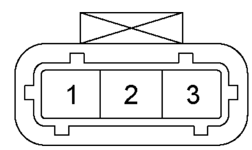
Brake Switch



RTW66ESH000401

Connector No.		C-44
Connector Color		White
Test Adapter No.		J-35616-40 (Pin 1 – 2) J35616-2A (Pin 3 – 4)
Pin	Wire Color	Pin Function
1	GRN	Brake Pedal 1 Switch (Stop Lamp Pedal Switch) 12 Volts Feed
2	RED	Brake Pedal 1 Switch (Stop Lamp Pedal Switch) Signal
3	BLU/RED	Brake Pedal 2 Switch Ignition Voltage
4	WHT/BLK	Brake Pedal 2 Switch Signal

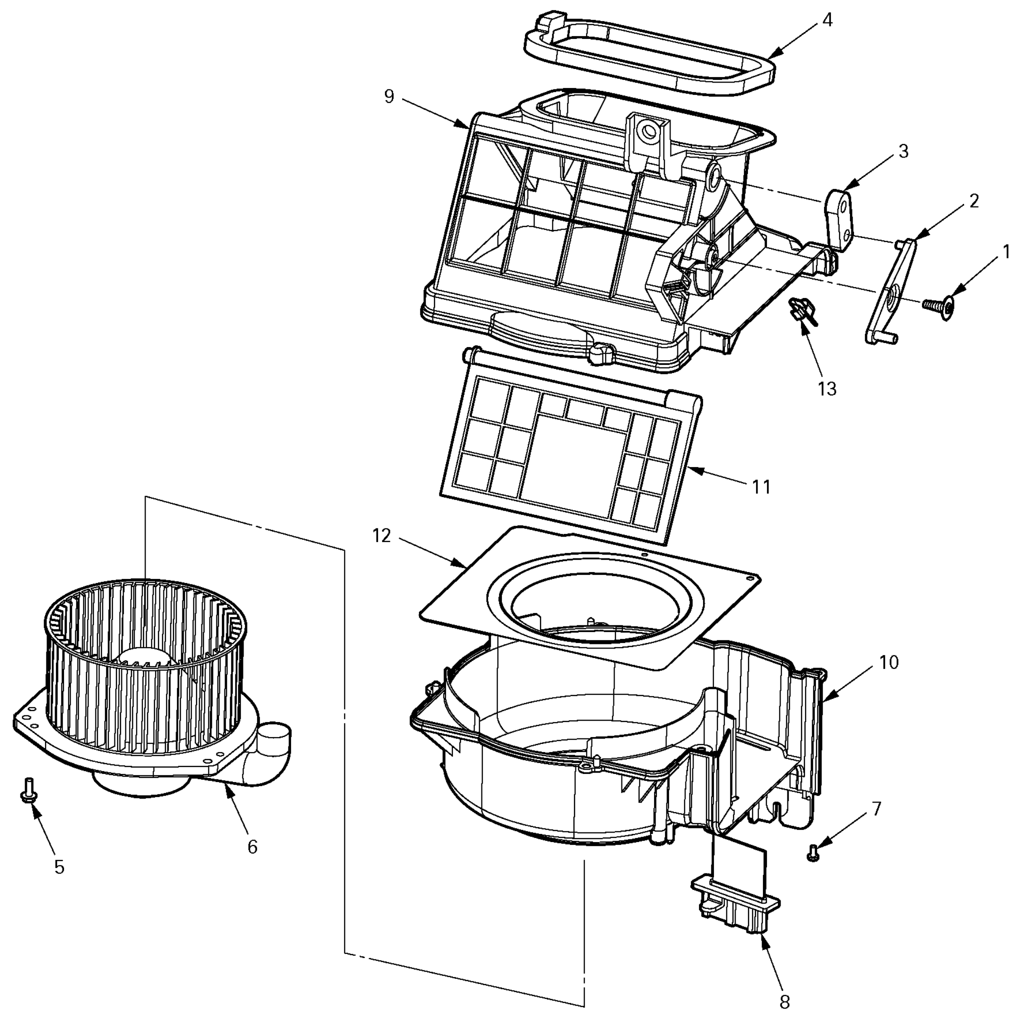
Crankshaft Position (CKP) Sensor



RTW66ESH000501

Connector No.		E-9
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	WHT	CKP Sensor Low Reference
2	RED	CKP Sensor Signal
3	BLK	CKP Sensor Shield Ground

DISASSEMBLY AND REASSEMBLY



This illustration is based on RHD model

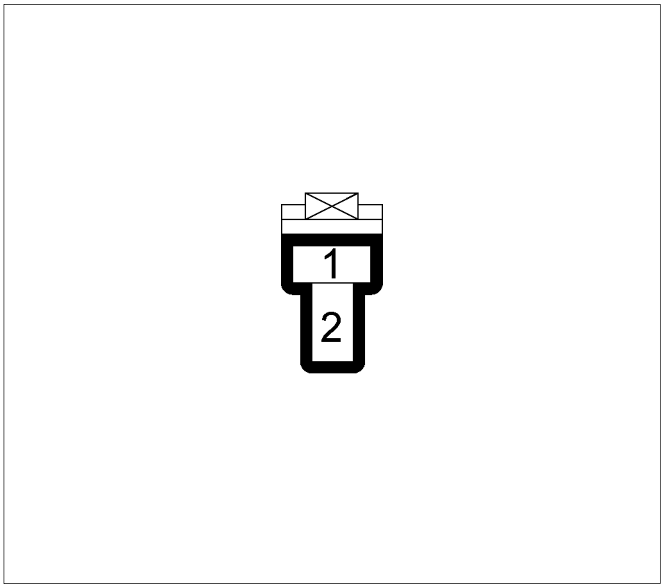
Disassembly Steps

1. Attaching screw
2. Intake link
3. Intake lever
4. Intake packing
5. Attaching screws
6. Blower motor assembly
7. Attaching screw
8. Flat resistor
9. Upper case
10. Lower case
11. Mode door
12. Bell mouth
13. Control cable clamp

Reassembly Steps

13. Control cable clamp
12. Bell mouth
11. Mode door
10. Lower case
9. Upper case
8. Flat resistor
7. Attaching screw
6. Blower motor assembly
5. Attaching screws
4. Intake packing
3. Intake lever
2. Intake link
1. Attaching screw

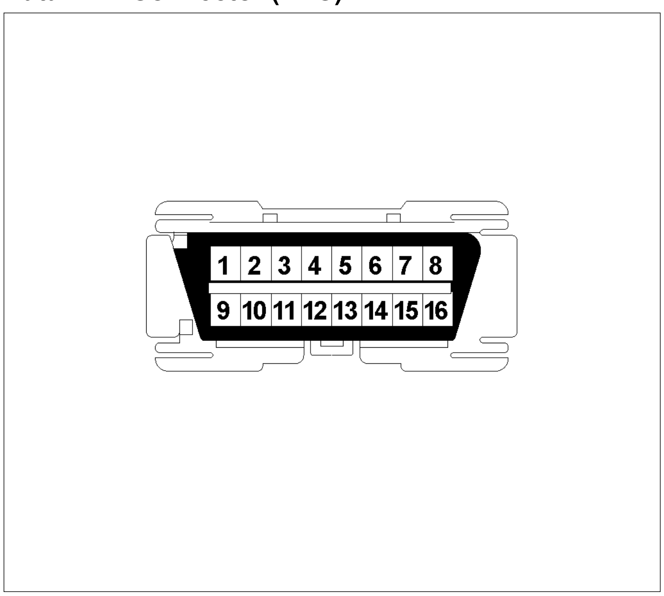
Clutch Switch



LNW46ESH000801

Connector No.		C-77
Connector Color		White
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	BLU/RED	Clutch Pedal Switch Ignition Voltage
2	YEL	Clutch Pedal Switch Signal

Data Link Connector (DLC)

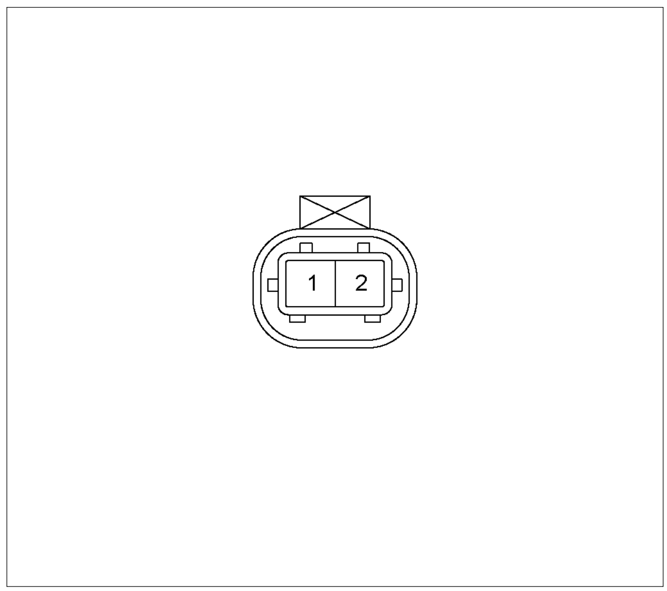


LNW36ESH015801

Connector No.		B-58
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin	Wire Color	Pin Function
1	—	Not Used
2	GRN	J1850 (Class 2)
3	—	Not Used

Connector No.		B-58
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin	Wire Color	Pin Function
4	BLK	Ground
5	BLK	Ground
6	BLU	Diag Request Switch
7	YEL/BLU	Keyword 2000
8	—	Not Used
9	—	Not Used
10	—	Not Used
11	YEL/BLK	TCM Diagnostic
12	ORN/WHT	ABS C/U Diagnostic
13	RED	SRS Diagnostic
14	—	Not Used
15	—	Not Used
16	RED/YEL	Power Supply

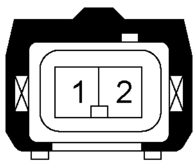
EGR Solenoid Valve



RTW66ESH000601

Connector No.		C-115
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	BLU/RED	Solenoid Valve 12 Volts Feed
2	BLK/ORN	Solenoid Valve Control

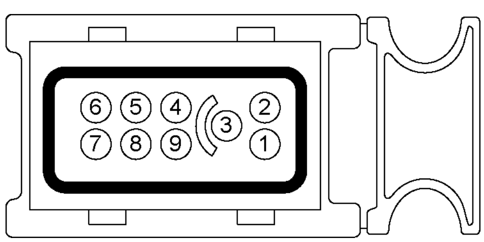
Engine Coolant Temperature Coolant (ECT) Sensor



LNW46ESH003901

Connector No.		E-41
Connector Color		Gray
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	GRY	ECT Sensor Signal
2	BLK/PNK	ECT Sensor Low Reference

Fuel Injection Pump Control Unit (PCU)

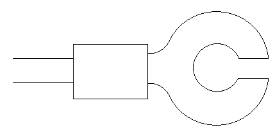


RTW66ESH000701

Connector No.		E-6
Connector Color		Black
Test Adapter No.		J-35616-8
Pin	Wire Color	Pin Function
1	RED	CAN Low Signal
2	YEL	CAN High Signal
3	—	Not Used

Connector No.		E-6
Connector Color		Black
Test Adapter No.		J-35616-8
Pin	Wire Color	Pin Function
4	—	Not Used
5	ORN	Engine Shutoff (ESO) Solenoid Valve Control Signal Input
6	BLK	Ground
7	BLU/RED	Battery voltage
8	PNK	CKP Sensor Signal Input
9	—	Not Used

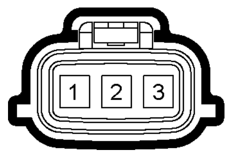
Glow Plug



LNW46ESH000701

Connector No.		E-49
Connector Color		Silver
Pin	Wire Color	Pin Function
1	BLK/RED	Power Supply

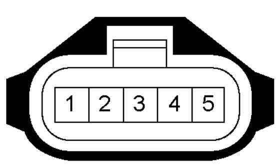
Idle Switch



RTW66ESH000301

Connector No.		E-23
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK	Idle Switch Ground
2	GRN/ BLK	Idle Switch Signal
3	—	Not Used

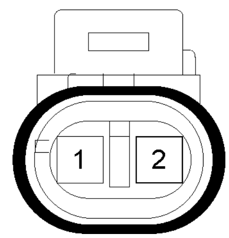
Mass Air Flow (MAF) / Intake Air Temperature Sensor



RTW66ESH000801

Connector No.		C-116
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	BLK/BLU	IAT Sensor Signal
2	BLU/RED	MAF Sensor Ignition Voltage Feed
3	BLK/RED	MAF Sensor & IAT Sensor Low Reference
4	WHT/RED	MAF Sensor 5 Volts Reference
5	GRN/RED	MAF Sensor Signal

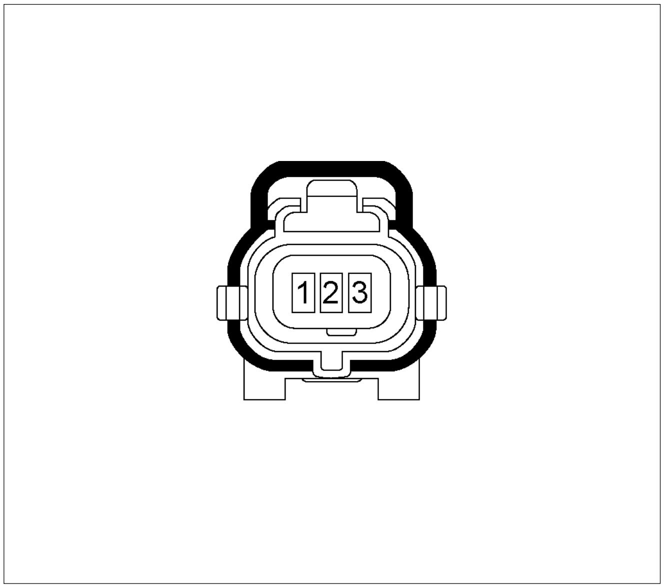
Turbocharger Solenoid Valve



RTW66ESH000901

Connector No.		C-123
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	BLU/RED	Solenoid Valve 12 Volts Feed
2	BRN/RED	Solenoid Valve Control

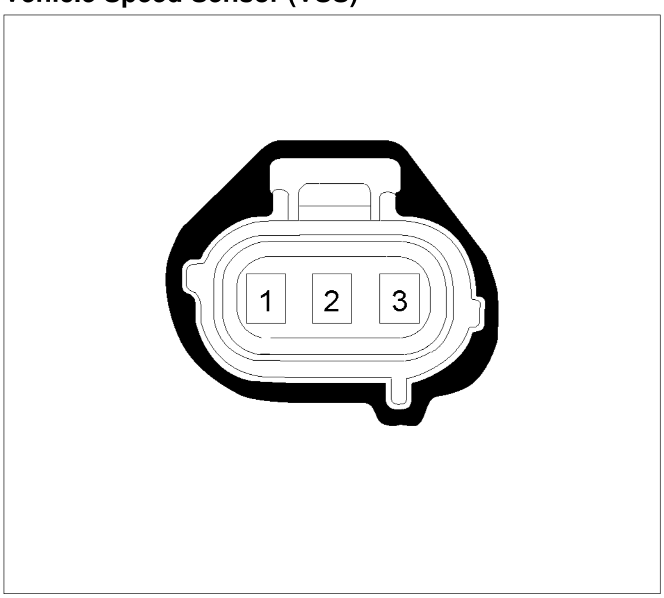
Vacuum Pressure Sensor



RTW66ESH001001

Connector No.		C-124
Connector Color		Black
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	RED/BLU	Vacuum Pressure Sensor Signal
2	BLK/PNK	Vacuum Pressure Sensor Low Reference
3	WHT/BLU	Vacuum Pressure Sensor 5 Volts Reference

Vehicle Speed Sensor (VSS)



LNW46ESH001401

Connector No.		E-44
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	YEL	VSS 12 Volts Feed
2	LT GRN/ WHT	VSS Low Reference
3	BLK/YEL	VSS Signal

Diagnostic Information And Prosedures

Engine Control System Check Sheet

ENGINE CONTROL SYSTEM CHECK SHEET		Inspectors Name	
Customer's Name		Model & Model Year	
Driver's Name		Chassis No.	
Date Vehicle Brought In		Engine No.	
License No.		Odometer Reading	Km/miles

Problem Symptoms	☐ Engine Does Not Run	☐ Engine does not crank	☐ No initial combustion	☐ No complete combustion
	☐ Hard Start	☐ Engine cranks slowly	☐ Other (	)
	☐ Incorrect Idle	☐ Abnormal idling speed ☐ Rough idling ☐ Other (	☐ High idling speed (RPM)	☐ Low idling speed (RPM))
	☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Lack of power, sluggishness, sponginess ☐ Other (	☐ Surge, chuggles	☐ Cut out, misses)
	☐ Engine Stall	☐ Soon after starting ☐ During A/C operation ☐ Other (	☐ After accelerator pedal depressed ☐ After accelerator pedal released	 ☐ Shifting from N to D)
	☐ Others	☐ Black smoke ☐ Fuel knock, combustion noise ☐ Other (	☐ White smoke	☐ Poor fuel economy)

Dates problem occurred					
Problem frequency		☐ Constant ☐ Other (	☐ Intermittently (times per day/month)		☐ Once only)
Condition When Problem Occurs	Weather	☐ Fine ☐ Various/Other (	☐ Cloudy	☐ Rainy	☐ Snow)
	Outside Temperature	☐ Hot (approx.) ☐ Any temperature	☐ Warm	☐ Cool	☐ Cold (approx.)
	Place	☐ Highway ☐ Downhill	☐ Suburbs ☐ Rough road	☐ City area ☐ Other (	☐ Uphill)
	Load Condition	☐ Over (approx. tons) ☐ Other (approx. tons)		☐ No load	
	Engine Temperature	☐ Cold ☐ Other (	☐ Warming up	☐ After warming up	☐ Any temperature)
	Engine Operation	☐ Starting ☐ Racing ☐ Deceleration ☐ Other (	☐ Just after starting (☐ Driving ☐ A/C switch On/Off	Min.) ☐ Constant speed	☐ Idling ☐ Acceleration)
	Fuel Amount	☐ Full	☐ Above 1/2	☐ Below 1/2	☐ Near empty
	Fuel Bland				

Condition of MIL		☐ Remains On	☐ Intermittently turns On	☐ Does not turn On
Diagnostic Trouble Code (DTC) or Flash Code	Present Code	☐ Nothing	☐ P Code & Symptom Code No. (	)
	History Code	☐ Nothing	☐ P Code & Symptom Code No. (	)
Other Additional Condition				

Diagnostic Starting Point - Engine Controls

Begin the system diagnosis with Diagnostic System Check - Engine Controls. The Diagnostic System Check - Engine Controls will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

The use of the Diagnostic System Check - Engine Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

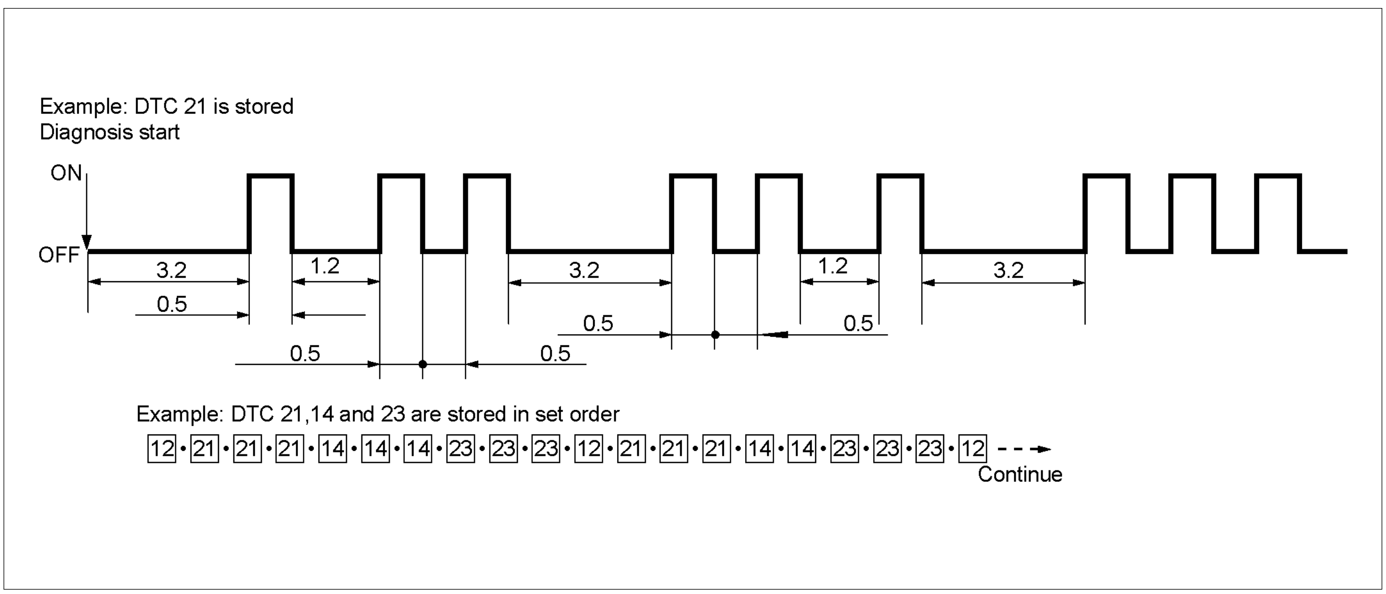
Important:

Engine Control System Check Sheet must be used to verify the complaint vehicle, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

Reading Flash Diagnostic Trouble Codes

The provision for communicating with the ECM is the Data Link Connector (DLC). The DTCs stored in the ECM memory can be read either through a hand-held diagnostic scanner such as scan tool plugged into the DLC or by counting the number of flashes of the MIL when the diagnostic test terminal of the DLC is grounded. The DLC terminal “6” (diagnostic request switch) is pulled “Low” (grounded) by jumped to DLC terminal “4”, which is a ground wire.

Once terminals “4” and “6” have been connected, the ignition switch must be moved to the “ON” position, with the engine not running. The MIL will initially flash 12. Then, the MIL will flash the first stored DTC three times, second stored DTC three times and so on. All the stored DTCs are flashed, then return 12 and continue to flash the DTC. If no DTC exists, the MIL flashes 12 continuously. The flash DTC display will continue as long as the DLC is shorted.



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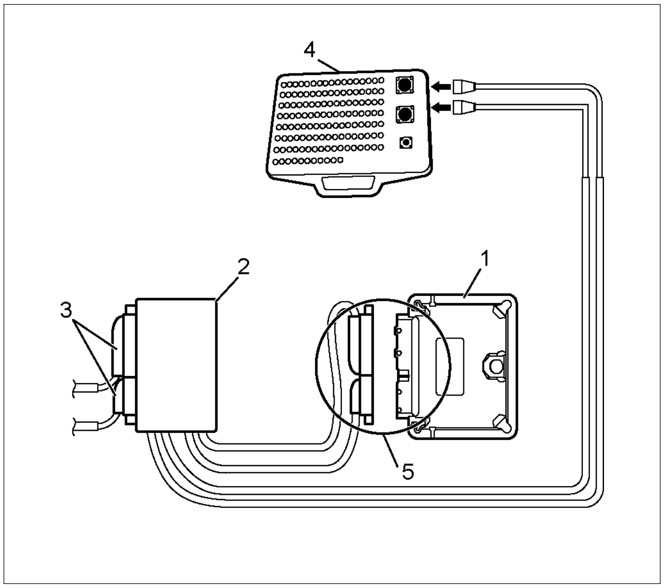
Breaker Box

Breaker Box Connection Type A



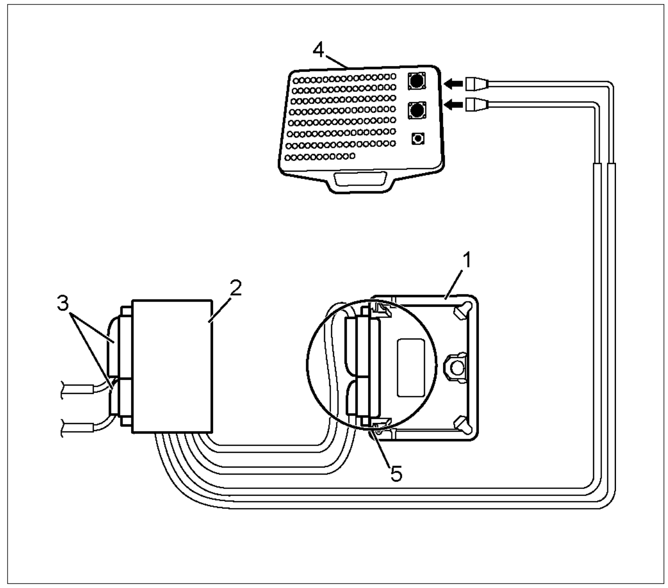
RTW66ESH003601

Legend

1. Engine Control Module (ECM)
2. Harness Adapter
3. ECM - Harness Connector
4. Breaker Box
5. ECM is disconnected

Although probe to the engine control module (ECM) harness connector is possible by Test Adapter, Breaker Box Connection Type A is suitable usage to prevent misprobe and damage of female terminals when test open circuit or short to ground between the ECM and electrical components, since the terminals where the harness connector of the ECM is thin have gathered.

Breaker Box Connection Type B



RTW66ESH003701

Legend

1. Engine Control Module (ECM)
2. Harness Adapter
3. ECM - Harness Connector
4. Breaker Box
5. ECM is connected

The ECM and other connectors have water proof terminal that is not allowed to back probe. Breaker Box Connection Type B is suitable usage to test short to voltage circuit or signal check between the ECM and electrical components.

Diagnostic System Check - Engine Controls

Description

The Diagnostic System Check-Engine Controls is an organized approach to identifying a condition that is created by a malfunction in the electronic engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2. Lack of communication may be because of a partial or a total malfunction of the Keyword 2000 serial data circuit. The specified procedure determines the particular condition.

11. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order.

- Component level DTCs, such as sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs. Diagnose the multiple DTCs within this category in numerical order. Begin with the lowest numbered DTC, unless the diagnostic table directs you otherwise.

Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- If there is a condition with the starting system, refer to the starting system section in the engine mechanical.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the ECM grounds are clean, tight, and in the correct location.
- Ensure the ECM harness connectors are clean and correctly connected.
- Ensure the ECM terminals are clean and correctly mating.
- Ensure the fuel injection pump control unit (PCU) ground is clean, tight, and in the correct location.
- Ensure the PCU harness connectors are clean and correctly connected.
- Ensure the PCU terminals are clean and correctly mating.
- Ensure the vehicle maintenance has been done enough.

Step	Action	Value(s)	Yes	No
1	Install the scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to scan tool Does Not Power Up

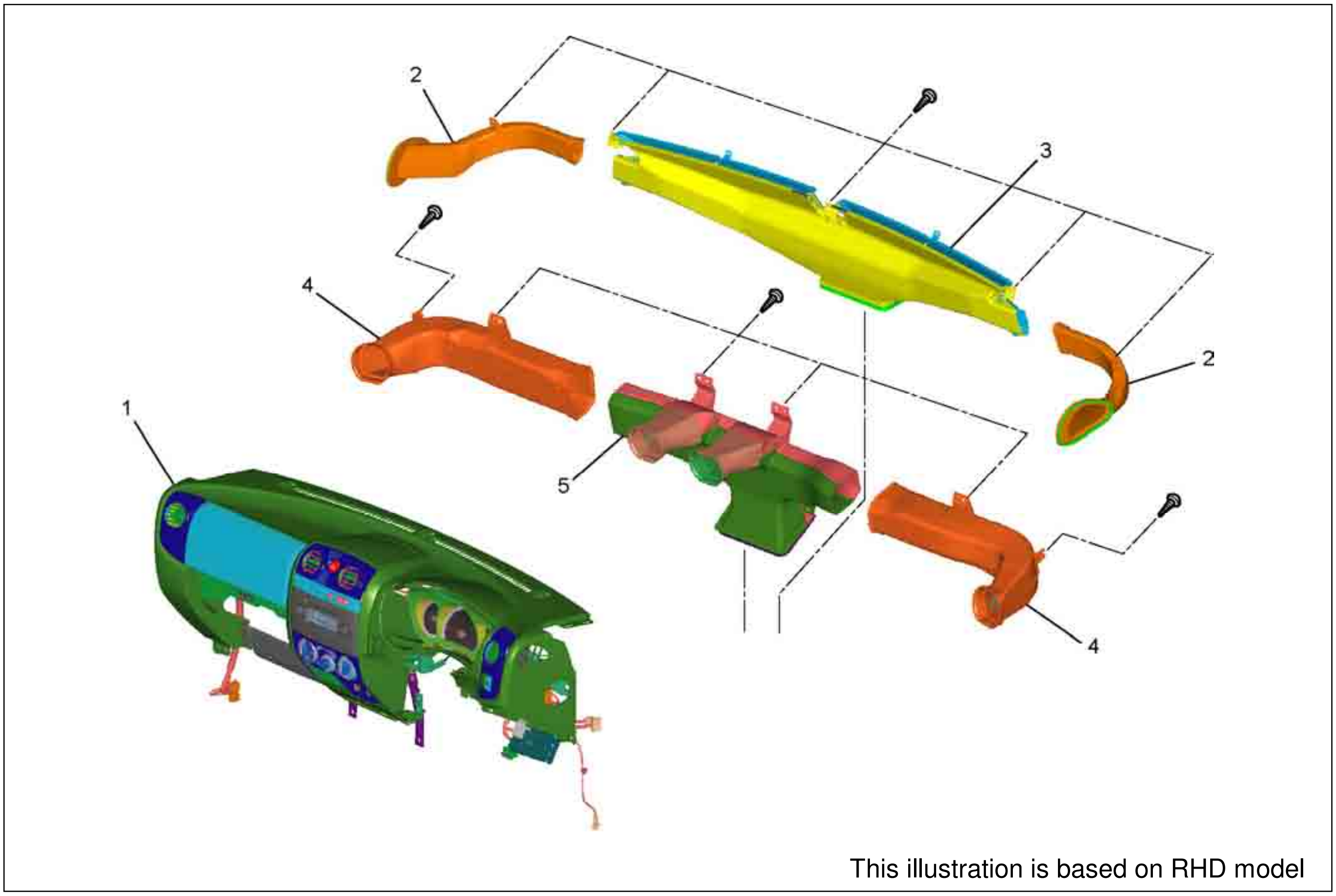
Step	Action	Value(s)	Yes	No
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. • Engine control module (ECM) • Transmission control module (TCM) (A/T only) • Electronic hydraulic control unit (EHCU) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to scan tool Does Not Communicate with Keyword 2000 Device
3	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 4	Go to Engine Cranks but Does Not Run
4	Select the DTC display function for the following control modules: • ECM • TCM (A/T only) • EHCU Does the scan tool display any DTCs?	—	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition for 30 seconds. 2. Start the engine. 3. Monitor the DTC Information with the scan tool. Did you complete the action?	—	Go to Step 6	—
6	Does the scan tool display ECM DTC P0602?	—	Go to Applicable DTC	Go to Step 7
7	Does the scan tool display ECM DTC P0251 (Symptom Code 9 or A), P0606 (Symptom Code A or B) or P1605 (Symptom Code C, D or E)?	—	Go to Applicable DTC	Go to Step 8
8	Does the scan tool display ECM DTC P0560 (Symptom Code 1, 2 or A)?	—	Go to Applicable DTC	Go to Step 9
9	Does the scan tool display following ECM DTC P0561 (Symptom Code A or B) or P1625 (Symptom Code A or B)?	—	Go to Applicable DTC	Go to Step 10
10	Does the scan tool display following ECM DTC P1650 (Symptom Code A or B) or P1651 (Symptom Code A or B)?	—	Go to Applicable DTC	Go to Step 11
11	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 12
12	Is the customer's concern with the automatic transmission?	—	Go to Diagnostic System Check Transmission Control	Go to Step 13
13	Is the customer's concern with the ABS system?	—	Go to Diagnostic System Check Brake Control	Go to Step 14

Step	Action	Value(s)	Yes	No
14	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • Cuts Out, Misses • Surge/Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Fuel Knock/Combustion Noise • Poor Fuel Economy • Excessive Smoke (Black Smoke) • Excessive Smoke (White Smoke) Did you find and correct the condition?	—	System OK	Go to Intermittent Conditions

BACK TO CHAPTER INDEX

DEFROSTER NOZZLE AND VENT DUCT

REMOVAL AND INSTALLATION



RTW710MF000201

Removal Steps

▲ 1. Instrument panel assembly and cross beam
2. Side def hose RH/LH
3. Defroster nozzle
4. Vent duct driver side and assist side
5. Center vent duct

Installation Steps

5. Center vent duct
4. Vent duct driver side and assist side
3. Defroster nozzle
2. Side def hose RH/LH
1. Instrument panel assembly and cross beam

Important Operation - Removal

1. Instrument Panel Assembly and Cross Beam

Refer to SECTION 10 “INSTRUMENT PANEL”.

Scan Tool Data List

The scan tool Data List contains all engine related parameters that are available on the scan tool. Use the scan tool Data List only after the following is determined:

- The Diagnostic System Check - Engine Controls is completed.
- No diagnostic trouble codes (DTCs) are present.
- On-board diagnostics are functioning properly.

The scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The scan tool Data List represents values that would be seen on a normal running engine.

Important:

A scan tool that displays faulty data should not be used. The scan tool problem should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000 RPM
Operating Conditions: Engine Idling or 2000 RPM / Engine Coolant Temperature is between 75-85°C (167-185°F) / Accelerator Pedal is Constant / Park or Neutral / Accessories OFF / Vehicle Located at Sea Level			
Ignition Switch	On/Off	On	On
System Voltage	V	11.0 – 15.0	11.0 – 15.0
ECM Main Relay	On/Off	On	On
Engine Speed	RPM	650 - 750	1950 – 2050
Desired Idle Speed	RPM	700	700
Injection Pump Speed	RPM	325 - 375	975 – 1025
Accelerator Pedal Position	%	0.0	5.0 – 7.0
Idle Switch	On/Off	On	Off
Intake Air Temperature	°C/°F	20 – 40°C / 68 – 104°F	20 – 40°C / 68 – 104°F
Engine Coolant Temperature	°C/°F	75 - 85°C / 167 - 185°F	75 - 85°C / 167 - 185°F
Fuel Temperature	°C/°F	20 – 60°C / 68 – 140°F	20 – 60°C / 68 – 140°F
Barometric Pressure	hPa	Nearly 1010 hPa at sea level	Nearly 1010 hPa at sea level
Vacuum Pressure Sensor	hPa	Nearly 2020 hPa at sea level	Nearly 2020 hPa at sea level
Turbocharger Solenoid Command	%	100% at sea level	100% at sea level
EGR Solenoid Command	%	Nearly 90%	Nearly 90%
Mass Air Flow Sensor	mg/strk	More than 430 mg/strk at sea level (with EGR system) More than 700 mg/strk at sea level (without EGR system)	More than 430 mg/strk at sea level (with EGR system) More than 700 mg/strk at sea level (without EGR system)
Desired Mass Air Flow	mg/strk	More than 430 mg/strk at sea level (with EGR system) 1500 mg/strk (without EGR system)	More than 430 mg/strk at sea level (with EGR system) 1500 mg/strk (without EGR system)
Actual Injection Quantity	mg/strk	6.0 – 9.0	7.0 – 11.0
Desired Injection Quantity	mg/strk	6.0 – 9.0	7.0 – 11.0
Actual Injection Timing	°CA	1.0 – 4.0	3.0 – 4.5
Desired Injection Timing	°CA	1.0 – 4.0	3.0 – 4.5
Neutral Switch	On/Off	On	On
Brake Pedal 1 Switch	Applied/ Released	Released	Released
Brake Pedal 2 Switch	Applied/ Released	Released	Released
Clutch Pedal Switch	Applied/ Released	Released	Released
Vehicle Speed	km/h / MPH	0	0

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000 RPM
Glow Relay Command	On/Off	Off	Off
Glow Indicator Lamp Command	On/Off	Off	Off
Malfunction Indicator Lamp (MIL) Command	On/Off	Off	Off
A/C Request Signal	On/Off	Off	Off
A/C Relay Command	On/Off	Off	Off

Scan Tool Data Definitions

A list of each message displayed on the scan tool will be explained in Engine Controls. This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnosis System Check – Engine Controls first. The Diagnostic System Check will confirm proper system operation.

Ignition Switch

This parameter displays the input status of the ignition switch to the ECM terminal (pin 39). The scan tool will display On or Off. On indicates the ignition switch is turned ON position.

System Voltage

This parameter displays the system voltage measured by the ECM terminal (pin 3) at the voltage feed from the ECM main relay.

ECM Main Relay

This parameter displays the commanded state of the ECM main relay control circuit (pin 58). The scan tool will display On or Off. On indicates the ECM main relay control circuit is being grounded by the ECM, allowing the main relay to supply voltage to the other circuits of the ECM. Off indicates the main relay is not being commanded On by the ECM.

Engine Speed

This parameter displays the speed of the crankshaft as calculated by the ECM based on input from the crankshaft position (CKP) sensor or camshaft position (CMP) sensor. The scan tool will display the engine speed in revolution per minute (RPM).

Desired Idle Speed

This parameter displays the idle speed requested by the ECM. The ECM will compensate for various engine loads based on engine coolant temperature (ECT) and A/C system status. If the A/C system is activated, the ECM sets 100 RPM higher than normal idle speed.

Injection Pump Speed

This parameter displays the speed of the injection pump as calculated by the fuel injection pump control unit (PCU) based on the input from the fuel injection pump camshaft position (CMP) sensor. The scan tool will display the injection pump speed in revolution per minute (RPM).

Accelerator Pedal Position

This parameter displays the angle of the accelerator pedal as calculated by the ECM using the signal from the accelerator pedal position (APP) sensor. The accelerator pedal position indicated angle is a range of values indicating a low percentage when the accelerator pedal is not depressed to a high percentage when the accelerator pedal is fully depressed.

Idle Switch

This parameter displays the input status of the idle switch to the ECM terminal (pin 69). The Tech will display On or Off. On indicates the accelerator pedal is not being pushed down. Off indicates the accelerator pedal is being depressed.

Intake Air Temperature

This parameter displays the temperature of the intake air based on a voltage input from the intake air temperature (IAT) sensor to the ECM. The scan tool will display a low temperature when signal voltage is high, and high temperature when the signal voltage is low. Note that the IAT sensor is internal to the mass air flow (MAF) sensor and the MAF sensor is heated.

Engine Coolant Temperature

This parameter displays the temperature of the engine coolant based on a voltage input from the engine coolant temperature (ECT) sensor to the ECM. The scan tool will display a low temperature when the signal voltage is high, and a high temperature when the signal voltage is low.

Fuel Temperature

This parameter displays the temperature of the fuel as calculated by the fuel injection pump control unit (PCU) using the signal from the fuel temperature sensor inside of the PCU.

Barometric Pressure

This parameter displays the barometric pressure as calculated by the ECM using the signal from the barometric pressure (BARO) sensor inside of the ECM.

Vacuum Pressure Sensor (High altitude specification only)

This parameter displays the amount of the vacuum pressure to the turbocharger wastegate valve. When a high vacuum pressure at a low vacuum pressure amount to the turbocharger wastegate valve. The scan tool will display doubled barometric pressure when the ignition is ON with the engine OFF.

Turbocharger Solenoid Command (High altitude specification only)

This parameter displays the turbocharger solenoid valuve control duty ratio commanded by the ECM terminal (pin 96) using the signal from various sensor inputs. When a low duty ratio, vacuum pressure to the turbocharger wastegate valve is controlled to increase. When a high duty ratio, vacuum pressure to the turbochager wastegate valve is controlled to reduce.

EGR Solenoid Command

This parameter displays the EGR solenoid valve control duty ratio commanded by the ECM terminal (pin 97) using the signal from engine speed, and injection volume and various sensor inputs. When a small duty ratio, the EGR valve is controlled to close. When a large duty ratio, the EGR valve is controlled to open.

Mass Air Flow Sensor

This parameter displays the air flow into the engine as calculated by the ECM based on the mass air flow (MAF) sensor input. The scan tool will display a high value at higher engine speeds, and a low value at idle. This can be compared to the Desired Mass Air Flow to determine MAF sensor accuracy, EGR problem or intake problem. Note that the MAF on the scan tool will only update with the engine running.

Desired Mass Air Flow

This parameter displays a mass air flow desired by the ECM based on current driving condition.

Actual Injection Quantity

This parameter displays the injection quantity calculated by the PCU based on the fuel injection solenoid valve On time which compensated from the timing device position and fuel temperature inputs. This can be compared to the Desired Injection Quantity to determine fuel system problem.

Desired Injection Quantity

This parameter displays an injection quantity desired by the ECM based on current driving condition using target injection maps.

Actual Injection Timing

This parameter displays the injection timing calculated by the PCU based on the timing device position which determined from the crankshaft position sensor and camshaft position sensor inputs. This can be compared to the Desired Injection Timing to determine timing device problem or fuel system problem.

Desired Injection Timing

This parameter displays injection timing desired by the ECM based on current driving condition using target injection timing maps. This timing is compensated by engine coolant temperature, altitude and intake air temperature, etc.

Neutral Switch

This parameter displays the state of the neutral switch as determined by the ECM terminal (pin 87) based on an input from the neutral switch or inhibitor switch.

Brake Pedal 1 Switch

This parameter displays the state of the brake pedal as determined by the ECM terminal (pin 30) based on an input from the brake pedal 1 switch. This switch turns On the stop lamps when the brake pedal is depressed. The scan tool will display Applied when the brake pedal is depressed.

Brake Pedal 2 Switch

This parameter displays the state of the brake pedal 2 switch as determined by the ECM terminal (pin 65). The scan tool will display Released or Applied. Released indicates the brake pedal is not being pushed down. Applied indicates the brake switch is being depressed.

Clutch Pedal Switch (M/T Only)

This parameter displays the state of the clutch pedal as determined by the ECM terminal (pin 31) based on an input from the clutch pedal switch. The scan tool will display Release or Applied. Release indicates the clutch pedal is not being push down. Applied indicates the clutch switch is being depressed.

Vehicle Speed

This parameter displays the vehicle speed calculated by the ECM based on an input from the vehicle speed sensor (VSS). The scan tool will display a high value at higher vehicle speeds, and low value at lower vehicle speeds.

Glow Relay Command

This parameter displays the commanded state of the glow plug relay control circuit (pin 94). The scan tool will display On or Off. On indicates the glow plug relay control circuit is being grounded by the ECM, allowing voltage to the glow plugs. Off indicates the glow plug relay is not being commanded On by the ECM.

Glow Indicator Lamp Command

This parameter displays the commanded state of the glow indicator lamp control circuit (pin 43). The glow indicator lamp should be On when the scan tool indicates On. The glow indicator should be Off when the scan tool indicates Off.

Malfunction Indicator Lamp (MIL) Command

This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit (pin 42). The MIL should be On when the scan tool indicates On. The MIL should be Off when the scan tool indicates Off. The ECM will command the MIL On for a certain length of time when the ignition is On with the engine Off in order to perform a bulb check.

A/C Request Signal

This parameter displays the state of the air conditioning (A/C) request input to the ECM terminal (pin 33) from the heating, ventilation, and air conditioning (HVAC) controls. The scan tool will display On or Off. On indicates the ECM is receiving a request from the HVAC system to ground the A/C compressor relay control circuit, engaging the A/C compressor clutch. Off indicates the ECM is not receiving a request from the HVAC system.

A/C Relay Command

This parameter displays the commanded state of the A/C compressor relay control circuit (pin 41). The scan tool will display On or Off. On indicates the A/C compressor relay control circuit is being grounded by the ECM, allowing voltage to the A/C compressor clutch. Off indicates the A/C compressor relay is not being commanded On by the ECM.

Scan Tool Output Controls

scan tool Output Control	Additional Menu Selection(s)	Descriptions
EGR Solenoid Valve	Solenoids	The purpose of this test is for checking whether the EGR valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits, a faulty vacuum hose routing, a faulty EGR valve or a faulty EGR solenoid could be considered if the mass air flow (MAF) sensor is not changed when commanded ON or OFF.
Engine Speed (RPM) Control	—	The purpose of this test is for checking whether the actual engine idle speed can change to match the commanded RPM.
Glow Indicator	Lamps	The purpose of this test is for checking whether the glow indicator lamp is operating when commanded ON. Faulty circuit(s) or an open bulb could be considered if not operating when commanded ON.
Glow Relay	Relays	The purpose of this test is for checking whether the glow relay is operating when commanded ON. Faulty circuit(s) or a faulty glow relay could be considered if not energizing when commanded ON.
Malfunction Indicator Lamp	Lamps	The purpose of this test is for checking whether the malfunction indicator lamp (MIL) is operating when commanded ON. Faulty circuit(s) or an open bulb could be considered if not operating when commanded ON.

Scan Tool Does Not Power Up

Circuit Description

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool power battery positive voltage at terminal 16.
- Scan tool power ground at terminal 4.
- Common signal ground at terminal 5.

The scan tool will power up with the ignition OFF. Some modules however, will not communicate unless the ignition is ON.

Scan tool Does Not Power Up
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	**Important:** Make sure the scan tool works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the Meter (+B) (10A) fuse (C-19) in the cabin fuse box. Is the Meter (+B) (10A) fuse (C-19) open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (+B) (10A) fuse (C-19). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (+B) (10A) fuse (C-19) or replace the shorted attached component fed by the Meter (+B) (10A) fuse (C-19). Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-58 connector) for a backed out, spread or missing terminal. 2. Repair the terminal as necessary. Did you find and complete the repair?	—	Go to Step 7	Go to Step 4
4	Connect a test lamp between the B+ circuit (pin 16 of B-58 connector) at the DLC and a known ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the battery voltage circuit to the DLC. Did you complete the repair?	—	Go to Step 7	—
6	1. Test each ground circuit at the DLC (pins 4 and 5 of B-58 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the scan tool to the DLC. 2. Attempt to turn ON the scan tool. Does the scan tool ON?	—	System OK	Go to Step 1

Scan Tool Does Not Communicate with Keyword 2000 Device

Circuit Description

The engine control module (ECM), transmission control module (TCM) and anti-theft (keyless entry) control unit (ACU) all communicate with the scan tool over the Keyword 2000 serial data link. However, the ECM and fuel injection pump control unit (PCU) communicates with each other over the controller area network (CAN) link. The CAN link is not used for communication with the scan tool and is shared only between the ECM and PCU.

Diagnostic Aids

The following conditions will cause a loss of Keyword 2000 serial data communication between the TCM and EHCU or between the scan tool and any control module:

- A Keyword 2000 serial data circuit open.
- A Keyword 2000 serial data circuit shorted to ground.
- A Keyword 2000 serial data circuit shorted to voltage.
- An internal condition within a module or connector on the Keyword 2000 serial data circuit, that causes a short to voltage or ground to the Keyword 2000 serial data circuit.
- Open ground circuit (pin 5) at the DLC.

Scan tool Does Not Communicate with Keyword 2000 Device
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to communicate with the listed control modules. • Engine control module (ECM) • Transmission control module (TCM) (A/T only) • Electronic hydraulic control unit (EHCU) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Step 8
3	Does the scan tool communicate with the ECM?	—	Go to Step 4	Go to Lost Communication with The ECM
4	Does the scan tool communicate with the TCM?	—	Go to Step 5	Go to Diagnostic System Check Transmission Control
5	Does the scan tool communicate with the EHCU?	—	Go to Step 6	Go to Diagnostic System Brake
6	Test the Keyword 2000 serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the Keyword 2000 serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 15	System OK
7	Test the data link connector (DLC) ground circuit at terminal 5 for an open circuit or poor connection. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Disconnect the ECM C-56 and C-57 harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the TCM and EHCU. Does the scan tool communicate with the TCM and EHCU?	—	Go to Step 12	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the ECM C-56 and C-57 harness connectors. 3. Disconnect the TCM A and B harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and EHCU. Does the scan tool communicate with the ECM and EHCU?	—	Go to Step 13	Go to Step 10
10	1. Turn OFF the ignition. 2. Reconnect the TCM A and B harness connectors. 3. Disconnect the EHCU C-67 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 14	Go to Step 11
11	Repair the short to ground or short to voltage on the Keyword 2000 serial data circuit between the DLC and ECM, TCM and EHCU. Did you complete the repair?	—	Go to Step 15	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
13	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to Transmission Control Module (TCM) Replacement in the transmission section. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the EHCU. Refer to Electronic Hydraulic Control Unit in the anti-lock brake system section. Did you complete the replacement?	—	Go to Step 15	—
15	Attempt to communicate with the ECM, TCM and EHCU. Does the scan tool communicate with the ECM, TCM and EHCU?	—	System OK	Go to Step 2

Lost Communication with The Engine Control Module (ECM)

Circuit Description

The engine control module (ECM), transmission control module (TCM) and electronic hydraulic control unit (EHCU) all communicate with the scan tool over the Keyword 2000 serial data link. However, the ECM and fuel injection pump control unit (PCU) communicates with each other over the controller area network (CAN) link. The CAN link is not used for communication with the scan tool and is shared only between the ECM and PCU.

Lost Communication with The Engine Control Module (ECM)

Schematic Reference: Engine Controls Schematics

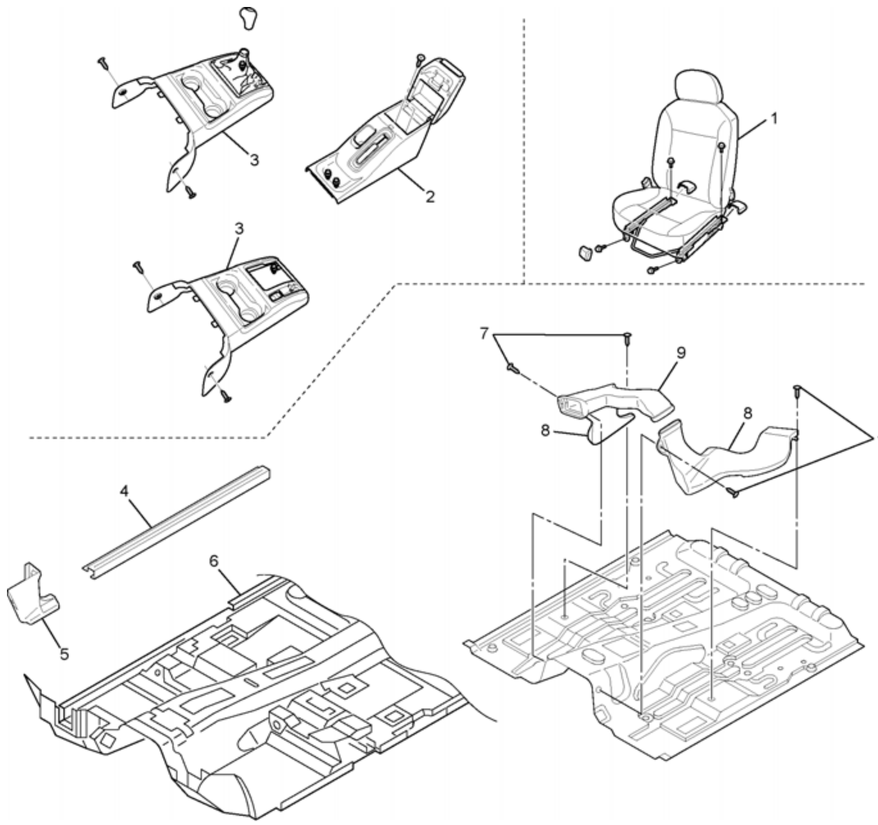
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	Attempt to establish engine control module (ECM) communications with the scan tool. Does the ECM communicate with the scan tool?	—	Go to Intermittent Conditions	Go to Step 3
3	Check the ECM C-56 and C-57 connectors for poor connections. Did you find and correct the condition?	—	Go to Step 17	Go to Step 4
4	Check the electronic hydraulic control unit (EHCU) C-67 connector for poor connection. Did you find and correct the condition?	—	Go to Step 17	Go to Step 5
5	1. Turn ON the ignition, with the engine OFF. 2. Check the ECM (30A) (SFB-4), ECM (10A) fuse (EB-4) and Engine (15A) fuse (C-6).Replace and retest if open. If any fuse continues to open, check for a short to ground on each circuit fed by that fuse. 3. Turn OFF the ignition. 4. Disconnect the ECM C-56 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the ECM (pin 39 of C-56 connector). Does the test lamp illuminate?	—	Go to Step 6	Go to Step 14
6	1. Turn OFF the ignition. 2. Connect a DMM between the Keyword 2000 serial data circuit at the ECM (pin 35 of C-56 connector) and the EHCU (pin 11 of C-67 connector). 3. Test the circuits for an open circuit or high resistance. 4. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 7
7	1. Turn OFF the ignition. 2. Connect a DMM between the Keyword 2000 serial data circuit at the EHCU (pin 11 of C-67 connector) and the DLC (pin 7 of B-58 connector). 3. Test the circuits for an open circuit or high resistance. 4. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8

Step	Action	Value(s)	Yes	No
8	**Important:** An open in a ground circuit at the ECM will not cause a loss of communication. 1. Check ECM ground for corrosion and tightness. 2. Clean or tighten grounds as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if previously disconnected. 3. Turn ON the ignition, with the engine OFF. 4. Replace the ECM main relay with the tail relay or replace with a known good relay. 5. Attempt to establish scan tool communications with the ECM. Does the ECM communicate with the scan tool?	—	Go to Step 15	Go to Step 10
10	1. Turn OFF the ignition. 2. Remove the ECM main relay. 3. Turn ON the ignition, with the engine OFF. 4. Using a test lamp, check for battery voltage at both of the battery voltage supply circuits to the ECM main relay (pins 2 and 5 of X-12 connector). 5. Repair the open in the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
11	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening or feeling for the ECM main relay click. Wait 2 seconds between transitions. Does the ECM main relay click when the ignition is turned ON or OFF?	—	Go to Step 13	Go to Step 12
12	Repair the ECM main relay control circuit between the ECM main relay (pin 4 of X-12 connector) and the ECM (pin 58 of C-56 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance or a poor connection at both the ECM and ECM main relay Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
13	1. Check ECM main relay voltage supply circuit to the ECM between the ECM main relay (pin 1 of X-12 connector) and the ECM (pin 3 of C-56 connector) for the following conditions: • An open circuit • High resistance or a poor connection at the ECM and ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
14	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 17	—
15	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—

REAR HEATER DUCT

REMOVAL AND INSTALLATION



RTW710LF004301

Disassembly Steps

1. Front seat assembly (RH/LH)
   - Refer to SECTION 10 “FRONT SEAT”.
2. Rear floor console
   - Refer to SECTION 10 “FLOOR CONSOLE”.
3. Front floor console (A/T, M/T Model)
   - Refer to SECTION 10 “FLOOR CONSOLE”.
4. Sill plate (RH/LH)
   - Refer to SECTION 10 “INTERIOR TRIM PANELS”.
5. Dash side trim cover (RH/LH)
6. Carpet
7. Clip
8. Rear Heater duct (RH/LH)
9. Rear Heater duct center

Reassembly Steps

9. Rear heater duct center
8. Rear heater duct (RH/LH)
7. Clip
6. Carpet
5. Dash side trim cover (RH/LH)
4. Sill plate (RH/LH)
   - Refer to SECTION 10 “INTERIOR TRIM PANELS”.
3. Front floor console (A/T, M/T Model)
   - Refer to SECTION 10 “FLOOR CONSOLE”.
2. Rear floor console
   - Refer to SECTION 10 “FLOOR CONSOLE”.
1. Front seat assembly (RH/LH)
   - Refer to SECTION 10 “FRONT SEAT”.

Step	Action	Value(s)	Yes	No
17	1. Turn OFF the ignition. 2. Reconnect all disconnected connectors. 3. Turn the ignition ON with the engine OFF. 4. Attempt to establish scan tool communications with the ECM. Does the scan tool communicate with the ECM?	—	System OK	Go to Step 3

Engine Cranks but Does Not Run

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

- The battery is completely charged and terminals are cleaned and tight.
- The engine cranking speed is normal.
- There is adequate fuel in the fuel tank.
- There is no fuel leak in the fuel line.
- There is no air in the fuel line.
- Filters (Air, Fuel) are clean.
- Fuse and slow blow fuse are normal.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for specified amount of time. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to Diagnostic Trouble Code (DTC) List	Go to Step 3
3	1. Check for normal readings at key up for the following inputs and output: Refer to the scan tool Data List or a known good vehicle to determine normal values. • System Voltage • Engine Coolant Temperature (ECT) • Intake Air Temperature (IAT) • Mass Air Flow (MAF) Sensor • Barometric Pressure • Desired Injection Quantity 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Inspect the high pressure side between the fuel injection pump and the fuel injection nozzles for fuel leakage. The following components may contain an external leak. • Fuel injection pump • Fuel injection pump control unit (PCU) • Fuel injection solenoid valve • Timing control valve (TCV) • Constant pressure valve (CPV) • Fuel pipe between the fuel injection pump and fuel injection nozzles • Each fuel pipe sleeve nuts • Each fuel pipe connectors • Each gaskets **Notice:** Fuel may leak into the engine from the fuel injection pump. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel injection pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	1. Remove the fuel hose that connects to the fuel injection pump suction side. 2. Remove the fuel pipe connector that connects to the fuel injection pump suction side. 3. Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval.Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Disconnect the fuel hose that connects to the fuel injection pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container. 2. Pump the priming pump on the fuel filter. **Notice:** If there is a leak on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently and fuel leakage may occur. Also if there is a restriction on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently that is most likely caused by clogged fuel filter or kinked fuel hose or pipe. 3. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. 4. Repair any fuel system leaks and restrictions as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	1. Other possible causes for the no-start condition: • Fuel injection pump mechanical timing incorrect • Flywheel installed incorrectly causing the crankshaft position (CKP) sensor to be incorrectly timed to the engine. Disconnect sensor and attempt to start engine to verify. • Heavily restricted intake, exhaust or catalytic converter plugged solid • Poor engine compression • Water or gasoline contamination in fuel 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Diagnostic Trouble Code (DTC) List

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0100 (7)	65	ON	Mass Air Flow (MAF) Sensor Circuit 5V Reference High Voltage	• The ignition switch is ON.	• The ECM detects that the MAF sensor 5 volts reference circuit voltage is more than 5.2 volts for 0.5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. • Sensor 5V reference circuit is short to the sensor ignition voltage circuit. • Faulty MAF sensor. • Faulty ECM.
P0100 (9)	65	ON	Mass Air Flow (MAF) Sensor Voltage 5V Reference Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the MAF sensor 5 volts reference circuit voltage is less than 4.6 volts for 0.5 seconds.	• Sensor 5V reference circuit is short to ground. • Sensor 5V reference circuit is short to the low reference circuit. • Faulty MAF sensor. • Faulty ECM.
P0100 (B)	65	ON	Mass Air Flow (MAF) Sensor Circuit Low Voltage	• The ignition switch is ON. • The engine is running.	• The ECM calculated MAF is lower than -18.6 kg/h for 5 seconds.	• ECM (10A) fuse (EB1) open. • Sensor ignition voltage feed circuit is open circuit or high resistance. • Sensor 5V reference circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty MAF sensor installation. • Faulty MAF sensor. • Faulty ECM.
P0100 (C)	65	ON	Mass Air Flow (MAF) Sensor Circuit High Voltage	• The ignition switch is ON. • The engine is running.	• The ECM calculated MAF is higher than 984 kg/h for 10 seconds.	• Sensor signal circuit is short to any 5V reference circuit, short to battery or ignition voltage circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty MAF sensor. • Faulty ECM.
P0105 (1)	34	ON	Vacuum Pressure Sensor Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the vacuum pressure sensor signal voltage is more than 4.4 volts for 3 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. • Sensor signal circuit is short to any 5V reference circuit, short to battery or ignition voltage. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty vacuum pressure sensor. • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0105 (2)	34	ON	Vacuum Pressure Sensor Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the vacuum pressure sensor signal voltage is less than 0.5 volts for 3 seconds.	• Sensor 5V reference circuit is open circuit or high resistance, short to ground or short to the low reference circuit. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty vacuum pressure sensor. • Faulty ECM.
P0105 (7)	34	ON	Vacuum Pressure Sensor Voltage 5V Reference Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the vacuum pressure sensor 5 volts reference circuit voltage is more than 5.2 volts for 2.5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. • Faulty ECM.
P0105 (9)	34	ON	Vacuum Pressure Sensor Voltage 5V Reference Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the vacuum pressure sensor 5 volts reference circuit voltage is less than 4.5 volts for 2.5 seconds.	• Sensor 5V reference circuit is short to ground or short to low reference circuit. • Faulty vacuum pressure sensor. • Faulty ECM.
P0110 (1)	23	ON	Intake Air Temperature (IAT) Sensor Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the IAT sensor signal voltage is more than 4.7 volts for 3 seconds.	• Sensor signal circuit is open circuit, high resistance, short to any 5V reference circuit, short to battery or ignition voltage. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty IAT sensor. • Faulty ECM.
P0110 (2)	23	ON	Intake Air Temperature (IAT) Sensor Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the IAT sensor signal voltage is less than 0.3volts for 3 seconds.	• Sensor signal circuit is short to ground or short to the low reference circuit. • Faulty IAT sensor. • Faulty ECM.
P0115 (1)	14	ON	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the ECT sensor signal voltage is more than 4.7 volts for 3 seconds.	• Sensor signal circuit is open circuit, high resistance, short to any 5V reference circuit, short to battery or ignition voltage. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty ECT sensor. • Faulty ECM.
P0115 (2)	14	ON	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the ECT sensor signal voltage is less than 0.3volts for 3 seconds.	• Sensor signal circuit is short to ground or short to the low reference circuit. • Faulty ECT sensor. • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0180 (B)	15	ON	Fuel Temperature Sensor Circuit	• Ignition switch is ON.	• The PCU internal FT sensor output is lower than -40°C (-40°F) for 3 seconds or higher than 150°C (302°F) for 3 seconds.	• Faulty PCU.
P0215 (A)	52	ON at next ignition cycle	Engine Shutoff (ESO) Solenoid Control Circuit	• The ignition switch is OFF. • The engine speed is lower than 1500 RPM. • The vehicle speed is lower than 1.5 km/h (1 MPH).	• After the condition for running the DTC for 2 seconds, the engine speed is higher than 200 RPM when the ESO solenoid valve is commanded shutoff from the PCU.	• Faulty fuel injection pump.
P0215 (B)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	• The ignition switch is ON.	• The PCU detects high voltage condition on the ESO solenoid valve control circuit for longer than 1 second when the ECM does not command shutoff.	• ESO solenoid valve control circuit is short to battery or ignition voltage. • Faulty PCU. • Faulty ECM.
P0215 (C)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	• The ignition switch is OFF. • The engine speed is lower than 1500 RPM. • The vehicle speed is lower than 1.5 km/h (1 MPH).	• The engine speed is higher than 200 RPM within 2 seconds after the condition for running the DTC are met.	• ESO solenoid valve control circuit is open circuit, high resistance or short to ground. • Faulty PCU. • Faulty ECM.
P0215 (D)	52	ON	Engine Shutoff (ESO) Solenoid Control Circuit	• The ignition switch is OFF.	• The ECM detects internal CAN controller does not Bus OFF mode.	• Faulty ECM.
P0216 (A)	54	ON	Injection Timing Control Circuit	• The engine speed is higher than 700 RPM. • The fuel injection quantity is higher than 4 mg/strk.	• The PCU monitored actual fuel injection timing is advanced more than desired by 3°CA for longer than 12 seconds or retarded more than desired by 6°CA for longer than 12 seconds.	• Excessive air in the fuel system. • Loss fuel. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • Contaminated fuel. • Faulty timing device. • Faulty fuel injection pump CMP sensor.
P0216 (B)	54	ON	Injection Timing Control Circuit	• The engine speed is higher than 2014 RPM.	• The PCU monitored actual fuel injection timing is oscillated higher than desired by 5.2°CA.	• Excessive air in the fuel system. • Loss fuel. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • Contaminated fuel. • Faulty timing device. • Faulty fuel injection pump CMP sensor.

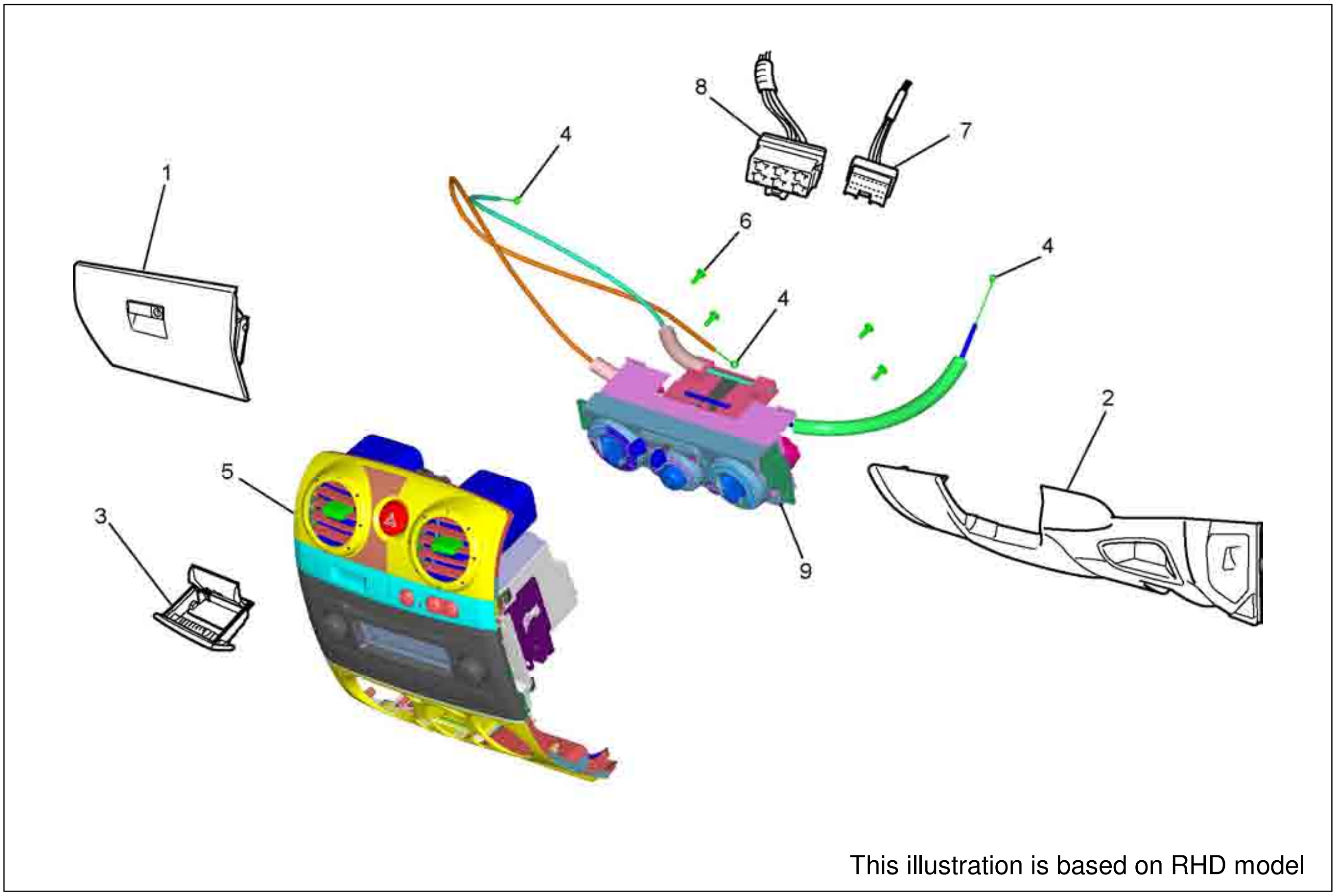
DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0243 (3)	64	ON	Turbocharger Waste gate Solenoid Boost Solenoid Circuit	• The ignition switch is ON. • The BARO is between 0 hPa and 3500 hPa. • The IAT is between -50°C (-58 °F) and 200°C (392°F). • The ECT is between -50°C (-58 °F) and 150°C (302°F).	• The ECM detects that the vacuum pressure is 50 hPa lower than the desired vacuum pressure for 3 seconds.	• Vacuum pressure sensor circuits are high resistance. • Faulty vacuum hoses • Misrouted vacuum hoses. • Faulty vacuum pressure sensor. • Faulty turbocharger solenoid valve. • Faulty vacuum regulating valve. • Faulty turbocharger wastegate valve. • Faulty ECM.
P0243 (4)	64	ON	Turbocharger Waste gate Solenoid Boost Solenoid Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the low voltage condition on the turbocharger solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.	• ECM (10A) fuse (EB1) open. • Turbocharger solenoid valve ignition voltage feed circuit is open circuit or high resistance. • Turbocharger solenoid valve control circuit is open circuit, high resistance or short to ground. • Poor harness connector connection. • Faulty turbocharger solenoid valve. • Faulty ECM.
P0243 (5)	64	ON	Turbocharger Wastegate Solenoid Boost Solenoid Circuit	• The ignition switch is ON. • The BARO is between 0 hPa and 3500 hPa. • The IAT is between -50°C (-58 °F) and 200°C (392°F). • The ECT is between -50°C (-58 °F) and 150°C (302°F).	• The ECM detects that the vacuum pressure is 50 hPa higher than the desired vacuum pressure for 3 seconds.	• Vacuum pressure sensor low reference circuit is high resistance. • Faulty vacuum hoses • Misrouted vacuum hoses. • Faulty vacuum pressure sensor. • Faulty turbocharger solenoid valve. • Faulty vacuum regulating valve. • Faulty turbocharger wastegate valve. • Faulty ECM.
P0243 (6)	64	ON	Turbocharger Waste gate Solenoid Boost Solenoid Circuit	• The ignition switch is ON. • The ECT is between -50°C (-58 °F) and 150°C (302°F). • The EGR solenoid valve control is OFF. • The MAF sensor DTC P0100 is not set. • The vacuum pressure sensor DTC P0105 is not set. • The IAT sensor DTC P0110 is not set.	• The ECM detects that the MAF amount is 56 mg/strk higher than the desired MAF for 3 seconds.	• Faulty turbocharger wastegate valve. • MAF sensor low reference circuit is high resistance. • Faulty EGR valve vacuum control system. • Faulty EGR valve. • Faulty EGR solenoid valve. • Faulty EGR solenoid valve vacuum hose routing. • Faulty MAF sensor.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0243 (8)	64	ON	Turbocharger Waste gate Solenoid Boost Solenoid Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the high voltage condition on the turbocharger solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.	• Turbocharger solenoid valve control circuit is short to battery or ignition voltage circuit. • Faulty turbocharger solenoid valve. • Faulty ECM.
P0251 (6)	53	ON	Injection Pump Fuel Metering Control	• The fuel injection pump CMP sensor signal is generated. • The CAN communication between the ECM and PCU is normal.	• The PCU detects that the fuel injection solenoid valve is operated when the desired fuel injection quantity is commanded 0 mg/strk.	• Faulty fuel injection pump. • Faulty PCU.
P0251 (7)	53	ON	Injection Pump Fuel Metering Control	• The fuel injection pump CMP sensor signal is generated. • The CKP sensor signal is generated. • The engine speed is higher than 500 RPM.	• The PCU detects that the doubled fuel injection pump speed is lower than engine speed by 690 RPM for longer than 0.2 seconds.	• Faulty CKP sensor signal. • Faulty fuel injection pump CMP sensor signal. • Electrical interference. • Magnetic interference. • Faulty PCU.
P0251 (9)	53	ON	Injection Pump Fuel Metering Control	• The ignition switch is ON.	• The PCU detects internal fuel injection pump control maps are not programmed during self-test.	• Faulty PCU.
P0251 (A)	53	ON	Injection Pump Fuel Metering Control	• The ignition switch is ON.	• The PCU detects internal EEPROM or A/D converter is failed during self-test.	• Faulty PCU.
P0251 (B)	53	ON	Injection Pump Fuel Metering Control	• The ignition switch is ON.	• The PCU detects that the fuel injection solenoid valve drive circuit is failed during self-test.	• Faulty fuel injection pump. • Faulty PCU.
P0251 (D)	53	ON	Injection Pump Fuel Metering Control	• The ignition switch is ON.	• The PCU detects that the fuel injection solenoid valve drive circuit voltage level is abnormal during self-test.	• Faulty fuel injection pump. • Faulty PCU.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0251 (E)	53	ON	Injection Pump Fuel Metering Control	• The ignition switch is ON.	• The ECM detects communication message from the PCU is not received for longer than 1 second.	• CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty PCU. • Faulty ECM.
P0335 (B)	43	ON	Crankshaft Position (CKP) Sensor Circuit	• The ignition switch is ON. • The engine speed is higher than 665 RPM.	• The ECM detects extra or missing CKP sensor signals while engine is running.	• Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Sensor low reference circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Sensor shield ground is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Faulty CKP sensor. • Faulty ECM. • Electrical interference. • Magnetic interference. • Faulty sensor installation. • Faulty flywheel circumference.
P0335 (D)	43	ON	Crankshaft Position (CKP) Sensor Circuit	• DTC P0335 (Symptom Code B) is not set. • The ignition switch is ON. • The fuel injection pump CMP sensor signal is generated. • The CAN communication between the ECM and PCU is normal.	• The ECM detects that the CKP sensor signals are not generated when doubled fuel injection pump rotation speed is higher than 50 RPM.	• Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Sensor low reference circuit is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Sensor shield ground is open circuit, high resistance, short to ground, short to battery or short to ignition voltage. • Faulty CKP sensor. • Faulty ECM. • Electrical interference. • Magnetic interference. • Faulty sensor installation. • Faulty flywheel circumference.
P0335 (E)	43	ON	Crankshaft Position (CKP) Sensor Circuit	• Ignition switch is ON.	• The ECM detects that the engine speed is higher than 5700 RPM for 0.2 seconds.	• Engine overrun. • Faulty CKP sensor. • Faulty ECM. • Electrical interference. • Magnetic interference. • Faulty flywheel circumference.

CONTROL LEVER ASSEMBLY

REMOVAL AND INSTALLATION



RTW710MF000801

Removal Steps

1. Glove box
▲ 2. Instrument panel driver side lower cover
3. Ash-tray
▲ 4. Control cables
▲ 5. Center cluster
6. Attaching screw
7. A/C switch connector
8. Fan switch connector
9. Control lever assembly

Installation Steps

▲ 9. Control lever assembly
8. Fan switch connector
7. A/C switch connector
6. Attaching screw
5. Center cluster
▲ 4. Control cables
3. Ash-tray
2. Instrument panel driver side lower cover
1. Glove box

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0380 (4)	66	ON	Glow Plug Relay Control Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the low voltage condition on the glow relay control circuit for longer than 3 seconds when the relay is commanded OFF.	• ECM (10A) fuse (EB1) open. • Glow relay ignition voltage feed circuit on coil side is open circuit or high resistance. • Glow relay control circuit is open circuit, high resistance or short to ground. • Glow relay is poor installation. • Faulty glow relay. • Faulty ECM.
P0380 (8)	66	ON	Glow Plug Relay Control Circuit High Voltage	• The ignition switch is ON.	• The ECM detect that the high voltage condition on the glow relay control circuit for longer than 1 second when the relay is commanded ON.	• Glow relay control circuit is short to battery or ignition voltage circuit. • Faulty glow relay. • Faulty ECM.
P0381 (4)	67	ON	Glow Plug Indicator Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the low voltage condition on the glow indicator lamp control circuit for longer than 3 seconds when the indicator lamp is commanded OFF.	• Meter (15A) fuse (C-14) open. • Glow indicator lamp ignition voltage feed circuit is open circuit or high resistance. • Glow indicator lamp control circuit is open circuit, high resistance or short to ground. • Poor harness connector connection. • Glow indicator lamp bulb burned out. • Faulty instrument panel cluster (meter assembly). • Faulty ECM.
P0381 (8)	67	ON	Glow Plug Indicator Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the high voltage condition on the glow indicator lamp control circuit for longer than 1 second when the indicator lamp is commanded ON.	• Glow indicator lamp control circuit is short to battery or ignition voltage circuit. • Faulty instrument panel cluster (meter assembly). • Faulty ECM.
P0400 (3)	32	ON	Exhaust Gas Recirculation (EGR) System Performance	• The ignition switch is ON. • The engine is running. • The BARO is between 850 hPa and 1100 hPa. • The IAT is between 15°C (59°F) and 100°C (212°F). • The ECT is between 35°C (95°F) and 100°C (211°F).	• The ECM detects that the MAF amount is 150 mg/strk lower than the desired MAF for 60 seconds.	• MAF sensor circuits are high resistance. • MAF sensor signal circuit is short to IAT sensor signal circuit. • Intake air leakage. • Intake duct disconnected. • Intake system is obstructed. • Faulty turbocharger. • Faulty exhaust system. • Faulty EGR valve vacuum control system. • Faulty EGR valve. • Faulty EGR solenoid valve. • Faulty EGR solenoid valve vacuum hose routing. • Faulty MAF sensor.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0400 (4)	32	ON	Exhaust Gas Recirculation (EGR) Solenoid Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the low voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.	• ECM (10A) fuse (EB1) open. • EGR solenoid valve ignition voltage feed circuit is open circuit or high resistance. • EGR solenoid valve control circuit is open circuit, high resistance or short to ground. • Poor harness connector connection. • Faulty EGR solenoid valve. • Faulty ECM.
P0400 (5)	32	ON	Exhaust Gas Recirculation (EGR) System Performance	• The ignition switch is ON. • The engine is running. • The BARO is between 850 hPa and 1100 hPa. • The IAT is between 15°C (59°F) and 100°C (212°F). • The ECT is between 35°C (95°F) and 100°C (211°F).	• The ECM detects that the MAF amount is 150 mg/strk higher than the desired MAF for 60 seconds.	• MAF sensor low reference circuit is high resistance. • Faulty EGR valve vacuum control system. • Faulty EGR valve. • Faulty vacuum pump • Faulty EGR solenoid valve. • Faulty EGR solenoid valve vacuum hose routing. • Faulty MAF sensor. • Faulty ECM.
P0400 (8)	32	ON	Exhaust Gas Recirculation (EGR) Solenoid Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the high voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.	• EGR solenoid valve control circuit is short to battery or ignition voltage circuit. • Faulty EGR solenoid valve. • Faulty ECM.
P0500 (1)	24	ON	Vehicle Speed Sensor (VSS) Circuit	• The ignition switch is ON.	• The ECM detects that the vehicle speed is higher than 200 km/h (125 MPH) for 5 seconds.	• Vehicle speed too high. • Electrical interference. • Magnetic interference. • Faulty A/T VSS. (2WD with A/T) • Faulty VSS. (Except 2WD with A/T) • Faulty ECM.
P0500 (A)	24	ON	Vehicle Speed Sensor (VSS) Circuit	• The ignition switch is ON.	• The ECM detects that the vehicle speed sensor signal frequency is too high for 0.6 seconds.	• Electrical interference. • Magnetic interference. • Faulty A/T VSS. (2WD with A/T) • Faulty VSS. (Except 2WD with A/T) • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0500 (B)	24	ON	Vehicle Speed Sensor (VSS) Circuit	• The ignition switch is ON. • The engine speed is higher than 3600 RPM. • The fuel injection quantity is more than 41 mg/strk.	• The ECM detects that the vehicle speed is lower than 1.5km/h (1 MPH) for 60 seconds.	• 2WD with A/T • VSS signal circuit is open circuit, high resistance, short to ground, short to battery or ignition. • Poor harness connector connection. • Faulty instrument panel cluster (meter assembly). • Faulty TCM. • Faulty ECM. • Except 2WD with A/T • Meter (15A) fuse (C-14) open. • Sensor ignition voltage circuit is open circuit or high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty instrument panel cluster (meter assembly). • Faulty VSS. • Faulty ECM.
P0560 (1)	35	OFF	System Voltage	—	• The ECM detects that the battery voltage feed circuit voltage is more than 20 volts.	• Incorrect “Jump Starting”. • Faulty charging system. • Faulty ECM.
P0560 (2)	35	OFF	System Voltage	—	• The ECM detects that the battery voltage feed circuit voltage is less than 7 volts.	• Faulty charging system. • Battery voltage feed circuit is high resistance. • Faulty ECM.
P0560 (A)	35	OFF	System Voltage	—	• The PCU battery voltage feed circuit voltage is less than 4.5 volts or more than 27 volts.	• Incorrect “Jump Starting”. • Faulty charging system. • Battery voltage feed or ground circuit is high resistance. • Faulty PCU.
P0561 (A)	18	OFF	Ignition Switch Circuit	—	• The ECM detects that the ignition voltage circuit is changed ON to OFF during initialization.	• ECM main relay control circuit is short to ground. • Ignition voltage feed circuit is intermittently open circuit or high resistance. • Faulty ignition switch.
P0561 (B)	18	OFF	Ignition Switch Circuit	—	• The ECM detects internal ignition voltage feed circuit is failed after initialization.	• Faulty ECM.
P0602	-	ON	Control Module Not Programmed	—	• VIN in the ECM is not programmed.	• VIN is not programmed.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0606 (A)	28	ON	Control Module Internal Performance	—	• The ECM detects that the internal CPU does not react.	• Faulty ECM.
P0606 (B)	28	ON	Control Module Internal Performance	• The accelerator pedal position is less than 1%. • The desired fuel injection quantity is 0 mg/strk.	• The ECM detects that the engine speed is higher than 2000 RPM.	• Faulty ECM.
P0645 (4)	46	ON	Air Conditioning (A/C) Clutch Relay Control Circuit Low Voltage	• The ignition switch is ON. • The A/C compressor relay is once commanded ON.	• The ECM detects that the low voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded OFF.	• ECM (10A) fuse (EB1) open. • A/C compressor relay ignition voltage feed circuit on coil side is open circuit or high resistance. • A/C compressor relay control circuit is open circuit, high resistance or short to ground. • A/C compressor relay is poor installation. • Faulty A/C compressor relay. • Faulty ECM.
P0645 (8)	46	ON	Air Conditioning (A/C) Clutch Relay Control Circuit High Voltage	• The ignition switch is ON. • The A/C compressor relay is once commanded ON.	• The ECM detects that the high voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded ON.	• A/C compressor relay control circuit is short to battery or ignition voltage circuit. • Faulty A/C compressor relay. • Faulty ECM.
P0703 (A)	25	ON	Brake Switch Circuit	• The ignition switch is ON. • The engine speed is higher than 665 RPM. • The vehicle speed is higher than 0 km/h (0 MPH).	• The ECM detects that the brake pedal 1 switch is ON (Applied) when the brake pedal 2 switch is OFF (Released) for longer than 30 seconds within the enabling conditions ever since ignition switch is ON.	• Stop (15A) fuse (C-15) open. • ECM (10A) fuse (EB-4) open. • Brake pedal 1 switch battery voltage feed circuit is open circuit or high resistance. • Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Brake pedal 2 switch ignition voltage feed circuit is open circuit or high resistance. • Brake pedal 2 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Misadjusted brake pedal switch. • Brake pedal switch is poor connection. • Faulty brake pedal switch. • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0703 (B)	25	ON	Brake Switch Circuit	• The ignition switch is ON. • The engine speed is higher than 665 RPM. • The vehicle speed is higher than 0 km/h (0 MPH).	• The ECM detects that the brake pedal 1 switch is OFF (Released) when the brake pedal 2 switch is ON (Applied) for longer than 30 seconds.	• Stop (15A) fuse (C-15) open. • ECM (10A) fuse (EB-4) open. • Brake pedal 1 switch battery voltage feed circuit is open circuit or high resistance. • Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Brake pedal 2 switch ignition voltage feed circuit is open circuit or high resistance. • Brake pedal 2 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Misadjusted brake pedal switch. • Brake pedal switch is poor connection. • Faulty brake pedal switch. • Faulty ECM.
P0704 (6)	57	ON	Clutch Switch Input Circuit	• The ignition switch is ON.	• The ECM detects that the clutch pedal switch signal does not change during the vehicle speed changes between 1.5 km/h (1 MPH) and 80 km/h (50 MPH).	• ECM (10A) fuse (EB-4) open. • Clutch pedal switch ignition voltage feed circuit is open circuit or high resistance. • Clutch pedal switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Misadjusted clutch pedal switch. • Clutch pedal switch is poor connection. • Faulty clutch pedal switch. • Faulty ECM.
P1105 (1)	86	ON	Barometric Pressure (BARO) Sensor Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the BARO sensor signal voltage is more than 4.4 volts for 1 second.	• Faulty ECM.
P1105 (2)	86	ON	Barometric Pressure (BARO) Sensor Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects that the BARO sensor signal voltage is less than 1.5 volts for 1 second.	• Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1120 (1)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit High Voltage	• The ignition switch is ON.	• The ECM detects that the APP sensor signal voltage is more than 4.5 volts for 0.5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. • Sensor 5V reference circuit is short to ground or short to the low reference circuit. • Sensor signal circuit is short to any 5V reference circuit, short to battery or ignition voltage circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty APP sensor. • Faulty ECM.
P1120 (7)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit 5V Reference High Voltage	• The ignition switch is ON.	• The ECM detects that the APP sensor voltage supply circuit is more than 5.2 volts for 0.5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage circuit. • Faulty ECM.
P1120 (9)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit 5V Reference Low Voltage	• The ignition switch is ON.	• The ECM detects that the APP sensor voltage supply circuit is less than 4.6 volts for 0.5 seconds.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. • Faulty APP sensor. • Faulty ECM.
P1120 (D)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit Correlation	• The ignition switch is ON. • The engine speed is higher than 1700 RPM. • The vehicle speed is higher than 1.5 km/h (1 MPH).	• The ECM detects APP sensor angle is stationary more than 8.7%, then brake pedal is depressed for longer than 2 seconds.	• Brake pedal 1 switch signal circuit is open circuit, high resistance, short to battery or ignition voltage. • Accelerator pedal stuck. • Intake throttle valve stuck. • Intake throttle valve control cable damaged, stuck or no free play. • Misadjusted APP sensor. • Faulty APP sensor. • Misadjusted brake pedal switch. • Faulty brake pedal switch. • Faulty ECM.
P1120 (E)	21	ON	Accelerator Pedal Position (APP) Sensor Circuit Correlation	• The ignition switch is ON.	Either of following condition is met. • The ECM detects APP sensor angle is less than 0.35%, then idle switch is OFF for longer than 0.6 seconds. OR • The ECM detects APP sensor angle is more than 8.7%, then idle switch is ON for longer than 0.6 seconds.	• APP sensor 5V reference circuit is open circuit or high resistance. • APP sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • APP sensor low reference circuit is high resistance. • Idle switch signal circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Poor harness connector connection. • Faulty APP sensor. • Faulty idle switch. • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1173 (3)	22	OFF	Limitation of Injection Quantity	• The ignition switch is ON.	• The ECM detects an excessive high coolant temperature for longer than 30 seconds.	• Engine overheat. • Faulty engine cooling system. • Faulty ECT sensor.
P1173 (7)	22	OFF	Limitation of Injection Quantity	• The ignition switch is ON.	• The ECM detects an excessive high FT for longer than 30 seconds.	• Faulty PCU.
P1173 (A)	22	OFF	Limitation of Injection Quantity	• The ignition switch is ON.	• The ECM detects an excessive low FT for longer than 30 seconds.	• Faulty PCU.
P1335 (A)	43	ON	Crankshaft Position (CKP) Sensor Circuit	• The ignition switch is ON.	• The PCU detects CKP sensor signal from the ECM is faulty.	• CKP sensor signal output circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Poor harness connector connection. • Faulty PCU. • Faulty ECM.
P1345 (A)	41	ON	Crankshaft Position (CKP) – Camshaft Position (CMP) Correlation	—	• The PCU received faulty fuel injection pump CMP sensor signal for 1 second.	• Faulty fuel injection pump. • Faulty PCU.
P1520 (A)	47	ON	Park/Neutral Position Switch Circuit	• The ignition switch is ON. • The engine speed is higher than 1500 RPM. • The vehicle speed is higher than 63 km/h (39 MPH) (M/T) or 78 km/h (49 MPH) (A/T). • The clutch pedal is released. (M/T)	• The ECM detects that the neutral switch signal is continuously ON (neutral or P/N range) during three consecutive driving cycles.	• Manual Transmission • Neutral switch signal circuit is short to battery or ignition voltage. • Faulty neutral switch. • Faulty ECM. • Automatic Transmission • P & N position switch signal circuit is short to battery or ignition voltage. • Misadjusted inhibitor switch. • Faulty inhibitor switch. • Faulty ECM.
P1520 (B)	47	ON	Park/Neutral Position Switch Circuit	• The ignition switch is ON. • The engine speed is higher than 665 RPM • The vehicle speed is lower than 2 km/h (1.2 MPH). • The clutch pedal is released after once depressed.	• The ECM detects that the neutral switch signal is continuously OFF (other than neutral) during three consecutive driving cycles.	• ECM (10A) fuse (EB-4) open. • Neutral switch ignition voltage feed circuit is open circuit or high resistance. • Neutral switch signal circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty neutral switch. • Faulty ECM.
P1605 (C)	55	ON	Control Module Internal Performance	—	• The ECM detects internal seed or key file in EEPROM data is destroyed.	• Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1605 (D)	55	ON	Control Module Internal Performance	—	• The ECM detects reading or writing from the EEPROM data is failed during initialization.	• Faulty ECM.
P1605 (E)	55	ON	Control Module Internal Performance	—	• The ECM detects total sum of EEPROM data is not equal to registered value during initialization.	• Faulty ECM.
P1610 (A) *1	56	ON	Immobilizer Function Not Programmed	—	• The ECM detects immobilizer security code and secret key is not programmed.	• Immobilizer function is not programmed into the ECM. • Faulty ECM.
P1611 (A) *1	56	ON	Wrong Security Code Entered	—	• The ECM detects wrong immobilizer security code is programmed.	• Programming ECM with wrong security code. • Faulty ECM.
P1612 (A) *1	56	ON	Immobilizer Wrong Signal	—	• The ECM receives wrong immobilizer response signal from the ICU.	• Keyword 2000 communication line is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty ECM. • Faulty ICU.
P1613 (A) *1	56	ON	Immobilizer No Signal	—	• The ECM does not receive the immobilizer response signal from the ICU.	• Keyword 2000 communication line is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty transponder key. • Faulty antenna coil. • Faulty ECM. • Faulty ICU.
P1614 (A) *1	56	ON	Wrong Transponder Key	—	• The ICU receives wrong immobilizer response signal from the transponder key.	• Faulty transponder key. • Faulty ICU.
P1625 (A)	76	OFF	ECM Main Relay Circuit	—	• The ECM detects that the ECM main relay is turned OFF before commanded turned OFF.	• ECM main relay control circuit is intermittently open circuit or high resistance. • ECM battery voltage feed circuit is intermittently open or high resistance. • Faulty ECM main relay.

*1: This DTC may be set if the ECM with wrong specification is installed.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1625 (B)	76	OFF	ECM Main Relay Circuit	• The ignition switch is OFF.	• The ECM detects that the ECM main relay is turned ON for longer than 2 seconds.	• ECM main relay control circuit is short to ground. • ECM battery voltage circuit is short to battery. • Faulty ECM main relay. • Faulty ECM.
P1630 (A)	51	ON	Injection Pump Fuel Metering Control	—	• The ECM detects that the PCU monitored fuel injection solenoid valve control current is too high.	• Faulty fuel injection pump. • Faulty PCU.
P1630 (B)	51	ON	Injection Pump Fuel Metering Control	—	• The ECM detects that the PCU continuously flow the control current to the fuel injection solenoid valve.	• Faulty fuel injection pump. • Faulty PCU.
P1650 (A)	44	ON	CAN Device Offline	—	• The ECM detects that the PCU receives from the CAN controller reset or Bus Offline.	• CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty PCU. • Faulty ECM.
P1650 (B)	44	ON	CAN Device Hang-up	—	• The ECM detects internal CAN controller does not react.	• Faulty ECM.
P1651 (A)	45	ON	CAN Malfunction	—	• The ECM detects that the PCU does not receive the CAN messages from the ECM.	• CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty PCU. • Faulty ECM.

DTC (Symptom Code)	Flash Code	MIL Status	DTC Name on scan tool	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1651 (B)	45	ON	CAN Malfunction	—	• The ECM does not receive the CAN messages from the PCU.	• CAN high circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • CAN low circuit is open circuit, high resistance, short to ground, short to battery or ignition voltage. • Electrical interference. • Magnetic interference. • Faulty PCU. • Faulty ECM.
P1690 (4)	77	OFF	Malfunction Indicator Lamp (MIL) Control Circuit Low Voltage	• The ignition switch is ON.	• The ECM detects a low voltage condition on the MIL control circuit for longer than 3 seconds when the MIL is commanded OFF.	• Meter (15A) fuse (C-14) open. • MIL ignition voltage feed circuit is open circuit or high resistance. • MIL control circuit is open circuit, high resistance or short to ground. • Poor harness connector connection. • MIL bulb burned out. • Faulty instrument panel cluster (meter assembly). • Faulty ECM.
P1690 (8)	77	OFF	Malfunction Indicator Lamp (MIL) Circuit High Voltage	• The ignition switch is ON.	• The ECM detects a high voltage condition on the MIL control circuit for longer than 1 second when the MIL is commanded ON.	• MIL control circuit is short to battery or ignition voltage circuit. • Faulty instrument panel cluster (meter assembly). • Faulty ECM.

CONVERSION TABLE

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LENGTH

MILLIMETERS TO INCHES

mm	in.	mm	in.	mm	in.	mm	in.
1	0.0394	26	1.0236	51	2.0079	76	2.9921
2	0.0787	27	1.0630	52	2.0472	77	3.0315
3	0.1181	28	1.1024	53	2.0866	78	3.0709
4	0.1575	29	1.1417	54	2.1260	79	3.1102
5	0.1969	30	1.1811	55	2.1654	80	3.1496
6	0.2362	31	1.2205	56	2.2047	81	3.1890
7	0.2756	32	1.2598	57	2.2441	82	3.2283
8	0.3150	33	1.2992	58	2.2835	83	3.2677
9	0.3543	34	1.3386	59	2.3228	84	3.3071
10	0.3937	35	1.3780	60	2.3622	85	3.3465
11	0.4331	36	1.4173	61	2.4016	86	3.3858
12	0.4724	37	1.4567	62	2.4409	87	3.4252
13	0.5118	38	1.4961	63	2.4803	88	3.4646
14	0.5512	39	1.5354	64	2.5197	89	3.5039
15	0.5906	40	1.5748	65	2.5591	90	3.5433
16	0.6299	41	1.6142	66	2.5984	91	3.5827
17	0.6693	42	1.6535	67	2.6378	92	3.6220
18	0.7087	43	1.6929	68	2.6772	93	3.6614
19	0.7480	44	1.7323	69	2.7165	94	3.7008
20	0.7874	45	1.7717	70	2.7559	95	3.7402
21	0.8268	46	1.8110	71	2.7953	96	3.7795
22	0.8661	47	1.8504	72	2.8346	97	3.8189
23	0.9055	48	1.8898	73	2.8740	98	3.8583
24	0.9449	49	1.9291	74	2.9134	99	3.8976
25	0.9843	50	1.9685	75	2.9528	100	3.9370
101	3.9764	111	4.3701	121	4.7638	131	5.1575
102	4.0157	112	4.4094	122	4.8031	132	5.1968
103	4.0551	113	4.4488	123	4.8425	133	5.2362
104	4.0945	114	4.4882	124	4.8819	134	5.2756
105	4.1339	115	4.5276	125	4.9213	135	5.3150
106	4.1732	116	4.5669	126	4.9606	136	5.3543
107	4.2126	117	4.6063	127	5.0000	137	5.3937
108	4.2520	118	4.6457	128	5.0394	138	5.4331
109	4.2913	119	4.6850	129	5.0787	139	5.4724

INCHES TO MILLIMETERS

in.	mm	in.	mm
1/64	0.3969	33/64	13.0969
1/32	0.7938	17/32	13.4938
3/64	1.1906	35/64	13.8906
1/16	1.5875	9/16	14.2875
5/64	1.9844	37/64	14.6844
3/32	2.3813	19/32	15.0813
7/64	2.7781	39/64	15.4781
1/8	3.1750	5/8	15.8750
9/64	3.5719	41/64	16.2719
5/32	3.9688	21/32	16.6688
11/64	4.3656	43/64	17.0656
3/16	4.7625	11/16	17.4625
13/64	5.1594	45/64	17.8594
7/32	5.5563	23/32	18.2563
15/64	5.9531	47/64	18.6531
1/4	6.3500	3/4	19.0500
17/64	6.7469	49/64	19.4469
9/32	7.1438	25/32	19.8438
19/64	7.5406	51/64	20.2406
5/16	7.9375	13/16	20.6375
21/64	8.3344	53/64	21.0344
11/32	8.7313	27/32	21.4313
23/64	9.1281	55/64	21.8281
3/8	9.5250	7/8	22.2250
25/64	9.9219	57/64	22.6219
13/32	10.3188	29/32	23.0188
27/64	10.7156	59/64	23.4156
7/16	11.1125	15/16	23.8125
29/64	11.5094	61/64	24.2094
15/32	11.9063	31/32	24.6063
31/64	12.3031	63/64	25.0031
1/2	12.7000	1	25.4000

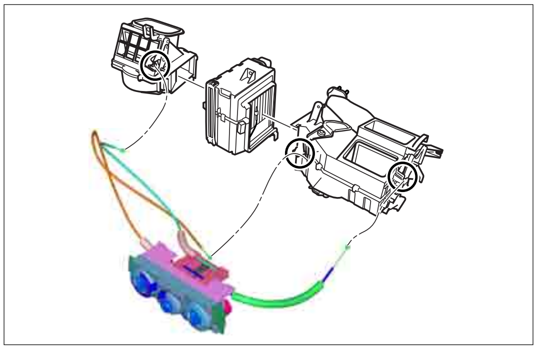
Important Operations - Removal

2. Instrument Panel Driver Lower Cover

Refer to SECTION 10 “INSTRUMENT PANEL” .

4. Control Cables

Disconnect control cables at each side of the unit.



RTW710SH000601

5. Center Cluster

Refer to SECTION 10 “INSTRUMENT PANEL”.

DTC P0100 (Symptom Code 7) (Flash Code 65)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit to the MAF sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high MAF sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF sensor 5 volts reference circuit voltage is more than 5.2 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the scan tool will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code 7) (Flash Code 65)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the scan tool. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code 7)?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of C-57 connector) and the MAF sensor (pin 4 of C-116 connector) for the following conditions: • A short to battery or ignition voltage • A short to the sensor ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0100 (Symptom Code 9) (Flash Code 65)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit to the MAF sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively low MAF sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF sensor 5 volts reference circuit voltage is less than 4.6 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the scan tool will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code 9) (Flash Code 65)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the scan tool. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code 9)?	—	Go to Step 5	Go to Step 4
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of C-57 connector) and the MAF sensor (pin 4 of C-116 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0100 (Symptom Code B) (Flash Code 65)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) monitors the MAF sensor signal for voltage outside the normal range of the MAF sensor. If the ECM detects an excessively low MAF sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM calculated MAF is lower than -18.6 kg/h for 5 seconds. This indicates the ECM detects that the MAF sensor signal voltage is smaller than a predetermined range during engine run.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL that the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Wrong direction of MAF sensor installation will cause this DTC to set.
- Contaminated or restricted MAF sensor will cause this DTC to set.
- The MAF Sensor parameter on the scan tool will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

7. If the MAF sensor signal circuit between the ECM and the sensor is short to ground or any low reference circuits, the sensor 5 volts reference voltage low DTC P0100 (Symptom Code 9) will set.

8. If the MAF sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage high DTC P0100 (Symptom Code C) will set.

DTC P0100 (Symptom Code B) (Flash Code 65)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 4	Go to Step 5
4	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Connect a test lamp between the ignition voltage feed circuit of the MAF sensor harness (pin 2 of C-116 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 9
6	1. Keep the ignition ON, with the engine OFF. 2. Connect a DMM between the 5 volts reference circuit of the MAF sensor harness (pin 4 of C-116 connector) and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 7	Go to Step 10
7	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the MAF sensor harness (pins 4 and 5 of C-116 connector). 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the DTC Information with the scan tool. Does DTC P0100 (Symptom Code 9) set, but not DTC P0100 (Symptom Code B)?	—	Go to Step 11	Go to Step 8
8	1. Keep the 3-amp fused jumper wire with connected. 2. Start the engine and let idle for 30 seconds. Does DTC P0100 (Symptom Code C) set, but not DTC P0100 (Symptom Code B)?	—	Go to Step 13	Go to Step 12
9	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM (10A) fuse (EB-4) and the MAF sensor (pin 2 of C-116 connector). Did you complete the repair?	—	Go to Step 17	—
10	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 83 of C-57 connector) and the MAF sensor (pin 4 of C-116 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
11	1. Test the signal circuit between the ECM (pin 88 of C-57 connector) and the MAF sensor (pin 5 of C-116 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	1. Test the signal circuit between the ECM (pin 88 of C-57 connector) and the MAF sensor (pin 5 of C-116 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
13	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the MAF sensor (pins 2, 4 and 5 of C-116 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the MAF sensor circuits at the harness connector of the ECM (pins 83 and 88 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0100 (Symptom Code C) (Flash Code 65)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor has the following circuits.

- Ignition voltage circuit
- 5 volts reference circuit
- Low reference circuit
- MAF sensor signal circuit

The engine control module (ECM) monitors the MAF sensor signal for voltage outside the normal range of the MAF sensor. If the ECM detects an excessively high MAF sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM calculated MAF is higher than 984 kg/h for 10 seconds. This indicates the ECM detects that the MAF sensor signal voltage is higher than a predetermined range during engine run.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a MAF substitution of 1600 mg/strk for engine control.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on the scan tool will only update with engine running.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the MAF sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0100 (Symptom Code B) will set.

DTC P0100 (Symptom Code C) (Flash Code 65)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor harness connector. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the scan tool. Does DTC P0100 (Symptom Code B) set, but not DTC P0100 (Symptom Code C)?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the MAF sensor harness (pin 3 of C-116 connector) and a battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
5	**Important:** The MAF sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 88 of C-57 connector) and the MAF sensor (pin 5 of C-116 connector) for the following conditions: • A short to battery or ignition voltage • A short to 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
6	1. Test the low reference circuit between the ECM (pin 92 of C-57 connector) and the MAF sensor (pin 3 of C-116 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the MAF sensor (pin 3 of C-116 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the MAF sensor circuit at the harness connector of the ECM (pin 92 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to Mass Air Flow Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0105 (Symptom Code 1) (Flash Code 34)

Circuit Description

The vacuum pressure sensor is installed to the turbocharger wastegate control hose and it detects the regulated vacuum pressure to the turbocharger wastegate valve. The vacuum pressure sensor is a transducer that varies voltage according to changes in the vacuum pressure inside the vacuum hose. The vacuum pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Vacuum pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the vacuum pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The vacuum pressure sensor provides a signal to the ECM on the vacuum pressure signal circuit which is relative to the vacuum pressure changes in the turbocharger wastegate valve control hose. The ECM should detect a low signal voltage at a high vacuum pressure and high signal voltage at a low vacuum pressure. The ECM monitors the vacuum pressure sensor signal for voltage outside the normal range of the vacuum pressure sensor. If the ECM detects an excessively high vacuum pressure sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vacuum pressure sensor signal voltage is more than 4.4 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses a barometric pressure of 615 hPa for turbocharger wastegate valve control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the vacuum pressure sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0105 (Symptom Code 2) will set.

DTC P0105 (Symptom Code 1) (Flash Code 34)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the vacuum pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Does DTC P0105 (Symptom Code 2) set, but not DTC P0105 (Symptom Code 1)?	—	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the vacuum pressure sensor harness (pin 2 of C-124 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7

Important Operations - Installation

9. Control Lever Assembly

Air source control cable

RHD

1) Slide the control lever to the left (“CIRC” position).
2) Connect the control cable at the "CIRC" position of the link unit of blower assembly and fix it with the clip.

LHD

1) Slide the control lever to the right (“FRESH” position).
2) Connect the control cable at the "FRESH" position of the link unit of blower assembly and fix it with the clip.

Temperature control cable

RHD

1) Turn the control knob to the right (“FULL HOT” position).
2) Connect the control cable at the “FULL HOT” position of the mix lever of the heater unit and fix it with the clip.

LHD

1) Turn the control knob to the left (“FULL COLD” position).
2) Connect the control cable at the “FULL COLD” position of the mix lever of the heater unit and fix it with the clip.

Air select control cable

RHD

1) Turn the control knob to the left (“VENT” position).
2) Connect the control cable at the “VENT” position of the mode control link of the heater unit and fix it with the clip.

LHD

1) Turn the control knob to the right (“DEF” position).
2) Connect the control cable at the “DEF” position of the mode control link of the heater unit and fix it with the clip.

4. Control Cables

Check control cable operation

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a DMM between the 5 volts reference circuit of the vacuum pressure sensor harness (pin 3 of C-124 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 8	Go to Step 9
6	**Important:** The vacuum pressure sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 85 of C-57 connector) and the vacuum pressure sensor (pin 1 of C-124 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	1. Test the low reference circuit between the ECM (pin 93 of C-57 connector) and the vacuum pressure sensor (pin 2 of C-124 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
8	1. Test the 5 volts reference circuit between the ECM (pin 57 of C-56 connector) and the vacuum pressure sensor (pin 1 of C-124 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the vacuum pressure sensor (pin 2 of C-124 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the vacuum pressure sensor circuit at the harness connector of the ECM (pin 93 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the vacuum pressure sensor. Refer to Vacuum Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0105 (Symptom Code 2) (Flash Code 34)

Circuit Description

The vacuum pressure sensor is installed to the turbocharger wastegate control hose and it detects the regulated vacuum pressure to the turbocharger wastegate valve. The vacuum pressure sensor is a transducer that varies voltage according to changes in the vacuum pressure inside the vacuum hose. The vacuum pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Vacuum pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the vacuum pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The vacuum pressure sensor provides a signal to the ECM on the vacuum pressure signal circuit which is relative to the vacuum pressure changes in the turbocharger wastegate valve control hose. The ECM should detect a low signal voltage at a high vacuum pressure and high signal voltage at a low vacuum pressure. The ECM monitors the vacuum pressure sensor signal for voltage outside the normal range of the vacuum pressure sensor. If the ECM detects an excessively low vacuum pressure sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vacuum pressure sensor signal voltage is less than 0.5 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses a barometric pressure of 615 hPa for turbocharger wastegate valve control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

4. If the vacuum pressure sensor signal circuit between the ECM and the sensor is normal, the sensor signal voltage high DTC P0105 (Symptom Code 1) will set.

DTC P0105 (Symptom Code 2) (Flash Code 34)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the vacuum pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the vacuum pressure sensor harness (pin 3 of C-124 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the vacuum pressure sensor harness (pins 1 and 3 of C-124 connector). 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Does DTC P0105 (Symptom Code 1) set, but not DTC P0105 (Symptom Code 2)?	—	Go to Step 7	Go to Step 6
5	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 82 of C-57 connector) harness and the vacuum pressure sensor (pin 3 of C-124 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
6	1. Test the signal circuit between the ECM (pin 85 of C-57 connector) and the vacuum pressure sensor (pin 1 of C-124 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the vacuum pressure sensor (pins 1 and 3 of C-124 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the vacuum pressure sensor circuits at the harness connector of the ECM (pins 82 and 85 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the vacuum pressure sensor. Refer to Vacuum Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0105 (Symptom Code 7) (Flash Code 34)

Circuit Description

The vacuum pressure sensor is installed to the turbocharger wastegate control hose and it detects the regulated vacuum pressure to the turbocharger wastegate valve. The vacuum pressure sensor is a transducer that varies voltage according to changes in the vacuum pressure inside the vacuum hose. The vacuum pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Vacuum pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the vacuum pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. If the ECM detects an excessively high vacuum pressure sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vacuum pressure sensor 5 volts reference circuit voltage is more than 5.2 volts for 2.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0105 (Symptom Code 7) (Flash Code 34)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 82 of C-57 connector) and the vacuum pressure sensor (pin 3 of C-124 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0105 (Symptom Code 9) (Flash Code 34)

Circuit Description

The vacuum pressure sensor is installed to the turbocharger wastegate control hose and it detects the regulated vacuum pressure to the turbocharger wastegate valve. The vacuum pressure sensor is a transducer that varies voltage according to changes in the vacuum pressure inside the vacuum hose. The vacuum pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Vacuum pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the vacuum pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. If the ECM detects an excessively low vacuum pressure sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vacuum pressure sensor 5 volts reference circuit voltage is less than 4.5 volts for 2.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the vacuum pressure sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal voltage low DTC P0105 (Symptom Code 2) will set.

DTC P0105 (Symptom Code 9) (Flash Code 34)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the vacuum pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Does DTC P0105 (Symptom Code 2) set, but not DTC P0105 (Symptom Code 9)?	—	Go to Step 5	Go to Step 4
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 82 of C-57 connector) and the vacuum pressure sensor (pin 3 of C-124 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the vacuum pressure sensor. Refer to Vacuum Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0110 (Symptom Code 1) (Flash Code 23)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively high IAT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is more than 4.7 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an IAT substitution of 0°C (32°F) for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

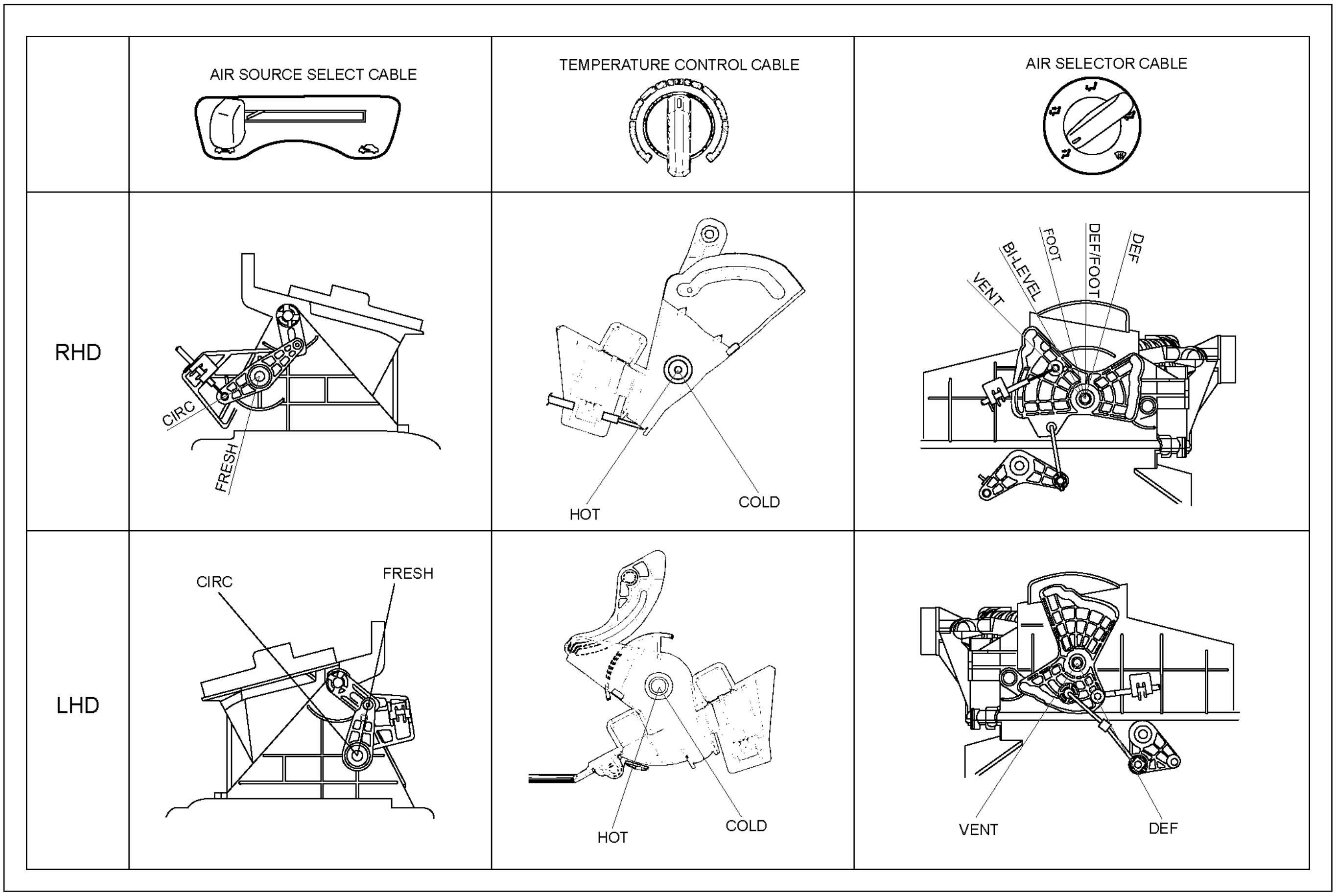
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Notice:

- The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake temperature if the ignition switch is being ON.

DTC P0110 (Symptom Code 1) (Flash Code 23)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Intake Air Temperature (IAT) parameter with the scan tool. Is the IAT parameter less than the specified value?	-38°C (-36°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/intake air temperature (MAF/IAT) sensor harness connector. 3. Connect a DMM between the signal circuit of the IAT sensor harness (pin 1 of C-116 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 4	Go to Step 5
4	**Important:** The IAT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 84 of C-57 connector) and the IAT sensor (pin 1 of C-116 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13



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Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the IAT sensor harness (pins 1 and 3 of C-116 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the scan tool. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor harness (pin 1 of C-116 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the scan tool. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 84 of C-57 connector) and the IAT sensor (pin 1 of C-116 connector) for an open circuit high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 92 of C-57 connector) and the IAT sensor (pin 3 of C-116 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 84 of C-57 connector) and the IAT sensor (pin 1 of C-116 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 1 and 3 of C-116 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the IAT sensor circuits at the harness connector of the ECM (pins 84 and 92 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the IAT sensor. Refer to Mass Air Flow Sensor Replacement in this section. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0110 (Symptom Code 2) (Flash Code 23)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively low IAT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is less than 0.3 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an IAT substitution of 0°C (32°F) for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Notice:

- The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake temperature if the ignition switch is being ON.

DTC P0110 (Symptom Code 2) (Flash Code 23)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Intake Air Temperature (IAT) parameter with the scan tool. Is the IAT parameter more than the specified value?	110°C (230°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/intake air temperature (MAF/IAT) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT parameter with the scan tool. Is the IAT parameter less than the specified value?	-38°C (-36°F)	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the engine control module (ECM) (pin 84 of C-57 connector) and the IAT sensor (pin 1 of C-116 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the IAT sensor. Refer to Mass Air Flow Sensor Replacement in this section. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the IAT sensor circuits at the harness connector of the ECM (pins 84 and 92 of C-57 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0115 (Symptom Code 1) (Flash Code 14)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively high ECT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is more than 4.7 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of fuel temperature for engine control.
- The ECM uses an ECT substitution of 60°C (120°F) for injection timing control.
- The ECM uses an ECT substitution of -15°C (5°F) for glow control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0115 (Symptom Code 1) (Flash Code 14)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Engine Coolant Temperature (ECT) parameter with the scan tool. Is the ECT parameter less than the specified value?	-35°C (-31°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Connect a DMM between the signal circuit of the ECT sensor harness (pin 1 of E-41 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 4	Go to Step 5
4	**Important:** The ECT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 89 of C-57 connector) and the ECT sensor (pin 1 of E-41 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the ECT sensor harness (pins 1 and 2 of E-41 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with the scan tool. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit of the ECT sensor harness (pin 1 of E-41 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. 4. Observe the ECT parameter with the scan tool. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 89 of C-57 connector) and the ECT sensor (pin 1 of E-41 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 93 of C-57 connector) and the ECT sensor (pin 2 of E-41 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 89 of C-57 connector) and the ECT sensor (pin 1 of E-41 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	Turn OFF the ignition. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-41 connector). Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the ECT sensor circuits at the harness connector of the ECM (pins 89 and 93 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0115 (Symptom Code 2) (Flash Code 14)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively low ECT signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is less than 0.3 volts for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of fuel temperature for engine control.
- The ECM uses an ECT substitution of 60°C (120°F) for injection timing control.
- The ECM uses an ECT substitution -15°C (5°F) for glow control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0115 (Symptom Code 2) (Flash Code 14)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Engine Coolant Temperature (ECT) parameter with the scan tool. Is the ECT parameter more than the specified value?	135°C (275°F)	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature parameter with the scan tool. Is the ECT parameter less than the specified value?	-35°C (-31°F)	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the engine control module (ECM) (pin 89 of C-57 connector) and the ECT sensor (pin 1 of E-41 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the ECT sensor. Refer to Engine Coolant Temperature Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the ECT sensor circuits at the harness connector of the ECM (pins 89 and 93 of C-57 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0180 (Symptom Code B) (Flash Code 15)

Circuit Description

The fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU). It detects fuel temperature in the fuel injection pump. The engine control module (ECM) and PCU communicates with each other over the controller area network (CAN) link. If the PCU internal FT sensor output is an excessively high or low, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU internal FT sensor output is lower than -40°C (-40°F) for 3 seconds or higher than 150°C (302°F) for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a default FT substitution for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

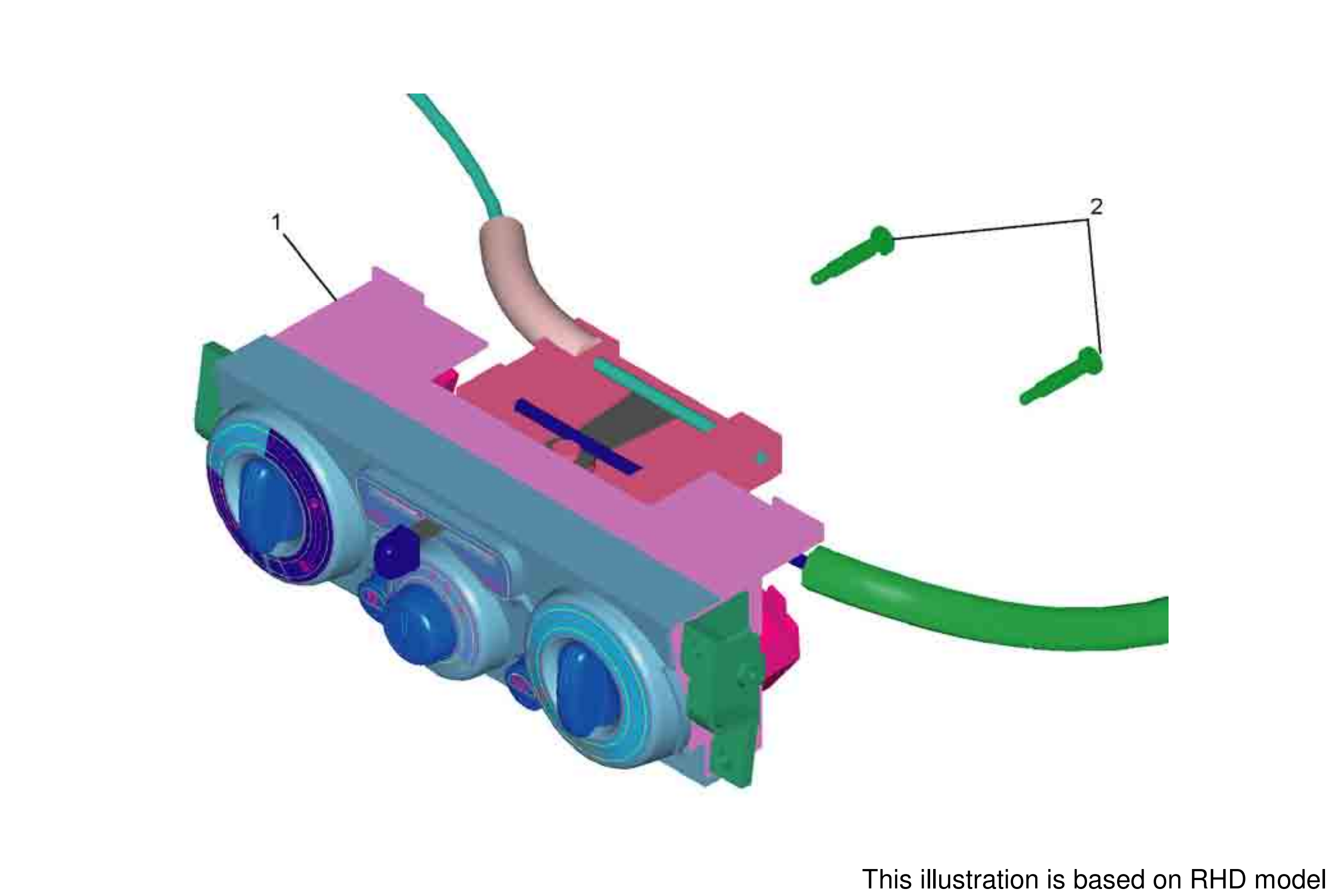
- FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.

DTC P0180 (Symptom Code B) (Flash Code 15)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (Fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU) and it is part of the fuel injection pump assembly.) Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

CONTROL PANEL ILLUMINATION BULB

REMOVAL AND INSTALLATION



RTW710MF000401

Removal Steps

▲ 1. Control lever assembly
▲ 2. Illumination bulb

Installation Steps

2. Illumination bulb
1. Control lever assembly

DTC P0215 (Symptom Code A) (Flash Code 52)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the engine is continuously run after the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.
- The engine speed is lower than 1500 RPM.
- The vehicle speed is lower than 1.5 km/h (1 MPH).

Condition for Setting the DTC

- After the condition for running this DTC for 2 seconds, the engine speed is higher than 200 RPM when the ESO solenoid valve is commanded shutoff from the CPU. This indicates the PCU reacts to the command from the ECM but ESO solenoid valve does not react to the command from the PCU and fuel cannot shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) at next ignition cycle.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0215 (Symptom Code A) (Flash Code 52)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turned OFF?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. 5. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0215 (Symptom Code B) (Flash Code 52)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the PCU detects that the ESO solenoid valve control circuit voltage level from the ECM to PCU is high, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects high voltage condition on the ESO solenoid valve control circuit for longer than 1 second when the ECM does not command shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.
- If this DTC is present, engine will not start.

DTC P0215 (Symptom Code B) (Flash Code 52)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a test lamp between the engine shutoff (ESO) solenoid valve control signal circuit (pin 5 of E-6 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) C-57 harness connector. Keep the C-56 harness connector with connected. 4. Connect a test lamp between the ESO solenoid valve control signal circuit (pin 105 of C-57 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Diagnostic Aids
5	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of C-57 connector) and the PCU (pin 5 of E-6 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
6	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 8	—
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0215 (Symptom Code C) (Flash Code 52)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the engine is continuously run after the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.
- The engine speed is lower than 1500 RPM.
- The vehicle speed is lower than 1.5 km/h (1 MPH).

Condition for Setting the DTC

- The engine speed is higher than 200 RPM within 2 seconds after the condition for running the DTC are met. This indicates the PCU does not react to the command from the ECM and fuel cannot shutoff.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0215 (Symptom Code C) (Flash Code 52)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turns OFF?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a test lamp between the engine shutoff (ESO) solenoid valve control signal circuit (pin 5 of E-6 connector) and battery voltage. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Connect a DMM between the ESO solenoid valve control signal circuit (pin 5 of E-6 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	10 volts	Go to Step 7	Go to Step 6
5	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of C-57 connector) and the PCU (pin 5 of E-6 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
6	1. Test the ESO solenoid valve control signal circuit between the ECM (pin 105 of C-57 connector) and the PCU (pin 5 of E-6 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent, for a poor connection and corrosion on the ESO solenoid valve control signal circuit at the harness connector of the PCU (pin 5 of E-6 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the ESO solenoid valve control signal circuit at the harness connector of the ECM (pin 105 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. 6. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0215 (Symptom Code D) (Flash Code 52)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the internal CAN controller does not Bus OFF when the ignition switch is OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.

Condition for Setting the DTC

- The ECM detects internal CAN controller does not Bus OFF mode.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- CAN controller is internal to the ECM.

DTC P0215 (Symptom Code D) (Flash Code 52)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. 5. Turn OFF the engine. Does the DTC fail this ignition before the engine control module (ECM) turns OFF?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the DTC Information with the scan tool. 5. Turn OFF the engine. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0216 (Symptom Code A, B) (Flash Code 54)

Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The timing device changes the optimum injection timing against various engine conditions. The pressure of the fuel fed from the feed pump is adjusted and it acts to the timing plunger by TCV controlled fuel pressure. (The TCV is installed to the fuel injection pump rear side and it is controlled by duty ratio cycle from the PCU.) The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement. Movement to the right of the timing plunger advances injection timing. If the PCU detects an excessive difference between actual and desired fuel injection timing, this DTC will set.

Condition for Running the DTC

Symptom Code A

- The engine speed is higher than 700 RPM.
- The fuel injection quantity is higher than 4 mg/strk.

Symptom Code B

- The engine speed is higher than 2014 RPM.

Condition for Setting the DTC

Symptom Code A

- The PCU monitored actual fuel injection timing is advanced more than desired by 3°CA for longer than 12 seconds or retarded more than desired by 6°CA for longer than 12 seconds.

Symptom Code B

- The PCU monitored actual fuel injection timing is oscillated higher than desired by 5.2°CA.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The fuel injection pump installation with incorrect mechanical timing may set this DTC.
- This DTC most likely indicate loss fuel pressure by restricted fuel line. Inspect the fuel line restriction between the fuel injection pump and fuel tank.
- The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load, which may set this DTC.
- Improper fuel will cause this DTC to set. Inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system.
- Contaminated fuel will cause this DTC to set. Inspect the pipe connector fixing bolt (eye bolt) on the fuel injection pump suction side.

Important:

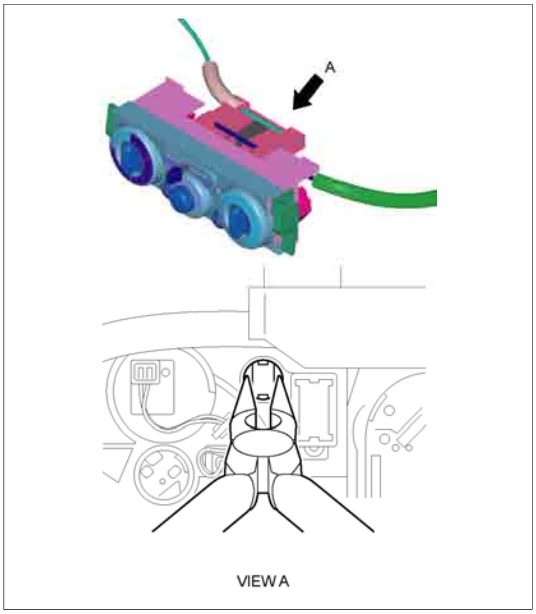
If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the fuel injection pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling. Refer to air bleeding procedure in fuel system section.

DTC P0216 (Symptom Code A, B) (Flash Code 54)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0335 (Symptom Code B or D), P1335 (Symptom Code A) or P1345 (Symptom Code A) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the engine. 2. Place the transmission in park or neutral (P or N) and set the park brake. 3. Start the engine and let engine idle for 30 seconds while observing the Actual Injection Timing parameter with the scan tool. 4. Accelerate the engine and keep the constant engine speed around 2000 RPM while observing the Actual Injection Timing parameter with the scan tool. 5. Accelerate the engine and keep the constant engine speed around 3000 RPM while observing the Actual Injection Timing parameter with the scan tool. Does the Actual Injection Timing parameter follow the Desired Injection Timing within 2°CA on each engine speed?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel injection pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Remove the fuel hose that connects to the fuel injection pump suction side. 2. Remove the fuel pipe connector that connects to the fuel injection pump suction side. 3. Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval.Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6
6	1. Disconnect the fuel hose that connects to the fuel injection pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container. 2. Pump the priming pump on the fuel filter. **Notice:** If there is a leak on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently and fuel leakage may occur. Also if there is a restriction on the suction side of the fuel system, the fuel from the disconnected hose will not flow out sufficiently that is most likely caused by clogged fuel filter or kinked fuel hose or pipe. 3. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. 4. Repair any fuel system leaks and restrictions as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 7



RTW710MH000101

Important Operations - Removal

1. Control lever assembly

Refer to “CONTROL LEVER ASSEMBLY” in this section.

2. Illumination Bulb

To remove the illumination bulb, insert a pliers (long nose) into the cap at the back of the bulb. Turn the bulb counterclockwise and pull it free.

Step	Action	Value(s)	Yes	No
7	1. Reconnect the fuel pipe connector that connects to the fuel injection pump suction side. 2. Remove the fuel hose that connects to the fuel injection pump suction side. 3. Substitute a clear hose. **Notice:** A hose must be cleaned. 4. Connect the clear hose to the fuel injection pump. 5. Bleed the fuel system. Refer to the Diagnostic Aids. 6. Let the engine run at idle for at least 2 minutes. 7. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 8. Repair as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Place the transmission in park or neutral (P or N) and set the park brake. 4. Start the engine and let engine idle for 30 seconds while observing the Actual Injection Timing parameter with the scan tool. 5. Accelerate the engine and keep the constant engine speed around 2000 RPM while observing the Actual Injection Timing parameter with the scan tool. 6. Accelerate the engine and keep the constant engine speed around 3000 RPM while observing the Actual Injection Timing parameter with the scan tool. Does the Actual Injection Timing parameter follow the Desired Injection Timing within 2°CA on each engine speed?	—	Go to Step 10	Go to Step 2
10	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0243 (Symptom Code 3) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure. An expected vacuum pressure amount should be detected while the engine running. If the ECM detects the actual vacuum pressure amount is higher than desired vacuum pressure amount, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The barometric pressure (BARO) is between 0 hPa and 3500 hPa.
- The intake air temperature (IAT) is between -50°C (-58 °F) and 200°C (392°F).
- The engine coolant temperature (ECT) is between -50°C (-58 °F) and 150°C (302°F)

Condition for Setting the DTC

- The ECM detects that the vacuum pressure is 50 hPa higher than the desired vacuum pressure for 3 seconds. This indicates excessive high vacuum pressure.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misrouted vacuum hoses will cause this DTC to set.

Test Description

The numbers below refer to the step number on the diagnostic table.

4. A skewed vacuum pressure sensor value (shifted to a high pressure) can set this DTC. The Vacuum Pressure on the scan tool should read near doubled barometric pressure (BARO) with the key ON and engine OFF.

5. A skewed BARO sensor value (shifted to a lower pressure) may set this DTC. The BARO on the scan tool should read near surrounding barometric pressure.

DTC P0243 (Symptom Code 3) (Flash Code 64)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0105 (Symptom Code 1, 2, 7 or 9) or P0243 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Inspect for the following conditions: • Vacuum hoses are damaged or kinked. • Misrouted vacuum hoses. • A turbocharger solenoid valve is damaged. • A vacuum pump is damaged. • A vacuum regulating valve is damaged. • A turbocharger wastegate valve is damaged. • Contaminated, skewed or slow vacuum pressure sensor. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the Vacuum Pressure Sensor and Barometric Pressure (BARO) with the scan tool. Does the scan tool indicate that the difference between the Vacuum Pressure Sensor and doubled BARO is less than the specified value?	10 hPa	Go to Step 7	Go to Step 5
5	1. Observe the BARO parameter with the scan tool. 2. Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs. Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 14
6	1. Turn OFF the ignition. 2. Disconnect the vacuum pressure sensor harness connector. 3. Inspect for an intermittent and for poor connections at the vacuum pressure sensor harness connector (pins 1 and 3 of C-124 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each vacuum pressure sensor circuit at the harness connector of the ECM (pins 82 and 85 of C-57 connector). 6. Test for high resistance on each vacuum pressure sensor circuit. 7. Test the vacuum pressure sensor signal circuit short to any other circuits. 8. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
7	1. Turn OFF the ignition. 2. Disconnect the vacuum hose from the turbocharger wastegate valve that is connected to the vacuum pressure sensor and the turbocharger solenoid valve. 3. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the turbocharger wastegate valve. This test is in order to verify an airtight of the turbocharger wastegate valve inside. 4. Start the engine and let engine idle. Does the hand-held vacuum pump indicate any vacuum pressure?	—	Go to Step 13	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the turbocharger wastegate valve. 3. Reconnect the vacuum hose to the turbocharger wastegate valve. 4. Disconnect the vacuum hose from the turbocharger solenoid valve that is connected to the vacuum regulating valve "Z" port. 5. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 6. Start the engine and let engine idle. Does the hand-held vacuum pump indicate less than 28 cmHg (11 inHg)?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Reconnect the vacuum hose to the turbocharger solenoid valve. 4. Disconnect the vacuum hose from the vacuum pressure sensor that is connected to the turbocharger solenoid valve and the turbocharger wastegate valve. 5. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 6. Disconnect the vacuum pressure sensor harness connector in order to active turbocharger solenoid valve. 7. Start the engine and let engine idle. Does the needle of hand-held vacuum pump shake between 0 and 20 cmHg (8 inHg)?	—	Go to Step 10	Go to Step 11
10	Replace the vacuum pressure sensor. Refer to Vacuum Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
11	Replace the turbocharger solenoid valve. Refer to Turbocharger Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the vacuum regulating valve. Did you compete the replacement?	—	Go to Step 15	—
13	Replace the turbocharger wastegate valve. Refer to Turbocharger in Engine Mechanical section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected hoses or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 16

Step	Action	Value(s)	Yes	No
16	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0243 (Symptom Code 4) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure. If the ECM detects that an open circuit or short to ground on the turbocharger solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the turbocharger solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses a turbocharger solenoid valve control substitution of 68%.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0243 (Symptom Code 4) (Flash Code 64)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 4	Go to Step 5
4	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 15	—
5	1. Turn OFF the ignition. 2. Disconnect the turbocharger solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the turbocharger solenoid valve harness (pin 1 of C-123 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Connect a test lamp between the control circuit of the turbocharger solenoid valve harness (pin 2 of C-123 connector) and battery voltage. 2. Turn ON the ignition, with the engine OFF. Does the test lamp continuously illuminate?	—	Go to Step 9	Go to Step 7
7	1. Keep the test lamp with connected. 2. Turn OFF the ignition. 3. Disconnect the vacuum pressure sensor harness connector in order to energize the turbocharger solenoid valve. 4. Turn ON the ignition, with the engine OFF. Does the test lamp blink?	—	Go to Step 11	Go to Step 10
8	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse (EB-4) and the turbocharger solenoid valve (pin 1 of C-123 connector). Did you complete the repair?	—	Go to Step 15	—
9	1. Test the control circuit between the engine control module (ECM) (pin 97 of C-57 connector) and the turbocharger solenoid valve (pin 2 of C-115 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the control circuit between the ECM (pin 96 of C-57 connector) and the turbocharger solenoid valve (pin 2 of C-123 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the turbocharger solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the turbocharger solenoid valve (pins 1 and 2 of C-123 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the turbocharger solenoid valve circuit at the harness connector of the ECM (pin 96 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the turbocharger solenoid valve. Refer to Turbocharger Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0243 (Symptom Code 5) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure. An expected vacuum pressure amount should be detected while the engine running. If the ECM detects the actual vacuum pressure amount is lower than desired vacuum pressure amount, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The barometric pressure (BARO) is between 0 hPa and 3500 hPa.
- The intake air temperature (IAT) is between -50°C (-58 °F) and 200°C (392°F).
- The engine coolant temperature (ECT) is between -50°C (-58 °F) and 150°C (302°F)

Condition for Setting the DTC

- The ECM detects that the vacuum pressure is 50 hPa lower than the desired vacuum pressure for 3 seconds. This indicates excessive low vacuum pressure.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misrouted vacuum hoses may set this DTC.
- A vacuum pump problem will cause this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.

4. A skewed vacuum pressure sensor value (shifted to a low pressure) can set this DTC. The Vacuum Pressure on the scan tool should read near doubled barometric pressure (BARO) with the key ON and engine OFF.

5. A skewed BARO sensor value (shifted to a higher pressure) may set this DTC. The BARO on the scan tool should read near surrounding barometric pressure.

DTC P0243 (Symptom Code 5) (Flash Code 64)

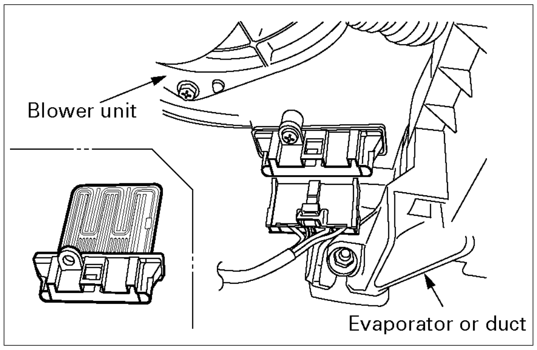
Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0105 (Symptom Code 1, 2, 7 or 9) or P0243 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Inspect for the following conditions: • Vacuum hoses are damaged or kinked. • Misrouted vacuum hoses. • A turbocharger solenoid valve is damaged. • A vacuum pump is damaged. • A vacuum regulating valve is damaged. • A turbocharger wastegate valve is damaged. • Contaminated, skewed or slow vacuum pressure sensor. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the Vacuum Pressure Sensor and Barometric Pressure (BARO) with the scan tool. Does the scan tool indicate that the difference between the Vacuum Pressure Sensor and doubled BARO is less than the specified value?	10 hPa	Go to Step 7	Go to Step 5
5	1. Observe the BARO parameter with the scan tool. 2. Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs. Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 14
6	1. Turn OFF the ignition. 2. Disconnect the vacuum pressure sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the vacuum pressure sensor harness connector (pin 2 of C-124 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on vacuum pressure sensor circuit at the harness connector of the ECM (pin 93 of C-57 connector). 6. Test for high resistance on vacuum pressure sensor low reference circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
7	1. Turn OFF the ignition. 2. Disconnect the vacuum hose from the turbocharger wastegate valve that is connected to the vacuum pressure sensor and the turbocharger solenoid valve. 3. Start the engine and accelerate the engine as necessary. Is there boost pressure leak from the turbocharger wastegate valve port?	—	Go to Step 13	Go to Step 8

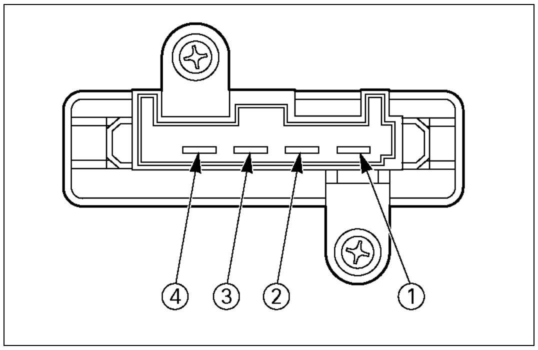
INSPECTION AND REPAIR



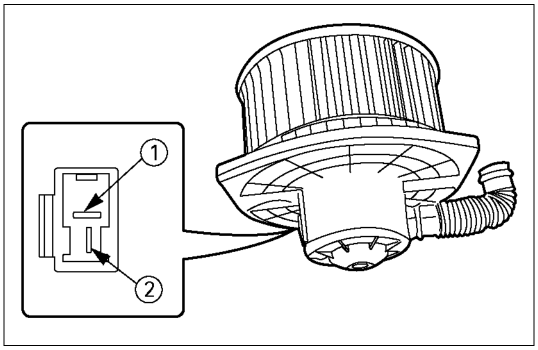
840R300005-X

Resistor

As for air-conditioning model, fixed on left (RHD) / right (LHD) side of the evaporator unit.
As for heater only model, fixed on left (RHD) / right (LHD) side of the duct placed between blower unit and heater unit.
Replace the resistor with a new on if the coil is found to be open or if the resistance value deviates from the specified range.



Terminal	Resistance
3 – 2	2.04 Ω
3 – 4	0.88 Ω
3 – 1	0.31 Ω



Blower motor

Check blower motor for smooth rotation.

Connect the battery positive terminal to the No.1 terminal of the blower motor and negative to the No.2.
Be sure to check to see if the blower motor operates correctly.

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Reconnect the vacuum hose to the turbocharger wastegate valve. 3. Disconnect the vacuum hose from the turbocharger solenoid valve that is connected to the vacuum regulating valve "Z" port. 4. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 5. Start the engine and let engine idle. Does the hand-held vacuum pump indicate more than 23 cmHg (9 inHg)?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Reconnect the vacuum hose to the turbocharger solenoid valve. 4. Disconnect the vacuum hose from the vacuum pressure sensor that is connected to the turbocharger solenoid valve and the turbocharger wastegate valve. 5. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 6. Disconnect the vacuum pressure sensor harness connector in order to active turbocharger solenoid valve. 7 Start the engine and let engine idle. Does the needle of hand-held vacuum pump shake between 0 and 20 cmHg (8 inHg)?	—	Go to Step 10	Go to Step 11
10	Replace the vacuum pressure sensor. Refer to Vacuum Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
11	Replace the turbocharger solenoid valve. Refer to Turbocharger Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the vacuum regulating valve. Did you compete the replacement?	—	Go to Step 15	—
13	Replace the turbocharger wastegate valve. Refer to Turbocharger in Engine Mechanical section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected hoses or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 16

Step	Action	Value(s)	Yes	No
16	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0243 (Symptom Code 6) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure.

The mass air flow (MAF) sensor monitors boost pressure by monitoring the amount of mass air flow. An expected MAF amount should be detected while the engine running. If the ECM detects the actual MAF amount is higher than desired MAF amount, this DTC will set. This indicates excessive high boost pressure and turbocharger wastegate valve most likely did not active.

Condition for Running the DTC

- The ignition switch is ON.
- The engine coolant temperature (ECT) is between -50°C (-58 °F) and 150°C (302°F).
- The EGR solenoid valve control is OFF.
- The MAF sensor DTC P0100 is not set.
- The vacuum pressure sensor DTC P0105 is not set.
- The intake air temperature (IAT) sensor DTC P0110 is not set.

Condition for Setting the DTC

- The ECM detects that the MAF amount is 56 mg/strk higher than the desired MAF for 3 seconds. This indicates an excessive high boost pressure.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Check the wastegate for a sticking or stuck condition. Refer to Wastegate Operation in the Engine Mechanical section.
- Use the scan tool to verify the integrity of the MAF sensor signal. Compare the sensor values under all load conditions for an excessively high value. Use the scan tool data list values for nominal sensor readings.
- The fuel with which gasoline was mixed may set this DTC.
- A sticking or intermittently sticking the EGR valve may set this DTC.
- Misrouted vacuum hoses may set this DTC.

DTC P0243 (Symptom Code 6) (Flash Code 64)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0105 (Symptom Code 1, 2, 7 or 9), P0243 (Symptom Code 3, 4, 5 or 8) or P0400 (Symptom Code 3, 4, 5 or 8) set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following for possible causes of high boost pressure. • Wastegate valve for a stuck closed condition. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Restricted intake or collapsed hose. 2. Repair the condition as necessary. Did you find and correction the condition?	—	Go to Step 11	Go to Step 4
4	1. Turn OFF the ignition for 30 seconds. 2. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). 3. Perform the EGR Solenoid Valve test with the scan tool. 4. Command the EGR Solenoid Valve ON and OFF with the scan tool while observing the Mass Air Flow (MAF) Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk within 2 seconds when the EGR Solenoid Valve is commanded ON?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Inspect for the following conditions: • An EGR valve control vacuum hose is damaged or kinked. • EGR solenoid valve vacuum hoses are damaged or kinked. • EGR solenoid valve ventilation is damaged. • An EGR valve is stuck close. • Restricted or collapsed EGR passage between the exhaust manifold and EGR valve. • Oil in the air tubing causing an incorrect MAF sensor signal. When there is adhesion of oil, inside of the tubing, intercooler and turbocharger needs to be wipe off. • Contaminated or skewed MAF sensor. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the EGR valve control vacuum hose from the EGR valve. 3. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 4. Start the engine and let engine idle. 5. Perform the EGR Solenoid Valve test with the scan tool. 6. Command the EGR Solenoid Valve ON and OFF with the scan tool. Does the hand-held vacuum pump indicate more than 50 cmHg (20 inHg) when commanding the ON and less than 10 cmHg (4 inHg) when commanding OFF?	—	Go to Step 7	Go to Step 10

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Connect the hand-held vacuum pump to the vacuum port of EGR valve. 4. Start the engine and let engine idle. 5. Apply vacuum pressure to the EGR valve while observing the MAF sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk when the vacuum pressure is applied?	—	Go to Diagnostic Aids	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the MAF sensor (pin 3 of C-116 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on each MAF sensor circuit at the harness connector of the ECM (pin 92 of C-57 connector). 6. Test for high resistance on each MAF sensor circuit. 7. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
9	Replace the EGR valve. Refer to EGR Valve Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]) while observing the MAF Sensor parameter with the scan tool. Does the MAF Sensor parameter follow the Desired MAF parameter within 50 mg/strk?	—	Go to Step 12	Go to Step 2
12	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0243 (Symptom Code 8) (Flash Code 64)

Circuit Description

The engine control module (ECM) controls the turbocharger wastegate valve based on the barometric pressure in order to reduce turbocharger spinning speeds at high altitude area. The ECM controls the turbocharger wastegate valve diaphragm by acting the regulated vacuum pressure via controlling the solenoid valve. The vacuum pressure sensor monitors the regulated vacuum pressure to the turbocharger wastegate valve. The ECM calculates desired vacuum pressure and it compares the calculated desired vacuum pressure to the actual value to determine the solenoid valve position. When the actual vacuum pressure is higher than the desired value, the solenoid valve is closed to decrease the vacuum pressure. If the ECM detects that a short to battery or ignition voltage on the turbocharger solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the turbocharger solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.
- The ECM uses a turbocharger solenoid valve control substitution of 32%.
- The ECM uses an EGR solenoid valve control substitution of 10%.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the turbocharger solenoid valve between the ECM and the solenoid valve is normal, the control circuit voltage low DTC P0243 (Symptom Code 4) will set.

DTC P0243 (Symptom Code 8) (Flash Code 64)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the turbocharger solenoid valve harness connector. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Does the DTC P0243 (Symptom Code 4) set, but not DTC P0243 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the control circuit between the engine control module (ECM) (pin 96 of C-57 connector) and the turbocharger solenoid valve (pin 2 of C-123 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the turbocharger solenoid valve. Refer to Turbocharger Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0251 (Symptom Code 6) (Flash Code 53)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.
The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shut off.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the PCU detects that the fuel injection solenoid valve is operated when the desired injection quantity from the ECM is 0 mg/strk, this DTC will set.

Condition for Running the DTC

- The fuel injection pump CMP sensor signal is generated.
- The CAN communication between the ECM and PCU is normal.

Condition for Setting the DTC

- The PCU detects that the fuel injection solenoid valve is operated when the desired fuel injection quantity is commanded 0 mg/strk.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 6) (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0251 (Symptom Code 7) (Flash Code 53)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The PCU also compares the engine speed signal sent from the ECM and the fuel injection pump speed. If the PCU detects that the doubled fuel injection pump speed is excessively lower than engine speed, this DTC will set.

Condition for Running the DTC

- The fuel injection pump CMP sensor signal is generated.
- The crankshaft position (CKP) sensor signal is generated.
- The engine speed is higher than 500 RPM.

Condition for Setting the DTC

- The PCU detects that the doubled fuel injection pump speed is lower than engine speed by 690 RPM for longer than 0.2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

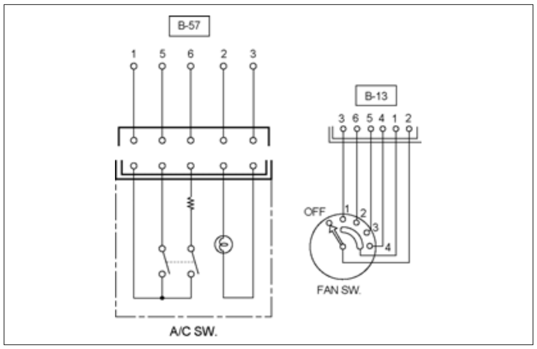
- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection pump CMP sensor is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 7) (Flash Code 53)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0335 (Symptom Code B, D or E), P1335 (Symptom Code A) or P1345 (Symptom Code A) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Start the engine. 2. Monitor the DTC Information with the scan tool. 3. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times. Does the DTC fail this ignition?		Go to Step 4	Go to Diagnostic Aids

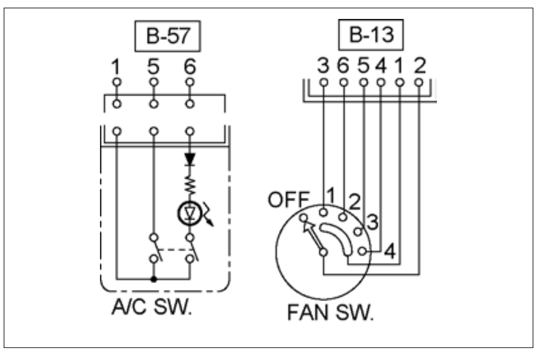


RTW710SH000801

Fan switch and A/C switch

Check for continuity between fan switch and A/C switch side connector terminals.
(A/C (4JA1-T, 4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output))

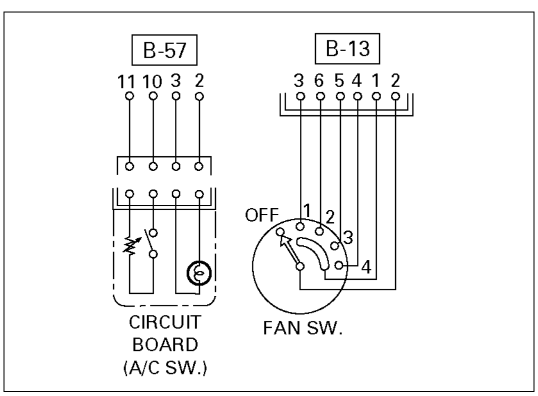
	Terminal No. / SW. position	B-13						B-57				
		1	2	3	4	5	6	2	3	1	5	6
(FAN SW.)	OFF											
	1	○	○	○								
	2	○	○				○					
	3	○	○			○						
	4	○	○		○							
(A/C SW.)	OFF							○	○			
	ON							○	○	○	○	○



RUW710SH000501

(A/C (4JH1-TC, C24SE)).

	Terminal No. / SW. position	B-13						B-57		
		1	2	3	4	5	6	1	5	6
(FAN SW.)	OFF									
	1	○	○	○						
	2	○	○				○			
	3	○	○			○				
	4	○	○		○					
(A/C SW.)	OFF									
	ON							○	○	○



D08R300070

(Cooler)

	Terminal No. / SW. position	B-13						B-57			
		1	2	3	4	5	6	2	3	10	11
(FAN SW.)	OFF										
	1	○	○	○							
	2	○	○				○				
	3	○	○			○					
	4	○	○		○						
(A/C SW.)	OFF							○	○		
	ON							○	○	○	○

Step	Action	Value(s)	Yes	No
4	1. Observe the Engine Speed parameter with the scan tool. 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the scan tool. Does the Engine Speed parameter indicate correct engine speed?	—	Go to Step 9	Go to Step 5
5	1. Inspect the crankshaft position (CKP) sensor for tightness. 2. Remove the CKP sensor and check for damage, metal particles on magnet and for flywheel circumference damage. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the CKP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on the CKP sensor terminal (pins 1, 2 and 3 of E-9 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition.	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on the CKP sensor signal input at the harness connector of the PCU (pin 8 of E-6 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	1. Turn OFF the ignition. Disconnect the engine control module (ECM) harness connector. 2. Inspect for an intermittent, for poor connections and corrosion on at the harness connector of the ECM (pins 90, 91, 98 and 101 of C-57 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0251 (Symptom Code 9, A, B, C) (Flash Code 53)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects internal fuel injection pump control maps are not programmed during self-test. (Symptom Code 9)
- The PCU detects internal EEPROM or A/D converter is failed during self-test. (Symptom Code A)
- The PCU detects that the fuel injection solenoid valve drive circuit is failed during self-test. (Symptom Code B)
- The PCU detects that the fuel injection solenoid valve drive circuit voltage level is abnormal during self-test. (Symptom Code D)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection. (Symptom Code 9)
- The ECM limits fuel injection quantity. (Symptom Code A)

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code 9, A, B, D) (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—

Step	Action	Value(s)	Yes	No
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0251 (Symptom Code E) (Flash Code 53)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the communication message from the PCU is not received, this DTC will set.

Condition for Running the DTC

The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects communication message from the PCU is not received for longer than 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- PCU is part of the fuel injection pump assembly.

DTC P0251 (Symptom Code E) (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P1650 (Symptom Code A or B) or P1651 (Symptom Code A or B) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—
5	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 6
6	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0335 (Symptom Code B, D) (Flash Code 43)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other.
If the ECM receives extra or missing CKP sensor signal pulses, this DTC will set. (Symptom Code B)
If the ECM receives a certain amount of injection pump CMP sensor signal pulses without a CKP sensor signal, this DTC will set. (Symptom Code D)

Condition for Running the DTC

Symptom Code B

- The ignition switch is ON.
- The engine speed is higher than 665 RPM

Symptom Code D

- DTC P0335 (Symptom Code B) is not set.
- The ignition switch is ON.
- The fuel injection pump CMP sensor signal is generated.
- The controller area network (CAN) communication between the ECM and PCU is normal.

Condition for Setting the DTC

Symptom Code B

- The ECM detects extra or missing CKP sensor signals while engine is running.

Symptom Code D

- The ECM detects that the CKP sensor signals are not generated when doubled fuel injection pump rotation speed is higher than 50 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
  The ECM uses an engine speed substitution of doubled fuel injection pump speed for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Ensure the sensor is tight and the flywheel circumference is not damaged.

DTC P0335 (Symptom Code B, D) (Flash Code 43)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the crankshaft position sensor (CKP) harness connector. 3. Connect a DMM across the CKP sensor terminals (pins 1 and 2 of E-9 connector). 4. Measure the resistance across the CKP sensor. Is the CKP sensor resistance within the specified value?	870 – 930 Ω	Go to Step 4	Go to Step 20

Step	Action	Value(s)	Yes	No
4	1. Connect a DMM across the CKP sensor terminals (measure the sensor output voltage). 2. Place the DMM on the AC volt scale. 3. Start the engine. 4. Monitor the DMM while accelerating the engine between idle and W.O.T. (accelerator pedal full travel). Does the DMM indicate an AC voltage increase in accordance with an engine speed increase (the range of approximately 1.4 volts is indicated from approximately 0.7 volts)?	—	Go to Step 5	Go to Step 19
5	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the low reference circuit of the CKP sensor harness (pin 1 of E-9 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 6
6	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the low reference circuit of the CKP sensor harness (pin 1 of E-9 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 12
7	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the shield ground circuit of the CKP sensor harness (pin 3 of E-9 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 8
8	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the shield ground circuit of the CKP sensor harness (pin 1 of E-9 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a test lamp between the signal circuit of the CKP sensor harness (pin 2 of E-9 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 10
10	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the signal circuit of the CKP sensor harness (pin 2 of E-9 connector) and a known good ground. Is the DMM voltage more than the specified value?	1 volt	Go to Step 16	Go to Step 17
11	**Important:** The ECM may be damaged if the sensor low reference circuit is shorted to a voltage source. 1. Test the low reference circuit of the CKP sensor between the engine control module (ECM) (pin 98 of C-57 connector) and the CKP sensor (pin 1 of E-9 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21

Step	Action	Value(s)	Yes	No
12	1. Test the low reference circuit of the CKP sensor between the ECM (pin 98 of C-57 connector) and the CKP sensor (pin 1 of E-9 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 18
13	**Important:** The ECM may be damaged if the sensor shield ground circuit is shorted to a voltage source. 1. Test the shield ground circuit of the CKP sensor between the ECM (pin 101 of C-57 connector) and the CKP sensor (pin 3 of E-9 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
14	1. Test the shield ground circuit of the CKP sensor between the ECM (pin 101 of C-57 connector) and the CKP sensor (pin 3 of E-9 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 18
15	1. Test the signal circuit of the CKP sensor between the ECM (pin 90 of C-57 connector) and the CKP sensor (pin 2 of E-9 connector) for the following conditions: • A short to ground • A short to the low reference circuit • A short to the shield ground 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
16	**Important:** The CKP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit of the CKP sensor between the ECM (pin 90 of C-57 connector) and the CKP sensor (pin 2 of E-9 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
17	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1, 2 and 3 of E-9 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
18	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CKP sensor circuits at the harness connector of the ECM (pins 90, 98 and 101 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21

Step	Action	Value(s)	Yes	No
19	1. Inspect the CKP sensor for tightness. 2. Retest if the sensor was loose. 3. Remove the CKP sensor and check for damage, metal particles on magnet and for flywheel circumference damage. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
20	Replace the CKP sensor. Refer to Crankshaft Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—
21	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—
22	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 23
23	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0335 (Symptom Code E) (Flash Code 43)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. The engine control module (ECM) calculates the engine speed and exact position of the crankshaft based on the signal from the CKP sensor. If the ECM detects an engine overrun condition, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the engine speed is higher than 5700 RPM for 0.2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Ensure the sensor is tight and the flywheel circumference is not damaged.

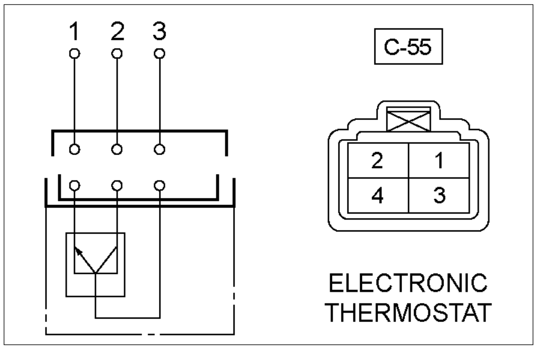
Notice:

- This DTC is caused by an engine over speed condition, which was most likely caused by driver error (i.e. downshifting a manual transmission on a steep grade). Ensure there are no signs of engine damage. Excessive engine over speed may damage internal engine components.

DTC P0335 (Symptom Code E) (Flash Code 43)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Start the engine. 3. Observe the Engine Speed parameter with the scan tool. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the scan tool. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 3
3	Ask the driver if overrun is caused by gear slip-out, shift error, down-slope diving, etc. If engine overrun has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 7	—
4	1. Remove the crankshaft position (CKP) sensor. Refer to CKP Sensor replacement in this section. 2. Visually inspect the CKP sensor for the following conditions: • For physical damage • For being loose • For improper installation Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	Visually inspect the flywheel circumference for damage. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the Engine Speed parameter with the scan tool. 6. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the scan tool. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK



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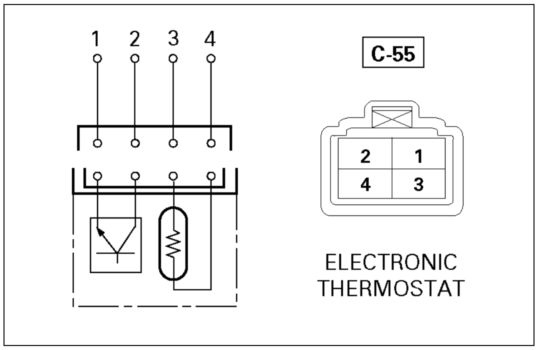


Electronic thermostat

Check for continuity between electronic thermostat side connector terminals.

(A/C)

(Cooler)

DTC P0380 (Symptom Code 4) (Flash Code 66)

Circuit Description

The engine control module (ECM) controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects an open circuit or short to ground on the glow relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the glow relay control circuit for longer than 3 seconds when the relay is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Notice:

- The glow relay is commanded OFF with ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).
- The glow relay is commanded OFF with engine run when the engine coolant temperature is reached at 60°C (140°F).

DTC P0380 (Symptom Code 4) (Flash Code 66)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Relay test with the scan tool. 4. Command the Glow Relay ON with the scan tool. Does the glow relay click when commanded ON with the scan tool?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Command the Glow Relay ON with the scan tool. Does the glow relay click when commanded ON with the scan tool?	—	Go to Step 12	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 5	Go to Step 6
5	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 16	—
6	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Connect a test lamp between the voltage feed circuit of the glow relay coil side (pin 2 of X-5 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 9

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Connect a test lamp between the control circuit of the glow relay (pin 3 of X-5 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp continuously illuminate (the test lamp blinks then goes out normally if the engine coolant temperature lower than 30°C [86°F])?	—	Go to Step 10	Go to Step 8
8	1. Keep the test lamp with connected. 2. Command the Glow Relay ON with the scan tool. Does the test lamp illuminate when commanded ON with the scan tool?	—	Go to Step 12	Go to Step 11
9	Repair the voltage feed circuit between the ECM (10A) fuse (EB-4) and the glow relay (pin 2 of X-5 connector) for an open circuit or high resistance. Did you complete the repair?	—	Go to Step 16	—
10	1. Test the control circuit of the glow relay between the engine control module (ECM) (pin 94 of C-57 connector) and the glow relay (pin 3 of X-5 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
11	1. Test the control circuit of the glow relay between the ECM (pin 94 of C-57 connector) and the glow relay (pin 3 of X-5 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
12	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the glow relay terminals (pins 2 and 3 of X-5 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow relay control circuit at the harness connector of the ECM (pin 94 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the glow relay. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
16	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 65°C [149°F]). 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 17
17	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0380 (Symptom Code 8) (Flash Code 66)

Circuit Description

The engine control module (ECM) controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects a short to battery or ignition voltage on the glow relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the glow relay control circuit for longer than 1 second when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Notice:

- The glow relay is commanded OFF with ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).
- The glow relay is commanded OFF with engine run when the engine coolant temperature is reached at 60°C (140°F).

DTC P0380 (Symptom Code 8) (Flash Code 66)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Relay test with the scan tool. 4. Command the Glow Relay ON with the scan tool. Does the glow relay click when commanded ON with the scan tool?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Command the Glow Relay ON with the scan tool. Does the glow relay click when commanded ON with the scan tool?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit of the glow relay between the engine control module (ECM) (pin 94 of C-57 connector) and the glow relay (pin 3 of X-5 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the glow relay. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 50°C [122°F]). 5. Start the engine. 6. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0381 (Symptom Code 4) (Flash Code 67)

Circuit Description

The glow indicator lamp is located on the instrument panel cluster (IPC). The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. If the ignition switch is turned ON when the engine coolant temperature is low, the engine control module (ECM) illuminates the glow indicator lamp and turns ON the glow plugs. After a fixed time passes, the ECM turns OFF the glow indicator lamp and the glow plugs. The ECM monitors the glow indicator lamp control circuit for conditions that are incorrect for the commanded state of the glow indicator lamp. If the ECM detects an open circuit or short to ground on the glow indicator control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the glow indicator lamp control circuit for longer than 3 seconds when the lamp is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The glow indicator lamp is commanded OFF with the ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).

DTC P0381 (Symptom Code 4) (Flash Code 67)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Indicator test with the scan tool. 4. Command the Glow Indicator ON with the scan tool. Does the glow indicator lamp turn ON when commanded ON with the scan tool?	—	Go to Step 3	Go to Step 4
3	Command the Glow Indicator OFF with the scan tool. Does the glow indicator lamp OFF?	—	Go to Step 17	Go to Step 10
4	1. Turn OFF the ignition. 2. Inspect the Meter (15A) fuse (C-14) in the cabin fuse block. Is the Meter (15A) fuse (C-14) open?	—	Go to Step 5	Go to Step 6
5	Replace the Meter (15A) fuse (C-14). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (15A) fuse (C-14) or replace the shorted attached component fed by the Meter (15A) fuse (C-14). Did you complete the repair?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the glow indicator lamp control circuit of the ECM harness connector (pin 43 of C-56 connector) and a known good ground. Does the glow indicator lamp illuminate?	—	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Remove the glow indicator bulb from the IPC (meter assembly). Is the glow indicator bulb burned out?	—	Go to Step 15	Go to Step 8
8	1. Disconnect the IPC harness B-24 connector. 2. Connect a test lamp between the voltage feed circuit of the glow indicator lamp (pin 30 of B-24 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector. 3. Connect a test lamp between the voltage feed circuit and control circuit of the glow indicator lamp (pins 6 and 30 of B-24 connector). 4. Turn ON the ignition, with the engine OFF. 5. Perform the Glow Indicator test with the scan tool. 6. Command the Glow Indicator ON with the scan tool. Does the test lamp turn ON when commanded ON with the scan tool?	—	Go to Step 14	Go to Step 13
10	1. Test the control circuit of the glow indicator lamp between the ECM (pin 43 of C-56 connector) and the IPC (pin 6 of B-24 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow indicator lamp control circuit at the harness connector of the ECM (pin 43 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
12	Repair the open circuit or high resistance on the voltage feed circuit of the glow indicator lamp between the IPC (pin 30 of B-24 connector) and Meter (15A) fuse (C-14). Did you complete the repair?	—	Go to Step 19	—
13	1. Repair the open circuit or high resistance on the control circuit of the glow indicator lamp between the ECM (pin 43 of C-56 connector) and the IPC (pin 6 of B-24 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
14	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the glow indicator lamp circuits at the IPC (pins 6 and 30 of B-24 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	Replace the glow indicator bulb. Did you complete the replacement?	—	Go to Step 19	—
16	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 19	—
17	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition for 30 seconds, with the engine OFF. 3. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 18	Go to Diagnostic Aids
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0381 (Symptom Code 8) (Flash Code 67)

Circuit Description

The glow indicator lamp is located on the instrument panel cluster (IPC). The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. If the ignition switch is turned ON when the engine coolant temperature is low, the engine control module (ECM) illuminates the glow indicator lamp and turns ON the glow plugs. After a fixed time passes, the ECM turns OFF the glow indicator lamp and the glow plugs. The ECM monitors the glow indicator lamp control circuit for conditions that are incorrect for the commanded state of the glow indicator lamp. If the ECM detects a short to battery or ignition voltage on the glow indicator control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the glow indicator lamp control circuit for longer than 1 second when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The glow indicator lamp is commanded OFF with the ignition ON and engine OFF when the engine coolant temperature is reached at 30°C (86°F).

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the glow indicator lamp between the ECM and the IPC is normal, the control circuit voltage low DTC P0381 (Symptom Code 4) will set.

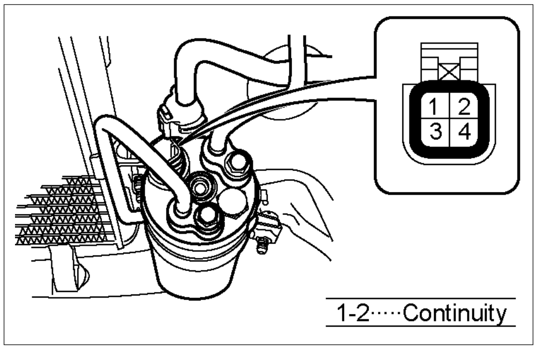
DTC P0381 (Symptom Code 8) (Flash Code 67)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Indicator test with the scan tool. 4. Command the Glow Indicator ON with the scan tool. Does the glow indicator lamp turn ON when commanded ON with the scan tool?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the IPC harness B-24 connector. 3. Disconnect the IPC harness B-24 connector. 4. Turn ON the ignition for 30 seconds, with the engine OFF. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does DTC P0381 (Symptom Code 4) set, but not DTC P0381 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4

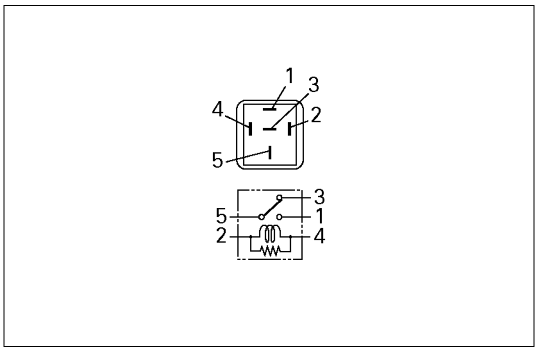
Step	Action	Value(s)	Yes	No
4	1. Test the control circuit of the glow indicator lamp between the engine control module (ECM) (pin 43 of C-56 connector) and the IPC (pin 6 of B-24 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 25°C [77°F]). 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK



RTW4A0SH000201

Triple Pressure switch

Disconnect pressure switch connector and check for continuity between pressure switch side connector terminal.

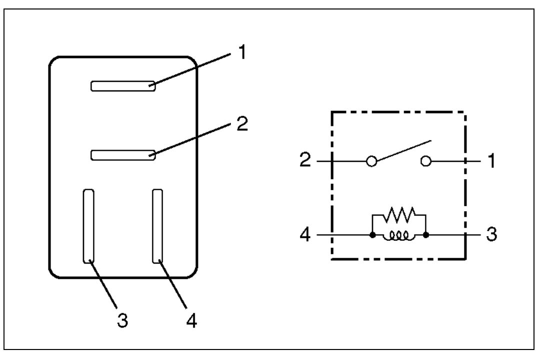


825r300045

Heater and thermo switch relay.

Check for continuity between the relay terminals.

1 - 5 ····· No continuity	
(When battery voltage is applied between 2 - 4)	
1 - 5 ····· Continuity	



825r300023

Check for continuity between the relay terminals.

1 - 2 ····· No continuity	
(When battery voltage is applied between 3 - 4)	
1 - 2 ····· Continuity	

DTC P0400 (Symptom Code 3) (Flash Code 32)

Circuit Description

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects the actual MAF amount is lower than desired MAF amount, this DTC will set. This indicates excessive amount of EGR gas flow.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.
- The barometric pressure (BARO) is between 850 hPa and 1100 hPa.
- The intake air temperature (IAT) is between 15°C (59°F) and 100°C (212°F).
- The ECT is between 35°C (95°F) and 100°C (211°F).

Condition for Setting the DTC

- The ECM detects that the MAF amount is 150 mg/strk lower than the desired MAF for 60 seconds. This indicates excessive amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the EGR valve will cause this DTC to set.
- Misrouted vacuum hoses will cause this DTC to set.

DTC P0400 (Symptom Code 3) (Flash Code 32)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0100 (Symptom Code 7, 9, B or C) or P0400 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). 4. Perform the EGR Solenoid Valve test with the scan tool. 5. Command the EGR Solenoid Valve ON and OFF with the scan tool while observing the Mass Air Flow (MAF) Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk within 2 seconds when the EGR Solenoid Valve is commanded ON?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Inspect for the following conditions: • An EGR valve control vacuum hose is damaged or kinked. • EGR solenoid valve vacuum hoses are damaged or kinked. • EGR solenoid valve ventilation is damaged. • An EGR valve is stuck open. • Any type of restriction in the exhaust system. • Air leakage around the MAF sensor or debris in the sensor housing. • Air leaking around any of the air induction tubing between the MAF sensor and intake manifold. • Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the turbocharger. • Oil in the air tubing causing an incorrect MAF sensor signal. When there is adhesion of oil, inside of the tubing, intercooler and turbocharger needs to be wipe off. • Contaminated, skewed or slow MAF sensor. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve control vacuum hose from the EGR valve. 3. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 4. Start the engine and let engine idle. 5. Perform the EGR Solenoid Valve test with the scan tool. 6. Command the EGR Solenoid Valve ON and OFF with the scan tool. Does the hand-held vacuum pump indicate more than 50 cmHg (20 inHg) when commanding the ON and less than 10 cmHg (4 inHg) when commanding OFF?		Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Connect the hand-held vacuum pump to the vacuum port of EGR valve. 4. Start the engine and let engine idle. 5. Apply vacuum pressure to the EGR valve while observing the MAF Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk when the vacuum pressure is applied?	—	Go to Diagnostic Aids	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the MAF sensor (pins 2, 4 and 5 of C-116 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each MAF sensor circuit at the harness connector of the ECM (pins 83 and 88 of C-57 connector). 6. Test for high resistance on each MAF sensor circuit. 7. Test the MAF sensor signal circuit short to intake air temperature (IAT) sensor signal. 8. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	Replace the EGR valve. Refer to EGR Valve Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]) while observing the MAF Sensor parameter with the scan tool. Does the MAF Sensor parameter follow the Desired MAF parameter within 50 mg/strk?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0400 (Symptom Code 4) (Flash Code 32)

Circuit Description

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects that an open circuit or short to ground on the EGR solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the low voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0400 (Symptom Code 4) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 4	Go to Step 5
4	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 15	—
5	1. Turn OFF the ignition. 2. Disconnect the EGR control solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the EGR control solenoid valve harness (pin 1 of C-115 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Connect a test lamp between the control circuit of the EGR solenoid valve harness (pin 2 of C-115 connector) and battery voltage. 2. Perform the EGR Solenoid Valve test with the scan tool. 3. Command the EGR Solenoid Valve ON with the scan tool. Does the test lamp illuminate when commanded ON with the scan tool?	—	Go to Step 7	Go to Step 9
7	Command the EGR Solenoid Valve OFF with the scan tool. Does the test lamp continuously illuminate same as step 6 when commanded OFF with the scan tool (the test lamp slightly illuminates if the circuit is normal when commanded OFF)?	—	Go to Step 10	Go to Step 11
8	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse (EB-4) and the EGR solenoid valve (pin 1 of C-115 connector). Did you complete the repair?	—	Go to Step 15	—
9	1. Test the control circuit between the engine control module (ECM) (pin 97 of C-57 connector) and the EGR solenoid valve (pin 2 of C-115 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	1. Test the control circuit between the ECM (pin 97 of C-57 connector) and the EGR solenoid valve (pin 2 of C-115 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Turn OFF the ignition. 2. Disconnect the EGR solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the EGR solenoid valve (pins 1 and 2 of C-115 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the EGR solenoid valve control circuit at the harness connector of the ECM (pin 97 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0400 (Symptom Code 5) (Flash Code 32)

Circuit Description

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects the actual MAF amount is higher than desired MAF amount, this DTC will set. This indicates insufficient amount of EGR gas flow.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.
- The barometric pressure (BARO) is between 850 hPa and 1100 hPa.
- The intake air temperature (IAT) is between 15°C (59°F) and 100°C (212°F).
- The ECT is between 35°C (95°F) and 100°C (211°F).

Condition for Setting the DTC

- The ECM detects that the MAF amount is 150 mg/strk higher than the desired MAF for 60 seconds. This indicates insufficient amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the EGR valve will cause this DTC to set.
- Misrouted vacuum hoses will cause this DTC to set.
- A vacuum pump problem will cause this DTC to set.

DTC P0400 (Symptom Code 5) (Flash Code 32)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle for 30 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0100 (Symptom Code 7, 9, B or C) or P0400 (Symptom Code 4 or 8) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). 4. Perform the EGR Solenoid Valve test with the scan tool. 5. Command the EGR Solenoid Valve ON and OFF with the scan tool while observing the Mass Air Flow (MAF) Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk within 2 seconds when the EGR Solenoid Valve is commanded ON?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Inspect for the following conditions: • An EGR valve control vacuum hose is damaged or kinked. • EGR solenoid valve vacuum hoses are damaged or kinked. • EGR solenoid valve ventilation is damaged. • An EGR valve is stuck close. • Restricted or collapsed EGR passage between the exhaust manifold and EGR valve. • A vacuum hose from the vacuum pump is damaged or kinked. • A vacuum pump is damaged. • Oil in the air tubing causing an incorrect MAF sensor signal. When there is adhesion of oil, inside of the tubing, intercooler and turbocharger needs to be wipe off. • Contaminated or skewed MAF sensor. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve control vacuum hose from the EGR valve. 3. Connect a hand-held vacuum pump (5-8840-0279-0/J-23738-A) to the disconnected vacuum hose. 4. Start the engine and let engine idle. 5. Perform the EGR Solenoid Valve test with the scan tool. 6. Command the EGR Solenoid Valve ON and OFF with the scan tool. Does the hand-held vacuum pump indicate more than 50 cmHg (20 inHg) when commanding the ON and less than 10 cmHg (4 inHg) when commanding OFF?		Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the hand-held vacuum pump from the vacuum hose. 3. Connect the hand-held vacuum pump to the vacuum port of EGR valve. 4. Start the engine and let engine idle. 5. Apply vacuum pressure to the EGR valve while observing the MAF Sensor parameter. Does the MAF Sensor parameter decrease by at least 200 mg/strk when the vacuum pressure is applied?	—	Go to Diagnostic Aids	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the MAF sensor (pin 3 of C-116 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on each MAF sensor circuit at the harness connector of the ECM (pin 92 of C-57 connector). 6. Test for high resistance on each MAF sensor circuit. 7. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	Replace the EGR valve. Refer to EGR Valve Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]) while observing the MAF Sensor parameter with the scan tool. Does the MAF Sensor parameter follow the Desired MAF parameter within 50 mg/strk?	—	Go to Step 11	Go to Step 2
11	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0400 (Symptom Code 8) (Flash Code 32)

Circuit Description

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running. If the ECM detects that detects a short to battery or ignition voltage on the EGR solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the high voltage condition on the EGR solenoid valve control circuit for longer than 3 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the EGR solenoid valve between the ECM and the solenoid valve is normal, the control circuit voltage low DTC P0400 (Symptom Code 4) will set.

DTC P0400 (Symptom Code 8) (Flash Code 32)

Schematic Reference: Engine Controls Schematics

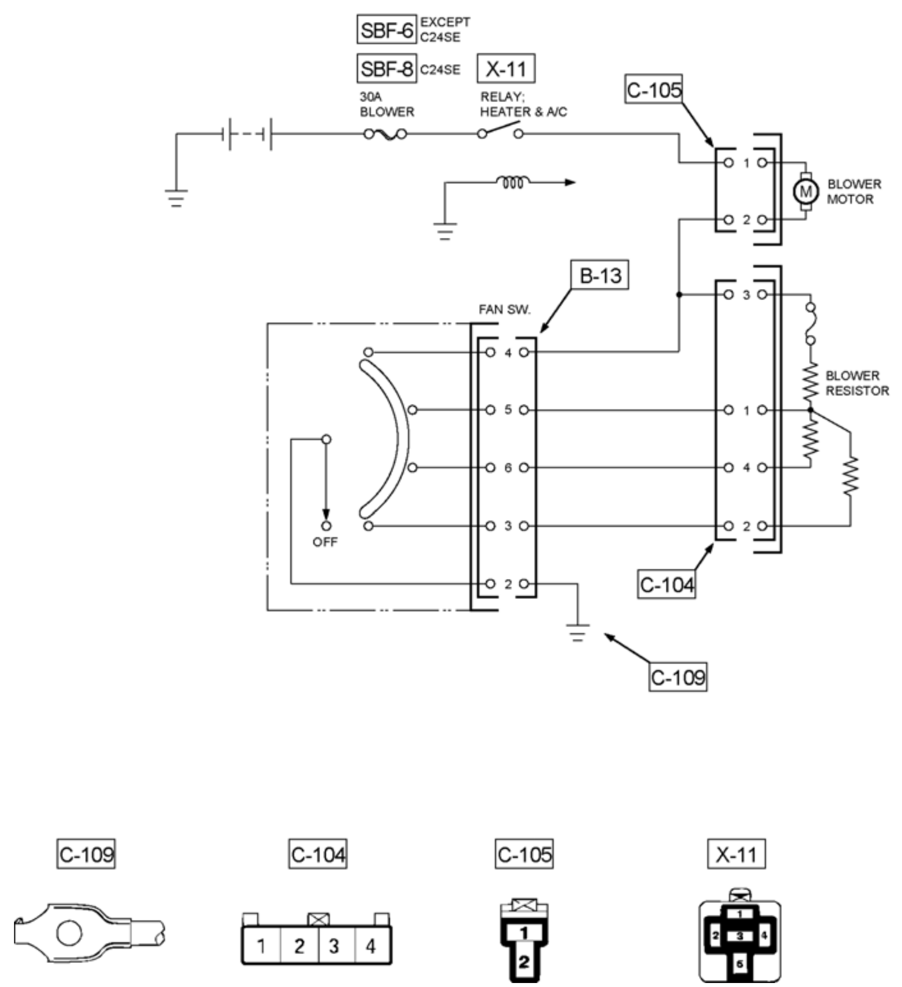
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR control solenoid valve harness connector. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Does the DTC P0400 (Symptom Code 4) set, but not DTC P0400 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the engine control module (ECM) (pin 97 of C-57 connector) and the EGR solenoid valve (pin 2 of C-115 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the EGR solenoid valve. Refer to EGR Solenoid Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—

TROUBLESHOOTING

FAN CONTROL KNOB (FAN SWITCH)

Current flows to the blower motor through the Heater & A/C relay (X-11) to activate the rotation of the blower motor by turning “ON” the fan control knob (fan switch). Blower motor speed is controlled in stages by the resistor, by operating the switch from “LOW” to “HIGH.”



RTW710LF004201

Step	Action	Value(s)	Yes	No
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0500 (Symptom Code 1, A) (Flash Code 24)

Circuit Description

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The 12 volts operating supply from the Meter fuse (except 2WD with A/T) or Back Up fuse (2WD with A/T). The ECM calculates the vehicle speed by the VSS. If the vehicle is 2WD with automatic transmission, VSS signals are sent from the transmission control module (TCM). If the ECM detects VSS signals are generated with high frequencies, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the vehicle speed is higher than 200 km/h (125 MPH) for 5 seconds. (Symptom Code 1)
- The ECM detects that the vehicle speed sensor signal frequency is too high for 0.6 seconds. (Symptom Code A)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a vehicle speed substitution of 5 km/h (3 MPH) for engine control.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0500 (Symptom Code 1, A) (Flash Code 24)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart for 2WD with A/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Inspect all of the circuits going to the automatic transmission (A/T) vehicle speed sensor (VSS) for the following: • Routed too closely to fuel injection solenoid wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 7	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the A/T VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the A/T VSS (pins 1, 2 and 3 of E-30 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on A/T VSS circuit at the harness connector of the ECM (pin 68 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the A/T VSS. Refer to A/T Speed Sensor Replacement in automatic transmission section. 2. Visually inspect the A/T VSS for the following conditions: • Physical damage • Being loose • Improper installation 3. The following conditions may cause this DTC to set: • Electromagnetic interference in the A/T VSS circuits 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the A/T VSS. Refer to A/T Speed Sensor Replacement in automatic transmission section Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for except 2WD with A/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Inspect all of the circuits going to the vehicle speed sensor (VSS) for the following: • Routed too closely to fuel injection solenoid wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 7	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1, 2 and 3 of E-44 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on VSS circuit at the harness connector of the ECM (pin 68 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. 2. Visually inspect the VSS for the following conditions: • Physical damage • Being loose • Improper installation 3. The following conditions may cause this DTC to set: • Electromagnetic interference in the VSS circuits 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0500 (Symptom Code B) (Flash Code 24)

Circuit Description

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The 12 volts operating supply from the Meter fuse (except 2WD with A/T) or Back Up fuse (2WD with A/T). The ECM calculates the vehicle speed by the VSS. If the vehicle is 2WD with automatic transmission, VSS signals are sent from the transmission control module (TCM). If the ECM detects VSS signals are not generated, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 3600 RPM.
- The fuel injection quantity is more than 41 mg/strk.

Condition for Setting the DTC

- The ECM detects that the vehicle speed is lower than 1.5 km/h (1 MPH) for 60 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0500 (Symptom Code B) (Flash Code 24)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart for 2WD with A/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “JR405E Automatic Transmission” in the system selection menu. 5. Monitor the Read Diagnostic Trouble Code (DTC) Info As Stored By ECU with the scan tool. Does the transmission control module (TCM) DTC P0722 set?	—	Go to Applicable DTC in Automatic Transmission Section	Go to Step 3
3	1. Drive the vehicle. 2. Select the data display function of engine control module (ECM). 3. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Intermittently jump the VSS signal output circuit (pin A-10 of C-94 connector) with a test lamp that is connected to a known good ground while monitoring the Vehicle Speed parameter with the scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 8	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the B-23 harness connector. 3. Disconnect the IPC B-23 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Intermittently jump the signal output circuit of the VSS signal output (pin 10 of B-23 connector) with a test lamp that is connected to a known good ground while monitoring the Vehicle Speed parameter with the scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 6	Go to Step 7
6	1. Test the VSS signal output circuit between the IPC (pin 9 of B-23 connector) and the TCM (pin A-10 of C-94 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
7	1. Test the VSS signal output circuit between the ECM (pin 68 of C-56 connector) and the IPC (pin 10 of B-23 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection on the VSS signal circuit at the harness connector of the TCM (pin A-10 of C-94 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
9	1. Turn OFF the ignition. 2. Disconnect the IPC B-23 harness connector. 3. Inspect for an intermittent and for poor connections on the VSS signal circuit at the harness connector of the IPC (pins 9 and 10 of B-24 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the VSS signal circuit at the harness connector of the ECM (pin 68 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

Step	Action	Value(s)	Yes	No
11	Replace the IPC (meter assembly). Refer to Meter Replacement in electrical section. Did you complete the replacement?	—	Go to Step 14	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to Transmission Control Module (TCM) Replacement in the transmission section. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 15	Go to Step 2
15	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for except 2WD with A/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Drive the vehicle. 3. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (15A) fuse (C-14) in the cabin fuse block. Is the Meter (15A) fuse (C-14) open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (15A) fuse (C-14). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (15A) fuse (C-14) or replace the shorted attached component fed by the Meter (15A) fuse (C-14). Did you complete the repair?	—	Go to Step 20	—

Step	Action	Value(s)	Yes	No
5	1. Remove the vehicle speed sensor (VSS). Refer to Vehicle Speed Sensor (VSS) Replacement in this section. 2. Visually inspect the VSS for the following conditions: • Physical damage • Being loose • Improper installation • For transmission output shaft teeth damage 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Connect a test lamp between the ignition voltage feed circuit of the VSS harness (pin 1 of E-44 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 9
7	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the ignition voltage feed circuit and low reference circuit of the VSS harness (pins 1 and 2 of E-44 connector). Does the test lamp illuminate?	—	Go to Step 8	Go to Step 10
8	1. Turn ON the ignition, with the engine OFF. 2. Intermittently jump the signal circuit of the VSS (pin 3 of E-44 connector) with a test lamp that is connected to a known good ground while monitoring the Vehicle Speed parameter with the scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 14	Go to Step 11
9	Repair the open or high resistance in the VSS ignition voltage feed circuit between the Meter (15A) fuse (C-14) and the VSS (pin 1 of E-44 connector). Did you complete the repair?	—	Go to Step 20	—
10	Repair the open or high resistance in the VSS low reference circuit between the VSS (pin 2 of E-44 connector) and the chassis ground. Did you complete the repair?	—	Go to Step 20	—
11	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the B-24 harness connector. 3. Disconnect the IPC B-24 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Intermittently jump the signal output circuit of the VSS signal (pin 10 of B-24 connector) with a test lamp that is connected to a known good ground while monitoring the Vehicle Speed parameter with the scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 12	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Test the VSS signal circuit between the VSS (pin 3 of E-44 connector) and the IPC (pin 9 of B-23 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
13	1. Test the VSS signal circuit between the engine control module (ECM) (pin 68 of C-56 connector) and the IPC (pin 10 of B-23 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
14	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pin 1, 2 and 3 of E-44 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
15	1. Turn OFF the ignition. 2. Disconnect the IPC B-23 harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the IPC (pins 9 and 10 of B-23 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the VSS signal circuit at the harness connector of the ECM (pin 68 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
17	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
18	Replace the IPC (meter assembly). Refer to Meter Replacement in electrical section. Did you complete the replacement?	—	Go to Step 20	—
19	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—

Step	Action	Value(s)	Yes	No
20	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the scan tool. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 21	Go to Step 3
21	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

FEET TO METERS

ft.	0	1	2	3	4	5	6	7	8	9	ft.
	m	m	m	m	m	m	m	m	m	m	
-		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	-
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17.983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METERS TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	
-		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	-
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	175.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

MILES TO KILOMETERS

miles	0	1	2	3	4	5	6	7	8	9	miles
	km	km	km	km	km	km	km	km	km	km	
-		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	-
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.592	69.202	70.811	72.420	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.389	103.000	104.607	106.217	107.826	109.435	111.045	60
70	112.654	114.263	115.873	117.482	119.091	120.700	122.310	123.919	125.529	127.138	70
80	128.748	130.357	131.966	133.576	135.185	136.794	138.404	140.013	141.622	143.232	80
90	144.841	146.450	148.060	149.669	151.278	152.888	154.497	156.106	157.716	159.325	90
100	160.934	162.544	164.153	165.762	167.372	168.981	170.590	172.200	173.809	175.418	100

KILOMETERS TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	miles	miles	miles	miles	miles	miles	miles	miles	miles	miles	
-		0.621	1.243	1.864	2.485	3.107	3.728	4.350	4.971	5.592	-
10	6.214	6.835	7.456	8.078	8.699	9.321	9.942	10.563	11.185	11.806	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020	20
30	18.641	19.262	19.884	20.505	21.127	21.748	22.370	22.990	23.612	24.233	30
40	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447	40
50	31.065	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.039	36.661	50
60	37.282	37.904	38.525	39.146	39.768	40.389	41.010	41.632	42.253	42.875	60
70	43.496	44.117	44.739	45.360	45.981	46.603	47.224	47.845	48.467	49.088	70
80	49.711	50.331	50.952	51.574	52.195	52.816	53.438	54.059	54.681	55.302	80
90	55.923	56.545	57.166	57.187	58.409	59.030	59.652	60.273	60.894	61.516	90
100	62.137	62.758	63.390	64.001	64.622	65.244	65.865	66.487	67.108	67.729	100

BLOWER MOTOR DOES NOT RUN

- Is heater & A/C relay (X-11) OK?

YES | NO → Replace

- Is No.SBF-6 (30A) (except C24SE) or No.SBF-8 (30A) (C24SE) slow blow fuse OK?

YES | NO → Replace

- Is resistor OK?

YES | NO → Replace

- Is fan control knob (Fan switch) OK?

YES | NO → Replace control lever assembly

- Is blower motor OK?

YES | NO → Replace

- Turn the ignition switch "ON" (Engine is running)
- Fan control knob (Fan switch) "ON"

- Check to see if battery voltage is present at chassis side connector terminal No.C105-1 is there a battery voltage?

YES → Open circuit either between chassis side connector terminal No.C105-2 and No.C104-3 or No.B13-1 and body ground No.C-109.

NO → Open circuit between No.SBF-6 (30A) (except C24SE) or No.SBF-8 (30A) (C24SE) slow blow fuse and No.C105-1.

DTC P0560 (Symptom Code 1) (Flash Code 35)

Circuit Description

The engine control module (ECM) monitors the system voltage on the ECM main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively high system voltage, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit voltage is more than 20 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- A charging system problem may set this DTC.
- Jump starting the vehicle or a battery charger may have set this DTC.

DTC P0560 (Symptom Code 1) (Flash Code 35)
Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Was the vehicle recently jump started from 24 volts system?	—	Go to Step 8	Go to Step 4
4	1. Start the engine and let idle for 30 seconds. 2. Observe the System Voltage parameter with the scan tool. Is the System Voltage parameter less than the specified value?	16 volts	Go to Diagnostic Aids	Go to Step 5
5	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 6	Go to Step 7
6	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 8	—
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the System Voltage parameter with the scan tool. Is the System Voltage parameter less than the specified value?	16 volts	Go to Step 9	Go to Step 5
9	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0560 (Symptom Code 2) (Flash Code 35)

Circuit Description

The engine control module (ECM) monitors the system voltage on the ECM main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low system voltage, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit voltage is less than 7 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A charging system problem may set this DTC.

DTC P0560 (Symptom Code 2) (Flash Code 35)
Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics
Connector End View Reference: Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine and let idle for 30 seconds. 2. Load the electrical system by turning ON the headlights, A/C, etc. 3. Observe the System Voltage parameter with the scan tool. Is the System Voltage parameter more than the specified value?	10 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Step 6
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and corrosion on the battery voltage feed at the harness connector of the ECM (pin 3 of C-56 connector). 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—

Step	Action	Value(s)	Yes	No
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Load the electrical system by turning ON the headlights, A/C, etc. 6. Observe the System Voltage parameter with the scan tool. Is the System Voltage parameter more than the specified value?	10 volts	Go to Step 9	Go to Step 4
9	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0560 (Symptom Code A) (Flash Code 35)

Circuit Description

The fuel injection pump control unit (PCU) monitors the system voltage on the engine control module (ECM) main relay load supply voltage terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively high or low system voltage, this DTC will set.

Condition for Setting the DTC

- The PCU battery voltage feed circuit voltage is less than 4.5 volts or more than 27 volts.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A charging system problem may set this DTC.
- Jump starting the vehicle or a battery charger may have set this DTC.

Notice:

- PCU is part of the fuel injection pump assembly.

DTC P0560 (Symptom Code A) (Flash Code 35)

Schematic Reference: Engine Controls Schematics & Starting and Charging Schematics

Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0560 (Symptom Code 1 or 2) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Start the engine and let idle for 30 seconds. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on the voltage feed or ground at the harness connector of the PCU (pins 6 and 7 of E-6 connector). 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 6	
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle for 30 seconds. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0561 (Symptom Code A) (Flash Code 18)

Circuit Description

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ignition voltage switch signal is changed to OFF during the ECM is energized, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the ignition voltage circuit is changed ON to OFF during initialization.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the ECM if the ignition voltage circuit is OFF even 1 second passes from the judgement.
- The ECM limits fuel injection quantity if the ignition voltage circuit is returned ON within 1 second from the judgement.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty or sticking ECM main relay may set this DTC.

Notice:

- Quick repetition ON and OFF of ignition switch may set this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.

2. If DTC P1625 (Symptom Code A) is present, scan tool can communicate with the ECM when the ignition switch is OFF.

DTC P0561 (Symptom Code A) (Flash Code 18)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P1625 (Symptom Code B) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the battery voltage feed harness connector (C-108) from the junction block (behind the cabin fuse block). 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the battery voltage feed (pin 2 of C-108 connector). 4. Disconnect the ignition switch harness connectors (B-62 and B-63) from the junction block (behind the cabin fuse block). 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ignition switch (pin 3 of B-62 connector and pin 3 of B-63 connector). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the ignition voltage feed harness connector (C-107) from the junction block (behind the cabin fuse block). 3. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ignition voltage feed (pin 9 of C-107 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion on ignition voltage feed circuit at the harness connector of the ECM (pin 39 of C-56 connector). 6. Test for high resistance on ignition voltage feed circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the ignition switch. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the DTC Information with the scan tool. 6. Turn OFF the ignition. Does the DTC fail this ignition before the ECM turns OFF?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0561 (Symptom Code B) (Flash Code 18)

Circuit Description

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ignition voltage switch signal is changed to OFF during the ECM is energized, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal ignition voltage feed circuit is failed after initialization.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM turns OFF the ECM.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0561 (Symptom Code B) (Flash Code 18)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0602

Description

The engine control module (ECM) has the ability to set a diagnostic trouble code (DTC) if it detects that there is no vehicle identification (VIN) programmed.

Diagnostic Aids

Notice:

- Production and service ECM does not require software programming when it is replaced except calibration software update. This DTC indicates that a production or service ECM does not program VIN.

DTC P0602

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
3	**Important:** Blank engine control module (ECM) must be programmed. Program the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 5	Go to Step 7
5	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0606 (Symptom Code A, B) (Flash Code 28)

Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Running the DTC

Symptom Code B

- The accelerator pedal position is less than 1%.
- The desired fuel injection quantity is 0 mg/strk.

Condition for Setting the DTC

Symptom Code A

- The ECM detects that the internal CPU does not react.

Symptom Code B

- The ECM detects that the engine speed is higher than 2000 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

DTC P0606 (Symptom Code A, B) (Flash Code 28)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

BLOWER MOTOR DOES NOT RUN IN CERTAIN POSITION

Blower motor does not run at Ⓐ1: (Low) Ⓑ2: (Medium Low) Ⓒ3: (Medium Hi) Ⓓ4: (High) Position

* Checking is performed only when in the malfunction mode.

- Is resistor OK?

NO → Replace

YES:

- Is fan control knob (Fan switch) OK?

NO → Replace control lever assembly

YES:

Ⓐ Condition:

- Open circuit between chassis side connector terminal No. C104-2 and No. B13-3

Ⓑ Condition :

- Open circuit between chassis side connector terminal No. C104-4 and No. B13-6

Ⓒ Condition:

- Open circuit between chassis side connector terminal No. C104-1 and No. B13-5

Ⓓ Condition:

- Open circuit between chassis side connector terminal No. C105-2 and No. B13-4

DTC P0645 (Symptom Code 4) (Flash Code 46)

Circuit Description

The engine control module (ECM) controls the air conditioning (A/C) compressor relay, which supplies power to the A/C compressor clutch based on A/C request input to the ECM from the heating, ventilation and air conditioning (HVAC) controls. The ECM commands the A/C compressor relay ON at engine run. If the ECM detects an open circuit or short to ground on the A/C compressor relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The A/C compressor relay is once commanded ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The A/C compressor relay is commanded OFF when the engine coolant temperature is reached around 105°C (221°F) and it commanded ON again below 100°C (212°F).

DTC P0645 (Symptom Code 4) (Flash Code 46)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Turn OFF the A/C compressor switch. 6. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the A/C compressor relay with the tail relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Turn OFF the A/C compressor switch. 6. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 14
4	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 5	Go to Step 6
5	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Remove the A/C compressor relay. 3. Connect a test lamp between the voltage feed circuit of the A/C compressor relay coil side (pin 3 of X-14 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 9
7	1. Turn OFF the ignition. 2. Connect a test lamp between the A/C compressor relay control circuit (pin 5 of X-14 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 8
8	1. Keep the test lamp with connected. 2. Start the engine. 3. Turn ON the blower motor switch and the A/C compressor switch. Does the test lamp illuminate when the A/C Compressor Relay parameter is ON?	—	Go to Step 12	Go to Step 11
9	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse (EB-4) and the A/C compressor relay (pin 3 of X-14 connector). Did you complete the repair?	—	Go to Step 16	—
10	1. Test the control circuit of the A/C compressor relay between the ECM (pin 41 of C-56 connector) and the A/C compressor relay (pin 5 of X-14 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
11	1. Test the control circuit of the A/C compressor relay between the engine control module (ECM) (pin 41 of C-56 connector) and A/C compressor relay (pin 5 of X-14 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
12	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the A/C compressor relay terminal (pins 3 and 5 of X-14 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the A/C compressor relay control circuit at the harness connector of the ECM (pin 41 of C-56 connector). 4. Repair the connection (s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the A/C compressor relay. Did you complete the replacement?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
15	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Turn ON the blower motor switch and the A/C compressor switch. 6. Turn OFF the A/C compressor switch. 7. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 17
17	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0645 (Symptom Code 8) (Flash Code 46)

Circuit Description

The engine control module (ECM) controls the air conditioning (A/C) compressor relay, which supplies power to the A/C compressor clutch based on A/C request input to the ECM from the heating, ventilation and air conditioning (HVAC) controls. The ECM commands the A/C compressor relay ON at engine run. If the ECM detects a short to battery or ignition voltage on the A/C compressor relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The A/C compressor relay is once commanded ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the A/C compressor relay control circuit for longer than 3 seconds when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The A/C compressor relay is commanded OFF when the engine coolant temperature is reached around 105°C (221°F) and it commanded ON again below 100°C (212°F).

DTC P0645 (Symptom Code 8) (Flash Code 46)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool when the A/C Relay Command parameter is ON. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the A/C compressor relay with the tail relay or replace with a known good relay. 3. Start the engine. 4. Turn ON the blower motor switch and the A/C compressor switch. 5. Monitor the DTC Information with the scan tool when the A/C Relay Command parameter is ON. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	1. Test the control circuit of the A/C compressor relay between the ECM (pin 41 of C-56 connector) and the A/C compressor relay (pin 5 of X-14 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the A/C compressor relay. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Turn ON the blower motor switch and the A/C compressor switch. 6. Monitor the DTC Information with the scan tool when the A/C Relay Command parameter is ON. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0703 (Symptom Code A, B) (Flash Code 25)

Circuit Description

The brake pedal switch is installed on the brake pedal bracket. The brake pedal 1 switch is a normally open type switch and the brake pedal 2 switch is a normally closed type switch. When the brake pedal is pressed, the brake pedal 1 switch signal is provided to the engine control module (ECM) and the stoplights are turned ON. Then, the brake pedal 2 switch signal to the ECM is stopped (low voltage). If the ECM detects the brake switch signals out of correlation, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 665 RPM.
- The vehicle speed is higher than 0 km/h (0 MPH).

Condition for Setting the DTC

- The ECM detects that the brake pedal 1 switch (normally open type switch) signal and brake pedal 2 switch (normally closed type switch) signal correlation error for longer than 30 seconds within the enabling conditions ever since ignition switch is ON. (Symptom Code A)
- The ECM detects that the brake pedal 1 switch (normally open type switch) signal and brake pedal 2 switch (normally closed type switch) signal correlation error for longer than 30 seconds. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted brake pedal switch will cause this DTC to set.

DTC P0703 (Symptom Code A, B) (Flash Code 25)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Brake Pedal 1 Switch parameter with the scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 10	Go to Step 3
3	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect the Stop (15A) fuse (C-15) in the cabin fuse block. Is the Stop (15A) fuse (C-15) open?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the Stop (15A) fuse (C-15). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Stop (15A) fuse (C-15) or replace the shorted attached component fed by the Stop (15A) fuse (C-15). Did you complete the repair?	—	Go to Step 22	—
6	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Connect a test lamp between the voltage feed circuit of the brake pedal 1 switch harness (pin 1 of C-44 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 8
7	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 1 Switch parameter with the scan tool while momentarily jumping 3-amp fused jumper wire across the brake pedal 1 switch harness connector between pins 1 and 2 of the C-44 connector. Does the scan tool indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 18	Go to Step 9
8	Repair the open circuit or high resistance on the voltage feed circuit between the Stop (15A) fuse (C-15) and the brake pedal 1 switch (pin 1 of C-44 connector). Did you complete the repair?	—	Go to Step 22	—
9	1. Test the brake pedal 1 switch signal circuit between the ECM (pin 30 of C-56 connector) and the brake pedal 1 switch (pin 2 of C-44 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 19
10	Observe the Brake Pedal 2 Switch parameter with the scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Diagnostic Aids	Go to Step 11
11	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 12
12	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 13	Go to Step 14

Step	Action	Value(s)	Yes	No
13	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 22	—
14	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the voltage feed circuit of the brake pedal 2 switch harness (pin 3 of C-44 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 16
15	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 2 Switch parameter with the scan tool while momentarily jumping 3-amp fused jumper wire across the brake pedal 2 switch harness connector between pins 3 and 4 of the C-44 connector. Does the scan tool indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 18	Go to Step 17
16	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse (EB-4) and the brake pedal 2 switch (pin 3 of C-44 connector). Did you complete the repair?	—	Go to Step 22	—
17	1. Test the brake pedal 2 switch signal circuit between the ECM (pin 65 of C-56 connector) and the brake pedal 2 switch (pin 4 of C-44 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 19
18	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the brake pedal switch (pins 1, 2, 3 and 4 of C-44 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 20
19	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the brake switch circuits at the harness connector of the ECM (pins 30 and 65 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 22	Go to Step 21
20	Replace brake pedal switch. Refer to Brake Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—

Step	Action	Value(s)	Yes	No
21	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 22	—
22	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Brake Pedal 1 Switch and the Brake Pedal 2 Switch with the scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 23	Go to Step 2
23	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P0704 (Symptom Code 6) (Flash Code 57)

Circuit Description

The clutch pedal switch is installed on the clutch pedal bracket. The clutch pedal switch is a normally closed type switch. When the clutch pedal is pressed, the clutch pedal switch signal to the engine control module (ECM) is stopped (low voltage). If the ECM detects the clutch pedal switch signal is not change during a predetermined vehicle speed range, this DTC will set. This DTC will only run once per ignition cycle within the enabling condition.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the clutch pedal switch signal does not change during the vehicle speed changes between 1.5 km/h (1 MPH) and 80 km/h (50 MPH). This DTC will only run once per ignition cycle within the enabling condition.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted clutch pedal switch will cause this DTC to set.

DTC P0704 (Symptom Code 6) (Flash Code 57)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Clutch Pedal Switch parameter with the scan tool while fully depressing and releasing the clutch pedal. Does the scan tool indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Check to ensure the clutch pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the clutch pedal full upward travel. 2. Adjust the clutch pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 5	Go to Step 6
5	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 16	—

BLOWER MOTOR DOES NOT STOP AT “OFF” POSITION

- Is fan control knob (Fan switch) OK?

YES

Check the circuit between chassis side connector terminals for short to GND

- No. C105-2 and No. C104-3
  (or)
- No. C105-2 and No. B13-4
  (or)
- No. C104-1 and No. B13-5
  (or)
- No. C104-4 and No. B13-6
  (or)
- No. C104-2 and No. B13-3

NO

Replace control lever assembly

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the clutch pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Clutch Pedal Switch parameter with the scan tool while momentarily jumping across the clutch pedal switch harness connector between pins 1 and 2 of C-77 connector. Does the scan tool indicate Applied when the circuit is jumped and Released when the circuit is not jumped?	—	Go to Step 12	Go to Step 7
7	1. Connect a test lamp between the ignition voltage feed circuit of the clutch pedal switch harness (pin 1 of C-77 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
8	1. Connect a test lamp between the signal circuit of the clutch pedal switch harness (pin 2 of C-77 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 11
9	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM (10A) fuse (EB-4) and the clutch pedal switch (pin 1 of C-77 connector). Did you complete the repair?	—	Go to Step 16	—
10	1. Test the clutch pedal switch signal circuit between the engine control module (ECM) (pin 31 of C-56 connector) and the clutch pedal switch (pin 2 of C-77 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
11	1. Test the clutch pedal switch signal circuit between the ECM (pin 31 of C-56 connector) and the clutch pedal switch (pin 2 of C-77 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
12	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the clutch pedal switch (pins 1 and 2 of C-77 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the clutch pedal switch circuit at the harness connector of the ECM (pin 31 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15

Step	Action	Value(s)	Yes	No
14	Replace the clutch pedal switch. Refer to Clutch Pedal Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Clutch Pedal Switch parameter with the scan tool while fully depressing and releasing the clutch pedal. Does the scan tool indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Go to Step 17	Go to Step 3
17	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1105 (Symptom Code 1) (Flash Code 86)

Circuit Description

The barometric pressure (BARO) sensor is installed inside of the engine control module (ECM) and converts the BARO into a voltage signal. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively high BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is more than 4.4 volts for 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 1013 hPa.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

DTC P1105 (Symptom Code 1) (Flash Code 86)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1105 (Symptom Code 2) (Flash Code 86)

Circuit Description

The barometric pressure (BARO) sensor is installed inside of the engine control module (ECM) and converts the BARO into a voltage signal. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively low BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 1.5 volts for 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 1013 hPa.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

DTC P1105 (Symptom Code 2) (Flash Code 86)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1120 (Symptom Code 1) (Flash Code 21)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the intake throttle assembly. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor signal for voltages outside the normal range of the APP sensor. If the ECM detects an excessively high APP sensor signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor signal voltage is more than 4.5 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code 1) (Flash Code 21)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Accelerator Pedal Position (APP) parameter with the scan tool. Does the APP parameter less than the specified value?	1%	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the APP sensor harness (pin 1 of E-22 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 8
5	1. Turn OFF the ignition. 2. Connect a DMM between the 5 volts reference circuit of the APP sensor harness (pin 3 of E-22 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 6	Go to Step 9

Step	Action	Value(s)	Yes	No
6	Is the DMM voltage less than the specified value at step 5?	5.5 volts	Go to Step 7	Go to Step 10
7	**Important:** The APP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 38 of C-56 connector) and the APP sensor (pin 2 of E-22 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
8	. Test the low reference circuit between the 1ECM (pin 49 of C-56 connector) and the APP sensor (pin 1 of E-22 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the 5 volts reference circuit between the ECM (pin 57 of C-56 connector) and the APP sensor (pin 3 of E-22 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the 5 volts reference circuit between the ECM (pin 57 of C-56 connector) and the APP sensor (pin 3 of E-22 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 1 of E-22 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the APP sensor circuit at the harness connector of the ECM (pin 49 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1120 (Symptom Code 7) (Flash Code 21)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the intake throttle assembly. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM provides 5 volts reference voltage through the reference circuit to the APP sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high APP sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor voltage supply circuit is more than 5.2 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code 7) (Flash Code 21)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Test the 5 volts reference circuit between 1the engine control module (ECM) (pin 57 of C-56 connector) and the accelerator pedal position (APP) sensor (pin 3 of E-22 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1120 (Symptom Code 9) (Flash Code 21)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the intake throttle assembly. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM provides 5 volts reference voltage through the reference circuit to the APP sensor. The ECM monitors the voltage on the 5 volts reference circuit. If the ECM detects an excessively high APP sensor 5 volts reference voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor voltage supply circuit is less than 4.6 volts for 0.5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the APP sensor 5 volts reference circuit between the ECM and the sensor is normal, the sensor signal correlation DTC P1120 (Symptom Code E) will set.

DTC P1120 (Symptom Code 9) (Flash Code 21)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Depress and release the accelerator pedal many times. 5. Monitor the DTC Information with the scan tool. Does DTC P1120 (Symptom Code E) set, but not DTC P1120 (Symptom Code 9)?	—	Go to Step 5	Go to Step 4
4	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 57 of C-56 connector) and the APP sensor (pin 3 of E-22 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

AIR CONDITIONING CYCLE TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	CORRECTION
No cooling or insufficient cooling	1. Magnetic clutch does not run	• Refer to "MAGNETIC CLUTCH" troubleshooting in this section
	2. Compressor is not rotating properly • Drive belt loosened or broken	• Adjust the drive belt to the specified tension or replace the drive belt
	• Magnetic clutch face is not clean and slips	• Clean the magnetic clutch face or replace
	• Incorrect clearance between magnetic drive plate and pulley	• Adjust the clearance (Refer to "COMPRESSOR OVERHAUL")
	• Compressor oil leaks from shaft seal or shell	• Replace the compressor
	• Compressor seized	• Replace the compressor
	3. Insufficient or excessive charge of refrigerant	• Discharge and recover refrigerant. Recharge to specified amount.
	4. Leaks in the refrigerant system	• Check refrigerant system for leaks and repair as necessary Discharge and recover refrigerant. Recharge to specified amount.
	5. Condenser clogged or insufficient radiation	• Clean the condenser or replace as necessary • Check radiator or condenser fan function
	6. Temperature control link unit of the heater unit defective	• Repair the link unit
	7. Unsteady operation due to foreign substance in expansion valve	• Replace the expansion valve
	8. Poor operation of electronic thermostat	• Check electronic thermostat and replace as necessary
Insufficient velocity of cooling air	1. Evaporator clogged or frosted	• Check evaporator core and replace or clean the core
	2. Air leaking from cooling unit or air duct	• Check evaporator and duct connection, then repair as necessary
	3. Blower motor does not rotate properly	• Refer to "FAN CONTROL KNOB (FAN SWITCH)" troubleshooting in this section

* For the execution of the charging and discharging operation in the table above, refer to the "RECOVERY, RECYCLING, EVACUATING AND CHARGING" in this section.

Step	Action	Value(s)	Yes	No
5	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Fully depress and release the accelerator pedal many times. 6. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1120 (Symptom Code D) (Flash Code 21)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the intake throttle assembly. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle.

The brake pedal switch is installed on the brake pedal bracket. The brake pedal 1 switch is a normally open type switch and the brake pedal 2 switch is a normally closed type switch. When the brake pedal is pressed, the brake pedal 1 switch signal is provided to the ECM and the stoplights are turned ON. Then, the brake pedal 2 switch signal to the ECM is stopped (low voltage).

If the ECM detects accelerator pedal or APP sensor signal is stuck while brake pedal is depressed, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 1700 RPM.
- The vehicle speed is higher than 1.5 km/h (1 MPH).

Condition for Setting the DTC

- The ECM detects APP sensor angle is stationary more than 8.7%, then brake pedal is depressed for longer than 2 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted brake pedal switch may set this DTC.
- Misadjusted APP sensor may set this DTC.
- Misadjusted throttle cable may set this DTC.
- A sticking or intermittently sticking the intake throttle valve, control cable or pedal may set this DTC.

DTC P1120 (Symptom Code D) (Flash Code 21)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Was DTC P0703 (Symptom Code A or B) or P1120 (Symptom Code 1, 7, 9 or E) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Pedal 1 Switch parameter with the scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 9	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Check to ensure the brake pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the brake pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Brake Pedal 1 Switch parameter with the scan tool while momentarily jumping 3-amp fused jumper wire across the brake pedal 1 switch harness connector between pins 1 and 2 of the C-44 connector. Does the scan tool indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 8	Go to Step 6
6	1. Test the brake pedal 1 switch signal circuit between the ECM (pin 30 of C-56 connector) and the brake pedal 1 switch (pin 2 of C-44 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the brake switch circuit at the harness connector of the ECM (pin 30 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Replace the brake pedal switch. Refer to Brake Pedal Switch Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
9	1. Turn ON the ignition, with the engine OFF. 2. Fully depress and release the accelerator pedal many times while observing the Accelerator Pedal Position (APP) parameter with the scan tool. Is the APP parameter smoothly changed within 0 to 100 % when the accelerator pedal is depressed and released?	—	Go to Diagnostic Aids	Go to Step 10
10	1. Turn OFF the ignition. 2. Inspect for the following conditions: • APP sensor is misadjusted. • An accelerator pedal that is stuck depressed. • An intake throttle valve control cable that is damaged, stuck or no free play. • An intake throttle valve that is stuck open. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11

Step	Action	Value(s)	Yes	No
11	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the APP parameter while fully depressing and releasing the accelerator pedal many times. Also observe the Brake Pedal 1 Switch parameter with the scan tool while depressing and releasing the brake pedal. Does the scan tool indicate the APP parameter smoothly changed within 0 to 100 % when the accelerator pedal is depressed and released, then scan tool indicate the Brake Pedal 1 Switch parameter Applied when the brake pedal is depressed and Released when the brake pedal is released?	—	Go to Step 14	Go to Step 2
14	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1120 (Symptom Code E) (Flash Code 21)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the intake throttle assembly. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control. The APP sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor signal circuit

The ECM supplies 5 volts to the APP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor provides a signal to the ECM on the APP sensor signal circuit, which is relative to the position changes of the accelerator pedal angle.
The idle switch is also mounted on the intake throttle assembly. The idle switch is part of the APP sensor assembly. The idle switch is a normally closed type switch. When the accelerator pedal is released, the idle switch signal to the ECM is low voltage.
If the ECM detects the APP sensor signal and the idle switch out of correlation, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met.

- The ECM detects APP sensor angle is less than 0.35%, then the idle switch is OFF for longer than 0.6 seconds.
- The ECM detects APP sensor angle is more than 8.7%, then the idle switch is ON for longer than 0.6 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an engine speed substitution of 1400 RPM.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1120 (Symptom Code E) (Flash Code 21)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Turn ON the ignition, with the engine OFF. 2. Observe the Idle Switch parameter with the scan tool while depressing and releasing the accelerator pedal. Does the scan tool indicate OFF when the accelerator pedal is depressed and ON when the accelerator pedal is released?	—	Go to Step 10	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the idle switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Idle Switch parameter with the scan tool while momentarily jumping 3-amp fused jumper wire across the idle switch harness connector between pins 1 and 2 of the E-23 connector. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 9	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn ON the ignition, with the engine OFF. 2. Connect a DMM between the signal circuit of the idle switch harness (pin 2 of E-23 connector) and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	Is the DMM voltage less than the specified value at step 4?	5.5 volts	Go to Step 8	Go to Step 7
6	1. Test the switch signal circuit between the engine control module (ECM) (pin 69 of C-56 connector) and the idle switch (pin 2 of E-23 connector) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 18
7	**Important:** The idle switch may be damaged if the switch signal circuit is shorted to a voltage source. 1. Test the switch signal circuit between the ECM (pin 69 of C-56 connector) and the idle switch (pin 2 of E-23 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 20
8	Repair the open circuit or high resistance on the idle switch ground circuit between the idle switch (pin 1 of E-23 connector) and engine ground. Did you complete the repair?	—	Go to Step 21	—
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the idle switch (pins 1 and 2 of E-23 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 19
10	1. Turn ON the ignition, with the engine OFF. 2. Fully depress and release the accelerator pedal many times while observing the Accelerator Pedal Position (APP) parameter with the scan tool. Is the APP parameter smoothly changed within 0 to 100 % when the accelerator pedal is depressed and released?	—	Go to Diagnostic Aids	Go to Step 11
11	1. Turn OFF the ignition. 2. Reconnect the idle switch harness connector if disconnected. 3. Disconnect the APP sensor harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the 5 volts reference circuit of the APP sensor harness (pin 3 of E-22 connector) and a known good ground. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 12	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire across the APP sensor connector between pins 2 and 3 of the E-22 connector. 3. Turn ON the ignition, with the engine OFF. Does DTC P1120 (Symptom Code 1) set, but not P1120 (Symptom Code E)?	—	Go to Step 15	Go to Step 14
13	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 57 of C-56 connector) and the APP sensor (pin 3 of E-22 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 18
14	1. Test the signal circuit between the ECM (pin 38 of C-56 connector) and the APP sensor (pin 2 of E-22 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 18
15	1. Test the signal circuit between the ECM (pin 38 of C-56 connector) and the APP sensor (pin 2 of E-22 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 16
16	1. Test the low reference circuit between the ECM (pin 49 of C-56 connector) and the APP sensor (pin 1 of E-22 connector) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 17
17	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections or corrosion at the harness connector of the APP sensor (pin 1, 2 and 3 of E-22 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 19
18	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the APP sensor circuits at the harness connector of the ECM (pins 38, 49 and 57 of C-56 connector) or the idle switch circuit at the harness connector of the ECM (pin 69 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 20
19	Replace the accelerator pedal position sensor. Refer to Accelerator Pedal Position Sensor Replacement in this section. (Idle switch is part of APP sensor) Did you complete the replacement?	—	Go to Step 21	—
20	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 21	—

Step	Action	Value(s)	Yes	No
21	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Idle Switch and APP parameter while fully depressing and releasing the accelerator pedal many times. Does the scan tool indicate the APP parameter smoothly changed within 0 to 100 % when the accelerator pedal is depressed and released, then scan tool indicate the Idle Switch parameter OFF when the accelerator pedal is depressed and ON when the accelerator pedal is released?	—	Go to Step 22	Go to Step 2
22	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1173 (Symptom Code 3) (Flash Code 22)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessive high coolant temperature, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessive high coolant temperature for longer than 30 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

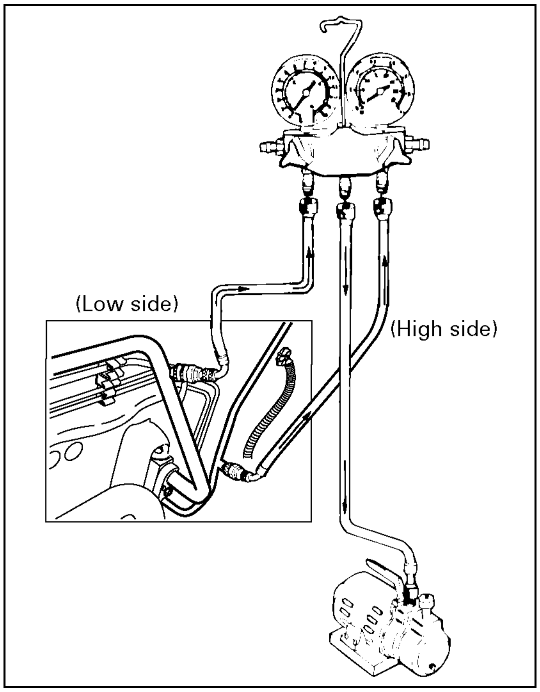
Notice:

- This DTC is caused by an engine overheat condition (i.e. low engine coolant level). Since this DTC does not illuminate any lamps, clear the DTC and ensure there are no signs of engine damage. Excessive engine overheat may damage internal engine components.

DTC P1173 (Symptom Code 3) (Flash Code 22)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and wait until engine is fully warms upped. 4. Observe the Engine Coolant Temperature (ECT) parameter with the scan tool. Is the ECT parameter more than the specified value?	100°C (212°F)	Go to Step 4	Go to Step 3
3	Ask the driver if overheat is caused by low engine coolant level, etc. If engine overheat has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 6	—
4	1. Test the ECT sensor at various temperature levels to evaluate the possibility if a skewed sensor. 2. Replace the ECT sensor as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the engine cooling system for the following condition. Refer to diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage • Cooling fan belt slippage • Cooling fan clutch working • Thermostat working • Water pump working • Radiator clogging 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and wait until engine is fully warms upped. 5. Observe the ECT parameter with the scan tool. Is the ECT parameter more than the specified value?	100°C (212°F)	Go to Step 4	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK



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CHECKING REFRIGERANT SYSTEM WITH MANIFOLD GAUGE

Conditions;

- Ambient temperature at approx. 30~35°C (86~95°F)
- Run the engine at Idling
- A/C switch is “ON”
- Run the blower motor at “4” (high) position
- Temperature control knob sets at “MAX COLD”
- Air source selector lever at “CIRC”
- Close the all doors

Normal pressures kPa (kg/cm^2/psi);

Low-pressure side:

Approx. 127 – 245 (1.3 – 2.5 / 18 – 36)

High-pressure side:

Approx. 1373 – 1670 (14 – 17 / 199 – 242)

Connect the manifold gauge

Low-pressure hose (LOW) ~ Suction side

High-pressure hose (HI) ~ Discharge side

DTC P1173 (Symptom Code 7, A) (Flash Code 22)

Circuit Description

The fuel temperature (FT) sensor is internal to the fuel injection pump control unit (PCU). It detects fuel temperature in the fuel injection pump. If the PCU detects an excessively high or low fuel temperature, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessive high FT for longer than 30 seconds. (Symptom Code 7)
- The ECM detects an excessive low FT for longer than 30 seconds. (Symptom Code A)

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The PCU limits fuel injection quantity. (Symptom Code 7)

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.

DTC P1173 (Symptom Code 7, A) (Flash Code 22)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (Fuel temperature [FT] sensor is internal to the fuel injection pump control unit [PCU] and it is part of the fuel injection pump assembly.) Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1335 (Symptom Code A) (Flash Code 43)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other. If the fuel injection pump control unit (PCU) receives faulty CKP sensor signal pulses, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The PCU detects CKP sensor signal from the ECM is faulty.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- PCU is part of the fuel injection pump assembly.

DTC P1335 (Symptom Code A) (Flash Code 43)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0335 (Symptom Code B or D) set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) C-57 harness connector. Keep the C-56 harness connector with connected. 3. Connect a DMM between the crankshaft position (CKP) sensor signal output circuit (pin 91 of C-57 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage more than the specified value?	10 volts	Go to Step 5	Go to Step 4
4	1. Test the CKP sensor signal output circuit between the ECM (pin 91 of C-57 connector) and the fuel injection pump (pin 8 of E-6 connector) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the CKP sensor signal output circuit between the ECM (pin 91 of C-57 connector) and the fuel injection pump control unit (PCU) (pin 8 of E-6 connector) for a short to battery or ignition voltage. **Notice:** Perform this by connecting a test lamp between the ECM harness connector (pin 91 of C-57 connector) and a known good ground. If the test lamp illuminate, circuit is short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
6	1. Turn OFF the ignition. 2. Disconnect the PCU harness connector. 3. Inspect for an intermittent and for a poor connection on the CKP sensor signal circuit at the harness connector of the PCU (pin 8 of E-6 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the CKP sensor signal output circuit at the harness connector of the ECM (pin 92 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 10	
9	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1345 (Symptom Code A) (Flash Code 41)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU. The PCU also compares the engine speed signal sent from the ECM and the fuel injection pump speed. If the PCU received faulty fuel injection pump CMP sensor signal, this DTC will set.

Condition for Setting the DTC

- The PCU received faulty fuel injection pump CMP sensor signal for 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection pump CMP sensor is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P1345 (Symptom Code A) (Flash Code 41)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1520 (Symptom Code A) (Flash Code 47)

Circuit Description

(Manual Transmission)

The neutral switch is installed on the transmission gear control box. When the gear position is neutral, the switch is closed and the switch signal is provided to the engine control module (ECM). If the ECM detects the neutral switch signal is not changed from neutral during the predetermined engine speed and vehicle speed range, this DTC will set.

(Automatic Transmission)

The inhibitor switch is installed to the transmission case. When the selector position is P or N range, the switch is closed and the switch signal is provided to the Emir the ECM detects the neutral switch signal is not changed from P or N during the predetermined engine speed and vehicle speed range, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 1500 RPM.
- The vehicle speed is higher than 63 km/h (39 MPH) (M/T) or 78 km/h (49 MPH) (A/T).
- The clutch pedal is released. (M/T).

Condition for Setting the DTC

- The ECM detects that the neutral switch signal is continuously ON (neutral or P/N range) during three consecutive driving cycles.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

Important:

- Following conditions must be met two consecutive driving cycles. (One driving cycle: Ignition switch ON > Engine run > Vehicle run > Ignition switch OFF for 10 seconds)
  - The engine speed is higher than 1500 RPM
  - The vehicle speed is higher than 63 km/h (39 MPH) (M/T) or 78 km/h (49 MPH) (A/T)
  - The clutch pedal is released (M/T)
  - Other than neutral or P/N range
  - After the above procedure is done, a history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1520 (Symptom Code A) (Flash Code 47)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart for M/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Neutral Switch parameter with the scan tool while shift to neutral and other positions. Does the scan tool indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the neutral switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the scan tool. Does the scan tool indicate ON?	—	Go to Step 4	Go to Step 5
4	1. Test the neutral switch input signal circuit between the engine control module (ECM) (pin 87 of C-57 connector) and the neutral switch (pin 1 of E-11 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the neutral switch. Refer to Neutral Switch Replacement in Transmission Section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. **Important:** Following conditions must be met two consecutive driving cycles before clear with the scan tool. (One driving cycle: Ignition switch ON > Engine run > Vehicle run > Ignition switch OFF for 10 seconds) • The engine speed is higher than 1500 RPM • The vehicle speed is higher than 63 km/h (39 MPH) • The clutch pedal is released • Other than neutral 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the scan tool while shift to neutral and other positions. Does the scan tool indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for A/T

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “JR405E Automatic Transmission” in the system selection menu. 5. Monitor the Read Diagnostic Trouble Code (DTC) Info As Stored By ECU with the scan tool. Does the transmission control module (TCM) DTC P0705 set?	—	Go to Applicable DTC in Automatic Transmission Section	Go to Step 3
3	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Neutral Switch parameter with the scan tool while shift to P or N and other positions. Does the scan tool indicate ON when the position is P or N and OFF when other than the P or N?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Check to ensure the inhibitor switch is adjusted correctly. 2. Adjust the inhibitor switch as necessary. Refer to Inhibitor Switch Adjustment in Automatic Transmission Section. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Test the P & N position switch signal circuit between the engine control module (ECM) (pin 87 of C-57 connector) and the diode (pin 2 of X-16 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. **Important:** Following conditions must be met two consecutive driving cycles before clear with the scan tool. (One driving cycle: Ignition switch ON > Engine run > Vehicle run > Ignition switch OFF for 10 seconds) • The engine speed is higher than 1500 RPM • The vehicle speed is higher than 78 km/h (49 MPH) • Other than P/N range 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the scan tool while shift to P or N and other positions. Does the scan tool indicate ON when the position is P or N and OFF when other than the P or N?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1520 (Symptom Code B) (Flash Code 47)

Circuit Description

The neutral switch is installed on the transmission gear control box. When the gear position is neutral, the switch is closed and the switch signal is provided to the engine control module (ECM). If the ECM detects the neutral switch signal is not changed from other than neutral during the predetermined engine speed and vehicle speed range, this DTC will set. This DTC runs only manual transmission.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is higher than 665 RPM
- The vehicle speed is lower than 2 km/h (1.2 MPH).
- The clutch pedal is released after once depressed.

Condition for Setting the DTC

- The ECM detects that the neutral switch signal is continuously OFF (other than neutral) during three consecutive driving cycles.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL/DTC

Important:

- Following conditions must be met two consecutive driving cycles. (One driving cycle: Ignition switch ON > Engine run > Ignition switch OFF for 10 seconds)
  - The engine speed is higher than 665 RPM
  - The vehicle speed is lower than 2 km/h (1.2 MPH)
  - The clutch pedal is released after once depressed
  - Neutral position
  - After the above procedure is done, a history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1520 (Symptom Code B) (Flash Code 47)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Neutral Switch parameter with the scan tool while shift to neutral and other positions. Does the scan tool indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the ECM (10A) fuse (EB-4) in the engine room fuse block. Is the ECM (10A) fuse (EB-4) open?	—	Go to Step 4	Go to Step 5
4	Replace the ECM (10A) fuse (EB-4). If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the ECM (10A) fuse (EB-4) or replace the shorted attached component fed by the ECM (10A) fuse (EB-4). Did you complete the repair?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the neutral switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the scan tool while momentarily jumping across the neutral switch harness connectors between pin 1 of E-11 connector and pin 1 of E-12 connector. Does the scan tool indicate ON when the circuit is jumped and OFF when the circuit is not jumped?	—	Go to Step 9	Go to Step 6
6	1. Connect a test lamp between the ignition voltage feed circuit of the neutral switch harness (pin 1 of E-12 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 7
7	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ECM (10A) fuse (EB-4) and the neutral switch (pin 1 of E-12 connector). Did you complete the repair?	—	Go to Step 13	—
8	1. Test the neutral switch signal circuit between the engine control module (ECM) (pin 87 of C-57 connector) and the neutral switch (pin 1 of E-11 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connectors of the neutral switch (pin 1 of E-11 connector and pin 1 of E-12 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the neutral switch circuit at the harness connector of the ECM (pin 87 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the neutral switch. Refer to Neutral Switch Replacement in Transmission Section. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. **Important:** Following conditions must be met two consecutive driving cycles before clear with the scan tool. (One driving cycle: Ignition switch ON > Engine run > Ignition switch OFF for 10 seconds) • The engine speed is higher than 665 RPM • The vehicle speed is lower than 2 km/h (1.2 MPH) • The clutch pedal is released after once depressed • Neutral position 3. Turn ON the ignition, with the engine OFF. 4. Observe the Neutral Switch parameter with the scan tool while shift to neutral and other positions. Does the scan tool indicate ON when the position is neutral and OFF when other than the neutral?	—	Go to Step 14	Go to Step 3
14	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

RESULT	SYMPTOM	TROUBLE CAUSE	CORRECTION
Discharge (High) pressure gauge abnormally high	Reduced or no air flow through the condenser	• Condenser clogged or dirty • Radiator (condenser) fan does not operate properly	• Clean • Check cooling fan operation
	No bubbles in sight glass when condenser is cooled by water (Insufficient cooling)	• Excessive refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Discharge and recover refrigerant. Recharge to specified amount
	After stopping air conditioning, pressure drops approx. 196 kPa (2.0kg/cm^2 / 28psi) quickly	• Air in system	• Evacuate and charge refrigerant system
Discharge (High) pressure gauge abnormally low	Insufficient cooling and excessive bubbles in the sight glass	• Insufficient refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount
	Low pressure gauge indicates vacuum	• Clogged or defective expansion valve	• Replace the expansion valve
	Frost or dew on refrigerant line before and after receiver/ drier or expansion valve, and low pressure gauge indicates vacuum	• Restriction caused by debris or moisture in receiver/drier	• Check system for restriction and replace receiver/drier
	After turning off air conditioning, high and low pressure gauge balanced quickly	• Compressor seal defective • Poor compression due to defective compressor gasket	• Replace or repair compressor
Suction (Low) pressure gauge abnormally high	Low pressure gauge is lowered after condenser is cooled by water	• Excessive refrigerant in system	• Discharge and recover refrigerant Recharge to specified amount
	Low pressure hose temperature around the compressor refrigerant line connector is lower than around evaporator	• Unsatisfactory valve operation due to defective temperature sensor of expansion valve • Expansion valve opens too long	• Replace the expansion valve
	After turning off air conditioning, high and low pressure gauge is balanced quickly	• Compressor gasket is defective	• Replace
	Air conditioning turns off before passenger compartment is sufficiently cool	• Electronic thermostat defective	• Check the electronic thermostat and replace as necessary

* For the charging and discharging operations in the table above, refer to "RECOVERY, RECYCLING, EVACUATION AND CHARGING" in this section.

DTC P1605 (Symptom Code C, D, E) (Flash Code 55)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM). The electronically erasable programmable read only memory (EEPROM) memorize some data for engine control and communication with other control module. If the ECM detects memory area malfunction inside of the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal seed or key file in EEPROM data is destroyed (Symptom Code C).
- The ECM detects reading or writing from the EEPROM data is failed during initialization (Symptom Code D).
- The ECM detects total sum of EEPROM data is not equal to registered value during initialization (Symptom Code E).

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses default EPROM data substitution of faulty EEPROM. (Symptom Code D & E).

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

DTC P1605 (Symptom Code C, D, E) (Flash Code 55)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1610 (Symptom Code A) (Flash Code 56)

Circuit Description

The electronically erasable programmable read only memory (EEPROM) memorize immobilizer security code and secret key for communication with the immobilizer control unit (ICU). If the engine control module (ECM) detects immobilizer functions are not programmed into the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects immobilizer security code and secret key is not programmed.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The desired fuel injection quantity is set 0 mg/strk.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Non programmed ECM may set this DTC.
- ECM with wrong specification may set this DTC.

DTC P1610 (Symptom Code A) (Flash Code 56)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program or reprogram immobilizer function into the engine control module (ECM). Refer to Programming Engine Control Module (ECM) in immobilizer section. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 5	—
5	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1611 (Symptom Code A) (Flash Code 56)

Circuit Description

The electronically erasable programmable read only memory (EEPROM) memorize immobilizer security code and secret key for communication with the immobilizer control unit (ICU). If the engine control module (ECM) detects wrong security code is programmed into the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects wrong immobilizer security code is programmed.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The desired fuel injection quantity is set 0 mg/strk.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Programming ECM with wrong security code may set this DTC.
- ECM with wrong specification may set this DTC.

DTC P1611 (Symptom Code A) (Flash Code 56)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “Immobilizer” in the system selection menu. 5. Monitor the Diagnostic Trouble Code (DTC) Info Ordered By Priority with the scan tool. Does the immobilizer DTCs fail this ignition which begin with B?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Program or reprogram immobilizer function into the engine control module (ECM). Refer to Programming Engine Control Module (ECM) in immobilizer section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1612 (Symptom Code A) (Flash Code 56)

Circuit Description

The engine control module (ECM) communicates with the immobilizer control unit (ICU) to execute immobilizer function. The ECM sends request signal to the ICU. The ECM receives response signal from the ICU. Both communication signals are carried out through the Keyword 2000 serial data link. If the ECM receives wrong response signal from the ICU, this DTC will set.

Condition for Setting the DTC

- The ECM receives wrong immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The desired fuel injection quantity is set 0 mg/strk.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Non programmed ECM may set this DTC.
- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Keyword 2000 serial data link circuit problem may cause this DTC set. The scan tool will not communicate. Refer to scan tool Does Not Communicate with Keyword 2000 Device in this section.
- ECM with wrong specification may set this DTC.

DTC P1612 (Symptom Code A) (Flash Code 56)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “Immobilizer” in the system selection menu. 5. Monitor the Diagnostic Trouble Code (DTC) Info Ordered By Priority with the scan tool. Does the immobilizer DTCs fail this ignition which begin with B?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Program or reprogram immobilizer function into the engine control module (ECM). Refer to Programming Engine Control Module (ECM) in immobilizer section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1613 (Symptom Code A) (Flash Code 56)

Circuit Description

The engine control module (ECM) communicates with the immobilizer control unit (ICU) to execute immobilizer function. The ECM sends request signal to the ICU. The ECM receives response signal from the ICU. Both communication signals are carried out through the Keyword 2000 serial data link. If the ECM does not detect response signal from the ICU, this DTC will set.

Condition for Setting the DTC

- The ECM does not receive the immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The desired fuel injection quantity is set 0 mg/strk.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Non programmed ECM may set this DTC.
- Transponder key problem may set this DTC.
- Antenna coil problem may set this DTC.
- Electrical or magnetic interference may affect intermittent condition.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Keyword 2000 serial data link circuit problem may cause this DTC set. The scan tool will not communicate. Refer to scan tool Does Not Communicate with Keyword 2000 Device in this section.
- ECM with wrong specification may set this DTC.

DTC P1613 (Symptom Code A) (Flash Code 56)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “Immobilizer” in the system selection menu. 5. Monitor the Diagnostic Trouble Code (DTC) Info Ordered By Priority with the scan tool. Does the immobilizer DTCs fail this ignition which begin with B?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Program or reprogram immobilizer function into the engine control module (ECM). Refer to Programming Engine Control Module (ECM) in immobilizer section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1614 (Symptom Code A) (Flash Code 56)

Circuit Description

The engine control module (ECM) communicates with the immobilizer control unit (ICU) to execute immobilizer function. The ECM sends request signal to the ICU. The ECM receives response signal from the ICU. Both communication signals are carried out through the Keyword 2000 serial data link. If ICU receives wrong immobilizer response signal from the transponder key, this DTC will set.

Condition for Setting the DTC

- The ICU receives wrong immobilizer response signal from the transponder key.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The desired fuel injection quantity is set 0 mg/strk.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- Non programmed ICU may set this DTC.
- Transponder key problem may set this DTC.
- ECM with wrong specification may set this DTC.

DTC P1614 (Symptom Code A) (Flash Code 56)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the “Immobilizer” in the system selection menu. 5. Monitor the Diagnostic Trouble Code (DTC) Info Ordered By Priority with the scan tool. Does the immobilizer DTCs fail this ignition which begin with B?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Program or reprogram immobilizer function into the immobilizer control unit (ICU). Refer to Programming Immobilizer Control Unit (ICU) in immobilizer section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ICU must be programmed. Replace the ICU. Refer to Immobilizer Control Unit (ICU) Replacement in the immobilizer section. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1625 (Symptom Code A) (Flash Code 76)

Circuit Description

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ECM main relay is turned OFF before ECM commanded OFF, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the ECM main relay is turned OFF before commanded turned OFF.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty ECM main relay may set this DTC.

DTC P1625 (Symptom Code A) (Flash Code 76)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. 5. Turn OFF the ignition. 6. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM main relay (pins 1, 2, 4 and 5 of X-12 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on ECM main relay control and battery voltage feed circuit at the harness connector of the ECM (pins 3 and 58 of C-56 connector). 6. Test for high resistance on each ECM main relay circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the DTC Information with the scan tool. 6. Turn OFF the ignition. 7. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1625 (Symptom Code B) (Flash Code 76)

Circuit Description

The engine control module (ECM) main relay is energized when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed. If the ECM detects the ECM main relay has been ON since the ignition switch was turned OFF, this DTC will set.

Condition for Running the DTC

- The ignition switch is OFF.

Condition for Setting the DTC

- The ECM detects that the ECM main relay is turned ON for longer than 2 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty or sticking ECM main relay may set this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.

2. If this DTC is present, scan tool can communicate with the ECM when the ignition switch is OFF.

DTC P1625 (Symptom Code B) (Flash Code 76)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail with the ignition switch OFF?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Disconnect the ECM main relay. 2. Monitor the DTC Information with the scan tool. Does the DTC fail with the ignition switch OFF?	—	Go to Step 6	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. 3. Connect a test lamp between the control circuit of the ECM main relay harness (pin 4 of X-12 connector) and battery voltage. 4. Keep the ignition switch OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7
5	1. Test the control circuit of the ECM main relay between the engine control module (ECM) (pin 58 of C-56 connector) and the ECM main relay (pin 4 of X-12 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
6	Repair the short to battery on the voltage feed supply circuit to the ECM between the ECM (pin 3 of C-56 connector) and the ECM main relay (pin 1 of X-12 connector). Did you complete the repair?	—	Go to Step 9	—
7	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 9	—

Step	Action	Value(s)	Yes	No
8	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Monitor the DTC Information with the scan tool. Does the DTC with the ignition switch OFF?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

RESULT	SYMPTOM	TROUBLE CAUSE	CORRECTION
Suction (Low) pressure abnormally low	Condenser is not hot and excessive bubble in sight glass	• Insufficient refrigerant	• Check sight glass.(See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount
	Frost on the expansion valve inlet line	• Expansion valve clogged	• Replace the expansion valve
	A distinct difference in temperature between the inlet and outlet refrigerant lines of the receiver/drier	• Receiver/drier clogged	• Replace the receiver/ drier
	Expansion valve outlet refrigerant line is not cold and low-pressure gauge indicates vacuum	• The temperature sensor of the expansion valve is defective, and the valve cannot regulate the correct flow of the refrigerant	• Replace the expansion valve
	Discharge temperature is low and air flow from vents is restricted	• Frozen evaporator core fins	• Check electronic thermostat and replace as necessary
	Low-pressure gauge reading is low, or a vacuum reading may be shown	• Clogged or blocked refrigerant line	• Replace refrigerant line
Suction (Low) and Discharge (High) pressure abnor-mally high	No bubbles in sight glass after condenser is cooled by water (Insufficient cooling)	• Excessive refrigerant in system	• Check sight glass.(See "Reading Sight Glass") • Discharge and recover refrigerant. Recharge to specified amount
	Reduce air flow through con-denser	• Condenser clogged • Radiator (condenser) fan does not rotate properly	• Clean • Check cooling fan operation
	Suction (Low) pressure hose is not cold	• Air in system	• Evacuate and charge refrigerant
Suction (Low) and Discharge (High) pres-sure abnor-mally low	Insufficient cooling and excessive bubbles in the sight glass	• Insufficient refrigerant in system	• Check sight glass. (See "Reading Sight Glass") • Check for leaks • Discharge and recover refrigerant. Recharge to specified amount

DTC P1630 (Symptom Code A, B) (Flash Code 51)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The fuel injection solenoid valve is installed to the fuel injection pump rear side. The fuel injection event is determined by this solenoid ON/OFF command. The fuel injection solenoid valve cuts the fuel when the engine shutoff (ESO) solenoid valve is commanded shutoff from the PCU. (The fuel injection solenoid valve and engine shutoff (ESO) solenoid valve is same part. It calls ESO solenoid valve when fuel is shutoff.) When the ignition switch is turned OFF or commanded from fail-safe action, the ESO solenoid valve is commanded shutoff to stop the engine running. If the ECM detects that the fuel injection solenoid valve control current problem, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the PCU monitored fuel injection solenoid valve control current is too high. (Symptom Code A)
- The ECM detects that the PCU continuously flow the control current to the fuel injection solenoid valve. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits fuel injection quantity. (Symptom Code A)
- The ECM cuts fuel injection. (Symptom Code B)

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Fuel injection solenoid valve is internal to the fuel injection pump assembly.
- PCU is part of the fuel injection pump assembly.

DTC P1630 (Symptom Code A, B) (Flash Code 51)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1650 (Symptom Code A) (Flash Code 44)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.
The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects that the PCU receives from the CAN controller rest or Bus Offline, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the PCU receives from the CAN controller reset or Bus Offline.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1650 (Symptom Code A) (Flash Code 44)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P1651 (Symptom Code A or B) set?	—	Go to Applicable DTC	Go to Step 3
3	Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a DMM across the controller area network (CAN) harness (pins 1 and 2 of E-6 connector). 4. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110-130 Ω	Go to Step 5	Go to Step 10
5	1. Connect a DMM between the CAN Low signal circuit (pin 1 of E-6 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 6	Go to Step 11
6	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit (pin 2 of E-6 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 7	Go to Step 12

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) C-57 harness connector. Keep the ECM C-56 harness connector with connected. 4. Connect a DMM across the CAN harness (pins 99 and 100 of C-57 connector). 5. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110-130 Ω	Go to Step 8	Go to Step 14
8	1. Connect a DMM between the CAN Low signal circuit of the ECM harness (pin 99 of C-57 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 9	Go to Step 16
9	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit of the ECM harness (pin 100 of C-57 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 13	Go to Step 16
10	1. Test the CAN Low and High circuit between the ECM (pins 99 and 100 of C-57 connector) and the PCU (pins 1 and 2 of E-6 connector) for the following conditions: • An open circuit • A short each other • High resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
11	1. Test the CAN Low circuit between the ECM (pin 99 of C-57 connector) and the PCU (pin 1 of E-9 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
12	1. Test the CAN Low circuit between the ECM (pin 100 of C-57 connector) and the PCU (pin 2 of E-9 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with the scan tool. Is DTC P0251 (Symptom Code E) set?	—	Go to Step 16	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
14	1. Turn OFF the ignition. 2. Disconnect the PCU harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the PCU (pins 1 and 2 of E-6 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CAN Low or High circuits at the harness connector of the ECM (pins 99 and 100 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (PCU is part of the fuel injection pump assembly) Did you complete the replacement?	—	Go to Step 18	—
17	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 18	—
18	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 19
19	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1650 (Symptom Code B) (Flash Code 44)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.
The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM detects internal CAN controller does not react, this DTC will set.

Condition for Setting the DTC

- The ECM detects internal CAN controller does not react.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Notice:

- CAN controller is internal to the ECM.

DTC P1650 (Symptom Code B) (Flash Code 44)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1651 (Symptom Code A, B) (Flash Code 45)

Circuit Description

The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensors. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The ECM monitors CAN operational status by expecting a constant flow of messages from the PCU. If the ECM fails to receive an expected message from the PCU, this will set depending on what communication is lost.

Condition for Setting the DTC

- The ECM detects that the PCU does not receive the CAN messages from the ECM. (Symptom Code A)
- The ECM does not receive the CAN messages from the PCU. (Symptom Code B)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

The ECM cuts the fuel injection.

Condition for Clearing the MIL/DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1651 (Symptom Code A, B) (Flash Code 45)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition. 2. Disconnect the fuel injection pump control unit (PCU) harness connector. 3. Connect a DMM across the controller area network (CAN) harness (pins 1 and 2 of E-6 connector). 4. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110-130 Ω	Go to Step 4	Go to Step 9
4	1. Connect a DMM between the CAN Low signal circuit (pin 1 of E-6 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 5	Go to Step 10
5	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit (pin 2 of E-6 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Reconnect the PCU harness connector. 3. Disconnect the engine control module (ECM) C-57 harness connector. Keep the ECM C-56 harness connector with connected. 4. Connect a DMM across the CAN harness pins 99 and 100 of C-57 connector). 5. Measure the resistance across the CAN terminals. Is the resistance within the specified value?	110-130 Ω	Go to Step 7	Go to Step 13
7	1. Connect a DMM between the CAN Low signal circuit of the ECM harness (pin 99 of C-57 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Is the DMM voltage within the specified value?	1.5 – 2.5 volts	Go to Step 8	Go to Step 15
8	1. Keep the ignition switch ON, with the engine OFF. 2. Connect a DMM between the CAN High signal circuit of the ECM harness (pin 100 of C-57 connector) and a known good ground. Is the DMM voltage within the specified value?	3.0 – 4.0 volts	Go to Step 12	Go to Step 15
9	1. Test the CAN Low and High circuit between the ECM (pins 99 and 100 of C-57 connector) and the PCU (pins 1 and 2 of E-6 connector) for the following conditions: • An open circuit • A short each other • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14
10	1. Test the CAN Low circuit between the ECM (pin 99 of C-57 connector) and the PCU (pin 1 of E-9 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
11	1. Test the CAN Low circuit between the ECM (pin 100 of C-57 connector) and the PCU (pin 2 of E-9 connector) for the following conditions: • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the DTC Information with the scan tool. Is DTC P0251 (Symptom Code E) set?	—	Go to Step 15	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
13	1. Turn OFF the ignition. 2. Disconnect the PCU harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the PCU (pins 1 and 2 of E-6 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CAN Low or High circuits at the harness connector of the ECM (pins 99 and 100 of C-57 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	**Important:** The fuel injection pump must be timed to the engine. Replace the fuel injection pump. Refer to Fuel Injection Pump Replacement in engine mechanical section. (PCU is part of the fuel injection pump assembly) Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 18
18	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1690 (Symptom Code 4) (Flash Code 77)

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The battery voltage is supplied to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit. After a fixed time passes, the ECM turns OFF the MIL with the ignition ON and the engine OFF. The MIL has the following functions:

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the ECM.

If the ECM detects an open circuit or short circuit on the MIL control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the MIL control circuit for longer than 3 seconds when the MIL is commanded OFF.

Action Taken When the DTC Sets

- The ECM does not illuminates the MIL when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1690 (Symptom Code 4) (Flash Code 77)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Malfunction Indicator Lamp (MIL) test with the scan tool. 4. Command the MIL ON with the scan tool. Does the MIL turn ON when commanded ON with the scan tool?	—	Go to Step 3	Go to Step 4
3	Command the MIL OFF with the scan tool. Does the MIL OFF?	—	Go to Step 17	Go to Step 10
4	1. Turn OFF the ignition. 2. Inspect the Meter (15A) fuse (C-14) in the cabin fuse block. Is the Meter (15A) fuse (C-14) open?	—	Go to Step 5	Go to Step 6
5	Replace the Meter (15A) fuse (C-14). If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (15A) fuse (C-14) or replace the shorted attached component fed by the Meter (15A) fuse (C-14). Did you complete the repair?	—	Go to Step 19	—
6	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit of the ECM harness connector (pin 42 of C-56 connector) and a known good ground. Does the MIL illuminate?	—	Go to Step 11	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Remove the MIL bulb from the IPC (meter assembly). Is the MIL bulb burned out?	—	Go to Step 15	Go to Step 8
8	1. Disconnect the IPC harness B-23 connector. 2. Connect a test lamp between the voltage feed circuit of the MIL (pin 30 of B-23 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 12
9	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector. 3. Connect a test lamp between the voltage feed circuit and control circuit of the MIL (pins 17 and 30 of B-23 connector). 4. Turn ON the ignition, with the engine OFF. 5. Perform the MIL test with the scan tool. 6. Command the MIL ON with the scan tool. Does the test lamp turn ON when commanded ON with the scan tool?	—	Go to Step 14	Go to Step 13
10	1. Test the control circuit of the MIL between the ECM (pin 42 of C-56 connector) and the IPC (pin 17 of B-23 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the MIL control circuit at the harness connector of the ECM (pin 42 of C-56 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
12	Repair the open circuit or high resistance on the voltage feed circuit of the MIL between the IPC (pin 8 of B-24 connector) and Meter (15A) fuse (C-14). Did you complete the repair?	—	Go to Step 19	—
13	Repair the open circuit or high resistance on the control circuit of the MIL between the ECM (pin 42 of C-56 connector) and the IPC (pin 17 of B-24 connector). Did you complete the repair?	—	Go to Step 19	—
14	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections on the MIL circuits at the IPC (pins 17 and 8 of B-24 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	Replace the MIL bulb. Did you complete the replacement?	—	Go to Step 19	—
16	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 19	—

MAGNETIC CLUTCH

When the A/C switch and the fan control knob (fan switch) are turned on with the engine running, current flows through the thermostat and the compressor relay to activate the magnetic clutch.
The air conditioning can be stopped by turning off the A/C switch or the fan control knob (fan switch).
However, even when the air conditioning is in operation, the electronic thermostat, the pressure switch or the ECM is used to stop the air conditioning temporarily by turning off the magnetic clutch in the prearranged conditions to reduce the engine load which is being caused by the rise in the engine coolant temperature, and the acceleration of the vehicle, etc.

Step	Action	Value(s)	Yes	No
17	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition for 10 seconds, with the engine OFF. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the DTC fail this ignition?	—	Go to Step 18	Go to Diagnostic Aids
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

DTC P1690 (Symptom Code 8) (Flash Code 77)

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The battery voltage is supplied to the MIL. The engine control module (ECM) turns the MIL ON by grounding the MIL control circuit. After a fixed time passes, the ECM turns OFF the MIL with the ignition ON and the engine OFF. The MIL has the following functions:

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the ECM.

If the ECM detects a short to battery or ignition voltage on the MIL control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the MIL control circuit for longer than 1 second when the MIL is commanded ON.

Action Taken When the DTC Sets

- The ECM does not illuminates the MIL when the diagnostic runs and fails.

Condition for Clearing the DTC

- A history DTC clears after 40 consecutive driving cycles without a fault. Or clear with the scan tool.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.

3. If the control circuit of the MIL between the ECM and the IPC is normal, the control circuit voltage low DTC P1690 (Symptom Code 4) will set.
4. If the control circuit of the MIL between the ECM and the IPC is normal, the control circuit voltage low DTC P1690 (Symptom Code 4) will set.

DTC P1690 (Symptom Code 8) (Flash Code 77)
Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Malfunction Indicator Lamp (MIL) test with the scan tool. 4. Command the MIL ON with the scan tool. Does the MIL turn ON when commanded ON with the scan tool?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC) in order to disconnect the IPC harness B-23 connector. 3. Disconnect the IPC harness B-23 connector. 4. Turn ON the ignition, with the engine OFF. 5. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Does DTC P1690 (Symptom Code 4) set, but not DTC P1690 (Symptom Code 8)?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit of the MIL between the engine control module (ECM) (pin 42 of C-56 connector) and the IPC (pin 17 of B-23 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Repair or replace the IPC (meter assembly). Did you complete the repair or replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Monitor the DTC Information with the scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Glow Control System Check

Description

The glow control system consists of the engine control module (ECM), the glow relay and glow plugs. The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. The ECM commands the glow relay ON for a certain length of time at ignition switch is ON with engine OFF. In after glow phase, the glow plugs remain energized for a certain period with engine run.

Glow Control Operation

- The pre glow control system operates when the engine coolant temperature is less than 30°C (86°F).
- The after glow control system operates when the engine coolant temperature is less than 60°C (140°F).

Glow Control System Check

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check-Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information of the engine control system with the scan tool and check whether following DTC(s) is set: • P0115 (Symptom Code 1 & 2) • P0380 (Symptom Code 4 & 8) • P0381 (Symptom Code 4 & 8) Are any of the above DTC(s) set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Make sure the metal bus bar that connects switched battery voltage supply terminal (E-49) and all glow plugs is secured tightly. 3. Turn ON the ignition, with the engine OFF 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 terminal) and a known good ground. 5. Perform the Glow Relay test with the scan tool. 6. Command the Glow Relay ON with the scan tool while observing the test lamp. Does the test lamp turn ON only when commanded ON with the scan tool?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Remove the metal bus bar from the glow plugs. 3. Measure resistance of each glow plug between the glow plug terminals and a known good ground. Make sure to record all measurements and take them quickly as to not allow engine temperature changes between measurements. Are the resistances within the specified value each other?	1 Ω	System OK	Go to Step 15

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 connector) and a known good ground. 5. Perform the Glow Relay test with the scan tool. 6. Command the Glow Relay ON with the scan tool while observing the test lamp. Does the test lamp turn ON only when commanded ON with the scan tool?	—	Go to Step 9	Go to Step 6
6	Inspect the Glow (60A) slow blow fuse (SBF-8) in the engine room fuse block. Is the Glow (60A) slow blow fuse (SBF-8) open?	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the glow relay in the engine room relay block. 3. Connect a test lamp between the voltage feed circuit of the glow relay terminal (pin 4 of X-5 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 11
8	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the power supply circuit of glow plugs (pin 1 of X-5 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the glow relay terminals (pins 1 and 4 of X-5 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
10	1. Replace the Glow (60A) slow blow fuse (SBF-8). If the slow blow fuse continues to open, repair the short to ground on a circuit fed by the slow blow fuse or check for a shorted attached component. 2. Repair the short to ground or replace the component as necessary. Did you complete the repair?	—	Go to Step 16	—
11	Repair the open circuit in the battery voltage supply circuit between the Glow (60A) slow blow fuse (SBF-8) and the glow relay (pin 1 of X-5 connector). Did you complete the repair?	—	Go to Step 16	—
12	Repair the open circuit in the switched battery voltage supply circuit between the glow relay (pin 1 of X-5 connector) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
13	**Important:** The glow plugs may be burnt out if the battery voltage supply circuit is shorted to a voltage source. Repair the short to battery or ignition voltage on the switched battery voltage supply circuit between the glow relay (pin 1 of X-5 connector) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 16	—
14	Replace the glow relay. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the appropriate glow plug. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected components, relay, fuse or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 connector) and a known good ground. 5. Perform the Glow Relay test with the scan tool. 6. Command the Glow Relay ON with the scan tool while observing the test lamp. Does the test lamp turn ON only when commanded ON with the scan tool?	—	Go to Step 4	Go to Step 2

DTC A/C Compressor System Check

Description

When air conditioning (A/C) and blower fan are selected, and if the system has a sufficient refrigerant charge. A 12-volt signal is supplied to the A/C request input of the Engine Control Module (ECM). The A/C request signal may be temporarily canceled during system operation by the electronic thermostat in the evaporator to prevent the evaporator icing. Also, it is cancelled when the pressure switch detected abnormal pressure in the line. When the A/C request signal is received by the ECM, the ECM supplies a ground from the A/C compressor relay if the engine operating conditions are within acceptable ranges. With the A/C compressor relay energized, voltage is supplied to the compressor clutch coil. The ECM will enable the compressor clutch to engage whenever A/C has been selected with the engine running and enable conditions are met.

Condition for Running the A/C Compressor:

- The engine is running.
- The A/C switch is ON.
- The engine coolant temperature (ECT) is less than 105°C(221°F).

A/C Compressor System Check

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart 1 of 2

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information of the engine control system with the scan tool and check whether following DTC(s) is set: • P0115 (Symptom Code 1 & 2) • P0645 (Symptom Code 4 & 8) Are any of the above DTC(s) set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Turn ON the blower motor switch. Does the blower motor turn ON and operate correctly?	—	Go to Step 4	Refer to Applicable Diagnostic Chart in Heating & Air Conditioning Section
4	1. Turn OFF the blower motor switch. 2. Keep the A/C switch OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 5	Go to Chart 2 of 2 with heater Step 1 OR Go to Chart 2 of 2 without heater Step 1
5	1. Start the engine and let the engine idle. 2. Keep the blower motor switch OFF. 3. Keep the A/C switch OFF. Does the A/C compressor clutch keep OFF (disengage)?	—	Go to Step 6	Go to Step 11
6	1. Turn ON the blower motor switch. 2. Keep the A/C switch OFF. Does the A/C compressor clutch keep OFF (disengage)?	—	Go to Step 7	Go to Chart 2 of 2 with heater Step 7 OR Go to Chart 2 of 2 without heater Step 4

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the blower motor switch. 2. Turn ON the A/C switch. Does the A/C compressor clutch keep OFF (disengage)?	—	Go to Step 8	Go to Chart 2 of 2 with heater Step 8 OR Go to Chart 2 of 2 without heater Step 10
8	1. Turn ON the blower motor switch. 2. Keep the A/C switch ON. Does the A/C compressor clutch ON and OFF (engage and disengage) periodically within the Condition for Running the A/C Compressor?	—	Go to Step 9	Go to Step 10
9	Does the air flow cool enough.	—	System OK	Refer to Applicable Diagnostic Chart in Heating & Air Conditioning Section
10	Does the A/C Relay Command parameter indicate ON at previous step?	—	Go to Step 14	Go to Chart 2 of 2 with heater Step 9 OR Go to Chart 2 of 2 without heater Step 11
11	1. Turn OFF the ignition. 2. Disconnect the A/C compressor clutch harness connector (E-3). 3. Start the engine. Does the A/C compressor clutch ON (engage)?	—	Go to Step 22	Go to Step 12
12	1. Turn OFF the ignition. 2. Remove the A/C compressor relay from the engine room relay block. 3. Connect a test lamp between the A/C compressor clutch voltage supply circuit (pin 2 of X-14 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 21
13	Repair the short to battery or ignition voltage on the A/C compressor voltage feed circuit between the A/C compressor relay (pin 2 of X-14 connector) and the A/C compressor (E-3). Did you complete the repair?	—	Go to Step 23	—
14	1. Turn OFF the ignition. 2. Remove the A/C compressor relay from the engine room fuel block. 3. Connect a test lamp between the voltage feed circuit of the relay switch side terminal (pin 1 of X-14 connector) and known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 17
15	1. Keep the ignition ON, with the engine OFF. 2. Disconnect the test lamp. 3. Connect a 3-amp fused jumper wire between both switch side terminals of the A/C compressor relay (pins 1 and 2 of X-14 connector). Does the A/C compressor clutch click (engage)?	—	Go to Step 19	Go to Step 16

Step	Action	Value(s)	Yes	No
16	1. Keep the ignition ON, with the engine OFF. 2. Keep 3-amp fused jumper wire with connected. 3. Disconnect A/C compressor clutch harness connector. 4. Connect a test lamp between A/C compressor voltage feed circuit (E-3) and a known good ground. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 18
17	Repair the open circuit or high resistance on the relay switch side voltage feed circuit between the A/C compressor relay (pin 1 of X-14 connector) and the A/C (10A) fuse (EB-13). Did you complete the repair?	—	Go to Step 23	—
18	Repair the open circuit or high resistance on the relay switched voltage supply circuit between the A/C compressor relay (pin 2 of X-14 connector) and the A/C compressor clutch (pin 1 of E-3 connector). Did you complete the repair?	—	Go to Step 23	—
19	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the A/C compressor relay terminals (pins 3 and 5 of X-14 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 23	Go to Step 21
20	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the A/C compressor clutch (E-3). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 23	Go to Step 22
21	Replace the A/C compressor relay. Did you complete the replacement?	—	Go to Step 23	—
22	Replace the A/C compressor. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 23	—
23	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the blower motor switch. Does the blower motor turn ON and operate correctly?	—	Go to Step 4	Refer to Applicable Diagnostic Chart in Heating & Air Conditioning Section

Chart 2 of 2 with heater

Step	Action	Value(s)	Yes	No
1	1. Turn OFF the ignition. 2. Replace the thermo relay with the horn relay or replace with a known good relay. 3. Turn OFF the blower motor switch. 4. Turn OFF the A/C switch. 5. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 33	Go to Step 2

Step	Action	Value(s)	Yes	No
2	1. Turn OFF the ignition. 2. Remove the thermo relay from the engine room relay block. 3. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition. 2. Reinstall the thermo relay. 3. Remove the radiator grille in order to access the pressure switch. 4. Disconnect the pressure switch harness connector (C-24). 5. Turn OFF the blower motor switch. 6. Turn OFF the A/C switch. 7. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 6	Go to Step 5
4	Repair the short to battery or ignition voltage on the thermo relay signal input circuit between the thermo relay (pin 1 of X-15 connector) and the engine control module (ECM) (pin 33 of C-56 connector). Did you complete the repair?	—	Go to Step 39	—
5	Repair the short to ground between the thermo relay (pin 5 of X-15 connector) and pressure switch (pin 1 of C-24 connector). Did you complete the repair?	—	Go to Step 39	—
6	Repair the short to ground between the pressure switch (pin 2 of C-24 connector) and the electronic thermostat (pin 2 of C-55 connector), then electronic thermostat (pin 1 of C-56 connector) and the A/C switch (pin 5 of B-57 connector). Did you complete the repair?	—	Go to Step 39	—
7	1. Test the A/C switch circuits shorted each other. (pins 1 and 5 of B-57 connector). 2. Repair the circuits as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 36
8	1. Test the circuit between the blower motor switch (pin 1 of B-13 connector) and the A/C switch (pin 1 of B-57 connector) for a short to ground. 2. Repair the circuits as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 37
9	Inspect the A/C (10A) fuse (EB-13) in the engine room fuse block. Is the A/C (10A) fuse (EB-13) open?	—	Go to Step 10	Go to Step 11
10	1. Replace the A/C (10A) fuse (EB-13). If the fuse continues to open, repair the short to ground on a circuit fed by the fuse or check for a shorted attached component. 2. Repair the short to ground or replace the component as necessary. Did you complete the repair?	—	Go to Step 39	—

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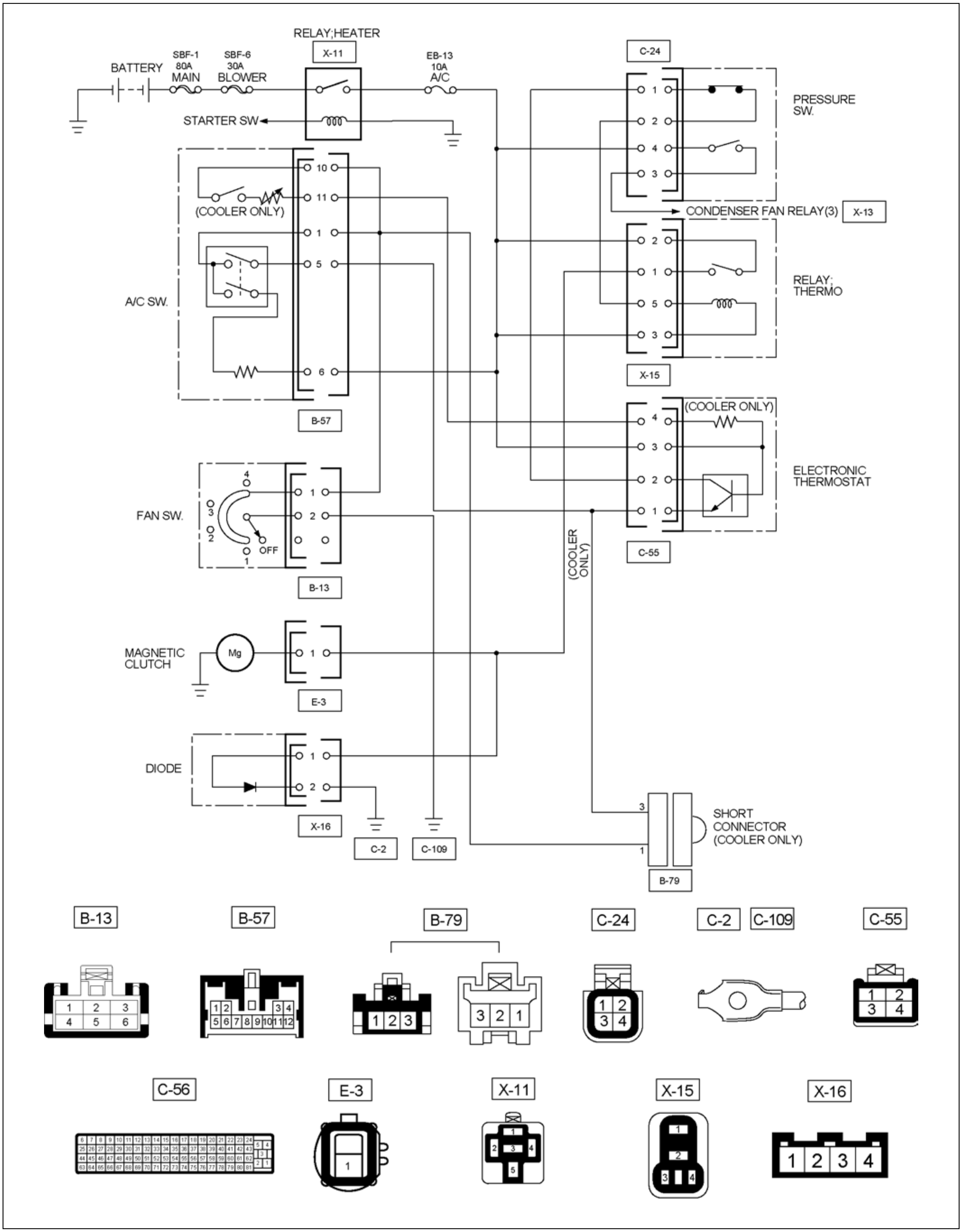

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Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Remove the thermo relay from the engine room relay block. 3. Connect a test lamp between the voltage feed circuit (pins 1 and 3 of X-15 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate on both circuits?	—	Go to Step 12	Go to Step 20
12	1. Turn OFF the ignition. 2. Reinstall the thermo relay. 3. Remove the radiator grille in order to access the pressure switch. 4. Disconnect the pressure switch harness connector (C-24). 5. Connect a 3-amp fused jumper wire between the pressure switch harness (pin 1 of C-24 connector) and a known good ground. 6. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 13	Go to Step 15
13	Does the A/C Request Signal Request parameter indicate ON?	—	Go to Step 16	Go to Step 14
14	1. Turn OFF the ignition. 2. Keep the 3-amp fused wire with connected. 3. Disconnect the ECM C-56 harness connector. 4. Connect a test lamp between the thermo relay input circuit (pin 33 of C-56 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. DO NOT START the engine. Does the test lamp illuminate?	—	Go to Step 32	Go to Step 21
15	1. Turn OFF the ignition. 2. Keep the 3-amp fused wire with connected. 3. Replace the thermo relay with the horn relay or replace with a known good relay. 4. Connect a 3-amp fused jumper wire between the pressure switch harness (pin 1 of C-24 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 27	Go to Step 22
16	1. Turn OFF the ignition. 2. Connect the pressure switch harness connector. 3. Remove the grove box in order to access electronic thermostat. 4. Disconnect the electronic thermostat harness connector (C-55). 5. Connect a 3-amp fused jumper wire between the electronic thermostat voltage feed circuit (pin 2 of C-55 connector) and a known good ground. 6. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 17	Go to Step 23
17	1. Turn OFF the ignition. 2. Connect a test lamp between the electronic thermostat terminal (pin 1 of C-55 connector) and battery voltage. 3. Turn ON the blower motor switch. 4. Turn ON the A/C switch. Does the test lamp illuminate?	—	Go to Step 18	Go to Step 19

Step	Action	Value(s)	Yes	No
18	1. Turn OFF the ignition. 2. Connect a test lamp between the electronic thermostat voltage feed circuit (pin 3 of C-55 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 29	Go to Step 25
19	1. Turn OFF the ignition. 2. Remove the center cluster bezel in order to remove HVAC control lever. 3. Disconnect the A/C switch harness connector (B-57). 4. Connect a test lamp between the A/C switch ground harness (pin 1 of B-57 connector) and battery voltage. 5. Turn ON the blower motor switch. Does the test lamp illuminate?	—	Go to Step 24	Go to Step 26
20	Repair the open circuit or high resistance on the thermo relay voltage feed circuits between the thermo relay (pin 2 of X-15 connector) and ECM (10A) fuse (EB-4), then thermo relay (pin 3 of X-15 connector) and A/C (10A) fuse (EB-13). Did you complete the repair?	—	Go to Step 39	—
21	Repair the open circuit or high resistance on thermo relay input circuit between the ECM (pin 33 of C-56 connector) and the thermo relay (pin 1 of X-15 connector). Did you complete the repair?	—	Go to Step 39	—
22	Repair the open circuit or high resistance on the pressure switch voltage feed circuit between the thermo relay (pin 4 of X-15 connector) and pressure switch (pin 1 of C-24) connector. Did you complete the repair?	—	Go to Step 39	—
23	1. Test the voltage feed circuit between the pressure switch (pin 2 of C-24 harness connector) and electronic thermostat (pin 2 of C-55 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 28
24	1. Test the electronic thermostat switching circuit between the electronic thermostat (pin 1 of C-55 connector) and the A/C switch (pin 5 of B-57 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 30
25	Repair the open or high resistance on the voltage feed circuit on the electronic thermostat between the A/C (10A) fuse (EB-13) and the electronic thermostat (pin 3 of C-55 connector). Did you complete the repair?	—	Go to Step 39	—
26	1. Test the A/C switch ground circuit between the A/C switch (pin 1 of B-57 connector) and blower motor switch (pin 1 of B-13 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 31

Step	Action	Value(s)	Yes	No
27	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the thermo relay terminals (pins 1, 2, 3 and 4 of X-15 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 33
28	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the pressure switch (pins 1 and 2 of C-24 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 34
29	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the electronic thermostat (pins 1, 2 and 3 of C-55 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 35
30	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the A/C switch (pins 1 and 5 of B-57 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 36
31	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the blower motor switch (pin 1 of B-13 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 37
32	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 33 of C-56 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 39	Go to Step 38
33	Replace the thermo relay. Did you complete the replacement?	—	Go to Step 39	—
34	Replace the pressure switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 39	—
35	Replace the electronic thermostat. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 39	—
36	Replace the A/C switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 39	—
37	Replace the blower motor switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 39	—
38	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 39	—

Step	Action	Value(s)	Yes	No
39	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the blower motor switch. Does the blower motor turn ON and operate correctly?	—	Go to Char 1 of 2 Step 4	Refer to Applicable Diagnostic Chart in Heating & Air Conditioning Section

Chart 2 of 2 without heater

Step	Action	Value(s)	Yes	No
1	1. Turn OFF the ignition. 2. Replace the thermo relay with the horn relay or replace with a known good relay. 3. Turn OFF the blower motor switch. 4. Turn OFF the A/C switch. 5. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 37	Go to Step 2
2	1. Turn OFF the ignition. 2. Remove the thermo relay from the engine room relay block. 3. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 3	Go to Step 5
3	1. Turn OFF the ignition. 2. Reinstall the thermo relay. 3. Remove the radiator grille in order to access the pressure switch. 4. Disconnect the pressure switch harness connector (C-24). 5. Turn OFF the blower motor switch. 6. Turn OFF the A/C switch. 7. Turn ON the ignition, with the engine OFF. Does the A/C Request Signal parameter indicate OFF?	—	Go to Step 7	Go to Step 6
4	1. Turn OFF the ignition. 2. Remove the glove box in order to access the electronic thermostat. 3. Back probe a test lamp between the electronic thermostat harness (pin 2 of C-55 connector) and battery voltage. 4. Turn ON the blower motor switch. 5. Turn OFF the A/C switch. 6. Keep the ignition OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
5	Repair the short to battery or ignition voltage on the thermo relay signal input circuit between the thermo relay (pin 1 of X-15 connector) and the engine control module (ECM) (pin 33 of C-56 connector). Did you complete the repair?	—	Go to Step 43	—
6	Repair the short to ground between the thermo relay (pin 5 of X-15 connector) and pressure switch (pin 1 of C-24 connector). Did you complete the repair?	—	Go to Step 43	—

Step	Action	Value(s)	Yes	No
7	Repair the short to ground between the pressure switch (pin 2 of C-24 connector) and the electronic thermostat (pin 2 of C-55 connector). Did you complete the repair?	—	Go to Step 43	—
8	1. Test the electronic thermostat switching circuits shorted each other. (pins 1 and 2 of C-55 connector). 2. Repair the circuits as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 39
9	1. Test the electronic thermostat circuit between the electronic thermostat (pin 4 of C-55 connector) and the A/C switch (pin 11 of B-57 connector) for a short to ground. 2. Repair the circuits as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 40
10	1. Test the ground circuit among the electronic thermostat (pin 1 of C-55 connector), the blower motor switch (pin 1 of B-13 connector) and the A/C switch (pin 10 of B-57 connector) for a short to ground. 2. Repair the circuits as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 41
11	Inspect the A/C (10A) fuse (EB-13) in the engine room fuse block. Is the A/C (10A) fuse (EB-13) open?	—	Go to Step 12	Go to Step 13
12	1. Replace the A/C (10A) fuse (EB-13). If the fuse continues to open, repair the short to ground on a circuit fed by the fuse or check for a shorted attached component. 2. Repair the short to ground or replace the component as necessary. Did you complete the repair?	—	Go to Step 43	—
13	1. Turn OFF the ignition. 2. Remove the thermo relay from the engine room relay block. 3. Connect a test lamp between the voltage feed circuit (pins 2 and 3 of X-15 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate on both circuits?	—	Go to Step 14	Go to Step 23
14	1. Turn OFF the ignition. 2. Reinstall the thermo relay. 3. Remove the radiator grille in order to access the pressure switch. 4. Disconnect the pressure switch harness connector (C-24). 5. Connect a 3-amp fused jumper wire between the pressure switch harness (pin 1 of C-24 connector) and a known good ground. 6. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 15	Go to Step 17
15	Does the A/C Clutch Switch parameter indicate ON?	—	Go to Step 18	Go to Step 16

Step	Action	Value(s)	Yes	No
16	1. Turn OFF the ignition. 2. Keep the 3-amp fused wire with connected. 3. Disconnect the ECM C-56 harness connector. 4. Connect a test lamp between the thermo relay input circuit (pin 33 of C-56 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. DO NOT START the engine. Does the test lamp illuminate?	—	Go to Step 36	Go to Step 24
17	1. Turn OFF the ignition. 2. Keep the 3-amp fused wire with connected. 3. Replace the thermo relay with the horn relay or replace with a known good relay. 4. Connect a 3-amp fused jumper wire between the pressure switch harness (pin 1 of C-24 connector) and a known good ground. 5. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 31	Go to Step 25
18	1. Turn OFF the ignition. 2. Connect the pressure switch harness connector. 3. Remove the grove box in order to access electronic thermostat. 4. Disconnect the electronic thermostat harness connector (C-55). 5. Connect a 3-amp fused jumper wire between the electronic thermostat voltage feed circuit (pin 2 of C-55 connector) and a known good ground. 6. Turn ON the ignition, with the engine OFF. Does the thermo relay click (engage)?	—	Go to Step 19	Go to Step 26
19	1. Turn OFF the ignition. 2. Connect a test lamp between the electronic thermostat terminal (pin 1 of C-55 connector) and battery voltage. 3. Turn ON the blower motor switch. Does the test lamp illuminate?	—	Go to Step 20	Go to Step 27
20	1. Turn OFF the ignition. 2. Connect a test lamp between the electronic thermostat voltage feed circuit (pin 3 of C-55 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 21	Go to Step 28
21	1. Turn OFF the ignition. 2. Connect a test lamp between the electronic thermostat terminal (pin 4 of C-55 connector) and battery voltage. 3. Turn ON the blower motor switch. 4. Turn ON the A/C switch. Does the test lamp illuminate?	—	Go to Step 33	Go to Step 22

Step	Action	Value(s)	Yes	No
22	1. Turn OFF the ignition. 2. Remove the center cluster bezel in order to remove HVAC control lever. 3. Disconnect the A/C switch harness connector (B-57). 4. Connect a test lamp between the A/C switch ground harness (pin 10 of B-57 connector) and battery voltage. 5. Turn ON the blower motor switch. Does the test lamp illuminate?	—	Go to Step 29	Go to Step 30
23	Repair the open circuit or high resistance on the thermo relay voltage feed circuits between the thermo relay (pin 2 of X-15 connector) and ECM (10A) fuse (EB-4), then thermo relay (pin 3 of X-15 connector) and A/C (10A) fuse (EB-13). Did you complete the repair?	—	Go to Step 43	—
24	Repair the open circuit or high resistance on thermo relay input circuit between the ECM (pin 33 of C-56 connector) and the thermo relay (pin 1 of X-15 connector). Did you complete the repair?	—	Go to Step 43	—
25	Repair the open circuit or high resistance on the pressure switch voltage feed circuit between the thermo relay (pin 5 of X-15 connector) and pressure switch (pin 1 of C-24) connector. Did you complete the repair?	—	Go to Step 43	—
26	1. Test the voltage feed circuit between the pressure switch (pin 2 of C-24 harness connector) and electronic thermostat (pin 2 of C-55 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 32
27	1. Test the electronic thermostat switching circuit between the electronic thermostat (pin 1 of C-55 connector) and the blower motor switch (pin 1 of B-13 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 35
28	Repair the open or high resistance on the voltage feed circuit on the electronic thermostat between the A/C (10A) fuse (EB-13) and the electronic thermostat (pin 3 of C-55 connector). Did you complete the repair?	—	Go to Step 43	—
29	1. Test the electronic thermostat circuit between the electronic thermostat (pin 4 of C-55 connector) and A/C switch (pin 11 of B-57 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 34
30	1. Test the A/C switch ground circuit between the A/C switch (pin 10 of B-57 connector) and blower motor switch (pin 1 of B-13 connector) for an open or high resistance. 2. Repair the circuit as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 35

Step	Action	Value(s)	Yes	No
31	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the thermo relay terminals (pins 1, 2, 3 and 4 of X-15 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 37
32	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the pressure switch (pins 1 and 2 of C-24 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 38
33	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the electronic thermostat (pins 1, 2, 3 and 4 of C-55 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 39
34	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the A/C switch (pins 10 and 11 of B-57 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 40
35	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the blower motor switch (pin 1 of B-13 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 41
36	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 33 of C-56 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 43	Go to Step 42
37	Replace the thermo relay. Did you complete the replacement?	—	Go to Step 43	—
38	Replace the pressure switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 43	—
39	Replace the electronic thermostat. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 43	—
40	Replace the A/C switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 43	—
41	Replace the blower motor switch. Refer to Heating and Air Conditioning section. Did you complete the replacement?	—	Go to Step 43	—
42	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement in this section. Did you complete the replacement?	—	Go to Step 43	—

Step	Action	Value(s)	Yes	No
43	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the blower motor switch. Does the blower motor turn ON and operate correctly?	—	Go to Char 1 of 2 Step 4	Refer to Applicable Diagnostic Chart in Heating & Air Conditioning Section

Symptoms – Engine Controls

Symptoms – Engine Controls

Important Preliminary Inspections Before Starting

Perform Diagnostic System Check – Engine Controls before using the symptom tables, and verify that all of the following are true:

- The engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no diagnostic trouble codes (DTCs) stored, or a DTC exists but without the MIL.
- The scan tool data is within the normal operating range. Refer to scan tool Data List in this section.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

- The ECM grounds are clean, tight, and in their proper location.
- The vacuum hoses are not split or kinked, and properly connected. Inspect thoroughly for any type of leak or restriction.
- The mass air flow (MAF) sensor is properly installed. The arrows on the plastic portion of the sensor must point toward the engine.
- The air intake ducts are not collapsed or damaged.
- There are no leaks at the MAF sensor, any connections or intake manifold sealing surfaces.
- The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

Important:

Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the keyword 2000 serial data circuit. If you cannot locate an intermittent condition, a cellular phone communication signal may cause the condition.

Important:

The problem may or may not turn ON the MIL or store a DTC.

Faulty electrical connections or wiring cause most intermittent problems. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
- Terminals that are not seated
- Terminals that are damaged or improperly formed

Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension. Remove the terminal from the connector body in order to inspect for poor terminal wire connection.

Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored.

Use the scan tool in order to help detect intermittent conditions. Useful features of the scan tool include the following:

- Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
- Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the scan tool Users Guide for more information.

Important:

If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent MIL with no stored DTC:

- The ECM grounds are loose or dirty. Refer to Engine Controls Schematics.
- The MIL circuit intermittently shorted to ground.
- Electrical system interference caused by a malfunctioning relay, ECM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- There is an open diode across the A/C compressor clutch or any other open diodes.

MAGNETIC CLUTCH DOES NOT RUN (4JA1-T)

- Are the No. SBF-6 fuse (30A) and the No. EB-13 (10A) fuses OK?
  - YES →
  - NO → Replace
- Are the A/C thermo (X-15) and heater & A/C (X-11) relay OK?
  - YES →
  - NO → Replace
- Is the pressure switch (C-24) OK?
  - YES →
  - NO → Defective switch or insufficient refrigerant
- Is the electronic thermostat (C-55) OK?
  - YES →
  - NO → Replace
- Are the A/C switch (B-57) and the fan switch (B-13) OK?
  - YES →
  - NO → Replace
- Turn the ignition switch "ON" (Engine is running)
- A/C switch and fan control knob (fan switch) "ON"
- Disconnect the magnetic clutch connector.
- Is there battery voltage between the engine room harness connector terminal No.1 (E-3) and ground?
  - YES → Does the magnetic clutch operate?
    - YES → Defective compressor
    - NO → Defective magnetic clutch
  - NO →
- Disconnect the A/C thermo relay.
- Is there continuity between the engine room harness connector terminal No.1 (E-3) and engine room harness connector terminal No.1 (X-15)?

Important:

The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to Engine Controls Schematics for an application.

Use the following tables when diagnosing a symptom complaint:

- Intermittent Conditions
- Hard Start
- Rough, Unstable, or Incorrect Idle and Stalling
- Cuts Out, Misses
- Surge/Chuggles
- Lack of Power, Sluggishness, or Sponginess
- Hesitation, Sag, Stumble
- Fuel Knock/Combustion Noise
- Poor Fuel Economy
- Excessive Smoke (Black Smoke)
- Excessive Smoke (White Smoke)

Intermittent Conditions

Checks	Action
DEFINITION:The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• Refer to Symptoms – Engine Controls before starting.
Harness/Connector	Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, engine torque, bumps/rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/system operation, or engine operation, inspect and repair the harness/connections as necessary. Refer to Electrical Connections or Wiring.

Checks	Action
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Inspect for poor mating of the connector halves, or terminals improperly seated in the connector body. • Inspect for improperly formed or damaged terminals. Test for poor terminal tension. • Inspect for poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Inspect for corrosion/water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Inspect for wires that are broken inside the insulation. • Inspect the harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the power source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component.
Temperature Sensitivity	• An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot. • If the intermittent is related to heat, review the data for a relationship with the following: - High ambient temperatures - Under hood/engine generated heat - Circuit generated heat due to a poor connection, or high electrical load - Higher than normal load conditions, towing, etc. • If the intermittent is related to cold, review the data for the following: - Low ambient temperatures–In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. - The condition only occurs on a cold start. - The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.

Checks	Action
Electromagnetic Interference (EMI) and Electrical Noise	Some electrical components/circuits are sensitive to EMI or other types of electrical noise. Inspect for the following conditions: • A misrouted harness that is too close to high voltage/high current devices such as injection components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation. • Electrical system interference caused by a malfunctioning relay, or the engine control module (ECM) driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related failure while in use, but do not fail when the accessories are not in use. • Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Incorrect ECM Programming	• There are only a few situations where reprogramming a ECM is appropriate: **Important:** DO NOT reprogram the ECM with the SAME software/calibration files that are already present in the ECM. This is not an effective repair for any type of driveability problem. - A ECM from another vehicle is installed. - Revised software/calibration files have been released for this vehicle. • Verify that the ECM contains the correct software/calibration. If incorrect programming is found, reprogram the ECM with the most current software/calibration.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.
scan tool Snapshot	The scan tool can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the scan tool user instructions for more information on the Snapshot function.

Hard Start

Checks	Action
DEFINITION:The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver is using the correct starting procedure. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing (timing gear) • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. • Inspect the glow plug control (preheating) system operation. • Inspect for slow cranking speed. • Inspect for weakened batteries.

Rough, Unstable, or Incorrect Idle And Stalling

Checks	Action
DEFINITION:Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the Engine Control Module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the scan tool to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. d. Connect the clear hose to the fuel injection pump. c. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for incorrect basic engine parts.

Checks	Action
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injection solenoid valve wiring, near the sensor circuits. • Inspect for faulty engine mounts. • Inspect faulty crank pulley. • Inspect faulty generator & A/C compressor. • Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation.

Cut Out, Misses

Checks	Action
DEFINITION:A constant jerking that follows the engine speed, usually more pronounced as the engine load increase. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Check	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to observe the Accelerator Pedal Position. Accelerator Pedal Position indicating angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at mass air flow (MAF) sensor.
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injection solenoid wiring, near the sensor circuits.

Surges/Chuggles

Checks	Action
DIFINITION:The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	

Checks	Action
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver understands the torque converter clutch (TCC) operation. • Ensure the driver understands the A/C compressor operation. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Mass Air Flow (MAF) Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the scan tool to observe the Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation. Also inspect the Accelerator Pedal Position indicating angle when the accelerator pedal is steady. If the indicating angle fluctuates, check for an intermittent open, high resistance in the circuits or for a skewed sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only)

AREA

SQUARE INCHES TO SQUARE CENTIMETERS

in^2	0 cm^2	1 cm^2	2 cm^2	3 cm^2	4 cm^2	5 cm^2	6 cm^2	7 cm^2	8 cm^2	9 cm^2	in^2
-		6.452	12.903	19.355	25.806	32.258	38.710	45.161	51.613	58.064	-
10	64.516	70.968	77.419	83.871	90.322	96.774	103.226	109.677	116.129	122.580	10
20	129.032	135.484	141.935	148.387	154.838	161.290	167.742	174.193	180.645	187.096	20
30	193.548	200.000	206.451	212.903	219.354	225.806	232.258	238.709	245.161	251.612	30
40	258.064	264.516	270.967	277.419	283.870	290.322	296.774	303.225	309.677	316.128	40
50	322.580	329.032	335.483	341.935	348.386	354.838	361.290	367.741	374.193	380.644	50
60	387.096	393.548	399.999	406.451	412.902	419.354	425.806	432.257	438.709	445.160	60
70	451.612	458.064	464.515	470.967	477.418	483.870	490.322	496.773	503.225	509.676	70
80	516.128	522.580	529.031	535.483	541.934	548.386	554.838	561.289	567.741	574.192	80
90	580.644	587.096	593.547	599.999	606.450	612.902	619.354	625.805	632.257	638.708	90
100	645.160	651.612	658.063	664.515	670.966	677.418	683.870	690.312	696.773	703.224	100

SQUARE CENTIMETERS TO SQUARE INCHES

cm^2	0 in^2	1 in^2	2 in^2	3 in^2	4 in^2	5 in^2	6 in^2	7 in^2	8 in^2	9 in^2	cm^2
-		0.155	0.310	0.465	0.620	0.775	0.930	1.085	1.240	1.395	-
10	1.550	1.705	1.860	2.015	2.170	2.325	2.480	2.635	2.790	2.945	10
20	3.100	3.255	3.410	3.565	3.720	3.875	4.030	4.185	4.340	4.495	20
30	4.650	4.805	4.960	5.115	5.270	5.425	5.580	5.735	5.890	6.045	30
40	6.200	6.355	6.510	6.665	6.820	6.975	7.130	7.285	7.440	7.595	40
50	7.750	7.905	8.060	8.215	8.370	8.525	8.680	8.835	8.990	9.145	50
60	9.300	9.455	9.610	9.765	9.920	10.075	10.230	10.385	10.540	10.695	60
70	10.850	11.005	11.160	11.315	11.470	11.625	11.780	11.935	12.090	12.245	70
80	12.400	12.555	12.710	12.865	13.020	13.175	13.330	13.485	13.640	13.795	80
90	13.950	14.105	14.260	14.415	14.570	14.725	14.880	15.035	15.190	15.345	90
100	15.500	15.655	15.810	15.965	16.120	16.275	16.430	16.583	16.740	16.895	100

VOLUME

CUBIC INCHES TO CUBIC CENTIMETERS

in^3	0 cm^3(cc)	1 cm^3(cc)	2 cm^3(cc)	3 cm^3(cc)	4 cm^3(cc)	5 cm^3(cc)	6 cm^3(cc)	7 cm^3(cc)	8 cm^3(cc)	9 cm^3(cc)	in^3
-		16.387	32.774	49.161	65.548	81.935	98.322	114.709	131.097	147.484	-
10	163.871	180.258	196.645	213.032	229.419	245.806	262.193	278.580	294.967	311.354	10
20	327.741	344.128	360.515	376.902	393.290	209.677	426.064	442.451	458.838	475.225	20
30	491.612	507.999	524.386	540.773	557.160	573.547	589.934	606.321	622.708	639.095	30
40	655.483	671.870	688.257	704.644	721.031	737.418	753.805	770.192	786.579	802.966	40
50	819.353	835.740	852.127	868.514	884.901	901.289	917.676	934.063	950.450	966.837	50
60	983.224	999.611	1015.998	1032.385	1048.772	1065.159	1081.546	1097.933	1114.320	1130.707	60
70	1147.094	1163.482	1179.869	1196.256	1212.643	1229.030	1245.417	1261.804	1278.191	1294.578	70
80	1310.965	1327.352	1343.739	1360.126	1376.513	1392.900	1409.288	1425.675	1442.062	1458.449	80
90	1474.836	1491.223	1507.610	1523.997	1540.384	1156.771	1573.158	1589.545	1605.932	1622.319	90
100	1638.706	1655.093	1671.481	1687.868	1704.255	1720.642	1737.029	1753.416	1769.803	1786.190	100

CUBIC CENTIMETERS TO CUBIC INCHES

cm^3(cc)	0 in^3	1 in^3	2 in^3	3 in^3	4 in^3	5 in^3	6 in^3	7 in^3	8 in^3	9 in^3	cm^3(cc)
-		0.0610	0.1220	0.1831	0.2441	0.3051	0.3661	0.4272	0.4882	0.5492	-
10	0.6102	0.6713	0.7323	0.7933	0.8543	0.9153	0.9764	1.0374	1.0984	1.1594	10
20	1.2205	1.2815	1.3425	1.4035	1.4646	1.5256	1.5866	1.6476	1.7086	1.7697	20
30	1.8307	1.8917	1.9527	2.0138	2.0748	2.1358	2.1968	2.2579	2.1389	2.3799	30
40	2.4409	2.5020	2.5630	2.6240	2.6850	2.7460	2.8071	2.8681	2.9291	2.9901	40
50	3.0512	3.1122	3.1732	3.2342	3.2952	3.3563	3.4173	3.4783	3.5393	3.6004	50
60	3.6614	3.7224	3.7834	3.8444	3.9055	3.9665	4.0275	4.0885	4.1496	4.2106	60
70	4.2716	4.3326	4.3937	4.4547	4.5157	4.5767	4.6377	4.6988	4.7598	4.8208	70
80	4.8818	4.9429	5.0039	5.0649	5.1259	5.1870	5.2480	5.3090	5.3700	5.4310	80
90	5.4921	5.5531	5.6141	5.6751	5.7362	5.7972	5.8582	5.9192	5.9803	6.0413	90
100	6.1023	6.1633	6.2243	6.2854	6.3464	6.4074	6.4684	6.5295	6.5905	6.6515	100

YES

• Is there continuity between the engine room harness connector terminal No.2 (X-15) and ground?

NO

Open circuit between the engine room harness connector terminal No.1 (X-15).

YES

• Is there battery voltage between the engine room harness connector terminal No.3 (X-15) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (X-15).

YES

• Disconnect the pressure switch.

• Is there continuity between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 2 (C-24)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (X-15).

YES

• Disconnect the condenser fan relay connector condenser fan.

• Is there continuity between the relay terminal No.3 (X-13)and engine room harness connector terminal No.3 (C-24)?

NO

Open circuit between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 2 (C-24).

YES

• Is there battery voltage between the engine room harness connector terminal No.4 (C-24) and ground?

NO

Open circuit between the condenser fan relay No. 3 (X-13) and engine room harness connector terminal No.3 (C-24).

Lack of Power, Sluggishness, Sponginess

Checks	Action
DEFINITION:The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Have the tire sizes changed? • Are excessively heavy loads being carried? • Inspect for clutch slip. • Inspect brake drag. • Inspect for a proper transmission shift pattern and down shift operation (A/T only). • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the scan tool to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the scan tool to observe the Accelerator Pedal Position Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

Checks	Action
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the engine overheat condition. Refer to the Engine Cooling section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation (A/T only).

Hesitation, Sag, Stumble

Checks	Action
DEFINITION:The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. If severe enough, the condition may cause the engine to stall.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the scan tool Data List in this section. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the scan tool to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the scan tool to observe the Accelerator Pedal Position Accelerator Pedal Position. Accelerator Pedal Position parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or fuel leakage into the engine oil. • Inspect the fuel lines between the fuel tank and fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel injection pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel injection pump internal pressure fluctuations especially at high engine speed and load. • Inspect for air in the fuel system. **Notice:** If many air bubbles appear in the fuel, check the fuel system line connections between the fuel tank and the fuel injection pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. a. Remove the fuel hose that connects to the fuel injection pump suction side. b. Substitute a clear hose. **Notice:** A hose must be cleaned. c. Connect the clear hose to the fuel injection pump. d. Bleed the fuel system. e. Let the engine run at idle for at least 2 minutes. f. Accelerator the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the clear hose. • Inspect the fuel tank vent hose for a plugged or kinked. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. Draw fuel from the fuel tank at the fuel line (as close to the fuel tank as possible) going to the fuel pickup tube to verify a clean stream of fuel comes out (use the hand-held vacuum pump 5-8840-0279-0/J-23738-A with a clear hose or equivalent). This will ensure the fuel pickup tube is not cracked drawing air into the fuel line. • Inspect the fuel injection pump operation. **Notice:** The fuel injection pump must be timed to the engine. • Inspect the eye bolt for any type of restriction or collapsed gauze filter. **Notice:** If any type of restriction found, check for a condition that causes contaminated fuel, such as the customer is using an aftermarket fuel filter or extended maintenance interval. Also inspect fuel waxing or icing that is caused by an incorrect fuel type used in winter season or water intrusion in the fuel system. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.

Checks	Action
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. Repair if less than 9 volts or more than 16 volts. • Inspect the EGR system operating correctly. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation.

Fuel Knock/Combustion Noise

Checks	Action
DEFINITION:A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the vehicle has an actual problem. • Inspect for smoke associated with the combustion noise. • Inspect the fuel quality (cetane index). • Inspect the scan tool Data List in this section. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the scan tool to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.
Fuel System Checks	• If excessive smoke is present, check for an injection nozzle(s).Remove each glow plug from the cylinder head and inspect the tip of the glow plugs for wet by fuel. Use the cylinder compression gauge. Proper compression is more than 2100 kPa (309 psi). If poor compression is observed, inspect the engine mechanical. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber.
Additional Checks	• Inspect the EGR system operating correctly. • Inspect other possible causes that can make similar noise such as loose component parts, bracket, mount and weak clutch damper spring.

Poor Fuel Economy

Checks	Action
DEFINITION:Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.	
Preliminary Checks	• Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the driving habits of the owner. • Is the A/C ON full time, defroster mode ON? • Are the tires at the correct pressure? • Are the tire sizes changed? • Are excessively heavy loads being carried? • Is the acceleration too much, too often? • Inspect for clutch slip. • Inspect brake drag. • Inspect dive belt tension. • Inspect for a proper transmission shift pattern and down shift operation (A/T only). • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Suggest to the owner to fill the fuel tank and recheck the fuel economy. • Suggest to the driver to read the Important Facts on Fuel Economy in the Owner Manual. • Inspect the odometer is correctly operated. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. Refer to the Cooling System Section. • Inspect the engine coolant level. • Inspect the engine thermostat for always being open or for the wrong heat range. • Inspect the engine cooling fan for always being ON.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi).

Excessive Smoke (Black Smoke)

Checks	Action
DEFINITION:Black smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the Service Bulletins for ECM software updates.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Use the scan tool to compare the MAF Sensor parameter with the Desired MAF parameter. Start the engine and warm up (allow engine coolant temperature to reach at least 60°C [140°F]). The MAF Sensor parameter must follow the Desired MAF parameter within 100 mg/strk. If not, inspect the air intake system, EGR system components and contaminated, skewed or slow MAF sensor. • Use the scan tool to observe the Accelerator Pedal Position Accelerator Pedal Position. Accelerator Pedal Position indicating angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or deposit in the intake throttle bore. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the catalytic converter or exhaust pipes.
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber. • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the EGR system operating correctly. • Inspect the excessive blow-by gasses. • Inspect the scan tool Data List in this section.

Excessive Smoke (White Smoke)

Checks	Action
DIFINITION:White smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the engine control module (ECM) and fuel injection pump control unit (PCU) grounds for being clean, tight, and in their proper locations. • Inspect the fuel quality (cetane index). • Inspect the Service Bulletins for ECM software updates.
Sensor Check	Inspect the engine control sensors for the following conditions. Refer to the scan tool Data List in this section. • Use the scan tool to compare the Engine Coolant Temperature (ECT) with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT sensor may indicate a higher than normal intake air temperature if the ignition switch is being ON. FT sensor is internal to the PCU and it is part of the fuel injection pump assembly. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel injection nozzle(s) for proper splay condition or operating pressure. **Notice:** Only first stage of operating pressure can be checked. • Inspect the timing device operating correctly. Observe the Actual Injection Timing parameter with the scan tool while running the engine. The Actual Injection Timing parameter must follow the Desired Injection Timing within 2°CA on each engine speed. Engine idle > around 2000 RPM> around 3000 RPM. If not, inspect the fuel system restriction, air in the fuel or fuel injection pump operation.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction or leak in the intercooler. • Inspect for a restriction in the turbocharger inlet duct. • Inspect for a restriction or leak in the intake manifold. • Inspect for a restriction or damage at MAF sensor. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 2100 kPa (309 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Improper mechanical timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for any excessive fuel entering combustion chamber. • Inspect for coolant entering the combustion chamber.
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. • Inspect the glow plug control (preheating) system operation.

Repair Instructions

Engine Control Module (ECM) Replacement

Engine Control Module (ECM) Replacement Procedure

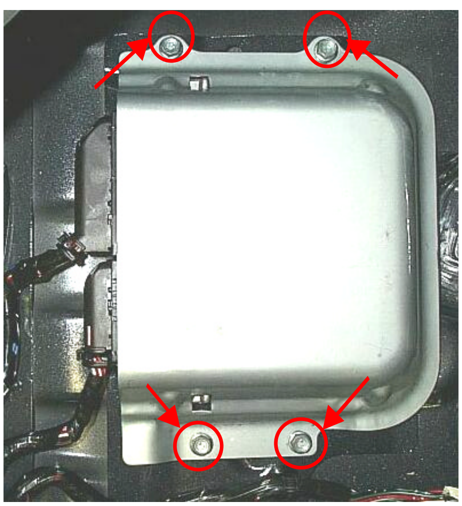
Important:

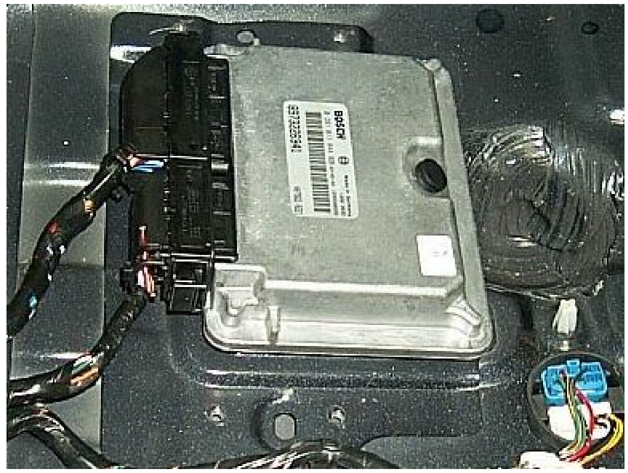
If the ECM is to be replaced the following programmed contents MUST be reprogrammed into the new ECM.

- Vehicle identification number (VIN).
- Latest software/calibrations if released. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the seat left-hand side.
3. Roll up the floor carpet.
4. Remove four bolts from the ECM cover.
5. Disconnect the two connectors from the ECM.





Installation Procedure

1. Connect the two connectors to the ECM.
2. Put on the ECM to the floor panel.
3. Tighten the ECM cover by four bolts with specified tightening torque.

Tightening torque

- Bolts: 8.0 - 12.0 N.m (0.8 - 1.2 kgf.m)

4. Lay the floor carpet exactly.
5. Put on the seat to the floor panel and tighten with specified tightening torque.

Tightening torque

- Bolts: 40.0 N.m (4.1 kgf.m)

6. Connect the negative battery cable.

Vehicle Identification Number (VIN) Programming Procedure

Important:

If the ECM from another vehicle is installed, VIN is not programmed by the scan tool. Use the SPS to change the original VIN. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section.

Important:

If an updated software/calibrations is released, DO NOT program the VIN now. The VIN is programmed at SPS procedure. Refer to Service Programming System (SPS) Description and Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure) in this section.

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 4 (C-24).

YES

- connect the A/C thermo relay connector.

- Disconnect the electronic thermostat.

- Is there continuity between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 1 (C-24)?

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (C-55) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 1 (C-24).

YES

- Is there continuity between the engine room harness connector terminal No.1 (C-55) and the chassis side harness connector terminal No.5 (B-57) ? or (cooler only) the short connector terminal No.3 (B-79) and the chassis side harness connector terminal No.5 (B-57)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (C-55).

YES

- Is there continuity between the engine room harness connector (cooler only) terminal No. 4 (C-55) and the chassis side harness connector terminal No. 11 (B-57)?

NO

Open circuit between the engine room harness connector terminal No. 1 (C-55) or (cooler only) the short connector No. 3 (B-79) and the chassis side harness connector terminal No.5 (B-57).

1. Connect the scan tool to the vehicle DLC, with the engine and the scan tool OFF.
2. Turn ON the scan tool.
3. Select Diagnostic > appropriate vehicle identification > Powertrain > 4JH1-TC > Programming > Program VIN.
4. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle.

Select Lock ECU and lock the programmed VIN.

Service Programming System (SPS) Description

The service programming system (SPS) allows a technician to program a control module through the data link connector (DLC). The information transfer circuit that is used at the DLC is the same serial data circuit used be the scan tool for retrieving diagnostic trouble codes (DTCs), displaying data, clearing DTCs etc. This procedure offers the ability to install software/calibrations matched to a particular vehicle.

Most control modules have two types of memory. The software/calibrations reside in the flash memory. The two types of memory are listed below:

- Electrically Erasable Programmable Read Only Memory (EEPROM).
  This type of memory allows selected portions of memory to be programmed while other portions remain unchanged.
  Certain learned values reside in the EEPROM, such as:
  - The vehicle identification number (VIN)
  - The software/calibrations identification numbers
  - The control module security information
- Flash Read Only Memory-Flash Memory
  Flash memory has increased memory storage capacity. During programming, all information within this type of memory is erased, and then replaced with entirely new information.

Service Programming Methods

The two methods of programming an engine control module (ECM) are listed below:

- Remote Programming
- Pass Thru Programming

For information on programming an ECM using one of the methods listed above, refer to Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure).

Before Programming a Control Module

Important:

DO NOT program an existing ECM with the identical software/calibration package. This procedure is not a short cut to correct the driveability condition. This is an ineffective repair. An ECM should only be programmed when the following occurs:

- When a service procedure instructs you to replace the ECM. When the ECM from another vehicle is installed, VIN must be changed. And change vehicle information as necessary such as type of transmission.
- An updated software/calibrations is released.

Ensure that the following conditions are met before programming an ECM:

- The scan tool PCMCIA card is programmed with the latest software.
- The TIS 2000 is installed with the latest software.
- The hardware key is plugged into the computer port.
- Vehicle system voltage:
  - There are no charging system concerns. All charging system concerns must be repaired before programming the ECM.
  - The battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the ECM.
  - A battery charger is NOT connected to the vehicles battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or ECM damage.
  - Turn OFF or disable any system that may put a load on the vehicles battery. Turn OFF or disable systems such as:
    ◊ Heating, ventilation, and air conditioning (HVAC) systems
    ◊ Headlights
    ◊ Room lights
    ◊ Accessory equipment
- The ignition switch is in the proper position. The scan tool prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure unless instructed to do so.
- All tool connections are secure:
  - The RS-232 cable
  - The connection at the DLC
  - The voltage supply circuits

- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or ECM damage may occur.
- If you are performing the Pass-Thru programming procedure using a notebook computer without the power cord, ensure that the internal battery is fully charged.

Service Programming System (SPS) (Remote Procedure)

The Remote Service Programming System (SPS) method is a three-step process that involves the following procedures:

1. Connecting the scan tool to the vehicle and obtaining the information from the engine control module (ECM).
2. Connecting the scan tool to the terminal and downloading a new calibration file from the terminal into the scan tool memory.
3. Reconnecting the scan tool to the vehicle and uploading the new calibration file into the ECM.

Performing the Remote Procedure

1. Connect the scan tool to the vehicle and obtain the ECM information using the following procedure:

Important:
Ensure the ECM is installed in the vehicle and the battery is fully charged before programming.

   a. Connect the scan tool to the vehicle data link connector (DLC), with the engine and the scan tool OFF.
   b. Turn ON the scan tool.
   c. Press Enter at the title screen.
   d. Turn ON the ignition, with the engine OFF.
   e. Select Service Programming System at the Main Menu.
   f. Select Request Info.
   g. If there is already stored in the scan tool, the existing data is displayed on the screen. The scan tool asks user to keep existing data Keep Data or Continue to request new vehicle information from the ECM. If there is no data in the scan tool, it will immediately start vehicle identification.
   h. Enter the vehicle description by following the on-screen instructions based on stamped VIN or affixed VIN plate on the vehicle.
   i. During obtaining information, the scan tool is receiving information from any modules at the same time. But only ECM information is displayed on the screen.
   j. Turn OFF all accessories and select Continue.
   k. Verify that the correct VIN is entered on the scan tool. If the VIN is incorrect, write down the correct VIN.
2. Turn OFF the scan tool.
3. Disconnect the scan tool from the vehicle.
4. Turn OFF the ignition.
5. Transfer the data from the terminal to the scan tool using the following procedure:

Important:
The TIS supports service programming with the scan tool scan tool only.

   a. Connect the scan tool to the terminal.
   b. Launch the TIS application at the terminal.
   c. Select the Service Programming System at the main screen.
   d. Highlight the following information on the Select Diagnostic Tool and Programming Process screen:
      - Select Diagnostic Tool-Select scan tool.
      - Select Programming Process-Identify whether an existing ECM is being reprogrammed or an ECM is being replaced with a new one.
      - Select ECU Location-Select Vehicle.
   e. Select Next.
   f. Verify the connections on the Preparing for Communication screen and select Next.
   g. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen and select Next.

Important:
If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

   h. Highlight Engine on the System Type screen and select Next, if requested.
   i. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until Next is highlighted:
      - Model
      - Model Year
      - Engine
      - Type of Transmission

- Destination Code

j. Select Next.
k. Verify your selection on the Summary screen.

Important:

Refer to Service Bulletins before service programming is performed if the bulletins are listed along with the calibration files.

Important:

Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the ECM and reprogramming with the same download is not allowed.

l. Select Reprog.
m. The Transfer Data screen will appear until the progress bar reaches 100%.

6. Close the application and return to the TIS application selection screen after the download is complete.
7. Turn OFF the scan tool.
8. Disconnect the scan tool from the terminal.
9. Transfer the data from the scan tool to the ECM using the following procedure:
   a. Connect the scan tool to the vehicle DLC, with the engine and the scan tool OFF.
   b. Turn ON the scan tool.
   c. Press Enter at the Title screen.
   d. Turn ON the ignition, with the engine OFF.
   e. Select Service Programming System.
   f. Select the Program ECU on the scan tool.
   g. Follow the on-screen instructions and select Continue.
   h. Programming in Process will appear until the progress bar reaches 100%.

Important:

The vehicle fitted with automatic transmission, Check Trans lamp may blink while programming the ECM since communication between the ECM and TCM is interrupted. Clear DTC in any module after programming.

   i. Select Continue and exit the program after the scan tool displays Programming Was Successful.

10. Turn OFF the ignition.
11. Turn OFF the scan tool.
12. Disconnect the scan tool from the vehicle.

Service Programming System (SPS) (Pass-Thru Procedure)

Pass-Thru programming allows the scan tool to remain connected to the terminal and to the vehicle throughout the programming process. The vehicle must be in close proximity to the terminal while using Pass-Thru.

Important:

The TIS supports service programming with the scan tool scan tool only.

1. Launch the TIS application at the terminal.
2. Select the Service Programming System at the main screen.
3. Highlight the following information on the Select Diagnostic Tool and Programming Process screen:
   - Select Diagnostic Tool-Select Pass-Thru
   - Select Programming Process-Identify whether as existing engine control module (ECM) is being reprogrammed or an ECM is being replaced with a new one.
   - Select ECU Location-Select Vehicle.
4. Select Next.
5. Complete all vehicle data on the Preparing for Communication/Determine Vehicle screen until Next is highlighted.
6. Select Next.
7. Follow the instruction on the Preparing for Communication screen.

Important:

In order to reduce the potential for signal loss, the RS-232 cable should not be more than 25 feet long.

8. Select Next.
9. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen and select Next.

Important:

If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

10. Highlight Engine on the System Type screen and select Next, if requested.
11. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until Next is highlighted:
    - Model
    - Model Year
    - Engine
    - Type of Transmission
    - Destination Code
12. Select Next.
13. Verify your selection on the Summary screen.

Important:

Refer to Service Bulletins before service programming is performed if the bulletins are listed along with the calibration files.

Important:

Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the scan tool and reprogramming with the same download is not allowed.

14. Select Reprog.
15. The Transfer Data screen will appear until the progress bar reaches 100%.

Important:

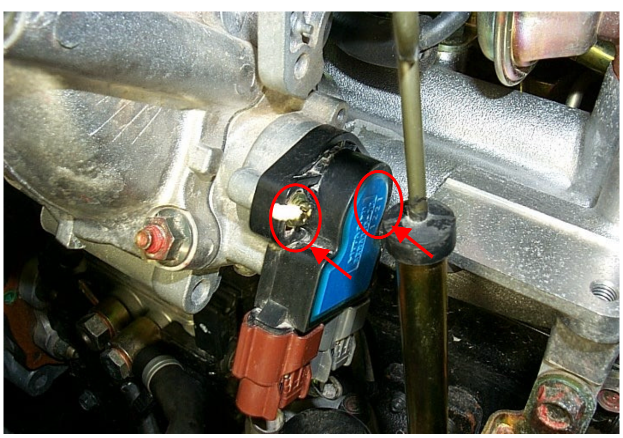
The vehicle fitted with automatic transmission, Check Trans lamp may blink while programming the ECM since communication between the ECM and TCM is interrupted. Clear DTC in any module after programming.

16. Select Close on the Programming Complete screen.
17. Turn OFF the scan tool.
18. Disconnect the scan tool from the vehicle.

Accelerator Pedal Position (APP) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the APP sensor connector.
3. Loosen two screws and remove APP sensor from the throttle body.



Installation Procedure

1. Temporary tighten the APP sensor by two screws.
2. Connect a APP sensor connectors to the APP sensor.
3. Connect the Tech2 to the vehicle.
4. Connect the negative battery cable.
5. Select "Data Display" with the Tech2.
6. Check the APP sensor data and adjust the APP sensor.
7. Tighten two screws.

Crankshaft Position (CKP) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect connector from the CKP sensor.
3. Loosen a bolt and remove the CKP sensor from the clutch housing.

Installation Procedure

1. Install the CKP sensor to the clutch housing.
2. Tighten CKP sensor by a bolt with specified tightening torque.

Tightening Torque

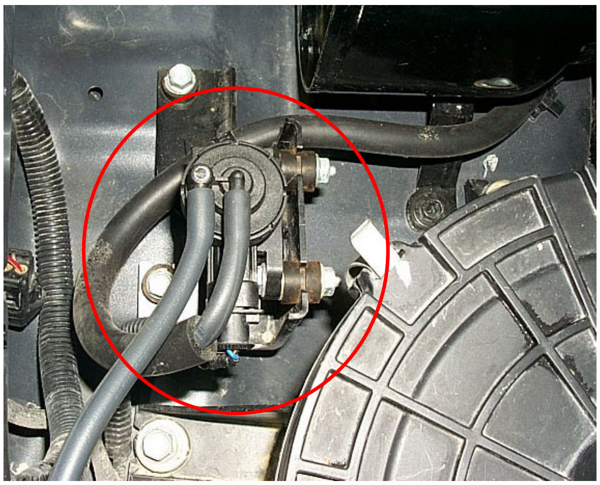
- Bolts: 8.0 - 12.0 N.m (0.8 - 1.2 kgf.m)

3. Connect a CKP sensor connector to the CKP sensor.
4. Connect the negative battery cable.

EGR Solenid Valve Replacement

Removal Procedure

1. Disconenct the negative battery cable.
2. Disconnect a EGR solenoid valve harness connector.
3. Disconnect two hoses from the EGR solenoid valve.
4. Loosen two bolts and remove the EGR solenoid valve from the bracket.



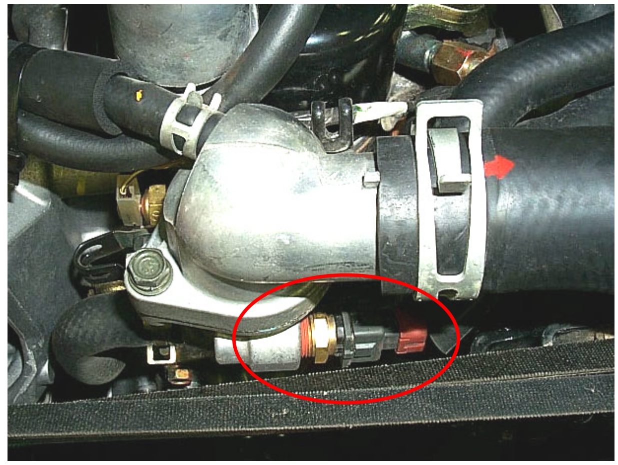
Installation Procedure

1. Tighten the purge solenoid by tow bolts.
2. Connect a connector to the EGR solenoid valve.
3. Connect two hoses to the EGR solenoid valve.
4. Connect the negative battery cable.

Engine Coolant Temperature (ECT) Sensor Replacement

1. Removal Procedure
2. Disconnect the negative battery cable.
3. Drain enough engine coolant so that the coolant level will be below the ECT sensor.
4. Disconnect connector from the ECT sensor.
5. Loosen and remove the ECT sensor from the thermostat housing.

Notice: Cool down the engine before above procedures are carried out.



Installation Procedure

1. Apply sealer to threads of screw at the ECT sensor.
2. Tighten the ECT sensor with specified tightening torque.

Tightening Torque

- Bolt: 13 N.m (1.3 kgf.m)

3. Connect a ECT sensor connector to the ECT sensor.
4. Fill the engine coolant.
5. Connect the negative battery cable.

Notice: Verify no engine coolant leaking from the sensor threads after replacement.

Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a MAF & IAT sensor connector from the MAF & IAT sensor assembly.
3. Loosen the clips and remove the MAF & IAT sensor assembly from the intake duct housing.

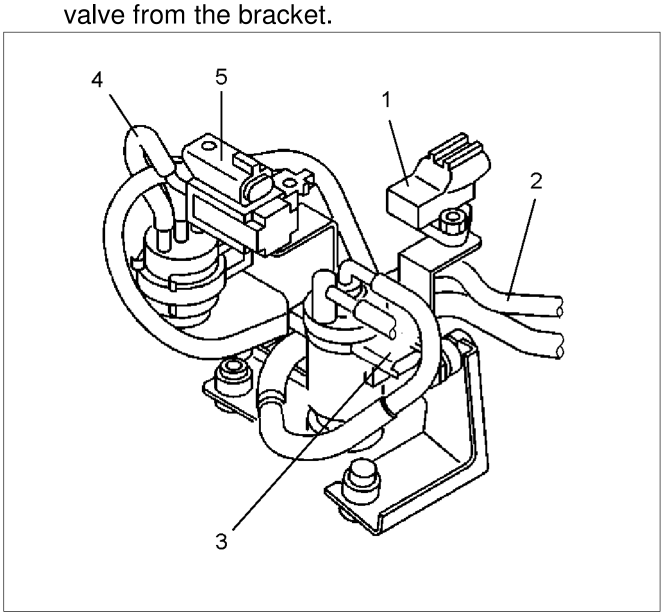
Installation Procedure

1. Install the MAF & IAT sensor assembly into intake air duct.
2. Tighten the clips.
3. Connect a MAF & IAT sensor connector to the MAF & IAT sensor assembly.
4. Connect the negative battery cable.

Turbocharger Solenoid Valve Replacement [High Altitude Spec]

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a harness connector from the turbocharger solenoid valve.
3. Disconnect two hoses from the turbocharger solenoid valve.
4. Loosen a nut and remove the turbocharger solenoid valve from the bracket.



RTW66ESH004001

Legend

1. Vaccum Pressure Sensor
2. To Turbocharger
3. EGR Solenoid Valve
4. To Vacuum Regulating Valve
5. Turbocharger Solenoid Valve

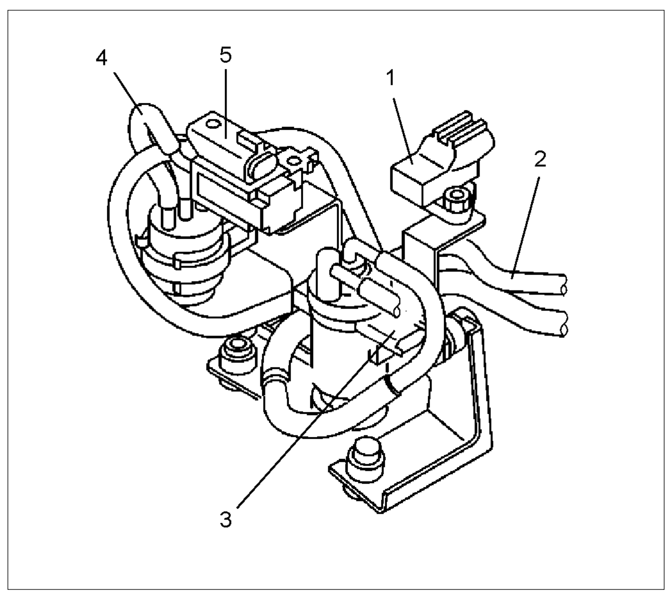
Installation Procedure

1. Set the turbocharger solenoid valve on the bracket and tighten a nut.
2. Connect a harness connector to the turbocharger solenoid valve.
3. Connect two hoses to the turbocharger solenoid valve.
4. Connect the negative battery cable.

Vacuum Pressure Sensor Replacement [High Altitude Spec]

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a harness connector from the vacuum pressure sensor.
3. Loosen a bolt and remove the vacuum pressure sensor from the bracket.



RTW66ESH004001

Legend

1. Vaccum Pressure Sensor
2. To Turbocharger
3. EGR Solenoid Valve
4. To Vacuum Regulating Valve
5. Turbocharger Solenoid Valve

Installation Procedure

1. Set the vacuum pressure sensor on the bracket and tighten a bolt.
2. Connect a harness connector to the vacuum pressure sensor.
3. Connect the negative battery cable.

Vehicle Speed Sensor (VSS) Replacement

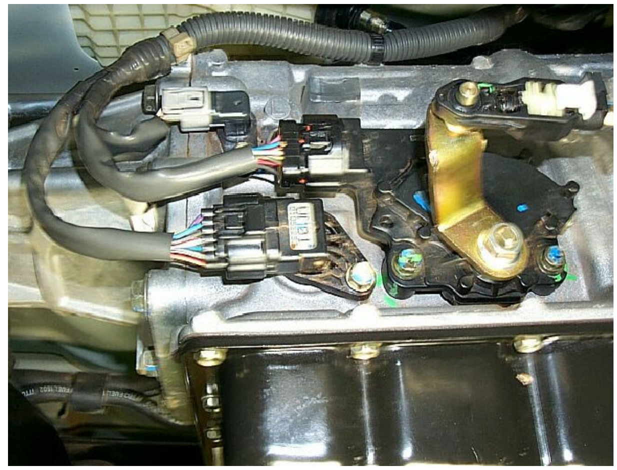
Removal Procedure

M/T & A/T (4WD)

1. Disconnect the negative battery cable.
2. Disconnect a harness connector from the vehicle speed sensor (VSS).
3. Remove the VSS from the transmission.

A/T (2WD)

1. Disconnect the negative battery cable.
2. Disconnect a harness connector from the vehicle speed sensor (VSS).
3. Loosen a bolt and remove the VSS from the transmission.



Installation Procedure

M/T & A/T (4WD)

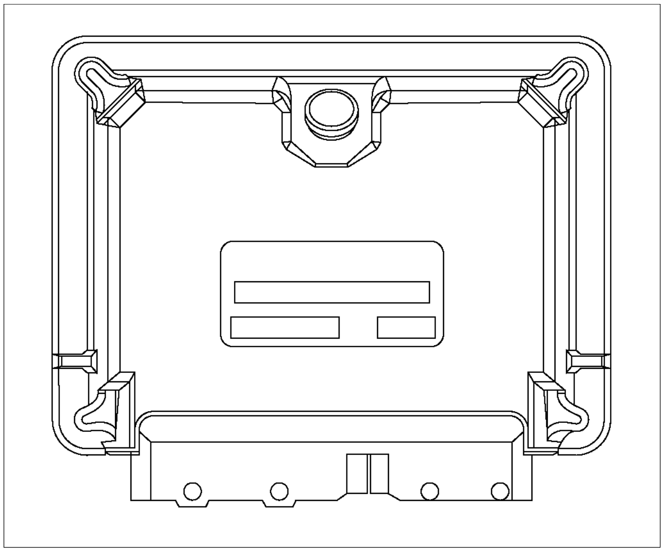
1. Install the VSS at the transmission.
2. Connect a harness connector to the VSS.
3. Connect the negative battery cable.

M/T & A/T (4WD)

1. Set the VSS at the transmission and tighten a bolt.
2. Connect a harness connector to the VSS.
3. Connect the negative battery cable.

Description And Operation

Engine Control Module (ECM) Description



RTW66ESH001201

The engine control module (ECM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM circuits unless instructed to do so. In some cases, these circuits should only be tested using a digital multi meter (DMM). The ECM should remain connected to the ECM harness.

The ECM is located on the floor panel. The ECM mainly controls the following.

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The preheating (glow) system control
- The A/C compressor control
- On-board diagnostics for engine control

The ECM constantly observes the information from various sensor s. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. The ECM can recognize operational problems, alert the driver through the malfunction indicator lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the system faults to aid the technician in making repairs.

ECM Voltage Description

The ECM supplies a buffered voltage to various switches and sensor s. The ECM can do this because resistance in the ECM is so high in value that a test lamp may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megaohm input impedance DMM, to ensure accurate voltage readings. The input and/or output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned ON.

Aftermarket Electrical and Vacuum Equipment

Aftermarket or add-on electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after the vehicle leaves the factory. No allowances have been made in the vehicle design for this type of equipment. No add-on vacuum equipment should be added to this vehicle. Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery power and ground. Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and audios. Therefore, the first step in diagnosing any powertrain fault is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the fault still exists, the fault may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. By comparison, as much as 4,000 volts may be needed for a person to feel even the zap of a static discharge. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.

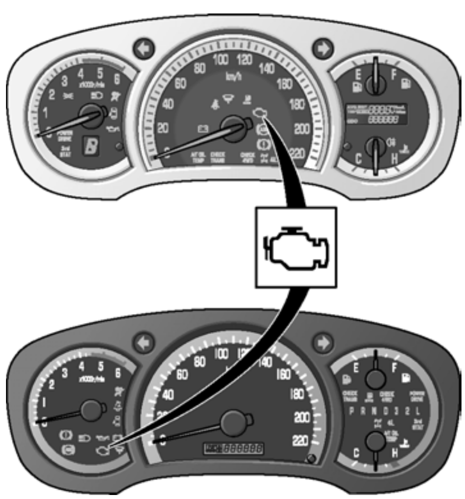
Important:

To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with opposite polarity.

Malfunction Indicator Lamp (MIL) Operation

The malfunction indicator lamp (MIL) is located in the instrument panel cluster (IPC). The MIL will display the following symbols when commanded ON:



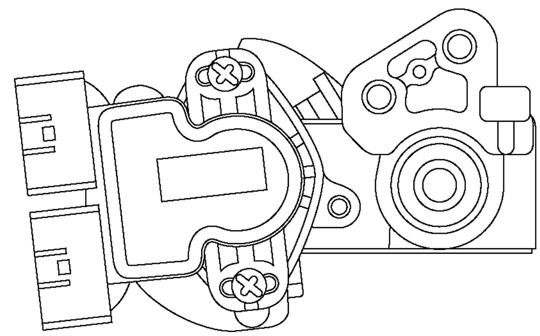
RTW76ESH004001

The MIL indicates that an emission or performance related fault has occurred and vehicle service is required. The following is a list of the modes of operation for the MIL:

- The MIL illuminates for approximately 2 seconds when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- The MIL remains illuminated after the engine is started if the ECM detects a fault. A DTC is stored any time the ECM illuminates the MIL due to an emission or performance related fault.

Engine Control Component Description

Accelerator Pedal Position (APP) Sensor & Idle Switch

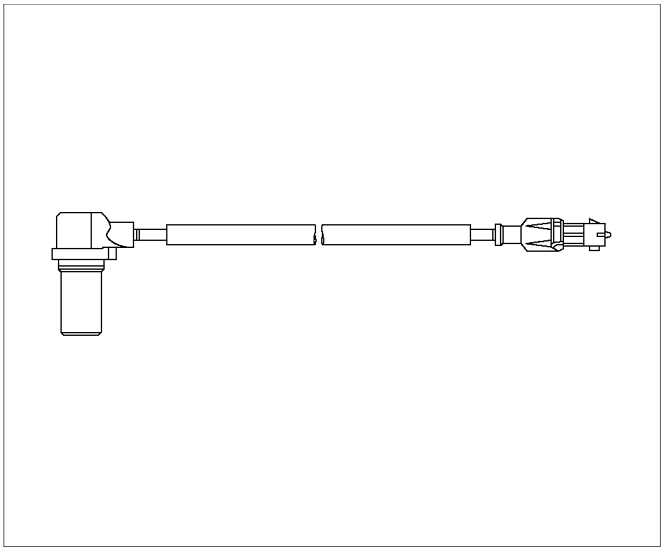


RTW66ESH001301

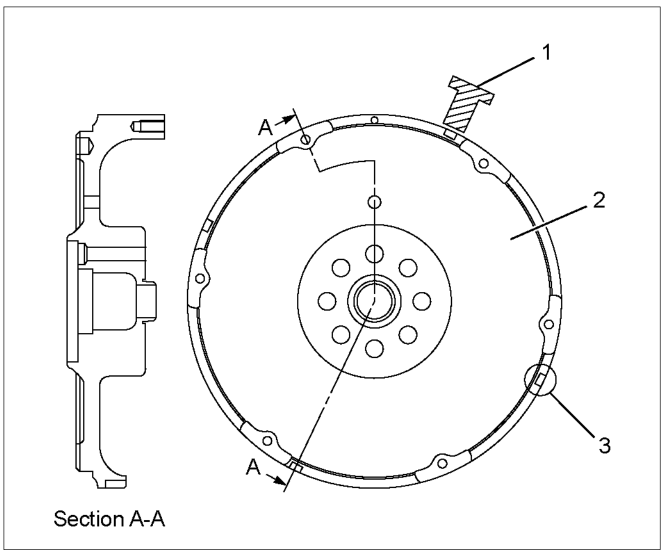
The accelerator pedal position (APP) sensor is mounted on the throttle assembly. The engine control module (ECM) uses the APP sensor s to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injection control.

The idle switch is also mounted on the intake throttle assembly. The idle switch is part of the APP sensor assembly. The idle switch is a normally closed type switch. When the accelerator pedal is released, the idle switch signal to the ECM is low voltage.

Crankshaft Position (CKP) Sensor



RTW06ESH000101



RTW66ESH001401

Legend

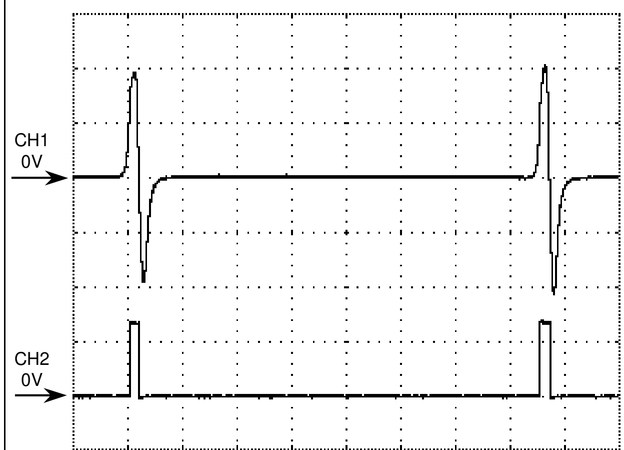
1. Crankshaft Position (CKP) Sensor
2. Flywheel
3. Slit

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 4 slits spaced 90° on the flywheel circumference. The CKP sensor is a magnetic coil type sensor , which generates an AC signal voltage based on the crankshaft rotational speed. The ECM monitors both the CKP sensor and injection pump camshaft position (CMP) sensor signals to ensure they correlate with each other.

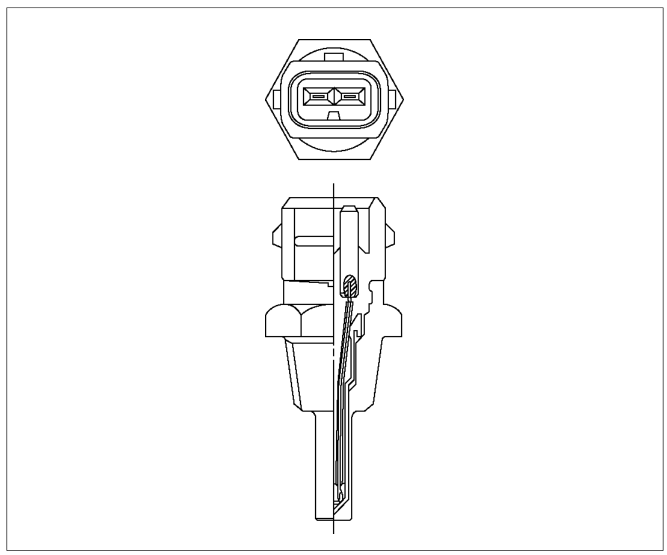
The following waveform aids to diagnose when there is an oscilloscope or equivalent.

Engine Coolant Temperature (ECT) Sensor

- Amplitudes of CKP sensor signal (CH1) increase as engine speed increases.
- Each waveform cycle shorten as the engine speed increases.



Terminal: 90 (CH1), 91 (CH2) (+) / GND (-)
Scale: 10V/div 2ms/div
Condition: Approximately 1000RPM



RTW66ESH001501

Legend

1. Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit.

YES

- Is there battery voltage between the chassis side harness connector terminal No. 10 (B-57) and ground?

NO

Open circuit between the engine room harness connector (cooler only) terminal No. 4 (C-55) and the chassis side harness connector terminal No. 11 (B-57).

YES

- Disconnect the A/C switch.

- Is there battery voltage between the chassis side harness connector terminal No. 6 (B-57) and ground (C-109)?

NO

Open circuit between the chassis side harness connector No. 1 (B-79) and the chassis side harness connector terminal No. 10 (B-57).

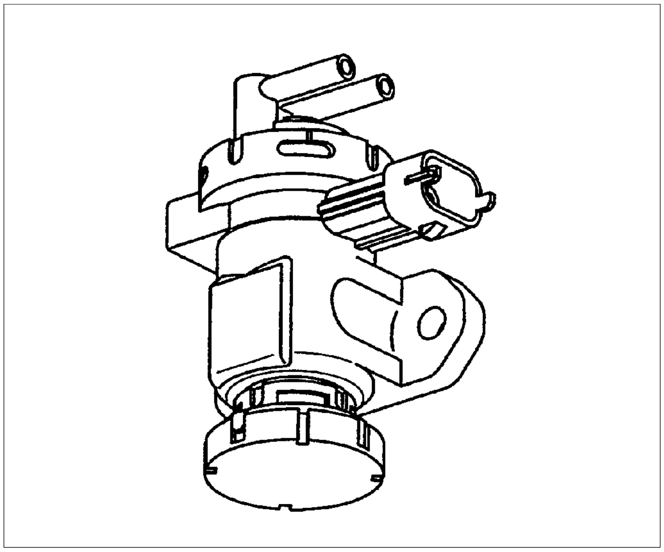
YES

- Defective ECM

NO

Open circuit between the No. EB-13 fuse and the chassis side harness connector No. 6 (B-57).

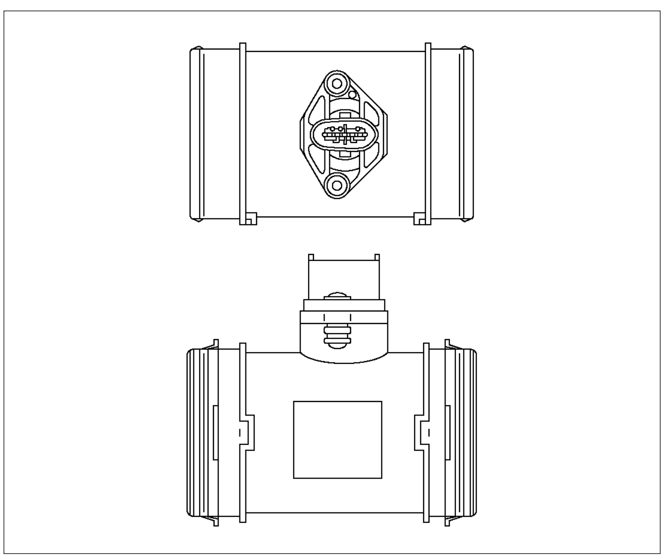
Exhaust Gas Recirculation (EGR) Solenoid Valve



RTW76ESH003601

The engine control module (ECM) controls the exhaust gas recirculation (EGR) flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR solenoid valve. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running.

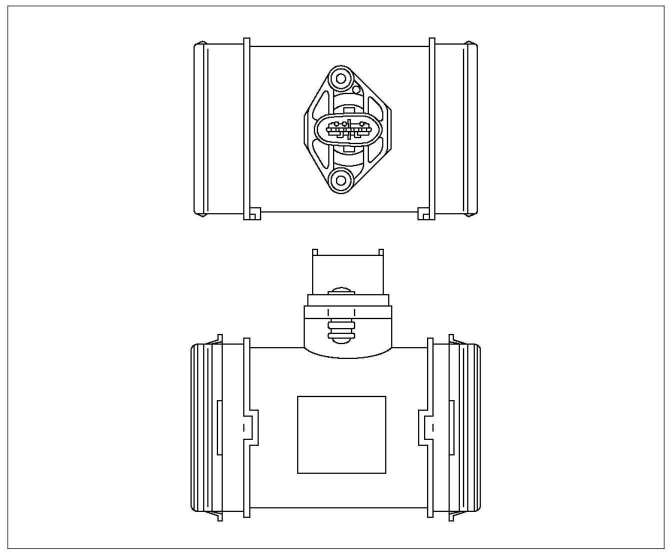
Intake Air Temperature (IAT) Sensor



RTW66ESH001701

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit.

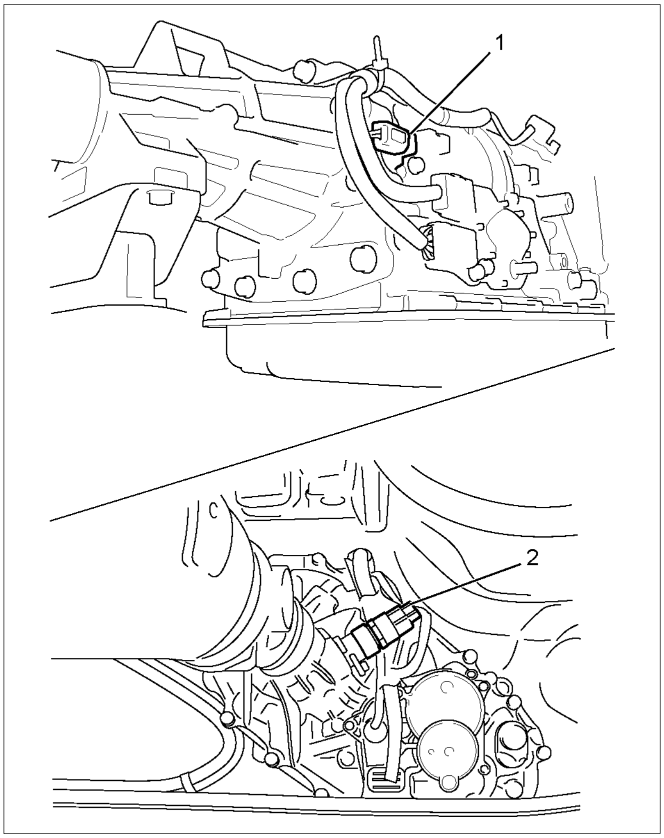
Mass Air Flow (MAF) Sensor



RTW66ESH001701

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor assembly consists of a MAF sensor element and an intake air temperature sensor that are both exposed to the air flow to be measured. The MAF sensor element measures the partial air mass through a measurement duct on the sensor housing.

Vehide Speed Sensor (VSS)



RTW56EMH000301

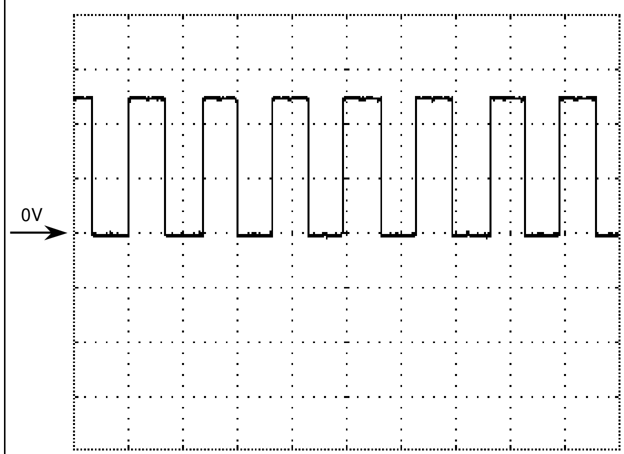
Legend

1. Vehicle Speed Sensor (VSS) 2WD with A/T
2. Vehicle Speed Sensor (VSS) except 2WD with A/T

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS.

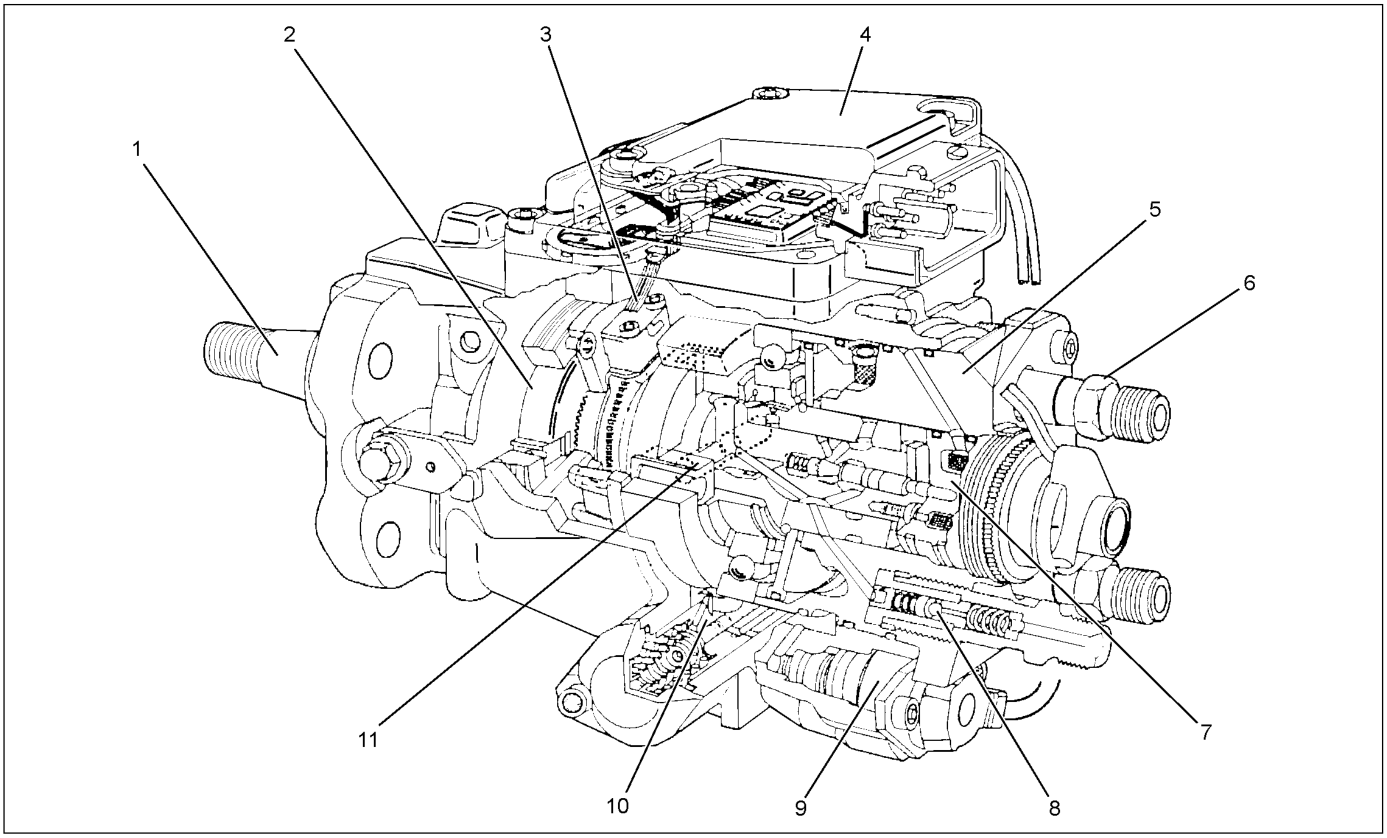
The following waveform aids to diagnose when there is an oscilloscope or equivalent.

- VSS waveform cycle shorten as the vehicle speed increases.



Terminal: 68 (+) / GND (-)
Scale: 5V/div 50ms/div
Condition: Approximately 20km/h (12MPH)

Fuel Injection System Description



Legend

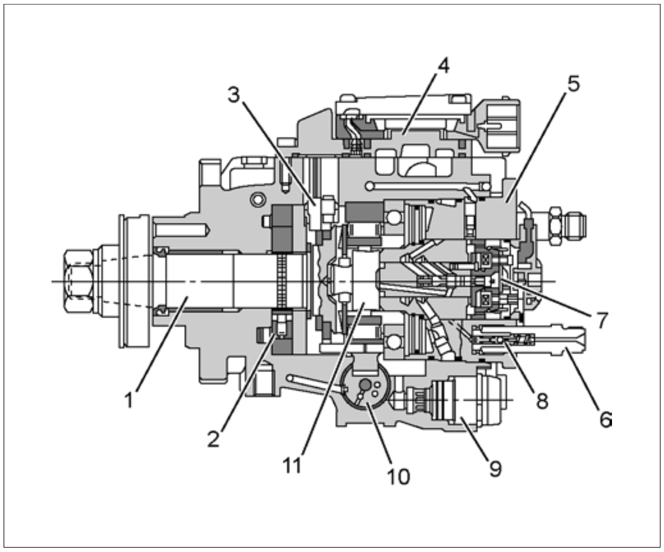
1. Drive Shaft
2. Fuel Feed Pump
3. Pump Camshaft Position (CMP) Sensor
4. Fuel Injection Pump Control Unit (PCU)
5. Distributor Head
6. Constant Pressure Valve (CPV) Holder
7. Fuel Injection Solenoid Valve
8. Constran Pressure Valve (CPV)
9. Timing Control Valve (TCV)
10. Timer
11. Radial Plunger

Bosch VP44 Fuel Injection Pump

Instead of the previous face cam type, the radial plunger distributor type injection pump utilizes a cam ring to enable fuel injection at high-pressures, marking it suitable for small, high-speed direct injection diesel engines. This pump was developed to provide the most suitable fuel injection quantity and injection timing to satisfy the demand for engine reliability, driveability, low smoke, low noise, high output and low exhaust emissions.

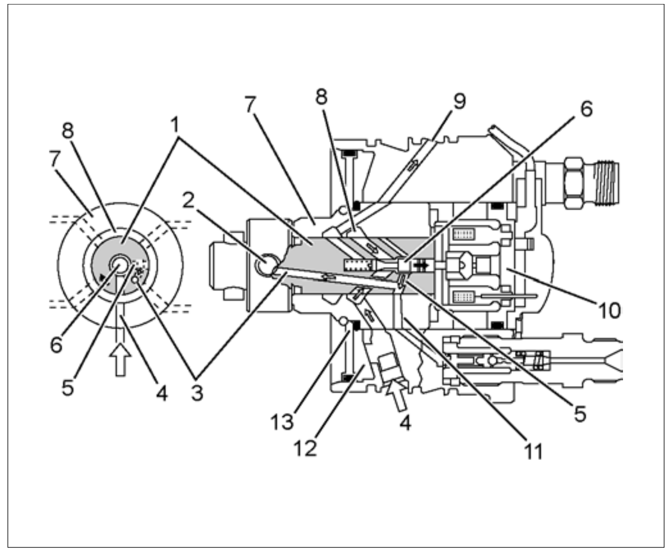
The engine control module (ECM) calculates the desired fuel injection quantity and timing using data sent from various sensor s. These desired data are sent to the fuel injection pump control unit (PCU) via a controller area network (CAN) communication bus. The PCU also receives signals from the internal inputs: pump camshaft position (CMP) sensor that is located inside the fuel injection pump to determine the cam ring rotation angle and the fuel injection pump speed. The fuel temperature (FT) sensor is internal the PCU. These values are used to compare the desired values sent from the ECM then PCU determines the injection timer piston position and fuel injection quantity, and actuates timing control valve (TCV) & fuel injection solenoid valve based on control maps in the PCU.

The timing device changes the optimum injection timing against various engine conditions. The pressure of the fuel fed from the feed pump is adjusted and it acts to the timing plunger by TCV controlled fuel pressure. (The TCV is installed to the fuel injection pump rear side and it is controlled by duty ratio cycle from the PCU.) The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement.



Legend

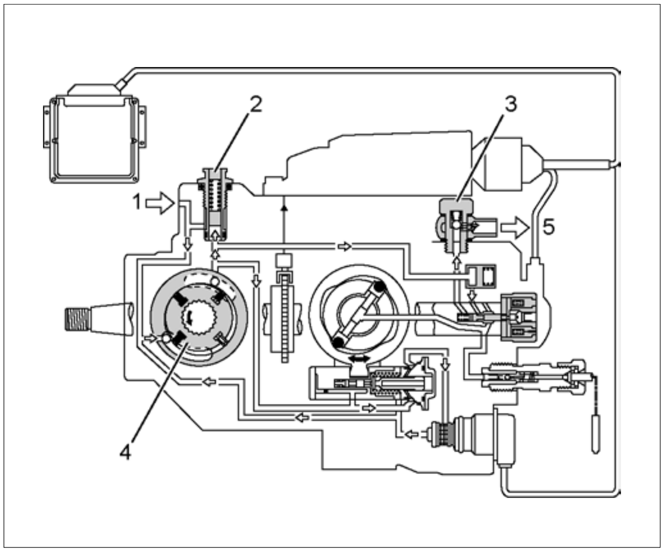
1. Drive Shaft
2. Feed Pump
3. Pump Camshaft Position (CMP) Sensor
4. Fuel Injection Pump Control Unit (PCU)
5. Distributor Head
6. Constant Pressure Valve (CPV) Holder
7. Fuel Injection Solenoid Valve
8. Constant Pressure Valve (CPV)
9. Timing Control Valve (TCV)
10. Timer
11. Radial Plunger



Legend

1. Rotor Shaft
2. Radial Plunger
3. High Pressure Passage
4. Low Pressure Inlet
5. Distribution Slit
6. Valve Needle
7. Barrel
8. Annular Passage
9. Fuel Return
10. Fuel Injection Solenoid Valve
11. High Pressure Outlet
12. Diaphragm Chamber
13. Accumulator Diaphragm

Low Pressure Fuel Circuit Description



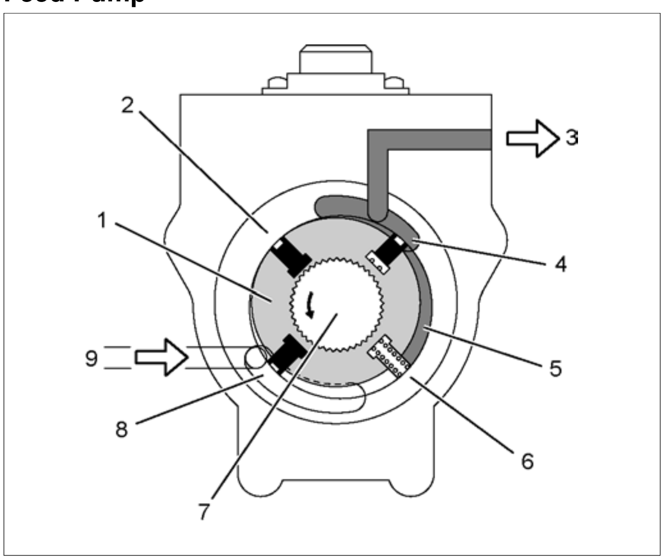
RTW66ESH002101

Legend

1. Fuel Suction
2. Regulating Valve
3. Overflow Valve
4. Feed Pump
5. To Fuel Tank

The low pressure fuel circuit must supply sufficient fuel to the high pressure fuel circuit. The main components are the feed pump, the regulating valve and the overflow valve.

Feed Pump



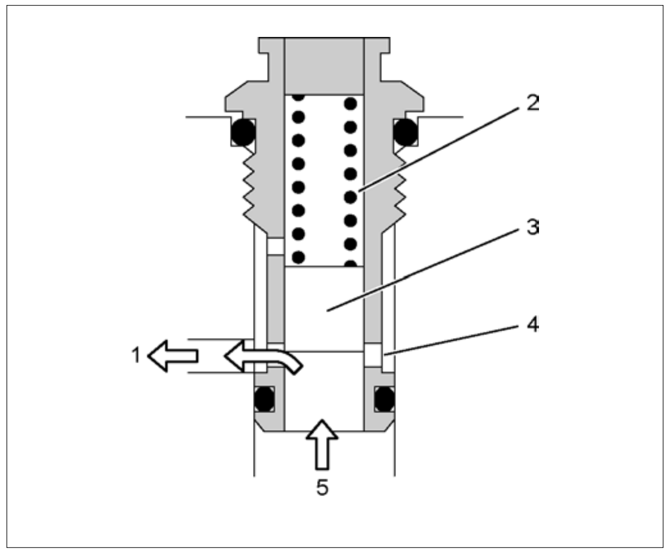
RTW66ESH002201

Legend

1. Rotor
2. Casing Ring
3. Fuel Supply
4. Outlet
5. Chamber
6. Vane
7. Driveshaft
8. Inlet
9. Fuel Suction

The feed pump is driven by the drive shaft, performs suction and supply of fuel. The vanes assembled in the rotor are pressed against the inside of the casing ring by spring forces and centrifugal force during rotation to form chambers. When the vanes rotate, the volume of these chambers increase when they reach recesses the casing ring connected to the inlet port. Pressure then decreases and fuel is drawn in. When the chambers have passed the inlets and recesses, the volume decreases and the fuel is compressed. Fuel pressure increases until the chamber reaches the outlet, where the fuel passes through the regulating valve to the high pressure fuel circuit.

Regulating Valve



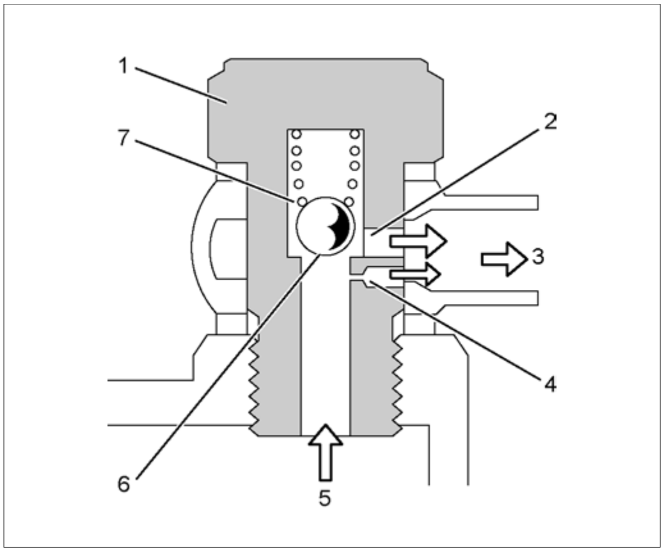
RTW66ESH002301

Legend

1. To Inlet
2. Spring
3. Valve Piston
4. Port
5. From Outlet

When feed pump speed increases so that the delivery pressure of the fuel delivered from the outlet exceeds the regulating valve spring force, the plunger is pushed upwards. Excess fuel passes through the ports and returns to the inlet side, and the delivery pressure is maintained within a specified range. When feed pump speed decreases so that the delivery pressure decreases, the plunger is pushed downwards by spring force to close the port.

Overflow Valve



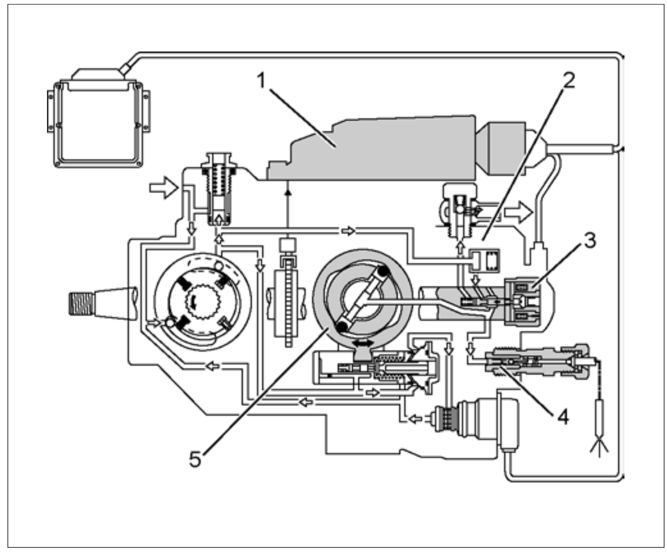
RTW66ESH002401

Legend

1. Valve Holder
2. Port
3. To Fuel Tank
4. Orifice Port
5. From Fuel Tank
6. Ball Valve
7. Spring

When the pressure of the fuel, returned from the distributor head, exceeds the spring force, the overflow valve's ball valve is pushed up. Excess fuel presses through the port and returns to the tank, and fuel pressure inside the pump chamber does not exceed a specified pressure. The flow of excess fuel serves cooling and automatic bleeding of the fuel pump during operation. Also the orifice port is installed to assist in automatic air bleeding.

High Pressure Fuel Circuit Description



RTW66ESH002501

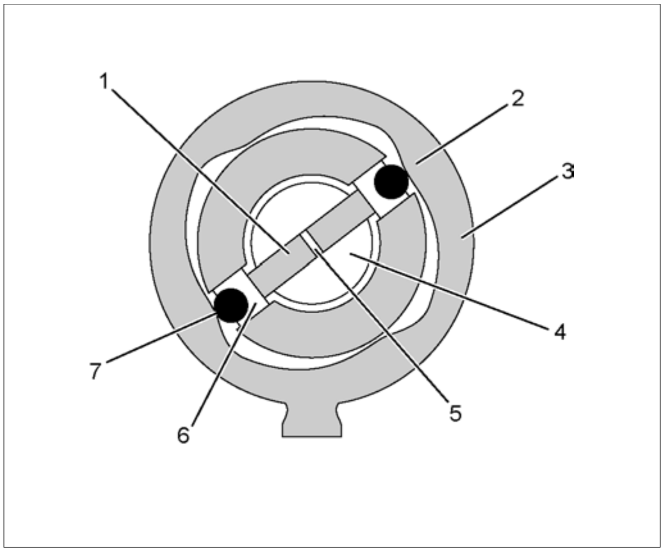
Legend

1. Fuel Injection Pump Control Unit (PCU)
2. Distributor Head
3. Fuel Injection Solenoid Valve
4. Constant Pressure Valve (CPV)
5. Radial Plunger

In addition high pressure generating device, the high pressure circuit also consists of fuel piping, and devices to set the beginning of injection and fuel injection quantity. The main components are as follows:

- High pressure generation: Radial Plunger
- Fuel distribution: Distributor Head
- Beginning of injection timing: Timing Device
- Prevention of secondary injection: Constant Pressure Valve (CPV)

Radial Plunger



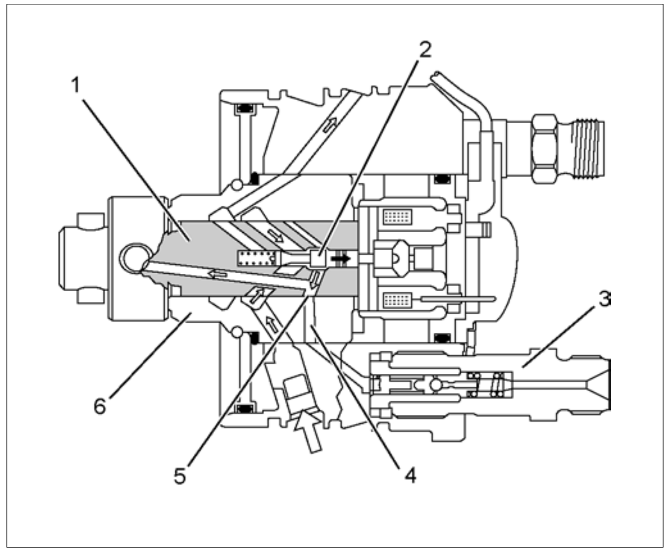
RTW66ESH002601

Legend

1. Radial Plunger
2. Internal Cam
3. Cam Ring
4. Rotor Shaft
5. Plunger Chamber
6. Roller Shoe
7. Roller

While the radial plungers assembled to the rotor shaft rotate, they are held against the inside of the cam ring (via the roller shoes and rollers) by fuel delivery pressure from the feed pump and centrifugal force. The radial plungers perform rotational movement as well as internal cam induced reciprocating movement to suck in and compress the fuel in the plunger chamber.

Distributor Head



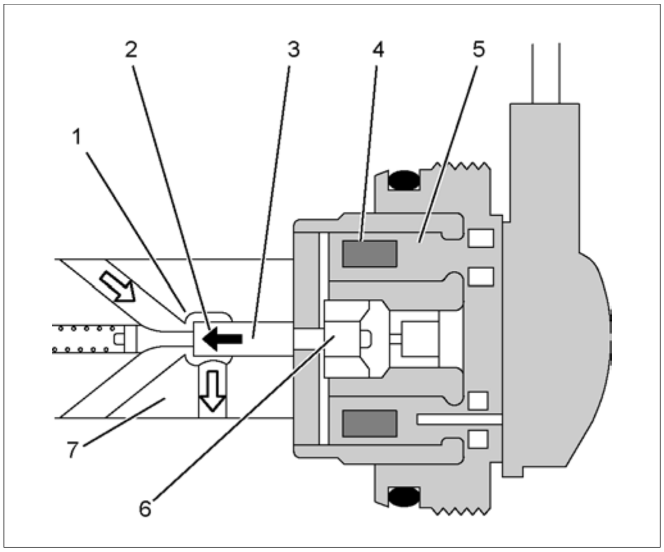
RTW66ESH002701

Legend

1. Rotor Shaft
2. Valve Needle
3. Constant Pressure Valve (CPV) Holder
4. High Pressure Outlet
5. Distributor Shaft
6. Barrel

The distributor head distribute the high pressure fuel that has flowed through the rotating rotor shaft's distributor slits and the barrel's high pressure outlets (4 cylinders: 4) to the engine cylinders via the constant pressure valve (CPV) and the nozzle holder assemblies. The fuel injection solenoid valve needle changes the passage to the radial plunger high pressure pump between fuel suction and fuel compression.

Fuel Injection Solenoid Valve



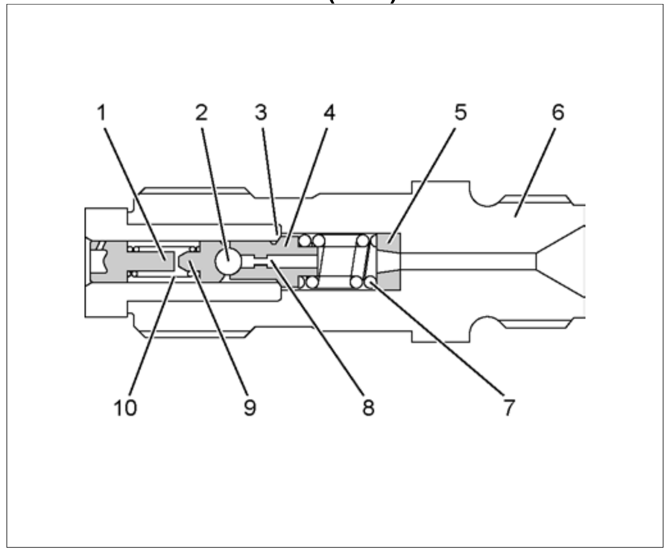
RTW66ESH002801

Legend

1. Valve Seat
2. Valve Closing Direction
3. Valve Needle
4. Coil
5. Magnet
6. Magnet Anchor
7. Rotor Shaft

The fuel injection solenoid valve consists of a valve seat, a valve needle, and a magnet anchor (a movable iron core), a coil and a magnet. The valve needle rotates together with the rotor shaft. When current controlled by the fuel injection pump control unit (PCU) flows to the coil, the magnet anchor and the valve needle are pushed towards the valve seat. When the valve seat is completely closed by the valve needle, the fuel in the high pressure passage is isolated from the low pressure passage, is compressed by the radial plunger high pressure pump, and injected into the engine cylinder through the nozzle holder assembly. When the required injection quantity is reached, the current to the coil is cut, the valve seat opens and injection of fuel is completed.

Constant Pressure Valve (CPV)



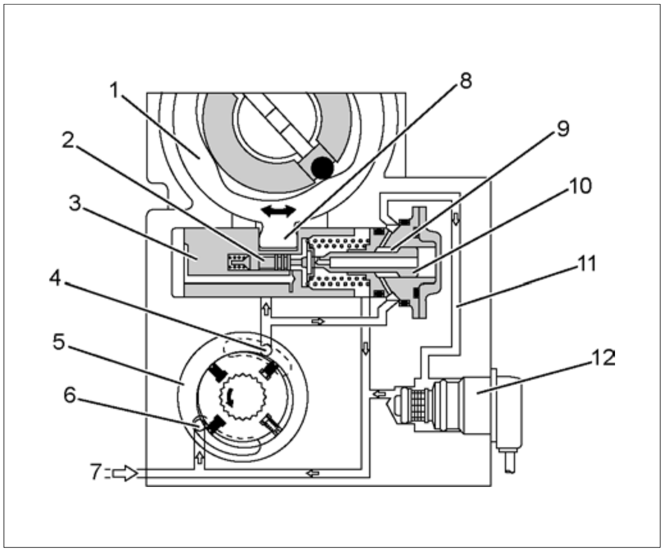
RTW66ESH002901

Legend

1. Plug
2. Ball
3. Seat
4. Valve
5. Spacer
6. Holder
7. Valve Spring
8. Oriffice
9. Ball Support
10. Spring

The constant pressure valve (CPV) consists of a holder, a spacer, a valve spring, a valve, a seat, a ball, a ball support, a spring and a plug. The valve is equipped with an orifice to suppress the reflected pressure wave (the cause of secondary injection) caused by nozzle closing at the end of the injection and maintains a stable pressure in the injection pipe (residual pressure) to ensure stabilized injection timing for subsequent injection. The valve is opened by pressurized fuel and this high pressure fuel is delivered to the nozzle holder assembly.

Timing Control Device Description



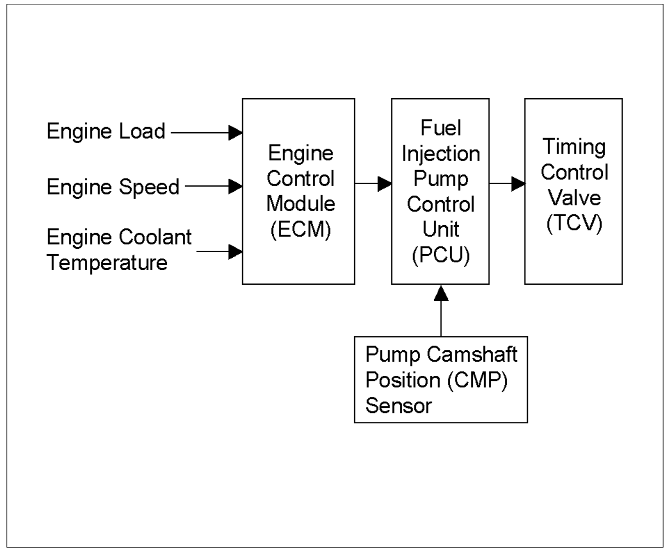
RTW66ESH003001

Legend

1. Cam Ring
2. Servo Valve
3. Timer Piston
4. Outlet
5. Feed Pump
6. Inlet
7. Fuel Suction
8. Ball Pin
9. Annular Chamber
10. Hydraulic Stopper
11. Return Passage
12. Timing Control Valve (TCV)

The timing device determines the optimum injection timing against variations in engine speed. The pressure of the fuel fed from the feed pump is adjusted in accordance with speed by the regulating valve. This delivery pressure acts on the hydraulic stopper's annular chamber as control pressure. The chamber pressure of the annular chamber is controlled by the timing control valve (TCV). The timing plunger is connected to the cam ring by a ball pin. Axial movement of the timing plunger is transferred to the cam ring in the form of rotational movement. Movement to the right of the timing plunger (to the spring side) advances injection timing. The main components are timing plunger, the TCV and pump camshaft position (CMP) sensor.

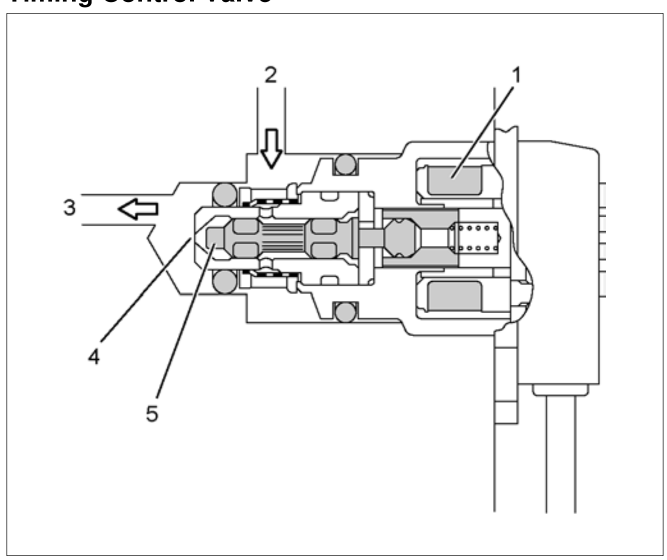
Beginning of Injection Staring



RTW66ESH003101

The engine control module (ECM) contains characteristic maps of the beginning of injection, corresponding to engine operating conditions (engine load, engine speed and engine coolant temperature). The fuel injection pump control unit (PCU) is constantly comparing the set beginning of injection timing and the actual beginning of injection timing. If there is a difference, the timing control valve (TCV) is controlled by the duty ratio. (The actual beginning of injection timing is determined from the pump camshaft position [CMP] sensor.)

Timing Control Valve



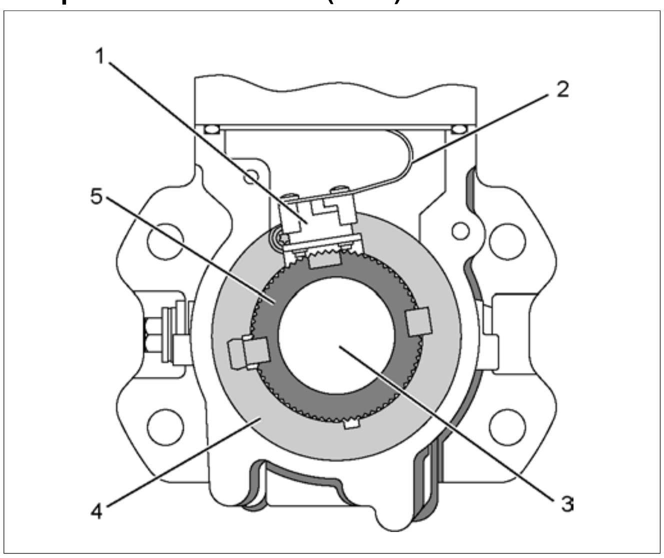
RTW66ESH003201

Legend

1. Coil
2. From Annular Chamber
3. To Feed Pump
4. Orifice
5. Valve Needle

The timing control valve (TCV) acts as a variable throttle, using the rapid opening and closing (cycling) of the valve needle in the TCV. At normal operation, the TCV controls the pressure acting on the annular chamber so that the hydraulic stopper cam move to any position, from the retard position to the advance position. At this time, the duty ratio is set by the fuel injection pump control unit (PCU).
When control current flows to the TCV coil, the valve needle opens and the fuel annular chamber flows through the orifice to the feed pump inlet. Consequently, the pressure of the annular chamber decreases and the hydraulic stopper is moved to the retard side.
When control current to the TCV coil is cut, the valve needle closes and the return passage is closed. Consequently, the pressure of the annular chamber increases and the hydraulic stopper is moved to the advance side.

Pump Camshaft Position (CMP) Sensor



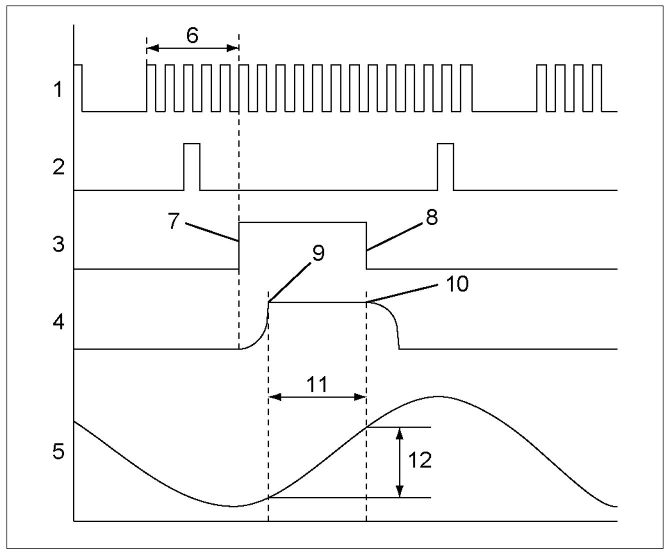
RTW66ESH003301

Legend

1. Pump Camshaft Position (CMP) Sensor
2. Flexible Connecting Harness
3. Drive Shaft
4. Pump Camshaft Position (CMP) Sensor Retaining Ring
5. Sensor Wheel

When the drive shaft rotates, the pump camshaft position (CMP) sensor receives signal form the sensor wheel, and an electric pulse is sent through the flexible connecting harness to the fuel injection pump control unit (PCU). From these signals the PCU can determine the average pump speed and the momentary pump speed. The pump CMP sensor is mounted to the cam ring. Thus, the relationship between the cam ring and the pump CMP sensor signal is constant. The pump CMP sensor signal is utilized for the following purposes:

- To determine the momentary angular position of the cam ring.
- To calculate the actual speed of the fuel injection pump.
- To determine the actual timing plunger position.

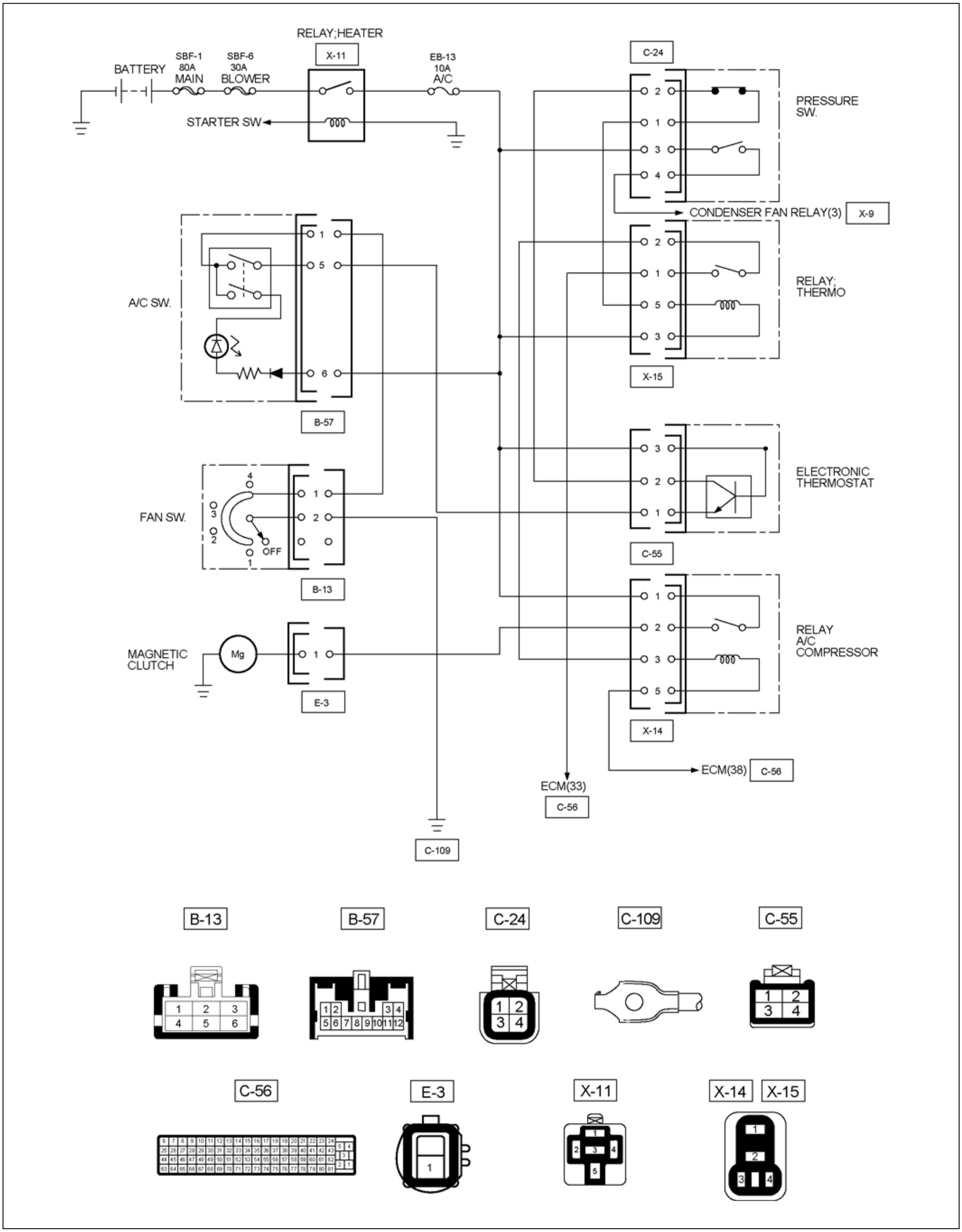


RTW66ESH003401

Legend

1. Pump Camshaft Position (CMP) Sensor Signal
2. Crankshaft Position (CKP) Sensor Signal
3. Fuel Injection Solenoid Valve Control Pulse
4. Fuel Injection Solenoid Needle Valve Lift
5. Cam Lift (Cam Profile)
6. Pulse Count
7. Fuel Injection Solenoid Valve Close
8. Fuel Injection Solenoid Valve Open
9. Start of Pressure Delivery
10. End of Pressure Delivery
11. Pressure Delivery Angle
12. Effective Stroke

4JH1 – TC



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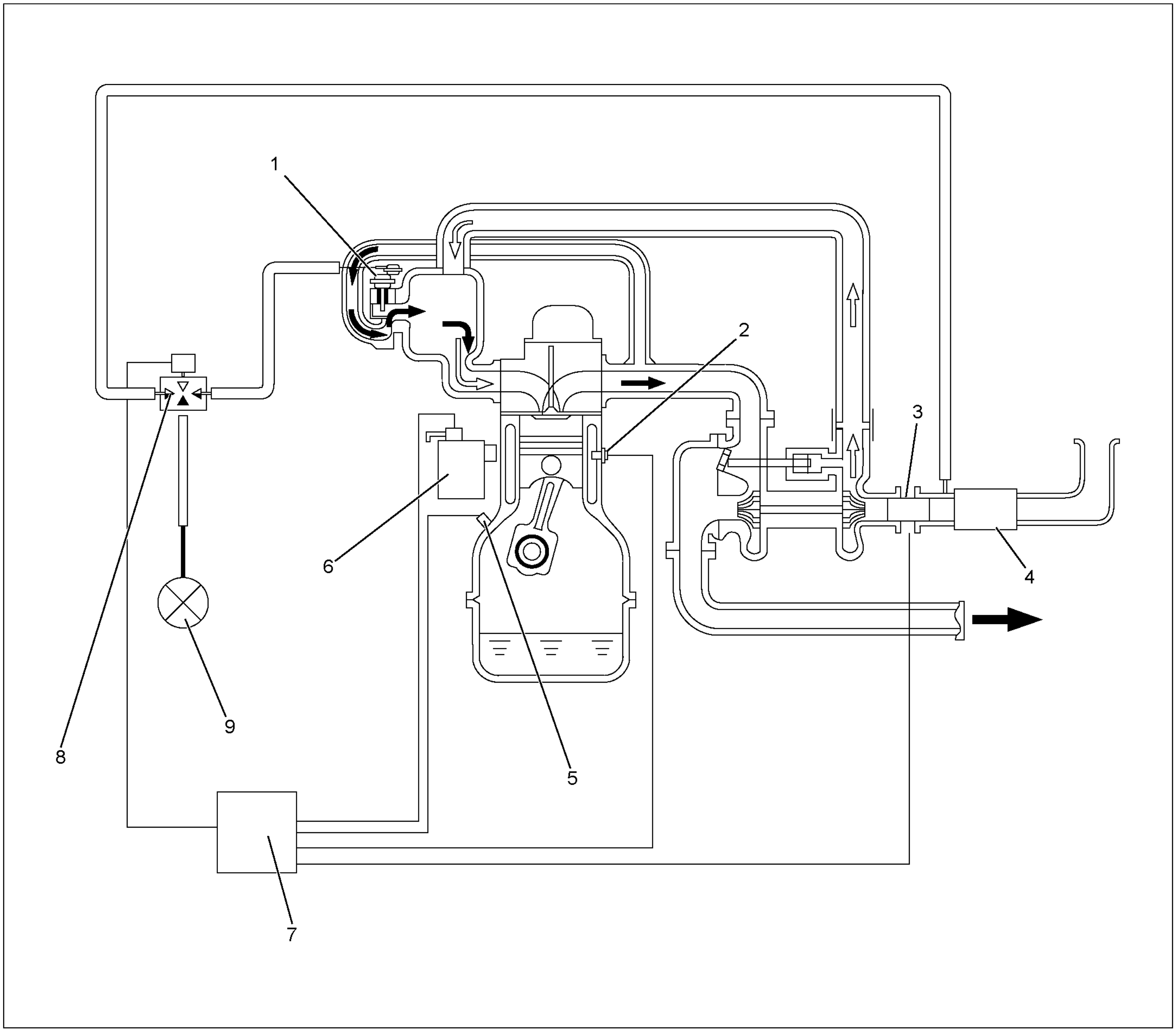
- Momentary Cam Ring Angular Position
  The momentary angular position of the cam ring is input into the fuel injection PCU as a fuel injection solenoid valve control signal. From momentary input of angular position for fluctuations in running conditions, the fuel injection solenoid valve open and close intervals corresponding to the cam ring's cam lift can be accurately determined.
- Actual Injection Pump Speed
  When the crankshaft position (CKP) sensor is faulty, the engine control module (ECM) uses the pump CMP signal as a replacement signal.
- Actual Timing Plunger Position
  The actual timing plunger position can be determined by comparing the CKP sensor signal with the pump CMP sensor angle. This position is used for timer control.

Exhaust Gas Recirculation (EGR) System Description



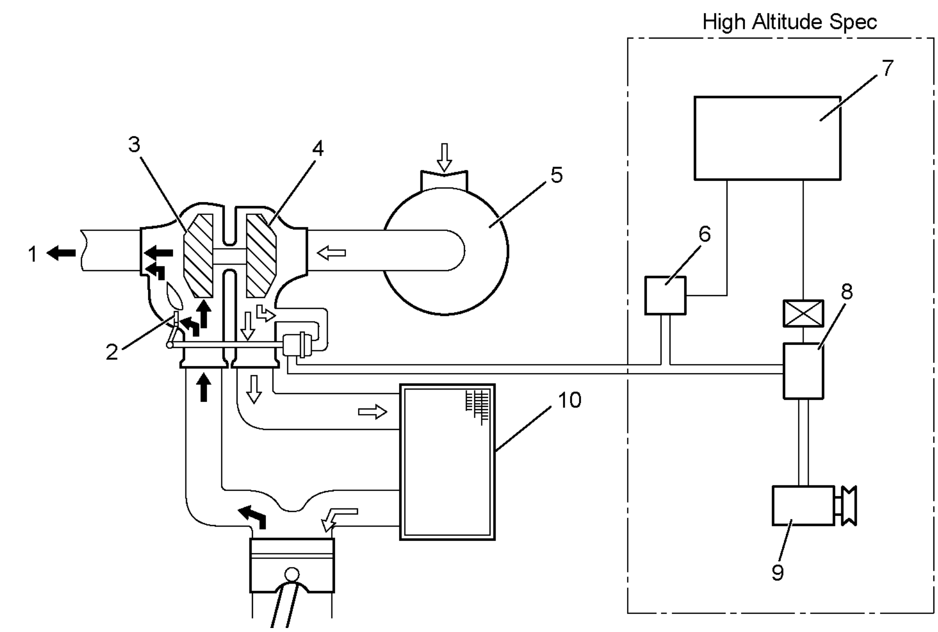
RTW66ELF000101

Legend

1. EGR Cooler
2. Engine Coolant Outlet
3. Engine Coolant Inlet
4. EGR Valve
5. ECM
6. MAF & IAT Sensor
7. Intake Throttle Valve

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing nitrogen oxide (NOx) emissions. The EGR control system uses an electronic control system solenoid valve and vacuum control EGR valve to ensure both driveability and low emission. The engine control module (ECM) controls the EGR flow amount based on the engine speed, engine coolant temperature, intake air temperature, barometric pressure and fuel injection quantity. The ECM controls the EGR valve opening by controlling the EGR solenoid valve drive duty. The mass air flow (MAF) sensor monitors EGR gas flow amount. An expected MAF amount should be detected while the engine running.

Turbocharger Description



RTW66EMF000501

Legend

1. Exhaust Gas
2. Wastegate Valve
3. Turbine Wheel
4. Compressor Wheel
5. Air Cleaner
6. Vacuum Pressure Sensor
7. Engine Control Module (ECM)
8. Turbocharger Solenoid Valve
9. Vacuum Pump (ACG)
10. Change Air Cooler (Intercooler)

The turbocharger is used to increase the amount of air that enters the engine cylinders. This allows a proportional increase of fuel to be injected into the cylinders, resulting in increased power output, more complete combustion of fuel, and increased cooling of the cylinder heads, pistons, valves, and exhaust gas. This cooling effect helps extend engine life.
Heat energy and pressures in the engine exhaust gas are utilized to drive the turbine. Exhaust gas is directed to the turbine housing. The turbine housing acts as a nozzle to direct the shaft wheel assembly. Since the compressor wheel is attached directly to the shaft, the compressor wheel rotates at the same speed as the turbine wheel. Clean air from the air cleaner is drawn into the compressor housing and wheel. The air is compressed and delivered through a crossover pipe to the engine air intake manifold, then into the cylinders. The amount of air pressure rise and air volume delivered to the engine from the compressor outlet is regulated by a wastegate valve in the exhaust housing. The position of the wastegate valve is controlled by the amount of pressure built up on the intake side of the turbocharger. The diaphragm on the inside of the wastegate is pressure sensitive, and controls the position of the valve inside the turbocharger. The position of the valve will increase or decrease the amount of boost to the turbocharger.
The charge air cooler also helps the performance of the diesel. Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler located in the front of the radiator.
From the charge air cooler, the air flows back into the intake manifold.
The charge air cooler is a heat exchanger that uses air flow to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases the engine efficiency and power by packing more air molecules into the same space.

Special Tools and Equipment

Special Tools and Equipment

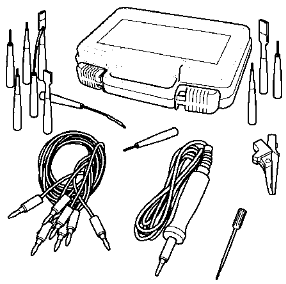
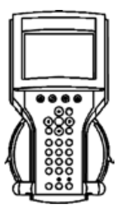
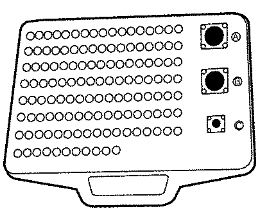
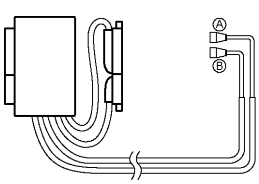
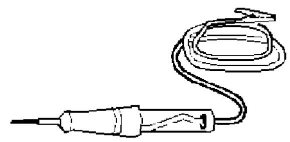
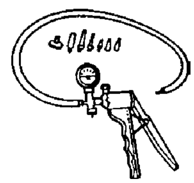
Illustration	Tool Number/ Description
	5-8840-2835-0 / J-35616-A Connector Test Adapter Kit (With Test Lamp)
	5-8840-0285-0 / J-39200 Digital Multimeter
	Tech2 Kit
	Breaker Box
 RTW66ESH003801	Adapter Harness

Illustration	Tool Number/ Description
 AAW0Z0SH013701	5-8840-0607-0 / J-34142-B Test Lamp
	5-8840-0279-0 / J-23738-A Vacuum Pump

SECTION 6F

EXHAUST SYSTEM

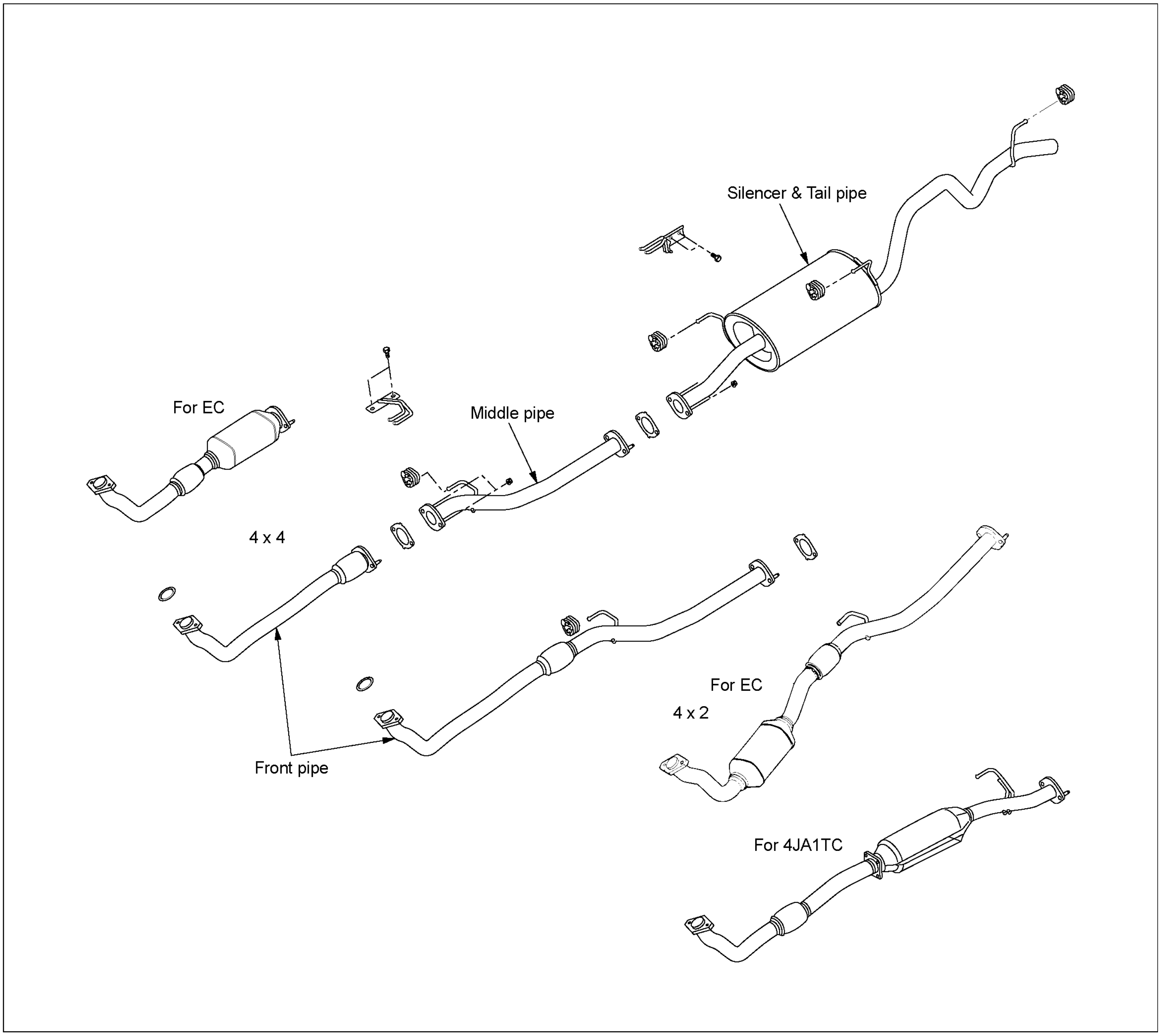
TABLE OF CONTENTS

PAGE

MAIN DATA AND SPECIFICATIONS

Front pipe		
Pipe outside diameter x thickness	mm (in)	50.8 x 1.5 (2.0 x 0.059) For EC model, catalitic converter is combined to the front pipe.
Middle pipe		
Pipe outside diameter x thickness	mm (in)	50.8 x 1.5 (2.0 x 0.059)
Silencer & tail pipe		
Type		Circular section-shell construction of double skin and end plates, internal construction of baffles and perforated tubes.
Tail pipe outside diameter x thickness	mm (in)	50.8 x 1.6 (2.0 x 0.063)
Length	mm (in)	Approximately 1335 (52.6)
Mounting		
Number of suspension points		4
Type		Rubber

GENERAL DESCRIPTION



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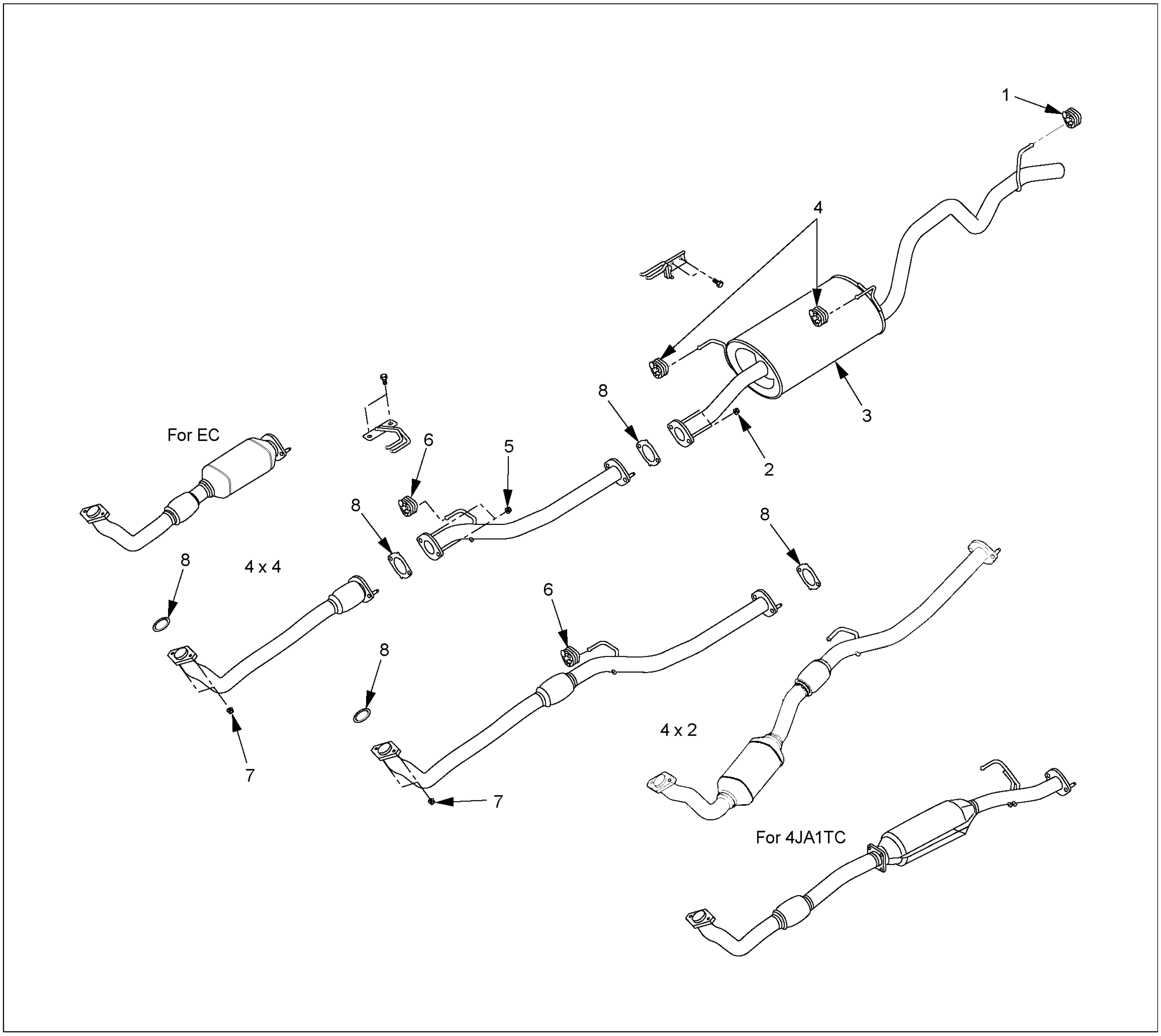
The exhaust pipe layout is described in the above illustration.
The catalytic coverter is installed between the turbocharger and the front pipe.

REMOVAL AND INSTALLATION



RTW46FLF000101

Removal Steps

1. Rear hanger rubber
2. Silencer front nut
3. Exhaust silencer
4. Silencer hanger rubber
5. Middle pipe nut
6. Front hanger rubber
7. Front pipe nut
8. Exhaust pipe gasket

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

1. Front Pipe Nut

Connect the exhaust pipe to the catalytic converter.

Torque	N·m (kg·m/lb·ft)
67 (6.8/49)	

2. Middle pipe Nut (4×4 only)

Connect the middle pipe to the front pipe.

Torque	N·m (kg·m/lb·ft)
43 (4.4/32)	

3. Silencer Front Nut

Connect the silencer to the front or middle pipe.

Torque	N·m (kg·m/lb·ft)
43 (4.4/32)	

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Front Exhaust Pipe

Exhaust Silencer

Check the pipes for corrosion, cracking, damage or misalignment and repair as required.

Check the rubber rings for deterioration or damage and repair as required.

Catalytic Converter

1. Inspect outside the catalytic converter for any hitting mark.
2. Visual check inside the catalytic converter for crack or break converter element.
3. If find any problem during the inspection, replace the catalytic converter assembly.

MAGNETIC CLUTCH DOES NOT RUN (4JH1-TC)

- Are the No. SBF-6 fuse (30A) and the No. EB-13 (10A) fuses OK?

NO → Replace

YES

- Are the A/C thermo (X-15) and heater & A/C (X-11) and A/C compressor (X-14) relay OK?

NO → Replace

YES

- Is the pressure switch (C-24) OK?

NO → Replace

YES

- Is the electronic thermostat (C-55) OK?

NO → Defective switch or insufficient refrigerant

YES

- Are the A/C switch (B-57) and the fan switch (B-13) OK?

NO → Replace

YES

- Turn the ignition switch "ON" (Engine is running)
- A/C switch and fan control knob (fan switch) "ON"

- Disconnect the magnetic clutch connector.

- Is there battery voltage between the engine room harness connector terminal No.1 (E-3) and ground?

YES → Does the magnetic clutch operate?

- YES → Defective compressor
- NO → Defective magnetic clutch

NO

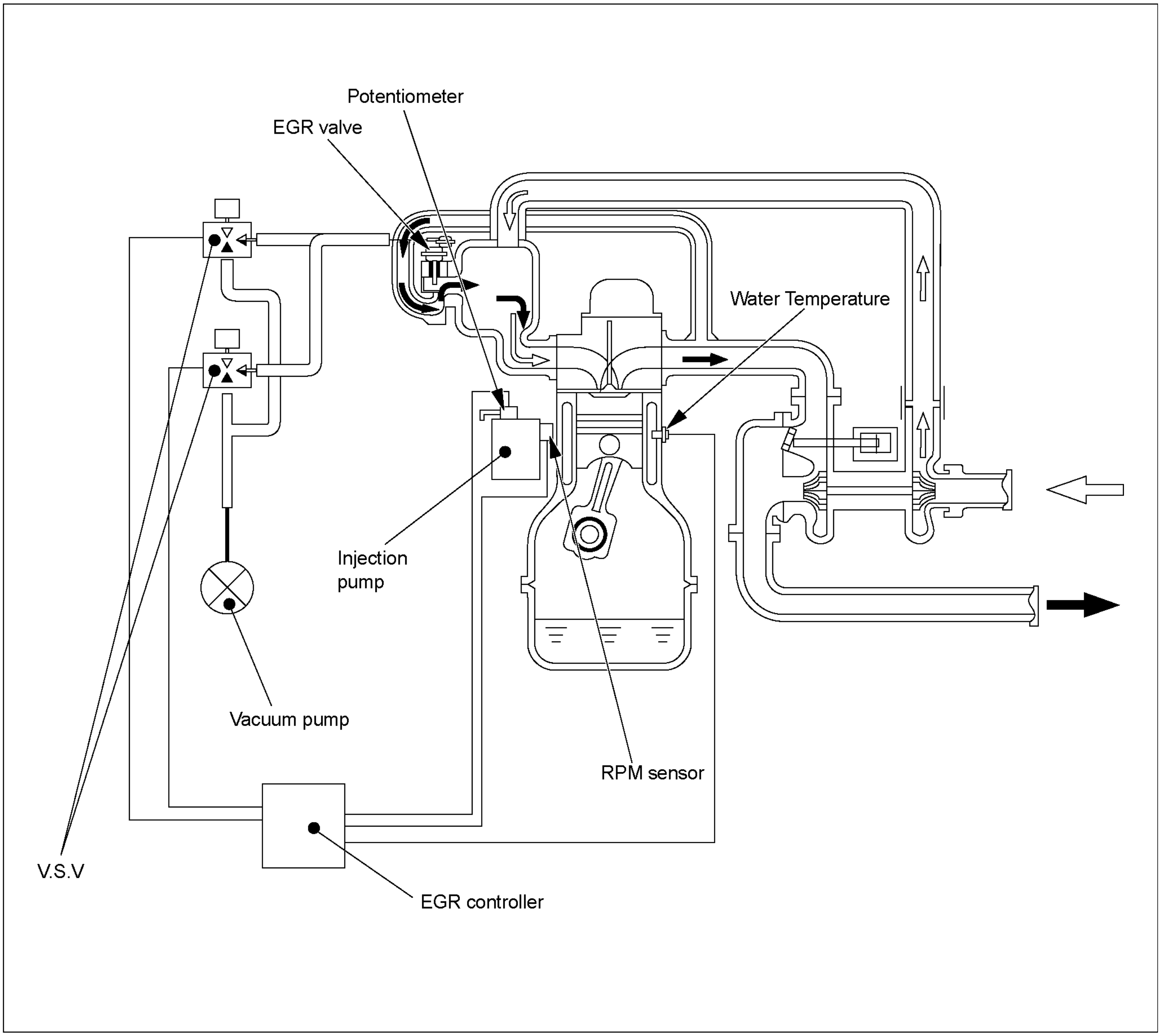
- Disconnect the A/C compressor relay.

- Is there continuity between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14)?

GENERAL DESCRIPTION

This system controls the formation of NOx emission by recirculating the exhaust gas into the combustion chamber through the intake manifold.

4JA1T(L):
The two EGR valves are controlled by two Vacuum Switching Valve (VSV) controlled by EGR controller according to signals from various sensors.
The amount of EGR depends on the number of engine rotations and the opening of the accelerator.



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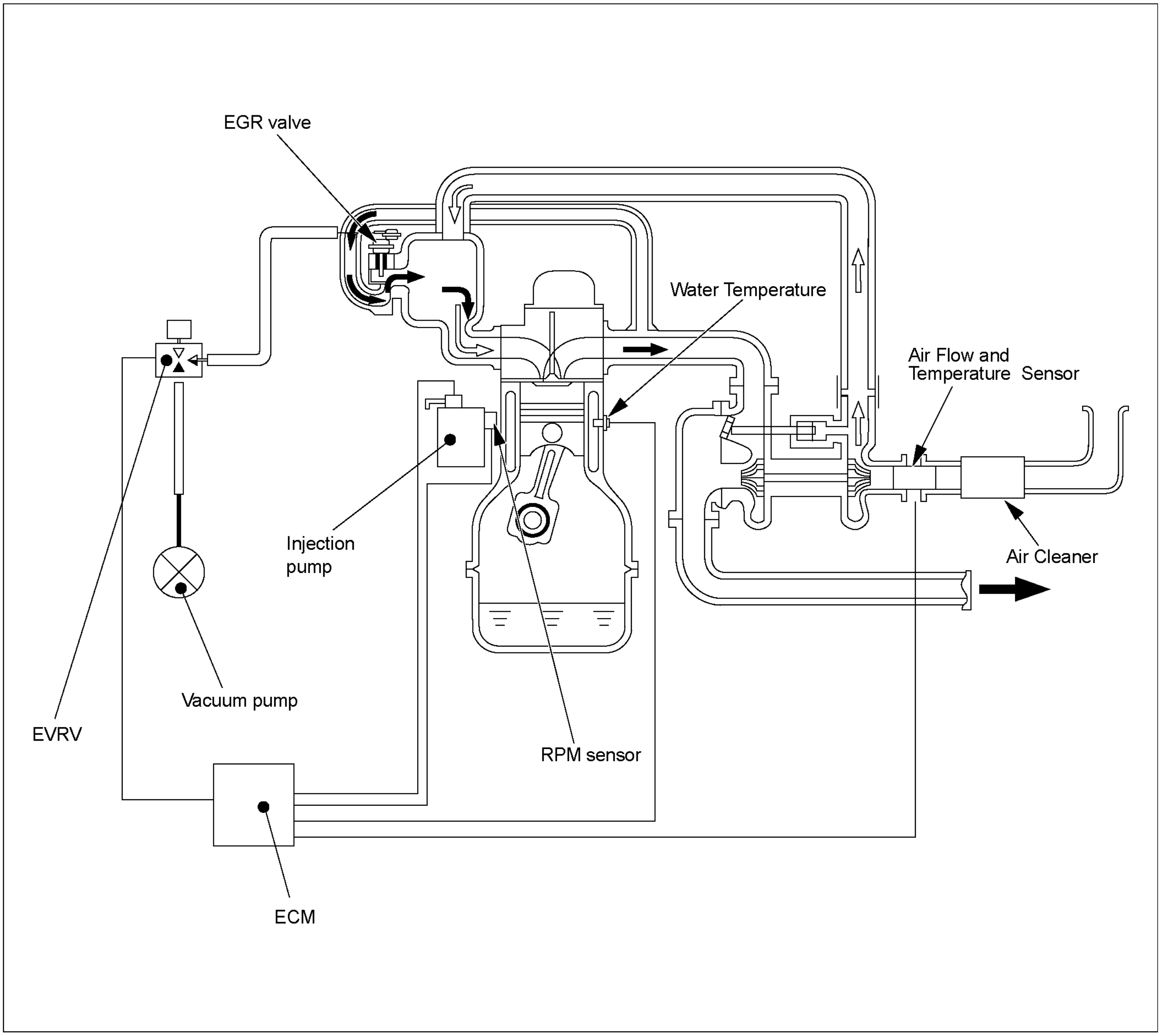
4JA1TC/4JH1TC

The EGR system engine is controlled by ECM. Refer to “Engine driveability and emissions” section for detail.



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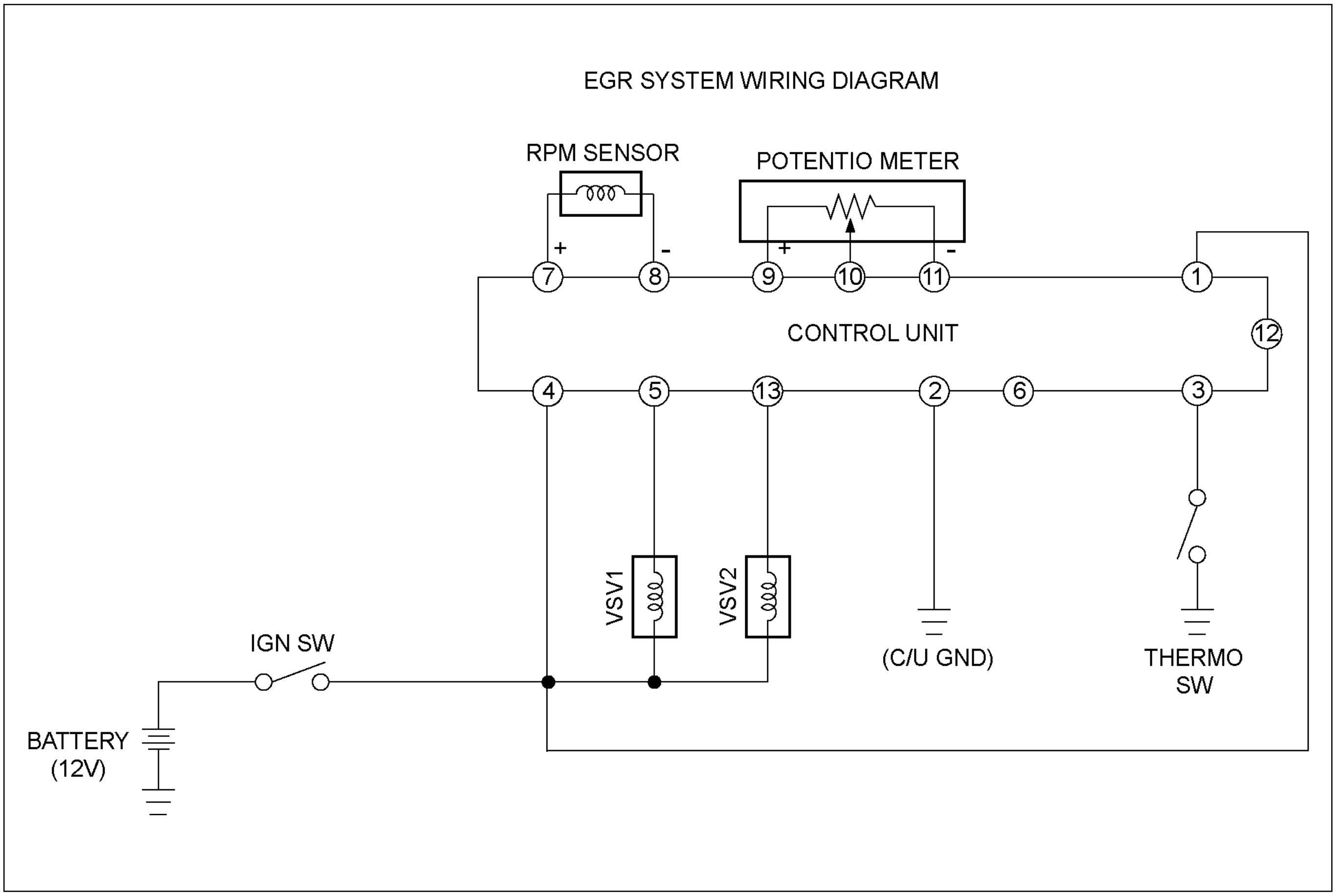
EGR SYSTEM DIAGRAM 4JA1T (L)



RTW46AMF000301

EGR System Operation

Inspect EGR valve motion visually while changing engine RPM under no load condition after warming-up.

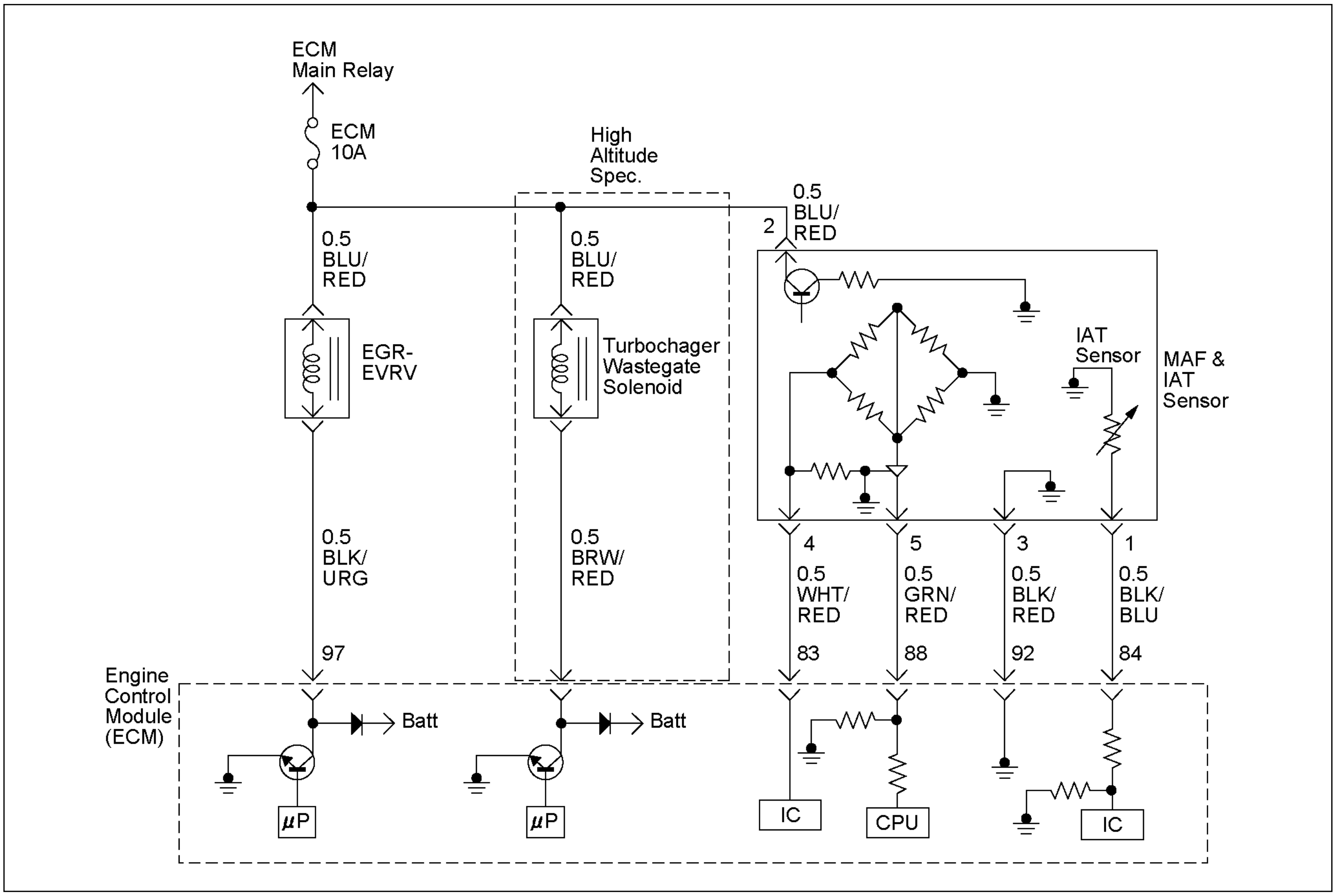
- **Inspection point (Engine RPM)**

RPM	Idling	900 ~ 960	2000	3250
Engine Front Side VSV-1	ON	ON	ON	OFF
Engine Rear Side VSV-2	ON	OFF	ON	OFF

ON means VSV should receive signal to move EGR valve.
OFF means VSV shouldn’t receive signal to move EGR valve.

4JA1TC/4JH1TC

The EGR system engine is controlled by ECM. Refer to "Engine driveability and emissions" section for detail.

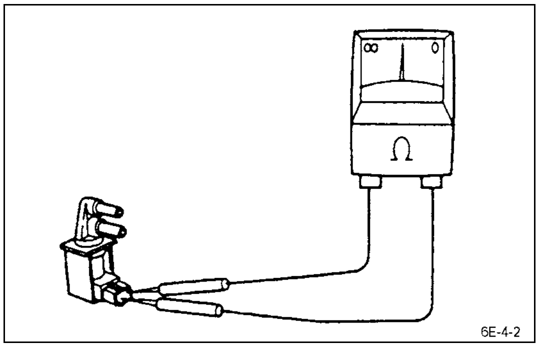


RTW46EMF000701

INSPECTION

4JA1T(L)

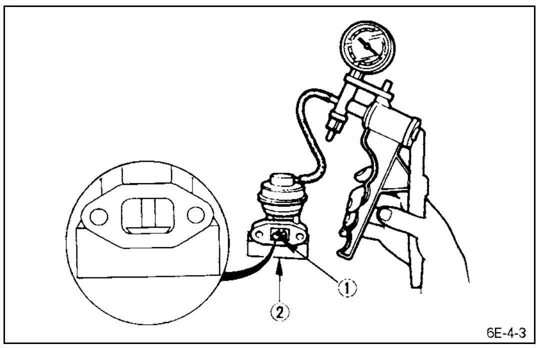
Vacuum switch valve (VSV)



Use a circuit tester to measure the V.S.V. resistance.

V.S.V Resistance	Ω at 20°C
37 ~ 44	

If the resistance is not within specification, replace it.



EGR Valve

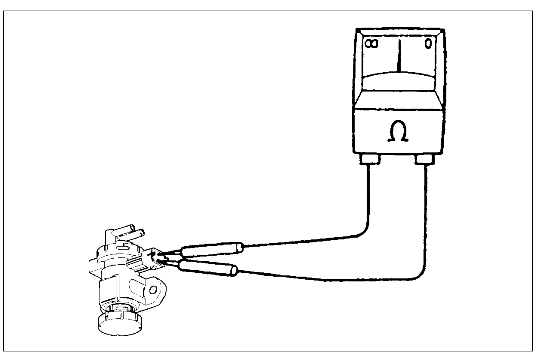
Apply vacuum to the EGR valve, check to see the valve operation.

Negative Pressure

Less then 180 mmHg	Not operation
More than 240 mmHg	Operation

4JA1TC/4JH1TC

EVRV

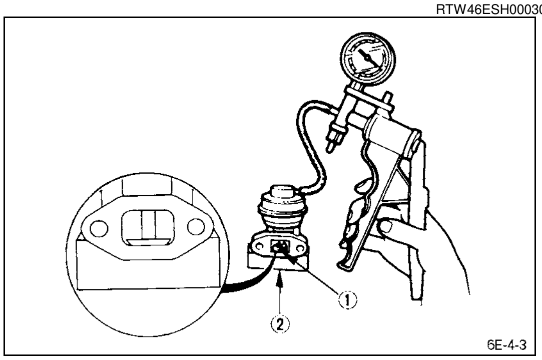


RTW46ESH000301

Use a circuit tester to measure the EVRV resistance.

EVRV Resistance	Ω at 20°C
14	

If the resistance is not within specification, replace it.



EGR Valve

Apply vacuum to the EGR valve, check to see the valve operation.

Negative Pressure 4JH1TC

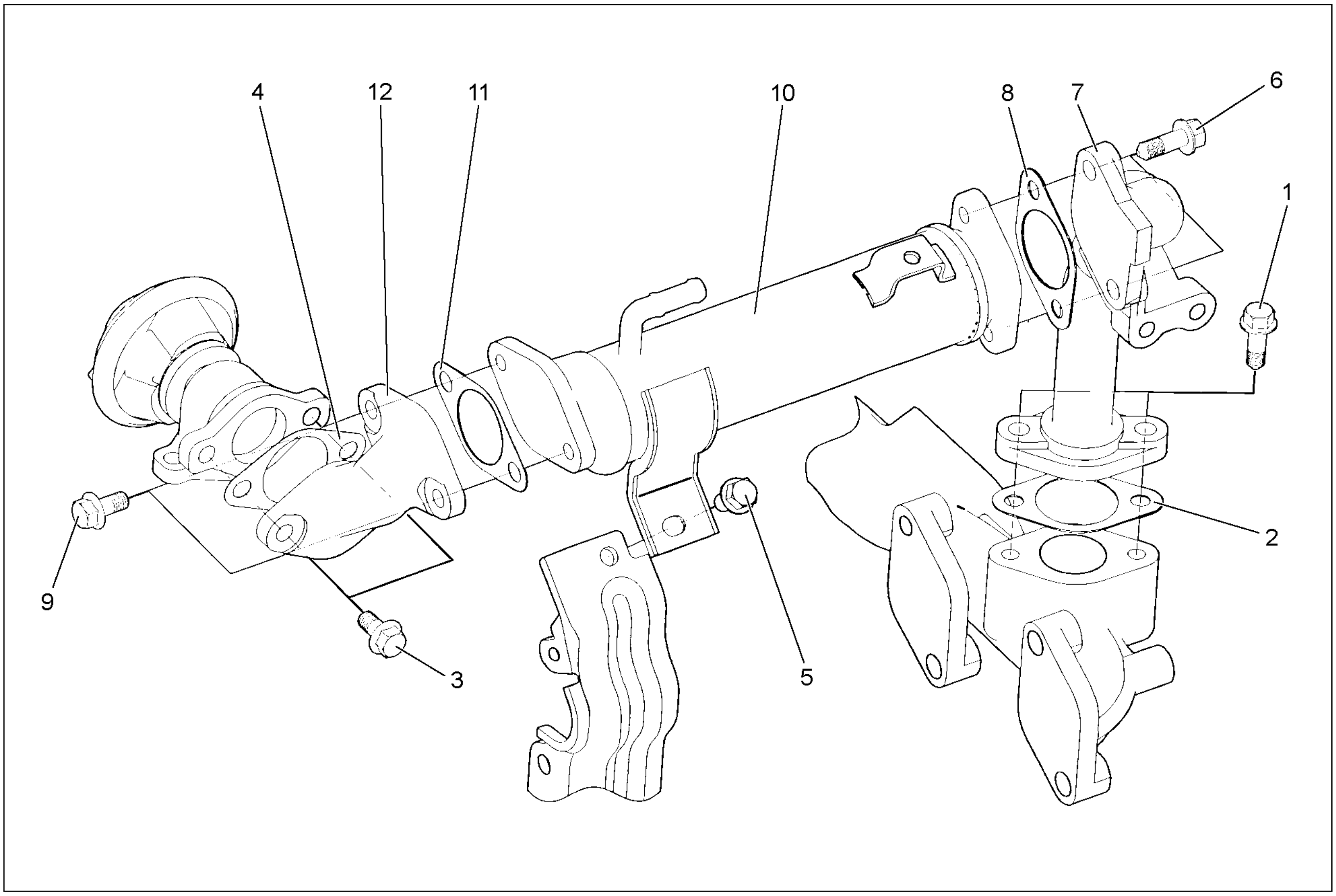
Less than 250 mmHg	Not operation
More than 300 mmHg	Operation

Negative Pressure 4JA1TC

Less than 100 mmHg	Not operation
More than 170 mmHg	Operation

EGR COOLER (4JA1TC/4JH1TC EURO-III MODEL)

REMOVAL AND INSTALLATION



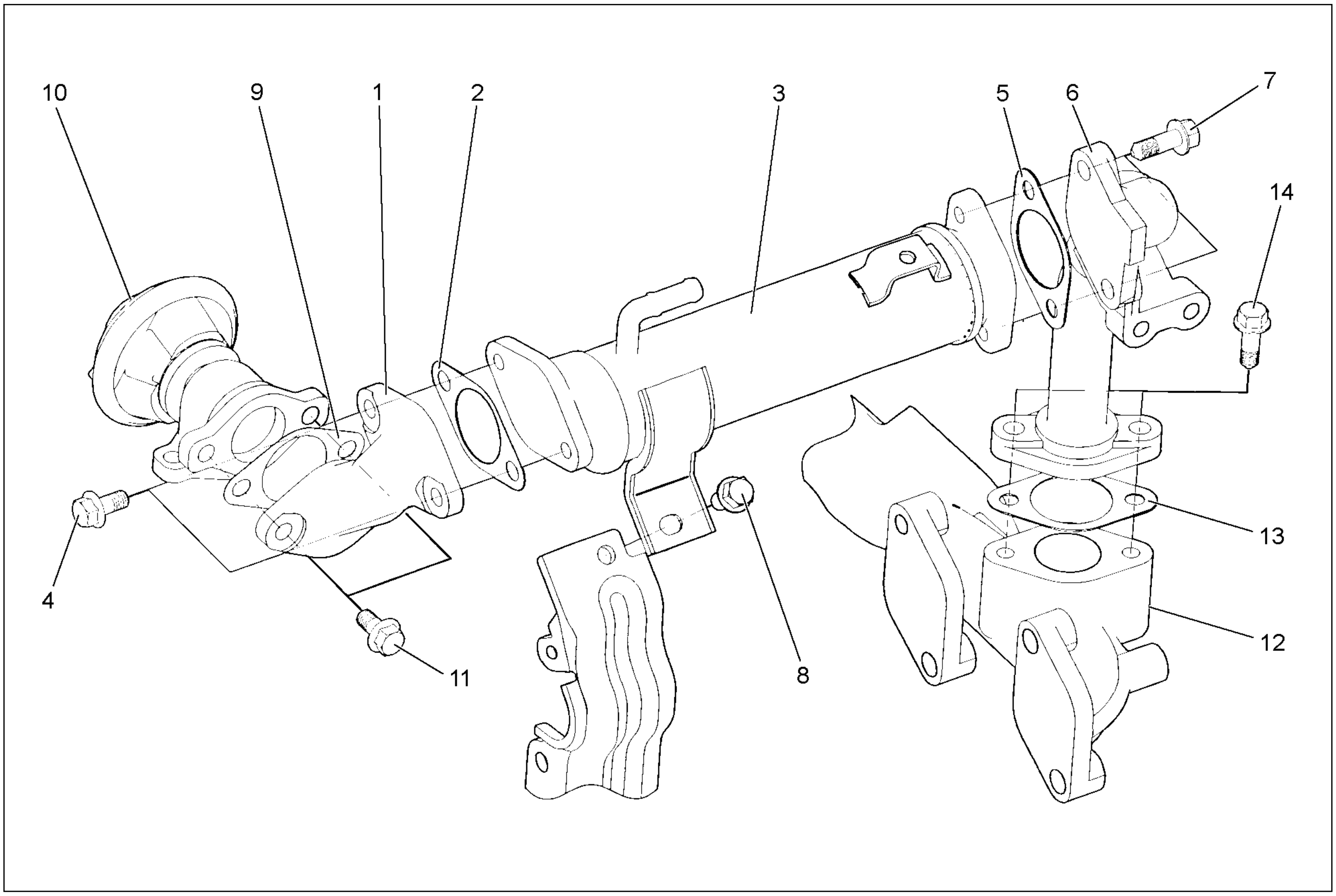
RTW46EMF000201

Removal Steps

1. Bolt
2. Gasket
3. Bolt
4. Gasket
5. Bolt
6. Bolt
7. EGR Pipe Assembly
8. Gasket
9. Bolt
10. EGR Cooler Assembly
11. Gasket
12. EGR Cooler Adapter

Removal

1. Bolt
2. Gasket
3. Bolt
4. Gasket
5. Bolt
6. Bolt
7. EGR Pipe Assembly
8. Gasket
9. Bolt
10. EGR Cooler Assembly
11. Gasket
12. EGR Cooler Adapter



RTW46EMF000901

Installation steps

1. EGR Cooler Adapter
2. Gasket
3. EGR Cooler Assembly
4. Gasket
5. Bolt
6. EGR Pipe Assembly
7. Bolt
8. Bolt
9. Gasket
10. EGR Valve Assembly
11. Bolt
12. EXH Manifold
13. Gasket
14. Bolt

Installation

1. EGR Cooler Adapter
2. Gasket
3. EGR Cooler Assembly
4. Bolt
   Tighten the bolts to the specified torque.

EGR adapter bolt torque	N·m(kg·m/lb ft)
27(2.8/20)	

5. Gasket
6. EGR Pipe Assembly
7. Bolt
   Tighten bolts temporarily.
8. Bolt
   Tighten bolts temporarily.
9. Gasket
10. Bolt
    Tighten bolts temporarily.
11. Gasket
12. Bolt
    Tighten bolts temporarily.
    Finally tighten all bolts to the specified torque.
    Confirm that there is no misalignment on the sealing surface.

Bolt torque (Cooler-pipe) N·m(kg·m/lb ft)
27(2.8/20)

Bolt torque (Cooler-bracket) N·m (kg·m/lb ft)
24(2.4/17)

Bolt torque (Adapter-EGR valve) N·m (kg·m/lb ft)
27(2.8/20)

Bolt torque (Pipe-manifold) N·m (kg·m/lb ft)
27(2.8/20)

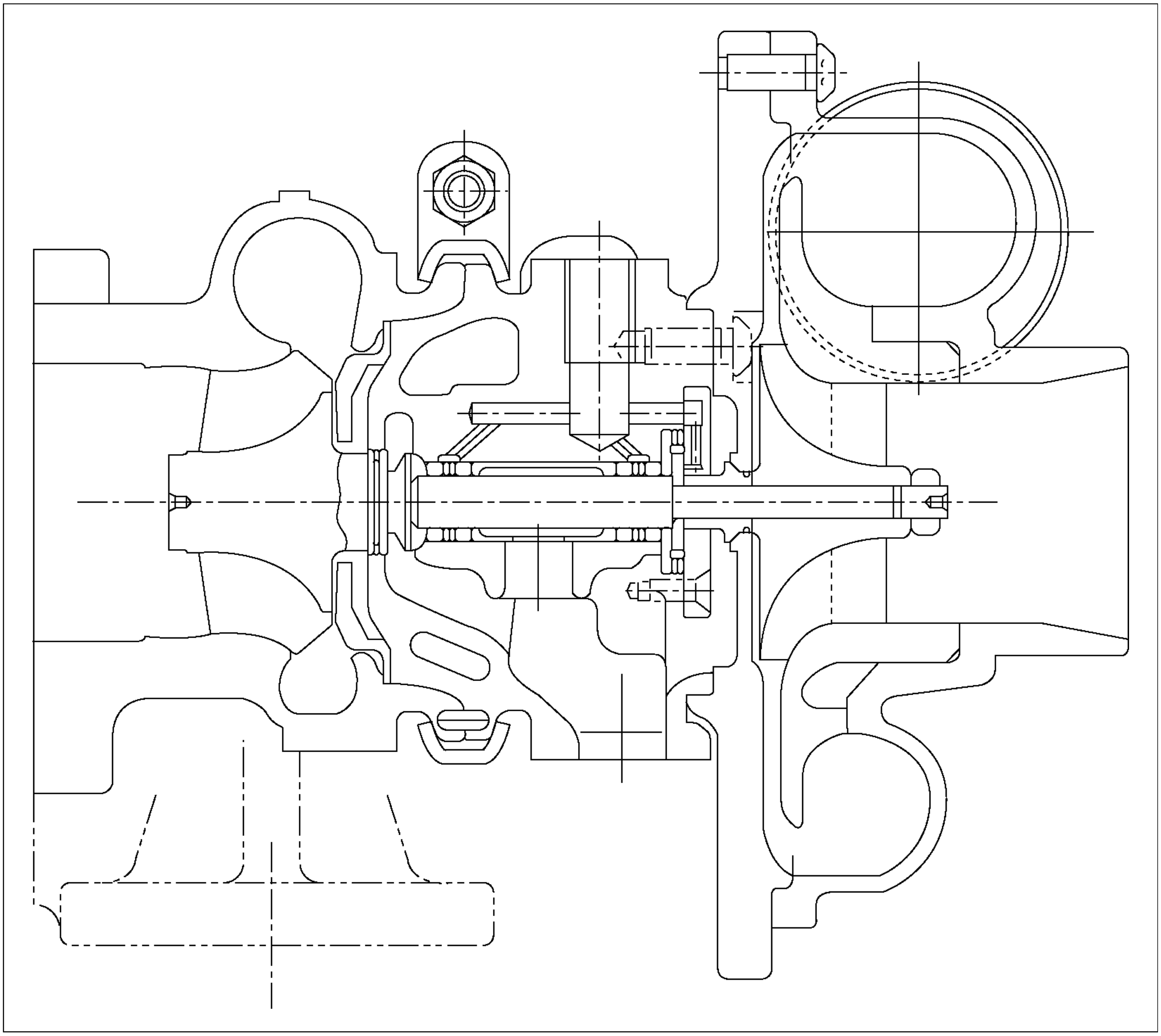
TURBOCHARGER

MAIN DATA AND SPECIFICATIONS

Engine	4JA1T(L)	4JA1TC	4JH1TC
Model	IHI RHF4H	IHI RHF4H	IHI RHF5
Turbine type	Mixed type		
Compressor type	Backword & rake type		
Maximum permissible speed rpm	190,000	190,000	180,000

IHI : Ishikawajima Harima Heavy Industries., Ltd.

GENERAL DESCRIPTION



036LV002

The turbocharger internal mechanism consists of the turbine wheel, the compressor wheel, and the radial bearings. These parts are supported by the bearing housing.

The turbocharger external mechanism consists of the compressor housing air intake port and the turbine housing air exhaust port.

The turbocharger increases air intake efficiency. This results in increased engine power, reduced fuel consumption, and minimal engine noise.

The turbocharger operates at very high speeds and temperatures. Part materials have been carefully selected and machined to extremely high precision.

Turbocharger servicing requires great care and expertise.

If reduced performance is noted, check the engine for damage or wear. If there is no apparent engine damage or wear, trouble with the turbocharger is indicated.

YES

- Is there battery voltage between the engine room harness connector terminal No.1 (X-14) and ground?

NO

Open circuit between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14).

YES

- Disconnect the A/C thermo relay.

- Is there continuity between the engine room harness connector terminal No.3 (X-14) and No.2 (X-15)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No.1 (X-14).

YES

- Disconnect the ECM harness connector.

- Is there continuity between the ECM harness connector terminal No.38 (C-56) and the engine room harness connector terminal No.5 (X-14)?

NO

Open circuit between the engine room harness connector terminal No.2 (X-15) and the engine room harness connector terminal No. 3 (X-14).

YES

- Is there continuity between the ECM harness connector terminal No.33 (C-56) and the engine room harness connector terminal No.1 (X-15)?

NO

Open circuit between the ECM harness connector terminal No.38 (C-56) and the engine room harness connector terminal No. 5 (X-14).

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (X-15) and ground?

NO

Open circuit between the ECM harness connector No. 33 (C-56) and the engine room harness connector terminal No. 1 (X-15).

YES

- Disconnect the pressure switch?

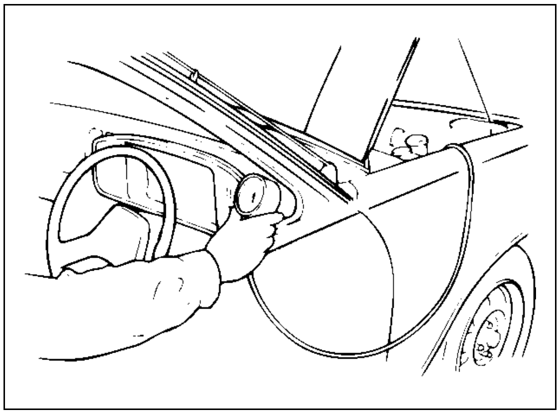
- Is there continuity between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (X-15).

INSPECTION AND REPAIR

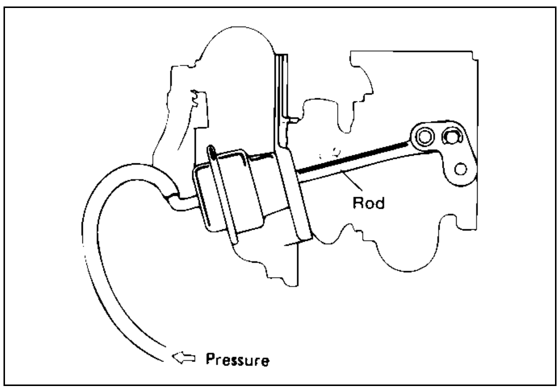
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



150RY00030

Turbocharger pressure check

1. Remove the hose between the waste gate and the compressor outlet pipe.
2. Connect the pressure gauge. To compressor outlet pipe.
3. Start the engine and gradually increase the engine speed (the vehicle must be stationary with no load applied to the engine).
4. Check to see that turbocharger pressure rises to approximately 141.3 Kpa (1060 mmHg).
   Pressure Gauge : 5-8840-0075-0



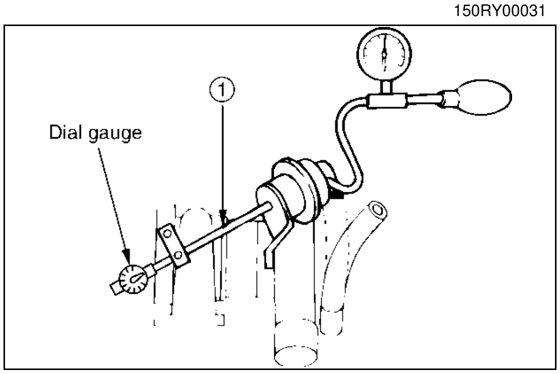
150RY00031

Waste gate operation check

1. Remove the hose between the waste gate and the compressor outlet pipe.
2. Connect the pressure gauge. To waste gate actuator.
3. Check to see that the rod begins to move when a pressure of approximately 118 Kpa (885 mmHg) is applied to the waste gate.

Note:

Do not apply a pressure greater than 150Kpa (1125 mmHg) to the waste gate during this check.



150RY00032

Unit Inspection (Remove Turbo. from engine)

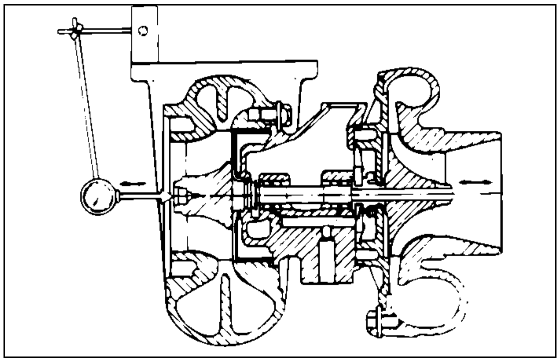
Check to see the pressure required to move the control rod 2 mm is within the limits shown below.

Kpa/mmHg

4JH1TC	134.8/1011
4JA1TC	147.7/1108

Contact the “ISUZU MOTORS LIMITED” Dealer service department or “IHI SERVICE FACILITY” for major repairs and maintenance.

Important wheel shaft end play and bearing clearance standards and limits are included below for your reference.



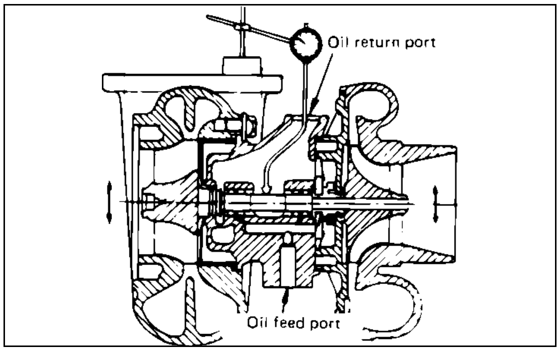
150RY00034

Wheel Shaft End Play

Use a dial indicator to measure the wheel shaft end play. Apply a force of 1.2 kg (2.6 lb/11.8N) alternately to the compressor wheel end and the turbine wheel end.

Wheel Shaft End Play mm (in)

Standard	Limit
0.03 - 0.06 (0.001 - 0.002)	0.09 (0.004)



150RY00036

Wheel Shaft and Bearing Clearance

Use a dial indicator to measure the wheel shaft and bearing clearance.

Wheel Shaft and Bearing Clearance mm (in)

Standard	Limit
0.056 - 0.127 (0.0022 - 0.0050)	0.127 (0.0050)

SPECIAL TOOLS

ILLUSTRATION	TOOL NUMBER	TOOL NAME
 901RX00143	5-8840-0075-0	Pressure Gauge

IHI SERVICE NETWORK

For inquiries relating to turbochargers, please contact your ISUZU distributor or the nearest IHI Turbocharger Service Facility.

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SECTION 6H

ACCELERATOR CONTROL

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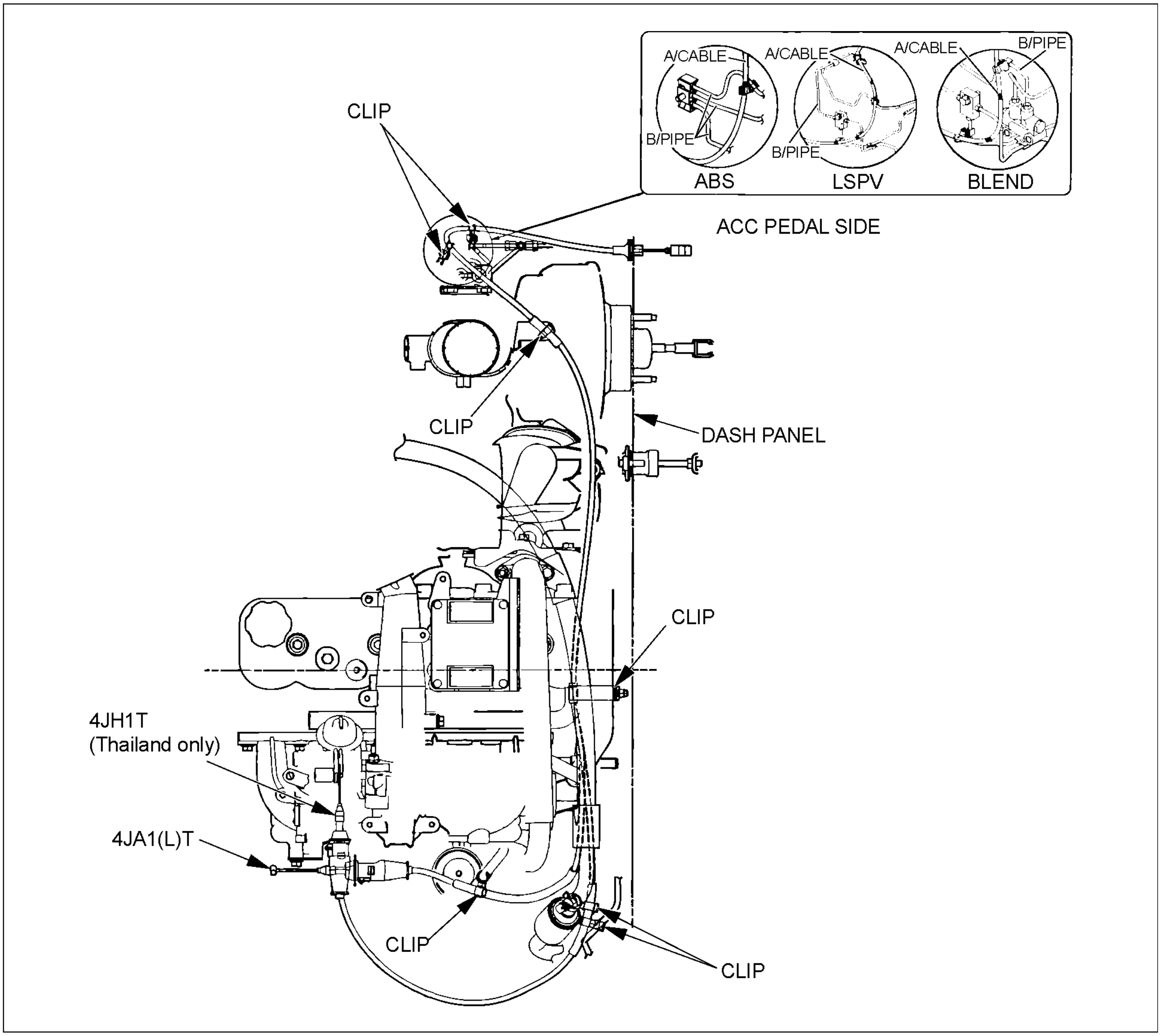
REMOVAL AND INSTALLATION

4JA1T(L)/RHD



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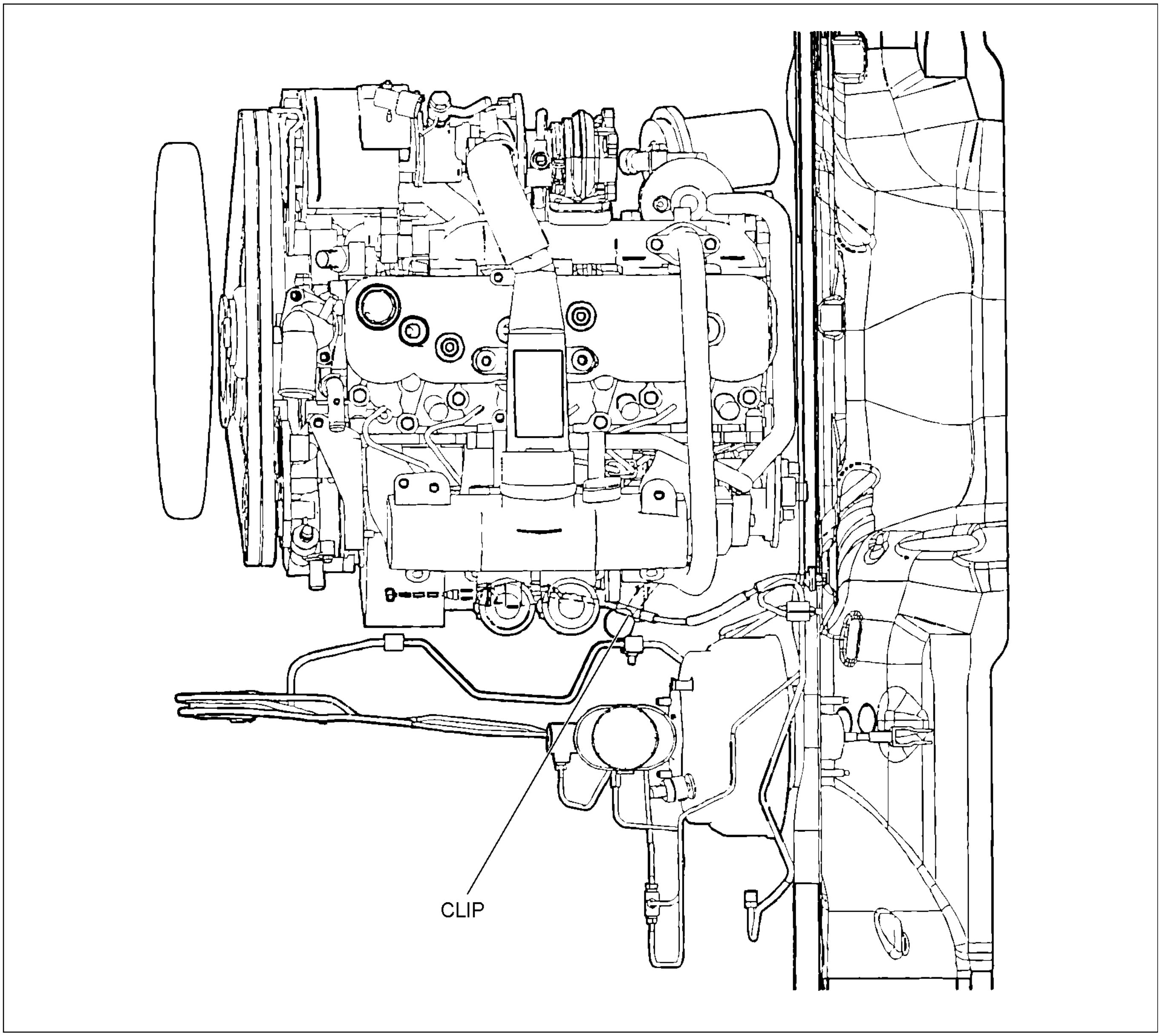
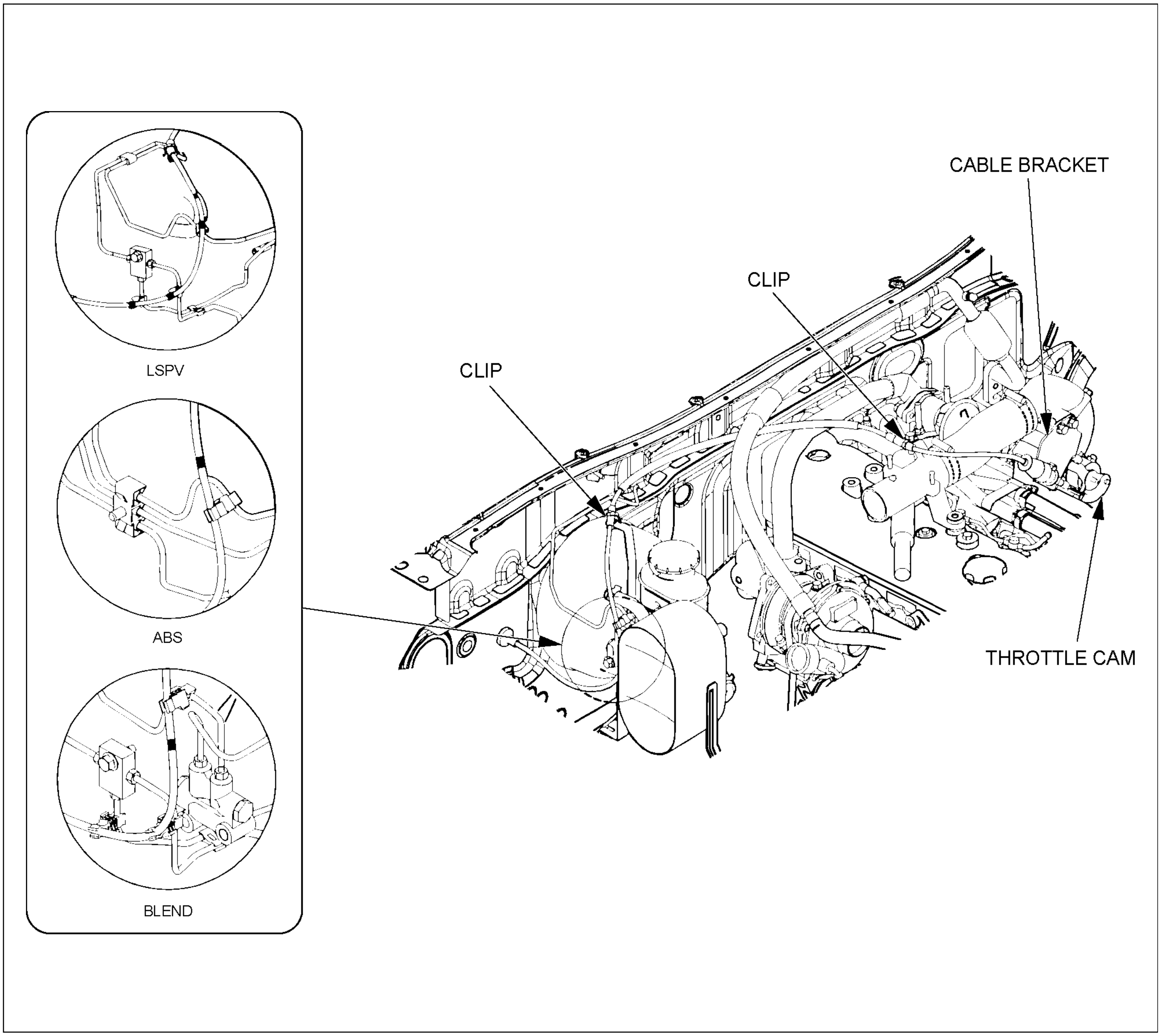
4JA1T(L)/LHD



RTW46HLF000601

4JA1TC, 4JH1TC/RHD



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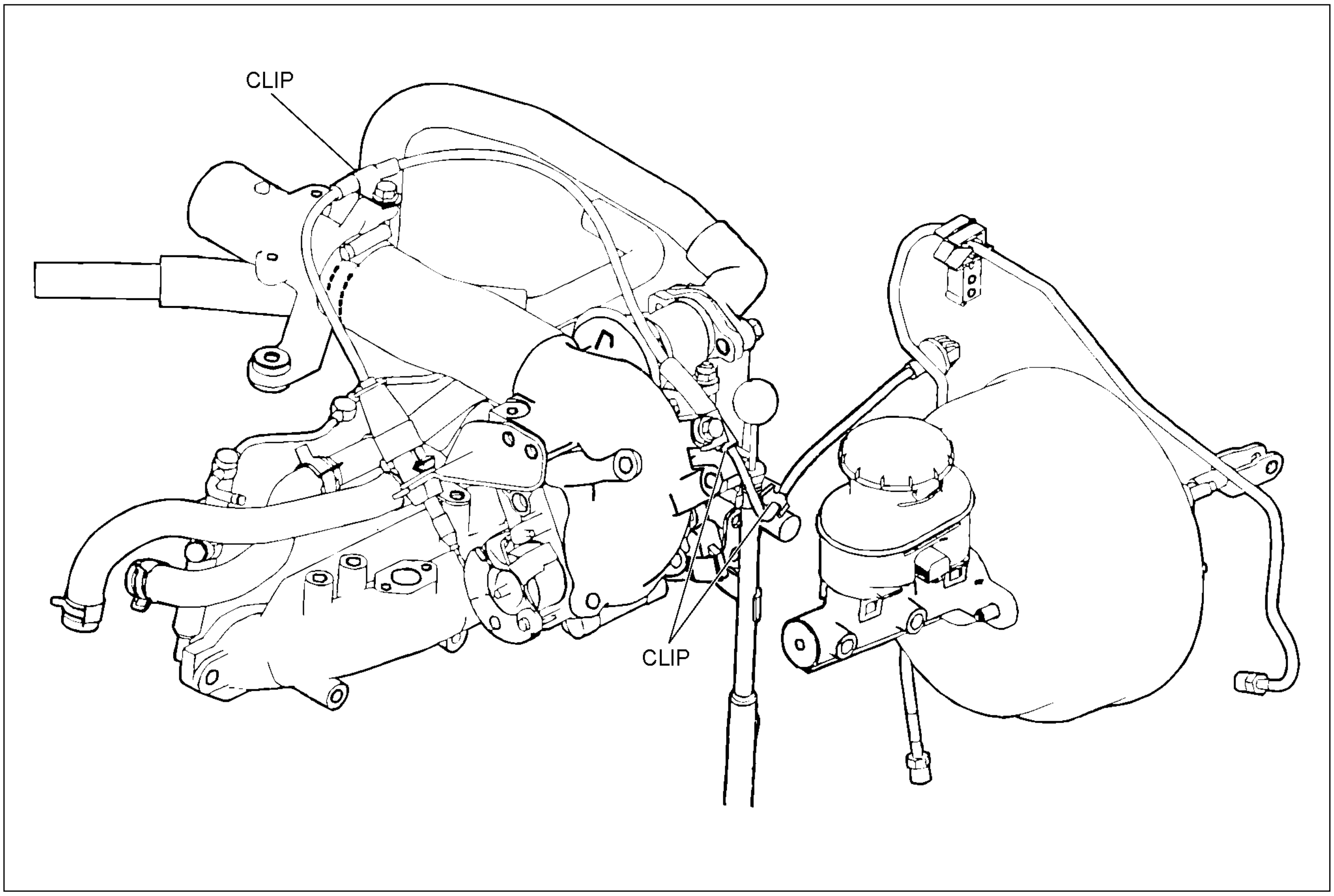
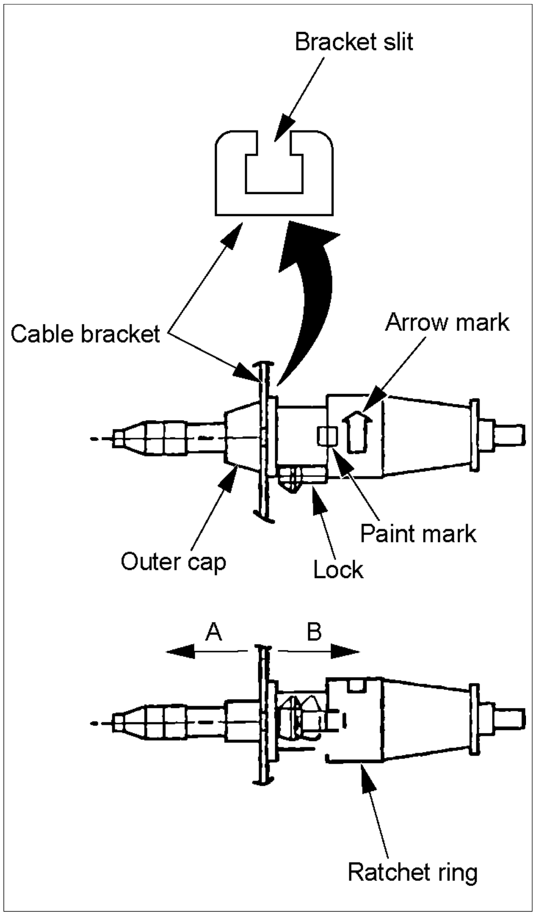
4JA1TC, 4JH1TC/LHD



PTW46BMF000101



RTW46HMH000201

Removal

1. Disconnect the accelerator control cable from the accelerator pedal and dash panel.
2. Remove the cable clips.
3. Remove the accelerator control cable from accelerator control cable bracket.
   1) Slide the lock in direction A
   2) Rotate the ratchet ring in undirection an arrow 90°.
4. Remove the accelerator control cable from the throttle.

Inspection

Check the following items and replace the control cable if any abnormality is found.

- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should not be damage or corrosion.

Installation

1. Install the accelerator control cable to accelerator control pedal dash panel.
2. Install the accelerator control cable to throttle.
   Attach T-END and inner cable to throttle cam of engine.
3. Install accelerator control cable to accelerator bracket.
   1) Rotate the ratchet ring in direction an arrow 90° until both white marking are aligned.
   2) Confirm marking of outer cap must be upper side.
   3) Slider the lock in direction B.
   4) Confirm ratchet ring is locked.
4. Install the cable clips to accelerator control cable.

NOTE:

Confirm that the throttle (engine side) is at full stroke when the accelerator pedal is at full stroke.

YES

- Disconnect the condenser fan relay connector condenser fan.

- Is there continuity between the relay terminal No. 3 (X-9) and engine room harness connector terminal No.4 (C-24)?

NO

Open circuit between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24).

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (C-24) and ground?

NO

Open circuit between the condenser fan relay No.3 (X-9) and the engine room harness connector terminal No. 4 (C-24).

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 3 (C-24).

YES

- connect the A/C thermo relay connector.

- Disconnect the electronic thermostat.

- Is there continuity between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 2 (C-24)?

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (C-55) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 2 (C-24).

YES

- Is there continuity between the engine room harness connector terminal No.1 (C-55) and ground (C-109) ?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (C-55).

SECTION 6

ENGINE

4JK1/4JJ1 MODELS

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SECTION 6A

ENGINE MECHANICAL (4JK1/4JJ1)

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ISUZU DIESEL ENGINE (4JK1/4JJ1)

Service Precautions

Matters that require attention in terms of maintenance

To prevent damage to the engine and ensure reliability of its performance, pay attention to the following in maintaining the engine:

- When lifting up or supporting the engine, do not apply a jack on the oil pan.
  When taking down the engine on the ground, do not make the bearing surface of the oil pan touch the ground directly. Use a wooden frame, for example, to support the engine with the engine foot and the flywheel housing.
  Because there is only a small clearance between the oil pan and the oil pump strainer, it can damage the oil pan and the oil strainer.
- When the air duct or air cleaner is removed, cover the air intake opening to prevent foreign matter from getting into the cylinder. If it gets contaminated, it can considerably damage the cylinder and others while the engine is operating.
- When maintaining the engine, never fail to remove the battery earth cable. If not, it may damage the wire harness or electrical parts. If you need electricity on for the purpose of inspection, for instance, watch out for short circuits and others.
- Apply engine oil to the sliding contact surfaces of the engine before reassembling it. This ensures adequate lubrication when the engine is first started.
- When valve train parts, pistons, piston rings, connecting rods, connecting rod bearings or crankshaft journal bearings are removed, put them in order and keep them.
- When installing them, put them back in the same location they were removed from.
- Gaskets, oil seals, O-rings, etc. must be replaced with new ones when the engine is reassembled.
- As for parts where a liquid gasket is used, remove an old liquid gasket completely and clean it up thoroughly so that no oil, water or dust is clinging to them. Then, apply the designated liquid gasket to each place anew before assembly.
- Surfaces covered with liquid gasket must be assembled within 5 minutes of gasket application. If more than 5 minutes has elapsed, remove the existing liquid gasket and apply a new liquid gasket.
- When assembling or installing parts, fasten them with the prescribed tightening torque so that they are installed properly.

Matters that require attention in specifically dealing with this engine.

Holes or clearances in the fuel system, which serve as a passage of fuel, including the inside of the injector, are made with extreme precision. For this reason, they are highly sensitive to foreign matter and, if it gets in, it can lead to an accident on the road, for instance; thus, make sure that foreign matter is prevented from getting in.

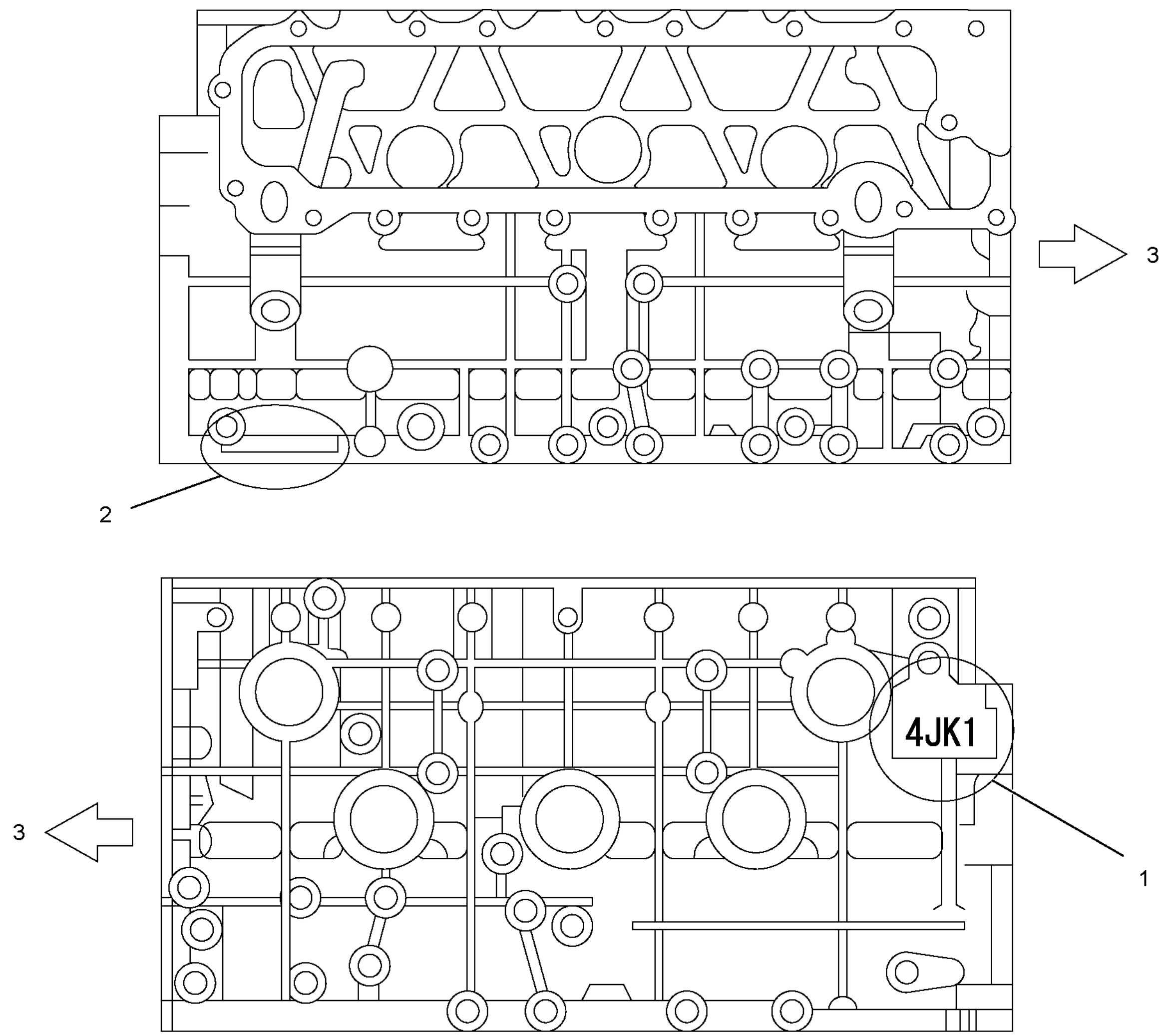
When servicing the fuel system, every precaution must be taken to prevent the entry of foreign material into the system.

- Before beginning the service procedure, wash the fuel line and the surrounding area.
- Perform the service procedures with clean hands. Do not wear work gloves.
- Immediately after removing the fuel hose and/or fuel pipe, carefully tape vinyl bags over the exposed ends of the hose or pipe.
- If parts are to be replaced (fuel hose, fuel pipe, etc.) do not open the new part packaging until installation.

Work procedure

- The fuel opening must be quickly sealed when removing the fuel pipe, injection pipe, fuel injector, fuel supply pump, and fuel rail.
- The eyebolts and gasket must be stored in a clean parts box with a lid to prevent adhesion of foreign matter.
- Fuel leakage could cause fires. Therefore, after finishing the work, wipe off the fuel that has leaked out and make sure there is no fuel leakage after starting the engine.

How to read the model (This illustration is 4JK1 engine)



RTW56ALF004701

Legend

1. Engine Model (Stamped)
2. Engine Number (Stamped)
3. Front

Explanation of functions and operations

Electronic engine control

With the control unit, the range from injection to air intake/exhaust, including fuel injection quantity, injection timing, intake air restriction, EGR, and idling rpm, is controlled.

Piston

The piston is aluminum-alloy and a thermal flow piston with a strut cast, while the combustion chamber is a round reentrant type.

Cylinder head

The cylinder head is aluminum-alloy and there are 4 valves per cylinder. The angular tightening method of the cylinder head bolt further increases reliability and durability.

EGR system

Based upon data, including water temperature, engine speeds or engine loads, it is controlled via Engine Control Module (ECM) to purify exhaust by recycling part of it.

Its main components include an EGR valve, an EGR cooler and various sensors.

Connecting rod cap bolt

The angular tightening method of the connecting rod cap bolt further increases reliability and durability.

Fuel rail-type electronic control injection system

The fuel rail-type electronic control injection system is composed of a fuel supply pump that sets the target pressure of high-pressure fuel and supply it, a fuel rail that measures such high-pressure fuel and a fuel injector that turns it into a fine spray and injects it. Each is controlled via ECM based upon various signals, while injection timing or fuel injection quantity is controlled under every possible driving condition.

Fuel injector

The fuel injector is a 6-hole nozzle that adjusts fuel injection quantity or injection timing by opening or closing an electromagnetic valve on the head of the fuel injector.

ECM corrects the dispersion of fuel injection quantity between fuel injector according to ID code data in memory. At the replacement of fuel injector, ID code data should be stored in ECM.

Fuel filter with sedimenter

It is a fuel filter with sedimenter that gets rid of water by making use of the difference in specific gravity between light oil and water, which comes with an indicator that notifies you that it is filled with water.

Preheating system

The preheating system consists of the ECM, the glow relay, glow plugs and the glow indicator lamp. The preheating system is operated when the engine coolant temperature is low, and makes the engine easy to start.

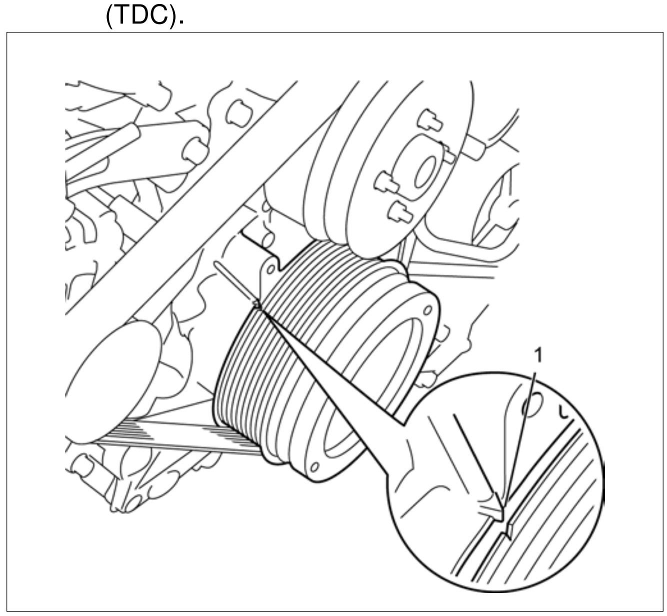
Lubrication system

It is an oil filter with full-flow bypass, which uses a water-cool oil cooler and oil jet to cool the piston.

Functional inspection

Inspection/adjustment of valve clearance

1. Inspection of valve clearance
   - Remove the fuel injector harness assembly.
   - Remove the leak off hose.
   - Remove the cylinder head cover.
   - Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).



RTW76ASH001301

Legend

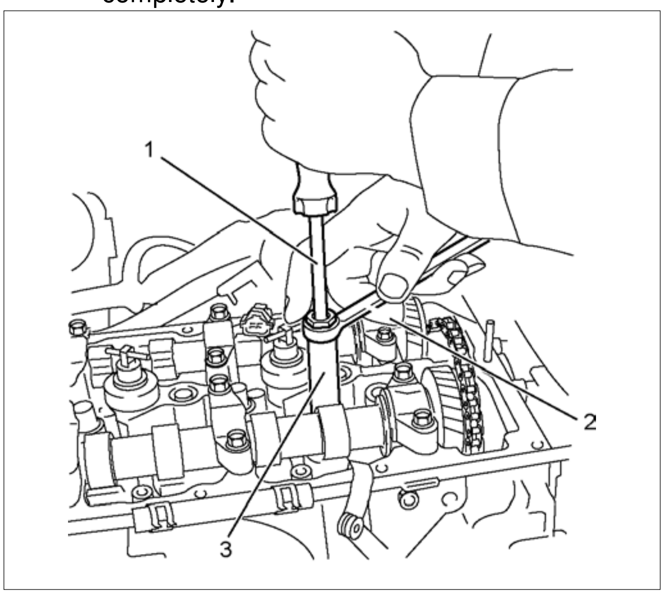
1. TDC

- Insert a 0.15 mm (0.006 in) thickness gauge between the roller of the rocker arm and the camshaft to tighten up the adjusting screw of the rocker arm. When the movement of the thickness gauge becomes tight, fasten the adjusting screw nut of the rocker arm.

Valve clearance	mm (in)
Intake valve	0.15 (0.006)
Exhaust valve	0.15 (0.006)

Note:
Adjust while cold.

2. Adjustment of valve clearance
   - Loosen each adjusting screw of the rocker arm completely.



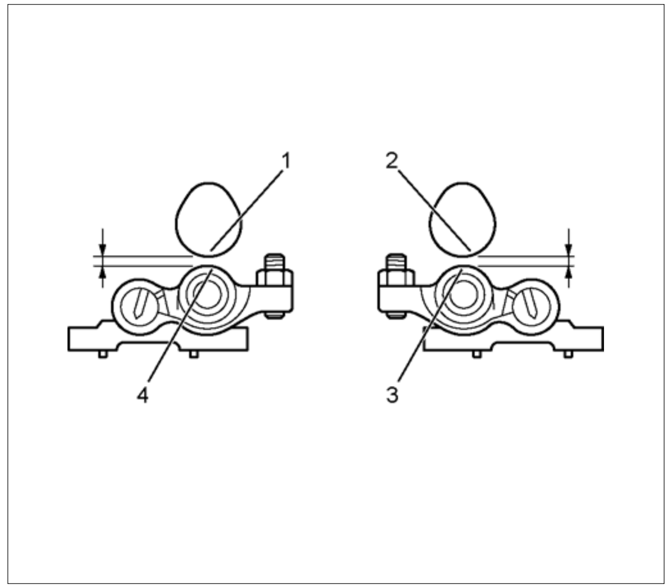
RTW56ASH003701

Legend

1. Screwdriver
2. Ring Spanner
3. Valve Clearance Adjust Nut Wrench

Special tool
Valve clearance adjust nut wrench: 5-8840-2822-0

- Insert a 0.15 mm (0.006 in) thickness gauge between the roller of the rocker arm and the camshaft to tighten up the adjusting screw of the rocker arm. When the movement of the thickness gauge becomes tight, fasten the adjusting screw nut of the rocker arm.



LHW71BSH001201

Legend

1. Cam; Exhaust
2. Cam; Intake
3. Roller; Intake
4. Roller; Exhaust

Tightening torque:

Rocker arm adjustment screw nut
18 N·m (1.8 kg·m/ 13 lb ft)

Adjustment table

Cylinder No.	1		2		3		4	
Valve arrangement	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder Compression TDC	○	○	○			○		
No. 4 cylinder Compression TDC				×	×		×	×

- If the No.1 cylinder is the compression TDC, adjust a valve clearance with ○ mark given on the table and if the No. 4 cylinder is the compression TDC, adjust that with × mark.
- Install the cylinder head cover.
  Refer to "Cylinder Head Cover."
- Install the leak off hose.
- Install the fuel injector harness assembly.

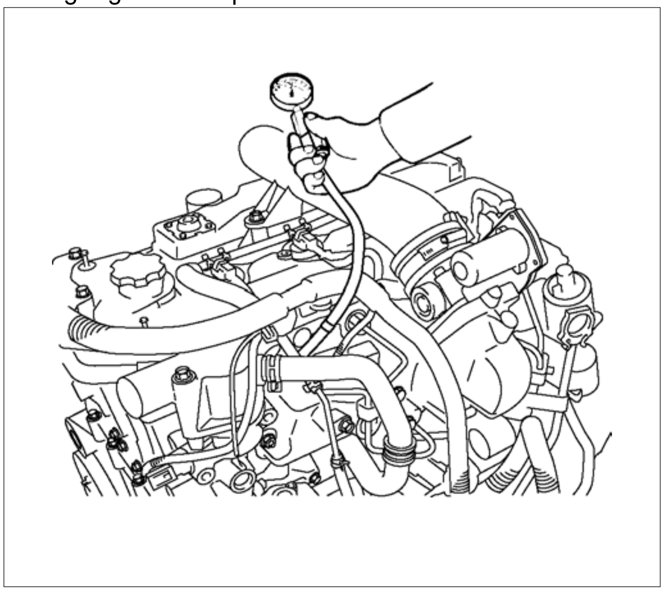
Compression pressure inspection

- Warm up the engine.
- Disconnect the negative battery cable.

- Remove the all glow plugs.

Note:
When the harness connector is removed, ECM judges that it broke down and DTC is recorded. Upon completion of measurement, never fail to clear the memory of the ECM.
(For how to clear the memory of the ECM, refer to "ENGINE CONTROL SYSTEM" Section)

- Connect the negative battery cable.
- Turn on the starter to emit foreign matter within the cylinders.
- Install an adapter and a gauge of a compression gauge of the special tool.



RTW56ASH003801

Compression gauge: 5-8840-2675-0
Gauge adapter: 5-8840-2815-0

- Turn on the starter to inspect compression pressure.

Compression pressure	MPa(psi)/200rpm
Standard	2.84 – 3.24 (412 – 469)
Limit	1.96 (284)
Differences among the cylinders	294 kPa (43)

- Measure each cylinder one by one.

Note:
To keep engine speed at 200 rpm or more, use fully charged batteries.

- Remove a compression gauge of the special tool.
- Disconnect the negative battery cable.
- Install the glow plugs.
- Connect the negative battery cable.

A list of defective phenomena

- Engine does not turn over.
- Engine turns over but does not start.
- Excessive black exhaust smoke.
- Excessive white exhaust smoke.
- Engine knocking.
- Abnormal engine rotation.
- Abnormal battery charging.
- Turbocharger trouble shooting.

Trouble Shooting

Engine does not turn over

Condition	Possible Cause	Correction
Starter motor does not rotate	Dead or weak battery	Charge battery Replace battery
	Incomplete circuit	Connect Repair
	Starter motor brushes stuck, worn, or broken	Replace brushes
	Starter motor internal damage	Repair motor
Starter motor not meshed with flywheel	Ring gear abrasion	Replace ring gear
	Magnetic switch (starter motor) not properly adjusted	Adjust
Starter motor pinion meshed with ring gear but does not rotate	Dead or weak battery	Charge battery Replace battery
	Insufficient contact pressure between starter motor brushes and commutator	Adjust pressure
	Armature (starter motor) stuck	Repair armature
	Engine internal damage (Seizure)	Repair engine

Engine turns over but does not start

Condition	Possible Cause	Correction
Fuel is not delivered to fuel supply pump	Air in fuel system	Bleed air from fuel system
	Air entering fuel pipe	Replace pipe and bleed air from fuel system
	Empty fuel tank	Replenish fuel
	Clogged strainer (fuel suction)	Clean or replace strainer
	Clogged fuel pipe	Clean or replace pipe
	Feed pump malfunction	Replace pump
	Use of wrong fuel for prevailing temperatures	Drain existing fuel and replace with appropriate fuel
	Clogged fuel filter	Replace filter
Fuel is delivered to fuel supply pump	Loose injection pipe connections	Tighten connections
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Bad rotational sensor	Replace sensor
	Engine control system malfunction	System diagnosis
Insufficient or unstable fuel delivery volume	Air in fuel system	Bleed air from fuel system
	Feed pump malfunction	Repair pump
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Clogged fuel filter	Replace filter
	Engine control system malfunction	System diagnosis

Excessive black exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Bad fuel injector condition	Carbon deposit at nozzle tip	Clean fuel injector assembly
	Sticking nozzle	Replace fuel injector assembly
	Engine control system malfunction	System diagnosis
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston
Fuel condition	Water in fuel	Drain existing fuel and replace with new fuel
	Poor fuel quality	Drain existing fuel and replace with new fuel
Poor engine aspiration	Clogged intake pipes	Clean or replace pipes
	Clogged air cleaner element	Clean or replace element
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Engine control system malfunction	System diagnosis
EGR valve and/or intake throttle valve malfunction	Intake throttle valve sticking	Repair or replace valve
	EGR valve sticking	Repair or replace valve
	Engine control system malfunction	System diagnosis
Turbocharger malfunction	Damaged turbocharger blade	Replace turbocharger
	Rough turbocharger shaft rotation	Replace turbocharger
	Oil leakage from oil seal	Replace turbocharger
	Broken actuator	Replace turbocharger

NO

Open circuit between the engine room harness connector terminal No. 1 (C-55) and ground (C-109).

YES

- Disconnect the A/C switch.

- Is there battery voltage between the chassis side harness connector terminal No. 6 (B-57) and ground (C-109)?

YES

- Defective ECM

NO

Open circuit between the No. EB-13 fuse and the chassis side harness connector No. 6 (B-57).

Excessive white exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Control unit malfunction	Replace unit
	Engine control system malfunction	System diagnosis
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston
Fuel condition	Water in fuel	Drain existing fuel and replace with new fuel
Excessive oil consumption	Worn or damaged piston ring(s)	Replace ring(s)
	Defective valve stem oil seal	Replace oil seal
	Defective turbocharger oil seal	Replace turbocharger
	Clogged turbocharger oil return pipe	Repair pipe

Engine knocking

Condition	Possible Cause	Correction
Bad timing	Engine control system malfunction	System diagnosis
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Control unit malfunction	Replace unit
	Engine control system malfunction	System diagnosis
Fuel condition	Poor quality fuel	Drain existing fuel and replace with new fuel
Poor engine aspiration	Clogged air cleaner element	Clean or replace element
	Clogged intake pipes	Clean or replace pipes
	Engine control system malfunction	System diagnosis
Engine break-down	Foreign material in cylinders	Engine overhaul
	Scored pistons and/or bearings	Replace pistons and/or bearings

Abnormal engine rotation

Condition	Possible Cause	Correction
Engine speed cannot be increased	Defective control unit	Replace unit
	Engine control system malfunction	System diagnosis
Engine speed unstable	Defective control unit	Replace unit
	Engine control system malfunction	System diagnosis
	Clogged fuel filter element	Replace element
	Defective fuel injector(s)	Replace fuel injector assembly
	Water in fuel	Drain existing fuel and replace with new fuel
	Air in fuel system	Bleed air from fuel system
Turbocharger malfunction	Damaged turbocharger fan	Replace turbocharger
	Rough turbocharger shaft rotation	Replace turbocharger
	Broken actuator	Replace turbocharger

Abnormal battery charging

Condition	Possible Cause	Correction
No charging	Open or shorted wiring and/or connectors	Repair or replace wiring and/or connectors
	Defective generator	Repair or replace generator
	Defective battery	Replace battery
Insufficient charging	Open or shorted wiring and/or connectors	Repair or replace wiring and/or connectors
	Defective generator	Repair or replace generator
	Loose generator drive belt	Adjust belt tension or replace belt
	Defective battery	Replace battery
Excessive charging	Shorted wiring	Repair or replace wiring
	Defective generator	Repair or replace generator
	Defective battery	Replace battery

Turbocharger Troubleshooting

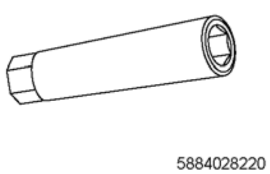
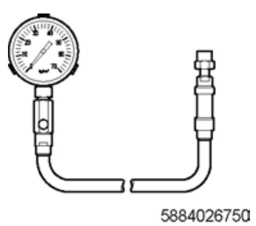
Condition	Possible Cause	Correction
Engine has less than normal power	Air leakage from intake pipe rubber hose	Repair
	Air leakage from intake cover	Repair
	Clogged intercooler cooling section	Clean
	Clogged air cleaner element	Clean or replace
	Intake throttle valve stuck	Repair or replace
	Turbine and housing contact (Interference)	Replace
	Excessive carbon deposit near turbine exhaust port that interferes with turbine	Clean or repair
	Rough turbine shaft rotation	Repair or replace
	Damaged turbine blade	Repair or replace
Blue exhaust smoke	Oil leakage from turbocharger oil seal	Repair or replace
	Clogged turbocharger oil return pipe	Repair
	Clogged center housing oil passages	Repair or replace
	Engine oil deterioration	Change engine oil
Noisy turbocharger operation	Gas leakage from intake or exhaust system	Repair
	Turbine and housing contact (Interference)	Repair or replace
	Damaged turbine blade	Replace
	Turbine shaft bearing abrasion or scoring	Repair or replace
Excessive rotating part wear	Engine oil deterioration	Change engine oil
	Clogged turbocharger oil feed pipe	Repair
	Low engine oil pressure	Repair

Main Data and specifications

Item		Engine model 4JK1	Engine model 4JJ1
Type		Diesel/4-cycle/water cooling-type in-line DOHC	
Combustion chamber type		Direct injection type	
Cylinder liner type		Liner less	
Number of cylinders -cylinder bore × strokes mm (in)		4-95.4 (3.76) × 87.4 (3.44)	4-95.4(3.76) × 104.9(4.13)
Displacement cc (cu.in)		2499 (152)	2999 (183)
Compression ratio		18.3	17.5
Compression pressure MPa (psi)/rpm		3 (435)/200	
Idling speed rpm		700 ± 25	
Valve clearance mm (in)	Intake	0.15 (0.006) (cold)	
	Exhaust	0.15 (0.006) (cold)	
Ignition type		Compressed ignition	
Injection order		1 - 3 - 4 - 2	
Lubricating system			
Lubricating type		Pressure delivery type	
Oil pump type		Gear type	
Volume of lubricating oil L (qts)		8.0 (8.5)	
Oil filter type		Full flow filter (cartridge type)	
Oil cooling type		Built-in-type, water cooling	
Cooling system			
Cooling type		Water cooling type	
Radiator type		Corrugated fin (pressure type)	
Water pump type		Centrifugal, belt drive type	
Thermostat type		Wax-type units	
Thermostat valve-opening temperature °C (°F)		85 (185)	
Volume of coolant L (qts)		M/T8.7 (9.2) A/T 8.6 (9.1) (incl. radiator)	
Fuel system			
Injection pump type		Fuel supply pump fuel rail type	
Fuel injector type		Electronic control injector 6-hole	
Fuel pump type		Into the fuel tank type	
Charging system			
Generator type		AC type	
Power output V-A		12 - 90	

Item		Engine model 4JK1	Engine model 4JJ1
Regulator type		IC	
Starting system		Engage magnet type	
Starter type		Reduction type	
Power output	V-kW	12 – 2.3	
Preheat system type		Glow plug	
Glow plug standard voltage/electric current	V-A	12 - 3.5	

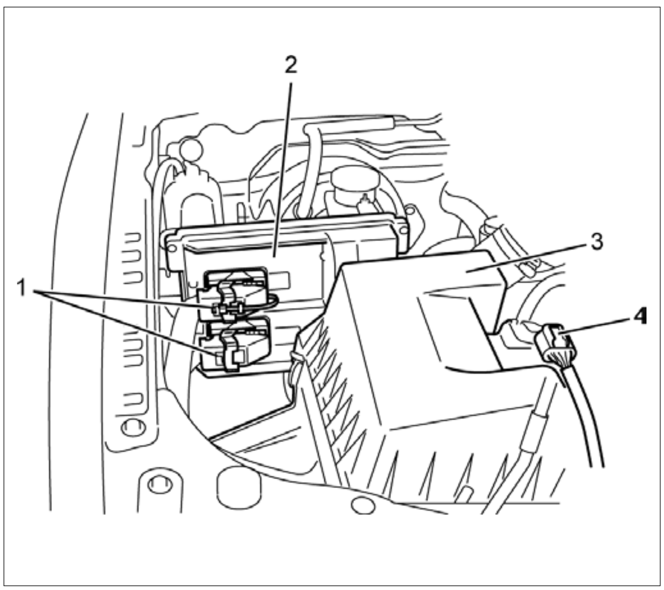
Special Tools

ILLUSTRATION	PART NO. PART NAME
	**5-8840-2822-0** Valve clearance adjust nut wrench
	**5-8840-2675-0** Compression gauge
	**5-8840-2815-0** Compression gauge adapter

Engine Assembly

Removal

1. Disconnect the negative battery cable.
2. Remove the engine hood.
3. Drain the coolant.
4. Remove the starter motor.
5. Remove the transmission assembly.
   Refer to removal procedure for “TRANSMISSION” in this manual.
6. Disconnect the ECM harness connector.
7. Remove the ECM.
8. Remove the air cleaner.
   - Disconnect the MAF sensor harness connector.
   - Remove the intake pipe with the lid of air cleaner box.
   - Remove the air cleaner box.

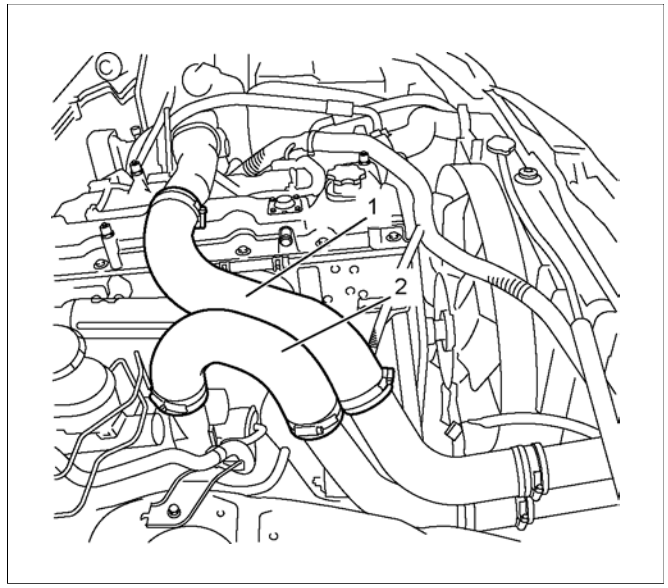


RTW76ASH000401

Legend

1. ECM Harness Connector
2. ECM
3. Air Cleaner Box
4. MAF Sensor Harness Connector

9. Remove the intake hose (intercooler - intake throttle) (Standard output).
10. Remove the intake hose (turbocharger - intercooler) (Standard output).
    Remove the harness connector.

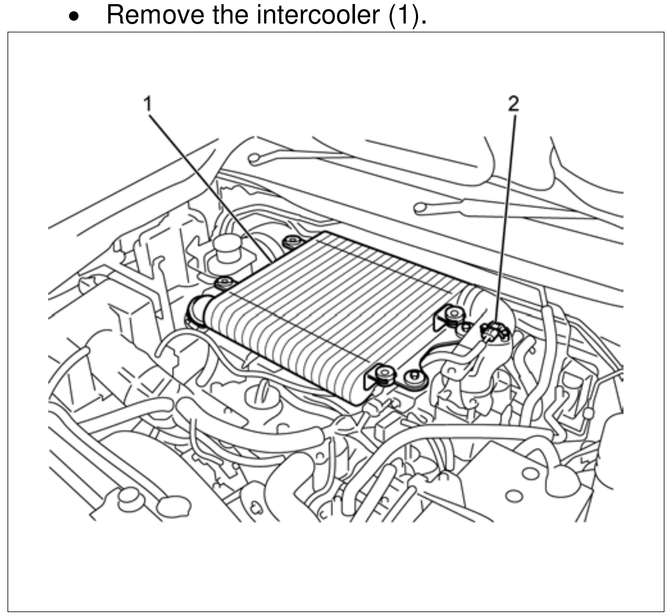


RTW56ASH004001

Legend

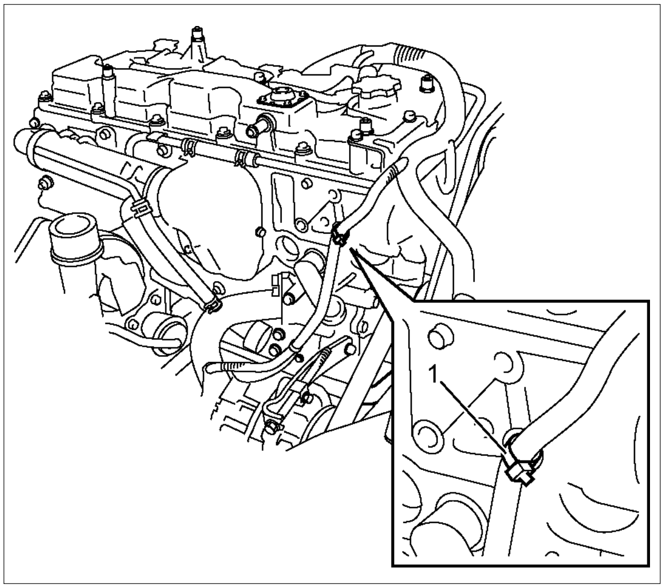
1. Intake Hose (intercooler - intake throttle)
2. Intake Hose (turbocharger - intercooler)

11. Remove the intercooler (High output).
    - Disconnect the BARO sensor harness connector (2).
    - Remove the two intake hoses.
    - Remove the intercooler (1).

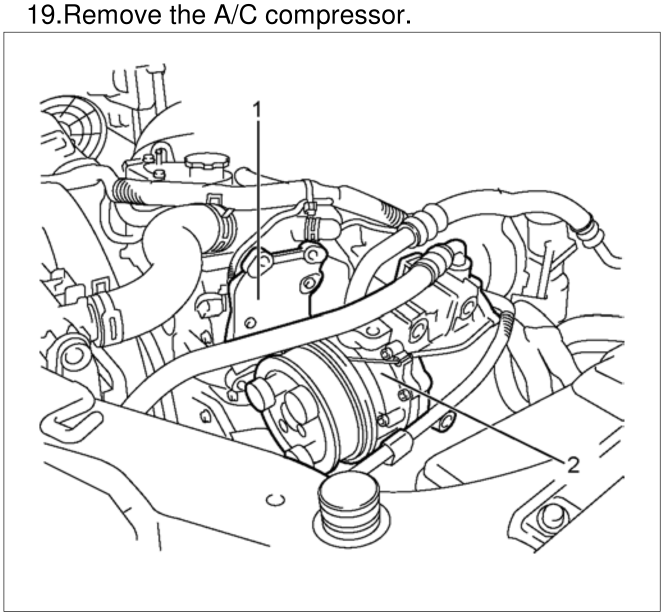


RTW76ASH000501

12. Remove the radiator upper hose.
13. Remove the engine harness clip (1).



14.Remove the breather hose and lower hose of the radiator.
15.Remove the fan guide.
16.Remove the drive belt.
17.Remove the fan assembly.
18.Remove the radiator.
19.Remove the A/C compressor.

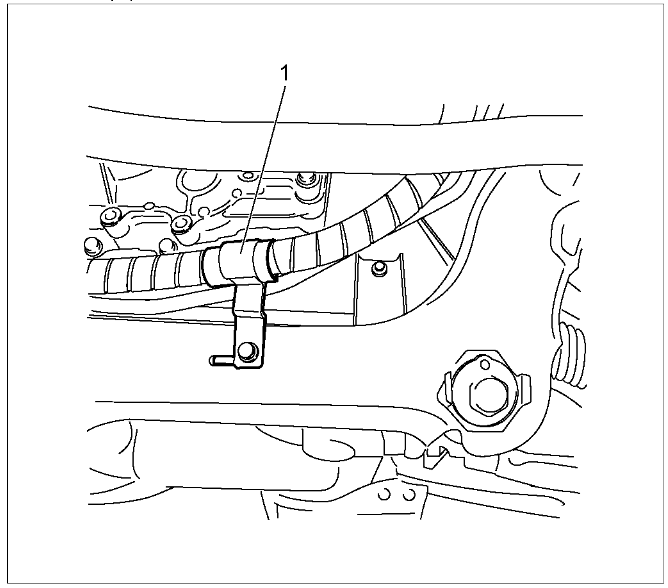


Legend

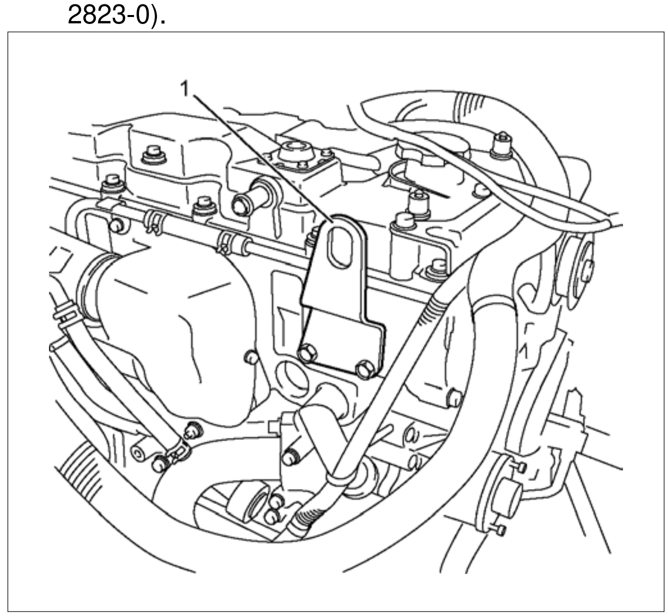
1. A/C Compressor Bracket
2. A/C Compressor

- Disconnect the connector.
- Disconnect the A/C generator harness.
- Disconnect the terminal B cable and harness connector from the generator.

20.Remove the power steering pump.
- Remove the bracket of power steering oil hose (1).

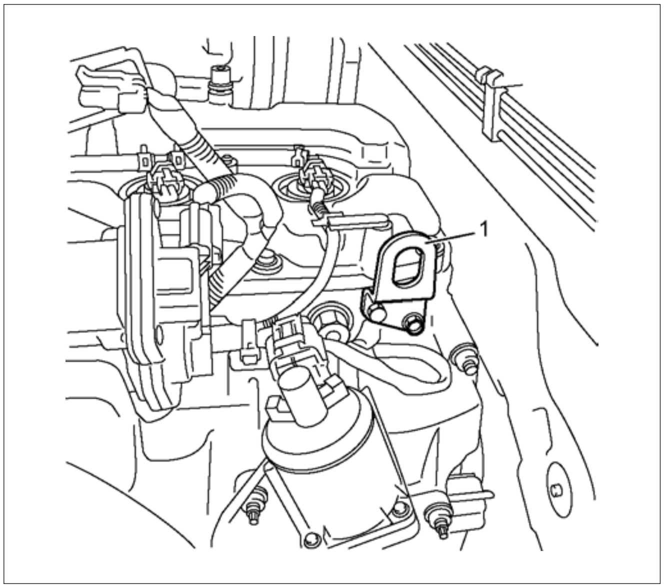


21.Remove the harness of engine, battery and earth from the body side.
22.Remove the connector of the shift on the fly (4×4).
23.Remove the vacuum hose of brake master-vac.
24.Remove the front exhaust pipe.
25.Disconnect the fuel hose on the feed and return sides.
26.Install the engine hanger (special tool 5-8840-2823-0).



Legend

1. Engine Hanger (Front Side)



RTW56ASH004401

Legend

1. Engine Hanger (Rear Side)

27. Hang wire on the engine hanger and hoist to lift up the engine slightly.
28. Remove the engine mount.
- Remove the fastening bolts for the engine mount on the engine side.
29. Remove the engine assembly.
- Hoist the engine slightly to provide space to remove the catalytic converter.

Installation

Notice:
Be absolutely sure that each harness is reconnected to its original position.

1. Install the engine assembly.
- Hang wire on the engine hanger and hoist to lift up the engine.
- Operate a hoist slowly to move the engine to the place where it is to be installed.
- Make the transmission side lower and operate a hoist slowly, pulling it backward to the engine.
2. Install the engine mount.

Tightening torque: 48 N·m (4.9kg·m / 35 lb ft)

3. Remove the engine hanger.
4. Install the catalytic converter.

Tightening torque: 27 N·m (2.8kg·m /20 lb ft)

5. Install the front exhaust pipe.

Tightening torque: 67 N·m (6.8kg·m / 49 lb ft)

6. Install the fuel hose on the feed and return sides.
7. Install the vacuum hose of brake master-vac.
8. Install the connector of the shift on the fly (4×4).
9. Install the harness of engine, battery and earth to the body side.
10. Install the power steering pump.

Tightening torque: 25 N·m (2.5kg·m / 18 lb ft)

- Install the bracket of power steering oil hose.
11. Install the A/C compressor.

Tightening torque: 25 N·m (2.5kg·m / 18 lb ft)

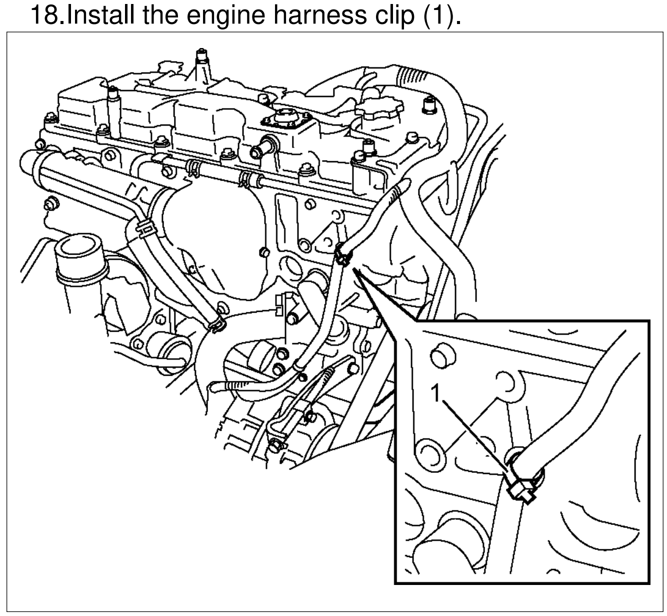
- Install the connector.
12. Install the A/C generator harness.
- Install the terminal B cable and the harness connector to the generator.
13. Install the radiator.

Tightening torque: 25 N·m (2.5kg·m / 18 lb ft)

14. Install the fan assembly.

Tightening torque: 8 N·m (0.8kg·m / 69 lb in)

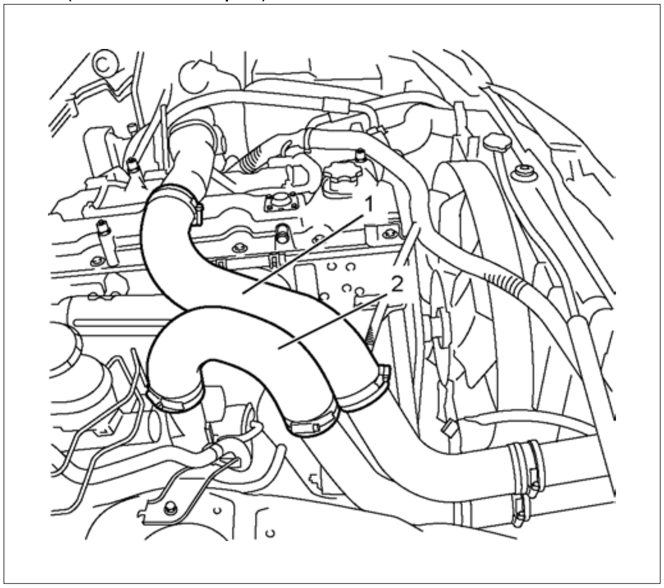
15. Install the drive belt.
Refer to removal procedure for drive belt in this manual.
16. Install the fan guide.
17. Install the breather hose and lower hose of the radiator.
18. Install the engine harness clip (1).



RTW76ASH001401

19. Install the radiator upper hose.
20. Install the intake hose (turbocharger -intercooler) (Standard output).
- Install the harness connector.

21.Install the intake hose (intercooler - intake throttle) (Standard output).



RTW56ASH004001

22.Install the intercooler (High output).
- Install the intercooler.
- Install the two intake hoses.
- Connect the BARO sensor harness connector.

23.Install the air cleaner.
- Install the intake pipe with the lid of air cleaner box.
- Install the air cleaner box.
- Connect the MAF sensor harness connector.

24.Install the ECM.

25.Connect the ECM harness connector.

26.Install the transmission assembly.
Refer to installation procedure for "TRANSMISSION".

27.Install the starter motor.

Tightening torque: 94 N·m (9.6kg·m / 69 lb ft)

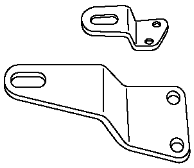
28.Replenish the coolant.

29.Install the engine hood.

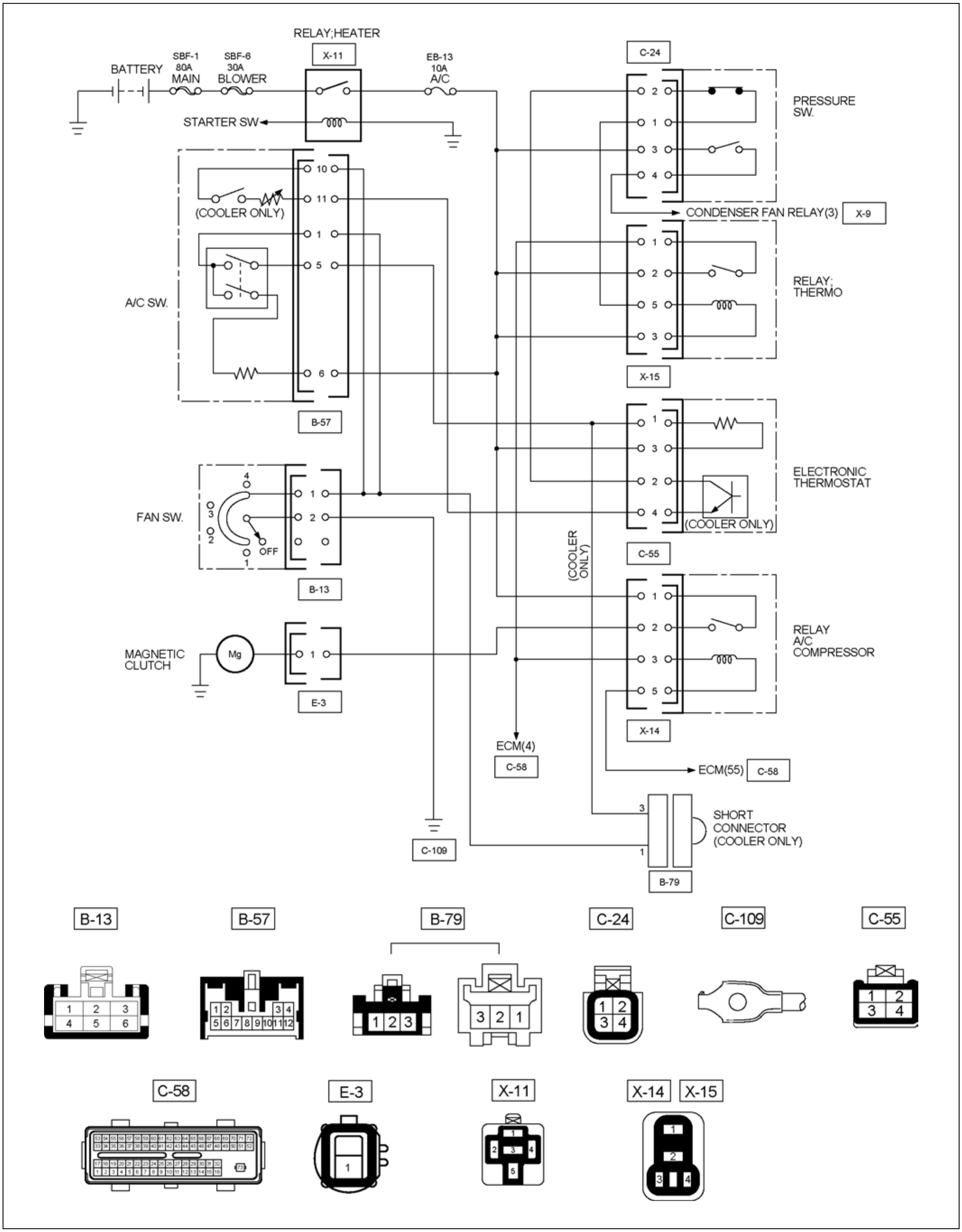
Tightening torque: 10 N·m (1.0kg·m / 87 lb in)

30.Connect the negative battery cable.

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884028230	**5-8840-2823-0** Engine hanger

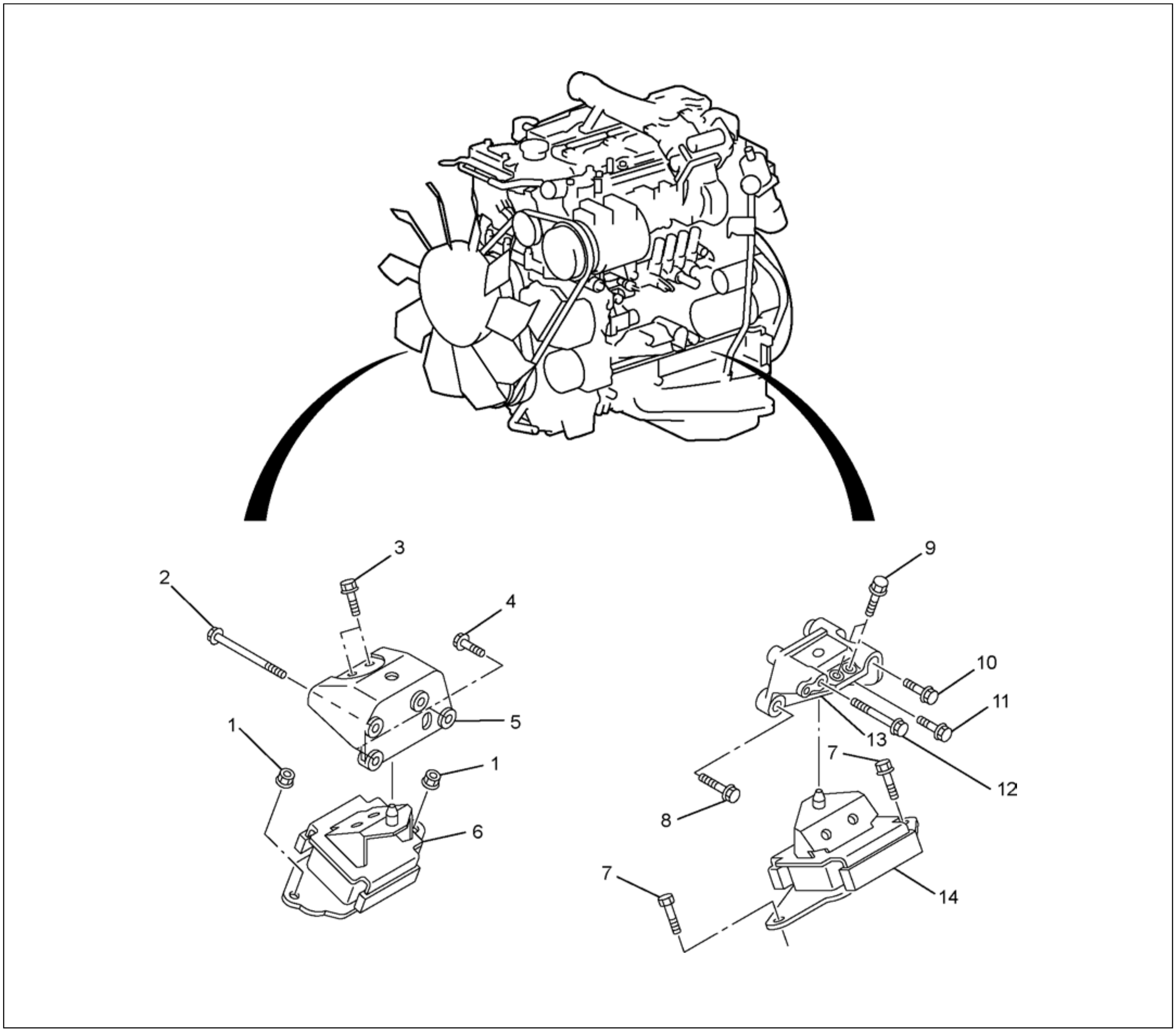
4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output RHD MODEL



RTW710XF000401

Engine Mount

Components



RTW56ALF001801

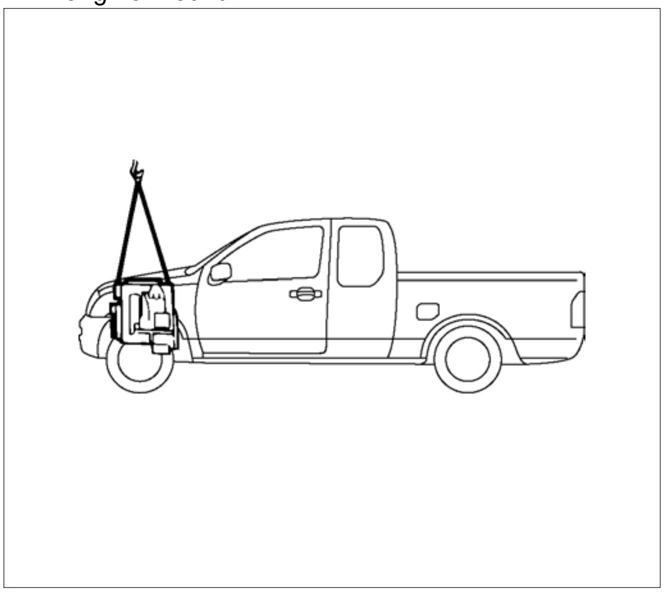
Legend

1. Nut
2. Bolt (L = 80 mm / 3.15 in)
3. Bolt (L = 30 mm / 1.18 in)
4. Bolt (L = 30 mm / 1.18 in)
5. Engine Foot RH
6. Engine Mount RH
7. Bolt (L = 25 mm / 0.98 in)
8. Bolt (L = 45 mm / 1.77 in)
9. Bolt (L = 30 mm / 1.18 in)
10. Bolt (L = 40 mm / 1.57 in)
11. Bolt (L = 20 mm / 0.78 in)
12. Bolt (L = 100 mm / 3.94 in)
13. Engine Foot LH
14. Engine Mount LH

Removal

1. Remove the engine hood.
2. Remove the engine cover.
3. Set the hoist and the engine hanger of the special tool (special tool 5-8840-2823-0).
4. Remove the engine mount.

- Before removing the engine mount, hang the engine with a hoist.
- Remove the bolts of the engine mount.
- Hoist the engine assembly slightly to remove the engine mount.



RTW56ASH004501

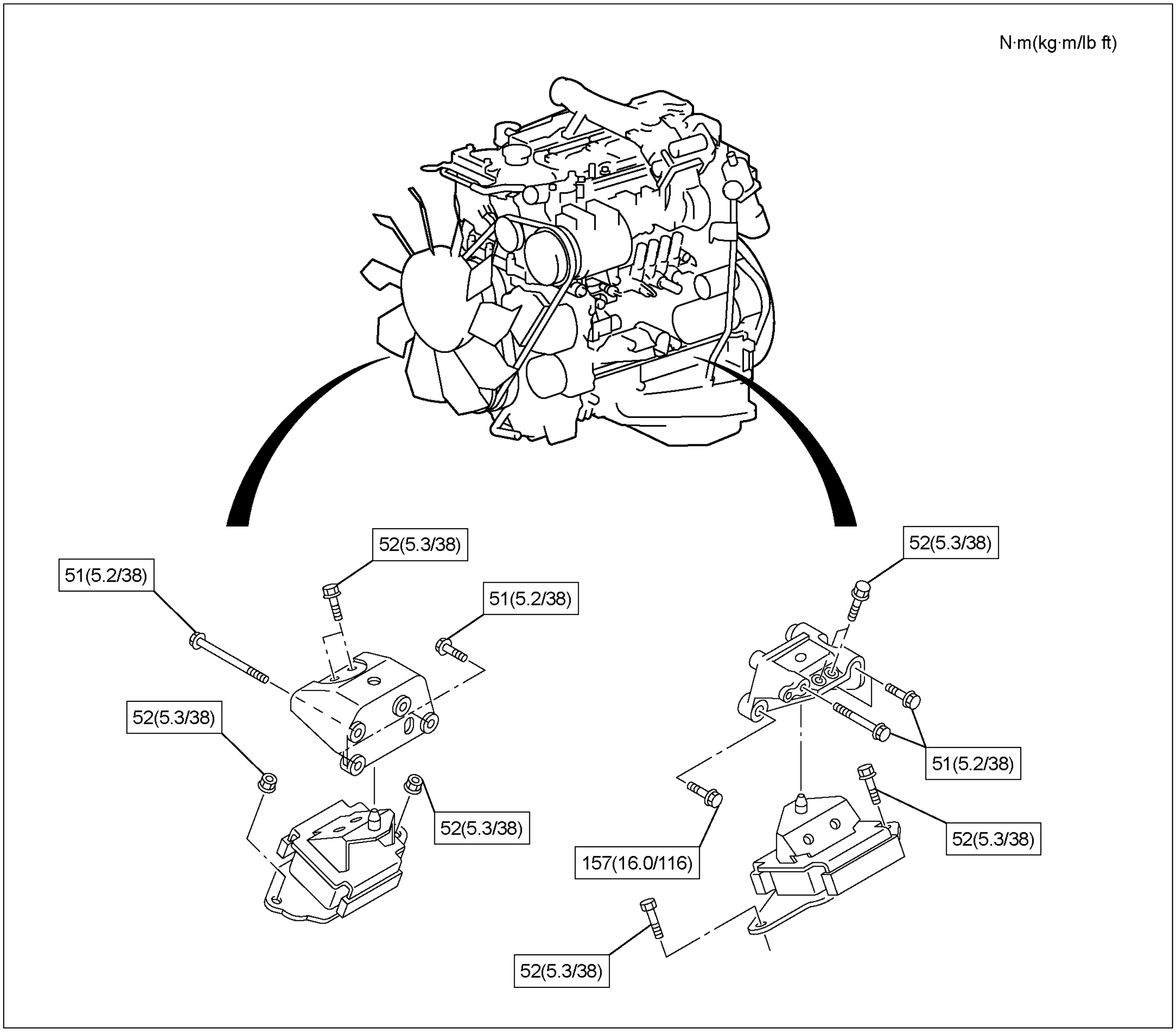
Installation

1. Install the engine mount and tighten up with the specified torque.

Tightening torque: 52 N·m (5.3 kg·m / 38 lb ft)

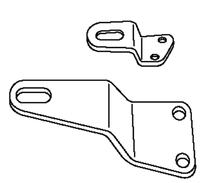
2. Install the engine cover.
3. Install the engine hood.
   - Check if nothing is wrong with the engine mount by starting the engine.

Torque Specifications



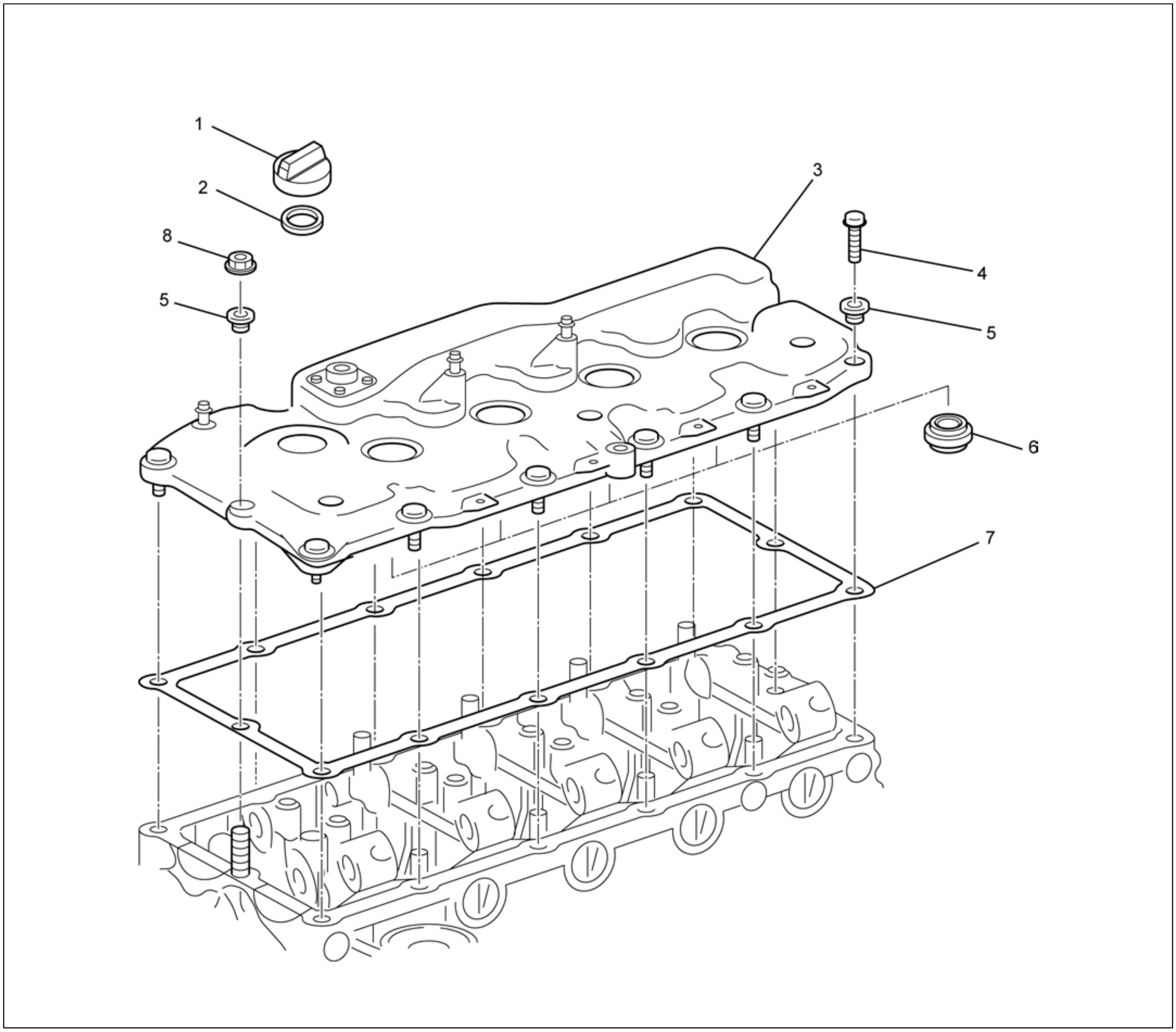
RTW56ALF003801

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884028230	**5-8840-2823-0** Engine hanger

Cylinder Head Cover

Components



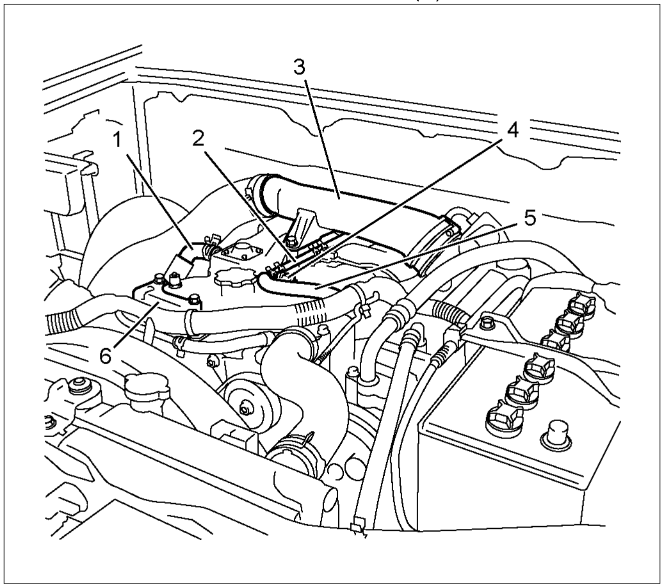
RTW76ALF000101

Legend

1. Oil Filler Cap
2. Oil Filler Cap Gasket
3. Cylinder Head Cover
4. Bolt
5. Head Cover Mounting Rubber
6. Nozzle Seal Cover
7. Head Cover Gasket
8. Nut

Removal

1. Remove the engine cover.
2. Remove the intake air duct (3) (Standard output).
3. Remove the harness bracket (6).

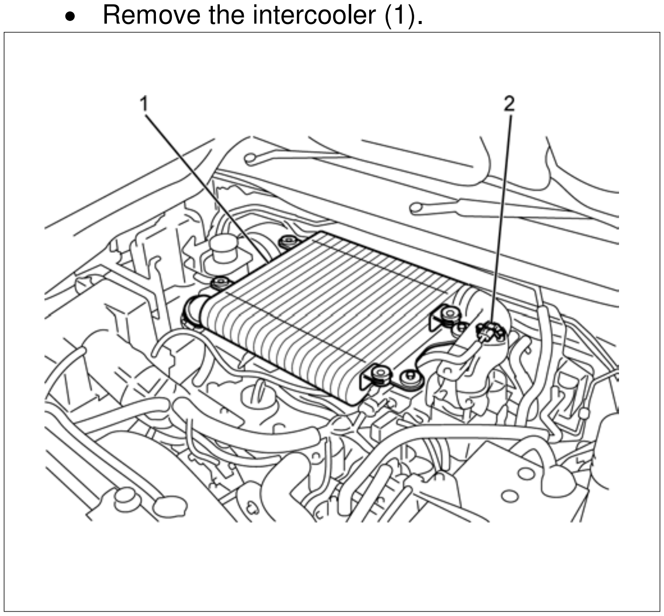


RTW56ASH025001

Legend

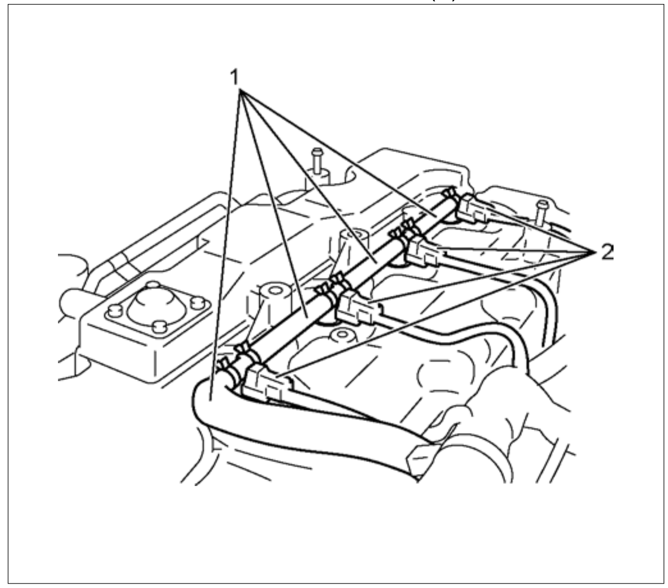
1. Blow-by Hose
2. Leak-off Hose
3. Intake Air Duct
4. Fuel Injector Connector
5. Leak-off Hose
6. Harness Bracket

4. Remove the intercooler (High output).
   - Disconnect the BARO sensor harness connector (2).
   - Remove the two intake hoses.
   - Remove the intercooler (1).



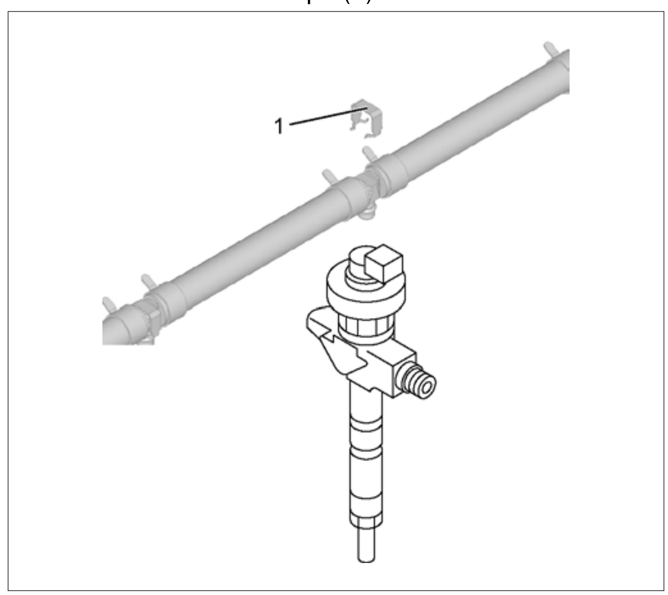
RTW76ASH000501

5. Disconnect the fuel injector connector (2).
6. Remove the fuel leak off hose (1).



RTW76ASH000101

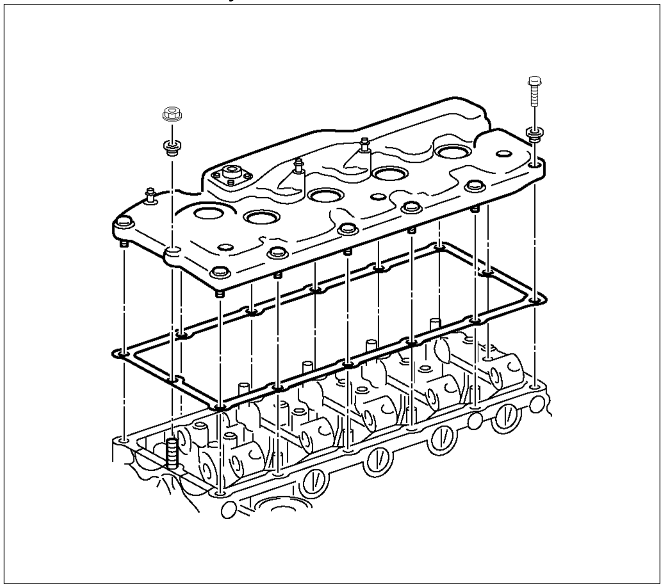
Note: Do not reuse the clips (1).



LNW76ASH002101

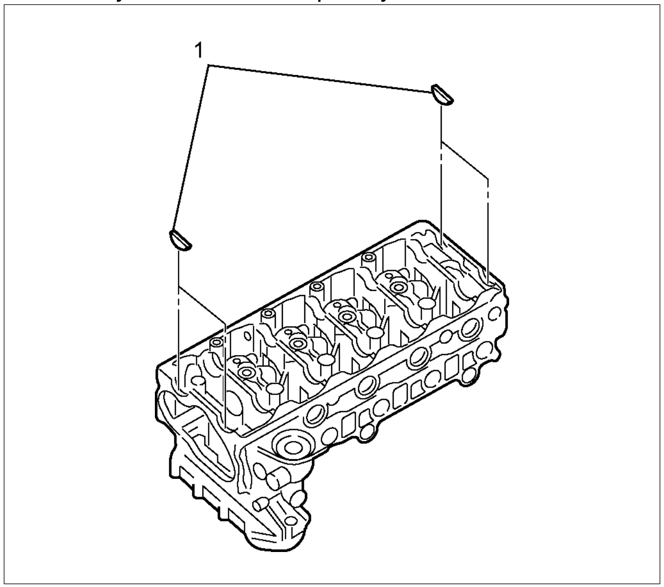
7. Disconnect the blow-by hose.

8. Remove the cylinder head cover.



LNW71BSH000401

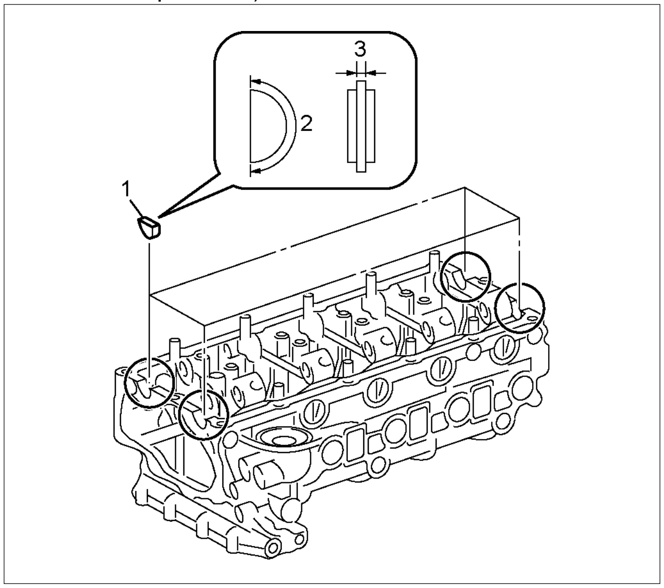
9. Remove the nozzle seal cover from the cylinder head cover.
   - Remove from the lower side of cylinder head cover.
10. Remove the cam end gasket (1).
   - Remove the liquid gasket that has adhered to cylinder head completely.



RTW56ASH020501

Installation

1. Install the nozzle seal cover.
   - Insert from the lower side of cylinder head cover.
   - Apply soapy water or engine oil to the surface of cylinder head cover side.
   - Insert the nozzle seal cover as far as it will go.
2. Install the cam end gasket.
   - Apply the liquid gasket (ThreeBond TB-1207B or equivalent) and mount.

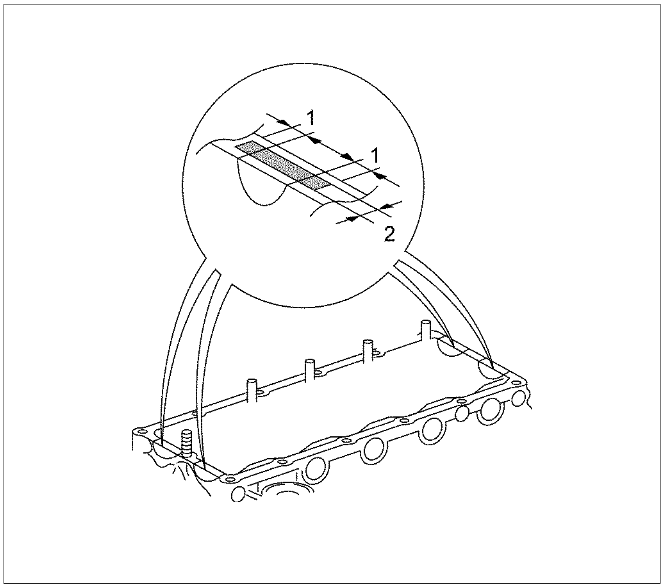


RTW56ASH020601

Legend

1. Cam End Gasket
2. Apply The Liquid Gasket
3. 2.0 - 3.0 mm (0.079 - 0.118 in)

- Apply attaching cam end gasket.
  Apply the liquid gasket (ThreeBond TB-1207B or equivalent).



RTW56ASH022701

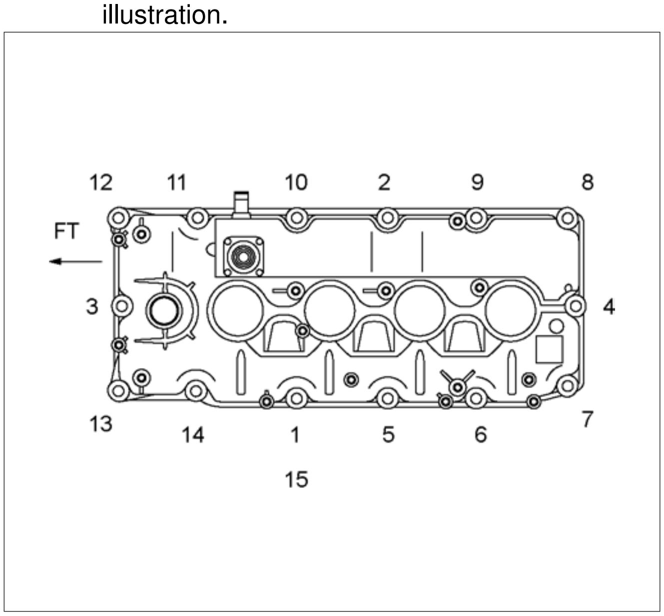
Legend

1. 3.0 - 5.0 mm (0.118 - 0.197 in)
2. 3.0 - 5.0 mm (0.118 - 0.197 in)

3. Install the cylinder head cover.

   Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

   - Tighten the nut and bolts in order shown in the illustration.



RTW56ASH004801

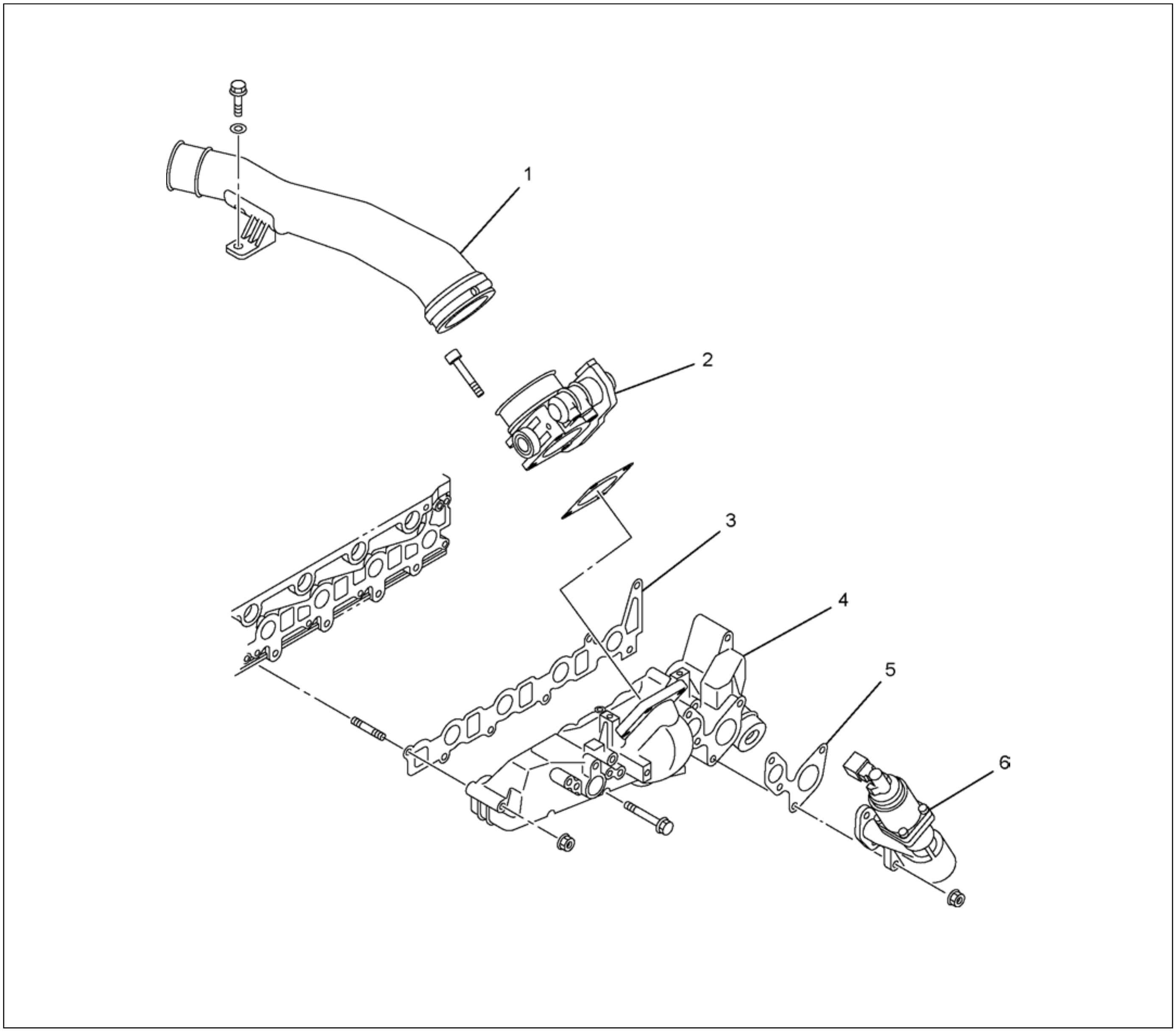
4. Install the blow-by hose.
5. Install the leak-off hose and the fuel injector connector.
6. Install the harness bracket to the cylinder head cover.
7. Install the intercooler (High output).
   - Install the intercooler.
   - Install the two intake hoses.
   - Connect the BARO sensor harness connector.
8. Install the intake air duct.

   Tightening torque: 25 N·m (2.5 kg·m / 18 lb in)

9. Install the engine cover.

Intake Manifold

Components (Standard Output)

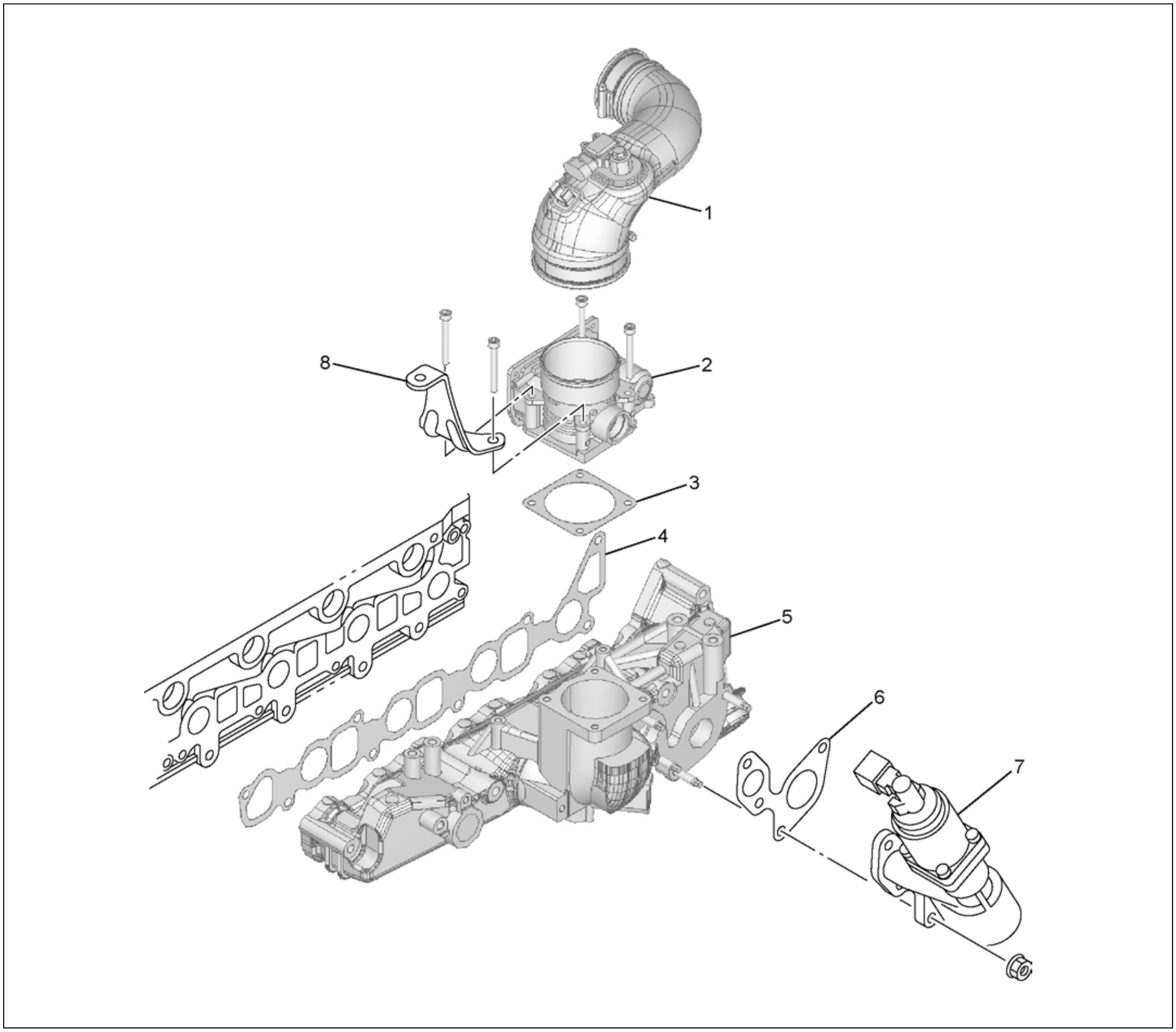


RTW76ALF000201

Legend

1. Intake Duct
2. Throttle Assembly
3. Intake Manifold Gasket
4. Intake Manifold
5. EGR Valve Assembly Gasket
6. EGR Valve Assembly

Components (High Output)



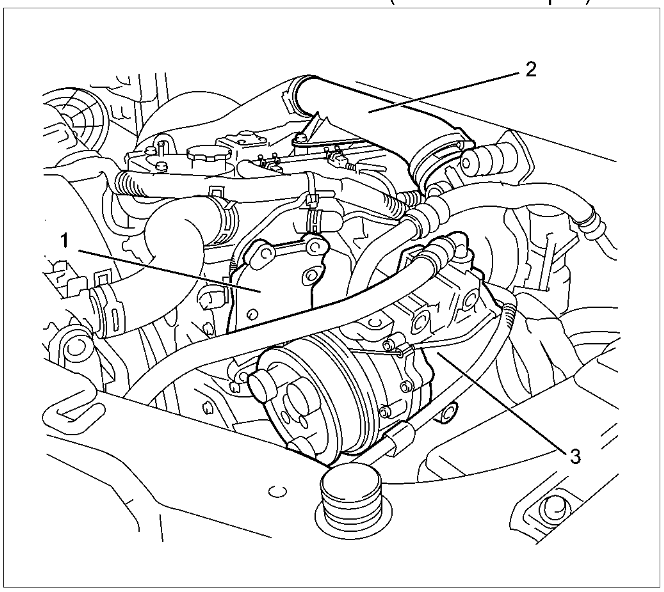
RTW76ALF000301

Legend

1. Intake Duct
2. Intake Throttle
3. Intake Throttle Gasket
4. Intake Manifold Gasket
5. Intake Manifold
6. EGR Valve Assembly Gasket
7. EGR Valve Assembly
8. Bracket

Removal

1. Remove the engine cover.
2. Disconnect the connectors.
   - Fuel Injector
   - Throttle Assembly
   - EGR Valve
   - Glow Plug
   - Barometric Sensor
   - A/C Compressor Connector
3. Remove the A/C belt
4. Remove the A/C compressor.
5. Remove the A/C compressor bracket.
6. Remove the intake air duct (Standard output).

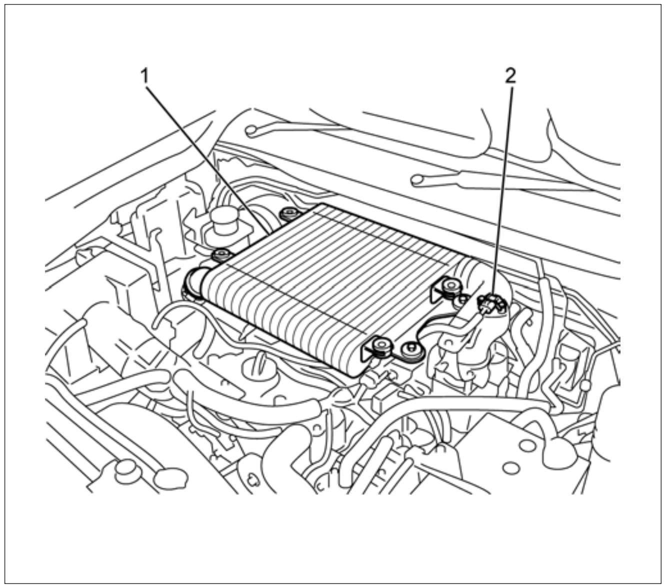


RTW56ASH024801

Legend

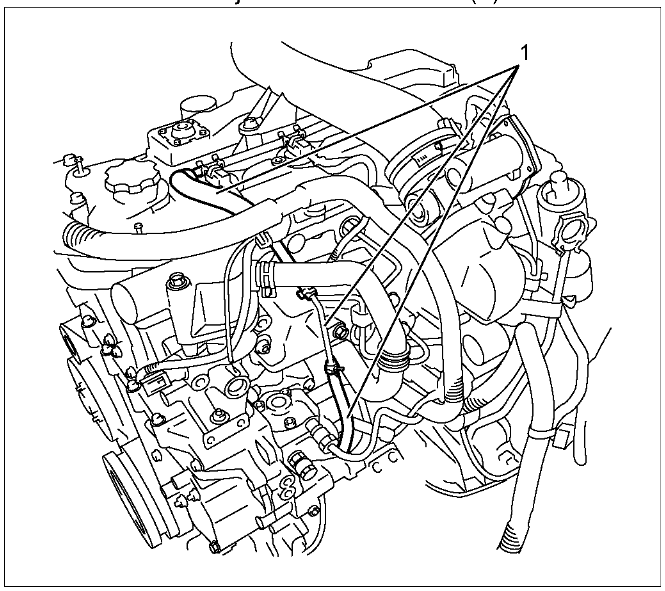
1. A/C Compressor Bracket
2. Intake Air Duct
3. A/C Compressor

7. Remove the intercooler (High output).
   - Disconnect the BARO sensor harness connector (2).
   - Remove the two intake hoses.
   - Remove the intercooler (1).



RTW76ASH000501

8. Remove the injector leak-off hose (1).



RTW56ASH024301

9. Remove the engine oil level gauge guide tube.
10. Remove the EGR valve.

MAGNETIC CLUTCH DOES NOT RUN (4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output RHD MODEL)

- Are the No. SBF-6 fuse (30A) and the No. EB-13 (10A) fuses OK?

YES | NO → Replace

- Are the A/C thermo (X-15), heater & A/C (X-11) and A/C compressor (X-14) relay OK?

YES | NO → Replace

- Is the pressure switch (C-24) OK?

YES | NO → Defective switch or insufficient refrigerant

- Is the electronic thermostat (C-55) OK?

YES | NO → Replace

- Are the A/C switch (B-57) and the fan switch (B-13) OK?

YES | NO → Replace

- Turn the ignition switch "ON" (Engine is running)
- A/C switch and fan control knob (fan switch) "ON"

- Disconnect the magnetic clutch connector.

- Is there battery voltage between the engine room harness connector terminal No.1 (E-3) and ground?

NO

- Disconnect the A/C compressor relay.

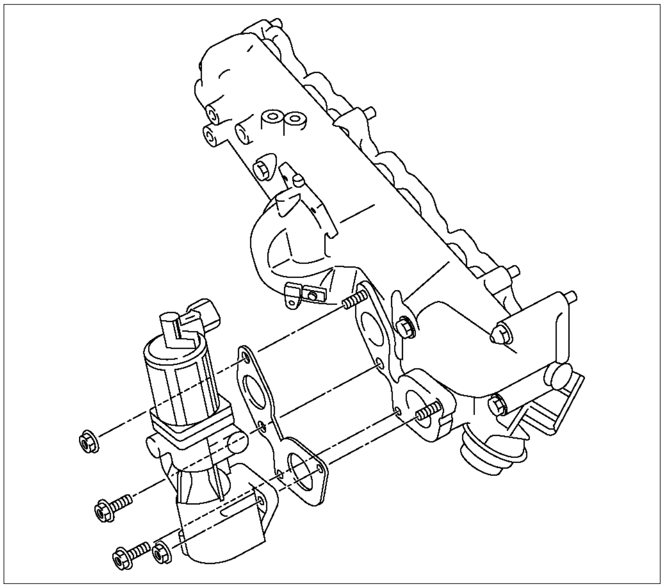
- Is there continuity between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14)?

YES

Does the magnetic clutch operate?

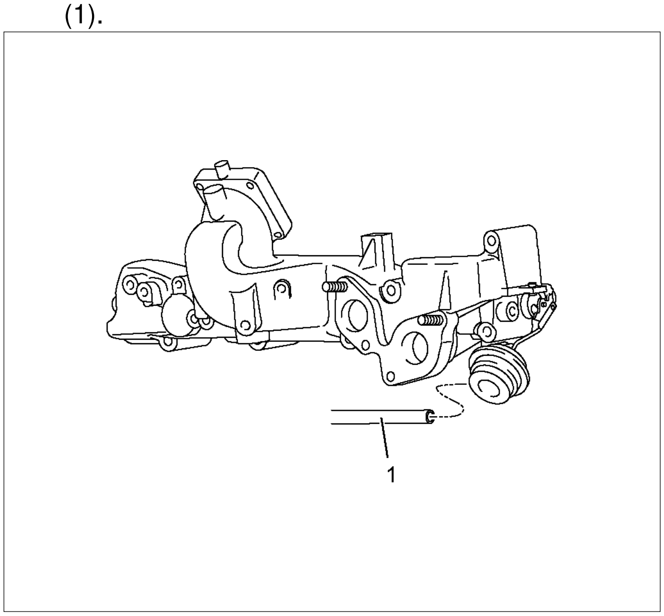
YES → Defective compressor

NO → Defective magnetic clutch



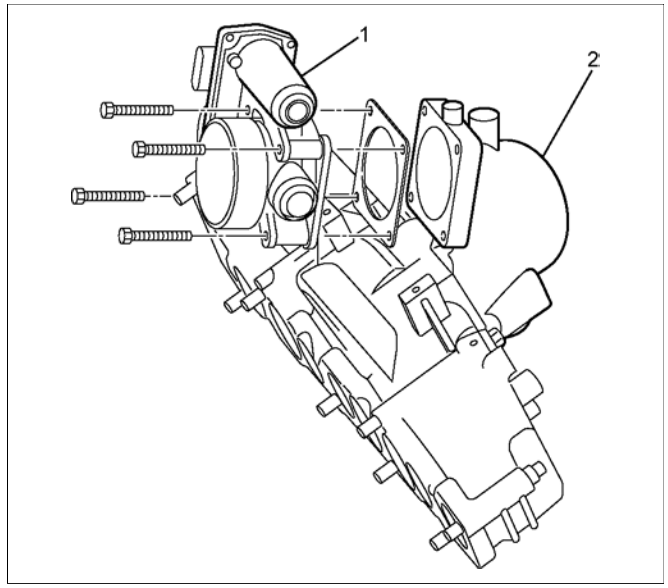
RTW66ASH003001

11. Remove the injection pipes.
    - Remove sequentially from No.1 cylinder.
12. Disconnect the vacuum hose of swirl control valve (1).



RTW66ASH003101

13. Remove the throttle assembly and gasket.

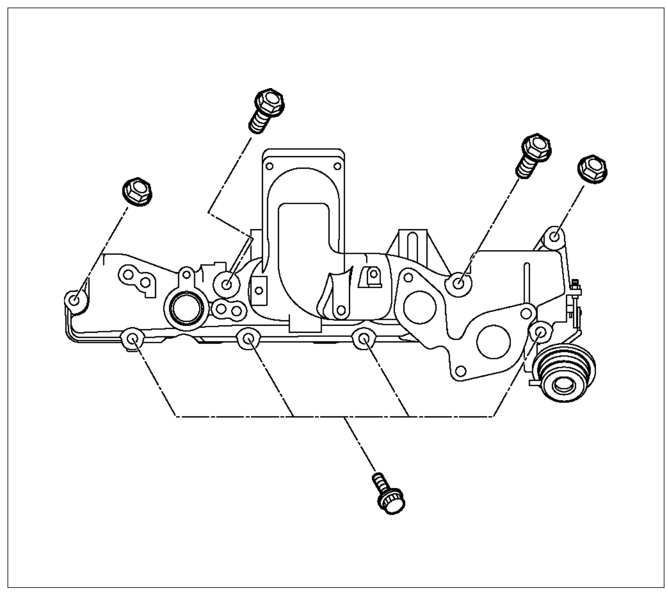


RTW56ASH005201

Legend

1. Throttle Assembly
2. Intake Manifold

14. Remove the intake manifold.



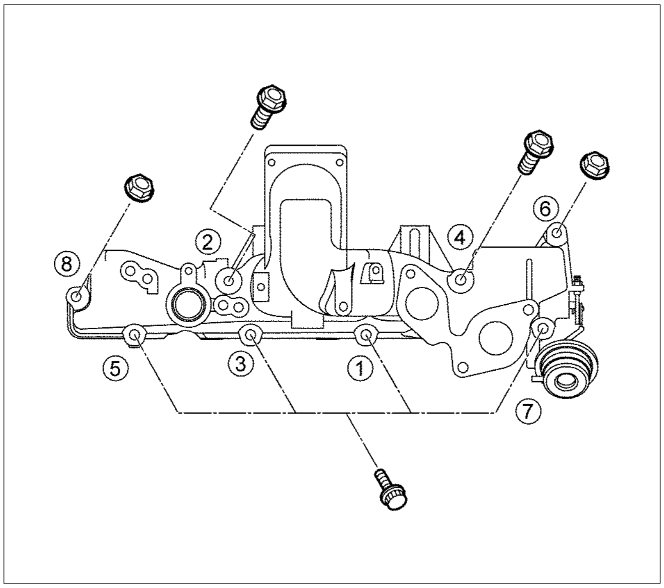
RTW56ASH018001

15. Remove the intake manifold gasket.

Installation

1. Install the intake manifold gasket.
2. Install the intake manifold.
   - Tighten the nuts and bolts in the order described in the drawing.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW56ASH018001

3. Install the throttle assembly and gasket.
   - Tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

4. Install the vacuum hose of swirl control valve.
5. Install the injection pipe (fuel rail - fuel injector).
   - It installs sequentially from No. 4 cylinder.

Tightening torque: 29 N·m (3.0 kg·m / 22 lb ft)

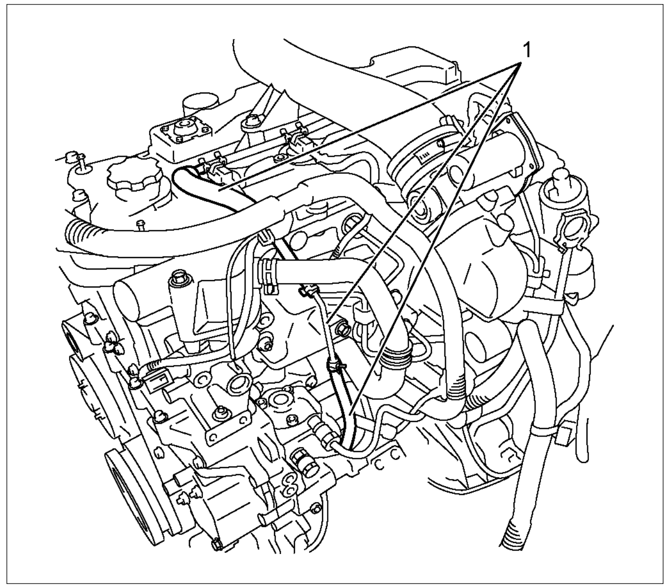
6. Install the EGR valve.
   - Tighten the nuts to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)

7. Install the engine oil level guide tube.
   Tighten the nuts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

8. Install the intercooler (High output).
9. Connect the connector of other parts.
   - Fuel Injector
   - Throttle Assembly
   - EGR Valve
   - Glow Plug
   - Barometric Sensor
   - A/C Compressor Connector
10. Install the leak-off hose.



RTW56ASH024301

Legend

1. Injector Leek-off Hose

11. Install the intake air duct.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

12. Install the A/C compressor bracket.

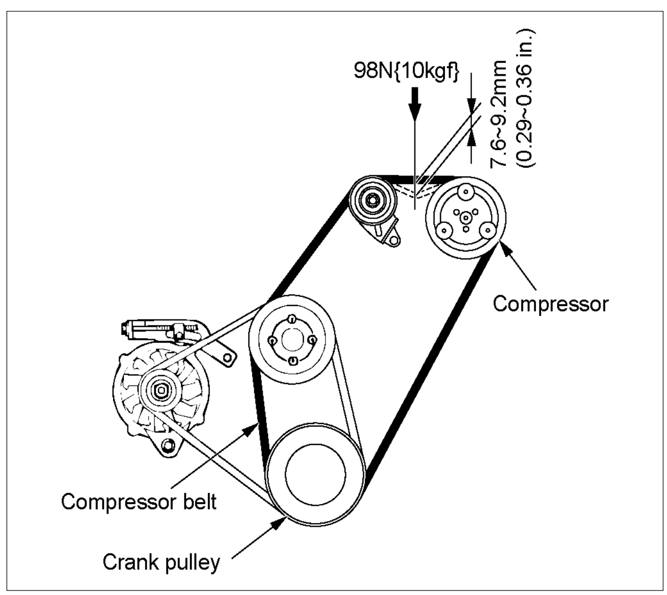
Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

13. Install the A/C compressor and A/C compressor connector.

Tightening torque: 44 N·m (4.5 kg·m / 33 lb ft)

14. Install the A/C belt.
    Check the A/C belt tension.
    Depress the A/C belt mid-portion with 98 N (10 kg / 22 lb) force.

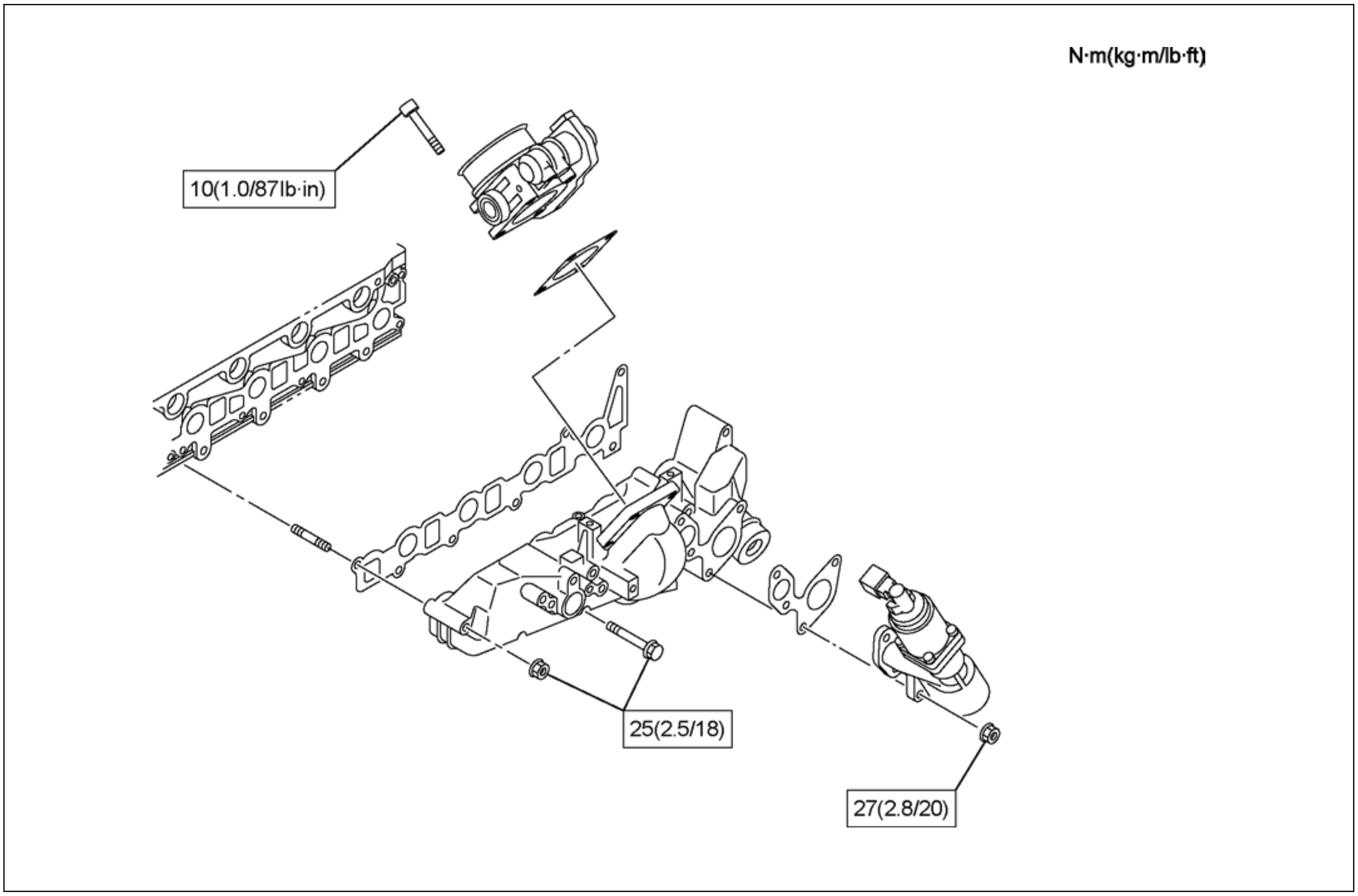
Standard deflection: 7.6 - 9.2 mm (0.29 - 0.36 in)



RTW510SH000201

15. Install the engine cover.

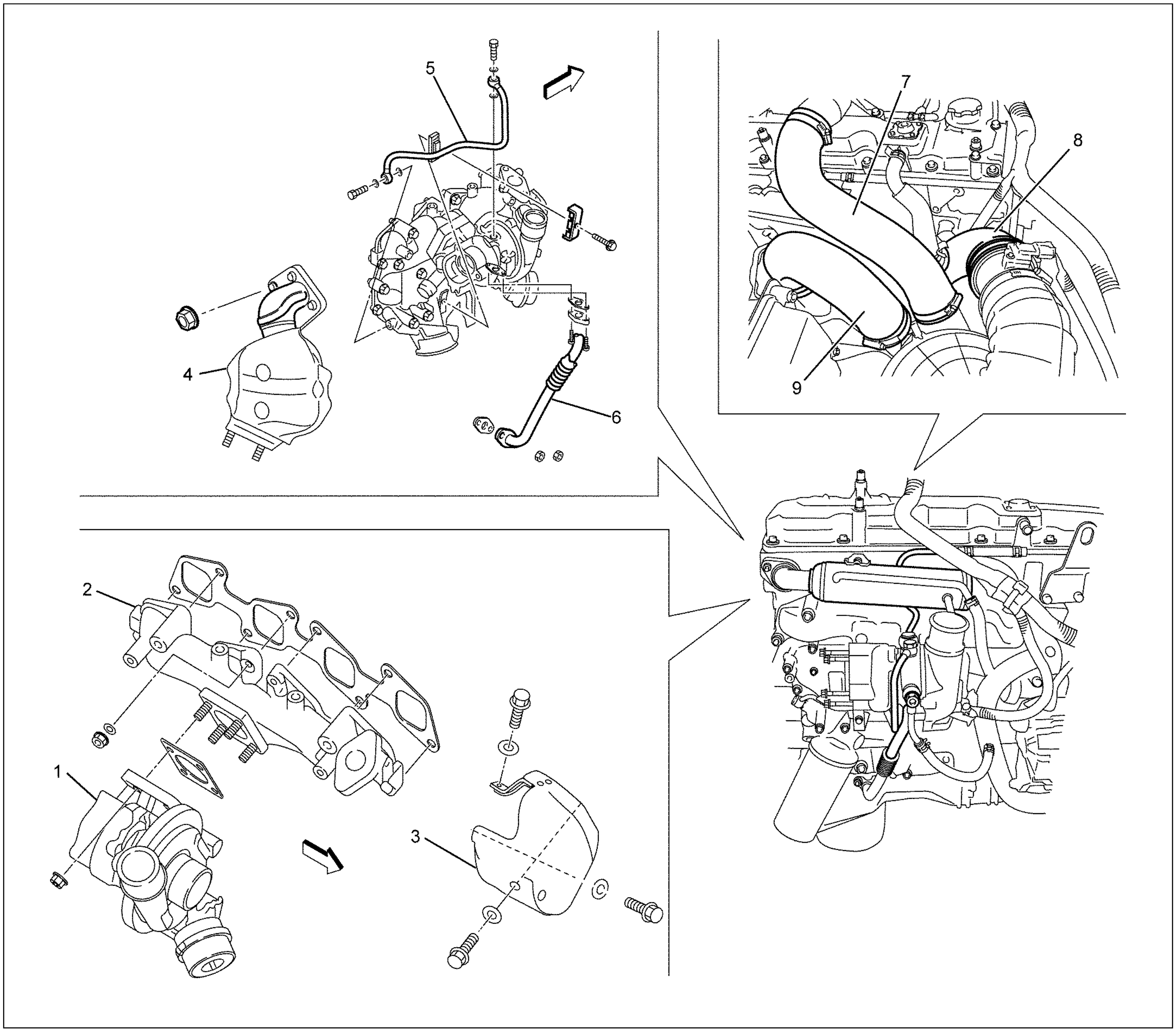
Torque Specifications



RTW76AMF000101

Turbocharger and Exhaust Manifold (Standard Output)

Components

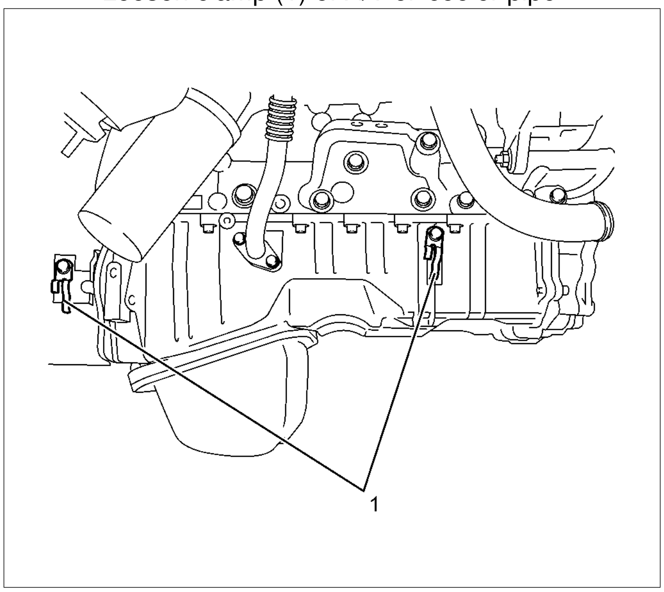


Legend

1. Turbocharger Assembly
2. Exhaust Manifold
3. Heat Protector
4. Catalyst Converter
5. Oil Feed Pipe
6. Oil Return Pipe
7. Intake Hose for Intercooler and Intake Throttle
8. Intake Duct for Turbocharger and Air Cleaner
9. Intake Hose for Turbocharger and Intercooler

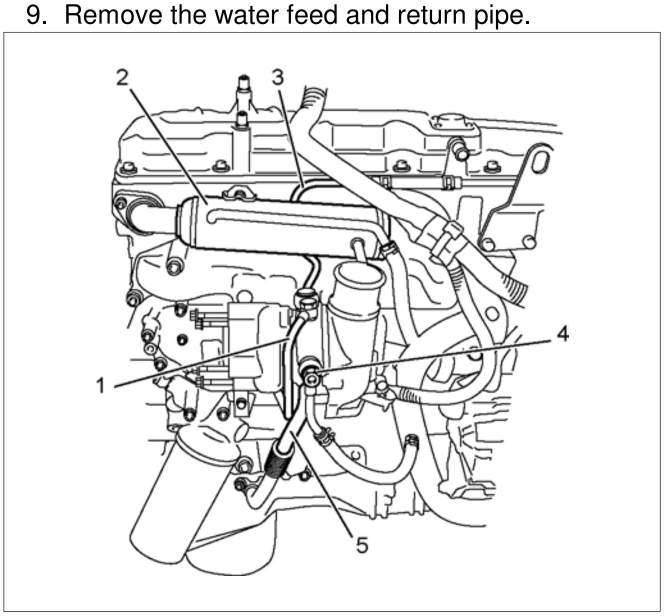
Removal

1. Loosen the radiator drain plug to drain coolant.
2. Remove the engine cover.
3. Remove the intake hose from the intercooler and intake throttle.
4. Remove the intake hose from the turbocharger and the intercooler.
5. Remove the air intake duct from the turbocharger and the air cleaner.
6. Remove the EGR cooler.
   Refer to “EGR Cooler” in EXHAUST SYSTEM Section.
7. Remove the oil feed pipe.
8. Remove the oil return pipe.
   - Loosen clamp (1) of A/T oil cooler pipe.



RTW56ASH025101

9. Remove the water feed and return pipe.

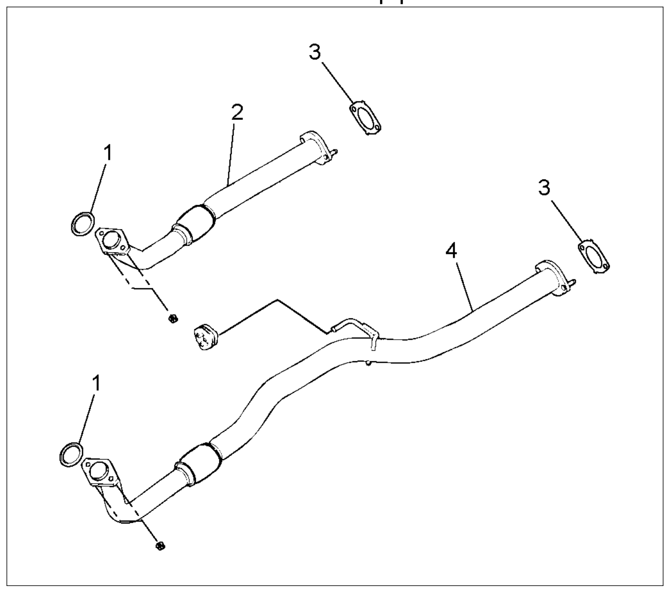


RTW56ASH005401

Legend

1. Oil Feed Pipe
2. EGR Cooler
3. Water Feed Pipe
4. Water Return Pipe
5. Oil Return Pipe

10. Remove the front exhaust pipe.

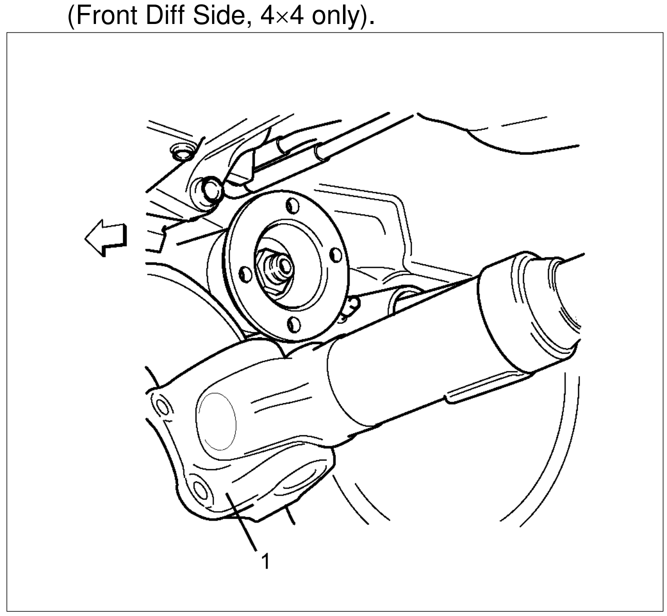


RTW56ASH018301

Legend

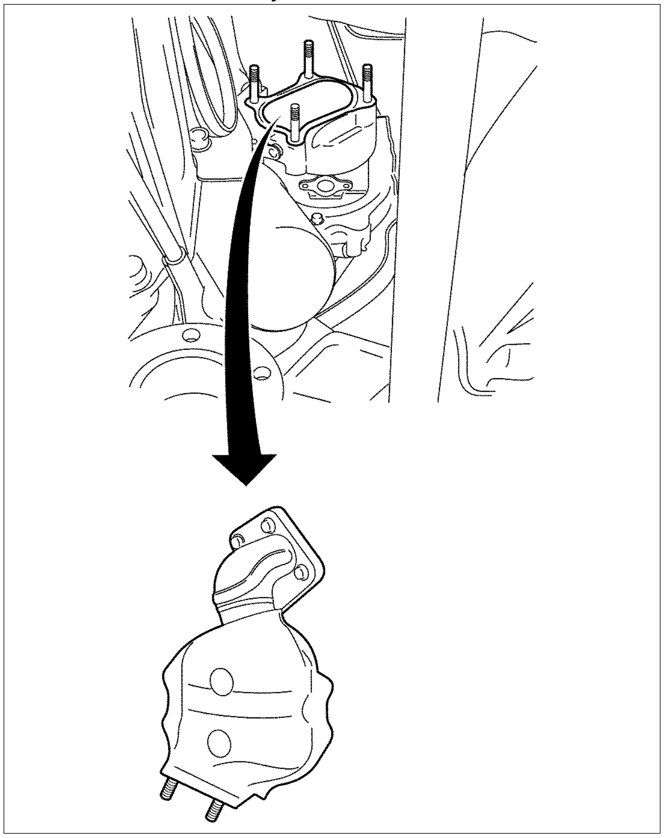
1. Gasket
2. Front Exhaust Pipe (4×2 High Ride Suspention, 4×4)
3. Gasket
4. Front Exhaust Pipe (4×2 Except High Ride Suspention)

11. Disconnect the front propeller shaft flange (1) (Front Diff Side, 4×4 only).



RTW76ASH002301

12. Remove the catalyst converter.



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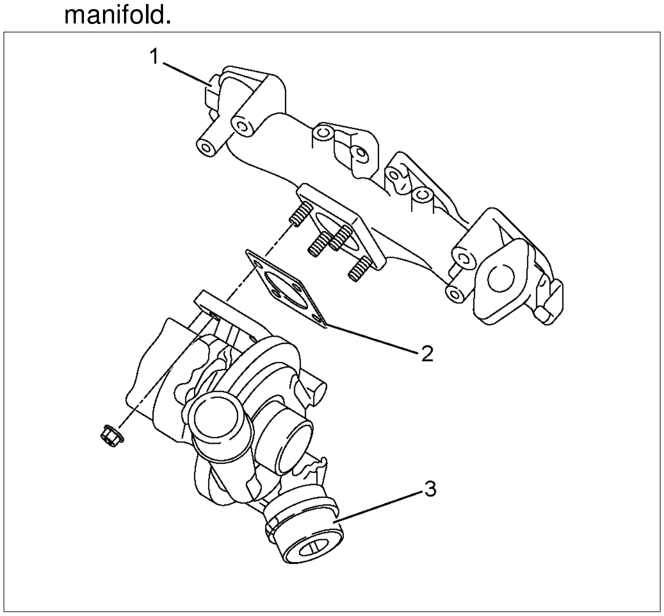
13. Remove the turbocharger from the exhaust manifold.

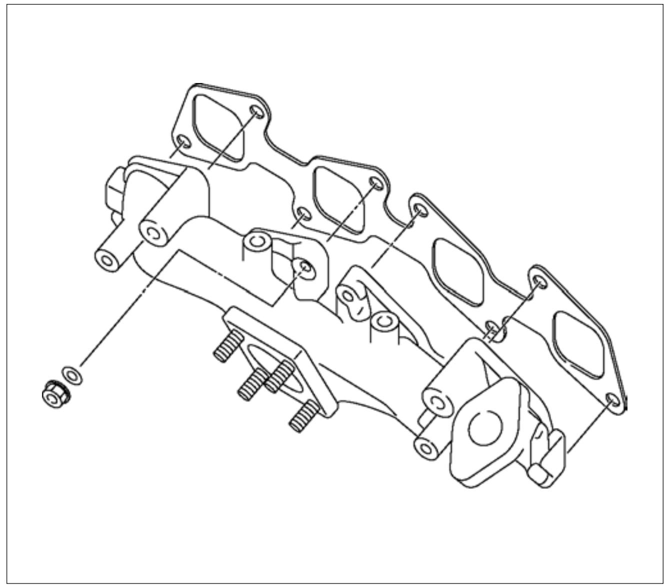


RTW56ASH005501

Legend

1. Exhaust Manifold
2. Gasket
3. Turbocharger

14. Remove the exhaust manifold.
    - Remove the 8 nuts from the exhaust manifold.



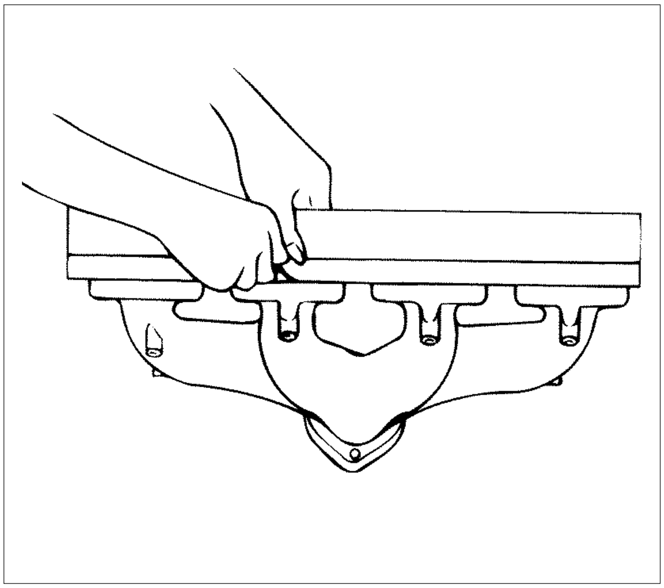
RTW56ASH005601

Inspection

- Inspection of the exhaust manifold. Inspect the plane surface of the plane on which the manifold and the cylinder head are to be installed.

Manifold installation plane surface	mm (in)
Standard	0.3 (0.01) or lower
Limit	0.5 (0.02)

Note:
If the plane surface exceeds the limit, replace it.



LNW21BSH022301

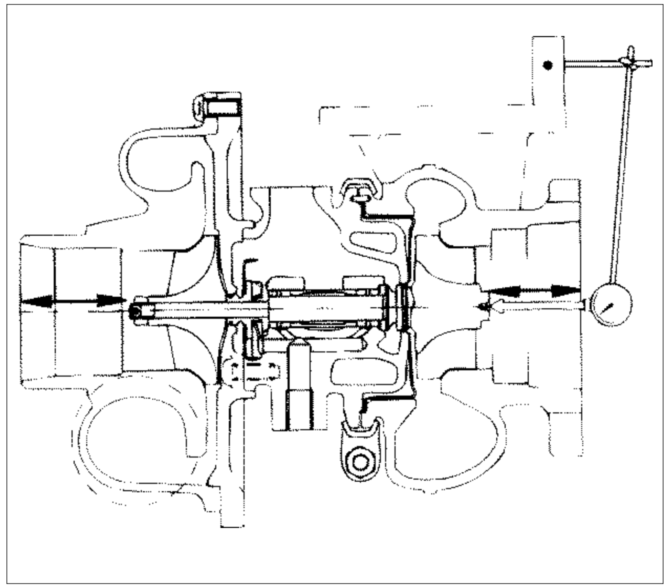
- Check a crack in the exhaust manifold visually.

Carefully inspect the turbocharger for abrasion and/or excessive wear. Make any necessary adjustments, repairs, and/or part replacements.

Wheel shaft axial play

Use a dial gauge to measure the wheel axle shaft play when a force of 12 N (1.2 kg / 2.6 lb) is alternately applied to both sides of the compressor wheel.

Axial play	mm (in)
Standard	0.03 – 0.06 (0.0012 – 0.0024)
Limit	0.09 (0.0035)

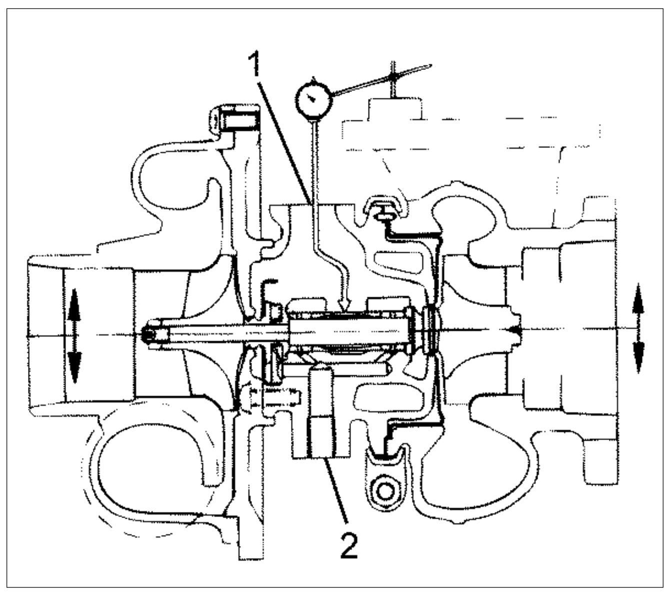


LNW21BSH022201

Wheel shaft and bearing clearance

Use a dial gauge to measure the clearance between the wheel shaft and the bearing.

Clearance	mm (in)
Standard	0.056 – 0.127 (0.0022 – 0.0050)
Limit	0.14 (0.0055)



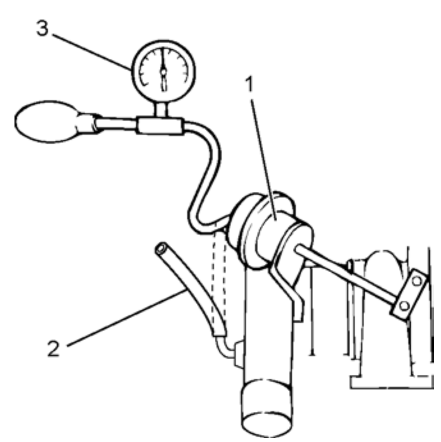
LNW21BSH022301

Legend

1. Oil Outlet
2. Oil Intake

Waste gate operation

1. Remove the hose from the waste gate actuator.
2. Install the pressure gauge (general tool). Refer to the illustration.



RTW56ASH005701

Legend

1. Waste Gate Actuator
2. Waste Gate Hose
3. Pressure Gauge (General Tool)

3. Use the pressure gauge pump to apply pressure (load) to the waste gate actuator (the engine must be off).
4. Note the pressure at which the control rod moves 2 mm (0.078 in). This pressure must be within the specified limit.

Control rod pressure range:	kPa (mmHg / psi)
109 – 118 (818 – 885 / 16 – 17)	

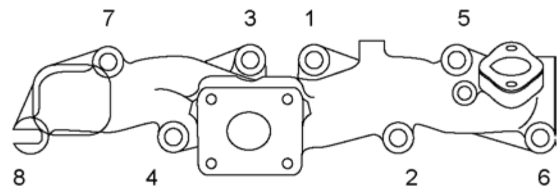
5. Inspect the hose for cracks and other damage. Replace the hose if necessary.
6. Do not apply a pressure of more than 120 kPa (900 mmHg) to the waste gate actuator.

Installation

1. Put the gasket in to install the exhaust manifold.
   - Tighten up with the 8 nuts according to the order given in the figure.

Tightening torque: 52 N·m (5.3 kg·m / 38 lb ft)

Note:
Do not tighten up too much because it hampers expansion and contraction due to the heat from the manifold.



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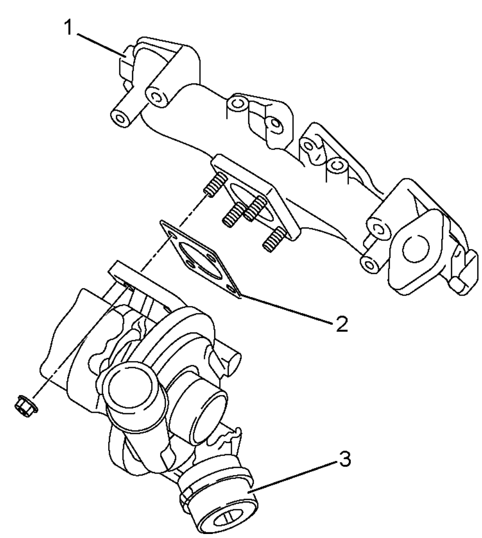
2. Install the gasket and turbocharger to the exhaust manifold. Tighten the nuts to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)



RTW56ASH005501

Legend

1. Exhaust Manifold
2. Gasket
3. Turbocharger

3. Install the catalyst converter.
   Tighten the nuts to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)

4. Connect the front propeller shaft flange (Front Diff Side, 4×4 only).
5. Install the front exhaust pipe.
   Tighten the nuts to the specified torque.

Tightening torque

Exhaust Manifold Side: 67 N·m (6.8 kg·m / 49 lb ft)

Exhaust Pipe Side: 43 N·m (4.4 kg·m / 32lb ft)

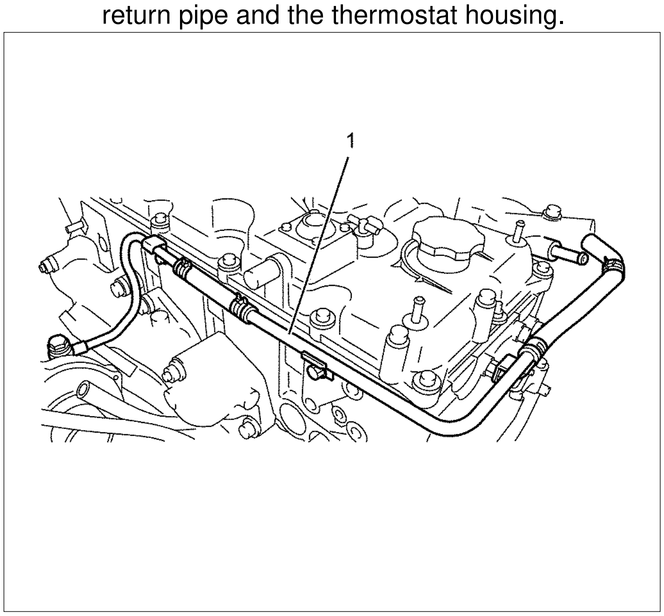
6. Install the water feed pipe to the turbocharger (1).
   - Tighten the joint bolts to the specified torque.

Tightening torque: 54 N·m (5.5 kg·m / 40 lb ft)

   - Install the pipe bracket and tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

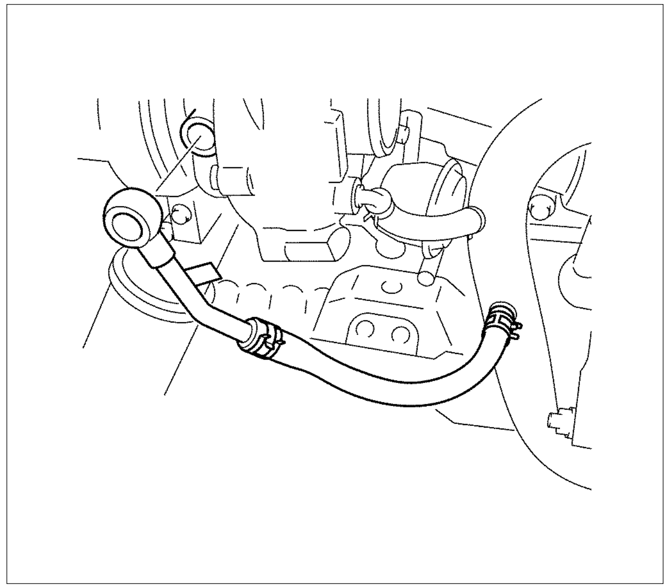
   - Install the rubber hose between the water return pipe and the thermostat housing.



RTW56ASH019101

7. Install the water return pipe. Tighten the joint bolt to the specified torque.

Tightening torque: 54 N·m (5.5 kg·m / 40 lb ft)


RTW56ASH019001

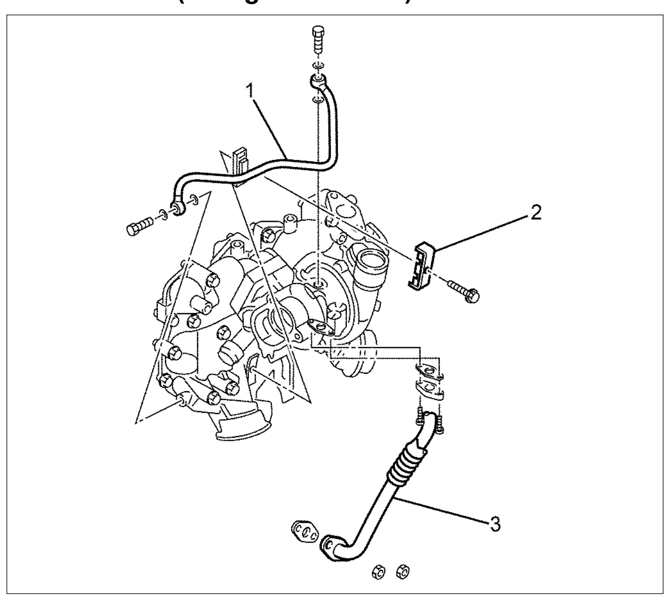
8. Install the turbocharger oil feed pipe to the top of the turbocharger. Tighten the joint bolts to the specified torque.

Tightening torque (Turbo charger side):
23 N·m (2.3 kg·m / 17 lb ft)

Tightening torque (Oil cooler side):
23 N·m (2.3 kg·m / 17 lb ft)

   - Install the pipe bracket and tighten the bolts to the specified torque.

Tightening torque: (Clip)
10 N·m (1.0 kg·m / 87 lb in)



RTW56ASH00610

Legend

1. Oil Feed Pipe
2. Clip
3. Oil Return Pipe

9. Tighten the oil return pipe bolts and nuts to the specified torque.

Tightening torque (Turbocharger side):
10 N·m (1.0 kg·m / 87 lb in)

Tightening torque (Crank case side):
25 N·m (2.5 kg·m / 18 lb ft)

10. Install the EGR cooler.
    - Refer to "EGR Cooler" in EXHAUST SYSTEM section.
11. Install the heat protector.
    - Refer to "EGR Cooler" in EXHAUST SYSTEM section.
12. Install the intake hose between the intercooler and the intake throttle (7).
13. Install the intake hose between the turbocharger and the intercooler (9).
14. Install the intake duct between the turbocharger and the air cleaner (8).

Tightening torque: 6 N·m (0.6 kg·m / 52 lb in)

15. Replenish the coolant.

GALLONS (U.S.) TO LITERS

U.S. gal.	0 liters	1 liters	2 liters	3 liters	4 liters	5 liters	6 liters	7 liters	8 liters	9 liters	U.S. gal.
-		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0633	-
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5629	117.3482	121.1337	124.9191	128.7045	132.4901	136.2754	140.0608	143.8462	147.6316	30
40	141.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

LITERS TO GALLONS (U.S.)

liters	0 gal.	1 gal.	2 gal.	3 gal.	4 gal.	5 gal.	6 gal.	7 gal.	8 gal.	9 gal.	liters
-		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	-
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2268	4.4909	4.7551	5.0193	10
20	5.2834	5.5476	5.8118	6.0760	6.3401	6.6043	6.8685	7.1326	7.3968	7.6610	20
30	7.9252	8.1893	8.4535	8.7117	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5669	10.8311	11.0952	11.3594	11.6236	11.8877	12.1519	12.4161	12.6803	12.9444	40
50	13.2086	13.4728	13.7369	14.0011	14.2653	14.5295	14.7936	15.0578	15.3220	15.5861	50
60	15.8503	16.1145	16.3787	16.6428	16.9070	17.1711	17.4354	17.6995	17.9637	18.2279	60
70	18.4920	18.7562	19.0204	19.2846	19.5487	19.8129	20.0771	20.3412	20.6054	20.8696	70
80	21.1338	21.3979	21.6621	21.9263	22.1904	22.4546	22.7188	22.9830	23.2471	23.5113	80
90	23.7755	24.0397	24.3038	24.5680	24.8322	25.0963	25.3605	25.6247	25.8889	26.1530	90
100	26.4172	26.6814	26.9455	27.2097	27.4739	27.7381	28.0022	28.2664	28.5306	28.7947	100

GALLONS (IMP.) TO LITERS

Imp gal.	0 liters	1 liters	2 liters	3 liters	4 liters	5 liters	6 liters	7 liters	8 liters	9 liters	Imp gal.
-		4.5459	9.0918	13.6377	18.1836	22.7295	27.2754	31.8213	36.3672	40.9131	-
10	45.4590	50.0049	54.5508	59.0967	63.6426	68.1885	72.7344	77.2803	81.8262	86.3721	10
20	90.9180	95.4639	100.0098	104.5557	109.1016	113.6475	118.1934	122.7393	127.2852	131.8311	20
30	136.3770	140.9229	145.4688	150.0147	154.5606	159.1065	163.6524	168.1983	172.7442	177.2901	30
40	181.8360	186.3819	190.9278	195.4737	200.0196	204.5655	209.1114	213.6573	218.2032	222.7491	40
50	227.2950	231.8409	236.3868	240.9327	245.4786	250.0245	254.5704	259.1163	263.6622	268.2081	50
60	272.7540	277.2999	281.8458	286.3917	290.9376	295.4835	300.0294	304.5753	309.1212	313.6671	60
70	318.2130	322.7589	327.3048	331.8507	336.8966	340.9425	345.4884	350.0343	354.5802	359.1261	70
80	363.6720	368.2179	372.7638	377.3097	381.8556	386.4015	390.9474	395.4933	400.0392	404.5851	80
90	409.1310	413.6769	418.2228	422.7687	427.3146	431.8605	436.4064	440.9523	445.4982	450.0441	90
100	454.5900	459.1359	463.6818	468.2277	472.7736	477.3195	481.8654	486.4113	490.9572	495.5031	100

LITERS TO GALLONS (IMP.)

liters	0 gal.	1 gal.	2 gal.	3 gal.	4 gal.	5 gal.	6 gal.	7 gal.	8 gal.	9 gal.	liters
-		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5399	1.7598	1.9798	-
10	2.1998	2.4198	2.6398	2.8597	3.0797	3.2997	3.5197	3.7397	3.9596	4.1796	10
20	4.3996	4.6196	4.8396	5.0595	5.2795	5.4995	5.7195	5.9395	6.1594	6.3794	20
30	6.5994	6.8194	7.0394	7.2593	7.4793	7.6993	7.9193	8.1393	8.3592	8.5792	30
40	8.7992	9.0192	9.2392	9.4591	9.6791	9.8991	10.1191	10.3391	10.5590	10.7790	40
50	10.9990	11.2190	11.4390	11.6590	11.8789	12.0989	12.3189	12.5389	12.7588	12.9788	50
60	13.1988	13.4188	13.6388	13.8587	14.0787	14.2987	14.5187	14.7387	14.9586	15.1786	60
70	15.3986	15.6186	15.8386	16.0585	16.2785	16.4985	16.7185	16.9385	17.1584	17.3784	70
80	17.5984	17.8184	18.0384	18.2583	18.4783	18.6983	18.9183	19.1383	19.3582	19.5782	80
90	19.7982	20.0182	20.2382	20.4581	20.6781	20.8981	21.1181	21.3381	21.5580	21.7780	90
100	21.9980	22.2180	22.4380	22.6579	22.8779	23.0979	23.3179	23.5379	23.7578	23.9778	100

YES

- Is there battery voltage between the engine room harness connector terminal No.1 (X-14) and ground?

NO

Open circuit between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14).

YES

- Disconnect the A/C thermo relay.
- Is there continuity between the engine room harness connector terminal No.3 (X-14) and the engine room harness connector terminal No.1 (X-15).

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No.1 (X-14).

YES

- Disconnect the ECM harness connector.
- Is there continuity between the ECM harness connector terminal No.55 (C-58) and the engine room harness connector terminal No.5 (X-14)?

NO

Open circuit between the engine room harness connector terminal No.3 (X-14) and the engine room harness connector terminal No. 1 (X-15).

YES

- Is there continuity between the ECM harness connector terminal No.4 (C-58) and the engine room harness connector terminal No.1 (X-15)?

NO

Open circuit between the ECM harness connector terminal No.55 (C-58) and the engine room harness connector terminal No. 5 (X-14).

YES

- Is there battery voltage between the engine room harness connector terminal No.2 (X-15) and ground?

NO

Open circuit between the ECM harness connector terminal No. 4 (C-58) and the engine room harness connector terminal No. 1 (X-15).

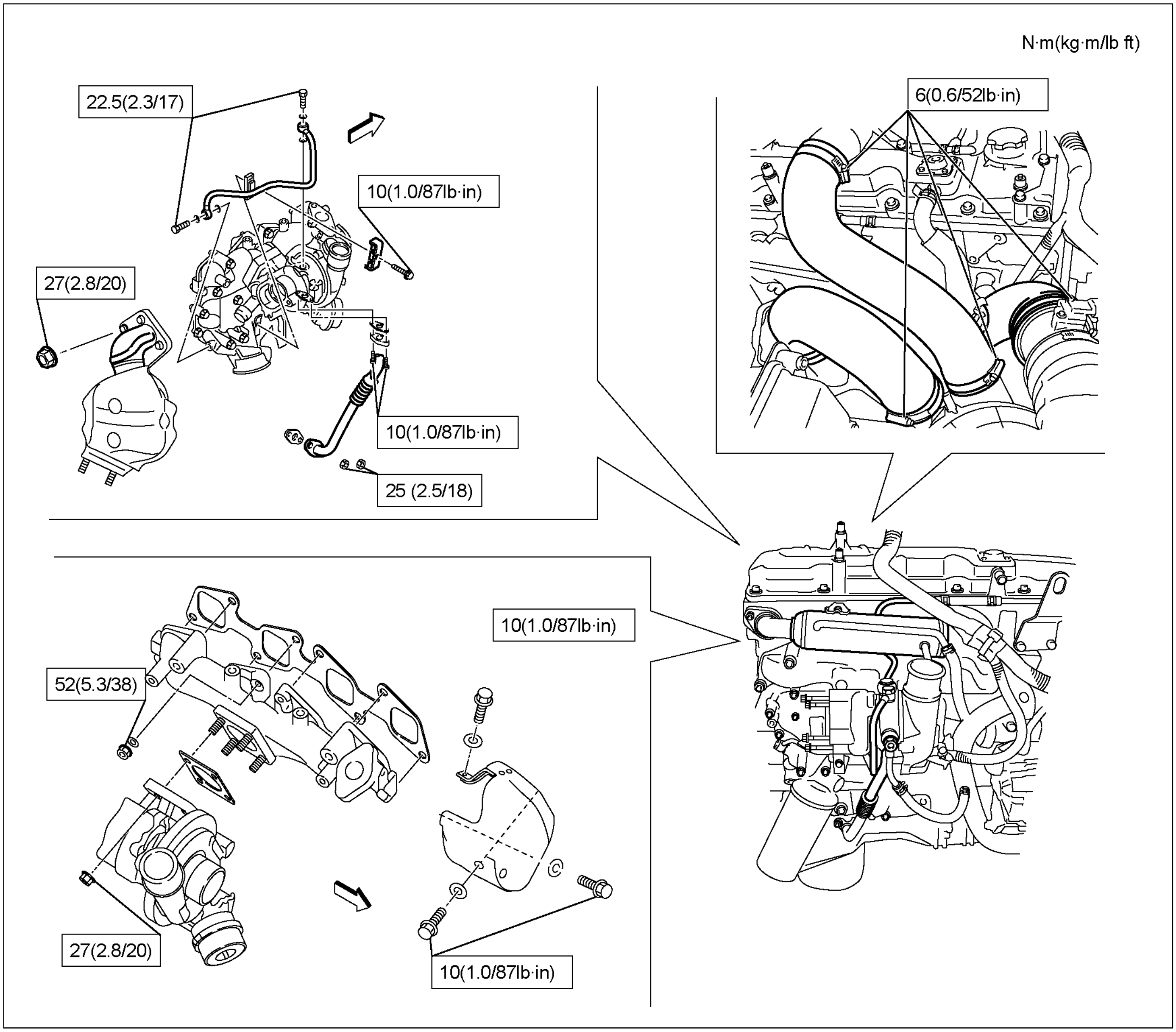
YES

- Disconnect the pressure switch.
- Is there continuity between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 2 (X-15).

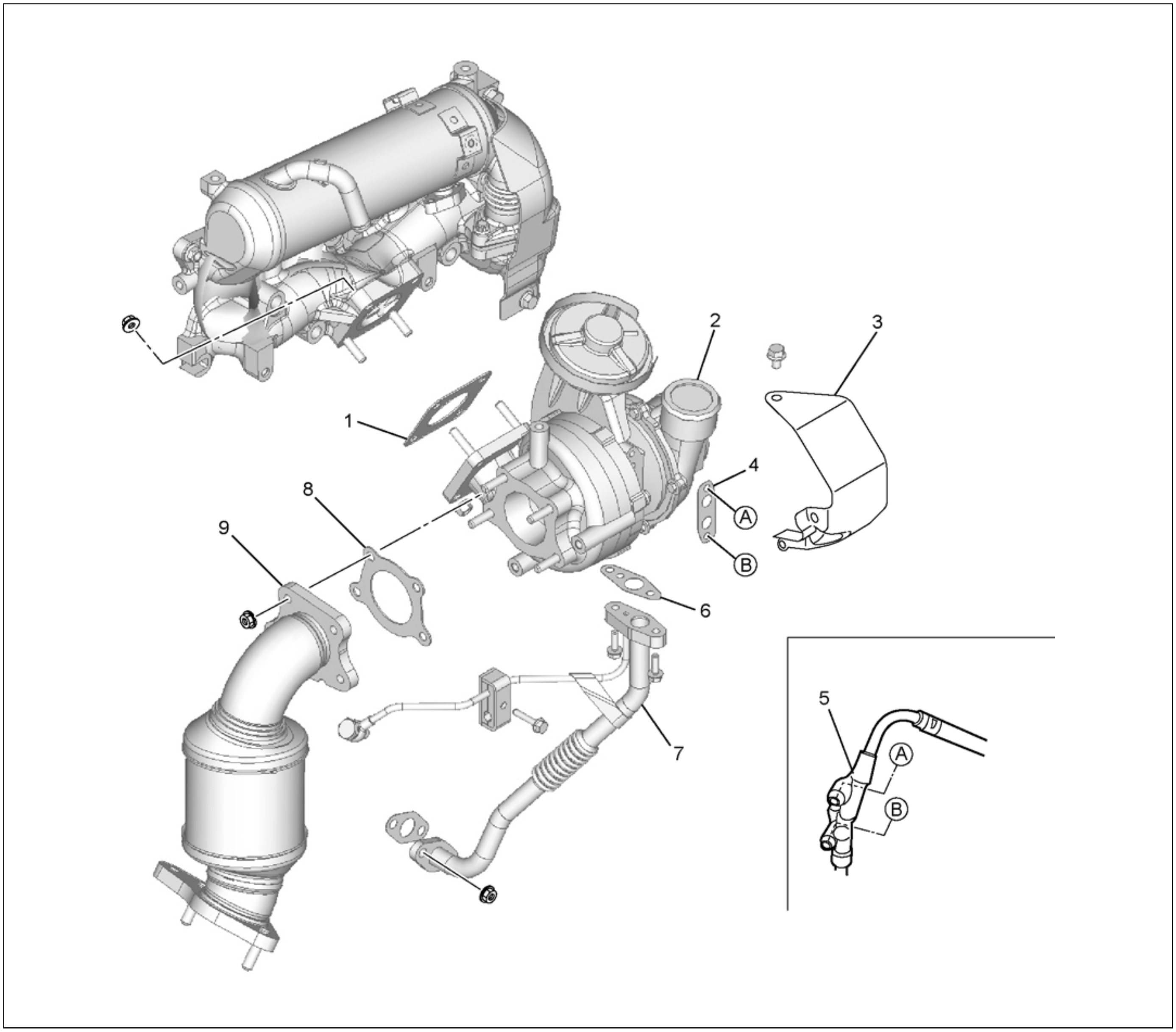
Torque Specifications



RTW76ALF000901

Turbocharger (High Output)

Components



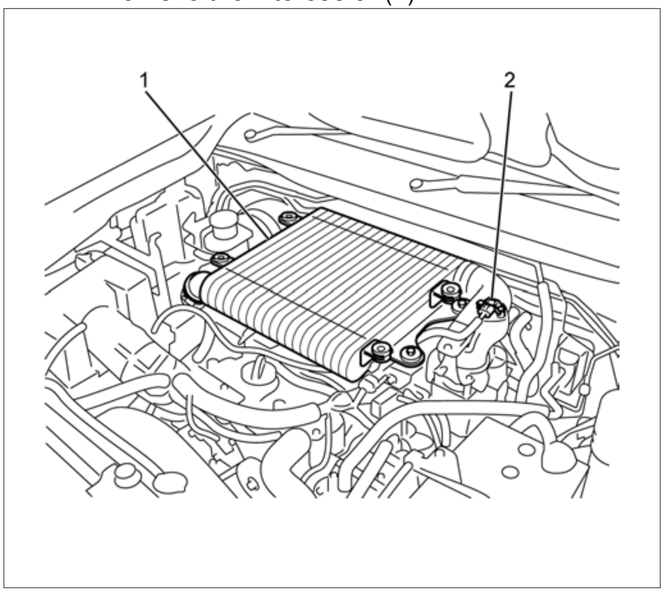
RTW76ALF000401

Legend

1. Turbocharger Assembly Gasket
2. Turbocharger Assembly
3. Turbocharger Heat Protecter
4. Water Feed and Return Pipe Gasket
5. Water Feed and Return Pipe
6. Oil Feed and Return Pipe Gasket
7. Oil Feed and Return Pipe
8. Catalyst Converter Gasket
9. Catalyst Converter

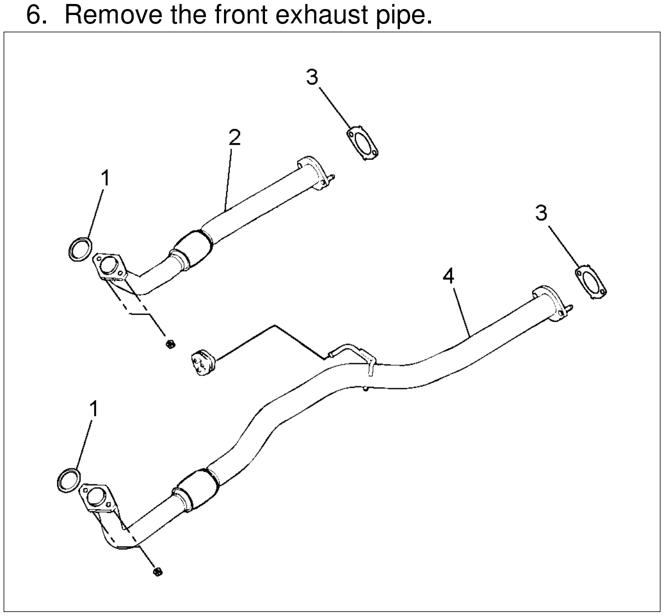
Removal

1. Drain the engine coolant.
2. Remove the engine cover.
3. Remove the intercooler.
   - Disconnect the BARO sensor harness connector (2).
   - Remove the two intake hoses.
   - Remove the intercooler (1).



RTW76ASH000501

4. Disconnect the vacuum hose from the turbocharger actuator.
5. Remove the air intake duct from the turbocharger and the air cleaner.
6. Remove the front exhaust pipe.

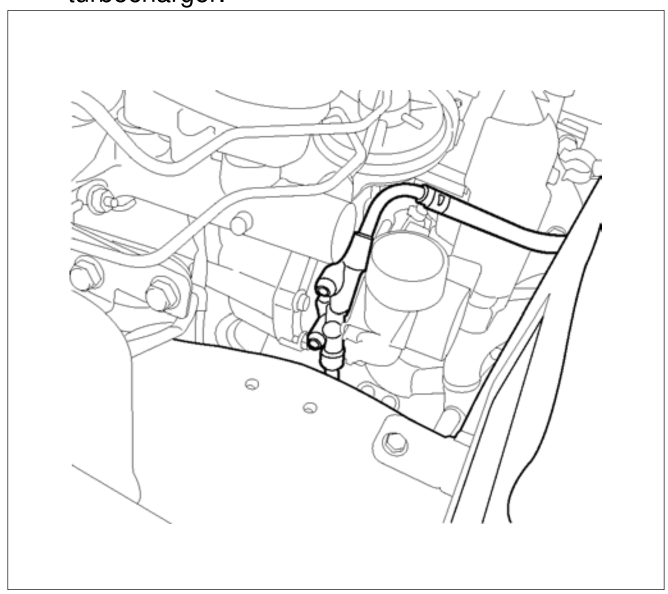


RTW56ASH018301

Legend

1. Gasket
2. Front Exhaust Pipe (4×2 High Ride Suspention, 4×4)
3. Gasket
4. Front Exhaust Pipe (4×2 Except High Ride Suspention)

7. Remove the heat protector of the turbocharger.
   - Remove the mud cover of front RH fender skirt (4×4 only).
   - Loosen the bolt of Turbocharger bracket.
8. Remove the catalyst converter.
9. Remove the turbocharger bracket.
10. Remove the oil feed and return pipe.
11. Remove the water feed and return pipe from the turbocharger.



RTW76ASH001001

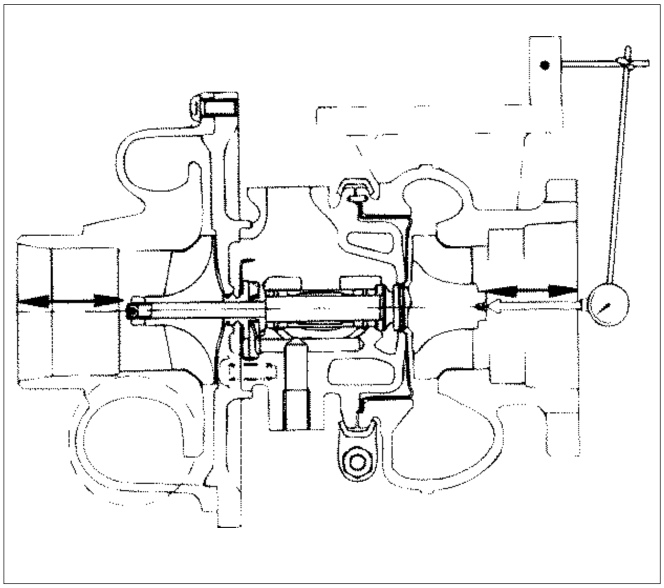
12. Remove the turbocharger from the exhaust manifold.

Inspection

Wheel shaft axial play

Use a dial gauge to measure the wheel axle shaft play when a force of 12 N (1.2kg / 2.6 lb) is alternately applied to both sides of the compressor wheel.

Axial play	mm (in)
Standard	0.03 – 0.06 (0.0012 – 0.0024)
Limit	0.09 (0.0035)

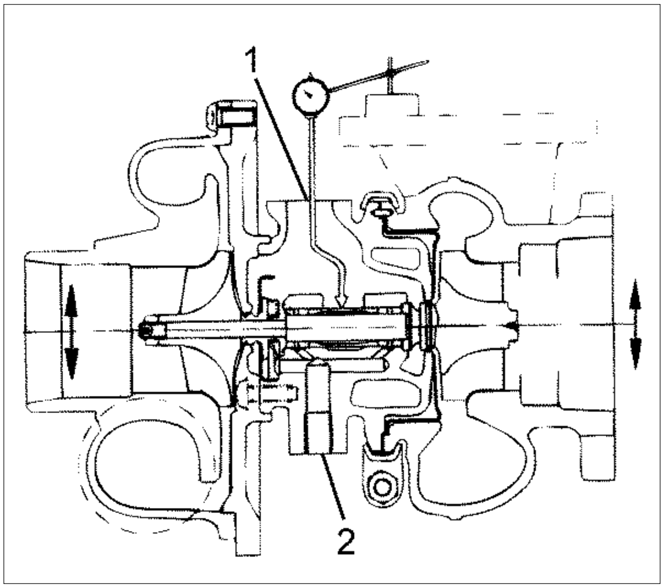


LNW21BSH022201

Wheel shaft and bearing clearance

Use a dial gauge to measure the clearance between the wheel shaft and the bearing.

Clearance	mm (in)
Standard	0.056 – 0.127 (0.0022 – 0.0050)
Limit	0.14 (0.0055)



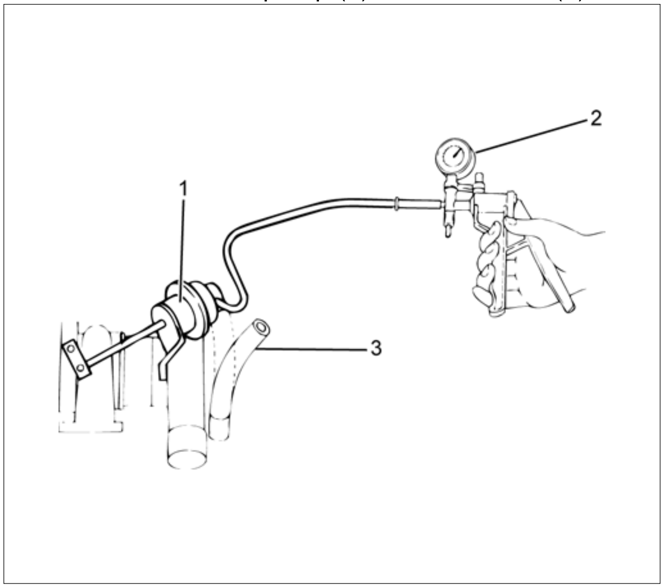
LNW21BSH022301

Legend

1. Oil Outlet
2. Oil Intake

Actuator operation

1. Install a vacuum pump (2) to the actuator (1).



LNW71JSH000201

2. Operate the vacuum pump and apply vacuum pressure to the actuator.

Working vacuum pressure	kPa (mmHg / psi)
52.8 (396 / 7.66)	

3. Place a vernier caliper on the end of the control rod of actuator. Release the vacuum pressure and check the control rod moves. Measure the length of the control rod moving.

Standard length	mm (in)
12 (0.48)	

Installation

1. Install the gasket and the turbocharger to the exhaust manifold. Temporarily tighten nuts.
2. Install the oil feed and return pipe and temporarily tighten.
3. Tighten the turbocharger nuts to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)

4. Tighten the oil feed and return pipe bolts and nuts to the specified torque.

Tightening torque (Turbocharger side):
10 N·m (1.0 kg·m / 87 lb in)

Tightening torque (Crank case side):
25 N·m (2.5 kg·m / 18 lb ft)

5. Install the water feed and return pipe to the turbocharger.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

6. Install the heat protector to the turbocharger.

Tightening torque: 10 N·m (1.0 kg·m / 18 lb ft)

7. Install the turbocharger bracket.
8. Install the catalyst converter.
   Tighten the nuts to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)

9. Install the mud cover of front RH fender skirt (4×4 only).
10. Install the front exhaust pipe.
    Tighten the nuts to the specified torque.

Tightening torque

Exhaust Manifold Side: 67 N·m (6.8 kg·m / 49 lb ft)

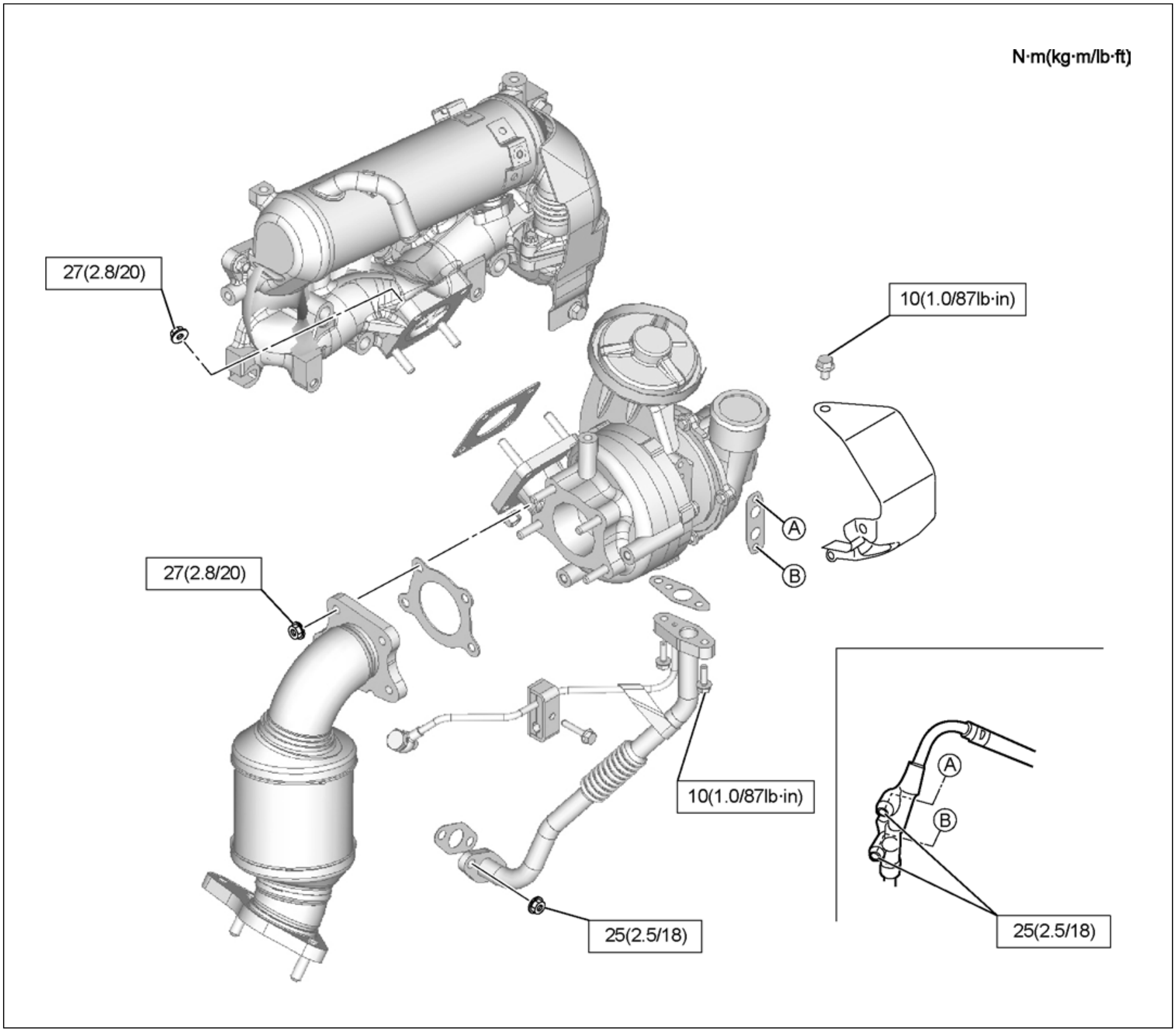
Exhaust Pipe Side: 43 N·m (4.4 kg·m / 32lb ft)

11. Install the intercooler.
    - Install the intercooler.
    - Install the two intake hoses.
    - Connect the BARO sensor harness connector.
12. Install the intake duct between the turbocharger and the air cleaner.

Tightening torque: 6 N·m (0.6 kg·m / 52 lb in)

13. Replenish the coolant.

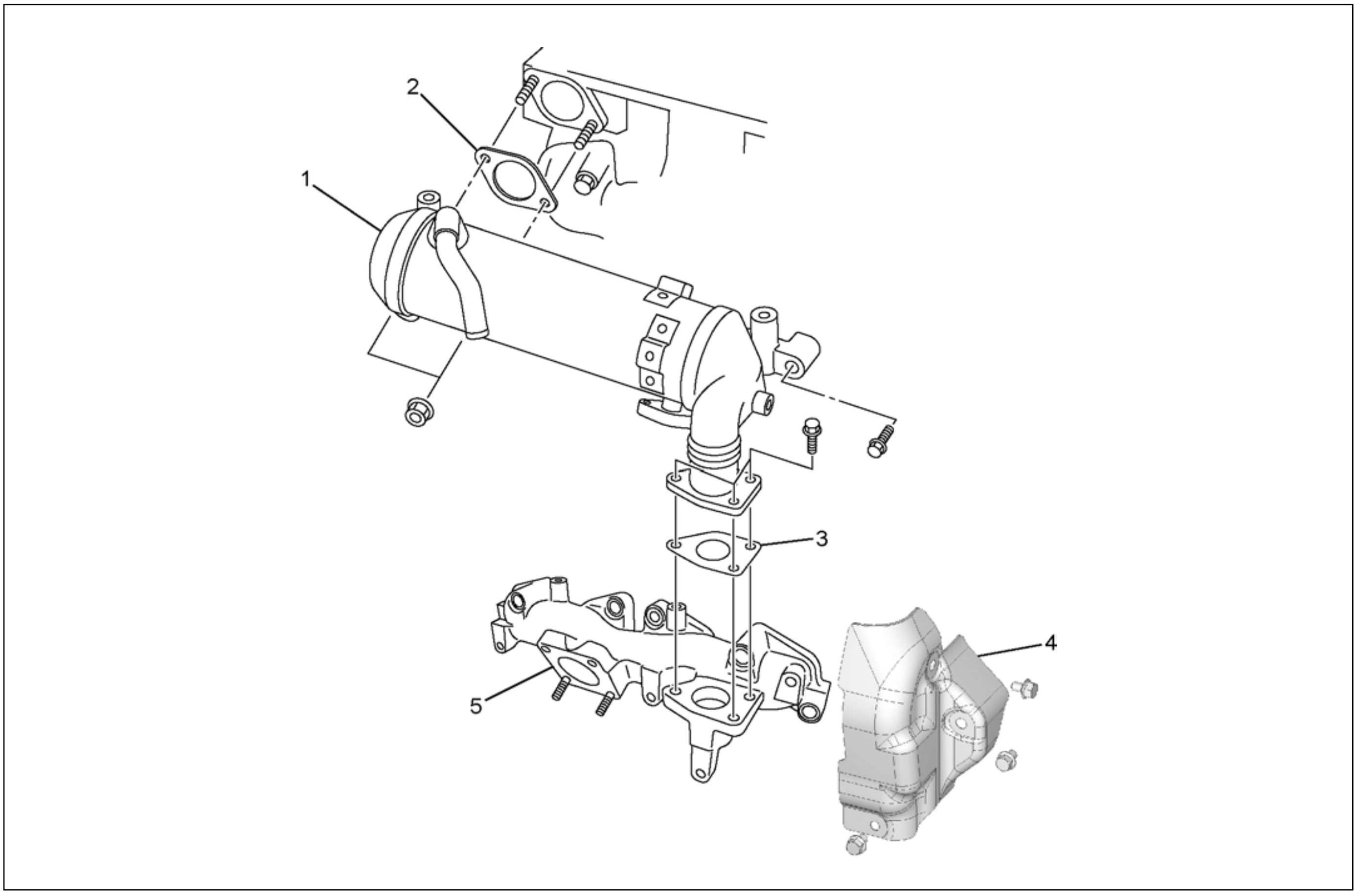
Torque Specifications



RTW76ALF000501

Exhaust Manifold (High Output)

Components



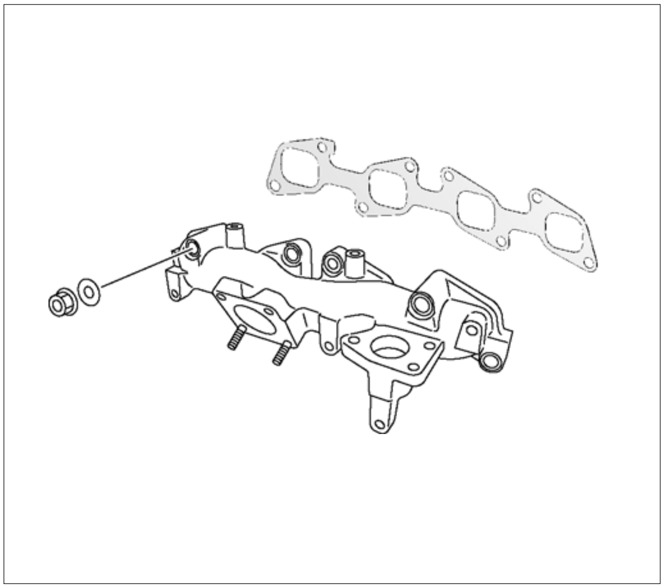
RTW76FMF000101

Legend

1. EGR Cooler
2. EGR Cooler Gasket
3. EGR Cooler Gasket
5. Heat Protector
6. Exhaust Manifold

Removal

1. Drain the engine coolant.
2. Remove the turbocharger.
   - Refer to “Turbocharger”.
3. Remove the EGR cooler heat protector.
4. Disconnect the water hoses from the EGR cooler water pipes.
5. Remove the EGR cooler.
6. Remove the exhaust manifold.



RTW76ASH002101

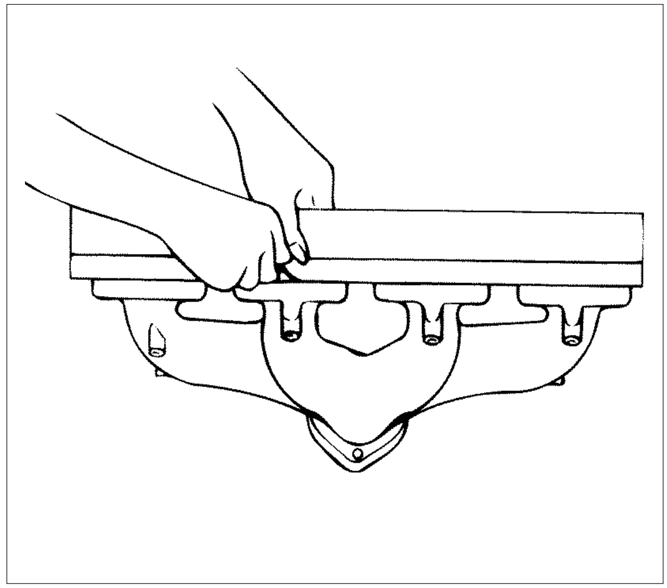
Inspection

- Inspection of the exhaust manifold. Inspect the plane surface of the plane on which the manifold and the cylinder head are to be installed.

Manifold installation plane surface	mm (in)
Standard	0.3 (0.01) or lower
Limit	0.5 (0.02)

Caution:

If the plane surface exceeds the limit, replace it.



LNW21BSH022301

- Check a crack in the exhaust manifold visually.

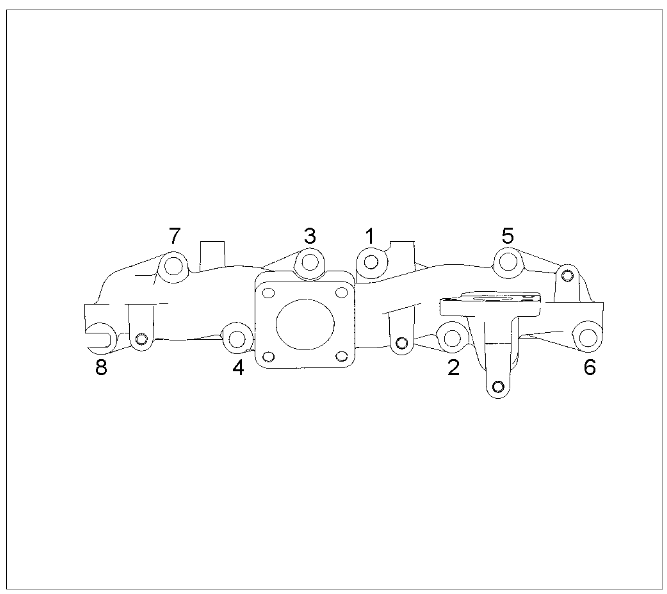
Carefully inspect the turbocharger for abrasion and/or excessive wear. Make any necessary adjustments, repairs, and/or part replacements.

Installation

1. Put the gasket in to install the exhaust manifold.
   - Tighten up with the 8 nuts according to the order given in the illustration.

Tightening torque: 52 N·m (5.3 kg·m / 38 lb ft)

Caution:
Do not tighten up too much because it hampers expansion and contraction due to the heat from the manifold.



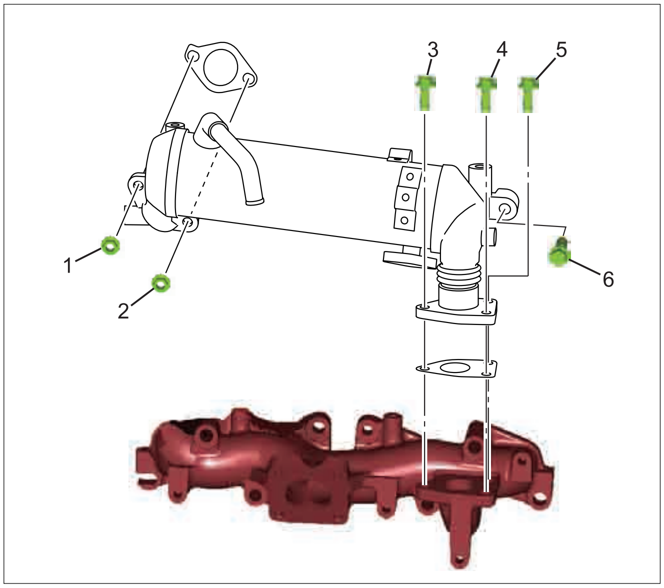
RTW76ASH002201

2. Install the EGR cooler.
   - Install the gaskets.
   - Install the EGR cooler.
   - Temporary tightening order.
     1→2→3→4→5→6
   - Fully tightening order.
     3→4→5→1→2→6

   Tighten the nut and bolts to the specified torque.

Tightening torque:

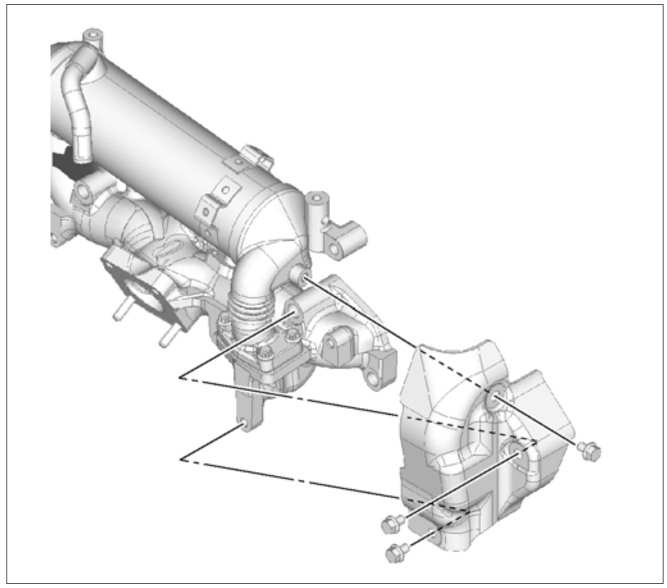
Nuts and bots 1-5: 27 N·m (2.8 kg·m / 20 lb ft)
Bolt 6: 52 N·m (5.3 kg·m / 38 lb ft)



RTW76FSH000201

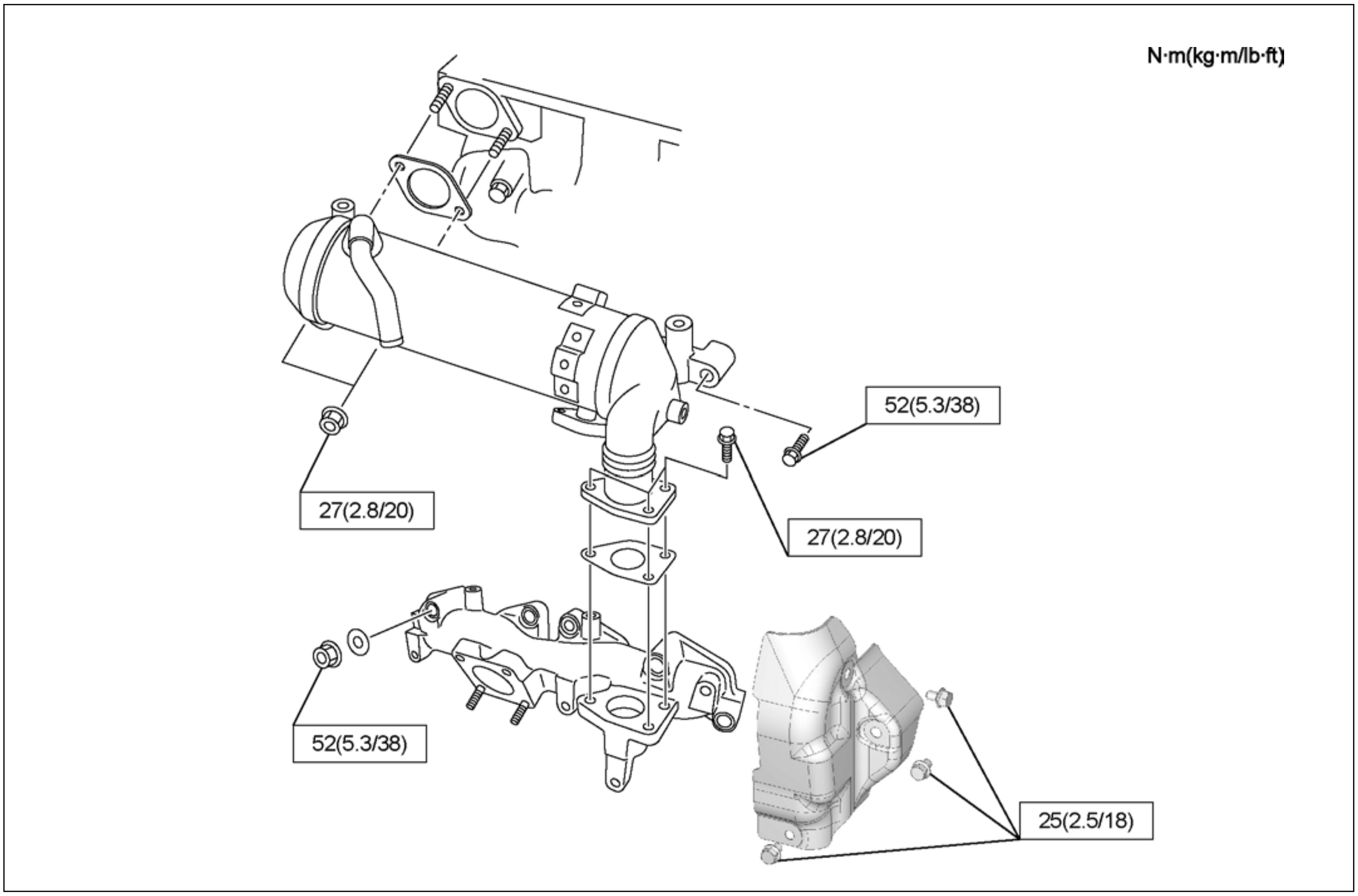
3. Install the water hoses to the EGR cooler water pipes.
4. Heat protector.
   Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)


RTW76FSH000101

5. Install the turbocharger.
   - Refer to “Turbocharger”.
6. Replenish the engine coolant.

Torque Specifications



RTW76AMF000701

YES

- Disconnect the condenser fan relay.

- Is there continuity between the relay terminal No. 3 (X-9) and engine room harness connector terminal No.4 (C-24)?

NO

Open circuit between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24).

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (C-24) and ground?

NO

Open circuit between the condenser fan relay No.3 (X-9) and the engine room harness connector terminal No. 4 (C-24).

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 3 (C-24).

YES

- connect the A/C thermo relay connector.
- Disconnect the electronic thermostat.
- Is there continuity between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 2 (C-24)?

YES

- Is there battery voltage between the engine room harness connector terminal No.3 (C-55) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (C-24) and the engine room harness connector terminal No. 2 (C-55).

YES

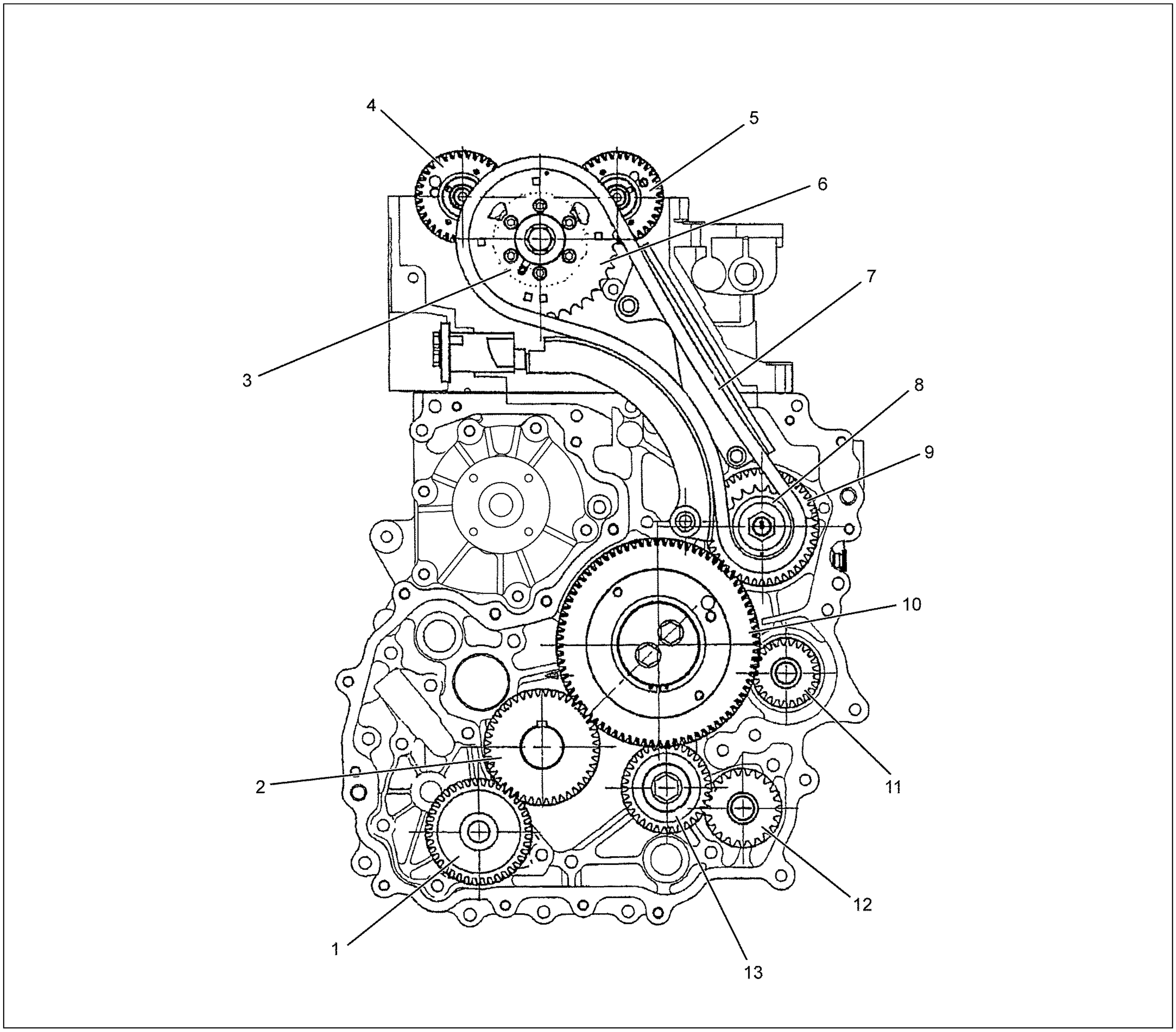
- Is there continuity between the engine room harness connector terminal No.1 (C-55) and ground (C-109) ? or (cooler only) the short connector terminal No.3 (B-79) and ground (C-109)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (C-55).

Timing Gear Train

Components



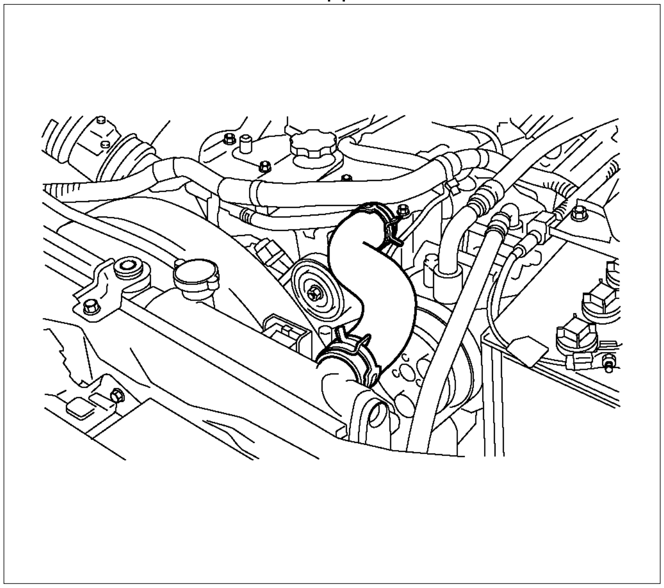
RTW56ALF001101

Legend

1. Oil Pump Gear
2. Crankshaft Gear
3. Idle Gear D
4. Exhaust Camshaft Gear
5. Intake Camshaft Gear
6. Idle Gear D Sprocket
7. Timing Chain
8. Injection Pump Sprocket
9. Injection Pump Gear
10. Idle Gear A
11. Vacuum Pump Gear
12. Power Steering Oil Pump Gear
13. Idle Gear C

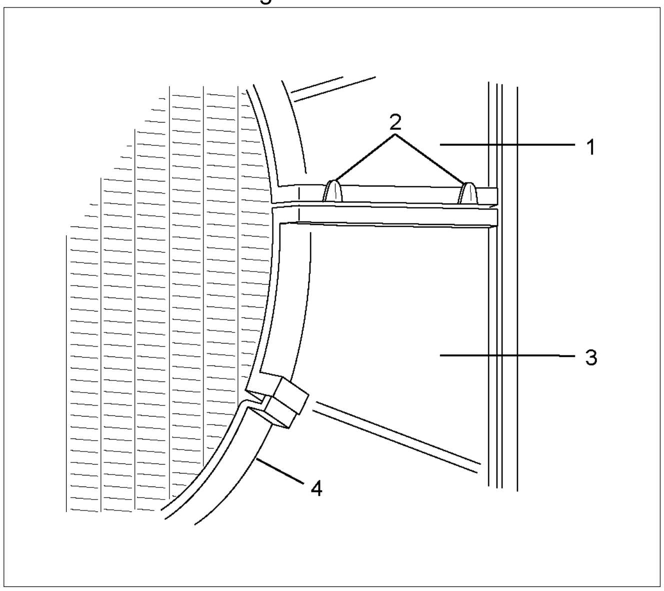
Removal

1. Partially drain the engine coolant.
2. Remove the radiator upper hose.



RTW56FSH000101

3. Remove the fan guide.

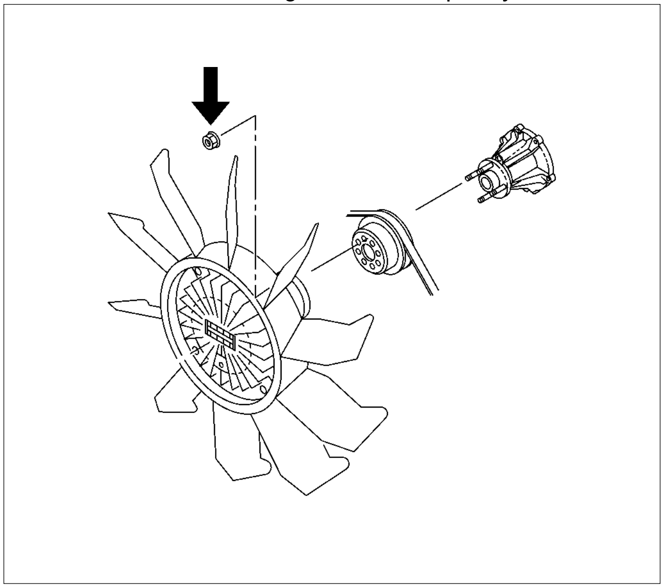


RTW46BSH000101

Legend

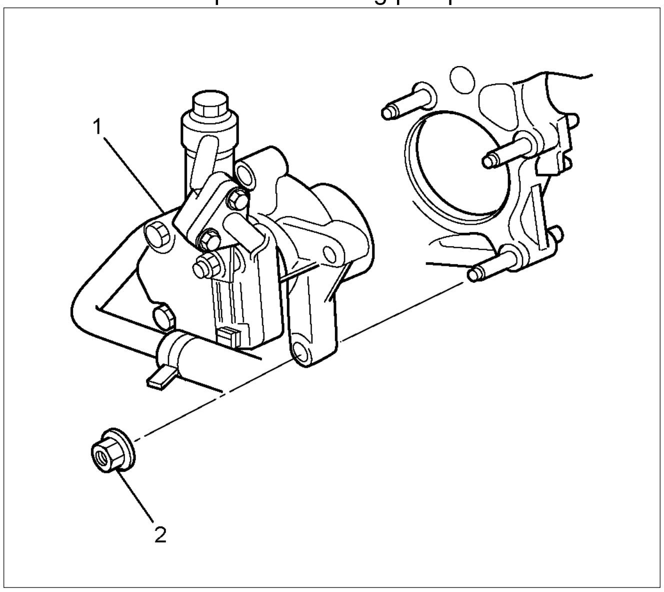
1. Fan Guide
2. Clips
3. Lower Fan Guide
4. Fan Shroud

4. Remove the cooling fan and fan pulley.



RTW56ASH025401

5. Remove the A/C compressor drive belt and fan belt.
6. Remove the crank pulley.
7. Remove the power steering pump with hose.

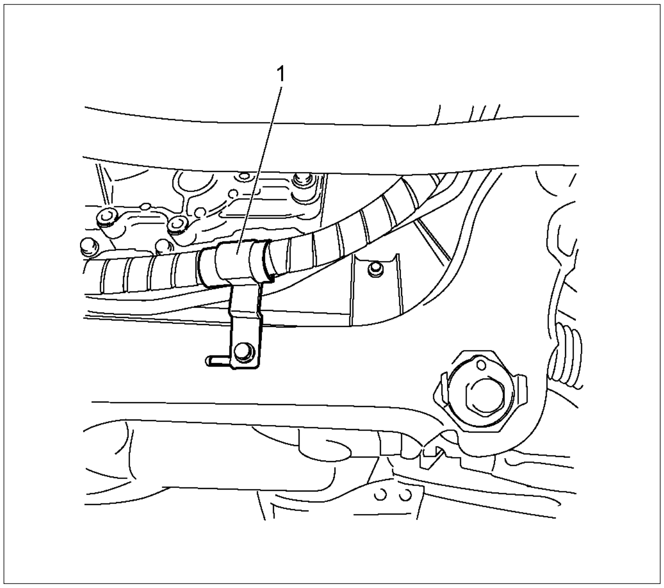


RTW56ASH021101

Legend

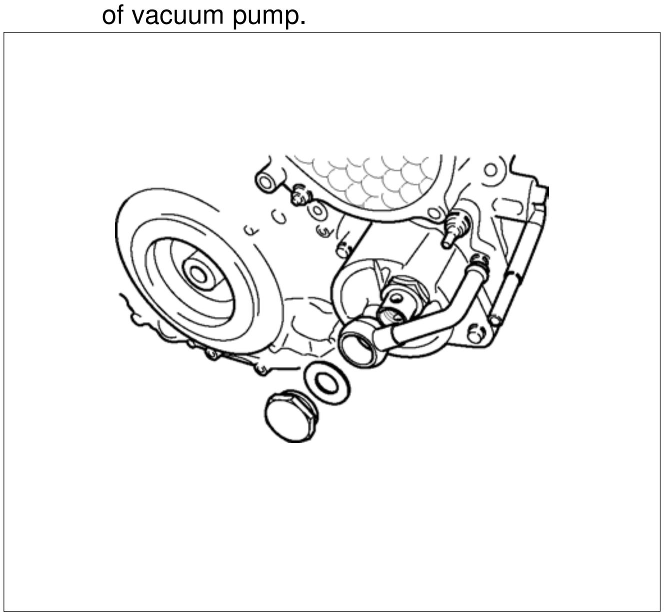
1. Power Steering Pump
2. Nut

- Disconnect the bracket (1) of power steering oil hose.



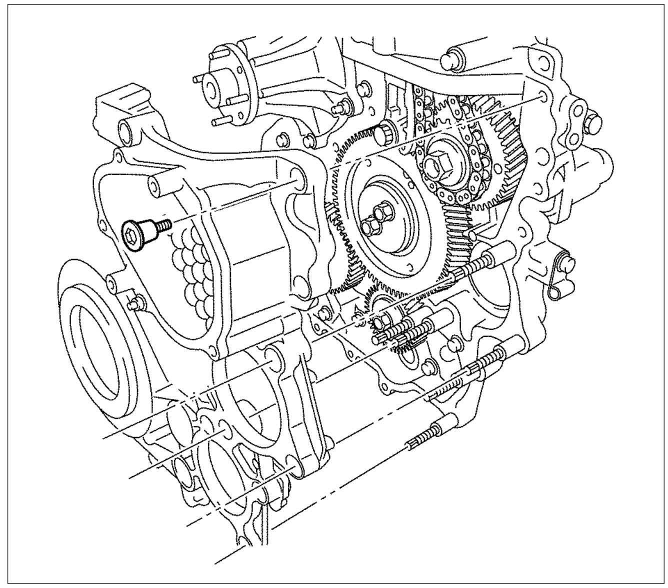
LTW56ASH000101

8. Remove the vacuum pump.
   - Remove the vacuum pipe bracket and vacuum pipe.
   - Remove the oil pipe (feed side and return side) of vacuum pump.



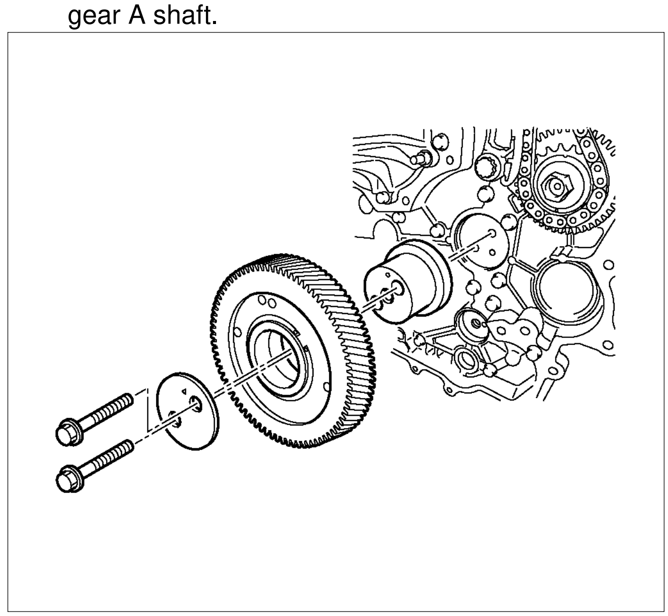
RTW76ASH000201

9. Remove the front cover.



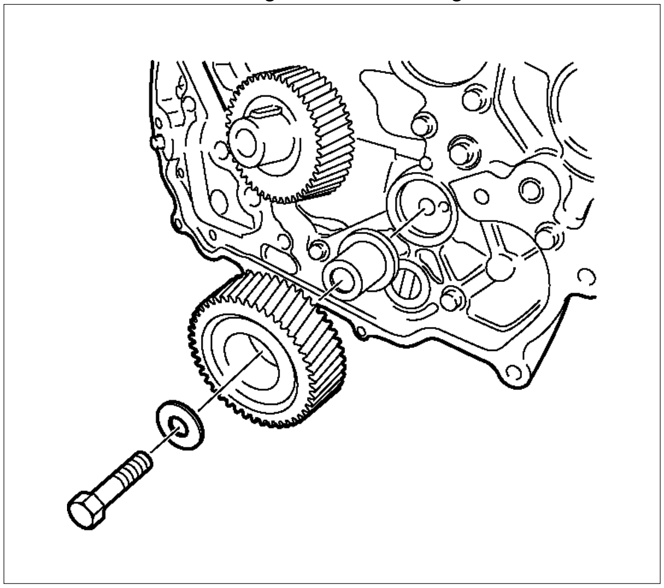
RTW56ASH019701

10. Install the M6 bolt to the idle gear A.
11. Remove the idle gear A and idle gear A flange, idle gear A shaft.



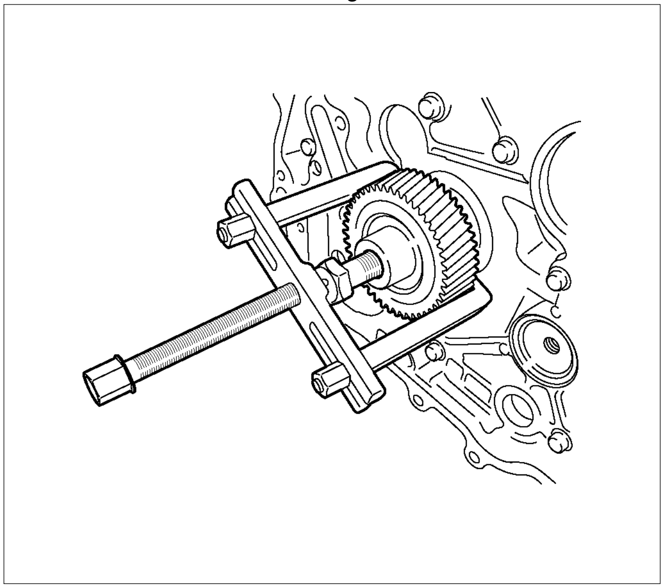
RTW56ASH011301

12. Remove the idle gear C and idle gear C shaft.



RTW56ASH011401

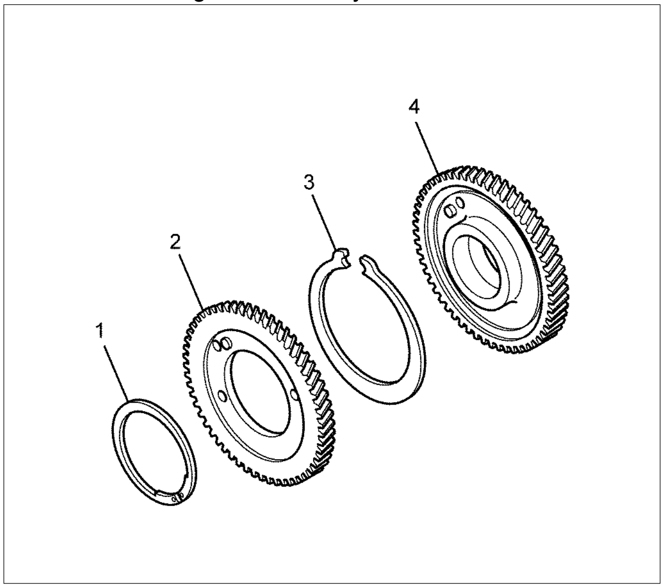
13. Remove the crankshaft gear.



RTW56ASH021501

Disassembly

1. Remove the scissor gear assembly.
   - Clamp the vise. Insert soft metal protectors (aluminum) between the vise and component. Use a pair of snap ring pliers to remove the scissor gear assembly.



RTW56ASH022001

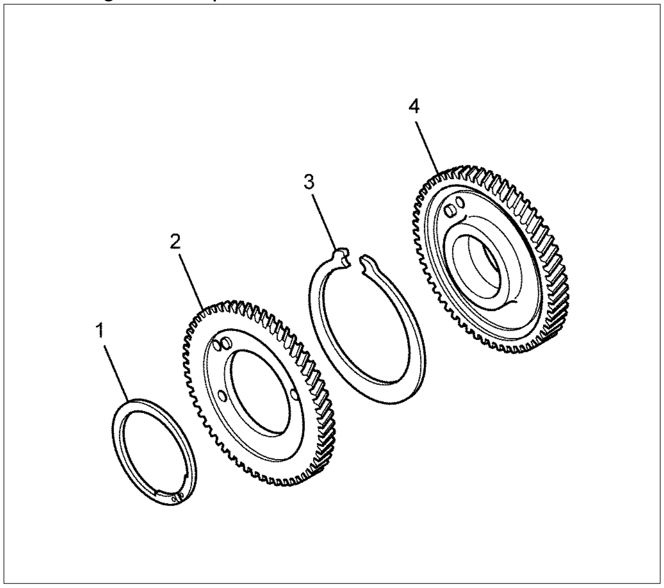
Legend

1. Snap Ring
2. Sub-gear
3. Spring
4. Idle Gear A

Reassembly

1. Install the scissor gear assembly.
   - Clamp the vise. Insert soft metal protectors (aluminum) between the vise and component. Press against the pin on the left side of the idle gear A spring to make a gap on the right side of the spring. Push the spring into place.

- Align the sub gear pin with the hole in the right side of the idle gear A spring. Press the sub-gear into place.



RTW56ASH022001

Legend

1. Snap Ring
2. Sub-gear
3. Spring
4. Idle Gear A

- Use a pair of snap ring pliers to snuggly install the snap ring.

Inspection

1. Measurement of idle gear backlash
   - Apply a dial gauge on the teeth of the idle gear to be measured and move the gear to right and left lightly to read how much the dial gauge shook (never fail to fix the gear).
   - If the measurement exceeds the limit, replace the idle gear.

Backlash of the idle gear	mm (in)
Standard	0.10 – 0.17 (0.004 – 0.006)
Limit	0.30 (0.01)

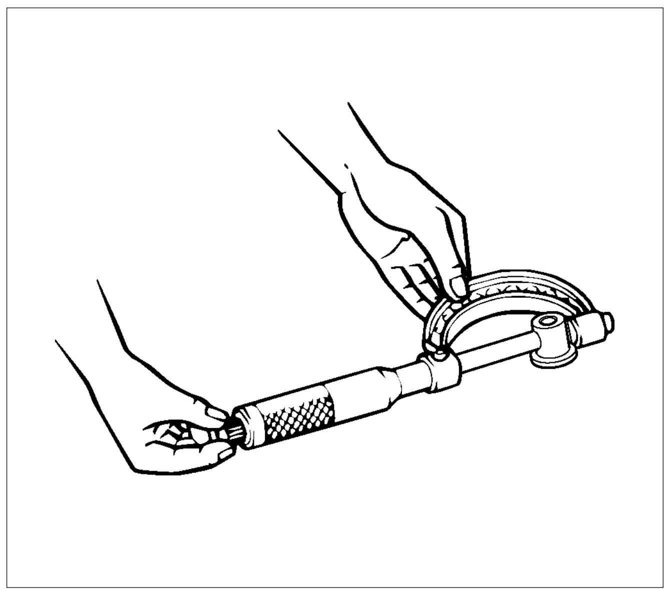
   - Measure backlash of the idle gear before removing the idle gear A.
2. Measurement of end clearance of the idle gear.
   - Insert a thickness gauge between the idle gear and the thrust collar to measure a clearance.
   - If the measurement exceeds the limit, replace either the idle gear or the thrust collar.

End clearance of the idle gear	mm (in)
Standard	0.080 – 0.155 (0.003 – 0.006)
Limit	0.20 (0.008)

   - Measure an end clearance of the idle gear before removing the idle gear B.
3. External diameter of the idle gear shaft.
   - Use a micrometer to measure an external diameter of each idle gear shaft.
   - If the measurement exceeds the limit, replace the shaft.

External diameter of the idle gear A shaft	mm (in)
Standard	44.950 – 44.957 (1.7697 – 1.7700)
Limit	44.80 (1.764)

External diameter of the idle gear C shaft	mm (in)
Standard	24.959 – 24.980 (0.9826 – 0.9835)
Limit	24.80 (0.976)



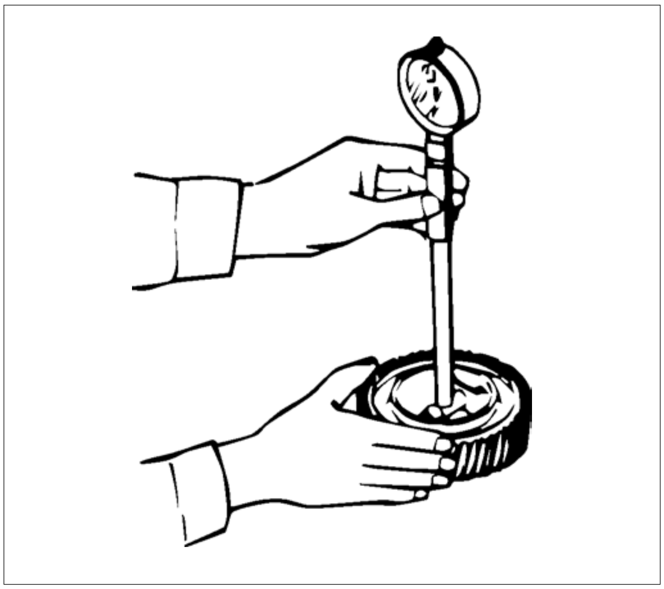
RTW56ASH021601

4. Clearance between the idle gear and the idle gear shaft
   - Measure an inside diameter of the idle gear bush to calculate a clearance between the idle gear and the idle gear shaft.

- If the measurement exceeds the limit, replace either the idle gear or the shaft.

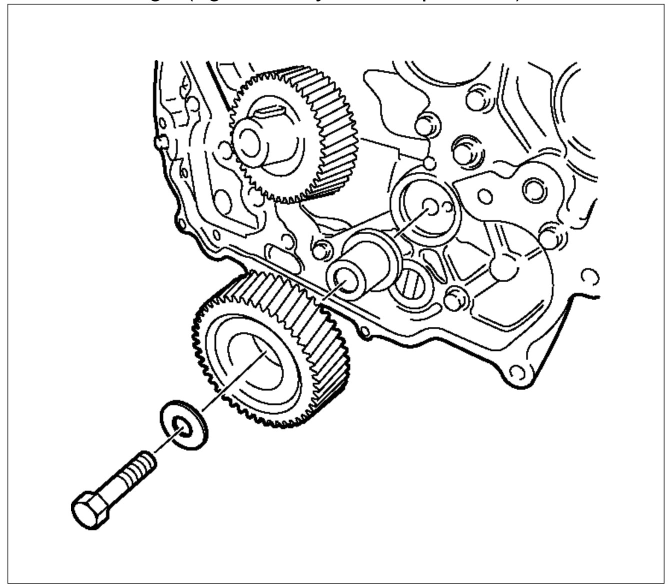
Clearance between the idle gear A and the shaft mm (in)	
Standard	0.020 – 0.062 (0.0007 – 0.0024)
Limit	0.200 (0.0079)

Clearance between the idle gear C and the shaft mm (in)	
Standard	0.025 – 0.075 (0.0010 – 0.0030)
Limit	0.200 (0.0079)

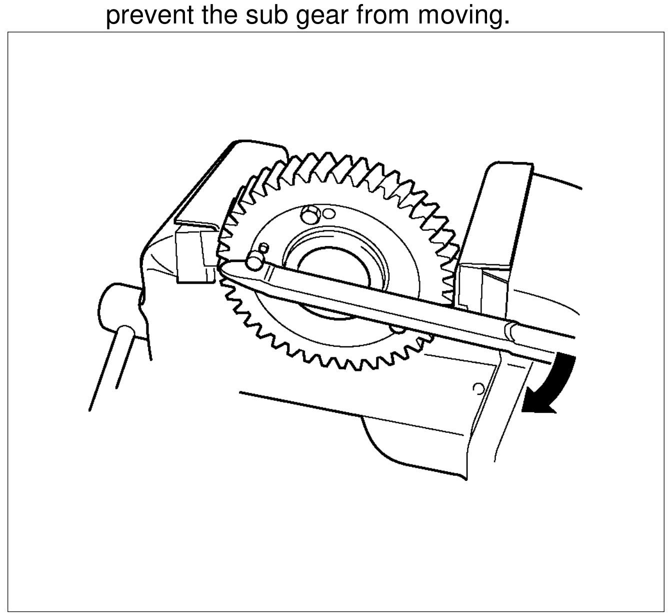

LNW21BSH003601

Installation

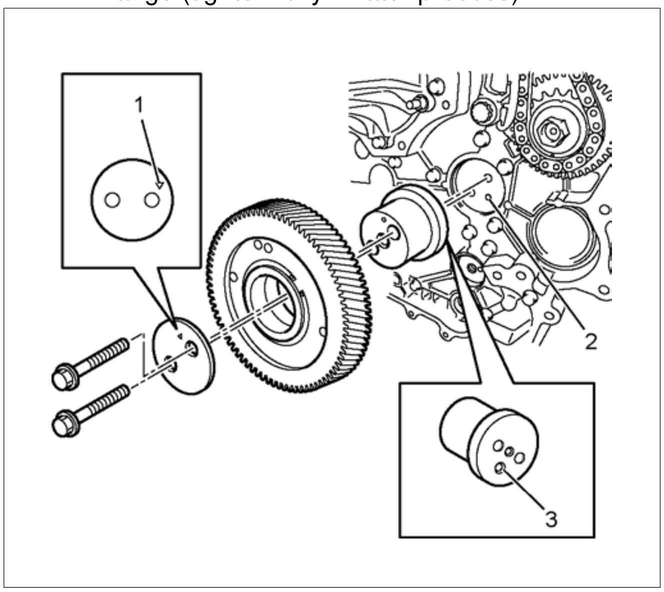
1. Install the crankshaft gear.
2. Install the idle gear C.
   - Apply engine oil over the part where the gear of the idle gear shaft is to be put together.
   - Apply engine oil to the bolt screw thread and seat, and temporarily tighten together with the flange (tighten fully in later process).


RTW56ASH011401

3. Install the idle gear A.
4. Tighten sub gear setting bolt.
   - Use the M6 bolts and lever to turn sub gear to right direction until it aligns with the M6 bolt hole between idle gear A and sub gear.
   - Tighten the M6 bolt to a suitable torque to prevent the sub gear from moving.


RTW56ASH011501

- Align the oil hole of the cylinder body (2) with the oil hole of the idle gear A shaft (3).
- Install the flange so that the front mark (1) face toward the front.
- Install the idle gear A and idle gear A flange, idle gear A shaft at the position shown in the figure.
- Apply engine oil over the part where the gear of the idle gear shaft is to be put together.
- Apply engine oil to the bolt screw thread and seat, and temporarily tighten together with the flange (tighten fully in later process).



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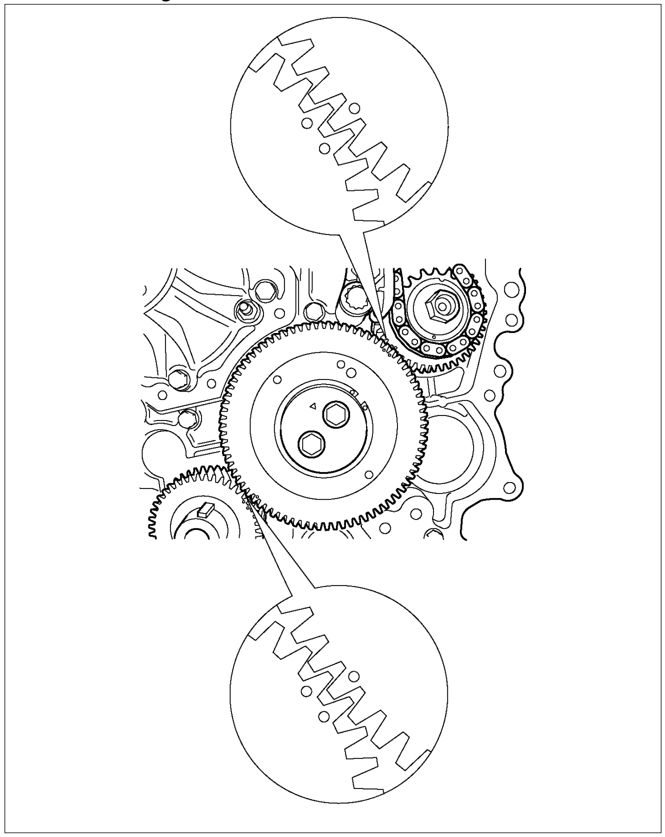
- Attach, aligning with the gear crank: idle A and timing mark.

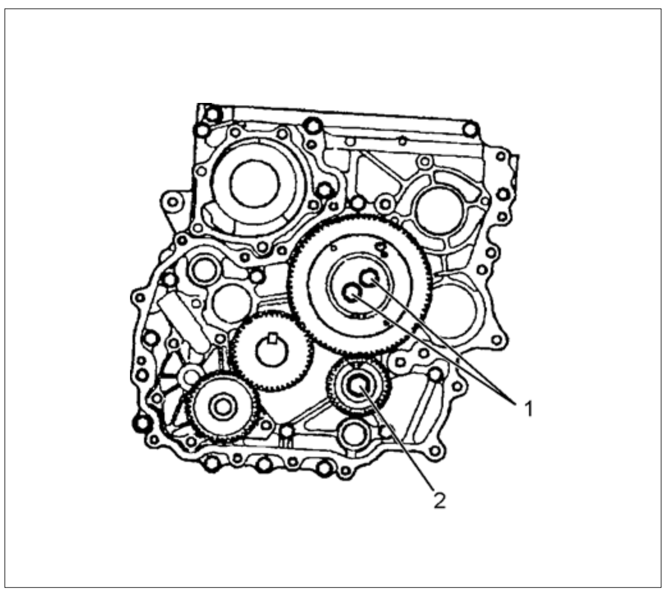


RTW56ALH000301

5. Tighten the bolts of idle gear A and idle gear C to the specified torque.

Tightening torque:

idle gear A 32 N·m (3.3 kg·m / 24 lb ft)
idle gear C 59 N·m (6.0 kg·m / 43 lb ft)

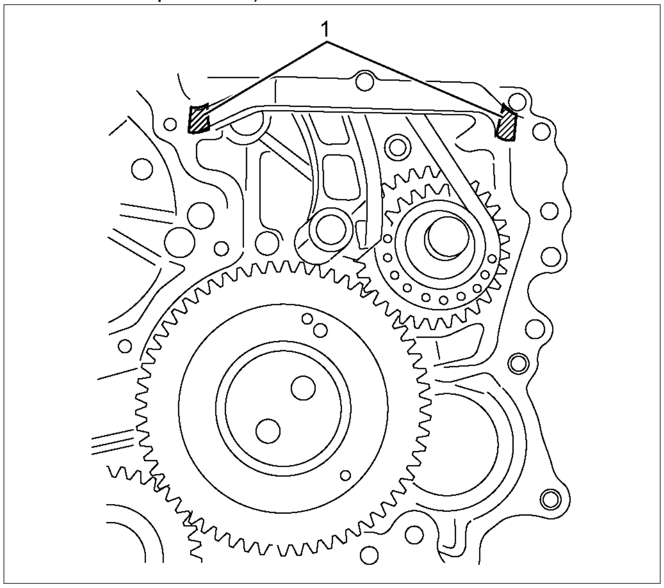


RTW56ASH011701

Legend

1. Idle Gear A Bolt
2. Idle Gear C Bolt

6. Remove the M6 bolt from the idle gear A.
7. Install the gear case cover.
   - Apply the liquid gasket (ThreeBond TB-1207B or equivalent).



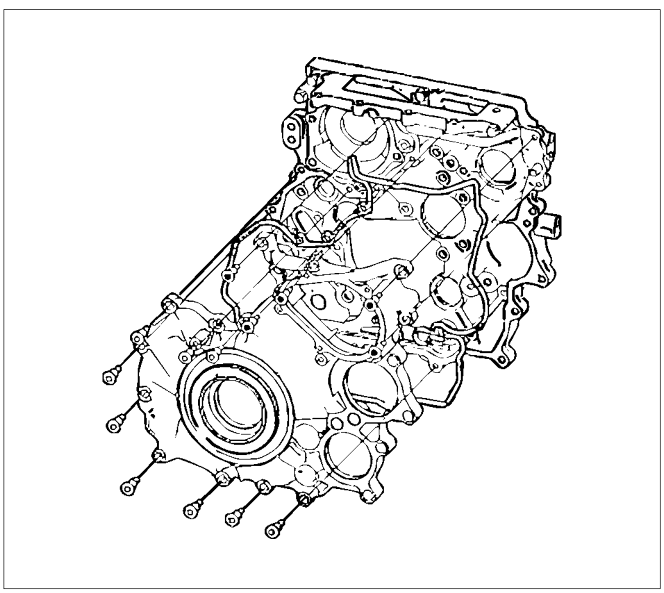
RTW56ASH020101

Legend

1. Apply the liquid gasket

   - Install the gasket in slot of the gear case cover.
   - Tighten the bolts to the specified torque.

Tightening torque: 8 N·m (0.8 kg·m / 69 lb in)



RTW56ASH012101

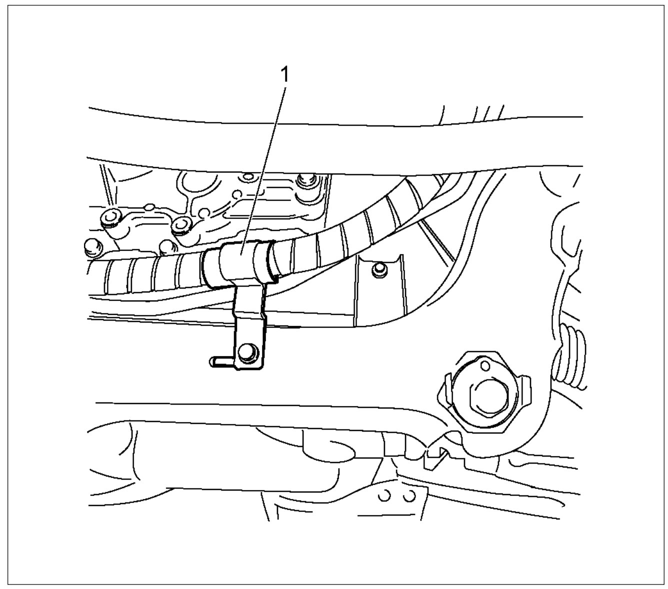
8. Install the vacuum pump.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

   - Install the oil pipe (feed side and return side) of vacuum pump.
   - Install the vacuum pipe bracket and vacuum pipe.
9. Install the power steering pump.
   - Tighten the nuts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

   - Connect the bracket (1) of power steering oil hose.



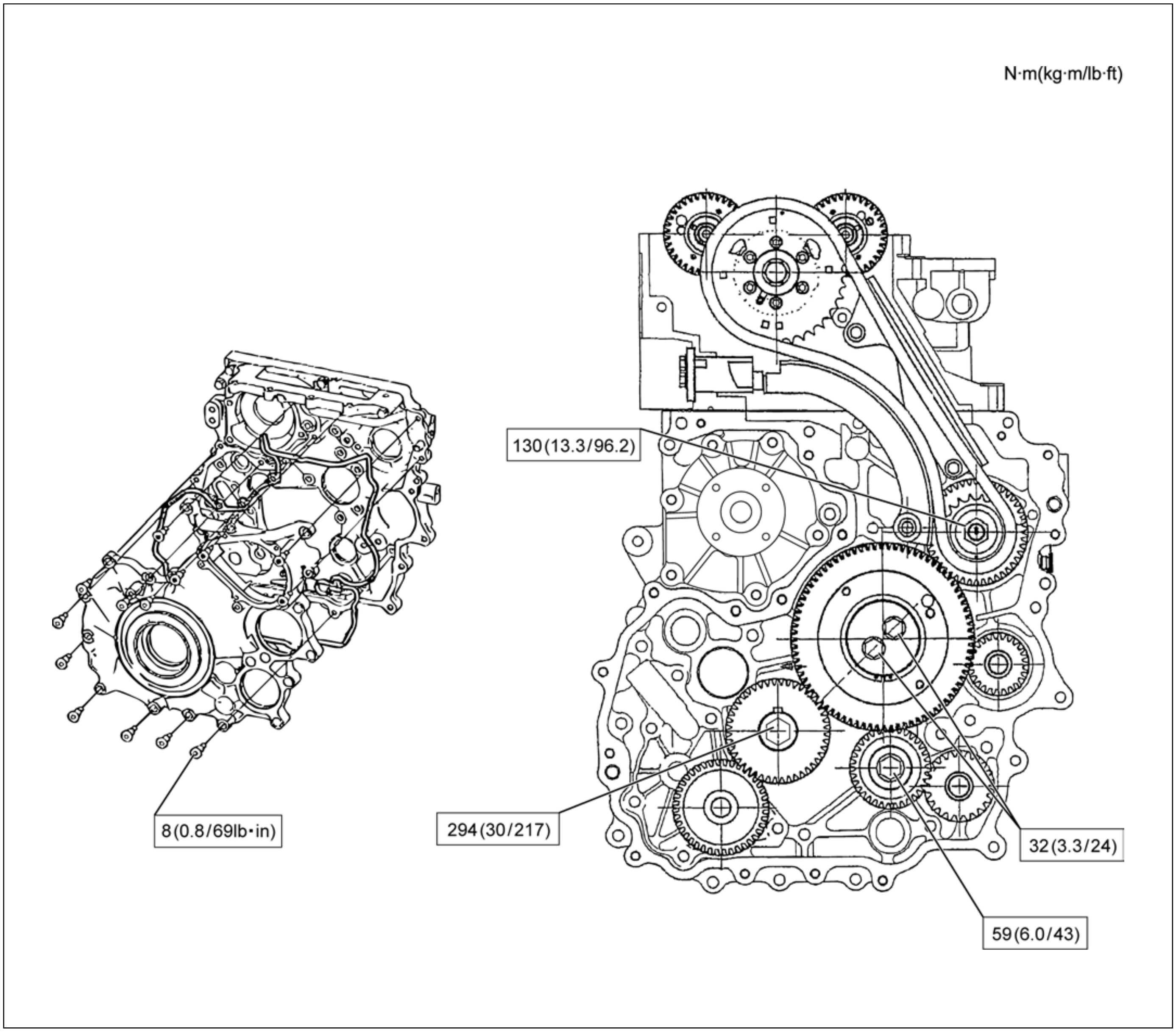
LTW56ASH000101

10. Install the crank pulley.

Tightening torque: 294 N·m (30.0 kg·m / 217 lb ft)

11. Install the A/C compressor drive belt and fan belt.
    Refer to drive belt tension check procedure for Heating and air conditioning and Engine cooling in this manual.
12. Install the cooling fan.
13. Install the fan guide.
14. Install the radiator upper hose.
15. Replenish the engine coolant.

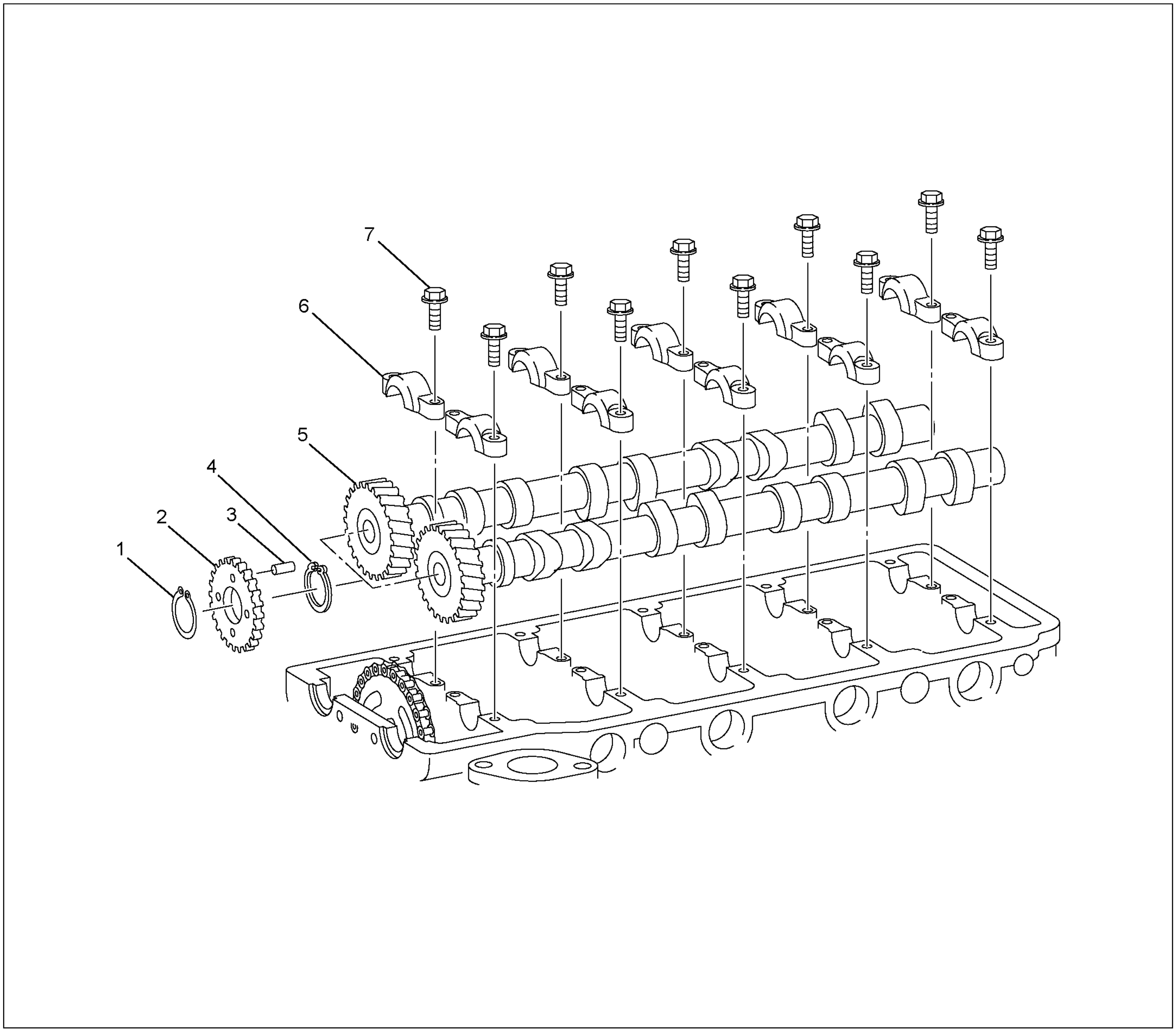
Torque Specifications



LNW76ALF000601

Camshaft Assembly

Components



RTW56ALF000901

Legend

1. Snap Ring
2. Sub Gear
3. Knock Pin
4. Damper Spring
5. Camshaft Gear and Camshaft
6. Camshaft Bearing Cap
7. Bolt

YES

- Is there continuity between the engine room harness connector (cooler only) terminal No. 4 (C-55) and the chassis side harness connector terminal No. 11 (B-57)?

NO

Open circuit between the engine room harness connector terminal No. 1 (C-55) or (cooler only) the short connector No. 3 (B-79) and ground (C-109).

YES

- Is there battery voltage between the chassis side harness connector terminal No. 10 (B-57) and ground?

NO

Open circuit between the engine room harness connector (cooler only) terminal No. 4 (C-55) and the chassis side harness connector terminal No. 11 (B-57).

YES

- Disconnect the A/C switch.

- Is there battery voltage between the chassis side harness connector terminal No. 6 (B-57) and ground?

NO

Open circuit between the chassis side harness connector No. 1 (B-79) and the chassis side harness connector terminal No. 10 (B-57).

YES

- Is the electronic thermostat OK?

NO

Open circuit between the No. EB-13 fuse and the chassis side harness connector No. 6 (B-57).

YES

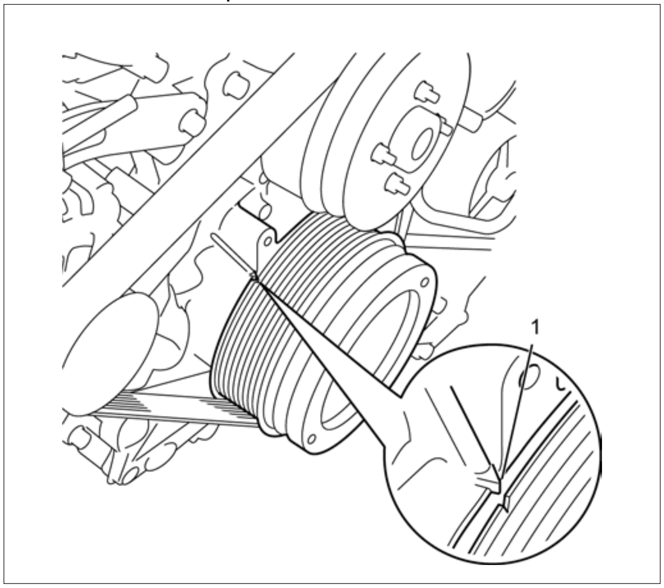
- Defective ECM

NO

Replace electronic thermostat

Removal

1. Rotate the crankshaft to make the No. 1 cylinder meet the compression TDC.

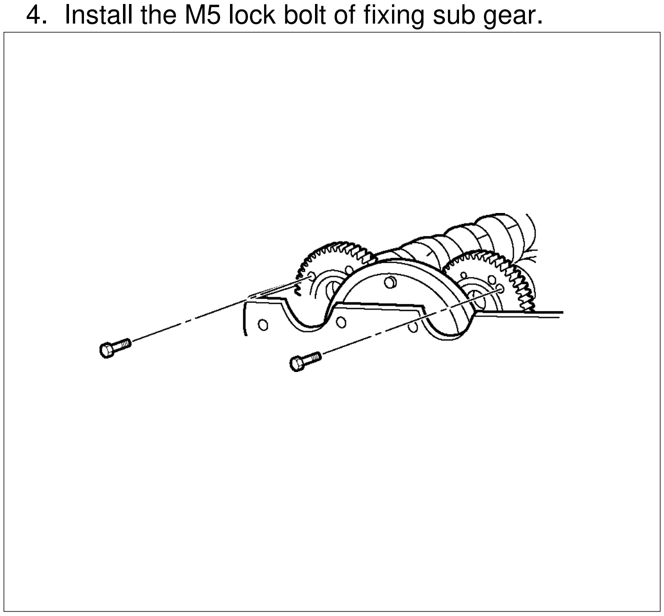


RTW76ASH001301

Legend

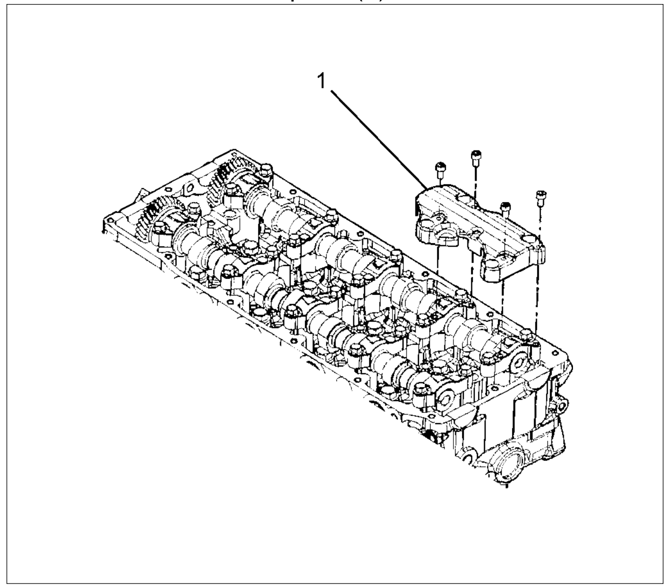
1. TDC

2. Remove the engine cover.
3. Remove the cylinder head cover.
   Refer to "Cylinder Head Cover".
4. Install the M5 lock bolt of fixing sub gear.



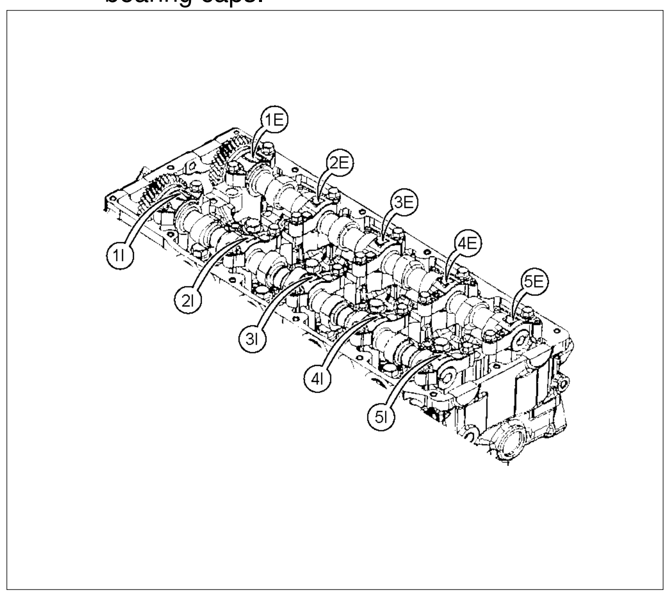
RTW56ASH007101

5. Remove the baffle plate (1).



RTW56ASH006301

6. Remove the camshaft bearing cap and camshaft.
   - Check the engraved making on the camshaft bearing caps.



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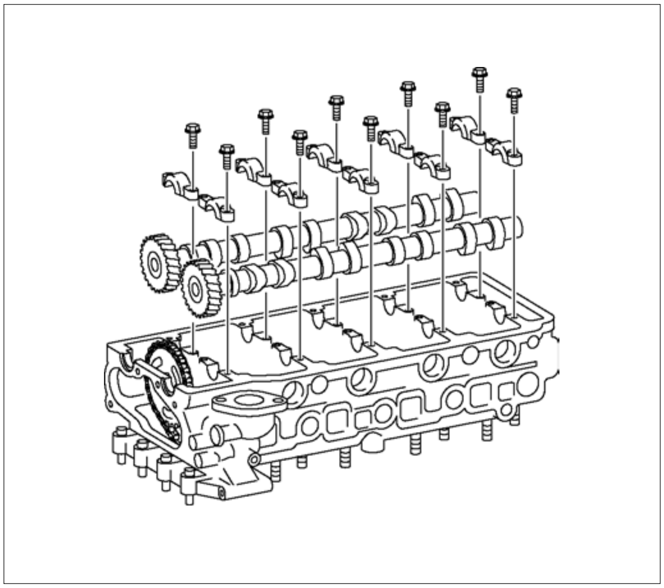
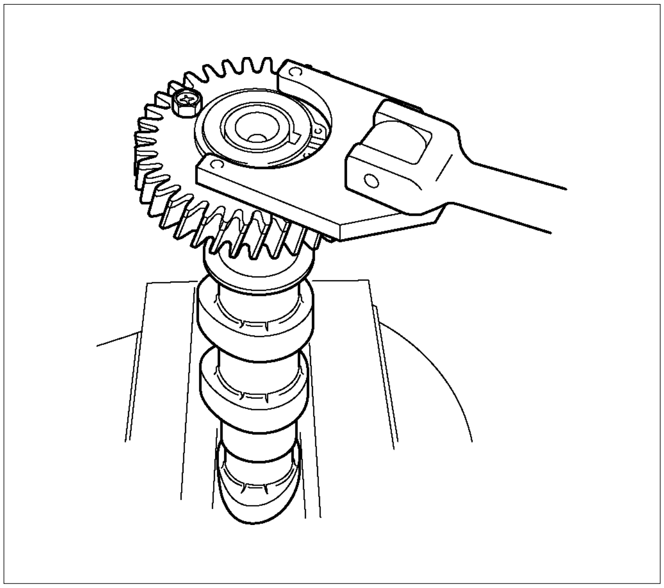


RTW56ASH013801

Disassembly

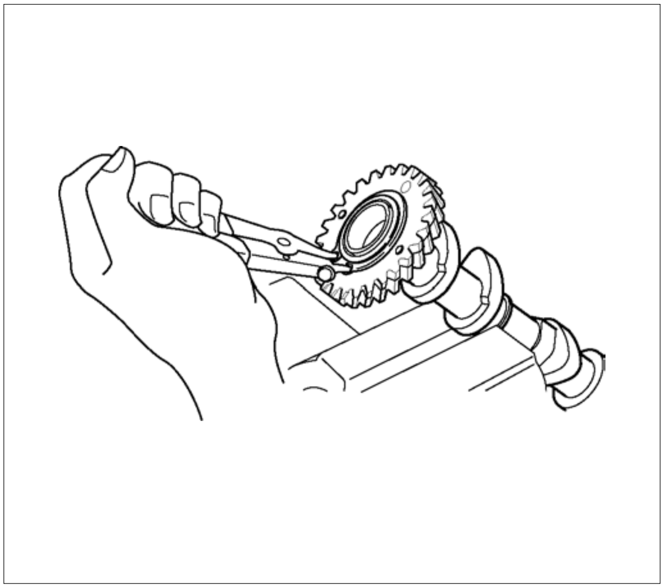
1. Remove the sub gear assembly.
   - Clamp the camshaft in a vise. Insert soft metal protectors (aluminum) between the vise surfaces and the camshaft.
   - Use 5-8840-2591-0 to turn sub gear to right direction to remove the M5 bolt.



RTW56ASH006801

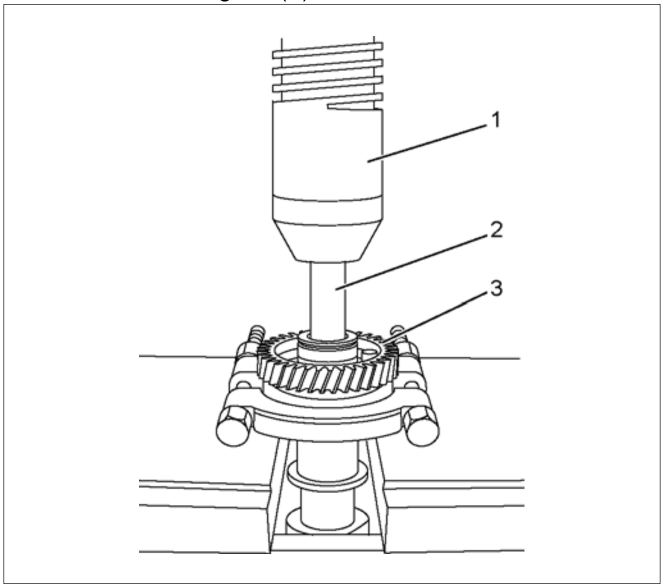
   - Use a pair of snap ring pliers to remove the scissor gear assembly.

Note:
Take care not to damage the camshaft cams and journals.



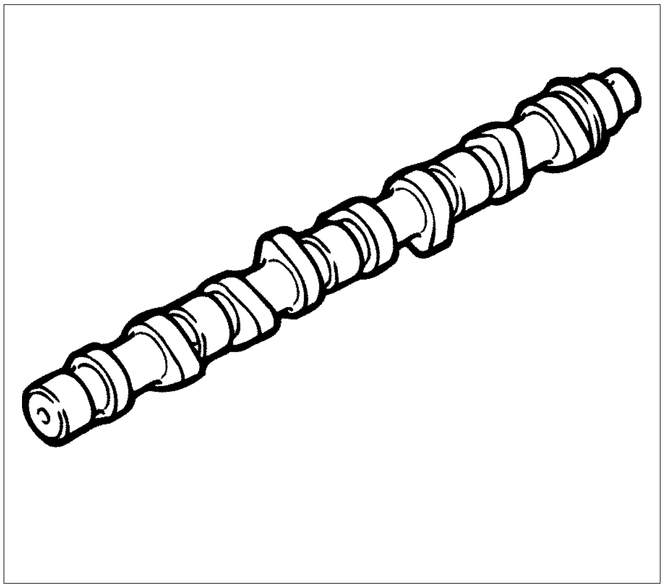
RTW56ASH006401

2. Remove the camshaft gear.
   - Use a press (1) and socket (2) to remove the camshaft gear (3).



RTW56ASH006501

3. Remove the dowel pin.
4. Inspect the camshaft visually.
   - Check if the journal and cam parts of the camshaft are worn or damaged, if so, replace it.

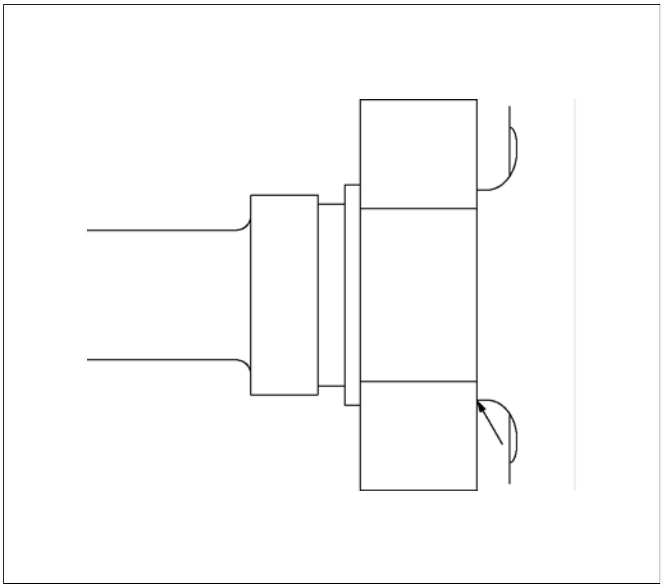


LNW21BSH020201

5. Inspect an end clearance of the camshaft.
   - Use a thickness gauge to measure an end clearance of the camshaft gear and the camshaft bracket.
   - If the measurement exceeds the limit, replace the camshaft gear or the camshaft.

End clearance of the camshaft	mm (in)
Standard	0.085 – 0.205 (0.003 – 0.008)
Limit	0.25 (0.010)

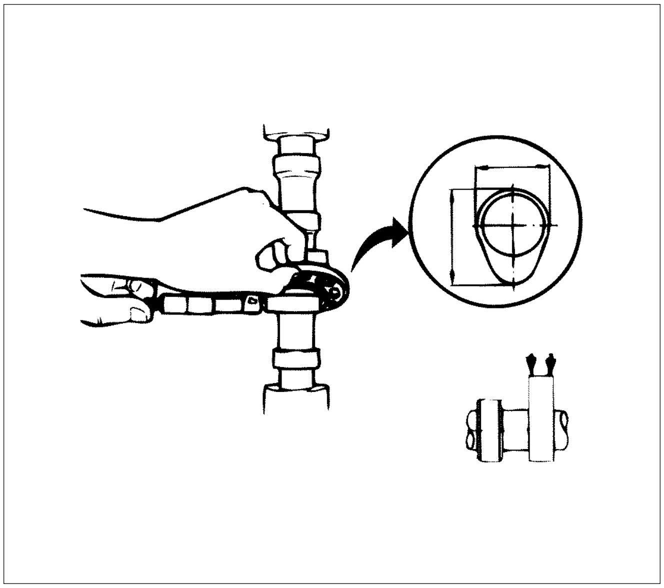
Note:
Measure an end clearance of the camshaft before disassembling.



RTW56ASH013901

6. Check if the cam lobe is worn.
   - Use a micrometer to measure the height of the cam lobe.
   - If the height of the cam lobe is at the limit or less, replace the camshaft.

Height of the cam lobe		mm (in)
	Inlet	Exhaust
Standard	40.6 (1.60)	40.6 (1.60)
Limit	39.6 (1.56)	39.6 (1.56)

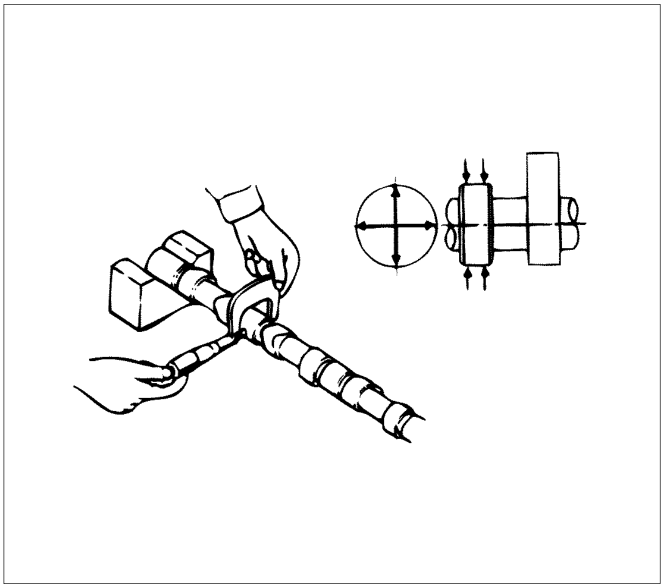


LNW21BSH020401

7. Check if the camshaft journal is worn.
   - Use a micrometer to measure wear which is not even with a diameter of the camshaft journal.
   - If the measured uneven wear exceeds the limit, replace the camshaft.

External diameter of the camshaft journal part mm (in)	
Standard	29.909 – 29.930 (1.1775 – 1.1783)
Limit	29.809 (1.1736)

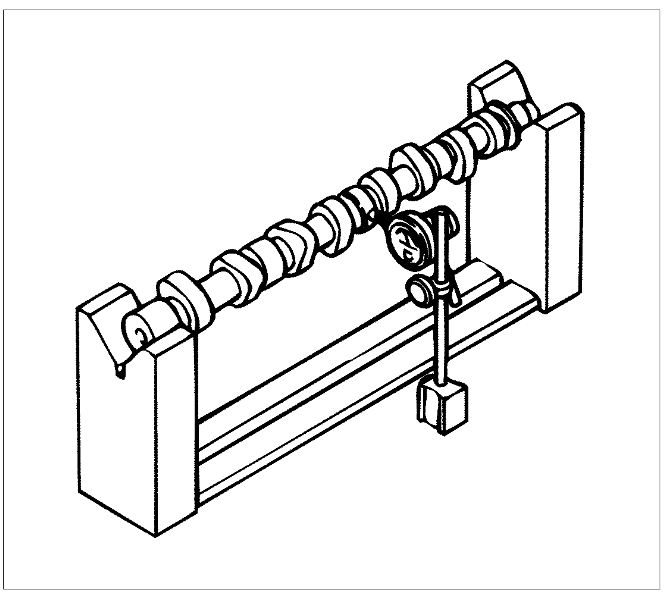
Partial wear of the camshaft journal part	mm (in)
Limit	0.05 (0.0020)



LNW21BSH020501

8. Check if the camshaft is runout.
   - Place the camshaft on a V block to measure a runout with a dial gauge.
   - Rotate the camshaft slowly to measure how much the dial indicator shook. If it exceeds the limit, replace the camshaft.

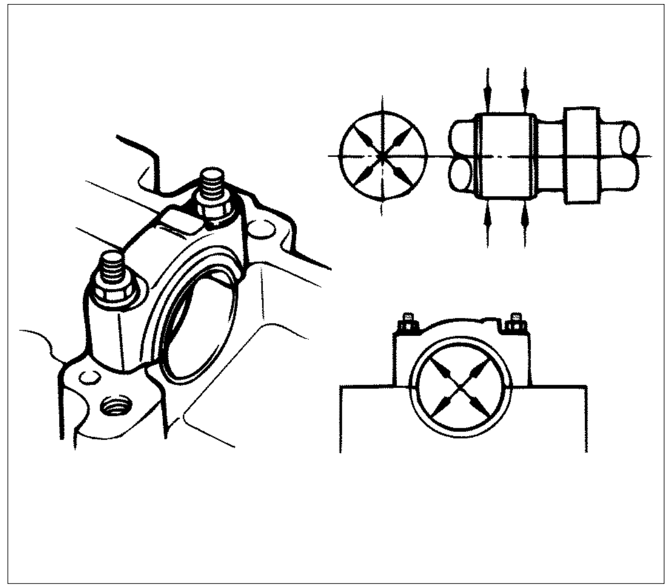
Runout of the camshaft	mm (in)
Limit	0.05 (0.0020)



LNW21BSH020601

9. Measure a camshaft journal oil clearance.
   a. Measure an inside diameter of the camshaft bearing with a dial gauge.
   b. Read the difference between the inside diameter of the camshaft bearing and the diameter of the camshaft journal.
      If the measured oil clearance exceeds the limit, replace the camshaft bearing.

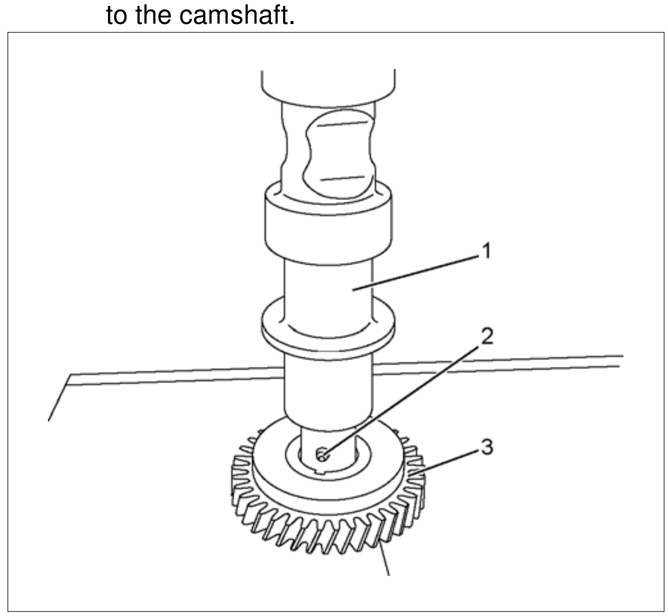
Clearance of the journal part	mm (in)
Standard	0.025 – 0.087 (0.0010 – 0.0034)
Limit	0.15 (0.0059)



LNW21BSH054601

Reassembly

1. Install the dowel pin.
2. Install the camshaft gear.
   - Align the knock pin with the slot in the camshaft gear. Use a press to install the camshaft gear to the camshaft.

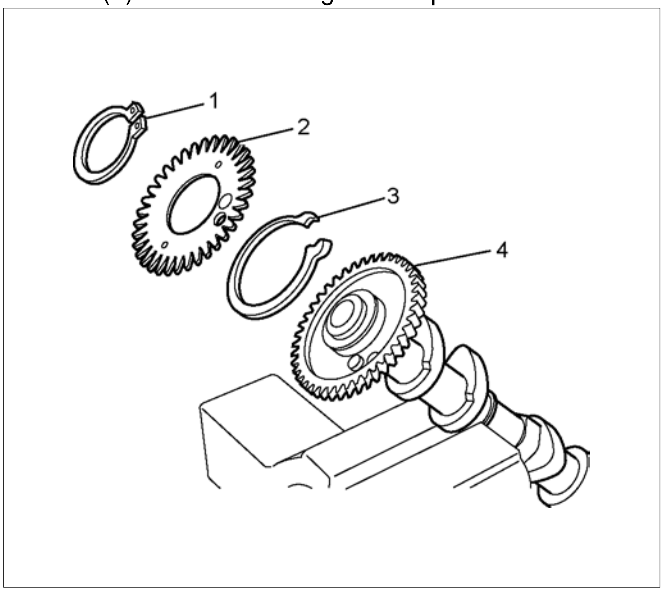


RTW56ASH006601

Legend

1. Camshaft
2. Dowel Pin
3. Camshaft Gear

3. Install the sub gear assembly.
   - Clamp the camshaft in a vise. Insert soft metal protectors (aluminum) between the vise surfaces and the camshaft. Press against the pin on the left side of the camshaft gear spring (3) to make a gap on the right side of the spring. Push the spring into place.
   - Align the sub gear pin (2) with the hole in the right side of the camshaft gear damper spring (3). Press the sub-gear into place.



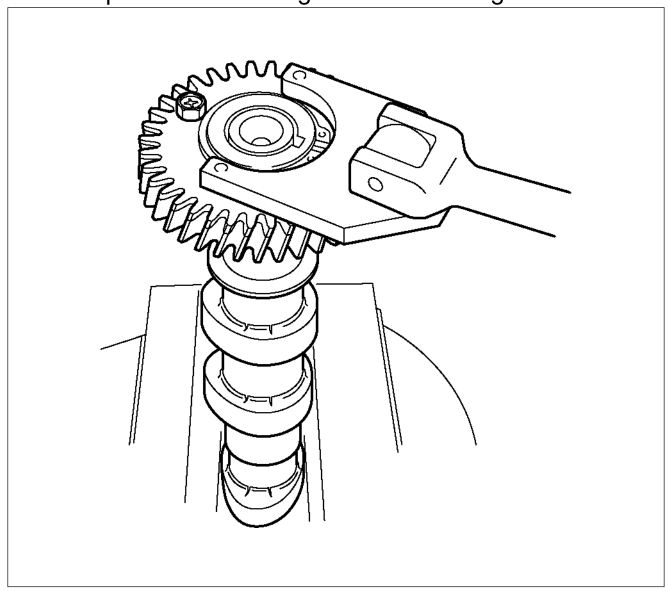
RTW56ASH006701

Legend

1. Snap Ring
2. Sub-gear
3. Damper Spring
4. Camshaft Gear

- Use a pair of snap ring pliers to snuggly install the snap ring.

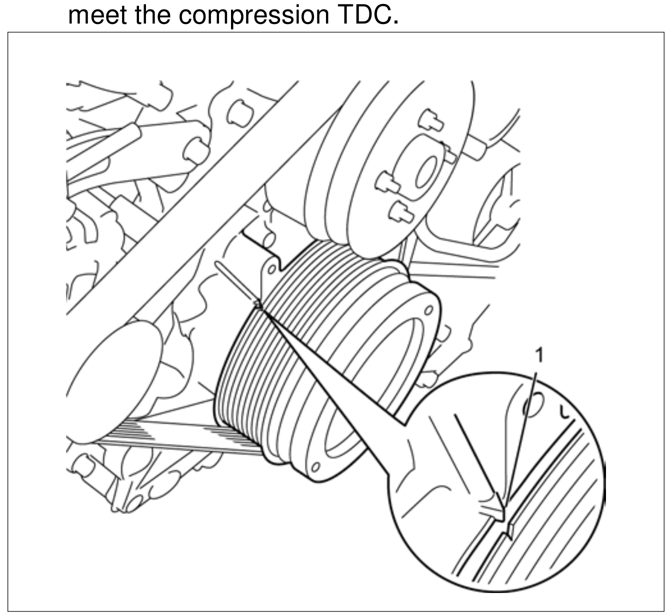
4. Tighten sub gear setting bolt.
   - Use 5-8840-2591-0 to turn sub gear to right direction until it aligns with the M5 bolt hole between camshaft driven gear and sub gear.
   - Tighten the M5 bolt to a suitable torque to prevent the sub-gear from moving.



RTW56ASH006801

Installation

1. Check the crankshaft to make the No. 1 cylinder meet the compression TDC.

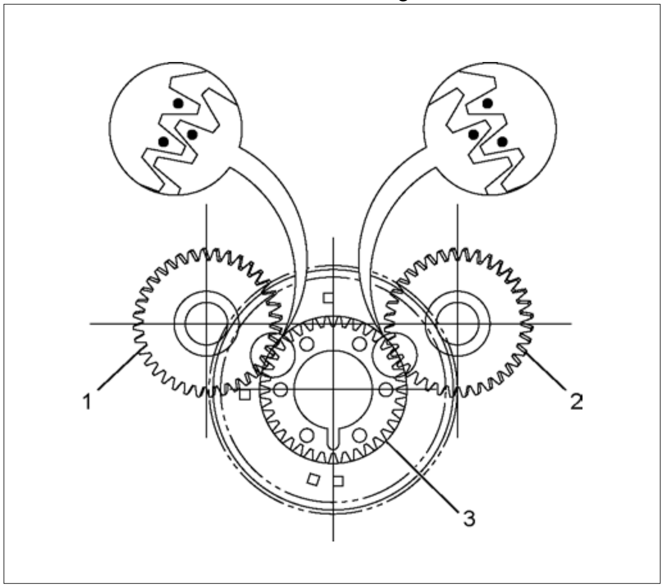


RTW76ASH001301

Legend

1. TDC

2. Install the camshaft assembly.
   - Align timing mark on intake camshaft and exhaust camshaft to idle gear D.

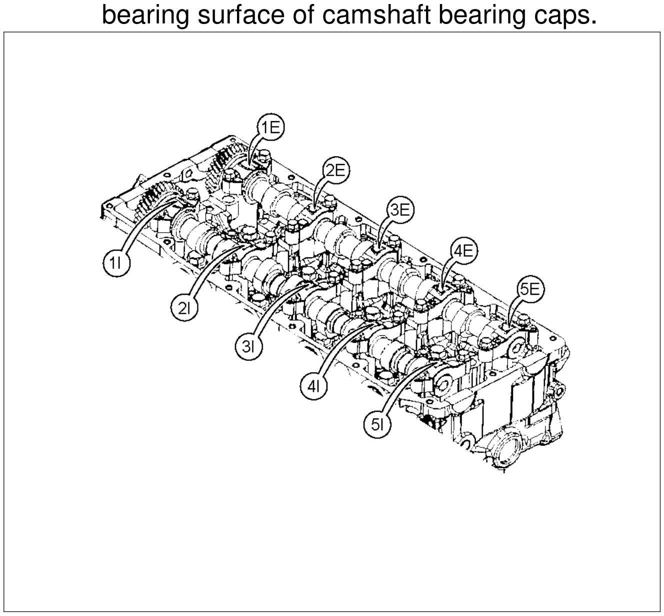


RTW56ASH007001

Legend

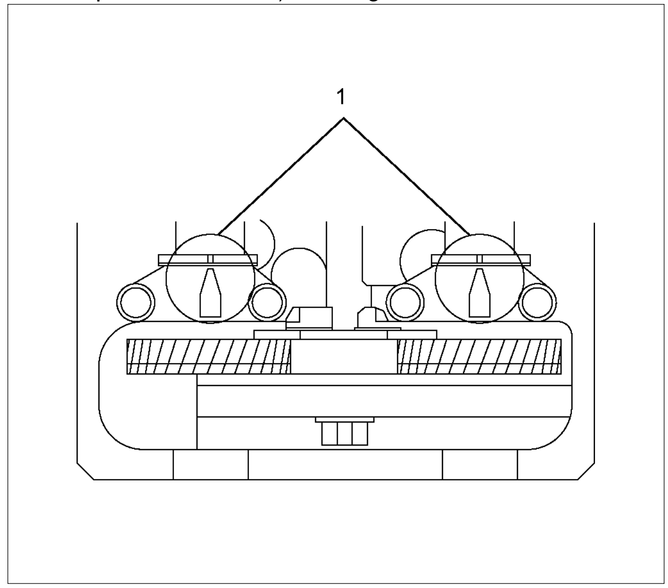
1. Exhaust Camshaft Gear
2. Intake Camshaft Gear
3. Idle Gear D

3. Camshaft bearing caps, tighten ten bolts on one side bank to the specified torque.
   - Apply engine oil to camshaft journal and bearing surface of camshaft bearing caps.



RTW56ASH018401

4. Check that the alignment marks (camshaft bearing cap and camshaft) are aligned.



RTW56ASH006901

Legend

1. Align mark on intake camshaft and exhaust camshaft to mark of bearing cap

   - Apply engine oil over the screw part and tighten up the bearing cap with the prescribed torque.

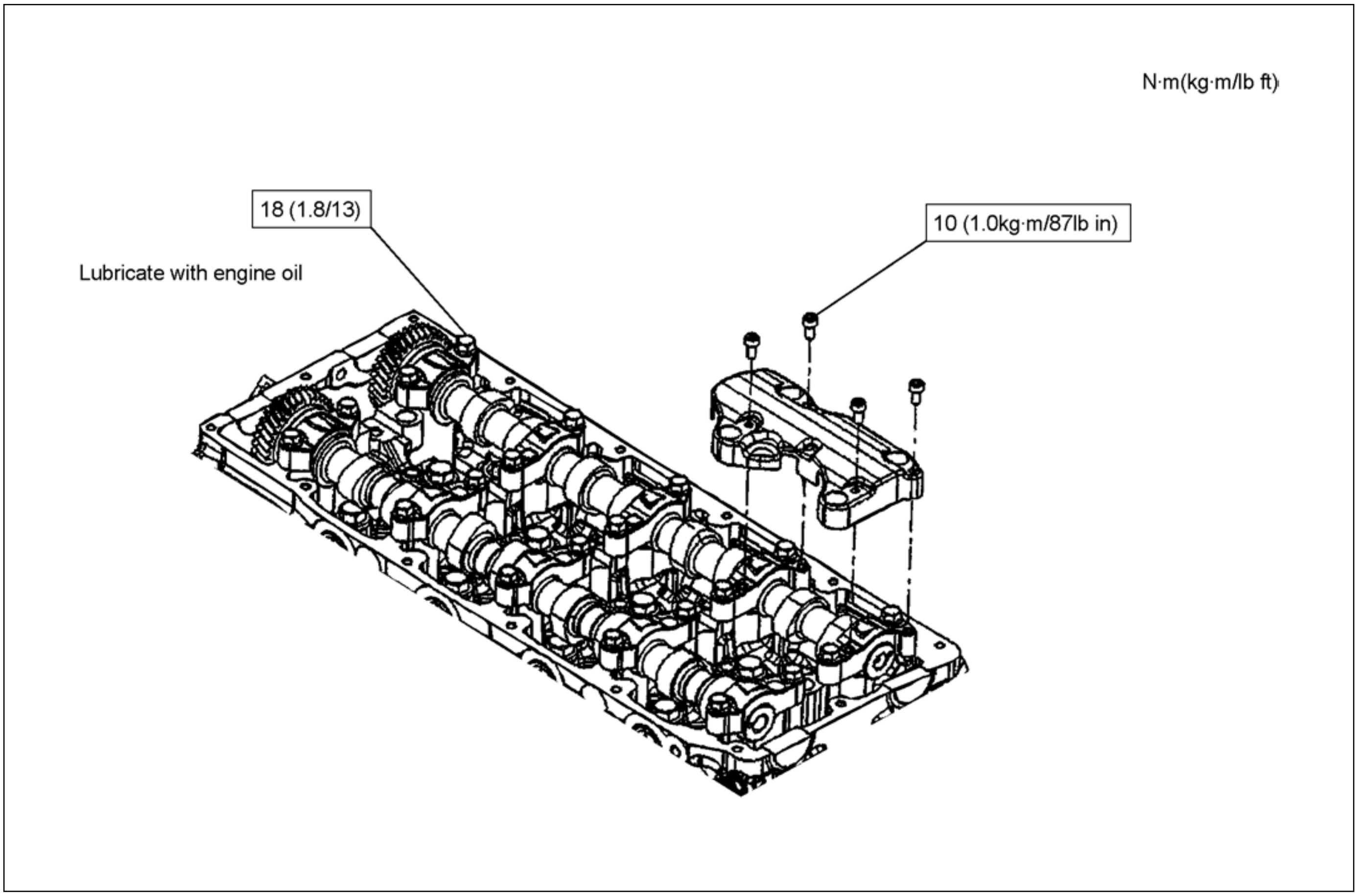
Tightening torque: 18 N·m (1.8kg·m / 13 lb ft)

5. Remove the M5 lock bolt of fixing sub gear.
6. Adjustment of valve clearance.
   - Refer to installation procedure for inspection / adjustment of valve clearance in this manual.
7. Install the baffle plate. Tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m/87 lb in)

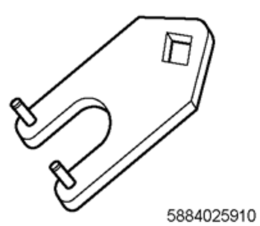
8. Install the cylinder head cover.
   Refer to "Cylinder Head Cover".
9. Install the engine cover.

Torque Specifications



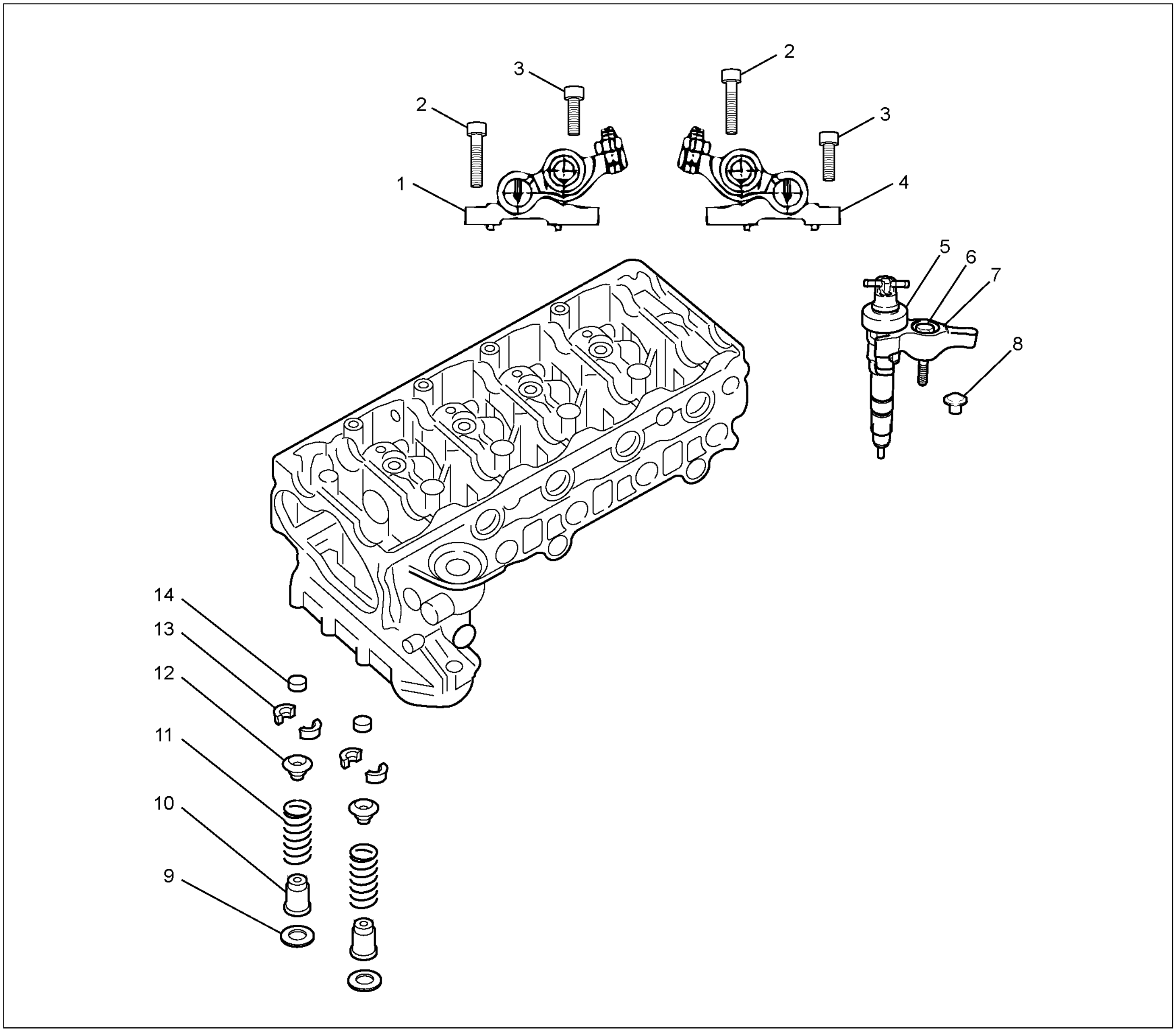
RTW56AMF001701

Special Tools

ILLUSTRATION	PART NO. PART NAME
	**5-8840-2591-0** Camshaft gear tool

Valve Stem Seal and Valve Spring

Components

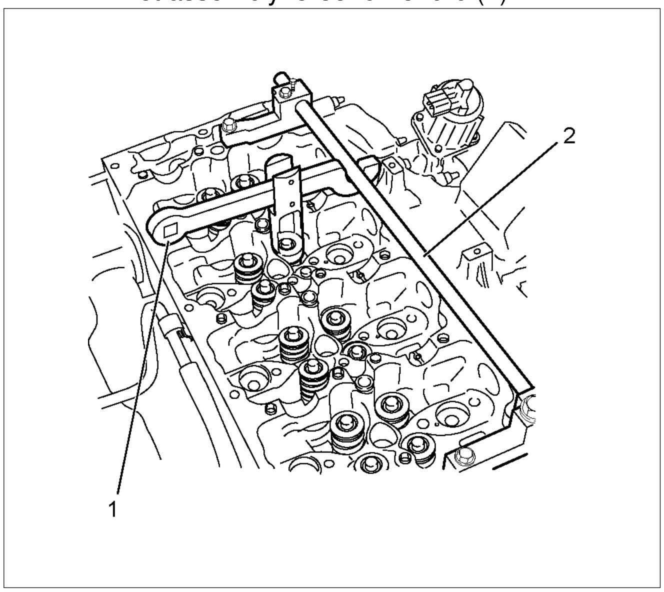


Legend

1. Exhaust Rocker Arm Shaft Assembly
2. Bolt (Long)
3. Bolt (Short)
4. Intake Rocker Arm Shaft Assembly
5. Fuel Injector Assembly
6. Bolt
7. Fuel Injector Clamp
8. Pin
9. Spring Lower Seat
10. Valve Stem Oil Seal
11. Valve Spring
12. Spring Upper Seat
13. Split Collar
14. Valve Stem End Cap

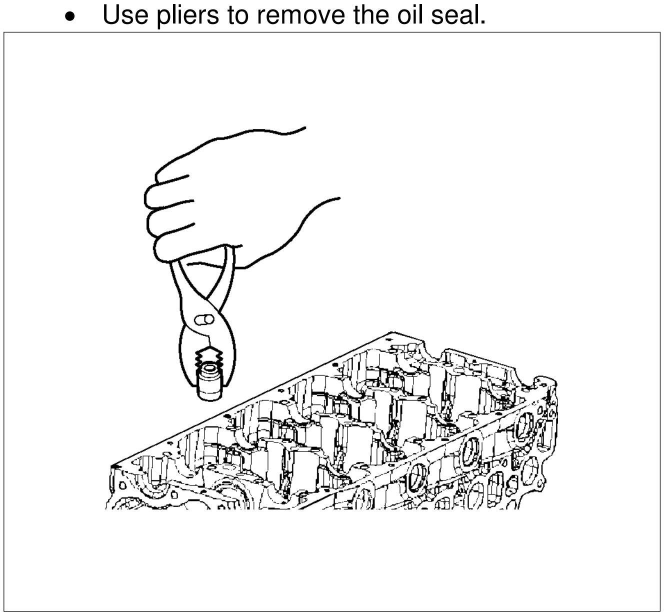
Removal

1. Remove the cylinder head.
   Refer to “Cylinder Head”.
2. Remove the split collar.
   - Use a replacer to compress the valve spring to remove the split collar.
     Special tool
     Valve spring replacer: 5-8840-2818-0 (1)
     Pivot assembly: 5-8840-2819-0 (2)



RTW56ASH012301

3. Remove the spring upper seat.
   - Remove the special tool to remove the upper seat.
4. Remove the valve spring.
   Put the removed valve springs in order by cylinder number.
5. Remove the valve stem oil seal.
   - Use pliers to remove the oil seal.



RTW56ASH012401

Note:
Do not use the removed oil seal again.

6. Remove the spring lower seat.

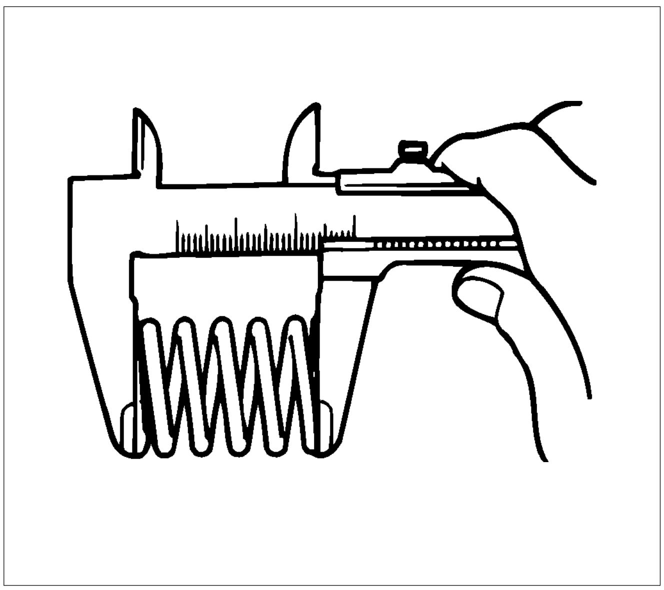
Inspection

Inspect the valve spring

Note:
Check the valve spring visually and if there is clear damage or wear, replace it.

1. Free length
   - Measure free length of the spring and if it is shorter than the prescribed limit, replace the spring.

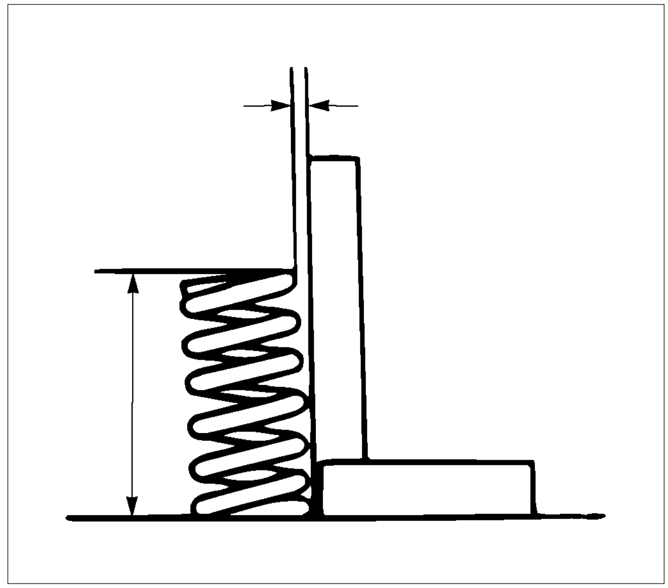
Free length of the valve spring	mm (in)
	Inlet / Exhaust
Standard	49.04 (1.93)
Limit	48.15 (1.89)



LNW21BSH017001

2. Valve spring squareness.
   - Use a surface plate and a square to measure the valve spring squareness.
     If the measured value exceeds the specified limit, the valve spring must be replaced.

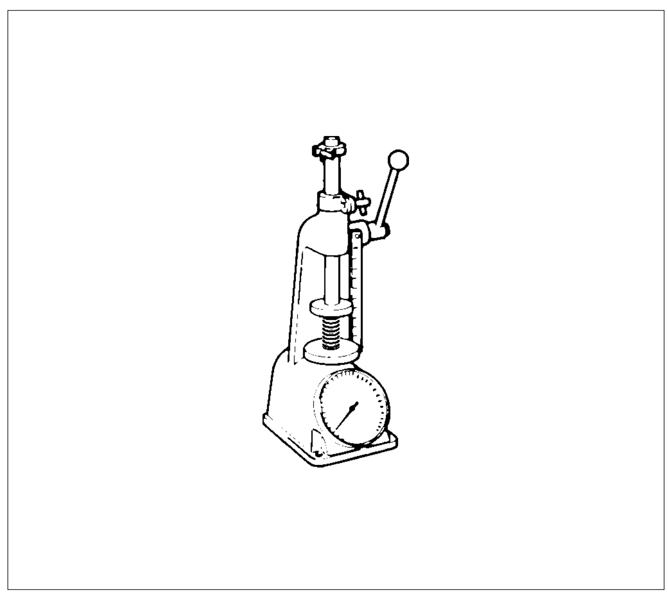
Valve spring squareness	mm (in)
Limit	2.1 (0.083)



LNW21BSH017101

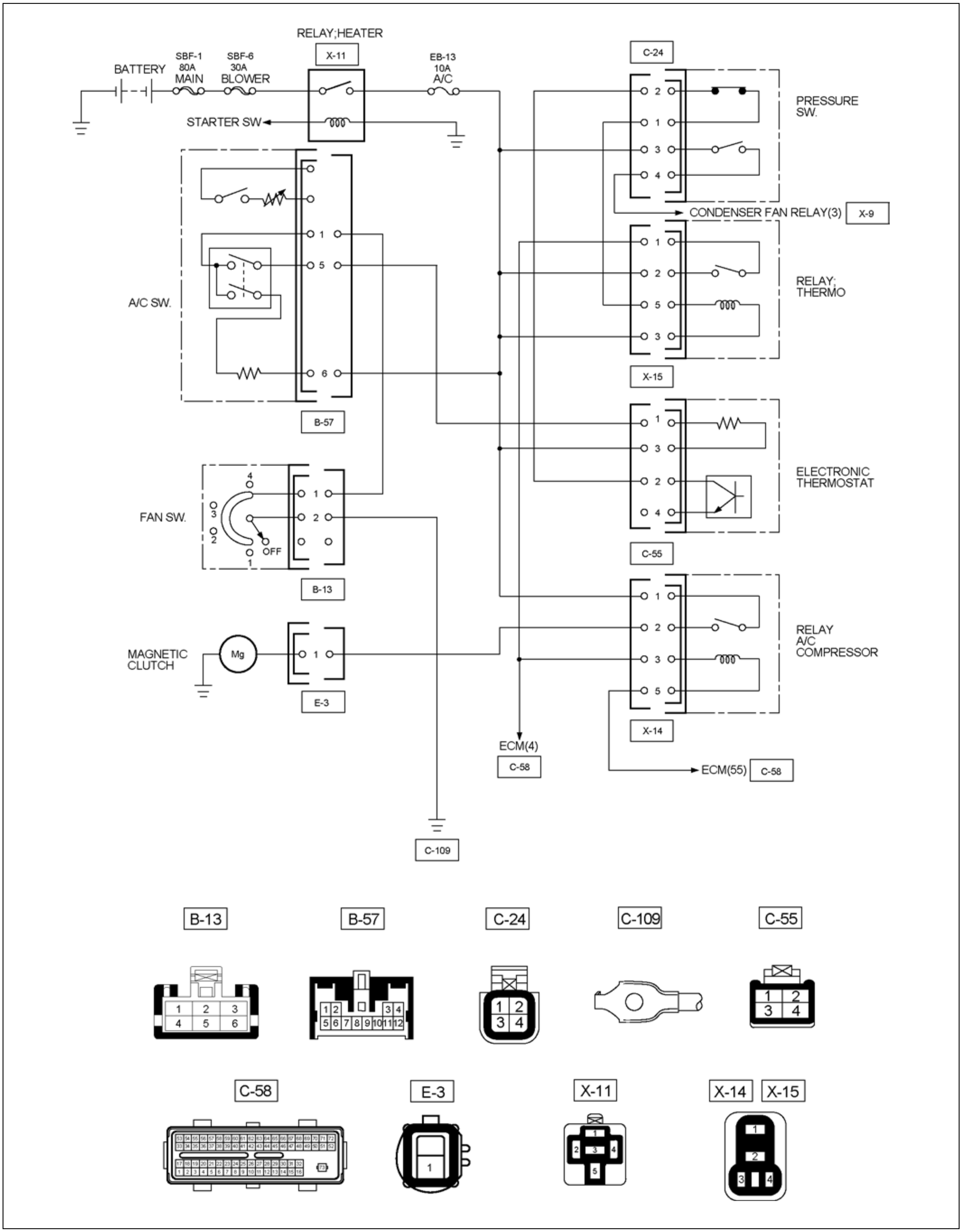
3. Tension
   - Use a spring tester to compress the spring to the installation height. Measure tension of the compressed spring. If the measurement is lower than the limit, replace the spring.

Tension of the valve spring	N (kg / lb)
	Inlet / Exhaust
Installation length mm (in)	37.80 (1.488)
Standard	213 (21.7 / 47.8)
Limit	188 (19.2 / 42.3)



LNW21BSH056701

4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output LHD MODEL



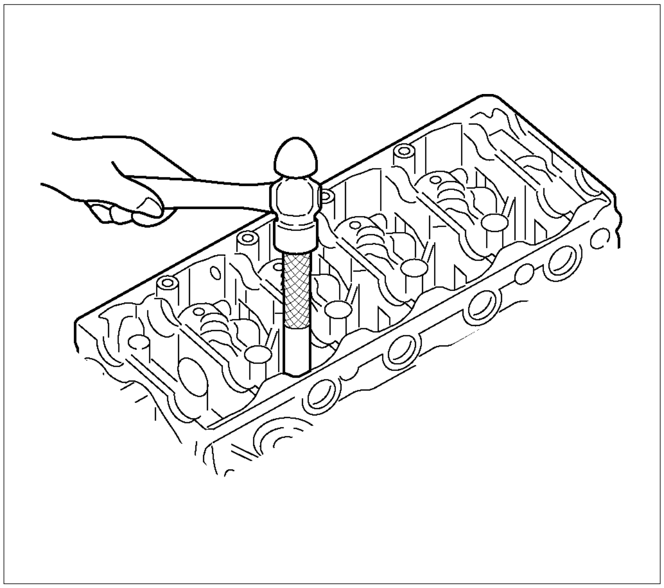
RTW710XF000501

Installation

1. Install the spring lower seat.
2. Install the valve stem oil seal.
   - Apply engine oil over the peripheral part of the valve guide and install the oil seal by using a valve stem seal installer.

Note:
After installing the valve stem oil seal, check if it is inserted nice and deep and the oil seal is not tilted or the garter spring has not come off.

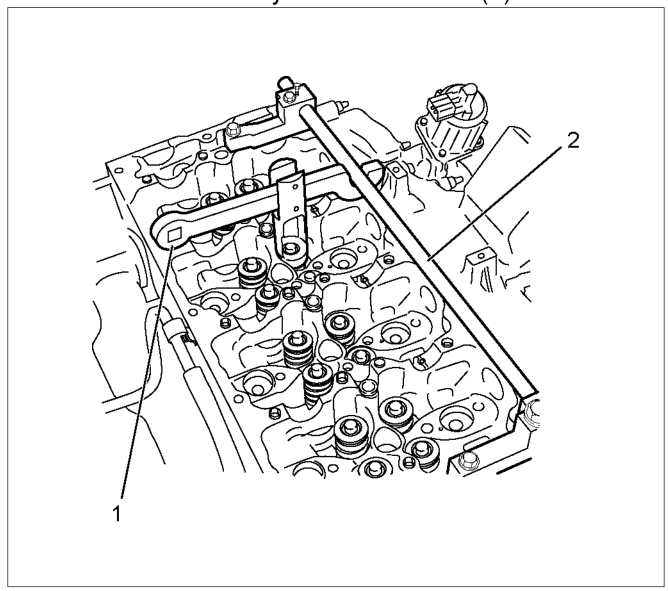
Special tool
Valve stem seal installer: 5-8840-2817-0



RTW56ASH013701

3. Install the valve spring.
4. Install the spring upper seat.
5. Install the split collar.
   - Use a replacer to compress the valve spring and install the split collar.

Special tool
Valve spring replacer: 5-8840-2818-0 (1)
Pivot assembly: 5-8840-2819-0 (2)

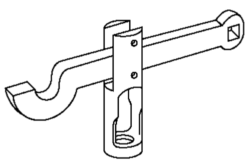
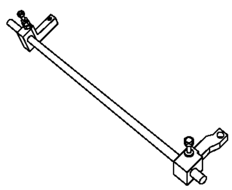
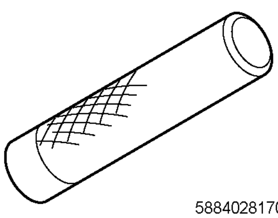


RTW56ASH012301

Note:
Move it up and down to check if it moves smoothly.

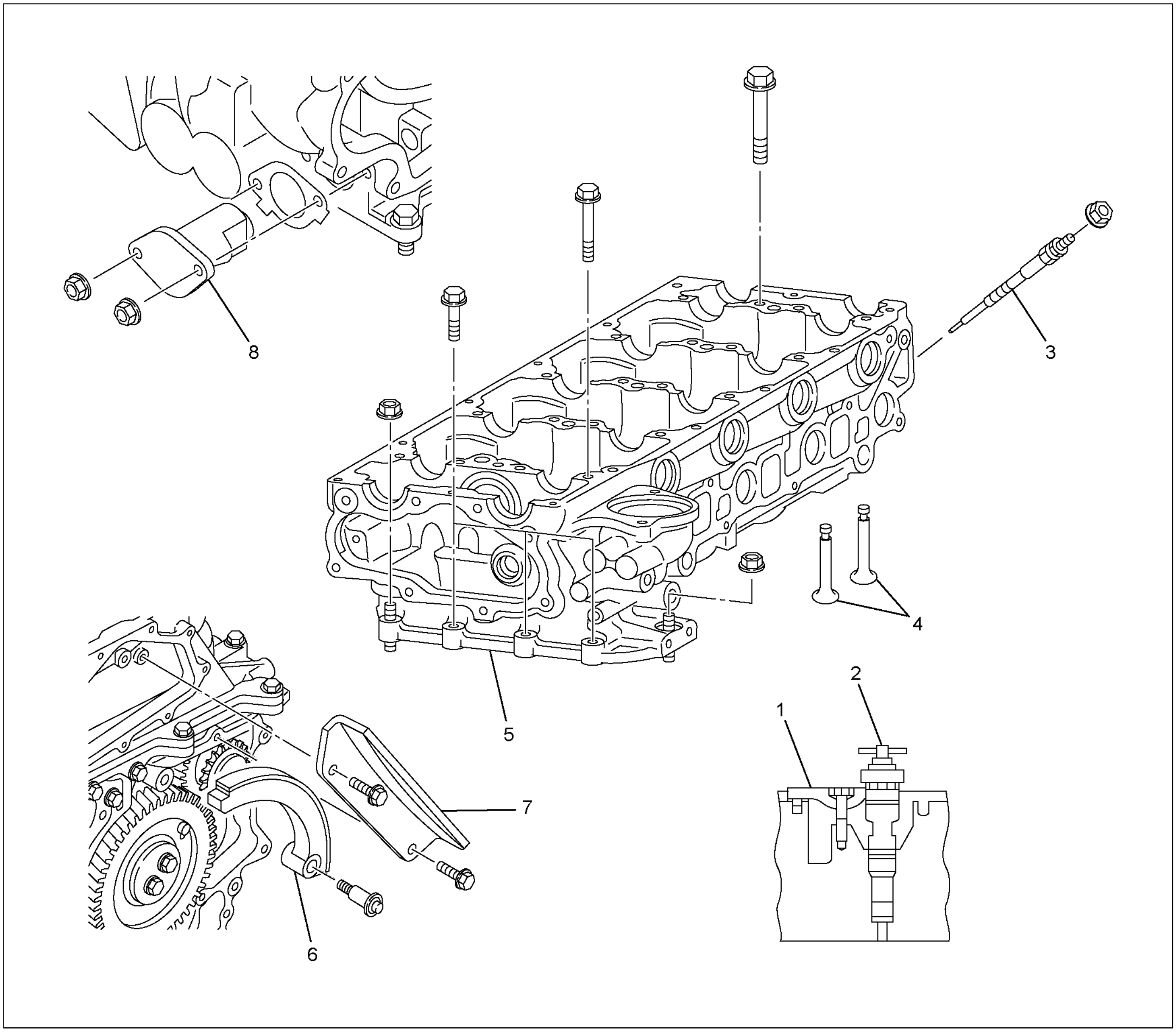
6. Install the cylinder head.
   Refer to “Cylinder Head”.

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884028180	**5-8840-2818-0** Valve spring replacer
 5884028190	**5-8840-2819-0** Pivot assembly
 5884028170	**5-8840-2817-0** Valve stem seal installer

Cylinder Head

Components



RTW56ALF001001

Legend

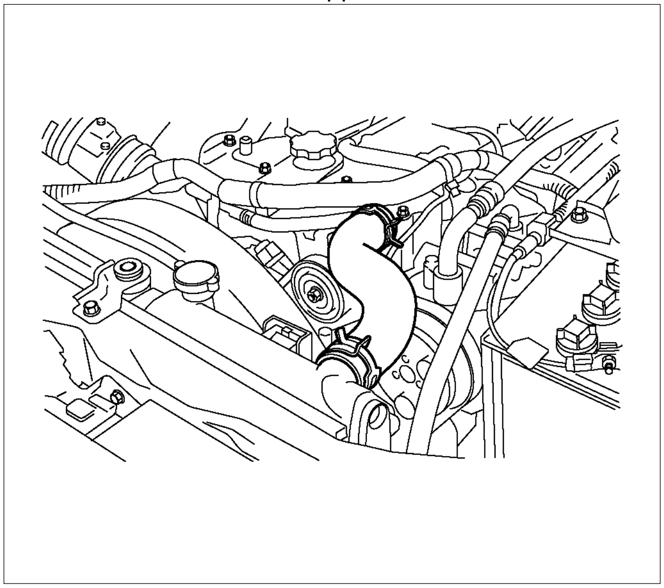
1. Fuel Injector Clamp
2. Fuel Injector Assembly
3. Glow Plug
4. Intake and Exhaust Valves
5. Cylinder Head
6. Timing Chain Tension Lever
7. Timing Chain Guide
8. Timing Chain Tensioner

Note:
To avoid electric shock;
Set the switch to the 'OFF' position and disconnect the negative battery cable before checking or repairing the fuel injector, wiring or/and connectors.

Removal

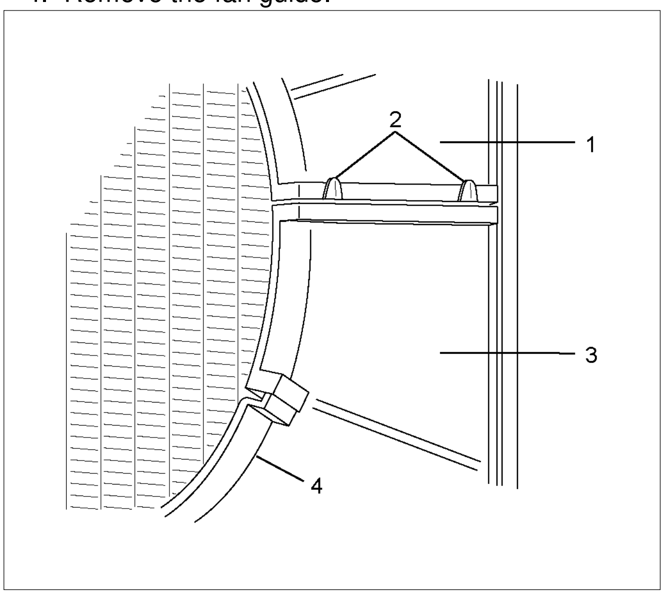
1. Remove the engine head cover.
2. Drain the engine coolant.

3. Remove the radiator upper hose.



RTW56FSH000101

4. Remove the fan guide.

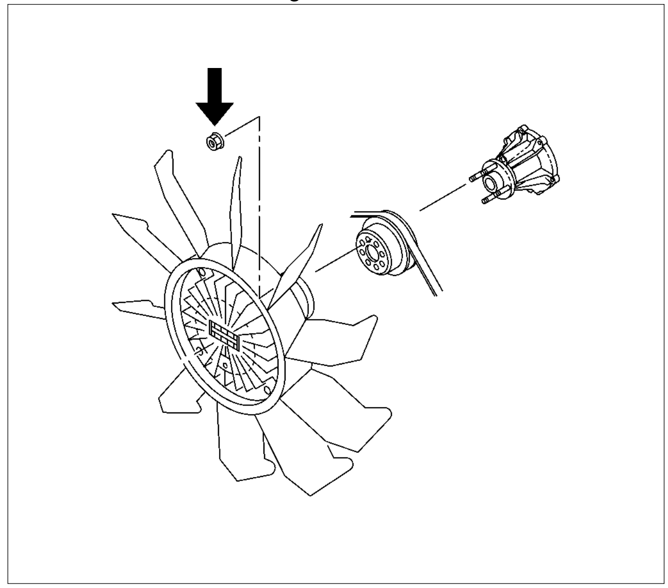


RTW46BSH000101

Legend

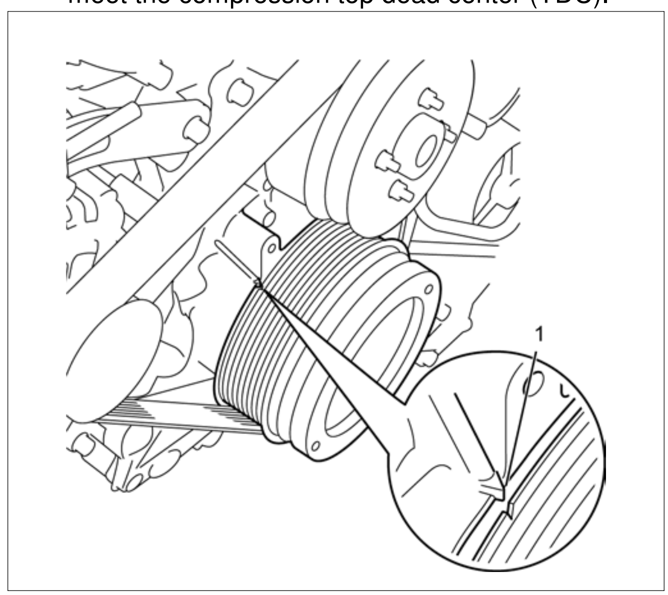
1. Fan Guide
2. Clips
3. Lower Fan guide
4. Fan Shroud

5. Remove the cooling Fan.



RTW56ASH025401

6. Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).



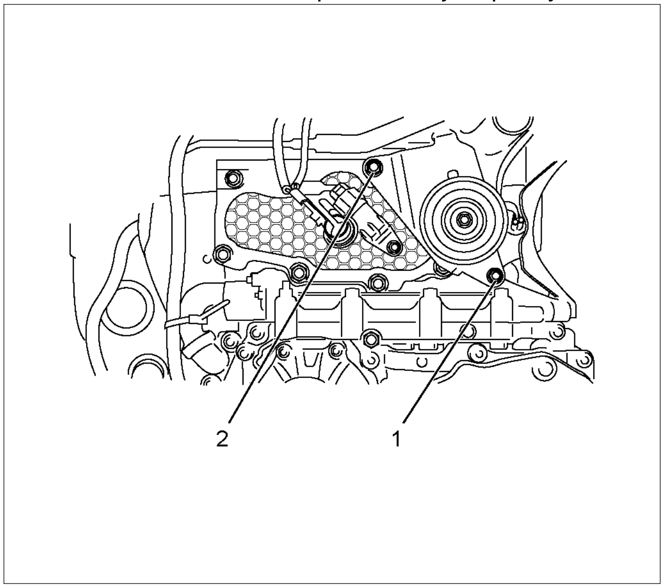
RTW76ASH001301

Legend

1. TDC

7. Remove the A/C compressor drive belt.

8. Remove the A/C compressor adjust pulley.

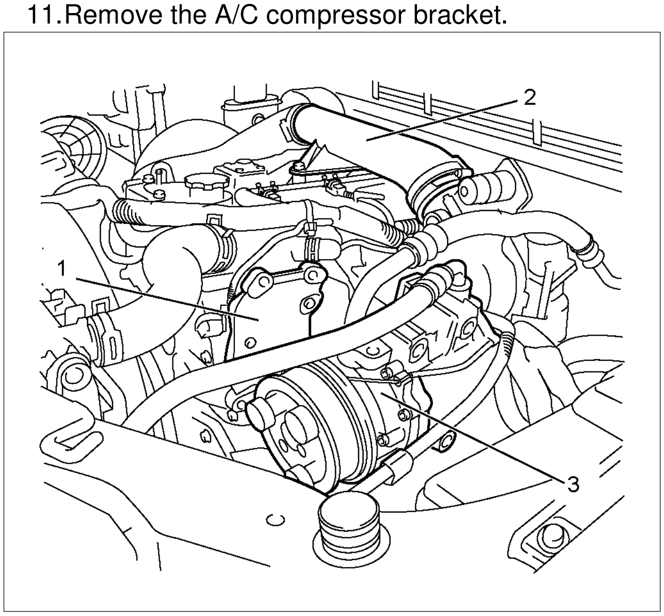


RTW56ASH010601

Legend

1. Bolt
2. Nut

9. Remove the battery.
10. Disconnect the A/C compressor connector and A/C compressor with hose.
11. Remove the A/C compressor bracket.

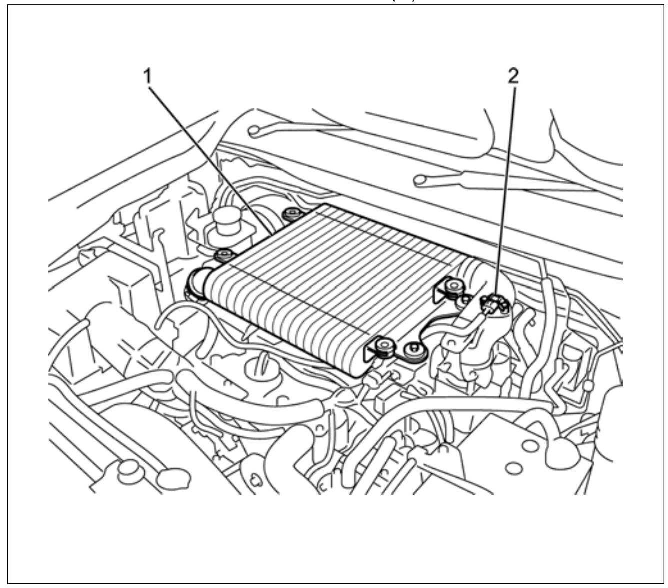


RTW56ASH024201

Legend

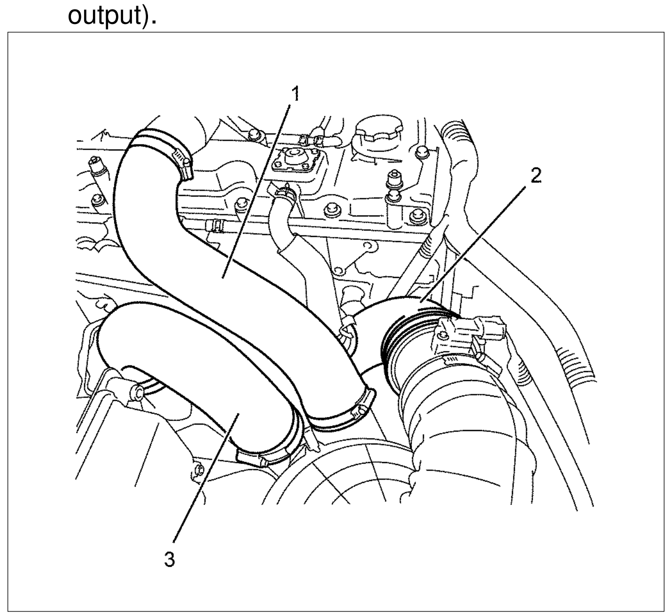
1. A/C Compressor Bracket
2. Intake Duct
3. A/C Compressor

12. Remove the intercooler (High output).
    - Disconnect the BARO sensor harness connector (2).
    - Remove the two intake hoses.
    - Remove the intercooler (1).



RTW76ASH000501

13. Remove the intake hose and duct (Standard output).

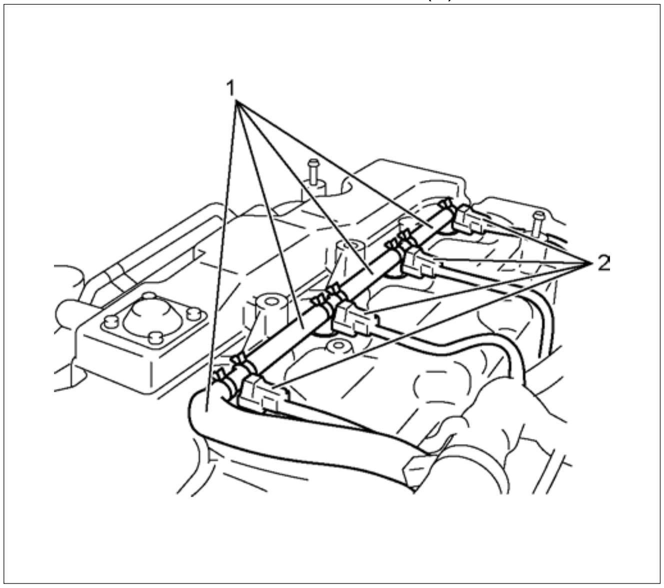


RTW56ASH022501

Legend

1. Intake Hose for Intercooler and Intake Throttle
2. Intake Duct for Turbocharger and Air Cleaner
3. Intake Hose for Turbocharger and Intercooler

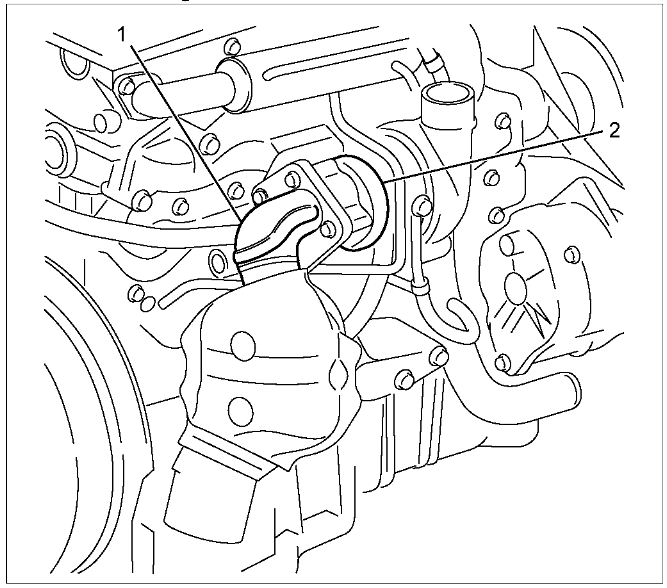
14. Disconnect the fuel injector connector (2).
15. Remove the fuel leak off hose (1).



RTW76ASH000101

Note:
Do not reuse the fuel leak off hose clips.

16. Disconnect each connector.
    - Glow Plug
    - EGR Valve
    - Throttle Assembly
    - Barometric Sensor
    - Water temperature sensor
    - Camshaft Position sensor
17. Remove the harness bracket.
18. Remove the cylinder head cover.
    Refer to "Cylinder Head Cover".
19. Remove the EGR cooler heat protector.
20. Remove the EGR cooler water pipe.
21. Remove the EGR cooler.
22. Loosen the nuts of catalyst converter and turbocharger.

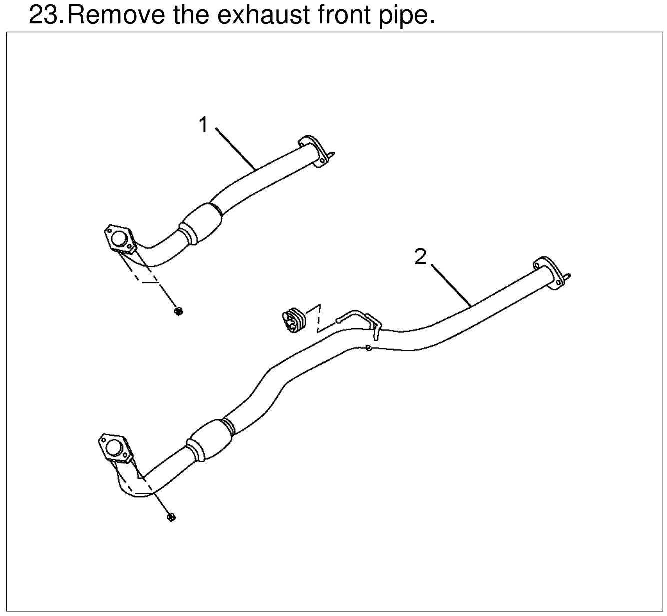


RTW56ASH006201

Legend

1. Catalyst Converter
2. Turbocharger

23. Remove the exhaust front pipe.

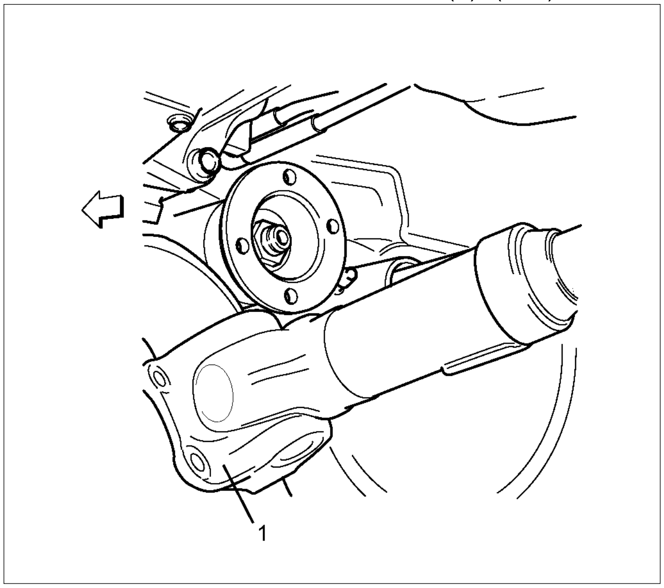


RTW56ASH007701

Legend

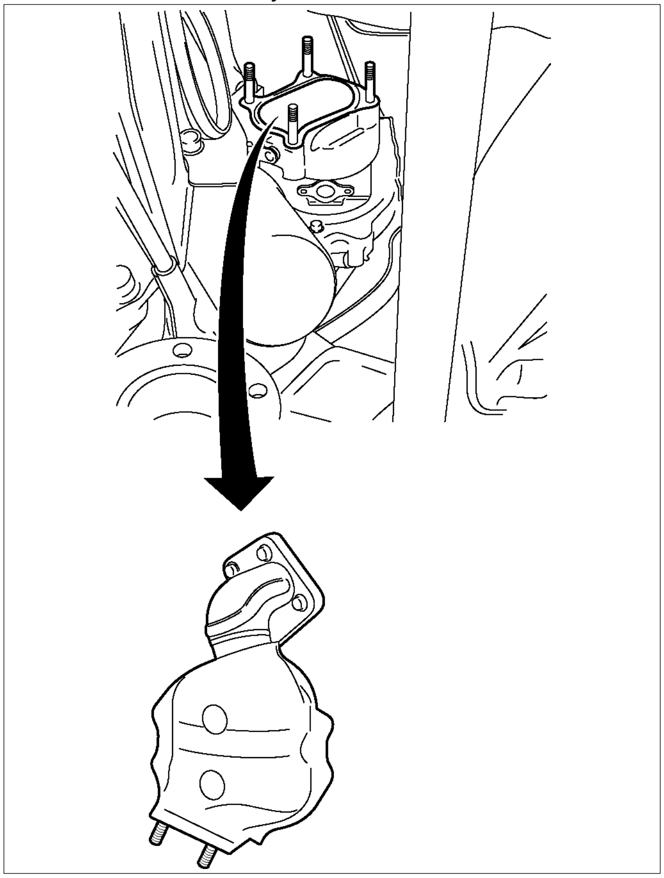
1. Exhaust Front Pipe (4×2 High Ride Suspension, 4×4)
2. Exhaust Front Pipe (4×2 Except High Ride Suspension)

24. Disconnect the Front drive shaft (1). (4×4)



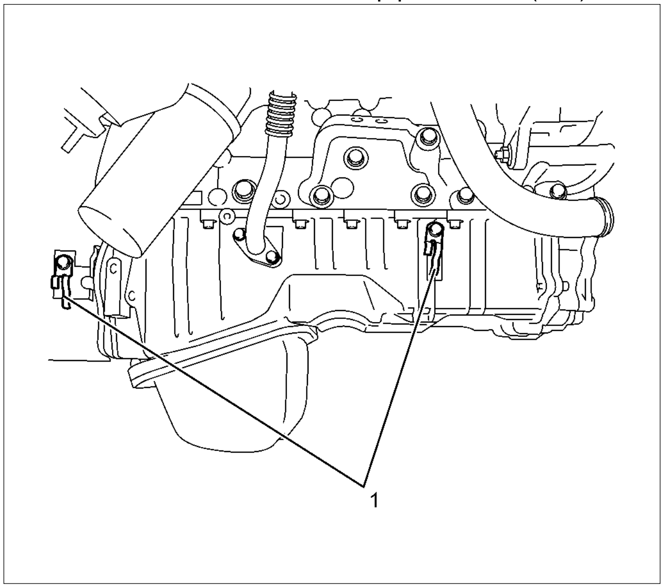
RTW76ASH002301

25. Remove the catalyst converter.



RTW56ALH000201

26. Remove the A/T oil cooler pipe bracket (A/T).

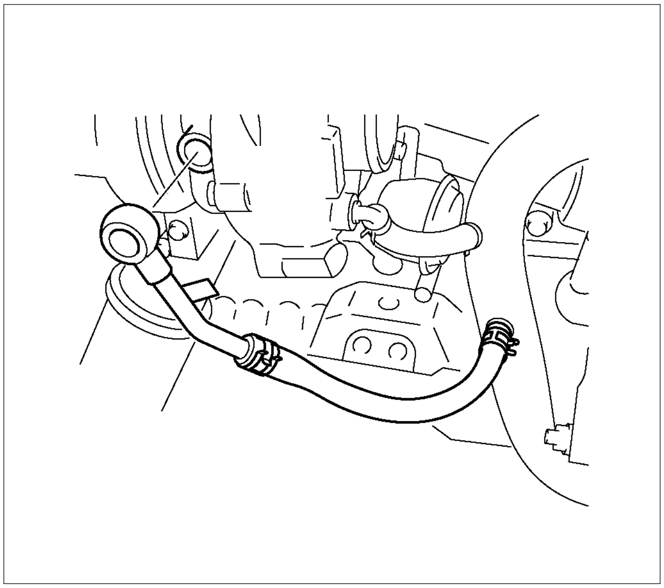


RTW56ASH025101

Legend

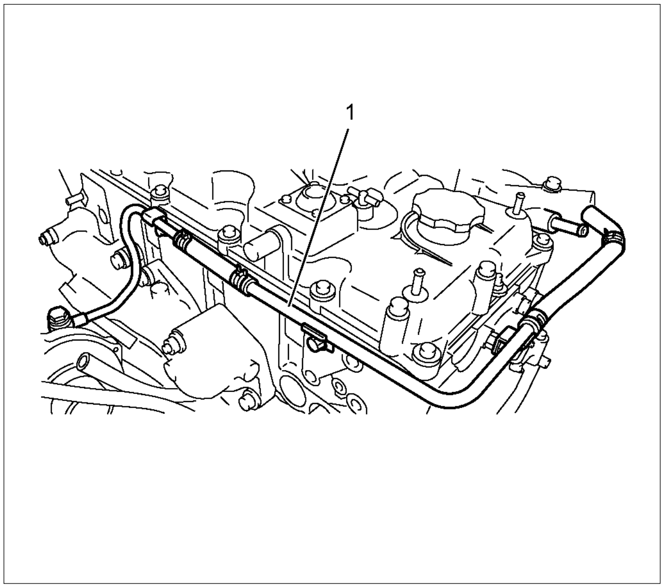
1. A/T Oil Cooler Pipe Bracket

27. Remove the turbocharger water return pipe and hose.



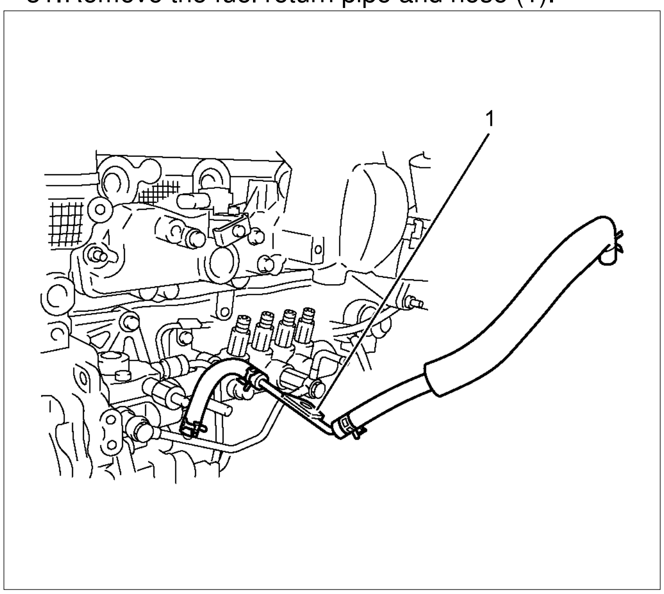
RTW56ASH019001

28. Remove the turbocharger water feed pipe (1) and hose.



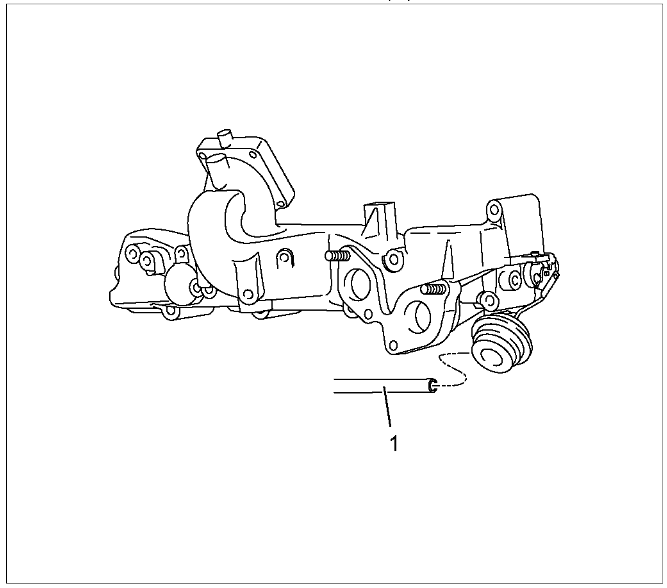
RTW56ASH019101

29. Remove the turbocharger engine oil feed pipe.
30. Remove the engine oil level gauge guide tube.
31. Remove the fuel return pipe and hose (1).



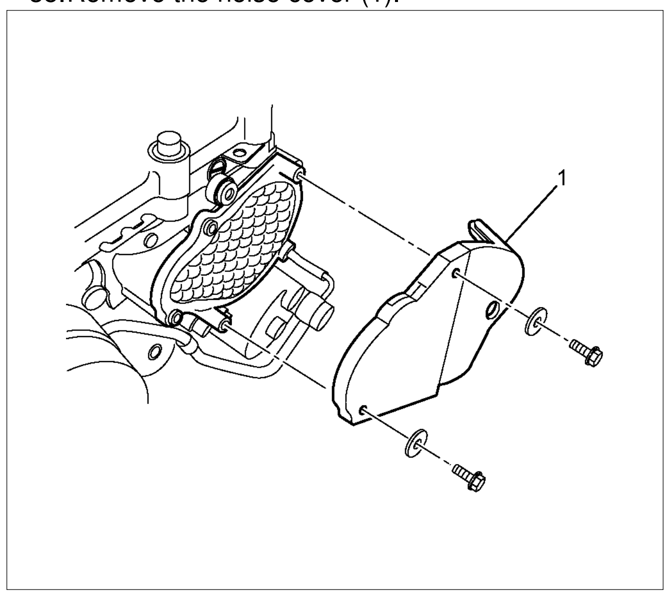
RTW56ASH019201

32. Remove the fuel injection pipe clip.
33. Remove the fuel injection pipe.
34. Remove the vacuum hose (1).



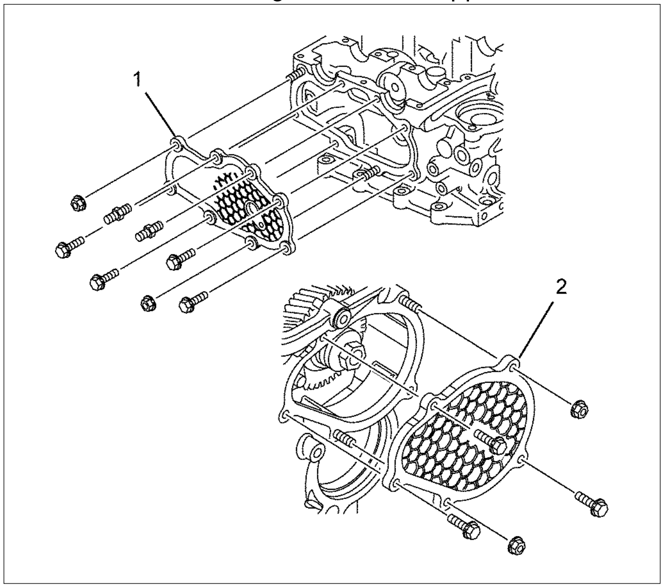
RTW66ASH003101

35. Remove the noise cover (1).



RTW56CSH001401

36. Remove the timing chain cover lower.
37. Remove the timing chain cover upper.

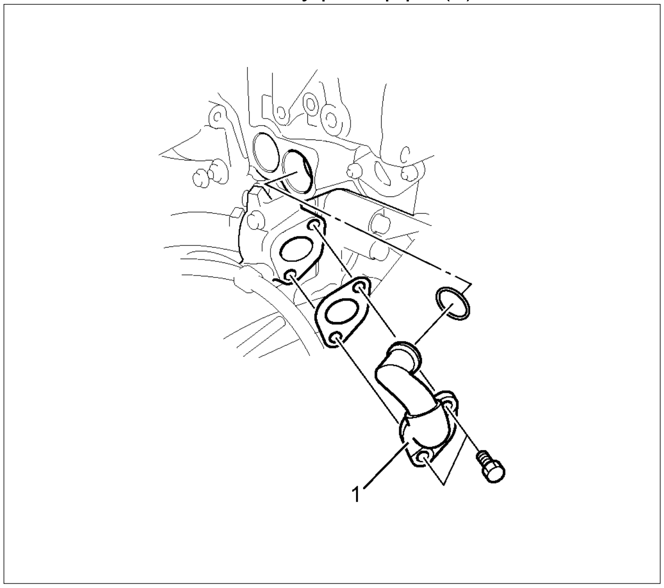


RTW56CSH001501

Legend

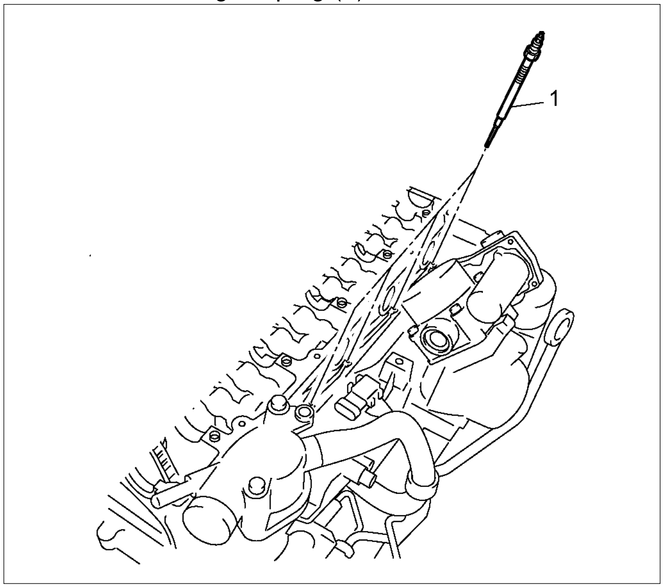
1. Timing Chain Cover Upper
2. Timing Chain Cover Lower

38. Remove the water by pass pipe (1).



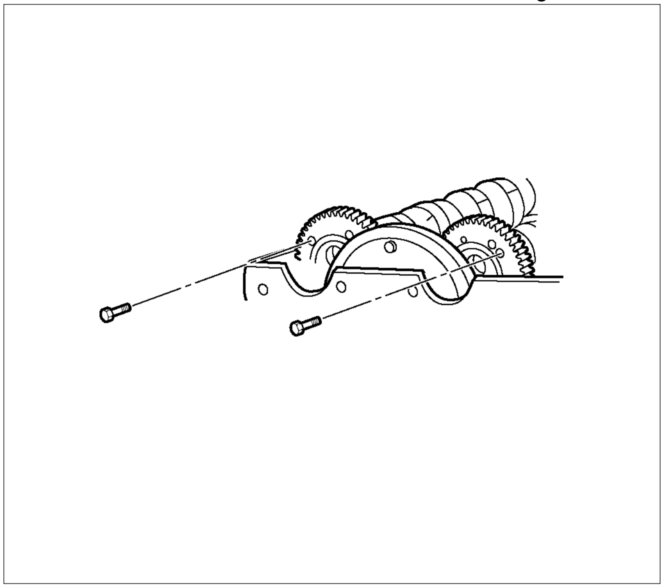
RTW56ASH008401

39. Remove the glow plug (1).



RTW56ASH019301

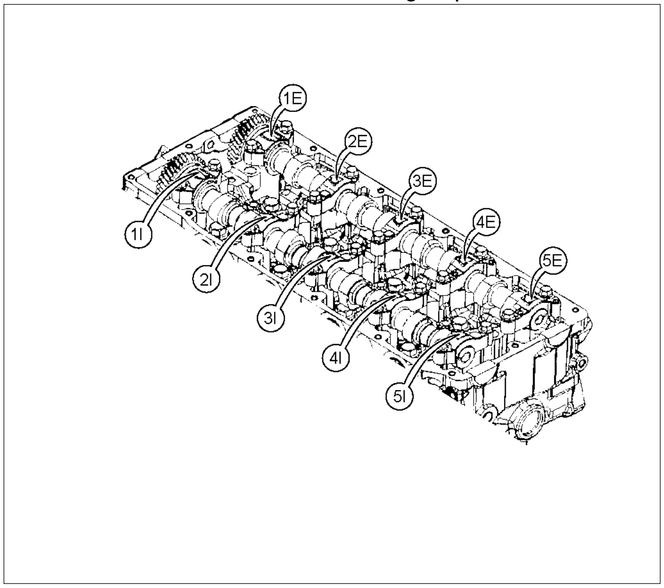
40. Remove the cylinder head cover.
Refer to “Cylinder Head Cover”.
41. Install the lock bolt for camshaft scissor gear.



RTW56ASH007101

42. Remove the fuel injector assembly.
43. Remove the baffle plate.

44. Remove the camshaft bearing cap.

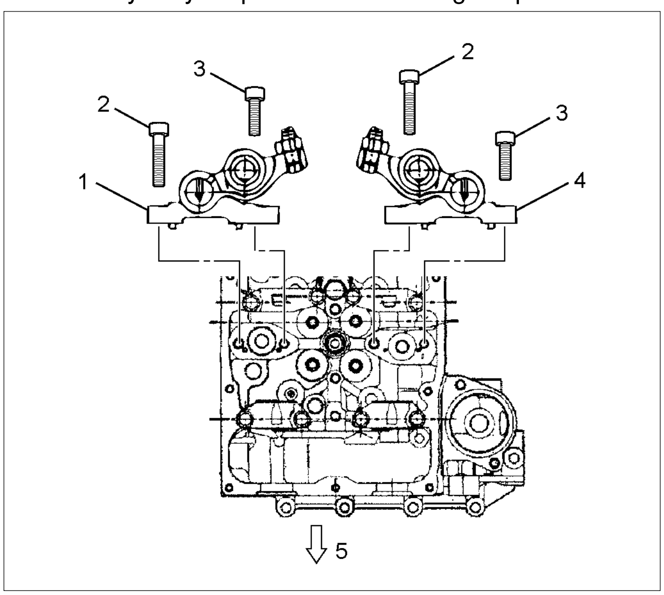


RTW56ASH018401

45. Remove the camshaft.

46. Remove the rocker arm shaft assembly.

Note:
Keep the removed rocker arm shaft assembly properly so that they may be put back to the original place.



RTW56ASH012201

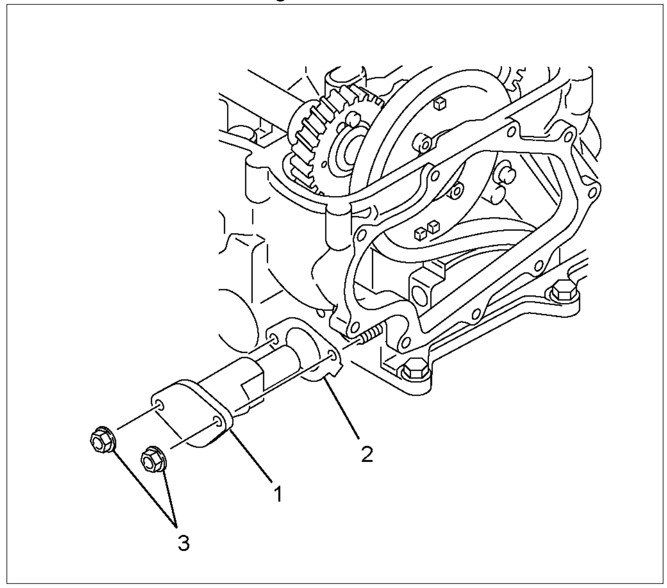
Legend

1. Exhaust Rocker Arm Shaft Assembly
2. Bolt (Long)
3. Bolt (Short)
4. Intake Rocker Arm Shaft Assembly
5. Front

Note:
Pay full attention so as not to drop the parts in the gear case of the front part of the cylinder head or a hole into which oil pours back in the front.

Note:
Remember the original position.

47. Remove the timing chain tensioner.



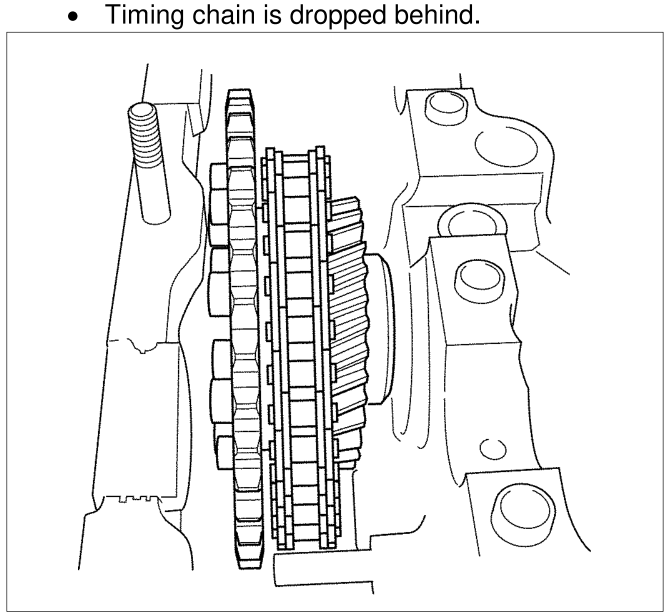
RTW56CSH003701

Legend

1. Timing Chain Tensioner
2. Gasket
3. Nut

48. Remove the idle gear D.

- Timing chain is dropped behind.

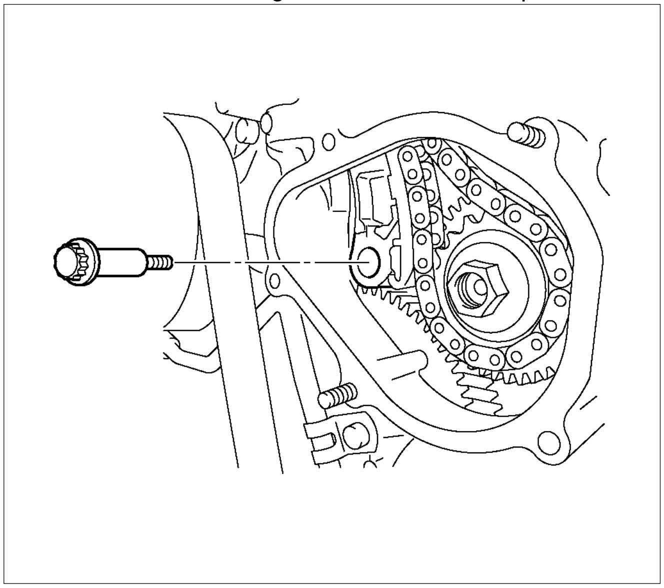


RTW56ASH022101

MAGNETIC CLUTCH DOES NOT RUN (4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output LHD MODEL)

- Are the No. SBF-6 fuse (30A) and the No. EB-13 (10A) fuses OK?
  - NO → Replace
  - YES ↓
- Are the A/C thermo (X-15), heater & A/C (X-11) and A/C compressor (X-14) relay OK?
  - NO → Replace
  - YES ↓
- Is the pressure switch (C-24) OK?
  - NO → Replace
  - YES ↓
- Is the electronic thermostat (C-55) OK?
  - NO → Defective switch or insufficient refrigerant
  - YES ↓
- Are the A/C switch (B-57) and the fan switch (B-13) OK?
  - NO → Replace
  - YES ↓
- Are the A/C switch (B-57) and the fan switch (B-13) OK?
  - NO → Replace
  - YES ↓
- Turn the ignition switch "ON" (Engine is running)
- A/C switch and fan control knob (fan switch) "ON"
- Disconnect the magnetic clutch connector.
- Is there battery voltage between the engine room harness connector terminal No.1 (E-3) and ground?
  - YES → Does the magnetic clutch operate?
    - YES → Defective compressor
    - NO → Defective magnetic clutch
  - NO ↓
- Disconnect the A/C compressor relay.
- Is there continuity between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14)?

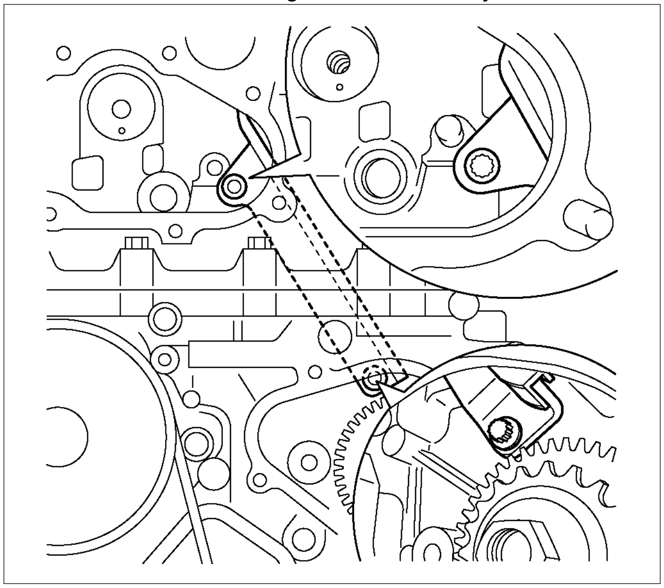
49. Remove the timing chain tension lever pivot.



RTW56ASH019401

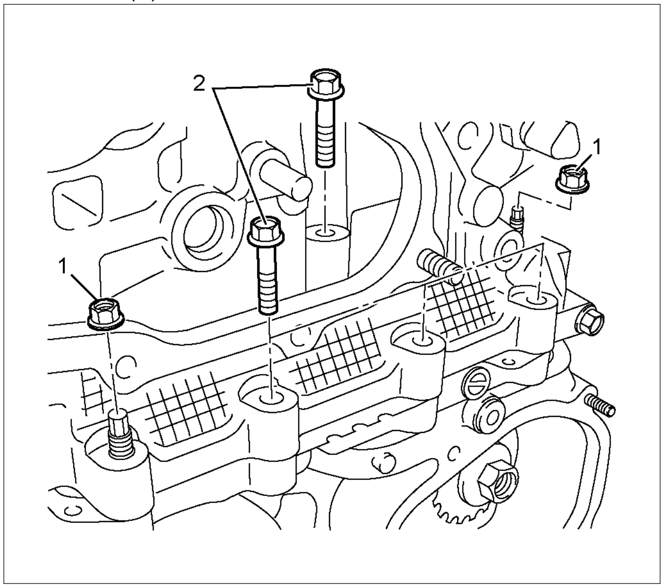
50. Remove the timing chain from supply pump sprocket.

51. Remove the chain guide bolt from cylinder head.



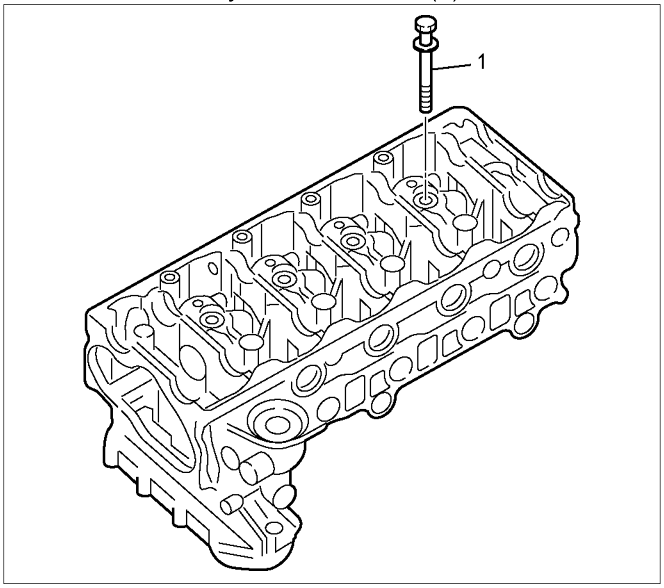
RTW56ASH019501

52. Remove the cylinder head gear case nuts (1) and bolts (2).



RTW56ASH020801

53. Remove the cylinder head bolt (1).

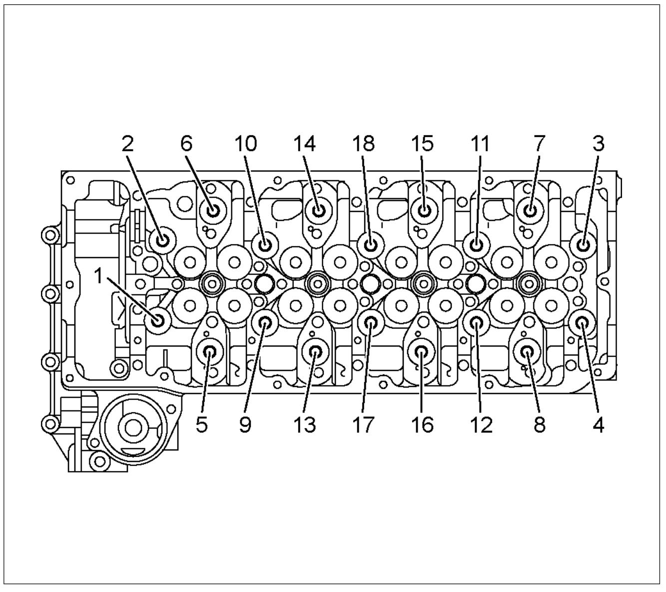


RTW56ASH008501

Note:
Do not reuse the cylinder head bolt.

54. Remove the cylinder head assembly.
- Loosen the cylinder head bolts in the order described in the drawing.
- Remove the cylinder head gasket.

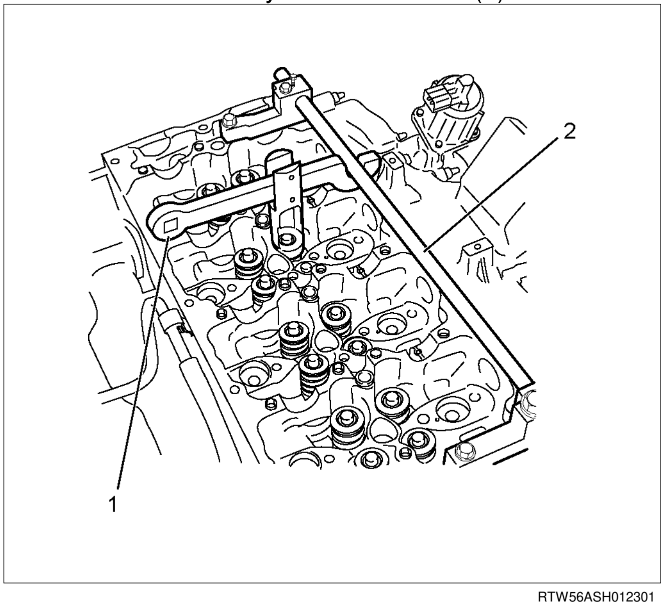
Note:
Replace the head gasket with a new one once it is removed.



RTW56ASH008601

Disassembly

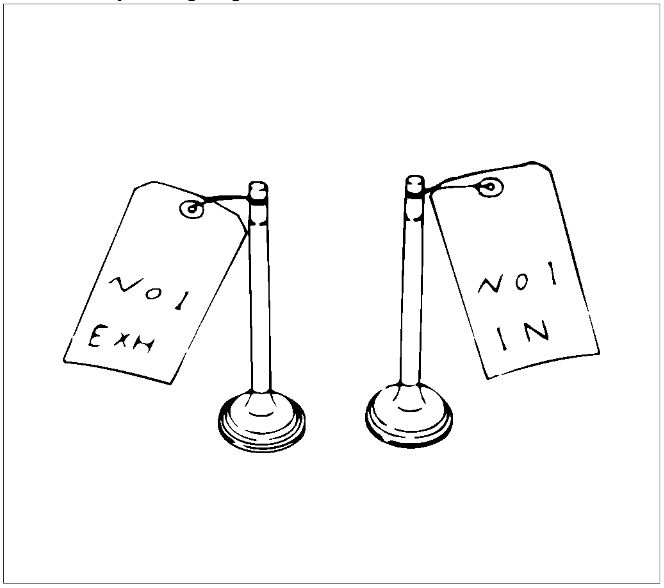
1. Remove the throttle assembly.
   - Refer to procedure for Intake Manifold in this manual.
2. Remove the intake manifold assembly.
   - Refer to procedure for Intake Manifold in this manual.
3. Remove the turbocharger.
   - Refer to “Turbocharger and Exhaust Manifold”.
4. Remove the exhaust manifold assembly.
   - Refer to procedure for Turbocharger and Exhaust Manifold in this manual.
5. Remove the water outlet pipe.
6. Remove the valve stem cap.
   Refer to procedure for valve stem and valve in this manual.
7. Remove the split collar.
   - Use a replacer to compress the valve spring to remove the split collar.
     Special tool
     Valve spring replacer: 5-8840-2818-0 (1)
     Pivot assembly: 5-8840-2819-0 (2)



RTW56ASH012301

8. Remove the spring upper seat.
   - Remove the special tool to remove the upper seat.
9. Remove the valve spring.
   - Put the removed valve springs in order by cylinder number.

10. Remove the intake and exhaust valve.
    - Sort the removed valves according to cylinders by using tags others.



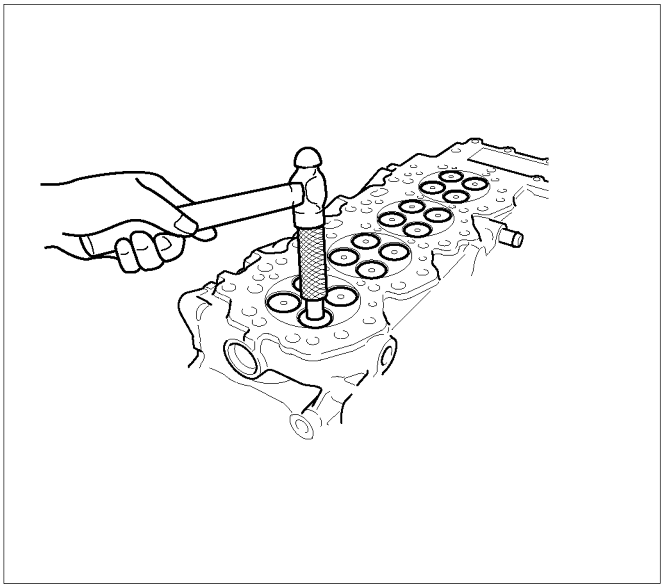
LNW21BSH016801

11. Remove the valve stem oil seal.
    - Refer to procedure for valve stem and valve in this manual.
12. Remove the spring lower seat.
13. Remove the valve guide.
    - Use the valve guide replacer to press out the valve guides from the bottom side of the cylinder head.

      Special tool

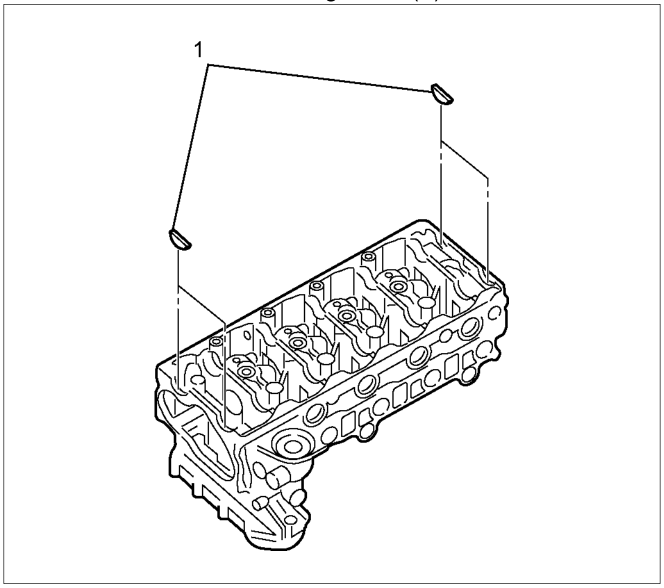
      Valve guide remover and installer:

      5-8840-2816-0



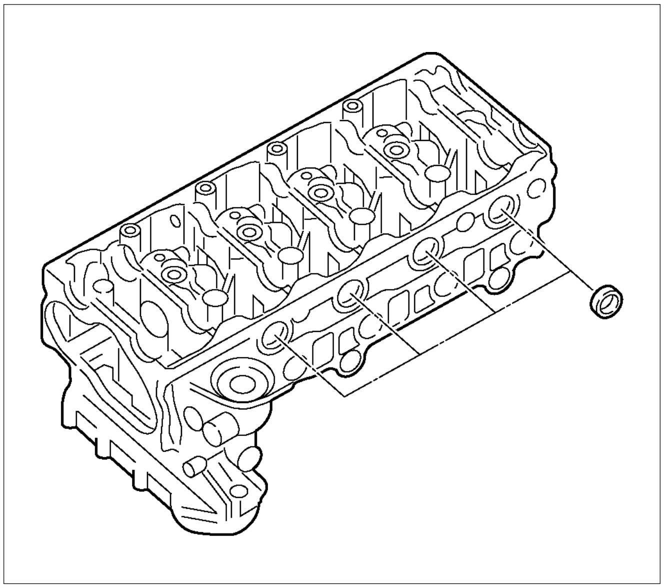
RTW56ASH008701

14. Remove the cam end gasket (1).



RTW56ASH020501

15. Remove the oil seal.



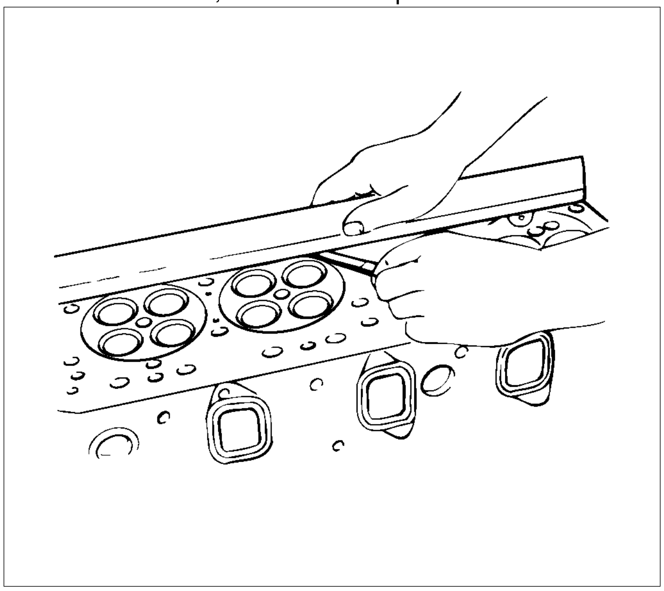
RTW56ASH008801

Inspection

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Cylinder Head Lower Face Warpage

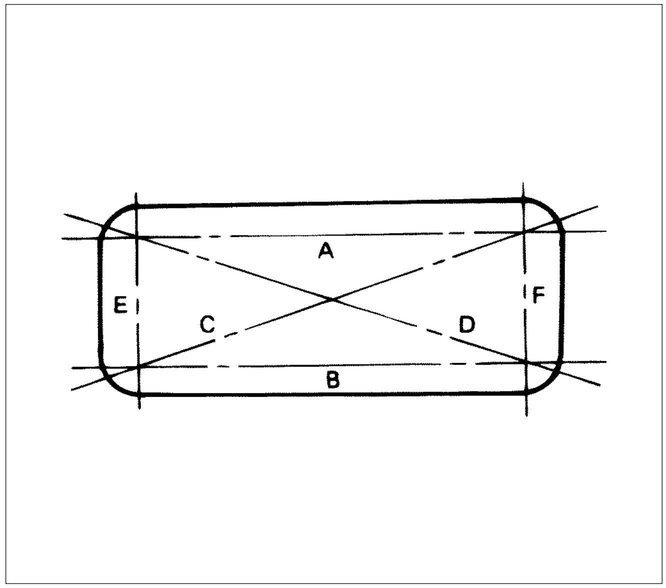
1. Use a straight edge and a thickness gauge to measure the four sides and the two diagonals of the cylinder head lower face.
2. The cylinder head lower surface warpage is more than the limit, it should be replaced.



RTW56ASH008901

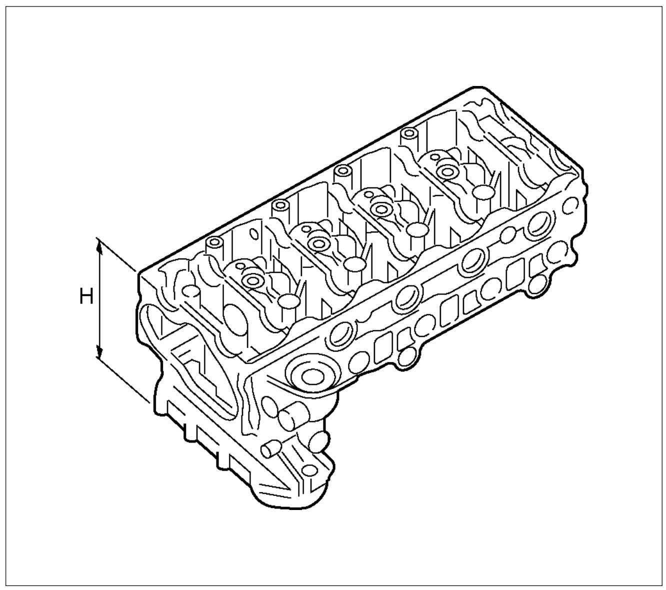
Cylinder Head Lower Face Warpage	mm (in)
Standard	0.05 (0.002) or less
Limit	0.20 (0.0079)

NOTE:
The cylinder head lower face cannot be regrind.



011RY00013

Cylinder Head Height (H) (Reference)	mm (in)
Standard	143.4 (5.646)



RTW56ASH017401

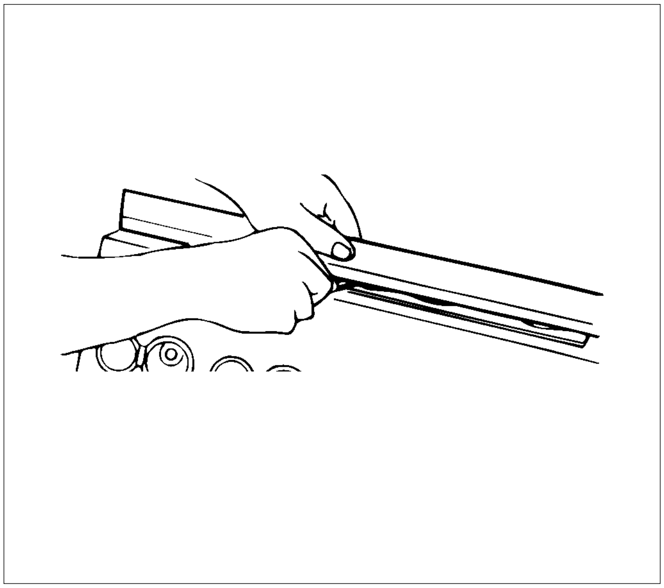
Manifold Fitting Face Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

Regrind the manifold cylinder head fitting surfaces if the measured values are greater than the specified limit but less than the maximum grinding allowance.

If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Manifold Fitting Face Warpage	mm (in)
Standard	0.05 (0.002) or less
Limit	0.20 (0.008)
Maximum Grinding Allowance	0.40 (0.016)



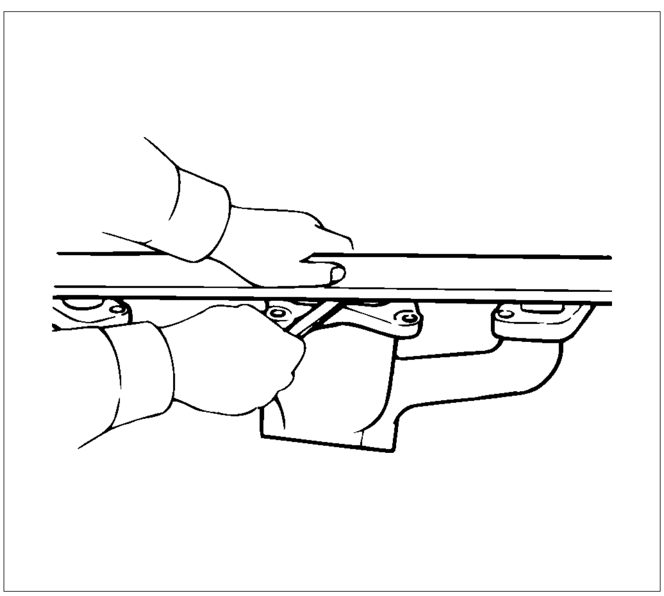
RTW56ASH017501

Exhaust Manifold Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.

If the measured values exceed the specified limit, the manifold must be replaced.

Exhasut Manifold Warpage	mm (in)
Standard	0.05 (0.002) or less
Limit	0.20 (0.008)



027RY00002

Valve Stem Cap

Make the necessary part replacements.

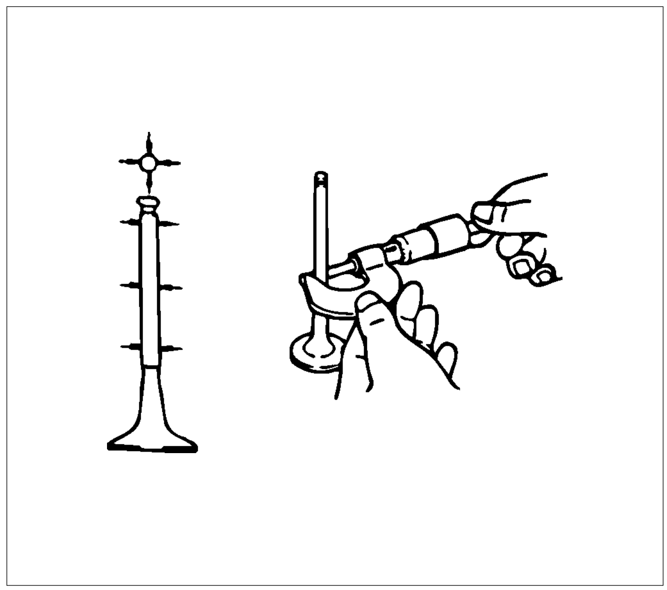
If excessive wear or damage is discovered during inspection.

Valve Stem Outside Diameter

Measure the valve stem diameter at three points.

If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter		mm (in)
	Intake Valve	Exhaust Valve
Standard	6.955 – 6.970 (0.2738 – 0.2744)	6.939 – 6.949 (0.2732 – 0.2736)
Limit	6.935 (0.2730)	6.920 (0.2724)

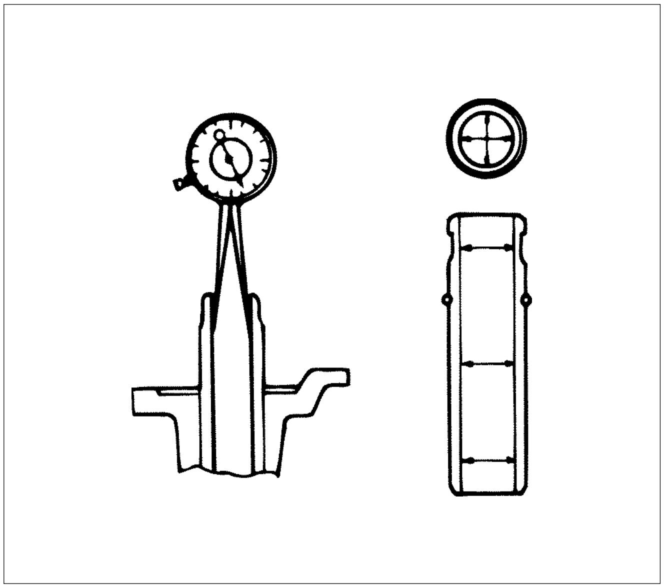


011LX027

Valve Stem and Valve Guide Clearance

1. Measure the valve stem outside diameter.
   Refer to the item "Valve Stem Outside Diameter".
2. Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.
   If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Clearance		mm (in)
	Intake Valve	Exhaust Valve
Standard	0.039 – 0.071 (0.0015 – 0.0028)	0.064 – 0.096 (0.0025 – 0.0038)
Limit	0.200 (0.008)	0.250 (0.0098)

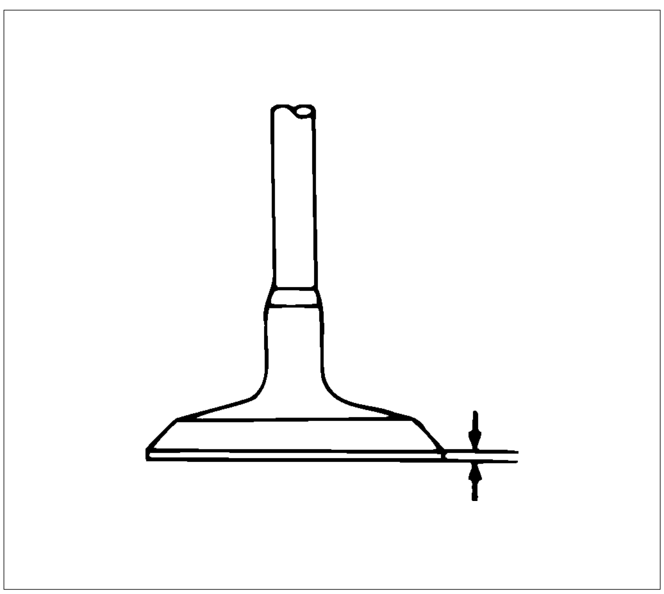


011RY00023

Valve Thickness

Measure the valve thickness.
If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Intake and Exhasut Valve Thickness	mm (in)
Standard	1.32 (0.052)
Limit	1.1 (0.043)

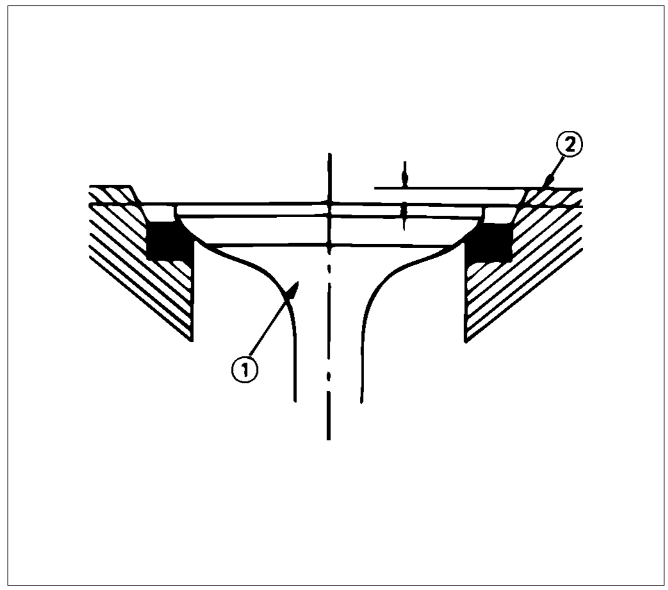


014RY00020

Valve Depression

1. Install the valve (1) to the cylinder head (2).
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Depression	mm (in)
Standard	1.8 (0.07)
Limit	2.5 (0.098)

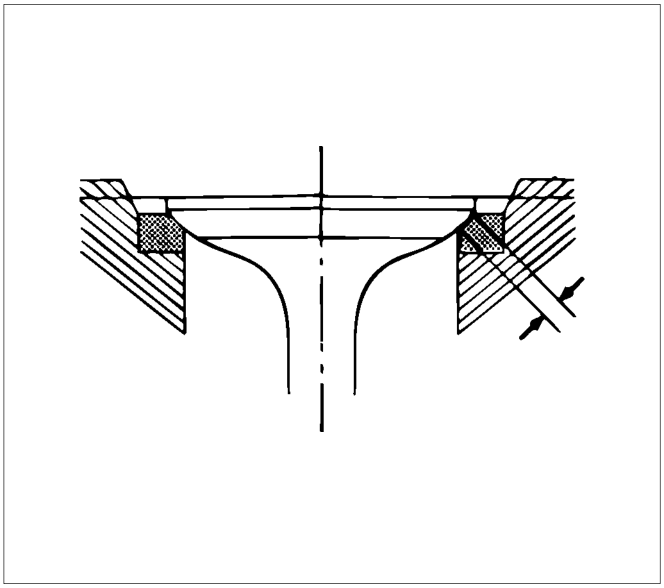


014RY00021

Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

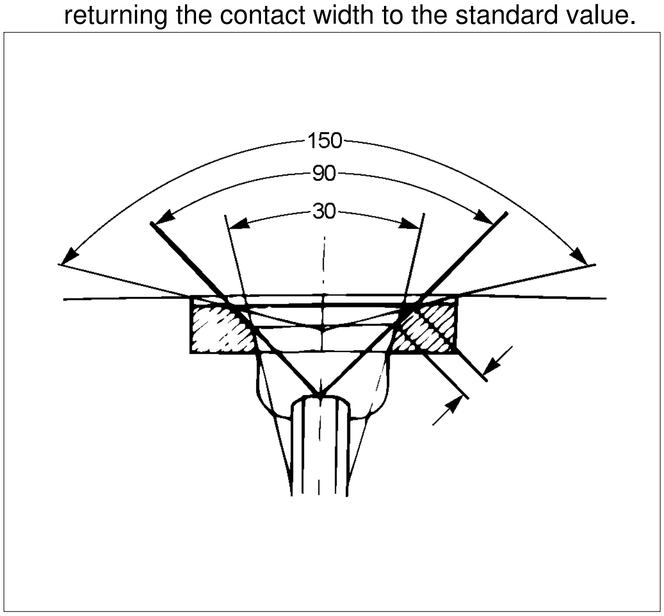
Valve Contact Width		mm (in)
	Intake	Exhaust
Standard	1.7 (0.067)	2.0 (0.079)
Limit	2.2 (0.087)	2.5 (0.098)



014RY00027

Repair of the seat surface

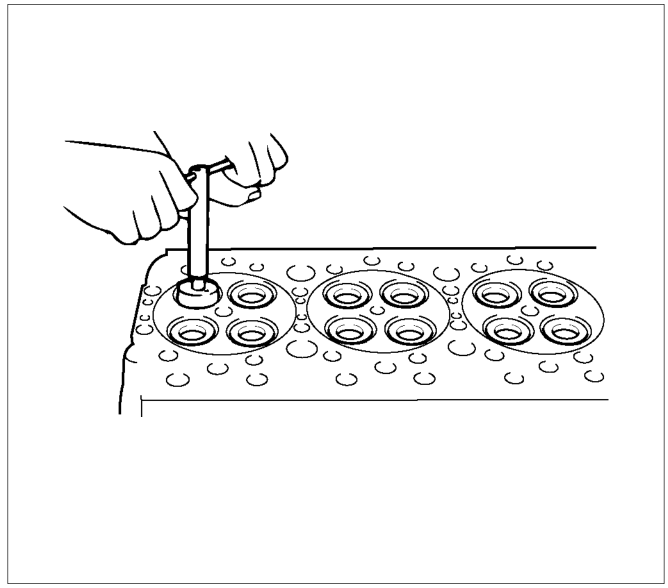
- Remove carbon from the surface of the valve insert seat.
- Use a seat cutter to minimize the scratch and other roughness (15/45/75 degree-blade), thereby returning the contact width to the standard value.



LNW21BSH018201

Note:
Remove only scratches and roughness, and do not cut the surface too much.
Use the free adjustment valve cutter pilot.
Do not let the valve cutter pilot waver inside the valve guide.

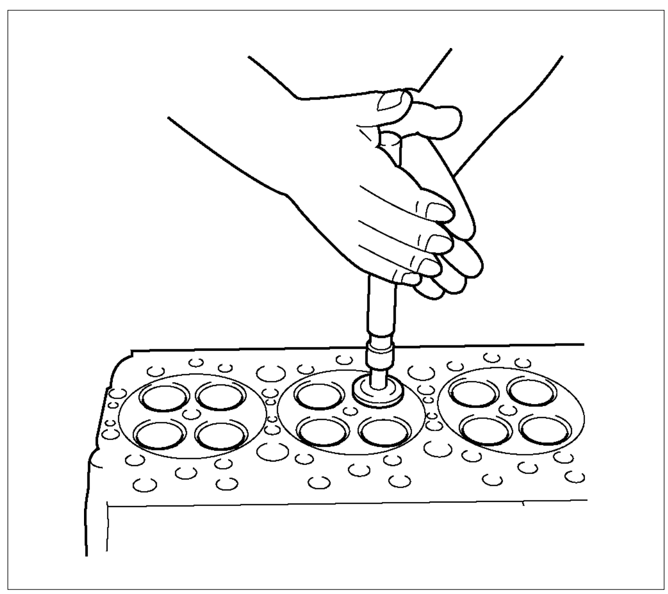
Valve Seat Angle	Degree
45	



LNW21BSH056101

- Attach compound in the valve insert seat.
- Insert the valve into the valve guide.
- Attach compound on the valve seat surface, rotate the valve and hit it lightly to grind it, and confirm that it has even contact all round.

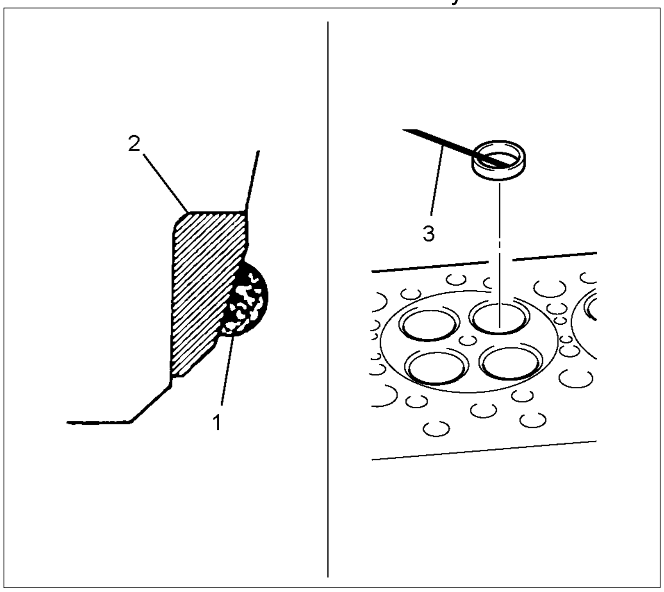
Note:
Remove compound completely after grinding.



LNW21BSH031801

Remove the valve seat insert

- Arc-weld the entire inner diameter of the valve seat insert.
- Cool the valve seat insert for two to three minutes. Contraction due to cooling makes it easier to remove the valve seat insert.
- Remove the valve seat insert, using a screw driver . Be sure not to harm the cylinder head.



LNW21BSH056001

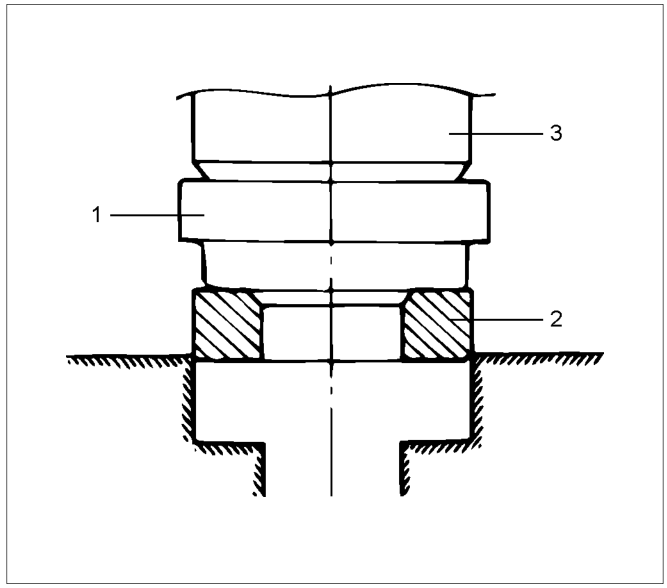
Legend

1. Arc-Weld
2. Valve Seat Insert
3. Screw Driver

Install the valve seat insert

- Carefully place a washer (the outer diameter is smaller than the valve seat insert) on the valve seat insert.
- Use the press to apply pressure gradually on the washer, thereby pushing the valve seat insert.

Note:
Do not apply too much pressure with the press. Attach compound on the valve seat surface, rotate the valve and hit it lightly to grind it, and confirm that it has even contact all round.



LNW21BSH018601

Legend

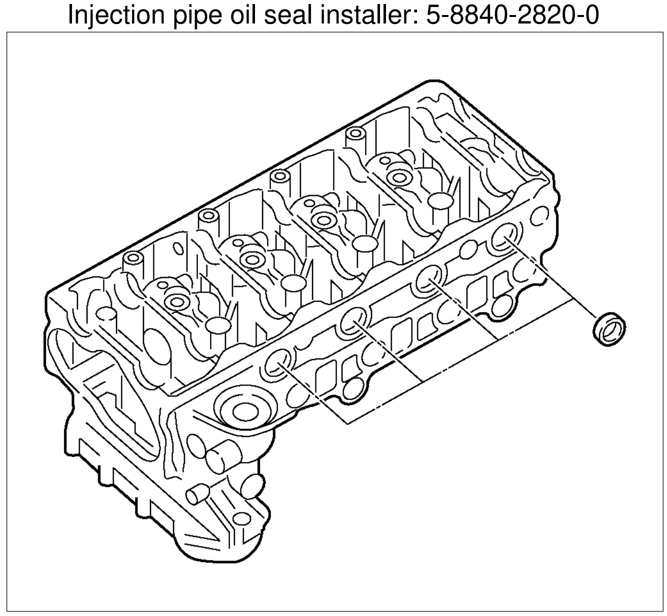
1. Attach Compound
2. Valve Seat
3. Press

Reassembly

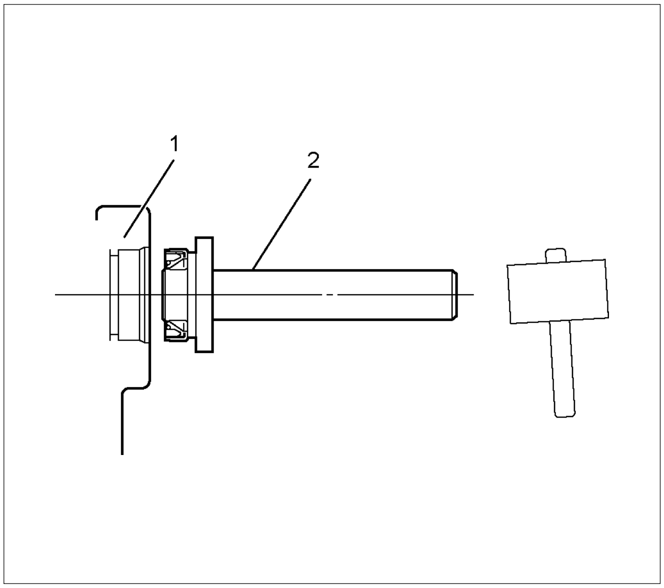
1. Install the oil seal.
   - Install on the surface of the injection pipe insert.
   - Hammer it in so that the seal does not incline.

Note:
Be sure not to harm the lip.

Special tool
Injection pipe oil seal installer: 5-8840-2820-0



RTW56ASH008801



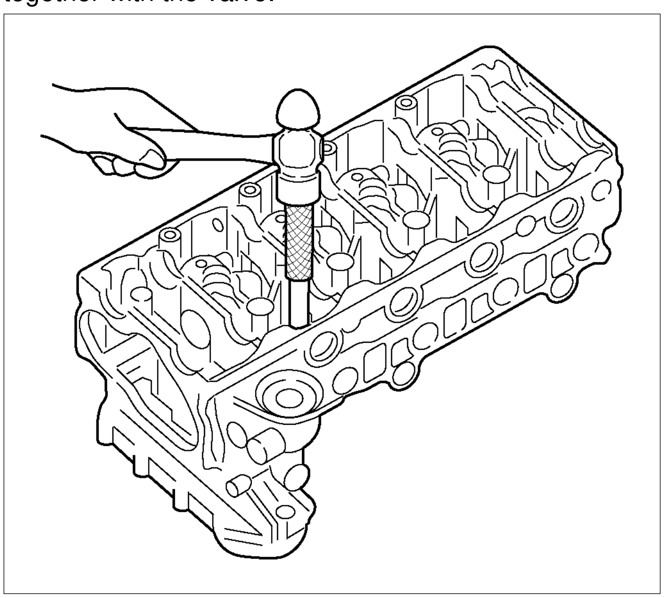
RTW56ASH009101

Legend

1. Cylinder Head
2. Oil Seal Installer

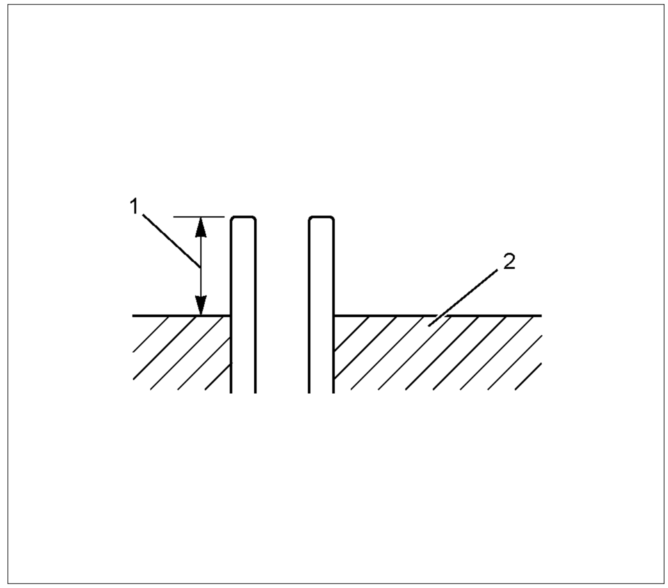
2. Install the valve guide.
   - Hammer in the valve guide from the upper surface of the cylinder head, using the valve guide installer.
     Special tool
     Valve guide remover and installer:
     5-8840-2816-0

Note:
When replacing the valve guide, it must be replaced together with the valve.



RTW56ASH009001

- Height from the upper surface of the cylinder head to the edge surface of the valve guide



RTW56ASH023001

Legend

1. 12.6 ± 0.1 mm (0.50 ± 0.0039 in)
2. Cylinder Head

3. Install the valve spring lower seat.
4. Install the valve stem oil seal.
   - Refer to procedure for valve stem and valve in this manual.
5. Install the intake and exhaust valve.
   - Apply engine oil on the valve stem part and install the valve.
6. Install the valve spring, the valve spring upper seat and the split collar.
   - Refer to procedure for valve stem and valve in this manual.
7. Install the rocker arm and shaft assembly.
   - Refer to procedure for valve stem and valve in this manual.
8. Install the exhaust manifold assembly.
   - Refer to procedure for Turbocharger and Exhaust Manifold in this manual.
9. Install the turbocharger.
   - Refer to procedure for Turbocharger and Exhaust Manifold in this manual.
10. Install the intake manifold assembly.
    - Refer to procedure for Intake Manifold in this manual.
11. Install the throttle assembly.
    - Refer to procedure for Intake Manifold in this manual.

Installation

1. Select the cylinder head gasket.

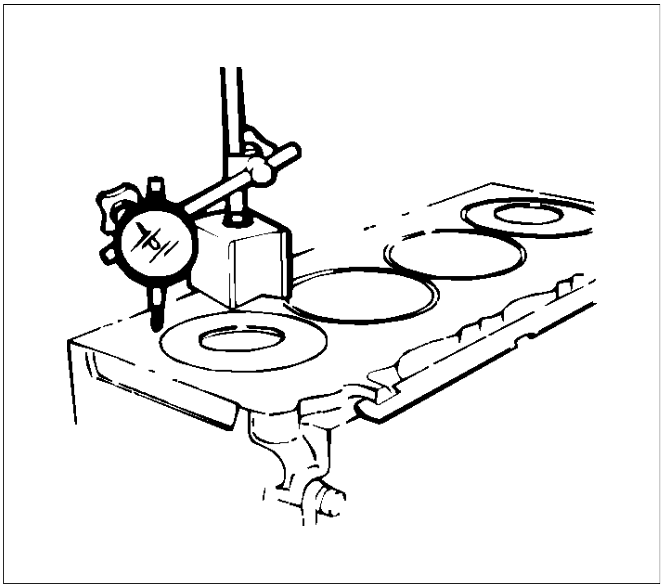
Cylinder Head Gasket Selection

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided with difference of thickness. Select the appropriate one out of three grades of

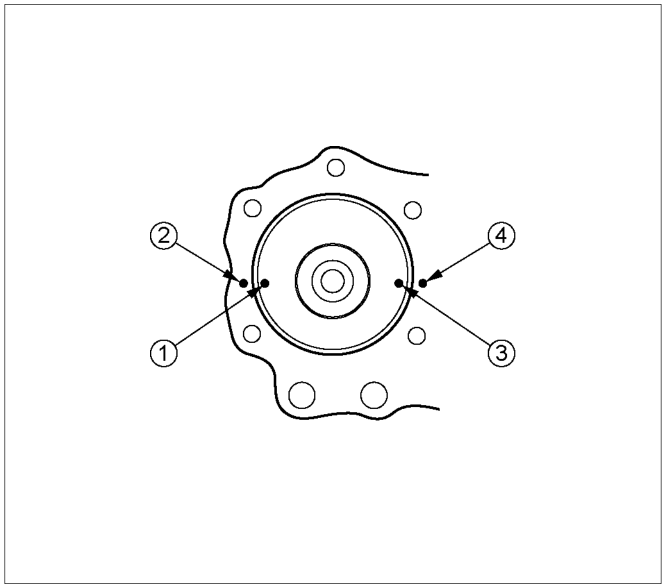
gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where the gasket was installed.



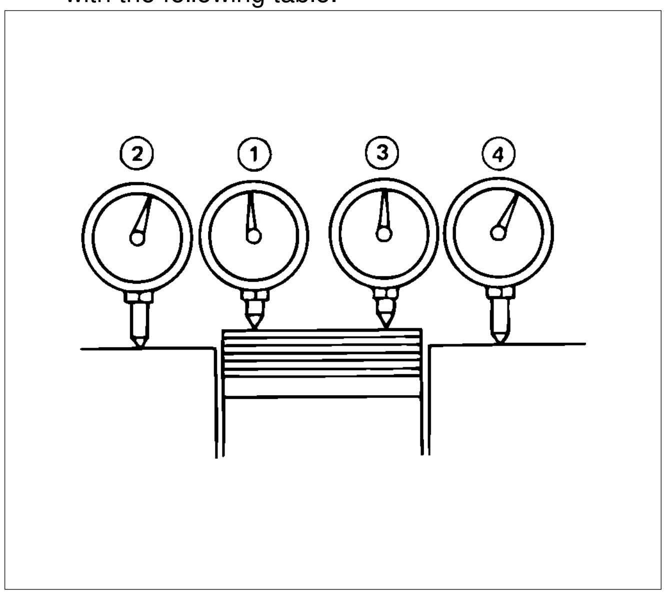
011LX011

1. Use a dial indicator to measure the piston projection amount.
2. Refer to the illustration for the piston head projection measuring positions. All measuring positions should be as close as possible to the cylinder block.



RTW36ASH001701

3. Measure the points 1, 2, 3, 4 and obtain two differences 1-2 and 3-4 on each cylinder. Calculate the average value of the piston head projection on each cylinder.
4. Obtain the maximum value in the four cylinders.
5. Determine the gasket grade required to the maximum value described above in accordance with the following table.



011RY00027

YES

- Is there battery voltage between the engine room harness connector terminal No.1 (X-14) and ground?

NO

Open circuit between the engine harness connector terminal No.1 (E-3) and the engine room harness connector terminal No.2 (X-14).

YES

- Disconnect the A/C thermo relay.
- Is there continuity between the engine room harness connector terminal No.3 (X-14) and the engine room harness connector terminal No.1 (X-15)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No.1 (X-14).

YES

- Disconnect the ECM harness connector.
- Is there continuity between the ECM harness connector terminal No.55 (C-58) and the engine room harness connector terminal No.5 (X-14)?

NO

Open circuit between the engine room harness connector terminal No.3 (X-14) and the engine room harness connector terminal No. 1 (X-15).

YES

- Is there continuity between the ECM harness connector terminal No.4 (C-58) and the engine room harness connector terminal No.1 (X-15)?

NO

Open circuit between the ECM harness connector terminal No.55 (X-58) and the engine room harness connector terminal No. 5 (X-14).

YES

- Is there battery voltage between the engine room harness connector terminal No.2 (X-15) and ground?

NO

Open circuit between the ECM harness connector terminal No. 4 (C-58) and the engine room harness connector terminal No. 1 (X-15).

YES

- Disconnect the pressure switch.
- Is there continuity between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24)?

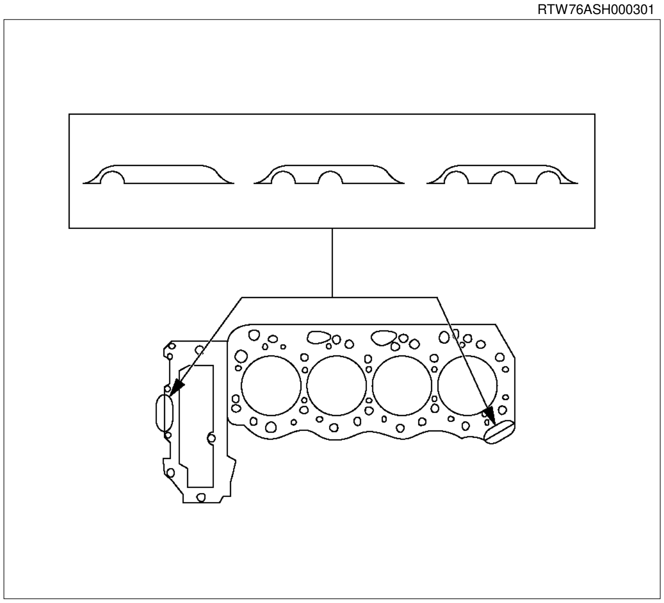
NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 2 (X-15).

Cylinder Head Gasket Combination mm (in)

Gasket Grade Mark	Piston Projection	Gasket Thickness
A	0.067-0.117 (0.0026-0.0046)	0.95 (0.0374)
B	0.117-0.167 (0.0046-0.0066)	1.00 (0.0394)
C	0.167-0.217 (0.0066-0.0085)	1.05 (0.0413)

RTW76ASH000301

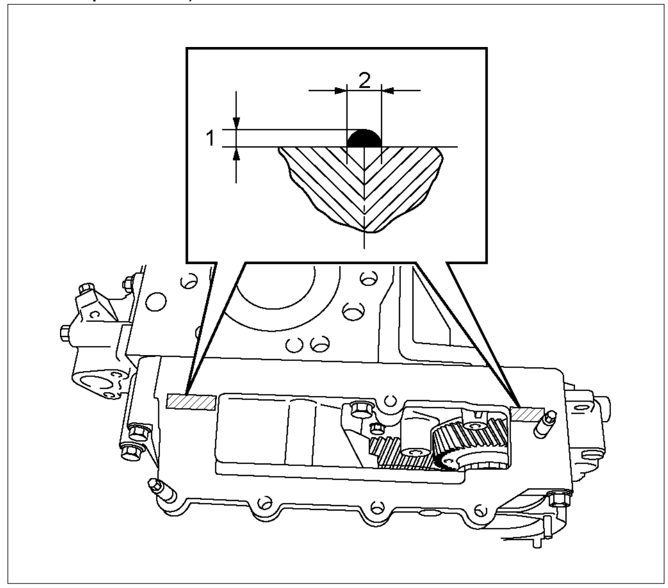


RTW56ASH009501

Note:
Difference of each piston projection must be equal or within 0.05 mm (0.002 in).

7. Select the gear case gasket.
   - This should be of the same grade as the cylinder gasket.

8. Apply liquid gasket (ThreeBond 1207B or equivalent) at the two locations.



RTW56ASH020901

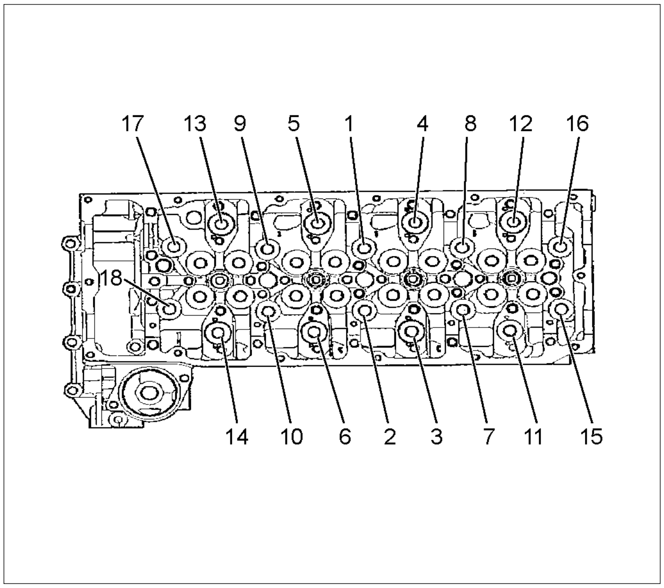
Legend

1. 2 - 3 mm (0.079 - 0.118 in)
2. 3 - 4 mm (0.118 - 0.157 in)

9. Install the cylinder head within 5 minutes application of the liquid gasket.
10. Install the cylinder head.
    - Wipe the cylinder head lower face.
    - Install the cylinder head, adjusting the dowel of the cylinder block.
11. Install the cylinder head bolt.
    - Please use new cylinder head bolt.
    - Use a torque wrench and angle gauge to tighten the head bolts in the order described in the drawing.

Tightening torque:

1st step = 70 N·m (7.1 kg·m / 51 lb ft)
2nd step = 70 N·m (7.1 kg·m / 51 lb ft)
3rd step = 60° (degrees)
4th step = 60° (degrees)

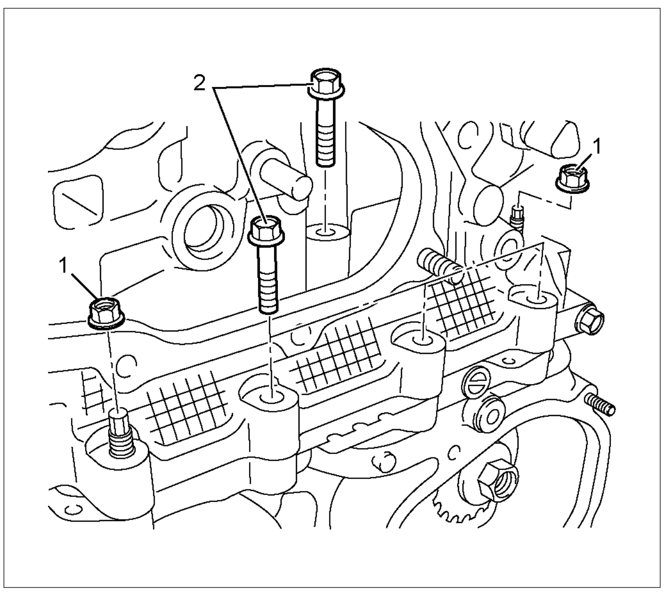


RTW56ASH009701

Special tool
Angle gauge: 5-8840-0266-0

12. Install the cylinder head gear case bolt and nut.
    - Tighten the nuts (1) and bolts (2) to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

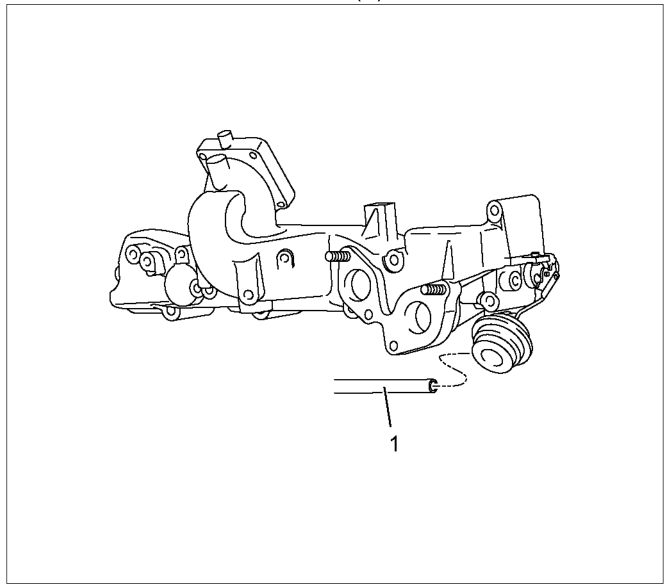


RTW56ASH020801

13. Install the water by pass pipe.
    Apply soapy water to the O-ring.
    Tighten the bolt to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

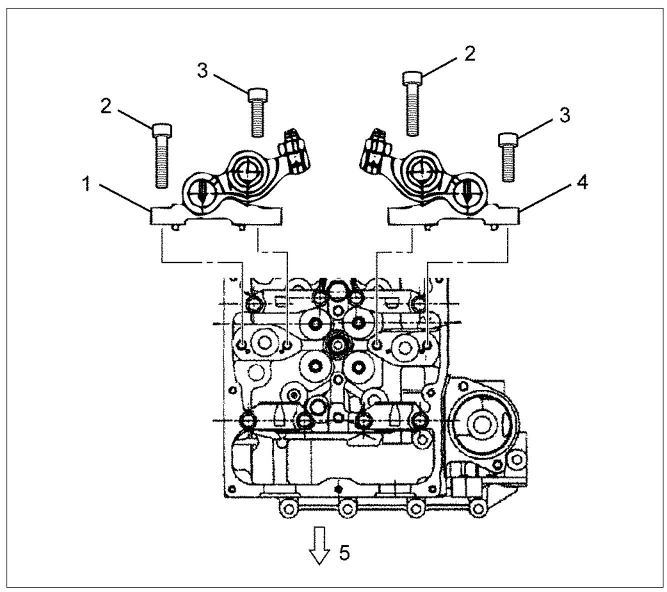
14. Install the vacuum hose (1).



RTW66ASH003101

15. Install the rocker arm shaft assembly.
    - Apply the engine oil.
    - Attach the rocker arm shaft assembly in sequence from No.1 to No.4.

Tightening torque: 21 N·m (2.1 kg·m / 15 lb ft)



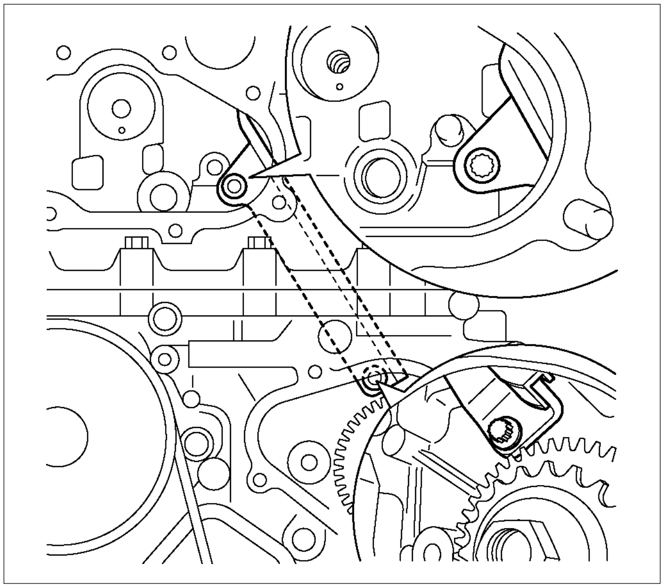
RTW56ASH012201

Legend

1. Exhaust Rocker Arm Shaft Assembly
2. Bolt (Long)
3. Bolt (Short)
4. Intake Rocker Arm Shaft Assembly
5. Front

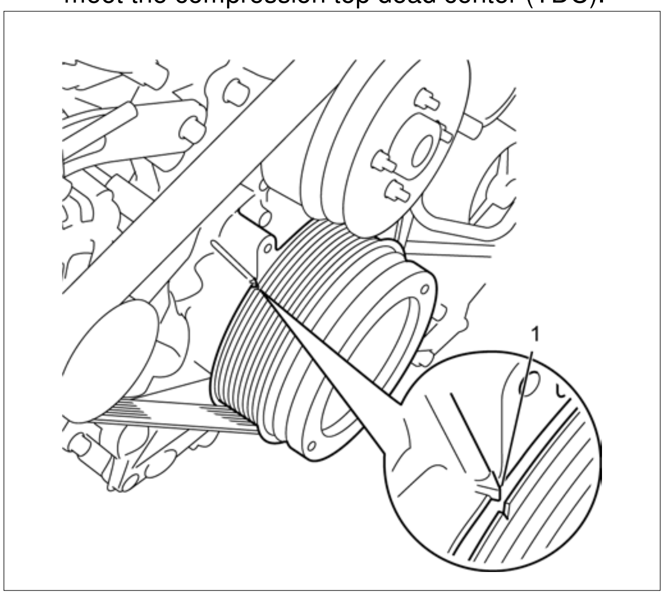
16. Install the chain guide bolt from cylinder head.
    Tighten the bolt to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)



RTW56ASH019501

17. Install the tension lever.
18. Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).



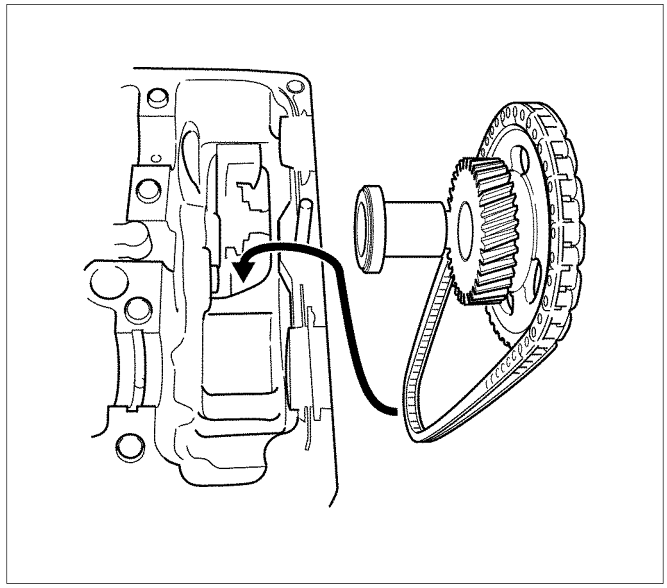
RTW76ASH001301

Legend

1. TDC

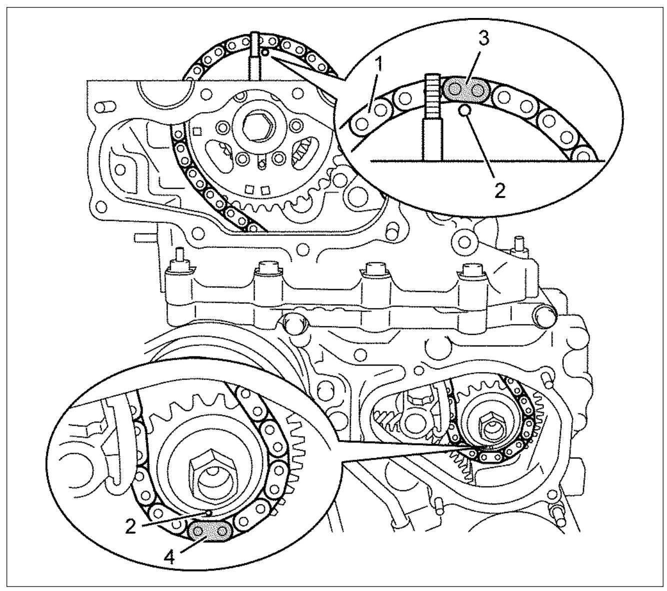
19. Install the timing chain with idle gear D.
    - Apply the engine oil bolt thread and seat.

Tightening torque : 59 N·m (6.0 kg·m/43 lb ft)



RTW56ASH021801

- Align the timing marks at two locations as shown.



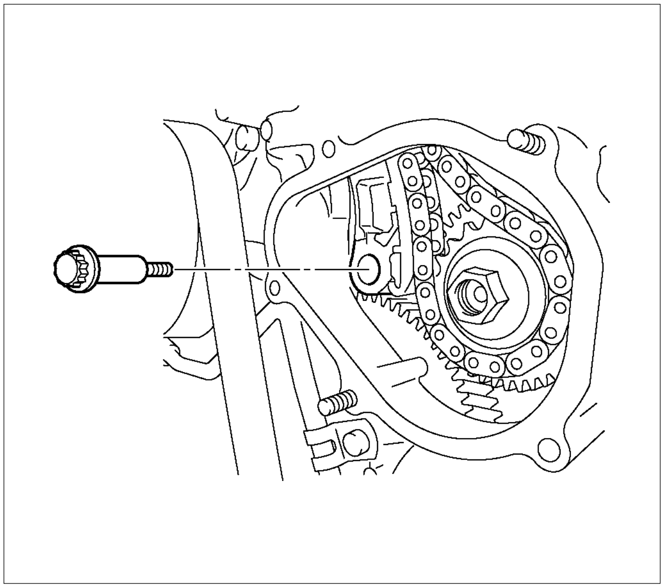
RTW56ASH020301

Legend

1. Timing Chain
2. Timing Mark
3. Blue Link
4. Yellow Link

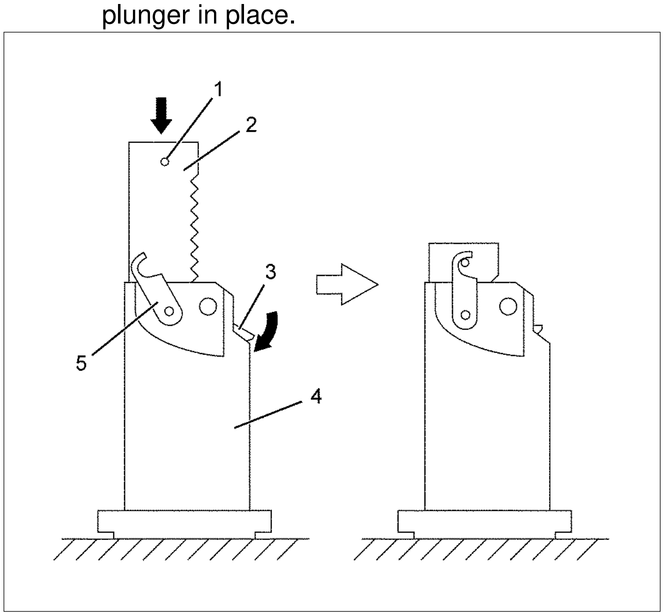
20. Install the timing chain tension lever pivot.
    Tighten the bolt to the specified torque.

Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)



RTW56ASH019401

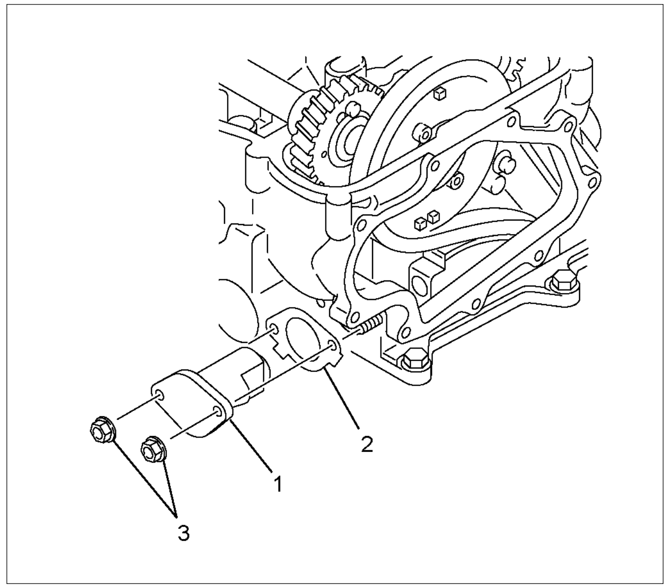
21. Attach the hook of the timing chain tensioner.
    - Hold the latch (3) depressed. Insert the plunger (2). Attach the hook (5) to the pin (1) to hold the plunger in place.



RTW56CSH004401

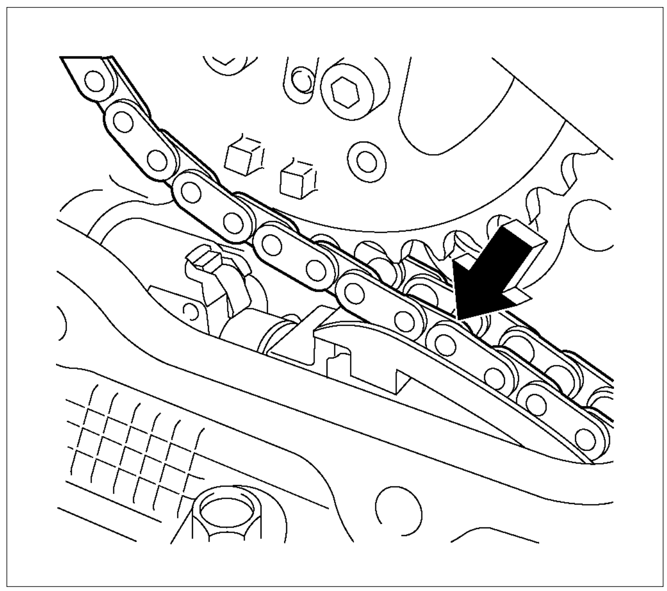
22. Install the timing chain tensioner (1) and the gasket (2).
    Tighten the nuts (3) to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)



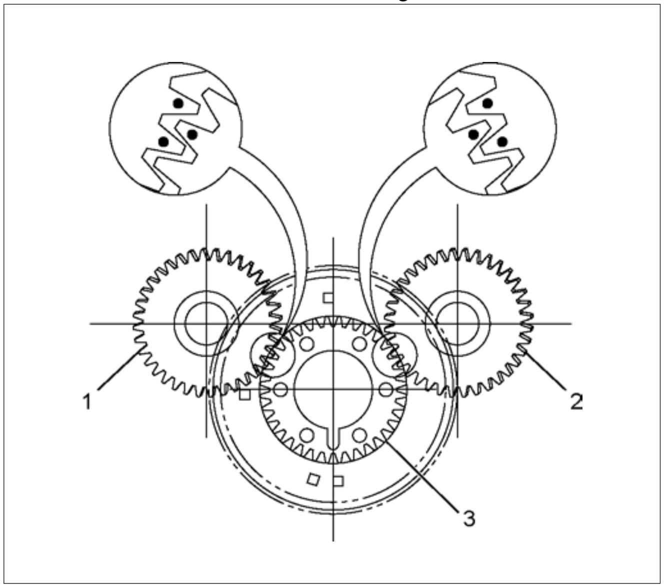
RTW56CSH001701

23. Unlock the tensioner hook.
    - Press the place of the arrow in the figure.
    - The hook is opened. The plunger pushes the tension lever.



RTW56ASH020401

24. Install the camshaft assembly.
    - Align timing mark on intake camshaft and exhaust camshaft to idle gear D.

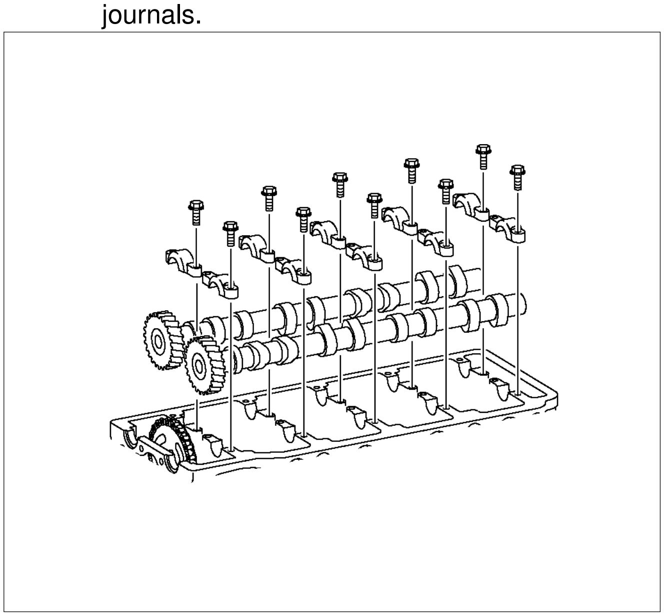


RTW56ASH007001

Legend

1. Exhaust Camshaft Gear
2. Intake Camshaft Gear
3. Idle Gear D

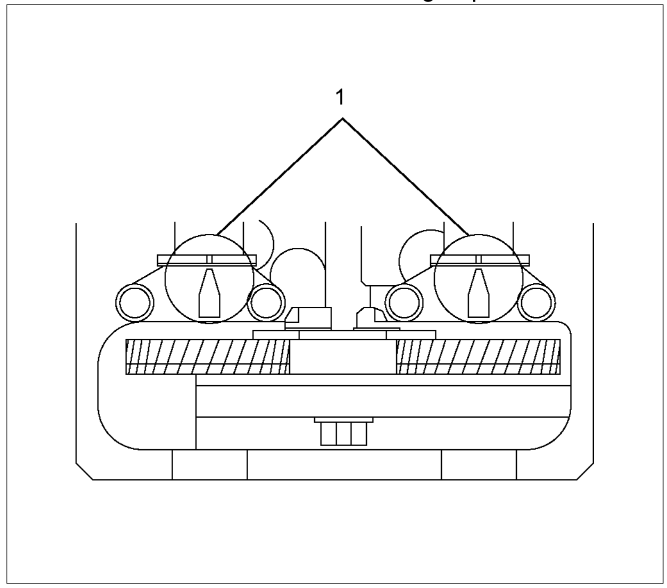
25. Install the camshaft bearing cap.
    - Apply engine oil to all of the cylinder head journals.



RTW56ASH013801

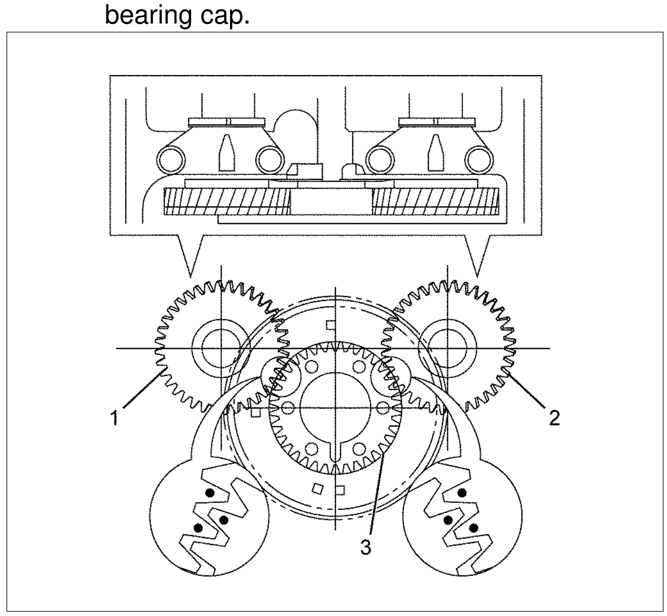
Tightening torque: 18 N·m (1.8 kg·m / 13 lb ft)

26. Align mark on camshaft to mark on camshaft bearing cap.
    - Align mark (1) on intake camshaft and exhaust camshaft to mark of bearing cap.



RTW56ASH006901

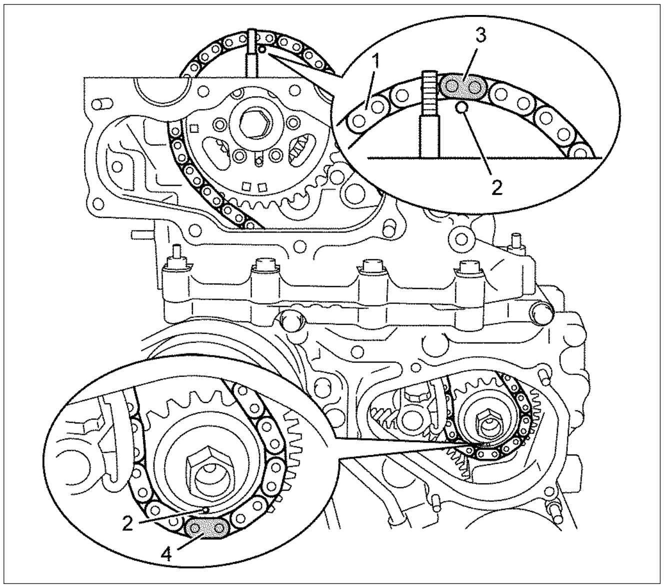
27. Remove the lock bolt from the camshaft gear.
28. Turn the crank pulley two rotation (720°CA).
    - Align mark on camshaft to mark on camshaft bearing cap.



RTW56ASH020701

Legend

1. Exhaust Camshaft Gear
2. Intake Camshaft Gear
3. Idle Gear D

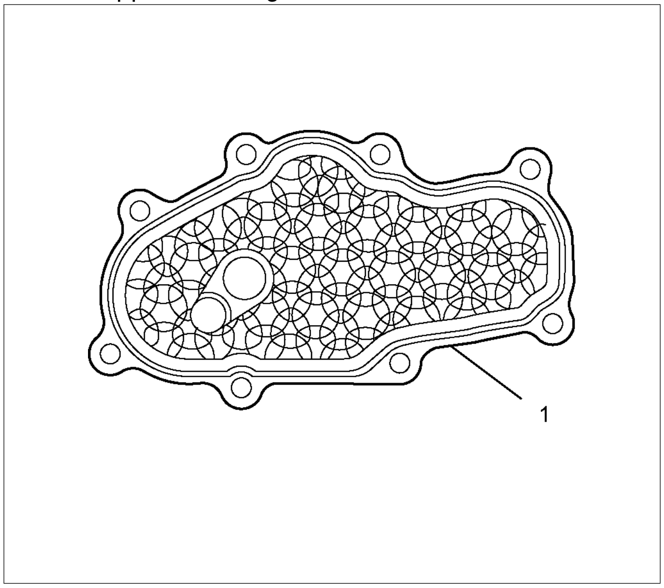


RTW56ASH020301

Legend

1. Timing Chain
2. Timing Mark
3. Blue Link
4. Yellow Link

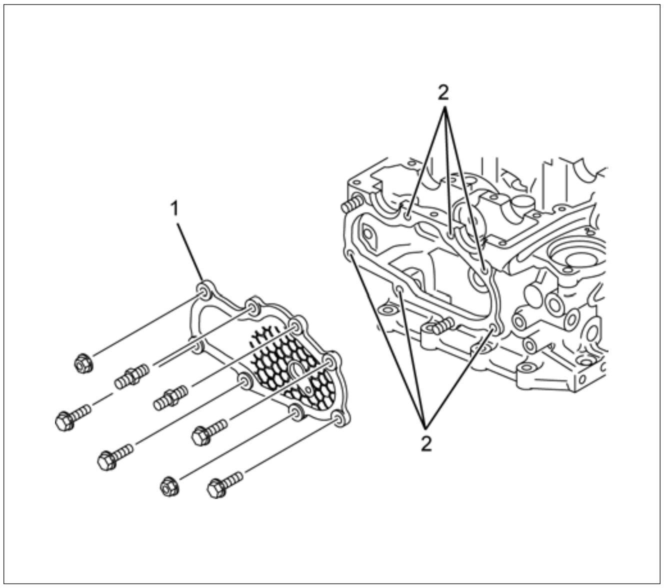
29. Apply liquid gasket (ThreeBond TB-1207C or equivalent) to timing chain cover upper (1).
    - Attach cover within 5minutes after the application of gasket.



RTW56CSH002101

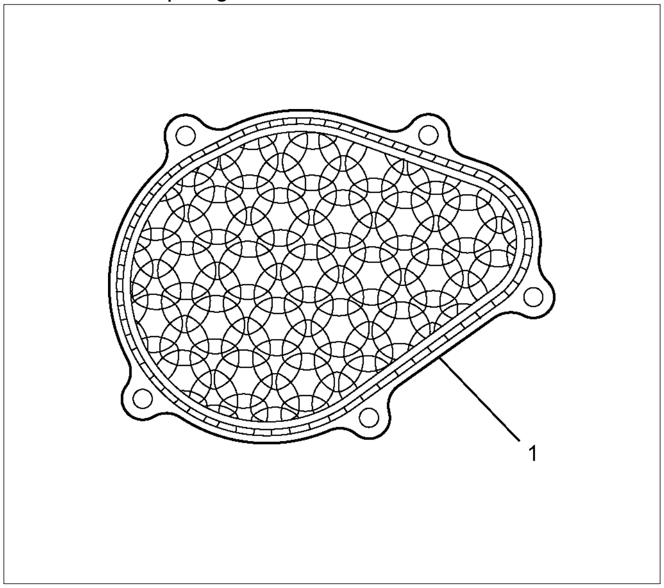
30. Install the timing chain cover upper (1).
    Tighten the bolt to the specified torque.
    - Apply loctite #262 or equivalent to the bolt and stud threads of cylinder side head side (2).

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW76CSH001201

31. Apply liquid gasket (ThreeBond TB-1207C or equivalent) to the timing chain cover lower (1).
    - Attach the cover within 5 minutes of applying the liquid gasket.



RTW56CSH002301

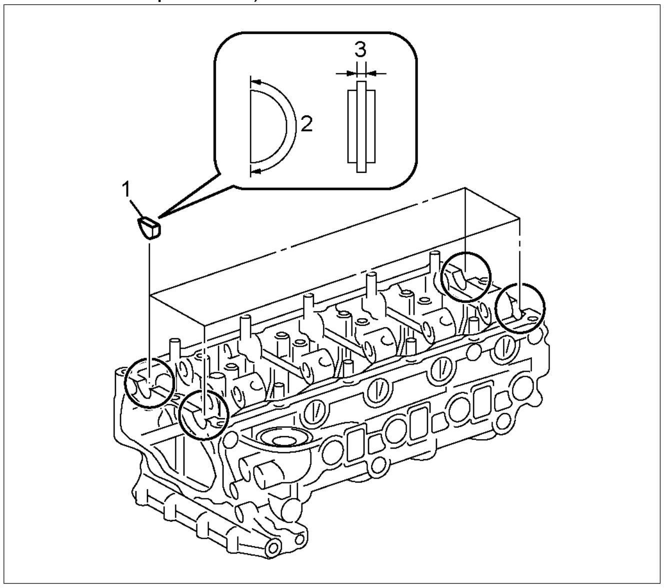
32. Install the timing chain cover lower.
    Tighten the bolts and nuts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

33. Install the noise cover to the timing chain cover lower.
    Tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

34. Inspection / adjustment of valve clearance.
    - Refer to procedure for Service Precautions in this manual.
35. Install the fuel injector.
    - Refer to procedure for Fuel System in this manual.
36. Install the baffle cover.
    - Refer to procedure for Camshaft Assembly in this manual.
37. Install the cam end gasket.
    - Apply the liquid gasket (ThreeBond TB-1207B or equivalent).



RTW56ASH020601

Legend

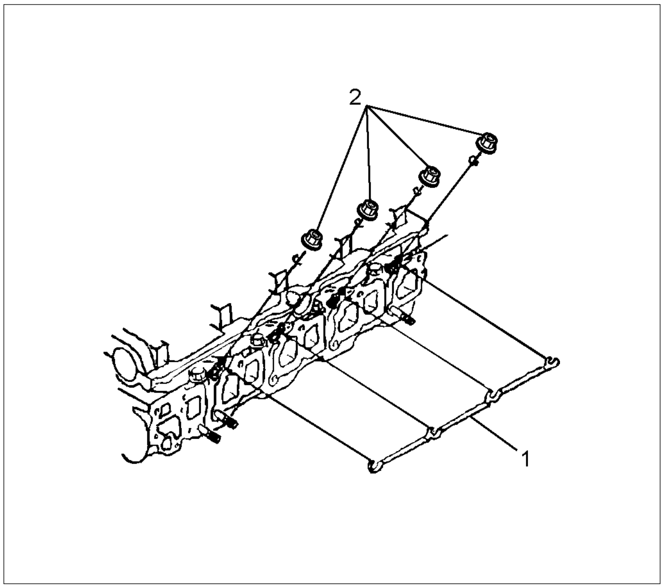
1. Cam End Gasket
2. 2.0 - 3.0 mm (0.078 - 0.118 in)

38. Install the cylinder head cover.
    Refer to procedure for Cylinder Head Cover in this manual.
39. Install the glow plug .
    Tighten the glow plug to the specified torque.

Tightening torque: 18 N·m (1.8 kg·m / 13 lb ft)

40. Install the glow plug connector.
    Tighten the nut to the specified torque.

Tightening torque: 2 N·m (0.2 kg·m / 17 lb in)



RTW56ASH010201

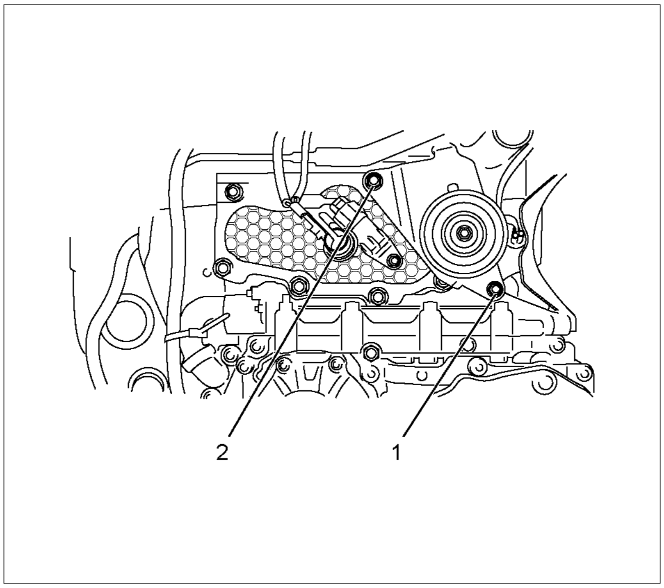
Legend

1. Glow Plug Connector
2. Nut

47. Install the A/C compressor adjust pulley.
    Tighten the bolt and nut to the specified torque.

Tightening torque: bolt 25 N·m (2.6 kg·m/19 lb ft)

Tightening torque: nut 25 N·m (2.6 kg·m/19 lb ft)



RTW56ASH010601

Legend

1. Bolt
2. Nut

---

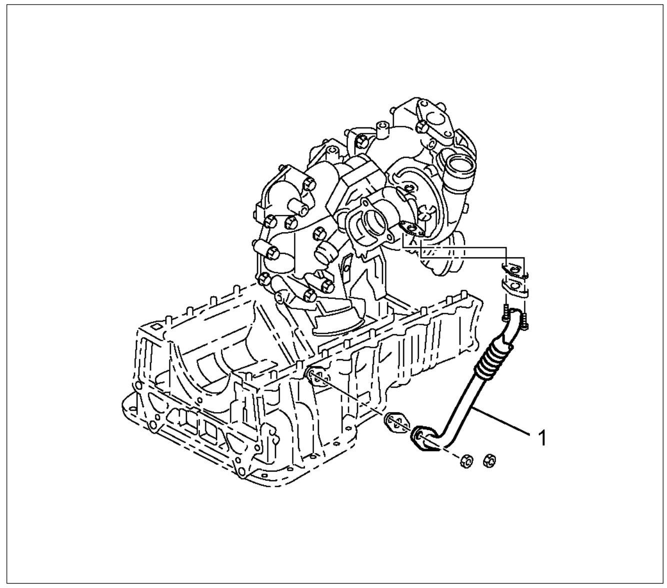
48. Install the A/C compressor and connector.
    Tighten the bolt to the specified torque.

Tightening torque: 44 N·m (4.5 kg·m / 33 lb ft)

49. Connect each connector.
    - Barometric Sensor
    - EGR Valve
    - Glow plug
    - Water temperature sensor
    - Camshaft Position sensor
    - Throttle Assembly

50. Install the turbocharger engine oil return pipe (1).
    Tighten the bolt and nut to the specified torque.

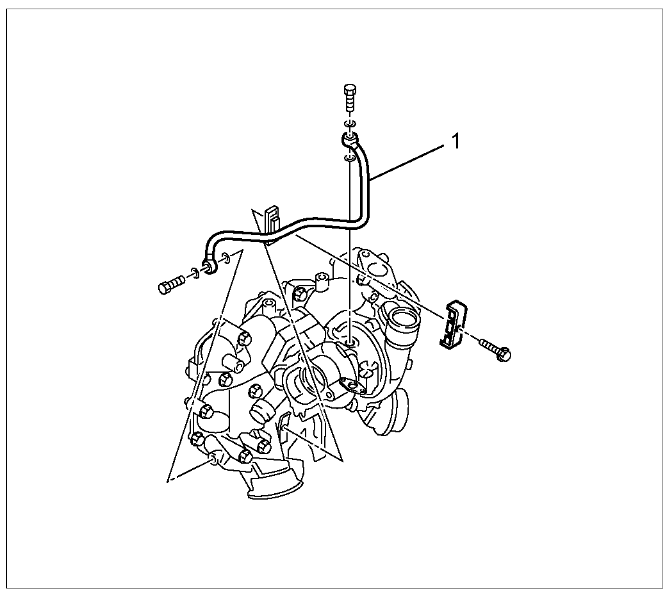
Tightening torque:
nut: 25 N·m (2.6 kg·m/19 lb ft)
bolt: 10 N·m (1.0 kg·m/87 lb in)



RTW56ASH010701

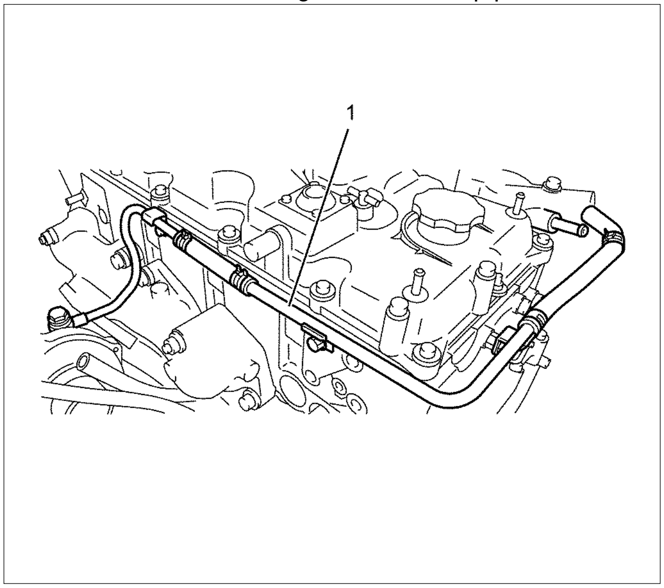
51. Install the turbocharger engine oil feed pipe (1).
    Tighten the bolt to the specified torque.

Tightening torque: bolt 23 N·m (2.3 kg·m/17 lb ft)



RTW56ASH010801

52. Install the turbocharger water feed pipe.

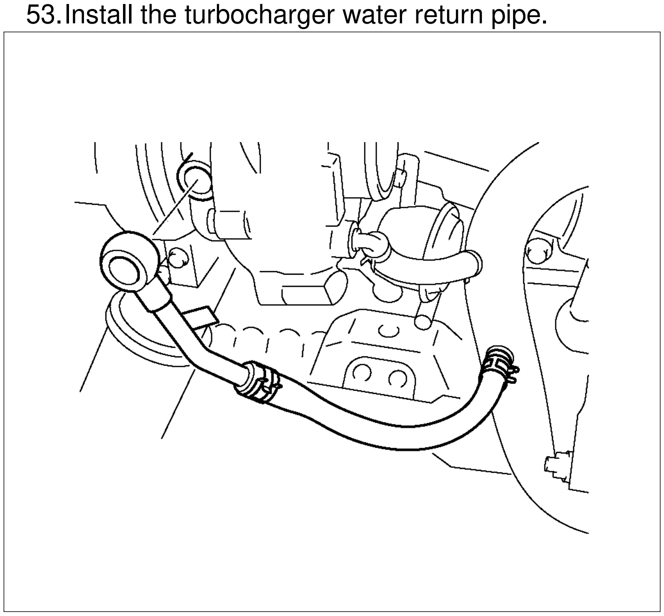


RTW56ASH019101

Legend

1. Turbocharger Water Feed Pipe

53. Install the turbocharger water return pipe.



RTW56ASH019001

Legend

1. Turbocharger Water Return Pipe

54 Install the A/T oil cooler pipe bracket.
Refer to procedure for automatic transmission in this manual.

55. Install the catalyst converter.
Refer to procedure for Turbocharger and Exhaust Manifold in this manual.

56. Connect the front drive shaft. (4×4)
Refer to procedure for front propeller shaft in this manual.

57. Install the exhaust front pipe.
  - Refer to procedure for “Exhaust System” in this manual.

58. Install the EGR cooler.
  - Refer to procedure for “Exhaust System” in this manual.

59. Install the EGR cooler water pipe.
  - Refer to procedure for “Exhaust System” in this manual.

60. Install the EGR cooler heat protector.
  - Refer to procedure for “Exhaust System” in this manual.

61. Install the cooling fan.
  - Refer to procedure for “Engine Cooling” in this manual.

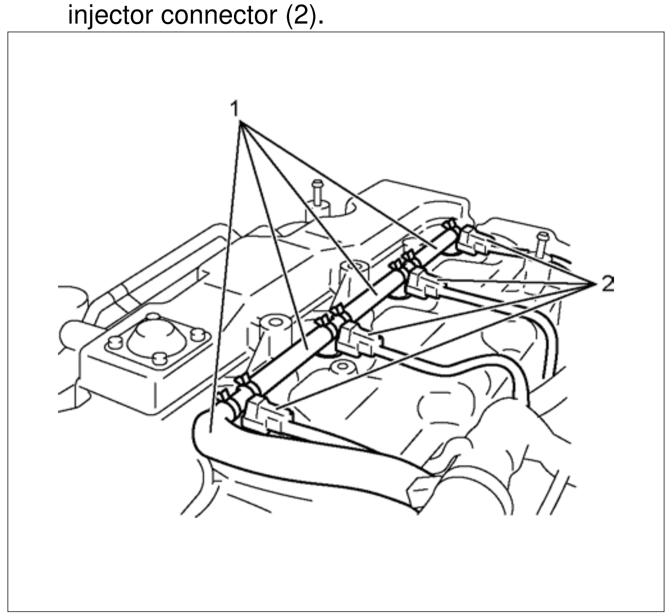
62. Install the A/C drive belt.
  - Refer to procedure for “Intake Manifold” in this manual.

63. Install the radiator fan shroud. Upper and lower.

64. Install the radiator upper hose.
  - Refer to procedure for engine cooling in this manual.

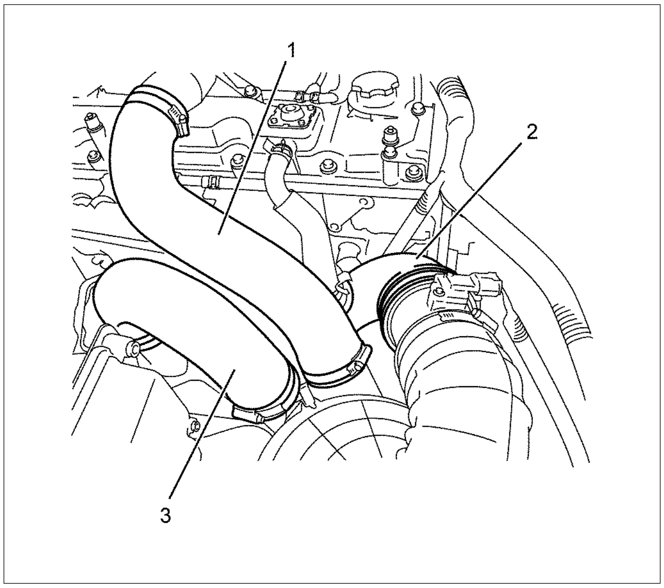
65. Install the harness bracket.

66. Install the fuel leak off hose (1), and the fuel injector connector (2).



RTW76ASH000101

67. Install the intercooler (High output).
    - Install the intercooler.
    - Install the two intake hoses.
    - Connect the BARO sensor harness connector.
68. Install the intake hose.



RTW56ASH022501

Legend

1. Intake Hose for Intercooler and Intake Throttle
2. Intake Duct for Turbocharger and Air Cleaner
3. Intake Hose for Turbocharger and Intercooler

69. Install the engine head cover.
70. Replenish the coolant.

YES

• Disconnect the condenser fan relay.

• Is there continuity between the relay terminal No. 3 (X-9) and engine room harness connector terminal No.4 (C-24)?

NO

Open circuit between the engine room harness connector terminal No. 5 (X-15) and the engine room harness connector terminal No. 1 (C-24).

YES

• Is there battery voltage between the engine room harness connector terminal NO.3 (C-24) and ground?

NO

Open circuit between the condenser fan relay No.3 (X-9) and the engine room harness connector terminal No. 4 (C-24).

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 3 (C-24).

YES

• connect the A/C thermo relay connector.

• Disconnect the electronic thermostat.

• Is there continuity between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 2 (C-24)?

YES

• Is there battery voltage between the engine room harness connector terminal No.3 (C-55) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (C-24) and the engine room harness connector terminal No. 2 (C-55).

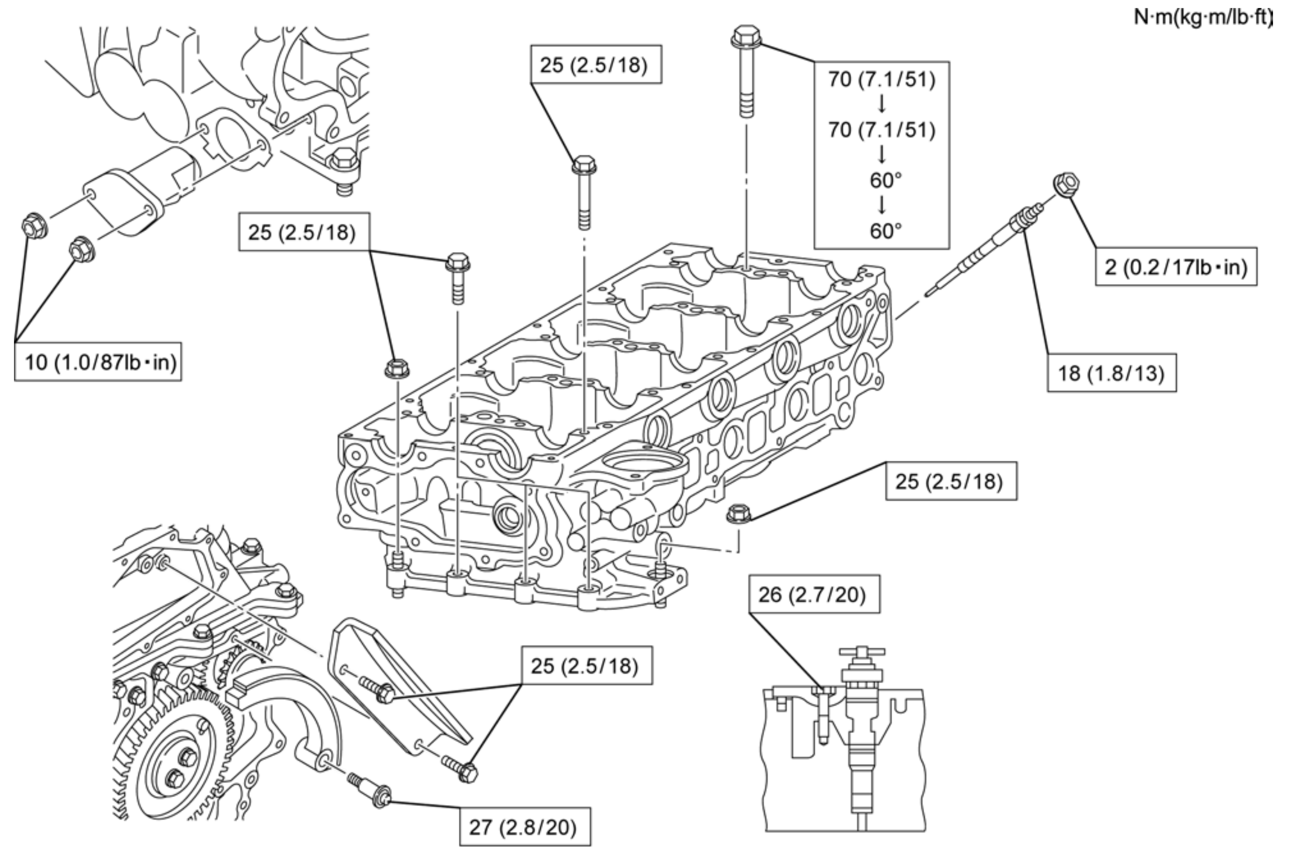
YES

• Is there continuity between the engine room harness connector terminal No.1 (C-55) and ground (C-109)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (C-55).

Torque Specifications



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Special Tools

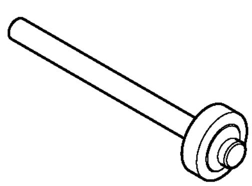
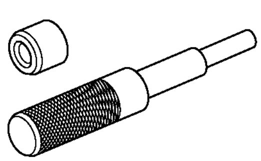
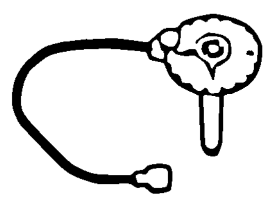
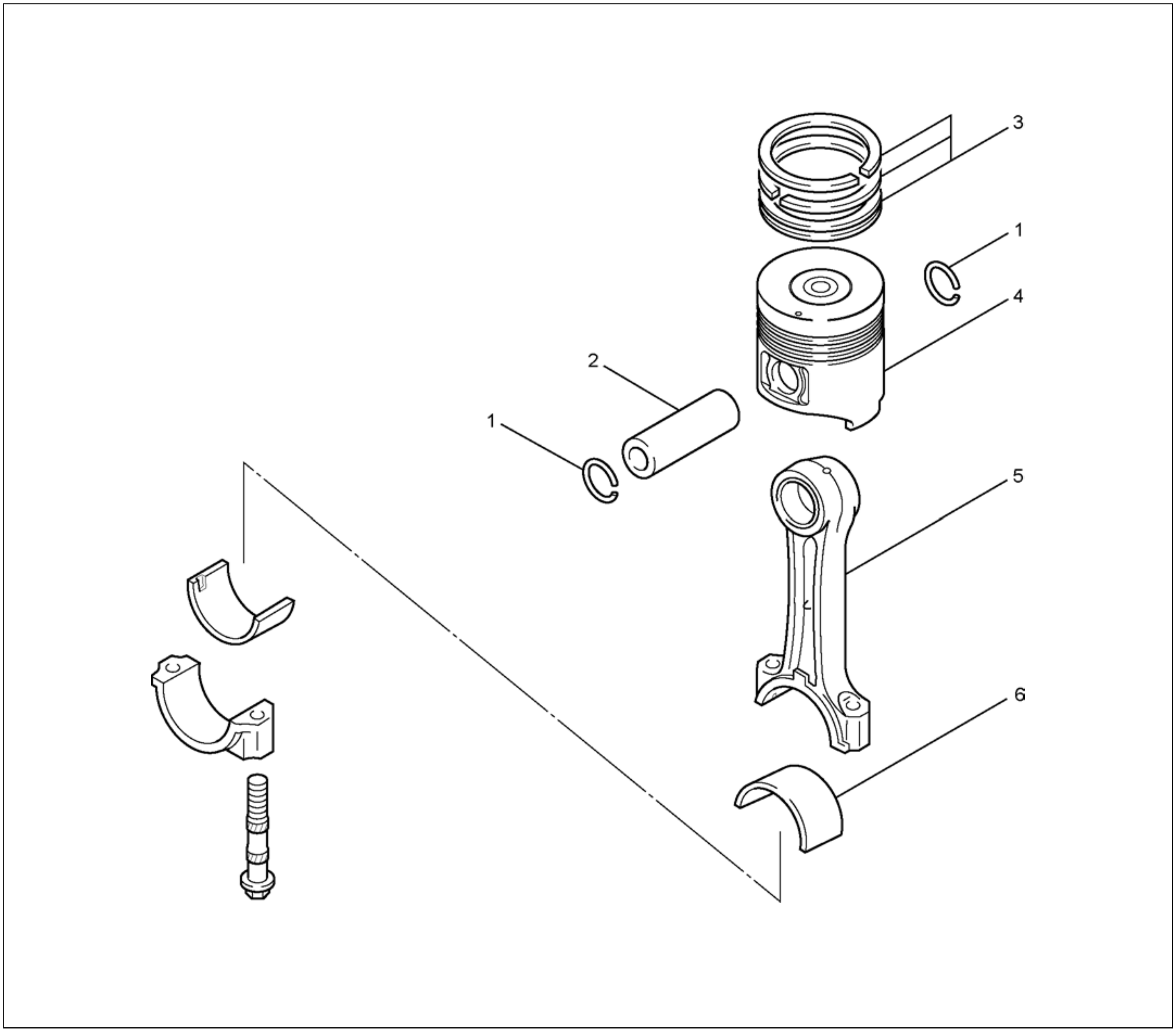
ILLUSTRATION	PART NO. PART NAME
 5884028200	**5-8840-2820-0** Injection pipe oil seal installer
 5884028160	**5-8840-2816-0** Valve guide remover and installer

ILLUSTRATION	PART NO. PART NAME
 5884002660	**5-8840-0266-0** Angle gauge

Piston and Connecting Rod

Components



RTWA56ALF001601

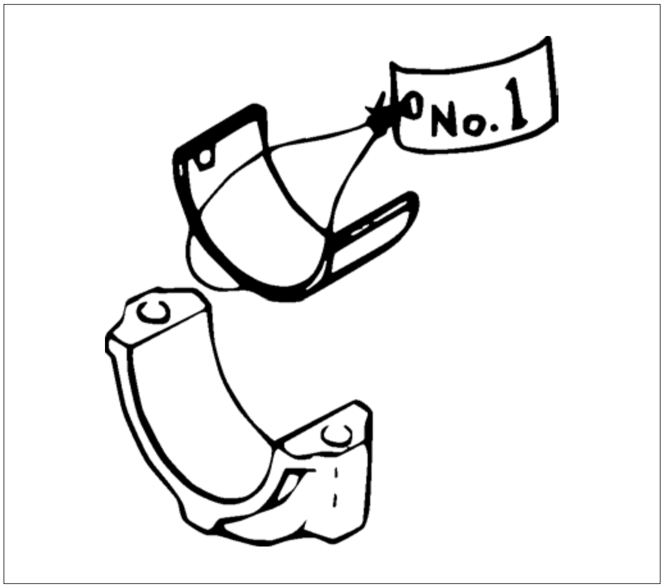
Legend

1. Piston Pin Snap Ring
2. Piston Pin
3. Piston Ring
4. Piston
5. Connecting Rod
6. Bearing

Removal

1. Demount the engine assembly.
   Refer to “Engine Assembly”.
2. Remove the cylinder head cover.
   Refer to “Cylinder Head Cover”.
3. Remove the camshaft assembly.
   Refer to “Camshaft Assembly”.
4. Remove the cylinder head.
   Refer to “Cylinder Head”.
5. Remove the gear case assembly.
   Refer to “Gear Case Assembly”.
6. Remove the oil pan.
   Refer to “Oil Pan” .
7. Remove the connecting rod cap.

Note:
Sort the removed bearings according to cylinders by using tags.



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8. Remove the piston and connecting rod.
   - Remove carbon on the upper side of the cylinder block with a scraper.
   - Pull out the piston and connecting rod towards the cylinder head.

Note:
Be sure not to damage the oil jet and cylinder block when pushing out the connecting rod.

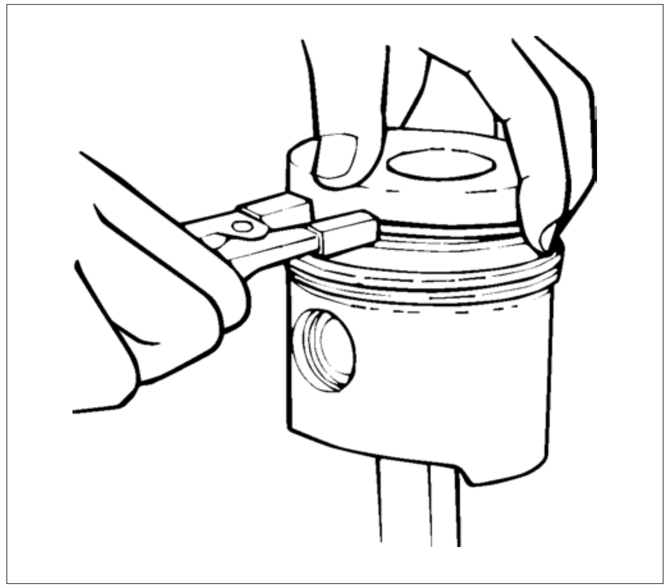
9. Remove the connecting rod bearing.

Note:
Sort the bearings in the order of cylinders when reusing them so that they are not confused with the bearings of other cylinders.

Disassembly

1. Remove the piston ring.
   - Use ring pliers to remove the piston ring.

Note:
Sort the piston rings in the same order as the cylinders when reusing them so that they are not confused with the pistons and piston rings of other cylinders.



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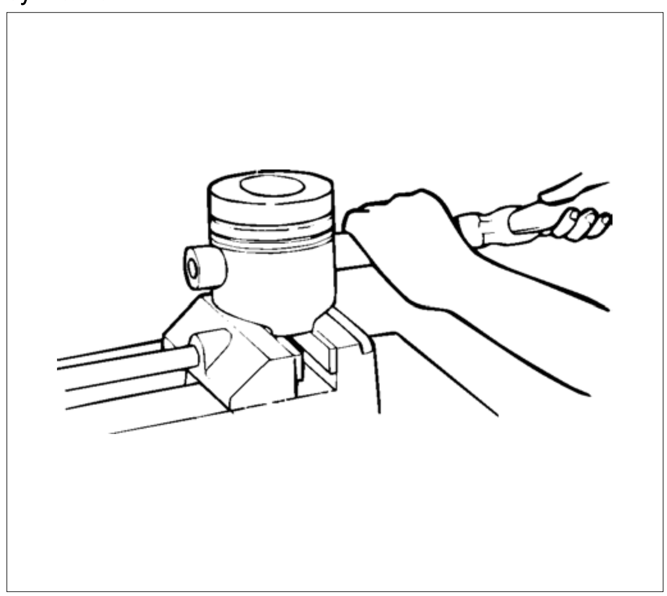
2. Remove the snap ring.
3. Remove the piston pin.

Note:
Sort the disassembled piston pins, pistons and connecting rods together in the same order as the cylinders.



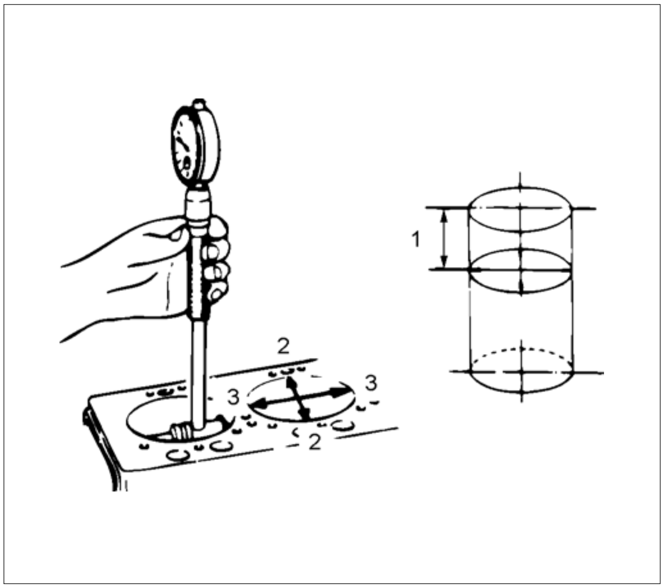
LNW21BSH005201

4. Remove the connecting rods from the piston.
5. Clean the piston.
   - Carefully clean carbon that is adhered to the head of the piston and the groove of the piston ring.

Note:
Do not use a wire brush to clean the piston because it scratches the piston.
Visually inspect the piston for cracks, burns and other excessive wear, and replace it if there is any abnormality.

6. Measure the gap between the piston and the inner diameter of the cylinder block.
   Inner diameter of the cylinder block.
   - Use a cylinder bore dial indicator to measure the cylinder block inner diameter both in the thrust and radial directions in the designated position.
   - Measurement position (from the upper surface of the cylinder block) 20 mm (0.79 in)
   - Measure the cylinder block inner diameter based on the average value of the actual measurement values on 6 positions.

Cylinder block inner diameter mm (in)
95.421 – 95.450 (3.75673 – 3.75787)



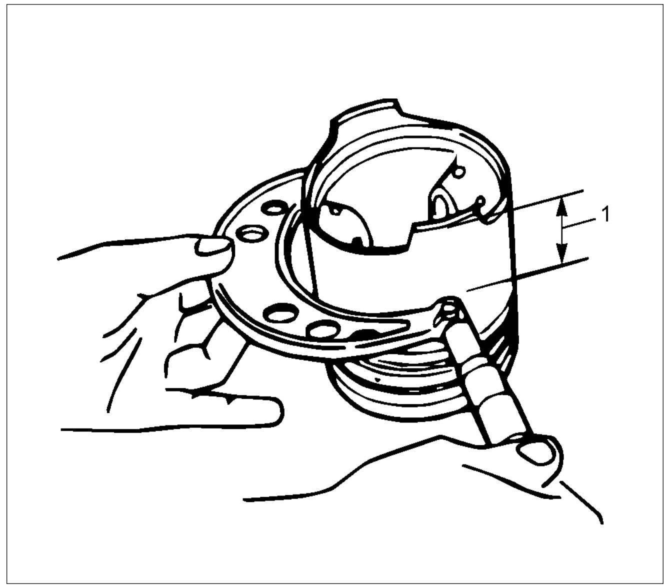
LNW61ASH006401

Legend

1. 20 mm (0.79 in)
2. Radial
3. Thrust

Piston outside diameter

- Use a micrometer to measure the outside diameter of the piston in the right angle to the piston pin in the designated position.
- Measurement position (from the bottom surface of the piston) 11.00 mm (0.43 in).



RTW56ASH023101

Legend

1. 11 mm (0.43 in)

Gap between the piston and the inner diameter of the cylinder block mm (in)	
Standard	0.082 – 0.100 (0.0032 – 0.0039)

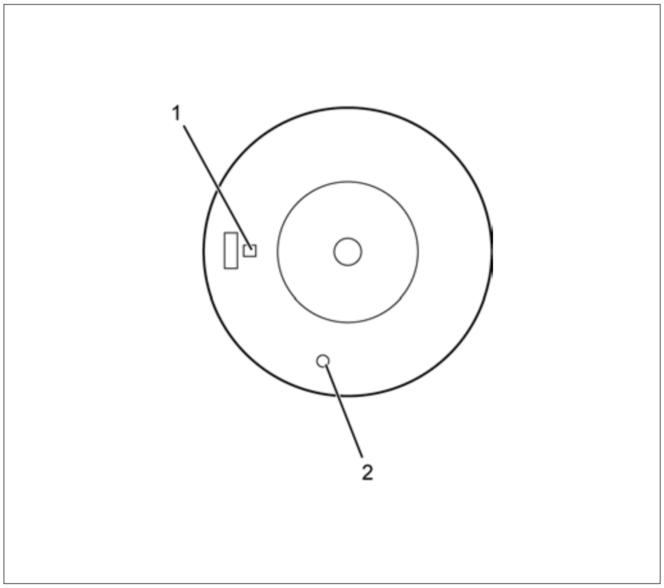
NOTE:

If the gap exceeds the standard value, replace the piston or rebore the cylinder block.

7. Piston replacement
   - The head of piston has a marking of grade A, B or C.
   - Refer to “Cylinder Block” if over size piston is installed.

Piston Grade (Service Part) mm (in)	
A	95.330 – 95.339 (3.75314 – 3.75350)
B	95.340 – 95.349 (3.75354 – 3.75389)
C	95.350 – 95.359 (3.75393 – 3.75428)

4JK1

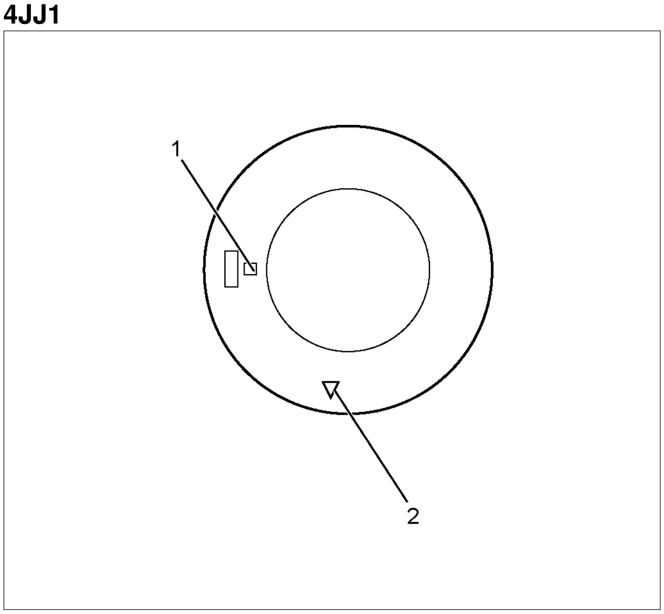


RTW56ASH025701

Legend

1. Grade
2. Front Mark Cut

4JJ1



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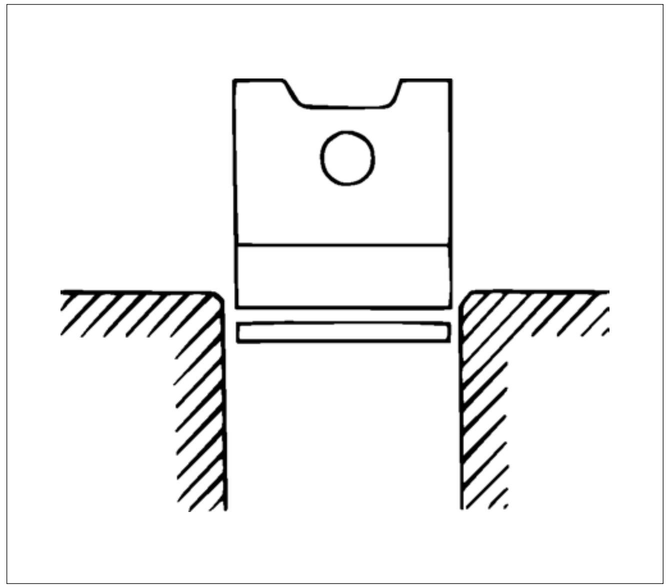
Legend

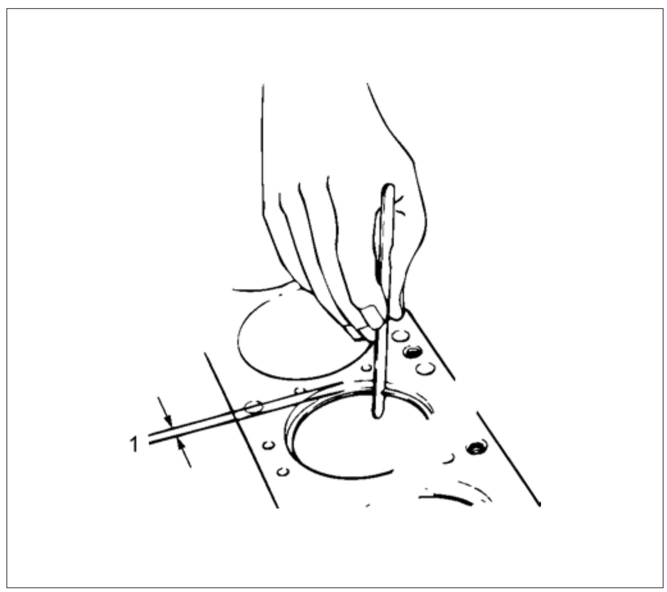
1. Grade
2. Front Mark Cut

8. Inspect the piston ring.
   - Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder block.



LNW21BSH009301

- Push the piston ring into the cylinder bore until it reaches the measuring point 1 or 2 where the cylinder block bore is the smallest.
  Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.
  Measuring Point 1 10 mm (0.4 in)
  or
  Measuring Point 2 120 mm (4.7 in).



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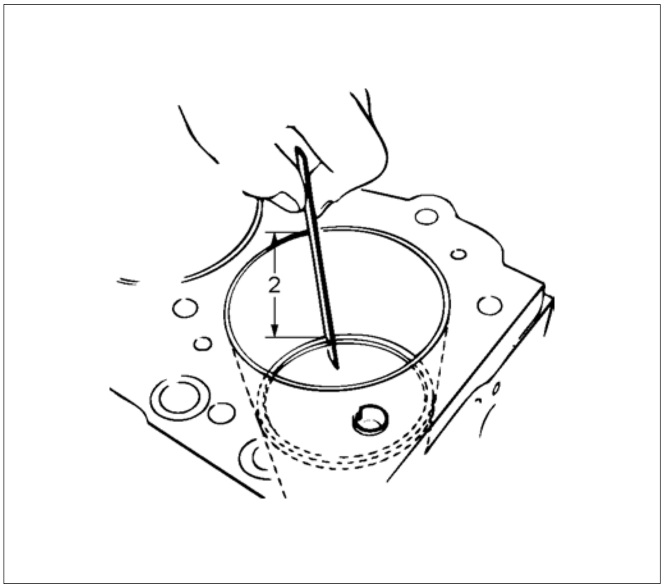


LNW61ASH004501

- Use a thickness gauge to measure the piston ring gap.
  If the measured value exceeds the specified limit, the piston ring must be replaced.

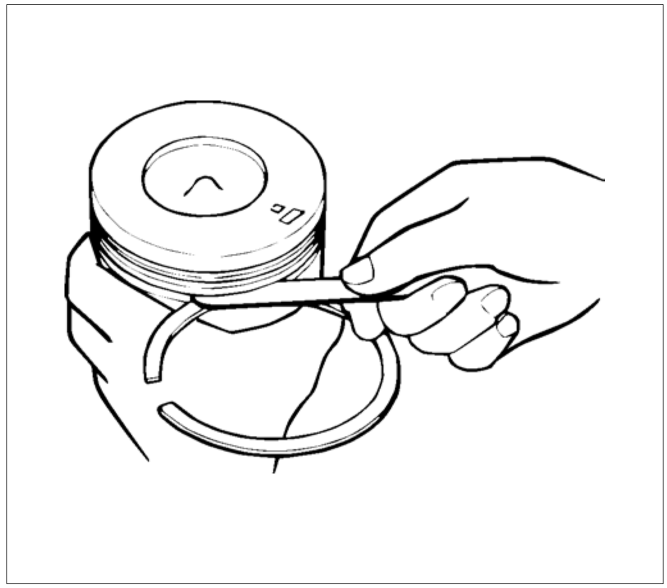
Piston ring gap		mm (in)
	Standard	Limit
1st compression ring	0.3 - 0.5 (0.0118 - 0.0197)	1.50 (0.059)
2nd compression ring	0.3 - 0.5 (0.0118 - 0.0197)	1.50 (0.059)
Oil ring	0.25 - 0.45 (0.0098- 0.0177)	1.50 (0.059)

Measure the clearance between the piston ring groove and the piston.

- Remove carbon in the piston ring groove.
- Put the piston ring in the piston ring groove, use a thickness gauge to measure the gap between them.
- If the clearance between the piston ring groove and the piston exceeds the limit, replace the piston and the piston ring.

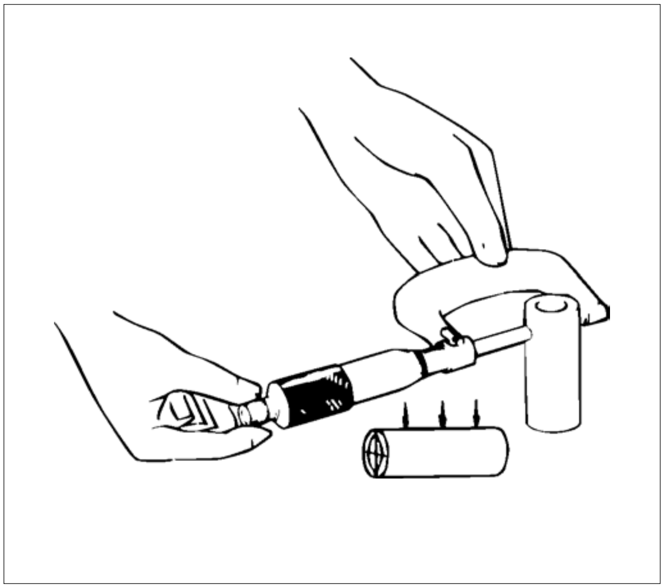
Piston ring and piston ring groove clearance		mm (in)
	Standard	Limit
1st compression ring	— *	— *
2nd compression ring	0.05 - 0.09 (0.0020 - 0.0035)	1.50 (0.059)
Oil ring	0.03 - 0.07 (0.0012- 0.0028)	1.50 (0.059)

* Measurement is impossible


LNW21BSH009501

9. Inspect the piston pin.
   - Visually inspect the piston pin for cracks, scratches and other damage, and replace it if necessary.
   - Use a micrometer to measure the outer diameter of the piston pin. If the measured value exceeds the limit, replace the piston pin.

Piston pin outer diameter	mm (in)
Standard	33.995 – 34.000 (1.33838 – 1.33858)
Limit	33.970 (1.33740)



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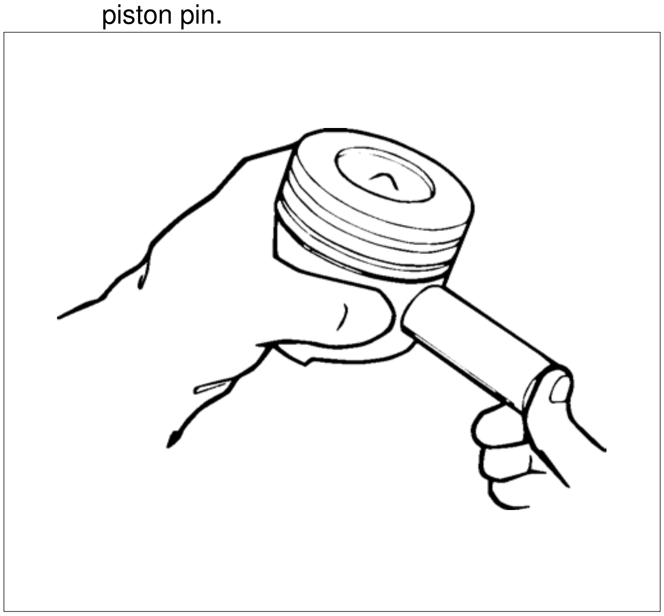
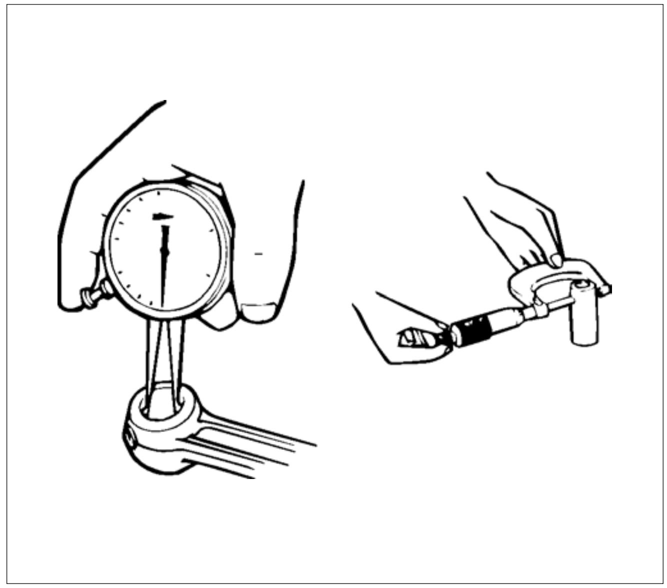
- Inspect to make sure that there is a resistance to the extent which the piston can push the piston pin lightly in normal temperatures.
- If it feels a large looseness or instability in normal temperatures, replace the piston or piston pin.



LNW21BSH009701

- Measure the bush of the small edge of the connecting rod. If the clearance of the bush inner diameter and the pin diameter exceeds the limit, replace the bush or connecting rod assembly, and the pin.

Piston pin and connecting rod small end bushing clearance mm (in)	
Standard	0.008 - 0.020 (0.0003 - 0.0008)
Limit	0.05 (0.0020)



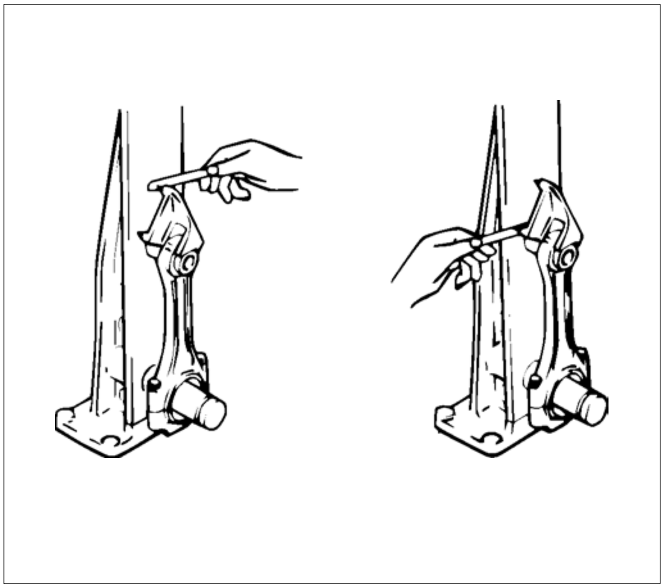
LNW21BSH009801

10. Measure the clearance between the piston and the piston pin.
    - Apply engine oil on the piston pin. Use your finger to push it in the piston hole and rotate it. If the pin smoothly rotates without instability, the clearance is normal. If there is instability, measure the clearance. If the clearance exceeds the limit, replace the piston and the piston pin.

Piston pin and piston pin hole clearance mm (in)	
Standard	0.004 - 0.017 (0.0002 - 0.0007)
Limit	0.04 (0.0016)

11. Measure the connecting rod alignment.
    - Use a connecting rod aligner to measure the torsion and parallel level of the big end hole and the small end hole. If the measured value exceeds the limit, replace it.

Connecting rod alignment (par length of 100 mm (3.94 in)) mm (in)		
	Standard	Limit
Distortion	0.08 (0.003) or less	0.20 (0.008)
Parallelism	0.05 (0.002) or less	1.50 (0.060)



LNW21BSH010401

12. Measure the bearing oil clearance.
    - Install the bearing to the connecting rod big end.
    - Tighten the bearing cap to the two step of angular tightening method.
    - Use an inside dial indicator to measure the connecting rod bearing inside diameter.

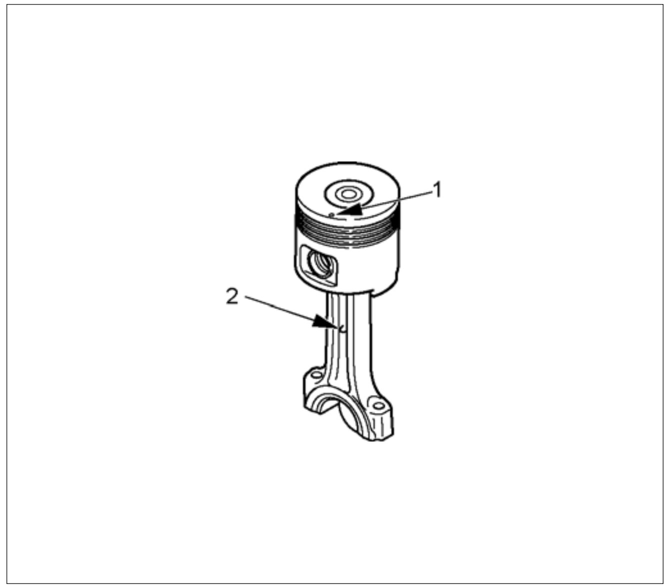
Connecting rod bearing cap bolt torque: N·m (kg·m / lb ft)	
1st step	29.4 (3.0 / 22)
2nd step	45 deg

If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankpin and bearing clearance	mm (in)
Standard	0.029 - 0.083 (0.0011 - 0.0033)
Limit	0.10 (0.0039)

Reassembly

1. Install the piston.
2. Install the connecting rod.
    - Install it so that the front mark of the head of the piston, and the connecting rod forging mark (projecting) on the connecting rod, both face in the same direction.
    - Install the snap ring of one side.



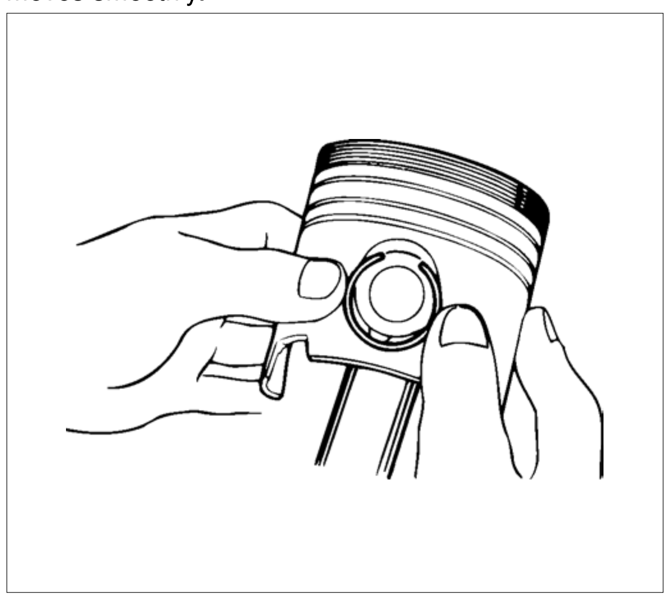
LNW46ASH004601

Legend

1. Front Mark
2. Forging Mark (Projecting)

4. Apply enough engine oil on the piston pin, push it in the piston and the connecting rod small edge.
5. Use snap ring pliers to install the snap ring.

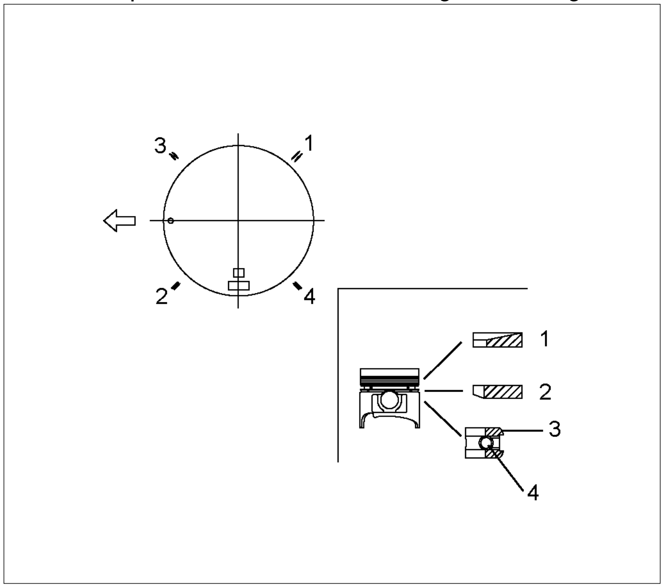
Note:
Make sure that the snap ring is installed in the ring groove properly. Make sure that the connecting rod moves smoothly.



015R100001

6. Use ring pliers to install the piston ring.
    - Install the piston rings in the order shown in the illustration.
    - Install 2nd and 1st compression rings in this order so that the marks “2N” and “N” face upward.

- Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.



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Legend

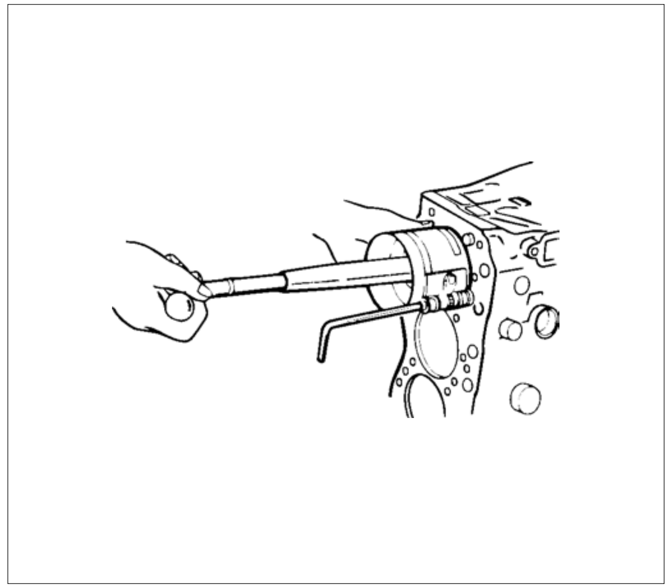
1. Compression Ring 1st
2. Compression Ring 2nd
3. Oil Ring
4. Expander

Installation

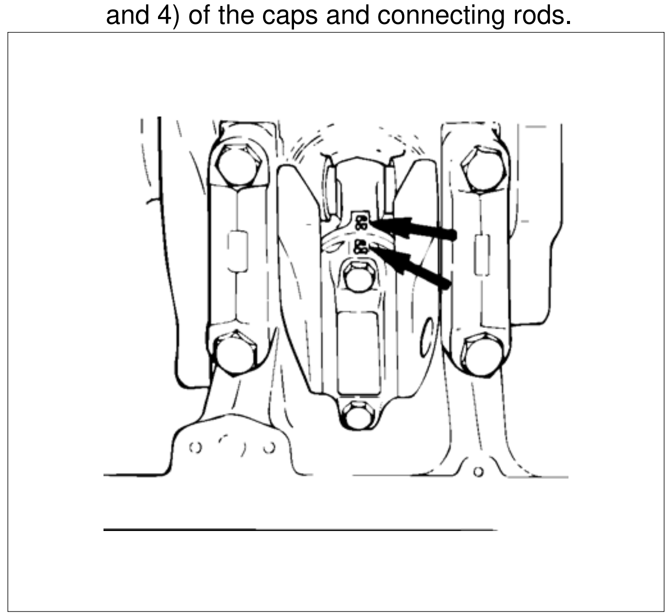
1. Install the connecting rod bearing.
   - Install the bearing on the connecting rod, and apply engine oil on the bearing.
2. Install the piston and connecting rod assembly.
   - Apply enough engine oil on the piston ring, ring groove and piston side surface.
   - With the piston front mark cut facing forward, use the piston ring compressor to insert the piston in the cylinder block.

Note:

- Be sure not to make the connecting rod touch the oil jet when pushing in the piston.
- Be sure not to harm the inside of the cylinder block when pushing in the piston.
  Special tool
  Piston ring compressor: 5-8840-9018-0


015LX096

3. Install the connecting rod cap.
   - Install the bearing on the connecting rod cap and apply engine oil.
   - Install the cap, matching the numbers (1, 2, 3, and 4) of the caps and connecting rods.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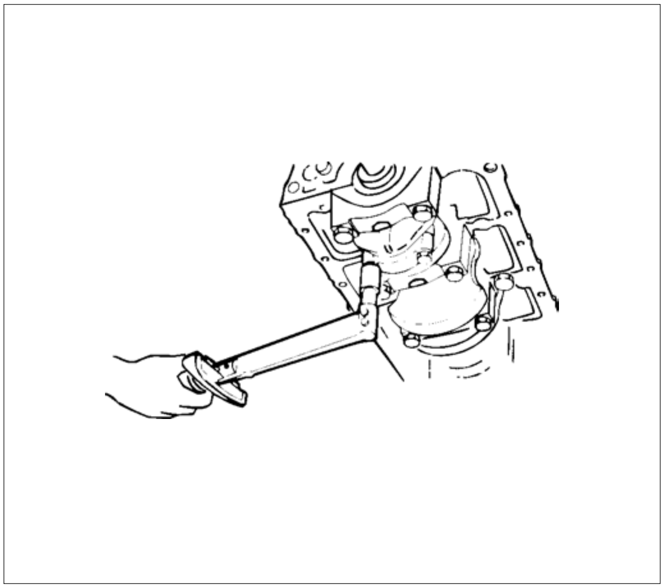
- Apply engine oil disulfide on the screw part and the setting face of the tightening bolt and tighten it with the designated torque.

Tightening torque:

1st step = 29 N·m (3.0 kg·m / 22 lb ft)
2nd step = 45° (degrees)

Special tool
Angle gauge: 5-8840-0266-0

Note:
Make sure that the crankshaft smoothly rotates.



015LX130

4. Install the oil pan.
   Refer to “Oil Pan”.
5. Install the gear case assembly.
   Refer to “Gear Case Assembly”.
6. Install the cylinder head.
   Refer to “Cylinder Head”.
7. Install the camshaft assembly.
   Refer to “Camshaft Assembly”.
8. Install the cylinder head cover.
   Refer to “Cylinder Head Cover”.

YES

- Disconnect the A/C switch.

NO

Open circuit between the engine room harness connector terminal No. 1 (C-55) and ground (C-109).

- Is there battery voltage between the chassis side harness connector terminal No. 6 (B-57) and ground?

YES

- Is the electronic thermostat OK?

NO

Open circuit between the No. EB-13 fuse and the chassis side harness connector No. 6 (B-57)

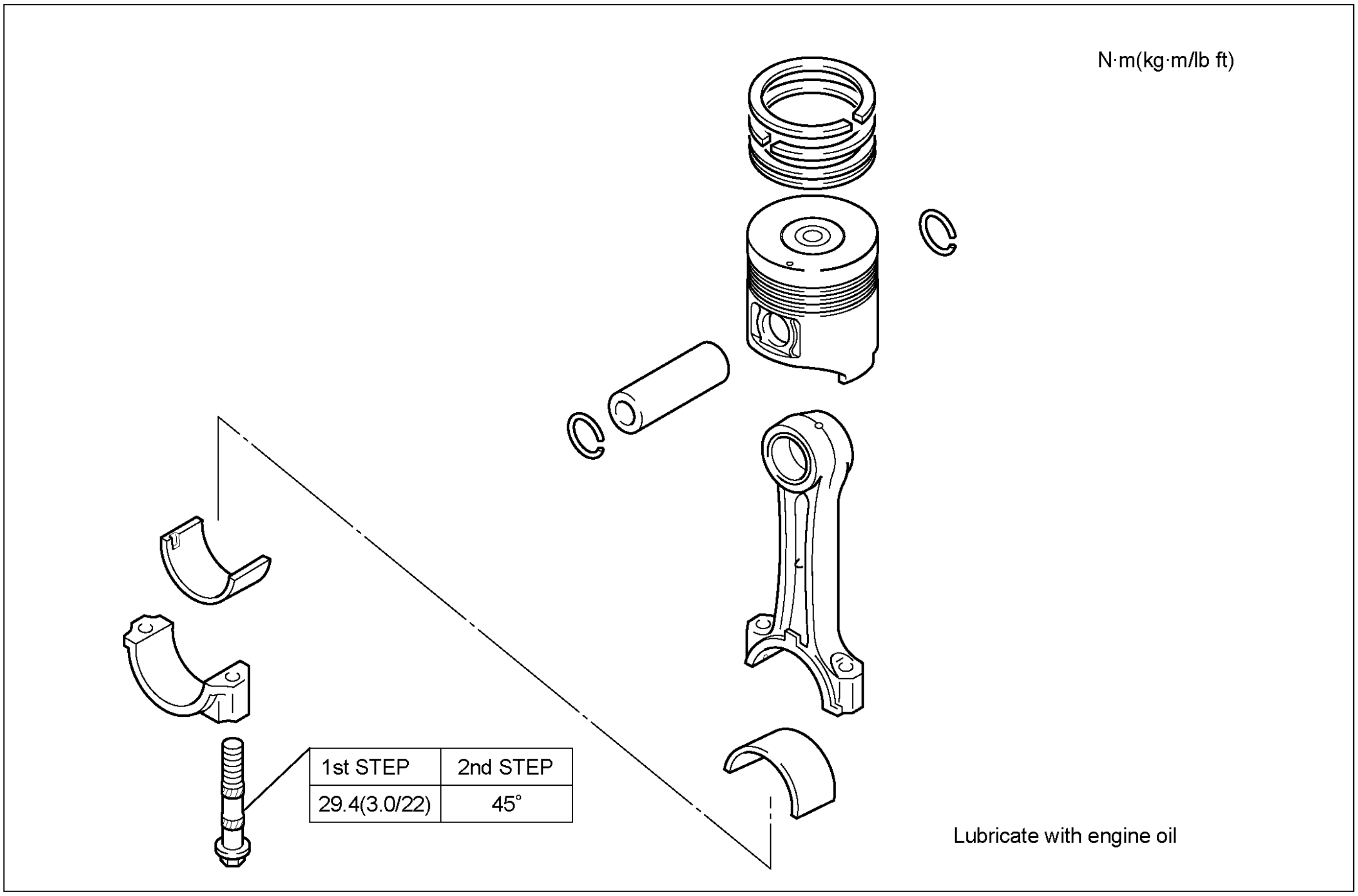
YES

- Defective ECM

NO

Replace electronic thermostat

Torque Specifications



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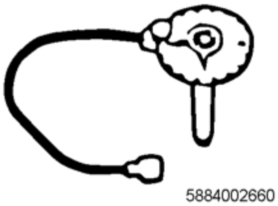
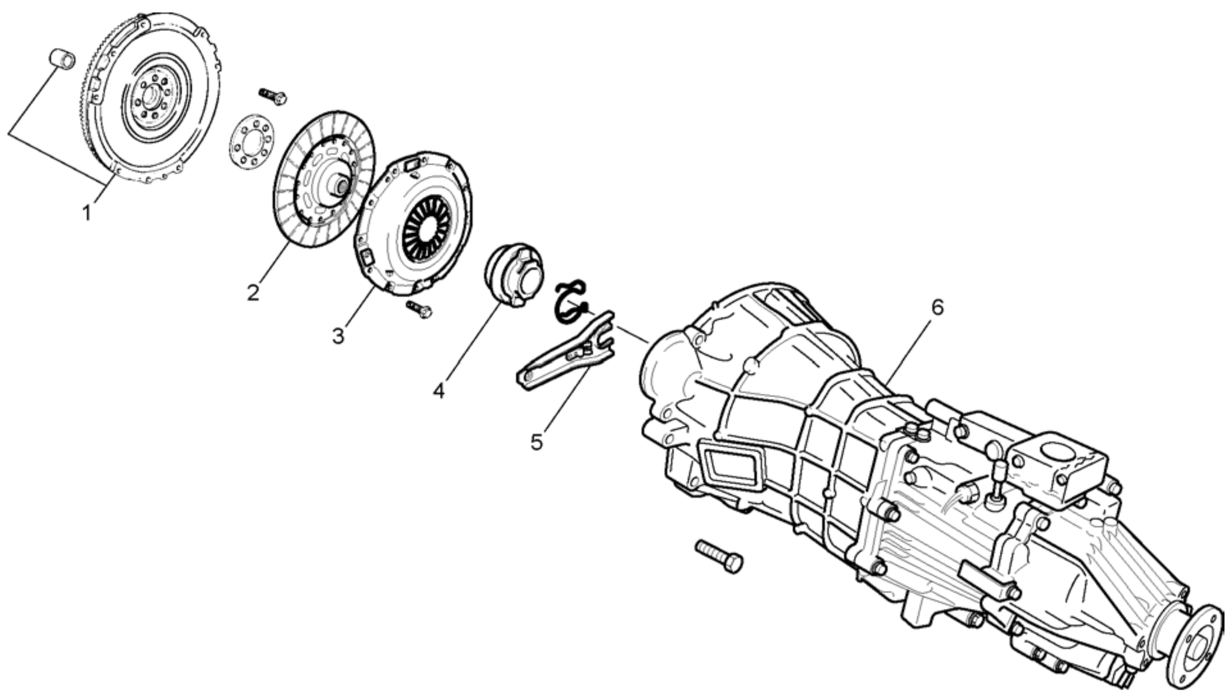
Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884090180	**5-8840-9018-0** Piston ring compressor
 5884002660	**5-8840-0266-0** Angle gauge

Flywheel

Components



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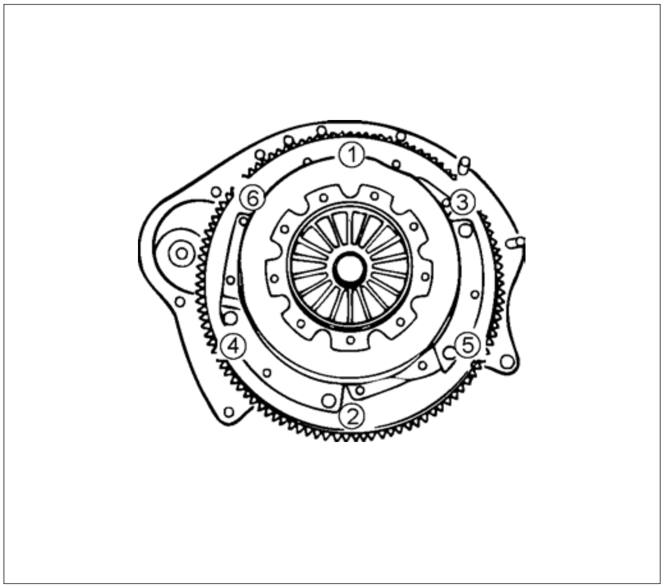
Legend

1. Flywheel Assembly and Pilot Bearing
2. Driven Plate
3. Pressure Plate Assembly
4. Release Bearing
5. Shift Fork
6. Transmission Assembly

Removal

1. Remove the transmission assembly.
   Refer to "transmission assembly removal and installation".
2. Remove the clutch pressure plate.
   - Remove the pressure plate installation bolts in the order shown in the drawing.
   - Remove the pressure plate from the flywheel.



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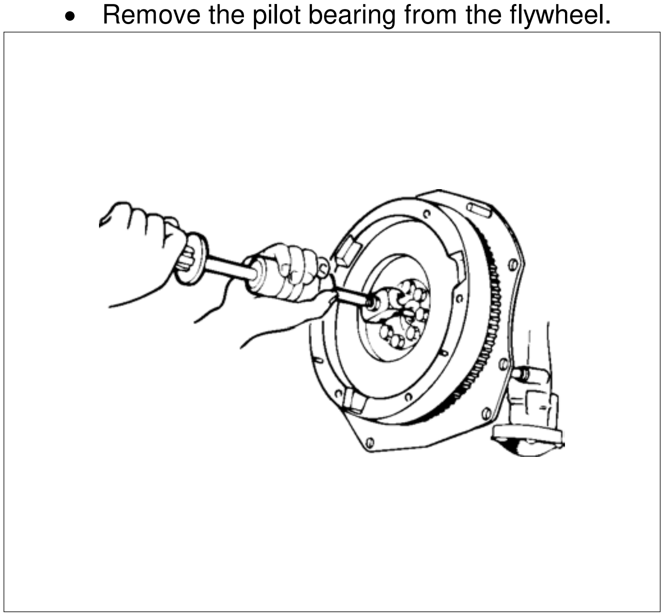
3. Remove the driven plate.
   - Remove the driven plate from the flywheel along with the clutch aligner.
   - Install the crankshaft stopper in the starter installation part of the rear plate.

Note:
Make sure that the stopper is applied with the ring gear and installed properly.

Special tool
Crankshaft stopper: 5-8840-0214-0

4. Remove the pilot bearing.
   - Remove the pilot bearing from the flywheel.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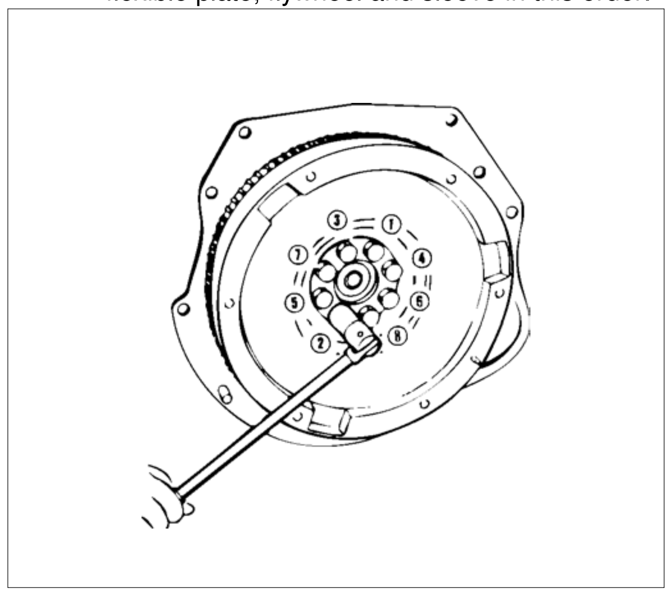
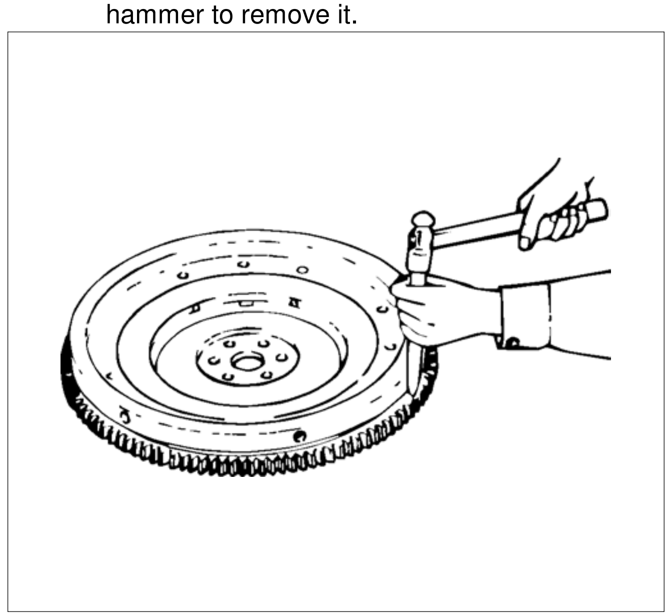
Special tool
Pilot Bearing Remover: 5-8840-2000-0
Sliding Hammer: 5-8840-0019-0

5. Remove the flywheel.
   - Gradually loosen the flywheel installation bolts in the order shown in the drawing so that the flywheel does not rotate.
   - After loosening the bolts, remove the stopper and remove the flywheel.
   - In the case of A/T car, after loosening the flywheel installation bolts, remove the washer, flexible plate, flywheel and sleeve in this order.



015RY00001

6. Remove the ring gear.
   - Put a bar on the ring gear and hit it with a hammer to remove it.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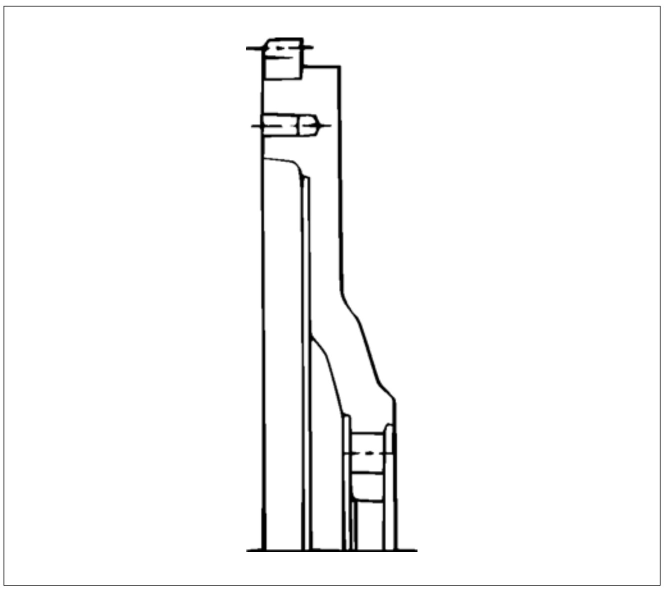
Inspection

1. Visual inspection
   - Inspect the flywheel friction surface for cracks and damages, and replace it if it has abnormality.
   - Inspect the tooth part of the ring gear, replace the ring gear if it has damage or serious wear.
2. Measurement of the friction surface
   - Measure the depth of the friction surface of the flywheel.
   - Adjust it if the measured value is within the standard value and the limit.
   - If the measured value exceeds the limit, replace the flywheel.

Depth of the friction surface of the flywheel	mm (in)
Standard	18 (0.7087)
Limit	19 (0.7480)

Depth = From the pressure installation surface to the friction surface.



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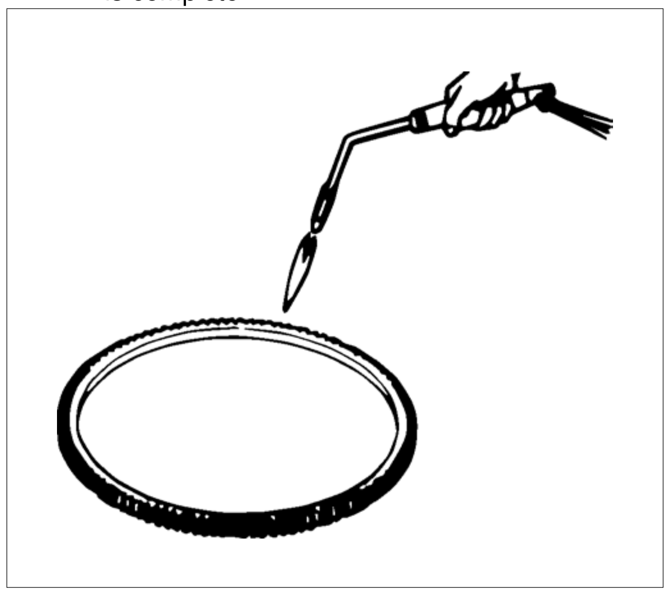
3. Flywheel installation bolts.
   - There is no damage in appearance.
   - Exchange for a new part if damage is extensive.

Installation

1. Install the ring gear.
   - Heat the ring gear evenly with a gas burner to invite thermal expansion. Do not allow the temperature of the gas burner to exceed 200°C (392°F).
   - Install the ring gear when it is sufficiently heated. The ring gear must be installed with the chamfer facing the clutch.

Note:

- Install the ring gear so that the side with a pattern faces forward.
- Shrink fit the ring gear to the flywheel.
  Make sure that flywheel and ring gear adhesion is complete.



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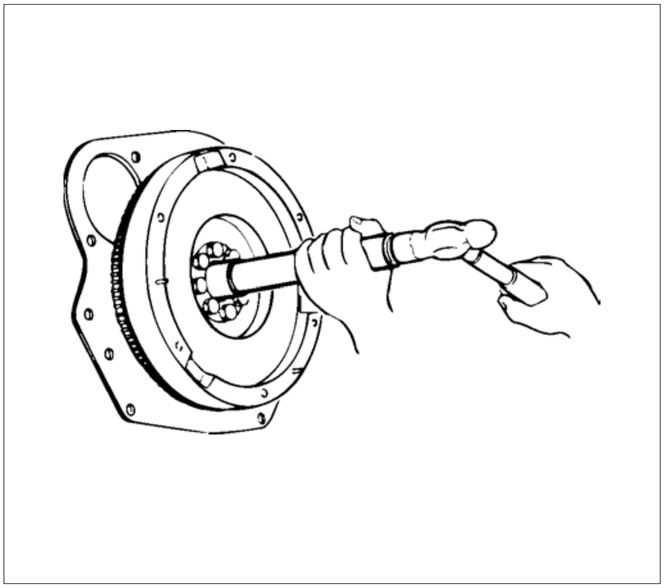
2. Install the pilot bearing.
   - Place the crankshaft pilot bearing right angle across the crankshaft bearing installation hole.
   - Tap around the edges of the crankshaft pilot bearing outer races with a brass hammer to drive the bearing into the crankshaft bearing installation hole.
     Special tool
     Pilot Bearing Installer: 5-8522-0024-0



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3. Install the flywheel.
   - Install the flywheel of the crankshaft, tighten them in the order shown in the illustration.
   - Apply molybdenum disulfide on the screw part and setting face of the bolt.
   - Install the crankshaft stopper on the starter installation part of the rear plate.

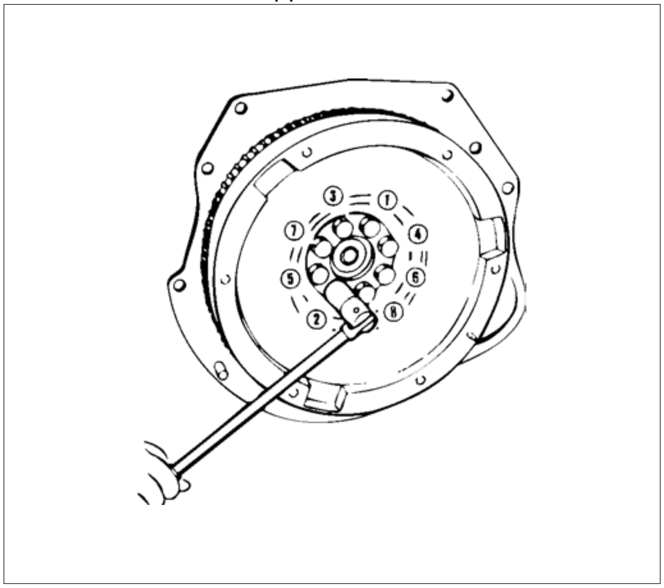
Tightening torque:

1st step = 59 N·m (6.0 kg·m / 43 lb ft)

2nd step = 60° - 90° (degrees)

Special tool

Crankshaft stopper: 5-8840-0214-0



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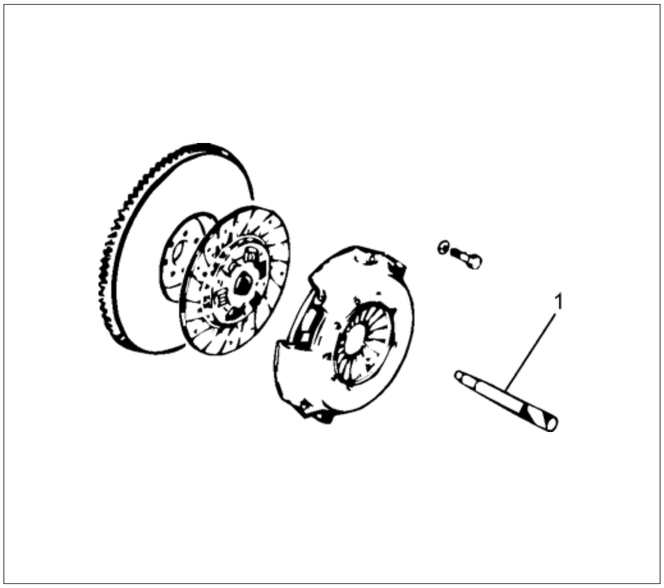
4. Install the driven plate.
   - Use a clutch aligner to install the driven plate on the flywheel.



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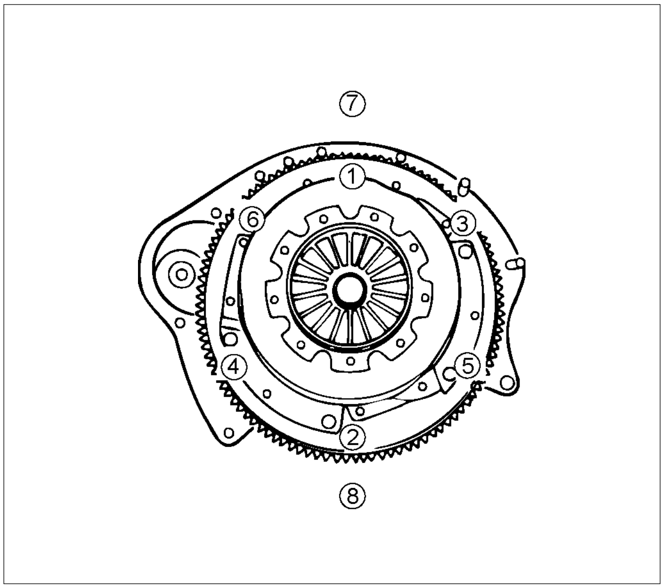
Legend

1. Clutch Aligner

5. Install the clutch pressure plate.
   - Install the pressure plate on the flywheel so that the installation hole of the pressure plate matches with the dowel pins of the flywheel.
   - Tighten the pressure plate in the order shown in the illustration.

Tightening torque: 18 N·m (1.8 kg·m / 13 lb ft)



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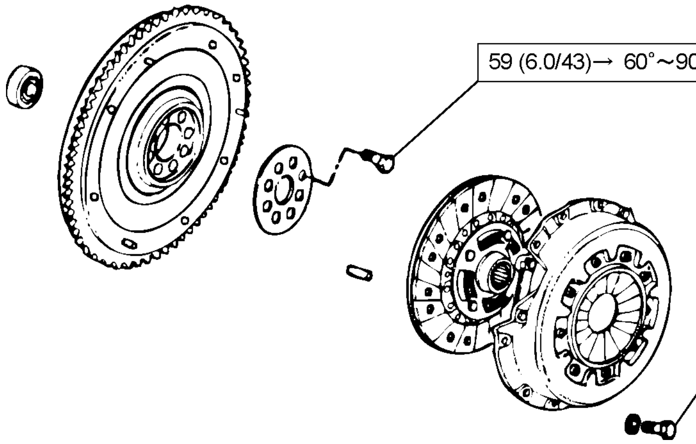
6. Install the transmission assembly.
   Refer to removal procedure for “TRANSMISSION”.

Torque Specifications

N·m (kg·m/lb ft)



Special Tools

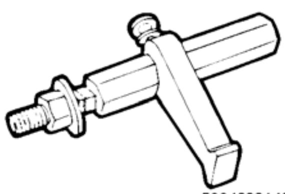
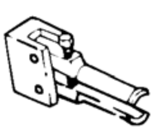
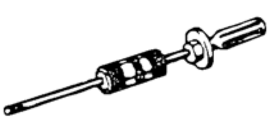
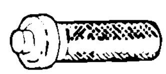
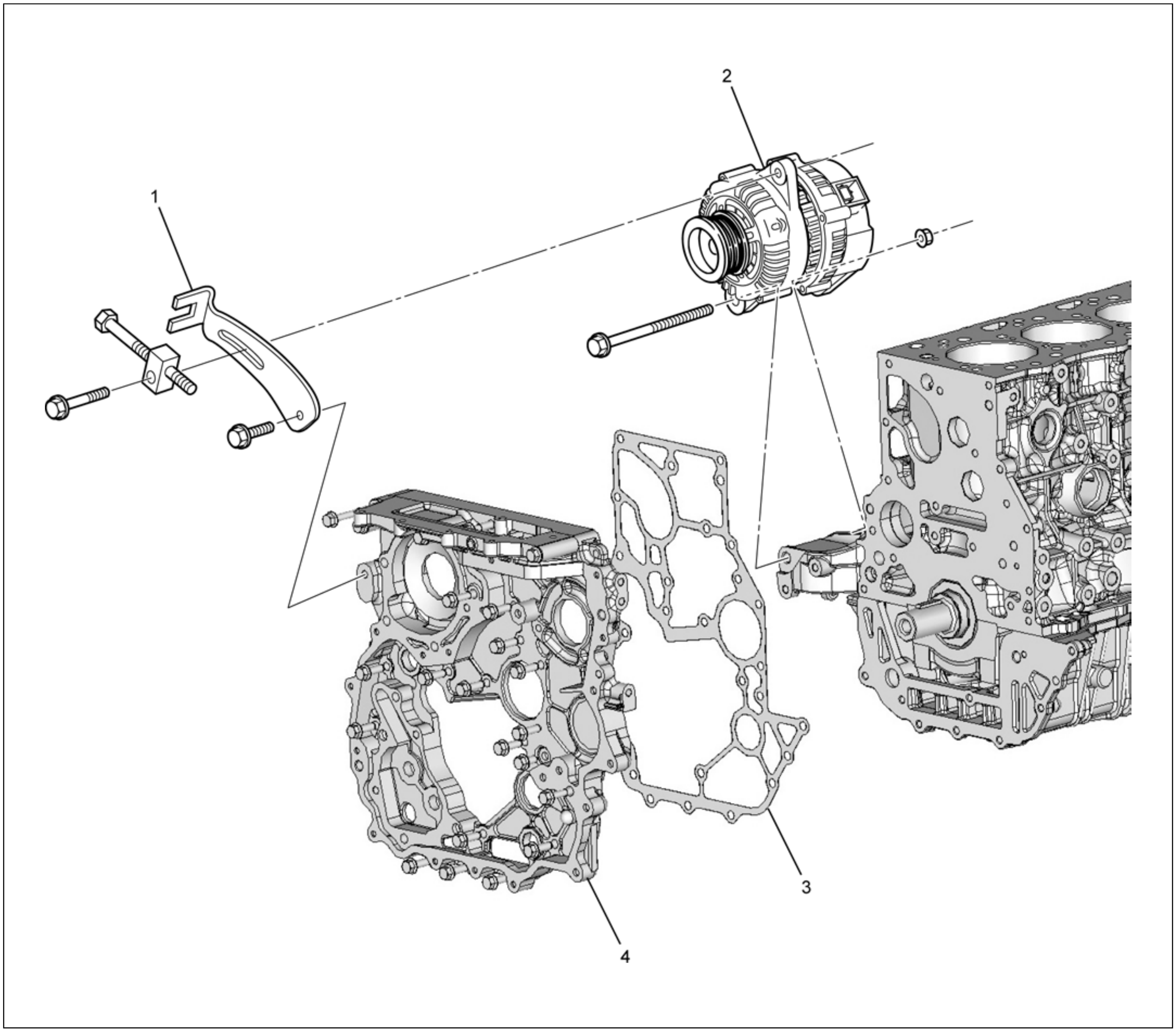
ILLUSTRATION	PART NO. PART NAME
	**5-8840-0214-0** Crankshaft stopper
	**5-8840-2000-0** Pilot Bearing Remover
	**5-8840-0019-0** Sliding Hammer

ILLUSTRATION	PART NO. PART NAME
	**5-8522-0024-0** Pilot Bearing Installer

Gear Case Assembly

Components



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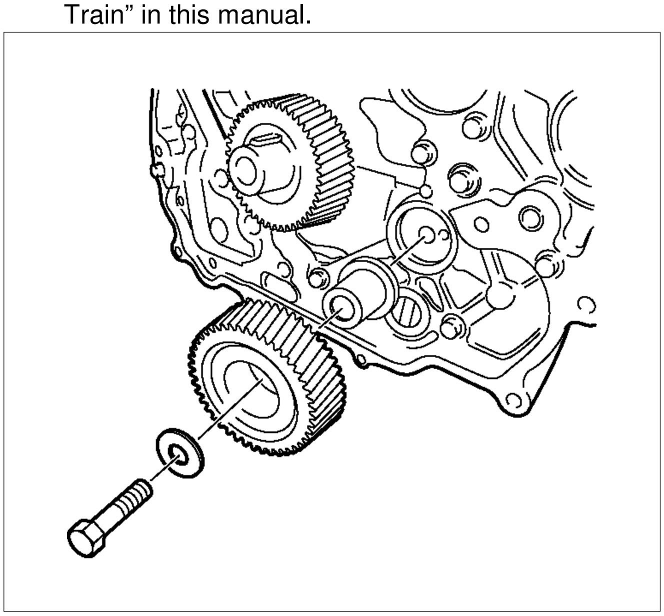
Legend

1. Adjust Plate
2. Generator
3. Gasket
4. Gear Case Assembly

Removal

1. Remove the engine assembly.
   Refer to removal procedure for “Engine Assembly” in this manual.
2. Remove the cylinder head.
   Refer to removal procedure for “Cylinder Head” in this manual.
3. Remove the adjustment bracket of generator.
4. Remove the vacuum pump and pipe.
   Refer to removal procedure for “Brake” in this manual.
5. Remove the power steering pump.
   Refer to removal procedure for “Power Steering” in this manual.
6. Remove the water pump.
   Refer to removal procedure for “Water Pump” in this manual.
7. Remove the fuel supply pump.
   Refer to removal procedure for “Fuel Supply Pump” in this manual.
8. Remove the crankshaft pulley.
   Refer to removal procedure for “Crankshaft Front Oil Seal” in this manual.
9. Remove the gear case cover.
   Refer to removal procedure for “Gear Case Cover” in this manual.
10. Remove the idle gear A and idle gear A shaft, idle gear C and idle gear C shaft.
    Refer to removal procedure for “Timing Gear Train” in this manual.



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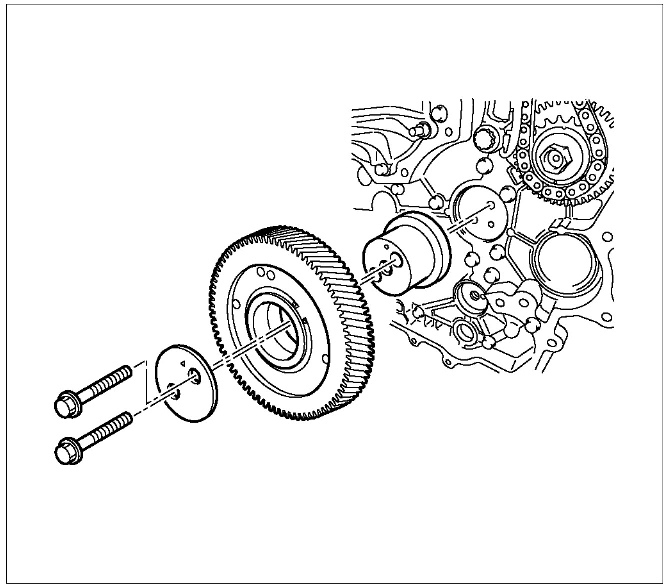

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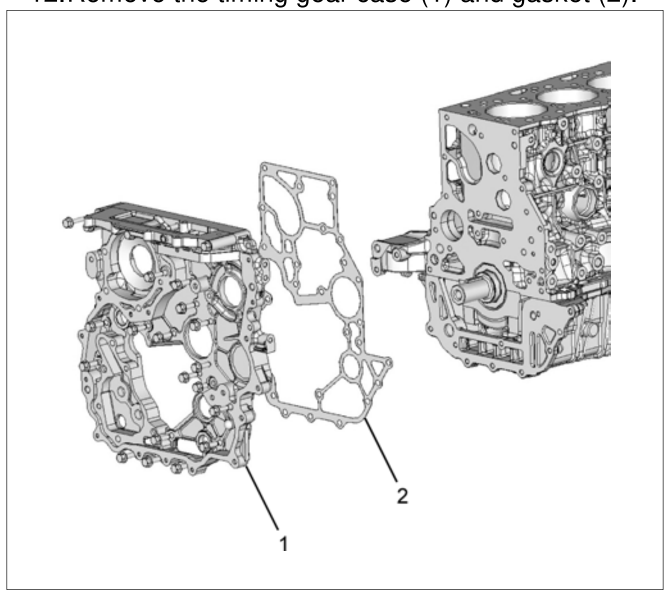
11. Remove the oil pump.
    Refer to removal procedure for “Oil Pump” in this manual.
12. Remove the timing gear case (1) and gasket (2).



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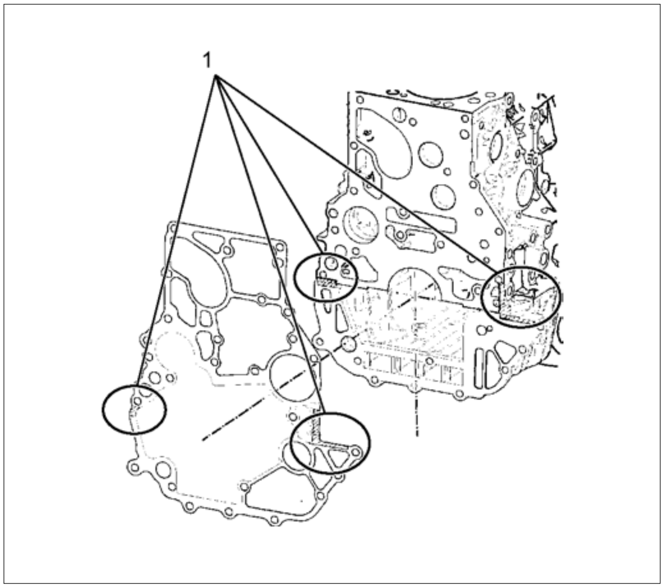
Installation

1. Install the packing of the timing gear case.
   - Apply liquid gasket (ThreeBond 1207B or equivalent) on the joint (1) of the cylinder block and the crank case.



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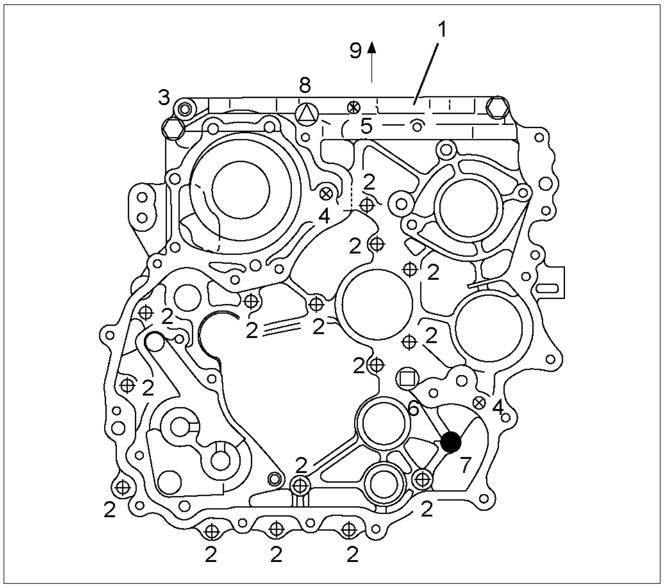
2. Install the timing gear case.
   - Install the timing gear case to match with the dowel pins, install bolts in the order shown in the illustration.



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Legend

1. Gear Case Assembly
2. Bolt L = 25 mm (0.98 in)
3. Bolt L = 60 mm (2.36 in)
4. Bolt L = 45 mm (1.77 in)
5. Bolt L = 35 mm (1.38 in)
6. Bolt L = 16 mm (0.63 in)
7. Bolt L = 20 mm (0.79 in)
8. Bolt L = 50 mm (1.97 in)
9. UP

- Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

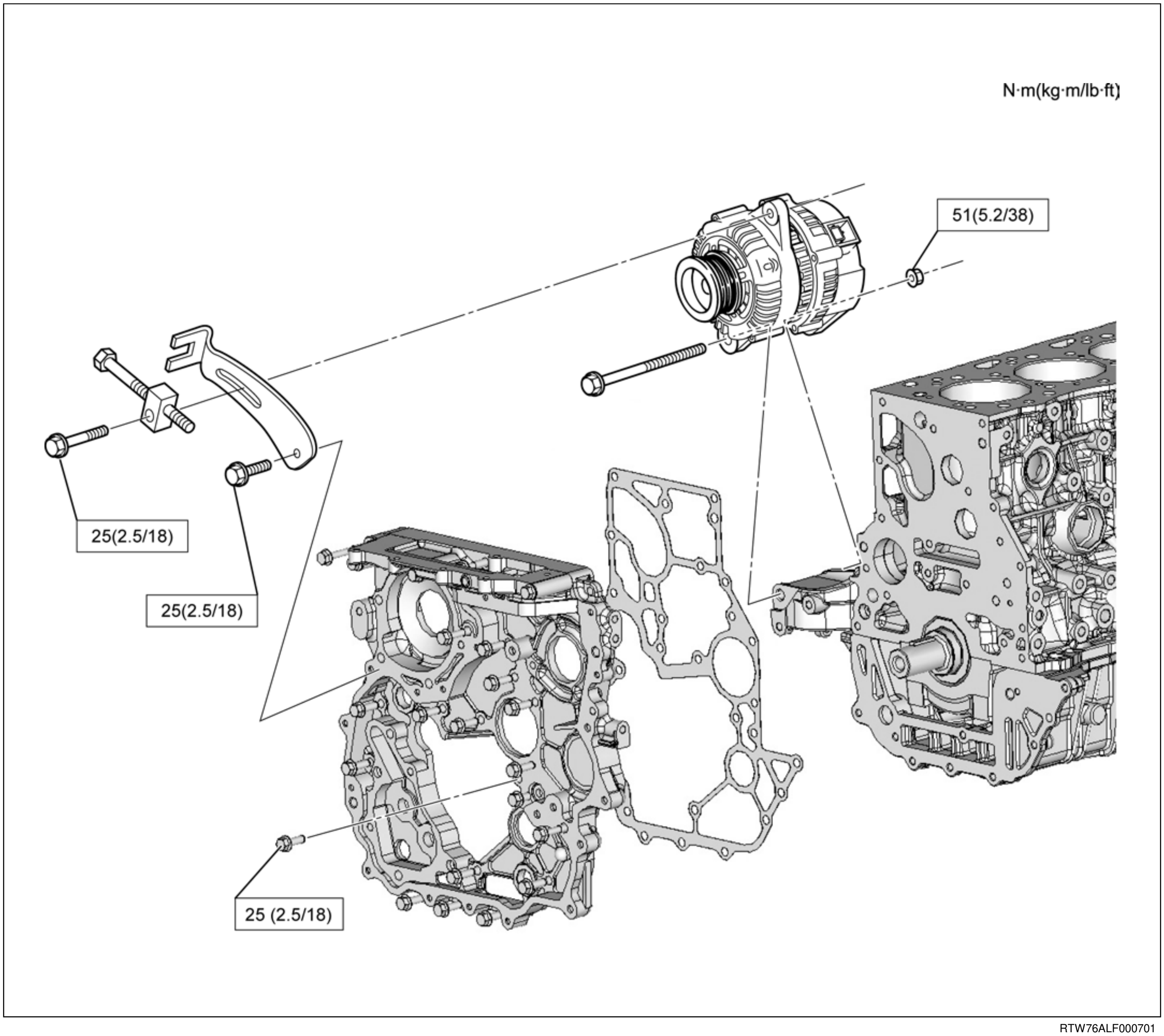
- Tighten them in the order shown in the illustration.

3. Install the oil pump.
   Refer to installation procedure for “Oil Pump” in this manual.
4. Install the idle gear C shaft and idle gear C, idle gear A shaft and idle gear A.
   Refer to installation procedure for “Timing Gear Train” in this manual.
5. Install the gear case cover.
   Refer to removal procedure for “Gear Case Cover” in this manual.
6. Install the crankshaft pulley.
   Refer to removal procedure for “Crankshaft Front Oil Seal” in this manual.
7. Install the fuel supply pump.
   Refer to installation procedure for “Fuel Supply Pump” in this manual.
8. Install the water pump.
   Refer to installation procedure for “Water Pump” in this manual.
9. Install the power steering pump.
   Refer to removal procedure for “Power Steering” in this manual.
10. Install the vacuum pump and pipe.
    Refer to removal procedure for “Brake” in this manual.
11. Install the adjustment bracket of generator.
    Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

12. Install the cylinder head.
    Refer to installation procedure for “Cylinder Head” in this manual.
13. Install the engine assembly.
    Refer to installation procedure for “Engine Assembly” in this manual.

Torque Specifications



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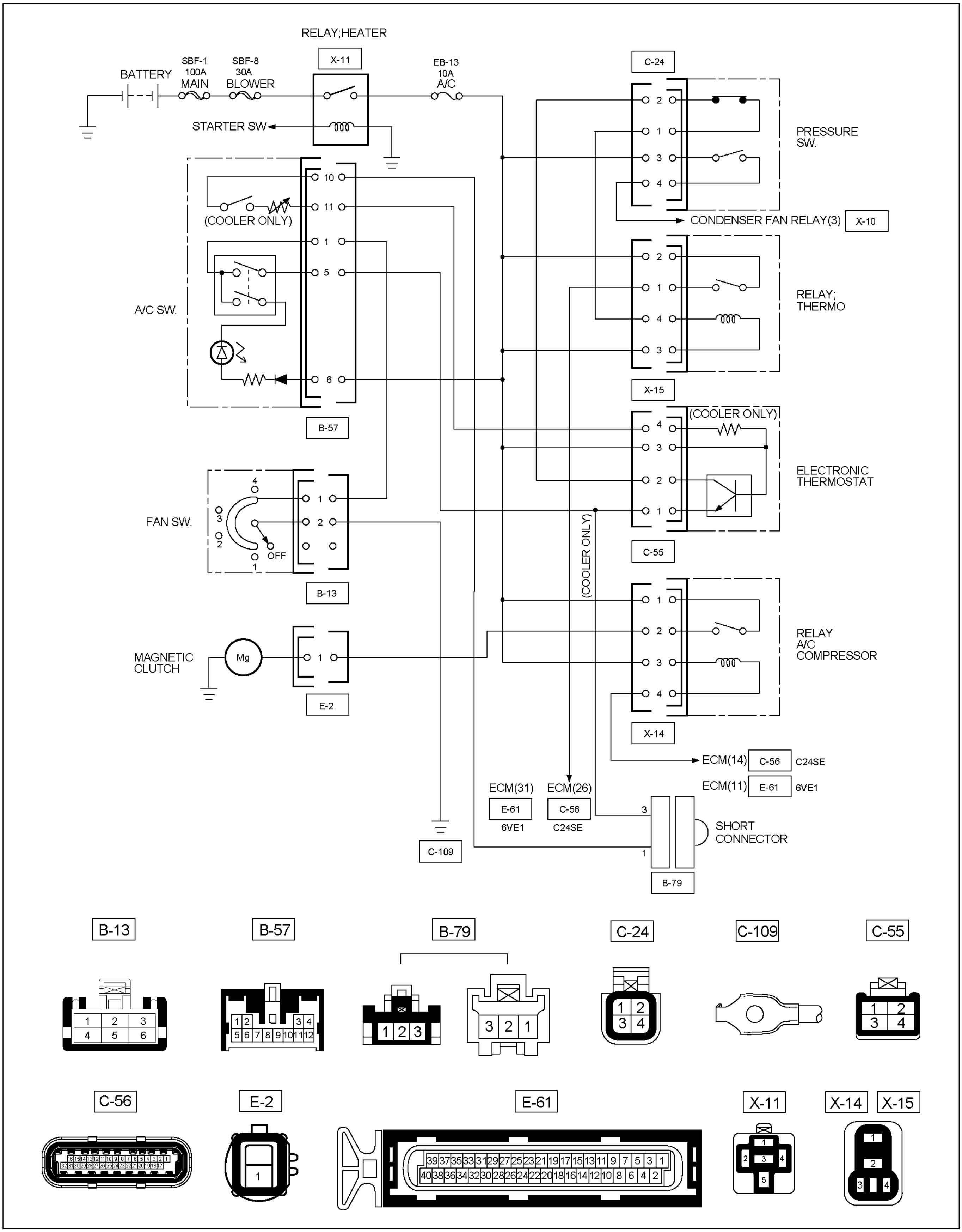

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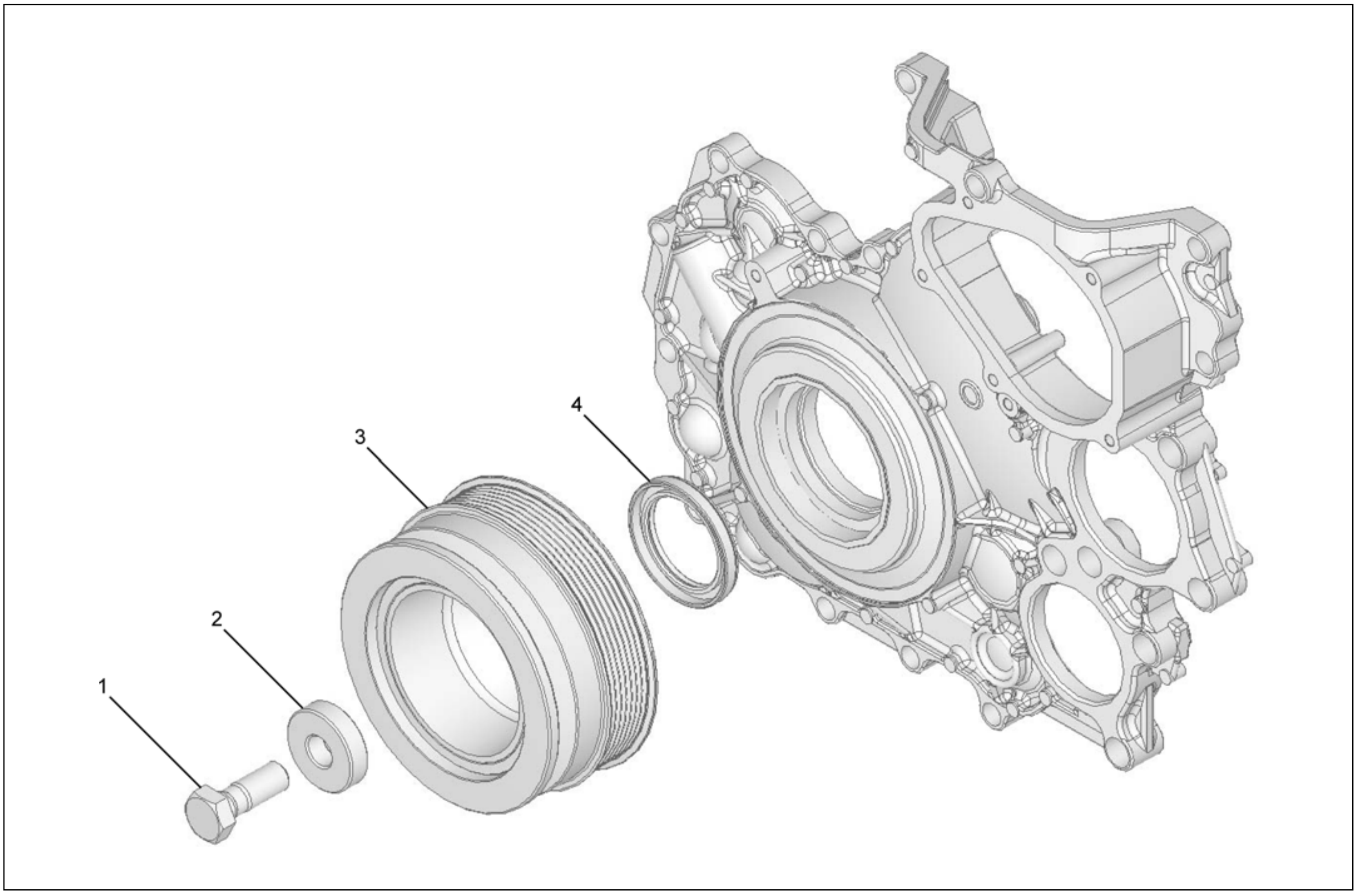
Crankshaft Front Oil Seal

Components



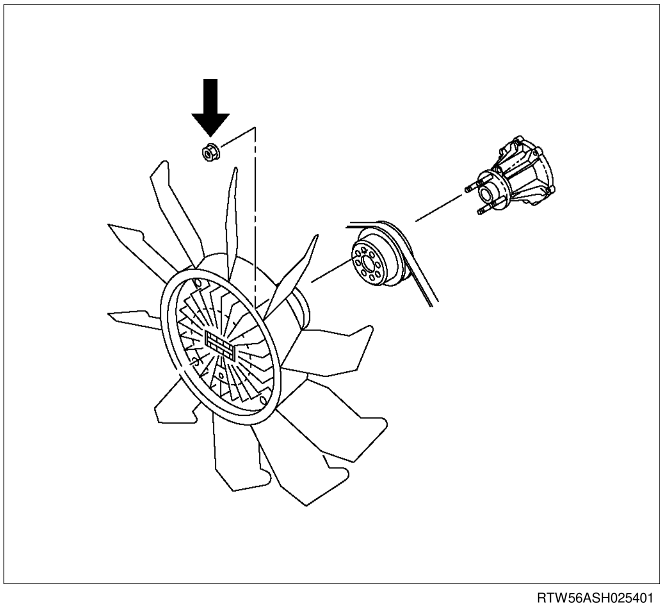
RTW76AMF000501

Legend

1. Bolt
2. Washer
3. Crankshaft Damper Pulley
4. Crankshaft Front Oil Seal

Removal

1. Remove the fan assembly.
   - Remove the fan assembly unscrewing four mounting nuts.



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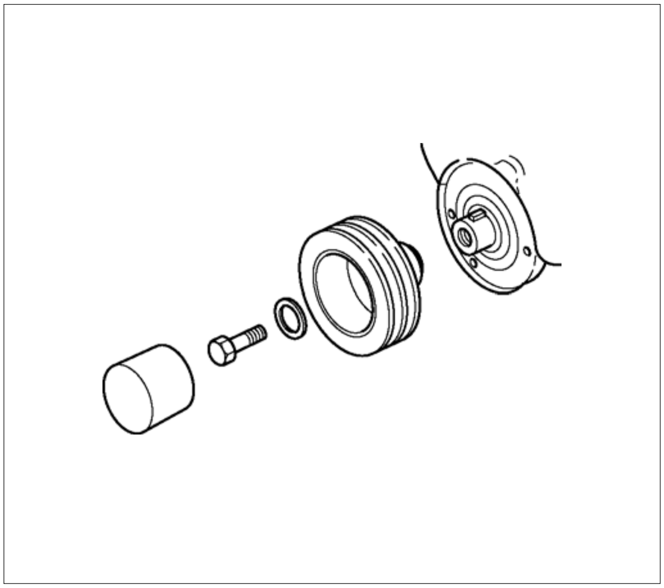
2. Remove the fan belt.

3. Remove the crankshaft pulley.

Note:
Do not reuse the bolt and the washer.



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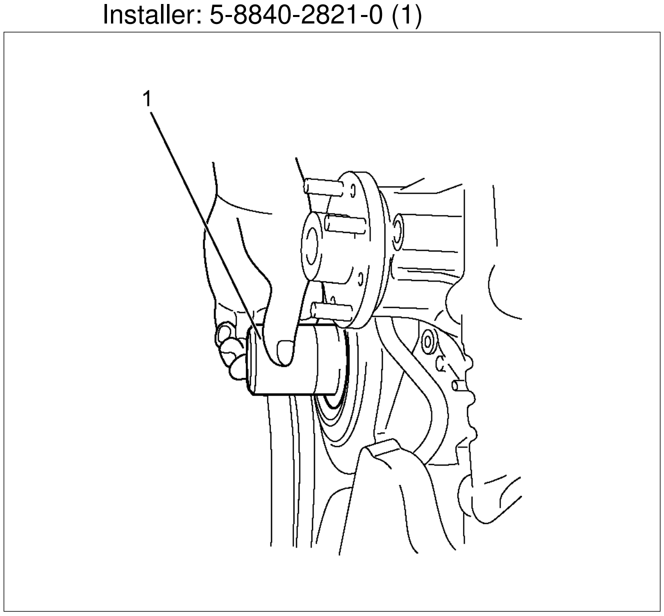
4. Remove the crankshaft front oil seal.
   - Remove only the oil seal with a screwdriver or the like, avoiding damage to the oil seal contact surface on the front cover and the shaft.

Installation

1. Install the crankshaft front oil seal.
   - Use the special tool to install the front oil seal.
     Front Oil Seal
     Installer: 5-8840-2821-0 (1)



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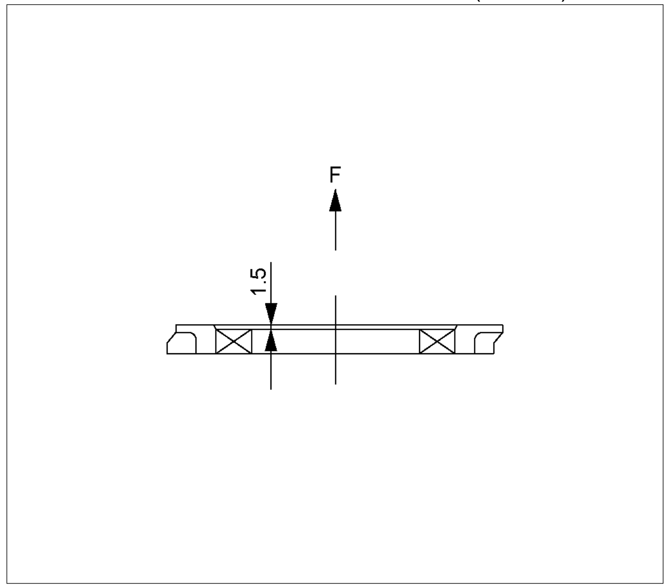
- Apply engine oil to the lip of the oil seal.
- With the seal pressed in check the dimension of the oil seal section.
  Standard Dimension = 1.5 mm (0.06 in)



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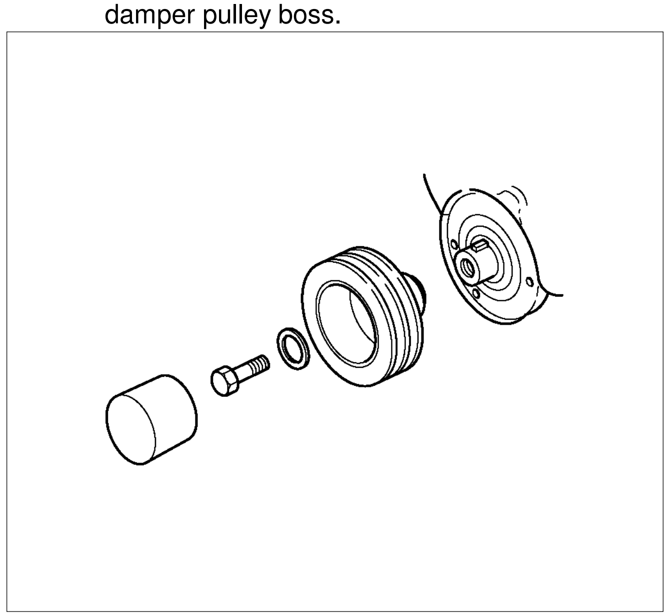
2. Install the crankshaft damper pulley.
   - Install the crankshaft pulley aligning with the key on the crankshaft.
   - Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley bolt.

Tightening torque: 294 N·m (30 kg·m/217 lb ft)

   - Take care not to damage the crankshaft damper pulley boss.



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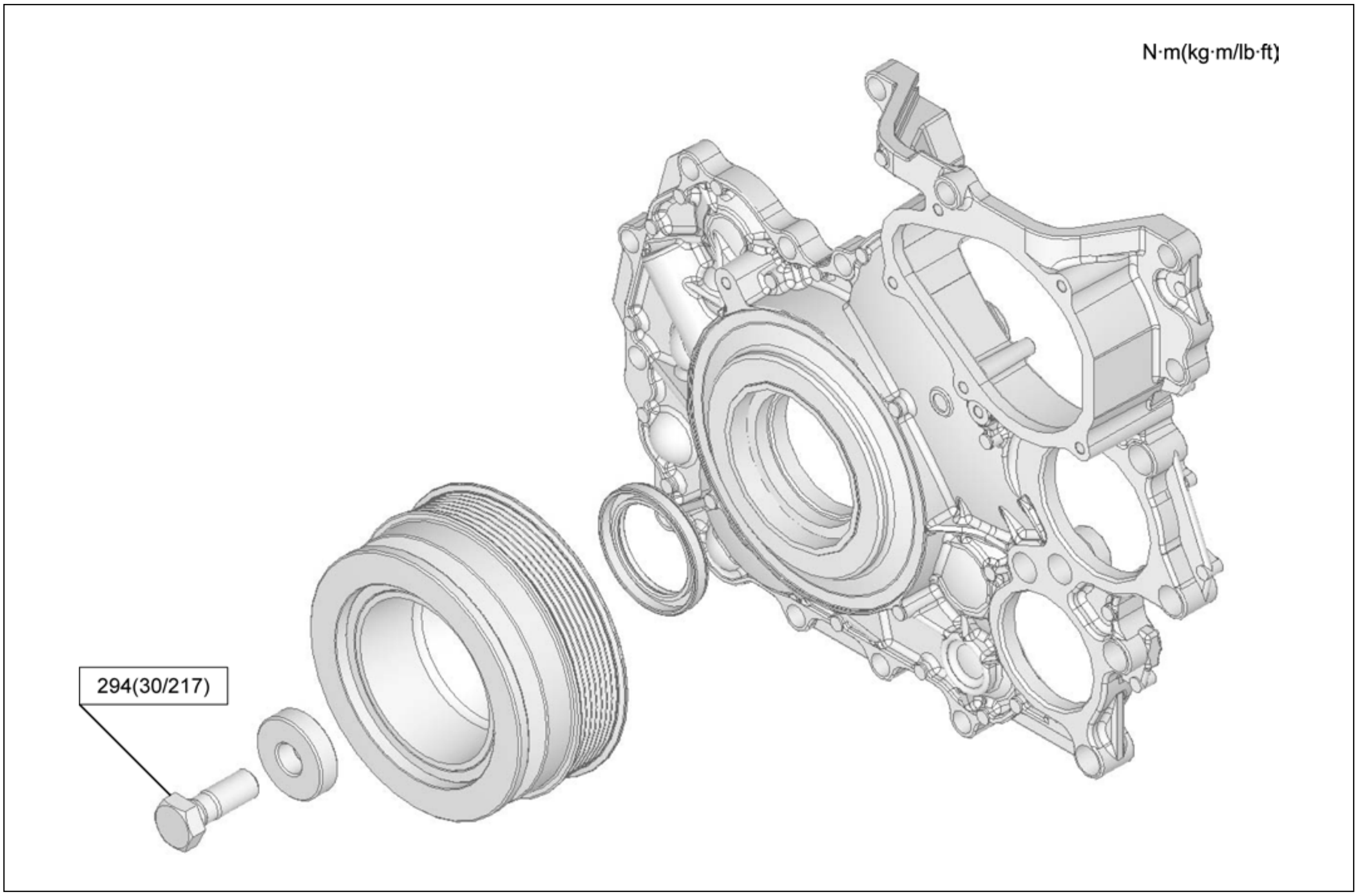
3. Install the fan belt.
   - Refer to “Engine Cooling”

Torque Specifications



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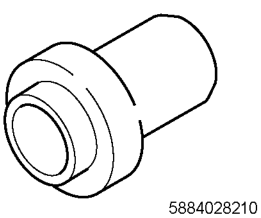
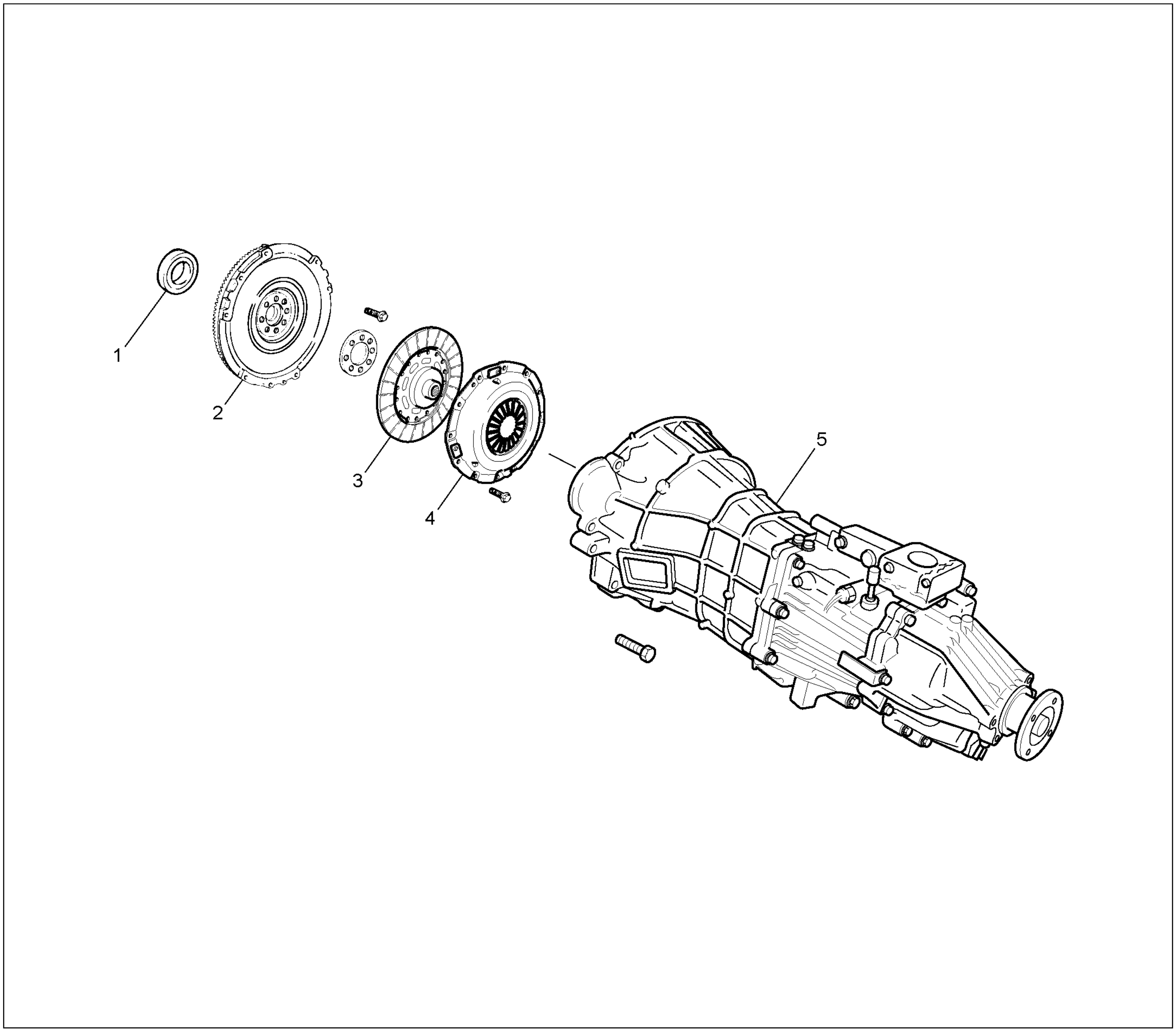
Special Tools

ILLUSTRATION	PART NO. PART NAME
	**5-8840-2821-0** Oil seal installer

Crankshaft Rear Oil Seal

Components

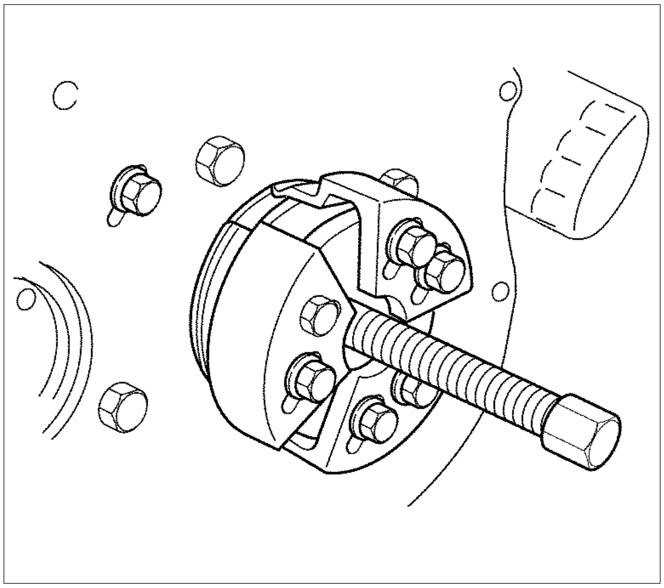


Legend

1. Crankshaft Rear Oil Seal
2. Flywheel
3. Driven Plate
4. Clutch Pressure Plate
5. Transmission Assembly

Removal

1. Remove the flywheel.
   Refer to "Flywheel".
   - With the oil seal pushed in deep, install the special tool as shown in the illustration and remove the oil seal.
     Oil Seal Remover: 5-8840-2360-0



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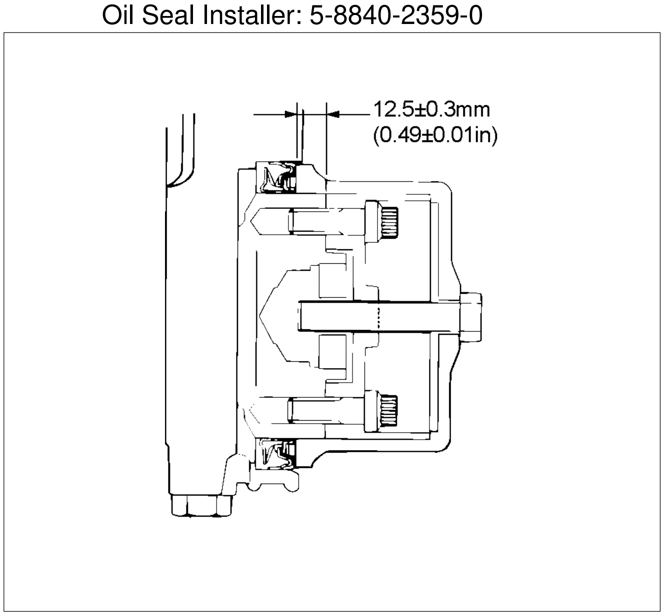
Installation

1. Install the crankshaft rear oil seal.
   - Use an oil seal install to install the crankshaft rear oil seal.
     Oil Seal Installer: 5-8840-2359-0



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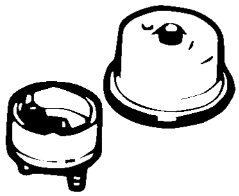
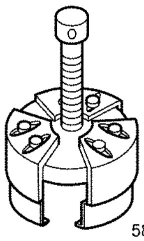
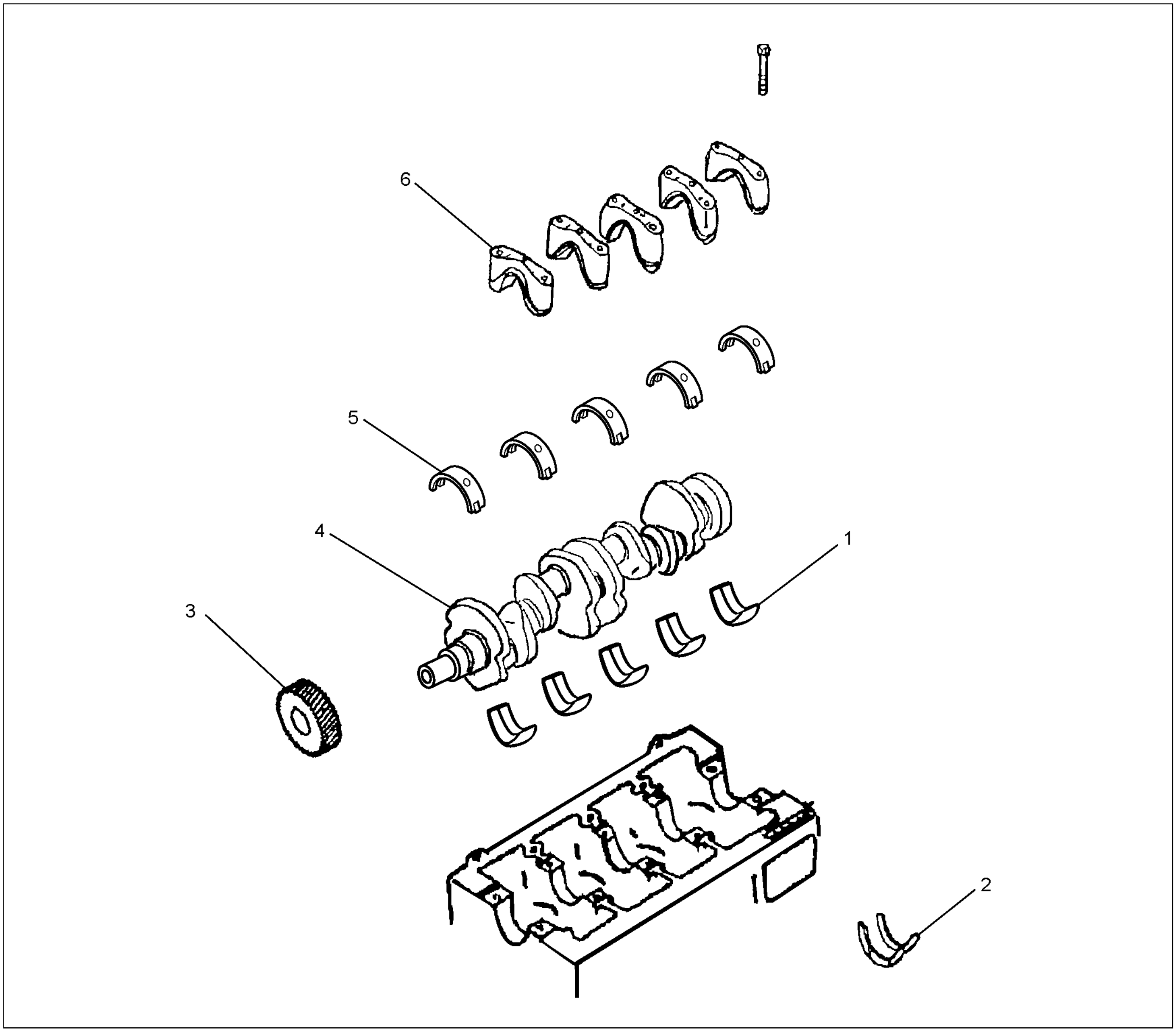
2. Install the flywheel.
   Refer to "Flywheel".

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884023590	**5-8840-2359-0** Oil seal installer
 5884023600	**5-8840-2360-0** Oil seal remover

Crankshaft

Components

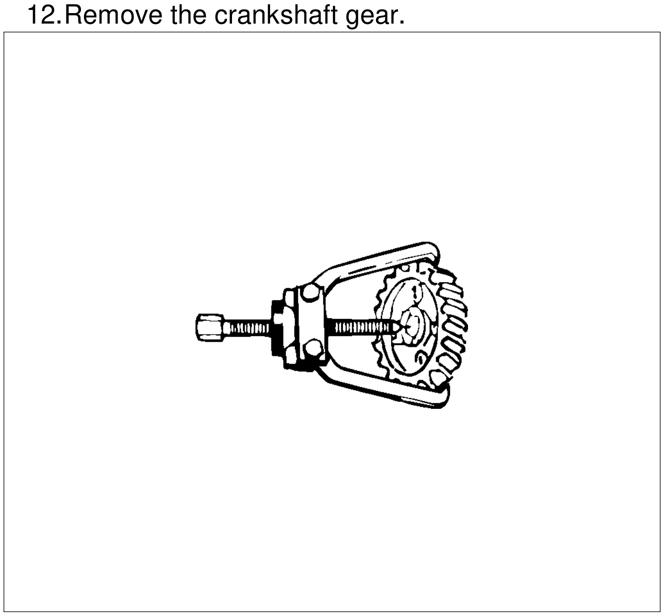


Legend

1. Upper Bearing
2. Thrust Bearing
3. Gear
4. Crankshaft
5. Lower Bearing
6. Bearing Cap

Removal

1. Demount the engine assembly.
   Refer to "Engine Assembly".
2. Remove the cylinder head cover.
   Refer to "Cylinder Head Cover".
3. Remove the camshaft.
   Refer to "Camshaft Assembly".
4. Remove the cylinder head.
   Refer to "Cylinder Head".
5. Remove the fuel supply pump and fuel rail.
   Refer to "Fuel Supply Pump" and "Fuel Rail" in the fuel system section.
6. Remove the front cover.
   Refer to "Front Cover".
7. Remove the crankshaft rear oil seal.
   Refer to "Crankshaft Rear Oil Seal".
8. Remove the water pump.
   Refer to "Water Pump" in Cooling System Section.
9. Remove the timing gear train.
   Refer to "Timing Gear Train".
10. Remove the oil pump.
    Refer to "Oil Pump".
11. Remove the gear case assembly.
    Refer to “Gear Case Assembly”.
12. Remove the crankshaft gear.



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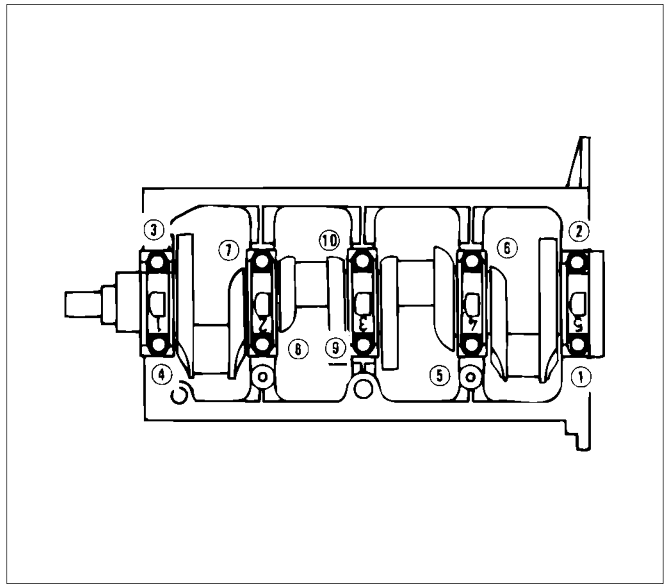
13. Remove the crank case.
    Refer to "Crank Case and Oil Pan".
14. Remove pistons and connecting rods.
    Refer to "Piston and Connecting Rod".
15. Remove the bearing cap.
    - Loosen the crankshaft bearing cap bolts in numerical order a little at a time.



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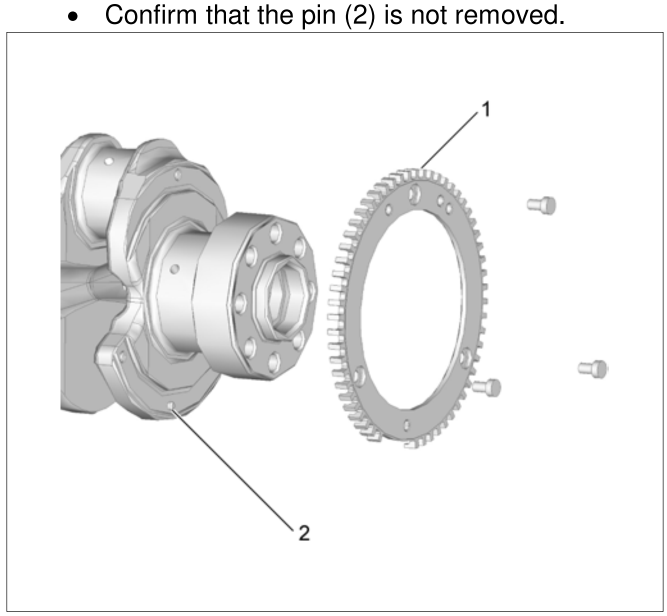
16. Remove the lower crankshaft bearings.
17. Remove the crankshaft assembly.
18. Remove the thrust bearing.
19. Remove the upper crankshaft bearings.

Disassembly

1. Remove the crank angle sensor rotor (1).
   - Confirm that the pin (2) is not removed.



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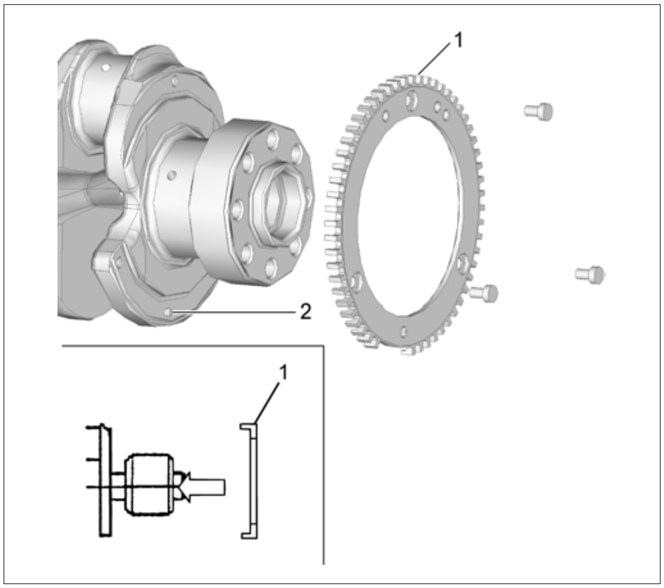
Reassembly

1. Install the crank angle sensor rotor.
   - Attach by making a rotor tooth's running out side into a front side.
   - Apply Loctite #262 or the equivalent to the bolt threads (if a new bolt is used, Loctite application is not required).

Tightening torque: 12 N·m (1.2 kg·m / 104 lb in)



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Legend

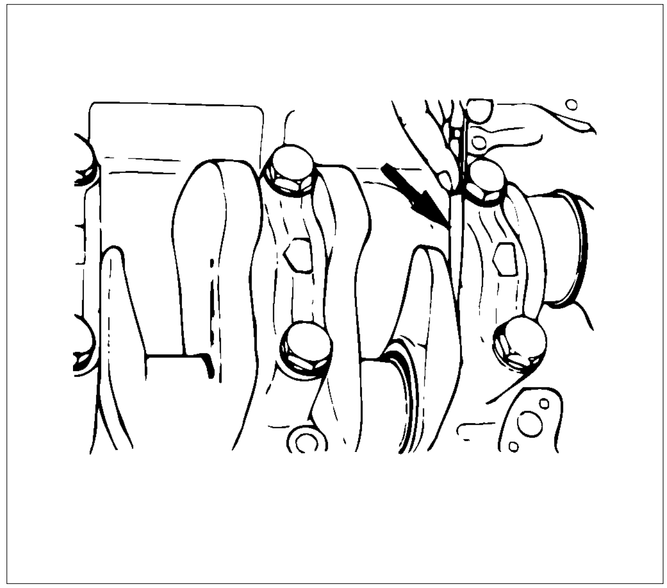
1. Crank Angle Sensor Rotor
2. Pin

Inspection

1. Thrust clearance
   - Measure the crankshaft end play at the center journal of the crankshaft.
   - Do this before removing the crankshaft bearing caps. If the measured value exceeds the specified limit, the crankshaft thrust bearing must be replaced.

Axial play of the crankshaft	mm (in)
Standard	0.10 (0.004)
Limit	0.30 (0.012)

Note:
Measure the thrust clearance before dismounting.



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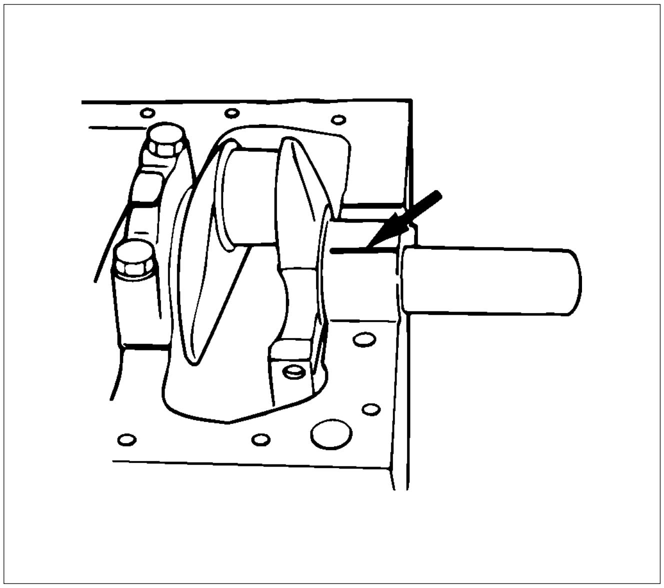
2. Main bearing clearance
   - Remove the crank case.
     Set out disassembled main bearings in the order of the numbers.
   - Remove the crankshaft. Remove the main bearings.
   - Clean the crankshaft journal and upper and lower bearings.
   - Check the bearings for damage or excessive wear.

     If you find damage or excessive wear, replace the bearings in pairs.

   - Place the upper bearings and the crankshaft on the cylinder block. Install the crankshaft so that it is horizontal.

Note:
Turn the crankshaft about 30 degrees to allow the bearings to settle in.

   - Place plastigage on the crankshaft journal as shown.
   - Place the lower bearings at original positions on the bearing cap.



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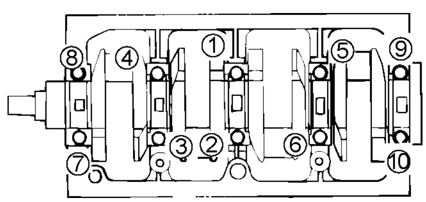
- Install the bearing cap and tighten bolts to the specified tightening torque.
- Tighten the bearing cap in the sequence shown using a torque wrench and an angle gauge.



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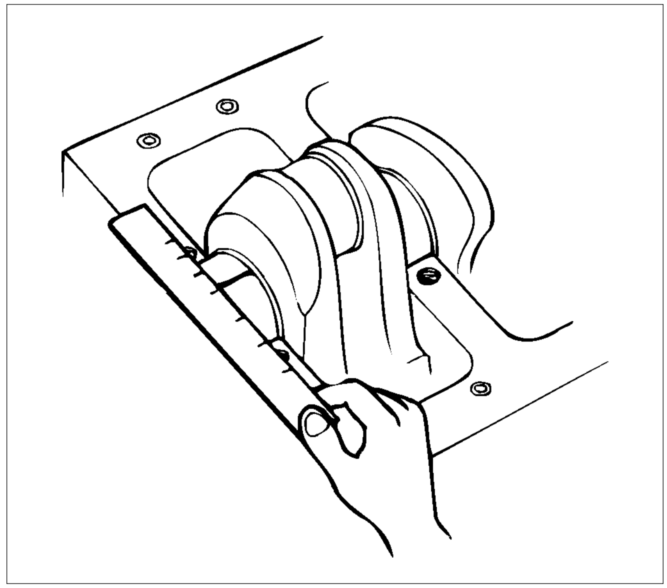
Tightening torque: 166 N·m (16.9 kg·m / 122 lb ft)

Note:
Do not turn the crankshaft after you have tightened the bearing cap.

- Loosen the bolts and gently remove the bearing cap.
- Measure the widest part of the Plastigage flattened by tightening the bearing cap to determine the clearance.

Journal oil clearance	mm (in)
Standard	0.032 - 0.077 (0.0013 - 0.0030)
Limit	0.11 (0.0043)



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- If the journal oil clearance exceeds the limit, replace the main bearings altogether or the crankshaft.
- Remove the Plastigage from the bearings and the crankshaft.

Inspection of the crankshaft

- Check the crankshaft journal and crank pin surfaces for wear and damage. Check the oil seal contact surface for excessive wear and damage.
- Check the oil port for clogging.

3. Crankshaft run-out
   Carefully set the crankshaft on the V block. Slowly turn the crankshaft to measure the run-out. If the crankshaft run-out exceeds the limit, replace the crankshaft.

Crankshaft run-out	mm (in)
Standard	0.05 or less (0.0020 or less)
Limit	0.08 (0.003)

MAGNETIC CLUTCH DOES NOT RUN (C24SE)

• Are the No. SBF 8 fuse (30A) and the No. EB-13 (10A) fuses OK?

YES

NO

Replace

• Are the A/C thermo (X-15), heater & A/C (X-11) and A/C compressor (X-14) relay OK?

YES

NO

Replace

• Is the pressure switch (C-24) OK?

YES

NO

Defective switch or insufficient refrigerant

• Is the electronic thermostat (C-55) OK?

YES

NO

Replace

• Are the A/C switch (B-57) and the fan switch (B-13) OK?

YES

NO

Replace

• Turn the ignition switch "ON" (Engine is running)
• A/C switch and fan control knob (fan switch "ON")

• Disconnect the magnetic clutch connector.

• Is there battery voltage between the engine room harness connector terminal No.1 (E-2) and ground?

NO

• Disconnect the A/C compressor relay.

• Is there continuity between the engine harness connector terminal No.1 (E-2) and the engine room harness connector terminal No.2 (X-14)?

YES

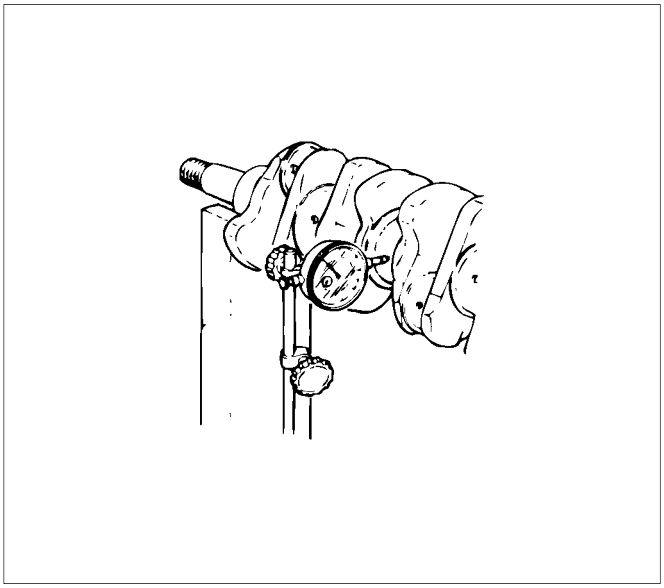
Does the magnetic clutch operate?

YES

Defective compressor

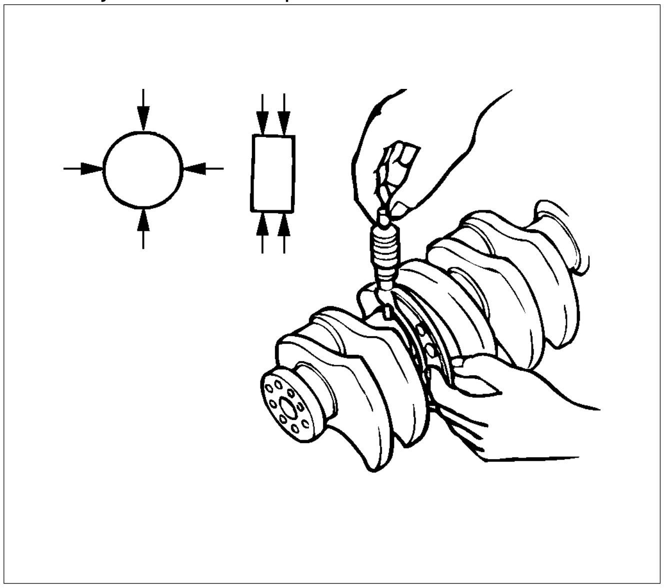
NO

Defective magnetic clutch



015LX061

4. Measure the journal and the crankpin diameters and uneven wear.
   - Measure outer diameters of the journal and the pin and calculate differences between the maximum and the minimum values. Take measurements at four positions for both the journal and the pin.



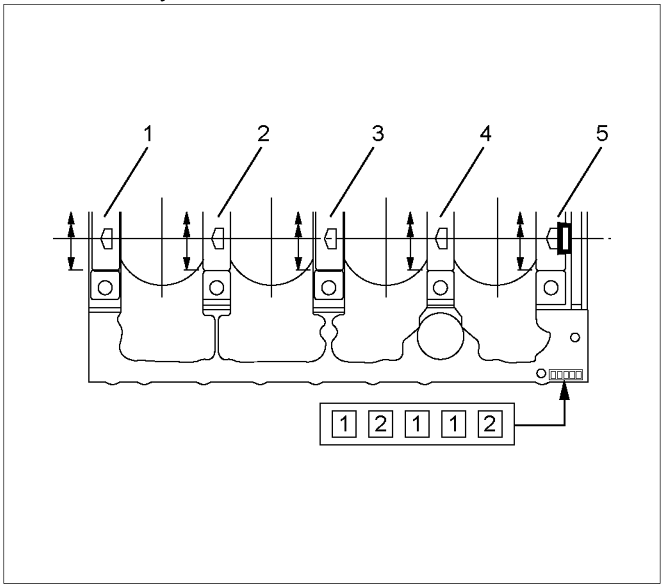
LNW21BSH024601

Crankshaft outside diameter		mm (in)
	Standard	Limit
Journal	69.917 – 69.932 (2.7526 – 2.7532)	69.91 (2.7524)
Pin	52.915 – 52.930 (2.0833 – 2.0839)	52.9 (2.083)

Note:
Tufftriding (soft nitriding treatment) is applied to enhance strength of the crankshaft. Therefore, you should not polish the surface of the crankshaft.

Crankshaft bearing selection

- Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.
- Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.
- Crankshaft bearing housing grade marks 1, 2 or 3 are stamped on the rear right hand side of the cylinder block.



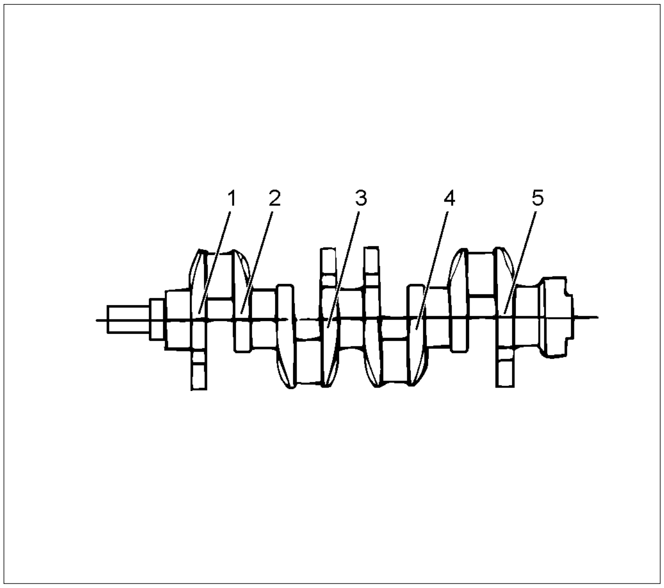
RTW56ASH017101

Legend

1. No.1
2. No.2
3. No.3
4. No.4
5. No.5

- The crankshaft journal grade marks (1 or -, 2 or --, 3 or ---) are stamped on each crankshaft journal web.
  The crankshaft journal and bearing clearance must be the same for each position after installation of the crankshaft and the crankshaft bearings.

4JK1



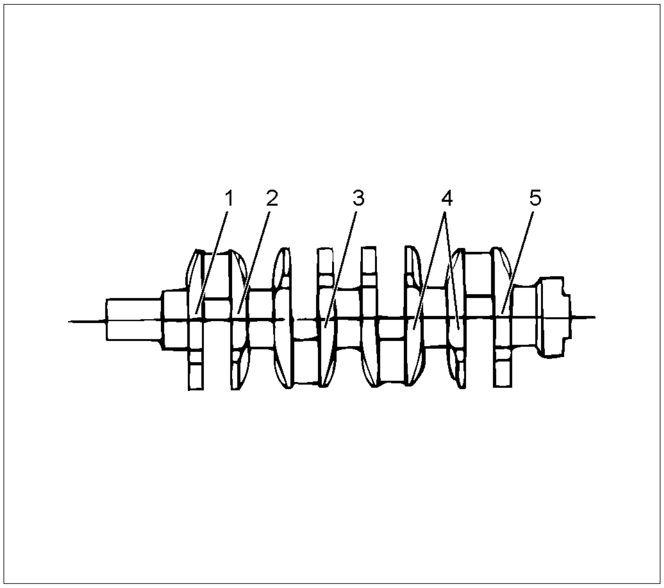
RTW56ASH023901

Legend

1. No.1
2. No.2
3. No.3
4. No.4
5. No.5

NOTE:
The crankshaft journal mark No. 4 is stamped on crankshaft No. 4 journal web front side or rear side.

4JJ1

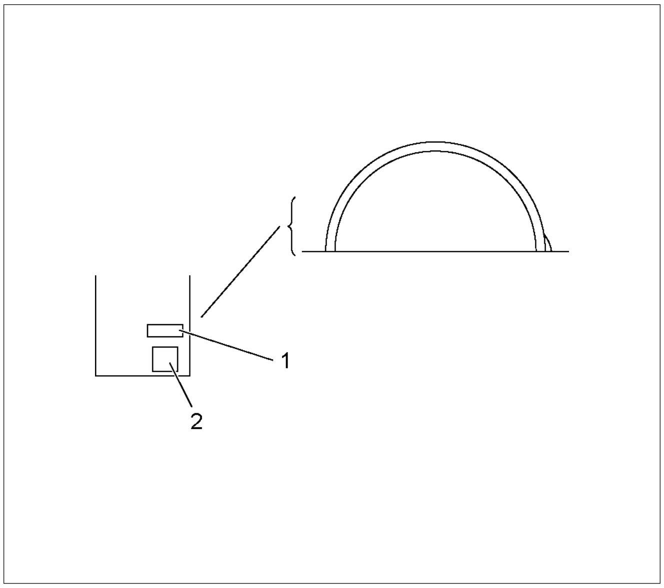


RTW56ASH017201

Legend

1. No.1
2. No.2
3. No.3
4. No.4
5. No.5

Note:
Be careful about difference in the shape of the bearings when installing them.



RTW56ASH017301

Legend

1. Lot No.
2. Size Code

Bearing Selection Table

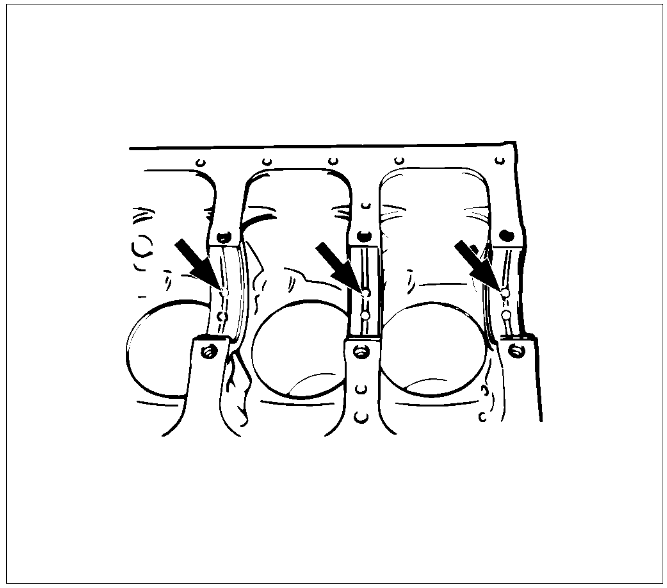
mm (in)

Crankshaft Bearing Housing		Crankshaft Journal		Crankshaft Bearing Size Code
Grade Mark	Diameater	Grade Mark	Diameater	
1	73.992-74.000 (2.9131-2.9134)	1 or -	69.927-69.932 (2.7530-2.7532)	4
		2 or - -	69.922-69.927 (2.7528-2.7530)	
		3 or - - -	69.917-69.922 (2.7526-2.7528)	5
2	73.983-73.991 (2.9127-2.9130)	1 or -	69.927-69.932 (2.7530-2.7532)	2
		2 or - -	69.922-69.927 (2.7528-2.7530)	3
		3 or - - -	69.917-69.922 (2.7526-2.7528)	4
3	73.975-73.982 (2.9124-2.9127)	1 or -	69.927-69.932 (2.7530-2.7532)	1
		2 or - -	69.922-69.927 (2.7528-2.7530)	2
		3 or - - -	69.917-69.922 (2.7526-2.7528)	

Installation

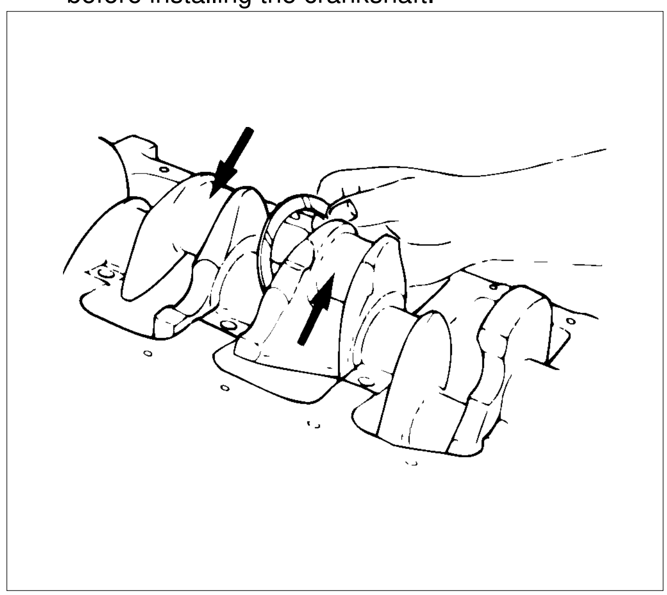
1. Install the crankshaft upper bearing.
   - The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not.
   - Carefully wipe any foreign material from the upper bearing.
   - Locate the position mark applied at disassembly if the removed upper bearings are to be reused.

Note:
Do not apply engine oil to the bearing back faces and the cylinder block bearing fitting surfaces.



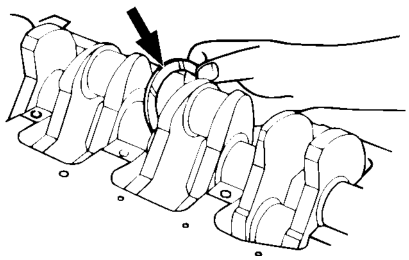
015LX125

2. Install the crankshaft assembly.
   Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft.



015R100004

3. Install the thrust bearing.
   - Apply an ample coat of engine oil to the thrust bearings before installation. Install the thrust bearings to the crankshaft center journal.
   - The thrust bearing oil grooves must be facing the sliding faces.

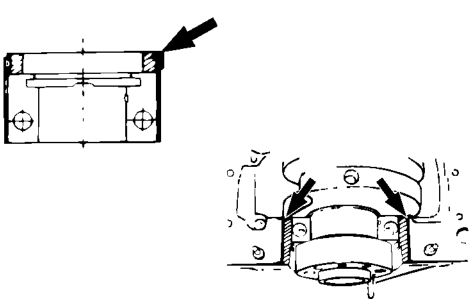


015LX115

4. Install the lower crankshaft bearing.
   - Before the crankshaft bearing installation, select the appropriate bearings in accordance with the description in CRANK BEARING SELECTION of INSPECTION AND REPAIR.
   - Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap cylinder body fitting surfaces at the points shown in the illustration.

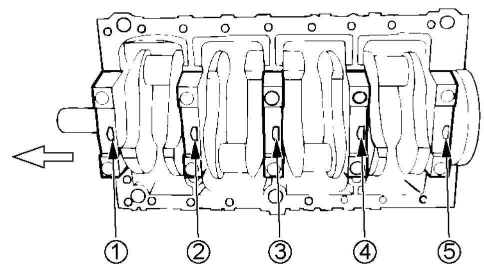
Note:
Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket. ThreeBond 1207B Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.

ThreeBond 1207B is a fast-drying liquid gasket. Tighten the bearing caps immediately after applying the gasket.



015LX127

5. Install the bearing cap.
   - Install the bearing caps with the bearing cap head arrow mark facing the front of the engine. The bearing cap numbers must be facing up.



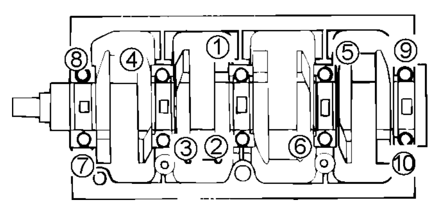
015LX128

   - Tighten the crankshaft bearing cap bolts to the specified torque a little at time in the sequence shown in the illustration.

Crankshaft Bearing Cap Torque	N·m (kg·m / lb ft)
166 (16.9 / 122)	

Check to see the crankshaft turns smoothly by rotating it manually.

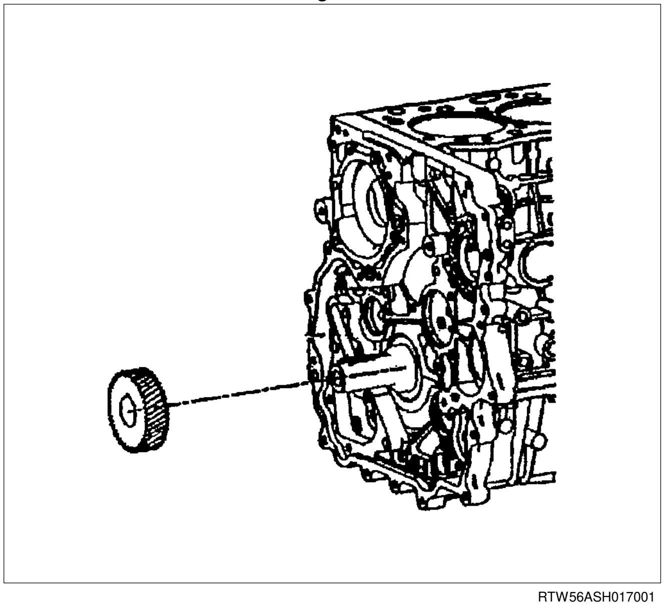
Note:
Confirm that the crankshaft turns smoothly.



015LX129

6. Install pistons and connecting rods.
   Refer to "Piston and Connecting Rod".

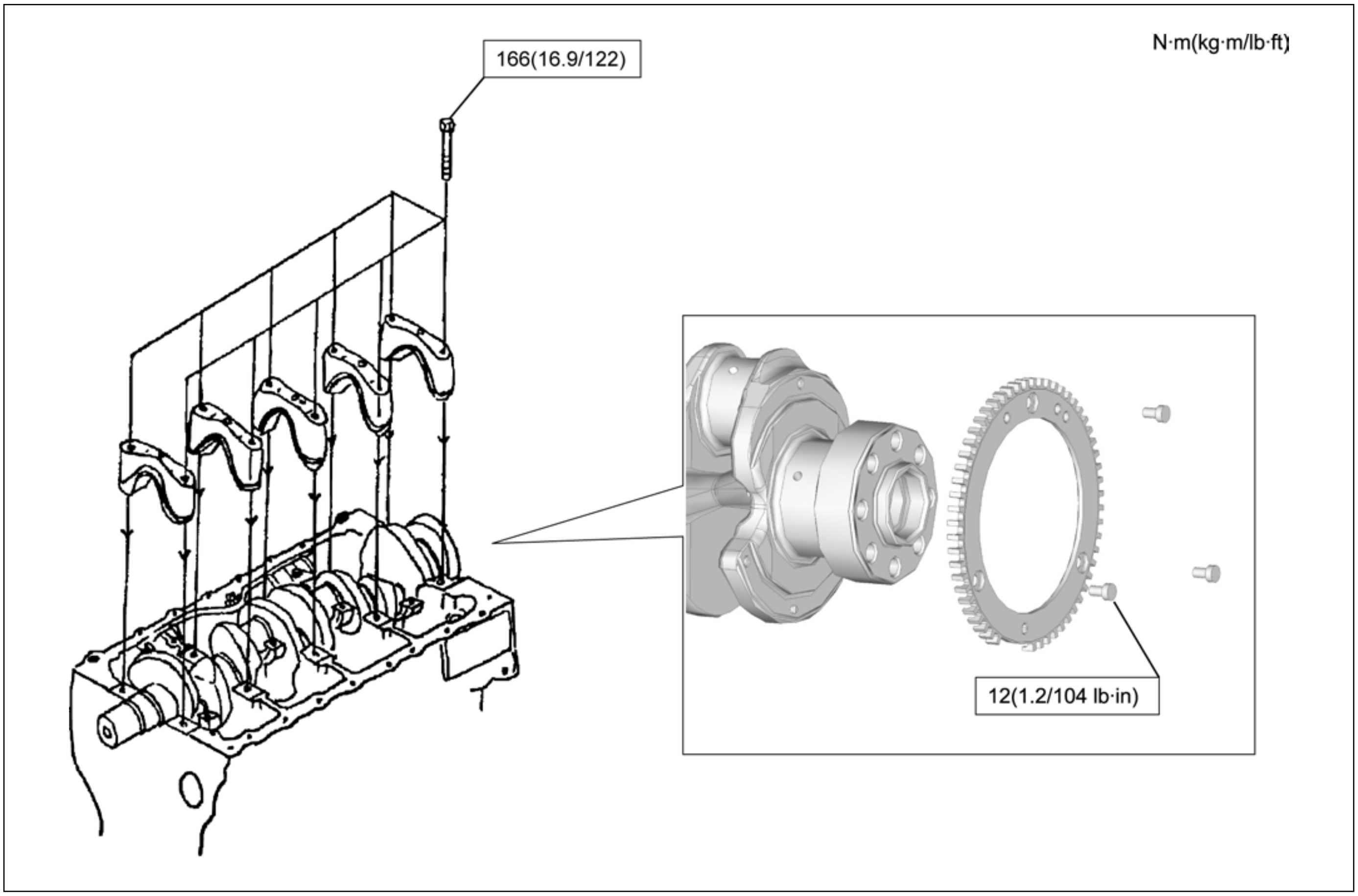
7. Install the crank case.
   Refer to "Crank Case and Oil Pan".
8. Install the crankshaft gear.



RTW56ASH017001

9. Install the gear case assembly.
   Refer to "Gear Case Assembly".
10. Install the oil pump.
    Refer to "Oil Pump".
11. Install the timing gear train.
    Refer to "Timing Gear Train".
12. Install the water pump.
    Refer to "Water Pump" in Cooling System Section.
13. Install the front cover.
    Refer to "Timing Gear Train".
14. Install the crankshaft rear oil seal.
    Refer to "Crankshaft Rear Oil Seal".
15. Install the fuel supply pump and fuel rail.
    Refer to "Fuel Supply Pump" and "Fuel Rail".
16. Install the cylinder head.
    Refer to "Cylinder Head".
17. Install the camshaft assembly.
    Refer to "Camshaft Assembly".
18. Install the cylinder head cover.
    Refer to "Cylinder Head Cover".
19. Mount the engine assembly on the chassis.
    Refer to "Engine Assembly".

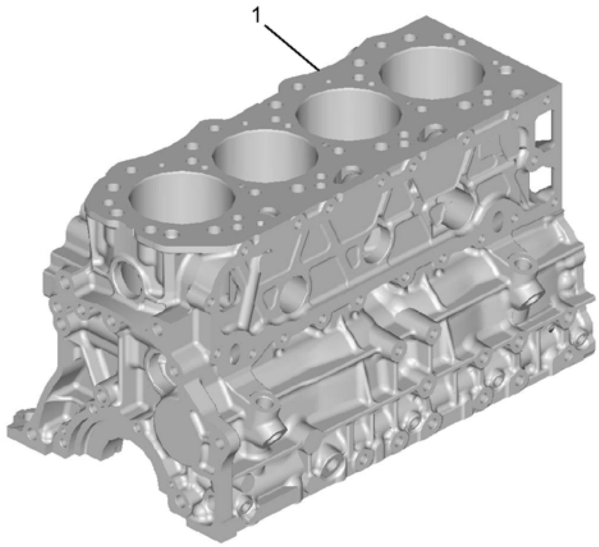
Torque Specifications



RTW76AMF000301

Cylinder Block

Components



RTW76ASF000101

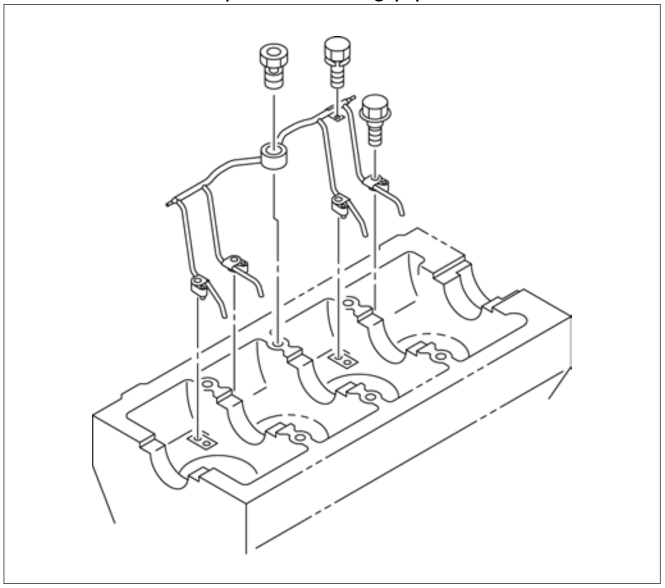
Legend

1. Cylinder Block

Removal

1. Demount the engine assembly.
   Refer to "Engine Assembly".
2. Remove the cylinder head cover.
   Refer to "Cylinder Head Cover".
3. Remove the camshaft assembly.
   Refer to "Camshaft Assembly".
4. Remove the cylinder head.
   Refer to "Cylinder Head".
5. Remove the fuel supply pump and fuel rail assembly.
   Refer to "Fuel Supply Pump" and "Fuel Rail Assembly" in FUEL SYSTEM Section.
6. Remove the oil filter assembly and oil cooler.
   Refer to “Oil Filter Assembly and Oil Cooler”.
7. Remove the crankshaft front oil seal.
   Refer to "Crankshaft Front Oil Seal".
8. Remove the crankshaft rear oil seal.
   Refer to "Crankshaft Rear Oil Seal".
9. Remove the oil pan.
   Refer to "Oil Pan".
10. Remove the water pump.
    Refer to "Water Pump" in Cooling System Section.
11. Remove the front cover.
    Refer to "Front Cover".
12. Remove the timing gear train.
    Refer to "Timing Gear Train".
13. Remove the oil pump.
    Refer to "Oil Pump".
14. Remove pistons and connecting rods.
    Refer to "Piston and Connecting Rod".
15. Remove the crankshaft.
    Refer to "Crankshaft".

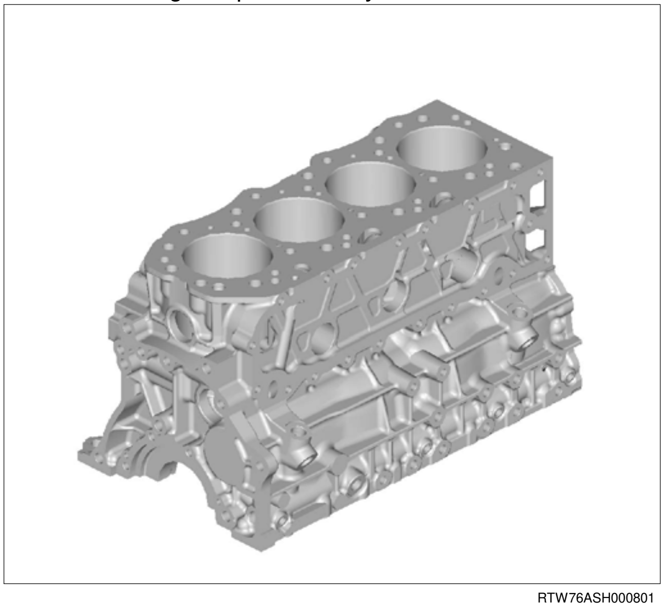
16. Remove the piston cooling pipe.



RTW76ASH001101

Inspection

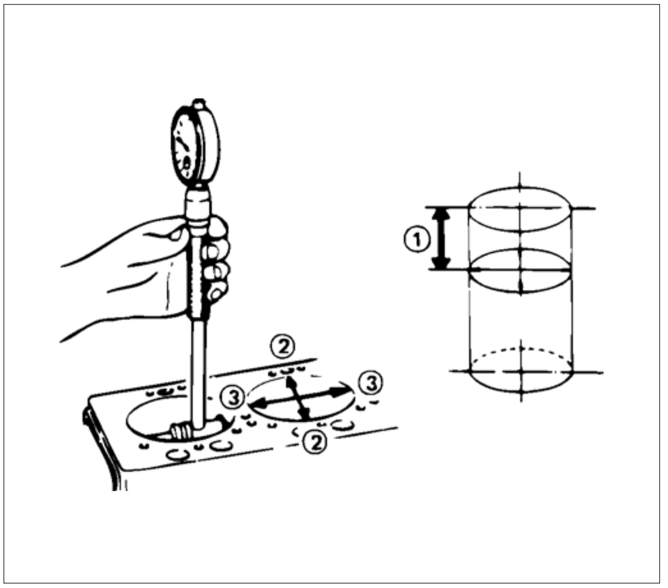
1. Carefully remove water stains or other foreign matters on the surface of the cylinder block.
   - Be careful not to damage the cylinder block.
2. Carefully remove the liquid gasket on the crankcase mounting surface.
3. Clean up the cylinder block.
4. Visually inspect the cylinder block.
   - Conduct color check and hydraulic (or pneumatic) test and if you find a crack or other damage, replace the cylinder block.



RTW76ASH000801

5. Cylinder block wear measurement.
   - Use a cylinder indicator to measure the cylinder bore at measuring point (1) in the thrust (2-2) and axial (3-3) directions of the crankshaft.
   - Measuring Point (1): 20 mm (0.79 in)

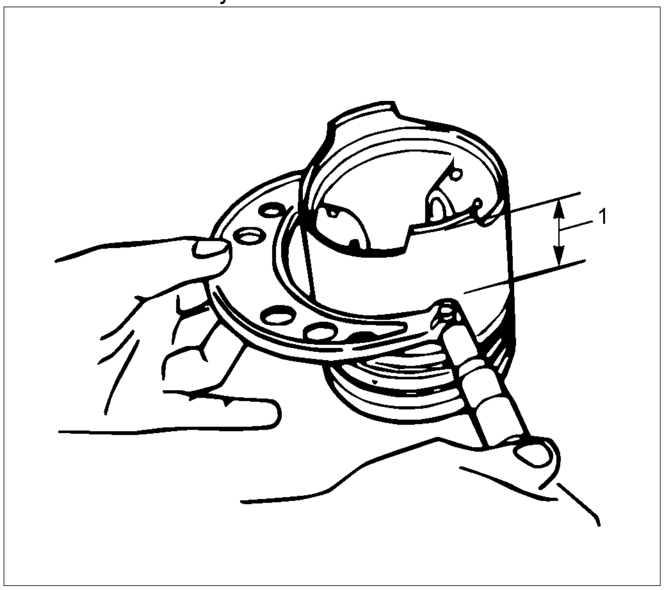
     If the measured value exceeds the specified limit, the cylinder block must be replaced or rebored.



012RY00010

Cylinder block bore diameter	mm (in)
Standard	95.421 – 95.450 (3.7567 – 3.7579)
Limit	95.48 (3.7590)

6. Cylinder Reboring.
   - Select oversize pistons to fit the largest cylinder bore (previously measured).
   - At a point 11 mm (0.43 in) above the lower edge of the piston skirt, measure the piston diameter at a right angle to the piston pin. Calculate the additional cylinder boring required for each cylinder.



RTW56ASH023101

Legend

1. 11mm (0.43in)

- Formula

Boring inside diameter = D + C - H ± E

D = Piston outside diameter

(Measured Oversize Piston)

C = Piston and cylinder bore clearance

0.082 - 0.100 mm (0.0032 - 0.0039 in)

H = Honing allowance

0.03 mm (0.0012 in) or less

E = Boring machine error

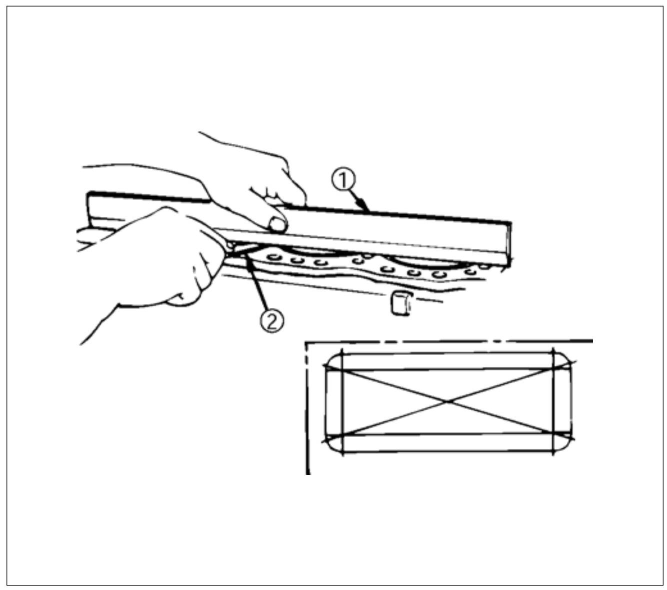
Piston size		mm (in)
Standard		95.330 - 95.359 (3.7531 - 3.7543)
Oversize	(0.25)	95.580 - 95.609 (3.7629 - 3.7641)
	(0.50)	95.830 - 95.859 (3.7728 - 3.7739)
	(0.75)	96.080 - 96.109 (3.7826 - 3.7838)

- Bore and hone the individual cylinders as required.
- Once again, measure the individual cylinder bores.

Each cylinder bore remainder mm (in)
0.02 (0.0008) or less.

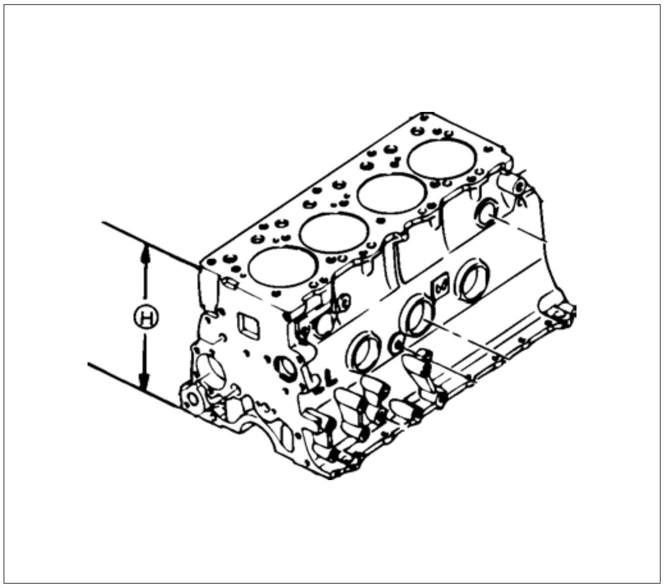
7. Cylinder block upper face warpage.
   - Use a straight edge (1) and a thickness gauge (2) to measure the four sides and the two diagonals of the cylinder block upper face.
   - If the measured values exceeds the limit, the cylinder block must be replaced.

Cylinder block upper face warpage	mm (in)
Standard	0.05 or less (0.002 or less)
Limit	0.20 (0.0080)



012R100001

Cylinder block height (H) (Reference)	mm (in)
Standard	259.945 – 260.055 (10.2340 – 10.2384)



012R100009

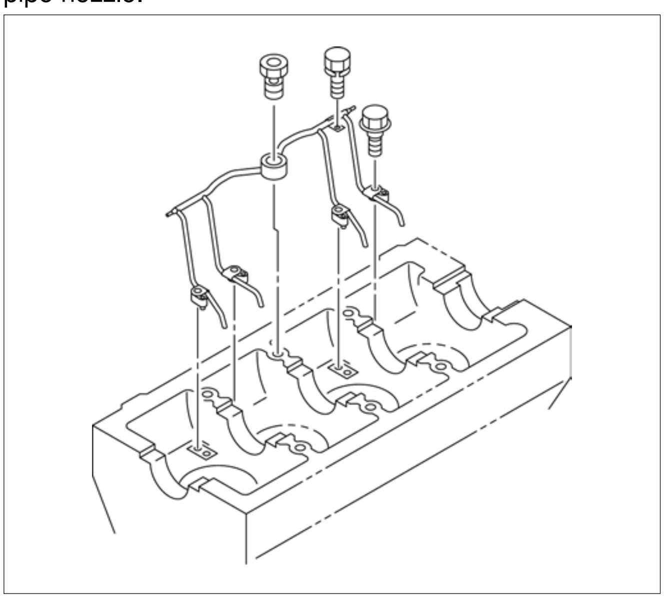
Installation

1. Install the piston cooling pipe.
   - Align the dowel pin of the piston cooling pipe with the pin hole on the cylinder block and tighten with the relief valve.

Tightening torque:

Relief valve 30 N·m (3.1 kg·m / 22 lb ft)
bolts M8 25 N·m (2.5 kg·m / 18 lb ft)
bolts M6 8 N·m (0.8 kg·m / 69 lb in)

Note:
Be careful not to deform or damage the piston cooling pipe nozzle.



RTW76ASH001101

2. Install the crankshaft.
   Refer to "Crankshaft".
3. Install pistons and connecting rods.
   Refer to "Piston and Connecting Rod".
4. Install the oil pump.
   Refer to "Oil Pump".
5. Install the timing gear train.
   Refer to "Timing Gear Train".
6. Install the front cover.
   Refer to "Front Cover".
7. Install the water pump.
   Refer to "Water Pump" in Cooling System Section.
8. Install the oil pan.
   Refer to "Oil Pan".
9. Install the crankshaft rear oil seal.
   Refer to "Crankshaft Rear Oil Seal".
10. Install the crankshaft front oil seal.
    Refer to "Crankshaft Front Oil Seal".
11. Install the oil filter assembly and oil cooler.
    Refer to "Oil Filter Assembly and Oil Cooler".
12. Install the fuel supply pump and fuel rail assembly.
    Refer to "Fuel Supply Pump" and "Fuel Rail Assembly " in Fuel System Section.
13. Install the cylinder head.
    Refer to "Cylinder Head".
14. Install the camshaft assembly.
    Refer to "Camshaft Assembly".
15. Install the cylinder head cover.
    Refer to "Cylinder Head Cover".
16. Mount the engine assembly on the chassis.
    Refer to "Engine Assembly".

MASS

POUNDS TO KILOGRAMS

lbs.	0	1	2	3	4	5	6	7	8	9	lbs.
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
-		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	-
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.731	42.184	42.638	43.091	43.545	43.998	44.452	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	47.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
-		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	-
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.753	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.390	92.594	94.799	97.003	99.208	101.413	103.617	105.822	108.026	40
50	110.231	112.436	114.640	16.845	119.050	121.254	123.459	125.633	127.868	130.073	50
60	132.277	134.482	136.687	138.891	141.096	143.300	145.505	147.710	149.914	152.119	60
70	154.324	156.528	158.732	160.937	163.142	165.347	167.551	169.756	171.961	174.165	70
80	176.370	178.574	180.780	182.984	185.188	187.393	189.597	191.802	194.007	196.211	80
90	198.416	200.621	202.825	205.030	207.234	209.439	211.644	213.848	216.053	218.258	90
100	220.462	222.667	224.871	227.076	229.281	231.485	233.690	235.895	238.099	240.304	100

KILOGRAMS TO NEWTONS

kg	0	1	2	3	4	5	6	7	8	9	kg
	N	N	N	N	N	N	N	N	N	N	
-	-	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	-
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.33	500.14	509.95	519.75	529.56	539.37	549.17	558.98	568.79	578.59	50
60	558.40	598.21	608.01	617.82	627.63	637.43	647.24	657.05	666.85	676.66	60
70	686.47	696.27	706.08	715.89	725.69	735.50	745.31	755.11	764.92	774.73	70
80	784.53	794.34	804.15	813.95	823.76	833.57	843.37	853.18	862.99	872.79	80
90	882.60	892.41	902.21	912.02	921.83	931.63	941.44	951.25	961.05	970.86	90
100	980.67	990.47	1000.28	1010.08	1019.89	1029.70	1039.50	1049.31	1059.12	1068.92	100

NEWTONS TO KILOGRAMS

N	0	10	20	30	40	50	60	70	80	90	kg
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	N
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	
10	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	10
20	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	20
30	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	30
40	40.789	41.809	42.828	43.848	44.868	45.887	46.907	47.927	48.947	49.966	40
50	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	50
60	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	60
70	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	70
80	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	80
90	91.775	92.795	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	90
100	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	100

YES

- Is there battery voltage between the engine room harness connector terminal No.1 (X-14) and ground?

NO

Open circuit between the engine harness connector terminal No.1 (E-2) and the engine room harness connector terminal No.2 (X-14).

YES

- Disconnect the A/C thermo relay.

- Is there battery voltage the engine room harness connector terminal No.3 (X-14) and ground?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No.1 (X-14).

YES

- Disconnect the ECM harness connector.

- Is there continuity between the ECM harness connector terminal C24SE No. 14 (C-56) and the engine room harness connector terminal No.4 (X-14)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (X-14).

YES

- Is there continuity between the ECM harness connector terminal C24SE No. 26 (C-56) and the engine room harness connector terminal No. 1 (X-15)?

NO

Open circuit between the ECM harness connector terminal C24SE No.14 (C-56) and the engine room harness connector terminal No. 4 (X-14).

YES

- Is there battery voltage between the engine room harness connector terminal No. 2 (X-15) and ground?

NO

Open circuit between the ECM harness connector terminal C24SE No. 26 (C-56) and the engine room harness connector terminal No. 1 (X-15).

YES

- Disconnect the pressure switch?

- Is there continuity between the engine room harness connector terminal No. 3 (X-15) and the engine room harness connector terminal No. 1 (C-24).

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 2 (X-15).

Lubrication System

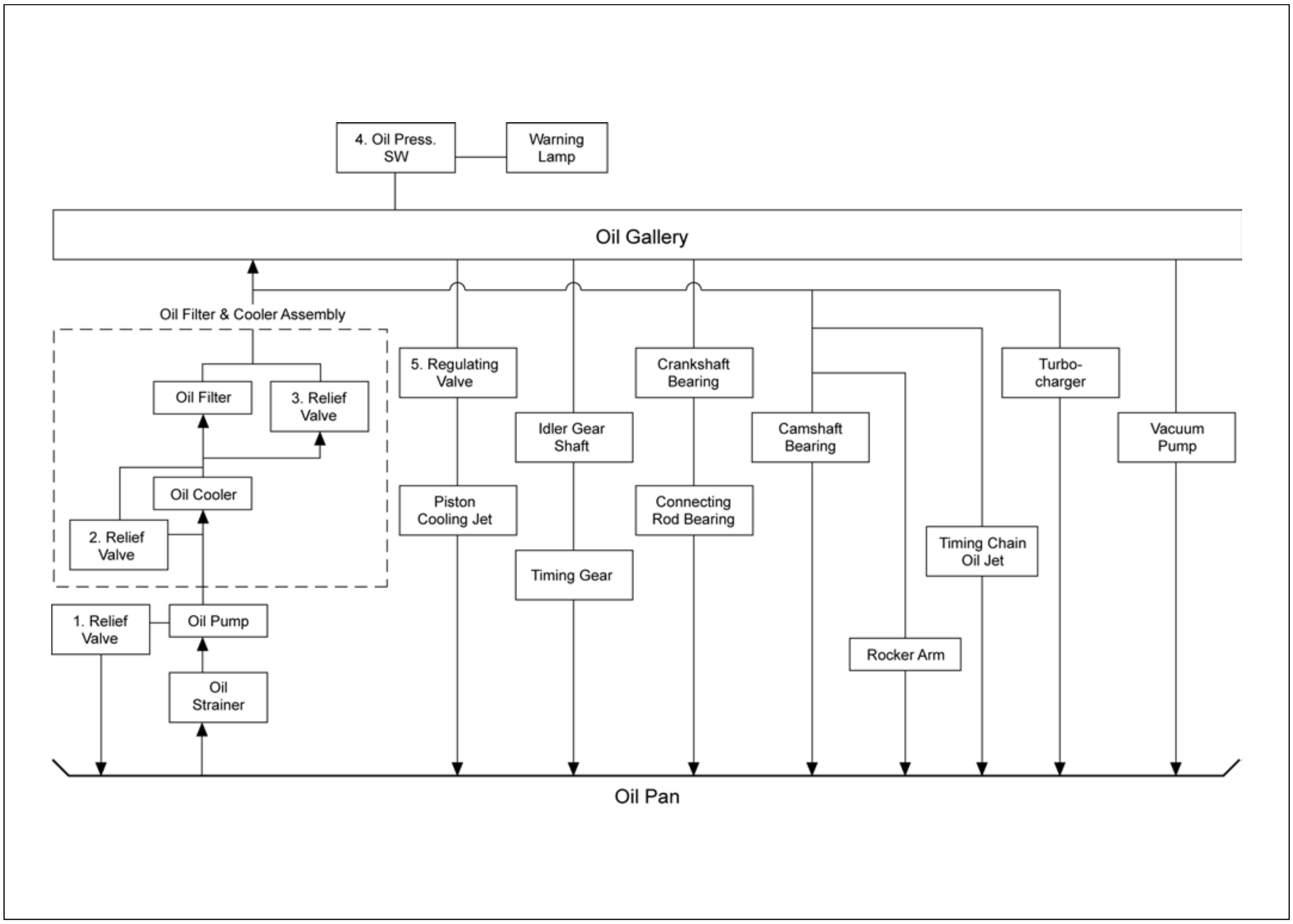
Service Precautions

- During each disassembly, remove the old gasket adhering to each part and mating part completely using a scraper at the location, where the fluid gasket is to be used, clean the traces of oil, moisture, and dirt completely using waste cotton and apply the specified new fluid gasket at each location.
- Avoid excessive or insufficient coating volume. Note that seizure may occur in case of excessive coating due to clogging of the oil gallery and oil jet, and oil and water leakage may occur if the coating is insufficient.
- Always, the start and end of the application should be overlapped.

Explanations on functions and operation

The lubrication system uses the filter element combined with a full flow bypass, water-cooled oil cooler, and oil jet for piston cooling.

Lubricating system diagram



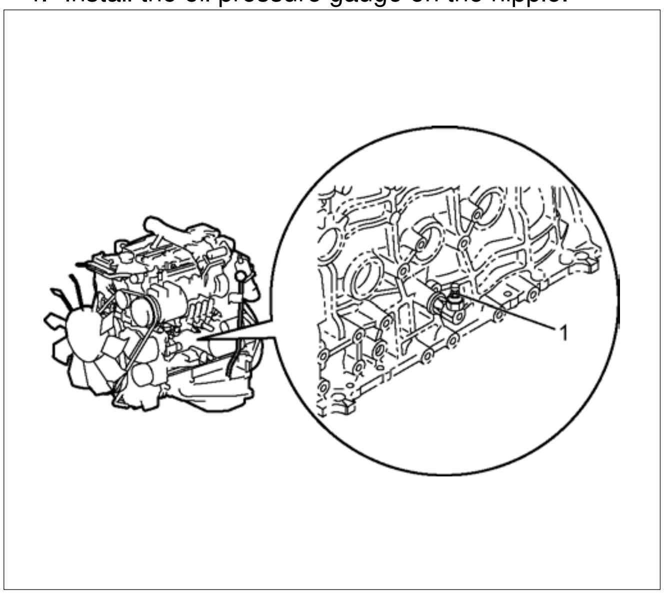
LNW76ALF000201

1. Oil Pump Relief Valve Operating Pressure: 490 – 686 kPa (5.0 – 7.0 kg/cm^2 / 71 – 100 psi)
2. Oil Cooler Relief Valve Opening Pressure: 176 – 216 kPa (1.8 – 2.2 kg/cm^2 / 26 – 31 psi)
3. Oil Filter Relief Valve Opening Pressure: 80 – 120 kPa (0.8 – 1.2 kg/cm^2 / 11 – 17 psi)
4. Oil Pressure Switch Operating Pressure: 29.4 – 49.0 kPa (0.3 – 0.5 kg/cm^2 / 4.3 – 7.1 psi)
5. Regulating Valve: 176 – 216 kPa (1.8 – 2.2 kg/cm^2 / 26 – 31 psi)

Functional Check

Oil pressure check

1. Check whether the engine oil is contaminated with dirt, light oil, or water. If contaminated with dirt, light oil, or water (after examining the cause and taking the appropriate measures for light oil or water contamination), replace the oil.
2. Check the engine oil level. The oil level should be between the two holes of the level gauge. If the oil level is insufficient, replenish it.
3. Remove the oil pressure switch on the nipple.
4. Install the oil pressure gauge on the nipple.



RTW56ASH015501

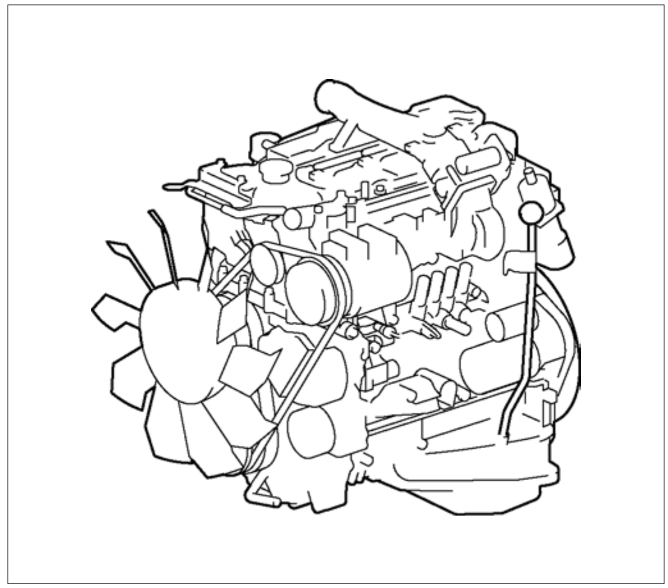
Legend

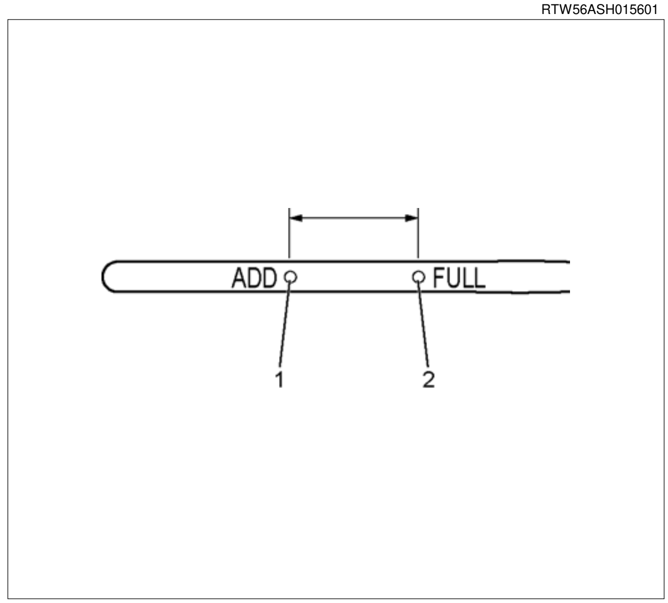
1. Oil Pressure Switch

5. Warm the engine.
6. Measure the oil pressure, to check whether it is more than 400 kPa (4 kg/cm^2 / 58 psi) at 3600 rpm.
7. Stop the engine.
8. Remove the oil pressure gauge.
9. Install the oil pressure switch.
10. Start the engine and check for oil leakage.

Engine oil

- Ensure the car is on level ground. Before starting the engine or when 30 minutes or more have elapsed after stopping the engine, check the engine oil volume using the level gauge. The volume is appropriate if the engine oil is between the upper and lower limits of the level gauge. Replenish the engine oil, if level is below the lower limit. Also, check for contamination of the engine oil.


RTW56ASH015601



RTW56ASH015701

Legend

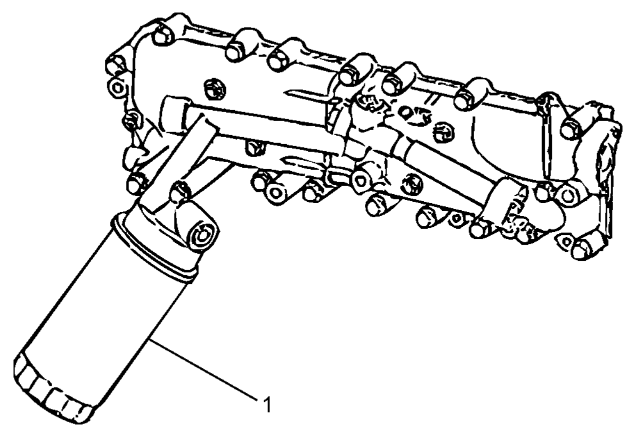
1. Lower Limit
2. Upper Limit

Engine oil leakage

- In the lift up condition, confirm that there are no leaks from the cylinder head cover and oil pan.

Oil Filter Cartridge

Components



RTW56ASF000101

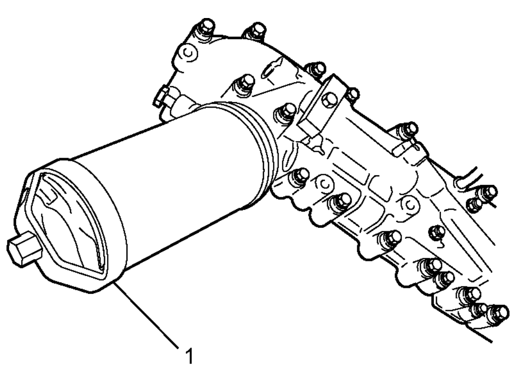
Legend

1. Oil Filter Cartridge

Removal

1. Place a tray under the oil filter cartridge.
2. Remove the oil filter cartridge using the oil filter wrench.

   Special tool
   Oil filter wrench: 5-8840-0203-0 (1)



RTW56ASH012501

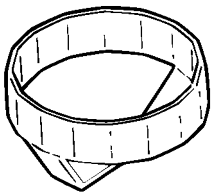
Installation

1. Install the oil filter cartridge.
   - Apply grease or engine oil to the seal in the cartridge and install it using the oil filter wrench.
   - Tighten the cartridge using the specified torque.

Tightening torque: 20 N·m (2.0 kg·m / 14 lb ft)
Or
After it comes in contact with the oil seal, tighten it through an additional turn of 1 and 1/4.

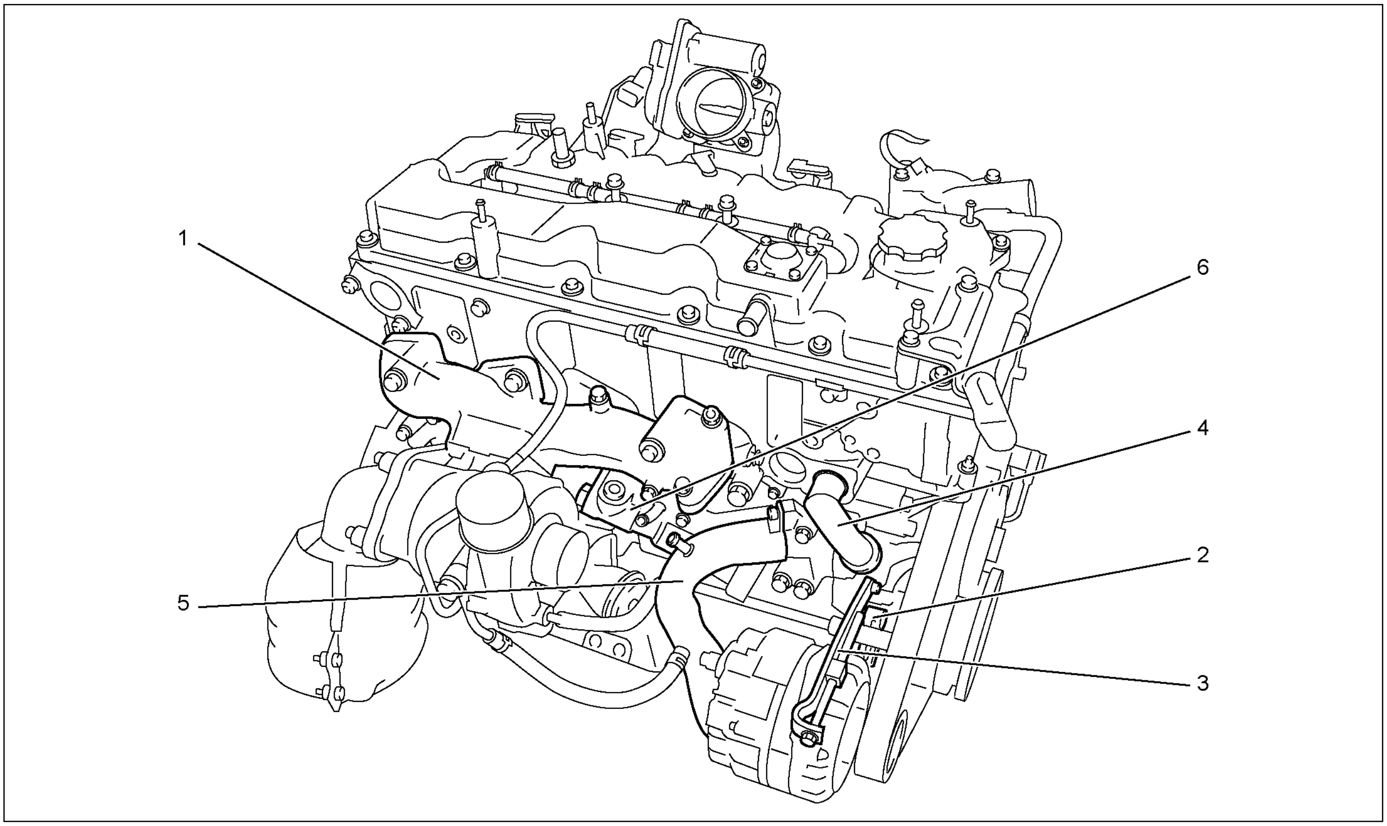
Special tool
Oil filter wrench: 5-8840-0203-0

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884002030	**5-8840-0203-0** Oil filter wrench

Oil Filter Assembly and Oil Cooler

Components



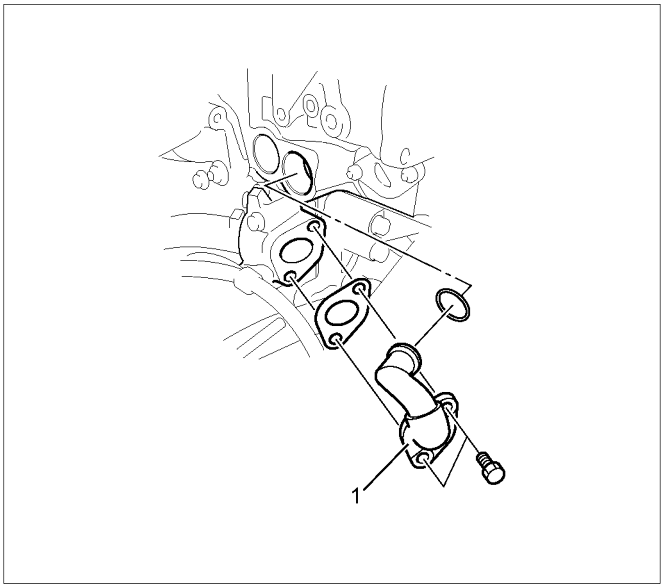
RTW56AMF000401

Legend

1. Exhaust Manifold
2. Generator Bracket
3. Generator Adjustment Bracket
4. Water Bypass Pipe
5. Water Intake Pipe
6. Oil Filter Assembly and Oil Cooler

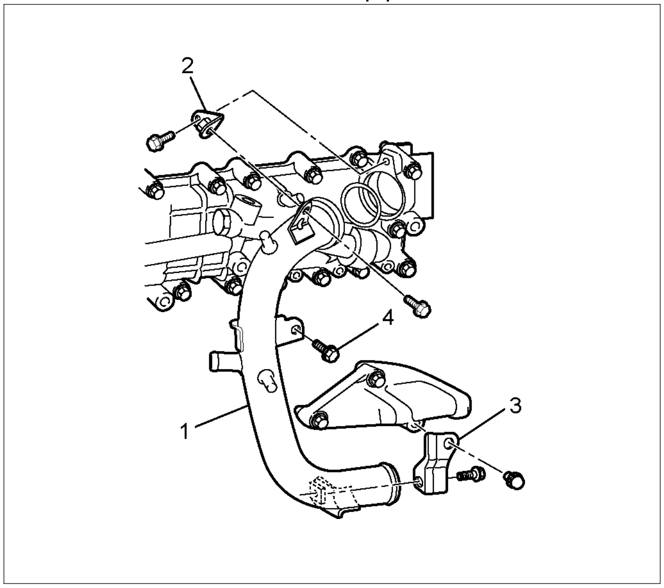
Removal

1. Remove the exhaust manifold.
   Refer to removal procedure for "Turbocharger and Exhaust Manifold" in this manual.
2. Remove the generator.
   Refer to removal procedure for generator in this manual.
3. Remove the adjustment bracket of generator.
4. Remove the bracket of generator.
5. Remove the water bypass pipe (1).



RTW56ASH008401

6. Remove the water intake pipe.

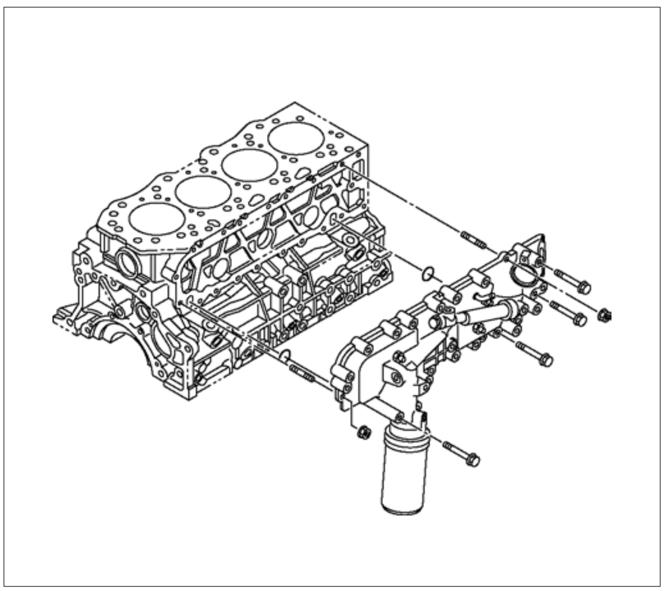


RTW56ASH012601

Legend

1. Water Intake Pipe
2. Bracket
3. Bracket
4. Bolt

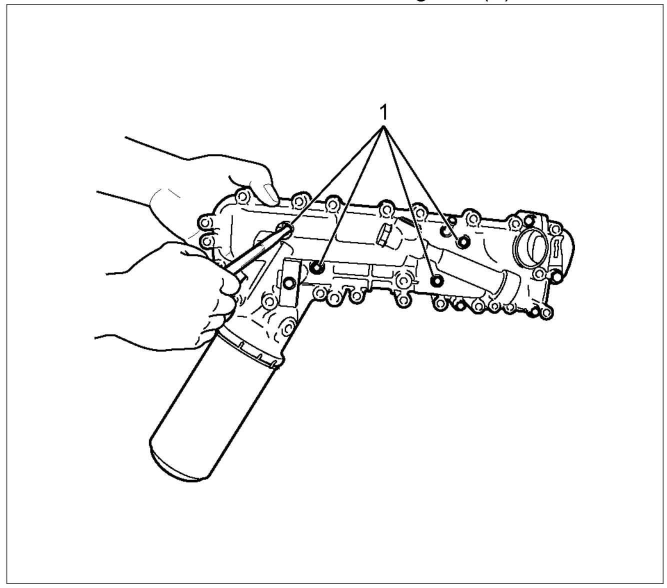
7. Remove the oil cooler.



RTW66ASH009101

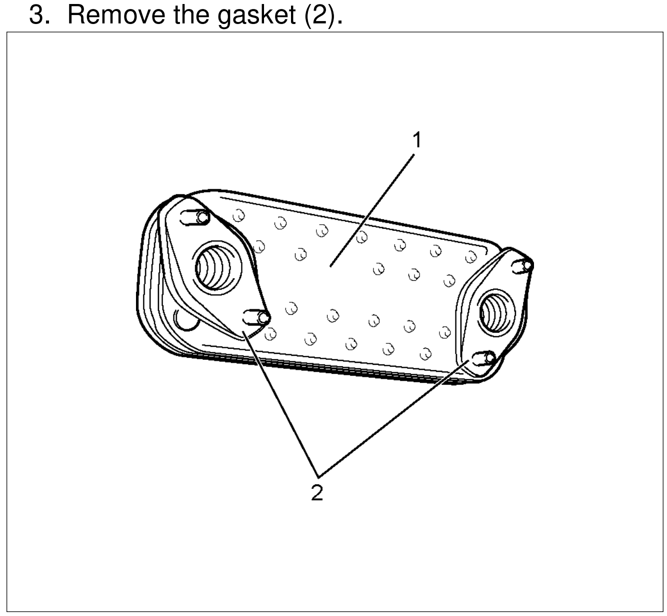
Disassembly

1. Remove the element mounting nut (1).



RTW56ASH012901

2. Remove the element (1).
3. Remove the gasket (2).



RTW56ASH013001

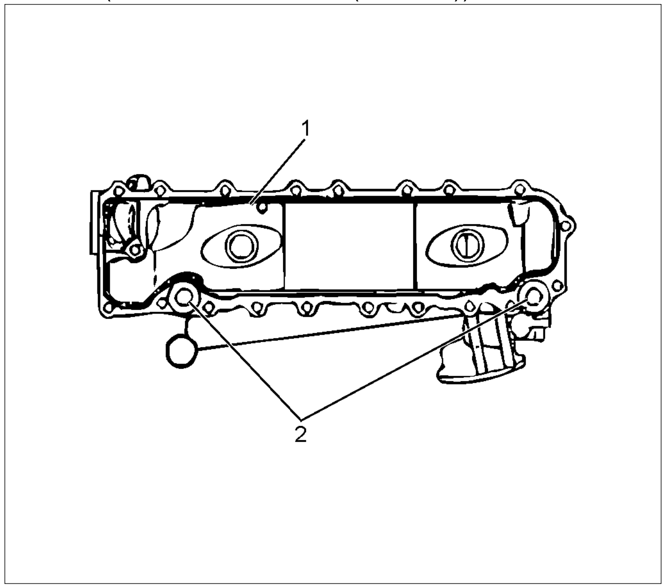
Reassembly

1. Install the gasket on the element.
2. Install the element.
3. Tighten the element fixing nut using the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

Installation

1. Install the oil filter and cooler.
   - Install the O-ring on the oil filter and cooler, apply grease.
   - Apply the liquid gasket and mount within 5 minutes. Apply liquid gasket (ThreeBond TB-1207C or equivalent) to the flange surface groove (cylinder block). Bead diameter must be between 2 and 3 mm (0.079 and 0.118 in). Refer to the illustration for the offset position (no more than 1 mm (0.004 in)).

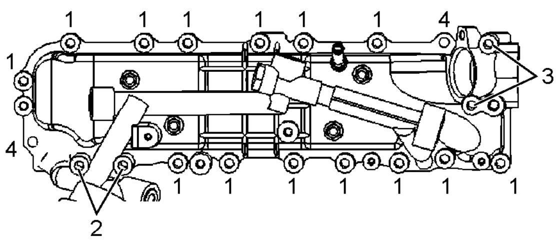


RTW56ASH013101

Legend

1. Liquid Gasket
2. O-ring

   - Align the oil filter and cooler holes with the cylinder block studs. Install the oil cooler to the cylinder clock.



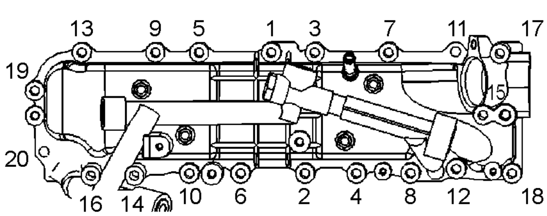
RTW56ASH013201

Legend

1. Bolt 45 mm (1.77 in)
2. Bolt 110 mm (4.33 in)
3. Bolt 70 mm (2.76 in)
4. Nut

- Tighten the bolts to the specified torque in the order shown in the illustration.

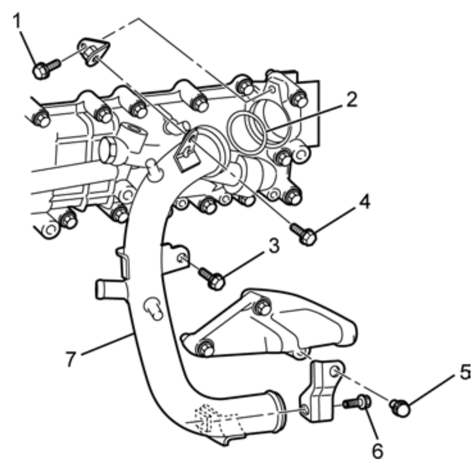
Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW56ASH013301

2. Install the water intake pipe.
   a. Temporarily tighten the bolt (6).
   b. Install the O-ring (2) to the water intake pipe (7).
   c. Apply soapy water to the O-ring (2) and install the water intake pipe (7).
      - Take care not to twist the O-ring.
   d. Temporarily tighten the bolts.
      Temporary tightening order: 1→3→4→5
   e. Tighten the bolts to the specified torque.
      Fully tightening order: 3→4→1→5→6

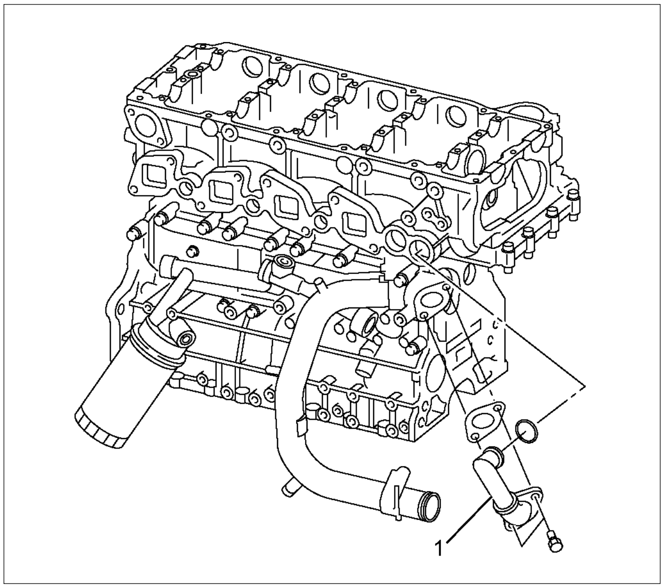
Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW76ASH001701

3. Install the water bypass pipe (1).
   - After applying soapy water to O-ring, set it on bypass pipe and insert into the cylinder head. Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW56ASH008401

4. Install the bracket of generator.
   Tighten the bolts to the specified torque.

Tightening torque: 51 N·m (5.2 kg·m / 38 lb ft)

5. Install the adjustment bracket of generator.
   Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

6. Install the generator.
   Refer to Installation procedure for generator in this manual.
7. Install the exhaust manifold.
   Refer to Installation procedure for turbocharger and exhaust manifold in this manual.

YES

- Disconnect the condenser fan relay connector condenser fan.

- Is there continuity between the relay terminal No. 3 (X-10) and engine room harness connector terminal No.4 (C-24)?

NO

Open circuit between the engine room harness connector terminal No.3 (X-15) and the engine room harness connector terminal No. 1 (C-24).

YES

- Is there battery voltage between the engine room harness connector terminal NO. 3 (C-24) and ground?

NO

Open circuit between the condenser fan relay No.3 (X-10) and engine room harness connector terminal No. 4 (C-24).

NO

Open circuit between the No. EB-13 fuse and engine room harness connector terminal No. 3 (C-24).

YES

- Disconnect the pressure switch.

- Is there continuity between the engine room harness connector terminal No. 4 (X-15) and the engine room harness connector terminal No. 1 (C-24).

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 2 (X-15).

YES

- Connect the A/C thermo relay connector.

- Disconnect the electronic thermostat.

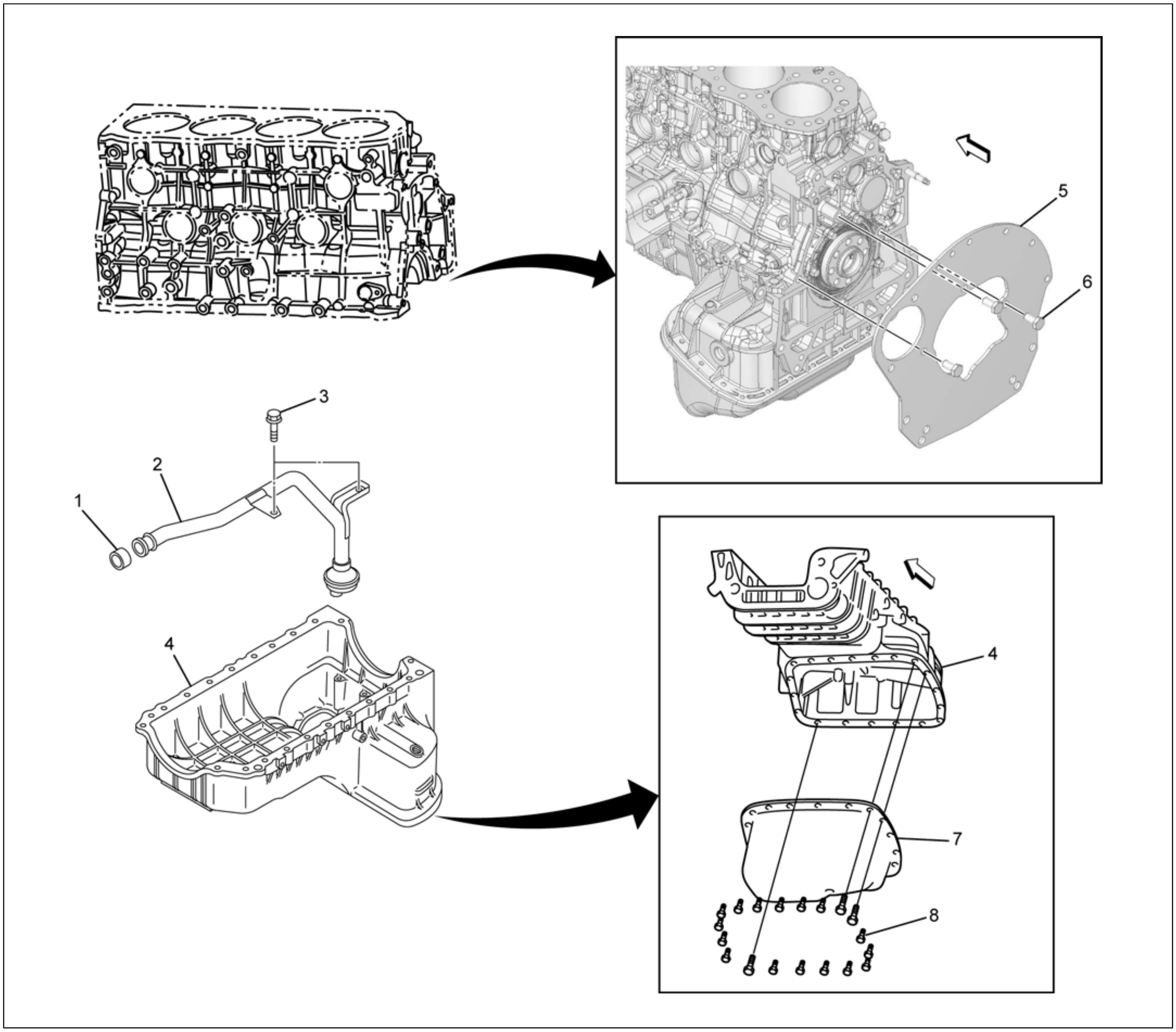
- Is there continuity between the engine room harness connector terminal No. 2 (C-55) and the engine room harness connector terminal No. 2 (C-24)?

NO

Open circuit between the engine room harness connector terminal No. 4 (X-15) and the engine room harness connector terminal No. 1 (C-24).

Crank Case and Oil Pan

Components

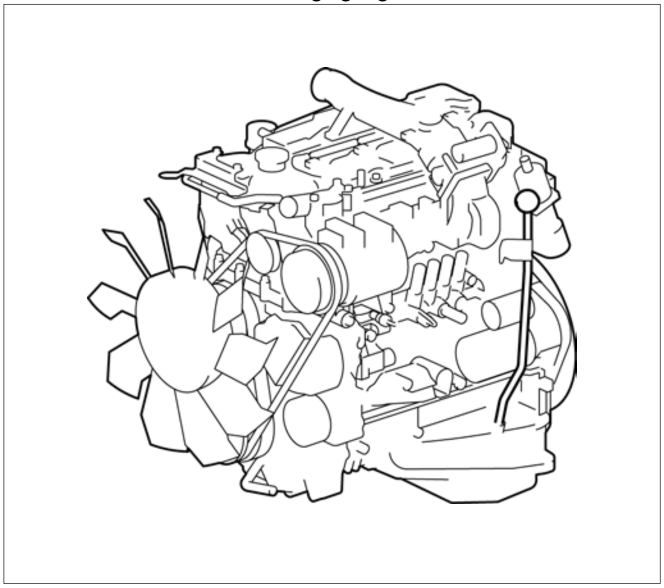


Legend

1. Gasket
2. Oil Strainer
3. Bolt
4. Crank Case
5. Rear Plate
6. Bolt
7. Oil Pan
8. Bolt

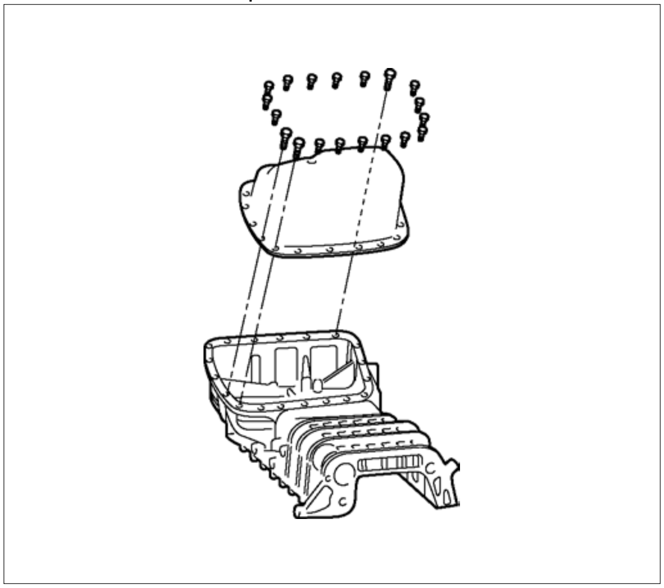
Removal

1. Remove the engine assembly.
   Refer to “Engine Assembly”.
2. Remove the oil level gage guide tube.



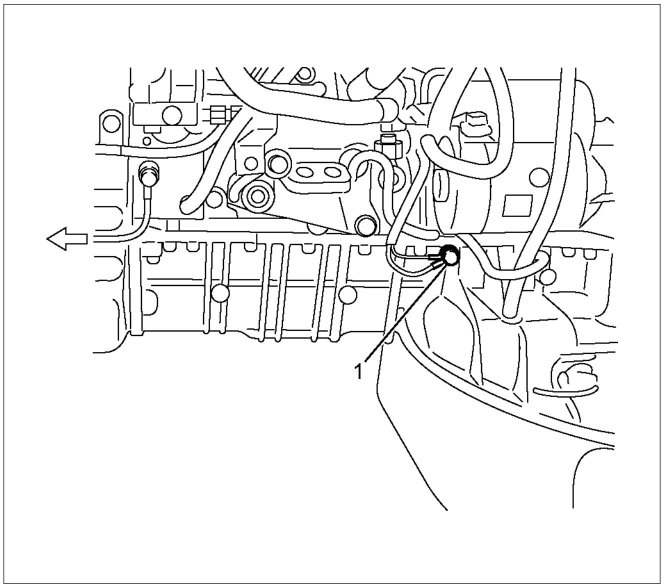
RTW56ASH015601

3. Remove the oil pan.



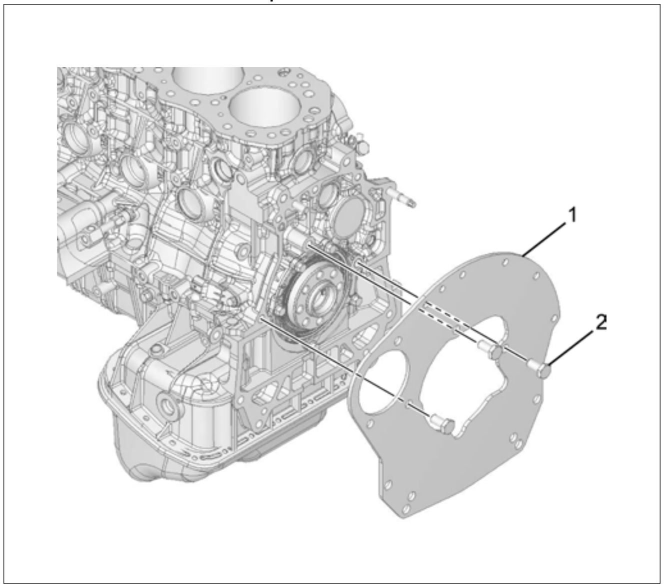
RTW56ASH015001

4. Disconnect the earth terminal (1) of crank case side.



RTW76ASH001801

5. Remove the flywheel.
   Refer to “Flywheel”.
6. Remove the rear plate.

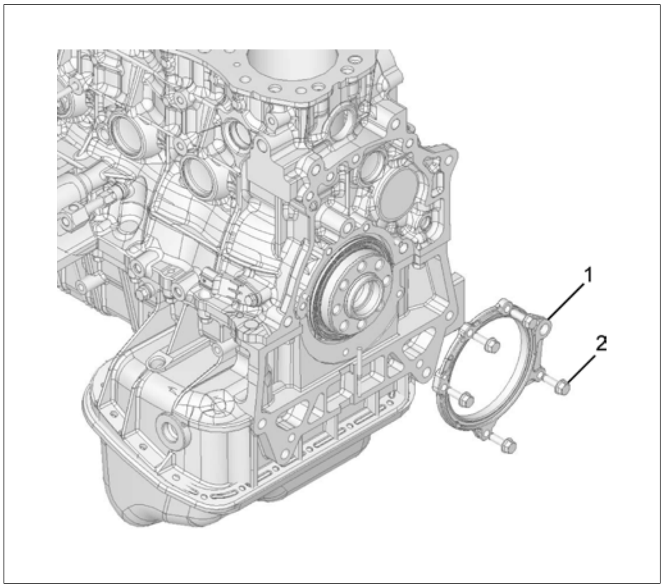


RTW76ASH001901

Legend

1. Rear Plate
2. Bolt

7. Remove the cylinder head.
   Refer to "Cylinder Head".
8. Remove the timing gear case.
   Refer to "Timing Gear Case".
9. Remove the retainer.

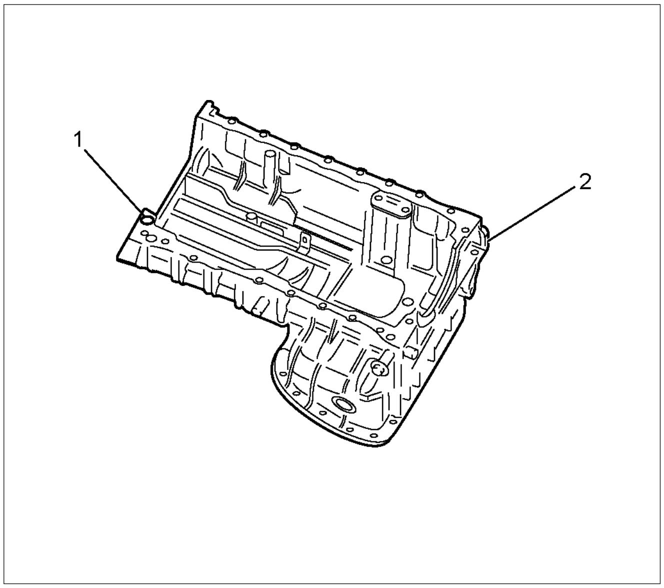


RTW76ASH002001

Legend

1. Retainer
2. Bolt

10. Remove the crank case.



RTW56ASH021901

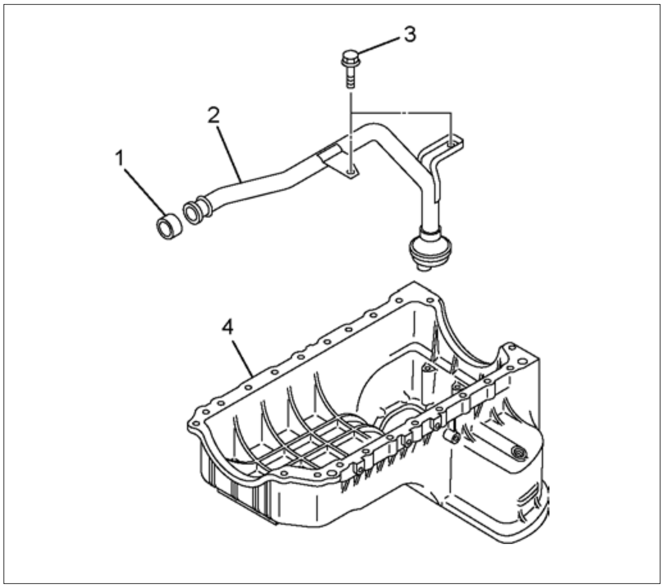
Legend

1. O-ring
2. Crank Case

Note:
Take care not to damage the O-ring.

Disassembly

1. Remove the oil strainer.



RTW66ASH009201

Legend

1. Gasket
2. Oil Strainer
3. Bolt
4. Crank Case

Reassembly

Install the oil strainer.

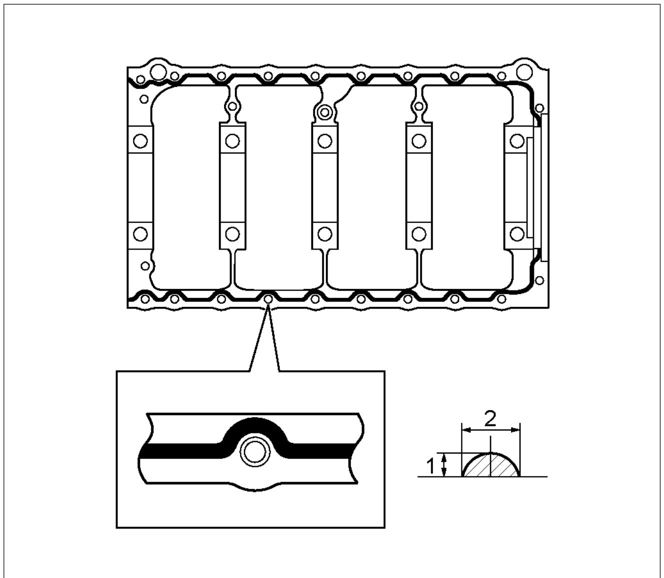
- Install the gasket on the strainer.
- Tighten the bolts to the specified torque.

Tightening torque: 22 N·m (2.2 kg·m / 16 lb ft)

Installation

1. Install the crank case.
   - Apply the liquid gasket (ThreeBond TB-1207C or equivalent) and mount within 5 minutes.

Tighteningtorque: 25 N·m (2.5 kg·m / 18 lb ft)



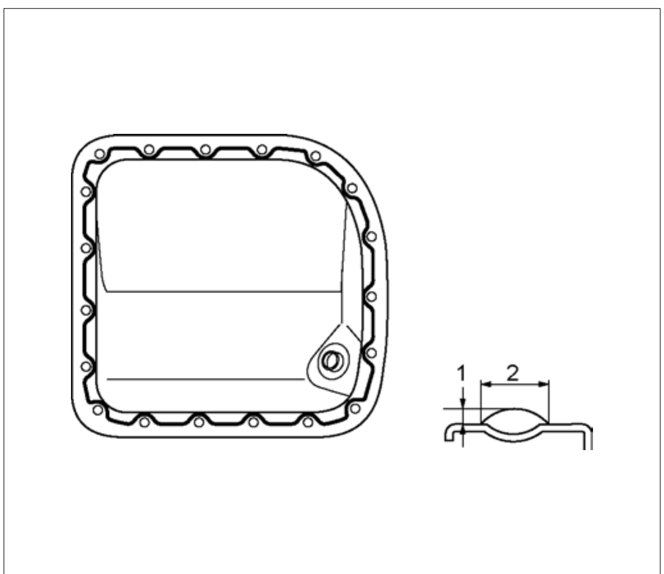
RTW56ASH015301

Legend

1. 2.0 - 3.0 mm (0.079 - 0.118 in)
2. 4.0 - 5.0 mm (0.157 - 0.197 in)

2. Install the oil pan.
   - Apply the liquid gasket (ThreeBond TB-1207B or equivalent)and mount within 5 minutes.

Tightening torque: 22 N·m (2.2 kg·m / 16 lb ft)



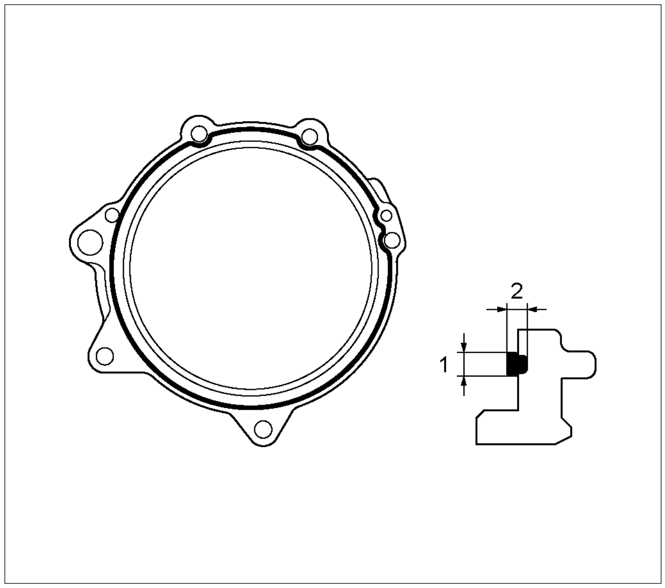
RTW56ASH015201

Legend

1. 2.0 mm (0.079 in)
2. 3.0 mm (0.118 in)

3. Install the retainer.
   - Apply the liquid gasket (ThreeBond TB-1207C or equivalent) and mount within 5 minutes.

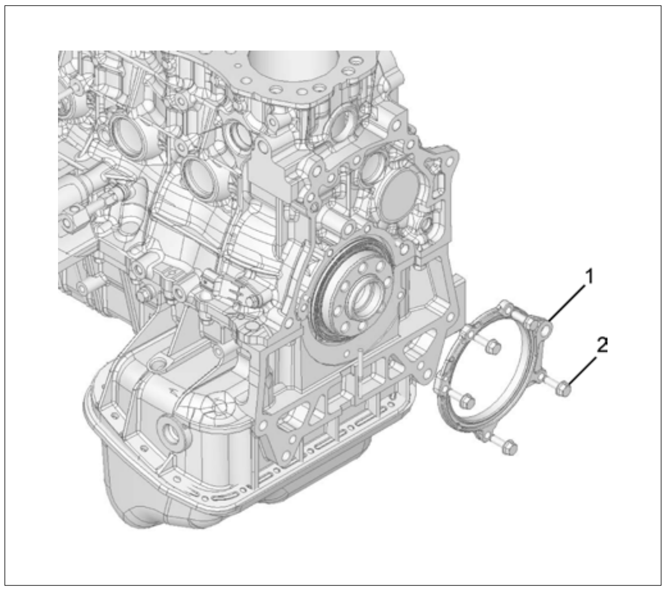
Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW56ASH017701

Legend

1. 2 - 2.5 mm (0.079 - 0.098 in)
2. 2 - 2.5 mm (0.079 - 0.098 in)



RTW76ASH002001

Legend

1. Retainer
2. Bolt

4. Install the timing gear case.
   Refer to “Gear Case Assembly”.
5. Install the cylinder head.
   Refer to “Cylinder Head”.

6. Install the rear plate.
   - Tighten the bolts to the specified torque.

Tightening torque: 82 N·m (8.4 kg·m / 61 lb ft)

7. Install the flywheel.
   Refer to "Flywheel".
8. Connect the earth terminal of crank case side.

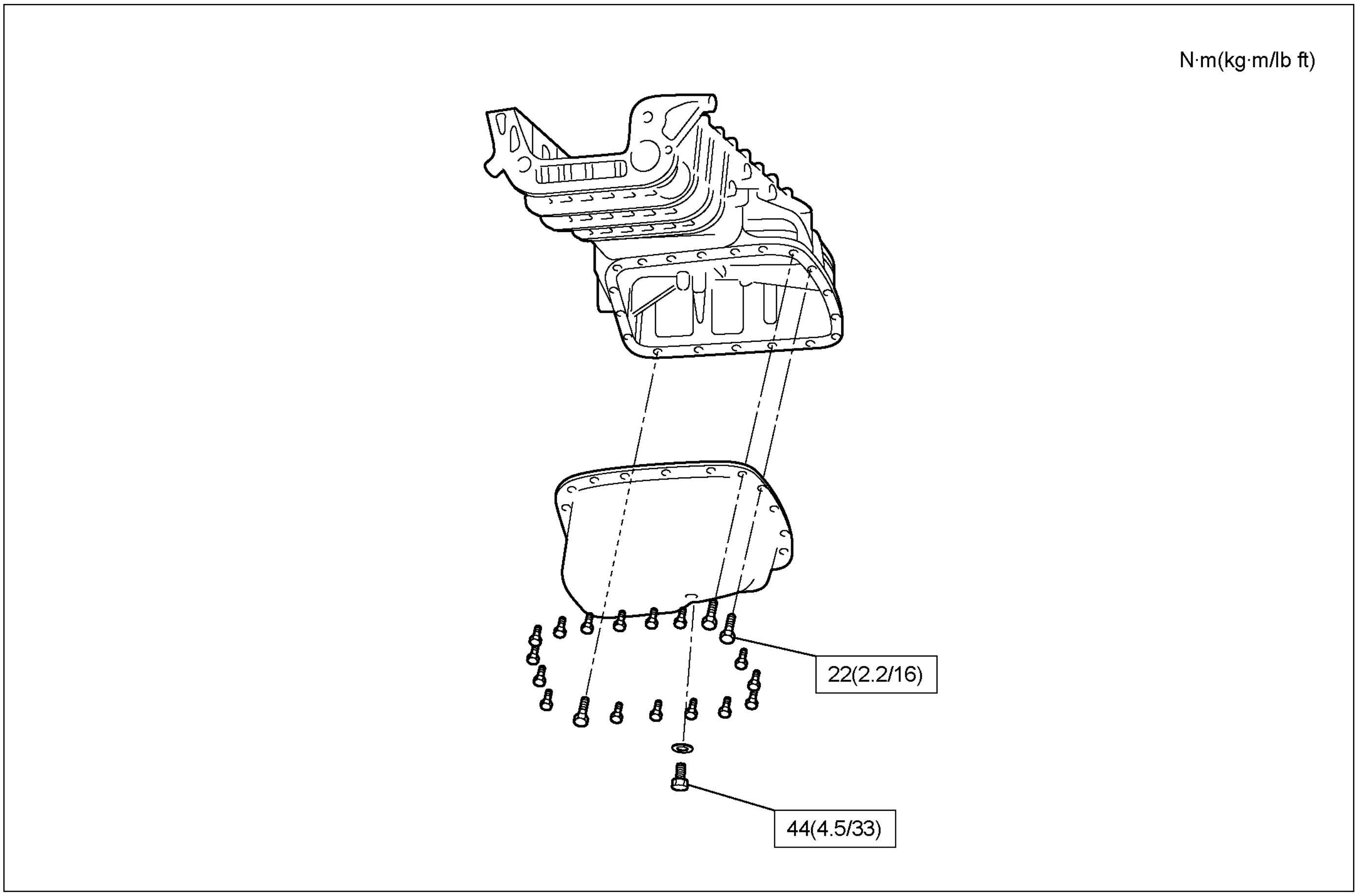
Note:
Do not allow the caulked portion of the terminal to interfere with nearby parts.

9. Install the oil level gage guide tube.
   - Apply the engine oil to the O-ring.
   - Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

10. Install the engine assembly.
    Refer to "Engine Assembly".

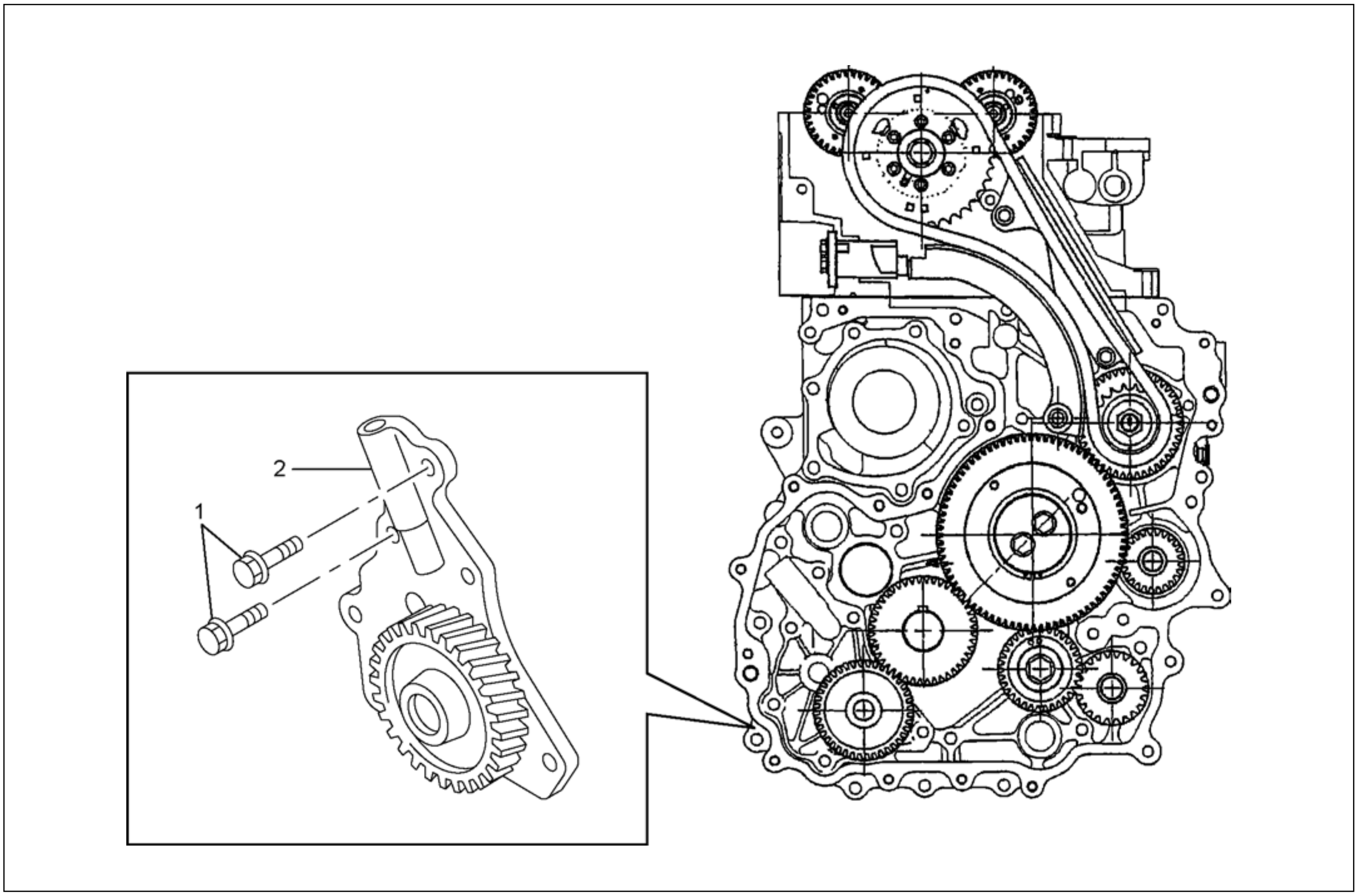
Torque Specifications



RTW56AMF001901

Oil Pump

Components



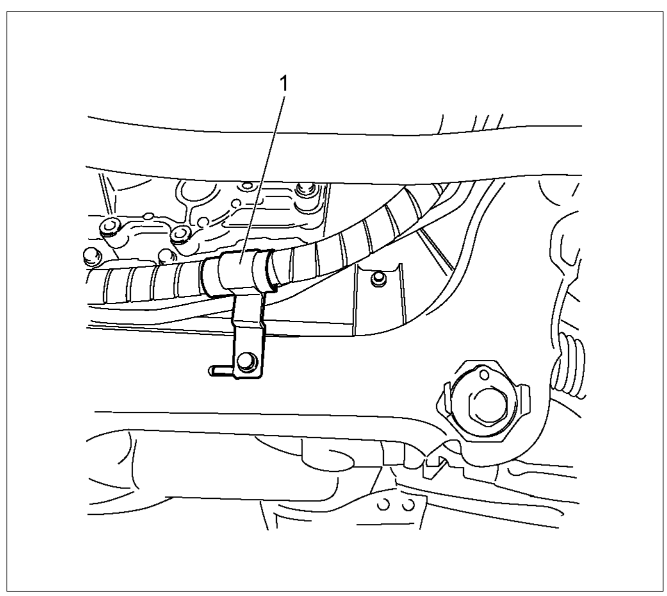
RTW66AMF000701

Legend

1. Bolt
2. Oil Pump Assembly

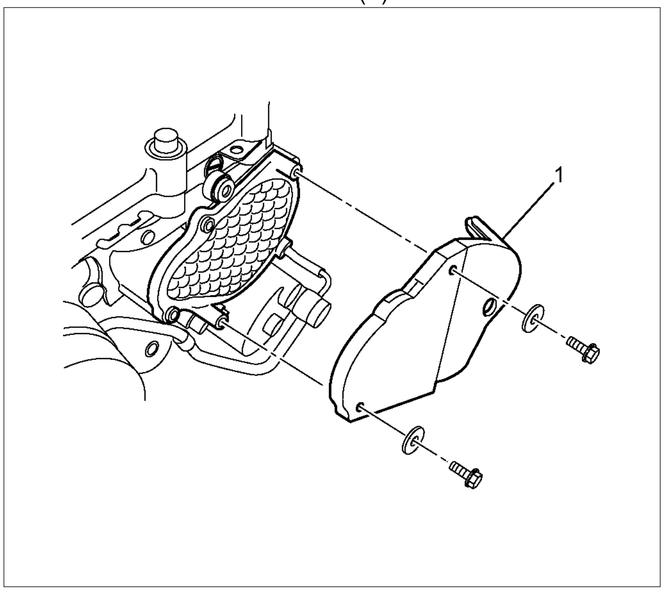
Removal

1. Drain the engine coolant.
2. Remove the radiator upper hose.
3. Remove the upper fan shroud.
4. Remove the fan and fan clutch.
   - Loosen the fan clutch nuts.
   - Remove the fan together with the fan clutch. Take care not to damage the radiator core.
5. Remove the fan drive belt and pulley.
   - Loosen the tension adjust bolt on the generator and A/C.
   - Remove the fan drive belt with the fan pulley.
6. Remove the lower fan shroud.
7. Disconnect the power steering pump.
   - Disconnect the bracket of the power steering oil hose clip (1).



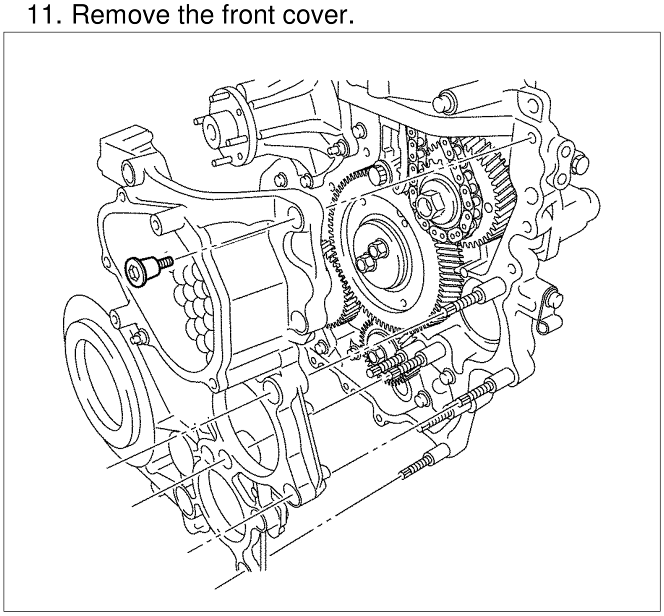
LTW56ASH000101

8. Remove the vacuum pump.
   - Remove the vacuum pipe bracket and vacuum pipe.
   - Remove the oil pipe (feed side and return side) of vacuum pump.
9. Remove the noise cover (1).



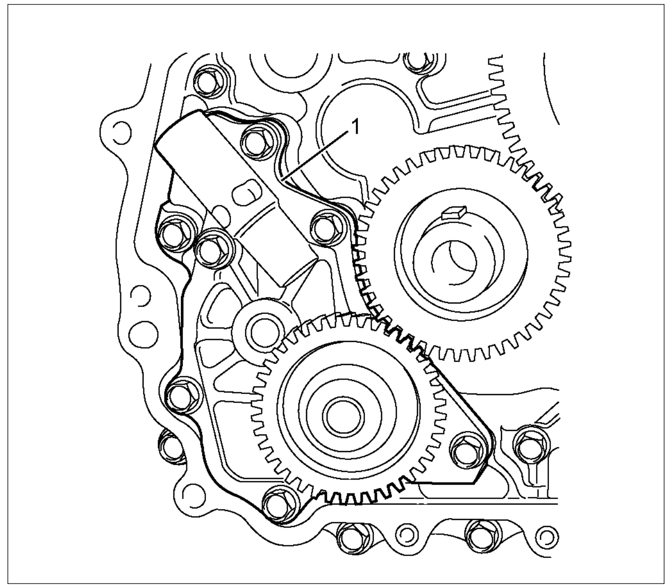
RTW56CSH001401

10. Remove the crank pulley.
11. Remove the front cover.



RTW56ASH019701

12. Remove the oil pump (1).



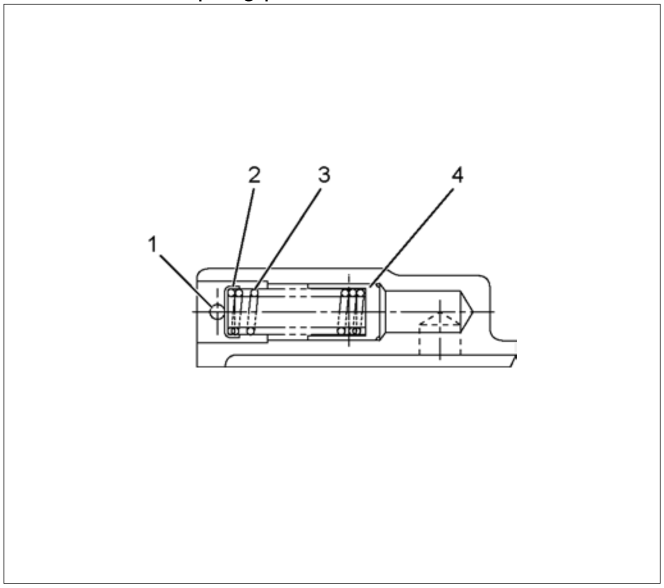
RTW56ASH020001

Disassembly

1. Remove the spring pin.
2. Remove the spring seat.
3. Remove the spring.
4. Remove the valve.

Reassembly

1. Install the valve.
2. Install the spring.
3. Install the spring seat.
4. Install the spring pin.



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Legend

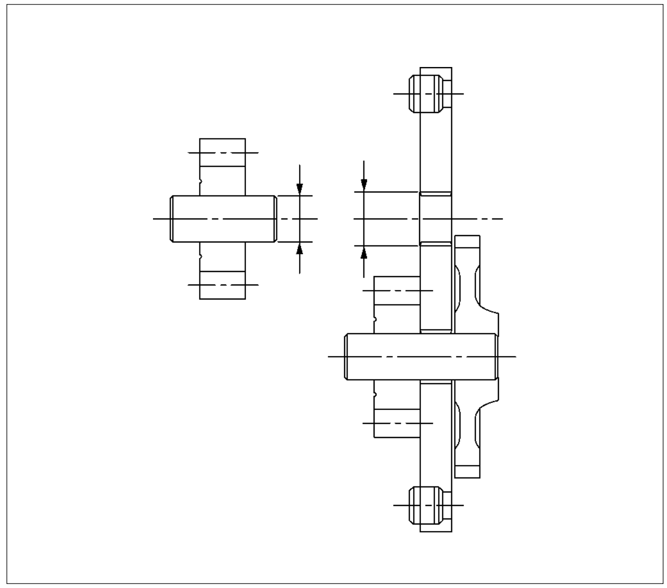
1. Spring Pin
2. Spring Seat
3. Spring
4. Valve

Inspection

NOTE:
Think to match direction of ditch of gear when assembling it.

1. Measure the clearance between the driven gear/drive gear shaft and the bush.
   - Measure the outside diameter of the driven gear shaft using a micrometer.

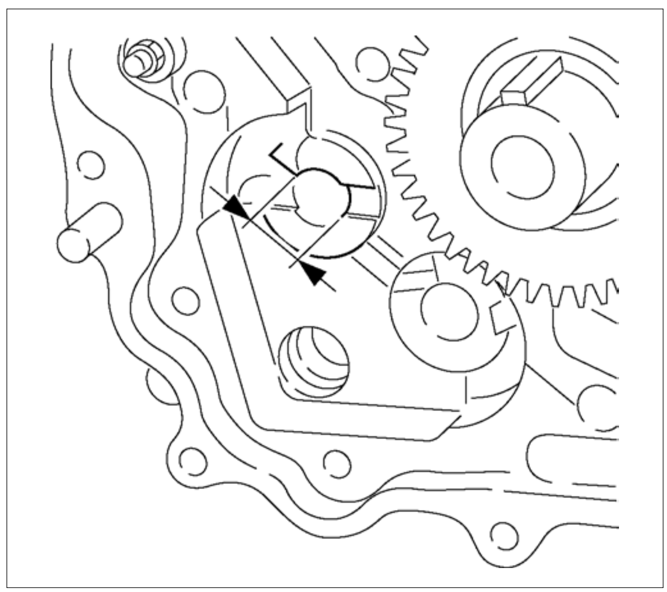
Outside diameter of the driven gear shaft/drive gear shaft mm (in)	
Standard	15.989 - 16.000 (0.62949 - 0.62992)
Limit	15.900 (0.62598)



RTW56ASH025601

- Measure the inside diameter of the bushes of the cylinder block using the dial gauge.
- If the clearance between the driven gear shaft/drive gear shaft and bush exceeds the limit, replace the oil pump assembly.

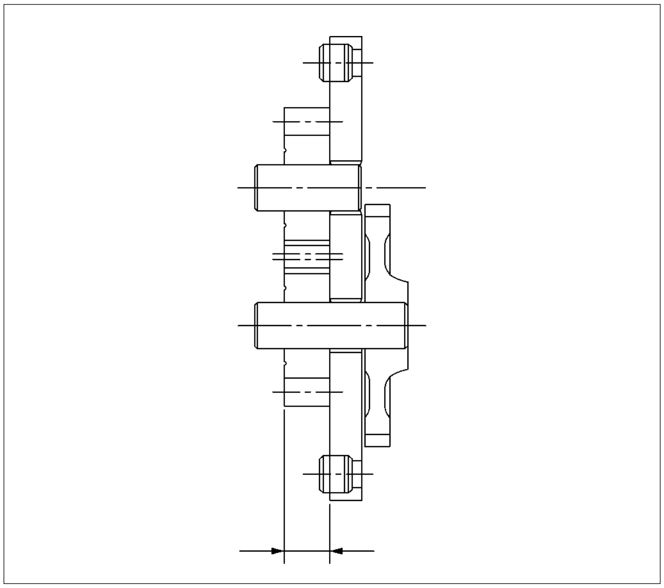
Clearance between the driven gear shaft/drive gear shaft and bush mm (in)	
Standard	0.04 - 0.07 (0.0016 - 0.0028)
Limit	0.20 (0.0079)



RTW56ASH014701

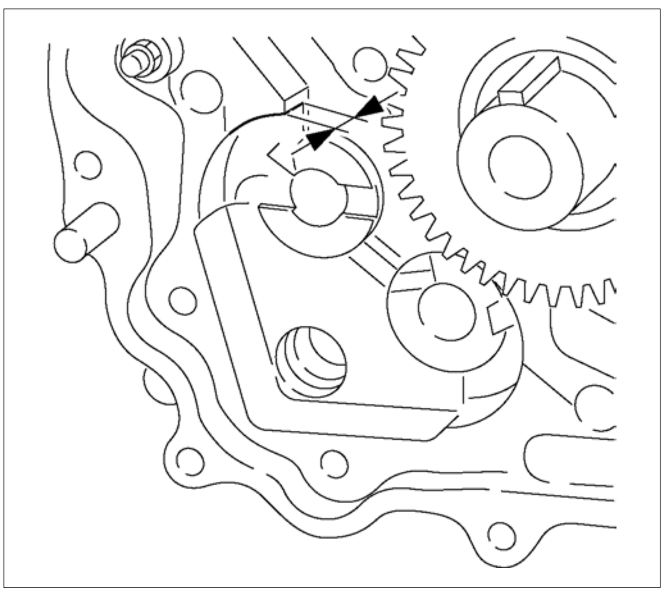
2. Measure the clearance between the gear side surface and the gear side surface of the oil pump housing.
   - Measure the width size the driven gear/drive gear.

Width size the driven gear/drive gear mm (in)	
Standard	14.5 (0.5709)


RTW56ASH025501

- Measure the Depth size of the gear case housing surface and the oil pump housing gear case side.

Depth size the gear case housing surface and the oil pump housing gear case side mm (in)	
Standard	14.500 - 14.527 (0.5709 - 0.5719)


RTW56ASH014801

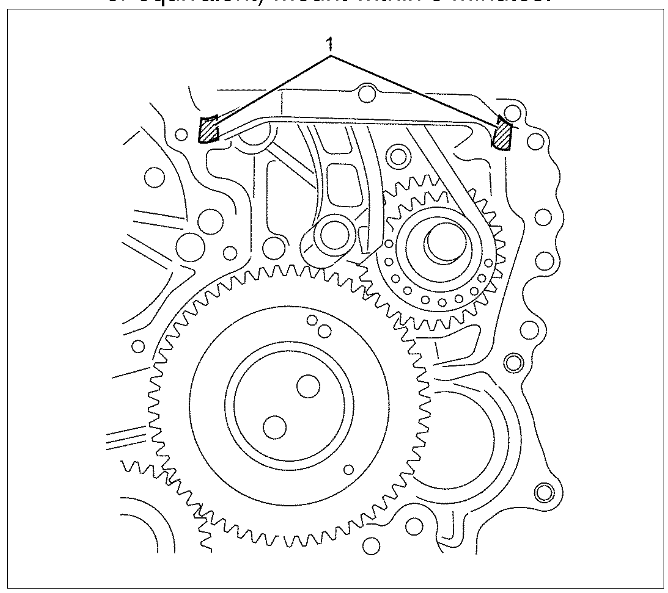
Clearance between the gear side surface and the gear side surface of the oil pump housing mm (in)	
Standard	0.063 - 0.027 (0.0025 - 0.0011)
Limit	0.20 (0.0079)

Installation

1. Install the oil pump.
   - Apply engine oil to the oil pump attachment gearbox.
   - Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

   - Installed pump gear should be smooth to rotate.
2. Install the gear case cover.
   - Apply the liquid gasket (Threebond TB-1207B or equivalent) mount within 5 minutes.



RTW56ASH020101

Legend

1. Apply the liquid gasket in area

YES

- Is there battery voltage between the engine room harness connector terminal No. 3 (C-55) and ground?

NO

Open circuit between the engine room harness connector terminal No. 2 (C-24) and the engine room harness connector terminal No. 2 (C-55).

YES

- Is there continuity between the engine room harness connector terminal No. 1 (C-55) and ground (C-109)?

NO

Open circuit between the No. EB-13 fuse and the engine room harness connector terminal No. 3 (C-55).

YES

- Disconnect the A/C switch.
- Is there battery voltage between the chassis side harness connector terminal No. 6 (B-57) and ground?

NO

Open circuit between the engine room harness connector No. 1 (C-55) and ground (C-109).

YES

- Is the electronic themostat OK?

NO

Open circuit between the No. EB-13 fuse and the chassis side harness connector No. 6 (B-57).

YES

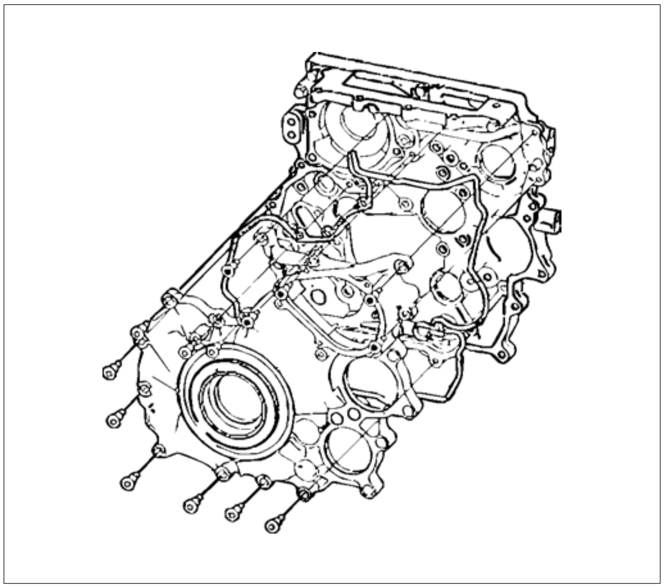
- Defective ECM

NO

Replace electronic thermostat

- Install the gasket in the slot of the gear case cover.
- Tighten the bolts to the specified torque.

Tightening torque: 8 N·m (0.8 kg·m / 69 lb in)



RTW56ASH012101

3. Install the crank pulley.
   - Tighten the bolts to the specified torque.

Tightening torque: 294 N·m (30.0 kg·m / 217 lb ft)

4. Install the noise cover to the timing chain cover lower.
   - Tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

5. Install the vacuum pump.
   - Tighten the nuts to the specified torque.

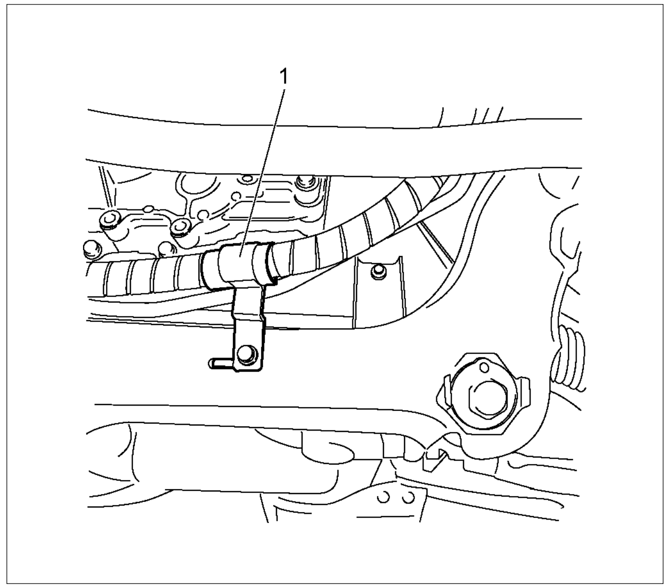
Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

- Install the oil pipe (feed side and return side) of vacuum pump.
- Install the vacuum pipe bracket and vacuum pipe.

6. Install the power steering pump.
   - Tighten the nuts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

- Install the bracket of power steering oil hose clip (1).



LTW56ASH000101

7. Install the lower fan shroud.
8. Install the fan drive belt and pulley.
   - Install the fan drive belt with the fan pulley.
9. Install the fan and fan clutch.
   - Tighten the bolts to the specified torque.

Tightening torque: 8 N·m (0.8 kg·m / 69 lb in)

10. Adjust the drive belt of generator and A/C compressor.
    - Apply tension to the fan drive belt by moving the generator.
    - Apply a force of 98 N (10 kg / 22 lb) to the drive belt mid portion to check the drive belt deflection.

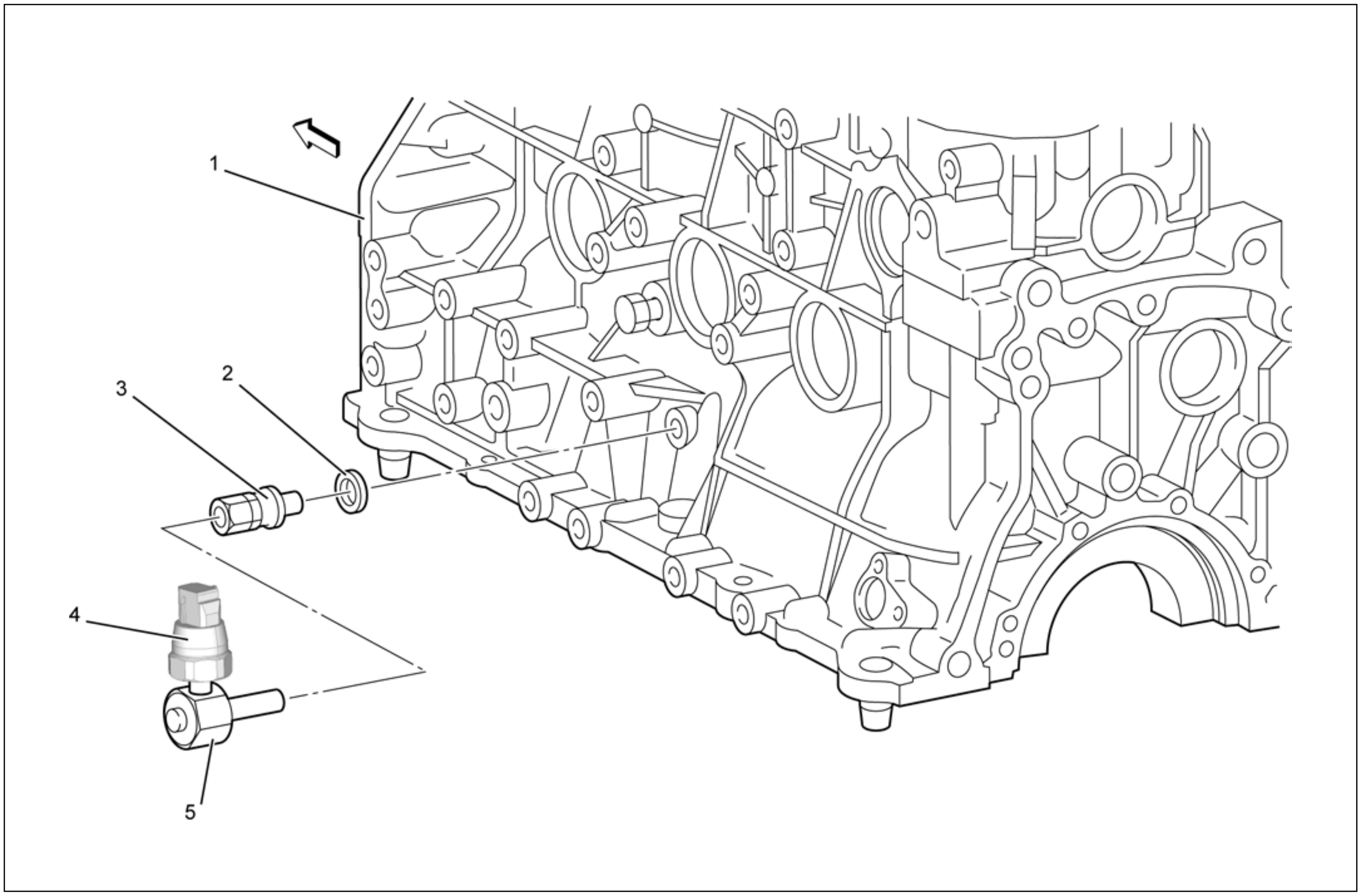
Generator drive belt deflection	mm (in)
New belt	5 - 6 (0.20 – 0.24)
Reuse belt	7 - 8 (0.28 – 0.31)

A/C compressor drive belt deflection	mm (in)
New belt	6 - 7 (0.24 – 0.28)
Reuse belt	8 - 9 (0.31 – 0.35)

11. Install the upper fan shroud.
12. Install the radiator upper hose.
13. Replenish the engine coolant.

Oil Pressure SW

Components



RTW76AMF000401

Legend

1. Cylinder Block
2. Gasket
3. Nipple; Oil Pressure Warning SW
4. Oil Pressure SW
5. Nipple; Oil Gallery

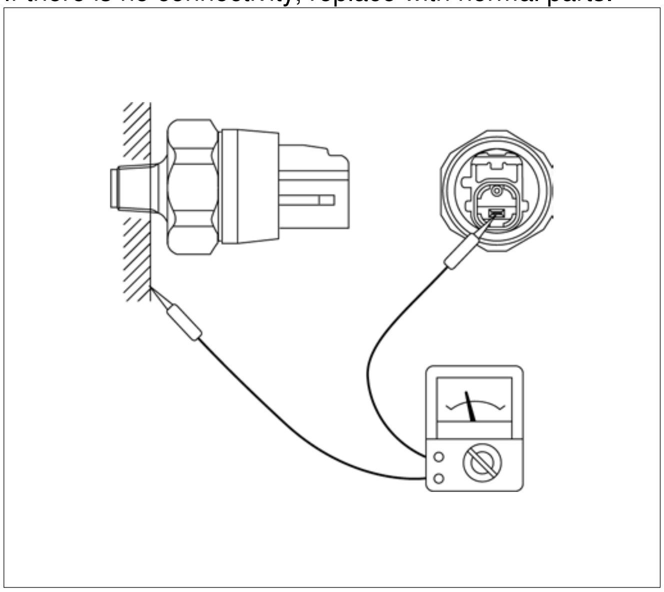
Removal

1. Remove the oil pressure SW.
2. Remove the nipple; oil gallery.
3. Remove the nipple; oil pressure warning SW and gasket.

Inspection

Check the continuity between the switch terminal and the body grounding in a no-load condition.

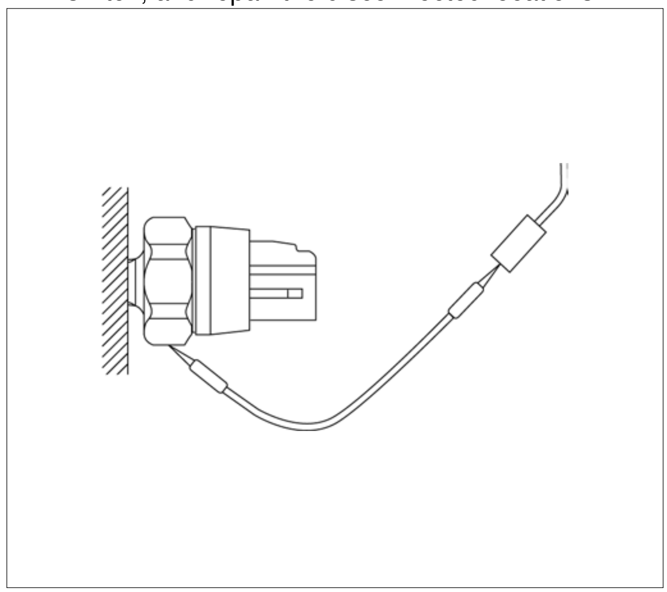
If there is no connectivity, replace with normal parts.



LNW21HSH003301

Circuit check

1. Turn the starter switch to ON.
2. Disconnect the oil pressure switch connector, and confirm that the oil pressure-warning lamp lights when the connector on the harness side is grounded.
   If the warning lamp does not light up, check the circuit between the meter and the oil pressure switch, and repair the disconnected locations.



LNW21HSH003401

Installation

1. Install the nipple; oil gallery, oil pressure warning SW and gasket.

   Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)

2. Install the Nipple.

   Tightening torque: 15 N·m (1.5 kg·m/11 lb ft)

3. Install the oil pressure SW.

   Tightening torque: 15 N·m (1.5 kg·m/11 lb ft)

Air Cleaner Element

Removal

1. Remove the air cleaner cover fixing clip.
2. Remove the air cleaner element assembly.

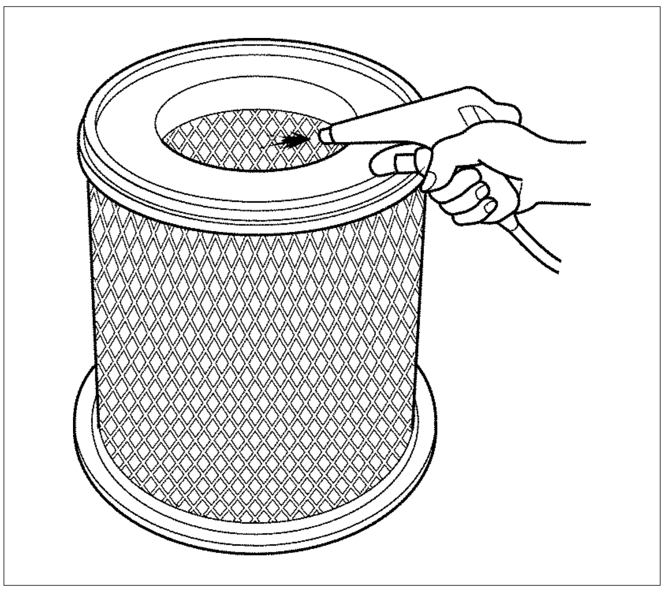
Cleaning

Dry type element

- Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

Compressed air pressure	kPa (kg/cm^2 /psi)
392 – 490 (4 – 5/57 – 71)	

Standard Output



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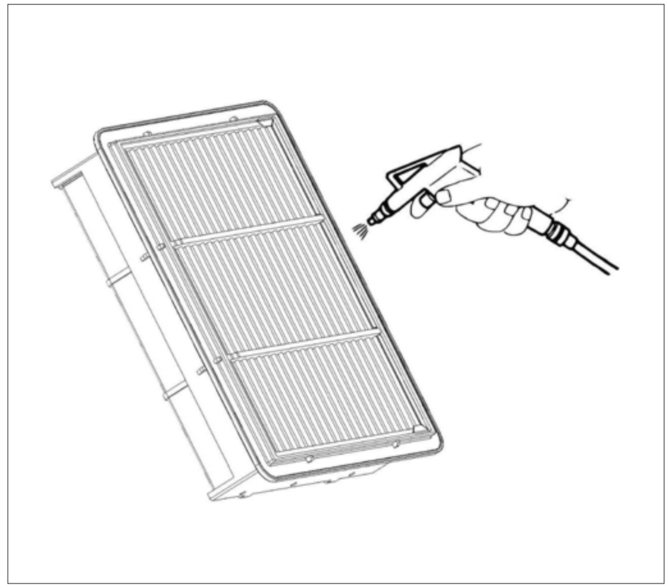
High Output



LNW71BSH000201

Installation

1. Install the air cleaner element assembly.
2. Install the air cleaner cover.

SECTION 6B

ENGINE COOLING

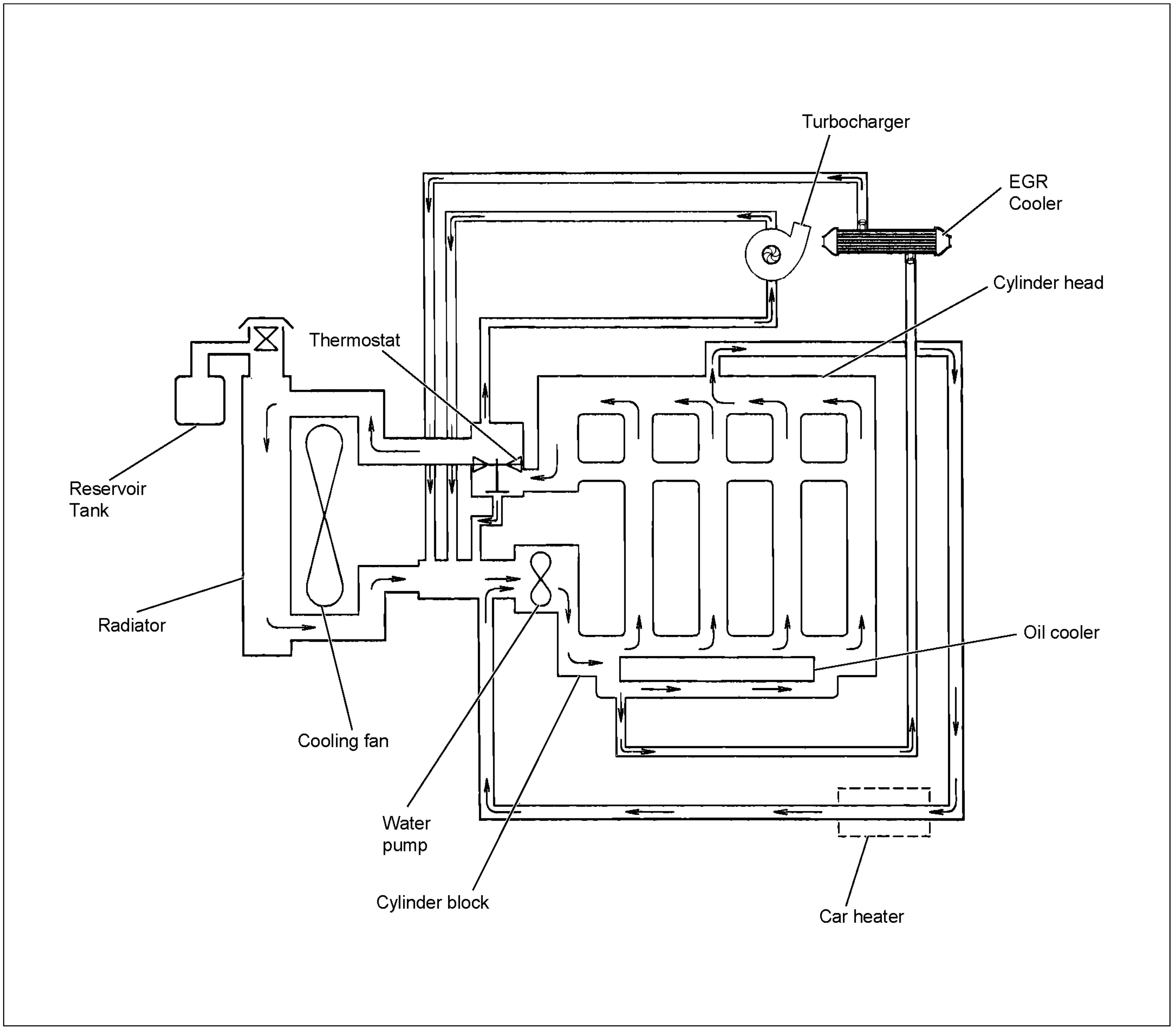
TABLE OF CONTENTS

Main Data and Specifications

Item		Description	
		M/T	A/T
Cooling system		Engine coolant forced circulation	
Water pump type		Centrifugal impeller type	
Pump to crankshaft speed ratio	(To 1)	1.25	
Delivery volume	lit (US/UK gal)/min	240 (63.1/53.3)	
Pump speed at 5600 rpm			
Water temperature at 30°C (86°F)			
Pump bearing type		Double row shaft	
Thermostat type		Wax pellet with jiggle valve	
Valve initial opening temperature	°C (°F)	85 (185)	
Valve full opening temperature	°C (°F)	100 (212)	
Valve lift at fully open position	mm (in)	10 (0.39)	
Radiator		Tube type corrugated	
Heat radiation capacity	kW (kcal/h)	93 (80.2)	
Heat radiation area	m^2 (ft^2)	11.63 (125.2)	
Radiator front area	m^2 (ft^2)	0.28 (3)	
Radiator dry weight	N (kg/lb)	52	53
Radiator cap valve opening pressure	kPa (kg/cm^2/psi)	93.3 - 122.7 (0.95 - 1.25/13.5 - 17.8)	
Engine coolant capacity	lit (U.S pint)	4.0 (8.5)	4.0 (8.5)
Engine coolant total capacity	lit (U.S pint)	8.7 (18.4)	8.6 (18.2)

General Description

Coolant Flow



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The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.

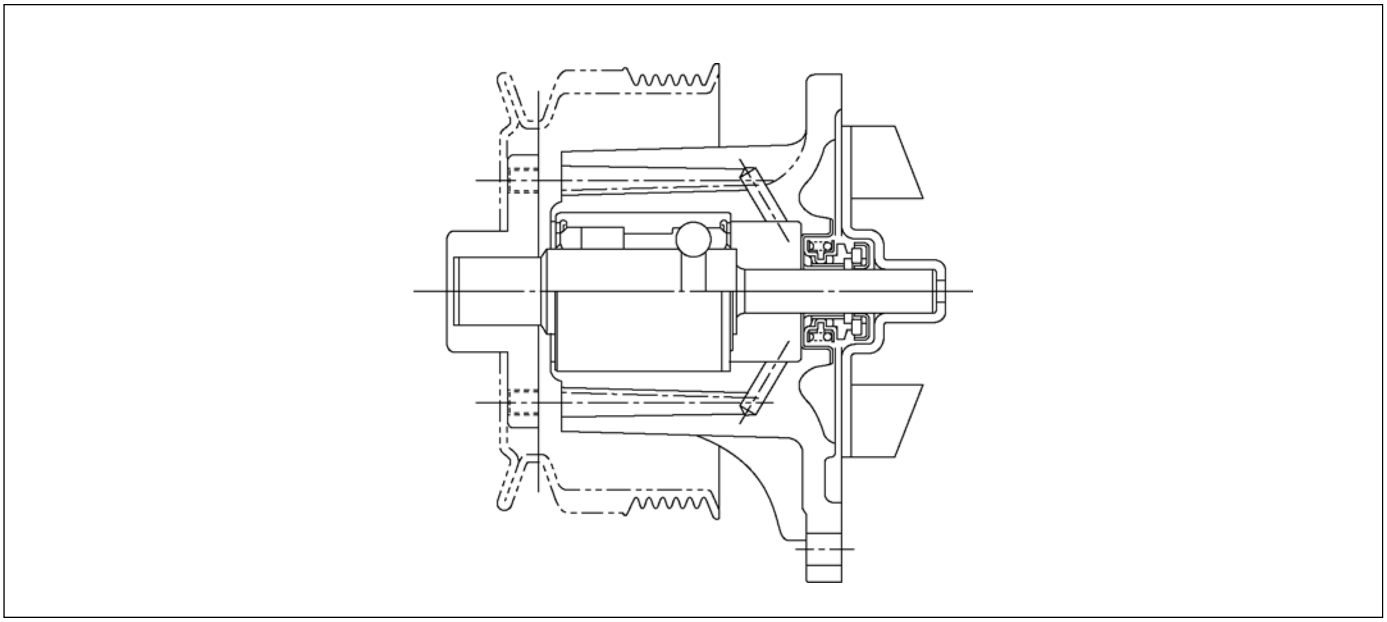
To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostat through the bypass pipe and back to the cylinder body.

The coolant does not circulate through the radiator.

When the coolant temperature reaches the specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostat will be fully open when the coolant temperature reaches the specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

Water Pump



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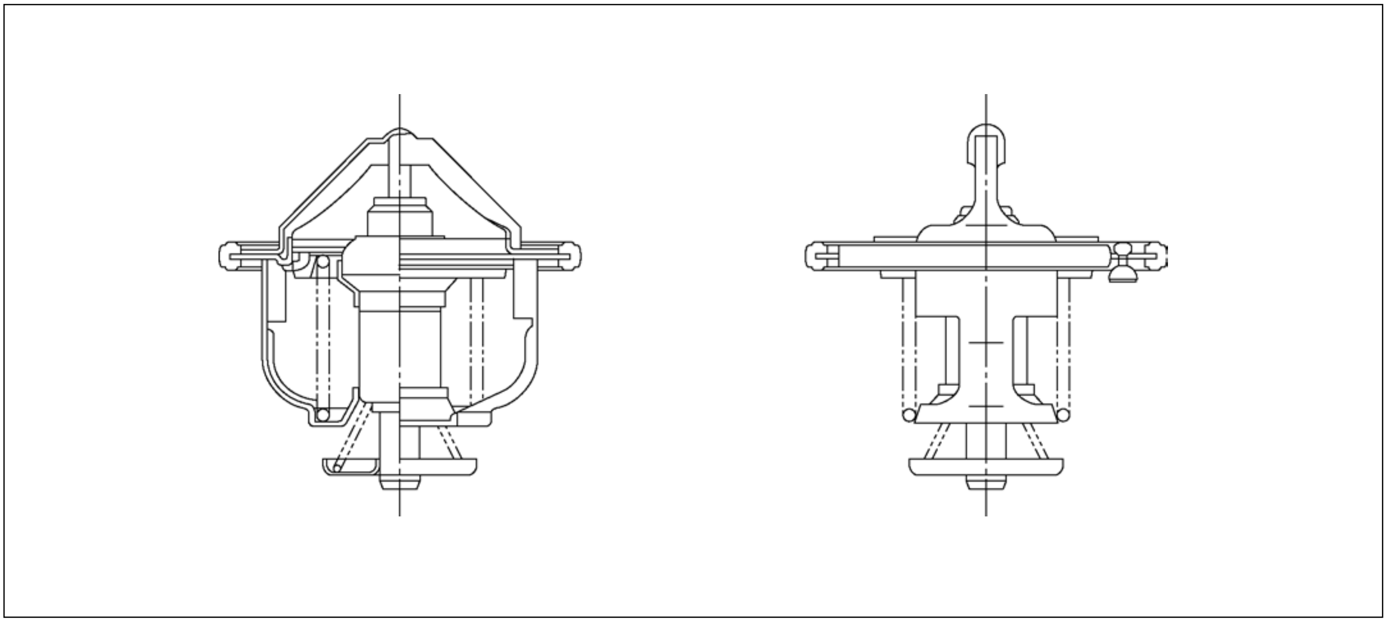
A centrifugal type water pump forcefully circulates the coolant through the cooling system.

The water pump is not a disassembled type.

Thermostat



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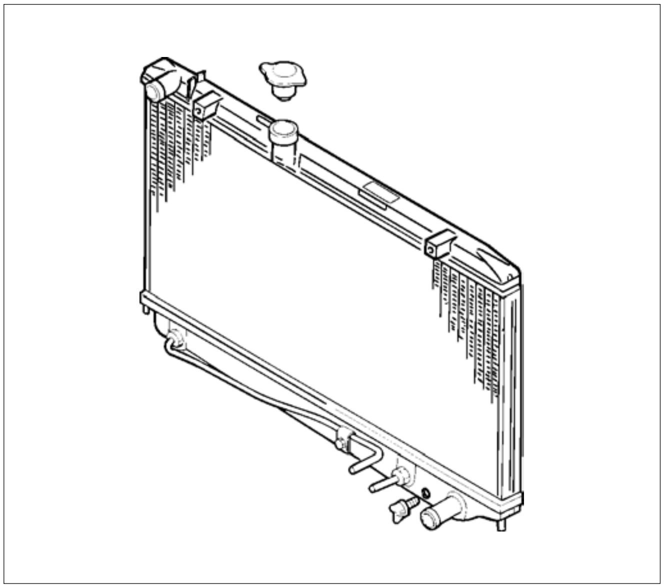
A wax pellet type thermostat is used.

Radiator

The radiator is a tube type with corrugated fins. In order to raise the boiling point of the coolant, the radiator is fitted with a cap in which the valve is operated at 93.3 - 122.7 kPa (0.95 - 1.25 kg / cm^2 / 13.5 - 17.8 psi) pressure. (No oil cooler provided for M/T)



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Antifreeze Solution

NOTE:
Antifreeze solution + Water = Total cooling system capacity.

Total Cooling System Capacity Lit (US / UK gal) (US pint)

M/T 8.7 (2.3/1.9) (18.4)
A/T 8.6 (2.3/1.9) (18.2)

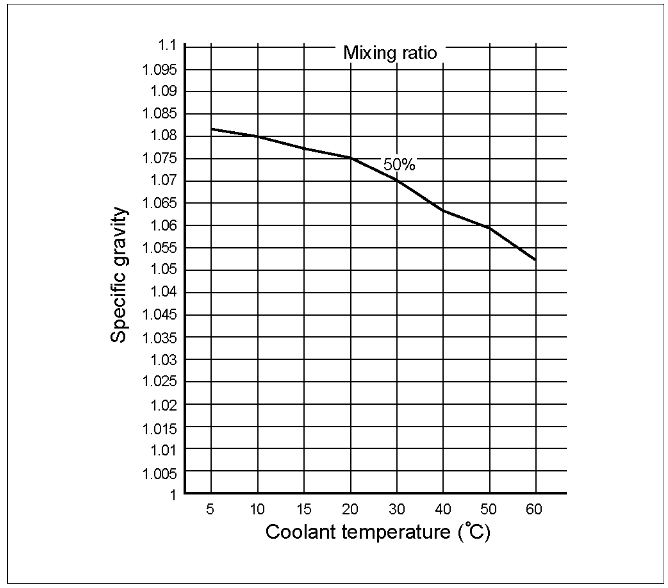
See section 0B *MAINTENANCE AND LUBRICATION*.

Mixing ratio

$$= \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.) + Water (Lit/gal.)}}$$

F06RW005

NOTE:
To maintain the corrosion resistance of the aluminum radiator, water and antifreeze must be combined in a 1:1 solution (50% antifreeze and 50% water).



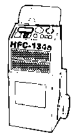
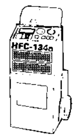
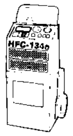
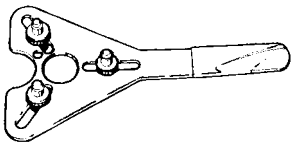
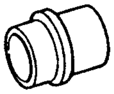
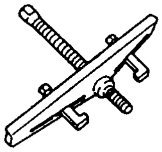
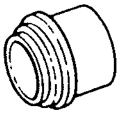
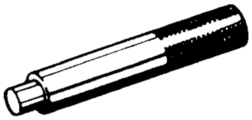
RTW76BSH000201

Diagnosis

Engine Cooling Trouble

Condition	Possible Cause	Correction
Engine overheating	Low Engine Coolant level	*Replenish*
	Thermo meter unit faulty	*Replace*
	Faulty thermostat	*Replace*
	Faulty Engine Coolant temperature sensor	*Repair or replace*
	Clogged radiator	*Clean or replace*
	Faulty radiator cap	*Replace*
	Low engine oil level or use of improper engine oil	*Replenish or change oil*
	Clogged exhaust system	*Clean exhaust system or replace faulty parts*
	Faulty Throttle Position sensor	*Replace throttle valve assembly*
	Open or shorted Throttle Position sensor circuit	*Repair or replace*
	Damaged cylinder head gasket	*Replace*
Engine overcooling	Faulty thermostat	*Replace*
Engine slow to warm–up	Faulty thermostat	*Replace*
	Thermo unit faulty	*Replace*

SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	5-8840-0629-0 (J-39500-A)	
	5-8840-0630-0 (J-39500-220A)	
	5-8840-0631-0 (J-39500-220ANZ)	
	5-8840-4056-0 (J-37872)	Drive plate holder
	5-8840-0121-0 (J-33943)	Clutch pulley puller pilot
	5-8840-0111-0 (J-8433)	Clutch pulley puller
	5-8840-0118-0 (J-33940)	Clutch pulley installer
	5-8840-0007-0 (J-8092)	Driver handle

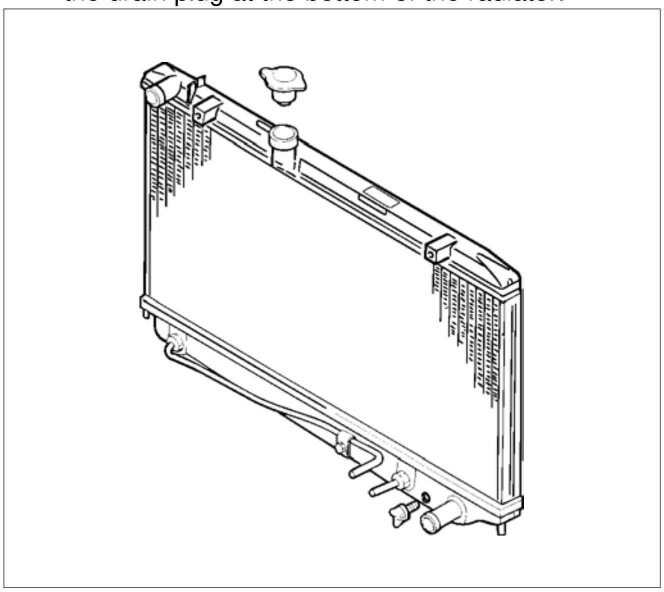
Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant (EC) level should be between the “MIN" and “MAX" lines of the reserve tank when the engine is cold. If low, check for leakage and add EC up to the “MAX" line.

There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the EC should also be free from oil.

Replace the EC if excessively dirty.

1. Remove the radiator skid plate.
2. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.



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3. Remove the radiator cap.

WARNING:
To avoid the danger of being burned, do not remove the cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure.

4. Disconnect all hoses from the EC reserve tank. Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.
5. Refill the cooling system with the EC using a solution that is at least 50 percent antifreeze.

Procedure for filling with coolant (in case of full change).

- Make sure that the engine is cool.
- Open radiator cap and pour coolant up to filler neck.
- Pour coolant into reservoir tank up to “MAX" line.
- Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen the radiator cap. If the water level is lower, replenish.

WARNING:
When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

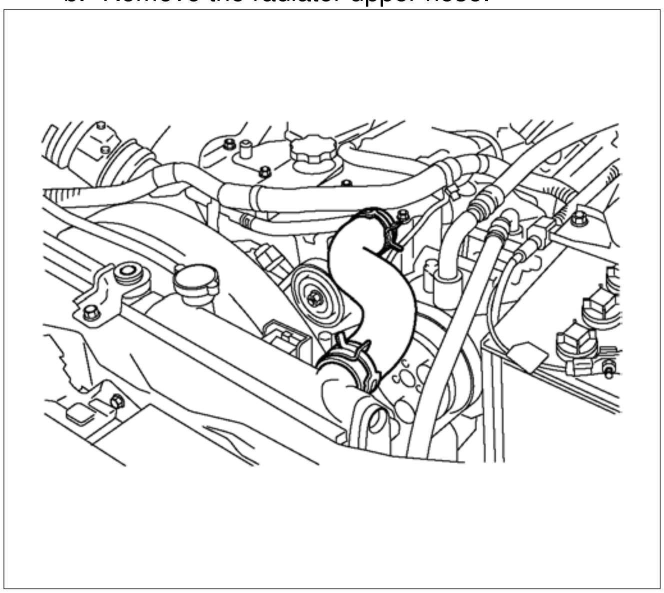
- After tightening the radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
- Check to see the thermostat has opened through the needle position of the water thermometer, conduct a 5–minute idling again and stop the engine.
- When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant be found, check the cooling system and reservoir tank hose for leakage.
- Pour coolant into the reservoir tank up to “MAX" line.

Water Pump

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

1. Remove the engine cover.
2. Radiator Upper Hose
   a. Partially drain the engine coolant.
   b. Remove the radiator upper hose.



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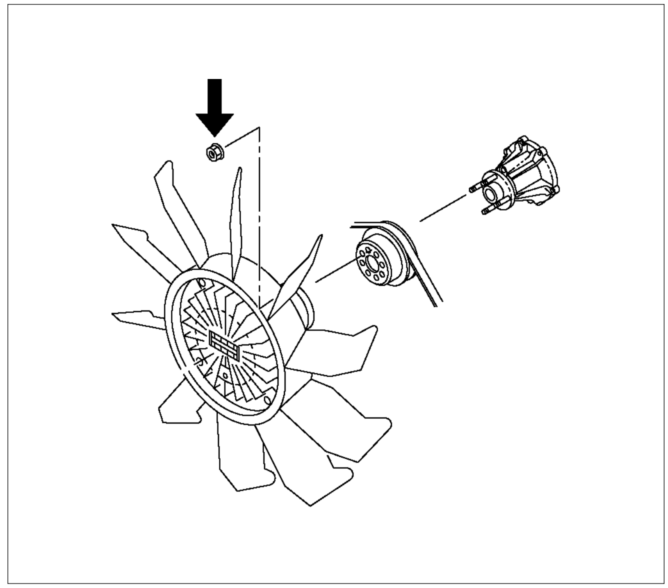
3. Water Outlet Pipe
   a. Disconnect the turbocharger-cooling pipe from the outlet pipe.
   b. Loosen the fixing bolt and remove the water outlet bolt.
4. Upper Fan Shroud
5. Fan and Fan Clutch
   a. Loosen the fan clutch nuts.
   b. Remove the fan together with the fan clutch. Take care not to damage the radiator core.
6. Fan Drive Belt and Pulley
   a. Loosen the tension adjust bolt on the generator.
   b. Remove the fan drive belt with the fan pulley.



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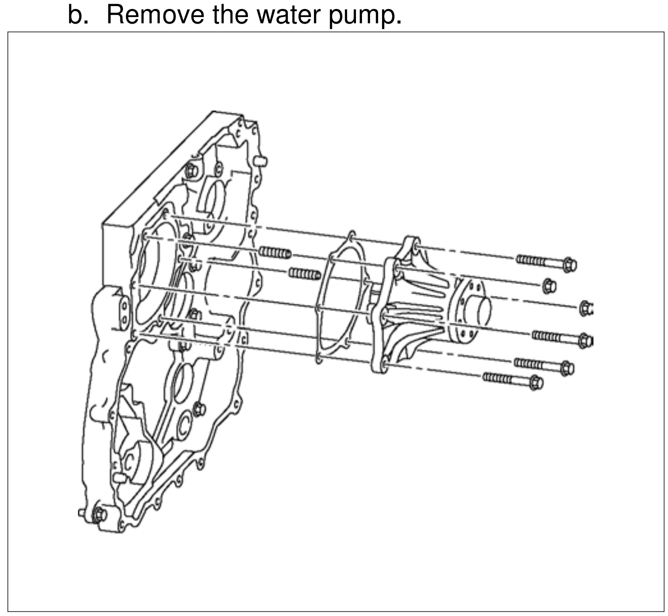
7. Water Pump
   a. Remove the water pump bolts and nuts.
   b. Remove the water pump.



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Inspection and Repair

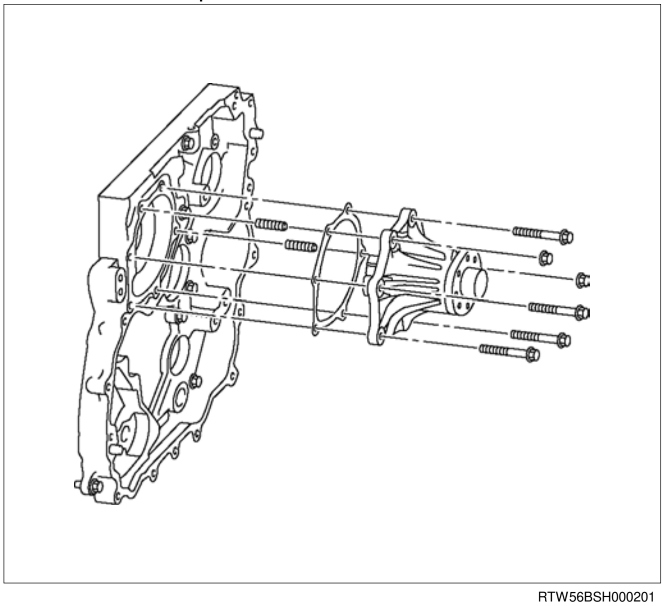
The water pump is not disassembled type.

Make necessary parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced.

- Cracks in the water pump body.
- Coolant leakage from the sealed unit.
- Excessive radial play or abnormal noise in the fan center when rotated by hand.
- Excessive thrust play in the fan center (Standard play: less than 0.2 mm (0.0078 in)).
- Cracks or corrosion in the impeller.

Installation

1. Water Pump



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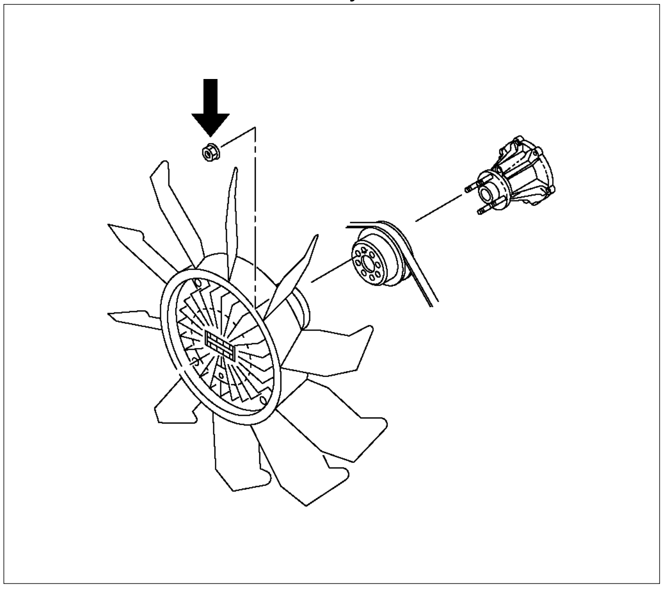
a. Install the water pump with a new gasket.

b. Tighten bolts and nuts to specified torque.

Water Pump Nut/Bolt Torque:
25 N·m (2.5 kg·m /18 lb ft)

2. Fan Drive Belt and Pulley and Fan and Fan Clutch.



RTW56ASH025401

a. Install the fan drive belt and fan pulley and fan and fan clutch.

b. Tighten the nuts to specified torque.

Fan Clutch Nut Torque: 8 N·m (0.8 kg·m /69 lb in)

c. Apply tension to the fan drive belt by moving the generator.

d. Apply a force of 98 N (10 kg/22 lb) to the drive belt mid-portion to check the drive belt deflection.

Fan Drive Belt Deflection	mm (in)
New belt	5 - 6 (0.20 – 0.24)
Reuse belt	7 - 8 (0.28 – 0.32)

3. Upper Fan Shroud
4. Water Outlet Pipe.

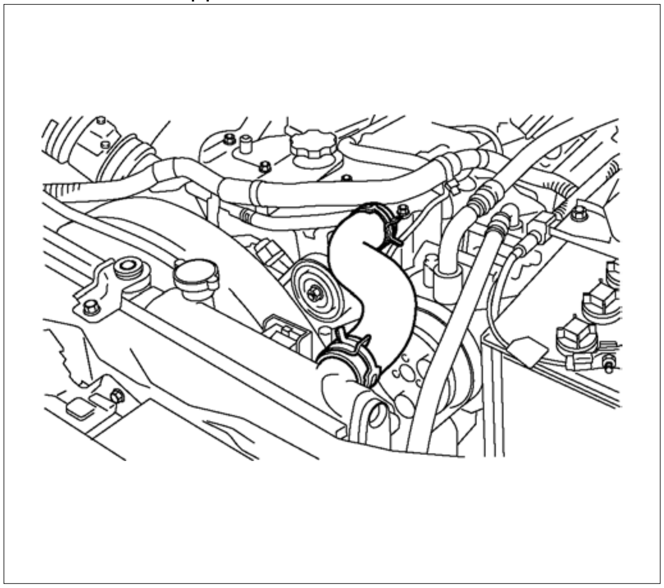
a. Install the water outlet pipe to the thermostat housing.

b. Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque:
25 N·m (2.5 kg·m /18 lb ft)

c. Connect the turbocharger-cooling pipe to outlet pipe.

5. Radiator Upper Hose.



RTW56FSH000101

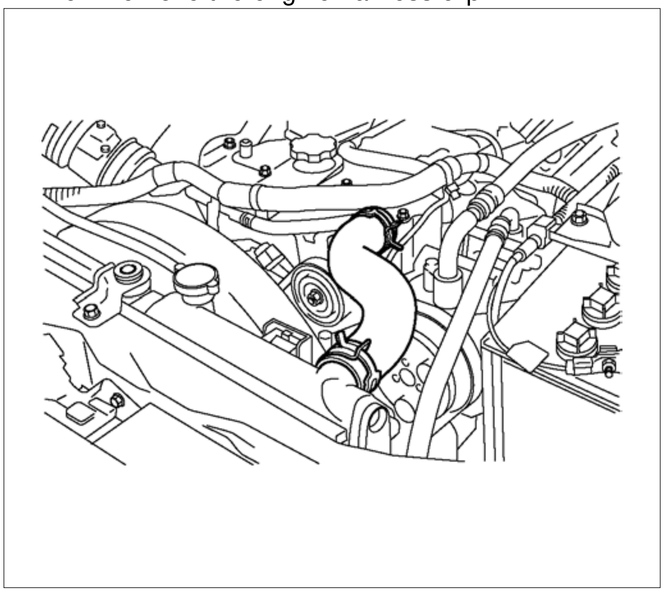
   a. Connect the radiator upper hose to the water outlet pipe.
   b. The knob of clamp shall be directed to horizontal.
   c. Replenish the engine coolant.
6. Install the engine cover.

Thermostat

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

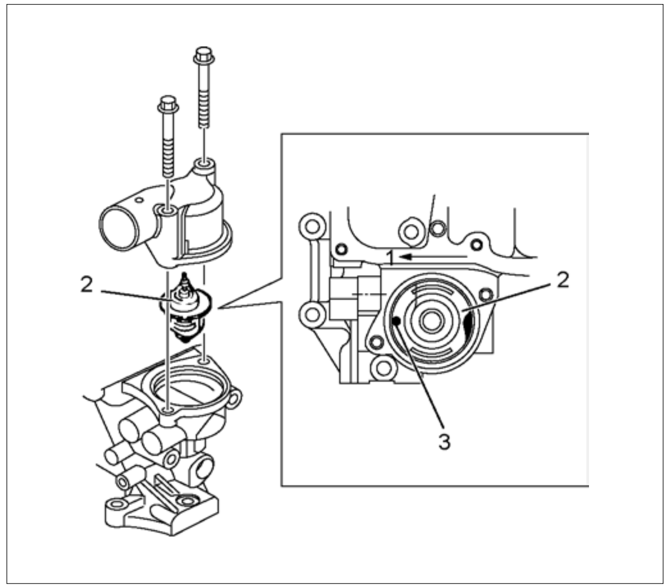
Removal

1. Remove the engine cover.
2. Radiator Upper Hose
   a. Partially drain the engine coolant.
   b. Remove the radiator upper hose.
   c. Remove the engine harness clip.



RTW56FSH000101

3. Water Outlet Pipe
   a. Disconnect the turbocharger-cooling pipe from outlet pipe.
   b. Loosen the fixing bolt and remove the water outlet bolt.
4. Thermostat
   Remove the thermostat from the thermostat housing.
   Take care not to damage the thermostat.



RTW56BSH000101

Legend

1. Front
2. Thermostat
3. Jiggle Valve

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Operating Test of Thermostat

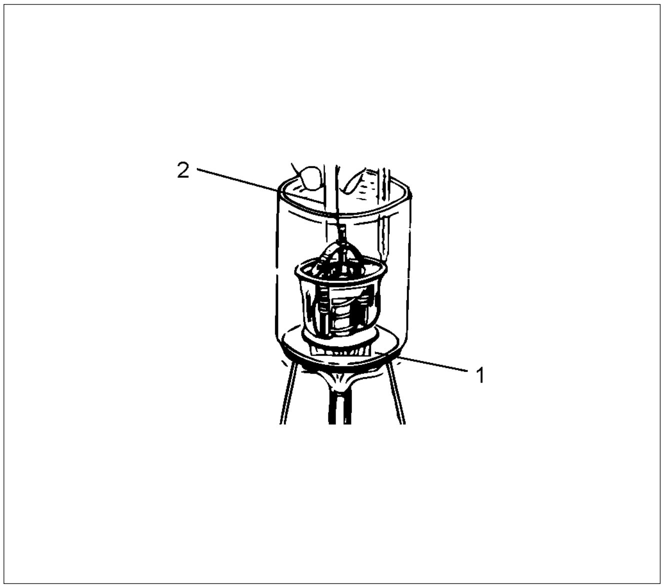
1. Completely submerge the thermostat in water.
2. Heat the water.Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial Opening Temperature °C (°F)
85 (185)

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature °C (°F)
100 (212)

Valve Lift At Fully Open Position mm (in)
10 (0.39)



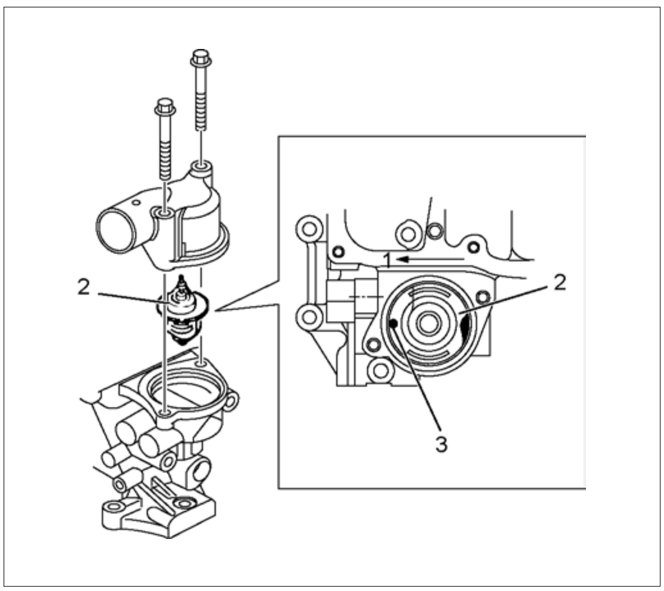
MFW41CSH001401

Legend

1. Wooden Piece
2. Agitating Rod

Installation

1. Thermostat
   Install the thermostat.
   Mount the jiggle valve with the valve facing engine front.



RTW56BSH000101

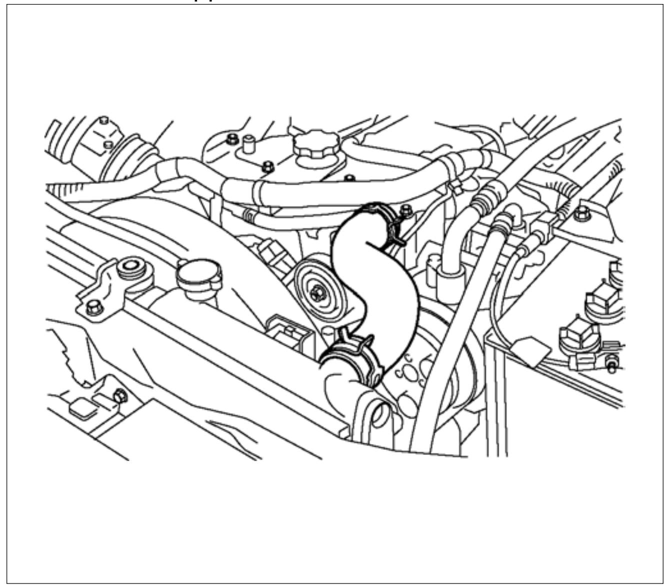
Legend

1. Front
2. Thermostat
3. Jiggle Valve

2. Water Outlet Pipe.
   a. Install the water outlet pipe with new gasket to the thermostat housing.
   b. Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque:
25 N·m (2.5 kg·m /18 lb ft)

   c. Connect the turbocharger-cooling pipe to outlet pipe.
   d. Install the engine harness clip.
3. Radiator Upper Hose.

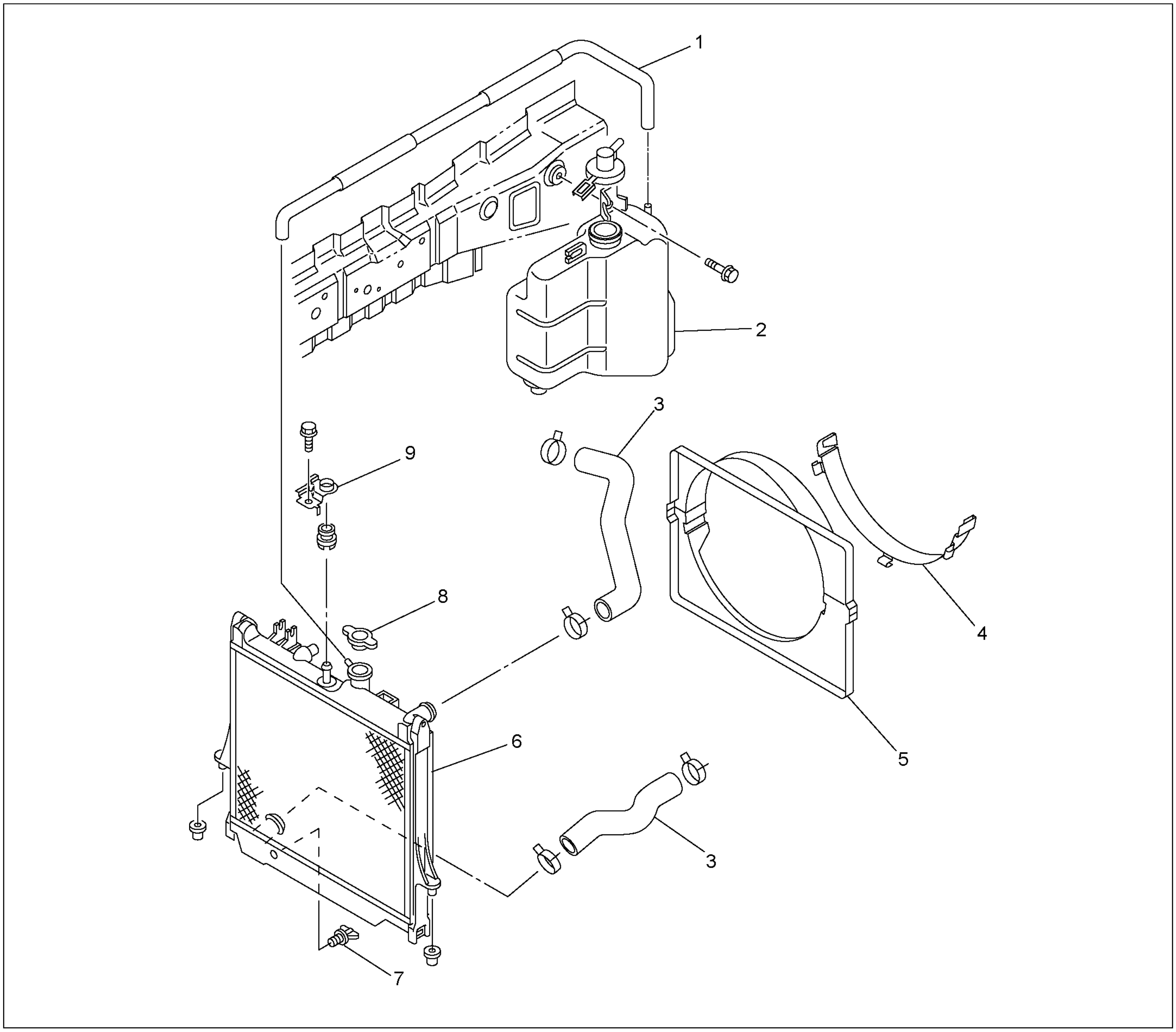


RTW56FSH000101

   a. Connect the radiator upper hose to the water outlet pipe.
   b. The knob of the clamp should be directed to the horizontal side.
   c. Replenish the engine coolant.
4. Install the engine cover.

Radiator

Radiator and Associated Parts

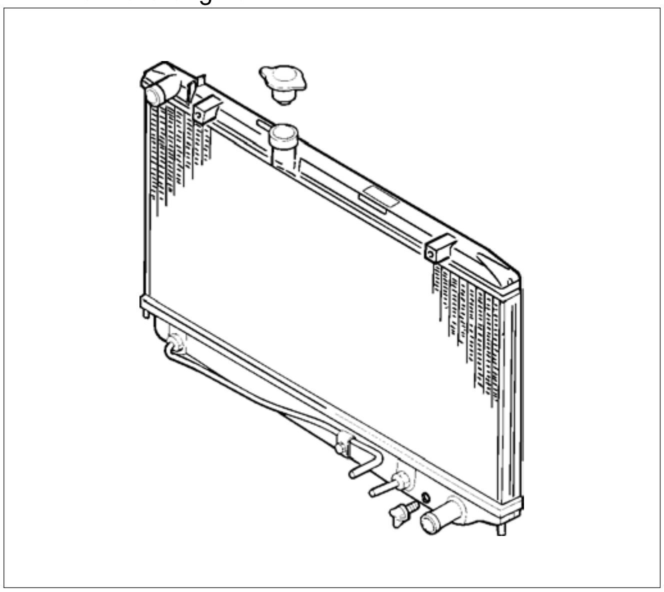


Legend

1. Reserve Tank Hose
2. Reserve Tank
3. Radiator Hose
4. Fan Guide; Lower
5. Fan Guide
6. Radiator Assembly
7. Drain Plug
8. Radiator Cap
9. Bracket

Removal

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain EC.
3. Disconnect oil cooler hose on automatic transmission (A/T).
4. Remove the engine cover.
5. Disconnect radiator inlet hose and outlet hose from the engine.



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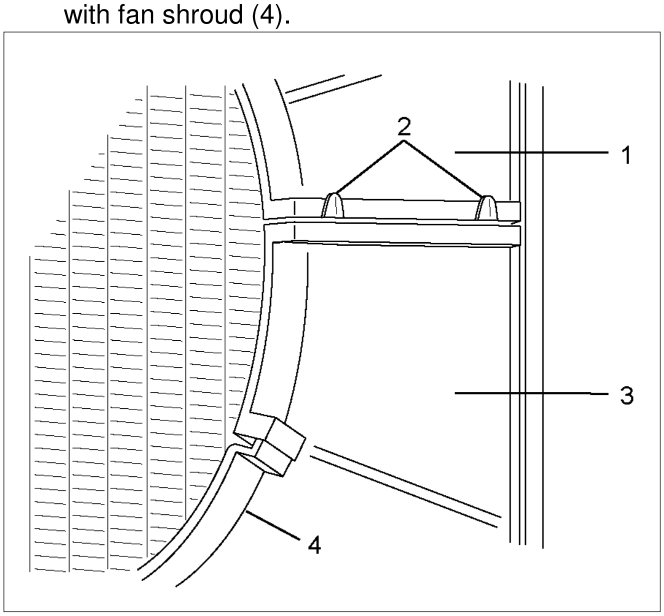
6. Remove fan guide (1), clips (2) on both sides and the bottom lock, then remove lower fan guide (3) with fan shroud (4).

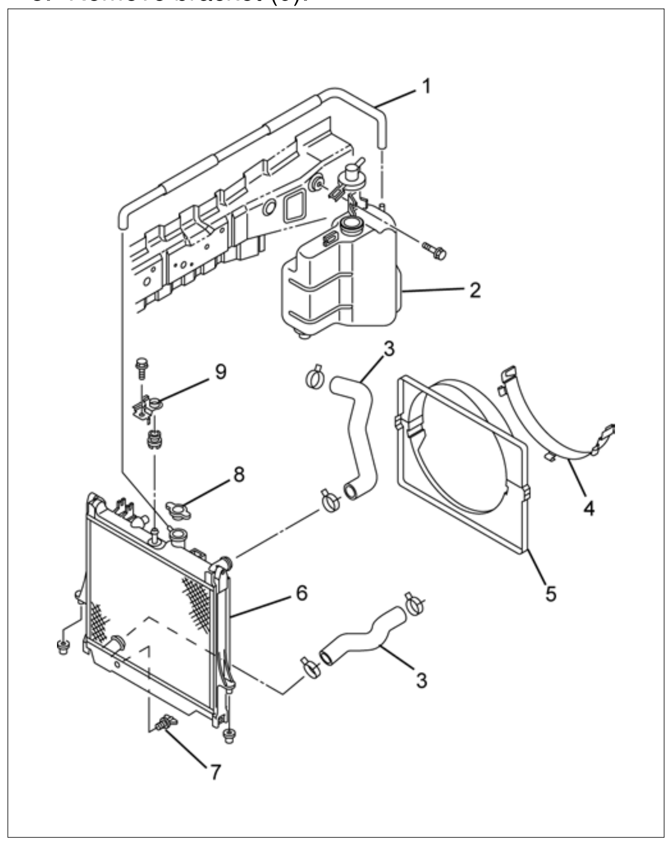


PTW46BSH000101

Legend

1. Fan Guide
2. Clips
3. Lower Fan Guide
4. Fan Shroud

7. Disconnect the reserve tank hose (1) from radiator.
8. Remove bracket (9).



RTW76BMH000101

Legend

1. Reserve Tank Hose
2. Reserve Tank
3. Radiator Hose
4. Fan Guide; Lower
5. Fan Guide
6. Radiator Assembly
7. Drain Plug
8. Radiator Cap
9. Bracket

9. Lift up and remove the radiator assembly with hose, taking care not to damage the radiator core with a fan blade.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.

Replace the cap if the valve opening pressure is outside the standard range.

Valve opening pressure:

93.3 - 122.7 kPa (0.95 - 1.25 kg / cm^2 / 13.5 - 17.8 psi)

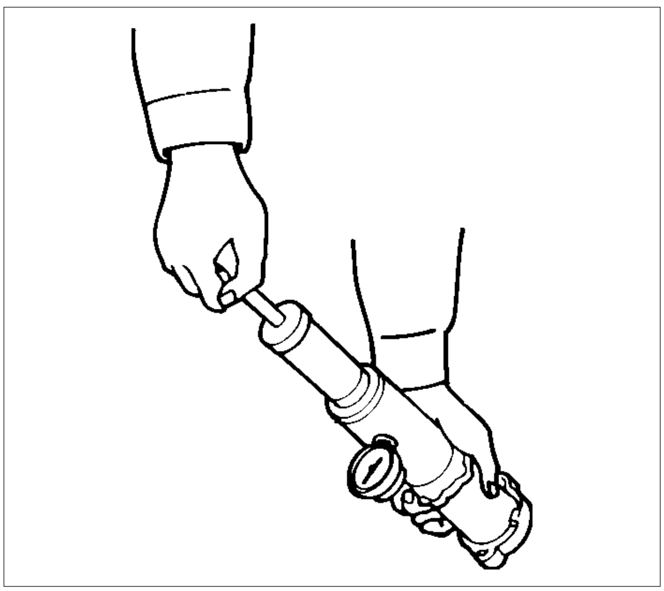
Cap tester: 5–8840–0277–0

Adapter: 5–8840–2603–0

Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

Valve opening vacuum:

1.96 - 4.91 kPa (0.02 - 0.05 kg / cm^2 / 0.28 - 0.71 psi)



110RS006

Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

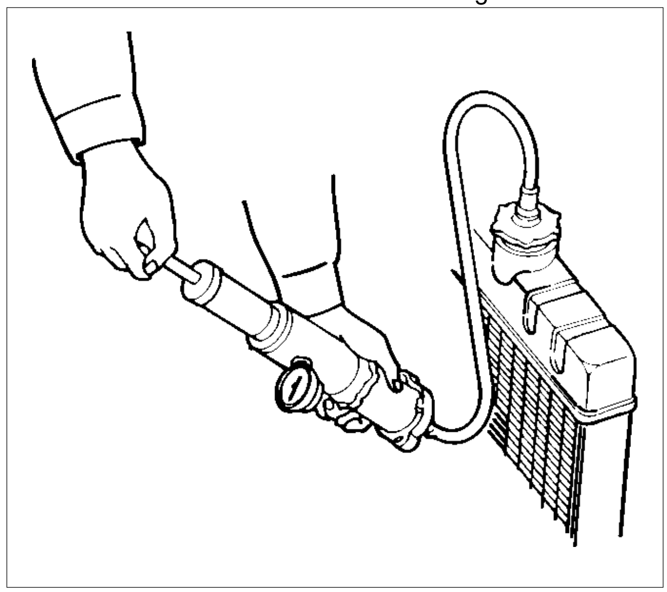
Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (2.0 kg / cm^2 / 28.5 psi) with a cap tester:

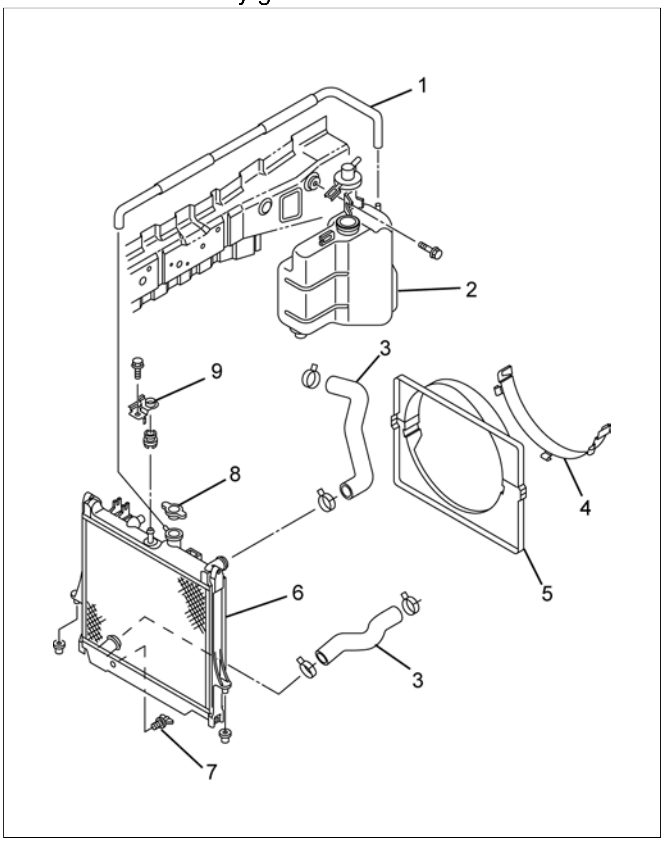
- Leakage from the radiator.
- Leakage from the coolant pump.
- Leakage from the water hoses.
- Check the rubber hoses for swelling.



110RS005

Installation

1. Install radiator assembly (6) with hose, taking care not to damage the radiator core with a fan blade.
2. Support the radiator upper tank with the bracket (9) and secure the radiator.
3. Connect reserve tank hose (1).
4. Install lower fan guide (4).
5. Connect radiator inlet hose and outlet hose (3) to the engine.
6. Install the engine cover.
7. Connect oil cooler hose to automatic transmission.
8. Connect battery ground cable.

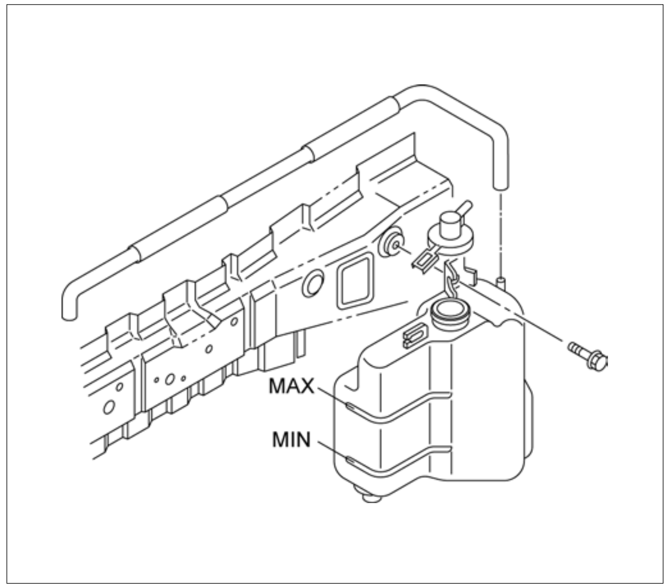


RTW76BMH000101

Legend

1. Reserve Tank Hose
2. Reserve Tank
3. Radiator Hose
4. Fan Guide; Lower
5. Fan Guide
6. Radiator Assembly
7. Drain Plug
8. Radiator Cap
9. Bracket

9. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.
   Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.



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Engine coolant change

Refer to change procedure for Draining and Refilling Cooling System in this section.

SECTION 2

FRAME AND CAB

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PAGE

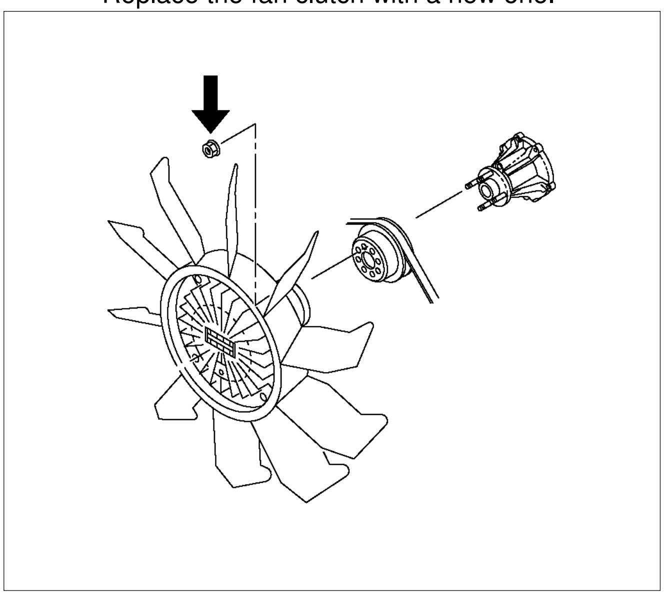
Fan Clutch with Cooling Fan

Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Visually inspect for damage, leak (silicon grease) or other abnormal conditions.

1. Inspection (on-vehicle)
   a) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.
   b) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 85°C (185°F). Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.
   If the fan clutch rotates more readily, however, this indicates that the silicone grease is leaking internally.
   Replace the fan clutch with a new one.



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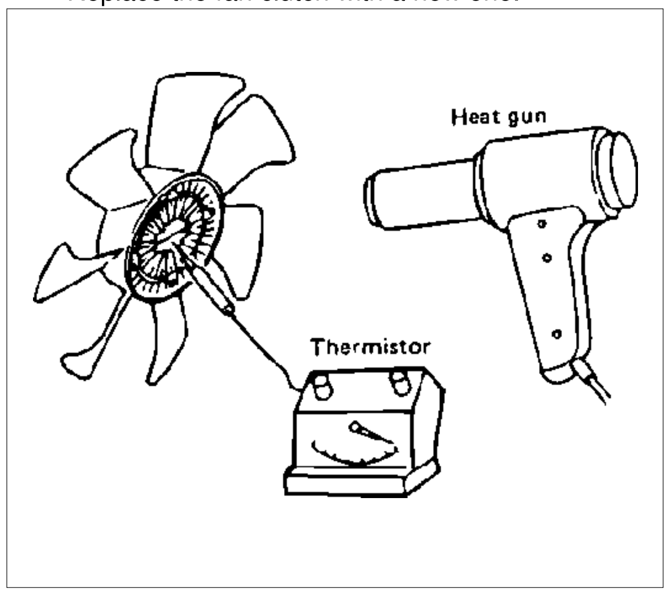
2. Inspection (in unit)
   Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 85°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).
   If the fan clutch rotates more readily at this time, this indicates that the silicone grease is leaking internally.
   Replace the fan clutch with a new one.



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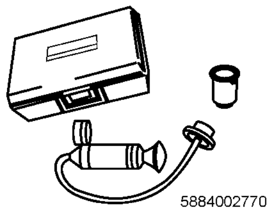
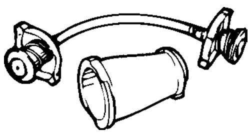
Special Tools

ILLUSTRATION	PART NO. PART NAME
	**5-8840-0277-0** Cap tester
	**5-8840-2603-0** Adapter

SECTION 6C

FUEL SYSTEM

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Fuel System

Service Precautions

Parts of the fuel system such as the internal part of the fuel injector, and holes and clearances that form passages for fuel are finished to a very high degree of accuracy. They are therefore highly sensitive to foreign matter and the entry of foreign matter could cause damage to the fuel passage. Therefore, effective measures should be taken to prevent the entry of foreign matter.

If a water removal agent is used in the fuel then it will absorb moisture in the light oil and may cause rust. Therefore, do not use a water removal agent in the fuel tank.

When servicing the fuel system, every precaution must be taken to prevent the entry of foreign material into the system.

- Before beginning the service procedure, wash the fuel line and the surrounding area.
- Perform the service procedures with clean hands. Do not wear work gloves.
- Immediately after removing the fuel hose and/or fuel pipe, carefully tape vinyl bags over the exposed ends of the hose or pipe.
- If parts are to be replaced (fuel hose, fuel pipe, etc.) do not open the new part packaging until installation.

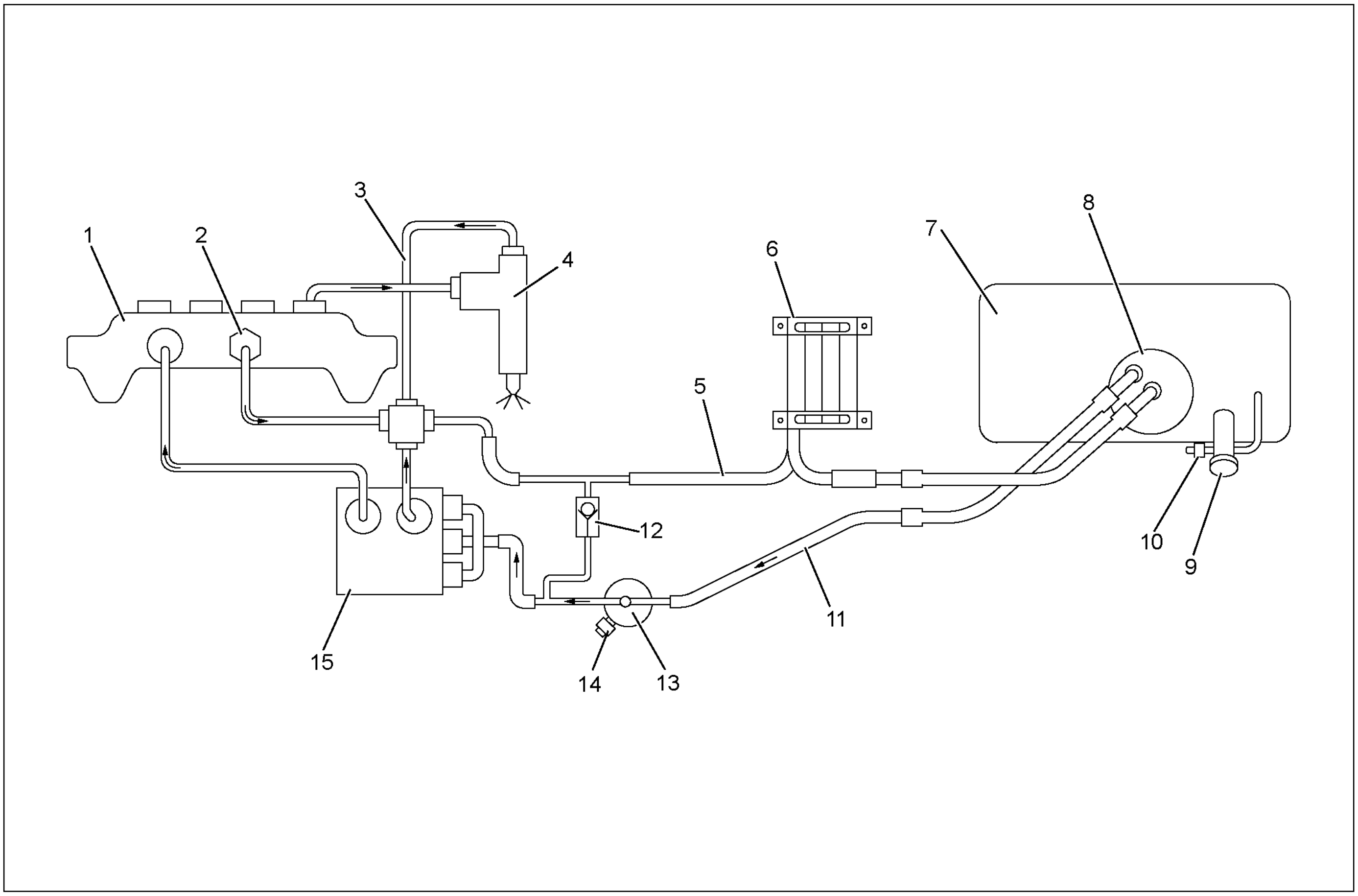
Discard gaskets and O-rings and replace them with new ones.

Work procedure

- The fuel opening must be quickly sealed when removing the fuel pipe, injection pipe, fuel injector, fuel supply pump, and fuel rail.
- The eyebolts and gasket must be stored in a clean parts box with a lid to prevent adhesion of foreign matter.
- Fuel leakage could cause fires. Therefore, after finishing the work, wipe off the fuel that has leaked out and make sure there is no fuel leakage after starting the engine.

Explanations on functions and operation

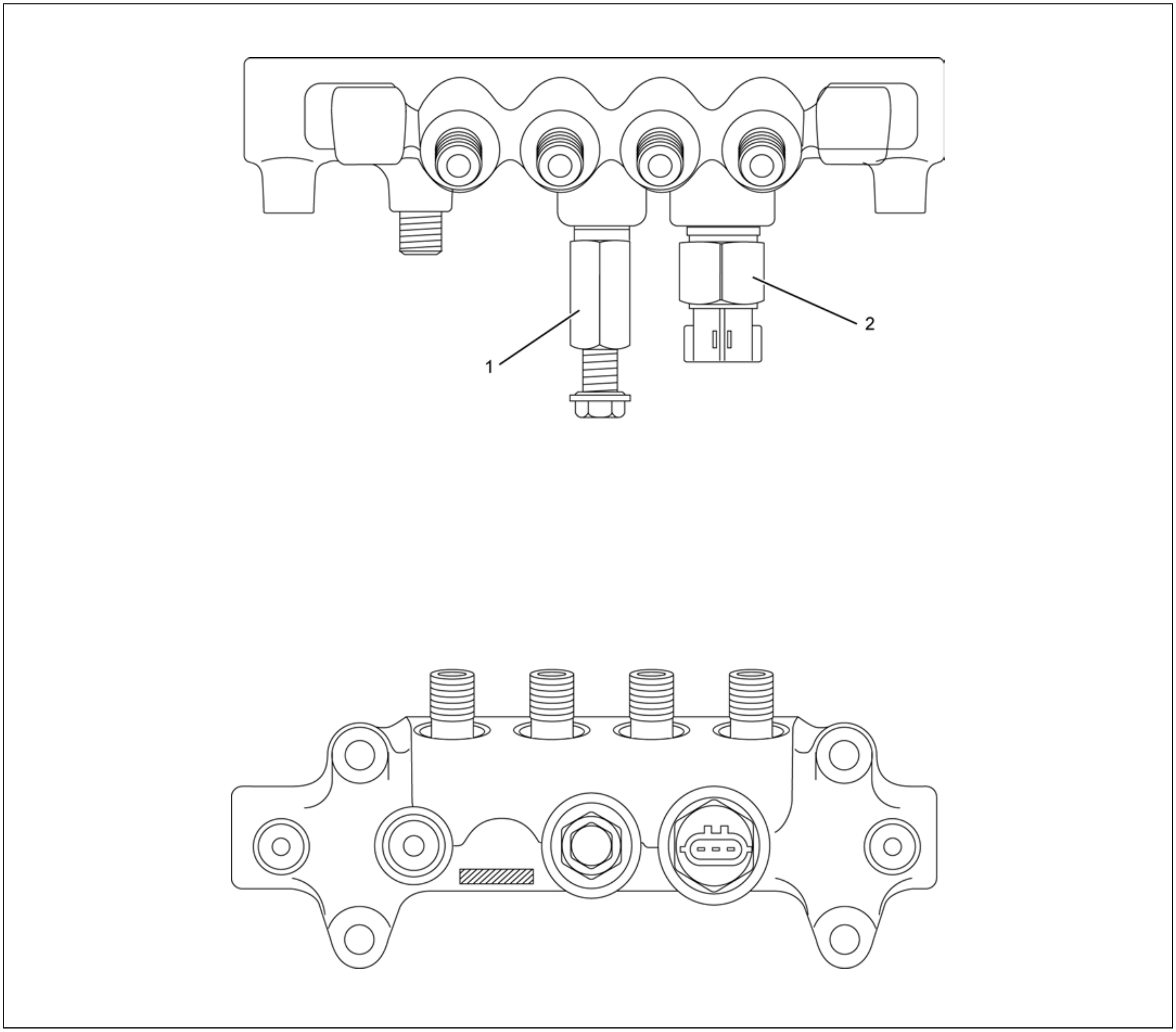
Fuel system diagram



Legend

1. Fuel Rail
2. Fuel Pressure Limiter
3. Leak Off Pipe
4. Fuel Injector
5. Fuel Return Pipe
6. Fuel Cooler
7. Fuel Tank
8. Fuel Pump and Sender Assembly
9. Fuel Filler Cap
10. Check Valve
11. Fuel Feed Pipe
12. One Way Valve
13. Fuel Filter With Sedimenter
14. Switch; Clogging Monitoring
15. Fuel Supply Pump

Fuel rail assembly



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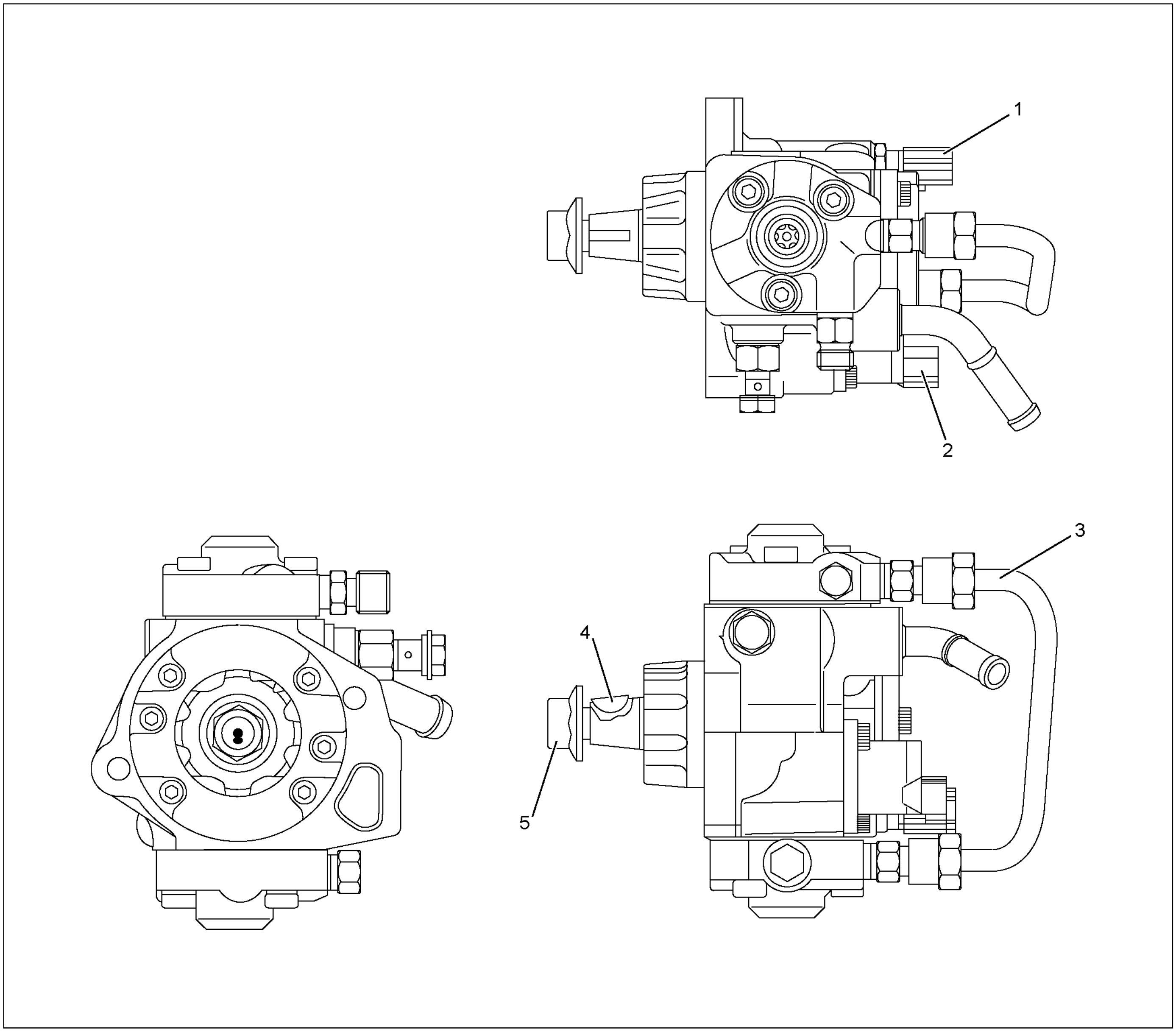
Legend

1. Fuel Pressure Limiter
2. Fuel Rail Pressure Sensor

Fuel supply pump

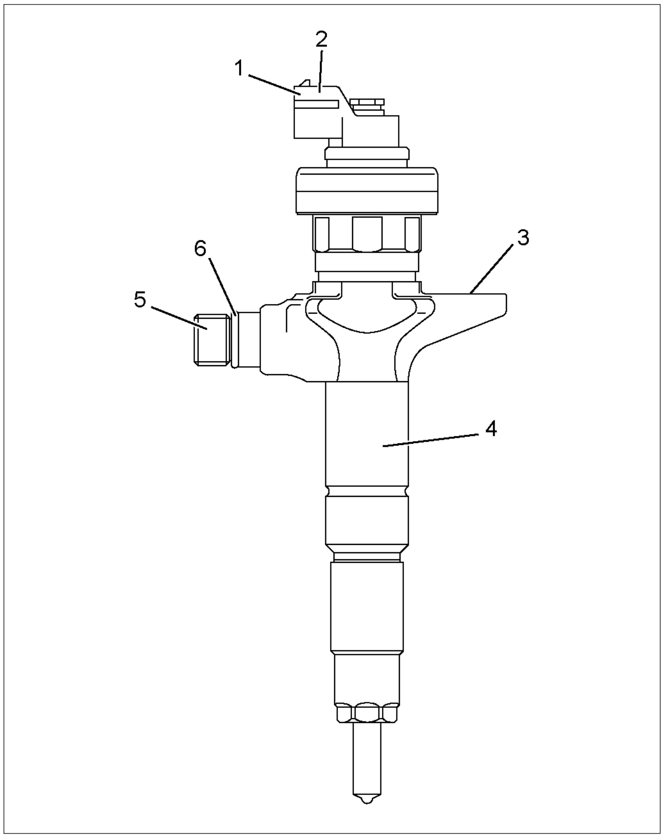


RTW56CLF000301

Legend

1. Fuel Temperature Sensor
2. Suction Control Valve
3. High Pressure Pipe
4. Camshaft Key
5. Camshaft Nut

Fuel injector

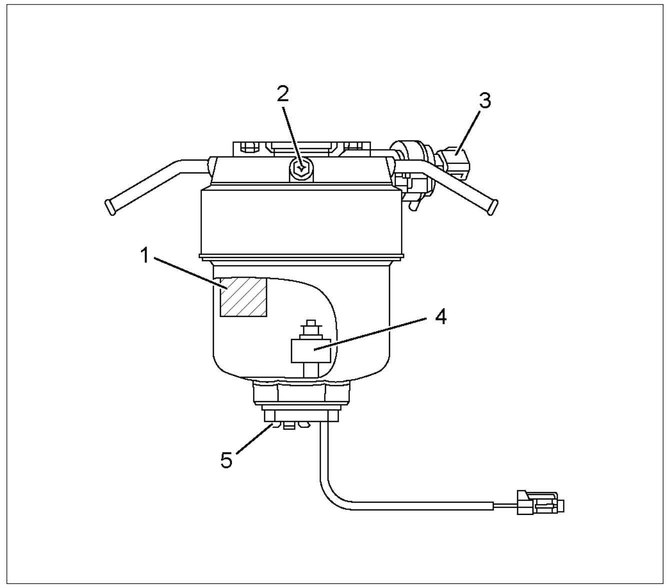


RTW76CMH000201

Legend

1. Terminal
2. Fuel Injector ID Code
3. Two Dimensional Barcode
4. Parts Number
5. Port for Mounting the Injection Pipe
6. O-ring

Fuel filter



RTW76CSH001001

Legend

1. Element
2. Air Bleeding Plug
3. Switch; Clogging Monitoring
4. Sensor; Water
5. Drain Plug

Functional check

Air bleeding

1. Ignition switch is turned to the ON position for 15 seconds.
2. Ignition switch is turned to the OFF position.
3. The above operation is repeated 5 times.

Note: If the air bleeding work is insufficient then it could lead to faults in the engine. Therefore, the procedures after starting the engine should always be implemented.

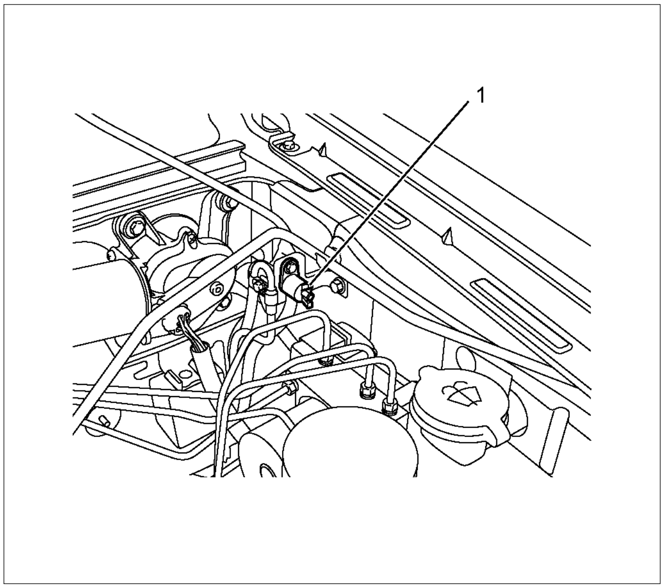
Water drain

A warning lamp will light up if water above the specified volume collects in the sedimenter. In such cases, drain out the water by performing the following operations:

1. Draining with fuel filter drain plug.
   a. Set a container at the tip of the plastic hose.
   b. Loosen the air bleeding plug and the drain plug.
   c. Discharge the water.
   d. Tighten the drain plug after discharging the water.
   e. Tighten the air bleeding plug to the specified torque.
      Tightening torque: 3 N·m(0.3 kg·m/26 lb in)
   f. Ignition switch is turned ON for 15 seconds check for fuel leakage.

g. Check that the warning lamp in the meter is off.

2. Draining with drain plug in engine room.
   a. With the engine off, open the engine hood and loosen the drain plug (1) located on the left hand side of the engine room. (3-4 turns)
   b. Turn the starter switch to the "ON" position for 10 seconds, and then turn the starter switch to the "OFF" position for 10 seconds. Then, once again turn the starter switch to the "ON" position for 10 seconds.
   c. Tighten the drain plug firmly.
   d. After starting the engine, check that there is no fuel leakage from the drain plug. Also check that the water separator indicator has turned off.



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NOTE:

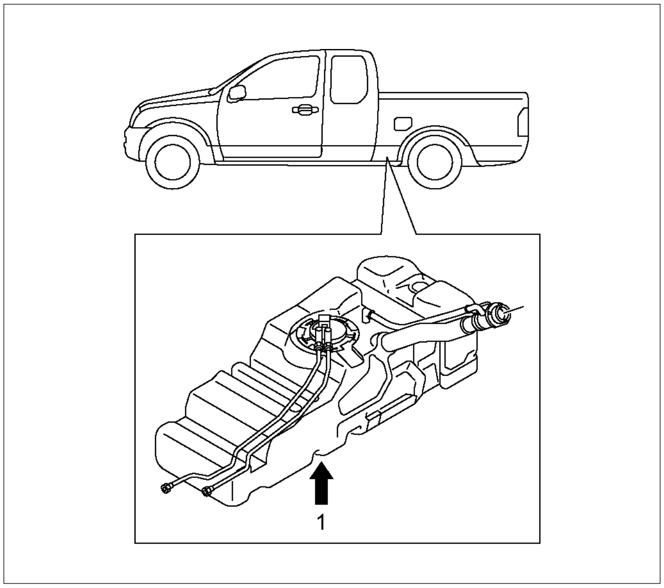
- If the water separator requires frequent draining, have the fuel tank drained at your ISUZU/GM Dealer.
- Be sure to stop the engine when draining the fuel tank.
- Confirm that there are no combustible materials under the drain hose, and use a receptacle to catch the drained water.

Engine starting cautions

- Before starting the engine, turn the ignition switch to the "ON" position. Wait 15 seconds. Return the switch to the "LOCK" position. Repeat this procedure 5 times.
- After starting the engine, allow it to idle for 10 minutes.

Fuel Pump Functional Check

1. Turn the starter switch to "ON" position.
2. Touch the under portion of the Fuel Tank by the hand as shown in the following figure within 12 seconds.



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Legend

1. Touch this area by the hand

3. Make sure a vibration by the Fuel Pump is detected.
   Fuel Pump stops within 12 seconds of turning the starter switch to the "ON" position.
   When the check is repeated, return the starter switch to the "LOCK" position for 10 – 15 seconds and perform procedures 1 – 3.

WARNING: FUEL PUMP FUNCTIONAL CHECK MUST BE CONDUCTED UNDER THE FOLLOWING CONDITIONS TO AVOID INJURY.

- **APPLY THE PARKING BRAKE.**
- **STOP THE ENGINE.**

Trouble Shooting

Problems with starting

Condition	Possible Cause	Correction
Problems with starting	Fuel tank is empty	Fill the tank.
	Air has entered the fuel system.	Bleed the air.
	Fuel line or fuel cooler is clogged or damaged. Connection to the fuel line is loose.	Repair or replace the fuel line and fuel cooler. Re-tighten the connection.
	Fuel filter element is clogged.	Replace the cartridge.
	Fault in the feed pump	Replace the fuel supply pump.
	Regulating valve is open.	Replace
	Sticking of the fuel injector	Replace the fuel injector.
	Defective engine control system	Diagnose the engine control system.

Hunting during idling

Condition	Possible Cause	Correction
Hunting during idling	Air has entered the fuel system.	Bleed air from the fuel system.
	Leakage or clogging of the fuel system	Repair or replace the fuel system.
	Drops of water have entered the fuel system.	Replace the fuel.
	Fuel filter element is clogged.	Replace the fuel filter element (cartridge).
	Sticking of the fuel injector	Replace the fuel injector.
	Defective engine control system	Diagnose the engine control system.

Insufficient horsepower

Condition	Possible Cause	Correction
Insufficient horsepower	Air has entered the fuel system.	Bleed air from the fuel system.
	Leakage or clogging of the fuel system	Repair or replace the fuel system.
	Water mixes in the fuel system	Replace the fuel.
	Fuel filter element is clogged.	Replace the element or the cartridge.
	Sticking of the fuel injector	Replace the fuel injector.
	Defective engine control system	Diagnose the engine control system.

Maximum engine speed is too low

Condition	Possible Cause	Correction
Maximum engine speed is too low	Fuel line, fuel cooler is clogged or damaged.	Repair or replace the fuel line, fuel cooler.
	Defective engine control system	Diagnose the engine control system.

SECTION 2A

FRAME AND BUMPER

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PAGE

Engine does not stop

Condition	Possible Cause	Correction
Engine does not stop	Defective engine control system	Diagnose the engine control system.

Exhaust gas is blue or black

Condition	Possible Cause	Correction
Exhaust gas is blue or black.	Reduction in injection-valve opening pressure or defective atomizing status	Replace the fuel injector.
	Engine control system malfunction	System diagnosis.

Fuel System Check

Description

Conforms to a fuel leak. Engine acceleration raises fuel pressure and which increases the leak.

Leak could be in the following pipes and locations.

- Between injectors and fuel rail.
- Between fuel rail and fuel supply pump.
- Between fuel supply pump and fuel filter.
- Between fuel filter and fuel tank.
- Between pressure limiter and fuel cooler.
- Between fuel cooler and fuel tank.
- Between injector over flow and leak off pipe.

Diagnostic Aids

Check the following items.

- Air in the fuel line
- Clogged fuel filter
- Fuel pipe malfunction (Crushing, breakage, clogging, disconnection, etc.)
- Fuel cooler malfunction (Crushing, breakage, clogging, disconnection, etc.)
- Fuel tank malfunction
- Injector malfunction
- Fuel supply pump malfunction
- Pressure limiter malfunction

An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness.

Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

ECU may set a DTC, if there is adequate air in fuel line.

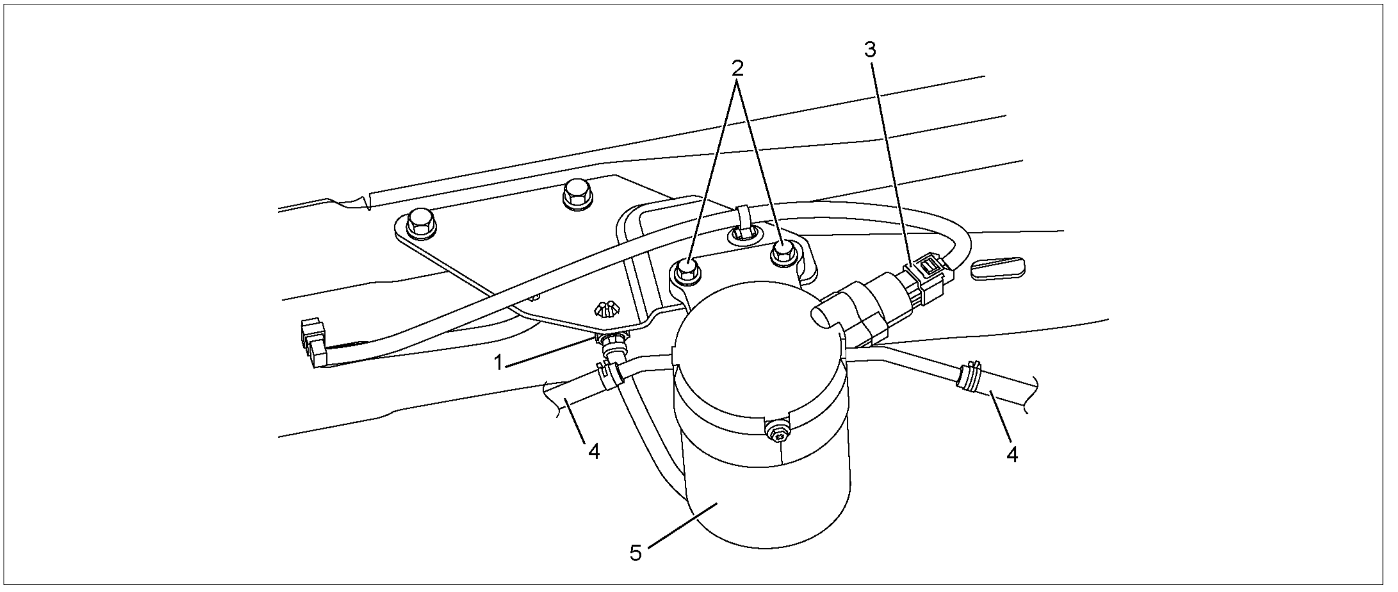
Schematic Reference: Engine Controls Schematics

Step	Action	Value(s)	Yes	No
1	Check the fuel quantity. Was a problem found?	—	Go to *Step 2*	Add fuel and Go to *Step 2*
2	Check the fuel quality. 1. Discharge the fuel from fuel tank 2. Replenish the tank with specified fuel 3. Bleed the air from the fuel system 4. Start the engine Could the engine be started?	—	Go to *Step 7*	Go to *Step 3*
3	Bleed the air from fuel system. Refer to Fuel System Air Bleeding in this section. Is the action complete?	—	Go to *Step 4*	—
4	Check the main fuel filter for clogging. Clean, repair, or replace as required. Notice: Replacement of a fuel filter is checking to a dealer. Is the action complete?	—	Go to *Step 5*	—
5	Check the fuel line and fuel cooler for damage and leakage. Clean, repair, or replace as required. • Crushed areas • Breakage • Cracks • Loose connections Is the action complete?	—	Go to *Step 6*	—

Step	Action	Value(s)	Yes	No
6	Check the fuel tank. If a problem is found, clean, repair, or replace as necessary. • Foreign material (Clogged suction port) • Bent or cracked suction pipe • Fuel tank distortion • Fuel tank improper installation • Fuel pump and sender malfunction • Clogged fuel cap hole • Water Is the action complete?	—	Go to *Step 7*	—
7	Bleed the air from the fuel pipe again. Refer to Fuel System Air Bleeding in this section. Is the action complete?	—	Verify repair	—

Fuel Filter Assembly

Components



RTW76CSF000101

Legend

1. Fuel Sedimenter Connector
2. Bolt
3. Harness Connector
4. Fuel Hose
5. Fuel Filter Assembly

Removal

1. Remove the fuel filler cap.
2. Remove the fuel sedimenter connector.
3. Disconnect the harness connector.
4. Remove the feed hose and the return hose from the fuel filter and plug it so that the fuel does not flow out.
5. Remove the bolts for mounting the fuel filter.
6. Remove the fuel filter assembly.

Installation

1. Install the fuel filter assembly.
2. Install the bolts for mounting the fuel filter.
3. Install the feed hose and the return hose.
4. Connect the harness connector.
5. Install the fuel sedimenter connector.
6. Install the fuel filler cap.
7. Bleed out the air.
   - Refer to "Fuel System".

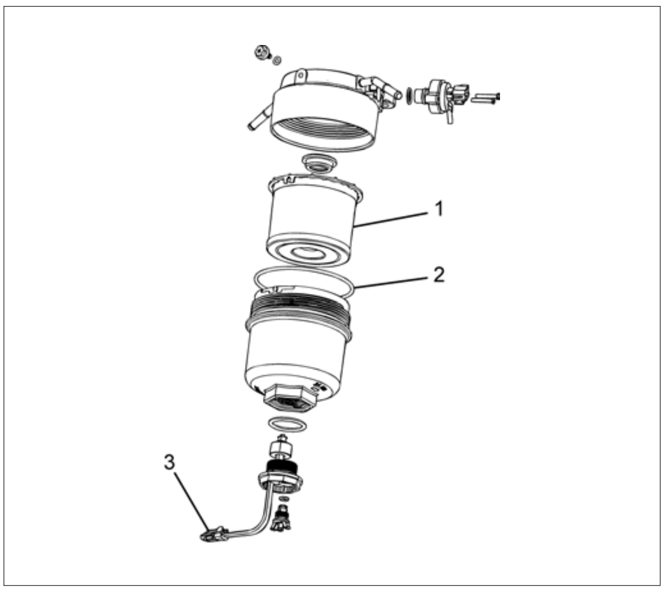
Fuel Filter Element

Removal

1. Detach the drain hose on the lower part of the fuel filter or the drain plug, loosen the air bleed plug, and drain the fuel from the fuel filter.
2. Detach the water-in-fuel switch harness.
3. Turn the element case counterclockwise to detach, and remove the filter element.
4. Replace the O-ring and confirm the snap-fit position, and fit a new filter element inside the element case.

NOTE

It is strongly advisable to use the ISUZU/GM genuine fuel filter for replacement.



RTW76CSH000901

Legend

1. Element
2. O-ring
3. Sedimenter Sensor

Installation

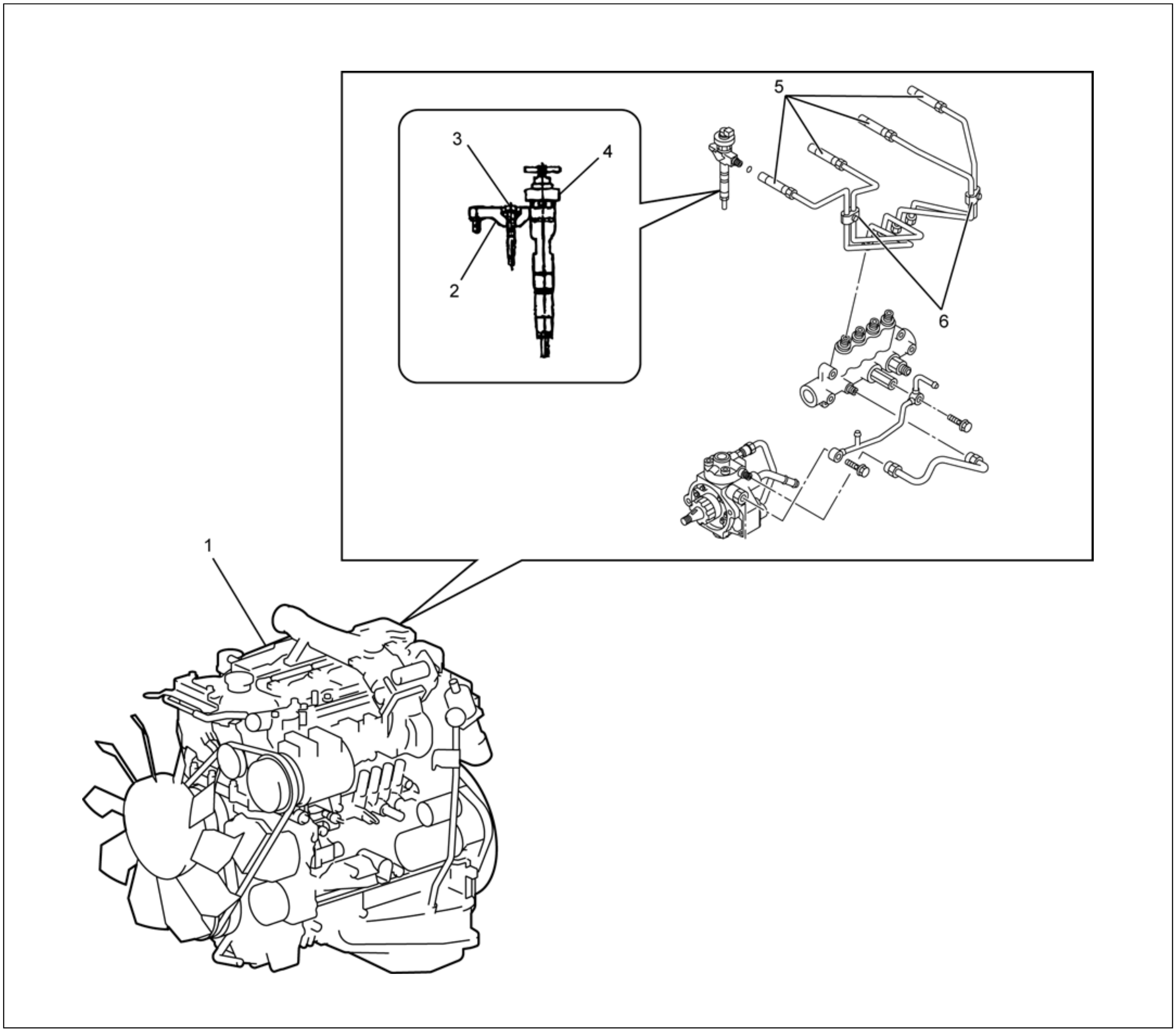
1. Apply a light coat of new diesel oil to the O-ring and gasket.
2. Turn the element case clockwise until it is completely seated against the upper cover. Then check that the drain hose is in its correct position, and then use a filter wrench and tighten to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

3. Use a clip to fix the drain hose at the base of the fuel filter, and fit the water-in-fuel switch harness.

Fuel Injector

Components



RTW76CLF000101

Legend

1. Cylinder Head Cover
2. Fuel Injector Clamp
3. Fuel Injector Clamp Bolt
4. Fuel Injector
5. Fuel Injection Pipe
6. Fuel Injection Pipe Clip

The fuel system consists of many tiny holes and spaces that allow the movement of fuel from one place to another. These holes and spaces are milled to extremely high precision. This is especially true of the fuel injector.

The fuel injector is very sensitive to foreign material. Foreign material will result in fuel system breakdown. Exercise great care not to allow the entry of foreign material into the fuel system or fuel injector during the removal and installation procedure.

Note: To avoid electric shock;
Set the switch to the 'OFF' position and disconnect the negative battery cable before checking or repairing the fuel injector, wiring or/and connectors.

Removal

1. Remove the cylinder head cover.
   Refer to the removal procedure for the cylinder head cover in this manual.

Remove the attachment bolt of the engine oil gauge guide tube.

2. Loosen the fuel injector clamp fixing bolts and remove the fuel injector.
   If the fuel injector is difficult to remove, use the remover. Use a screwdriver to force the fuel injector clamp off the fuel injector.

Note: Do not remove the fuel injector sleeve.

Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.

3. Mark each fuel injector with the number of the cylinder from which it was removed. Store the fuel injector in a safe place. Position the fuel injector so that the nozzle is protected.

Note: Do not tamper with the electromagnetic portion of the fuel injector. Reduced electromagnetic function will result in injector failure.

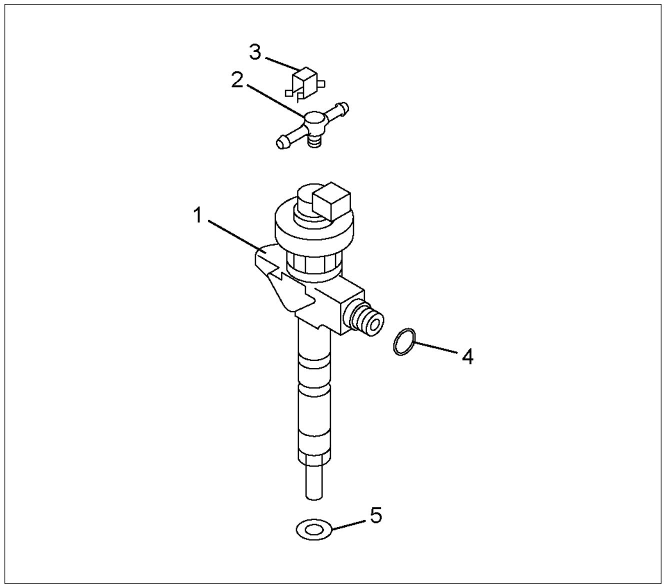
Note: After replacement of the fuel injector, perform the following procedure.

- All fuel injectors are replaced:
  Remove the fuel injector ID code label on the cylinder head cover.
- Any fuel injector(s) is replaced:
  Black out the replaced cylinder of the fuel injector ID code on the fuel injector ID code label with a marking pen or equivalent.

Installation

1. Install the new gasket and O-ring to each fuel injector.

Note: Do not reuse the clips (3).

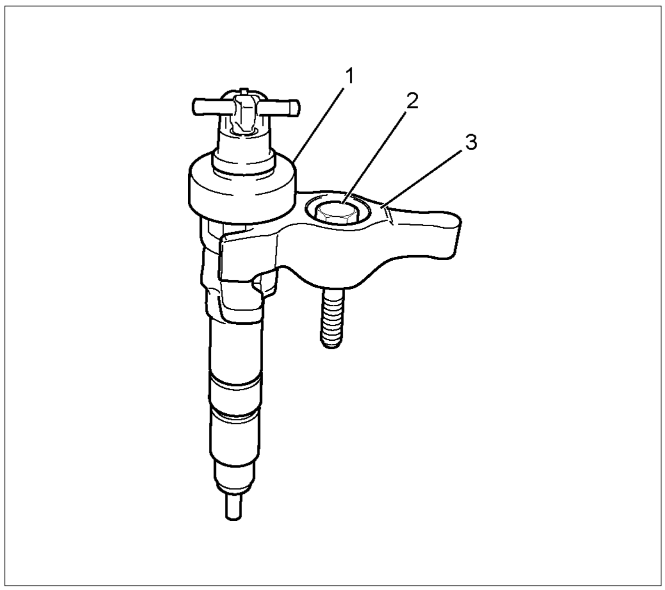


RTW66CSH000101

Legend

1. Fuel Injector
2. Leak Off Pipe
3. Clip
4. O-ring
5. Gasket

2. Install the fuel injector clamps. Refer to the illustration.



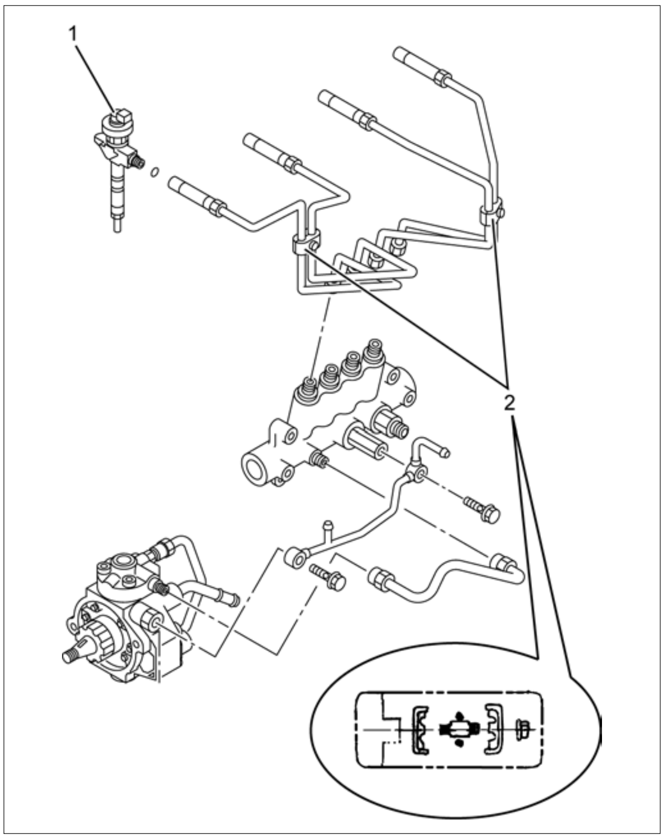
RTW56CSH000601

Legend

1. Fuel Injector
2. Bolt
3. Fuel Injector Clamp

3. Apply Engine oil to the threads and seating surfaces of the clamp bolts.
4. Install the fuel injector clamps to the cylinder head.
5. Temporarily tighten the clamp bolts.
6. Apply a thin coat of engine oil to the outer surface of the fuel injector side sleeve nuts.
7. Install the fuel injector pipes to the position shown in the illustration.
8. Use a spanner to carefully tighten the sleeve nuts until the fuel injector pipes contact the fuel injector and fuel rail.
9. Tighten the fuel injector pipe clips to the specified torque.

Tightening torque: 8 N·m (0.8 kg·m / 69 lb in)



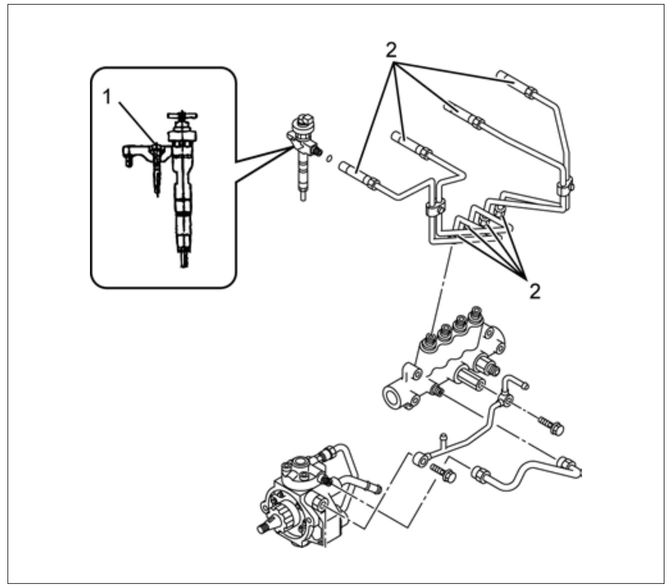
RTW76CMH000101

Legend

1. Fuel Injector
2. Pipe Clip

10. Tighten the injection pipes to the specified torque.

Tightening torque: 30 N·m (3.1 kg·m / 22 lb ft)



RTW76CSH000201

Legend

1. Clamp Bolt
2. Sleeve Nut

11. Tighten the fuel injector clamp bolts to the specified torque.

Tightening torque: 26 N·m (2.7 kg·m / 20 lb ft)

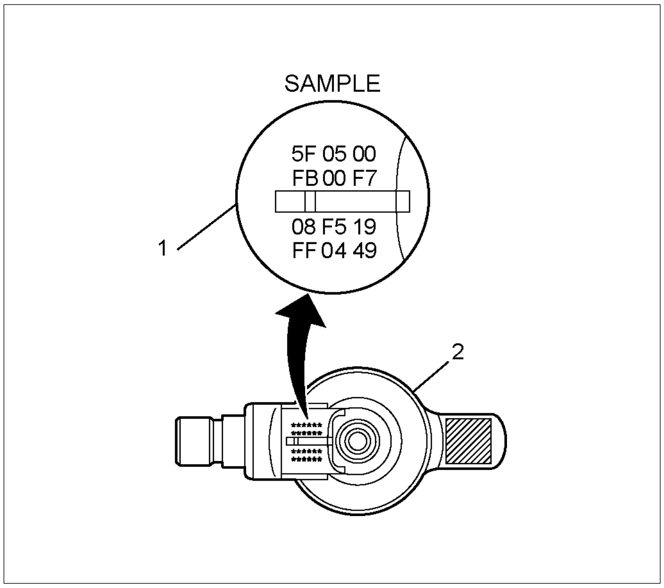
12. Tighten the engine oil level gauge guide tube.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

13. Install the cylinder head cover.
    Refer to the install procedure for the cylinder head cover in this manual.

Record the Fuel Injector ID Code Data from each injector housing

1. Remove each fuel injector harness connector.
2. Record all numbers of each cylinder on the harness connector housing. The correct order for the fuel injector ID codes of the following illustration is as follows:
   5F 05 00 FB 00 F7 08 F5 19 FF 04 49



RTW76ESH002601

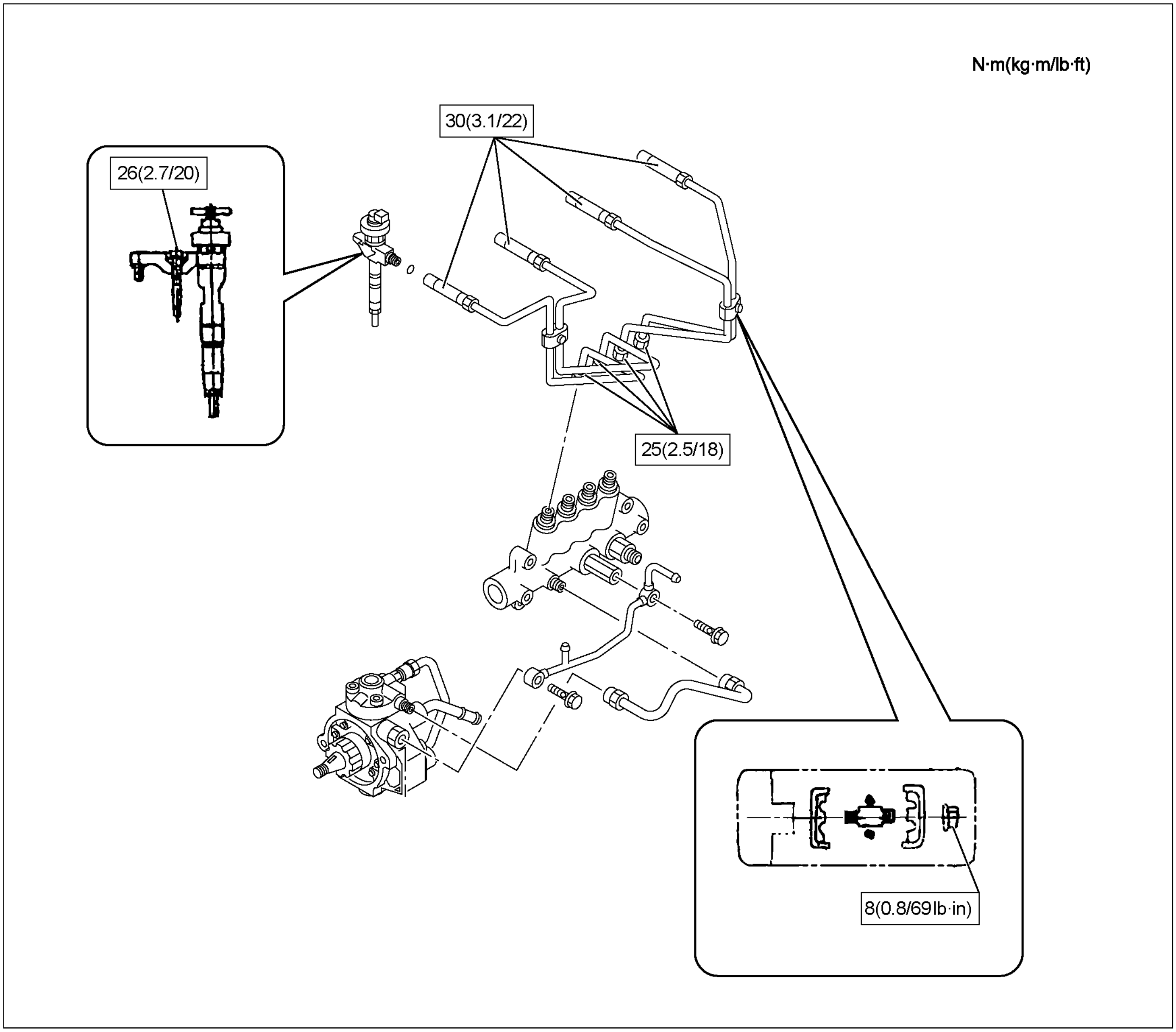
Legend

1. Fuel Injector ID Code
2. Fuel Injector

Programming Fuel Injector ID Codes

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4JK1 or 4JJ1 > Programming > Replace Injector.
4. In order to get programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight the "Tech" 2 on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > appropriate vehicle identification > 4JK1 or 4JJ1 > Programming > Replace Injector.
8. Enter 24 figures of replaced fuel injector ID code.
9. After complete the programming, turn OFF the ignition for 30 seconds.
10. Start the engine and let idle.
11. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check - Engine Controls if needed.

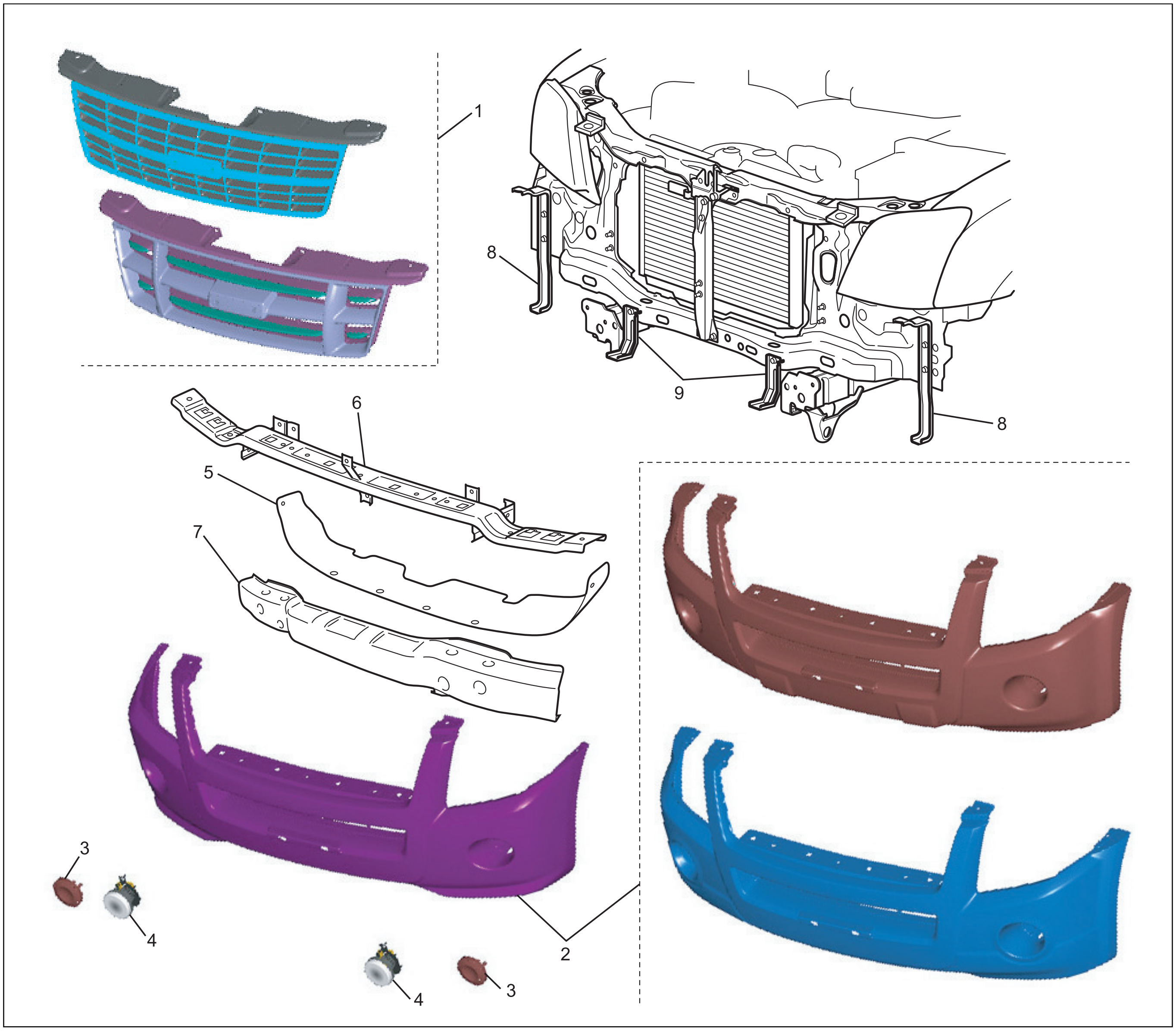
Torque Specifications



RTW76CLF000201

FRONT BUMPER (A TYPE)

REMOVAL AND INSTALLATION



RTW72ALF000501

Removal Steps

▲ 1. Radiator grille
▲ 2. Front bumper fascia
3. Bezel (W/O fog light)
4. Fog light
▲ 5. Bumper seal
6. Front bumper impact support assembly
7. Front bumper impact bar assembly
8. Fascia support side bracket
9. Fascia support lower bracket

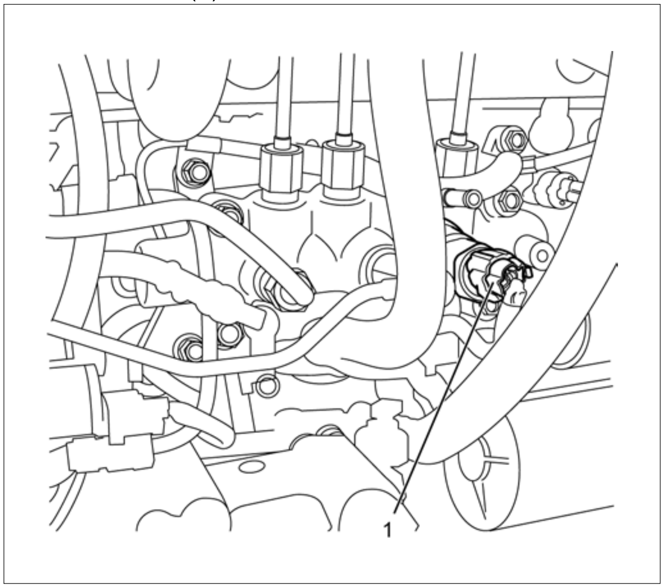
Installation Steps

9. Fascia support lower bracket
8. Fascia support side bracket
▲ 7. Front bumper impact bar assembly
6. Front bumper impact support assembly
5. Bumper seal
▲ 4. Fog light
3. Bezel (W/O fog light)
2. Front bumper fascia
1. Radiator grille

Fuel Rail Pressure Sensor

Removal

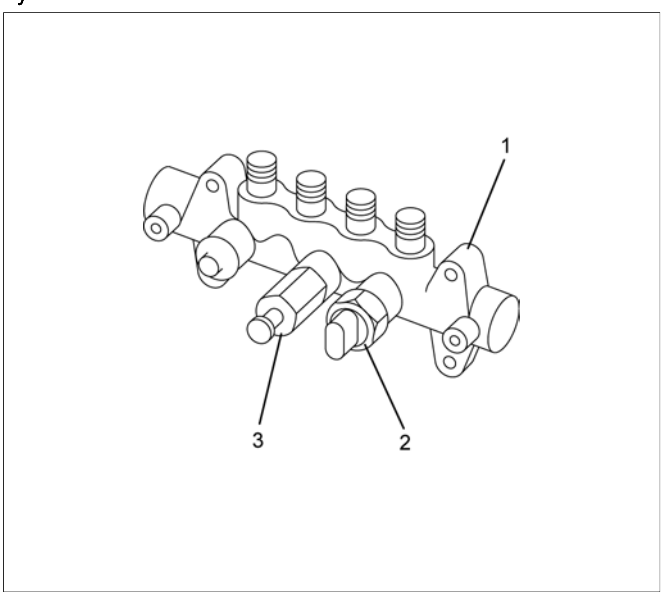
1. Disconnect the fuel pressure sensor harness connector (1).



LNW76CSH001601

2. Remove the fuel pressure sensor (2).

Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000101

Legend

1. Fuel Rail
2. Fuel Rail Pressure Sensor
3. Fuel Pressure Limiter

Installation

1. Install the fuel pressure sensor.

Tightening torque: 98 N·m (10.0 kg·m/72 lb ft)

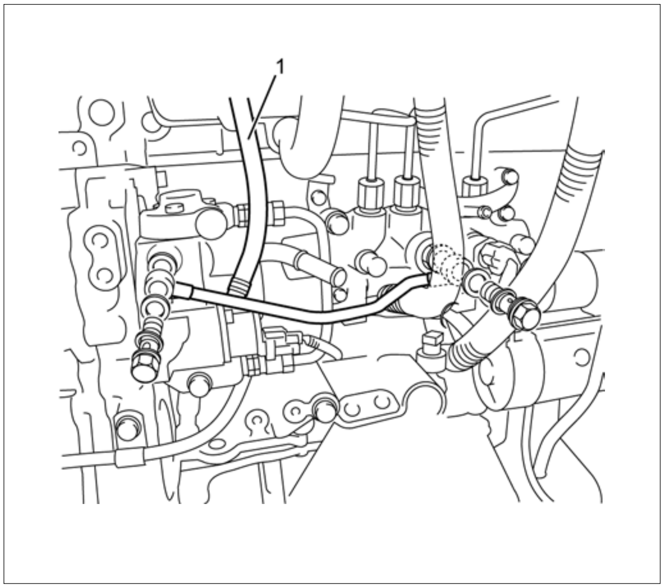
2. Connect the fuel pressure sensor connector.

Fuel Pressure Limiter

Removal

1. Remove the leak off pipe and hose (1).

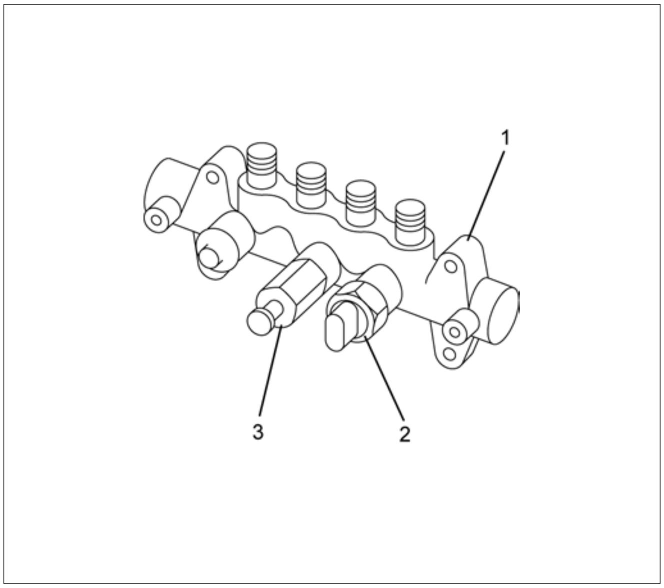
Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000301

2. Remove the fuel pressure limiter.

Note: Cover the areas exposed during part removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000101

Legend

1. Fuel Rail
2. Fuel Rail Pressure Sensor
3. Fuel Pressure Limiter

Installation

1. Install the fuel pressure limiter.

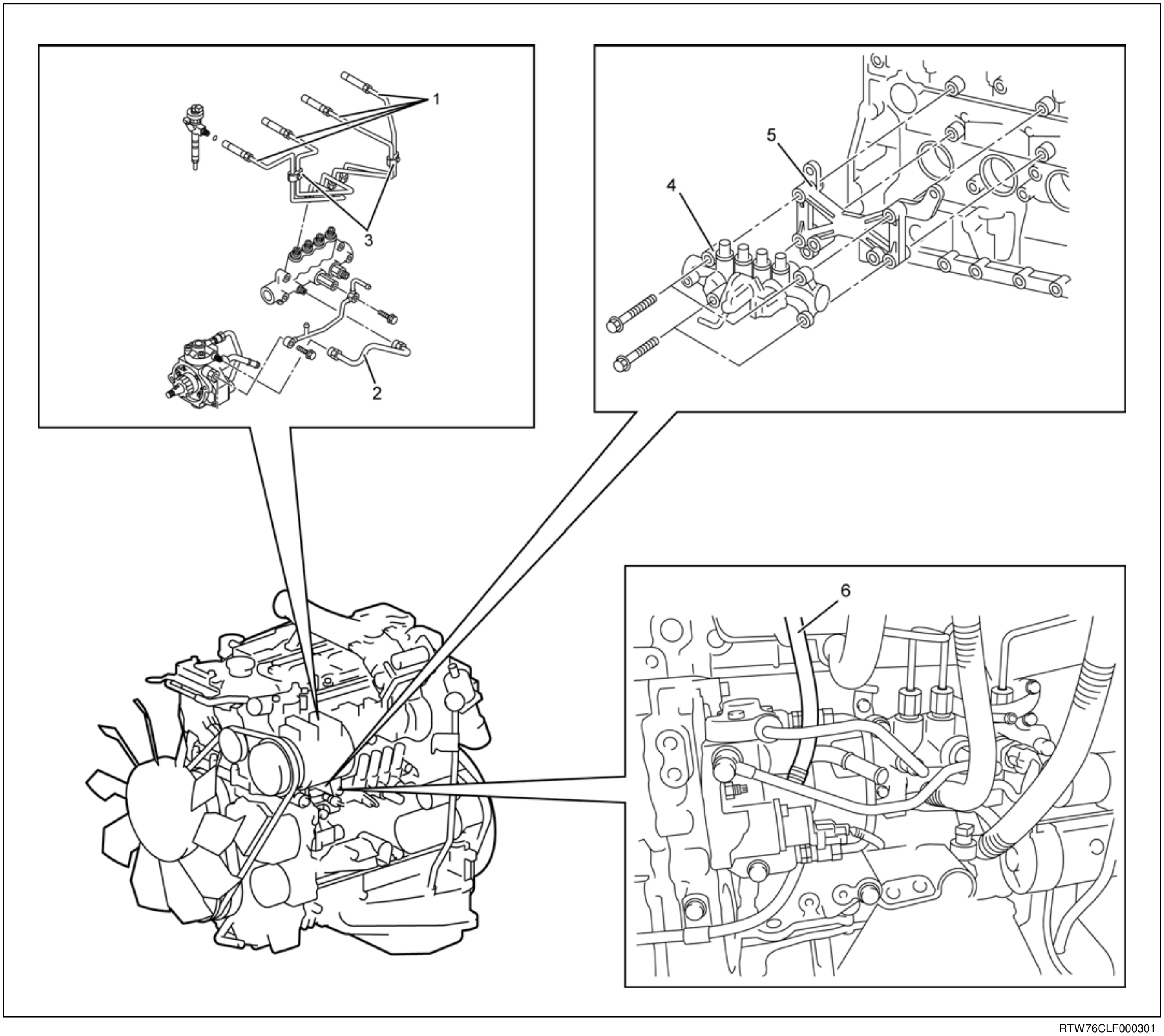
Tightening torque: 172 N·m (17.5 kg·m/127 lb ft)

2. Install the fuel leak off pipe and hose using the mounting eyebolt using the specified torque.

Tightening torque: 10 N·m (1.0 kg·m/87 lb in)

Fuel Rail Assembly

Components



Legend

1. Injection Pipe (#1 to #4)
2. Fuel Feed Pipe Assembly
3. Injection Pipe Clips
4. Fuel Rail
5. Fuel Rail Bracket
6. Fuel Leak Off Pipe and Hose

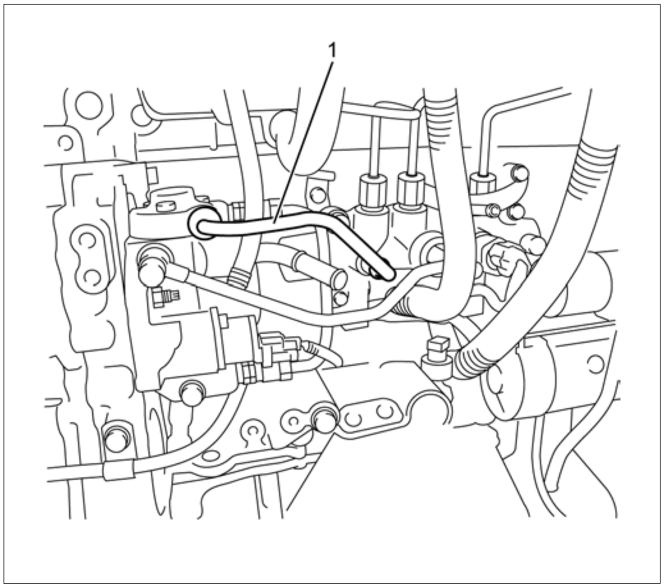
Parts of the fuel system such as the internal part of the fuel injector, holes and clearances that form passages for fuel are finished to a very high degree of accuracy.

They are therefore highly sensitive to foreign matter and the entry of foreign matter could cause damage to the fuel passage. Therefore, effective measures should be taken to prevent the entry of foreign matter.

Removal

1. Remove the starter motor.
   - Refer to the removal procedure for engine electricals in this manual.
2. Remove the fuel feed pipe (1) for supply pump.

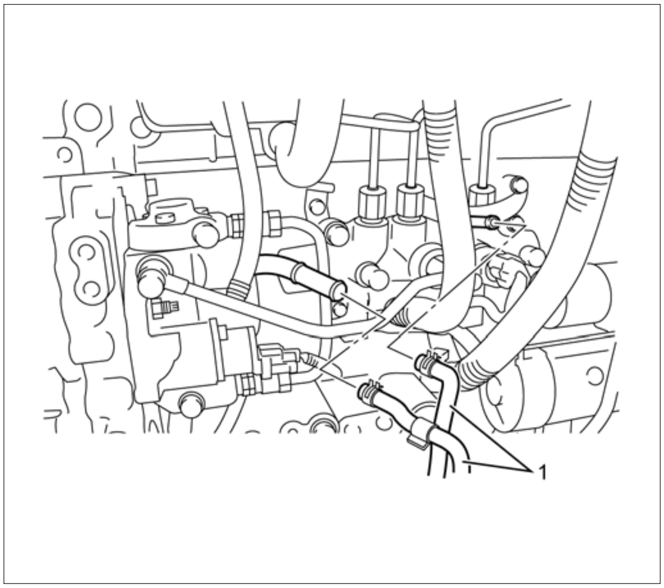
Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000501

3. Remove the fuel hose (1).

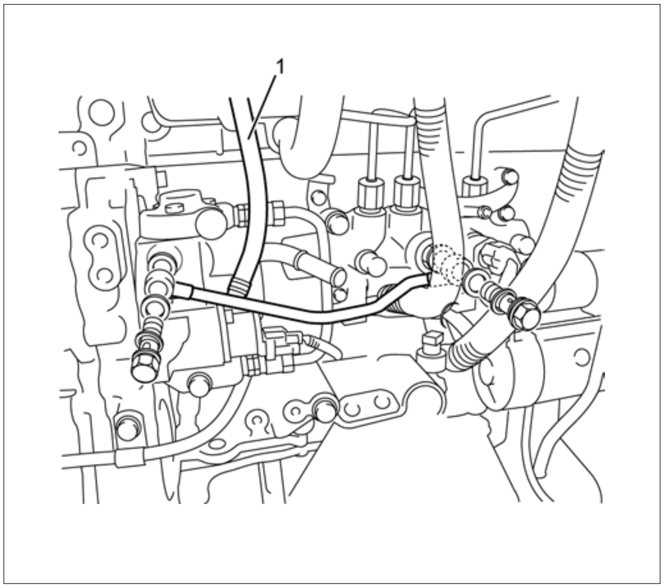
Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000601

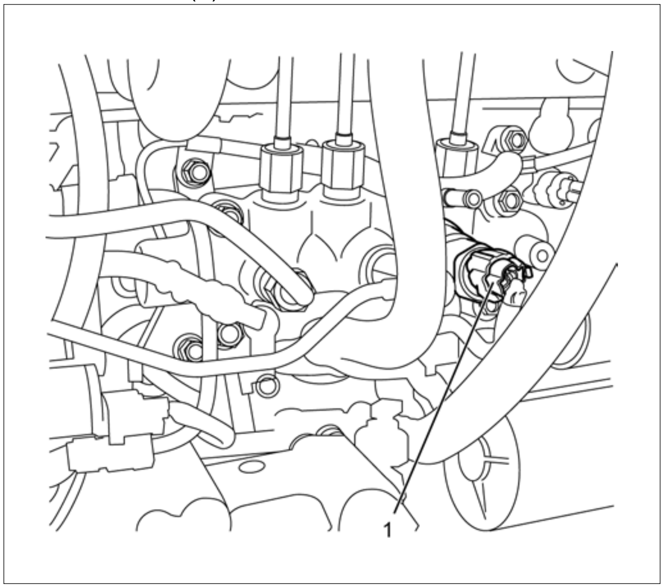
4. Remove the leak off pipe and hose (1).

Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.



RTW76CSH000301

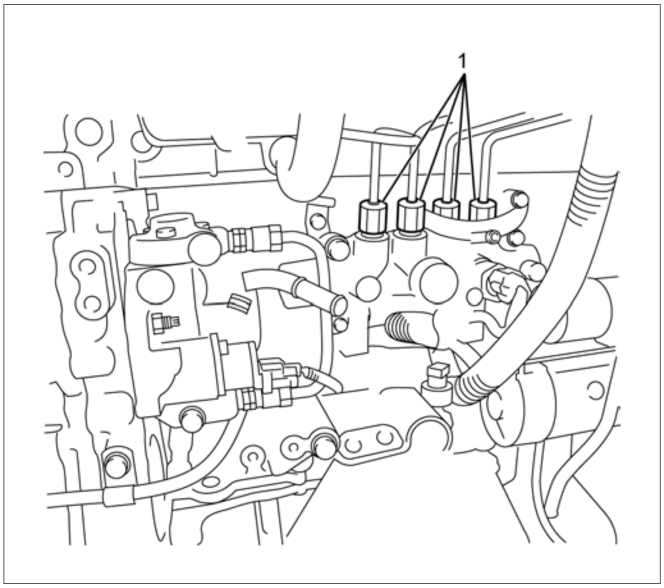
5. Disconnect the fuel rail pressure sensor harness connector (1).



LNW76CSH001601

6. Disconnect the injection pipe sleeve nut (1).

Note: Cover the areas exposed during parts removal to prevent the entry of foreign material into the fuel system.

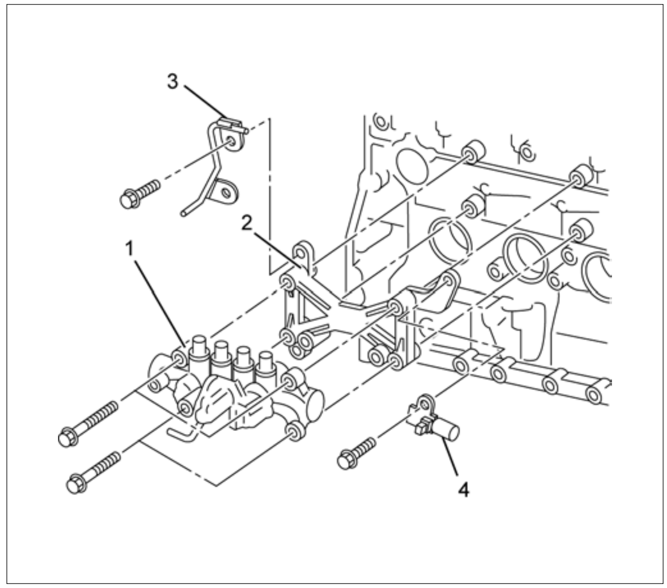


RTW76CSH000701

7. Disconnect the vacuum pipe and swirl control solenoid valve from the fuel rail bracket.
8. Remove the fuel rail and fuel rail bracket.

Note:

- Do not grasp the pressure sensor, during the fuel rail removal procedure.
- Take care not to damage the connector unit of the pressure sensor.



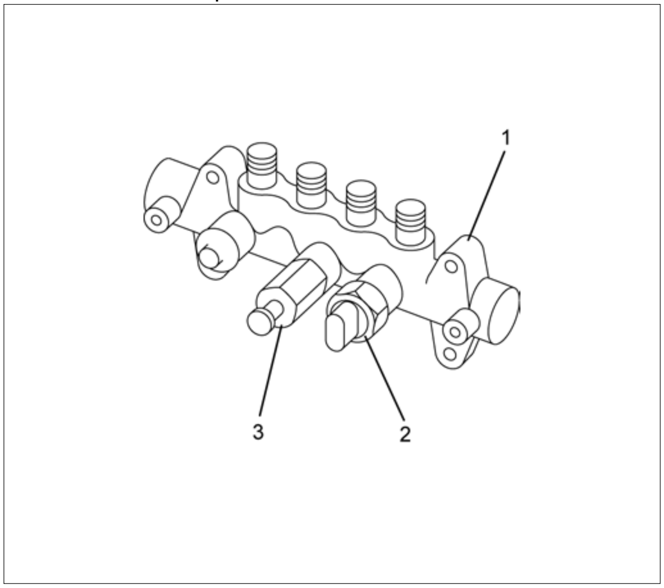
RTW76CSH000801

Legend

1. Fuel Rail
2. Fuel Rail Bracket
3. Vacuum Pipe
4. Swirl Control Solenoid Valve

Disassembly

1. Remove the fuel pressure limiter.
2. Remove the pressure sensor.



RTW76CSH000101

Legend

1. Fuel Rail
2. Fuel Rail Pressure Sensor
3. Fuel Pressure Limiter

Reassembly

1. Install the fuel pressure limiter.

Tightening torque: 172 N·m (17.5 kg·m/127 lb ft)

2. Install the fuel pressure sensor.

Tightening torque: 98 N·m (10.0 kg·m/72 lb ft)

Installation

1. Tighten the fuel rail bracket and fuel rail using the specified torque.

Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)

2. Tighten the vacuum pipe to the fuel rail bracket using the specified torque.

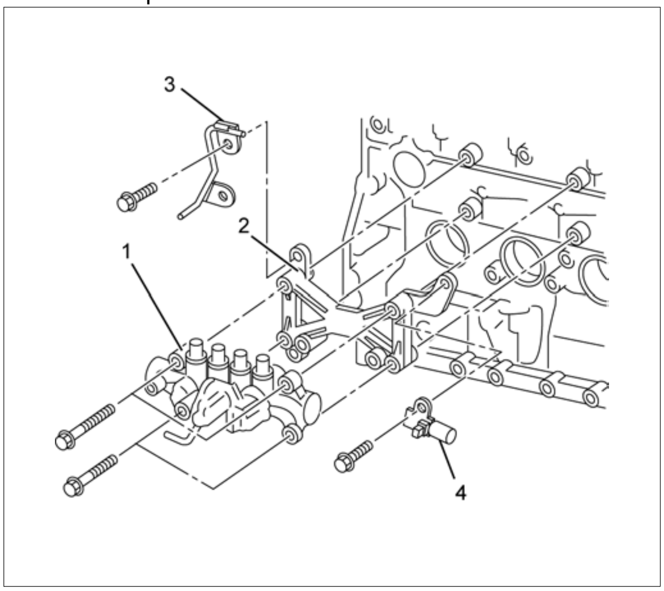
Tightening torque: 10 N·m (1.0 kg·m/87 lb in)

3. Tighten the swirl control solenoid valve to the fuel rail bracket using the specified torque.

Tightening torque: 20 N·m (2.0 kg·m/14 lb ft)

Note:

- Do not grasp the pressure sensor, during the fuel rail removal procedure.
- Take care not to damage the connector unit of the pressure sensor.



RTW76CSH000801

Legend

1. Fuel Rail
2. Fuel Rail Bracket
3. Vacuum Pipe
4. Swirl Control Solenoid Valve

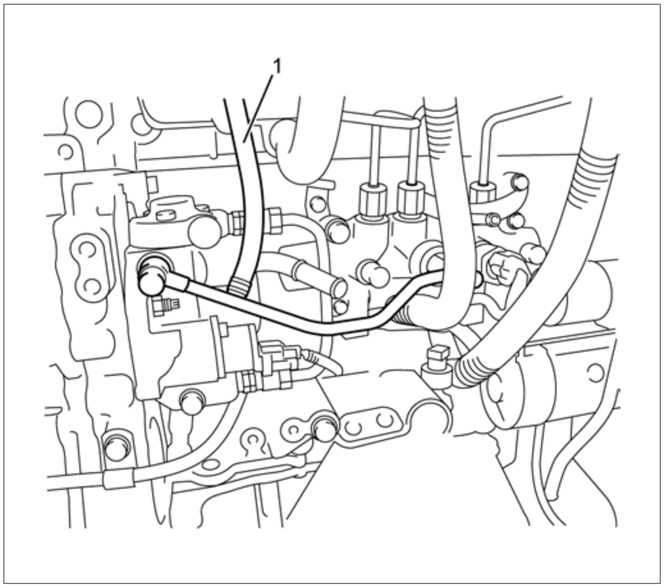
4. Tighten the fuel pipe using the mounting sleeve nut and the specified torque.

Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)

5. Connect the fuel rail pressure sensor harness connector.

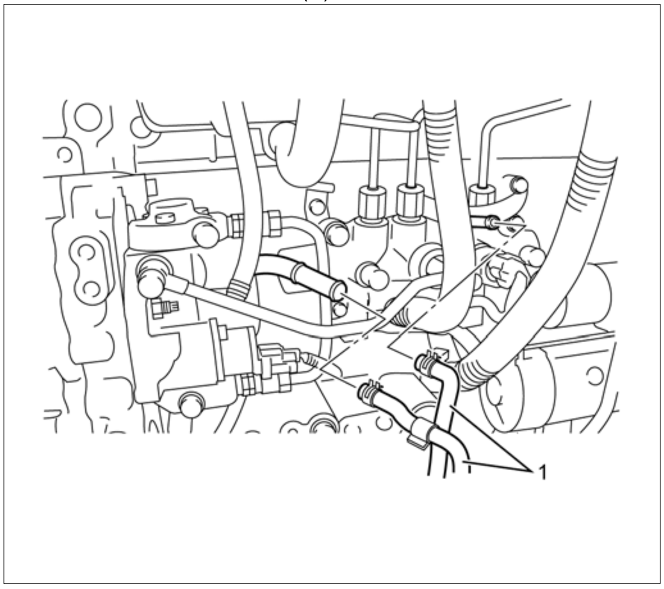
6. Tighten the fuel leak off pipe and hose (1) using the mounting eyebolt using the specified torque.

Tightening torque: 10 N·m (1.0 kg·m/87 lb in)



RTW76CSH000401

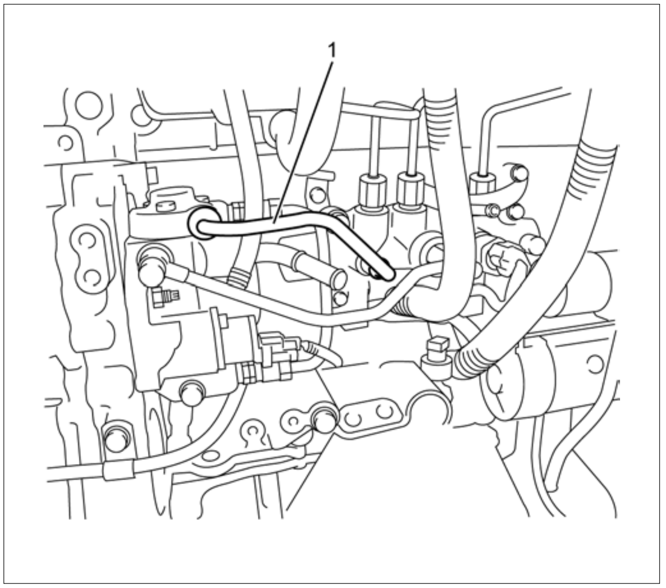
7. Install the fuel hose (1).



RTW76CSH000601

8. Install the fuel feed pipe (1) for supply pump and tighten the bolts to the specified torque.

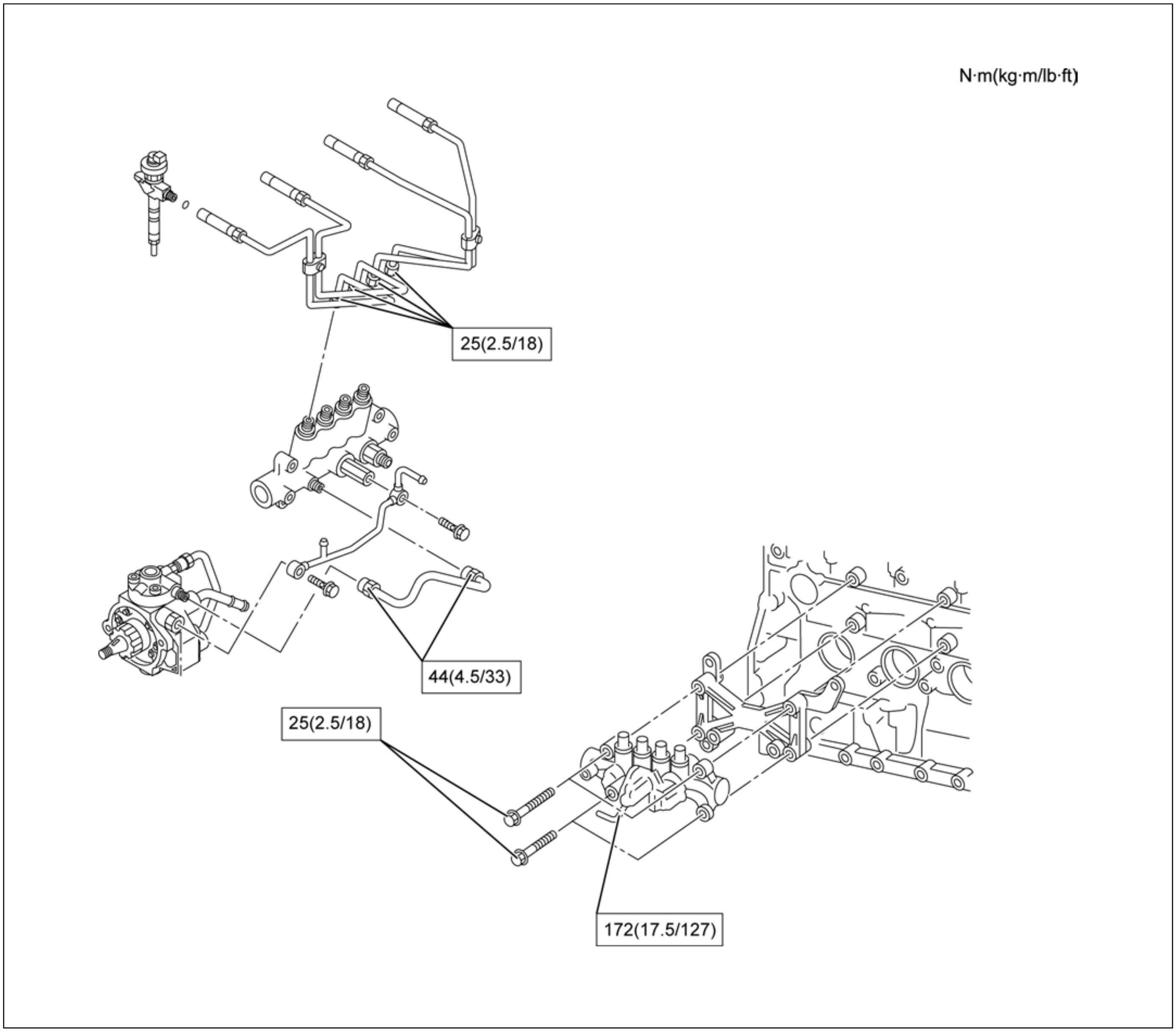
Tightening torque: 44 N·m (4.5 kg·m/33 lb ft)



RTW76CSH000501

9. Install the starter motor.
   - Refer to removal procedure for engine electricals in this manual.

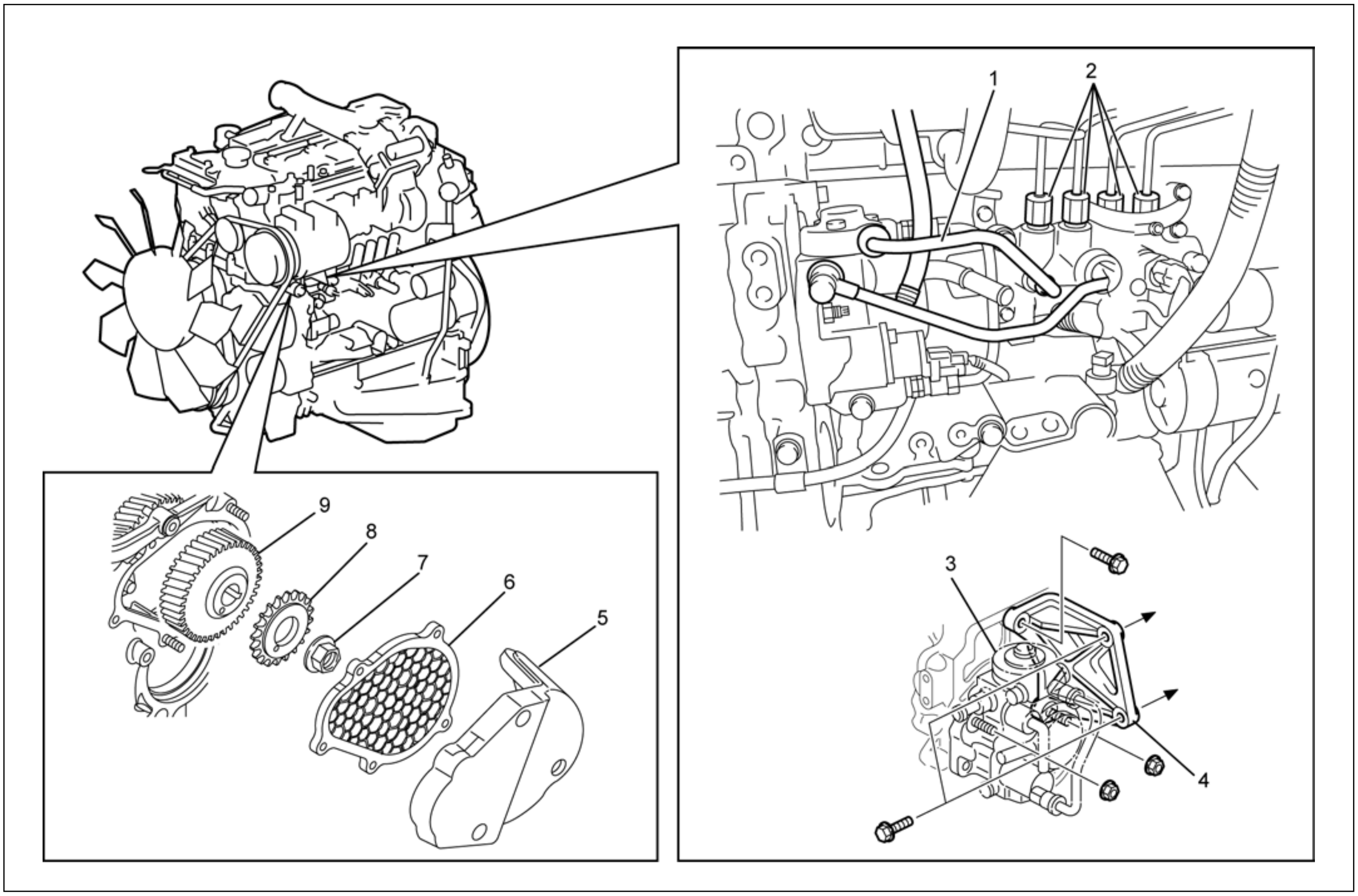
Torque Specifications



RTW76CLF000401

Fuel Supply Pump

Components



RTW76CMF000201

Legend

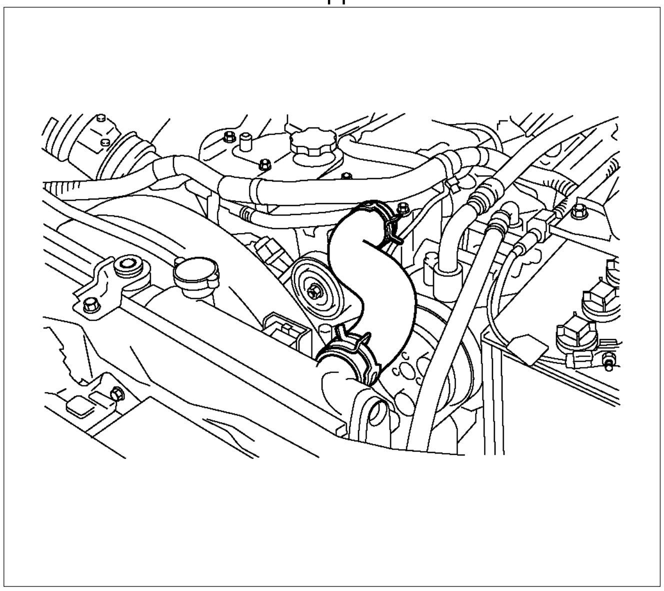
1. Fuel Feed Pipe Assembly
2. Injection Pipe Sleeve Nut
3. Fuel Supply Pump
4. Bracket
5. Noise Cover
6. Timing Chain Cover Lower
7. Nut
8. Sprocket
9. Fuel Supply Pump Gear

The fuel system consists of many tiny holes and spaces that allow the movement of fuel from one place to another. These holes and spaces are milled to extremely high precision. This is especially true of the fuel injector.

The fuel injector is very sensitive to foreign material. Foreign material will result in fuel system breakdown. Exercise great care not to allow the entry of foreign material into the fuel system or fuel injector during the removal and installation procedure.

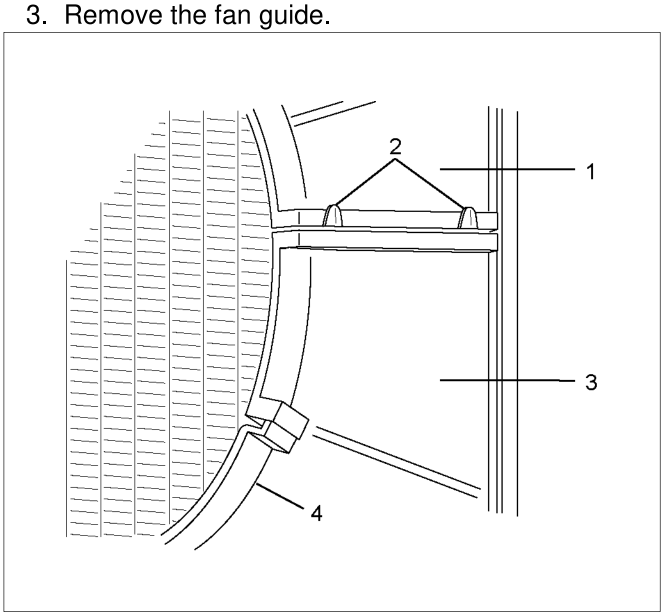
Removal

1. Partially drain the engine coolant.
   Refer to drain procedure for engine cooling in this manual.
2. Remove the radiator upper hose.



RTW56FSH000101

3. Remove the fan guide.

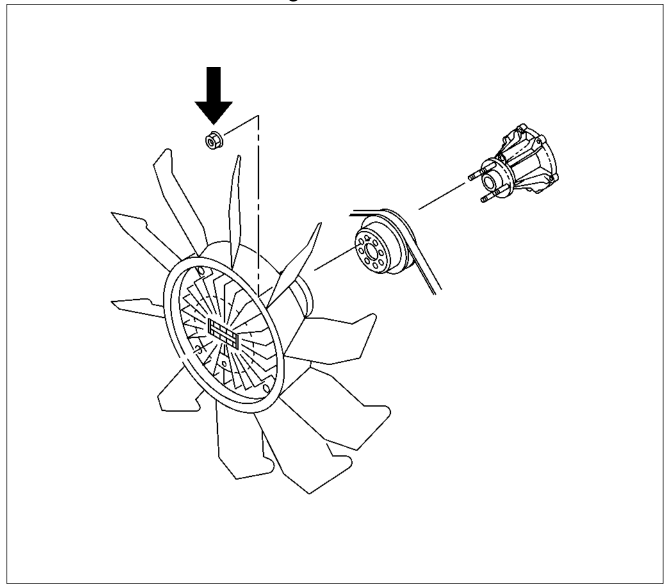


RTW46BSH000101

Legend

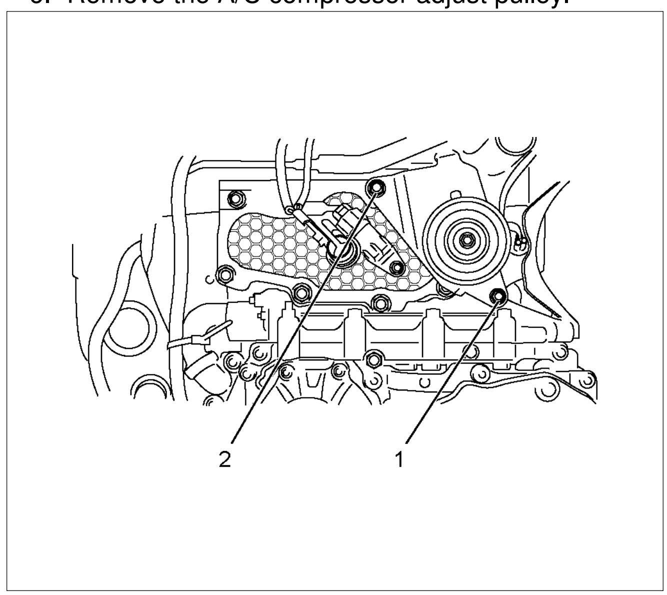
1. Fan Guide
2. Clips
3. Lower Fan Guide
4. Fan Shroud

4. Remove the cooling Fan.



RTW56ASH025401

5. Remove the A/C compressor drive belt.
6. Remove the A/C compressor adjust pulley.



RTW56ASH010601

Legend

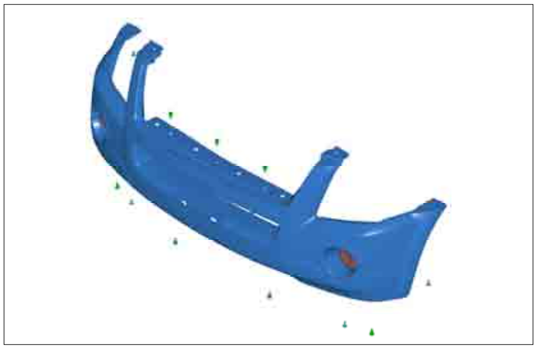
1. Bolt
2. Nut

7. Remove the battery.

Important Operations - Removal

1. Radiator Grille

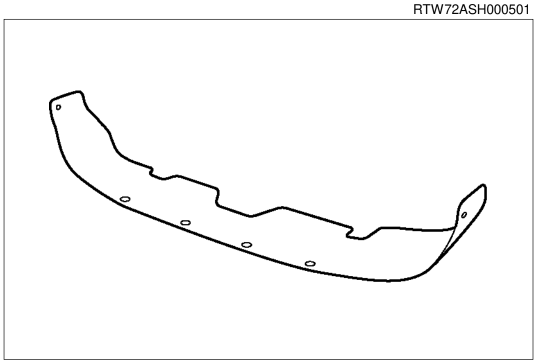
Refer to the Radiator Grille in this section.



RTW72ASH000501

2. Front Bumper Fascia

- Remove the 7 clips and 4 bolts.
- Disconnect the fog light harness connectors.

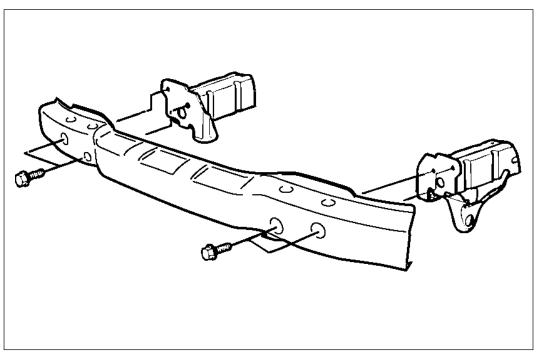


RTW52ASH000401

5. Bumper Seal

Remove the 6 clips.

Important Operations - Installation



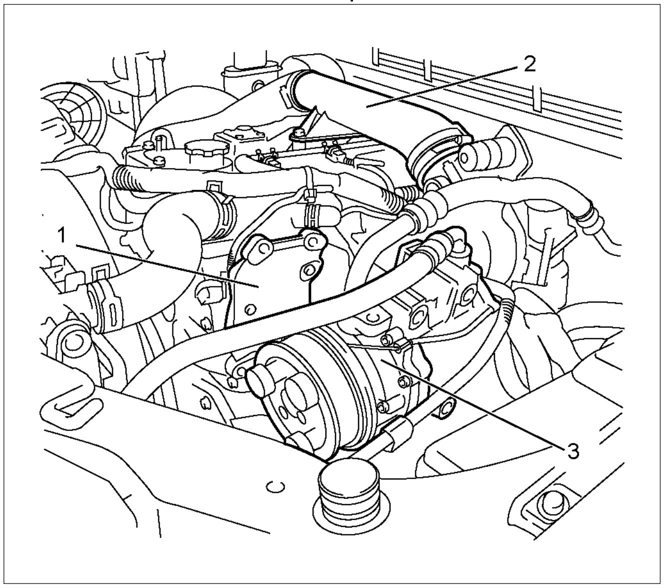
RTW52ASH000301

7. Front Bumper Impact Bar Assembly

Tighten the fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·ft)
62 (6.3 / 46)	

8. Disconnect the A/C compressor.

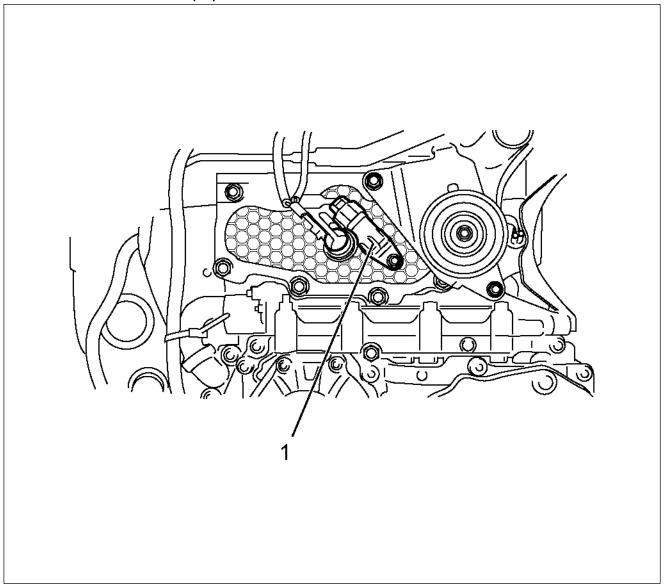


RTW56ASH024201

Legend

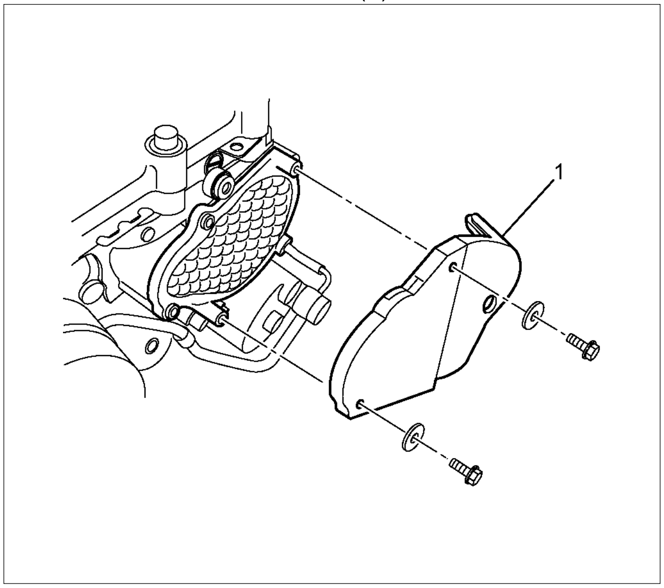
1. A/C Compressor Bracket
2. Intake Duct
3. A/C Compressor

9. Remove the A/C compressor bracket.
10. Remove the fuel rail assembly.
    Refer to “Fuel Rail Assembly”.
11. Remove the cylinder head cover.
    Refer to “Cylinder Head Cover” in ENGINE MECHANICAL section.
12. Disconnect the camshaft position sensor connector (1).



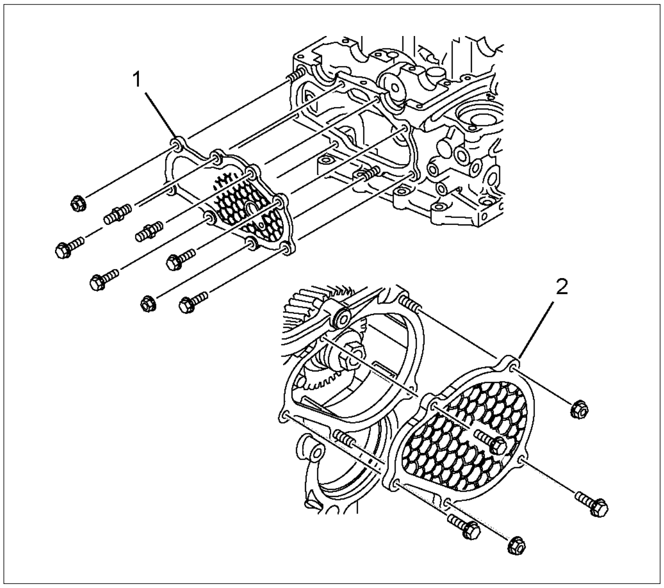
RTW56ESH003201

13. Remove the noise cover (1).



RTW56CSH001401

14. Remove the timing chain cover assembly. Upper & lower.

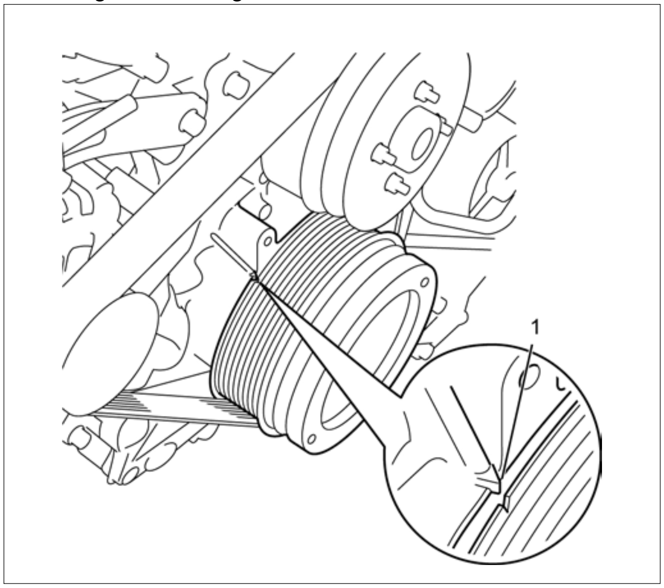


RTW56CSH001501

Legend

1. Timing Chain Cover Upper
2. Timing Chain Cover Lower.

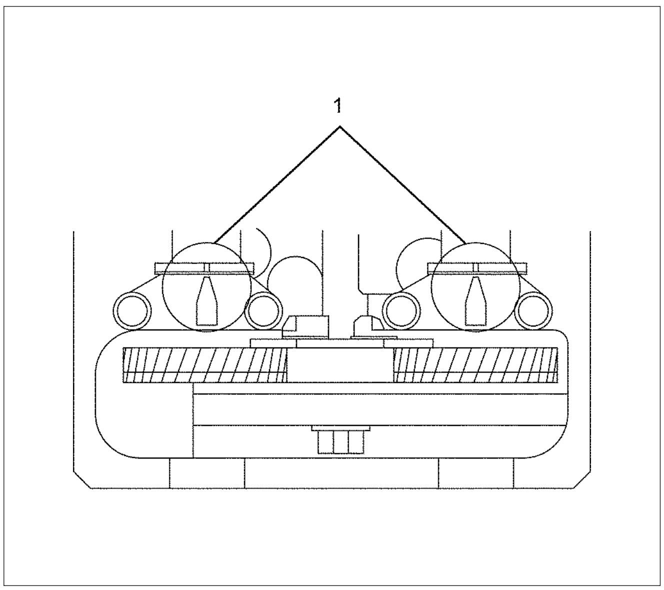
15. Align the timing marks at 3 locations as shown.



RTW76ASH001301

Legend

1. TDC

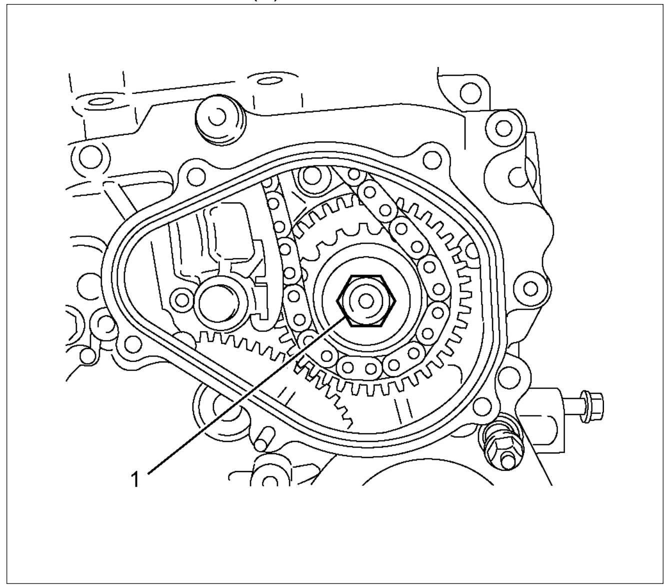


RTW56ASH006901

Legend

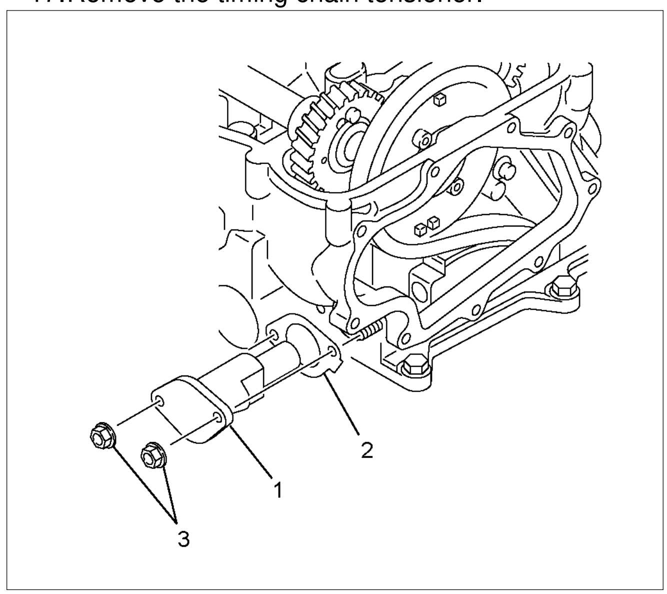
1. Align mark on intake camshaft and exhaust camshaft to mark of bearing cap

16. Loosen the nut (1).



RTW56CSH001601

17. Remove the timing chain tensioner.

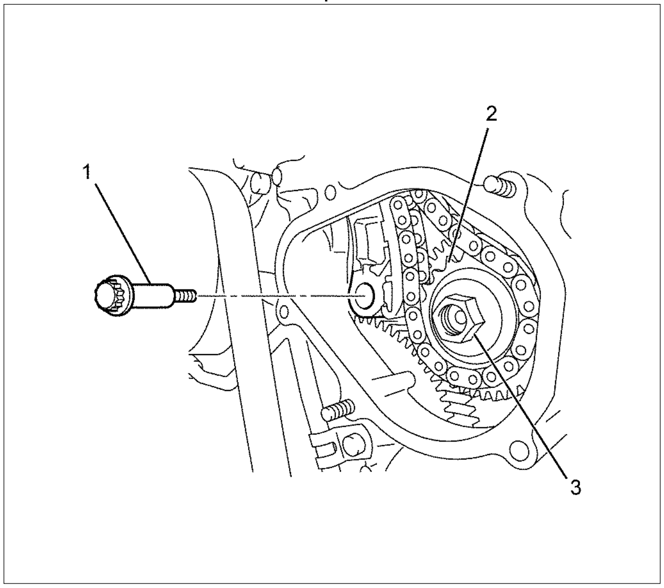


RTW56CSH003701

Legend

1. Timing Chain Tensioner.
2. Gasket
3. Nut

18. Remove the timing chain tension lever pivot.
19. Remove the nut and sprocket.

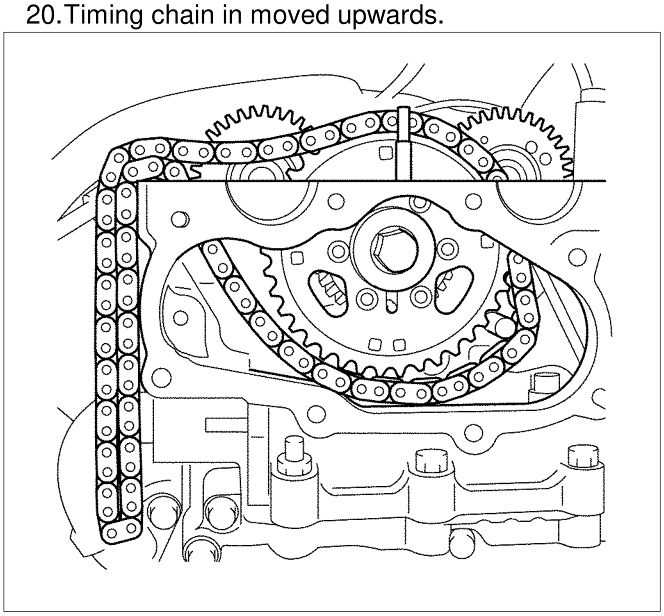


RTW56CSH004101

Legend

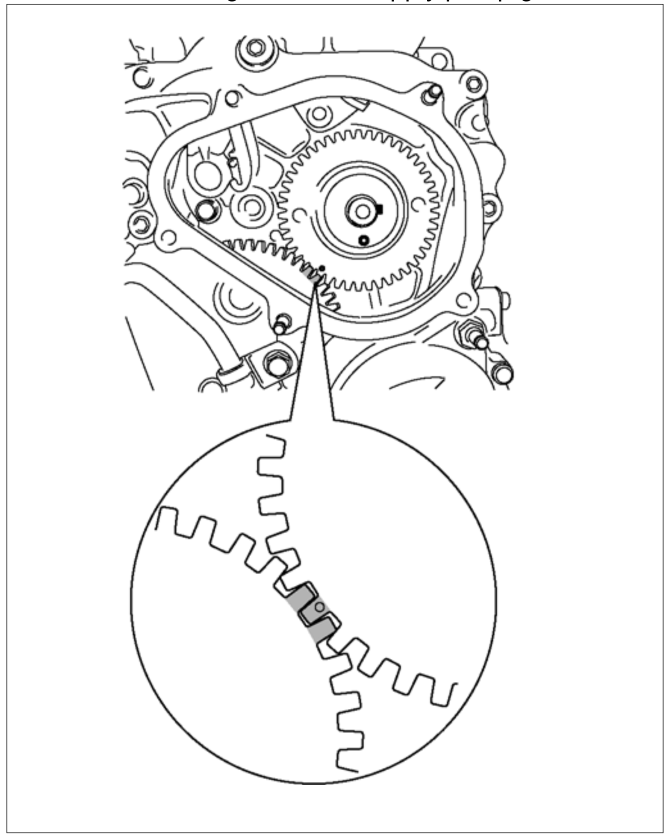
1. Tension Lever Pivot
2. Sprocket
3. Nut

20. Timing chain in moved upwards.



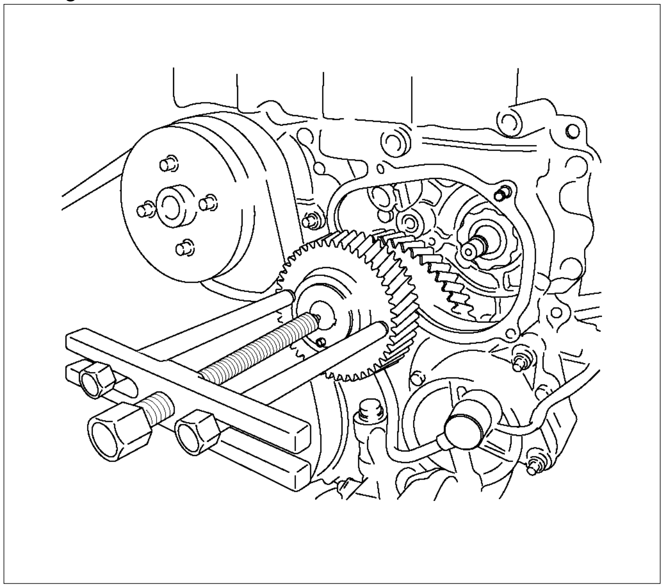
RTW56CSH003301

21. Paint the alignment mark.
Between idle gear A and supply pump gear.



RTW56AMH000401

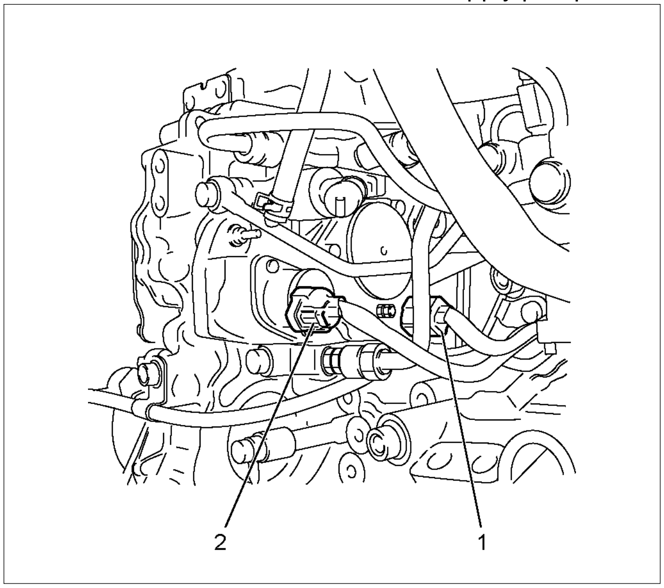
22. Use a gear puller to remove the fuel supply pump gear.



RTW56CSH002901

23. Remove the supply pump (1) and supply pump bracket (2).

- Disconnect the connector of supply pump.



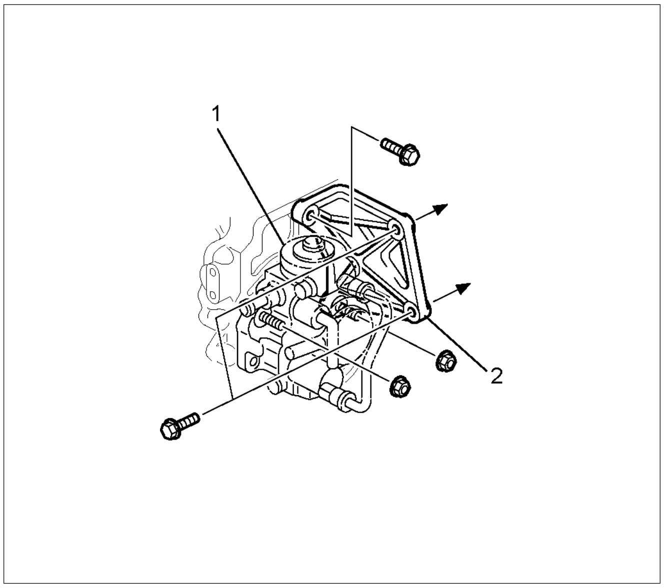
RTW58ESH002901

Legend

1. Fuel Temperature (FT) Sensor
2. Suction Control Valve (SCV)

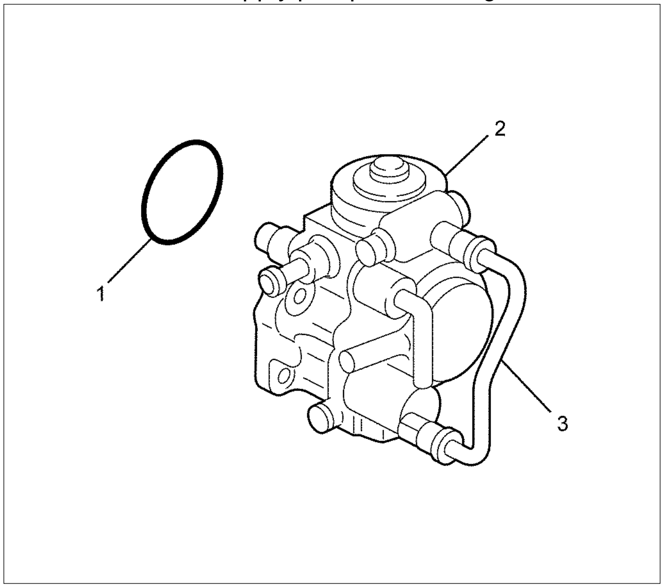
Note:

- Do not hold the high pressure pipe, during the supply pump removal procedure.
- Do not grasp the high pressure pipe, when moving the supply pump from one location to another.



RTW56CSH002001

24. Remove the supply pump and O-ring.



RTW56CSH002501

Legend

1. O-ring
2. Supply Pump
3. High Pressure Pipe

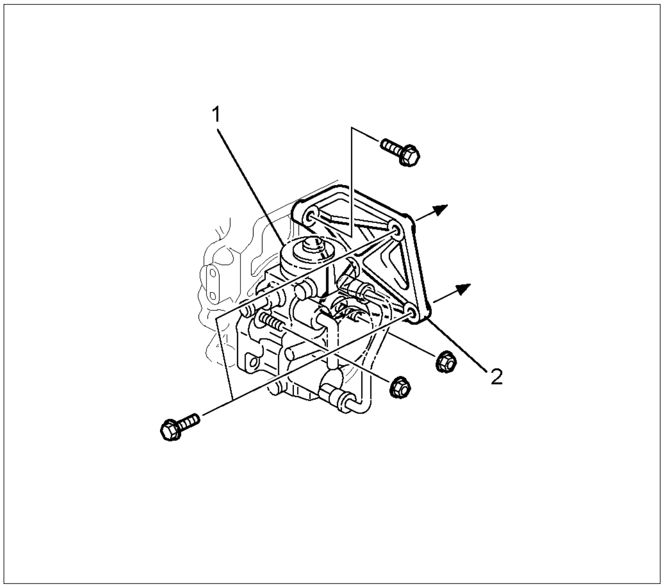
Installation

1. Install the O-ring to the fuel supply pump.
2. Install the fuel supply pump.
   Apply soapy water to the O-ring before attaching.

Note: Take care not to twist the O-ring.

3. Install the fuel supply pump bracket.
   Temporarily tighten with the bolts and nuts (Gear case side).
   Temporarily tighten with the bolts (Cylinder body side).
   Fully tighten the nuts and bolts (Gear case side).
   Fully tighten the bolts (Cylinder body side).

Tightening torque: 25 N·m (2.5 kg·m /18 lb ft)

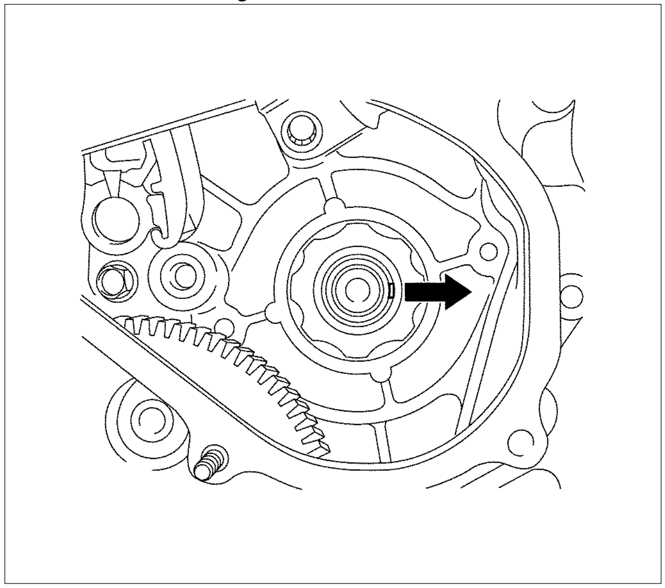


RTW56CSH002001

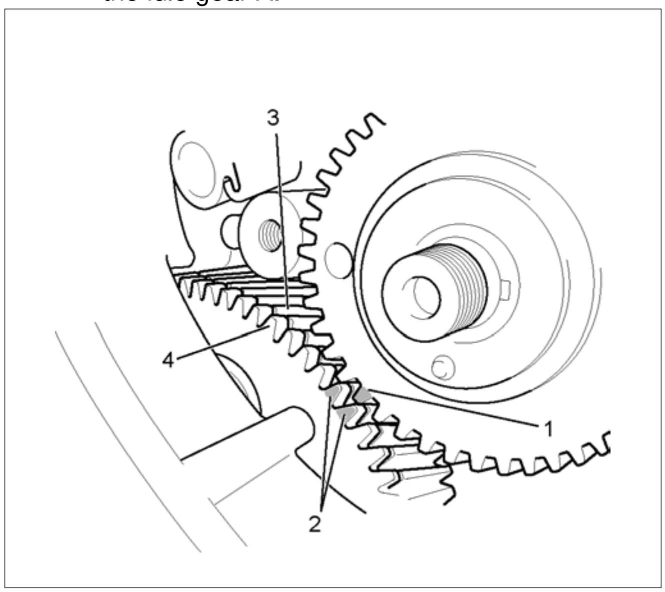
Legend

1. Fuel Supply Pump
2. Fuel Supply Pump Bracket

4. Confirm that the supply pump camshaft key is turned to the right and is horizontal.

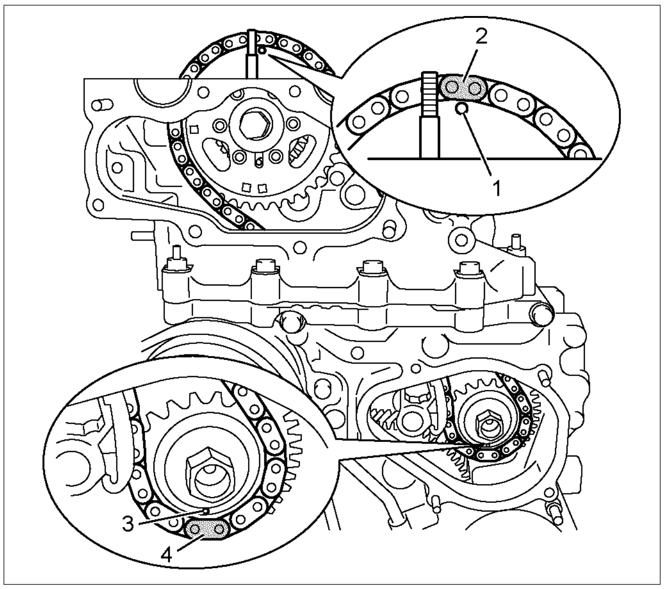

RTW56CSH004301

5. Install the fuel supply pump gear to the pump shaft.
   a. Align the fuel pump gear timing mark (1) with the idle gear A paint marks (2).
   b. Ensure that the pump gear is bitten with main gear (3) of the idle gear A. Depress the pump gear when it is bitten with scissors gear (4) of the idle gear A.



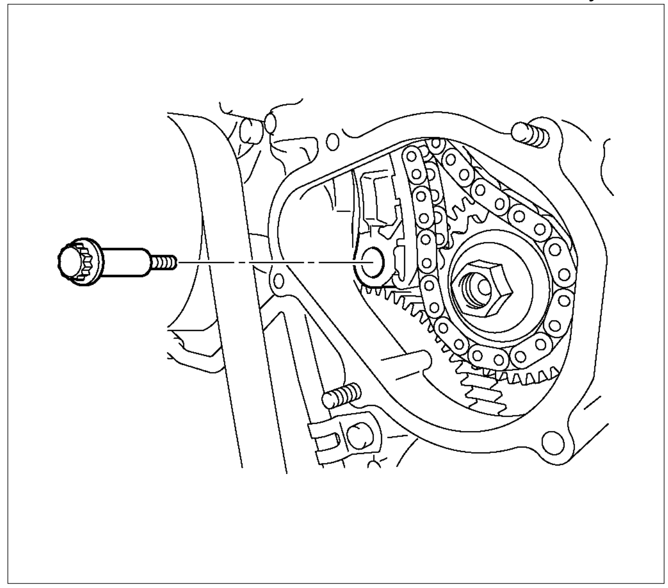
RTW56CSH005101

6. Install the timing chain to the each sprocket and install the fuel supply pump sprocket to the pump shaft.
   a. Align the camshaft sprocket timing mark (1) with the dark plate timing chain link (2).
   b. Align the fuel supply pump sprocket timing mark (3) with the yellow plate timing chain link (4).
   c. Install the fuel supply pump sprocket to the fuel pump shaft by aligning the dowel pin that is attached to the gear.
   d. Hand-tighten the fuel supply pump shaft nut.

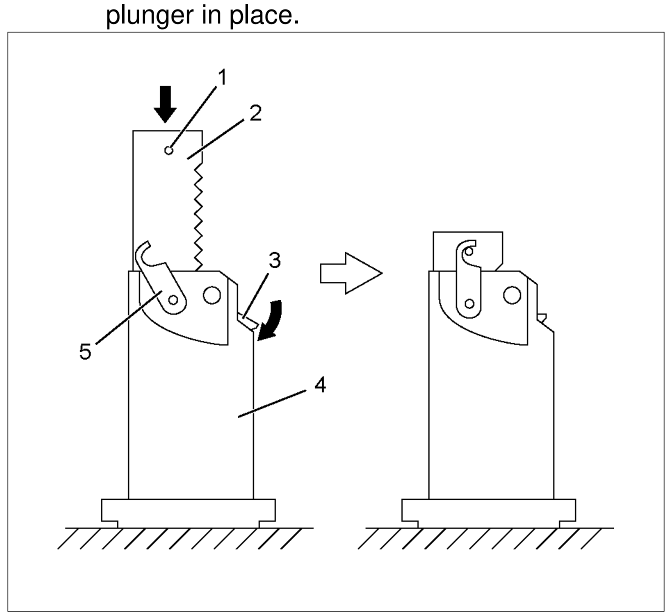


RTW56CSH005001

7. Install the timing chain tension lever pivot. Hand-tighten the pivot bolt.
   - Confirm the tension lever moves smoothly.


RTW56ASH019401

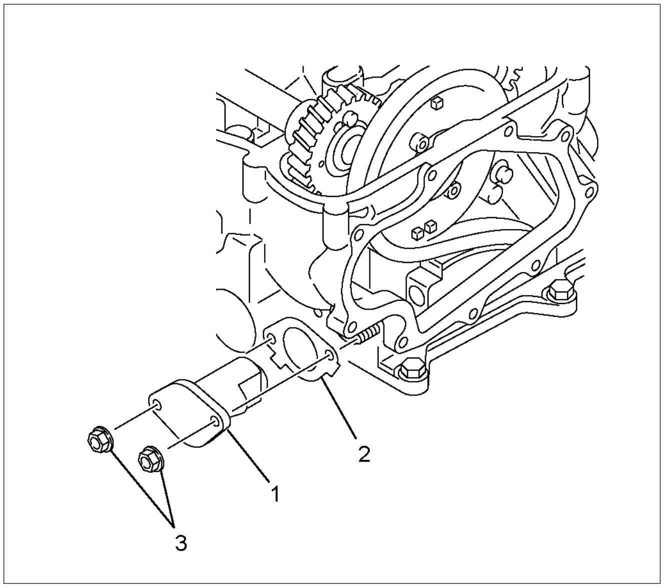
8. Attach the hook of the timing chain tensioner.
   - Hold the latch (3) depressed. Insert the plunger (2). Attach the hook (5) to the pin (1) to hold the plunger in place.



RTW56CSH004401

9. Install the timing chain tensioner.
   Tighten the nut to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m/ 87 lb in)

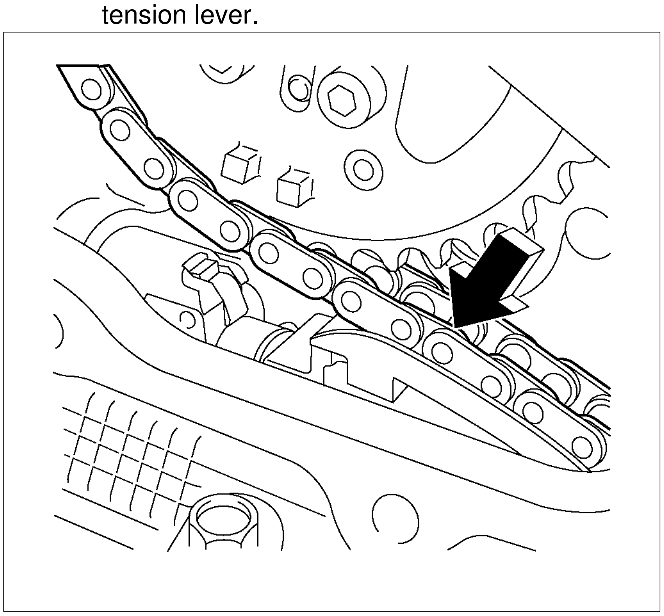


RTW56CSH001701

Legend

1. Timing Chain Tensioner
2. Gasket
3. Nut

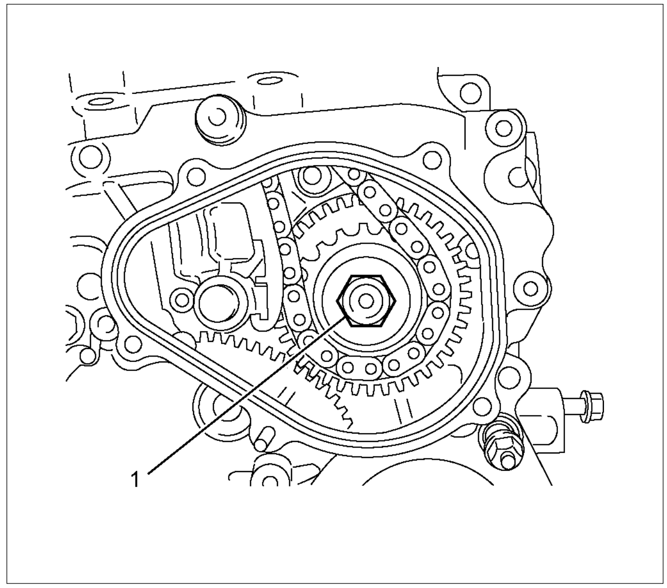
10. Unlock the tensioner hook.
    - Press the place of the arrow in the figure.
    - The hook is opened. The plunger pushes the tension lever.



RTW56ASH020401

11. Tighten the fuel supply pump shaft nut.
    Tighten the nut (1) to the specified torque.

Tightening torque: 130 N·m (13.3 kg·m / 96 lb ft)

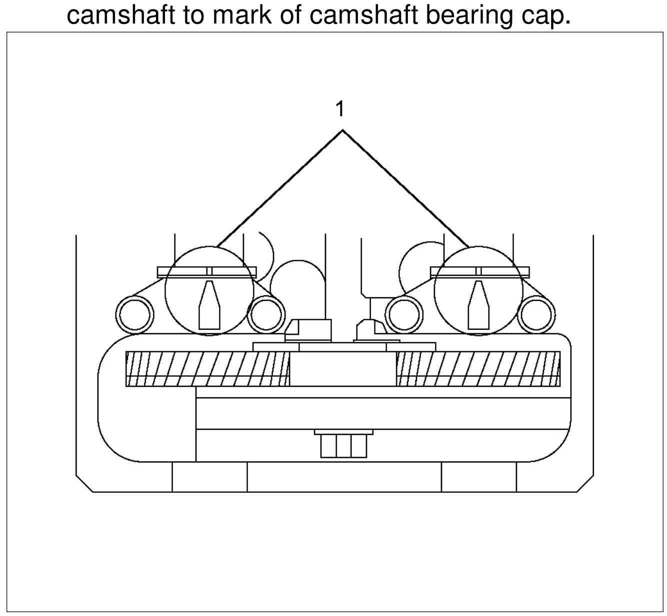


RTW56CSH001601

12. Tighten the timing chain tension lever pivot bolt to the specified torque.

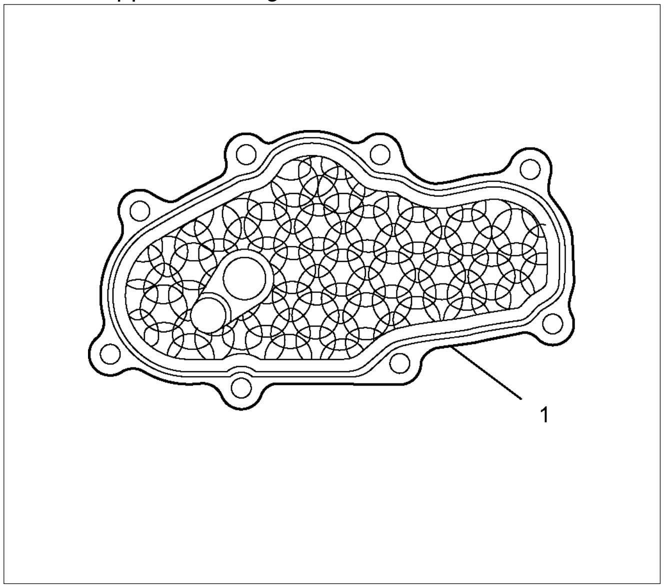
Tightening torque: 27 N·m (2.8 kg·m / 20 lb ft)

13. Turn the crank pulley two rotations (720°CA).
14. Check mark (1) on intake camshaft and exhaust camshaft to mark of camshaft bearing cap.



RTW56ASH006901

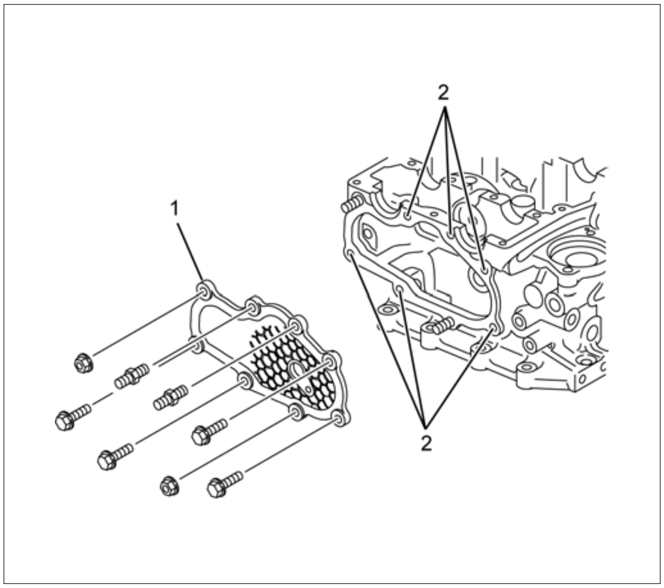
15. Install the cylinder head cover.
    Refer to "Cylinder Head Cover" in ENGINE MECHANICAL section.
16. Apply liquid gasket (ThreeBond TB-1207C or equivalent) to timing chain cover upper (1).
    - Attach cover within 5minutes after the application of gasket.



RTW56CSH002101

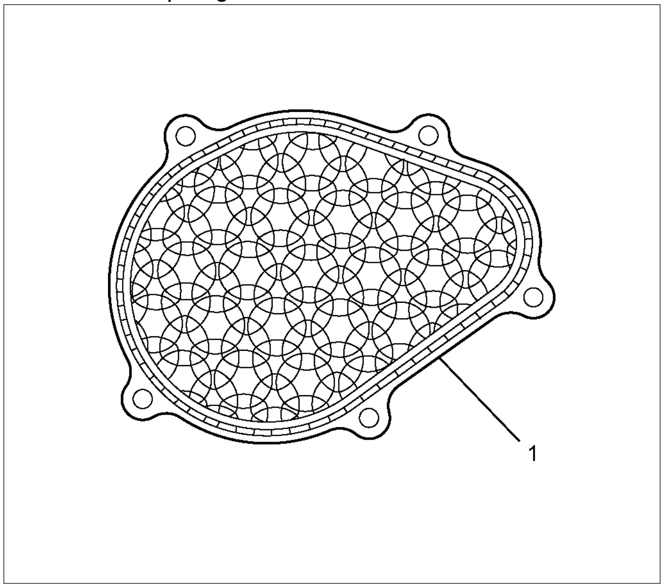
17. Install the timing chain cover upper (1).
    Tighten the bolt to the specified torque.
    - Apply Loctite #262 or equivalent to the bolt and stud threads of cylinder head side (2).

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)



RTW76CSH001201

18. Apply liquid gasket (ThreeBond TB-1207C or equivalent) to the timing chain cover lower (1).
    - Attach the cover within 5 minutes of applying the liquid gasket.



RTW56CSH002301

19. Install the timing chain cover lower.
    Tighten the nuts and bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

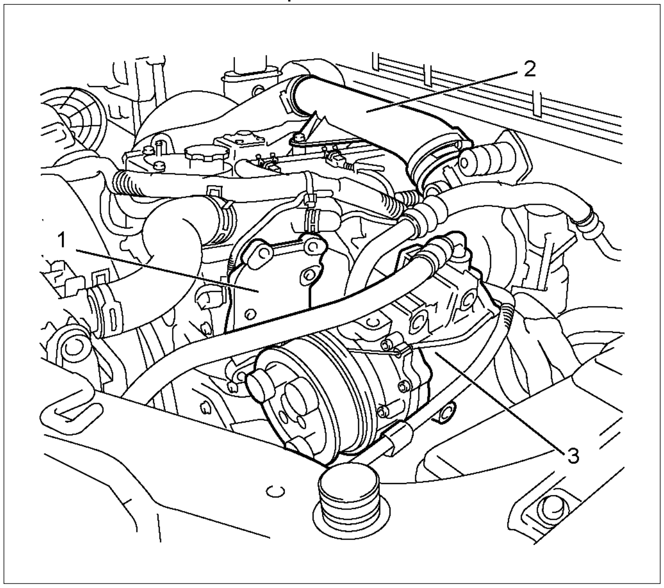
20. Install the noise cover to the timing chain cover lower.
    Tighten the bolts to the specified torque.

Tightening torque: 10 N·m (1.0 kg·m / 87 lb in)

21. Connect the connectors.
    - Supply pump
    - Camshaft position sensor
22. Install the fuel rail assembly.
    - Refer to the Install procedure for "Fuel rail assembly" in this manual.
23. Install the A/C compressor bracket.
    Tighten the bolts to the specified torque.

Tightening torque: 25 N·m (2.5 kg·m / 18 lb ft)

24. Install the A/C compressor.



RTW56ASH004201

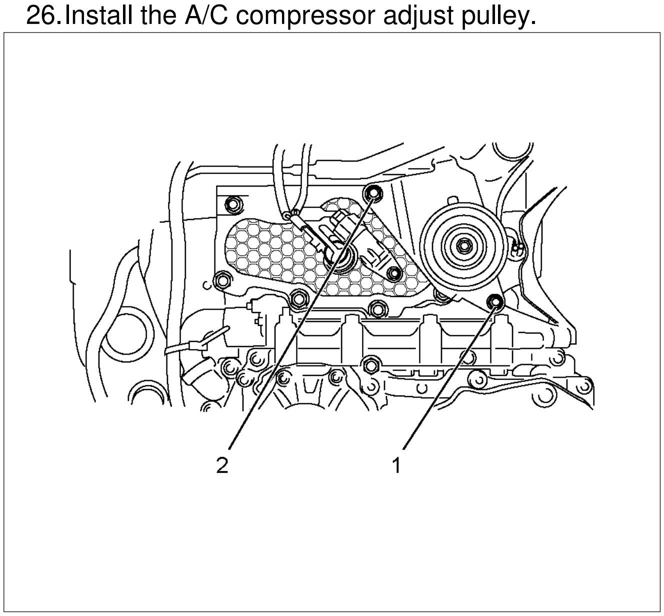
Legend

1. A/C Compressor Bracket
2. Intake Duct
3. A/C Compressor

Tighten the bolts to the specified torque.

Tightening torque: 44 N·m (4.5 kg·m / 33 lb ft)

25. Install the battery.
26. Install the A/C compressor adjust pulley.



RTW56ASH010601

Legend

1. Bolt
2. Nut

Tighten the nut and bolt to the specified torque.

Bolt Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)

Nut Tightening torque: 25 N·m (2.5 kg·m/18 lb ft)

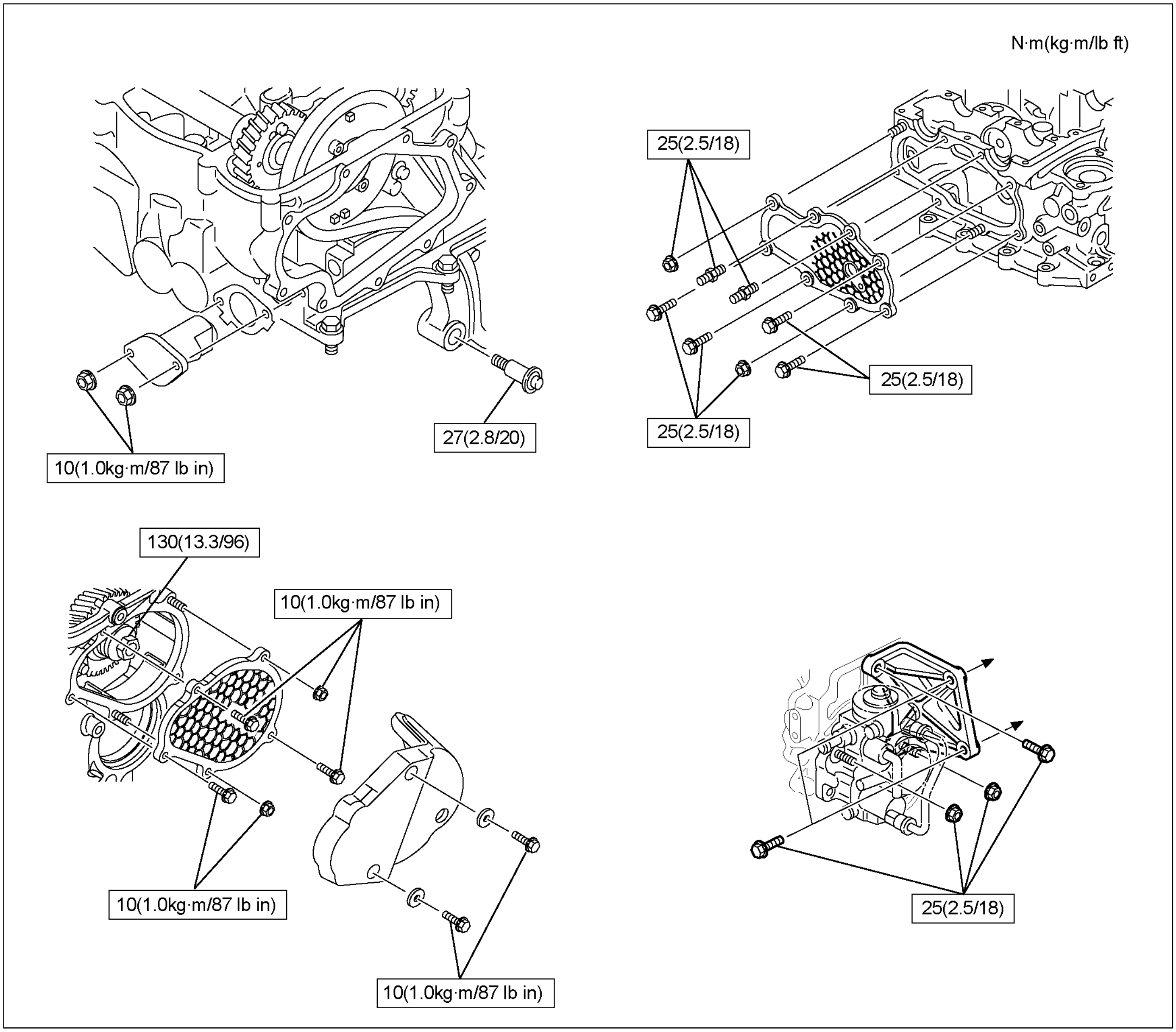
27. Install the A/C compressor drive belt.
Refer to the drive belt tension check procedure for Heating and air conditioning in this manual.
28. Install the cooling fan.
29. Install the fan guide.
30. Install the radiator upper hose.
31. Replenish the engine coolant.

Fuel Supply Pump Relearn Procedure

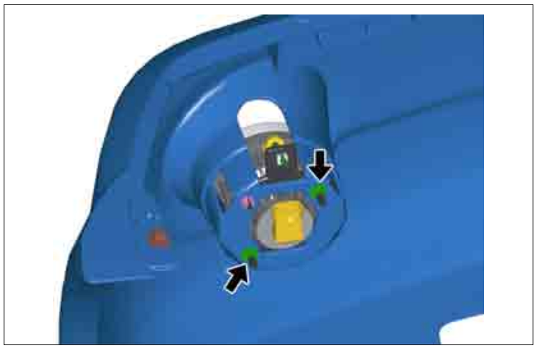
The ECM goes through a fuel supply pump learn procedure to fine tune the current supplied to the fuel rail pressure (FRP) regulator. This learning process in only performed when the engine is idling.

1. Install the scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Command the Supply Pump Learn Reset with the scan tool.
4. Observe the Supply Pump Status parameter with the scan tool. Confirm the scan tool indicates Not Learn.
5. Start the engine and let idle until engine coolant temperature (ECT) reads 149°F (65°C) or higher while observing Supply Pump Status parameter with the scant tool. The scan tool changes status Not Learn > Learning > Learned.
6. If the ECM has correctly learned the fuel supply pump current adjustment, the Supply Pump Status parameter on the scan tool will repeatedly indicate Learning and Learned.

Torque Specifications



RTW56CLF001501



RTW72ASH000601

4. Fog Light

Tighten the fixing nuts to the specified torque.

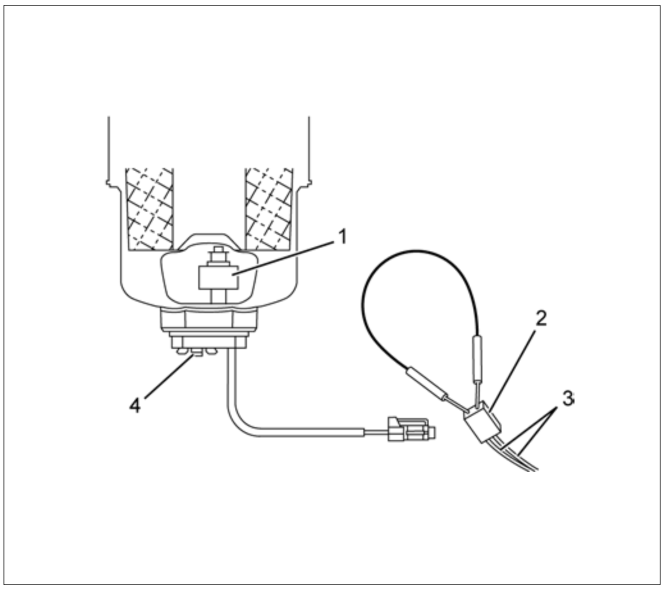
Torque	N·m(kgf·m/lb·in)
7 (0.7 / 61)	

Fuel Sedimenter Switch

Inspection

1. Check that there is continuity between the switch connector terminals when the float in the fuel sedimenter is above the water drain line.
2. Turn on the ignition switch, remove the fuel sedimenter connector, and connect the terminals of the connectors on the harness side. Confirm that the sedimenter warning lamp lights up.

If abnormalities are detected during the check, replace the switch parts and carry out repairs in case of defective connection between circuits or short circuits.



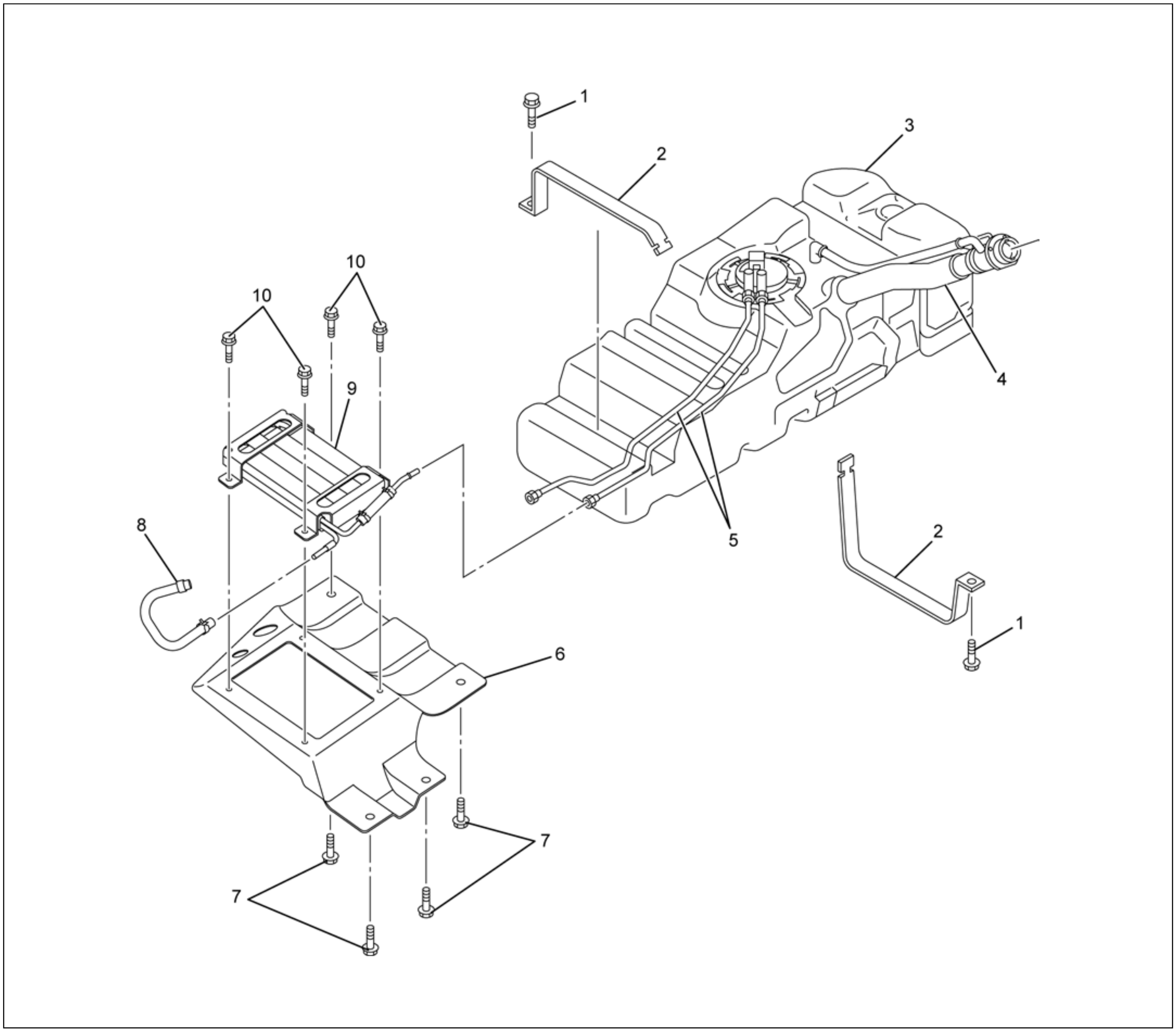
RTW76CSH001101

Legend

1. Sensor
2. Connector on The Vehicle Side
3. Harness
4. Drain Valve

Fuel Tank and Fuel Cooler

Fuel Tank and Associated Parts



RTW76CLF000501

Legend

1. Bolt; Fuel Tank
2. Fuel Tank Band
3. Fuel Tank
4. Fuel Filler Hose and Pipe
5. Fuel Tube/Quick Connector
6. Bracket; Fuel Cooler
7. Bolt; Fuel Cooler Bracket
8. Fuel Return Hose
9. Fuel Cooler
10. Bolt; Fuel Cooler

Removal

Note: When repairs to the fuel system have been completed, start the engine and check the fuel system for loose connections or leakage. For the fuel system diagnosis, see Section "Drivability and Emission".

1. Disconnect the battery ground cable.
2. Slowly loosen the fuel filler cap.

Note: Be careful that fuel does not spout out because of change of pressure in the fuel tank.

Note: Cover opening of the filler neck to prevent any dust entering.

3. Jack up the vehicle.
4. Disconnect the quick connector (5) of the fuel tube at the fuel cooler way.
5. Remove fuel return hose (8) from the pipe.
6. Remove fixing bolt (7) of the bracket fuel cooler and remove bracket fuel cooler (6).

Note: Cover the opening of the pipe to prevent any dust and fuel leakage.

Note: For remove fuel cooler, Remove bolts (10) of the fuel cooler and remove fuel cooler.

7. Support underneath of the fuel tank with a lifter.
8. Remove the inner liner of the wheel house at rear left side.
9. Remove fixing bolt of the filler neck from the body.
10. Disconnect the quick connector (5) of the fuel tube from the fuel pipe and the evapo tube from evapo joint connector.

Note: Cover the quick connector to prevent any dust entering and prevent fuel leakage.

Note: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

11. Remove fixing bolt (1) of the tank band and remove the tank band (2).
12. Disconnect the pump and sender connector on the fuel pump and remove the harness from the weld clip on the fuel tank.
13. Lower the fuel tank (3).

Note: When lowering the fuel tank from the vehicle, do not scratch the hoses and tubes by contact with other parts.

Installation

1. Raise the fuel tank.

Note: When raising the fuel tank to the vehicle, do not scratch the hoses and tubes by contact with other parts.

2. Connect the pump and sender connector to the fuel pump and install the harness to the weld clip on the tank.

Note: The connector must be securely connected against the stopper.

3. Install the tank band and fasten bolt.

Torque: 68 N·m (6.9 kg·m /50 lb ft)

Note: The anchor of the tank band must be securely installed to the guide hole on the frame.

4. Connect the quick connector of the fuel tube to the fuel pipe and the evapo tube from evapo joint connector.

Note: Pull off the left checker on the fuel pipe.

Note: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

5. Install the filler neck to the body with bolt.

Note: For install the fuel cooler to the bracket with bolt.

Torque: 6.5 N·m (0.7 kg·m /61 lb in)

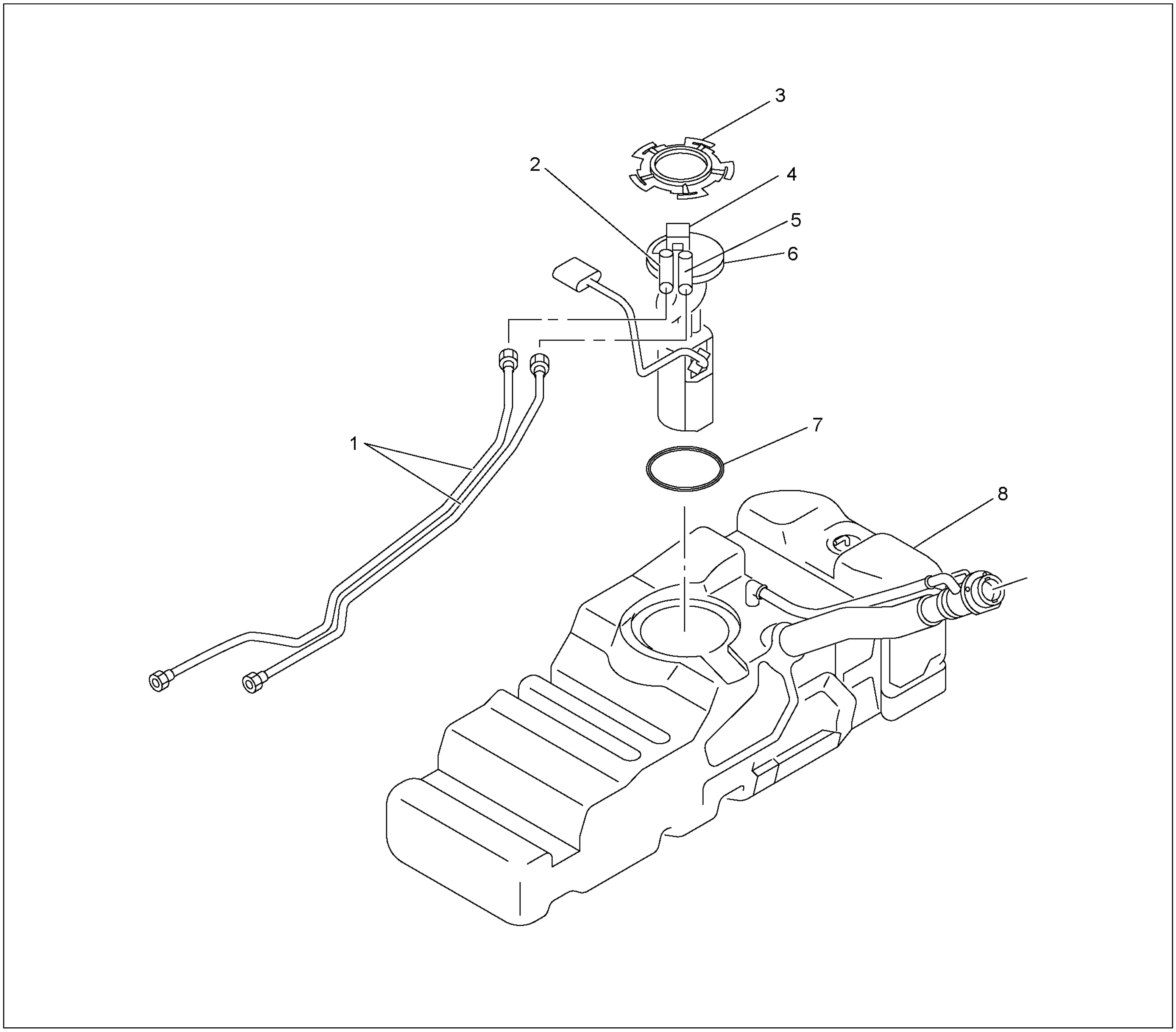
6. Install the bracket to Frame with bolt.

Torque: 48 N·m (4.9 kg·m /35 lb ft)

7. Install the fuel return hose at the fuel cooler way.
8. Install the quick connector at the fuel cooler way.
9. Install the inner liner of the wheel house at rear left side.
10. Remove lifter from the fuel tank.
11. Lower the vehicle.
12. Tighten the filler cap until at least three clicks.
13. Connect the battery ground cable.

Fuel Gauge Unit

Fuel Gauge Unit and Associated Parts



RTW56CLF001001

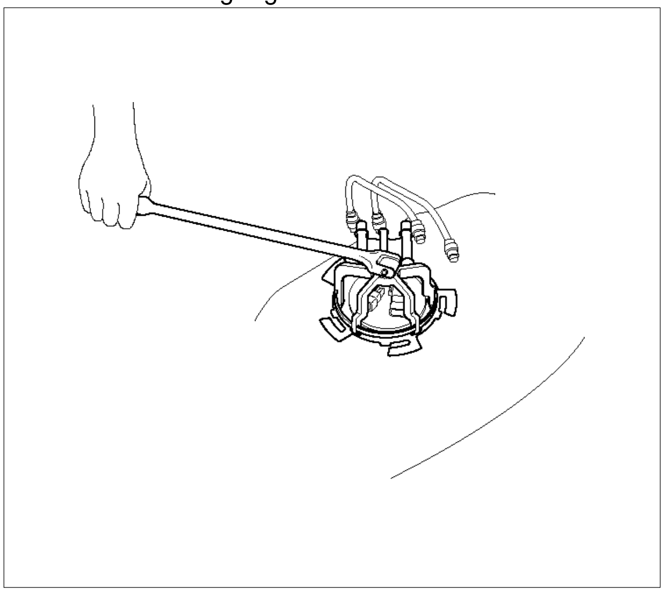
Legend

1. Fuel Tube/Quick Connector
2. Fuel Feed Port
3. Retainer Ring (Fuel Gauge Unit Lock)
4. Connector; Fuel Gauge Unit
5. Fuel Return Port
6. Fuel Gauge Unit and Sender Assembly
7. Seal; Fuel Gauge Unit
8. Fuel Tank Assembly

Removal

Note: When repairs to the fuel system have been completed, start the engine and check the fuel system for loose connections or leakage. For the fuel system diagnosis, see Section "Drivability and Emission".

1. Remove the fuel tank assembly (8). Refer to "Fuel Tank Removal" in this section.
2. Disconnect the quick connector (1) of the fuel tube from the fuel gauge unit.



140R100035

3. Remove the retainer ring (3) from the fuel tank with the removal tool 5-8840-2602-0.
4. Slowly remove the fuel gauge unit (6) from the fuel tank as no bend float arm.

Note: Cover opening for the fuel gauge unit on the fuel tank to prevent any dust entering.

5. Discard the fuel gauge unit seal (7) because it cannot be reused.

Installation

1. Clean the seal surface of the fuel tank and the fuel gauge unit.

Note: If there is dust on the seal surface, it can cause a fuel leak.

2. Install the new fuel gauge unit seal (7) to the opening of the fuel tank along the groove.
3. Slowly install the fuel gauge unit (6) into the fuel tank so there is no bend in the float arm.
4. Set the flange of the fuel gauge unit on the fuel gauge unit seal as mating convexity of the fuel gauge unit and reentrant of the fuel tank.
5. Slowly lock the retainer ring (3) to the fuel tank with the remover tool 5-8840-2602-0.
6. Connect the quick connector (1) of the fuel tube to the gauge unit.

Note: Pull off the left checker of the fuel pipe.

Note: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

7. Check for leak.

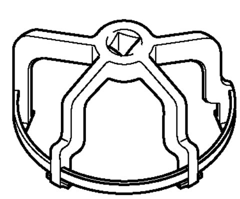
   Method of leak check.

   1. Plug the end of the quick connector and breather hose (Pull off the breather hose from fuel tank) and tighten fuel filler cap until at least one click is heard.
   2. Apply soapy water around the fuel gauge unit seal area.
   3. Pressure air into the fuel tank from the end of the breather pipe at 34.3 kPa (0.35 kg / cm^2 / 5 psi) over 15 seconds.
   4. Verify that no bubbles from around the fuel gauge unit seal area.

8. Install the fuel tank assembly (8).

Note: Refer to "Install the fuel tank" in this section.

Special Tool

ILLUSTRATION	PART NO. PART NAME
 5884026020	**5-8840-2602-0** Remover: fuel pump retainer ring

Fuel Tube / Quick - Connector Fittings

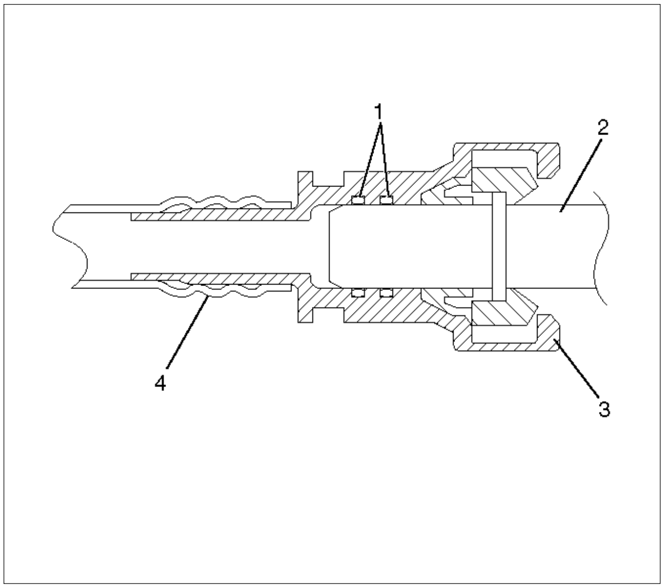
Precautions

- Do not light a match or create a flame.
- Keep flames away from your work area to prevent flammable materials from catching fire.
- Disconnect the battery ground cable to prevent electrical shorts.
- Pre–treat the piping system or associated parts from thermal damage or from spattering when welding or similar heat–generating work.

Cautions During Work

Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electrolyte.

Piping that has been splattered with battery electrolyte or battery electrolyte soaked cloth that was wiped on the piping cannot be used.



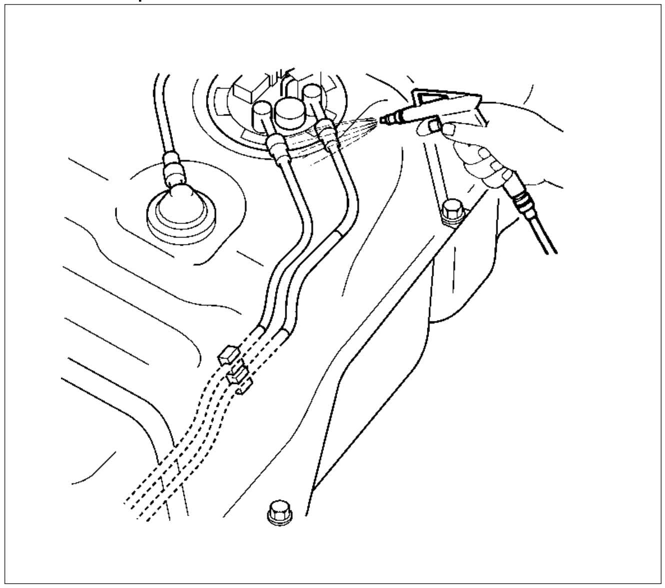
140R100032

Legend

1. O-ring
2. Port
3. Connector
4. Plastic Tube

Removal

1. Open the fuel cap to relieve the fuel pressure in the tank. Use compressed air to remove any dirt on the fuel quick connect fittings prior to disconnecting the fittings. When disconnecting the fuel pipe, cover the area with a cloth to prevent fuel from splashing as the fuel pipe may still have some pressure in it.



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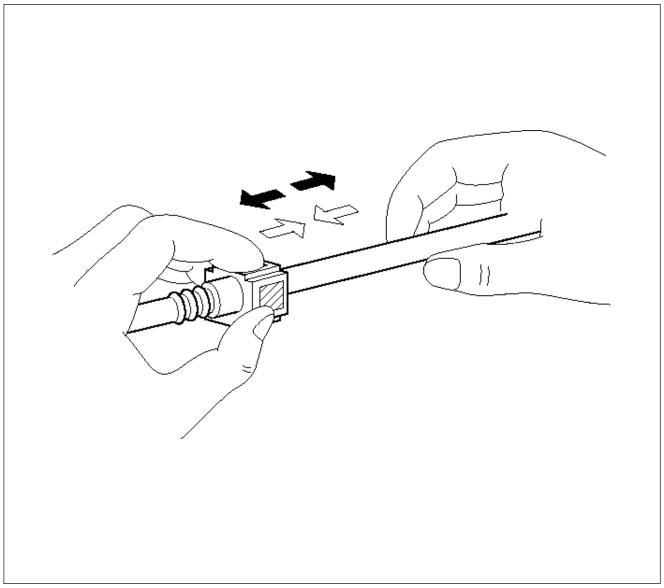
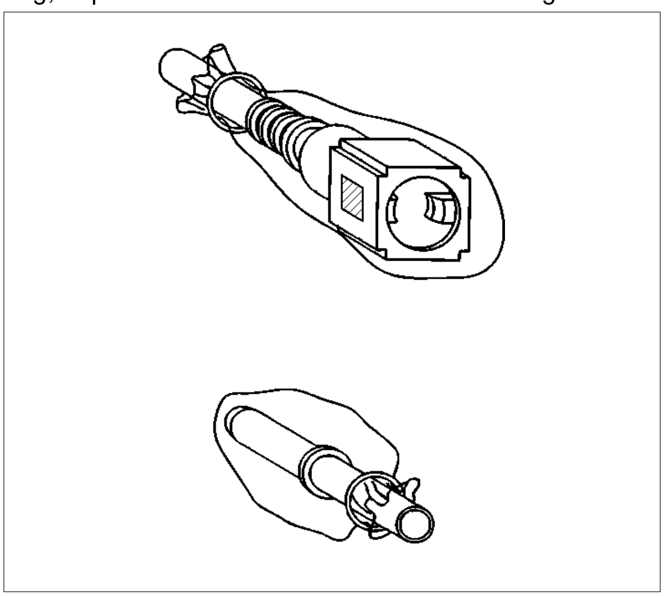
2. For removal of the quick connector, hold the quick connector in one hand, and pull out the connector with the other hand while pressing the square release button of the connector, as illustrated.

Note: Do not use tools of any kind. Only use bare hands when disconnecting the connector. Use a lubricant (light oil) and/or push and pull the connector until the pipe is disconnected.



140R100037

Cover the connectors that were removed with a plastic bag, to prevent dust or rain water from entering.



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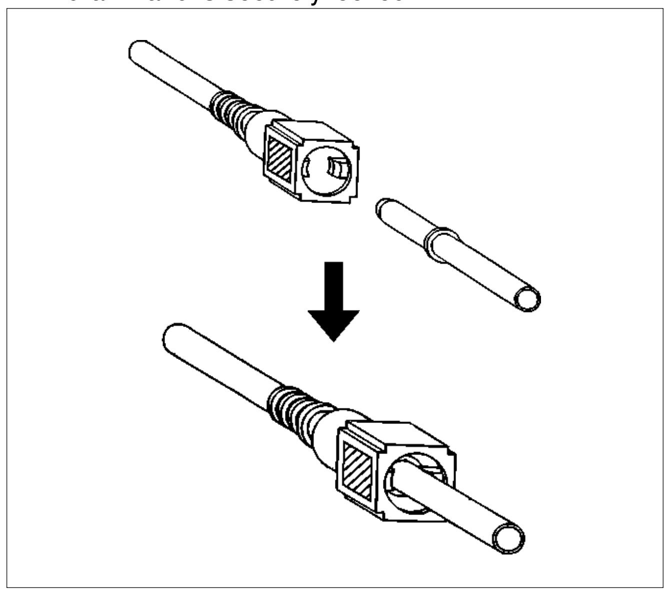
Reuse of Quick-Connector

- Replace the port and connector if a scratch, dent or crack is found.
- Remove any dirt build up on the port when installing the connector. Replace the connector, if there is any rust, dents or scratches.
- After cleaning the port, insert it straight into the connector until it clicks. After it clicks, try pulling it out at 49 N (5 kg / 11 lb) to make sure that it is not drawn and is securely locked.



140R100036

Assembling Advice

By applying engine oil or light oil to the pipe, port makes pipe assembly easier. The pipe assembly should take place immediately after applying oil (to prevent dust from sticking to the pipe surface - which may decrease sealing ability).

Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Start the engine and observe the engine idle speed. The presence of dirt in the fuel system may affect the fuel injection system.
3. Check for fuel leakage from the connector.

Filler Neck

Removal

1. Remove the fuel tank.

Note: Refer to "Fuel Tank" in this section.

2. Put a marking on the following points as the filler neck assembly is restored.
   - Each joint area of the hose (to restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (to restore axial direction and position of the clamp)
   - Each bolt in the clamp (to restore fasten length of bolt in the clamp)
   - The band clip (to restore position and fasten length of the band clip)

Note: Cover end of each hose and pipe to prevent any dust entering.

Installation

1. Align each marking and restore the following point.
   - Each joint area of the hose (Restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (Restore axial direction and position of the clamp)

   Tightening torque: 2.5 N·m (0.25 kg·m /21.7 lb in)

   Filler neck side except flat deck model.
   - Each bolt in the clamp (Restore fasten length of bolt in the clamp)

   Tightening torque: 2.5 N·m (0.25 kg·m /21.7 lb in)

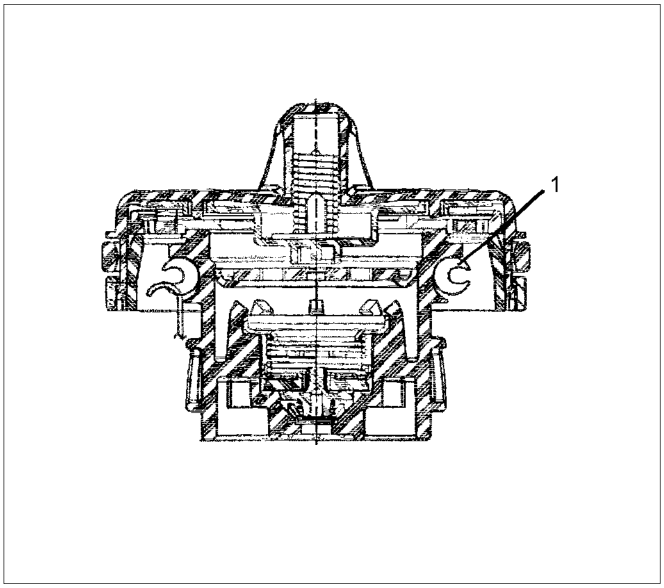
   Filler neck side except flat deck model.
   - The band clip (Restore position and fasten length of the band clip)
2. Install the fuel tank.

Note: Refer to "Fuel Tank" in this section.

Fuel Filler Cap

General Description

A vacuum valve and pressure valve are built into the fuel filler cap which adjusts the fuel pressure in the fuel tank to prevent fuel tank damage.



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Legend

1. Seal Ring

Inspection

The fuel filler cap must be inspected for seal condition.

The fuel filler cap must be replaced if found defective.

Note: A replacement fuel filler cap must be the same as the original. The fuel filler cap valve was designed primarily for this application and must be replaced with the same type or decreased engine performance may occur.

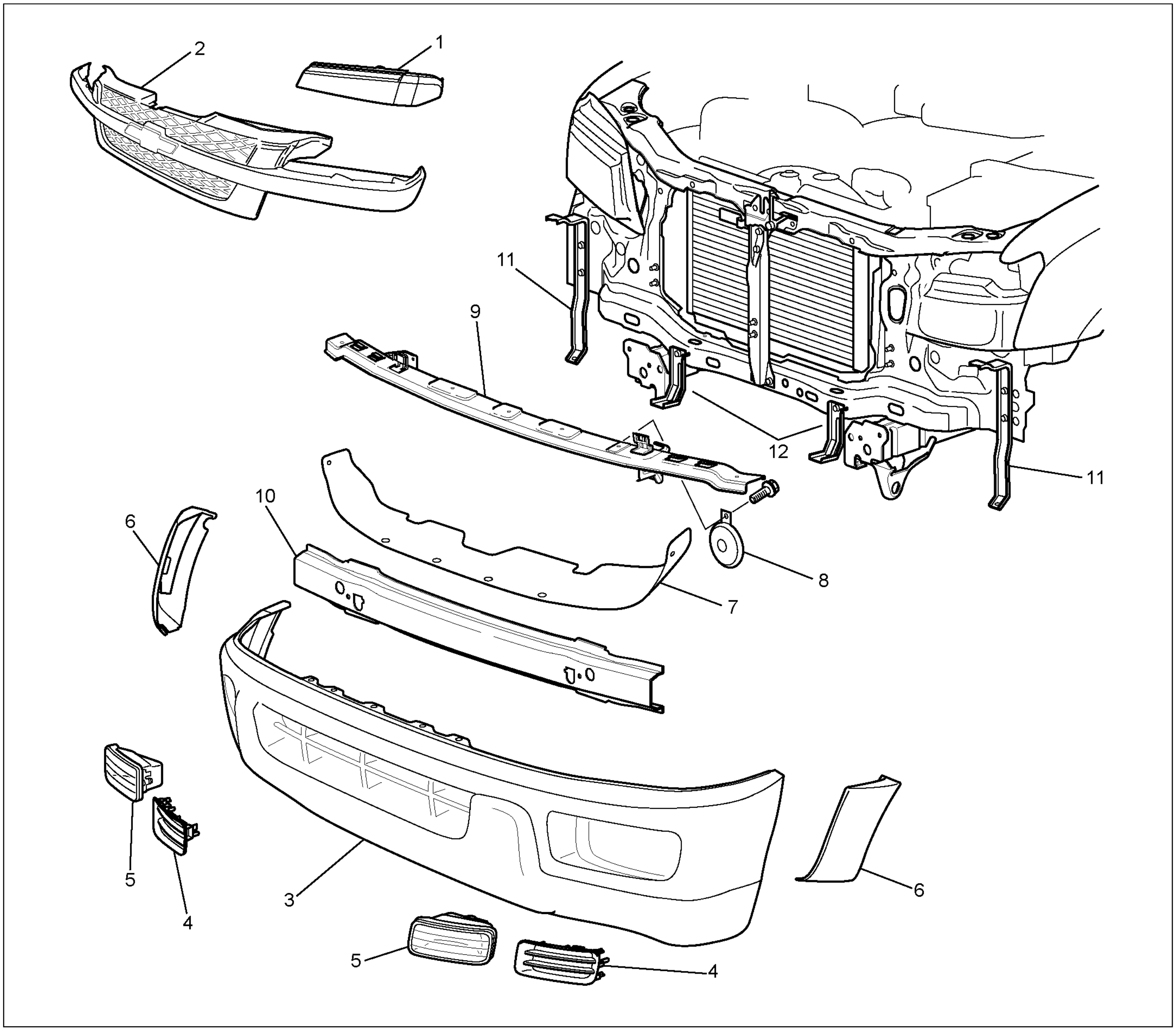
SECTION 6D

ENGINE ELECTRICAL

TABLE OF CONTENTS

FRONT BUMPER (B TYPE)

REMOVAL AND INSTALLATION



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Removal Steps

▲ 1. Front combi lamp assembly
▲ 2. Radiator grille
▲ 3. Front bumper fascia
4. Bezel (W/O fog light)
5. Fog light
▲ 6. Bumper seal
7. Front bumper flare assembly (W/ Front wheel extension)
8. Horn
9. Front bumper impact support assembly
10. Front bumper impact bar assembly
11. Fascia support side bracket
12. Fascia support lower bracket

Installation Steps

12. Fascia support lower bracket
11. Fascia support side bracket
▲ 10. Front bumper impact bar assembly
9. Front bumper impact support assembly
8. Horn
▲ 7. Front bumper flare assembly (W/ Front wheel extension)
6. Bumper seal
▲ 5. Fog light
4. Bezel (W/O fog light)
3. Front bumper fascia
2. Radiator grille
1. Front combi lamp assembly

Charging System

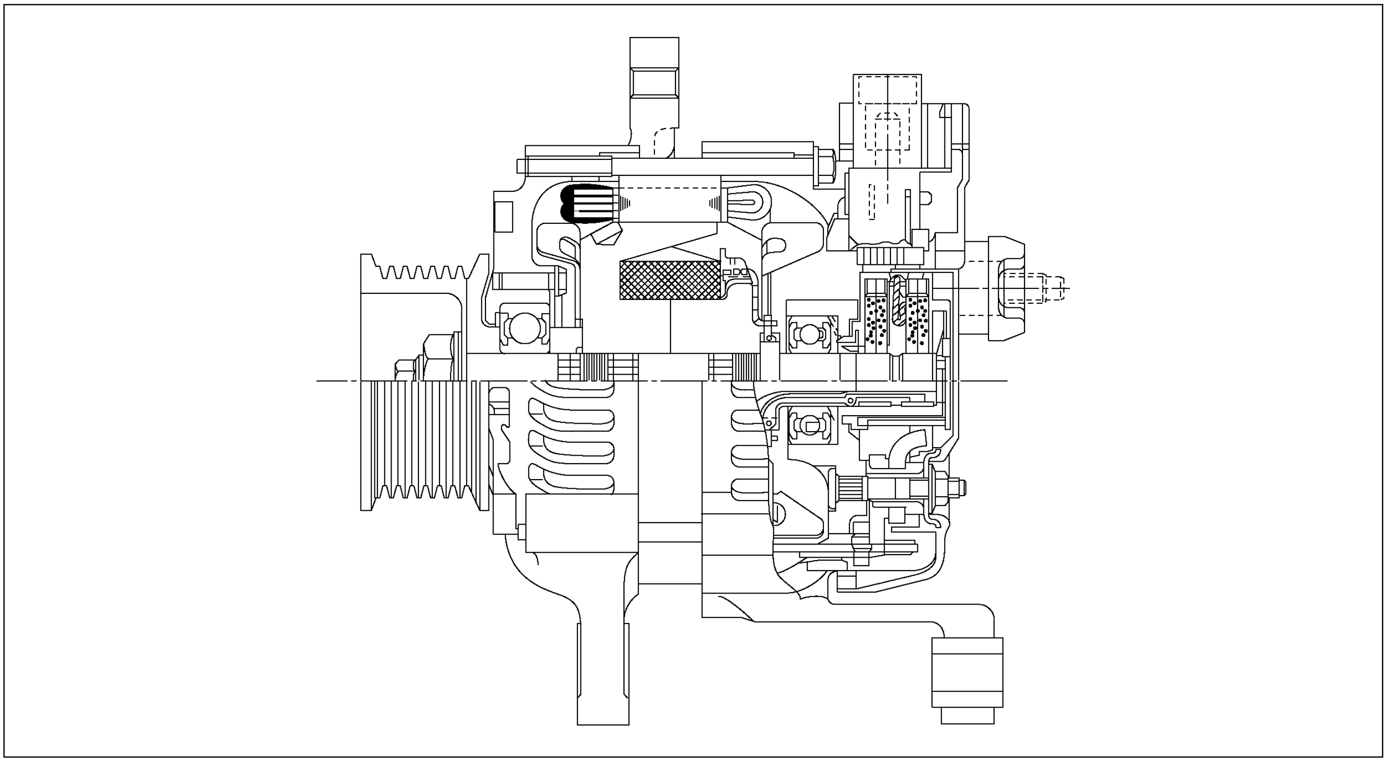
Servicing Cautions

- Battery polarity is important. If the battery cables are reversed, the generator diodes will be destroyed.
- Do not remove the battery cables or the charging circuit wiring when the engine is running.
- Confirm that the terminal wires are connected to the proper terminals by checking the terminal numbers (the number on the terminal wire and the terminal must be the same).
- Disconnect the battery negative cable (-) before inspecting the generator.
- Do not open or close the battery relay switch when the engine is running.
- Disconnect the battery negative cable (-) when using external equipment (Quick-Charge) to charge the battery.
- When steam cleaning or washing the engine, do not allow steam or water to come in direct contact with the battery and other electrical system components.
- Be sure to read the item on belt tension adjustment before beginning the procedure.

Important Generator Components and Function

- The generator used on 4JK1 engine cannot be disassembled.
- The generator uses a built-in solid-state IC voltage regulator. The regulator and other important components together with their connections are shown in the illustration.
- The voltage regulator is installed to the rear cover assembly of the generator together with the brush holder and the rectifier. The generator requires no additional voltage regulation.
- 9 diodes are connected to the stator coil to convert AC to DC. The DC voltage is delivered to the generator output terminal.

AC Generator (4JK1)



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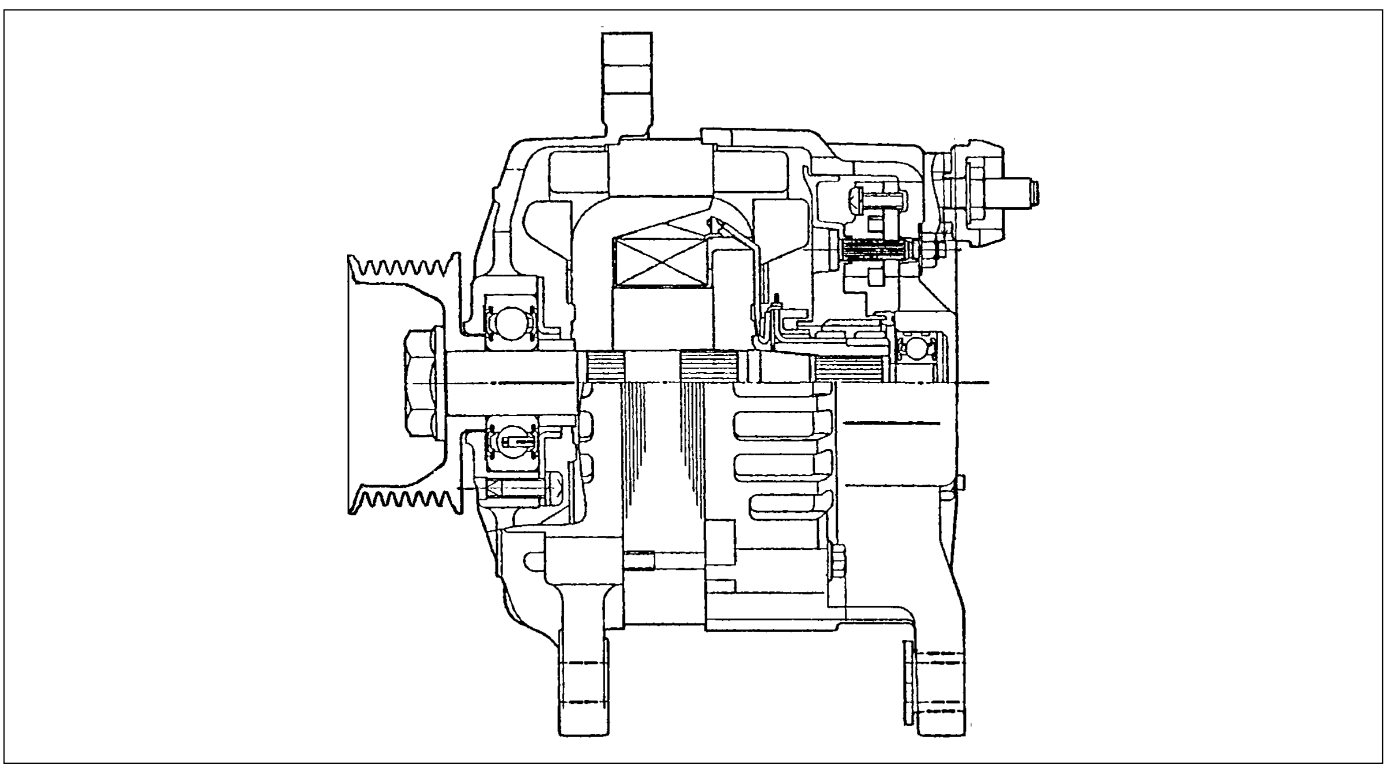
AC Generator (4JJ1)



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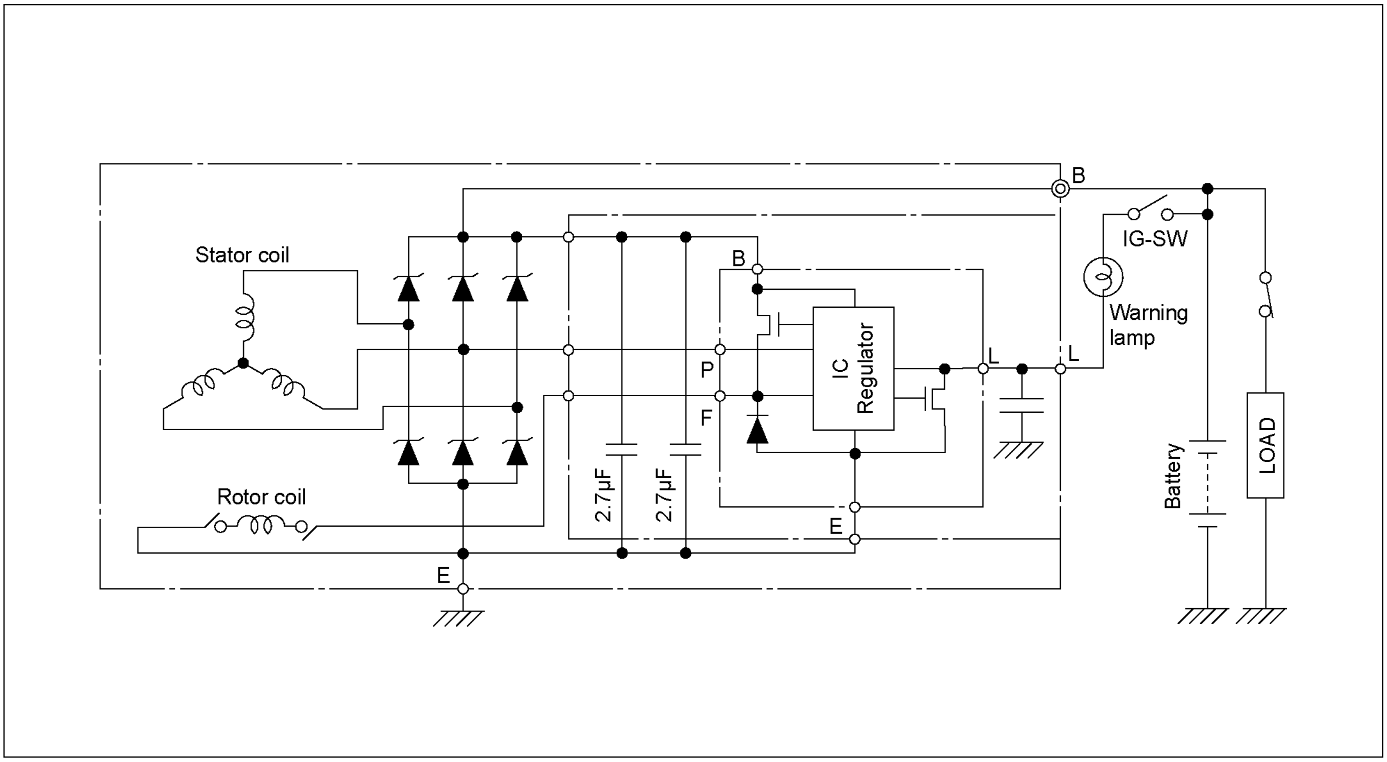
Charging System (4JK1)



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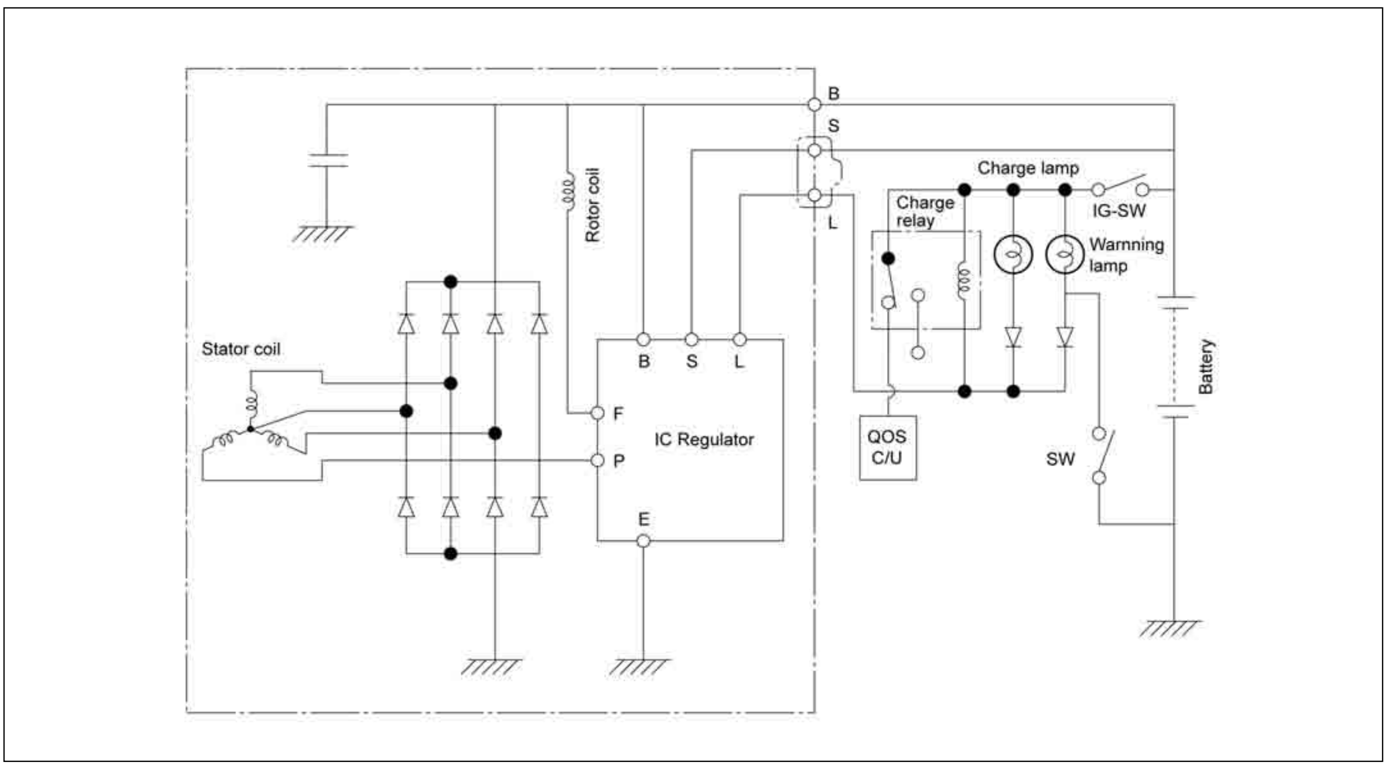
Charging System (4JJ1)



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Troubleshooting

Symptoms

- No charging
- Inadequate charging
- Excessive charging
- Unstable charging current
- Abnormal generator noise

No charging

Possible problem	Countermeasure
Dead battery	Replace
Open or shorted wiring	Repair
Open or shorted ammeter	
Loose wiring connections	
One or more generator coils open or shorted	Replace
Bad diode	
Bad regulator	
Loose regulator connections	Repair

Inadequate charging

Possible problem	Countermeasure
Dead battery	Replace
Open or shorted wiring	Repair
Loose wiring connections	
Loose generator drive belt	Adjust belt tension
Stator coil intermittent short	Replace
Bad diode	
Loose battery connections	Repair
Bad regulator	Replace
Loose regulator connections	Repair

Excessive charging

Possible problem	Countermeasure
Bad regulator	Replace

Unstable charging current

Possible problem	Countermeasure
Open wiring connection or broken wire	Repair
Loose generator drive belt	Adjust belt tension
Open or shorted stator coil	Replace
Loose terminal connections	Repair
Bad regulator	Replace
Loose regulator terminal connections	Repair

Abnormal operating noise

Possible problem	Countermeasure
Loose generator drive belt	Adjust belt tension
Bad bearing	Replace
Loose rotor core or stator core	Repair
Bad diode	Replace
Open or shorted stator coil	Replace

Diagnosis

On-vehicle Inspection

The charging system warning light tells the vehicle operator of possible problems with the system.

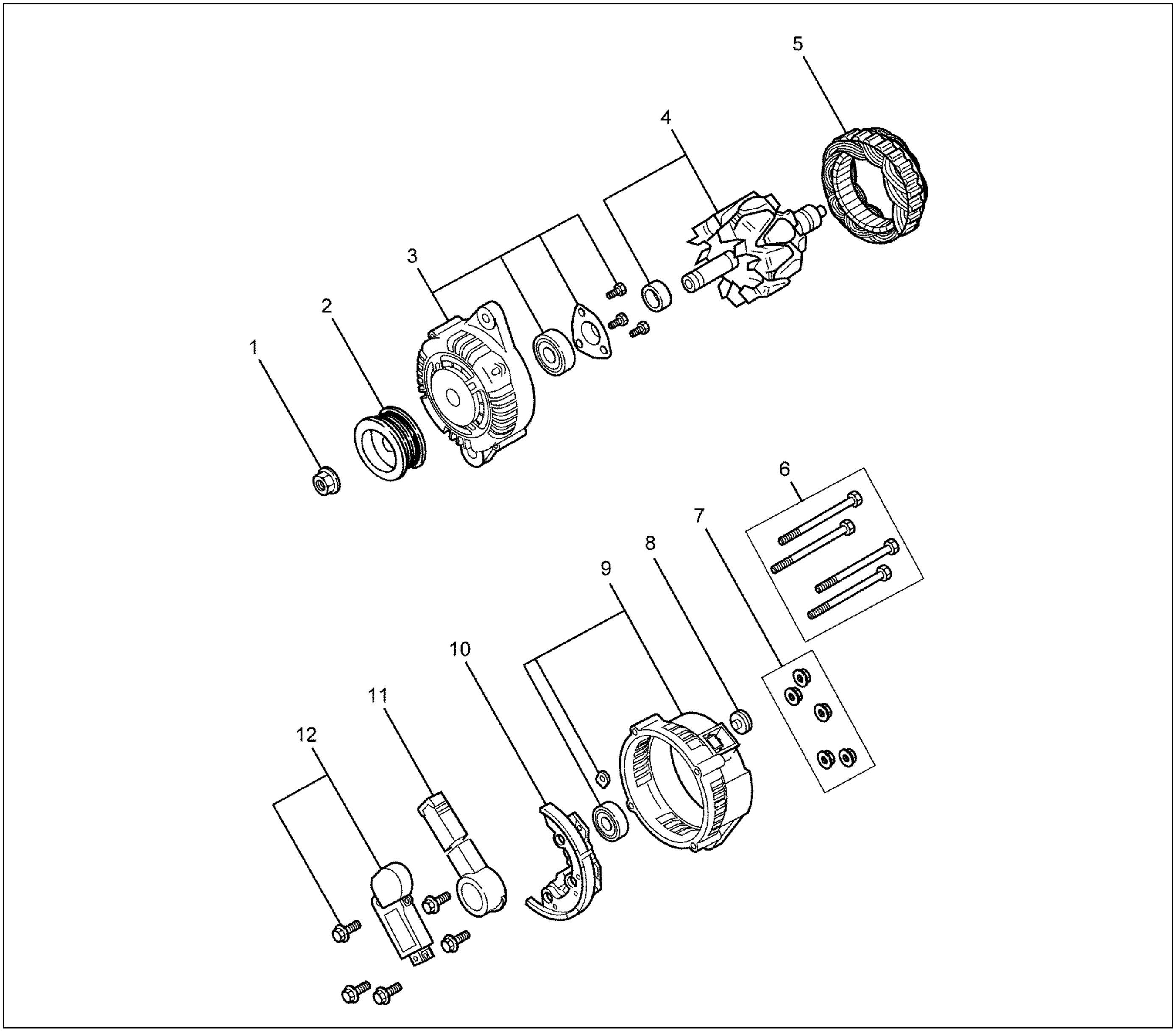
When the ignition switch is moved to the ON position, the light turns on. The light turns off immediately after the engine is started. If the light turns on during engine operation, there is a problem with the charging system. Perform the checks described below.

1. Check the belt (broken or loose).
2. Check the harness connectors (loose or disconnected).
3. With the engine off, turn the ignition switch to the ON position. If the warning lamp does not light, remove the harness connector from the generator. Ground the connector IG terminal. The lamp should light. If it does not, the bulb is burned out. Replace the bulb.
4. Start the engine. If the warning lamp remains on, the generator must be repaired or replaced.

Specifications

Battery power	Volts	12
Generator output	Amperes	90
Rotational direction (Viewed from pulley)	—	Clockwise
Rated speed	rpm	5,000
Maximum speed		18,000

Unit Servicing (4JJ1)



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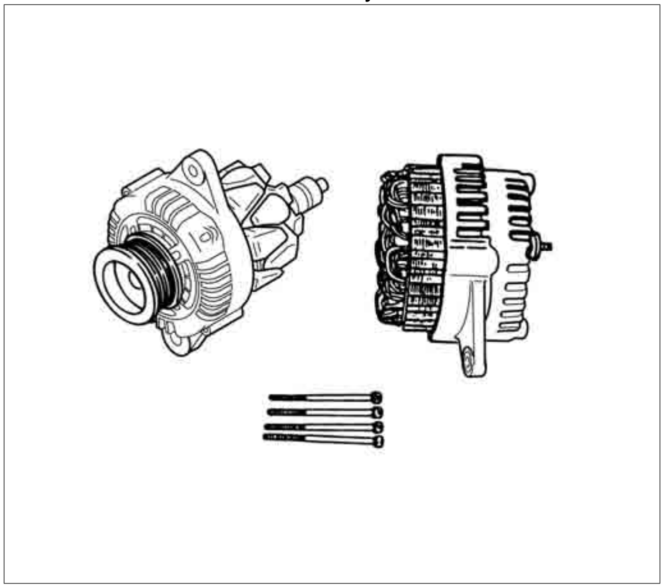
Legend

1. Pulley Nut
2. Pulley
3. Front Cover Assembly
4. Rotor Assembly
5. Stator
6. Through Bolts
7. Nuts
8. Terminal Insulation Plate
9. Rear Cover Assembly
10. Rectifier
11. Brush Holder
12. Regulator Assembly

Disassembly

1. Remove the through bolts.
2. Insert a flat-blade screwdriver between the front cover and the stator. Pry the parts apart.
3. Separate the front cover/rotor assembly from the rear cover/stator assembly.



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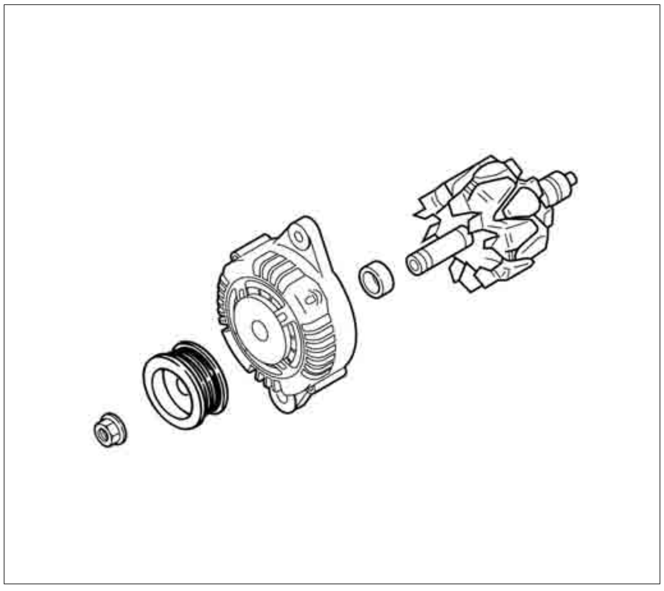
4. Place the front cover and rotor in a vise.
5. Remove the pulley nut and the pulley.
6. Remove the rotor from the front cover.



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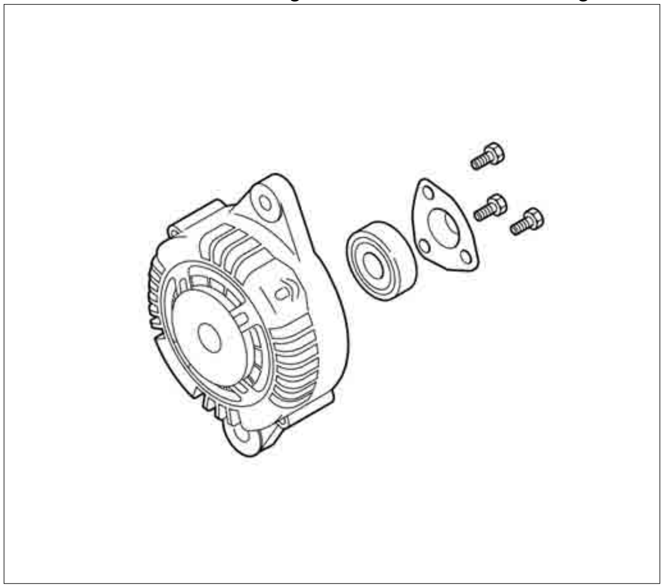
7. Remove the screw from the front cover.
8. Remove the bearing retainer and the bearing.



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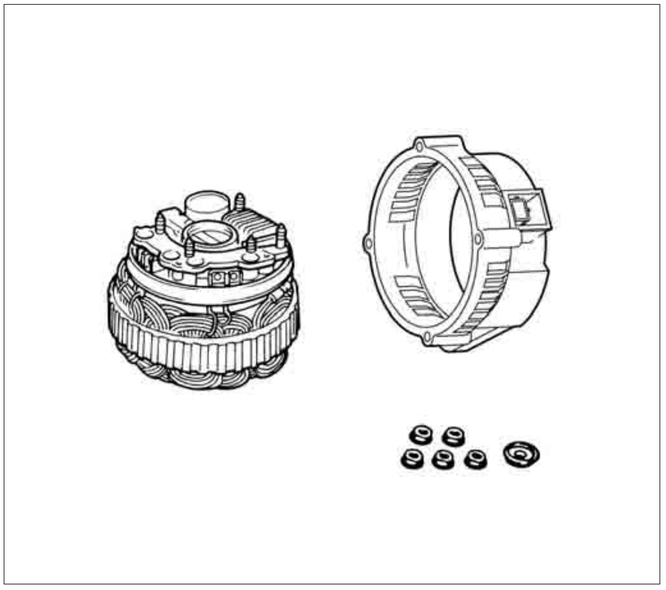
9. Remove the B-terminal nut.
10. Remove the rectifier and the brush holder.
11. Remove the rear cover from the stator.



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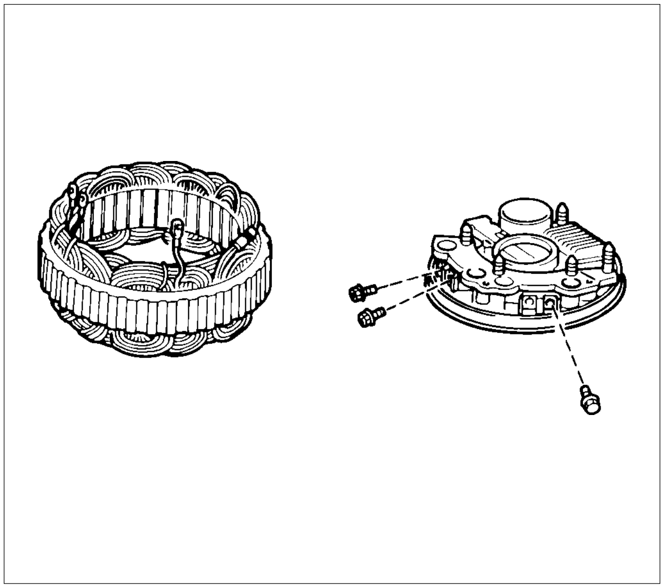
12. Remove the bolts securing the stator terminal to the rectifier.

13.Remove the stator.



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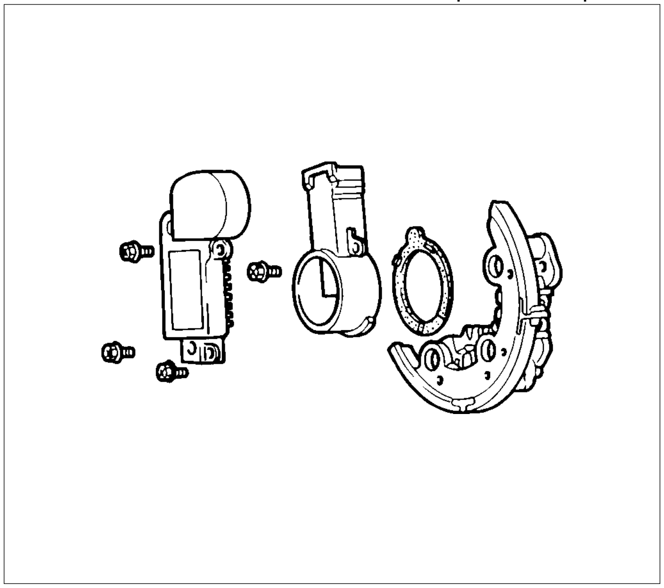
14.Remove the bolts securing the regulator, the rectifier, and the brush holder. Separate the parts.



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Inspection and Repair

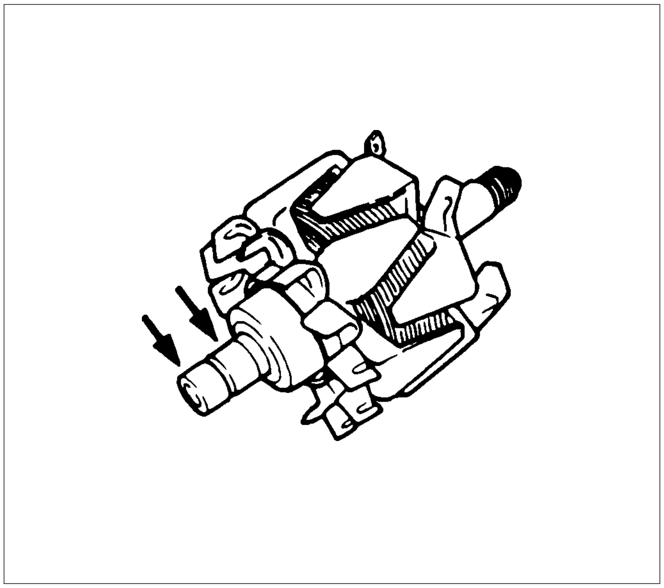
Repair or replace any parts found to be excessively worn or damaged during the inspection procedure.

Rotor Assembly

1. Check for dirty or rough slip ring surfaces. Remove dirt from the surfaces with a clean rag. Use No. 500 or No. 600 sandpaper to smooth the surfaces.
2. Measure the slip ring diameters. Replace the slip ring if the diameter is less than the specified limit.

Slip ring diameter mm (in)

Standard	27 (1.063)
Limit	26 (1.024)



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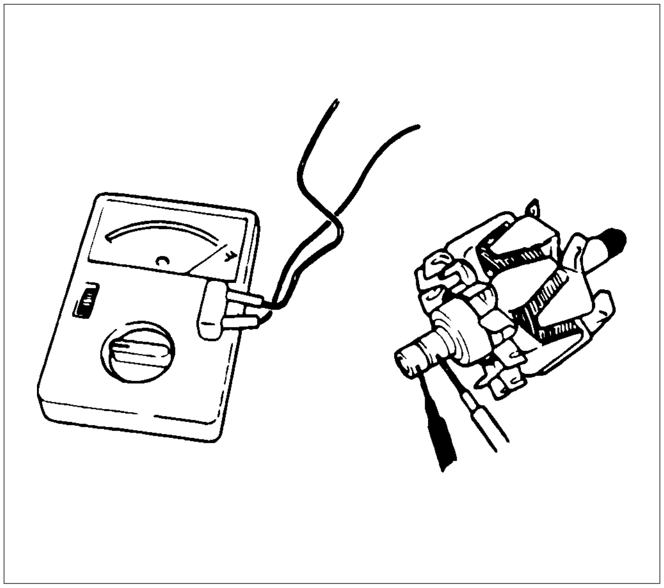
3. Measure the electrical resistance between the slip rings. If the resistance is greater than the specified limit (open circuit), repair is required.

Slip ring resistance Ω

Less than 3.75



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PRESSURE

POUNDS PER SQUARE INCH TO KILOGRAMS PER SQUARE CENTIMETER

lb/in^2 (psi)	0 kg/cm^2	1 kg/cm^2	2 kg/cm^2	3 kg/cm^2	4 kg/cm^2	5 kg/cm^2	6 kg/cm^2	7 kg/cm^2	8 kg/cm^2	9 kg/cm^2	lb/in^2 (psi)
-		0.0703	0.1406	0.2109	0.2812	0.3515	0.4218	0.4921	0.5625	0.6328	-
10	0.7031	0.7734	0.8437	0.9140	0.9843	1.0546	1.1249	1.1952	1.2655	1.3358	10
20	1.4061	1.4764	1.5468	1.6171	1.6874	1.7577	1.8280	1.8983	1.9686	2.0389	20
30	2.1092	2.1795	2.2498	2.3201	2.3904	2.4607	2.5311	2.6014	2.6717	2.7420	30
40	2.8123	2.8826	2.9529	3.0232	3.0935	3.1638	3.2341	3.3044	3.3747	3.4450	40
50	3.5154	3.5857	3.6560	3.7263	3.7966	3.8669	3.9372	4.0075	4.0778	4.1481	50
60	4.2184	4.2887	4.3590	4.4293	4.4996	4.5700	4.6403	4.7106	4.7809	4.8512	60
70	4.9215	4.9918	5.0621	5.1324	5.2027	5.2730	5.3433	5.4136	5.4839	5.5543	70
80	5.6246	5.6947	5.7652	5.8355	5.9058	5.9761	6.0464	6.1167	6.1870	6.2573	80
90	6.3276	6.3979	6.4682	6.5386	6.6089	6.6792	6.7495	6.8198	6.8901	6.9604	90
100	7.0307	7.1010	7.1713	7.2416	7.3119	7.3822	7.4525	7.5228	7.5932	7.6635	100

KILOGRAMS PER SQUARE CENTIMETER TO POUNDS PER SQUARE INCH

kg/cm^2	0 lb/in^2(psi)	1 lb/in^2(psi)	2 lb/in^2(psi)	3 lb/in^2(psi)	4 lb/in^2(psi)	5 lb/in^2(psi)	6 lb/in^2(psi)	7 lb/in^2(psi)	8 lb/in^2(psi)	9 lb/in^2(psi)	kg/cm^2
-		14.22	28.45	42.67	56.89	71.12	85.34	99.56	113.78	128.01	-
10	142.23	156.45	170.68	184.90	199.12	213.35	227.57	241.79	256.01	270.24	10
20	284.46	298.6	312.91	327.13	341.35	355.58	369.80	384.02	398.24	412.47	20
30	426.69	440.91	455.14	469.36	483.58	497.81	512.03	526.25	540.47	554.70	30
40	568.92	583.14	597.37	611.59	625.81	640.04	654.26	668.48	682.70	696.93	40
50	711.16	725.37	739.60	753.82	768.04	782.27	795.49	810.71	824.93	839.16	50
60	853.38	867.60	881.83	896.05	910.27	924.50	938.72	952.94	967.16	981.39	60
70	995.61	1009.83	102406	1038.28	1052.50	1066.73	1080.95	1095.17	1109.39	1123.62	70
80	1137.84	1152.06	1166.27	1180.51	1194.73	1208.96	1223.18	1237.40	1251.62	1265.85	80
90	1280.07	1294.20	1308.52	1322.74	1336.96	1351.19	1365.41	1379.63	1393.85	1408.08	90
100	1422.30	1436.52	1450.75	1464.97	1479.19	1493.42	1507.64	1521.86	1536.08	1550.31	100

KILOGRAMS PER SQUARE CENTIMETER TO KILO-PASCALS

kg/cm^2	0 KPa	1 KPa	2 KPa	3 KPa	4 KPa	5 KPa	6 KPa	7 KPa	8 KPa	9 KPa	kg/cm^2
-	-	98.1	196.1	294.2	392.3	490.3	588.4	686.5	784.5	882.6	-
10	980.7	1078.7	1176.8	1274.9	1372.9	1471.0	1569.1	1667.1	1765.2	1863.3	10
20	1961.3	2059.4	2157.5	2255.5	2353.6	2451.7	2549.7	2647.8	2745.9	2843.9	20
30	2942.0	3040.1	3138.1	3236.2	3334.3	3432.3	3530.4	3628.5	3726.5	3824.6	30
40	3922.7	4020.7	4118.8	4216.9	4314.9	4413.0	4511.1	4609.1	4707.2	4805.3	40
50	4903.3	5001.4	5099.5	5197.5	5295.6	5393.7	5491.7	5589.8	5687.9	5785.9	50
60	5584.0	5982.1	6080.1	6178.2	6276.3	6374.3	6472.4	6570.5	6668.5	6766.6	60
70	6864.7	6962.7	7060.8	7158.9	7256.9	7355.0	7453.1	7551.1	7649.2	7747.3	70
80	7845.3	7943.4	8041.5	8139.5	8237.6	8335.7	8433.7	8531.8	8629.9	8727.9	80
90	8826.0	8924.1	9022.1	9120.2	9218.3	9316.3	9414.4	9512.5	9610.5	9708.6	90
100	9806.7	9904.7	10002.8	10100.8	10198.9	10297.0	10395.0	10493.1	10591.2	10689.2	100

KILO-PASCALS TO KILOGRAMS PER SQUARE CENTIMETER

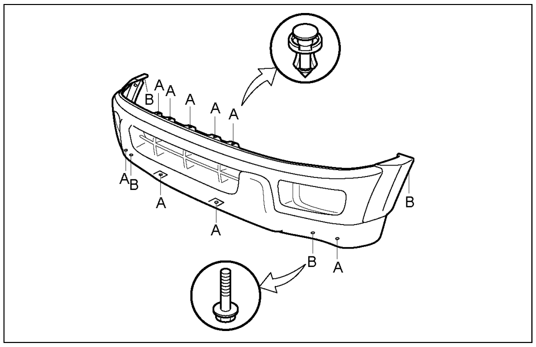
KPa	0	100	200	300	400	500	600	700	800	900	KPa
	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	kg/cm^2	
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	-
1000	10.197	11.217	12.237	13.256	14.276	15.296	16.316	17.335	18.355	19.375	1000
2000	20.394	21.414	22.434	23.453	24.473	25.493	26.513	27.532	28.552	29.572	2000
3000	30.592	31.611	32.631	33.651	34.670	35.690	36.710	37.730	38.749	39.769	3000
4000	40.789	41.809	42.828	743.848	44.868	45.887	46.907	47.927	48.947	49.966	4000
5000	50.986	52.006	53.025	54.045	55.065	56.085	57.104	58.124	59.144	60.163	5000
6000	61.183	62.203	63.223	64.242	65.262	66.282	67.302	68.321	69.341	70.361	6000
7000	71.380	72.400	73.420	74.440	75.459	76.479	77.499	78.518	79.538	80.558	7000
8000	81.578	82.597	83.617	84.637	85.656	86.676	87.696	88.716	89.735	90.755	8000
9000	91.775	92.794	93.814	94.834	95.854	96.873	97.893	98.913	99.933	100.952	9000
10000	101.972	102.992	104.011	105.031	106.051	107.071	108.090	109.110	110.130	111.149	10000

Important Operations - Removal

1. Front Combi Lamp Assembly

2. Radiator Grille

Refer to the Radiator Grille in this section.



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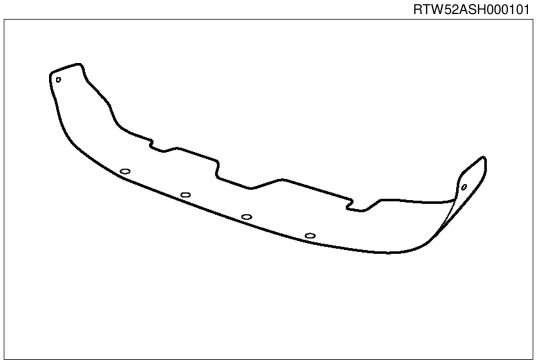
3. Front Bumper Fascia

- Remove the 9 clips and 4 screws.
- Disconnect the fog light harness connectors.



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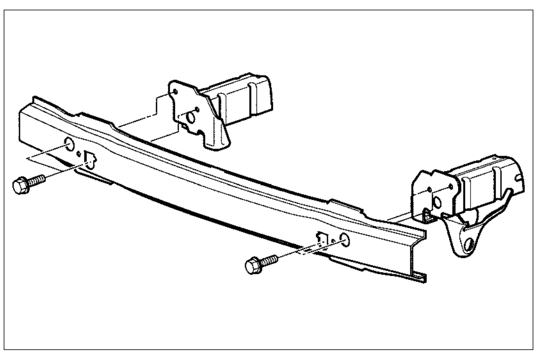
6. Bumper Seal

Remove 6 clips.

Important Operations - Installation



10.Front Bumper Impact Bar Assembly

Tighten the fixing bolts to the specified torque.

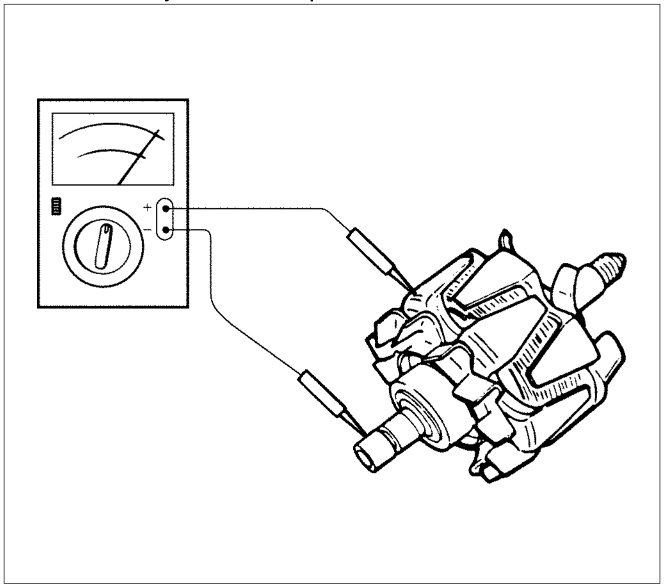
Torque	N·m(kgf·m/lb·ft)
62 (6.3 / 46)	

7. Front Bumper Flare Assembly

Tighten the fixing nuts to the specified torque.

Torque	N·m(kgf·m/lb·in)
7 (0.7 / 61)	

4. Check for conductivity between the slip rings and the rotor core. If there is continuity, the rotor assembly must be replaced.



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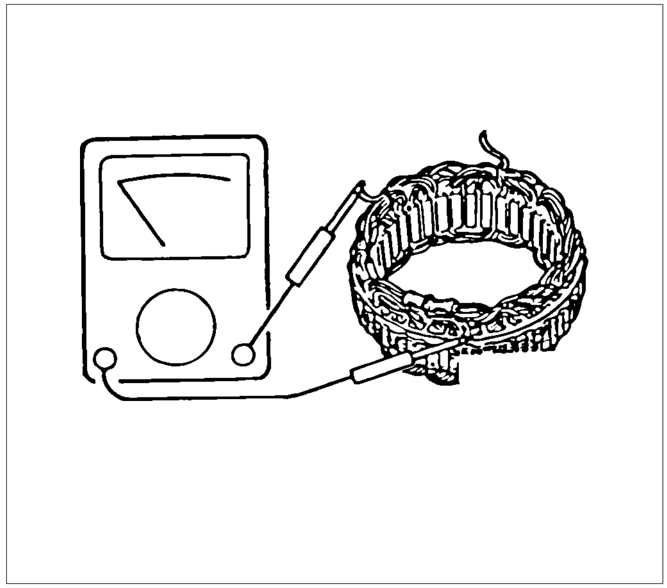
Stator coil/core resistance MΩ

1



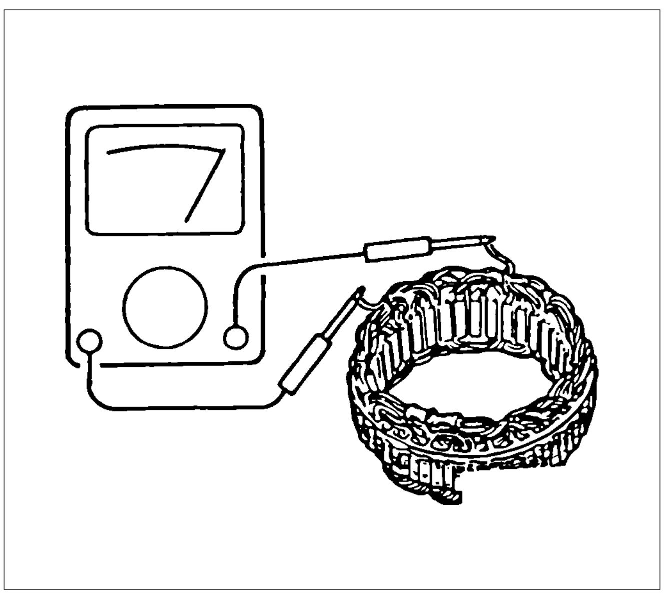
066RS035

Stator Coil

1. Measure the stator coil resistance. If the resistance is less than the specified value, the stator coil must be replaced.

Stator coil resistance

0.07Ω at 20°C (68°F)



066RS034

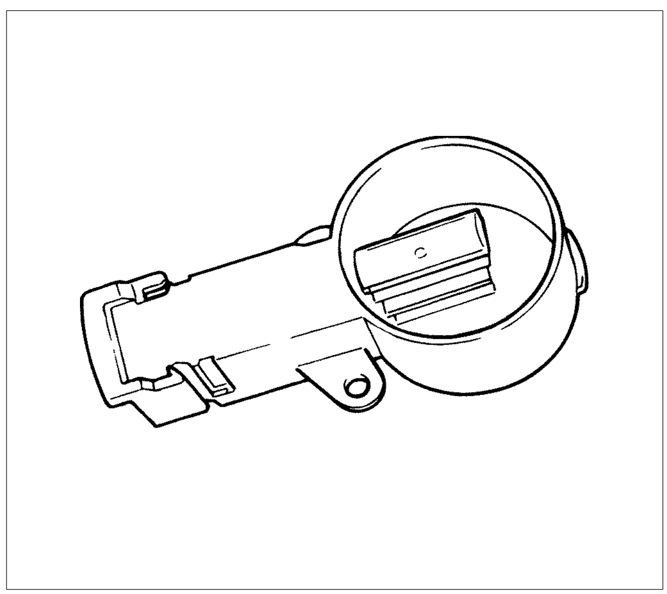
2. Measure the resistance between the stator coil and the stator core. If the resistance is less than the specified value, the stator coil must be replaced.

Brushes

Measure the brush height. If the height is less than the specified limit, the brushes must be replaced.

Brush height mm (in)

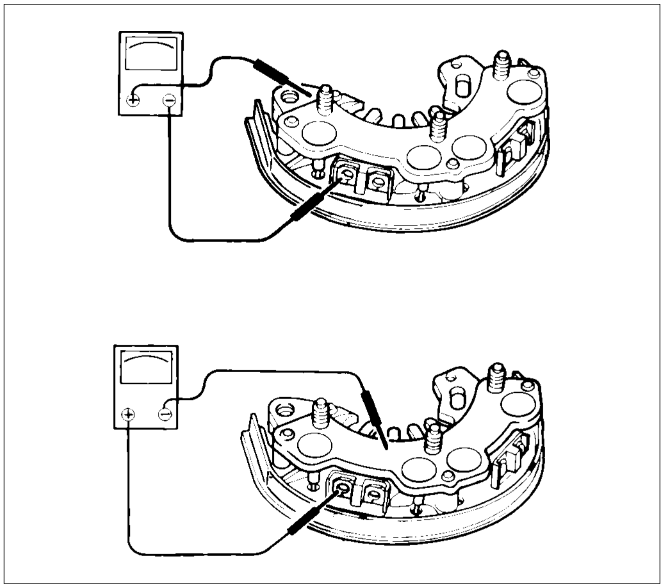
Standard	18 (0.709)
Limit	5.5 (0.217)



066RW024

Rectifier

Measure each of the diode resistances in both directions (anode/cathode and cathode/anode). If any of the diodes have the same resistance in both directions, the rectifier must be replaced.



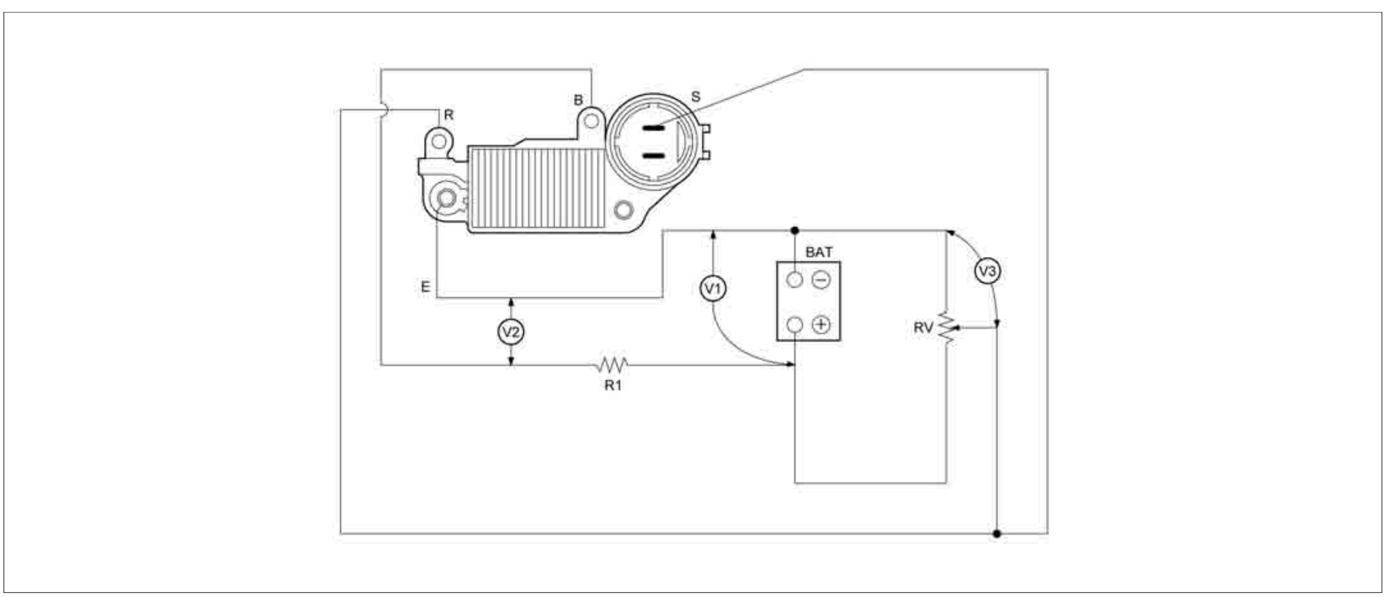
066RS036

Regulator Assembly

There are 3 checkpoints (12V batteries, 10 ohms 3W resistor, 0-50V/0.5V steps, and 300 ohms 12W variable resistor). Refer to the schematic below.

Measuring Procedure

1. Measure the voltage (BAT) at the V1 checkpoint. A 10-13 volt reading indicates that the BAT battery is good.
2. Measure the voltage at checkpoints V1 and V2 as you gradually increase the resistance of the variable resistor from 0. The voltage at V1 should change with the voltage at V2. If it does not, the regulator is damaged and must be replaced.
3. Measure the voltage at checkpoint V3 with the variable resistor setting fixed. If the measured voltage is 14.4 ± 0.3, the regulator is good. If the measured voltage is outside this range, the regulator is damaged and must be replaced.



RTW56DMF000301

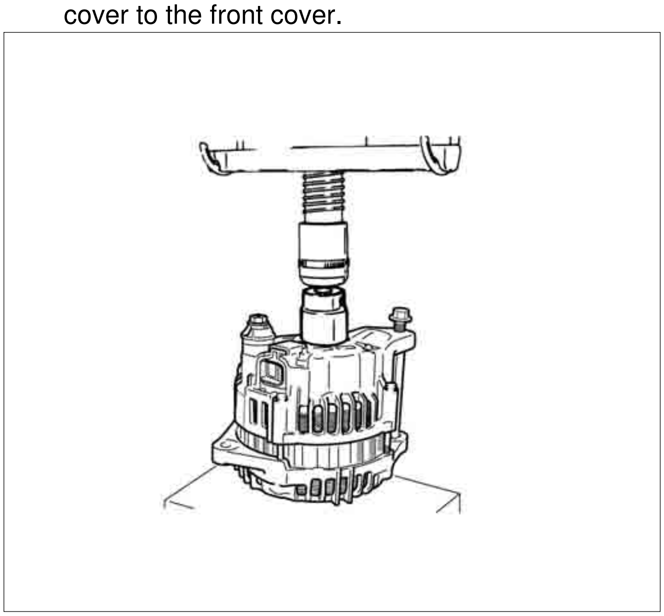
Reassembly

Follow the disassembly steps in reverse order to reassemble the generator. Pay close attention to the items below.

- Be very careful not to reverse battery polarity. Reversed battery polarity will destroy the rectifier diodes.
- Do not ground the generator B-terminal. Heat and fire damage to the harness will result.
- If using a fast charge procedure, be sure to disconnect the battery positive cable. If you do not, the rectifier diodes will be exposed to high positive voltage that will destroy them.
- Be very careful to reassemble the parts to their original positions. Particular care must be taken with insulated parts.
- Carefully clean all insulated parts so that they are completely free of oil and/or grease.
- Be sure that B-terminal twist-type stoppers (round terminal) are securely inserted before tightening the nuts.

Final Assembly

1. Use a bench press to install the rotor and rear cover to the front cover.

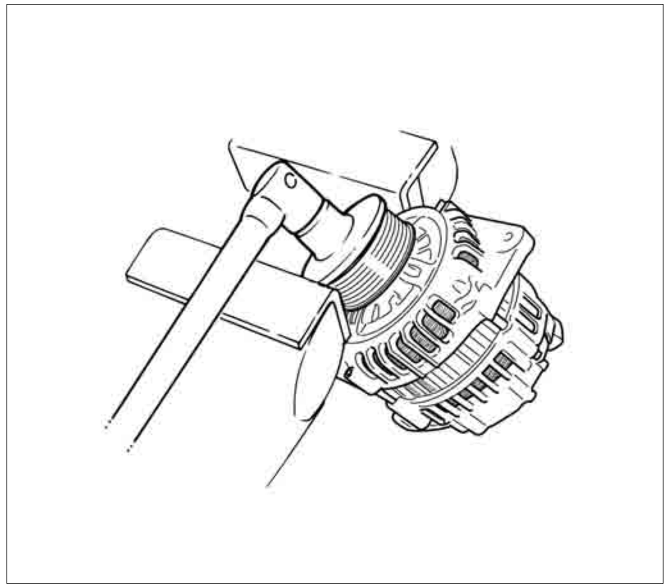


RTW56DSH000201

2. Install the pulley to the rotor shaft and tighten the bolt to the specified torque.

Pulley bolt torque N·m (kg·m / lb ft)

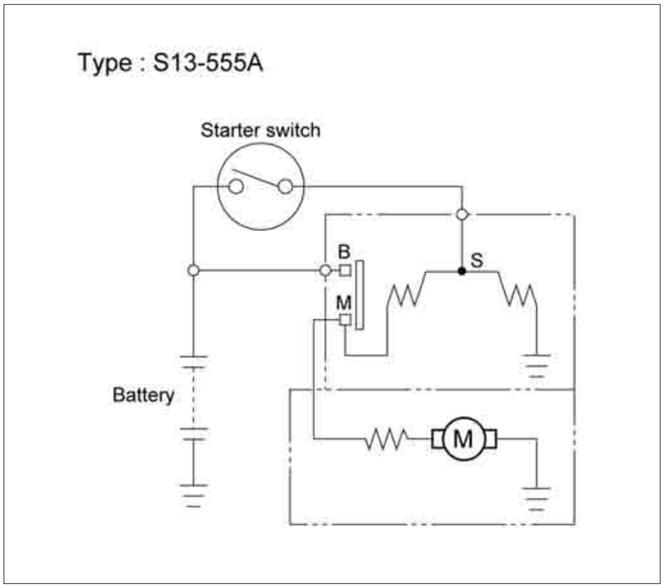
111 (11.3 / 81.7)



RTW56DSH000101

Starter Motor

Starting Circuit Diagram



RTW46DSH005501

Removal and Installation

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Important Operations - Removal

Starter Motor

1. Disconnect the battery cable and the ground cable at the battery terminals.
2. Remove the A/T oil level gage.
3. Remove the Engine oil level gage.
4. Disconnect the magnetic switch cable at the terminal bolts.
5. Disconnect the battery cable at the starter motor and the ground cable at the cylinder body.
6. Remove the starter motor from the engine.

Important Operations – Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

Starter Motor

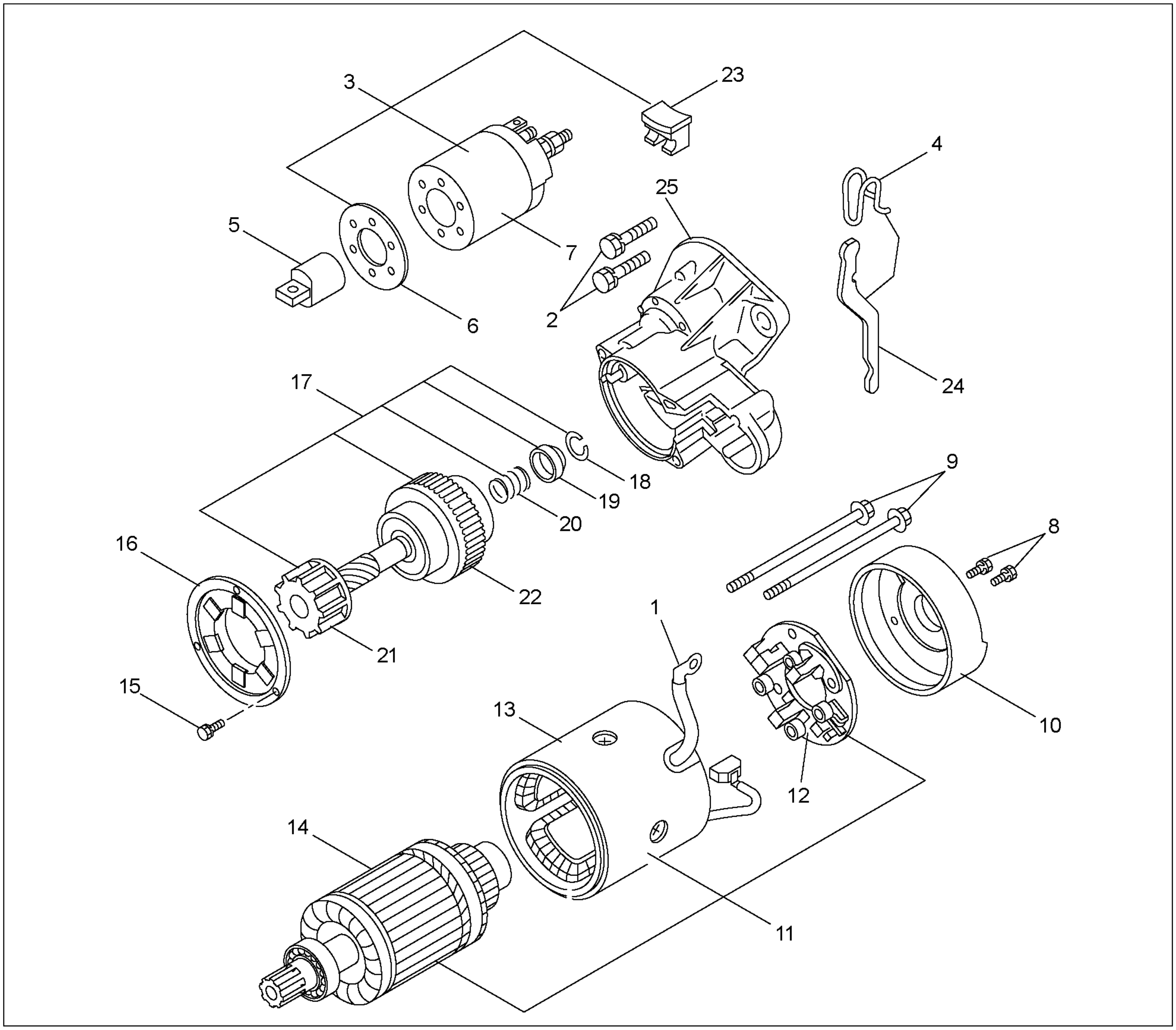
1. Install the starter motor to the rear plate.
2. Tighten the starter motor bolts to the specified torque.

Starter Motor Bolt Torque N·m (kg·m/lb ft)

85 (8.7 / 63)

3. Install the Engine oil level gage.
4. Install the A/T oil level gage.
5. Reconnect the battery cable at the starter motor and the ground cable at the cylinder body.
6. Reconnect the battery cable and the ground cable at the battery terminals.

Disassembly



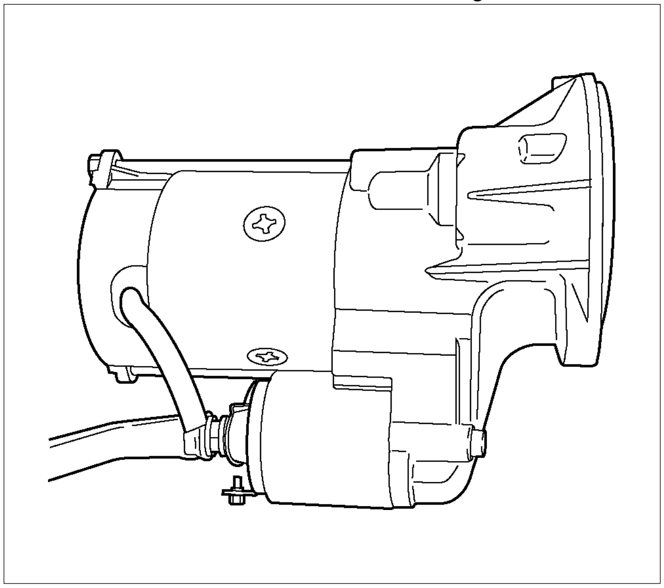
RTW460LF000201

Disassembly Steps

1. Lead Wire
2. Bolt
3. Magnetic Switch Assembly
4. Torsion Spring
5. Plunger
6. Dust Cover
7. Magnetic Switch
8. Screw
9. Through Bolt
10. Rear Cover
11. Motor Assembly
12. Brush Holder
13. Yoke
14. Armature
15. Bolt
16. Bearing Retainer
17. Pinion Assembly
18. Pinion Stopper Clip
19. Pinion Stopper
20. Return Spring
21. Pinion Shaft
22. Clutch
23. Dust Cover
24. Shift Lever
25. Gear Case

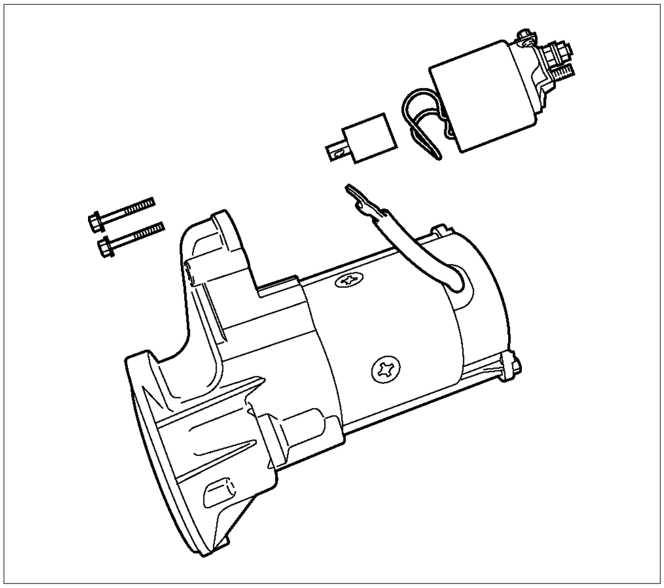
Important Operations

1. Lead Wire
   Disconnect the lead wire at the magnetic switch.



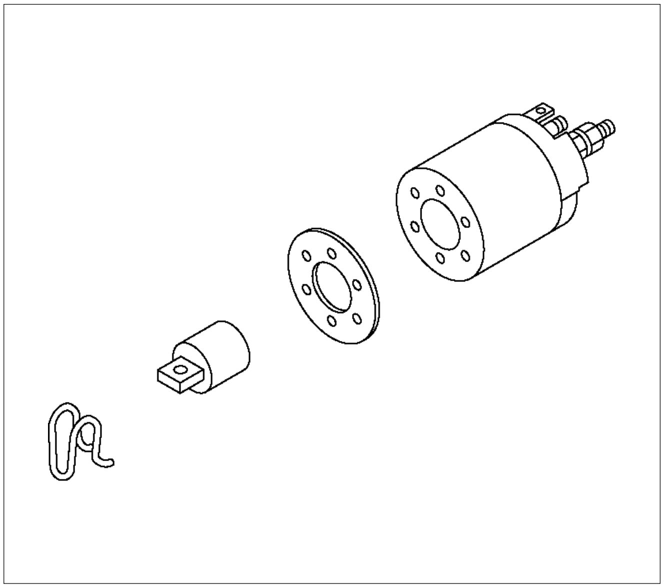
RTW46DSH002601

2. Magnetic Switch Assembly
   Remove the magnetic switch bolts, then remove the switch from the shift lever.



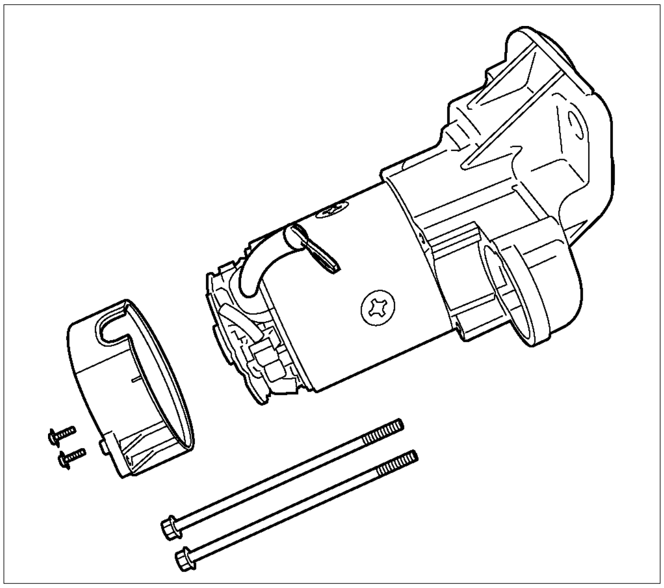
RTW46DSH002701

Remove the torsion spring from the magnetic switch.



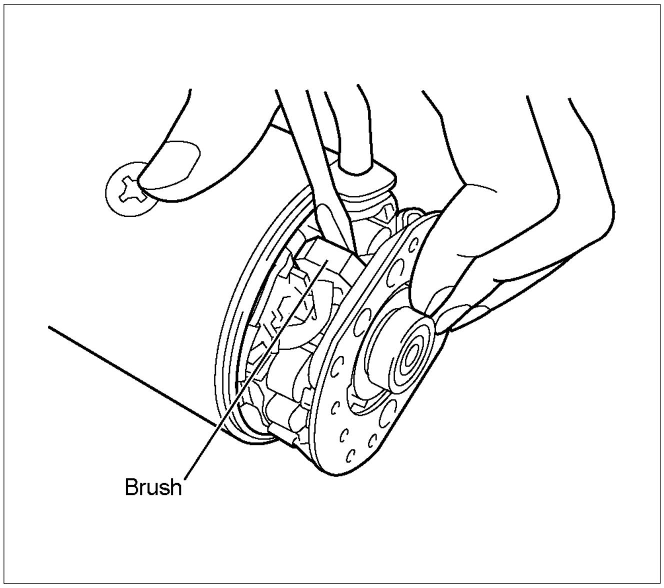
RTW46DSH002801

3. Through Bolt
4. Screw
5. Rear Cover
   Remove the through bolts, then remove the rear cover.



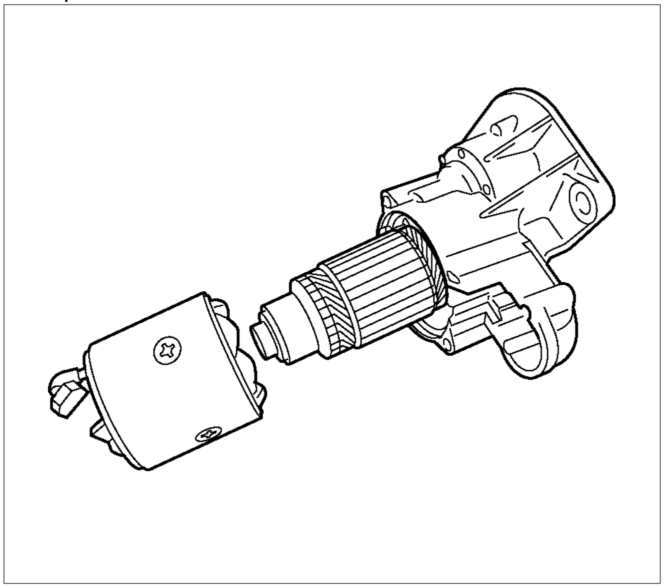
RTW46DSH002901

6. Motor Assembly
   Remove the four brushes from the brush holders.

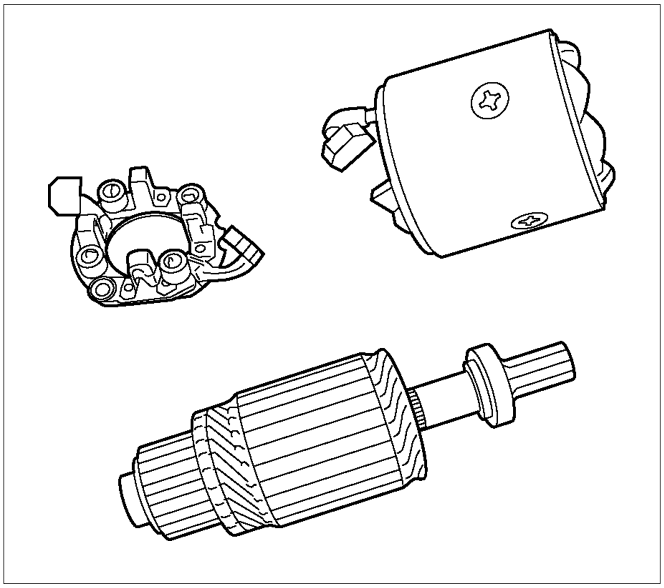


RTW46DSH003001

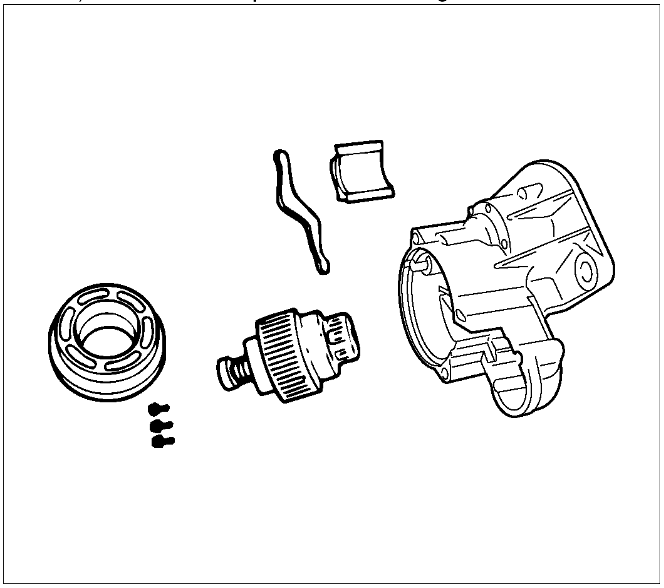
   Remove the yoke along with the armature and the brush holder from the gear case.
   Remove the brushes and commutator carefully so as not to allow them in contact with the adjacent parts.


RTW46DSH003101

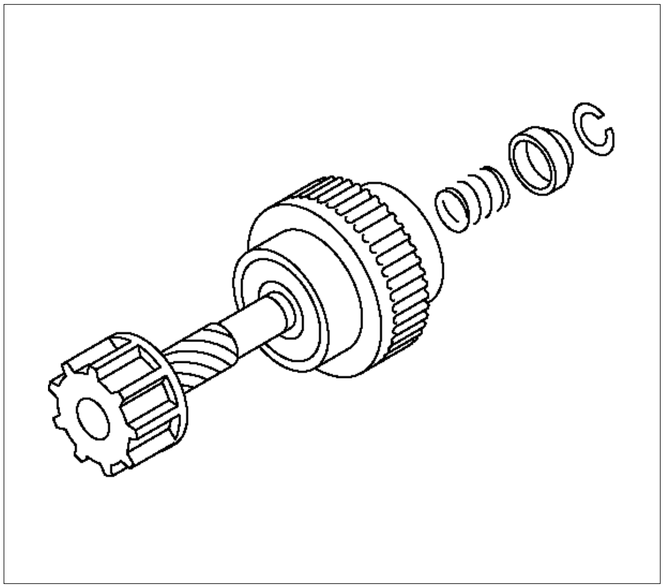
7. Brush Holder
8. Yoke
9. Armature
   Remove the brush holder and pull out the armature assembly free from the yoke.


RTW46DSH003201

10. Bearing Retainer
11. Pinion Assembly
12. Dust Cover
13. Shift Lever
14. Gear Case
    1) Remove the bearing retainer.
    2) Remove the pinion from the gear case.


RTW46DSH003301

    3) Use a screwdriver to remove the stopper clip. Then disassemble the pinion assembly.



RTW46DSH003401

Inspection and Repair

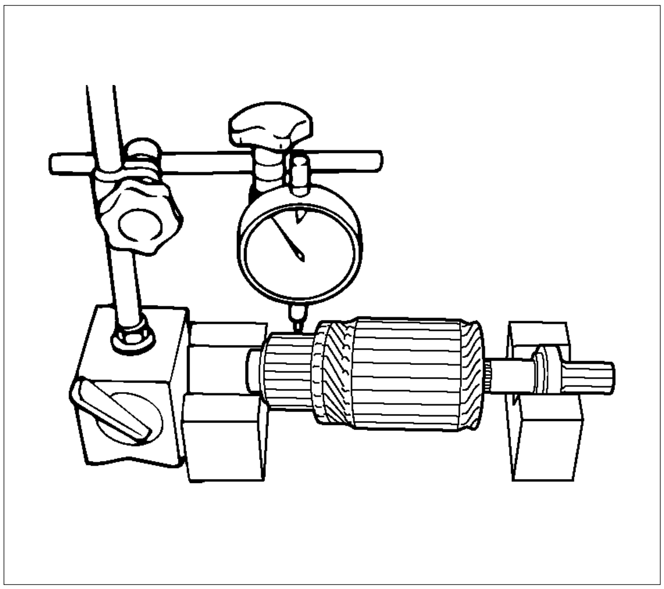
Make the necessary adjustments, repairs, and part replacement if excessive wear or damage is discovered during inspection.

Armature

1. Measure the commutator run-out. Replace the commutator if the measured run-out exceeds the specified limit.

Commutator Run-Out mm (in)

Standard	Limit
0.05 (0.002)	0.25 (0.010)



RTW46DSH003501

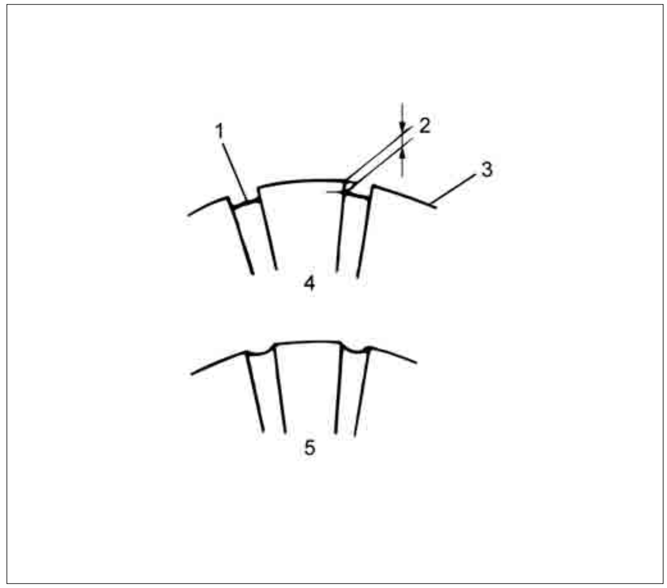
2. Check the commutator mica segments for excessive wear.
3. Measure the mica segment depth.

Mica Segment Depth mm (in)

Standard	Limit
0.5 - 0.8 (0.020 - 0.030)	0.2 (0.008)

If the mica segment depth is less than the standard but more than the limit, the commutator may be reground.

If the mica segment depth is less than the limit, the commutator must be replaced.



RTW56DSH000701

Legend

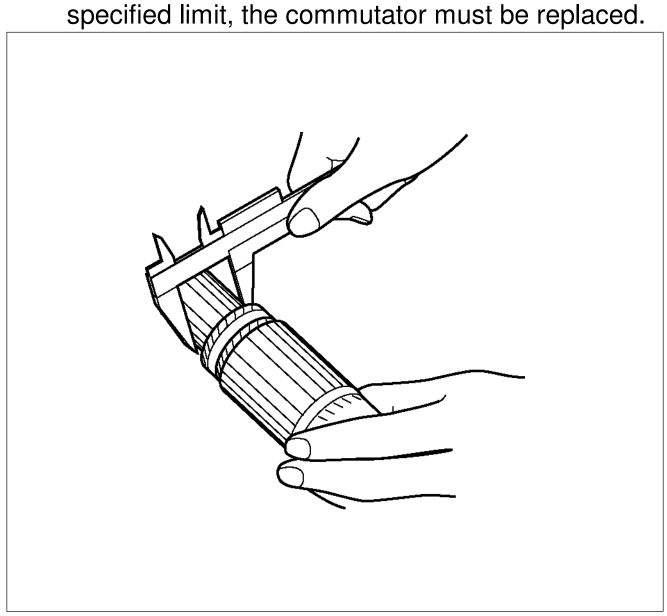
1. Insulator
2. 0.5 - 0.8 mm (0.020 - 0.030 in)
3. Commutator Segments
4. Correct
5. Incorrect

4. Measure the commutator outside diameter.

Commutator Outside Diameter mm (in)

Standard	Limit
36.5 (1.44)	35.5 (1.40)

If the measured outside diameter is less than the specified limit, the commutator must be replaced.

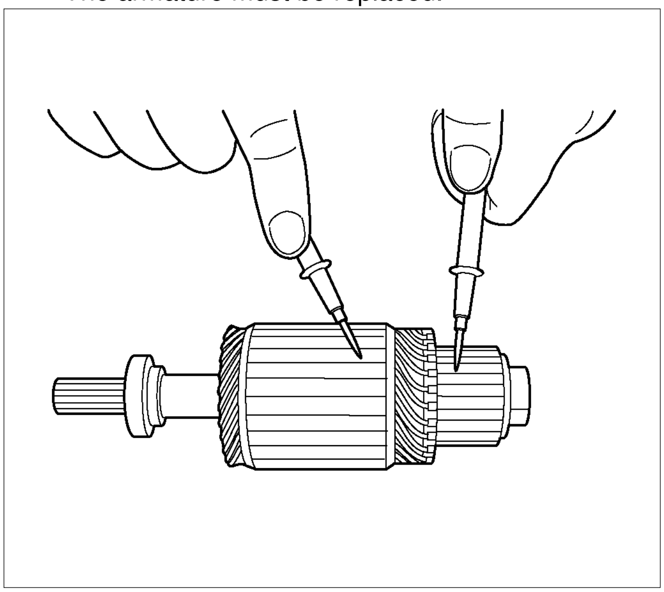


HCW51ESH000901

5. Use a circuit tester to check the armature for grounding.
   1) Hold one probe of the circuit tester against the commutator segment.
   2) Hold the other circuit tester probe against the armature core.

   If the circuit tester indicates continuity, the armature is grounded.

   The armature must be replaced.

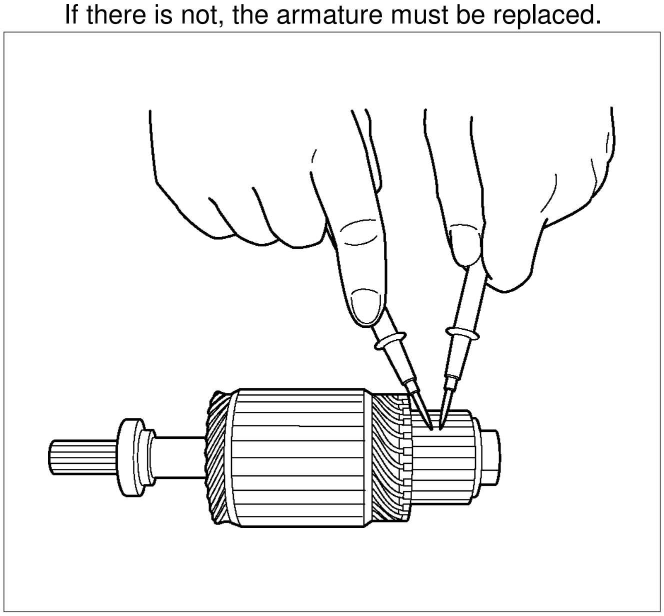


RTW46DSH003601

6. Use the circuit tester to check the armature for continuity.
   1) Hold the circuit tester probes against two commutator segments.
   2) Repair Step 1 at different segments of the armature core.

   There should be continuity between all segments of the commutator.

   If there is not, the armature must be replaced.

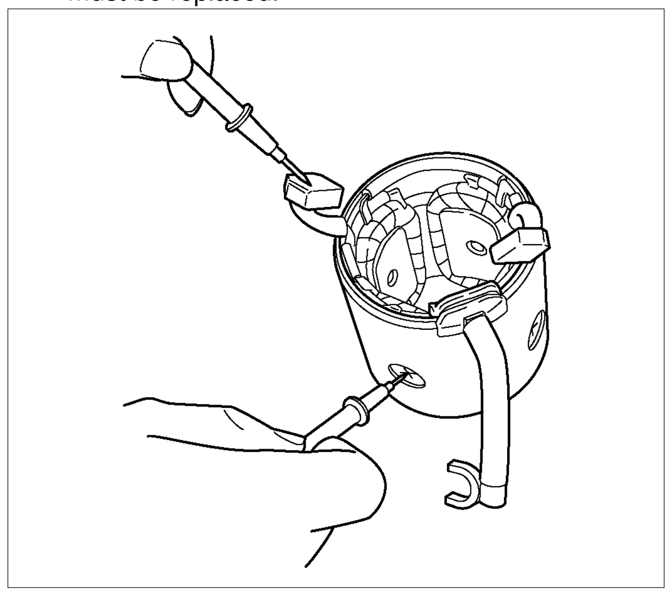


RTW46DSH003701

Yoke

1. Use a circuit tester to check the field winding ground.
   1) Hold one circuit tester probe against the field winding end or brush.
   2) Hold the other circuit tester probe against the bare surface of the yoke body.

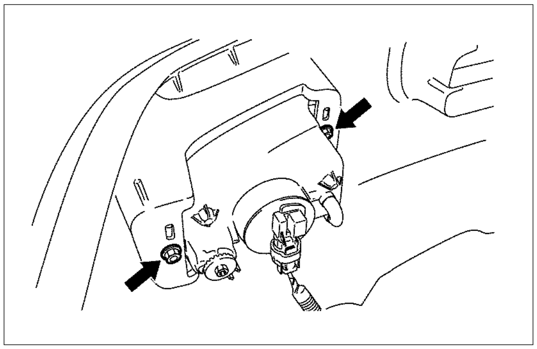
   There should be no continuity. If there is continuity, the field coil is grounded. The yoke must be replaced.



RTW46DSH003801

2. Use the circuit tester to check the field winding continuity.
   1) Hold one circuit tester probe against the “M” terminal lead wire.
   2) Hold the other circuit tester probe against the field winding brush.

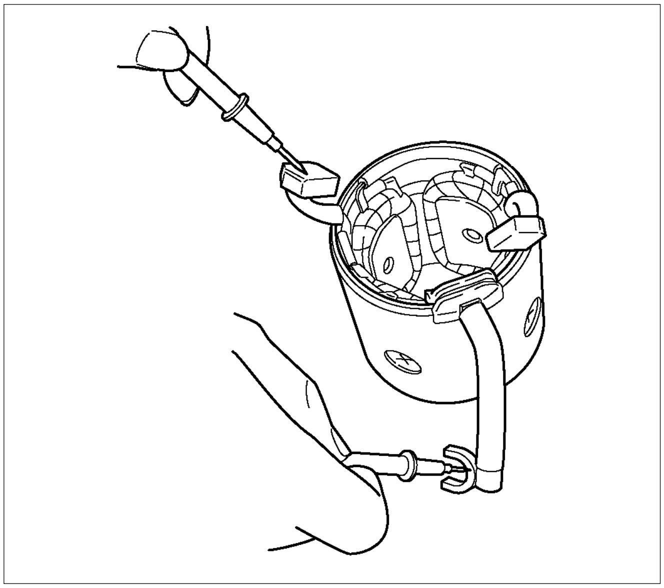
   There should be continuity.If there is no continuity, the yoke must be replaced.



5. Fog Light

Tighten the fixing nuts to the specified torque.

Torque	N·m(kgf·m/lb·in)
7 (0.7 / 61)	

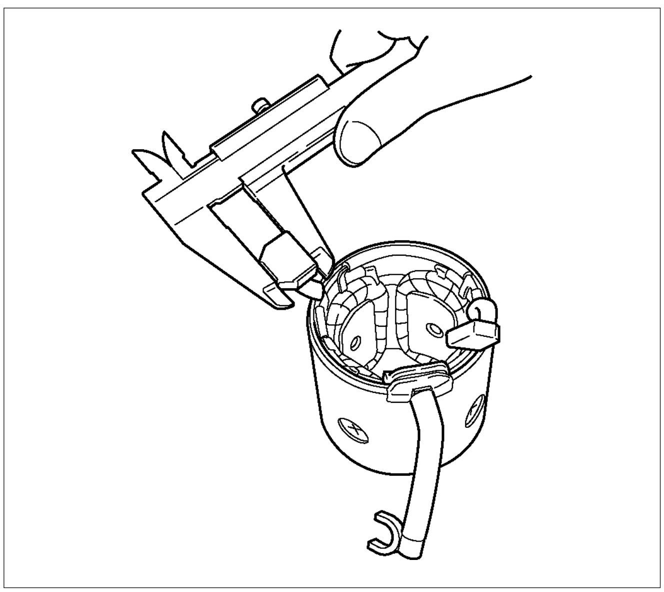

RTW46DSH003901

Brush and Brush Holder

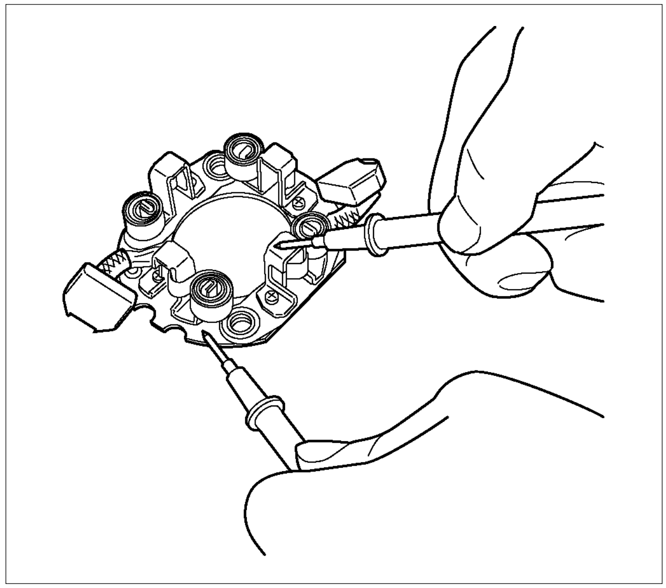
1. Use a vernier caliper to measure the brush length (four brushes).
   Replace the brushes as a set if one or more of the brush lengths is less than the specified limit.

Brush Length mm (in)

Standard	Limit
15 (0.59)	12 (0.47)


RTW46DSH004001

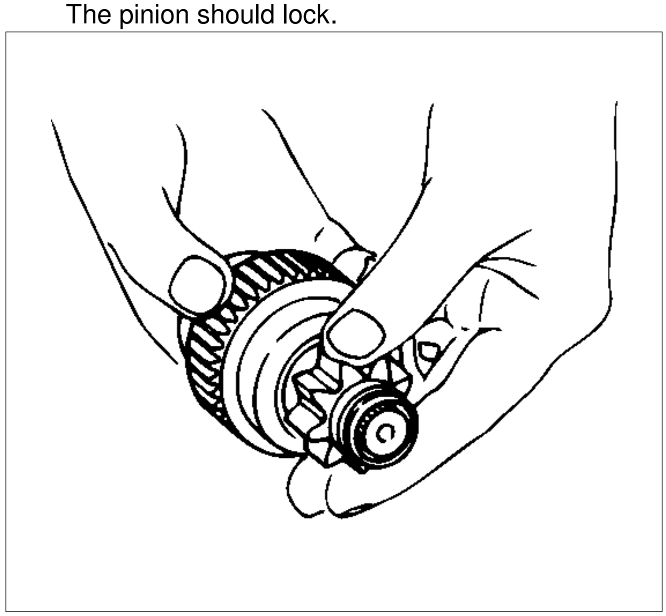
2. Use a circuit tester to check the brush holder insulation.
   Touch one probe to the holder plate and the other probe to the positive brush holder.
   There should be no continuity.


RTW46DSH004101

3. Inspect the brushes for excessive wear.
   If the negative brushes have excessive wear, the entire brush holder assembly must be replaced.
   If the positive brushes have excessive wear, the entire yoke must be replaced.

Overrunning Clutch

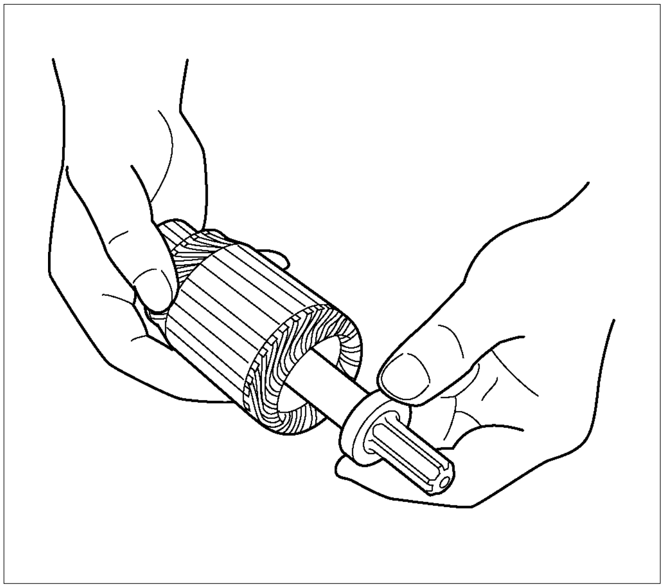
1. Inspect the overrunning clutch gear teeth for excessive wear and damage.
   Replace the overrunning clutch if necessary.
2. Rotate the pinion clockwise.
   It should turn smoothly.
3. Try to rotate the pinion in the opposite direction.
   The pinion should lock.


065RY00035

Bearing

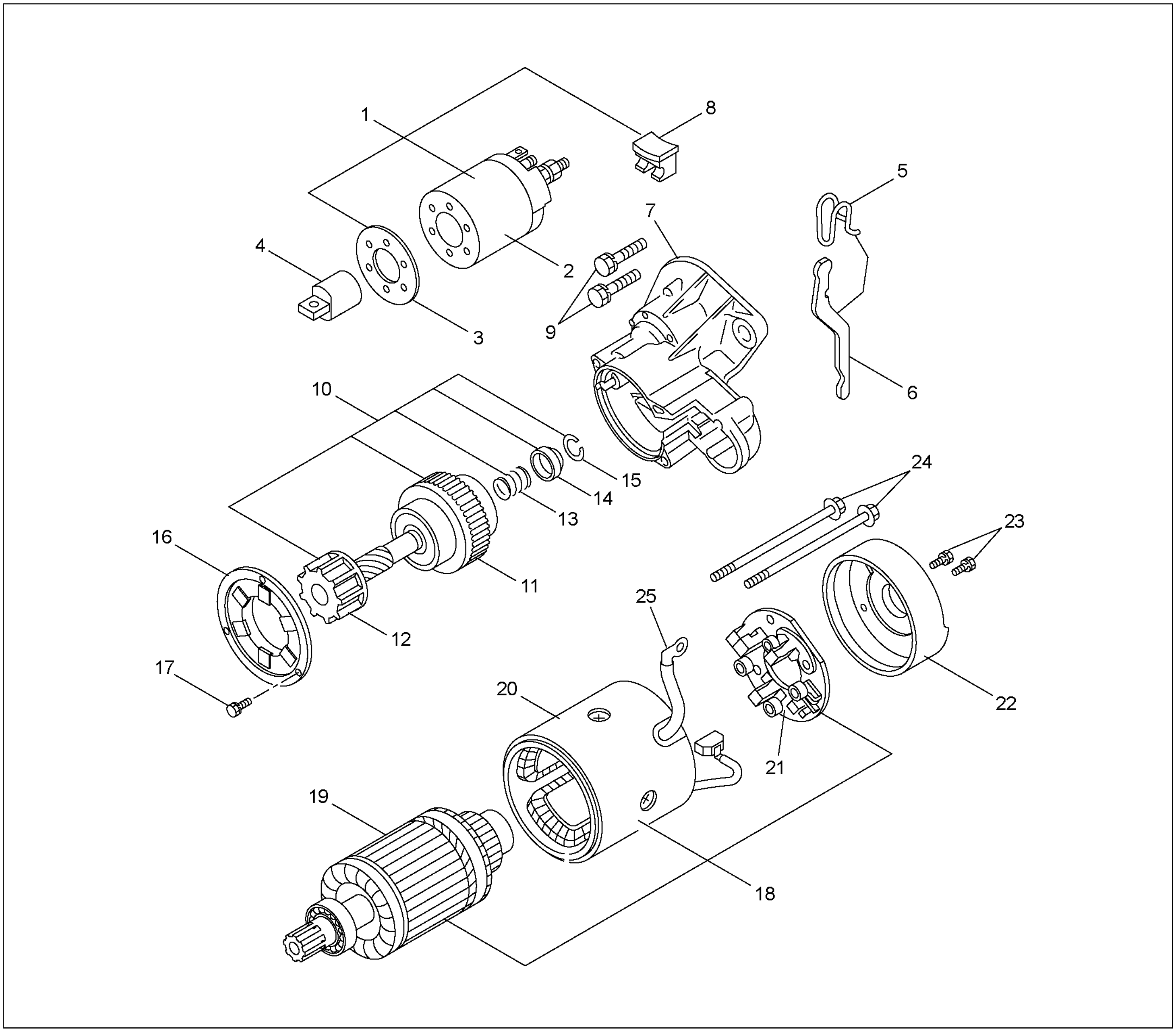
Inspect the bearings for excessive wear and damage.

Replace the bearings if necessary.



RTW46DSH004401

Reassembly



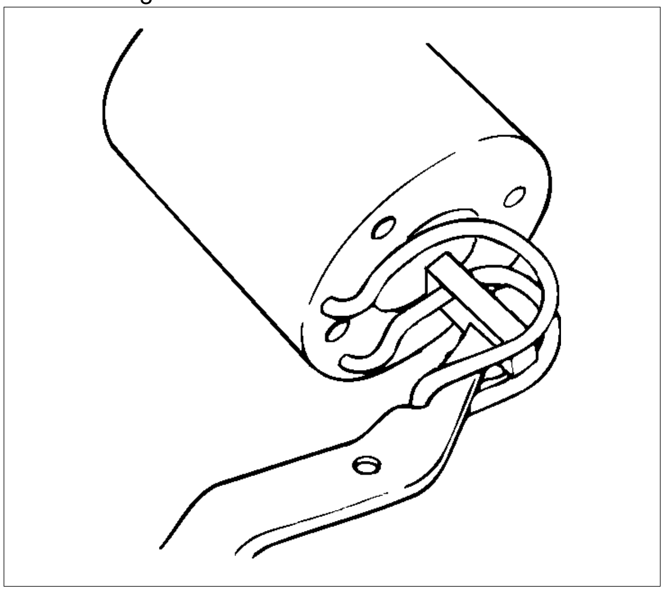
RTW46DLF000601

Reassembly Steps

1. Magnetic Switch Assembly
2. Magnetic Switch
3. Dust Cover
4. Plunger
5. Torsion Spring
6. Shift Lever
7. Gear Case
8. Dust Cover
9. Bolt
10. Pinion Assembly
11. Clutch
12. Pinion Shaft
13. Return Spring
14. Pinion Stopper
15. Pinion Stopper Clip
16. Bearing Retainer
17. Bolt
18. Motor Assembly
19. Armature
20. Yoke
21. Brush Holder
22. Rear Cover
23. Screw
24. Through Bolt
25. Lead Wire

Important Operations

1. Magnetic Switch Assembly
   1) Attach the torsion spring to the hole in the magnetic switch as illustrated.
   2) Insert the shift lever into the plunger hole of the magnetic switch.

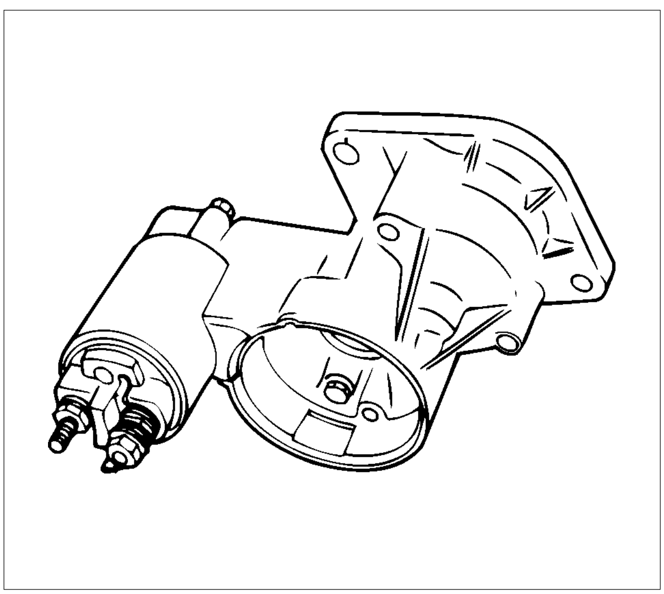


RTW46DSH005601

2. Gear Case
3. Dust Cover
   1) Install the magnetic switch assembly in the gear case.
   2) Install the dust cover.

Dust Cover Bolt Torque N·m (kg·m/lb in)

8 (0.8 / 69)



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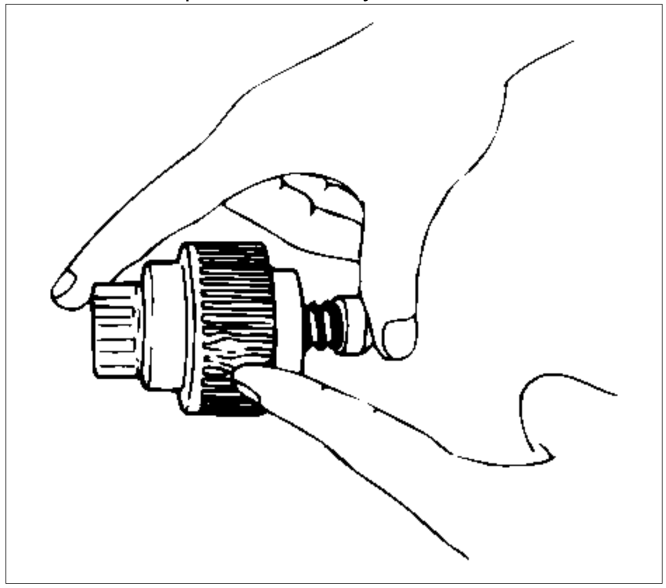
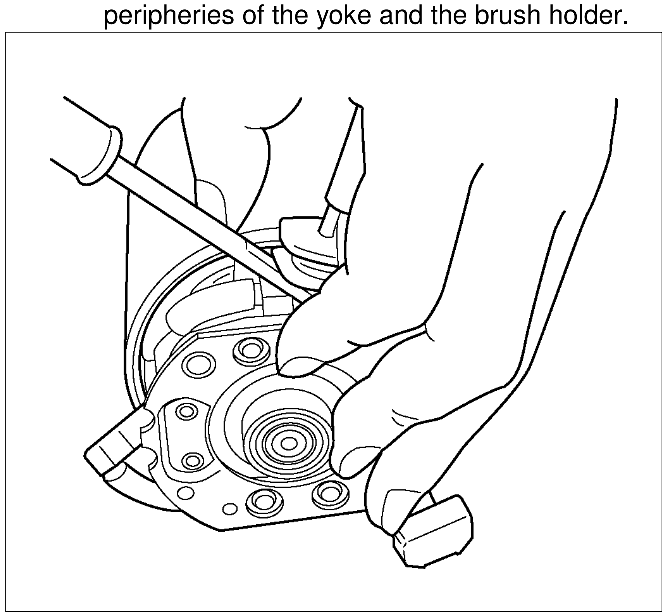
4. Pinion Assembly
   Apply a coat of grease to the reduction gear and install the pinion assembly to the armature shaft.



065RY00041

5. Brush Holders
   1) Install the brushes into the brush holder with raising the spring end of the brush spring.
      Take care not to damage the commutator face.
   2) Install the brush holder with aligning the peripheries of the yoke and the brush holder.

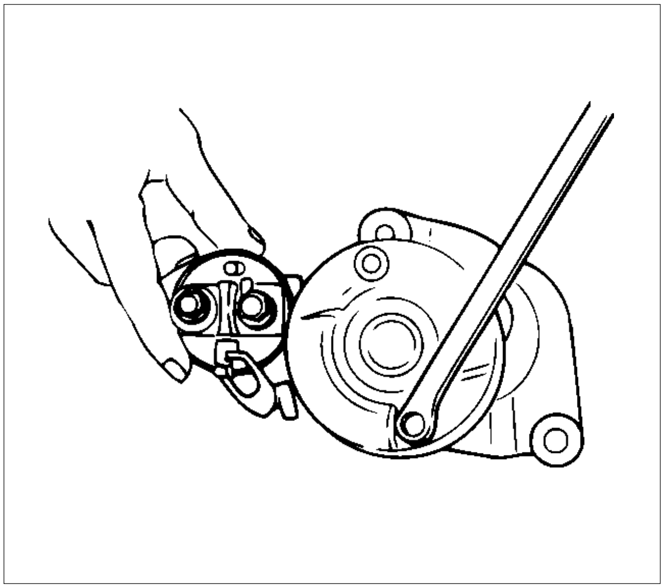


RTW46DSH004501

6. Through Bolt
   Install the through bolts in the rear cover and tighten them to the specified torque.

Through Bolt Torque N·m (kg·m/lb in)

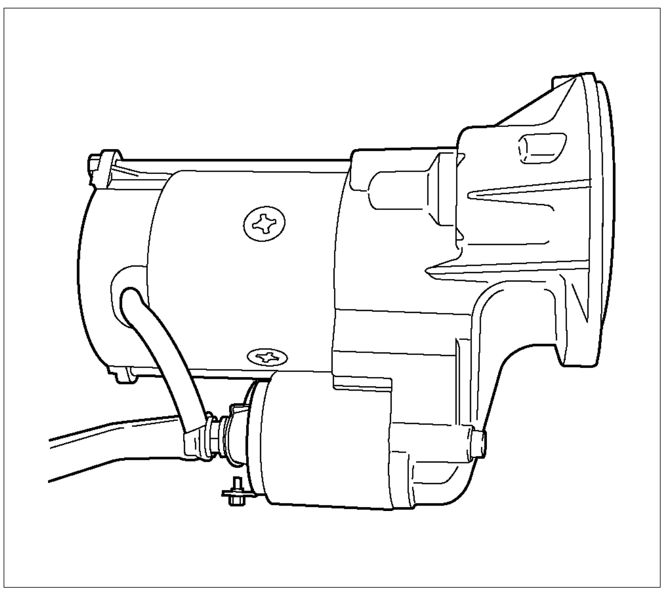
8.1 (0.83 / 69.7)



065RY00044

7. Lead Wire
   Connect the lead wire in the magnetic switch and tighten the terminal nut to the specified torque.

Lead Wire Terminal Nut Torque	N·m (kg·m/lb in)
8.6 (0.88 / 74.9)	



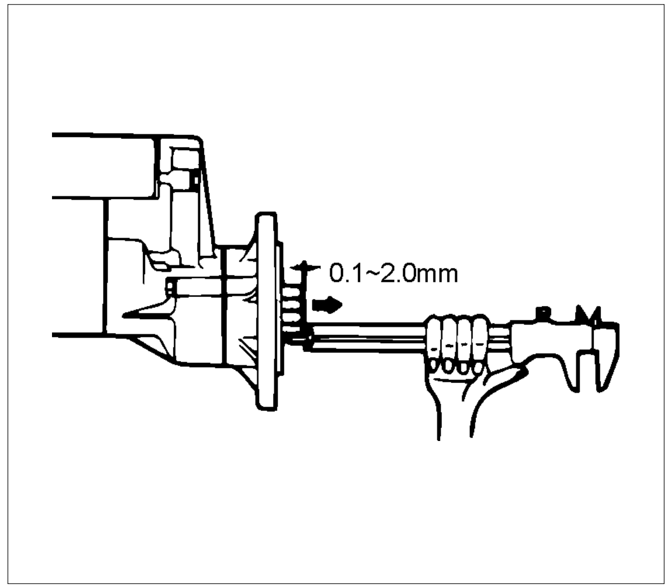
RTW46DSH002601

Inspection After Assembly

Use a vernier caliper to measure the pinion shaft thrust play.

The pinion shaft thrust play is equal to the pinion shaft end and pinion stopper clearance.

Pinion Shaft Thrust Play	mm (in)
0.1 – 2.0 (0.004 – 0.078)	



RTW46DSH005801

Magnetic Switch

The following tests must be performed with the starter motor fully assembled.

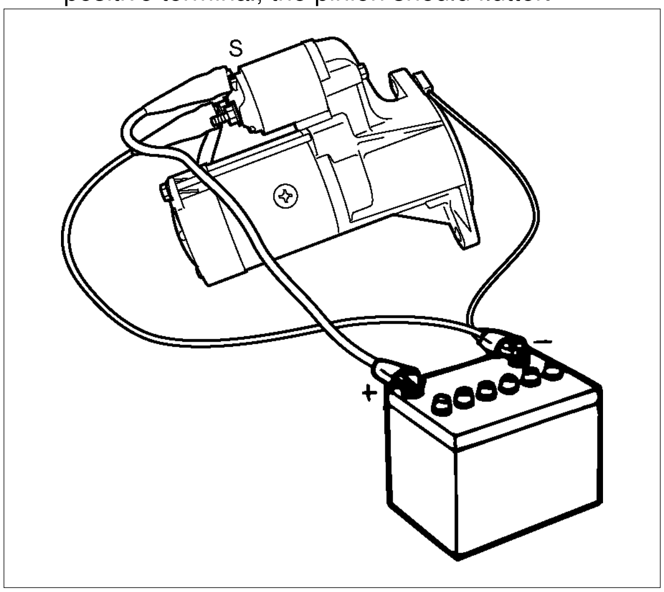
The yoke lead wire must be disconnected from the “M” terminal.

To prevent coil burning, complete each test as quickly as possible (within three to five seconds).

Temporarily connect the solenoid switch between the clutch and the housing and run the following test. Complete each test within three to five seconds.

1. Pull-in Test

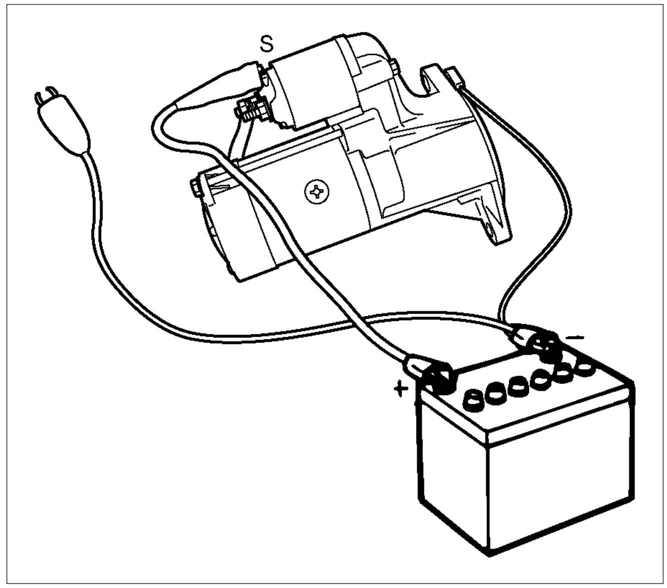
   Connect the battery negative terminal with the solenoid switch body and the M terminal. When current is applied to the S terminal from the battery positive terminal, the pinion should flutter.



RTW46DSH004601

2. Hold-in Maintenance Test

   Disconnect the lead at the M terminal. The pinion should continue to flutter.



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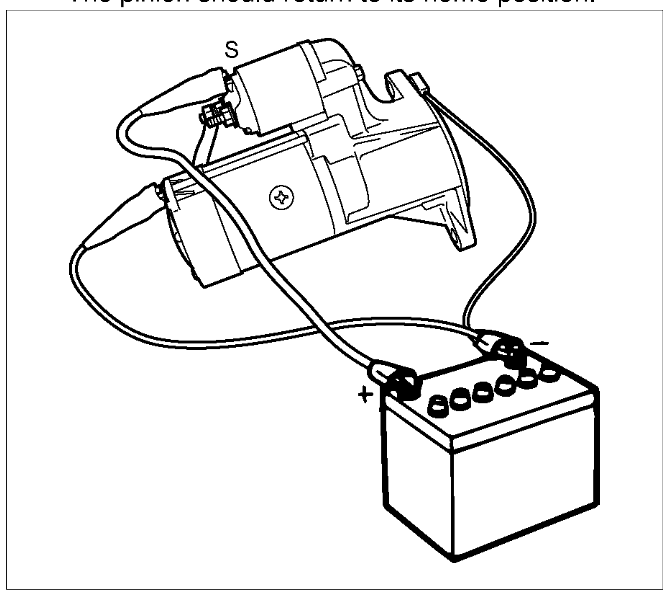
3. Return Test

   Disconnect the battery positive lead at the S terminal.

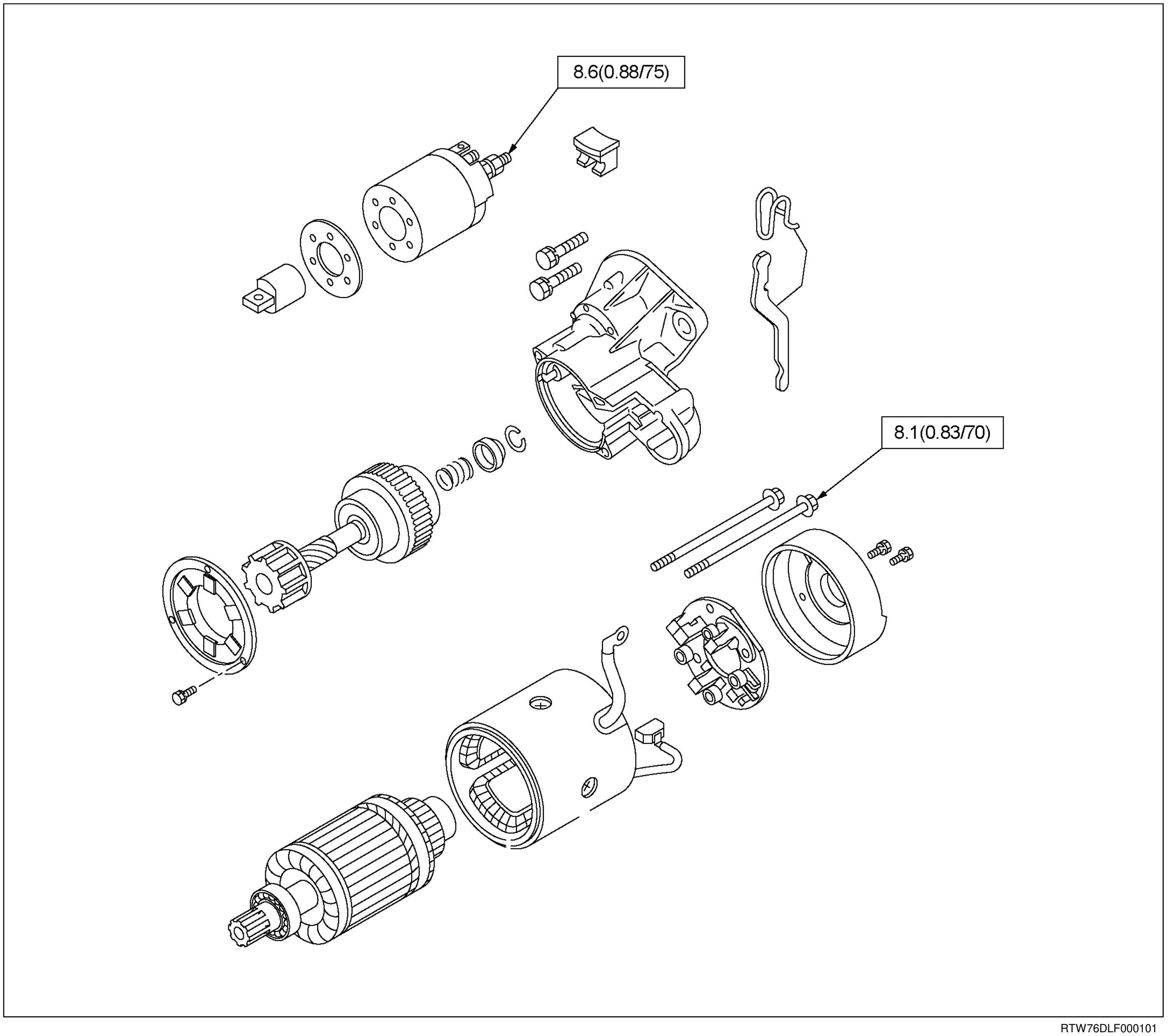
   The pinion should return to its home position.



RTW46DSH004701

Torque Specifications

N·m (kg·m/lb in)



RTW76DLF000101

Pre-Heating System

Inspection and Repair

Make the necessary adjustments, repairs, and part replacement if excessive wear of damage is discovered during inspection.

Visual Check

Check the main fuses and glow indicator for damage.

Replace the part(s) if required.

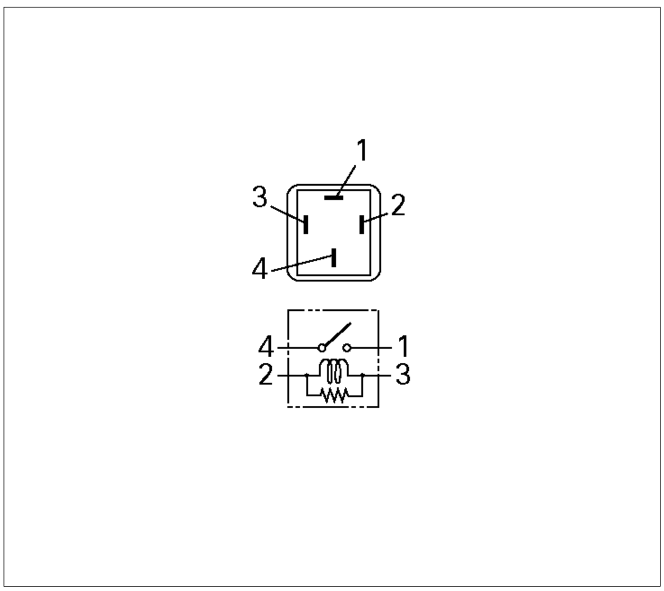
Glow Relay

The glow relay is located in the relay box the engine compartment.

Use an ohmmeter to measure the resistance between terminals No.2 and No.3.

If the measured value is outside the specified range, the glow relay must be replaced.

Glow Relay Resistance	Ohms
94 - 114	



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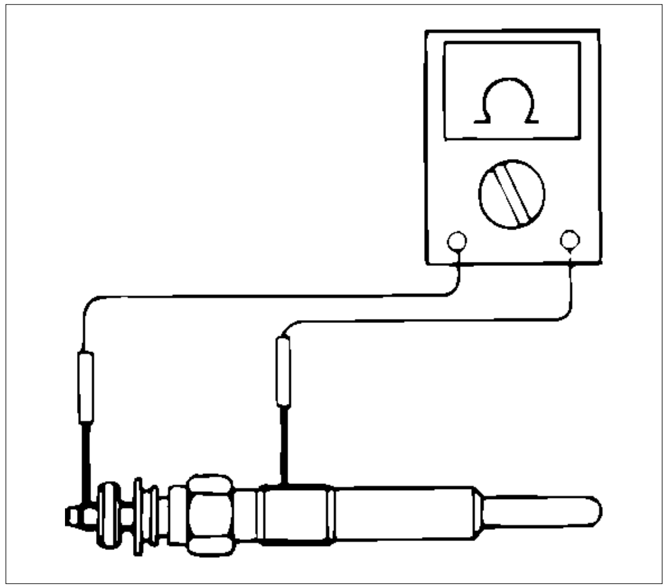
Glow Plug

Use a circuit tester to test the glow plugs for continuity.

Glow Plug Resistance (Reference)	Ohms
Approximately 0.9	



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SECTION 6E

ENGINE CONTROL SYSTEM

(4JK1/4JJ1)

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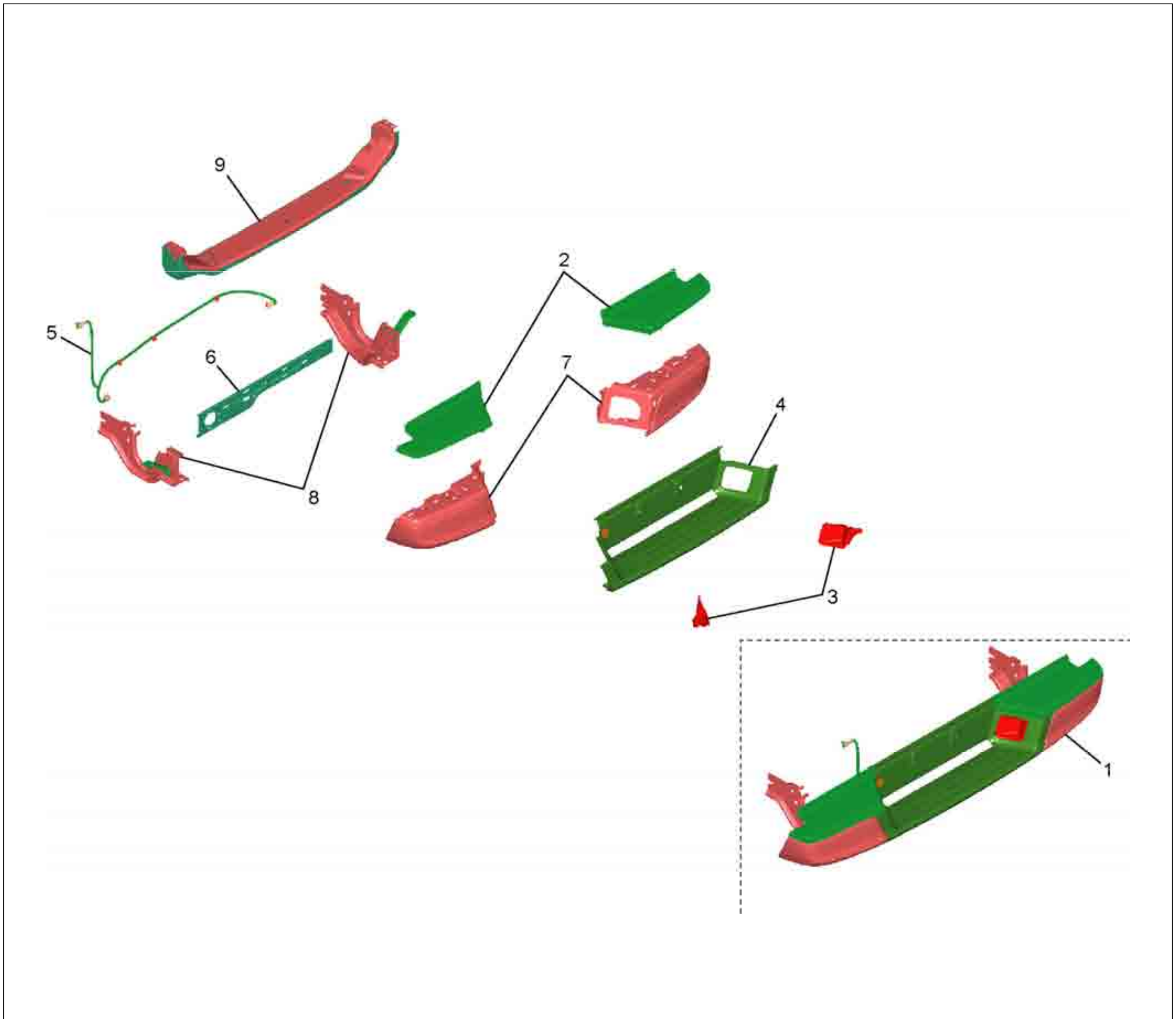
REAR STEP BUMPER

REMOVAL AND INSTALLATION



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Removal Steps

▲ 1. Rear step bumper assembly
▲ 2. Side step pad
3. License plate light
▲ 4. Rear bumper center pad
5. Extension harness
6. Center bar
7. Shell
8. Back bar / corner brace
9. Reinforcement assembly

Installation Steps

▲ 9. Reinforcement assembly
8. Back bar / corner brace
▲ 7. Shell
▲ 6. Center bar
5. Extension harness
4. Rear bumper center pad
3. License plate light
2. Side step pad
▲ 1. Rear step bumper assembly

Specifications

Temperature vs Resistance

Engine Coolant Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
110	230	160
100	212	200
90	194	260
80	176	350
70	158	470
60	140	640
50	122	880
40	104	1250
30	86	1800
20	68	2650
10	50	4000
0	32	6180
-10	14	9810
-20	-4	16000
-30	-22	27000

Intake Air Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
90	194	240
80	176	320
70	158	430
60	140	590
50	122	810
40	104	1150
30	86	1650
20	68	2430
10	50	3660
0	32	5650
-10	14	8970
-20	-4	14700

Fuel Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
110	230	140
100	212	180
90	194	240
80	176	310
70	158	420
60	140	580
50	122	810
40	104	1150
30	86	1660
20	68	2450
10	50	3700
0	32	5740
-10	14	9160
-20	-4	15000
-30	-22	25400

Altitude vs Barometric Pressure

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)
Determine your altitude by contacting a local weather station or by using another reference source.		
4267	14000	56 - 64
3962	13000	58 - 66
3658	12000	61 - 69
3353	11000	64 - 72
3048	10000	66 - 74
2743	9000	69 - 77
2438	8000	71 - 79
2134	7000	74 - 82
1829	6000	77 - 85
1524	5000	80 - 88
1219	4000	83 - 91
914	3000	87 - 98
610	2000	90 - 98
305	1000	94 - 102
0	0 Sea Level	96 - 104
-305	-1000	101 - 105

Diagnostic Trouble Code (DTC) Type Definitions

Emission Related DTC

Action Taken When the DTC Sets - Type A

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Freeze Frame/ Failure Records.

Action Taken When the DTC Sets - Type B

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the ECM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the ECM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/ DTC - Type A or Type B

- The ECM turns OFF the MIL after 3 consecutive driving cycles when the diagnostic runs and does not fail. (Euro 4 Specification)
- The ECM turns OFF the MIL after 1 driving cycle when the diagnostic runs and does not fail. (Except Euro 4 Specification)
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the MIL and the DTC.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The ECM illuminates the Service Vehicle Soon (SVS) lamp when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the SVS Lamp/ DTC - Type C

- The ECM turns OFF the SVS lamp after 1 driving cycle when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the SVS lamp and the DTC.

Action Taken When the DTC Sets - Type D

- The ECM will not illuminate the MIL or SVS lamp.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Failure Records.

Conditions for Clearing the DTC - Type D

- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the DTC.

Diagnostic Trouble Code (DTC) List

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0016	16	C	A	A	Crankshaft Position - Camshaft Position Correlation
P0045	33	A	A	-	Turbocharger Boost Control Solenoid Circuit
P0087	225	A	A	A	Fuel Rail/ System Pressure Too-Low
P0088	118	A	A	A	Fuel Rail/ System Pressure Too-High (First Stage)
P0088	118	C	A	A	Fuel Rail/ System Pressure Too-High (Second Stage)
P0089	151	A	A	A	Fuel Pressure Regulator Performance
P0091	247	A	A	A	Fuel Pressure Regulator Control Circuit Low
P0092	247	A	A	A	Fuel Pressure Regulator Control Circuit High

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0093	227	A	A	A	Fuel System Leak Detected
P0101	92	A	-	-	Mass Air Flow Sensor Circuit Range/ Performance
P0102	91	A	A	A	Mass Air Flow Sensor Circuit Low Input
P0103	91	A	A	A	Mass Air Flow Sensor Circuit High Input
P0107	32	A	A	-	Manifold Absolute Pressure Sensor Circuit Low Input
P0108	32	A	A	-	Manifold Absolute Pressure Sensor Circuit High Input
P0112	22	A	A	A	Intake Air Temperature Sensor Circuit Low
P0113	22	A	A	A	Intake Air Temperature Sensor Circuit High
P0116	23	A	-	-	Engine Coolant Temperature Sensor Circuit Range/ Performance
P0117	23	A	A	A	Engine Coolant Temperature Sensor Circuit Low
P0118	23	A	A	A	Engine Coolant Temperature Sensor Circuit High
P0122	43	B	A	A	Throttle Position Sensor Circuit Low
P0123	43	B	A	A	Throttle Position Sensor Circuit High
P0182	211	A	A	A	Fuel Temperature Sensor Circuit Low
P0183	211	A	A	A	Fuel Temperature Sensor Circuit High
P0192	245	A	A	A	Fuel Rail Pressure Sensor Circuit Low
P0193	245	A	A	A	Fuel Rail Pressure Sensor Circuit High
P0201	271	A	A	A	Injector Circuit Open - Cylinder 1
P0202	272	A	A	A	Injector Circuit Open - Cylinder 2
P0203	273	A	A	A	Injector Circuit Open - Cylinder 3
P0204	274	A	A	A	Injector Circuit Open - Cylinder 4
P0217	542	D	D	D	Engine Coolant Over Temperature Condition
P0219	543	C	A	A	Engine Overspeed Condition
P0231	69	C	A	A	Fuel Pump Secondary Circuit Low
P0232	69	C	A	A	Fuel Pump Secondary Circuit High
P0234	42	A	A	-	Turbocharger Overboost Condition
P0299	65	A	A	-	Turbocharger Underboost
P0335	15	A	A	A	Crankshaft Position Sensor Circuit
P0336	15	A	A	A	Crankshaft Position Sensor Circuit Range/ Performance
P0340	14	C	A	A	Camshaft Position Sensor Circuit
P0341	14	C	A	A	Camshaft Position Sensor Circuit Range/ Performance
P0380	66	C	A	A	Glow Plug Circuit
P0401	93	A	-	-	EGR Flow Insufficient Detected
P0403	37	B	A	A	EGR Control Circuit
P0404	45	A	A	A	EGR Control Circuit Range/ Performance
P0405	44	B	A	A	EGR Sensor Circuit Low
P0406	44	B	A	A	EGR Sensor Circuit High
P0500	25	A	A	A	Vehicle Speed Sensor

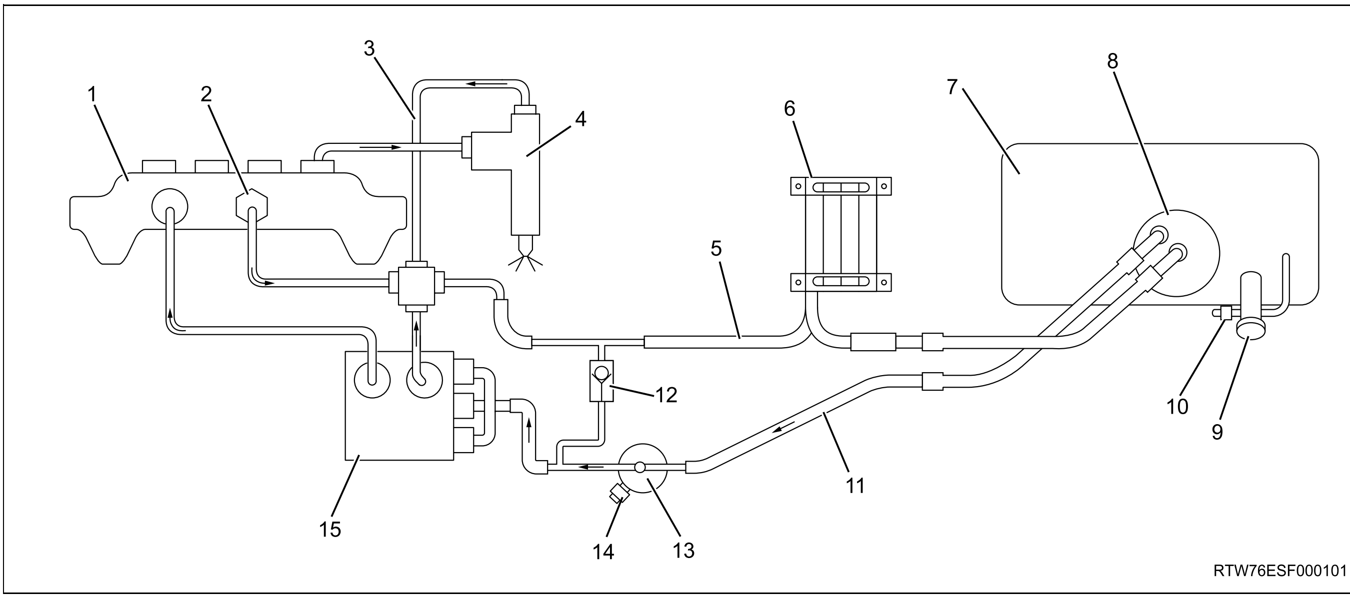
DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P0501	25	A	A	A	Vehicle Speed Sensor Circuit Range/ Performance
P0512	417	C	-	-	Starter Request Circuit
P0562	35	C	A	A	System Voltage Low
P0563	35	C	A	A	System Voltage High
P0565	515	D	D	-	Cruise Control On Signal
P0566	516	D	D	-	Cruise Control Off Signal
P0567	517	D	D	-	Cruise Control Resume Signal
P0568	518	D	D	-	Cruise Control Set Signal
P0571	26	D	D	-	Brake Switch Circuit
P0601	53	C	A	A	Internal Control Module Memory Check Sum Error
P0602	154	C	A	A	Control Module Programming Error
P0604	153	C	A	A	Internal Control Module RAM Error
P0606	51	C	A	A	ECM Processor
P0615	19	C	-	-	Starter Relay Circuit
P0633	176	C	A	A	Immobilizer Not Programmed
P0638	61	A	A	A	Throttle Actuator Control Range/ Performance
P0642	55	C	A	A	Sensor Reference Voltage 1 Circuit Low
P0643	55	C	A	A	Sensor Reference Voltage 1 Circuit High
P0650	77	A	A	A	Malfunction Indicator Lamp (MIL) Control Circuit
P0652	56	A	A	A	Sensor Reference Voltage 2 Circuit Low
P0653	56	A	A	A	Sensor Reference Voltage 2 Circuit High
P0661	58	C	A	A	Intake Manifold Turning Valve Control Circuit Low
P0662	58	C	A	A	Intake Manifold Turning Valve Control Circuit High
P0698	57	A	A	A	Sensor Reference Voltage 3 Circuit Low
P0699	57	A	A	A	Sensor Reference Voltage 3 Circuit High
P0700	185	A	A	-	Transmission Control System (MIL Request)
P1064	247	A	A	A	Fuel Pressure Regulator Control Circuit
P1065	247	A	A	A	Fuel Pressure Regulator Control Circuit
P1093	227	A	A	A	Fuel Rail Pressure Too Low
P1094	226	A	A	A	Fuel Rail Pressure Too Low (FRP Regulator Commanded High)
P1094	226	C	A	A	Fuel Rail Pressure Too Low (Fuel Pressure Drop)
P1196	461	A	A	A	Intake Throttle Solenoid Control Driver
P1197	461	A	A	A	Intake Throttle Solenoid Control Driver
P1198	461	A	A	A	Intake Throttle Solenoid Control Driver
P124B	157	C	A	A	Injector Circuit Short Across Group 1 & 2
P1261	34	A	A	A	Injector Positive Voltage Control Circuit Group 1
P1261	34	A	A	A	Injector Positive Voltage Control Circuit (Supply Voltage Low)

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P1261	34	C	A	A	Injector Positive Voltage Control Circuit (Supply Voltage High)
P1262	34	A	A	A	Injector Positive Voltage Control Circuit Group 2
P1404	45	A	A	A	EGR Position Fault (Closed Position Error)
P1404	45	A	-	-	EGR Position Fault (Learned Position Error)
P1411	445	A	A	A	EGR Solenoid Control Driver
P1412	445	A	A	A	EGR Solenoid Control Driver
P1413	445	A	A	A	EGR Solenoid Control Driver
P156A	135	C	A	A	Battery Voltage Low
P156B	135	C	A	A	Battery Voltage High
P161B	179	C	A	A	Immobilizer Wrong Response
P1621	54	C	A	A	Control Module Long Term Memory Performance (Learned Data)
P1621	254	C	A	A	Control Module Long Term Memory Performance (VIN or Immobilizer Data)
P1664	76	D	-	-	Service Vehicle Soon Lamp Control Circuit (Low Voltage)
P1664	76	C	-	-	Service Vehicle Soon Lamp Control Circuit (High Voltage)
P2100	446	B	A	A	Intake Throttle Solenoid Circuit Open
P2101	446	B	A	A	Intake Throttle Solenoid Circuit Low
P2103	446	B	A	A	Intake Throttle Solenoid Circuit High
P2122	121	C	A	A	Pedal Position Sensor 1 Circuit Low Input
P2123	121	C	A	A	Pedal Position Sensor 1 Circuit High Input
P2127	122	C	A	A	Pedal Position Sensor 2 Circuit Low Input
P2128	122	C	A	A	Pedal Position Sensor 2 Circuit High Input
P2132	123	C	A	A	Pedal Position Sensor 3 Circuit Low Input
P2133	123	A	A	A	Pedal Position Sensor 3 Circuit High Input
P2138	124	C	A	A	Pedal Position Sensor 1 - 2 Voltage Correlation
P2139	125	C	A	A	Pedal Position Sensor 1 - 3 Voltage Correlation
P2140	126	C	A	A	Pedal Position Sensor 2 - 3 Voltage Correlation
P2146	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit Short
P2147	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit Low
P2148	158	A	A	A	Fuel Injector Group 1 Supply Voltage Circuit High
P2149	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit Short
P2150	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit Low
P2151	159	A	A	A	Fuel Injector Group 2 Supply Voltage Circuit High
P2227	71	A	A	-	Barometric Pressure Sensor Circuit Range/ Performance
P2228	71	A	A	A	Barometric Pressure Sensor Circuit Low
P2229	71	A	A	A	Barometric Pressure sensor Circuit High
P2621	94	-	-	A	Throttle Position Output Circuit Low

DTC	Flash Code	DTC Type			DTC Descriptor
		Euro 4 Specification	Except Euro 4 Specification (High Output)	Except Euro 4 Specification (Standard Output)	
P2622	94	-	-	A	Throttle Position Output Circuit High
U0001	84	A	A	A	High Speed CAN Communication Bus
U0101	85	A	A	-	Lost Communication with TCM
U0167	177	C	A	A	Lost Communication With Vehicle Immobilizer Control Module

Schematic and Rounting Diagrams

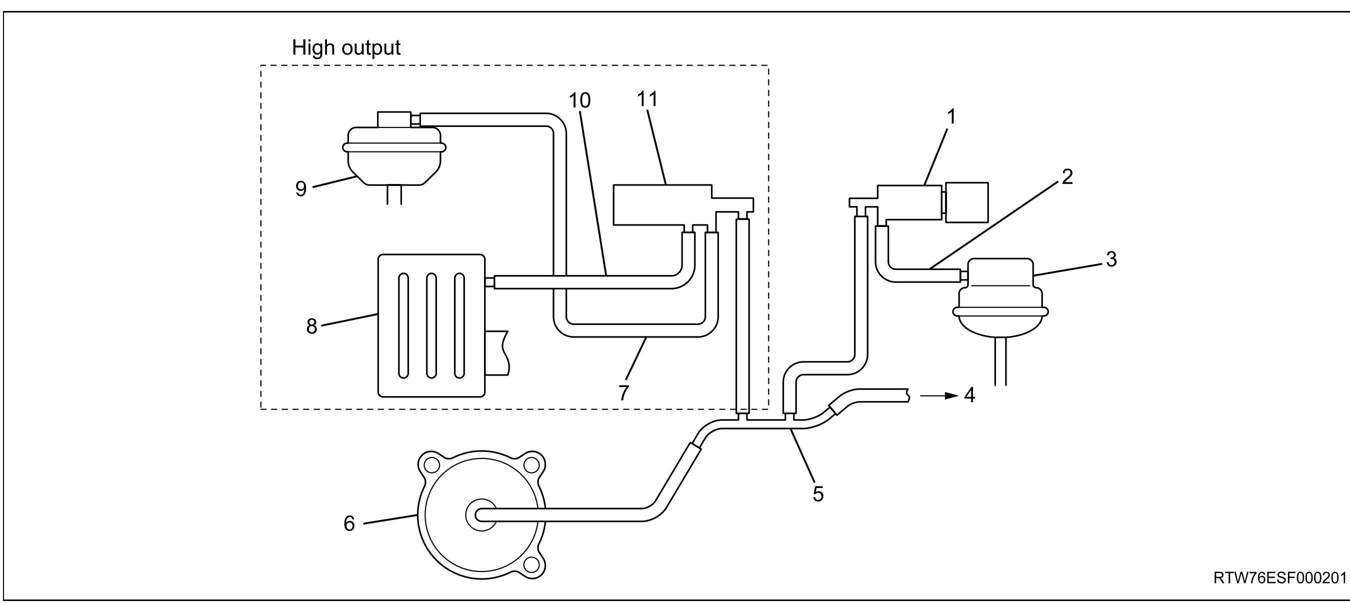
Fuel System Routing Diagram



Legend

1. Fuel rail
2. Fuel pressure limiter
3. Leak off pipe
4. Fuel injector
5. Fuel return pipe
6. Fuel cooler
7. Fuel tank
8. Fuel pump and sender assembly
9. Fuel filler cap
10. Vent valve
11. Fuel feed pipe
12. One-way valve
13. Fuel filter with sedimenter
14. Fuel pressure switch
15. Fuel supply pump

Vacuum Hose Routing Diagram

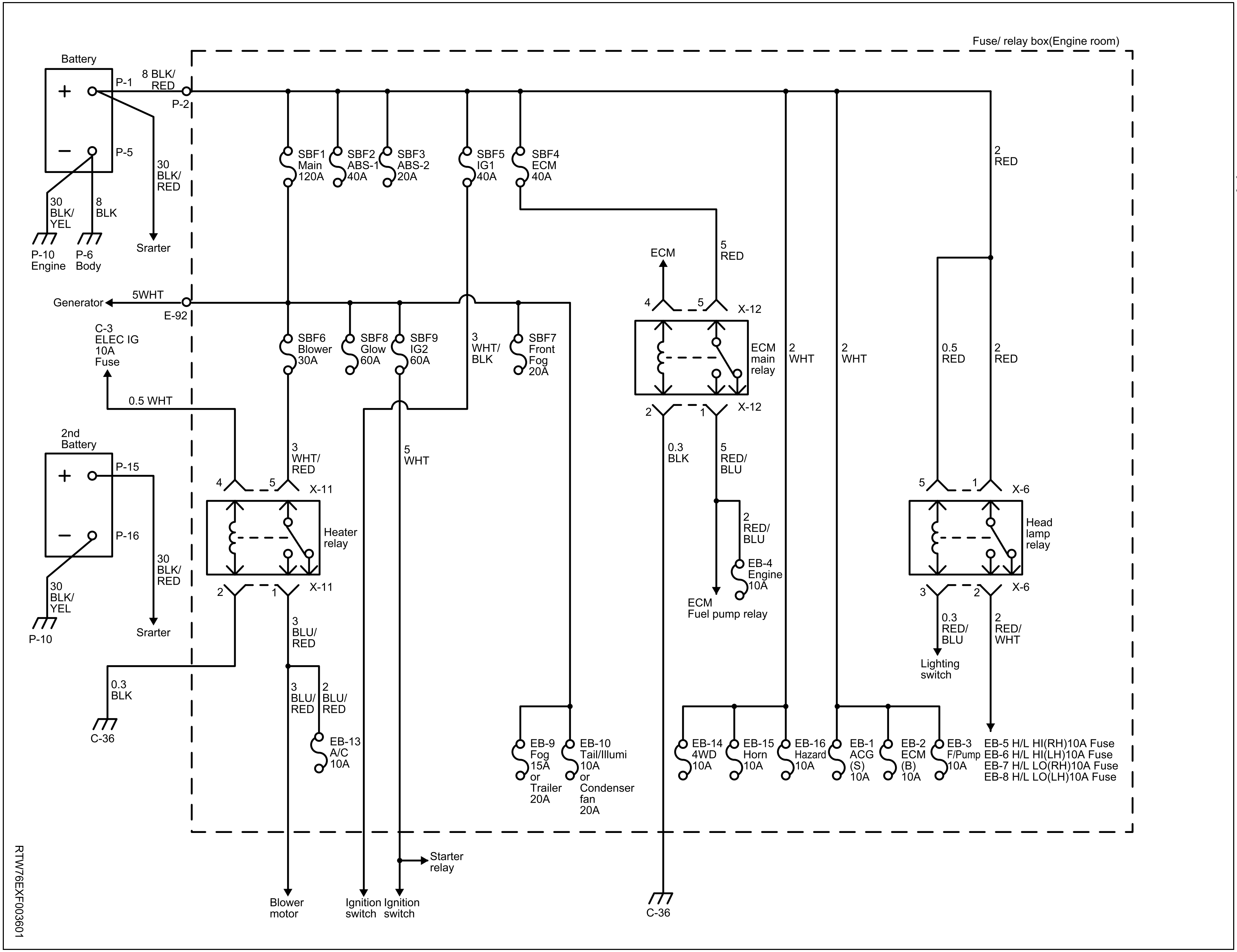


Legend

1. Swirl control solenoid valve
2. Actuator control vacuum hose
3. Swirl control actuator
4. Brake booster
5. Vacuum pipe
6. Vacuum pump
7. Actuator control vacuum hose
8. Air cleaner
9. Turbocharger nozzle control actuator
10. Solenoid valve ventilation hose
11. Turbocharger nozzle control solenoid valve

Engine Controls Schematics

Power Distribution (1)



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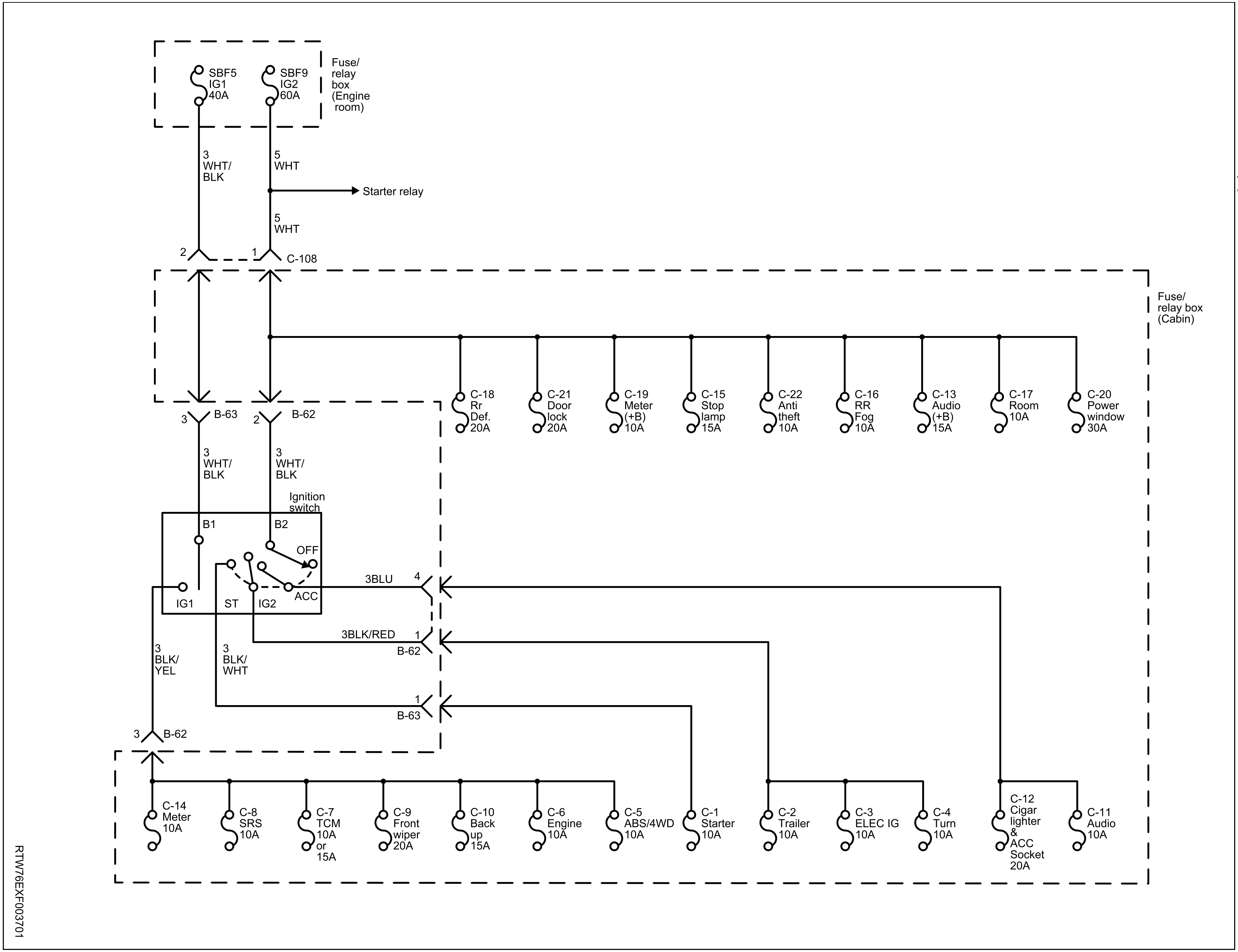
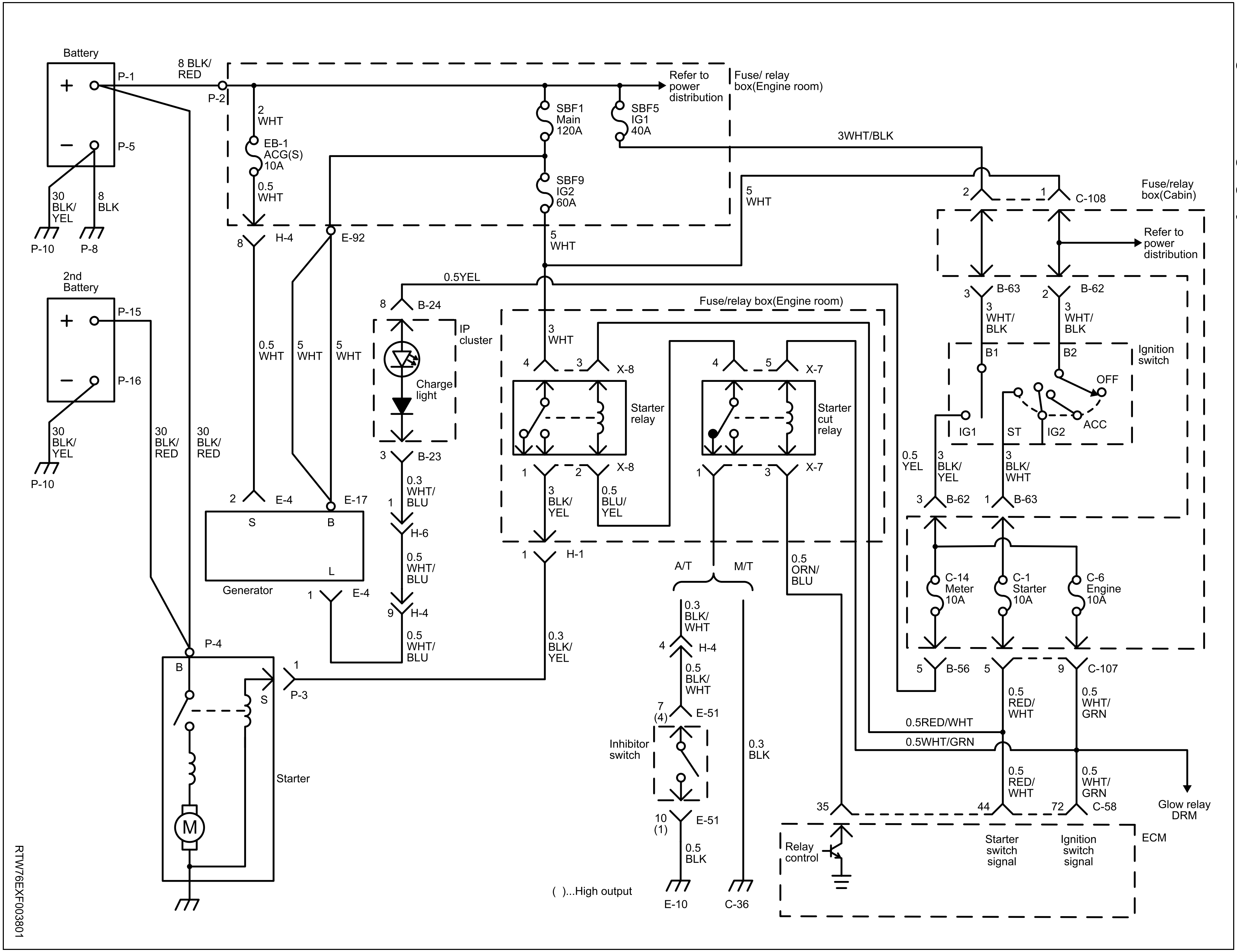
Power Distribution (2)



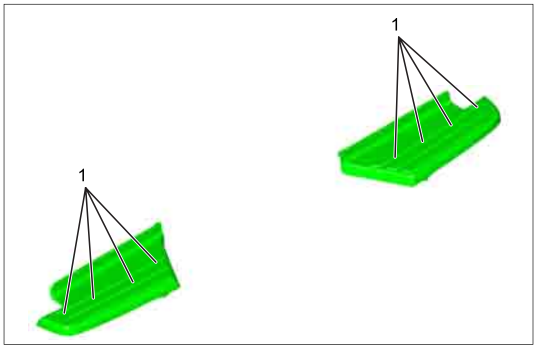
Starting and Charging System



Important Operations - Removal

1. Rear Step Bumper Assembly

- Remove the 3 bolts from each side.
- Disconnect the extension harness connector.



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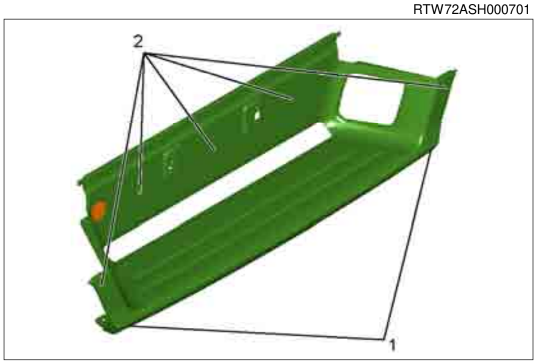
2. Side Step Pad

- Push out the 4 fixing portions (1) of side step pad from the back face of the rear step bumper.



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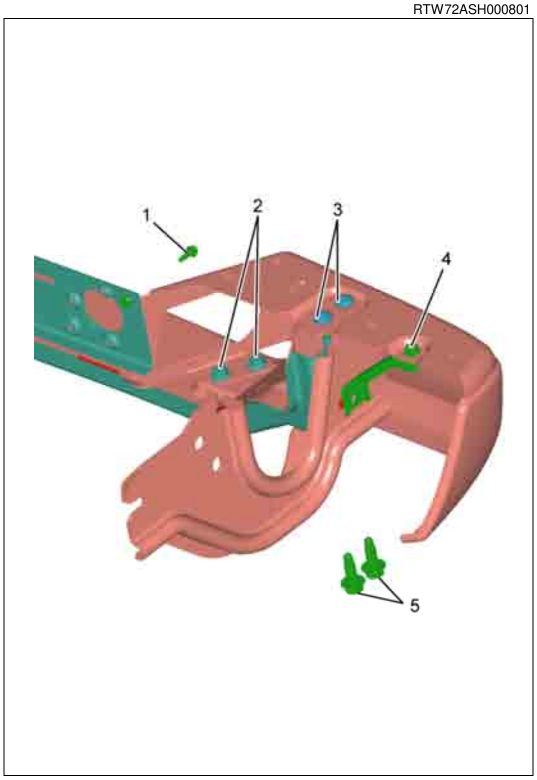
4. Rear Bumper Center Pad

- Remove the 2 clips (1) from both ends of the center pad.
- Push out the 5 fixing portions (2) of the center pad from the back face of the rear step bumper.



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Important Operations - Installation

9. Reinforcement assembly

- Tighten the fixing bolts to the specified torque.

Bolt (5)

Torque	N·m(kgf·m/lb·ft)
85 (8.7 / 63)	

7. Shell

Bolt (2), (3)

Torque	N·m(kgf·m/lb·ft)
42 (4.3 / 31)	

6. Center bar

Bolt (1)

Torque	N·m(kgf·m/lb·in)
7 (0.7 / 61)	

Bolt (4)

Torque	N·m(kgf·m/lb·ft)
18 (1.8 / 13)	

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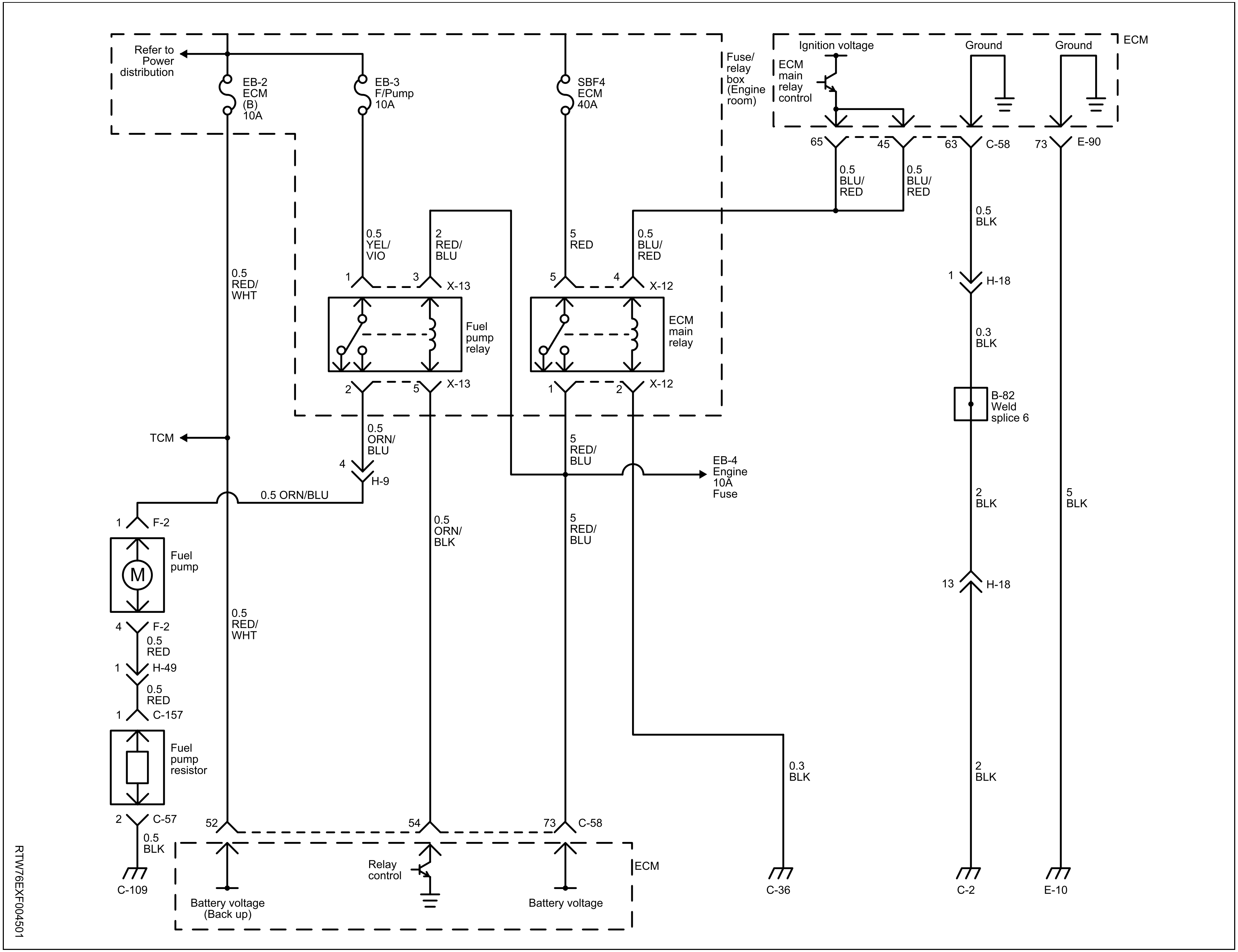
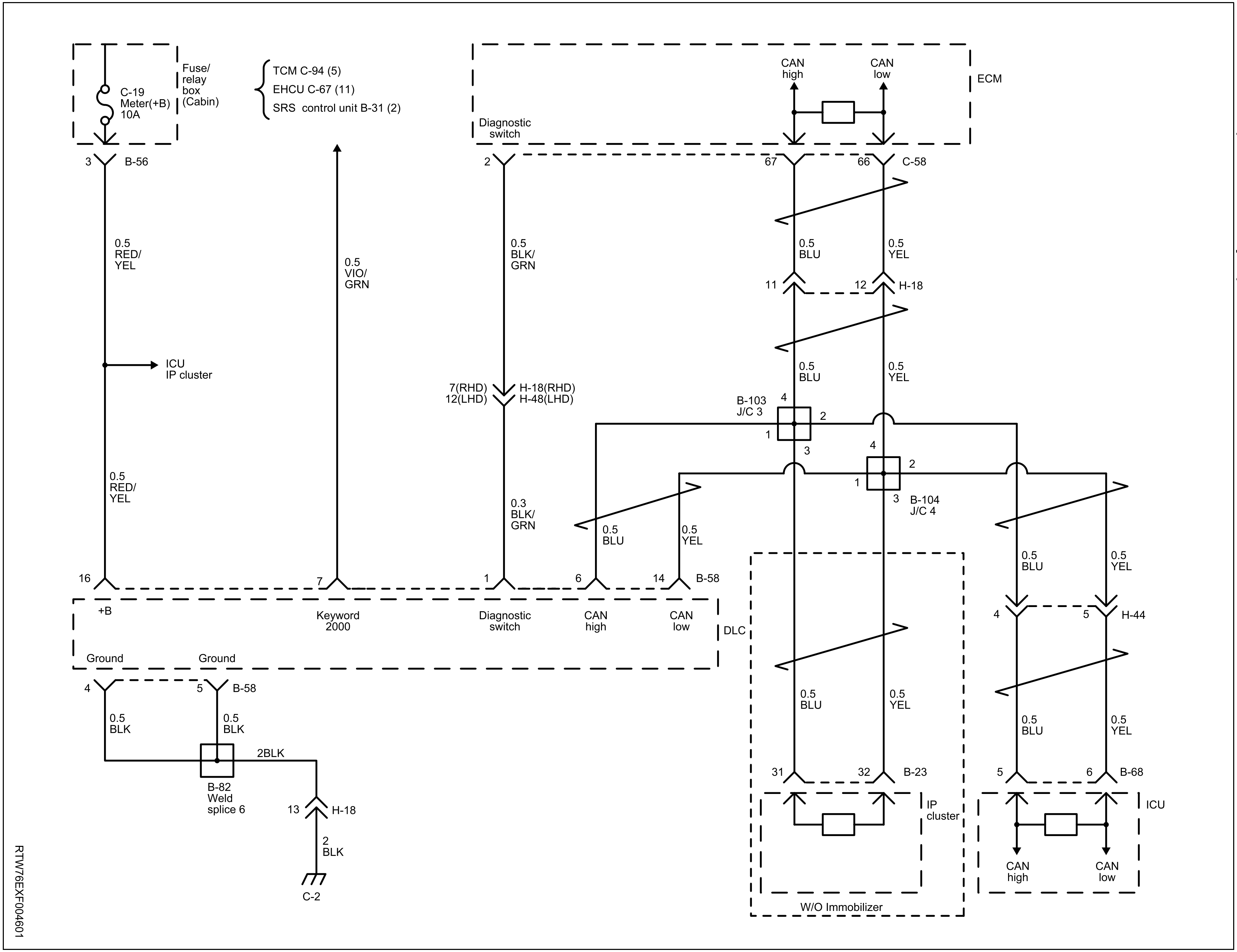
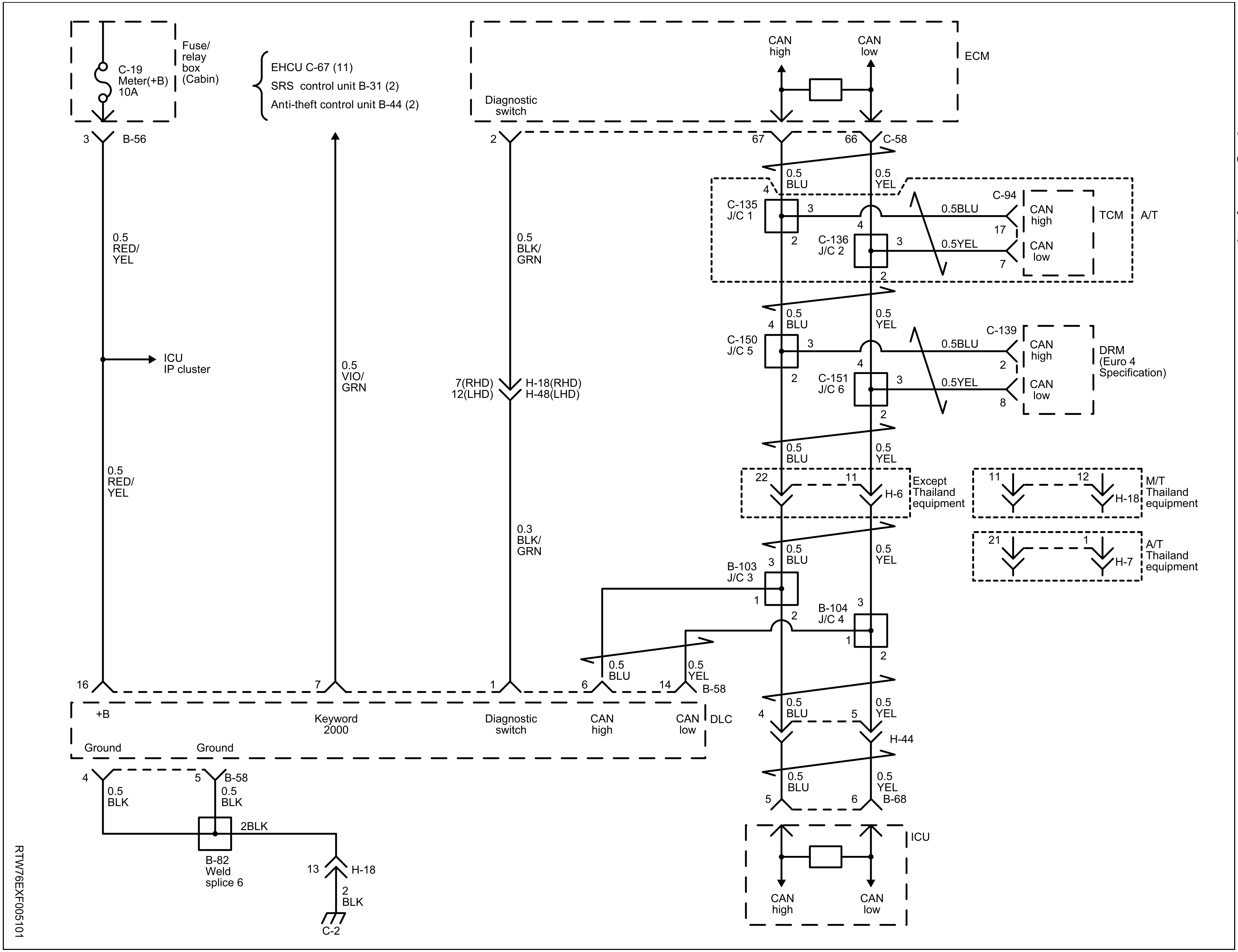
ECM Power and Ground



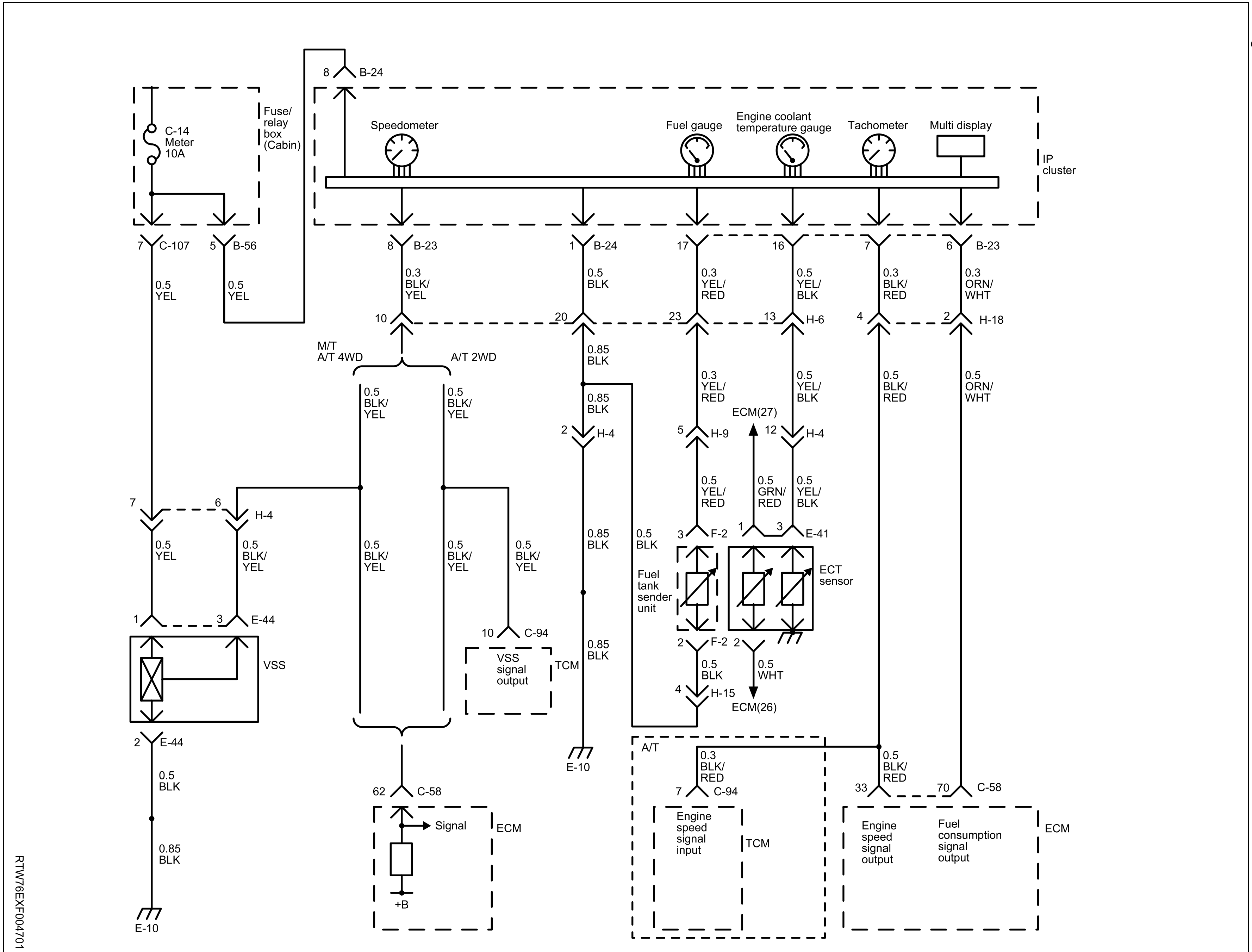
DLC and CAN (Standard output)



DLC and CAN (High output)



Gauges



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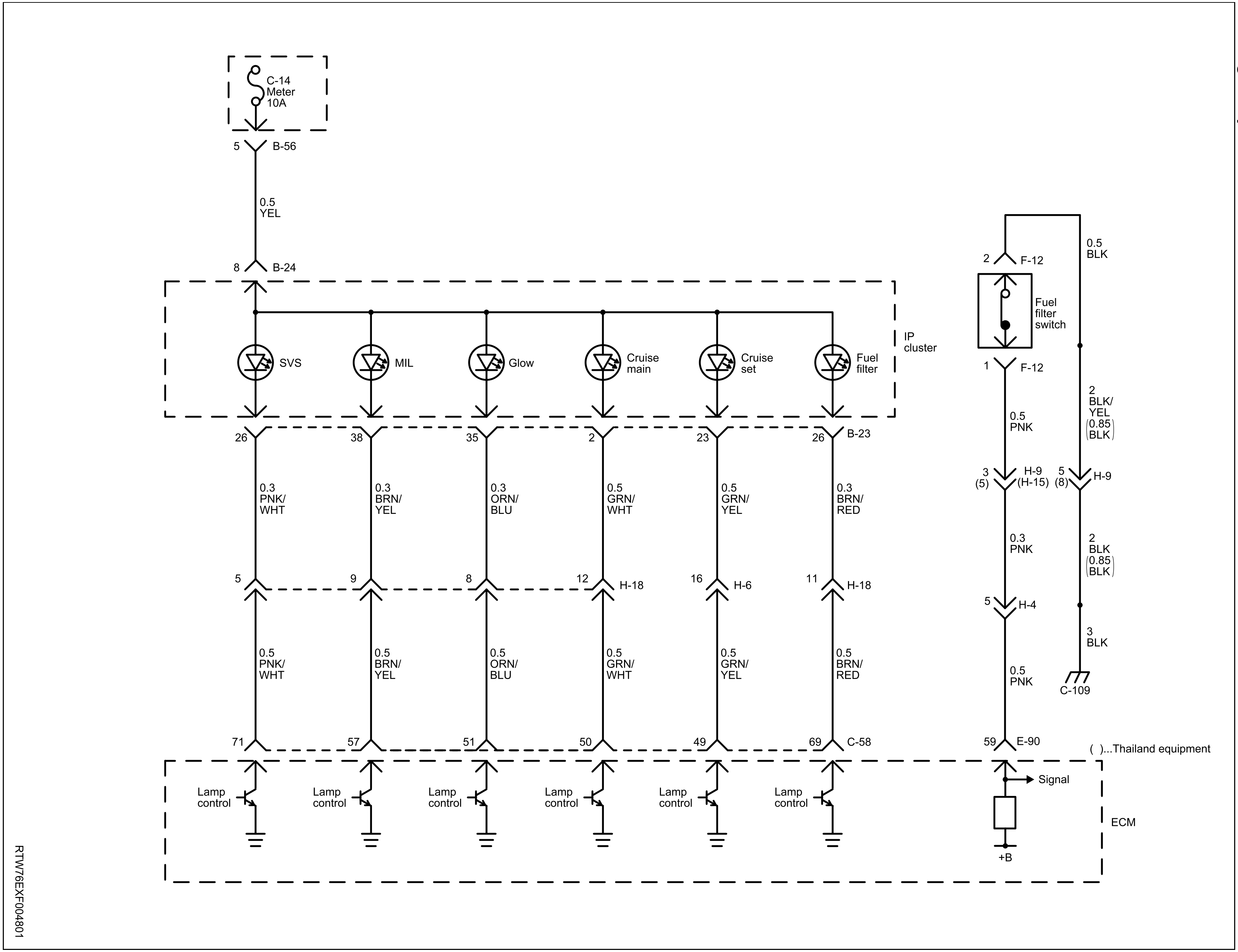
Warning Lamps and Fuel Filter Switch



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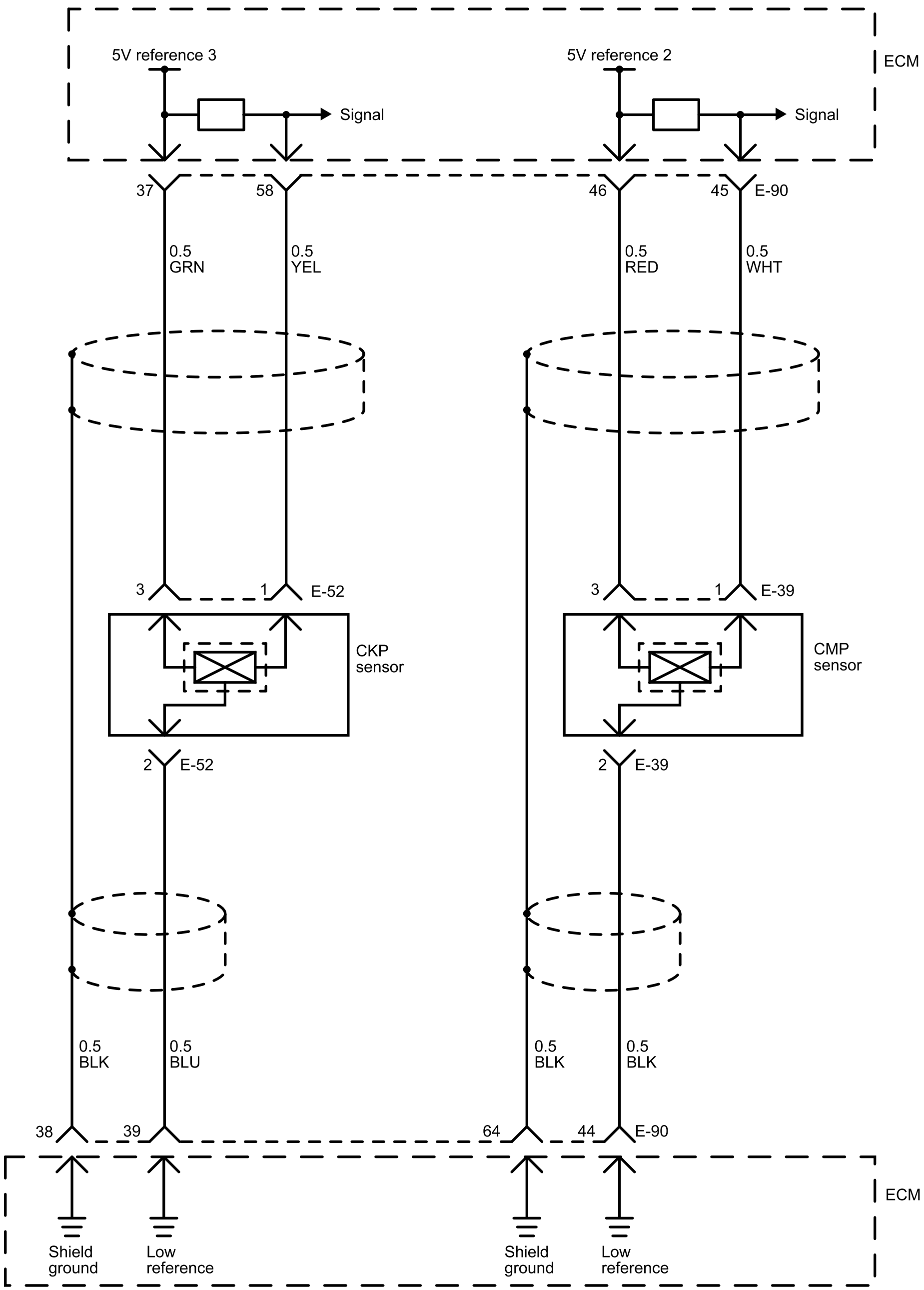
CKP and CMP Sensors



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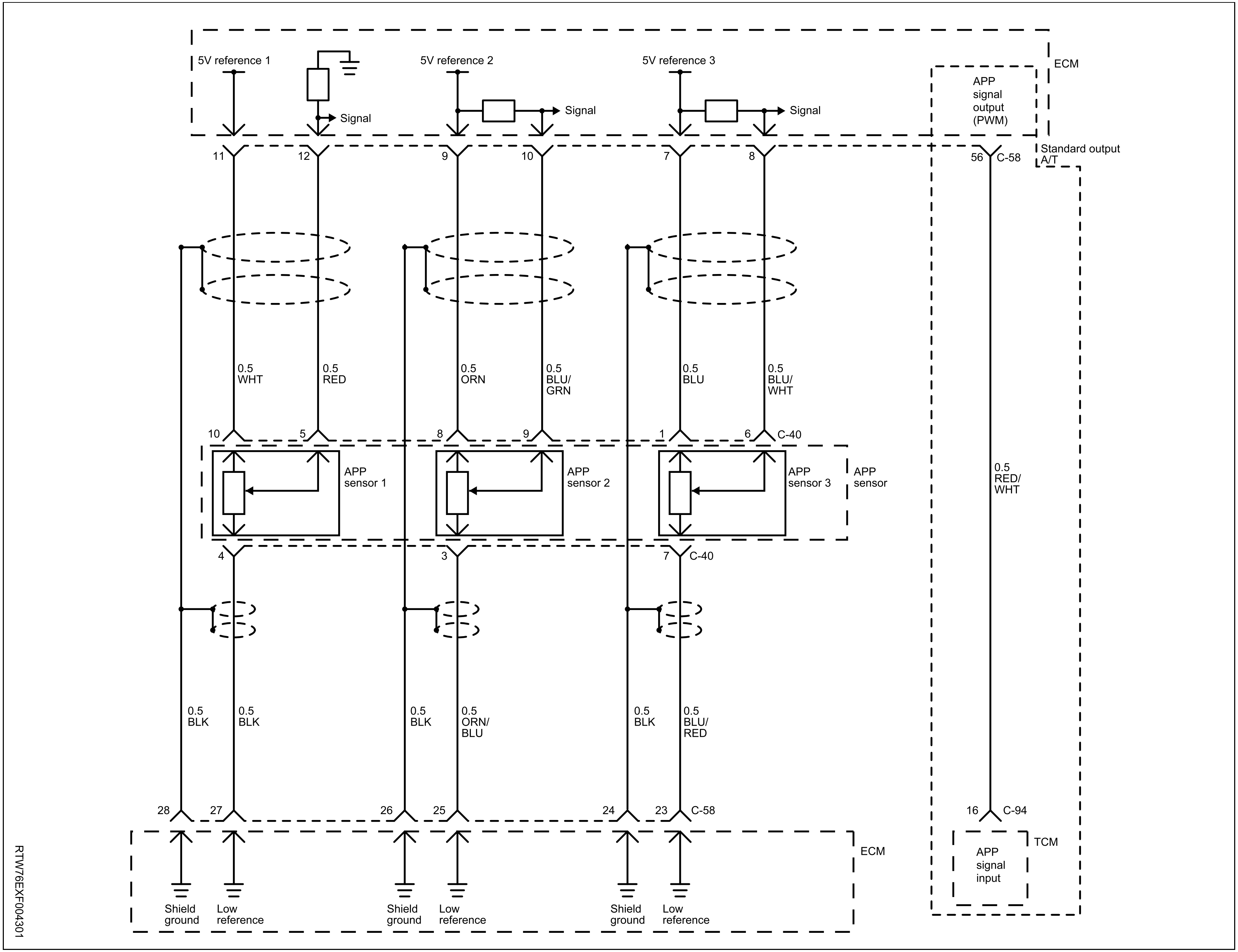
APP Sensors



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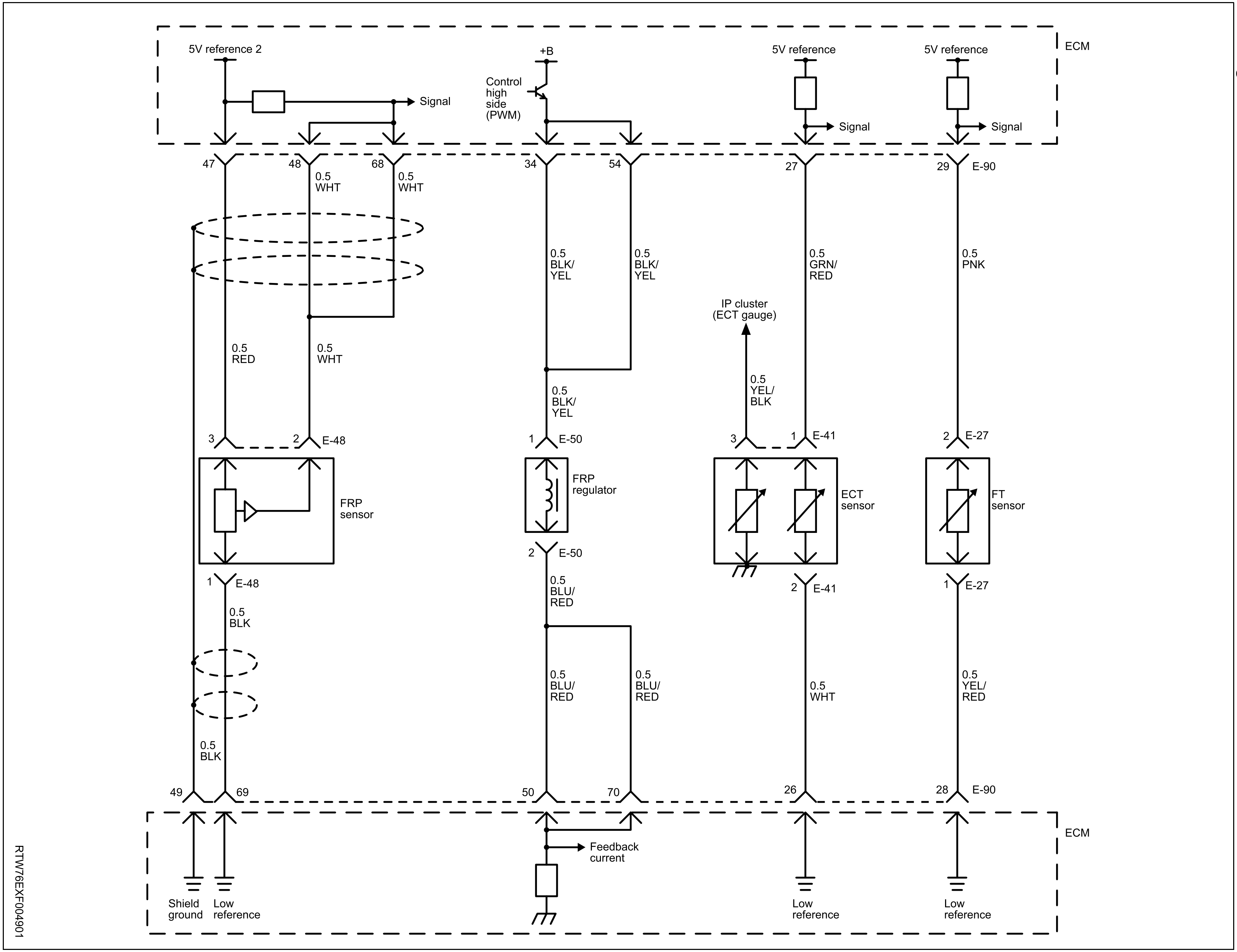
FRP Regulator, FRP, ECT and FT Sensors



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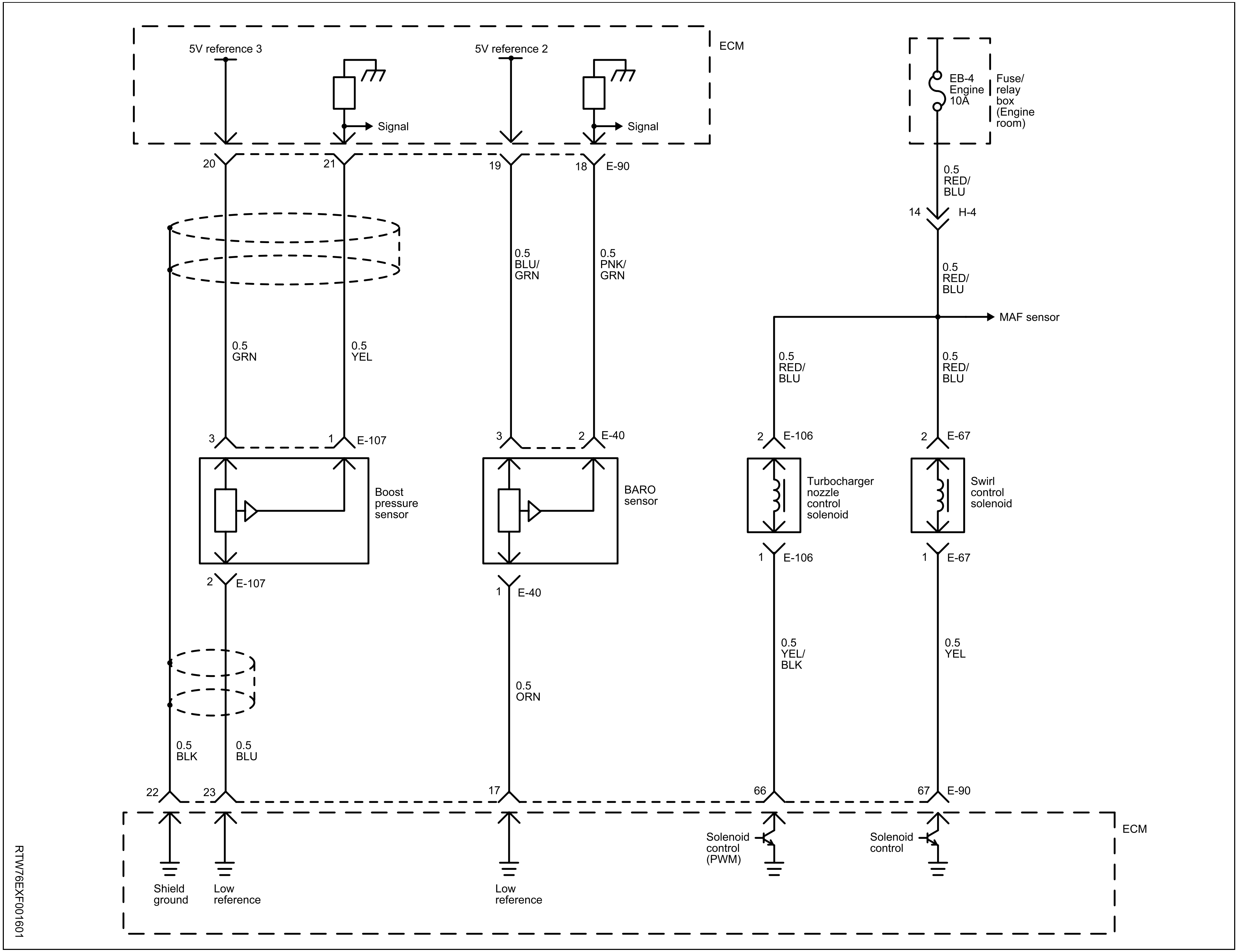
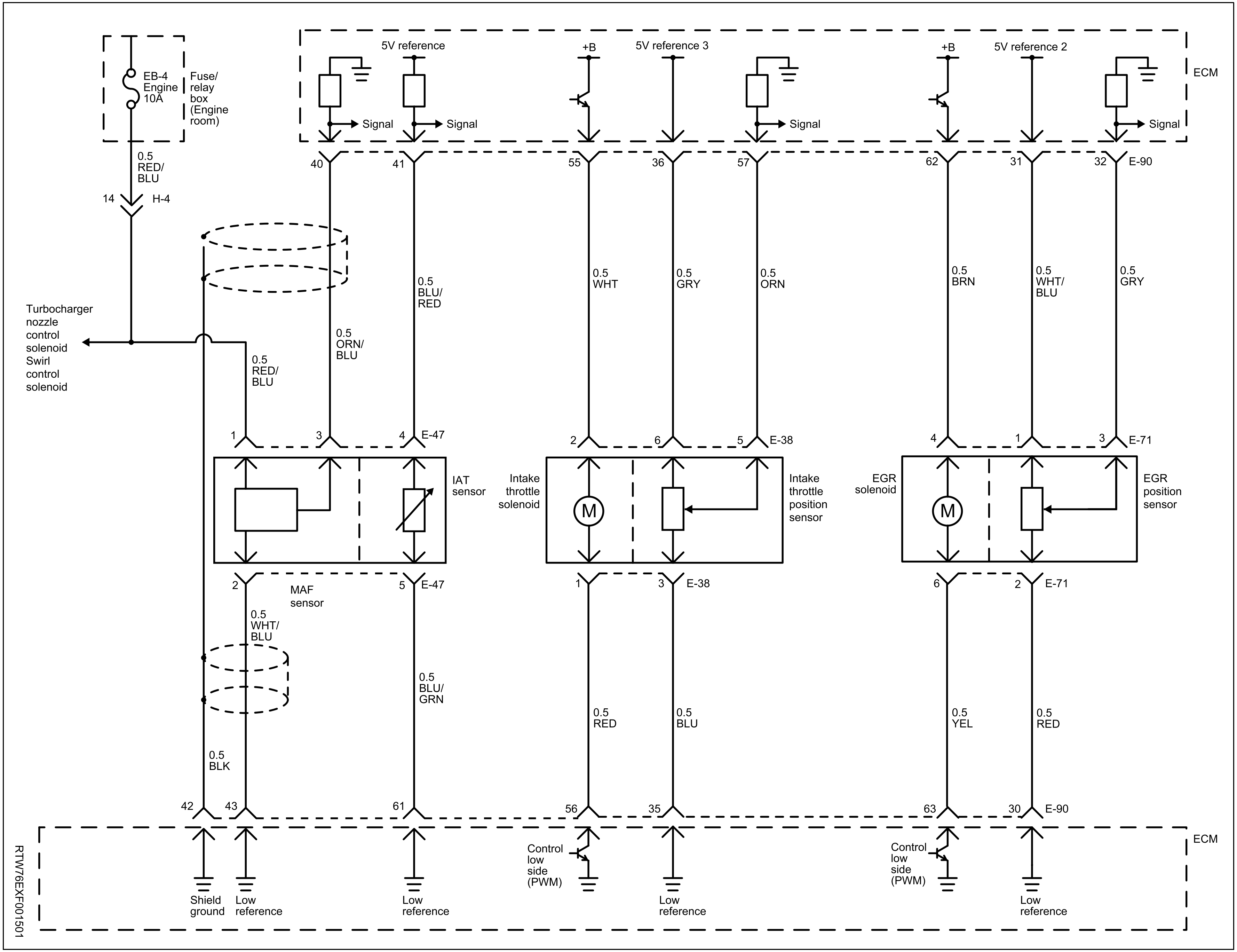
Boost Pressure, BARO Sensors and Solenoids



MAF & IAT Sensors, Intake Throttle and EGR Valves



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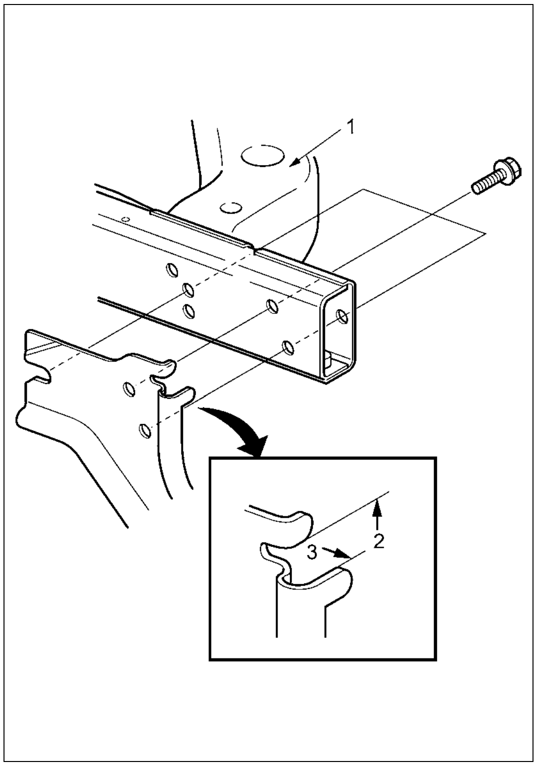

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1. Rear Step Bumper Assembly

1) Align the back bar to the frame (1) as follows:

- Face A (2) should be in contact with the upper face of the frame.
- Face B (3) should be in contact with the rear end of the frame.

2) Tighten the 3 fixing bolts on each side of the back bar.

Torque	N·m(kgf·m/lb·ft)
150 (15.3 / 111)	

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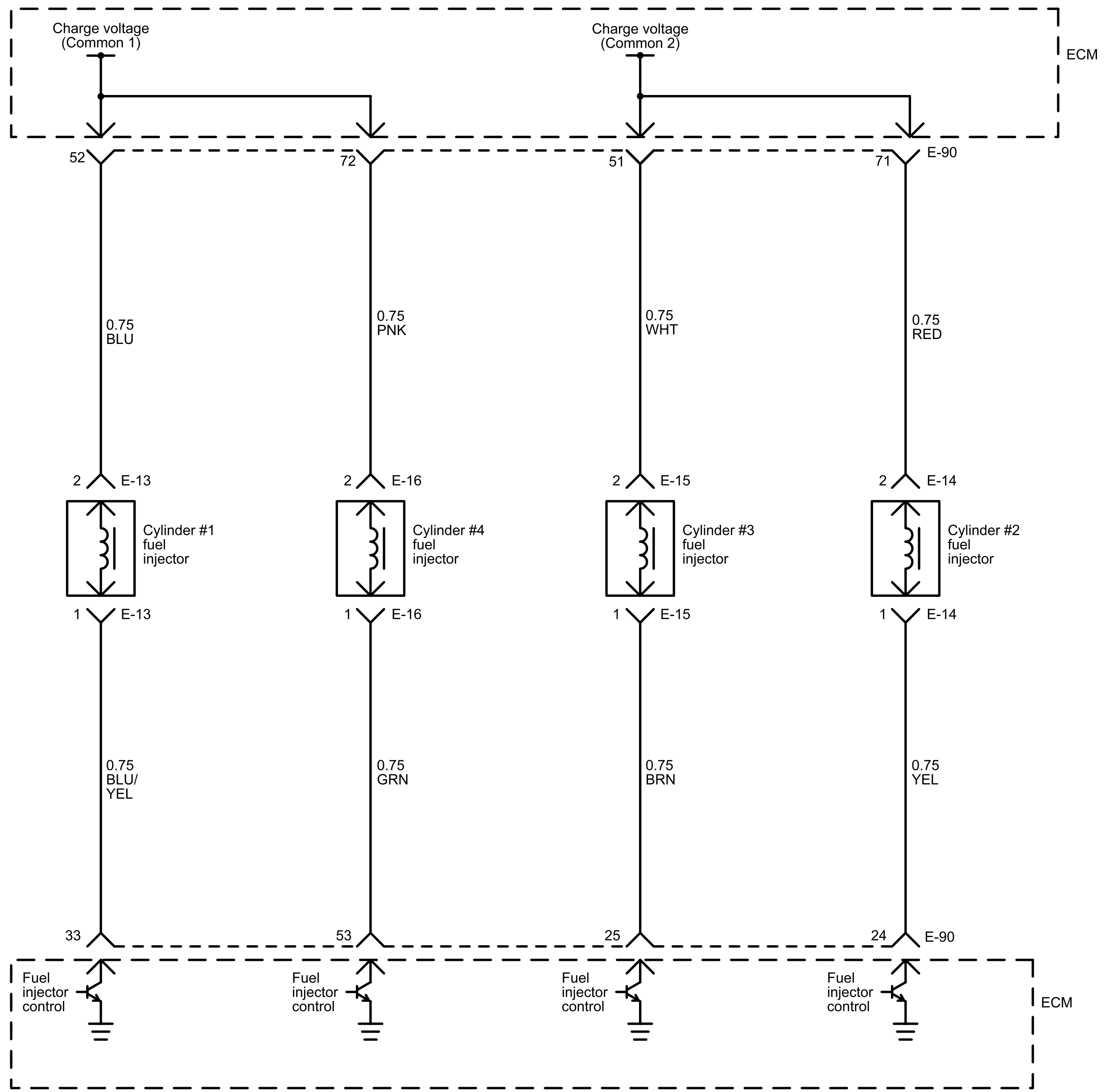
Fuel Injectors



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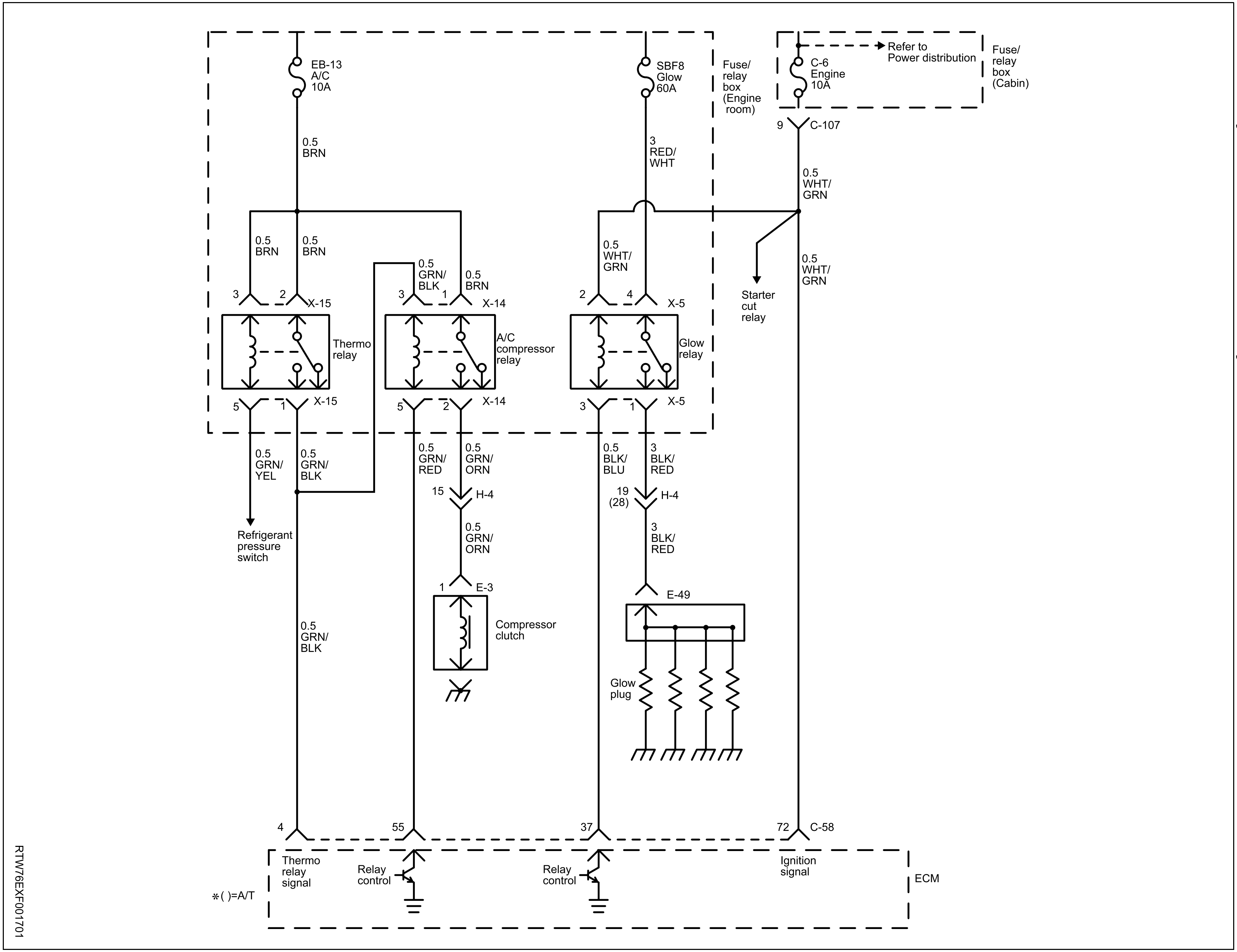
A/C Control System and Glow Control System



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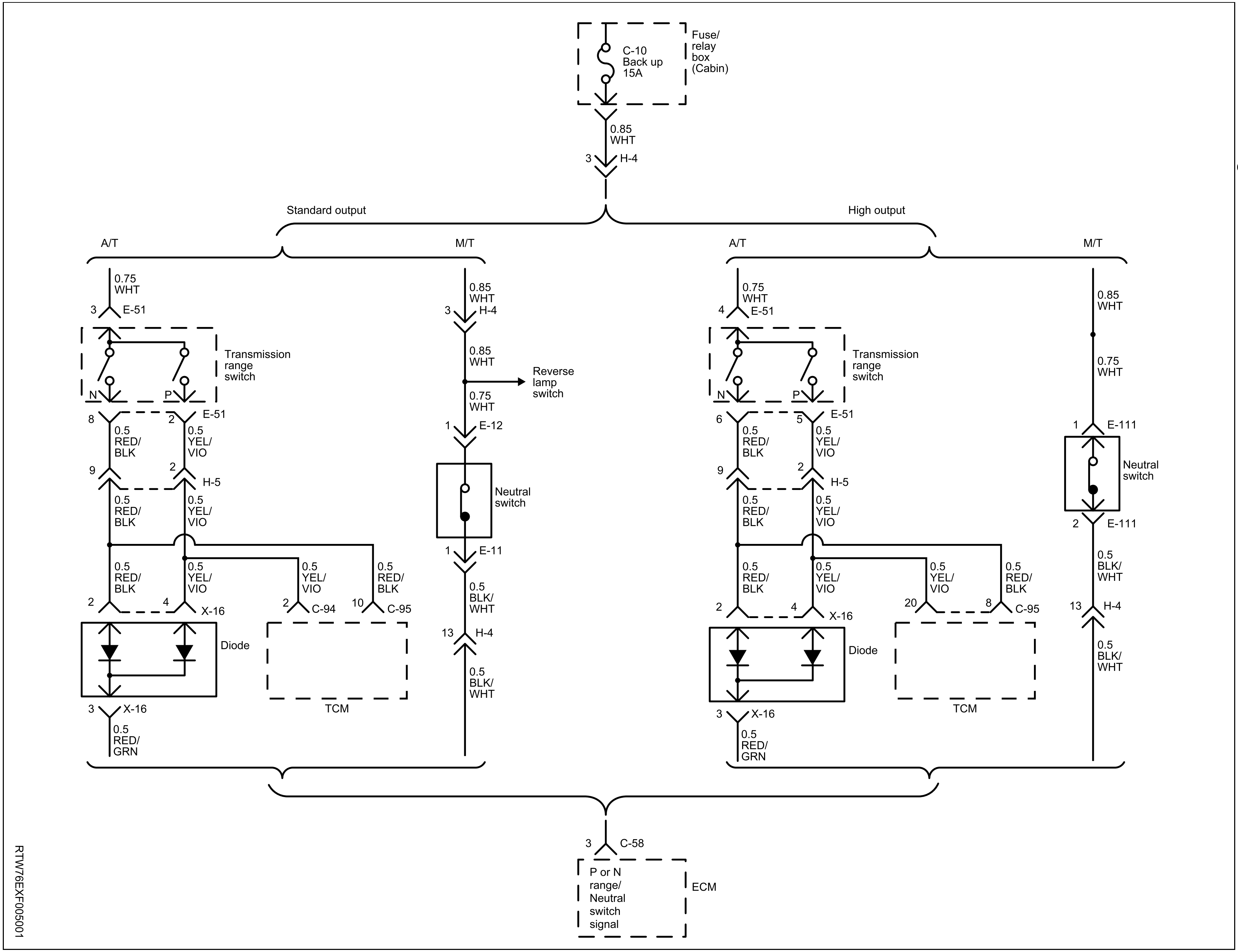
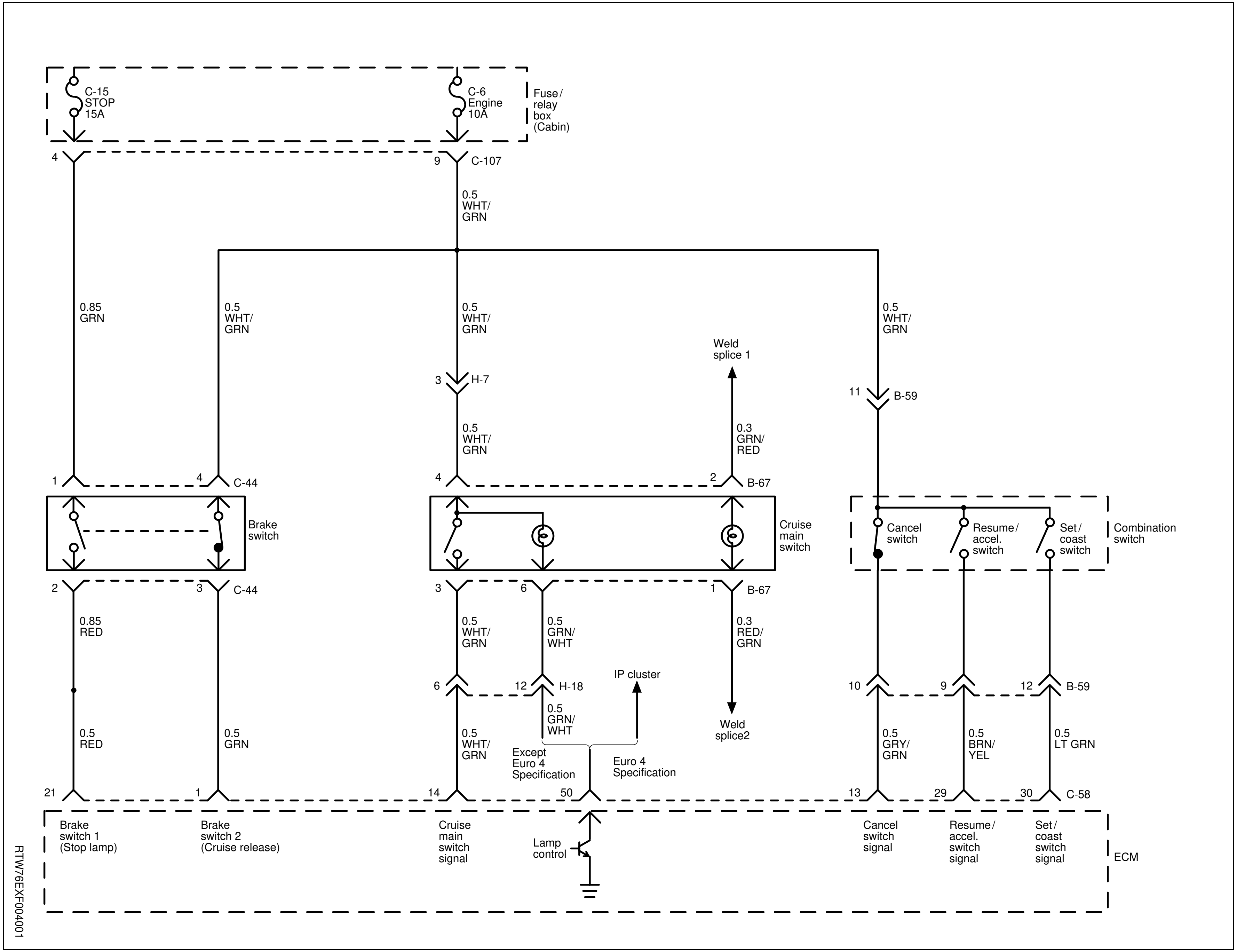
TO MODEL INDEX

Transmission Range Switch and Neutral Switch

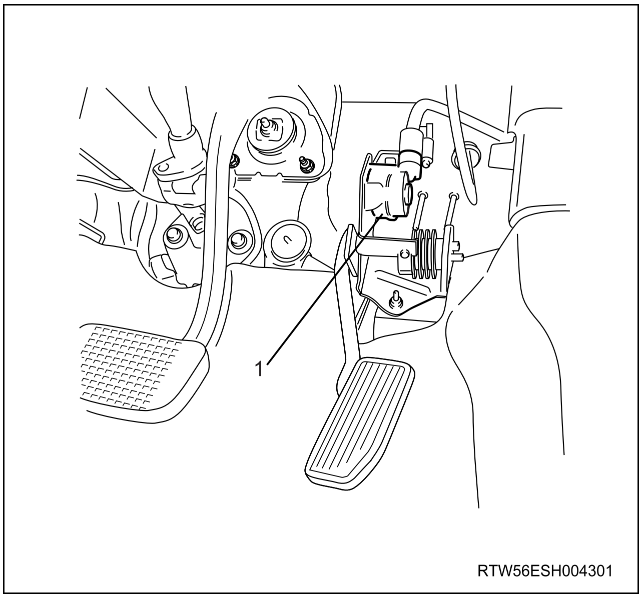


Brake Switch and Cruise Control



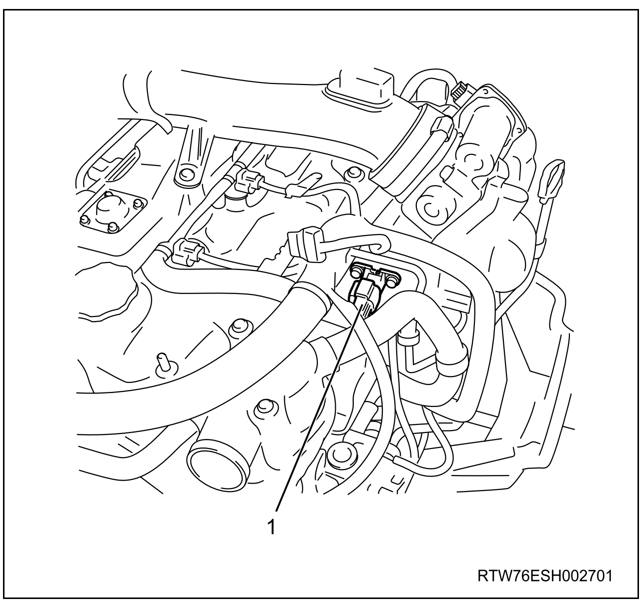
Component Locator

Engine Controls Component Views



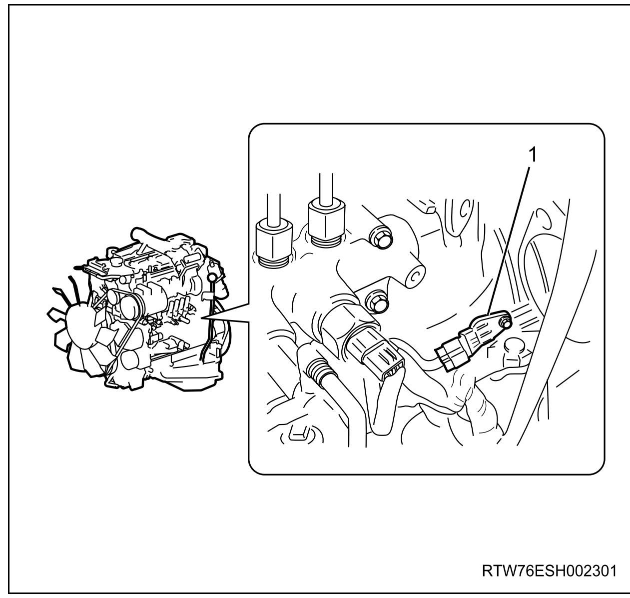
Legend

1. Accelerator pedal position (APP) sensor



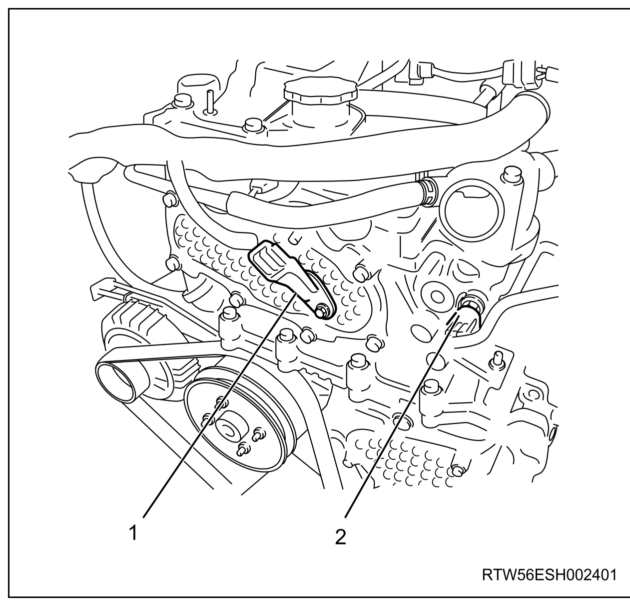
Legend

1. Barometric pressure (BARO) sensor (Standard output)



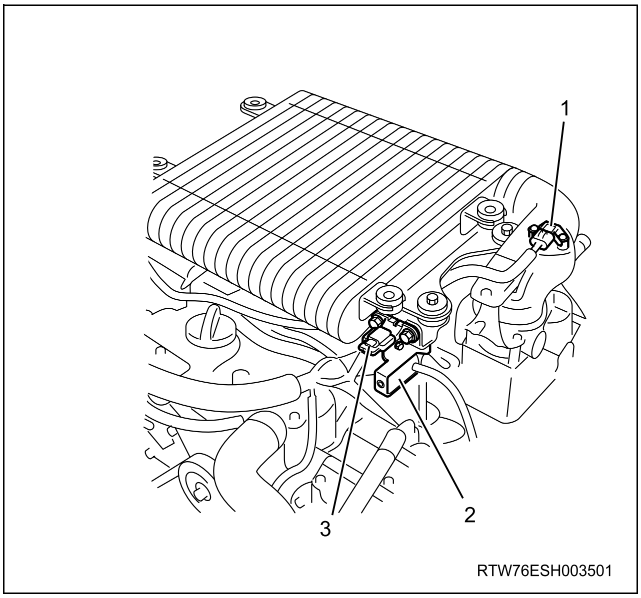
Legend

1. Crankshaft (CKP) sensor

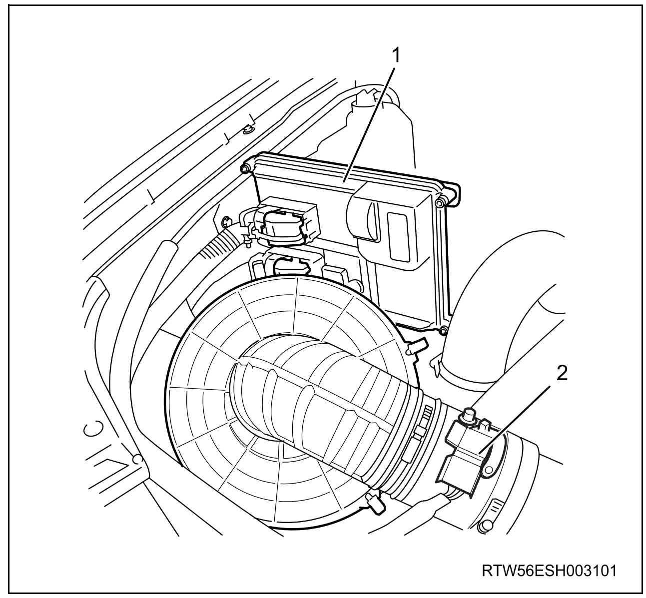


Legend

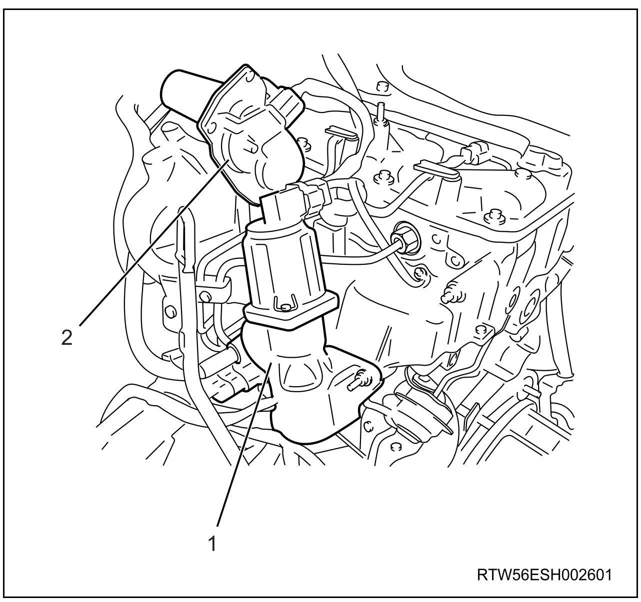
1. Camshaft position (CMP) sensor
2. Engine coolant temperature (ECT) sensor



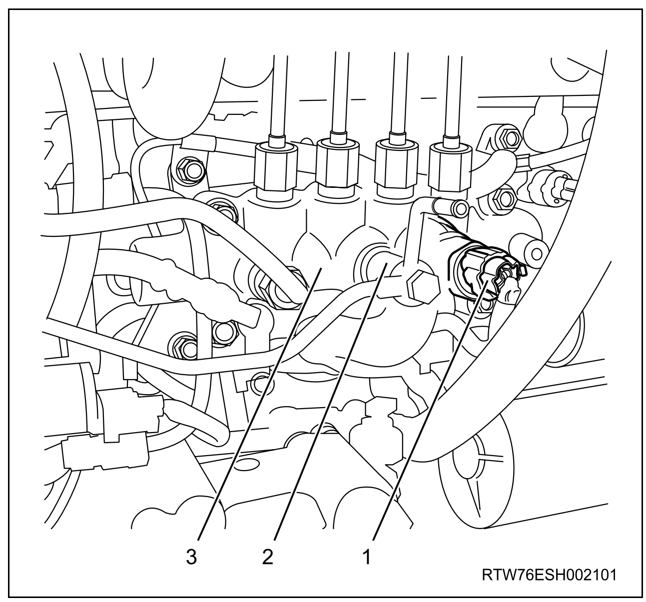
Legend
1. Boost pressure sensor
2. Turbocharger nozzle control solenoid
3. Barometric pressure (BARO) sensor (High output)



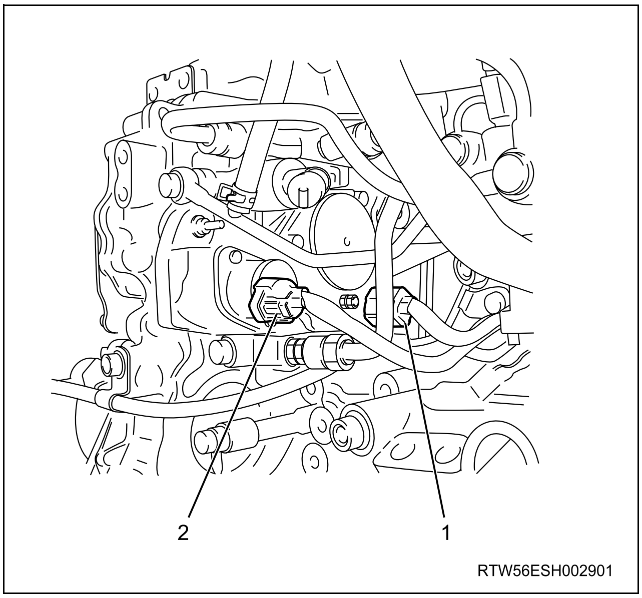
Legend
1. Engine control module (ECM)
2. Mass air flow (MAF) sensor / intake air templature (IAT) sensor



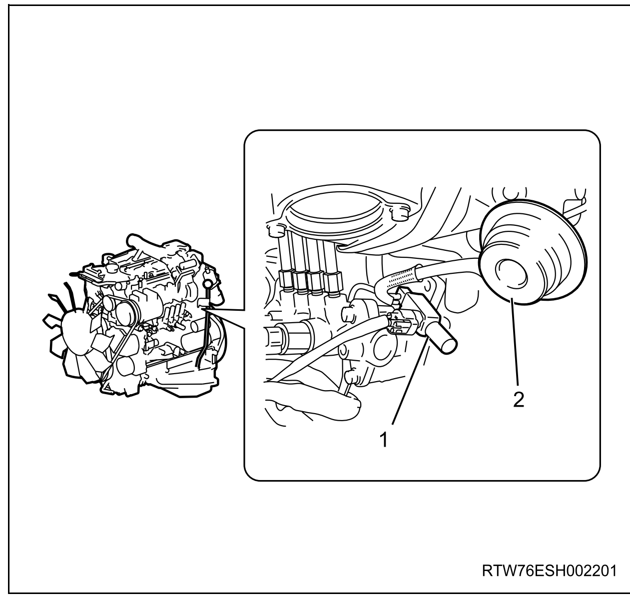
Legend
1. Exhaust gas recirculation (EGR) valve
2. Intake throttle valve



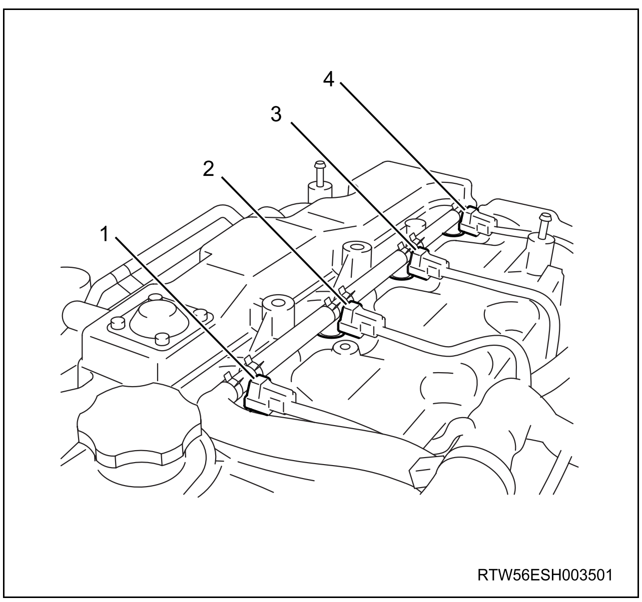
Legend
1. Fuel rail pressure (FRP) sensor
2. Pressure limiter valve
3. Fuel rail



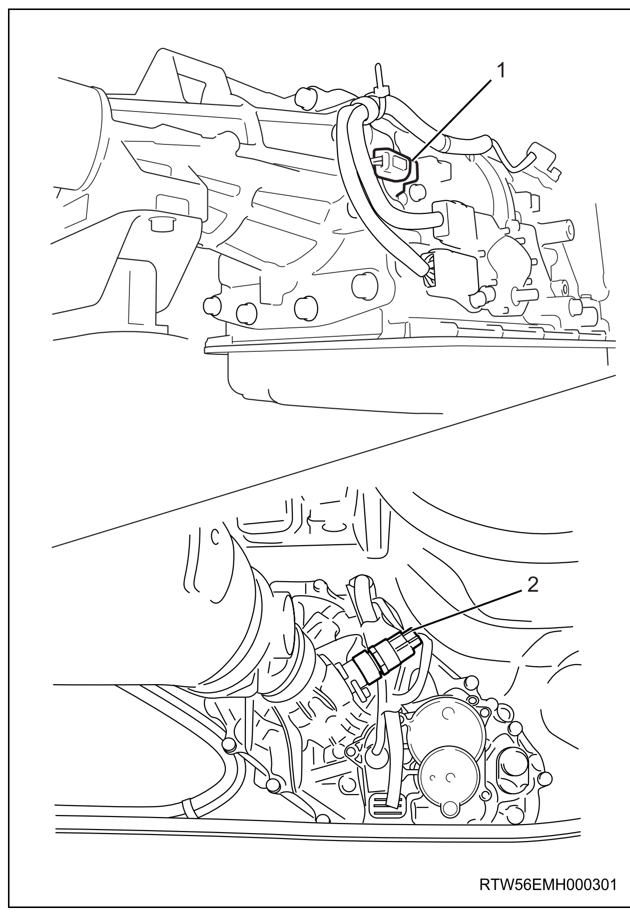
Legend
1. Fuel temperature (FT) sensor
2. Fuel Rail Pressure (FRP) regulator



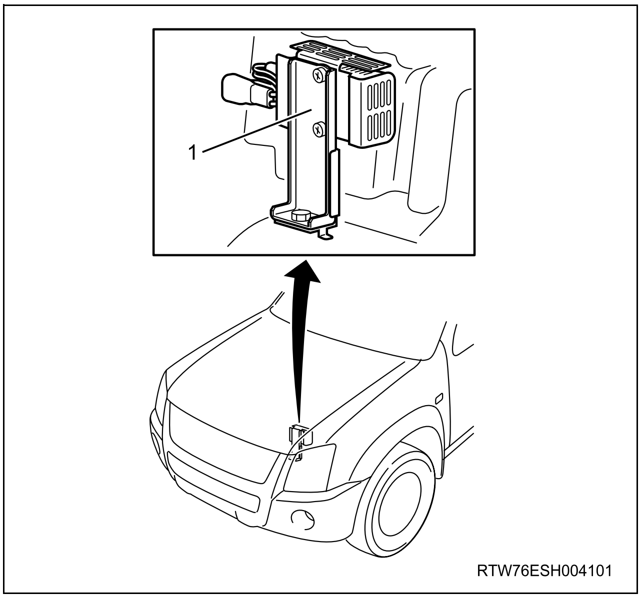
Legend
1. Swirl control solenoid valve
2. Swirl control actuator



Legend
1. Fuel injector No.1 cylinder
2. Fuel injector No.2 cylinder
3. Fuel injector No.3 cylinder
4. Fuel injector No.4 cylinder

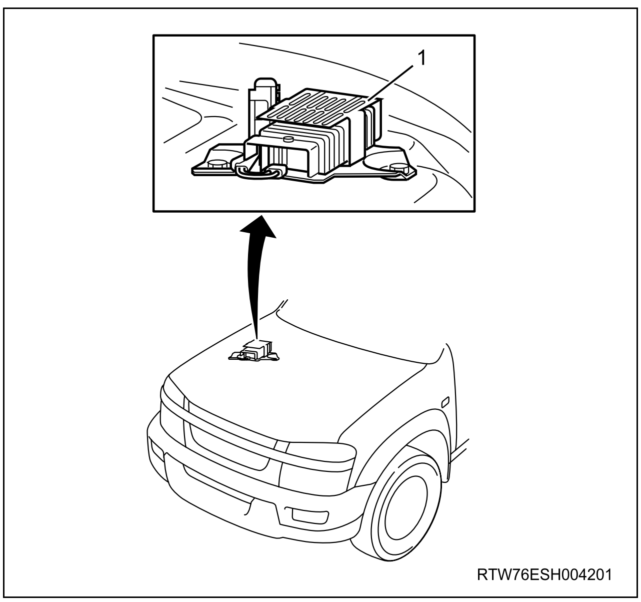


Legend
1. Vehicle speed sensor (VSS) 2WD with A/T
2. Vehicle speed sensor (VSS) except 2WD with A/T



Legend

1. Fuel pump resistor (A type)

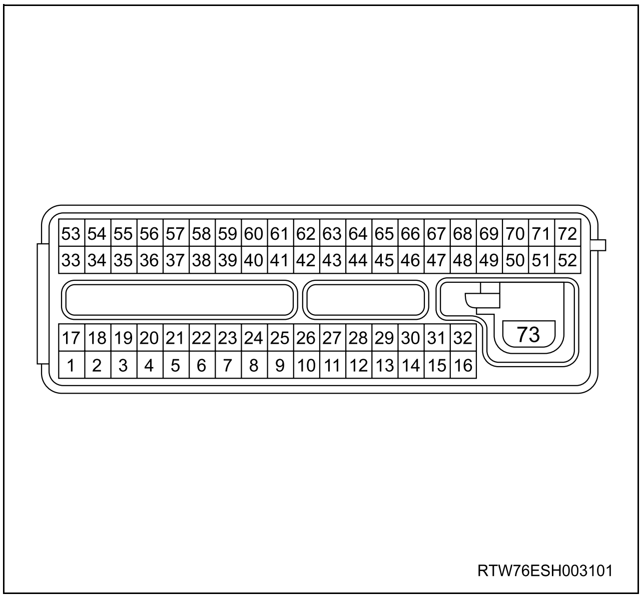


Legend

1. Fuel pump resistor (B type)

Engine Control Module (ECM) Connector End Views

Engine Control Module (ECM)-J1

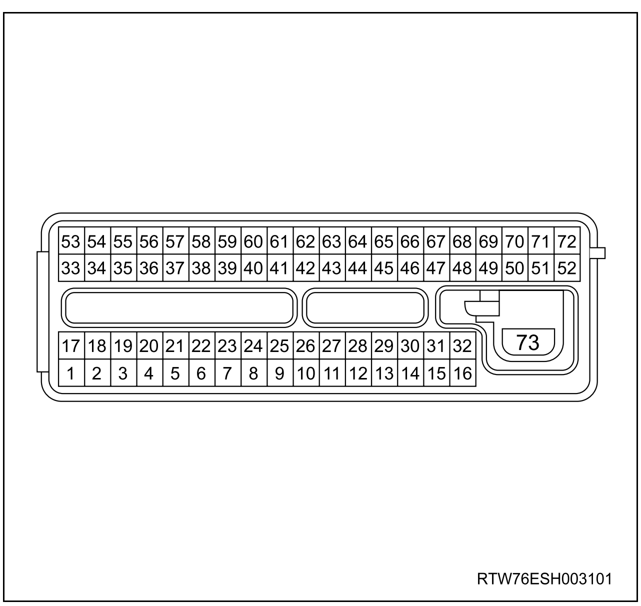


Connector No.		E-90
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	—	Not used
2	—	Not used
3	—	Not used
4	—	Not used
5	—	Not used
6	—	Not used
7	—	Not used
8	—	Not used
9	—	Not used
10	—	Not used
11	—	Not used
12	—	Not used
13	—	Not used
14	—	Not used
15	—	Not used
16	—	Not used
17	ORN	BARO sensor low reference
18	PNK/ GRN	BARO sensor signal
19	BLU/ GRN	BARO sensor 5V reference
20	GRN	Boost pressure sensor 5V reference
21	YEL	Boost pressure sensor signal

Pin No.	Wire Color	Pin Function
22	BLK	Boost pressure sensor shield ground
23	BLU	Boost pressure sensor low reference
24	YEL	Cylinder #2 fuel injector control
25	BRN	Cylinder #3 fuel injector control
26	WHT	ECT sensor low reference
27	GRN/ RED	ECT sensor signal
28	YEL/ RED	FT sensor low reference
29	PNK	FT sensor signal
30	RED	EGR position sensor low reference
31	WHT/ BLU	EGR position sensor 5V reference
32	GRY	EGR position sensor signal
33	BLU/ YEL	Cylinder #1 fuel injector control
34	BLU/ YEL	FRP regulator control high side
35	BLU	Intake throttle position sensor low reference
36	GRY	Intake throttle position sensor 5V reference
37	GRN	CKP sensor 5V reference
38	BLK	CKP sensor shield ground
39	BLU	CKP sensor low reference
40	ORN/ BLU	MAF sensor signal
41	BLU/ RED	IAT sensor signal
42	BLK	MAF sensor shield ground
43	WHT/ BLU	MAF sensor low reference
44	BLK	CMP sensor low reference
45	WHT	CMP sensor signal
46	RED	CMP sensor 5V reference
47	RED	FRP sensor 5V reference
48	WHT	FRP sensor signal
49	BLK	FRP sensor shield ground
50	BLU/ RED	FRP regulator low side
51	WHT	Cylinder #3 fuel injector charge voltage
52	BLU	Cylinder #1 fuel injector charge voltage
53	GRN	Cylinder #4 fuel injector control
54	BLK/ YEL	FRP regulator control high side
55	WHT	Intake throttle drive voltage
56	RED	Intake throttle control low side
57	ORN	Intake throttle position sensor signal

Pin No.	Wire Color	Pin Function
58	YEL	CKP sensor signal
59	PNK	Fuel filter switch signal
60	—	Not used
61	BLU/ GRN	IAT sensor low reference
62	BRN	EGR drive voltage
63	YEL	EGR control low side
64	BLK	CMP sensor shield ground
65	—	Not used
66	ORN/ BLK	Turbocharger nozzle control solenoid valve control
67	YEL	Swirl control solenoid valve control
68	WHT	FRP sensor signal
69	BLK	FRP sensor low reference
70	BLU/ RED	FRP regulator low side
71	RED	Cylinder #2 fuel injector charge voltage
72	PNK	Cylinder #4 fuel injector charge voltage
73	BLK	Ground

Engine Control Module (ECM)-J2

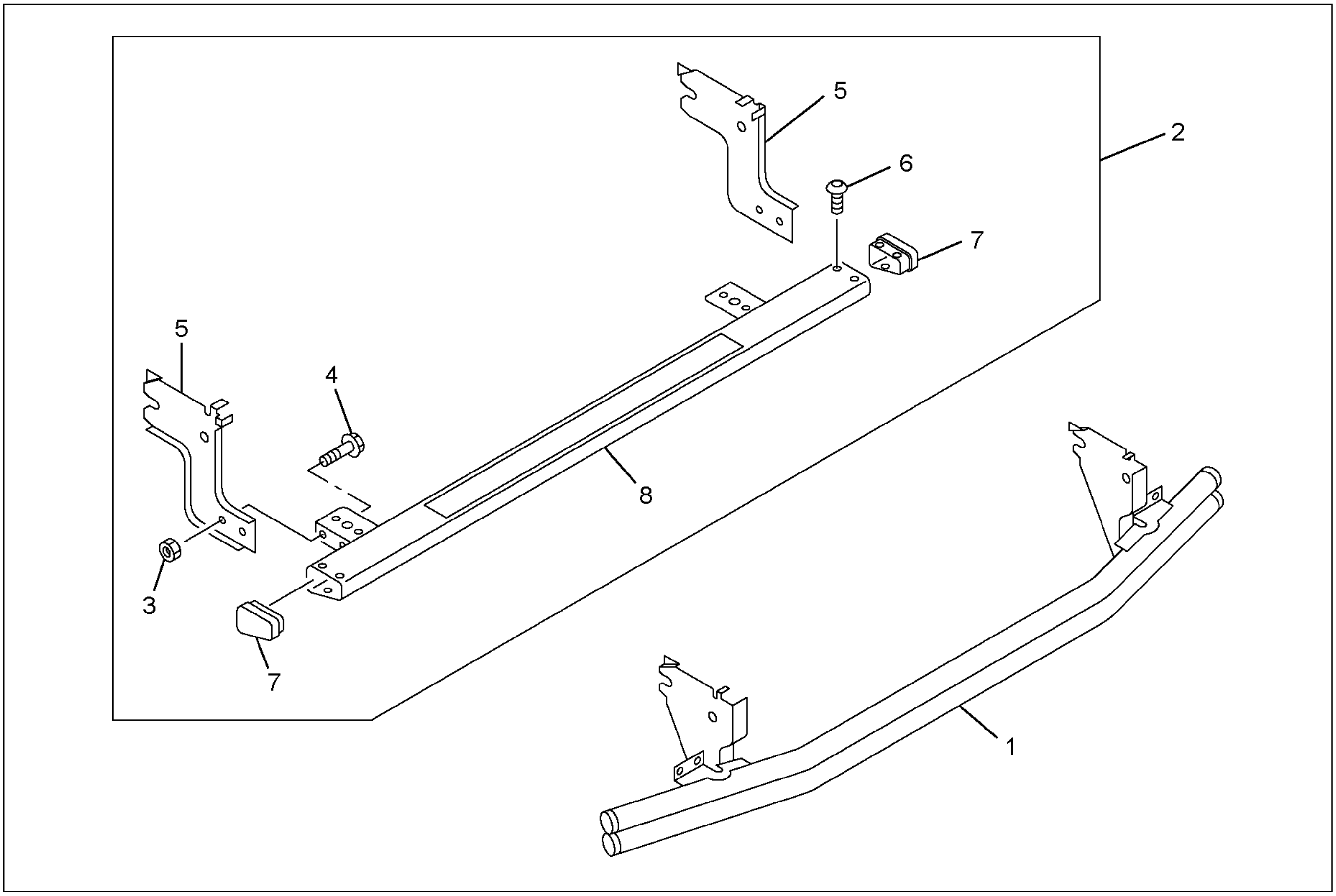


Connector No.		C-58
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	ORN	Brake switch 2 signal
2	BLK/ GRN	Diagnostic request switch

Pin No.	Wire Color	Pin Function
3	RED/ GRN	P or N range switch (A/T)
	BLK/ WHT	Neutral switch (M/T)
4	GRN/ BLK	Thermo relay signal
5	—	Not used
6	—	Not used
7	BLU	APP sensor 3 5V reference
8	BL/ UWHT	APP sensor 3 signal
9	ORN	APP sensor 2 5V reference
10	BLU/ GRN	APP sensor 2 signal
11	WHT	APP sensor 1 5V reference
12	RED	APP sensor 1 signal
13	GRY/ GRN	Cruise cancel switch signal
14	WHT/ GRN	Cruise main switch signal
15	—	Not used
16	—	Not used
17	—	Not used
18	—	Not used
19	YEL	Clutch switch signal
20	—	Not used
21	RED	Brake switch 1 signal
22	—	Not used
23	BLU/ RED	APP sensor 3 low reference
24	BLK	APP sensor 3 shield ground
25	ORN/ BLU	APP sensor 2 low reference
26	BLK	APP sensor 2 shield ground
27	BLK	APP sensor 1 low reference
28	BLK	APP sensor 1 shield ground
29	BRN/ YEL	Cruise resume switch signal
30	LT GRN	Cruise set switch signal
31	—	Not used
32	—	Not used
33	BLK/ RED	Engine speed signal output
34	—	Not used
35	ORN/ BLU	Starter cut relay control
36	—	Not used
37	BLK/ BLU	Glow relay control
38	—	Not used
39	—	Not used
40	—	Not used
41	—	Not used
42	—	Not used

REAR BUMPER AND REAR GUARD

REMOVAL AND INSTALLATION



RTW42AMF000201

Removal Steps

▲ 1. Rear guard assembly
▲ 2. Rear bumper assembly
3. Nut
4. Bolt
5. Bumper bracket
6. Screw
7. Cap
8. Rear bumper

Installation Steps

8. Rear bumper
7. Cap
6. Screw
5. Bumper bracket
4. Bolt
▲ 3. Nut
▲ 2. Rear bumper assembly
▲ 1. Rear guard assembly

Important Operations - Removal

1. Rear Guard Assembly

- Remove the 2 bolts from each side.

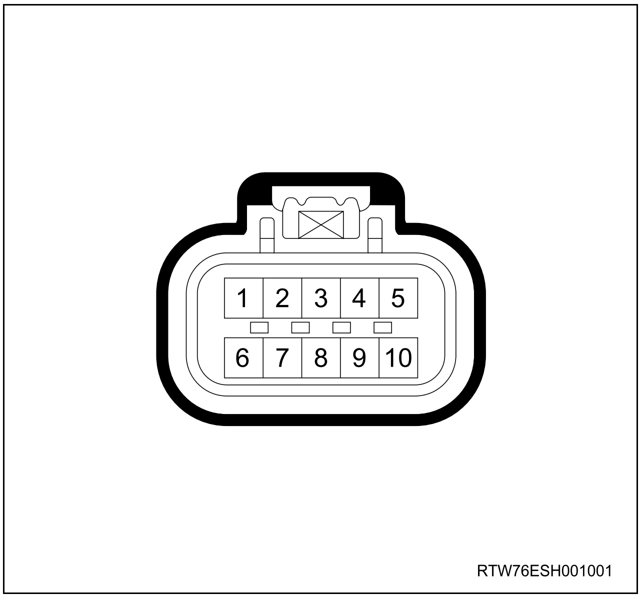
2. Rear bumper assembly

- Remove the 2 bolts from each side.

Pin No.	Wire Color	Pin Function
43	—	Not used
44	RED/ WHT	Starter switch signal
45	BLU/ RED	ECM main relay control
46	—	Not used
47	—	Not used
48	—	Not used
49	GRN/ YEL	Cruise set lamp control
50	GRN/ WHT	Cruise main lamp control
51	—	Not used
52	RED/ WHT	Battery voltage (Back-up)
53	—	Not used
54	ORN/ BLK	Fuel pump relay control
55	GRY/ RED	A/C compressor relay control
56	RED/ WHT	Accelerator pedal position signal output
57	BRN/ YEL	MIL control
58	—	Not used
59	—	Not used
60	—	Not used
61	—	Not used
62	BLK/ YEL	VSS signal
63	BLK	Ground
64	—	Not used
65	BLU/ RED	ECM main relay control
66	YEL	CAN High
67	BLU	CAN Low
68	—	Not used
69	BRN/ RED	Fuel filter lamp control
70	ORN/ WHT	Fuel consumption signal output
71	PNK/ WHT	SVS lamp control (Euro 4 specification)
72	WHT/ GRN	Ignition voltage
73	RED/ BLU	Battery voltage

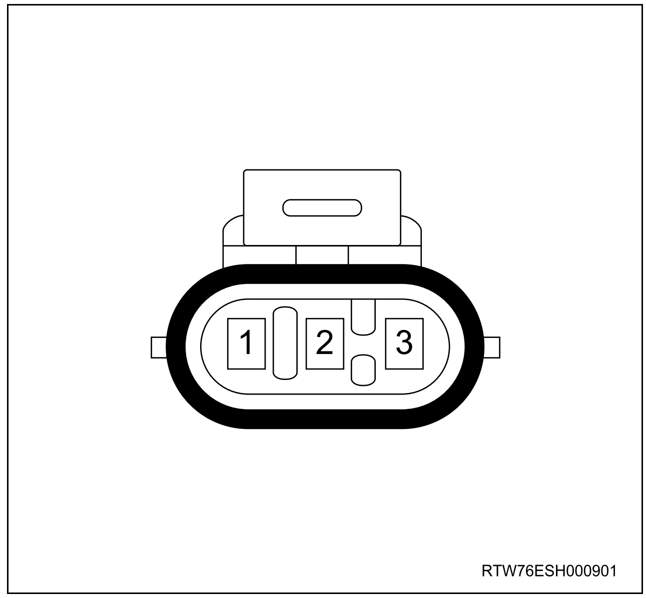
Engine Control Connector End Views

Accelerator Pedal Position (APP) Sensor



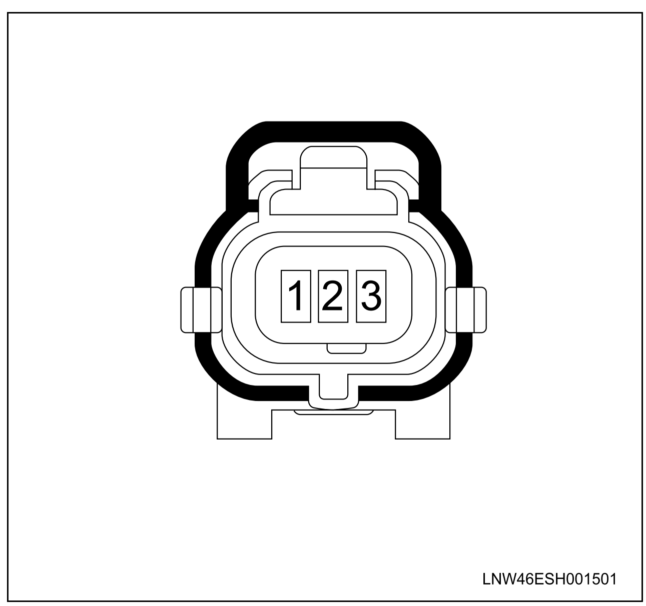
Connector No.		C-40
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLU	APP sensor 3 5V reference
2	—	Not used
3	ORN/ BLU	APP sensor 2 low reference
4	BLK	APP sensor 1 low reference
5	RED	APP sensor 1 signal
6	BLU/ WHT	APP sensor 3 signal
7	BLU/ RED	APP sensor 3 low reference
8	ORN	APP sensor 2 5V reference
9	BLU/ GRN	APP sensor 2 signal
10	WHT	APP sensor 1 5V reference

Barometric Pressure (BARO) Sensor



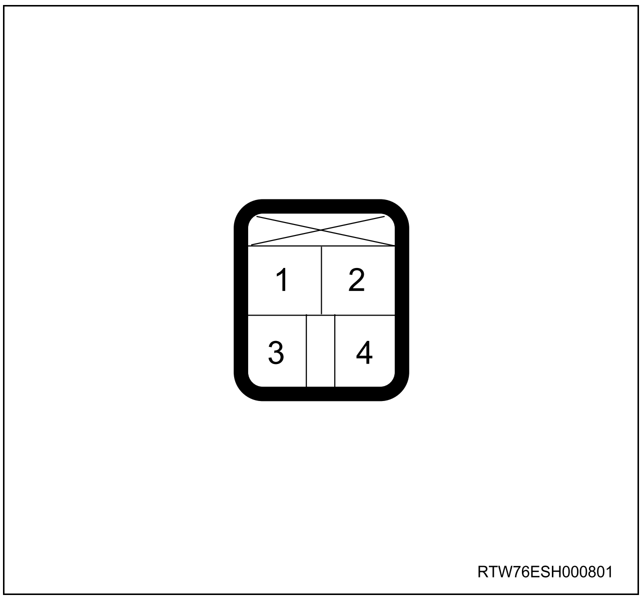
Connector No.		E-40
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	ORN	Sensor low reference
2	PNK/ GRN	Sensor signal
3	BLU/ GRN	Sensor 5V reference

Boost Pressure Sensor



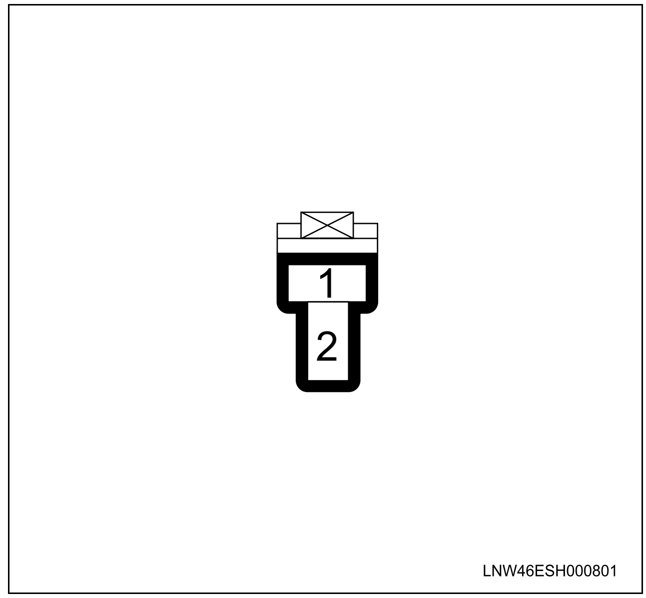
Connector No.		E-107
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5V reference

Brake Switch



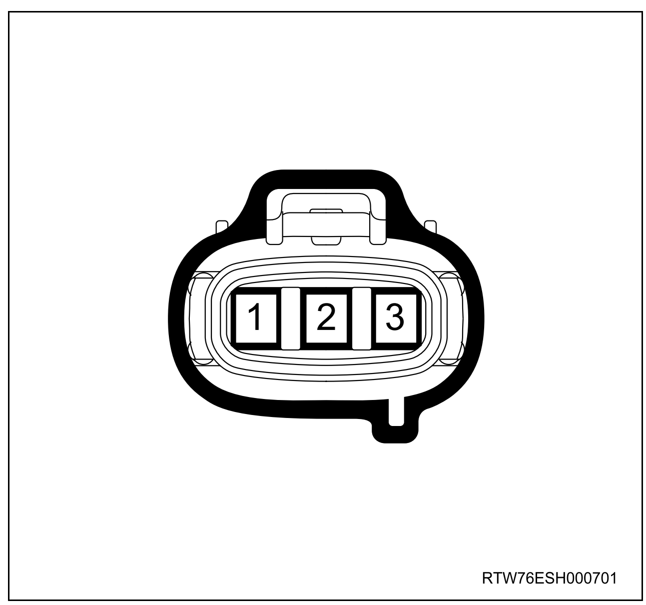
Connector No.		C-44
Connector Color		White
Test Adapter No.		J-35616-40 (Pin1-2) J-35616-2A (Pin3-4)
Pin No.	Wire Color	Pin Function
1	GRN	Switch 1 (stop lamp switch) battery voltage feed
2	RED	Switch 1 (stop lamp switch) signal
3	ORN	Switch 2 signal
4	WHT/ GRN	Brake switch 2 ignition voltage feed

Clutch Switch



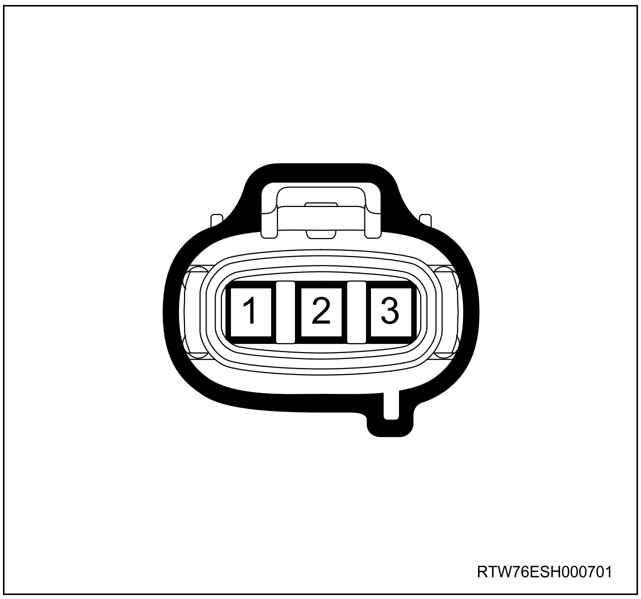
Connector No.		C-77
Connector Color		White
Test Adapter No.		J-35616-42
Pin No.	Wire Color	Pin Function
1	WHT/ GRN	Ignition voltage feed
2	YEL	Switch signal

Camshaft Position (CMP) Sensor



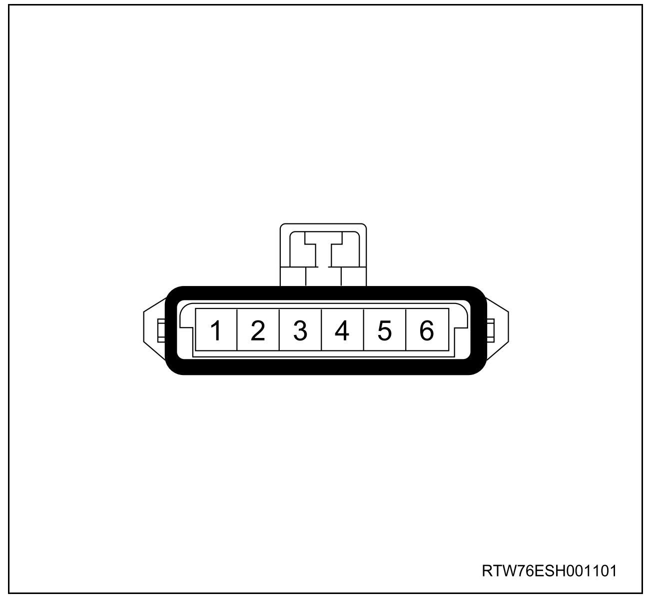
Connector No.		E-39
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	WHT	Sensor signal
2	BLK	Sensor low reference
3	RED	Sensor 5V reference

Crankshaft Position (CKP) Sensor



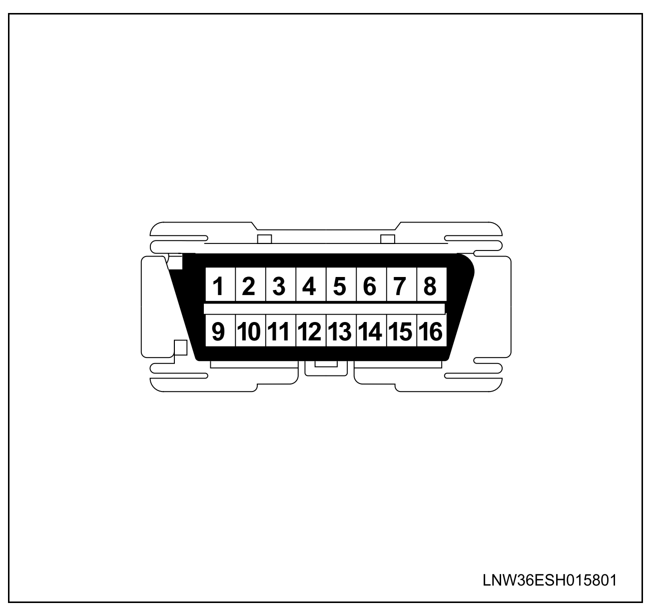
Connector No.		E-52
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Sensor signal
2	BLU	Sensor low reference
3	GRN	Sensor 5V reference

Cruise Main Switch



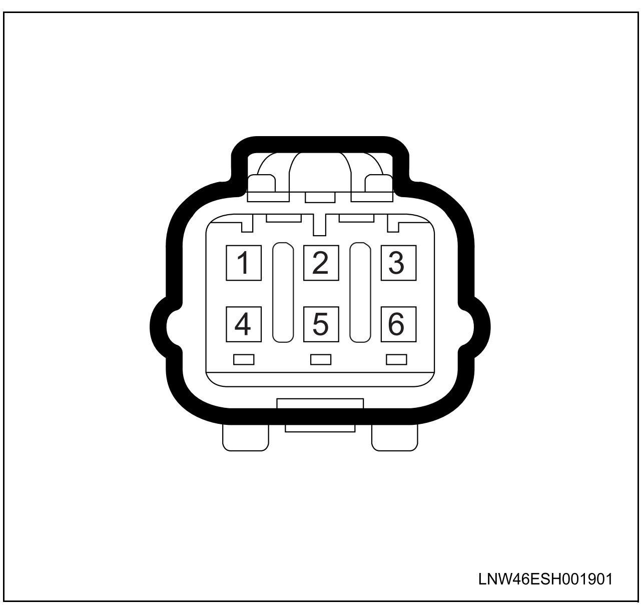
Connector No.		B-67
Connector Color		White
Test Adapter No.		J-35616-33
Pin No.	Wire Color	Pin Function
1	RED/ GRN	Illumination lamp ground
2	GRN/ RED	Illumination lamp voltage feed
3	WHT/ GRN	Cruise main switch signal
4	WHT/ GRN	Cruise main switch ignition voltage
5	—	Not used
6	GRN/ WHT	Cruise main switch ignition lamp ground

Data Link Connector (DLC)



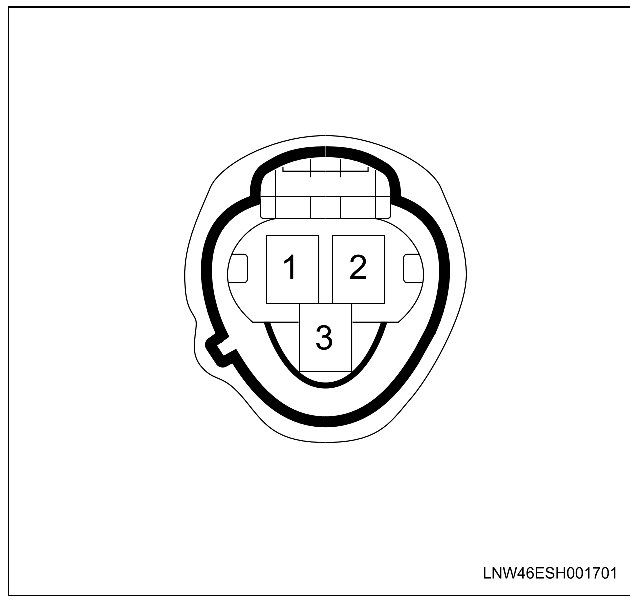
Connector No.		B-58
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin No.	Wire Color	Pin Function
1	BKL/ GRN	Diagnostic request switch (ECM)
2	—	Not used
3	—	Not used
4	BLK	Ground
5	BLK	Ground
6	BLU	CAN high
7	VIO/ GRN	Keyword serial data (TCM [standard output], EHCU [ABS module] and SRS control unit)
8	—	Not used
9	—	Not used
10	—	Not used
11	YEL/ BLK	Diagnostic request switch (TCM)
12	ORN/ WHT	Diagnostic request switch (EHCU [ABS module])
13	RED	Diagnostic request switch (SRS control unit)
14	YEL	CAN low
15	—	Not used
16	RED/ YEL	Battery voltage

EGR Valve



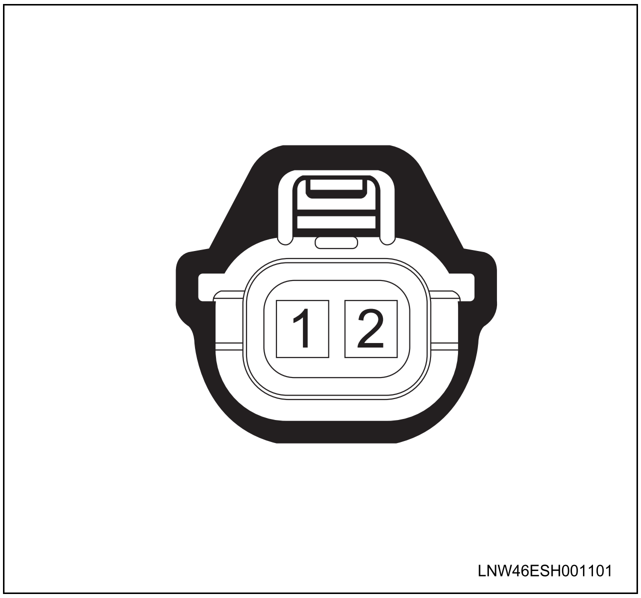
Connector No.		E-71
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	WHT/ BLU	Position sensor 5V reference
2	RED	Position sensor low reference
3	GRY	Position sensor signal
4	BRN	Solenoid drive voltage
5	—	Not used
6	YEL	Solenoid control low side (PWM)

Engine Coolant Temperature (ECT) Sensor



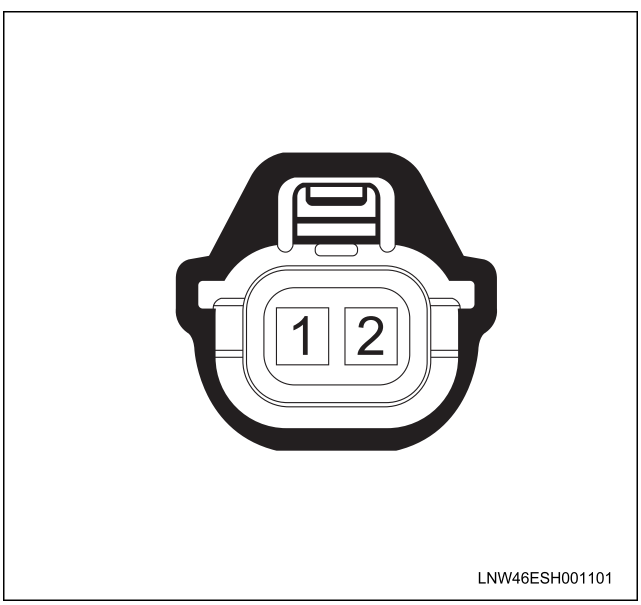
Connector No.		E-41
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	GRN/ RED	Sensor signal
2	WHT	Sensor low reference
3	YEL/ BLK	Gauge signal

Fuel Injector No.1 Cylinder



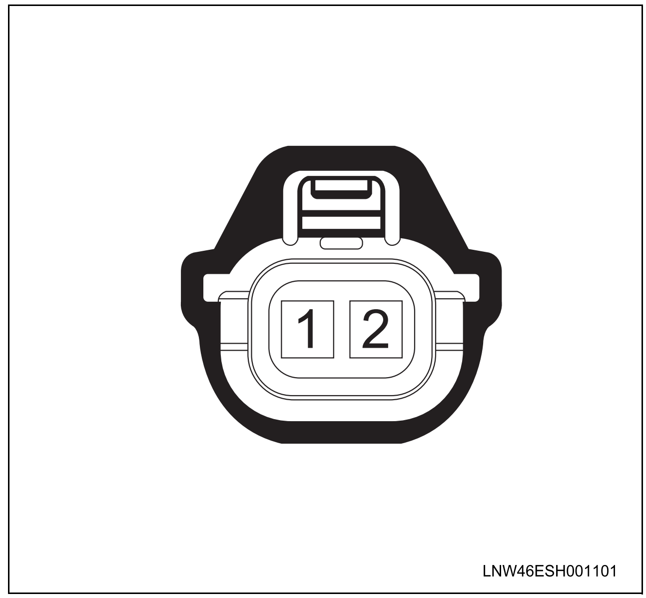
Connector No.		E-13
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLU/ YEL	Solenoid control
2	BLU	Charge voltage

Fuel Injector No.2 Cylinder



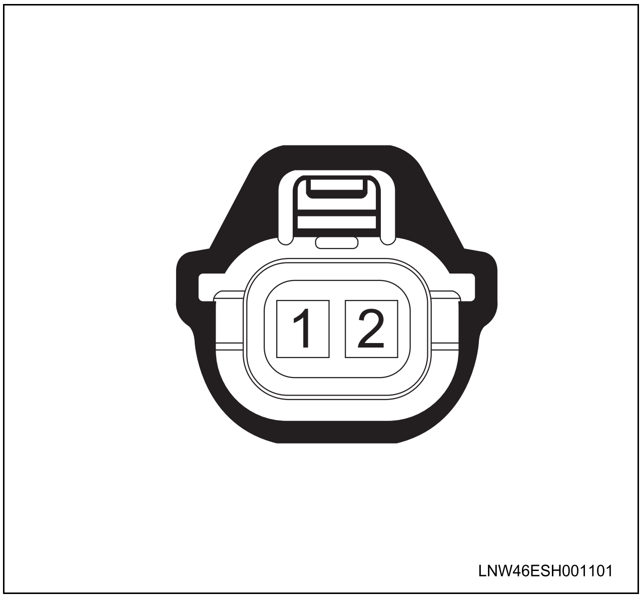
Connector No.		E-14
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Solenoid control
2	RED	Charge voltage

Fuel Injector No.3 Cylinder



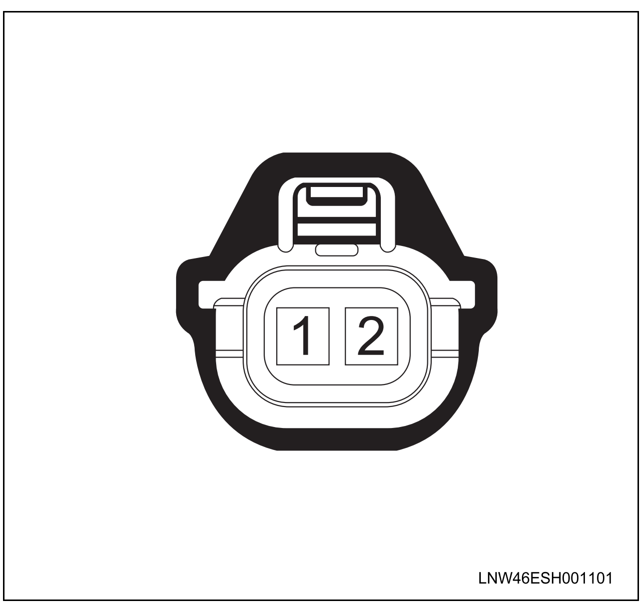
Connector No.		E-15
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BRN	Solenoid control
2	WHT	Charge voltage

Fuel Injector No.4 Cylinder



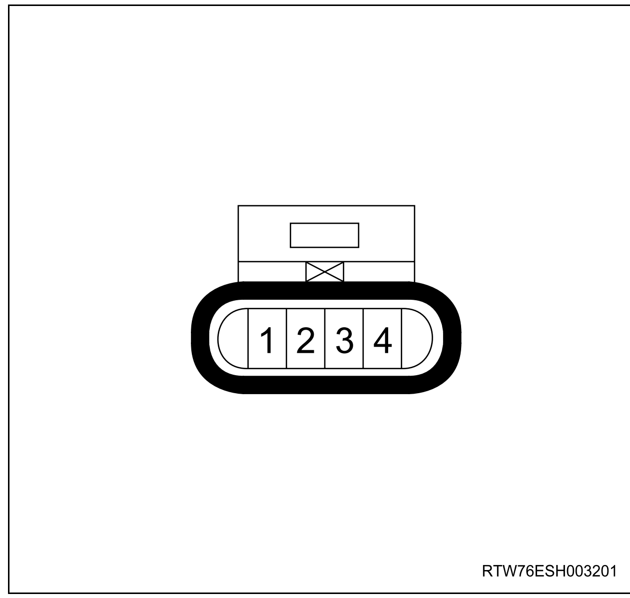
Connector No.		E-16
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	GRN	Solenoid control
2	PNK	Charge voltage

Fuel Rail Pressure (FRP) Regulator



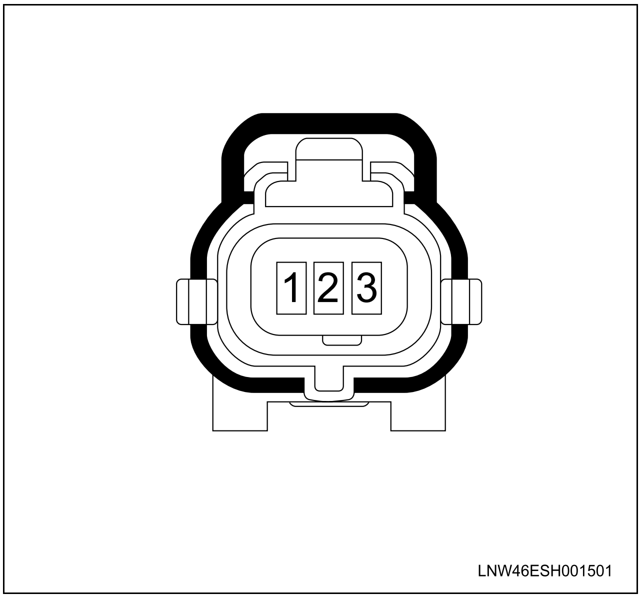
Connector No.		E-50
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLK/ YEL	Control high side (PWM)
2	BLU/ RED	Low side

Fuel Pump & Sender Assembly



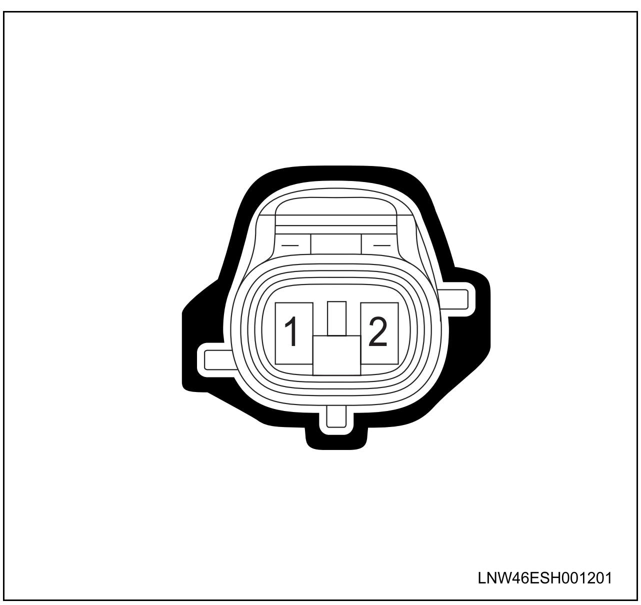
Connector No.		F-2
Connector Color		White
Test Adapter No.		J-35616-4A
Pin No.	Wire Color	Pin Function
1	ORN/ BLU	Fuel pump motor voltage feed
2	BLK	Fuel gauge ground
3	YEL/RED	Fuel gauge signal
4	BLK	Fuel pump motor ground

Fuel Rail Pressure (FRP) Sensor



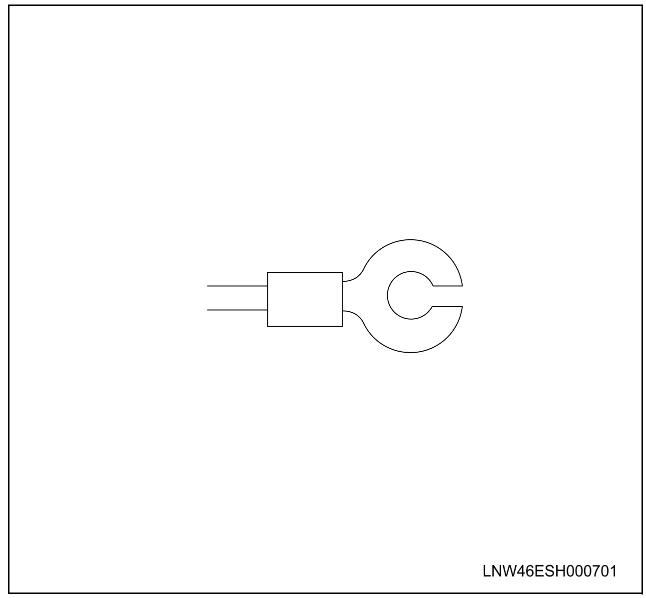
Connector No.		E-48
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	BLK	Sensor low reference
2	WHT	Sensor signal
3	RED	Sensor 5V reference

Fuel Temperature (FT) Sensor



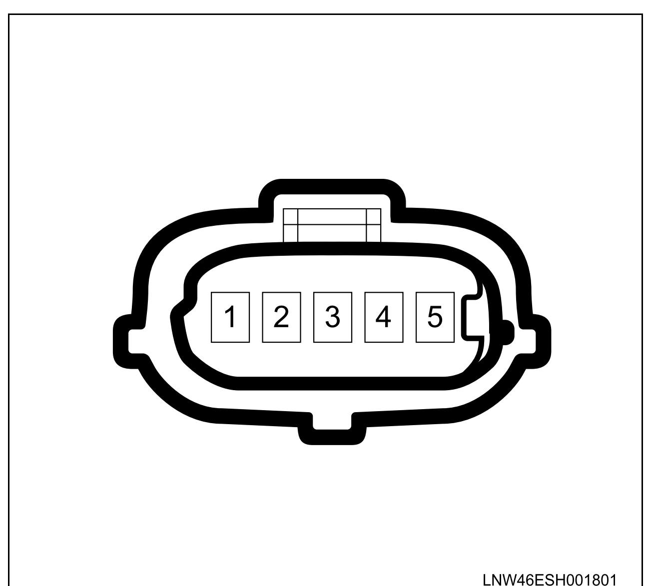
Connector No.		E-27
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL/ RED	Sensor low reference
2	PNK	Sensor signal

Glow Plug



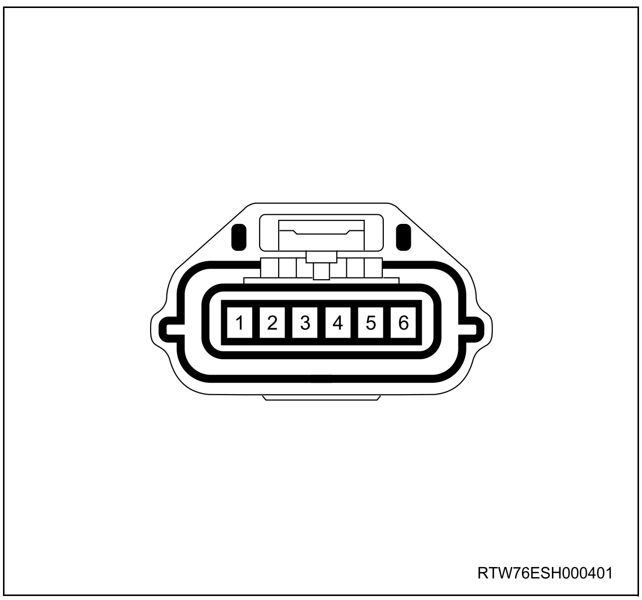
Connector No.		E-49
Connector Color		Silver
Pin No.	Wire Color	Pin Function
1	BLK/ RED	Power supply

Mass Air Flow (MAF)/ Intake Air Temperature (IAT) Sensor



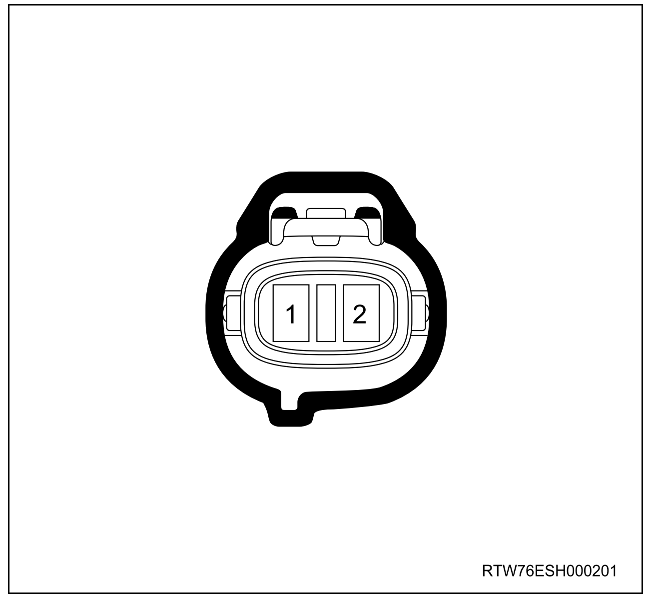
Connector No.		E-47
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	RED/ BLU	MAF sensor ignition voltage feed
2	WHT/ BLU	MAF sensor low reference
3	ORN/ BLU	MAF sensor signal
4	BLU/ RED	IAT sensor signal
5	BLU/ GRN	IAT sensor low reference

Intake Throttle Valve



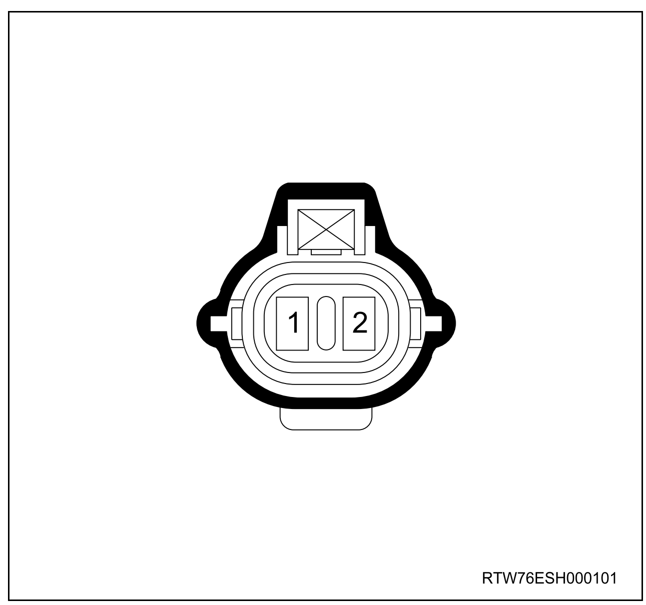
Connector No.		E-38
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	RED	Solenoid control low side (PWM)
2	WHT	Solenoid drive voltage
3	BLU	Position sensor low reference
4	—	Not used
5	ORN	Position sensor signal
6	GRY	Position sensor 5V reference

Swirl Control Solenoid Valve



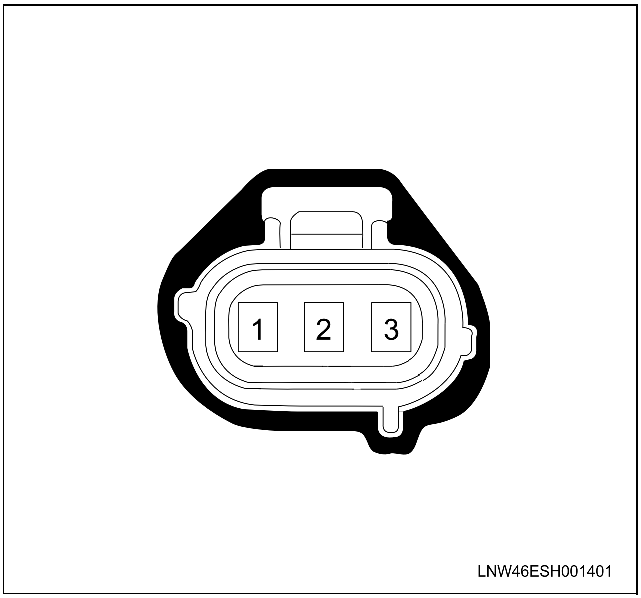
Connector No.		E-67
Connector Color		Brown
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Solenoid valve control
2	RED/ BLU	Ignition voltage feed

Turbocharger Nozzle Control Solenoid Valve



Connector No.		E-106
Connector Color		Brown
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL/ BLK	Solenoid valve control (PWM)
2	RED/ BLU	Ignition voltage feed

Vehicle Speed Sensor (VSS)



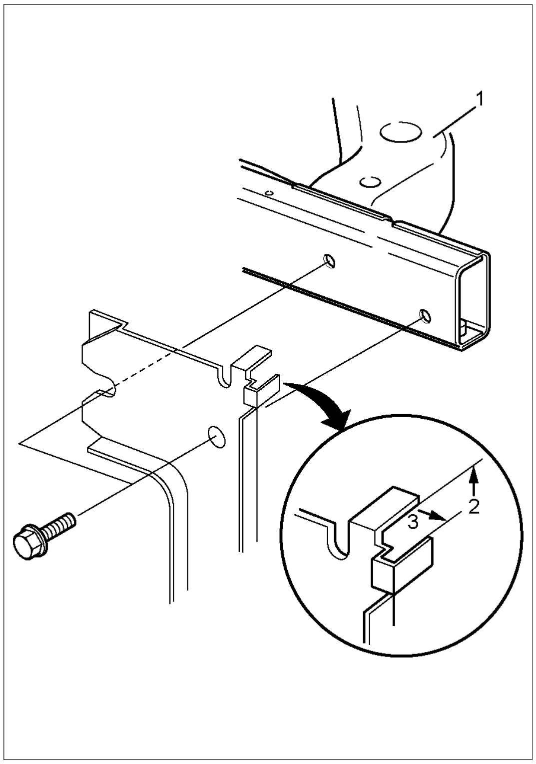
Connector No.		E-44
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	YEL	Ignition voltage feed
2	GRN/ WHT	Sensor low reference
3	BLK/ YEL	Sensor signal

Important Operations - Installation

3. Nut

- Tighten the fixing bolts to the specified torque.

Torque	N·m (kgf·m/lb·ft)
116 (11.8 / 85)	



RTW72AMH000201

2. Rear Bumper Assembly

1) Align the back bar to the frame (1) as follows:
   - Face A (2) should be contacted with the upper face of the frame
   - Face B (3) should be contacted with the rear end of the frame.
2) Tighten the 2 fixing bolts on the each side of back bar.

Torque	N·m (kgf·m/lb·ft)
150 (15.3 / 111)	

1. Rear Guard Assembly

1) Align the back bar to the frame (1) as follows:
   - Face A (2) should be contacted with the upper face of the frame
   - Face B (3) should be contacted with the rear end of the frame.
2) Tighten the 2 fixing bolts on the each side of back bar.

Torque	N·m (kgf·m/lb·ft)
150 (15.3 / 111)	

Diagnostic Information and Procedures

Engine Control System Check Sheet

ENGINE CONTROL SYSTEM CHECK SHEET		Inspectors Name	
Customer's Name		Model & Model Year	
Driver's Name		Chassis No.	
Date Vehicle Brought In		Engine No.	
License No.		Odometer Reading	Km/miles

Problem Symptoms	☐ Engine Does Not Run	☐ Engine does not crank	☐ No initial combustion	☐ No complete combustion
	☐ Hard Start	☐ Engine cranks slowly	☐ Other (	)
	☐ Incorrect Idle	☐ Abnormal idling speed ☐ Rough idling ☐ Other (	☐ High idling speed (RPM)	☐ Low idling speed (RPM))
	☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Lack of power, sluggishness, sponginess ☐ Other (	☐ Surge	☐ Cut out)
	☐ Engine Stall	☐ Soon after starting ☐ During A/C operation ☐ Other (	☐ After accelerator pedal depressed ☐ After accelerator pedal released	 ☐ Shifting from N to D)
	☐ Others	☐ Black smoke ☐ Fuel knock, combustion noise ☐ Other (	☐ White smoke	☐ Poor fuel economy)

Dates problem occurred					
Problem frequency		☐ Constant ☐ Other (	☐ Intermittently (times per day/month)		☐ Once only)
Condition When Problem Occurs	Weather	☐ Fine ☐ Various/Other (	☐ Cloudy	☐ Rainy	☐ Snow)
	Outside Temperature	☐ Hot (approx.) ☐ Any temperature	☐ Warm	☐ Cool	☐ Cold (approx.)
	Place	☐ Highway ☐ Downhill	☐ Suburbs ☐ Rough road	☐ City area ☐ Other (	☐ Uphill)
	Load Condition	☐ Over (approx. tons) ☐ Other (approx. tons)		☐ No load	
	Engine Temperature	☐ Cold ☐ Other (	☐ Warming up	☐ After warming up	☐ Any temperature)
	Engine Operation	☐ Starting ☐ Racing ☐ Deceleration ☐ Other (	☐ Just after starting (Min.) ☐ Driving ☐ A/C switch On/Off	 ☐ Constant speed	☐ Idling ☐ Acceleration)
	Fuel Amount	☐ Full	☐ Above 1/2	☐ Below 1/2	☐ Near empty
	Fuel Bland				

Condition of MIL or SVS lamp		☐ Remains On	☐ Intermittently turns On	☐ Does not turn On
DTC or Flash Code	Present Code	☐ Nothing	☐ P or U Code No. (	)
	History Code	☐ Nothing	☐ P or U Code No. (	)
Other Additional Condition				

Diagnostic Starting Point - Engine Controls

Begin the system diagnosis with Diagnostic System Check - Engine Controls. The Diagnostic System Check - Engine Controls will provide the following information:

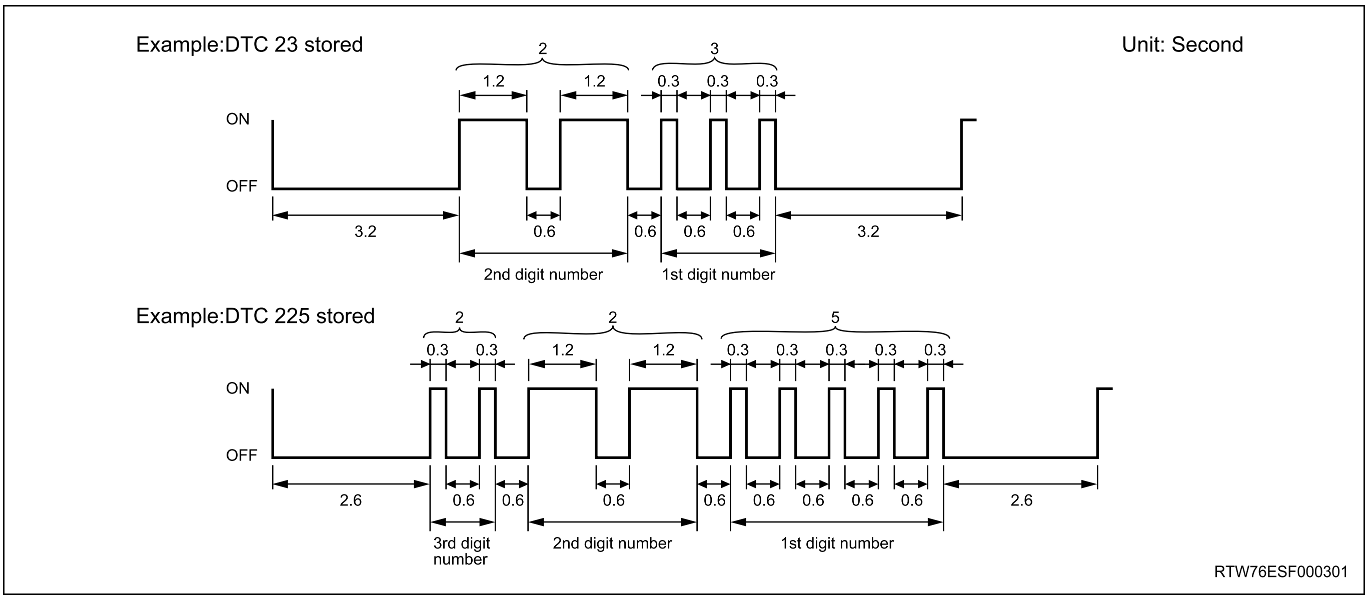
- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

The use of the Diagnostic System Check - Engine Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

Important: Engine Control System Check Sheet must be used to verify the complaint vehicle, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

Reading Flash Diagnostic Trouble Codes (DTC)

The provision for communicating with the ECM is the Data Link Connector (DLC). The DTC(s) stored in the ECM memory can be read either through a hand-held diagnostic scanner such as Tech 2 plugged into the DLC or by counting the number of flashes of the malfunction indicator lamp (MIL) or the service vehicle soon (SVS) lamp when the diagnostic test terminal of the DLC is grounded. The DLC terminal "1" (diagnostic request) is pulled "Low" (grounded) by jumped to DLC terminal "4", which is a ground wire. Once terminals "1" and "4" have been connected, turn the ignition switch ON, with the engine OFF. The MIL (except Euro 4 specification) or the SVS lamp (Euro 4 specification) will indicate a DTC three times is a DTC is present and history. If more than one DTC has been stored in the ECM's memory, the DTCs will be output set order with each DTC being displayed three times. The flash DTC display will continue as long as the DLC is shorted.



Diagnostic System Check - Engine Controls

Description

The Diagnostic System Check - Engine Controls is an organized approach to identifying a condition that is created by a malfunction in the electronic engine control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.
2. Lack of communication may be because of a partial or a total malfunction of the serial data circuit.
7. The presence of DTCs which begin with U, indicate that some other module is not communicating.
10. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order:

- Component level DTCs, such as sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs. Diagnose the multiple DTCs within this category in numerical order. Begin with the lowest numbered DTC, unless the diagnostic table directs you otherwise.

Diagnostic System Check Engine Controls Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- If there is a condition with the starting system, refer to the starting system section in the engine mechanical.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the ECM grounds are clean, tight, and in the correct location.
- Ensure the ECM harness connectors are clean and correctly connected. DO NOT attempt to crank the engine with ECM harness connectors disconnect.
- Ensure the ECM terminals are clean and correctly mating.
- Ensure the fuel injector ID code data is correctly programmed in to the ECM.
- Ensure the immobilizer security information is correctly programmed into the ECM and immobilizer control unit (ICU).
- If there are fuel system DTC's (P0087, P0088, P0089, P0093, P1093 or P1094), diagnose sensor DTCs, solenoid DTCs, actuator DTCs and relay DTCs first.

Diagnostic System Check - Engine Controls

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to Scan Tool Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. • ECM • Immobilizer control unit (ICU) (If so equipped) • Transmission control module (TCM) (AISIN A/T only) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with CAN Device

Step	Action	Value(s)	Yes	No
3	**Notice:** If an immobilizer system is active the ECM will disable the fuel injection causing the engine to stall immediately after starting and energize the starter cut relay to disable cranking. Attempt to crank the engine. Does the engine crank?	—	Go to Step 4	Go to Step 5
4	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 6	Go to Engine Cranks but Does Not Run
5	Does the scan tool display ECM DTCs P0615, P0633, P161B or U0167?	—	Go to Applicable DTC	Problem is relating to starting system. Refer to the applicable diagnostic chart in starting system
6	Select the DTC display function for the following control modules: • ECM • ICU (If so equipped) • TCM (AISIN A/T only) Does the scan tool display any DTCs?	—	Go to Step 7	Go to Step 11
7	Does the scan tool display DTCs which begin with U or other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 8
8	Does the scan tool display ECM DTCs P0601, P0602, P0604, P0606 or P1621?	—	Go to Applicable DTC	Go to Step 9
9	Does the scan tool display ECM DTCs P0562 or P0563, P156A or P156B?	—	Go to Applicable DTC	Go to Step 10
10	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 11
11	Is the customer's concern with the automatic transmission?	—	Go to Diagnostic System Check - Transmission Controls	Go to Step 12
12	Is the customer's concern with the immobilizer system?	—	Go to Diagnostic System Check - Immobilizer Controls	Go to Step 13
13	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • High Idle Speed • Cuts Out • Surges • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Abnormal Combustion Noise • Poor Fuel Economy • Excessive Smoke (Black Smoke) • Excessive Smoke (White Smoke) Did you find and correct the condition?	—	System OK	Go to Intermittent Conditions

Scan Tool Data List

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together. Use the Engine Scan Tool Data List only after the following is determined:

- The Engine Controls - Diagnostic System Check is completed.
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Operating Conditions: Engine idling or 2000RPM/ Engine coolant temperature is between 75 to 85°C (167 to 185°F)/ Accelerator pedal is constant/ Neutral or Park/ Accessories OFF/ Vehicle located at sea level			
Engine Speed	RPM	Nearly 700 RPM	Nearly 2000 RPM
Desired Engine Idle Speed	RPM	700 RPM	700 RPM
Calculated Engine Load	%	-	-
Coolant Temperature	°C/ °F	75 to 85 °C/ 167 to 185°F	75 to 85 °C/ 167 to 185°F
Engine Coolant Temperature Sensor	Volts	0.4 to 0.6 volts	0.4 to 0.6 volts
Intake Air Temperature	°C/ °F	20 to 40 °C/ 68 to 104 °F	20 to 40 °C/ 68 to 104 °F
Intake Air Temperature Sensor	Volts	1.4 to 2.3 volts	1.4 to 2.3 volts
Fuel Temperature	°C/ °F	20 to 60 °C/ 68 to 140 °F	20 to 60 °C/ 68 to 140 °F
Fuel Temperature Sensor	Volts	0.8 to 2.3 volts	0.8 to 2.3 volts
MAF (Mass Air Flow)	g/sec	300 to 600 g/sec	200 to 600 g/sec
MAF Sensor (Mass Air Flow)	Volts	1.2 to 1.6 volts	2.0 to 2.7 volts
Barometric Pressure	kPa/psi	Nearly 100 kPa/ 14.5 psi at sea level	Nearly 100 kPa/ 14.5 psi at sea level
Barometric Pressure Sensor	Volts	Nearly 2.3 volts at sea level	Nearly 2.3 volts at sea level
Turbocharger Solenoid Command	%	50 to 60 %	50 to 60 %
Desired Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 120 kPa/ 17.4 psi
Boost Pressure	kPa/ psi	Nearly 100 kPa/ 14.5 psi at sea level	Less than 120 kPa/ 17.4 psi
Boost Pressure Sensor	Volts	Nearly 1.0 volt	Less than 1.3 volts
Desired Fuel Rail Pressure	MPa/ psi	30 MPa/ 4,350 psi	More than 70 MPa/ 10,200 psi (4JJ1 Euro 4 specification) More than 50 MPa/ 7,250 psi (4JJ1 except Euro 4 specification) More than 60 MPa/ 8,700 psi (4JK1)
Fuel Rail Pressure	MPa/ psi	27 to 33 MPa/ 3,900 to 4,800 psi	More than 70 MPa/ 10,200 psi (4JJ1 Euro 4 specification) More than 50 MPa/ 7,250 psi (4JJ1 except Euro 4 specification) More than 60 MPa/ 8,700 psi (4JK1)

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Fuel Rail Pressure Sensor	Volts	1.4 to 1.5 volts	More than 2.1 volts (4JJ1 Euro 4 specification) More than 1.8 volts (4JJ1 except Euro 4 specification) More than 1.9 volts (4JK1)
FRP Regulator Command (Fuel Rail Pressure)	%	35 to 50 %	35 to 45 %
FRP Regulator Commanded Fuel Flow	mm^3/sec	More than 1,000 mm^3/sec	More than 2,000 mm^3/sec
FRP Regulator Feedback (Fuel Rail Pressure)	mA	1,600 to 2,000 mA	1,500 to 1,800 mA
Accelerator Pedal Position	%	0%	10 to 25 %
APP Sensor 1 (Accelerator Pedal Position)	Volts	0.2 to 1.0 volts	1.0 to 1.7 volts
APP Sensor 2 (Accelerator Pedal Position)	Volts	3.8 to 4.6 volts	3.3 to 3.9 volts
APP Sensor 3 (Accelerator Pedal Position)	Volts	3.8 to 4.6 volts	3.7 to 4.0 volts
EGR Solenoid Command	%	Less than 30 %	Less than 30 %
Desired EGR Position	%	Less than 70 %	Less than 80 %
EGR Position	%	Less than 70 %	Less than 80 %
EGR Position Sensor	Volts	Less than 2.9 volts	Less than 3.1 volts
Intake Throttle Solenoid Command	%	Less than 30 %	Less than 40 %
Desired Intake Throttle Position	%	Less than 30 %	Less than 80 %
Intake Throttle Position	%	Less than 30 %	Less than 80 %
Intake Throttle Position Sensor	Volts	Less than 1.6 volts	Less than 3.3 volts
Desired Injection Quantity	mm^3	7 to 12 mm^3	7 to 12 mm^3
Main Injection Quantity	mm^3	3 to 8 mm^3	5 to 10 mm^3
Main Injection Timing	°CA	2 to 12 °CA	0 to 10 °CA
Main Injection On Time	ms	600 to 800 ms	400 to 550 ms
Pre Injection Quantity	mm^3	1 to 4 mm^3	2 to 4 mm^3
Pre Injection Interval	°CA	3 to 20 °CA	10 to 30 °CA
Fuel Compensation Cyl. 1	mm^3	-5.0 to 5.0 mm^3 (varies)	0.0 mm^3
Fuel Compensation Cyl. 2	mm^3	-5.0 to 5.0 mm^3 (varies)	0.0 mm^3
Fuel Compensation Cyl. 3	mm^3	-5.0 to 5.0 mm^3 (varies)	0.0 mm^3
Fuel Compensation Cyl. 4	mm^3	-5.0 to 5.0 mm^3 (varies)	0.0 mm^3
Cylinder Balancing Update	Enabled/ Disabled	Enabled	Disabled
Fuel Supply Pump Status	Not Learn/ Learning/ Learned	Learning or Learned	Learning or Learned
Rail Pressure Feedback Mode	Wait Mode/ Feedback Mode/ Shutoff Mode	Feedback Mode	Feedback Mode
Engine Running Status	Off/ Ignition On/ Cranking/ Running	Running	Running

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Cam/ Crank Sensor Signal Synchronization Status	Asynchronous/ No Crank Signal/ Synchronous	Synchronous	Synchronous
Engine Runtime	Time (hour: minute: second)	Varies	Varies
Vehicle Speed	km/h / MPH	0 km/h / 0 MPH	0 km/h / 0 MPH
Transmission Gear	Out of gear/ 1st/ 2nd/ 3rd/ 4th/ 5th	Out of gear	Out of gear
Starter Switch	On/Off	On	On
Ignition Switch	On/Off	On	On
Ignition Voltage	Volts	11.0 to 15.0 volts	11.0 to 15.0 volts
Battery Voltage	Volts	11.0 to 15.0 volts	11.0 to 15.0 volts
Fuel Pump Relay Command	On/ Off	On	On
Swirl Control Solenoid Command	On/ Off	On	On
Fuel Filter Switch	On/ Off	On	On
A/C Request Signal	On/ Off	Off	Off
A/C Relay Command	On/ Off	Off	Off
Park/ Neutral Switch	Neutral/ In Gear	Neutral	Neutral
Glow Relay Command	On/ Off	Off	Off
Glow Plug Lamp Command	On/ Off	Off	Off
Brake Switch 1	Applied/ Released	Released	Released
Brake Switch 2	Applied/ Released	Released	Released
Clutch Pedal Switch	Applied/ Released	Released	Released
Cruise Main Lamp Command	On/ Off	Off	Off
Cruise Main Switch	On/ Off	Off	Off
Cruise Cancel Switch	On/ Off	On	On
Cruise Resume Switch	On/ Off	Off	Off
Cruise Set Switch	On/ Off	Off	Off
MIL Command (Malfunction Indicator Lamp)	On/ Off	Off	Off
SVS Lamp Command (Service Vehicle Soon)	On/ Off	Off	Off
Limp Home Mode	None/ 1/ 2/ 3/ 4	None	None
Distance While MIL is Activated	km/ Mile	0 km/ 0 Mile	0 km/ 0 Mile
Engine Runtime With MIL Active	minutes	0	0
Total Engine Overspeed Event	Counter	Varies	Varies
Total Engine Coolant Overtemperature Event	Counter	Varies	Varies
Total Fuel Temperature Overtempeatrure Event	Counter	Varies	Varies
Total Intake Air Temperature Overtemperaure Event	Counter	Varies	Varies
Immobilizer Function Programmed	Yes/ No	Yes	Yes
Wrong Immobilizer Signal	Yes/ No	No	No

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 2000RPM
Immobilizer Signal	Yes/ No	Yes	Yes
Security Wait Time	Inactive/ Time (hour: minute: second)	Inactive	Inactive

Scan Tool Data Definitions

This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnostic System Check - Engine Controls first. The Diagnostic System Check will confirm proper system operation.

Engine Speed
This parameter displays the rotational speed of the crankshaft as calculated by the ECM based on inputs from the crankshaft position (CKP) sensor or camshaft position (CMP) sensor.

Desired Idle Speed
This parameter displays the idle speed requested by the ECM. The ECM will change desired idle speed based on engine coolant temperature and other inputs.

Calculate Engine Load
This parameter displays the engine load in percent based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the engine is at idle with little or no load. The scan tool will display a higher percentage when the engine is running at high engine speed under a heavy load.

Coolant Temperature
This parameter displays the temperature of the engine coolant as calculated by the ECM using the signal from the engine coolant temperature (ECT) sensor. The scan tool will display a low temperature when the ECT sensor signal voltage is high, and a high temperature when the ECT sensor signal voltage is low.

Engine Coolant Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the engine coolant temperature (ECT) sensor. ECT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Intake Air Temperature
This parameter displays the temperature of the intake air as calculated by the ECM using the signal from the intake air temperature (IAT) sensor. The scan tool will display a low temperature when the IAT sensor signal voltage is high, and a high temperature when the IAT sensor signal voltage is low.

Intake Air Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the intake air temperature (IAT) sensor. IAT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

Fuel Temperature
This parameter displays the temperature of the fuel as calculated by the ECM using the signal from the fuel temperature (FT) sensor. The scan tool will display a low temperature when the FT sensor signal voltage is high, and a high temperature when the FT sensor signal voltage is low.

Fuel Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the fuel temperature (FT) sensor. FT sensor is a range of value indicating a low voltage when the temperature is high, and a high voltage when the temperature is low.

MAF (Mass Air Flow)
This parameter displays the air flow into the engine as calculated by the ECM based on the mass air flow (MAF) sensor input. The scan tool will display a high value at higher engine speeds, and a low value at lower engine speed.

MAF Sensor (Mass Air Flow)
This parameter displays the voltage signal sent to the ECM from the mass air flow (MAF) sensor. MAF sensor is a range of value indicating a low voltage at lower engine speed, and a high voltage at a higher engine speeds.

Barometric Pressure
This parameter displays the barometric pressure (BARO) as calculated by the ECM using the signal from the BARO sensor. The scan tool will display a low barometric pressure in high altitude area.

Barometric Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the barometric pressure (BARO) sensor. BARO sensor is a range of value indicating a low voltage in high altitude area, and a middle voltage in sea level.

Turbocharger Solenoid Command
This parameter displays the turbocharger nozzle control solenoid valve control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the nozzle is controlled to open (vacuum pressure supply to the actuator is reduced). The scan tool will display a higher percentage when the nozzle is controlled to close (vacuum pressure supply to the actuator is increased).

Desired Boost Pressure
This parameter displays boost pressure desired by the ECM based on current driving conditions. This can be compared to the actual boost pressure to determine sensor accuracy or turbocharger control problems.

Boost Pressure
This parameter displays the boost pressure in the intake duct as calculated by the ECM using the signal from the boost pressure sensor. The scan tool will display a low boost pressure when the low engine load, and a high boost pressure when the high engine load. Note that the true boost pressure is determined by subtracting barometric pressure from the actual reading.

Boost Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the boost pressure sensor. Boost pressure sensor is a range of value indicating a low voltage when the boost pressure is low (idle or lower engine load) and a high voltage when the boost pressure is high (higher engine load).

Desired Fuel Rail Pressure
This parameter displays fuel rail pressure desired by the ECM based on current driving conditions. This can be compared to the actual fuel rail pressure to determine sensor accuracy or fuel pressure control problems.

Fuel Rail Pressure
This parameter displays the fuel rail pressure as calculated by the ECM using the signal from the fuel rail pressure (FRP) sensor. The scan tool will display a low pressure when the low engine load, and a high pressure when the high engine load.

Fuel Rail Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the fuel rail pressure (FRP) sensor. FRP sensor is a range of value indicating a low voltage when the fuel rail pressure is low, and a high voltage when the fuel rail pressure is high.

FRP Commanded Fuel Flow (Fuel Rail Pressure)
This parameter displays the commanded fuel flow quantity of the fuel rail pressure (FRP) regulator to the fuel rail.

FRP Regulator Command (Fuel Rail Pressure)
This parameter displays the fuel rail pressure (FRP) regulator control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The scan tool will display higher percentage when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

FRP Regulator Feedback (Fuel Rail Pressure)
This parameter displays the fuel rail pressure (FRP) regulator control feedback current as measured by the ECM. The scan tool will display a low current when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The scan tool will display a high current when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

Accelerator Pedal Position
This parameter displays the angle of the accelerator pedal as calculated by the ECM using the signals from the accelerator pedal position (APP) sensors. The scan tool will display linearly from 0 to 100% according to the pedal operation.

APP Sensor 1 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 1 of the APP sensor assembly. APP sensor 1 is a range of value indicating a low voltage when the accelerator pedal is not depressed, and a high voltage when the accelerator pedal is fully depressed.

APP Sensor 2 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of value indicating a high voltage when the accelerator pedal is not depressed, and a low voltage when the accelerator pedal is fully depressed.

APP Sensor 3 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 3 of the APP sensor assembly. APP sensor 3 is a range of value indicating a high voltage when the accelerator pedal is not depressed, and a middle voltage when the accelerator pedal is fully depressed.

EGR Solenoid Command
This parameter displays the EGR solenoid valve control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the EGR solenoid valve is controlled to close (EGR gas supply to the intake is reduced). The scan tool will display a higher percentage when the EGR solenoid valve is controlled to open (EGR gas supply to the intake is increased).

Desired EGR Position
This parameter displays EGR position desired by the ECM based on current driving conditions. This can be compared to the actual EGR position to determine sensor accuracy or EGR control problems.

EGR Position
This parameter displays the EGR valve position calculated by the ECM using the signal from EGR position sensor. The scan tool will display a low percentage when the EGR valve is closed, and a high percentage when the ERG valve is opened.

EGR Position Sensor
This parameter displays the voltage signal sent to the ECM from the EGR position sensor. EGR position sensor is a range of value indicating a low voltage when the EGR valve is closed, and a high voltage when the EGR valve is opened.

Intake Throttle Solenoid Command
This parameter displays the intake throttle solenoid valve control duty ratio based on inputs to the ECM from various engine sensors. The scan tool will display a lower percentage when the intake throttle solenoid valve is controlled to open. The scan tool will display a higher percentage when the intake throttle solenoid valve is controlled to close.

Desired Intake Throttle Position
This parameter displays intake throttle position desired by the ECM based on current driving conditions. This can be compared to the actual intake throttle position to determine sensor accuracy or intake throttle control problems.

Intake Throttle Position
This parameter displays the intake throttle valve position calculated by the ECM using the signal from intake throttle position sensor. The scan tool will display a low percentage when the intake throttle valve is closed, and a high percentage when the intake throttle valve is opened. Note that the intake throttle position indicates over 100% if the solenoid is commanded OFF.

Intake Throttle Position Sensor
This parameter displays the voltage signal sent to the ECM from the intake throttle position sensor. Intake throttle position sensor is a range of value indicating a low voltage when the intake throttle valve is closed to a high voltage when the intake throttle valve is opened.

Desired Injection Quantity
This parameter displays a total injection quantity (main injection quantity + pre injection quantity) desired by the ECM based on current driving conditions.

Main Injection Quantity
This parameter displays a main injection quantity desired by the ECM based on current driving conditions.

Main Injection Timing
This parameter displays a main injection timing desired by the ECM based on current driving conditions.

Main Injection On Time
This parameter displays the time the ECM turns ON the fuel injectors. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.

Pre Injection Quantity
This parameter displays a pilot injection quantity desired by the ECM based on current driving conditions.

Pre Injection Interval
This parameter displays a injection interval between end of pilot injection and start of main injection desired by the ECM based on current driving condition.

Fuel Compensation Cyl. 1 to 4
This parameter displays the adjustment of fuel volume for each cylinder at low engine speed area as calculated by the ECM. The scan tool will display a negative value if the fuel volume is lowered. The scan tool will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Cylinder Balancing Update
This parameter displays the state of the fuel compensation for each cylinder. Enabled indicates the adjustment of fuel volume for each cylinder is being executed by the ECM when the engine is idle speed, the engine coolant temperature sensor, the intake air temperature sensor, barometric pressure sensor and the vehicle speed sensor inputs are normal state.

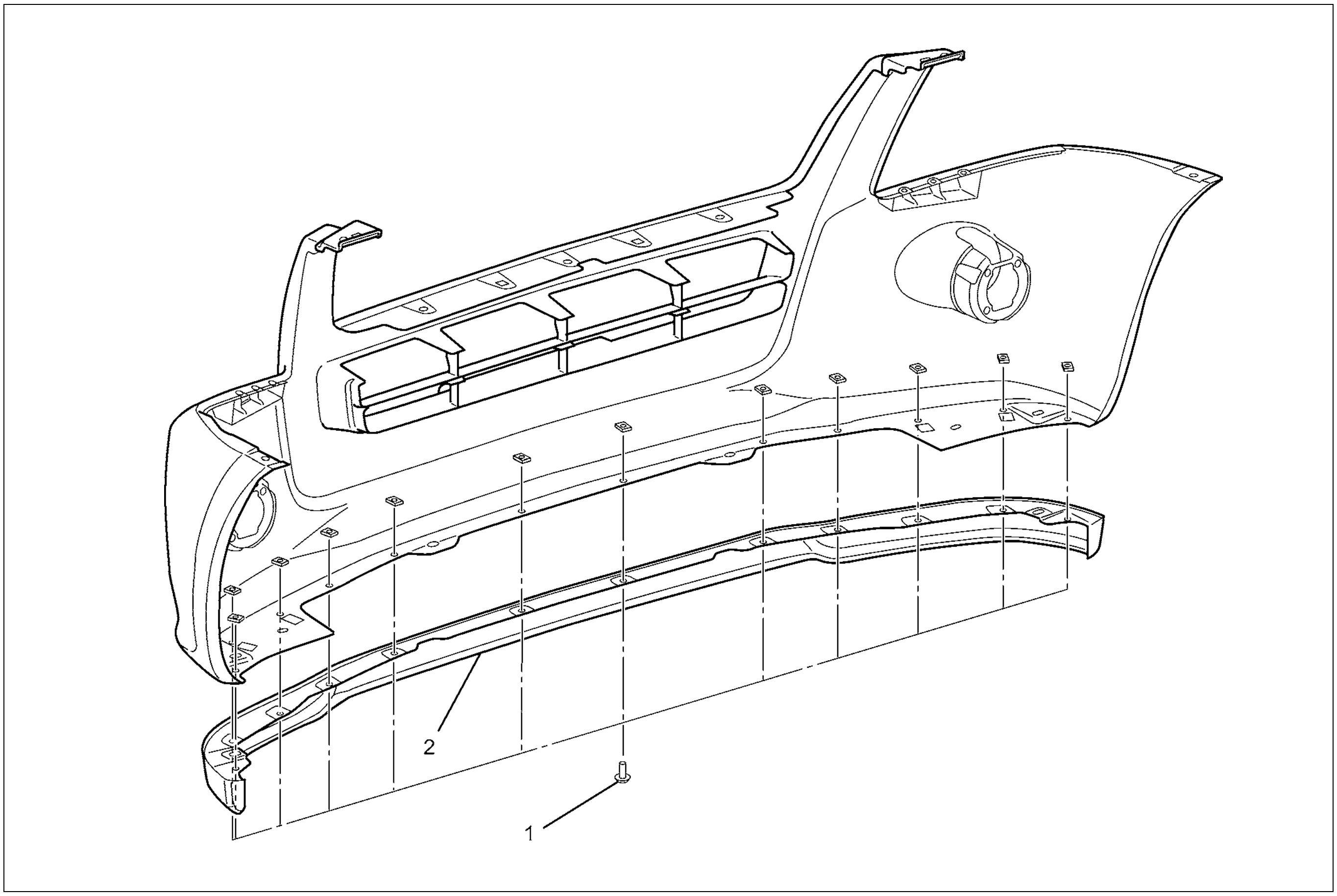
Fuel Supply Pump Status
This parameter displays the learning state of the fuel supply pump. Not Learn indicates initialized state that is replaced to a new ECM or adjustment value is reset. After engine is warm upped, leaning will start at idle speed. Learning indicates learning state. Learned indicates learning process is completed state.

Rail Pressure Feedback Mode
This parameter displays the state of the fuel rail pressure feedback to the ECM. Wait Mode indicates the ignition switch is turned ON position. Feedback Mode indicates the engine is during crank or run. Shutoff Mode indicates the ignition switch is turned OFF position.

Engine Mode
This parameter displays the state of engine. Ignition On indicates the ignition switch is turned ON position. Cranking indicates the engine is during crank. Running indicates the engine is run. Off indicates the ignition switch is tuned OFF position.

FRONT AIR DAM

REMOVAL AND INSTALLATION



RTW72AMF000201

Removal Steps

▲ 1. Bolt
2. Front air dam

Installation Steps

2. Front air dam
1. Bolt

Important Operation - Removal

1. Bolt

Remove the 12 fixing bolts.

Important Operation - Installation

1. Bolt

Torque	N·m (kgf·m/lb·in)
3 (0.3 / 26)	

Cam/ Crank Sensor Signal/ Synchronization Status
This parameter displays the synchronization state of the crankshaft position (CKP) sensor signal and camshaft position (CMP) sensor signal. Asynchronous indicates the CMP sensor signal is not detected or only CKP sensor signal is detected. No Crank Signal indicates CMP sensor signal is detected but CKP sensor signal is not detected. Synchronous indicates both sensor signals are detected correctly.

Engine Runtime
This parameter displays the time elapsed since the engine start. The scan tool will display the time in hours, minutes and seconds. The engine run time will reset to zero as soon as the ignition switch is OFF.

Vehicle Speed
This parameter indicates the vehicle speed calculated by the ECM using the signal from the vehicle speed sensor (VSS). The scan tool will display a low value at lower vehicle speeds, and a high value at higher vehicle speeds.

Transmission Gear
This parameter displays the estimated transmission gear position as calculated by the ECM based on inputs from the vehicle speed and the engine speed.

Starter Switch
This parameter displays the input status of the starter switch to the ECM. When the ignition switch is turned at START position, the scan tool displays On.

Ignition Switch
This parameter displays the input status of the ignition switch to the ECM. When the ignition switch is turned ON position, the scan tool displays On.

Ignition Voltage
This parameter displays the ignition voltage measured at the ignition feed circuit of the ECM. Voltage is applied to the ECM when the ignition switch is ON position.

Battery Voltage
This parameter displays the battery voltage measured at the ECM main relay switched voltage feed circuit of the ECM. Voltage is applied to the ECM when the ECM main relay is energized.

Fuel Pump Relay Command
This parameter displays the commanded state of the fuel pump relay control circuit. On indicates the fuel pump relay control circuit is being grounded by the ECM, allowing fuel pumping from the tank.

Swirl Control Solenoid Command
This parameter displays the commanded state of the swirl control solenoid control circuit. On indicates the swirl control solenoid control circuit is being grounded by the ECM, allowing vacuum pressure to the swirl control actuator.

Fuel Filter Switch
This parameter displays the input state of the fuel pressure switch to the ECM. When the large vacuum pressure is generated in the fuel suction line such as clogged fuel filter, the scan tool displays Off.

A/C Request Signal
This parameter displays the input state of the air conditioning (A/C) request to the ECM from the heating, ventilation, and air conditioning (HVAC) controls. When the HVAC system is requesting to ground the A/C compressor clutch, the scan tool displays On.

A/C Relay Command
This parameter displays the commanded state of the A/C compressor relay control circuit. On indicates the A/C compressor relay control circuit is being grounded by the ECM, allowing voltage to the A/C compressor.

Park/ Neutral Switch
This parameter displays the input state of the neutral switch to the ECM. When the transmission gear is Park or Neutral, the scan tool displays Neutral.

Glow Relay Command
This parameter displays the commanded state of the glow relay control circuit. On indicates the glow relay control circuit is being grounded by the ECM, allowing voltage to the glow plugs.

Glow Plug Lamp Command
This parameter displays the commanded state of the glow indicator lamp control circuit. The glow indicator lamp should be On when the scan tool indicates command On. The glow indicator lamp should be Off when the scan tool indicates command Off.

Brake Switch 1
This parameter displays the input state of the brake pedal switch 1 to the ECM. When the brake pedal is depressed, scan tool displays Applied.

Brake Switch 2
This parameter displays the input state of the brake pedal switch 2 to the ECM. When the brake pedal is depressed, scan tool displays Applied.

Clutch Pedal Switch
This parameter displays the input state of the clutch pedal switch to the ECM. When the clutch pedal is depressed, scan tool displays Applied.

Cruise Main Lamp Command
This parameter displays the commanded state of the cruise main lamp control circuit. The cruise main lamp should be On when the scan tool indicates command On. The cruise main lamp should be Off when the scan tool indicates command Off.

Cruise Main Switch
This parameter displays the input state of the cruise main switch to the ECM. When the Cruise Main switch is pushed, the scan tool displays On.

Cruise Cancel Switch
This parameter displays the input state of the cruise cancel switch to the ECM. When the Cruise Cancel switch is applied, the scan tool displays Off.

Cruise Resume Switch
This parameter displays the input state of the cruise resume/accel. switch to the ECM. When the Cruise Resume/Accel. switch is applied, the scan tool displays On.

Cruise Set Switch
This parameter displays the input state of the cruise set/coast switch to the ECM. When the Cruise Set/Coast switch is pushed, the scan tool displays On.

MIL Command (Malfunction Indicator Lamp)
This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit. The MIL should be On when the scan tool indicates command On. The MIL should be Off when the scan tool indicates command Off.

SVS Lamp Command (Service Vehicle Soon)
This parameter displays the commanded state of the service vehicle soon (SVS) lamp control circuit. The SVS lamp should be On when the scan tool indicates command On. The SVS lamp should be Off when the scan tool indicates command Off.

Limp Home Mode
This parameter indicates the state of the limp-home mode. None indicates limp-home mode is not applied. 1, 2, 3 and 4 indicates fuel injection quantity reduction is applied. 2 or higher number inhibits pilot injection. If 4 is indicated, engine running will be stopped when the vehicle speed is less than 5 km/h (3 MPH) for 5 seconds.

Distance While MIL is Activated
This parameter displays the mileage since the malfunction indicator lamp (MIL) is turned ON.

Engine Runtime With MIL Active
This parameter displays the engine run time elapsed since the malfunction indicator lamp (MIL) is turned ON. The scan tool will display the time in minutes.

Total Engine Overspeed Event
This parameter indicates counter of engine overspeed event. Counter will be zero if any DTC is cleared.

Total Engine Coolant Overtemperature Event
This parameter indicates counter of engine overheat event. The counter is active if engine coolant is over 110°C (230°F). Counter will be zero if any DTC is cleared.

Total Fuel Temperature Overtemperature Event
This parameter indicates counter of fuel temperature excessively high condition. The counter is active if fuel temperature is over 95°C (203°F). Counter will be zero if any DTC is cleared.

Total Intake Air Temperature Overtemperature Event
This parameter indicates counter of intake air temperature excessively high condition. The counter is active if intake air temperature is over 55°C (131°F). Counter will be zero if any DTC is cleared.

Immobilizer Function Programmed
This parameter displays the state of the immobilizer function programming in the ECM. The scan tool will display Yes or No. Yes indicates the immobilizer security information is correctly programmed in the ECM. No indicates the ECM is not programmed or ECM is reset.

Wrong Immobilizer Signal
This parameter displays the input state of the received response signal to the ECM. When the ECM received wrong response signal from the immobilizer control unit (ICU), the scan tool displays Yes.

Immobilizer Signal
This parameter displays the input state of the response signal to the ECM. When the ECM received any response signal from the immobilizer control unit (ICU), the scan tool displays Yes.

Security Wait Time
This parameter displays the security wait time length in the ECM. Inactive indicates not in security wait time. Time indicates under security wait time. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed. The wait time will increase each time an incorrect security code is entered. Note that this parameter is not count downed. It keeps displaying the same time until that wait time has elapsed. The ignition switch must be kept at ON position during the wait time period.

Scan Tool Output Controls

Scan Tool Output Control	Descriptions
Fuel Supply Pump Learn Resetting	The purpose of this test to reset the fuel supply pump adjustment value. **Important:** The fuel supply pump relearn procedure must be done when the fuel supply pump or engine is replaced, or an ECM from another vehicle is installed. Refer to Fuel Supply Pump Replacement.
Fuel Pressure Control	The purpose of this test is for checking whether the fuel rail pressure is changing when commanded within 30 to 80MPa (4,350 to 11,600psi) when commanded. Faulty fuel supply pump, fuel rail pressure (FRP) regulator, pressure limiter valve or other fuel lines could be considered if the differential fuel rail pressure is large.
Pilot Injection Control	The purpose of this test is for checking whether the pilot fuel injection is operated when it is commanded to ON/ OFF. Faulty injector(s) could be considered if engine noise does not change when commanded OFF.
Injection Timing Control	The purpose of this test is for checking whether the main injection timing is changing when commanded Retard/ Advance within -5 to 5°CA.
Injector Force Drive	The purpose of this test is for checking whether the fuel injector is correctly operating when commanded ON. Faulty injector(s) could be considered if it does not create a clicking noise (solenoid operating noise), contains an interrupted noise or has abnormal noise when commanded ON.
Cylinder Balance Test	The purpose of this test is for checking whether the fuel injector is operating when commanded ON/ OFF. Faulty injector(s) could be considered if engine does not change speed when commanded OFF.
Intake Throttle Solenoid Control	The purpose of this test is for checking whether the intake throttle valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits or a faulty valve could be considered if the position difference is large.
EGR Solenoid Control	The purpose of this test is for checking whether the EGR valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits or a faulty valve could be considered if the position difference is large.
Swirl Control Solenoid Control	The purpose of this test is for checking whether the swirl control solenoid is operating when commanded ON. Faulty circuit(s) or a faulty solenoid could be considered if not energizing when commanded ON.
Turbocharger Solenoid Control	The purpose of this test is for checking whether the turbocharger nozzle control actuator is correctly moved with command. Restricted actuator movement by foreign materials, excessive deposits, misrouted vacuum hoses, a faulty solenoid or a faulty actuator could be considered if the actuator is not moved correctly.
Glow Relay Control	The purpose of this test is for checking whether the glow relay is operating when commanded ON. Faulty circuit(s) or a faulty glow relay could be considered if not energizing when commanded ON.
Glow Plug Lamp Control	The purpose of this test is for checking whether the glow indicator lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Malfunction Indicator Lamp (MIL) Control	The purpose of this test is for checking whether the MIL is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Service Vehicle Soon (SVS) Lamp Control	The purpose of this test is for checking whether the SVS lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Cruise Main Lamp Control	The purpose of this test is for checking whether the cruise main lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Cruise Set Lamp Control	The purpose of this test is for checking whether the cruise set lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.

Scan Tool Does Not Power Up

Circuit Description

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool power battery positive voltage at terminal 16.
- Scan tool power ground at terminal 4.
- Common signal ground at terminal 5.

The scan tool will power up with the ignition OFF. Some modules however, will not communicate unless the ignition is ON.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Scan Tool Does Not Power Up

Step	Action	Value(s)	Yes	No
1	**Important**: Make sure the scan tool works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the Meter (+B) (10A) fuse in the cabin fuse block. Is the Meter (+B) (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (+B) (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (+B) (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-58) for a backed out, spread or missing terminal. 2. Repair the terminal as necessary. Did you find and complete the repair?	—	Go to Step 7	Go to Step 4
4	Connect a test lamp between the +B circuit (pin 16 of B-58) at the DLC and a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the battery voltage circuit to the DLC. Did you complete the repair?	—	Go to Step 7	—
6	1. Test each ground circuit at the DLC (pins 4 and 5 of B-58) for an open circuit or high resistance. 2. Repair the circuit(s), clean or tighten ground as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the scan tool to the DLC. 2. Attempt to turn ON the scan tool. Does the scan tool ON?	—	System OK	Go to Step 1

Scan Tool Does Not Communicate with CAN Device

Circuit Description

The ECM, transmission control module (TCM) (AISIN A/T only) and immobilizer control unit (ICU) all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. If no immobilizer system is installed, the instrument panel (IP) cluster has a CAN terminating resistor instead of the ICU.

Diagnostic Aids

The following conditions will cause a loss of CAN serial data communication between the TCM and ICU or between the scan tool and any control module:

- A CAN serial data circuit open
- A CAN serial data circuit shorted to ground
- A CAN serial data circuit shorted to voltage
- An internal condition within a module or connector on the CAN serial data circuit, that causes a short to voltage or ground to the CAN serial data circuit

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Scan Tool Does Not Communicate with CAN Device

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	**Important**: Make sure the CANdi module is not malfunctioning. When functioning properly, the CANdi module LED will be flashing. In the event of a problem, the LED will be continually illuminated or not illuminated. 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the listed control modules. • ECM • Immobilizer Control Unit (ICU) (If so equipped) • Transmission control module (TCM) (AISIN A/T only) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 7
3	Does the scan tool communicate with the ECM?	—	Go to Step 4	Go to Lost Communication with The Engine Control Module (ECM)
4	**Notice:** If no AISIN automatic transmission is installed, skip to Step 5. Does the scan tool communicate with the TCM?	—	Go to Step 5	Go to Diagnostic System Check - Transmission Controls
5	**Notice:** If no immobilizer system is installed, skip to Step 6. Does the scan tool communicate with the ICU?	—	Go to Step 6	Go to Diagnostic System Check - Immobilizer Controls
6	Test the CAN Low and High serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the CAN Low and High serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 19	System OK

Step	Action	Value(s)	Yes	No
7	1. Inspect for an intermittent, for poor connections and for corrosion at the data link connector (DLC) (pins 6 and 14 of B-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	**Notice:** If no data recording module (DRM) is installed, skip to Step 9. 1. Turn OFF the ignition. 2. Disconnect the DRM C-139 harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the DRM harness connector if disconnected. 3. Disconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the TCM and ICU. Does the scan tool communicate with the TCM and ICU?	—	Go to Step 15	Go to Step 10
10	**Notice:** If no AISIN automatic transmission is installed, skip to Step 11. 1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 3. Disconnect the TCM C-94 and C-95 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and ICU. Does the scan tool communicate with the ECM and ICU?	—	Go to Step 16	Go to Step 11
11	**Notice:** If no immobilizer system is installed, skip to Step 12. 1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors if disconnected. 3. Reconnect the TCM C-94 and C-95 harness connectors if disconnected. 4. Disconnect the ICU B-68 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors if disconnected. 3. Reconnect the TCM C-94 and C-95 harness connectors if disconnected. 4. Disconnect the instrument panel (IP) cluster B-23 and B-24 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 18	Go to Step 13
13	Repair the open circuit, short to ground or short to voltage on the CAN Low or High serial data circuit between the DLC and ECM, TCM, ICU, DRM or IP cluster. Did you complete the repair?	—	Go to Step 19	—
14	Replace the DRM. Refer to DRM Replacement. Did you complete the replacement?	—	Go to Step 19	—
15	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—
16	**Important**: Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 19	—
17	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	Replace the IP cluster. Refer to IP Cluster Replacement. Did you complete the replacement?	—	Go to Step 19	—
19	Attempt to establish communication with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	System OK	Go to Step 2

Lost Communication with The Engine Control Module (ECM)

Circuit Description

The ECM, transmission control module (TCM) (AISIN A/T only) and immobilizer control unit (ICU) all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. If no immobilizer system is installed, the instrument panel (IP) cluster has a CAN terminating resistor instead of the ICU.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Lost Communication with The Engine Control Module (ECM)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Intermittent Conditions	Go to Step 3
3	Check the ECM C-58 and E-90 connectors for poor connections. Did you find and correct the condition?	—	Go to Step 16	Go to Step 4
4	1. Check the ECM (40A) slow blow fuse, ECM (B) (10A) fuse and Engine (10A) fuse. Replace and retest if open. If any fuse continues to open, repair the short to ground on each circuit fed by that fuse. 2. Turn OFF the ignition. 3. Disconnect the ECM C-58 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the ECM (pin 72 of C-58). Does the test lamp illuminate?	—	Go to Step 5	Go to Step 13
5	1. Turn OFF the ignition. 2. Disconnect the scan tool from the data link connector (DLC) if connected. 3. Measure the resistance across the CAN Low and High circuits by probing the DLC (pins 6 and 14 of B-58). Is the resistance within the specified value (parallel resistance of the 120 Ω resistor in the ECM and the 120 Ω resistor in the ICU or IP cluster should be 60Ω)?	50 to 70 Ω	Go to Step 7	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 66 and 67 of C-58). 4. Test for high resistance on each circuit. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15

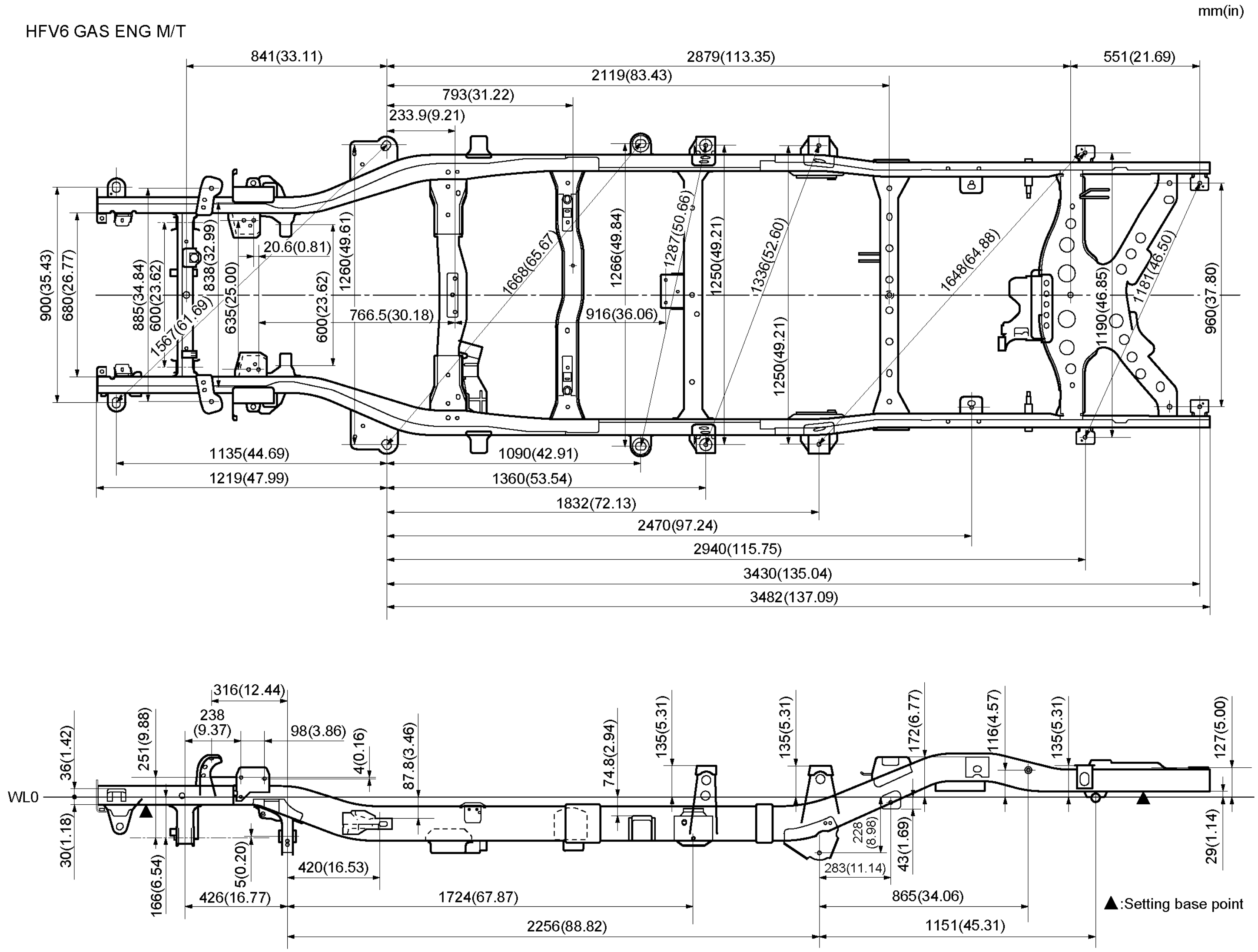
Step	Action	Value(s)	Yes	No
7	1. Check ECM ground for corrosion and tightness. 2. Clean or tighten grounds as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 8
8	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if disconnected. 3. Replace the ECM main relay with the heater relay or replace with a known good relay. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Remove the ECM main relay. 3. Turn ON the ignition, with the engine OFF. 4. Using a test lamp, check for both voltage supply circuits to the ECM main relay (pins 4 and 5 of X-12). 5. Repair the open circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 10
10	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening of feeling for the ECM main relay click. Wait 7 seconds between transitions. Does the ECM main relay click when the ignition switch is turned ON or OFF?	—	Go to Step 12	Go to Step 11
11	Repair the ECM main relay ground circuit between the ECM main relay (pin 2 of X-12) and engine room ground terminal (C-36) for the following conditions: • An open circuit • High resistance or a poor connection at the ECM main relay or ground terminal Did you complete the repair?	—	Go to Step 16	—
12	1. Test the battery voltage circuit between the ECM (pin 73 of C-58) and the ECM main relay (pin 1 of X-12) for the following conditions: • An open circuit • High resistance or a poor connection at ECM or ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
13	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 16	—
14	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
15	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 16	—
16	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse, relay or harness connector(s). 3. Turn ON the ignition, with the engine OFF. 4. Attempt to establish communication with the ECM. Does the scan tool communicate with the ECM?	—	System OK	Go to Step 3

FRAME DIMENSIONS

4×2, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



RTW72AXF000601

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Engine Cranks but Does Not Run

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

- The battery is completely charged and terminals are cleaned and tight.
- The engine cranking speed is normal.
- There is adequate fuel in the fuel tank.
- There is no fuel leak in the fuel line.
- There is no air in the fuel line.
- Filters (air, fuel) are clean.
- Fuse and slow blow fuse are normal.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the Circuit/ System Testing.

5. If the fuel rail pressure (FRP) regulator low side circuits between the ECM and the FRP regulator are shorted to ground, FRP Regulator Feedback will be approximately 400mA lower as compared with normal.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Engine Cranks but Does Not Run (1of 2)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for the specified amount of time. 4. Monitor the DTC Information with a scan tool. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure parameter with a scan tool. Does the scan tool indicate the specified value?	0 MPa (0 psi)	Go to Step 4	Go to Step 6
4	**Notice:** If the vehicle has run out of fuel, air may be trapped in the fuel system. 1. Make sure the fuel tank have adequate fuel and the fuel quality is good (take a sample). 2. Observe the Fuel Rail Pressure parameter on the scan tool while cranking over the engine for 5 seconds. Does the scan tool indicate more than the specified value during crank?	20 MPa (2,900 psi)	Go to Step 9	Go to Step 5
5	Observe the FRP Regulator Feedback parameter on the scan tool while cranking over the engine for 5 seconds. Does the scan tool indicate more than the specified value during crank?	1500 mA	Go to 2 of 2 Step 1	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 7
7	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
8	Repair the short to ground between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50). Did you compete the repair?	—	Go to Step 11	—
9	1. Check for normal readings at key up for the following sensor inputs: Use the Scan Tool Data List or a known good vehicle to determine nominal values. • Engine Coolant Temperature Sensor • Barometric Pressure (BARO) Sensor • Boost Pressure Sensor • Intake Throttle Position Sensor 2. Repair the circuit(s) or replace the sensor as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
10	1. Other possible causes for the no-start condition: • Engine mechanical timing • Heavily restricted intake or exhaust plugged solid. • Poor engine compression. • Water or gasoline contamination in fuel. 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 12	Go to Step 2
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing Engine Cranks but Does Not Run (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Remove the engine cover. 2. Perform the Injector Force Drive with a scan tool. 3. Command each injector ON and verify clicking noise (solenoid operating noise). Is there an injector that does not create a clicking noise (solenoid operating noise), contains an interrupted noise or abnormal noise when commanded ON?	—	Go to Step 8	Go to Step 2
2	1. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak. • Fuel supply pump • Fuel rail • Pressure limiter valve • Fuel rail pressure (FRP) sensor • Fuel pipe between the fuel supply pump and fuel rail • Fuel pipe between the fuel rail and fuel injectors • Each fuel pipe sleeve nuts **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 3
3	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 4

Step	Action	Value(s)	Yes	No
4	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 5
5	1. Turn OFF the ignition. 2. Remove the Fuel Pump (10A) fuse from the engine room fuse block in order to disable in-tank fuel pump. 3. Disconnect each fuel injector harness connector from all fuel injectors in order to disable injection. 4. Remove the rubber fuel hose from the leak-off pipe. Then, remove the leak-off pipe assembly from the engine that is jointed to the fuel supply pump and the pressure limiter valve. Use a pan to catch the fuel from the removed fuel line. 5. Crank over the engine while observing the fuel leak from the pressure limiter valve. **Important:** Safety glasses must be worm. Fuel may splash if the pressure limiter valve is faulty. Is there fuel leak from the pressure limiter valve?	—	Go to Step 11	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Remove the rubber hoses from the leak-off pipes that are connected to each fuel injector. 2. Crank over the engine while observing the fuel leak from the leak-off pipe of each fuel injector (very small leak is normal). **Important:** Safety glasses must be worm. Fuel may splash if the fuel injector is faulty. **Important:** Replacement fuel injector must be programmed. 3. Replace the fuel injector(s) that return fuel is excessive. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. 4. Retest after replacement of the fuel injector(s). Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	1. Remove each glow plug from the cylinder head. 2. Inspect for fuel leakage into the combustion chamber. Is there a cylinder that fuel leakage into the combustion chamber?	—	Go to Step 9	Go to Step 10
8	**Important**: Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contains an interrupted noise or abnormal noise at Step 1. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 12	—
9	**Important**: Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was leaking fuel found at Step 7 and inspect the engine mechanical for any damage or poor engine compression. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 12	—
10	**Important**: The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	Replace the pressure limiter valve. Refer to Fuel Rail Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 13	Go to Step 1
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0016 (Flash Code 16)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC).
The camshaft position (CMP) sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface).
Detecting the open span portion from the CKP sensor and one reference projection from the CMP sensor, the ECM determines cylinder #1 compression TDC to ensure they correlate with each other. If the ECM detects both signals are out of synchronization, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0336, P0340 and P0341 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor signals and CMP sensor signals are out of synchronization during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- This DTC is caused by an incorrect mechanical timing condition, which is most likely caused by wrong installation of timing gear or chain.
- The engine reverse rotation may set this DTC.

Circuit/ System Testing DTC P0016

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Is DTC P0335, P0336, P0340 or P0341 also set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor or chain sprocket • Physical damage of sensor rotor or chain sprocket • Loose or improper installation of sensor rotor or chain sprocket 2. Inspect the engine mechanical timing for the following conditions: • Incorrectly installed timing gear or chain • Faulty timing chain tensioner • Excessive play in the timing chain • Timing chain that jumped teeth 3. Repair or replace as necessary. Did you complete the repair?	—	Go to Step 4	—
4	1. Reconnect all previously disconnected harness connector(s) if disconnected. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0045 (Flash Code 33)

Circuit Description

The position of the turbocharger nozzle is controlled by the ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor to control the turbocharger nozzles. When the engine is not under load, the turbocharger nozzles are in an open position, or no boost condition. When the engine is under load, the ECM commands the control solenoid valve to close the turbocharger nozzles, thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve. If the ECM detects an open circuit or short circuit on the solenoid valve circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the turbocharger nozzle control solenoid circuit when the solenoid is commanded OFF.
- The ECM detects a high voltage condition on the turbocharger nozzle control solenoid circuit when the solenoid is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test description

The number below refers to the step number on the Circuit/ System Testing.

4. If the solenoid control circuit between the ECM and the solenoid is normal, the test lamp changes from Bright to Dim when commanded from Increase to Decrease.

Schematic Reference: Vacuum Hose Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

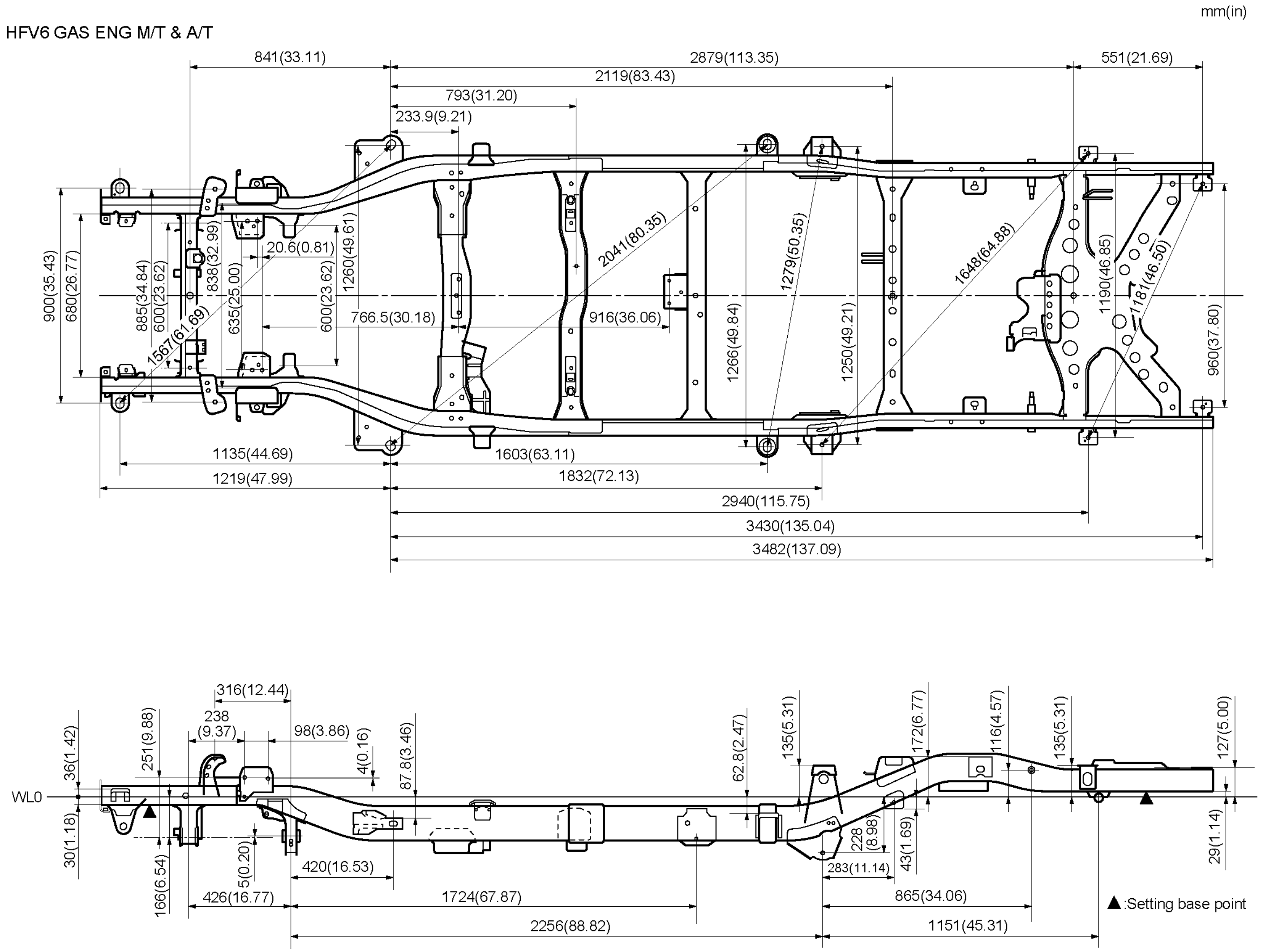
Circuit/ System Testing DTC P0045

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the turbocharger nozzle control solenoid valve harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-106) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the control circuit (pin 1 of E-106) and battery voltage. 2. Perform the Turbocharger Solenoid Control with a scan tool. 3. Command the solenoid valve Increase and Decrease while observing the test lamp. Does the test lamp change brightness when commanded Increase and Decrease?	—	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the Engine (10A) fuse and the solenoid valve (pin 2 of E-106). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the control circuit between the ECM (pin 66 of E-90) and the solenoid valve (pin 1 of E-106) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Inspect for an intermittent and for poor connections at the harness connector of the solenoid valve (pins 1 and 2 of E-106). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 66 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the turbocharger nozzle control solenoid valve. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12

4×2, LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0087 (Flash Code 225)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank. If the ECM detects that the fuel rail pressure went excessively high, then sharply decreased, this DTC will set indicating high fuel pressure, which activated the pressure limiter valve.

Condition for Running the DTC

- DTCs P0192 and P0193 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the pressure limiter valve is activated with overpressure (more than 190 MPa [27,600 psi]) in the fuel rail.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to open the pressure limiter valve.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice:

- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0087

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0088, P0089, P0091, P0092, P0192, P0193, P0201 - P0204, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 5	Go to Step 10
5	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 12	Go to Step 6
6	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
12	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0088 (Flash Code 118)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail.

If the ECM detects that the fuel pressure went excessively high for a certain length of time, this DTC will set (First Stage). If the ECM detects that during the same ignition cycle the fuel pressure rose even higher than the amount to set DTC P0088 for a certain length of time, the engine is stopped (Second Stage). If the engine is stopped, the fuel pressure was too high and the pressure limiter valve did not active or did not active quick enough.

Condition for Running the DTC

- DTCs P0192 and P0193 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

First Stage

- The ECM detects that the fuel rail pressure is more than 197 MPa (28,600 psi) for longer than 5 seconds.

Second Stage

- The ECM detects that the fuel rail pressure is more than 200 MPa (29,000 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

First Stage

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Second Stage

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

First Stage

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Second Stage

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- An intermittently sticking Fuel Rail Pressure regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 48,00 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0088

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0089, P0091, P0092, P0192, P0193, P0201 - P0204, P0219, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Fuel Rail Pressure parameter with a scan tool. Does the Fuel Rail Pressure parameter ever exceed the specified value?	190 MPa (27,600 psi)	Go to Step 4	Go to Step 11
4	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 5	Go to Step 10
5	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 13	Go to Step 6
6	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	**Notice:** An intermittent problem by foreign material in the fuel is suspected. Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
13	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 15	—

TORQUE

FOOT POUNDS TO KILOGRAM METERS

ft. lbs.	0	1	2	3	4	5	6	7	8	9	ft. lbs.
	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	
-		0.138	0.277	0.415	0.553	0.691	0.830	0.968	1.106	1.244	-
10	1.383	1.521	1.659	1.797	1.936	2.074	2.212	2.350	2.489	2.627	10
20	2.765	2.903	3.042	3.180	3.318	3.456	3.595	3.733	3.871	4.009	20
30	4.148	4.286	4.424	4.562	4.700	4.839	4.977	5.115	5.253	5.392	30
40	5.530	5.668	5.807	5.945	6.083	6.221	6.360	6.498	6.636	6.774	40
50	6.913	7.051	7.189	7.328	7.466	7.604	7.742	7.881	8.019	8.157	50
60	8.295	8.434	8.572	8.710	8.848	8.987	9.125	9.263	9.401	9.540	60
70	9.678	9.816	9.954	10.093	10.231	10.369	10.507	10.646	10.784	10.922	70
80	11.060	11.199	11.337	11.475	11.613	11.752	11.890	12.028	12.166	12.305	80
90	12.442	12.581	12.719	12.858	12.996	13.134	13.272	13.410	13.549	13.687	90
100	13.826	13.964	14.102	14.240	14.379	14.517	14.655	14.793	14.932	15.070	100

KILOGRAM METERS TO FOOT POUNDS

kg-m	0	1	2	3	4	5	6	7	8	9	kg-m
	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	ft. lbs.	
-		7.23	14.47	21.70	28.93	36.17	43.40	50.63	57.86	65.10	-
10	72.33	79.56	86.80	94.03	101.26	108.50	115.73	122.96	130.19	137.43	10
20	144.66	151.89	159.13	166.36	173.59	180.83	188.06	195.29	202.52	209.76	20
30	217.00	224.22	231.46	238.69	245.92	253.16	260.39	267.62	274.85	282.09	30
40	289.32	296.55	303.79	311.02	318.25	325.49	332.72	339.95	347.18	354.42	40
50	361.65	368.88	376.12	383.35	390.58	397.82	405.05	412.28	419.51	426.75	50
60	433.98	441.21	448.45	455.68	462.91	470.15	477.38	484.61	491.84	499.08	60
70	506.31	513.54	520.78	528.01	535.24	542.48	549.71	556.94	564.17	571.41	70
80	578.64	585.87	593.11	600.34	607.57	614.81	622.04	629.27	636.50	643.74	80
90	650.97	658.20	665.44	672.67	679.90	687.14	694.37	701.60	708.83	716.07	90
100	723.30	730.53	737.77	745.00	752.23	759.47	766.70	773.93	781.16	788.40	100

KILOGRAM METERS TO NEWTON METERS

kg-m	0	1	2	3	4	5	6	7	8	9	kg-m
	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	N-m	
-	-	9.81	19.61	29.42	39.23	49.03	58.84	68.65	78.45	88.26	-
10	98.07	107.87	117.68	127.49	137.29	147.10	156.91	166.71	176.52	186.33	10
20	196.13	205.94	215.75	225.55	235.36	245.17	254.97	264.78	274.59	284.39	20
30	294.20	304.01	313.81	323.62	333.43	343.23	353.04	362.85	372.65	382.46	30
40	392.27	402.07	411.88	421.69	431.49	441.30	451.11	460.91	470.72	480.53	40
50	490.33	500.14	509.95	519.75	529.56	539.37	549.17	558.98	568.79	578.59	50
60	588.40	589.21	608.01	617.82	627.63	637.43	647.24	657.05	666.85	676.66	60
70	686.47	696.27	706.08	715.89	725.69	735.50	745.31	755.11	764.92	774.73	70
80	784.53	794.34	804.15	813.95	823.76	833.57	843.37	853.18	862.99	872.79	80
90	882.60	892.41	902.21	912.02	921.83	931.63	941.44	951.25	961.05	970.86	90
100	980.67	990.47	1000.28	1010.08	1019.89	1029.70	1039.50	1049.31	1059.12	1068.92	100

NEWTON METERS TO KILOGRAM METERS

N-m	0	10	20	30	40	50	60	70	80	90	N-m
	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	kg-m	
-	-	1.020	2.039	3.059	4.079	5.099	6.118	7.138	8.158	9.177	-
100	10.197	11.217	12.236	13.256	14.276	15.296	16.315	17.335	18.355	19.374	100
200	20.394	21.414	22.433	23.453	24.473	25.493	26.512	27.532	28.552	29.571	200
300	30.591	31.611	32.630	33.650	34.670	35.690	36.710	37.729	38.749	39.768	300
400	40.789	41.808	42.827	43.847	44.867	45.887	46.906	47.926	48.946	49.965	400
500	50.986	52.005	53.024	54.044	55.064	56.084	57.103	58.123	59.143	60.162	500
600	61.183	62.202	63.221	64.241	65.261	66.281	67.300	68.320	69.340	70.359	600
700	71.380	72.399	73.418	74.438	75.485	76.478	77.497	78.517	79.537	80.556	700
800	81.577	82.596	83.615	84.635	85.655	86.675	87.694	88.714	89.734	90.753	800
900	91.774	92.793	93.812	94.832	95.852	96.872	97.891	98.911	99.931	100.950	900
1000	101.972	102.990	104.009	105.029	106.049	107.069	108.088	109.108	110.128	111.147	1000

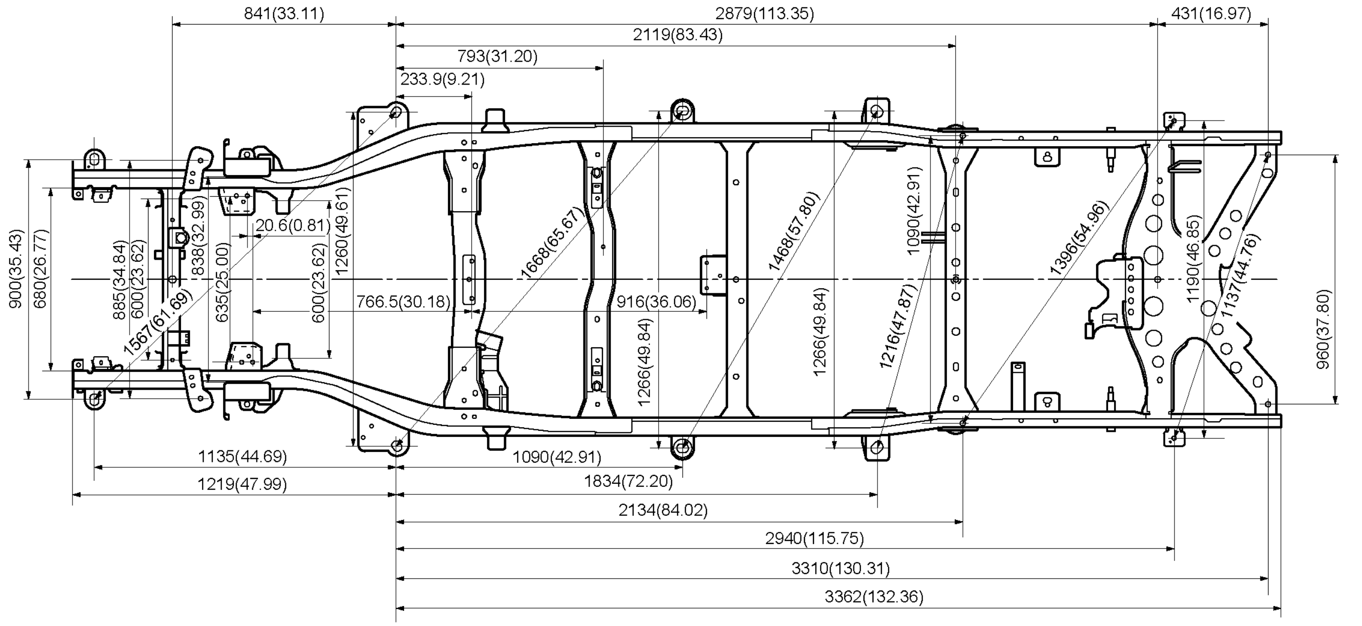
BACK TO CHAPTER INDEX

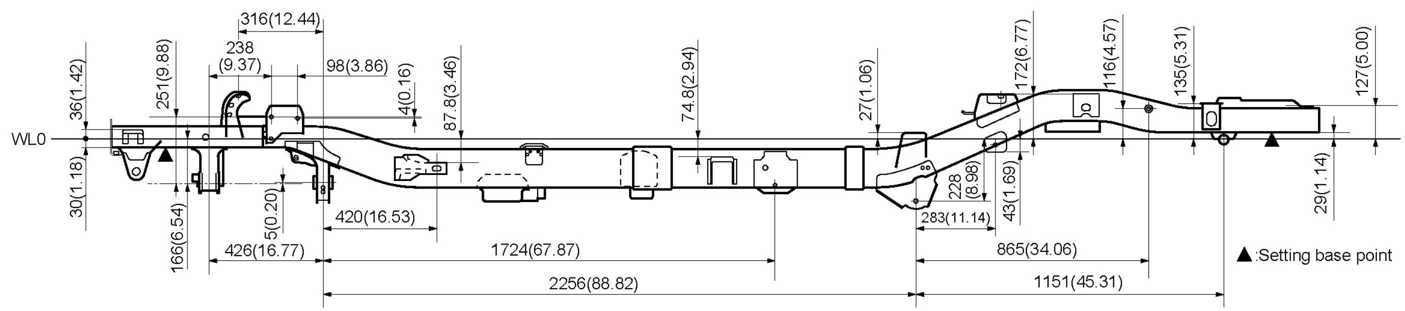
4×2, LWB, CREW CAB MODEL

This illustration is based on the RHD model.

HFV6 GAS ENG M/T & A/T

mm(in)





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TO MODEL INDEX

Step	Action	Value(s)	Yes	No
14	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	**Notice:** There is a possibility that the pressure limiter valve did not active. Replace the pressure limiter valve. Refer to Fuel Rail Replacement. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 17
17	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0089 (Flash Code 151)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that fuel pressure is a certain pressure higher than the desired pressure, this DTC will set.

Condition for Running the DTC

- DTCs P0091, P0092, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is more than 20 to 40 MPa (2,900 to 5,800 psi) over the desired pressure for longer than 20 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0089

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0091, P0092, P0192, P0193, P0201 - P0204, P0219, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
5	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T (accelerator pedal full travel) many times while observing the Fuel Rail Pressure and Desired Fuel Rail Pressure Parameter with a scan tool. Does the Fuel Pressure parameter follow within the specified value quick enough (compare with a similar unit if available)?	±5 MPa (±725 psi)	Go to Step 7	Go to Step 9
7	**Notice:** An intermittent problem by foreign material in the fuel is suspected. Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 10	—
8	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—

Step	Action	Value(s)	Yes	No
9	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0091 or P0092 (Flash Code 247)

Circuit Description

The fuel rail pressure (FRP) regulator is installed to the fuel supply pump and controls the suction fuel quantity into the fuel rail. The FRP regulator is fully opened in the normal state and larger drive current results in smaller opening. The ECM calculates desired fuel rail pressure and fuel flow rate and it compares the calculated desired fuel rail pressure to the actual value to determine the FRP regulator position. When the actual fuel rail pressure is higher than the desired value, the FRP regulator is closed to decease the flow rate. If the ECM detects an excessively low or high FRP regulator feedback current, DTC P0091 or P0092 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP regulator feedback current is less than 100mA, or more than 1000mA below the desired current. (DTC P0091)
- The ECM detects that the FRP regulator feedback current is more than 2450mA, or more than 1000mA over the desired current. (DTC P0092)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the Circuit/ System Testing.
8. If the FRP regulator high side circuit is shorted to voltage, engine stalls and will not start.
9. If the FRP regulator low side circuit is shorted to ground, this DTC may not set. This will cause engine stall or no engine start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0091 or P0092

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Is DTC P1064 also set?	—	Go to DTC P1064	Go to Step 4
4	Observe the Fuel Rail Pressure (FRP) Regulator Feedback parameter with a scan tool. Does the scan tool indicate more than the specified value?	300 mA	Go to Step 5	Go to Step 6
5	Does the scan tool indicate more than the specified value at Step 4?	1300 mA	Go to Step 8	Go to Step 9

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the high side circuit (pin 1 of E-50) and a known good ground. 4. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 7	Go to Step 10
7	1. Turn OFF the ignition for 30 seconds. 2. Connect a test lamp between the low side circuit (pin 2 of E-50) and battery voltage. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 12	Go to Step 11
8	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
9	1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
10	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) for the following conditions: • An open circuit • A short to ground • A short to the low side circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
11	**Important:** The ECM may be damaged if the FRP regulator low side circuit is shorted to a voltage source. 1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13

Step	Action	Value(s)	Yes	No
12	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the FRP regulator. Refer to Fuel Pump Replacement. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 17
17	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0093 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that the fuel rail pressure is certain pressure low as compared with the engine speed, this DTC will set.

Condition for Running the DTC

- DTC P0087, P0091, P0092, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is lower than 15 MPa (2,180 psi) for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector first.
- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0093

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak. • Fuel supply pump • Fuel rail • Pressure limiter valve • Fuel rail pressure (FRP) sensor • Fuel pipe between the fuel supply pump and fuel rail • Fuel pipe between the fuel rail and fuel injectors • Each fuel pipe sleeve nuts **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. **Notice:** Remove and inspect the inlet high pressure joint to the fuel injectors for fuel leaking from the sleeve nut(s). Replace the fuel injector and injection pipe when foreign material was in contact. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 3
3	1. Remove each glow plug from the cylinder head. 2. Inspect for fuel leakage into the combustion chamber. Is there a cylinder that fuel leakage into the combustion chamber?	—	Go to Step 13	Go to Step 4
4	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 5
5	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the FRP Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Perform the Cylinder Balance Test with a scan tool. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 14	Go to Step 7
7	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 8
8	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 9

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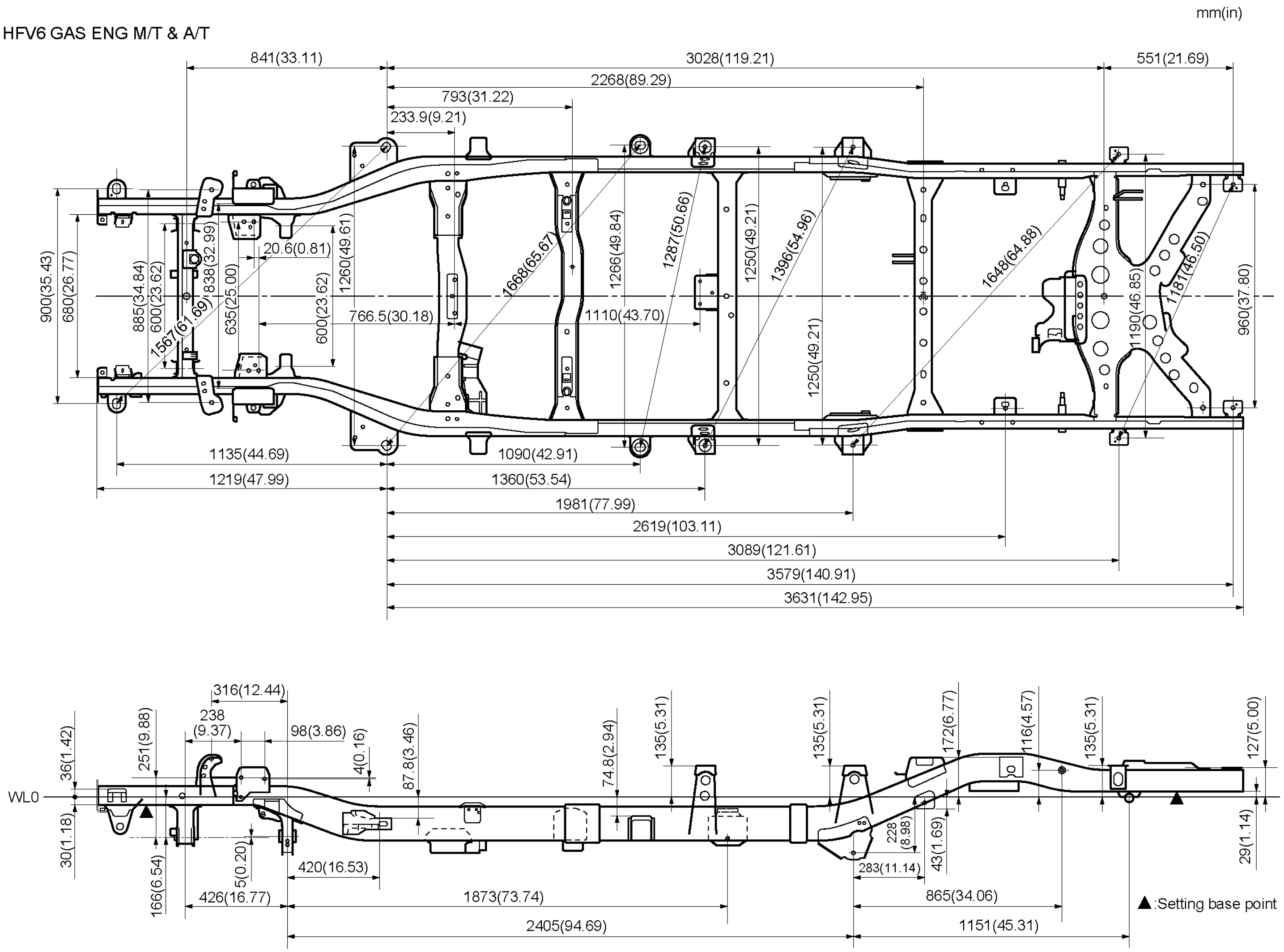
4×2, EXTRA LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
9	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 10
10	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
11	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 12

Step	Action	Value(s)	Yes	No
12	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 16	—
13	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was leaking fuel found at Step 3 and inspect the engine mechanical for any damage or poor engine compression. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 16	—
14	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 17
17	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0101 (Flash Code 92)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The ECM will calculate a predicted MAF value and compares the actual MAF sensor voltage signal to the predicted MAF value. This comparison will determine if the signal is stuck, or is too low or too high for a given operating condition. If the ECM detects that the actual MAF sensor signal voltage is not within a predetermined range of the calculated MAF value, this DTC will set.

Condition for Running the DTC

- DTCs P0045, P0102, P0103, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0234, P0403, P0404, P0405, P0406, P0638, P0652, P0653, P0698, P0699, P1404, P2100, P2101, P2103, P2227, P2228 and P2229 are not set.

AND following conditions are met longer than 10 seconds.

- The battery voltage is between 10.0 to 16.0 volts.
- The ignition switch is ON.
- The intake air temperature is less than 110°C (230°F).
- The engine coolant temperature is between 0 to 110°C (32 to 230°F).
- The engine speed is between 850 to 3700 RPM.
- The EGR control is commanded OFF.
- The intake throttle control is commanded OFF.
- The commanded fuel injection quantity is OFF (accelerator pedal is not depressed).
- The engine run time is longer than 5 seconds.

Condition for Setting the DTC

- The ECM detects that the MAF sensor signal voltage is not within a predetermined range of the calculated MAF value for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Any unmetered air that enters the engine downstream of the MAF sensor will cause this DTC to set.
- High resistance in the MAF sensor circuit will set this DTC.
- A short between the signal circuit of the MAF sensor and the signal circuit of the intake air temperature (IAT) sensor will skew the MAF sensor lower than normal at higher air flows.

Notice:

- The MAF Sensor parameter on scan tool will only update with engine running or one time after the key is cycled when the ignition has been turned OFF for longer than 10 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0101

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Inspect the following conditions: • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any contamination or objects that block the MAF sensor inlet • Skewed or slow MAF sensor • Any water intrusion in the induction system • Any type of restriction in the exhaust system • A sticking intake throttle valve • A sticking EGR valve • A sticking turbocharger nozzle control actuator or solenoid valve 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the MAF sensor (pins 1, 2 and 3 of E-47). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 40, 42 and 43 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4
4	1. Test each sensor circuit between the ECM (pins 40 and 43 of E-90) and the MAF sensor (pins 2 and 3 of E-47) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the MAF sensor. Refer to MAF Sensor Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0102 or P0103 (Flash Code 91)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The sensor has the following circuits.

- Ignition voltage circuit
- Low reference circuit
- MAF sensor signal circuit

The ECM monitors the MAF sensor signal voltage. This output voltage will display on the scan tool as a voltage parameter and as a grams per second (g/s) parameter. If the ECM detects an excessively low or high signal voltage, DTC P0102 or P0103 will set.

Condition for Running the DTC

- The battery voltage is between 11.5 to 16.0 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the MAF sensor signal voltage is less than 0.1 volts. (DTC P0102)
- The ECM detects that the MAF sensor signal voltage is more than 4.9 volts for 3 seconds. (DTC P0103)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a MAF substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The MAF Sensor parameter on scan tool will only update with engine running or one time after the key is cycled when the ignition has been turned OFF for longer than 10 seconds.

Test description

The number below refers to the step number on the Circuit/ System Testing.
DTC P0102
4. This step tests for proper operation of the circuit in the signal circuit. If the fuse in the jumper opens when you perform this test, the signal circuit is shorted to ground or low reference circuits.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0102

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Mass Air Flow (MAF) Sensor parameter with a scan tool. Is the MAF Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the MAF sensor harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 1 of E-47) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition for 30 seconds. 2. Connect a 3-amp fused jumper wire between the ignition voltage feed circuit and the signal circuit (pins 1 and 3 of E-47). 3. Turn ON the ignition, with the engine OFF. Is the MAF Sensor parameter more than the specified value?	4.9 volts	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the ECM Main Relay (pin 1 of X-12) and the MAF sensor (pin 1 of E-47) for and open circuit or high resistance. Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 40 of E-90) and the MAF sensor (pin 3 of E-47) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Inspect for an intermittent and for poor connections at the harness connector of the MAF sensor (pins 1 and 3 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 40 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to MAF Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0103

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Mass Air Flow (MAF) Sensor parameter with a scan tool. Is the MAF Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the MAF sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MAF Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Step 5
4	Connect a test lamp between the low reference circuit (pin 2 of E-47) and battery voltage. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
5	1. Test the signal circuit between the ECM (pin 40 of E-90) and the MAF sensor (pin 3 of E-47) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
6	1. Test the low reference circuit between the ECM (pin 43 of E-90) and the MAF sensor (pin 2 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8

Step	Action	Value(s)	Yes	No
7	1. Inspect for an intermittent and for a poor connection at the harness connector of the MAF sensor (pin 2 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 43 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the MAF sensor. Refer to MAF Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0107 or P0108 (Flash Code 32)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Boost pressure sensor signal circuit

The boost pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes in the air tubing. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load. If the ECM detects an excessively low or high signal voltage, DTC P0107 or P0108 will set.

Condition for Running the DTC

- DTCs P0698 and P0699 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the boost pressure sensor signal voltage is less than 0.1 volts. (DTC P0107)
- The ECM detects that the boost pressure sensor signal voltage is more than 4.75 volts. (DTC P0108)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a boost pressure substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0107

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0698 also set?	—	Go to DTC P0698	Go to Step 3
3	Observe the Boost Pressure Sensor parameter with a scan tool. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-107) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

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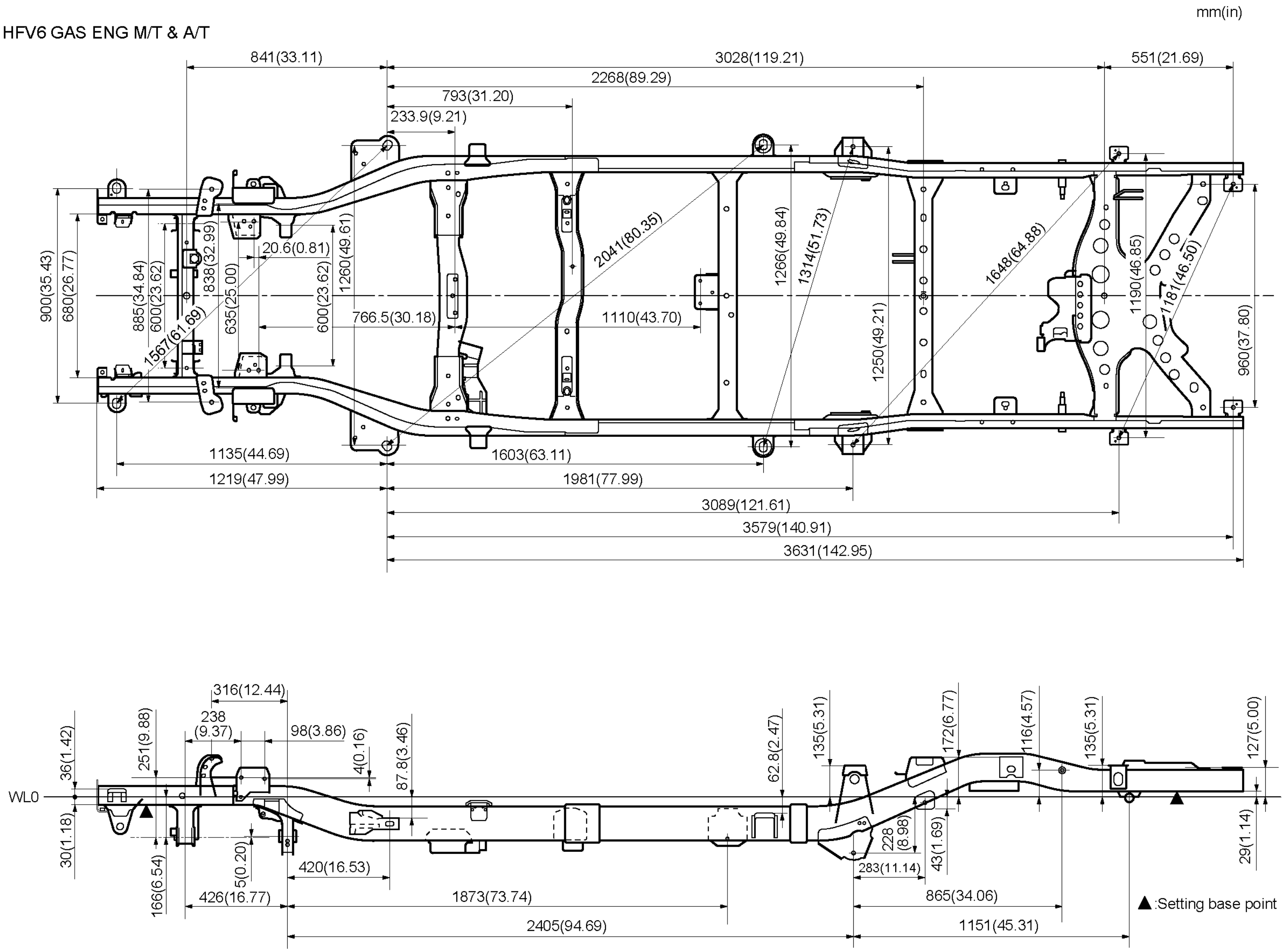
4×2, EXTRA LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 3 and 1 of E-107). Is the Boost Pressure Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 20 of E-90) and the boost pressure sensor (pin 3 of E-107) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 21 of E-90) and the boost pressure sensor (pin 1 of E-107) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the boost pressure sensor (pins 1 and 3 of E-107). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 20 and 21 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0108

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Boost Pressure Sensor parameter with a scan tool. Is the Boost Pressure Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0699 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0699	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 2 of E-107) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The boost pressure sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 21 of E-90) and the boost pressure sensor (pin 1 of E-107) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 23 of E-90) and the boost pressure sensor (pin 2 of E-107) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 2 of E-107). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 23 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0112 or P0113 (Flash Code 22)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger. It is internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor and it measures the temperature of the air entering the engine. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0112 or P0113 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (DTC P0113)

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0112)
- The ECM detects that the IAT sensor signal voltage is more than 4.75 volts for 3 seconds. (DTC P0113)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses an IAT substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0112

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the IAT Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the MAF sensor. Refer to MAF Sensor Replacement. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 41 and 61 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0113

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Intake Air Temperature (IAT) Sensor parameter with a scan tool. Is the IAT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow/ intake air temperature (MAF/ IAT) sensor harness connector. 3. Connect a DMM between the signal circuit (pin 4 of E-47) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**Important:** The IAT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 4 and 5 of E-47). Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 4 of E-47) and a known good ground. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 61 of E-90) and the IAT sensor (pin 5 of E-47) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 41 of E-90) and the IAT sensor (pin 4 of E-47) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 4 and 5 of E-47). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 41 and 61 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the MAF sensor. Refer to MAF Sensor Replacement. (IAT sensor is internal to MAF sensor) Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0116 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. If the ECM detects that the difference of engine coolant temperature is smaller than the calculated range during the predetermined conditions, this DTC will set. This DTC will only run once per ignition cycle within the enabling condition.

Condition for Running the DTC

- DTCs P0117, P0118, P0201 - P0204, P0500, P0501 P124B, P1261, P1262 and P2146 - P2151 are not set.
- The ignition switch is ON.
- The engine coolant temperature is between -10 to 110°C (14 to 230°F).
- The vehicle run time is longer than 18 minutes.
- The engine run time is longer than 5 minutes with engine speed is more than 1200 RPM.
- The accumulation fuel injection quantity since engine start is more than a threshold.

Condition for Setting the DTC

- The ECM detects that the difference of maximum and minimum engine coolant temperature is less than 5°C (9°F).

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- After starting the engine the ECT should rise steadily to about 80 to 85°C (176 to 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0116

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Test the engine cooling system for the following condition. Refer to diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage 2. Repair or replace as necessary Did you find and correct the condition?	—	Go to Step 6	Go to Step 3
3	1. Turn OFF the ignition 2. Disconnect the engine coolant temperature (ECT) sensor harness connector. 3. Inspect for an intermittent, for poor connectors and corrosion at the harness connector of the ECT sensor (pins 1 and 2 of E-41). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 26 and 27 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test each sensor circuit between the ECM (pins 26 and 27 of E-90) and the ECT sensor (pins 1 and 2 of E-41) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the ECT sensor. Refer to ECT Sensor Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 50°C [122°F]). 5. Start the engine and wait until engine is warm upped while comparing the Coolant Temperature parameter on the scan tool to the water temperature gauge on the instrument panel (IP) cluster. Does the Coolant Temperature rise from 50 to 80°C (122 to 176°F) in proportion to the coolant temperature gauge indicates from lowest scale to slightly below middle?	—	Go to Step 7	Go to Step 2
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0117 or P0118 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0117 or P0118 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (DTC P0118)

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0117)
- The ECM detects that the ECT sensor signal voltage is more than 4.75 volts for 3 seconds. (DTC P0118)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses an ECT substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0117

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the ECT Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4

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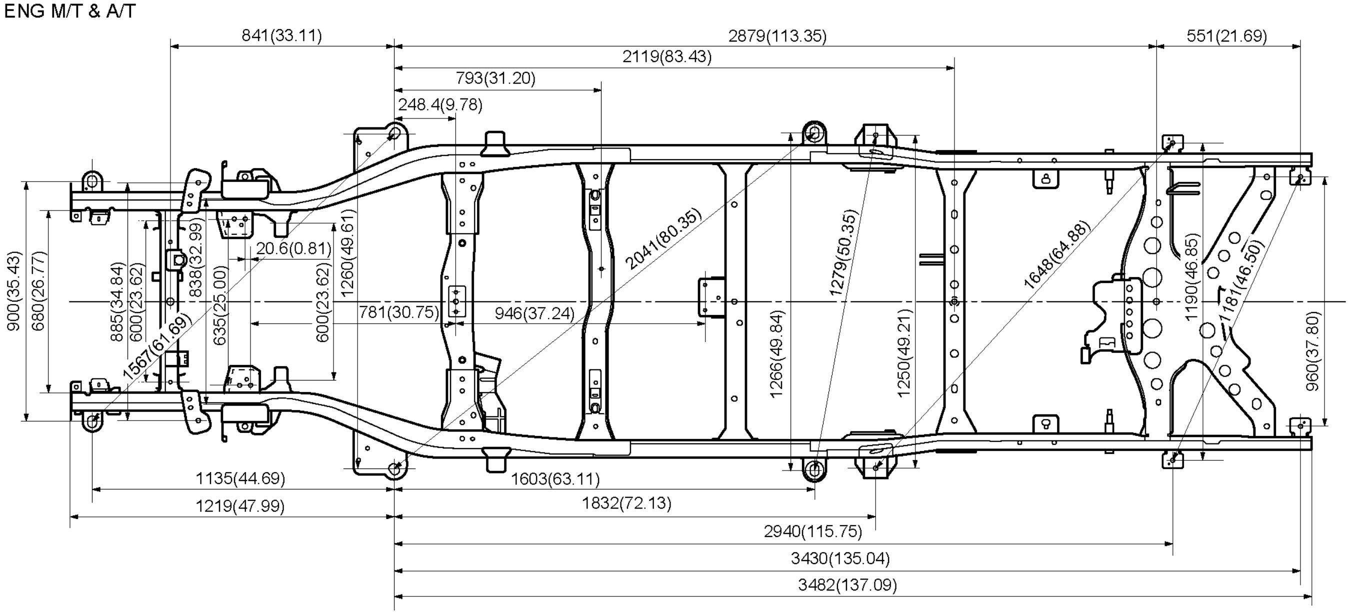
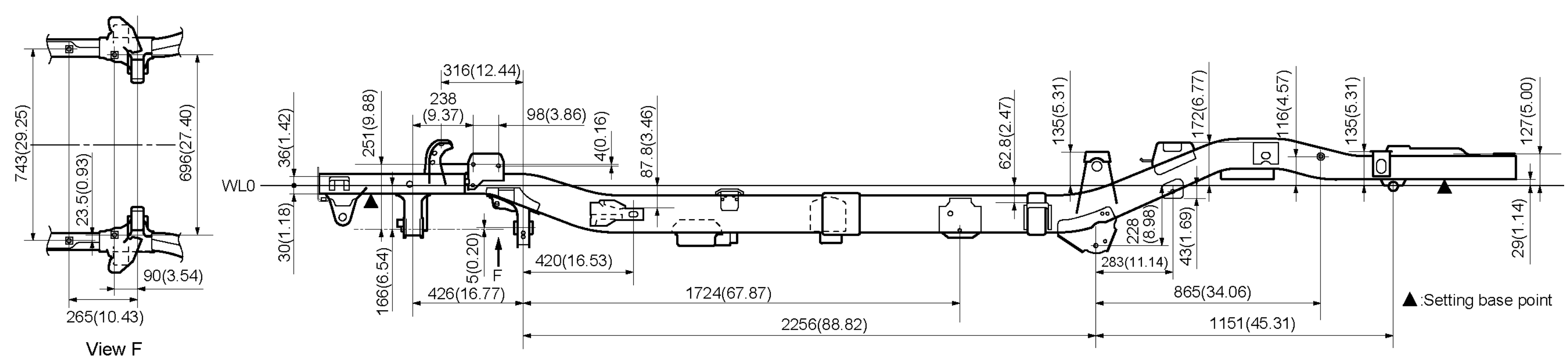
4×4, LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.

mm(in)

HFV6 GAS ENG M/T & A/T





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Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the ECT sensor. Refer to ECT Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 26 and 27 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0118

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Engine Coolant Temperature (ECT) Sensor parameter with a scan tool. Is the ECT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the ECT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 1 of E-41) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**Important:** The ECT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-41). Is the Engine Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 1 of E-41) and a known good ground. Is the Engine Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 26 of E-90) and the ECT sensor (pin 2 of E-41) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 27 of E-90) and the ECT sensor (pin 1 of E-41) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-41). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 26 and 27 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the ECT sensor. Refer to ECT Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0122 or P0123 (Flash Code 43)

Circuit Description

The intake throttle position sensor is installed on the intake throttle valve body together with the control solenoid. The intake throttle position sensor changes output voltage according to intake throttle valve position. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Intake throttle position sensor signal circuit

The intake throttle position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the intake throttle valve. If the ECM detects an excessively low or high signal voltage, DTC P0122 or P0123 will set.

Condition for Running the DTC

- DTCs P0698 and P0699 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the intake throttle position sensor signal voltage is less than 0.1 volts. (DTC P0122)
- The ECM detects that the intake throttle position sensor signal voltage is less than 4.75 volts. (DTC P0123)

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0122

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0698 also set?	—	Go to DTC P0698	Go to Step 3
3	Observe the Intake Throttle Position Sensor parameter with a scan tool. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 6 of E-38) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 5 and 6 of E-38). Is the Intake Throttle Position Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 36 of E-90) and the intake throttle valve (pin 6 of E-38) for an open circuit for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 57 of E-90) and the intake throttle valve (pin 5 of E-38) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle valve (pins 5 and 6 of E-38). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 36 and 57 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0123

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Intake Throttle Position Sensor parameter with a scan tool. Is the Intake Throttle Position Sensor parameter more than the specified valve?	4.7 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0699 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0699	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the Intake Throttle Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 3 of E-38) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The intake throttle position sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 57 of E-90) and the intake throttle valve (pin 5 of E-38) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 35 of E-90) and the intake throttle valve (pin 3 of E-38) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the intake throttle valve (pin 3 of E-38). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 35 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0182 or P0183 (Flash Code 211)

Circuit Description

The fuel temperature (FT) sensor is installed to the fuel supply pump. The FT sensor is a variable resistor and it measures the temperature of the fuel entering the fuel supply pump. The sensor has a signal circuit and a low reference circuit. The ECM supplies 5 volts to the signal circuit and a ground for the low reference circuit. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit. If the ECM detects an excessively low or high signal voltage, DTC P0182 or P0183 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine run time is longer than 3 minutes. (DTC P0183)

Condition for Setting the DTC

- The ECM detects that the FT sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P0182)
- The ECM detects that the FT sensor signal voltage is more than 4.75 volts for 3 seconds. (DTC P0183)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a FT substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Before starting a cold engine, FT sensor and engine coolant temperature (ECT) sensor temperature should be relatively close to each other.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the FT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0182

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Temperature (FT) Sensor parameter with a scan tool. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the FT Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the FT sensor. Refer to FT Sensor Replacement. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections at the harness connector of the ECM (pins 28 and 29 of E-90) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0183

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Temperature (FT) Sensor parameter with a scan tool. Is the FT Sensor parameter more than the specified value?	4.7 volts	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Connect a DMM between the signal circuit (pin 2 of E-27) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 4	Go to Step 5
4	**Important:** The FT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-27). Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit (pin 2 of E-27) and a known good ground. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 8	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
8	1. Test the low reference circuit between the ECM (pin 28 of E-90) and the FT sensor (pin 1 of E-27) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 29 of E-90) and the FT sensor (pin 2 of E-27) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the FT sensor (pins 1 and 2 of E-27). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 28 and 29 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

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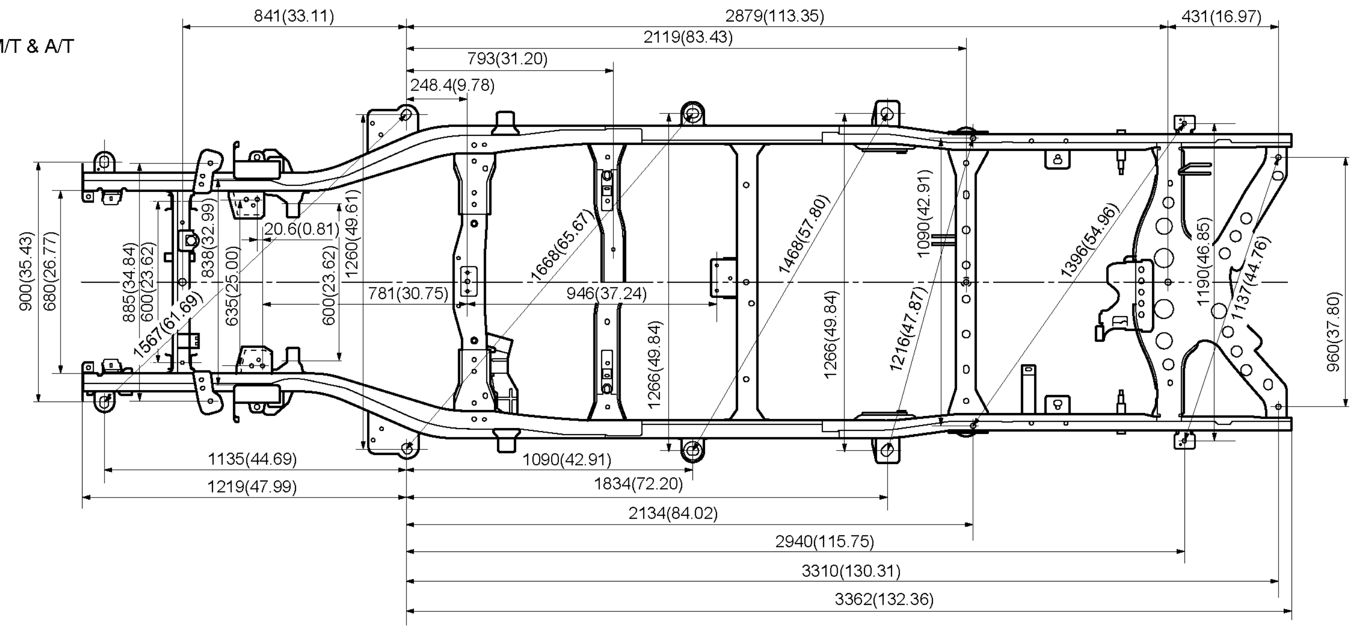
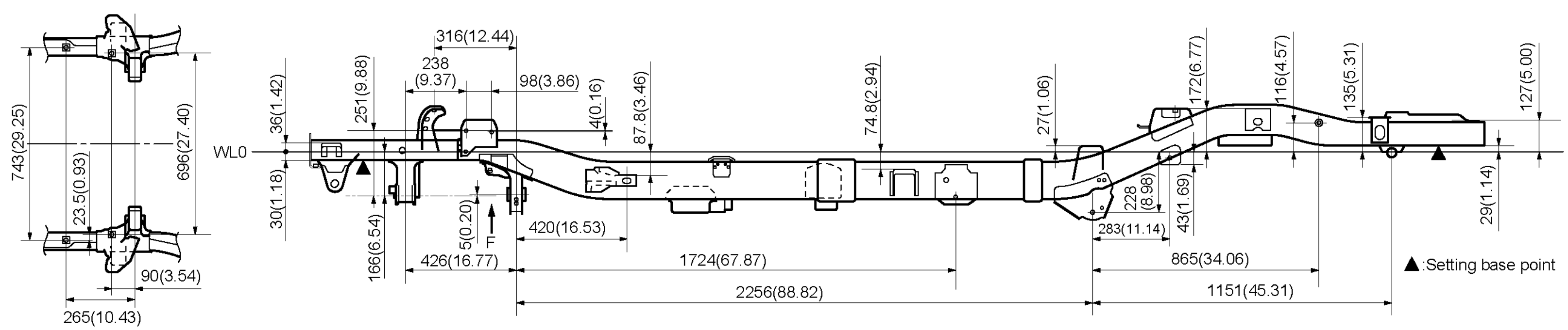
4×4, LWB, CREW CAB MODEL

This illustration is based on the RHD model.

mm(in)

HFV6 GAS ENG M/T & A/T





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TO MODEL INDEX

Step	Action	Value(s)	Yes	No
12	Replace the FT sensor. Refer to FT Sensor Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0192 or P0193 (Flash Code 245)

Circuit Description

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the ECM. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- FRP sensor signal circuit

The ECM monitors the FRP sensor signal voltage. Higher fuel rail pressure provides higher signal voltage while lower pressure provides lower signal voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks. If the ECM detects an excessively low or high signal voltage, DTC P0192 or P0193 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is less than 0.4 volts. (DTC P0192)
- The ECM detects that the FRP sensor signal voltage is more than 4.75 volts. (DTC P0193)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a FRP substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference may affect intermittent condition.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0192

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Observe the Fuel Rail Pressure (FRP) Sensor parameter with a scan tool. Is the FRP Sensor parameter less than the specified value?	0.4 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the FRP Sensor parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 3 of E-48) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Test the signal circuits between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
7	1. Test the 5 volts reference circuit between the ECM (pin 47 of E-90) and the FRP sensor (pin 3 of E-48) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for a poor connection at the harness connector of the FRP sensor (pin 3 of E-48). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 47 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0193

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to DTC P0653	Go to Step 3
3	Observe the Fuel Rail Pressure (FRP) Sensor parameter with a scan tool. Is the FRP Sensor parameter more than the specified value?	4.7 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 2 of E-48) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit (pin 2 of E-48) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 1 and 2 of E-48). Is the FRP Sensor parameter less than the specified value?	0.1 volts	Go to Step 11	Go to Step 7
7	1. Test the low reference circuit between the ECM (pin 69 of E-90) and the FRP sensor (pin 1 of E-48) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the signal circuit between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuits between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
10	**Important:** The FRP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuits between the ECM (pins 48 and 68 of E-90) and the FRP sensor (pin 2 of E-48) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP sensor (pins 1 and 2 of E-48). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 48, 68 and 69 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0201, P0202, P0203 or P0204 (Flash Code 271, 272, 273 or 274)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). If the fuel injector charge voltage circuit or solenoid control circuit is open circuit, this DTC will set. DTC P0201 - P0204 will set depending upon which cylinder injector circuit failed.

Condition for Running the DTC

- DTCs P2146, P2147 and P2148 are not set. (DTC P0201 or P0204)
- DTCs P2149, P2150 and P2151 are not set. (DTC P0203 or P0204)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.
- The engine speed is lower than 2000RPM.

Condition for Setting the DTC

- The ECM detects an open circuit on the fuel injector solenoid circuits.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Each DTC agrees with engine cylinder order.
  - P0201: Cylinder #1
  - P0202: Cylinder #2
  - P0203: Cylinder #3
  - P0204: Cylinder #4

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0201

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #1 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-13). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #1 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	1. Disconnect the cylinder #4 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #1 and #4 fuel injector (pin 2 of E-13 and pin 2 of E-16). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 33 of E-90) and the cylinder #1 fuel injector (pin 1 of E-13) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 52 of E-90) and the cylinder #1 fuel injector (pin 2 of E-13) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 33 and 52 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #1 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0202

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #2 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-14). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #2 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #3 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #2 and #3 fuel injector (pin 2 of E-14 and pin 2 of E-15). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 24 of E-90) and the cylinder #2 fuel injector (pin 1 of E-14) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 71 of E-90) and the cylinder #2 fuel injector (pin 2 of E-14) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 24 and 71 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #2 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0203

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #3 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-15). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #3 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #2 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #2 and #3 fuel injector (pin 2 of E-14 and pin 2 of E-15). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Test the control circuit between the ECM (pin 25 of E-90) and the cylinder #3 fuel injector (pin 1 of E-15) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 51 of E-90) and the cylinder #3 fuel injector (pin 2 of E-15) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 25 and 51 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #3 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

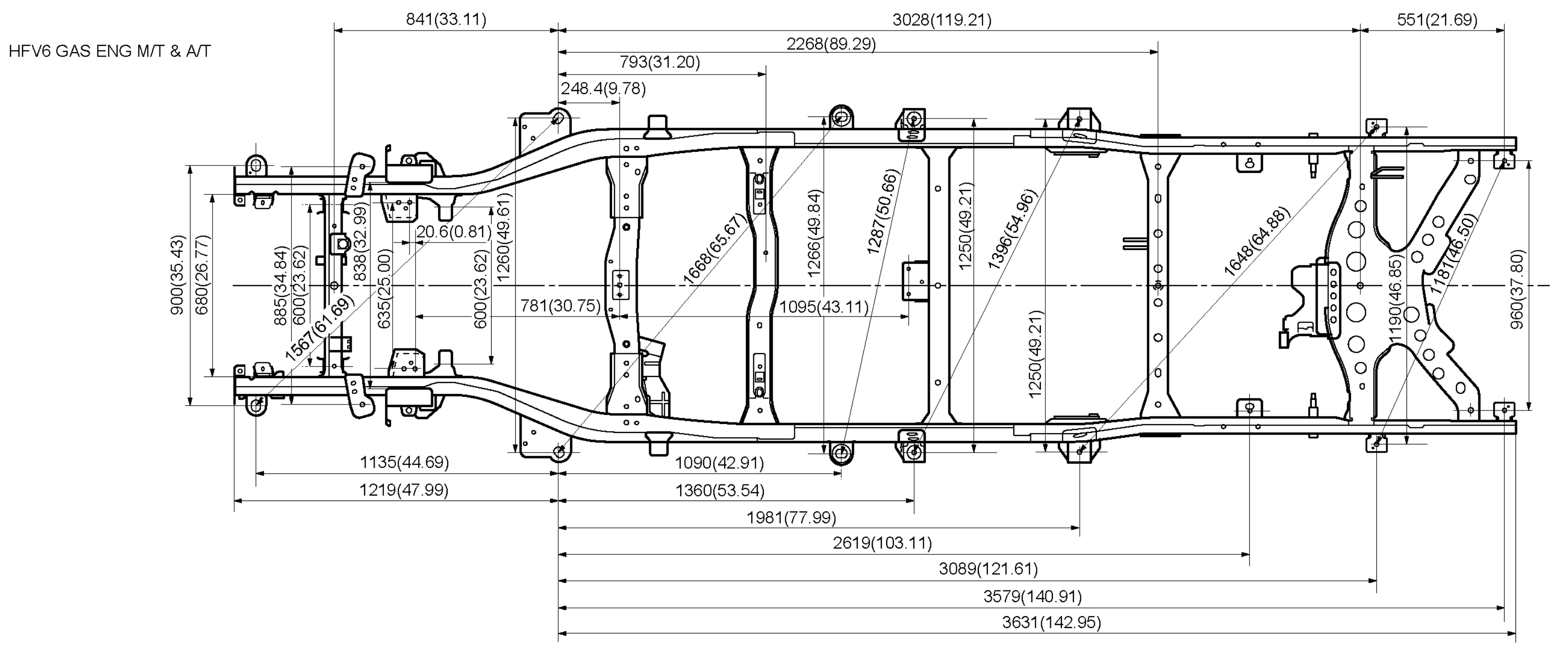
Circuit/ System Testing DTC P0204

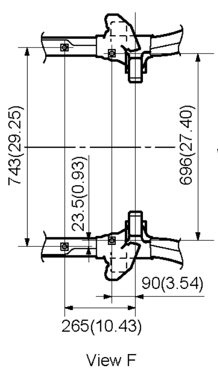
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls

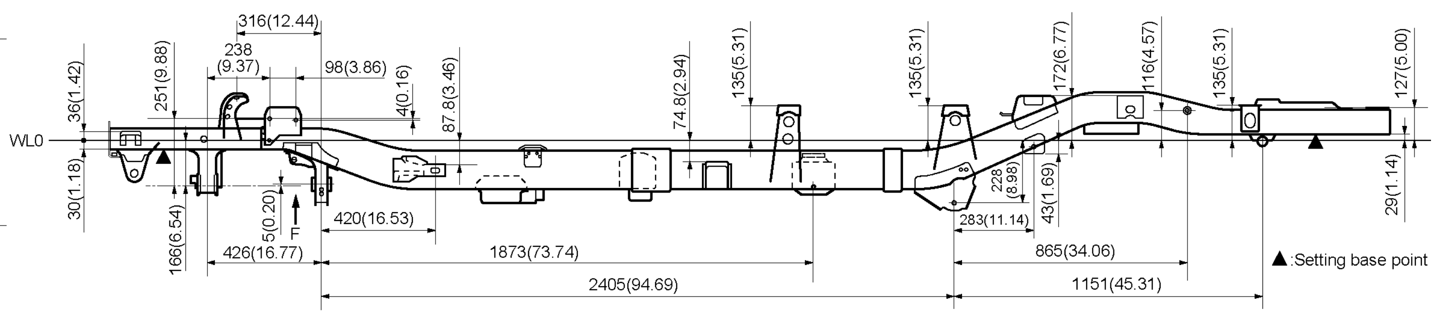
4×4, EXTRA LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.

mm(in)







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Step	Action	Value(s)	Yes	No
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #4 fuel injector harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector (pins 1 and 2 of E-16). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 4
4	Measure the resistance of cylinder #4 fuel injector solenoid. Is the resistance less the specified value?	2.0 Ω	Go to Step 5	Go to Step 9
5	1. Disconnect the cylinder #1 fuel injector harness connector. 2. Measure the resistance of the charge voltage circuit between the cylinder #1 and #4 fuel injector (pin 2 of E-13 and pin 2 of E-16). Is the resistance less than the specified value?	1.0 Ω	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 53 of E-90) and the cylinder #4 fuel injector (pin 1 of E-16) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Test the charge voltage circuit between the ECM (pin 72 of E-90) and the cylinder #4 fuel injector (pin 2 of E-16) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 53 and 72 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement fuel injector must be programmed. Replace the cylinder #4 fuel injector. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0217 (Flash Code 542)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. If the ECM detects an excessive high coolant temperature, this DTC will set.

Condition for Running the DTC

- DTCs P0116, P0117 and P0118 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the engine coolant temperature is more than 110°C (230°F) for 5 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- After starting the engine, the ECT should rise steadily to about 80 to 85°C (176 to 185°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.
- The Total Engine Coolant Overtemperature Events parameter on scan tool indicates number of overheat events.

Notice:

- This DTC is caused by an engine overheat condition (e.g. low engine coolant level). Since this DTC does not illuminate any lamps, clear the DTC and ensure there are no signs of engine damage. Excessive engine overheat may damage internal engine components.

Circuit/ System Testing DTC P0217

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0117 also set?	—	Go to DTC P0117	Go to Step 3
3	1. Test the engine cooling system for the following condition. Refer to diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage • Cooling fan belt slippage • Cooling fan clutch working • Thermostat working • Water pump working • Radiator clogging 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Start the engine and wait until engine is fully warm upped while observing the Coolant Temperature parameter with a scan tool. Does the scan tool indicate more than the specified value?	110°C (230°F)	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Ask the driver if overheat is caused by low engine coolant level, etc. If engine overheat has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 7	—
6	1. Test the engine coolant temperature (ECT) sensor at various temperature levels to evaluate the possibility of a skewed sensor. 2. Replace the ECT sensor as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Diagnostic Aids
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and wait until engine is fully warm upped while observing the Coolant Temperature parameter with a scan tool. Does the scan tool indicate more than the specified value?	110°C (230°F)	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0219 (Flash Code 543)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The ECM calculates the engine speed and exact position of the crankshaft based on the signal pulse from the CKP sensor. If the ECM detects an engine overrun condition, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the engine speed is more than 4900 RPM (4JK1 standard output) or 4700 RPM (4JK1 high output and 4JJ1).

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- Make sure the CKP sensor is tight and the teeth are not damaged.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- The Total Engine Overspeed Events parameter on scan tool indicates number of overrun events.

Notice:

- This DTC is caused by an engine overspeed condition, which was most likely caused by driver error (i.e. downshifting a manual transmission on a steep grade). Excessive engine overspeed may damage internal engine components.

Circuit/ System Testing DTC P0219

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	**Important:** If DTC P0335 or P0336 is set, diagnose that DTC first. 1. Install a scan tool. 2. Start the engine. 3. Observe the Engine Speed parameter with a scan tool. 4. Accelerate the engine as necessary. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 3
3	Ask the driver if overrun is caused by gear slip-out, shift error, down-slope driving, etc. If engine overrun has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
4	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the CKP sensor. Refer to CKP Sensor Replacement. Did you complete the replacement?	—	Go to Step 5	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Engine Speed parameter with a scan tool. Does the Engine Speed parameter ever exceed the specified value?	5000 RPM	Go to Step 4	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0231 or P0232 (Flash Code 69)

Circuit Description

The ECM controls the fuel pump relay which supplies power to the fuel pump in the fuel tank. The ECM commands the fuel pump relay ON for a certain length of time at ignition switch is ON with the engine OFF. During the engine running it is continuously commanded ON. If the ECM detects an improper voltage level on the relay control circuit, DTC P0231 or P0232 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the fuel pump relay control circuit for longer than 3 second when the relay is commanded OFF. (DTC P0231)
- The ECM detects a high voltage condition on the fuel pump relay control circuit for longer than 3 second when the relay is commanded ON. (DTC P0232)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- The fuel pump relay is commanded ON for 12 seconds at ignition switch is ON with the engine OFF.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0231

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition for 20 seconds while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition for 20 seconds while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 7

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Probe the ignition voltage feed circuit of the relay coil side (pin 3 of X-13) with a test lamp that is connected a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 6
5	1. Test the control circuit between the ECM (pin 54 of C-58) and the relay (pin 5 of X-13) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
6	Repair the open circuit or high resistance between the ECM main relay (pin 1 of X-12) and the fuel pump relay (pin 3 of X-13). Did you complete the repair?	—	Go to Step 11	—
7	1. Remove the fuel pump relay. 2. Inspect for an intermittent and for a poor connection on each relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 54 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 20 seconds while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0232

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail?	—	Go to Step 4	Go to Step 5
4	1. Test the control circuit between the ECM (pin 54 of C-58) and the relay (pin 5 of X-13) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0234 (Flash Code 42)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The ECM monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the sensor signal is excessively high, this DTC will set. This indicates excessive high boost pressure.

Condition for Running the DTC

- DTCs P0045, P0107 and P0108 are not set.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the actual boost pressure is more than 20 kPa (3 psi) over the desired boost pressure under certain conditions for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Diagnostic Aids

- An open circuit or high resistance in the boost pressure low reference circuit may set this DTC.
- Misrouted vacuum hoses may set this DTC.
- Check the turbocharger nozzle control actuator for a sticking. Refer to Turbocharger in the Engine Mechanical section.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the Boost Pressure to the Desired Boost Pressure under all load conditions for an excessively high value.
- The fuel with which gasoline was mixed may set this DTC.

Test Description

The numbers below refer to the step number on the Circuit/ System Testing.

3. A skewed boost pressure sensor value (shifted to a higher pressure) can set this DTC. The Boost Pressure on the scan tool should read near Barometric Pressure (BARO) with the key ON and engine OFF.

4. A skewed BARO sensor value (shifted to a lower pressure) may indicate a wrong boost pressure. The BARO on the scan tool should read near surrounding barometric pressure.

Schematic Reference: Vacuum Hose Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0234

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System - Check Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0045, P0107, P0108, P0638, P1196, P1197, P1198, P2227, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Boost Pressure and Barometric Pressure (BARO) with a scan tool. Does the scan tool indicate that the difference between the Boost Pressure and BARO is more than the specified value?	10 kPa (1.5 psi)	Go to Step 4	Go to Step 5

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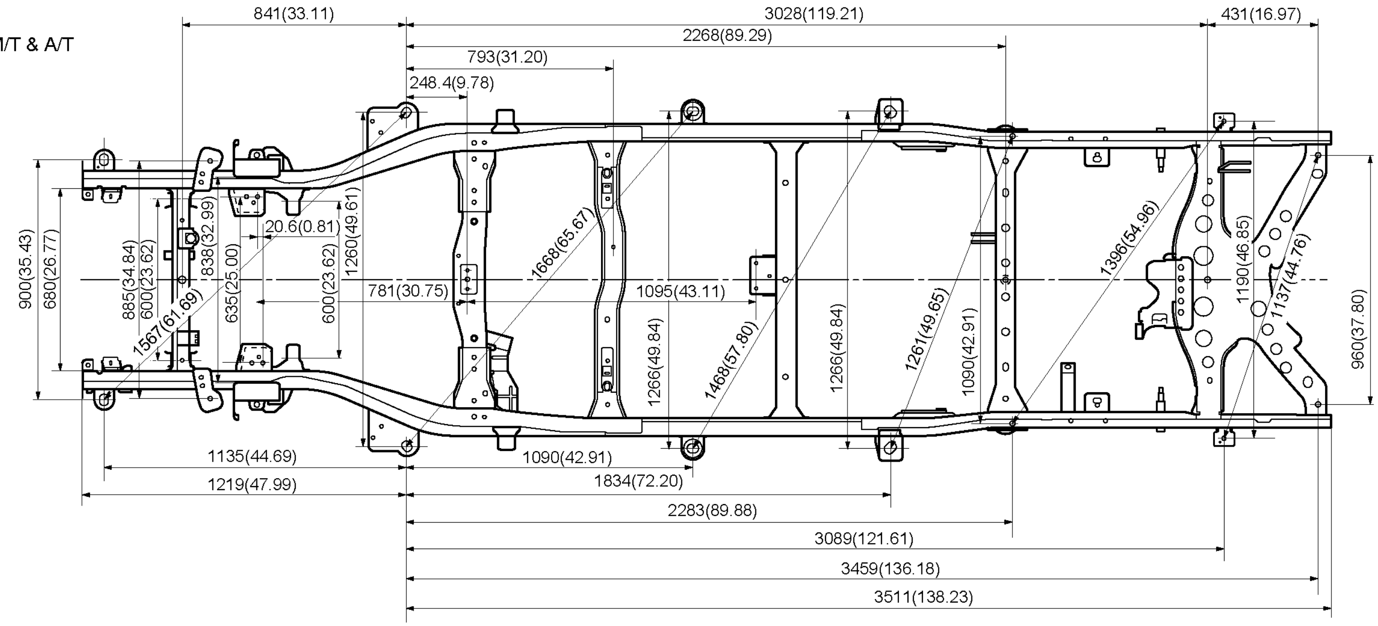
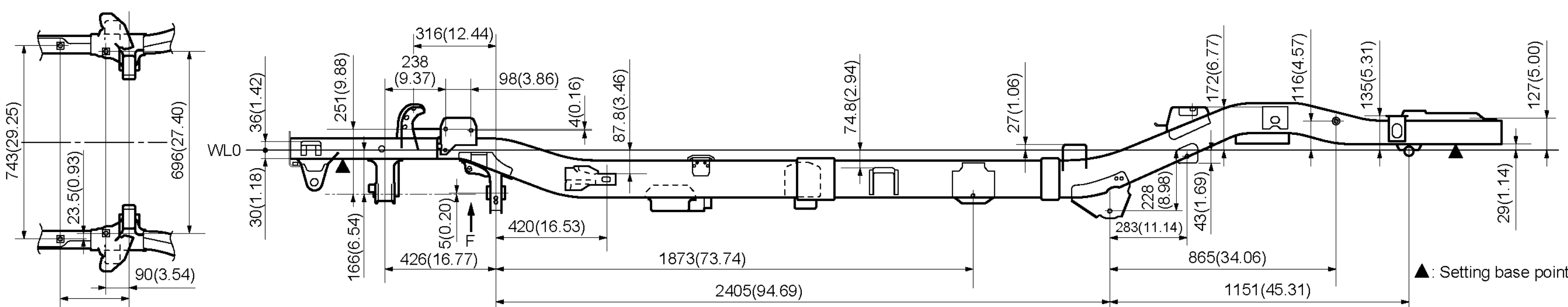
4×4, EXTRA LWB, CREW CAB MODEL

This illustration is based on the RHD model.

mm(in)

HFV6 GAS ENG M/T & A/T





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Step	Action	Value(s)	Yes	No
4	Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 7
5	1. Inspect the following for possible causes of high boost pressure. • Misrouted turbocharger nozzle control actuator vacuum hoses • Turbocharger nozzle control actuator or solenoid valve for a stuck condition. Refer to Turbocharger Control System Check in this section. • Intake throttle valve sticking. Perform the Intake Throttle Solenoid Control with a scan tool • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair or replace as necessary. Did you find and correction the condition?	—	Go to Step 10	Go to Diagnostic Aids
6	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 2 of E-107). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 23 of E-90). 6. Test for high resistance of the low reference circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the BARO sensor (pins 2 and 3 of E-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 18 and 19 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9

Step	Action	Value(s)	Yes	No
8	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle that the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	Go to Step 11	Go to Step 2
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0299 (Flash Code 65)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The ECM monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the sensor signal is excessively low, this DTC will set. This indicates excessive low boost pressure.

Condition for Running the DTC

- DTCs P0045, P0087, P0088, P0089, P0091, P0092, P0093, P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0192, P0193, P0401, P0403, P0404, P0405, P0406, P0638, P0652, P0653, P0698, P0699, P1064, P1065, P1093, P1404, P2100, P2101, P2103, P2227, P2228 and P2229 are not set.
- The ignition switch is ON.
- The engine is running.
- The fuel injection quantity is higher than a predetermined value.

Condition for Setting the DTC

- The ECM detects that the actual boost pressure is more than 40 kPa (6 psi) below the desired boost pressure under certain conditions for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Induction air leakage can cause a low boost pressure condition. A whistling noise may be heard if a component is allowing air to enter the induction system.
- Check for cracked air tubing that may only open during certain engine movement conditions.
- Misrouted vacuum hoses may set this DTC.
- Check the turbocharger nozzle control actuator for a sticking. Refer to Turbocharger in the Engine Mechanical section.
- Use a scan tool to verify the integrity of the boost pressure sensor signal. Compare the Boost Pressure to the Desired Boost Pressure under all load conditions for an excessively low value.
- Loss of vacuum pressure or vacuum pump problem sets this DTC.

Test Description

The numbers below refer to the step number on the diagnostic table.
4. A skewed boost pressure sensor value (shifted to a lower pressure) can set this DTC. The Boost Pressure on the scan tool should read near Barometric Pressure (BARO) with the key ON and engine OFF.
5. A skewed BARO sensor value (shifted to a higher pressure) may indicate a wrong boost pressure. The BARO on the scan tool should read near surrounding barometric pressure.

Schematic Reference: Vacuum Hose Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0299

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0045, P0107, P0108, P2227, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following for possible causes of low boost pressure. • Air leakage around the boost pressure sensor or objects that block the sensor hole. • Air leaking around any of the air induction tubing between the turbocharger and intake manifold. Check for damaged components and for loose clamps. • Misrouted, disconnected or kinked turbocharger nozzle control actuator vacuum hose. • Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Turbocharger nozzle control actuator or solenoid valve for a stuck condition. Refer to Turbocharger Control System Check in this section. • Intake throttle valve sticking. Perform the Intake Throttle Solenoid Control with a scan tool. • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the boost pressure sensor. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the Boost Pressure and Barometric Pressure (BARO) with a scan tool. Does the scan tool indicate that the difference between the Boost Pressure and BARO is more than the specified value?	10 kPa (1.5 psi)	Go to Step 5	Go to Diagnostic Aids
5	Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the boost pressure sensor (pins 1 and 3 of E-107). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 20 and 21 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of E-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 17 of E-90). 6. Test for high resistance of the low reference circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle that the engine speed is more than 2000 RPM and the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	Go to Step 11	Go to Step 2
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0335 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The CKP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- CKP sensor signal circuit

The ECM monitors both CKP sensor and camshaft position (CMP) sensor signal pulses to ensure they correlate with each other. If the ECM receives a certain amount of CMP sensor signal pulses without a CKP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor signal pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- An intermittent CKP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the sensor rotor teeth are not damaged.

Notice:

- If the CKP sensor signal pulse is lost while running, the engine will stop.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0335

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the DTC Information with a scan tool. Is DTC P0340, P0341, P0698 or P0699 also set?	—	Go to Applicable DTC	Go to Step 3
3	Observe the Cam/ Crank Sensor Signal Synchronization Status parameter with a scan tool. Does the scan tool indicate Synchronous?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-52) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 9

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the signal circuit (pin 1 of E-52) and a known good ground. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.7 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-52) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 13	Go to Step 8
8	Connect a DMM between the 5 volts reference circuit and low reference circuit (pins 2 and 3 of E-52). Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 14	Go to Step 10
9	1. Test the 5 volts reference circuit between the ECM (pin 37 of E-90) and the CKP sensor (pin 3 of E-52) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
10	1. Test the low reference circuit between the ECM (pin 39 of E-90) and the CKP sensor (pin 2 of E-52) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
11	1. Test the signal circuit between the ECM (pin 58 of E-90) and the CKP sensor (pin 1 of E-52) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
12	**Important:** The CKP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 58 of E-90) and the CKP sensor (pin 1 of E-52) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
13	1. Test the signal circuit between the ECM (pin 58 of E-90) and the CKP sensor (pin 1 of E-52) for a short to any 5 volts reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18

Step	Action	Value(s)	Yes	No
14	1. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1, 2 and 3 of E-52). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 37, 38, 39 and 58 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
16	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
17	Replace the CKP sensor. Refer to CKP Sensor Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0336 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The ECM monitors both CKP sensor and camshaft position (CMP) sensor signal pulses to ensure they correlate with each other. If the ECM receives extra or missing CKP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTC P0335 is not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CKP sensor signal pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CKP sensor circuits may set this DTC.
- An intermittent CKP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the sensor rotor teeth are not damaged.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

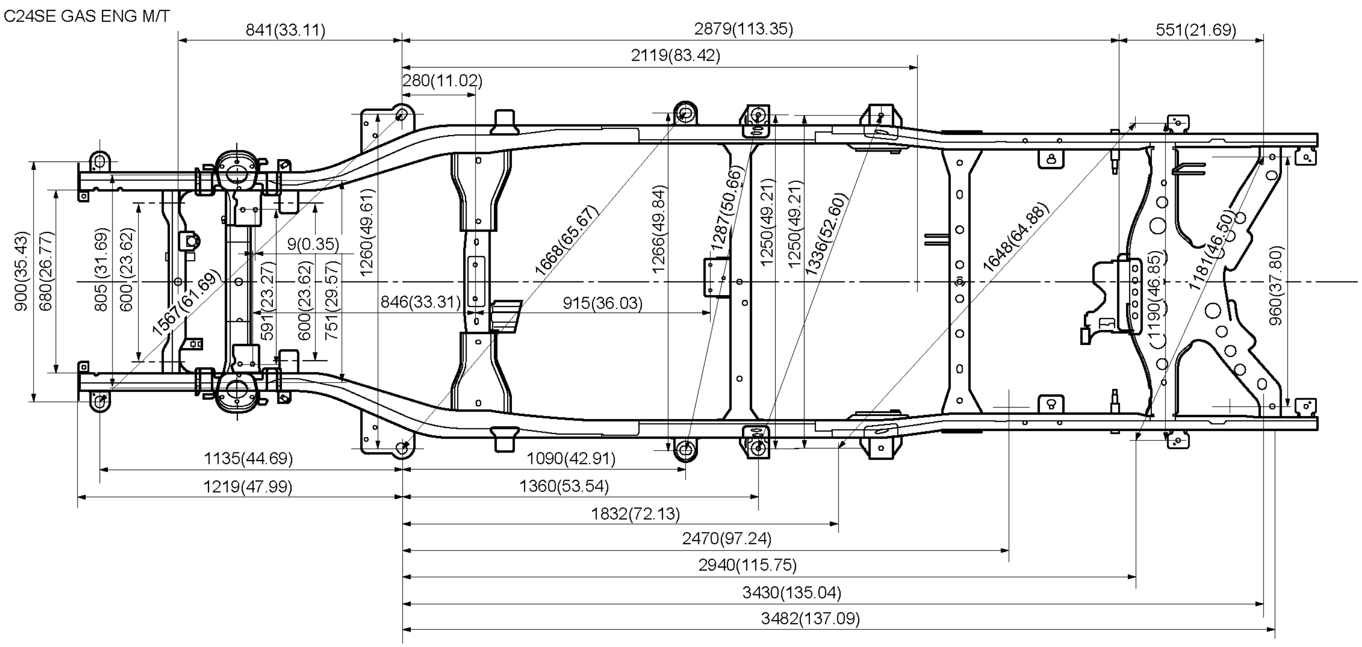
Circuit/ System Testing DTC P0336

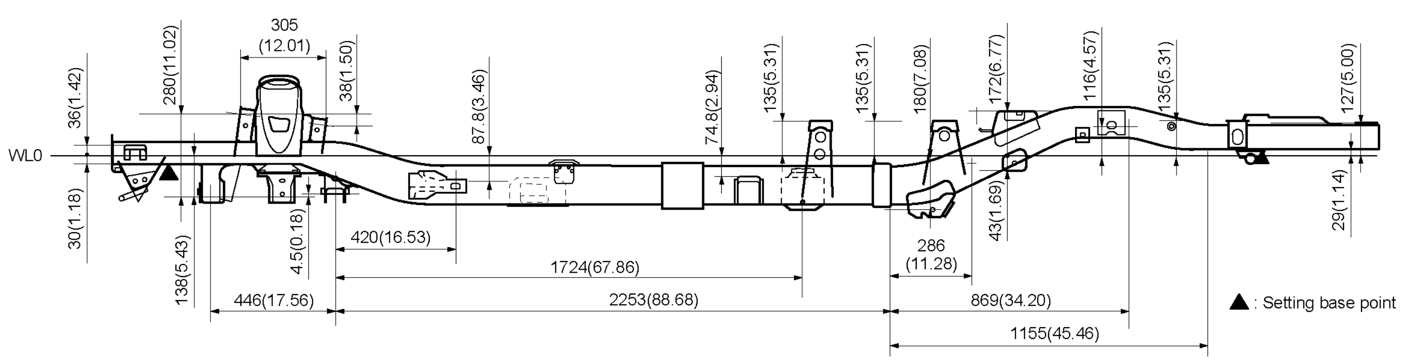
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the DTC Information with a scan tool. Is DTC P0335, P0340, P0341, P0698 or P0699 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Inspect all of the circuits going to the crankshaft position (CKP) sensor for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids and relays 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 37, 38, 39 and 58 of E-90). 4. Disconnect the CKP sensor harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the CKP sensor (pins 1, 2 and 3 of E-52). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Inspect the CKP sensor and sensor rotor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and sensor rotor • Physical damage of sensor rotor • Loose or improper installation of sensor rotor 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the CKP sensor. Refer to CKP Sensor Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

4×2, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model





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DTC P0340 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface). The CMP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- CMP sensor signal circuit

The ECM monitors both crankshaft position (CKP) sensor and CMP sensor signal pulses to ensure they correlate with each other. If the ECM receives a certain amount of CKP sensor signal pulses without a CMP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016 and P0341are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The CKP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CMP sensor signal pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CMP sensor circuits may set this DTC.
- An intermittent CMP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the timing chain sprocket is not damaged.

Notice:

- If the CMP sensor signal pulse is lost while running, the engine will operate normally. If the CMP sensor signal pulse is not present on start-up, the engine will not start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0340

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 or P0653 also set?	—	Go to Applicable DTC	Go to Step 3
3	Start the engine. If the engine does not start, crank over the engine for 10 seconds while observing the Cam/ Crank Sensor Signal Synchronization Status parameter with a scan tool. Does the scan tool indicate Synchronous?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the camshaft position (CMP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-39) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 9
5	Connect a DMM between the signal circuit (pin 1 of E-39) and a known good ground. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 12	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	4.7 volts	Go to Step 7	Go to Step 11
7	1. Connect a test lamp between the signal circuit (pin 1 of E-39) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 13	Go to Step 8
8	Connect a DMM between the 5 volts reference circuit and low reference circuit (pins 2 and 3 of E-39). Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 14	Go to Step 10
9	1. Test the 5 volts reference circuit between the ECM (pin 46 of E-90) and the CMP sensor (pin 3 of E-39) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
10	1. Test the low reference circuit between the ECM (pin 44 of E-90) and the CMP sensor (pin 2 of E-39) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
11	1. Test the signal circuit between the ECM (pin 45 of E-90) and the CKP sensor (pin 1 of E-39) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
12	**Important:** The CMP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 45 of E-90) and the CMP sensor (pin 1 of E-39) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18

Step	Action	Value(s)	Yes	No
13	1. Test the signal circuit between the ECM (pin 45 of E-90) and the CMP sensor (pin 1 of E-39) for a short to any 5 volts reference. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
14	1. Inspect for an intermittent and for poor connections at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-39). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 44, 45, 46 and 64 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
16	1. Inspect the CMP sensor and chain sprocket for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and chain sprocket • Physical damage of chain sprocket • Loose or improper installation of chain sprocket 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
17	Replace the CMP sensor. Refer to CMP Sensor Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0341 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface). The ECM monitors both crankshaft position (CKP) sensor and CMP sensor signal pulses to ensure they correlate with each other. If the ECM receives extra or missing CMP sensor signal pulse, this DTC will set.

Condition for Running the DTC

- DTCs P0016 and P0340 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CMP sensor signal pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the CMP sensor circuits may set this DTC.
- An intermittent CMP sensor signal pulse may set this DTC.
- Ensure the sensor is tight and the timing chain sprocket is not damaged.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0341

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the DTC Information with a scan tool. Is DTC P0340, P0652 or P0653 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Inspect all of the circuits going to the camshaft position (CMP) sensor for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids and relays 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-39). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 44, 45, 46 and 64 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Inspect the CMP sensor and chain sprocket for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and chain sprocket • Physical damage of chain sprocket • Loose or improper installation of chain sprocket 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the CMP sensor. Refer to CMP Sensor Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0380 (Flash Code 66)

Circuit Description

The ECM controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects an open circuit or short circuit on the relay control circuit, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the glow relay control circuit for longer than 3 second when the relay is commanded OFF.
- The ECM detects a high voltage condition on the glow relay control circuit for longer than 3 second when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The numbers below refers to the step number on the Circuit/ System Testing.
2. Listen for an audible click when the glow relay operates. Command both the ON and OFF states.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0380

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Perform the Glow Relay Control with a scan tool. 3. Command the relay ON and OFF. Does the glow relay click with each command?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the engine coolant temperature (ECT) sensor harness connector in order to gain glow ON time long enough. 3. Turn ON the ignition for 30 seconds while observing the DTC Information with a scan tool. Does the DTC P0380 fail this ignition?	—	Go to Step 11	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Perform the Glow Relay Control with a scan tool. 4. Command the relay ON and OFF. Does the glow relay click with each command?	—	Go to Step 8	Go to Step 5
5	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition voltage feed circuit of the relay coil side (pin 2 of X-5) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the ECM (pin 37 of C-58) and the relay (pin 3 of X-5) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	Repair the open circuit or high resistance between the Engine (10A) fuse and the glow relay coil side (pin 2 of X-5). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 12	—
8	1. Remove the glow relay. 2. Inspect for an intermittent and for a poor connection on each relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 37 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the glow relay. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Disconnect the ECT sensor harness connector in order to gain glow ON time long enough. 5. Turn ON the ignition for 30 seconds while observing the DTC Information with a scan tool. Did the DTC P0380 fail this ignition?	—	Go to Step 2	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0401 (Flash Code 93)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. When the proper enabling conditions are met, the ECM will open the EGR valve while monitoring the mass air flow (MAF) signal. An expected MAF difference should be detected between the closed and open positions. If the ECM detects the MAF difference less than expected, this DTC will set. This DTC will only run once per ignition cycle within the enabling conditions.

Condition for Running the DTC

- DTCs P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0122, P0123, P0403, P0404, P0405, P0406, P0500, P0501, P0652, P0653, P0698, P0699, P2100, P2101, P2102, P2103, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MAF amount is not within the calculated range during the EGR flow test. This indicates insufficient amount of EGR flow.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking the EGR valve may set this DTC.

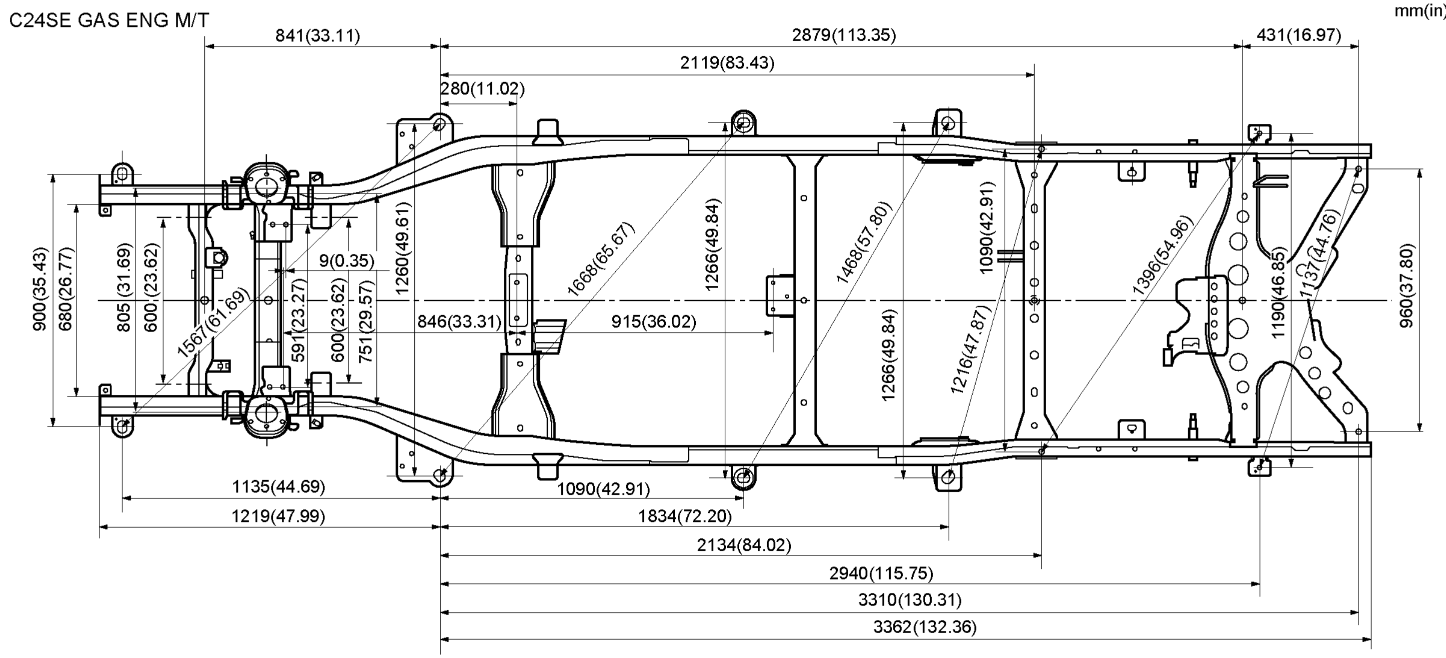
Circuit/ System Testing DTC P0401

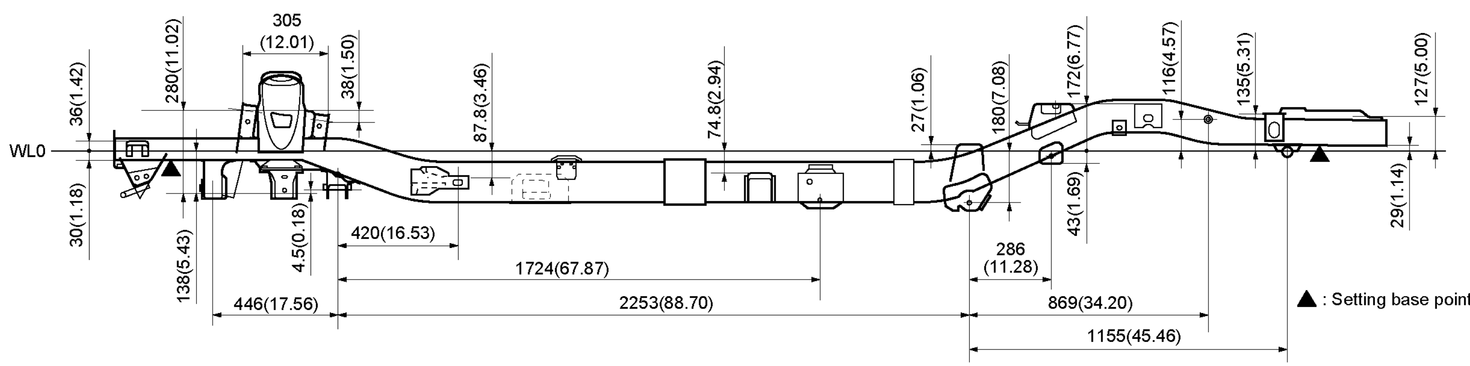
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and warm up as necessary (allow engine coolant temperature to reach at least 60°C [140°F]). 4. Perform the EGR Solenoid Control with a scan tool. 5. Command the Desired EGR Position Increase or Decrease while observing the Mass Air Flow (MAF) Sensor parameter with a scan tool. Does the MAF Sensor parameter decrease by at least 0.5 volts when the Desired EGR Position is commanded from 0 to 90%?	—	Go to Diagnostic Aids	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Inspect the following conditions: • An EGR valve gasket that is missing or damaged • A sticking EGR valve • EGR gas leakage from any of the EGR passages between the exhaust manifold and intake manifold • Restricted or collapsed EGR passage between the exhaust manifold and the EGR valve • Any type of restriction in the exhaust system • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any water intrusion in the induction system • Any contamination or objects that block the MAF sensor inlet • Skewed or slow MAF sensor • A ventilation duct that is connected to the exhaust tail pipe. Retest without the duct if connected. 2. Repair or replace as necessary Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and warm up as necessary (allow engine coolant temperature to reach at least 60°C [140°F]). 5. Perform the EGR Solenoid Control with a scan tool. 6. Command the Desired EGR Position Increase or Decrease while observing the MAF Sensor parameter with a scan tool. Does the MAF parameter decrease by at least 0.5 volts when the Desired EGR Position is commanded from 0 to 90%?	—	Go to Step 6	Go to Step 3
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

4×2, LWB, CREW CAB MODEL

This illustration is based on the RHD model.





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DTC P0403 (Flash Code 37)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects an open circuit or short circuit on the solenoid circuits, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects an open circuit on the EGR solenoid circuits.
- The ECM detects a short to ground on the EGR solenoid circuits.
- The ECM detects a short to voltage circuit on the EGR solenoid circuits.

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0403

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the drive voltage circuit (pin 4 of E-71) and a known good ground. 5. Connect a DMM between the low side circuit (pin 6 of E-71) and a known good ground. Are both voltage readings within the specified value?	1.4 - 1.8 volts	Go to Step 5	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the circuits between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
6	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) for the following conditions: • An open circuit • A short to ground • A short to the position sensor low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 62 and 63 of E-90) and the EGR valve (pins 4 and 6 of E-71) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
8	1. Inspect for an intermittent and for poor connections at the harness connector of the EGR valve (pins 4 and 6 of E-71). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 62 and 63 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
10	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 10	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0404 (Flash Code 45)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects a variance between the actual EGR valve position and desired EGR valve position for a calibrated amount of time while the EGR valve is commanded ON, this DTC will set.

Condition for Running the DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0405, P0406, P0652, P0653, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 volts.
- The ignition switch is ON.
- The engine coolant temperature is between 20 to 110 °C (68 to 230 °F).
- The intake air temperature is between 0 to 110 °C (32 to 230°F).
- The barometric pressure is between 60 to 120 kPa (8.7 to 17.4 psi).
- The EGR control is commanded ON.

Condition for Setting the DTC

- The ECM detects that the actual EGR position is more than 10% below the desired position for 4 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking EGR valve may set this DTC.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0404

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0403, P0405 or P0406 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position. Does the EGR Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0405 or P0406 (Flash Code 44)

Circuit Description

The exhaust gas recirculation (EGR) position sensor is installed on the EGR valve body together with the control solenoid. The EGR position sensor changes output voltage according to EGR valve position. The sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- EGR position sensor signal circuit

The EGR position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the EGR valve. If the ECM detects an excessively low or high signal voltage, DTC P0405 or P0406 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the EGR position sensor signal voltage is less than 0.2 volts for 3 seconds. (DTC P0405)
- The ECM detects that the EGR position sensor signal voltage is more than 4.6 volts for 3 seconds. (DTC P0406)

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0405

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Observe the EGR Position Sensor parameter with a scan tool. Is EGR Position Sensor parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of E-71) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 1 and 3 of E-71). Is the EGR Position Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 31 of E-90) and the EGR valve (pin 1 of E-71) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 32 of E-90) and the EGR valve (pin 3 for E-71) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the EGR valve (pins 1 and 3 of E-71). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 31 and 32 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0406

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the EGR Position Sensor parameter with a scan tool. Is the EGR Position Sensor parameter more than the specified valve?	4.6 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the EGR Position Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0653	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. Is the EGR Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 2 of E-71) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The EGR position sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 32 of E-90) and the EGR valve (pin 3 of E-71) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 30 of E-90) and the EGR valve (pin 2 of E-71) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the EGR valve (pin 2 of E-71). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 30 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0500 (Flash Code 25)

Circuit Description

The vehicle speed sensor (VSS) is used by the ECM and speedometer, which generates a speed signal from the transmission output shaft rotational speed or transfer output shaft rotational speed. The sensor has the following circuits.

- Ignition voltage circuit
- Low reference circuit
- VSS signal circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the 2WD fitted with Jatco automatic transmission, VSS signals are sent from the TCM. If the ECM detects VSS signals are not generated, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.
- The engine speed is more than 1000 RPM.
- The commanded fuel injection quantity is OFF (accelerator pedal is not depressed).

Condition for Setting the DTC

- The ECM detects that the VSS signals are not generated for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the VSS circuits may set this DTC.

Notice:

- If this DTC set, the Vehicle Speed parameter on the scan tool will display 3 km/h (2 MPH).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

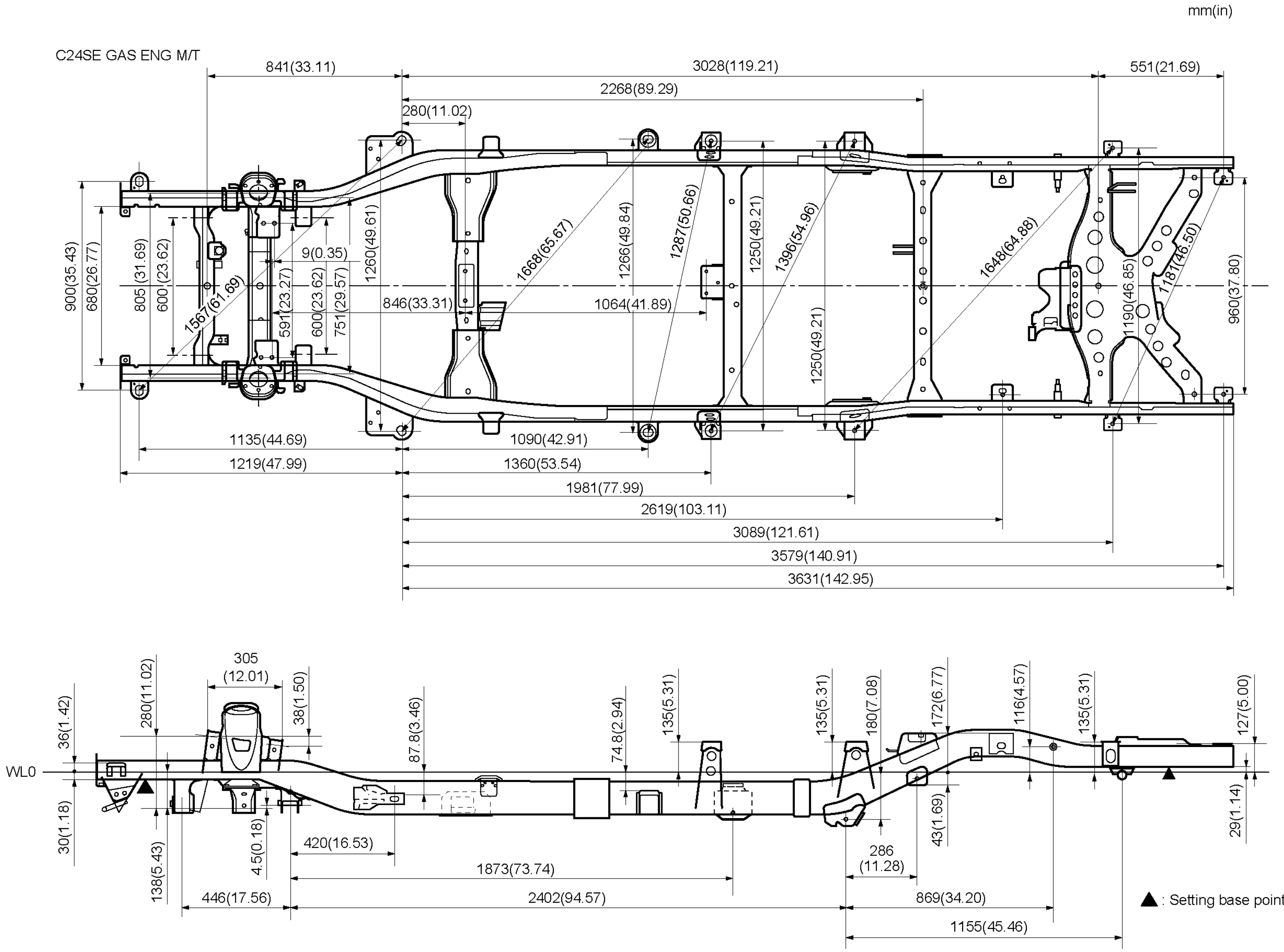
Circuit/ System Testing DTC P0500 (2WD fitted with Jatco A/T)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0219 also set?	—	Go to DTC P0219	Go to Step 3
3	Monitor the transmission DTC Information with a scan tool. Is DTC P0722 set?	—	Go to P0722 in Automatic Transmission Section	Go to Step 4
4	Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 5

BACK TO CHAPTER INDEX

4×2, EXTRA LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Intermittently jump the signal circuit (pin 10 of C-94) with a test lamp that is connected to a known good ground while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 7	Go to Step 6
6	1. Test the signal circuit between the ECM (62 of C-58) and the TCM (10 of C-94) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 10 of C-94). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 62 of C-58). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 12	Go to Step 3
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0500 (except 2WD fitted with Jatco A/T)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0219 also set?	—	Go to DTC P0219	Go to Step 3
3	Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the vehicle speed sensor (VSS) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit (pin 1 of E-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7
5	Intermittently jump the signal circuit (pin 3 of E-44) with a test lamp that is connected to a known good ground while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate any vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 6	Go to Step 9
6	Connect a test lamp between the voltage feed circuit and the low reference circuit (pins 1 and 2 of E-44). Does the test lamp illuminate?	—	Go to Step 10	Go to Step 8
7	Repair the open circuit or high resistance between the Meter (10A) fuse and the VSS (pin 1 of E-44). Check the Meter (10A) fuse first. Did you complete the repair?	—	Go to Step 15	—
8	Repair the open circuit or high resistance on the low reference circuit between the VSS (pin 2 of E-44) and ground terminal (E-10). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 15	—
9	1. Test the signal circuit between the ECM (pin 62 of C-58) and the VSS (pin 3 of E-44), then between the instrument panel (IP) cluster (pin 8 of B-23) and the VSS (pin 3 of E-44) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11

Step	Action	Value(s)	Yes	No
10	1. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pin 1, 2 and 3 of E-44). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 62 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
12	1. Inspect the VSS, drive gear, driven gear or output shaft for the following conditions: • Physical damage of sensor, drive gear or driven gear • Loose or improper installation of sensor, drive gear or driven gear • Transmission output shaft teeth damage • Excessive transmission output shaft play • Transfer output shaft teeth damage • Excessive transfer output shaft play 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
13	Replace the VSS. Refer to VSS Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 16	Go to Step 4
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0501 (Flash Code 25)

Circuit Description

The vehicle speed sensor (VSS) is used by the ECM and speedometer, which generates a speed signal from the transmission output shaft rotational speed or transfer output shaft rotational speed. The sensor has the following circuits.

- Ignition voltage feed circuit
- Low reference circuit
- VSS signal circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the 2WD fitted with Jatco automatic transmission, VSS signals are sent from the TCM. If the ECM detects VSS signals are sharply changed, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the VSS signal are changed larger than a predetermined vehicle speed within a very short calibrated time.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the VSS circuits may set this DTC.

Notice:

- If this DTC set, the Vehicle Speed parameter on the scan tool will display 3 km/h (2 MPH).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0501

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Inspect all of the circuits going to the vehicle speed sensor (VSS) for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 8	Go to Step 3
3	1. Inspect for an intermittent, for poor connections and corrosion at the Meter (10A) fuse. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Inspect for an intermittent, a poor connection and corrosion at the ground terminal (E-10). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the VSS (pins 1, 2 and 3 of E-44). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for a poor connection and corrosion at the harness connector of the ECM (pin 62 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	1. Inspect the VSS, drive gear, driven gear or output shaft for the following conditions: • Physical damage of sensor, drive gear or driven gear • Loose or improper installation of sensor, drive gear or driven gear • Transmission output shaft teeth damage • Excessive transmission output shaft play • Transfer output shaft teeth damage • Excessive transfer output shaft play 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Replace the VSS. Refer to VSS Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed with a scan tool. Does the scan tool parameter indicate correct vehicle speed?	—	Go to Step 9	Go to Step 2
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0512 (Flash Code 417)

Circuit Description

The starter switch signal is inputted to the ECM during the ignition switch START position. If the ECM detects the starter switch signal continuously ON during the engine running, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the starter switch signal is stuck at the ON position (high voltage) for longer than 20 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- This DTC will set if the ignition switch continues being START position for longer than 20 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0512

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Turn OFF the ignition. 2. Remove the starter cut relay in order to inhibit starter motor engagement at ignition switch ON. 3. Install a scan tool. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Starter Switch parameter with a scan tool. Does the Starter Switch parameter indicate OFF?	—	Go to Diagnostic Aids	Go to Step 3
3	Remove the Starter (10A) fuse in the cabin fuse block. Does the Starter Switch parameter indicate OFF?	—	Go to Step 4	Go to Step 5
4	1. Test the signal circuit between the starter switch (pin 1 of B-63) and each terminal of the ignition switch (pins 1, 2, 3 and 4 of B-62 and pin 3 of B-63) for short circuit each other at the ignition switch ON. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
5	1. Test the signal circuit between the ECM (pin 44 of C-58) and the Starter (10A) fuse or starter relay (pin 3 of X-8) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect the connection on the starter switch signal circuit at the harness connector of the ECM (pin 44 of C-58) for corrosion. 4. Repair the connection(s) as necessary. Did you complete the action?	—	Go to Step 8	—
7	Repair or replace the ignition switch. Did you complete the repair or replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0562 or P0563 (Flash Code 35)

Circuit Description

The ECM monitors the ignition voltage on the ignition feed terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low or high ignition voltage, DTC P0562 or P0563 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.

Condition for Setting the DTC

- The ECM detects that the ignition voltage feed circuit is less than 8 volts for 5 seconds. (DTC P0562)
- The ECM detects that the ignition voltage feed circuit is more than 16 volts for 5 seconds. (DTC P0563)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity. (DTC P0563)
- The ECM inhibits pilot injection. (DTC P0563)
- The ECM inhibits cruise control. (DTC P0563)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- A charging system problem may set this DTC.
- The weakened battery may set DTC P0562.
- Jump starting the vehicle or a battery charger may have set this DTC P0563.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0562

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle. 4. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Ignition Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Diagnostic Aids	Go to Step 3
3	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 4	Go to Step 5
4	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and for corrosion at the harness connector of the ECM (pin 72 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Ignition Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Step 7	Go to Step 3
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0563

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	Was the vehicle recently jump started or a battery charger placed on the battery?	—	Go to Step 7	Go to Step 3
3	1. Install a scan tool. 2. Start the engine and let idle. 3. Observe the Ignition Voltage parameter with the scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Observe the ignition Voltage parameter with a scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Step 7	Go to Step 4
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

TEMPERATURE

FAHRENHEIT TO CENTIGRADE

°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C
-60	-51.1	-2	-18.9	56	13.3	114	45.6	172	77.8	230	110.0	288	142.2	346	174.4
-58	-50	0	-17.8	58	14.4	116	46.7	147	78.9	232	111.1	290	143.3	348	175.6
-56	-48.9	2	-16.7	60	15.6	118	47.8	176	80.0	234	112.2	292	144.4	350	176.7
-54	-47.8	4	-15.6	62	16.7	120	48.9	178	81.1	236	113.3	294	145.6	352	177.8
-52	-46.7	6	-14.4	64	17.8	122	50.0	180	82.2	238	114.4	296	146.7	354	178.9
-50	-45.6	8	-13.3	66	18.9	124	51.1	182	83.3	240	115.6	298	147.8	356	180.0
-48	-44.4	10	-12.2	68	20.0	126	52.2	184	84.4	242	116.7	300	148.9	358	181.1
-46	-43.3	12	-11.1	70	21.1	128	53.3	186	85.6	244	117.8	302	150.0	360	182.2
-44	-42.2	14	-10.0	72	22.2	130	54.4	188	86.7	246	118.9	304	151.1	362	183.3
-42	-41.1	16	-8.9	74	23.3	132	55.6	190	87.8	248	120.0	306	152.2	364	184.4
-40	-40.0	18	-7.8	76	24.9	134	56.7	192	88.9	250	121.1	308	153.3	366	185.6
-38	-38.9	20	-3.7	78	25.6	136	57.8	194	90.0	252	122.2	310	154.4	368	186.7
-36	37.8	22	-5.6	80	26.7	138	58.9	196	91.1	254	123.3	312	155.6	370	187.8
-34	36.7	24	-4.4	82	27.8	140	60.0	198	92.2	256	124.4	314	156.7	372	188.9
-32	-35.6	26	-3.3	84	28.9	142	61.1	200	93.3	258	125.6	316	157.8	374	190.0
-30	-34.4	28	-2.2	86	30.0	144	62.2	202	94.4	260	126.7	318	158.9	376	191.1
-28	-33.3	30	-1.1	88	31.1	146	63.3	204	95.6	262	127.8	320	160.0	378	192.2
-26	-32.2	32	-0	90	32.2	148	64.4	206	96.7	264	128.9	322	161.1	380	193.3
-24	-31.1	34	1.1	92	33.3	150	65.6	208	97.8	266	130.0	324	162.2	382	194.4
-22	-30.0	36	2.2	94	34.4	152	66.7	210	98.9	268	131.1	326	163.3	384	195.6
-20	-28.9	38	3.3	96	35.6	154	67.8	212	100.0	270	132.2	328	164.4	386	196.7
-18	-27.8	40	4.4	98	36.7	156	68.9	214	101.1	272	133.3	330	165.6	388	197.8
-16	-26.7	42	5.6	100	37.8	158	70.0	216	102.2	274	134.4	332	166.7	390	198.9
-14	-25.6	44	6.7	102	38.9	160	71.1	218	103.3	276	135.6	334	167.8	382	200.0
-12	-24.4	46	7.8	104	40.0	162	72.2	220	104.4	278	136.7	336	168.9	400	204.4
-10	-23.3	48	8.9	106	41.1	164	73.3	222	105.6	280	137.8	338	170.0	410	210.0
-8	-22.2	50	10.0	108	42.2	166	74.4	224	106.7	282	138.9	340	171.1	420	215.6
-6	-21.1	52	11.1	110	43.3	168	75.6	226	107.8	284	140.0	342	172.2	430	221.1
-4	-20.0	54	12.2	112	44.4	170	76.7	228	108.9	286	141.1	344	173.3	440	226.7

CENTIGRADE TO FAHRENHEIT

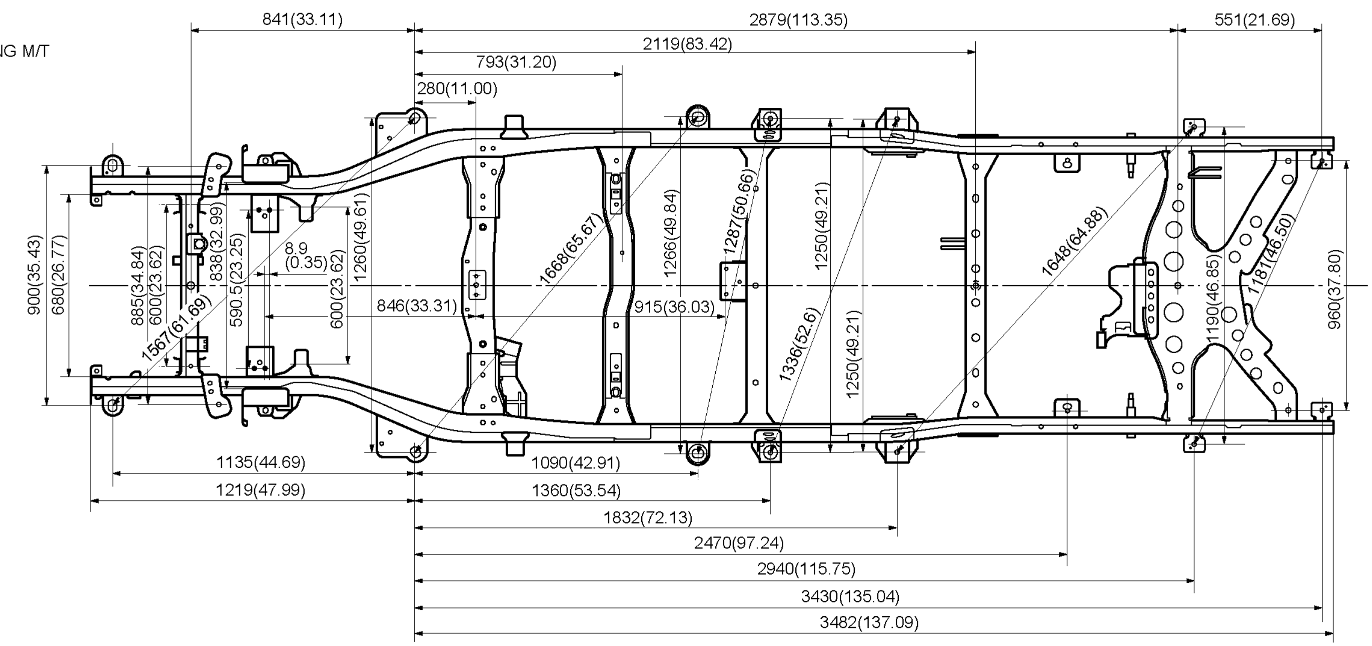
°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-50	-58.0	-18	-0.4	14	57.2	46	114.8	78	172.4	110	230.0	142	287.6	174	345.2
-49	-56.2	-17	1.4	15	59.0	47	116.6	79	174.2	111	231.8	143	289.4	175	347.0
-48	-54.4	-16	3.2	16	60.8	48	118.4	80	176.0	112	233.6	144	291.2	176	348.8
-47	-52.6	-15	5.0	17	62.6	49	120.2	81	177.8	113	235.4	145	293.0	177	350.6
-46	-50.8	-14	6.8	18	64.4	50	122.0	82	179.6	114	237.2	146	294.8	178	352.4
-45	-49.0	-13	8.6	19	66.2	51	123.8	83	181.4	115	239.0	147	296.6	179	354.2
-44	-47.2	-12	10.4	20	68.0	52	125.6	84	183.2	116	240.8	148	298.4	180	356.0
-43	-45.4	-11	12.2	21	69.8	53	127.4	85	185.0	117	242.6	149	300.2	181	357.8
-42	-43.6	-10	14.0	22	71.6	54	129.2	86	186.8	118	244.4	150	302.0	182	359.6
-41	-41.8	-9	15.8	23	73.4	55	131.0	87	188.6	119	246.2	151	303.8	183	361.4
-40	-40.0	-8	17.6	24	75.2	56	132.8	88	190.4	120	248.0	152	305.6	184	363.2
-39	-38.2	-7	19.4	25	77.0	57	134.6	89	192.2	121	249.8	153	307.4	185	365.0
-38	-36.4	-6	21.2	26	78.8	58	136.4	90	194.0	122	251.6	154	309.2	186	366.8
-37	-34.6	-5	23.0	27	80.6	59	138.2	91	195.8	123	253.4	155	311.0	187	368.6
-36	-32.8	-4	24.8	28	82.4	60	140.0	92	197.6	124	255.2	156	312.8	188	370.4
-35	-31.0	-3	26.6	29	84.2	61	141.8	93	199.4	125	257.0	157	314.6	189	372.2
-34	-29.2	-2	28.4	30	86.0	62	143.6	94	201.2	126	258.8	158	316.4	190	374.0
-33	-27.4	-1	30.2	31	87.8	63	145.4	95	203.0	127	260.6	159	318.2	191	375.8
-32	-25.6	0	32.0	32	89.6	64	147.2	96	204.8	128	262.4	160	320.0	192	377.6
-31	-23.8	1	33.8	33	91.4	65	149.0	97	206.6	129	264.2	161	321.8	193	379.4
-30	-22.0	2	35.6	34	93.2	66	150.8	98	208.4	130	266.0	162	323.6	194	381.2
-29	-20.2	3	37.4	35	95.0	67	152.6	99	210.2	131	267.8	163	325.4	195	383.0
-28	-18.4	4	39.2	36	96.8	68	154.4	100	212.0	132	269.6	164	327.2	196	384.8
-27	-16.6	5	41.0	37	98.6	69	156.2	101	213.8	133	271.4	165	329.0	197	386.6
-26	-14.8	6	42.8	38	100.4	70	158.0	102	215.6	134	273.2	166	330.8	198	388.4
-25	-13.0	7	44.6	39	102.2	71	159.8	103	217.4	135	275.0	167	332.6	199	390.2
-24	-1.2	8	46.4	40	104.0	72	161.6	104	219.2	136	276.8	168	334.4	200	392.0
-23	-9.4	9	48.2	41	105.8	73	163.4	105	221.0	137	278.6	169	336.4	210	410.0
-22	-7.6	10	50.0	42	107.6	74	165.2	106	222.8	138	280.4	170	338.0	220	428.0
-21	-5.8	11	51.8	43	109.4	75	167.0	107	224.6	139	282.2	171	339.8	230	446.0
-20	-4.4	12	53.6	44	111.2	76	168.8	108	226.4	140	284.0	172	341.6	240	464.0
-19	-2.2	13	55.4	45	113.0	77	170.6	109	228.2	141	285.8	173	343.4	250	482.0

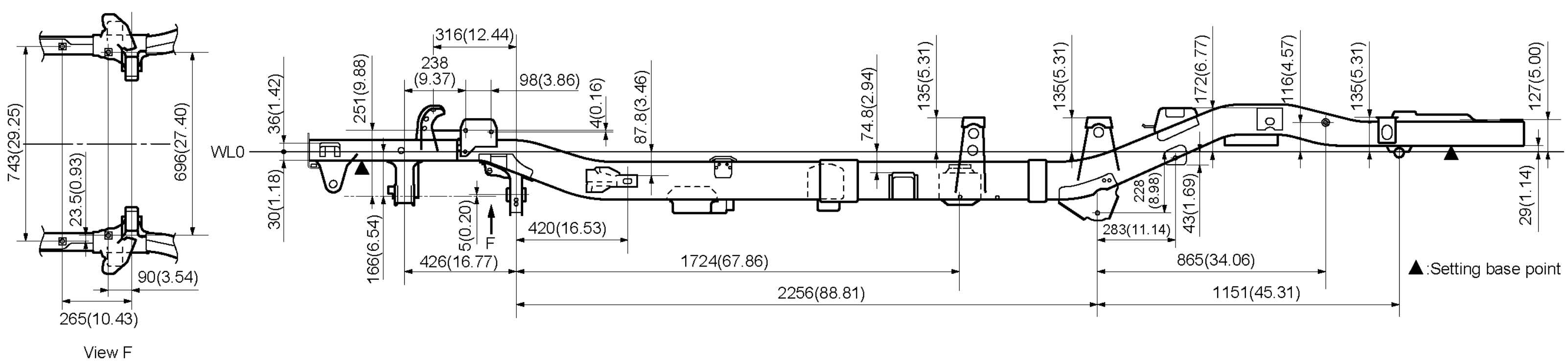
4×2, HIGH RIDE, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.

mm(in)

C24SE GAS ENG M/T





RTW72AXF002001

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DTC P0565 (Flash Code 515)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. If the ECM detects the cruise main switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the cruise main switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise main switch signal is stuck at the ON position (high voltage) for longer than 15 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- This DTC will set if the cruise main switch continues being pushed for longer than 15 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0565

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Cruise Main Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the cruise main switch harness connector. (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Main Switch indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 14 of C-58) and the cruise main switch (pin 3 of B-67) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the cruise main switch. Did you complete the repair or replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Main Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0566 (Flash Code 516)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. The cruise cancel switch is a normally closed type switch. When the cruise cancel switch is applied, the switch signal to the ECM is stopped (low voltage) and the cruise control system is inactive. If the ECM detects the cruise cancel switch signal repeats ON/ OFF or continuously OFF this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the cruise cancel switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise cancel switch signal is stuck at the OFF position (low voltage) for longer than 40 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- This DTC will set if the cruise cancel switch continues being applied for longer than 40 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0566

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Cruise Cancel Switch parameter with a scan tool. Does the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the combination switch harness (pin 11 of B-59 male side) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	Observe the Cruise Cancel Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 10 and 11 of B-59. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 7	Go to Step 6
5	Repair the open circuit or high resistance between the Engine (10A) fuse and the combination switch (pin 11 of B-59). Check Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 13 of C-58) and the combination switch (pin 11 of B-59) for and open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did your find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1. Inspect fro an intermittent and for a poor connection at the harness connector of the combination switch (pin 11 of B-59). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pin 13 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Cancel Switch parameter with a scan tool. Dose the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Step 12	Go to Step 3
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0567 (Flash Code 517)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. When the cruise resume/ accel. switch is applied, the switch signal is provided to the ECM and the vehicle speed is reset to the previous set speed or vehicle speed is increased. If the ECM detects the cruise resume/ accel. switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the cruise resume/ accel. switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise resume/ accel. switch signal is stuck at the ON position (high voltage) for longer than 120 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- This DTC will set if the cruise resume/ accel. switch continues being applied for longer than 120 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0567

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Cruise Resume Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Resume Switch parameter indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 29 of C-58) and the combination switch (pin 9 of B-59) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Resume Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0568 (Flash Code 518)

Circuit Description

The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch or the instrument panel cluster will light up. When the cruise set/ coast switch is turned ON, the switch signal is provided to the ECM and the vehicle speed is set or vehicle speed is decreased. If the ECM detects the cruise set/ coast switch signal repeats ON/ OFF or continuously ON, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the cruise set/ coast switch signal is repeated ON/ OFF continuously within a very short calibrated time.
- The ECM detects that the cruise set/ coast switch signal is stuck at the ON position (high voltage) for longer than 120 seconds.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- This DTC will set if the cruise set/ coast switch continues being pushed for longer than 120 seconds.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0568

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Cruise Set Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. Does the Cruise Set Switch parameter indicate OFF?	—	Go to Step 5	Go to Step 4
4	1. Test the signal circuit between the ECM (pin 30 of C-58) and the combination switch (pin 12 of B-59) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Set Switch parameter with a scan tool. Dose the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Step 8	Go to Step 3
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0571 (Flash Code 26)

Circuit Description

The brake switch is installed on the brake pedal bracket. The brake switch 1 is a normally open type switch and the brake switch 2 is a normally closed type switch. When the brake pedal is pressed, the brake switch 1 signal is provided to the ECM and the stoplights are turned ON. Then, the brake switch 2 signal to the ECM is stopped (low voltage). If the ECM detects the brake switch signals out of correlation, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a brake switch 1 (normally open type switch) signal and brake switch 2 (normally closed type switch) signal correlation error for longer than 10 seconds over 33 times since ignition switch is ON.

Action Taken When the DTC Sets

- The ECM will not illuminate the MIL or SVS lamp. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Misadjusted brake switch will cause this DTC to set.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0571

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Brake Switch 1 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Step 8	Go to Step 3
3	1. Check to ensure the brake switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake switch as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the brake switch harness connector. 3. Connect a test lamp between the battery voltage feed circuit of the brake switch 1 harness (pin 1 of C-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 6

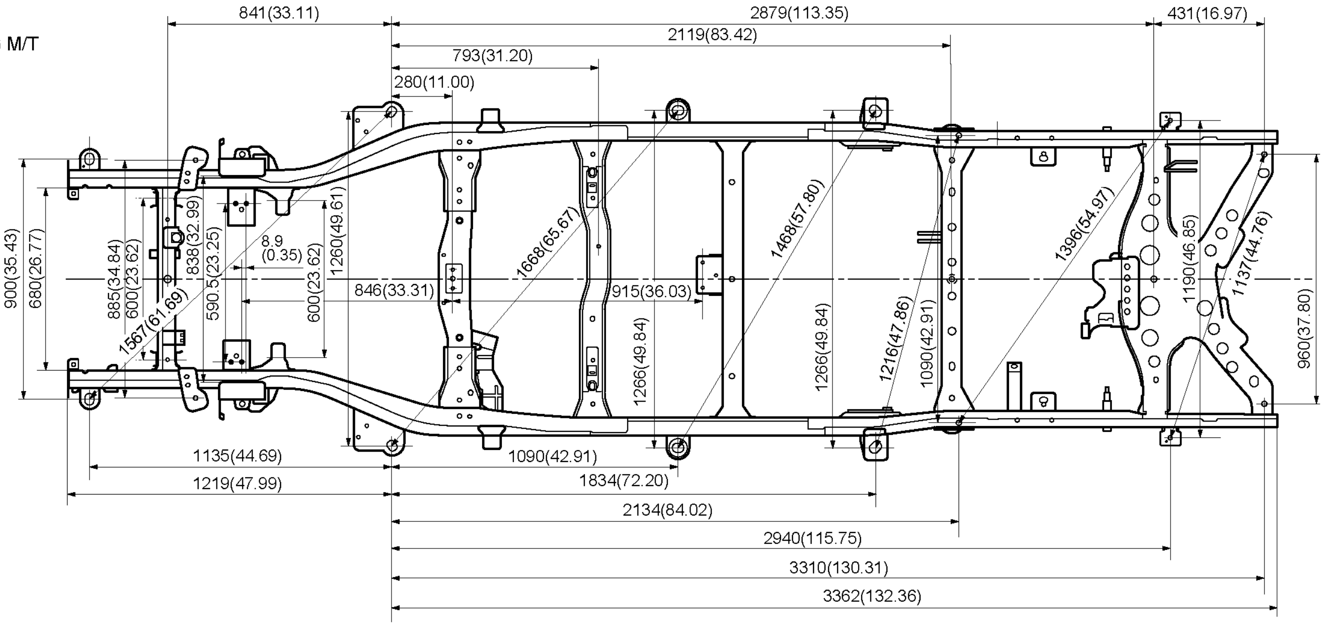
Step	Action	Value(s)	Yes	No
5	1. Turn ON the ignition, with the engine OFF. 2. Observe the Brake Switch 1 parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the brake switch harness connector between pins 1 and 2 of the C-44. Does the scan tool indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 14	Go to Step 7
6	Repair the open circuit or high resistance between the Stop Light (15A) fuse and the brake switch (pin 1 of C-44). Check the Stop Light (15A) fuse first. Did you complete the repair?	—	Go to Step 18	—
7	1. Test the signal circuit between the ECM (pin 21 of C-58) and the brake switch (pin 2 of C-44) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
8	Observe the Brake Switch 2 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released?	—	Go to Diagnostic Aids	Go to Step 9
9	1. Check to ensure the brake switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the brake pedal full upward travel. 2. Adjust the brake switch as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 10
10	1. Turn OFF the ignition. 2. Disconnect the brake switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the brake switch 2 harness (pin 4 of C-44) and a known good ground. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 12
11	Observe the Brake Switch 2 parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the brake switch harness connector between pins 3 and 4 of the C-44. Does the scan tool indicate Released when the circuit is jumpered and Applied when the circuit is not jumpered?	—	Go to Step 14	Go to Step 13
12	Repair the open circuit or high resistance between the Engine (10A) fuse and the brake switch (pin 4 of C-44). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 18	—

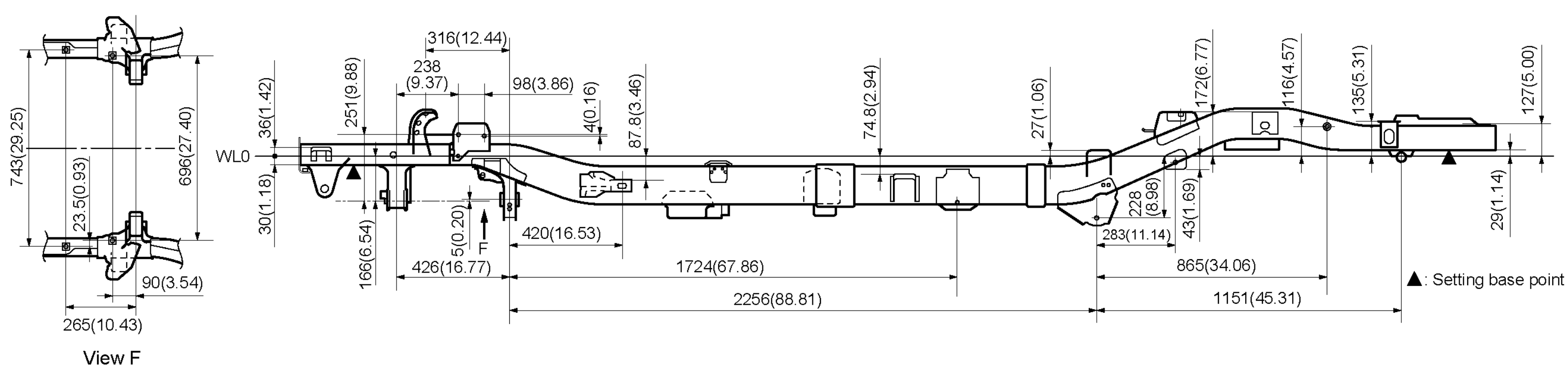
4×2, HIGH RIDE, LWB, CREW CAB MODEL

This illustration is based on the RHD model.

mm(in)

C24SE GAS ENG M/T





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Step	Action	Value(s)	Yes	No
13	1. Test the signal circuit between the ECM (pin 1 of C-58) and the brake switch (pin 3 of C-44) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
14	1. Inspect for an intermittent and for poor connections at the harness connector of the brake switch (pins 1, 2, 3 and 4 of C-44). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 1 and 21 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Replace brake switch. Refer to Brake Switch Replacement. Did you complete the replacement?	—	Go to Step 18	—
17	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 18	—
18	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the Brake Switch 1 and Brake Switch 2 parameter with a scan tool while fully depressing and releasing the brake pedal. Does the scan tool indicate Applied when the brake pedal is applied and Released when the brake pedal is released on each parameter?	—	Go to Step 19	Go to Step 2
19	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0601 (Flash Code 53)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the ECM.

Condition for Setting the DTC

- The ECM detects that the calculated checksum does not agree with the ECM internal registered checksum.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Circuit/ System Testing DTC P0601

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0602 (Flash Code 154)

Circuit Description

The electrically erasable & programmable read only memory (EEPROM) memorizes fuel injector ID code information. If the ECM detects fuel injector ID codes are not programmed into the ECM or an error in the programmed fuel injector ID codes, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the fuel injector ID code is not programmed.
- The ECM detects an error in the programmed fuel injector ID code.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Notice:

- Clear the DTC with a scan tool after programming the fuel injector ID code.

Circuit/ System Testing DTC P0602

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Ensure that all tool connections are secure. 2. Ensure that programming equipment is operating correctly. 3. Install a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
3	1. Verify the correct fuel injector ID codes are entered into the ECM with a scan tool. Refer to ECM Replacement. If the fuel injector ID codes are correctly entered, clear the DTC with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0604 or P0606 (Flash Code 153 or 51)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the ECM.

Condition for Setting the DTC

- The ECM detects a malfunction in its internal random access memory (RAM). (DTC P0604)
- The ECM detects a malfunction in its internal main central processing unit (CPU) or sub integrated circuit (IC). (DTC P0606)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity. (DTC P0604)
- The ECM inhibits pilot injection. (DTC P0604)
- The ECM inhibits cruise control. (DTC P0604)
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds. (DTC P0604)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Circuit/ System Testing DTC P0604 or P0606

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0615 (Flash Code 19)

Circuit Description

The ECM controls the starter cut relay, which de-energizes the starter relay based on engine speed inputs or immobilizer command signal. The starter cut relay uses normally close type relay. During engine stopping, the starter cut relay is closed to allow grounding the starter relay. Once engine run, the ECM energizes the starter cut relay to open the starter relay circuit and starter motor is disengaged even the ignition is positioned at START. If the ECM detects an improper voltage on the starter cut relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a short to ground circuit condition on the starter cut relay control circuit for longer than 3 seconds when the relay is commanded OFF.
- The ECM detects a short to voltage circuit condition on the starter cut relay control circuit for longer than 3 seconds when the relay is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- If the starter cut relay control circuit is short to ground, engine does not crank.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0615

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 3
3	1. Start the engine. 2. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 6	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Replace the starter cut relay with the head light dimmer relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Test the control circuit between the ECM (pin 35 of C-58) and the relay (pin 3 of X-7) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
6	1. Test the control circuit between the ECM (pin 35 of C-58) and the relay (pin 3 of X-7) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
7	Replace the starter cut relay. Did you complete the replacement?	—	Go to Step 9	—
8	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 10 seconds. 5. Start the engine. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0633 (Flash Code 176)

Circuit Description

The electronically erasable & programmable read only memory (EEPROM) memorizes immobilizer security information for communication with the immobilizer control unit (ICU) and enabling the engine to start. If the ECM detects immobilizer security information are not programmed into the ECM, this DTC will set.

Condition for Setting the DTC

- The ECM detects that the immobilizer security information is not programmed.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- Non-programmed ECM sets this DTC.

Circuit/ System Testing DTC P0633

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in immobilizer section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0638 (Flash Code 61)

Circuit Description

The ECM controls the intake throttle valve opening based on the engine running condition and by controlling the intake throttle solenoid. The intake throttle valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects a variance between the actual intake throttle position and desired intake throttle position while the intake throttle solenoid is commanded ON, this DTC will set.

Condition for Running the DTC

- DTCs P0122, P0123, P0698 and P0699 are not set.
- The battery voltage is between 11 to 16 volts.
- The ignition switch is ON.
- The intake throttle solenoid commanded ON.
- The desired intake throttle position is stable.

Condition for Setting the DTC

- The ECM detects that the difference between the actual and the desired intake throttle position is more than 10% for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking intake throttle valve may set this DTC.
- A sticking intake throttle valve at full closed position will cause engine starting problem.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0638

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0122, P0123, P2100, P2101 or P2103 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Remove the intake duct that is connected to the intake throttle valve. 2. Inspect the intake throttle valve for the following conditions: • Restricted intake throttle valve by foreign materials • Excessive deposits at throttle bore • Bent butterfly valve **Notice:** Replace the intake throttle valve if there is any sticking. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the intake throttle valve (pins 1, 2, 3, 5 and 6 of E-38). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 35, 36, 55, 56 and 57 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

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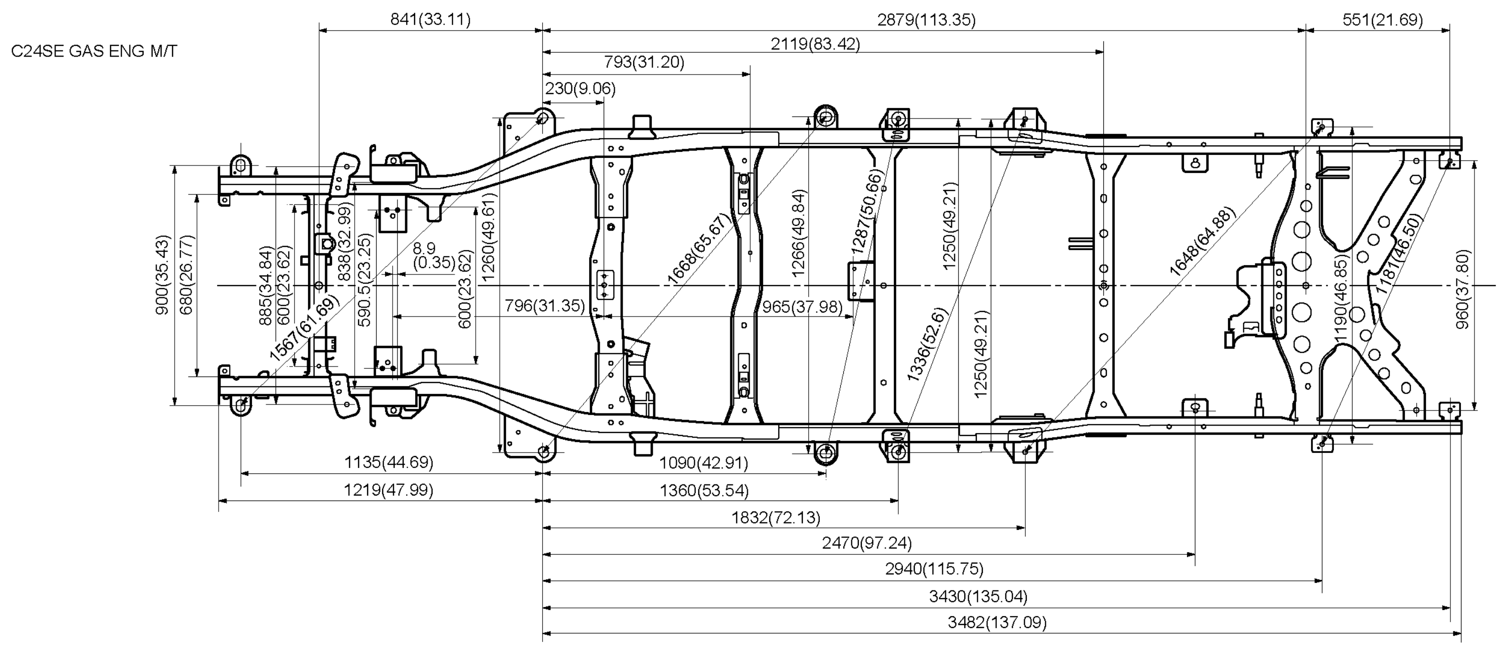
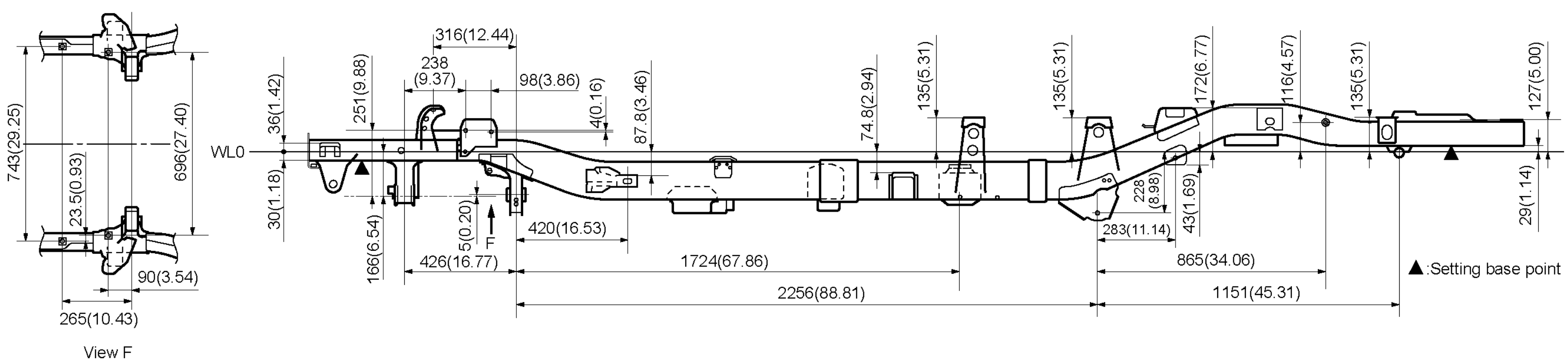
4×4, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.

mm(in)





RTW72AXF001701

DTC P0642 or P0643 (Flash Code 55)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 1 to the accelerator pedal position (APP) sensor 1. The ECM monitors the voltage on the 5 volts reference circuit 1. If the ECM detects the voltage is excessively low or high, DTC P0642 or P0643 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 1 voltage is less than 4.7 volts. (DTC P0642)
- The ECM detects that the 5 volts reference circuit 1 voltage is more than 5.3 volts. (DTC P0643)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0642

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 10 of C-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 4
4	1. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor (pin 10 of C-40) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0643

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor 1 (pin 10 of C-40) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0650 (Flash Code 77)

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel (IP) cluster. The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service.
The ECM monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the ECM detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the MIL control circuit when the lamp is commanded OFF.
- The ECM detects a high voltage condition on the MIL control circuit when the lamp is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0650

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Perform the Malfunction Indicator Lamp (MIL) Control with a scan tool. 4. Command the lamp ON and OFF. Does the MIL turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cabin fuse block. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-2 (C-58) harness connector. 3. Turn ON the ignition, with the engine OFF. Is the MIL OFF?	—	Go to Sep 6	Go to Step 12

Step	Action	Value(s)	Yes	No
6	1. Remove the Meter (10A) fuse that supplies voltage to the MIL. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the MIL control circuit in the ECM harness connector (pin 57 of C-58) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 57 of C-58) and a known good ground. Is the MIL illuminated?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the IP cluster. 3. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 8 of B-24) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 57 of C-58) and the IP cluster (pin 38 of B-23) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 8 of B-24 and pin 38 of B-23). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 57 of C-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 57 of C-58) and the IP cluster (pin 38 of B-23). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 57 of C-58) and the IP cluster (pin 38 of B-23). Did you complete the repair?	—	Go to Step 17	—
14	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. Did you complete the repair or replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the MIL Control with a scan tool. 5. Command the lamp ON and OFF. Does the MIL turn ON and OFF with each command?	—	Go to Step 18	Go to Step 3
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0652 or P0653 (Flash Code 56)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 2 to the following sensors:

- Accelerator pedal position (APP) sensor 2
- Fuel rail pressure (FRP) sensor
- Barometric pressure (BARO) sensor
- Camshaft position (CMP) sensor
- EGR position sensor

The 5 volts reference circuits are independent of each other outside the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one 5 volts reference circuit affects the entire 5 volts reference circuit 2. The ECM monitors the voltage on the 5 volts reference circuit 2. If the ECM detects the voltage is excessively low or high, DTC P0652 or P0653 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 2 voltage is less than 4.7 volts. (DTC P0652)
- The ECM detects that the 5 volts reference circuit 2 voltage is more than 5.3 volts. (DTC P0653)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- If this DTC is present, the engine cranks but does not start.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0652

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the barometric pressure (BARO) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 9	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Leave the DMM connected to the BARO sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the EGR valve harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 10	Go to Step 5
5	1. Leave the DMM connected to the BARO sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the fuel rail pressure (FRP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 11	Go to Step 6
6	1. Leave the DMM connected to the BARO sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the camshaft position (CMP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 12	Go to Step 7
7	1. Leave the DMM connected to the BARO sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the accelerator pedal position (APP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 13	Go to Step 8
8	1. Test the 5 volts reference circuit between the ECM and the following components for a short to ground or short to the low reference circuit: • ECM (pin 19 of E-90) and BARO sensor (pin 3 of E-40) • ECM (pin 31 of E-90) and EGR position sensor (pin 1 of E-71) • ECM (pin 47 of E-90) and FRP sensor (pin 3 of E-48) • ECM (pin 46 of E-90) and CMP sensor (pin 3 of E-39) • ECM (pin 9 of C-58) and APP sensor 2 (pin 8 of C-40) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
10	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
11	Replace the FRP sensor. Refer to FRP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the CMP sensor. Refer to CMP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
13	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0653

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Test the 5 volts reference circuit between the ECM and the following components for a short to battery or ignition voltage: • ECM (pin 19 of E-90) and BARO sensor (pin 3 of E-40) • ECM (pin 31 of E-90) and EGR position sensor (pin 1 of E-71) • ECM (pin 47 of E-90) and FRP sensor (pin 3 of E-48) • ECM (pin 46 of E-90) and CMP sensor (pin 3 of E-39) • ECM (pin 9 of C-58) and APP sensor 2 (pin 8 of C-40) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

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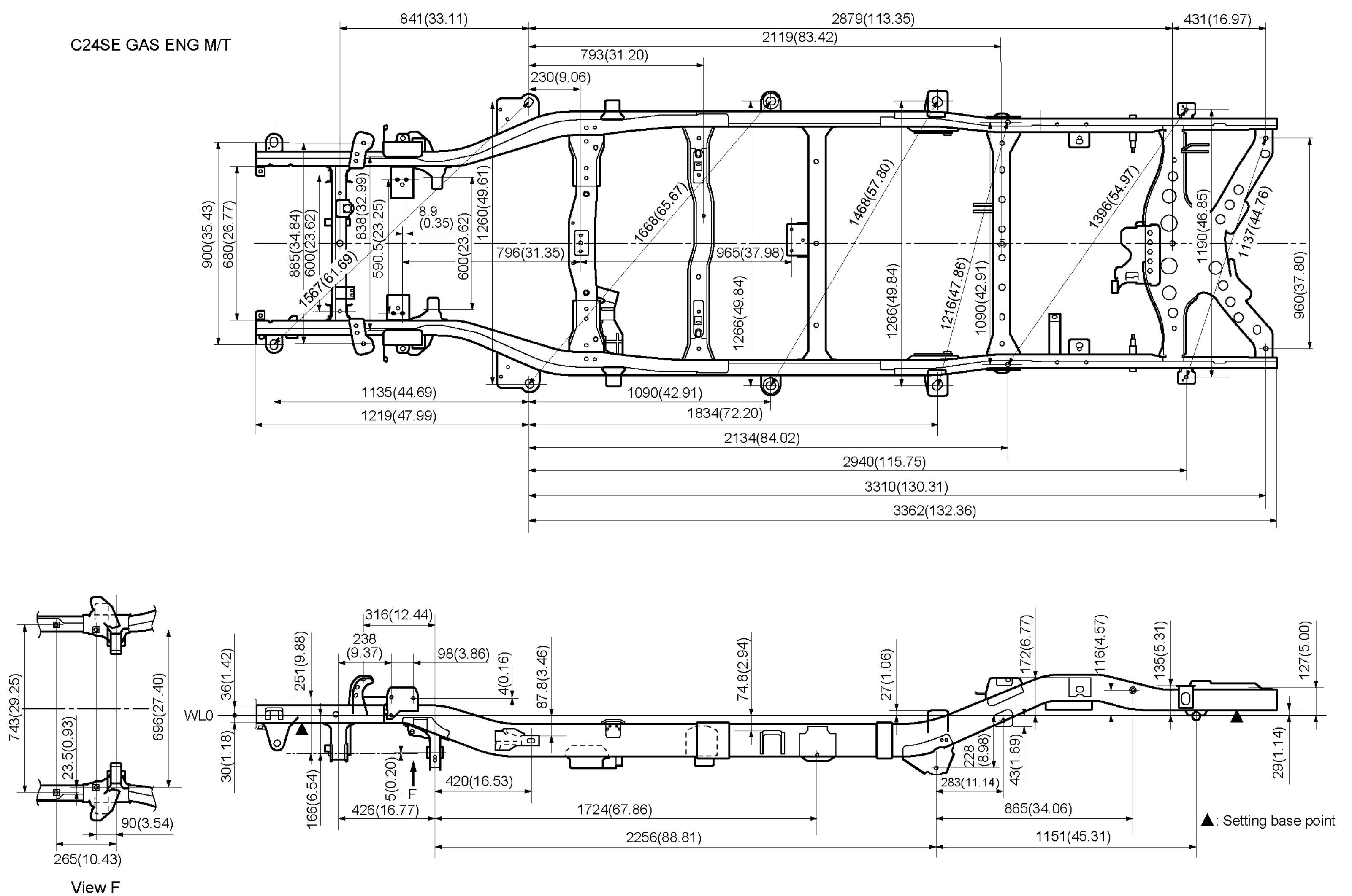
4×4, LWB, CREW CAB MODEL

This illustration is based on the RHD model.

mm(in)



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DTC P0661 or P0662 (Flash Code 58)

Circuit Description

The ECM controls the swirl levels, which energize the swirl control solenoid valve based on the engine running condition. The ECM commands the swirl control solenoid valve to apply vacuum pressure to the diaphragm actuator to operate swirl control butterflies that is provided each intake port. If the ECM detects an open circuit or short circuit on the solenoid valve circuit, DTC P0661 or P0662 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the swirl control solenoid valve circuit when the solenoid is commanded OFF. (DTC P0661)
- The ECM detects a high voltage condition on the swirl control solenoid valve circuit when the solenoid is commanded ON. (DTC P0662)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity. (DTC P0661)
- The ECM inhibits cruise control. (DTC P0661)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Vacuum Hose Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0661

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the swirl control solenoid valve harness connector. 3. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-67) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the control circuit (pin 1 of E-67) and battery voltage. 2. Perform the Swirl Control Solenoid Test with a scan tool. 3. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command (if test is aborted, go to Step 5)?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 8	Go to Step 7
6	Repair the open circuit or high resistance between the Engine (10A) fuse and the solenoid valve (pin 2 of E-67). Check the Engine (10A) fuse first. Did you complete the repair?	—	Go to Step 13	—
7	1. Test the control circuit between the ECM (pin 67 of E-90) and the solenoid valve (pin 1 of E-67) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
8	1. Test the control circuit between the ECM (pin 67 of E-90) and the solenoid valve (pin 1 of E-67) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Inspect for an intermittent and for poor connections at the harness connector of the solenoid valve (pins 1 and 2 of E-67). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at harness connector of the ECM (pin 67 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the swirl control solenoid valve. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0662

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the swirl control solenoid valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0661 set, but not P0662?	—	Go to Step 5	Go to Step 4
4	1. Test the control circuit between the ECM (pin 67 of E-90) and the solenoid valve (pin 1 of E-67) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the swirl control solenoid valve. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—

Step	Action	Value(s)	Yes	No
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0698 or P0699 (Flash Code 57)

Circuit Description

The ECM provides 5 volts reference voltage through the reference circuit 3 to the following sensors:

- Accelerator pedal position (APP) sensor 3
- Boost pressure sensor
- Crankshaft position (CKP) sensor
- Intake throttle position sensor

The 5 volts reference circuits are independent of each other outside the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one 5 volts reference circuit affects the entire 5 volts reference circuit 3. The ECM monitors the voltage on the 5 volts reference circuit 3. If the ECM detects the voltage is excessively low or high, DTC P0698 or P0699 will set.

Condition for Running the DTC

- The battery voltage is more than 6 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the 5 volts reference circuit 3 voltage is less than 4.7 volts. (DTC P0698)
- The ECM detects that the 5 volts reference circuit 3 voltage is less than 5.3 volts. (DTC P0699)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P0698

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 1 of C-40) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 4
4	**Notice:** If no boost pressure sensor is installed, skip to Step 5. 1. Leave the DMM connected to the APP sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the boost pressure harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Leave the DMM connected to the APP sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the intake throttle valve harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 10	Go to Step 6
6	1. Leave the DMM connected to the APP sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the camshaft position (CKP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value?	4.7 volts	Go to Step 11	Go to Step 7
7	1. Test the 5 volts reference circuit between the ECM and the following components for a short to ground or short to the low reference circuit: • ECM (pin 7 of C-58) and APP sensor 3 (pin 1 of C-40) • ECM (pin 20 of E-90) and boost pressure sensor (pin 3 of E-107) • ECM (pin 36 of E-90) and intake throttle position sensor (pin 6 of E-38) • ECM (pin 37 of E-90) and CKP sensor (pin 3 of E-52) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
10	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 13	—
11	Replace the CKP sensor. Refer to CKP Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P0699

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Test the 5 volts reference circuit between the ECM and the following components for a short to battery or ignition voltage: • ECM (pin 7 of C-58) and APP sensor 3 (pin 1 of C-40) • ECM (pin 20 of E-90) and boost pressure sensor (pin 3 of E-107) • ECM (pin 36 of E-90) and intake throttle position sensor (pin 6 of E-38) • ECM (pin 37 of E-90) and CKP sensor (pin 3 of E-52) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0700 (Flash Code 185)

Circuit Description

The transmission control module (TCM) requests to illuminate the malfunction indicator lamp (MIL) via a controller area network (CAN) communication bus to the ECM when the TCM sets a MIL request DTC(s). If the ECM detects the MIL illumination request signal, this DTC will set.

Condition for Running the DTC

- DTCs U0001 and U0101 are not set.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the MIL illumination is requested by the TCM.

Action Taken When the DTC Sets

- The ECM illuminates MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- Under normal conditions if the TCM sets a DTC that requests the MIL to be illuminated, P0700 will set.

Test Description

The number below refers to the step number on the Circuit/ System Testing.
2. If the TCM has DTCs set that are requesting MIL illumination, diagnose that DTC first.
3. If the TCM has DTCs set, clear the DTCs in the TCM first.

Circuit/ System Testing DTC P0700

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the transmission DTC Information with a scan tool. Are there any transmission DTCs set?	—	Go to Applicable DTC in Automatic Transmission Section	Go to Step 3
3	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 4
4	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1064 or P1065 (Flash Code 247)

Circuit Description

The fuel rail pressure (FRP) regulator is installed to the fuel supply pump and controls the suction fuel quantity into the fuel rail. The FRP regulator is fully opened in the normal state and larger drive current results in smaller opening. The ECM calculates desired fuel rail pressure and fuel flow rate and it compares the calculated desired fuel rail pressure to the actual value to determine the FRP regulator position. When the actual fuel rail pressure is higher than the desired value, the FRP regulator is closed to decease the flow rate.

If the ECM detects an over current condition on the FRP regulator feedback circuit, DTC P1064 will set.

If the ECM detects an improper voltage level on the FRP regulator control high side circuit, DTC P1065 will set.

Condition for Running the DTC

- DTC P1064 is not set. (DTC P1065)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an over current condition on the FRP regulator feedback circuit. (DTC P1064)
- The ECM detects a low or high voltage condition on the FRP regulator high side circuit. (DTC P1065)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

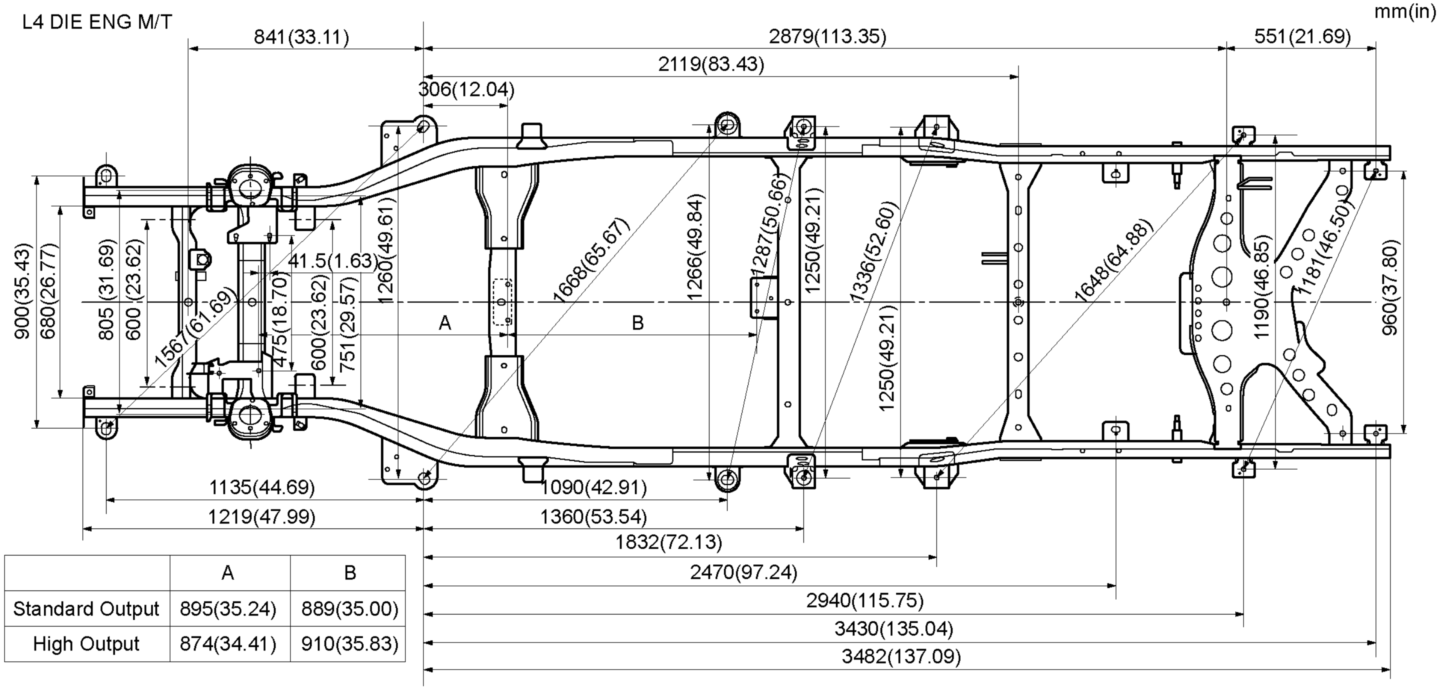
Circuit/ System Testing DTC P1064

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	**Important:** The ECM may be damaged if the FRP regulator low side circuit is shorted to a voltage source. 1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

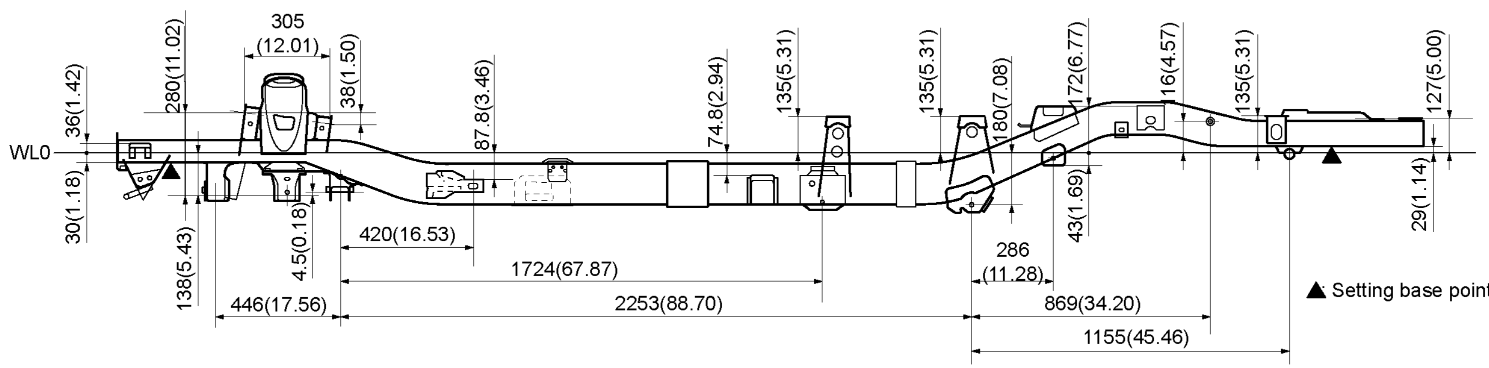
BACK TO CHAPTER INDEX

4×2, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



	A	B
Standard Output	895(35.24)	889(35.00)
High Output	874(34.41)	910(35.83)



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TO MODEL INDEX

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P1065

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Is DTC P0091 or P0092 also set?	—	Go to Applicable DTC	Go to Step 4
4	Observe the Fuel Rail Pressure (FRP) Regulator Feedback parameter with a scan tool. Is the scan tool parameter more than the specified value?	300 mA	Go to Step 7	Go to Step 5
5	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the high side circuit (pin 1 of E-50) and a known good ground. 4. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 6	Go to Step 8
6	1. Turn OFF the ignition for 30 seconds. 2. Connect a test lamp between the low side circuit (pin 2 of E-50) and battery voltage. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate then go out?	—	Go to Step 10	Go to Step 9

Step	Action	Value(s)	Yes	No
7	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
8	1. Test the high side circuits between the ECM (pins 34 and 54 of E-90) and the FRP regulator (pin 1 of E-50) for the following conditions: • An open circuit • A short to ground • A short to the low side circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the low side circuits between the ECM (pins 50 and 70 of E-90) and the FRP regulator (pin 2 of E-50) for the following conditions: • An open circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Inspect for an intermittent and for poor connections at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the FRP regulator. Refer to Fuel Pump Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1093 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. If the ECM detects that the fuel rail pressure is certain pressure lower than the desired pressure, this DTC will set.

Condition for Running the DTC

- DTC P0087, P0091, P0092, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.
- The FRP regulator commanded fuel flow is more than a threshold.

Condition for Setting the DTC

- The ECM detects that the actual fuel rail pressure is more than 10 to 20 MPa (1,450 to 2,900 psi) below the desired pressure for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a restricted suction side fuel line. Inspect the suction side fuel restriction between the fuel supply pump and the fuel tank.
- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1093

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P1064, P1065, P1094, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 4	Go to Step 10
4	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times. 5. Let idle for at least 3 minutes while observing the DTC Information with a scan tool. Is DTC P1094 set?	—	Go to Step 14	Go to Step 5
5	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 12	Go to Step 6
6	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 3. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7

Step	Action	Value(s)	Yes	No
7	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
10	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
12	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 15	—
13	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
14	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1094 (Flash Code 226)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the ECM using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail.

If the ECM detects that the difference between the actual and the desired fuel pressure is small at low engine speed but the FRP regulator commanded fuel flow is certain amount high, this DTC will set. (FRP Regulator Commanded High DTC)

If the ECM detects that the fuel rail pressure is sharply decreased when fuel cut, this DTC will also set. (Fuel Pressure Drop DTC)

Condition for Running the DTC

FRP Regulator Commanded High DTC

- DTCs P0087, P0091, P0092, P0117, P0118, P0182, P0183, P0192, P0193, P0500, P0501, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The accelerator pedal is not depressed.
- The engine coolant temperature is more than 50°C (122°F).
- The vehicle speed is less than 3km/h (2MPH).

Fuel Pressure Drop DTC

- DTCs P0087, P0091, P0092, P0182, P0183, P0192, P0193, P0652, P0653, P0201 - P0204, P1064, P1065, P124B and P2146 - P2151 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The accelerator pedal is not depressed.
- The engine speed is more than 1500RPM.
- The vehicle speed is more than 3km/h (2MPH).

Condition for Setting the DTC

FRP Regulator Commanded High DTC

- The ECM detects that the FRP regulator commanded fuel flow is more than a predetermined range for longer than 10 seconds when the engine speed is near idle speed.

Fuel Pressure Drop DTC

- The ECM detects that the fuel rail pressure is dropped more than a threshold when the commanded fuel is cut.

Action Taken When the DTC Sets

FRP Regulator Commanded High DTC

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Fuel Pressure Drop DTC

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.
- The ECM stops engine running when the vehicle speed is lower than 5 km/h (3 MPH) for 5 seconds. The engine will run after the key is cycled when the ignition has been tuned OFF for longer than 10 seconds.

Condition for Clearing the DTC

FRP Regulator Commanded High DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Fuel Pressure Drop DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal Fuel Rail Pressure readings on the scan tool with the engine running in neutral at idle is around 27 to 33 MPa (3,900 to 4,800 psi) after warm up.
- A skewed FRP sensor value can set this DTC. The FRP Sensor on the scan tool should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector first.
- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Schematic Reference: Fuel System Routing Diagram and Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1094

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak. • Fuel supply pump • Fuel rail • Pressure limiter valve • Fuel rail pressure (FRP) sensor • Fuel pipe between the fuel supply pump and fuel rail • Fuel pipe between the fuel rail and fuel injectors • Each fuel pipe sleeve nuts **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. **Notice:** Remove and inspect the inlet high pressure joint to the fuel injectors for fuel leaking from the sleeve nut(s). Replace the fuel injector and injection pipe when foreign material was in contact. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 3
3	1. Remove each glow plug from the cylinder head. 2. Inspect for fuel leakage into the combustion chamber. Is there a cylinder that fuel leakage into the combustion chamber?	—	Go to Step 15	Go to Step 4
4	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0087, P0091, P0092, P0192, P0193, P0201 - P0204, P1064, P1065, P124B or P2146 - P2151 set?	—	Go to Applicable DTC	Go to Step 5

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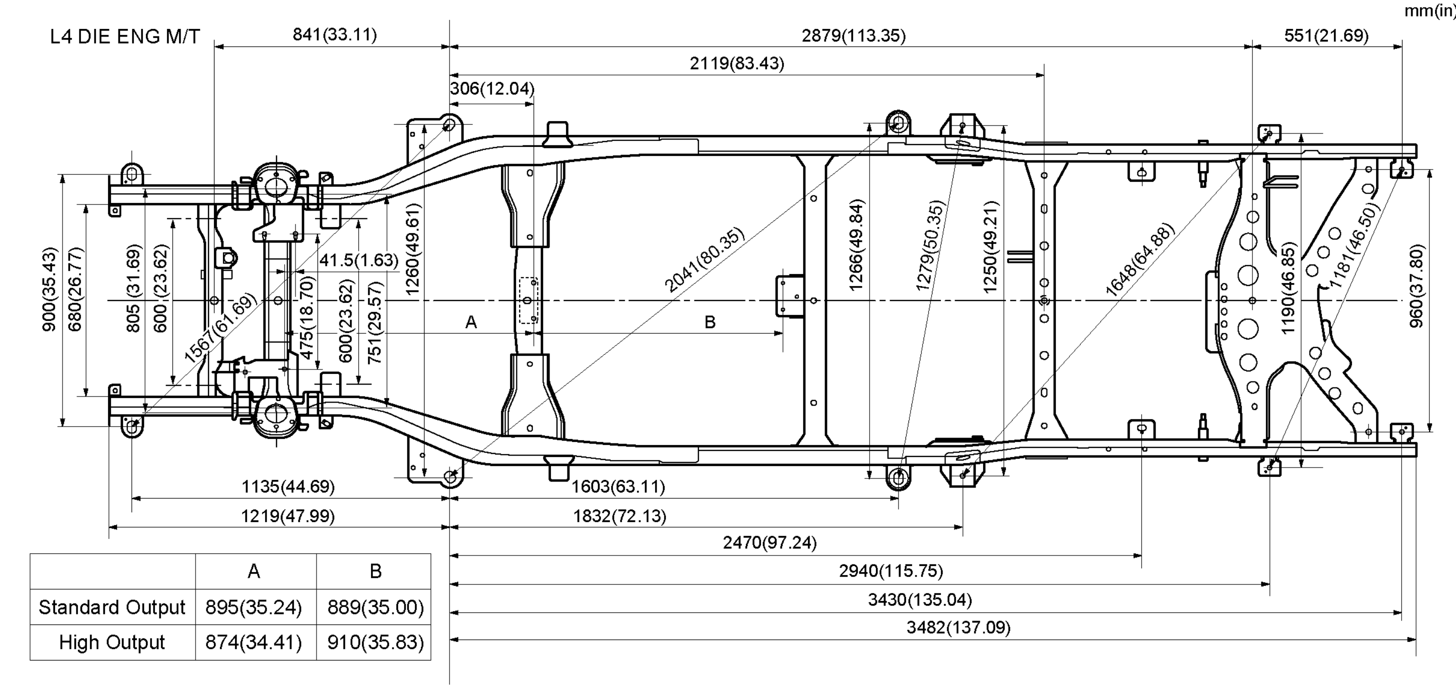
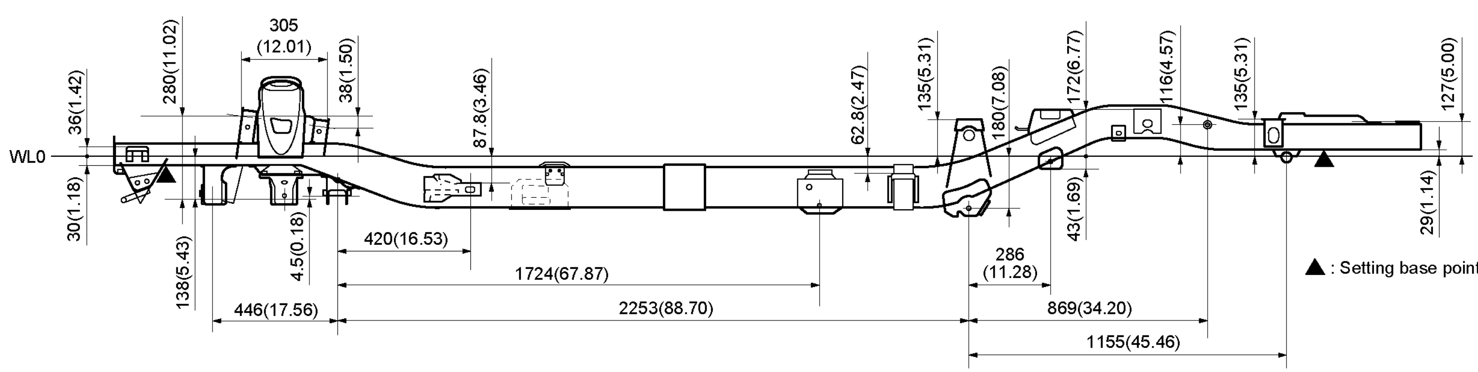
4×2, LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.



	A	B
Standard Output	895(35.24)	889(35.00)
High Output	874(34.41)	910(35.83)



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Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Wait 1 minute for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the scan tool. Does the scan tool indicate within the specified value?	0.9 to 1.0 volt	Go to Step 6	Go to Step 13
6	1. Turn OFF the ignition. 2. Place the transmission in Neutral and set the parking brake. 3. Start the engine and let idle for at least 3 minutes while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 8	Go to Step 7
7	1. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times. 2. Let idle for at least 3 minutes while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 18	Go to Step 8
8	1. Start the engine. 2. Perform the Cylinder Balance Test with a scan tool. 3. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 16	Go to Step 9
9	1. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 10

Step	Action	Value(s)	Yes	No
10	**Notice:** Make sure the in-tank fuel pump operation before performing the following procedures. Refer to In-tank Fuel Pump System Check in this section. 1. Turn OFF the ignition. 2. Disconnect the fuel hose from the fuel supply pump suction side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 3. Turn ON the ignition for 20 seconds, with the engine OFF. 4. Turn OFF the ignition for 10 seconds. 5. Perform 3 and 4 three times. The accumulated fuel of three ignition cycles must be more than 300 cc. (Normal amount is more than 100 cc per one ignition cycle.) **Notice:** If there is a leak or a restriction on the suction side, the fuel from the hose will not flow out sufficiently that is most likely caused by fuel leakage, clogged fuel filter, kinked or crushed fuel hose or pipe. Also inside the fuel tank for any foreign materials may be getting drawn into the fuel line pickup. 6. Repair fuel system leaking or restrictions as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1. Remove the fuel hose that connects to the fuel supply pump suction side and substitute a clear hose. **Notice:** The hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the hose may damage the fuel supply pump. 2. Bleed the fuel system. Repeat as necessary until the engine starts. 3. Let the engine run at idle for at least 1 minute. 4. Observe the clear hose while holding the engine speed higher than 3000 RPM for a minimum of 1 minute. **Notice:** If many air bubbles appear in the fuel, check the fuel line connections between the fuel supply pump and the fuel tank for tightness and all fuel hoses for cuts, cranks and for the uses of proper clamps. 5. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 12

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-50). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 34, 50, 54 and 70 of E-90). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-48). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 47, 48, 68 and 69 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
14	Replace the FRP sensor. Refer to FRP sensor Replacement. Did you complete the replacement?	—	Go to Step 19	—
15	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was leaking fuel found at Step 3 and inspect the engine mechanical for any damage or poor engine compression. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming and engine mechanical section. Did you complete the replacement?	—	Go to Step 19	—
16	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
17	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement and Fuel Filter Cartridge Replacement. Did you complete the replacement?	—	Go to Step 19	—
18	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 20
20	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1196, P1197 or P1198 (Flash Code 461)

Circuit Description

The ECM controls the intake throttle valve opening based on the engine running condition and by controlling the intake throttle solenoid. The intake throttle valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects an excessively high temperature condition in its internal intake throttle solenoid drive circuit for certain length of time, DTC P1196, P1197 or P1198 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 30 seconds. (DTC P1196)
- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 60 seconds in accumulation time during same ignition cycle. (DTC P1197)
- The ECM detects an excessively high temperature in its internal intake throttle solenoid drive circuit for longer than 120 seconds in accumulation time exceeding ignition cycle. (DTC P1198)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking intake throttle valve may set this DTC.

Circuit/ System Testing DTC P1196, P1197 or P1198

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0638 also set?	—	Go to DTC P0638	Go to Step 3
3	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Remove the intake duct that is connected to the intake throttle valve. 2. Inspect the intake throttle valve for the following conditions: • Restricted intake throttle valve by foreign materials • Excessive deposits at throttle bore • Bent butterfly valve **Notice:** Replace the intake throttle valve if there is any sticking. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 7	Go to Step 9
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P124B (Flash Code 157)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 and common 2 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for each cylinder in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the fuel injector charge voltage circuit or solenoid control circuit is shorted across the bank, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine speed is lower than 2000RPM.

Condition for Setting the DTC

- The ECM detects that the fuel injector charge voltage circuit or solenoid control circuit is shorted across the bank.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P124B

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>3</td><td>1. Turn OFF the ignition.
2. Disconnect all fuel injector harness connectors.
3. Disconnect the ECM harness connector.
4. Measure continuity through the fuel injector harness connectors.
• #1 and #2 solenoid control circuits (pin 1 of E-13 and pin 1 of E-14)
• #1 and #2 charge voltage circuits (pin 2 of E-13 and pin 2 of E-14)
• #1 solenoid control circuit (pin 1 of E-13) and #2 charge voltage circuit (pin 2 of E-14)
• #2 solenoid control circuit (pin 1 of E-14) and #1 charge voltage circuit (pin 2 of E-13)
• #1 and #3 solenoid control circuits (pin 1 of E-13 and pin 1 of E-15)
• #1 and #3 charge voltage circuits (pin 2 of E-13 and pin 2 of E-15)
• #1 solenoid control circuit (pin 1 of E-13) and #3 charge voltage circuit (pin 2 of E-15)
• #3 solenoid control circuit (pin 1 of E-15) and #1 charge voltage circuit (pin 2 of E-13)
• #2 and #4 solenoid control circuits (pin 1 of E-14 and pin 1 of E-16)
• #2 and #4 charge voltage circuits (2 of E-14 and pin 2 of E-16)
• #2 solenoid control circuit (pin 1 of E-14) and #4 charge voltage circuit (pin 2 of E-16)
• #4 solenoid control circuit (pin 1 of E-16) and #2 charge voltage circuit (pin 2 of E-14)
• #3 and #4 solenoid control circuits (pin 1 of E-15 and pin 1 of E-16)
• #3 and #4 charge voltage circuits (pin 2 and of E-15 and pin 2 of E-16)
• #3 solenoid control circuit (pin 1 of E-15) and #4 charge voltage circuit (pin 2 of E-16)
• #4 solenoid control circuit (pin 1 of E-16) and #3 charge voltage circuit (pin 2 of E-15)
5. Repair the short circuit if continuity exists for any measurement.

Did you find and correct the condition?</td><td>—</td><td>Go to Step 5</td><td>Go to Step 4</td></tr>
<tr><td>4</td><td>Important: Replacement ECM must be programmed and learned.
Replace the ECM. Refer to ECM Replacement.

Did you complete the replacement?</td><td>—</td><td>Go to Step 5</td><td>—</td></tr>
</table>

Step	Action	Value(s)	Yes	No
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1261 (Flash Code 34)

Circuit Description

The charge up circuit in the ECM steps up the voltage for fuel injectors and is divided into two banks, common 1 and common 2. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3.
If the common 1 fuel injector charge up circuit in the ECM is an insufficient charge or an overcharge, this DTC will set. (Charge Up Voltage DTC)
If the supply voltage to the common 1 and common 2 fuel injector charge up circuits is an excessively low or high voltage, this DTC will also set. (Supply Voltage Low or High DTC)

Condition for Running the DTC

Charge Up Voltage DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is not running.

Supply Voltage Low or High DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Charge Up Voltage DTC

- The ECM detects that the common 1 fuel injector charge up circuit is an insufficient charge or an overcharge.

Supply Voltage Low or High DTC

- The ECM detects that the supply voltage to the common 1 and common 2 fuel injector charge up circuits is an excessively low or high voltage.

Action Taken When the DTC Sets

Charge Up Voltage DTC & Supply Voltage Low DTC

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Supply Voltage High DTC

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

Charge Up Voltage DTC & Supply Voltage Low DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A

Supply Voltage High DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

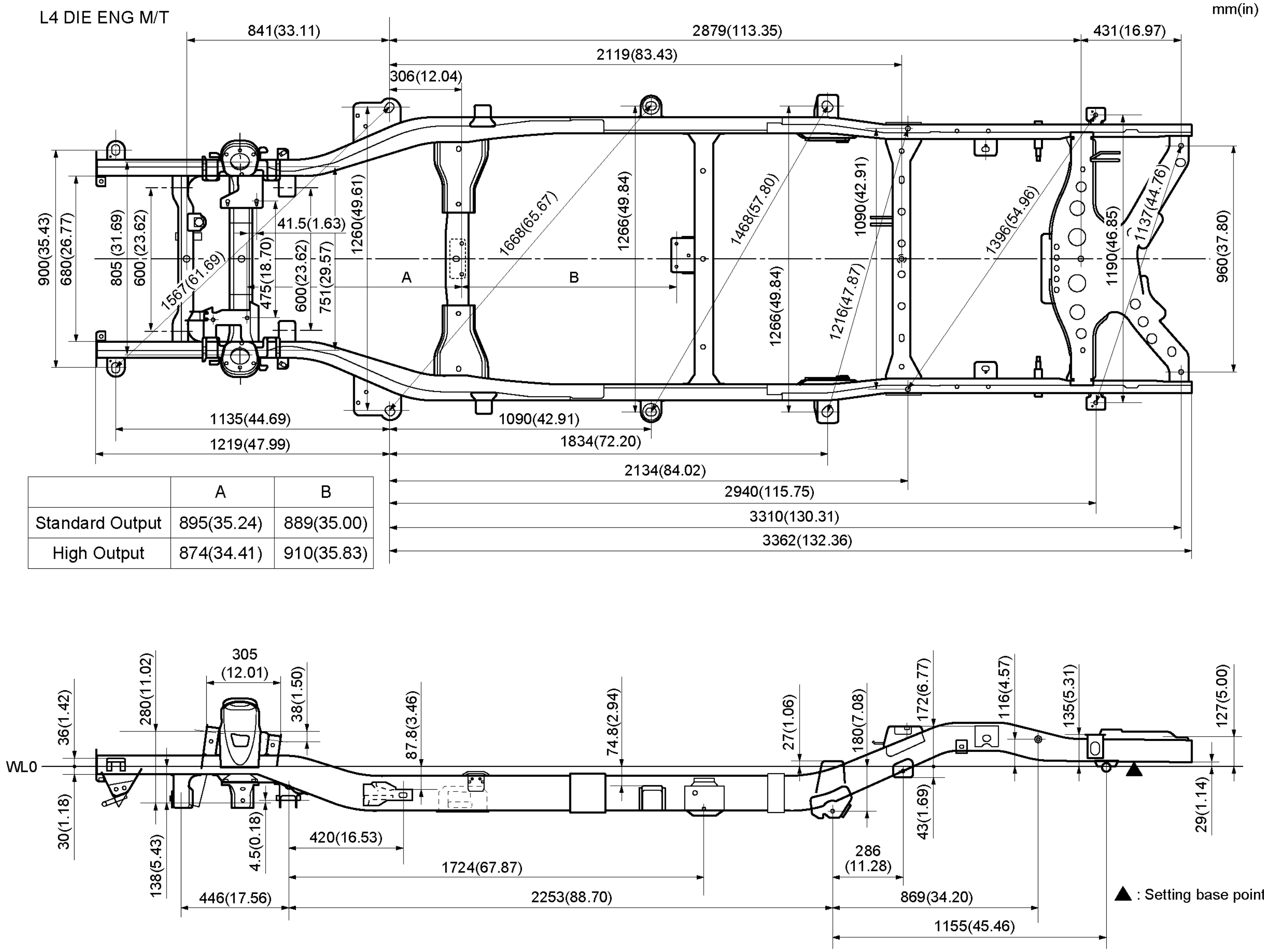
Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1261

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8

4×2, LWB, CREW CAB MODEL

This illustration is based on the RHD model.



	A	B
Standard Output	895(35.24)	889(35.00)
High Output	874(34.41)	910(35.83)

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Step	Action	Value(s)	Yes	No
3	1. Inspect for an intermittent, for poor tightening and corrosion at the engine ground terminal (E-10). 2. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Test ground circuit between the ECM (pin 73 of E-90) and the engine ground terminal (E-10) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test the battery voltage feed circuit between the ECM (pin 73 of E-90) and the ECM main relay (pin 1 of X-12) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pin 73 of C-58 and pin 73 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1262 (Flash Code 34)

Circuit Description

The charge up circuit in the ECM steps up the voltage for fuel injectors and is divided into two banks, common 1 and common 2. The common 1 covers fuel injectors in cylinders #1 and #4, and the common 2 covers fuel injectors in cylinders #2 and #3. If the common 2 fuel injector charge up circuit in the ECM is an insufficient charge or an overcharge, this DTC will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is not running.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge up circuit is an insufficient charge or an overcharge.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1262

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
3	1. Inspect for an intermittent, for poor tightening and corrosion at the engine ground terminal (E-10). 2. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Test ground circuit between the ECM (pin 73 of E-90) and the engine ground terminal (E-10) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test the battery voltage feed circuit between the ECM (pin 73 of E-90) and the ECM main relay (pin 1 of X-12) for an intermittently open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pin 73 of E-90 and pin 73 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1404 (Flash Code 45)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM.
If the ECM detects that the actual EGR position is higher than certain amount, this DTC will set. (Closed Position Error DTC)
If the ECM detects a variance between the learned closed position and actual closed position, this DTC will also set. (Learned Position Error DTC)

Condition for Running the DTC

Closed Position Error DTC

- DTCs P0112, P0113, P0116, P0117, P0118, P0404 P0405, P0406, P0652, P0653, P2227, P2228 and P2229 are not set.
- The battery voltage is between 10 to 16 volts.
- The ignition switch is ON.
- The engine coolant temperature is between 20 to 110 °C (68 to 230 °F).
- The intake air temperature is between 0 to 110 °C (32 to 230 °F).
- The barometric pressure is between 60 to 120 kPa (8.7 to 17.4 psi)

Learned Position Error DTC

- DTCs P0404, P0405 and P0406 are not set.

Condition for Setting the DTC

Closed Position Error DTC

- The ECM detects that the actual EGR position is more than 20% for 5 seconds when the EGR control is commanded OFF.

Learned Position Error DTC

- The ECM detects that the EGR learned minimum position is more than 10% or less than -10% when the ignition switch is OFF.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR control. (Closed Position Error DTC)
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking EGR valve may set this DTC.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1404

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0403, P0405 or P0406 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). **Notice:** Ignition switch must be cycled before clear the DTC. 2. Turn ON the ignition, with the engine OFF. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition and clear the DTCs with a scan tool. 5. Turn OFF the ignition for 30 seconds. 6. Start the engine. 7. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1411, P1412 or P1413 (Flash Code 445)

Circuit Description

The ECM controls the EGR valve opening based on the engine running condition and by controlling the EGR solenoid. The EGR valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects an excessively high temperature condition in its internal EGR solenoid drive circuit for certain length of time, DTC P1411, P1412 or P1413 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 30 seconds. (DTC P1411)
- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 60 seconds in accumulation time during same ignition cycle. (DTC P1412)
- The ECM detects an excessively high temperature in its internal EGR solenoid drive circuit for longer than 120 seconds in accumulation time exceeding ignition cycle. (DTC P1413)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits pilot injection.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking EGR valve may set this DTC.

Circuit/ System Testing DTC P1411, P1412 or P1413

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0404 or P1404 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position. Does the EGR Position parameter follow within the specified value quick enough (compare with a similar unit if available)?	±5%	Go to Diagnostic Aids	Go to Step 4
4	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Replace the EGR valve. Refer to EGR Valve Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 7	Go to Step 9
7	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P156A or P156B (Flash Code 135)

Circuit Description

The ECM monitors the battery voltage on the ECM main relay voltage feed terminal to make sure that the voltage stays within the proper range. If the ECM detects an excessively low or high battery voltage, DTC P156A or P156B will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts. (DTC P156B)

Condition for Setting the DTC

- The ECM detects that the battery voltage feed circuit is less than 8 volts for 20 seconds. (DTC P156A)
- The ECM detects that the battery voltage feed circuit is more than 16 volts for 5 seconds. (DTC P156B)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity. (DTC P156B)
- The ECM inhibits pilot injection. (DTC P156B)
- The ECM inhibits cruise control. (DTC P156B)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- A charging system problem may set this DTC.
- The weakened battery may set DTC P156A.
- Jump starting the vehicle or a battery charger may have set DTC P156B.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P156A

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle. 4. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Battery Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Diagnostic Aids	Go to Step 3
3	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 4	Go to Step 5
4	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for a poor connection and for corrosion at the harness connector of the ECM (pin 73 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Load the electrical system by turning ON the headlights, A/C, etc. while observing the Battery Voltage parameter with a scan tool. Does the scan tool indicate more than the specified value?	10.0 volts	Go to Step 7	Go to Step 3
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P156B

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	Was the vehicle recently jump started or a battery charger placed on the battery?	—	Go to Step 7	Go to Step 3
3	1. Install a scan tool. 2. Start the engine and let idle. 3. Observe the Battery Voltage parameter with the scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Diagnostic Aids	Go to Step 4
4	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 5	Go to Diagnostic Aids
5	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—

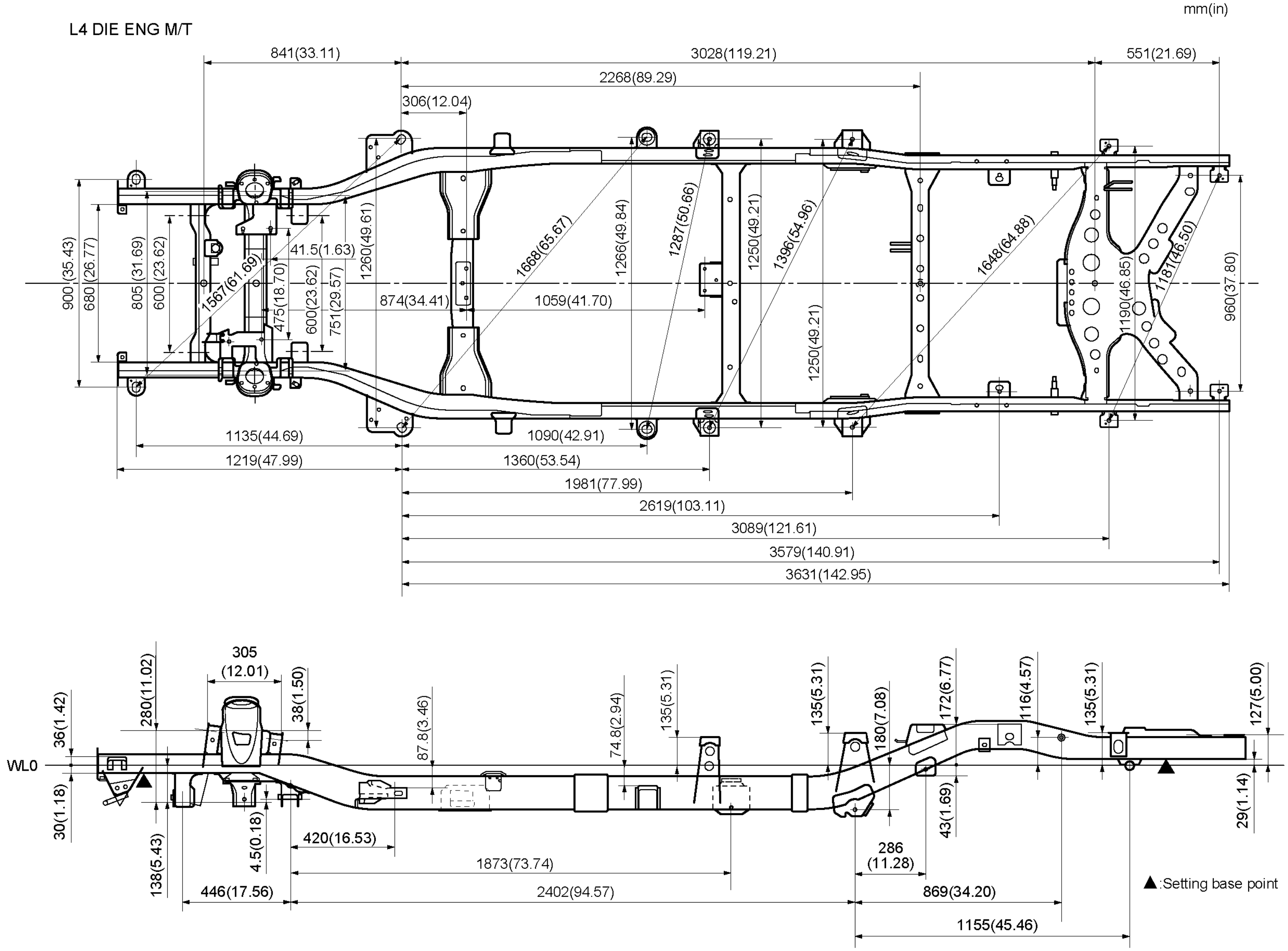
Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Observe the Battery Voltage parameter with a scan tool. Does the scan tool indicate less than the specified value?	16.0 volts	Go to Step 7	Go to Step 4
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

BACK TO CHAPTER INDEX

4×2, EXTRA LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.

mm(in)



RTW72AXF002601

DTC P161B (Flash Code 179)

Circuit Description

The ECM communicates with the immobilizer control unit (ICU) to execute immobilizer function. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus. If the ECM receives a wrong response signal from the ICU, this DTC will set.

Condition for Setting the DTC

- The ECM receives a wrong immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference may affect intermittent condition.

Circuit/ System Testing DTC P161B

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0633, U0001 or U0167 also set?	—	Go to Applicable DTC	Go to Step 3
3	Monitor the immobilizer DTC Information with a scan tool. Does the immobilizer DTCs fail this ignition which begin with B or U?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 4
4	Program immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in immobilizer section. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 6	—

Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1621 (Flash Code 54, 254)

Circuit Description

The electrically erasable & programmable read only memory (EEPROM) memorizes learning data, VIN data and immobilzer security information. If the ECM detects an error in either of their data, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a faulty learning data in its internal EEPROM. (Flash Code 54)
- The ECM detects a faulty VIN data or immobilizer security information in its internal EEPROM. (Flash Code 254)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity. (Flash Code 54)
- The ECM inhibits cruise control. (Flash Code 54)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Circuit/ System Testing DTC P1621

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Ensure that all tool connections are secure. 2. Ensure that programming equipment is operating correctly. 3. Install a scan tool. 4. Turn OFF the ignition for 30 seconds. 5. Turn ON the ignition, with the engine OFF. 6. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
3	1. Verify the correct VIN and immobilizer code are entered into the ECM with a scan tool. Refer to ECM Replacement. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—

Step	Action	Value(s)	Yes	No
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1664 (Flash Code 76)

Circuit Description

The service vehicle soon (SVS) lamp is located on the instrument panel (IP) cluster. The SVS lamp informs the driver that a non-emission related fault has occurred and vehicle service required.
The ECM monitors the SVS lamp control circuit for conditions that are incorrect for the commanded state of the SVS lamp. For example, a failure condition exists if the ECM detects low voltage when the SVS lamp is commanded OFF, or high voltage when the SVS lamp is commanded ON. If the ECM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

Low Voltage DTC

- The ECM detects a low voltage condition on the SVS lamp control circuit when the lamp is commanded OFF.

High Voltage DTC

- The ECM detects a high voltage condition on the SVS lamp control circuit when the lamp is commanded ON.

Action Taken When the DTC Sets

Low Voltage DTC

- The ECM will not illuminate the MIL or SVS lamp.
- Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type D.

High Voltage DTC

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C.

Condition for Clearing the DTC

Low Voltage DTC

- Refer to DTC Type Definitions for Condition for Clearing the DTC - Type D.

High Voltage DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P1664

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Perform the Service Vehicle Soon (SVS) Lamp Control with a scan tool. 4. Command the lamp ON and OFF. Does the SVS lamp turn ON and OFF with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cabin fuse block. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the ECM J-2 (C-58) harness connector. 3. Turn ON the ignition, with the engine OFF. Is the SVS lamp OFF?	—	Go to Sep 6	Go to Step 12
6	1. Remove the Meter (10A) fuse that supplies voltage to the SVS lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the SVS lamp control circuit in the ECM harness connector (pin 71 of C-58) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 13
7	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 71 of C-58) and a known good ground. Is the SVS lamp illuminated?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the IP cluster. 3. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 8 of B-24) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 14
9	1. Test the control circuit between the ECM (pin 71 of C-58) and the IP cluster (pin 26 of B-23) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
10	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 8 of B-24 and pin 26 of B-23). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 71 of C-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	Repair the short to ground between the ECM (pin 71 of C-58) and the IP cluster (pin 26 of B-23). Did you complete the repair?	—	Go to Step 17	—
13	Repair the short to battery or ignition voltage between the ECM (pin 71 of C-58) and the IP cluster (pin 26 of B-23). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
14	Repair the open circuit or high resistance on the ignition voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 17	—
15	Repair or replace the IP cluster. Did you complete the repair or replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Perform the SVS Lamp Control with a scan tool. 5. Command the lamp ON and OFF. Does the SVS lamp turn ON and OFF with each command?	—	Go to Step 18	Go to Step 3
18	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2100, P2101 or P2103 (Flash Code 446)

Circuit Description

The ECM controls the intake throttle valve opening based on the engine running condition and by controlling the intake throttle solenoid. The intake throttle valve position is detected by the position sensor, and relayed to the ECM. If the ECM detects an open circuit or short circuit on the solenoid circuits, DTC P2100, P2101 or P2103 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects an open circuit on the intake throttle solenoid circuits. (DTC P2100)
- The ECM detects a short to ground on the intake throttle solenoid circuits. (DTC P2101)
- The ECM detects a short to voltage circuit on the intake throttle solenoid circuits. (DTC P2103)

Action Taken When the DTC Sets

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type B. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM inhibits EGR control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type B (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2100, P2101 or P2103

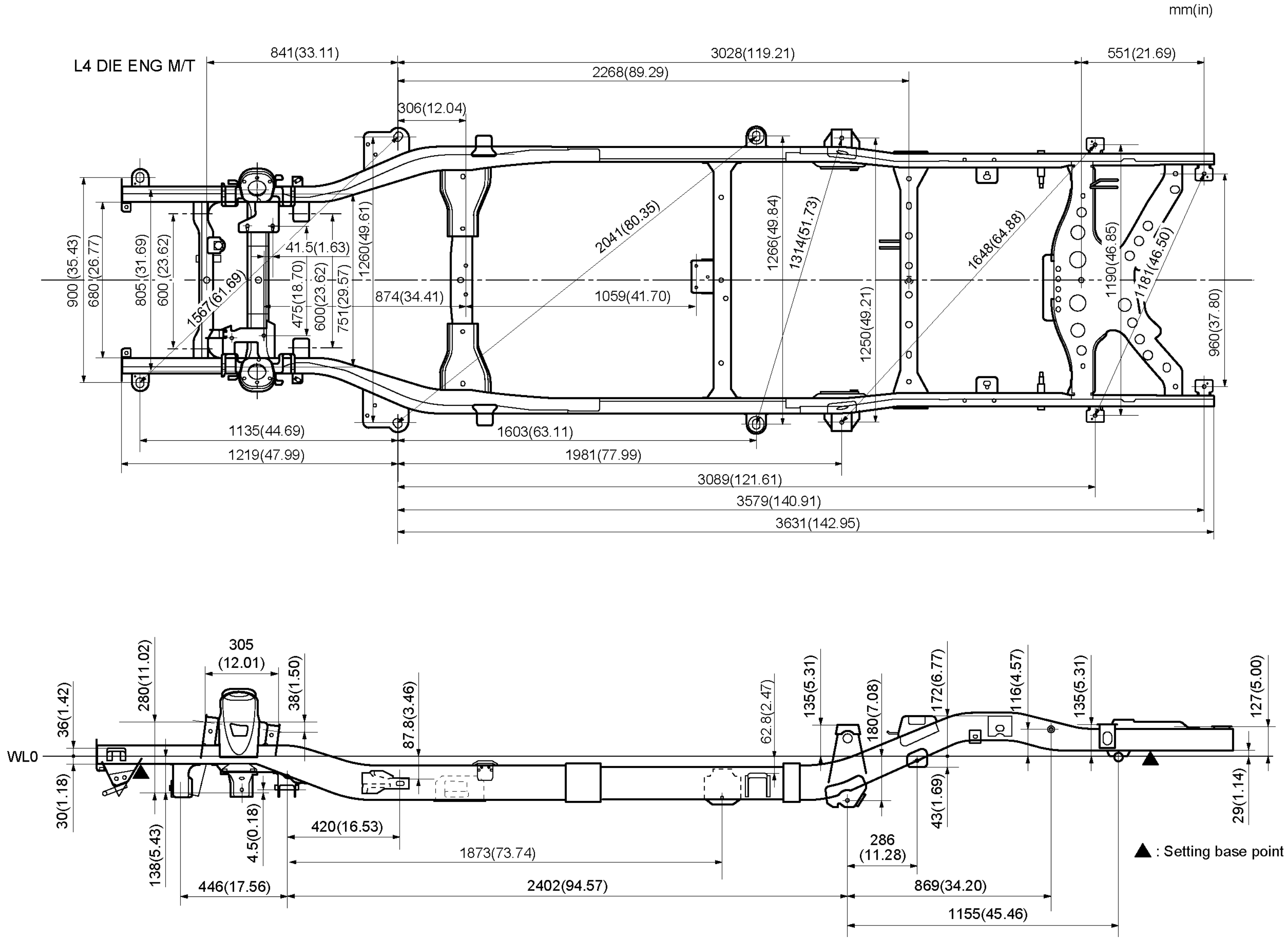
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the drive voltage circuit (pin 2 of E-38) and a known good ground. 5. Connect a DMM between the low side circuit (pin 1 of E-38) and a known good ground. Are both voltage readings within the specified value?	1.4 to 1.8 volts	Go to Step 5	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	—	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the circuits between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
6	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) for the following conditions: • An open circuit • A short to ground • A short to the position sensor low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the circuits (which ever voltage reading did not read within the specified value at Step 3) between the ECM (pins 55 and 56 of E-90) and the intake throttle valve (pins 1 and 2 of E-38) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
8	1. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle valve (pins 1 and 2 of E-38). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 55 and 56 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 10	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

4×2, EXTRA LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.



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DTC P2122 or P2123 (Flash Code 121)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensor 1 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 1 signal circuit

The APP sensor 1 provides a signal to the ECM on the signal circuit, which is relative to the position changes of the accelerator pedal angle. If the ECM detects an excessively low or high signal voltage, DTC P2122 or P2123 will set.

Condition for Running the DTC

- DTCs P0642 and P0643 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 signal voltage is less than 0.15 volts. (DTC P2122)
- The ECM detects that the APP sensor 1 signal voltage is more than 4.85 volts. (DTC P2123)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 1 may have an intermittent open somewhere in the pedal range.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2122

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0642 also set?	—	Go to DTC P0642	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 1 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 10 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 5 and 10 of C-40). Is the APP Sensor 1 parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 11 of C-58) and the APP sensor (pin 10 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 12 of C-58) and the APP sensor (pin 5 of C-40) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 5 and 10 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 11 and 12 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2123

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 1 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0643 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 1 parameter less than the specified value?	0.1 volts	Go to DTC P0643	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 1 parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 4 of C-40) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
7	**Important:** The APP sensor 1 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 12 of C-58) and the APP sensor (pin 5 of C-40) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 27 of C-58) and the APP sensor (pin 4 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 4 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 27 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2127 or P2128 (Flash Code 122)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensor 2 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 2 signal circuit

The APP sensor 2 provides a signal to the ECM on the signal circuit, which is relative to the position changes of the accelerator pedal angle. If the ECM detects an excessively low or high signal voltage, DTC P2127 or P2128 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 2 signal voltage is less than 0.15 volts. (DTC P2127)
- The ECM detects that the APP sensor 2 signal voltage is more than 4.85 volts. (DTC P2128)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 2 may have an intermittent open somewhere in the pedal range.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2127

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 2 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 2 parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a DMM between the 5 volts reference circuit (pin 8 of C-40) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
7	1. Test the 5 volts reference circuit between the ECM (pin 9 of C-58) and the APP sensor (pin 8 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 8 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 9 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 2 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2128

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to DTC P0653	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 2 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 9 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit of the sensor 2 harness (pin 9 of C-40) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the sensor 2 harness (pins 3 and 9 of C-40). Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 11	Go to Step 7
7	1. Test the low reference circuit between the ECM (pin 25 of C-58) and the APP sensor (pin 3 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
10	**Important:** The APP sensor 2 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 10 of C-58) and the APP sensor (pin 9 of C-40) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 3 and 9 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 10 and 25 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 2 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2132 or P2133 (Flash Code 123)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensor 3 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 3 signal circuit

The APP sensor 3 provides a signal to the ECM on the signal circuit, which is relative to the position changes of the accelerator pedal angle. If the ECM detects an excessively low or high signal voltage, DTC P2132 or P2133 will set.

Condition for Running the DTC

- DTCs P0698 and P0699 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the APP sensor 3 signal voltage is less than 1.2 volts. (DTC P2132)
- The ECM detects that the APP sensor 3 signal voltage is more than 4.85 volts. (DTC P2133)

Action Taken When the DTC Sets

DTC P2132

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

DTC P2133

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

DTC P2132

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

DTC P2133

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 3 may have an intermittent open somewhere in the pedal range.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2132

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0698 also set?	—	Go to DTC P0698	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 3 parameter with a scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	1.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the APP Sensor 3 parameter more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6
5	Connect a DMM between the 5 volts reference circuit (pin 1 of C-40) and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
7	1. Test the 5 volts reference circuit between the ECM (pin 7 of C-58) and the APP sensor (pin 1 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 1 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 7 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—

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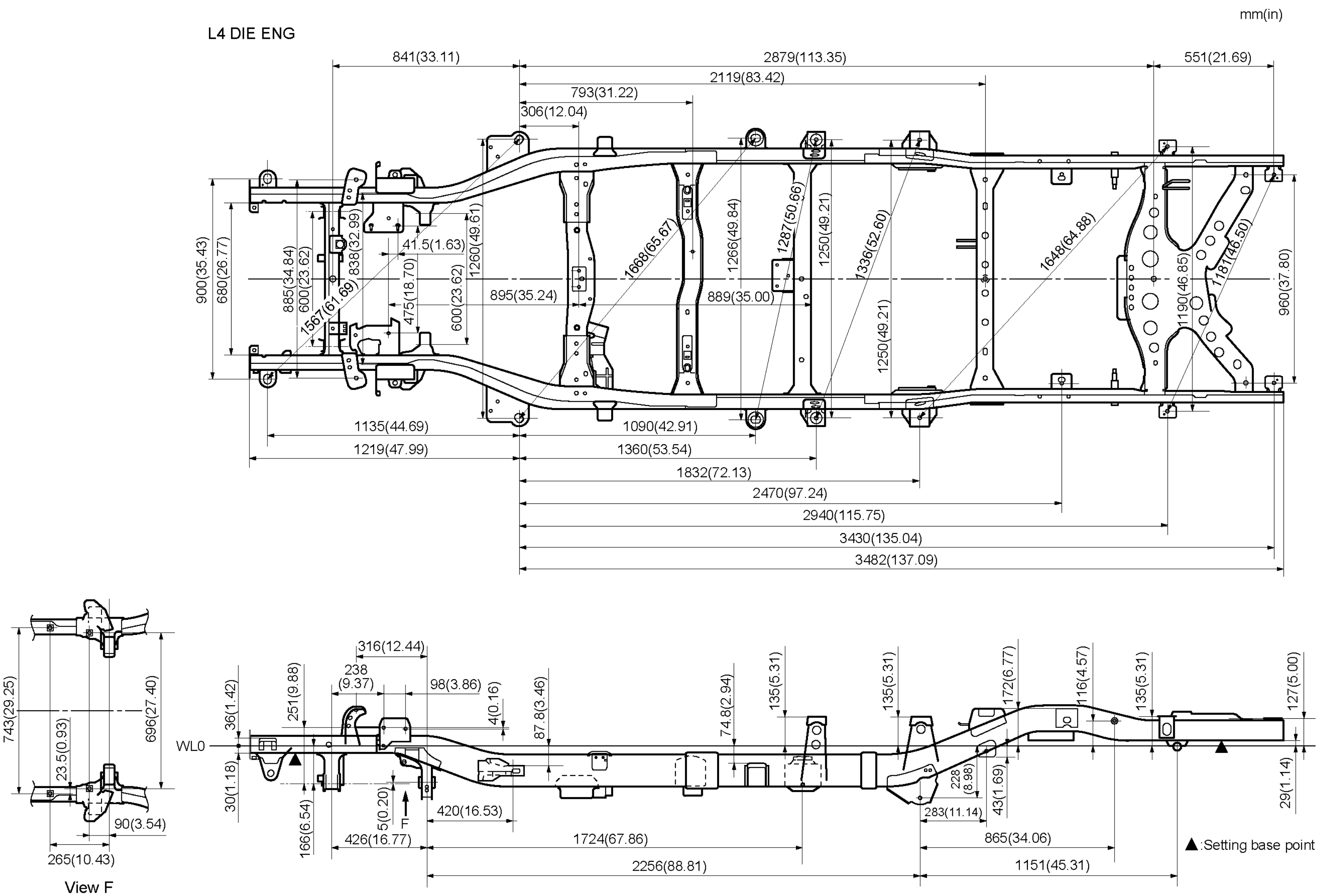
4×2, HIGH RIDE, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 3 parameter with the scan tool. Does the scan tool indicate less than the specified value during depressing or releasing the pedal?	1.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2133

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0699 also set?	—	Go to DTC P0653	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 3 parameter with a scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the signal circuit (pin 6 of C-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.3 volts	Go to Step 10	Go to Step 5
5	1. Connect a test lamp between the signal circuit (pin 6 of C-40) and a known good ground. 2. Connect a DMM between the probe of the test lamp and a known good ground. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 9	Go to Step 6
6	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the sensor 3 harness (pins 6 and 7 of C-40). Is the APP Sensor 3 parameter less than the specified value?	0.2 volts	Go to Step 11	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Test the low reference circuit between the ECM (pin 23 of C-58) and the APP sensor (pin 7 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	**Important:** The APP sensor 3 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 8 of C-58) and the APP sensor (pin 6 of C-40) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 6 and 7 of C-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 8 and 23 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 3 parameter with the scan tool. Does the scan tool indicate more than the specified value during depressing or releasing the pedal?	4.8 volts	Go to Step 3	Go to Step 16
16	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2138, P2139 or P2140 (Flash Code 124, 125 or 126)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The APP sensor 1, APP sensor 2 and APP sensor 3 are potentiometer type sensors, each with the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Signal circuit

The APP sensor provides a signal to the ECM on the signal circuits, which is relative to the position changes of the accelerator pedal angle. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 and APP sensor 3 signal voltage is high at rest and decreases as the pedal is depressed. If the ECM detects that each APP sensor signal voltage is out of the correlation, DTC P2138, P2139 or P2140 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The APP sensor 1 signal voltage is between 0.15 to 4.85 volt. (DTC P2138 or P2139)
- The APP sensor 2 signal voltage is between 0.15 to 4.85 volt. (DTC P2138 or P2140)
- The APP sensor 3 signal voltage is between 1.20 to 4.85 volt. (DTC P2139 or P2140)

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 and 2 are more than 40% out of range of each other. (DTC P2138)
- The ECM detects that the APP sensor 1 and 3 are more than 40% out of range of each other. (DTC P2139)
- The ECM detects that the APP sensor 2 and 3 are more than 40% out of range of each other. (DTC P2140)

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2138

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0642, P0643, P0652, P0653, P0698, P0699, P2132 or P2133 also set?	—	Go to Applicable DTC	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Is DTC P2140 also set?	—	Go to Step 6	Go to Step 5
5	Is DTC P2139 also set?	—	Go to Step 7	Go to Step 8

Step	Action	Value(s)	Yes	No
6	1. Test each accelerator pedal position (APP) sensor 2 circuits between the ECM (pins 9, 10 and 25 of C-58) and the APP sensor (pins 3, 8 and 9 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	1. Test each APP sensor 1 circuits between the ECM (pins 11, 12 and 27 of C-58) and the APP sensor (pins 4, 5 and 10 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Test each APP sensor 3 circuits between the ECM (pins 7, 8 and 23 of C-58) and the APP sensor (pins 1, 6 and 7 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 3, 4, 5, 6, 7, 8, 9 and 10 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 7, 8, 9, 10, 11, 12, 23, 25 and 27 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
10	1. Test the APP sensor 1 and sensor 3 signal circuit between the ECM (pins 8 and 12 of C-58) and the APP sensor (pins 5 and 6 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 13	Go to Step 15

Step	Action	Value(s)	Yes	No
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2139

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0642, P0643, P0652, P0653, P0698, P0699, P2127 or P2128 also set?	—	Go to Applicable DTC	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Is DTC P2138 also set?	—	Go to DTC P2138	Go to Step 5
5	Is DTC P2140 also set?	—	Go to DTC P2140	Go to Step 6
6	1. Test each accelerator pedal position (APP) sensor 2 circuits between the ECM (pins 9, 10 and 25 of C-58) and the APP sensor (pins 3, 8 and 9 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 3, 8 and 9 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 9, 10 and 25 of C-58). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 8
8	1. Test the APP sensor 1 and sensor 2 signal circuit between the ECM (pins 10 and 12 of C-58) and the APP sensor (pins 5 and 9 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
9	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 11	Go to Step 13
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2140

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0642, P0643, P0652, P0653, P0698, P0699, P2122 or P2123 also set?	—	Go to Applicable DTC	Go to Step 3
3	Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	Is DTC P2138 also set?	—	Go to DTC P2138	Go to Step 5
5	Is DTC P2139 also set?	—	Go to Step 6	Go to Step 7
6	1. Test each accelerator pedal position (APP) sensor 3 circuits between the ECM (pins 7, 8 and 23 of C-58) and the APP sensor (pins 1, 6 and 7 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 7
7	1. Test each APP sensor 1 circuits between the ECM (pins 11, 12 and 27 of C-58) and the APP sensor (pins 4, 5 and 10 of C-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 4, 5, 6, 7 and 10 of C-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 7, 8, 11, 12, 23 and 27 of C-40). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Test the APP sensor 1 and sensor 2 signal circuit between the ECM (pins 10 and 12 of C-58) and the APP sensor (pins 5 and 9 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Test the APP sensor 1 and sensor 3 signal circuit between the ECM (pins 8 and 12 of C-58) and the APP sensor (pins 5 and 6 of C-40) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
11	Replace the APP sensor. Refer to APP Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 13	Go to Step 15
13	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2146, P2147 or P2148 (Flash Code 158)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 1 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for cylinder #1 and #4 in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the common 1 fuel injector charge voltage circuit is shorted to cylinder #1 or #4 fuel injector solenoid control circuit, shorted to ground or shorted voltage circuit DTC P2146, P2147 or P2148 will set. If the cylinder #1 and #4 fuel injector solenoid control circuit is shorted each other, shorted to ground or shorted voltage circuit DTC P2146, P2147 or P2148 will also set.

Condition for Running the DTC

- DTCs P0201, P0204, P2147 and P2148 are not set. (DTC P2146)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the common 1 fuel injector charge voltage circuit is shored to cylinder #1 or #4 fuel injector solenoid control circuit, or cylinder #1 and #4 fuel injector solenoid control circuit is shorted each other. (DTC P2146)
- The ECM detects that the common 1 fuel injector charge voltage circuit, cylinder #1 or #4 fuel injector solenoid control circuit is shorted to ground. (DTC P2147)
- The ECM detects that the common 1 fuel injector charge voltage circuit, cylinder #1 or #4 fuel injector solenoid control circuit is shorted to voltage circuit. (DTC P2148)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2146

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Accelerate the engine and keep the accelerator pedal at any position. 5. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

SECTION 0B

MAINTENANCE AND LUBRICATION

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4×2, HIGH RIDE, LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.

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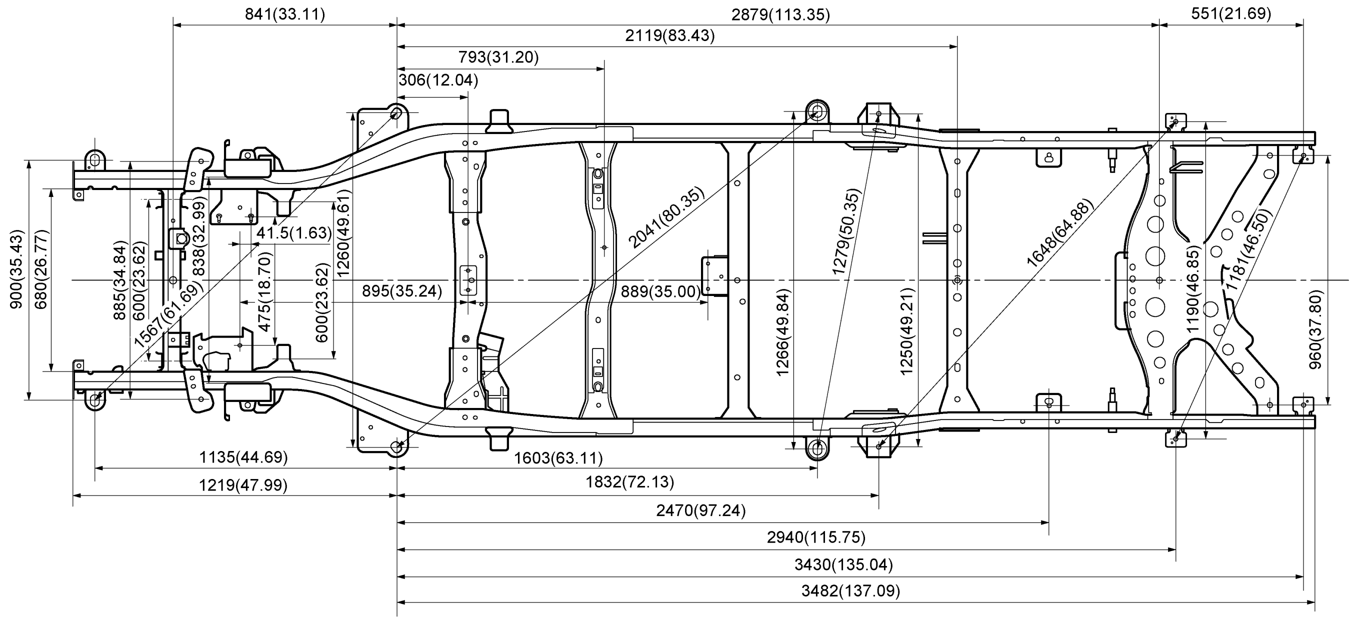

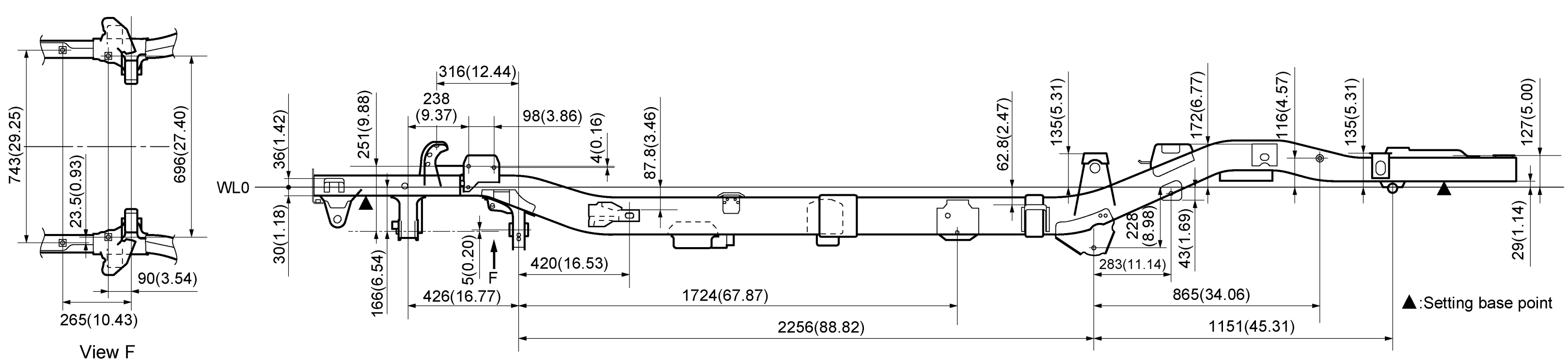

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TO MODEL INDEX

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #1 and #4 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity through the fuel injector harness connector(s). • Each #1 fuel injector circuit (pins 1 and 2 of E-13) • Each #4 fuel injector circuit (pins 1and 2 of E-16) • #1 and #4 solenoid control circuits (pin 1 of E-13 and pin 1 of E-16) • #1 solenoid control circuit (pins 1 of E-13) and #4 charge voltage circuit (pin 2 of E-16) • #1 charge voltage circuit (pins 2 of E-13) and #4 solenoid control circuit (pin 1 of E-16) 5. Repair the short circuit if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure the resistance of cylinder #1 and #4 fuel injector solenoid. Is the resistance more than the specified value?	0.5Ω	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less solenoid resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2147

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #1 and #4 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity between each fuel injector circuit and a known good ground. • #1 (pins 1 and 2 of E-13) and a known good ground • #4 (pins 1 and 2 of E-16) and a known good ground 5. Repair the short to ground if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure insulation resistance of the cylinder #1 and #4 fuel injector between each fuel injector terminal and a known good ground. Is the resistance more than the specified value?	1MΩ	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engineOFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2148

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #1 and #4 fuel injector harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between each fuel injector circuit and a known good ground. • #1 (pins 1 and 2 of E-13) and a known good ground • #4 (pins 1 and 2 of E-16) and a known good ground 5. Repair the short to battery or ignition voltage if the test lamp illuminates. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engineOFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2149, P2150 or P2151 (Flash Code 159)

Circuit Description

The ECM calculates the optimum fuel injection ON time using data sent from various engine sensors. The common 2 fuel injector charge voltage circuit is a high-voltage supply which drives fuel injectors for cylinder #2 and #3 in conjunction with the ECM grounding the fuel injector solenoid control circuit. If the common 2 fuel injector charge voltage circuit is shorted to cylinder #2 or #3 fuel injector solenoid control circuit, shorted to ground or shorted voltage circuit DTC P2149, P2150 or P2151 will set. If the cylinder #2 and #3 fuel injector solenoid control circuit is shorted each other, shorted to ground or shorted voltage circuit DTC P2149, P2150 or P2151 will also set.

Condition for Running the DTC

- DTCs P0202, P0203, P2150 and P2151 are not set. (DTC P2149)
- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge voltage circuit is shored to cylinder #2 or #3 fuel injector solenoid control circuit, or cylinder #2 and #3 fuel injector solenoid control circuit is shorted each other. (DTC P2149).
- The ECM detects that the common 2 fuel injector charge voltage circuit, or cylinder #2 or #3 fuel injector solenoid control circuit is shorted to ground. (DTC P2150)
- The ECM detects that the common 2 fuel injector charge voltage circuit, or cylinder #2 or #3 fuel injector solenoid control circuit is shorted to voltage circuit. (DTC P2151)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2149

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Accelerate the engine and keep the accelerator pedal at any position. 5. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #2 and #3 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity through the fuel injector harness connector(s). • Each #2 fuel injector circuit (pins 1 and 2 of E-14) • Each #3 fuel injector circuit (pins 1and 2 of E-15) • #2 and #3 solenoid control circuits (pin 1 of E-14 and pin 1 of E-15) • #2 solenoid control circuit (pin 1 of E-14) and #3 charge voltage circuit (pin 2 of E-15) • #2 charge voltage circuit (pin 2 of E-14) and #3 solenoid control circuit (pin 1 of E-15) 5. Repair the short circuit if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure the resistance of cylinder #2 and #3 fuel injector solenoid. Is the resistance less than the specified value?	0.5Ω	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less solenoid resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2150

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #2 and #3 fuel injector harness connector. 3. Disconnect the ECM harness connector. 4. Measure continuity between each fuel injector circuit and a known good ground. • #2 (pins 1 and 2 of E-14) and a known good ground • #3 (pins 1 and 2 of E-15) and a known good ground 5. Repair the short to ground if continuity exists for any measurement. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4
4	Measure insulation resistance of the cylinder #2 and #3 fuel injector between each fuel injector terminal and a known good ground. Is the resistance more than the specified value?	1MΩ	Go to Step 6	Go to Step 5
5	**Important:** Replacement fuel injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 4. Refer to Fuel Injector Replacement/ Fuel Injector ID Code Data Programming. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engineOFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2151

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the cylinder #2 and #3 fuel injector harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between each fuel injector circuit and a known good ground. • #2 (pins 1 and 2 of E-14) and a known good ground • #3 (pins 1 and 2 of E-15) and a known good ground 5. Repair the short to battery or ignition voltage if the test lamp illuminates. Did you find and correct the condition?	—	Go to Step 5	Go to Step 4
4	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 5	—
5	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engineOFF. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2227 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located on the intake manifold. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. Within the ECM, the diagnostic compares the BARO sensor input to the boost pressure sensor input. If the ECM detects that the inputs are not within a specified amount of each other, this DTC will set.

Condition for Running the DTC

- DTCs P0101, P0102, P0103, P0107, P0108, P0116, P0117, P0118, P0122, P0123, P0500, P0501, P0638, P0652, P0653, P0698, P0699, P2100, P2101, P2103, P2228 and P2229 are not set.

AND following conditions are met for longer than 3 seconds.

- The ignition switch is ON.
- The engine coolant temperature is more than 5°C (41°F).
- The engine speed is less than 800 RPM.
- The fuel injection quantity is less than a predetermined value.
- The accelerator pedal is not depressed.
- The vehicle is not running.
- The engine run time is longer than 5 seconds.

Condition for Setting the DTC

- The ECM detects that the differential pressure between the barometric pressure and the boost pressure is more than 10 kPa (1.5 psi) for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2227

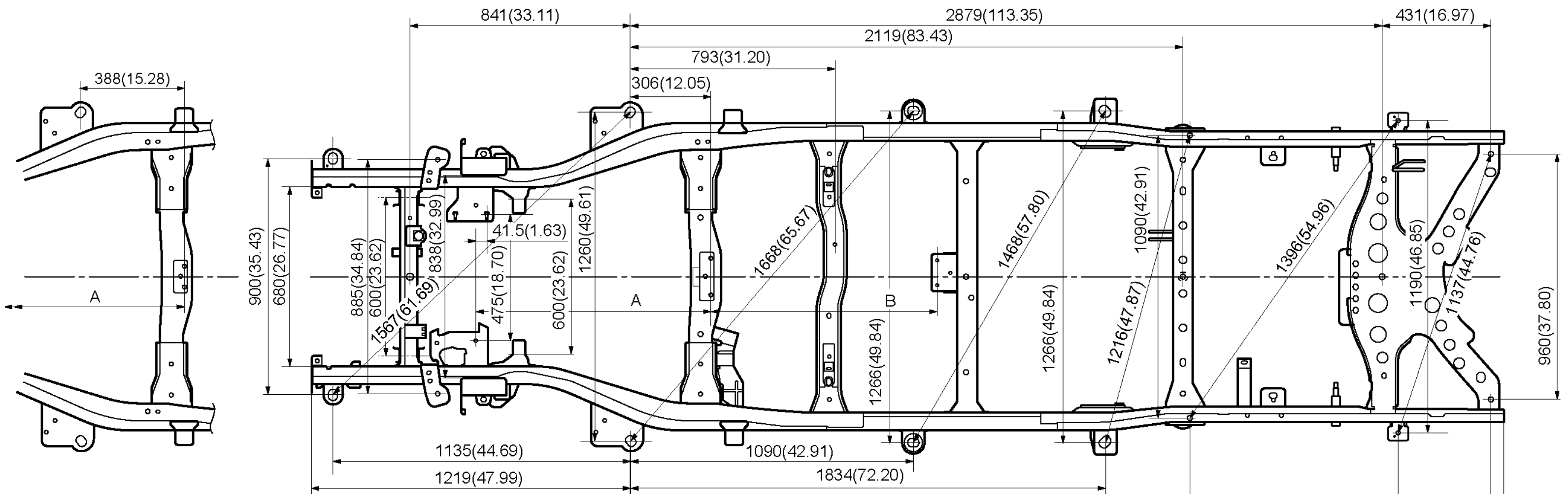
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0107, P0108, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Compare the Boost Pressure parameter to the Barometric Pressure (BARO) parameter with a scan tool. Are both parameter within the range specified of each other?	10 kPa (1.5 psi)	Go to Diagnostic Aids	Go to Step 4
4	Determine the outside barometric pressure from your location specified in the altitude vs barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter on the scan tool close to the outside barometric pressure?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. 1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the boost pressure sensor (pins 1, 2 and 3 of E-107). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 20, 21, 22 and 23 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 6
6	1. Test each sensor circuit between the ECM (pins 20, 21 and 23 of E-90) and the boost pressure sensor (pins 1, 2 and 3 of E-107) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
7	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the BARO sensor (pins 1, 2 and 3 of E-40). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 17, 18 and 19 of E-90). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
8	1. Test each sensor circuit between the ECM (pins 17, 18 and 19 of E-90) and the BARO sensor (pins 1, 2 and 3 of E-40) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacemenet in this section. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 11	—

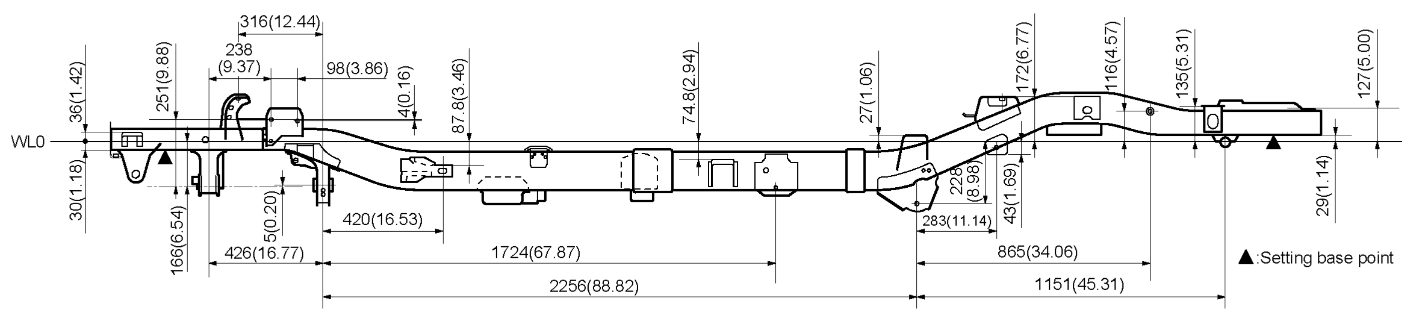
Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

4×2, HIGH RIDE, LWB, CREW CAB MODEL

This illustration is based on the RHD model.



	A	B
Standard Output M/T	895(35.24)	889(35.00)
A/T	977(38.46)	889(35.00)
High Output M/T	874(34.41)	910(35.83)
A/T	960(37.80)	824(32.44)



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DTC P2228 or P2229 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located on the intake manifold. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. The sensor has the following circuits.

- 5 volts reference circuit.
- Low reference circuit.
- BARO sensor signal circuit.

The BARO sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes of the barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively low or high signal voltage, DTC P2228 or P2229 will set.

Condition for Running the DTC

- DTCs P0652 and P0653 are not set.
- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 0.1 volts for 3 seconds. (DTC P2228)
- The ECM detects that the BARO sensor signal voltage is less than 4.3 volts for 3 seconds. (DTC P2229)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM uses a BARO substitution of default value.
- The ECM limits fuel injection quantity.
- The ECM inhibits EGR control.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2228

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0652 also set?	—	Go to DTC P0652	Go to Step 3
3	Observe the Barometric Pressure (BARO) Sensor parameter with a scan tool. Is the BARO Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit (pin 3 of E-40) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.7 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit (pins 2 and 3 of E-40). Is the BARO Sensor parameter more than the specified value?	4.7 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the ECM (pin 19 of E-90) and the BARO sensor (pin 3 of E-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 18 of E-90) and the BARO sensor (pin 2 of E-40) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Inspect for an intermittent and for poor connections at the harness connector of the BARO sensor (pins 2 and 3 of E-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 18 and 19 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13

Step	Action	Value(s)	Yes	No
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2229

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Barometric Pressure (BARO) Sensor parameter with a scan tool. Is the BARO Sensor parameter more than the specified value?	4.3 volts	Go to Step 3	Go to Diagnostic Aids
3	Monitor the DTC Information with a scan tool. Is DTC P0653 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the BARO Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0653	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. Is the BARO Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	Connect a test lamp between the low reference circuit (pin 1 of E-40) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The BARO sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 18 of E-90) and the BARO sensor (pin 2 of E-40) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 17 of E-90) and the BARO sensor (pin 1 of E-40) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of E-40). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 17 of E-90). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the BARO sensor. Refer to BARO Sensor Replacement. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P2621 or P2622 (Flash Code 94)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The analogue APP signals are converted by the ECM into a pulse width modulation (PWM) signal. This converted signal is sent from the ECM to the TCM to determine appropriate shift points depending on the accelerator pedal pressing amount. If the ECM detects an improper voltage level on the APP PWM signal circuit, DTC P2621 or P2622 will set.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the APP PWM signal circuit for longer than 3 seconds. (DTC P2621)
- The ECM detects a high voltage condition on the APP PWM signal circuit for longer than 3 seconds. (DTC P2622)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC P2621

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Back probe a DMM between the accelerator pedal position (APP) signal circuit of the TCM harness connector (pin 16 of C-94) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	10.0 volts	Go to Step 6	Go to Step 4
4	Is the DMM voltage more than the specified value at Step 3?	2.0 volts	Go to Step 7	Go to Step 5
5	Repair the short to ground between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94). Did you complete the repair?	—	Go to Step 11	—
6	1. Test the signal circuit between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 16 of C-94). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 56 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 11	—
10	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 12
12	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Circuit/ System Testing DTC P2622

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Connect a test lamp between the accelerator pedal position (APP) signal circuit of the TCM harness connector (pin 16 of C-94) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 5
4	1. Test the signal circuit between the ECM (pin 56 of C-58) and the TCM (pin 16 of C-94) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0001 or U0101 (Flash Code 84 or 85)

Circuit Description

The ECM, the transmission control module (TCM), the immobilizer control unit (ICU), the data recording module (DRM), instrument panel (IP) cluster and scan tool communicate control and diagnostic information via a controller area network (CAN) communication bus. The ECM monitors CAN operational status by expecting a constant flow of messages from the TCM, ICU, DRM and IP cluster. If the ECM fails to send or receive an expected message from the TCM, ICU, DRM and IP cluster, DTC U0001 or U0101 will set depending on what communication is lost.

Condition for Running the DTC

- The battery voltage is more than 9 volts.
- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the CAN Bus OFF status. (DTC U0001)
- The ECM detects that the CAN Bus messages from the TCM are not being received. (DTC U0101)

Action Taken When the DTC Sets

- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A.
- The ECM inhibits cruise control.

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- If the TCM has DTCs set, clear the DTCs in the TCM first.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing DTC U0001 or U0101

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	Refer to Scan Tool Does Not Communicate with The CAN Device in this section. Did you complete the action?	—	Go to Step 3	—
3	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 4
4	Observe the DTC information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0167 (Flash Code 177)

Circuit Description

The ECM communicates with the immobilizer control unit (ICU) to execute immobilizer function. The ECM sends request signal to the ICU. The ECM receives response signal from the ICU. Both communication signals are carried out via a controller area network (CAN) communication bus. If the ECM does not detect a response signal from the ICU, this DTC will set.

Condition for Setting the DTC

- The ECM does not receive an immobilizer response signal from the ICU.

Action Taken When the DTC Sets

- The ECM illuminates the SVS lamp when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type C. (Euro 4 Specification)
- The ECM illuminates the MIL when the diagnostic runs and fails. Refer to DTC Type Definitions for Action Taken When the DTC Sets - Type A. (Except Euro 4 Specification)

Condition for Clearing the DTC

- Refer to DTC Type Definitions for Condition for Clearing the SVS Lamp/ DTC - Type C. (Euro 4 Specification)
- Refer to DTC Type Definitions for Condition for Clearing the MIL/ DTC - Type A. (Except Euro 4 Specification)

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference may affect intermittent condition.
- Any communication fault with the ICU may set this DTC.

Circuit/ System Testing DTC U0167

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC U0001 also set?	—	Go to DTC U0001	Go to Step 3
3	Attempt to communicate with the immobilizer control unit (ICU) via the Immobilizer Data table. Does the scan tool communicate with the ICU?	—	Go to Step 4	Go to Diagnostic System Check - Immobilizer Controls
4	Monitor the immobilizer DTC Information with a scan tool. Does the immobilizer DTCs fail this ignition which begin with B or U?	—	Go to Applicable DTC in Immobilizer Section	Go to Step 5
5	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 6	—
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

EGR Control System Check

Description

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing NOx emissions. The EGR control system uses an electronic control system to ensure both driveability and low emission. A control current from the ECM operates a solenoid to control the lift amount of EGR valve. Also, an EGR position sensor is provided at the rear of the solenoid to feed actual valve lift amount back to the ECM for more precision control.

The EGR control starts when the conditions for engine speed, engine coolant temperature, intake air temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the solenoid is determined and the valve is driven accordingly. The intake throttle valve is provided to adequate intake manifold depression to ensure EGR gas flow.

EGR Control Operation

- The engine coolant temperature (ECT) is between 5°C (41°F) and 100°C (212°F).
- The intake air temperature (IAT) is more than 5°C (41°F).
- The barometric pressure (BARO) is more than 90kPa (13psi).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing EGR Control System Check

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Are any DTCs set in which the “Action Taken When the DTC Sets” under that particular code states, “The ECM inhibits EGR control”?	—	Refer to Applicable DTC	Go to Step 3

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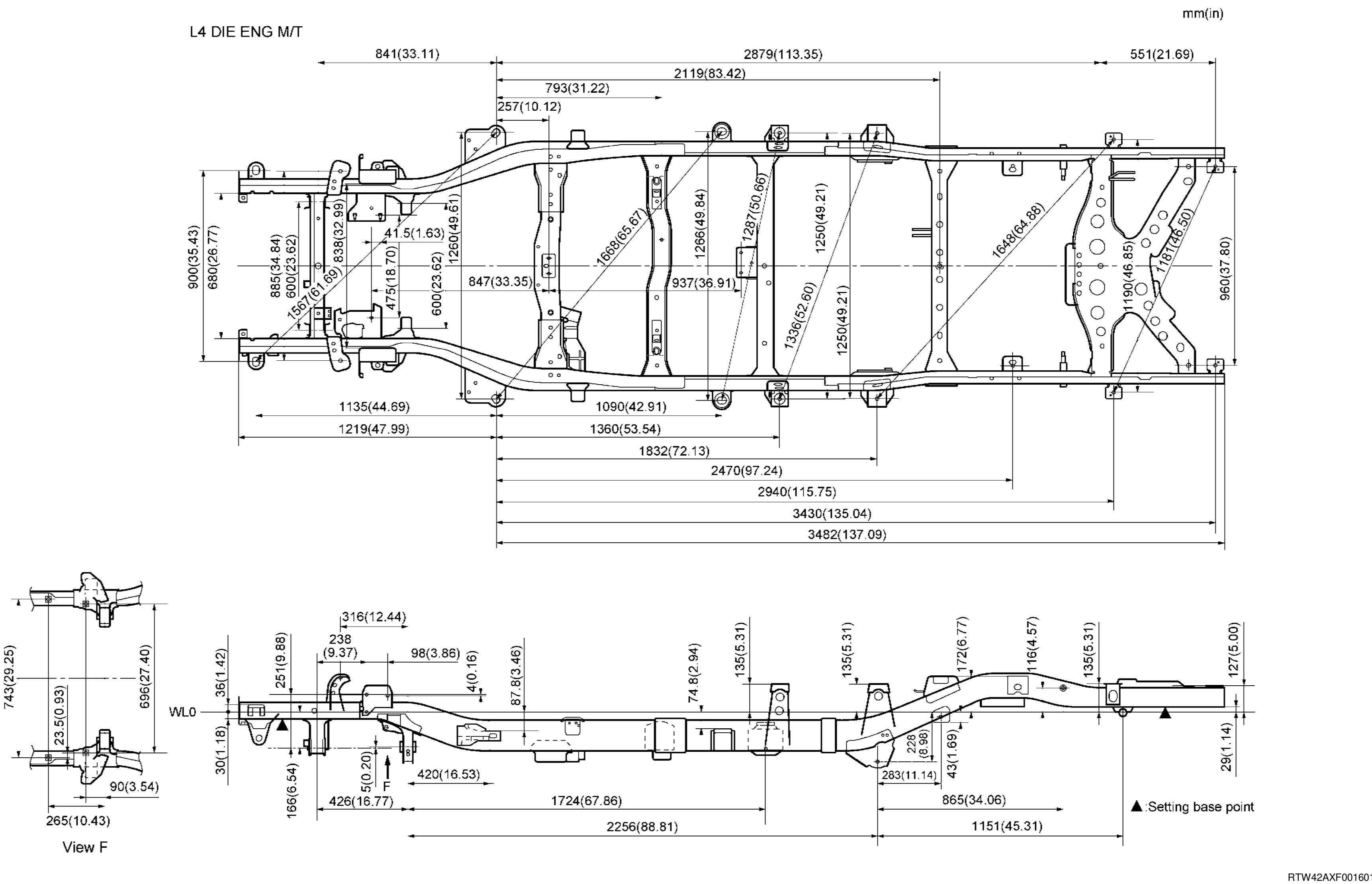
4×4, LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
3	1. Inspect the following conditions: • An EGR valve gasket that is missing or damaged • A sticking EGR valve • EGR gas leakage any of the EGR passage between the exhaust manifold and intake manifold • Restricted or collapsed EGR passage between the exhaust manifold and the EGR valve • Any type of restriction in the exhaust system • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake manifold • Any air induction leak • Any water intrusion in the induction system • Any contamination or objects that block the MAF sensor inlet • Skewed or slow MAF sensor • Skewed engine coolant temperature (ECT) sensor. Refer to Temperature vs Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. • Skewed barometric pressure (BARO) sensor. Determine the outside barometric pressure from you location specified in the altitude vs barometric pressure table. Refer to Altitude vs Barometric Pressure. • A sticking intake throttle valve 2. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 4
4	1. Place the transmission in Neutral and set the parking brake. 2. Start the engine and warm up (arrow engine coolant temperature to reach at least 60°C [140°F]). 3. Accelerate the engine between idle and W.O.T (accelerator pedal full travel) many times while observing the Desired EGR Position and EGR Position parameter with a scan tool. Does the EGR Position parameter follow within the specified value?	±5%	Go to Step 5	Go to Step 8
5	1. Perform the EGR Solenoid Control with a scan tool several times. 2. Command the Desired EGR Position Increase and Decrease while observing the EGR Position. Does the EGR Position parameter follow within the specified value quick enough?	±5%	Go to Step 6	Go to Step 8

Step	Action	Value(s)	Yes	No
6	**Notice:** If the intake throttle solenoid is commanded OFF, Intake Throttle Position parameter indicates over 100%. Observe the Desired Intake Throttle Position and Intake Throttle Position parameter with a scan tool. Does the Intake Throttle Position parameter follow within the specified value?	±5%	Go to Step 7	Go to Step 10
7	1. Perform the Intake Throttle Solenoid Control with a scan tool several times. 2. Command the Desired Intake Throttle Position Increase and Decrease while observing the Intake Throttle Position. Does the Intake Throttle Position parameter follow within the specified value quick enough?	±5%	System OK	Go to Step 10
8	1. Remove the EGR valve assembly from the engine. 2. Inspect the EGR valve for the following conditions: • Restricted EGR valve by foreign materials • Excessive deposits at valve • Bent valve shaft 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 6 of E-71). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 30, 31, 32, 62 and 63 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
10	1. Remove the intake duct that is connected to the intake throttle valve. 2. Inspect the intake throttle valve for the following conditions: • Restricted intake throttle valve by foreign materials • Excessive deposits at throttle bore • Bent butterfly valve **Notice:** Replace the intake throttle valve is there is any sticking 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the intake throttle valve (pins 1, 2, 3, 5 and 6 of E-38). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM (pins 35, 36, 55, 56 and 57 of E-90). 6. Test for high resistance on each circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the EGR valve. Refer to EGR valve Replacement. Did you complete the replacement?	—	Go to Step 14	—
13	Replace the intake throttle valve. Refer to Intake Throttle Valve Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	Reconnect all previously disconnected components or harness connector(s). Did you complete the action?	—	Go to Step 2	—

Glow Control System Check

Description

The glow control system consists of the ECM, the glow relay, the glow indicator lamp and glow plugs. The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. The ECM commands the glow relay ON for a certain length of time at ignition switch is ON with engine OFF. In after glow phase, the glow plugs remain energized for a certain period with engine run.

Glow Control Operation

- The glow indicator lamp illuminates between 0.5 seconds to 7 seconds depending upon the engine coolant temperature.
- The pre glow control system operates when the engine coolant temperature is less than 30°C (86°F).
- The after glow control system operates when the engine coolant temperature is less than 60°C (140°F).

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Glow Control System Check (1 of 2)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0117, P0118 or P0380 set?	—	Refer to Applicable DTC	Go to Step 3
3	**Notice:** If no glow indicator lamp is equipped, skip to Step 3. 1. Verify whether the instrument panel (IP) cluster is operational. 2. Perform the Glow Plug Lamp Control with a scan tool. 3. Command the lamp ON and OFF. Does the glow indicator lamp turn ON and OFF with each command?	—	Go to Step 4	Go to 2 of 2 Step 1
4	1. Turn OFF the ignition. 2. Make sure the metal bus bar that connects switched battery voltage supply terminal (E-49) and all glow plugs is secured tightly. 3. Turn ON the ignition, with the engine OFF 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 terminal) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Remove the metal bus bar from the glow plugs. 3. Measure resistance of each glow plug between the glow plug terminals and a known good ground. Make sure to record all measurements and take them quickly as to not allow engine temperature changes between measurements. Are the resistances within the specified value each other?	1Ω	System OK	Go to Step 16
6	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 connector) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	Go to Step 14	Go to Step 7
7	Inspect the Glow (60A) slow blow fuse in the engine room fuse block. Is the Glow (60A) slow blow fuse open?	—	Go to Step 8	Go to Step 9
8	Replace the Glow (60A) slow blow fuse. If the slow blow fuse continues to open, repair the short to ground on a circuit fed by the slow blow fuse or check for a shorted attached component. Did you complete the repair?	—	Go to Step 17	—
9	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Probe the battery voltage feed circuit of the relay (pin 4 of X-5) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 11
10	1. Probe the voltage supply circuit of glow plugs (pin 1 of X-5) with a test lamp that is connected to a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 12
11	Repair the open circuit or high resistance between the Glow (60A) slow blow fuse and the glow relay (pin 4 of X-5). Did you complete the repair?	—	Go to Step 17	—
12	Repair the open circuit or high resistance between the glow relay (pin 1 of X-5) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
13	**Important**: The glow plugs may be burnt out if the battery voltage supply circuit is shorted to a voltage source. Repair the short to battery or ignition voltage between the glow relay (pin 1 of X-5) and the glow plugs (E-49 terminal). Did you complete the repair?	—	Go to Step 17	—
14	1. Remove the glow relay. 2. Inspect for an intermittent and for poor connection on each glow relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
15	Replace the glow relay. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the appropriate glow plug. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected components, relay, fuse or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-49 connector) and a known good ground. 5. Perform the Glow Relay Control with a scan tool. 6. Command the relay ON while observing the test lamp. Does the test lamp turn ON only when commanded ON?	—	Go to Step 5	Go to Step 2

Circuit/ System Testing Glow Control System Check (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in cabin fuse block. Is the Meter (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 14	—
3	1. Turn OFF the ignition. 2. Disconnect the ECM J-2 (C-58) harness connector. 3. Turn ON the ignition, with the engine OFF. Is the glow indicator lamp OFF?	—	Go to Step 4	Go to Step 10

Step	Action	Value(s)	Yes	No
4	1. Remove the Meter (10A) fuse that supplies voltage to the glow indicator lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the glow indicator lamp control circuit in the ECM harness connector (pin 51 of C-58) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 5	Go to Step 11
5	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the ECM harness connector (pin 51 of C-58) and a known good ground. Is the glow indicator lamp illuminated?	—	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Remove the IP cluster. 3. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 8 of B-24) and a known good ground. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 12
7	1. Test the control circuit between the ECM (pin 51 of C-58) and the IP cluster (pin 35 of B-23) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 35 of B-23 and pin 8 of B-24). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 51 of C-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	Repair the short to ground between the ECM (pin 51 of C-58) and the IP cluster (pin 35 or of B-23). Did you complete the repair?	—	Go to Step 15	—
11	Repair the short to battery or ignition voltage between the ECM (pin 51 of C-58) and the IP cluster (pin 35 of B-23). Did you complete the repair?	—	Go to Step 15	—
12	Repair the open circuit or high resistance on ignition the voltage feed circuit the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
13	Repair or replace the IP cluster. Did you complete the repair or replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Perform the Glow Plug Lamp Control with a scan tool. 3. Command the lamp ON and OFF. Does the glow indicator lamp turn ON and OFF with each command?	—	Go to 1 of 2 Step 4	Go to Step 1

In-Tank Fuel Pump System Check

Description

The ECM controls the fuel pump relay, which supplies power to the fuel pump in the fuel tank. The ECM commands the fuel pump relay ON for a certain length of time at ignition switch is ON with the engine OFF. During the engine is running it is continuity commanded ON.

In-tank Fuel Pump Control Operation

- The battery voltage is more than 9 volts.
- The ignition switch is ON.
- The fuel pump is commanded ON for 12 seconds at ignition switch is ON with the engine OFF.
- The fuel pump is continuously ON while engine is running.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing In-Tank Fuel Pump System Check

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition for 20 seconds, then start the engine. 4. Monitor the DTC Information with a scan tool. Is DTC P0231 or P0232 set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Remove the fuel filler cap. 3. Turn ON the ignition, with the engine OFF. Is the fuel pump operating sound heard from the fuel filler?	—	Go to Step 4	Go to Step 7
4	Does the fuel pump operating sound stop after approximately 12 seconds passed?	—	Go to Step 21	Go to Step 5
5	1. Turn OFF the ignition for 30 seconds. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Does the fuel pump operating sound stop after approximately 12 seconds passed?	—	Go to Step 20	Go to Step 6
6	Repair the short to battery or ignition voltage between the fuel pump relay (pin 2 of X-13) and the fuel pump (pin 1 of F-2). Did you complete the repair?	—	Go to Step 25	—
7	1. Turn OFF the ignition for 30 seconds. 2. Replace the fuel pump relay with the head light relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. Is the fuel pump operating sound heard from the fuel filler?	—	Go to Step 17	Go to Step 8
8	Inspect the Fuel Pump (10A) fuse in the engine room fuse block. Is the Fuel Pump (10A) fuse open?	—	Go to Step 9	Go to Step 10

Step	Action	Value(s)	Yes	No
9	Replace the Fuel Pump (10A) fuse. If the fuse continues to open, repair the short to ground on a circuit fed by the fuse or check for a shorted attached component. Did you complete the repair?	—	Go to Step 25	—
10	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Probe the battery voltage feed circuit of the relay (pin 1 of X-13) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 11
11	Repair the open circuit or high resistance between the Fuel Pump (10A) fuse and the fuel pump relay (pin 1 of X-13). Did you complete the repair?	—	Go to Step 25	—
12	1. Reconnect the fuel pump relay. 2. Disconnect the fuel pump resistor harness connector. 3. Measure the resistance across the fuel pump resistor. Is the resistance within the specified value?	2.2 to 2.7 Ω	Go to Step 13	Go to Step 23
13	1. Connect a test lamp between the fuel pump side voltage feed circuit on the resistor harness (pin 1 of C-157) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate for approximately 12 seconds then go out?	—	Go to Step 14	Go to Step 15
14	Connect a test lamp between the ground circuit on the resistor harness (pin 2 of C-157) and battery voltage. Does the test lamp illuminate?	—	Go to Step 18	Go to Step 16
15	1. Test the fuel pump circuit between the fuel pump (pins 1 and 4 of F-2) and the fuel pump relay (pin 2 of X-13) or the fuel pump resistor (pin 1 of C-157) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 19
16	Repair the open circuit or high resistance between the fuel pump resistor (pin 2 of C-57) and the body ground terminal (C-109). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 25	—
17	1. Remove the fuel pump relay. 2. Inspect for an intermittent and for poor connection on each relay terminal. 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 20

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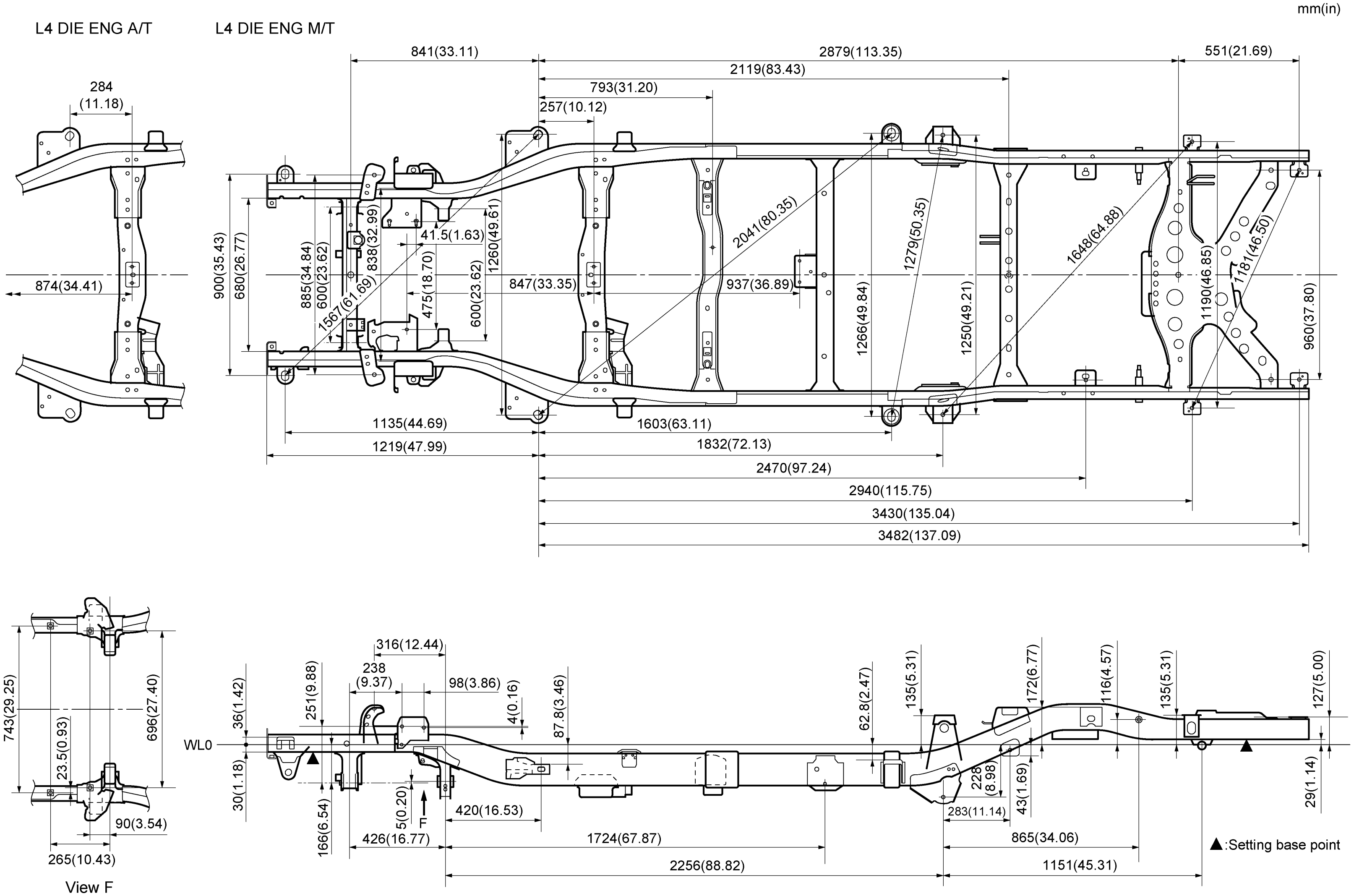
4×4, LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.



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Step	Action	Value(s)	Yes	No
18	1. Inspect for an intermittent, poor connections and corrosion at the harness connector of the fuel pump resistor (pins 1 and 2 of C-57). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	—
19	1. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the fuel pump (pins 1 and 4 of F-2). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
20	Replace the fuel pump relay. Did you complete the replacement?	—	Go to Step 25	—
21	1. Make sure the fuel amount in the fuel tank. Refill adequate fuel as necessary. 2. Check the fuel system connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, kinks, cracks and for the use of proper clamps. Repair or replace as necessary. 3. Turn OFF the ignition. 4. Disconnect the fuel hose that connects to the fuel filter inlet side. In order to measure the discharged fuel amount, put the hose into a bottle or a container with a scale. (The inlet of a bottle or a container must be larger than the diameter of hose.) 5. Turn ON the ignition for 20 seconds, with the engine OFF. 6. Turn OFF the ignition for 10 seconds. 7. Perform 5 and 6 three times. The accumulated fuel of three ignition cycles must be more than 300cc. (Normal amount is more than 100cc per one ignition cycle.) Is enough amount of fuel discharged?	—	System OK	Go to Step 22
22	1. Remove the fuel pump from the fuel tank. Refer to Fuel Gauge Unit in the Fuel System section. 2. Inspect the fuel pump for any type of restriction or damage on the fuel pipes. 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
23	Replace the fuel pump resistor. Did you complete the replacement?	—	Go to Step 25	—
24	Replace the fuel pump. Refer to Fuel Gauge Unit in the Fuel System section. Did you complete the replacement?	—	Go to Step 25	—
25	Reconnect all previously disconnected components, fuse, relay or harness connector(s). Did you complete the action?	—	Go to Step 3	—

Cruise Control System Check

Description

The cruise control system consists of the ECM, the cruise main switch, set/ coast switch, resume/ accel. switch and cancel switch. The cruise control keeps the vehicle speed at a driver's set speed. When the cruise main switch is turned ON, signal is provided to the ECM and the cruise main indicator lamp on the switch will light up. When the cruise set/ coast switch is turned ON, the switch signal is provided to the ECM and the vehicle speed is set. The vehicle speed is increased or decreased if the set/ coast switch or the resume/ accel. switch is turned ON. When the cruise cancel switch is applied, the switch signal is provided to the ECM and the cruise control system is inactive.

Condition for Running the Cruise Control

- The vehicle speed is between approximately 40 km/h (24 MPH) to 175 km/h (105 MPH).
- The engine speed is less than 4500 PRM.
- The cruise main switch is ON.

1. Function of "SET"
If the set/ coast switch is pressed and released while condition for running the cruise control are satisfied, the ECM memorize and maintain the vehicle speed at that time.
2. Function of "COAST"
If the set/ coast switch is pressed while the cruise control system is operating, the vehicle speed is decreased. Then, when the set/ coast switch is released, the vehicle will maintain the vehicle speed at that time.
3. Function of "RESUME"
If the resume/ accel. switch is applied while the cruise control system is operating and the ECM memorizes the vehicle speed, the vehicle speed is returned to the vehicle speed memorized by the ECM.
4. Function of "ACCEL"
If the resume/ accel. switch is applied while the cruise control system is operating, the vehicle speed is increased. Then, when the resume/ accel. switch is released, the vehicle will maintain the vehicle speed at that time.
5. Function of "TAP UP"
If the resume/ accel. switch is tapped (momentarily applied) while the cruise control system is operating, the vehicle speed is increased 1 km/h (0.6 MPH) at a time.
6. Function of "TAP DOWN"
If the set/ coast switch is tapped while the cruise control system is operating, the vehicle speed is decreased 1 km/h (0.6 MPH).
7. Function of Temporary Acceleration
If the accelerator pedal is pressed while the cruise control system is operating, the vehicle speed is increased.
8. Function of Temporary Cancellation
The cruise control is canceled temporarily if any of the following condition is met:
   - The cruise cancel switch is applied.
   - The brake pedal is depressed.
   - The clutch pedal is depressed (M/T).
   - The selector lever position is not D, 3, 2 or L (A/T).
   - The cruise set/ coast switch and resume/ accel. switch are ON at the same time.
   - The actual vehicle speed becomes less than approximately 35 km/h (22 MPH).
   - The actual vehicle speed is more than 40 km/h (24 MPH) over the set speed, or more than 10 km/h (6 MPH) over the set speed for longer than 3 minutes.
   - The actual vehicle speed is more than 70 km/h (42 MPH) below the set speed, or more than 10 km/h (6 MPH) below the set speed for 3 minutes.

   By applying the resume/ accel. switch, the vehicle speed is returned to the vehicle speed memorized by the ECM (resume function) if within the condition for running the cruise control are satisfied.
9. Function of Complete Cancellation
The cruise control is canceled completely if any of the following condition is met:
   - The cruise main switch is OFF.
   - The ignition switch is OFF.
   - The vehicle is once stopped.
   - The DTCs relating to the cruise control system inhibits are set.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Cruise Control System Check (1 of 2)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Drive the vehicle at 50 km/h (30 MPH) on a flat level road. 2. Press and release the cruise main switch. 3. Press and release the cruise set/ coast switch. 4. Verify the 50 km/h (30 MPH) vehicle speed is maintained. 5. Tap the cruise set/ coast. Did the vehicle maintain the set speed of 50 km/h (30 MPH), and then decrease by 1 km/h (0.6 MPH) each time the switch was tapped?	—	Go to Step 3	Go to Step 7
3	Tap (momentarily apply) the cruise resume/ accel. switch 10 times. Does the vehicle speed increase by 1 km/h (0.6 MPH) each time the switch was tapped (momentarily applied)?	—	Go to Step 4	Go to Step 10
4	Are the cruise main and cruise set lamps illuminated while in cruise control?	—	Go to Step 5	Go to 2 of 2 Step 1
5	Apply the cruise cancel switch Does the cruise control cancel?	—	Go to Step 6	Go to Step 11
6	1. Reenter the cruise control. 2. Depress and release the brake pedal. Does the cruise control cancel?	—	System OK	Refer to DTC P0571 for brake switch diagnosis
7	1. Park the vehicle. 2. Install a scan tool. 3. Monitor the DTC Information with a scan tool. Are any DTCs set in which the “Action Taken When the DTC Sets” under that particular code states, “The ECM inhibits cruise control” ?	—	Refer to Applicable DTC	Go to Step 8
8	Observe the Cruise Main Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Go to Step 9	Go to Step 12
9	Observe the Cruise Set/ Coast Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is pushed and OFF when the switch is released?	—	Retest the cruise control. Refer to Condition for Running the Cruise Control	Go to Step 17
10	Observe the Cruise Resume/ Accel. Switch parameter with a scan tool. Does the scan tool indicate ON when the switch is applied and OFF when the switch is released?	—	Go to Intermittent Conditions	Go to Step 19
11	Observe the Cruise Cancel Switch parameter with a scan tool. Does the scan tool indicate OFF when the switch is applied and ON when the switch is released?	—	Go to Intermittent Conditions	Go to Step 23

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the cruise main switch harness connector. (Remove the switch from the IP bezel as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit of the cruise main switch harness (pin 4 of B-56) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 14
13	Observe the Cruise Main Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the cruise main switch harness connector between pins 3 and 4 of the B-67. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 16	Go to Step 15
14	Repair the open circuit or high resistance between the Engine (10A) fuse and the cruise main switch (pin 4 of B-67). Did you complete the repair?	—	Go to Step 28	—
15	1. Test the signal circuit between the ECM (pin 14 of C-58) and the cruise main switch (pin 3 of B-67) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 22
16	1. Inspect for an intermittent and for poor connections at the harness connector of the cruise main switch (pins 3 and 4 of B-67). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 25
17	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Set Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 11 and 12 of B-59. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 21	Go to Step 18
18	1. Test the signal circuit between the ECM (pin 30 of C-58) and the combination switch (pin 12 of B-59) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 22

Step	Action	Value(s)	Yes	No
19	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). (Remove the IP cluster lower cover as necessary) 3. Turn ON the ignition, with the engine OFF. 4. Observe the Cruise Resume Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the combination switch harness connector (male side) between pins 9 and 11 of B-59. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 21	Go to Step 20
20	1. Test the signal circuit between the ECM (pin 29 of C-58) and the combination switch (pin 9 of B-59) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 22
21	1. Inspect for an intermittent and for poor connections at the harness connector of the combination switch (pins 9 or 12 of B-59). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 26
22	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the ECM (pins 14, 29 or 30 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
23	1. Turn OFF the ignition. 2. Disconnect the combination switch harness connector (B-59). 3. Turn ON the ignition, with the engine OFF. Does the Cruise Cancel Switch indicate OFF?	—	Go to Step 26	Go to Step 24
24	1. Test the signal circuit between the ECM (pin 13 of C-58) and the combination switch (pin 10 of B-59) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 28	Go to Step 27
25	Repair or replace the cruise main switch. Did you complete the repair or replacement?	—	Go to Step 28	—
26	Repair or replace the combination switch. Did you complete the repair or replacement?	—	Go to Step 28	—
27	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 28	—

Step	Action	Value(s)	Yes	No
28	Reconnect all previously disconnected components, fuse or harness connector(s). Did you complete the action?	—	Go to Step 2	—

Circuit/ System Testing Cruise Control System Check (2 of 2)

Step	Action	Value(s)	Yes	No
1	1. Verify whether the instrument panel (IP) cluster is operational. 2. Install a scan tool. 3. Perform the Lamp Control with a scan tool. 4. Command the lamp ON and OFF with a scan tool. 5. Perform the Cruise Set Lamp Control with a scan tool. 6. Command the lamp ON and OFF with a scan tool. Are both lamps ON and OFF when commanded with a scan tool?	—	Go to Intermittent Conditions	Go to Step 2
2	Is the cruise main lamp inoperative?	—	Go to Step 3	Go to Step 7
3	1. Remove the Meter (10A) fuse that supplies voltage to the IP cluster (Euro 4 specification) or the Engine (10A) fuse that supplies voltage to the cruise main switch (Except Euro 4 specification). 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the cruise main lamp control circuit in the ECM harness connector (pin 50 of C-58) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 4	Go to Step 6
4	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) or Engine (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the cruise main lamp control circuit of the ECM harness connector (pin 50 of C-58) and a known good ground. Is the cruise main lamp illuminated?	—	Go to Step 12	Go to Step 5
5	1. Test the control circuit between the ECM (pin 50 of C-58) and the IP cluster (pin 2 of B-23) or the cruise main switch (pin 6 of B-67) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
6	Repair the short to battery or ignition voltage on the control circuit between the ECM (pin 50 of C-58) and the IP cluster (pin 2 of B-23) or the cruise main switch (pin 6 of B-67). Did you complete the repair?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
7	1. Remove the Meter (10A) fuse that supplies voltage to the IP cluster. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the cruise set lamp control circuit in the ECM harness connector (pin 49 of C-58) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 8	Go to Step 10
8	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the cruise set lamp control circuit of the ECM harness connector (pin 49 of C-58) and a known good ground. Is the cruise main lamp illuminated?	—	Go to Step 12	Go to Step 9
9	1. Test the control circuit between the ECM (pin 49 of C-58) and the IP cluster (pin 23 of B-23) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
10	Repair the short to battery or ignition voltage on the control circuit between the ECM (pin 49 of C-58) and the IP cluster (pin 23 of B-23). Did you complete the action?	—	Go to Step 15	—
11	1. Inspect for an intermittent and for a poor connection at the harness connector of the IP cluster (pins 23 of B-23). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the cruise main or set lamp control circuit at the harness connector of the ECM (pin 49 or 50 of C-58). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Repair or replace the IP cluster. Did you complete the repair or replacement?	—	Go to Step 15	—
14	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	Reconnect all previously disconnected components, fuse or harness connector(s). Is the action complete?	—	Go to 1 of 2 Step 2	—

Turbocharger Control System Check

Description

The position of the turbocharger nozzle is controlled by the ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor to control the turbocharger nozzles. When the engine is not under load, the turbocharger nozzles are in an open position, or no boost condition. When the engine is under load, the ECM commands the control solenoid valve to close the turbocharger nozzles, thus increasing the boost. The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve.

Notice:

- This Circuit/ System Testing is only applicable to high output engine.

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or ECM Connector End Views

Circuit/ System Testing Turbocharger Control System Check

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Engine Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC P0045, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0234, P0299, P0638, P0698, P0699, P1196, P1197, P1198, P2227, P2228 or P2229 also set?	—	Go to Applicable DTC	Go to Step 3

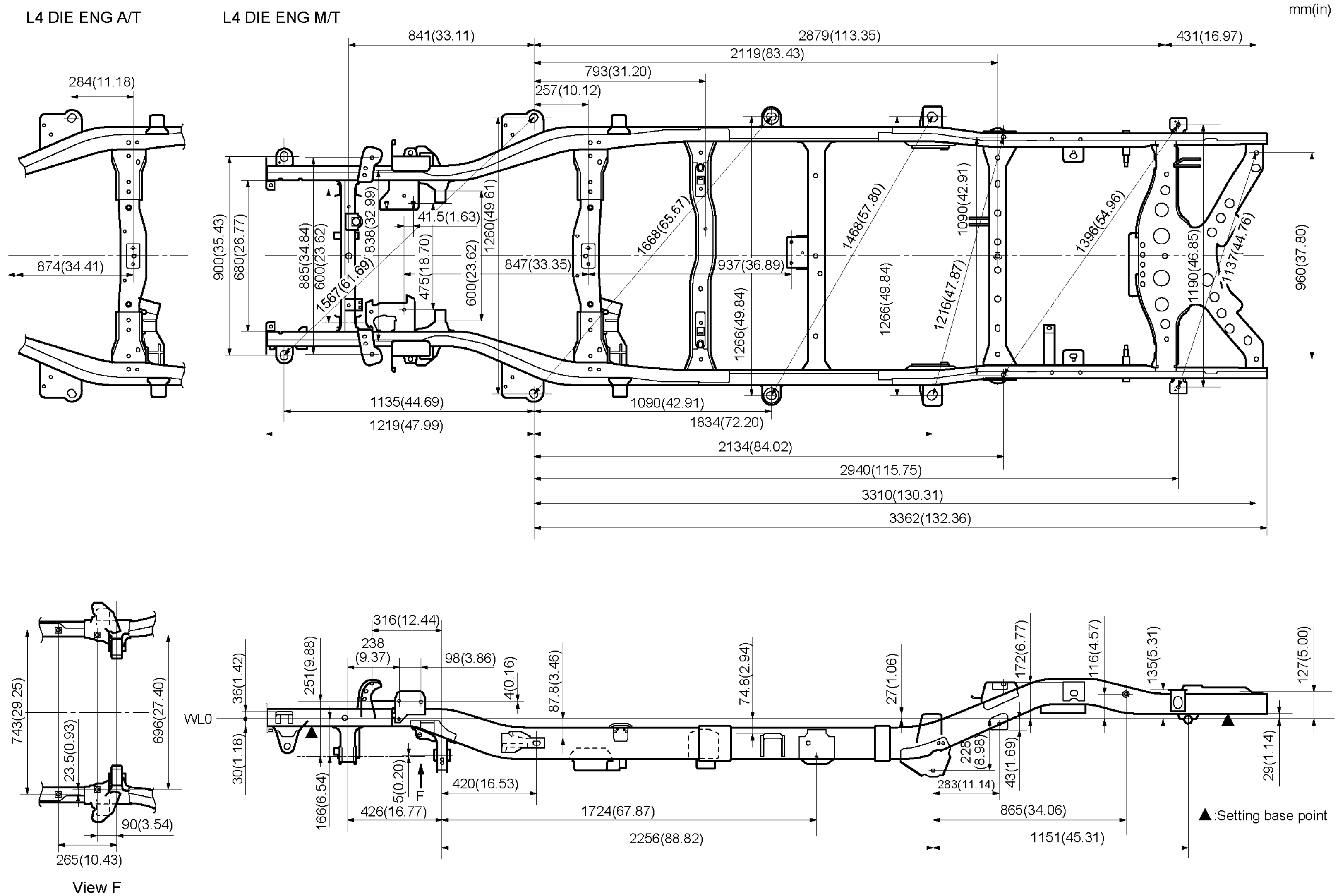
Step	Action	Value(s)	Yes	No
3	1. Inspect the following conditions: • Air leakage around the boost pressure sensor objects that block the sensor hole. • Air leaking around any of the air induction tubing between the turbocharger and intake manifold. Check for damaged components and for loose clamps. • Misrouted, disconnected or kinked turbocharger nozzle control actuator vacuum hoses. Refer to Vacuum Hose Routing Diagram in this section for correct routing. • Turbine shaft binding causing lower turbocharger spinning speeds. Refer to the Turbocharger in engine mechanical section for diagnosis. • Turbocharger nozzle control actuator for a stuck condition or slow movement. Refer to Turbocharger in engine mechanical section for testing. • Intake throttle valve sticking. Perform the Intake Throttle Solenoid Control with a scan tool. • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the boost pressure sensor. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Place the transmission in Neutral and set the parking brake. 2. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Desired Boost Pressure and Boost Pressure parameter with a scan tool. 3. Drive the vehicle that the engine speed is more than 2000 RPM and the Calculated Engine Load parameter reaches at least 50% for longer than 10 seconds (such as acceleration on ramp) while comparing the Boost Pressure to the Desired Boost Pressure. Does the Boost Pressure parameter follow within the specified value?	±20 kPa (±3 psi)	System OK	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the vacuum hose from the turbocharger nozzle control actuator diaphragm. 3. Connect a hand-held vacuum pump (5-8840-0279-0/ J-23738-A) to the disconnected vacuum hose. 4. Start the engine and let idle. 5. Perform the Turbocharger Solenoid Control with a scan tool. 6. Command the solenoid valve Increase and Decrease while observing the vacuum pump. Does the hand-held vacuum pump reading more than 50 cmHg (20 inHg) when commanded maximum Increase and ZERO range when commanded minimum Decrease?	—	Go to Step 8	Go to Step 6
6	1. Inspect the following conditions: • Misrouted, disconnected, kinked or plugged turbocharger nozzle actuator control vacuum hose. • Misrouted, disconnected, kinked or plugged solenoid valve ventilation hose. • Misrouted, disconnected, kinked or plugged vacuum source hose or pipe. 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	Replace the turbocharger nozzle control solenoid valve. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool if set. 3. Turn OFF the ignition for 30 seconds. Did you complete the action?	—	Go to Step 2	—

BACK TO CHAPTER INDEX

4×4, LWB, CREW CAB MODEL

This illustration is based on the RHD model



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TO MODEL INDEX

Symptoms - Engine Controls

Symptoms - Engine Controls

Important Preliminary Inspections Before Starting

Perform Diagnostic System Check - Engine Controls before using the symptom tables, and verify that all of the following are true:

- The ECM and malfunction indicator lamp (MIL)/ service vehicle soon (SVS) lamp are operating correctly.
- The scan tool data is within the normal operating range. Refer to Scan Tool Data List in this section.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

- The ECM grounds are clean, tight, and in their proper location.
- The vacuum hoses are not split or kinked, and properly connected. Inspect thoroughly for any type of leak or restriction.
- The air intake ducts are not collapsed or damaged.
- The exhaust pipes are not collapsed or damaged.
- The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

Important: Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the controller area network (CAN) or other serial data circuit.

Important: The problem may or may not turn ON the MIL/ SVS lamp or store a DTC. Faulty electrical connections or wiring cause most intermittent problems. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
- Terminals that are not seated
- Terminals that are damaged or improperly formed

Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension. Remove the terminal from the connector body in order to inspect for poor terminal wire connection.
Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored.
Use the scan tool in order to help detect intermittent conditions. Useful features of the Tech 2 scan tool include the following:

- Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
- Freeze Frame/ Failure Record can also aid in locating an intermittent condition. Review and capture the information in the Freeze Frame/ Failure Record associated with the intermittent DTC being diagnosed. Drive the vehicle within the conditions that were present when the DTC originally set.
- Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the scan tool Users Guide for more information.

Use the data recording module (DRM) in order to help detect intermittent conditions. The DRM has ability to store engine log data when an event of DTC. Maximum three log data can be stored in the DRM memory. If more than maximum number of storage is set, oldest log data is overwritten. However, if same DTC is set within eight hours that DTC is not stored in the DRM memory.
The manual trigger function is to store the log data by an arbitrary operation of the driver when an event of wrong vehicle performance that is instead of an event of DTC. If the driver presses and releases the manual trigger switch once, that time becomes a trigger and one log data before and behind the trigger is stored in the DRM memory. When there is a space in the DRM memory, log data is stored in that space. However, when more than maximum number of storage is set, oldest log data is overwritten.
Refer to the DRM Users Guide for more information.

Important: If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc..
Any of the following may cause an intermittent MIL/ SVS lamp with no stored DTC:

- The ECM grounds are loose or dirty. Refer to Engine Controls Schematics.

- The MIL/ SVS lamp circuit intermittently shorted to ground
- Electrical system interference caused by a malfunctioning relay, ECM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- There are any open diodes.

Important: The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to Engine Controls Schematics for an application.
Use the following tables when diagnosing a symptom complaint:

- Intermittent Conditions
- Hard Start
- Rough, Unstable, or Incorrect Idle and Stalling
- High Idle Speed
- Cuts Out
- Surges
- Lack of Power, Sluggishness or Sponginess
- Hesitation, Sag or Stumble
- Abnormal Combustion Noise
- Poor Fuel Economy
- Excessive Smoke (Black Smoke)
- Excessive Smoke (White Smoke)

Intermittent Conditions

Checks	Action
Definition: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• Refer to Symptoms - Engine Controls before starting.
Harness/ Connector	Many intermittent open or shorted circuits are affected by harness/ connector movement that is caused by vibration, engine torque, bumps/ rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/ system operation, or engine operation, inspect and repair the harness/ connections as necessary.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Poor mating of the connector halves, or terminals improperly seated in the connector body. • Improperly formed or damaged terminals. Test for poor terminal tension. • Poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Corrosion/ water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Wires that are broken inside the insulation. • Harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/ component connectors, fuses, and any intermediate connections between the power source and the module/ component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component.

Checks	Action
Temperature Sensitivity	• An intermittent condition may occur when a component/ connection reaches normal operating temperature. The condition may occur only when the component/ connection is cold, or only when the component/ connection is hot. • Freeze Frame, Failure Records or Snapshot Data may help with this type of intermittent conditions, where applicable. • If the intermittent is related to heat, review the data for a relationship with the following: - High ambient temperatures. - Underhood/ engine generated heat. - Circuit generated heat due to a poor connection, or high electrical load. - Higher than normal load conditions, towing, etc.. • If the intermittent is related to cold, review the data for the following: - Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. - The condition only occurs on a cold start. - The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise	Some electrical components/ circuits are sensitive to EMI or other types of electrical noise. Inspect the following conditions: • A misrouted harness that is too close to high voltage/ high current devices such as injection components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation. • Electrical system interference caused by a malfunctioning relay, or the ECM driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related failure while in use, but do not fail when the accessories are not in use. • Test for any open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Incorrect ECM Programming	• There are only a few situations where reprogramming a ECM is appropriate: - An ECM from another vehicle is installed. - Revised software/ calibration files have been released for this vehicle. **Important:** DO NOT reprogram the ECM with the SAME software/ calibration files that are already present in the ECM. This is not an effective repair for any type of driveability problem. • Verify that the ECM contains the correct software/ calibration. If incorrect programming is found, reprogram the ECM with the most current software/ calibration.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/ or capture the failure conditions. • Freeze Frame/ Failure Records data, where applicable, contains the conditions that were present when the DTC set. - Review and record Freeze Frame/ Failure Records data. - Operate the vehicle under the same conditions that were noted in Freeze Frame/ Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text of the DTC being diagnosed. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.

Checks	Action
Scan Tool Snapshot	The scan tool can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the scan tool Users Guide for more information.
DRM Memory	Use data stored in the DRM memory or use manual trigger function. The DRM has ability to store engine log data when an event of DTC. The manual trigger function is to store the log data by an arbitrary operation of the driver when an event of wrong vehicle performance that is instead of an event of DTC. If the driver presses and releases the manual trigger switch once, that time becomes a trigger and one log data before and behind the trigger is stored in the DRM memory. Refer to the DRM Users Guide for more information.

Hard Start

Checks	Action
Definition: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver is using the correct starting procedure. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the timing chain sprocket is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent valve and hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the FRP Regulator Feedback current on the scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. • Glow plug control system operation. Refer to Glow Control System Check in this section. • Slow cranking speed. • Weakened batteries.

Rough, Unstable, or Incorrect Idle and Stalling

Checks	Action
Definition: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure parameter at idle in Neutral. The Fuel Rail Pressure should always be within 27 to 33 MPa (3,900 to 4,800 psi) after warm up. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged. • Camshaft position (CMP) sensor is tight and the timing chain sprocket is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent valve and hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool. • Observe the FRP Regulator Feedback current on the scan tool.

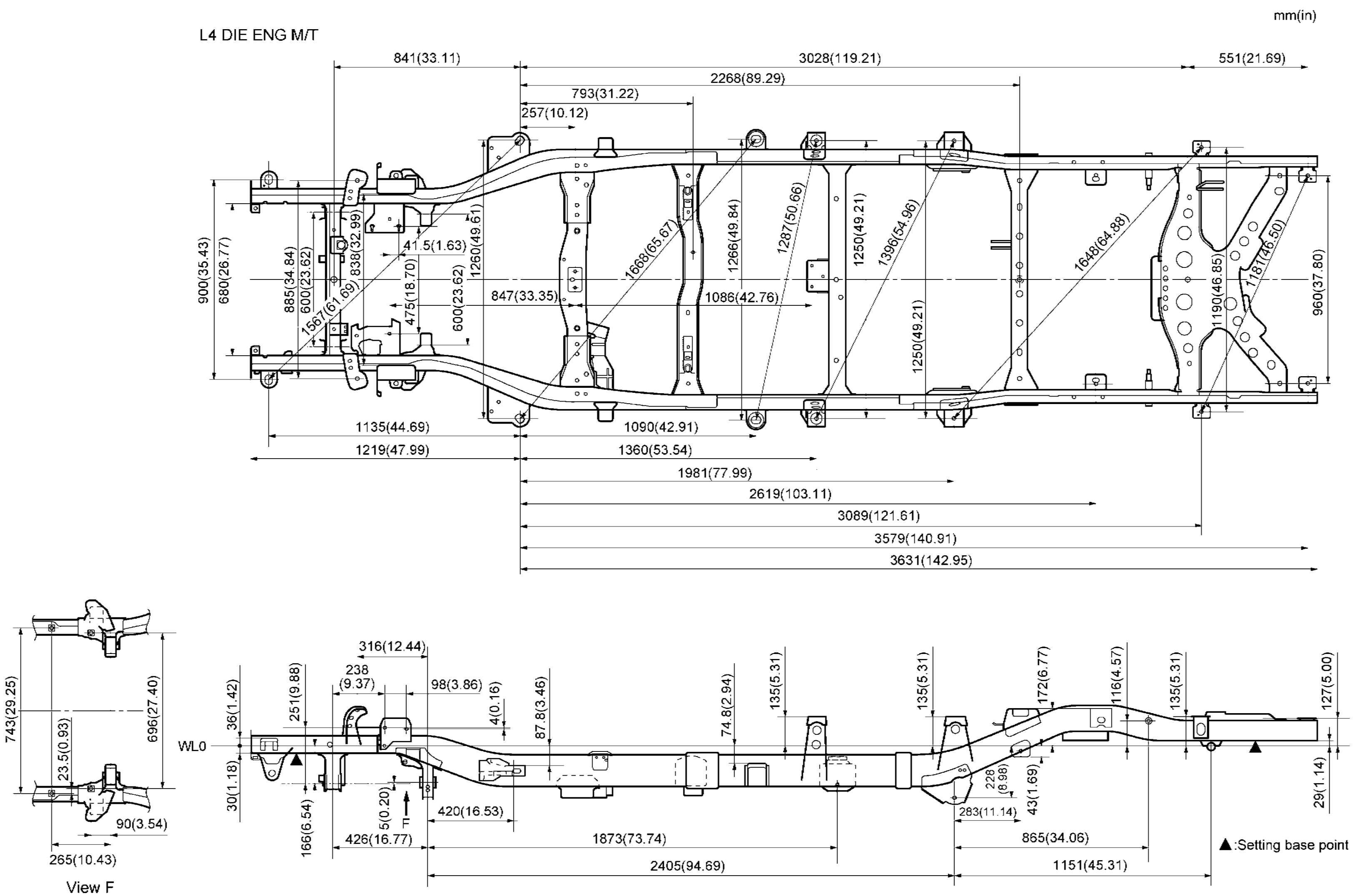
Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc..
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid valve wiring, near the sensor circuits. • Faulty engine mounts. • Faulty crank pulley. • Faulty generator & A/C compressor. • Generator output voltage. • EGR system operating correctly. Refer to EGR Control System Check in this section. • A/C operation.

High Idle Speed

Checks	Action
Definition: Engine idle speed is higher than normal in regardless of engine coolant temperature.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Use the scan tool to compare the engine speed and tachometer on the instrument panel (IP) cluster. • Inspect the battery voltage. If the battery voltage is less than 11 volts, the ECM set the idle speed 50RPM higher than normal. • Inspect the A/C operation. • Inspect the fuel type and quality. • Inspect the engine oil level. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure parameter at idle in Neutral. The Fuel Rail Pressure should always be within 27 to 33 MPa (3,900 to 4,800 psi) after warm up. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Fuel injectors. Remove the injectors and visually inspect. (Injector tip(s) may be damaged)

4×4, EXTRA LWB, REGULAR CAB MODEL

This illustration is based on the RHD model.



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Cuts Out

Checks	Action
Definition: A constant jerking that follows the engine speed, usually more pronounced as the engine load increase. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Check	• Diagnostic System Check - Engine Controls. • Inspect that the harness connectors are correctly connected. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Observe the Mass Air Flow (MAF) parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The scan tool can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid valve wiring, near the sensor circuits.

Surges

Checks	Action
Difinition: The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the driver understands the A/C compressor operation. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Observe the Mass Air Flow (MAF) parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent valve and hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only) • Inspect deformed tire(s) that may cause surges at fixed vehicle speed range.

Lack of Power, Sluggishness or Sponginess

Checks	Action
Definition: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Have the tire sizes changed? • Are excessively heavy loads being carried? • Inspect for clutch slip. • Inspect brake drag. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Use the scan tool in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output)

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent valve and hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Observe the Park/ Neutral Switch parameter with a scan tool. • Inspect for an engine overheat condition. Refer to Engine Cooling section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only).

Hesitation, Sag or Stumble

Checks	Action
Definition: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. If severe enough, the condition may cause the engine to stall.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output) • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Air in the fuel system. • Water contamination in the fuel. • Fuel waxing or icing. • Fuel filter indicator lamp is continuously or frequently turned ON with engine run. • External fuel leaks or high engine oil level. • In-tank fuel pump operation. Refer to In-tank Fuel Pump System Check in this section. • Fuel leak off from the fuel pressure limiter valve and fuel injectors. • Fuel lines between the fuel tank and fuel supply pump for being crushed, kinked, tightness, cracks and plugged. • A plugged fuel tank vent valve and hose. • Inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect for an engine overheat condition. Refer to Engine Cooling section. • Inspect the A/C operation. • Inspect the torque converter clutch (TCC) operation. (A/T only)

Abnormal Combustion Noise

Checks	Action
Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Diagnostic System Check - Engine Controls. • Ensure the vehicle has an actual problem. • Inspect for smoke associated with the combustion noise. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	• If excessive smoke is present, check for a stuck open fuel injector. Inspect for fuel leakage into the combustion chamber. • Inspect the fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Injector Force Drive with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Incorrect basic engine parts such as camshaft, cylinder head, pistons, etc.. • Inspect for any excessive oil entering combustion chamber.
Additional Checks	• Inspect other possible causes that can make similar noise such as loose component parts, bracket, mount and weak clutch damper spring.

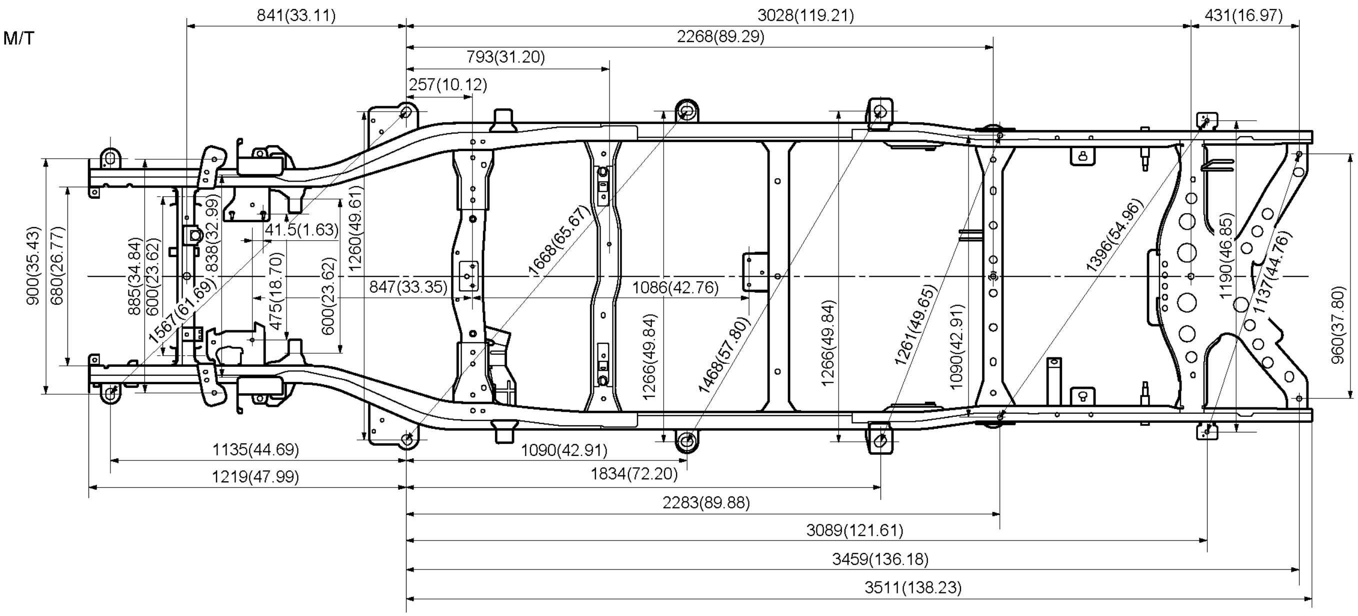
Poor Fuel Economy

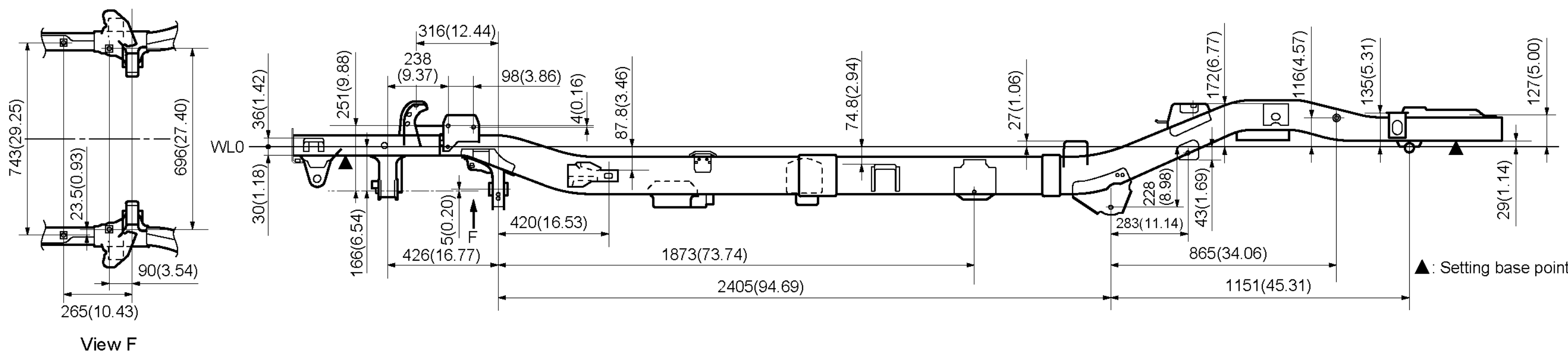
Checks	Action
Definition: Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.	
Preliminary Checks	• Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the driving habits of the owner. • Is the A/C ON full time, defroster mode ON? • Are the tires at the correct pressure? • Are the tire sizes changed? • Are excessively heavy loads being carried? • Is the acceleration too much, too often? • Inspect for clutch slip. • Inspect brake drag. • Inspect dive belt tension. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Suggest to the owner to fill the fuel tank and recheck the fuel economy. • Inspect the odometer is correctly operated. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Fuel type and quality. • Check fuel leak.
Cooling System Checks	Inspect the cooling system for the following conditions. Refer to the Cooling System Section. • Engine coolant level. • Engine thermostat for always being open or for the wrong heat range. • Engine cooling fan for always being ON.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section. (Standard output) • Turbocharger nozzle control actuator operation. Refer to Turbocharger Control System Check in this section. (High output)
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes.

4×4, EXTRA LWB, EXTEND CAB MODEL

This illustration is based on the RHD model.





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Excessive Smoke (Black Smoke)

Checks	Action
Definition: Black smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the MAF parameter for a skewed or slow MAF sensor. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ±5 MPa (±725 psi) quick enough. • Observe the Barometric Pressure (BARO) parameter. The BARO parameter should indicate near surrounding barometric pressure. Refer to Altitude vs. Barometric Pressure. (Standard output) • Observe the Boost Pressure and BARO with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. (High output)
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pilot Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Any excessive oil entering combustion chamber.
Additional Checks	• EGR system operating correctly. Refer to EGR Control System Check in this section. • Excessive blow-by gasses.

Excessive Smoke (White Smoke)

Checks	Action
Difinition: White smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the ECM grounds for being clean, tight, and in their proper locations. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Scan Tool Data List in this section. • Inspect the Service Bulletin.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Scan Tool Data List in this section. • Compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) parameters on a cold engine condition. If the difference among temperature reading is more than 5 °C (9 °F) on a cold engine, check for high resistance in each circuit or for a skewed sensor. **Notice:** The mass air flow (MAF) sensor is heated and as a result the IAT may indicate a higher than normal intake air temperature if the ignition switch is being ON. • Observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor should read 0.9 to 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 1 minute. If not, check for high resistance in each circuit or for a skewed sensor. • Observe the Fuel Rail Pressure and Desired Fuel Rail Pressure parameter between idle and W.O.T. (accelerator pedal full travel) in Neutral. Fuel Rail Pressure parameter should follow within ± 5 MPa (± 725 psi) quick enough. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 100% according to the accelerator pedal operation. • Observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Both parameters should be within the 7.0 kPa (1.0 psi) each other. • Crankshaft position (CKP) sensor is tight and the sensor rotor is not damaged.
Fuel System Checks	• If excessive smoke is present, check for a stuck open fuel injector. Inspect for fuel leakage into the combustion chamber. • Fuel injectors. Remove the injectors and visually inspect. • Perform the Cylinder Balance Test with a scan tool. • Perform the Pilot Injection Control with a scan tool. • Observe the Fuel Compensation for each cylinder at idle on the scan tool.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Air cleaner, air intake ducts and charge air cooler for a restriction, holes, or leaks. • A restriction in the turbocharger inlet duct. • Intake throttle valve for a stuck condition. • A restriction or leak in the intake manifold. • A restriction or damaged at MAF sensor. • Perform the Swirl Control Solenoid Test with a scan tool. Inspect the diaphragm valve operation when it commanded ON/ OFF. • A worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Oil leak from turbocharger. Refer to turbocharger inspection in the Engine Mechanical section.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Poor cylinder compression. • Improper mechanical timing (timing gear and timing chain). • Improper valve gap. • Broken or weak valve springs. • Worn camshaft lobes. • Thermostat working (open stuck). • Any excessive oil entering combustion chamber.
Electrical System Checks	• Glow plug control (preheating) system operation. Refer to Glow Control System Check in this section.

Repair Instructions

Engine Control Module (ECM) Replacement

Description

The following A - G steps provide an overview procedure to replace and reprogram an ECM. Each A - G steps is explained further in this section.

A. Record the fuel injector ID codes manually from the old ECM.
B. Reset the immobilizer security information in the old ECM. (If so equipped)
C. Replace the old ECM with the new ECM.
D. Program the immoblizer security information into the new ECM. (If so equipped)
E. Program the latest software and calibrations into the new ECM using the Service Programming System (SPS).
F. Program the recorded fuel injector ID codes and the vehicle identification number (VIN) into the ECM using a scan tool programming function.
G. Perform the fuel supply pump relearn procedure by allowing the engine to idle in Park or Neutral until normal operating temperature is achieved.

A. Recoding Fuel Injector ID Code

Each fuel injector is designated with 24 hexadecimal characters (0 - 9 or A - F) that MUST be programmed into the ECM for correct engine fueling for each specific cylinder. These characters can be retrieved in one of following places:

Retrieving the Fuel Injector ID Code Data from the ECM

The current fuel injector ID code data can be retrieved with a scan tool. If the old ECM cannot be communicated with a scan tool, go to the next procedure.

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4JK1 or 4JJ1 > Programming > Injector ID Code.
4. Record 24 digits of each fuel injector ID code.
5. After complete the recording, turn OFF the scan tool.
6. Turn OFF the ignition.

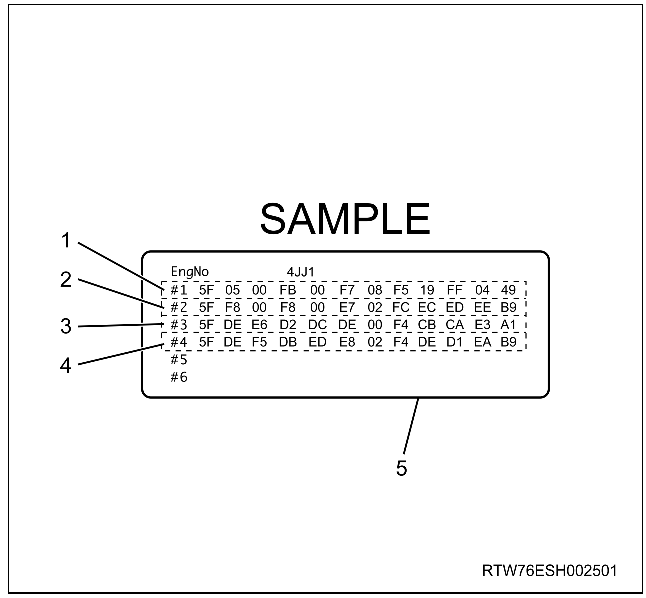
Retrieving the Fuel Injector ID Code Data with a Non-communicating ECM

If a scan tool does not communicate, the fuel injector ID codes must be recorded from the factory affixed label on the cylinder head cover or each fuel injector harness connector housing.

Recording from the label on cylinder head cover

Notice: Only perform this procedure if the fuel injectors are not being replaced in the past.

1. Record all numbers of each cylinder on the label.



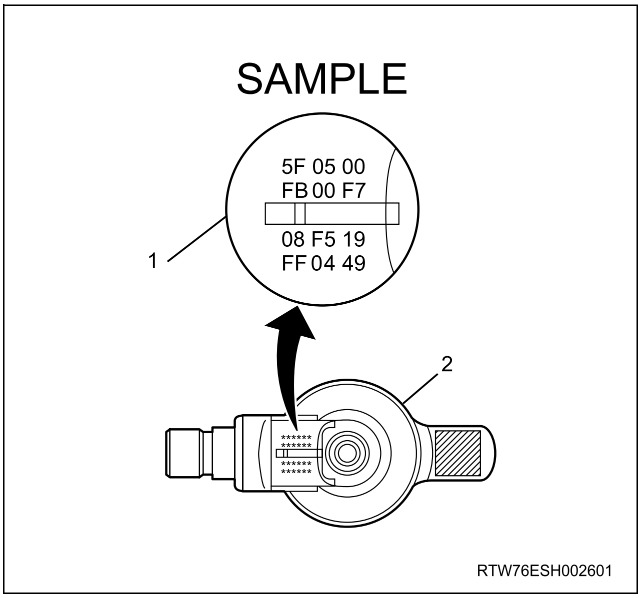
Legend

1. Cylinder #1 fuel injector ID code
2. Cylinder #2 fuel injector ID code
3. Cylinder #3 fuel injector ID code
4. Cylinder #4 fuel injector ID code
5. Injector ID code label

Recording from each fuel injector

1. Disconnect each fuel injector harness connector.

2. Record all numbers of each cylinder on the harness connector housing. The correct order for the fuel injector ID codes of the following illustration is as follows:
5F 05 00 FB 00 F7 08 F5 19 FF 04 49



Legend
1. Fuel injector ID code
2. Fuel injector

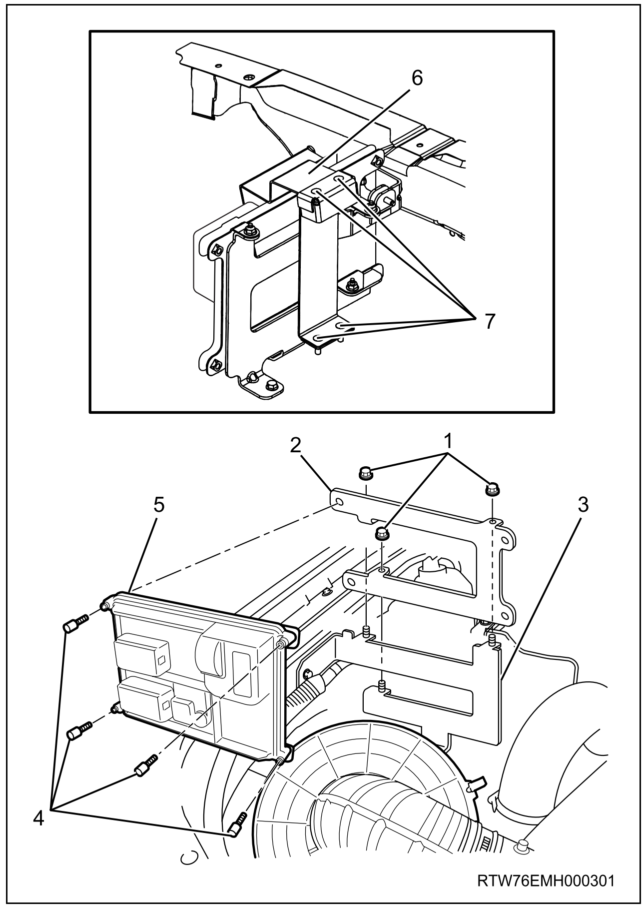
B. Resetting Immobilizer Security Information (If so equipped)

Reset immobilizer security information in the old ECM. Refer to Resetting and Programming Guidelines in immobilizer section. If the old ECM cannot be communicated with a scan tool, go to the next produce.

C. Removal and Installation

Removal Procedure

1. Disconnect the negative battery cable.
2. Loosen bolts (7) and remove the ECM cover (6). (If so equipped)
3. Disconnect the ECM harness connectors.
4. Loosen nuts (1) and remove the ECM with bracket (2) from the base bracket (3).
5. Loosen bolts (4) and remove the ECM (5).



Installation Procedure

1. Install the ECM (5) to the bracket (2) and tighten bolts (4).
2. Install the ECM with bracket (2) to the base bracket (3) and tighten nuts (1).
3. Connect the ECM harness connectors.
4. Install the ECM cover (6) and tighten bolts (7).
5. Connect the negative battery cable.

D. Programming Immobilizer Security Information (If so equipped)

Programming immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in immobilizer section.

E. Programming Software and Calibrations

Program latest software/ calibrations if released. Refer to Service Programming System (SPS) Description and SPS (Remote Procedure) or SPS (Pass-Thru Procedure) in this section.

F. Programming Fuel Injector ID Codes and VIN

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4JK1 or 4JJ1 > Programming > Program ECU.

4. In order to get programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight the “Tech 2” on the Diagnostic Tool Selection screen and click “Next”.
   f. Click “Close” on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Install a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > appropriate vehicle identification > 4JK1 or 4JJ1 > Programming > Program ECU.
8. Verify the VIN on the screen if programmed at previously described SPS. If not programmed or incorrect VIN, input correct VIN.
9. Input 24 digits of each fuel injector ID code.
10. After complete the programming, turn OFF the ignition for 30 seconds.
11. Start the engine and let idle.
12. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check - Engine Controls if needed.

G. Supply Pump Relearn

1. Install a scan tool.
2. Start the engine and let idle until engine coolant temperature reads 65°C (149°F) or higher while observing the Supply Pump Status parameter with a scan tool. The scan tool parameter changes status Not Learn > Learning > Learned.
3. If the ECM has correctly learned the fuel supply pump current adjustment, the Supply Pump Status parameter on the scan tool will repeatedly indicate Learning and Learned.

Service Programming System (SPS) Description

The service programming system (SPS) allows a technician to program a control module through the data link connector (DLC). The information transfer circuit that is used at the DLC is the same serial data circuit used by the scan tool for retrieving DTCs, displaying data, clearing DTCs etc. This procedure offers the ability to install software/ calibrations matched to a particular vehicle.
Most control modules have two types of memory. The software/ calibrations reside in the flash memory. The two types of memory are listed below:

- Electrically Erasable Programmable Read Only Memory (EEPROM)
  This type of memory allows selected portions of memory to be programmed while other portions remain unchanged.
  Certain learned values reside in the EEPROM, such as:
  - The vehicle identification number (VIN)
  - The software/ calibrations identification numbers
  - The control module security information
- Flash Read Only Memory-Flash Memory
  Flash memory has increased memory storage capacity. During programming, all information within this type of memory is erased, and then replaced with entirely new information.

Service Programming Methods

The two methods of programming an ECM are listed below:

- Remote Programming
- Pass Thru Programming

For information on programming an ECM using one of the methods listed above, refer to Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure).

Before Programming a Control Module

Important: DO NOT program an existing ECM with the identical software/ calibration package. This procedure is not a short cut to correct the driveability condition. This is an ineffective repair. An ECM should only be programmed when the following occurs:

- When a service procedure instructs you to replace the ECM.
- An updated software/ calibrations is released.

Ensure that the following conditions are met before programming an ECM:

- The scan tool PCMCIA card is programmed with the latest software.
- The TIS 2000 is installed with the latest software.

- The hardware key is plugged into the computer port.
- Vehicle system voltage:
  - There are no charging system concerns. All charging system concerns must be repaired before programming the ECM.
  - The battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the ECM.
  - A battery charger is NOT connected to the vehicles battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or ECM damage.
  - Turn OFF or disable any system that may put a load on the vehicles battery. Turn OFF or disable systems such as:
    - ◊ Heating, ventilation, and air conditioning (HVAC) systems
    - ◊ Headlights
    - ◊ Room lights
    - ◊ Accessory equipment
- The ignition switch is in the proper position. The scan tool prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure unless instructed to do so.
- All tool connections are secure:
  - The RS-232 cable
  - The connection at the DLC
  - The voltage supply circuits
- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or ECM damage may occur.
- If you are performing the Pass-Thru programming procedure using a notebook computer without the power cord, ensure that the internal battery is fully charged.

Service Programming System (SPS) (Remote Procedure)

Notice: Some module will not accept SPS remote procedure using 10MB PCMCIA card. In such case, use 32MB PCMCIA card or SPS pass-thru procedure. The Remote SPS method is a three-step process that involves the following procedures:

1. Connecting the scan tool to the vehicle and obtaining the information from the ECM.
2. Connecting the scan tool to the terminal and downloading a new calibration file from the terminal into the scan tool memory.
3. Reconnecting the scan tool to the vehicle and uploading the new calibration file into the ECM.

Performing the Remote Procedure

1. Connect a scan tool to the vehicle and obtain the ECM information using the following procedure:

Notice: Ensure the ECM is installed in the vehicle and the battery is fully charged before programming.

   a. Install a scan tool.
   b. Turn ON the ignition, with the engine OFF.
   c. Select Service Programming System (SPS) > Request Info.
   d. If there is already stored in the scan tool, the existing data is displayed on the screen. The scan tool asks user to keep existing data "Keep Data" or "Continue" to request new vehicle information from the ECM. If there is no data in the scan tool, it will immediately start vehicle identification.
   e. Select the vehicle description by following the on-screen instructions based on stamped VIN or affixed VIN plate on the vehicle.
   f. During obtaining information, the scan tool is receiving information from all modules at the same time. But only ECM information is displayed on the screen.
   g. Turn OFF all accessories and press "Okay".
   h. Verify that the correct VIN is displayed on the scan tool. If the VIN is incorrect or no VIN, record the correct VIN.
2. Turn OFF the ignition.
3. Turn OFF the scan tool and disconnect from the vehicle.
4. Transfer the data from the terminal to the scan tool using the following procedure:

Notice: The TIS supports service programming with the Tech 2 scan tool only.

   a. Connect the scan tool to the terminal.
   b. Launch the TIS application.
   c. Select the Service Programming System at the main screen.
   d. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next".
      - Select Diagnostic Tool - Tech 2
      - Select Programming Process - Identify whether an existing ECM is being reprogrammed or an ECM is being replaced with a new one
      - Select ECU Location - Vehicle
   e. Verify the connections on the Preparing for Communication screen, then click "Next".
   f. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click "Next".

Notice: If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

g. Highlight Engine on the Select System Type screen, then click "Next", if on-screen instruction displayed.
h. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until "Next" is highlighted, then click "Next".
   - Model
   - Model year
   - Engine type
   - Model designator
   - Destination code
   - Transmission type
i. Verify your selection on the Summary screen.

Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.

Notice: Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the ECM and reprogramming with the same download is not allowed.

j. Click "Reprog".
k. The Transfer Data screen will appear until the progress bar reaches 100%.

5. Close the application and return to the TIS application selection screen after the download is completed.
6. Turn OFF the scan tool and disconnect from the terminal.
7. Transfer the data from the scan tool to the ECM using the following procedure:
   a. Install a scan tool.
   b. Turn ON the ignition, with the engine OFF.
   c. Select Service Programming System (SPS) > Program ECU.
   d. Turn OFF all accessories and press "Continue".
   e. Programming in Process will appear until the progress bar reaches 100%.

Notice: Some warning lamp may turn ON or blink while programming the ECM since communication between the ECM and other modules are interrupted. Clear DTC in any module after programming.

   f. Press "Continue" and exit the program after the scan tool displays "Programming Was Successful".
8. Turn OFF the ignition.
9. Turn OFF the scan tool and disconnect from the vehicle.

Service Programming System (SPS) (Pass-Thru Procedure)

Pass-Thru programming allows the scan tool to remain connected to the terminal and to the vehicle throughout the programming process. The vehicle must be in close proximity to the terminal while using Pass-Thru.

1. Launch the TIS application.
2. Select the Service Programming System at the main screen.
3. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next":
   - Select Diagnostic Tool-Select Pass - Thru
   - Select Programming Process - Identify whether as existing ECM is being reprogrammed or an ECM is being replaced with a new one.
   - Select ECU Location - Vehicle
4. Complete all vehicle data on the Preparing for Communication/ Determine Vehicle screen until "Next" is highlighted, then click "Next".
5. Follow the instruction on the Preparing for Communication screen, then click "Next".

Notice: In order to reduce the potential for signal loss, the RS-232 cable should not be more than 25 feet long.

6. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click "Next".

Notice: If the ECM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the ECM from another vehicle is installed, input correct VIN by same way.

7. Highlight Engine on the Select System Type screen, then click "Next", if on-screen instruction displayed.
8. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until "Next" is highlighted, then click "Next".
   - Model
   - Model year
   - Engine type
   - Model designator
   - Destination code
   - Transmission type
9. Verify your selection on the Summary screen.

Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.

Notice: Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the ECM and reprogramming with the same download is not allowed.

10. Click "Reprog".

11. The Transfer Data screen will appear until the progress bar reaches 100%.

Notice: Some warning lamp may turn ON or blink while programming the ECM since communication between the ECM and other modules are interrupted. Clear DTC in any module after programming.

12. Close the application and return to the TIS application selection screen after the download is completed.
13. Turn OFF the ignition.
14. Turn OFF the scan tool and disconnect from the vehicle.

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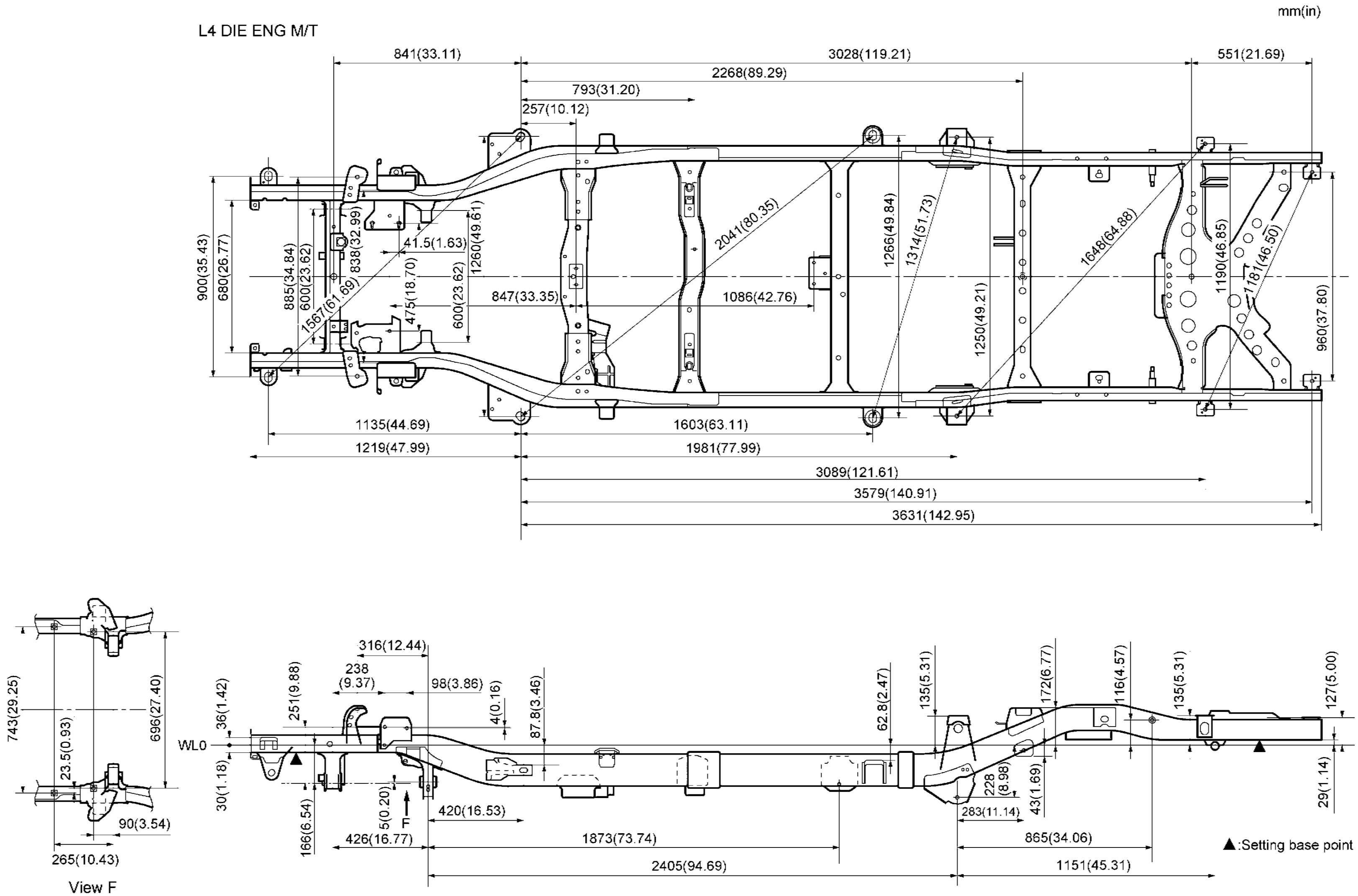
TO MODEL INDEX

4×4, EXTRA LWB, CREW CAB MODEL

This illustration is based on the RHD model.



RTW32AXF005001

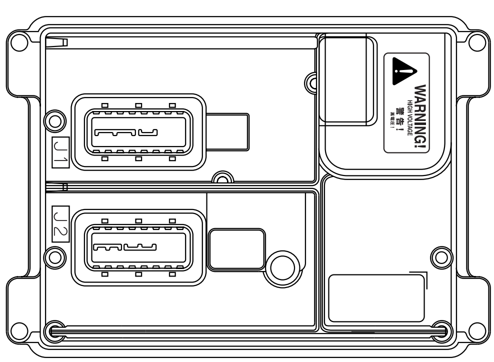
Description and Operation

Engine Control Module (ECM) Description

Engine Control Module (ECM) Service Precautions

RTW56ESH000201

Important: The symbol ! warns you of an electric shock hazard. To avoid shock and possible serious injury, DO NOT touch the terminals. When disconnecting the harness connectors, always turn OFF the ignition switch or disconnect the battery cable.



RTW56ESH004401

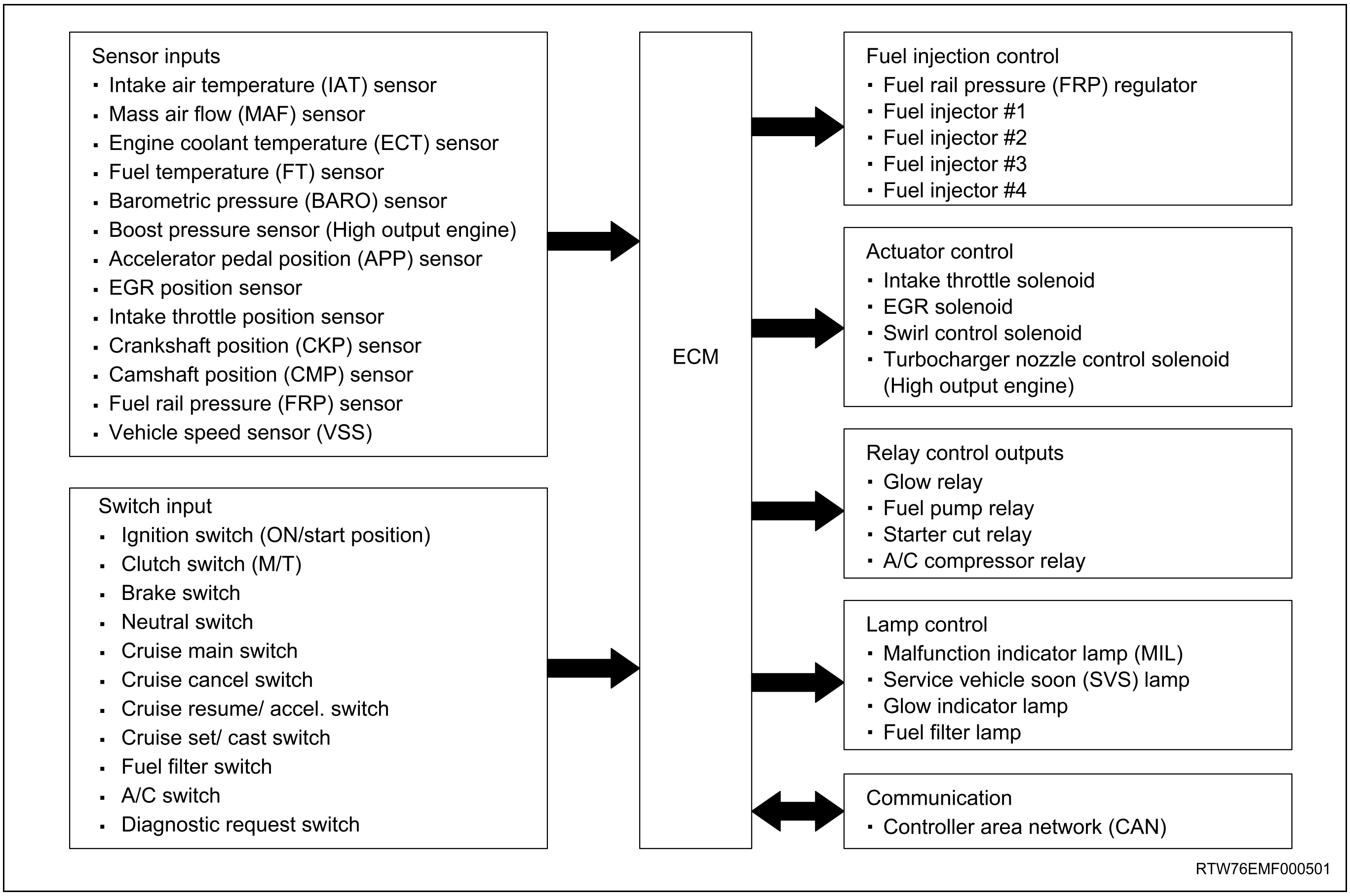
The engine control module (ECM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM circuits unless instructed to do so. In some cases, these circuits should only be tested using a DMM. The ECM should remain connected to the ECM harness.

The ECM is located inside of engine compartment via mounting bracket and is behind air cleaner case. The ECM mainly controls the following.

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The preheating (glow) system control
- The A/C compressor control
- The immobilizer control
- On-board diagnostics for engine control

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. The ECM can recognize operational problems, alert the driver through the malfunction indicator lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the system faults to aid the technician in making repairs.

ECM Input & Output



ECM Voltage Description

The ECM supplies a buffered voltage to various switches and sensors. The ECM can do this because resistance in the ECM is so high in value that a test lamp may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megaohm input impedance DMM, to ensure accurate voltage readings. The input and/ or output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned ON.

Aftermarket Electrical and Vacuum Equipment

Aftermarket or add-on electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after the vehicle leaves the factory. No allowances have been made in the vehicle design for this type of equipment. No add-on vacuum equipment should be added to this vehicle. Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery power and ground. Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and audios. Therefore, the first step in diagnosing any powertrain fault is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the fault still exists, the fault may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. By comparison, as much as 4,000 volts may be needed for a person to feel even the zap of a static discharge. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

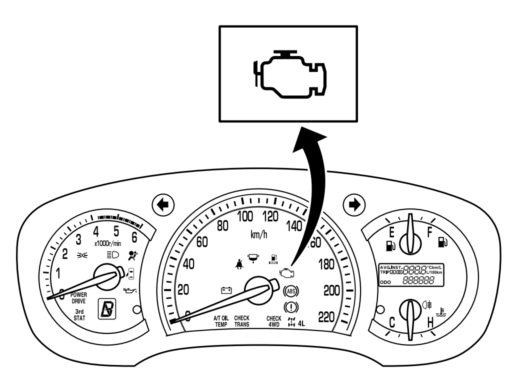
- An example of charging by friction is a person sliding across a vehicle seat.

Important: To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with opposite polarity.

Malfunction Indicator Lamp (MIL) Operation

The MIL is located in the instrument panel cluster. The MIL will display the following symbols when commanded ON:



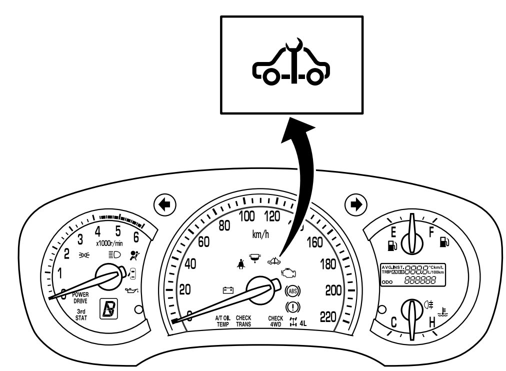
RTW76ESH001901

The MIL indicates that an emission related fault (Type A or B) has occurred (Euro 4 specification) or engine performance related fault has occurred (except Euro 4 specification) and vehicle service is required. The following is a list of the modes of operation for the MIL:

- The MIL illuminates when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- The MIL turns OFF after the engine is started if a diagnostic fault is not present.
- The MIL remains illuminated after the engine is started if the ECM detects a fault. A DTC is stored any time the ECM illuminates the MIL due to an emission related fault (Euro 4 specification), and engine performance related fault has occurred (except Euro 4 specification).

Service Vehicle Soon (SVS) Lamp Operation (Euro 4 Specification)

The service vehicle soon (SVS) lamp is located in the instrument panel cluster. The SVS lamp will display the following symbol when commanded ON:



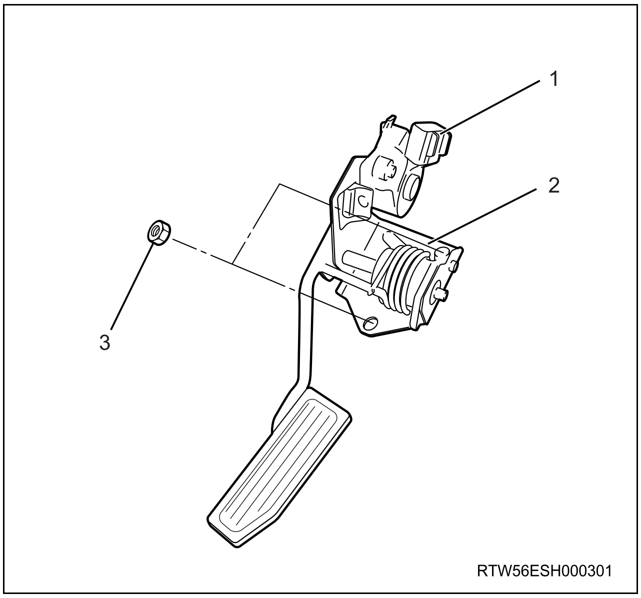
RTW76ESH002901

The SVS lamp indicates that a non-emission related fault (Type C) has occurred and vehicle service required. The following is a list of the modes of operation for the SVS lamp:

- The SVS lamp illuminates when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the SVS lamp is able to illuminate.
- The SVS lamp turns OFF after the engine is started if a diagnostic fault is not present.
- The SVS lamp remains illuminated after the engine is started if the ECM detects a fault. A DTC is stored any time the ECM illuminates the SVS lamp due to a non-emission related fault.

Engine Control Component Description

Accelerator Pedal Position (APP) Sensor

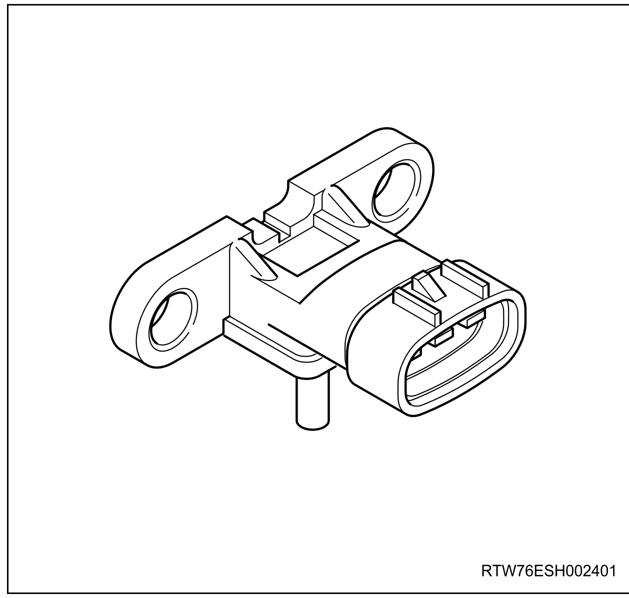


Legend

1. Accelerator pedal position (APP) sensor
2. Accelerator pedal bracket
3. Nut

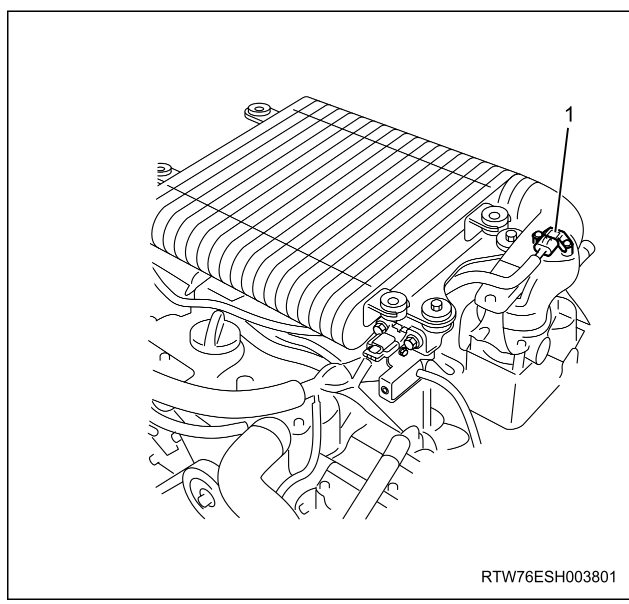
The APP sensor is mounted on the accelerator pedal control assembly. The sensor is made up of three individual sensors within one housing. The ECM uses the APP sensors to determine the amount of acceleration or deceleration that is desired. The APP sensors are potentiometer type sensors. Each APP sensor provides a different signal to the ECM on the each signal circuit, which relative to the position changes of the accelerator pedal angle. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 and APP sensor 3 signal voltage is high at rest and decreases as the pedal is depressed.

Barometric Pressure (BARO) Sensor



The BARO sensor is located on the intake manifold. The BARO sensor is a transducer that varies voltage according to changes the barometric pressure. The BARO sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes of the barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation.

Boost Pressure Sensor

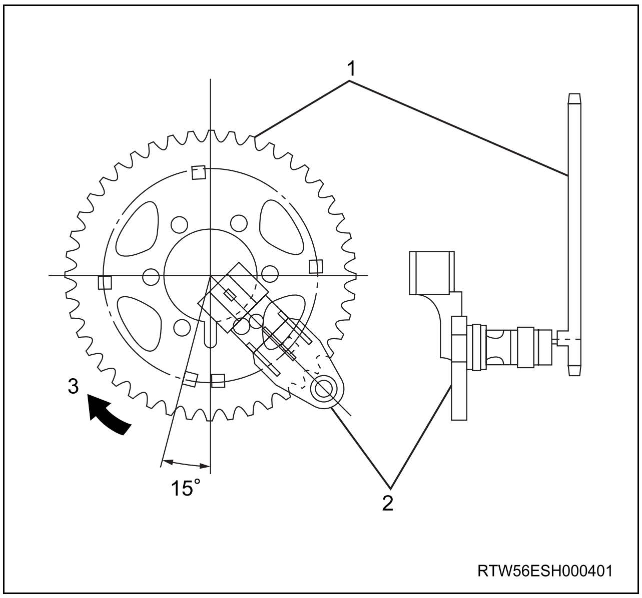


Legend

1. Boost pressure sensor

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The boost pressure sensor provides a signal to the ECM on the signal circuit, which is relative to the pressure changes in the air tubing. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load.

Camshaft Position (CMP) Sensor

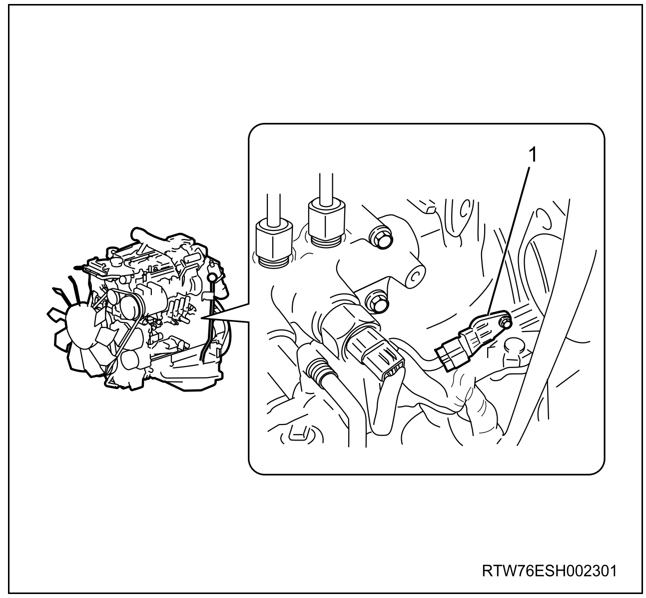


Legend

1. Timing chair sprocket
2. Camshaft position (CMP) sensor
3. Rotating direction

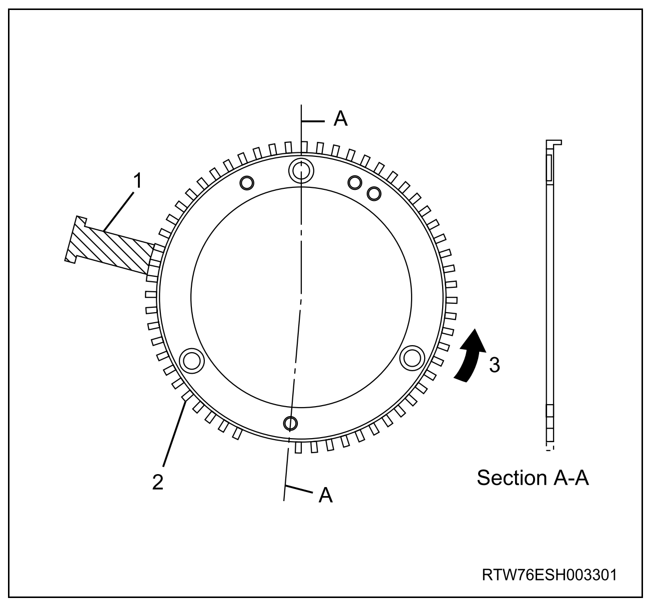
The CMP sensor is installed on the timing chain sprocket cover at the front of the camshaft idle gear. The CMP sensor detects total of five projections per one engine cycle (four projections arranged equally every 90° and one reference projection on the timing chain sprocket surface). The CMP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse.

Crankshaft Position (CKP) Sensor



Legend

1. Crankshaft position (CKP) sensor

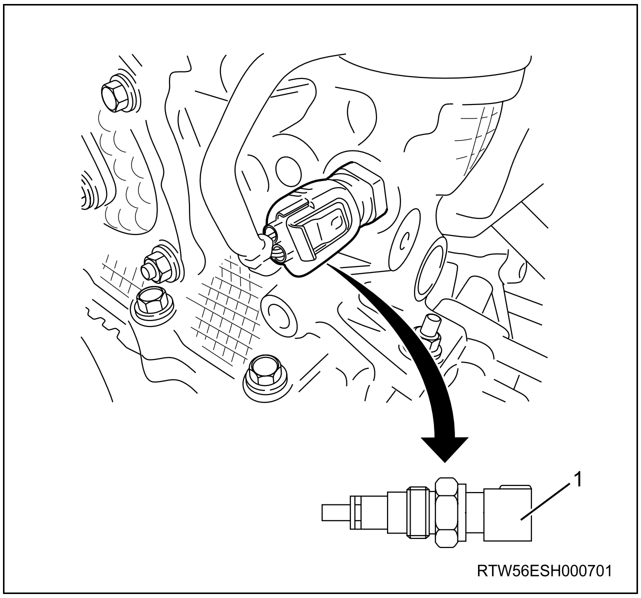


Legend

1. Crankshaft position (CKP) sensor
2. Sensor rotor
3. Rotating direction

The CKP sensor is located on the left-hand of the cylinder block rear and it is behind the starter motor. The sensor rotor is fixed on the crankshaft. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of top dead center (TDC). The CKP sensor is a magnetic resistance element (MRE) type sensor, which generates a square wave signal pulse. Detecting the open span portion from the CKP sensor and one reference projection from the camshaft position (CMP) sensor, the ECM determines cylinder #1 compression TDC to ensure they correlate with each other.

Engine Coolant Temperature (ECT) Sensor

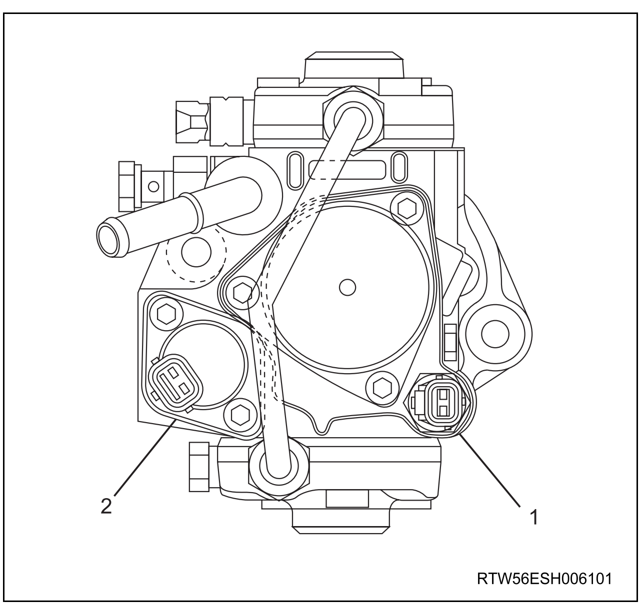


Legend

1. Engine coolant temperature (ECT) sensor

The ECT sensor is installed to the thermostat housing. The ECT sensor is a variable resistor and it measures the temperature of the engine coolant. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Fuel Temperature (FT) Sensor

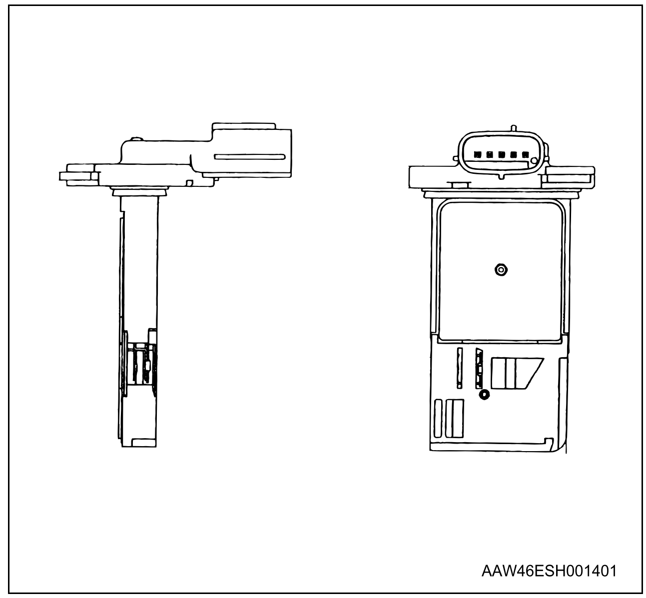


Legend

1. Fuel temperature (FT) sensor
2. Fuel rail pressure (FRP) regulator

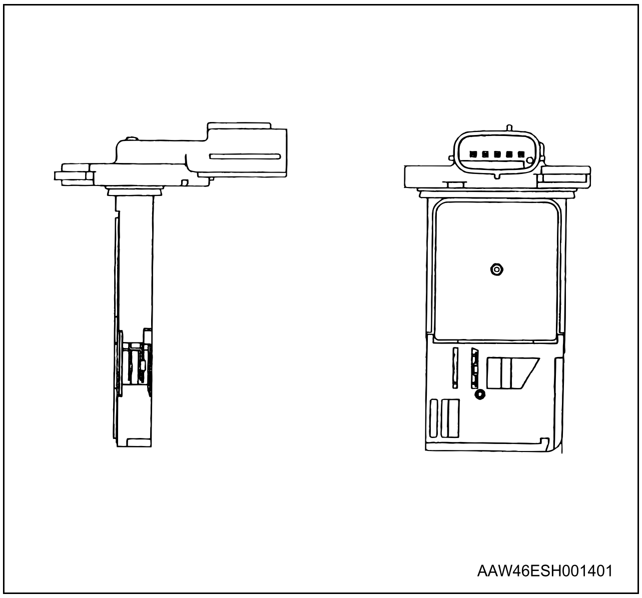
The FT sensor is installed to the fuel supply pump. The FT sensor is a variable resistor and it measures the temperature of the fuel entering the fuel supply pump. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Intake Air Temperature (IAT) Sensor



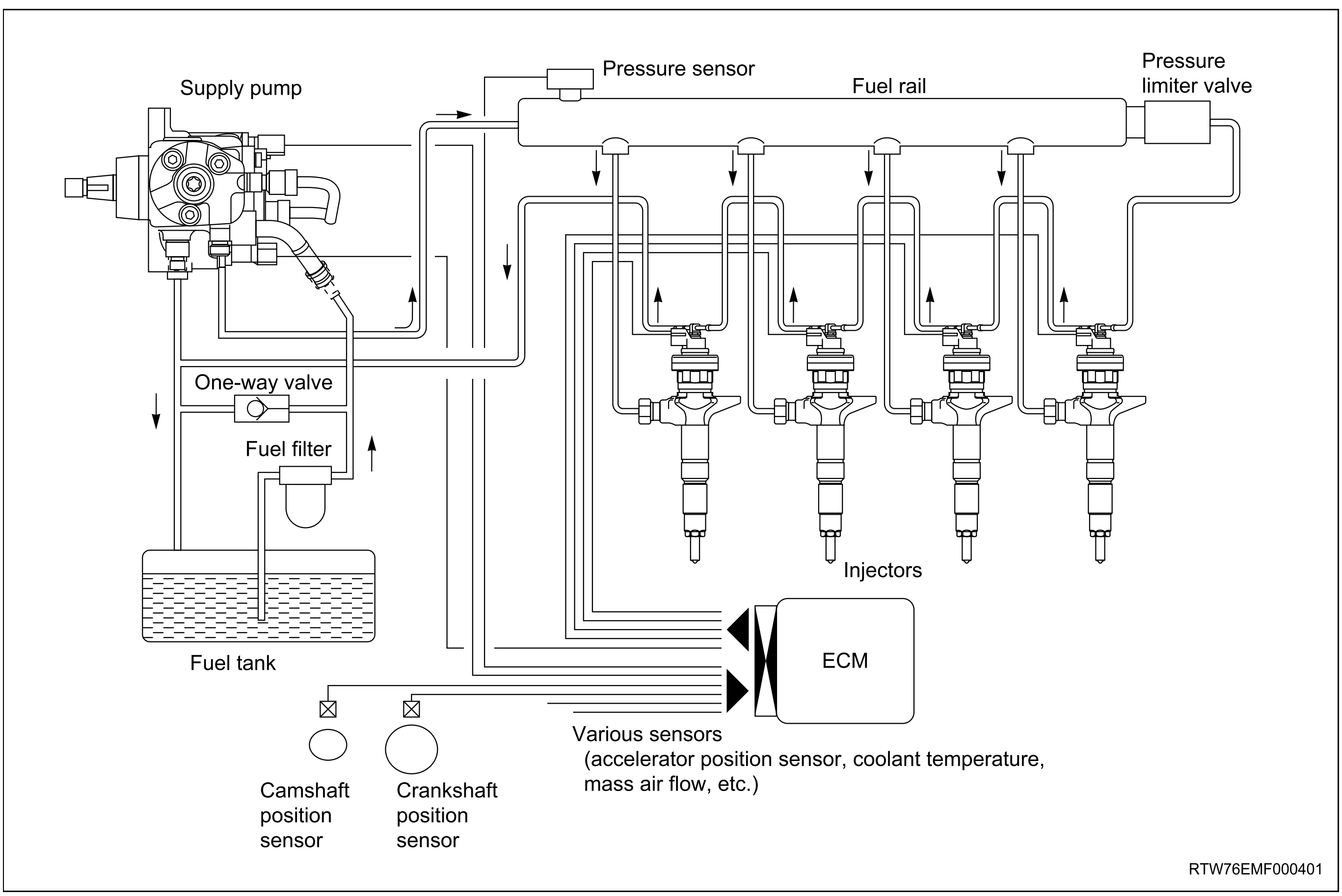
The IAT sensor is fitted between the air cleaner and turbocharger. It is internal to the mass air flow (MAF) sensor. The IAT sensor is a variable resistor and it measures the temperature of the air entering the engine. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the signal circuit.

Mass Air Flow (MAF) Sensor



The MAF sensor is an air flow meter that measures the amount of air that enters the engine. It is fitted between the air cleaner and turbocharger. A small quantity of air that enters the engine indicates deceleration or idle speed. A large quantity of air that enters the engine indicates acceleration or a high load condition. The MAF sensor assembly consists of a MAF sensor element and an intake air temperature (IAT) sensor that are both exposed to the air flow to be measured. The MAF sensor element measures the partial air mass through a measurement duct on the sensor housing.

Fuel System Description



The common rail system uses a type of accumulator chamber called the fuel rail to store pressurized fuel, and injectors that contain electronically controlled solenoid valves to spray the pressurized fuel in the combustion chambers. The injection system (injection pressure, injection rate, and injection timing) is controlled by the ECM, and therefore the common rail system can be controlled independently, free from the influence of engine speed and load. This ensures a stable injection pressure at all time, particularly in the low engine speed range, so that black smoke specific to diesel engines generated during vehicle starting or acceleration can be reduced dramatically. As a result, exhaust gas emissions are clear and reduced, and higher output is achieved.

1. High Pressure Control

- Enables high pressure injection from low engine speed range.
- Optimizes control to minimize particulate matter and NOx emissions.

2. Injection Timing Control

- Enables finely tuned optimized control in accordance with running conditions.

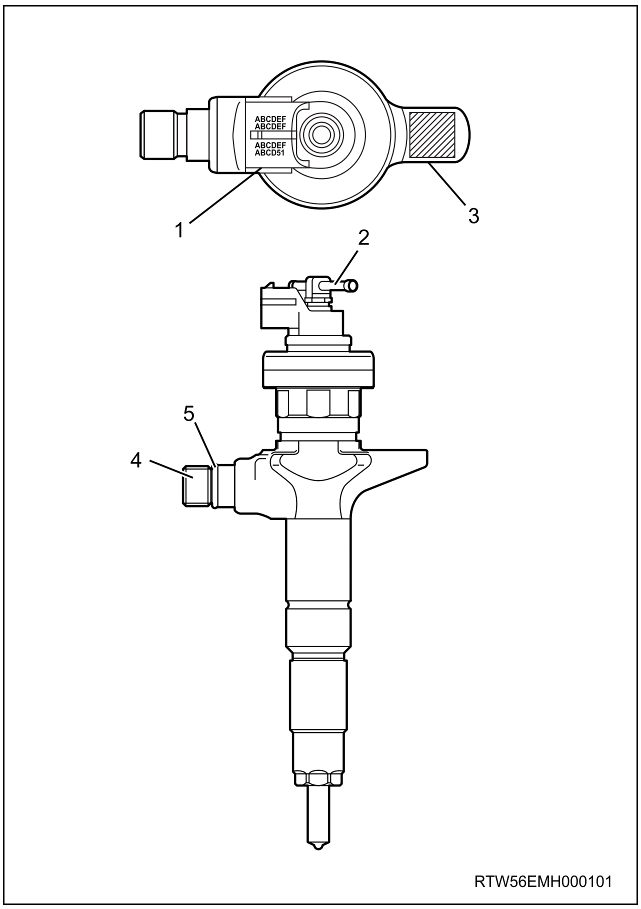
3. Injection Rate Control

- Pilot injection control that performs a small amount of injection before main injection.

The fuel rail system consists primarily of a fuel supply pump, fuel rail, injectors, and ECM.

Fuel System Component Description

Injector



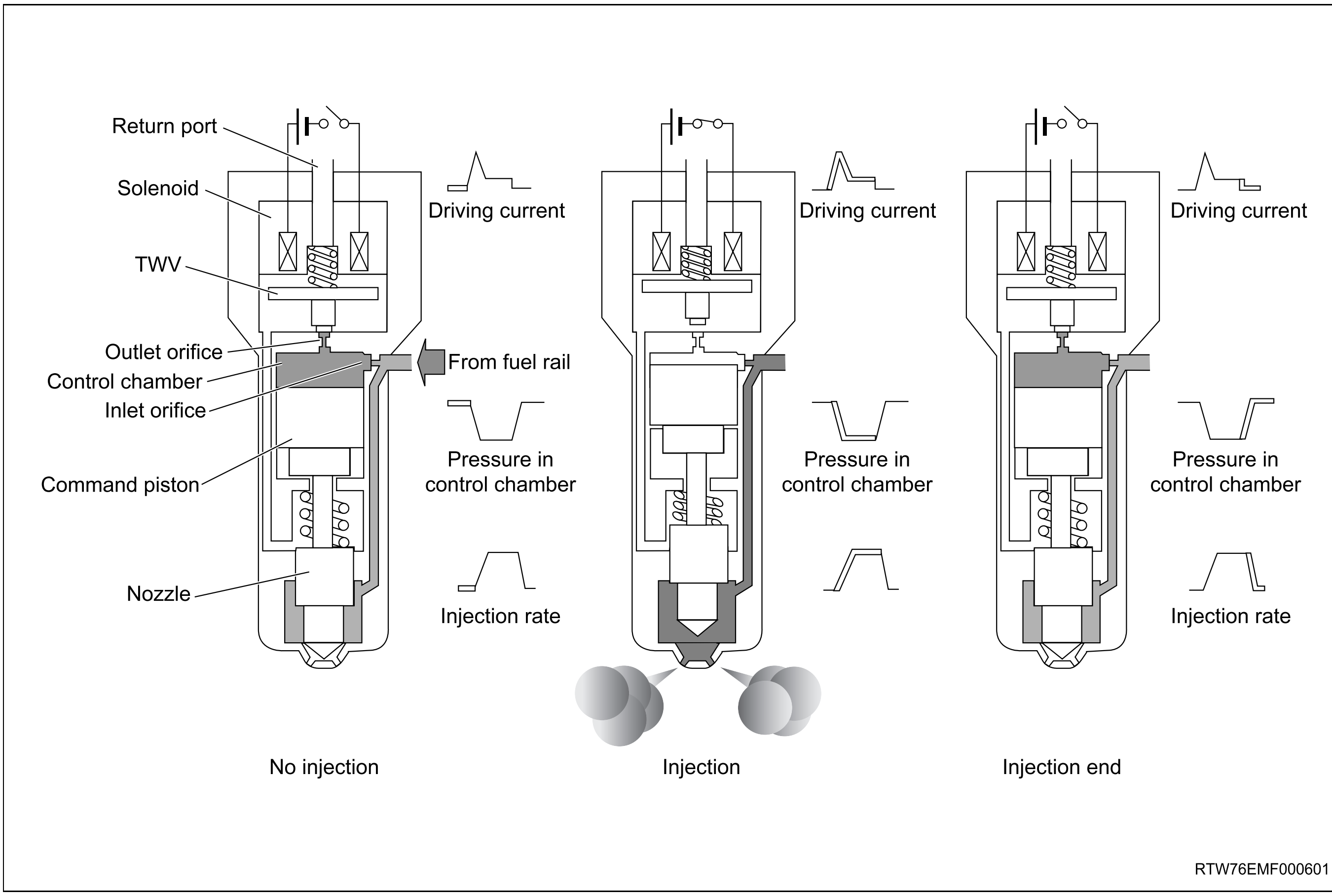
Legend

1. Fuel injector ID code
2. Leak off pipe
3. Two dimensional barcode
4. Port for mounting the injection pipe
5. O-ring

Electronic control type injectors controlled by the ECM are used. Compared with conventional injection nozzles, a command piston, solenoid valve, etc. are added.

ID codes displaying various injector characteristic are laser marked on the connector housing, and ID codes showing these in numeric form (24 alphanumeric figures). This system uses fuel injector flow rate information (ID codes) to optimize injection quantity control. When an injector is newly installed in a vehicle, it is necessary to input the ID codes in the ECM.

QR (Quick Response) codes or fuel injector flow rate (ID codes) have been adopted to enhance the injection quantity precision of the injectors. The adoption of codes enables injection quantity dispersion control throughout all pressure ranges, contributing to improvement in combustion efficiency and reduction in exhaust gas emissions.



1) Non-injection state

The two way valve (TWV) closes the outlet orifice by means of a spring force, when no current is supplied from the ECM to the solenoid. At this time, the fuel pressure applied to the nozzle leading end is equal to the fuel pressure applied to the control chamber through the inlet orifice. As for the force competition in this state, the pressure on the command piston upper surface + nozzle spring force defeat the pressure on the nozzle leading end, and consequently the nozzle is pushed downward to close the injection holes.

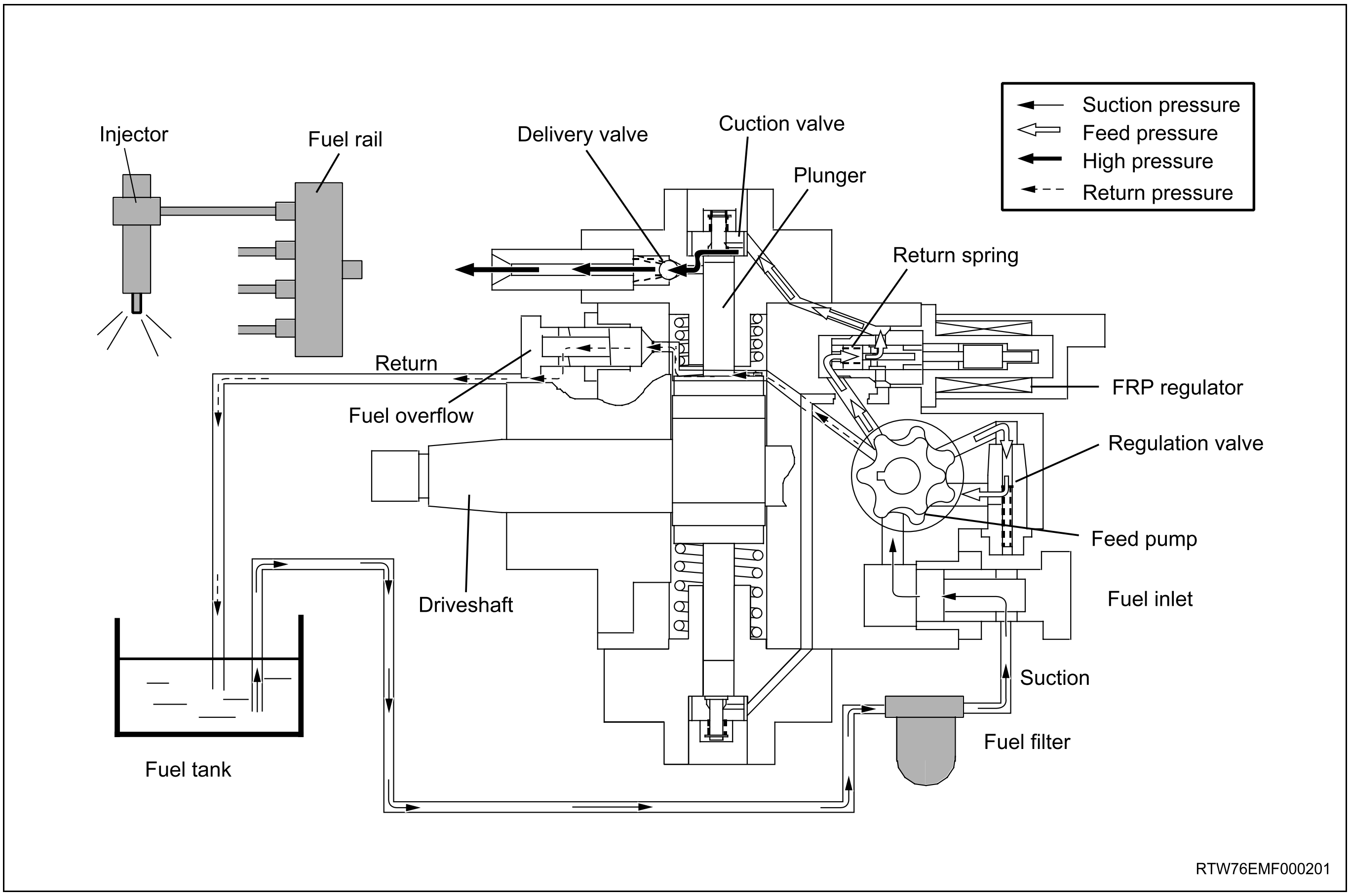
2) Injection start

The TWV is pulled up to open the outlet orifice, and thus the fuel leaks toward the return port, when the current is supplied from the ECM to the solenoid. As a result, the nozzle is pushed up together with the command piston by the fuel pressure applied to the nozzle leading end, and then the nozzle injection holes open to inject the fuel.

3) Injection end

The TWV lowers to close the outlet orifice, when the ECM shuts off a current supply to the solenoid. As a result, the fuel cannot leak from the control chamber, and thus the fuel pressure in the control chamber rises abruptly and then the nozzle is pushed down by the command piston to close the nozzle injection holes, resulting in the end of fuel injection.

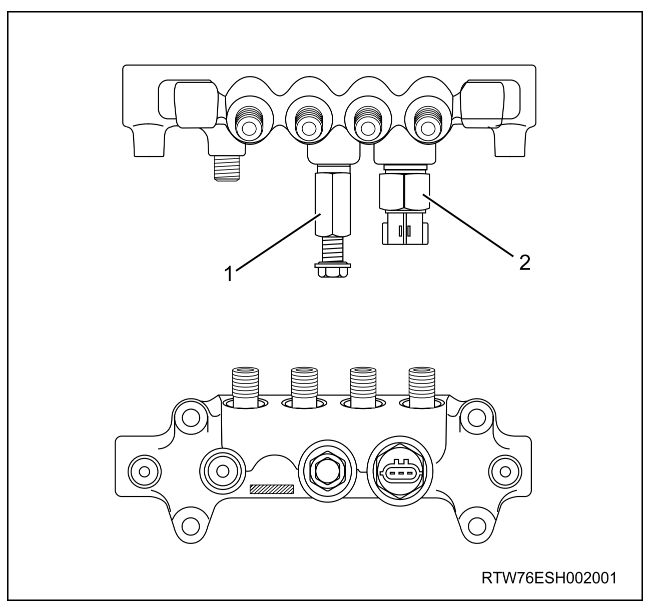
Fuel Supply Pump



The fuel supply pump is the heart of the common rail type electronic fuel injection system. The fuel supply pump is installed at the same location as the conventional injection type pump, which spins at a 1 to 1 ratio of fuel supply pump to crankshaft speed. A fuel rail pressure (FRP) regulator and fuel temperature sensor are part of the fuel supply pump assembly.

Fuel is drawn from the fuel tank via the fuel supply pump by the use of an internal feed pump (trochoid type). This feed pump pumps fuel into a 2-plunger chamber also internal to the fuel supply pump. Fuel into this chamber is regulated by the FRP regulator solely controlled by current supplied from the ECM. No current to the solenoid results in maximum fuel flow whereas full current to the solenoid produces no fuel flow. As the engine spins, these two plungers produce high pressure in the fuel rail. Since the ECM controls the flow of fuel into this 2-plunger chamber, it therefore controls the quantity and pressure of the fuel supply to the fuel rail. This optimizes performance, improves economy and reduces NOx emissions.

Fuel Rail (Common Rail)



Legend

1. Pressure limiter valve
2. Fuel rail pressure (FRP) sensor

SECTION 2B

SHEET METAL

This section includes items of front end sheet metal that are attached by bolts, screws or clips and related accessory components.

Anticorrosion materials have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels, areas on which this material has been disturbed, should be properly recoated with service-type anticorrosion material.

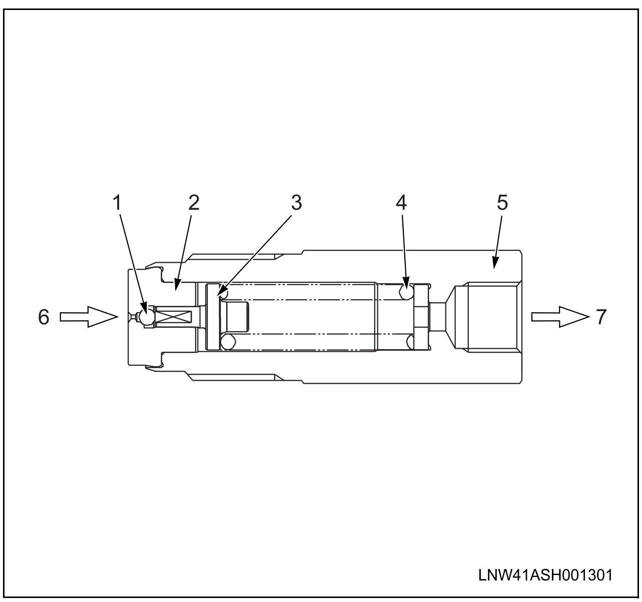
TABLE OF CONTENTS

Along with the employment of a common rail type electronic control fuel injection system, the fuel rail is provided to store high pressure fuel between supply pump and injectors. A pressure sensor and a pressure limiter are installed on the fuel rail. The pressure sensor detects the fuel pressure inside the fuel rail and sends its signal to the ECM. Based on this signal, the ECM controls the fuel pressure inside the fuel rail via the fuel rail pressure (FRP) regulator of the supply pump. The pressure limiter opens the valve mechanically to relieve the pressure when the fuel pressure inside the fuel rail is excessive.

Fuel Rail Pressure Sensor

The FRP sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the ECM. The ECM monitors the FRP sensor signal voltage. Higher fuel rail pressure provides higher signal voltage while lower pressure provides lower signal voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks.

Pressure Limiter Valve

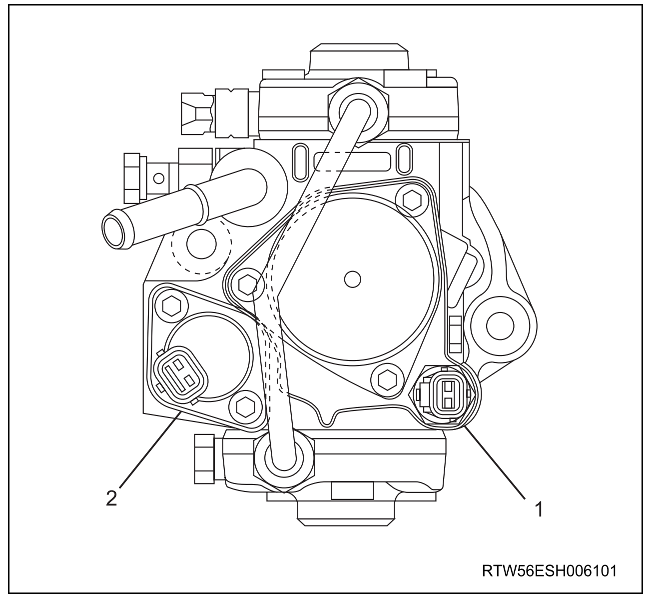


Legend

1. Valve
2. Valve body
3. Valve guide
4. Spring
5. Housing
6. Fuel rail
7. Fuel return pipe

The pressure limiter relieves pressure by opening the valve if abnormally high pressure is generated. The valve opens when pressure in rail reaches approximately 220 MPa (32,000 psi), and closes when pressure falls to approximately 50 MPa (7,250 psi). Fuel leakage through the pressure limiter re-turns to the fuel tank.

Fuel Rail Pressure (FRP) Regulator



The ECM controls the duty ratio of the linear type fuel rail pressure (FRP) regulator (the length of time that the current is applied to the FRP regulator), in order to control the quantity of fuel that is supplied to the high-pressure plungers. Since only the quantity of fuel that is required for achieving the target rail pressure is drawn in, the drive load of the supply pump is decreased. When current flows to the FRP regulator, variable electromotive force is created in accordance with the duty ratio, moving the armature to the left side. The armature moves the cylinder to the left side, changing the opening of the fuel passage and thus regulating the fuel quantity. With the FRP regulator OFF, the return spring contracts, completely opening the fuel passage and supplying fuel to the plungers (Full quantity intake and full quantity discharge). When the FRP regulator is ON, the force of the return spring moves the cylinder to the right, closing the fuel passage (normally opened). By turning the FRP regulator ON/OFF, fuel is supplied in an amount corresponding to the actuation duty ratio, and fuel is discharged by the plungers.

Fuel Injection System Description

Fuel Injection Quantity Control

This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, barometric pressure, mass air flow and some switch inputs information corrections to the basic injection quantity is calculated by the ECM based on the engine operating conditions (engine speed, accelerator pedal pressing amount and boost pressure sensor). More fuel rate indicates if the engine load is increased as the accelerator pedal is stepped on at constant engine speed.
Combined with high pressure injection of atomized fuel, this control improves exhaust gas and ensures proper fuel consumption. Compared with conventional mechanical governors, an electronic control system provides higher degree of freedom of fuel injection quantity control, thereby presenting high accelerator response (acceleration feeling and pressing feeling).

Starting Injection Quantity Control

At the engine starting (after the key switch is turned to the START position to start the engine, up to return of key switch to the ON position), optimum fuel injection quantity is controlled based on the information on the engine speed and coolant temperature. At low temperature, the fuel injection quantity increases. When the engine started completely, this boosted quantity mode at the starting is cancelled and normal running mode is restored.

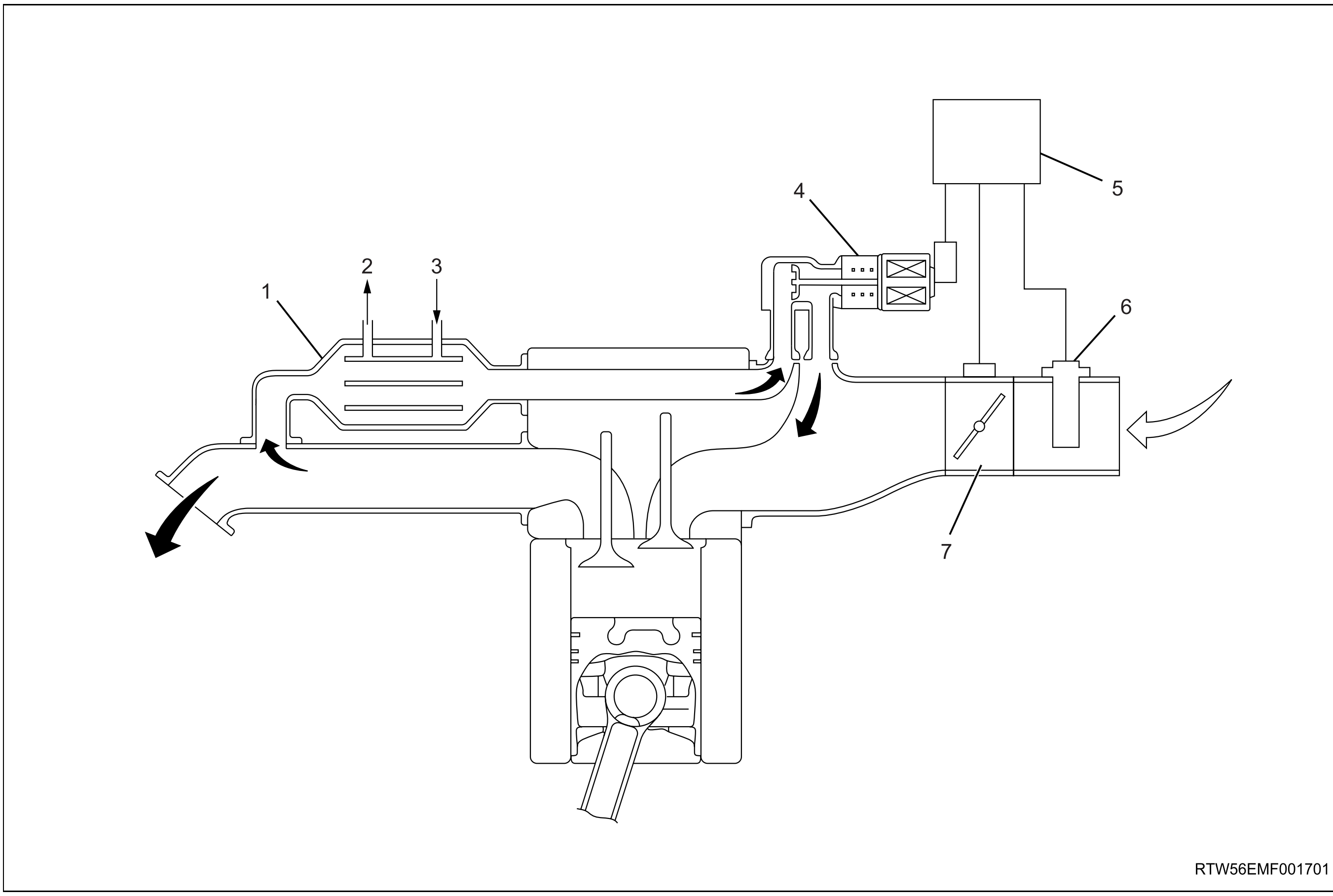
Idle Speed Control

A control is made so as to achieve stable idling speed at all time regardless of engine secular changes or engine condition variations. The ECM sets target idling speed and controls the fuel injection quantity according to the engine conditions (actual engine speed, coolant temperature and engine load) to follow actual engine speed to the target idling speed so as to ensure stable idling speed.

Idle Vibration Control

A control is made so as to reduce the engine vibration caused by torque variations between cylinders due to variations in fuel injection quantity of each cylinder or injector performance. The ECM corrects the injection quantity between cylinders based on the revolution signals from the crankshaft position (CKP) sensor. Normal range of correction quantity between cylinders is within ±5 mm^3.

Exhaust Gas Recirculation (EGR) System Description

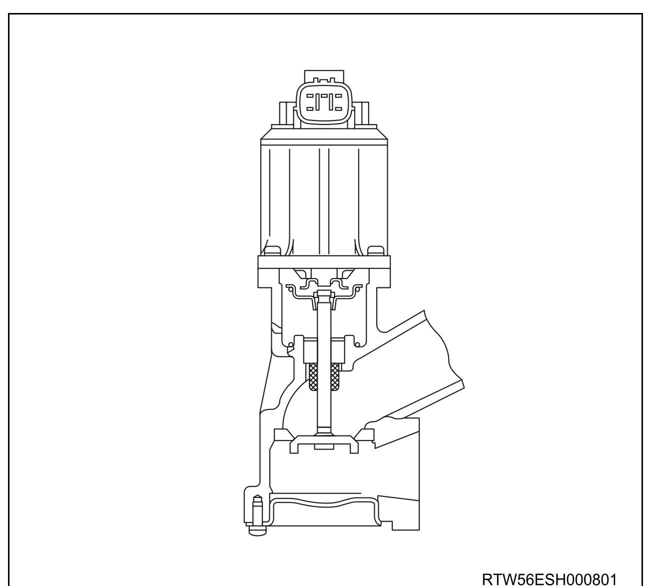


Legend

1. EGR cooler
2. Engine coolant outlet
3. Engine coolant inlet
4. EGR valve
5. ECM
6. MAF sensor
7. Intake throttle valve

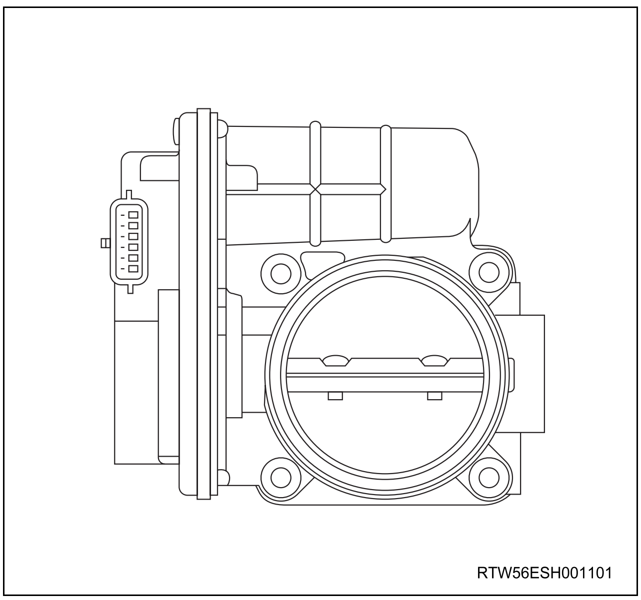
The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing nitrogen oxide (NOx) emissions. The EGR control system uses an electronic control system to ensure both driveability and low emission. A control current from the ECM operates a solenoid to control the lift amount of EGR valve. Also, an EGR position sensor is provided at the rear of the motor to feed actual valve lift amount back to the ECM for more precision control of the EGR amount.
The EGR control starts when the conditions for engine speed, engine coolant temperature, intake air temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the solenoid is determined and the valve is driven accordingly. The intake throttle valve is provided to adequate intake manifold depression to ensure EGR gas flow.

EGR Valve



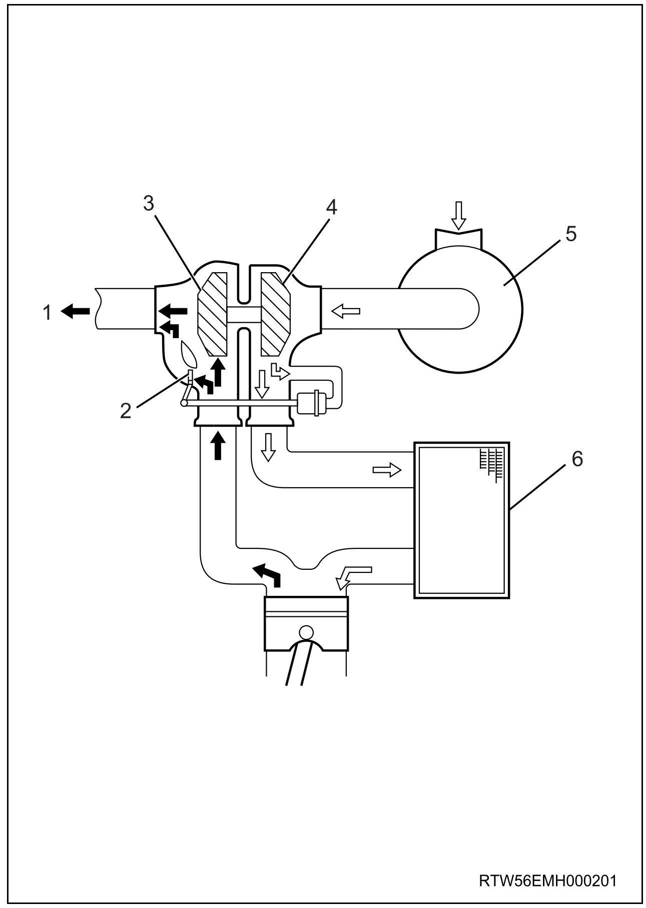
The EGR valve is mounted on the intake manifold. The ECM controls the EGR valve opening based on the engine running condition. The ECM controls the EGR valve by controlling the solenoid. The solenoid is controlled based on pulse width modulation (PWM) signal sent from the ECM. A duty ratio change 0% to appropriate percentage is EGR valve lift control. To open the valve, duty ratio is increased. To close the valve, duty ratio becomes small.
The EGR valve position is detected by the position sensor, and relayed to the ECM. The position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the EGR valve. The ECM should detect a low signal voltage at a small lift amount or closed position. The ECM should detect high signal voltage at a large lift amount.

Intake Throttle Valve



The intake throttle valve is located on the intake manifold inlet. The ECM controls the intake throttle valve opening based on the engine running condition. The ECM controls the intake throttle valve by controlling the solenoid. The solenoid is controlled based on pulse width modulation (PWM) signal sent from the ECM. A duty ratio change 0% to appropriate percentage is intake throttle valve opening angle control. To open the valve, duty ratio is increased. To close the valve, duty ratio becomes small.
The intake throttle valve position is detected by the position sensor, and relayed to the ECM. The position sensor provides a signal to the ECM on the signal circuit, which is relative to the position changes of the intake throttle valve. The ECM should detect a low signal voltage at a small opening amount or closed position. The ECM should detect high signal voltage at a large opening amount.

Turbocharger Description

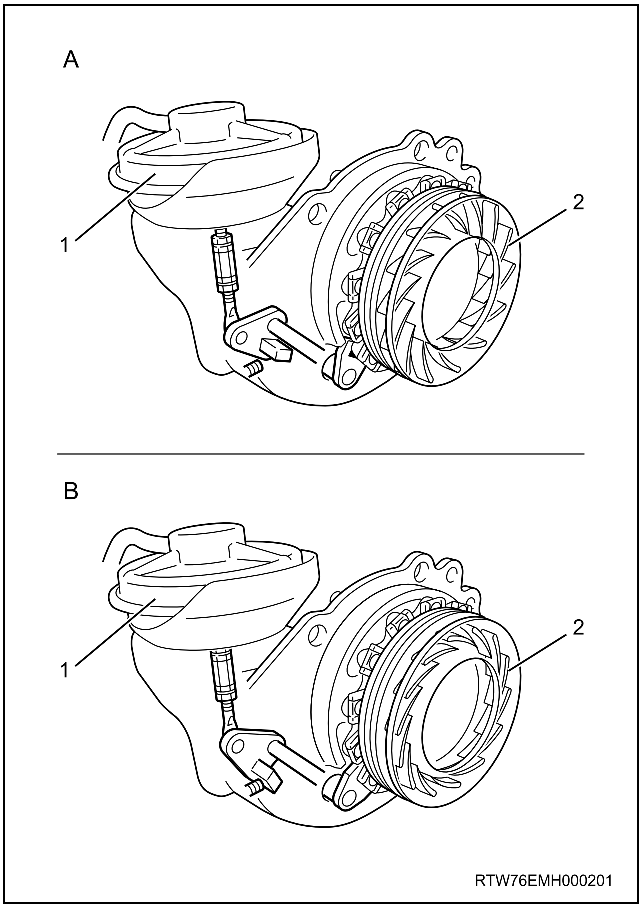


Legend

1. Exhaust gas
2. Waste gate valve
3. Turbine wheel
4. Compressor wheel
5. Air cleaner
6. Charge air cooler (Intercooler)

The turbocharger is used to increase the amount of air that enters the engine cylinders. This allows a proportional increase of fuel to be injected into the cylinders, resulting in increased power output, more complete combustion of fuel, and increased cooling of the cylinder heads, pistons, valves, and exhaust gas. This cooling effect helps extend engine life.
Heat energy and pressures in the engine exhaust gas are utilized to drive the turbine. Exhaust gas is directed to the turbine housing. The turbine housing acts as a nozzle to direct the shaft wheel assembly. Since the compressor wheel is attached directly to the shaft, the compressor wheel rotates at the same speed as the turbine wheel. Clean air from the air cleaner is drawn into the compressor housing and wheel. The air is compressed and delivered through a crossover pipe to the engine air intake manifold, then into the cylinders.

The amount of air pressure rise and air volume delivered to the engine from the compressor outlet is regulated by a waste gate valve in the exhaust housing. The position of the waste gate valve is controlled by the amount of pressure built up on the intake side of the turbocharger. The diaphragm on the inside of the waste gate is pressure sensitive, and controls the position of the valve inside the turbocharger. The position of the valve will increase or decrease the amount of boost to the turbocharger. (Standard output engine)



Legend

1. Turbocharger nozzle control actuator
2. Nozzle

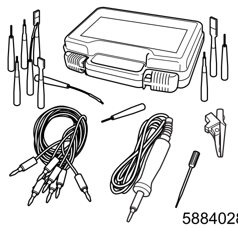
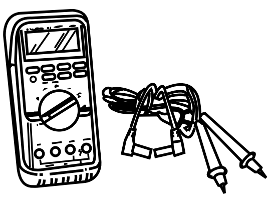
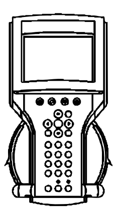
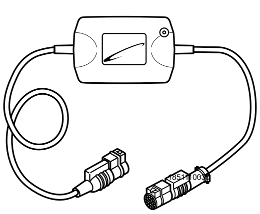
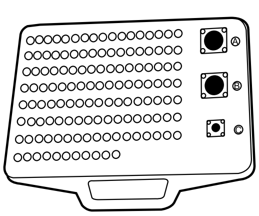
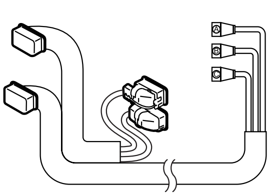
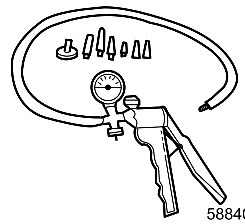
The amount of air pressure rise and air volume delivered to the engine from compressor outlet is regulated by a turbocharger nozzle control actuator indirectly. The position of the turbocharger nozzle is controlled by the ECM. The ECM utilizes a turbocharger nozzle control solenoid valve and a boost pressure sensor to control the turbocharger nozzles. When the engine is not under load, the turbocharger nozzles are in an open position (A), or no boost condition (vacuum pressure supply to the actuator is reduced). When the engine is under load, the ECM commands the control solenoid valve to close the turbocharger nozzles (B), thus increasing the boost (vacuum pressure supply to the actuator is increased). The ECM will vary the boost dependant upon the load requirements of the engine. The ECM uses a pulse width modulation (PWM) on the control circuit to open and control the solenoid valve. (High output engine)

The charge air cooler also helps the performance of the diesel. Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler located in the front of the radiator. From the charge air cooler, the air flows back into the intake manifold.

The charge air cooler is a heat exchanger that uses air flow to dissipate hear from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases the engine efficiency and power by packing more air molecules into the same space.

Special Tools and Equipment

Special Tools and Equipment

Illustration	Tool Number/ Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
 AAW0Z0SH015701	Tech2 Kit
	CAN-di Module
	Breaker Box
	Adapter Harness
 5884002790	5-8840-0279-0 (J-23738-A) Vacuum Pump

SECTION 6F

EXHAUST SYSTEM

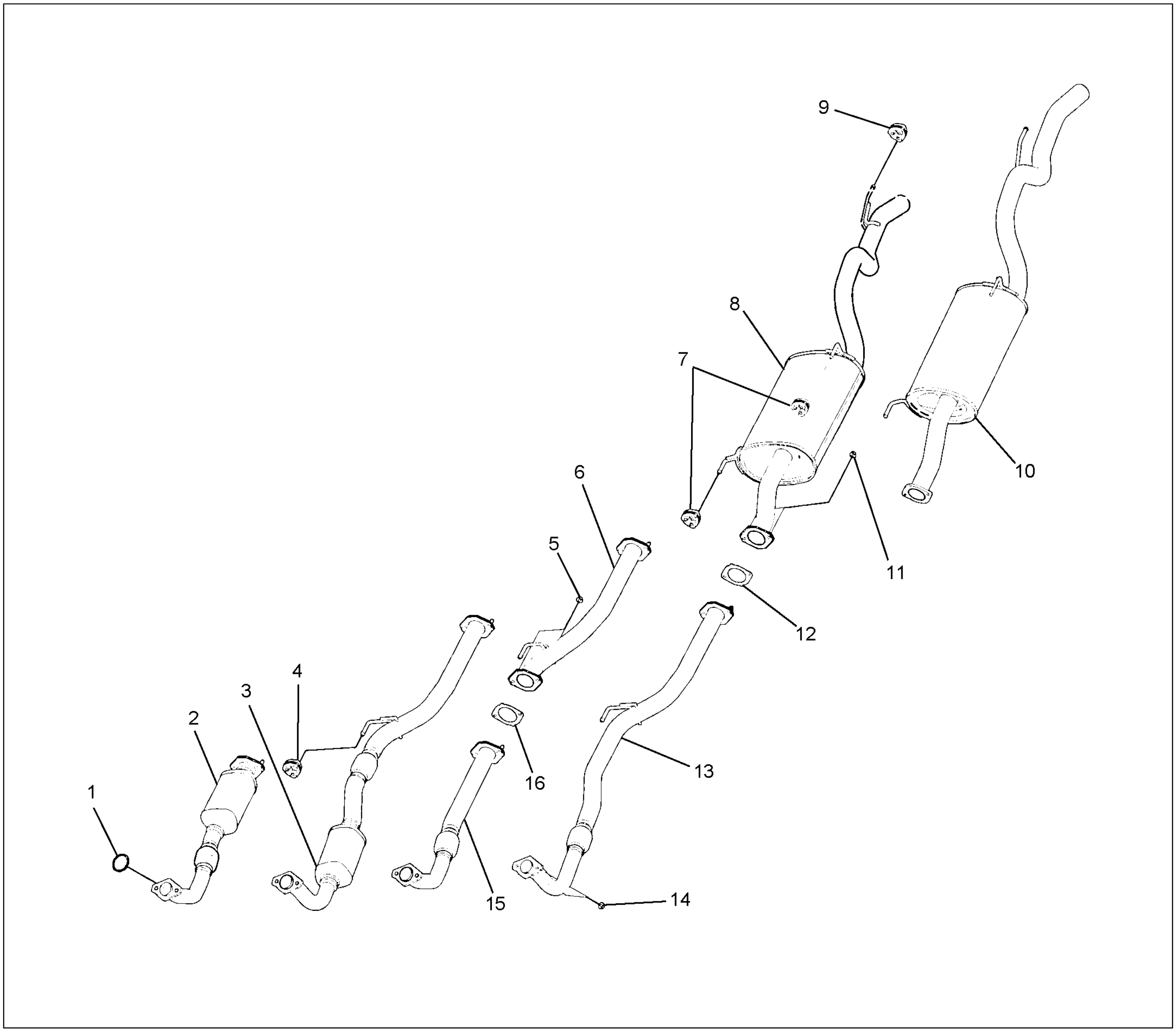
CONTENTS

Exhaust Silencer and Exhaust Pipe

Main Data and Specifications

Front pipe		
Pipe outside diameter × thickness	mm (in)	50.8 × 1.5 (2.0 × 0.059) and 60.5 × 1.5 (2.38 × 0.059)
Middle pipe		
Pipe outside diameter × thickness	mm (in)	60.5 × 1.5 (2.38 × 0.059)
Silencer & tail pipe		
Type		Circular section-shell construction of double skin and end plates, internal construction of baffles and perforated tubes.
Tail pipe outside diameter × thickness	mm (in)	Standard output: 60.5 × 1.6 (2.38 × 0.063)
		High output: 63.5 × 1.6 (2.5 × 0.063)
Length	mm (in)	Approximately 1335 (52.6)
Mounting		
Number of suspension points		4
Type		Rubber

Components



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Legend

1. Exhaust Pipe Gasket
2. Front Pipe (4×2 High Ride Suspension, 4×4)
3. Front Pipe (4×2 Except High Ride Suspension)
4. Front Hanger Rubber
5. Middle Pipe Nut (4×2 High Ride Suspension, 4×4)
6. Middle Pipe (4×2 High Ride Suspension, 4×4)
7. Silencer Hanger Rubber
8. Exhaust Silencer
9. Rear Hanger Rubber
10. Exhaust Silencer
11. Silencer Front Nut
12. Exhaust Pipe Gasket
13. Front Pipe (4×2 Except High Ride Suspension)
14. Front Pipe Nut
15. Front Pipe (4×2 High Ride Suspension, 4×4)
16. Front Pipe Gasket
    (4×2 High Ride Suspension, 4×4)

Removal

1. Rear hanger rubber
2. Silencer front nut
3. Exhaust silencer
4. Silencer hanger rubber
5. Front hanger rubber
6. Middle pipe nut (4×2 High Ride Suspension, 4×4)
7. Middle pipe (4×2 High Ride Suspension, 4×4)
8. Front pipe nut
9. Exhaust pipe gasket

Installation

Follow the removal procedure in the reverse order to perform the installation procedure. Pay careful attention to the important points during the installation procedure.

1. Front Pipe Nut
   Connect the exhaust pipe to the catalytic converter.

Torque: 67 N·m (6.8 kg·m / 49 lb ft)

2. Middle pipe Nut (4×2 High Ride Suspension,4×4)
   Connect the middle pipe to the front pipe.

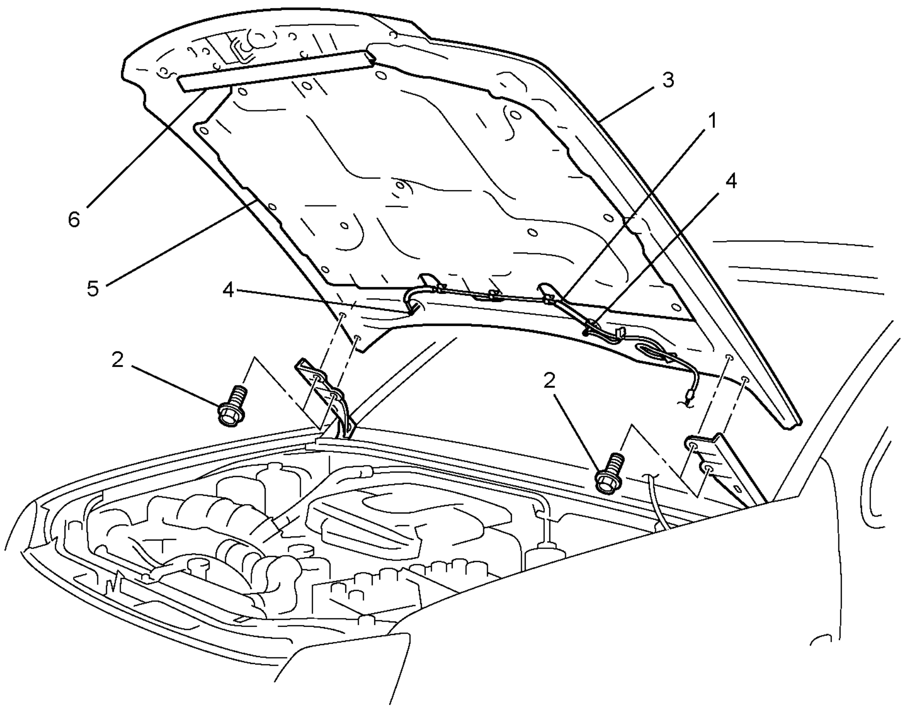
Torque: 43 N·m (4.4 kg·m / 32 lb ft)

3. Silencer Front Nut
   Connect the silencer to the front or middle pipe.

Torque: 43 N·m (4.4 kg·m / 32 lb ft)

ENGINE HOOD ASSEMBLY (A TYPE)

REMOVAL AND INSTALLATION



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Except 4JK1 (High Output) / 4JJ1 (High Output) Model

Removal Steps

- ▲ 1. Washer nozzle tube
- ▲ 2. Hood hinge bolt
- 3. Engine hood
- 4. Washer nozzle
- 5. Hood insulator
- 6. Hood seal

Installation Steps

- 6. Hood seal
- 5. Hood insulator
- 4. Washer nozzle
- ▲ 3. Engine hood
- ▲ 2. Hood hinge bolt
- 1. Washer nozzle tube

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

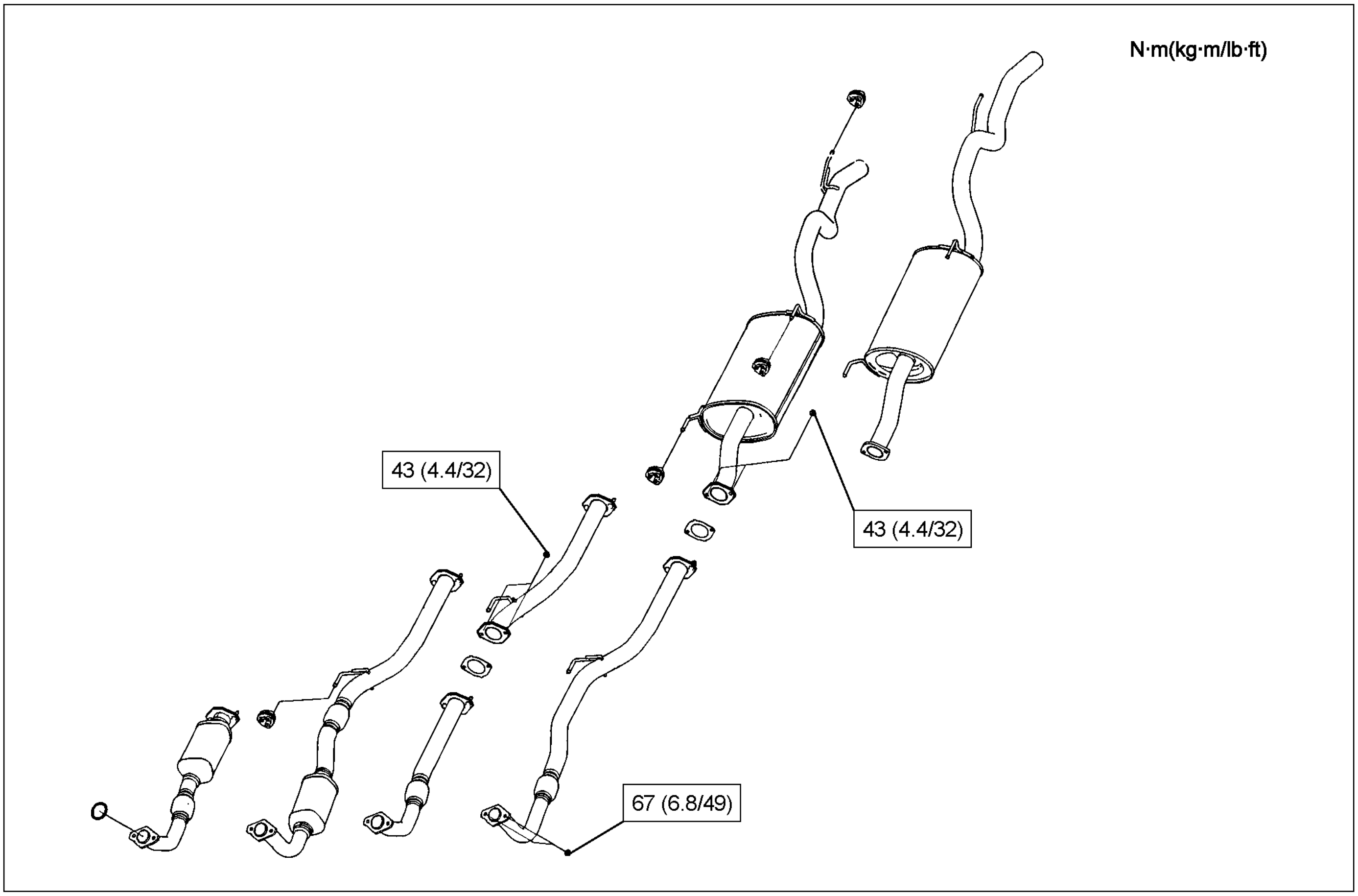
Front Exhaust Pipe

Exhaust Silencer

Check the pipes for corrosion, cracking, damage or misalignment and repair as required.

Check the rubber rings for deterioration or damage and repair as required.

Torque Specifications



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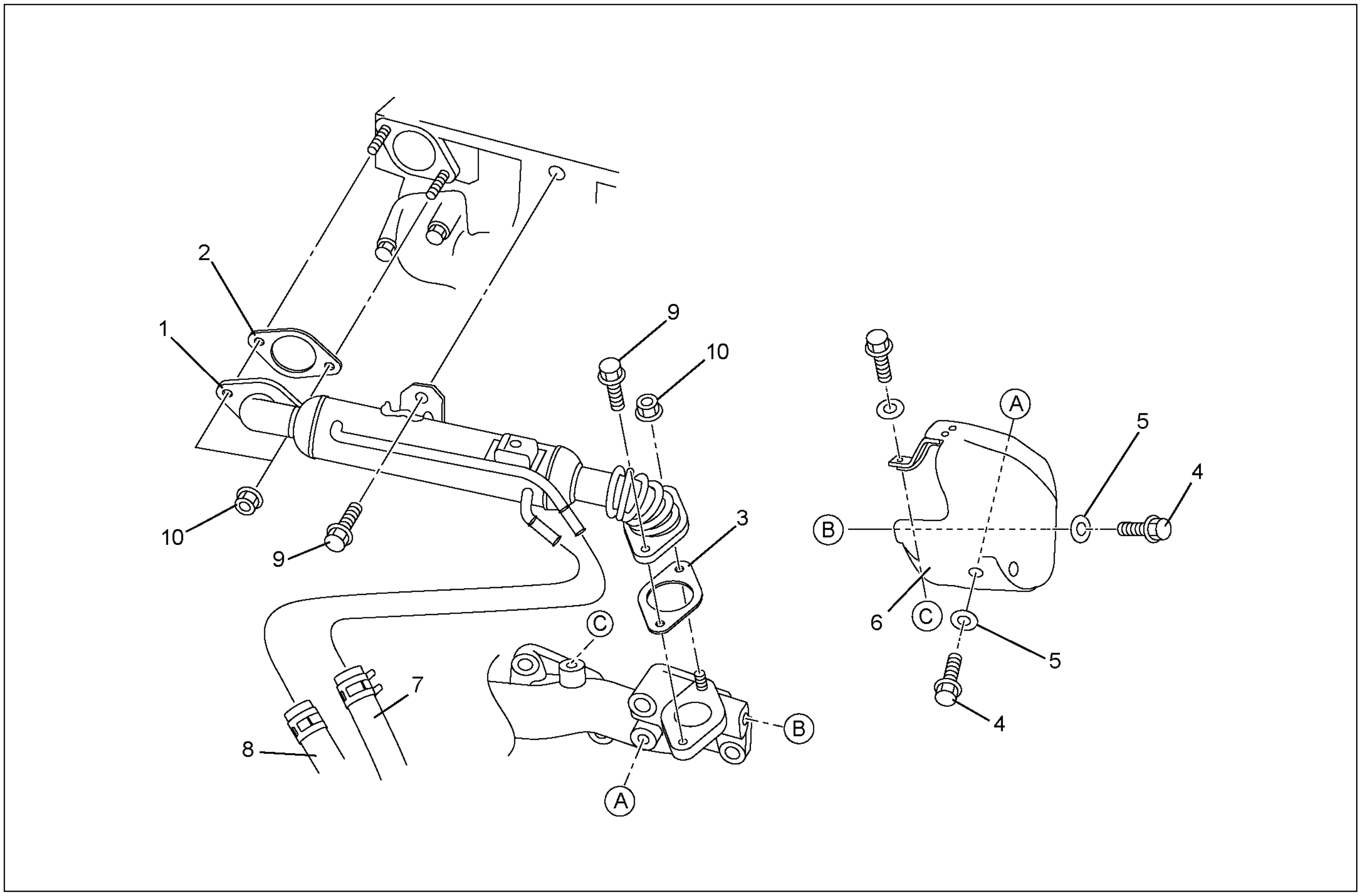
EGR Cooler

Components (Standard Output)



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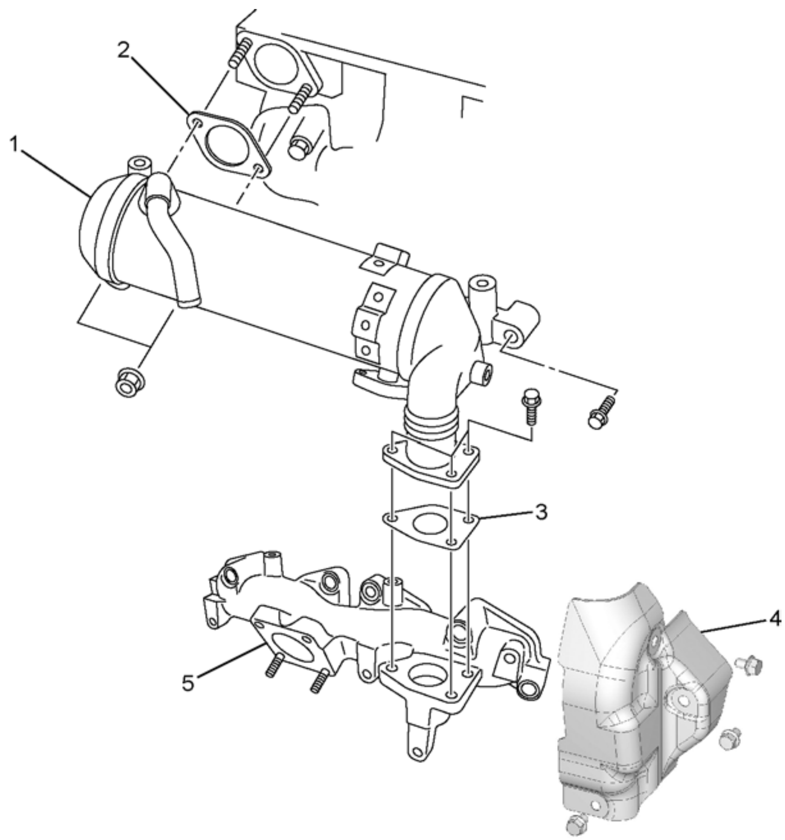
Legend

1. EGR Cooler
2. Gasket
3. Gasket
4. Bolt
5. Washer
6. Heat Protector
7. Water Hose Intake
8. Water Hose Return
9. Bolt
10. Nut

Components (High Output)



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Legend

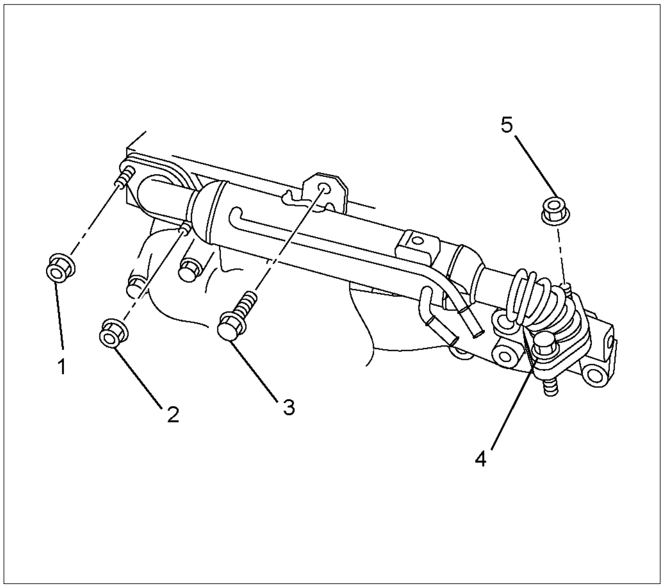
1. EGR Cooler
2. EGR Cooler Gasket
3. EGR Cooler Gasket
4. Heat Protector
5. Exhaust Manifold

Removal

1. Drain the coolant.
2. Remove the intercooler.
3. Remove the heat protector.
4. Disconnect the water hoses from the EGR cooler water pipes.
5. Remove the EGR cooler.

Installation (Standard Output)

1. Gasket
2. EGR Cooler
3. Nuts and Bolts



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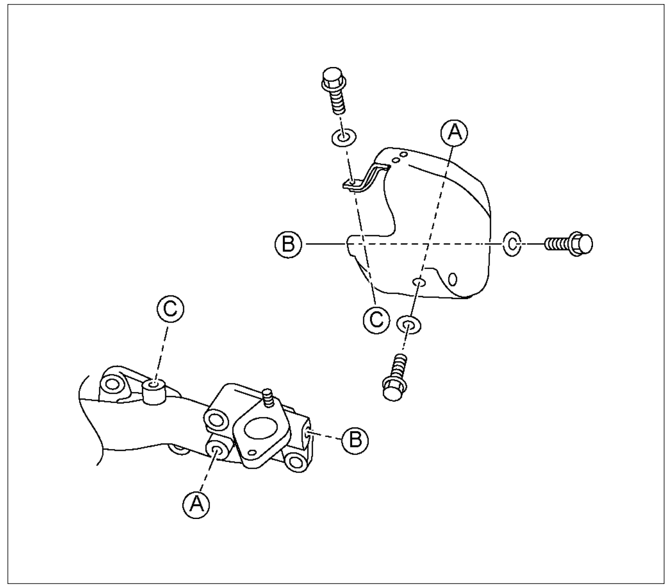
- Temporary tightening order
  1 – 2 – 4 – 5 - 3
- Fully tightening order
  4 – 5 – 1 – 2 - 3

Tighten the nuts and bolts to the specified torque.

Tightening torque:
27 N·m (2.8 kg·m / 20 lb ft)

4. Water hose
5. Heat protector
   - Tighten the bolts to the specified torque.

Tightening torque:
10 N·m (1.0 kg·m / 87 lb in)



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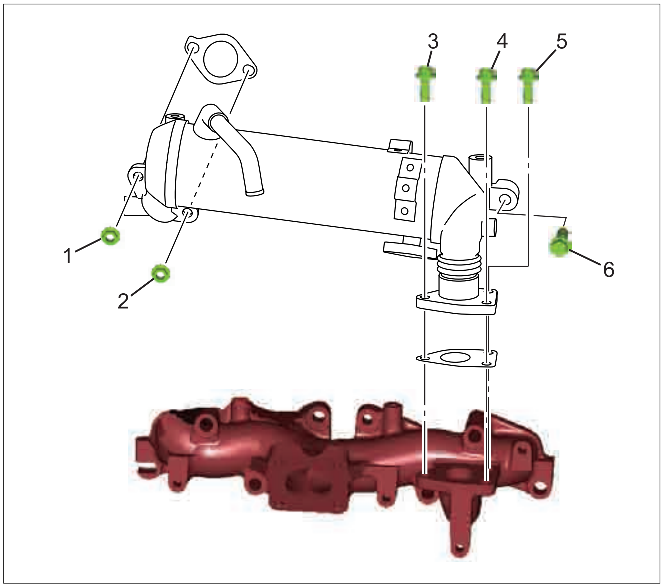
6. Replenish the engine coolant.

Installation (High Output)

1. Gasket
2. EGR Cooler
3. Nuts and Bolts



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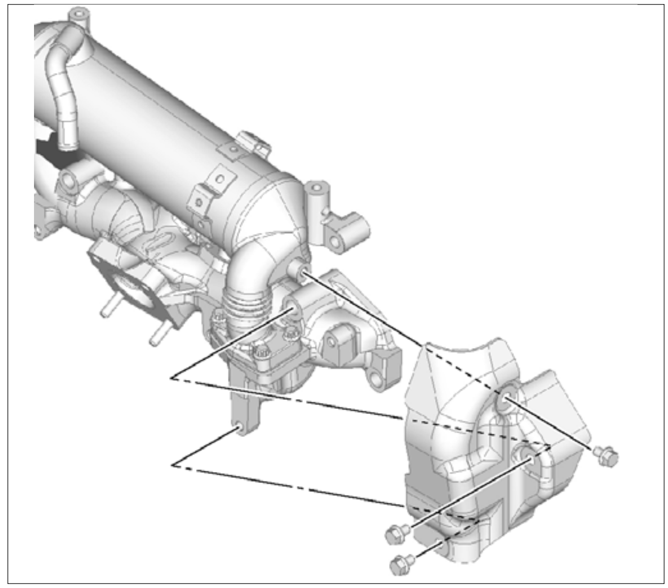
- Temporary tightening order
  1→2→3→4→5→6
- Fully tightening order
  3→4→5→1→2→6

Tighten the nuts and bolts to the specified torque.

Tightening torque:
Nuts and bolts 1-5: 27 N·m (2.8 kg·m / 20 lb ft)
Bolt 6: 52 N·m (5.3 kg·m / 38 lb ft)

4. Water hose
5. Heat protector
   - Tighten the bolts to the specified torque.

Tightening torque:
25 N·m (2.5 kg·m / 18 lb ft)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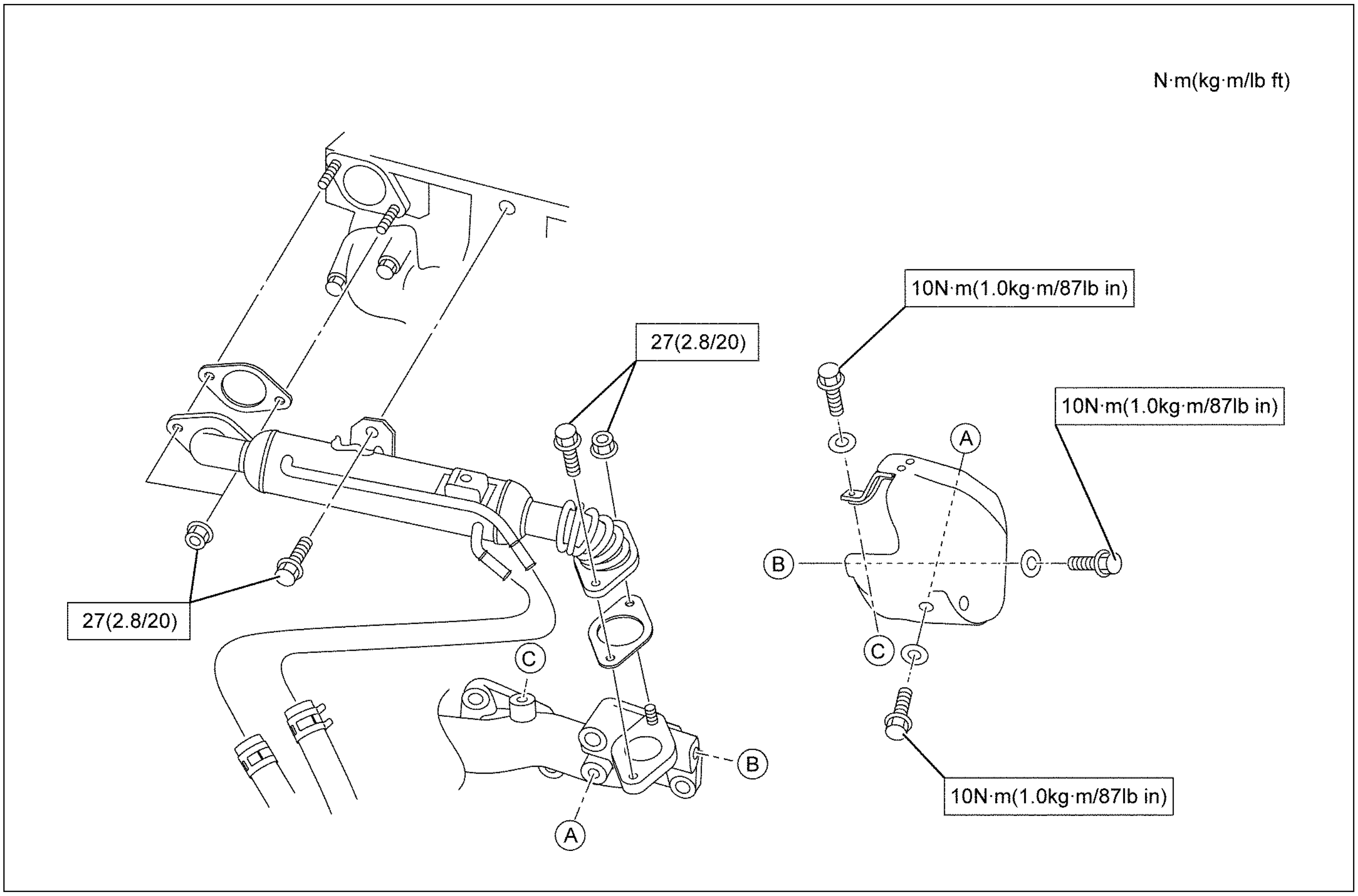
6. Replenish the engine coolant.

Torque Specifications (Standard Output)



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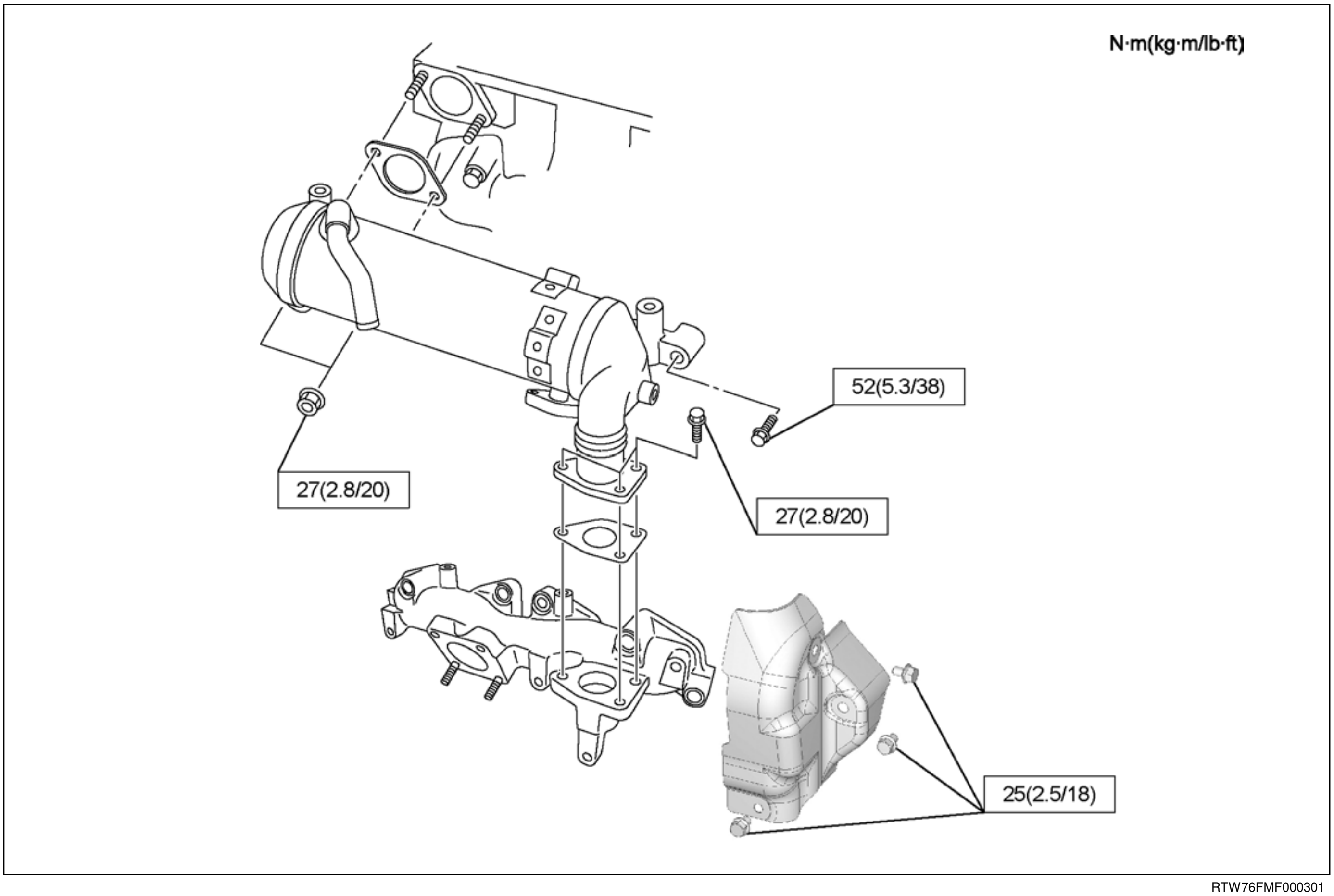
Torque Specifications (High Output)



SECTION 6H

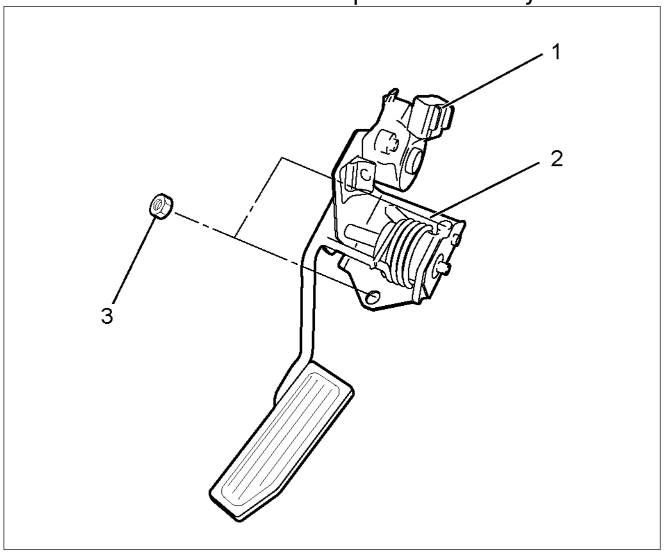
ENGINE SPEED CONTROL SYSTEM

CONTENTS

Accelerator Pedal Position (APP) Sensor

Removal

1. Turn OFF the ignition.
2. Disconnect the APP sensor harness connector.
3. Loosen the accelerator pedal assembly nuts (3).
4. Remove the accelerator pedal assembly.



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5. Remove the APP sensor (1) from accelerator pedal bracket (2).

Installation

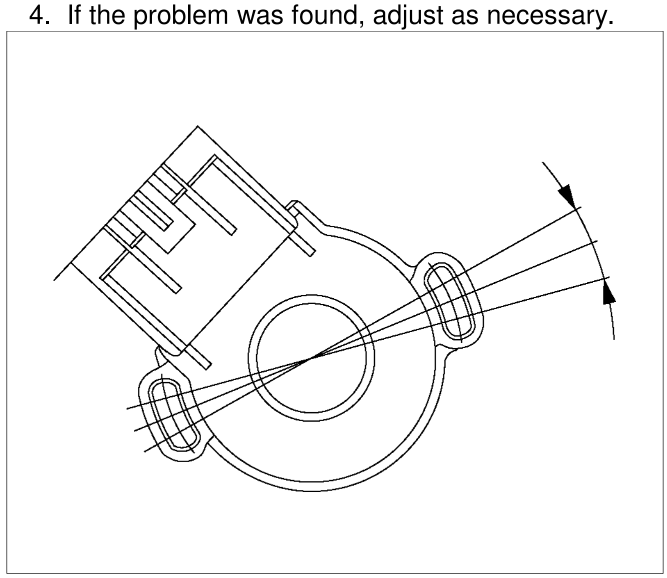
1. Install the APP sensor (1) in accelerator pedal bracket (2).
2. Install the accelerator pedal assembly.
3. Tighten the accelerator pedal assembly nuts (3).
4. Connect the APP sensor harness connector.

How to adjust for APP Sensor

1. Install the Tech2.
2. Turn ON the ignition.
3. Observe the APP sensor parameter.
   Check the unique functionality of each sensor as shown in the table below.

APP Sensor	Pedal Position	Pedal Position as Observed on the Tech2 (%)	Voltage as Observed on the Tech2 (volt)
1	Pedal at reset	0	0.1-1.2
1	Pedal at full travel	100	3.8-4.8
2	Pedal at reset	0	3.8-4.8
2	Pedal at full travel	100	0.2-1.2
3	Pedal at reset	0	3.8-4.8
3	Pedal at full travel	100	1.2-2.2

4. If the problem was found, adjust as necessary.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SECTION 0

GENERAL INFORMATION

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MAINTENANCE SCHEDULE (For GENERAL EXPORT)

Items followed by an asterisk (*) require more frequent maintenance if the vehicle is driven under severe conditions.
Replace the fuel filter (**Mark) when the fuel filter indicator light is lit.
Refer to "SEVERE CONDITIONS MAINTENANCE SCHEDULE."

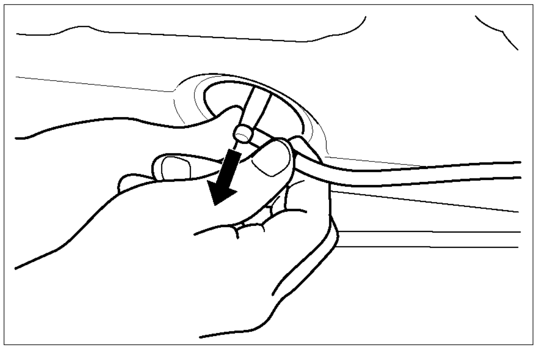
I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
or months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
ENGINE																				
Idling speed and acceleration																				
(GASOLINE)	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
(DIESEL)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Air cleaner element																				
(GASOLINE)	-	I	-	I	-	I	-	R	-	I	-	I	-	I	-	R	-	I	-	I
(DIESEL)	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
* Engine oil (HFV6)	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-
(C24SE)	Replace every 12,000km																			
(4JH1-TC, 4JJ1 (Standard Output), 4JJ1 (High Output))	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R
(4JA1-T)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
* Engine oil filter (HFV6)	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-
(C24SE)	Replace every 12,000km																			
(4JH1-TC, 4JA1-T)	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R
(4JJ1 (Standard Output), 4JJ1 (High Output))	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R
Oil leakage and contamination																				
(GASOLINE)	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
(DIESEL)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Fuel leakage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Fuel tank	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
O_2 Sensor (C24SE)	Replace every 160,000km																			
(HFV6)	MIL diagnostic Indicates O_2 Sensor																			
Valve clearances (6VE1)	Check and adjust if noisy																			
(4JH1-TC, 4JA1-T)	A	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A
(4JJ1 (Standard Output), 4JJ1 (High Output))	-	-	-	-	-	-	-	A	-	-	-	-	-	-	-	A	-	-	-	-
Spark plugs (C24SE) (for leaded fuel use)	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R
Spark plugs (C24SE) (for unleaded fuel use)	-	-	-	-	-	R	-	-	-	-	-	R	-	-	-	-	-	R	-	-
Spark plugs (HFV6)	Replace every 120,000km																			
Spark plug wire	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Fuel filter (GASOLINE)	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R
(4JH1-TC, 4JA1-T)	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-	R	-	-
** (4JJ1 (Standard Output), 4JJ1 (High Output))	Replace the fuel filter when the fuel filter indicator light is lit.																			
Fuel pump in fuel tank (4JJ1 (Standard Output), 4JJ1 (High Output))	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	I	-	-	-	-
Engine / Accessory drive belt (C24SE)	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-	-	I
(HFV6)	Replace every 100,000km																			
Fan belt tension and damage (DIESEL)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Exhaust system	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Engine coolant concentration (HFV6)	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	R
(C24SE)	-	I	-	I	-	I	-	I	-	R	-	I	-	I	-	I	-	I	-	R
(DESEL)	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Engine coolant (4JJ1 (Standard Output), 4JJ1 (High Output))	Change every 2 years																			
Cooling system for water leakage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
All hoses and pipes in engine compartment for clogs or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Timing belt (C24SE)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-
	Replace every 120,000km																			
Timing belt (6VE1)	Replace every 160,000km																			

Important Operations - Removal

1. Washer Nozzle Tube

1) Open the hood.
2) Support the hood.
3) Remove the windshield washer nozzle tube.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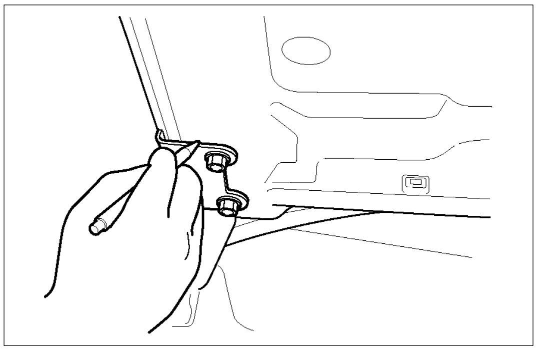
2. Hood Hinge Bolt

- Before removing the hinges from the engine hood, scribe a mark showing location of the hinges to facilitate installation in the original position.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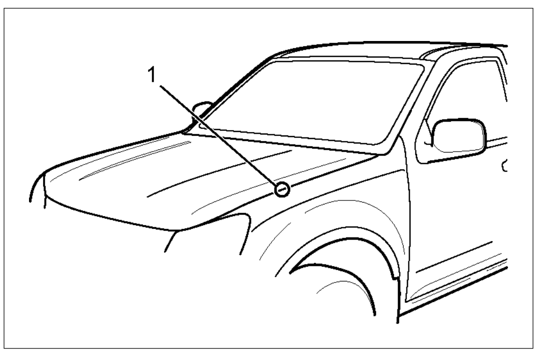
Important Operations - Installation

3. Engine Hood

- Check the engine hood and fender (1).



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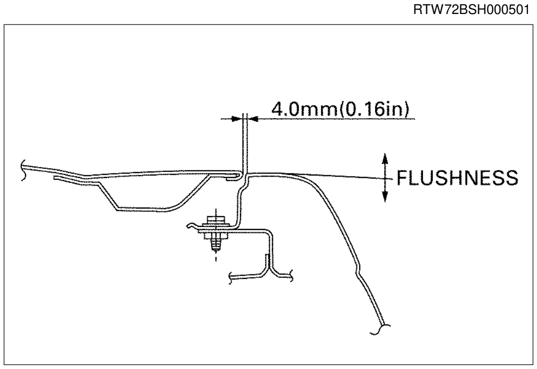
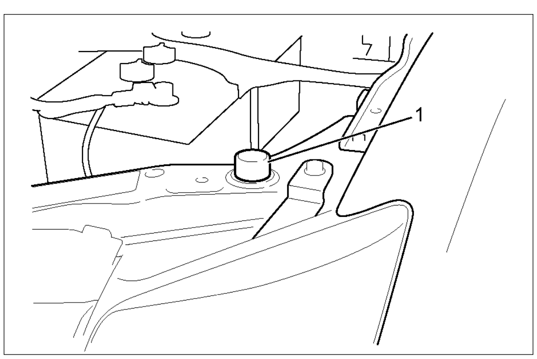
- Clearance : 4.0 mm (0.16 in)
- Height (step) : Flushness
- Adjust clearance using the hinges on the engine hood.



- Adjust height (step) using the hood rests (1).



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Engine Hood Striker

- Apply a light coat of grease to the striker.

SECTION 6

ENGINE

C24SE MODEL

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SECTION 6

ENGINE DIAGNOSIS

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Engine Diagnosis

Hard Starting

1.Starting Motor Does Not Turn Over

Trouble Shooting Procedure

Turn on headlights and starter switch.

Condition	Possible cause	Correction
Headlights go out or dim considerably	Battery run down or under charged	Recharge or replace battery
	Terminals poorly connected	Clean battery posts and terminals and connect properly
	Starting motor coil circuit shorted	Overhaul or replace
	Starting motor defective	Overhaul or replace

2.Ignition Trouble - Starting Motor Turns Over But Engine Does Not Start

Spark Test

Disconnect a high tension cable from any spark plug. Connect the spark plug tester (use commercially available tool), crank the engine, and check if a spark is generated in the spark plug tester. Before cranking the engine, make sure that the spark plug tester is properly grounded. To avoid electrical shock, do not touch the high tension cable while the engine is running.

Condition	Possible cause	Correction
Spark jumps across gap	Spark plug defective	Clean, adjust spark gap or replace
	Spark plug wire in correct	Connect properly or replace
	Ignition timing incorrect	Refer to Ignition System
	Fuel not reaching fuel injector(s) or engine	Refer to item 3 (Trouble in fuel system)
	Valve timing incorrect	Adjust
	Engine lacks compression	Refer to item 4 (Engine lacks compression)
No sparking takes place	Ignition coil disconnected or broken	Connect properly or replace
	Electronic Ignition System with module	Replace
	Poor connections in engine harness	Correct
	Engine Control Module cable disconnected or defective	Correct or replace

3.Trouble in Fuel System

Condition	Possible cause	Correction
Starting motor turns over and spark occurs but engine does not start.	Fuel tank empty	Fill
	Water in fuel system	Clean
	Fuel filter clogged	Replace filter
	Fuel pipe clogged	Clean or replace
	Fuel pump defective	Replace
	Fuel pump circuit open	Correct or replace
	Evaporative Emission Control system circuit clogged	Correct or replace
	Multiport Fuel Injection System faulty	Refer to "Electronic Fuel Injection" section

4.Engine Lacks Compression

Condition	Possible cause	Correction
Engine lacks compression	Spark plug loosely fitted or spark plug gasket defective	Tighten to specified torque or replace gasket
	Spark plug wire incorrect	Connect properly or replace
	Valve timing incorrect	Adjust
	Cylinder head gasket defective	Replace gasket
	Valve incorrectly seated	Lap valve
	Valve stem seized	Replace valve and valve guide
	Valve spring weakened	Replace
	Cylinder or piston rings worn	Overhaul engine
	Piston ring seized	Overhaul engine.

Engine Compression Test Procedure

1. Start and run the engine until the engine reaches normal operating temperature.
2. Turn the engine off.
3. Remove all the spark plugs.
4. Remove ignition coil fuse (15A) and disable the ignition system.
5. Remove the fuel pump relay from the relay and fuse box.
6. Engage the starter and check that the cranking speed is approximately 300 rpm.
7. Install cylinder compression gauge into spark plug hole.
8. With the throttle valve opened fully, keep the starter engaged until the compression gauge needle reaches the maximum level. Note the reading.
9. Repeat the test with each cylinder.
   The pressure difference between the individual cylinders should not exceed 100kPa (14.5 psi).

Rough Engine Idling or Engine Stalling

Condition	Possible cause	Correction
Trouble in fuel injection system	Idle air control valve defective	Replace
	Throttle shutting off incomplete	Correct or replace
	Throttle position sensor circuit open or shorted	Correct or replace
	Fuel injector circuits open or shorted	Correct or replace
	Fuel injectors damaged	Replace
	Fuel pump relay defective	Replace
	Manifold Absolute Pressure Sensor cable disconnected or broken	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature Sensor cable disconnected or broken	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	Intake Air Temperature sensor cable disconnected or broken	Correct or replace
	Intake Air Temperature sensor defective	Replace
	Knock Sensor (KS) circuits open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or ground	Correct or replace
	KS Module defective	Replace
	Vehicle Speed Sensor circuit open or shorted	Correct or replace
	Vehicle Speed Sensor defective	Replace
Trouble in emission control system	Engine Control Module defective	Replace
	Canister purge solenoid circuit open	Correct
	Canister purge solenoid defective	Replace
	Evaporative Emission Canister Purge control valve defective	Replace
	Trouble in ignition system	Refer to Hard Start Troubleshooting Guide
Others	Engine lacks compression	Refer to Hard Start Troubleshooting Guide
	Valve incorrectly seated	Lap valve
	Air Cleaner Filter clogged	Replace filter element
	Valve timing incorrect	Readjust
	Idle air control valve broken	Replace

Rough Engine Running

Condition	Possible cause	Correction
Engine misfires regularly	Ignition coil layer shorted	Replace
	Spark plugs fouling	Clean or install hotter type plug
	Spark plug(s) insulator nose leaking	Replace
	Spark plug wire incorrect	Connect properly or replace
	Fuel injector(s) defective	Replace
	Engine control module faulty	Replace
Engine knocks regularly	Spark plugs running too hot	Install colder type spark plugs
	Powertrain control module faulty	Replace
Engine lacks power	Spark plugs fouled	Clean
	Spark plug wire incorrect	Connect properly or replace
	Fuel injectors defective	Replace
	Manifold Absolute Pressure (MAP) Sensor or Manifold Absolute Pressure Sensor circuit defective	Correct or replace
	Engine Coolant Temperature Sensor or Engine Coolant Temperature Sensor circuit defective	Correct or replace
	Engine Control Module faulty	Replace
	Intake Air Temperature Sensor or Intake Air Temperature Sensor circuit defective	Correct or replace
	Throttle Position Sensor or Throttle Position Sensor circuit defective	Correct or replace
	Knock Sensor or Knock Sensor circuits defective	Correct or replace
	Knock Sensor Module or Knock Sensor Module circuits defective	Correct or replace

Hesitation

Condition	Possible cause	Correction
Hesitation on acceleration	Throttle Position Sensor adjustment incorrect	Replace throttle valve assembly
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Excessive play in accelerator linkage	Adjust or replace
	Manifold Absolute Pressure (MAP) Sensor circuit open or shorted	Correct or replace
	MAP Sensor defective	Replace
	Intake Air Temperature (IAT) Sensor circuit open or shorted	Correct or replace
	Knock Sensor (KS) Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuits open or shorted	Correct or replace
	KS Module defective	Replace
	IAT Sensor defective	Replace
Hesitation at high speeds (Fuel pressure too low)	Fuel tank strainer clogged	Clean or replace
	Fuel pipe clogged	Clean or replace
	Fuel filter clogged	Replace
	Defective fuel pump system	Check and replace
	Fuel Pressure Control Valve leaking	Replace
Hesitation at high speeds (Fuel injector not working normally)	Power supply or ground circuit for Multiport Fuel Injection System shorted or open	Check and correct or replace
	Cable of Multiport Fuel Injection System disconnected or defective	Correct or replace
Hesitation at high speeds	Engine Control Module defective	Replace
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Throttle Position Sensor defective	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	MAP Sensor cable open or shorted	Correct or replace
	MAP Sensor defective	Replace
	IAT Sensor circuit open or shorted	Correct or replace
	IAT Sensor defective	Replace
	KS Circuit open or shorted	Correct or replace
	KS defective	Replace
	KS Module circuit open or shorted	Correct or replace
	KS Module defective	Replace
	Throttle valve not wide opened	Check and correct or replace
	Air Cleaner Filter clogged	Replace filter element
	Power supply voltage too low	Check and correct or replace

Engine Lacks Power

Condition	Possible cause	Correction
Trouble in fuel system	Fuel Pressure Control Valve not working normally	Replace
	Fuel injector clogged	Clean or replace
	Fuel pipe clogged	Clean
	Fuel filter clogged or fouled	Replace
	Fuel pump drive circuit not working normally	Correct or replace
	Fuel tank not sufficiently breathing due to clogged Evaporative Emission Control System circuit	Clean or replace
	Water in fuel system	Clean
	Inferior quality fuel in fuel system	Use fuel of specified octane rating
	Engine Control Module supplied poor voltage	Correct circuit
	Throttle Position Sensor cable disconnected or broken	Correct or replace
	Throttle Position Sensor defective	Replace
	Manifold Absolute Pressure Sensor not working normally	Replace
	Intake Air Temperature sensor not working normally	Replace
	Engine Coolant Temperature Sensor circuit open or shorted	Correct or replace
	Engine Coolant Temperature Sensor defective	Replace
	Engine Control Module defective	Replace
Trouble in intake or exhaust system	Air Cleaner Filter clogged	Replace filter element
	Air duct kicked or flattened	Correct or replace
Ignition failure	-	Refer to Hard Start Troubleshooting Guide
	Heat range of spark plug inadequate	Install spark plugs of adequate heat range
	Electronic Ignition System with module	Replace

Condition	Possible cause	Correction
Engine overheating	Level of Engine Coolant too low	Replenish
	Thermo switch or fan motor defective	Replace
	Thermostat defective	Replace
	Engine Coolant pump defective	Correct or replace
	Radiator clogged	Clean or replace
	Radiator filter cap defective	Replace
	Level of oil in engine crankcase too low or wrong oil in engine	Change or replenish
	Resistance in exhaust system increased	Clean exhaust system or replace defective parts
	Throttle Position Sensor adjustment incorrect	Adjust Wide Open Throttle switch setting
	Throttle Position Sensor circuit open or shorted	Correct or replace
	Cylinder head gasket damaged	Replace
	Cooling Fan clutch defective	Replace
	Fan belt slipping	Adjust tension of V-belt or replace V-belt
Engine overcooling	Thermostat defective	Replace (Use a thermostat set to open at 92°C (197.6°F))
Engine lacks compression	-	Refer to Hard Start
Others	Tire inflation pressure abnormal	Adjust to recommend pressures
	Brake drag	Adjust
	Clutch slipping	Adjust or replace
	Level of oil in engine crankcase too high	Correct level of engine oil

Engine Noisy

Abnormal engine noise often consists of various noises originating in rotating parts, sliding parts and other moving parts of the engine. It is, therefore, advisable to locate the source of noise systematically.

Condition	Possible cause	Correction
Noise from crank journals or from crank bearings (Faulty crank journals and crank bearings usually make dull noise that becomes more evident when accelerating)	Oil clearance increased due to worn crank journals or crank bearings	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crankshaft out of round	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing
	Crank bearing seized	Replace crank bearings and crankshaft or regrind crankshaft and install the over size bearing

Abnormal Noise Due to Hydraulic Lash Adjuster

Should abnormal noise due to the hydraulic lash adjuster trouble be heard immediately after the engine is started, inspect as follows:

Condition	Possible cause	Correction
Abnormal noise is heard	Air contaminated	Bleed
HLA is spongy	Check ball valve broken	Repair
	Safety valve in cylinder head broken	Replace
Valve clearance is not zero	HLA inside stick	Replace HLA assembly

Troubleshooting Procedure

Short out each spark plug in sequence using insulated spark plug wire removers. Locate cylinder with defective bearing by listening for abnormal noise that stops when spark plug is shorted out.

Condition	Possible cause	Correction
Noise from connecting rods or from connecting rod bearings (Faulty connecting rods or connecting rod bearings usually make an abnormal noise slightly higher than the crank bearing noise, which becomes more evident when engine is accelerated)	Bearing or crankshaft pin worn	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Crankpin out of round	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing
	Connecting rod bent	Correct or replace
	Connecting rod bearing seized	Replace connecting rod bearings and crankshaft or regrind crankshaft and install the under size bearing

Troubleshooting Procedure

Abnormal noise stops when the spark plug on the cylinder with defective parts is shorted out.

Condition	Possible cause	Correction
Piston and cylinder (Faulty piston or cylinder usually makes a combined mechanical thumping noise which increases when engine is suddenly accelerated but diminishes gradually as the engine warms up)	Piston clearance increased due to cylinder wear	Replace piston and cylinder body
	Piston seized	Replace piston and cylinder body
	Piston ring broken	Replace piston and cylinder body
	Piston defective	Replace pistons and others

2. Hood Hinge Bolt

- Tighten the engine hood hinge fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	

Troubleshooting Procedure

Condition	Possible cause	Correction
Piston pin noise (Piston makes noise each time it goes up and down)	Piston pin or piston pin hole worn	Replace piston, piston pin and connecting rod assy

Troubleshooting Procedure

The slapping sound stops when spark plug on bad cylinder is shorted out.

Condition	Possible cause	Correction
Timing belt noise	Timing belt tension is incorrect	Replace pusher or adjust the tension pulley or replace timing belt
	Tensioner bearing defective	Replace
	Timing belt defective	Replace
	Timing wheels defective	Replace
	Timing belt comes in contact with timing cover	Replace timing belt and timing cover
Valve noise	Valve and valve guide seized	Replace valve and valve guide
	Valve spring broken	Replace
	Valve seat off-positioned	Correct
Crankshaft noise	Crankshaft end play excessive (noise occurs when clutch is engaged)	Replace thrust bearing
Engine knocking	Preignition due to use of spark plugs of inadequate heat range	Install Spark Plugs of adequate heat range
	Fuel too low in octane rating	Replace fuel
	Wide Open Throttle enrichment system failure	Refer to Section 6E
	Selection of transmission gear incorrect	Caution operator or incorrect gear selection
	Engine overheating	Refer to "Engine Lacks Power"
Others	Water pump defective	Replace
	V-belt slipping	Adjust tension of V-belt or replace V-belt

Abnormal Combustion

Condition	Possible cause	Correction
Trouble in fuel injection system	Fuel pressure control valve defective	Replace
	Fuel filter clogged	Replace
	Fuel pump clogged	Clean or replace
	Fuel tank or fuel pipe clogged	Clean or replace
	Fuel injector clogged	Clean or replace
	Fuel pump relay defective	Replace
	Power supply cable for fuel pump loosely connected or defective	Reconnect, correct or replace
	Manifold Absolute Pressure Sensor circuit open or shorted	Correct or replace
	Manifold Absolute Pressure Sensor defective	Replace
	Engine Coolant Temperature (ECT) Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Throttle Position Sensor adjustment incorrect	Reconnect
	Throttle Position Sensor defective	Replace
	Throttle Position Sensor connector loosely connected	Reconnect
	Vehicle Speed Sensor cable loosely connected or defective	Correct or replace
	Vehicle Speed Sensor loosely fixed	Fix tightly
	Vehicle Speed Sensor in wrong contact or defective	Replace
	Engine Control Module cable loosely connected or defective	Correct or replace
Trouble in emission control system	Heated Oxygen Sensor circuit open (If applicable)	Correct or replace
	Heated Oxygen Sensor defective (If applicable)	Replace
	Signal vacuum hose loosely fitted or defective	Correct or replace
	ECT Sensor circuit open or shorted	Correct or replace
	ECT Sensor defective	Replace
	Evaporative Emission Control system (If applicable)	Refer to Section 6E
Trouble in ignition system	-	Refer to "Engine Lacks Power"
Trouble in cylinder head parts	Carbon deposits in combustion chamber	Remove carbon
	Carbon deposit on valve, valve seat and valve guide	Remove carbon

Engine Oil Consumption Excessive

Condition	Possible cause	Correction
Oil leaking	Oil pan drain plug loose	Retighten or replace gasket
	Oil pan setting bolds loosened	Retighten
	Oil pan gasket broken	Replace gasket
	Front cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Head cover retaining bolts loose or gasket broken	Retighten or replace gasket
	Oil filter adapter cracked	Replace
	Oil filter attaching bolt loose or rubber gasket broken	Retighten or replace oil filter
	Crankshaft front or rear oil seal defective	Replace oil seal
	Oil pressure unit loose or broken	Retighten or replace
	Blow-by gas hose broken	Replace hose
	Engine/Transmission coupling area	Replace oil seal
Oil leaking into combustion chambers due to poor seal in valve system	Valve stem oil seal defective	Replace
	Valve stem or valve guide worn	Replace valve and valve guide
Oil leaking into combustion chambers due to poor seal in cylinder parts	Cylinders and pistons worn excessively	Rebore cylinder and replace pistons and others
	Piston ring gaps incorrectly positioned	Correct
	Piston rings set with wrong side up	Correct
	Piston rings sticking	Rebore cylinder and replace pistons and others
	Piston ring and ring groove worn	Replace pistons and others
	Return ports in oil rings clogged	Clean piston and replace rings
Crank case ventilation, Positive Crankcase Ventilation System malfunctioning	Positive Crankcase Ventilation Hose clogged	Clean
Others	Improper oil viscosity	Use oil of recommended S.A.E. viscosity
	Continuous high speed driving and or severe usage such as trailer towing	Continuous high speed operation and or severe usage will normally cause increased oil consumption

Fuel Consumption Excessive

Condition	Possible cause	Correction
Trouble in fuel system	Mixture too rich or too lean due to trouble in fuel injection system	Refer to "Abnormal Combustion"
	Fuel cut function does not act	Refer to "Abnormal Combustion"
Trouble in ignition system	Misfiring or abnormal combustion due to trouble in ignition system	Refer to Hard Start or Abnormal Combustion Troubleshooting Guide
Others	Engine idle speed too high	Reset Idle Air Control Valve
	Returning of accelerator control sluggish	Correct
	Fuel system leakage	Correct or replace
	Clutch slipping	Correct
	Brake drag	Correct
	Selection of transmission gear incorrect	Caution operator of incorrect gear selection

Oil Problems

Condition	Possible cause	Correction
Oil pressure too low	Wrong oil in use	Replace with correct engine oil
	Relief valve sticking	Replace
	Oil pump not operating properly	Correct or replace
	Oil pump strainer clogged	Clean or replace strainer
	Oil pump worn	Replace
	Oil pressure gauge defective	Correct or replace
	Crankshaft bearing or connecting rod bearing worn	Replace
Oil contamination	Wrong oil in use	Replace with new engine oil
	Oil filter clogged	Replace oil filter
	Cylinder head gasket damage	Replace gasket
	Burned gases leaking	Replace piston and piston rings or rebore cylinders
Oil not reaching valve system	Oil passage in cylinder head or cylinder body clogged	Clean or correct

Engine Oil Pressure Check

1. Check for dirt, gasoline or water in the engine oil.
   a. Check the viscosity of the oil.
   b. Change the oil if the viscosity is outside the specified standard.
   c. Refer to the "Maintenance and Lubrication" section of this manual.
2. Check the engine oil level.
   The level should fall somewhere between the "ADD" and the "FULL" marks on the oil level dipstick.
   If the oil level does not reach the "ADD" mark on the oil level dipstick, engine oil must be added.
3. Remove the oil pressure unit.
4. Install an oil pressure gauge.
5. Start the engine and allow the engine to reach normal operating temperature (About 80°C).
6. Measure the oil pressure.

   Oil pressure should be:
   150 kPa(21.8 psi) at idle speed.
7. Stop the engine.
8. Remove the oil pressure gauge
9. Install the oil pressure unit.
10. Start the engine and check for leaks.

Malfunction Indicator Lamp

The instrument panel "CHECK ENGINE" Malfunction Indicator lamp (MIL) illuminates by self diagnostic system when the system checks the starting of engine, or senses malfunctions.

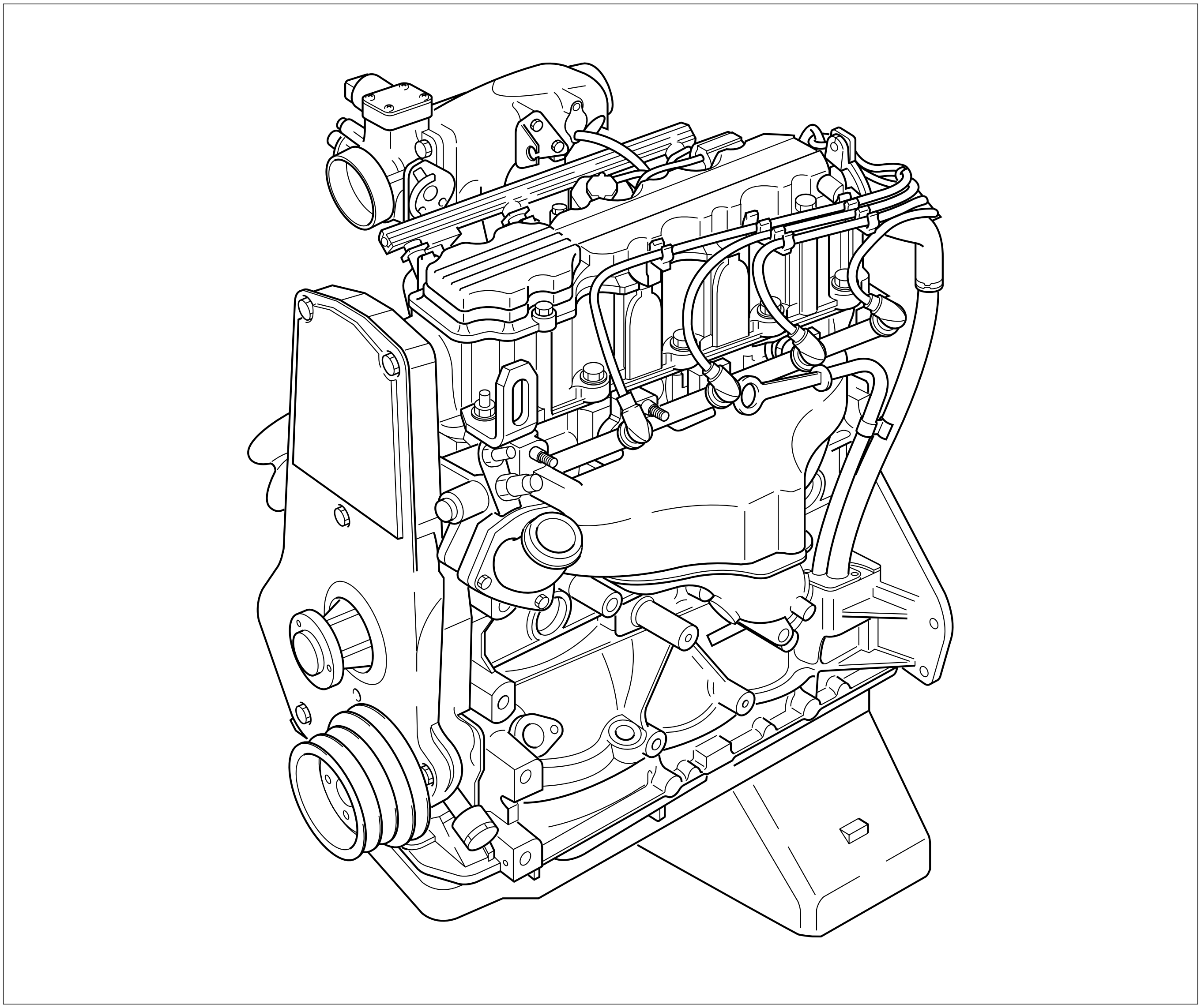
Condition	Possible cause	Correction
"CHECK ENGINE" MIL does not illuminate at the starting of engine	Bulb defective	Replace
	MIL circuit open	Correct or replace
	Command signal circuit to operate self diagnostic system shorted	Correct or replace
	Engine Control Module (ECM) cable loosely connected, disconnected or defective	Correct or replace
	ECM defective	Replace
"CHECK ENGINE" MIL illuminates, and stays on	Deterioration heated oxygen sensor of internal element	Replace
	Heated oxygen sensor connector terminal improper contact (If applicable)	Reconnect properly
	Heated oxygen sensor lead wire shorted (If applicable)	Correct
	Heated oxygen sensor circuit open (If applicable)	Correct or replace
	Deterioration engine coolant temperature sensor of internal element	Replace
	Engine coolant temperature sensor connector terminal improper contact	Reconnect properly
	Engine coolant temperature sensor lead wire shorted	Correct
	Engine coolant temperature sensor circuit open	Correct or replace
	Throttle position sensor open or shorted circuits	Correct or replace
	Deterioration of crankshaft position sensor	Replace
	Crankshaft position sensor circuit open or shorted	Correct or replace
	Vehicle speed sensor circuit open	Correct or replace
	Manifold absolute pressure sensor circuit open or shorted	Correct or replace
	Intake air temperature sensor circuit open or shorted	Correct or replace
	Fuel injector circuit open or shorted	Correct or replace
	ECM driver transistor defective	Replace EPROM or ECM
	Malfunctioning of ECM RAM (Random Access Memory) or Malfunctioning of ECM PROM (Programmed Read Only Memory)	Replace EPROM or ECM

SECTION 6A
ENGINE MECHANICAL

TABLE OF CONTENTS

PAGE

GENERAL DESCRIPTION



Engine Cleanliness And Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the thousandths of a millimeter (ten thousandths of an inch). Accordingly, when any internal engine parts are serviced, care and cleanliness are important. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

- A liberal coating of engine oil should be applied to all friction areas during assembly to protect and lubricate the surfaces on initial operation.
- Whenever valve train components, pistons, piston rings, connecting rods, rod bearings, and crankshaft journal bearings are removed for service, they should be retained in order.
- At the time of installation, they should be installed in the same locations and with the same mating surfaced as when removed.
- Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.
- The four cylinders of this engine are identified by numbers; cylinders 1, 2, 3 and 4, as counted from crankshaft pulley.

General Information on Engine Service

The following information on engine service should be noted carefully, as it is important in preventing damage and contributing to reliable engine performance:

- When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump strainer, jacking against the oil pan may cause damage to the oil pick up unit.
- The 12-volt electrical system is capable of damaging circuits. When performing any work where electrical terminals could possible be grounded, the ground cable of the battery should be disconnected at the battery.
- Any time the intake air duct or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material into the cylinder which could cause extensive damage when the engine is started.

Cylinder Block

The cylinder block is made of cast iron. The crankshaft is supported by five bearings. The bearing cap is made of nodular cast iron.

Cylinder Head

The cylinder head is made of aluminum alloy casting with a spark plug in the center.

Valve Train

Valve system is a single over head camshaft.
The valves clearance adjustment are hydraulic.
Hydraulic valve lifter adjustment, no adjustment necessary.

Intake Manifold

The intake manifold is made of aluminum alloy.

Exhaust Manifold

The exhaust manifold is made of high Si-Mo nodular iron.

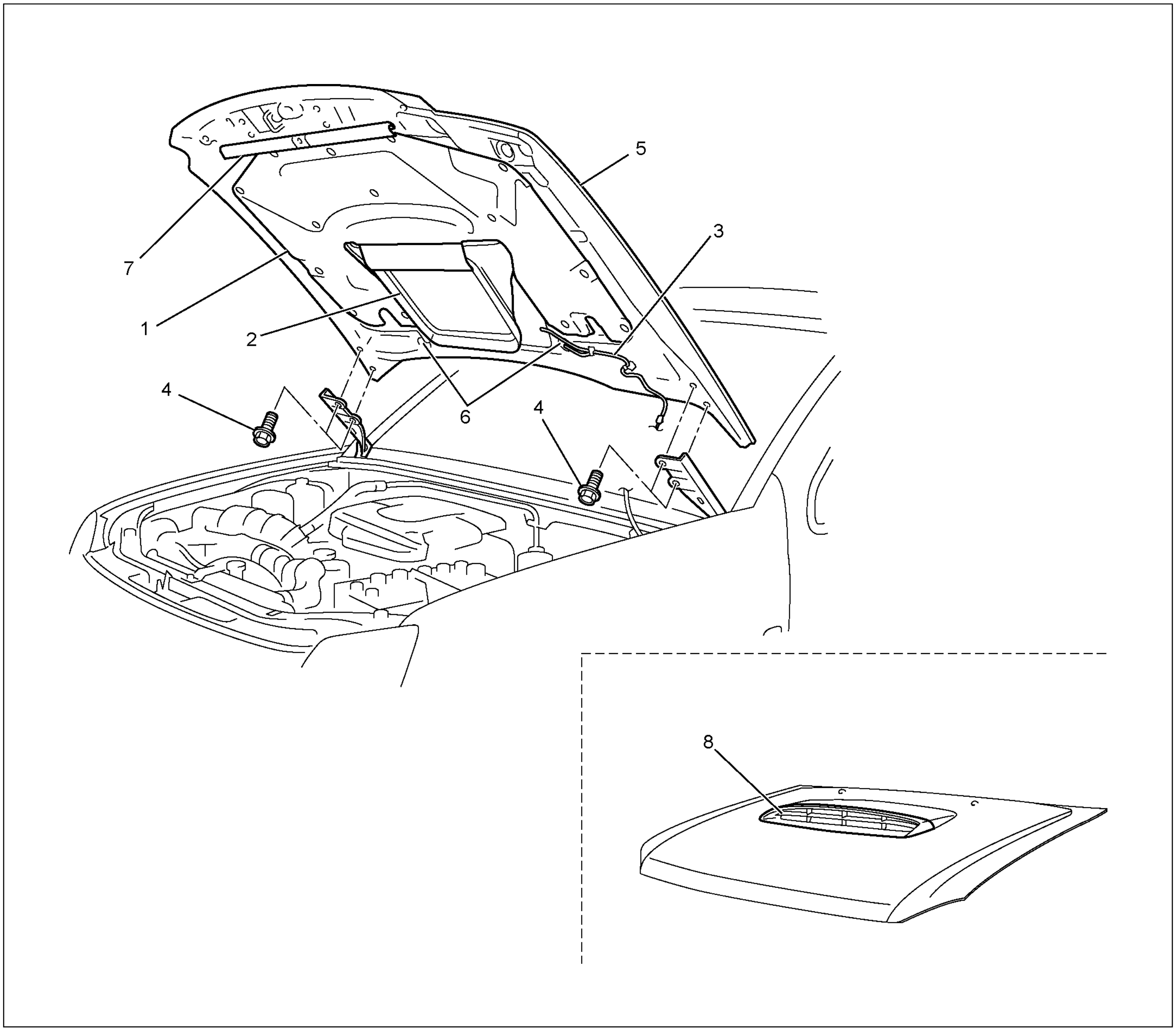
Pistons and Connecting Rods

Aluminum pistons are used after selecting the grade that meets the cylinder bore diameter. Each piston has two compression rings and one oil ring. The piston pin is made of cast hardened steel. The connecting rod bearings are made of modular cast iron. The connecting rod bearings are made of steel backed with tri-metal babbitt metal.

Crankshaft and Bearings

The crank shaft is made of modular cast iron. Pins and journal are graded for correct size selection for their bearing.

REMOVAL AND INSTALLATION



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4JK1 (High Output) / 4JJ1 (High Output) Model

Removal Steps

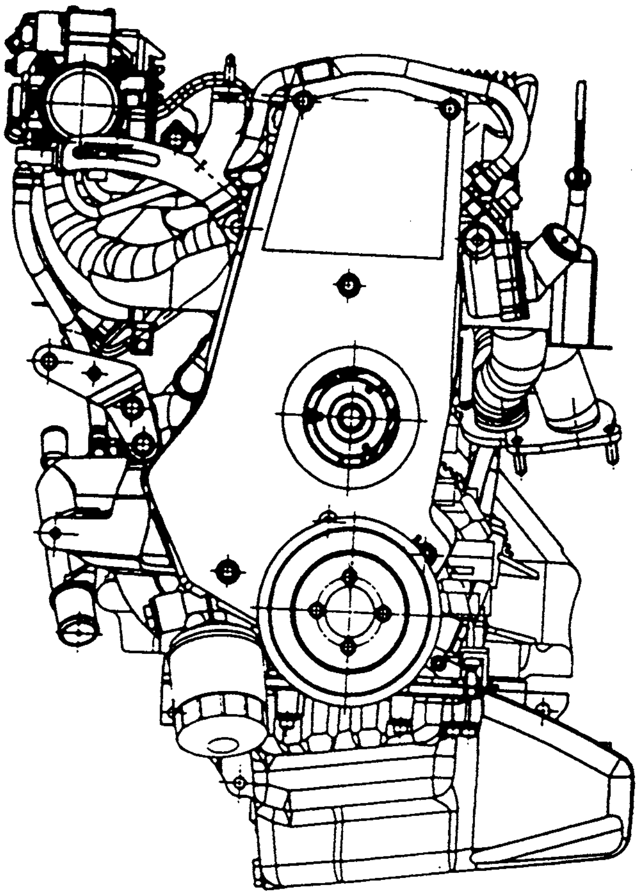
1. Hood insulator
2. ▲ Intercooler seal
3. ▲ Washer nozzle tube
4. ▲ Hood hinge bolt
5. Engine hood
6. Washer nozzle
7. Hood seal
8. ▲ Engine hood bulge

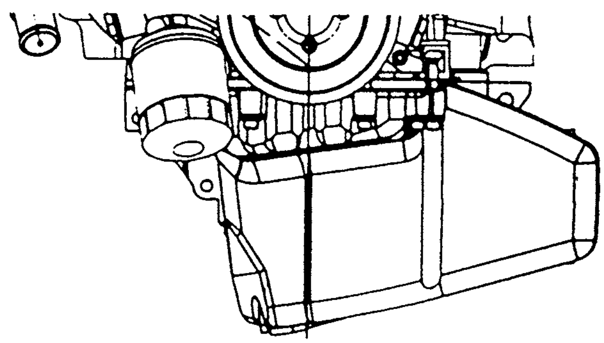
Installation Steps

8. Engine hood bulge
7. Hood seal
6. Washer nozzle
5. ▲ Engine hood
4. ▲ Hood hinge bolt
3. Washer nozzle tube
2. Intercooler seal
1. Hood insulator

ENGINE PICTORIAL

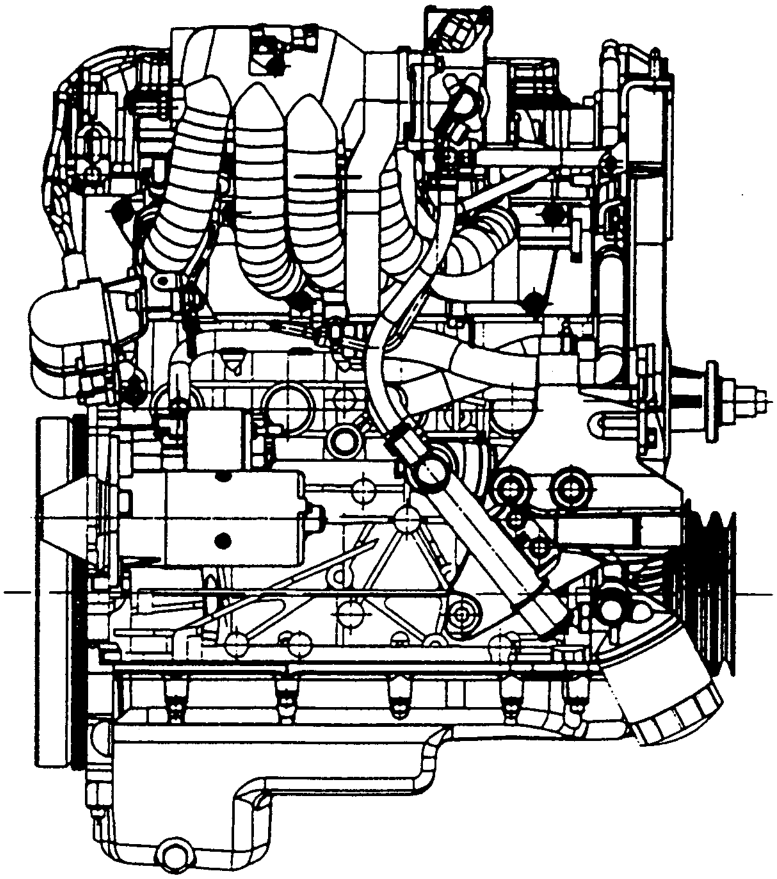
Front View

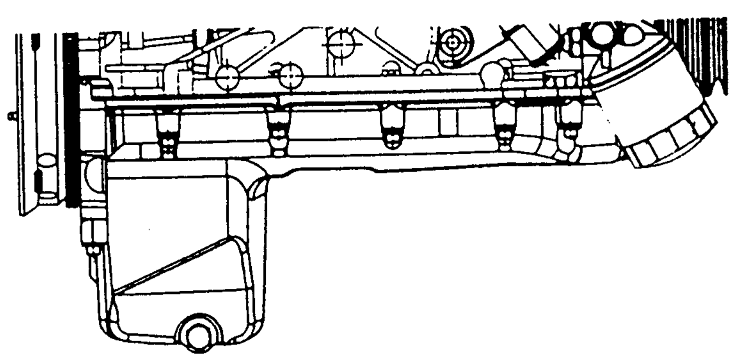




"4WD OIL PAN"

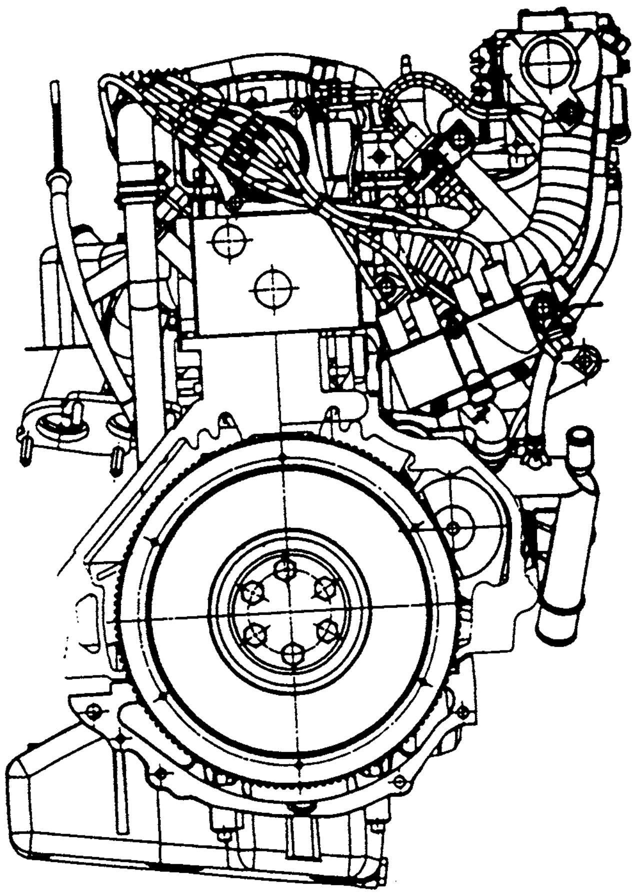
Inlet Side View

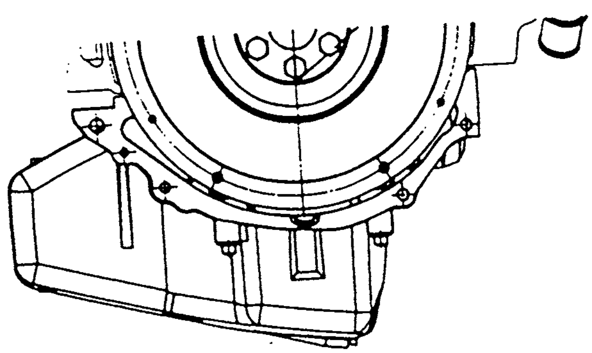




“4WD OIL PAN”

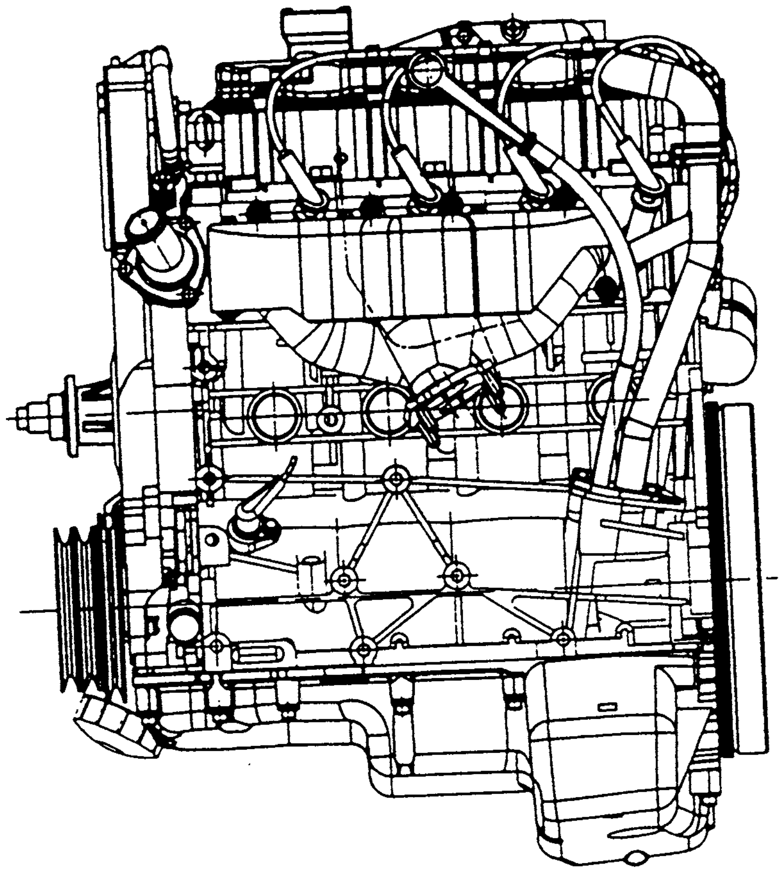
Rear View

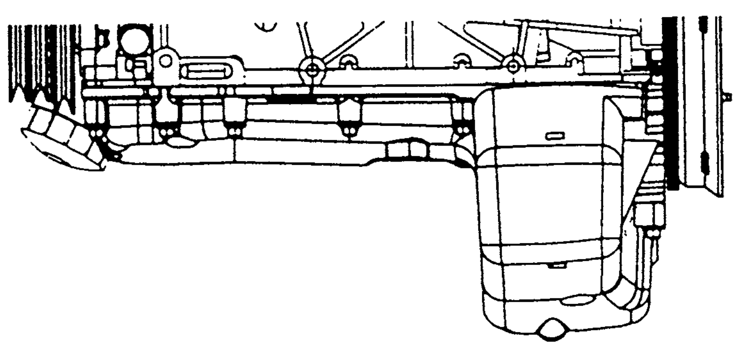




"4WD OIL PAN"

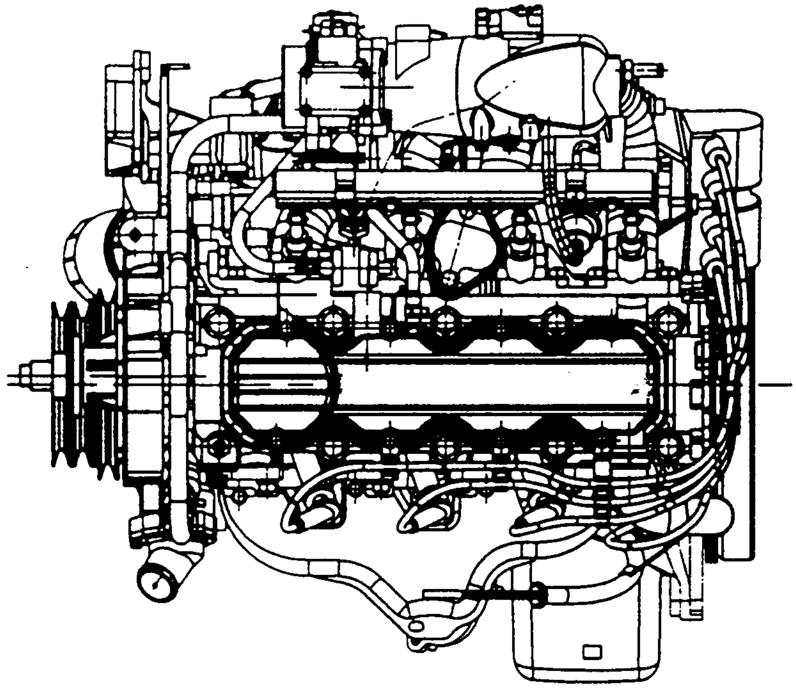
Exhaust Side View





“4WD OIL PAN”

Top View



Main Data and Specifications

Engine - General	C24SE
Engine type	Four-cycle, water cooled cross-flow with single over head camshaft Micro-computer control, fuel injection
Combustion chamber type (Volume)	Hemispherical (43.3cm^3)
Timing train system	Belt drive
No. of cylinders-bore × stroke mm (in)	4-87.5×100.0 (3.44×3.93)
Bore Spacing(C/L to C/L)	93.0 mm (3.66 in)
Firing Order	1-3-4-2
Bore×Stroke mm (in)	87.5×100.0 (3.44×3.93)
Total piston displacement cm^3 (in^3)	2,405(146.80)
Combustion Chamber Volume	43.3cm^3
No. of piston ring	Compression ring: 2, Oil ring: 1
Compression pressure kg/cm^2 (psi/pa)	12.2-16.3 (174-232/1200-1600)
Ignition timing (BTDC)	No adjustment
Idling speed: rpm(WO/AC,W/AC) A/C off	825
Valve clearances (At cold)	
Intake mm (in)	0 (0) (Hydraulic valve lash adjustment)
Exhaust mm (in)	0 (0) (")
Open at (BTDC) deg	17°30’
Close at (ABDC) deg	76°30’
Exhaust valves	
Open at (BBDC) deg	58°30’
Close at (ATDC) deg	35°30’
Ignition system	Fully transistorized battery ignition
Distributor type	Not applicable, Electronic Spark Timing control
Distributor advance type	Not applicable, Electronic Spark Timing control
Spark plug type	RN9YC4
Spark plug gap mm (in)	1.0--1.1 (0.039--0.043)
Lubrication system	
Lubricating method	Fully flow pressure circulation
Special engine oil (API grade)	SE, SF, SG or SH grade
Oil pressure kg/cm^2 (psi/Pa) rpm	4-4.6 (56.9-65.4/400-450)
Oil pump type	Gear
Oil filter type	Cartridge full flow
Oil capacity lit. (US/UK gal.)	4.25
Cooling system	
Radiator type	Corrugated fin with reserve tank
Coolant capacity lit. (US/UK gal.)	2.3 (0.66/0.55)
Water pump type	Centrifugal
Thermostat	Wax pellet with jiggle hole

Engine - General	C24SE
Fuel system	Electronically controlled Multi Port Fuel Injection System
Fuel pump type	Electric
Fuel pressure kg/cm^2 (psi/Pa)	3.4 (48.4/334)
Fuel filter type	Cartridge paper element
Air cleaner type	Dry paper element
Battery Type/V-Ax No. of units	34B19L/50D20L
Alternator	
Capacity V-A(W)	12-90 (1080), 12-100 (1200)
Starter	
Output V-kW	1.4
Exhaust system CO Adjustment	(1) Applicable to Open Loop System (Not equipped H2OS)
	(2) Not applicable to Closed Loop System (Equipped H2OS)
Compression Ratio (with Tolerance)	9.6:1±0.25
Cylinder Head Material	Aluminum Alloy (gravity cast)
Cylinder Block Material	Cast Iron
No. of Mounting Points (including trans.)	3
Engine Installation Angles -Longitudinal	4° 60'
-Lateral	7° 50' (towards exhaust side)
Overall Dimensions (L × W ×H):	
- TF (2.4Litre/2WD)	610×564×708mm
- TF (2.4Litre/4WD)	610×564×746mm
Engine Weight	
Engine Weight - TF (2.4Liter/Man)	140kg
Camshaft Type	SOHC
No. of Valves per Cylinder - Inlet	1
- Exhaust	1
Spark Plug Location	Side
Port Arrangement	Cross Flow
Working Principle	Spark Ignition 4-stroke

Valve System	C24SE
Actuation Type	Direct-acting Inverted Bucked Tappet
Valve Clearance Adjustment	Hydraulic
Valve Rotor Type	None
Inlet-Valve Material	Chromium Alloyed Steel
-Seat Insert Material	Sintered Iron
Exhaust-Valve Material	Head: Cr-Mn-Ni Alloyed Shaft: Cr-Si Alloyed &Cr plated
-Seat Insert Material	Sintered Iron
Valve Spring Material	GME 06 100-C1
Valve Guide Material	QS 13 MR 00
Valve Seal Type	Lip

Water Pump	C24SE
Type	Centrifugal
Drive-Material &Type	HNBR Toothed-belt
Bearing Type	Double Row Ball
Shaft Seal Type	Mechanical Ceramic

Thermostat-Coolant	C24SE
Type	Bypass

Oil Pump & Filter	C24SE
Type	Gear Pump
Location	Front of Engine
Drive	Direct Crankshaft Driven
Filter Type	Full Flow with Bypass for blocked filter

Oil & Oil Reservoir	C24SE
Reservoir-Description & Location	1-piece below Engine
Reservoir Material	Aluminum Alloy (pressure cast)
Replacement Oil Fill Volume	
-With Filter change	4.25liters
-Without Filter change	4.00liters
Recommended Oil-Run-in	10W/30SG
-Service (above-18°C)	10W/40SG
-Service (below-18°C)	5W/30SG
Oil Classification	API&CCMC

Ignition Components	C24SE
Spark Plugs	Conventional
Type	Electronic Spark Control
No. of Coils &Type	2 Solid State
Coil Location	Engine-mounted
Ignition Lead Type	Inductive (hi-resistance)

Crankshaft	C24SE
Material	Nodular Cast Iron
Bearing subjected to End Thrust	Guide Bearing NO.3
Main Bearing-Material &Type	Steel Backed Tri-metal Babbitt
Front Seal-Diameter &Type	35.0mm Lip Seal
Rear seal-Diameter &Type	90.0mm Micro-lip Seal
Crankshaft Balancing	Individually Balanced
No. of Counterweights	8

Camshaft	C24SE
Location	Overhead (Cylinder Head)
Material	Grey Cast Iron
Bearing Material	Aluminum
No. of Bearings Camshaft Drive-Material &Type	200-250 HB5/750 (Camshaft drive type: toothed belt Camshaft drive material: rubber composite GD380)

Pistons	C24SE
Material	Aluminum Alloy
Finish & Type	Tin-coated Strutless
Piston Rings	
Function (top to bottom) -Ring 1	Compression Ring
-Ring 2	Compression Ring
-Ring 3	Oil Ring
Description -Ring 1	Rectangular
-Ring 2	Taper Face
-Ring 3	3-piece (2 Scrapers&1 Expander)
Material -Ring 1	Molybdenum Inlay Nodular Cast Iron
-Ring 2	Cast Iron (individually cast)
-Ring 3	Steel
Material	Case Hardened Steel
Retention	Locked in Rod
Bearing	Machined in Piston Pin Boss

Connecting Rod	C24SE
Material	Nodular Cast Iron
Bearing-Material &Type	Steel Backed Tri-metal Babbitt

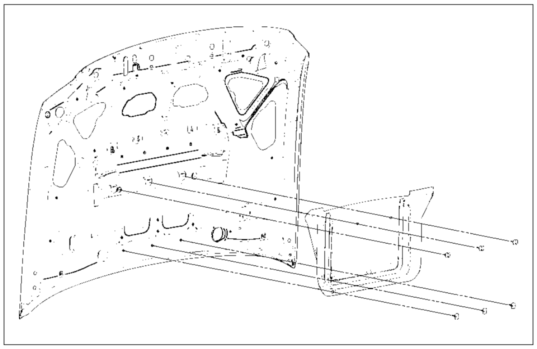
Inlet Manifold	C24SE
Material	Aluminum Alloy

Exhaust Manifold	C24SE
Description	Dual Take-down
Material	High Si-Mo Nodular Iron

Engine Specification Matrix for destination

04 HEO FOR TF MODEL: VEHICLE MODEL TFR/S	**2.4L**				
Major Description	AUSTRALIA, CHILE, GULF, NEW ZEALAND, SAUDI ARABIA, SOUTH AFRICA		COLOMBIA, COSTA RICA, EQUADOR, GUATEMALA		BOLIVIA, GENERAL EXPORT, PERU, VENEZUELA
VEHICLE TYPE	4×2	4x4	4×2	4×4	4×2
VEHICLE IDENT. CODE	TX	TY	TX	TY	TX
ENGINE TYPE	C24SE		←		←
FUEL CONTROL SYSYTEM	CLOSE LOOP		CLOSED LOOP		OPEN LOOP
COMPRESSION RATIO	9.6:1		←		←
FUEL OCTANE(ROD)	91RON		85RON		80RON
FUEL TYPE	UN-LEADED		UN-LEADED		LEADED
HO2	YES		YES	YES	NO
EVAP CANISTER	YES		YES	YES	YES
PURGE CONTROL SOLENOID	YES		YES	YES	YES
CHECK & RELIEF VALVE	YES		YES	YES	YES
ECM	YES		YES	YES	YES
EXHAUST SYSTEM					
FRONT PIPE					
SILENCER					
TWC	YES		YES	YES	NO
CO ADJUSTMENT	NO		NO	NO	YES
	Refer to 6A-77		Refer to 6A-77		Refer to 6A-77

Important Operations - Removal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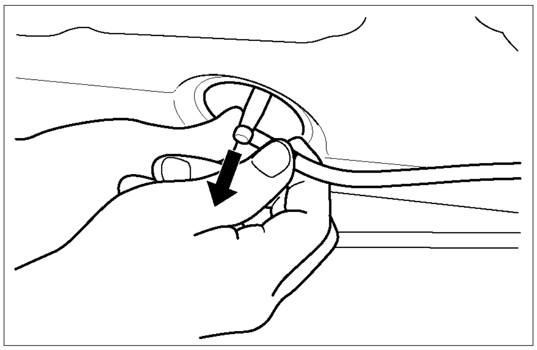
2. Intercooler Seal

- Remove the 6 clips.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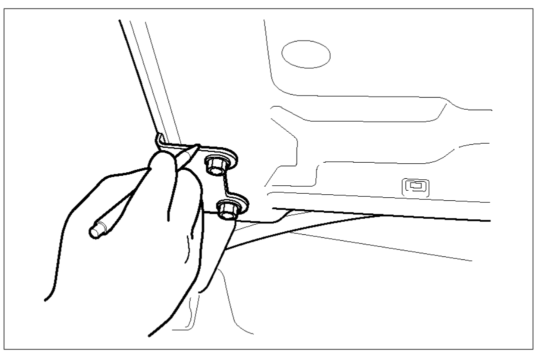
3. Washer Nozzle Tube

1) Open the hood.
2) Support the hood.
3) Remove the windshield washer nozzle tube.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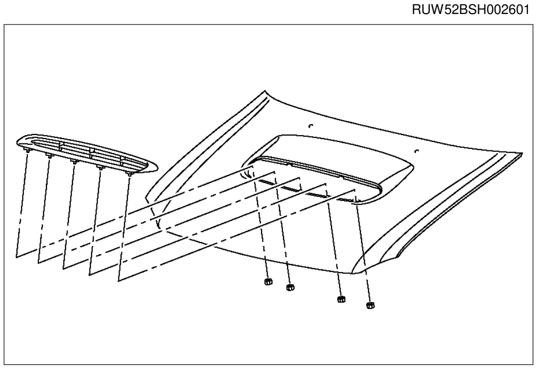
4. Hood Hinge Bolt

- Before removing the hinges from the engine hood, scribe a mark showing location of the hinges to facilitate installation in the original position.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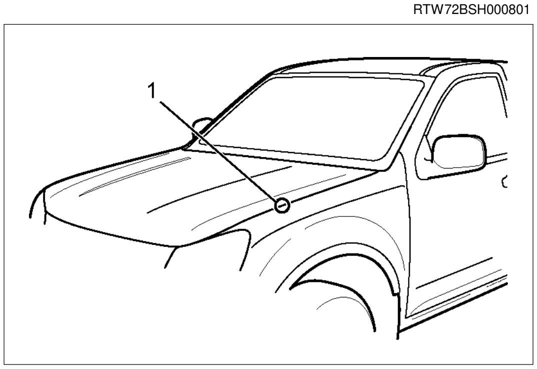
8. Engine Hood Bulge

- Remove the 4 nuts.

Important Operations - Installation



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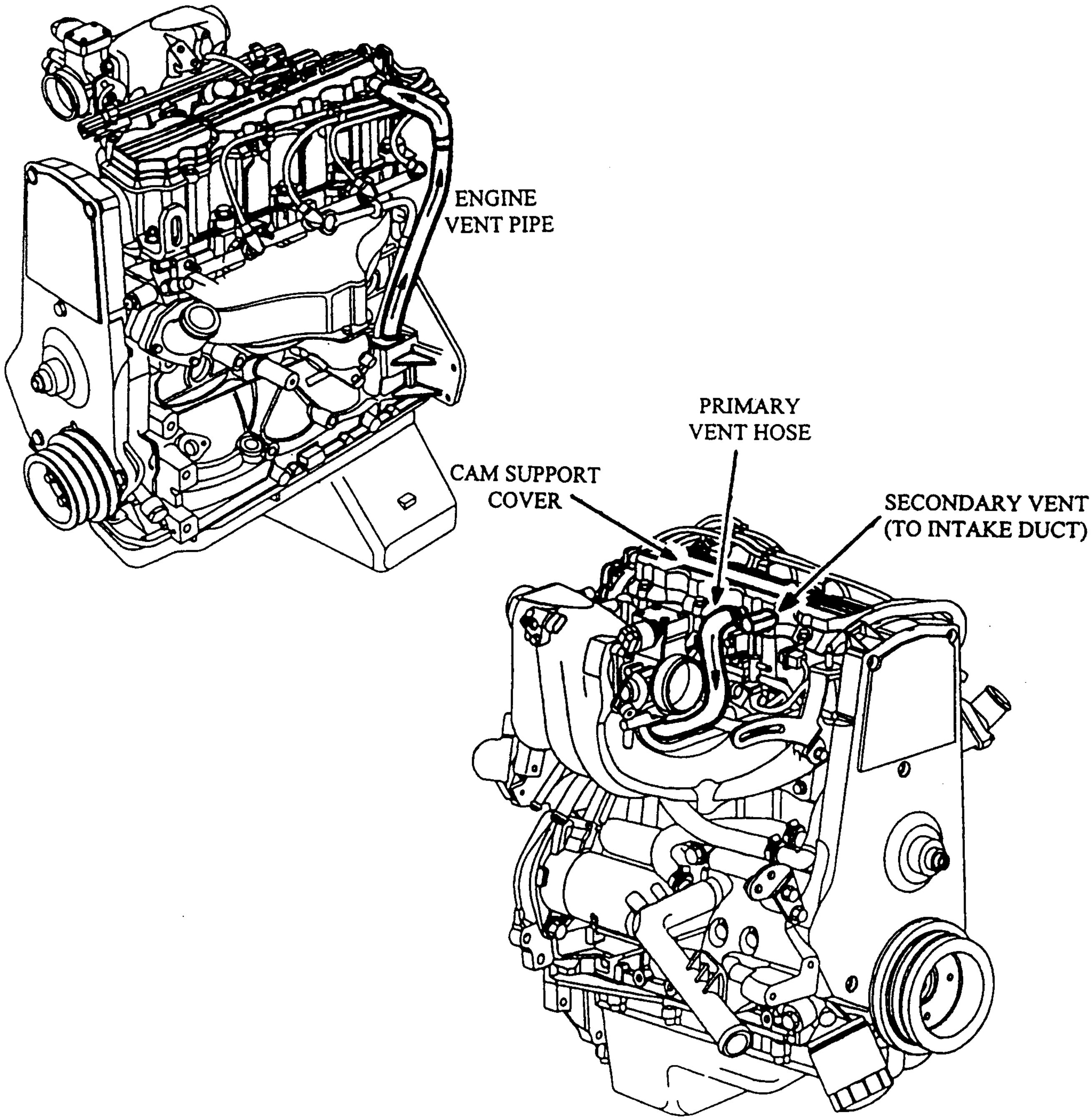
5. Engine Hood

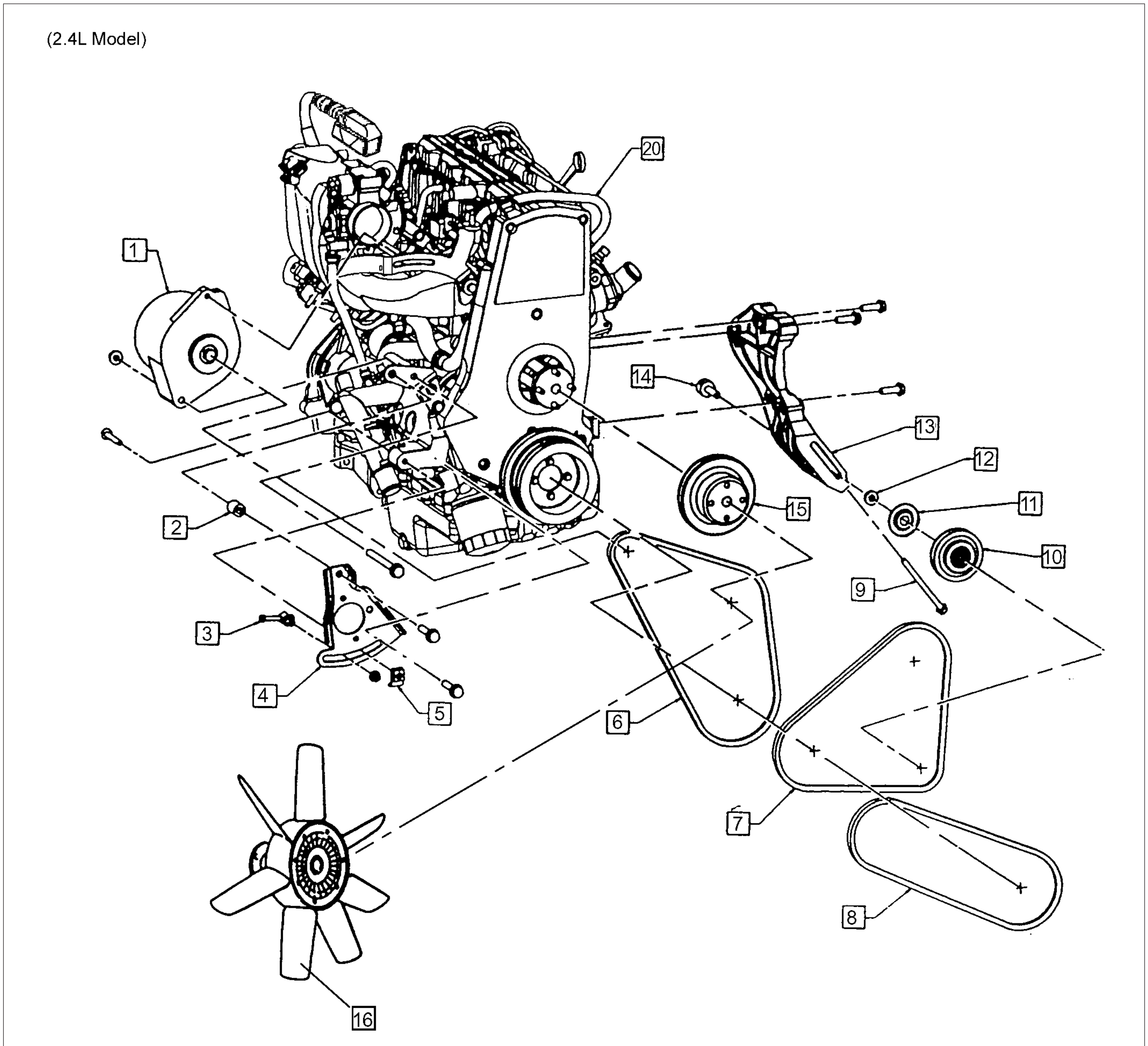
- Check the engine hood and fender (1).

CRANKCASE VENTILATION SYSTEM



The Engine Ventilation System passes crankcase vapours, via the Engine Vent Pipe, to the Cam Support Cover, where separation of oil and exhaust gases occur. The oil drains into the Cylinder Head, via the Camshaft Support. The gases pass through the Primary and Secondary Vent Hoses to the intake system, and are consumed during the combustion process.

ENGINE ASSEMBLY & LOOSE PARTS



Loose Parts

1 Alternator
2 P/S Pivot Spacer
3 P/S Adjusting Screw
4 P/S Adjusting Plate
5 P/S Adjusting Nut
6 Alternator & Fan Drive Belt
7 A/C Compressor Drive Belt
8 P/S Pump Drive Belt
9 Tensioner Bolt
10 Tensioner Pulley
11 Pulley Dust Shield Cover
12 Pulley Spacer
13 A/C Compressor Bracket
14 Pulley Bolt
15 Fan Pulley
16 Cooling Fan

Engine Assembly

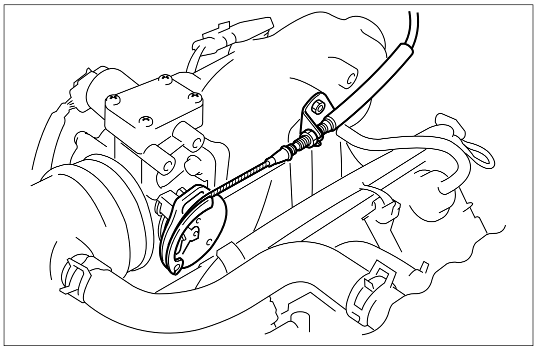
20 C24SE

OPERATIONS ON ENGINE AGGREGATES

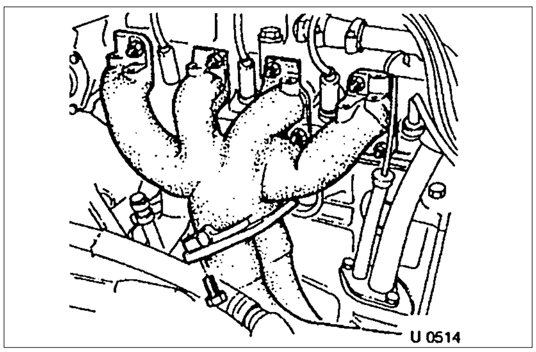
Engine Damping Blocks (Engine Without Transmission)

Removal

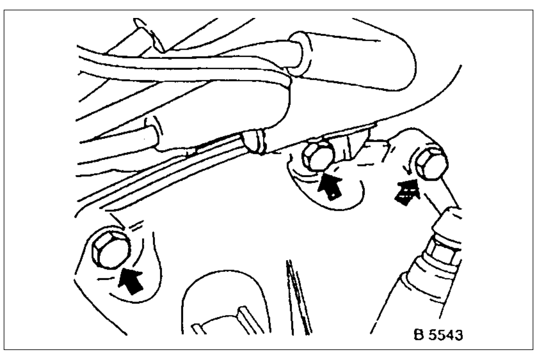
1. Remove bonnet.
2. Remove radiator.
3. Remove air inlet hose.
4. Remove power steering pump drive belt and power steering pump from engine.



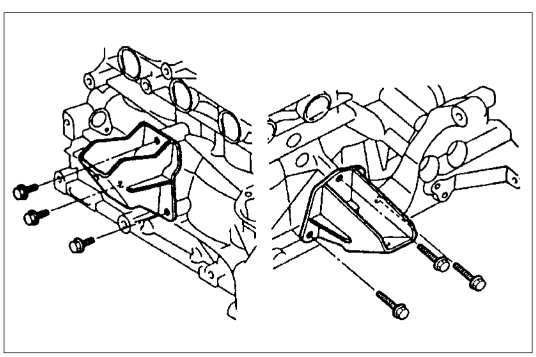
5. Remove all cable connections, hoses and lines from engine.
6. Remove accelerator cable from inlet pipe.



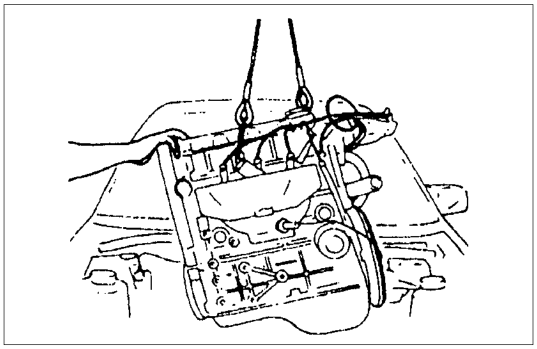
7. Remove exhaust pipe from manifold.



8. Remove lower nine bolts and transmission from engine block.
9. Remove clutch slave cylinder and allow to hang free.
10. Remove starter from engine block.



11. Remove upper bolts of left and right engine mounting from damping blocks.
12. Raise engine slightly.
13. Remove lower bolts of left and right damping blocks.
14. Remove damping blocks.



Attach engine to cable, support transmission with car jack and remove upper transmission fastening bolt.

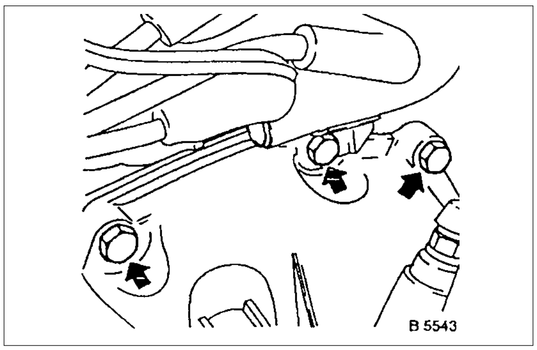
Press off engine from transmission and lift out of engine compartment.

Installation

Lower engine into engine compartment and insert guide bushings on cylinder block into transmission.

Tighten (Torque)

Transmission to cylinder block (M10)	-45 N·m (4.6 kgf·m)
Transmission to cylinder block (M12)	-60 N·m (6.1 kgf·m)

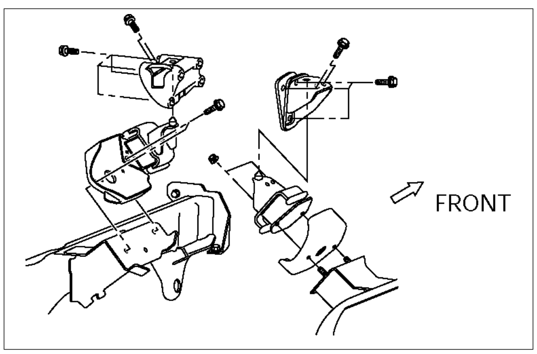


Installation

1. Install engine to vehicle and transmission.
2. Install clutch slave cylinder.

Tighten (Torque)

Transmission to engine block bolts - 76 N·m (7.6 kgf·m)



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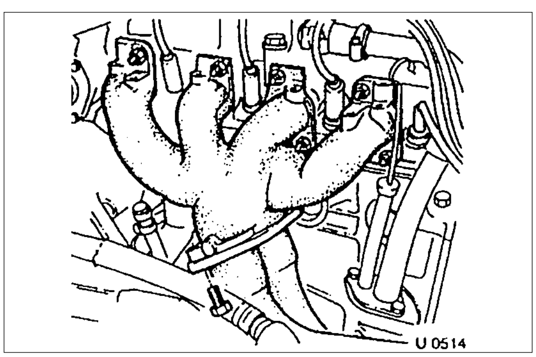
3. Install left engine damping block to side member.
4. Install left and right engine damping blocks to engine brackets.

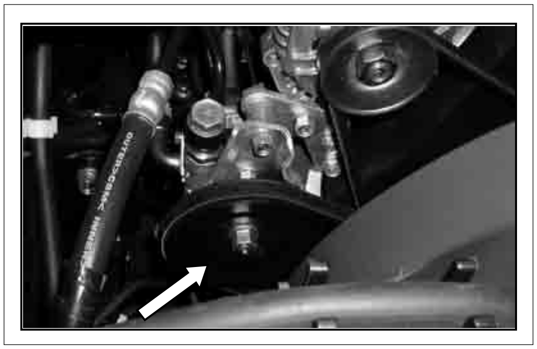
Tighten (Torque)

Engine damper block to side member - 52 N·m (5.3 kgf·m)

Engine damper block to engine bracket - 85 N·m (8.7 kgf·m)



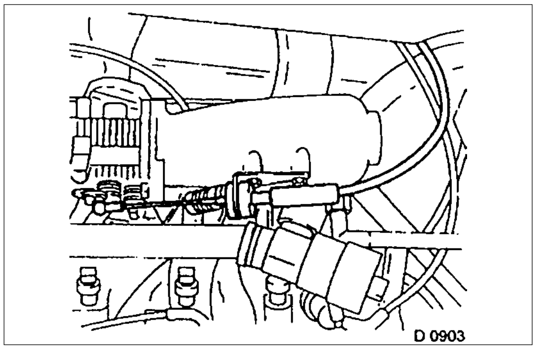
5. Install exhaust pipe to manifold.



6. Install power steering pump and V-belt.

Adjust

Adjust power steering pump V-belt tension according to the corresponding operation.



Installation

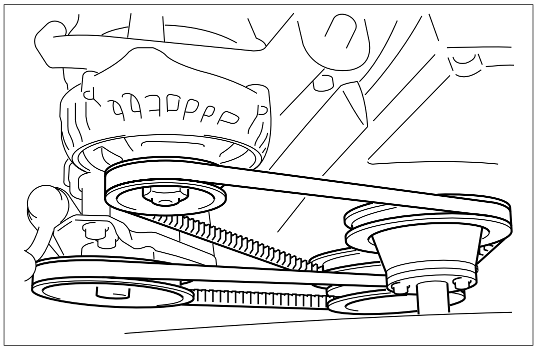
7. Install radiator according to the corresponding operation.
8. Install air inlet hose.
9. Install all electrical cable connections, hoses and lines to engine.
10. Install accelerator cable from inlet pipe.
11. Install bonnet.

Inspection

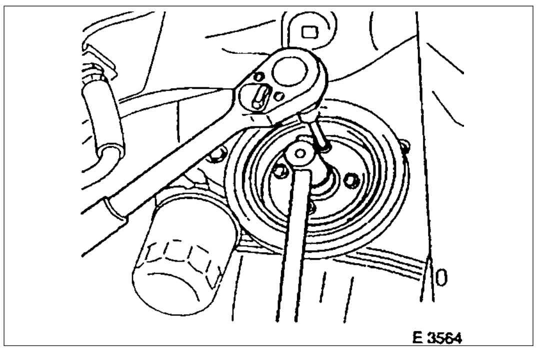
1. Check engine oil level.
2. Fill up cooling system and bleed according to the corresponding operation.

Toothed Belt and Timing Check

Removal

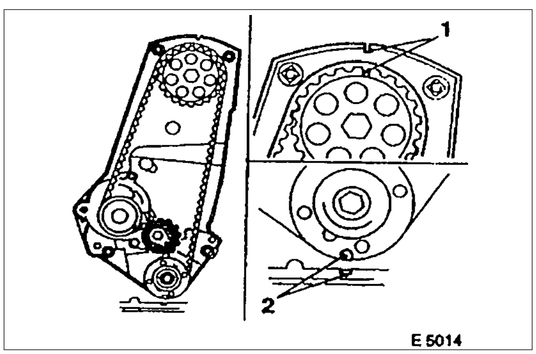


1. Remove the belts on the bracket for alternator.
2. Remove the fan.
3. Remove the V-belt for power steering.
4. Remove the V-belt for A/C.
5. Remove the fan belt.
6. Remove the fan shroud.

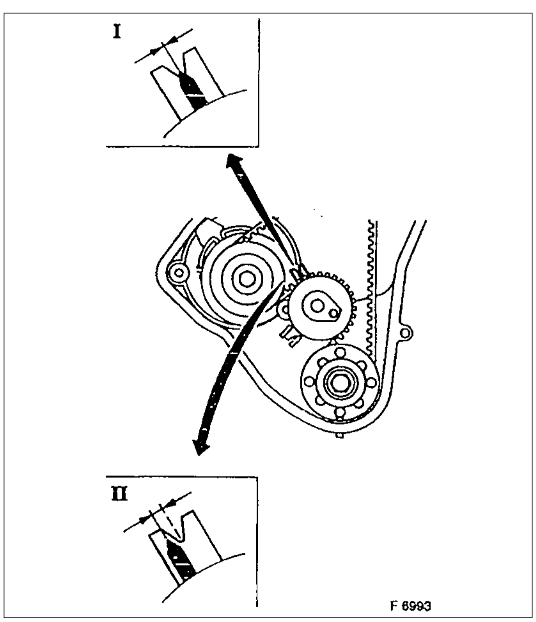


7. Remove the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
8. Remove the toothed belt from cover.

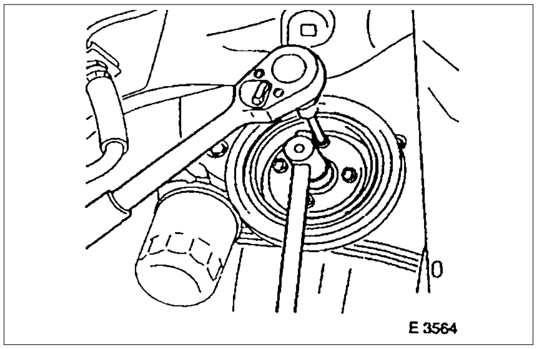
Inspection



1. Turn the crankshaft in the engine rotational direction mark(2) so that the notch (1) on the camshaft gear aligns with the mark on toothed belt rear cover.
2. Check the timing belt for worn, cracks or oil adhesion.



3. Check that the cast on the water pump aligns with the counterpart on cylinder block (arrowed).
4. The tension of a toothed belt is correctly adjusted when the pointer and the center of the notch are aligned(I). The tension of a run-in toothed belt (regardless of mileage covered) is correctly adjusted when the pointer is positioned approx. 4mm (0.16 in.) to the left of the center of the notch(II).
   Check the condition of the run-in toothed belt for suitability for reuse. Only toothed belts of the toothed belt tension rollers must be replaced and the source of oil contamination must be eliminated.

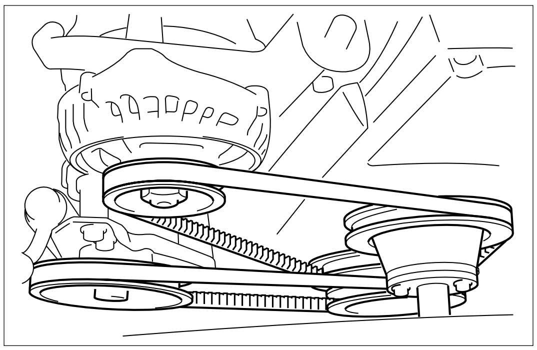


Installation

1. Install the toothed belt to the cover.
2. Install the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
3. Install the fan shroud.

Tighten(Torque)

Crankshaft pulley bolts - 20 N·m (2.1 kgf·m)



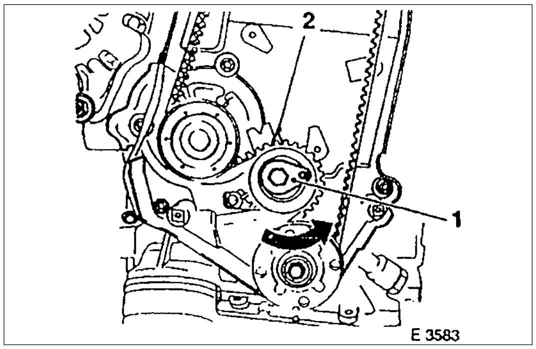
4. Install the fan belt
5. Install the V-belt for A/C.
6. Install the V-belt for power steering.
7. Install the fan.
8. Install the belts on the bracket for alternator.

Toothed Belt Tension, Adjust (Engines with toothed belt tension roller)

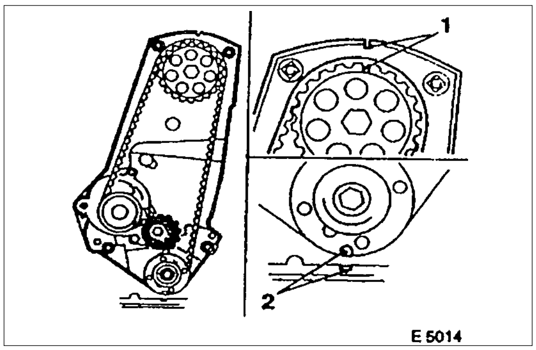
Removal

Refer to 6A-21. Toothed Belt and Timing check and removal steps.

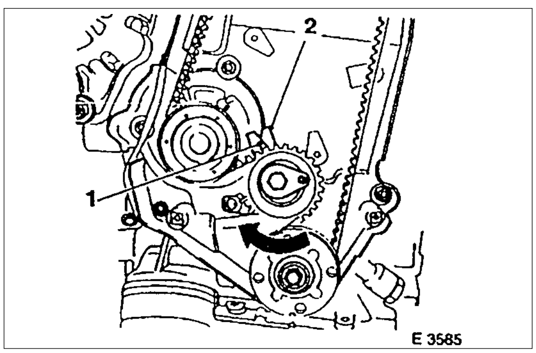
Adjust



1. Loosen the fastening bolt of the toothed belt tension roller.
2. Turn the toothed belt tension roller at adjustment eccentric (1) in the direction of arrow (counterclockwise), until pointer (2) comes to the right stop.
3. If necessary tighten the fastening bolt of toothed belt tension roller.



4. Rotate the crankshaft twice (720°) in the engine rotational direction until marks (2) and (1) align again.

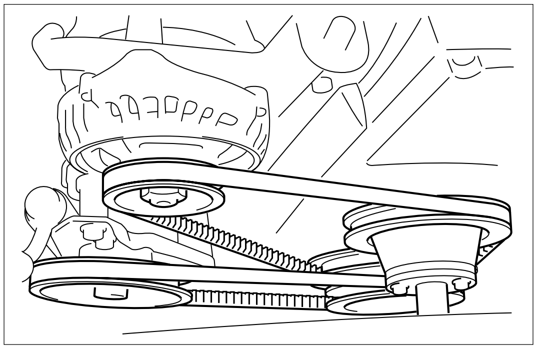


5. Turn the eccentric in the direction of arrow (clockwise) until pointer (1) and notch (2) are positioned to suit age of toothed belt.
6. Rotate the crankshaft twice (720°) in the engine rotational direction again and correct adjustment if necessary.

Installation

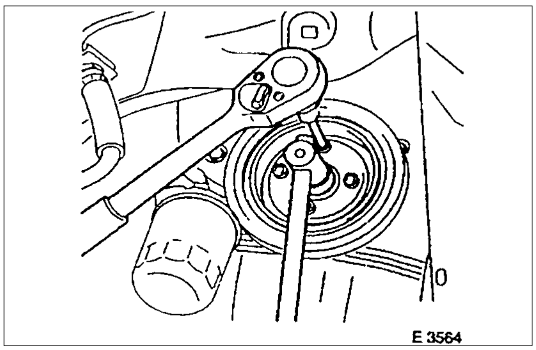
Refer to 6A-21. Toothed Belt and Timing check and installation steps.

Toothed Belt, Replace (Engine with toothed belt tension roller)

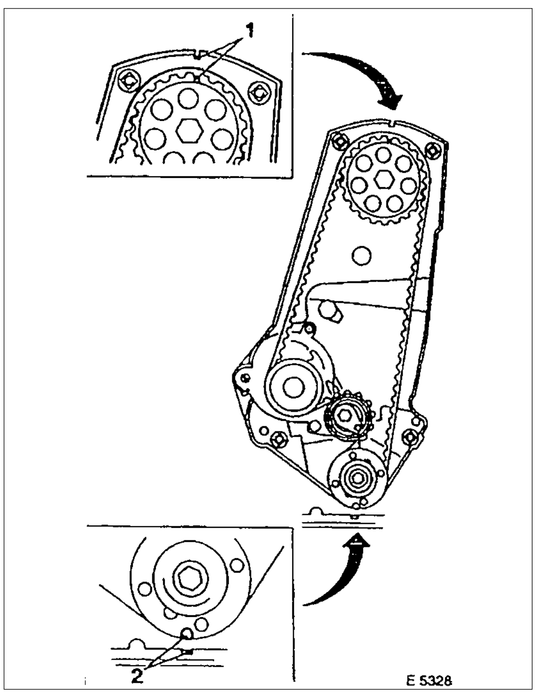


Removal

1. Remove the belts on the bracket for alternator.
2. Remove the fan.
3. Remove the V-belt for power steering.
4. Remove the V-belt for A/C.
5. Remove the fan belt.
6. Remove the fan shroud.

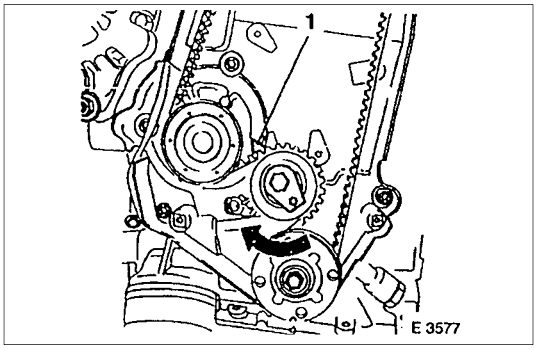


7. Remove the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
8. Remove the toothed belt from cover.



Adjust

Turn the crankshaft in the engine rotational direction to mark(2).
Align markings on toothed belt and on toothed belt rear cover. Simultaneously, notch (1) on camshaft gear must align with the mark on toothed belt rear cover.
Turn the crankshaft slowly and smoothly.



Adjust

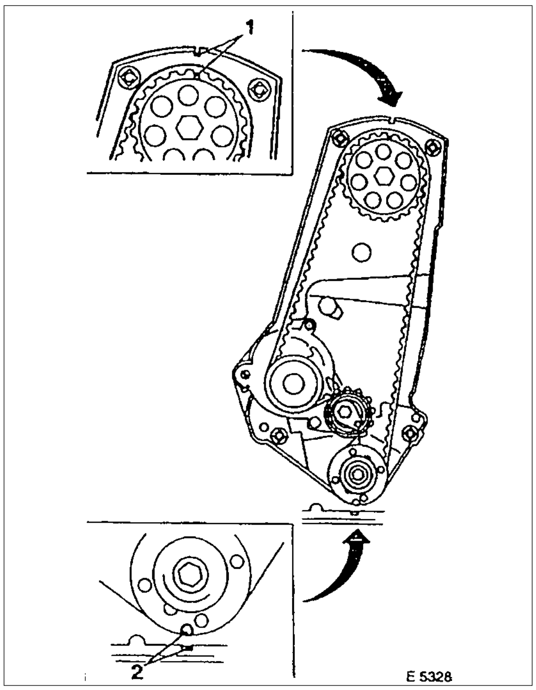
Loosen the fastening bolt of the toothed belt tension roller and turn the adjustment eccentric in the direction of arrow (clockwise) until pointer (1) comes to the left stop.
Remove the toothed belt.

Installation

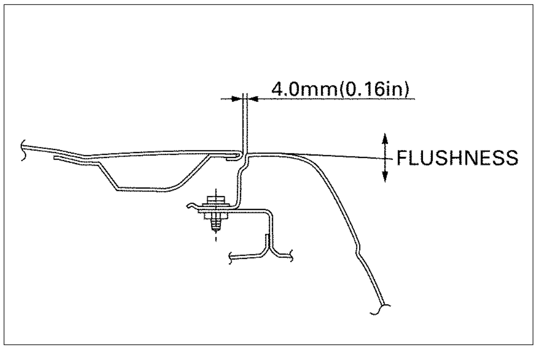
1. Install a new toothed belt while keeping tension side taut.

Adjust

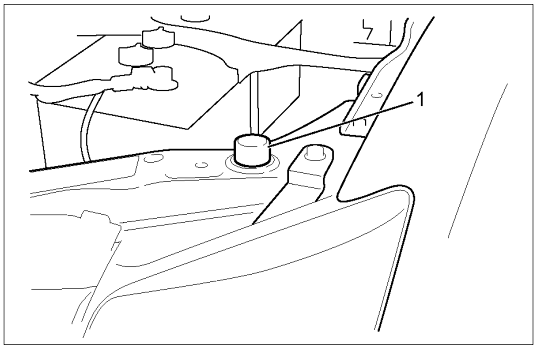
Toothed belt tension - see operation " Toothed Belt Tension".



2. Install the toothed belt to the cover.
3. Install the crankshaft pulley while counterholding on the fastening bolt of toothed belt drive gear.
4. Install the fan shroud.
5. Install the fan belt.
6. Install the V-belt for A/C.
7. Install the V-belt for power steering.
8. Install the fan.
9. Install the belts to the bracket for alternator.



- Clearance : 4.0 mm (0.16 in)
- Height (step) : Flushness
- Adjust clearance using the hinges on the engine hood.



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- Adjust height (step) using the hood rests (1).

Engine Hood Striker

- Apply a light coat of grease to the striker.

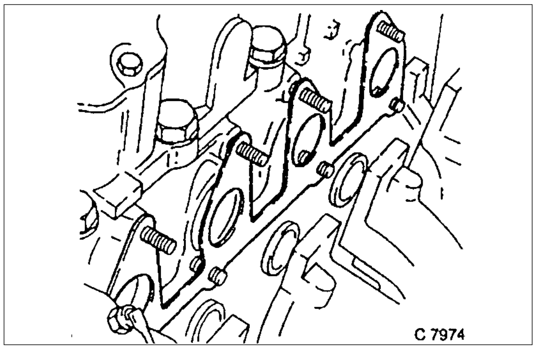
4. Hood Hinge Bolt

- Tighten the engine hood hinge fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	

OPERATIONS ON INSTALLED ENGINE

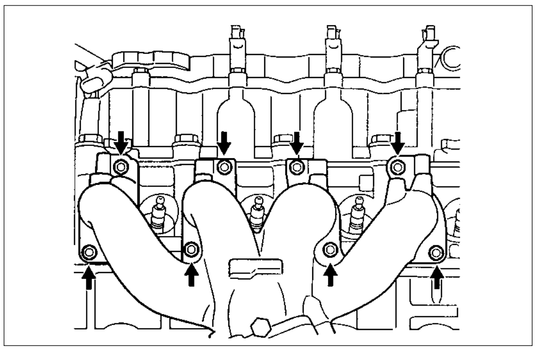
SEALING OPERATIONS



Gasket, Exhaust Manifold, Cylinder Head

Removal

1. Remove front exhaust pipe from exhaust manifold.
2. Remove exhaust manifold heat shield.
3. Remove exhaust manifold retaining nut.
4. Remove exhaust manifold from cylinder head.

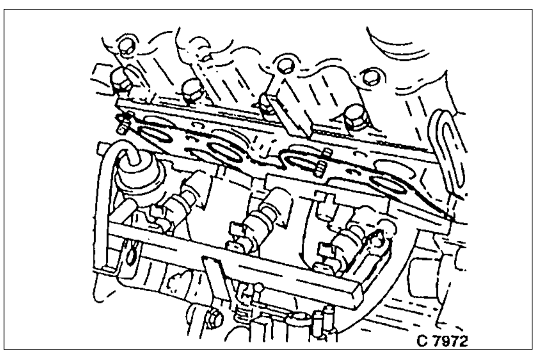


Clean

Sealing surfaces.

Tighten (Torque)

Exhaust manifold to cylinder head - 22 N·m (2.2 kgf·m)
Front exhaust pipe to exhaust manifold - 25 N·m (2.6 kgf·m)



Gasket, Intake Manifold, Cylinder Head

Removal

1. Remove air intake hose.
2. Remove drive belt for alternator.
3. Remove bolt clamping bracket for alternator from intake manifold.
4. Remove intake manifold from cylinder head.

Clean

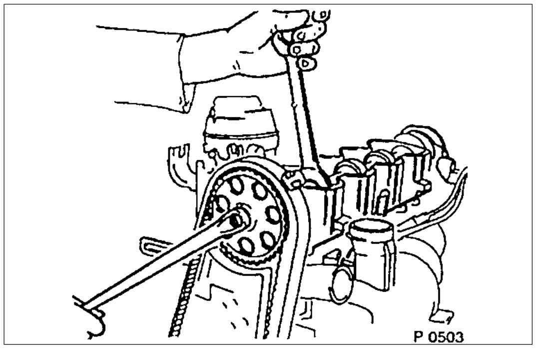
Sealing surfaces

Tighten (Torque)

Intake manifold to cylinder head - 22 N·m (2.2 kgf·m)
Clamping bracket for alternator to intake manifold - 25 N·m (2.5 kgf·m)

Installation

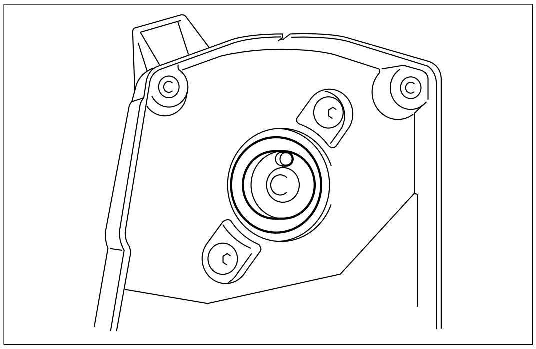
1. Install V-belt according to the corresponding operation.
2. Install air intake hose.



Seal Ring, Camshaft Housing, Timing Side

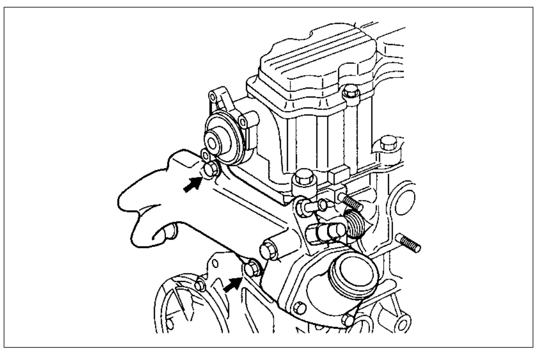
Removal

1. Remove front toothed belt cover toothed belt from camshaft timing gear according to the corresponding operation.
2. Remove camshaft housing cover and camshaft timing gear.
3. Remove sealing ring by making hole in middle of ring, turning in self-tapping screw and edging out.



Installation

1. Install sealing ring by using 5-8840-0451-0 with camshaft sprocket bolt and washer.
2. Install coat seal lips of shaft seal ring slightly.



Seal Ring, Thermostat Housing, Cylinder Head

Removal

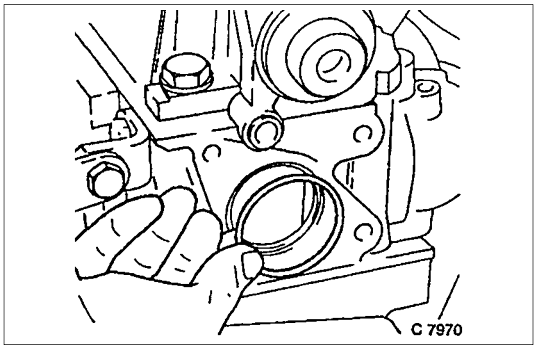
1. Open radiator drain tap and collect coolant.
2. Remove toothed belt rear cover and toothed belt according to the corresponding operation.
3. Remove camshaft housing cover.
4. Remove camshaft timing gear by counterholding camshaft with a flat spanner.
5. Remove cable from temperature sensor.
6. Remove upper inner hex bolts of rear toothed belt cover.
7. Turn rear toothed belt cover to one side.
8. Remove thermostat housing.
9. Remove sealing ring from cylinder head.

Clean

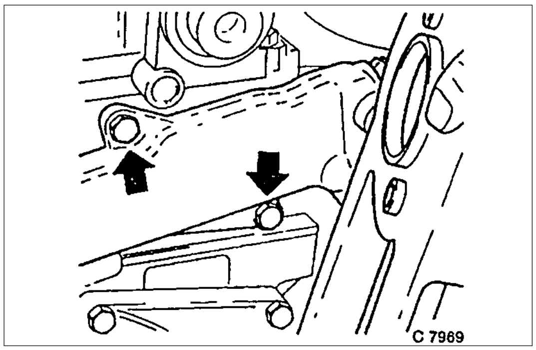
Sealing surfaces in cylinder head and thermostat housing.

Installation

1. Install sealing ring in recess of cylinder head.

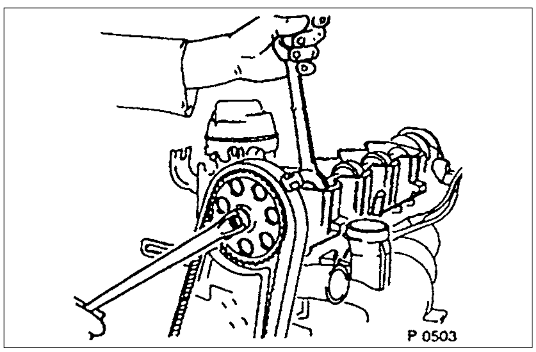


2. Install cable to temperature sensor.
3. Install upper bolts of rear toothed belt rear cover.
4. Install camshaft timing gear then check timing according to the corresponding operation.
5. Install camshaft housing cover.
6. Install toothed belt and front cover.
7. Fill up and bleed cooling system according to the corresponding operation.



Tighten (Torque)

Thermostat housing to cylinder head - 15 N·m/1.5 kgf·m.

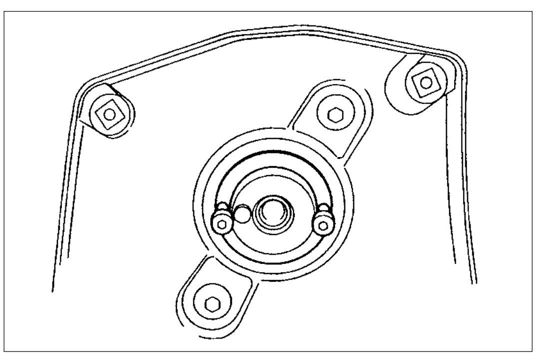


Seal Ring - Front Camshaft Housing, Replace

Removal

Mark running direction of toothed belt.
Remove toothed belt-see operation “Toothed Belt, Replace”.

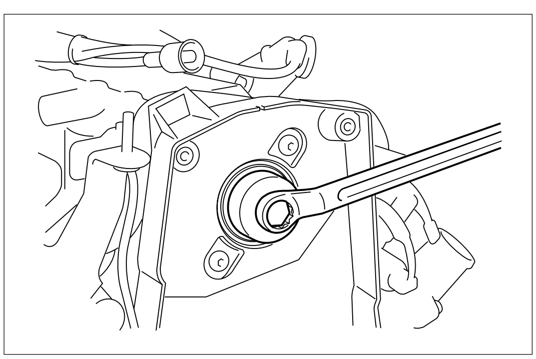
Camshaft housing cover, camshaft pulley-counterhold on hex of camshaft.



Removal

Screw self-tapping screw into seal ring.

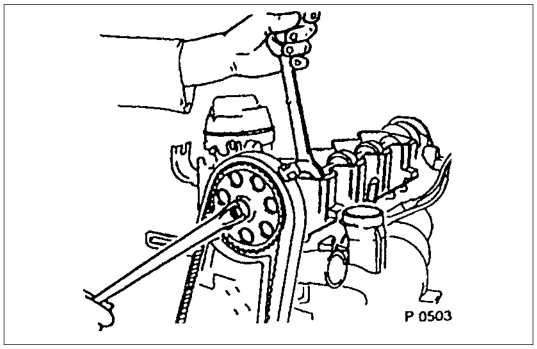
Edge out seal ring.



Installation

Lightly coat sealing lip of seal ring with protective grease.

Install seal ring with 5-8840-0451-0 into camshaft housing-use screw and washer of camshaft pulley.



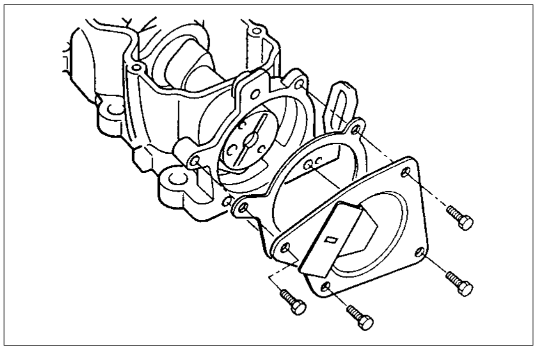
Installation

Camshaft pulley-counterhold at hex head of camshaft, camshaft housing cover.

Toothed belt-see operation “Toothed Belt, Replace”. Note operating erection of toothed belt.

Tighten (Torque)

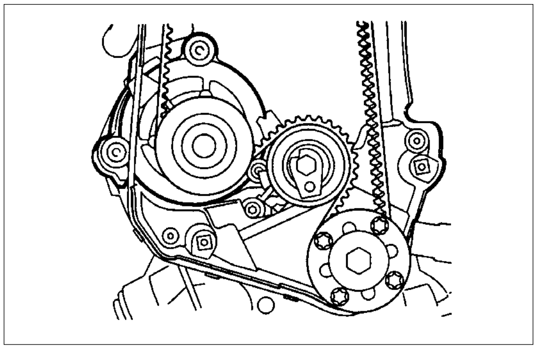
Camshaft pulley to cammshaft-45 N·m (3.7 kgf·m)



Tighten (Torque)

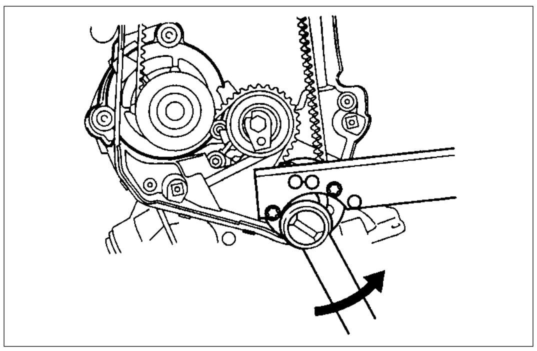
Camshaft housing cover to cover to housing-8 N·m (0.8 kgf·m)

Toothed Belt Rear Cover (Engine with toothed belt tension roller)

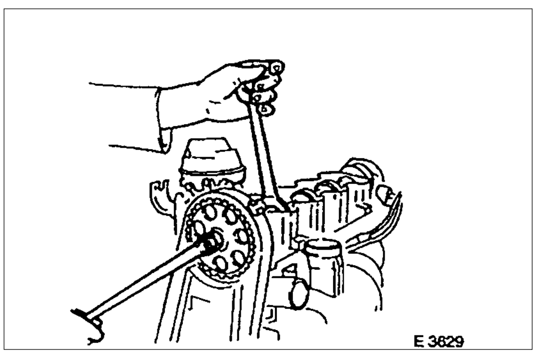


Removal

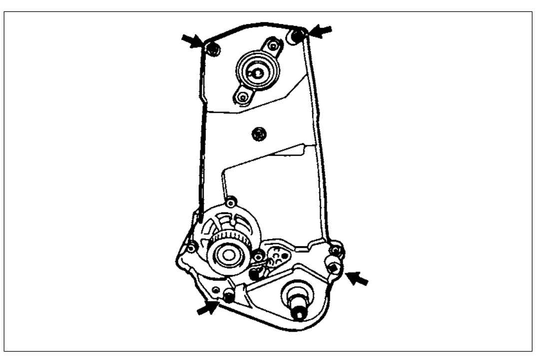
1. Mark operating direction of toothed belt.
2. Remove toothed belt according to the operation "Toothed Belt".
3. Remove toothed belt tension roller according to the operation "Toothed Belt Tension Roller ".



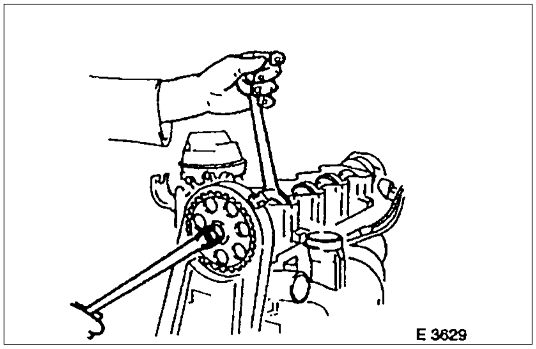
4. Remove fastening bolt while counterholding with 5-8840-2598-0 (Holding wrench).



5. Remove toothed belt drive gear while counterholding with 5-8840-2598-0 (Holding wrench).
6. Remove camshaft housing cover.
7. Remove camshaft pulley while counterholding at hex head of camshaft.



8. Remove toothed belt rear cover (arrows) from oil pump and camshaft housing.



Installation

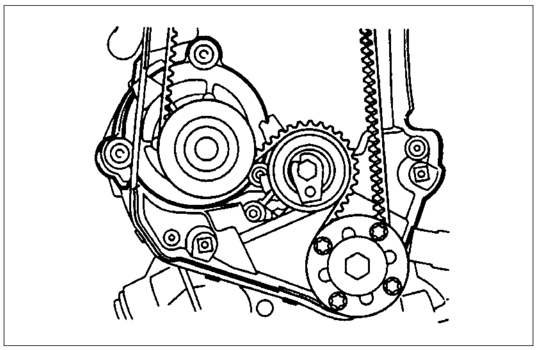
1. Install toothed belt rear cover.
2. Install camshaft pulley while counterholding at camshaft hex head.
3. Install camshaft housing cover.

Tighten (Torque)

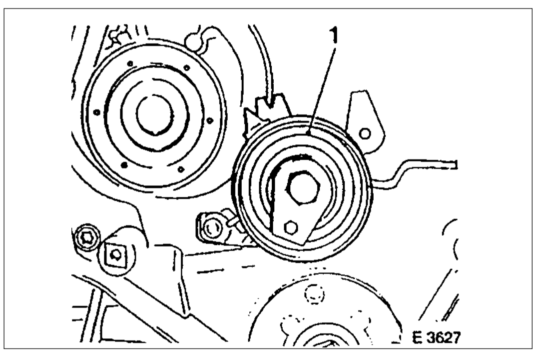
Toothed belt rear cover to oil pump and camshaft housing - 6 N·m/4 lbf ft.

Camshaft housing cover to housing - 6 N·m (0.6 kgf·m).

Camshaft pulley to camshaft - 45 N·m (4.6 kgf·m).



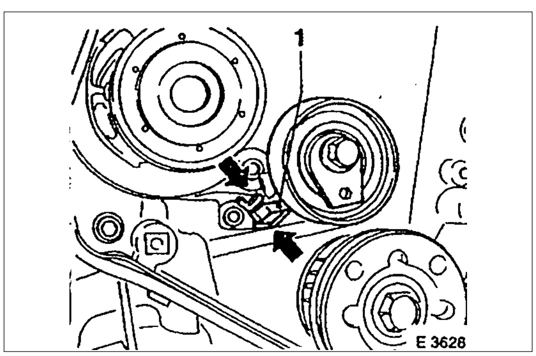
4. Install toothed belt drive gear to crankshaft - 130 N·m (13.3 kgf·m).
5. Install toothed belt according to the operation "Toothed Belt".



Toothed Belt Tension Roller

Removal

1. Mark operating direction of toothed belt.
2. Remove toothed belt according to the operation "Toothed Belt".
3. Remove toothed belt tension roller (1) from oil pump.



Installation

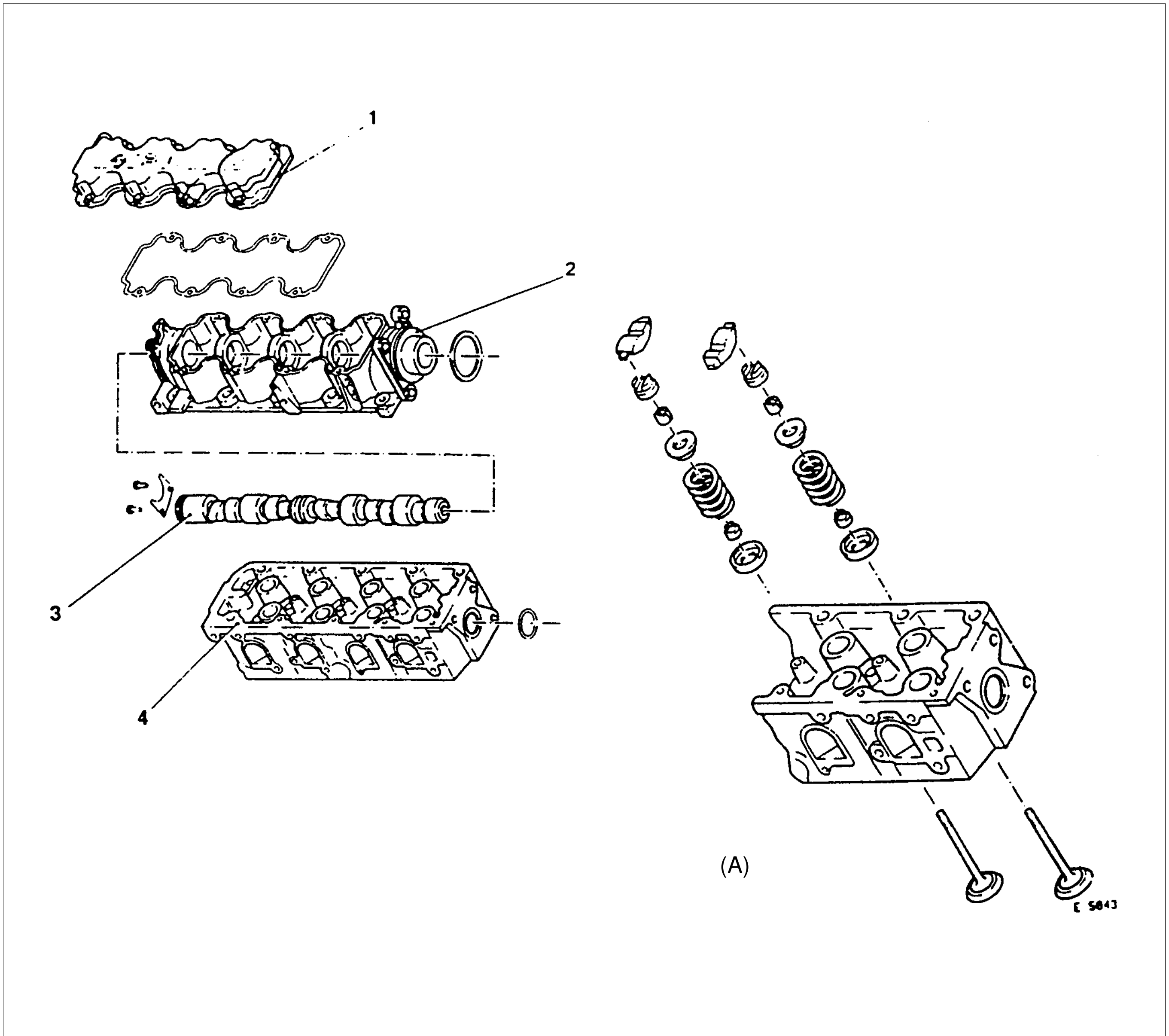
1. Install toothed belt tension roller and make sure that the locking lever (1) engages in the guide lugs (arrowed) on the oil pump housing.
2. Install toothed belt according to the operation "Toothed Belt" with paying attention to the operating direction of toothed belt.

Tighten (Torque)

Toothed belt tension roller to oil pump - 25 N·m (2.5 kgf·m)

COMPONENT PARTS

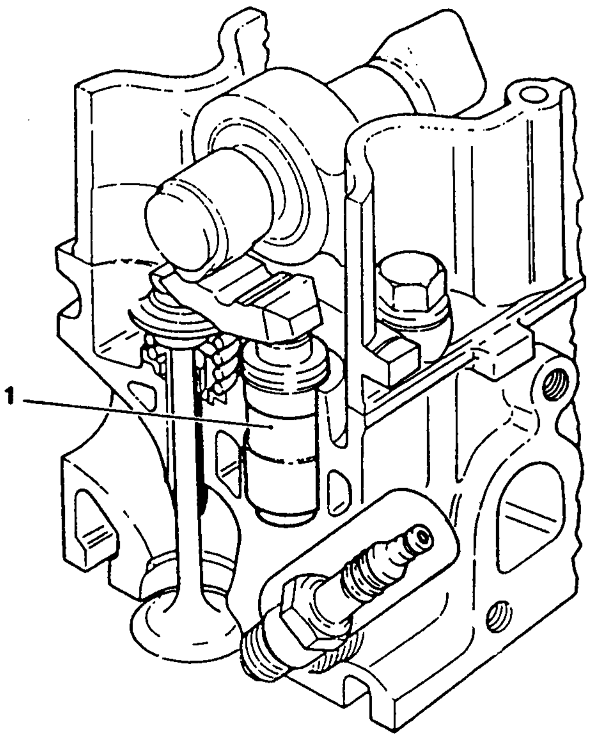
CYLINDER HEAD

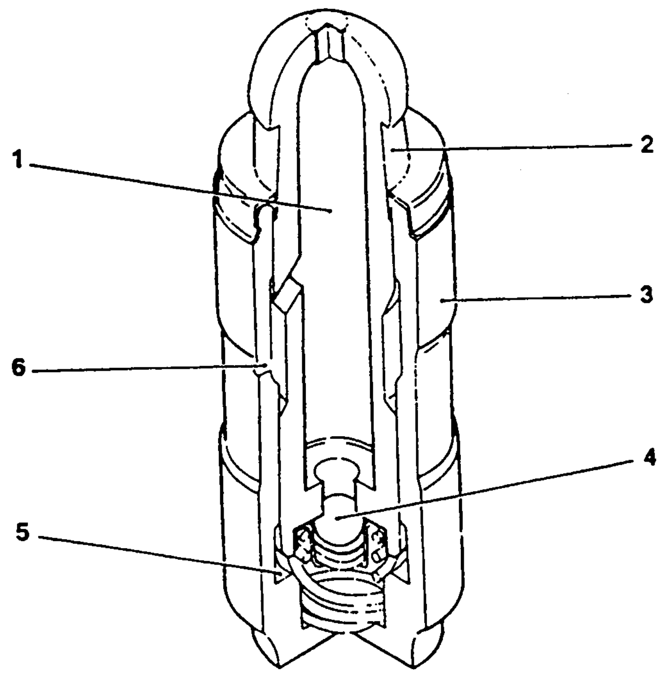


1. Camshaft Housing Cover
2. Camshaft Housing
3. Camshaft
4. Cylinder Head

(A) Valve Drive

HYDRAULIC VALVE LIFTER



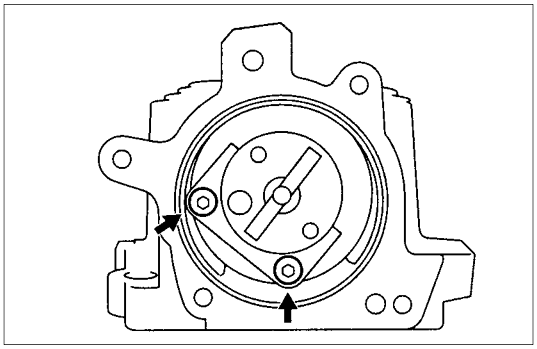


1. Hydraulic Valve Lifter

1. Oil reservoir
2. Piston with ball head (moving)
3. Pressure cylinder (fixed)
4. Check ball
5. Pressure chamber
6. Oil feed

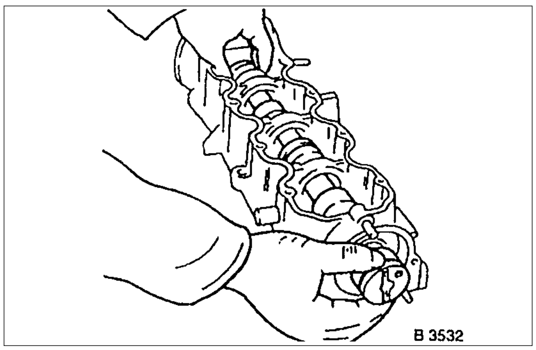
OPERATIONS ON CYLINDER HEAD AND CAMSHAFT HOUSING

Camshaft



Removal

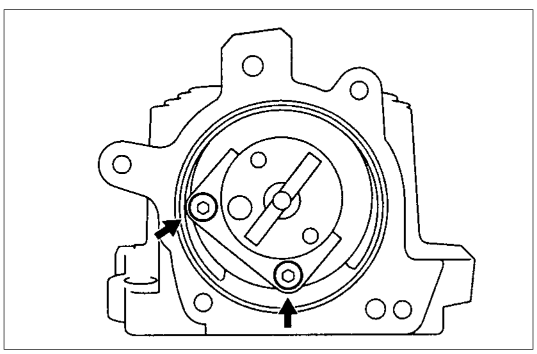
1. Remove cylinder head according to the corresponding operation.
2. Remove camshaft housing from cylinder head and lay housing on base provided
3. Remove rear sealing gasket and plate camshaft housing with taking care not to damage housing.
4. Remove thrust plate.



5. Remove camshaft.
6. Remove front sealing gasket and plate from camshaft housing with taking care not to damage housing.

Inspection

All parts.



Installation

1. Install camshaft.
2. Coat sliding surfaces with molybdenum disulphate paste.

Tighten (Torque)

Thrust plate for camshaft housing - 8 N·m (0.8 kgf·m)

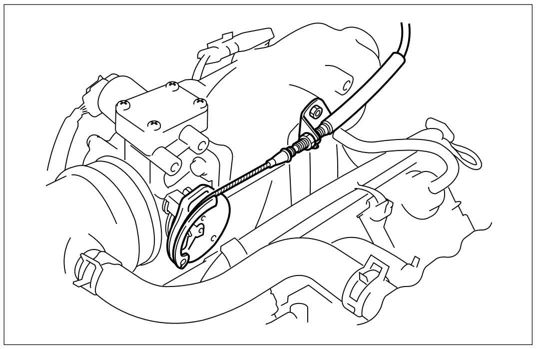
Camshaft Housing, Removal and Installation

Cylinder Head

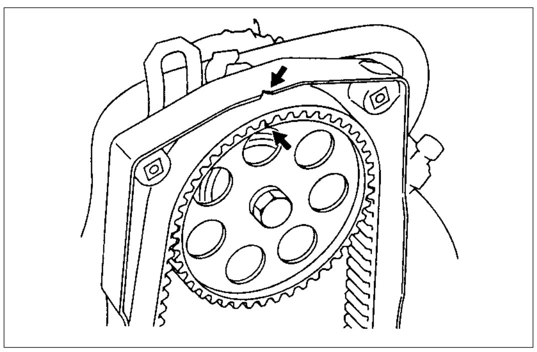
Important!

Remove cylinder head only from cold engine (room temperature).

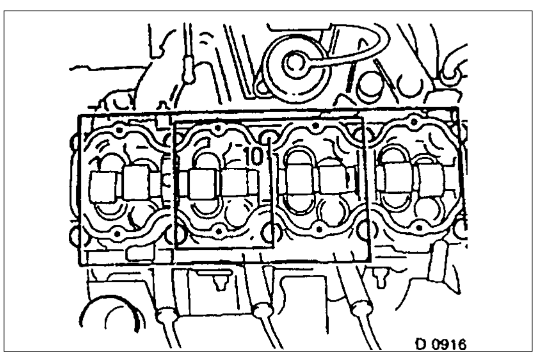
Removal



1. Remove ground cable from battery.
2. Open radiator drain tap and collect coolant.
3. Remove air intake hose.
4. Remove all cable connections, hoses and lines to the cylinder head.
5. Remove accelerator cable on the throttle valve.
6. Remove V-belt for alternator.



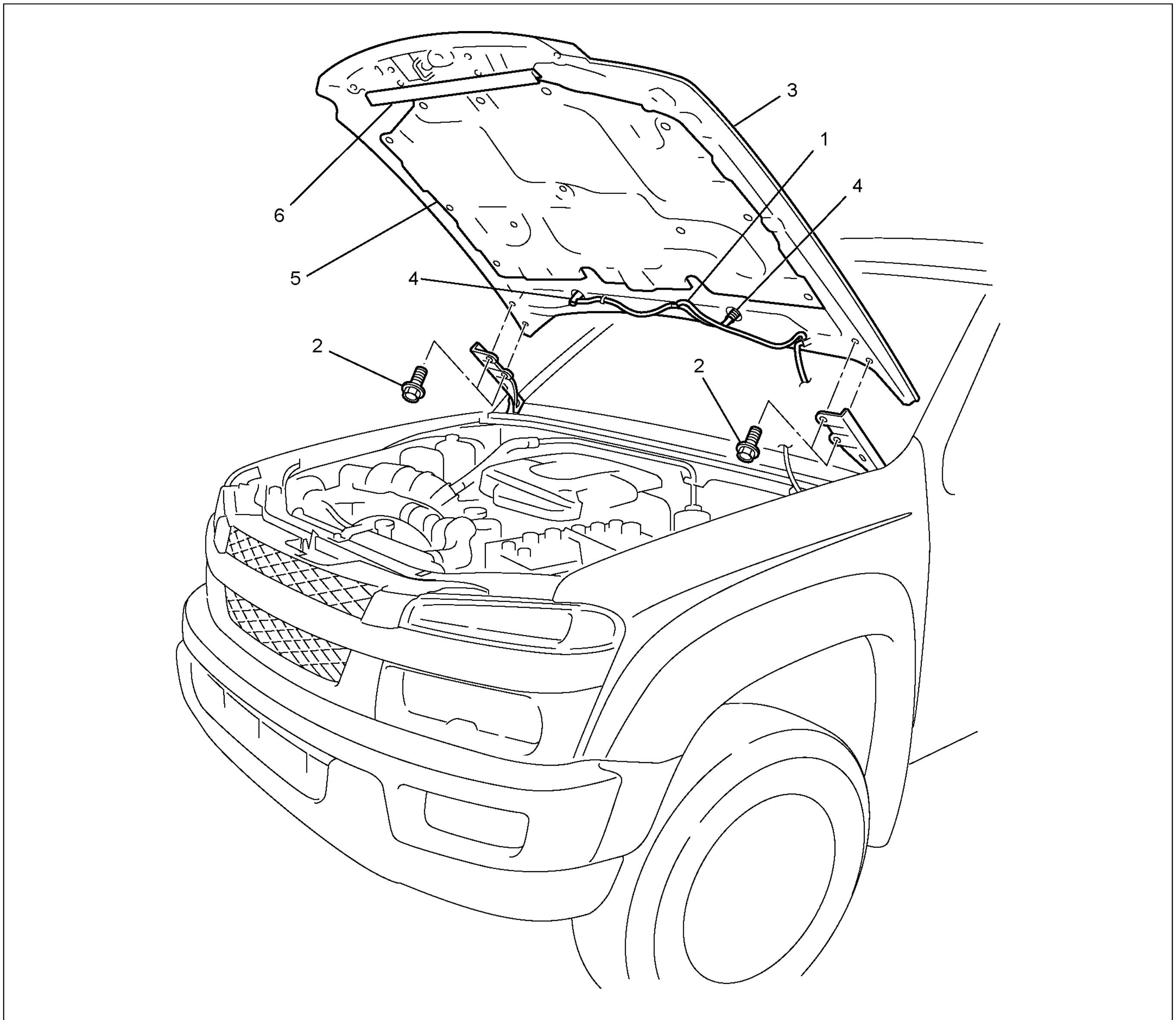
7. Remove front toothed belt cover according to the corresponding operation.
8. Bring piston of 1st cylinder to TDC and mark the position.
9. Remove camshaft housing cover.
10. Remove camshaft timing gear after releasing tension on toothed belt.



11. Remove upper bolts of rear toothed belt cover.
12. Remove exhaust pipe from exhaust manifold.
13. Remove cylinder head after loosening bolts from outside inwards (at first quarter turn then half turn) in a spiral pattern.
14. Remove camshaft housing from cylinder head.
15. Remove rocker arm, pressure parts and hydraulic valve lifter adjuster.

ENGINE HOOD ASSEMBLY (B TYPE)

REMOVAL AND INSTALLATION



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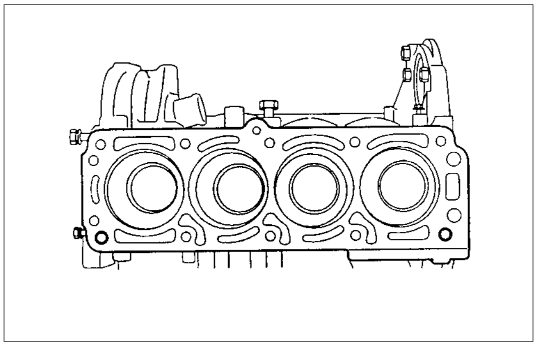
Removal Steps

▲ 1. Washer nozzle tube
▲ 2. Hood hinge bolts
3. Engine hood
4. Washer nozzle
5. Hood insulator
6. Hood seal

Installation Steps

6. Hood seal
5. Hood insulator
4. Washer nozzle
▲ 3. Engine hood
▲ 2. Hood hinge bolts
1. Washer nozzle tube



Clean

All sealing surfaces, drill holes in cylinder head bolts.

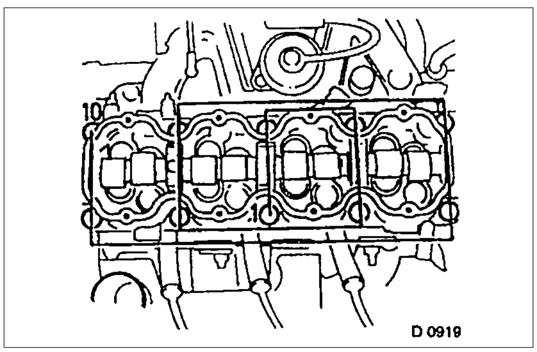
Check cylinder block and cylinder head for plane surface according to the corresponding operations.

Installation

1. Install cylinder head sealing with marking "OBEN/TOP" facing upwards and to right side of engine.
2. Install cylinder head on cylinder block.
3. Install hydraulic valve lash adjuster, pressure parts and rocker arm - molybdenum disulphate paste.
4. Install camshaft housing-Sealing Compound TB-1207C or equivalent.

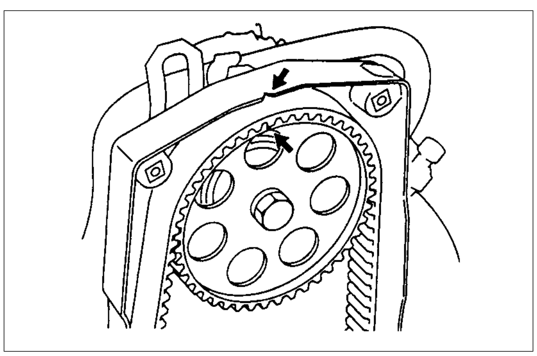
Important!

Use new cylinder head bolts.
Screw in bolts until they rest on cover.



Torque - Angle Method

Cylinder head to cylinder block - 25 N·m (2.5 kgf·m)
Further turn angle 90°+90°+ 90°.
Tighten cylinder head bolts from inside outwards. In four stages in a spiral pattern.

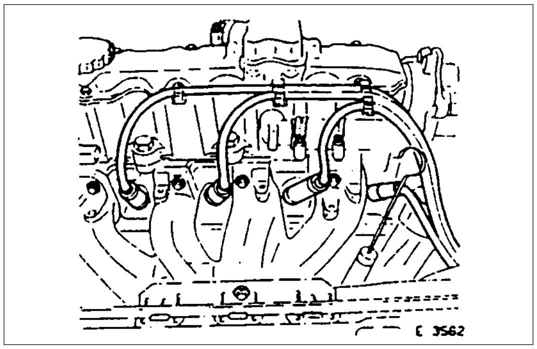


5. Install rear toothed belt cover onto camshaft housing.
6. Install toothed belt and apply tension according to the corresponding operation.

Tighten (Torque)

Camshaft timing gear to camshaft - 45 N·m (4.6 kgf·m)

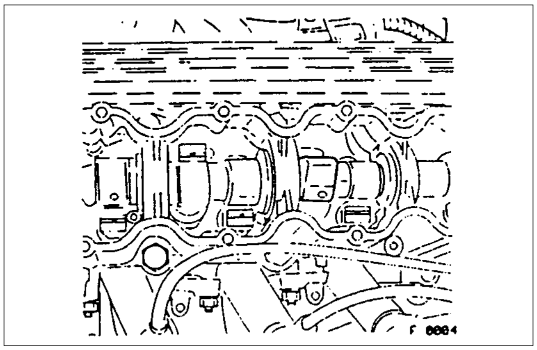
7. Install camshaft housing cover and front toothed belt cover.
8. Install cable connections, all hoses and lines onto cylinder head.
9. Adjust accelerator cable for free of play.
10. Install V-belt according to the corresponding operation.
11. Install air intake hose.
12. Install front exhaust pipe.
13. Install ground cable onto battery.
14. Fill up cooling system and bleed according to the corresponding operation.



Hydraulic Valve Lifters, Replace

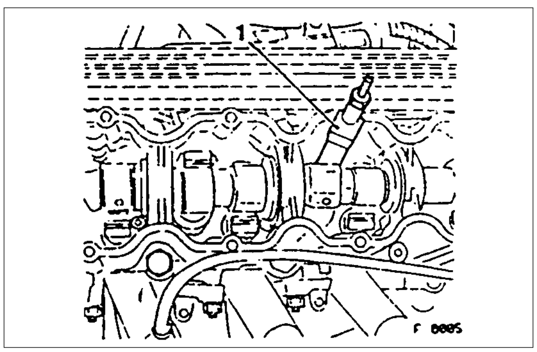
Removal

1. Remove the spark plug connectors and spark plugs.
2. Remove the camshaft housing cover.



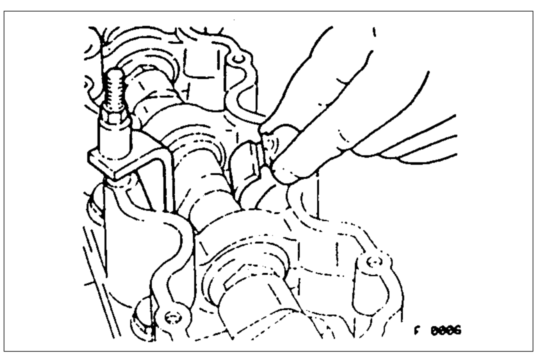
Removal

3. Turn the crankshaft at fastening bolt of toothed belt drive gear in the direction of the engine rotation until the cam of hydraulic valve lifter being replaced stands vertically.



Removal

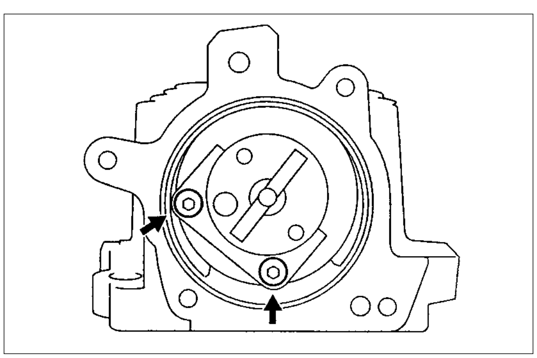
4. Apply 5-8840-0457-0 to the camshaft housing, valve spring cap and tension valve spring.



Removal

5. Remove the cam follower from camshaft housing.

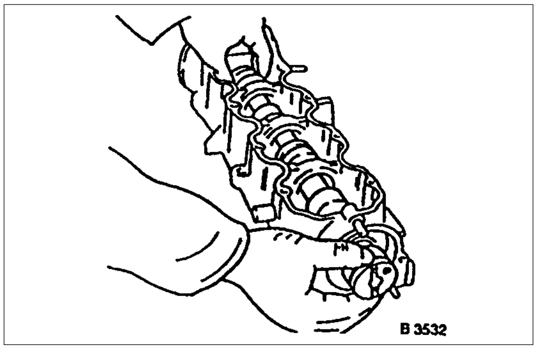
   Note thrust pieces.
6. Remove hydraulic valve lifter from camshaft housing.



Camshaft Housing, Replace

Removal

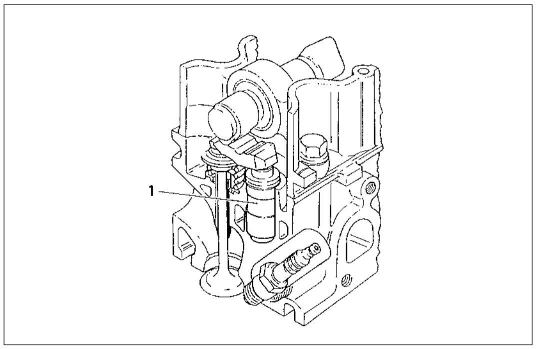
Cylinder head-see operation “Cylinder Head. Remove and Install”.



Inspection

All parts, if necessary replace.

When replacing camshaft, always replace all cam followers.



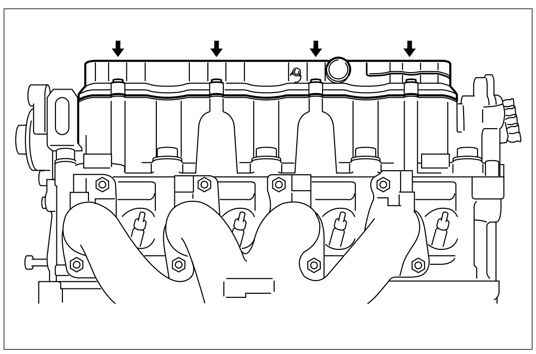
Installation

Insert hydraulic valve lifter (1) in camshaft housing.

Coat sliding surfaces of rocker arm with Mcs, Paste and insert in camshaft housing.

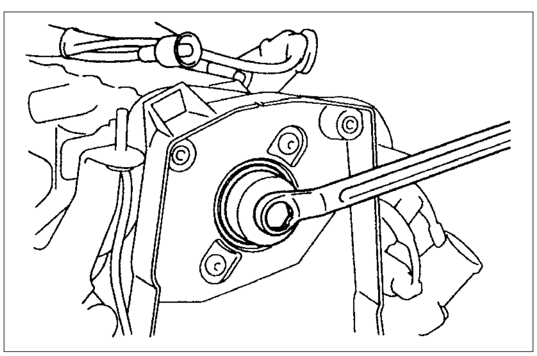
Adjust

Adjustment of the hydraulic valve liters is not required.
Pretension is provided by the design.



Installation

1. Remove 5-8840-0457-0 and install the camshaft housing cover.
2. Insert the spark plug connectors.

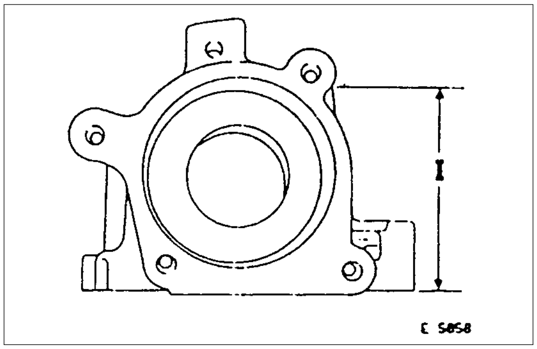


Tighten (Torque)

Guide plate to camshaft housing.
Insert camshaft with MoS_2 paste.

Installation

1. Install the front seal ring in camshaft housing with 5-8840-0451-0.
2. Install the camshaft housing rear cover.
3. Install the cylinder head.



Camshaft Housing, Check for Plane Surface

Clean

Sealing surfaces.

Inspection

Check length and width of sealing surface for deformation and diagnosis for warpage and use straight edge feeler gauge.

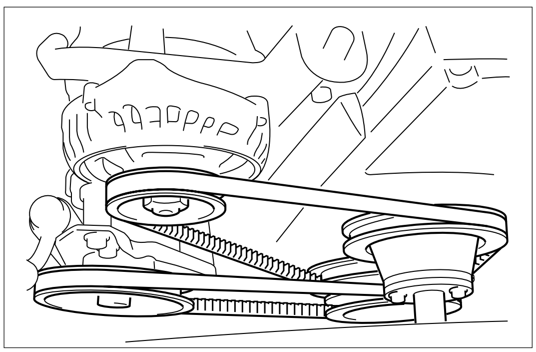
Measure

Height of camshaft housing (sealing surface to sealing surface).
Dimension I: (74.0 mm)

Cylinder Head, Removal and Installation

Important

Only remove cylinder head with engine cold (room temperature).

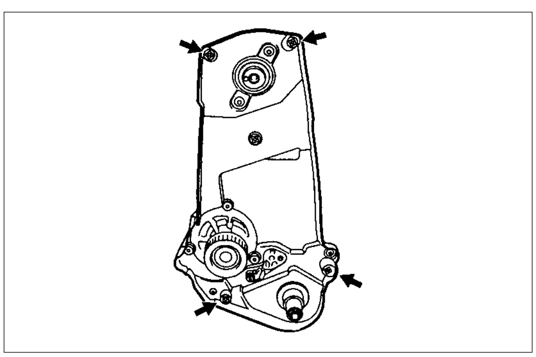


Removal

1. Remove the alternator, power steering and V-belts.

Removal

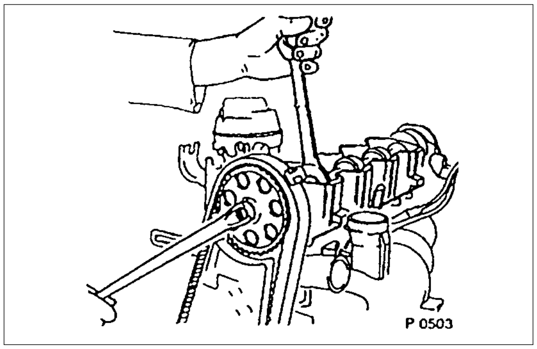
2. Loosen the fastening bolts from alternator.
3. Loosen the lower alternator fastening bolt by swinging the alternator to the rear.



Removal

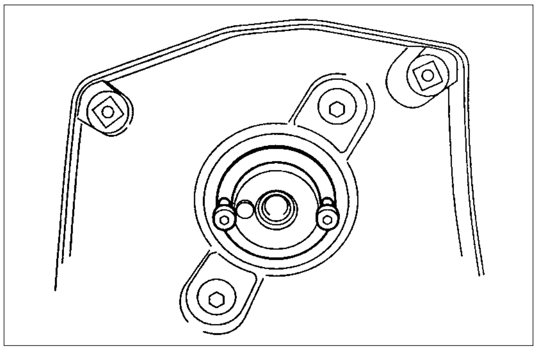
4. Remove the front toothed belt cover.
5. Remove the toothed belt from camshaft pulley.

   See operation "Timing Check and Adjust".



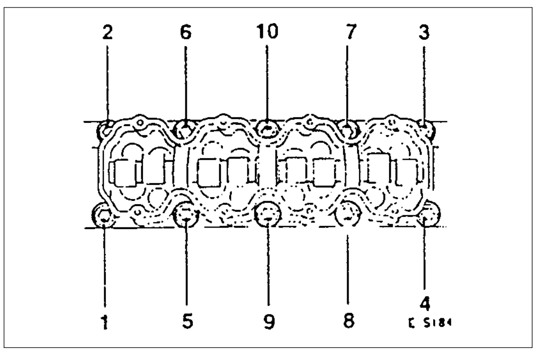
Removal

6. Remove the camshaft housing cover and camshaft pulley by counter-holding at the hex head of camshaft.



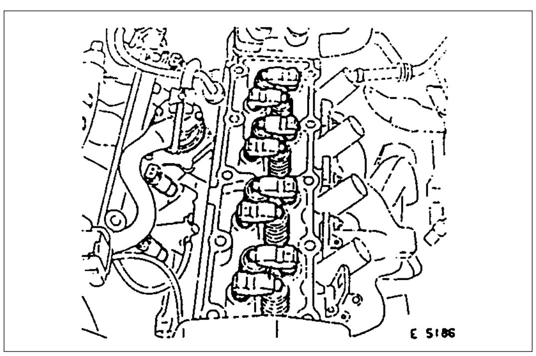
Removal

7. Remove the fastening bolts from camshaft housing.



Removal

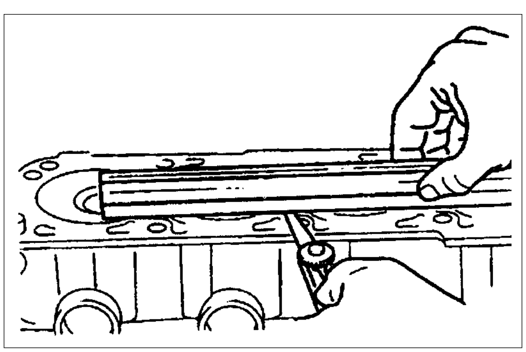
8. Remove the exhaust pipe from exhaust manifold.
9. Loosen the cylinder head bolts spirally from the outside inwards (first 1/4, then 1/2 revolution).



Removal

1. Remove the camshaft housing from cylinder head.
2. Remove the cam followers, thrust pieces and hydraulic valve lifters.

   Note the allocation.
3. Remove the cylinder head.

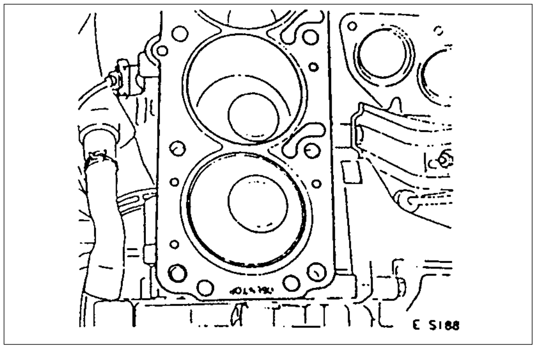


Clean

Sealing surfaces, bores and threads of cylinder head bolts.

Inspection

Check cylinder head and cylinder block for plane surfface-see operations “Cylinder Head, Check for Plane Surface” and “Cylinder Block, Check for Plane Surface.”

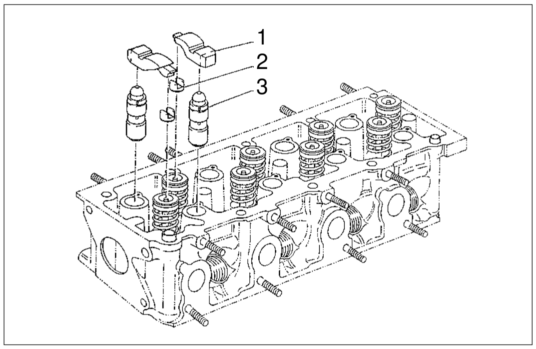


Installation

1. Install the cylinder head gasket.

   Mark "OBEN/TOP" on top and turn it towards timing side of engine.

2. Place cylinder head on cylinder block.



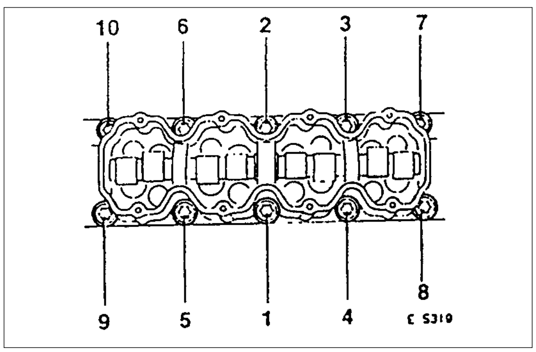
Installation

1. Insert the hydraulic valve lifters (3), thrust pieces (2) and cam followers (1) with MoS2 paste.

   Note allocation.

2. Apply a bead of Sealing Compound TB1207C to sealing surface of cylinder head.

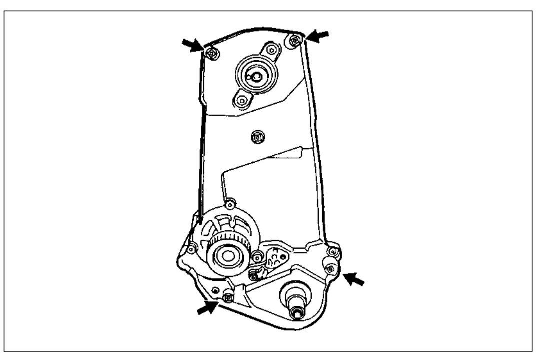
3. Install the camshaft housing on cylinder head.



Torque-Angle Method

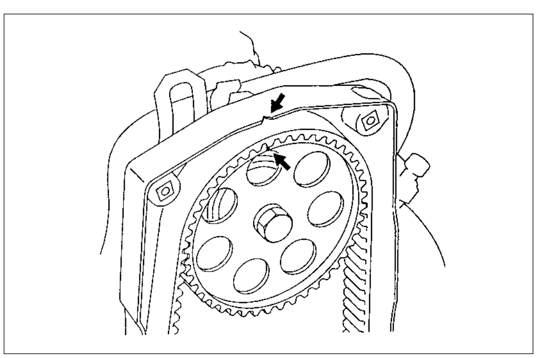
Cylinder head and camshaft housing with new cylinder head bolts to cylinder block.

Cylinder head bolts in sequence shown.



Installation

1. Install the rear toothed belt cover to camshaft housing.
2. Install the camshaft pulley to camshaft.
3. Install the camshaft housing cover to housing.



Installation

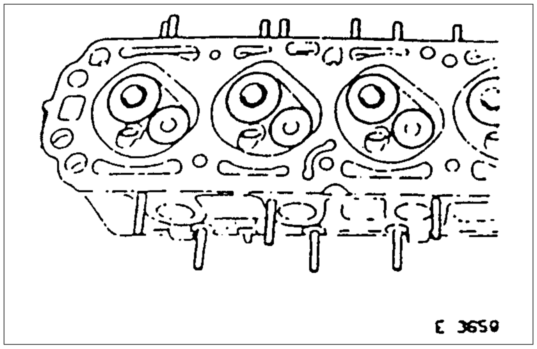
1. Install the toothed belt on camshaft pulley.

   See operation "Timing Adjust".

2. Install the front toothed belt cover.

Installation

1. Install the fastening bolts.
2. Loosen the lower alternator fastening bolt.
3. Install the alternator, power steering and V-belts.

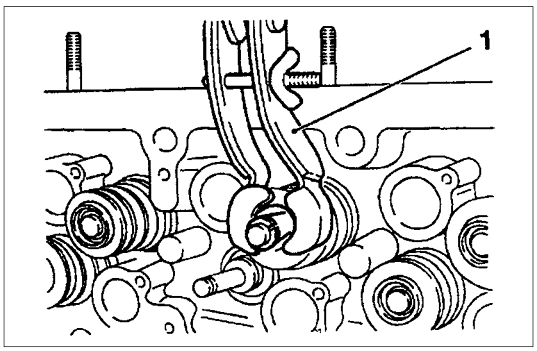


Cylinder Head, Disassemble and Assemble

Removal

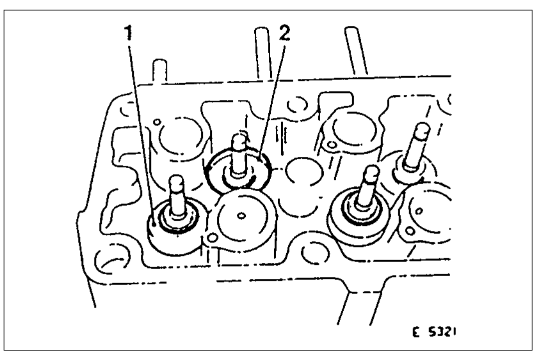
1. Remove the hydraulic valve lifters.

   Lay aside in installation positions.
2. Remove the spark plugs, exhaust manifold and intake manifold from cylinder head.



Removal

1. Mark valves.
2. Remove the tension valve springs with 5-8840-2594-0 (1).
3. Remove valve keepers, valve spring cap and valve spring.



Removal

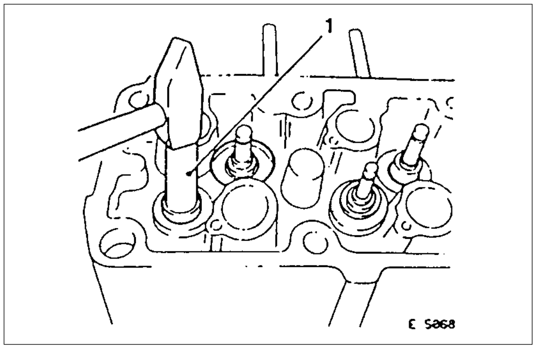
1. Remove the valve and valve stem seal.
2. Remove the valve spacer ring (1-exhaust) and valve spring seat (2-intake).
3. Remove valve from cylinder head.

Clean

Sealing surfaces.

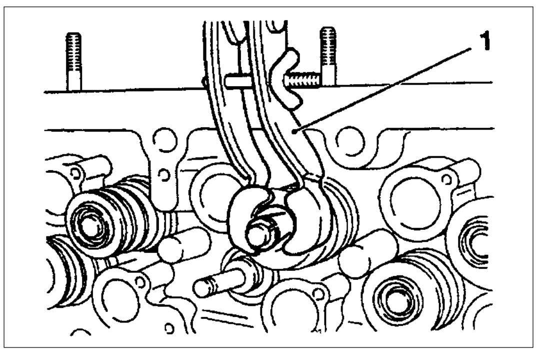
Inspection

Sealing surfaces for plane surface, guides, sliding and bearing points for wear-see operation “Cylinder Head. Overhaul”.



Installation

1. Coat the valves with engine oil and insert in cylinder head.
2. Install the valve spacer ring or valve rotator(exhaust) and valve spring seal(intake).
3. Push the accompanying assembly sleeve onto valve stem and coat with engine oil.
4. Insert a new valve stem seal with 5-8840-2601-0 (1).
5. Drive the valve stem seal carefully in to stop with light hammer blow.

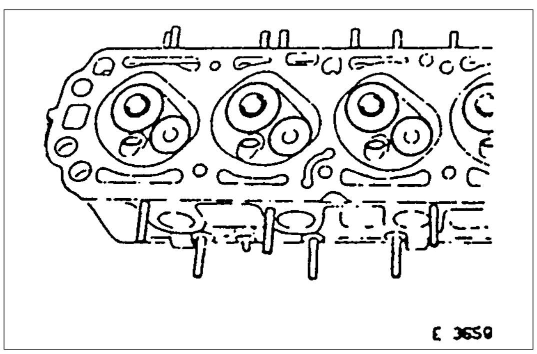


Installation

1. Install the valve springs and valve spring caps.
2. Install the tension valve springs with 5-8840-2594-0 (1), valve keeper.

Important!

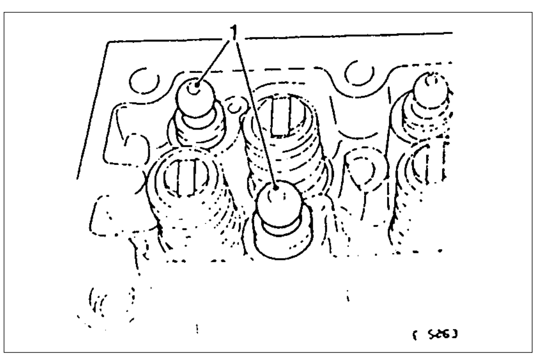
Note markings made on valves.



Tighten (Torque)

Exhaust manifold and intake manifold with new gaskets to cylinder head.

Thermostat housing with new seal ring to cylinder head:



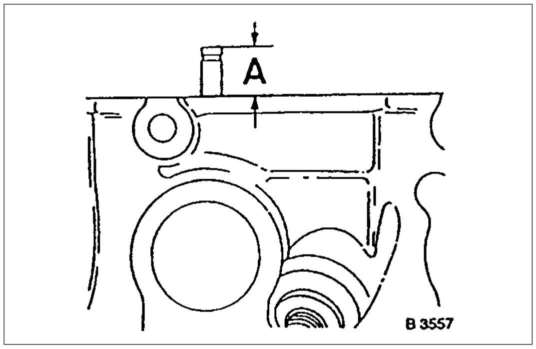
Tighten (Torque)

Spark plugs with spark plug wrench to cylinder head.

Installation

1. Coat hydraulic valves lifters (1) with oil.
2. Insert them in cylinder head.

   Note installation position.

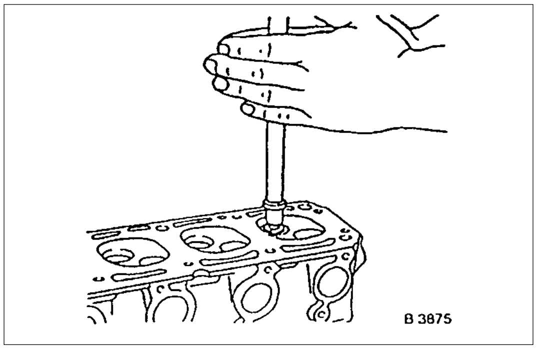


Valve, Grind

Valves can be reused once or twice after regrinding-only if there are no crater-like burns on the valve cone.
Excessive grinding can cause the upper valve head edge to become too thin.

Important!

Valve stem protection must not exceed dimension “A”-use 5-8840-2596-0.
Do not regrind valve stem ends.
For all valve reworking note that angle of valve head is 44° and the valve seat 45°-see also “Technical Data”.



Valve, Grind In

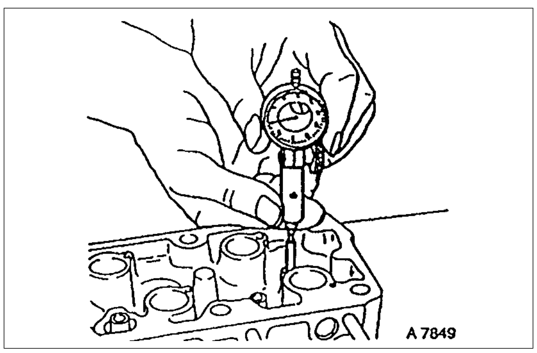
Grind-In the valve to improve valve seating.
Grind-In by rhythmically lifting valves and turning uniformly.
Use commercially available grinding tool.

Important!

Use only fine-grained pastes for grinding.
Lubricate valve stem before grinding in.

Clean

After grinding, carefully clean valve and valve soat.



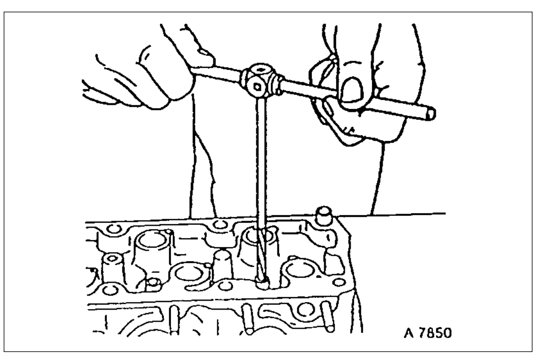
Valve Guide, Ream

Measure

Diameter of valve guide-dial gauge and internal measuring instrument.

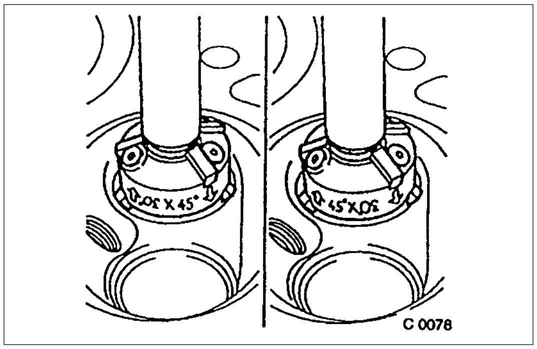
Important!

Valve oversizes are available ex-works.
Oversize identification, on the valve guide and on the valve stem end with the following specified identificaton flgures/letters-see also “Technical Data”.



	Identification Mark		
Size	Production	Customer Service	Reamer
Normal	none	K	
0.075 mm	1	K1	
0.150mm	2	K2	

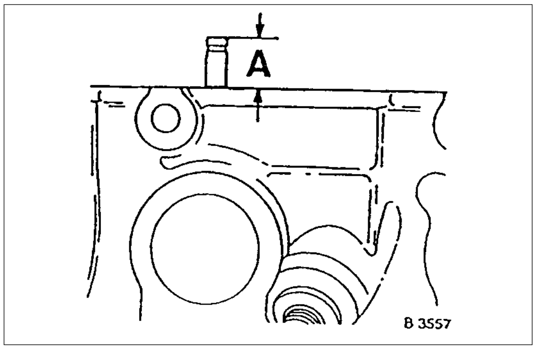
Ream valve guide from the upper side of the cylinder head to the next oversize (use 5-8840-2599-0).
After reaming, cross out identification mark and stamp in new identification mark.



Valve Seating, Mill

Place cylinder head on block of wood.
Inlet and exhaust, Guide Drift and Valve Seat Cutter 5-8840-2593-0.
Valve seat-45°, side face, upper correction-30°, side face (arrows on cutter).
Valve seat width:

Inlet-1.0 to 1.5 mm/0.04 to 0.06 in.
Exhaust-1.7 to 2.2 mm/0.072 to 0.088 in.

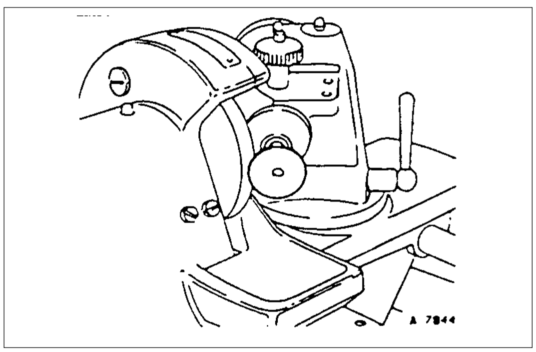


Inspection

Valve stem projection-use 5-8840-2596-0.

Important!

If dimension “A” is exceeded, use new valves.
Check valve stem projection again. If dimension “A” is exceeded, replace cylinder head.



Cylinder Head, Overhaul

Cylinder head disassembled.

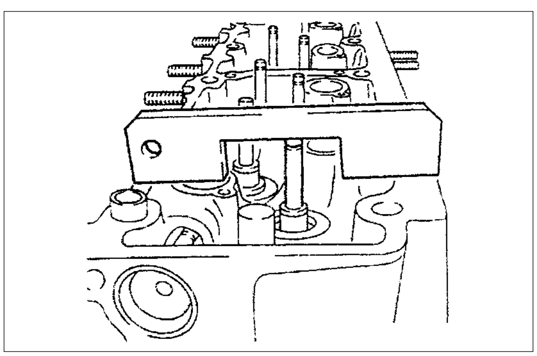
Valve, Grind

Important!

Ensure that there are no crater-like burns on the valve cone.

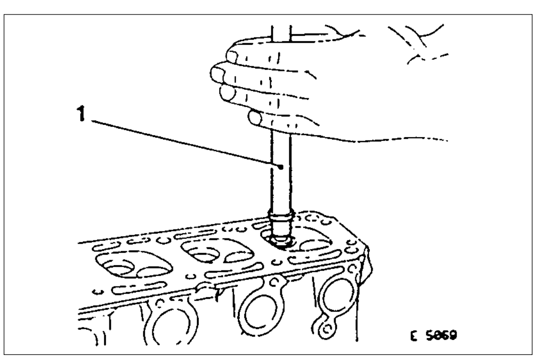
Regrinding possible once or twice.
Grinding of valve stem end is not permitted.

Angle at valve head-44°



Inspection

Check valve stem projection as shown 5-8840-2596-0.

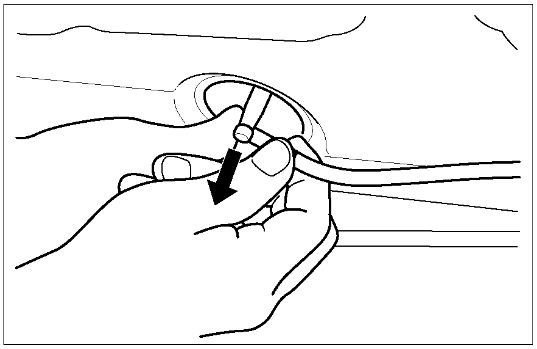


Valve, Grind in

Lubricate valve stem, use fine-graining grinding paste.

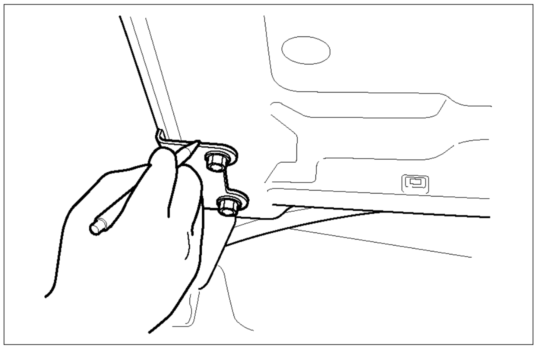
Lift up valve from seat rythmically using valve grinding tool (1) for distribution of grinding paste.

Important Operations - Removal


RUW52BSH002501

1. Washer Nozzle Tube

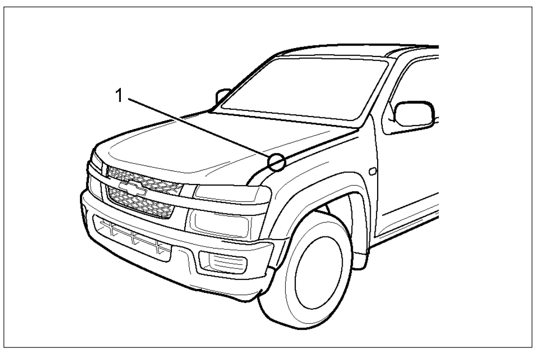
4) Open the hood.
5) Support the hood.
6) Remove the windshield washer nozzle tube.


RUW52BSH002601

2. Hood Hinge Bolts

- Before removing the hinges from the engine hood, scribe a mark showing location of the hinges to facilitate installation in the original position.

Important Operations - Installation



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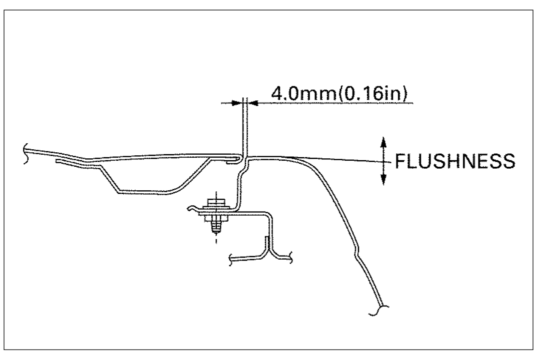
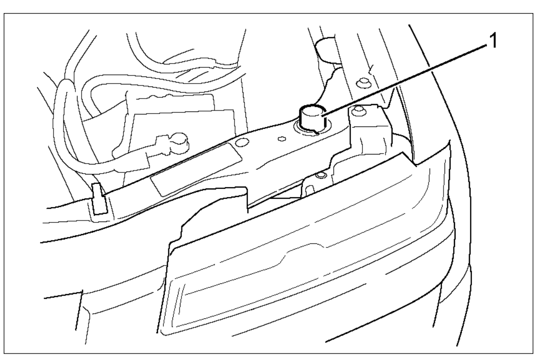
3. Engine Hood

- Check the engine hood and fender. (1)



- Clearance : 4.0 mm (0.16 in)
- Height (step) : Flushness
- Adjust clearance using the hinges on the engine hood.

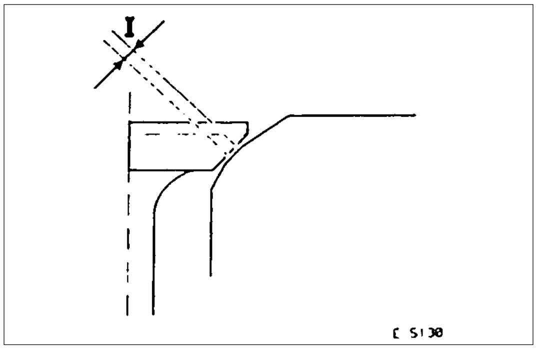


RTW52BSH000301

- Adjust height (step) using the hood rests (1).

Engine Hood Striker

- Apply a light coat of grease to the striker.



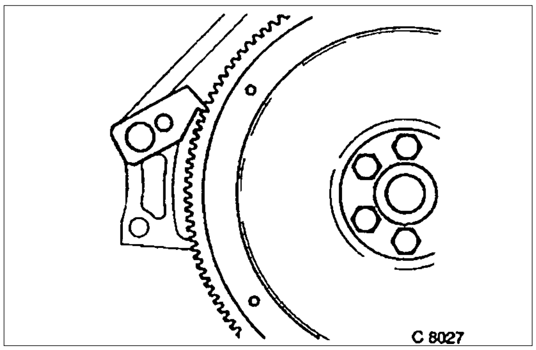
Inspection

Check contact pattern (I) on valve seat and in cylinder head.

Clean

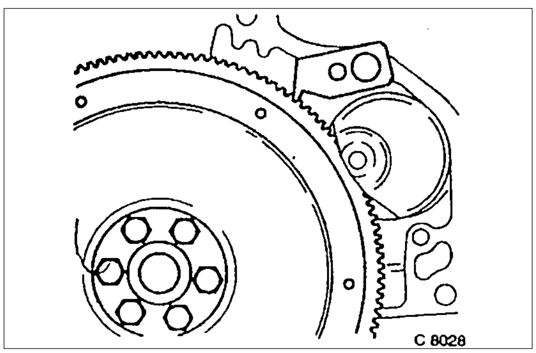
Valves, valve guides, cylinder head.

Flywheel



Removal

1. Remove transmission and clutch.
2. Remove flywheel while locking with 5-88400-446-0.



Torque - Angle Method

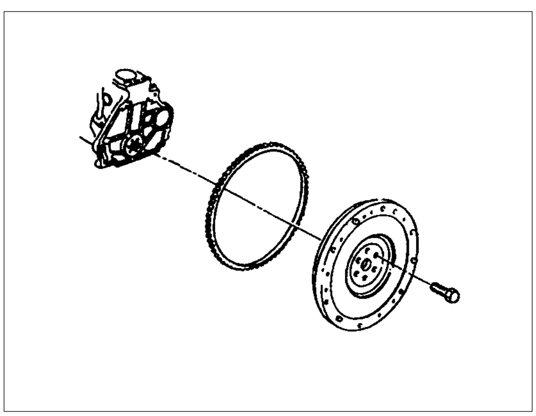
Flywheel to crankshaft - 65 Nm/6.5 kgf·m.+30° to 45°

Important!

Use new bolts.
Do not apply grease to the thread.

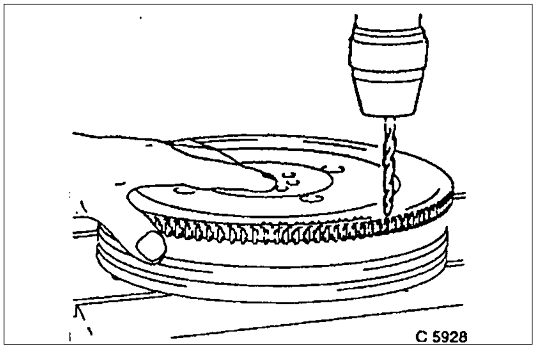
Installation

1. Install clutch and transmission.



Component Parts

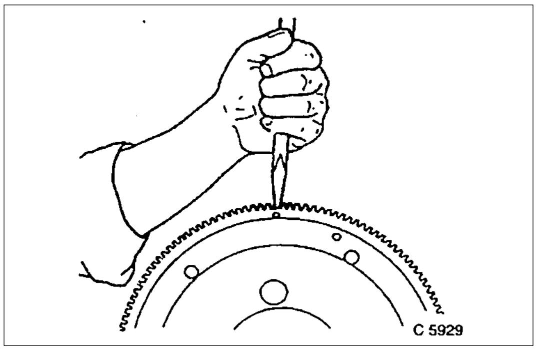
Flywheel and Ring gear. (Manual Transmission)



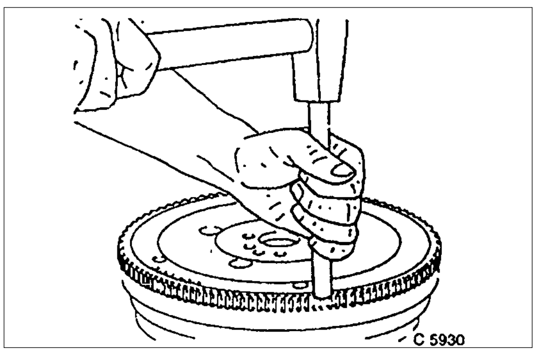
Starter Ring Gear (Manual Transmission)

Removal

1. Remove flywheel according to the corresponding operation.
2. Drill starter ring gear underneath tooth gap approx. 8mm/0.30in. deep with 8mm/0.25in. diameter drill.

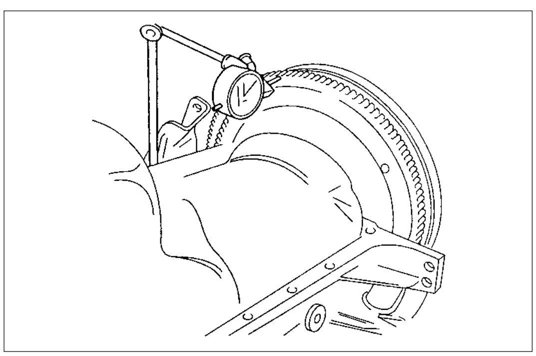


3. Separate starter ring gear with chisel on the drilling point.



Installation

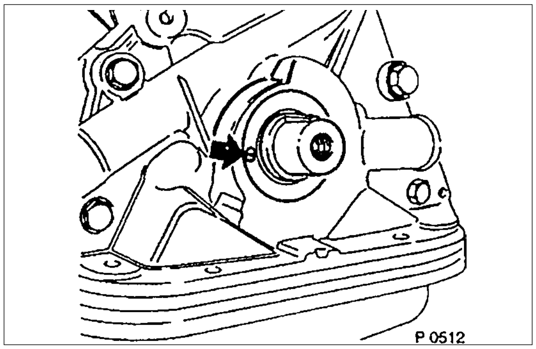
1. Install starter ring gear with inner chamfered edge to flywheel.
2. Heat starter ring gear evenly to 180°C /356°F to 230°C /446°F (yellow paint mark)
3. Install flywheel according to the corresponding operation.



Inspection

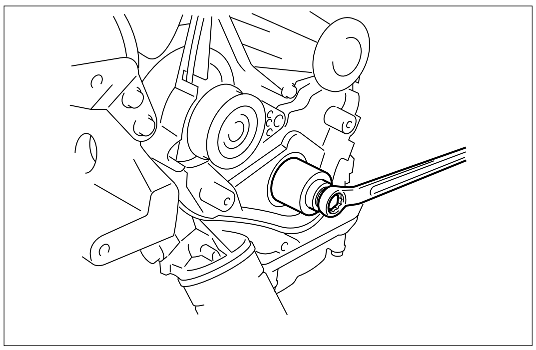
Lateral run-out of starter ring gear - max. 0.5mm/0.02in.

Seal Ring, Crankshaft (Oil Pump Housing)



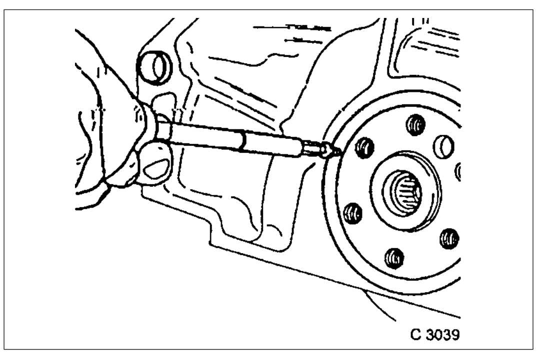
Removal

1. Remove toothed belt rear cover according to the corresponding operation.
2. Remove sealing ring by making hole in middle of ring, turning in self-tapping screw and edging out.



Installation

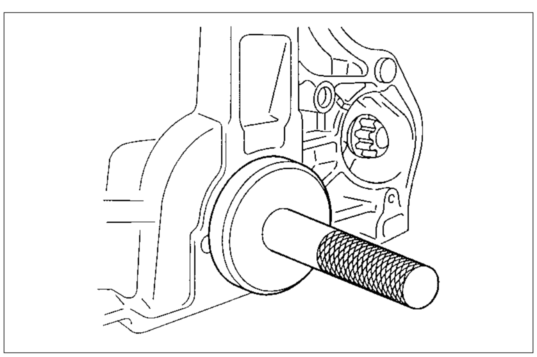
1 Install the protective sleeve to the crankshaft.
2. Coat the sealing lip with protective grease.
3. Install the sealing ring.
4. Install the sealing ring using 5-8840-0455-0.
5. Install the rear toothed belt cover and toothed belt according to the corresponding operations.
6. Replace the sealing ring with a new one.
7. Tighten the belt to the crankshaft.



Seal Ring, Crankshaft Rear

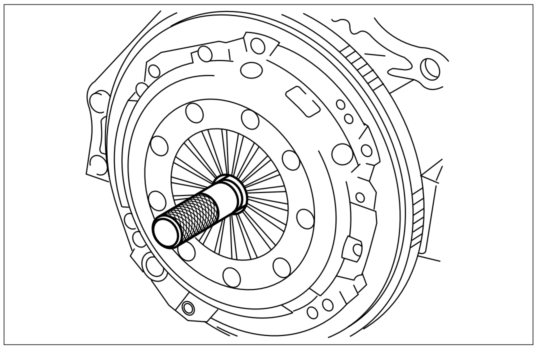
Removal

1. Remove transmission and clutch.
2. Remove flywheel or flex plate according to the corresponding operations.
3. Make hole in middle of sealing ring, turn in self-tapping screw and edge out.



Installation

1. Install protective sleeve.
2. Coat sealing lip with Protective Grease.
3. Install sealing ring using 5-8840-0459-0 and 5-8840-2597-0.
4. Install flywheel, clutch and transmission.



Reassembly

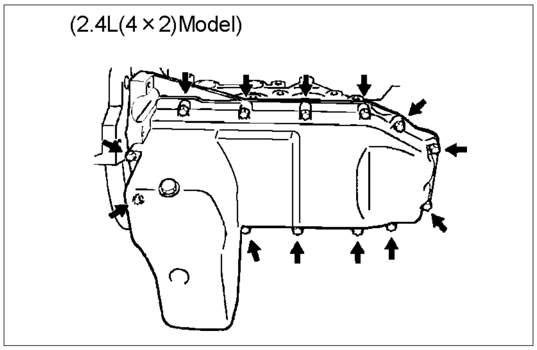
Reassemble clutch assembly.

Disassembly

Disassemble clutch assembly to flywheel using 5-8840-2634-0

Torque Angle-Method

Clutch assembly to flywheel-17.6Nm/1.8 kgf·m.

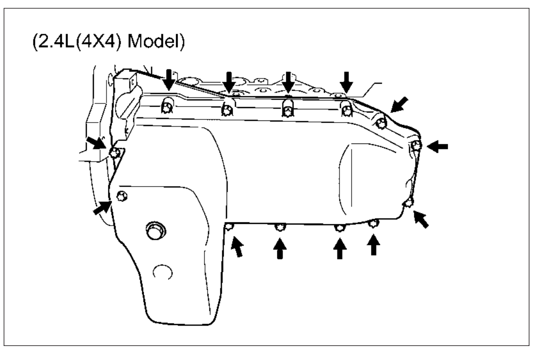


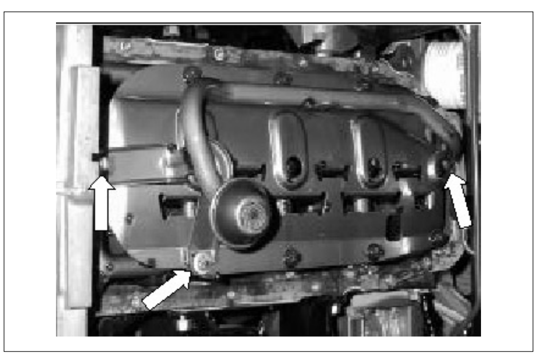
RTW46ASH002801

Oil Pan and Bearing Bridge

Removal

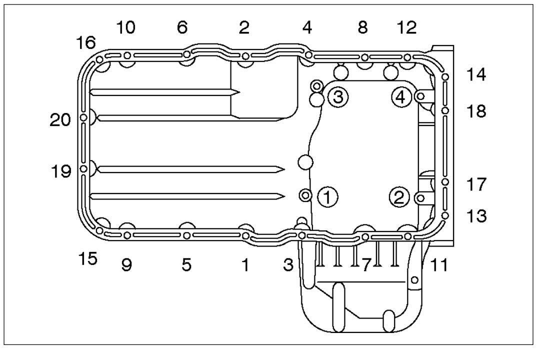
1. Remove the crossmember.
2. Shift downward the power steering unit (and front axle [4×4 model only]).
3. Loosen fixing bolts.
4. Remove oil pan from oil pump and cylinder block.
5. Remove oil intake pipe, oil intake pipe bracket, and oil baffle plate.
6. Remove the bearing bridge.





Clean

Sealing surfaces.



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Installation

1. Apply a bead of Sealing Compound, TB120TC or eguivalent to joint of oil pump.
2. Apply the recommended light gasket to the oil pan fitting surface as shown in the illustration.
3. Install the bearing bridge.
4. Install baffle plate, or reuse baffle plate.

Caution

Baffle plates can be retrofitted without difficulty - replace baffle plate.

5. Install oil intake pipe to oil pump and oil intake pipe bracket to cylinder block.
6. Install oil pan and new gasket to cylinder block and insert bolts with Locking Compound 15 10 177 (90 167 347). Maximum assembly time including torque check is 10 min.
7. Return the power steering unit (and front axle [4×4 model only]).
8. Install the crossmember.

Tighten (Torque)

Oil intake pipe to oil pump -8N·m (0.8 kgf·m)

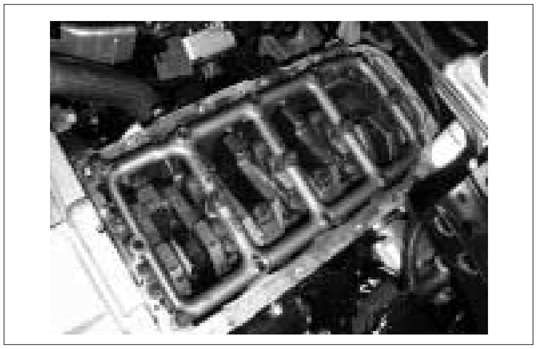
Oil intake pipe bracket to cylinder block - 6 N·m (0.6 kgf·m)

Oil pan to cylinder block - 8 N·m (0.8 kgf·m)

Bearing bridge to cylinder block – 8 N·m (0.8 kgf·m)

OPERATIONS ON CRANK DRIVE

Con-Rod Bearing

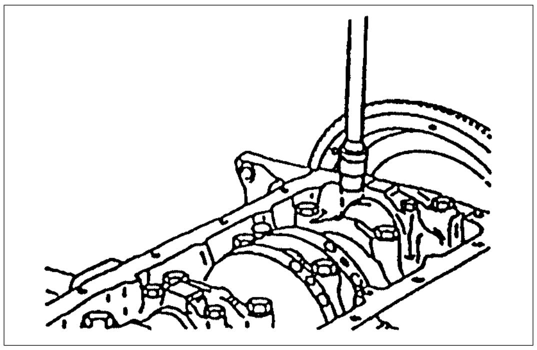


Removal

1. Remove oil pan and bearing bridge according to the corresponding operation.
2. Remove con-rod bearing cap and con-rod bearing after marking both sides.

Clean

Con-rod journal, con-rod bearing cap



Installation

1. Install new bearing shafts lightly coated with engine oil.
2. Install con-rod bearing cap.

Torque-Angle Method

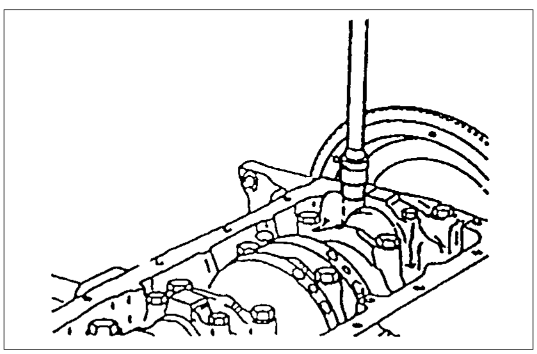
Con-rod bearing cap to con-rod - 35N·m (3.5 kgf·m) +45° to 60°

Important!

Use new bolts.

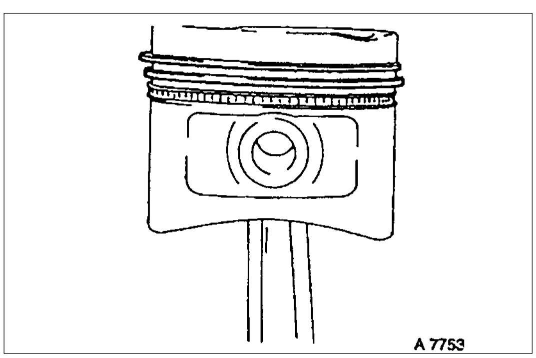
3. Install oil pan and bearing bridge according to the corresponding operation.

Piston with Con-Rod



Removal

1. Remove cylinder head and oil pan according to the corresponding operations.
2. Remove piston with con-rod after marking con-rod bearing cap.



Inspection

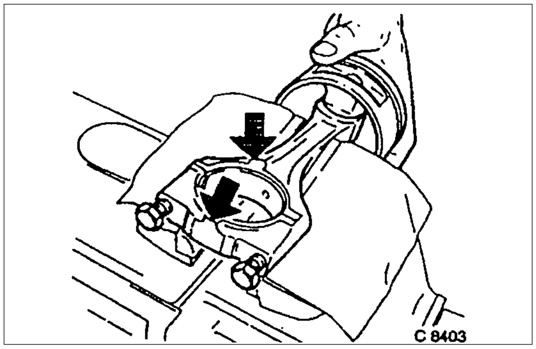
Remove and install all parts, if applicable.

Important!

Ring gap offset:

Piston rings - 180°.

Oil scraper rings - 25 to 50 mm/1 to 2 in. from gap of intermediate ring to the left and to the right.



Installation

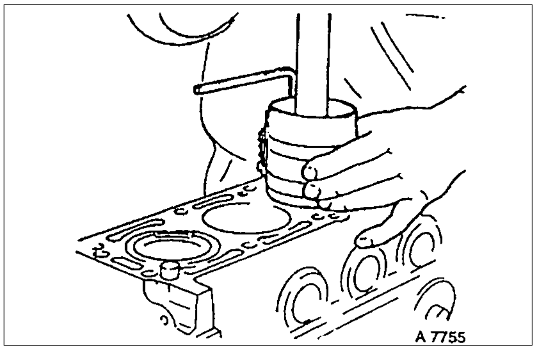
1. Install piston with con-rod by inserting with engine oil.
2. Coat piston rings with engine oil and compress with piston ring compressor.

Important!

Installation position:

Arrow / notch on piston head on timing side of engine

Beads on con-rod on clutch side



Torque-Angle Method

Piston to cylinder block.

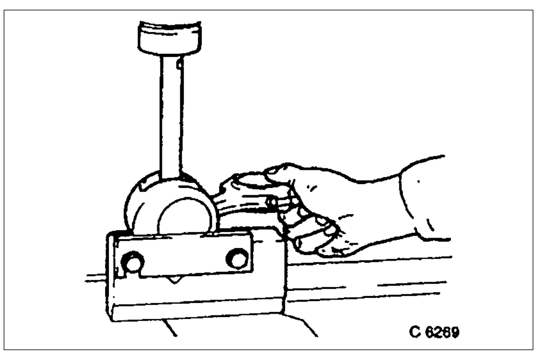
Con-rod bearing cap to con-rod-35N·m (3.5 kgf·m) +45° to 60°

Important!

Use new bolts.

Installation

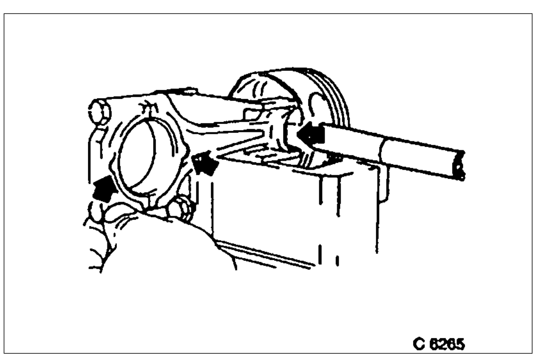
1. Install oil pan and cylinder head according to the corresponding operations.
2. Install sealing Gasket or replace if damaged.
3. Install camshaft housing to cylinder head.
4. Install cylinder head according to the corresponding operation.



Con-Rod

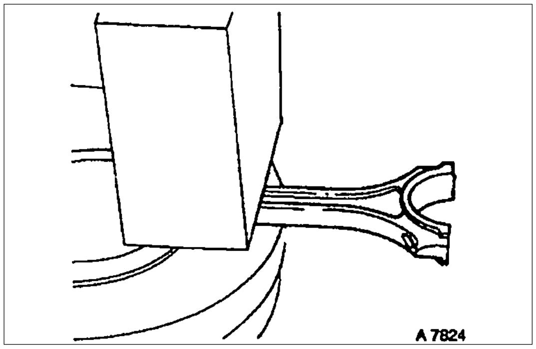
Removal

1. Remove piston with con-rod according to the corresponding operation.
2. Disassemble con-rod piston assembly by pressing out piston pin, using 5-8840-0468-0.

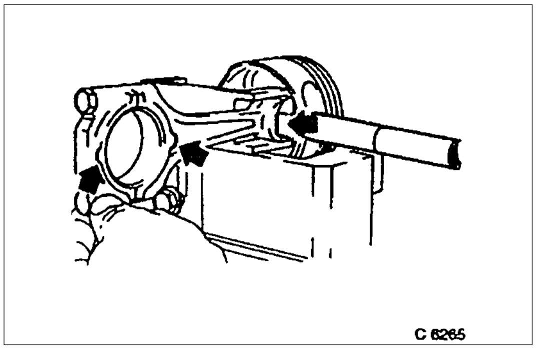


Installation

1. Slide guide drift (5-8840-0468-0) in horizontal position through piston and con-rod as far as side plate stops.
2. Tighten bolts evenly so that the piston rests flush on the rear plate.
3. Remove centre piece from guide drift and insert piston bolts (lubricated) into guide drift.



4. Heat a new con-rod to 280°C in the oil bath.
5. Install the con-rod to the piston and insert the piston pin.



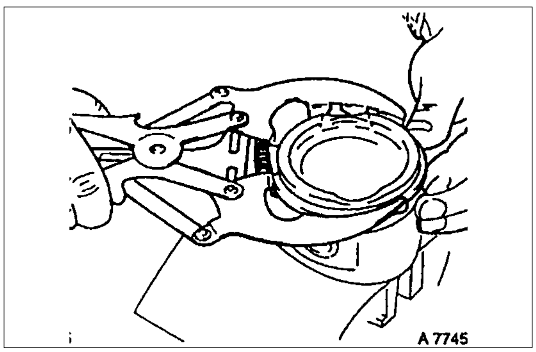
Important!

Since the con-rods have no weight balancing studs, re-working is not possible.

Exchange con-rods in sets only.

Installation position, beads on con-rod point to the flattening on the piston pin eye.

Firmly seated piston pin cannot be pushed in. Carry out installation quickly.



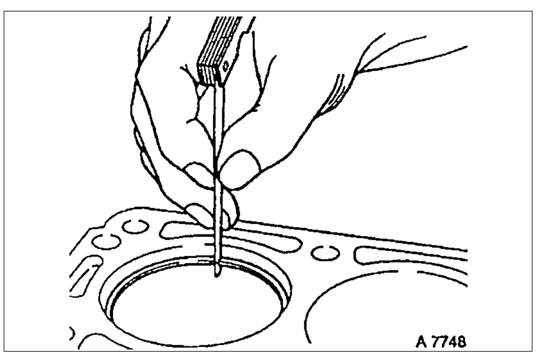
Piston Rings

Removal

1. Remove piston with con-rod according to the corresponding operation.
2. Remove piston rings using commercially available ring installer or piston ring clamp pliers.

Clean

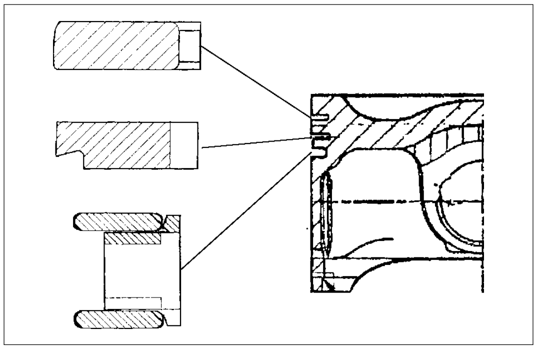
Piston ring grooves - ground piece of old piston ring



Inspection

Piston ring gap

For piston ring sizes, permissible piston ring gaps - see "Technical Data"



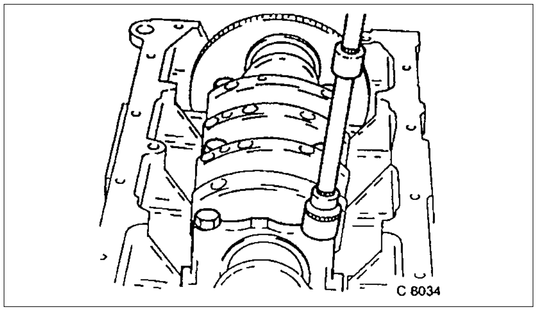
RTW46ASH002401

Installation

1. Install oil scraper ring.
2. Offset ring gaps of steel band rings each 25 to 50 mm/1 to 2in. to the left or right of the intermediate ring gap.
3. Install piston rings.
4. Offset ring gaps by approx. 180°.
5. Install second piston ring with identification mark "TOP" facing upwards.
6. Install piston with con-rod according to the corresponding operation.

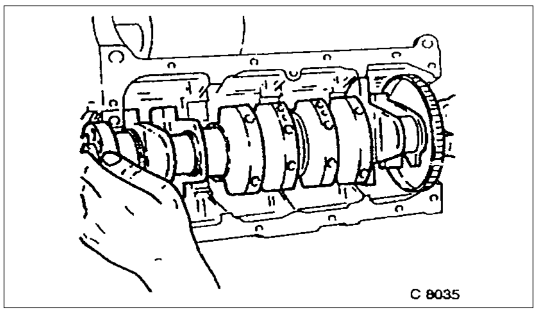
OPERATIONS ON REMOVED ENGINE

Crankshaft



Removal

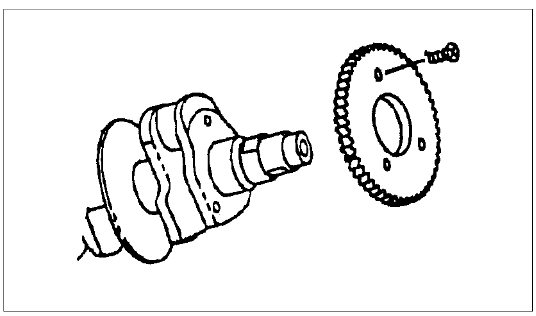
1. Mount the engine on an engine overhaul stand with appropriate adapters.
2. Remove the aggregates, flywheel/drive disc, oil pan, bearing bridge and oil pump according to the corresponding operation.
3. Mark the con-rod bearing cover.
4. Remove the crankshaft bearing cover.
5. Remove the crankshaft from cylinder block.



Inspection

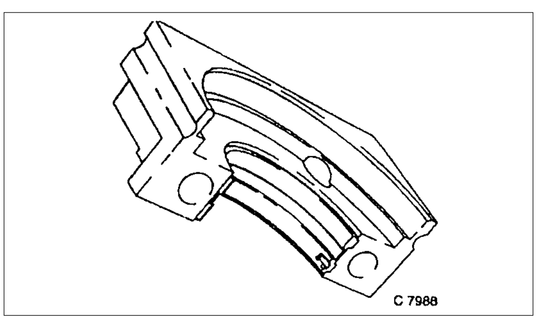
Remove and install all parts if necessary.

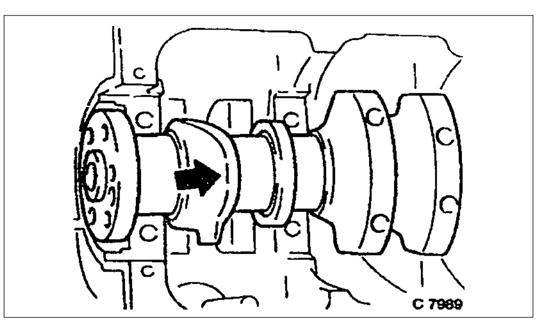
Crankshaft pulse pickup sensor rotor inspection and repair.
Inspect the crankshaft pulse pickup sensor rotor for excessive wear and damage.
Replace the crankshaft pulse pickup rotor if the inspection results exceed wear and damage limits.



Installation

1. **Install the crankshaft pulse pickup sensor.**
   Torque: 13N·m (1.3 kgf·m)
2. **Install new bearing shells into the cylinder block and bearing cover.**
3. **Coat the bearing shafts with engine oil.**
   For oversizes-see "Technical Data"
4. **Install a new crankshaft into the cylinder block.**





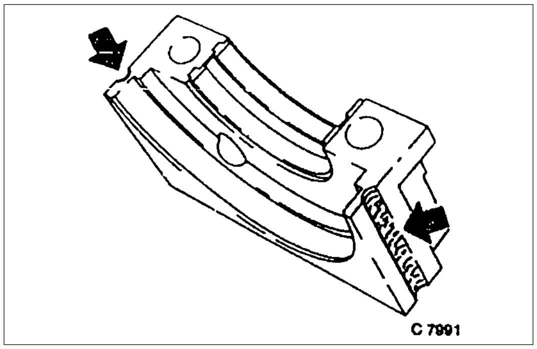
Note

The sealing of the crankshaft can be corrected with light blows with a rubber hammer on the crank arm (arrowed).

2. Hood Hinge Bolts

- Tighten the engine hood hinge fixing bolts to the specified torque.

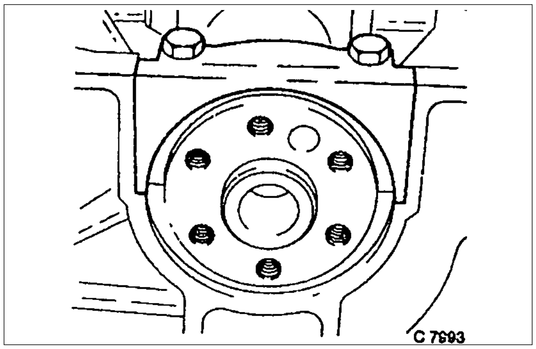
Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	



5. Apply a bead of sealant (TB-1207C or equivalent) in the grooves of both bearing shells.

Important!

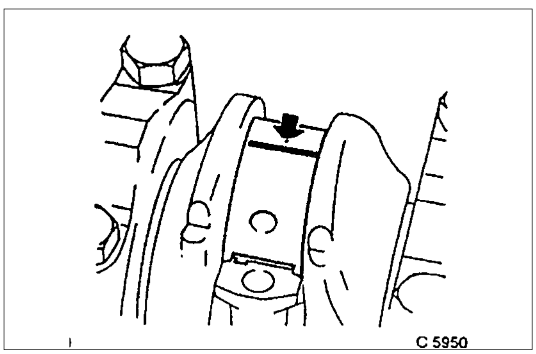
After installation of bearing cover, press in sealing compound again from above, until compound emerges at the joints.



Torque - Angle Method

Bearing cover to cylinder block - 50 N·m (5.1 kgf·m) +40° to 50°
Con-rod bearing cover to con-rod - 35 N·m (3.5 kgf·m) +45° to 60°.
Use new bolts.

6. Install oil pump, oil pan, bearing bridge rear crankshaft sealing, flywheel/drive plate, and aggregates according to the corresponding operations.



Inspection

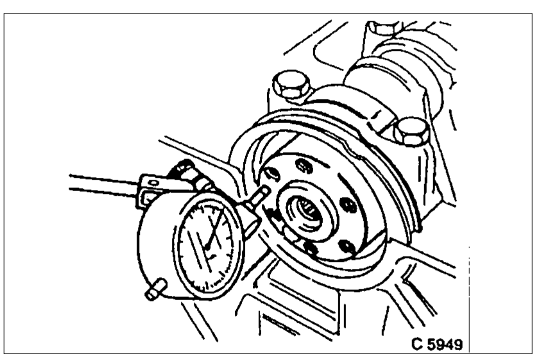
Bearing play - bearing cover removed

Measure

With "Plastigage" (ductile plastic threads)
Cut threads to length of bearing width and lay axiaity between crankshaft journal and bearing shell (arrowed).
Install bearing cover with correct torque.

Important!

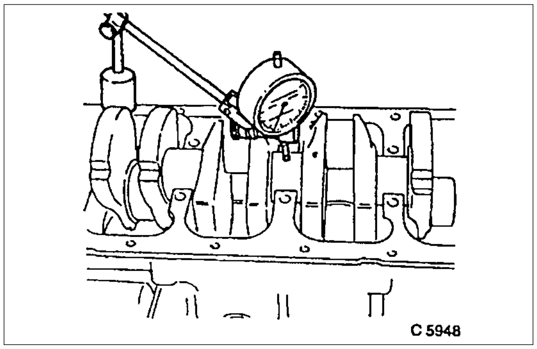
Grease crankshaft journal and lubricate bearing shell slightly so that the thread does not tear when the bearing cover is moved.



Crankshaft

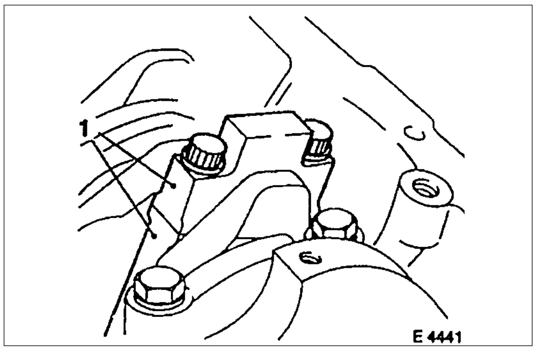
Inspection

End play when bearing shells are installed.
Front end contact surfaces of flywheel/flexible plate.
Permissible end play - see "Technical Data "



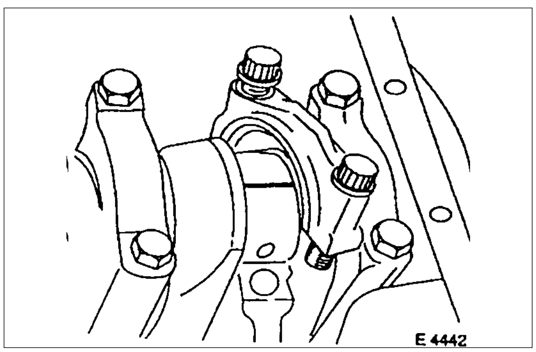
Inspection

Out-of-round (run-out)-middle bearing shell removed when mounting on front and rear bearing.
Permissible out-of-round - see "Technical Data"



Bearing Free Play Measurement

Two methods for measuring bearing free play are described - 1. Plastigage method and 2. micrometer and gauge method. The two procedures are suitable for measuring both con-rod and main bearing free play.
For both methods ensure con-rod and main bearing caps are identified (1) prior to removal as they are machine matched.



1.Plastigage Method

Removal

1. Remove bearing cap and shell.
2. Lightly coat journals and bearings with engine oil to prevent Plastigage from tearing when cap is removed.

Installation

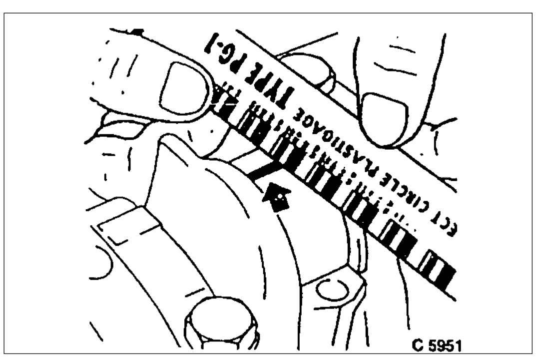
1. Lay a length of Plastigage across width of crank pin and fit bearing cap and shell using old bolts at this stage.

Important!

Do not allow crankshaft to rotate.

Torque - Angle Method

Main bearing cap bolt - 60 N·m (6.1 kgf·m) +40° + to 50°.
Con-rod bearing cap bolts - 35 N·m (3.6 kgf·m) +45°.



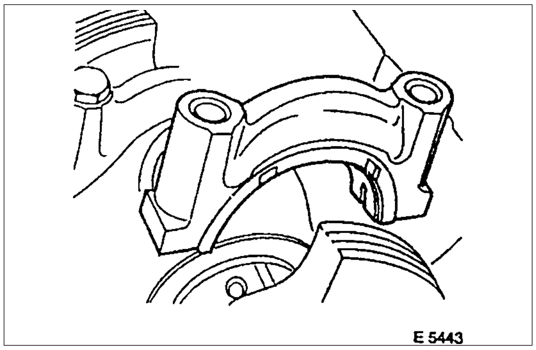
Removal

1. Remove bearing cap and shell.

Measure

Width of Plastigage -use scale supplied with Plastigage.

If con-rod bearing clearance exceeds 0.031mm/0.001in or main journal bearing clearance exceeds 0.04mm/0.02in. - check crankshaft journal diameters - see corresponding operation.
Replace bearing if crankshaft is within specification - see "Technical Data"



Clean

Plastigage from journals.

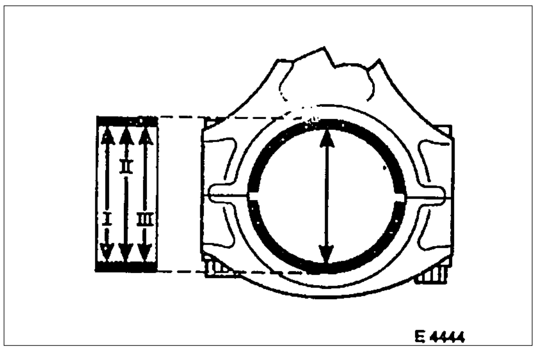
Lightly coat journals and bearings with engine oil.

Installation

Install bearing cap and shell using new bolts.

Torque - Angle Method

Main bearing cap bolt - 60 N·m (6.1 kgf·m) +40° to 50°.
Con-rod bearing cap bolts - 35 N·m (3.9 kgf·m) +45°.

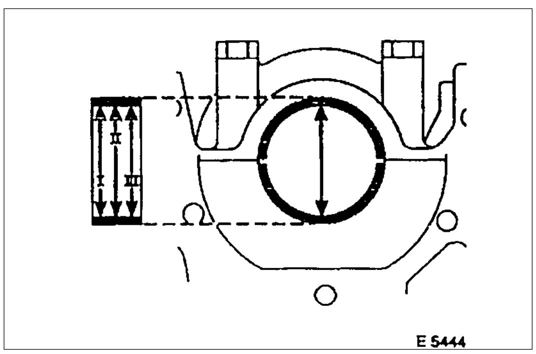


2.Micrometer and gauge method.

Crankshaft removed.

Installation

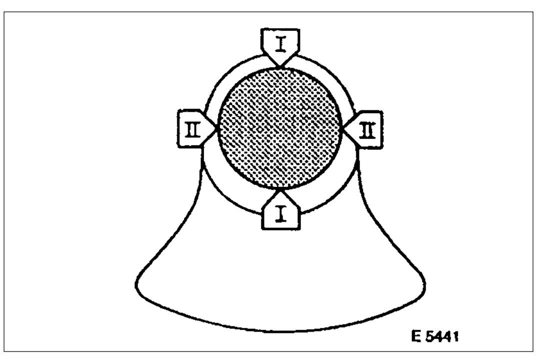
1. Install caps and bearing shells to con-rods and cylinder block.



Measure

Con-rod and main bearing diameters at three points I, II, III (arrowed).
Divide the sum of the three measurements by three to obtain a mean diameter.

The top illustration shows con-rod measuring points.
The second illustration shows main bearing measuring points.



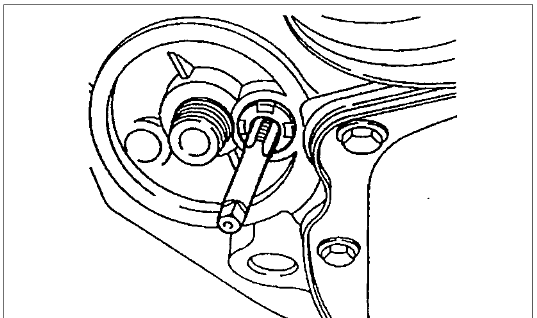
Measure

Crankshaft main and con-rod bearing journals at points I and II. Divide the sum of both measurements to obtain a mean diameter.

Crankshaft must be replaced if mean diameter of main or con-rod journals is below specified limit - see "Technical Data".

If crankshaft is serviceable subtract crankshaft mean journal diameters from corresponding shell bearing mean diameters to determine bearing clearance.

Permissible main bearing clearance - 0.015 to 0.04mm/0.0006 to 0.002in.
Permissible con-rod bearing clearance - 0.006 to 0.031mm/0.002 to 0.001in.


B 2774

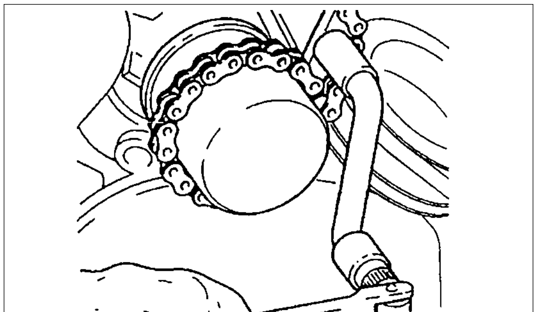
Bypass Valve

Removal

1. Remove oil filter.
2. Remove bypass valve by cutting thread in locking disc with M 10 tap (3rd stage), turning in M 10 bolt and taking out bypass valve from seating.

Installation

1. Install bypass valve using drift (diameter approx. 15mm/0.6in.).


C 7982

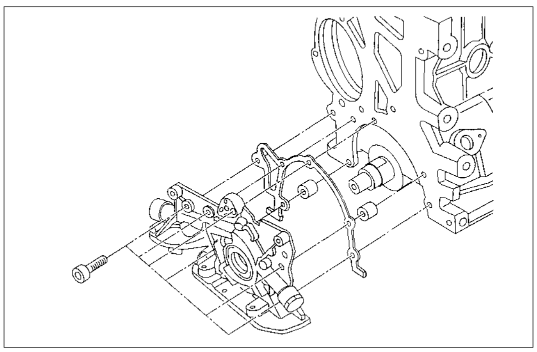
Oil Filter

Removal

1. Remove oil filter using commercially available tool.

Installation

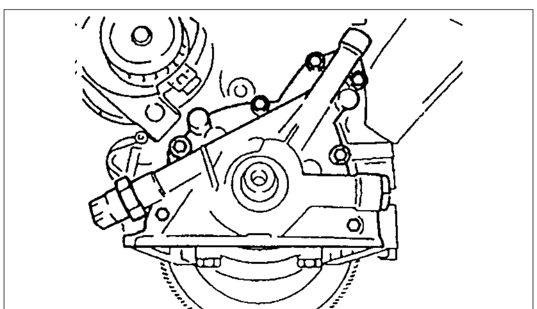
1. Install oil filter by hand and oil seal ring.
2. Fill up engine oil while preventing overflow.



Oil Pump

Removal

1. Remove rear toothed belt cover, and oil pan according to the corresponding operations.
2. Remove oil filter, wiring plug from oil pressure switch, oil pump from cylinder block, and oil pressure switch from oil pump.


P 0531

Clean

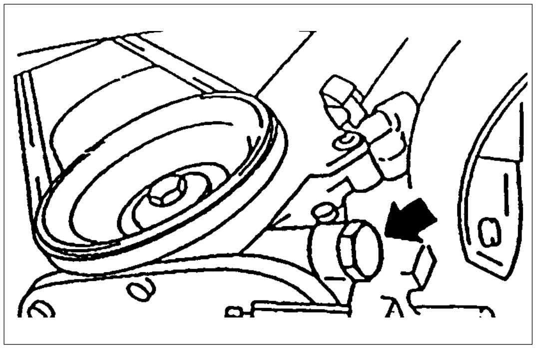
Sealing surfaces

Installation

1. Install oil pressure switch to oil pump, oil pump to cylinder block, oil pan, bearing bridge wiring plug, oil filter and toothed belt cover.

Tighten (Torque)

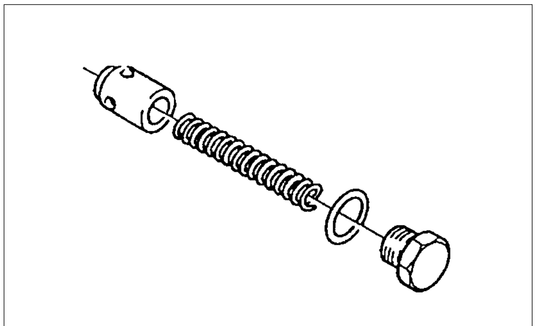
Oil pressure switch to oil pump - 30 N·m (3.2 kgf·m)
Oil pump to cylinder block - 6 N·m (0.6 kgf·m)
Oil intake pipe to oil pump - 8 N·m (0.8 kgf·m)
Intake pipe bracket to cylinder block - 8 N·m (0.8 kgf·m)
*Insert bolts with Locktite (Refer to General Description Recommended Liguid Gasket)



Oil Pump Safety Valve

Removal

1. Remove closure plug.
2. Remove seal ring.
3. Remove spring.
4. Remove piston.

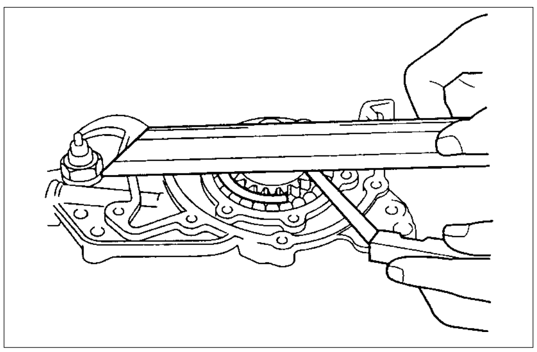


Installation

1. Install piston (observe installation position).
2. Install spring.
3. Install seal ring.
4. Install closure plug.

Tighten (Torque)

Closure plug - 30 N·m (3.0 kgf·m)



Oil Pump (Overhaul)

Removal

1. Remove oil pump according to the corresponding operation.
2. Remove oil cover and pressure control valve.

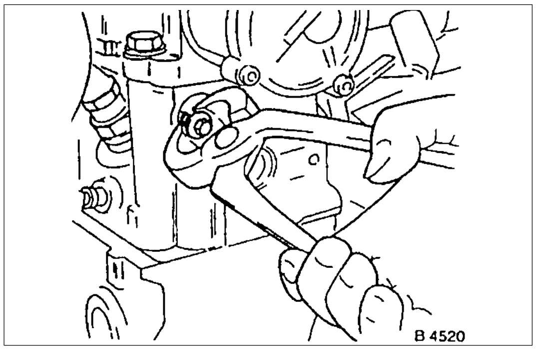
Inspect

Clearance between gear pair and housing upper edge - see “Technical Data”.
Check housing, cover and pressure control valve.

Installation

1. Install pump cover with Sealing Compound 15 03 166 (90 094 714).
2. Install oil pump safety valve according to the corresponding operation.
3. Install oil pump according to the corresponding operation.

OPERATIONS ON OIL CIRCULATION


B 4520

Cylinder Head Safety Valve

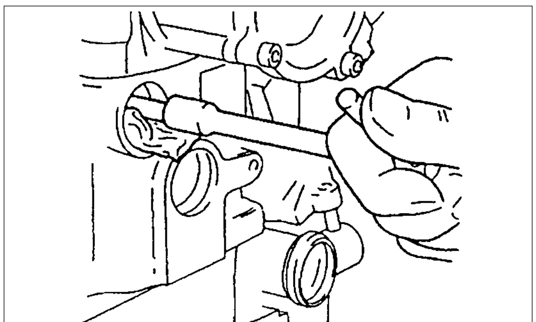
Removal

1. Remove cylinder head according to the corresponding operation.
2. Make hole in core plugs with pointed drift, turn in self tapping screw and edge out.

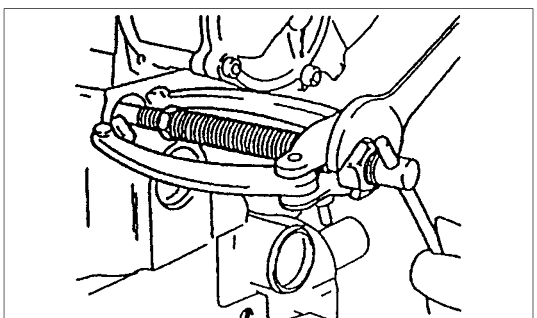
Important!

Cover oil duct in cylinder head with piece of cloth.

3. Pull out valve retainer, using commercially available tool.
4. Remove ball and spring.


B 4523

5. Cut three threads in the ball seating with M 10 tap (3rd stage).
6. Coat tap with grease.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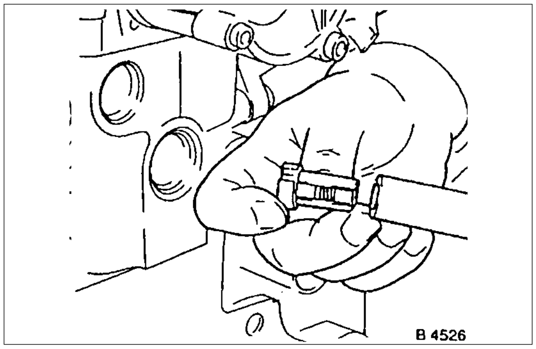
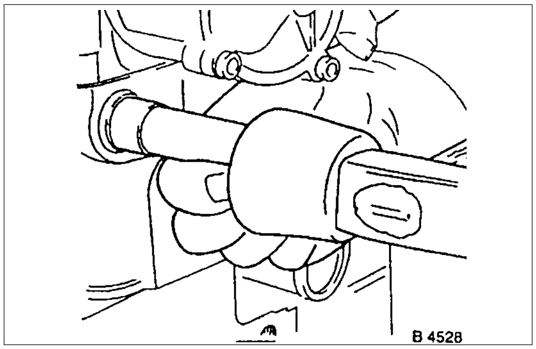
7. Remove ball seating from cylinder head with commercially available tool.
   Do not damage cylinder head.



Installation

1. Install new pressure valve into cylinder head - with suitable pipe until stop.

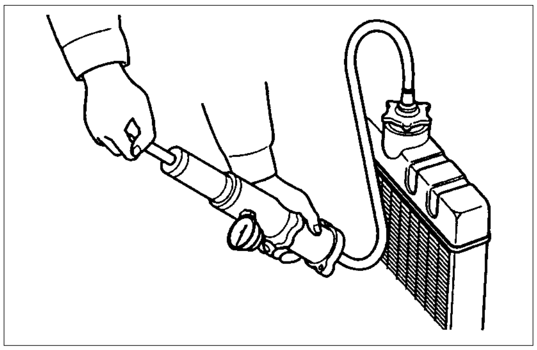


2. Install core hole plugs into cylinder head - with suitable pipe to end of chamfer.

OPERATIONS ON COOLING SYSTEM

Caution!

Before working with the cooling system, be sure to confirm that the temperature of the engine is cooled down.
Failure to observe this may cause burn.



Cooling System, Check for Leaks

Installation

1. Install commercially available coolant checking instrument onto compensation tank (Refer to section 6B; Engine cooling).
2. Check coolant level.

Inspection

Use 5-8840-0277-0 tester & 5-8840-2603-0 adaptor.

Cooling System, Fill Up and Bleed

Important!

Radiator and heater core are made from alminium.
To avoid corrosion, use only anti-freeze with corrosion protection.

Replace Coolant

1. Confirm the engine is cold enough.
2. Open the radiator cap, pour coolant to the filler neck level and close the cap.
3. Pour coolant into the reservoir until MAX line is reached.
4. Start the engine, run 2 ~ 3 minutes at idling speed and switch off the engine.
5. Refill coolant if the coolant level is lowered.

Important!

Do not loosen or open the radiator cap when coolant is hot. Doing so may cause hot water or steam to splash out, resulting in burn. When opening the radiator cap, be sure to confirm the coolant is cold. Cover a thick cloth over the cap and loosen it slowly to reduce pressure, then open the cap.

6. Close the radiator cap firmly and run the engine at approx. 2000 rpm. In addition, set the heater temperature adjuster to the max position to circulate coolant in the heater conduit system.
7. Confirm that the temperature gauge reads half or more of full scale and that the thermostat is activated. Then continue idling 5 minutes more and switch off the engine, and allow it to cool.
8. After the engine cools down, check the coolant level and refill it if necessary. When the level is lowered extremely, check the coolant conduit system and reservoir hose for leak.
9. Pour coolant into the reservoir to MAX level.

Refill Coolant

Important!

After closing the cooling system, let engine run warm until thermostat opens (coolant approx. 92°C/197.6F)

Inspection

Coolant level

Allow engine to cool. If necessary, refill coolant.

Check that cooling system self-bleeds during engine warming-up phase.

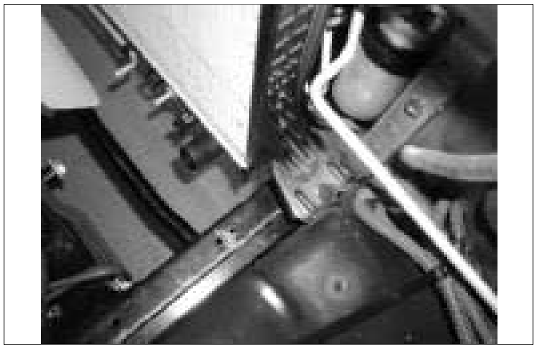
Ignition Timing, Check

No Adjustment

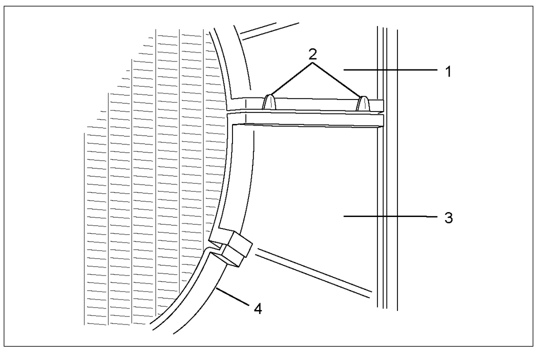
ENGINE EXTERNAL PARTS

Radiator

Removal



1. Disconnect battery ground cable.
2. Loosen a drain plug to drain EC.
3. Disconnect radiator inlet hose and outlet hose from the engine.



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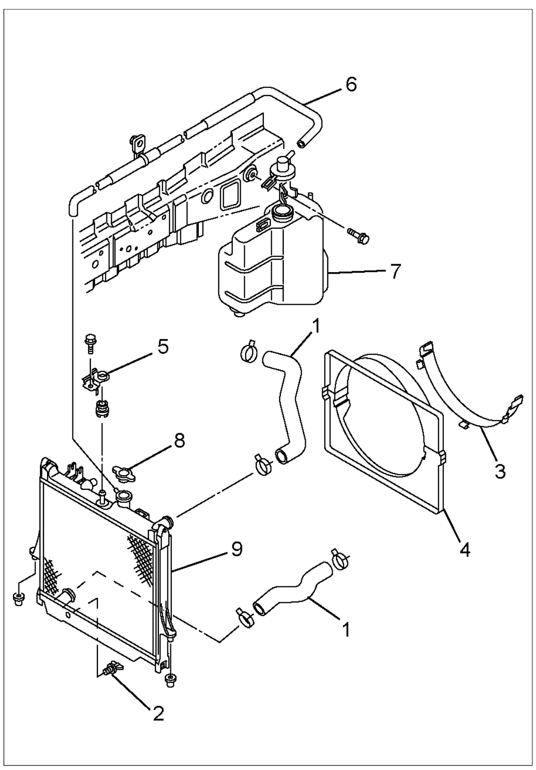
4. Remove fan guide(1), clips(2) on both sides and the bottom lock, then remove lower fan guide(3) with fan shroud(4).
5. Disconnect the reserve tank hose(6) from radiator.



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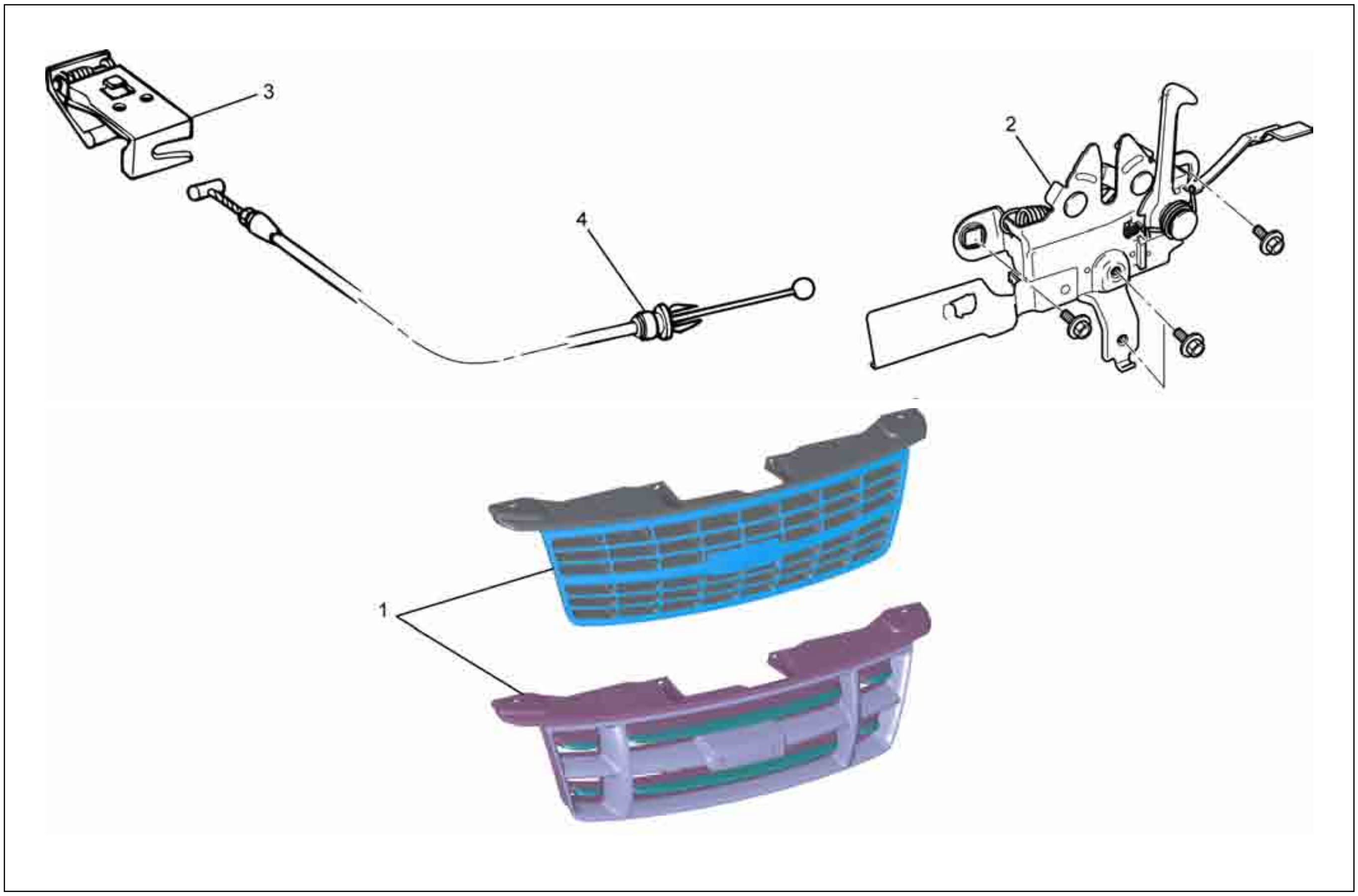
6. Remove bracket(5).
7. Lift up and remove the radiator assembly with hose, taking care not to damage the radiator core with a fan blade.

ENGINE HOOD LOCK (A TYPE)

REMOVAL AND INSTALLATION



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Removal Steps

▲ 1. Radiator grille
▲ 2. Engine hood lock assembly
3. Hood lock control lever
▲ 4. Control cable

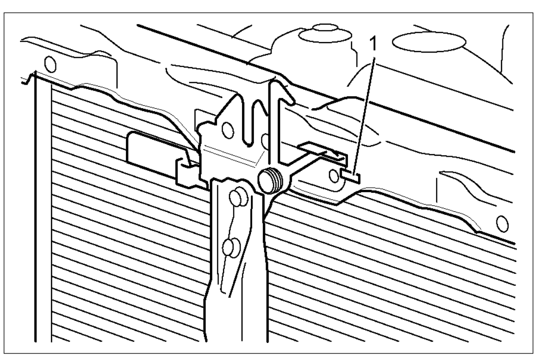
Installation Steps

▲ 4. Control cable
3. Hood lock control lever
▲ 2. Engine hood lock assembly
1. Radiator grille

Important Operations - Removal

1. Radiator Grille
Refer to the Radiator Grille in this section.

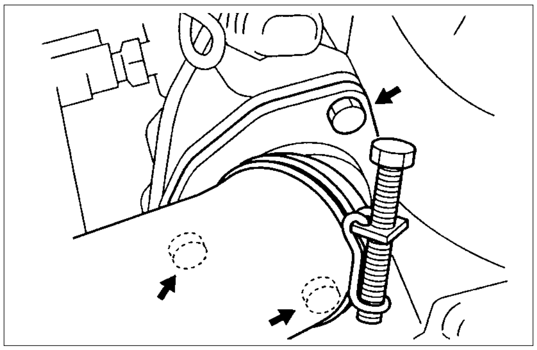
2. Engine Hood Lock Assembly
Apply setting marks (1) to the hood lock assembly and the body prior to removal.



4. Control Cable
Pull out the control cable toward the passenger compartment.

Installation

Follow the removal procedure in the reverse order to install the radiator.



Thermostat

Removal

1. Remove water outlet nozzles with thermostat from thermostat housing.
2. Remove coolant hose and collect coolant.

Important!

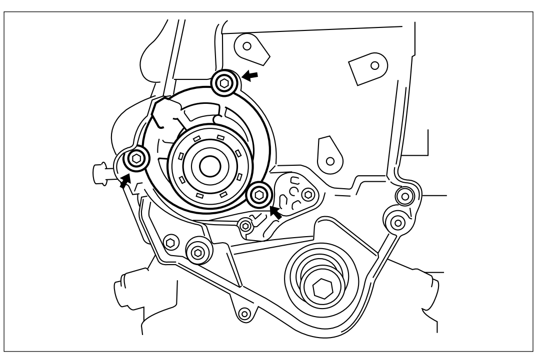
Remove and Install thermostat only together with water outlet nozzles.

Tighten (Torque)

Water outlet nozzles to thermostat housing - 8 N·m (0.8 kgf·m)

Installation

1. Install coolant hose.
2. Fill cooling system and bleed according to the corresponding operation.



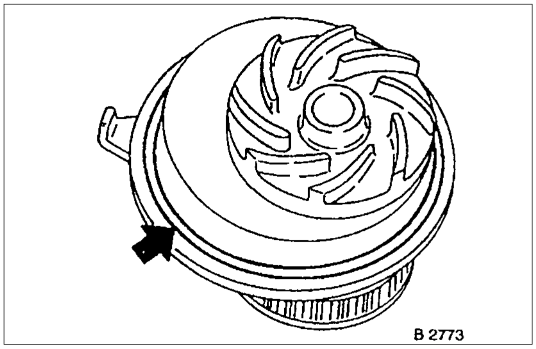
Water Pump

Removal

1. Remove lower hose band from pipe band and collect coolant.
2. Remove front toothed belt cover according to the corresponding operation.
3. Remove water pump from cylinder block after releasing tension on toothed belt.

Clean

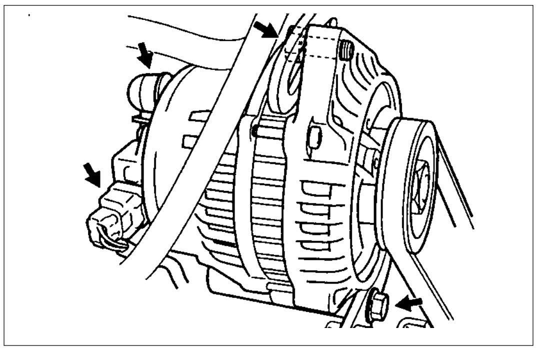
Sealing surfaces



Coating sealing surfaces with Silicone Grease

Installation

1. Install water pump to cylinder block with new rubber O-ring.
2. Apply tension to toothed belt according to the corresponding operation.
3. Install coolant hoses.
4. Fill cooling system and bleed according to the corresponding operation.



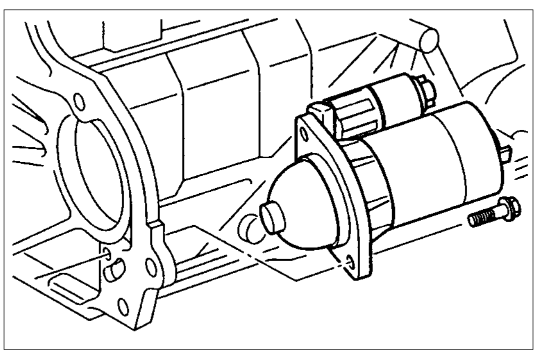
Alternator

Removal

1. Remove ground cable from battery.
2. Remove cable connection from alternator and V-belt.
3. Remove alternator from retaining strap and lower fastening.

Installation

1. Install alternator by tightening firmly by hand.
2. Install V-belt and apply tension according to the corresponding operation.
3. Install cable connections to alternator.
4. Install ground cable to battery.



Starter

Removeal

1. Remove cable connections from starter.
2. Remove upper bolt of transmission side.
3. Remove lower bolt of engine side.

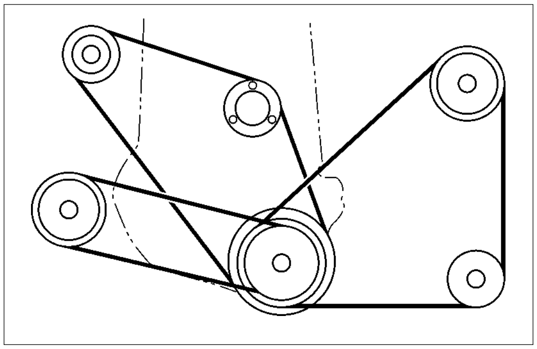
Tighten (Torque)

Starter to cylinder block:
Engine side - 51 N·m (5.2 kgf·m)
Transmission side - 75 N·m (7.6 kgf·m)

Starter support to cylinder block - 25 N·m (2.5 kgf·m)

Re-connect cables.

V-belt Tension of Alternator



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Measure

Measure V-belt tension of alternator.
Permitted values for new V-belt are approx. 311-489N (31-50 kgf).
Note:
V-belt to deflection as loaded with 10kg : 8-12mm.

Adjust

Adjust V-belt tension by loosening clamping bracket and lower alternator bracket and moving alternator.

Tighten (Torque)

Clamping bracket to alternator - 35 N·m (3.6 kgf·m)
Lower alternator bracket - 25 N·m (2.6 kgf·m)

V-Belt Tension of Power Steering Pump

Measure

Measure V-belt tension of power steering pump. Permitted values for new belt are approx. 578-712N (59-73 kgf) and 534-667N (54-68 kgf) for used belt.
Note:
V-belt to deflection as loaded with 10kg : 8-12mm.

Adjust

Adjust V-belt tension by loosening clamping bolt, lower pump bracket, and adjusting nuts and moving steering pump.

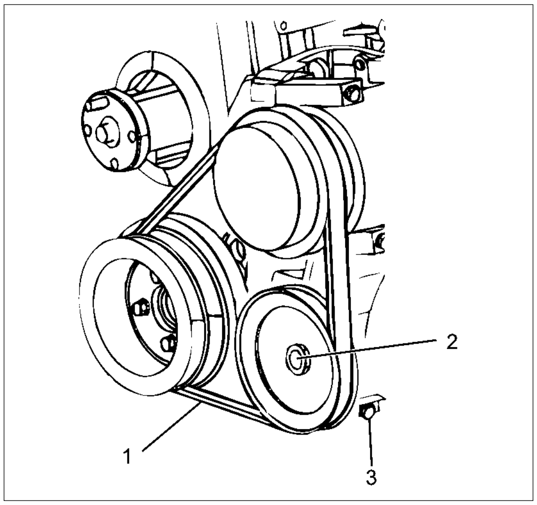
Tighten (Torque)

Adjusting nuts - 18 N·m (1.8 kgf·m)
Clamping bolt - 25 N·m (2.6 kgf·m)
Lower pump bracket - 26 N·m (2.6 kgf·m)

V-Belt Tension of Air Conditioning Compressor

Measure

Measure V-belt tension of air conditioning compressor.
Permitted values for new V-belt are approx. 422N (43 kgf).
Note:
V-belt to deflection as loaded with 10kg : 8-12mm.



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Adjust

Adjust the A/C compressor V-belt (1) for adjustment of belt.

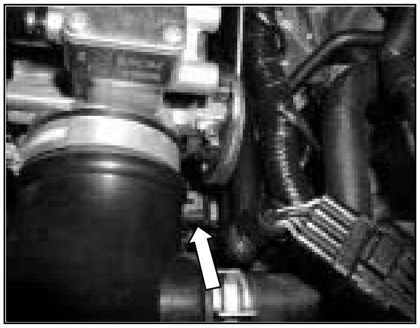
1. Loosen the tension pulley lock nut (2) and tension pulley adjusting bolt (3) of the tension pulley of the A/C compressor V-belt (1) and bring the belt to free state.
2. Rotate the adjusting bolt (3) of A/C compressor adjust the belt (remove and fit).
   - When replacing the belt, you must always replace both the belts.
3. After adjustments, tighten the lock nut (2) using the specified torque.

Tightening torque: 40 N·m (4.1 kgf·m)

- Finally, adjust the tension of A/C compressor V-belt.

FUEL INJECTION SYSTEM

MAP SENSOR

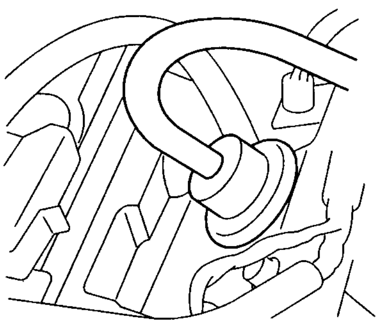


Removal

1. Disconnect the battery cable.
2. Disconnect the electrical connector from the sensor.
3. Remove the mounting bolts securing the sensor to the manifold.
4. Remove the sensor from the intake manifold.

Installation

1. Push MAP sensor into the manifold.
2. Install the mounting bolts and tighten them.
3. Connect electrical connector.
4. Connect the battery cable.



Pressure Regulator

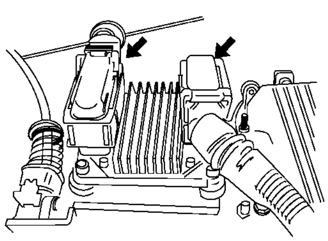
Removal

1. Remove vacuum hose.
2. Remove fuel hoses.
3. Remove pressure regulator.

Installation

1. Install pressure regulator.
2. Install fuel hoses.
3. Install vacuum hoses.

(2.4L Model)



ECM (Engine Control Module)

Removal

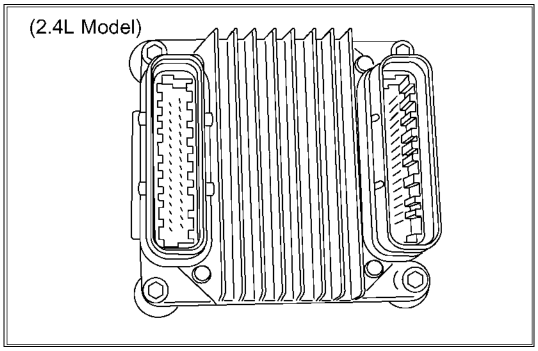
(2.4L)

1. Disconnect the ECM connector.
2. Remove the four hex bolts and nuts.
3. Remove the ECM from the ECM bracket on engine.

Installation

(2.4L)

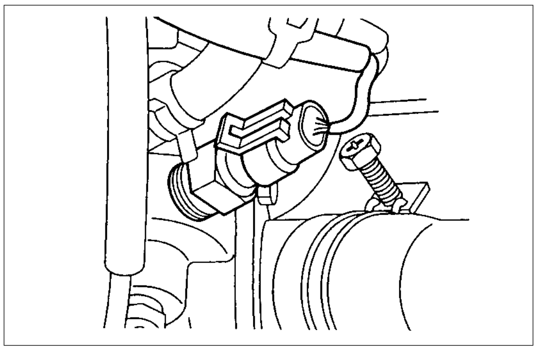
1. Install the ECM to the ECM bracket on engine.
2. Tighten the four screws to the bracket.
3. Connect the connector.



ECT

Removal

1. Remove wiring harness plug and coolant temperature sensor.



Tighten (Torque)

Temperature sensor to intake pipe - 10 N·m (1.0 kgf·m)
Wiring harness plug to temperature sensor

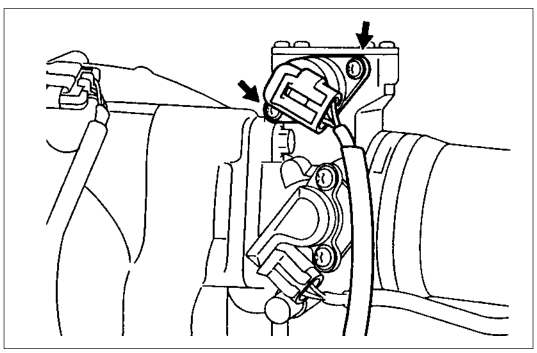
Inspection

Coolant level

Idle Air Control (IAC) Valve

Removal

1. Remove wiring harness plug, hose clamps and idle speed adjuster.



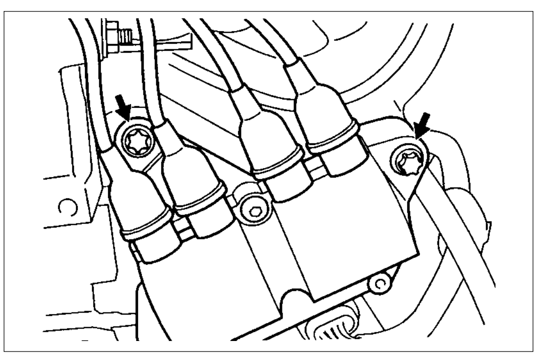
Installation

1. Install idle speed adjuster, hose clamps and wiring harness plug.

Ignition Coil

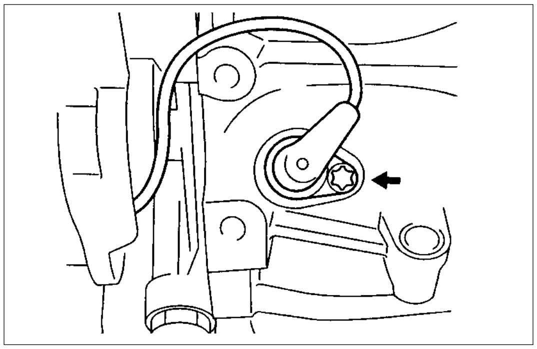
Removal

1. Remove 2 bolts, plug and ignition coil.



Installation

1. Install ignition coil, plug and bolts.



Crank Position Sensor

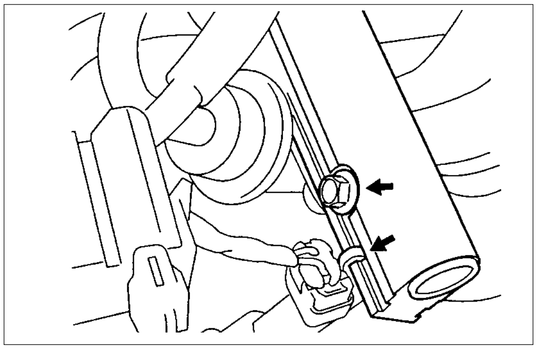
Removal

1. Remove crank position sensor.

Installation

1. Install crank position sensor.

FUEL INJECTOR



Removal

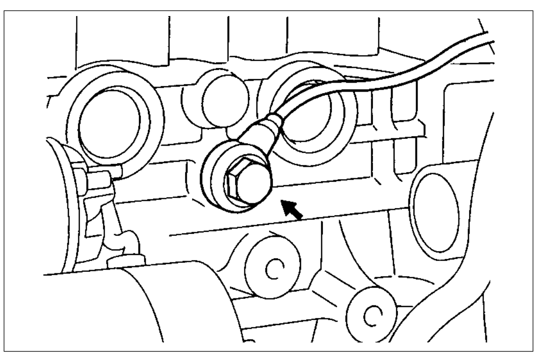
Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a shop towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Depressurize the fuel system.
2. Disconnect the fuel inlet.
3. Disconnect the fuel return line.
4. Remove the fuel rail from the intake manifold.
5. Remove the fuel injector from the fuel rail by disengaging claws.

Installation

1. Install the fuel injector to the fuel rail by engaging claws.
2. Install the fuel rail to the intake manifold.
3. Connect the fuel return line firmly.
4. Connect the fuel supply line firmly.



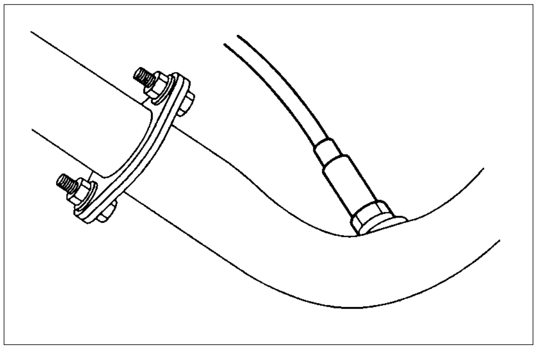
Knock sensor

Removal

1. Remove fixing bolts.
2. Disconnect the connector at the other side.

Tighten (Torque)

Oxygen sensor in exhaust pipe - 30N·m (3.1 kgf·m)
When re-using, insert oxygen sensor.



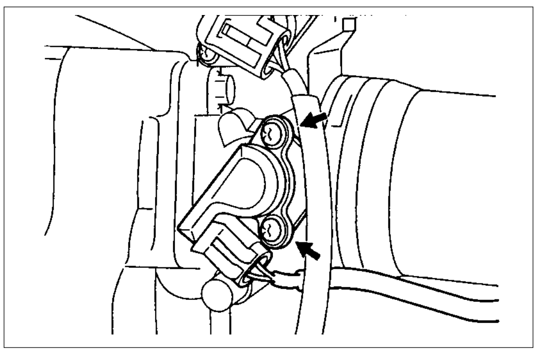
Oxygen Sensor (If applicable)

Removal

1. Remove wiring harness plug.
2. Remove oxygen sensor from the front exhaust pipe.

Tighten (Torque)

Oxygen sensor in exhaust pipe - 30 N·m (3.1 kgf·m)



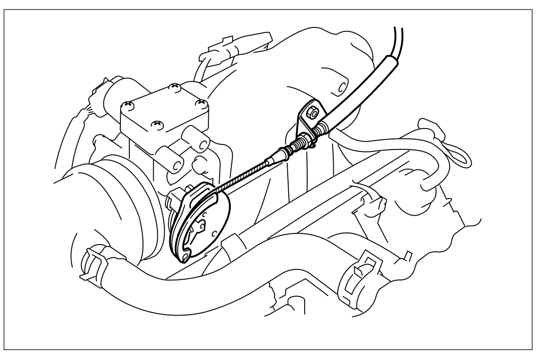
Throttle Valve Position Sensor

Removal

1. Remove wiring harness connector.
2. Remove throttle valve position sensor.

Installation

1. Install throttle valve position sensor.
2. Install wiring harness connector.



Accelerator Pedal and Cable

Removal

1. Remove pad stopper from pedal stop bolt.

Installation

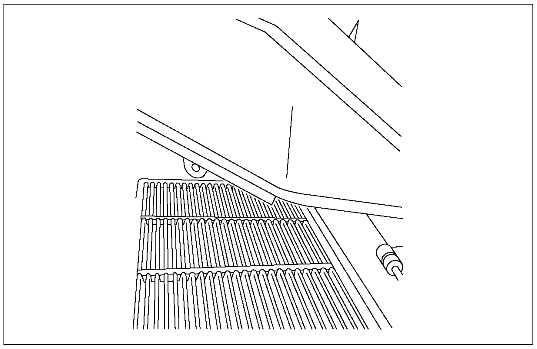
1. Install pad stopper.

Inspection

Ensure that accelerator pedal is fully in idle position and accelerator level at engine is in closed position.

Pull outer sleeve of accelerator cable towards pedal and check that clip on sleeve is in slot nearest to grommet.

Reposition clip if necessary, and check that full throttle and idle positions are obtained at engine lever.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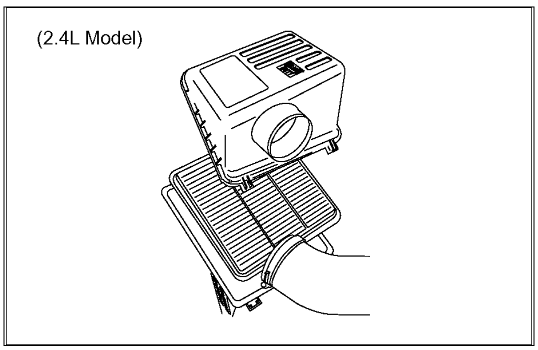
Air Cleaner Filter

NOTE:
The air cleaner filter is not damaged with the edge of the air cleaner housing.

Removal

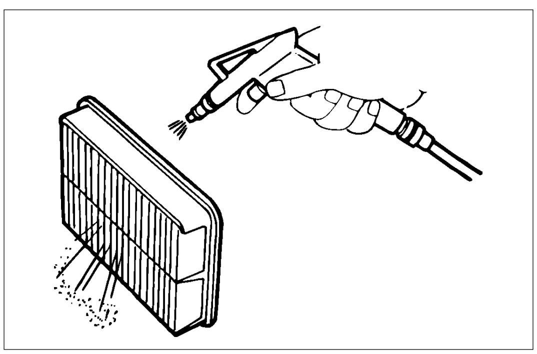
(2.4L)

1. Remove air cleaner cover and air cleaner element.
2. Remove air intake nose.
3. Remove lower air cleaner.
4. Remove mud guard.
5. Remove front fender cover.
6. Remove outside air intake duct.



Inspection

Check the air cleaner filter for damage or dust clogging.
Replace if it is damaged, or clean if it is clogged.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Cleaning Method

Tap the air cleaner filter gently so as not to damage the paper filter, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.

Installation

(2.4L)

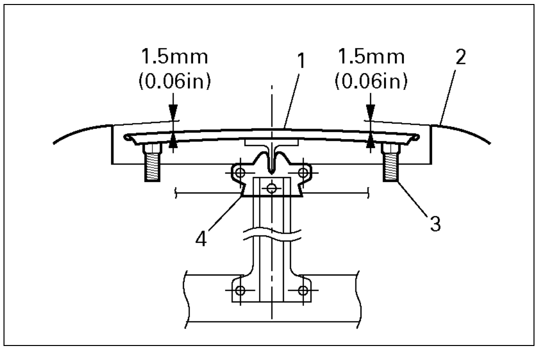
1. Install outside air intake duct.
2. Install front fender cover.
3. Install mud guard.
4. Install lower air cleaner.
5. Install air intake hose.
6. Install air cleaner element and air cleaner cover.

Important Operations - Installation

4. Control Cable

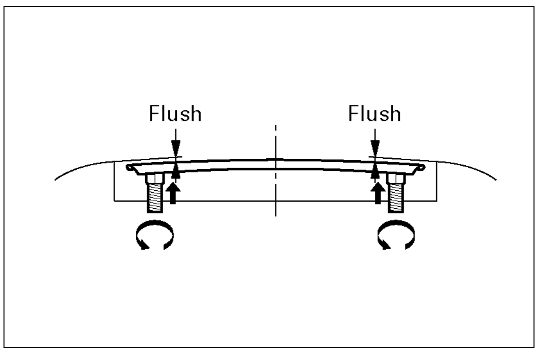
Reroute the control cable to its original position, and check to see if the lock assembly and control lever work normally.

2. Engine Hood Lock Assembly



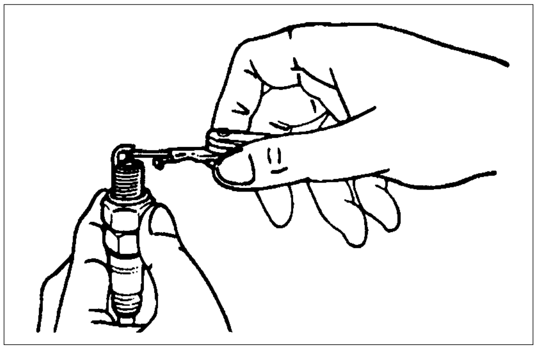
Adjustment

1) Install the engine hood lock assembly (4) and temporarily tighten the bolts securing it.
2) Close the hood.
3) Position the hood so that the stepped portion between the hood (1) and the fender (2) is precisely 1.5 mm (0.06 in) high.
4) Finally tighten the bolts securing the engine hood lock assembly.



5) Turn the buffers (3) counterclockwise until the stepped portion between the hood and the fender disappears.
6) Tighten the hood lock assembly fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	



Spark Plug Thread

Recondition

Ream thread and recut using commercially available spark plug thread drill (observe manufacturer's instructions).

Removal

Remove thread bush on spark plug. (dimensions (A) = 17mm/0.67in.)

Tighten (Torque)

Spark plug with thread bush into cylinder head - 25N·m (2.5 kgf·m) - use.

TECHNICAL DATA

SOHC Gasoline Engine C24SE

Engine Oil Viscosity

The following engine oils can be used:
A = single-grade oils
B = multigrade oils
C = easy run oils
depending on the outside temperature.

Engine Oil Quality

It is important that the following API and CCMC classes are used:

Engines	Single and multigrade oils	Easy run oils
Petrol	API-SF/CC, SF/CD, SG/CC, SG/CD, CCMC/G4	API-SF/CC, SF/CD, SG/CD CCMC-G5/PD2

Important!

CD engine oils designed by manufacturers specially for diesel engines are not suitable for petrol engines, unless a sufficient performance class for petrol engines (e.g. API-SF/CCMC-G4) is also indicated.

Disposal.

Observe the relevant national regulations when disposing of used oil.

Engine Oil Filling Quantities

Engine Model	Initial filling (litres)	Filling quantity with filter change* (litres)	MIN to MAX (litres)
2.4L	4.80	4.25	1.00

*Up to mark "MAX" on oil dipstick

Oil Pump

Backlash 0.1 to 0.2mm
Gaps in gears opposite housing 0.03 to 0.1mm
Oil pressure at idle speed Engine at operating temperature (>70°C oil and approx. 80°C coolant) 450 - 500 kpa

Oil drain plug M14 × 1.5

Cooling System

Radiator

Type: Cross-flow

Radiator core surface in cm^2: 2000

Cooling system capacity (in litres): 8

Anti-freeze Mixture

Anti-freeze Mixture

Required Quantity (in litres)	Up to-10°C Quantity in litres		Up to-20°C Quantity in litres		Up to-30°C Quantity in litres		Up to-40°C Quantity of litres	
	Water (80%)	Anti-Freeze (20%)	Water (66%)	Anti-Freeze (34%)	Water (56%)	Anti-Freeze (44%)	Water (48%)	Anti-Freeze (52%)
7.2	5.7	1.5	4.7	2.5	4.0	3.2	3.4	3.8

Cooling System (continued)

Fan

Type Visco Clutch Fan
Number of blades 5
Distribution of blades asymmetric
Diameter mm

Radiator cap

Boiling point 123°C
Opening pressure kPa (bar) 120 to 135 (1.20 to 1.35)

Thermostat

Start of opening 92°C
Fully opened 107°C
Type Bypassed

Idle Speeds, CO Content, Ignition Adjustment

Applicable System	Idle speed in min^{-1} (rpm) Manual	CO content in vol. %	Ignition timing in CA BTDC (adjustment ensues at able speed, ignition marks must align) with TDC sensor measuring instrument:
Closed Loop System	825	*<0.4	*** 8 to 12
Open Loop System	825	**$1.0^{+0.2}_{-0.5}$	*** 8 to 12

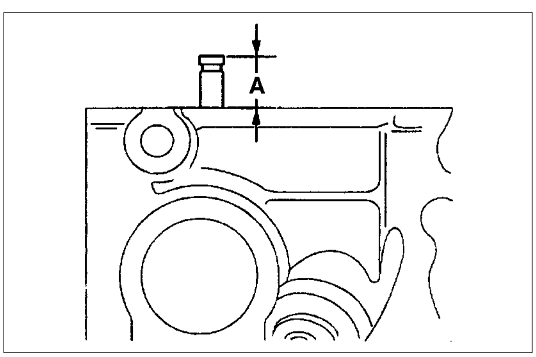
Note) * CO content adjustment not applicable.
** CO content adjustment refer to Section 6E1 (W/O catalytic converter system)
*** Ignition timing adjustment not possible.

Adjustment Values/Checking Values

Valve clearance	
Inlet	Hydraulic valve lash adjustment
Outlet	No adjustment necessary
Spark plugs - electrode gap	1.0 ~ 1.1mm
Compression	The difference in compression between the individual cylinders in the engine must not exceed 100 kPa (1 bar).
Pressure loss	The pressure loss of an engine in perfect condition per cylinder is not more than max. 25%

Cylinder Head

Cylinder Head Gasket		
Thickness - installed	mm	1.2
Valve seat width at cylinder head		
inlet	mm	1.0 to 1.5
outlet	mm	1.7 to 2.2
Valve stem play inlet	mm	0.018 to 0.052
outlet	mm	0.038 to 0.072
Permissible valve stem to cone runout		
inlet	mm	0.03
outlet	mm	0.33
Overall height of cylinder head		
(Sealing surface to sealing surface)	mm	95.5 ± 0.25
Installation height		
inlet and		
outlet valves	mm	17.85 to 18.25
dimension "A"		Distance Gauge 5-8840-2596-0
Installation height valve guide	mm	83.50 to 83.80
Sealing surface peak-to-valley height	mm	max. 0.025



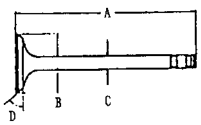
Cylinder Head (continued)

Valve System

Valve lifter			valve play compensator (hydraulic)
Valve rotators (inlet or outlet)			outlet
Valve play (warm or cold)	inlet	mm	0
	outlet	mm	0

Cylinder head bottom, face parallelism mm 0.05

Valve Dimensions

	**C24SE**							
	A in mm		**B in mm**	**C(diameter in mm) and identification mark**				**D**
	1)	**2)**		**Normal K**	**Oversize K1 0.075**	**Oversize K2 0.150**	**Oversize A 0.250**	
Inlet valve	104.2	103.8	41.8	7.012 6.998	7.087 7.073	7.162 7.148	7.262 7.248	44°
Outlet valve	104.0	103.6	36.5	6.992 6.978	7.087 7.053	7.142 7.128	7.242 7.228	44°
Valve stem bore	-			7.050 7.030	7.125 7.105	7.200 7.180	7.300 7.280	-

1) Production

2) Customer service

The P and A department only supplies valves with a length of 103.8mm (inlet valve) and 103.6mm (outlet valve) only

Camshaft

			2.4L
Identification letter			K
Colour code	Normal size		-
	0.1mm undersize		violet
Radial runout		mm	0.03
End play		mm	0.09 to 0.21
Cam lift	Inlet and outlet valve	mm	6.67

Grinding Dimension for Camshaft Bearing Position

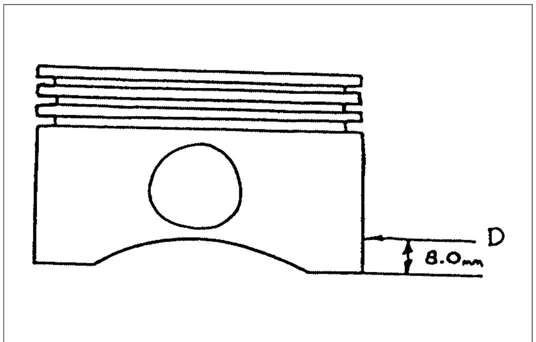
Bearing	Bearing journal diameter in mm		Diameter in housing	
	normal	-0.1mm	normal	-0.1mm
1	42.470 42.455	42.370 42.355	42.525 42.425	42.500 42.400
2	42.720 42.705	42.620 42.605	42.775 42.750	42.675 42.650
3	42.970 42.955	42.870 42.855	43.025 43.000	42.925 42.900
4	43.220 43.205	43.120 43.105	43.275 43.250	43.175 43.150
5	43.470 43.455	43.370 43.355	43.525 43.500	43.425 43.400

Crankshaft, Cylinder Block

Cylinder Grinding and Piston Dimensions

	Size	Cylinder bore dia. in mm		Cylinder to Crankshaft housing co-efficient	Related piston dia. in mm		Piston head co- efficient
		over	to		over	to	
Production (2.4L)	1	87.48 87.49	87.49 87.50	99 00	87.46 87.47	87.47 87.48	99 00
Customer service (2.4L)	-	87.99	88.00	0+0.5	87.97	87.98	7+0.5

Piston diameter must be measured at the position "D".
*inclusive



Cylinder Bore

Rebore cylinder — Permissible oversize to 0.5mm (see parts microfiche)

After reboring, invalidate original crankcase housing coefficient and drive in new oversize coefficient

Permissible out-of-round: 0.013mm
Permissible taper: 0.013mm
Measure out-of-round in bore at 4 different heights

Piston projection above upper edge of cylinder block
0.40mm

Piston

Type — Recessed pistons

Clearance — For short-blocks and cylinder blocks with complete pistons, the clearance is 0.02 to 0.04mm

For replacement (oversize), depending on available pistons, a clearance of 0.02 to 0.04mm is permissible

Crankshaft, Cylinder Block (continued)

Piston Rings

			2.4L
Square ring	Height	mm	1.2
Tapered ring	Height	mm	1.5
Oil scraper	Height	mm	2.5
Ring gap offset			180°

Note that the upper steel band ring gap is offset 25 to 50mm to the left and the lower 25 to 50mm to the right opposite the intermediate ring gap.

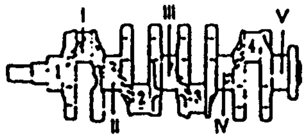
Piston Pin

Length		mm	61.5
Diameter		mm	21
Type			Shrunk into con-rod
Play		mm	2.4L
	in piston		0.010-0.015
	in con-rod		none
Installation			When installing piston pins, heat con-rods to approx. 280°C in oil bath. This temperature should under no circumstances be exceeded.

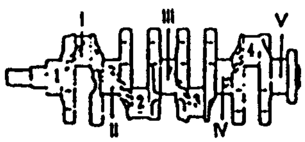
Crankshaft, Cylinder Block (continued)

The permissible weight variation of con-rods without piston and bearing shell inside an engine is 8 g.
As the con-rods do not have balancing studs, reworking is not possible.
Con-rods can only be replaced in sets.

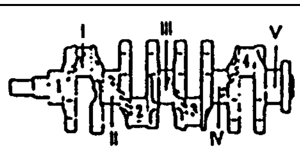
Crankshaft, Cylinder Block (continued)

	Crankshaft journal I, II, IV, V	Guide bearing III	Con-rod journal 1 to 4		Con-rod width
	Diameter mm	Widtht mm	Diameter mm	Width mm	mm
	Normal size				
Bearing journal and colour code	from 57.9820 green to 57.9885 > 57.9885 brown to 57.9950	25.900 25.850	48.988 48.970	26.580 26.460	26.390 26.338

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown-662N green-663N	brown-655N green-658N		

	Crankshaft journal I, II, IV, V	Guide bearing III	Con-rod journal 1 to 4		Con-rod width
	Diameter mm	Widtht mm	Diameter mm	Width mm	mm
	0.25mm Undersize for Production and Customer Service				
Bearing journal and colour code	from 57.7320 green/ to 57.7385 blue > 57.7385 brown/ to 57.7450 blue	26.100 26.050	48.738 48.720		26.580 26.460

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown/blue-664 A green/blue-655 A	brown/blue-657 A green/blue-658 A		

	Crankshaft journal I, II, IV, V	Guide bearing III	Con-rod journal 1 to 4		Con-rod width
	Diameter mm	Widtht mm	Diameter mm	Width mm	mm
	0.50mm Undersize Customer Service				
Bearing journal and colour code	from 57.4820 green/ to 57.4885 blue > 57.4885 brown/ to 57.4950 blue	26.300 26.250	48.488 48.470		26.580 26.460

Bearing shell identification mark Colour code and embossed Identification mark	Crankshaft bearing I, II, IV, V	Guide bearing III	Con-rod bearing 1 to 4	
	brown/white-666 B green/white-667 B	brown/blue-659 B green/blue-660 B		

Piston Pins

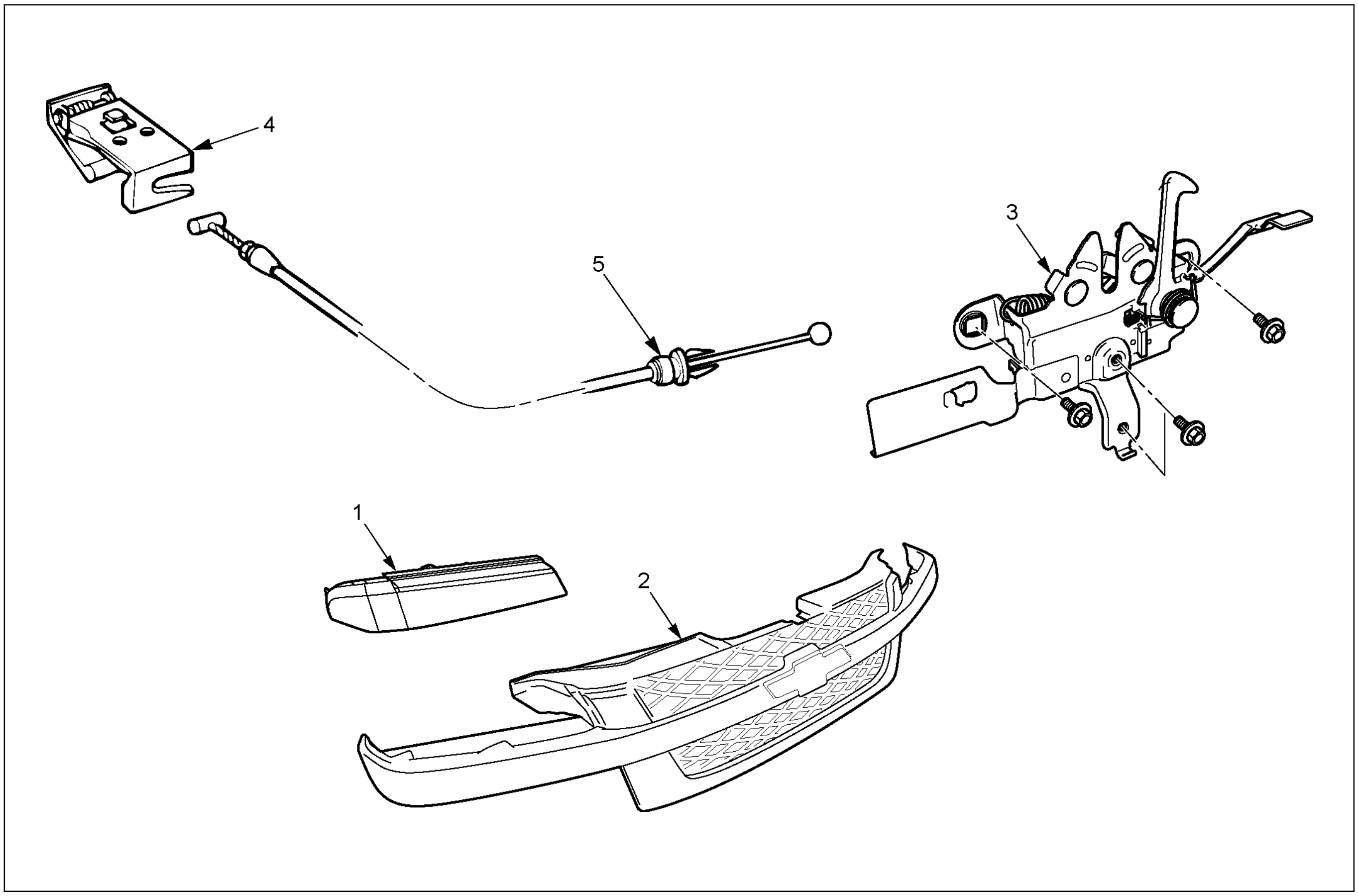
Dimensions		
Length	mm	61.5
Diameter	mm	21
Type		Shank-fit in con-rod
Clearance		2.4L
In piston	mm	0.010 to 0.015
In con-rod	mm	0
Installation		See operation “Con-rod, Replace”

I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
or months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
CLUTCH																				
Clutch fluid	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Clutch pedal travel and free play	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
TRANSMISSION OR TRANSMISSION WITH TRANSFER CASE																				
* Automatic transmission fluid (HFV6)	-	-	I	-	-	I	-	-	I	-	-	I	-	-	I	-	-	I	-	R
(4JH1-TC, 4JJ1 (Standard Output), 4JJ1 (High Output))	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
* Transfer case oil	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
* Manual transmission fluid	-	R	-	I	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Gear control mechanism for looseness	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
PROPELLER SHAFT																				
Loose connections	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Universal joints and splines for wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Universal joints and sliding sleeve (4WD)	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L
FRONT AND REAR AXLE																				
* Differential gear oil (Front and rear)	-	R	-	I	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Shift on the fly system gear oil	I	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Front axle shaft boot for damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle shafts for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle case for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
STEERING																				
Power steering fluid	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Steering system for looseness or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Power steering hose	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	R	-	I	-	I
Steering wheel play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Right and left turning radius	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Wheel alignment	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Joint ball for oil leakage or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Joint ball rubber boot for damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
SERVICE BRAKES																				
Brake fluid	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Brake system for fluid leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Brake function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Rear brake lining and drum wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Front disc brake pads and discs wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Brake pedal travel and free play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Pipes and hoses loose connections or damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I

ENGINE HOOD LOCK (B TYPE)

REMOVAL AND INSTALLATION



RTW52BMF000101

Removal Steps

▲ 1. Front combi lamp assembly
▲ 2. Radiator grille
▲ 3. Engine hood lock assembly
4. Hood lock control lever
▲ 5. Control cable

Installation Steps

▲ 5. Control cable
4. Hood lock control lever
▲ 3. Engine hood lock assembly
2. Radiator grille
1. Front combi lamp assembly

Important Operations - Removal

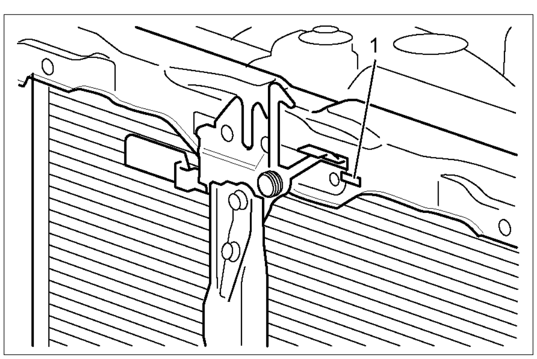
1. Front combi lamp assembly

2. Radiator Grille

Refer to the Radiator Grille in this section.

3. Engine Hood Lock Assembly

Apply setting marks (1) to the hood lock assembly and the body prior to removal.



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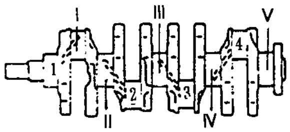
5. Control Cable

Pull out the control cable toward the passenger compartment.

Con-rod

Permissible, weight variation of con-rods without pistons and bearing shells within an engine 8 g.
As the con-rods have no counterweights, re-working is not possible. Con-rods must be replaced only as a set.

Crankshaft Grinding Dimensions					
	Crankshaft bearing journals I, II, III, IV, V diameter in mm/colour code	Guide bearings III width in mm	Con-Rod bearing journals 1 to 4 diameter in mm	 width in mm	Con-rod width in mm
	Standard Size for Production and Service				
	from 57.974 white to 57.981 over 57.981 green to 57.988 over 57.988 brown to 57.995	26.002 25.950	48.988 48.970	26.580 26.450	26.390 26.338

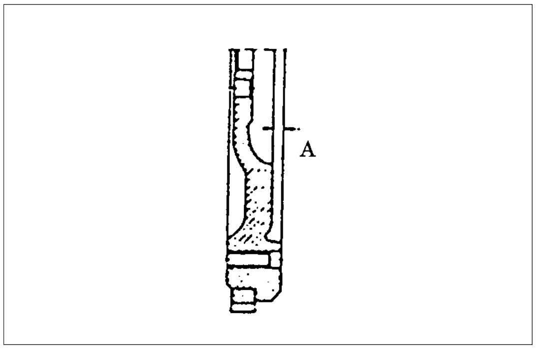
Crankshaft, Cylinder Block (continued)

Crankshaft and con-rod journal	Permissible out-of-round: 0.04mm
Out-of-round	Permissible variation of middle crankshaft bearing journal when seating shaft into cylinder block: 0.03mm
Permissible end play	0.05 to 0.152mm
Permissible main bearing play	Bearing I to V0.015 to 0.04mm
Permissible con-rod play	0.006 to 0.031mm
Permissible con-rod and play	0.07 to 0.24mm

Crankshaft, Cylinder Block (continued)

Flywheel

Starter ring gear	Before fitting, heat ring gear to 180°C - 230°C
Lateral run-out	Permissible lateral run-out of installed starter ring gear to flywheel: 0.5mm
Precision turning	Permissible removal of material in clutch disc lining surface area: 0.3mm In order to achieve the functional relationship again after removal of material, the same removal of material must take place on the fore part of the flywheel (contact for clutch assembly)



Dimension A: 2.1 to 2.2mm

Cylinder block

Top deck flatness	mm	0.05
Cylinder block height	mm	280±0.075

Recommended Torque Values

	N·m	(kgf·m)	
Bearing cover to cylinder block	60 [1]	6.1	+40° to 50°
Bracket for alternator to cylinder block	40	4.1	
Bracket for engine damping block to transmission	60 [2]	6.1	
Bracket for engine damping block to engine block	60	6.1	
Bracket for pump/compressor to engine block	35	3.6	
Camshaft housing cover to housing	8	0.8	
Camshaft timing gear to camshaft	50	5.1	
Clamping bracket for alternator to intake manifold	25	2.5	
Clamping bracket to alternator	25	2.5	
Con-rod bearing cap to con-rod	35 [1]	3.5	+45° to 60°
Crankshaft pulley bolts	20	2.0	
Cylinder head to cylinder block	25 [1)2)] +90°	2.5	+90° +90°
Engine damping block to engine bracket	85	8.7	
Engine damping block to side member	52 [1]	5.3	
Exhaust manifold to cylinder head	22	2.2	

1) Use new bolts
2) Use new locking plates

Recommended Torque Values

	N·m	(kgf·m)	
Flywheel to crankshaft	65 [1]	6.6	+30° to 45°
Front exhaust pipe to exhaust manifold	25	2.5	
Guide sleeve for pressure bearing to transmission	22	2.2	
Intake manifold to cylinder head	22	2.2	
Lower alternator bracket	25	2.5	
Oil drain plug to oil pan	45	4.6	
Oil intake pipe bracket to cylinder block	6 [2]	0.6	
Oil intake pipe to oil pump	8	0.8	
Oil pan to cylinder block	8 [2)3)]	0.8	
Bearing bridge to cylinder block	8 [2)3)]	0.8	
Oil pressure switch to oil pump	30	3.2	
Pump for power steering (ribbed V-belt) to engine block	30	3.2	
Spark plugs in cylinder head	20	2.3	
Starter support to cylinder block	25	2.5	
Starter to cylinder block - engine side	45	4.6	
Starter to cylinder block - transmission side	75	7.6	
Thermostat housing to cylinder head	15	1.5	
Toothed belt drive gear to crankshaft	130 [1]	13.3	
Toothed belt front cover	4	0.4	
Toothed belt rear cover	6	0.6	
Toothed belt tension roller to oil pump	20	2.3	
Transmission to engine block (M10)	45	4.6	
Transmission to engine block	76	7.7	
Transmission to engine block (M12)	60	6.1	
Water pump to cylinder block	17	1.7	

1) Use new bolts
2) Use Locking Compound
3) Maximum installation time - 10 minutes

SPECIAL SERVICE TOOLS

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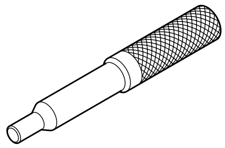
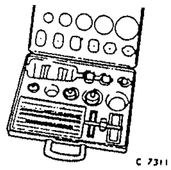
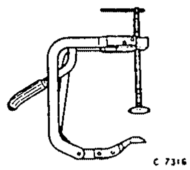
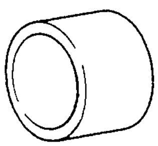
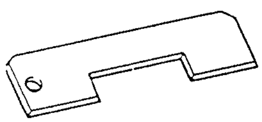
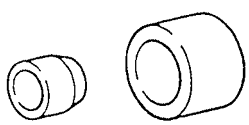
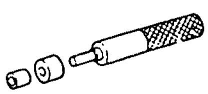
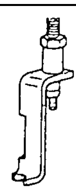
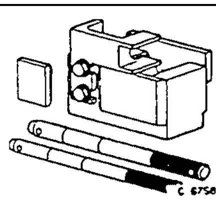
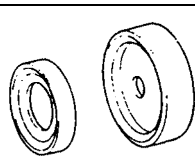
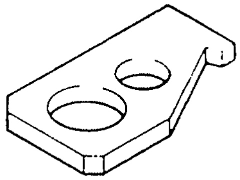
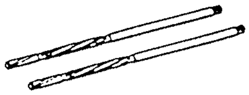
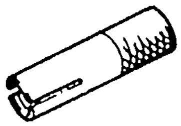
4		5-8840-2634-0	Aligner
2		5-8840-2593-0	Cutter set
3		5-8840-2594-0	Spring Compressor
4		5-8840-0451-0	Installer
5		5-8840-2596-0	Distance Gauge
6		5-8840-0455-0	Assembly Sleeves
7		5-8840-2597-0	Installer
8		5-8840-0457-0	Remover / Installer
10		5-8840-0468-0	Remover / Installer
11		5-8840-0459-0	Installer

ITEM NO.	ILLUSTRATION	PART NO.	PART NAME
13		5-8840-0446-0	Flywheel Holder
4		5-8840-2598-0	Holding Wrench
4		5-8840-2599-0	Reamer Set
17		5-8840-2601-0	Installer

SECTION 6B

ENGINE COOLING

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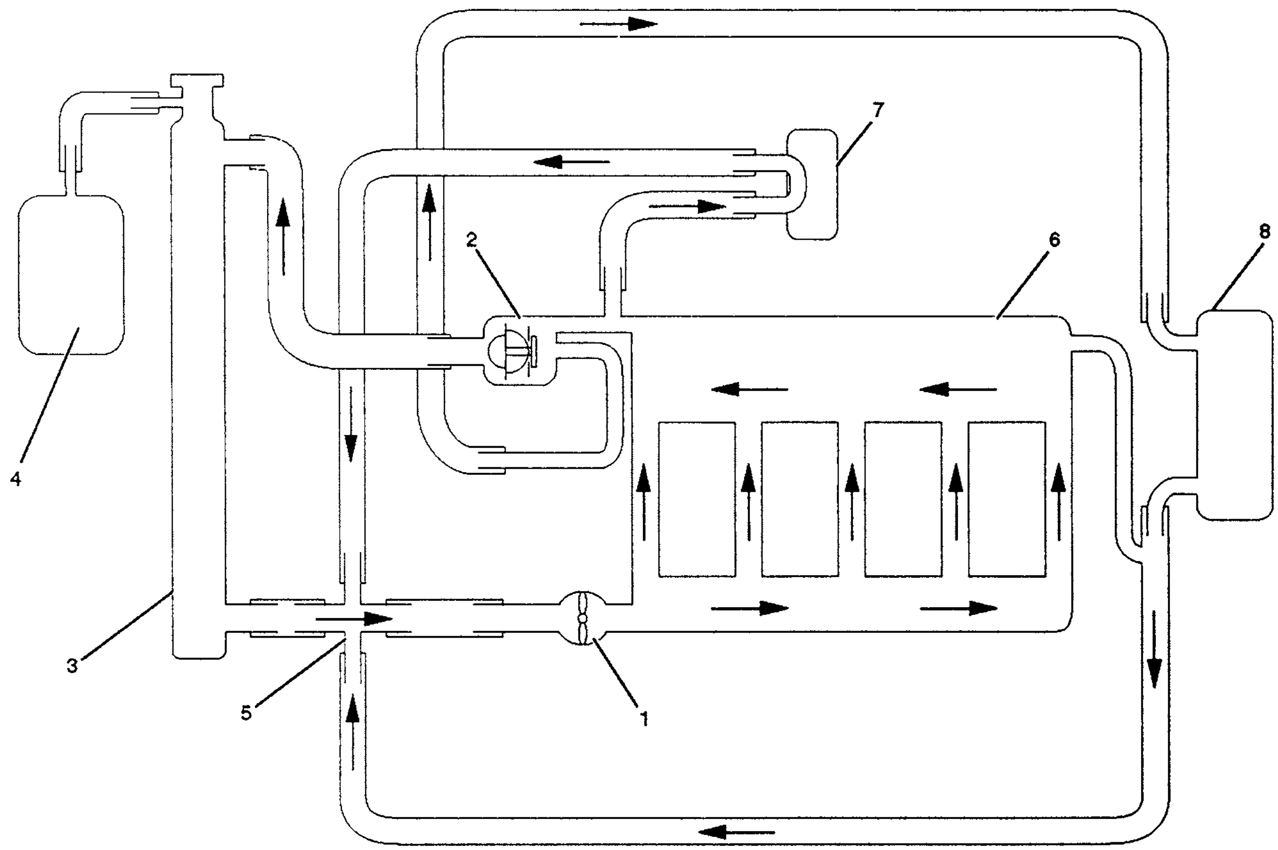
General Description



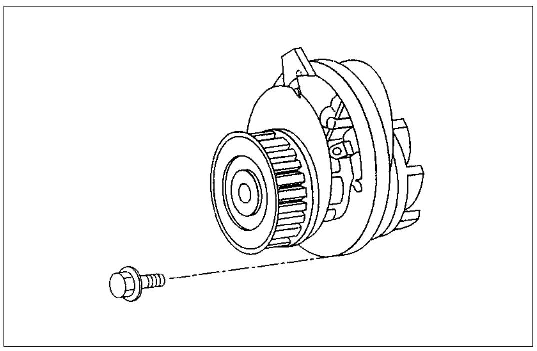
Legend

1 Water Pump
2 Thermostat
3 Radiator
4 Reserve Tank
5 Coolant Distributor
6 Cylinder Block and Head
7 Throttle Body
8 Heater

The Cooling System is a pressurized type, where the water pump, which is cambelt driven, forces the circulation of the coolant through the cylinder block and head. The thermostat regulates the flow of coolant between the radiator and the bypass circuit. The heater is part of the bypass circuit. The throttle body pre-heat is a separate circuit which is not regulated by the thermostat. An oil cooler may be fitted as part of this circuit.

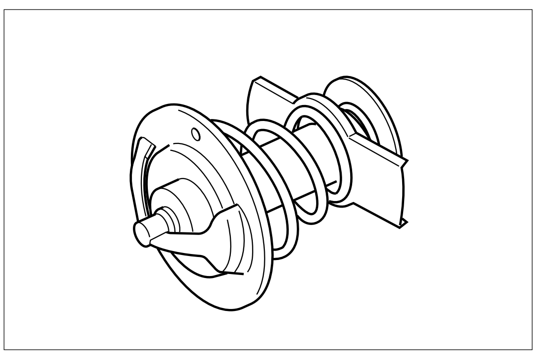
Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



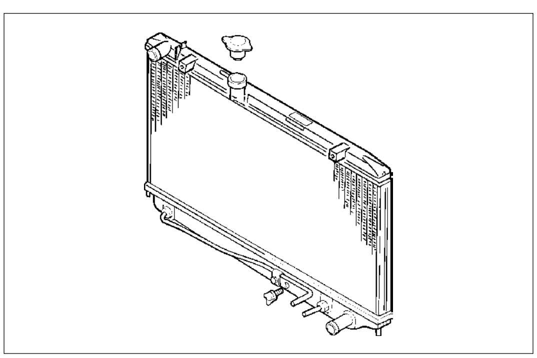
Water pump

The water pump is centrifugal type and is driven by timing belt.



Thermostat

The thermostat is a bypass type and is a wax pellet type with a air hole.



110RS001

Radiator

The radiator is a flow type with corrugated fins.

Antifreeze Solution

- Calculating mixing ratio

Mixing ratio

$$= \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.) + Water (Lit/gal.)}}$$

NOTE: Antifreeze solution + Water = Total cooling system capacity.

- **Total Cooling System Capacity**

  8Lit

- Mixing ratio

  Check the specific gravity of engine coolant in the cooling system temperature ranges from 0°C to 50°C using a suction type hydrometer, then determine the density of the engine coolant by referring to the table.

NOTE: The LLC is 50% at all environment in order to prevent the corrosion of cooling system parts.

Diagnosis
Engine Cooling Trouble

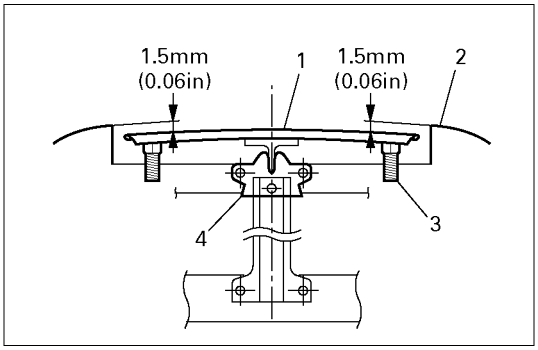
Condition	Possible cause	Correction
Engine overheating	Low Engine Coolant level	Replenish
	Thermo mater unit faulty	Replace
	Faulty thermostat	Replace
	Faulty Engine Coolant temperature sensor	Repair or replace
	Clogged radiator	Clean or replace
	Faulty radiator cap	Replace
	Low engine oil level or use of improper engine oil	Replenish or change oil
	Clogged exhaust system	Clean exhaust system or replace faulty parts
	Faulty Throttle Position sensor	Replace throttle valve assembly
	Open or shorted Throttle Position sensor circuit	Repair or replace
	Damaged cylinder head gasket	Replace
	Loosen V-belt tension	Adjust belt tension or replace.
	Collapsed hoses	Replace
	Faulty Fan clutch	Replace
Engine overcooling	Faulty thermostat	Replace
Engine slow to warm-up	Faulty thermostat	Replace
	Thermo unit faulty	Replace

Important Operations - Installation

5. Control Cable

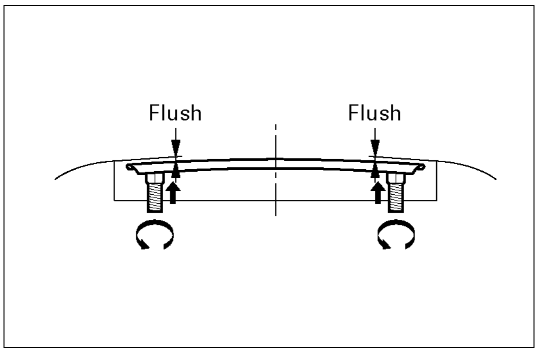
Reroute the control cable to its original position, and check to see if the lock assembly and control lever work normally.

3. Engine Hood Lock Assembly



Adjustment

6) Install the engine hood lock assembly (4) and temporarily tighten the bolts securing it.
7) Close the hood.
8) Position the hood so that the stepped portion between the hood (1) and the fender (2) is precisely 1.5 mm (0.06 in) high.
9) Finally tighten the bolts securing the engine hood lock assembly.



10) Turn the buffers (3) counterclockwise until the stepped portion between the hood and the fender disappears.
6) Tighten the hood lock assembly fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	

Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant level should be between the "MIN" and "MAX" lines of reserve tank when the engine is cold. If low, check for leakage and add engine coolant up to the "MAX" line. There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the engine coolant should also be free from oil.
Replace the engine coolant if excessively dirty.

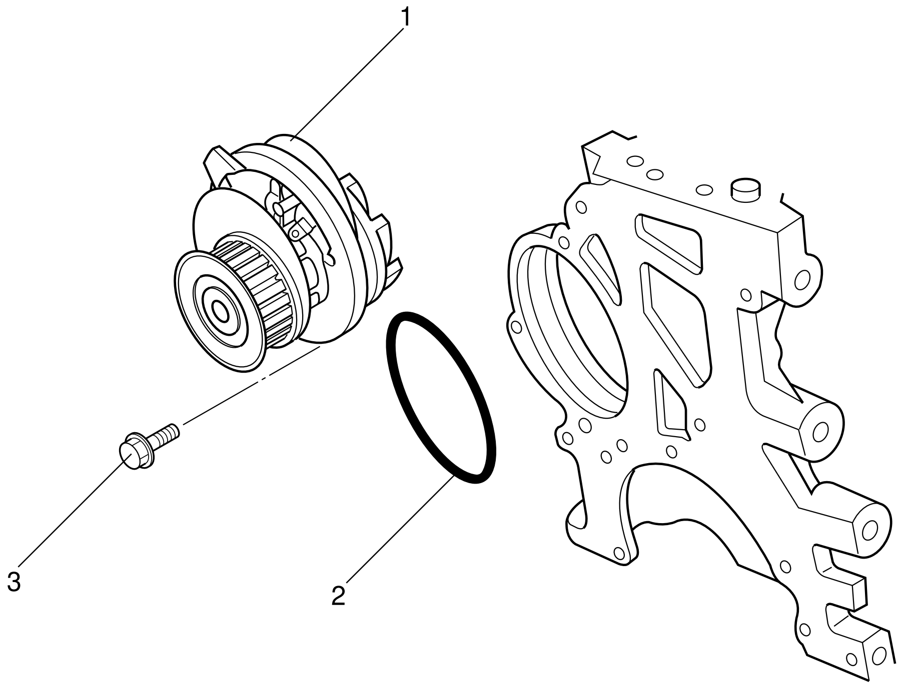
1. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.
2. Remove the radiator cap.

WARNING: TO AVOID THE DANGER OF BEING BURNED, DO NOT REMOVE THE CAP WHILE THE ENGINE AND RADIATOR ARE STILL HOT. SCALDING FLUID AND STEAM CAN BE BLOWN OUT UNDER PRESSURE.

3. Disconnect all hoses from the engine coolant reserve tank. Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.
4. Refill the cooling system with the engine coolant using a solution that is at least 50 percent antifreeze.
5. Fill the radiator to the base of the filler neck. Fill the engine coolant reserve tank to "MAX" line when the engine is cold.
6. Block the drive wheels and firmly apply the parking brake and place the shift lever in the "NEUTRAL" position.
7. Remove the radiator cap. Start the engine and warm it up at 2,500 - 3,000 rpm for about 30 minutes.
8. When the air comes out from the radiator filler neck and the engine coolant level has gone down, replenish with the engine coolant. Repeat this procedure until the engine coolant level does not go down. Then stop the engine and install the radiator cap. Let the engine cool down.
9. After the engine has cooled, replenish with engine coolant up to the "MAX" line of the reserve tank.
10. Start the engine. With the engine running at 3,000 rpm, make sure there is no running water sound from the heater core (behind the center console).
11. If the running water sound is heard, repeat steps 8 to 10.

Water Pump

Water Pump and Associated Parts



Legend
1 Water Pump Assembly
2 O-Ring
3 Bolt

Removal

1. Disconnect battery ground cable.
2. Drain coolant.
3. Disconnect radiator hose (on inlet pipe side).
4. Remove timing belt, refer to "Timing Belt" in this manual.
5. Remove water pump assembly.

Inspection

Make necessary repair and parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced:

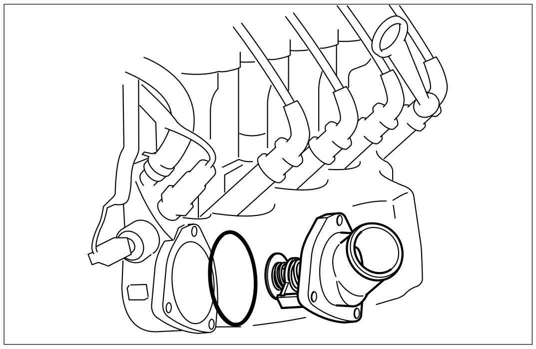
- Crack in the water pump body
- EC leakage from the seal unit
- Play or abnormal noise in the bearing
- Cracks or corrosion in the impeller

Installation

1. Before installing water pump, coat sealing surface with silicon grease.
2. Install water pump assembly and tighten bolts to the specified torque.

   Torque: 25 N·m (2.5 kgf·m)
3. Timing belt
   - Install timing belt, refer to timing belt installation step in "Timing Belt" in this manual.
4. Connect radiator hose and replenish EC.
5. Connect battery ground cable.

Thermostat



Removal

1. Disconnect battery ground cable.
2. Drain engine coolant from the radiator and engine.
3. Disconnect radiator hose from the inlet pipe.
4. Remove thermostat housing.
5. Remove thermostat from thermostat housing.

Inspection

Suspend the thermostat in a water-filled container using thin wire. Place a thermometer next to the thermostat.
Do not directly heat the thermostat.
Gradually increase the water temperature. Stir the water so that the entire water is same temperature.
Confirm the temperature when the valve first begins to open.

Valve opening temperature 92°C (197.6°F)

Confirm the temperature when the valve is fully opened.

Valve full open temperature 107°C(224.6°F)

Make necessary repair and parts replacement if extreme wear or damage is found during inspection.

Installation

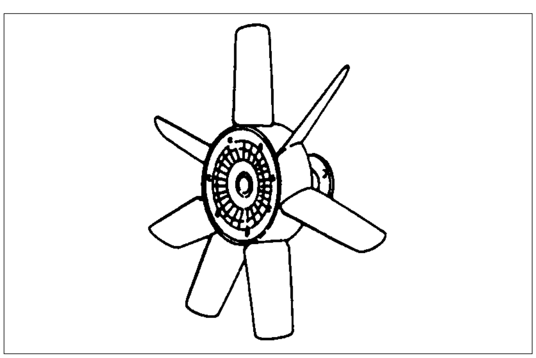
1. Before installing thermostat, coat sealing surface with silicon grease.
2. Install O-ring.
3. Install thermostat housing and tighten bolts to the specified torque.

   Torque: 15 N·m (1.5 kgf·m)
4. Installation rubber hose.
5. Replenish engine coolant (EC).
6. Start engine and check for EC leakage.

Fan Clutch with Cooling Fan

Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



Visually inspect for damage, leak (silicon grease) or other abnormal conditions.

1. Inspection (on-vehicle)

1) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.

2) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 80°C. Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.

If the fan clutch rotates more readily, however, this indicates that the silicon grease is leaking internally. Replace the fan clutch with a new one.

2. **Inspection (in unit)**

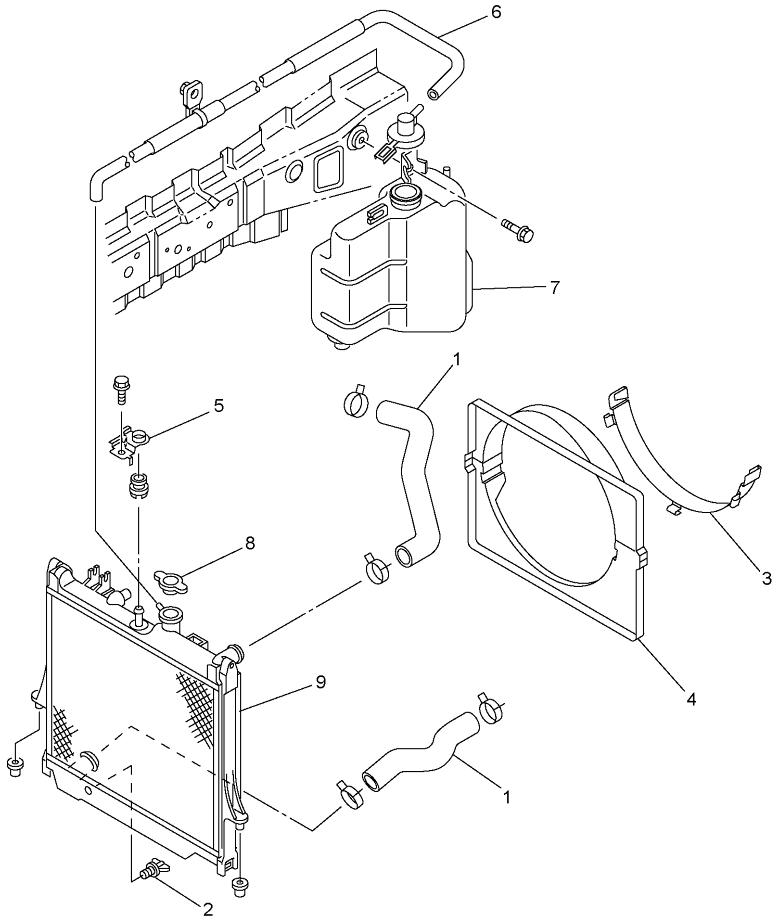
   Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 80°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).

   If the fan clutch retates more readily at this time, this indicates that the silicon grease is leaking internally.

   Replace the fan clutch with a new one.

Radiator

Radiator and Associated Parts

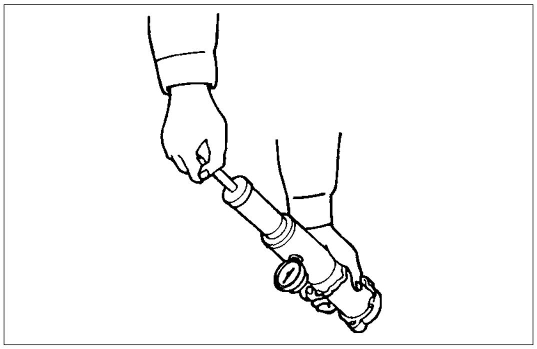


Legend

1 Radiator Hose
2 Drain Plug
3 Fan Guide, Lower
4 Fan Guide
5 Bracket
6 Reserve Tank Hose
7 Reserve Tank
8 Radiator Cap
9 Radiator Assembly

Removal

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain engine coolant (EC).
3. Disconnect radiator inlet hose and outlet hose.
4. Disconnect the reserve tank hose from radiator.
5. Lift out the radiator assembly, taking care not to damage the radiator core.



Inspection

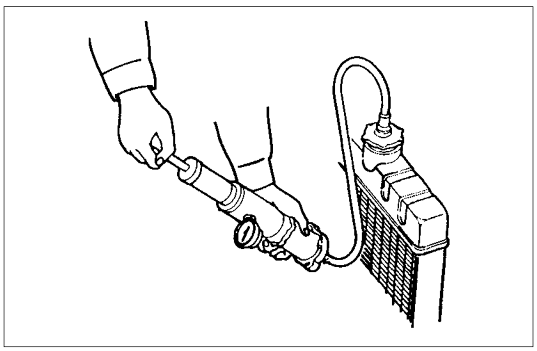
Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.
Replace the cap if the valve opening pressure is outside the standard range.

Valve opening pressure kPa (psi) 88.3 – 103.0 (13.5 – 15.7)

Cap tester: 5-8840-0277-0
Adapter: 5-8840-2603-0
Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

Valve opening vacuum kPa (psi) 1.9 - 4.9 (0.28 - 0.71)



Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all sign of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (28.5 psi) with a cap tester:

- Leakage from the radiator
- Leakage from the coolant pump
- Leakage from the water hoses
- Check the rubber hoses for swelling.

Cap tester: 5-8840-0277-0
Adapter: 5-8840-2603-0

Installation

1. Install radiator assembly, taking care not to damage the radiator core.
2. Install the radiator assembly.
3. Connect reserve tank hose.
4. Connect radiator inlet hose and outlet hose.
5. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.
   Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.

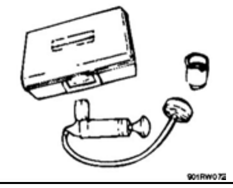
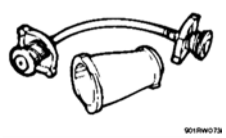
- Remove radiator cap.
- Fill with engine coolant to the radiator filler neck.
- Fill with EC to the "MAX" line on the reservoir tank.
- Start the engine with the radiator cap removed and bring to operating temperature by running engine at 2,500 - 3,000 rpm for 30 minutes.
- By engine coolant temperature gauge reading make sure that the thermostat is open.
- If air bubbles come up to the radiator filler neck, replenish with engine coolant. Repeat until the EC level does not drop any further. Install the radiator cap and stop the engine.
- Replenish engine coolant to the "MAX" line on the reservoir tank and leave as it is until the engine gets cool.
- After the engine gets cool, start the engine and make sure there is no water running noise heard from the heater core while the engine runs at 3000 rpm.
- Should water running noise be heard, repeat the same procedure from the beginning.

Main Data and Specifications

General Specifications

Cooling system	Engine Coolant forced circulation
Radiator	Tube type corrugated (2 tube in row)
Heat radiation capacity	66.3 kcal/h
Heat radiation area	7.08 m^2
Radiator front area	028 m^2
Radiator dry (weight)	3.1 kg
Radiator cap valve opening pressure	93.3 – 122.7 kpa
Engine coolant capacity	3.4L
Engine coolant pump	Centrifugal type
Thermostat	Bypass type
Engine coolant total capacity	8lit

SPECIAL SERVICE TOOL

ITEM NO.	ILLUSTRATION	PART NO.	PART NAME
1		5-8840-0277-0	Tester; radiator cap
2		5-8840-2603-0	Adapter; radiator cap

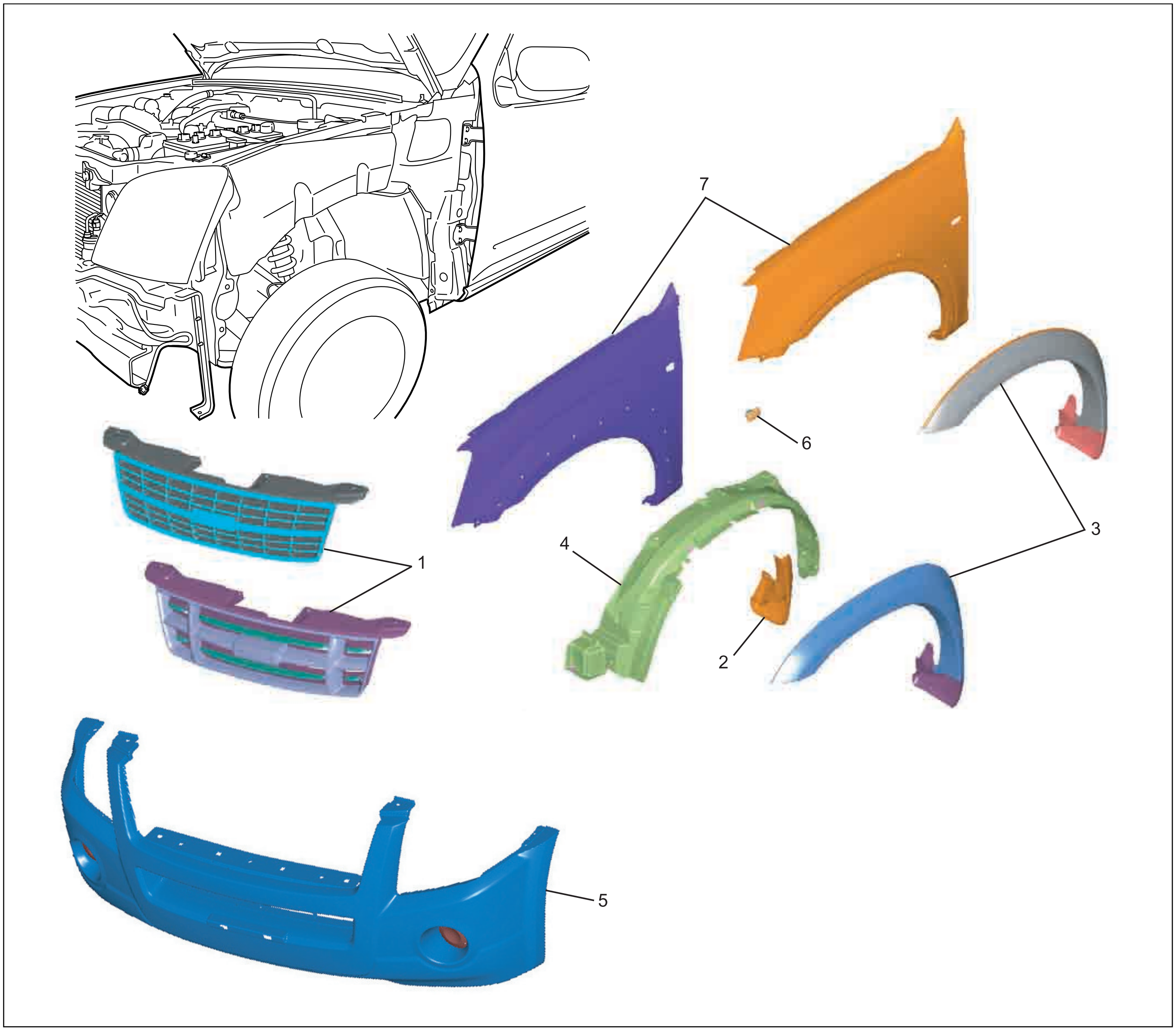
SECTION 6C

ENGINE FUEL (C24SE)

TABLE OF CONTENTS

FRONT FENDER PANEL (A TYPE)

REMOVAL AND INSTALLATION



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Removal Steps

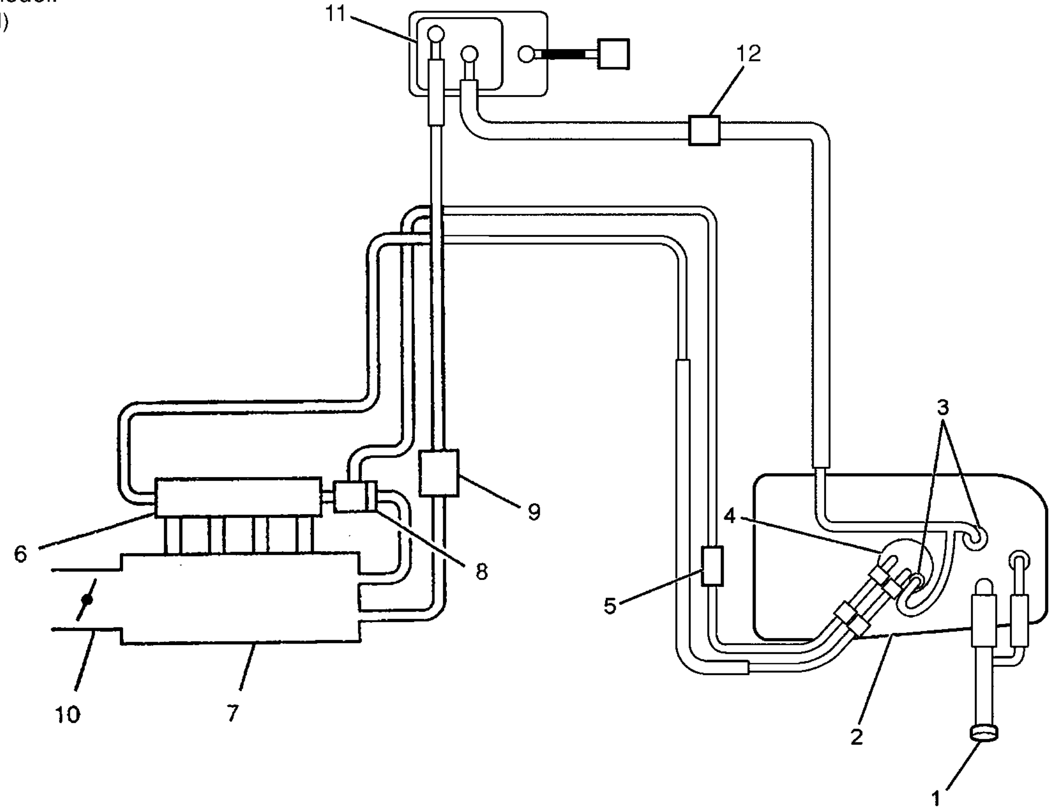
▲ 1. Radiator grille
2. Mud guard (W/O front wheel extension)
▲ 3. Front wheel extension (W/ front wheel extension)
▲ 4. Inner liner
▲ 5. Front bumper fascia
6. Side turn signal light
▲ 7. Front fender panel

Installation Steps

▲ 7. Front fender panel
6. Side turn signal light
5. Front bumper fascia
4. Inner liner
3. Front wheel extension (W/ front wheel extension)
2. Mud guard (W/O front wheel extension)
1. Radiator grille

General Description

This illustration is based on the with canister model.
(2.4L Model)



Legend

1 Fuel Filter Cap
2 Fuel Tank
3 Rollover Valve*
4 Fuel Pump and Sender Assembly
5 Fuel Fillter
6 Fuel Rail
7 Intake
8 Fuel Pressure Control Valve
9 Duty Solenoid Valve
10 Throttle Valve
11 Canister *
12 Check and Relief Valve*

* Applicable to EVAP Emission Control System

** Not applicable to EVAP Emission Control System

When working on the fuel system, there are several things to keep in mind:

- Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Replace all pipes with the same pipe and fittings that were removed.
- Clean and inspect "O" rings. Replace if required.
- Always relieve the line pressure before servicing any fuel system components.
- Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.
- Adhere to all Notices and Cautions.

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation.

Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage.

All cars are equipped with an Evaporative Emission Control System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere.

Service Precaution

CAUTION:

Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Fuel Metering

Engine Control Module (ECM) is in complete control of this fuel delivery system during normal driving conditions.

The intake manifold function, like that of a diesel, is used only to let air into the engine. The fuel is injected by separate injectors that are mounted over the intake manifold.

The Manifold Absolute Pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, which the MAP sensor converts to a voltage output.

This sensor generates the voltage to change corresponding to the flow of the air drawn into the engine.

The changing voltage is transformed into an electric signal and provided to the ECM.

With receipt of the signals sent from the MAP sensor, Intake Air Temperature sensor and others, the ECM determines an appropriate fuel injection pulse width feeding such information to the fuel injector valves to effect an appropriate air/fuel ratio.

The Multiport Fuel Injection system utilizes an injection system where the injectors turn on at every crankshaft revolution. The ECM controls the injector on time so that the correct amount of fuel is metered depending on driving conditions.

Two interchangeable "O" rings are used on the injector that must be replaced when the injectors are removed.

The fuel rail is attached to the top of the intake manifold and supplies fuel to all the injectors.

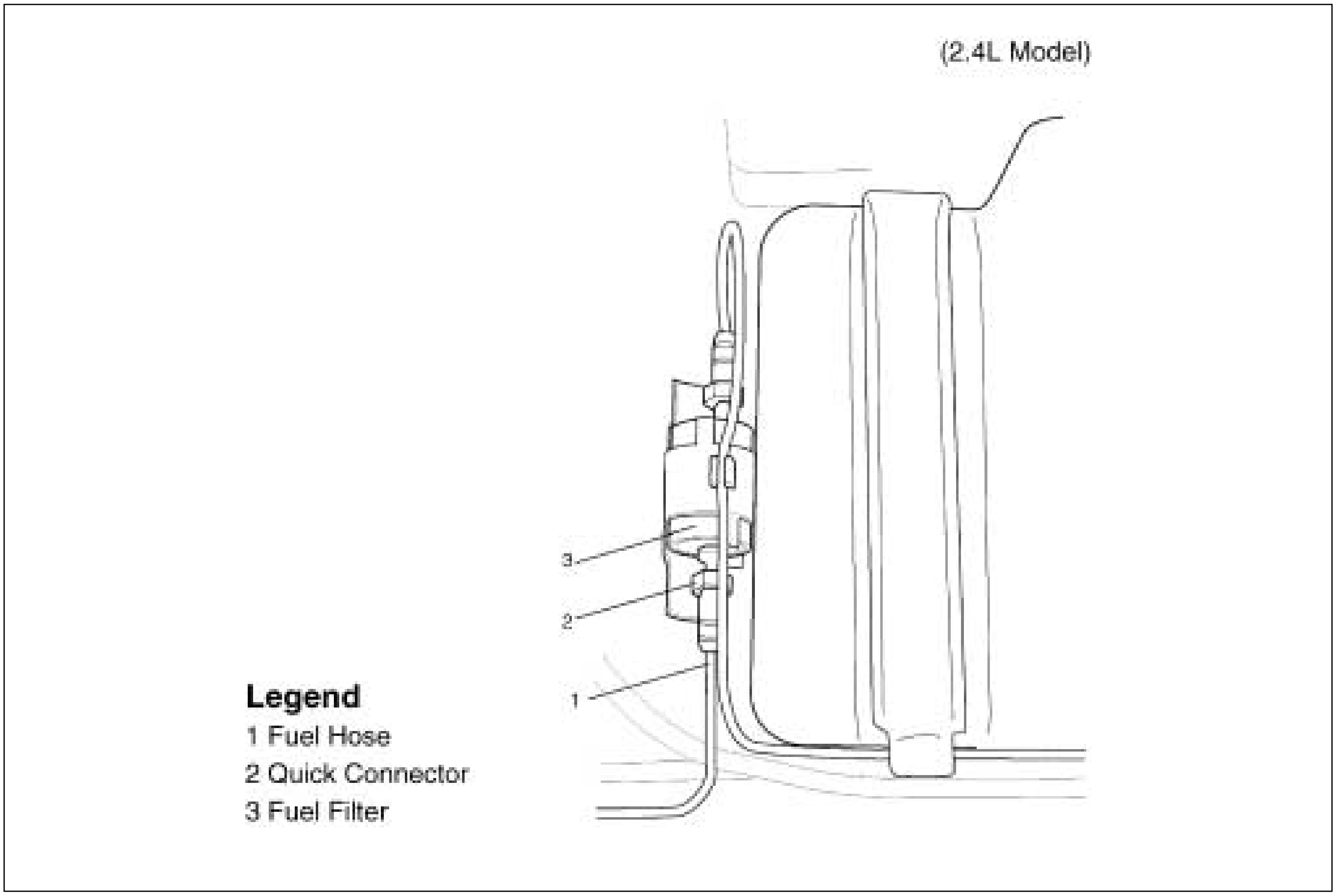
Fuel is recirculated through the rail continually while the engine is running. This removes air and vapors from the fuel as well as keeping the fuel cool during hot weather operation.

The fuel pressure control valve that is mounted on the fuel rail maintains a pressure differential across the injectors under all operating conditions. It is accomplished by controlling the amount of fuel that is recirculated back to the fuel tank based on engine demand.

See Section "Driveability and Emission" for more information and diagnosis.

Fuel Filter

Fuel Filter and Associated Parts



Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connections or leakage. For the fuel system diagnosis, see Section "Driveability and Emissions".

(2.4L)

1. Disconnect battery ground cable.
2. Disconnect the quick connector from the fuel filter.
3. Pull off fuel filter from the holder to side member side.
4. Remove the fuel filter.

Fuel Filter

Inspection

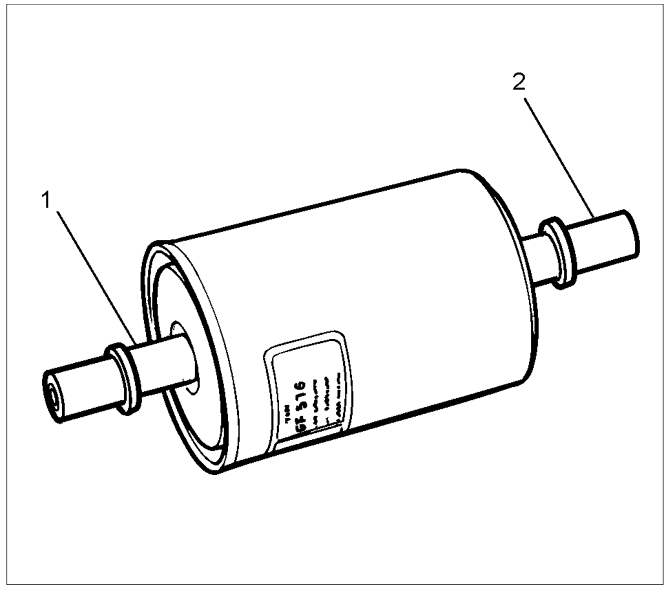
1. Replace the fuel filter if the fuel leaks from fuel filter body or if the fuel filter body itself is damaged.
2. Replace the filter if it is clogged with dirt or sediment.

Installation

1. Install the filter to holder from fuel tank front side.

NOTE: Attend direction of fuel filter. (1) to engine side (2) to fuel tank side.

NOTE: Verify to hang holder hook to fuel filter.



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2. Connect the quick connector from the fuel tube to the fuel filter.

NOTE: Pull of the left checker into the fuel pipe.

NOTE: Refer to “Fuel Tube/Quick Connector Fittings” in this section when performing any repairs.

3. Tighten fuel filler cap until at least one click are heard.
4. Connect the battery ground cable.

Inspection

After installation, start engine and check for fuel leakage.

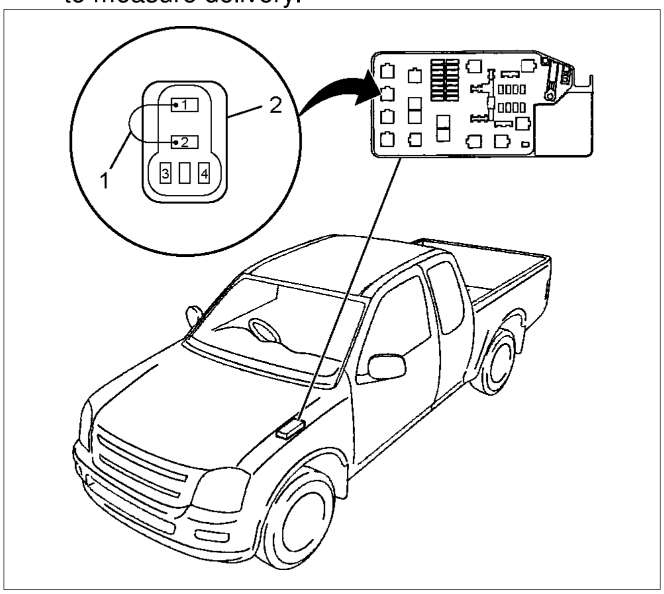
In–Tank Fuel Filter

The filter is located on the lower end of fuel pickup tube in the fuel tank. It prevents dirt from entering the fuel pipe and also stops water unless the filter is completely submerged in the water. It is a selfcleaning type, not requiring scheduled maintenance. Excess water and sediment in the tank restricts fuel supply to the engine, resulting in engine stoppage. In such a case, the tank must be cleaned thoroughly.

Fuel Pump Flow Test

If reduction of fuel supply is suspected, perform the following checks.

1. Make sure that there is fuel in the tank.
2. With the engine running, check the fuel feed pipe and hose from fuel tank to injector for evidence of leakage. Retighten, if pipe or hose connection is loose. Also, check pipes and hoses for squashing or clogging.
3. Insert the hose from fuel feed pipe into a clean container, and check for fuel pump flow rate.
4. Connect the pump relay terminals (2) with a jumper wire (1) as shown and start the fuel pump to measure delivery.



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CAUTION: Never generate sparks when connecting a jumper wire.

Delivery	Delivery
15 seconds	0.38 liters minimum

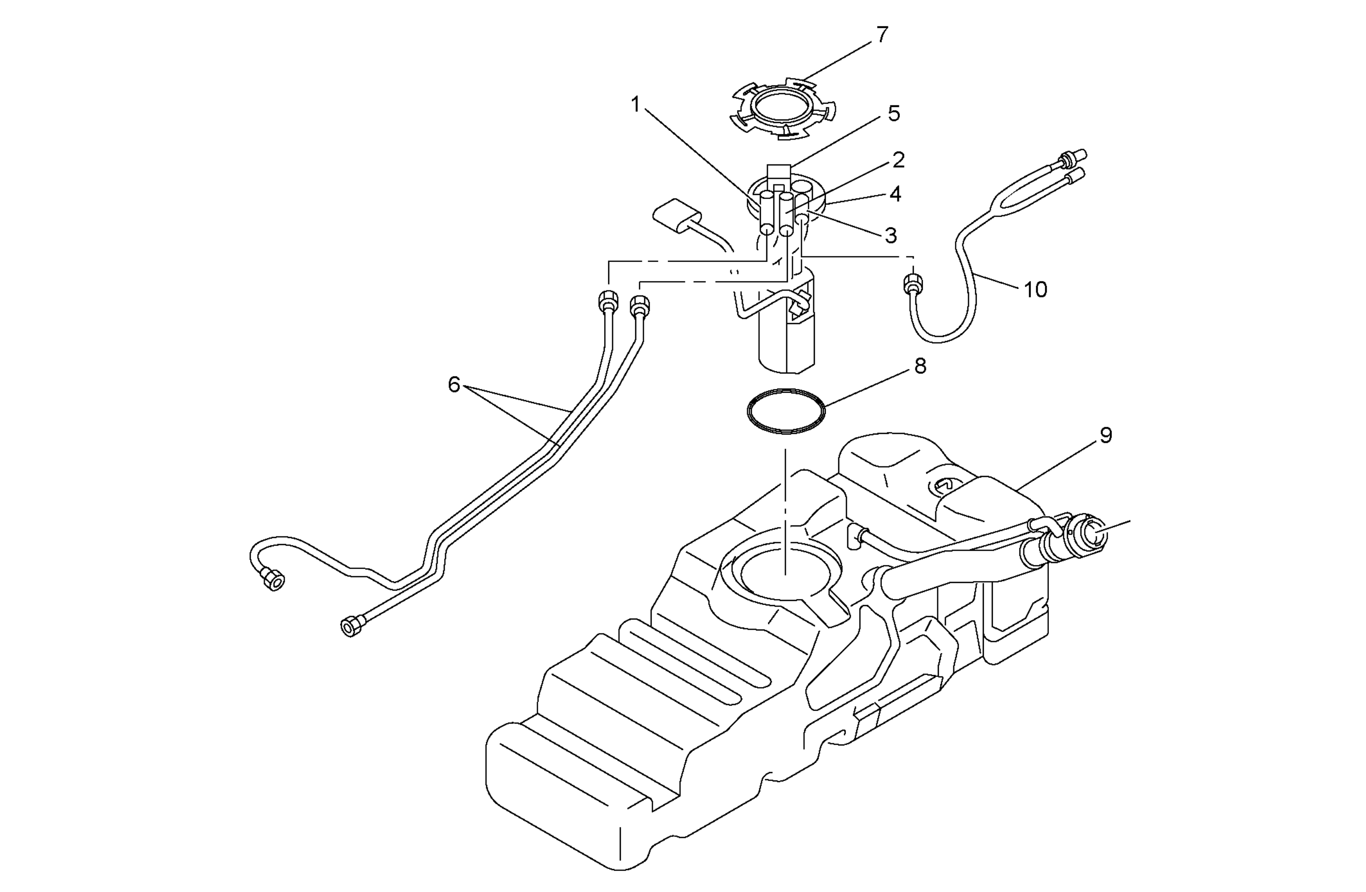
If the measure value is out of standard, conduct the pressure test.

Pressure test

For the pressure test to the fuel system, see Section 6E “Fuel Control System".

Fuel Pump

Fuel Pump and Associated Parts



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Legend

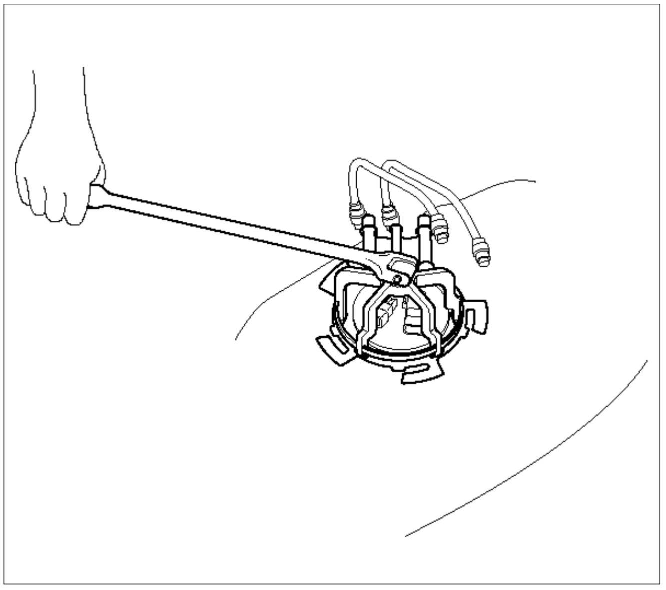
(1) Fuel Feed Port
(2) Fuel Return Port
(3) Fuel Emission Port
(4) Fuel Pump and Sender Assembly
(5) Connector; Fuel Feed Pump & Sender
(6) Fuel Tube/Quick Connector
(7) Retainer Ring (Fuel Pump Lock)
(8) Seal; Fuel Pump
(9) Fuel Tank Assembly
(10) Evapo Tube/Quick Connector

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section “Driveability and Emission".

1. Remove fuel tank assembly (9). Refer to “Fuel Tank Removal" in this section.
2. Disconnect the quick connector (6) into the fuel tube from fuel pump.
3. Disconnect the quick connector (10) into the evapo tube from fuel pump.

3. Remove the retainer ring (7) from the fuel tank with the removal tool 5-8840-2602-0.



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4. Remove slowly the fuel pump (4) from the fuel tank as no bend float arm.

NOTE: Cover opening for the fuel pump on fuel tank to prevent any dust enthering.

5. Discard fuel pump seal (8) because it cannot be reusable.

Installation

1. Clean the seal surface of the fuel tank and the fuel pump.

NOTE: If there is dust on the seal surface, it becomes cause of fuel leak.

2. Install the new fuel pump seal (8) to opening of the fuel tank as along the groove.
3. Install slowly the fuel pump (4) into the fuel tank as no bend float arm.
4. Set flange of the fuel pump on fuel pump seal as mating convexity of the fuel pump and reentrant of the fuel tank.
5. Lock slowly the retainer ring (7) to the fuel tank with the remover tool 5-8840-2602-0.
6. Connector the quick conector (10) into the evapo tube to fuel pump.
7. Connect the quick connector (6) into the fuel tube to fuel pump.

NOTE: Pull off the left ckecker into the fuel pipe.

NOTE: Refer to “Fuel Tube/Quick Connector Fittings” in this section when performing any repairs.

8. Check leak.

Methed of leak check.

(1) Plug end of quick connector and breather hose (Pull off the breather hose from fuel tank) and tighten fuel filler cap until at least one click are heard.

(2) Apply water soap around the fuel pump seal area.

(3) Pressure air into the fuel tank from end of breather pipe at 5psi (34.3 kPa/2.8kgf/cm^2) over 15 seconds.

(4) Verify no bubbles around the fuel pump seal area.

8. Install the fuel tank assembly (9).

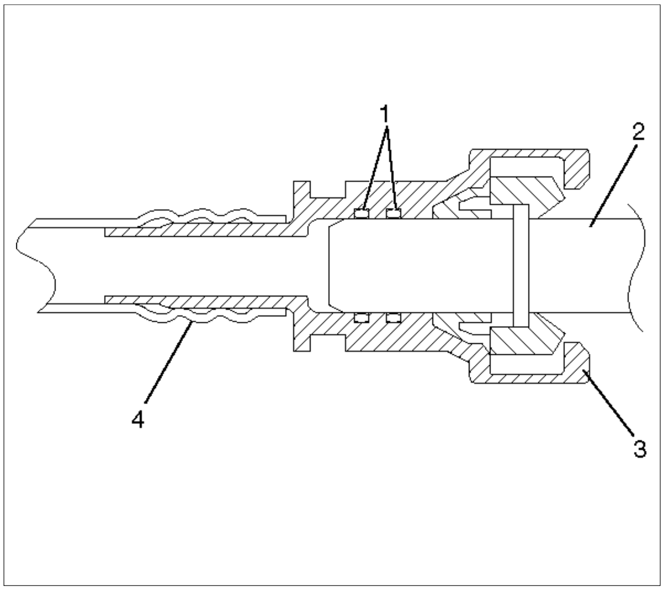
NOTE: Refer to “Install the fuel tank” in this section.

Fuel Tube / Quick – Connector Fittings

Precautions

- Do not light a match or create a flame.
- Keep flames away from your work area to prevent flammable materials from catching fire.
- Disconnect battery ground cable to prevent electrical shorts.
- Pre-treat piping system or associated parts from thermal damage or from spattering when welding or similar heat-generating work.

Cautions During Work



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Legend

(1) O-ring
(2) Port
(3) Connector
(4) Plastic Tube

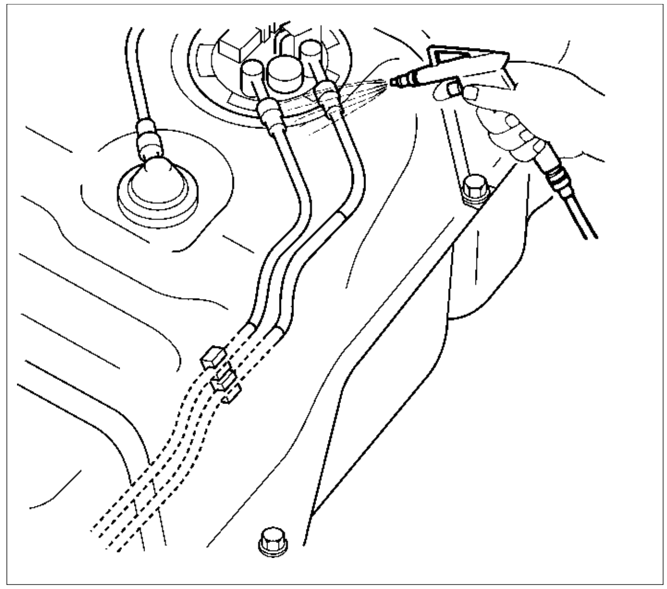
Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electorolyte.

Piping that has been splattered with battery electrolyte or battery electrolyte soaked cloth that was wiped on the piping cannot be used.

Removal

1. Open the fuel cap to relieve the fuel pressure in the tank.

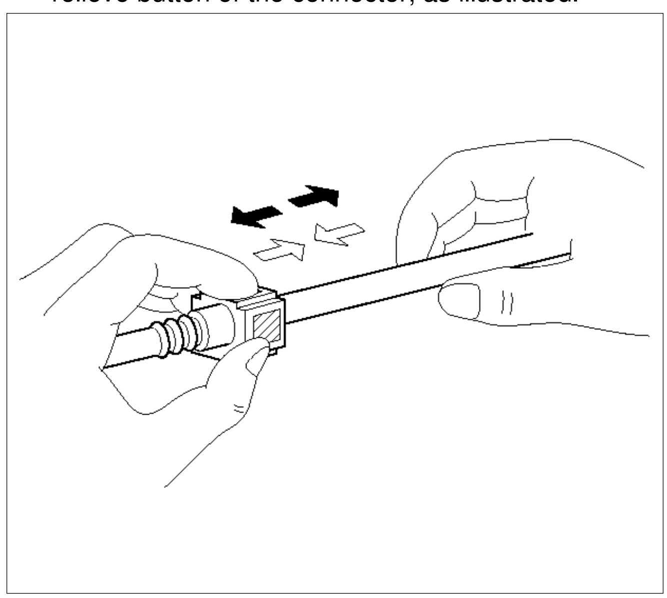
   Use compressed air to remove any dirt on the fuel quick connect fittings prior to disconnecting the fittings.



141R100002

   When disconnecting the fuel pipe, cover the area with a cloth to prevent fuel from splashing as the fuel pipe may still have some pressure in it.

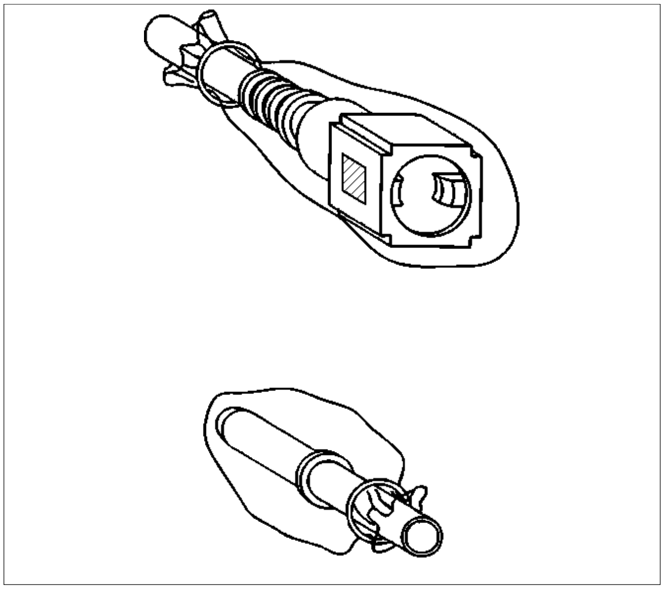
2. For removal of the quick connector, hold the quick connector in one hand, and pull out the connentor with the other hand while pressing the square relieve button of the connector, as illustrated.



140R100037

NOTE: Do not use tools of any kind. Only use bare hands when disconnecting the connector. Use a lubricant (light oil) and/or push and pull the connector until the pipe is disconnected.

   Cover the connectors that was removed with a plastic bag, to prevent dust or rain water from entering.



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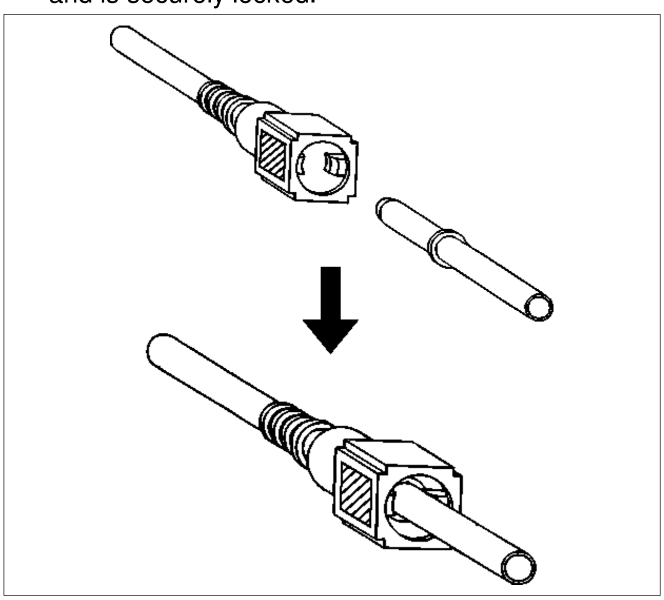
Reuse of Quick–Connector

- Replace the port and connector if scratch, dent or crack is found.
- Remove any dirt build up on the port when installing the connector. Replace the connector, if there is any forms of rust, dent, scratch.
- After cleaning the port, insert it straight into the connector until it clicks. After it clicks, try pulling at 49N (5kgf) it out to make sure that it is not drawn and is securely locked.



140R100036

Assembling Advice

By applying engine oil or light oil to the pipe, port makes pipe assembly easier. The pipe assembly should take place immediately after applying oil (to prevent dust from sticking to the pipe surface – which may decrease sealing ability).

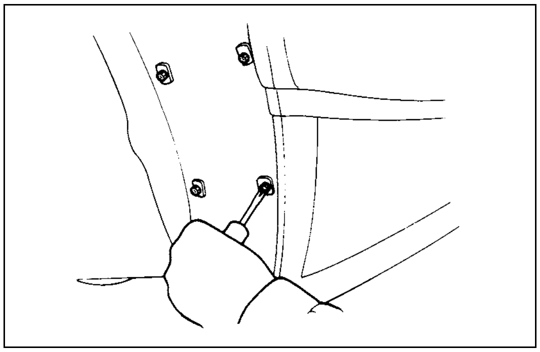
Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Turn the ignition key to the “ON" position and listen for pump start-up sound. Inspect for leaks, the fuel pressure will increase as the fuel pump is actuated.
3. Perform leak inspection (step 2) several times.
4. Start the engine and observe the engine idle speed. The presence of dirt in the fuel system may affect the fuel injection system.

Important Operations - Removal

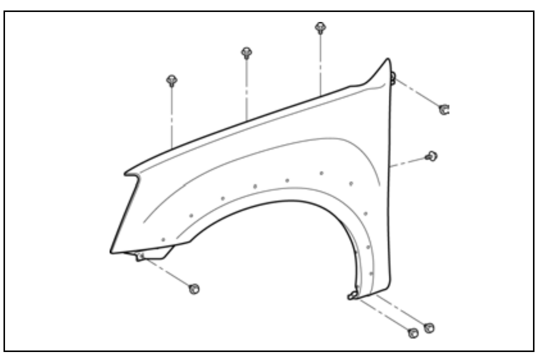
1. Radiator Grille
Refer to the Radiator Grille in this section.

3. Front wheel extension (W/front wheel extension)
Refer to the SECTION 10 “Front Wheel Extension”.



4. Inner Liner
Remove the inner liner fixing screws.

5. Front Bumper Fascia
Refer to the Front Bumper in this section.



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7. Front Fender Panel
Remove the 8 fixing bolts.

Important Operation - Installation

7. Front Fender Panel

1) Tighten the front fender panel fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	

Fuel Pump Relay

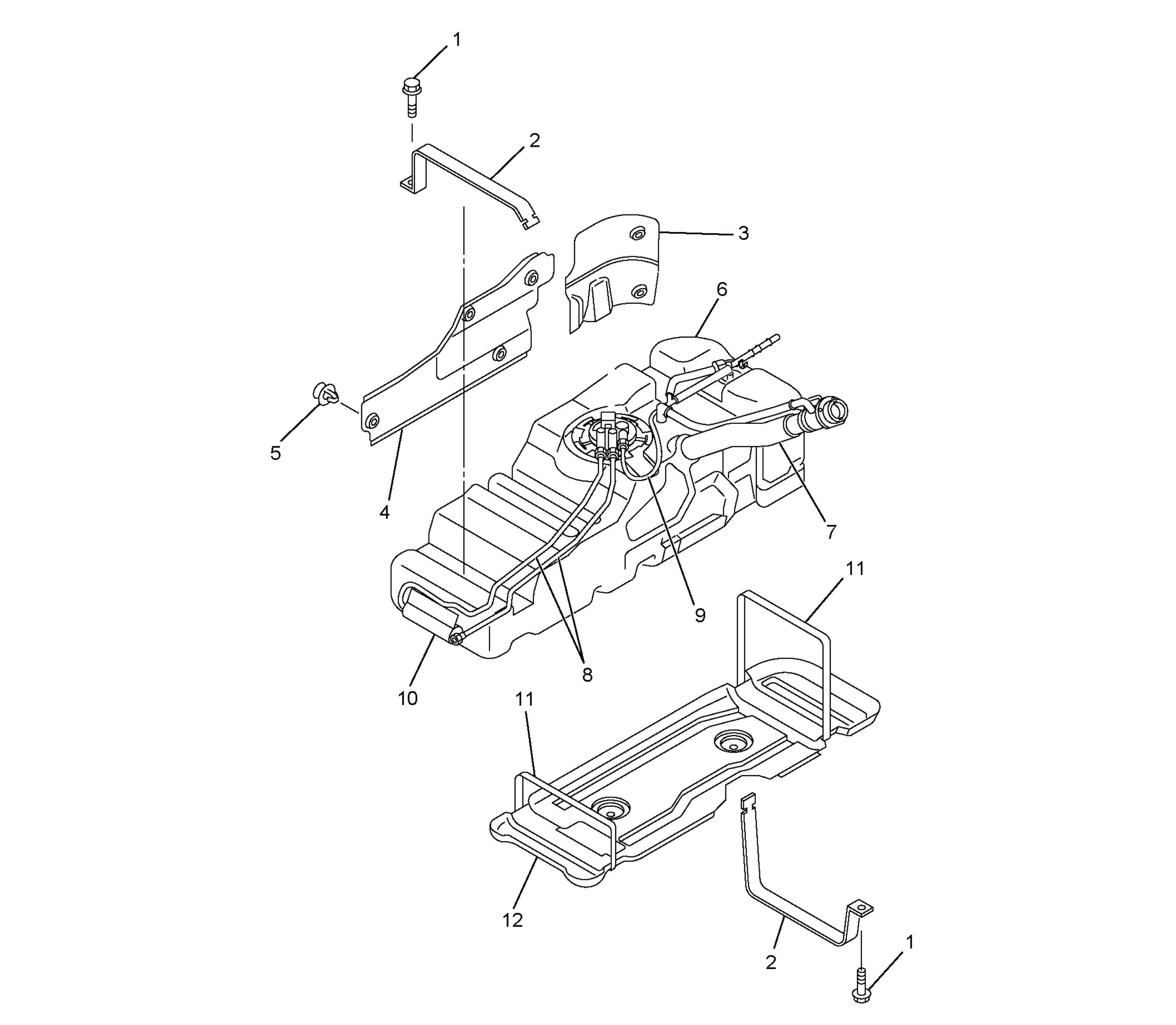
General Description

In order to control the fuel pump and sender assembly (FPAS) operation, the FPAS relay is provided. When the starter switch is turned to “ON" position, the FPAS relay operates the FPAS for 2 seconds.

When it is turned to “START" position, the Engine Control Module receives the reference pulse from the Ignition Control Module and it operates the relay, again causing the FPAS to feed fuel.

Fuel Tank

Fuel Tank and Associated Parts



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Legend

(1) Bolt; Fuel Tank
(2) Fuel Tank Band
(3) Rear Side Shield
(4) Side Shield
(5) Retainer
(6) Fuel Tank
(7) Fuel Filler Hose
(8) Fuel Tube/Quick Connector
(9) Evapo Tube/Quick Connector
(10) Fuel Filter
(11) Band; Under Shield – Only Specified Model
(12) Under Shield – Only Specified Model

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section "Driveability and Emission".

1. Disconnect battery ground cable.
2. Loosen slowly the fuel filler cap.

NOTE: To prevent spouting out fuel to change the pressure in the fuel tank.

NOTE: Cover opening of the filler neck to prevent any dust entering.

3. Jack up the vehicle.
4. Support underneath of the fuel tank with a lifter.
5. Remove the inner liner of the wheel house on rear left side.
6. Remove fasten bolt to the filler neck from the body.
7. Disconnect the quick connector (8) into the fuel tube from the fuel pipe and the evapo tube from evapo joint connector.

NOTE: Cover the quick connector to prevent any dust entering and fuel leaking.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

8. Remove fasten bolt (1) to the tank band and the tank band (2).
9. Disconnect the pump and sender connector on the fuel pump and remove the harness from weld clip on the fuel tank.
10. Lower the fuel tank (6).

NOTE: When the fuel tank is lowered from the vehicle, don't scratch each hose and tube by around other pars.

Installation

1. Rise the fuel tank into position.

NOTE: Ensure hoses and tubes do not foul on other component.

2. Connect the pump and sender connector to the fuel pump and install harness to into the plastic clip welded to the top of the fuel tank..

NOTE: The connector must be certainly connected against stopper.

Ensure tank band anchor mates with guide hole on frame.

3. Install the tank band to fasten bolt.

Torque: 68 N·m (6.9kg·m/50 lb ft)

NOTE: The anchor of the tank band must be certainly installed to guide hole on frame.

4. Connect the quick connector from the fuel tube to the fuel pipe and the evapo tube from evapo joint connector.

NOTE: Pull off the left checker into the fuel pipe.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

5. Install the filler neck to the body by bolt.
6. Install the inner liner of the wheel house on rear side.
7. Remove lifter to support underneath of the fuel tank.
8. Put back the vehicle.
9. Tigten the filler cap until at least three clicks are heard.
10. Connect the battery ground cable.

Filler Neck

Removal

1. Remove the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

2. Put a marking the following point as the filler neck assembly is restored.
   - Each joint area of the hose (to restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (to restore axial direction and position of the clamp)
   - Each bolt in the clamp (to restore fasten length of bolt in the clamp)
   - The band clip (to restore position and fasten length of the band clip)

NOTE: Cover end of each hose and pipe to prevent any dust entering.

Installation

1. Align each marking and restore the following point.
   - Each joint area of the hose (Restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (Restore axial direction and position of the clamp)
   - Each bolt in the clamp (Restore fasten length of bolt in the clamp)

   Torque: 2.5 N·m (0.25 kg·m / 2 lb ft) … filler neck side except flat deck model.

   - The band clip (Restore position and fasten length of the band clip)
2. Install the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

Fuel Gauge Unit

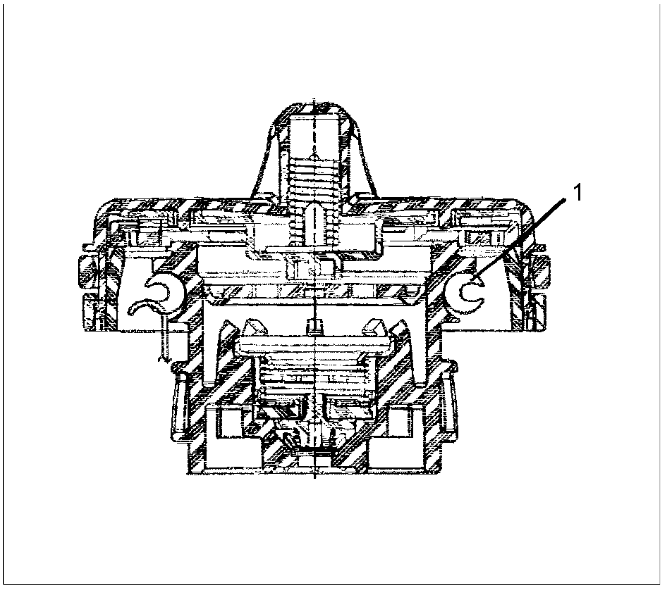
Removal and Installation

As for removal and installation of the Fuel Gauge Unit, refer to “Fuel Tank" of this section 6C as the fuel gauge unit is combined with the fuel pump and sender assembly.

Fuel Filler Cap

General Description

A vacuum valve and pressure valve are built into the fuel filler cap which adjusts the fuel pressure in the fuel tank to prevent fuel tank damage.



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Legend

(1) Seal Ring

Inspection

The fuel filler cap must be inspected for seal condition.

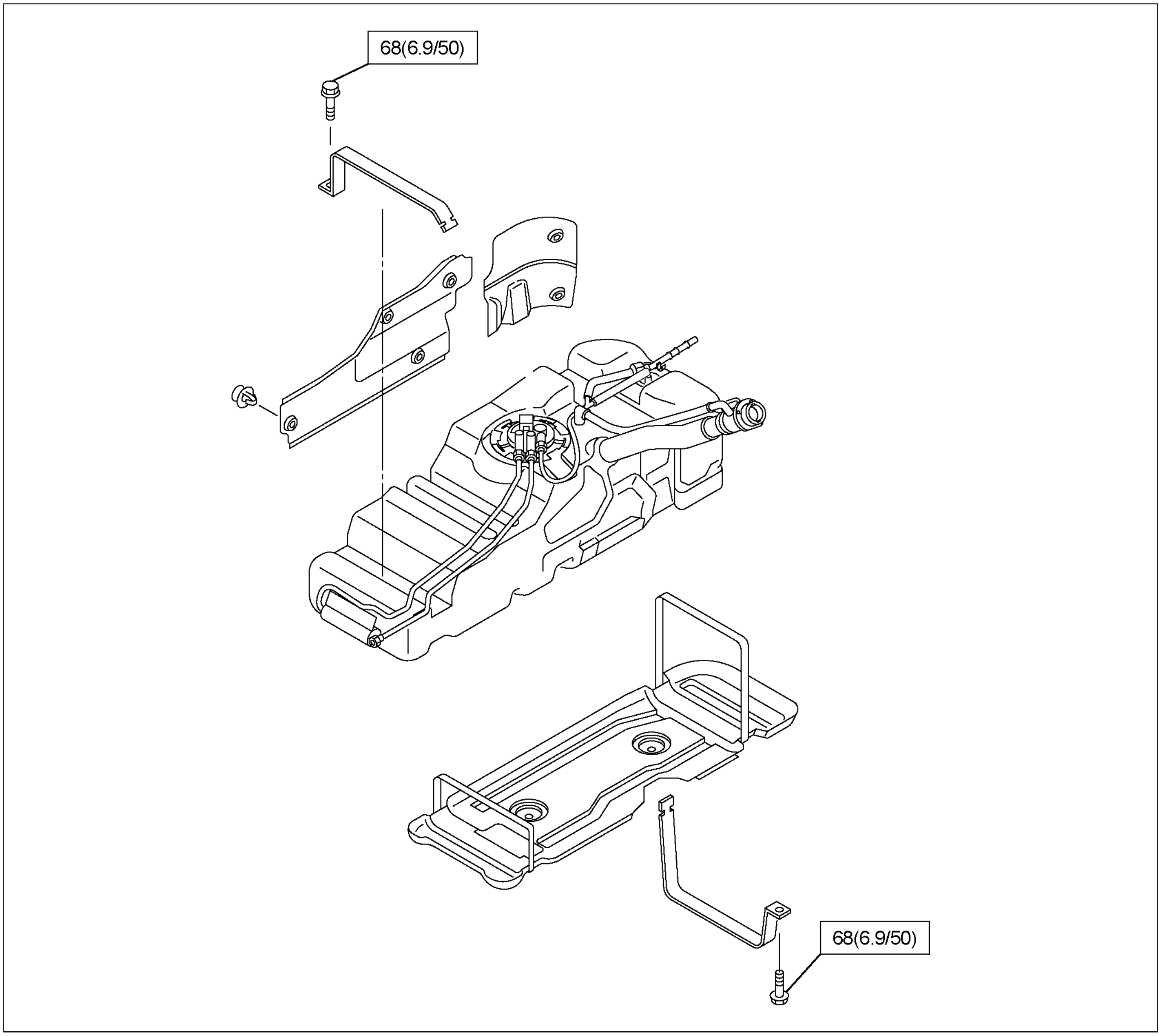
The fuel filler cap must be replaced if found defective

CAUTION: A replacement fuel filler cap must be the same as the original. The fuel filler cap valve was designed primarily for this application and must be replaced with the same type or decreased engine performance may occur.

Main Data and Specifications

Torque Specification

N·m (kg·m/ lb ft)



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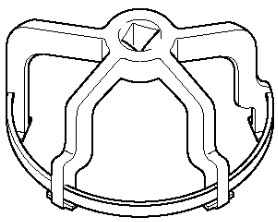
Special Tools

ILLUSTRATION	PART NO. PART NAME
 140RW009	**5–8840–2602–0** **(J–39765)** Remover; fuel pump retainer

SECTION 6D

Engine electrical

C24SE MODEL

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SECTION 6D1

ENGINE ELECTRICAL

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Battery

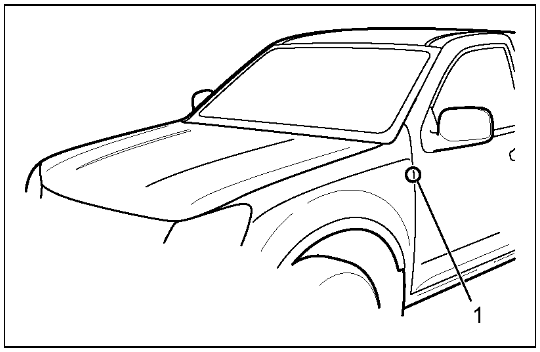
General Description

There are six battery fluid caps on top of the battery. These are covered by a paper label.
The battery is completely sealed except for the six small vent holes on the side. These vent holes permit the escape of small amounts of gas generated by the battery.
This type of battery has the following advantages over conventional batteries:

1. There is no need to add water during the entire service life of the battery.
2. The battery protects itself against overcharging. The battery will refuse to accept an extensive charge. (A conventional battery will accept an excessive charge, resulting in gassing and loss of battery fluid.)
3. The battery is much less vulnerable to self discharge than a conventional type battery.

Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.



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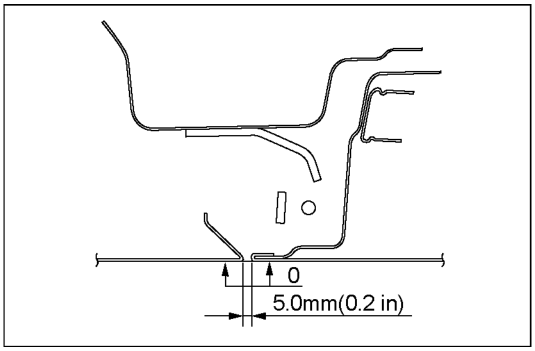

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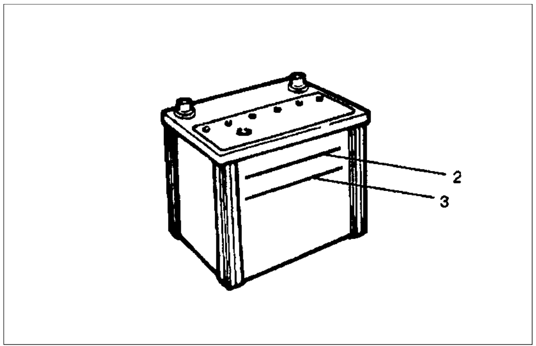
2) Check the fender and front door (1).

- Clearance : 5.0 mm (0.2 in)
- Height (step) : Flushness

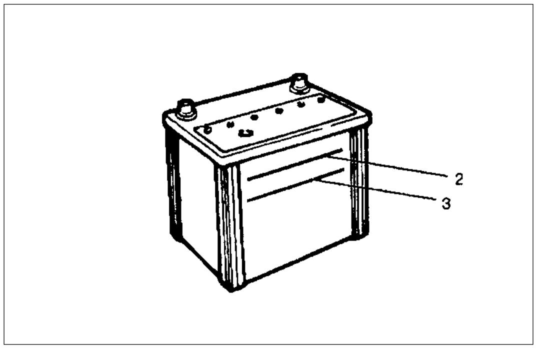
Diagnosis

1. Visual Inspection

Inspect the battery for obvious physical damage, such as a cracked or broken case, which would permit electrolyte loss. Replace the battery if obvious physical damage is discovered during inspection.
Check for any other physical damage and correct it as necessary.



2. Hydrometer Check



3. Fluid Level Check

The fluid level should be between the upper level line (2) and lower lever line (3) on side of battery.

a. CORRECT FLUID LEVEL - Charge the battery.
b. BELOW LOWER LEVEL - Replace battery.

4. Voltage Check

1. Put voltmeter test leads to battery terminals.
   a. VOLTAGE IS 12.4V OR ABOVE - Go to Step 5.
   b. VOLTAGE IS UNDER 12.4V - Go to procedure (2) below.
2. Determine fast charge amperage from specification. (See Main Data and Specifications in this section).
   Fast charge battery for 30 minutes at amperage rate no higher than specified value.
   Take voltage and amperage readings after charge.
   a. VOLTAGE IS ABOVE 16V AT BELOW 1/3 OF AMPERAGE RATE - Replace battery.
   b. VOLTAGE IS ABOVE 16V AT ABOVE 1/3 OF AMPERAGE RATE - Drop charging voltage to 15V and charge for 10 - 15 hours. Then go to Step 5.
   c. VOLTAGE IS BETWEEN 12V AND 16V - Continue charging at the same rate for an additional 3-1/2 hours. Then go to Step 5.
   d. VOLTAGE BELOW 12V - Replace Battery.

Battery Charging

Observe the following safety precautions when charging the battery:

1. Never attempt to charge the battery when the fluid level is below the lower level line on the side of the battery. In this case, the battery must be replaced.
2. Pay close attention to the battery during charging procedure.
   Battery charging should be discontinued or the rate of charge reduced if the battery feels hot to the touch.
   Battery charging should be discontinued or the rate of charge reduced if the battery begins to gas or spew electrolyte from the vent holes.
3. In order to more easily view the hydrometer blue dot or ring, it may be necessary to jiggle or tilt the battery.
4. Battery temperature can have a great effect on battery charging capacity.
5. The sealed battery used on this vehicle may be either quick charged or slow charged in the same manner as other batteries.
   Whichever method you decide to use, be sure that you completely charge the battery. Never partially charge the battery.

Jump Starting

Jump Starting with an Auxiliary (Booster) Battery

CAUTION: Never push or tow the vehicle in an attempt to start it. Serious damage to the emission system as well as other vehicle parts will result.
Treat both the discharged battery and the booster battery with great care when using jumper cables.
Carefully follow the jump starting procedure, being careful at all times to avoid sparking.
WARNING: FAILURE TO CAREFULLY FOLLOW THE JUMP STARTING PROCEDURE COULD RESULT IN THE FOLLOWING:

1. Serous personal injury, particularly to your eyes.
2. Property damage from a battery explosion, battery acid, or an electrical fire.
3. Damage to the electronic components of one or both vehicles particularly.

Never expose the battery to an open flame or electrical spark. Gas generated by the battery may catch fire or explode.
Remove any rings, watches, or other jewelry before working around the battery. Protect your eyes by wearing an approved set of goggles.
Never allow battery fluid to come in contact with your eyes or skin.
Never allow battery fluid to come in contact with fabrics or painted surfaces.

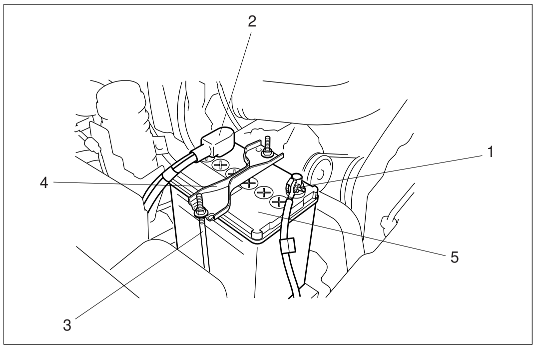
Battery fluid is a highly corrosive acid.
Should battery fluid come in contact with your eyes, skin, fabric, or a painted surface, immediately and thoroughly rinse the affected area with clean tap water.
Never allow metal tools or jumper cables to come in contact with the positive battery terminal, or any other metal surface of the vahicle. This will protect against a short circuit.
Always keep batteries out of reach of young children.

Jump Starting Procedure

1. Set the vehicle parking brake and place the shift lever in the "NEUTRAL" position.
   Turn "OFF" the ignition.
   Turn "OFF" all lights and any other accessory requiring electrical power.
2. Look at the built-in hydrometer.
   If the indication area of the built-in hydrometer is completely clear, do not try to jump start.
3. Attach the end of one jumper cable to the positive terminal of the booster battery.
   Attach the other end of the same cable to the positive terminal of the discharged battery.
   Do not allow the vehicles to touch each other. This will cause a ground connection, effectively neutralizing the charging procedure.
   Be sure that the booster battery has a 12 volt rating.
4. Attach one end of the remaining cable to the negative terminal of the booster battery.
   Attach the other end of the same cable to a solid engine ground (such as the air conditioning compressor bracket or the generator mounting bracket) of the vehicle with the discharged battery.
   The ground connection must be at least 450 mm (18 in.) from the battery of the vehicle whose battery is being charged.

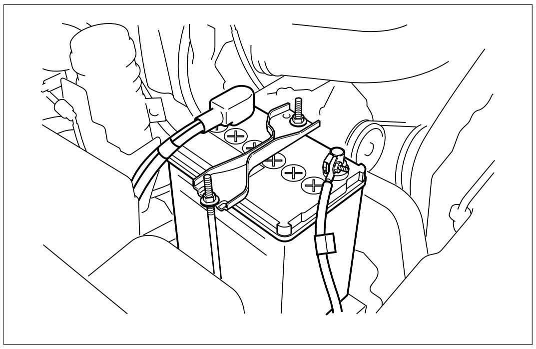
WARNING: NEVER ATTACH THE END OF THE JUMPER CABLE DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY.

5. Start the engine of the vehicle with the good battery.
   Make sure that all unnecessary electrical accessories have been turned "OFF".
6. Start the engine of the vehicle with the dead battery.
7. To remove the jumper cables, follow the above directions in reverse order.
   Be sure to first disconnect the negative cable from the vehicle with the discharged battery.



Removal

1. Remove negative cable (1).
2. Remove positive cable (2).
3. Remove retainer screw and rods (3).
4. Remove retainer (4).
5. Remove battery (5).



Installation

1. Install battery.
2. Install retainer.
3. Instal retainer screw and rods.

NOTE: Make sure that the rod is hooked on the body side.

4. Install positive cable.
5. Install negative cable.

Main Data and Specifications

General Specifications

Model (JIS)	34B19L	50D20L
Voltage (V)	12	12
Cold Cranking Performance (Amp)	272	306
Reserve Capacity (Min)	49	78

SECTION 6D2

IGNITION SYSTEM

TABLE OF CONTENTS

General Description

Ignition is done by the Ignition Module that fires.
Since the cylinder on exhaust stroke requires less energy to fire its spark plug, energy from the ignition coils can be utilized to fire the mating cylinder on compression stroke.
A notch in the timing disc on the crankshaft activates the crank angle sensor which then sends information such as firing order and starting timing of ignition coil to the ECM.
By receiving signals such as crank position, engine speed, water temperature and Manifold Absolute Pressure (MAP), the ECM controls the ignition timing.

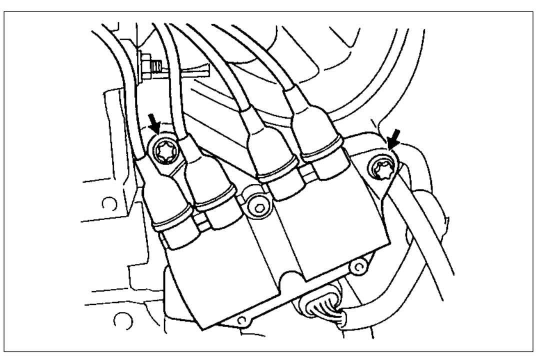
Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnosis

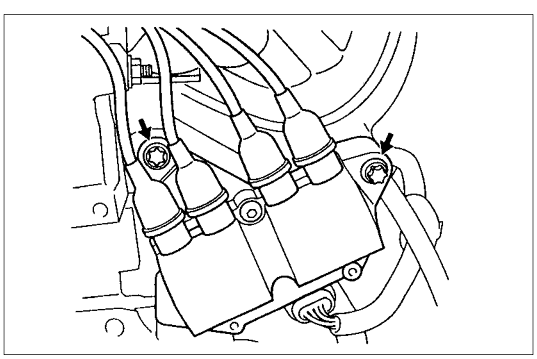
Refer to Section Drivability and Emissions for the diagnosis to electronic ignition system (EI system).

Ignition Coil



Removal

1. Disconnect battery ground cable.
2. Disconnect the Ignition coil connector.
3. Remove the ignition coil.



Installation

1. Install the ignition coil.
   Connect ignition coil connector and ignition coil, then tighten bolt to the specified torque.
   Torque: 20 N·m (2.0 kgf·m)
2. Connect battery ground cable.

Spark Plug

Removal

1. Remove spark plugs.

Inspection and Repair

The spark plug affects entire engine performance and therefore its inspection is very important.

- Check electrode and insulator for presence of cracks, and replace if any.
- Check electrode for wear, and replace if necessary.
- Check gasket for damage, and replace if necessary.
- Measure insulation resistance with an ohmmeter, and replace if faulty.
- Adjust spark plug gap to 1.0 - 1.1 mm (0.027 in) - 0.8 mm (0.031 in).
- Check fuel and electrical systems if spark plug is extremely dirty.
- Use spark plugs having low heat value (hot type plug) if fuel and electrical systems are normal.
- Use spark plugs having high heat value (cold type plug) if insulator and electrode are extremely burned.

Sooty Spark Plugs

Much deposit of carbon or oil on the electrode and insulator of spark plug reduces the engine performance.

Possible causes:

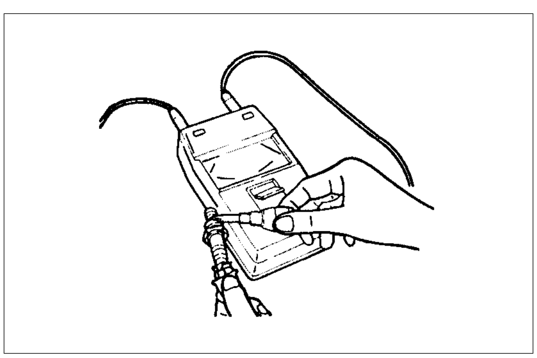
- Too rich mixture
- Presence of oil in combustion chamber
- Incorrectly adjusted spark plug gap

Burning Electrodes

This fault is characterized by scorched or heavily oxidized electrode or blistered insulator nose.

Possible causes:

- Too lean mixture
- Improper heat value



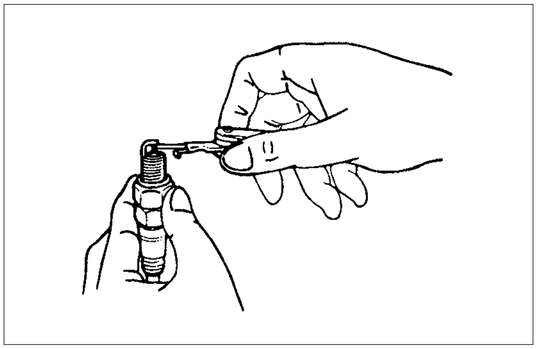
Measuring Insulation Resistance

- Measure insulation resistance using a 500 volt megaohm meter.
- Replace spark plugs if measured value is out of standard.

  Insulation resistance: 50 MΩ or more

Cleaning Spark Plugs

- Clean spark plugs with a spark plug cleaner.
- Raise the ground electrode to an angle of 45 to 60 degrees. if electrode is wet, dry it gefore cleaning.
- After spark plug is thoroughly cleaned, check insulator for presence of cracks.

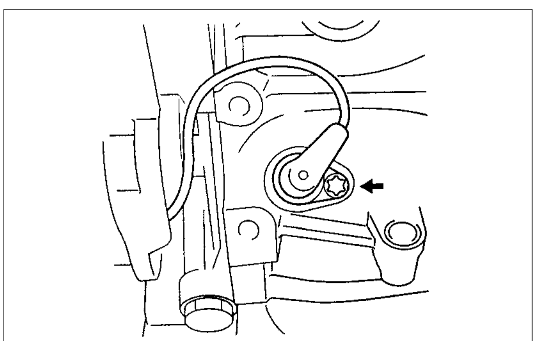


- Clean threads and metal body with a wire brush.
- File the electrode tip if electrode is extremely worn.
- Bend the ground electrode to adjust the spark plug gap.

Installation

1. Spark plugs
   - Tighten spark plugs to the specified torque.

   Torque: 20 N·m (2.0 kgf·m)



Crankshaft Angle Sensor

Removal

1. Disconnect battery ground cable
2. Disconnect the wiring connector from crankshaft angle sensor.
3. Remove crankshaft angle sensor from cylinder block.

Installation

1. Install crankshaft angle sensor into the cylinder block. Before installation, apply small amount of engine oil to the O-ring.

   Torque: 6 N·m (0.6 kgf·m)
2. Reconnect wiring connector to crankshaft angle sensor.

Main Data and Specifications

General Specifications

Ignition System	
Ignition Form	Electronic Ignition System (El system) with Crankshaft angle Sensor
Spark Plug	
Type	Electronic Spark Control
No. of Coils and Type	2 Solid State
Coil Location	Engine-mounted
Torque	20 N·m (2.0 kgf·m)

SECTION 6D3

STARTING AND CHARGING SYSTEM

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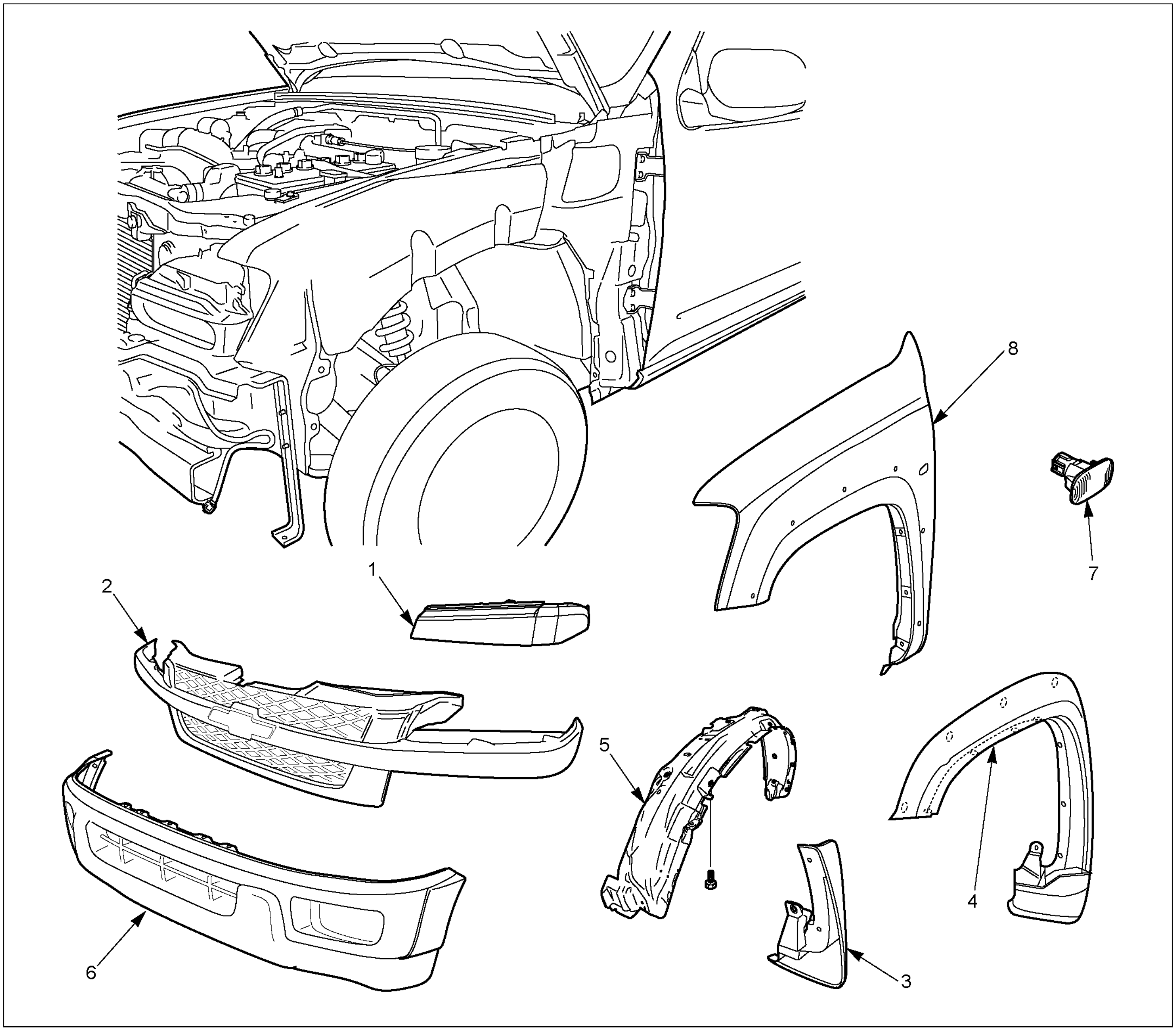
FRONT FENDER PANEL (B TYPE)

REMOVAL AND INSTALLATION



Removal Steps

- ▲ 1. Front combi lamp assembly
- ▲ 2. Radiator grille
- 3. Mud guard (W/O front wheel extension)
- 4. Front wheel extension (W/ front wheel extension)
- ▲ 5. Inner liner
- ▲ 6. Front bumper fascia
- 7. Side turn signal light
- ▲ 8. Front fender panel

Installation Steps

- ▲ 8. Front fender panel
- 7. Side turn signal light
- 6. Front bumper fascia
- 5. Inner liner
- 4. Front wheel extension (W/ front wheel extension)
- 3. Mud guard (W/O front wheel extension)
- 2. Radiator grille
- 1. Front combi lamp assembly

Starting System

General Description

Cranking Circuit

The cranking system consists of a battery, starter, starter switch, starter relay, etc. These main components are connected.

Starter

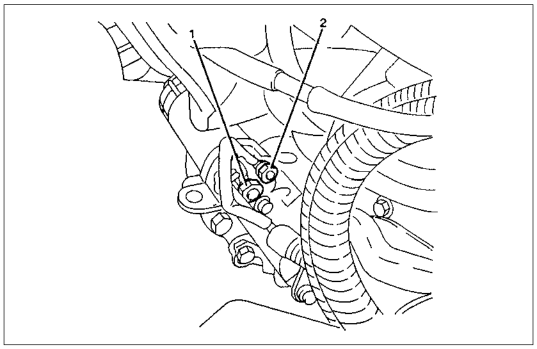
The cranking system employs a magnetic type reduction starter in which the motor shaft is also used as a pinion shaft. When the starter switch is turned on, the contacts of magnetic switch are closed, and the armature rotates. At the same time, the plunger is attracted, and the pinion is pushed forward by the shift lever to mesh with the ring gear.
Then, the ring gear runs to start the engine. When the engine starts and the starter switch is turned off, the plunger returns, the pinion is disengaged from the ring gear, and the armature stops rotation. When the engine speed is higher than the pinion, the pinion idles, so that the armature is not driven.

Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnosis

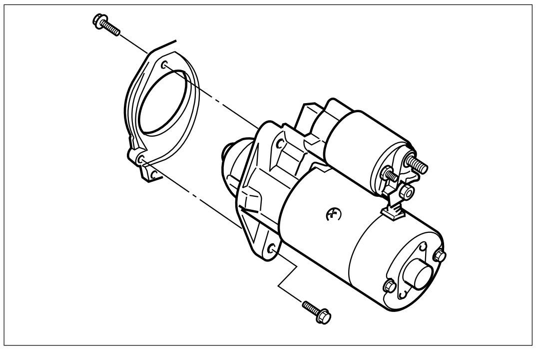
Condition	Possible cause	Correction
Starter does not run	Charging failure	Repair charging system
	Battery Failure	Replace Battery
	Terminal connection failure	Repair or replace terminal connector and/or wiring harness
	Starter switch failure	Repair or replace starter switch
	Starter failure	Repair or replace starter



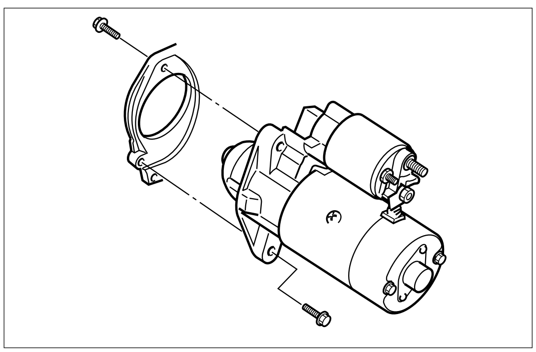
Starter

Removal

1. Remove the battery ground cable.
2. Remove harness connectors (1) and (2).



3. Remove bolts from starter.

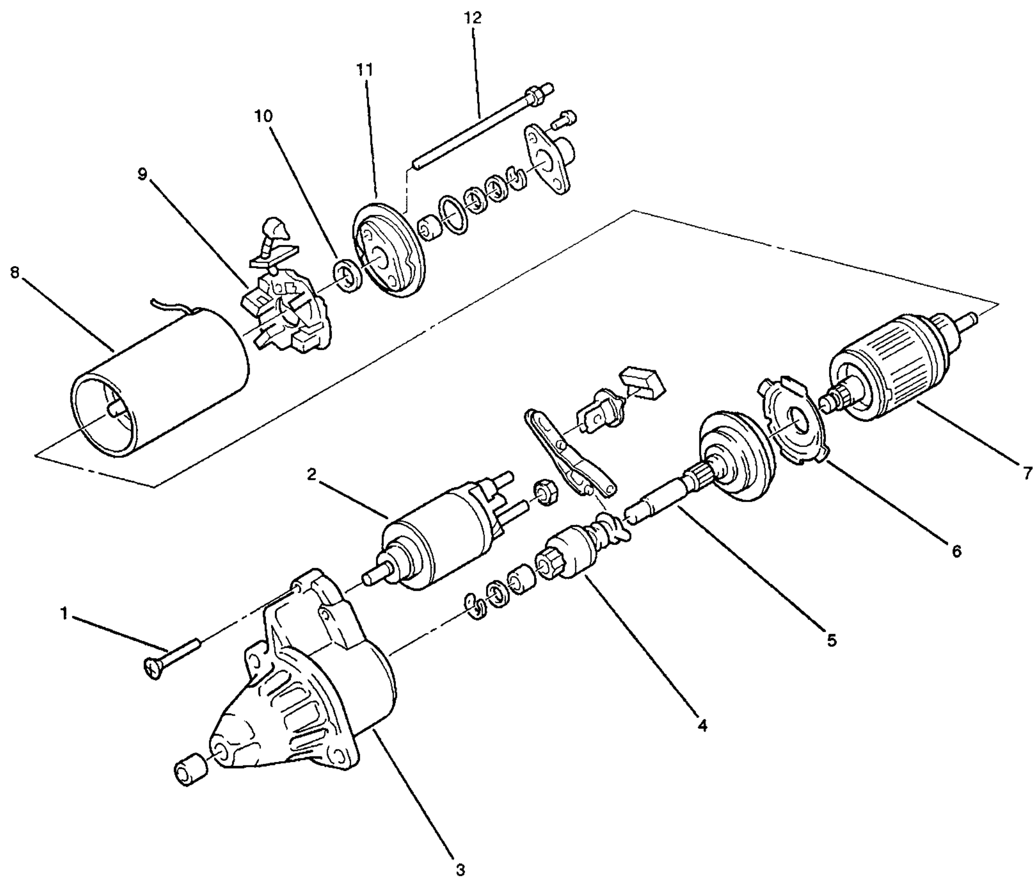


Installation

1. Install starter assembly.
2. Install mounting bolts and tighten bolts to specified torque.

   Torque: 51 N·m (5.2 kgf·m)
3. Connect harness.
4. Reconnect the battery ground cable.

Disassembled View

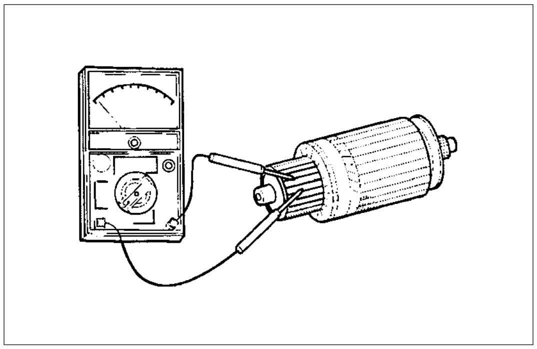


Legend

1 Bolt
2 Magnetic Switch
3 Gear Case
4 Piston
5 Piston Shaft
6 Center Bracket
7 Armature
8 Yoke Assembly
9 Brush and Brush Holder
10 Washer
11 Rear Cover
12 Through Bolt

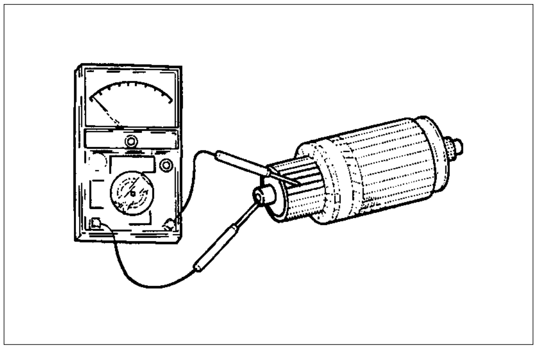
Inspection and Repair

Repair or replace necessary parts if extreme wear or damage is found during inspection.

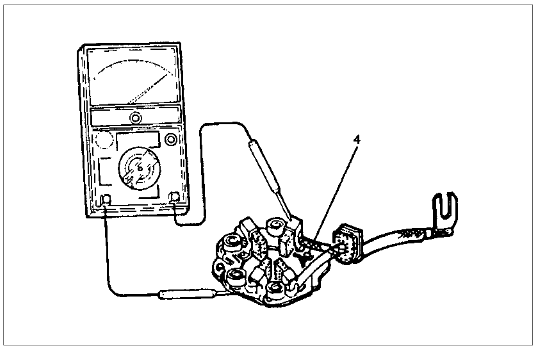


Armature

Check for continuity between commutator and segment.
Replace commutator if there is no continuity (i.e., disconnected).



Check for continuity between commutator and shaft.
Also, check for continuity between commutator and armature core, armature core and shaft. Replace commutator if there is continuity (i.e., internally grounded).

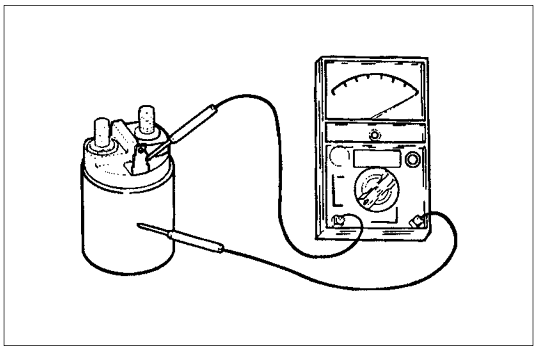


Brush

Measure the length of brush.
Replace with a new one, if it is below the limit.

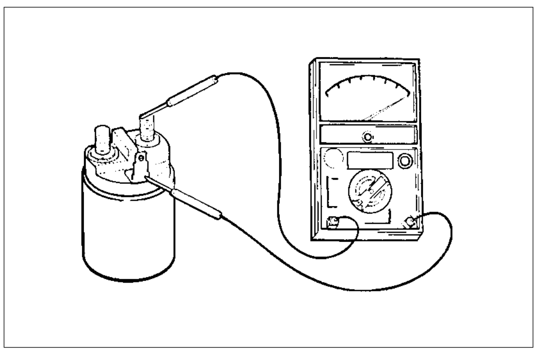
Brush Holder

Check for continuity between brush holder (+) (4) and base (-).
Replace, if there is continuity (i.e., insulation is broken).



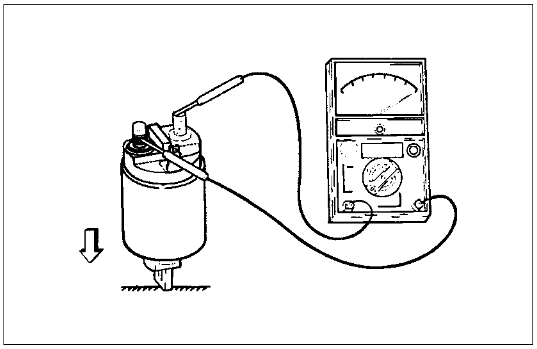
Magnetic Switch

Check for continuity of shunt coil between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



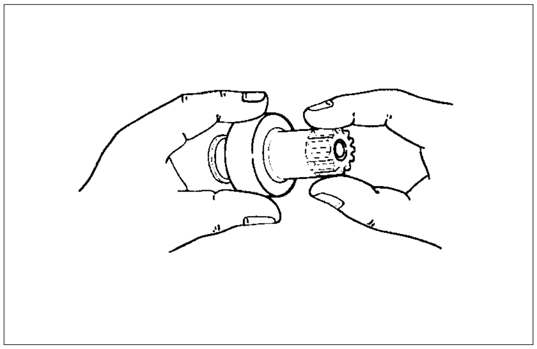
Continuity of Series Coil

Check for continuity between terminals S and M.
Replace, if there is no continuity (i.e., coil is disconnected).



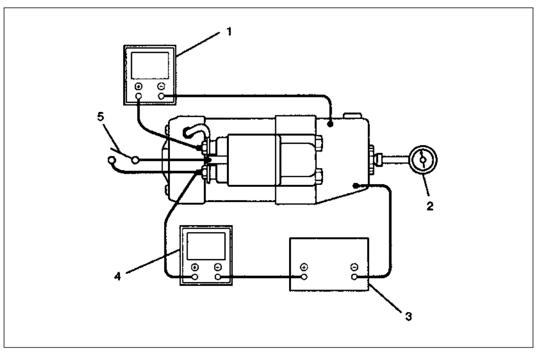
Continuity of Contacts

With the plunger faced downward, push down the magnetic switch. In this state, check for continuity between terminals B and M. Replace, if there is no continuity (i.e., contacts are faulty).



Pinion

Check if the pinion rotates smoothly in drive direction by hand, or if it is locked when it is rotated in reverse. If not, replace the pinion.



Characteristic Test

For easily confirming the characteristics, conduct the noload test as follows:
Rating as short as 30 seconds requires rapid testing.
Fix the starter on the test bench, and wire as shown in illustration. When the switch is closed, the current flows and the starter runs under no load. At this time, measure current, voltage and speed to check if they satisfy the standard.

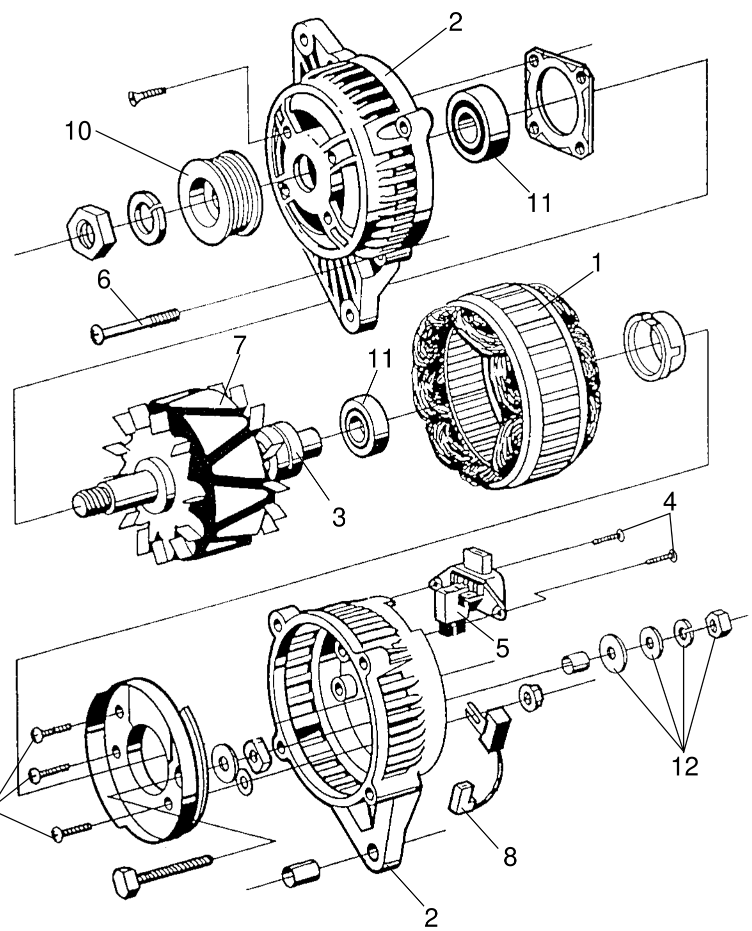
Legend

1 Volt Meter
2 Revolution Indicator
3 Battery
4 Ammeter
5 Switch

Charging System

General Description

The charging system is an IC integral regulator charging system and its main components are connected as shown in illustration.
The regulator is a solid state type and it is mounted along with the brush holder assembly inside the generator installed on the rear end cover.
The generator does not require particular maintenance such as voltage adjustment. The rectifier connected to the stator coil has eight diodes to transform AC voltage into DC voltage.
This DC voltage is connected to the output terminal of generator.



Legend

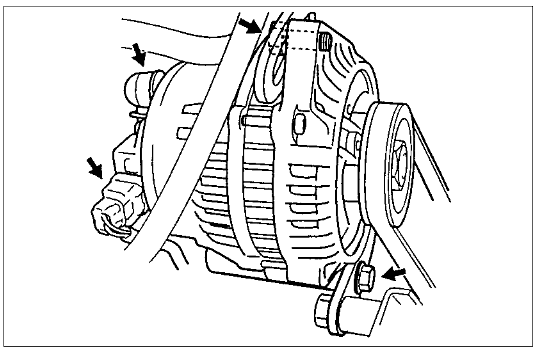
1 Startor assembly
2 Housing
3 Slipring
4 Screws (2)
5 Regulator
6.Bolt (4)
7 Rectifier assembly
8 Retaining assembly
9 B+ terminal nut and washer
10 Pulley
11 Rotor assembly
12 Ball bearing

General On-Vehicle Inspection

The operating condition of charging system is indicated by the charge warning lamp. The warning lamp comes on when the starter switch is turned to "ON" position. The charging system operates normally if the lamp goes off when the engine starts. If the warning lamp shows abnormality or if undercharged or overcharged battery condition is suspected, perform diagnosis by checking the charging system as follows:

1. Check visually the belt and wiring connector.
2. With the engine stopped, turn the stator switch to "ON" position and observe the warning lamp.
   If lamp does not come on:
   Disconnect wiring connector from generator, and ground the terminal "L" on connector side.
   If lamp comes on:
   Repair or replace the generator.

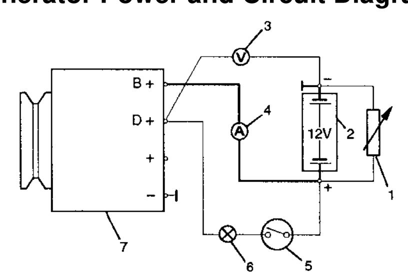
Generator



Removal

1. Disconnect battery ground cable.
2. Move drive belt tensioner to loose side using wrench then remove drive belt.
3. Disconnect terminal "B" wiring connector and connector.
4. Remove generator assembly.

Generator Power and Circuit Diagram

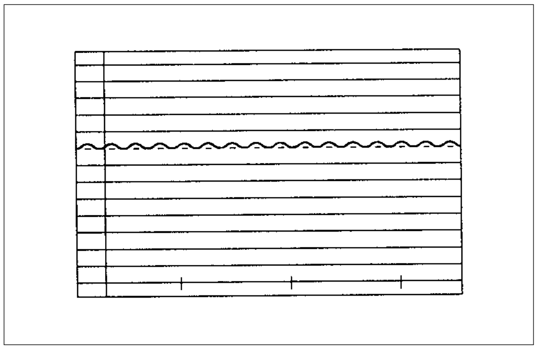


Inspection

Legend

1 Load resistor, set parallel to battery
2 Battery
3 Voltmeter
4 Ammeter
5 Ignition Lock
6 Charge Telltale
7 Generator

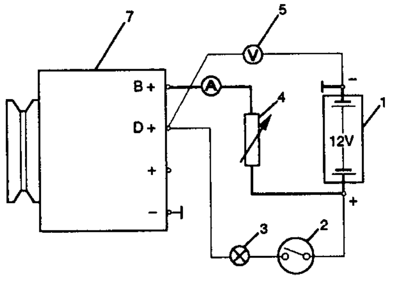
1. Disconnect battery.
2. Close off connecting cable from alternator terminal "B+".
3. Set ammeter (measuring range 100A) in disconnected line.
4. Connect controllable load resistor to battery terminal.
5. Set resistor in front of connection to "O"; connect first to battery, then to resistor.
6. Connect tachometer.
7. Connect oscilloscope according to manufacturer's instructions.
8. Connect battery.
9. Start engine and read off resulting current at various engine speeds.



Generator Power

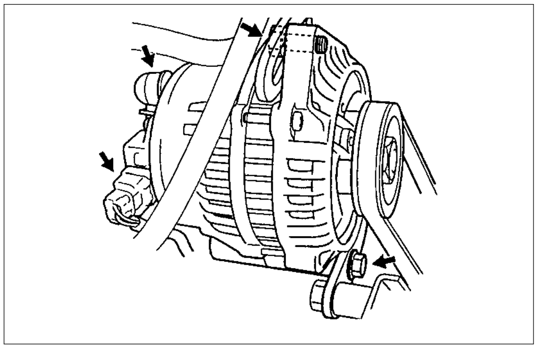
1. Adjust load resistor, if the required load currents are not attained.
2. The shape of the voltage curves on oscilloscope curve should be regular.
3. Test value: 5 to 7A.
4. If the required minimum current intensity is not attained, or if the oscilloscope picture shows variations, the alternator should be overhauled.

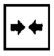
Regulated Voltage Circuit Diagram



Legend

1 Battery
2 Ignition Lock
3 Charge Telltale
4 Resistor, for attainment of load current with the battery set in series
5 Voltmeter
6 Ammeter
7 Generator





Installation

1. Install generator assembly and bring generator assembly to the position to be installed.
2. Install generator assembly and tighten to the specified torque.

   Torque:

   Long bolt: 35 N·m (3.6 kgf·m)

   Short bolt: 20 N·m (2.0 kgf·m)
3. Connect wiring harness connector.
4. Move drive belt tensioner to loose side using a wrench, then install drive belt to normal position.
5. Reconnect battery ground cable.

The generator has four external connections; the "B+" lead to battery positive, "L" lead to the warning lamp circuit(max. 2 watts), "S" lead to battery positive terminal for battery sensing and an earth connection.

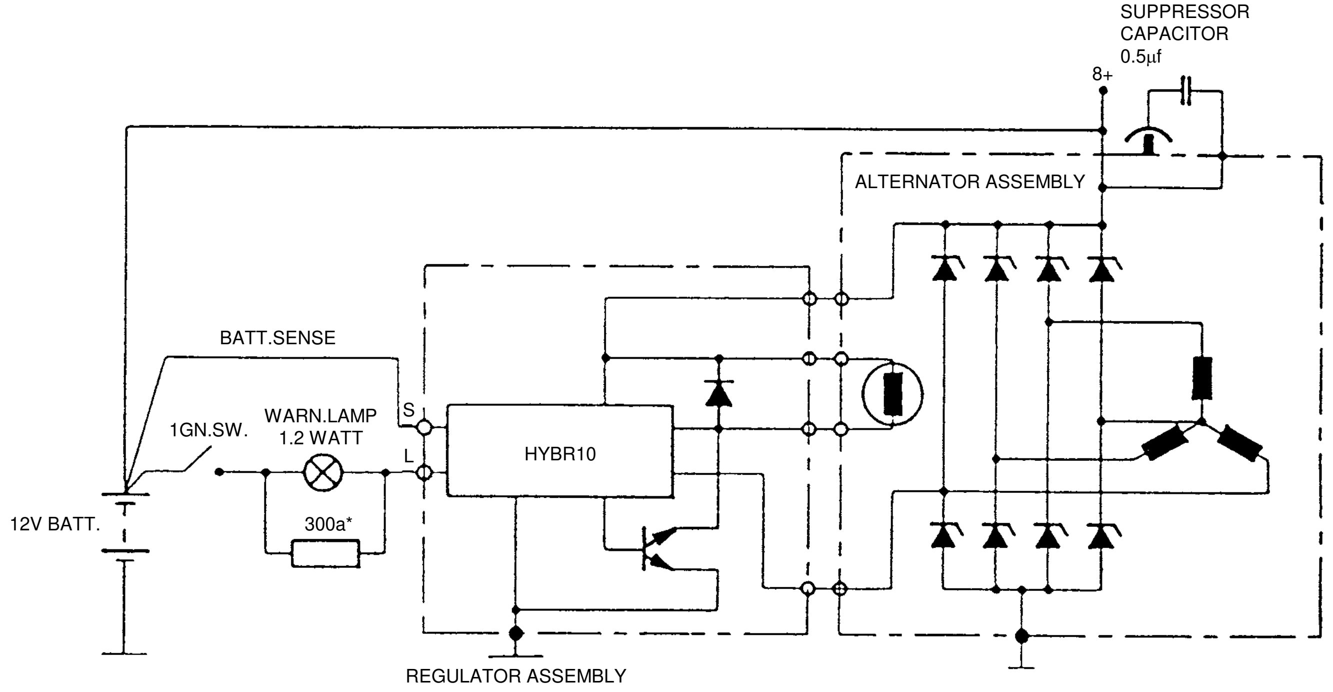
Explanation of type inscripiton

Example:KC-A--> 14V 50-90A.

K = Code for Stator OD(126mm OD).
C = Compact Generator.
A = Ausland (countries other than Germany)
> = Direction of rotation(clockwise).
14V = Generator Operating Voltage.
50A = Stabilised output at 25 C at 1800 RPM./13.5 Volts.
90A = Stabilised output at 25 C at 1800 RPM./13.5 Volts.

Generator Connetions.

B+ : Battery Main Connection (battery positive)
S : Battery Sense Connection(battery positive)
L : Waring lamp(via warning lamp to Ignition switch)



NOTE: * RESISTOR IS RECOMMENDED TO ENSURE THAT THE GENERATOR REMAINS FUNCTIONAL IN CASE OF WARNING LAMP FAILURE

Warning

Do not reverse S and L connections as this will destroy the warning lamp circuit of the regulator.
Ensure good electrical contact beween generator earth and battery negative,

Operation

With the Iginiton switch turnded "ON", current is supplied via the warning lamp to the "L" terminal of the regulator. Base current is fed to T15 causing it to turn on, current then flows from B+ through the rotor winding via the regulator brushes and the collector emitter junction of T15 to earth completing the circuit. The current in the rotor causes a magnetic field between adjacent poles to be created, this field is rotated and cuts the windings of the stator at right angles inducing a voltage into them.
As the speed is increased this induced voltage increases and results in curent being rectified in the 3 phase diode bridge and supplied as DC to the B+ output and hence to the battery.
When the voltage at the B+ terminal of the battery reaches around 14.2 volts, this voltage is monitored by the "S" lead and turns the regulator Hybrid base current to T15 OFF removing rotor current, resulting in a decrease in output voltage to below the regulating voltage, T15 base current turns ON and the whole cycle is repeated very rapidly.
D38 protects T15 and the regulator against the back voltage developed across the rotor winding when T15 turns OFF.
The new generated EP regulators incorporate current limiting in the warning lamp circuit.

Backup Regulation

The EP regulator will limit the output voltage to a safe level should either the main B+ cable or the battery sense wire become decoupled, the output voltage will be slightly above the normal setting(1-3 volts).

Start up phase

When the Iginition switch is turned on and the engine is not running, the current to the rotor is reduced by switching it on and off at a 50% duty cycle, the frequency is approximately 4 KHz and may be audible at times.
This is quite normal, once the engine is started normal regulation commences.

Warning lamp failure

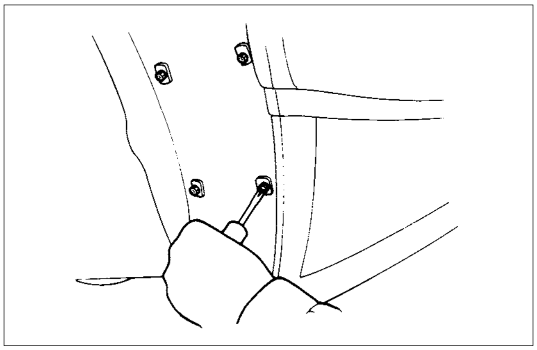
Should the warning lamp fail, the generator will self excite by deriving a small current from the phase connecion allowing the voltage to build up to regulating level.
Note: no filed current will flow when the engine is cranking.

Important Operations - Removal

1. Front Combi Lamp Assembly

2. Radiator Grille

Refer to the Radiator Grille in this section.

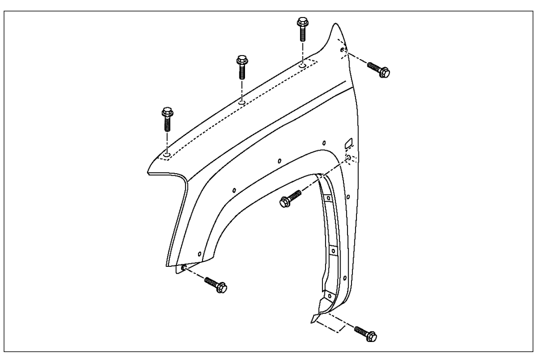


5. Inner Liner

Remove the inner liner fixing screws.

6. Front Bumper Fascia

Refer to the Front Bumper in this section.



RTW52BSH000401

8. Front Fender Panel

Remove the 8 fixing bolts.

Important Operation - Installation

8. Front Fender Panel

1) Tighten the front fender panel fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
10 (1.0 / 87)	

Diagnosis

The EP regulator incorporates diagnostics which will illuminate the warning lamp as a result of fault conditions in the generator and external circuitry.

These conditions include:

1. An open circuit in the regulator battery sensing wire (S Terninal)
2. An open circuit or excessive voltage drop in the B+ cable.
3. An open circuit in the generator phase connection.
4. Overcharging of the battery.
5. Regulator output stage short circuit.
6. Open circuit rotor.

The regulator compares the voltage at B+ with the voltage at the "S" terminal connceted to battery positive. If the voltage differential exceeds a predetermined threshold, the regulator will operate in backup mode to limit the output voltage to a safe level. The warning lamp; will remain illuminated as along as these conditions prevail.
Sources of high resistance which will trigger the warning lamp are:

a. Poor contact in wiring harness connectors.
b. Poor contact between rectifier and regulator.
c. High resistance in fusible link assembly.

Caution:
When bench testing the generator it is important that the warning lamp wattage of 2 watts is not exceeded.
Reversal of the "S" and "L" on the regulator will damage the regulator.
The correct plug for the regulator is a 9 122 067 011 for the Bosch tye and for the Shinagawa connector the number is X02FW.

See appendix 1 for daignostic matrix.
Before testing or disassembling the generator please observe the following points.

1. When testing the diodes with AC type testers the RMS. Vlotage output must not exceed 12.0 volts, it is recommended that the stator should be disconnected during this test.
2. Where zener power diodes are used, the breakdown voltage should be tested to ensure all diodes have the same zener voltage.
3. Insulation tests on the rotor and stator should use a voltage not exceeding 110v for a series test lamp. The rectifier must be disconnected from the stator prior to testing.
4. When carrying out repairs to the charging system always disconnected the battery negative first, and reconnect it last.

5. During current output tests please make sure that the ammeter is securely connceted into the charge circuit.
6. Some battery powered timing lights can produce high transient voltages when connected or disconnected. Only disconnect or connect timing lights when the engine is switched off.
7. Make sure the warning lamp circuit is functioning normally before commencing tests.
8. Battery isolation switches must only be operated when the engine is stopped.
9. To protect the charging system when using 240 volt chargers it is recommeneded that the battery is disconnected whilst charging.
10. Due to the very low resistance value of the stator winding it may not be possible to obtain accurate readings without special equipment.
11. 12 volts must never be connected to the "L" terminal of the regulator as this will damage the lamp driver circuit.
12. No loads apart from the warning lamp can be connected to the "L" termainal. The "W" terminal is provided for this purpose.

Disassembly

1. Mark the relative positions of the end housings in relation to the stator assembly to aid reassembly. Use a permanent marking pen do not use centre punched as this can cause misalignmnet of the housings.
2. Remove the EP regulator from the slipring end housing by removing the two screws. Tilt the regulator slightly from the plug connection until the regulator clears the housing, then lift clear.
3. Remove the four through bolts.
4. Carefully remove the stator assembly along with the slipring end housing taking care not to put strain on the stator wires.
5. To disconnect the stator from the rectifier assembly, grasp the stator wires close to the wire loop with a pair of long nosed pliers, heat the joint with a soldering iron, when the point becomes plastic apply a slight twisting motion to the wires, then pull upwards to release the wires. Remove the stator.

   This procedure opens the wire loop to release the stator connections easily.
6. To remove the rectifier remove the three retaining screw and the B+ terminal nut and washers.

Note: the B+ bolt and the positive heatsink retaining screw are fitted with mica insulating washers.
These must be discarded and replaced with new washers and heatsink compound.

7. To remove the pulley, mount an 8mm Allen key in the vice with the short end upwards, place a 24mm ring spanner on the puley nut, position the internal hexagon of the rotor shaft onto the Allen ken, loosen the nut and remove the pulley.

Note: the pulley has an integral boss which locks up against the bearing,
therefore no thrust collar is provided.

8. Removing the rotor assembly. Remove the four retaining screws from the drive end housing, withdraw the rotor complete with the bearing.

Note: the rotor must not be pressed from the drive end housing using a press as the bearing retaining plate and drive end housing will be damaged or distorted. Parts removed in this way must be replaced if the integrity of the generator is to be maintained.

9. Remove the drive end bearing from the rotor shaft using a chuck type puler, take care not to distort the fan assembly during this process.
10. Remove the slipring end bearing using the same meghod as in 9.

Clean

Thoroughly clean all components except the rotor and stator with an approved cleaning agent. Ensure that all traced of oil and dirt are removed. If an abrasive cleaner is used to remove scale and paint from the housings take care not to abrade the bearing and mounting spigot surfaces. The rotor and stator must be cleaned with compressed air only, the use of solvents could cause damage to the insulating materials.

Inspection

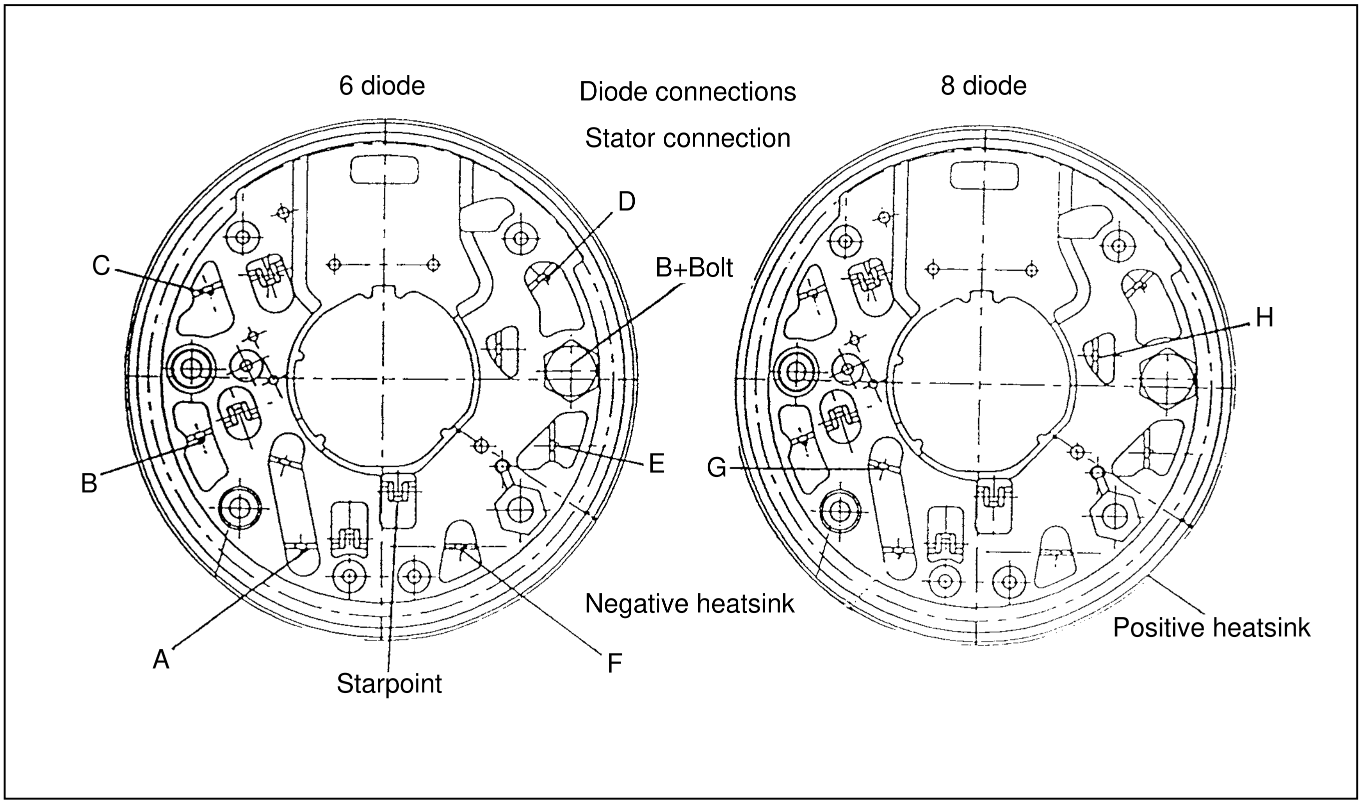
1. Rectifier assembly

The following test equipment is required.
The recitifier assembly is not repairable and must be replaced if a faulty diode is detected during inspection.

(a) Adiode tester where the DC output at the test probes does not exceed 14 volts or in the case of AC testers 12 volts RMS. This is to ensue that when inspection rectifiers fitted with zener power diodes the forward and reverse checks are completer and are not masked by the diode turning on due to the zener breakdown voltage.

(b) A zenere diode tester with a DC output in excess of 30 volts, the tester should also incorporate internal current limiting set to 5 Ma. to prevent high currents during inspection.

(c) Diodes can be destroyed during service due to high temperature and overload, open circuits are usually a result of excessive voltage.

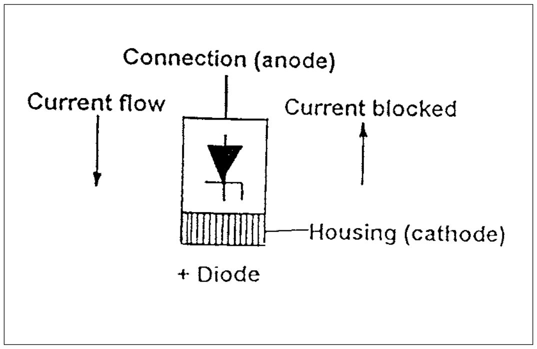


1.1 Power Diodes.

Apply the negative test probe of the diode tester or a multimeter with a diode test feature to the positive heatsink and the positive probe alternately to A,B,C, a low resistance reading, or the forward voltage drop across the diode shoud be obtained. Reverse the test probes, a high resistance reading or a higher reverse voltage should be obtained.

Now connect the positive test probe to the negative heatsink and the negative alternatively to D,E,F, a low resistance or forward voltage drop across the diode should be obtained. Reverse the test probes, a high resistance reading or a higher reverse voltage should be obtained.

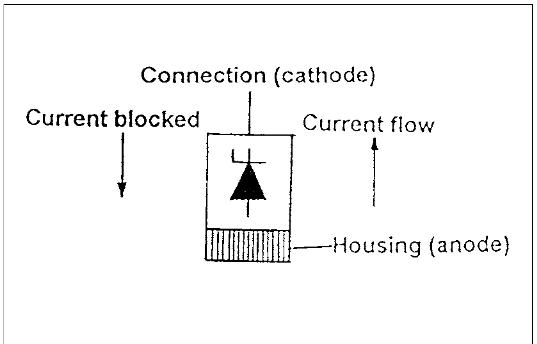
For 8 diode rectifier plates tests for G and H should be included. When the reverse voltage test is done the applied voltage should be less than 14 volts DC or 12 volts RMS for AC testers.



1.2 Zener Diode

The basic tests in 1.1 should be undertaken first before the diode zener voltage is tested. Diodes are grouped together according to their zener voltag i.e. all diodes within a rectifier must have the same zener voltage.

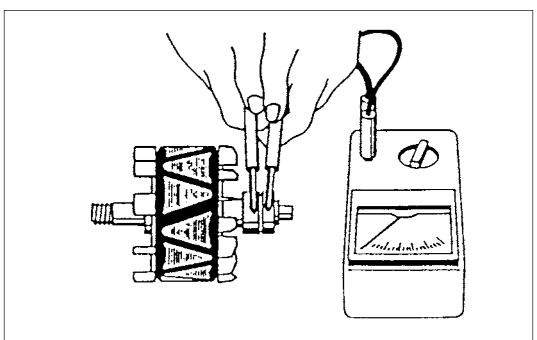
Connect the test probes as for the reverese test listed above i.e. reverse biased apply the test voltage form the zener diode tester (current limited to 5ma) and read to zener breakdown voltage this should be a steady reading and not increase with increased voltage from the tester.



Readings for Zener diode groups 011 to 042

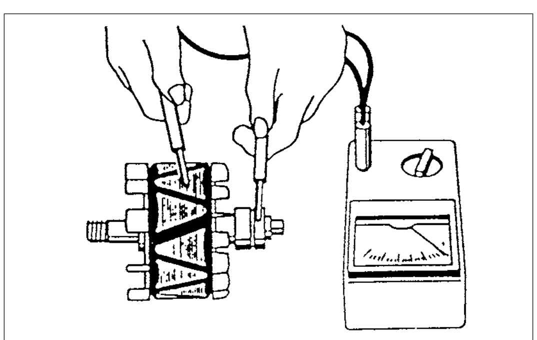
Zener voltage at 5Ma.	Positive diode	Negative diode	Fordward current Rating
17.8v-19.2v	011	012	25A
18.8v-20.2v	013	014	25A
19.8v-21.2v	015	016	25A
20.8v-22.2v	017	018	25A
21.8v-23.2v	019	020	25A
22.8v-24.2v	021	022	25A
17.8v-19.2v	031	032	35A
18.8v-20.2v	033	034	35A
19.8v-21.2v	035	036	35A
20.8v-22.2v	037	038	35A
21.8v-23.2v	039	040	35A
22.8v-24.2v	041	042	35A

Note: Diode number is stamped on the rear of the diode.



2. Stator

Inspect the stator insulation resistance to ground with an insuation tester or a series test lamp up to 110 volts.
The insulation resistance must be greater than 1 megohm.
The winding reisistance is measured between phases using a low reading ohmmeter designed for this purpose, the values are given at the rear of this instruction.



3. Rotor

Inspect the rotor for insulation resistance to ground using an insulation tester or a series test lamp up to 110 volts.
The insulation resistance must be grater than 1 megohm.
Measure the rotor resistance between the sliprings using an ohmmeter or apply 12 volts across the sliprings and measure the rotor current flow, then divide 12 by the measured current, the results is the rotor resistance in ohms. values are given at the rear of this instruction.

If the sliprings are worn or out of round they must be re-machined to a minimum diameter or 26.7 mm and should have a runout not exceeding 0.060mm. If the slipring is below these limits it must be replaced with a new one.

Warning; extreme care must be exercised when machining the slipring as it is possible for the turning tool to foul the

fan.

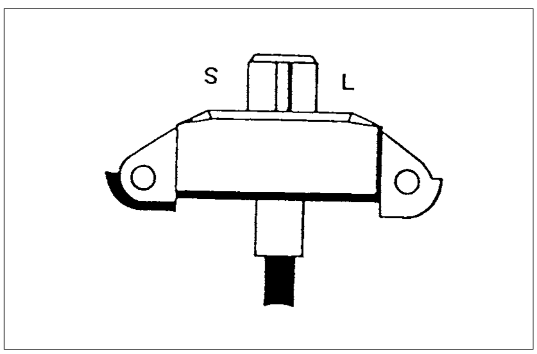
4. Replacing the brushes (inbuilt regulator)

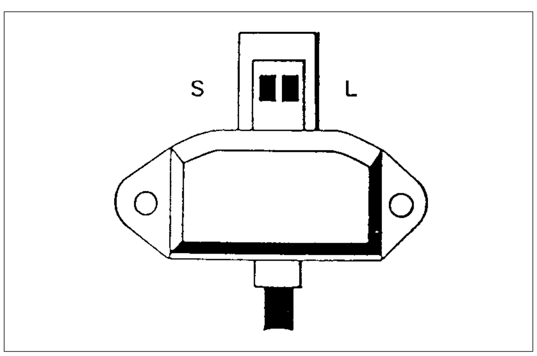
Check the brushes for length, this is measured from the brush holder to the end of the brush along it's centre line. Also inspect for any sideways wear. If worn replace both brushes. The minimum length is 3.8mm. Inspect the brush springs for signs of corrosion or loss of tension or uneven tension.

Replacing the brushes, using a soldering iron apply heat to the soldered joints on the rear of the brush holder of the regulator, using a small lever prise up the retaining tabs to release the brush lead and spring. Thread the new brush lead up the brush holder along with the spring, pull the lead through the tabs until the brush is protruding 12mm from the holder. Bend down the tabs and solder the brush lead taking care not to allow the solder to run up the lead which will reduce flexibility. Use 60/40 resin cored solder.

5. Ball bearing

Please note the bearings used in this KCA generator are a high
tolerance type, only fully sealed bearings of the same specification are to be used as replacements. It is recommended that the bearings be replaced during the reconditioning process to restore the unit to original specification.





6. Regulator

The regulator can only be tested when fitted into an altenator.

Warning: do not reverse"S" and "L" connections or put 12 volt supply to "L" terminal, this connection must not be used as a supply source other than to supply the requirements of the warning lamp 2(watts).
Such action will destroy the regulator warning lamp circuit.

For test voltages refer to Generator output testing section. See also additional information on regulator function earlier in this instruction.

Reassembly

Generator

(a) Press new bearing onto slipring end of the rotor taking care to aplly the force to the bearing inner race only, otherwise the bearing will be noisy and it's life will be shortened.

(b) Fit a new bearing to the drive end housing, fit the bearing plate, and four retaining screws, press the rotor into the bearing, using a support tool to take the thrust against the bearing inner.
The support is fitted from the pulley side of the bearing. In this way the thrust is not taken by the drive end housing.

(c) To fit pulley, mount an 8mm Allen key in the vice with the short end upwards, place a 24mm ring spanner on the shaft nut, position the internal hexagon of the rotor shaft onto the Allen key, tighten the nut to the required torque(See torque chart)

(d) Inspect the bearing support ring for signs of damage, if in doubt replace the ring by pressing it into the housing by hand, do not use excessive force.

(e) To refit the rectifier, fit new mica washers to the positive heatsink B+ bolt and retaining screw each washer must have heatsink compound applied to both surfaces before fitting.
Fit the three retaining screws to the rectifier then install into slipring end housing. Tighten the B+ bolt to the reuired torque.

(f) To refit the stator, make sure the spigot surface are clean and free from damage, fit the stator into the slipring end housing noting the correct lead connection positioning. Fit the stator leads into the wire loops in the recrifier. Using a pair of pliers squeeze the loop to retain the stator lead prior to soldering. Repeat for each lead in turn, solder the leads into position using 60/40 resin cored solder. Make sure the leads will be clear of the internal fan when the rotor is assmebled into the stator.

(g) Carefully install the rotor into the stator/slipring end housing assembly, noting the alignment of the housings and through bolt holes. Fit the through bolts making sure the stator is seated correctly, tighten the through bolts to the correct torque setting (uneven torque can produce magnetic noise levels above normal).

(h) Fitting the regulator. Compress the brushes into the brush holder by hand, slip the regulator through the opening in the rear of the slipring end housing until the brushes come in contact with the slipring. Press the regulator towards the slipring until the holes are aligned then fit the retaining screws and tighten.

Inspection

Generator

Before any in field testing can be undertaken it is important that the battery's conditions is established and the terminals are clean and tight.

Check the condition of the generator drive belt and ensure that it is adjusted in accordance with the engine manufacturer's recommnedations.

Battery conditions:
Note: This assessment may be difficult with maintenance free assemblies.

Test the specific gravity of the individual cells the readings should be within 10 points of each other, it is recommended that the average SG should be 1.260 or higher.
A load test should be carried out to determine the ability of the battery to supply and accept current. This is a good indicator as to the general condition of the battery.
A load equal to the normal starting current should be placed across the battery, the duration of this load test should not exceed 10 seconds, during this time the terminal voltage across the battery should not drop below 9.6 volts. Observe each cell for signs of excessive gas liberation, usuall an indication of cell failure.
If the battery test is clear proceed with the Generator tests as follows.

Care should be taken when making the following connections. It is recommended that the battery negative terminal be disconnected before the test meters are connected, and reconnecting the negative terminal when the meters are inserted into the circuit under test. The warning lamp in the D+ circuit should not exceed 2 watts.

Regulating voltage test on the vehicle.

Connect a voltmeter to the generator, the positive lead to the B+ terminal and the nagative lead to the generator casing. Select the voltage range to suit the system, i.e. 20v for 12 volt sysytems or 40v for 24 volt systems. Connect an ammeter in series with the main output cable from the B+ terminal on the generator, the range selected must be capable of reading the maximum output from the generator.

Note the voltmeter reading before starting the engine. This reading should increase when the engine is running indicating generator output, start the engine and increase the engine speed until the generator is running at 4000 rpm, switch on vehicle loads of 5-10 A is indcated on the ammeter, the voltmeter shoud read 14.0-14.2 v for a 12 volt system, for a 24 volt system the readings should be 5-10 A and 27.7-28.5 volts.

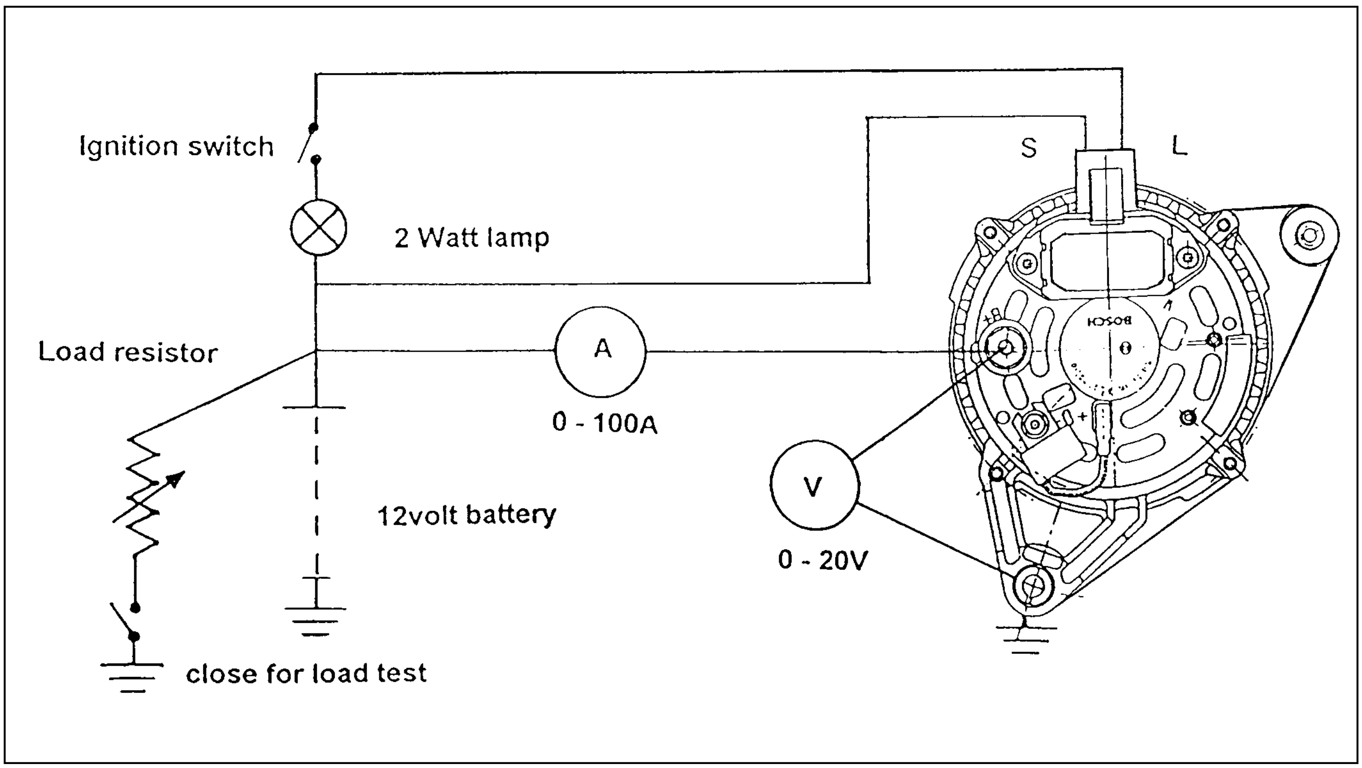
Load regulation test

Increase the engine speed until the generator is running at 6000 rpm, increase the load to 90% of full output a decrease in the regulating voltage should not exceed 0.50 volts for 12 v and 0.70 v for 24 v regulators of the readings obtained in the previous test. If so, the regulator is defective.

Generator output test at full load

Increase engine speed until the altenator is running at 6000 rpm, switch on electrical loads until the generator voltage drops to 13.5 volts for 12 v systems and 26 volts for 24 v systems, full outut should be obtained under these conditions. It may be necessary to adjust engine speed to maintain altenator speed. If sufficient electrical loads are not available a carbon pile resistance can be connected across the battery and adjusted until maximum output is obtained.

Keep the time for this test to a minimum to avoid undue heating and high engine speeds.



Technical Data

(mm)

Brush wear	-	Minimum Length	3.8
Sliprings	-	Minimum Diameter	26.7
Sliprings	-	Trueness	<0.06
Pole claws	-	Trueness	<0.05(93.25±0.05)

Torque

N.m(kgf·m)

Pulley retaining nut	54-68(5.5-6.9)
Capacitor retaining screw	2.7-3.8(0.3-0.4)
Capacitor whiz nut	1.5-2.2(0.1-0.2)
B+ terminal nut M8	7.5-8.5(0.8-0.9)
B+ terminal rectifier nut	6.0-7.5(0.6-0.8)
Regulator retaining screw	1.6-2.3(0.1-0.2)
Rectifier retaining screw	1.6-2.3(0.1-0.2)
Bearing retaining plate screw	2.1-3.0(0.2-0.3)
Through bolt	3.8-5.5(0.4-0.6)

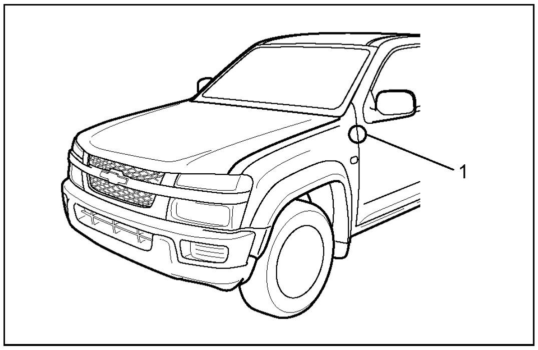
Winding resistance(between phases)

(Ω)

	Stator	Rotor
70 Amp generator	0.086+10%	2.6±0.13
85 Amp generator	0.058+10%	2.6±0.13
90 Amp generator	0.056+10%	2.6±0.13

Warning lamp fault indication

Fault running	Generator not running Ignition ON	Generator Iginiton ON
Generator out cable O/C	ON	ON
Battery "S" cable O/C	ON	ON
Battery overcharged	ON	ON
Positive diode short	OFF	ON
Negative diode short	ON	ON
Positive diode open	ON	OFF
Negative diode open	ON	OFF
Phase voltage sensing cable open circuit	ON	ON
Power transistor shorted	ON	ON
Warnign lamp driver O/C	OFF	OFF



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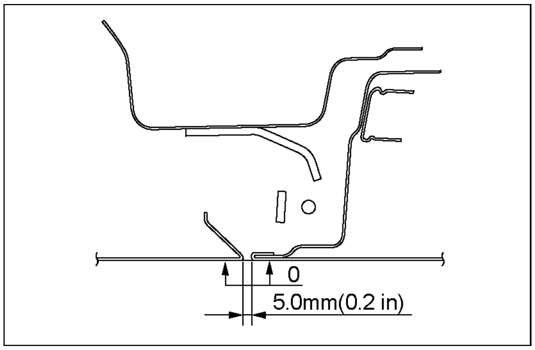

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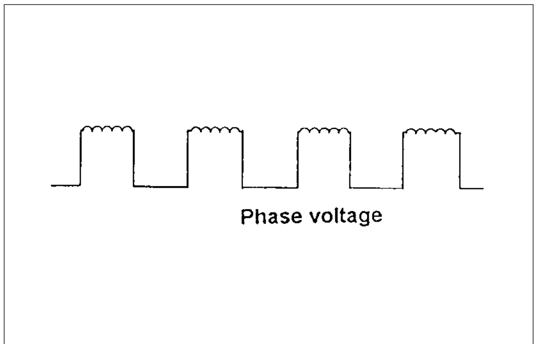
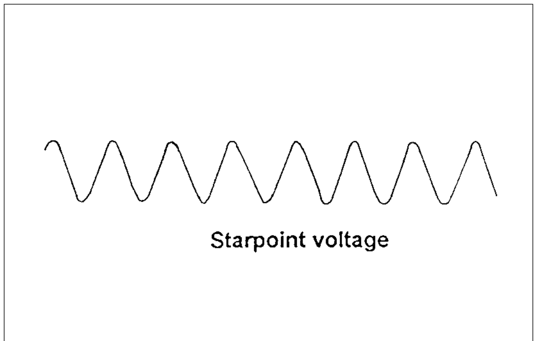
2) Check the fender and front door (1).

- Clearance : 5.0 mm (0.2 in)
- Height (step) : Flushness





Output wave forms for phase and startpoint connections.

Note; the average of these two waveforms are identical from no load to 100% output of rated load.

Voltage phase = Voltage startpoint
6.9v@ rated output 7.2v@ Zero output

Note: The phase frequency is one third of the startpoint frequency.

SECTION 6E

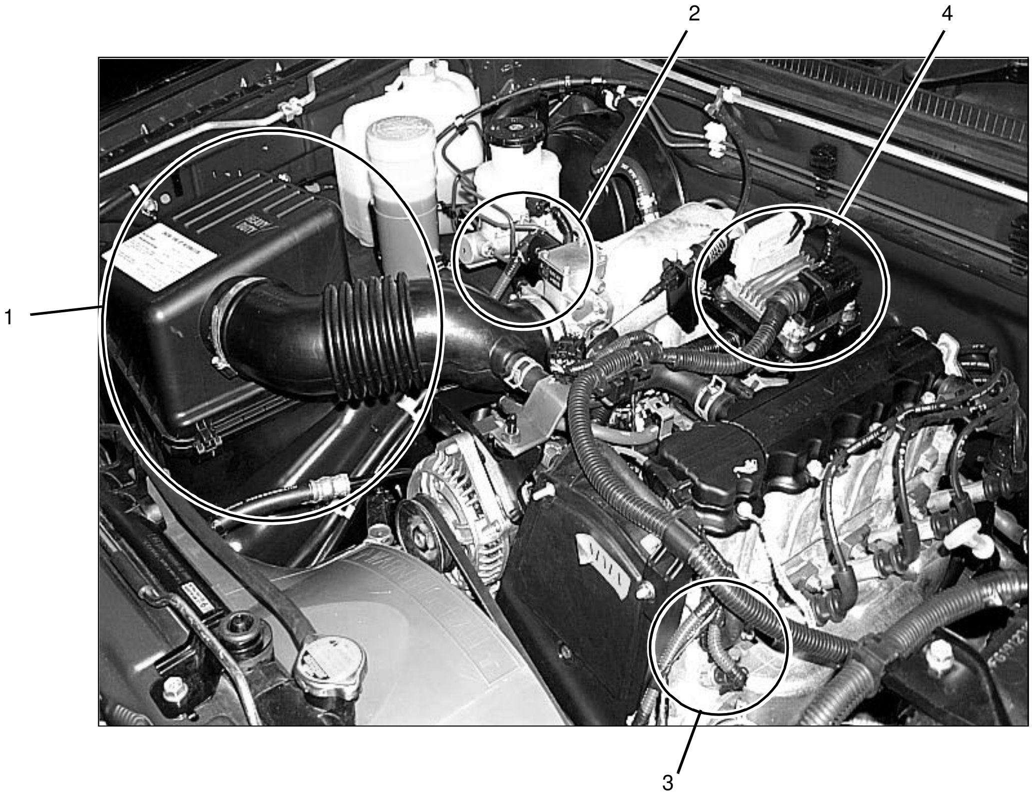
C24SE ENGINE DRIVEABILITY AND EMISSIONS

TABLE OF CONTENTS

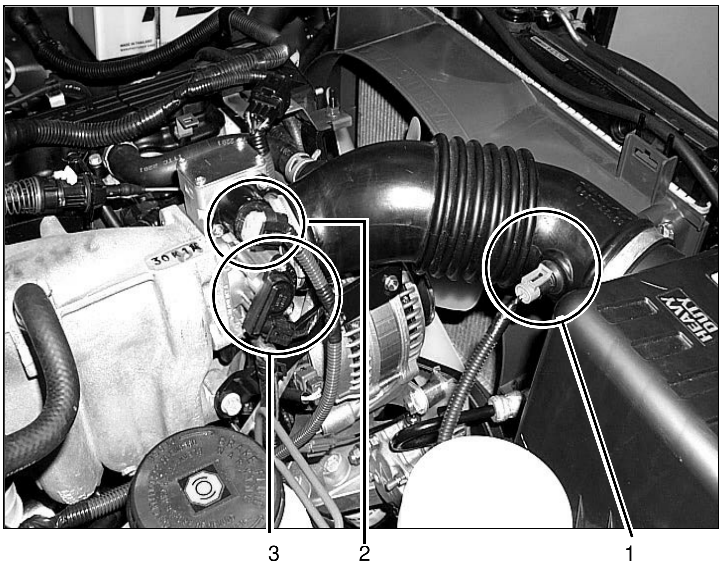
ABBREVIATIONS CHARTS

Abbreviations	Appellation
A/C	Air Conditioner
A/T	Automatic Transmission
ACC	Accessory
BLK	Black
BLU	Blue
BRN	Brown
CEL	Check Engine Lamp
CKP	Crankshaft Position
DLC	Data Link Connector
DTC	Diagnostic Trouble Code
DVM	Digital Volt Meter
ECM	Engine Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable & Programmable Read Only Memory
EVAP	Evaporative Emission
EVRV	Electric Vacuum Regulating Valve
EXH	Exhaust
FT	Fuel Temperature
GND	Ground
GRY	Gray
HOS2	Heated Oxygen Sensor
IAC	Idel Air Control
IAT	Intake Air Temperature
IG	Ignition
ITP	Intake Throttle Position
KS	Knock Sensor
M/T	Manual Transmission
MAP	Manifold Absolute Pressure
MIL	Malfunction Indicator Lamp
OBD	On-Board Diagnostic
ORN	Orange
OT	Oil Temperature
PNK	Pink
RED	Red
SW	Switch
TB	Throttle Body
TEMP	Temperature
TP	Throttle Position
VCC	Voltage Constant Control
VSS	Vehicle Speed Sensor
WHT	White
YEL	Yellow

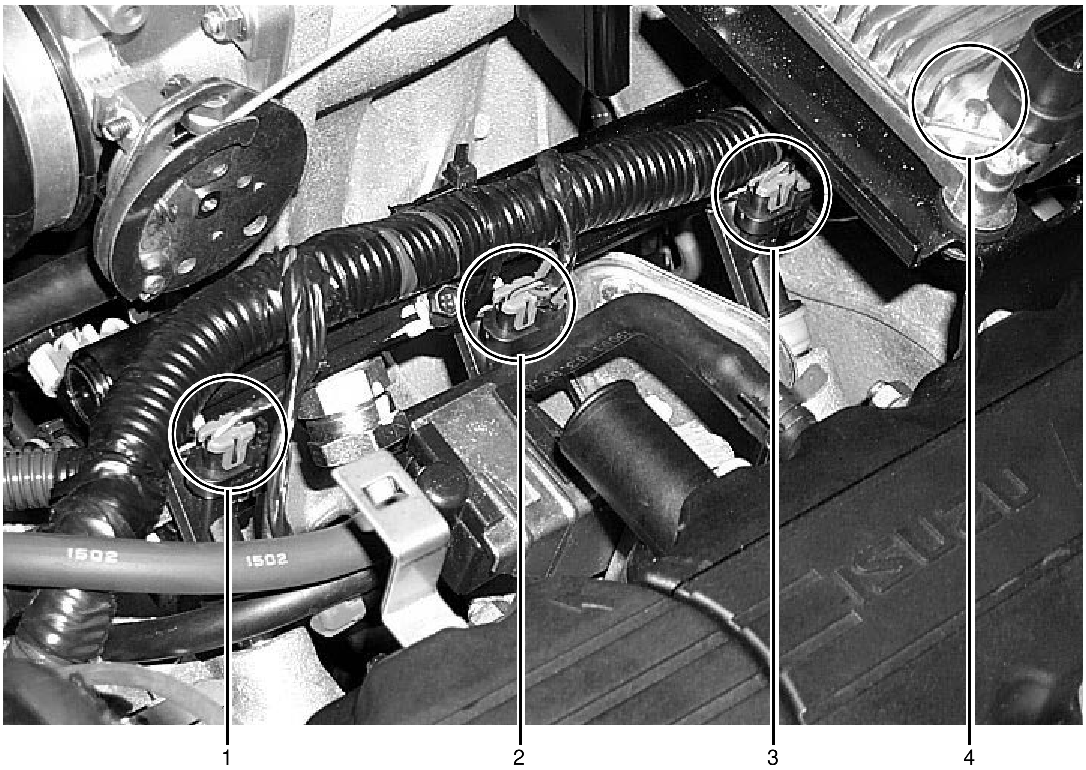
COMPONENT LOCATOR



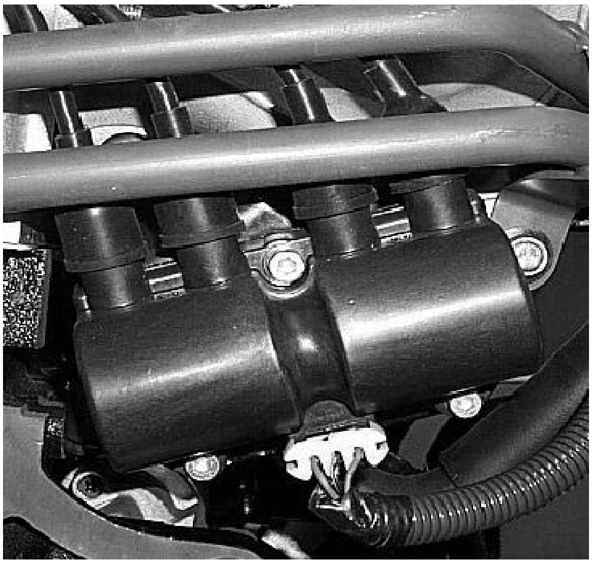
(1) Air Cleaner
(2) Idle Air Control (IAC) Valve
(3) Engine Coolant Temperature (ECT) Sensor
(4) Engine Control Module (ECM)



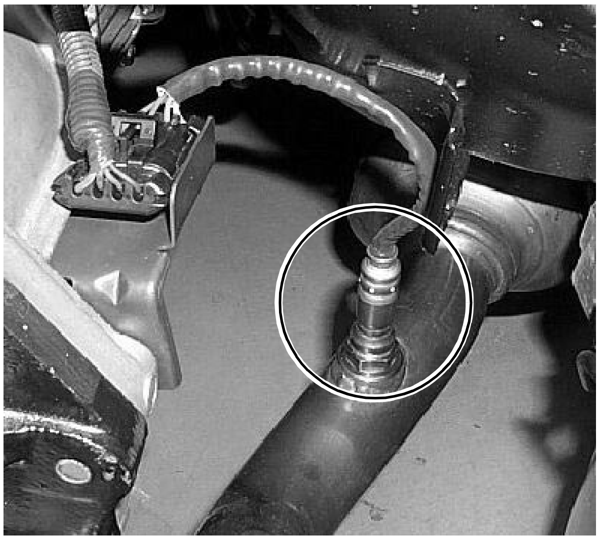
(1) Intake Air Temperature (IAT) Sensor
(2) Idle Air Control (IAC) Valve
(3) Throttle Position Sensor (TPS)



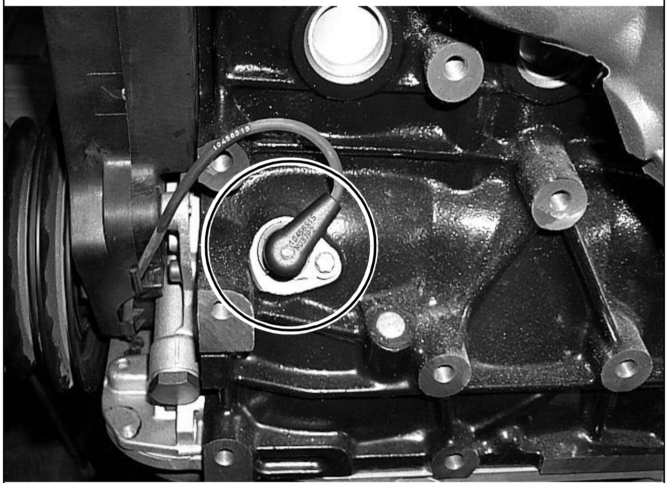
(1) Injector #1 Cylinder
(2) Injector #2 Cylinder
(3) Injector #3 Cylinder
(4) Injector #4 Cylinder (Under the ECM)



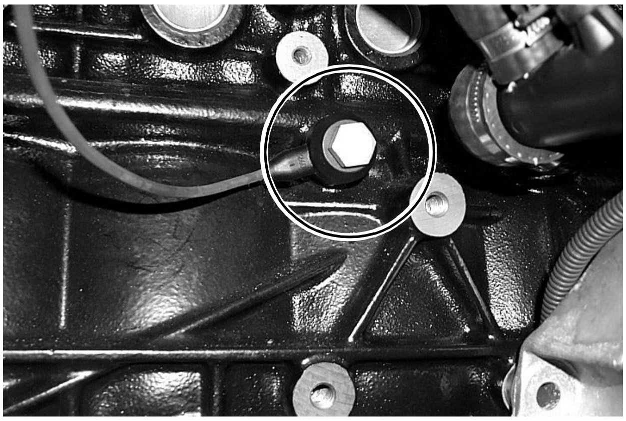
(1) Ignition Coil Module Assembly



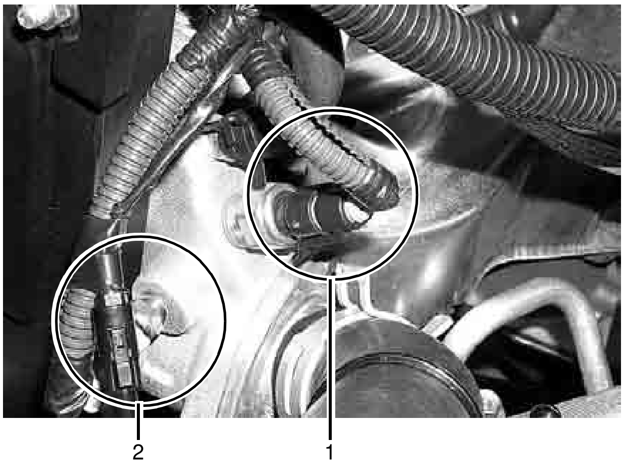
(1) Heated Oxygen Sensor (HO2S)



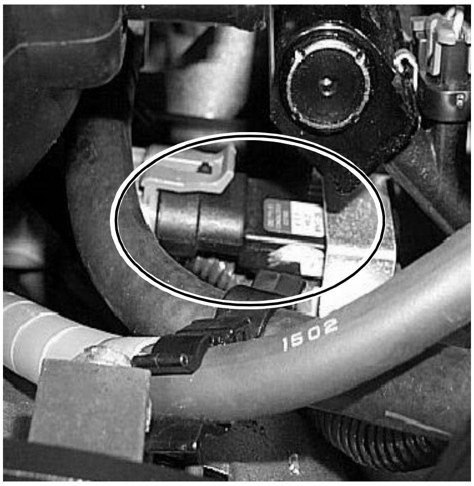
(1) Crankshaft Position (CKP) Sensor



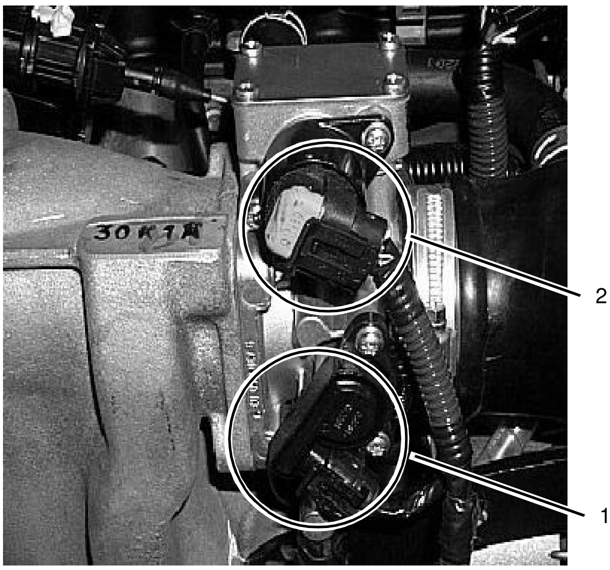
(1) Knock Sensor (KS)



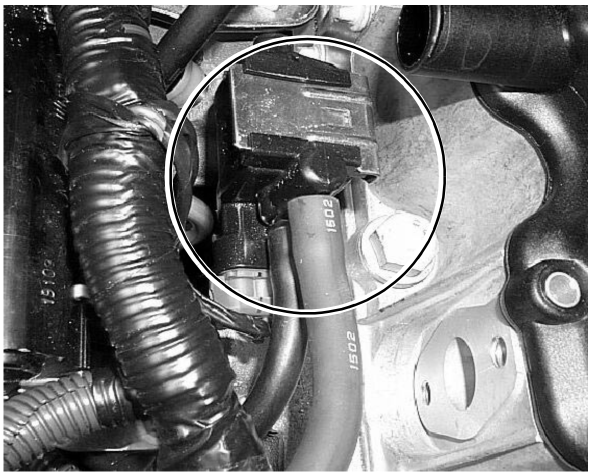
(1) Engine Coolant Temperature (ECT) Sensor
(2) Thermo Meter Sensor



(1) Manifold Absolute Pressure (MAP) Sensor



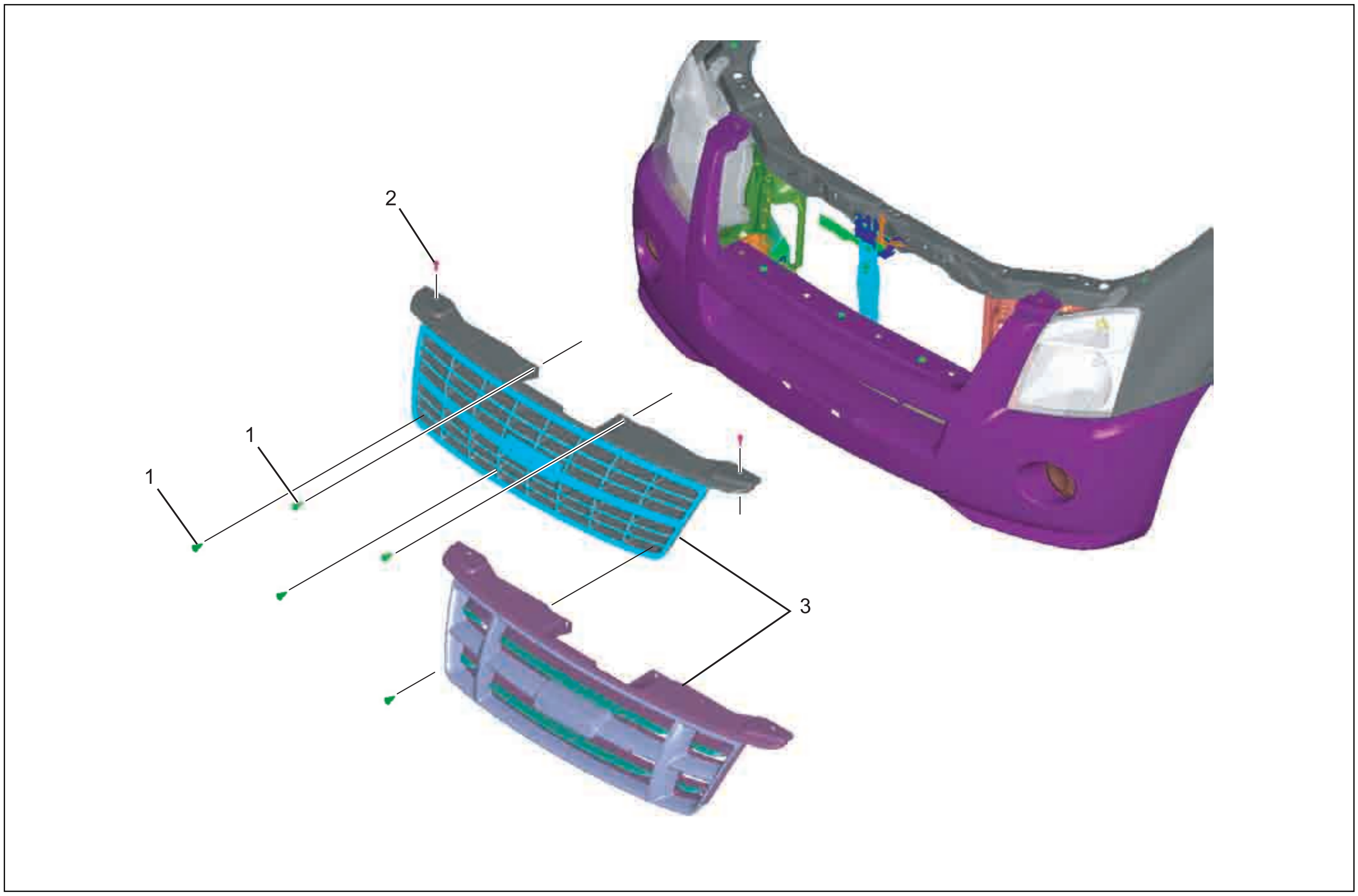
(1) Throttle Position Sensor
(2) Idle Air Control (IAC) Valve



(1) EVAP Purge Solenoid

RADIATOR GRILLE (A TYPE)

REMOVAL AND INSTALLATION



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Removal Steps

1. Screw
▲ 2. Clip
3. Bolt
4. Radiator grille

Installation Steps

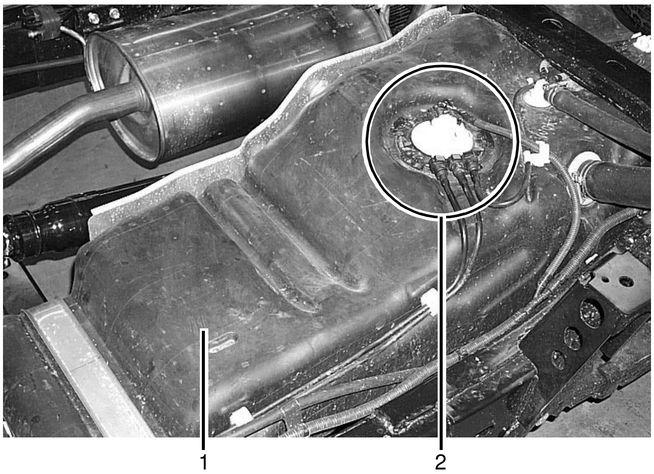
4. Radiator grille
3. Bolt
2. Clip
1. Screw

Important Operation - Removal

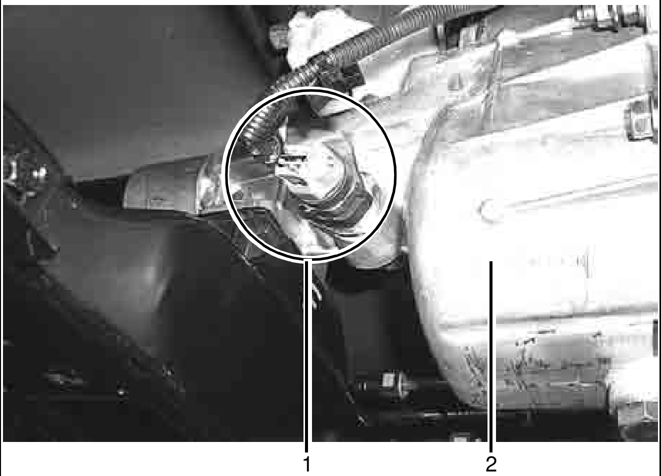
2. Clip

Pull the grille together with the 2 clips from the vehicle.

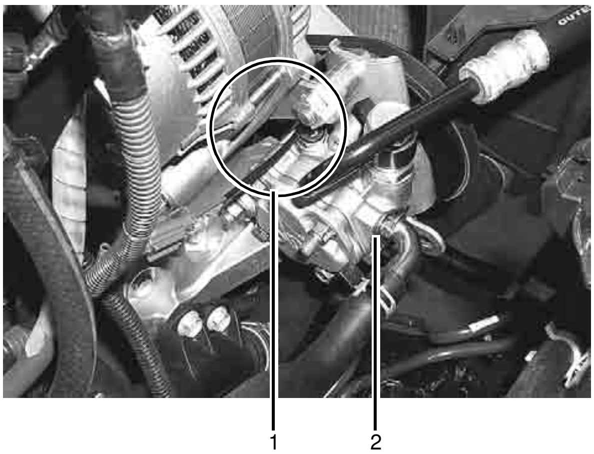
(1) Canister



(1) Fuel Tank
(2) Fuel Pump

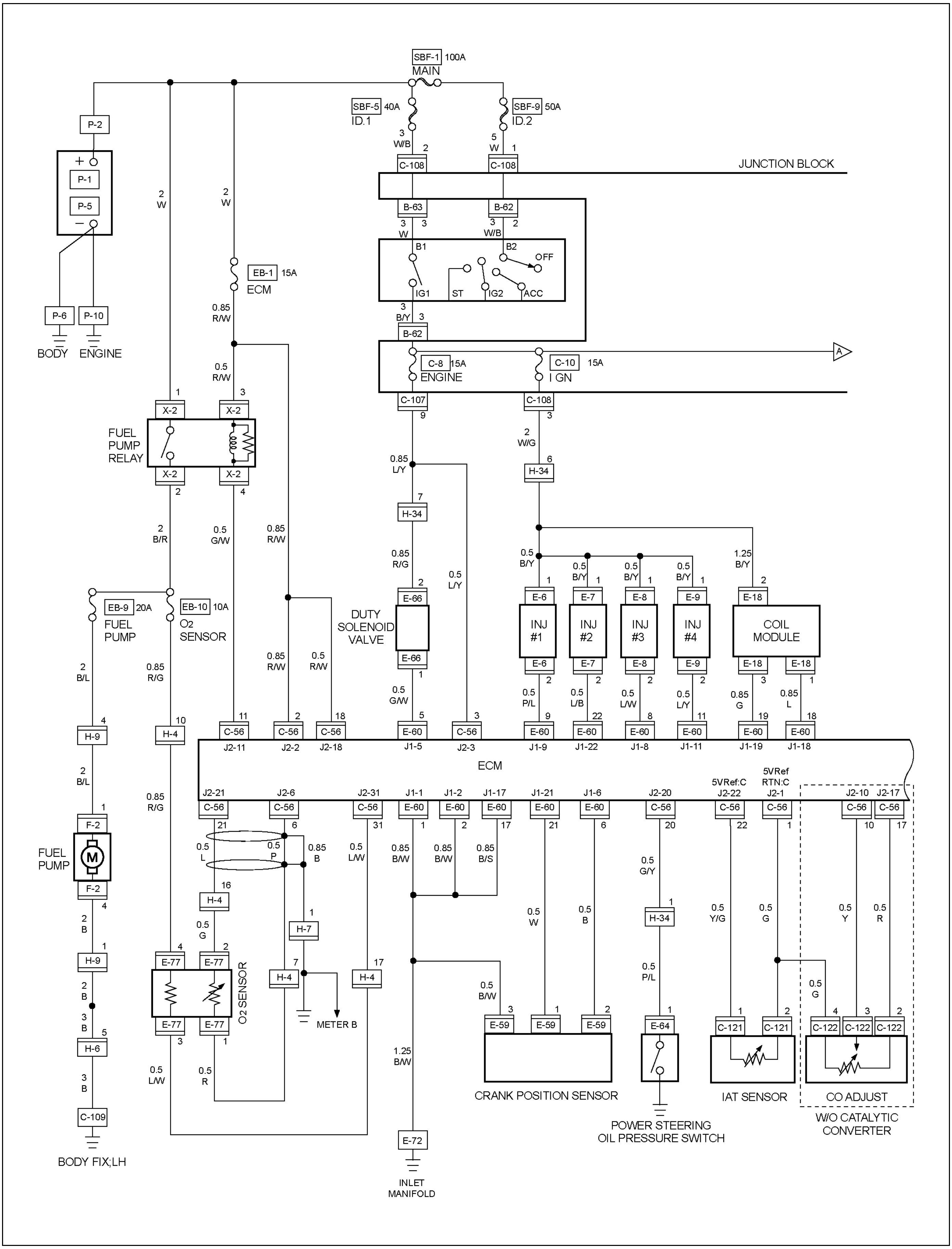


(1) Vehicle Speed Sensor (VSS)
(2) Transmission Assembly

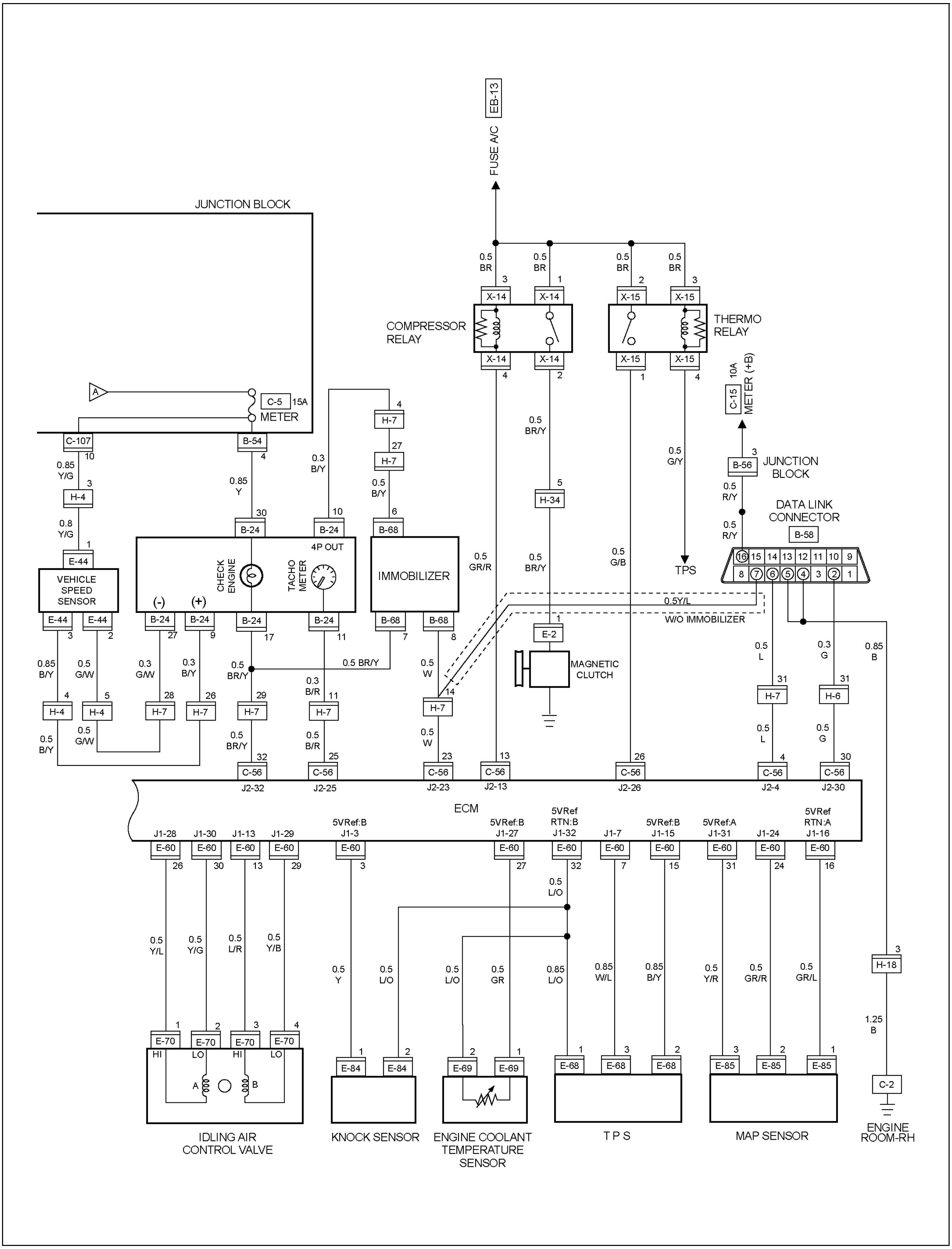


(1) Power Steering Pressure Switch
(2) Power Steering Oil Pump Assembly

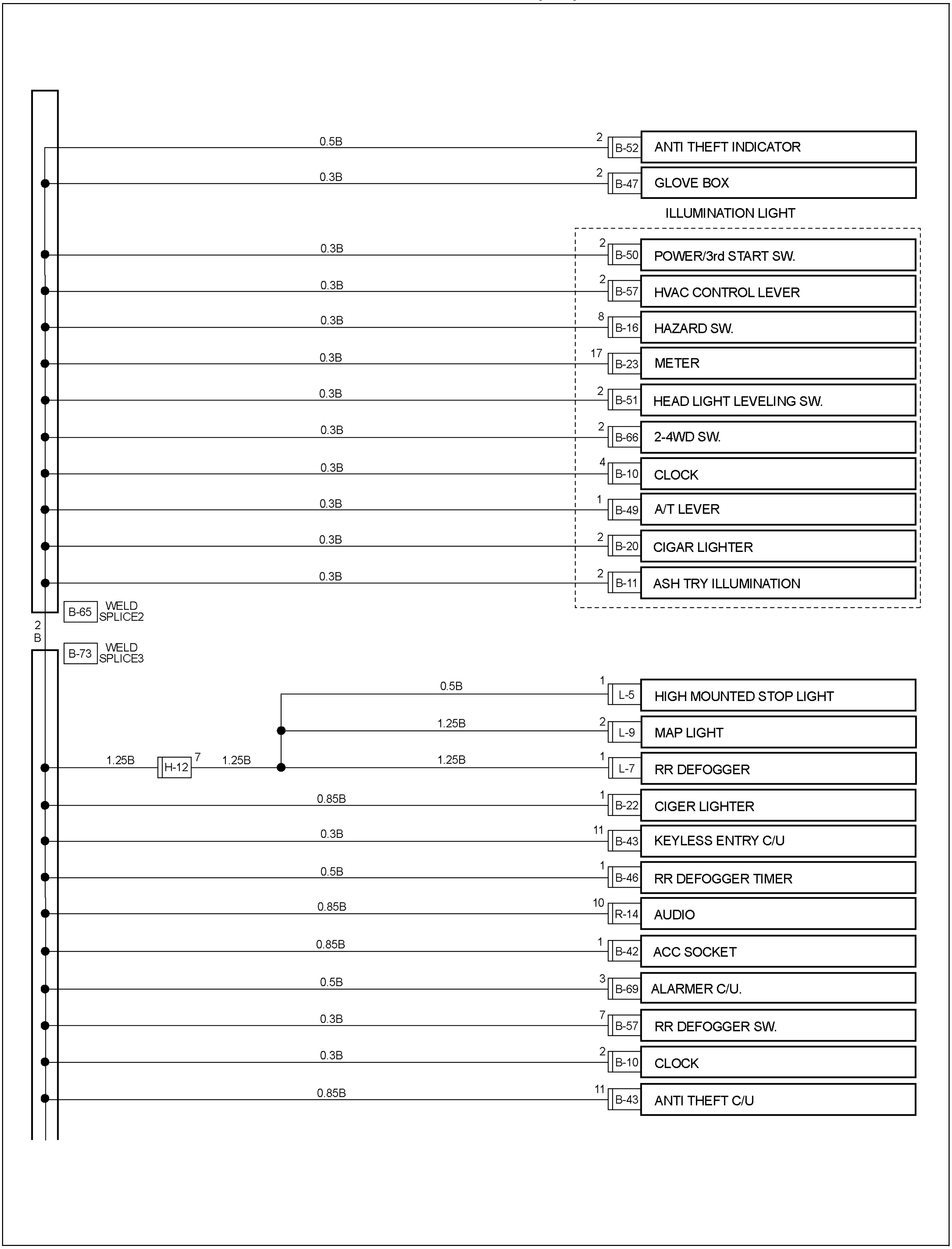
ECM Circuit Diagram (1/2)



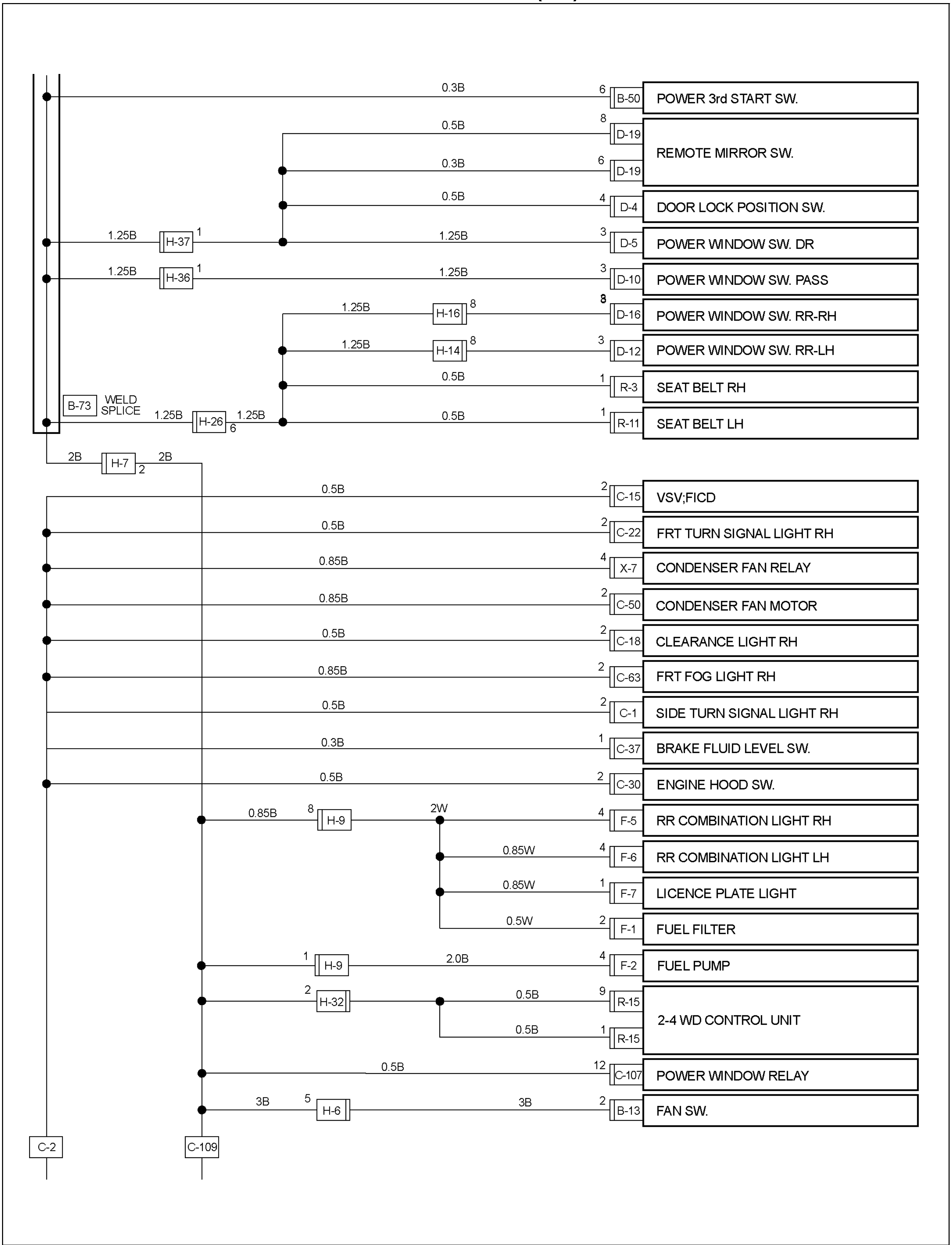
ECM Circuit Diagram (2/2)



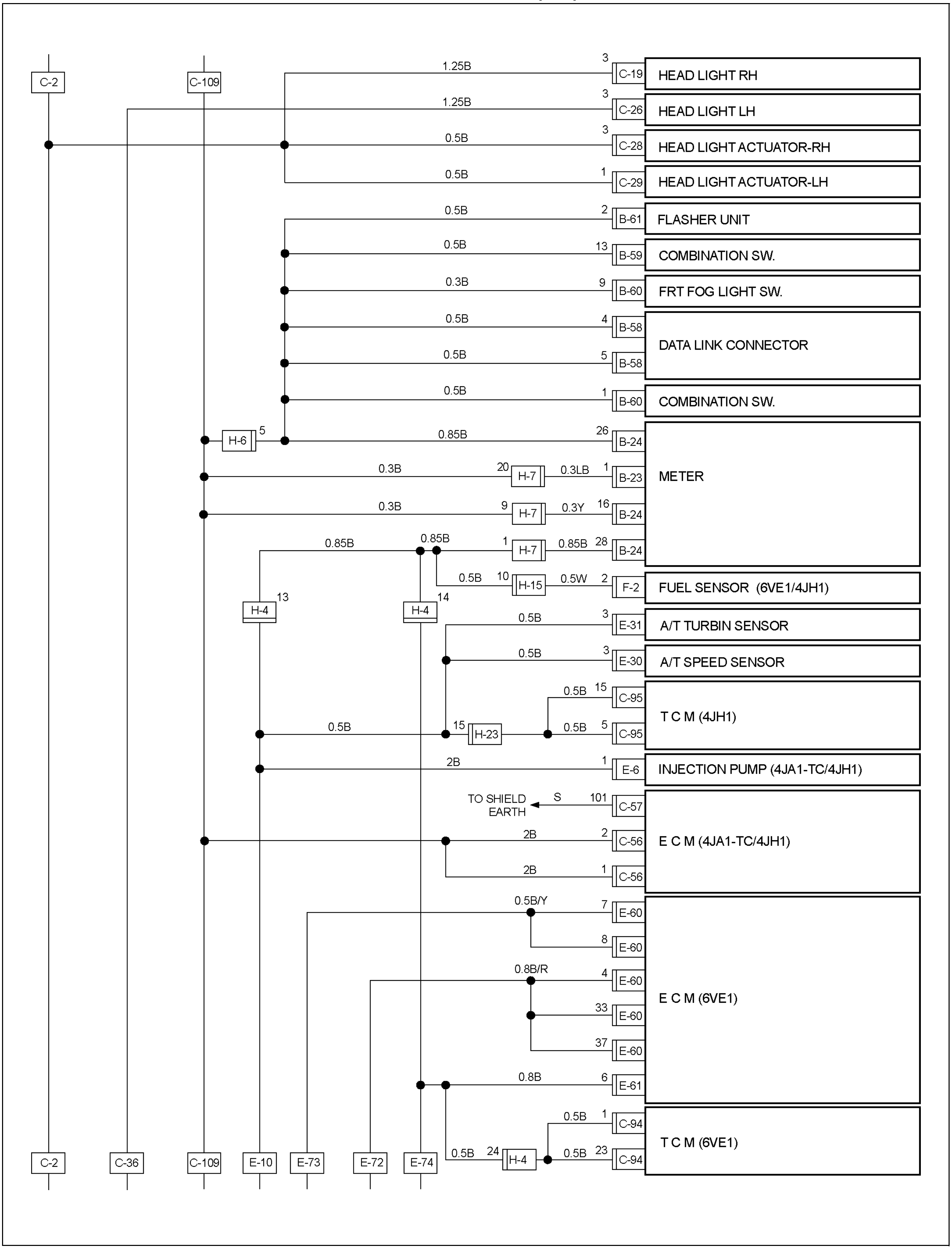
GROUND POINT CHART - LHD GENERAL EXPORT (1/4)



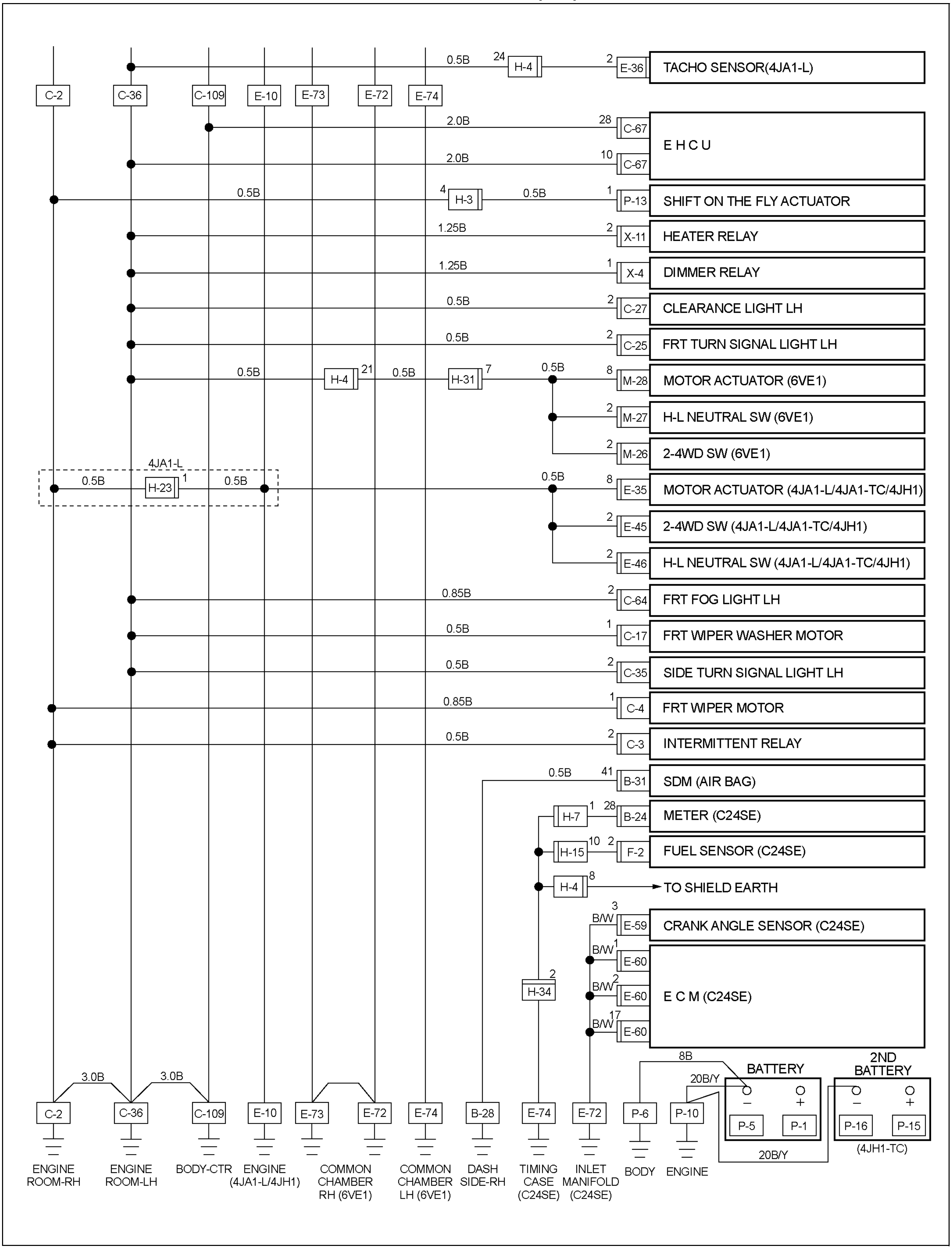
GROUND POINT CHART - LHD GENERAL EXPORT (2/4)



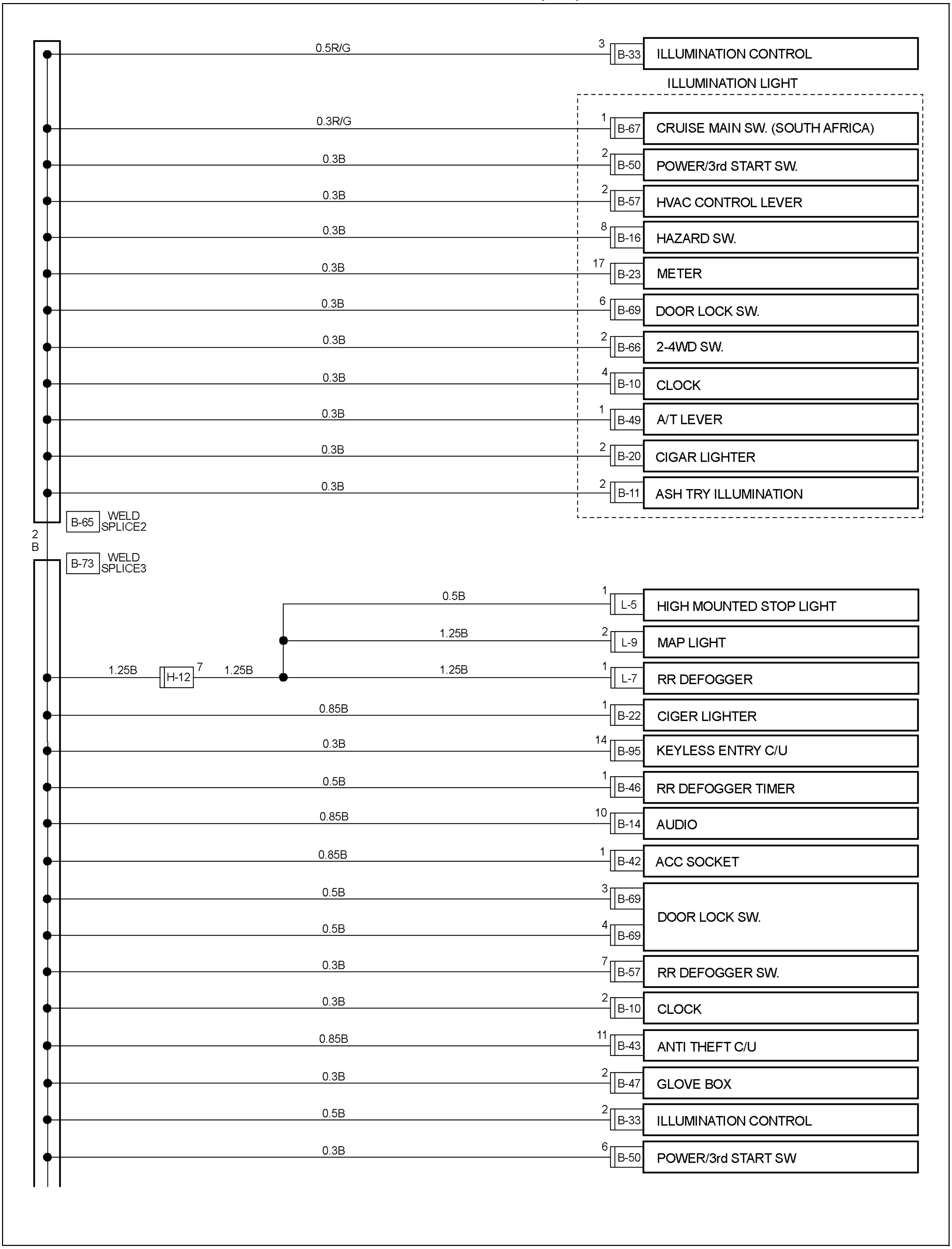
GROUND POINT CHART - LHD GENERAL EXPORT (3/4)



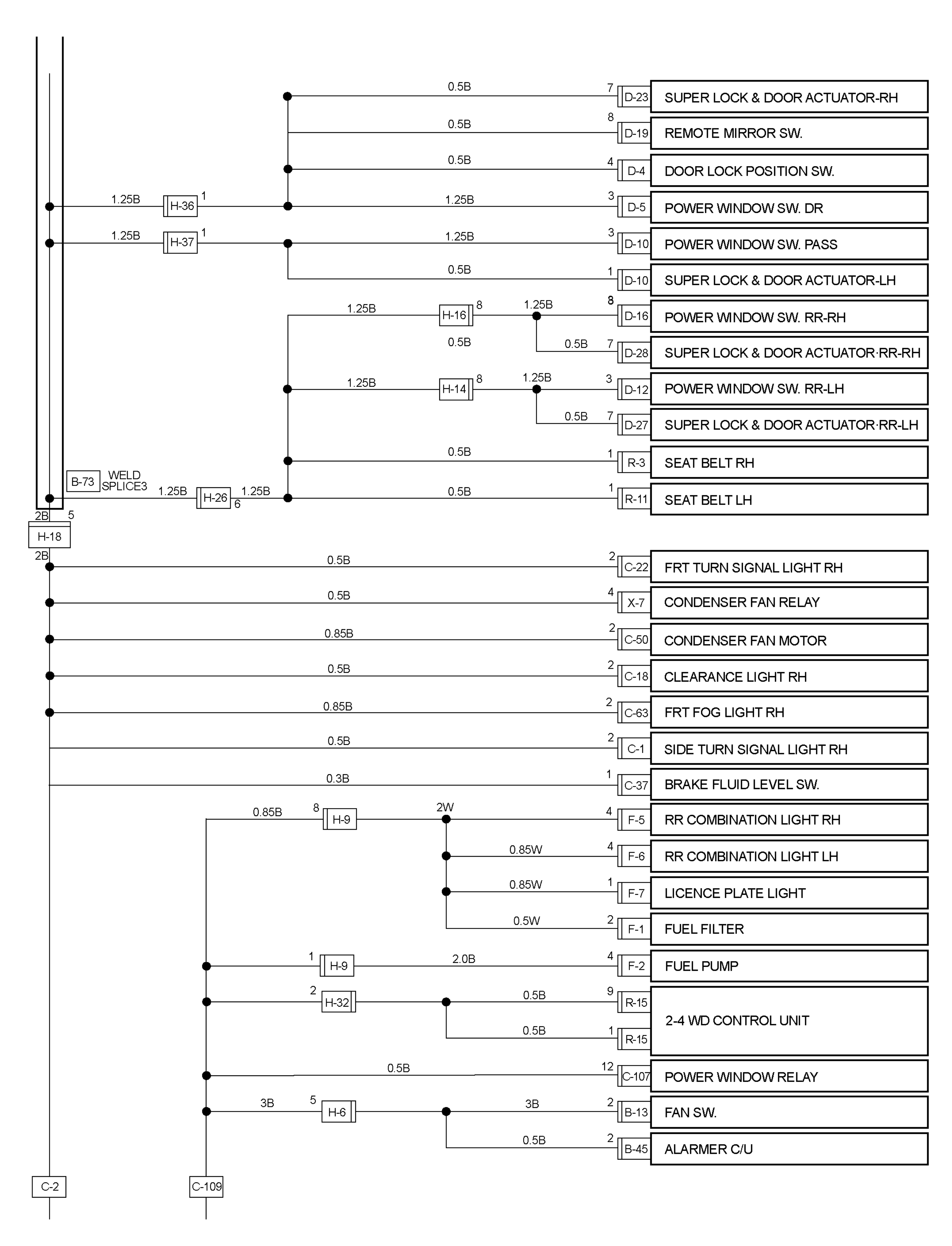
GROUND POINT CHART - LHD GENERAL EXPORT (4/4)



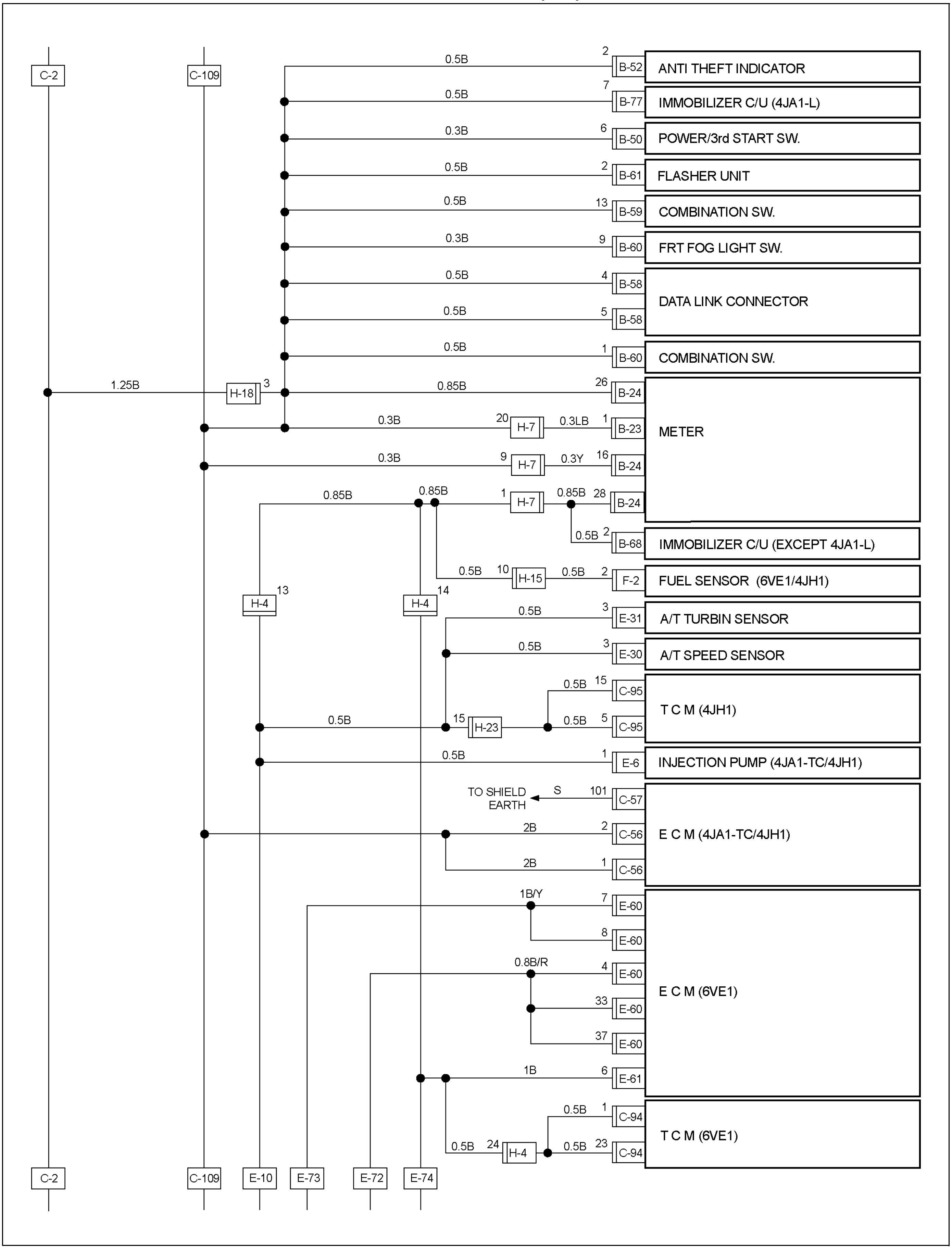
GROUND POINT CHART - RHD GENERAL EXPORT (1/4)



GROUND POINT CHART - RHD GENERAL EXPORT (2/4)

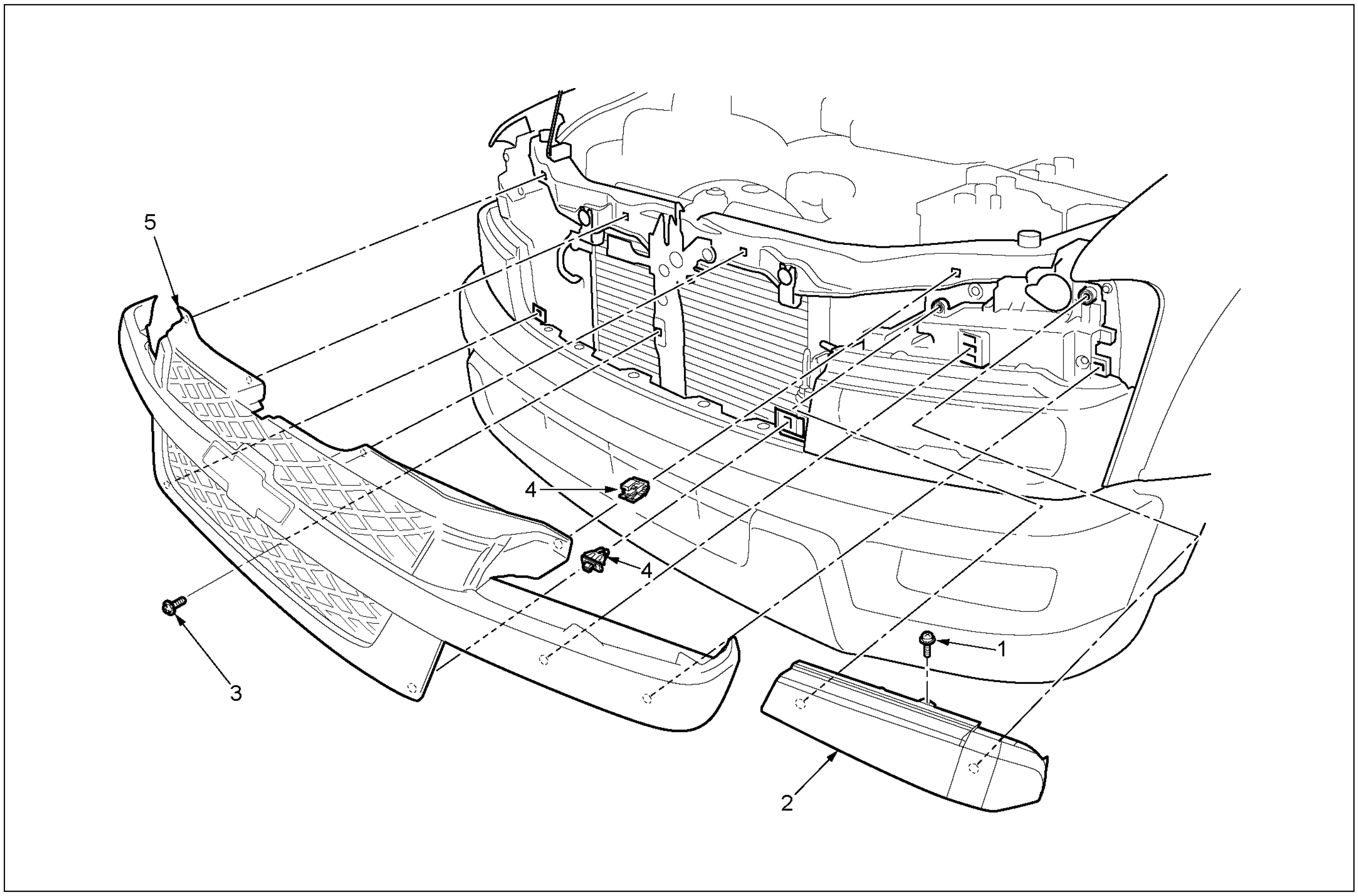


GROUND POINT CHART - RHD GENERAL EXPORT (3/4)



RADIATOR GRILLE (B TYPE)

REMOVAL AND INSTALLATION



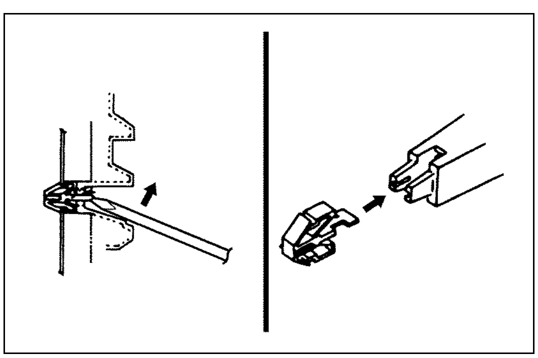
RTW52BMF000201

Removal Steps

1. Screw
2. Front combi lamp assembly
3. Screw
4. ▲ Clip
5. Radiator grille

Installation Steps

5. Radiator grille
4. Clip
3. Screw
2. Front combi lamp assembly
1. Screw

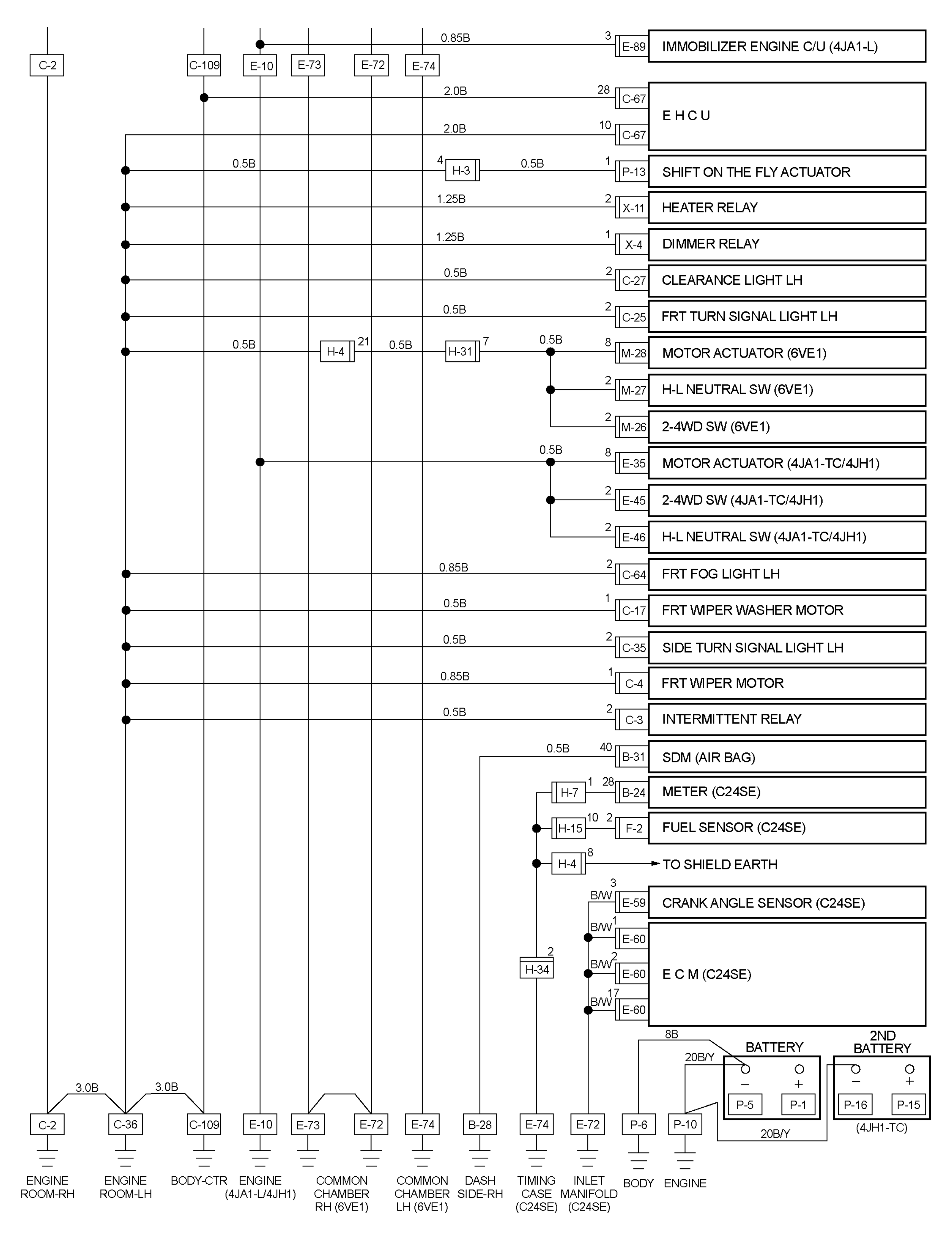


Important Operation - Removal

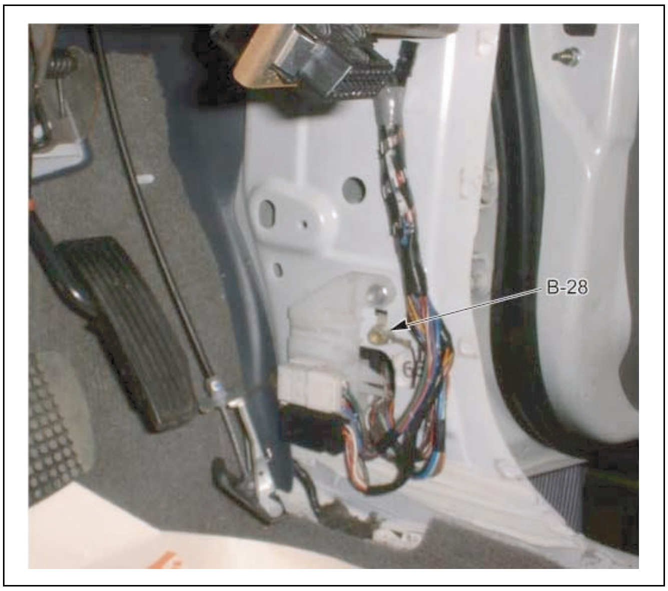
4. Clip

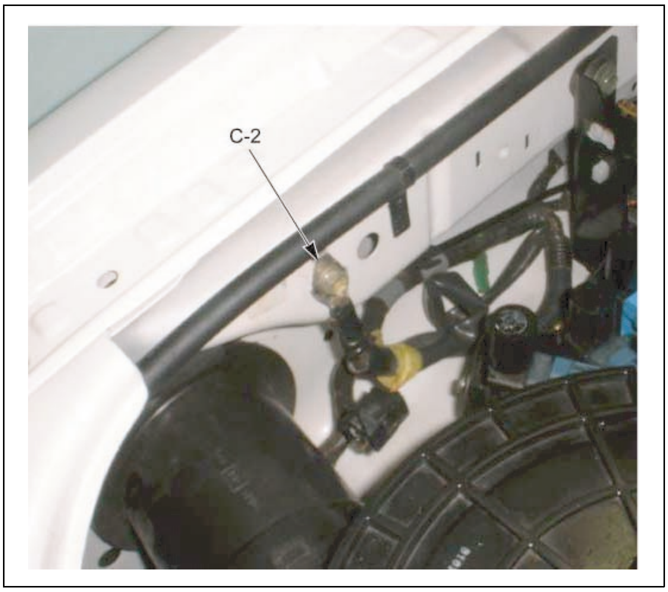
- Use a screwdriver to release the 4 clips at the top of the radiator grille.
- Pull the grille together with the 2 bottom clips from the vehicle.

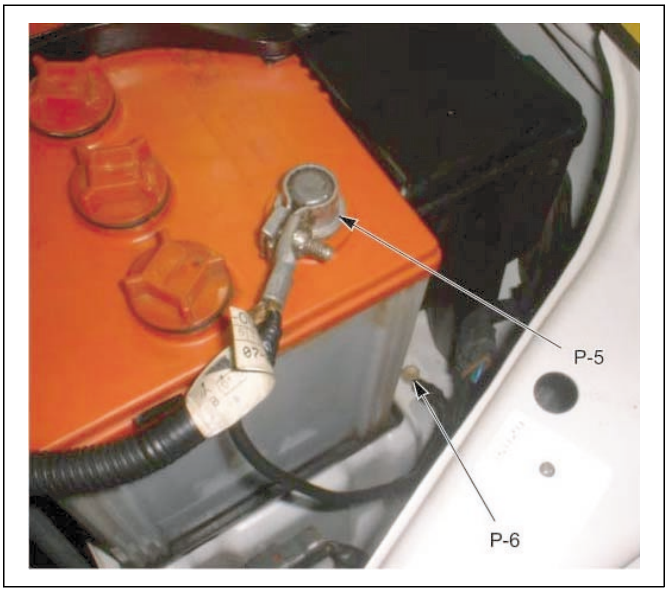
GROUND POINT CHART - RHD GENERAL EXPORT (4/4)

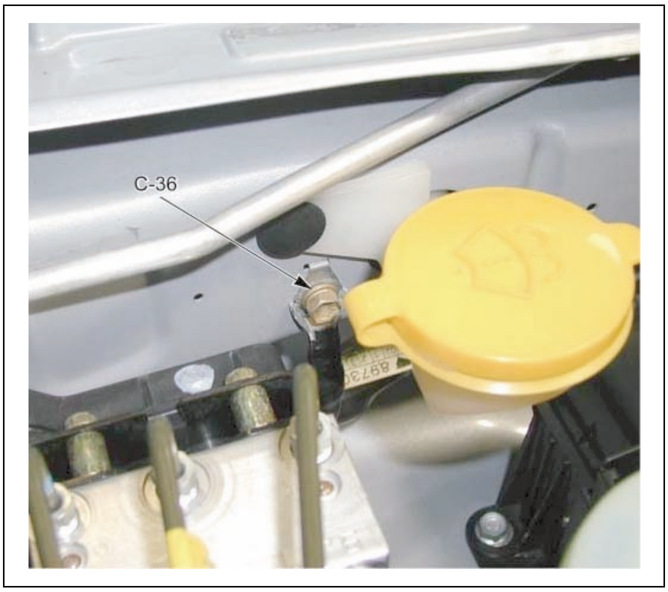


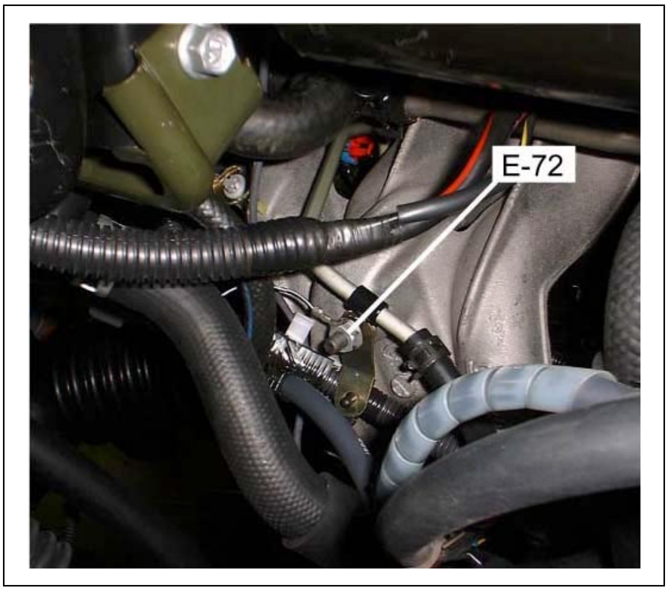
LOCATION



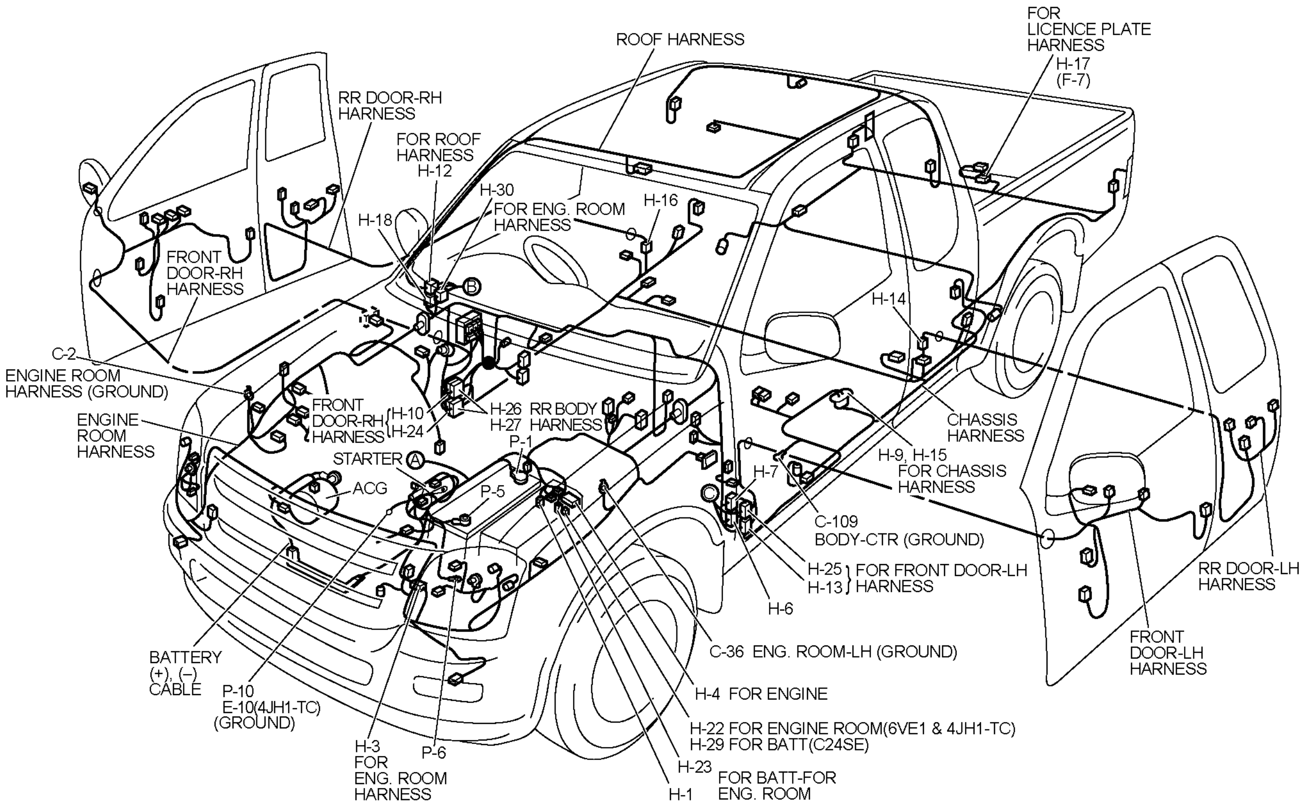




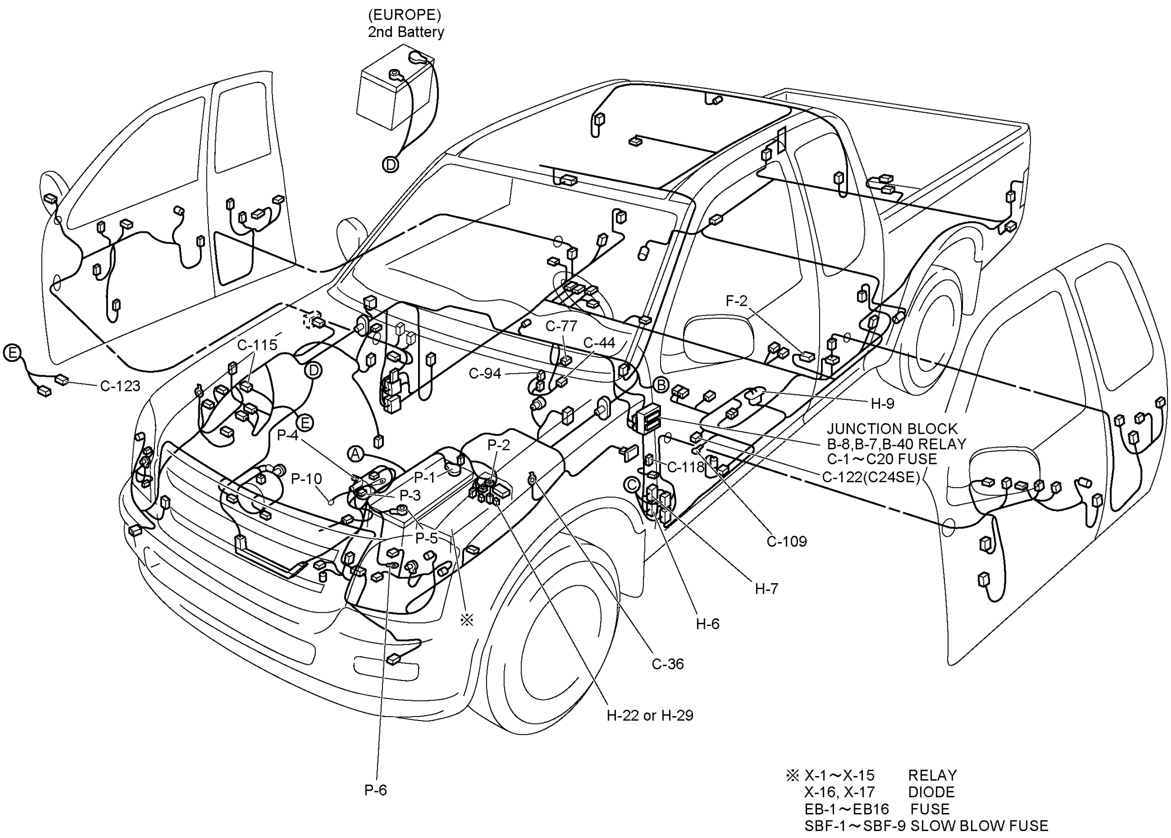


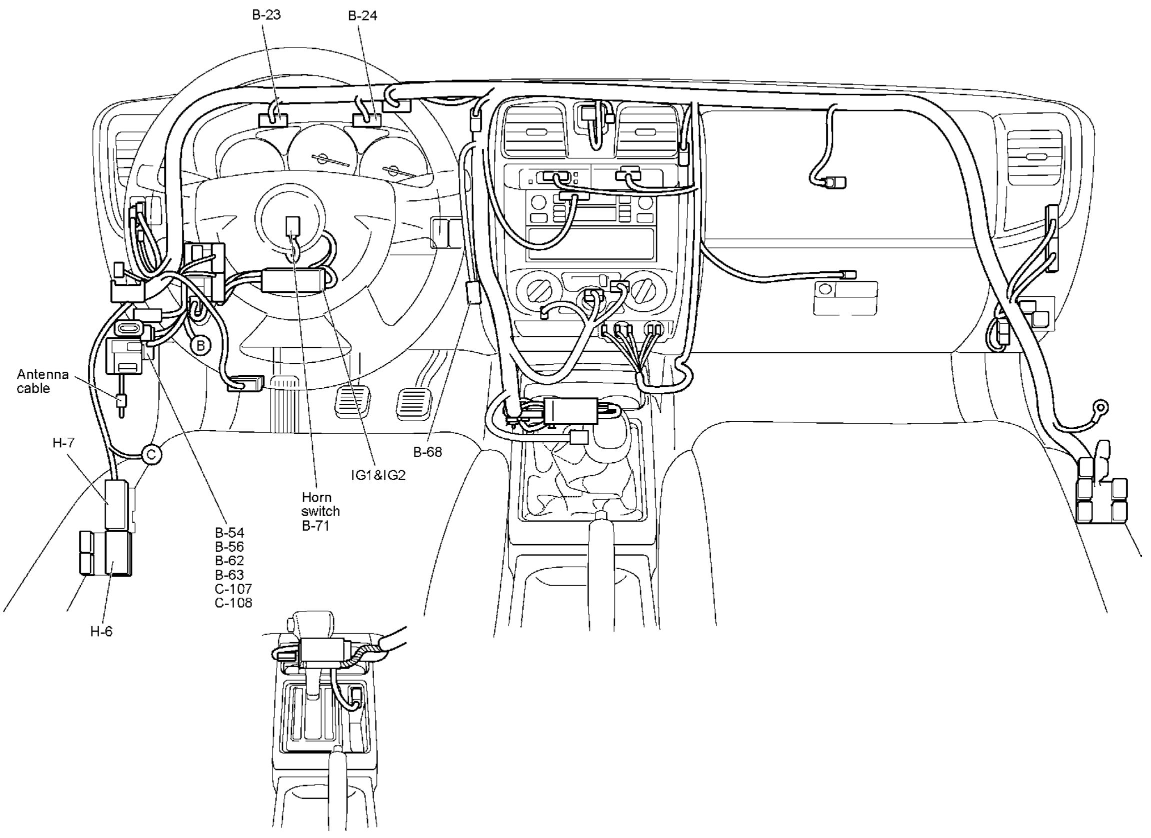

E-72

CABLE HARNESS & CONNECTOR LOCATION

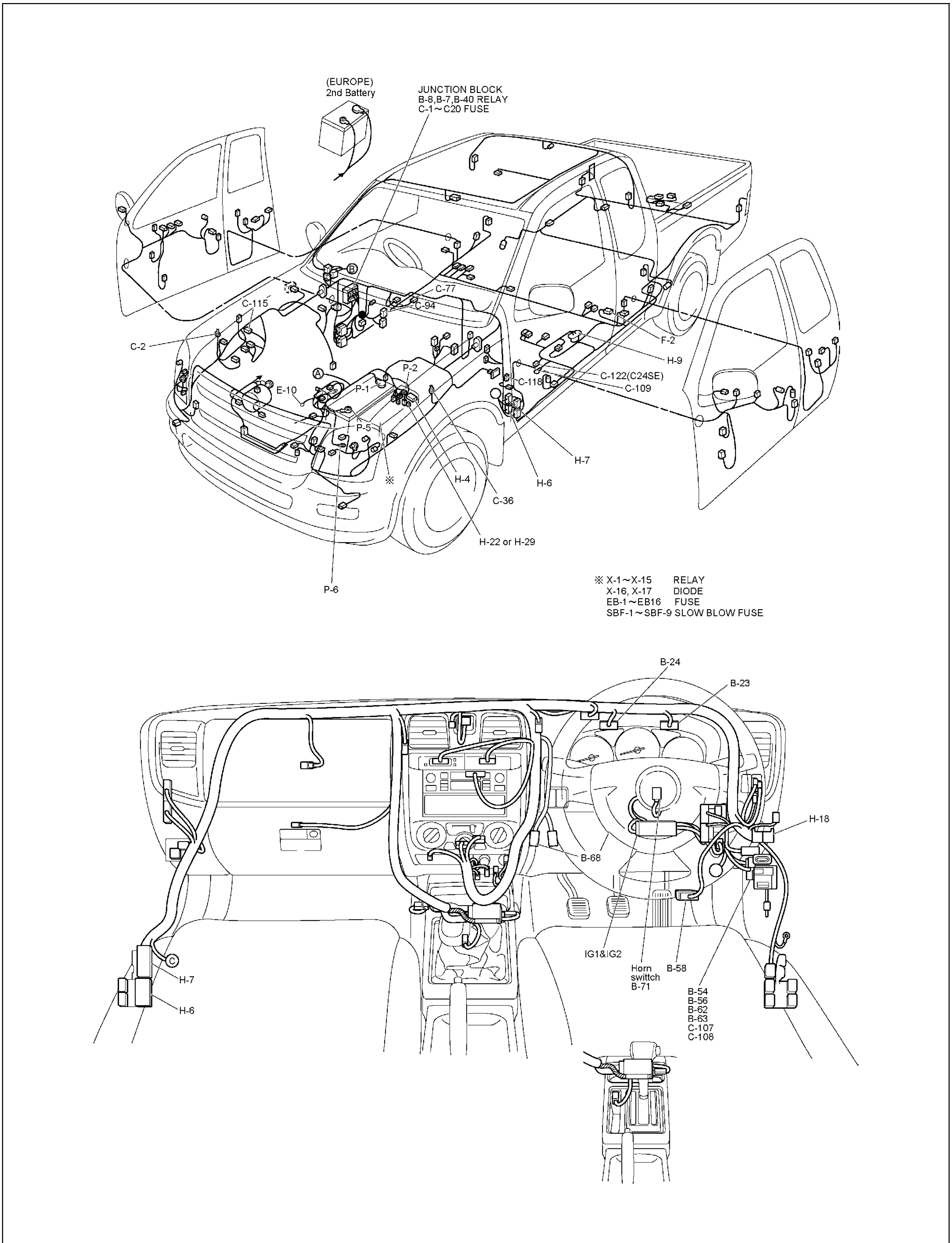


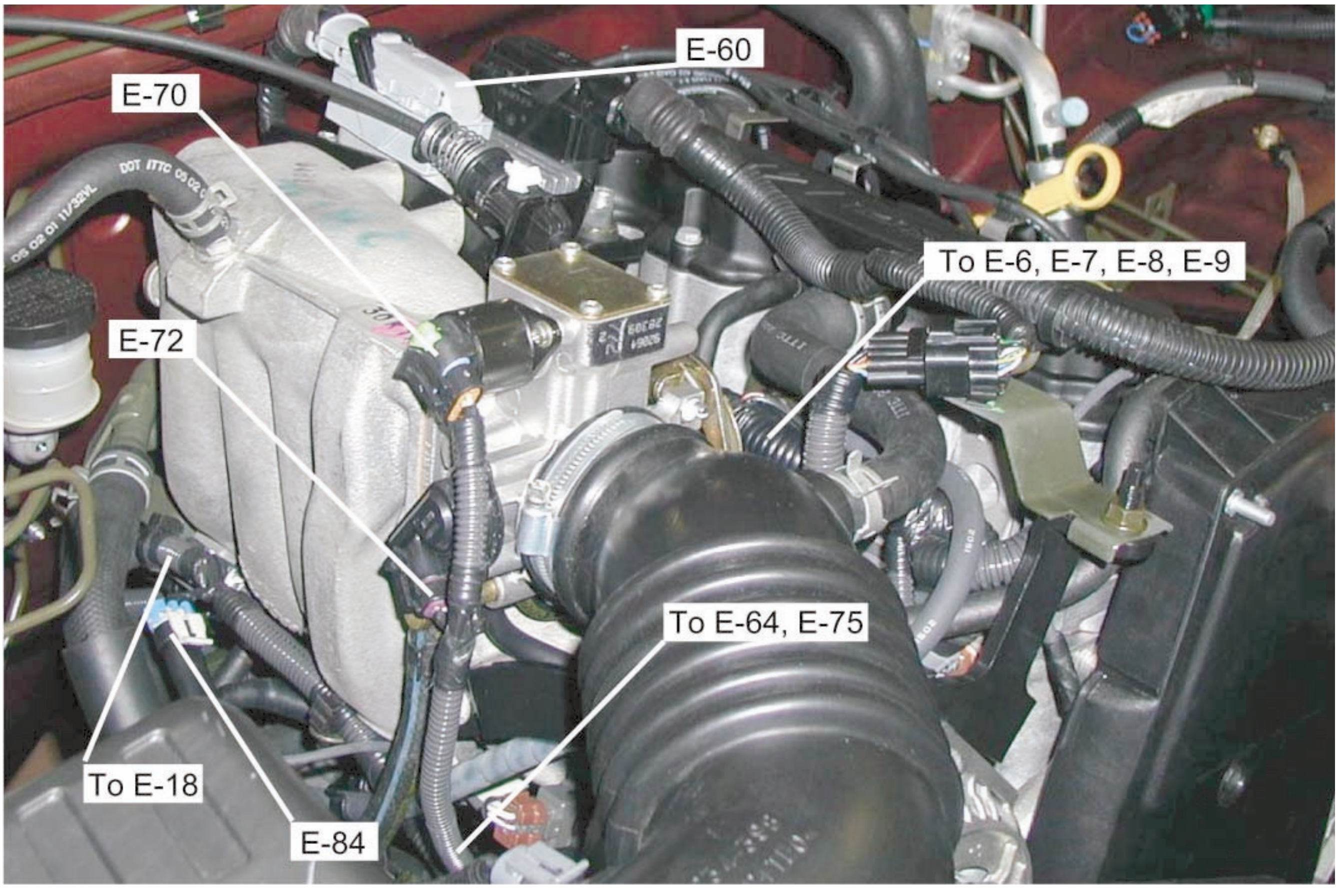
CABLE HARNESS & CONNECTOR LOCATION – LHD

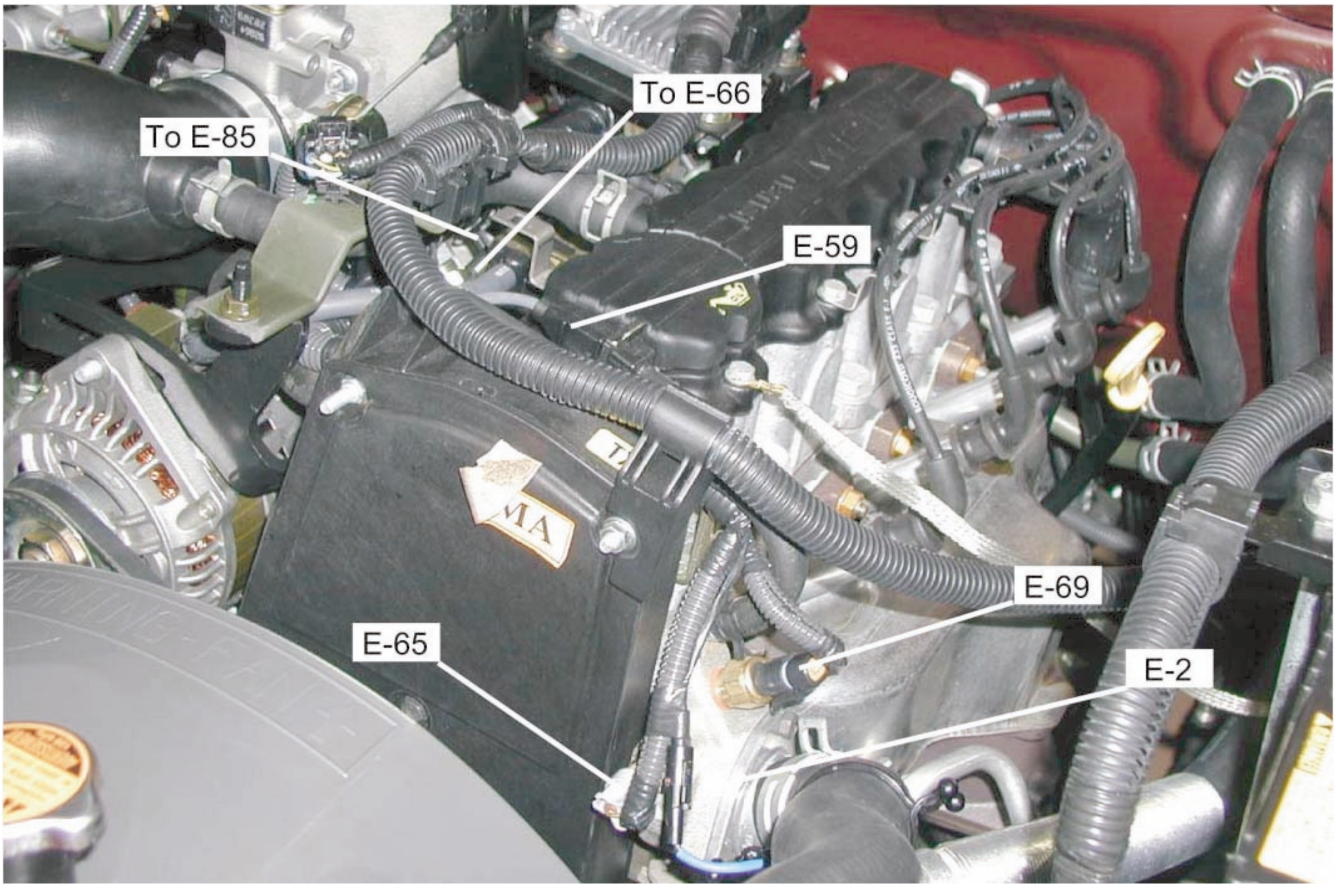




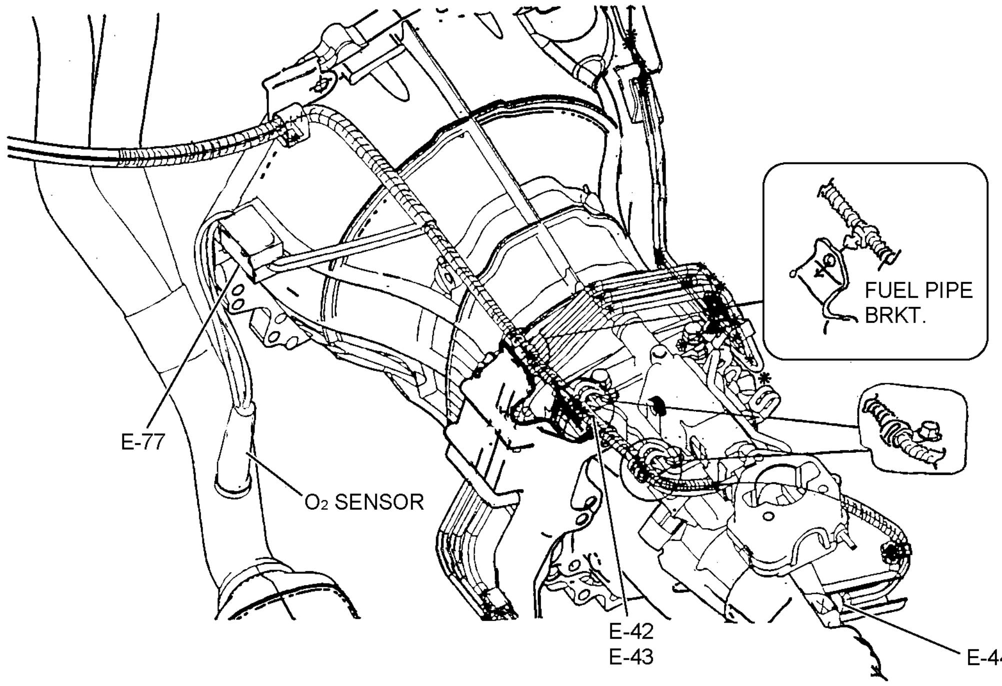
CABLE HARNESS & CONNECTOR LOCATION – RHD



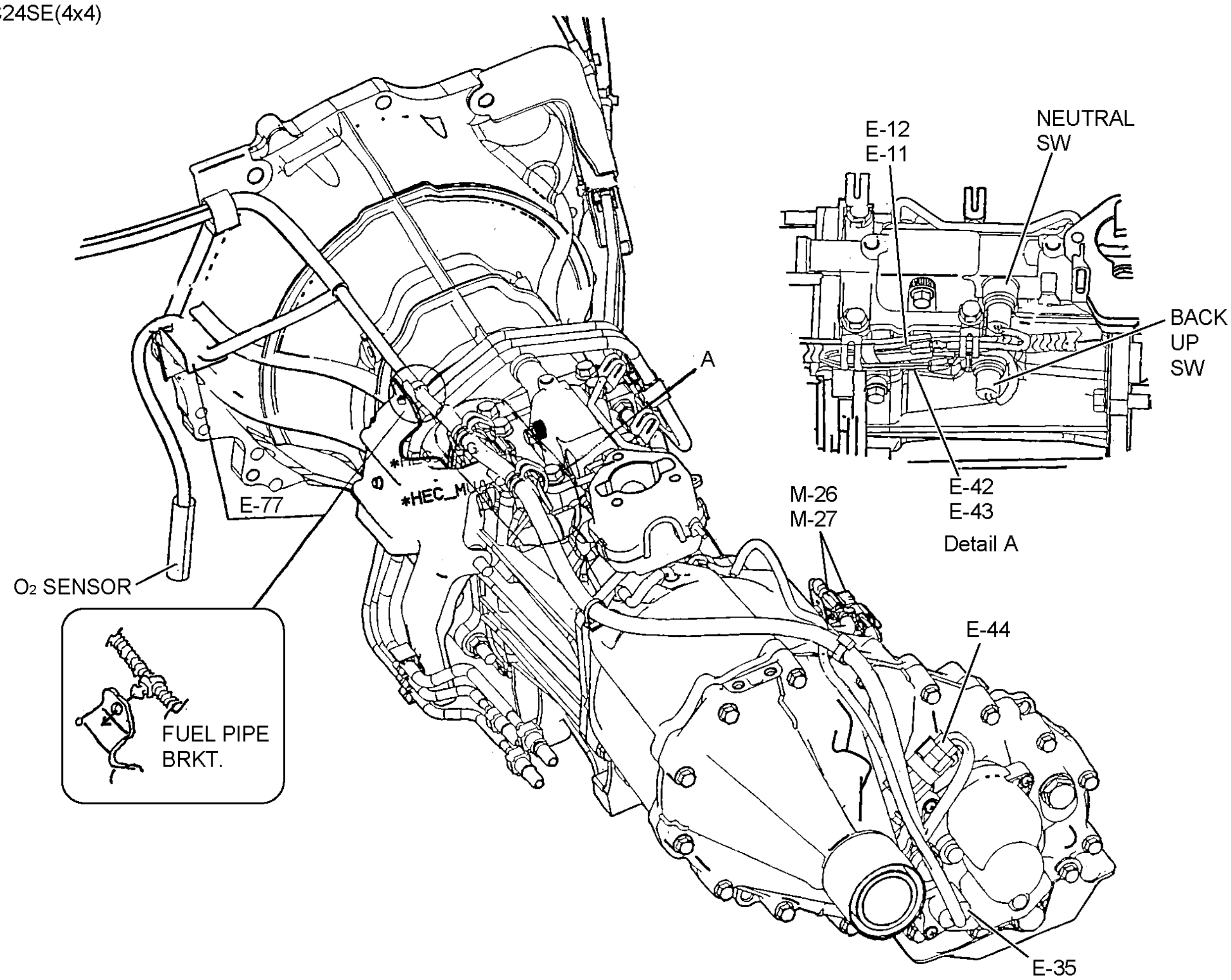

E-60
E-70
To E-6, E-7, E-8, E-9
E-72
To E-64, E-75
To E-18
E-84


To E-66
To E-85
E-59
E-69
E-65
E-2

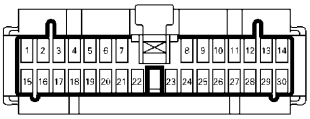
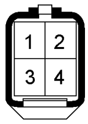
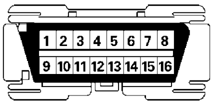
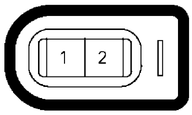
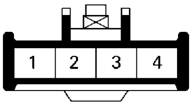
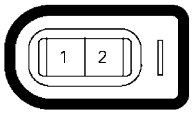
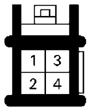
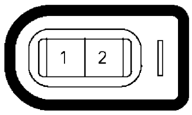
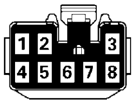
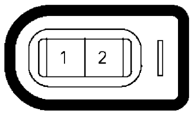
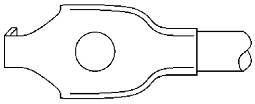
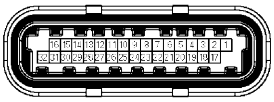
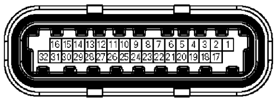
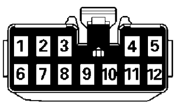
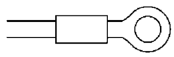
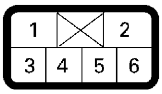
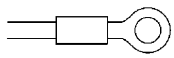
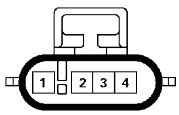
C24SE(4x2)

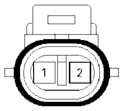
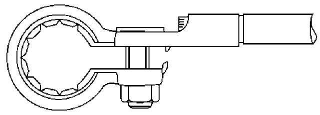
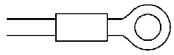
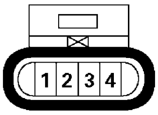
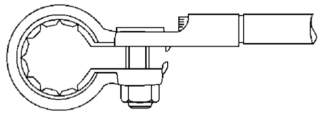
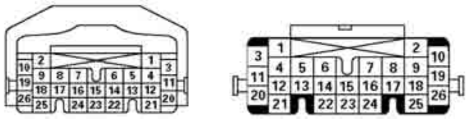
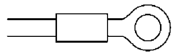
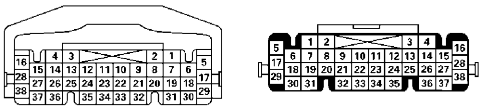
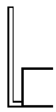
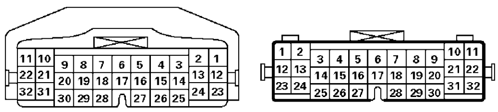
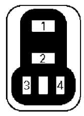
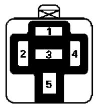
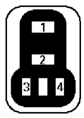


C24SE(4x4)



CONNECTOR LIST

No.	Connector face	No.	Connector face
B-24 Green	 Meter-B	C-122	 CO Adjuster
B-58 Black	 Check connector	E-6	 Fuel injector
B-62 White	 Ignition switch (IGSUB : G1)	E-7	 Fuel injector
B-63 White	 Ignition switch (IGSUB : G2)	E-8	 Fuel injector
B-68	 Immobilizer	E-9	 Fuel injector
C-2 Silver	 Engine room-RH ground	E-18	 Ignition coil
C-56	 ECM	E-60	 ECM
C-107 White	 J/B E2	E-72	 Engine earth-A
C-108 White	 J/B E1	E-74	 Engine earth-B
C-121	 IAT sensor	E-77	 O_2 sensor

No.	Connector face	No.	Connector face
E-84	 Knock sensor	P-1 Silver	 Battery (+)
E-85	 MAP sensor	P-2 Silver	 Relay & Fuse box
F-2 White	 Fuel pump & sensor	P-5 Silver	 Battery (-)
H-4 White	 Engine room ~ Mission	P-6 Silver	 Body earth (Ground)
H-6 White	 Engine room ~ INST	P-10 Silver	 Engine ground
H-7 White	 Engine room ~ INST	X-2 Black	 Relay; Fuel pump
H-9 Blue	 Engine room ~ Chassis	X-11 Black	 Relay; Heater
H-18 White	 Engine room ~ INST	X-14 Black	 Relay; A/C Compressor
H-31	 Engine room ~ Mission		
H-34	 Engine ~ Engine room		

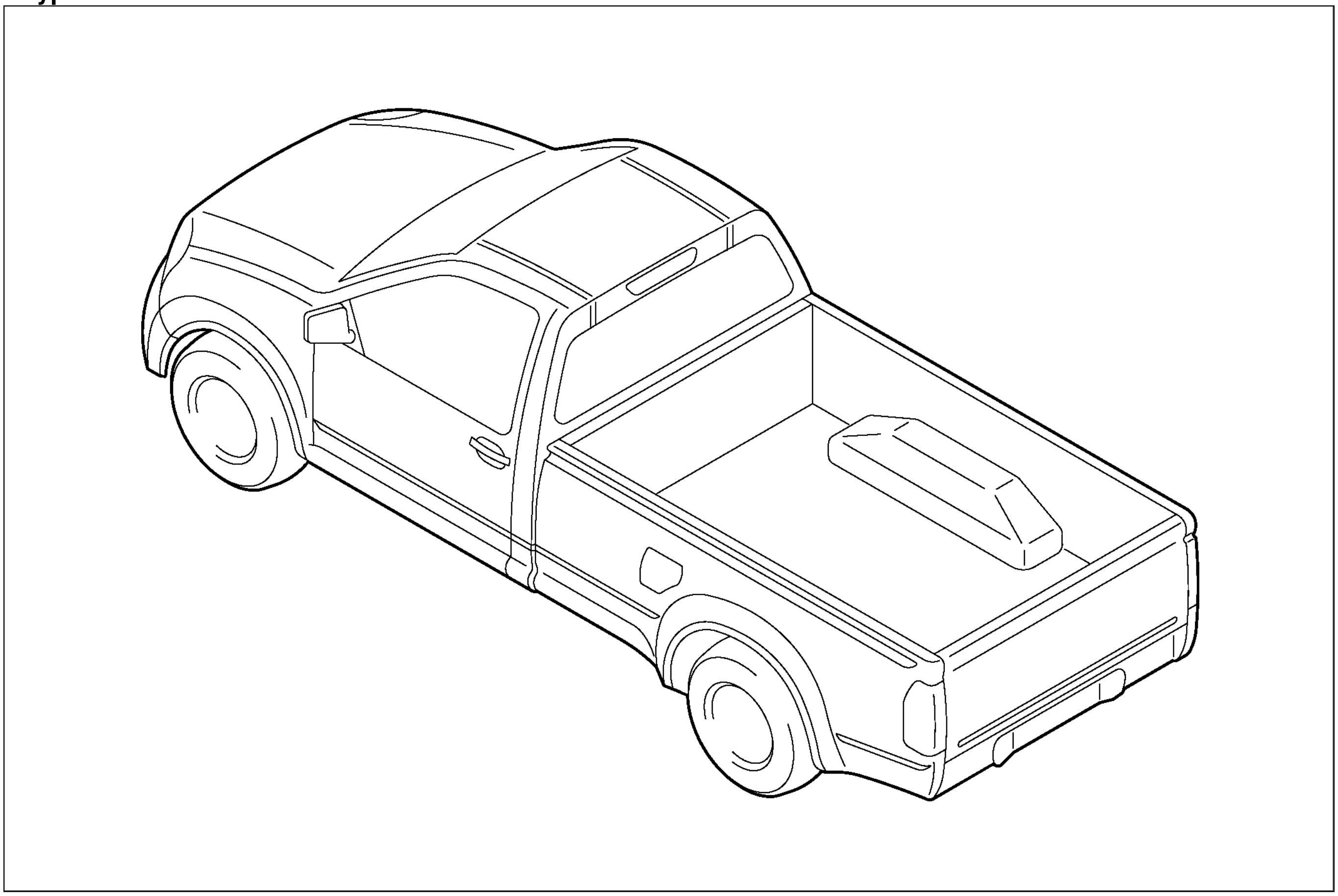
I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: (Use odometer reading or months whichever comes first)		5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	× 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
	× 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
	or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
PARKING BRAKE																					
Parking brake function		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Parking brake lever travel		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Cables for looseness or damage and guide for damage		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ratchet for wear or damage		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
SUSPENSION																					
Leaf / Coil / Torsion bar springs for damage		I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Mount for looseness or damage		I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorbers for oil leakage		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorber mount for looseness		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Rubber bushes of suspension for wear or damage		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Spring action for loss of balance due to weakening		-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Joint ball rubber boot for damage		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
WHEELS																					
Wheel nuts		T	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T
Wheel disc for damage		I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Front hub bearing grease		-	-	-	-	-	R	-	-	-	-	-	R	-	-	-	-	-	R	-	-
Front and rear hub bearing for looseness		-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire pressure and damage		I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire rotation		(Rotate as required)																			
OTHERS																					
Bolts and nuts on chassis and body		I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Lube front free – wheeling hubs		-	-	-	-	-	L	-	-	-	-	-	L	-	-	-	-	-	L	-	-

REAR BODY

REMOVAL AND INSTALLATION

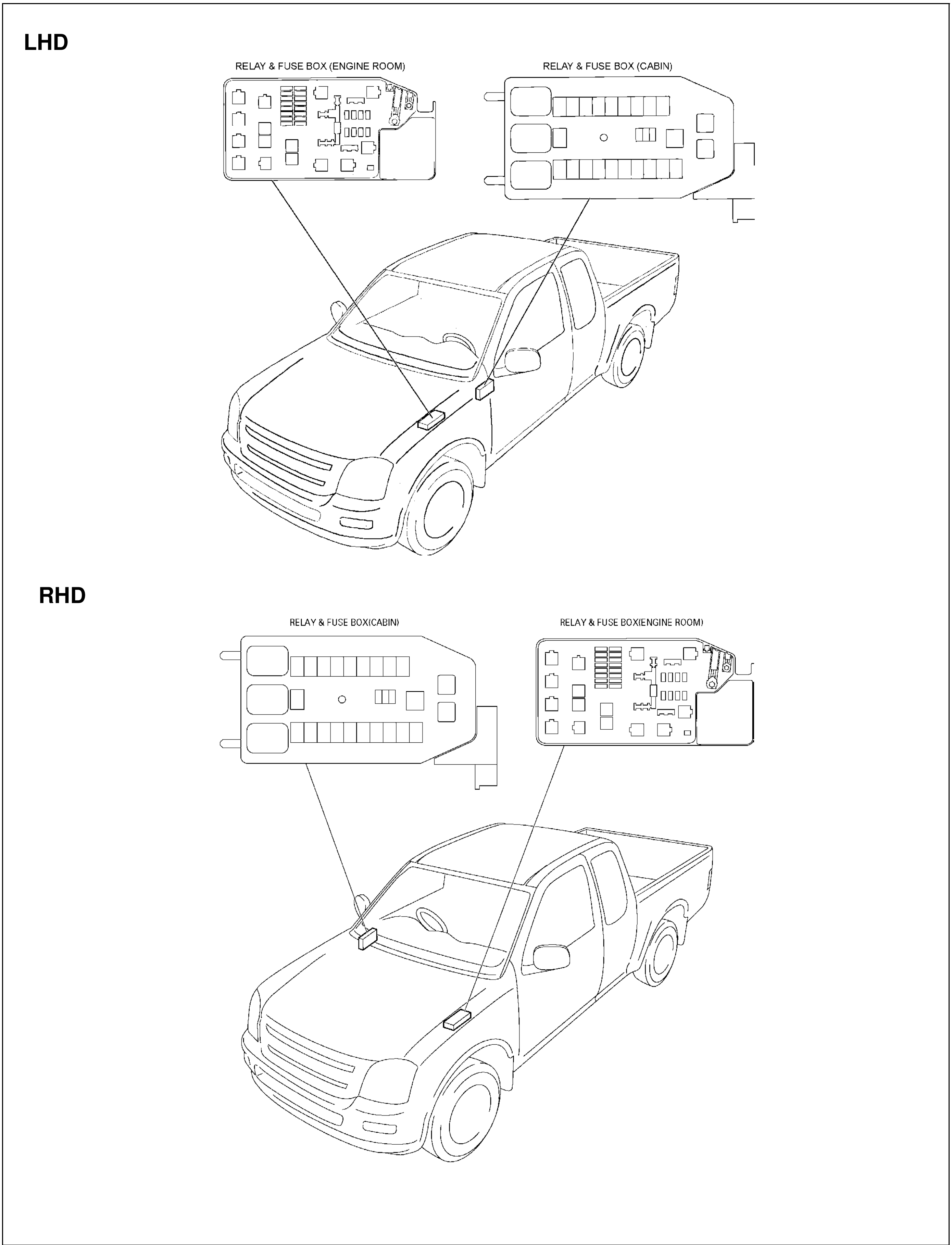
A type



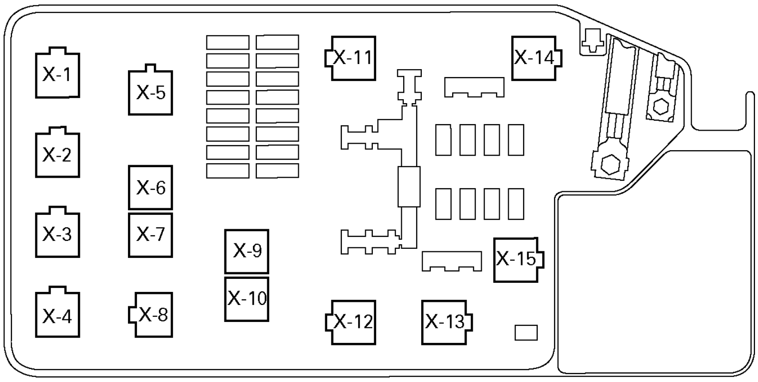
RTW32MF000301

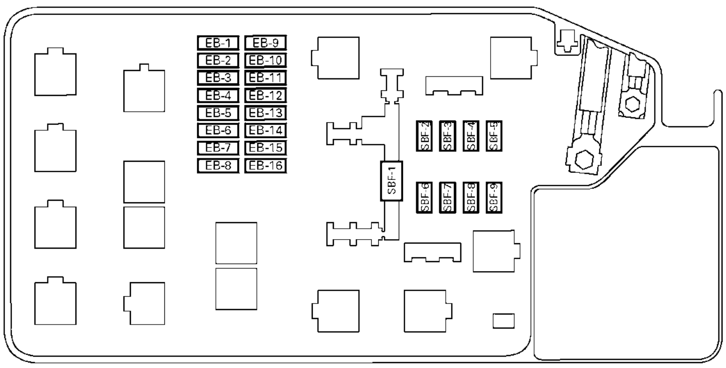
RELAY AND FUSE

RELAY AND FUSE BOX LOCATION (LHD & RHD)



RELAY AND FUSE BOX LOCATION (LHD & RHD)





RELAY

No.	Relay Name
X-1	RELAY; TAIL LIGHT
X-2	RELAY; FUEL PUMP
X-3	RELAY; HORN
X-4	RELAY; DIMMER
X-5	—
X-6	RELAY; STARTER
X-7	RELAY; H/LAMP (Except AUSTRALIA) RELAY; COND FAN (AUSTRALIA)
X-8	—
X-9	RELAY; FRT FOG LIGHT
X-10	—
X-11	RELAY; HEATER
X-12	RELAY; STARTER CUT (AUSTRALIA)
X-13	RELAY; STARTER CUT (Except AUSTRALIA) REPLAY; H/LAMP (AUSTRALIA)
X-14	RELAY; A/C COMP
X-15	RELAY; THERMO

FUSE

NO.	Fuse Name
EB-1	15A ECM
EB-2	—
EB-3	15A FRT FOG 20A TRAILER ∗1
EB-4	15A ACG (S)
EB-5	10A ILLUMI 10A ILLUMI & TAIL-RF ∗1
EB-6	10A TAIL
EB-7	10A H/LIGHT-RH 10A H/LIGHT-RH-LOW ∗2
EB-8	10A H/LIGHT-LH 10A H/LIGHT-LH-LOW ∗2
EB-9	20A FUEL PUMP
EB-10	10A O_2 SENSOR
EB-11	10A H/LIGHT-RH-HIGH ∗2
EB-12	10A H/LIGHT-LH-HIGH ∗2
EB-13	10A A/C
EB-14	10A 4WD
EB-15	10A HORN
EB-16	10A HAZARD

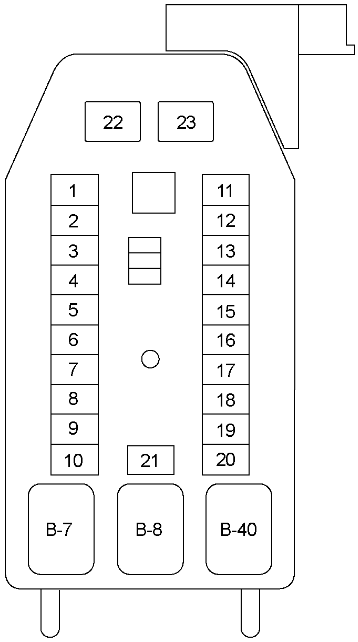
SLOW BLOW FUSE

NO.	Slow Blow Fuse Name
SBF-1	100A MAIN
SBF-2	—
SBF-3	—
SBF-4	20A COND, FAN
SBF-5	40A IG 1
SBF-6	—
SBF-7	—
SBF-8	30A BLOWER
SBF-9	50A IG 2

∗1 AUSTRALIA
∗2 WITH HEADLIGHTS LEVELING

FUSE AND RELAY LOCATION (LHD & RHD)

FUSE BOX



FUSE

No.	Capacity	Indication on label	No.	Capacity	Indication on label
1	—	—	12	15A	CIGER/ACC SOCKET
2	10A	ABS/4WD	13	15A	AUDIO (+B)
3	10A	TRAILER	14	20A	DOOR LOCK
4	15A	BACK UP	15	10A	METER (+B)
5	15A	METER	16	10A	ROOM
6	10A	TURN	17	10A	ANTI THEFT
7	15A	ELEC.IG	18	15A	STOP
8	15A	ENGINE	19	—	—
9	20A	FRT WIPER	20	10A	STARTER
10	15A	EGR (RHD) IG.COIL (LHD)	21	10A	SRS
11	10A	AUDIO			

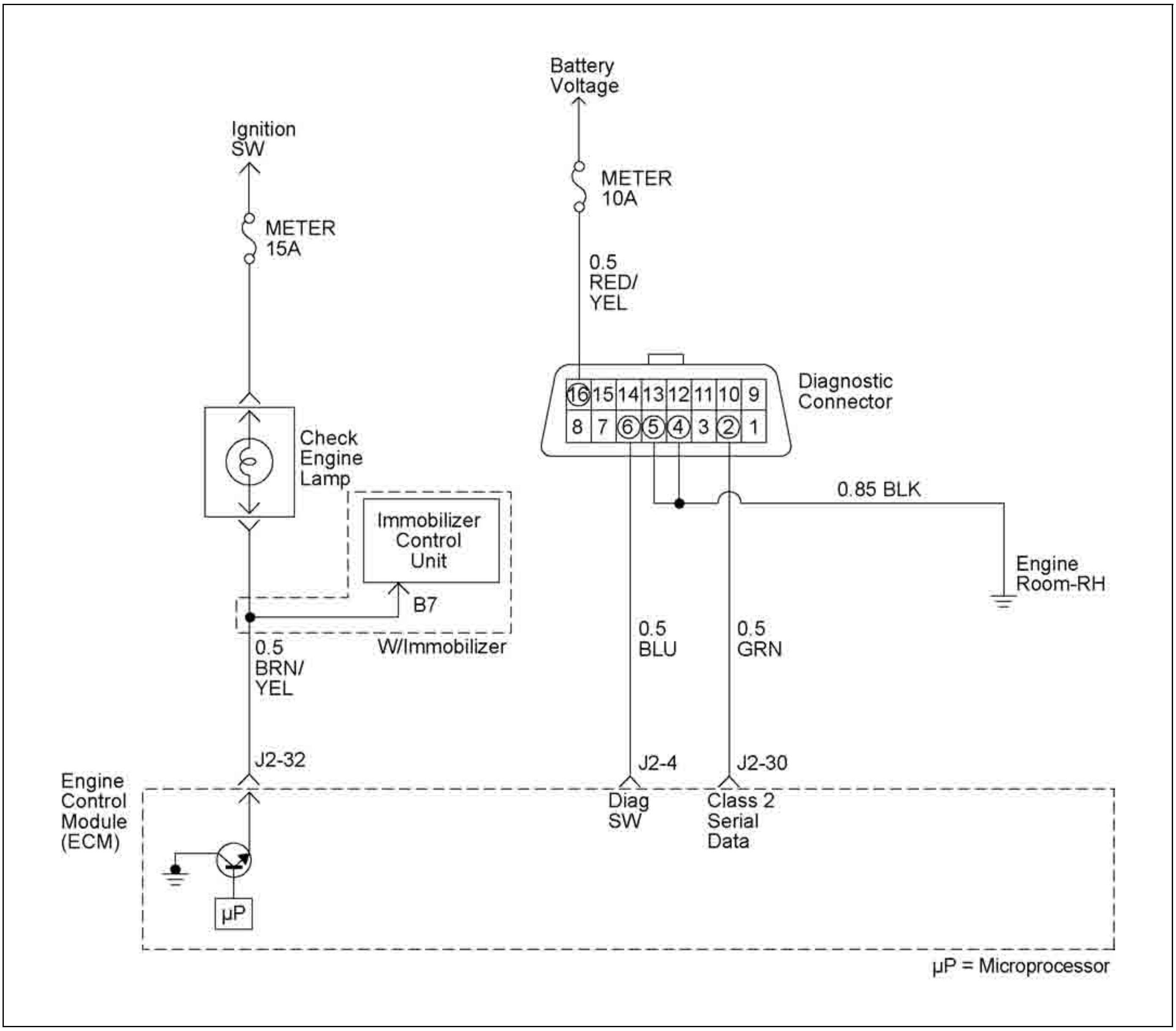
SLOW BLOW FUSE

No.	Capacity	Indication on label
22	20A	RR DEF
23	30A	POWER WINDOW

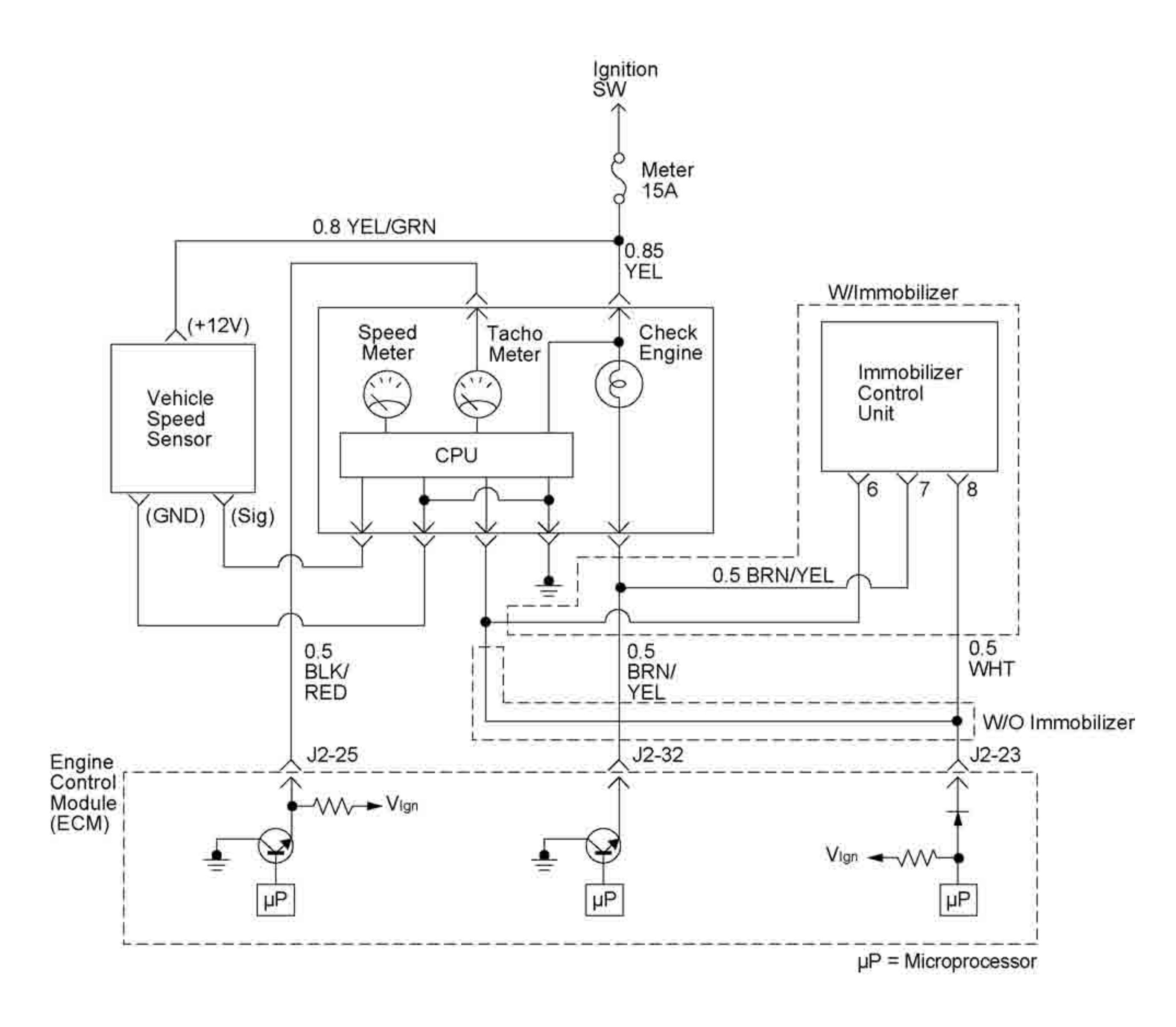
RELAY

Connector No.	B-7	B-8	B-40
C24SE	REAR DEFOGGER	POWER WINDOW	(NO RELAY)

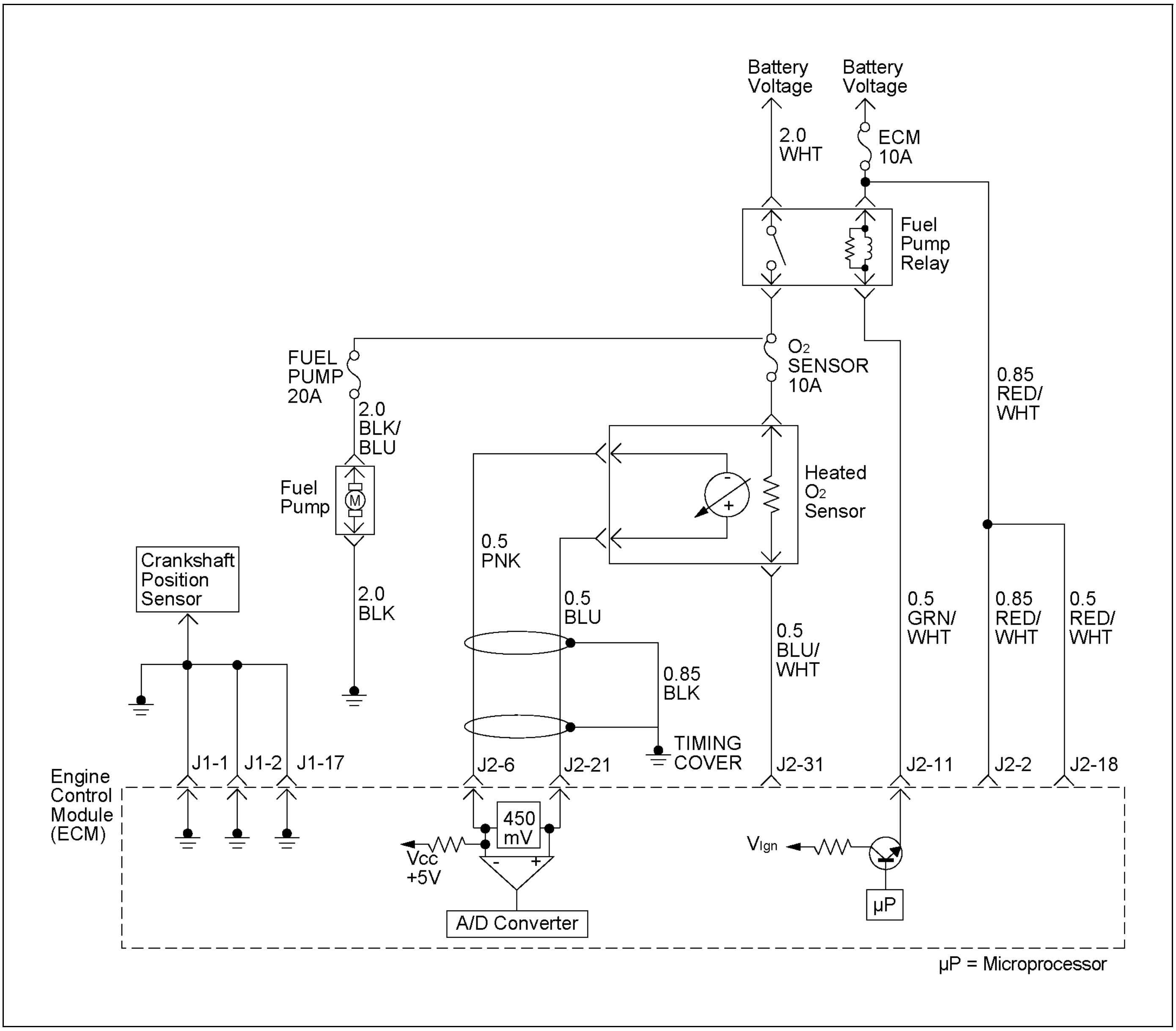
ECM WIRING DIAGRAM (1/9)



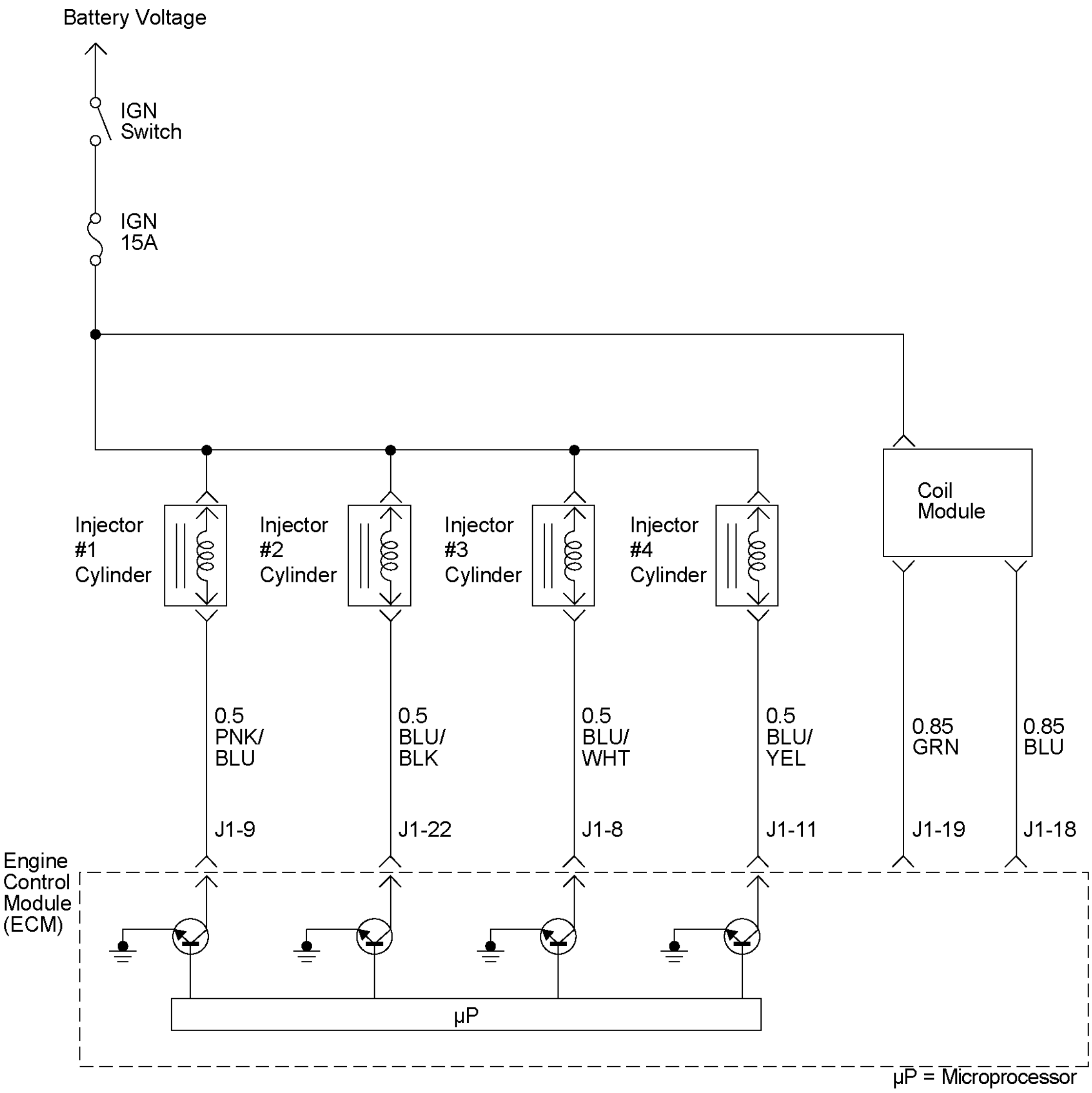
ECM WIRING DIAGRAM (2/9)



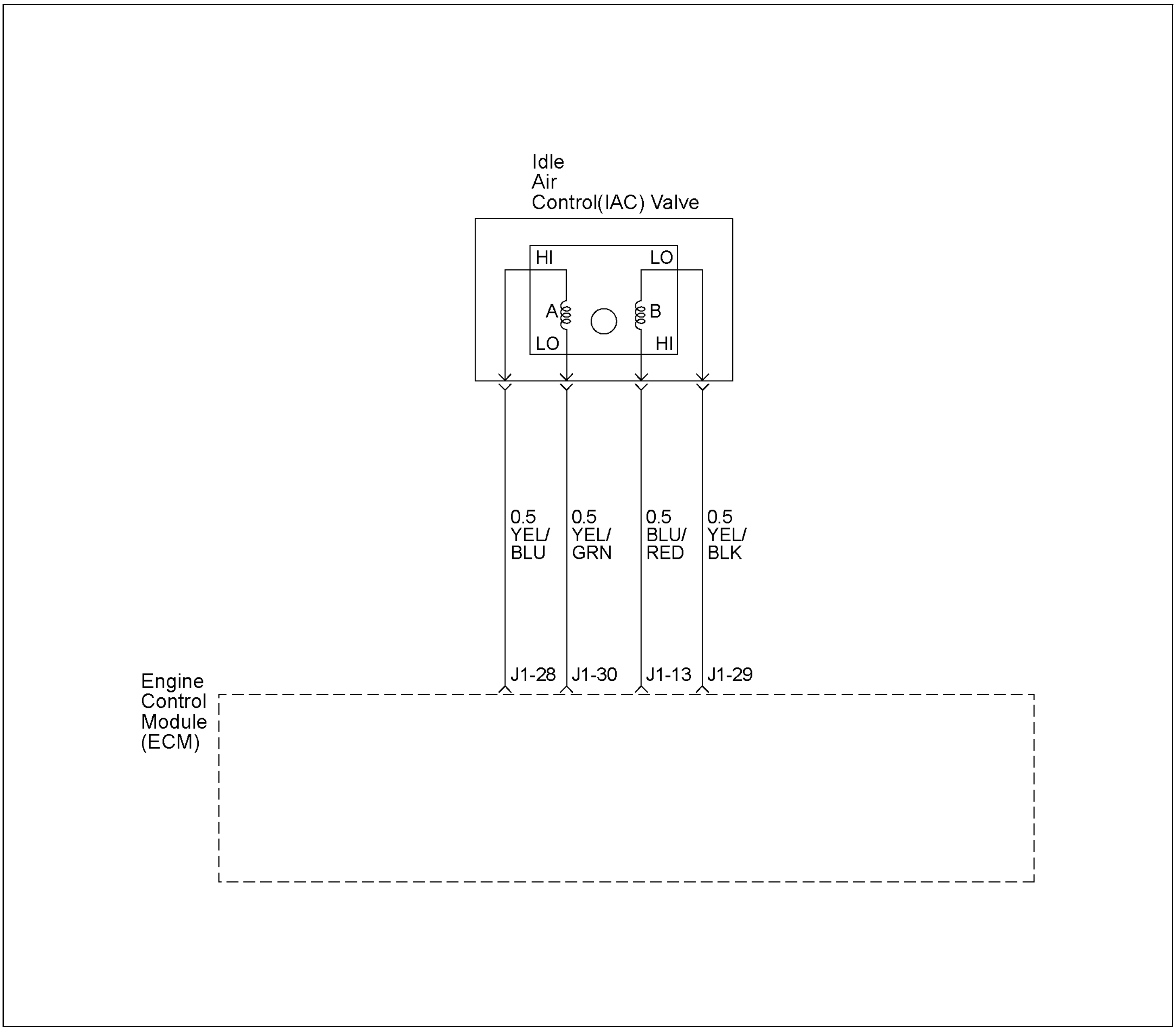
ECM WIRING DIAGRAM (3/9)



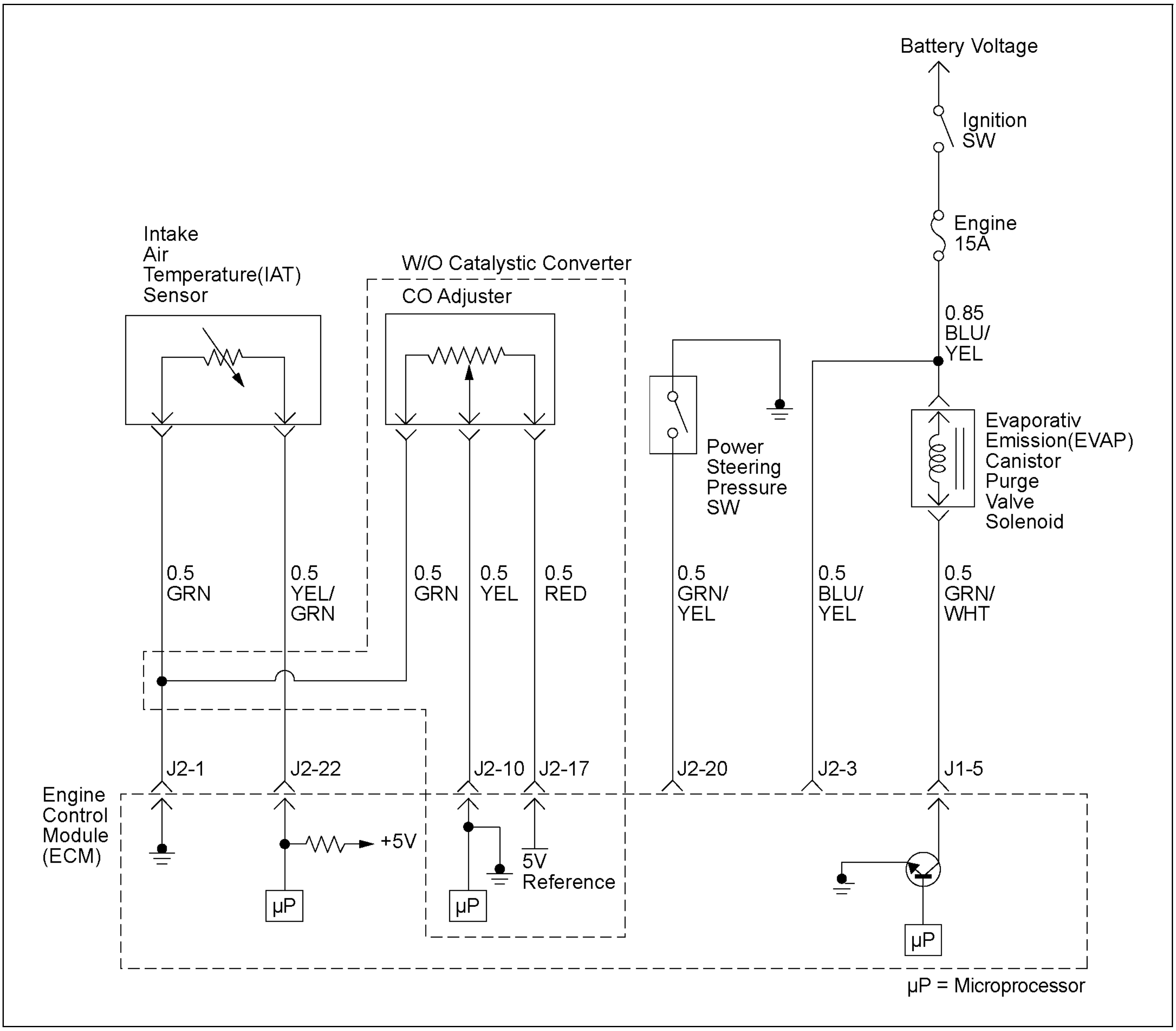
ECM WIRING DIAGRAM (4/9)



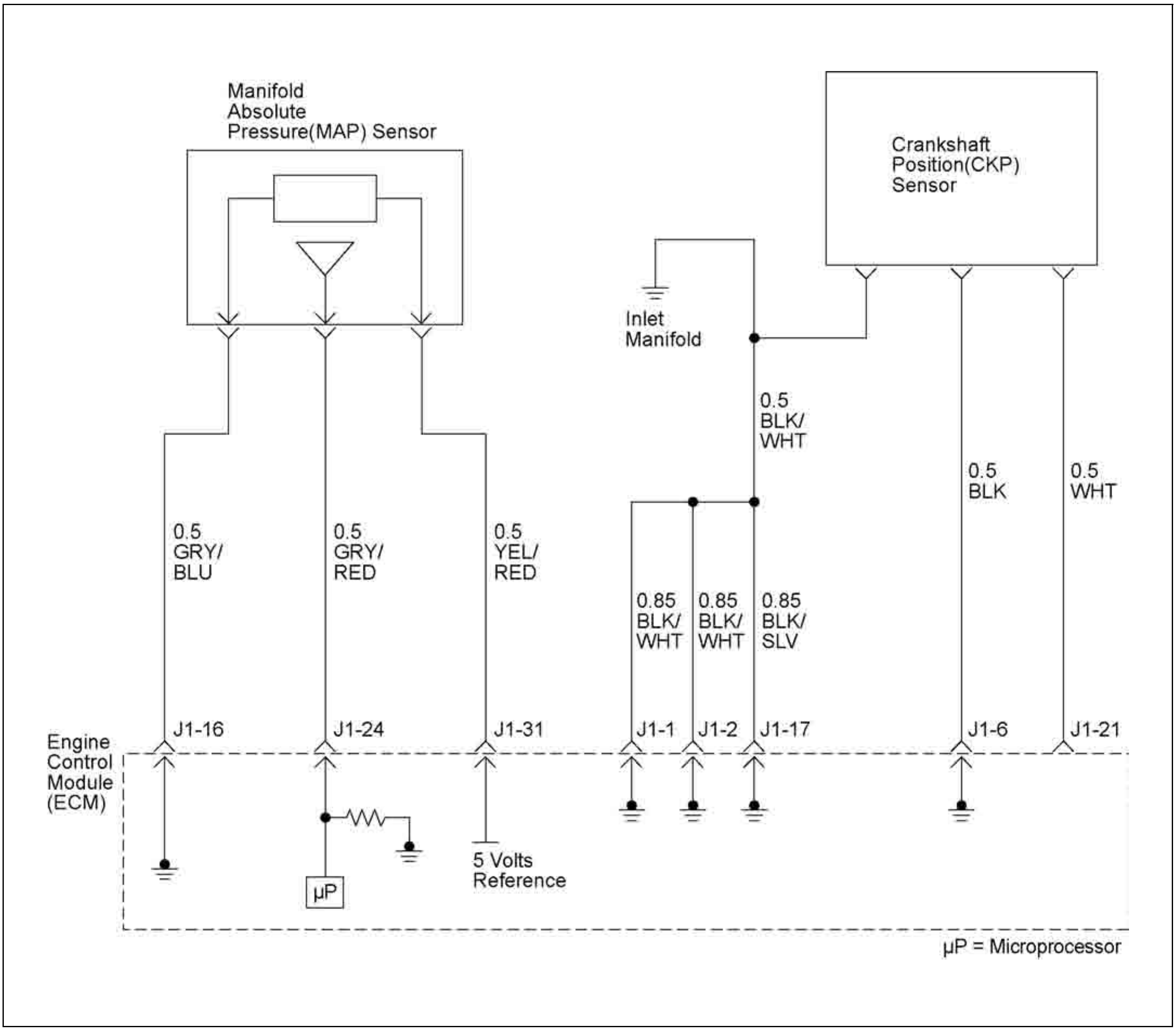
ECM WIRING DIAGRAM (5/9)



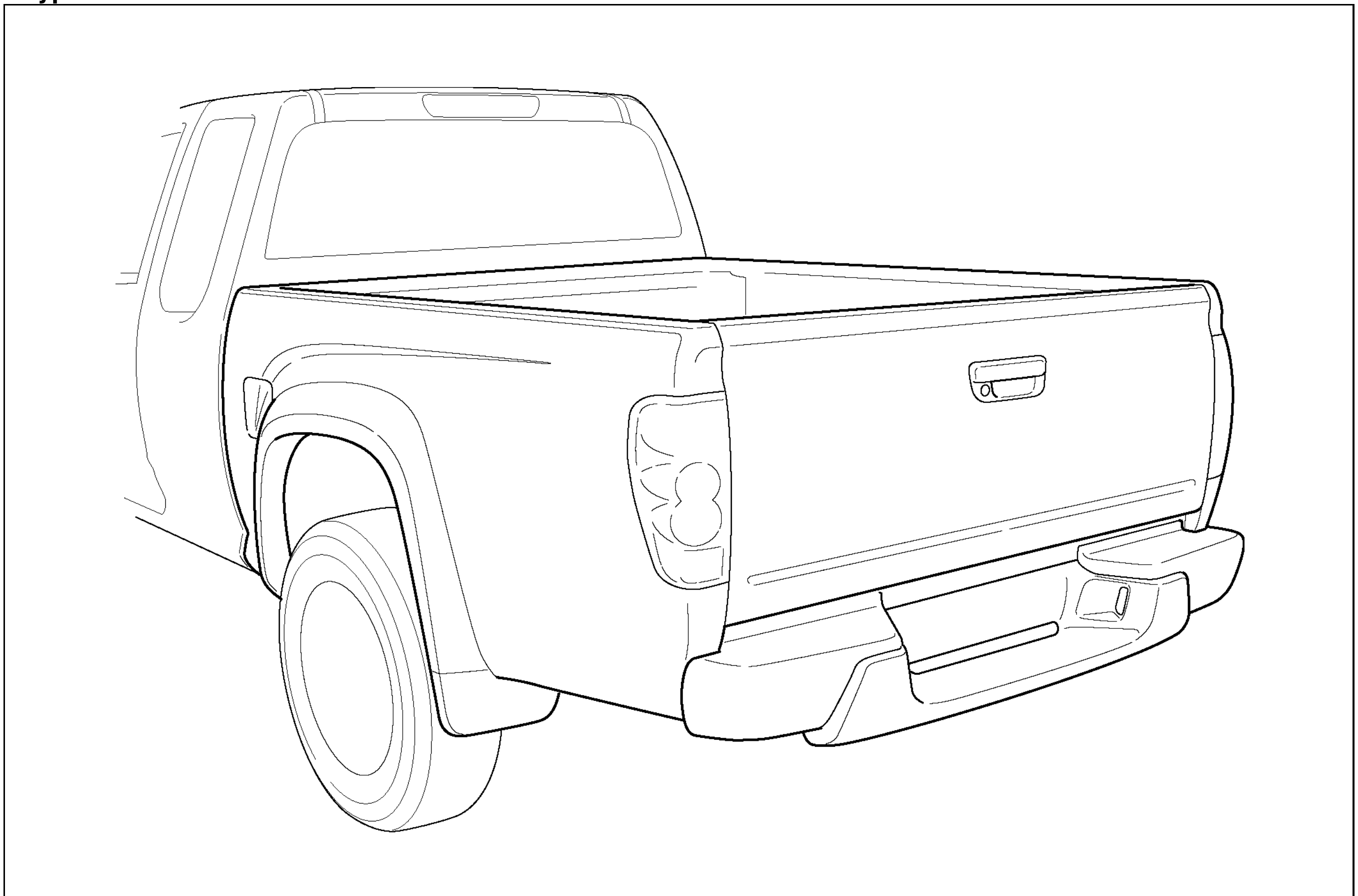
ECM WIRING DIAGRAM (6/9)



ECM WIRING DIAGRAM (7/9)



B type



RTW52BMF000301

Removal Steps

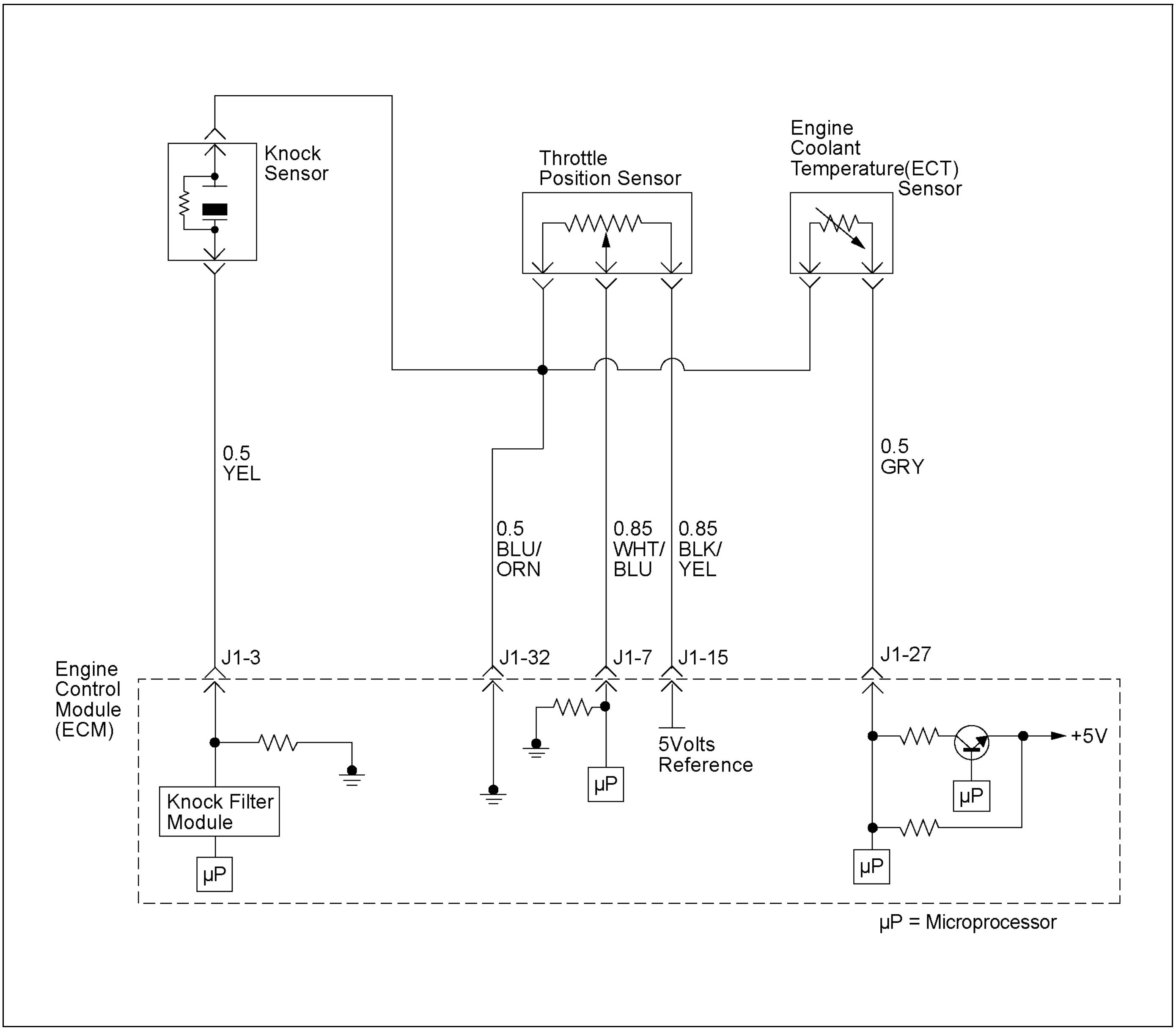
1. Battery ground cable
2. Rear combination lamp & license lamp harness connector
3. Rear wheel housing extension panel
4. Fuel filler door release cable assembly
5. ▲ Fuel filler pipe and evaporator hose
6. Bolt; frame to rear body
7. ▲ Rear body assembly

Installation Steps

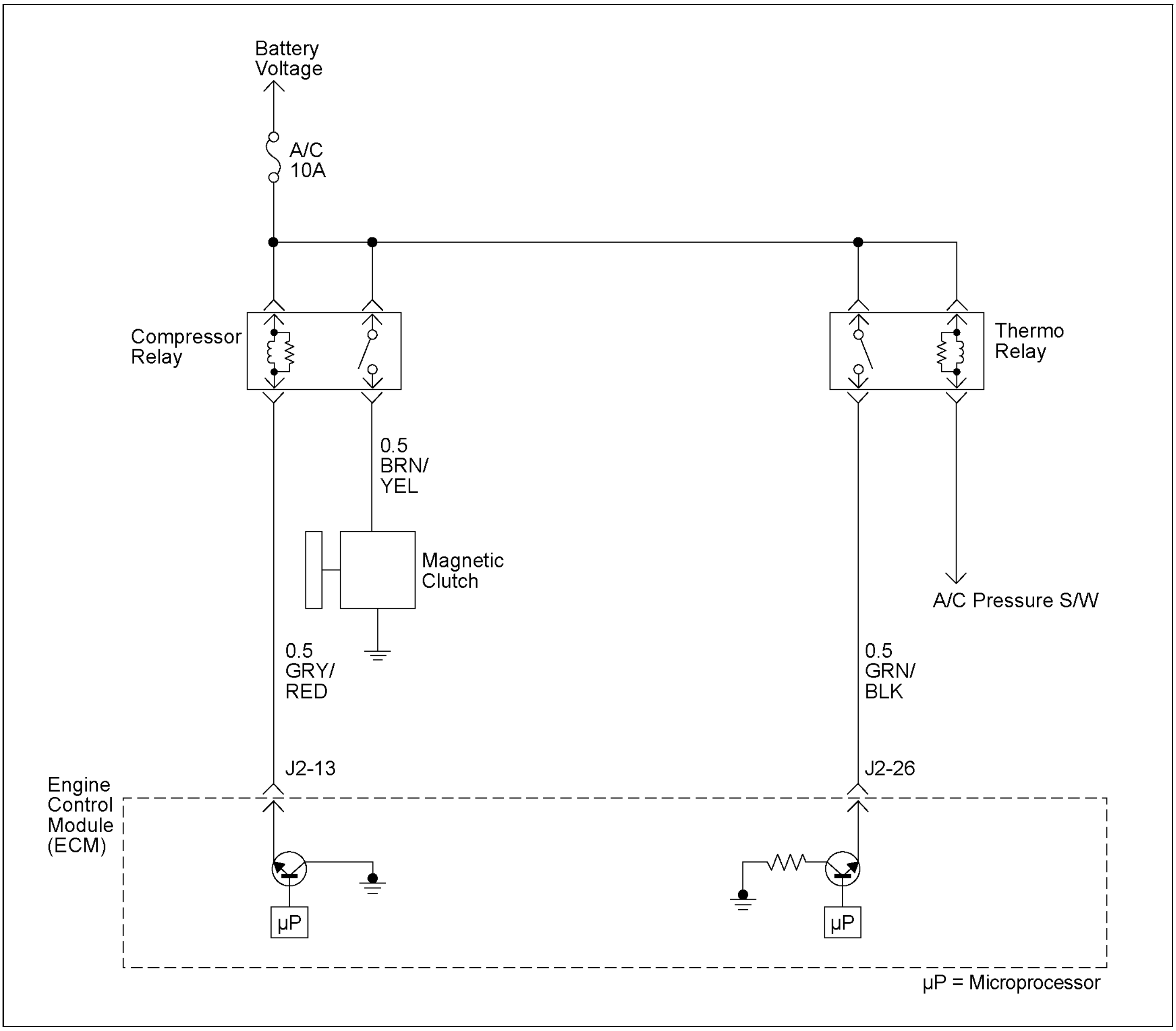
7. Rear body assembly
6. ▲ Bolt; frame to rear body
5. Fuel filler pipe and evaporator hose
4. Fuel filler door release cable assembly
3. Rear wheel housing extension panel
2. Rear combination lamp & license lamp connector
1. Battery ground cable

NOTE:
The rear body must be empty before removal.

ECM WIRING DIAGRAM (8/9)

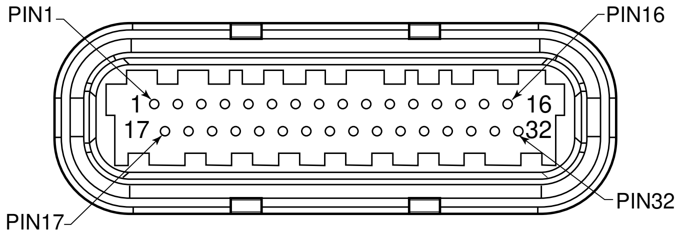


ECM WIRING DIAGRAM (9/9)



ECM CONNECTOR PIN ASSIGNMENT & OUTPUT SIGNAL

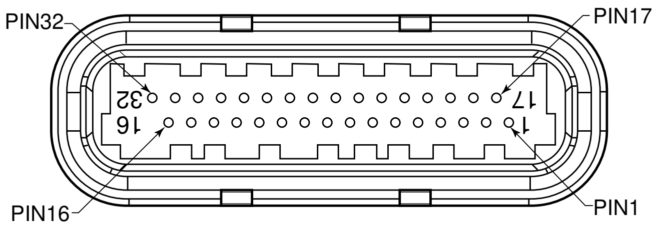
Connector J1 Port: View Looking Into ECM Case



Pin No.	B/ Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J1-1	J1-1	Ground	BLK/ WHT	Continuity with ground	-	-	-	Disconnect	Ω	J1-1	GND
J1-2	J1-2	Ground	BLK/ WHT	Continuity with ground	-	-	-	Disconnect	Ω	J1-2	GND
J1-3	J1-3	Knock Sensor Signal	YEL	Less than 1V	-	-	-	-	-	-	-
J1-4	J1-4	No Connection	-	-	-	-	-	-	-	-	-
J1-5	J1-5	Canister Purge Solenoid Valve	RED/ YEL	Less than 1V	Wave form G or 12-14V			Connect	DC V	J1-5	GND
J1-6	J1-6	Crankshaft Position (CKP) Sensor (Ground)	RED	Approx. 0.58kΩ	-	-	-	Disconnect	Ω	J1-6	J1-21
J1-7	J1-7	Throttle Position Sensor (TPS) Output Signal	BLU	Less than 1V	Approx 0.7V		Approx 0.8V	Connect	DC V	J1-7	J1-32
J1-8	J1-8	No. 3 Injector	GRN/ BLK	Less than 1V	Wave form E or 12-14V			Connect	DC V	J1-8	GND
J1-9	J1-9	No. 1 Injector	GRN/ WHT	Less than 1V	Wave form E or 12-14V			Connect	DC V	J1-9	GND
J1-10	J1-10	No Connection	-	-	-	-	-	-	-	-	-
J1-11	J1-11	No. 4 Injector	GRN	Less than 1V	Wave form E or 12-14V			Connect	DC V	J1-11	GND
J1-12	J1-12	No Connection	-	-	-	-	-	-	-	-	-
J1-13	J1-13	Idle Air Control Valve (IACV) Coil B High	BLU/ RED	Less than 1V	Less than 1V / 10-14V			Connect	DC V	J1-13	GND
J1-14	J1-14	No Connection	-	-	-	-	-	-	-	-	-
J1-15	J1-15	Throttle Position Sensor (TPS) Power Supply	RED	Less than 1V	Approx. 5V			Connect	DC V	J1-15	J1-32
J1-16	J1-16	MAP Sensor Ground	GRN	Continuity with ground	-	-	-	Connect	Ω	J1-16	GND
J1-17	J1-17	Ground	BLK/ WHT	Continuity with ground	-	-	-	Connect	Ω	J1-17	GND
J1-18	J1-18	Coil Module 2 (No. 2 & 3 Cylinder)	BLU	-	-	Wave form F		-	-	-	-
J1-19	J1-19	Coil Module 1 (No. 1 & 4 Cylinder)	GRN	-	-	Wave form F		-	-	-	-
J1-20	J1-20	No Connection	-	-	-	-	-	-	-	-	-

Pin No.	B/ Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J1-21	J1-21	Crankshaft Position (CKP) Sensor Signal	WHT	-	-	Wave form or approx. 3.7V	Wave form A or approx. 7.8V	Connect	AC V	J1-21	J1-6
J1-22	J1-22	No.2 Injector	GRN/ WHT	Less than 1V	Wave form E or 12-14V			Connect	DC V	J1-22	GND
J1-23	J1-23	No Connection	-	-	-	-	-	-	-	-	-
J1-24	J1-24	MAP Sensor Signal	GRY	Less than 1V	Approx. 4.8V	Approx. 1.3V	Approx. 0.9V	Connect	DC V	J1-24	J1-16
J1-25	J1-25	No Connection	-	-	-	-	-	-	-	-	-
J1-26	J1-26	No Connection	-	-	-	-	-	-	-	J1-26	-
J1-27	J1-27	Engine Coolant Temp. (ECT) Sensor Signal	GRY	Less than 1V	20℃: Approx. 2.4V / 40℃: Approx. 1.4V or 4.1V / 60℃: Approx. 3.3V / 80℃: Approx. 2.5V			Connect	DC V	J1-27	J1-32
J1-28	J1-28	Idle Air Control Valve (IACV) Coil A High	BLU	Less than 1V	Less than 1V / 10-14V			Connect	DC V	J1-28	GND
J1-29	J1-29	Idle Air Control Valve (IACV) Coil B Low	BLU/ BLK	Less than 1V	Less than 1V / 10-14V			Connect	DC V	J1-29	GND
J1-30	J1-30	Idle Air Control Valve (IACV) Coil A Low	BLU/ WHT	Less than 1V	Less than 1V / 10-14V			Connect	DC V	J1-30	GND
J1-31	J1-31	MAP Sensor Power Supply	RED	Less than 1V	Approx.. 5V			Connect	DC V	J1-31	J1-16
J1-32	J1-32	ECT Sensor, Knock Sensor, Throttle Position Sensor Ground	GRN	Continuity with ground	-	-	-	Connect	Ω	J1-32	GND

Connector J2 Port: View Looking Into ECM Case

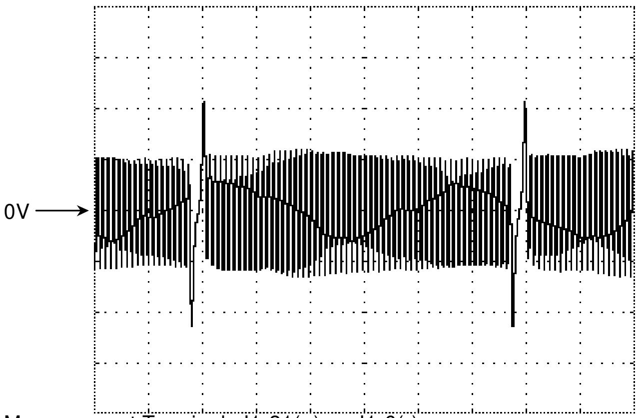


Pin No.	B/ Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J2-1	J2-1	Intake Air Temp. (IAT) Sensor Ground	GRN	Continuity with ground	-	-	-	Disconnect	Ω	J2-1	GND
J2-2	J2-2	Battery Power Supply	RED/ WHT	10-14V				Connect	DC V	J2-2	GND
J2-3	J2-3	Ignition Power Supply	BLU/ YEL	Less than 1V	10-14V			Connect	DC V	J2-3	GND
J2-4	J2-4	To Data Link Connector No. 6	BLU	-	-	-	-	-	-	-	-
J2-5	J2-5	No Connection	-	-	-	-	-	-	-	-	-
J2-6	J2-6	Oxygen Sensor (Ground)	PNK	Continuity with ground	-	-	-	Connect	Ω	J2-6	GND
J2-7	J2-7	No Connection	-	-	-	-	-	-	-	-	-
J2-8	J2-8	No Connection	-	-	-	-	-	-	-	-	-
J2-9	J2-9	No Connection	-	-	-	-	-	-	-	-	-
J2-10	J2-10	CO Adjust Signal (W/O Catalystic Converter)	YEL	-	-	-	-	-	-	-	-
J2-11	J2-11	Fuel Pump Relay	GRN/ WHT	10-14V	While relay is activated; 10-14V Relay is not activated; Less than 1V	10-14V		Connect	DC V	J2-11	GND
J2-12	J2-12	No Connection	-	-	-	-	-	-	-	-	-
J2-13	J2-13	A/C Compressor Relay	GRY/ RED	Less than 1V	A/C comp. is operated: Less than 1V A/C comp. is not operated: 10-14V			Connect	DC V	J2-13	GND
J2-14	J2-14	No Connection	-	-	-	-	-	-	-	-	-
J2-15	J2-15	No Connection	-	-	-	-	-	-	-	-	-
J2-16	J2-16	No Connection	-	-	-	-	-	-	-	-	-
J2-17	J2-17	CO Adjust (W/O Catalystic Converter)	RED	-	-	-	-	-	-	-	-
J2-18	J2-18	Battery Power Supply	RED/ WHT	10-14V				Connect	DC V	J2-18	GND
J2-19	J2-19	No Connection	-	-	-	-	-	-	-	-	-
J2-20	J2-20	Power Steering Pressure Switch	GRN/ YEL	Less than 1V	Pressure switch is turned on: Less than 1V Pressure switch is turned off: 10-14V			Connect	DC V	J2-20	GND
J2-21	J2-21	Oxygen Sensor	BLU	Less than 1V	Approx. 0.4V	Wave form D or 0.1 - 0.9V		Connect	DC V	J2-21	J2-6
J2-22	J2-22	Intake Air Temp. (IAT) Sensor (Signal)	YEL/ GRN	Less than 1V	20℃: Approx. 2.9V / 40℃: Approx. 1.8V V / 60 ℃ : Approx. 1.1V / 80 ℃ : Approx. 0.6V			Connect	DC V	J2-22	33

Pin No.	B/ Box No.	Pin Function	Wire Color	Signal or Continuity				ECM Connection	Tester Position		
				Key SW Off	Key SW On	Engine Idle	Engine 2000rpm		Range	(+)	(-)
J2-23	J2-23	Vehicle Speed Sensor (VSS) Signal (Immobilizer Control Unit Terminal B8)	WHT	-	-	Wave form C or Approx. 6.5V at 20km/h		Connect	AC V	J2-23	GND
J2-24	J2-24	No Connection	-	-	-	-	-	-	-	-	-
J2-25	J2-25	Tachometer Output Signal	BLK/ RED	-	-	Wave form	Wave form B or Approx. 4.5V	Connect	AC V	J2-25	GND
J2-26	J2-26	Thermo Relay	GRN/ BLK	Less than 1V	A/C request is activated: 10-14V A/C request is not activated: Less than 1V			Connect	DC V	J2-26	GND
J2-27	J2-27	No Connection	-	-	-	-	-	-	-	-	-
J2-28	J2-28	No Connection	-	-	-	-	-	-	-	-	-
J2-29	J2-29	No Connection	-	-	-	-	-	-	-	-	-
J2-30	J2-30	To Data Link Connector No. 2	GRN	-	-	-	-	-	-	-	-
J2-31	J2-31	Oxygen Sensor Heater	BLU/ WHT	Continuity with ground	-	Wave Form	Wave Form D	Connect	Ω	J2-31	GND
J2-32	J2-32	Check Engine Lamp (Immobilizer Control Unit Terminal B7)	BRN/ YEL	Less than 1V	Less than 1V	Lamp is turned on: Less than 1V Lamp is turned off: 10-14V		Connect	DC V	J2-32	GND

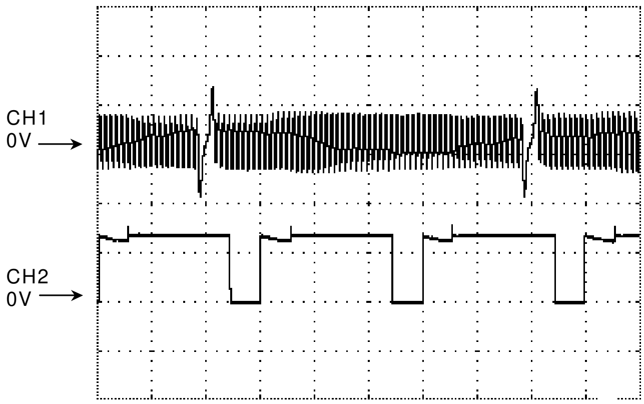
Reference Wave Form

Crankshaft Position (CKP) Sensor Reference Wave Form



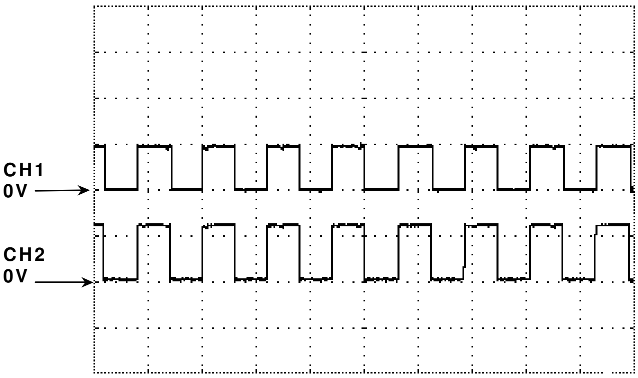
Measurement Terminal: J1-21(+) J1-6(-)
Measurement Scale: 10V/div 5ms/div
Measurement Condition: Approximately 2000rpm

Crankshaft Position (CKP) Sensor & Tacho Output Signal Reference Wave Form



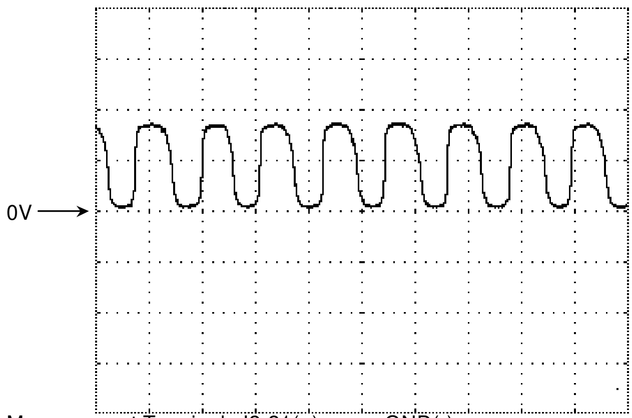
Measurement Terminal: CH1: J1-21(+) / CH2: J2-25(+) GND(-)
Measurement Scale: CH1: 2V/div / CH2: 10V/div 5ms/div
Measurement Condition: Approximately 2000rpm

Vehicle Speed Sensor (VSS) Reference Wave Form



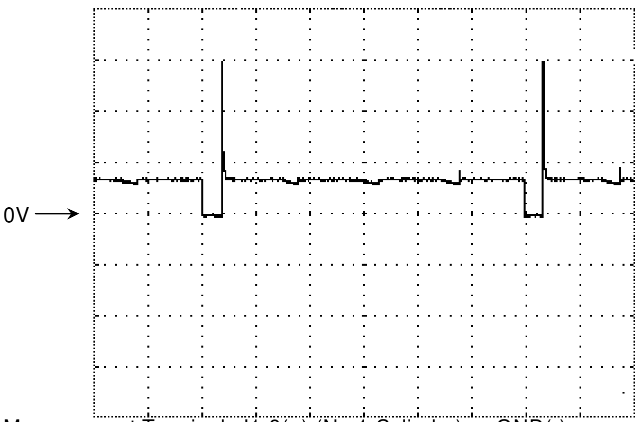
Measurement Terminal: CH1: ECM J2-23(+) / CH2: VSS 3(+) GND(-)
Measurement Scale: CH1: 10V/div / CH2: 10V/div 50ms/div
Measurement Condition: Approximately 20km/h
Note: The vehicle is without immobilizer system, CH1 signal is same as CH2.

Heated Oxygen Sensor (HO2S) Reference Wave Form



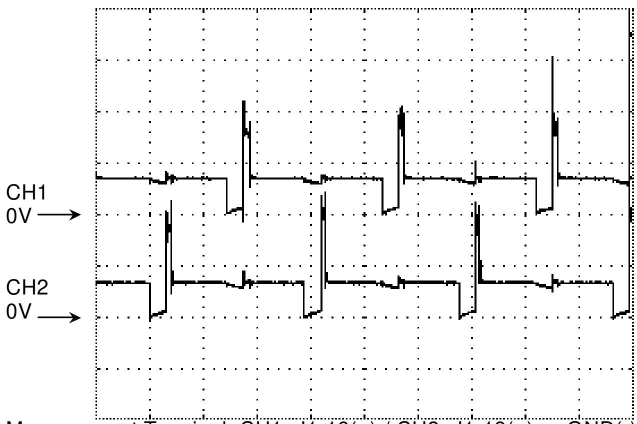
Measurement Terminal: J2-21(+) GND(-)
Measurement Scale: 500mV/div 500ms/div
Measurement Condition: Approximately 2000rpm in Closed Loop

Injector Control Signal Reference Wave Form



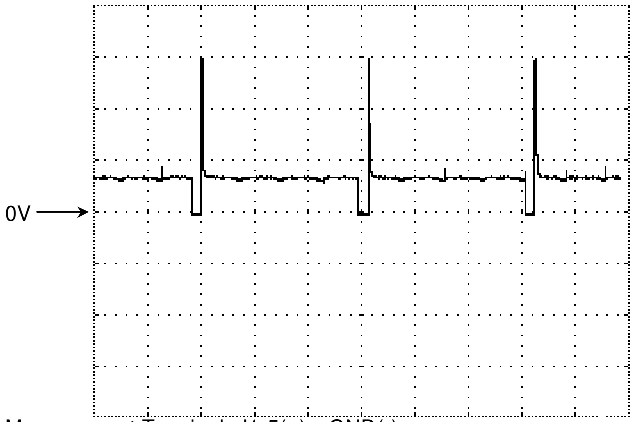
Measurement Terminal: J1-9(+) (No.1 Cylinder) GND(-)
Measurement Scale: 20V/div 5ms/div
Measurement Condition: Approximately 2000rpm

Ignition Coil Control Signal Reference Wave Form



Measurement Terminal: CH1: J1-19(+) / CH2: J1-18(+) GND(-)
Measurement Scale: CH1: 20V/div / CH2: 20V/div 10ms
Measurement Condition: Approximately 2000rpm

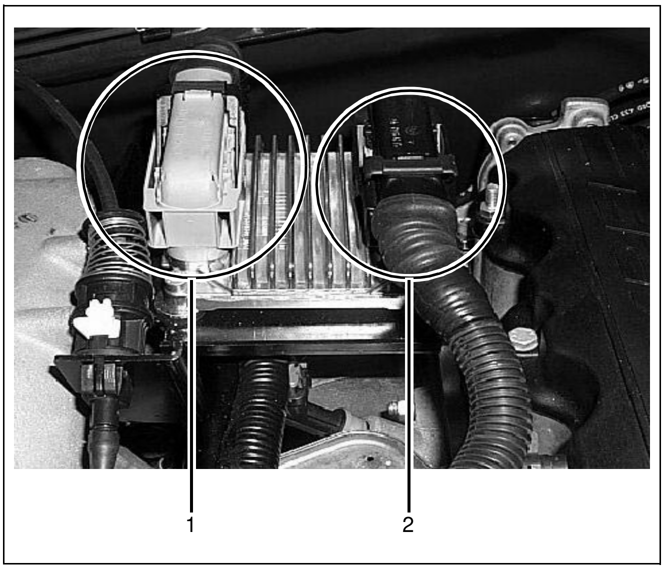
EVAP Canister Purge Solenoid Reference Wave Form



Measurement Terminal: J1-5(+) GND(-)
Measurement Scale: 20V/div 20ms/div
Frequency: Approximately 16Hz

GENERAL DESCRIPTION FOR ECM AND SENSORS

Engine Control Module (ECM)



(1) J1 Port
(2) J2 Port

The engine control module (ECM) is located on the intake manifold. The ECM controls the following.

- Fuel metering system
- Ignition timing
- On-board diagnostics for electrical functions.

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. And it performs the diagnostic function of the system.
The function can recognize operational problems, and warn to the driver through the check engine lamp, and store diagnostic trouble code (DTC). DTCs identify the problem areas to aid the technician in marking repairs.

The input / output devices in the ECM include analog to digital converts, signal buffers, counters and drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned on.

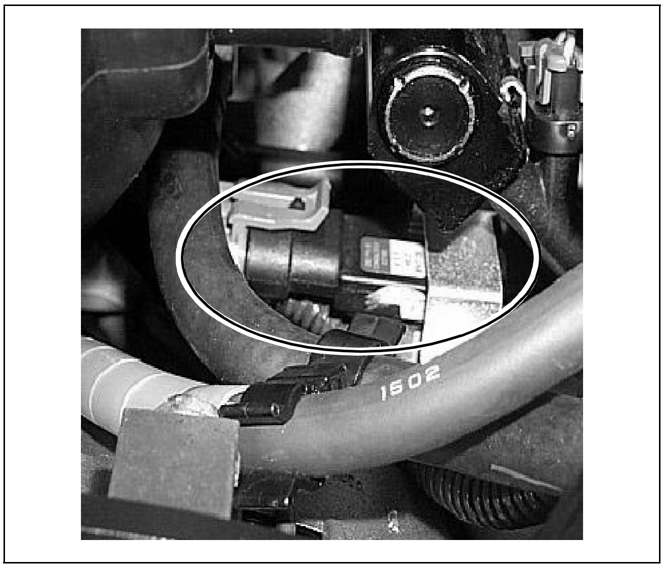
Inputs (Operating condition read):

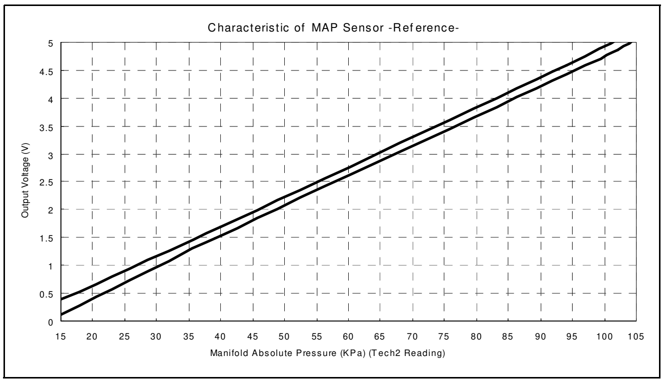
- Battery voltage
- Electrical ignition
- Exhaust oxygen content
- Intake manifold pressure
- Intake air temperature
- Engine coolant temperature
- Crankshaft position
- Knock signal
- Throttle position
- Vehicle speed
- Power steering pressure
- Air conditioning request on or off

Outputs (Systems controlled):

- Ignition control
- Fuel control
- Idle air control
- Fuel pump
- EVAP canister purge
- Air conditioning
- Diagnostics functions

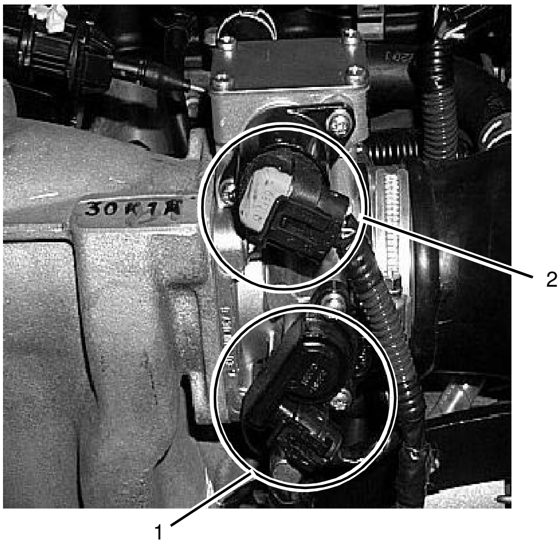
Manifold Absolute Pressure (MAP) Sensor



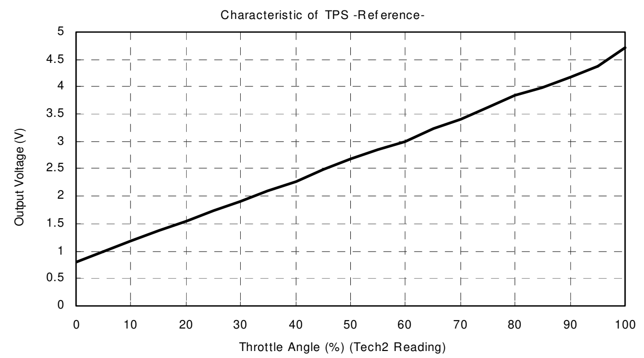


The MAP sensor is a strain gage. A pressure strains the resistance on the silicon base. At that time the resistance value changes. And it changes voltage. In other words it measures a pressure value. It is installed to the intake manifold. Output voltage of the MAP sensor is low as pressure is low.

Throttle Position Sensor (TPS)



(1) Throttle Position Sensor
(2) Idle Air Control (IAC) Valve



The TPS is a potentiometer connected to throttle shaft on the throttle body.
The engine control module (ECM) monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed when accelerator pedal moved. The TPS signal also changed at a moved throttle valve. As the throttle valve opens, the output increases so that the output voltage should be high.
The throttle body has a throttle plate to control the amount of the air delivered to the engine.
Engine coolant is directed through a coolant cavity in the throttle body to warm the throttle valve and to prevent icing.

Idle Air Control (IAC) Valve

Step / Coil	A	B	C	D
Coil A High (ECM J1-28)	On			On
Coil A Low (ECM J1-30)		On	On	
Coil B High (ECM J1-13)	On	On		
Coil B Low (ECM J1-29)			On	On

← (IAC Valve Close Direction)

(IAC Valve Open Direction) →

The idle air control valve (IAC) valve is two directional and gives 2-way control. With power supply to the coils controlled steps by the engine control module (ECM), the IAC valve's pintle is moved to adjust idle speed, raising it for fast idle when cold or there is extra load from the air conditioning or power steering.
By moving the pintle in (to decrease air flow) or out (to increase air flow), a controlled amount of the air can move around the throttle plate. If the engine speed is too low, the engine control module (ECM) will retract the IAC pintle, resulting in more air moving past the throttle plate to increase the engine speed.
If the engine speed is too high, the engine control module (ECM) will extend the IAC pintle, allowing less air to move past the throttle plate, decreasing the engine speed.

The IAC pintle valve moves in small step called counts. During idle, the proper position of the IAC pintle is calculated by the engine control module (ECM) based on battery voltage, coolant temperature, engine load, and engine speed.
If the engine speed drops below a specified value, and the throttle plate is closed, the engine control module (ECM) senses a near-stall condition. The engine control module (ECM) will then calculate a new IAC pintle valve position to prevent stalls.
If the IAC valve is disconnected and reconnected with the engine running, the idle speed will be wrong. In this case, the IAC must be reset. The IAC resets when the key is cycled “On” then “Off”. When servicing the IAC, it should only be disconnected or connected with the ignition “Off”.
The position of the IAC pintle valve affects engine start-up and the idle characteristic of the vehicle.
If the IAC pintle is fully open, too much air will be allowed into the manifold. This results in high idle speed, along with possible hard starting and lean air/ fuel ratio.

Important Operations - Removal

5. Fuel Filler Pipe and Evaporator Hose

7. Rear Body Assembly
Attach lifting wires to the rear body hooks and raise the rear body.

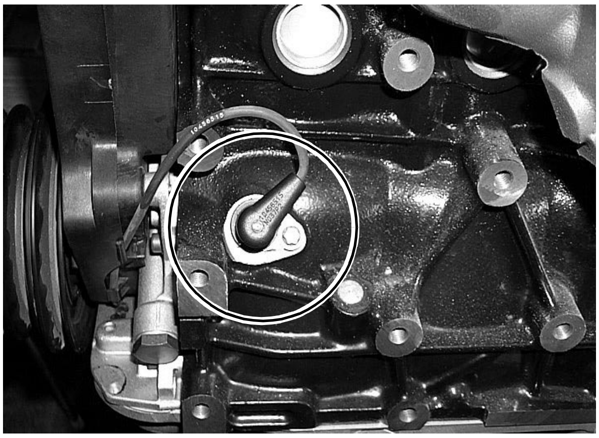
Note:
In lifting up rear body, take care not to strike it against cab body.

Important Operation – Installation

6. Bolt; Frame to Body

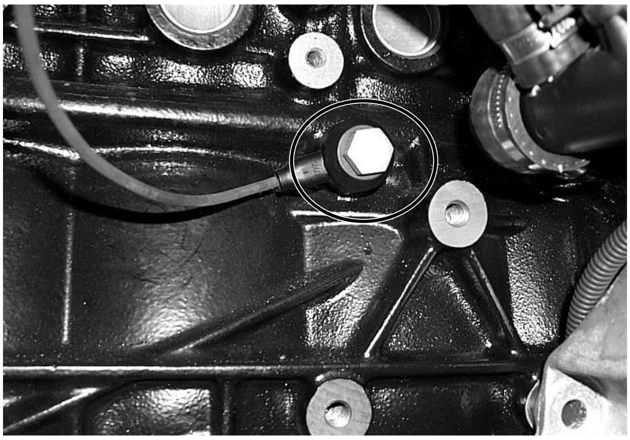
Torque	N·m(kgf·m/lb·ft)
54 (5.5 / 40)	

Crankshaft Position (CKP) Sensor



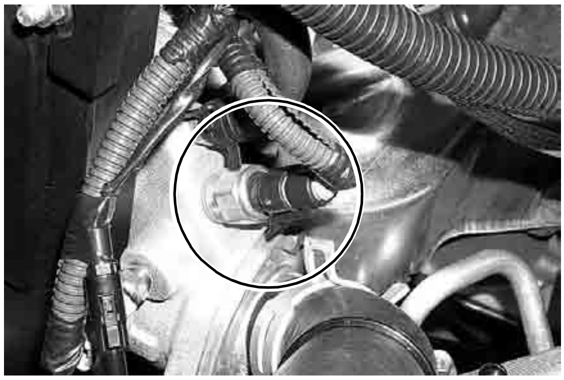
The crankshaft position (CKP) sensor, which sends a signal necessary for deciding on injection timing to the ECM, is mounted on the left-hand side of the cylinder block just back of the A/C compressor.
The crankshaft has a 58 teeth press-fit timing disc, from which the CKP sensor reads the position of the crankshaft at all the times. It converts this to an electrical signal, which it sends to the ECM.
Using the 58 X signals per rotation and the timing-mark signal sent by the CKP sensor, the ECM is able to accurately calculate engine speed and crank position.
The ECM converts the 58 X signals into square signals. This converted signal is sent from the ECM terminal J2-25 to the tachometer.

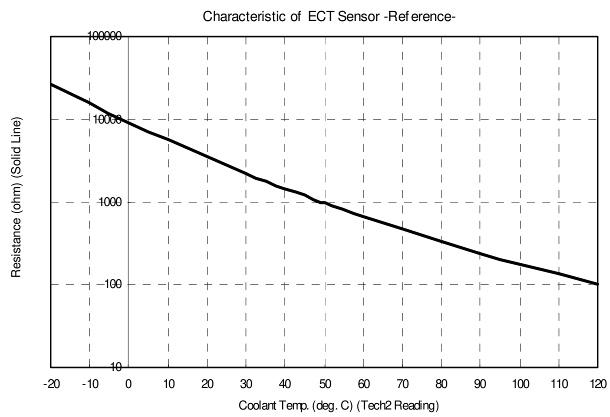
Knock Sensor (KS)



The knock sensor (KS) contains an element that converts detection of knock into an electrical signal, and is mounted on cylinder block wall.
When the ECM receives a signal that indicates knock, the ECM orders ignition timing to be adjusted to compensate.

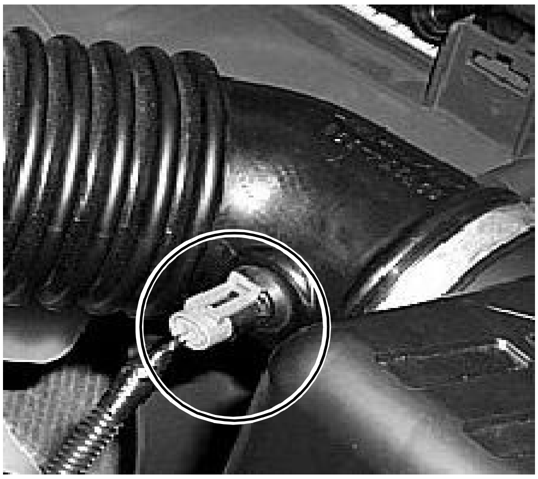
Engine Coolant Temperature (ECT) Sensor

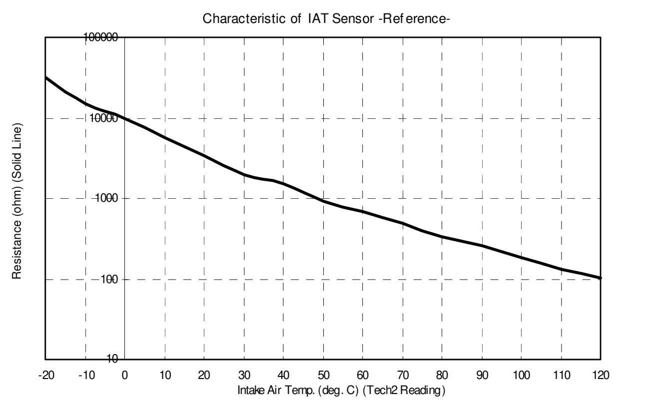




The ECT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. It is installed on the coolant stream. Low coolant temperature produces a high resistance.
The ECM supplies 5 volts signal to the ECT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the engine temperature is cold, and it will be low when the engine temperature is hot.

Intake Air Temperature (IAT) Sensor



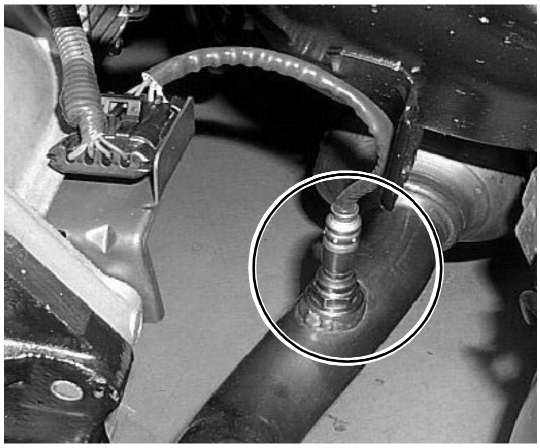


The IAT sensor is a thermistor. A temperature changes the resistance value. And it changes voltage. In other words it measures a temperature value. Low air temperature produces a high resistance.
The ECM supplies 5 volts signal to the IAT sensor through resisters in the ECM and measures the voltage. The signal voltage will be high when the air temperature is cold, and it will be low when the air temperature is hot.

Vehicle Speed Sensor (VSS)

The VSS is a magnet rotated by the transmission output shaft. The VSS uses a hall element. It interacts with the magnetic field treated by the rotating magnet. It outputs pulse signal. The 12 volts operating supply from the meter fuse.

Heated Oxygen (O_2) Sensor



The heated oxygen sensor consists of a 4-wire low temperature activated zirconia oxygen analyzer element with heater for operating temperature of 315°C, and there is one mounted on each exhaust pipe.
A constant 450millivolt is supplied by the ECM between the two supply terminals, and oxygen concentration in the exhaust gas is reported to the ECM as returned signal voltage.
The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100mV to 1000mV and the ECM calculates the pulse width commanded for the injectors to produce the proper combustion chamber mixture.
Low oxygen sensor output voltage is a lean mixture which will result in a rich commanded to compensate.
High oxygen sensor output voltage is a rich mixture which result in a lean commanded to compensate.
When the engine is first started the system is in “Open Loop” operation. In “Open Loop”, the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters “Closed Loop” operation. In “Closed Loop”, the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
Heated oxygen sensors are used to minimize the amount of time required for closed loop fuel control to begin operation and allow accurate catalyst monitoring.
The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors to become active.
Oxygen sensor heaters are required by catalyst monitor and sensors to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further away from the engine.

GENERAL DESCRIPTION FOR FUEL METERING

The fuel metering system starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank, pumps fuel to the fuel rail through an in-line fuel filter.
The pump is designed to provide fuel at a pressure above the pressure needed by the injectors.
A fuel pressure regulator in the fuel rail keeps fuel available to the fuel injectors at a constant pressure.
A return line delivers unused fuel back to the fuel tank.
The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold.
The main control sensor is the heated oxygen sensor located in the exhaust system. The heated oxygen sensor reports to the ECM how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by controlling the amount of time that fuel injector is “On”.
The best mixture to minimize exhaust emissions is 14.7 parts of air to 1 part of gasoline by weight, which allows the catalytic converter to operate most efficiently.
Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a “closed loop” system.
The ECM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called “mode”.
All modes are controlled by the ECM.

Battery Voltage Correction Mode

When battery voltage is low, the ECM will compensate for the weak spark by increasing the following:

- The amount of fuel delivered.
- The idle RPM.

Clear Flood Mode

Clear a flooded engine by pushing the accelerator pedal down all the way. The ECM then de-energizes the fuel injectors. The ECM holds the fuel injectors de-energized as long as the throttle remains above 75% and the engine speed is below 800 RPM. If the throttle position becomes less than 75%, the ECM again begins to pulse the injectors ON and OFF, allowing fuel into the cylinders.

Deceleration Fuel Cutoff (DFCO) Mode

The ECM reduces the amount of fuel injected when it detects a decrease in the throttle position and the air flow. When deceleration is very fast, the ECM may cut off fuel completely. Until enable conditions meet the engine revolution less 1000 rpm or manifold absolute pressure less than 10 kPa.

Engine Speed/ Vehicle Speed/ Fuel Disable Mode

The ECM monitors engine speed. It turns off the fuel injectors when the engine speed increases above 6000 RPM. The fuel injectors are turned back on when engine speed decreases below 3500 RPM.

Acceleration Mode

The ECM provides extra fuel when it detects a rapid increase in the throttle position and the air flow.

Fuel Cutoff Mode

No fuel is delivered by the fuel injectors when the ignition is OFF. This prevents engine run-on. In addition, the ECM suspends fuel delivery if no reference pulses are detected (engine not running) to prevent engine flooding.

Starting Mode

When the ignition is first turned ON, the ECM energizes the fuel pump relay for two seconds to allow the fuel pump to build up pressure. The ECM then checks the engine coolant temperature (ECT) sensor and the throttle position sensor to determine the proper air/fuel ratio for starting.
The ECM controls the amount of fuel delivered in the starting mode by adjusting how long the fuel injectors are energized by pulsing the injectors for very short times.

Run Mode

The run mode has the following two conditions:

- Open loop
- Closed loop

When the engine is first started, the system is in “open loop” operation. In “Open Loop,” the ECM ignores the signal from the heated oxygen sensor (HO2S). It calculates the air/fuel ratio based on inputs from the TP, ECT, and MAP sensors.
The system remains in “Open Loop” until the following conditions are met:

- The HO2S has a varying voltage output showing that it is hot enough to operate properly (this depends on temperature).
- The ECT has reached a specified temperature.
- A specific amount of time has elapsed since starting the engine.
- Engine speed has been greater than a specified RPM since start-up.

The specific values for the above conditions vary with different engines and are stored in the programmable read only memory (PROM). When these conditions are met, the system enters “closed loop” operation. In “closed loop,” the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Fuel Metering System Components

The fuel metering system is made up of the following parts.

- Fuel injector
- Throttle body
- Fuel rail
- Fuel pressure regulator
- ECM
- Crankshaft position (CKP) sensor
- Idle air control (IAC) valve
- Fuel pump

Fuel Injector

The group fuel injection fuel injector is a solenoid operated device controlled by the ECM. The ECM energizes the solenoid, which opens a valve to allow fuel delivery.

The fuel is injected under pressure in a conical spray pattern at the opening of the intake valve. Excess fuel not used by the injectors passes through the fuel pressure regulator before being returned to the fuel tank.

Fuel Pressure Regulator

The fuel pressure regulator is a diaphragm-operated relief valve mounted on the fuel rail with fuel pump pressure on one side and manifold pressure on the other side. The fuel pressure regulator maintains the fuel pressure available to the injector at three times barometric pressure adjusted for engine load. It may be serviced separately.

If the pressure is too low or poor performance, DTC P0131 or P1171 will be the result. If the pressure is too high, DTC P0132 or P1167 will be the result. Refer to *Fuel System Diagnosis* for information on diagnosing fuel pressure conditions.

Fuel Rail

The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines. The fuel goes through the fuel rail to the fuel pressure regulator. The fuel pressure regulator maintains a constant fuel pressure at the injectors. Remaining fuel is then returned to the fuel tank.

Fuel Pump Electrical Circuit

When the key is first turned ON, the ECM energizes the fuel pump relay for two seconds to build up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump off and waits until the engine is cranked. When the engine is cranked and the 58X crankshaft position signal has been detected by the ECM, the ECM supplies 12 volts to the fuel pump relay to energize the electric in-tank fuel pump.

An inoperative fuel pump will cause a “no-start” condition. A fuel pump which does not provide enough pressure will result in poor performance.

Thottle Body Unit

The throttle body has a throttle plate to control the amount of air delivered to the engine. The Thottle position sensor and IAC valve are also mounted on the throttle body.

Vacuum ports located behind the throttle plate provide the vacuum signals needed by various components. Engine coolant is directed through a coolant cavity in the throttle body to warm the throttle valve and to prevent icing.

GENERAL DESCRIPTION FOR ELECTRIC IGNITION SYSTEM

The engine use two ignition coils, one per two cylinders. A two wire connector provides a battery voltage primary supply through the ignition fuse.

The ignition control spark timing is the ECM's method of controlling the spark advance and the ignition dwell.

The ignition control spark advance and the ignition dwell are calculated by the ECM using the following inputs.

- Engine speed
- Crankshaft position (CKP) sensor
- Engine coolant temperature (ECT) sensor
- Throttle position sensor
- Vehicle speed sensor
- ECM and ignition system supply voltage

Ignition coil works to generate only the secondary voltage be receiving the primary voltage from ECM.

The primary voltage is generated at the coil driver located in the ECM. The coil driver generate the primary voltage based on the crankshaft position signal. In accordance with the crankshaft position signal, ignition coil driver determines the adequate ignition timing and also cylinder number to ignite.

Ignition timing is determined the coolant temperature, intake air temperature, engine speed, engine load, knock sensor signal, etc.

Spark Plug

Although worn or dirty spark plugs may give satisfactory operation at idling speed, they frequently fail at higher engine speeds. Faulty spark plugs may cause poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance. Follow the scheduled maintenance service recommendations to ensure satisfactory spark plug performance. Refer to *Maintenance and Lubrication*.

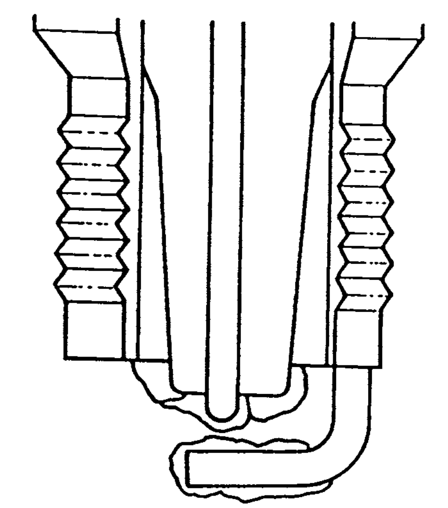
Normal spark plug operation will result in brown to grayish-tan deposits appearing on the insulator portion of the spark plug. A small amount of red-brown, yellow, and white powdery material may also be present on the insulator tip around the center electrode. These deposits are normal combustion by-products of fuels and lubricating oils with additives. Some electrode wear will also occur. Engines which are not running properly are often referred to as "misfiring." This means the ignition spark is not igniting the air/fuel mixture at the proper time. While other ignition and fuel system causes must also be considered, possible causes include ignition system conditions which allow the spark voltage to reach ground in some other manner than by jumping across the air gap at the tip of the spark plug, leaving the air/fuel mixture unburned. Misfiring may also occur when the tip of the spark plug becomes overheated and ignites the mixture before the spark jumps. This is referred to as "pre-ignition."

Spark plugs may also misfire due to fouling, excessive gap, or a cracked or broken insulator. If misfiring occurs before the recommended replacement interval, locate and correct the cause.

Carbon fouling of the spark plug is indicated by dry, black carbon (soot) deposits on the portion of the spark plug in the cylinder. Excessive idling and slow speeds under light engine loads can keep the spark plug temperatures so low that these deposits are not burned off. Very rich fuel mixtures or poor ignition system output may also be the cause. Refer to *DTC P1167*.

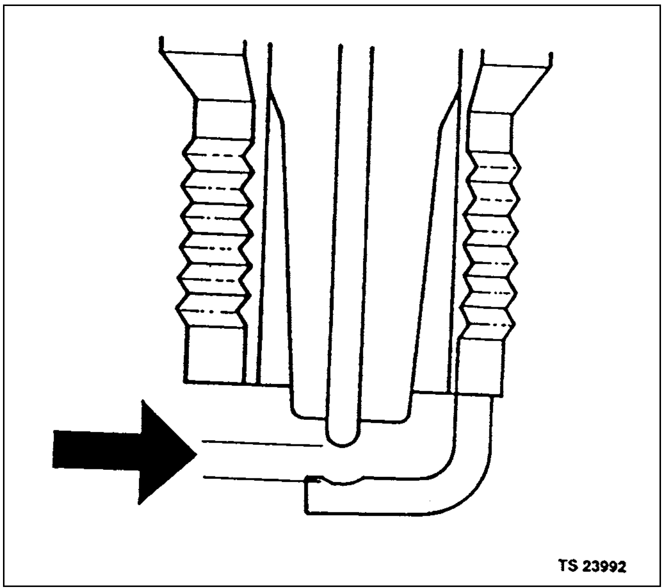
Oil fouling of the spark plug is indicated by wet oily deposits on the portion of the spark plug in the cylinder, usually with little electrode wear. This may be caused by oil during break-in of new or newly overhauled engines.

Deposit fouling of the spark plug occurs when the normal red-brown, yellow or white deposits of combustion by-products become sufficient to cause misfiring. In some cases, these deposits may melt and form a shiny glaze on the insulator around the center electrode. If the fouling is found in only one or two cylinders, valve stem clearances or intake valve seals may be allowing excess lubricating oil to enter the cylinder, particularly if the deposits are heavier on the side of the spark plug facing the intake valve.



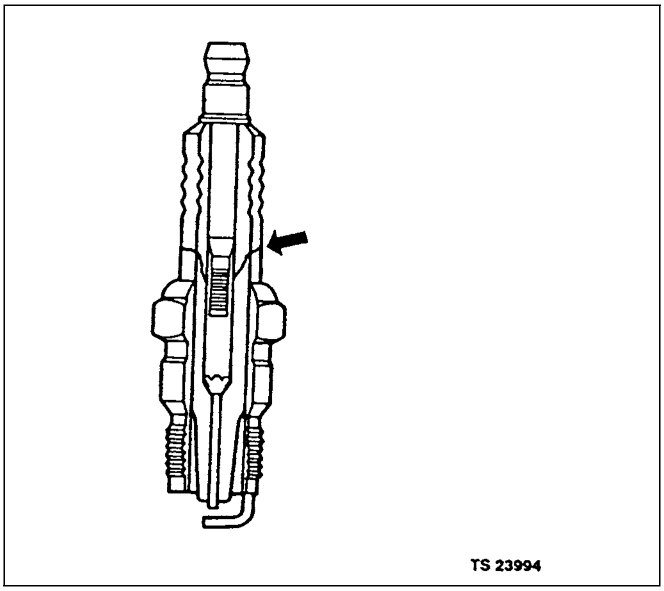
TS 23995

Excessive gap means that the air space between the center and the side electrodes at the bottom of the spark plug is too wide for consistent firing. This may be due to improper gap adjustment or to excessive wear of the electrode during use. A check of the gap size and comparison to the gap specified for the vehicle in Maintenance and Lubrication will tell if the gap is too wide. A spark plug gap that is too small may cause an unstable idle condition. Excessive gap wear can be an indication of continuous operation at high speeds or with engine loads, causing the spark to run too hot. Another possible cause is an excessively lean fuel mixture.



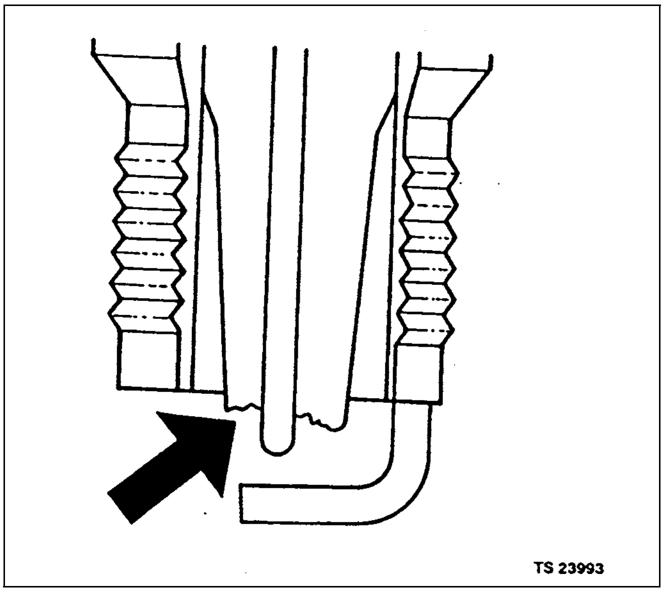
Low or high spark plug installation torque or improper seating can result in the spark plug running too hot and can cause excessive center electrode wear. The plug and the cylinder head seats must be in good contact for proper heat transfer and spark plug cooling. Dirty or damaged threads in the head or on the spark plug can keep it from seating even though the proper torque is applied. Once spark plugs are properly seated, tighten them to the torque shown in the Specifications Table. Low torque may result in poor contact of the seats due to a loose spark plug. Over tightening may cause the spark plug shell to be stretched and will result in poor contact between the seats. In extreme cases, exhaust blow-by and damage beyond simple gap wear may occur.

Cracked or broken insulators may be the result of improper installation, damage during spark plug re-gapping, or heat shock to the insulator material. Upper insulators can be broken when a poorly fitting tool is used during installation or removal, when the spark plug is hit from the outside, or is dropped on a hard surface. Cracks in the upper insulator may be inside the shell and not visible. Also, the breakage may not cause problems until oil or moisture penetrates the crack later.



A broken or cracked lower insulator tip (around the center electrode) may result from damage during re-gapping or from "heat shock" (spark plug suddenly operating too hot).

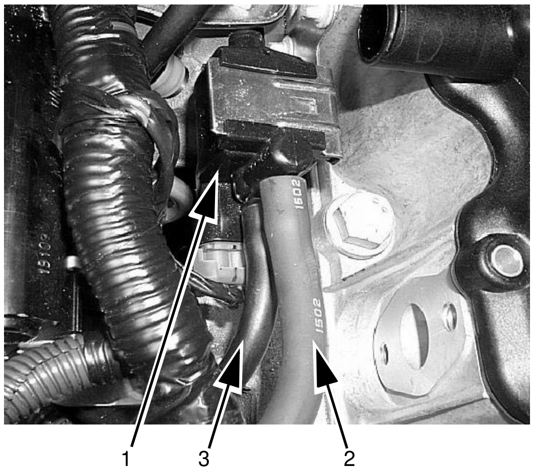
- Damage during re-gapping can happen if the gapping tool is pushed against the center electrode or the insulator around it, causing the insulator to crack. When re-gapping a spark plug, make the adjustment by bending only the ground side terminal, keeping the tool clear of other parts.



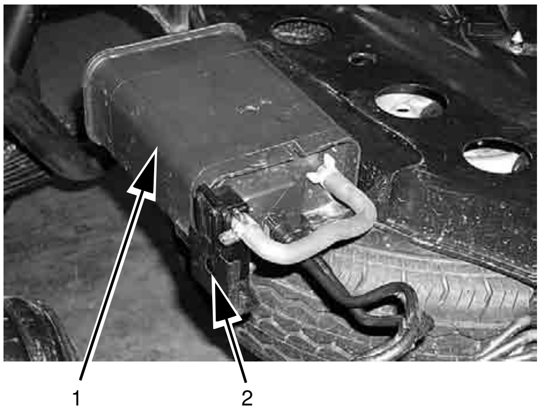
- "Heat shock" breakage in the lower insulator tip generally occurs during several engine operating conditions (high speeds or heavy loading) and may be caused by over-advanced timing or low grade fuels. Heat shock refers to a rapid increase in the tip temperature that causes the insulator material to crack.

Spark plugs with less than the recommended amount of service can sometimes be cleaned and re-gapped, then returned to service. However, if there is any doubt about the serviceability of a spark plug, replace it. Spark plugs with cracked or broken insulators should always be replaced.

GENERAL DESCRIPTION FOR EVAPORATIVE EMISSION SYSTEM



(1) Purge Solenoid Valve
(2) From Canistor to Purge Solenoid
(3) From Purge Solenoid to Intake



(1) Canistor
(2) Air Separator

EVAP Emission Control System Purpose

The basic evaporative emission control system used on the charcoal canister storage method. The method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage devise to hold the vapors when the vehicle is not operating.
The canister is located on the rear axle housing by the frame cross-member.
When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

EVAP Emission Control System Operation

The EVAP canister purge is controlled by a solenoid valve that allows the manifold vacuum to purge the canister. The engine control module (ECM) supplies a ground to energize the solenoid valve (purge on). The EVAP purge solenoid control is pulse-width modulated (PWM) (turned on and off several times a second). The duty cycle (pulse width) is determined by engine operating conditions including load, throttle position, coolant temperature and ambient temperature. The duty cycle is calculated by the ECM. the output is commanded when the appropriate conditions have been met. These conditions are:

- The engine is fully warmed up.
- The engine has been running for a specified time.
- The IAT reading is above 10°C (50°F).
- Purge/Vacuum Hoses. Made of rubber compounds, these hoses route the gasoline fumes from their sources to the canister and from the canister to the intake air flow.
- EVAP Canister. Mounted on a bracket ahead of the fuel tank, the canister stores fuel vapors until the ECM determined that engine conditions are right for them to be removed and burned.

Poor idle, stalling and Poor driveability can be caused by:

- A malfunctioning purge solenoid.
- A damaged canister.
- Hoses that are split, cracked, or not connected properly.

System Fault Detection

The EVAP leak detection strategy is based on applying vacuum to the EVAP system and monitoring vacuum decay. At an appropriate time, the EVAP purge solenoid is turned "ON," allowing the engine vacuum to draw a small vacuum on the entire evaporative emission system.
After the desired vacuum level has been achieved, the EVAP purge solenoid is turned "OFF," sealing the system. A leak is detected by monitoring for a decrease in vacuum level over a given time period, all other variables remaining constant.
If the desired vacuum level cannot be achieved in the test described above, a large leak or a faulty EVAP purge control solenoid valve is indicated.
Leaks can be caused by the following conditions:

- Missing or faulty fuel cap
- Disconnected, damaged, pinched, or blocked EVAP purge line
- Disconnected, damaged, pinched, or blocked fuel tank vapor line
- Disconnected or faulty EVAP purge control solenoid valve
- Open ignition feed circuit to the purge solenoid

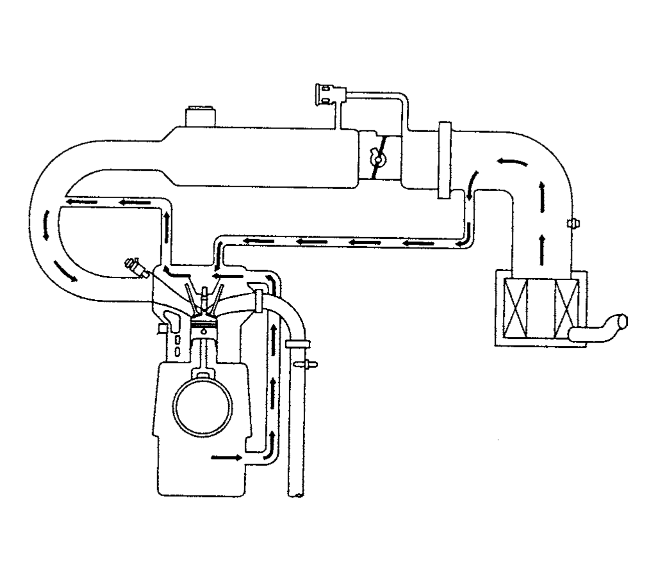
- Damaged EVAP canister
- Leaking fuel sender assembly O-ring
- Leaking fuel tank or fuel filler neck

The ECM supplies a ground to energize the purge control solenoid valve (purge "ON"). The EVAP purge control is turned "ON" and "OFF," several times a second. The duty cycle (pulse width) is determined by engine operating conditions including load, throttle position, coolant temperature and ambient temperature. The duty cycle is calculated by the ECM and the output is commanded when the appropriate conditions have been met.

The system checks for conditions that cause the EVAP system to purge continuously by commanding the EVAP purge solenoid "OFF", EVAP purge solenoid duty ratio "0%". If fuel tank vacuum level increases during the test, a continuous purge flow condition is indicated. This can be caused by the following conditions:

- EVAP purge solenoid leaking
- EVAP purge and engine vacuum lines switched at the EVAP purge control solenoid valve
- EVAP purge control solenoid valve driver circuit grounded

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM



Crankcase Ventilation System Purpose

The crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting them to the atmosphere. Fresh air from the throttle body is supplied to the crankcase and mixed with blow-by gases. This mixture is then passed through the positive crankcase ventilation (PCV) port into the intake manifold.
While the engine is running, exhaust gases and small amounts of the fuel/air mixture escape past the piston rings and enter the crankcase. these gases are mixed with clean air entering through a tube from the air intake duct.

During normal, part-throttle operation, the system is designed to allow crankcase gases to flow through the PCV hose into the intake manifold to be consumed by normal combustion.
A plugged positive crankcase ventilation port or PCV hose may cause the following conditions:

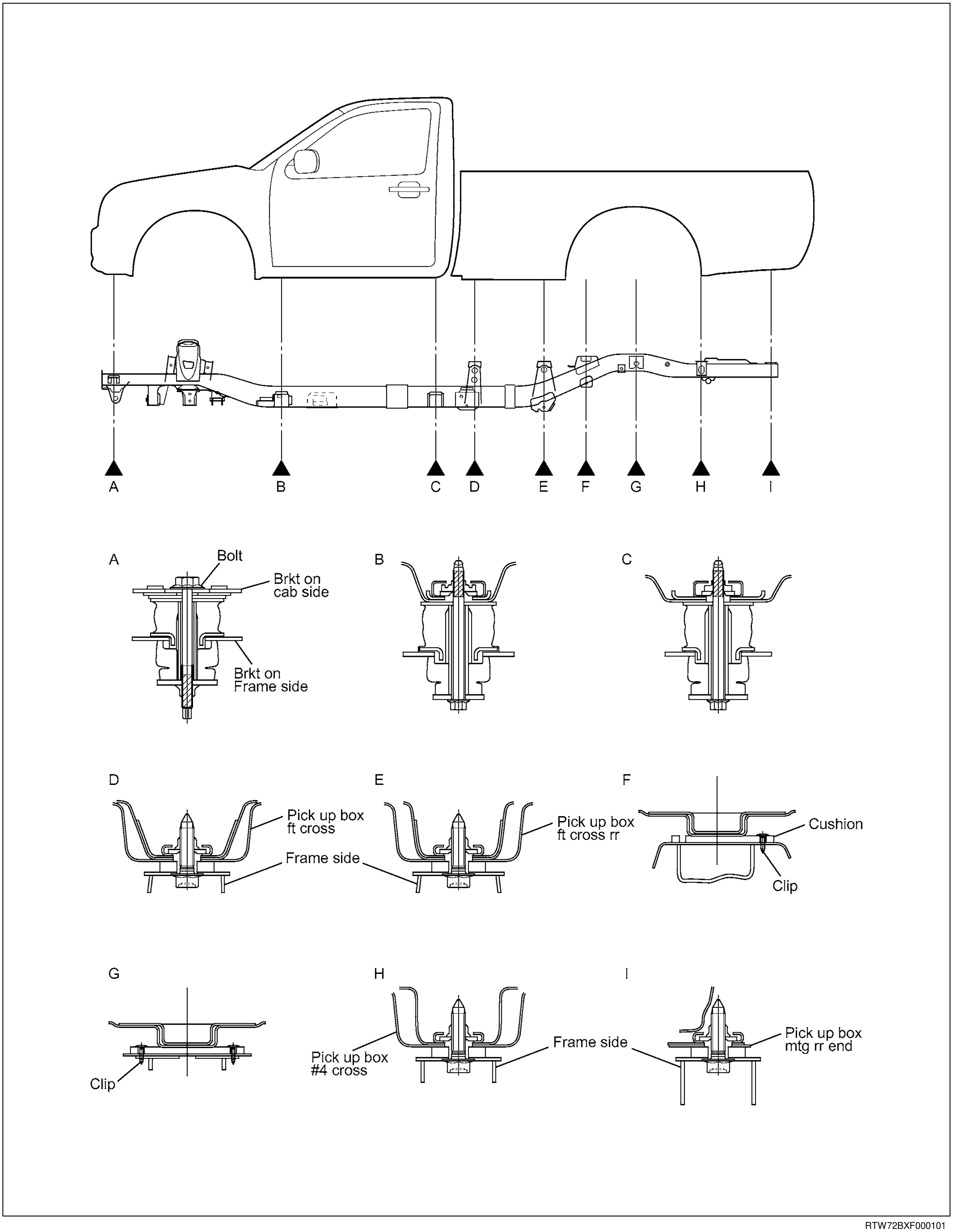
- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in the engine.

A leaking PCV hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

BODY MOUNTING

REGULAR CAB Model



A/C CLUTCH DIAGNOSIS

A/C Clutch Circuit Operation

A 12-volt signal is supplied to the A/C request input of the ECM when the A/C is selected through the A/C control switch.

The A/C compressor clutch relay is controlled through the ECM. This allows the ECM to modify the idle air control position prior to the A/C clutch engagement for better idle quality. If the engine operating conditions are within their specified calibrated acceptable ranges, the ECM will enable the A/C compressor relay. This is done by providing a ground path for the A/C relay coil within the ECM. When the A/C compressor relay is enabled, battery voltage is supplied to the compressor relay is enabled, battery voltage is supplied to the compressor clutch coil.

The ECM will enable the A/C compressor clutch whenever the engine is running and the A/C has been requested. The ECM will not enable the A/C compressor clutch if any of the following conditions are met:

- The engine speed is greater than 6000 RPM.
- The ECT is greater than 122°C (251°F).
- The throttle is more than 95% open.

A/C Clutch Circuit Purpose

The A/C compressor operation is controlled by the engine control module (ECM) for the following reasons:

- It improves idle quality during compressor clutch engagement.
- It improves wide open throttle (WOT) performance.
- It provides A/C compressor protection from operation with incorrect refrigerant pressures.

The A/C electrical system consists of the following components:

- The A/C control switch.
- The A/C refrigerant pressure switches.
- The A/C compressor clutch.
- The A/C compressor clutch relay.
- The ECM.

A/C Request Signal

This signal tells the ECM when the A/C mode is selected at the A/C control switch. The ECM uses this input to adjust the idle speed before turning on the A/C clutch. The A/C compressor will be inoperative if this signal is not available to the ECM.

Refer to *A/C Clutch Circuit Diagnosis* for A/C wiring diagrams and diagnosis for the A/C electrical system.

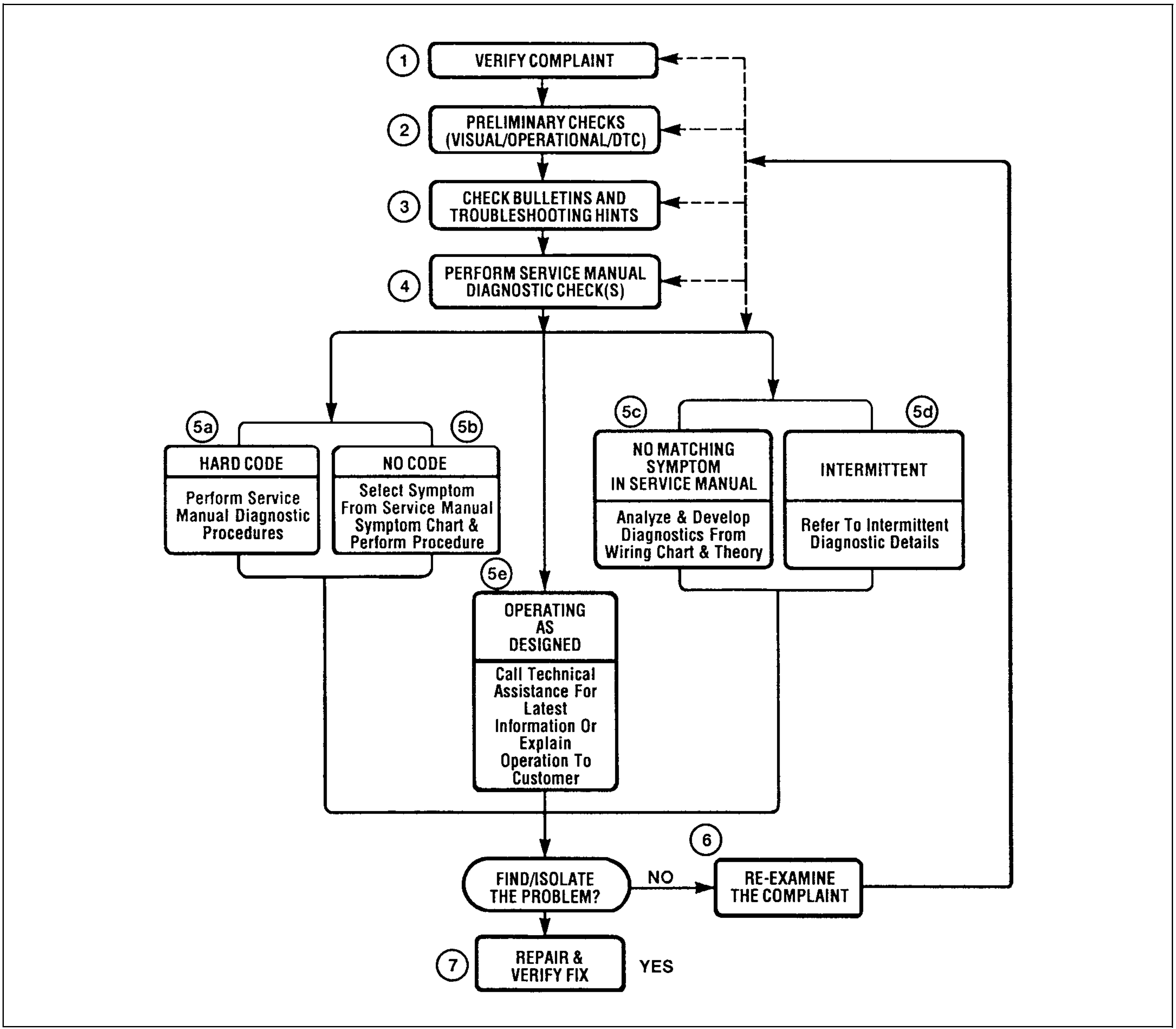
ISUZU STRATEGY BASED DIAGNOSTICS

Overview

As a retail service technician, you are part of the ISUZU service team. The team goal is FIX IT RIGHT THE FIRST TIME for the satisfaction of every customer. You are a very important member of the team as you diagnose and repair customer vehicles.

You have maximum efficiency in diagnosis when you have an effective, organized plan for your work. Strategy Based Diagnostics (refer to Figure 1) provides you with guidance as you create and follow a plan of action for each specific diagnostic situation.

STRATEGY BASED DIAGNOSTICS CHART



Diagnostic Thought Process

As you follow a diagnostic plan, every box on the Strategy Based Diagnostics chart requires you to use the diagnostic thought process. This method of thinking optimizes your diagnosis in the following ways:

- Improves your understanding and definition of the customer complaint
- Saves time by avoiding testing and/or replacing good parts
- Allows you to look at the problem from different perspectives
- Guides you to determine what level of understanding about system operation is needed:
  - Owner's manual level
  - Service manual level
  - In-depth (engineering) level
    - Owner's manual level
    - Service manual level
    - In-depth (engineering) level

1. Verify the Complaint

What you should do

To verify the customer complaint, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.
The following information will help you verify the complaint:

- WHAT the vehicle model/options are
- WHAT aftermarket and dealer-installed accessories exist
- WHAT related system(s) operate properly
- WHEN the problem occurs
- WHERE the problem occurs
- HOW the problem occurs
- HOW LONG the condition has existed (and if the system ever worked correctly)
- HOW OFTEN the problem occurs
- Whether the severity of the problem has increased, decreased or stayed the same

What resources you should use

Whenever possible, you should use the following resources to assist you in verifying the complaint:

- Service manual Theory or Circuit Description sections
- Service manual "System Performance Check"
- Owner manual operational description
- Technician experience
- Identical vehicle for comparison
- Circuit testing tools
- Vehicle road tests
- Complaint check sheet
- Contact with the customer

2. Perform Preliminary Checks

NOTE: An estimated 10 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You perform preliminary checks for several reasons:

- To detect if the cause of the complaint is VISUALLY OBVIOUS
- To identify parts of the system that work correctly
- To accumulate enough data to correctly and accurately search for a ISUZU Service Bulletin on ISUZU Web site.

The initial checks may vary depending on the complexity of the system and may include the following actions:

- Operate the suspect system
- Make a visual inspection of harness routing and accessible/visible power and ground circuits
- Check for blown fuses
- Make a visual inspection for separated connectors
- Make a visual inspection of connectors (includes checking terminals for damage and tightness)
- Check for any DTCs stored by the on-board computers
- Sense unusual noises, smells, vibrations or movements
- Investigate the vehicle service history (call other dealerships, if appropriate)

What resources you should use

Whenever appropriate, you should use the following resources for assistance in performing preliminary checks:

- Tech II or other technical equipment for viewing DTCs
- Service manual information:
  - Component locations
  - Harness routing
  - Wiring schematics
  - Procedures for viewing DTCs
- Dealership service history file
- Vehicle road test
- Identical vehicle or system for comparison

3. Check Bulletins and Troubleshooting Hints

NOTE: As estimated 30 percent of successful vehicle repairs are diagnosed with this step!

What you should do

You should have enough information gained from preliminary checks to accurately search for a bulletin and other related service information. Some service manual sections provide troubleshooting hints that match symptoms with specific complaints.

What resources you should use

You should use the following resources for assistance in checking for bulletins and troubleshooting hints:

- Printed bulletins
- Access ISUZU Bulletin Web site.
- Videotapes
- Service manual

4. Perform Service Manual Diagnostic Checks

What you should do

The “System Checks” in most service manual sections and in most cells of section 8A (electrical) provide you with:

- A systematic approach to narrowing down the possible causes of a system fault
- Direction to specific diagnostic procedures in the service manual
- Assistance to identify what systems work correctly

What resources you should use

Whenever possible, you should use the following resources to perform service manual checks:

- Service manual
- Technical equipment (for viewing DTCs and analyzing data)
- Digital multimeter and circuit testing tools
- Other tools as needed

5a and 5b. Perform Service Manual Diagnostic Procedures

NOTE: An estimated 40 percent of successful vehicle repairs are diagnosed with these steps!

What you should do

When directed by service manual diagnostic checks, you must then carefully and accurately perform the steps of diagnostic procedures to locate the fault related to the customer complaint.

What resources you should use

Whenever appropriate, you should use the following resources to perform service manual diagnostic procedures:

- Service manual
- Technical equipment (for analyzing diagnostic data)
- Digital multimeter and circuit testing tools
- Essential and special tools

5c. Technician Self Diagnoses

When there is no DTC stored and no matching symptom for the condition identified in the service manual, you must begin with a thorough understanding of how the system(s) operates. Efficient use of the service manual combined with you experience and a good process of elimination will result in accurate diagnosis of the condition.

What you should do

Step 1: Identify and understand the suspect circuit(s)

Having completed steps 1 through 4 of the Strategy Based Diagnostics chart, you should have enough information to identify the system(s) or sub-system(s) involved. Using the service manual, you should determine and investigate the following circuit characteristics:

- Electrical:
  - How is the circuit powered (power distribution charts and/or fuse block details)?
  - How is the circuit grounded (ground distribution charts)?
  - How is the circuit controlled or sensed (theory of operation):
    - If it is a switched circuit, is it normally open or normally closed?
    - Is the power switched or is the ground switched?
    - Is it a variable resistance circuit (ECT sensor or TP sensor, for example)?
    - Is it a signal generating device (MAF sensor of VSS, for example)?
    - Does it rely on some mechanical/vacuum device to operate?
- Physical:
  - Where are the circuit components (component locators and wire harness routing diagrams):
    - Are there areas where wires could be chafed or pinched (brackets or frames)?
    - Are there areas subjected to extreme temperatures?

  - Are there areas subjected to vibration or movement (engine, transmission or suspension)?
  - Are there areas exposed to moisture, road salt or other corrosives (battery acid, oil or other fluids)?
  - Are there common mounting areas with other systems/components?
- Have previous repairs been performed to wiring, connectors, components or mounting areas (causing pinched wires between panels and drivetrain or suspension components without causing and immediate problem)?
- Does the vehicle have aftermarket or dealer-installed equipment (radios, telephone, etc.)

Step 2: Isolate the problem

At this point, you should have a good idea of what could cause the present condition, as well as could not cause the condition. Actions to take include the following:

- Divide (and separate, where possible) the system or circuit into smaller sections
- Confine the problem to a smaller area of the vehicle (start with main harness connections while removing panels and trim as necessary in order to eliminate large vehicle sections from further investigation)
- For two or more circuits that do not share a common power or ground, concentrate on areas where harnesses are routed together or connectors are shared (refer to the following hints)

Hints

Though the symptoms may vary, basic electrical failures are generally caused by:

- Loose connections:
  - Open/high resistance in terminals, splices, connectors or grounds
- Incorrect connector/harness routing (usually in new vehicles or after a repair has been made):
  - Open/high resistance in terminals, splices, connectors of grounds
- Corrosion and wire damage:
  - Open/high resistance in terminals, splices, connectors of grounds
- Component failure:
  - Opens/short and high resistance in relays, modules, switches or loads
- Aftermarket equipment affecting normal operation of other systems

You may isolate circuits by:

- Unplugging connectors or removing a fuse to separate one part of the circuit from another part
- Operating shared circuits and eliminating those that function normally from the suspect circuit
- If only one component fails to operate, begin testing at the component
- If a number of components do no operate, begin tests at the area of commonality (such as power sources, ground circuits, switches or major connectors)

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Technical equipment (for data analysis)
- Experience
- Technical Assistance
- Circuit testing tools

5d. Intermittent Diagnosis

By definition, an intermittent problem is one that does not occur continuously and will occur when certain conditions are met. All these conditions, however, may not be obvious or currently known. Generally, intermittents are caused by:

- Faulty electrical connections and wiring
- Malfunctioning components (such as sticking relays, solenoids, etc.)
- EMI/RFI (Electromagnetic/radio frequency interference)
- Aftermarket equipment

Intermittent diagnosis requires careful analysis of suspected systems to help prevent replacing good parts. This may involve using creativity and ingenuity to interpret customer complaints and simulating all external and internal system conditions to duplicate the problem.

What you should do

Step 1: Acquire information

A thorough and comprehensive customer check sheet is critical to intermittent problem diagnosis. You should require this, since it will dictate the diagnostic starting point. The **vehicle service history** file is another source for accumulating information about the complaint.

Step 2: Analyze the intermittent problem

Analyze the customer check sheet and service history file to determine conditions relevant to the suspect system(s).

Using service manual information, you must identify, trace and locate all electrical circuits related to the malfunctioning system(s). If there is more than one system failure, you should identify, trace and locate areas of commonality shared by the suspect circuits.

Step 3: Simulate the symptom and isolate the problem

Simulate the symptom and isolate the system by reproducing all possible conditions suggested in Step 1 while monitoring suspected circuits/components/ systems to isolate the problem symptom. Begin with the most logical circuit/component.

Isolate the circuit by dividing the suspect system into simpler circuits. Next, confine the problem into a smaller area of the system. Begin at the most logical point (or point of easiest access) and thoroughly check the isolated circuit for the fault, using basic circuit tests.

Hints

You can isolate a circuit by:

- Unplugging connectors or removing a fuse to separate one part of the circuit from another
- If only component fails to operate, begin testing the component
- If a number of components do not operate, begin test at areas of commonality (such as power sources, ground circuits, switches, main connectors or major components)
- Substitute a known good part from the parts department or the vehicle system
- Try the suspect part in a known good vehicle

See **Symptom Simulation Tests** on the next page for problem simulation procedures. Refer to service manual sections 6E and 8A for information about intermittent diagnosis. Follow procedures for basic circuit testing in service manual section 8A.

What resources you should use

Whenever appropriate, you should use the following resources to assist in the diagnostic process:

- Service manual
- Bulletins
- Digital multimeter (with a MIN/MAX feature)
- Tech II and Tech II upload function
- Circuit testing tools (including connector kits/ harnesses and jumper wires)
- Experience
- Intermittent problem solving simulation methods
- Customer complaint check sheet

Symptom Simulation Tests

1. Vibration

This method is useful when the customer complaint analysis indicates that the problem occurs when the vehicle/system undergoes some form of vibration.

For connectors and wire harness, slightly shake vertically and horizontally. Inspect the connector joint and body for damage. Also, tapping lightly along a suspected circuit may be helpful.

For parts and sensors, apply slight vibration to the part with a light tap of the finger while monitoring the system for a malfunction.

2. Heat

This method is important when the complaint suggests that the problem occurs in a heated environment. Apply moderate heat to the component with a hair drier or similar tool while monitoring the system for a malfunction.

CAUTION: Care must be take to avoid overheating the component.

3. Water and Moisture

This method may be used when the complaint suggests that the malfunction occurs on a rainy day or under conditions of high humidity. In this case, apply water in a light spray on the vehicle to duplicate the problem.

CAUTION: Care must be take to avoid directly exposing electrical connections to water.

4. Electrical loads

This method involves turning systems ON (such as the blower, lights or rear window defogger) to create a load on the vehicle electrical system at the same time you are monitoring the suspect circuit/component.

5e. Vehicle Operates as Designed

This condition refers to instances where a system operating as designed is perceived to be unsatisfactory or undesirable. In general, this is due to:

- A lack of understanding by the customer
- A conflict between customer expectations and vehicle design intent
- A system performance that is unacceptable to the customer

What you should do

You can verify that a system is operating as designed by:

- Reviewing service manual functional/diagnostic checks
- Examining bulletins and other service information for supplementary information
- Compare system operation to an identical vehicle

If the condition is due to a customer misunderstanding or a conflict between customer expectation and system operation, you should explain the system operation to the customer.

If the complaint is due to a case of unsatisfactory system performance, you should contact Technical Assistance for the latest information.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Vehicle service information (service manual, etc.)
- ISUZU field support
- Experience
- Identical vehicle or system for comparison

6. Re-examine the complaint

When you do not successfully find/isolate the problem after executing a diagnostic path, you should re-examine the complaint.

What you should do

In this case, you will need to backtrack and review information accumulated from step 1 through 4 of Strategy Based Diagnostics. You also should repeat any procedures that require additional attention.
A previous path may be eliminated from consideration only if you are certain that all steps were executed as directed. You must then select another diagnostic path (step 5a, 5b, 5c or 5d). If all possible options have been explored, you may call or seek ISUZU field support.

What resources you should use

Whenever possible, you should use the following resources to facilitate the diagnostic process:

- Service manual
- Accumulated information form a previous diagnostic path
- Service information and publications
- ISUZU field support

7. Repair and Verify Fix

What you should do

After you have located the cause of the problem, you must execute a repair by following recommended service manual procedures.
When the repair is completed, you should verify the fix by performing the system checks under the conditions listed in the customer complaint.
If applicable, you should carry out preventive measures to avoid a repeat complaint.

What resources you should use

Whenever possible, you should use the following resources to facilitate the repair process:

- Electrical repair procedures
- Service manual information and publications

GENERAL SERVICE INFORMATION

Aftermarket Electrical and Vacuum Equipment

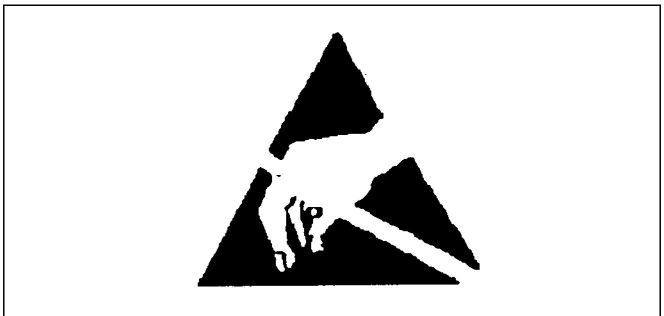
Aftermarket (add-on) electrical and vacuum equipment is defined as any equipment which connects to the vehicle's electrical or vacuum systems that is installed on a vehicle after it leaves the factory. No allowances have been made in the vehicle design for this type of equipment.

NOTE: No add-on vacuum equipment should be added to this vehicle.

NOTE: Add-on electrical equipment must only be connected to the vehicle's electrical system at the battery (power and ground).

Add-on electrical equipment, even when installed to these guidelines, may still cause the electric system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any electric problem is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, it may be diagnosed in the normal manner.

Electrostatic Discharge Damage



Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4000 volts for a person to feel even the zap of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

- An example of charging by friction is a person sliding across a vehicle seat.
- Charge by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to use care when handling and testing electronic components.

Non-OEM Parts

All of the OBD diagnostics have been calibrated to run with OEM parts. Accordingly, if commercially sold sensor or switch is installed, it makes a wrong diagnosis and turns on the check engine lamp.

Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may radiate EMI into the control system if they are improperly installed. This may cause a false sensor reading and turn on the check engine lamp.

Poor Vehicle Maintenance

The sensitivity of OBD diagnostics will cause the check engine lamp to turn on if the vehicle is not maintained properly. Restricted oil filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance can not be classified as a “non-vehicle fault”, but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Related System Faults

Many of the OBD system diagnostics will not run if the ECM detects a fault on a related system or component.

Visual/Physical Engine Compartment Inspection

Perform a careful visual and physical engine compartment inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

NOTE: Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

On-Board Diagnostic (OBD)

On-Board Diagnostic Tests

A diagnostic test is a series of steps, the result of which is a pass or fail reported to the diagnostic executive. When a diagnostic test reports a pass result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The diagnostic test has passed during the current ignition cycle.
- The fault identified by the diagnostic test is not currently active.

When a diagnostic test reports a fail result, the diagnostic executive records the following data:

- The diagnostic test has been completed since the last ignition cycle.
- The fault identified by the diagnostic test is currently active.
- The fault has been active during this ignition cycle.
- The operating conditions at the time of the failure.

The Diagnostic Executive

The Diagnostic Executive is a unique segment of software which is designed to coordinate and prioritize the diagnostic procedures as well as define the protocol for recording and displaying their results. The main responsibilities of the Diagnostic Executive are listed as follows:

- Commanding the check engine lamp on and off
- DTC logging and clearing
- Current status information on each diagnostic

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by the control module, a diagnostic trouble code is set and the check engine lamp is illuminated.

Check Engine Lamp

The check engine lamp looks the same as the check engine lamp you are already familiar with, the “Check Engine” lamp.

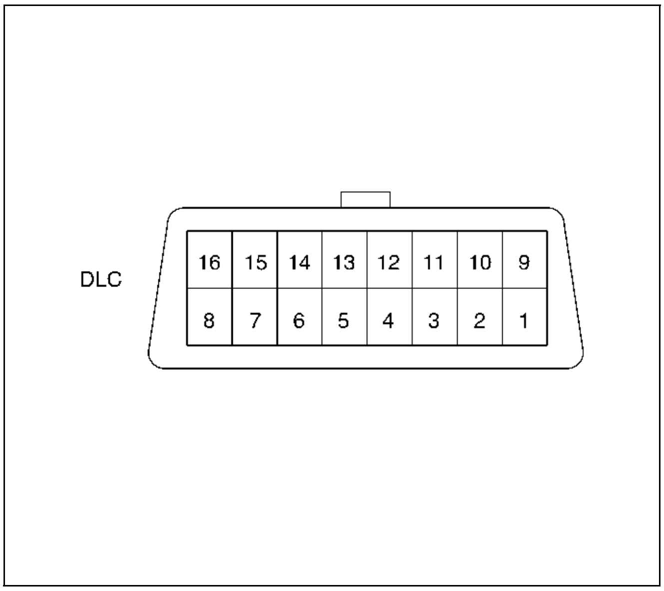
Basically, the check engine lamp is turned on when the ECM detects a DTC that will impact the vehicle emissions.

- When the check engine lamp remains “ON” while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, a Powertrain On-Board Diagnostic (OBD) System Check must be performed. The procedures for these checks are given in On-Board Diagnostic (OBD) System Check. These checks will expose faults which may not be detected if other diagnostics are performed first.

Data Link Connector (DLC)

The provision for communication with the contorl module is the Data Link Connector (DLC). It is located behind the lower front instrument panel. The DLC is used to connect to a Tech2. Some common uses of the Tech2 are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs.
- Reading serial data.



Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with OBD system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps is very important in verifying repairs on OBD systems. Failure to follow these steps could result in unnecessary repairs.

Reading Diagnostic Trouble Codes Using a Tech 2

The procedure for reading diagnostic trouble code(s) is to used a diagnostic Tech2. When reading DTC(s), follow instructions supplied by Tech2 manufacturer.

Clearing Diagnostic Trouble Codes

To clear Diagnostic Trouble Codes (DTCs), use the Tech2 “clear DTCs” or “clear information” function. When clearing DTCs follow instructions supplied by the Tech2 manufacturer.

Diagnosis With Tech 2

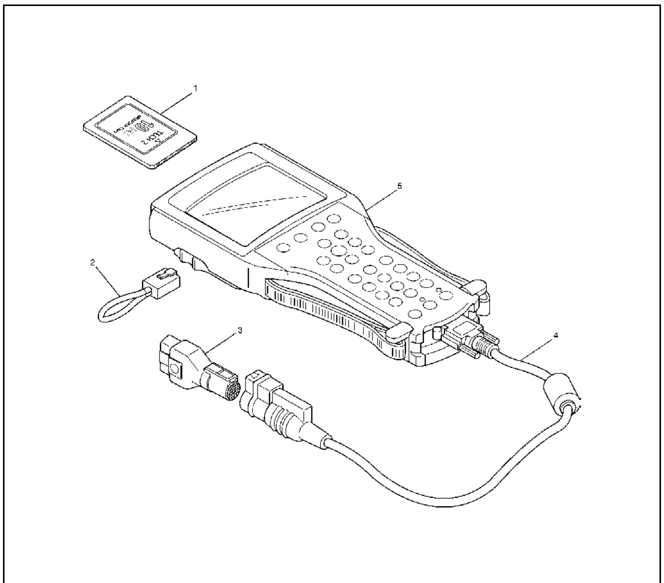
If no codes are set:

- Refer to **F1: Data Display** and identify the electrical faults that are not indicated by trouble code.
- Refer to “**SYMPTOM DIAGNOSIS**”.

If codes are set:

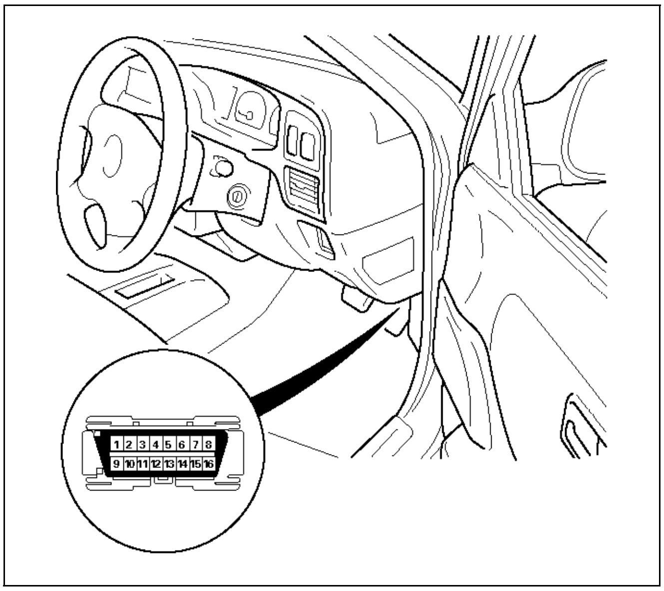
1. Record all trouble codes displayed by Tech 2 and check id the codes are intermittent.
2. Clear the codes.
3. Drive the vehicle for a test to reproduce the faulty status.
4. Check trouble codes again using the Tech 2.
5. If no codes is displayed by test driving, the fault is intermittent. In this case, refer to “DIAGNOSIS AIDS”.
6. If a code is present, refer to DTC Chart for diagnosis.
7. Check trouble codes again using the Tech 2.

Tech 2 CONNECTION



Tech 2 scan tool is used to electrically diagnose the automatic transmission system and to check the system. The Tech 2 enhances the diagnosis efficiency though all the troubleshooting can be done without the Tech 2.

1. Configuration of Tech 2
   - Tech 2 scan tool kit (No. 7000086), Tech 2 scan tool (No. 7000057) and DLC cable (No. 3000095).
   - SAE 16/19 adapter (No. 3000098) (3), RS232 loop back connector (No. 3000112) (2) and PCMCIA card (No. 3000117) (1).
2. Tech 2 Connection
   - Check the key switch is turn OFF.
   - Insert the PCMCIA card (1) into the Tech 2 (5).
   - Connect the SAE 16/19 adapter (3) to the DLC cable (4).
   - Connect the DLC cable (4) to the Tech 2 (5).
   - Connect the SAE 16/19 adapter (3) to the data link connector of the vehicle.



   - Turn the key switch of the vehicle ON and press the “PWR” key of the Tech 2.
   - Check the display of the Tech 2.

NOTE: Be sure to check that the power is not supplied to the Tech 2 when attaching or removing the PCMCIA card.

Important Operations – Installation

Bolt : A

Torque	N·m(kgf·m/lb·ft)
50 (5.1 / 37)	

Bolt : B,C

Torque	N·m(kgf·m/lb·ft)
72 (7.3 / 53)	

Bolt : D,E,H,I

Torque	N·m(kgf·m/lb·ft)
54 (5.5 / 40)	

NOTE :

Discard the used mounting bolts D,E,H,I shown in the figure and install new ones.

Tech 2 Operating Flow Cart (Start Up)

Tech 2

Press (ENTER) to Continue

Press “ENTER” key.

Main Menu
- F0: Diagnostic
- F1: Service Programming System (SPS)
- F2: View Capture Data
- F3: Tool Option
- F4: Download/ Upload Help

Select “F0: Diagnostic”.

Vehicle Identification
- (3) 2003
- (2) 2002
- (1) 2001
- (Y) 2000
- (X) 1999
- (W) 1998

Select “(3) 2003” or later.

Vehicle Identification
- (UB) Trooper, Bighorn
- (UE) Rodeo,/Amigo, Wizard/Mu
- (TF/UC) LUV, Frontier, LAO-Rodeo
- (TBR)
- (N*) ELF, NPR, NQR

Select “(TF/UC)”.

System Selection Menu
- F0: Powertrain
- F1: Chassis
- F3: Body

Select “F0: Powertrain”.

Vehicle Identification
- 4JH1-TC Bosch
- 4JH1-T Denso
- 2.XL L4 HV240
- 3.5L V6 6VE1 Hitachi
- AW30-40LE
- AT JR405E

Select “2.XL L4 HV240”.

Select “2.XL L4 HV240” in Vehicle Identification menu and the following table is shown in the Tech 2 screen.

F0: Diagnostic Trouble Code
- F0: Read DTC Infor By Priority
- F1: Clear DTC Information
- F2: DTC Information
  - F0: History
  - F1: MIL SVS or Message Requested
  - F2: Last Test Failed
  - F3: Test Failed Since Code Cleared
  - F4: Not Run Since Code Cleared
  - F5: Failed This Ignition

F1: Data Display
- F0: Engine Data
- F1: O_2 Sensor Data

F2: Snapshot

F3: Miscellaneous Test
- F0: Lamps
  - F0: Malfunction Indicator Lamps
- F1: Relays
  - F0: Fuel Pump Relay
  - F1: A/C Clutch Relay
- F2: EVAP
  - F0: Purge Solenoid
- F3: IAC System
  - F0: IAC Control
  - F1: IAC Reset
- F4: Injector Balance Test

F0: Diagnostic Trouble Code
The purpose of the “Diagnostic Trouble Codes” mode is to display stored trouble code in the ECM.
When “Clear DTC Information” is selected, a “Clear DTC Information”, warning screen appears.
This screen informs you that by cleaning DTC's “all stored DTC information in the ECM will be erased”.
After clearing codes, confirm system operation by test driving the vehicle.
Use the “DTC Information” mode to search for a specific type of stored DTC information.

History
This selection will display only DTCs that are stored in the ECM's history memory. It will not display Type B DTCs that have not requested the MIL (“Check Engine Lamp”). It will display all type A and B DTCs that requested the MIL and have failed within the last 40 warm-up cycles. In addition, it will display all type C and D DTCs that have failed within the last 40 warm-up cycles.

MIL SVC or Message Request
This selection will display only DTCs that are requesting the MIL. Type C and Type D DTCs cannot be displayed using the MIL. Type C and D DTCs cannot be displayed using this option.
This selection will report type B DTCs only after the MIL has been requested.

Last Test Failed
This selection will display only DTCs that have failed the last time the test run. The last test may have run during a previous ignition cycle of a type A or type B DTC is displayed. For type C and type D DTCs, the last failure must have occurred during the current ignition cycle to appear as last test fail.

Test Failed Since Code Cleared
The selection will display all active and history DTCs that have reported a test failure since the last time DTCs were cleared. DTCs that last failed more that 40 warm-up cycles before this option is selected will not be displayed.

No Run Since Code Cleared
This selection will display up to DTCs that have not run since the DTCs were last cleared. Since any displayed DTCs have not run, their condition (passing or failing) is unknown.

Failed This Ignition
This selection will display all DTCs that have failed during the present ignition cycle.

F1: Data Display
The purpose of the “Data Display” mode is to continuously monitor data parameters.
The current actual values of all important sensors and signals in the system are display through F1 mode.
See the “Typical Scan Data” section.

F2: Snapshot
“Snapshot” allows you to focus on making the condition occur, rather than trying to view all of the data in anticipation of the fault.
The snapshot will collect parameter information around a trigger point that you select.

F3: Miscellaneous Test:
The purpose of “Miscellaneous Test” mode is to check for correct operation of electronic system actuators.

TYPICAL SCAN DATA & DEFINITIONS (ENGINE DATA)

Use the Typical Values Table only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing.
Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80 deg.)

	Tech 2 Parameter	Units	Idle	2000rpm	Description
1	Engine Speed	rpm	775 - 875	1950 - 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
2	Desired Idle Speed	rpm	825	800 - 850	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
3	Engine Coolant Temperature	°C or °F	80 - 90	80 - 90	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
4	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on ECT at start-up	Depends on ECT at start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
5	Intake Air Temperature	°C or °F	Depends on ambient temp	Depends on ambient temp	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
6	Start Up IAT (Intake Air Temperature)	°C or °F	Depends on IAT at start-up	Depends on IAT at start-up	Start-up IAT is measured by ECM from IAT sensor output voltage when engine is started.
7	Manifold Absolute Pressure	kPa	31 - 36	25 - 30	The MAP (kPa) is measured by ECM from MAP output voltage. This data is changing by inlet manifold pressure.
8	Barometric Pressure	kPa	Depends on altitude	Depends on altitude	The barometric pressure is measured by ECM from the MAP sensor output voltage monitored during key up and wide open throttle. This data is changing by altitude.
9	Throttle Position	%	0	2-4	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 - 100% at full throttle.
10	Calculated Air Flow	g/s	3.5 -4.50	8.0 - 10.0	This displays calculated air mount from MAP sensor output. This data is changing by inlet manifold pressure.
11	Air Fuel Ratio		14.6:1	14.6:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 - 14.7:1.
12	Spark Advance	°CA	8 - 15	25 - 32	This displays the amount of spark advance being commanded by the ECM.
13	Engine Load	%	2 - 5	5 - 10	This displays is calculated by the ECM form engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
14	Injection Pulse Width	ms	1.0 - 3.0	3.0 - 4.0	This displays the amount of time the ECM is commanding each injector On during each engine cycle. A longer injector pulse width will cause more fuel to be delivered. Injector pulse width should increase with increased engine load.
15	Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in “Open Loop” operation. In “Open Loop”, the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters “Closed Loop” operation. In “Closed Loop”, the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
16	Knock Present	Yes/No	No	No	This displays knock sensor detection status. When engine knock is occurred, displays "Yes".
17	Knock Counter		-	-	This displays the number of knock during a ignition cycle.
18	Knock Retard	°CA	0	0	This displays the commanded ignition spark timing retard timing based on the signal from the knock sensor.
19	A/C Clutch Relay	On/Off	Off	Off	This displays whether the ECM has commanded the A/C compressor clutch “On” or “Off”.

	Tech 2 Parameter	Units	Idle	2000rpm	Description
20	A/C Request	Yes/No	Off	Off	This displays the air conditioner request signal. This should display “On” when the air conditioner switch is switched on.
21	EVAP Purge Solenoid (Evaporative Emission)	%	0 - 10	0 - 10	This displays the duty signal from the ECM to control the canister purge solenoid valve.
22	Fuel Pump	On/Off	On	On	This displays operating status for the fuel pump main relay. This should display “On” when the key switch is turned on and while engine is running.
23	Idle Air Control	Steps	20 - 30	65 - 75	This displays the ECM commanded position of the idle air control valve pintle. A larger number means that more air is being commanded through the idle air passage.
24	Idle Speed Variation	rpm	-25 - 0	1125 - 1225	This displays variation of actual engine speed & desired idle speed.
25	Vehicle Speed	km/h or mph	0	0	This displays vehicle speed. The vehicle speed is measured by ECM from the vehicle speed sensor.
26	Ignition Voltage	V	10.0 - 14.5	10.0 - 14.5	This displays the system voltage measured by the ECM at ignition feed.
27	Reference Voltage	V	5.00	5.00	
28	Malfunction Indicator Lamp	On/Off	Off	Off	This displays operating status for the Check Engine Lamp. This should display “On” when the Check Engine Lamp is turned on.
29	Time From Start		-	-	This displays the engine time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00

TYPICAL SCAN DATA & DEFINITIONS (O_2 SENSOR DATA)

Use the Typical Values Table only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly. Tech 2 values from a properly-running engine may be used for comparison with the engine you are diagnosing.
Condition : Vehicle stopping, engine running, air conditioning off & after warm-up (Coolant temperature approximately 80 deg.)

	Tech 2 Parameter	Units	Idle	2000rpm	Description
1	Engine Speed	rpm	710 - 875	1950 - 2050	The actual engine speed is measured by ECM from the CKP sensor 58X signal.
2	Desired Idle Speed	rpm	825	800 - 850	The desired engine idle speed that the ECM commanding. The ECM compensates for various engine loads.
3	Engine Coolant Temperature	°C or °F	80 - 90	80 - 90	The ECT is measured by ECM from ECT sensor output voltage. When the engine is normally warm upped, this data displays approximately 80 °C or more.
4	Start Up ECT (Engine Coolant Temperature)	°C or °F	Depends on ECT at start-up	Depends on ECT at start-up	Start-up ECT is measured by ECM from ECT sensor output voltage when engine is started.
5	Intake Air Temperature	°C or °F	Depends on ambient temp	Depends on ambient temp	The IAT is measured by ECM from IAT sensor output voltage. This data is changing by intake air temperature.
6	Start Up IAT (Intake Air Temperature)	°C or °F	Depends on IAT at start-up	Depends on IAT at start-up	Start-up IAT is measured by ECM from IAT sensor output voltage when engine is started.
7	Manifold Absolute Pressure	kPa	31 - 36	25 - 30	The MAP (kPa) is measured by ECM from MAP output voltage. This data is changing by inlet manifold pressure.
8	Barometric Pressure	kPa	Depends on altitude	Depends on altitude	The barometric pressure is measured by ECM from the MAP sensor output voltage monitored during key up and wide open throttle. This data is changing by altitude.
9	Throttle Position	%	0	2 - 4	Throttle position operating angle is measured by the ECM from throttle position output voltage. This should display 0% at idle and 99 - 100% at full throttle.
10	Calculated Air Flow	g/s	3.5 -4.50	8.0 - 10.0	This displays intake air amount. The mass air flow is measured by ECM from the MAF sensor output voltage.
11	Air Fuel Ratio		14.6:1	14.6:1	This displays the ECM commanded value. In closed loop, this should normally be displayed around 14.2:1 - 14.7:1.
12	Fuel System Status	Open Loop/ Close Loop	Close Loop	Close Loop	When the engine is first started the system is in "Open Loop" operation. In "Open Loop", the ECM ignores the signal from the oxygen sensors. When various conditions (ECT, time from start, engine speed & oxygen sensor output) are met, the system enters "Closed Loop" operation. In "Closed Loop", the ECM calculates the air fuel ratio based on the signal from the oxygen sensors.
13	Engine Load	%	2 - 5	5 - 10	This displays is calculated by the ECM form engine speed and MAF sensor reading. Engine load should increase with an increase in engine speed or air flow amount.
14	B1 O_2 Sensor Ready (Bank 1)	Yes/No	Yes	Yes	This displays the status of the exhaust oxygen sensor. This display will indicate "Yes" when the ECM detects a fluctuating oxygen sensor output voltage sufficient to allow closed loop operation. This will not occur unless the oxygen sensor is warmed up.
15	B1S1 Status (Bank 1 Sensor 1)	Rich / Lean	Rich / Lean	Rich / Lean	This displays dependent on the exhaust oxygen sensor output voltage. Should fluctuate constantly "Rich" and "Lean" in closed loop.
16	Fuel Trim Learned	Yes/No	Yes	Yes	When conditions are appropriate for enabling long term fuel trim corrections, fuel trim learn will display "Yes". This indicates that the long term fuel trim is responding to the short term fuel trim. If the fuel trim lean displays "No", then long term fuel trim will not respond to changes in short term fuel trim.

	Tech 2 Parameter	Units	Idle	2000rpm	Description
17	Fuel Trim Cell		15 - 20	1 - 2	This displays dependent on engine speed and calculated intake air flow reading. A plot of engine speed versus intake air flow amount is divided into the cells. Fuel trim cell indicates which cell is currently active.
18	B1S1 O_2 Sensor (Bank1 Sensor 1)	mV	50 - 950	50 -950	This displays the exhaust oxygen sensor output voltage. Should fluctuate constantly within a range between 10mV (lean exhaust) and 1000mV (rich exhaust) while operating in closed loop.
19	B1 Short Term Fuel Trim (Bank 1)	%	-6 - 0	-6 - 0	The short term fuel trim to a bank represents a short term correction to the bank fuel delivery by the ECM in response to the amount of time the bank fuel control oxygen sensor voltage spends above or below the 450mV threshold. If the oxygen sensor voltage has mainly remained less than 450mV, indicating a lean air/ fuel, short term fuel trim will increase into the positive range above 0% and the ECM will pass fuel. If the oxygen sensor voltage stays mainly above the threshold, short term fuel trim will decrease below 0% into the negative range while the ECM reduces fuel delivery to compensate for the indicated rich condition. Under certain conditions such as extended idle and high ambient temperatures, canister purge may cause short term fuel trim to read in the negative range during normal operation. Fuel trim values at maximum authority may indicate an excessively rich or lean system.
20	B1 Long Term Fuel Trim (Bank 1)	%	-10 - 0	-5 - 0	The long term fuel trim is delivered from the short term fuel term values and represents a long term correction of fuel delivery for bank in question. A value of 0% indicates that fuel delivery requires no compensation to maintain the ECM commanded air fuel ratio. A negative value indicates that the fuel system is rich and fuel delivery is being reduced (decreased injector pulse width). A positive value indicates that a lean condition exists and the ECM is compensating by add fuel (increased injector pulse width). Because long term fuel trim tends to follow short term fuel trim, a value in the negative range due to canister purge at idle should not be considered unusual. Fuel trim values at maximum authority may indicate an excessively rich or lean system.
21	Injection Pulse Width	ms	3.0 - 1.0	3.0 - 4.0	This displays the amount of time the ECM is commanding each injector On during each engine cycle. A longer injector pulse width will cause more fuel to be delivered. Injector pulse width should increase with increased engine load.
22	Power Enrichment	Yes/No	No	No	The ECM provides the extra amount of fuel when it detects a rapid increase in the throttle position and air flow (Power Enrichment). Under this condition the ECM should detect a “rich condition (high oxygen sensor voltage).
23	Deceleration Fuel Cutoff	Active/ Inactive	Inactive	Inactive	The ECM reduces the amount of fuel injected when it detects a decrease in the throttle position and the air flow. When deceleration is very fast, the ECM may cut off fuel completely. Until enable conditions meet the engine revolution less than 1000rpm or MAP less than 10kPa.
24	Time From Start		-	-	This displays the engine time elapsed since the engine was started. If the engine is stopped, engine run time will be reset to 00:00:00

MISCELLANEOUS TEST

The state of each circuit can be tested by using miscellaneous test menus. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing each circuit by means of these menus.
Even DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble.
Connect Tech 2 and select "Powertrain", "2.XL L4 HV240" & "Miscellaneous Test".

F0: Lamps
F0: Malfunction Indicator Lamp
When the Tech 2 is operated, "Malfunction Indicator Lamp (Check Engine Lamp)" is turned on or off.
The circuit is normal if the "Malfunction Indicator Lamp (Check Engine Lamp)" in the instrument panel is turned on or off in accordance with this operation.

F1: Relays
F0: Fuel Pump Relay
When the Tech 2 is operated, fuel pump relay signal turns ON or OFF.
The circuit is normal if fuel pump sound is generated in accordance with this operation when key switch is turned ON.

F1: A/C Clutch Relay
When the Tech 2 is operated, A/C clutch relay signal turns ON or OFF.
The circuit is normal if A/C compressor clutch is energized in accordance with this operation when the engine is running.

F2: EVAP
F0: Purge Solenoid
When the Tech 2 is operated, duty ratio of EVAP purge solenoid is changed 10%-by-10%.

Purge Solenoid	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35kPa
EVAP Purge Solenoid	30%

- Press "Increase" key.
  Then, EVAP Purge Solenoid is increases 10%-by-10%.
- Press "Quit" Key.

F3: IAC System
F0: IAC Control
When the Tech 2 is operated, "Idle Air Control" increases or decreases 5steps-by-5steps up to 150steps.
The circuit is normal if idle engine speed is changed in accordance with this operation.

IAC Control	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35kPa
Idle Air Control	30 Steps

- Press "Increase" key.
  Then, Idle Air Control is increases 1osteps-by-10steps up to 160steps. Engine speed is also changed by this operation.
- Press "Quit" Key.

F1: IAC Reset
When the Tech 2 is operated, "Idle Air Control" resets.
The circuit is normal if idle engine speed is droped in accordance with this operation.

IAC Reset	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80 °C
Start Up ECT	50 °C
Intake Air Temperature	30 °C
Start Up IAT	25 °C
Manifold Absolute Pressure	35kPa
Idle Air Control	30 Steps

- Press "Increase" key.
  Then, Desired Idle speed is increases 50rpm-by-50rpm up to 1550rpm. Engine speed is also changed by this operation.
- Press "Quit" Key.

F4: Injector Balance Test

When the Tech 2 is operated, selected injector turns ON or OFF.

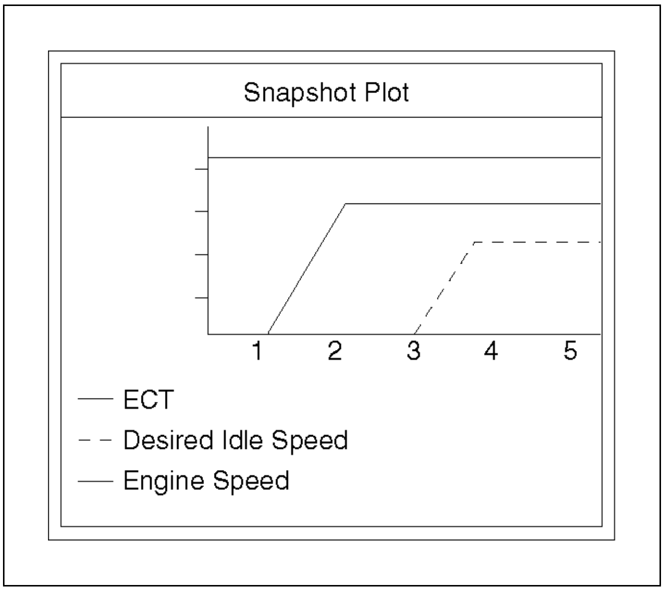
The circuit is normal if engine vibration is changed at selected cylinder in accordance with this operation when engine is idling.

Injector Balance Test	
Engine Speed	800 RPM
Desired Idle Speed	762 RPM
Engine Coolant Temperature	80
Start Up ECT	50
Intake Air Temperature	30
Start Up IAT	25
Manifold Absolute Pressure	35kPa
Injector 1	On

- Press “Injector Off” key.
  Then, engine speed drops and vibration occurs when a cylinder is selected.
- Press “Quit” Key.

PLOTTING SNAPSHOT GRAPH

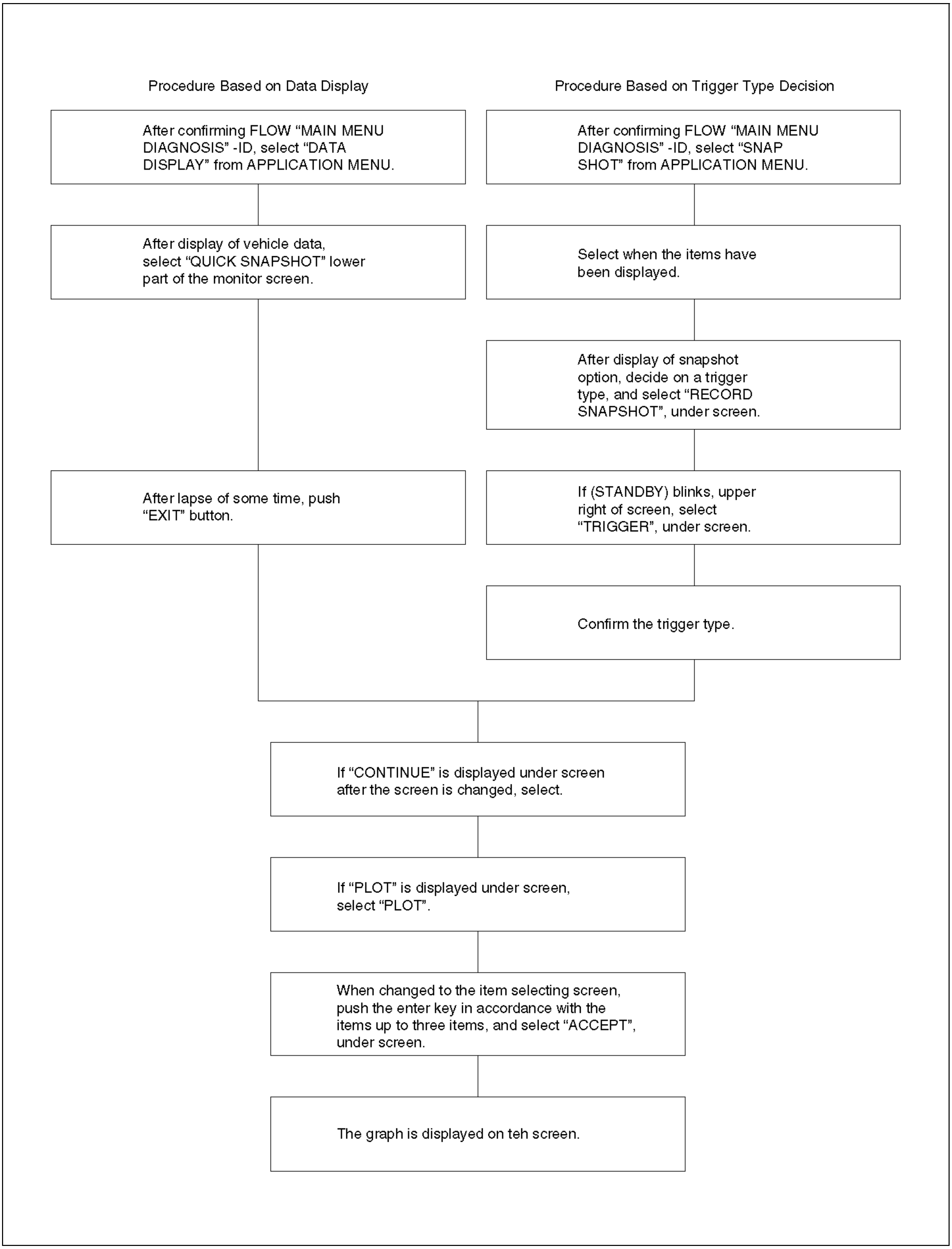
This test selects several necessary items from the data list to plot graphs and makes data comparison on a long term basis. It is an effective test particularly in emission related evaluations.



060RX037

For trouble diagnosis, you can collect graphic data (snap shot) directly from the vehicle.
You can replay the snapshot data as needed. Therefore, accurate diagnosis is possible, even though the vehicle is not available.

Plotting Graph Flow Chart (Plotting graph after obtaining vehicle information)



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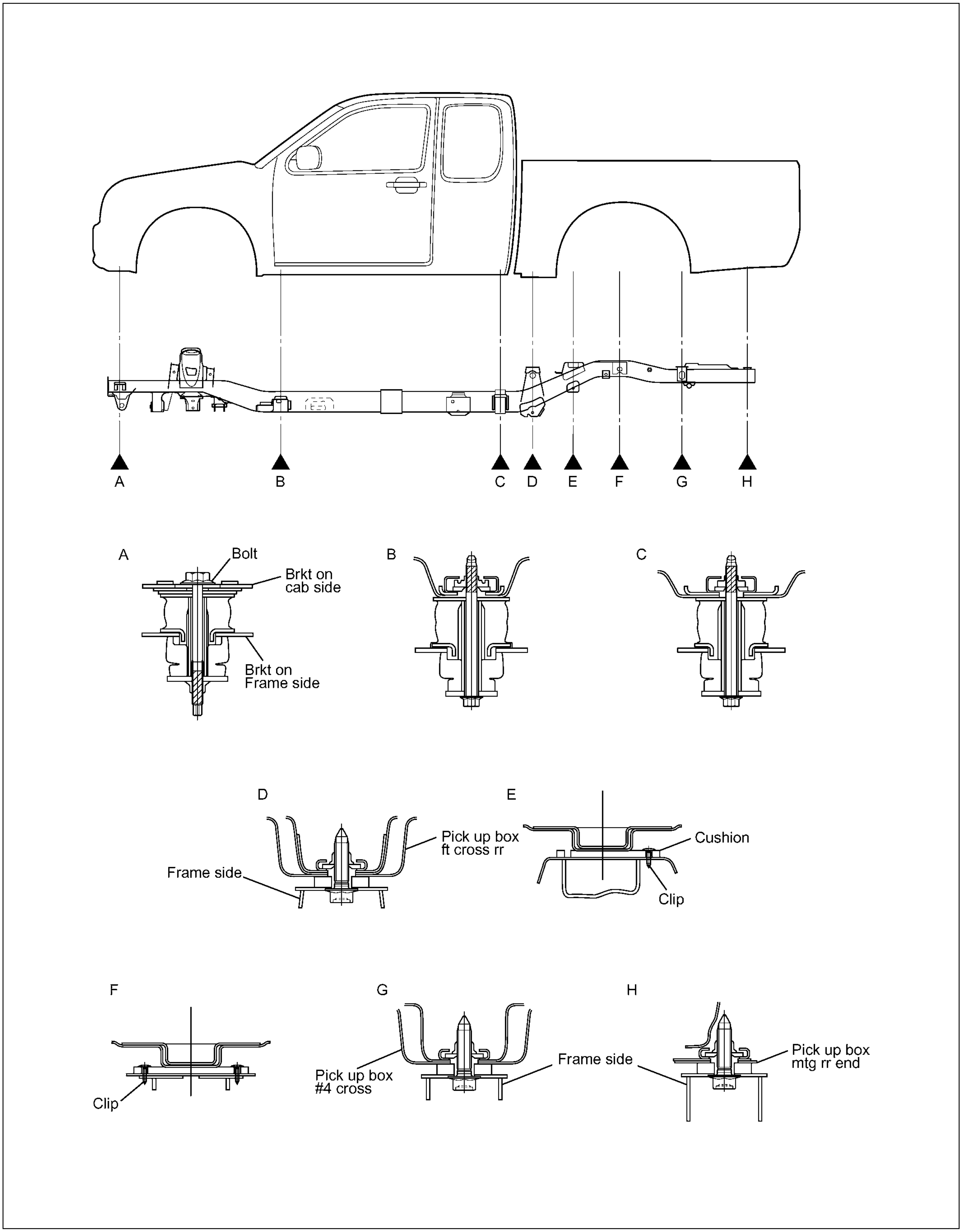
EXTEND CAB Model



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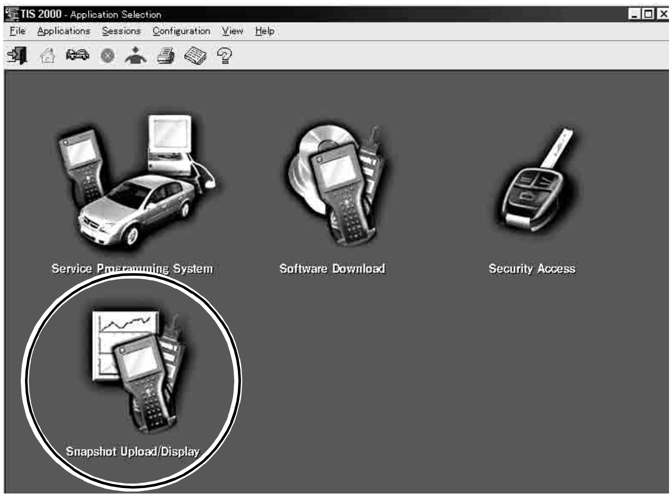
Flow Chart for Snapshot Replay (Plotting Graph)

1. Press the enter-key in initial display.
2. Select "VIEW CAPTURE DATA"
3. If snapshot option is displayed, decide on a trigger type, and slect "REVIEW DATA" under screen.
4. When the data triggered by vehicle is displayed, select the data.
   (Plural display of data depending on the number of times of triggering.)
5. data is displayed on the screen.
   To see the graph, select "PLOT" under screen.
6. Changed to the item selection screen, push the enter key up to three times, and select "ACCEPT" under screen.
7. The graph is displayed on the screen.

060RX0-40

SNAPSHOT DISPLAY WITH TIS2000

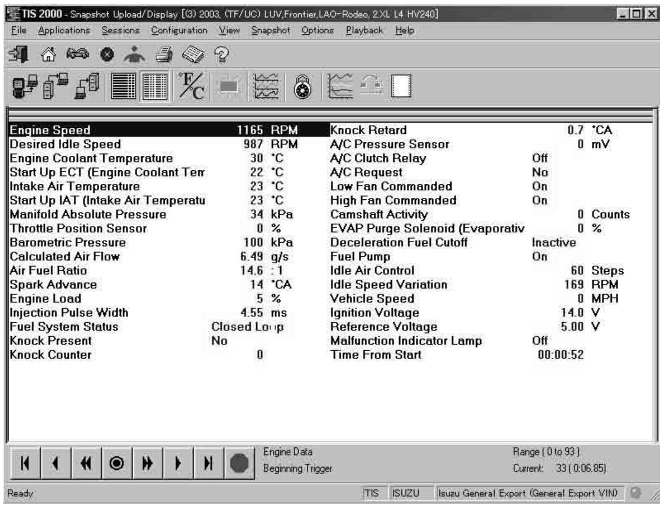


Procedures for transferring and displaying Tech2 snapshot data by using TIS2000 [Snapshot Upload] function is described below.
Snapshot data can be displayed with [Snapshot Upload] function included in TIS2000.

By analyzing these data in various methods, trouble conditions can be checked.
Snapshot data is displayed by executing the three steps below shown:

1. Record the snapshot data, in Tech2.

2. Transfer the snapshot data to PC.



After recording the snapshot in Tech2, transfer the data from Tech2 to PC by the below procedures.

1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Upload from trouble diagnosis tool (transfer from diagnosis tester)] or click the corresponding icon of the tool bar.
4. Select Tech2, and transfer the recorded snapshot information.
5. Select the transferred snapshot.
6. After ending transfer of the snapshot, data parameter list is displayed on the screen.

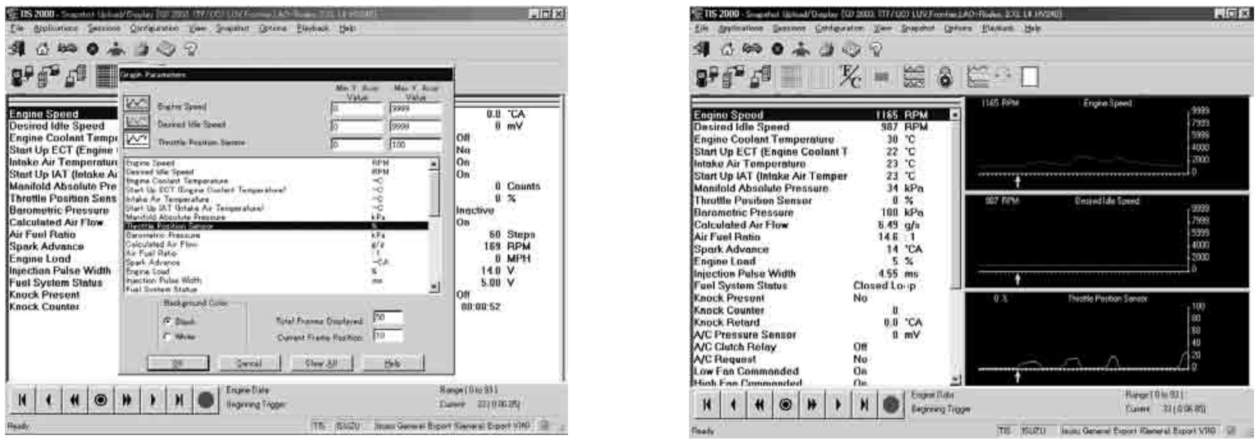
3. Snapshot data is displayed with TIS2000 [Snapshot Upload] function.

Snapshot is stored in the PC hard disk or floppy disk, and can be displayed any time.

Stored snapshot can be displayed by the below procedures.

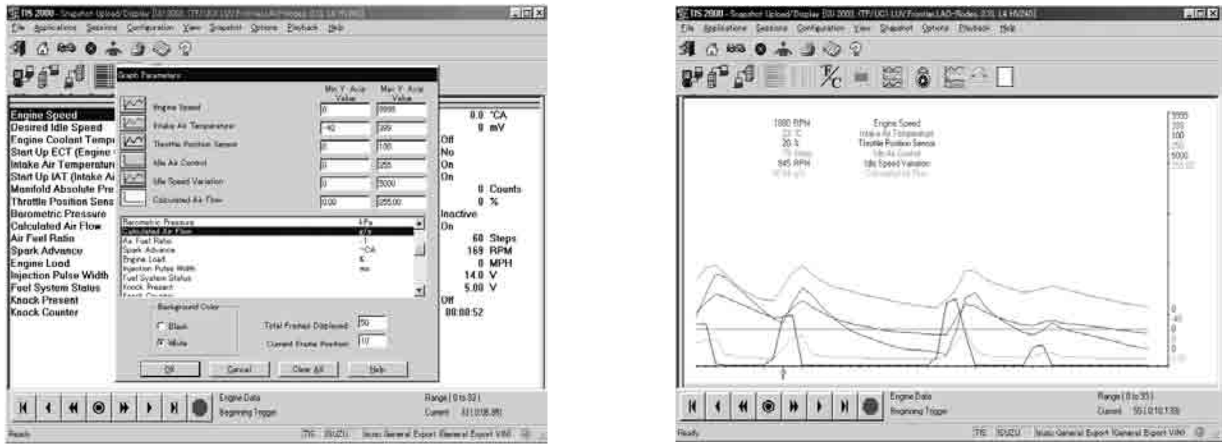
1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Open the existing files] or click the corresponding icon of the tool bar.
4. Select the transferred snapshot.
5. Open the snapshot, to display the data parameter list on the screen.

Graph display Values and graphs (Max. 3 graphs):



1. Click the icon for graph display. [Graph Parameter] window opens.
2. Click the first graph icon of the window upper part, and select one parameter from the list of the window lower part. Selected parameter is displayed nest to the graph icon. Graph division can be selected in the field on the parameter right side.
3. Repeat the same procedures with the 2nd and 3rd icons.
4. After selecting all parameters to be displayed (Max. 3 parameters), click [OK] button.
5. Parameter selected is displayed in graph form on the right of the data parameter on the screen.
6. Graph display can be moved with the navigation icon.
7. For displaying another parameter by graph, click the parameter of the list, drug the mouse to the display screen while pressing the mouse button and release the mouse button. New parameter is displayed at the position of the previous parameter. For displaying the graph display screen in full size, move the cursor upward on the screen. When the cursor is changed to the magnifying glass form, click the screen. Graph screen is displayed on the whole screen.

Display of graphs on one screen (Max. 6 graphs):



1. Click the 6 graph icon. [Graph Parameter] window opens.
2. Click the graph icon, select the parameter to be displayed from the list and change divisions according to necessity.
3. Repeat the same procedures with the graph icons, from the 2nd to 6th.
4. Click the [OK] button to display.
5. In this case, parameters are displayed only in graph form. All parameters are displayed in one graph.
6. The graph display screen can be moved with the navigation icon.

SERVICE PROGRAMMING SYSTEM (SPS)

The procedure to program the control unit by using the Service Programming System (SPS) software contained in TIS2000 is explained below.

NOTE:

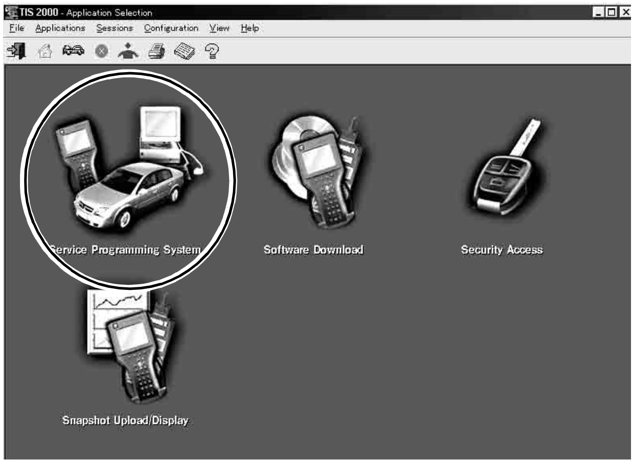
- **If the Engine Control Module (ECM) was programmed, the Immobilizer System must be linked to the ECM: Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.**
- **Should Tech2 display "SPS Procedure was not successful", engine will not start, but no DTCs are present, low battery voltage or poor electrical connections should be the primary suspects. Perform the SPS procedure again after rectifying the fault/s.**

IMPORTANT:
Perform the following checks before attempting to program the control unit:

- **The Tech2 PCMCIA card is programmed with The latest software release.**
- **The latest release of TIS2000 is loaded on the PC.**
- **The vehicle battery is fully charged.**
- **The control unit to be programmed is connected to the vehicle.**

1. Preparations of TIS 2000

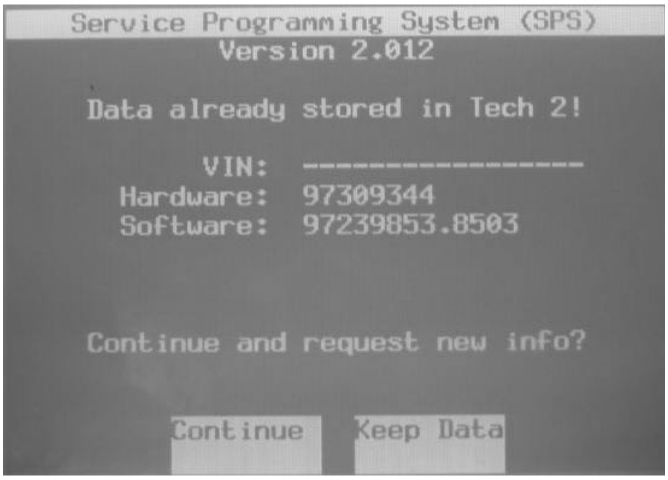
1. Connect Tech 2 to P/C.
2. Check to see if Hardware Key is plugged into Port.
3. Activate TIS 2000 by P/C.
4. On the activating screen of TIS2000, choose "Service Programming System"



5. On the screen of "Diagnostic Tester and Processing Program Selection", choose the one that will comply with the following.
   - Tech-2 in use
   - New programming by the existing module or new programming by the replaced/new module.
   - Fixing position of the control unit.
6. Upon completion of the selection, push the button of "Next".

2. Demand of Data

1. Connect Tech-2 to the vehicle. When activated by turning on the power of Tech-2, push the “Enter” switch.
2. Turn on the ignition switch (without starting the engine)
3. In the main menu of Diagnostic Tester, push “F1: Service Programming System (SPS)”.
4. Push “F0: Request Info” of Tech-2.
5. Where vehicle data has been already saved in Tech 2, the existing data come on display. In this instance, as Tech-2 starts asking whether to keep the data or to continue obtaining anew data from the control unit, choose either of them



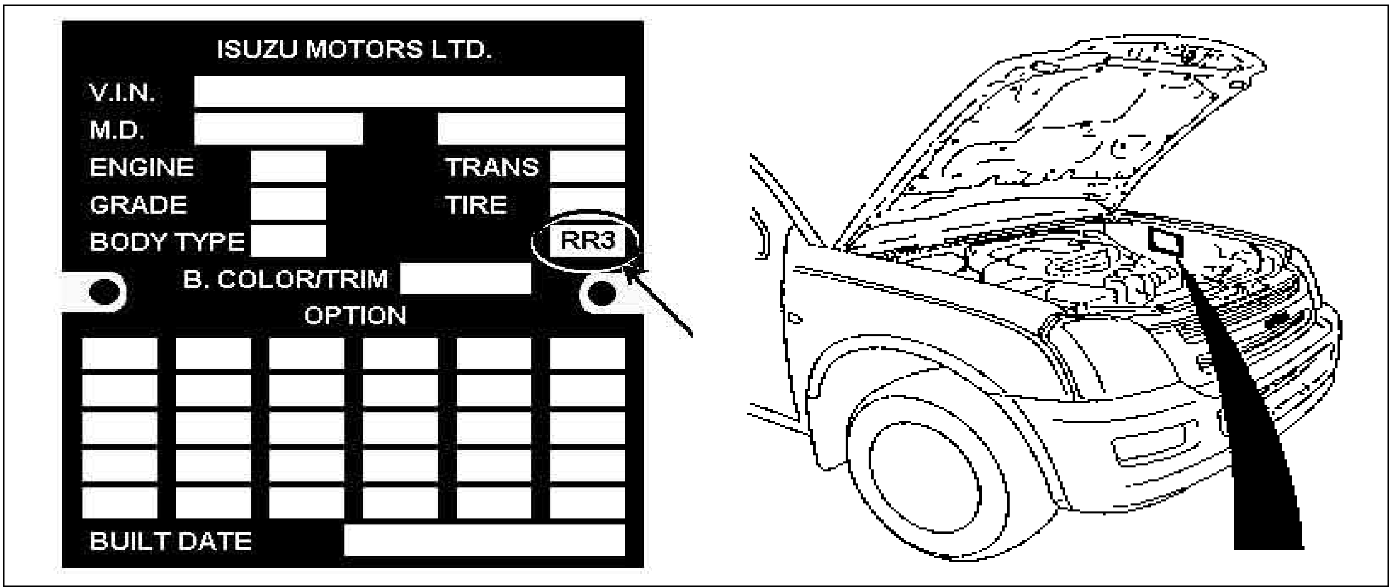
6. If you select “continue”, you have to select “Model Year”, “Vehicle Type”.
7. After that. then push button and turn Ignition switch tuned on, off, on following Tech-2 display. Tech-2 will read information from controller after this procedure.
8. During obtaining information, Tech-2 is receiving information from the control unit ECM and TCM (A/T only) at the same time. With VIN not being programmed into the new control unit at the time of shipment, "obtaining information" is not complete (because the vehicle model, engine model and model year are specified from VIN). For the procedure get additional information on vehicles, instruction will be provided in dialog form, when TIS2000 is in operation.
9. Following instructions by Tech-2, push the “Exit” switch of Tech-2, turn off the ignition of the vehicle and turn off the power of Tech-2, thereby removing from the vehicle.

3. Data Exchange

1. Connect Tech-2 to P/C, turn on the power and click the “Next” button of P/C.
2. Check VIN of the vehicle and choose “Next”.
3. Select “System Type” for required control unit.
   - Engine (Programming for ECM or PCM)
   - Transmission (Programming for TCM)
4. When a lack of data is asked from among the following menu, enter accordingly.
   Select following Menu
   - Model Year
   - Model
   - Engine type
   - Transmission type
   - Destination code (vehicles for general export)*1
   - Immobilizer

   Etc.

* 1: How to read the destination code
Destination code can be read from ID Plate affixed on vehicles, while on VIN plate the destination code is described at the right-hand edge of Body Type line. In the figure, the destination code can be read as "RR3" (Australia).

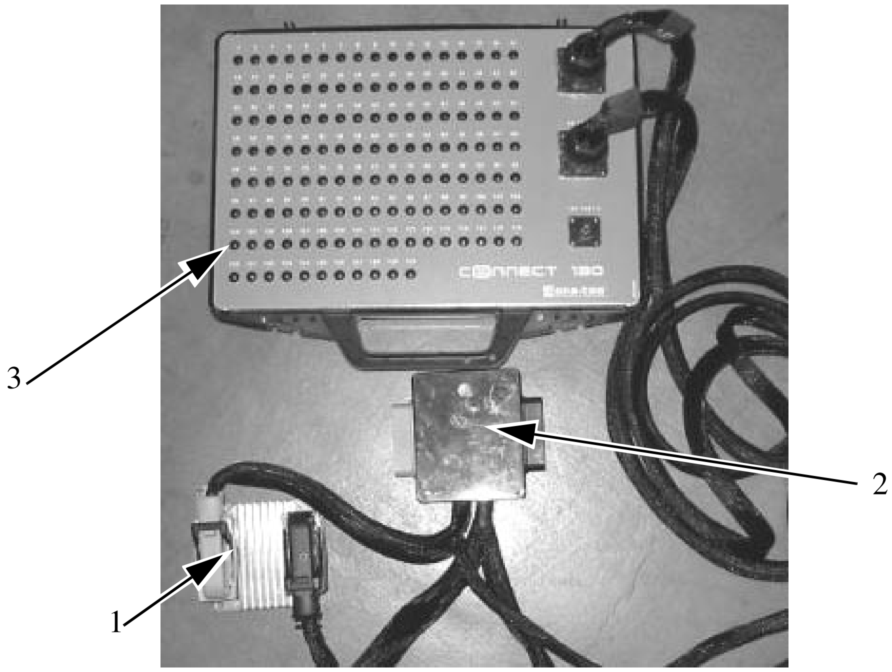


5. After choosing the data, click the “Next” button.
6. When all the necessary information is entered, the “details” of software within the database that match the entered data will appear for confirmation. Click the “Program” switch and then download the new software onto Tech-2.
7. “Data Transfer” comes on display. The progress of downloading will be displayed on the screen in the form of bar graph.
8. Upon finishing the data transfer, turn off the power of Tech-2, removing from P/C.

4. Programming of ECM

1. Check to see if batteries are fully charged, while ABS connectors shall be removed from the vehicle.
2. Connect Tech-2 to Vehicle Diagnostic Connectors.
3. Turn on the power of Tech-2 and the title screen comes on display.
4. Turn on the ignition (without allowing the engine to start)
5. On the title screen of Tech-2, push the “Enter” button.
6. Choose “F1: Service Programming System” on the main screen and then choose “FI: Program ECU”.
7. While data is being transferred, “Programming in Progress” will be displayed on the Tech-2 screen.
8. Upon finishing the data transfer, Tech-2 will display “Reprogramming Was Successful”. Push the “Exit” button to bring program to completion
9. Following “Procedure 2: Demand of Data”, try over again “Information Obtaining” and check to confirm if the data has been correctly re-loaded.
10. Upon finishing confirmation, turn off the ignition of the vehicle and then turn off the power of Tech-2, removing from the vehicle.

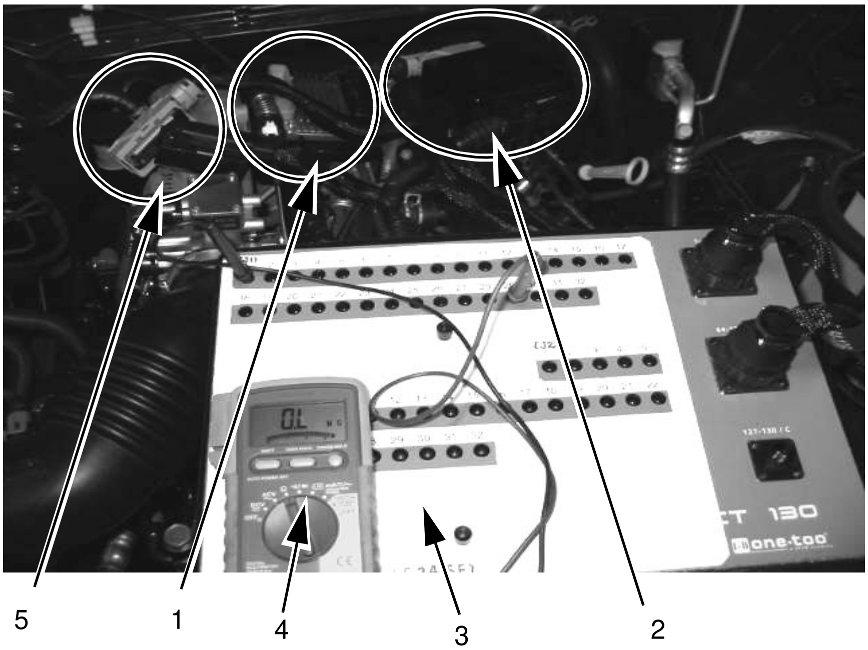
HOW TO USE BREAKER BOX



(1) Engine Control Module (ECM)
(2) Harness Adapter
(3) Breaker Box

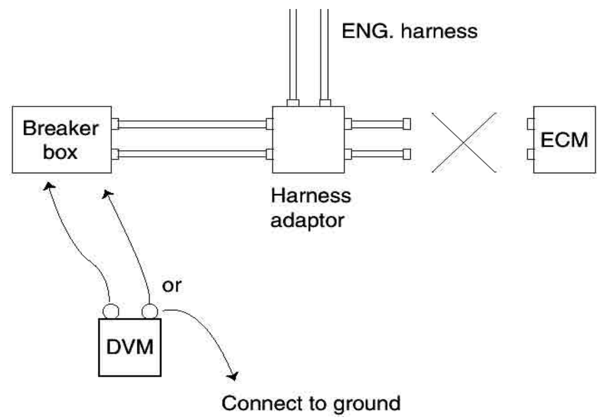
The engine control module (ECM) and other connectors have water proof connector and special terminal. Water proof terminal does not allow to use back prove. In addition, the engine control module (ECM) special terminal can not let regular digital voltage meter prove to access, because terminal shape is very fin pin type.
In order to prevent damage of female terminal and connector itself, the breaker box and adapter is the most suitable special tool.

Breaker Box Connection Type A

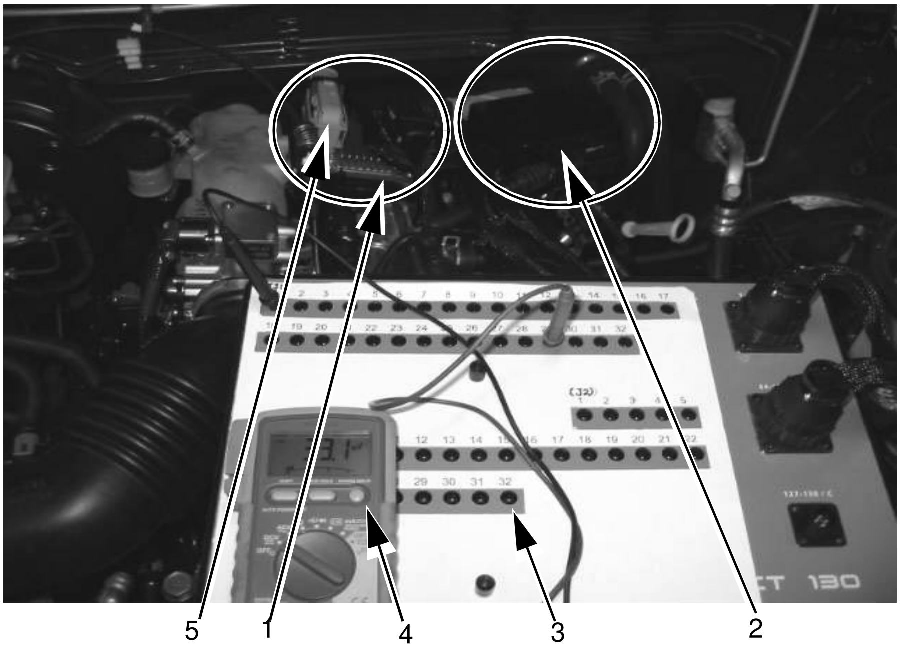


(1) Engine Control Module (ECM)
(2) Harness Adapter
(3) Breaker Box
(4) Digital Voltage Meter
(5) ECM - Harness Adapter Disconnection

Breaker box connection type A, check for “open circuit” and “short to ground circuit”.

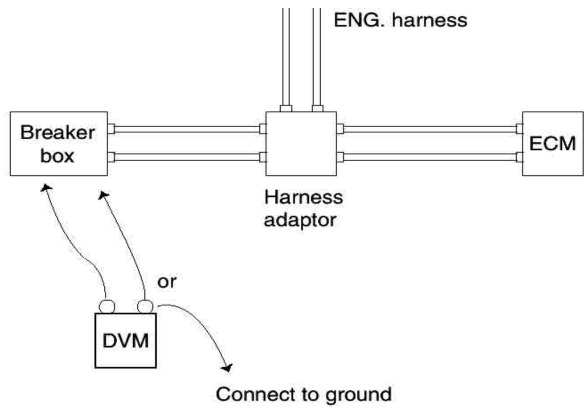


Breaker Box Connection Type B



(1) Engine Control Module (ECM)
(2) Harness Adapter
(3) Breaker Box
(4) Digital Voltage Meter
(5) ECM - Harness Adapter Connection

Breaker box connection type B, check for "short to power supply circuit" and "power, signal voltage check" between the engine control module (ECM) and electrical components.



Important Operations – Installation

Bolt : A

Torque	N·m(kgf·m/lb·ft)
50 (5.1 / 37)	

Bolt : B,C

Torque	N·m(kgf·m/lb·ft)
72 (7.3 / 53)	

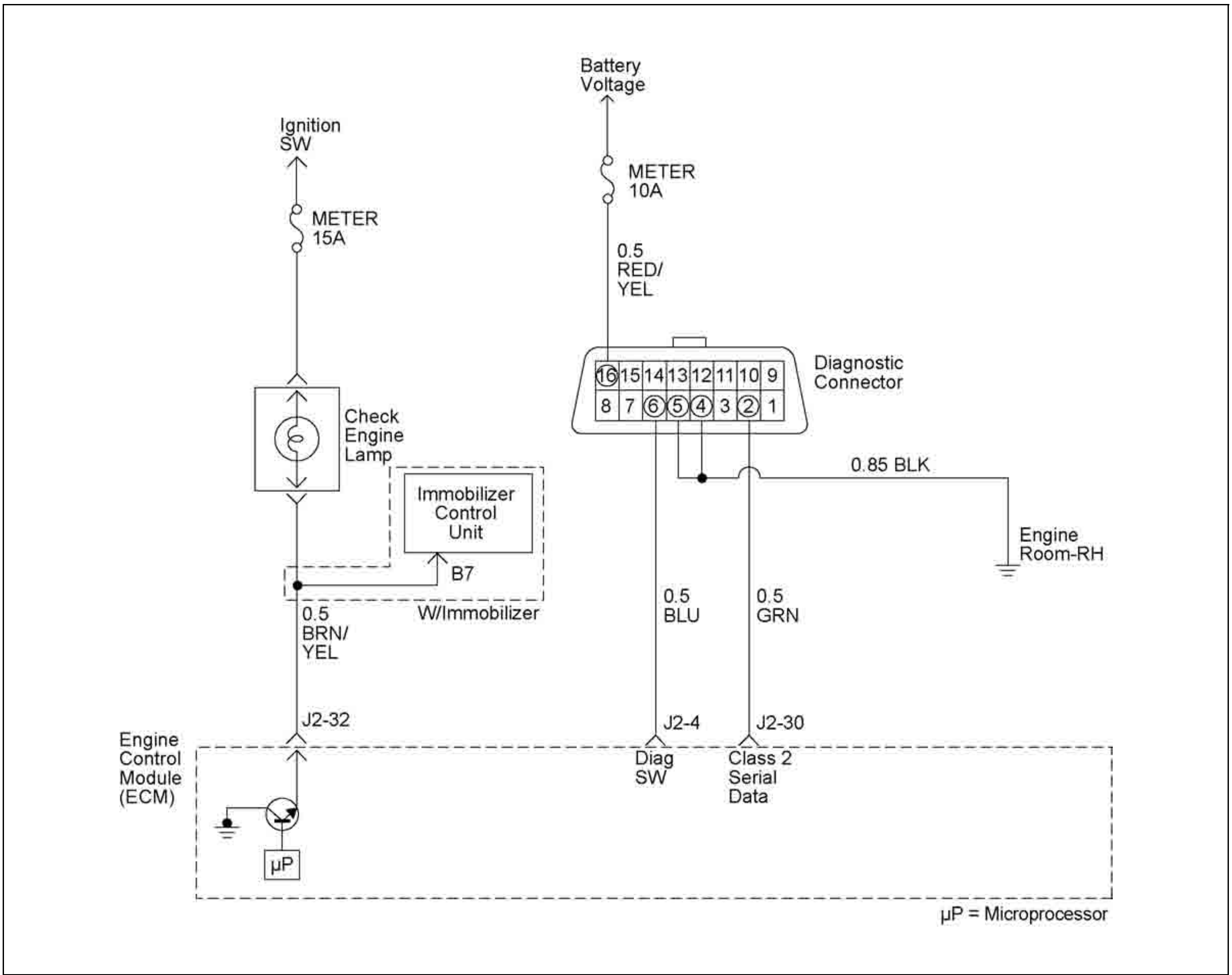
Bolt : D,G,H

Torque	N·m(kgf·m/lb·ft)
54 (5.5 / 40)	

NOTE :

Discard the used mounting bolts D,G,H shown in the figure and install new ones.

ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK



Circuit Description

The on-board diagnostic system check is the starting point for any driveability complaint diagnosis. Before using this procedure, perform a careful visual/physical check of the ECM and engine grounds for cleanliness and tightness.

The on-board diagnostic system check is an organized approach to identifying a problem created by an electronic engine control system malfunction.

Diagnostic Aids

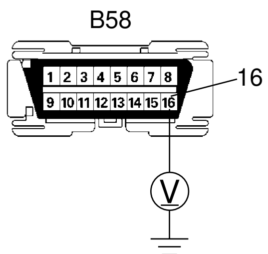
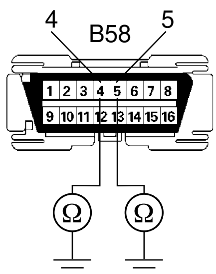
An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for poor connections or a damaged harness. Inspect the ECM harness and connector for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

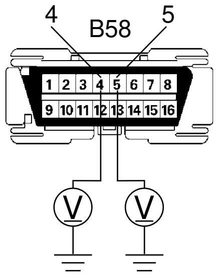
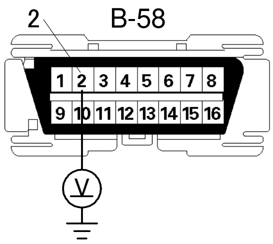
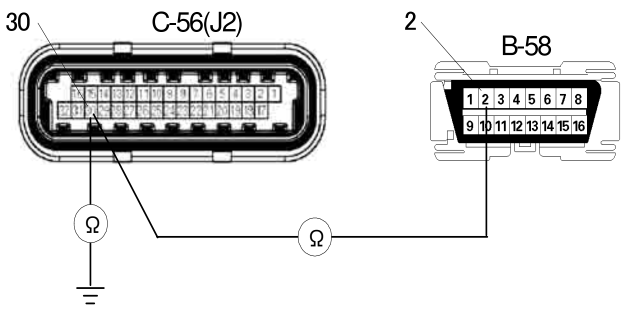
Test Description

Number(s) below refer the step number(s) on the Diagnostic Chart:

1. The Check Engine Lamp (MIL) should be ON steady with the ignition “On”, engine “Off”. If not, “No Check Engine Lamp (MIL)” chart should be used to isolate the malfunction.
2. Checks the Class 2 data circuit and ensures that the ECM is able to transmit serial data.
3. This test ensures that the ECM is capable of controlling the Check Engine Lamp (MIL) and the Check Engine Lamp (MIL) driver circuit is not shorted to ground circuit.
4. If the engine will not start, “Engine Cranks But Will Not Run” chart should be used to diagnose the fault.
6. The Tech2 parameters which is not within the typical range may help to isolate the area which is causing the problem.
12. This vehicle is equipped with ECM which utilizes an electrically erasable programmable read only memory (EEPROM).

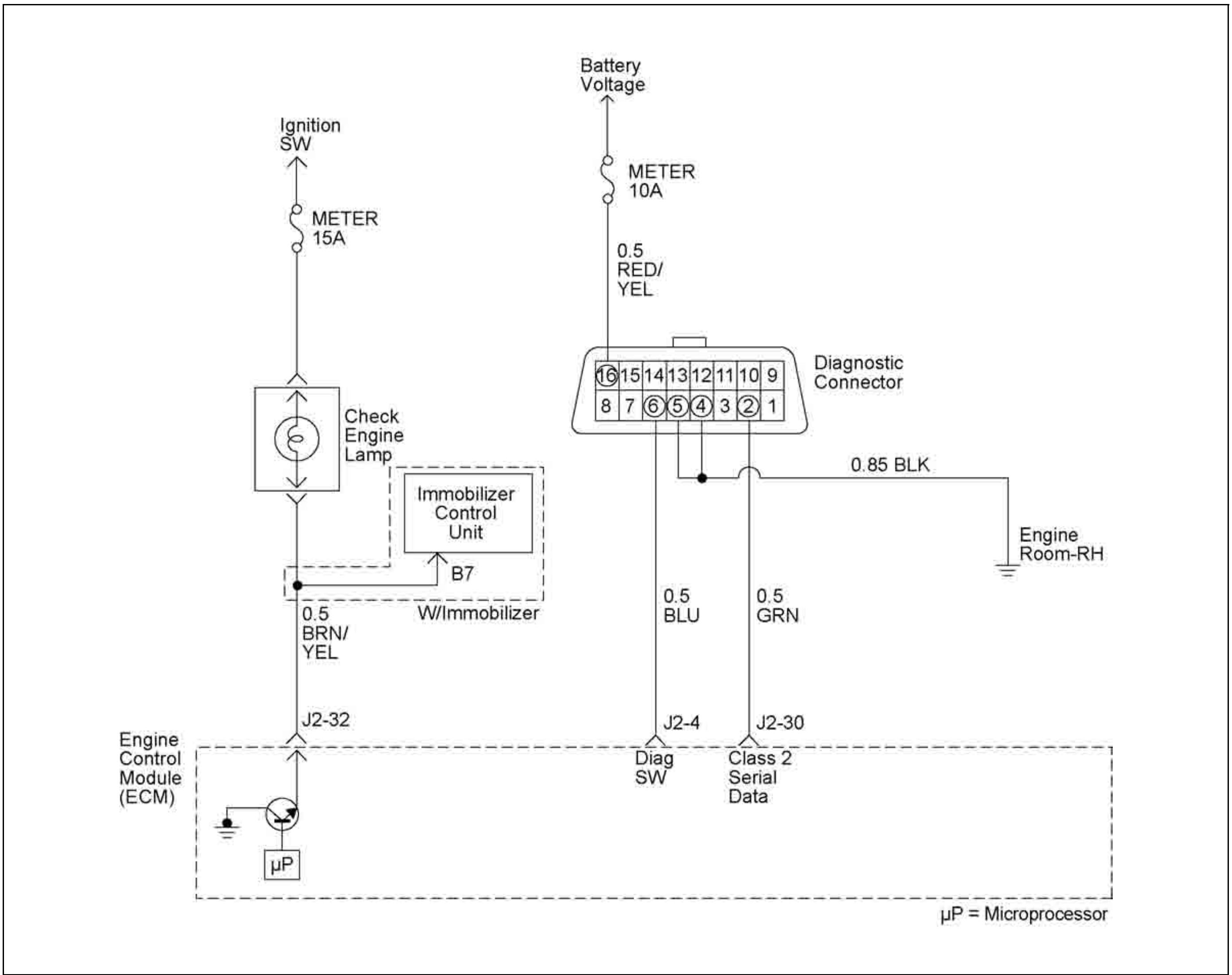
ON-BOARD DIAGNOSTIC (OBD) SYSTEM CHECK

Step	Action	Value(s)	Yes	No
1	1. Ignition “On”, engine “Off”. 2. Check the “CHECK ENGINE” lamp (MIL). Does the “CHECK ENGINE” lamp turn “On”?	—	Go to *Step 2*	Go to *No CHECK ENGINE Lamp*
2	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Attempt to display “Engine Data” with the Tech 2. Does the Tech 2 display “Engine Data” and “O_2 Sensor Data”?	—	Go to *Step 3*	Go to *Step 7*
3	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Select the “Miscellaneous Test” and perform the “Malfunction Indicator Lamp” in “Lamps”. 3. Operate the Tech 2 in accordance with the Tech 2 instructions. Does the “CHECK ENGINE” lamp turn “Off”?	—	Go to *Step 4*	Go to *CHECK ENGINE LAMP On Steady*
4	Attempt to start the engine. Does the engine start and continue to “Run”?	—	Go to *Step 5*	Go to *Engine Cranks But Will Not Run*
5	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Select the “Read DTC Infor By Priority” in “Diagnostic Trouble Code”. 3. Are any DTCs stored?	—	Go to *DTC Chart*	Go to *Step 6*
6	Compare typical scan data values displayed on the Tech 2 “Engine Data” and “O_2 Sensor Data”. Are the displayed values within the range?	—	Refer to *SYMPTOM DIAGNOSIS*	Refer to *TYPICAL SCAN DATA*
7	Using the DVM and check the data link connector power supply circuit. 1. Ignition “Off”, engine “Off”. 2. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 8*
8	Using the DVM and check the data link connector ground circuit. 1. Ignition “Off”, engine “Off”. 2. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the data link connector ground circuit. 1. Ignition “On”, engine “Off”. 2. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the data link connector communication circuit. 1. Ignition “On”, engine “Off”. 2. Check the circuit for short to power supply circuit. Was the DVM indicated battery voltage? 	—	Repair faulty harness and verify repair	Go to *Step 11*
11	Using the DVM and check the data link connector communication circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 13*

Step	Action	Value(s)	Yes	No
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

NO CHECK ENGINE LAMP (MIL)



Circuit Description

The check engine lamp should be illuminated and steady for about five seconds with the ignition "ON" and the engine stopped. Ignition feed voltage is supplied to the check engine lamp bulb through the meter fuse. The Engine Control Module (ECM) turns the check engine lamp "ON" by grounding the check engine lamp driver circuit.

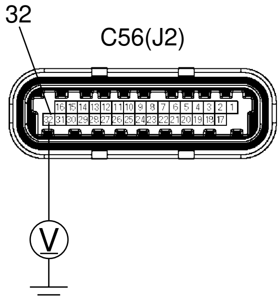
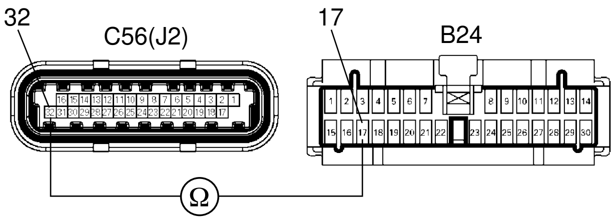
Diagnostic Aids

An intermittent check engine lamp may be cased by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

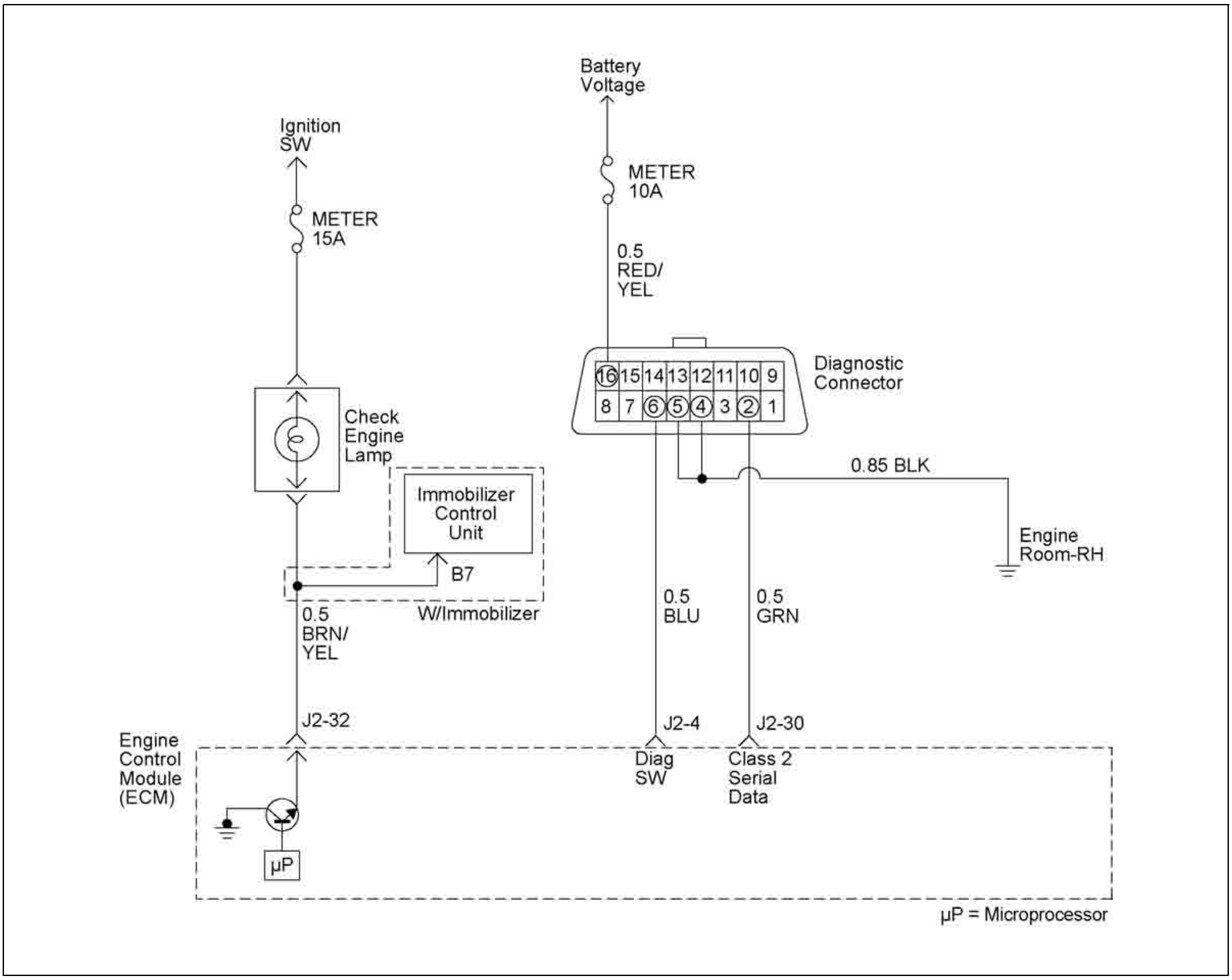
- Inspect the ECM harness and connections for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- If the engine runs OK, check for a faulty light bulb, an open in the check engine lamp driver circuit, or an open in the instrument cluster ignition feed.
- If the engine cranks but will not run, check for an open ECM ignition or battery feed, or a poor ECM to engine ground.

No Check Engine Lamp (MIL)

Step	Action	Value(s)	Yes	No
1	Check the "Meter" fuse (15A). If the fuse is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 2*

Step	Action	Value(s)	Yes	No
2	Using the DVM and check the “CHECK ENGINE” lamp circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Ignition “On”. 4. Check the circuit for open circuit. Was the DVM indicated specified value? 	10 - 14.5V	Go to *Step 5*	Go to *Step 3*
3	Check the “CHECK ENGINE” lamp bulb. If the bulb is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	Using the DVM and check the “CHECK ENGINE” lamp circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

CHECK ENGINE LAMP (MIL) "ON" STEADY



Circuit description

The check engine lamp should always be illuminated and steady for about five seconds with ignition "ON" and the engine stopped. Ignition feed voltage is supplied directly to the check engine lamp indicator. The Engine Control Module (ECM) turns the check engine lamp "ON" by grounding the check engine lamp driver circuit. The check engine lamp should not remain "ON" with the engine running and no DTC(s) set. A steady check engine lamp with the engine running and no DTC(s) suggests a short to ground in the check engine lamp driver circuit.

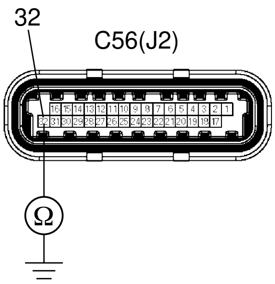
Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Check Engine Lamp (MIL) "ON" Steady

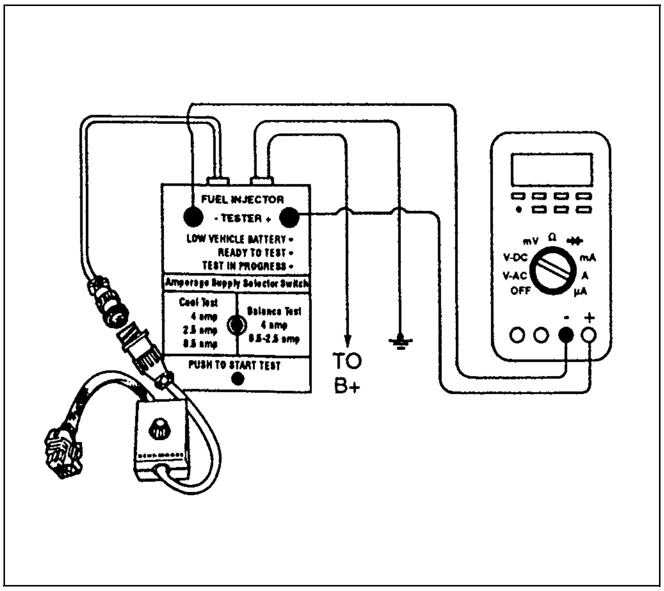
Step	Action	Value(s)	Yes	No
1	1. Ignition "Off", engine "Off". 2. Disconnect the ECM connector. 3. Ignition "On". Was the "CHECK ENGINE" lamp turned on?	—	Go to *Step 2*	Go to *Step 4*

Step	Action	Value(s)	Yes	No
2	Using the DVM and check the “CHECK ENGINE” lamp circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the meter connector and ECM connector. 3. Check the circuit for short to ground circuit. Was the problem found? 	—	Verify repair	Go to *Step 3*
3	Replace the meter assembly. Is the action complete?	—	Verify repair	—
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 5*
5	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

FUEL METERING SYSTEM CHECK

Some failures of the fuel metering system will result in an "Engine Cranks But Will Not Run" symptom. If this condition exists, refer to *the Cranks But Will Not Run* chart. This chart will determine if the problem is caused by the ignition system, the ECM, or the fuel pump electrical circuit.
Refer to *Fuel System Electrical Test* for the fuel system wiring schematic.
If there is a fuel delivery problem, refer to *Fuel System Diagnosis*, which diagnoses the fuel injectors, the fuel pressure regulator, and the fuel pump.
Followings are applicable to the vehicles with closed Loop System:
If a malfunction occurs in the fuel metering system, it usually results in either a rich HO2S signal or a lean HO2S signal. This condition is indicated by the HO2S voltage, which causes the ECM to change the fuel calculation (fuel injector pulse width) based on the HO2S reading. Changes made to the fuel calculation will be indicated by a change in the long term fuel trim values which can be monitored with a Scan Tool. Ideal long term fuel trim values are around 0%; for a lean HO2S signal, the ECM will add fuel, resulting in a fuel trim value above 0%. Some variations in fuel trim values are normal because all engines are not exactly the same. If the evaporative emission canister purge is 02 status may be rich condition. 02 status indicates the lean condition, refer *to DTC P1171* for items which can cause a lean HO2S signal.

FUEL INJECTOR COIL TEST PROCEDURE AND FUEL INJECTOR BALANCE TEST PROCEDURE



Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart:

2. Relieve the fuel pressure by connecting 5-8840-0378-0 T-Joint to the fuel pressure connection on the fuel rail.

   Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.
   Place the fuel pressure gauge bleed hose in an approved gasoline container.
   With the ignition switch OFF open the valve on the fuel pressure gauge.

3. Record the lowest voltage displayed by the DVM after the first second of the test. (During the first second, voltage displayed by the DVM may be inaccurate due to the initial current surge.)
   Injector Specifications:

Resistance Ohms	Voltage Specification at 10°C-35°C (50°F-95°F)
11.8-12.6	5.7-6.6

- The voltage displayed by the DVM should be within the specified range.
- The voltage displayed by the DVM may increase throughout the test as the fuel injector windings warm and the resistance of the fuel injector windings changes.

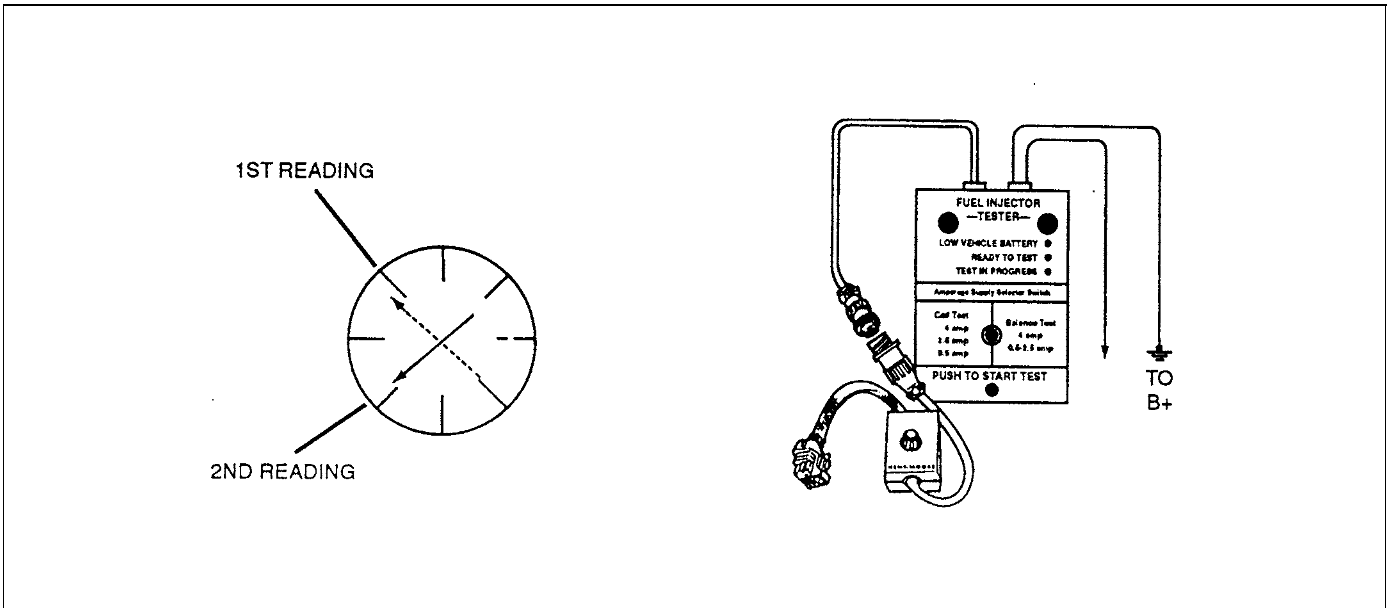
- An erratic voltage reading (large fluctuations in voltage that do not stabilize) indicates an intermittent connection within the fuel injector.

5. Injector Specifications:

Highest Acceptable Voltage Reading Above/Below 35°C/10°C (95°F/50°F)	Acceptable Subtracted Value
9.5Volts	0.6Volt

7. The Fuel Injector Balance Test portion of this chart (Step 7 through Step 11) checks the mechanical (fuel delivery) portion of the fuel injector. An engine cooldown period of 10 minutes is necessary in order to avoid irregular fuel pressure readings due to "Hot Soak" fuel boiling.

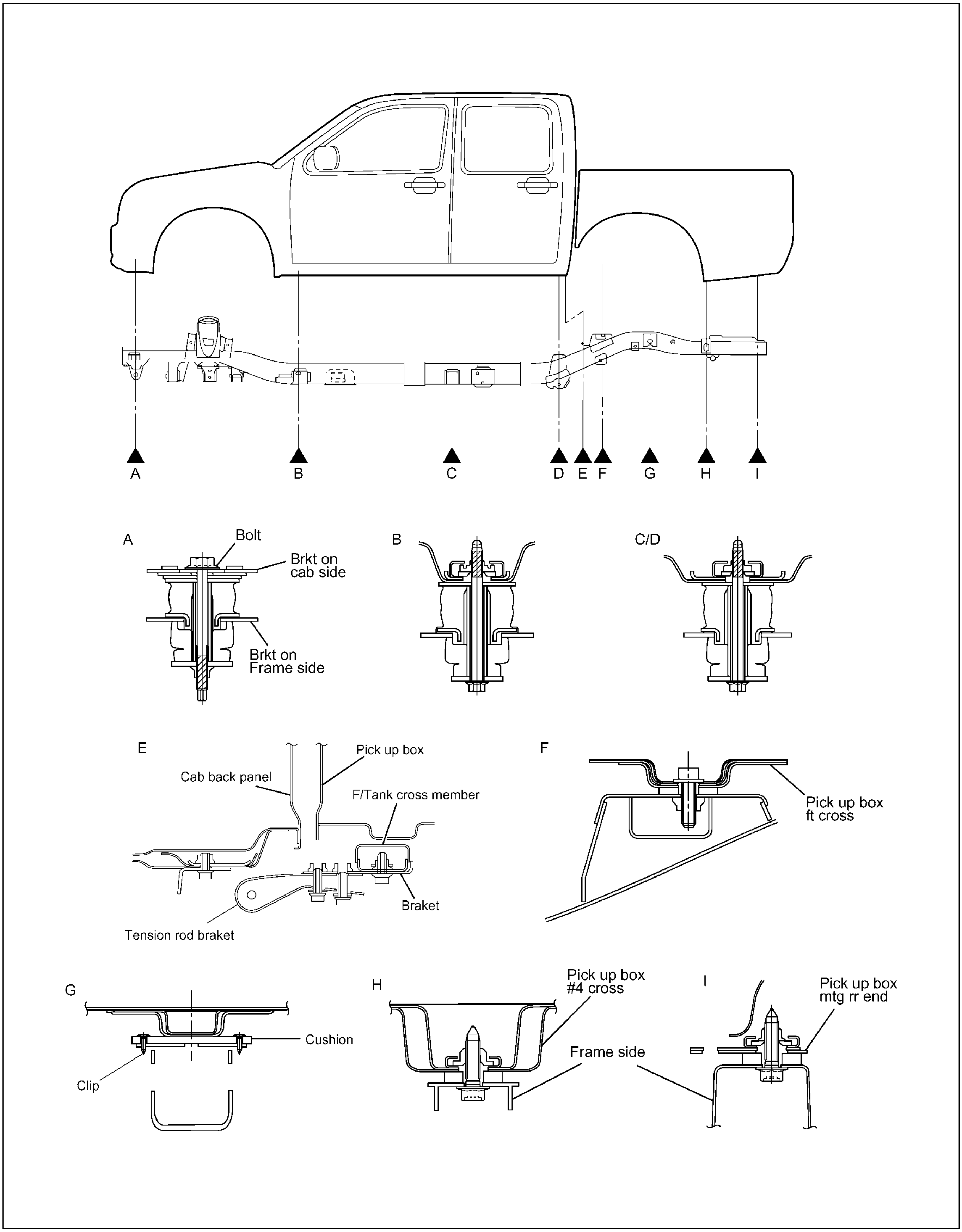
Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)



CYLINDER				
	1	2	3	4
1st Reading (1)	296kPa (43psi)	296kPa (43psi)	296kPa (43psi)	296kPa (43psi)
2nd Reading (2)	205kPa (29psi)	205kPa (29psi)	196kPa (28psi)	274kPa (39psi)
Amount of Drop (1st Reading-2nd Reading)	91kPa (14psi)	91kPa (14psi)	100kPa (15psi)	22kPa (4psi)
Av. Drop = 166kPa/24psi ±10kPa/1.5psi = 156 - 176kPa or 22.5 - 25.5psi	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)	Faulty, Lean (Too Little Fuel Drop)

NOTE: These figures are examples only.

CREW CAB Model



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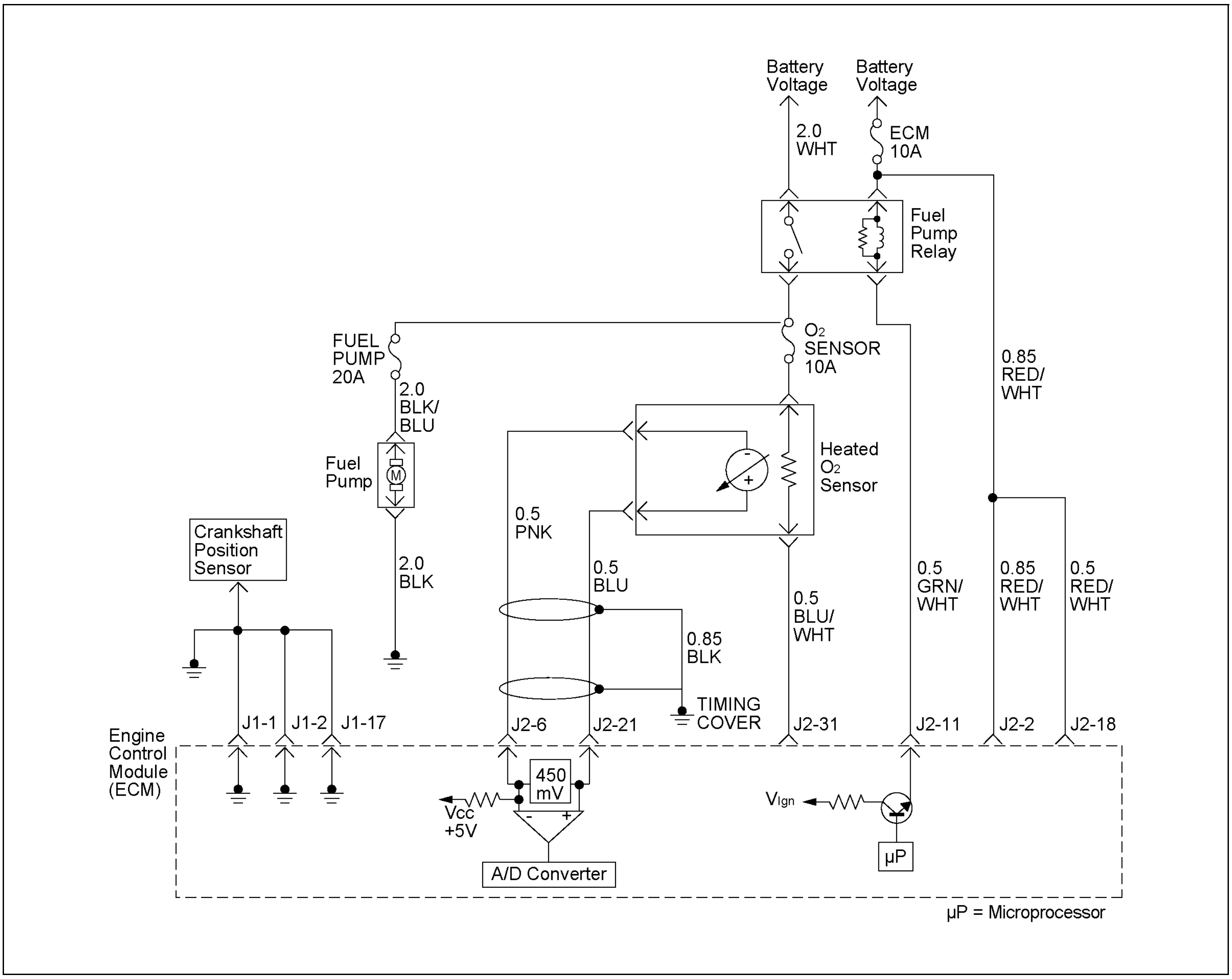
Injector Coil Test Procedure (Steps 1-6) and Injector Balance Test Procedure (Steps 7-11)

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Turn the engine OFF. **NOTE:** In order to prevent flooding of a single cylinder and possible engine damage, relieve the fuel pressure before performing the fuel injector coil test procedure. 2. Relieve the fuel pressure. Refer to Test Description Number 2. 3. Connect the 5-8840-2618-0 Fuel Injector Tester to B+ and ground, and to the 5-8840-2589-0 Injector Adapter Cable. 4. Remove the harness connector of the Fuel Injector and connect the 5-8840-2589-0 Injector Adapter Cable for F/I check. 5. Set the amperage supply selector switch on the fuel injector tester to the "Coil Test" 0.5 amp position. 6. Connect the leads from the 5-8840-2392-0 Digital Voltmeter (DVM) to the fuel injector tester. Refer to the illustrations associated with the test description. 7. Set the DVM to the tenths scale (0.0). 8. Observe the engine coolant temperature. Is the engine coolant temperature within the specified values?	10°C (50°F) to 35°C (95°F)	Go to *Step 3*	Go to *Step 5*
3	1. Set the injector adapter cable to injector #1. 2. Press the "Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. **Important:** The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the injector adapter cable to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading outside of the specified values?	5.7-6.6V	Go to *Step 4*	Go to *Step 7*
4	Replace the faulty fuel injector(S). Refer to *Fuel Injector*. Is the action complete?	—	Go to *Step 7*	—

Step	Action	Value(s)	Yes	No
5	1. Set the Injector Adapter Cable to injector #1. 2. Press the "Push to Start Test" button on the fuel injector tester. 3. Observe the voltage reading on the DVM. **Important:** The voltage reading may rise during the test. 4. Record the lowest voltage observed after the first second of the test. 5. Set the Injector Adapter Cable to the next injector and repeat steps 2, 3, and 4. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilize) or a voltage reading above the specified value?	9.5V	Go to *Step 4*	Go to *Step 6*
6	1. Identify the highest voltage reading recorded (other than those above 9.5V). 2. Subtract the voltage reading of each injector from the highest voltage selected in step 1. Repeat until you have a subtracted value for each injector. For any injector, is the subtracted value in step 2 greater than the specified value?	0.6V	Go to *Step 4*	Go to *Step 7*
7	***Caution: In order to reduce the risk of fire and personal injury, wrap a shop towel around the fuel pressure connection. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the Towel in an approved container when the connection of the fuel pressure gauge is complete.*** 1. Connect the 5-8840-0378-0 Fuel Pressure Gauge to the fuel pressure test port. 2. Energize the fuel pump using the Scan Tool. 3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container. 4. Bleed the air out of the fuel pressure gauge. 5. With the fuel pump running, observe the reading on the fuel pressure gauge. Is the fuel pressure within the specified values?	296kPa-376kPa (43-55psi)	Go to *Step 8*	Go to *Fuel System Diagnosis*
8	Turn the fuel pump OFF. Does the fuel pressure remain constant?	—	Go to *Step 9*	Go to *Fuel System Diagnosis*

Step	Action	Value(s)	Yes	No
9	1. Connect the 5-8840-0378-0 Fuel Injector Tester and 5-8840-2589-0 Injector Adapter Cable to the fuel injector harness connector. 2. Set the amperage supply selector switch on the fuel injector tester to the “Balance Test” 0.5-2.5 amp position. 3. Using the Scan Tool turn the fuel pump ON then OFF in order to pressurize the fuel system. 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the first pressure reading. 5. Energize the fuel injector by depressing the “Push to Start Test” button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure gauge needle has stopped moving. This is the second pressure reading. 7. Repeat steps 1 through 6 for each fuel injector. 8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10kPa (1.5psi)	Go to *Step 10*	Go to *OBD System Check*
10	Re-test any fuel injector that does not meet the specification. Refer to the procedure in Step 11. **NOTE:** Do not repeat any portion of this test before running the engine in order to prevent the engine from flooding. Does any fuel injector still have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?	10kPa (1.5psi)	Go to *Step 11*	Go to *Symptoms*
11	1. Replace the faulty fuel injector(s). Refer to *Fuel Injector*. 2. Disconnect the 5-8840-2589-0 Injector Adapter Cable for F/I check and re-connect the original F/I check connector. Is the action complete?	—	Verify repair	—

FUEL SYSTEM ELECTRICAL TEST



Circuit Description

When the ignition switch is first turned ON, the engine control module (ECM) energizes the fuel pump relay which applies power to the in-tank fuel pump. The fuel pump relay will remain ON as long as the engine is running or cranking and the ECM is receiving 58X crankshaft position pulses. If no 58X crankshaft position pulses are present, the ECM de-energizes the fuel pump relay within 2 seconds after the ignition is turned ON or the engine is stopped.

The fuel pump delivers fuel to the fuel rail and injectors, then to the fuel pressure regulator. The fuel pressure regulator controls fuel pressure by allowing excess fuel to be returned to the fuel tank. With the engine stopped and ignition ON, the fuel pump can be turned ON by using a command by the scan tool.

Diagnostic Aids

An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

  Caution: To reduce the risk of fire and personal injury:

  - ***It is necessary to relieve fuel system pressure before connecting a fuel pressure gauge. Refer to Fuel Pressure Relief Procedure, below.***
  - ***A small amount of fuel may be released when disconnecting the fuel lines. Cover fuel line fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.***

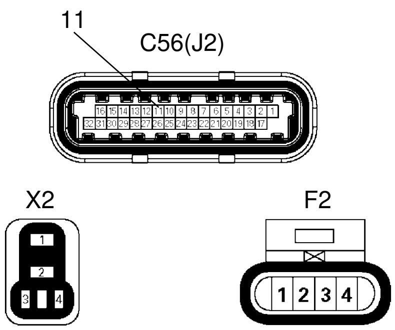
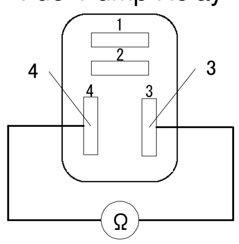
Fuel Pressure Relief Procedure

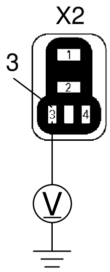
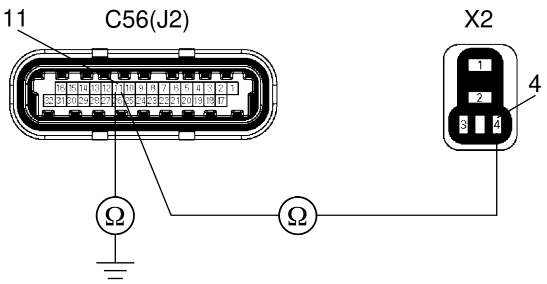
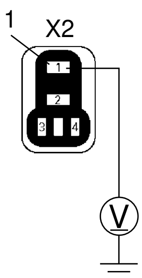
1. Remove the fuel cap.
2. Remove the fuel pump relay from the underhood relay center.
3. Start the engine and alow it to stall.
4. Crank the engine for an additional 3 seconds.

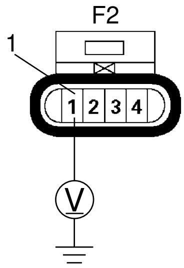
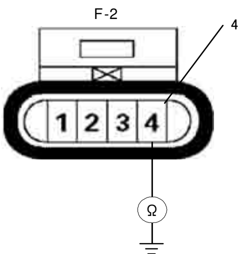
Fuel Pressure Gauge Installation

1. Remove the fuel pressure fitting cap.
2. Install fuel pressure gauge 5-8840-0378-0 to the fuel feed line located in front of and above the right side valve cover.
3. Reinstall the fuel pump relay.

Fuel System Electrical Test

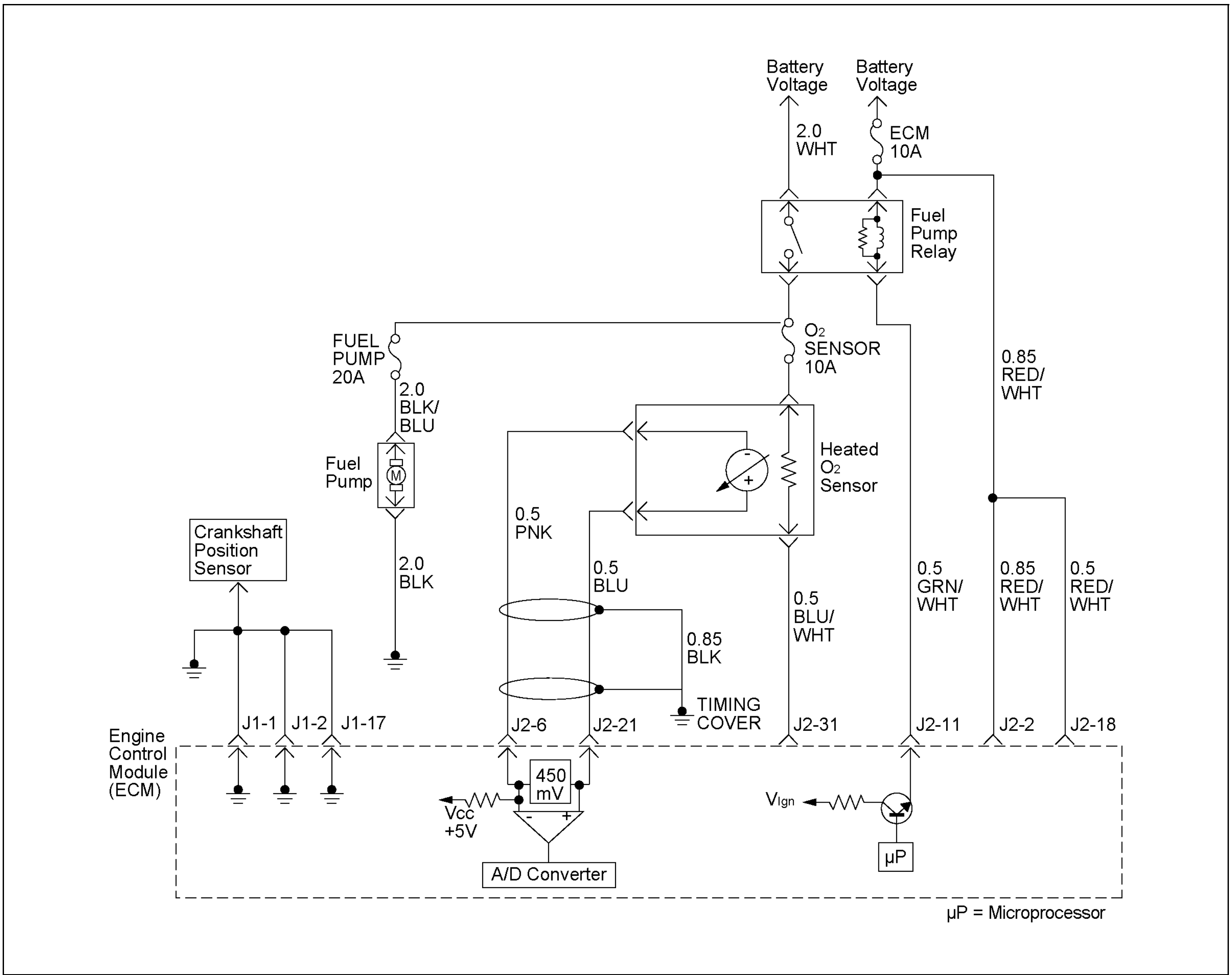
Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “Fuel Pump Relay” in the “Relays”. 3. Operate the Tech 2 in accordance with procedure. Was the fuel pump operated, when the Tech 2 is operated?	—	Go to *Fuel System Diagnosis*	Go to *Step 3*
3	Check the “Fuel Pump” fuse (20A). If the fuse is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	Check for poor/faulty connection at the fuel pump, fuel pump relay or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	—	Verify repair	Go to *Step 5*
5	Using the DVM and check the fuel pump relay. 1. Ignition “Off”, engine “Off”. 2. Remove the fuel pump relay from the relay box. 3. Check the relay coil. Was the DVM indicated specified value? Fuel Pump Relay  	120 - 150 Ω	Go to *Step 6*	Replace fuel pump relay and verify repair

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition “On”, engine “Off”. 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value?  	10 - 14.5V	Go to *Step 8*	Go to *Step 7*
7	Repair the open or short to ground circuit between the “ECM” fuse (15A) and fuel pump relay. Is the action complete?	—	Verify repair	—
8	Using the DVM and check the fuel pump relay ground circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Remove the fuel pump relay from the relay box. 4. Check the circuit for open or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 9*
9	Using the DVM and check the fuel pump relay power supply circuit. 1. Ignition “Off”, engine “Off”. 2. Remove the fuel pump relay from the relay box. 3. Check the circuit for open circuit. Was the DVM indicated specified value?  	10 - 14.5V	Go to *Step 11*	Go to *Step 10*

Step	Action	Value(s)	Yes	No
10	Repair the open circuit between the fuel pump relay and battery. Is the action complete?	—	Verify repair	—
11	Using the DVM and check the fuel pump power supply circuit. 1. Ignition "On", engine "Off". 2. Disconnect the fuel pump connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	10 - 14.5V	Go to *Step 13*	Go to *Step 12*
12	Repair the open or short to ground circuit between the fuel pump relay and fuel pump. Is the action complete?	—	Verify repair	—
13	Using the DVM and check the fuel pump ground circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the fuel pump connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Continuity	Go to *Step 15*	Go to *Step 14*
14	Repair the open circuit between the fuel pump and body ground. Is the action complete?	—	Verify repair	—
15	Replace the fuel pump. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 17*

Step	Action	Value(s)	Yes	No
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

FUEL SYSTEM DIAGNOSIS



Circuit Description

When the ignition switch is turned ON, the engine control module (ECM) will turn ON the in-tank fuel pump. The in-tank fuel pump will remain ON as long as the engine is cranking or running and the ECM is receiving 58X crankshaft position pulses. If there are no 58X crankshaft position pulses, the ECM will turn the in-tank fuel pump OFF 2 seconds after the ignition switch is turned ON or 2 seconds after the engine stops running.

The in-tank fuel pump is an electric pump within an integral reservoir. The in-tank fuel pump supplies fuel through an in-line fuel filter to the fuel rail assembly. The fuel pump is designed to provide fuel at a pressure above the pressure needed by the fuel injectors. A fuel pressure regulator, attached to the fuel rail, keeps the fuel available to the fuel injectors at a regulated pressure. Unused fuel is returned to the fuel tank by a separate fuel return line.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Chart.

2. Connect the fuel pressure gauge to the fuel feed line as shown in the fuel system illustration. Wrap a shop towel around the fuel pressure connection in order to absorb any duel leakage that may occur when installing the fuel pressure gauge. With the ignition switch ON and the fuel pump running, the fuel pressure indicated by the fuel pressure gauge should be 283-376 kPa (41-55 psi). This pressure is controlled by the amount of pressure the spring inside the fuel pressure regulator can provide.
3. A fuel system that cannot maintain a constant fuel pressure has a leak in one or more of the following areas:
   - The fuel pump check valve.
   - The fuel pump flex line.
   - The valve or valve seat within the fuel pressure regulator.

- The fuel injector(s).

4. Fuel pressure that drops off during acceleration, cruise, or hard cornering may case a lean condition. A lean condition can cause a loss of power, surging, or misfire. A lean condition can be diagnosed using a Tech 2 Scan Tool.

Following are applicable to the vehicle with closed Loop System:

If an extremely lean condition occurs, the oxygen sensor(s) will stop toggling. The oxygen sensor output voltage(s) will drop below 500 mV. Also, the fuel injector pulse width will increase.

Important: Make sure the fuel system is not operating in the "Fuel Cut-Off Mode."

When the engine is at idle, the manifold pressure is low (high vacuum). This low pressure (high vacuum) is applied to the fuel pressure regulator diaphragm. The low pressure (high vacuum) will offset the pressure being applied to the fuel pressure regulator diaphragm by the spring inside the fuel pressure regulator. When this happens, the result is lower fuel pressure. The fuel pressure at idle will vary slightly as the barometric pressure changes, but the fuel pressure at idle should always be less than the fuel pressure noted in step 2 with the engine OFF.

16. Check the spark plug associated with a particular fuel injector for fouling or saturation in order to determine if that particular fuel injector is leaking. If checking the spark plug associated with a particular fuel injector for fouling or saturation does not determine that a particular fuel injector is leaking, use the following procedure:
    - Remove the fuel rail, but leave the fuel lines and injectors connected to the fuel rail. Refer to *Fuel Rail Assembly in On-Vehicle Service.*
    - Lift the fuel rail just enough to leave the fuel injector nozzles in the fuel injector ports.

    Caution: In order to reduce the risk of fire and personal injury that may result from fuel spraying on the engine, verify that the fuel rail is positioned over the fuel injector ports and verify that the fuel injector retaining clips are intact.

    - ***Pressurize the fuel system by connecting a 20 amp fused jumper between B+ and the fuel pump relay connector.***
    - ***Visually and physically inspect the fuel injector nozzles for leaks.***

17. A rich condition may result from the fuel pressure being above 376 kPa (55 psi). A rich condition may cause a 45 to set. Driveability conditions associated with rich conditions can include hard starting (followed by black smoke) and a strong sulfur smell in the exhaust.

20. This test determines if the high fuel pressure is due to a restricted fuel return line or if the high fuel pressure is due to a faulty fuel pressure regulator.

21. A lean condition may result from fuel pressure below 333 kPa (48 psi). A lean condition may cause a 44 to set. Driveability conditions associated with lean conditions can include hard starting (when the engine is cold), hesitation, poor driveability, lack of power, surging, and misfiring.

22. Restricting the fuel return line causes the fuel pressure to rise above the regulated fuel pressure. Command the fuel pump ON with the scan tool. The fuel pressure should rise above 376 kPa (55 psi) as the fuel return line becomes partially closed.

NOTE: Do not allow the fuel pressure to exceed 414 kPa (60 psi). Fuel pressure in excess of 414 kPa (60 psi) may damage the fuel pressure regulator.

Caution: To reduce the risk of fire and personal injury:

- ***It is necessary to relieve fuel system pressure before connecting a fuel pressure gauge. Refer to Fuel Pressure Relief Procedure, below.***
- ***A small amount of fuel may be released when disconnecting the fuel lines. Cover fuel line fittings with a shop towel before disconnecting, to catch any fuel that may leak out. Place the towel in an approved container when the disconnect is completed.***

Fuel Pressure Relief Procedure

1. Remove the fuel cap.
2. Located on the intake manifold which is at the top right part of the engine.
3. Start the engine and allow it to stall.
4. Crank the engine for an additional 3 seconds.

Fuel Pressure Gauge Installation

1. Remove the fuel pressure fitting cap.
2. Install fuel pressure gauge 5-8840-0378-0 to the fuel feed line located on the upper right side of the engine.
3. Reinstall the fuel pump relay.

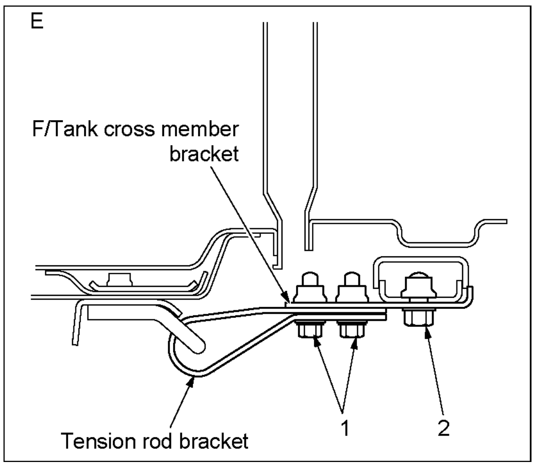
Important Operations – Installation

Bolt : A

Torque	N·m(kgf·m/lb·ft)
50 (5.1 / 37)	

Bolt : B,C/D

Torque	N·m(kgf·m/lb·ft)
72 (7.3 / 53)	



RTW32BSH000401

Bolt : E-1

Torque	N·m(kgf·m/lb·ft)
116 (11.8 / 85)	

Bolt : E-2

Torque	N·m(kgf·m/lb·ft)
168 (17.1 / 124)	

Bolt : F,H,I

Torque	N·m(kgf·m/lb·ft)
54 (5.5 / 40)	

NOTE :

Discard the used mounting bolts G,H shown in the figure and install new ones.

Fuel System Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Turn the ignition OFF. 2. Turn the air conditioning system OFF. 3. Relieve fuel system pressure and install the fuel pressure gauge. 4. Turn the ignition ON. NOTE: The fuel pump will run for approximately 2 seconds. Use the Scan Tool to command the fuel pump ON. 5. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	283-376 kPa (41-55 psi)	Go to *Step 3*	Go to *Step 17*
3	Does the fuel pressure indicated by the fuel pressure gauge remain constant? NOTE: The fuel pressure will drop when the fuel pump stops running, then it should stabilize and remain constant.	—	Go to *Step 4*	Go to *Step 12*
4	1. When the vehicle is at normal operating temperature, turn the ignition ON to build fuel pressure and observe the measurement on the gauge. 2. Start the engine and observe the fuel pressure gauge. Did the reading drop by the amount specified after the engine was started?	21-105 kPa (3-15 psi)	Go to *Step 5*	Go to *Step 9*
5	Is fuel pressure dropping off during acceleration, cruise, or hard cornering?	—	Go to *Step 6*	Check for improper fuel
6	Visually and physically inspect the following items for a restriction: • The in-line fuel filter. • The fuel feed line. Was a restriction found?	—	Verify repair	Go to *Step 7*
7	Remove the fuel tank and visually and physically inspect the following items: • The fuel pump strainer for a restriction. • The fuel line for a leak. • Verify that the correct fuel pump is in the vehicle. Was a problem found in any of these areas?	—	Verify repair	Go to *Step 8*
8	Replace the fuel pump. Is the action complete?	—	Verify repair	—
9	1. Disconnect the vacuum hose from the fuel pressure regulator. 2. With the engine idling, apply 12-14 inches of vacuum to the fuel pressure regulator. Does the fuel pressure indicated by the fuel pressure gauge drop by the amount specified?	21-105 kPa (3-15 psi)	Go to *Step 10*	Go to *Step 11*

Step	Action	Value(s)	Yes	No
10	Locate and repair the loss of vacuum to the fuel pressure regulator. Is the action complete?	—	Verify repair	—
11	Replace the fuel pressure regulator. Is the action complete?	—	Verify repair	—
12	1. Run the fuel pump with the Scan Tool. 2. After pressure has built up, turn off the pump and clamp the supply hose shut with suitable locking pliers. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 13*	Go to *Step 15*
13	Visually inspect the fuel supply line and repair any leaks. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Remove the fuel tank and inspect for leaky hose or in-tank fuel line. Was a problem found?	—	Verify repair	Go to *Step 8*
15	1. If the pliers are still clamped to the fuel supply hose, remove the locking pliers. 2. With suitable locking pliers, clamp the fuel return line to prevent fuel from returning to the fuel tank. 3. Run the fuel pump with the Scan Tool. 4. After pressure has built up, remove power to the pump. Does the fuel pressure indicated by the fuel pressure gauge remain constant?	—	Go to *Step 11*	Go to *Step 16*
16	Locate and replace any leaking fuel injector(s). Is the action complete?	—	Verify repair	—
17	Is the fuel pressure indicated by the fuel pressure gauge above the specified limit?	376 kPa (55 psi)	Go to *Step 18*	Go to *Step 21*
18	1. Relieve the fuel pressure. Refer to the *Fuel Pressure Relief*. 2. Disconnect the fuel return line from the fuel rail. 3. Attach a length of flexible hose to the fuel rail return outlet passage. 4. Place the open end of the flexible hose into an approved gasoline container. 5. Run the fuel pump with the Scan Tool. 6. Observe the fuel pressure indicated by the fuel pressure gauge with the fuel pump running. Is the fuel pressure within the specified limits?	290-376 kPa (42-55 psi)	Go to *Step 19*	Go to *Step 20*
19	Locate and correct the restriction in the fuel return line. Is the action complete?	—	Verify repair	—
20	Visually and physically inspect the fuel rail outlet passages for a restriction. Was a restriction found?	—	Verify repair	Go to *Step 11*
21	Is the fuel pressure indicated by the fuel pressure gauge above the specified value?	0 kPa (0 psi)	Go to *Step 22*	Go to *Step 23*

Step	Action	Value(s)	Yes	No
22	1. Command the fuel pump ON with the Scan Tool. 2. Using suitable pliers which will not damage the fuel hose, gradually apply pressure with the pliers to pinch the flexible fuel return hose closed. Does the fuel pressure indicated by the fuel pressure gauge rise above the first specified value? ***Caution: Do not let the fuel pressure exceed the second specified value.***	376 kPa (55 psi) 414 kPa (60 psi)	Go to *Step 11*	Go to *Step 7*
23	1. Command the fuel pump ON with the Scan Tool. 2. Remove the fuel filler cap and listen for the sound of the fuel pump running. 3. Turn the pump off. Was the fuel pump running?	—	Go to *Step 7*	Go to *Fuel System Electrical Test Chart*

ECM DIAGNOSTIC TROUBLE CODES (DTC)

Type A

- Emission related.
- Requests illumination of the MIL (Malfunction Indicator Lamp = Check Engine Lamp) of the first trip with a fail.
- Stores a history DTC on the first trip.
- Stores a freeze frame (If empty).
- Stores a fail record.
- Updates the fail record each time the diagnostic test fails.

Type B

- Emission related.
- “Armed” after one trip with fail.
- “Disarmed” after one trip with a pass.
- Requests illumination of the MIL on the second consecutive trip with a fail.
- Store a history DTC on the second consecutive trip with a fail. (The DTC will be armed after the first fail.)
- Stores a freeze frame on the second consecutive trip with a fail (If empty).
- Stores a fail record when the first test fails (not dependent on consecutive trip).
- Updates the fail record each time the diagnostic test fails.

Type D

- Non emission related.
- Does not request illumination of any lamp.
- Stores a history DTC on the first trip.
- Does not store a freeze frame.
- Stores fail record when test fails.
- Updates the fail record each time the diagnostic test fails.

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0107	A	Manifold Absolute Pressure Circuit Low Input	1. No DTC relating to TPS. 2. Throttle position is more than 0% if engine speed is below 1000rpm, or throttle position more than 5% if engine speed is more than 1000rpm. 3. MAP sensor output is below 12kPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.	MAP sensor output is more than 12kPa.	1. Sensor power supply circuit open or short to ground circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. MAP sensor malfunction. 5. ECM malfunction.	J1-24/ J1-31
P0108	A	Manifold Absolute Pressure Circuit High Input	1. No DTC relating to TPS. 2. Throttle position is below 15% if engine speed is below 2500rpm, or throttle position is below 35% if engine speed is more than 2500rpm. 3. Engine run time is longer than 10 seconds. 4. MAP sensor output is more than 103kPa.		MAP sensor output is below 103kPa.	1. Sensor power supply circuit short to voltage circuit. 2. Sensor signal circuit short to voltage circuit. 3. Sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. MAP sensor malfunction. 6. ECM malfunction.	J1-16/ J1-24/ J1-31
P0112	A	Intake Air Temperature Sensor Low Input	1. No DTC relating to VSS. 2. Vehicle speed is more than 25km/h. 3. Engine run time is longer than 120 seconds. 4. IAT sensor output is more than 149 deg. C.	The ECM uses 20 deg. C condition as substitute.	IAT sensor output is below 149 deg. C.	1. Sensor signal circuit short to ground circuit. 2. IAT sensor malfunction. 3. ECM malfunction.	J2-22
P0113	A	Intake Air Temperature Sensor High Input	1. No DTC relating to VSS & ECT sensor. 2. Vehicle speed is below 70km/h. 3. 3Engine coolant temperature is more than -8 deg. C. 4. Engine run time is longer than 120 seconds. 5. Mass air flow is below 30g/s. 6. IAT sensor output is below -38 deg. C.		IAT sensor output is more than -38 deg. C.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. IAT sensor malfunction. 5. ECM malfunction.	J2-1/ J2-22
P0117	A	Engine Coolant Temperature Sensor Low Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is more than 149 deg. C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.	ECT sensor output is below 149 deg. C.	1. Sensor signal circuit short to ground circuit. 2. ECT sensor malfunction. 3. ECM malfunction.	J1-27
P0118	A	Engine Coolant Temperature Sensor High Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is below -38 deg. C.		ECT sensor output is more than -38 deg. C.	1. Sensor signal circuit open or short to voltage circuit. 2. Sensor ground circuit open or short to voltage circuit. 3. Poor connector connection 4. ECT sensor malfunction. 5. ECM malfunction.	J1-27/ J1-32

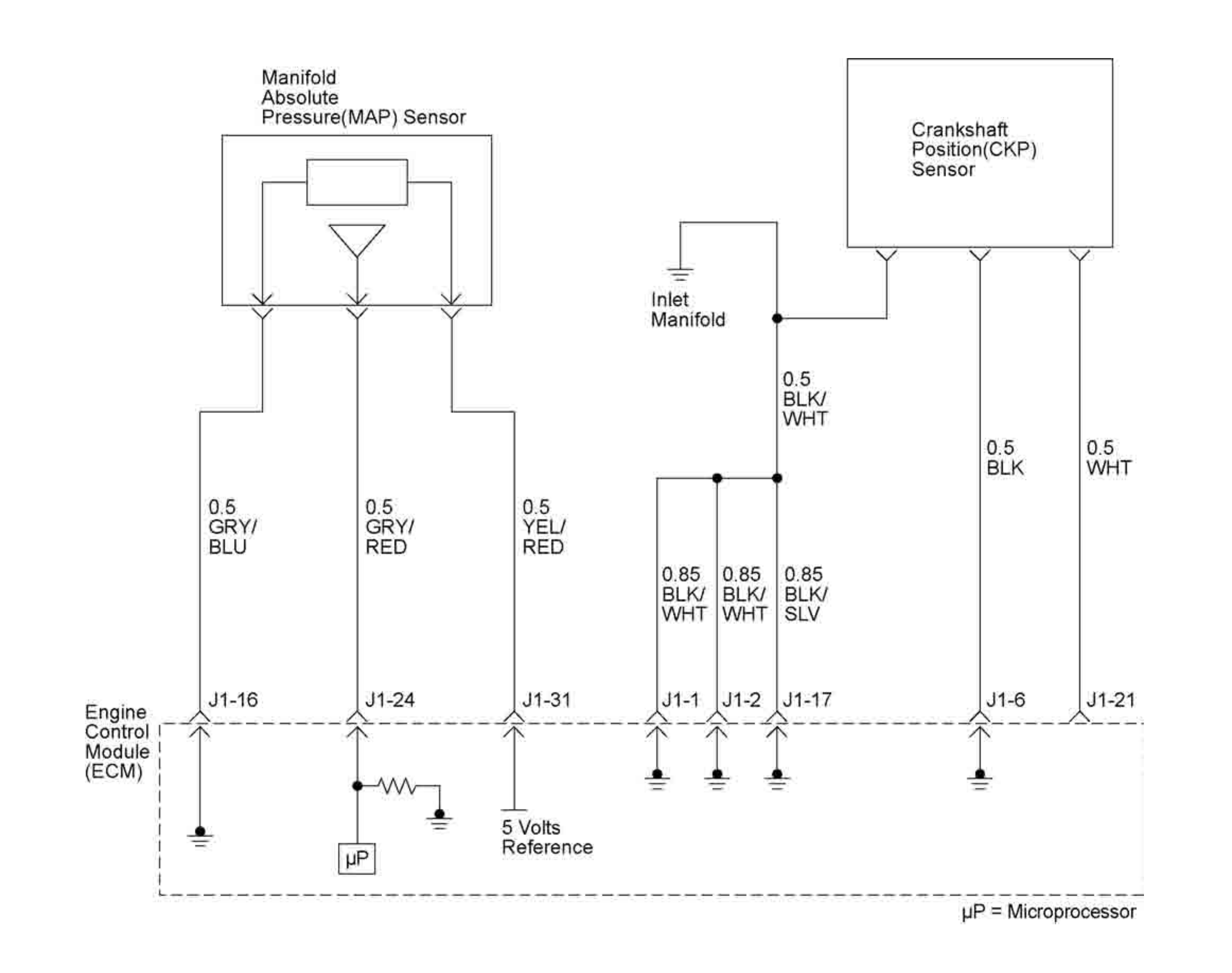
Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.14V.	The ECM uses 0% condition as substitute.	TPS output voltage is more than 0.14V.	1. Sensor power supply circuit open or short to ground circuit. 2. Sensor signal circuit open or short to ground circuit. 3. Poor connector connection. 4. TPS malfunction. 5. ECM malfunction.	J1-7/ J1-15/
P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.9V.		TPS output voltage is below 4.9V.	1. Sensor power supply circuit short to voltage circuit. 2. Sensor signal circuit short to voltage circuit. 3. Sensor ground circuit open or short to voltage circuit. 4. Poor connector connection. 5. TPS malfunction. 6. ECM malfunction.	J1-7/ J1-15/ J1-32
P0131	A	O_2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. O_2 sensor bank 1 output voltage is below 50mV in “Closed Loop” condition.	“Open Loop” fuel control.	O_2 sensor bank 1 output voltage is more than 50mV.	1. Sensor harness short to ground circuit. 2. O_2 sensor malfunction. 3. ECM malfunction.	J2-6/ J2-21
P0132	A	O_2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. O_2 sensor bank 1 output voltage is more than 952mV in “Closed Loop” condition.		O_2 sensor bank 1 output voltage is below 952mV.	1. Sensor harness short to voltage circuit. 2. O_2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Incorrect fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21
P0134	A	O_2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. Engine run time is longer than 40 seconds. 4. Mass air flow is more than 7g/s. 5. O_2 sensor bank 1 output voltage is between 300mV and 600mV.		O_2 sensor bank 1 output voltage is below 300mV consecutively. OR O_2 sensor bank 1 output voltage is more than 600mV consecutively.	1. Sensor harness open circuit. 2. O_2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Incorrect fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0135	A	O_2 Sensor Heater Circuit (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor and ECT sensor. 2. Engine coolant temperature is more than 60 deg. C. 3. Engine run time is longer than 20 seconds. 4. MAP sensor output is more than 70kPa. 5. O_2 sensor bank 1 heater current more than 10mA.	No fail-safe function.	O_2 sensor bank 1 heater circuit is correct condition.	1. Heater harness open, short to ground or short to voltage circuit. 2. O_2 sensor heater malfunction. 3. ECM malfunction.	J2-31
P0201	A	Injector 1 Control Circuit	1. Engine is running. 2. Engine speed is more than 1000rpm. 3. Injector voltage does not meet to the battery voltage when the injector is commanded Off or does not meet to the 0V when the injector is commanded On.		Injector circuit is correct condition.	1. Injector harness open circuit, short to ground or short to voltage circuit. 2. Injector malfunction. 3. ECM malfunction.	J1-9
P0202	A	Injector 2 Control Circuit					J1-22
P0203	A	Injector 3 Control Circuit					J1-8
P0204	A	Injector 4 Control Circuit					J1-11
P0325	B	Knock Sensor Module Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50 deg. C. 3. Engine speed is more than 1600rpm. 4. Knock sensor filter module integrated circuit malfunction.	ECM retards ignition timing 4 deg. C.	Knock sensor is correct condition.	1. KS harness open circuit. 2. Poor connector connection. 3. KS sensor malfunction. 4. ECM malfunction.	J1-3/ J1-32
P0327	A	Knock Sensor Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50 deg. C. 3. Engine speed is more than 1600rpm. 4. Knock sensor harness short to ground or short to voltage circuit.			1. KS harness short to ground or short to voltage circuit. 2. Poor connector connection. 3. KS sensor malfunction. 4. ECM malfunction.	J1-3/ J1-32
P0336	B	Crankshaft Position Sensor Circuit Range/ Performance (58X)	1. Engine is running. 2. Extra or missing pulse is detected consecutively.	No fail-safe function.	Correct pulse is detected consecutively.	1. CKP sensor harness open circuit, short to ground or short to voltage circuit. 2. Poor connector connection. 3. CKP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Pluser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	J1-6/ J1-21
P0337	B	Crankshaft Position Sensor Circuit Low Input (58X)	No pulse is detected during engine cranking.			1. CKP sensor harness open circuit, short to ground or short to voltage. 2. Poor connector connection. 3. CKP sensor malfunction. 4. Pulse sensing gap incorrect. 5. Pluser malfunction. 6. Electrical interference. 7. Magnetic interference. 8. ECM malfunction.	J1-6/ J1-21

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P0351	A	Ignition 1 Control Circuit	#1 or #4cylinder ignition signals are not detected consecutively.	No fail-safe function.	Consecutive ignition signals are detected.	1. Ignition coil module 1 harness open circuit, short to ground or short to voltage circuit. 2. Ignition coil module malfunction. 3. ECM malfunction.	J1-19
P0352	A	Ignition 2 Control Circuit	#2 or #3 cylinder ignition signals are not detected consecutively.			1. Ignition coil module 2 harness open circuit, short to ground or short to voltage circuit. 2. Ignition coil module malfunction. 3. ECM malfunction.	J1-18
P0443	B	EVAP Emission Control System Purge Control Circuit	EVAP purge solenoid circuit open, short to ground or short to voltage circuit.	No fail-safe function.	EVAP purge solenoid circuit is correct condition.	1. Solenoid harness open circuit, short to ground or short to voltage circuit. 2. Solenoid malfunction. 3. ECM malfunction.	J1-5
P0502	B	Vehicle Speed Sensor Circuit Low Input	1. No DTC relating to MAP sensor, TPS, ECT sensor, injector control circuit and ignition control circuit. 2. Engine is running. 3. Vehicle speed is below 3km/h in power condition or 2km/h in deceleration condition.	ECM uses 0km/h condition as substitute.	VSS circuit correct condition.	1. Sensor harness open circuit, short to ground circuit or short to voltage circuit. 2. Poor connector connection. 3. VSS malfunction. 4. ECM malfunction.	J2-23
P0562	D	System Voltage Low	Battery voltage is below 11V.	No fail-safe function.	Battery voltage is between 11V and 16V.	1. Battery power feed harness open circuit or short to ground circuit. 2. ECM ground harness open or poor connection. 3. Poor connector connection. 4. Battery malfunction. 5. Charge system malfunction. 6. ECM malfunction.	-
P0563	A	System Voltage High	Battery voltage is above 16V.			1. Charge system malfunction. 2. Battery jump start cable misconnect. 3. ECM malfunction.	-
P0601	A	ECM Memory Checksum	ECM memory area error.	Engine control disabled.	Memory are is OK.	ECM malfunction.	-
P0602	-	ECU Programming Error	ECM memory area error.	Engine control disabled.	Memory are is OK.	ECM is not programmed.	-
P0650	A	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	Check engine lamp circuit open, short to ground or short to voltage circuit.	No fail-safe function.	Check engine lamp circuit is correct condition.	1. Solenoid harness open circuit, short to ground or short to voltage circuit. 2. Solenoid malfunction. 3. ECM malfunction.	J2-32

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)	Recovery Condition	Related Failure Parts	Related ECM Pin No.
P1167	D	Fuel Supply System Rich During Deceleration Fuel Cutoff	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. O_2 sensor bank 1 output voltage is more than 550mV in deceleration fuel cutoff mode.	No fail-safe function.	O_2 sensor output voltage is below 550mV.	1. Sensor harness open or short to ground circuit. 2. O_2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. EVAP purge solenoid valve malfunction. 9. Ignition system malfunction. 10. Spark plug malfunction. 11. ECM malfunction.	J2-6/ J2-21
P1171	D	Fuel Supply System Lean During Power Enrichment	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60deg. C. 3. Mass air flow is below 13.5m/s. 4. O_2 sensor bank 1 output voltage is below 350mV in power enrichment mode.	No fail-safe function.	O_2 sensor output voltage is more than 350mV.	1. Sensor harness open or short to ground circuit. 2. O_2 sensor malfunction. 3. MAF sensor output is incorrect. 4. Air intake line malfunction. 5. IAC valve malfunction. 6. Low fuel pressure. 7. Injector malfunction. 8. ECM malfunction.	J2-6/ J2-21
P1625	B	ECM System Reset	ECM reset has occurred other than "On".	Engine control disabled.	Memory are is OK.	1. Electrical interference. 2. Magnetic interference. 3. ECM malfunction.	-
P1626	-	Immobilizer No Signal	No response from immobilizer control unit.	1. Engine does not start. 2. Check engine lamp flash.	No recovery.	1. ECM and immobilizer control unit communication circuit open circuit, short to ground circuit or short to voltage circuit. 2. ECM malfunction. 3. Immobilizer control unit malfunction. 4. Transponder key malfunction.	J2-23/ J2-32
P1631	-	Immobilizer Wrong Signal	Received response is not correct.			1. ECM malfunction. 2. Immobilizer control unit malfunction. 3. Transponder key malfunction.	-
P1648	-	Wrong Security Code Entered	Received incorrect security code.			1. ECM malfunction. 2. Immobilizer control unit malfunction. 3. Transponder key malfunction.	-
P1649	-	Immobilizer Function Not Programmed	Immobilizer function is not programmed in the ECM.			ECM malfunction.	-
P1693	B	Tachometer Output Low Voltage	Tacho output circuit short to ground circuit.	No fail-safe function.	Tacho output circuit is correct condition.	1. Tacho output circuit short to ground circuit. 2. Poor connector connection. 3. ECM malfunction.	J2-25

DIAGNOSTIC TROUBLE CODE (DTC) P0107 MANIFOLD ABSOLUTE PRESSURE CIRCUIT LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0107	A	Manifold Absolute Pressure Circuit Low Input	1. No DTC relating to TPS. 2. Throttle position is more than 0% if engine speed is below 1000rpm, or throttle position more than 5% if engine speed is more than 1000rpm. 3. MAP sensor output is below 12kPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure. The MAP sensor signal voltage to the engine control module (ECM) varies from below 2 volts at idle (low manifold pressure) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (high manifold pressure).

A “speed density” method of determining engine load is used on the 2.4L engine. This is calculated using inputs from the MAP sensor, the CKP Sensor, and the Intake Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

The ECM monitors the MAP signals for voltages outside the normal range (10-104 kPa) of the MAP sensor. If the ECM detects a MAP signal voltage that is excessively low, Diagnostic Trouble Code P0107 will be set.

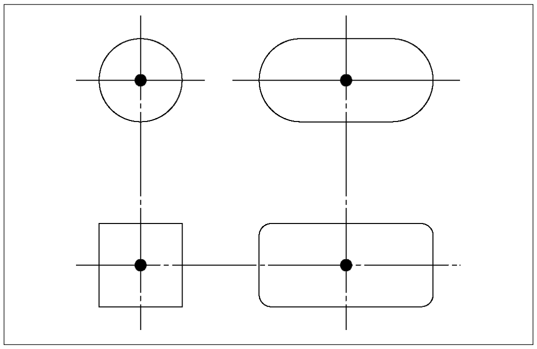
Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM - Inspect harness

BODY DIMENSIONS

Service Precaution



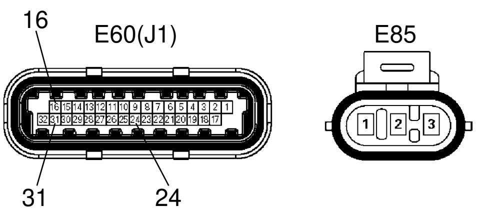
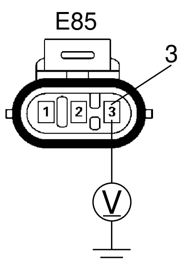
RUW52BSH003301

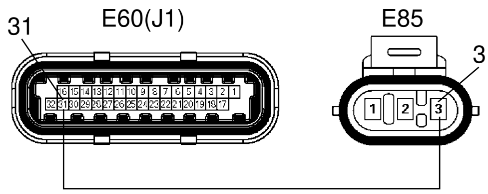
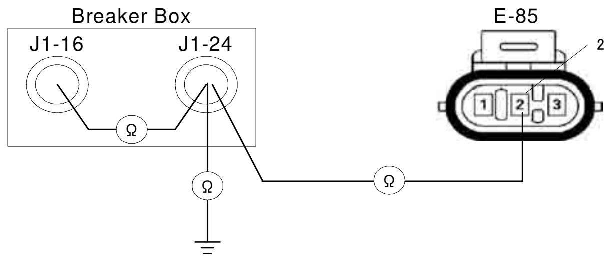
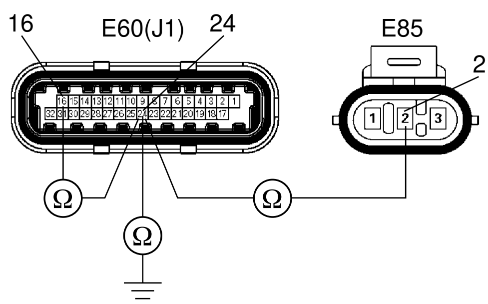
Note : Be sure to measure from the center of one hole to the center of the other hole.

connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

- If these codes are also set, it could indicate a problem with the 5 Volt reference circuit.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the MAP display on the Tech 2 while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

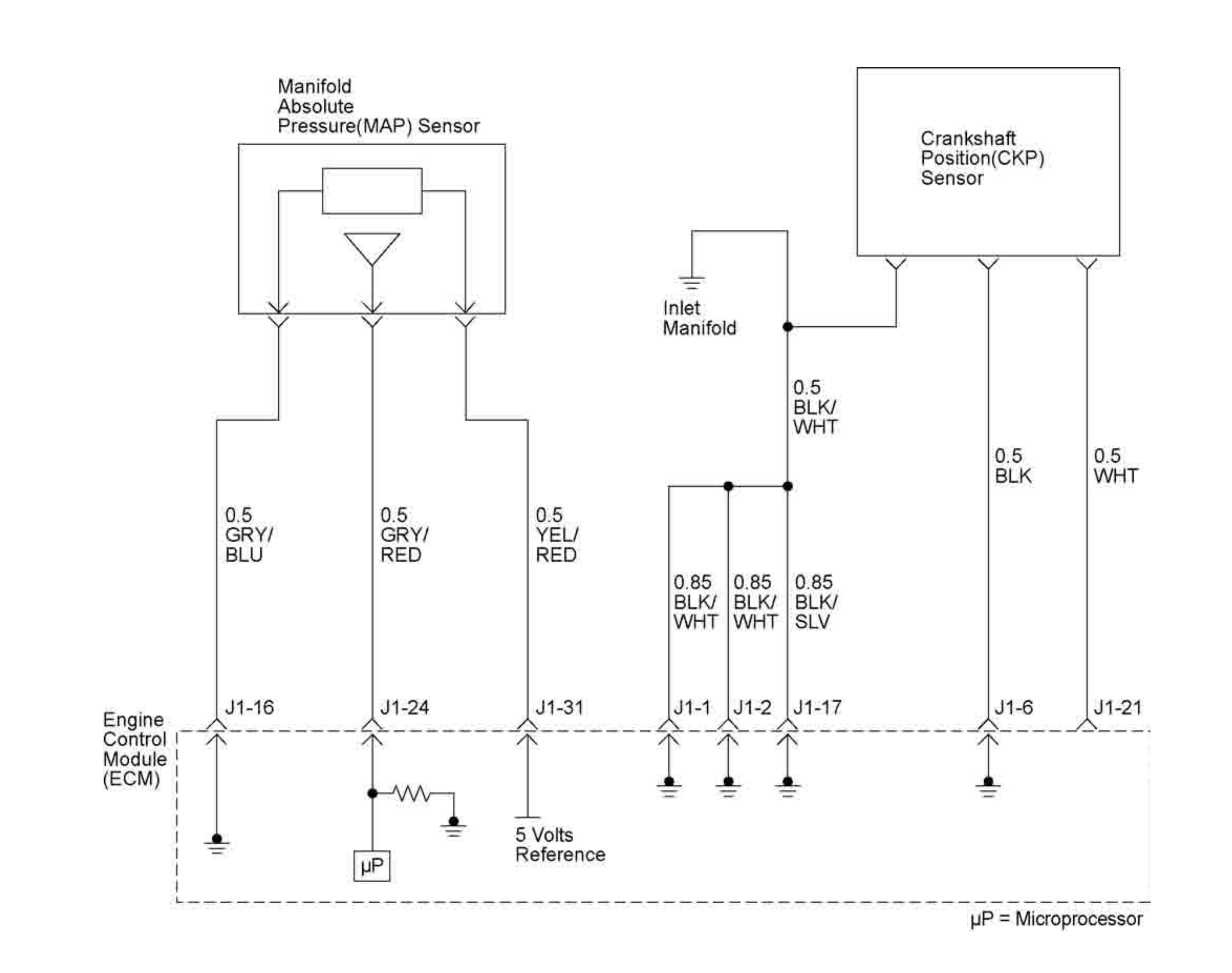
Diagnostic Trouble Code (DTC) P0107
Manifold Absolute Pressure Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0107 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0107 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the MAP sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Visually check the MAP. Was the problem found?	—	Go to Step 9	Go to *Step 6*
6	Using the DVM and check the MAP sensor power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the MAP sensor connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 8*	Go to *Step 7*

Step	Action	Value(s)	Yes	No
7	Repair the open or short to ground circuit between the ECM and MAP sensor Was the problem solved?  	—	Verify repair	Go to *Step 11*
8	Using the DVM and check the MAP sensor signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect MAP sensor connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the MAP sensor connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 9*
9	Substitute a known good MAP sensor and recheck. Was the problem solved?	—	Go to *Step 10*	Go to *Step 11*
10	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 12*

Step	Action	Value(s)	Yes	No
12	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0108 MANIFOLD ABSOLUTE PRESSURE CIRCUIT HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0108	A	Manifold Absolute Pressure Circuit High Input	1. No DTC relating to TPS. 2. Throttle position is below 15% if engine speed is below 2500rpm, or throttle position is below 35% if engine speed is more than 2500rpm. 3. Engine run time is longer than 10 seconds. 4. MAP sensor output is more than 103kPa.	The ECM uses default manifold absolute pressure value based on engine speed and throttle position.

Circuit Description

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure. The MAP sensor signal voltage to the engine control module (ECM) varies from below 2 volts at idle (low manifold pressure) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (high manifold pressure).

A "speed density" method of determining engine load is used on the 2.4L engine. This is calculated using inputs from the MAP sensor, RPM, CKP Sensor, and the Intake Air Temperature (IAT) sensor. The MAP sensor is the main sensor used in this calculation, and measuring engine load is its main function.

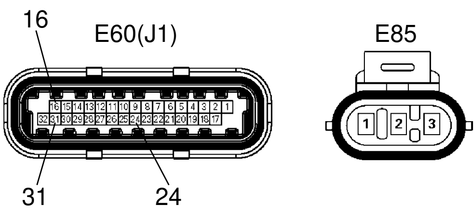
The ECM monitors the MAP signals for voltages outside the normal range (10-104 kPa) of the MAP sensor. If the ECM detects a MAP signal voltage that is excessively high, Diagnostic Trouble Code P0108 will be set.

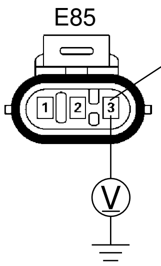
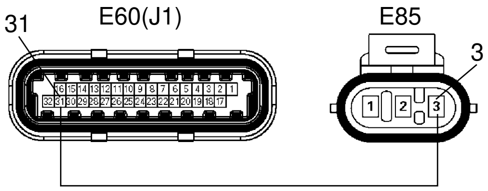
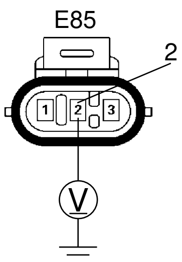
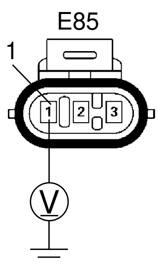
Diagnostic Aids

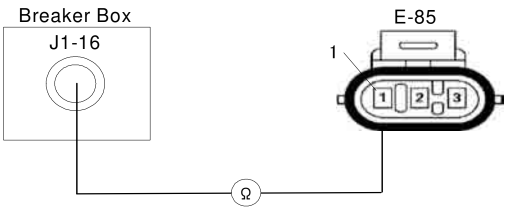
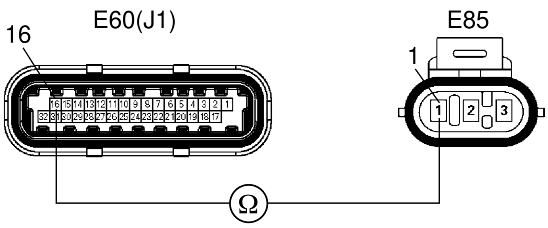
Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- If these codes are also set, it could indicate a problem with the 5 Volt reference circuit.
- Damaged harness - Inspect the wiring harness for damage; an open circuit, a short to ground, or a short to voltage. If the harness appears to be OK, observe the MAP display on the Tech 2 while moving connectors and wiring harnesses related to the sensor. A change in the display will indicate the location of the fault.

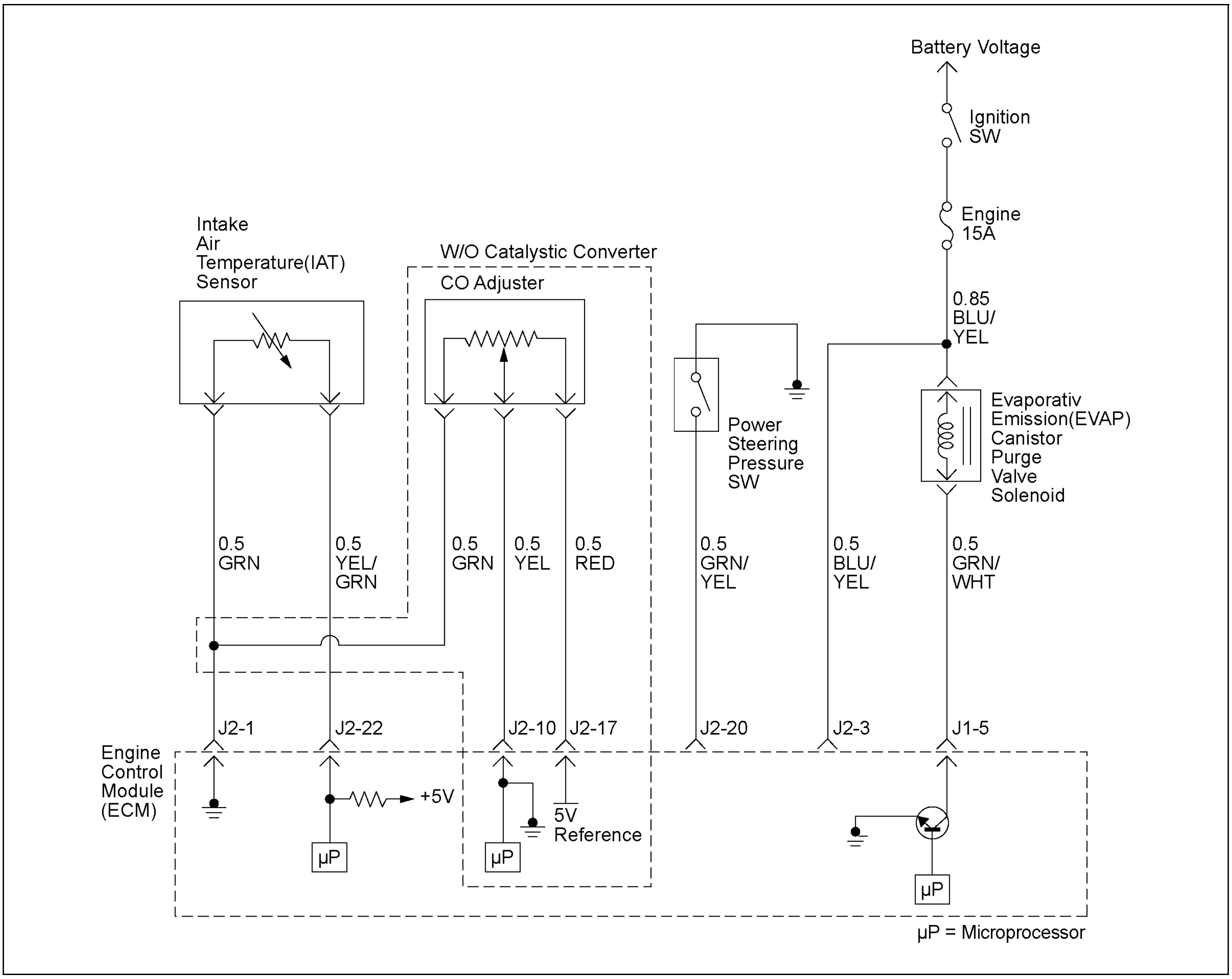
Diagnostic Trouble Code (DTC) P0108 Manifold Absolute Pressure Circuit High Input

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0108 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0108 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the MAP sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	—	Verify repair	Go to *Step 5*
5	Visually check the MAP sensor. Was the problem found?	—	Go to *Step 11*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the MAP sensor power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the MAP sensor connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated specified value?  	Approximately 5.0V	Go to *Step 8*	Go to *Step 7*
7	Repair the short to voltage circuit between the ECM and MAP sensor. Was the problem solved?  	—	Verify repair	Go to *Step 13*
8	Using the DVM and check the MAP sensor signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the MAP sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value?  	Less than 1V	Go to *Step 9*	Repair faulty harness and verify repair
9	Using the DVM and check the MAP sensor ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the MAP sensor connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value?  	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair

Step	Action	Value(s)	Yes	No
10	Using the DVM and check the MAP sensor ground circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the MAP sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the MAP sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 11*
11	Substitute a known good MAP sensor and recheck. Was the problem solved?	—	Go to Step 12	Go to *Step 13*
12	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0112 INTAKE AIR TEMPERATURE SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0112	A	Intake Air Temperature Sensor Low Input	1. No DTC relating to VSS. 2. Vehicle speed is more than 25km/h. 3. Engine run time is longer than 120 seconds. 4. IAT sensor output is more than 149 deg. C.	The ECM uses 20 deg. C condition as substitute.

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower, causing the ECM to monitor a lower voltage. Diagnostic Trouble Code P0112 will set when the ECM detects an excessively low signal voltage (short to ground) on the intake air temperature sensor signal circuit.

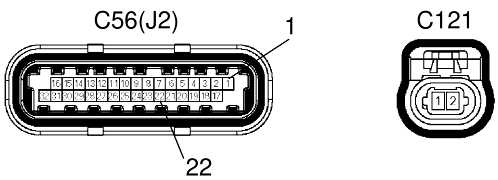
Diagnostic Aids

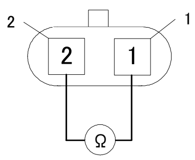
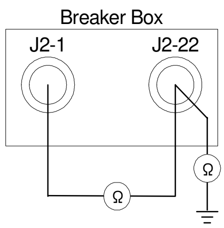
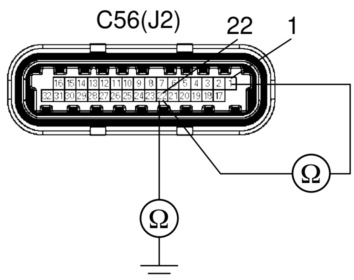
Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery and open

circuit. If the harness appears to be OK, observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0112
Intake Air Temperature Sensor Low Input

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0112 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0112 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Remove the IAT sensor and visually check. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the IAT sensor.
1. Ignition “Off”, engine “Off”.
2. Disconnect IAT sensor connector.
3. Measure the resistance of IAT sensor.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>32500</td></tr>
<tr><td>0</td><td>9910</td></tr>
<tr><td>20</td><td>3400</td></tr>
<tr><td>40</td><td>1509</td></tr>
<tr><td>60</td><td>670</td></tr>
<tr><td>80</td><td>329</td></tr>
<tr><td>100</td><td>182</td></tr>
<tr><td>120</td><td>101</td></tr>
</table>
IAT Sensor
</td><td>Standard resistance</td><td>Go to *Step 7*</td><td>Go to *Step 8*</td></tr>
<tr><td>7</td><td>Using the DVM and check the IAT sensor signal circuit.
Breaker box is available:
1. Ignition “Off”, engine “Off”.
2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page.
3. Disconnect the IAT sensor connector.
4. Check the circuit for short to sensor ground or ground circuit.
Was the problem found?

Breaker box is not available:
1. Ignition “Off”, engine “Off”.
2. Disconnect the IAT sensor connector.
3. Check the circuit for short to sensor ground or ground circuit.
Was the problem found?
</td><td>—</td><td>Repair faulty harness and verify repair</td><td>Go to *Step 10*</td></tr>
</table>

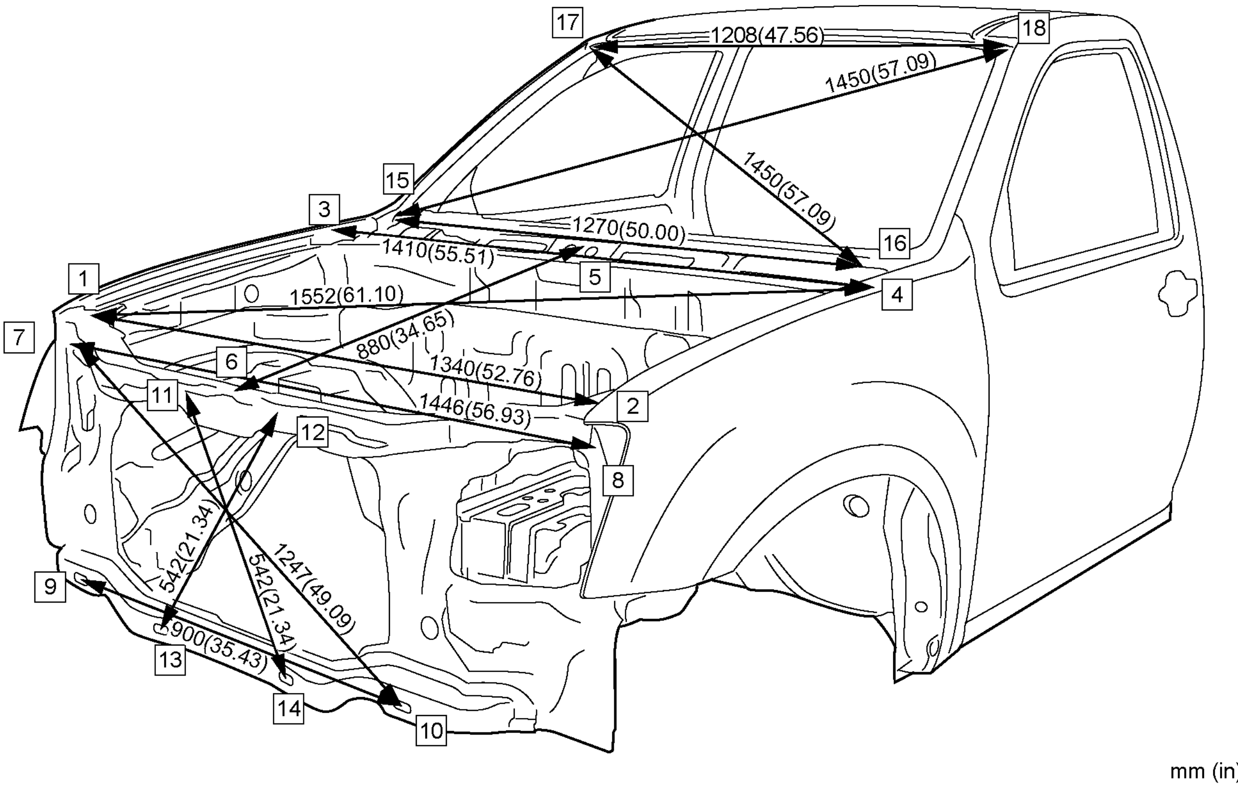
MAINTENANCE SCHEDULE (For EUROPE)

Items followed by an asterisk (*) require more frequent maintenance if the vehicle is driven under severe conditions.
Replace the fuel filter (**Mark) when the fuel filter indicator light is lit.
Refer to "SEVERE CONDITIONS MAINTENANCE SCHEDULE."
Diesel Engine model (ACEA B2 specification engine oil)

I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading or × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
DIESEL ENGINE																				
* Engine oil	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R	-	R
* Engine oil filter	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R
Oil leakage and contamination	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Idling speed and acceleration	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Fan belt tension and damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Exhaust system	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
All hoses and pipes in engine compartment for clog of damage	-	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Valve clearance	-	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A
* Air cleaner element	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
** Fuel filter	Replace the fuel filter when the fuel filter indicator light is lit.																			
Engine coolant concentration	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Cooling system for water leakage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
CLUTCH																				
Clutch fluid	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Clutch pedal travel and play	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
TRANSMISSION OR TRANSMISSION WITH TRANSFER CASE																				
* Manual transmission with fluid	-	R	-	I	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I
* Transfer case oil (MT)	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Gear control mechanism for looseness	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
* Automatic transmission fluid	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
* Transfer case oil (AT)	-	-	-	I	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	I
PROPELLER SHAFT																				
Loose connections	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Universal joints and splines for wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Universal joints and sliding sleeve (4WD)	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L
FRONT AND REAR AXLE																				
* Differential gear oil (Front and rear)	-	R	-	I	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Shift on the fly system gear oil	I	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Front axle shaft boot for damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle case for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle shafts for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I

FRONT SECTION



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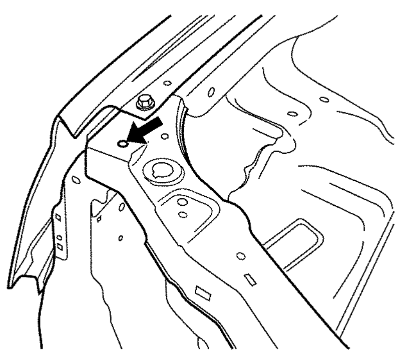

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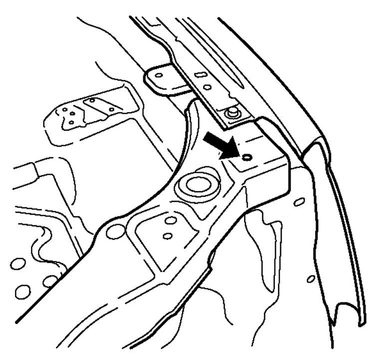

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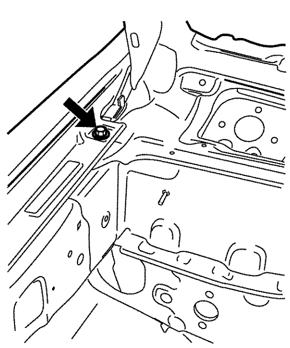

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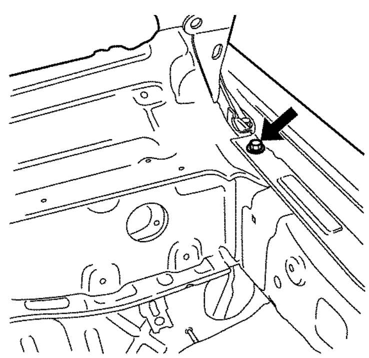
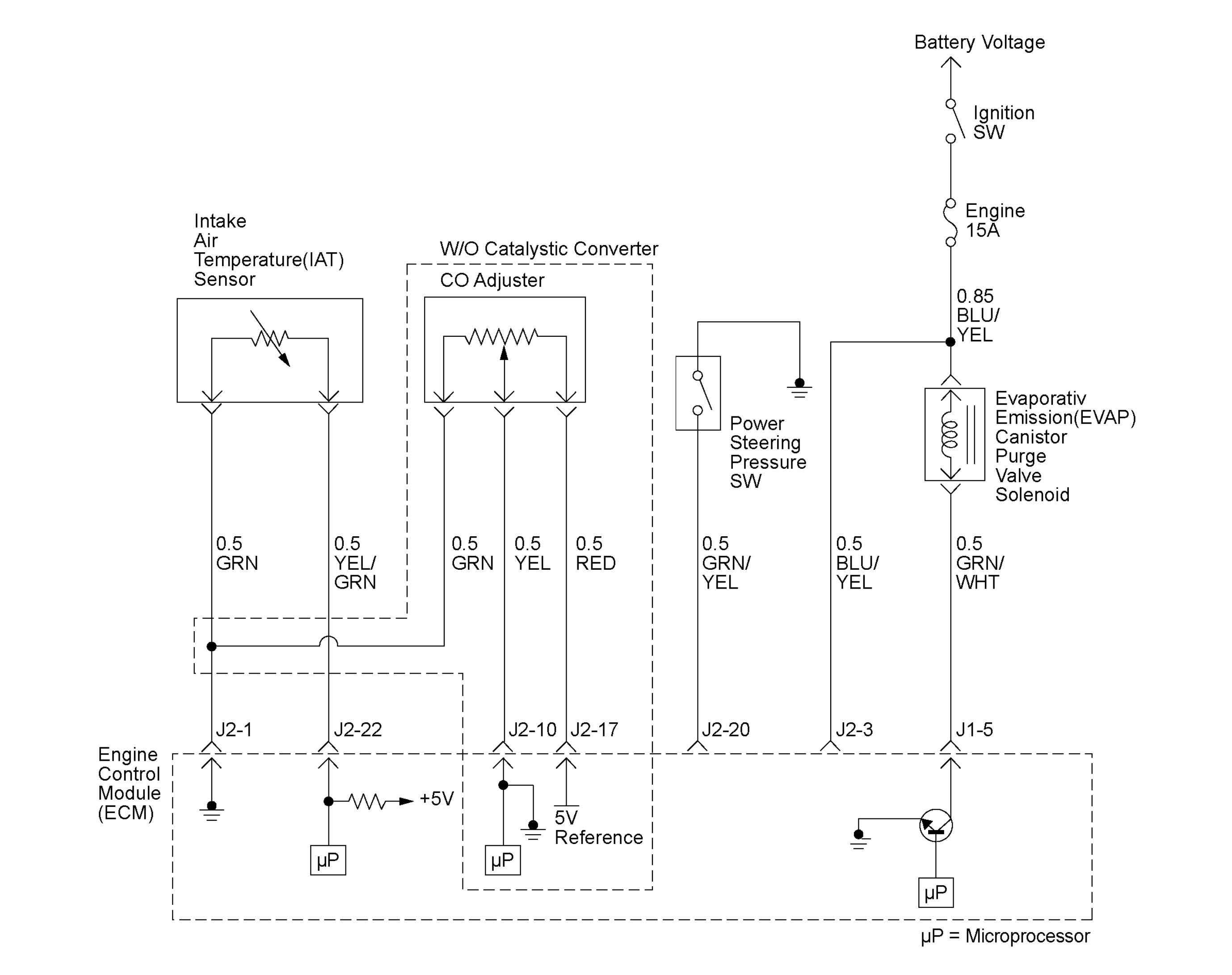


Step	Action	Value(s)	Yes	No
8	Substitute a known good IAT sensor assembly and recheck. Was the problem solved?	—	Go to *Step 9*	Go to *Step 10*
9	Replace the IAT sensor assembly. Is the action complete?	—	Verify repair	—
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0113 INTAKE AIR TEMPERATURE SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0113	A	Intake Air Temperature Sensor High Input	1. No DTC relating to VSS & ECT sensor. 2. Vehicle speed is below 70km/h. 3. 3Engine coolant temperature is more than -8 deg. C. 4. Engine run time is longer than 120 seconds. 5. Mass air flow is below 30g/s. 6. IAT sensor output is below -38 deg. C.	The ECM uses 20 deg. C condition as substitute.

Circuit Description

The intake air temperature (IAT) sensor is a thermistor which measures the temperature of the air entering the engine. The engine control module (ECM) applies 5 volts through a pull-up resistor to the IAT sensor. When the intake air is cold, the sensor resistance is high and the ECM will monitor a high signal voltage on the IAT signal circuit. If the intake air is warm, the sensor resistance is lower causing the ECM to monitor a lower voltage. Diagnostic Trouble Code P0113 will set when the ECM detects an excessively high signal voltage on the intake air temperature sensor signal circuit.

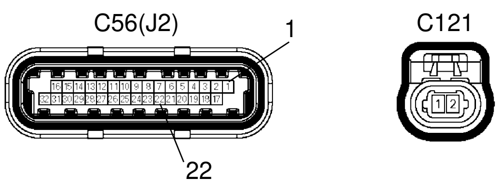
Diagnostic Aids

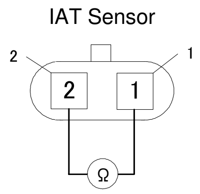
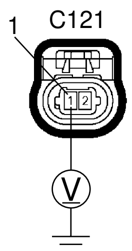
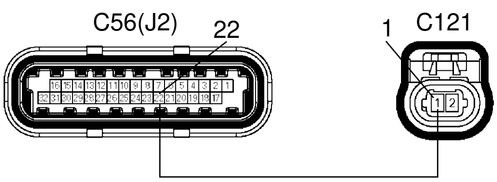
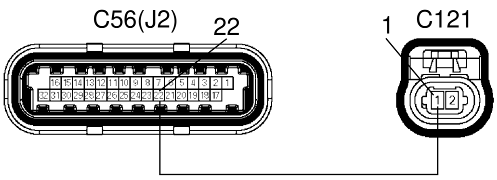
Check for the following conditions:

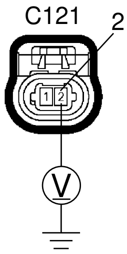
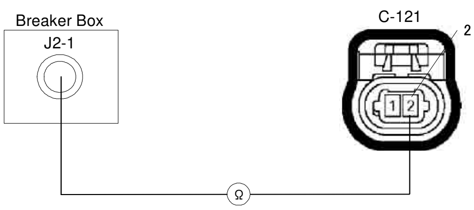
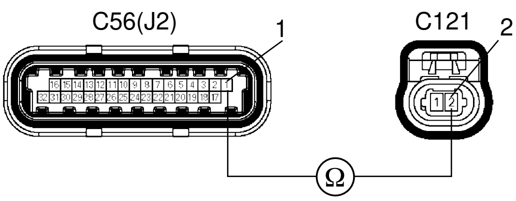
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.

- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the IAT display on the Tech 2 while moving connectors and wiring harnesses related to the IAT sensor. A change in the IAT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0113
Intake Air Temperature Sensor High Input

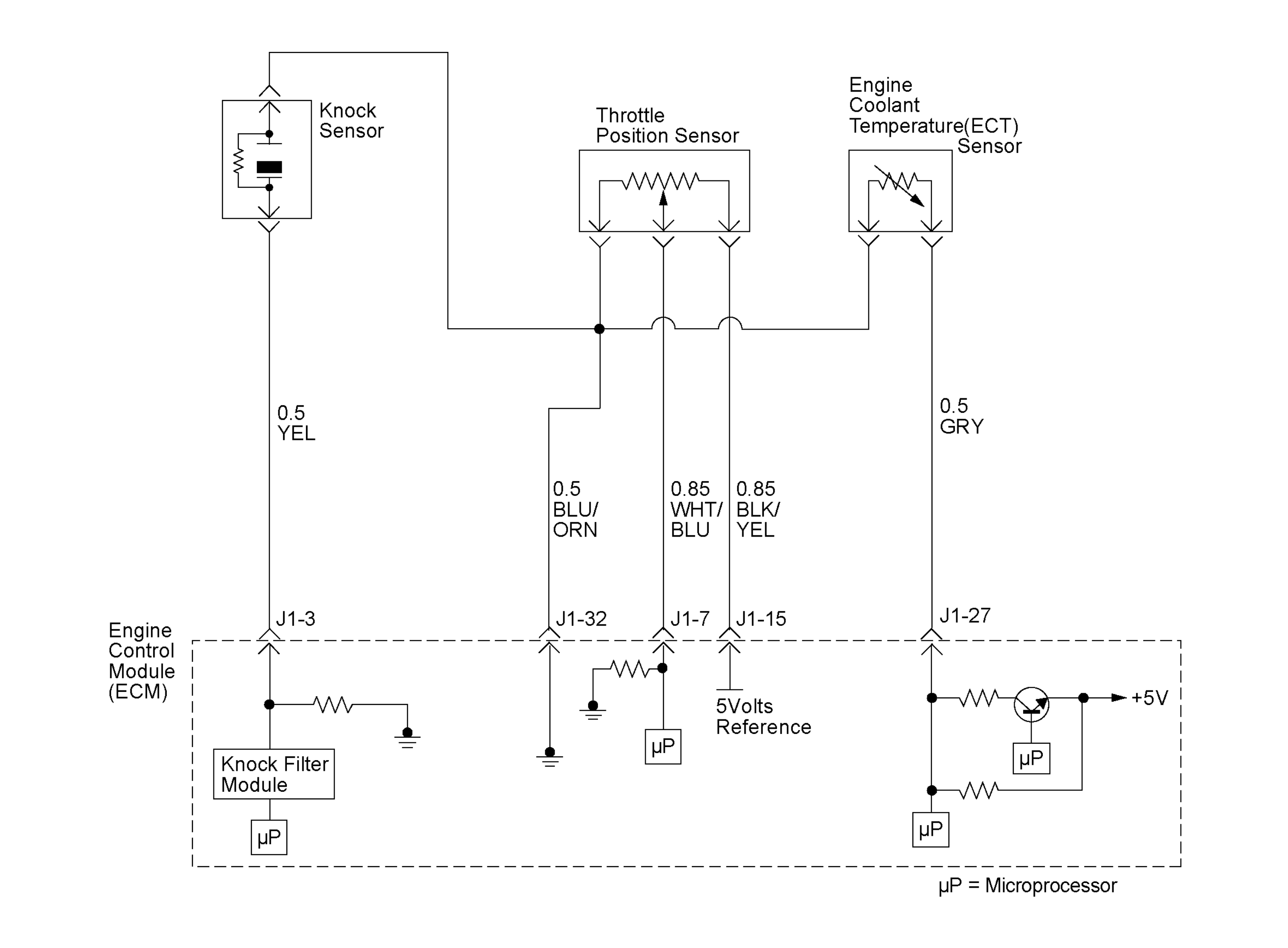
Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0113 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0113 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the IAT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Visually check the IAT sensor. Was the problem found?	—	Go to *Step 12*	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the IAT sensor.
1. Ignition “Off”, engine “Off”.
2. Disconnect IAT sensor connector.
3. Measure the resistance of IAT sensor.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>32500</td></tr>
<tr><td>0</td><td>9910</td></tr>
<tr><td>20</td><td>3400</td></tr>
<tr><td>40</td><td>1509</td></tr>
<tr><td>60</td><td>670</td></tr>
<tr><td>80</td><td>329</td></tr>
<tr><td>100</td><td>182</td></tr>
<tr><td>120</td><td>101</td></tr>
</table>

</td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
<tr><td>7</td><td>Using the DVM and check the IAT sensor signal circuit.
1. Ignition “On”, engine “Off”.
2. Disconnect the IAT sensor connector.
3. Check the circuit for open circuit.
Was the DVM indicated specified value?

</td><td>Approximately 5.0V</td><td>Go to Step 10</td><td>Less than 1V: Go to Step 8
More than specified value: Go to Step 9</td></tr>
<tr><td>8</td><td>Repair the open circuit between the ECM and IAT sensor.
Was the problem solved?

</td><td>—</td><td>Verify repair</td><td>Go to Step 14</td></tr>
<tr><td>9</td><td>Repair the short to voltage circuit between the ECM and IAT sensor.
Was the problem solved?

</td><td>—</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

Step	Action	Value(s)	Yes	No
10	Using the DVM and check the IAT sensor ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the IAT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair
11	Using the DVM and check the IAT sensor ground circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the IAT sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the IAT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good IAT sensor assembly and recheck. Was the problem solved?	—	Go to *Step 13*	Go to *Step 14*
13	Replace the IAT sensor assembly. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 15*

Step	Action	Value(s)	Yes	No
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0117 ENGINE COOLANT TEMPERATURE SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0117	A	Engine Coolant Temperature Sensor Low Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is more than 149 deg. C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.

Circuit Description

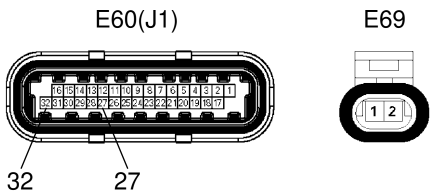
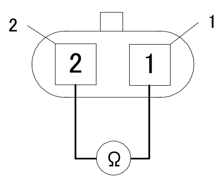
The engine coolant temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes lower, and the ECT signal voltage measured at the ECM drops. Diagnostic Trouble code P0117 set when the ECM detects an excessively low signal voltage on the engine coolant temperature sensor signal circuit.

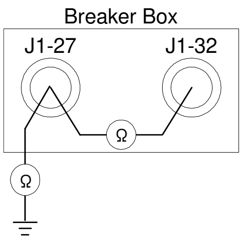
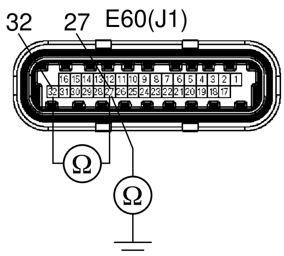
Diagnostic Aids

Check for the following conditions:

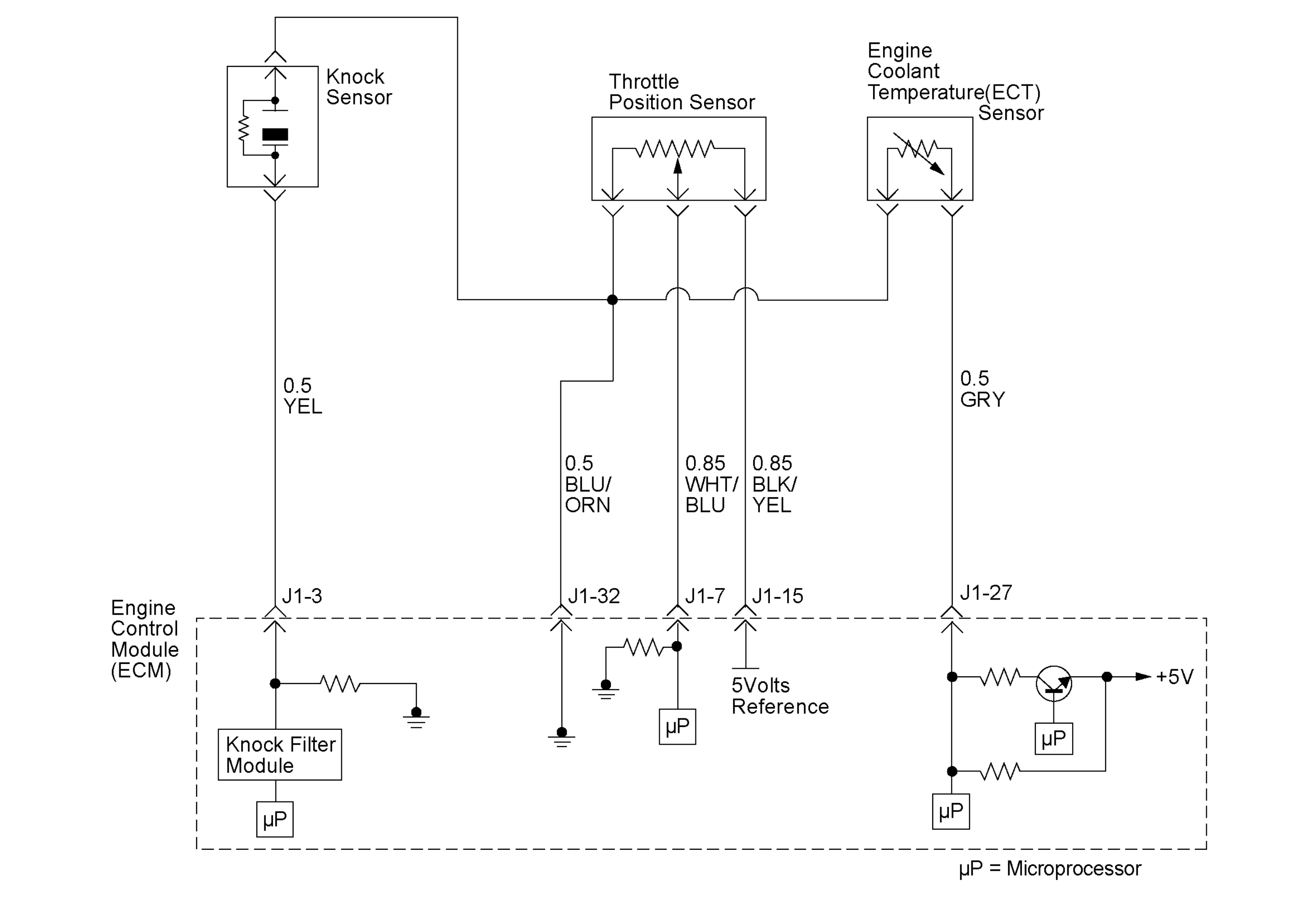
- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0117
Engine Coolant Temperature Sensor Low Input

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to Step 2</td><td>Go to On Board Diagnostic (OBD) System Check</td></tr>
<tr><td>2</td><td>1. Connect the Tech 2.
2. Review and record the failure information.
3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”.
Is the DTC P0117 stored as “Present Failure”?</td><td>—</td><td>Go to Step 3</td><td>Refer to Diagnostic Aids and Go to Step 3</td></tr>
<tr><td>3</td><td>1. Using the Tech2, ignition “On” and engine “Off”.
2. Select “Clear DTC Information” with the Tech2 and clear the DTC information.
3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”.
Was the DTC P0117 stored in this ignition cycle?</td><td>—</td><td>Go to Step 4</td><td>Refer to Diagnostic Aids and Go to Step 4</td></tr>
<tr><td>4</td><td>Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary.
Was the problem found?

</td><td>—</td><td>Verify repair</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Visually check the ECT sensor.
Was the problem found?</td><td>—</td><td>Go to Step 8</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>Using the DVM and check the ECT sensor.
1. Ignition “Off”, engine “Off”.
2. Disconnect ECT sensor connector.
3. Measure the resistance of ECT sensor.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>26740</td></tr>
<tr><td>0</td><td>9120</td></tr>
<tr><td>20</td><td>3500</td></tr>
<tr><td>40</td><td>1464</td></tr>
<tr><td>60</td><td>664</td></tr>
<tr><td>80</td><td>333</td></tr>
<tr><td>100</td><td>175</td></tr>
<tr><td>120</td><td>102</td></tr>
</table>
ECT Sensor

</td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 8</td></tr>
</table>

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ECT sensor signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the ECT sensor connector. 4. Check the circuit for short to sensor ground or ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 10*
8	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	—	Go to *Step 9*	Go to *Step 10*
9	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0118 ENGINE COOLANT TEMPERATURE SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0118	A	Engine Coolant Temperature Sensor High Input	1. Engine run time is longer than 120 seconds. 2. ECT sensor output is below -38 deg.C.	The ECM uses default engine coolant temperature value based on intake air temperature and engine run time.

Circuit Description

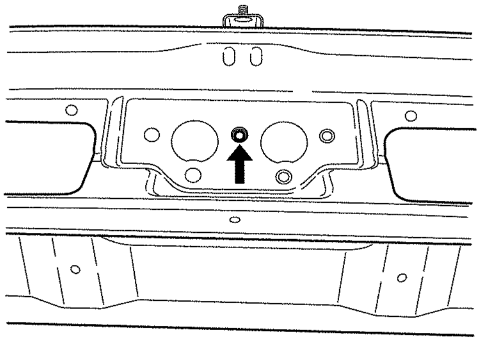
The engine coolant temperature (ECT) sensor is a thermistor mounted in the engine coolant stream. The engine control module (ECM) applies a voltage (about 5 volts) through a pull-up resistor to the ECT signal circuit. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore the ECM will measure a high signal voltage. As the engine coolant warms, the sensor resistance becomes less, and the ECT signal voltage measured at the ECM drops. Diagnostic Trouble code P0118 set when the ECM detects an excessively high signal voltage on the engine coolant temperature sensor signal circuit.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the ECT display on the Tech 2 while moving connectors and wiring harnesses related to the ECT sensor. A change in the ECT display will indicate the location of the fault.

5



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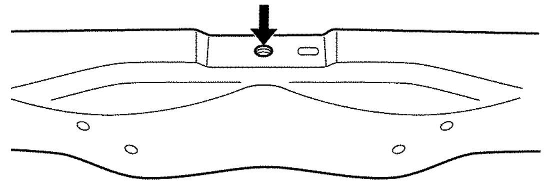

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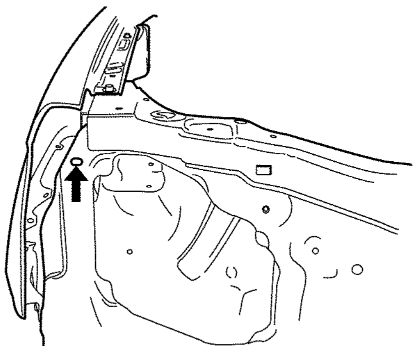

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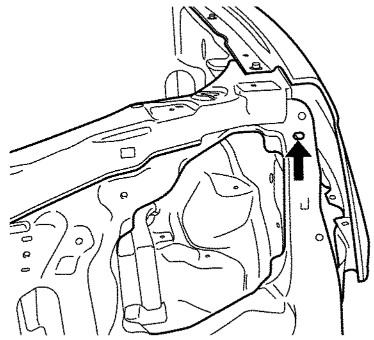

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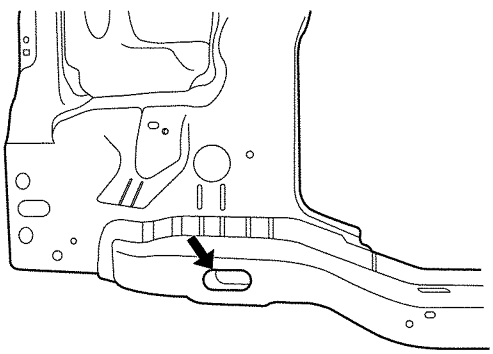

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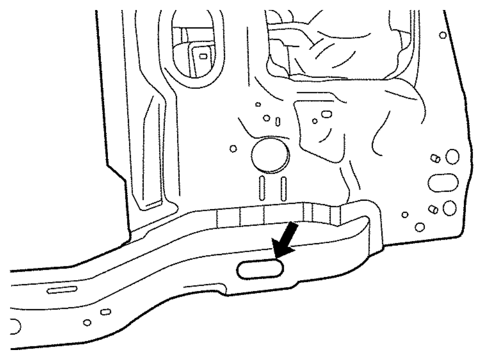
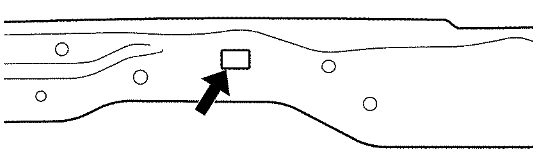
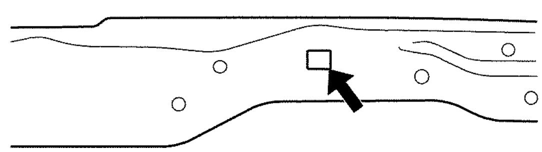


11



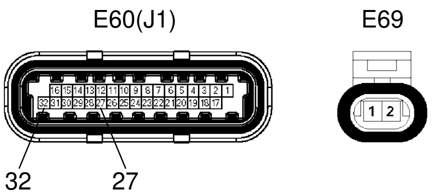
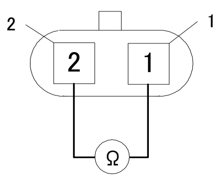
12

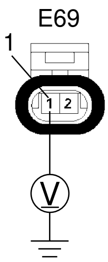
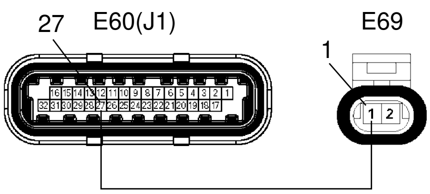
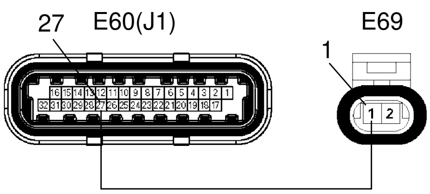
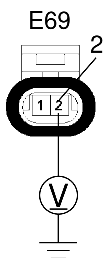


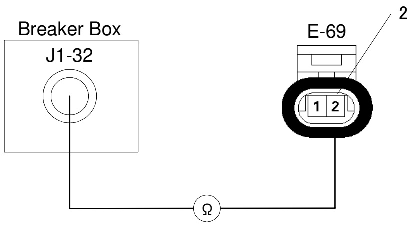
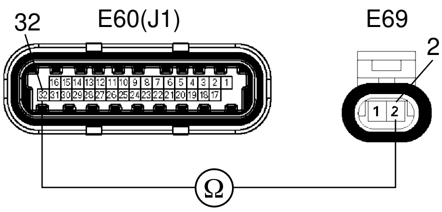
BACK TO CHAPTER INDEX

ISUZU KB P190 2007
TO MODEL INDEX

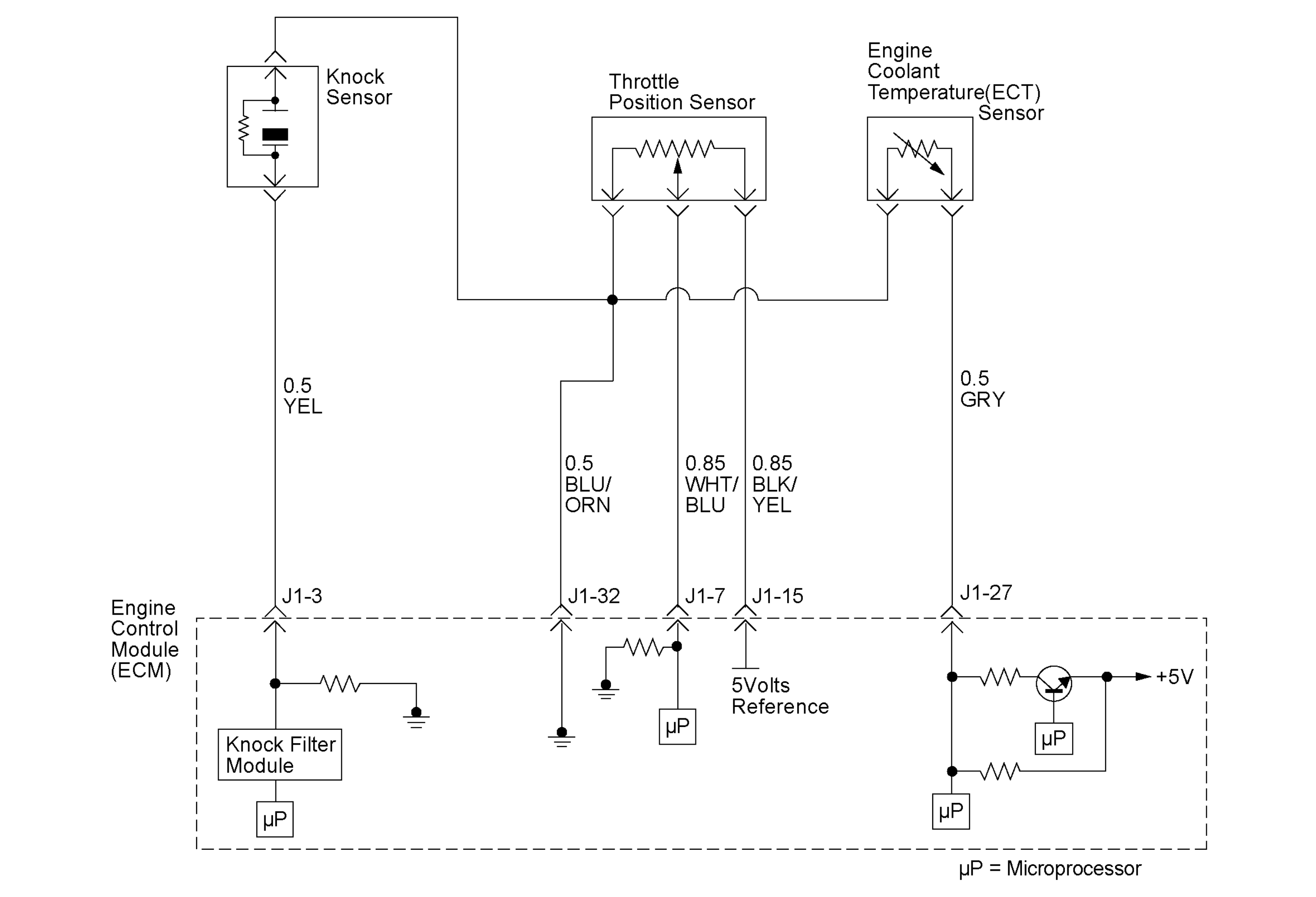
Diagnostic Trouble Code (DTC) P0118
Engine Coolant Temperature Sensor High Input

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to Step 2</td><td>Go to On Board Diagnostic (OBD) System Check</td></tr>
<tr><td>2</td><td>1. Connect the Tech 2.
2. Review and record the failure information.
3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”.
Is the DTC P0118 stored as “Present Failure”?</td><td>—</td><td>Go to Step 3</td><td>Refer to Diagnostic Aids and Go to Step 3</td></tr>
<tr><td>3</td><td>1. Using the Tech2, ignition “On” and engine “Off”.
2. Select “Clear DTC Information” with the Tech2 and clear the DTC information.
3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”.
Was the DTC P0118 stored in this ignition cycle?</td><td>—</td><td>Go to Step 4</td><td>Refer to Diagnostic Aids and Go to Step 4</td></tr>
<tr><td>4</td><td>Check for poor/faulty connection at the ECT sensor or ECM connector. If a poor/faulty connection is found, repair as necessary.
Was the problem found?

</td><td>—</td><td>Verify repair</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Visually check the ECT sensor.
Was the problem found?</td><td>—</td><td>Go to Step 12</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>Using the DVM and check the ECT sensor.
1. Ignition “Off”, engine “Off”.
2. Disconnect ECT sensor connector.
3. Measure the resistance of ECT sensor.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>26740</td></tr>
<tr><td>0</td><td>9120</td></tr>
<tr><td>20</td><td>3500</td></tr>
<tr><td>40</td><td>1464</td></tr>
<tr><td>60</td><td>664</td></tr>
<tr><td>80</td><td>333</td></tr>
<tr><td>100</td><td>175</td></tr>
<tr><td>120</td><td>102</td></tr>
</table>
ECT Sensor

</td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
</table>

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ECT sensor signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the ECT sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 10*	Less than 1V: Go to Step 8 More than specified value: Go to *Step 9*
8	Repair the open circuit between the ECM and ECT sensor. Was the problem solved? 	—	Verify repair	Go to *Step 14*
9	Repair the short to voltage circuit between the ECM and ECT sensor. Was the problem solved? 	—	Verify repair	Go to *Step 14*
10	Using the DVM and check the ECT sensor ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the ECT sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair

Step	Action	Value(s)	Yes	No
11	Using the DVM and check the ECT sensor ground circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the ECT sensor connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECT sensor connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good ECT sensor assembly and recheck. Was the problem solved?	—	Go to *Step 13*	Go to *Step 14*
13	Replace the ECT sensor. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0122 THROTTLE POSITION SENSOR LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0122	A	Throttle Position Sensor Low Input	TPS output voltage is below 0.14V.	The ECM uses 0% condition as substitute.

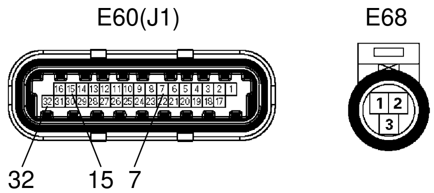
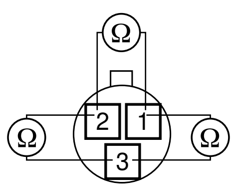
Circuit Description

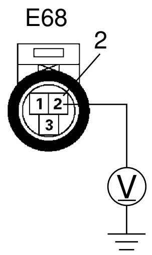
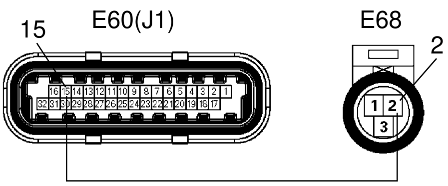
The throttle position sensor circuit provides a signal voltage that changes relative to throttle blade angle. The signal voltage will vary from below 1 volt at closed throttle to about 4 volts at wide open throttle (WOT).
The TPS signal is used by the engine control module (ECM) for fuel control and most of the ECM-controlled outputs. If the ECM detect a continuous short to ground in the TPS or circuit, then a code P0122 will set.

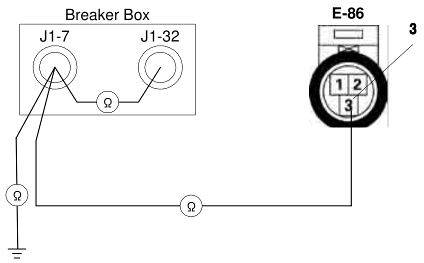
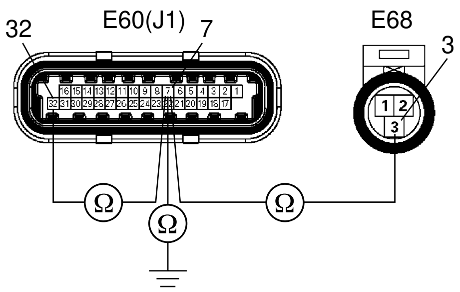
Diagnostic Aids

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive, and open circuit. If the harness appears to be OK, observe the throttle position display on the Tech 2 while moving connectors and wiring harnesses related to the TPS. A change in the display will indicate the location of the fault.

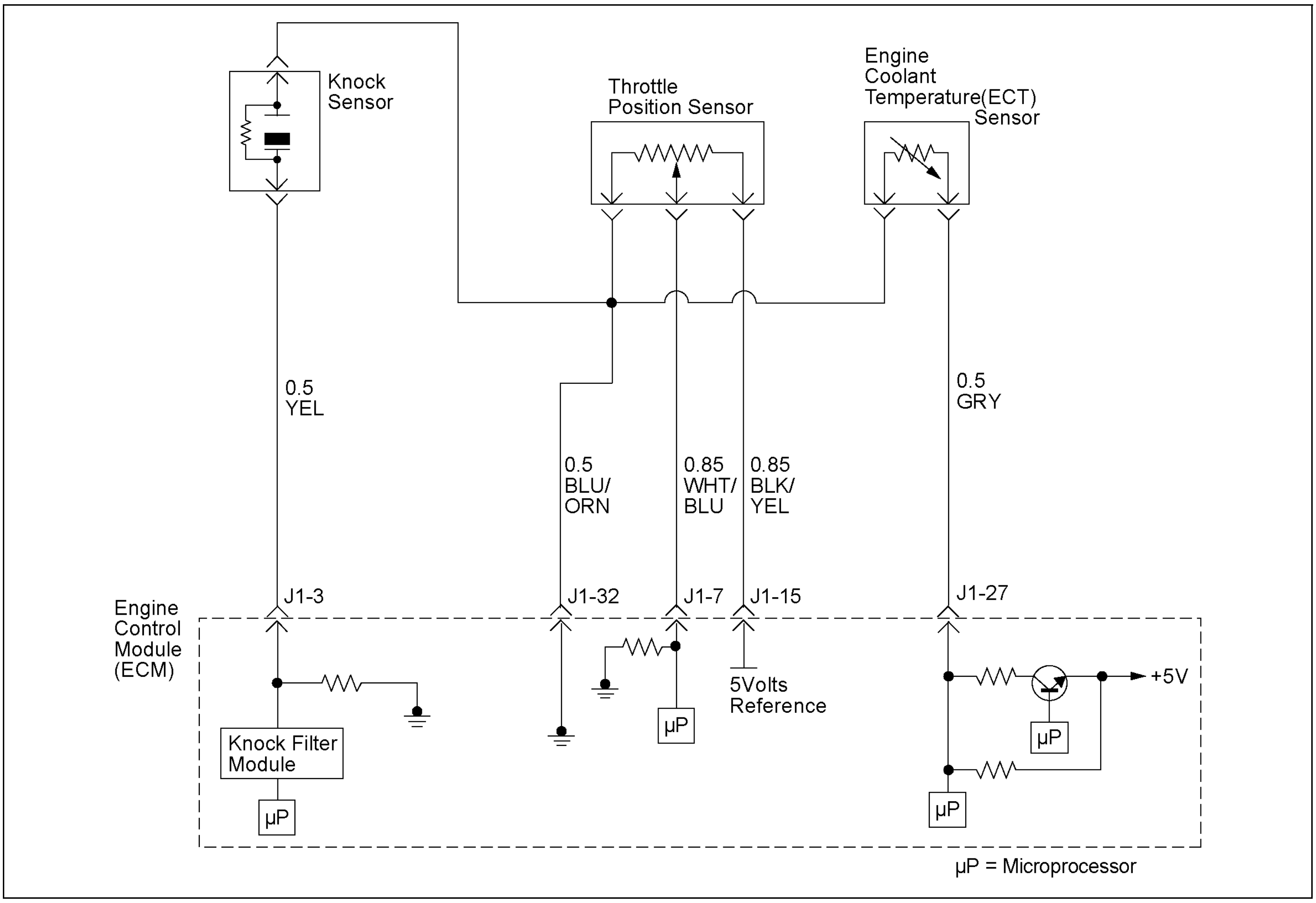
Diagnostic Trouble Code (DTC) P0122 Throttle Position Sensor Low Input

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to Step 2</td><td>Go to On Board Diagnostic (OBD) System Check</td></tr>
<tr><td>2</td><td>1. Connect the Tech 2.
2. Review and record the failure information.
3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”.
Is the DTC P0122 stored as “Present Failure”?</td><td>—</td><td>Go to Step 3</td><td>Refer to Diagnostic Aids and Go to Step 3</td></tr>
<tr><td>3</td><td>1. Using the Tech2, ignition “On” and engine “Off”.
2. Select “Clear DTC Information” with the Tech2 and clear the DTC information.
3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”.
Was the DTC P0122 stored in this ignition cycle?</td><td>—</td><td>Go to Step 4</td><td>Refer to Diagnostic Aids and Go to Step 4</td></tr>
<tr><td>4</td><td>Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary.
Was the problem found?
</td><td>—</td><td>Verify repair</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Visually check the TPS.
Was the problem found?</td><td>—</td><td>Go to Step 10</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>Using the DVM and check the TPS.
1. Ignition “Off”, engine “Off”.
2. Disconnect TPS connector.
3. Measure the resistance of TPS.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td>1 - 2</td><td>Approximately 5.6kΩ at idle position & WOT</td></tr>
<tr><td rowspan="2">2 - 3</td><td>Approximately 6.0kΩ at idle position</td></tr>
<tr><td>Approximately 1.7kΩ at WOT</td></tr>
<tr><td rowspan="2">1 - 3</td><td>Approximately 2.3kΩ at idle position & WOT</td></tr>
<tr><td>Approximately 6.6kΩ at WOT</td></tr>
</table>
TPS
</td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 10</td></tr>
</table>

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the TPS power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the TPS connector. 3. Check the circuit for open or short to ground circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 9*	Go to *Step 8*
8	Repair the open or short to ground circuit between the ECM and TPS. Was the problem solved? 	—	Verify repair	Go to *Step 12*

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the TPS signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect TPS connector. 4. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open, short to sensor ground or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 12*
10	Substitute a known good TPS and recheck. Was the problem solved?	—	Go to *Step 11*	Go to *Step 12*
11	Replace the TPS. Is the action complete?	—	Verify repair	-
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 12*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0123 THROTTLE POSITION SENSOR HIGH INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0123	A	Throttle Position Sensor High Input	TPS output voltage is more than 4.9V.	The ECM uses 0% condition as substitute.

Circuit Description

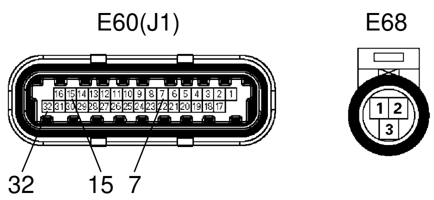
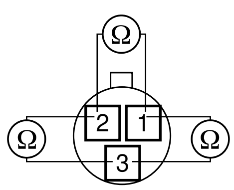
The throttle position sensor circuit provides a voltage signal that changes relative to throttle blade angle. The signal voltage will vary from below 1 volt at closed throttle to about 4 volts at wide open throttle (WOT).
The TPS is used by the engine control module (ECM) for fuel control and most of the ECM-controlled outputs.
If the ECM detect a continuous short voltage in the TPS or circuit, then a code P0123 will set.

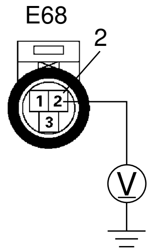
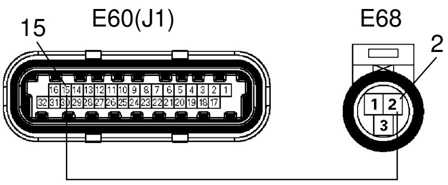
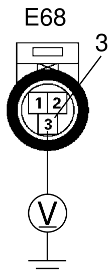
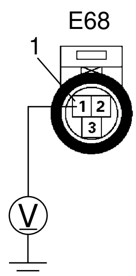
Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- If these codes are also set, it could indicate a problem with the 5 Volt reference circuit or components itself.
- Damaged harness - Inspect the wiring harness for damage, short to ground, short to battery positive and open circuit. If the harness appears to be OK, observe the Throttle Position sensor display on the Tech 2 while moving connectors and wiring harnesses related to the TP sensor. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0123 Throttle Position Sensor High Input

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>Was the “On-Board Diagnostic (OBD) System Check” performed?</td><td>—</td><td>Go to Step 2</td><td>Go to On Board Diagnostic (OBD) System Check</td></tr>
<tr><td>2</td><td>1. Connect the Tech 2.
2. Review and record the failure information.
3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”.
Is the DTC P0123 stored as “Present Failure”?</td><td>—</td><td>Go to Step 3</td><td>Refer to Diagnostic Aids and Go to Step 3</td></tr>
<tr><td>3</td><td>1. Using the Tech2, ignition “On” and engine “Off”.
2. Select “Clear DTC Information” with the Tech2 and clear the DTC information.
3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”.
Was the DTC P0123 stored in this ignition cycle?</td><td>—</td><td>Go to Step 4</td><td>Refer to Diagnostic Aids and Go to Step 4</td></tr>
<tr><td>4</td><td>Check for poor/faulty connection at the TPS or ECM connector. If a poor/faulty connection is found, repair as necessary.
Was the problem found?

</td><td>—</td><td>Verify repair</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Visually check the TPS.
Was the problem found?</td><td>—</td><td>Go to Step 12</td><td>Go to Step 6</td></tr>
<tr><td>6</td><td>Using the DVM and check the TPS.
1. Ignition “Off”, engine “Off”.
2. Disconnect TPS connector.
3. Measure the resistance of TPS.
Does the tester indicate standard resistance as shown in the following table?
<table>
<tr><th>Measurement Terminal</th><th>Resistance (Ω)</th></tr>
<tr><td>1 - 2</td><td>Approximately 5.6kΩ at idle position & WOT</td></tr>
<tr><td rowspan="2">2 - 3</td><td>Approximately 6.0kΩ at idle position</td></tr>
<tr><td>Approximately 1.7kΩ at WOT</td></tr>
<tr><td rowspan="2">1 - 3</td><td>Approximately 2.3kΩ at idle position & WOT</td></tr>
<tr><td>Approximately 6.6kΩ at WOT</td></tr>
</table>
TPS

</td><td>Standard resistance</td><td>Go to Step 7</td><td>Go to Step 12</td></tr>
</table>

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the TPS power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the TPS connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated specified value? 	Approximately 5.0V	Go to *Step 9*	Go to *Step 8*
8	Repair the short to voltage circuit between the ECM and TPS. Was the problem solved? 	—	Verify repair	Go to *Step 14*
9	Using the DVM and check the TPS signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the TPS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the TPS ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the TPS connector . 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 11*	Repair faulty harness and verify repair

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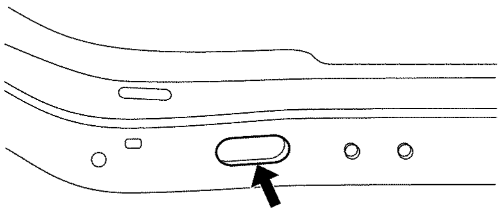

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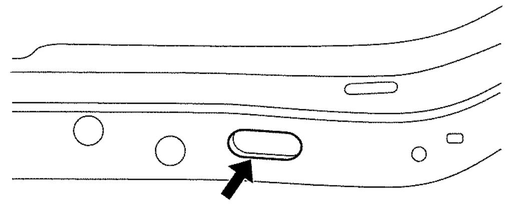

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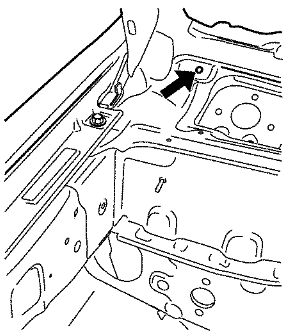

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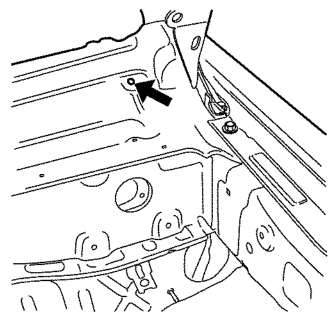

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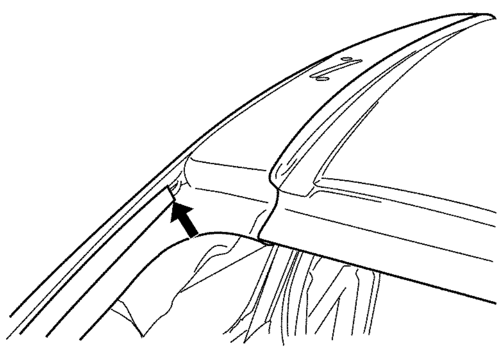

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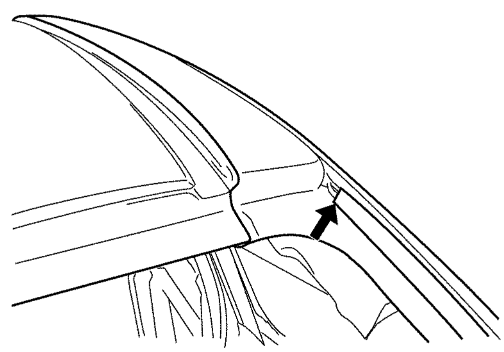
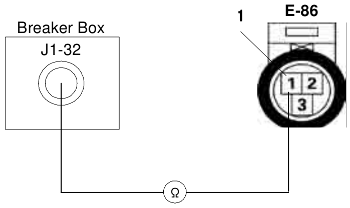
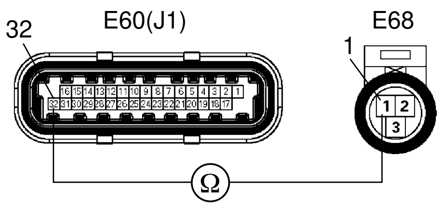
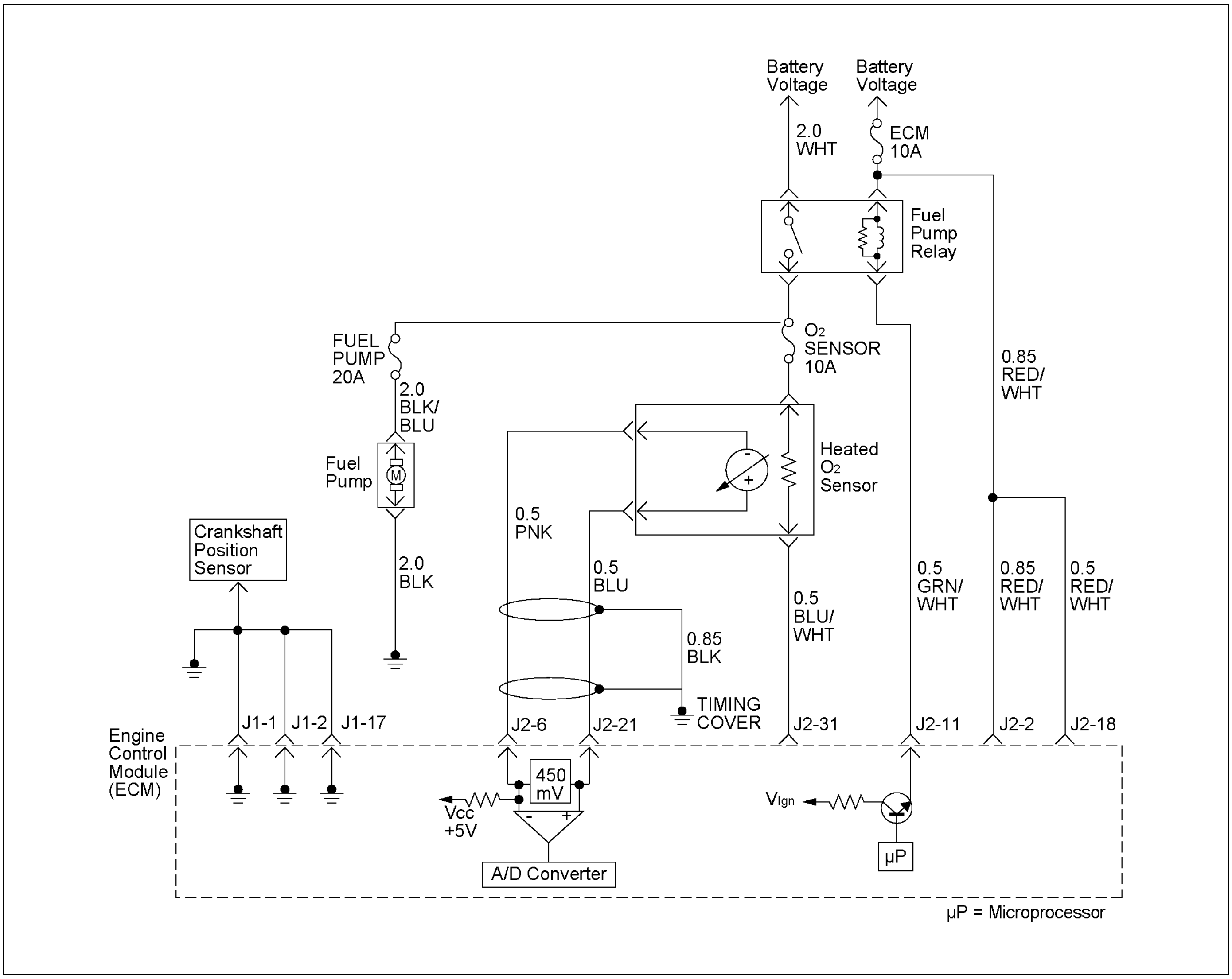


Step	Action	Value(s)	Yes	No
11	Using the DVM and check the TPS ground circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the TPS connector. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the TPS connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 14*
12	Substitute a known good TPS and recheck. Was the problem solved?	—	Go to *Step 13*	Go to *Step 14*
13	Replace the TPS. Is the action complete?	—	Verify repair	—
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 14*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0131 O_2 SENSOR CIRCUIT LOW VOLTAGE (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0131	A	O_2 SensorCircuit Low Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. O_2 sensor bank 1 output voltage is below 50mV in "Closed Loop" condition.	"Open Loop" fuel control.

Circuit Description

The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO2S signal during "Closed Loop" operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the Bank 1 HO2S 1 voltage remains excessively low for an extended period of time, Diagnostic Trouble Code P0131 will be set.

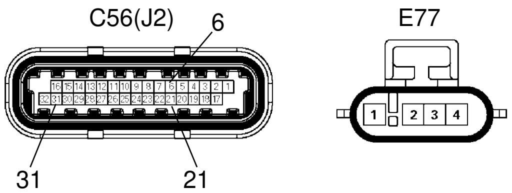
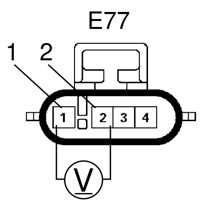
Diagnostic Aids

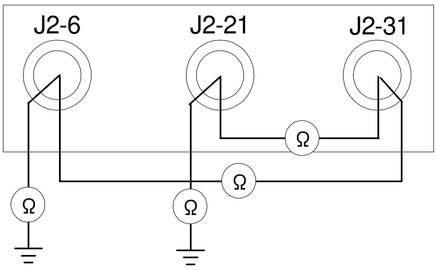
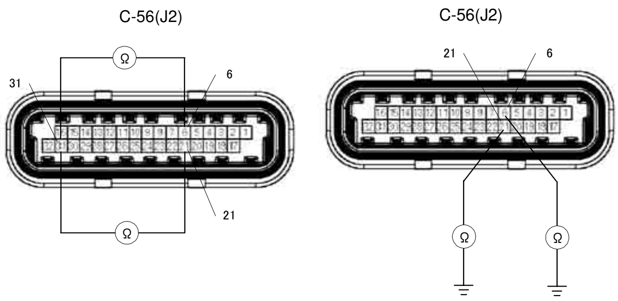
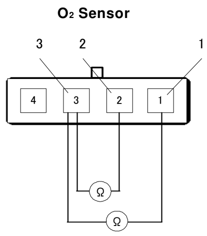
Check for the following conditions:

- Heated oxygen sensor wiring - The sensor pigtail may be routed incorrectly and/or contacting the exhaust system. Also, check for shorts to ground, shorts to battery positive and open circuits.

- Poor ECM to engine block grounds.
- Fuel pressure - The system will go lean if pressure is too low. The ECM can compensate for some decrease. However, if fuel pressure is too low, a Diagnostic Trouble Code P0131 may be set. Refer to Fuel System Diagnosis.
- Lean injector(s) - Perform “Injector Balance Test.”
- Vacuum leaks - Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, EGR system, and PCV system.
- Exhaust leaks - An exhaust leak may cause outside air to be pulled into the exhaust gas stream past the HO2S, causing the system to appear lean. Check for exhaust leaks that may cause a false lean condition to be indicated.
- Fuel contamination - Water, even in small amounts, can be delivered to the fuel injectors. The water can cause a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. For the procedure to check for fuel contamination, Refer to Fuel System Diagnosis.

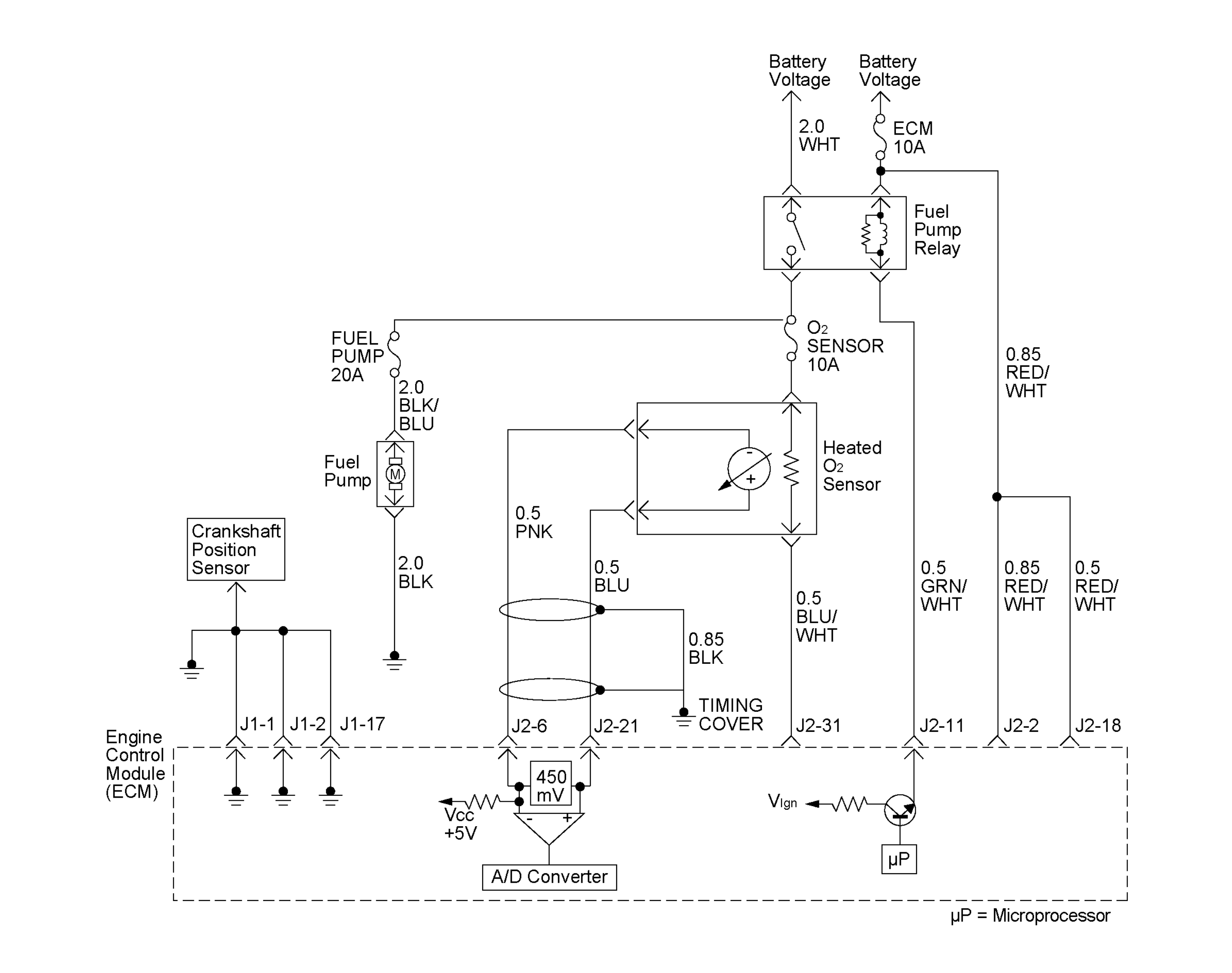
Diagnostic Trouble Code (DTC) P0131
O_2 Sensor Circuit Low Voltage (Bank 1 Sensor 1)

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0131 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0131 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O_2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Using the DVM and check the O_2 sensor circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the O_2 sensor connector. 3. Check the circuit for short to heater ground or ground circuit. Was the DVM indicated specified value? 	Approximatly 450mV	Go to *Step 7*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the O_2 sensor circuit. **Breaker box is available:** 1. Ignition "Off", engine "Off". 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the O_2 sensor. 4. Check the circuit for short to heater ground or short to ground circuit. Was the problem found? Breaker Box  **Breaker box is not available:** 1. Ignition "Off", engine "Off". 2. Disconnect the O_2 sensor connector and ECM connector. 3. Check the circuit for short to heater ground or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 15*
7	Using the DVM and check the O_2 sensor circuit. 1. Ignition "Off", engine "Off". 2. Disconnect the the O_2 sensor connector. 3. Check the circuit for short to heater ground circuit. Was the DVM indicated specified value? 	No continuity	Go to *Step 9*	Go to *Step 8*
8	Repair the short to heater ground circuit. Was the problem found?	—	Verify repair	Go to *Step 15*

Step	Action	Value(s)	Yes	No
9	1. Using the Tech 2, ignition “On” and engine “On”. 2. Monitor the “Manifold Absolute Pressure” in the data display. Does the Tech 2 indicate correct “Manifold Absolute Pressure” in accordance with engine speed or acceleration?	—	Go to *Step 11*	Go to *Step 10*
10	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 11*
11	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to *Step 13*	Go to *Step 12*
12	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 13*
13	Check for injector for the affected bank. Refer to *“Injector Coil Test & Injector Balance Test Procedure”* 6E-98 page. Was the injector operation correct?	—	Go to *Step 14*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
14	Check for fuel pressure. Refer to *“Fuel System Diagnosis”* 6E-108 page. Was the fuel pressure correct?	—	Go to *Step 15*	Refer to *Fuel System Diagnosis*
15	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0132 O_2 SENSOR CIRCUIT HIGH VOLTAGE (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0132	A	O_2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. O_2 sensor bank 1 output voltage is more than 952mV in “Closed Loop” condition.	“Open Loop” fuel control.

Circuit Description

The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) signal and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO2S signal during “Closed Loop” operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the Bank 1 HO2S 1 voltage remains excessively high for an extended period of time, Diagnostic Trouble Code P0132 will be set.

Diagnostic Aids

Check the following items:

- Fuel pressure - The system will go rich if pressure is too high. The ECM can compensate for some increase. However, if fuel pressure is too high, a Diagnostic Trouble Code P0132 may be set. Refer to

BACK TO CHAPTER INDEX

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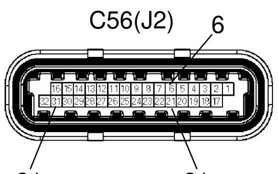
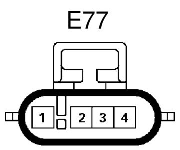
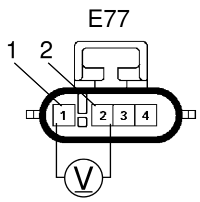
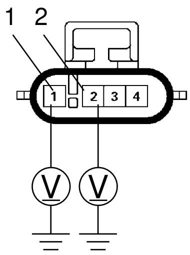
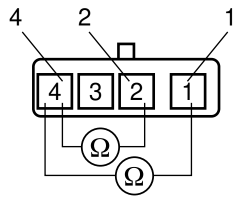
TO MODEL INDEX

Fuel System Diagnosis.

- Perform "Injector Balance Test" - Refer to Fuel System Diagnosis.
- Check the EVAP canister for fuel saturation - If full of fuel, check canister control and hoses. Refer to Evaporative (EVAP) Emission Control System.
- Check for a leak in the fuel pressure regulator diaphragm by checking the vacuum line to the regulator for the presence of fuel.
- An intermittent TPS output will cause the system to go rich due to a false indication of the engine accelerating.
- Silicon contamination of the HO2S can also cause a high HO2S voltage to be indicated. This condition is indicated by a powdery white deposit on the portion of the HO2S exposed to the exhaust stream. If contamination is noticed, replace the affected HO2S.

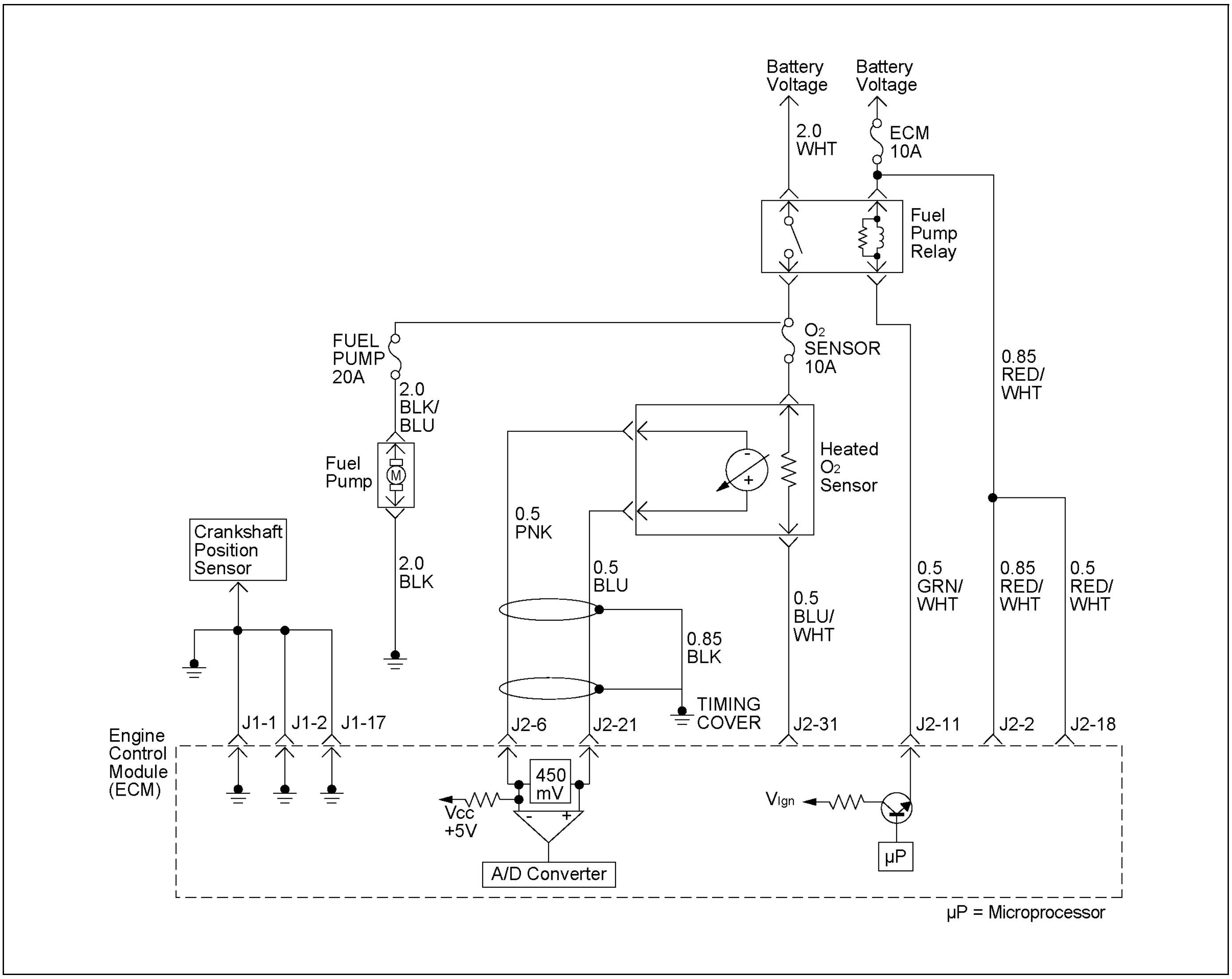
Diagnostic Trouble Code (DTC) P0132
O_2 Sensor Circuit High Voltage (Bank 1 Sensor 1)

Step	Action	Value(S)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0132 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0132 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O_2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?   	—	Verify repair	Go to *Step 5*
5	Using the DVM and check the O_2 sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the the O_2 sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value?  	Approximatly 450mV	Go to *Step 7*	Go to *Step 6*

Step	Action	Value(S)	Yes	No
6	Using the DVM and check the O_2 sensor circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the O_2 sensor connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specifed value? E77 	Less than 1V	Go to *Step 15*	Repair faulty harness and verify repair
7	Using the DVM and check the O_2 sensor circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the the O_2 sensor connector. 3. Check the circuit for short to heater power supply circuit. Was the DVM indicated specified value? O2 Sensor 	No continuity	Go to *Step 9*	Go to *Step 8*
8	Repair the short to heater power supply circuit. Was the problem found?	—	Verify repair	Go to *Step 15*
9	1. Using the Tech 2, ignition “On” and engine “On”. 2. Monitor the “Manifold Absolute Pressure” in the data display. Does the Tech 2 indicate correct “Manifold Absolute Pressure” in accordance with engine speed or acceleration?	—	Go to *Step 11*	Go to *Step 10*
10	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 11*
11	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to *Step 13*	Go to *Step 12*

Step	Action	Value(S)	Yes	No
12	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 13*
13	Check for injector for the affected bank. Refer to *"Injector Coil Test & Injector Balance Test Procedure"* 6E-98 page. Was the injector operation correct?	—	Go to *Step 14*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
14	Check for fuel pressure. Refer to *"Fuel System Diagnosis"* 6E-108 page. Was the fuel pressure correct?	—	Go to *Step 15*	Refer to *Fuel System Diagnosis*
15	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0134 O_2 SENSOR NO ACTIVITY DEFECTED (BANK 1 SENSOR 1)



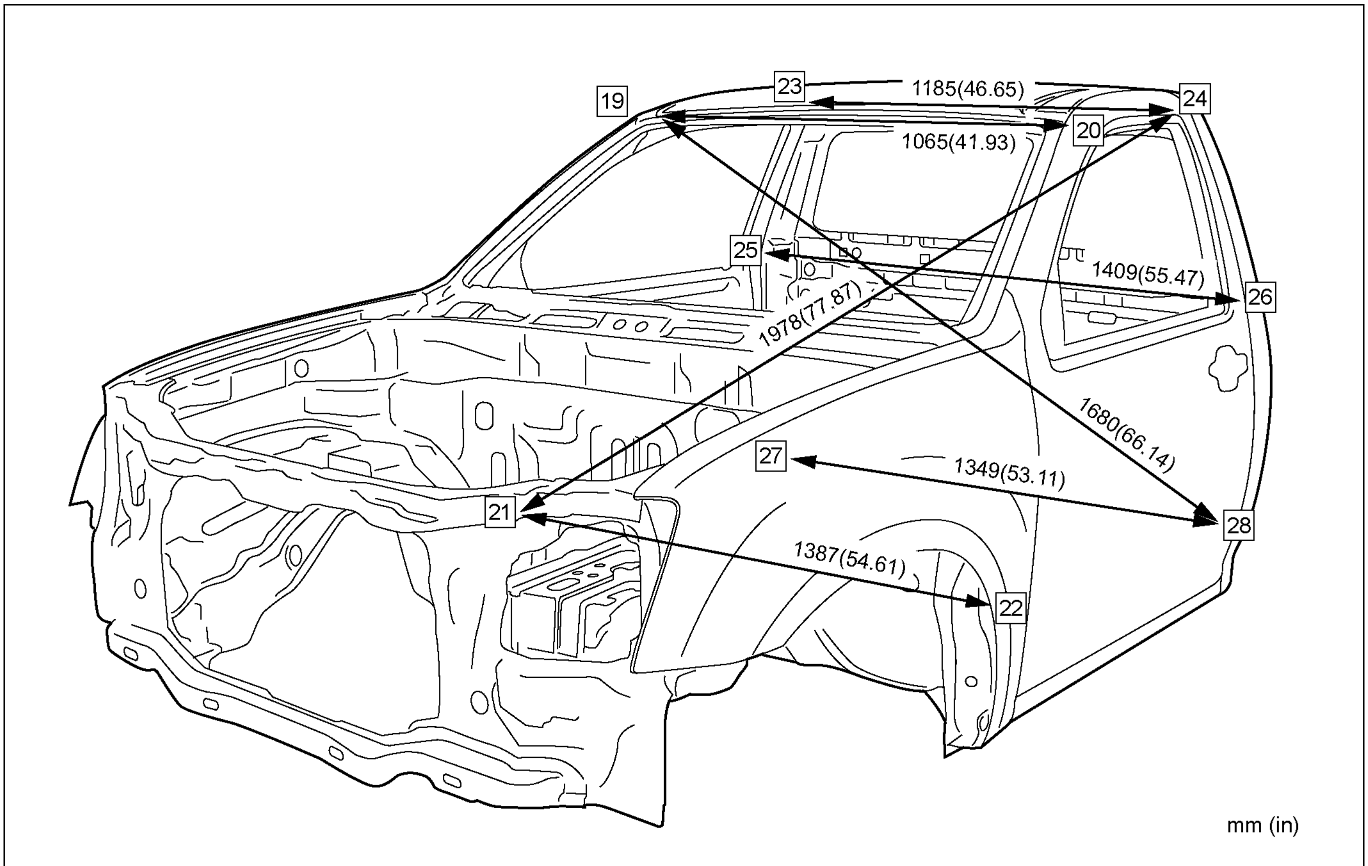
Condition for setting the DTC and action taken when the DTC sets

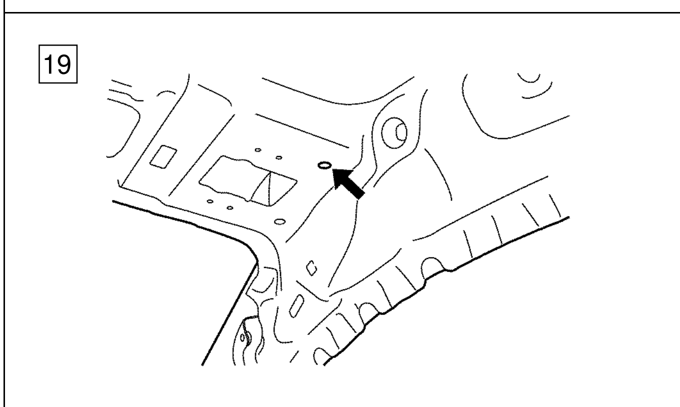
Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0134	A	O_2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg.C. 3. Engine run time is longer than 40 seconds. 4. Mass air flow is more than 7g/s. 5. O_2 sensor bank 1 output voltage is between 300mV and 600mV.	“Open Loop” fuel control.

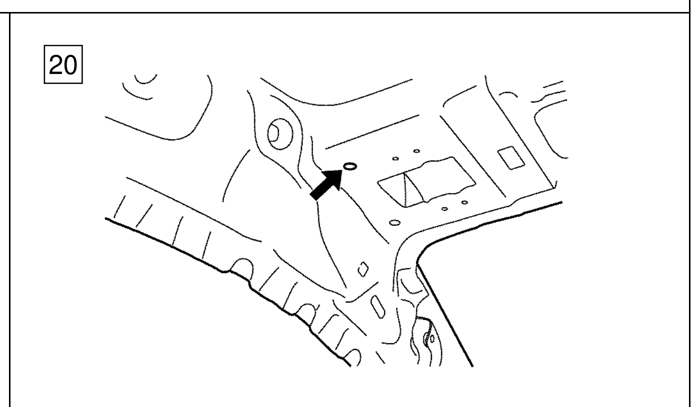
Circuit Description

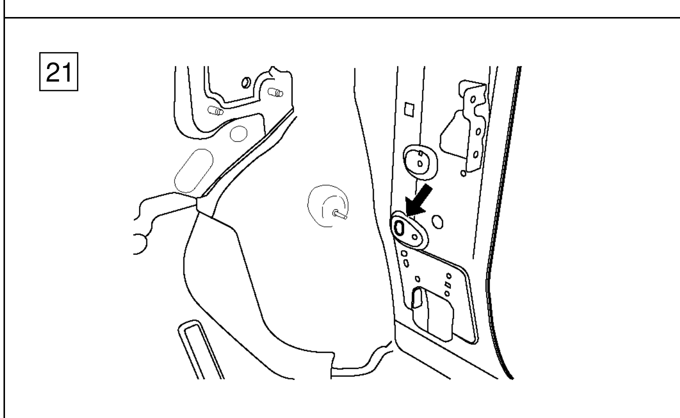
The engine control module (ECM) supplies a bias voltage of about 450 mV between the heated oxygen sensor (HO2S) high and low circuits. The oxygen sensor varies the voltage within a range of about 1000 mV when the exhaust is rich, down through about 10 mV when exhaust is lean. The ECM constantly monitors the HO2S signal during “Closed Loop” operation and compensates for a rich or lean condition by decreasing or increasing injector pulse width as necessary. If the Bank 1 HO2S 1 voltage remains at or near the 450 mV bias for an extended period of time, Diagnostic Trouble Code P0134 will be set, indicating an open sensor signal or sensor low circuit.

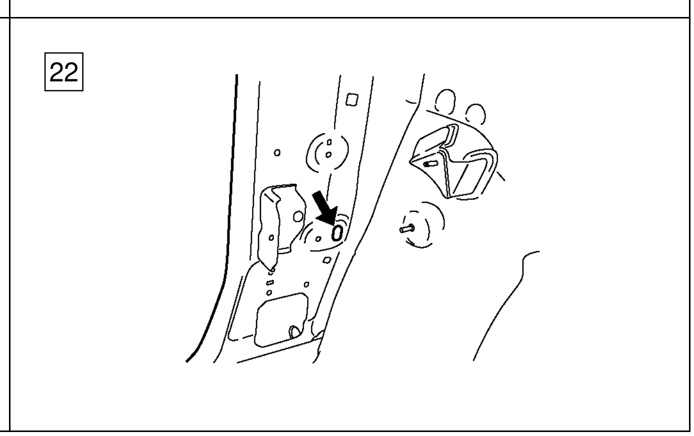
ROOM SECTION (REGULAR CAB)









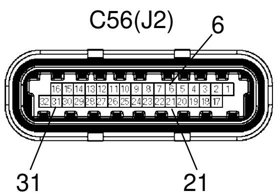
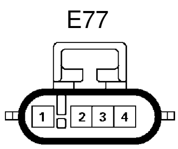
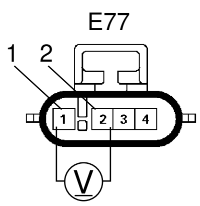


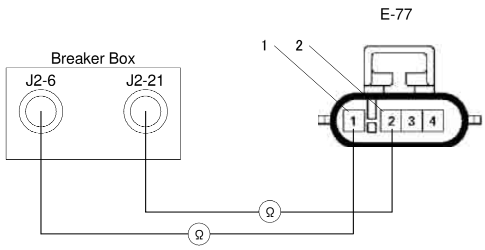
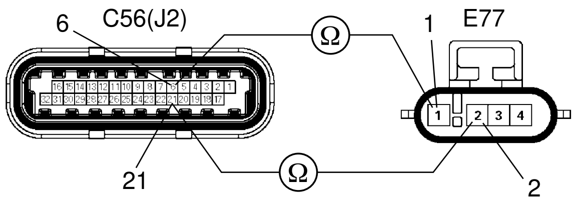
Diagnostic Aids

Check for the following conditions:

- Poor connection or damaged harness - Inspect the harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

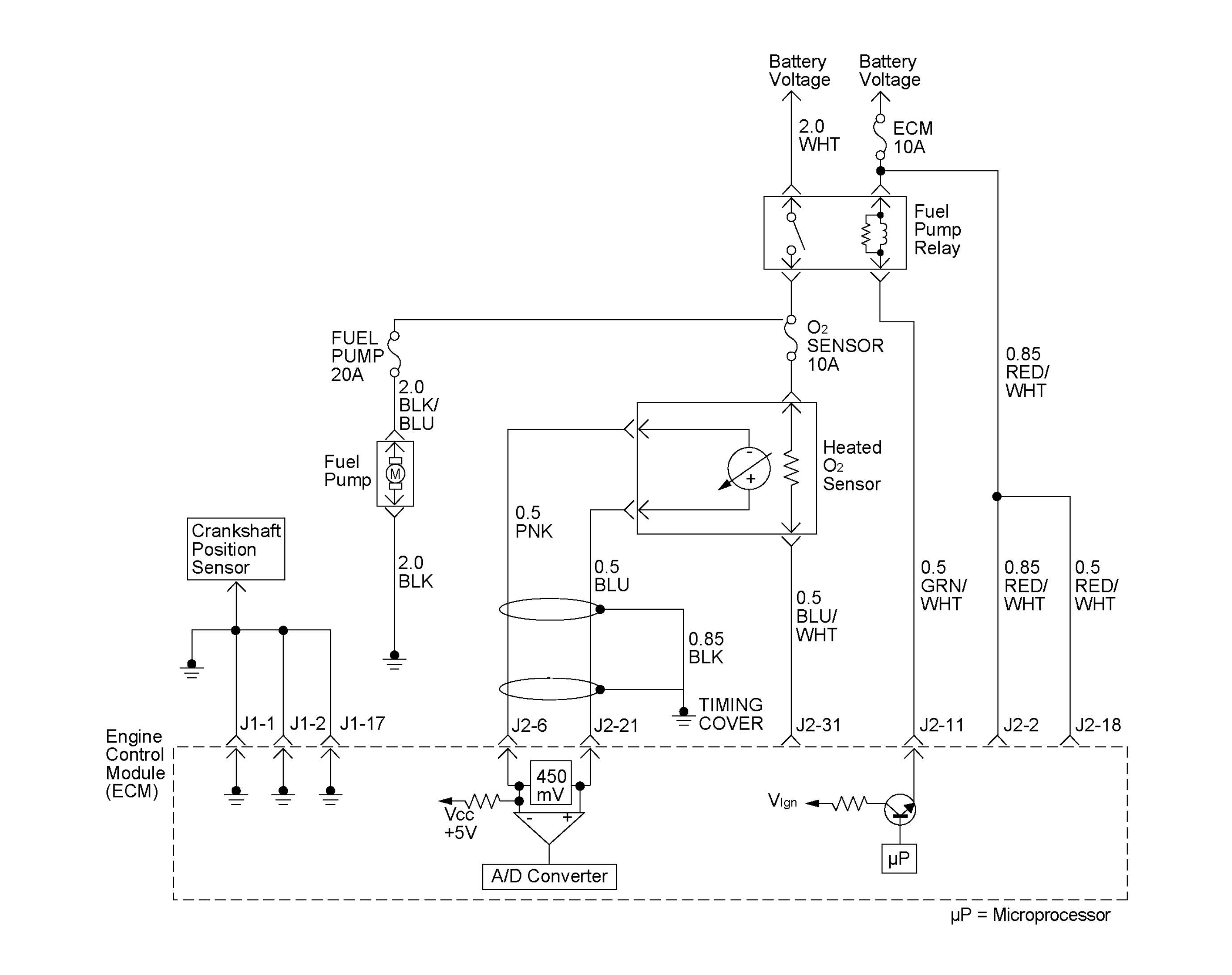
Diagnostic Trouble Code (DTC) P0134
O_2 Sensor Circuit No Activity Detected (Bank 1 Sensor 1)

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0134 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0134 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O_2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Using the DVM and check the O_2 sensor circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the O_2 sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	Approximatly 450mV	Go to *Step 7*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the O_2 sensor circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the O_2 sensor. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the O_2 sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 13*
7	1. Using the Tech 2, ignition “On” and engine “On”. 2. Monitor the “Manifold Absolute Pressure” in the data display. Does the Tech 2 indicate correct “Manifold Absolute Pressure” in accordance with engine speed or acceleration?	—	Go to *Step 9*	Go to *Step 8*
8	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 9*
9	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to *Step 11*	Go to *Step 10*

Step	Action	Value(s)	Yes	No
10	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 11*
11	Check for injector for the affected bank. Refer to *"Injector Coil Test & Injector Balance Test Procedure"* 6E-98 page. Was the injector operation correct?	—	Go to *Step 12*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
12	Check for fuel pressure. Refer to *"Fuel System Diagnosis"* 6E-108 page. Was the fuel pressure correct?	—	Go to *Step 13*	Refer to *Fuel System Diagnosis*
13	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 14*
14	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 15*
15	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0135 O_2 SENSOR HEATER CIRCUIT (BANK 1 SENSOR 1)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0135	A	O_2 SensorHeater Circuit (Bank 1 Sensor 1)	1. No DTC relating to MAP sensor and ECT sensor. 2. Engine coolant temperature is more than 60 deg. C. 3. Engine run time is longer than 20 seconds. 4. MAP sensor output is more than 70kPa. 5. O_2 sensor bank 1 heater current more than 10mA.	No fail-safe function.

Circuit Description

Heated oxygen sensors are used to minimize the amount of time required for “Closed Loop” fuel control operation and to allow accurate catalyst monitoring. The oxygen sensor heater greatly decreases the amount of time required for fuel control sensors Bank 1 HO2S 1 1 to become active. Oxygen sensor heaters are required by catalyst monitor sensors Bank 1 HO2S 2 to maintain a sufficiently high temperature which allows accurate exhaust oxygen content readings further from the engine.

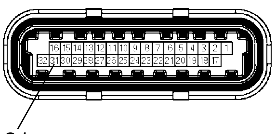
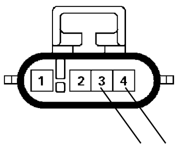
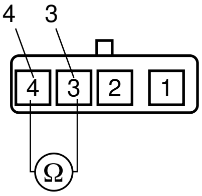
The engine control module (ECM) will run the heater test only after a cold start (determined by engine coolant and intake air temperature at the time of start-up) and only once during an ignition cycle. When the engine is started the ECM will monitor the HO2S voltage. When the HO2S voltage indicates a sufficiently active sensor, the ECM looks at how much time has elapsed since start-up. If the ECM determines that too much time was required for the Bank 1 HO2S 1 to become active, a Diagnostic Trouble Code P0135 will set.

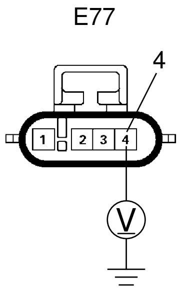
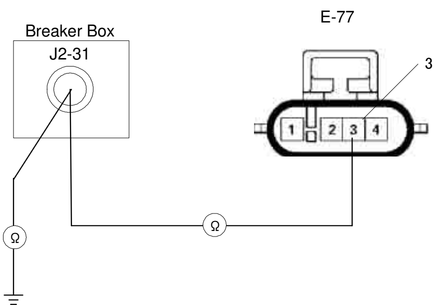
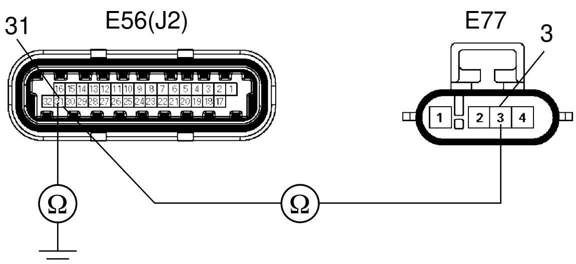
Diagnostic Aids

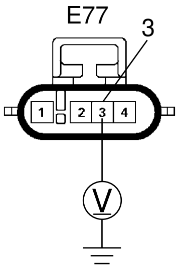
Check for the following conditions:

- Poor connection at ECM - Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage; shorts to ground, shorts to battery positive and open circuits.

Diagnostic Trouble Code (DTC) P0135
O_2 Sensor Heater Circuit (Bank 1 Sensor 1)

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0135 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0135 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the O_2 sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? C56(J2)  E77 	—	Verify repair	Go to *Step 5*
5	Visually check the O_2 sensor. Was the problem found?	—	Go to *Step 11*	Go to *Step 6*
6	Using the DVM and check the O_2 sensor. 1. Ignition "Off", engine "Off". 2. Disconnect O_2 sensor connector 3. Measure the resistance of heater. Was the tester indicated specified value? O2 Sensor 	Approximately 12.5Ω at 20°C	Go to *Step 7*	Go to *Step 11*

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the heater power supply circuit for the affected cylinder. 1. Ignition “On”, engine “Off”. 2. Disconnect the O_2 sensor connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value? 	10 - 14.5V	Go to *Step 9*	Go to *Step 8*
8	Repair the open or short to ground circuit between the “O_2 Sensor” fuse (10A) and O_2 sensor. Is the action complete?	—	Verify repair	—
9	Using the DVM and check the heater ground circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the O_2 sensor connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the O_2 sensor connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 10*

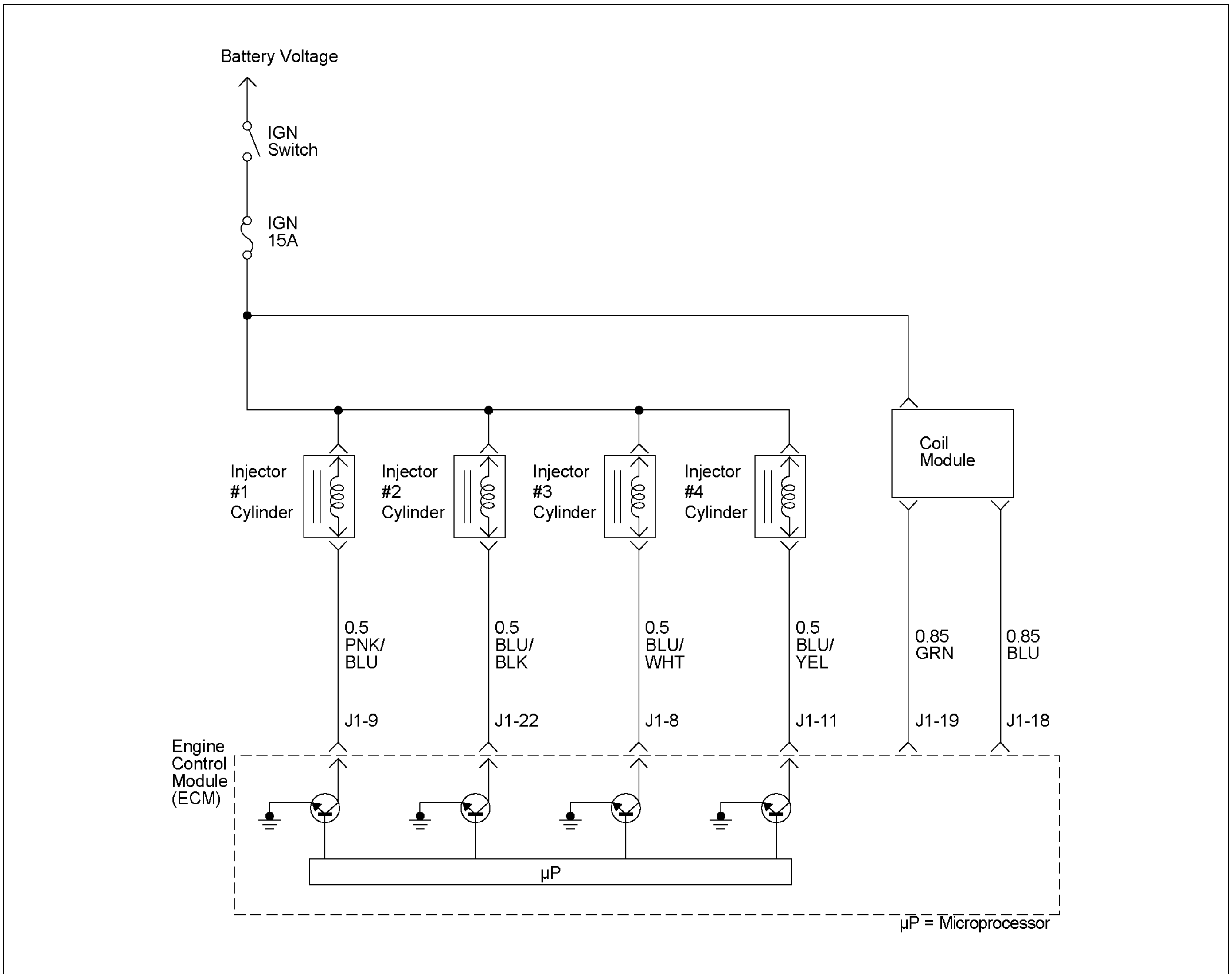
Step	Action	Value(s)	Yes	No
10	Using the DVM and check the heater ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the O_2 sensor connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated voltage?  	—	Repair faulty harness and verify repair	Go to *Step 12*
11	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0201 INJECTOR 1 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0202 INJECTOR 2 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0203 INJECTOR 3 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0204 INJECTOR 4 CONTROL CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0201	A	Injector 1 Control Circuit	1. Engine is running. 2. Engine speed is more than 1000rpm. 3. Injector voltage does not meet to the battery voltage when the injector is commanded Off or does not meet to the 0V when the injector is commanded On.	No fail-safe function.
P0202	A	Injector 2 Control Circuit		
P0203	A	Injector 3 Control Circuit		
P0204	A	Injector 4 Control Circuit		

Circuit Description

The engine control module (ECM) has four individual injector driver circuits. Each controls an injector. When a driver circuit is grounded by the ECM, the injector is activated. The ECM monitors the current in each driver circuit. The ECM measures a voltage drop through a fixed resistor and controls it. The voltage on each driver is monitored to detect a fault. If the voltage is not what the ECM expects to monitor on the circuit, a Diagnostic

Trouble Code is set. This Diagnostic Trouble Code is also set if an injector driver is shorted to voltage.

Diagnostic Aids

An injector driver circuit that is open or shorted to voltage will cause a Diagnostic Trouble Code P0201 to set. It will also cause a misfire due to an inoperative injector. A misfire Diagnostic Trouble Code will also be set indicating which cylinder is inoperative.

Long term and short term fuel trims that are excessively high or low are a good indication that an injector is faulty.

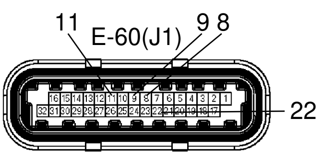
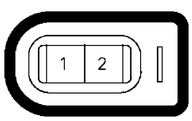
Use Fuel Injector Coil Test Procedure to check for faulty injectors.

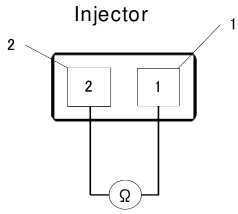
Diagnostic Trouble Code (DTC) P0201 Injector 1 Control Circuit

Diagnostic Trouble Code (DTC) P0202 Injector 2 Control Circuit

Diagnostic Trouble Code (DTC) P0203 Injector 3 Control Circuit

Diagnostic Trouble Code (DTC) P0204 Injector 4 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0201, P0202, P0203 or P0204 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0201, P0202, P0203 or P0204 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the injector or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  E-6/E-7/E-8/E-9 	—	Verify repair	Go to *Step 5*
5	Visually check the injector for the affected cylinder. Was the problem found?	—	Go to *Step 11*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the injector coil for the affected cylinder. 1. Ignition “Off”, engine “Off”. 2. Disconnect injector connector for the affected cylinder. 3. Measure the resistance of injector coil. Was the tester indicated specified value? 	Approximately 12.5Ω at 20°C	Go to *Step 7*	Go to *Step 11*

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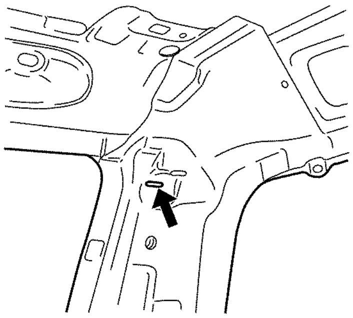

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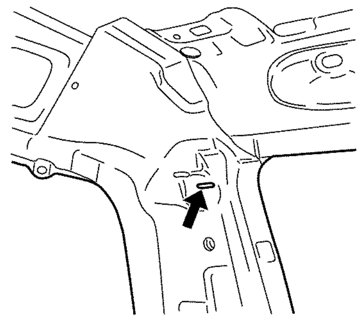

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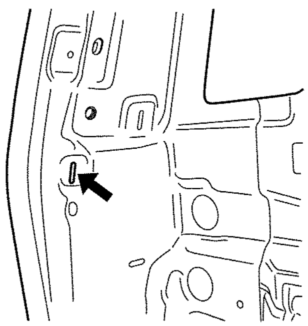

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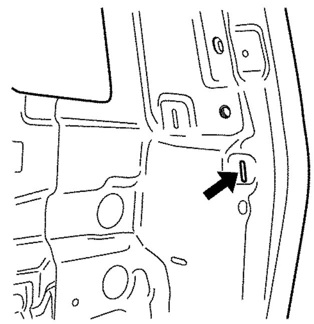

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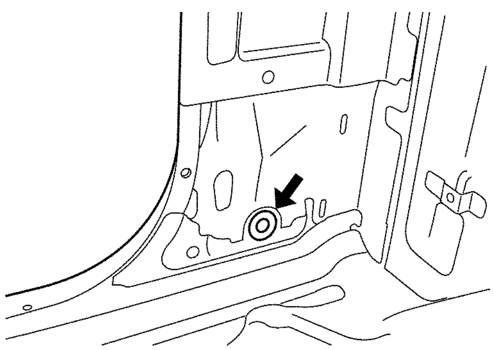

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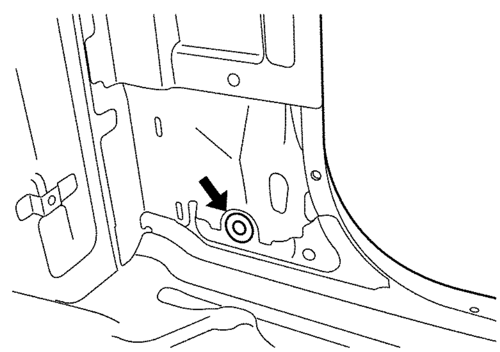
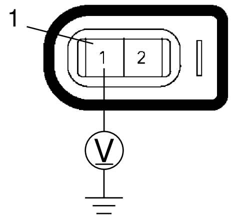
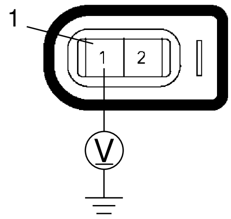
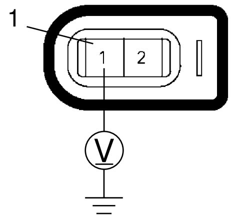
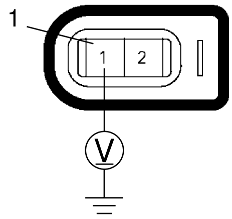
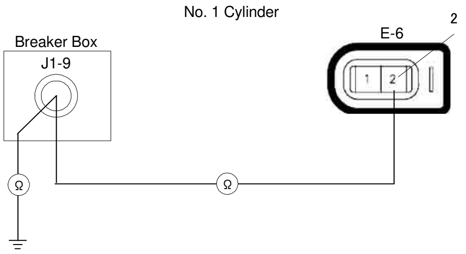
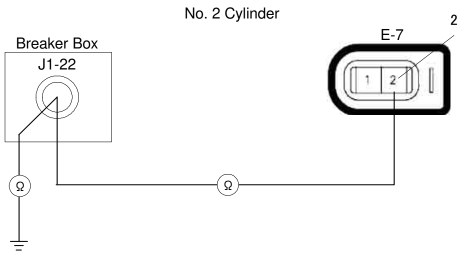
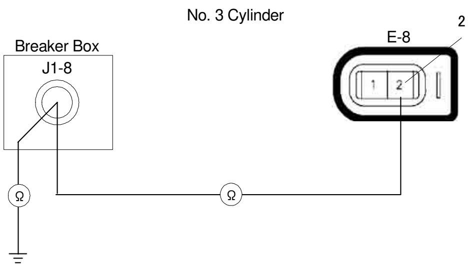
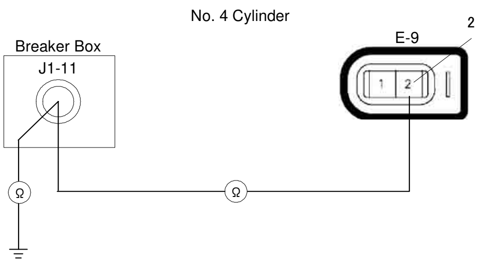


Step	Action	Value(s)	Yes	No
7	Using the DVM and check the injector power supply circuit for the affected cylinder. 1. Ignition “On”, engine “Off”. 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for open circuit. Was the DVM indicated specified value? No.1 Cylinder E-6  No.2 Cylinder E-7  No.3 Cylinder E-8  No.4 Cylinder E-9 	10 - 14.5V	Go to *Step 9*	Go to *Step 8*
8	Repair the open or short to ground circuit between the “IGN” fuse (15A) and injector for the affected cylinder. Is the action complete?	—	Verify repair	—

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the injector signal circuit for the affected cylinder. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the injector connector for the affected cylinder. 4. Check the circuit for open or short to ground circuit. Was the problem found?    	—	Repair faulty harness and verify repair	Go to *Step 10*

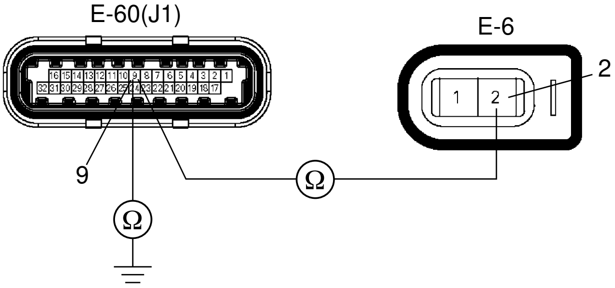
<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>9</td><td>

Breaker box is not available:

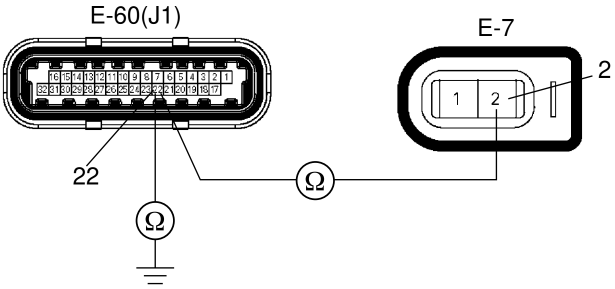
1. Ignition “Off”, engine “Off”.
2. Disconnect the injector connector for the affected cylinder and ECM connector.
3. Check the circuit for open or short to ground circuit.

Was the problem found?

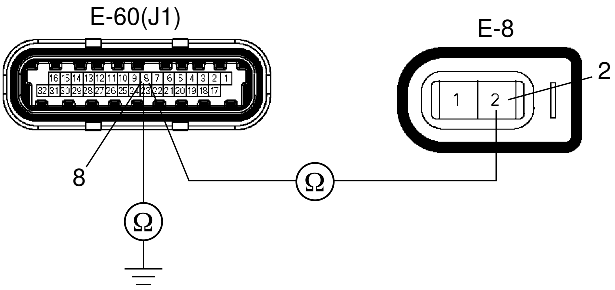
No.1 Cylinder



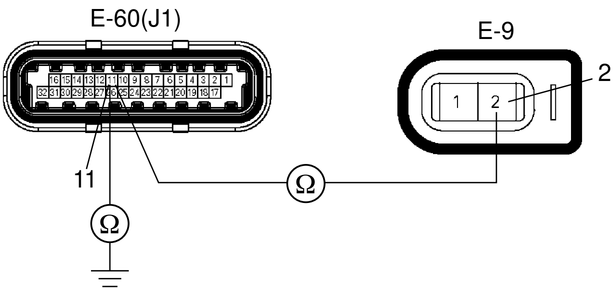
No.2 Cylinder



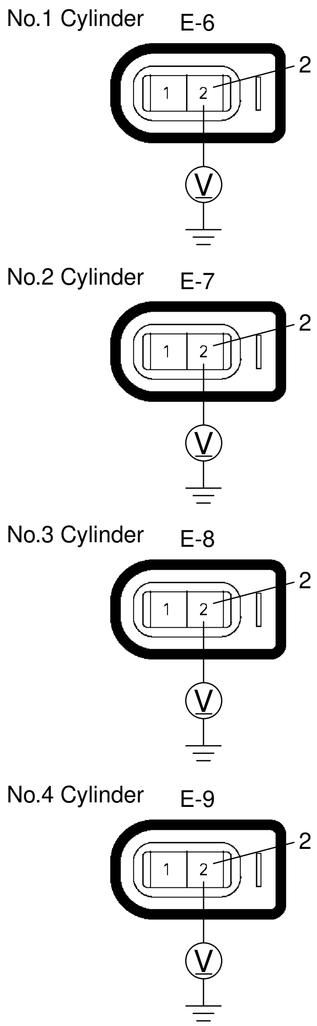
No.3 Cylinder



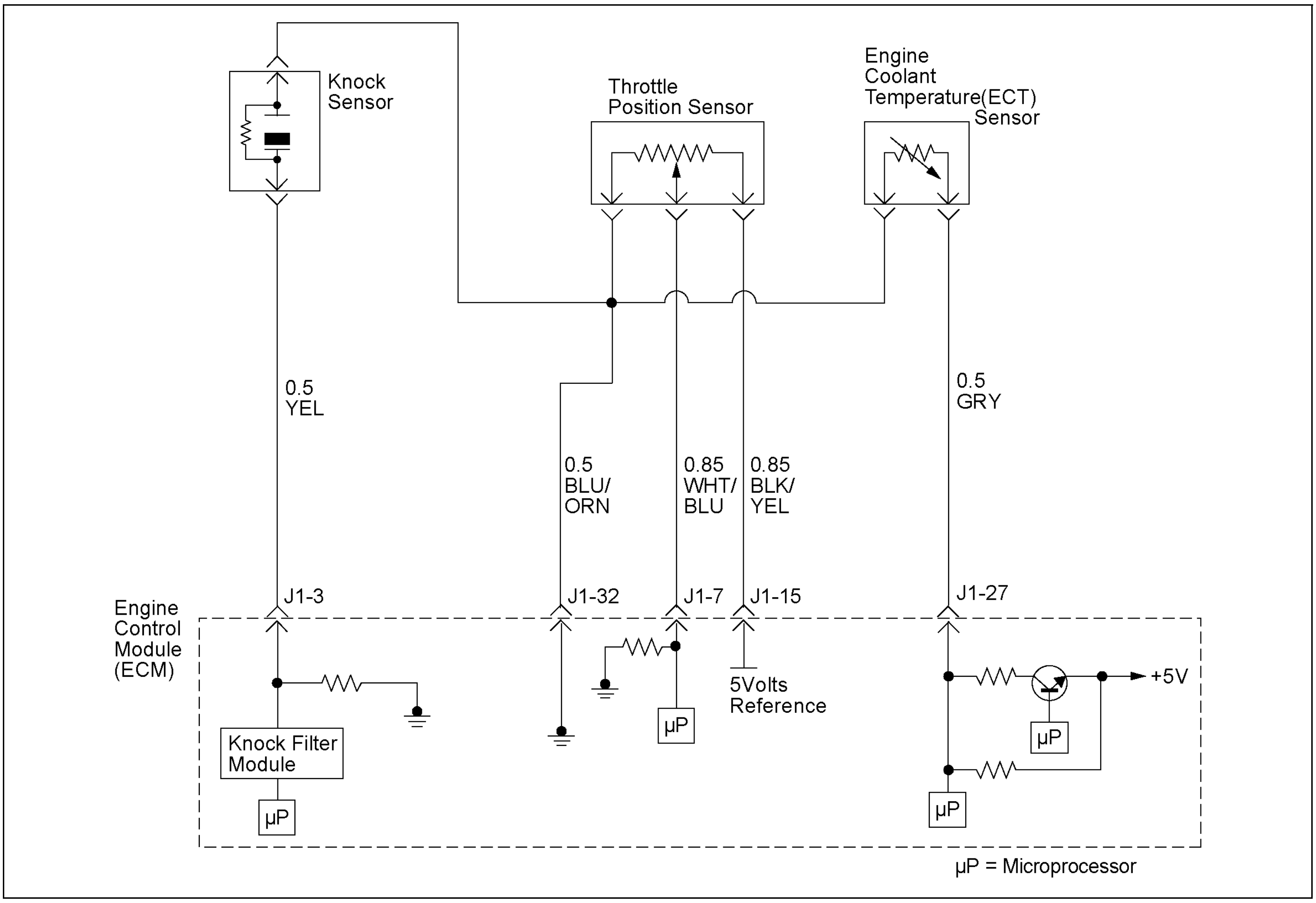
No.4 Cylinder



</td><td>—</td><td>Repair faulty harness and verify repair</td><td>Go to *Step 10*</td></tr>
</table>

Step	Action	Value(s)	Yes	No
10	Using the DVM and check the injector signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the injector connector for the affected cylinder. 3. Check the circuit for short to voltage circuit. Was the DVM indicated voltage?  	—	Repair faulty harness and verify repair	Go to *Step 12*
11	Replace the injector for the affected cylinder. Was the problem solved?	—	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0325 KNOCK SENSOR (KS) MODULE CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0325	B	Knock Sensor Module Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50 deg. C. 3. Engine speed is more than 1600rpm. 4. Knock sensor filter module integrated circuit malfunction.	ECM retards ignition timing 4 deg. C.

Circuit Description

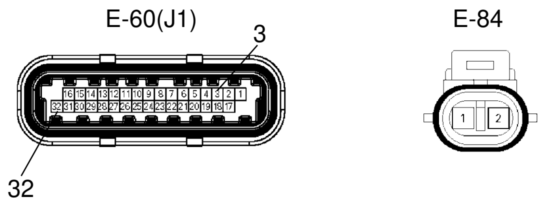
The knock sensor (KS) system is used to detect engine detonation. The knock sensor produced an AC voltage signal. The knock sensor sends this signal to the ECM. The amplitude and the frequency of the AC voltage signal depends upon the knock level being detected. The ECM will then retard the spark timing based on the signals from the Knock Sensor.

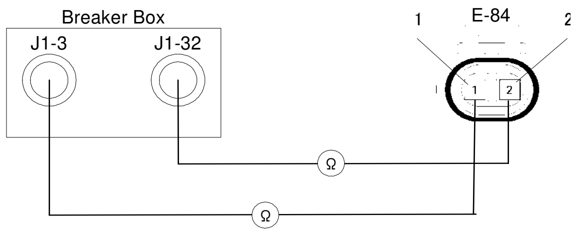
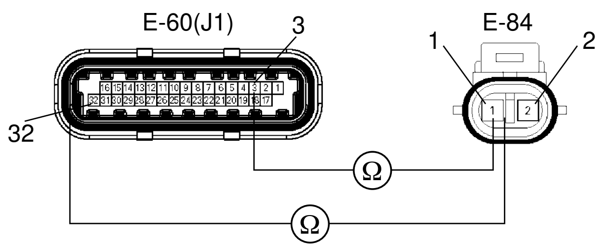
Diagnostic Aids

Correct any abnormal engine noise before using the diagnostic table.
Check for an open circuit.

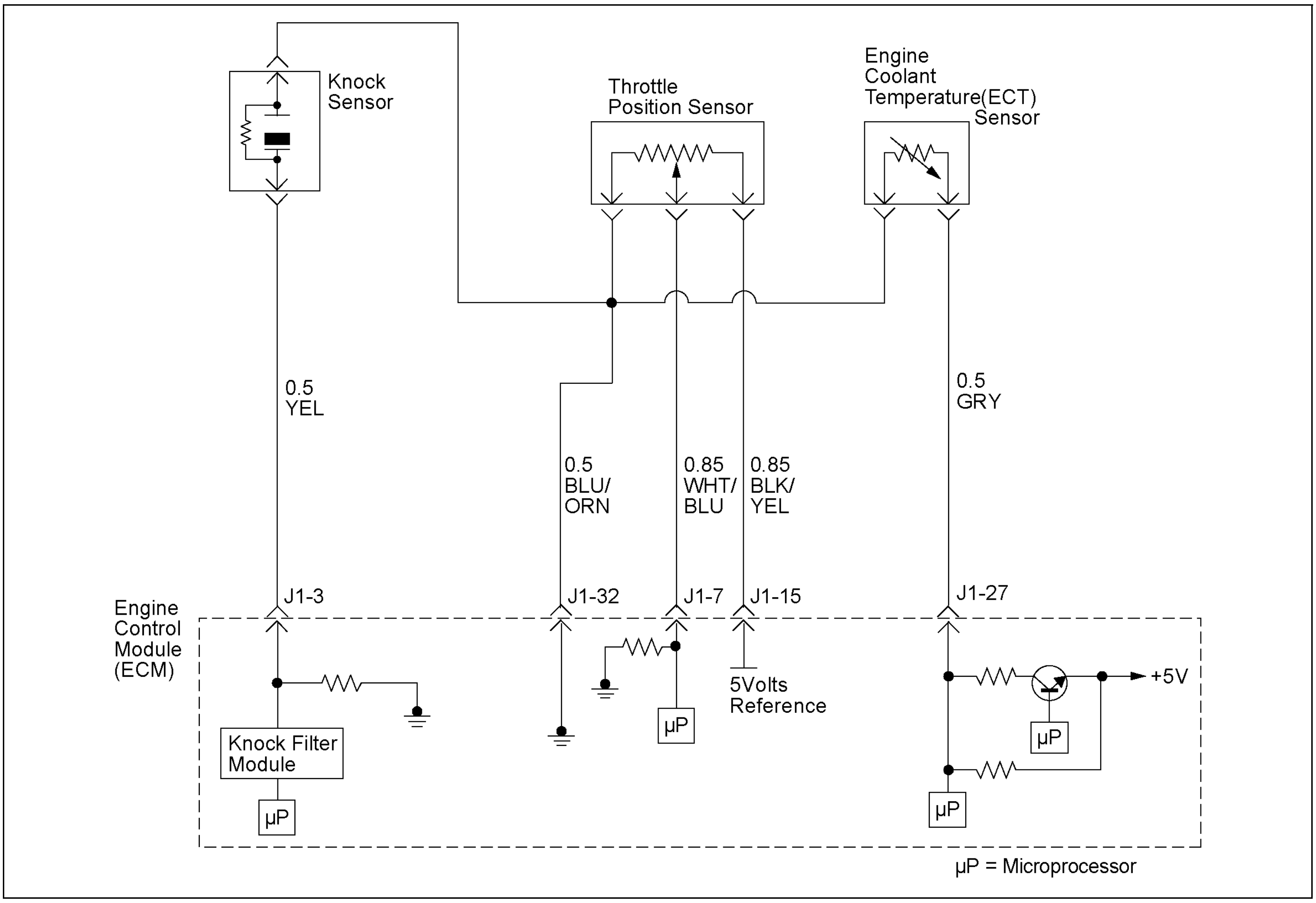
Diagnostic Trouble Code (DTC) P0325 Knock Sensor Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0325 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0325 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the knock sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found?  	—	Verify repair	Go to *Step 5*
5	Visually check the knock sensor. Was the problem found?	—	Go to *Step 10*	Go to *Step 6*
6	Listen to the engine noise while raising and lowering the engine speed. Is a knock or audible noise present?	—	Go to *Step 7*	Go to *Step 8*
7	Repair the mechanical engine problem or a loose bracket or component. Is the action complete?	—	Verify repair	—

Step	Action	Value(s)	Yes	No
8	Using the DVM and check the knock sensor circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the knock sensor. 4. Check the circuit for open circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the knock sensor connector and ECM connector. 3. Check the circuit for open circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 9*
9	Substitute a known good knock sensor and recheck. Was the problem solved?	—	Go to Step 10	Go to *Step 11*
10	Replace the knock sensor. Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 12*
12	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0327 KNOCK SENSOR (KS) CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0327	A	Knock Sensor Circuit	1. No DTC relating to MAP sensor. 2. Engine coolant temperature is more than 50 deg. C. 3. Engine speed is more than 1600rpm. 4. Knock sensor harness short to ground or short to voltage circuit.	ECM retards ignition timing 4 deg. C.

Circuit Description

The ECM uses the Knock Sensor (KS) in order to detect engine detonation. This allows the ECM to retard the Ignition Control (IC) spark timing based on the KS signal the ECM receives. The knock sensors produce an AC signal that rides on the 1.3 volts DC. The signal's amplitude and frequency are dependent upon the amount of the knock being experienced.
The ECM determines whether the knock is occurring by comparing the signal level on the KS circuit with a voltage level on the noise channel. The normal engine noise varies depending on the engine speed and load. Then the ECM determines that an abnormally high noise channel voltage level is being experienced, a Diagnostic Trouble Code P0327 sets.

Diagnostic Aids

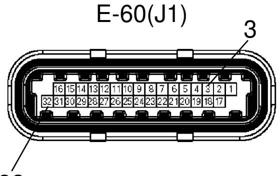
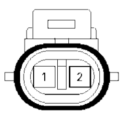
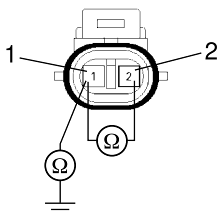
Check for the following conditions:
A poor connection at the ECM. Inspect the knock sensor and the ECM connectors for: , broken locks, improperly formed or damaged terminals.

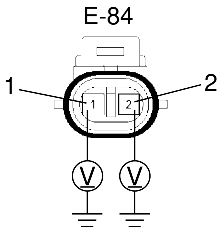
- Backed out terminals
- Broken locks
- Improperly formed or damaged terminals

Also, check the wiring harness for: shorts to ground, shorts to battery positive, and open circuits.

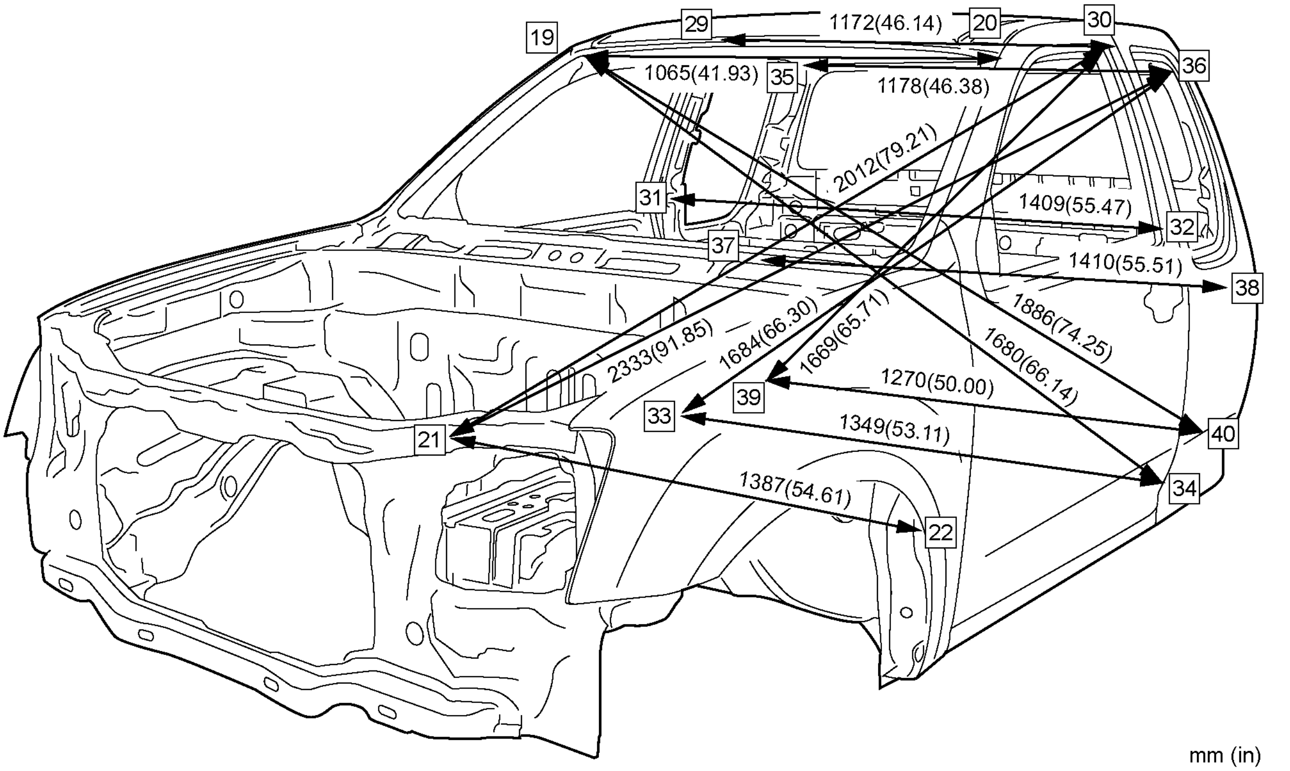
- A misrouted harness. Inspect the knock sensor harness in order to ensure that it is not routed too close to high voltage wires such as spark plug leads.

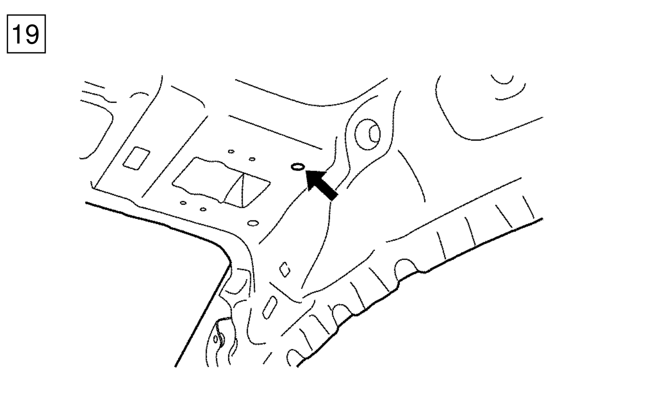
Diagnostic Trouble Code (DTC) P0327 Knock Sensor Circuit

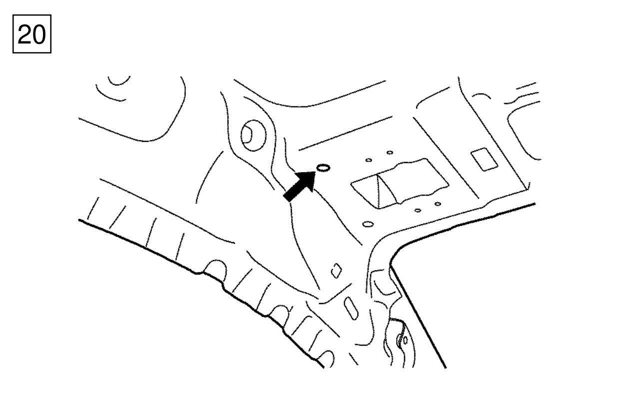
Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0327 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0327 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the knock sensor or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E-60(J1)  E-84 	—	Verify repair	Go to *Step 5*
5	Visually check the knock sensor. Was the problem found?	—	Go to *Step 9*	Go to *Step 6*
6	Using the DVM and check the knock sensor circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the knock sensor connector and ECM connector. 3. Check the circuit for short to sensor ground or ground circuit. Was the problem found? E-84 	—	Repair faulty harness and verify repair	Go to *Step 7*

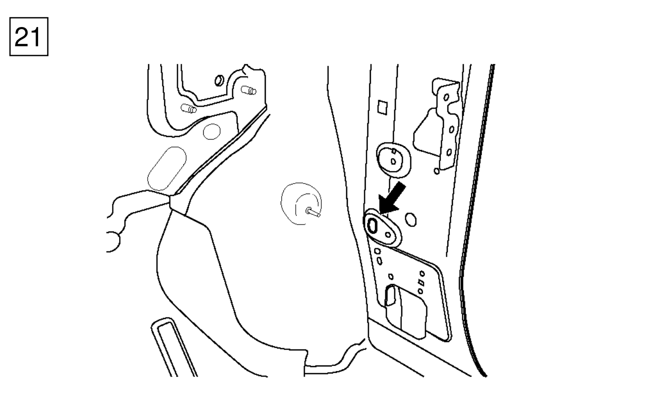
Step	Action	Value(s)	Yes	No
7	Using the DVM and check the knock sensor circuit. 1. Ignition "On", engine "Off". 2. Disconnect the knock sensor connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated voltage? 	—	Repair faulty harness and verify repair	Go to *Step 8*
8	Substitute a known good knock sensor and recheck. Was the problem solved?	—	Go to *Step 9*	Go to *Step 10*
9	Replace the knock sensor. Was the problem solved?	—	Verify repair	Go to *Step 10*
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

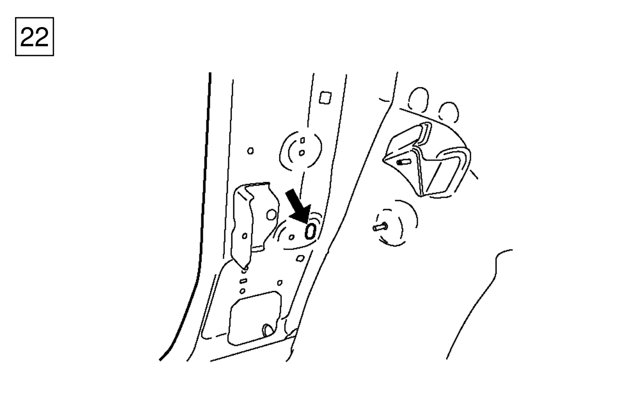
ROOM SECTION (EXTEND CAB)





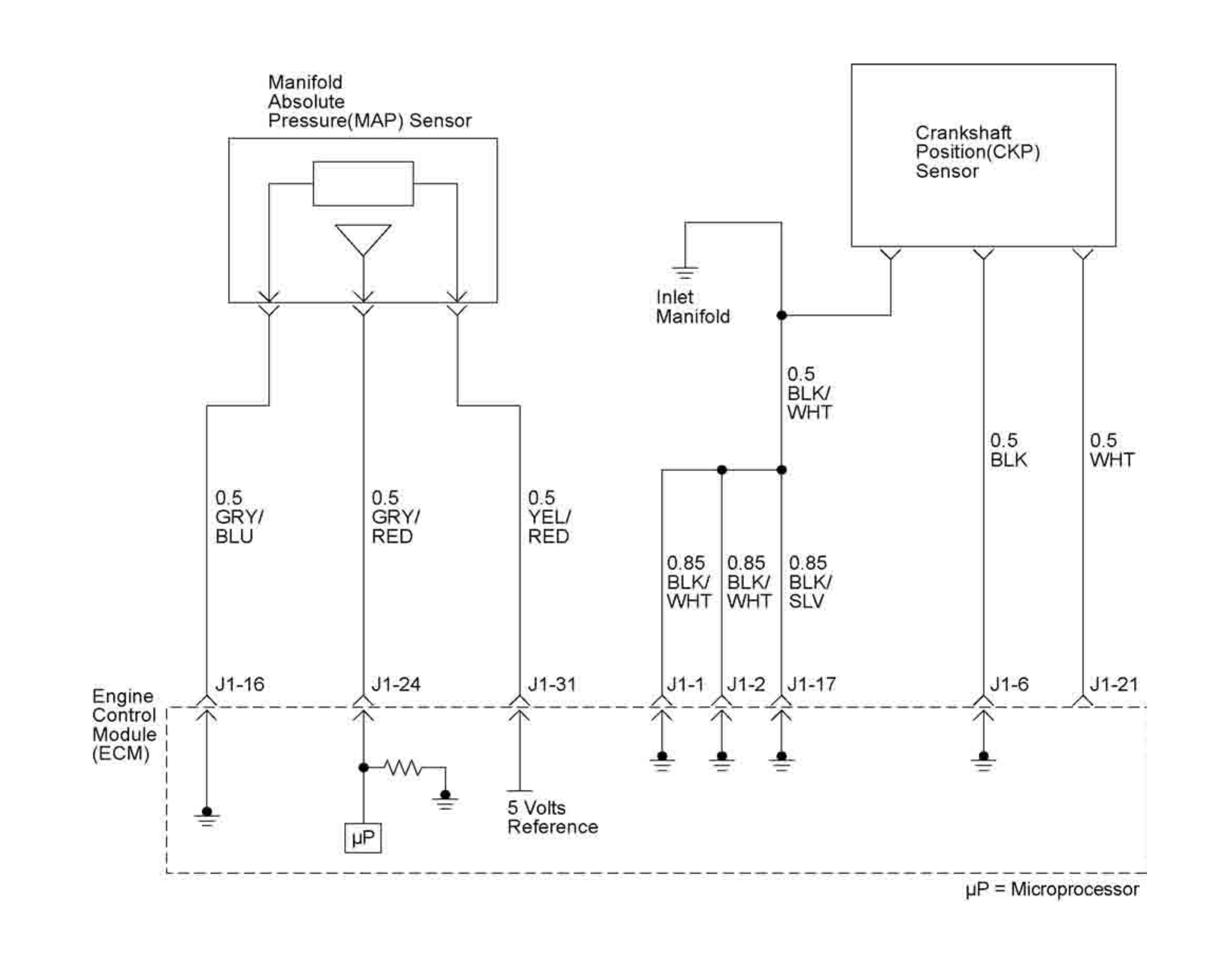






DIAGNOSTIC TROUBLE CODE (DTC) P0336 CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT RANGE/PERFORMANCE (58X)

DIAGNOSTIC TROUBLE CODE (DTC) P0337 CRANKSHAFT POSITION (CKP) SENSOR CIRCUIT LOW INPUT (58X)



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0336	B	Crankshaft Position Sensor Circuit Range/Performance (58X)	1. Engine is running. 2. Extra or missing pulse is detected consecutively.	No fail-safe function.
P0337	B	Crankshaft Position Sensor Circuit Low Input (58X)	No pulse is detected during engine cranking.	

Circuit Description

The 58X reference signal is produced by the crankshaft position (CKP) sensor. During one crankshaft revolution, 58 crankshaft pulses will be produced. The engine control module (ECM) uses the 58X reference signal to calculate engine RPM and crankshaft position. The ECM constantly monitors the number of pulses on the 58X reference circuit. If the ECM receives an incorrect number of pulses on the 58X reference circuit, Diagnostic Trouble Code P0336 will set. If the ECM does not receive pluses on the 58X reference circuit, Diagnostic Trouble Code P0337 will set.

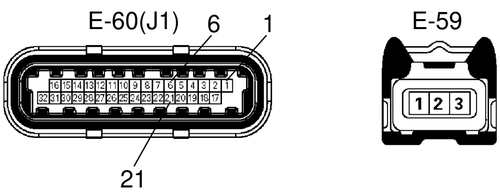
Diagnostic Aids

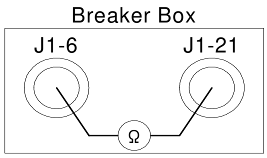
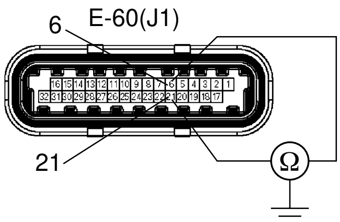
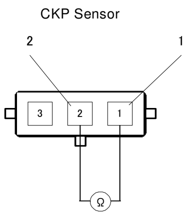
An intermittent may be caused by a poor connection, rubbed-through wire insulation or a wire broken inside the insulation. Check for:

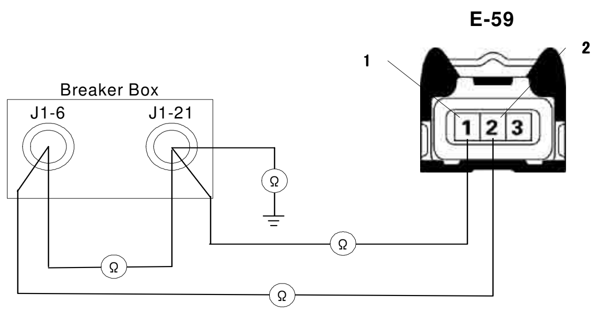
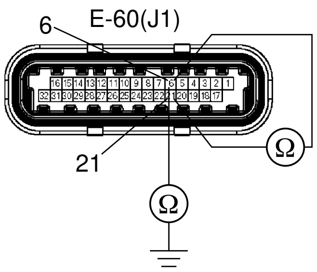
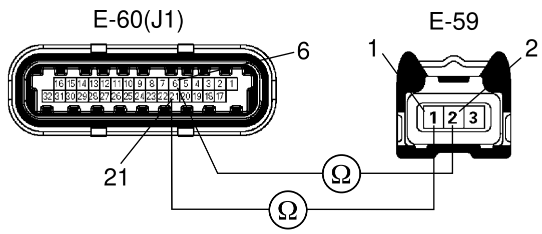
- Poor connection - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness - Inspect the wiring harness for damage; shorts to ground, shorts to battery positive and open circuits. If the harness appears to be OK, disconnect the ECM, turn the ignition on and observe a voltmeter connected to the 58X reference circuit at the ECM harness connector while moving connectors and wiring harnesses related to the ECM. A change in voltage will indicate the location of the fault.

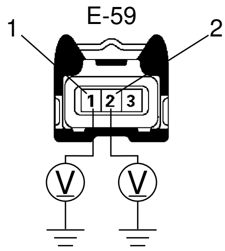
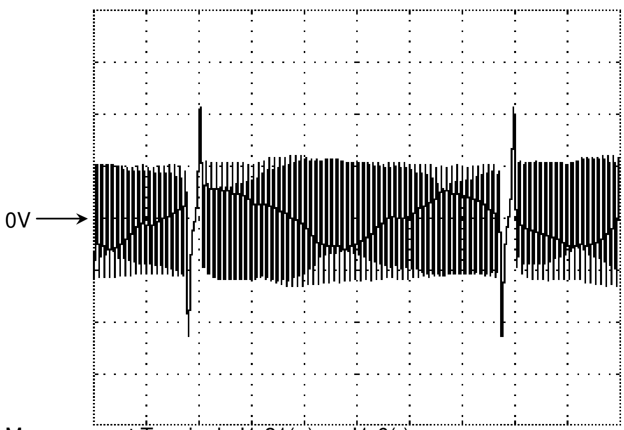
Diagnostic Trouble Code (DTC) P0336
Crankshaft Position Sensor Circuit Range/performance (58x)

Diagnostic Trouble Code (DTC) P0337
Crankshaft Position Sensor Circuit Low Input (58x)

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0336 or P0337 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0336 or P0337 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the CKP sensor or ECM connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Visually check the CKP sensor. If a faulty installation is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the CKP sensor circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value? 	Approximately 0.58kΩ at 20°C	Go to *Step 10*	Go to *Step 7*
7	Using the DVM and check the CKP sensor circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the CKP sensor connector. 3. Check the resistance of the CKP sensor. Was the DVM indicated specified value? 	Approximately 0.58kΩ at 20°C	Go to *Step 8*	Go to *Step 14*

Step	Action	Value(s)	Yes	No
8	Using the DVM and check the CKP sensor circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the CKP sensor connector. 4. Check the circuit for open, short to sensor wire or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Disconnect the CKP sensor connector. 4. Check the circuit for open, short to sensor wire or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 9*

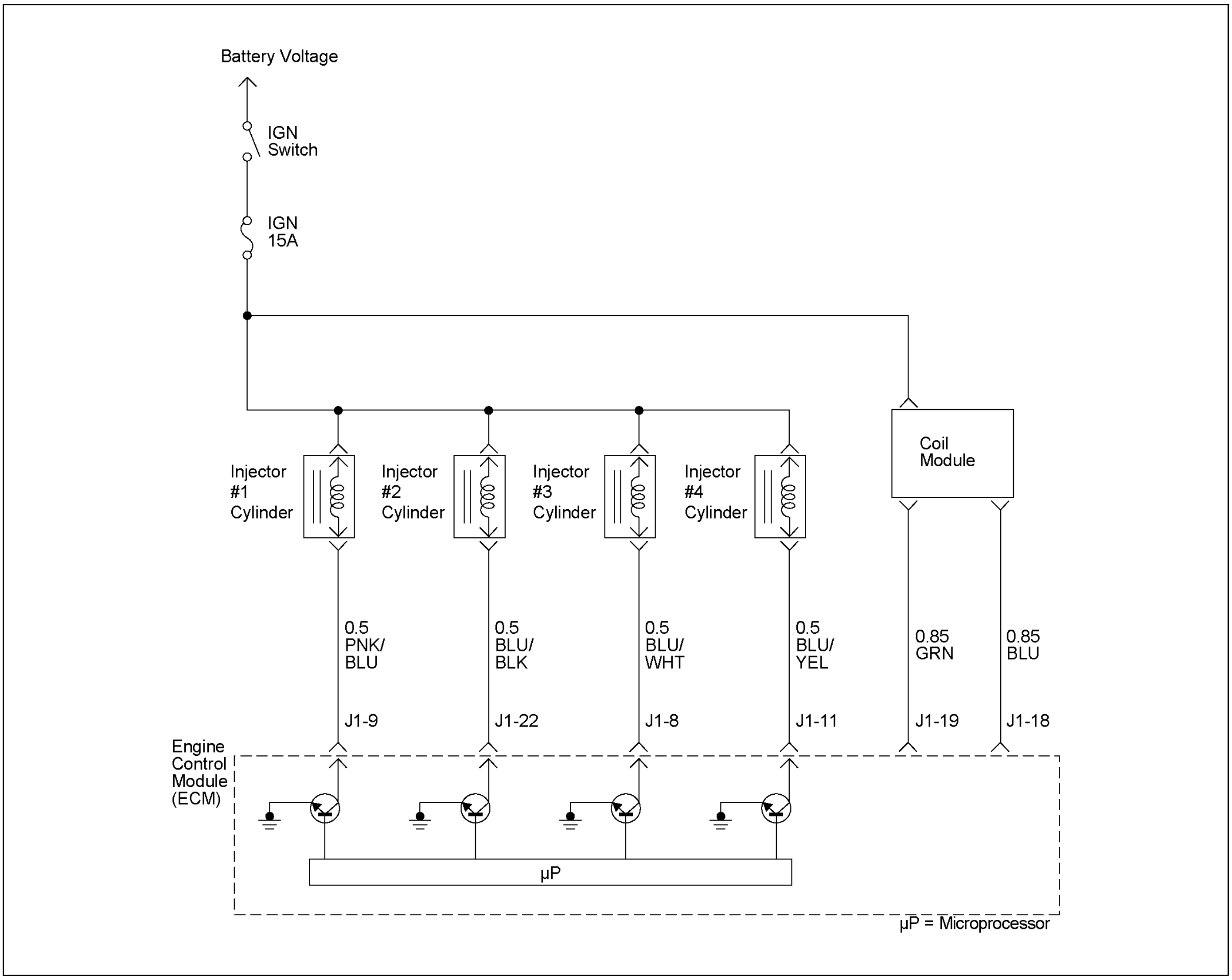
<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>9</td><td>Using the DVM and check the CKP sensor circuit.
1. Ignition “On”, engine “Off”.
2. Disconnect the CKP sensor connector.
3. Check the circuit for short to power supply circuit.
If the DVM indicated out of specified value, repair faulty harness and verify repair.
Is the action complete?

</td><td>Less than 1V</td><td>Verify repair</td><td>—</td></tr>
<tr><td>10</td><td>Using the DVM and check the CKP sensor signal.
1. Ignition “On”, engine “On”.
2. Measure the CKP output voltage at the sensor and ECM.
Does the tester indicate standard voltage?
<table><tr><th>Measurement Point</th><th>Voltage (V) (AC Range)</th></tr><tr><td>At CKP sensor terminal 1 & 2</td><td rowspan="2">Approx. 3.7V in engine idle
Approx. 7.8V at 2000rpm</td></tr><tr><td>At ECM E60 (J1) connector 21 & 6</td></tr></table>If a oscilloscope is available, monitor the CKP sensor signal. Does the oscilloscope indicate correct wave form?
Crankshaft Position (CKP) Sensor Reference Wave Form


Measurement Terminal: J1-21(+) J1-6(-)
Measurement Scale: 10V/div 5ms/div
Measurement Condition: Approximately 2000rpm</td><td></td><td>Go to Step 13</td><td>Go to Step 11</td></tr>
<tr><td>11</td><td>Remove the CKP sensor from the flywheel housing and visually check.
Check for the following conditions.
• Objects sticking the CKP sensor.
• Objects sticking the CKP sensor pulser.
If a problem is found, repair as necessary.
Was the problem found?</td><td>—</td><td>Verify repair</td><td>Go to Step 12</td></tr>
<tr><td>12</td><td>Check the CKP sensor shield wire for open or short circuit.
Was the problem found?</td><td>—</td><td>Repair faulty harness and verify repair</td><td>Go to Step 13</td></tr>
</table>

Step	Action	Value(s)	Yes	No
13	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	—	Remove the accessory parts and verify repair	Go to *Step 14*
14	Substitute a known good CKP sensor and recheck. Was the problem solved?	—	Go to *Step 15*	Go to *Step 16*
15	Replace the CKP sensor. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0351 IGNITION 1 CONTROL CIRCUIT

DIAGNOSTIC TROUBLE CODE (DTC) P0352 IGNITION 2 CONTROL CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0351	A	Ignition 1 Control Circuit	#1 or #4cylinder ignition signals are not detected consecutively.	No fail-safe function.
P0352	A	Ignition 2 Control Circuit	#2 or #3 cylinder ignition signals are not detected consecutively.	

Circuit Description

The ignition control circuit provides a zero volt or a 5 volt signal to the ignition control module. The normal circuit voltage is zero volts. When the module receives the 5 volt signal from the ECM, it provides a ground path for the B+ voltage supplied to the ignition primary coil. When the ECM turns off the 5 volts to the module, the module will remove the ground path of the ignition primary coils; causing the magnetic field produces a voltage in the secondary coils which fires the spark plug.

The circuit between the ECM and the ignition control module is monitored for an open circuit, short to voltage, and short to ground. When the ECM detects a problem in the ignition control circuit, it will set DTC P0351 or P0352.

Diagnostic Aids

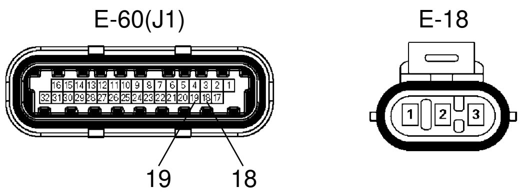
Check for the following conditions:

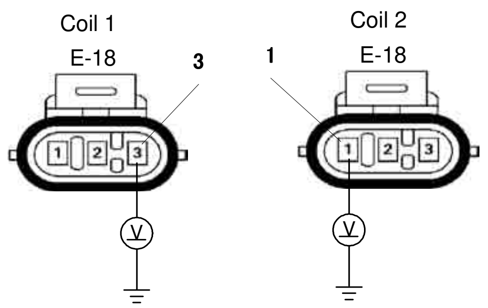
- Poor connection at the ECM - Inspect the harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connections.

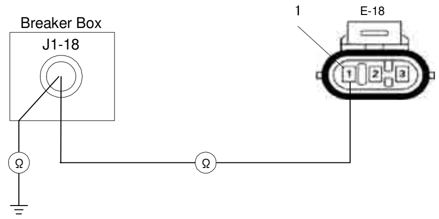
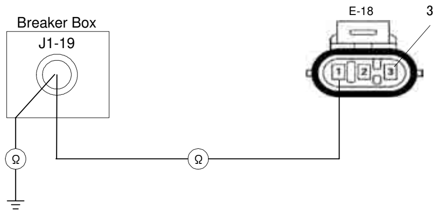
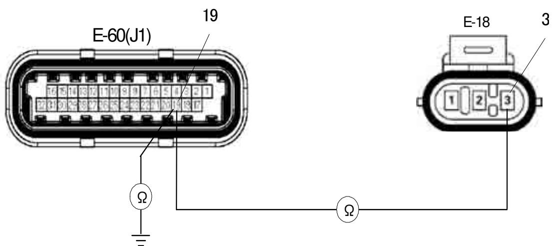
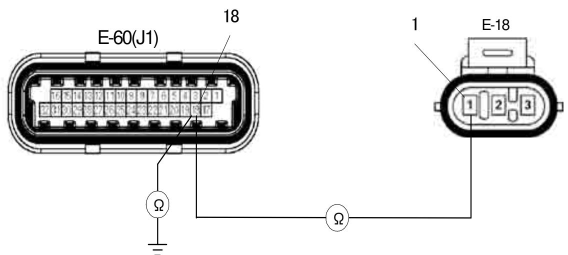
- Damaged harness - Inspect the wiring harness for damage; Open circuits, shorts to ground, or shorts to Voltage. If the harness appears to be OK, observe the Tech 2 display related to DTC P0351 or P0352 while moving the connector and wiring related to the ignition system. A change in the display will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P0351 Ignition 1 Control Circuit

Diagnostic Trouble Code (DTC) P0352 Ignition 2 Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0351 or P0352 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0351 or P0352 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the ignition coil module or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 5*
5	Visually check the ignition coil module. Was the problem found?	—	Go to *Step 12*	Go to *Step 6*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the ignition coil module signal circuit for the affected coil. 1. Ignition “On”, engine “Off”. 2. Disconnect the ignition coil module connector. 3. Check the circuit for short to battery voltage circuit for the affected coil. Was the DVM indicated battery voltage? 	—	Repair faulty harness and verify repair	Go to *Step 7*

Step	Action	Value(s)	Yes	No
7	Using the DVM and check the ignition coil signal circuit for the affected coil. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the ignition coil module connector. 4. Check the circuit for open or short to ground circuit for the affected coil. Was the problem found? Coil 2  Coil 1  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ignition coil module connector and ECM connector. 3. Check the circuit for open or short to ground circuit for the affected coil. Was the problem found? Coil 1  Coil 2  	—	Repair faulty harness and verify repair	Go to *Step 8*

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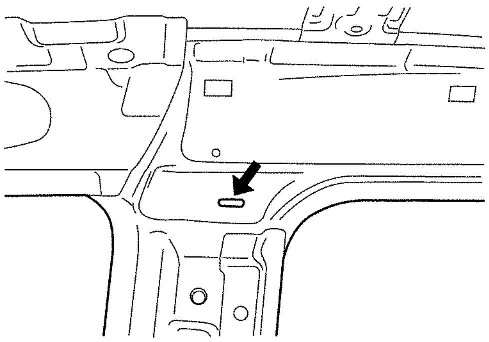

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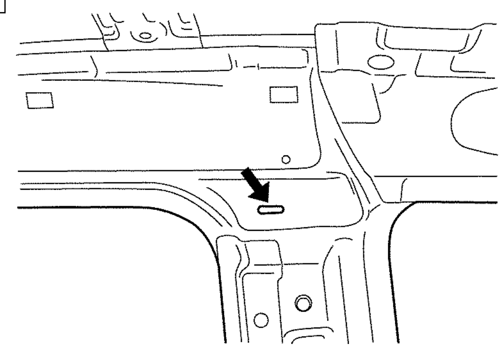

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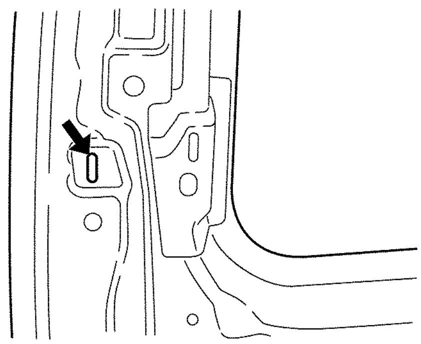

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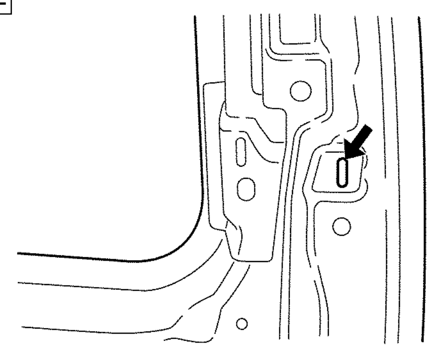

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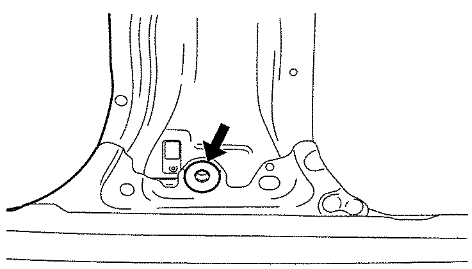

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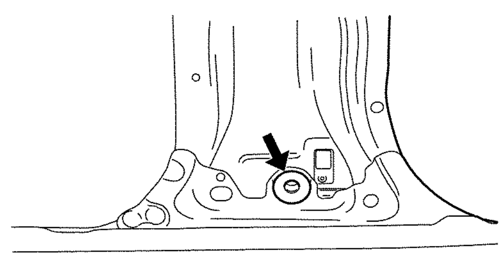

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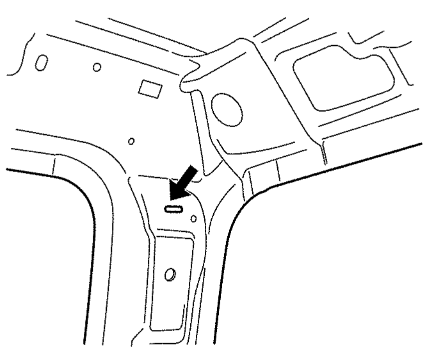

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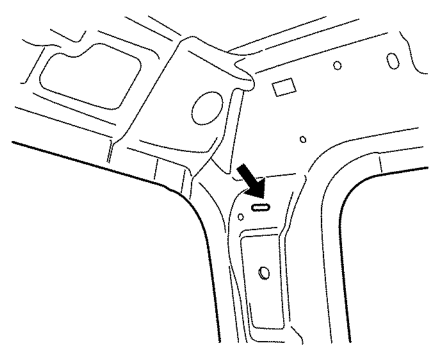
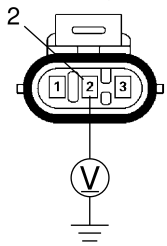
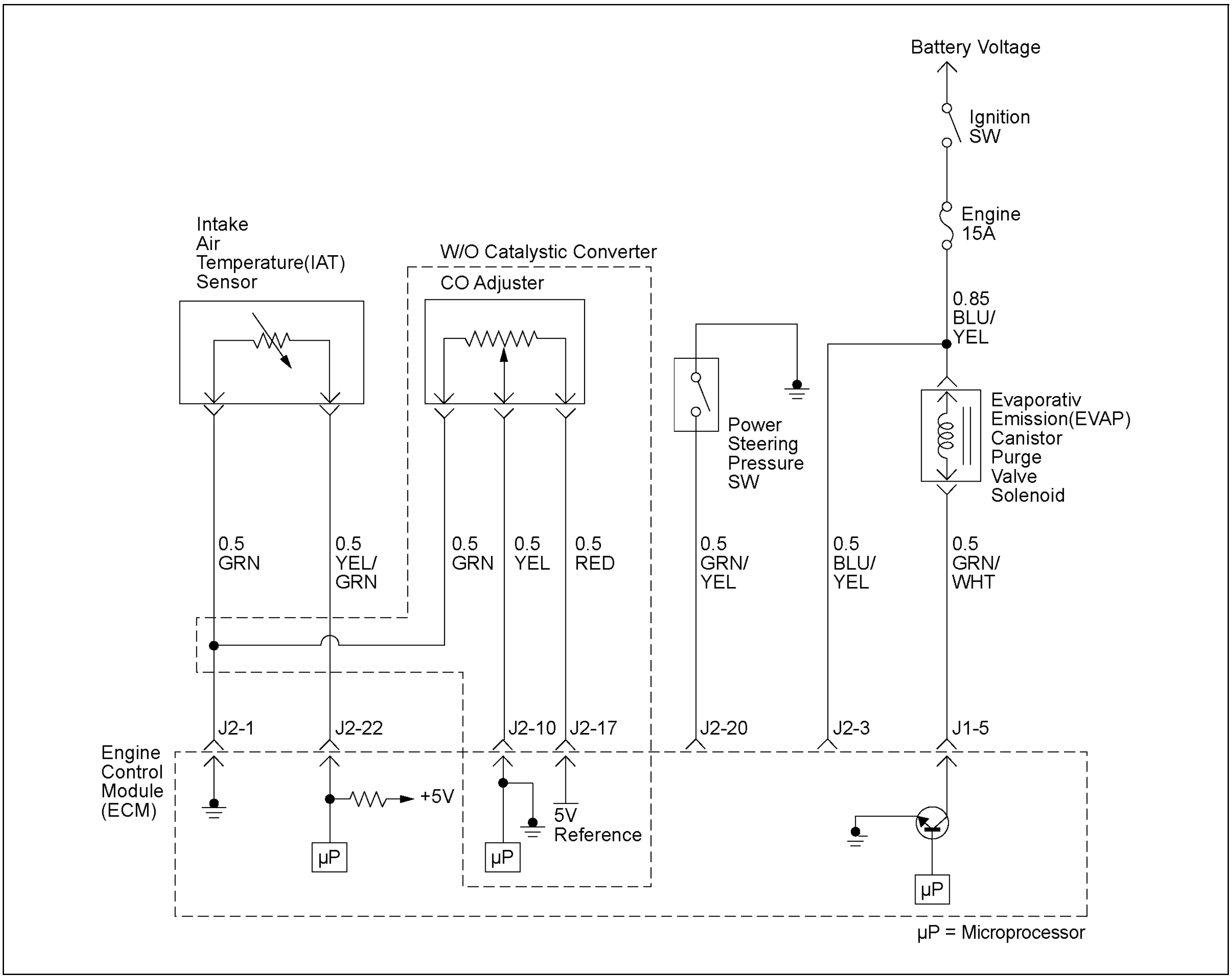


Step	Action	Value(s)	Yes	No
8	Using the DVM and check the ignition coil module power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the ignition coil module connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value?  	10 - 14.5V	Go to *Step 10*	Go to *Step 9*
9	Repair the open or short to ground circuit between the “IGN. Coil” fuse (15A) and ignition coil module. Is the action complete?	—	Verify repair	—
10	Replace the ignition coil module. Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 12*
12	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0443 EVAPORATIVE (EVAP) EMISSION CONTROL SYSTEM PURGE CONTROL CIRCUIT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0443	B	EVAP Emission Control System Purge Control Circuit	EVAP purge solenoid circuit open, short to ground or short to voltage circuit.	No fail-safe function.

Circuit Description

The Engine Control Module (ECM) controls the Evaporative Emission (EVAP) Canister Purge Solenoid Valve through the use of a control (ground) circuit. If the ECM commands the Purge solenoid to maximum duty cycle (100%) but the voltage remains High (12 Volts); or, if the ECM commands the Purge solenoid to minimum duty cycle (0%) but the voltage remains Low (0 volts), then DTC P0443 will set.

Diagnostic Aids

- Poor connections, or a damaged harness - Inspect the harness connectors for: backed-out terminals, improper mating or damaged terminals. Also check for open circuits, shorts to ground, and shorts to voltage.

BACK TO CHAPTER INDEX

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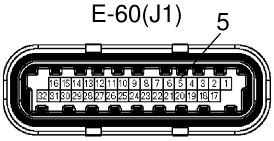
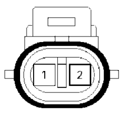
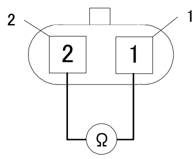
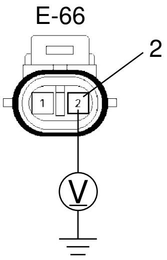
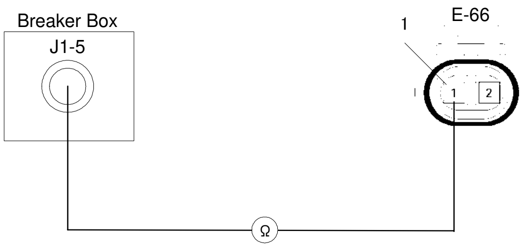
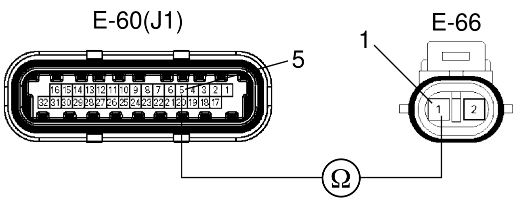
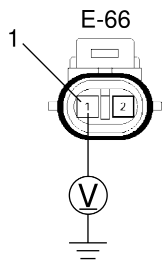
TO MODEL INDEX

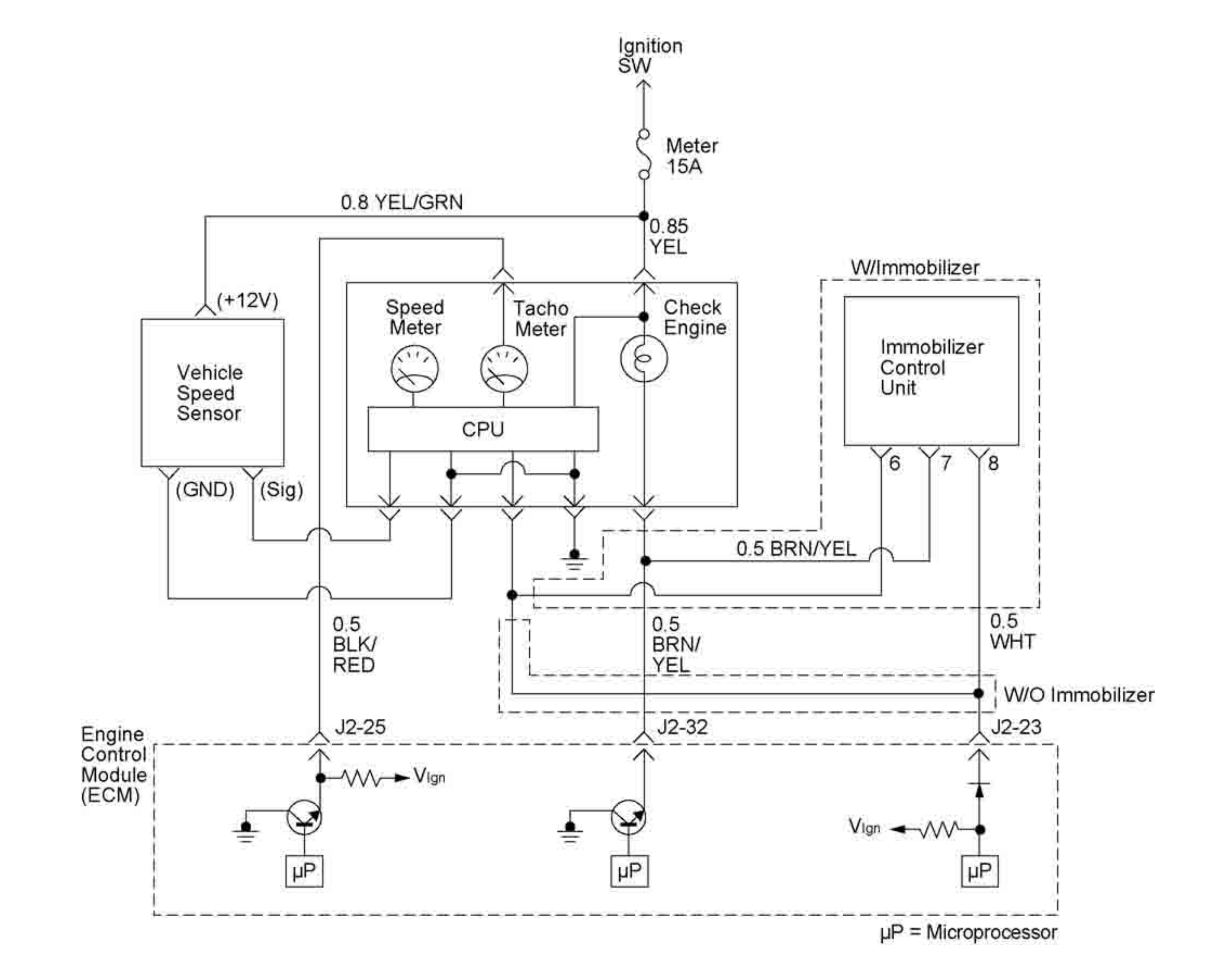
Diagnostic Trouble Code (DTC) P0443
EVAP Emission Control System Purge Control Circuit

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0443 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0443 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the purge solenoid valve or ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? E-60(J1)  E-66 	—	Verify repair	Go to *Step 5*
5	Using the DVM and check the purge solenoid valve. 1. Ignition “Off”, engine “Off”. 2. Disconnect purge solenoid valve connector. 3. Measure the resistance of purge solenoid valve coil. Does the tester indicate standard resistance? EVAP Purge Solenoid 	25 - 30Ω at 20°C	Go to *Step 6*	Go to *Step 9*

Step	Action	Value(s)	Yes	No
6	Using the DVM and check the purge solenoid valve power supply circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for open circuit. Was the DVM indicated specified value?  	10 - 14.5V	Go to *Step 8*	Go to *Step 7*
7	Repair the open or short to ground circuit between the “Engine” fuse (15A) and purge solenoid valve. Is the action complete?	—	Verify repair	-
8	Using the DVM and check the purge solenoid valve solenoid signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the purge solenoid valve connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the purge solenoid valve connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the purge solenoid valve signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the purge solenoid valve connector. 3. Check the circuit for short to voltage circuit. Was the DVM indicated voltage?  	—	Repair faulty harness and verify repair	Go to *Step 10*
10	Substitute a known good purge solenoid valve and recheck. Was the problem solved?	—	Go to *Step 11*	Go to *Step 12*
11	Replace the purge solenoid valve. Was the problem solved?	—	Verify repair	Go to *Step 12*
12	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 13*
13	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0502 VEHICLE SPEED SENSOR (VSS) CIRCUIT LOW INPUT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0502	B	Vehicle Speed Sensor Circuit Low Input	1. No DTC relating to MAP sensor, TPS, ECT sensor, injector control circuit and ignition control circuit. 2. Engine is running. 3. Vehicle speed is below 3km/h in power condition or 2km/h in deceleration condition.	ECM uses 0km/h condition as substitute.

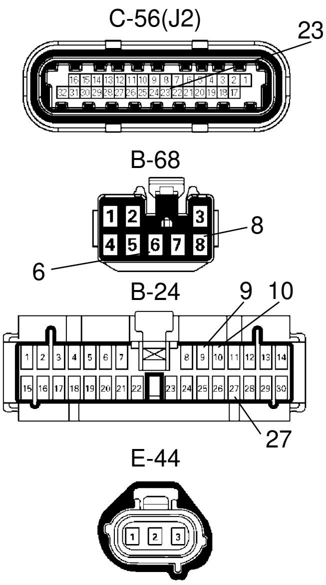
Circuit Description

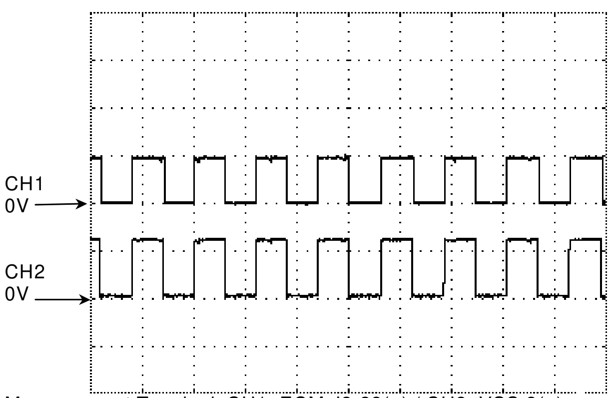
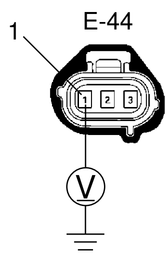
The vehicle speed sensor has a magnet rotated by the transmission output shaft. Attached to the sensor is a hall effect circuit that interacts with the magnetic field created by the rotating magnet. A 12-volt operating supply for the speed sensor hall circuit is supplied from the meter fuse.

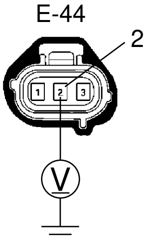
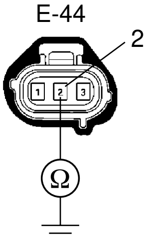
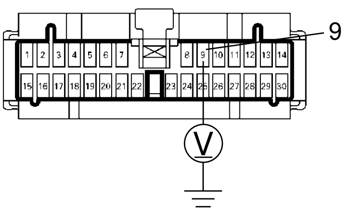
Diagnostic Aids

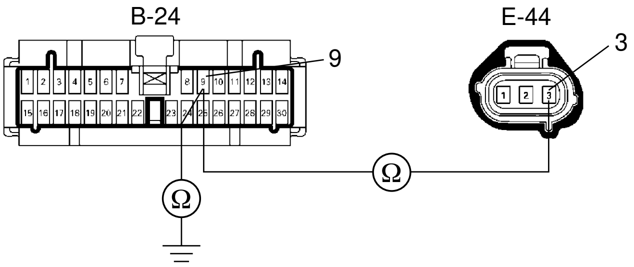
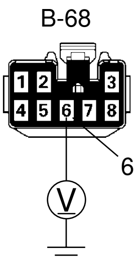
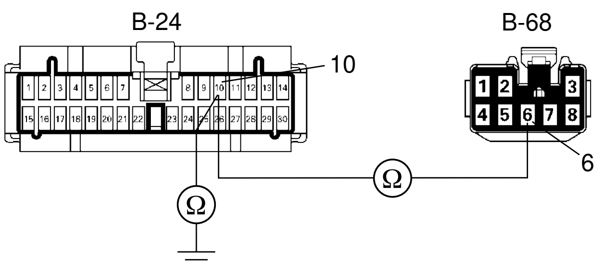
- Poor connection at ECM: Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.

Diagnostic Trouble Code (DTC) P0502 Vehicle Speed Sensor Circuit Low Input

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0502 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0502 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the VSS, meter, immobilizer control unit (if equipped), ECM and other connectors. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found?  	—	Verify repair	Go to *Step 5*
5	Remove the VSS from the housing case and visually check. Was the problem found?	—	Go to *Step 19*	Go to *Step 6*

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>6</td><td>Using the DVM and check the VSS signal.
1. Ignition “On”, vehicle “Run (lift up)”.
2. Measure the VSS output voltage at sensor, meter, immobilizer control unit (if equipped) and ECM.
Does the tester indicate specified value?
<table>
<tr><th>Measurement Position</th><th>Voltage (V) (AC Range)</th><th>If No Good</th></tr>
<tr><td>VSS terminal 3 & GND</td><td>Approximately 7.0 V at 20km/h</td><td>Go to Step 7</td></tr>
<tr><td>Meter B24 connector 9 & GND</td><td></td><td>Go to Step 11</td></tr>
<tr><td>Meter B24 connector 10 & GND</td><td></td><td>Go to Step 13</td></tr>
<tr><td>Immobilizer control unit B68 connector 6 & GND</td><td></td><td>Go to Step 14</td></tr>
<tr><td>Immobilizer control unit B68 connector 8 & GND</td><td>Approximately 6.5V at 20km/h</td><td>Go to Step 16</td></tr>
<tr><td>ECM C56 (J2) connector 23 & GND</td><td></td><td>Go to Step 17</td></tr>
</table>
If a oscilloscope is available, monitor the VSS signal.
Does the oscilloscope indicate correct wave form?
Vehicle Speed Sensor (VSS) Reference Wave Form

Measurement Terminal: CH1: ECM J2-23(+) / CH2: VSS 3(+) GND(-)
Measurement Scale: CH1: 10V/div / CH2: 10V/div 50ms/div
Measurement Condition: Approximately 20km/h
Note: The vehicle is without immobilizer system, CH1 signal is same as CH2.</td><td></td><td>Refer to Diagnostic Aids and Go to Step 21</td><td>Refer the table</td></tr>
<tr><td>7</td><td>Using the DVM and check the VSS power supply circuit.
1. Ignition “On”, engine “Off”.
2. Disconnect the VSS connector.
3. Check the circuit for open or short to ground circuit.
Was the DVM indicated specified value?
</td><td>10 - 14.5V</td><td>Go to Step 9</td><td>Go to Step 8</td></tr>
<tr><td>8</td><td>Repair the open circuit between the VSS and meter fuse.
Is the action complete?</td><td>—</td><td>Verify repair</td><td>—</td></tr>
</table>

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the VSS ground circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the VSS connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? E-44 	Less than 1V	Go to *Step 10*	Repair faulty harness and verify repair
10	Using the DVM and check the VSS ground circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the VSS connector. 3. Check the circuit for open circuit. Was the problem found? E-44 	—	Repair faulty harness and verify repair	Go to *Step 19*
11	Using the DVM and check the VSS signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? B-24 	Less than 1V	Go to *Step 12*	Repair faulty harness and verify repair

Step	Action	Value(s)	Yes	No
12	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the VSS connector and meter connector. 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	—	Verify repair	—
13	Replace the speed meter. Is the action complete?	—	Verify repair	—
14	Using the DVM and check the VSS signal circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the meter connector and immobilizer control unit connector (if equipped). 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 15*	Repair faulty harness and verify repair
15	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the meter connector and immobilizer control unit connector (if equipped). 3. Check the circuit for open or short to ground circuit. If a open or short to ground circuit is found, repair the faulty harness and verify repair. Is the action complete? 	—	Verify repair	—

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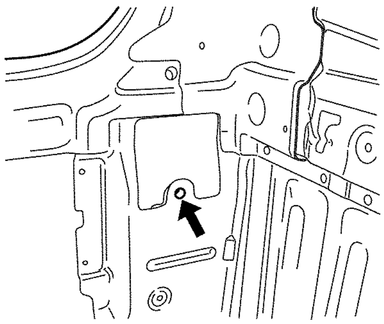

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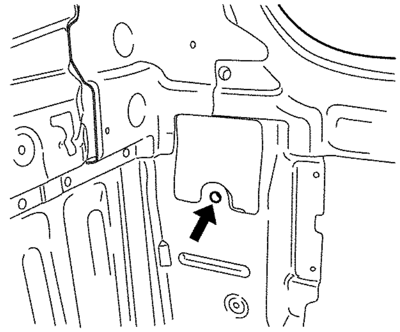

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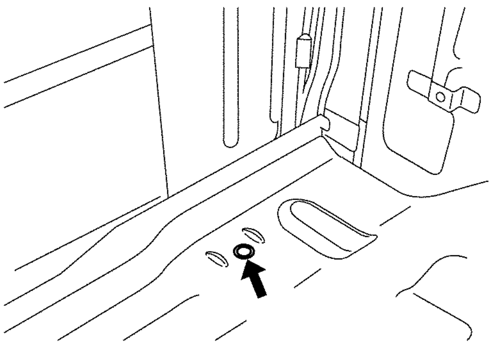

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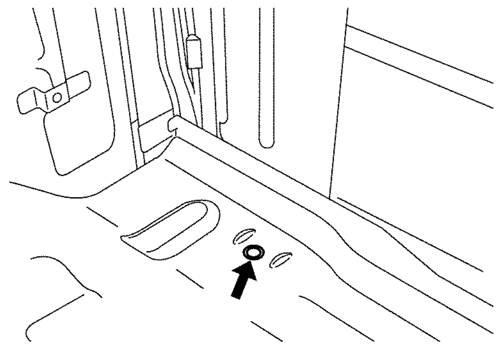
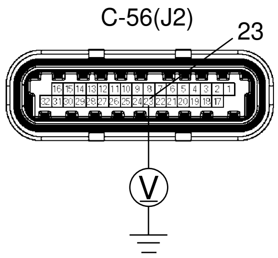
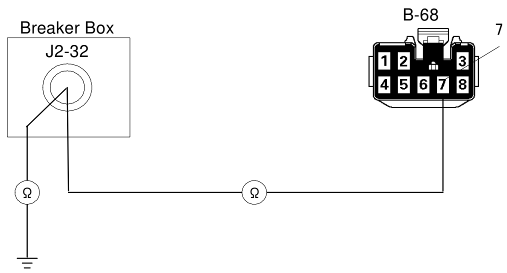
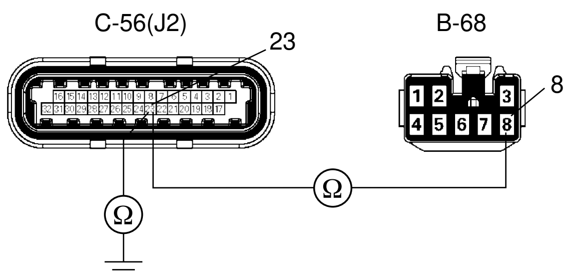
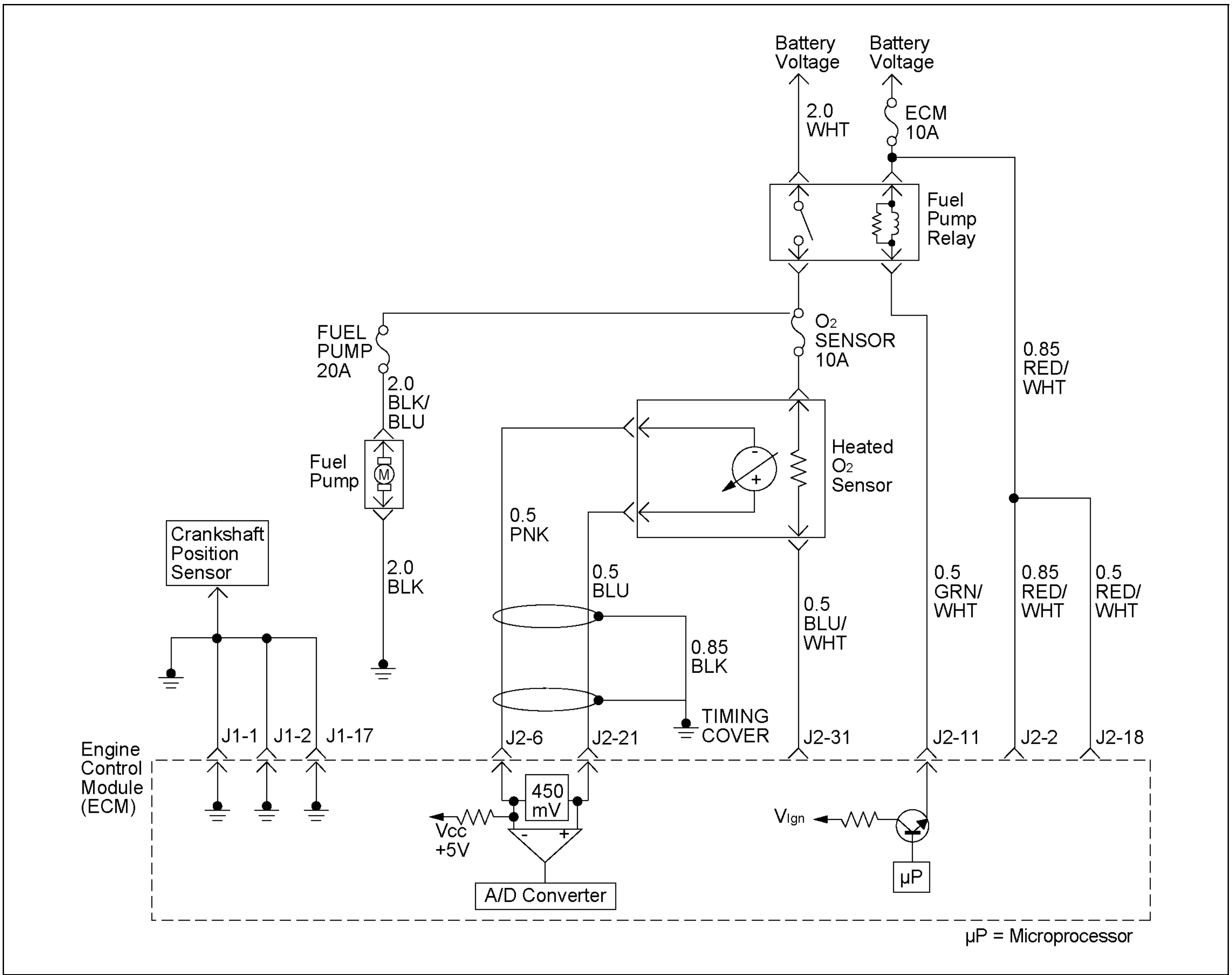


Step	Action	Value(s)	Yes	No
16	Replace the immobilizer control unit (if equipped). Is the action complete?	—	Verify repair	—
17	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobilizer control unit connector (if equipped) and ECM connector. 3. Ignition “On”. 4. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 18*	Repair faulty harness and verify repair
18	Using the DVM and check the VSS signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the immobilizer control unit connector (if equipped). 4. Check the circuit for open or shot to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobilizer control unit connector (if equipped) and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 21*
19	Substitute a known good VSS and recheck. Was the problem solved?	—	Go to *Step 20*	Go to *Step 21*

Step	Action	Value(s)	Yes	No
20	Replace the VSS. Was the problem solved?	—	Verify repair	Go to *Step 21*
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 22*
22	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0562 SYSTEM VOLTAGE LOW



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0562	D	System Voltage Low	Battery voltage is below 11V.	No fail-safe function.

Circuit Description

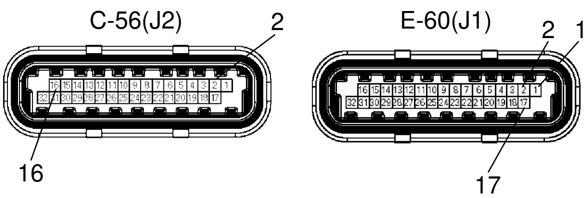
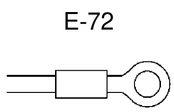
The engine control module (ECM) monitors the system voltage on the ignition feed terminal to the ECM. A system voltage Diagnostic Trouble Code will set whenever the voltage is below a calibrated value.

Diagnostic Aids

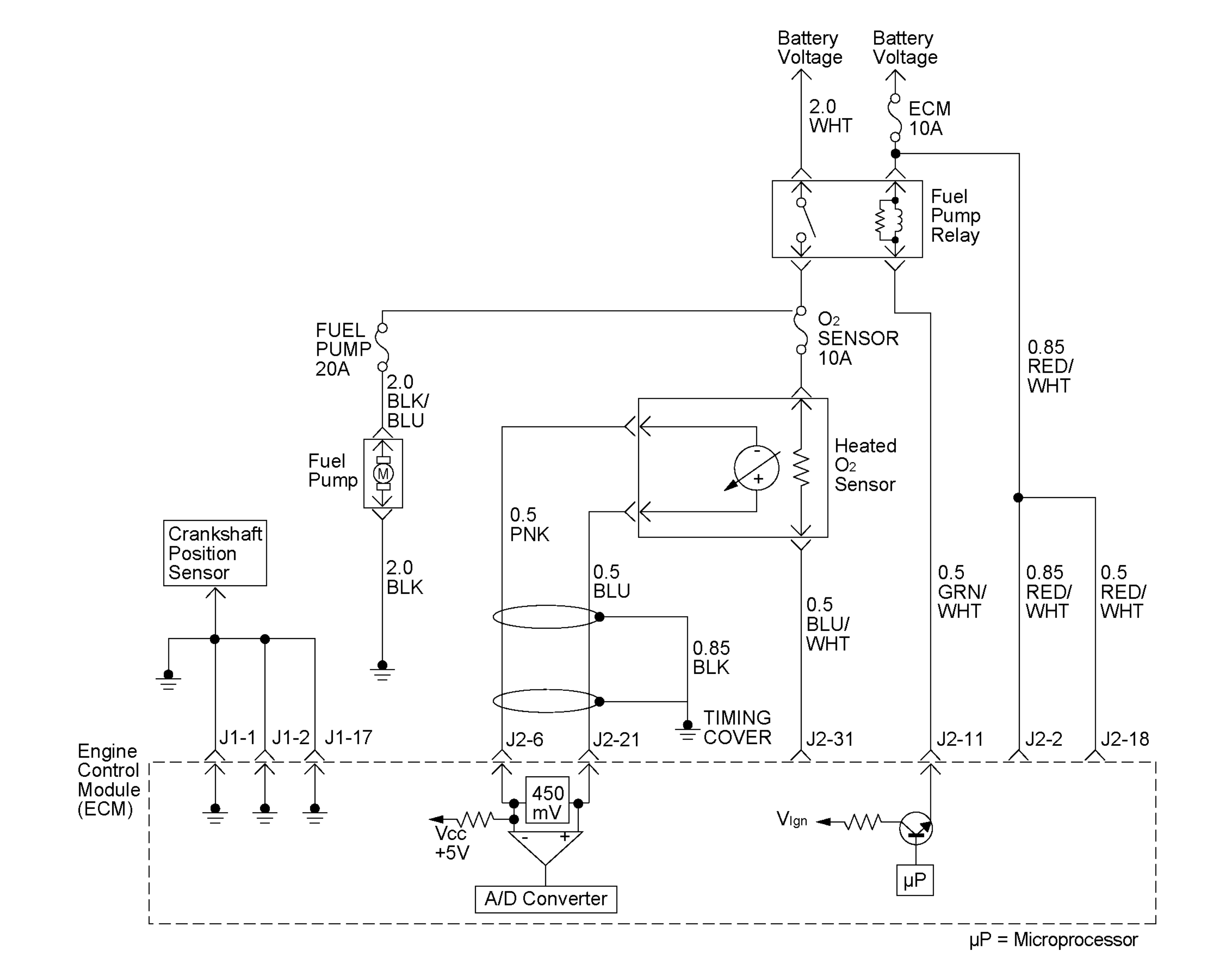
- If the Diagnostic Trouble Code sets when an accessory is operated, check for a poor connection or excessive current draw.
- Check for open circuits or shorts to ground on the ECM's battery or ignition inputs.

Diagnostic Trouble Code (DTC) P0562 System Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0562 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0562 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition “On” and engine “On”. 2. Monitor the “Ignition Voltage” in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate enough ignition voltage?	10 - 14.5V	Go to *Step 6*	Go to *Step 5*
5	Using the DVM and check the battery voltage at the battery terminal. Does the tester indicate enough battery voltage?	10 - 14.5V	Go to *Step 6*	Check the charging system, charge or replace the battery
6	Check for poor/faulty connection at the ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 7*
7	Check for poor/faulty connection of the ECM ground at the inlet manifold. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 8*
8	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 9*
9	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0563 SYSTEM VOLTAGE HIGH



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0563	A	System Voltage High	Battery voltage is above 16V.	No fail-safe function.

Circuit Description

The engine control module (ECM) monitors the system voltage on the ignition feed terminals to the ECM. A system voltage Diagnostic Trouble Code will set whenever the voltage is above a calibrated value.

Diagnostic Aids

Check for a faulty charging system components.

Diagnostic Trouble Code (DTC) P0563 System Voltage High

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*

Step	Action	Value(s)	Yes	No
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P0563 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P0563 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Ignition Voltage" in the data display. 3. Load the electrical system by turning on the headlights, etc.. Does the Tech 2 indicate correct ignition voltage?	Less than 16V	Go to *Step 5*	Check the charging system and Go to *Step 5*
5	Is the battery jamp start cable incorrectly connecting?	—	Verify procedure	Go to *Step 6*
6	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 7*
7	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0601 ECM MEMORY CHECKSUM

Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0601	A	ECM Memory Checksum	ECM memory area error.	Engine control disabled.

Circuit Description

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and powertrain diagnostics operation.
Unlike the PROM used in past applications, the EEPROM is not replaceable. When the ECM is replaced or a calibration update is required, the ECM must be programmed using a Tech 2.

Diagnostic Aids

- Diagnostic Trouble Code P0601 indicates that the contents of the EEPROM have changed since the ECM was programmed. The only possible repair is ECM reprogramming or replacement. Check service bulletins to program the replacement ECM with the correct software and calibration for the vehicle.

Diagnostic Trouble Code (DTC) P0601 ECM Memory Checksum

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0601 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0601 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 5*
5	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P0602 ECU PROGRAMMING ERROR

Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0602	-	ECU Programming Error	ECM memory area error.	Engine control disabled.

Circuit Description

The engine control module (ECM) used in this vehicle utilizes an electrically erasable programmable read-only memory (EEPROM). The EEPROM contains program information and the calibrations required for engine, transmission, and powertrain diagnostics operation.

Unlike the PROM used in past applications, the EEPROM is not replaceable. When the ECM is replaced or a calibration update is required, the ECM must be programmed using a Tech 2.

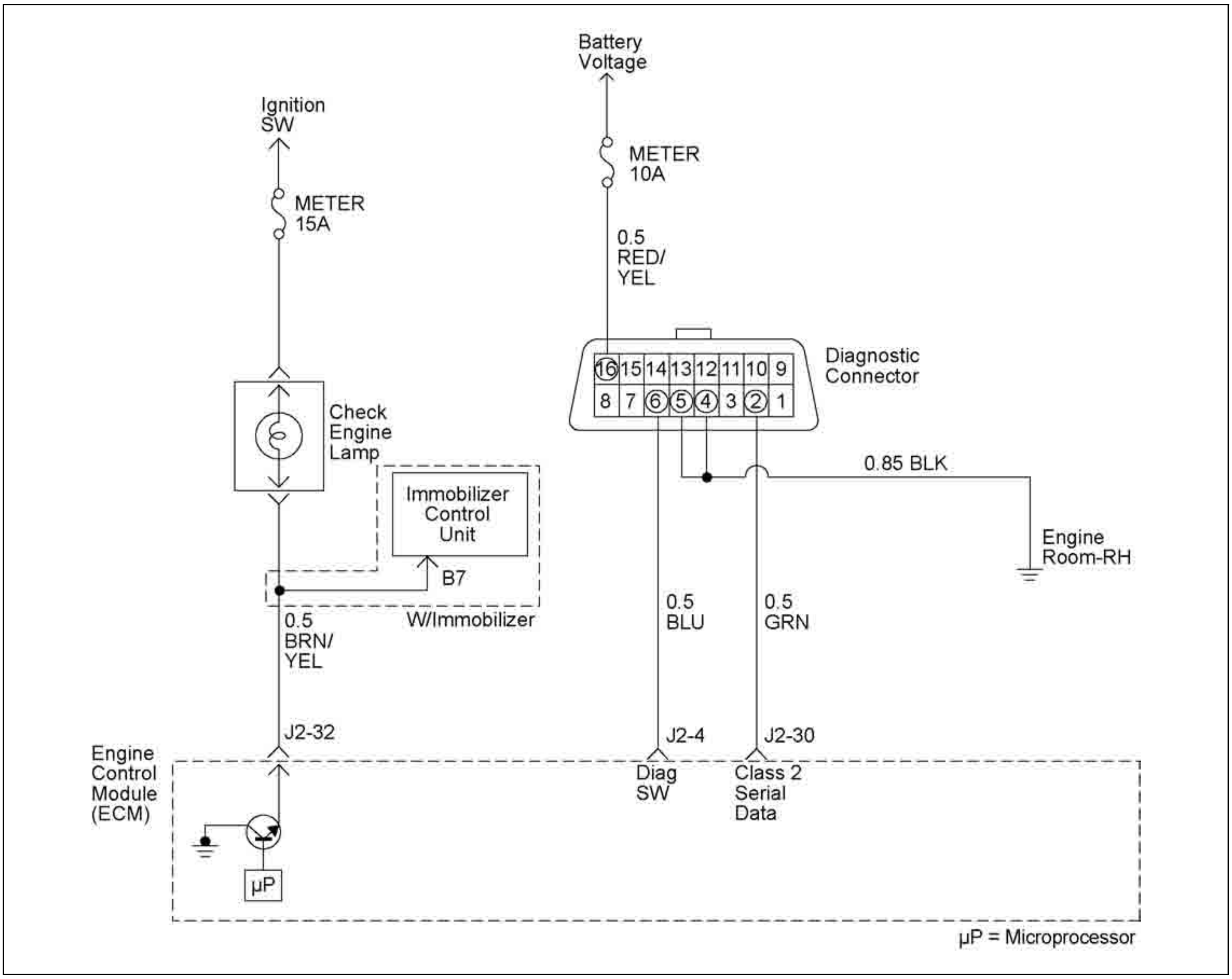
Diagnostic Aids

- Diagnostic Trouble Code P0602 indicates when non programmed ECM is used without service programming system (SPS). The replacement ECM must be programmed.

Diagnostic Trouble Code (DTC) P0602 ECU Programming Error

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0602 stored as “Present Failure”?	—	Go to Step 3	Refer to *Diagnostic Aids*
3	Download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Is the action complete?	—	Verify repair	—

DTC P0650 MALFUNCTION INDICATOR LAMP (MIL) CONTOROL CIRCUIT MALFUNCTION



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P0650	A	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	Check engine lamp circuit open, short to ground or short to voltage circuit.	No fail-safe function.

Circuit Description

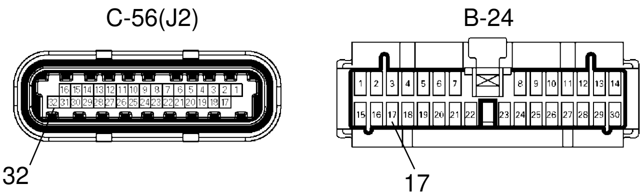
The check engine lamp should always be illuminated and steady with ignition “ON” and the engine stopped. Ignition feed voltage is supplied directly to the check engine lamp indicator. The Engine Control Module (ECM) turns the check engine lamp “ON” by grounding the check engine lamp driver circuit. The check engine lamp should not remain “ON” with the engine running and no DTC(s) set. A steady check engine lamp with the engine running and no DTC(s) suggests a short to ground in the check engine lamp driver circuit.

Diagnostic Aids

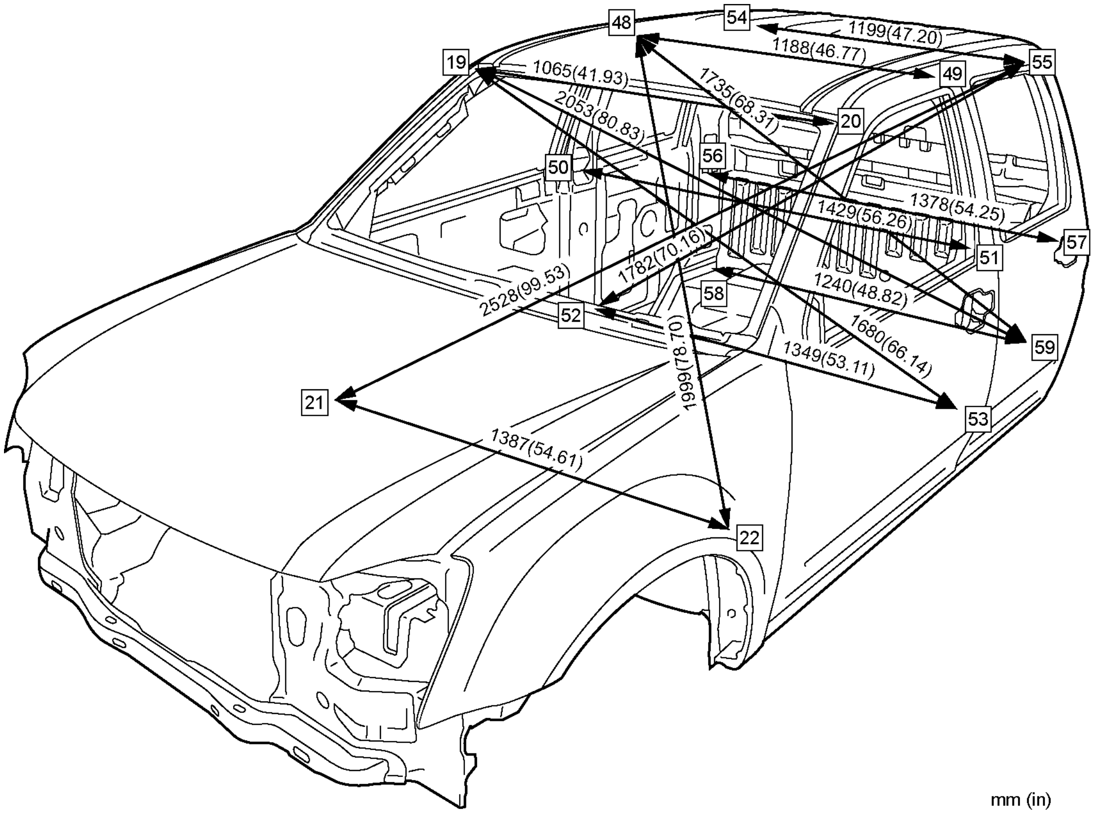
An intermittent may be caused by a poor connection, rubbed-through wire insulation, or a wire broken inside the insulation. Check for the following items:

- Poor connection or damaged harness - Inspect the ECM harness and connectors for improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.

Diagnostic Trouble Code (DTC) P0650
Malfunction Indicator Lamp (MIL) Control Circuit Malfunction

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P0650 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P0650 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Ignition “On”, engine “Off”. 2. Check the “Check Engine” lamp. Does the lamp turn “On”?	—	Go to *Step 5*	Go to *Step 6*
5	1. Ignition “On”, engine “Off”. 2. Check the “Check Engine” lamp. Does the lamp turn “Off”?	—	Go to *Step 9*	Go to *Step 7*
6	Check the “Check Engine” lamp bulb. If the bulb is burnt out, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 7*
7	Check for poor/faulty connection at the meter connector and ECM connector. If a poor/faulty connection is found, repair as necessary. Was the problem found? 	—	Verify repair	Go to *Step 8*

ROOM SECTION (CREW CAB)



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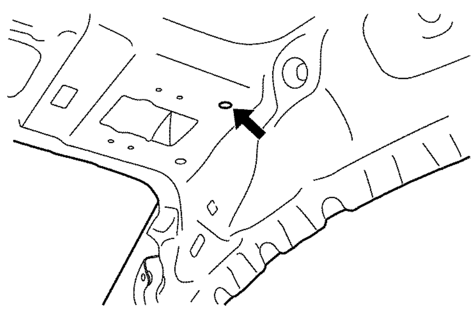

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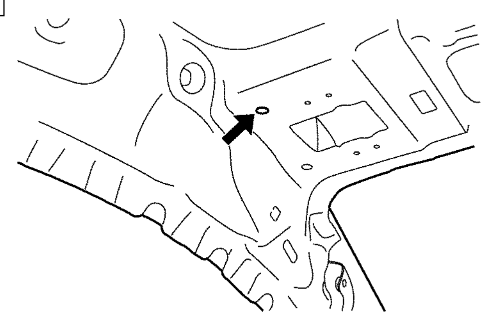

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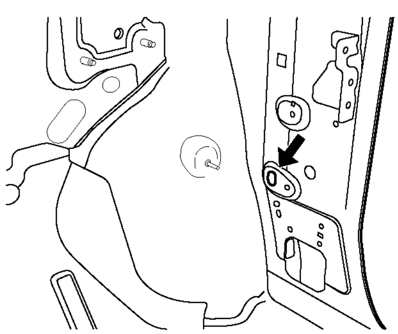

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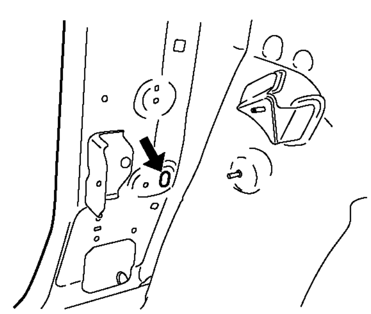
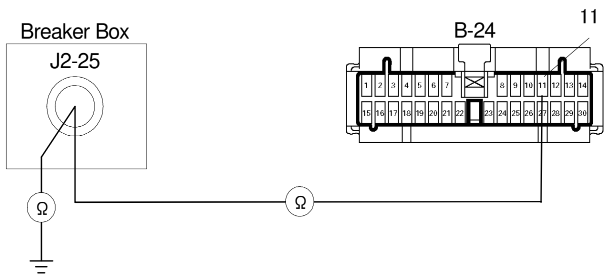
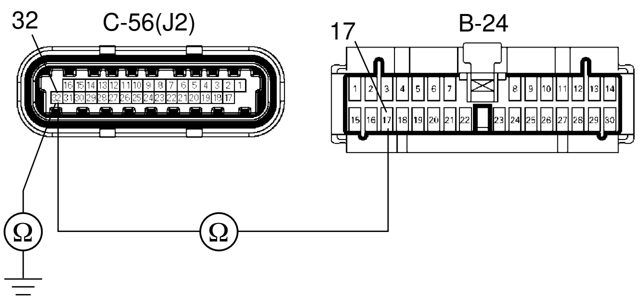
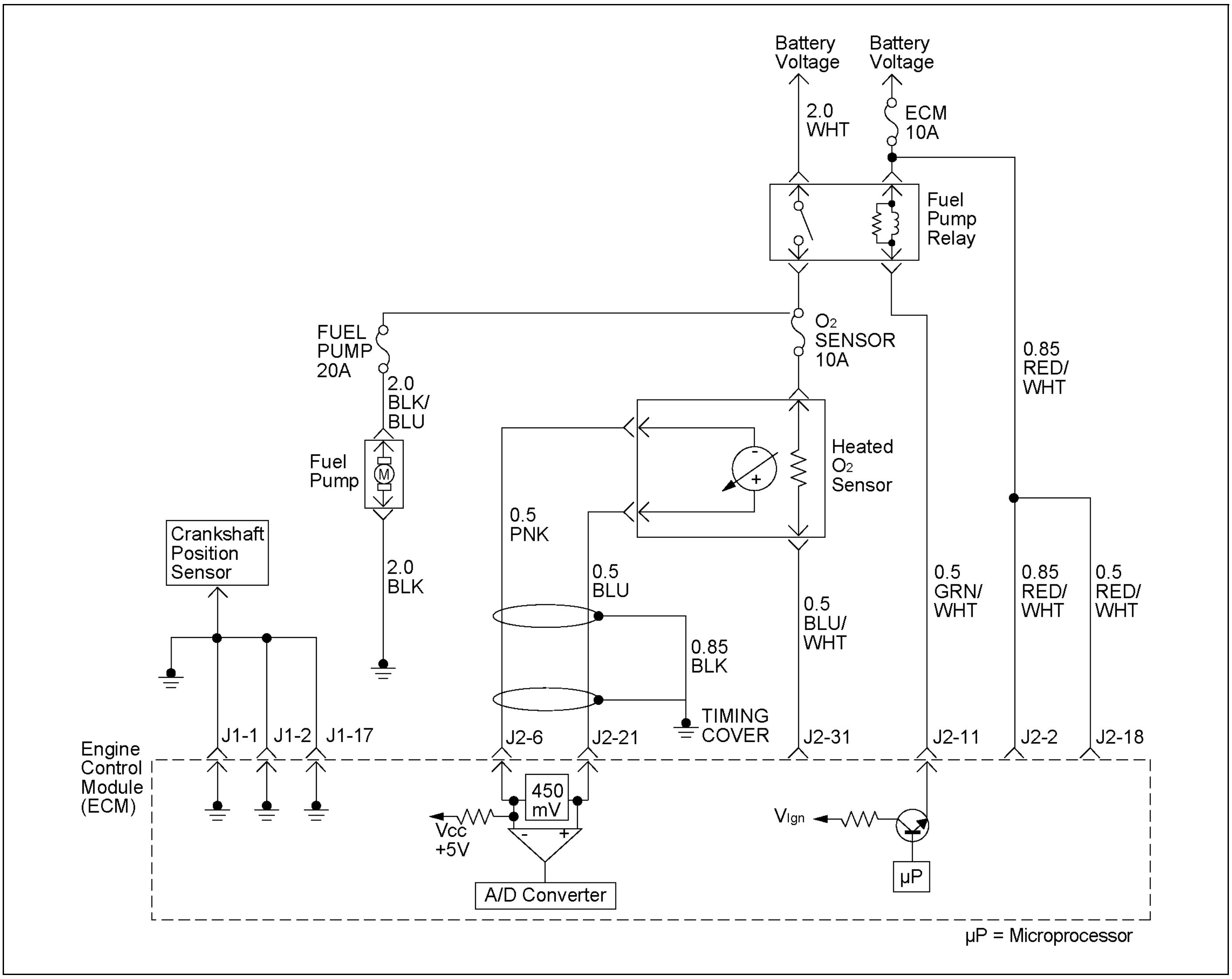


Step	Action	Value(s)	Yes	No
8	Using the DVM and check the “Check Engine” lamp circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Remove the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Remove the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 9*
9	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 10*
10	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1167 FUEL SUPPLY SYSTEM RICH DURING DECELERATION FUEL CUT OFF



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1167	D	Fuel Supply System Rich During Deceleration Fuel Cutoff	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. O_2 sensor bank 1 output voltage is more than 550mV in deceleration fuel cutoff mode.	No fail-safe function.

Circuit Description

The engine control module (ECM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during deceleration (fuel cut off). The ECM monitors the voltage of the oxygen sensor during fuel cut off. When a fuel cut off mode of operation is requested during “Closed Loop” operation (by deceleration), the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a “lean” condition (low oxygen sensor voltage). If this “lean” exhaust is not detected at this time, a Diagnostic Trouble Code P1167 will set.

Diagnostic Aids

Check the following items:

- Fuel pressure - The system will go rich if pressure is too high. The ECM can compensate for some increase. However, if fuel pressure is too high, a Diagnostic Trouble Code P1167 may be set. Refer to *Fuel System Diagnosis*.

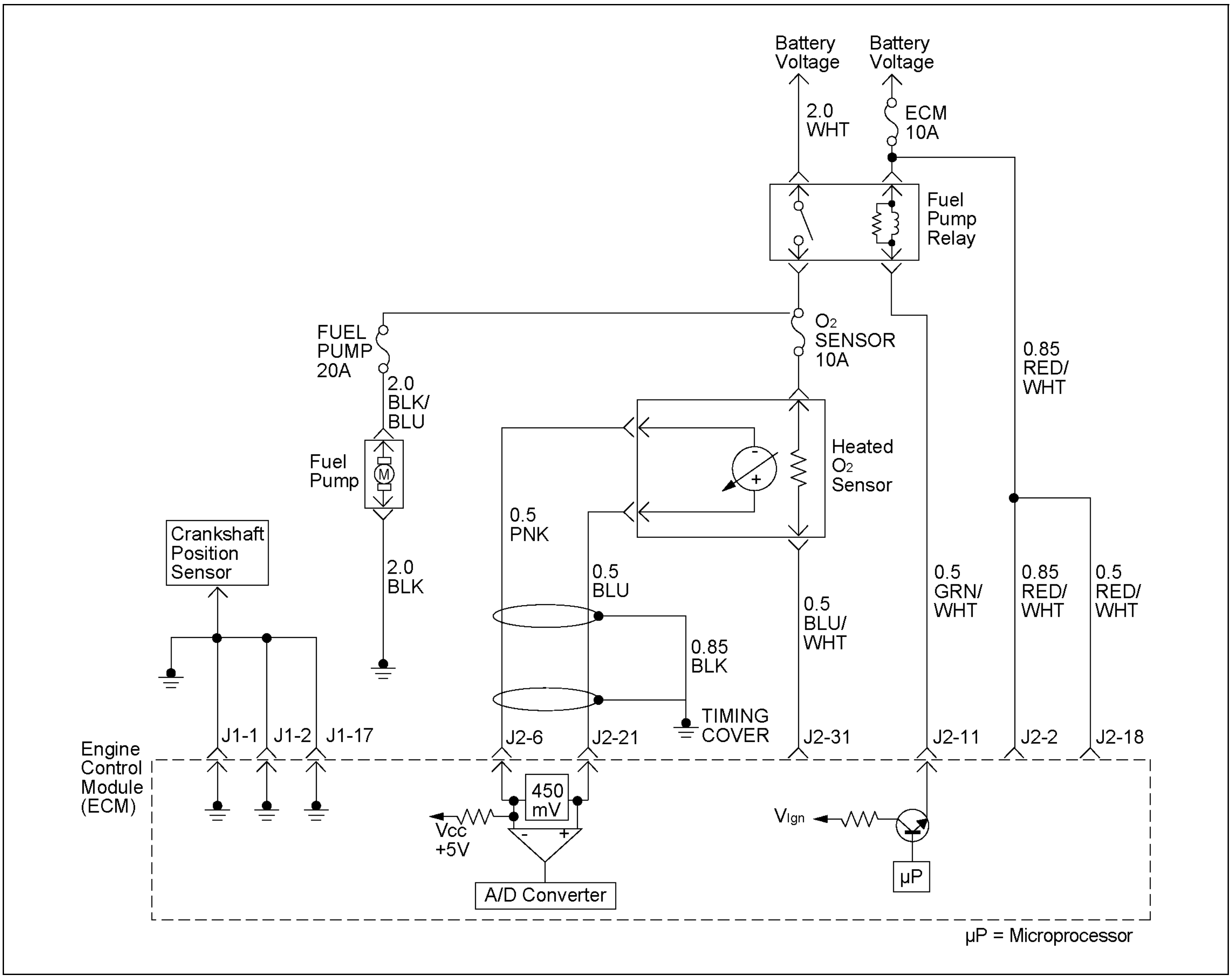
- Perform "Injector Balance Test" - Refer to *Fuel System Diagnosis*.
- Check the EVAP canister for fuel saturation - If full of fuel, check canister control and hoses. Refer to *Evaporative (EVAP) Emission Control System*.
- Check for a leak in the fuel pressure regulator diaphragm by checking the vacuum line to toe regulator for the presence of fuel.
- An intermittent TP sensor output will cause the system to go rich due to a false indication of the engine accelerating.
- Silicon contamination of the HO2S can also cause a high HO2S voltage to be indicated. This condition is indicated by a powdery white deposit on the portion of the HO2S exposed to the exhaust stream. If contamination is noticed, replace the affected HO2S.

Diagnostic Trouble Code (DTC) P1167
Fuel Supply System Rich During Deceleration Fuel Cutoff

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1167 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1167 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" in accordance with accelerator pedal operation?	—	Go to *Step 6*	Go to *Step 5*
5	Check for the following conditions. • Objects blocking the throttle valve. • Incorrectly installed. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 12*
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to *Step 8*	Go to *Step 7*
7	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 13*

Step	Action	Value(s)	Yes	No
8	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to *Step 10*	Go to *Step 9*
9	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 14*
10	Check for injector for the affected bank. Refer to *“Injector Coil Test & Injector Balance Test Procedure”* 6E-98 page. Was the injector operation correct?	—	Go to *Step 11*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
11	Check for fuel pressure. Refer to *“Fuel System Diagnosis”* 6E-108 page. Was the fuel pressure correct?	—	Go to *Step 15*	Refer to *Fuel System Diagnosis*
12	Replace the TPS. Is the action complete?	—	Verify repair	—
13	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
14	Replace the IAC valve. Is the action complete?	—	Verify repair	—
15	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1171 FUEL SUPPLY SYSTEM LEAN DURING POWER ENRICHMENT



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1171	D	Fuel Supply System Lean During Power Enrichment	1. No DTC relating to MAP sensor, TPS, EVAP purge, ECT sensor, CKP sensor, VSS, injector control circuit and ignition control circuit. 2. Engine coolant temperature is more than 60 deg. C. 3. Mass air flow is below 13.5m/s. 4. O_2 sensor bank 1 output voltage is below 350mV in power enrichment mode.	No fail-safe function.

Circuit Description

The engine control module (ECM) internal circuitry can identify if the vehicle fuel system is capable of supplying adequate amounts of fuel during heavy acceleration (power enrichment). The ECM monitors the voltage of the oxygen sensor during power enrichment. When a power enrichment mode of operation is requested during “Closed Loop” operation (by heavy acceleration), the ECM will provide more fuel to the engine. Under these conditions the ECM should detect a “rich” condition (high oxygen sensor voltage). If this “rich” exhaust is not detected at this time, a Diagnostic Trouble Code P1171 will set. A plugged fuel filter or restricted fuel line can prevent adequate amounts of fuel from being supplied during power enrichment mode.

Diagnostic Aids

Check for the following conditions:

- Heated oxygen sensor wiring - The sensor pigtail may be routed incorrectly and contacting the exhaust system.
- Poor ECM to engine block ground.
- Fuel pressure - The system will go lean if pressure is too low. The ECM can compensate for some decrease. However, if fuel pressure is too low, a diagnostic Trouble Code P1171 may be set. Refer to *Fuel System Diagnosis*.
- Lean injector(s) - Perform "Injector Balance Test."
- Vacuum leaks - Check for disconnected or damaged vacuum hoses and for vacuum leaks at the intake manifold, throttle body, and PCV system.
- Exhaust leaks - An exhaust leak may cause outside air to be pulled into the exhaust gas stream past the HO2S, causing the system to appear lean. Check for exhaust leaks that may cause a false lean condition to be indicated.
- Fuel contamination - Water, even in small amounts, can be delivered to the fuel injectors. The water can cause a lean exhaust to be indicated, Excessive alcohol in the fuel can also cause this condition. Refer to *Fuel System Diagnosis* for the procedure to check for fuel contamination.

Diagnostic Trouble Code (DTC) P1171
Fuel Supply System Lean During Power Enrichment

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1171 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1171 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Monitor the "Throttle Position" in the data display. Does the Tech 2 indicate correct "Throttle Position" in accordance with accelerator pedal operation?	—	Go to *Step 6*	Go to *Step 5*
5	Check for the following conditions. • Objects blocking the throttle valve. • Incorrectly installed. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 12*
6	1. Using the Tech 2, ignition "On" and engine "On". 2. Monitor the "Manifold Absolute Pressure" in the data display. Does the Tech 2 indicate correct "Manifold Absolute Pressure" in accordance with engine speed or acceleration?	—	Go to *Step 8*	Go to *Step 7*

Step	Action	Value(s)	Yes	No
7	Remove the MAP sensor and check for the following conditions. • Objects blocking the air cleaner. • Objects blocking the MAP sensor. • Objects blocking the throttle valve. • Vacuum leaking at intake duct. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 13*
8	1. Using the Tech 2, ignition “On” and engine “On”. 2. Select the “Miscellaneous Test” and perform the “IAC Control” in the “IAC System”. 3. Operate the Tech 2 in accordance with procedure. Was the engine speed changed, when the IAC valve is operating step by step?	—	Go to *Step 10*	Go to *Step 9*
9	Check for the following conditions. • Objects blocking the IAC valve. • Objects blocking the throttle valve. • Vacuum leaking at throttle body. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 14*
10	Check for injector for the affected bank. Refer to *“Injector Coil Test & Injector Balance Test Procedure”* 6E-98 page. Was the injector operation correct?	—	Go to *Step 11*	Refer to *Injector Coil Test & Injector Balance Test Procedure*
11	Check for fuel pressure. Refer to *“Fuel System Diagnosis”* 6E-108 page. Was the fuel pressure correct?	—	Go to *Step 15*	Refer to *Fuel System Diagnosis*
12	Replace the TPS. Is the action complete?	—	Verify repair	—
13	Replace the MAP sensor. Is the action complete?	—	Verify repair	—
14	Replace the IAC valve. Is the action complete?	—	Verify repair	—
15	Replace the O_2 sensor. Was the problem solved?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1625 ECM SYSTEM RESET

Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1625	B	ECM System Reset	ECM reset has occurred other than “On”.	Engine control disabled.

Circuit Description

The engine control module (ECM) monitors unexpected ECM reset. This will not turn on MIL light on, only records code DTC P1625.

Diagnostic Aids

Check for the follwing conditions:

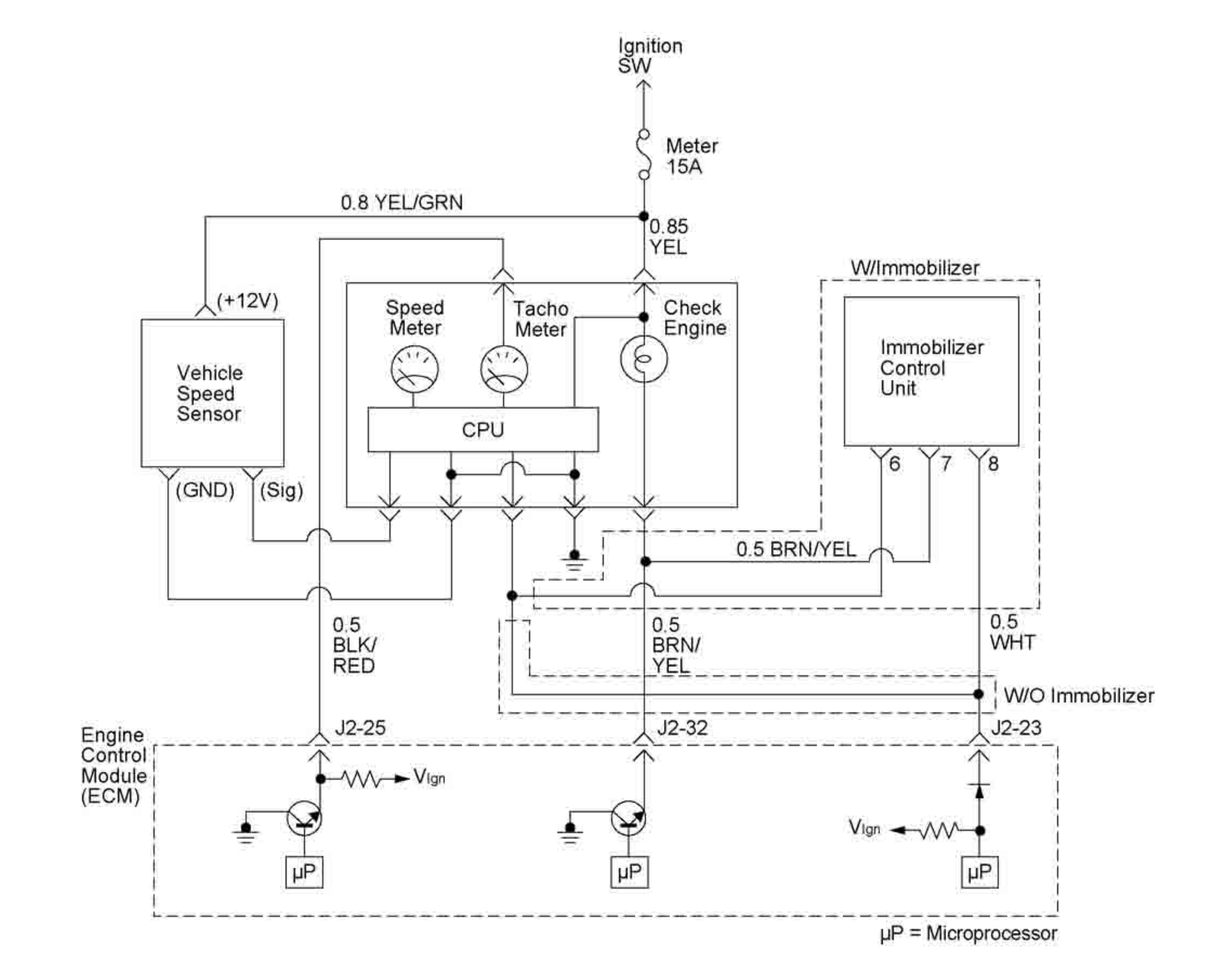
- P1625 alone stored does not need diagnosis. Clear DTC code.

NOTE: DTC P1625 is a DTC to record a ECM reset history. If DTC P1625 is not reset and no engine abnormality occurs after learing the DTC, no farther diagnostic procedures are required.

Diagnostic Trouble Code (DTC) P1625 ECM System Reset

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P1625 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P1625 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Is the Immobilizer function programmed in the ECM?	—	Verify repair	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1626 IMMOBILIZER NO SIGNAL



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1626	-	Immobilizer No Signal	No response from immobilizer control unit.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

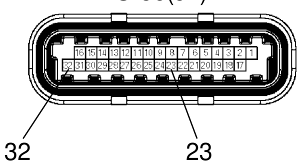
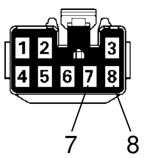
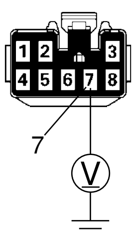
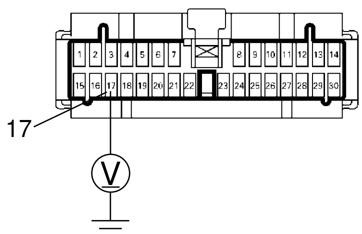
The ECM decides whether that is an abnomality in the immobilizer control system. DTC P1626 is recorded by the ECM when no response from immobiliser.

Diagnostic Aids

Check for the following conditions:

- Poor connection at ECM and Immobilizer-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobilizer, turn the ignition “ON” and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobilizer harnass connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1626 Immobilizer No Signal

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P1626 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P1626 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Select “Immobilizer” in the system selection menu “Body”. 3. Select “Read DTC Info Ordered By Priority” in the “Diagnositic Trouble Code”. Was the DTC B0007 stored in this ignition cycle?	—	Refer to *“Immobilizer Workshop Manual” & Go to DTC Chart B0007*	Go to *Step 5*
5	Check for poor/faulty connection at the immobilizer control unit connector or ECM connector. If a poor/ faulty connection is found, repair as necessary. Was the problem found? C-56(J2)  B-68 	—	Verify repair	Go to *Step 6*
6	Using the DVM and check the “CHECK ENGINE” lamp circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the meter connector and immobilizer control unit connector. 3. Ignition “On”. 4. Check the circuit for short to power supply circuit. Was the problem found? B-68  B-24 	—	Repair faulty harness and verify repair	Go to *Step 7*

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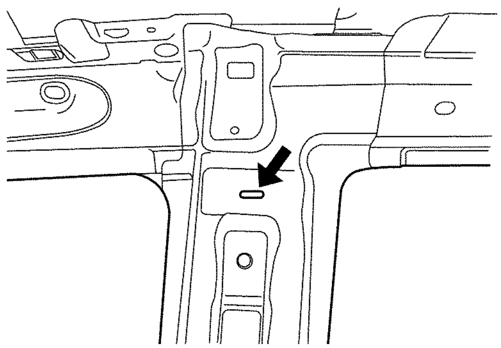

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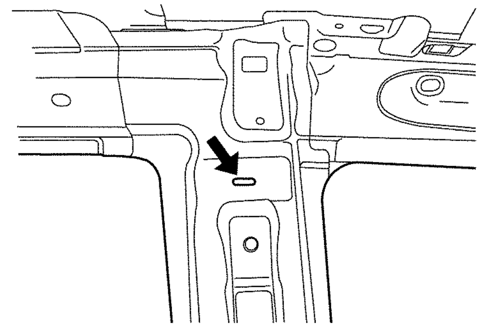

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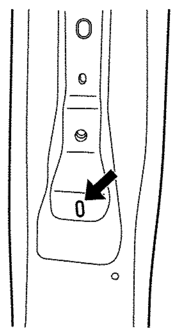

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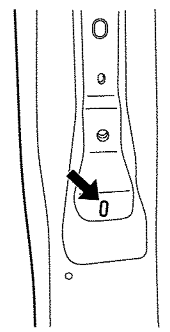

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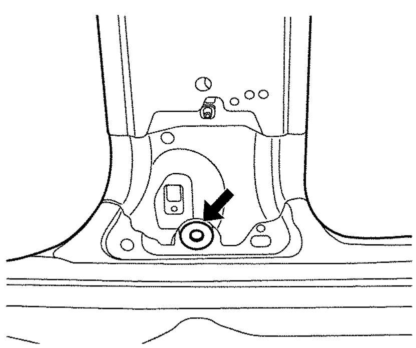

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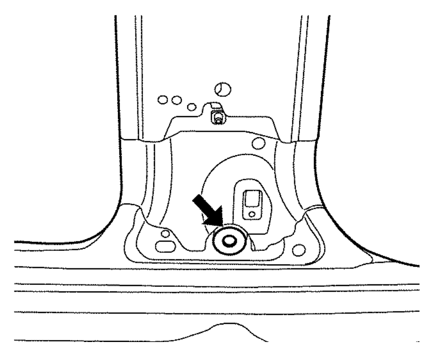

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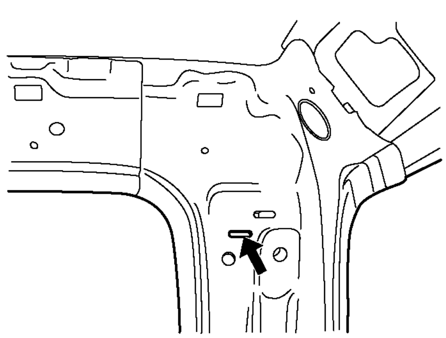

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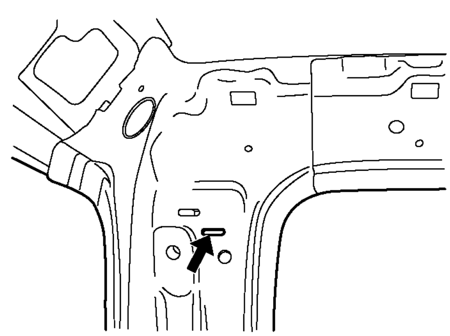
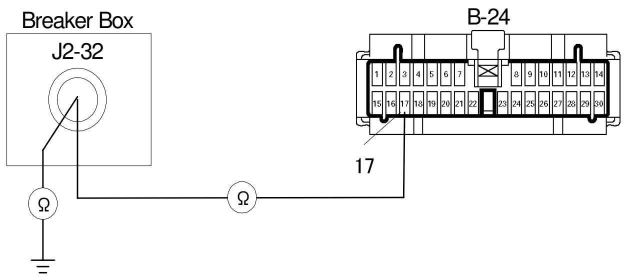
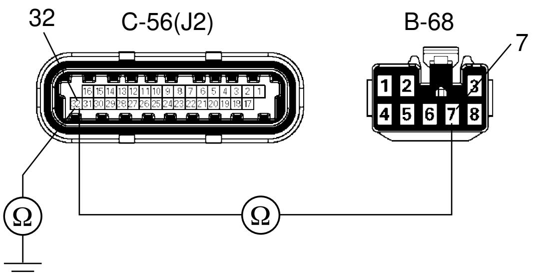
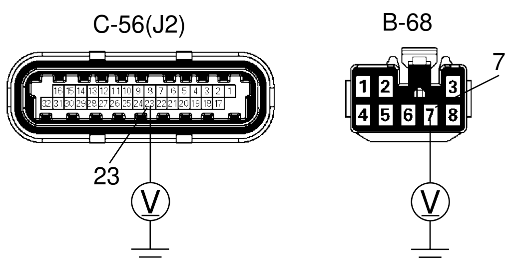
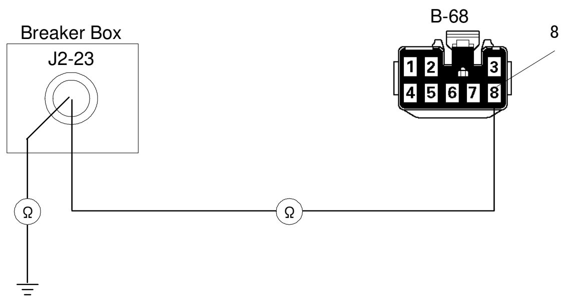
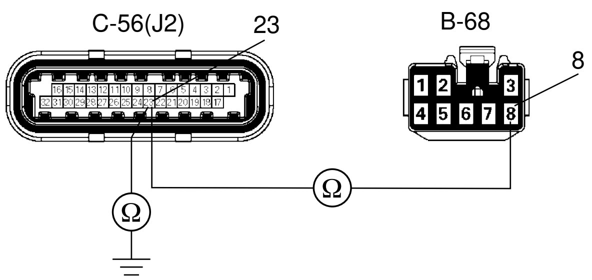
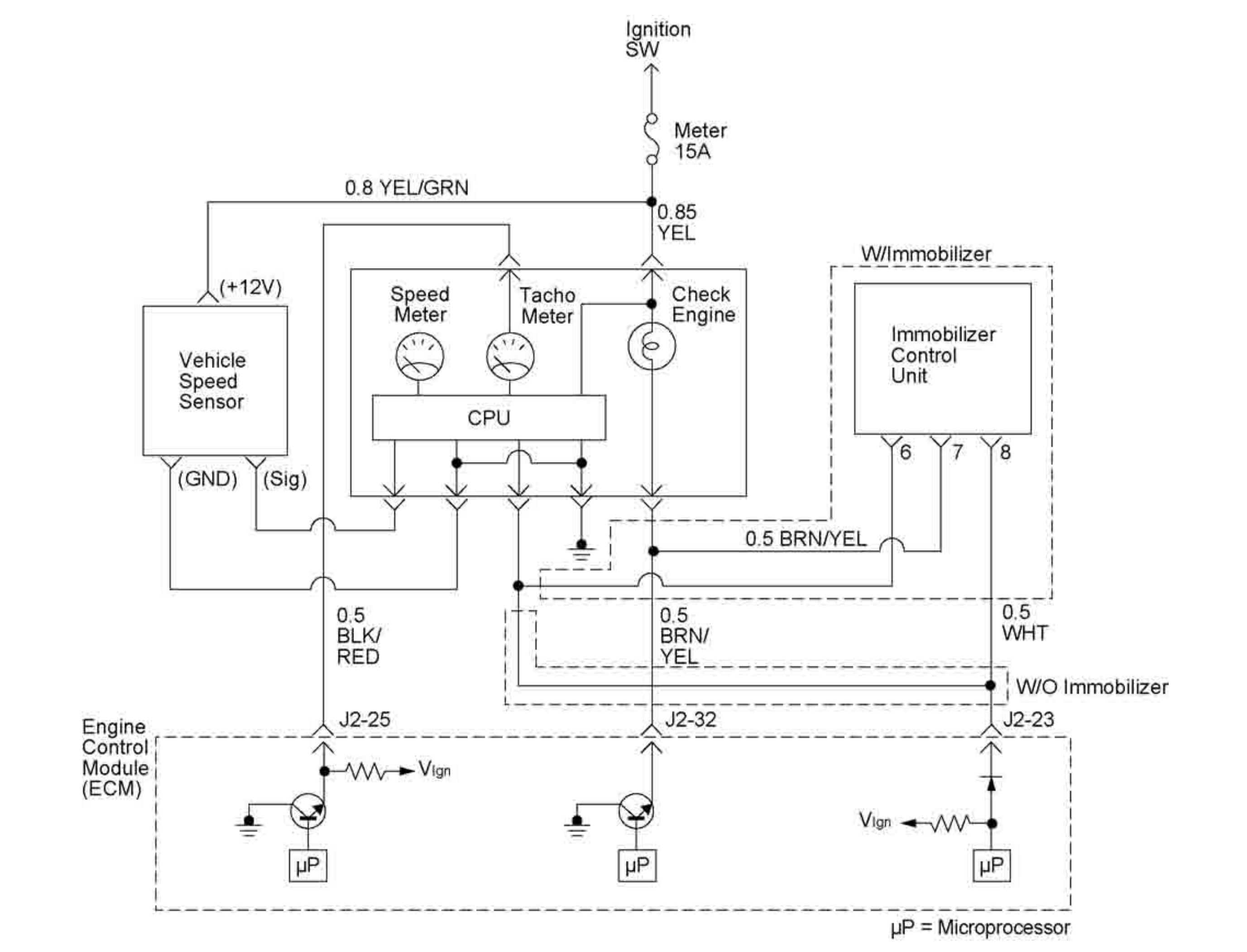


Step	Action	Value(s)	Yes	No
7	Using the DVM and check the “CHECK ENGINE” lamp circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the immobilizer control unit connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the the immobilizer control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 8*
8	Using the DVM and check the VSS signal circuit. 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobilizer control unit connector and ECM connector. 3. Ignition “On”. 4. Check the circuit for short to power supply circuit. Was the problem found?  	—	Repair faulty harness and verify repair	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	Using the DVM and check the VSS signal circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the immobilizer control unit connector. 4. Checkthecircuitforopenorshottogroundcircuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the immobilizer control unit connector and ECM connector. 3. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Srtep 10*
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1631
IMMOBILIZER WRONG SIGNAL



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1631	-	Immobilizer Wrong Signal	Received response is not correct.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnomality in the immobilizer control system. DTC P1631 is recorded by the ECM when received response was not correct.

Diagnostic Aids

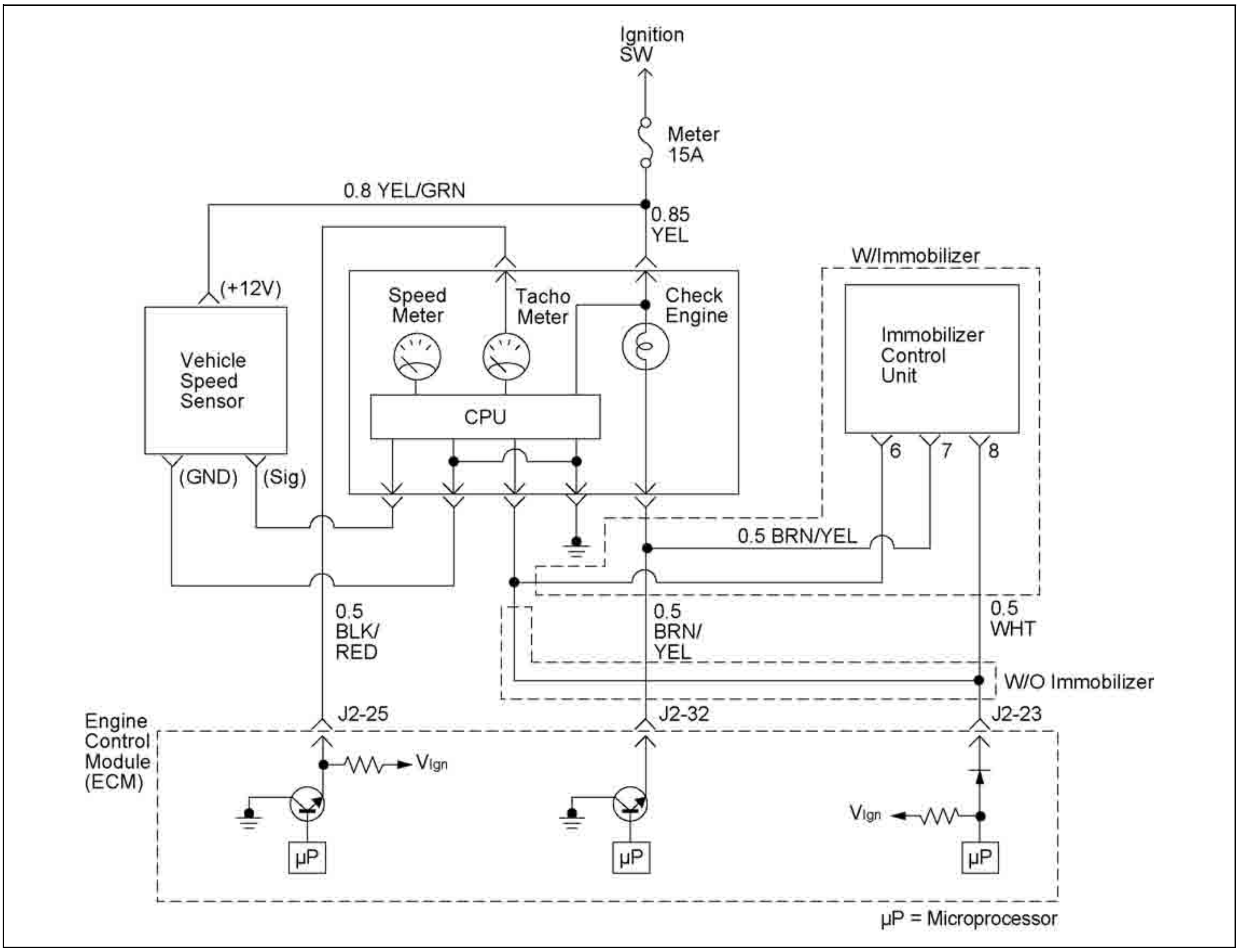
Check for the following conditions:

- Poor connection at ECM and Immobilizer-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobilizer, turn the ignition “ON” and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobilizer harnass connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1631 Immobilizer Wrong Signal

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select "F0: Read DTC Infor By Priority" in "F0: Diagnostic Trouble Code". Is the DTC P1631 stored as "Present Failure"?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition "On" and engine "Off". 2. Select "Clear DTC Information" with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the "F5: Failed This Ignition" in "F2: DTC Information". Was the DTC P1631 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition "On" and engine "Off". 2. Select "Immobilizer" in the system selection menu "Body". 3. Select "Read DTC Info Ordered By Priority" in the "Diagnositic Trouble Code". Was the DTC B0007 stored in this ignition cycle?	—	Refer to *"Immobilizer Workshop Manual" & Go to DTC Chart B0007*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1648
WRONG SECURITY CODE ENTERED



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1648	-	Wrong Security Code Entered	Received incorrect security code.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnomality in the immobilizer control system. DTC P1648 is recorded by the ECM when received incorrect security code.

Diagnostic Aids

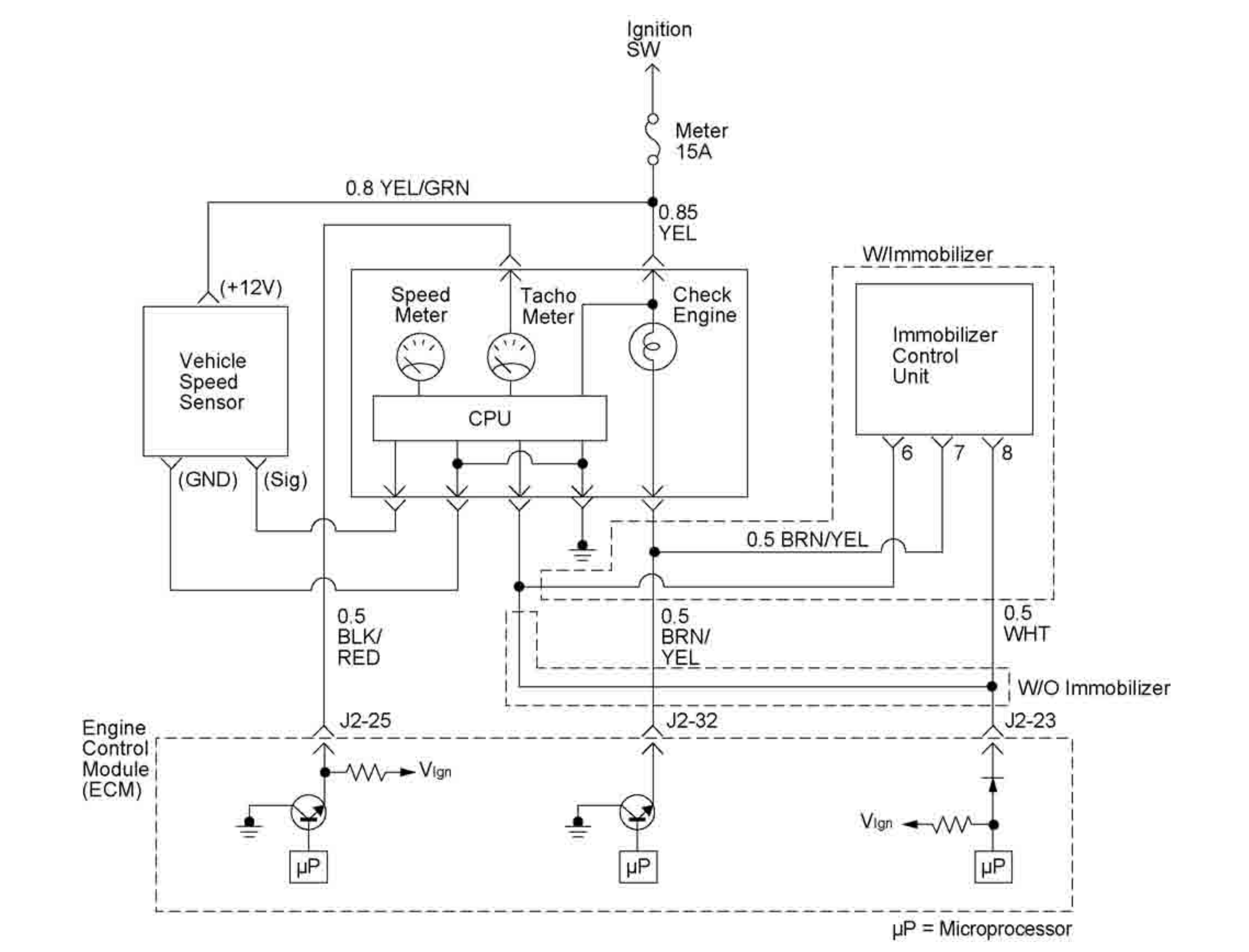
Check for the following conditions:

- Poor connection at ECM and Immobilizer-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobilizer, turn the ignition "ON" and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobilizer harnass connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1648 Wrong Security Code Entered

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P1648 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P1648 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Select “Immobilizer” in the system selection menu “Body”. 3. Select “Read DTC Info Ordered By Priority” in the “Diagnositic Trouble Code”. Was the DTC B0007 stored in this ignition cycle?	—	Refer to *“Immobilizer Workshop Manual” & Go to DTC Chart B0007*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1649 IMMOBILIZER FUNCTION NOT PROGRAMMED



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1649	-	Immobilizer Function Not Programmed	Immobilizer function is not programmed in the ECM.	1. Engine does not start. 2. Check engine lamp flash.

Circuit Description

The ECM decides whether that is an abnomality in the immobilizer control system. DTC P1649 is recorded by the ECM when security code & secret key not programmed.

Diagnostic Aids

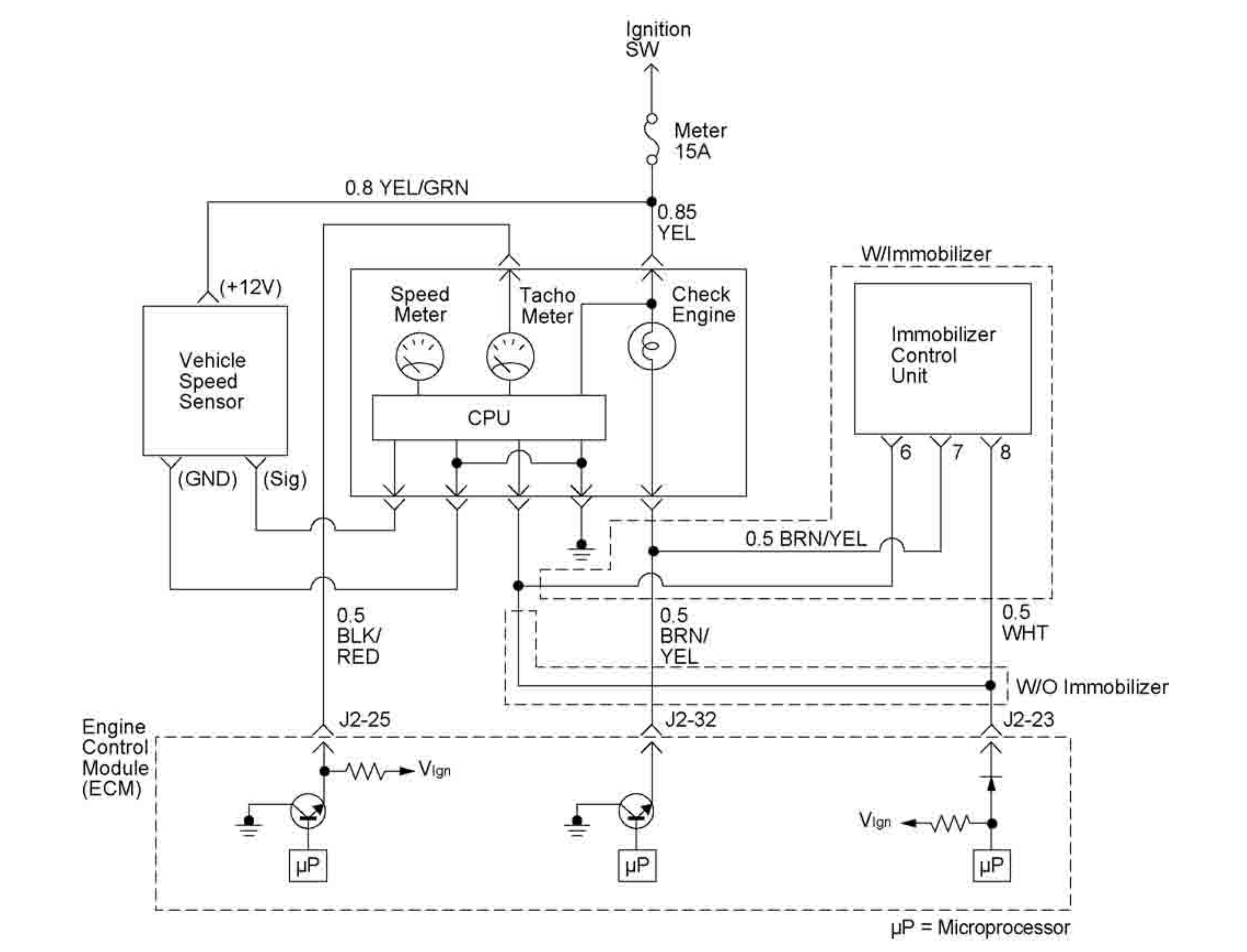
Check for the following conditions:

- Poor connection at ECM and Immobilizer-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness Inspect the wiring harness for damage, If the harness appears to be OK, disconnect the ECM and Immobilizer, turn the ignition “ON” and observe a voltmeter connected to the suspect driver circuit at the ECM and Immobilizer harnass connector while moving connectors and wiring harnesses relates to the MIL. A change in voltage will indicate the location of the fault.

Diagnostic Trouble Code (DTC) P1649 Immobilizer Function Not Programmed

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P1649 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P1649 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	1. Using the Tech 2, ignition “On” and engine “Off”. 2. Select “Immobilizer” in the system selection menu “Body”. 3. Select “Read DTC Info Ordered By Priority” in the “Diagnositic Trouble Code”. Were the any DTC's B0002 or B0009 stored in this ignition cycle?	—	Refer to *“Immobilizer Workshop Manual” & Go to DTC Chart B0002 or B0009*	Go to *Step 5*
5	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 6*
6	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

DIAGNOSTIC TROUBLE CODE (DTC) P1693 TACHOMETER OUTPUT LOW VOLTAGE



Condition for setting the DTC and action taken when the DTC sets

Code	Type	DTC Name	DTC Setting Condition	Fail-Safe (Back Up)
P1693	B	Tachometer Output Low Voltage	Tacho output circuit short to ground circuit.	No fail-safe function.

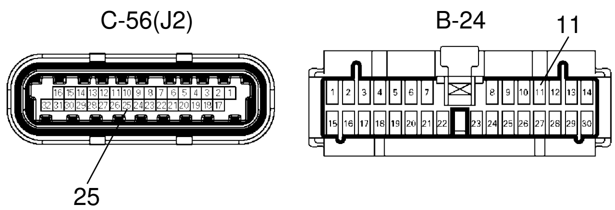
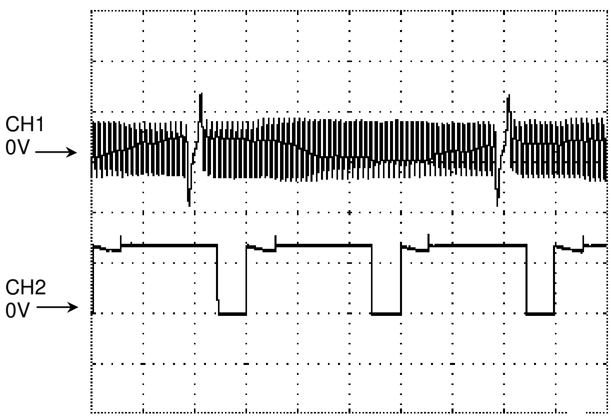
Circuit Description

Based on the information from the Crank Position Sensor (CKP), X58 reference signal is generated at each rotation of the crankshaft.
Engine Control Module (ECM) converts X58 reference signal into the square wave signal which is used to drive the pulse generator of the tachometer.
When the wave length of the output signal is long, the tacho meter indicates the engine speed is low, and vise versa.
This malfunction detects a low impedance short to ground or open contact on the Tacho output, the Diagnostic Trouble Code P1693 will be set.

Diagnostic Aids

- Poor connections or a damaged harness - Inspect the harness connections for: backed out terminals, imprope, mating or damaged terminals. Also check for open circuit, short to ground, and short to voltage.
- This malfunction detects a low impedance short to ground or open contact on the ECM out put circuit.

Diagnostic Trouble Code (DTC) P1693 Tachometer Output Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the “On-Board Diagnostic (OBD) System Check” performed?	—	Go to *Step 2*	Go to *On Board Diagnostic (OBD) System Check*
2	1. Connect the Tech 2. 2. Review and record the failure information. 3. Select “F0: Read DTC Infor By Priority” in “F0: Diagnostic Trouble Code”. Is the DTC P1693 stored as “Present Failure”?	—	Go to *Step 3*	Refer to *Diagnostic Aids* and Go to *Step 3*
3	1. Using the Tech2, ignition “On” and engine “Off”. 2. Select “Clear DTC Information” with the Tech2 and clear the DTC information. 3. Operate the vehicle and monitor the “F5: Failed This Ignition” in “F2: DTC Information”. Was the DTC P1693 stored in this ignition cycle?	—	Go to *Step 4*	Refer to *Diagnostic Aids* and Go to *Step 4*
4	Check for poor/faulty connection at the ECM or meter connector. If a poor/faulty connection is found, repair the faulty terminal. Was the problem found?  	—	Verify repair	Go to *Step 5*
5	If a oscilloscope is available, monitor the Tachometer output signal. Does the oscilloscope indicate correct wave form? Crankshaft Position (CKP) Sensor & Tacho Output Signal Reference Wave Form  Measurement Terminal: CH1: J1-21(+) / CH2: J2-25(+) GND(-) Measurement Scale: CH1: 2V/div / CH2: 10V/div 5ms/div Measurement Condition: Approximately 2000rpm	—	Go to *Step 10*	Not available: Go to *Step 6* Fixed at low: Go to *Step 6* Fixed at High: Go to *Step 7*

I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading or × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
STEERING																				
Power steering fluid	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Steering system for looseness or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Power steering hose	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	R	-	I	-	I
Steering wheel play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Right and left turning radius	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Wheel alignment	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Joint ball for oil leakage or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Joint ball rubber boot for damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
SERVICE BRAKES																				
Brake fluid	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Brake system for fluid leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Brake function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Front disc brake pads and discs wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Rear brake lining and drum wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Brake pedal travel and play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Pipes and hoses for loose connections or damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
PARKING BRAKE																				
Parking brake function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Parking brake lever travel	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Cables for looseness or damage and guide for damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ratchet for wear or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
SUSPENSION																				
Leaf/Coil/Torsion bar springs for damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Mount for looseness or damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorbers for oil leakage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorbers mount for looseness	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Rubber bushes of suspension wear or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Spring action for loss of balance due to weakening	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Joint ball rubber boot for damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
WHEELS																				
Wheel nuts	T	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T
Wheel disc for damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Front hub bearing grease	-	-	-	-	-	R	-	-	-	-	-	R	-	-	-	-	-	R	-	-
Front and rear hub bearings for looseness	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire pressure and damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire rotation	Rotate as required																			
OTHERS																				
Bolts and nuts on chassis and body	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Lube front free - wheeling hubs	-	-	-	-	-	L	-	-	-	-	-	L	-	-	-	-	-	L	-	-

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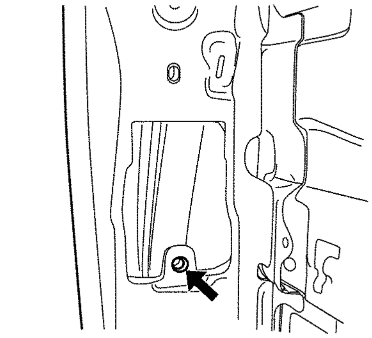

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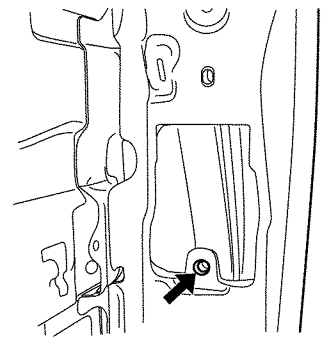

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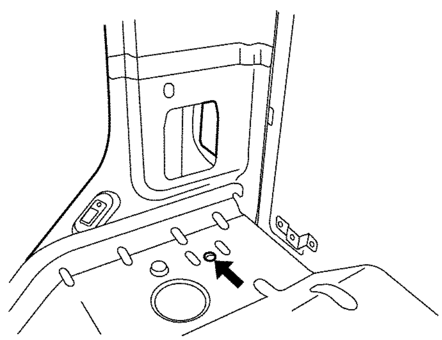

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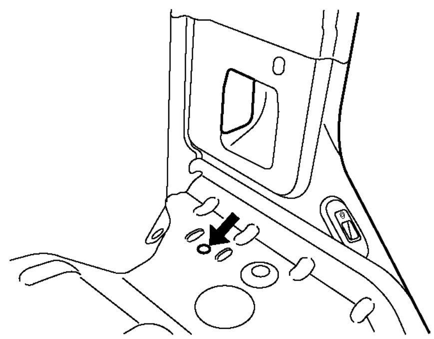
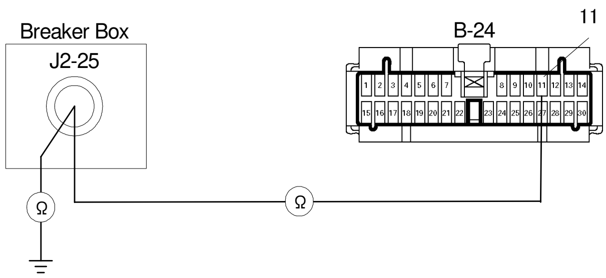
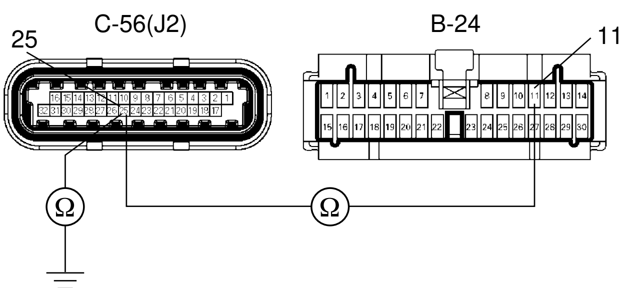
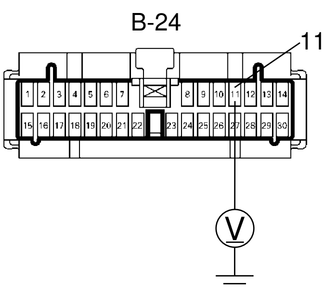


Step	Action	Value(s)	Yes	No
6	Using the DVM and check the Tacho output circuit. **Breaker box is available:** 1. Ignition “Off”, engine “Off”. 2. Install the breaker box as type A. (ECM disconnected) Refer to 6E-88 page. 3. Disconnect the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found?  **Breaker box is not available:** 1. Ignition “Off”, engine “Off”. 2. Disconnect the ECM connector. 3. Disconnect the meter connector. 4. Check the circuit for open or short to ground circuit. Was the problem found? 	—	Repair faulty harness and verify repair	Go to *Step 7*
7	Using the DVM and check the Tacho output circuit. 1. Ignition “On”, engine “Off”. 2. Disconnect the meter connector. 3. Check the circuit for short to power supply circuit. Was the DVM indicated specified value? 	Less than 1V	Go to *Step 8*	Repair faulty harness and verify repair
8	Check any accessory parts which may cause electric interference or magnetic interference. Was the problem found?	—	Remove the accessory parts and verify repair	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	Replace the Tacho meter. Was the problem solved?	—	Verify repair	Go to *Step 10*
10	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 11*
11	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

SYMPTOM DIAGNOSIS

PRELIMINARY CHECKS

Before using this section, perform the "On-Board Diagnostic (OBD) System Check" and verify all of the following items:

- The engine control module (ECM) and malfunction indicator lamp (MIL = Check Engine Lamp) are operating correctly.
- There are no Diagnostic Trouble Code(s) stored.
- Tech 2 data is within normal operating range. Refer to Typical Scan Data Values.
- Verify the customer complaint and locate the correct symptom in the table of contents. Perform the procedure included in the symptom chart.

VISUAL/PHYSICAL CHECK

Several of the symptom procedures call for a careful visual/physical check. This can lead to correcting a problem without further checks and can save valuable time. This check should include the following items:

- ECM grounds for cleanliness, tightness and proper location.
- Vacuum hoses for splits, kinks, and proper connection, shown on the "Emission Control System Schematics". Check thoroughly for any type of leak or restriction.
- Air intake ducts for collapsed or damaged areas.
- Air leaks at throttle body mounting area, manifold absolute pressure (MAP) sensor and intake manifold sealing surfaces.
- Ignition wires for cracking, harness, and carbon tracking.
- Wiring for proper connections, pinches and cuts.

INTERMITTENT

Important: An intermittent problem may or may not turn on the malfunction indicator lamp (MIL) or store a Diagnostic Trouble Code. Do NOT use the Diagnostic Trouble Code (DTC) charts for intermittent problems.
The fault must be present to locate the problem.
Most intermittent problems are cased by faulty electrical connections or wiring. Perform a careful visual/physical check for the following conditions.

- Poor mating of the connector halves or a terminal not fully seated in the connector (backed out).
- Improperly formed or damaged terminal.
- All connector terminals in the problem circuit should be carefully checked for proper contact tension.
- Poor terminal-to-wire connection. This requires removing the terminal form the connector body to check.
- Ignition coils shorted to ground and arcing at ignition wires or plugs.
- MIL (Check Engine Lamp) wire to ECM shorted to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Road test the vehicle with a Digital Multimeter connected to a suspected circuit. An abnormal voltage when the malfunction occurs is a good indication that there is a fault in the circuit being monitored.
Using Tech 2 to help detect intermittent conditions. The Tech 2 has several features that can be used to located an intermittent condition.

An intermittent MIL (Check Engine Lamp) with no stored Diagnostic Trouble Code may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- MIL (Check Engine Lamp) wire to ECM short to ground.
- Poor ECM grounds. Refer to the ECM wiring diagrams.

Check for improper installation of electrical options such as light, cellular phones, etc. Check all wires from ECM to the ignition control module for poor connections.
Check for an open diode across the A/C compressor clutch and check for other open diodes (refer to wiring diagrams in Electrical Diagnosis).

If problem has not been found, refer to ECM connector symptom tables.

- Check the "Broadcast Code" of the ECM, and compare it with the latest Isuzu service bulletins and/ or Isuzu EEPROM reprogramming equipment to determine if an update to the ECM's reprogrammable memory has been released.

To check the "Broadcast Code", connect the Tech 2, then look for "ID info." then select "Broadcast Code". This should display a 4 character code, such as "XBYA" (example only).
This identifies the contents of the reprogrammable software and calibration contained in the ECM.
If the "Broadcast Code" is not the most current available, it is advisable to reprogram the ECM's EEPROM memory, which may either help identify a hard-to find problem or may fix the problem.
The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes.

ENGINE CRANKS BUT WILL NOT RUN

DEFINITIONS: Engine cranks, but will not run. (The engine never start.)
NOTE: The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM.
Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.
NOTE: The vehicle with immobilizer system, this system may be activated. Check the immobilizer system diagosis.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check.*
4	Check the "Ignition coil" fuse (15A) and "ECM" fuse (15A). Was a fuse blown?	—	Verify repair	Go to *Step 5*
5	1. Ignition ON 2. Use a DVM to verify that battery voltage at the ignition coil fuse, and the ECM fuse. Was battery voltage presented at the fuses?	—	Go to *Step 6*	Verify & repair
6	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	—	Verify repair	Go to *Step 8*
8	1. Using a Tech 2, display the MAP sensor value. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 9*
9	If oscilloscope is available, check the wave form of the CKP signal. Was the correct wave form found?	—	Go to *Step 12*	Go to *Step 10*
10	Check the CKP sensor wire for open or short circuit. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Replace CKP sensor. Is there still problem?	—	Replace pulsar ring.	Verify repair

Step	Action	Value(s)	Yes	No
12	Visually/physically inspect the secondary ignition wires. Check for the following conditions: • Verify that all ignition wire resistance are less than the specified value. • Verify that ignition wires are correctly routed to eliminate cross-fitting. • Verify that ignition wires are not arcing to ground. Spraying the secondary ignition wires with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to *Step 13*
13	1. Disconnect the spark plug high tension cable from No.1 spark plug. 2. Install a spark tester at the end of the disconnected ignition coil. 3. Clip the spark tester to a good ground. 4. Observe the spark tester while the engine is cranking. Was a crisp blue spark observed? (Only one or two sparks followed by no result is considered the same as “No Spark”.)	—	Go to *Step 21*	Go to *Step 14*
14	1. Disconnect the ignition coil harness connector. 2. Check for an open or short circuit between the ignition coil and the ECM. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Ignition “On”. 2. Using a Digital Voltmeter (DVM) check the ignition wire coil at the ignition coil harness connector. Was the voltage equal to the specified value?	Battery voltage	Go to *Step 16*	Verify repair
16	1. Ignition “Off”. 2. With DVM, check for an open in the ground wire at the ignition coil harness connector. Was the ground wire OK?	—	Go to *Step 17*	Verify repair
17	Replace the ignition coil, verify the repair. Attempt to start the engine. Is there still a problem?	—	Go to *Step 18*	Verify repair
18	Use an ohmmeter to check the ignition coil primary winding resistance. Was the primary winding resistance approximately equal to the specified value?	0.8-18kΩ	Go to *Step 19*	Go to *Step 20*
19	Use an ohmmeter to check the ignition coil secondary winding resistance. Was the primary winding resistance hear around the to the specified value?	2.5kΩ	Go to *Step 21*	Go to *Step 20*
20	Replace the ignition coil.	—	Verify repair	—
21	1. Remove the spark plugs from all cylinders. 2. Visually inspect the spark plug electrodes. 3. Replace any spark plugs with loose or missing electrodes or cracked insulators. Did your inspection reveal any spark plugs exhibiting excessive fouling?	—	Correct the fouling condition	Go to *Step 22*

Step	Action	Value(s)	Yes	No
22	Perform the procedure in Fuel System Pressure Test (Refer to 6E-108 "*Fuel System Diagnosis*") to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to *Step 23*
23	Refer to 6E-108 page "*Fuel System Diagnosis*" to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to *Step 24*
24	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to *Step 25*
25	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 26*
26	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 27*
27	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

HARD START SYMPTOM

DEFINITIONS: Engine cranks, but does not start for a long time. Does eventually start, of may start and then immediately stall.

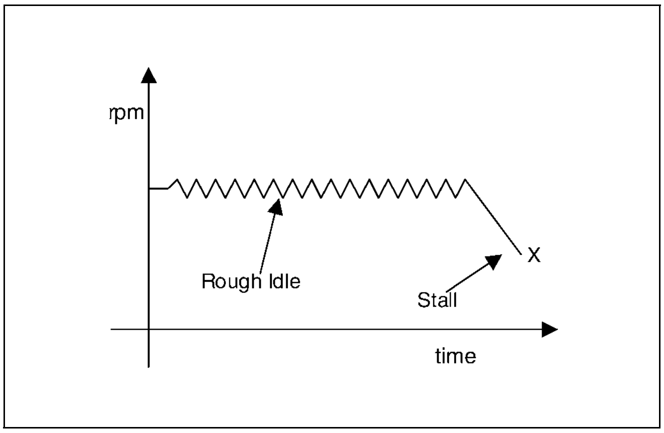
Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visually/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check.*
4	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Using a Tech 2, display the IAC value. 2. Check for a faulty, plugged, or sticking IAC operation. Was the problem found?	—	Verify repair	Go to *Step 6*
6	Check engine coolant temperature (ECT) sensor for shift in value. 1. After 8 hours with hood up and the engine not running, connect the Tech 2. 2. Ignition On, engine not running. 3. Using Tech 2, compare Engine Coolant Temperature to Intake Air Temperature. Are ECT and IAT within the specified value of each other?	±5°C	Go to *Step 8*	Go to *Step 7*

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>7</td><td>1. Using a Tech 2, display the engine coolant temperature and note the value.
2. Check the resistance of the engine coolant temperature sensor.
Is the actual resistance near the resistance value in the chart for the temperature that was noted?
<table>
<tr><th>Temperature (°C)</th><th>Resistance (Ω) (Approximately)</th></tr>
<tr><td>-20</td><td>26740</td></tr>
<tr><td>0</td><td>9120</td></tr>
<tr><td>20</td><td>3500</td></tr>
<tr><td>40</td><td>1464</td></tr>
<tr><td>60</td><td>664</td></tr>
<tr><td>80</td><td>333</td></tr>
<tr><td>100</td><td>175</td></tr>
<tr><td>120</td><td>102</td></tr>
</table></td><td>—</td><td>Go to Step 8</td><td>Replace the ECT sensor. Verify repair</td></tr>
<tr><td>8</td><td>1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature.
2. Check for a faulty, plugged, or incorrectly installed MAP sensor.
Was the problem found?</td><td>—</td><td>Verify repair</td><td>Go to Step 9</td></tr>
<tr><td>9</td><td>Visually/physically inspect all spark plug high-tension cables. Check for the following conditions:
• Verify that the resistance of all spark plug high-tension cables are less than the specified value.
• Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting.
• Verify that the all spark plug high-tension cables are not arcing to ground.
Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem.
Was a problem found?</td><td>#1 cyl. 4.4kΩ
#2 cyl. 3.6kΩ
#3 cyl. 3.1kΩ
#4 cyl. 2.8kΩ</td><td>Verify repair</td><td>Go to Step 10</td></tr>
<tr><td>10</td><td>Check for proper ignition voltage output with a spark tester.
Was the problem found?</td><td>—</td><td>Verify repair</td><td>Go to Step 11</td></tr>
<tr><td>11</td><td>1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range.
2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs.
Was a problem found?</td><td>—</td><td>Verify repair</td><td>Go to Step 12</td></tr>
<tr><td>12</td><td>Check for a loose ignition control module ground.
Was a problem found?</td><td>—</td><td>Verify repair</td><td>Go to Step 13</td></tr>
<tr><td>13</td><td>1. Check the ignition coil secondary resistance.
2. Replace the coil if it is greater than the specified resistance.
Did the coil require replacement?</td><td>2.5kΩ</td><td>Verify repair</td><td>Go to Step 14</td></tr>
</table>

Step	Action	Value(s)	Yes	No
14	Drain sample fuel, visual inspection. Any suspecion about the fuel, such as discoloration, particle, contamination, water, unusual smell, then drain the fuel from fuel tank. Replace the fuel from know vehicle source. If any suspicion of alcohol contamination, completely drain the fuel, replace by fuel from known vehicle source.	—	Verify repair	Go to *Step 15*
15	Perform the procedure in Fuel System Pressure Test (Refer to 6E-108 "*Fuel System Diagnosis*") to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*
17	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to *Step 18*
18	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 19*
19	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 20*
20	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

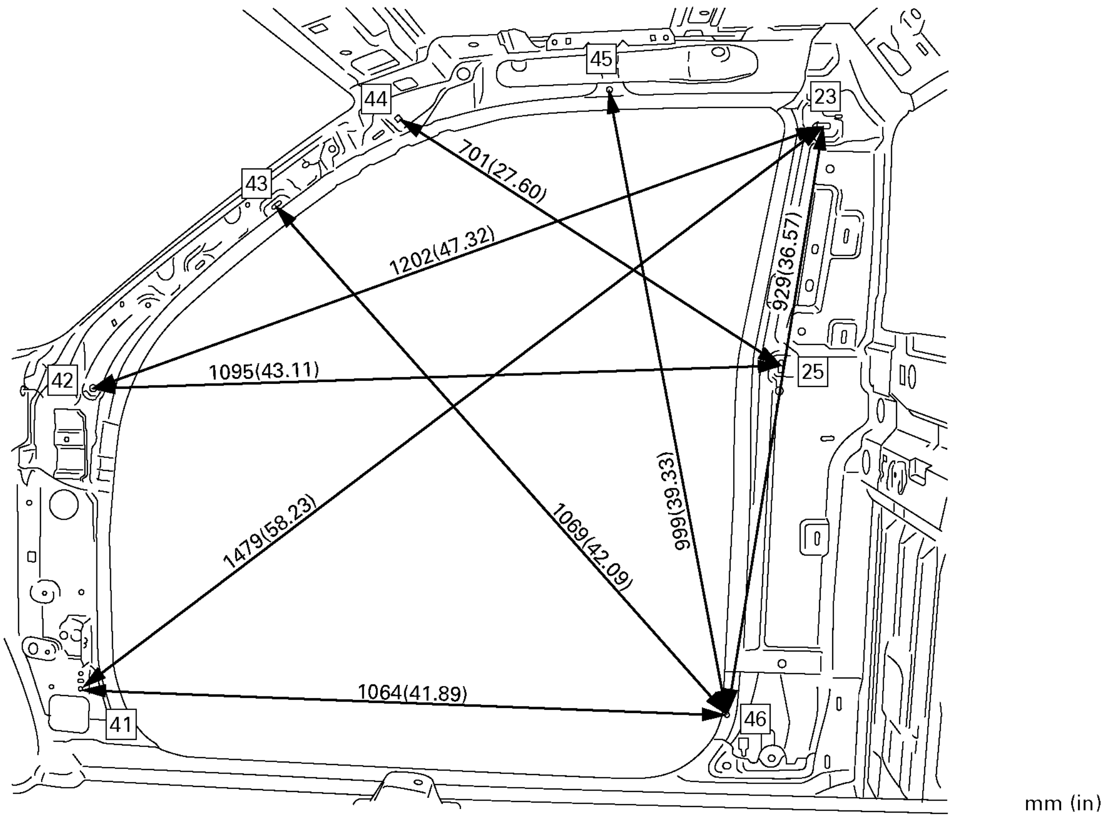
ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING SYMPTOM

DEFINITIONS: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.



Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check.*
4	1. Check for faulty, plugged or incorrectly installed PCV valve. 2. Verify that the PCV system is not plugged. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Check for incorrect idle speed. Ensure that the following conditions are present. • Engine fully warm • Accessories are "Off" 2. Using a Tech 2, monitor IAC position. Is the IAC position within the specified values?	20-30 Steps	Go to *Step 7*	Go to *Step 6*
6	1. Visually/physically inspect for the following conditions: • Restriction of the air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to *Step 7*

SIDE BODY SECTION (REGULAR CAB)



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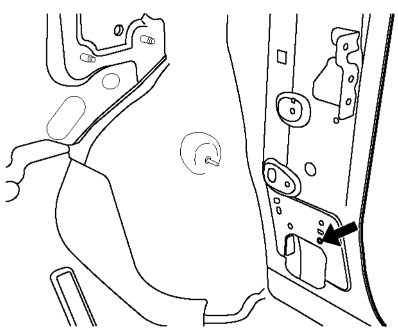

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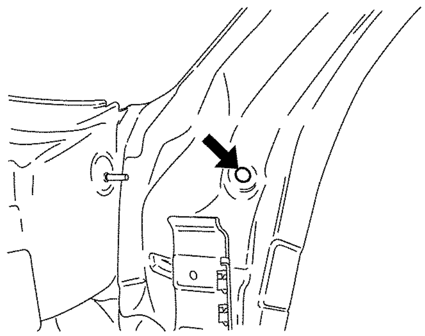

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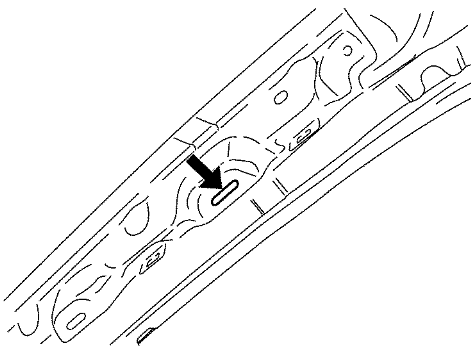

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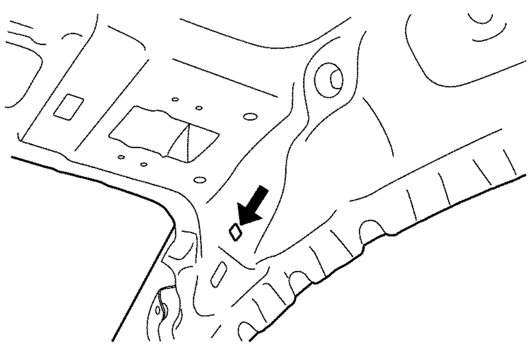
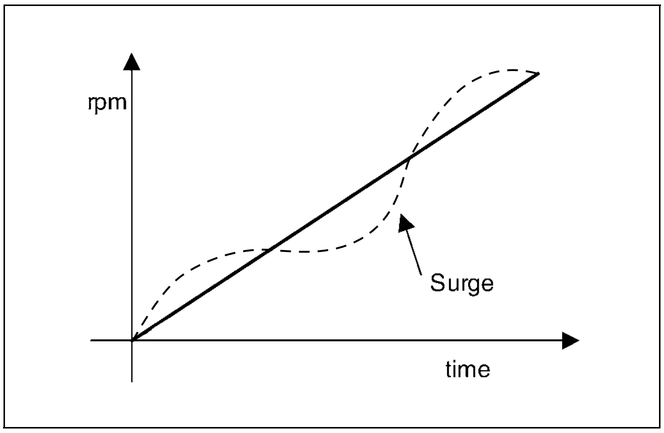


Step	Action	Value(s)	Yes	No
7	1. Using a Tech 2, display the engine coolant temperature and note the value. 2. Check the resistance of the engine coolant temperature sensor. Is the actual resistance near the resistance value in the chart for the temperature that was noted? Temperature (°C) / Resistance (Ω) (Approximately): -20 / 26740 0 / 9120 20 / 3500 40 / 1464 60 / 664 80 / 333 100 / 175 120 / 102	—	Go to *Step 8*	Replace the ECT sensor. Verify repair
8	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 9*
9	Using Tech 2, monitor throttle position with the engine idling. Is the throttle position at the specified value and steady?	0%	Go to *Step 10*	Refer to *Diagnostic Trouble Code P0123 for further diagnosis*
10	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to *Step 11*
11	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 12*
12	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to *Step 13*
13	Check items that can cause the engine to run rich. Refer to DTC P1167 “Fuel Supply System Rich During Deceleration Fuel Cut Off”. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check items that can cause the engine to run lean. Refer to DTC P1171 “Fuel Supply System Lean During Power Enrichment”. Was a problem found?	—	Verify repair	Go to *Step 15*
15	Check the injector connectors, if any of the injectors are connected any incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 17*

Step	Action	Value(s)	Yes	No
17	Perform the procedure in Fuel System Pressure Test (Refer to 6E-108 "*Fuel System Diagnosis*") to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to *Step 18*
18	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to *Step 19*
19	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 20*
20	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 21*
21	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

SURGES AND/OR CHUGS SYMPTOM

DEFINITIONS: See the illustration below. Feels like the vehicle speeds up and slows down with no charge in the accelerator pedal.



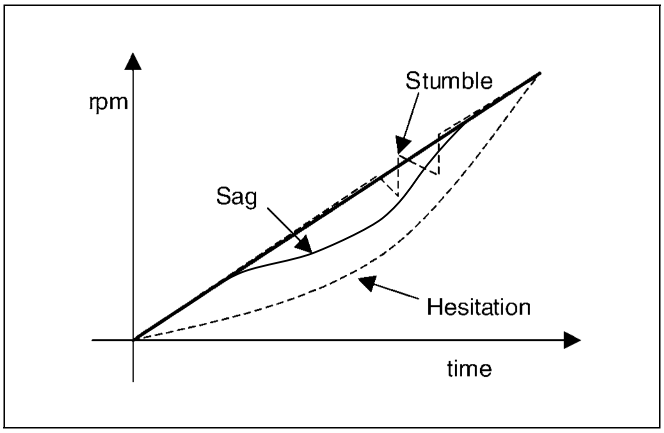
Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check.*
4	Be sure that the driver understands A/C compressor operation as explained in the owner's manual. Inform the customer how the A/C clutch operate. Is the customer experiencing a normal condition?	—	System OK	Go to *Step 5*
5	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 6*
6	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Is the throttle position at the specified value and steady in any position?	—	Go to *Step 7*	Refer to *Diagnostic Trouble Code P0123 for further diagnosis*
7	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 8*
8	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command an excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to *Step 9*

Step	Action	Value(s)	Yes	No
9	Check the fuel pressure. Refer to 6E-108 page "*Fuel System Diagnosis*". Was a problem found?	—	Verify repair	Go to *Step 10*
10	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Verify repair	Go to *Step 11*
11	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to *Step 12*
12	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to *Step 13*
13	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to *Step 15*
15	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to *Step 16*
16	1. Check the ignition coil secondary resistance. 2. Replace the coil if it is greater than the specified resistance. Did the coil require replacement?	2.5kΩ	Verify repair	Go to *Step 17*
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 18*
18	1. Check the injector connectors. 2. If any of the connectors are connected at an improper cylinder, connect as necessary. Was a problem found?	—	Verify repair	Go to *Step 19*
19	Check the ECM grounds to verify that they are clean and tight. Refer to the *ECM wiring diagrams*. Was a problem found?	—	Verify repair	Go to *Step 20*
20	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	—	Verify repair	Go to *Step 21*

Step	Action	Value(s)	Yes	No
21	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes • Internal muffler failure Was a problem found?	—	Verify repair	Go to *Step 22*
22	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 23*
23	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 24*
24	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

HESITATION, SAG, STUMBLE SYMPTOM

DEFINITIONS: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually most pronounced when first trying to make the vehicle move, as from a stop sign. May cause the engine to stall if severe enough.



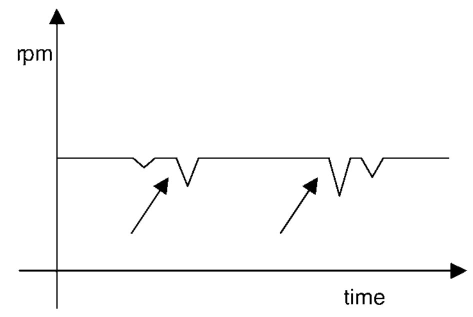
Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	Check the fuel quality. Is the customer using improper fuel or degraded fuel?	—	Replace fuel	Go to *Step 5*
5	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 6*
6	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to *Step 7*	Refer to *Diagnostic Trouble Code P0123 for further diagnosis*
7	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 8*
8	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to *Step 9*
9	Check the fuel pressure. Refer to 6E-108 "*Fuel System Diagnosis*". Was a problem found?	—	Verify repair	Go to *Step 10*

Step	Action	Value(s)	Yes	No
10	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Go to *Step 11*	Go to *Step 12*
11	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to *Step 12*
12	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to *Step 13*
13	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check for a loose ignition control module ground. Was a problem found?	—	Verify repair	Go to *Step 15*
15	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to *Step 16*
16	1. Check the ignition coil secondary resistance. 2. Replace the coil if it is greater than the specified resistance. Did the coil require replacement?	2.5kΩ	Verify repair	Go to *Step 17*
17	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 18*
18	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	—	Verify repair	Go to *Step 19*
19	Visually/physically check the vacuum hose for splits, kinks and proper connections and routing. Was a problem found?	—	Verify repair	Go to *Step 20*

Step	Action	Value(s)	Yes	No
20	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 21*
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 22*
22	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

CUTS OUT, MISSES SYMPTOM

DEFINITIONS: Steady pulsation or jerking that follows engine speed; usually more pronounced as engine load increases.



Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams in *Electrical Diagnosis*. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Check for a loose or short circuit of ignition coil module voltage feed. Was a problem found?	—	Verify repair	Go to *Step 6*
6	Check for a loose or short circuit of ignition coil module ground. Was a problem found?	—	Verify repair	Go to *Step 7*
7	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to *Step 7*
8	Check the CKP sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 9*
9	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Go to *Step 10*	Go to *Step 11*

Step	Action	Value(s)	Yes	No
10	Check items that can cause the engine to run rich. Refer to *DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off"*. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the lean condition?	—	Go to *Step 12*	Go to *Step 13*
12	Check items that can cause the engine to run lean. Refer to *DTC P1171 "Fuel Supply System Lean During Power Enrichment"*. Was a problem found?	—	Verify repair	Go to *Step 13*
13	1. Visually/physically inspect for the following conditions: • Restriction of air intake system. Check for a restricted air filter element, or foreign objects blocking the air intake system. • Check for objects blocking the IAC passage or throttle bore, excessive deposits in the throttle bore and on the throttle plate. • Check for a condition that causes a large vacuum leak, such as an incorrectly installed or faulty crankcase ventilation hose/brake booster hose. Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check the injector connectors, if any of the injectors are connected an incorrect cylinder, correct as necessary. Was a problem found?	—	Verify repair	Go to *Step 15*
15	Perform the "*Injector Coil/Balance Test*" (Refer to 6E-98 page). Was a problem found.	—	Verify repair	Go to *Step 16*
16	1. Check for fuel in the pressure regulator vacuum hose. 2. If fuel is present, replace the fuel pressure regulator assembly. Was a problem found?	—	Verify repair	Go to *Step 17*
17	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to *Step 18*
18	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 19*

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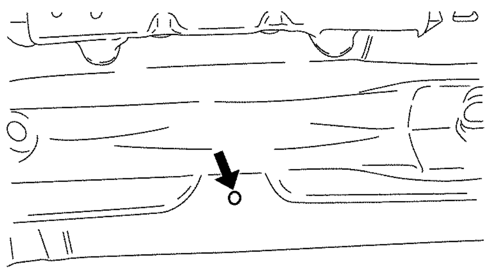

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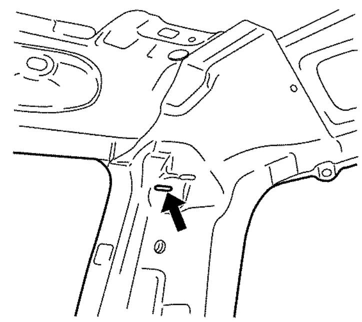

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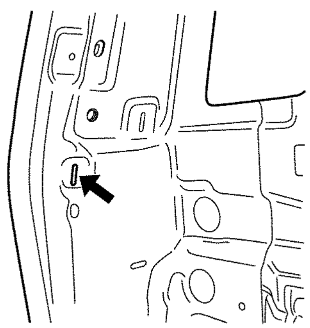

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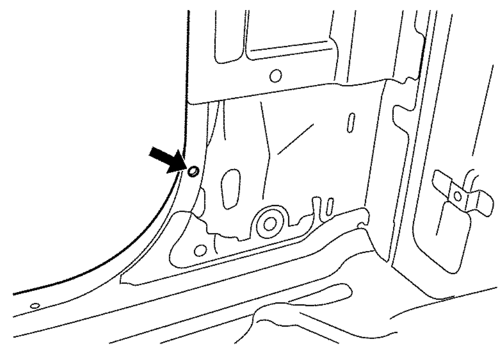


Step	Action	Value(s)	Yes	No
19	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to *Step 20*
20	1. Check for faulty engine mounts. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 21*
21	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 22*
22	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 23*
23	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

LACK OF POWER, SLUGGISH OR SPONGY SYMPTOM

DEFINITIONS: Engine delivers less than expected power. Attempting part-throttle acceleration results in little or no increase in vehicle speed.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	1. Remove and check the air filter element for dirt or restrictions. 2. Replace the air filter element if necessary. Was a repair required?	—	Verify repair	Go to *Step 5*
5	Check the ECM grounds to verify that they are clean and tight. Refer to the ECM wiring diagrams. Was a problem found?	—	Verify repair	Go to *Step 6*
6	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 7*
7	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to *Step 8*
8	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to *Step 9*	Refer to *Diagnostic Trouble Code P0123 for further diagnosis*
9	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 10*
10	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Check the fuel pressure. Refer to "*Fuel System Diagnosis*" 6E-108. Was a problem found?	—	Verify repair	Go to *Step 12*

Step	Action	Value(s)	Yes	No
12	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Verify repair	Go to *Step 13*
13	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to *Step 14*
14	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to *Step 15*
15	Check for proper ignition voltage output with a spark tester. Was the problem found?	—	Verify repair	Go to *Step 16*
16	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 17*
17	Drain sample fuel, visual inspection. Any suspecion about the fuel, such as discoloration, particle, contamination, water, unusual smell, then drain the fuel from fuel tank. Replace the fuel from know vehicle source. If any suspencion of alcohol contamination, completely drain the fuel, replace by fuel from known vehicle source.	—	Verify repair	Go to *Step 18*
18	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes • Internal muffler failure Was a problem found?	—	Verify repair	Go to *Step 19*
19	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Loose timing belt Was a problem found?	—	Verify repair	Go to *Step 20*
20	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 21*

Step	Action	Value(s)	Yes	No
21	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 22*
22	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

DETONATION/SPARK KNOCK SYMPTOM

DEFINITIONS: A mild to severe ping, usually worse under acceleration. The engine makes a sharp metallic knocking sound that changes with throttle opening. Prolonged detonation may lead to complete engine tailure.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	1. If Tech 2 readings are normal (refer to Typical Scan Data Values) and there are no engine mechanical faults, fill the fuel tank with a known quality gasoline. 2. Re-evaluate the vehicle performance. Is detonation present?	—	Go to *Step 5*	Verify repair
5	1. Check for obvious overheating problems: • Low engine coolant • Restricted air flow to radiator • Incorrect coolant solution 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 6*
6	Check the fuel pressure. Refer to 6E-108 page "*Fuel System Diagnosis*". Was a problem found?	—	Verify repair	Go to *Step 7*
7	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 8*
8	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to *Step 9*
9	Observe the throttle position display on the Tech 2 while slowly increasing throttle pedal. Does the throttle position increase steady with increasing smoothly?	—	Go to *Step 10*	Refer to *Diagnostic Trouble Code P0123 for further diagnosis*
10	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 11*
11	Check items that can cause the engine to run lean. Refer to DTC P1171 "Fuel Supply System Lean During Power Enrichment". Was a problem found?	—	Verify repair	Go to *Step 12*

Step	Action	Value(s)	Yes	No
12	Check spark plugs for proper heat range. Were incorrect spark plugs installed?	—	Verify repair	Go to *Step 13*
13	1. Remove excessive carbon buildup with a top engine cleaner. 2. Re-evaluate vehicle performance. Is detonation still present?	—	Verify repair	Go to *Step 14*
14	Check for an engine mechanical problem. Perform a cylinder compression check. Refer to *Engine Mechanical*. Was a problem found?	—	Verify repair	Go to *Step 15*
15	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 16*
16	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 17*
17	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

POOR FUEL ECONOMY SYMPTOM

DEFINITIONS: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to Visual / physical Check.
4	Check owner's driving habits. • Is the A/C On full time (defroster mode On)? • Are tires at the correct pressure? • Are excessively heavy loads being carried? • Is acceleration too much, too often?	—	Go to *Step 5*	Go to *Step 6*
5	Review the items in Step 4 with the customer and advise as necessary. Is the action complete?	—	System OK	—
6	Visually/physically check: Vacuum hoses for splits, kinks, and improper connections and routing as shown on the "Emission Control System Schematics". Was a problem found?	—	Verify repair	Go to *Step 7*
7	Check for low engine coolant level. Was a problem found?	—	Verify repair	Go to *Step 8*
8	Check for incorrect or faulty engine thermostat. Refer to *Engine Cooling*. Was a problem found?	—	Verify repair	Go to *Step 9*
9	Remove and check the air filter element for dirt or for restrictions. Was a problem found?	—	Verify repair	Go to *Step 10*
10	1. Using a Tech 2, display the MAP sensor value in comparison with atmosphere temperature. 2. Check for a faulty, plugged, or incorrectly installed MAP sensor. Was the problem found?	—	Verify repair	Go to *Step 11*
11	1. Using a Tech 2, display the ECT sensor and IAT sensor value and warm up condition compared with the typical data. 2. Check the specified value or wire. Was the problem found?	—	Verify repair	Go to *Step 12*
12	Check the knock sensor wire, shield wire, or installation condition. Was a problem found?	—	Verify repair	Go to *Step 13*
13	Check the fuel pressure. Refer to 6E-108 page "*Fuel System Diagnosis*". Was a problem found?	—	Verify repair	Go to *Step 14*

Step	Action	Value(s)	Yes	No
14	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Verify repair	Go to *Step 15*
15	Check items that can cause the engine to run rich. Refer to DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off". Was a problem found?	—	Verify repair	Go to *Step 16*
16	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 17*
17	Check for proper calibration of the speedometer. Does the speed indicated on the speed meter closely match the vehicle speed displayed on the Tech 2?	—	Go to *Step 19*	Go to *Step 18*
18	Diagnose and repair the inaccurate speedometer condition as necessary. Refer to *Vehicle Speed Sensor in Electrical Diagnosis*.	—	Verify Repair	—
19	Check for proper calibration of the fuel gauge. Was a problem found?	—	Verify repair	Go to *Step 20*
20	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Worn camshaft • Sticking or leaking valves • Valve timing Was a problem found?	—	Verify repair	Go to *Step 21*
21	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 22*
22	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 23*
23	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

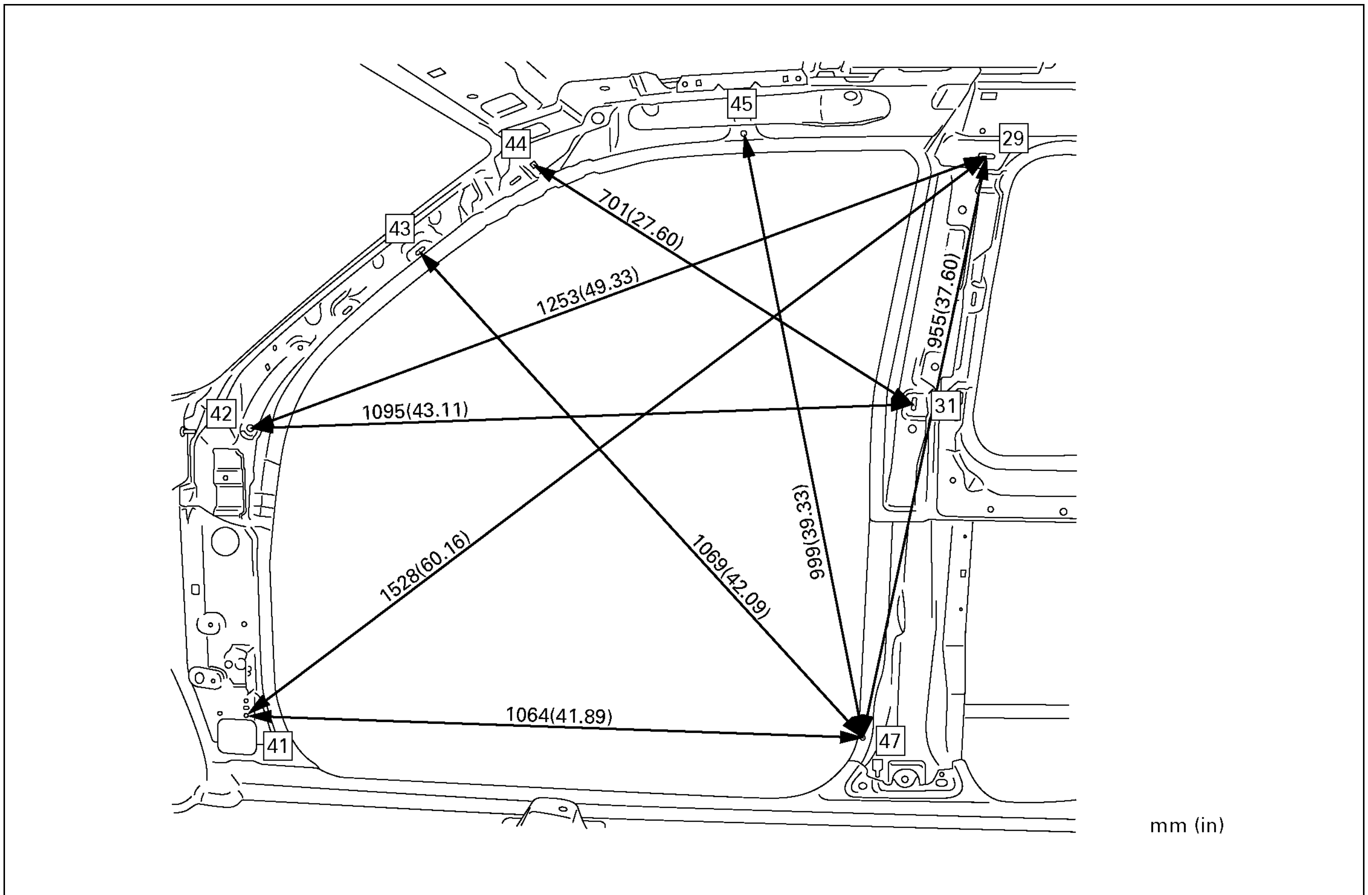
EXCESSIVE EXHAUST EMISSIONS OR ODORS SYMPTOM

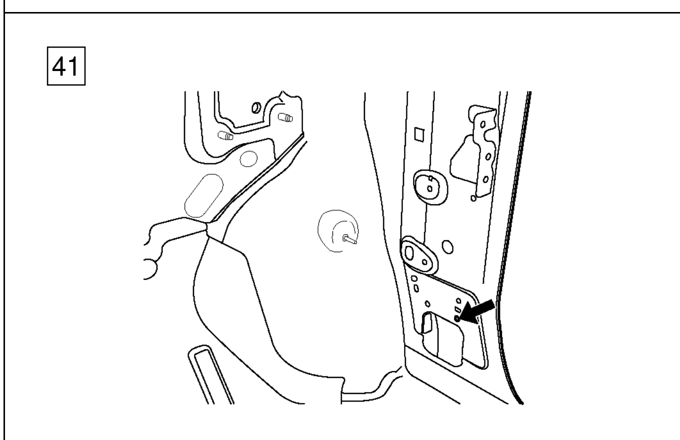
DEFINITIONS: Vehicle fails an emission test. There is excessive “rotten egg” smell. (Excessive odors do not necessarily indicate excessive emissions.)

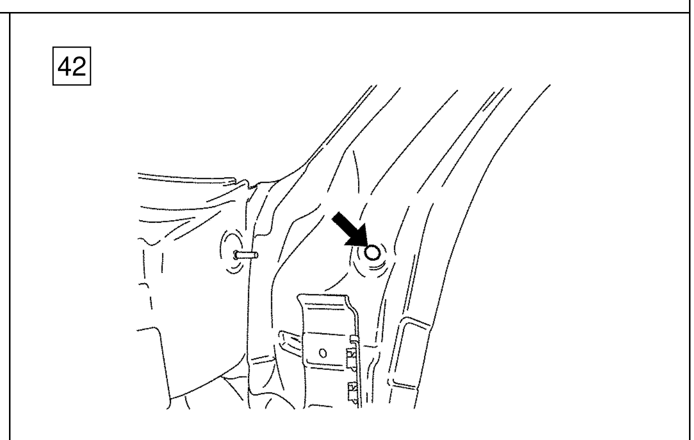
Step	Action	Value(s)	Yes	No
1	Was the “*On-Board Diagnostic (OBD) System Check*” performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	Does the customer continual accelerate On/Off during cold condition?	—	System OK	Go to *Step 5*
5	Is the customer using the incorrect fuel type?	—	Replace with unleaded fuel	Go to *Step 6*
6	Check for vacuum leaks (vacuum lines, intake manifold, throttle body, etc.) Were any vacuum leaks found?	—	Go to *Step 17*	Go to *Step 7*
7	1. Check fuel cap for proper installation. 2. Secure the fuel cap if necessary. Was a problem found?	—	Go to *Step 17*	Go to *Step 8*
8	Check the fuel pressure. Refer to 6E-108 page *“Fuel System Diagnosis”* . Was a problem found?	—	Go to *Step 17*	Go to *Step 9*
9	1. Check for faulty, plugged or incorrectly installed PCV valve. 2. Verify that the PCV system is not plugged. Was a problem found?	—	Go to *Step 17*	Go to *Step 10*
10	Check the injector connectors, if any of the injectors are connected to an incorrect cylinder, correct as necessary. Was a problem found?	—	Go to *Step 17*	Go to *Step 11*
11	Perform the *“Injector Coil/Balance Test”* (Refer to 6E-98 page). Was a problem found.	—	Go to *Step 17*	Go to *Step 12*
12	Check for a problem with the engine cooling system. Was a problem found?	—	Go to *Step 17*	Go to *Step 13*
13	Check EVAP canister for fuel loading. Refer to Evaporative Emission Control System. Was a problem found?	—	Go to *Step 17*	Go to *Step 14*
14	Check the EVAP purge solenoid valve operation. Is the valve operated normally?	—	Go to *Step 17*	Verify repair & Go to *Step 15*
15	Check the exhaust system for a possible restriction: • Damaged or collapsed pipes • Internal catalytic converter failure Was a problem found?	—	Verify repair & Go to *Step 16*	Go to *Step 17*

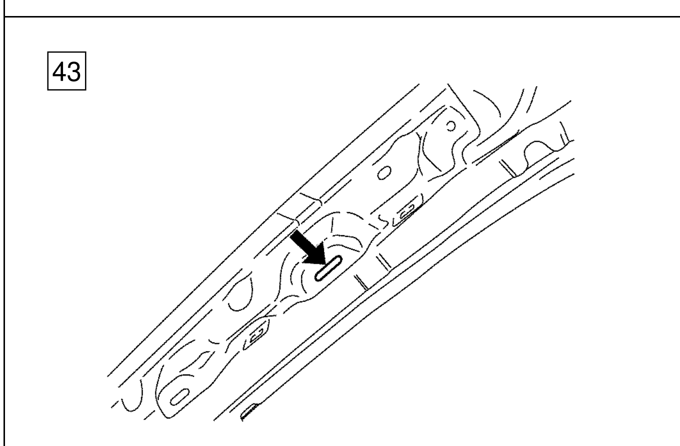
Step	Action	Value(s)	Yes	No
16	1. Remove excessive carbon buildup with a top engine cleaner. Refer to the instructions on the top engine cleaner can. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 18*
17	Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 18*
18	Run Engine. Check the fuel control Heated Oxygen Sensor (HO2S). When monitored on the Tech 2, the HO2S should respond quickly to different throttle positions. If it doesn't check for silicon or other contaminates from fuel or use of improper sealant. The sensors may have a white powdery coating. Silicon contamination sends a rich exhaust signal which causes the ECM to command and excessively lean air/fuel mixture. Was a problem found?	—	Verify repair	Go to *Step 19*
19	Monitor "*B1S1 (Bank 1 Sensor 1) Status*" on the Tech 2. Is the "*B1S1 (Bank 1 Sensor 1) Status*" in the rich condition?	—	Go to *Step 20*	Go to *Step 21*
20	1. Check items that can cause the engine to run rich. Refer to *Diagnostic Aids in DTC P1167 "Fuel Supply System Rich During Deceleration Fuel Cut Off"*. Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 22*
21	1. Check items that can cause the engine to run lean. Refer to Diagnostic Aids in *DTC P1171 "Fuel Supply System Lean During Power Enrichment"*. Make any necessary repairs. 2. Perform the exhaust emission test. Does the vehicle pass the test?	—	System OK	Go to *Step 22*
22	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs Was a problem found?	—	Verify repair	Go to *Step 23*
23	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 24*

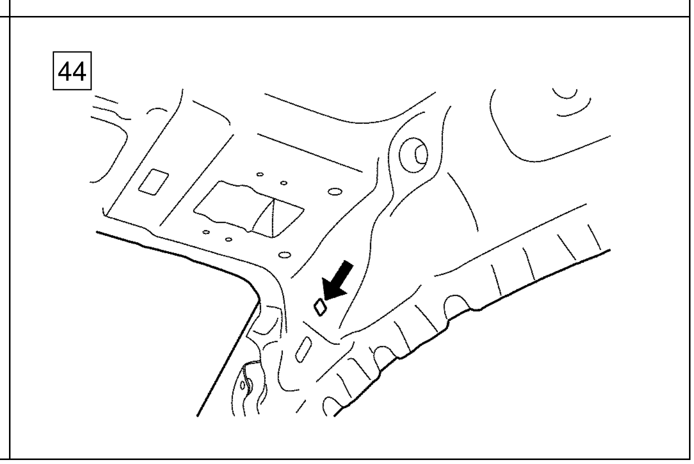
SIDE BODY SECTION (EXTEND CAB)











Step	Action	Value(s)	Yes	No
24	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 25*
25	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify Repair	—

DIESELING, RUN-ON SYMPTOM

DEFINITIONS: Engine continues to run after key is turned OFF, but runs very rough. If engine runs smoothly, check the ignition switch and adjustment.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	Check for a short between battery voltage and the ignition feed circuit. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Check the fuel leaking from injector. Refer to Fuel System Diagnostic. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 7*
7	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***"SPS (Service Programming System)".*** Was the problem solved?	—	Verify repair	Go to *Step 8*
8	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 "Immobilizer System-ECM replacement" for the ECM/Immobilizer linking procedure.	—	Verify repair	—

BACKFIRE SYMPTOM

DEFINITIONS: Fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.

Step	Action	Value(s)	Yes	No
1	Was the "*On-Board Diagnostic (OBD) System Check*" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Perform a bulletin search. 2. If a bulletin that addresses the symptom is found, correct the condition as instructed in the bulletin. Was a bulletin found that addresses the symptom?	—	Verify repair	Go to *Step 3*
3	Was a visual/physical check performed?	—	Go to *Step 4*	Go to *Visual / physical Check*.
4	Check for proper ignition voltage output with the spark tester. Was a problem found?	—	Verify repair	Go to *Step 5*
5	1. Remove the spark plugs and check for gas or oil fouling cracks, wear, improper gap, burned electrodes, heavy deposits, or improper heat range. 2. If spark plugs are fouled, the cause of fouling must be determined before replacing the spark plugs. Was a problem found?	—	Verify repair	Go to *Step 6*
6	Visually/physically inspect all spark plug high-tension cables. Check for the following conditions: • Verify that the resistance of all spark plug high-tension cables are less than the specified value. • Verify that the all spark plug high-tension cables are correctly fitted to eliminate cross-fitting. • Verify that the all spark plug high-tension cables are not arcing to ground. Spraying the spark plug high-tension cables with a light mist of water may help locate an intermittent problem. Was a problem found?	#1 cyl. 4.4kΩ #2 cyl. 3.6kΩ #3 cyl. 3.1kΩ #4 cyl. 2.8kΩ	Verify repair	Go to *Step 7*
7	Check the fuel pressure. Refer to 6E-108 page *"Fuel System Diagnosis"*. Was a problem found?	—	Verify repair	Go to *Step 8*
8	Check for an intermittent ignition system malfunction: • Intermittent CKP 58X signal • Intermittent ignition feed circuit or sensor ground circuit to the crankshaft position sensor. Was a problem found?	—	Verify repair	Go to *Step 9*
9	Refer to 6E-108 page *"Fuel System Diagnosis"* to determine if there is a problem with fuel delivery. Was a problem found?	—	Verify repair	Go to *Step 10*

Step	Action	Value(s)	Yes	No
10	Check for the following engine mechanical problems (refer to *Engine Mechanical*): • Low compression • Leaking cylinder head gaskets • Worn camshaft • Sticking or leaking valves • Valve timing • Broken valve springs • Camshaft drive belt slipped or stripped Was a problem found?	—	Verify repair	Go to *Step 11*
11	Check leakage at exhaust system. Check the intake and exhaust manifold for casting flash. Refer to *Engine Mechanical*. Was a problem found?	—	Verify repair	Go to *Step 12*
12	1. Review all diagnostic procedures within this table. 2. If all procedures have been completed and no malfunctions have been found, review/inspect the following: • Visual/physical inspection • Tech 2 data • All electrical connections within a suspected circuit and/or system Was a problem found?	—	Verify repair	Go to *Step 13*
13	Is the ECM programmed with the latest software release? If not, download the latest software to the ECM using the ***“SPS (Service Programming System)”.*** Was the problem solved?	—	Verify repair	Go to *Step 14*
14	Replace the ECM. Is the action complete? **IMPORTANT:** The replacement ECM must be programmed. Refer to section of the Service Programming System (SPS) in this manual. Following ECM programming, the immobilizer system (if equipped) must be linked to the ECM. Refer to section 11 “Immobilizer System-ECM replacement” for the ECM/Immobilizer linking procedure.	—	Verify repair	—

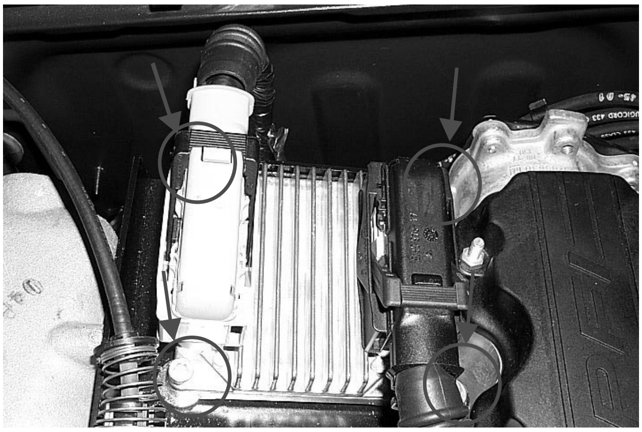
ON-VEHICLE SERVICE PROCEDURE

ENGINE CONTROL MODULE (ECM)

Location
On the intake manifold.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the two connectors from the ECM.
3. Remove four bolts.
4. Remove the ECM from bracket.



Installation Procedure

1. Put on the ECM to the bracket.
2. Tighten the ECM by four bolts with specified tightening torque.

Tightening torque

- Bolts: 8.0 - 12.0 N·m (0.8 - 1.2 kgf·m)

3. Connect the two connectors to the ECM.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

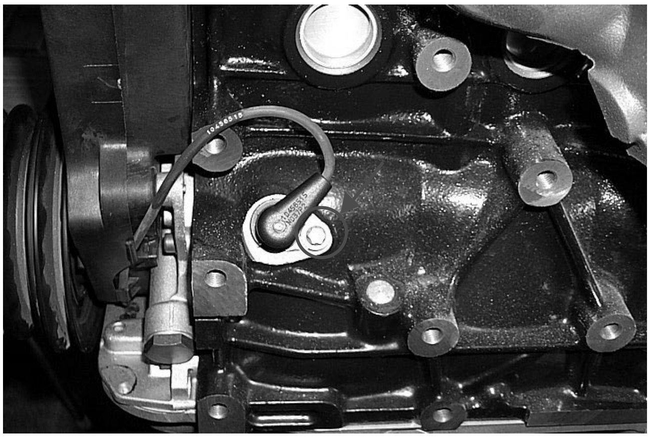
CRANKSHAFT POSITION (CKP) SENSOR

Location
Left-hand side of the cylinder block. (Back of the A/C compressor)

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the drive belt. Refer to Engine Mechanical Section.
3. Remove the A/C compressor from engine. Refer to Engine Mechanical Section.
4. Disconnect connector from the CKP sensor.
5. Loosen a bolt and remove the CKP sensor from the cylinder block.

NOTE: Use caution to avoid any hot oil that might drip out.



Installation Procedure

1. Install the CKP sensor to the cylinder block.
2. Tighten CKP sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 6N·m (0.6kgf·m)

3. Reinstall the A/C compressor to the engine.
4. Reinstall the accessory drive belt.
5. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

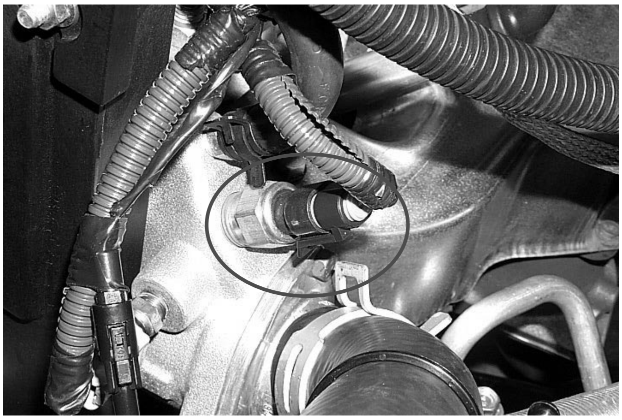
ENGINE COOLANT TEMPERATURE (ECT) SENSOR

Location
Installed to the thermostat housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Drain enough engine coolant so that the coolant level will be below the ECT sensor.
3. Disconnect connector from the ECT sensor.
4. Loosen and remove the ECT sensor from the thermostat housing.

NOTE: Cool down the engine before above procedures are carried out.



Installation Procedure

1. Apply sealer to threads of screw at the ECT sensor.
2. Tighten the ECT sensor with specified tightening torque.

Tightening Torque

- Bolt: 13N·m (1.3kgf·m)

3. Connect a ECT sensor connector to the ECT sensor.
4. Fill the engine coolant.
5. Connect the negative battery cable.

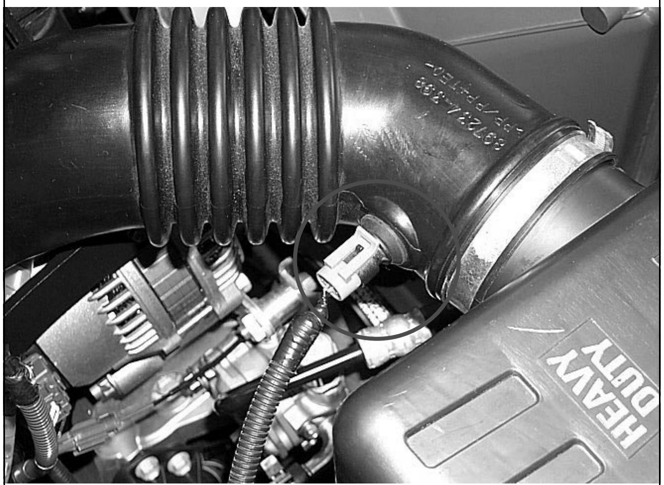
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify no engine coolant leaking from the sensor threads after replacement.

INTAKE AIR TEMPERATURE (IAT) SENSOR

Location
Installed to the intake duct housing.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect a IAT sensor connector from the IAT sensor.
3. Remove the IAT sensor from the intake duct.



Installation Procedure

1. Install the IAT sensor into intake air duct.
2. Connect a IAT sensor connector to the IAT sensor.
3. Connect the negative battery cable.

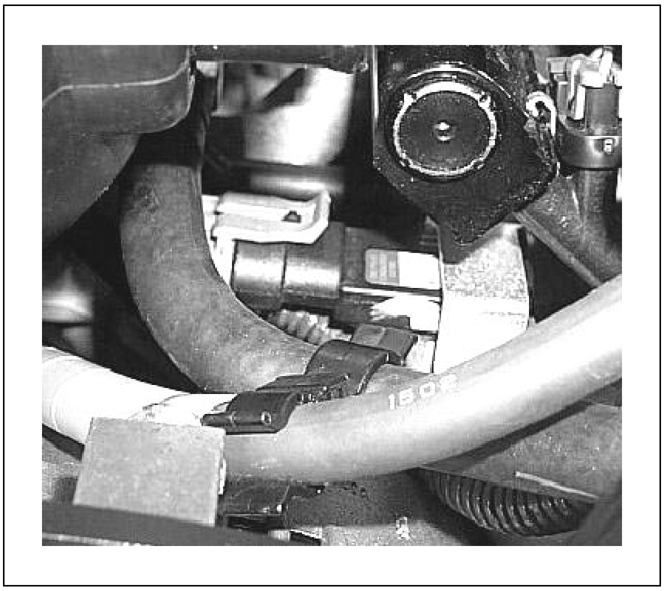
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

Location
Installed on the intake manifold.

Removal Procedure

1. Disconenct the negative battery cable.
2. Disconnect a MAP sensor connector from the MAP sensor.
3. Loosen a bolt and remove the MAP sensor from the intake manifold.
4. Remove the MAP sensor from the bracket.



Installation Procedure

1. Tighten the MAP sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 8N·m (0.8kgf·m)

2. Connect a MAP sensor connector to the MAP sensor.
3. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

THROTTLE POSITION SENSOR (TPS)

Location
Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the TPS connector.
3. Loosen two screws and remove TPS from the throttle body.

Installation Procedure

1. Temporary tighten the TPS by two screws.
2. Connect a TPS connectors to the TPS.
3. Connect the Tech2 to the vehicle.
4. Connect the negative battery cable.
5. Select "Data Display" with the Tech2.
6. Check the throttle position data and adjust the TPS position.
7. Tighten two screws.

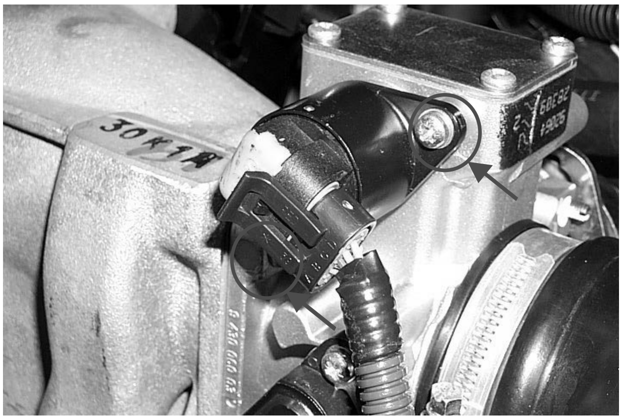
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

IDLE AIR CONTROL (IAC) VALVE

Location
Installed on the throttle body.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the IAC valve connector.
3. Loosen two screws and remove IAC valve from the throttle body.

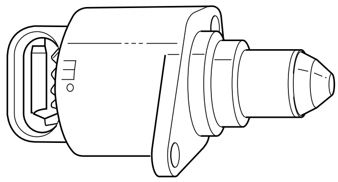


Cleaning and Inspection

1. Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
2. Use carburetor cleaner and a parts cleaning brush to remove carbon deposit.
   Do not use a cleaner that contain methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
3. Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
4. Inspect the IAC valve O-ring for cuts, cracks or distortion.

Measurement

- Clean the IAC valve O-ring sealing surface, pintle valve seat and air passage.
- Use carburetor cleaner and a parts cleaning brush to remove carbon deposit. Do not use a cleaner that contain methyl ethyl ketone. This is an extremely strong solvent and not necessary for this type of deposit.
- Shiny spots on the pintle are normal and do not indicate misalignment or a bent pintle shaft.
- Inspect the IAC valve O-ring for cuts, cracks or distortion. Replace the O-ring if damaged.



Installation Procedure

1. Tighten the IAC valve by two screws.
2. Connect a IAC valve connector to the MAP sensor.
3. Connect the negative battery cable.

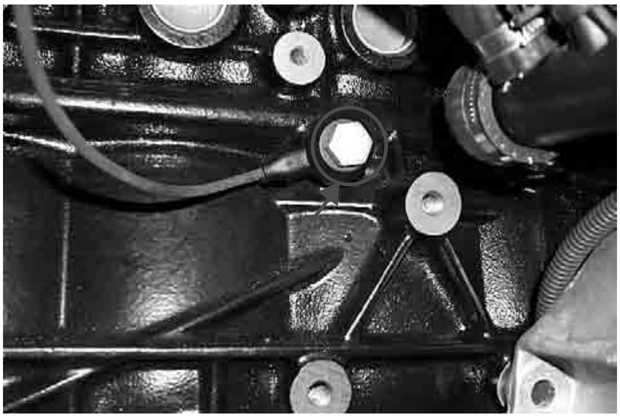
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

KNOCK SENSOR

Location
Right-hand side of the cylinder block.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the knock sensor connector.
3. Loosen a bolt and remove knock sensor from the cylinder block.



Installation Procedure

1. Tighten the knock sensor by a bolt with specified tightening torque.

Tightening Torque

- Bolt: 20N·m (2.0kgf·m)

2. Connect a knock sensor connector to the knock sensor.
3. Connect the negative battery cable.

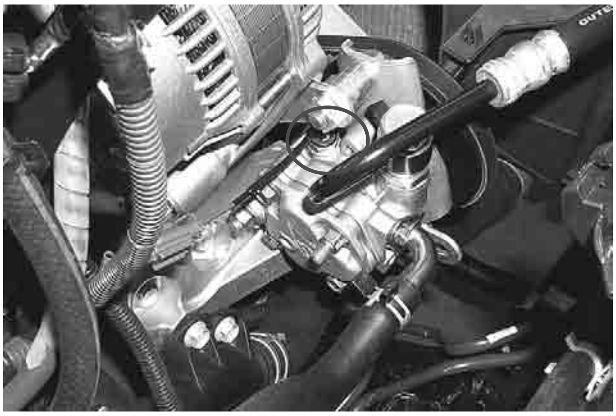
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.

POWER STEERING PRESSURE (PSP) SWITCH

Location
Installed on the power steering pump assembly.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the power steering pressure switch connector.
3. Loosen and remove the power steering pressure switch from the power steering pump.



Installation Procedure

1. Install the power steering pressure switch to the power steering pump.
2. Tighten the power steering pressure switch.
3. Connect a connector to the power steering pressure switch.
4. Connect the negative battery cable.

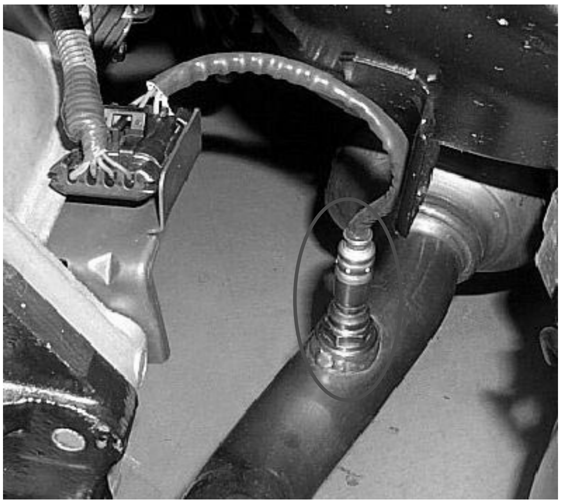
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify no power steering fluid leaking from the sensor threads after replacement.

HEATED OXYGEN SENSOR (HO2S)

Location
Installed on the exhaust pipe.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the O_2 sensor connector.
3. Loosen and remove the O_2 sensor from the exhaust pipe.



Inspection
Inspect the louvered end of the sensor for grease, dirt, excessive carbon build up or other contamination.

Installation Procedure

1. Install the O_2 sensor to the exhaust pipe.
2. Tighten the O_2 sensor with specified tightening torque.

Tightening Torque

- Bolt: 42N·m (4.3kgf·m)

3. Connect a O_2 sensor connector to the O_2 sensor.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify no exhaust gas leaking from the sensor threads after replacement.

EVAP CANISTER PURGE VALVE SOLENOID

Location
On the intake manifold.

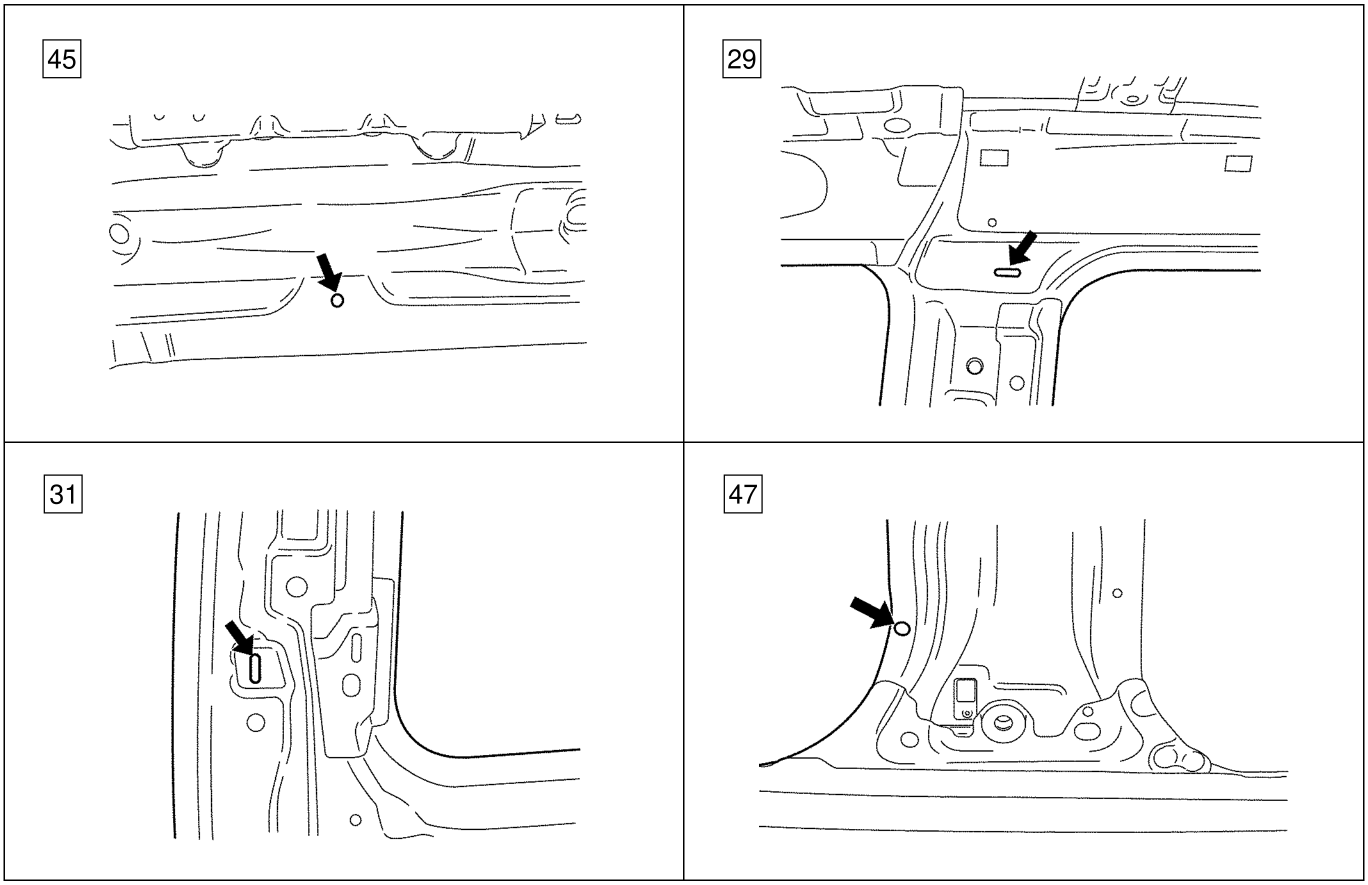
Removal Procedure

1. Disconenct the negative battery cable.
2. Disconnect a purge solenoid connector from the purge solenoid.
3. Disconnect two hoses from the purge solenoid valve.
4. Slide from the bracket and remove the purge solenoid.

Installation Procedure

1. Insert EVAP purge solenoid valve onto the bracket.
2. Connect two hoses to the purge solenoid valve.
3. Connect a purge solenoid connector to the purge solenoid.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of two hoses.


45
29
31
47

FUEL PRESSURE RELIEF

Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a short towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

1. Remove the fuel filler cap.
2. Remove the fuel pump relay from the underhood relay box.
3. Start the engine and allow it to stall.
4. Crank the engine for about 30 seconds.
5. Disconnect the negative battery cable.

FUEL RAIL ASSEMBLY

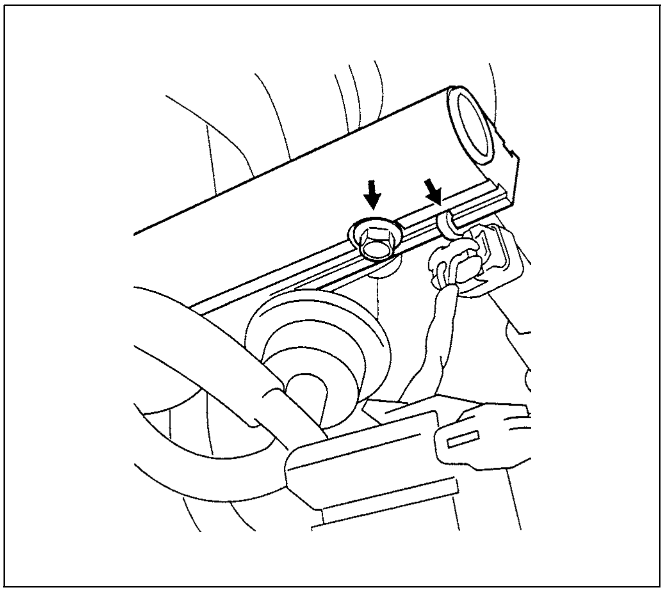
Removal Procedure

NOTE:

- Use care when removing the fuel rail assembly in order to prevent damage to the injector al connector terminal and the injector spray tips.
- Fitting should be capped and holes plugged during servicing to prevent dirt and other contaminants from entering open lines and passage.

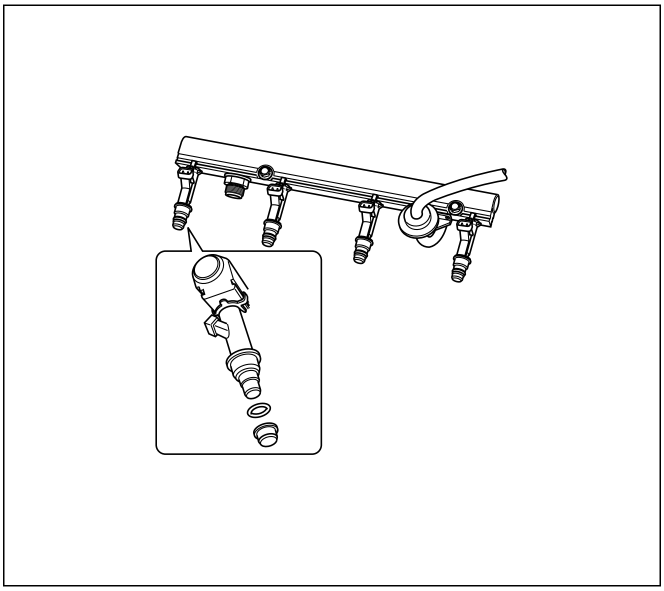
Important: An eight-digit identification number is stamped on side of the fuel injector. Refer to this number when you service the fuel rail or when a replacement part is required.

1. Disconnect 4 injector connectors.
2. Lift side-clip up on the fuel rail.
3. Disconnect fuel pressure regulator hose.
4. Disconnect wiring harness from the bands on the fuel rail.
5. Remove the intake pipe.
6. Loosen flare nut.
   A. Lift up the injectors carefully to separate them from intake manifold.
   B. Lift up the fuel rail with injectors as assembly. Do not separate the fuel injectors from fuel rail.
   C. If an injector become separated from fuel rail, injector backup O-ring and injector retainer clip must be replaced.
   D. Drain residual fuel from fuel rail into an approved container.



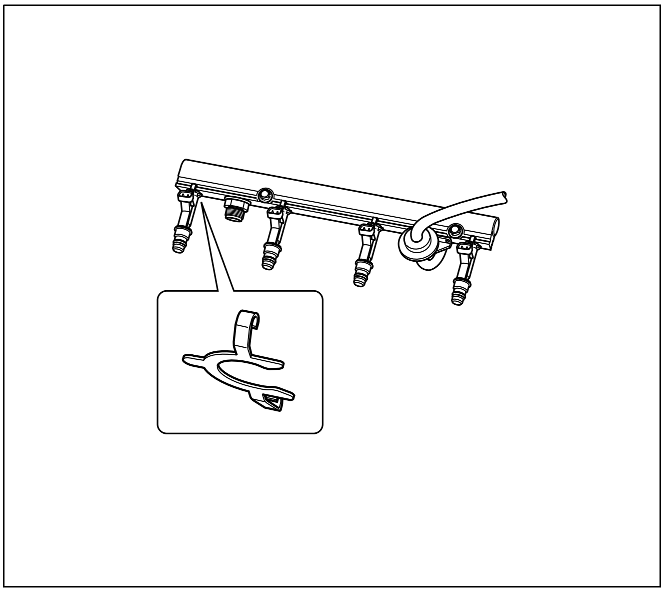
7. If removal of fuel pressure regulator is necessary, Refer to *Fuel Pressure Regulator Removal Procedure*.

8. If removal of fuel injector is necessary, Refer to *Fuel Injectors Removal Procedure*.

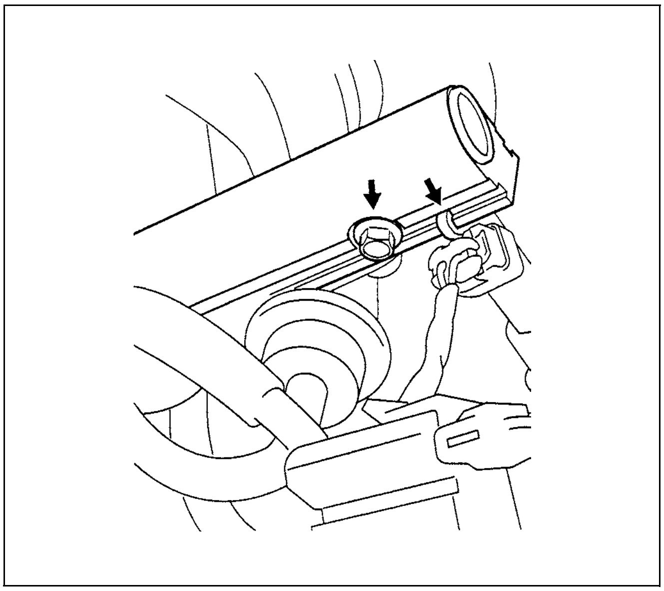


Installation Procedure

1. Install the fuel injectors if necessary. Refer to Fuel Injector Installation Procedure.
2. Install the fuel pressure regulator if necessary. Refer to *Fuel Pressure Regulator Installation Procedure*.
3. Place the fuel injector rail assembly on the manifold and insert the injectors into each port by pushing fuel rail.



4. Install two fuel rail retaining bolts. Tighten fuel rail retaining bolt to 19 N·m (1.9kgf·m)
5. Place wiring harness in its place and secure it with two nuts.
6. Connect all connector to each fuel injector.
7. Connect the fuel supply line securely. Do not over tighten.
8. Connect the fuel return line securely. Do not over tighten.
9. Connect the negative battery cable.
10. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel system. Check for leak. If fuel leak is observed, stop engine immediately. Before correcting fuel leak, be sure to depressurize system again.

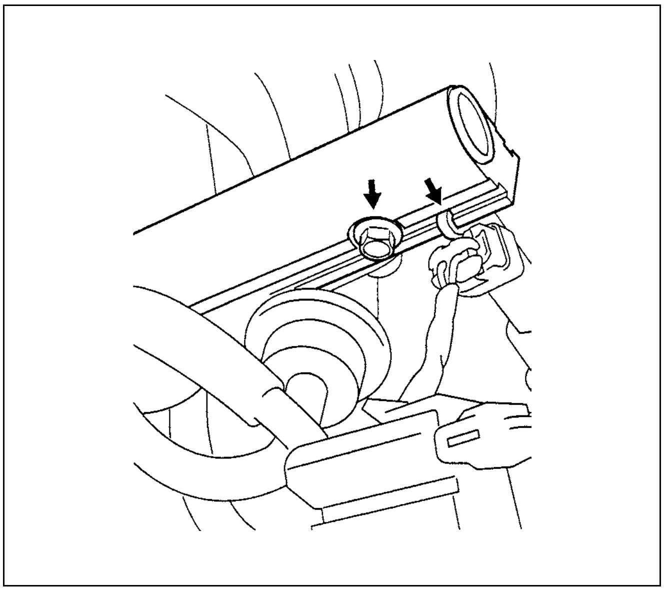


FUEL INJECTOR

Removal Procedure

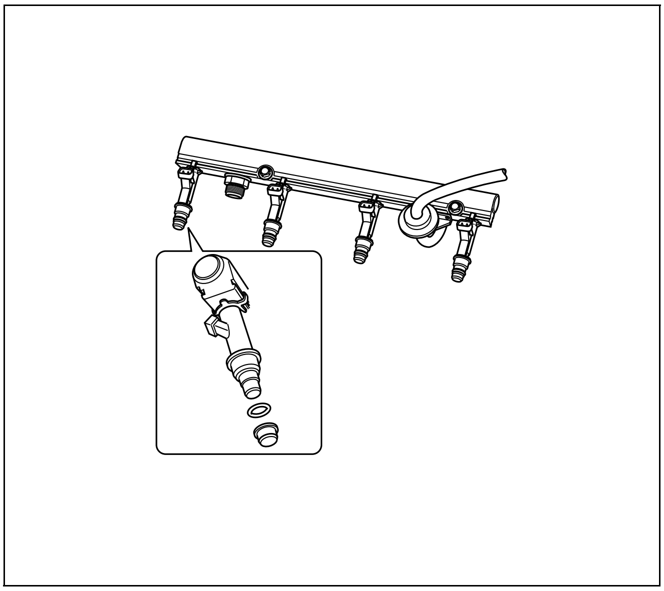
NOTE: If the fuel injectors are leaking, the engine oil may be contaminated with fuel. Check the oil for signs of contamination and change the oil and filter if necessary.

NOTE: Use care in removing the fuel injector in order to prevent damage to the fuel injector al connector pins or fuel injector nozzles. The fuel injector is an al component and should not be immersed in any type of cleaner as this may damage the fuel injector.



Important: Fuel injectors are serviced as complete assembly only.

1. Disconnect the negative battery cable.
2. Disconnect al connector from fuel injector.
3. Remove the fuel rail. Refer to *Fuel Rail Removal Procedure*.
4. Remove the fuel injector retainer clip.
5. Remove the fuel injector assembly from fuel rail.
6. Remove O-ring from the fuel injector.
7. Remove O-ring backup from fuel injector.

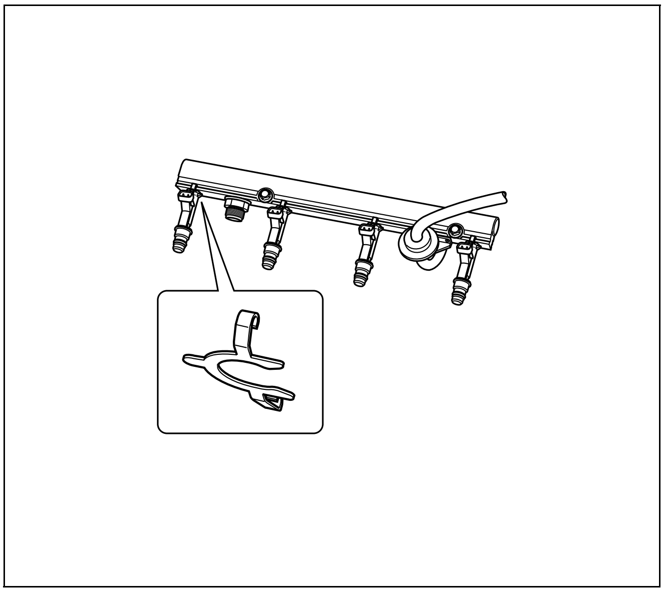


Inspection

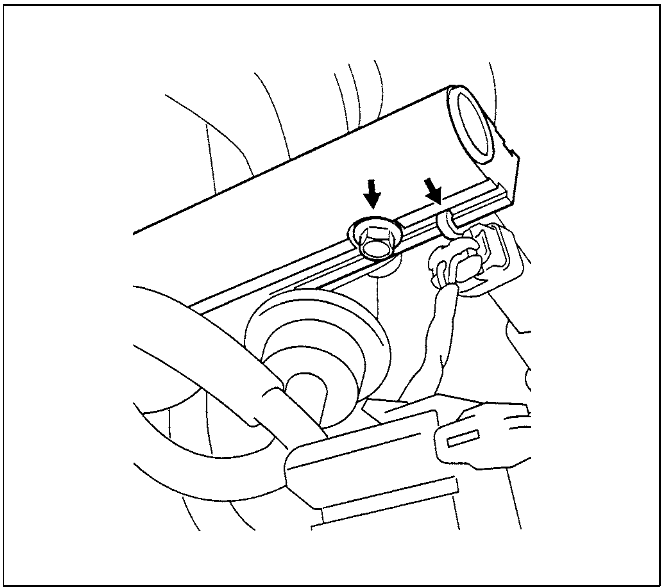
1. Inspect O-ring for crack, damage or leaks.
2. Replace worn or damaged O-ring.
3. Lubricate the new O-rings with engine oil before installation.

Installation Procedure

1. Lubricate the new O-ring with engine oil.
2. Install the O-ring backup on the fuel injector.
3. Install new O-ring on the fuel injector.
4. Install all four injector on the fuel rail.
5. Use new injector retainer clip to retain the injetor to the fuel rail.
6. Coat the end of the fuel injector with engine oil.



7. Install fuel rail assembly. Tighten the nuts to 19 N·m (1.9 kgf·m). Refer to *Fuel Rail Installation Procedure*.
   Tighten the flare nut to 27 - 33 N·m (2.8 - 3.4 kgf·m).
8. Connect the negative battery cable.



FUEL PRESSURE REGULATOR

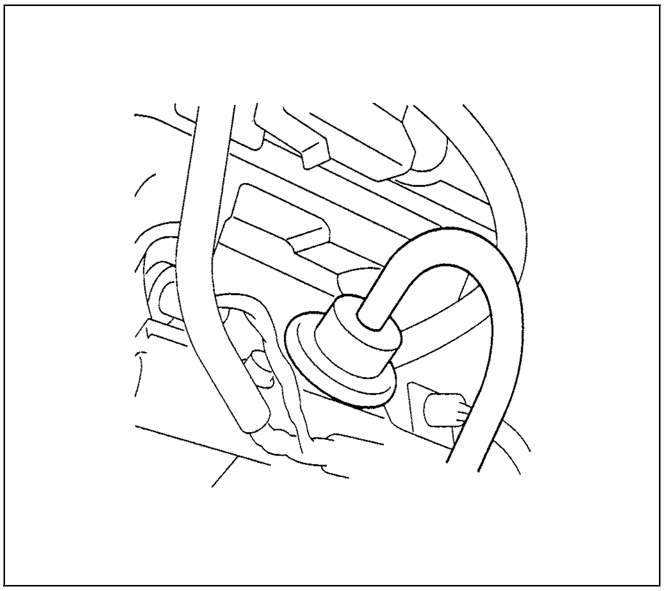
Removal Procedure

Caution: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing the fuel system components.

Caution: After relieving the fuel system pressure, a small amount of fuel may be released when servicing fuel lines or connections. Reduce the chance of personal injury by covering the fuel line fitting with a shop towel before disconnecting the fittings. The towel will absorb any fuel that may leak out. When the disconnect is completed, place the towel in an approved container.

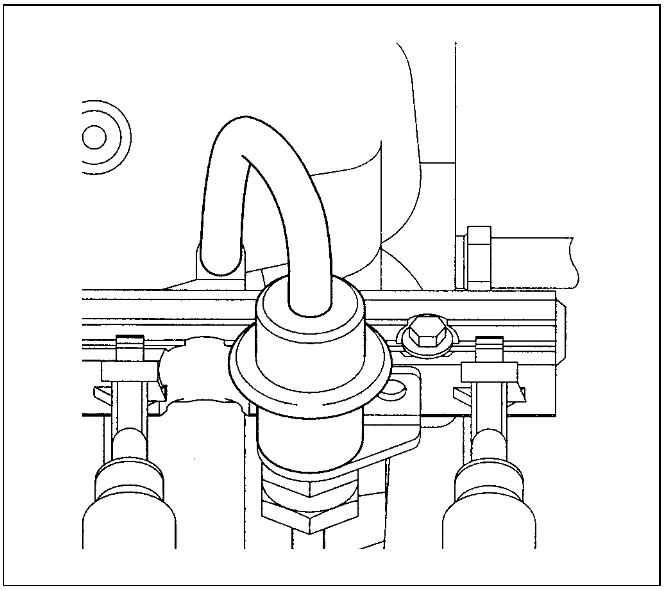
NOTE: Compressed air must never be used to test or clean a fuel pressure regulator, as damage to the fuel pressure regulator may occur.

NOTE: To prevent damage to the fuel pressure regulator, do not immerse the pressure regulator in solvent.

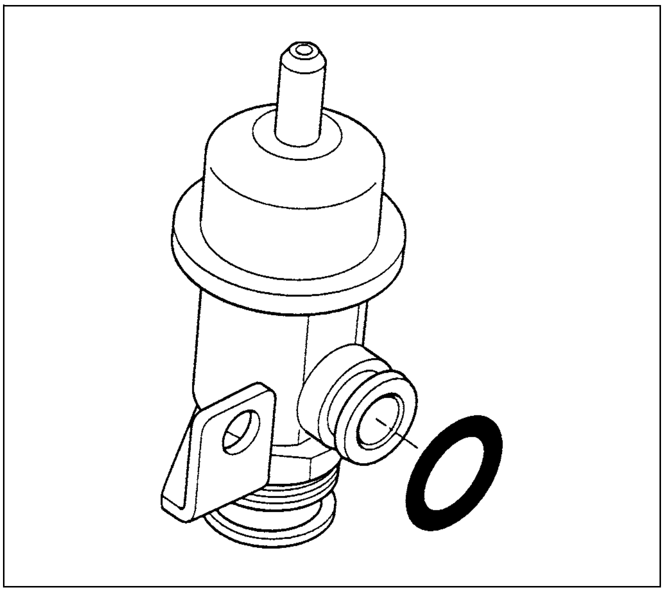


Removal Procedure

1. Depressurize the fuel system. Refer to *Fuel Pressure Relief Procedure.*
2. Disconnect the negative battery cable.
3. Remove the fuel pump relay.
4. Disconnect the vacuum line form fuel pressure regulator.

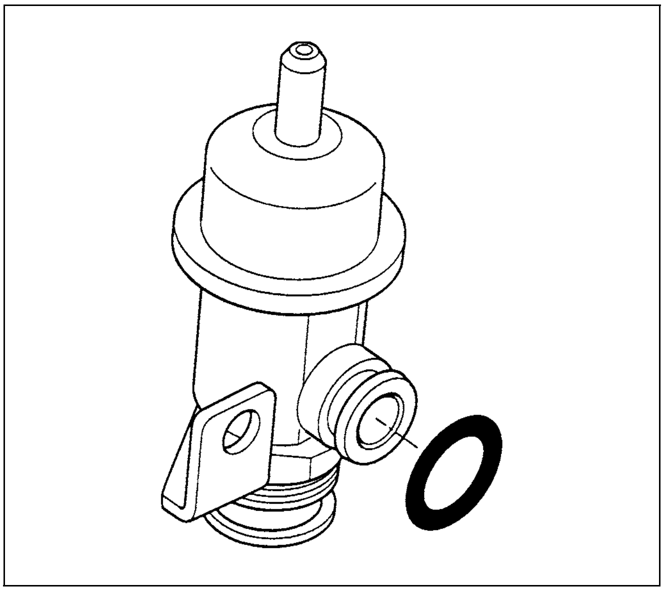


5. Remove the fuel pressure regulator retaining screw.
6. Remove the fuel pressure regulator from fuel rail.

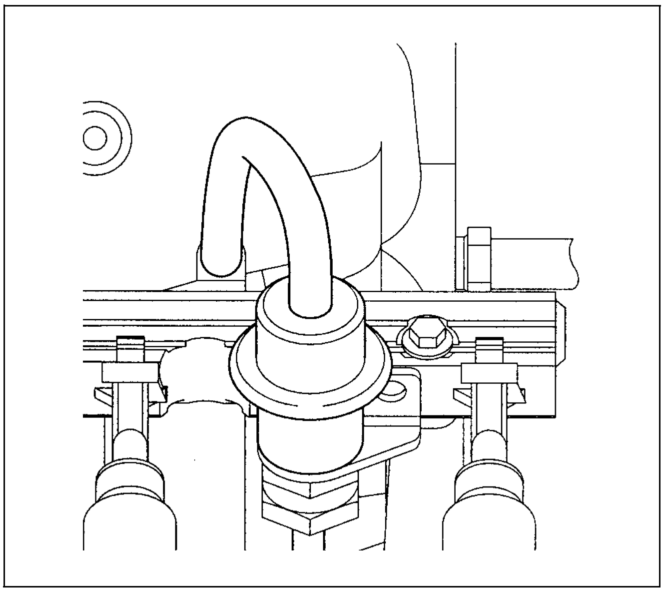


Installation Procedure

1. Insert the fuel pressure regulator into the fuel rail.



2. Install the fuel pressure regulator retaining bracket and tighten with a screw.
3. Connect vacuum line onto the fuel pressure regulator.



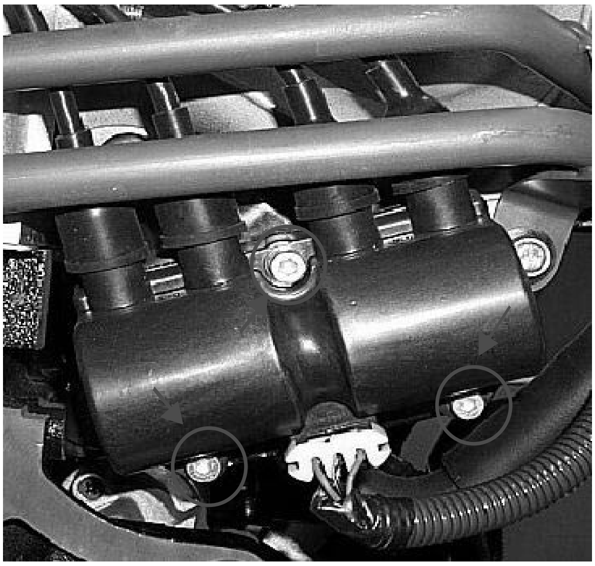
4. Install the fuel pump relay.
5. Connect the negative battery cable.
6. Crank the engine until it starts. Cranking the engine may take longer than usual due to trapped air in the fuel line.
7. Tighten the flare nut to 27 - 33 N·m (2.8 - 3.4 kgf·m).

IGNITION COIL

Location
Back of the engine right-hand side.

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the ignition coil connector.
3. Disconnect four spark plug cables from the ignition coil.
4. Loosen three bolts and remove ignition coil from the bracket.



Installation Procedure

1. Tighten the ignition coil by three bolts.
2. Connect four spark plug cables to the ignition coil.
3. Connect a ignition coil connector to the ignition coil.
4. Connect the negative battery cable.

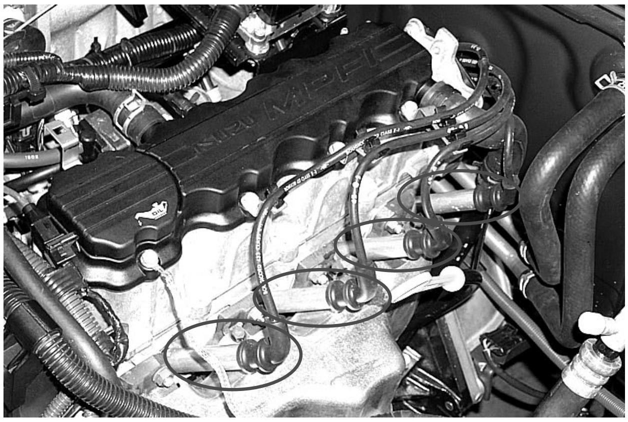
NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of spark plug cables for each cylinders.

SPARK PLUGS

Location
Installed on the left-hand side of cylinder head.

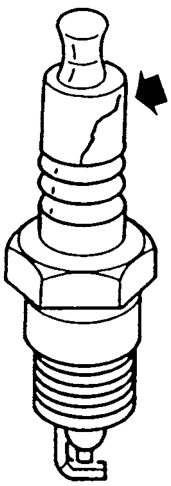
Removal Procedure

1. Disconnect the negative battery cable
2. Remove the spark plug cable.
3. Remove the spark plug.



Inspection

1. Check the insulator for cracks. Replace the spark plug if cracks are present.
2. Check the electrode condition and replace the spark plug if necessary.



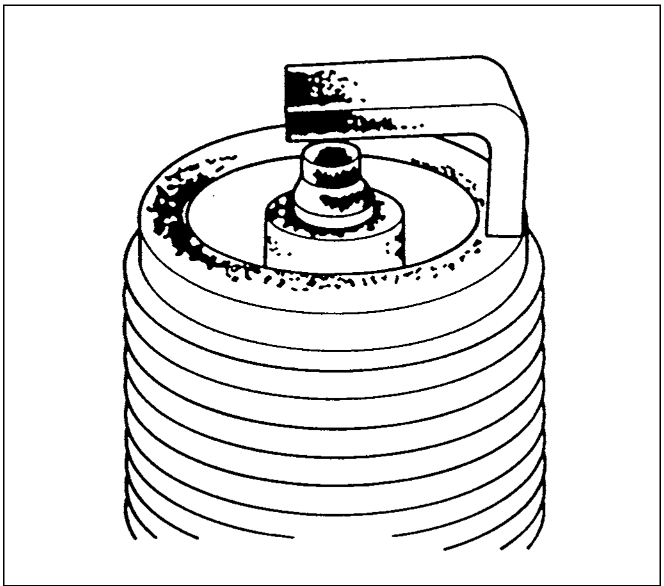
If the spark plug electrodes and insulators are fouled with carbon or oil, the engine will not operate efficiently. There are a number of possible causes:

- Fuel mixture is too rich.

- Oil in the combustion chamber.
- The spark plug gap is not set correctly.

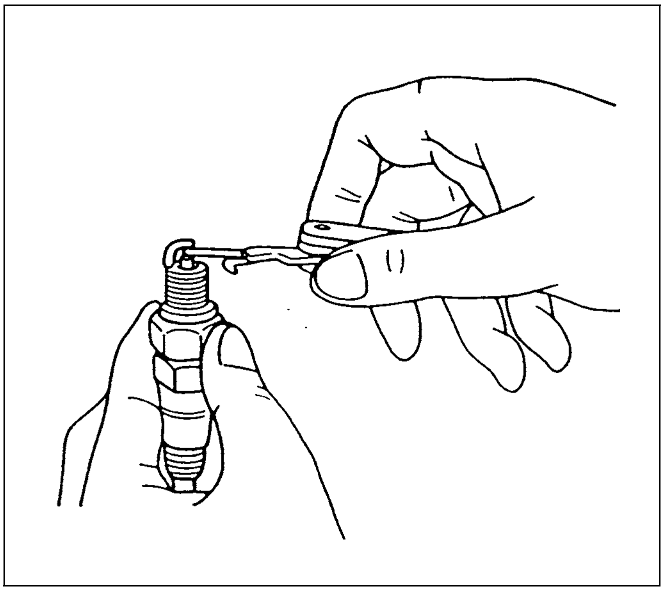
If spark plug fouling is excessive, check the fuel and al system for possible causes of trouble. If fuel and al system are normal, install spark plugs of a higher heat range which have the same physical dimensions as the original equipment spark plugs.
The following symptoms are characteristics of spark plugs that are running too hot:

- Fuel mixture is too lean.
- Heat range is incorrect.



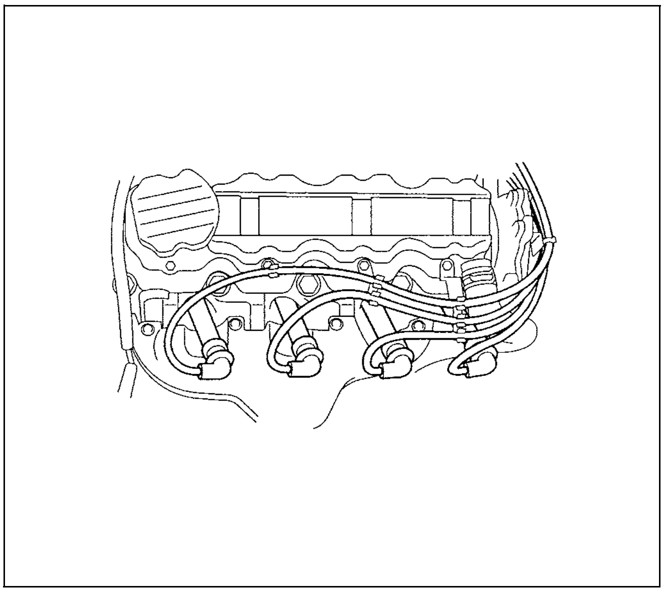
If vehicle usage does not conform to normal driving conditions, a more suitable spark plug may be substituted.
If fuel and al system are normal, in most cases of this sort, the problem can be corrected by using a colder type spark plug with the same physical dimensions as the original equipment spark plug.

3. Check the gaskets for damage and replace if necessary.
4. Measure the spark plug gap. The specification is 1.0 to 1.1mm (0.039 to 0.043").
5. Adjust the spark gap by bending the grounded electrode.



Installation

1. Tighten the spark plug to the 25N·m (2.5kgf·m).
2. Push the spark plug cable in until it snaps in.



Installation Procedure

1. Install the spark plug to the cylinder head.
2. Tighten the spark plug with specified tightening torque.

Tightening Torque

- Bolt: 25N·m (2.5kgf·m)

3. Connect the spark plug cable to the spark plug.
4. Connect the negative battery cable.

NOTE: Verify any DTCs (diagnosis Trouble Code) are not stored after replacement.
Verify proper connection of spark plug cables for each cylinders.

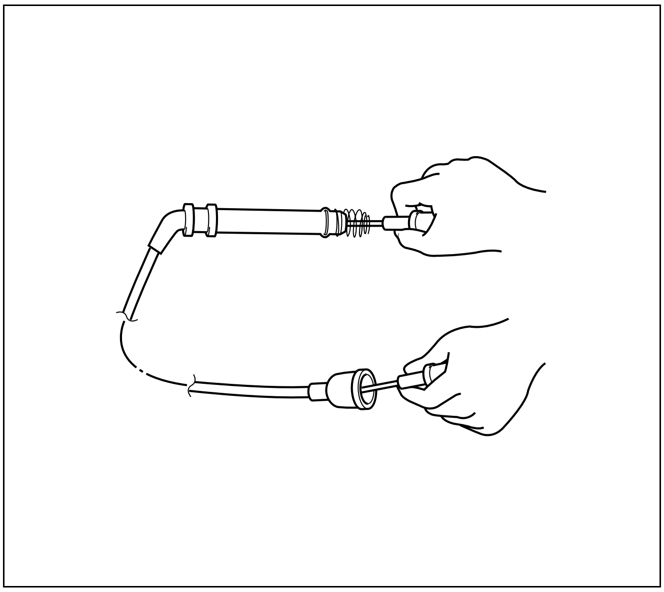
SPARK PLUG CABLES

The cable contains a synthetic conductor which is easily damaged. Never stretch or kink the cable. Disconnect the cable from spark plug and the ignition coil.
The original equipment cables and the ignition coil are marked to show correct location of the cables. If spark plug cables or the ignition coil are replaced previously, before cables are removed from the ignition coil, mark the cables and the coil so they can be reconnected in the same position.

Inspection

NOTE: Never puncture the spark plug cable's insulation with a needle or the pointed end of a probe into the cable. An increase in resistance would be created which would cause the cable to become defective.

1. If the cable has broken or cracked insulation, it must be replaced.
2. If the terminals are corroded or loose, the cable must be replaced.
3. Check that the cable resistance does not exceed specified value.
   #1 cylinder: 3.50kΩ - 5.24kΩ
   #2 cylinder: 2.89kΩ - 4.33kΩ
   #3 cylinder: 2.49kΩ - 3.73kΩ
   #4 cylinder: 2.22kΩ - 3.32kΩ



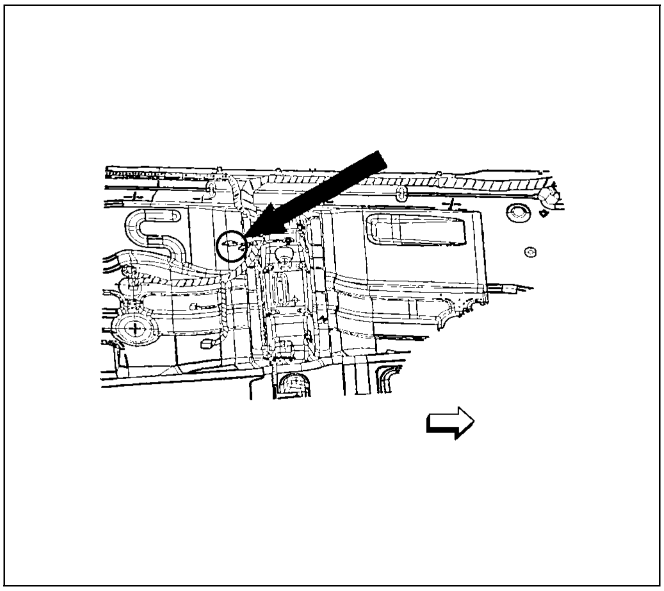
EMISSION CONTROL ; *CO ADJUSTER (W/O CATALYSTIC CONVERTER)

*CO : Carbon monoxide

Location
Under the leht-hand side of the front sheet.

Removal Procedure

1. Remove the left-hand side of the front sheet. Refer to Sec.10 CAB “Front Sheet”.
2. Disconnect the CO adjuster connector.



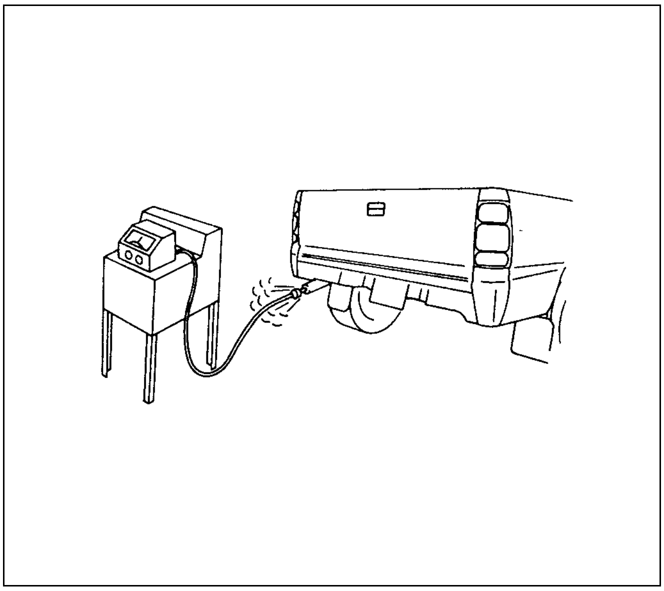
3. Remove the CO adjuster.

Installation Procedure

1. Connect the CO adjuster connector.
2. Install the left-hand side of the front sheet. Refer to Sec.10 CAB “Front Sheet”.
3. Check and adjust CO concentration.

Checking procedure

1. Operate the engine at normal temperature.
2. Turn all accessories switch OFF.
3. Place the select lever in the “N” range.
4. Start the engine at idle.

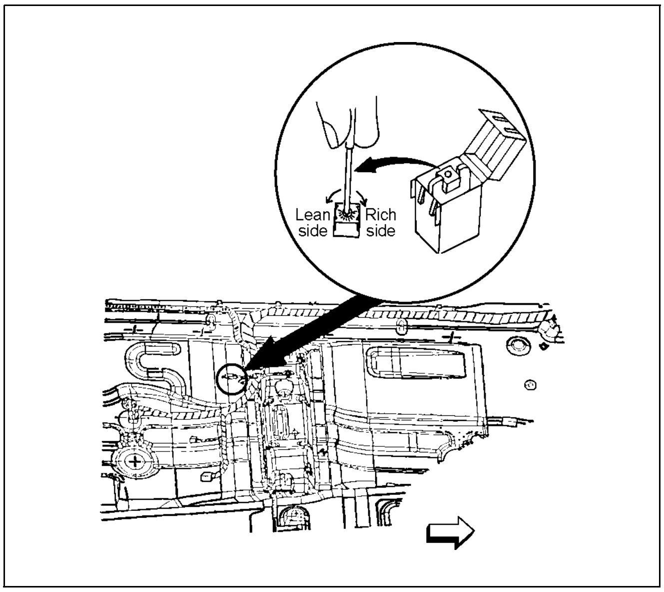


5. Measure the CO concentration for 1-3 minutes, after idlling the engine to allow the CO concentration to stabilize.
6. Check the CO concentration.
7. If the value is not within specification, adjust the CO concentration.

Adjustment Procedure

1. Warm-up the engine.
2. Turn OFF switches of all electrical equipment.
3. Open the CO adjuster cap.
4. Turn the CO adjuster screw checking the CO concentration

.

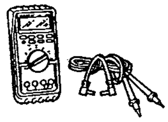
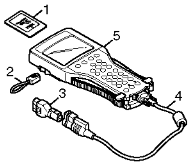


5. Adjust the CO concentration within specification.

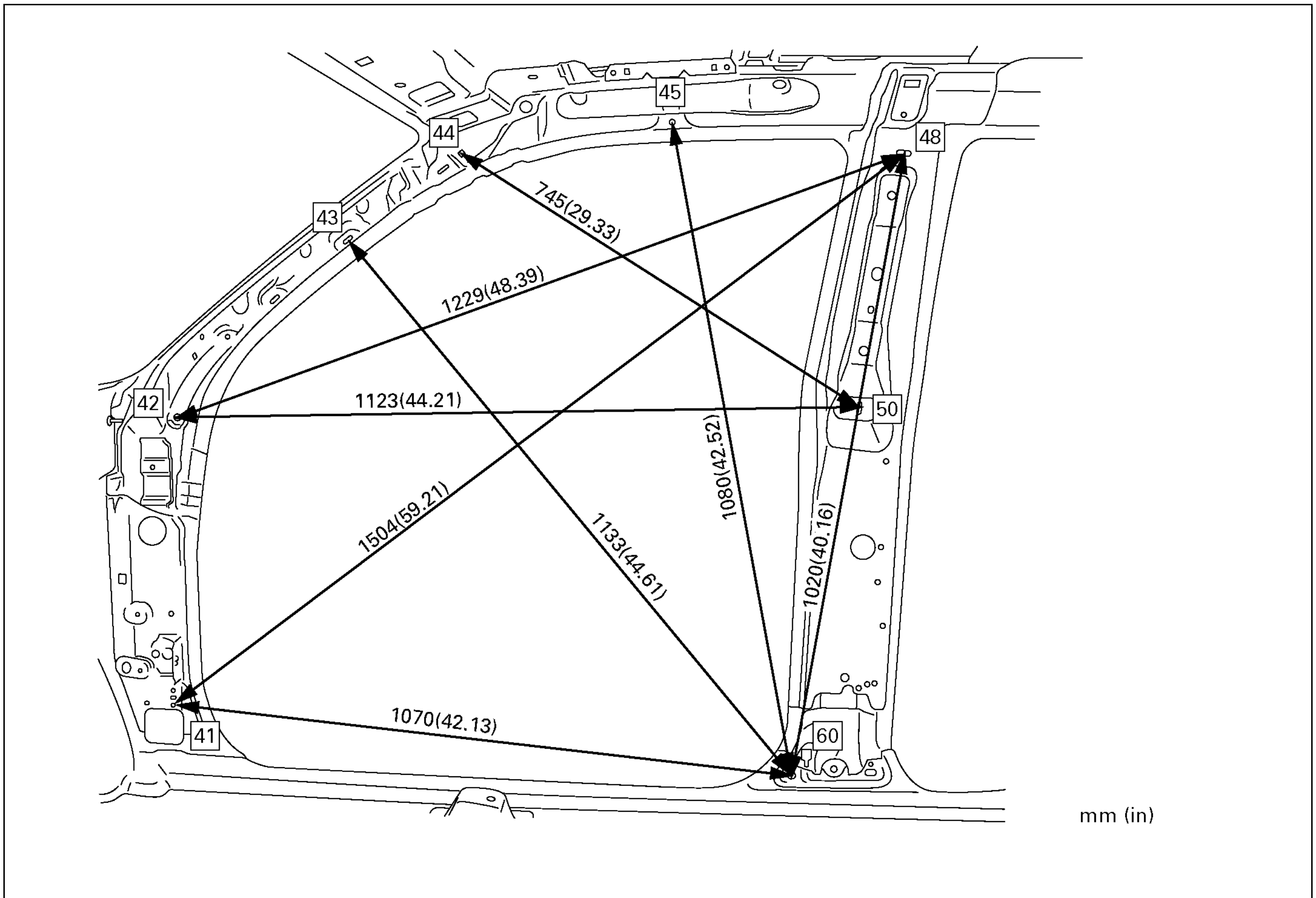
Specification:
CO concentration : 0.6 — 1.0 %

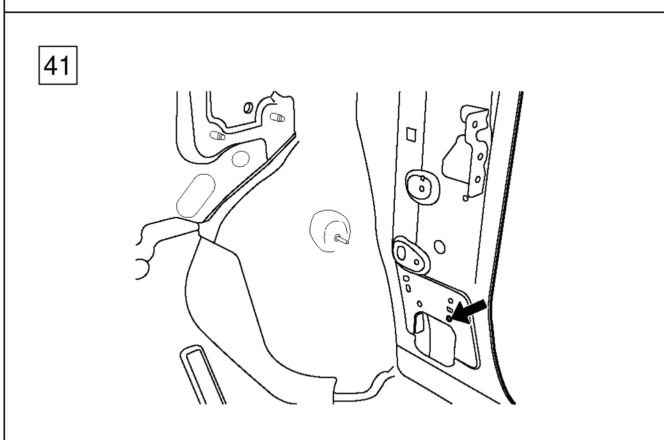
NOTE: Apply the liquid gasket to the CO adjuster screw after the adjustment.

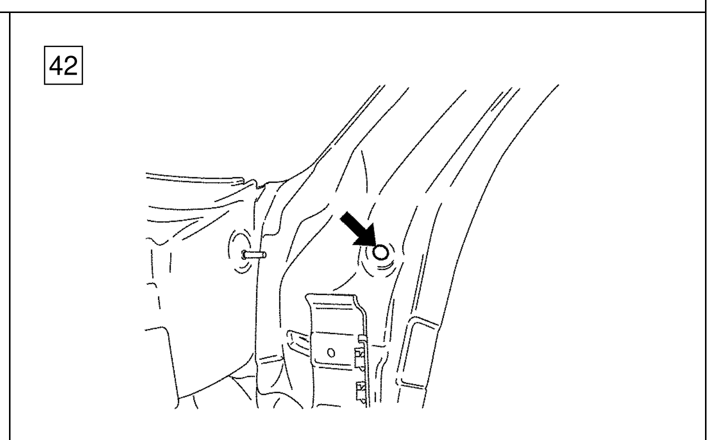
SPECIAL SERVICE TOOLS

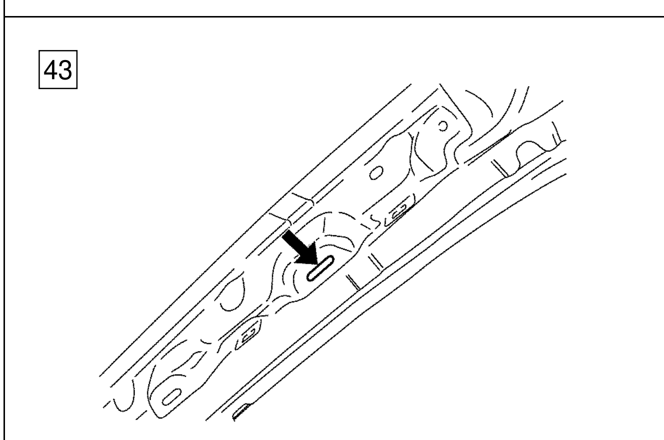
ILLUSTRATION	TOOL NO. TOLL NAME
 TS 22900	**5-8840-0285-0** **(J 39200)** High Impedance Multimeter (Digital Voltmeter -DVM)
	(1) PCMCIA Card (2) RS232 Loop Back Connector (3) SAE 16/19 Adapter (4) DLC Cable (5) TECH 2
 TS 23369	**5-8840-0385-0** **(J 35616-A/BT-8637)** Connector Test Adapter Kit
	**5-8840-0378-0** **(J34730-E)** Port Fuel Injection Diagnostic Kit
	Breaker Box
	**5-8840-2589-0** Injector Adapter Cable

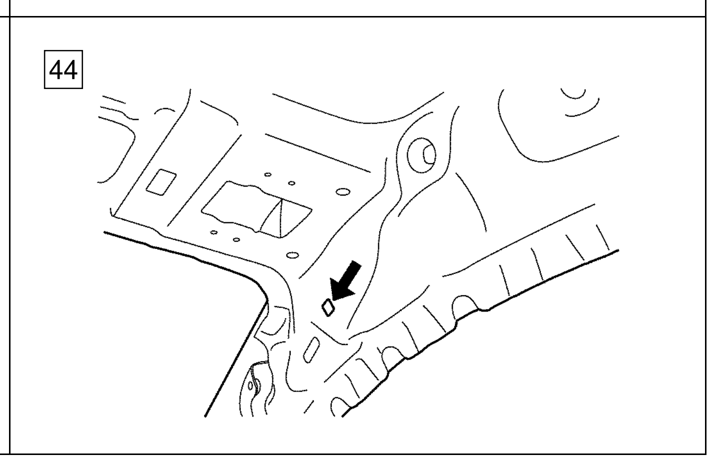
SIDE BODY SECTION; FRONT SIDE (CREW CAB)











SECTION 6F

ENGINE EXHAUST

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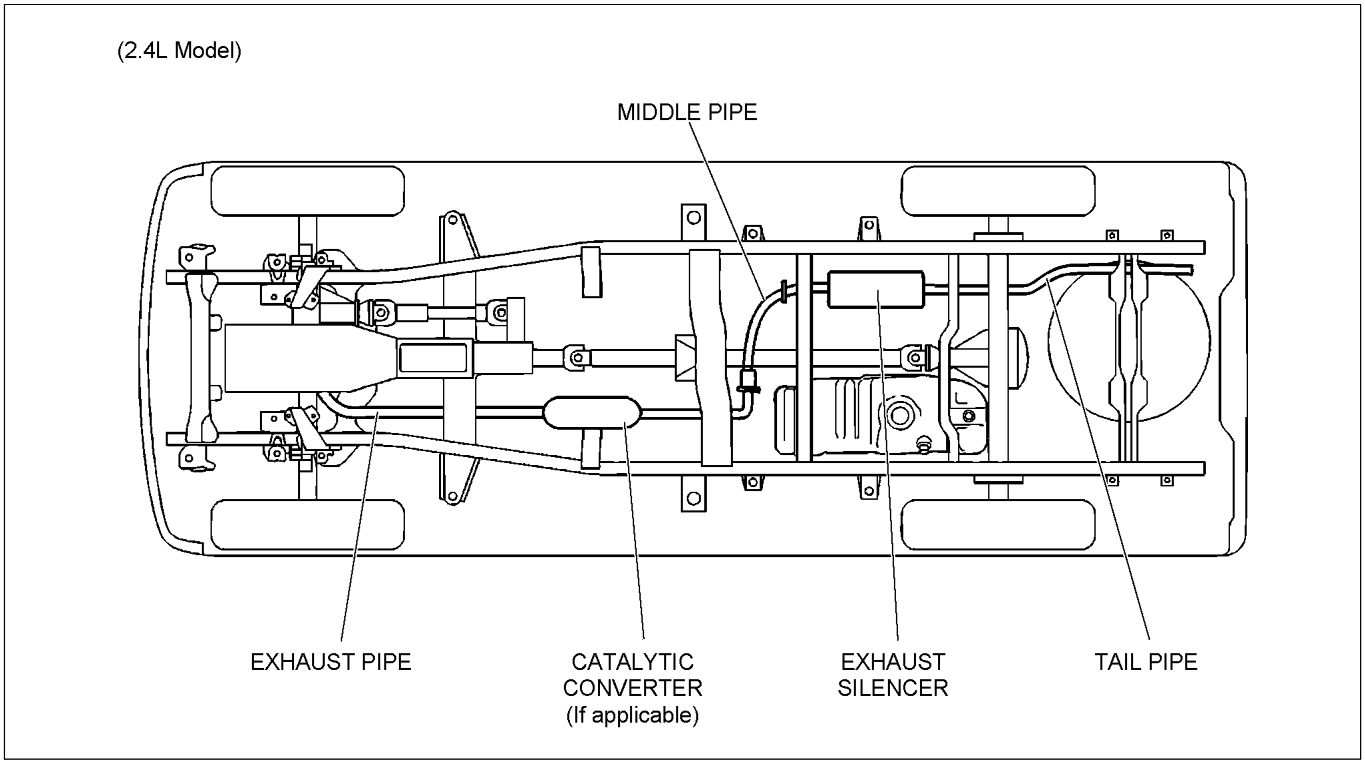
General Description



RTW46AMF000501

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating the floor pan and possible damage to the passenger compartment insulation and trim materials.
Check complete exhaust system and nearby body areas and rear compartment lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.

Hangers

Various types of hangers are used to support exhaust system(s). These include conventional rubber straps, rubber rings, and rubber blocks.
The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations which can be difficult to diagnose.

Three Way Catalytic Converter (If applicable)

The three way catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

CAUTION: The catalytic converter requires the use of unleaded fuel only.
Periodic maintenance of the exhaust system is not required. If the vehicle is raised for other service, it is advisable to check the condition of the complete exhaust system.
A dual bed monolith catalytic converter is used in combination with three way catalytic converter.
Catalytic Types:
Three way (Reduction/Oxidation) catalyst
The catalyst coating on the three way (reduction) converter contains platinum and rhodium which lowers the levels of nitrous oxide (NOx) as well as hydrocarbons (HC) and carbon monoxide (Co).

Gasket

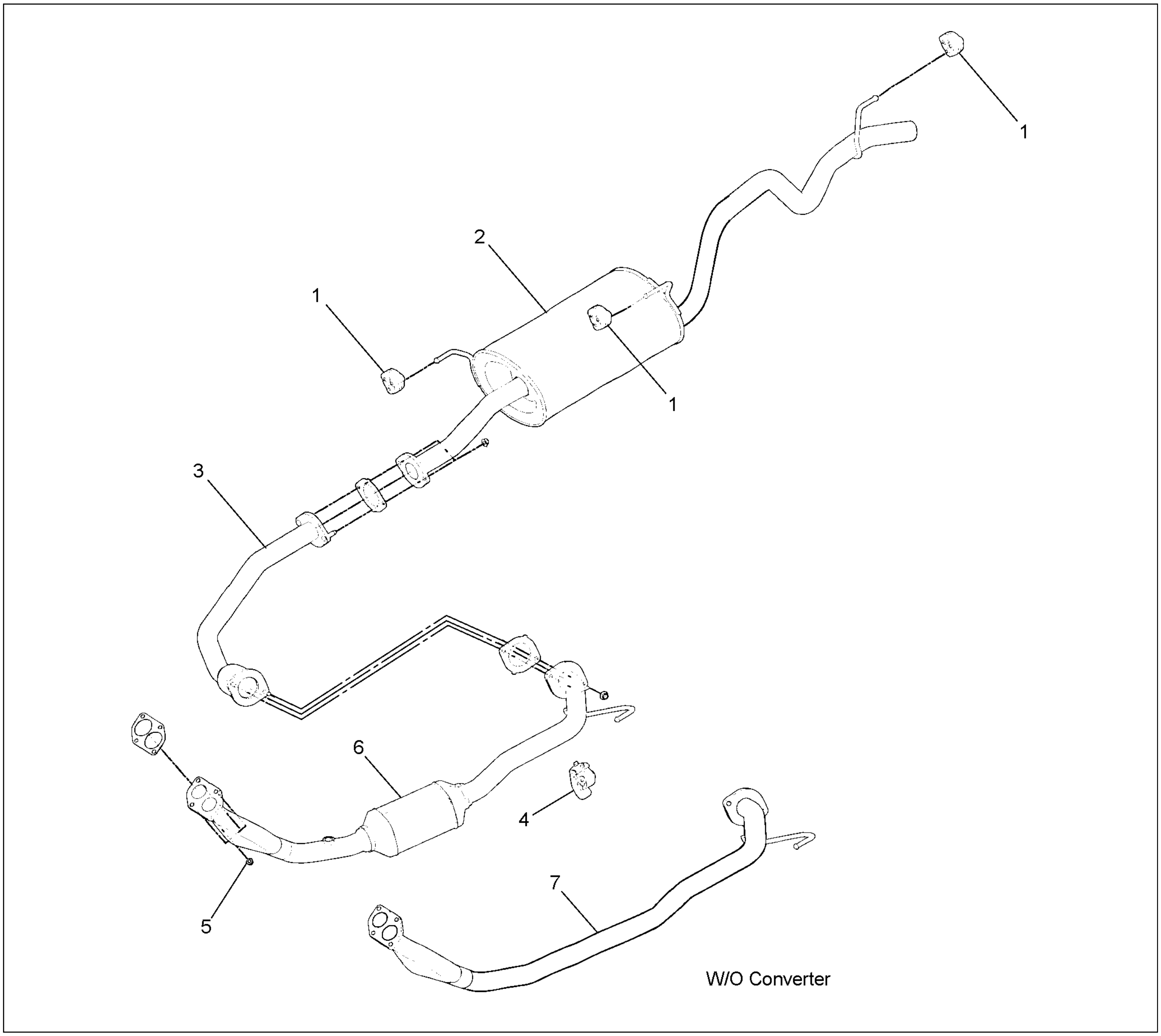
The gasket must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Exhaust Pipe

Exhaust Pipe and Associated parts



RTW46FLF000401

Removal

(2.4L)

CAUTION

When you remove or install the front exhaust pipe, make sure not to damage the fuel evaporative pipe.

1. Damper rubber
2. Exhaust silencer
3. Mid pipe
4. Damper rubber
5. Front exhaust pipe fixing nut
6. Catalytic converter (If applicable)
7. Front exhaust pipe

Installation

To install, follow the removal steps in the reverse order.

Important - Installation

1. Front Exhaust Pipe Flange Nut

Connect the exhaust pipe to the exhaust manifold.
Front exhaust pipe to manifold nut.
Torque

N·m (kgf·m)
28 (2.9)

Inspection

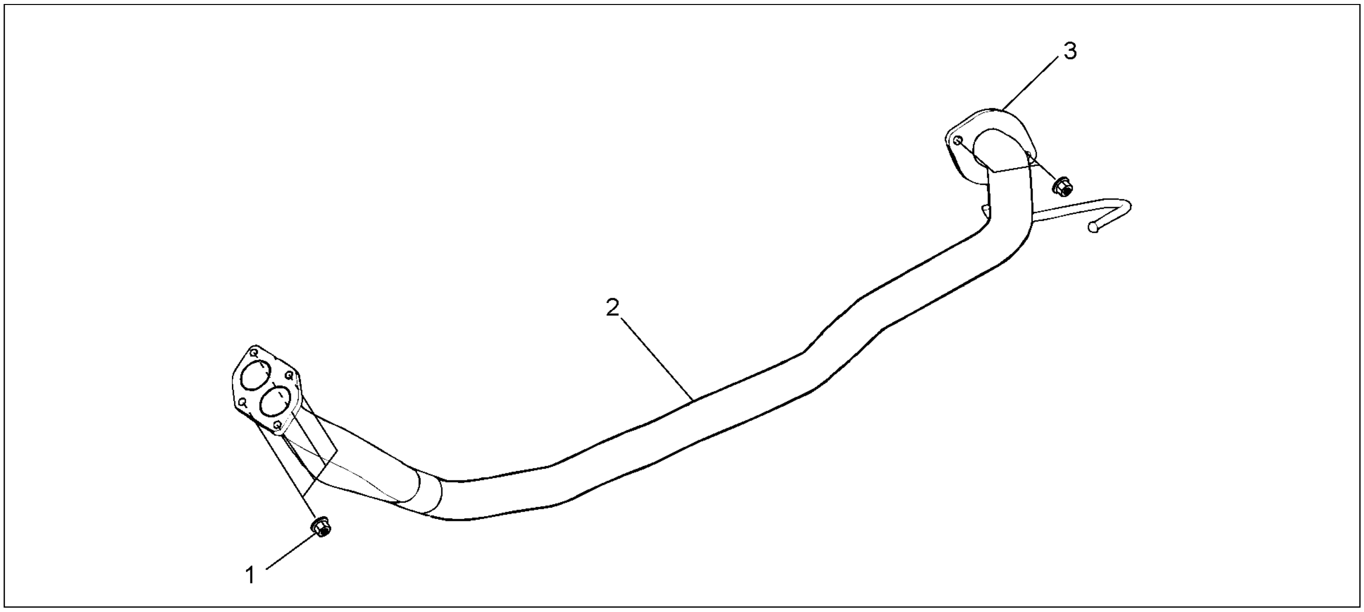
Make the necessary adjustments, and part replacements if excessive wear or damage is discover during inspection.

1. Front Exhaust Pipe
2. Center Exhaust Pipe and Catalytic Converter Flange Nut
3. Exhaust Pipe Damper Rubber
4. Exhaust Silencer with Rear Exhaust Pipe

Check the pipes for for corrosion, cracking , damage or misalignment and repair if required.
Check the damper rubber for deterioration or damage and repair if required.

Front Exhaust Pipe (W/O Catalytic Converter)

Front Exhaust Pipe and Associated Parts



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Legend

1. Front Exhaust Pipe Fixing Nuts
2. Front Exhaust Pipe
3. Mid Exhaust Pipe Fixing Nuts

Removal

(2.4L)

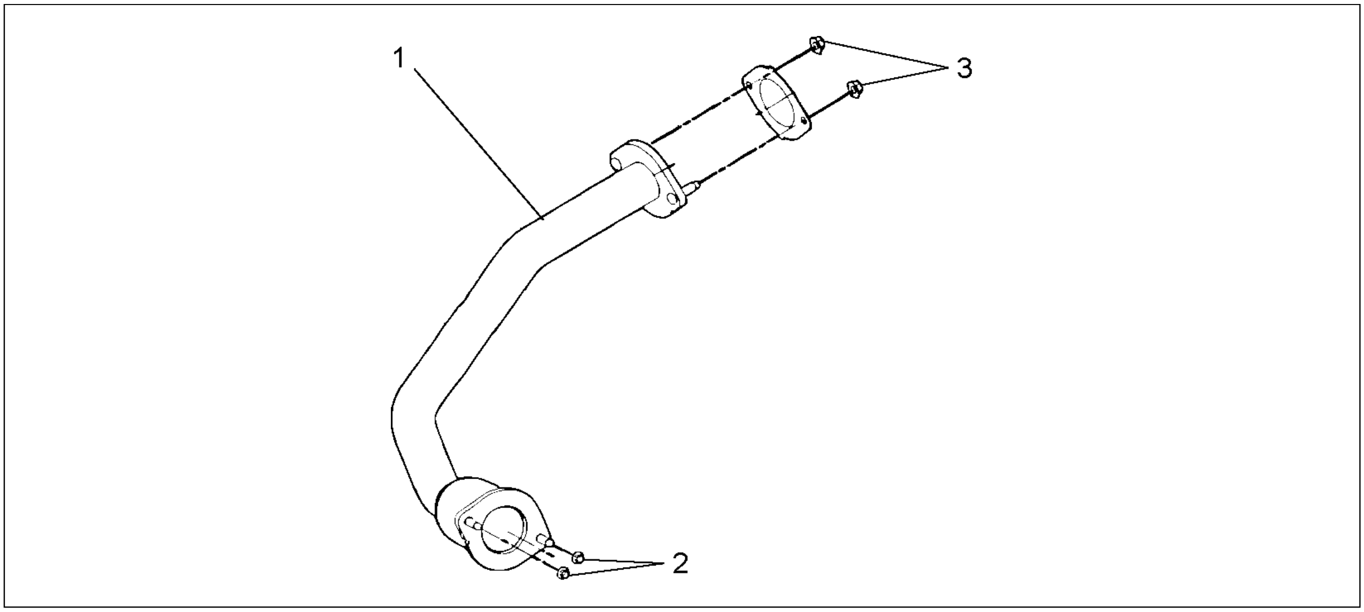
1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove the front exhaust pipe fixing nuts (1).
4. Remove mid pipe fixing nuts (3).
5. Remove front exhaust pipe (2).

Installation

1. Install front exhaust pipe (2) and tighten four nuts (1).
   Torque:
   Nuts: 28 N·m (2.9 kgf·m)
2. Tighten two nuts (3).
   Torque: 43 N·m (4.4 kgf·m)

Mid Pipe

Mid Pipe and Associated Parts



RTW46FSF000201

Legend

1. Mid Exhaust Pipe
2. Mid Exhaust Pipe Fixing Nuts
3. Exhaust Silencer Fixing Nuts

Removal

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove mid pipe fixing nuts (2).
4. Remove exhaust silencer fixing nuts (3).
5. Remove the pipe.

Installation

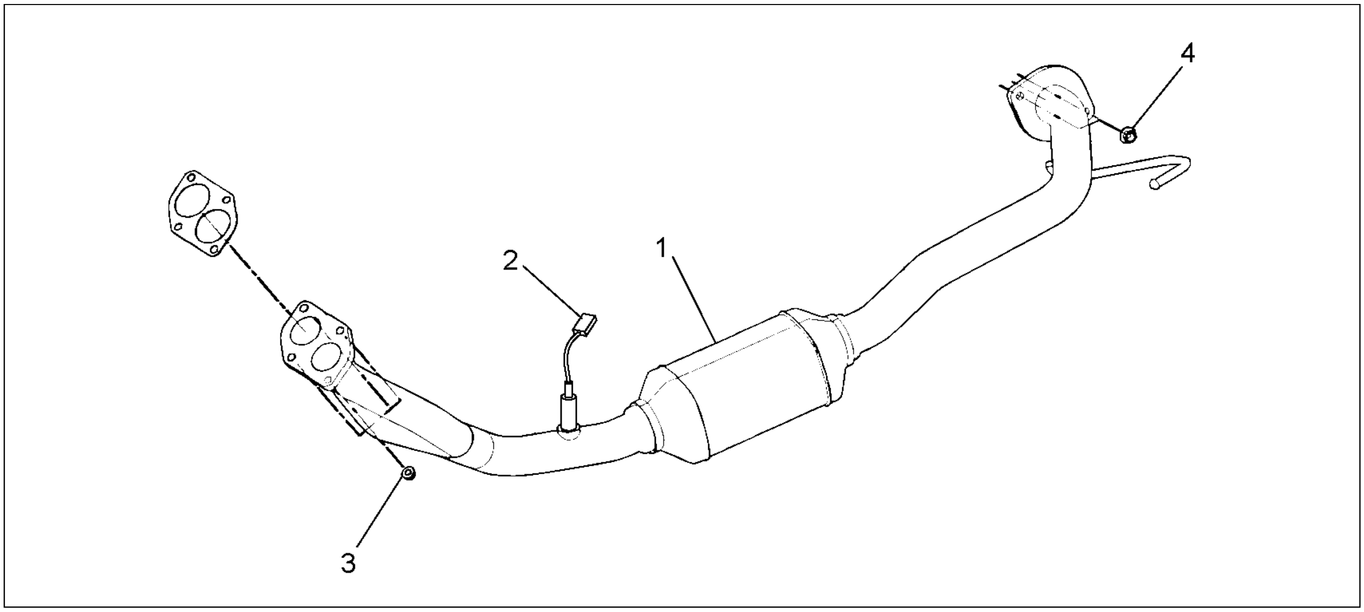
1. Install mid exhaust pipe (1) and tighten four fixing nuts (2)(3) to the specified torque:

   Torque:

   Fixing nuts: 43 N·m (4.4 kgf·m)

Catalytic Converter (If applicable)

Catalytic Converter and Associated Parts



RTW46FSF000301

Legend

1. Catalytic Converter
2. O_2 Sensor Converter
3. Front Pipe Fixing Nuts
4. Mid Pipe Fixing Nuts

Removal

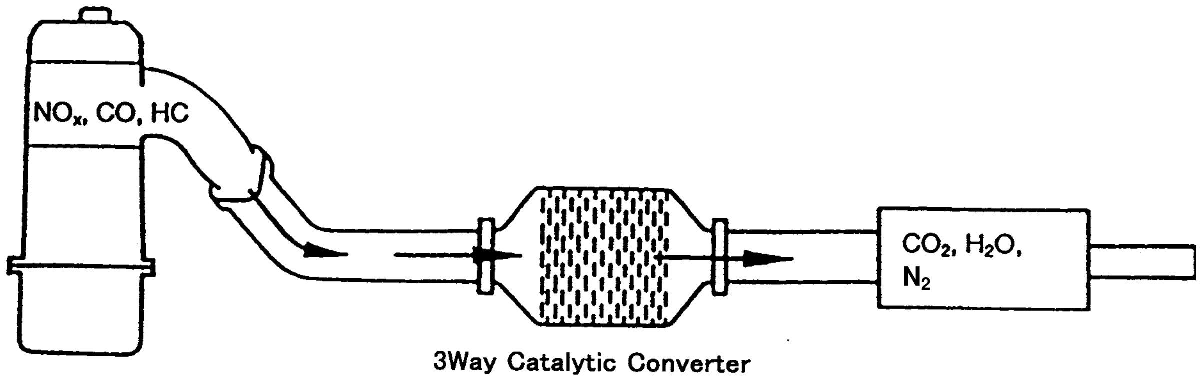
(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove front pipe fixing nuts (3).
4. Remove mid pipe fixing nuts (4).
5. Remove the O_2 sensor connector (2).
6. Remove the front exhaust pipe with catalytic converter (1).

Installation

1. Install Catalytic Converter (1) and tighten four to the specified torque:
   Torque:
   Fixing nuts: 28 N·m (2.9 kgf·m)
2. Tight two nuts (4)
   Torque:
   Nuts: 43 N·m (4.4 kgf·m)
3. Connect the O_2 sensor connector (2).

3 WAY CATALYTIC CONVERTER SYSTEM (If applicable)



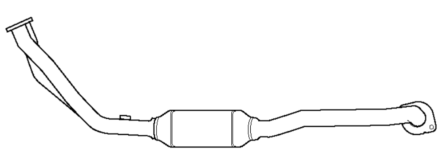
Inspection

Make the necessary adjustments, and part replacements if excessive or damage is discovered during inspection.

Exhaust Pipe Assembly

1. Check connections for looseness or damage.
2. Check clamps for weakness, crack, or damage.

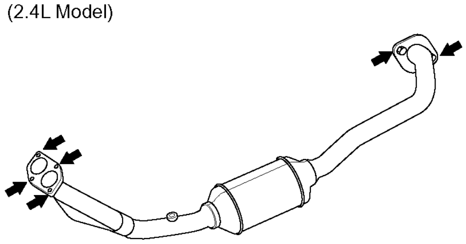
(2.4L Model)



Catalytic Converter

Check for dents or damage.
If any part of the converter is damaged or dented, repair or replace it.

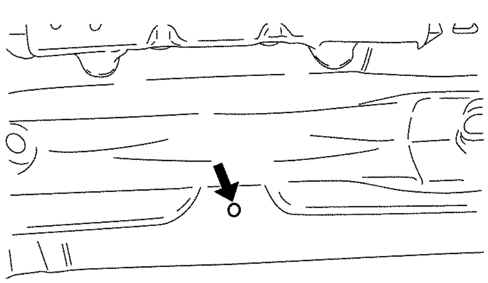
(2.4L Model)



Removal

1. Jack up the vehicle.
2. Check that the converter is cool.
3. Remove the bolts at the front and rear of the converter.
4. Remove the converter and gaskets.

45



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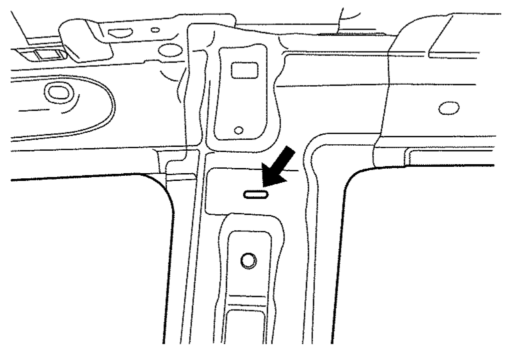

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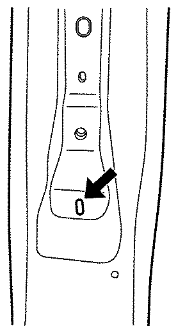

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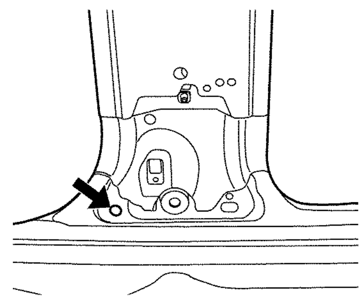
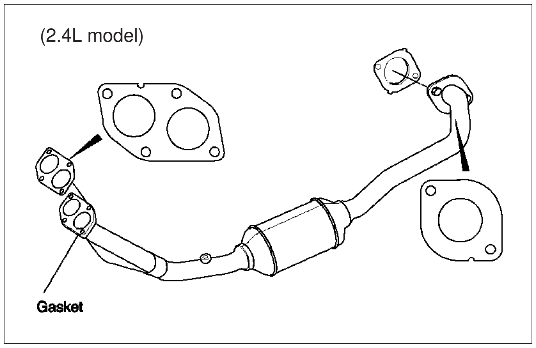


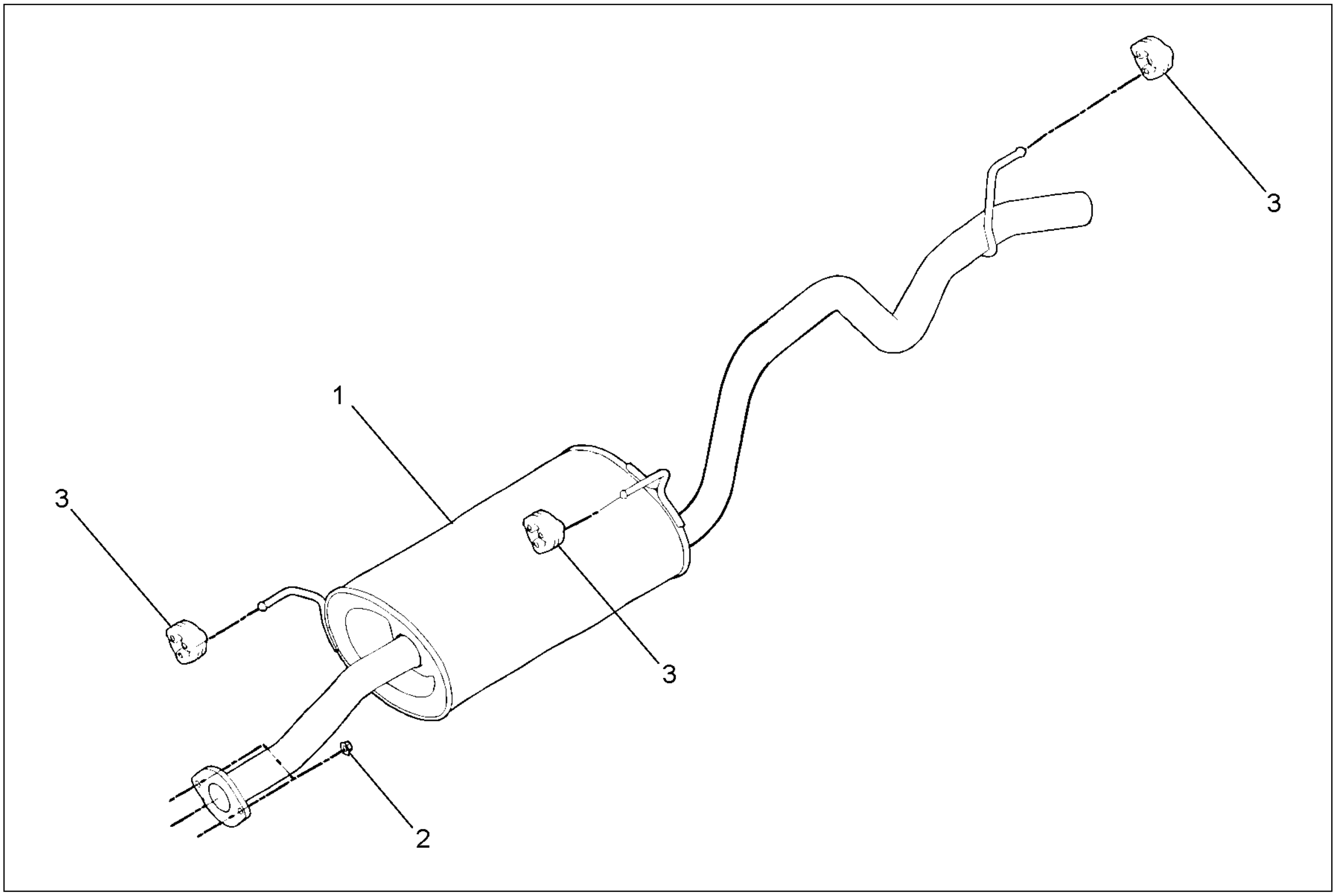


Installation

1. Place new gaskets on the converter front and rear pipes, and connect the converter to the exhaust pipes.
2. Tighten the bolts with the specified torque.
3. Reinstall the bracket bolts and tighten them.

Exhaust Silencer

Exhaust Silencer and Associated Parts



RTW46FMF000701

Legend

1. Exhaust Silencer
2. Exhaust Silencer Fixing Nuts
3. Rubber

Removal

(2.4L)

1. Disconnect battery ground cable.
2. Raise the vehicle and support with suitable safety stands.
3. Remove the damper rubber and nut (2)(3).
4. Remove exhaust silencer (1).

Installation

(2.4L)

1. Install the exhaust silencer and tighten two nuts and the damper rubbers.

Torque:
Bolts: 43 N·m (4.4 kgf·m)

Main Data and Specifications

Exhaust system		
Pipe outside diameter × thickness		
Front pipe	mm(in)	44.5 × 1.5 (1.75×0.059)
Middle pipe	mm(in)	50.8 × 1.5 (2.00 × 0.059)
Rear pipe	mm(in)	50.8 × 1.5 (2.0 × 0.059)
Silencer		
Type		Circular section-shell construction of triple; double skin and end plates, internal construction of baffles and perforated tubes.
Number of suspension points		4
Type		Rubber
Catalytic converter type (If applicable)		Three way Catalytic Converter

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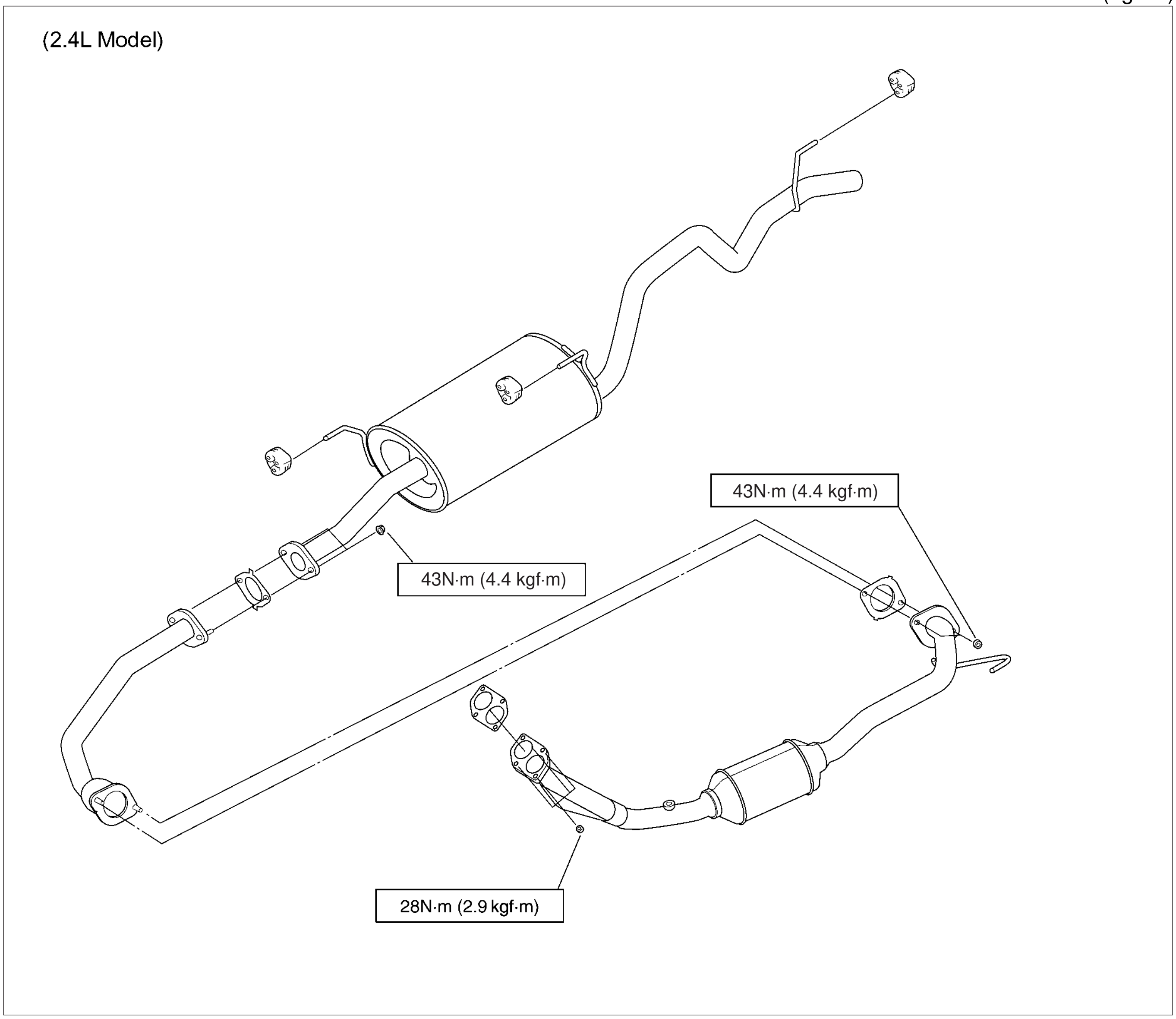
ISUZU KB P190 2007
TO MODEL INDEX

Main Data and Specifications

Torque Specification

N·m (kgf·m)



SECTION 6G

ENGINE LUBRICATION

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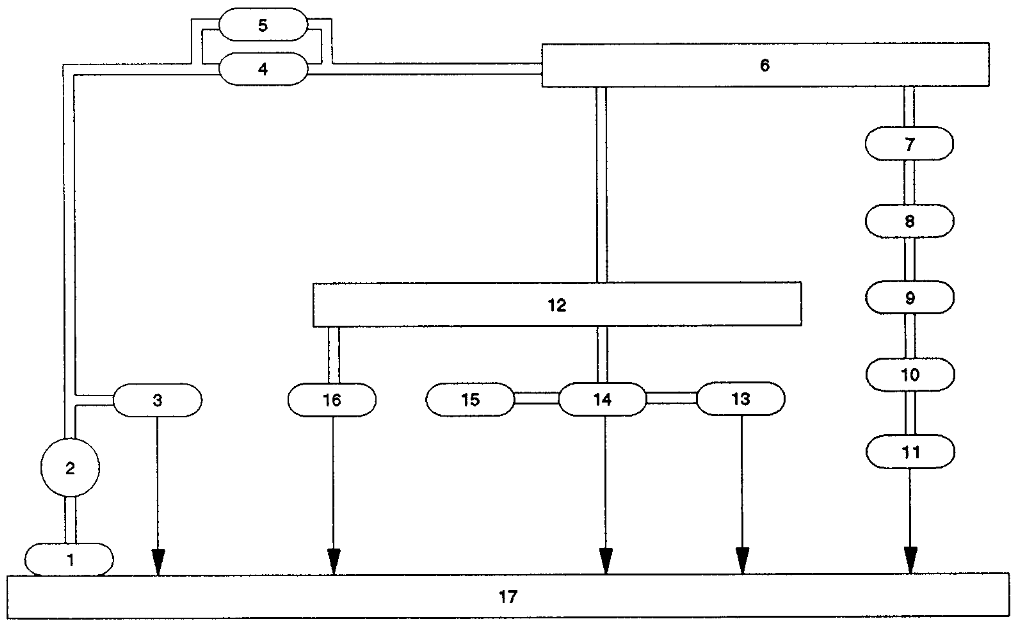
General Description



Legend

1 Oil Strainer
2 Oil Pump
3 Relief Valve
4 Oil Filter
5 Safety Valve
6 Oil Gallery
7 Crankshaft Bearing
8 Crankshaft
9 Connecting Rod Bearing
10 Connecting Rod
11 Piston
12 Oil Gallery; Cylinder Head
13 Camshaft
14 Camshaft Journal
15 HLV
16 Check relief valve
17 Oil Pan

A gear-type oil pump is directly driven by the crankshaft and draws oil from the oil pan, via the suction pipe. If then passes the pressured oil through a full-flow disposable oil filter, to the main oil gallery in the cylinder Block. An oil pump pressure relief valve and oil filter bypass valve are incorporated in the system.

From the main oil gallery in the cylinder block, the cylinder head and crankshaft main bearings are supplied with oil.

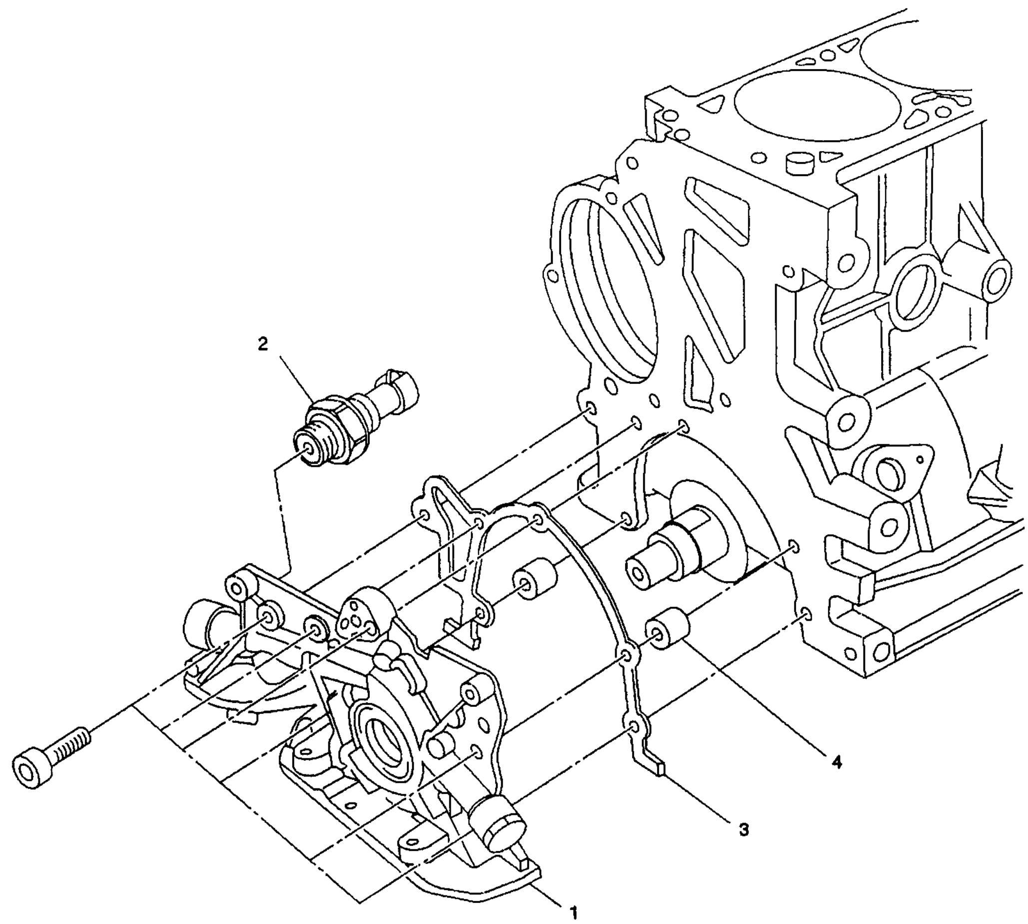
The camshaft bearings and hydraulic tappets are supplied through the main feed galleries in the cylinder head. Vent valves allow air to be expelled from the oil galleries in the cylinder head. The balance shaft journals are directly fed from the crankshaft main bearings. The connecting rod bearings are fed via passages in the crankshaft. The oil returns to the oil pan via passages in the cylinder block.

Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

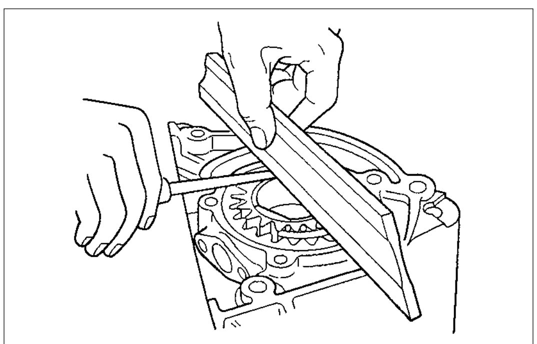
Oil Pump

Oil Pump and Associated Parts



Legend

1 Oil Pump Assembly
2 Oil Pressure Switch
3 Gasket
4 Sleeve



Disassembly

1. Remove crankshaft timing pulley.
2. Remove oil pan.
3. Remove oil strainer.
4. Remove oil pump assembly.
5. Remove oil pressure switch.
6. Remove gasket.
7. Remove sleeve.

Inspection and Repair

CAUTION: Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Body and Gears

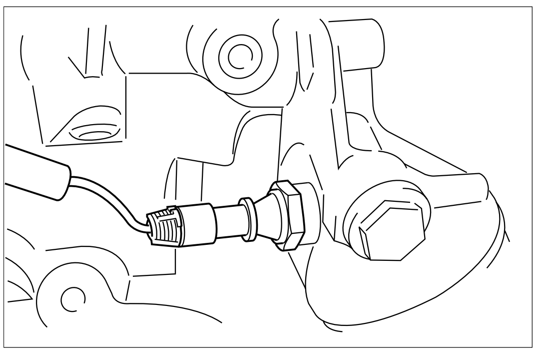
The pump assembly must be replaced if one or more of the conditions below is discovered during inspection:
Indentation of gear pair - Use feeler strip and straight edge.

Dimension: 0.03 mm to 0.10 mm

(0.0012 to 0.0039 in)

Oil Strainer

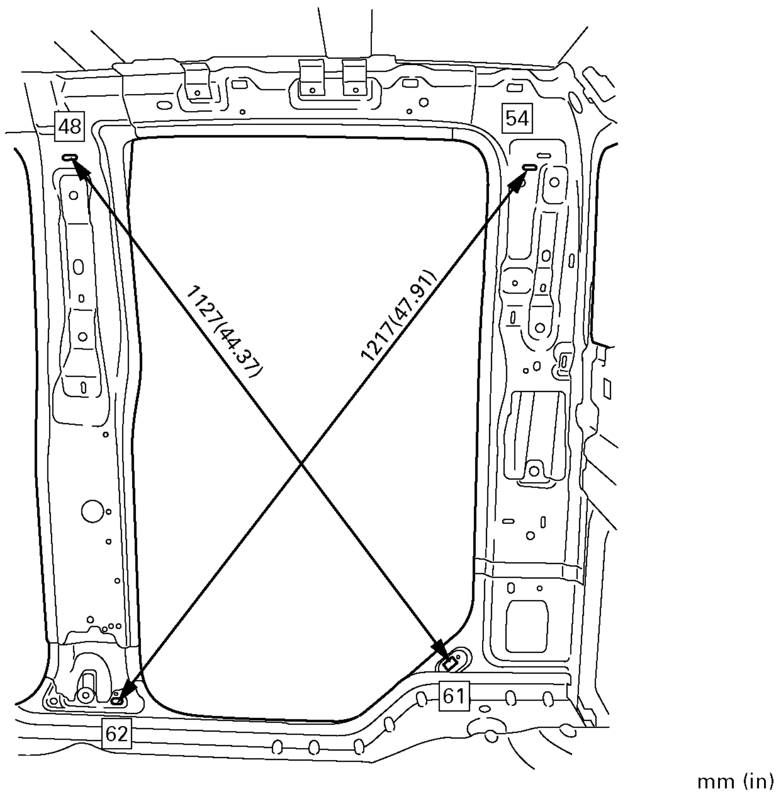
Check the oil strainer for cracking and scoring. If cracking and scoring are found, the oil strainer must be replaced.

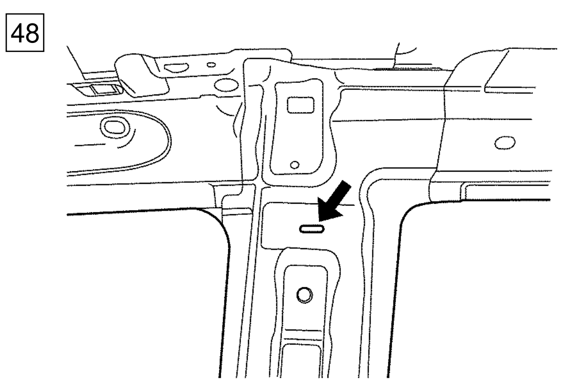


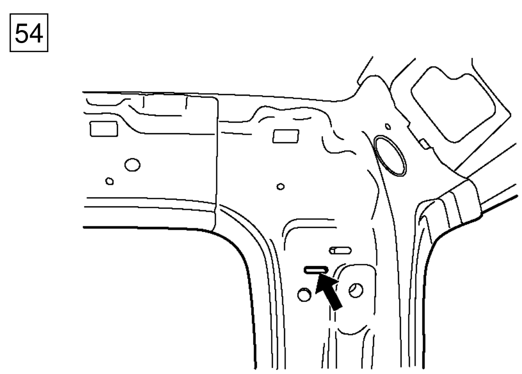
Reassembly

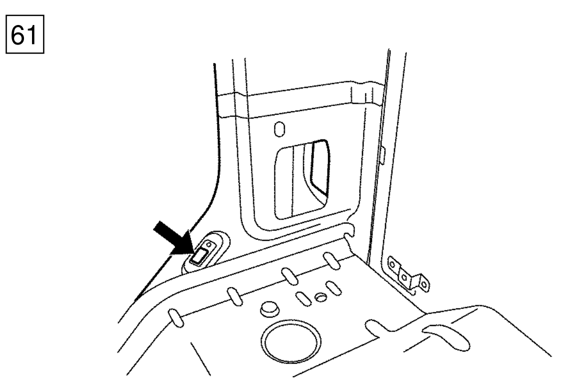
1. Install oil pressure switch to the oil pump.
   Torque: 40 N·m (4.1 kgf·m)
2. Install the oil pump with the sleeve and the gasket.
   Torque: 6 N·m (0.6 kgf·m)
3. Install oil strainer.
   Torque: 8 N·m (0.8 kgf·m)
4. Install the oil pan.
   Tighten the bolts:
   15 N·m (1.5 kgf·m)
5. Install crankshaft timing pulley.
   Tighten the bolts:
   20 N·m (2.0 kgf·m)

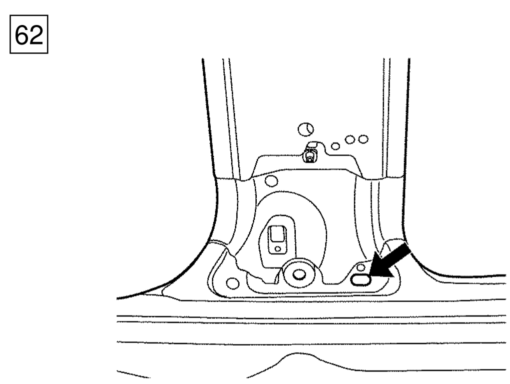
SIDE BODY SECTION; REAR SIDE (CREW CAB)





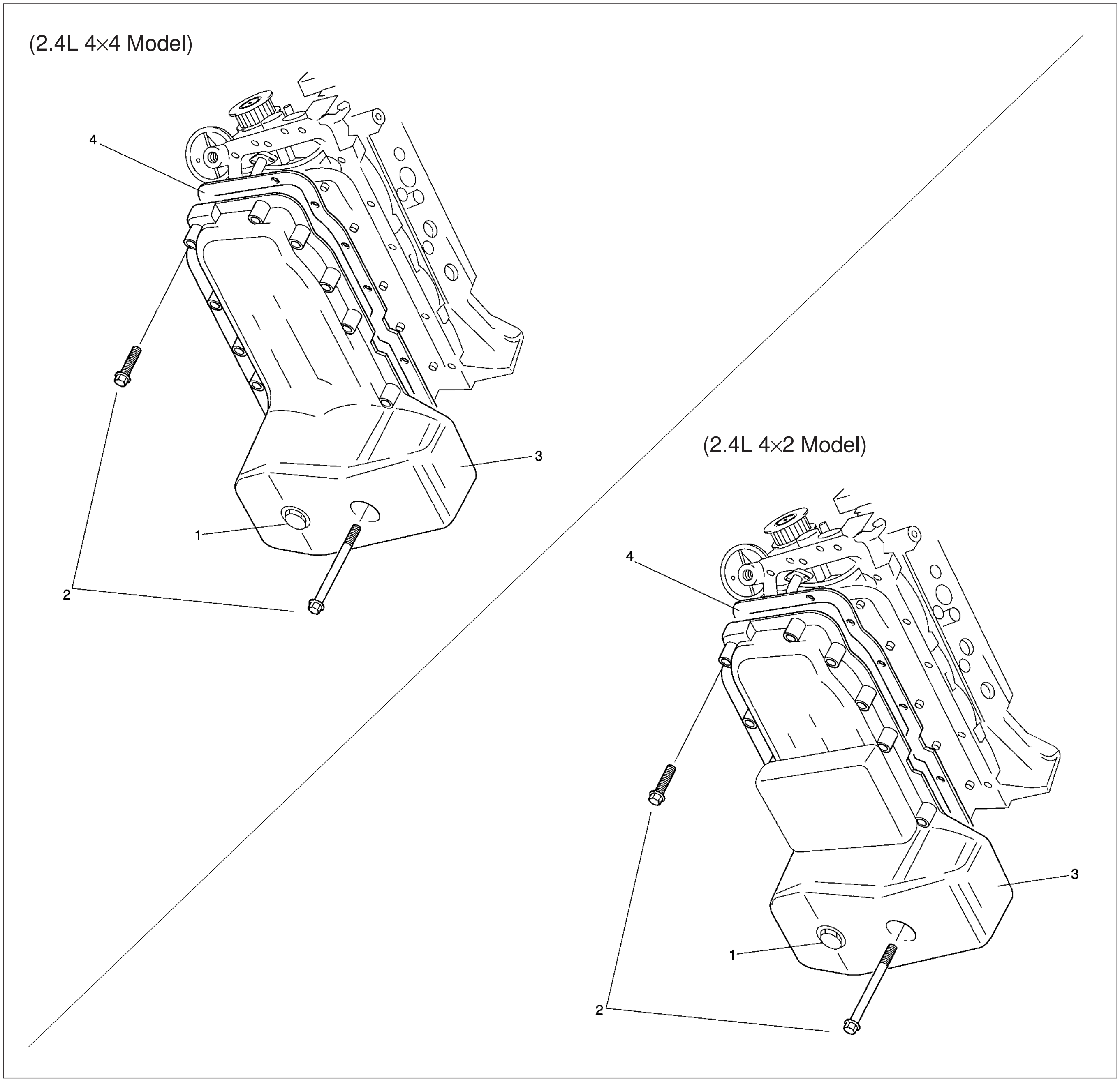






Oil Pan

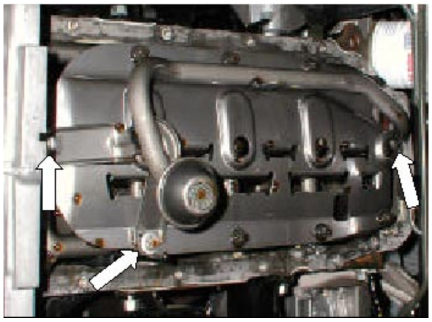
Oil Pan and Associated Parts



Important

Disassembly

1. Loosen a drain plug to drain oil.
2. Remove engine hood.
3. Remove engine rear mounting.
4. Remove transmission assembly.
5. Remove engine front mounting.
6. Raise the vehicle and support with switch stands, and then remove engine.
7. Remove oil pan.



Inspection and Repair

CAUTION: Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

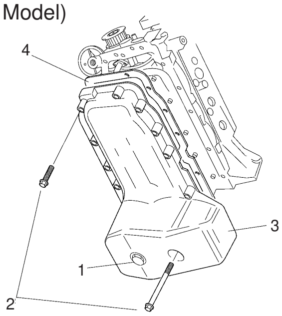
Reassembly

To install, follows the disassembly steps in the reverse order.

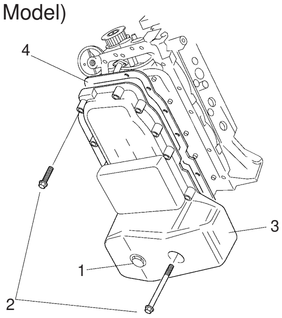
Important

Sealer - Apply silicon into groove in oil pan lugs prior to fitment of oil pan to block, remove excess sealer after oil pan is bolted to block.

(2.4L 4×4 Model)



(2.4L 4×2 Model)



Torque

Bolts - Tighten bolts to the specified torque.
Torque : 20 N·m (2.0 kgf·m)
Engine oil - Refill engine oil to the oil pan.

(Lit)

Replacement Oil Fill Volume	2.4L
Without filter change	4.00
With filter change	4.25

SECTION 6H

ENGINE SPEED CONTROL SYSTEM (C24SE)

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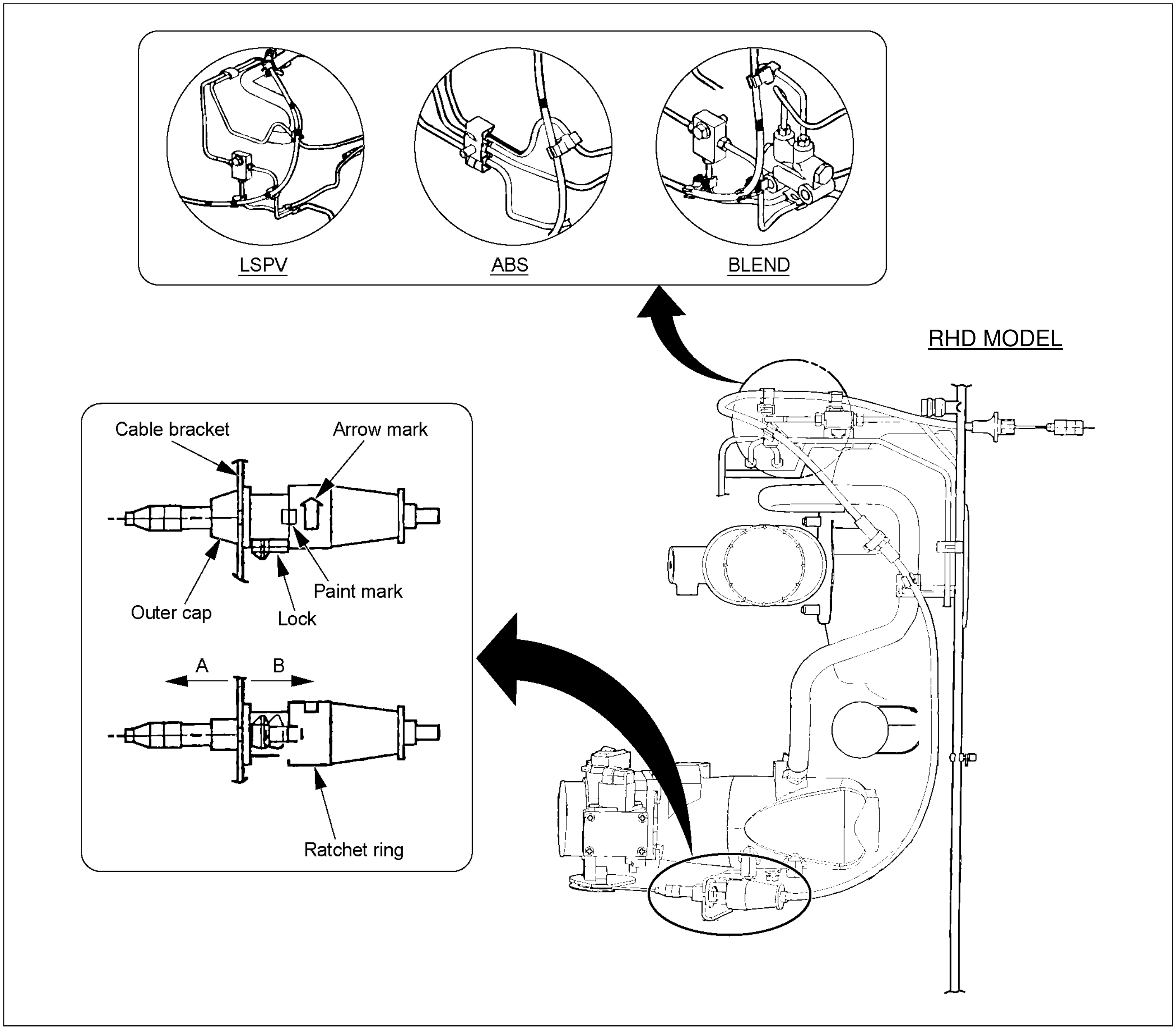
Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Accelerator Pedal Control Cable

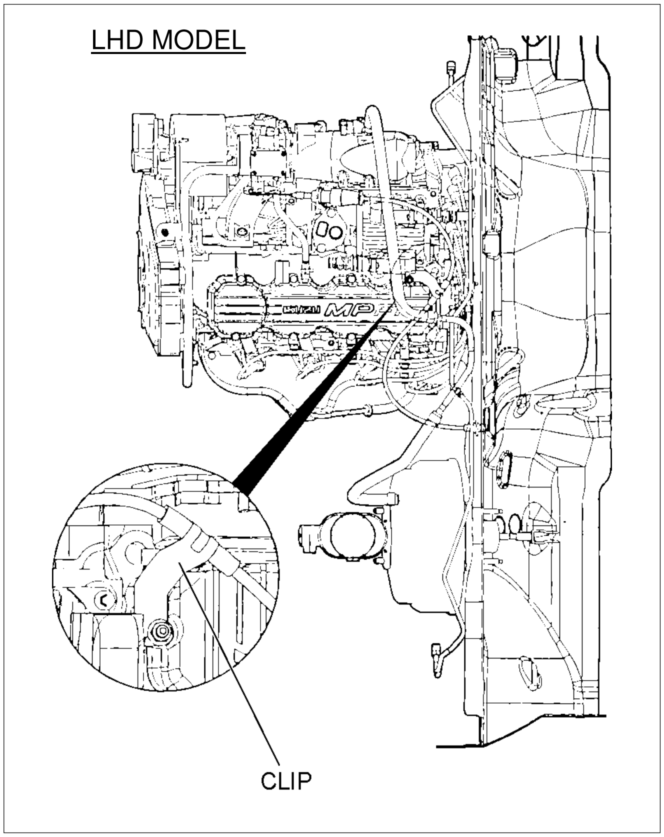


RTW46HLF000501

Removal

1. Disconnect the accelerator control cable from the accelerator pedal and dash panel.
2. Remove the cable clips.
3. Remove the accelerator control cable from accelerator control cable bracket.
   1) Slide the lock in direction A
   2) Rotate the ratchet ring in indirection an arrow 90°.

4. Remove the accelerator control cable from the throttle.



RTW46AMH000101

Inspection

Check the following items and replace the control cable if any abnormality is found.

- The control cable should move smoothly.
- The control cable should not be bent or kinked.
- The control cable should not be damage or corrosion.

Installation

1. Install the accelerator control cable to accelerator control pedal dash panel.
2. Install the accelerator control cable to throttle. Attach T-END and inner cable to throttle cam of engine.
3. Install accelerator control cable to accelerator bracket.
   1) Rotate the ratchet ring in direction an arrow 90° until both white marking are aligned.
   2) Confirm marking of outer cap must be upper side.
   3) Slider the lock in direction B.
   4) Confirm ratchet ring is locked.

SECTION 6J

INDUCTION

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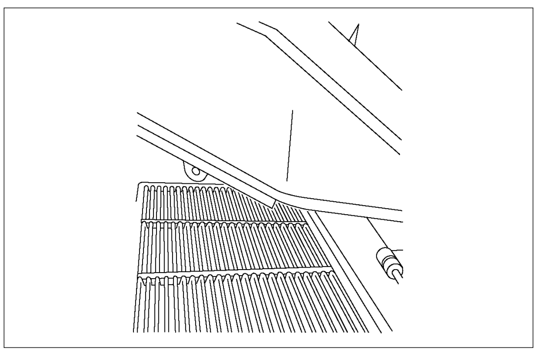
Service Precaution

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Air Cleaner Filter



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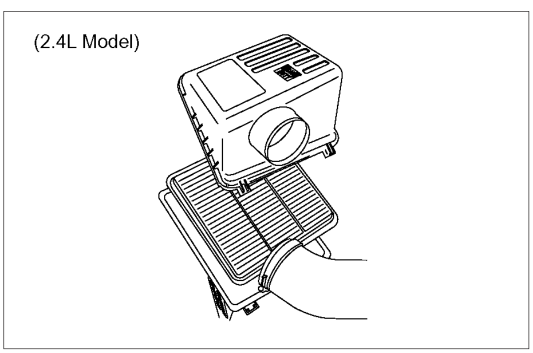
NOTE:
The air cleaner filter is not damaged with the edge of the air cleaner housing.

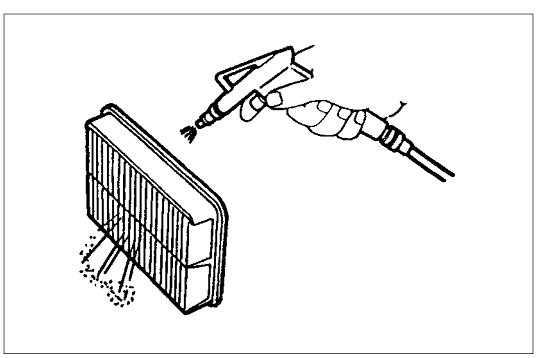
Removal

1. Remove positive ventilation hose connector.
2. Remove intake air temperature sensor.
3. Remove mass air flow sensor.
4. Remove air cleaner duct assembly.
5. Remove air cleaner element.



Inspection

Check the air cleaner filter for damage or dust clogging. Replace if it is damaged, or clean if it is clogged.



Cleaning Method

Tap the air cleaner filter gently so as not to damage the paper filter, or clean the element by blowing with compressed air of about 490 kPa (71 psi) from the clean side if it is extremely dirty.

Installation

1. Install air cleaner element.
2. Attach the air cleaner duct cover to the body completely, then clamp it with the clip.
3. Install mass air flow sensor.
4. Install mass air temperature sensor.
5. Install positive crankcase ventilation hose connector.

SECTION 6

ENGINE

HFV6 MODEL

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SECTION 3

STEERING SUSPENSION
WHEELS AND TIRES

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6A1
Engine Mechanical – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

1 General Information

The HFV6 engine features a closed vee, deep skirt die cast aluminium cylinder block with cast iron cylinder liners, internally balanced crankcase, full length water jackets and six bolt main bearing caps.

The cylinders are arranged in two banks of three with a 60 degree included angle between the two banks.

The right-hand bank of cylinders consists of number 1-3-5 cylinders and the left-hand bank of cylinders consists of number 2-4-6.

The engine firing order is 1-2-3-4-5-6.

Each aluminium cylinder head is fitted with hardened valve seats and four valves per cylinder: two intake and two exhaust.

The valves are operated by two camshafts (DOHC) per cylinder bank, one each for intake and exhaust valves.

The crankshaft is manufactured from forged steel. A reluctor wheel is pressed in place onto the rear of the crankshaft for the crankshaft position sensor.

The connecting rods are manufactured from powdered metal and the rod cap is separated during the manufacturing process using the fractured method. This creates a stronger, visually seamless rod to cap union.

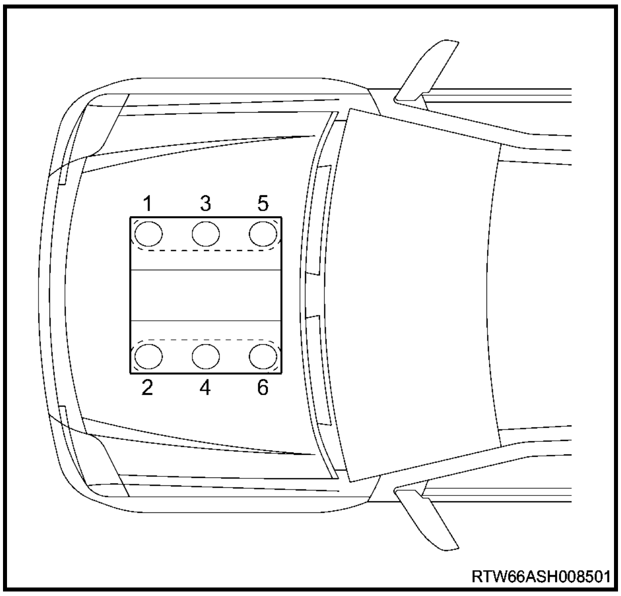


Figure 6A1 – 1

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,

- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or

Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 Engine Components

Major Component Assemblies

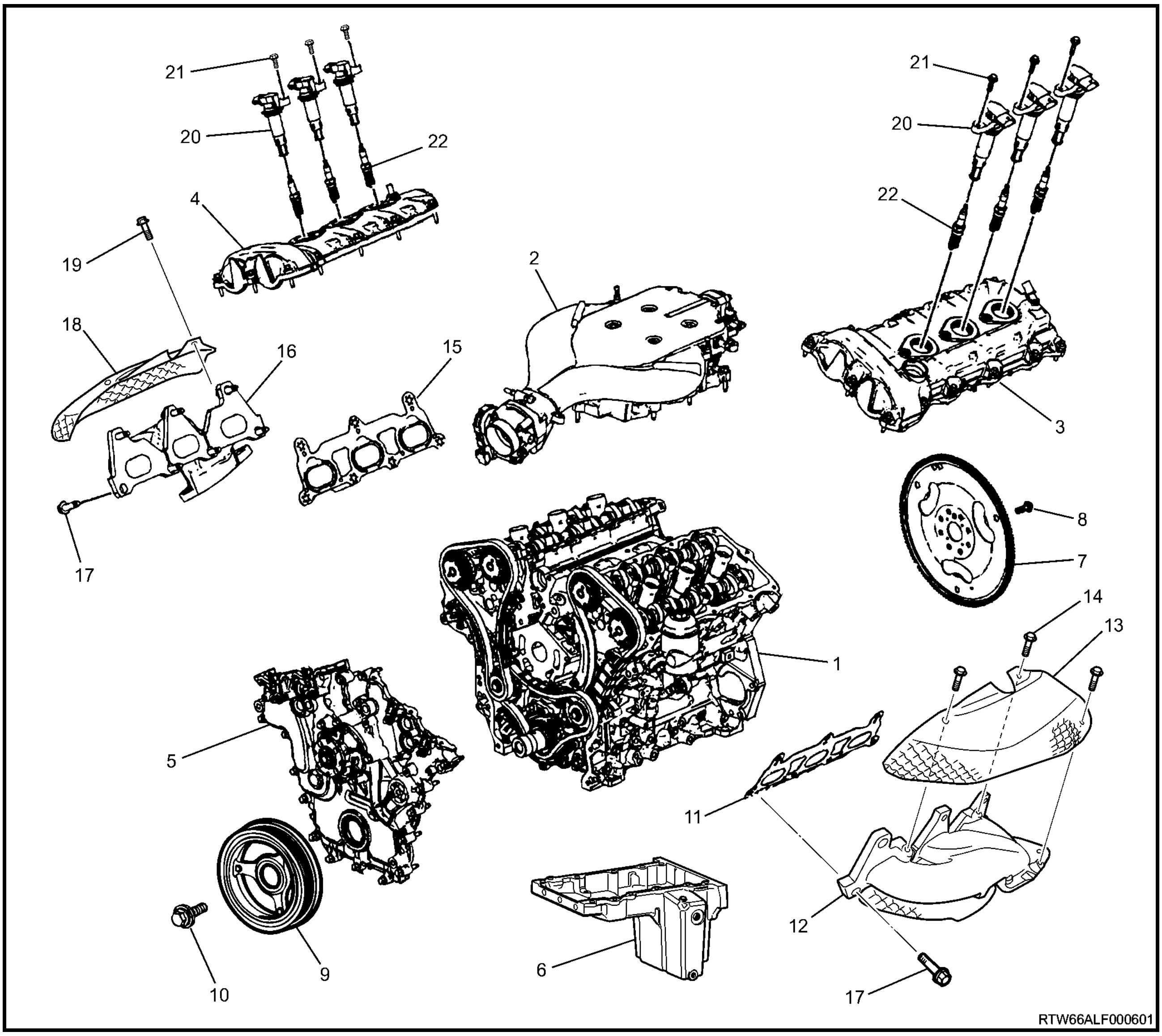
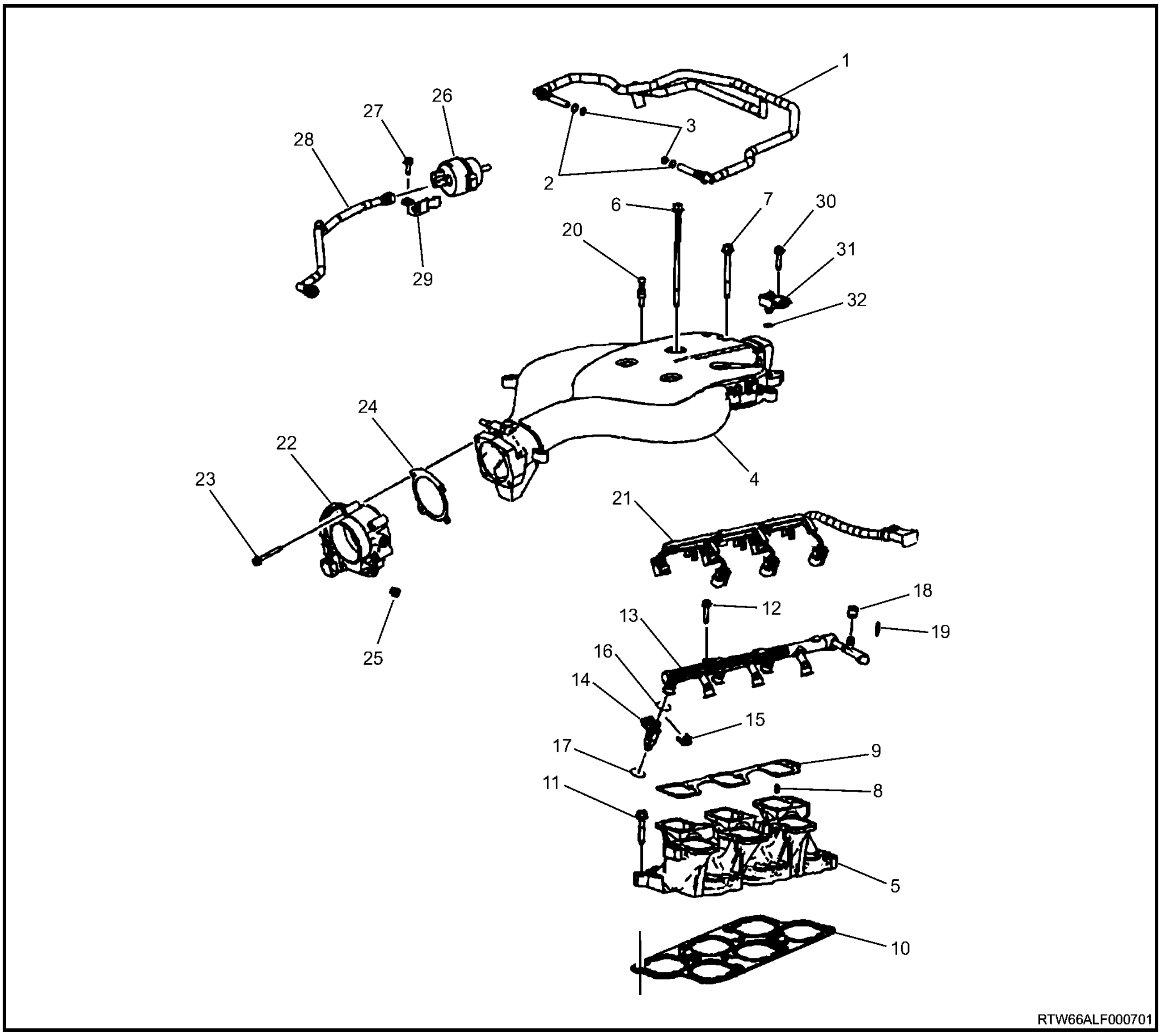


Figure 6A1 – 2

Legend

1	Engine Assembly	12	Exhaust Manifold, Left-hand
2	Intake Manifold Assembly	13	Exhaust Manifold Heat Shield, Left-hand
3	Camshaft Cover Assembly, Left-hand	14	Exhaust Manifold Heat Shield Bolt, Left-hand
4	Camshaft Cover Assembly, Right-hand	15	Exhaust Manifold Gasket, Right-hand
5	Engine Front Cover Assembly	16	Exhaust Manifold, Right-hand
6	Oil Pan Assembly	17	Cylinder Head Exhaust Manifold Bolt
7	Engine Flywheel	18	Exhaust Manifold Heat Shield, Right-hand
8	Engine Flywheel Bolt	19	Exhaust Manifold Heat Shield Bolt, Right-hand
9	Crankshaft Balancer	20	Ignition Coil Assembly
10	Crankshaft Balancer Bolt	21	Ignition Coil Assembly Bolt
11	Exhaust Manifold Gasket, Left-hand	22	Spark Plug

Intake Manifold Assembly



SECTION 3A

FRONT ALIGNMENT

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Figure 6A1 – 3

Legend

1	PCV Hose
2	PCV Hose O-Ring Outer (larger)
3	PCV Hose O-Ring Inner (smaller)
4	Upper Intake Manifold
5	Lower Intake Manifold
6	Upper Intake Manifold Bolt – Long
7	Upper Intake Manifold Bolt – Short
8	Lower Intake Manifold to Upper Intake Manifold Guide Pin
9	Upper Intake Manifold to Lower Intake Manifold Gasket
10	Lower Intake Manifold to Cylinder Head Gasket
11	Lower Intake Manifold Bolt
12	Fuel Rail Bolt
13	Fuel Rail
14	Fuel Injector
15	Fuel Injector Retainer
16	Fuel Injector Upper O-ring
17	Fuel Injector Lower O-ring
18	Fuel Pressure Service Valve Cap
19	Fuel Pressure Service Valve
20	Ball Stud
21	Fuel Injector Wiring Harness
22	Throttle Body
23	Throttle Body Bolt
24	Throttle Body Gasket
25	Throttle Body Engine Wiring Harness Clip
26	EVAP Purge Solenoid
27	EVAP Purge Solenoid Bolt
28	EVAP Purge Solenoid Tube
29	EVAP Purge Solenoid Bracket
30	BARO Sensor Bolt
31	BARO Sensor
32	BARO Sensor O-Ring

Engine Front Cover

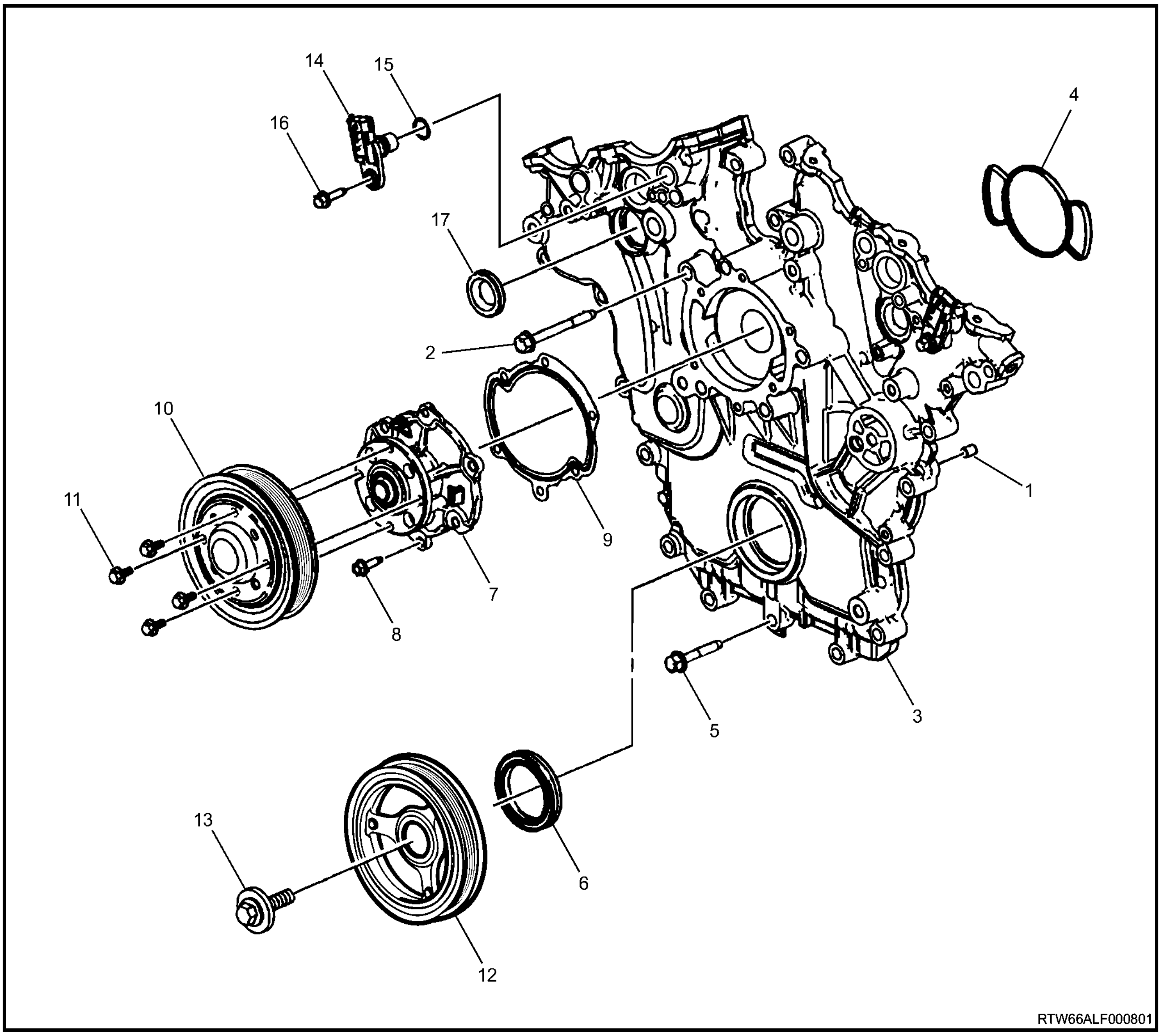


Figure 6A1 – 4

Legend

1 Engine Front Cover Locating Pin
2 Engine Front Cover Bolt, M10
3 Engine Front Cover
4 Engine Front Cover Gasket
5 Engine Front Cover Bolt, M8
6 Engine Front Cover Seal
7 Coolant Pump Assembly
8 Coolant Pump Bolt
9 Coolant Pump Gasket
10 Coolant Pump Pulley
11 Coolant Pump Pulley Bolt
12 Crankshaft Balancer
13 Crankshaft Balancer Bolt
14 Camshaft Position Sensor
15 Camshaft Position Sensor O-ring
16 Camshaft Position Sensor Bolt
17 Camshaft Position Actuator Solenoid Valve Seal

Camshaft Timing Components

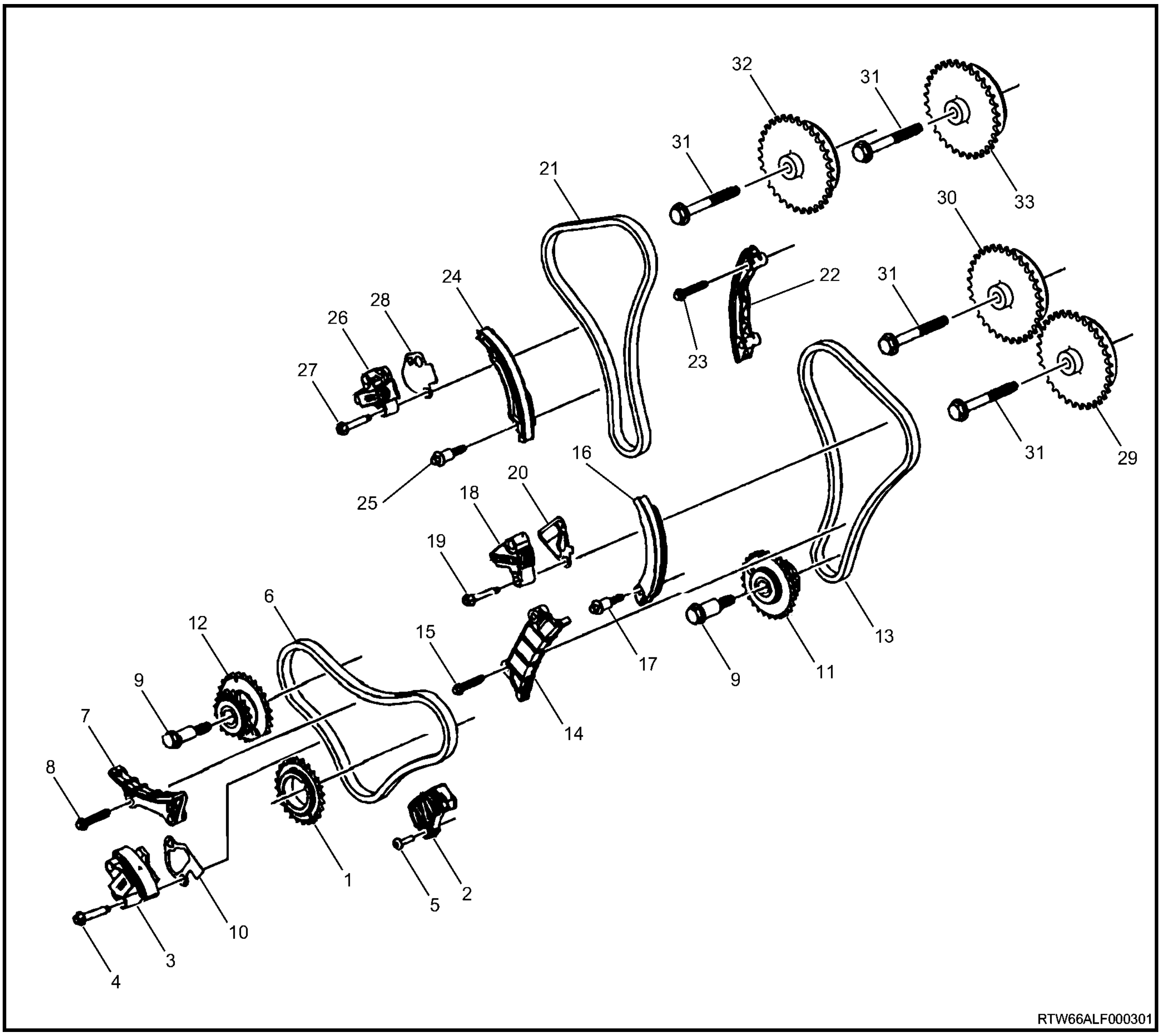


Figure 6A1 – 5

Legend

1	Crankshaft Sprocket
2	Lower Primary Timing Chain Guide
3	Primary Timing Chain Tensioner
4	Primary Timing Chain Tensioner Bolt
5	Lower Primary Timing Chain Guide Bolt
6	Primary Timing Chain
7	Upper Primary Timing Chain Guide
8	Upper Primary Timing Chain Guide Bolt
9	Camshaft Intermediate Driveshaft Sprocket Bolt
10	Primary Timing Chain Tensioner Gasket
11	Camshaft Intermediate Driveshaft Sprocket, Left-hand
12	Camshaft Intermediate Driveshaft Sprocket, Right-hand
13	Secondary Timing Chain, Left-hand
14	Secondary Timing Chain Guide, Left-hand
15	Secondary Timing Chain Guide Bolt, Left-hand
16	Secondary Timing Chain Shoe, Left-hand
17	Secondary Timing Chain Shoe Bolt, Left-hand
18	Secondary Timing Chain Tensioner, Left-hand
19	Secondary Timing Chain Tensioner Bolt, Left-hand
20	Secondary Timing Chain Tensioner Gasket, Left-hand
21	Secondary Timing Chain, Right-hand
22	Secondary Timing Chain Guide, Right-hand
23	Secondary Timing Chain Guide Bolt, Right-hand
24	Secondary Timing Chain Shoe, Right-hand
25	Secondary Timing Chain Shoe Bolt, Right-hand
26	Secondary Timing Chain Tensioner, Right-hand
27	Secondary Timing Chain Tensioner Bolt, Right-hand
28	Secondary Timing Chain Tensioner Gasket, Right-hand
29	Exhaust Camshaft Sprocket, Left-hand
30	Intake Camshaft Sprocket, Left-hand
31	Camshaft Sprocket Bolt
32	Exhaust Camshaft Sprocket, Right-hand
33	Intake Camshaft Sprocket, Right-hand

Camshaft Cover Assembly

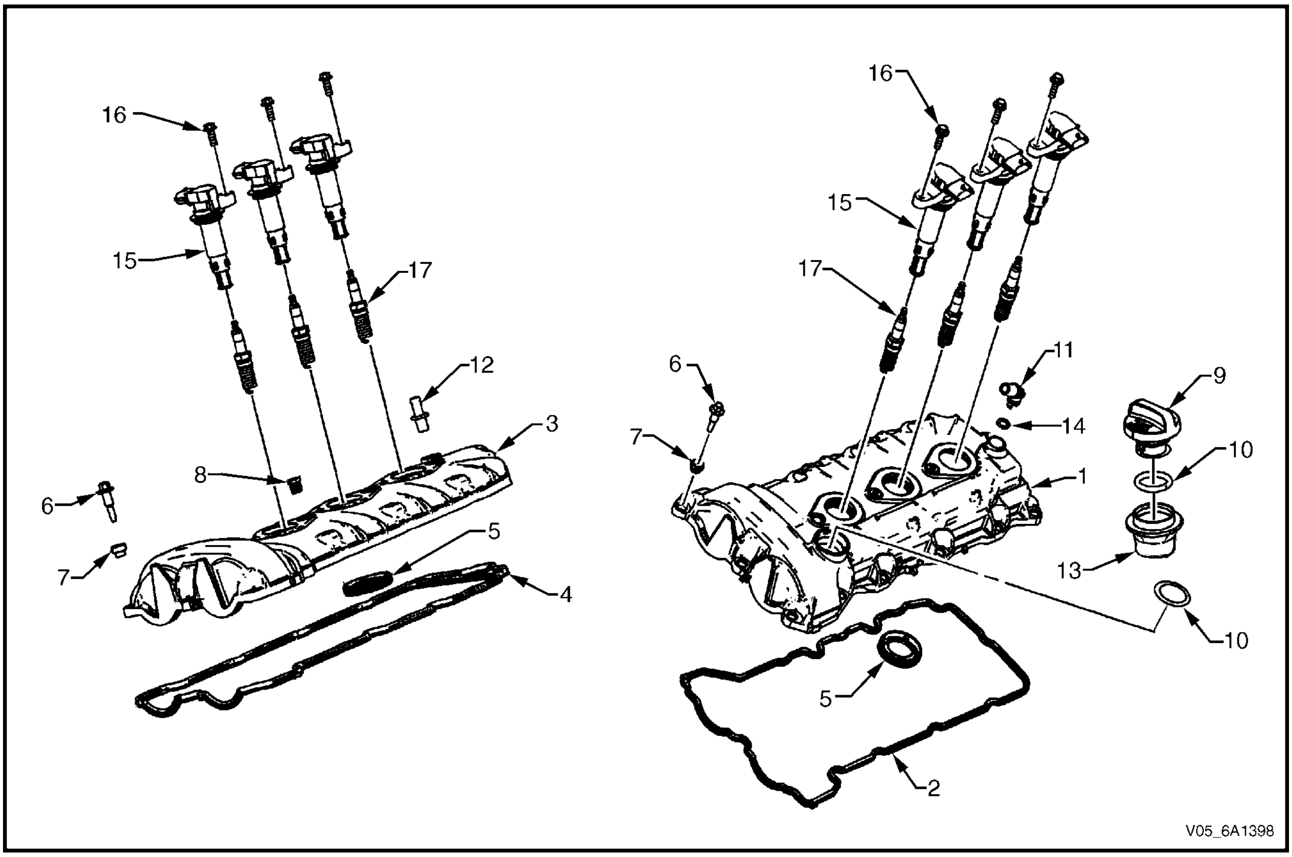


Figure 6A1 – 6

Legend

1	Camshaft Cover, Left-hand
2	Camshaft Cover Gasket, Left-hand
3	Camshaft Cover, Right-hand
4	Camshaft Cover Gasket, Right-hand
5	Camshaft Cover Spark Plug Port Seal
6	Camshaft Cover Bolt
7	Camshaft Cover Bolt Insulator
8	Ignition Coil Bolt Thread Insert
9	Oil Fill Cap
10	Oil Fill O-Ring
11	Camshaft Cover PCV Fitting, Left-hand
12	Camshaft Cover PCV Fitting Orifice, Right-hand
13	Oil Fill Tube
14	Camshaft Cover PCV Fitting O-Ring, Left-hand
15	Ignition Coil
16	Ignition Coil Bolt
17	Spark Plug

Cylinder Head Assembly

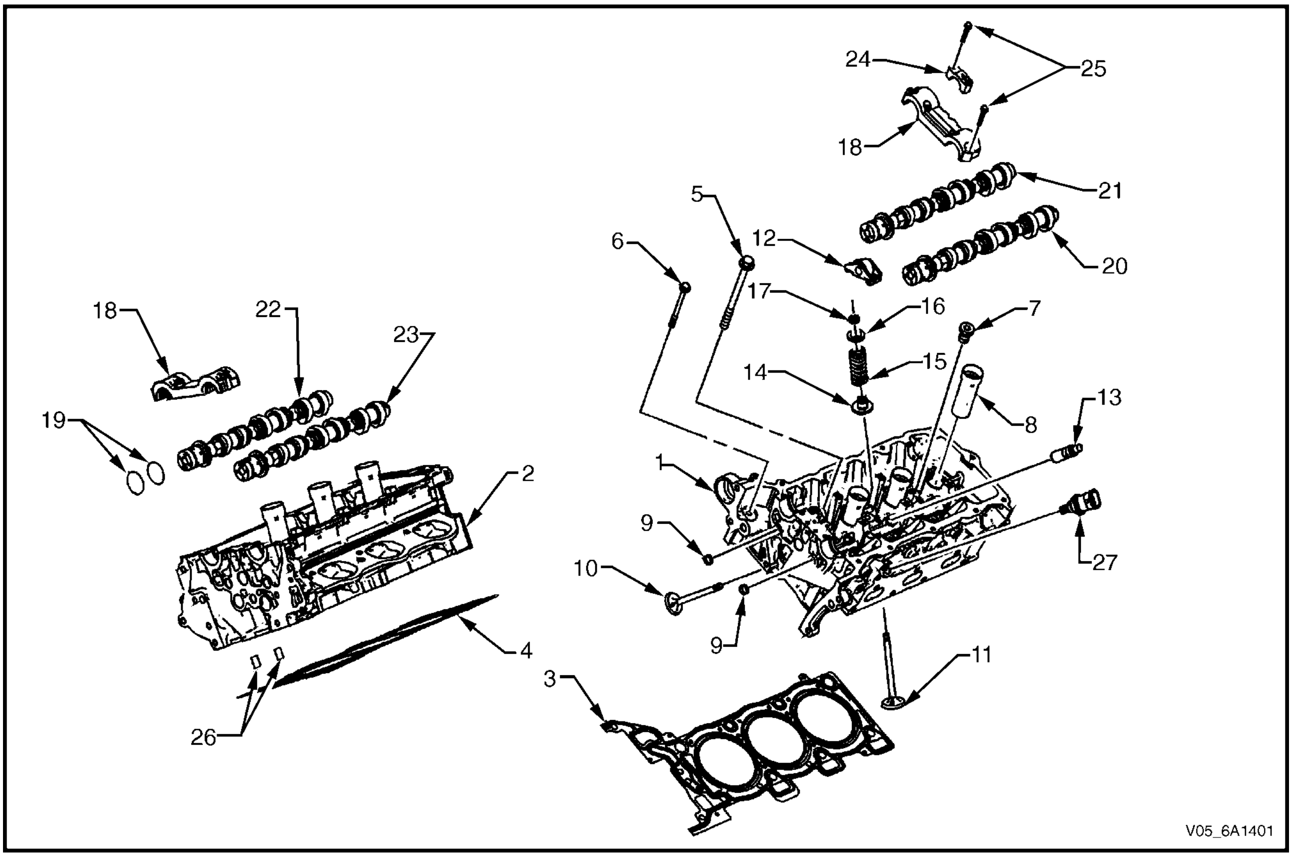


Figure 6A1 – 7

Legend

1	Cylinder Head, Left-hand
2	Cylinder Head, Right-hand
3	Cylinder Head Gasket, Left-hand
4	Cylinder Head Gasket, Right-hand
5	Cylinder Head Bolt
6	Cylinder Head Front Bolt
7	Cylinder Head Coolant Hole Threaded Plug
8	Spark Plug Sleeve
9	Cylinder Head Oil Gallery Expansion Plug
10	Exhaust Valve
11	Intake Valve
12	Valve Rocker Arm Assembly
13	Hydraulic Valve Lash Adjuster Assembly
14	Valve Stem Oil Seal
15	Valve Spring
16	Valve Spring Cap
17	Valve Stem Key
18	Cylinder Head Camshaft Front Thrust Bearing Cap
19	Camshaft Oil Seal Ring
20	Exhaust Camshaft
21	Intake Camshaft, Left-hand (bank 2)
22	Intake Camshaft, Right-hand (bank 1)
23	Exhaust Camshaft, Right-hand (bank 1)
24	Cylinder Head Camshaft Cap – Intermediate
25	Cylinder Head Camshaft Cap Bolt
26	Cylinder Head Oil Galley Check Valve
27	Engine Coolant Temperature Sensor

Oil Pump

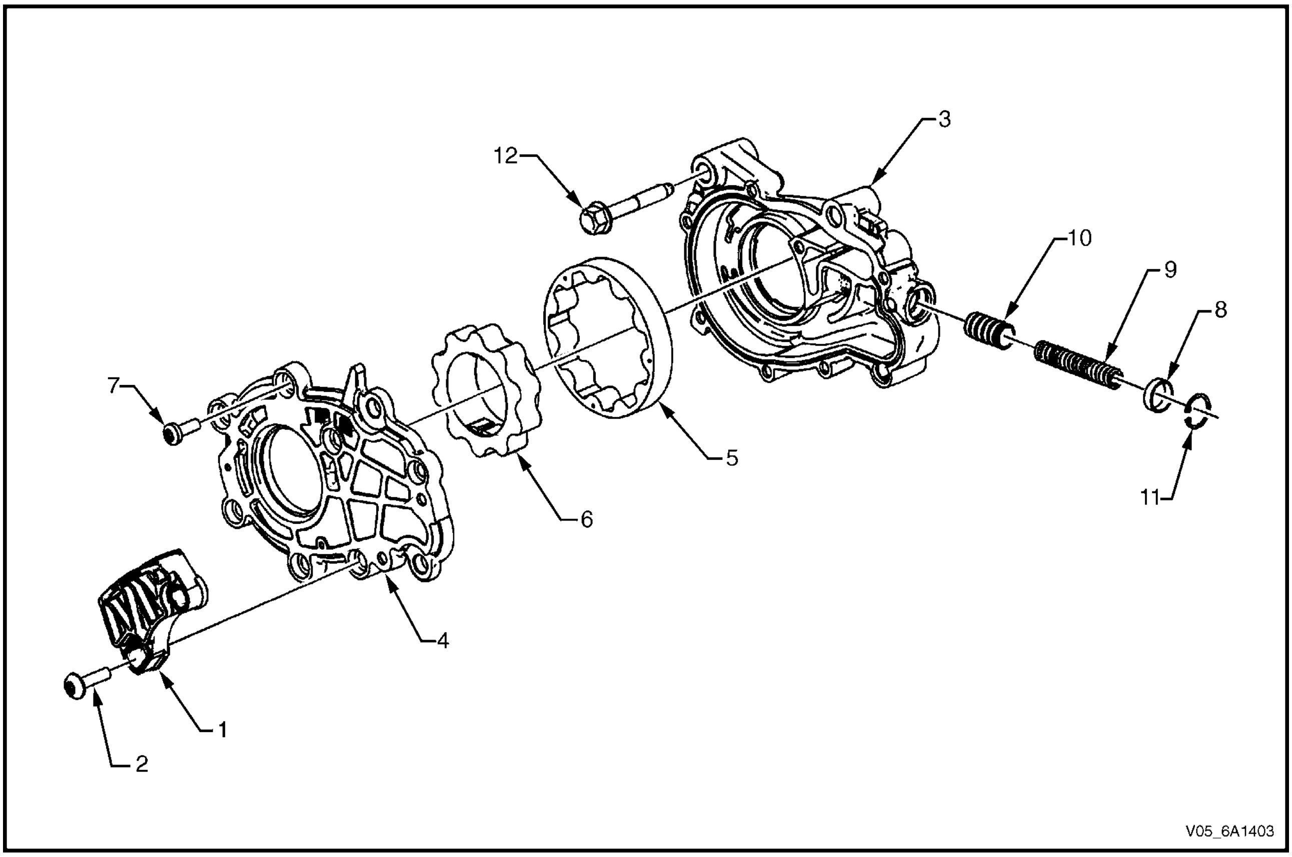


Figure 6A1 – 8

Legend

1	Lower Primary Timing Chain Guide	7	Oil Pump Cover Bolt
2	Lower Primary Timing Chain Guide Bolt	8	Oil Pressure Relief Valve Bore Plug
3	Oil Pump Housing	9	Oil Pressure Relief Valve Spring
4	Oil Pump Cover	10	Oil Pressure Relief Valve
5	Oil Pump Gerotor Outer Ring	11	Oil Pressure Relief Valve Bore Plug Retainer Clip
6	Oil Pump Gerotor Inner Ring	12	Oil Pump Bolt

NOTE

Oil pump components are not serviced individually.

Engine Block Assembly

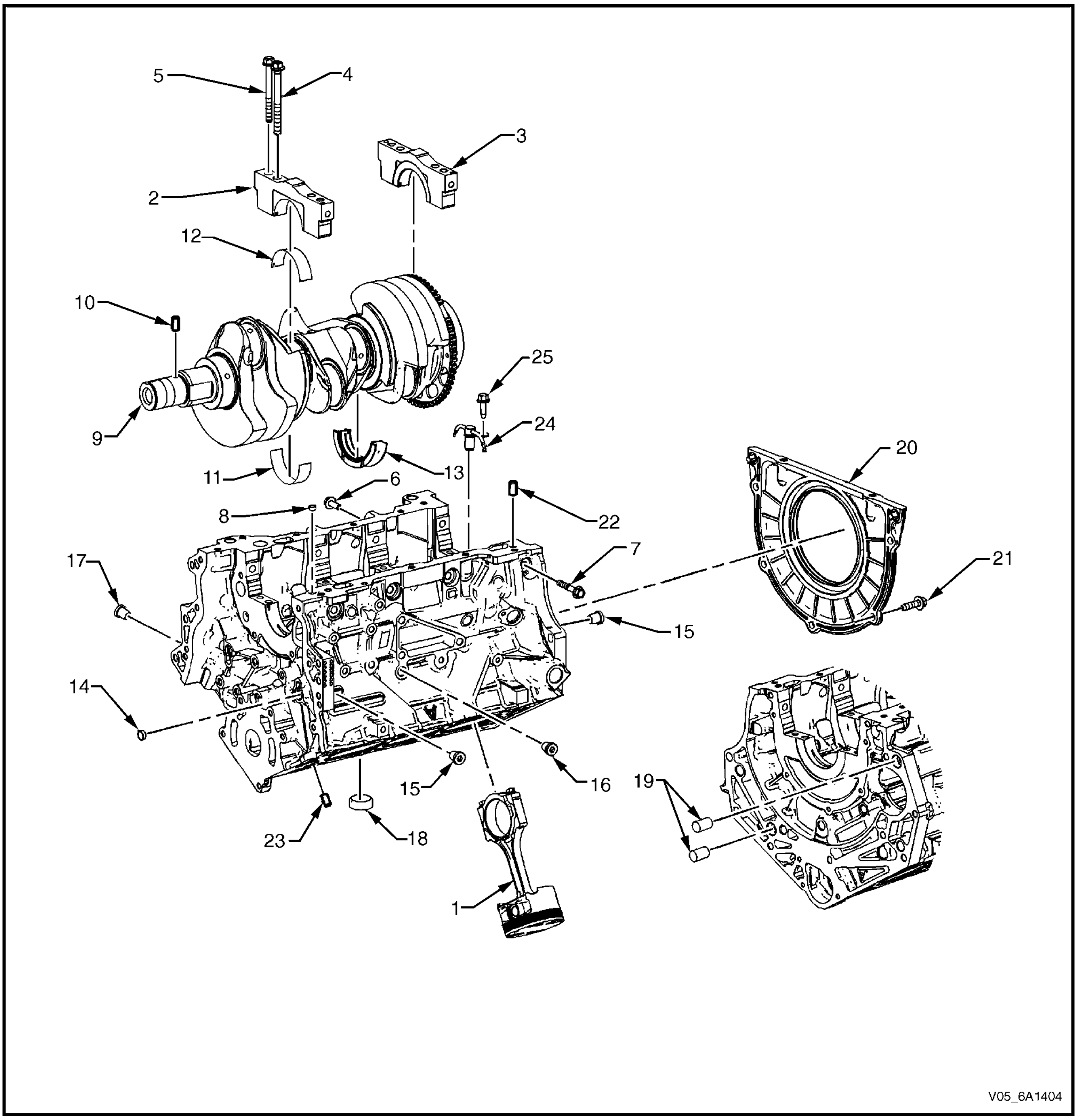


Figure 6A1 – 9

Legend

1	Piston and Connecting Rod Assembly
2	Crankshaft Bearing Cap
3	Crankshaft Bearing Thrust Cap
4	Crankshaft Bearing Cap Inboard Bolt
5	Crankshaft Bearing Cap Outboard Bolt
6	Crankshaft Bearing Cap Side Bolt, Short
7	Crankshaft Bearing Cap Side Bolt, Long
8	Engine Block Oil Gallery Expansion Plug, 10 mm
9	Crankshaft
10	Crankshaft Sprocket Locating Pin
11	Crankshaft Upper Bearing
12	Crankshaft Lower Bearing
13	Crankshaft Upper Thrust Bearing #3
14	Engine Block Oil Gallery Expansion Plug, 14 mm
15	Engine Block Oil Gallery Threaded Plug, 14 mm
16	Engine Block Coolant Drain Threaded Plug, 14 mm
17	Engine Block Oil Gallery Threaded Plug, 20 mm
18	Engine Block Core Coolant Expansion Plug, 34.3 mm
19	Transaxle Locating Pin
20	Crankshaft Rear Oil Seal Housing Assembly
21	Crankshaft Rear Oil Seal Housing Assembly Bolt
22	Oil Pan Locating Pin
23	Cylinder Head Locating Pin
24	Piston Oil Nozzle
25	Piston Oil Nozzle Bolt

Pistons, Rings, Bearing and Connecting Rod

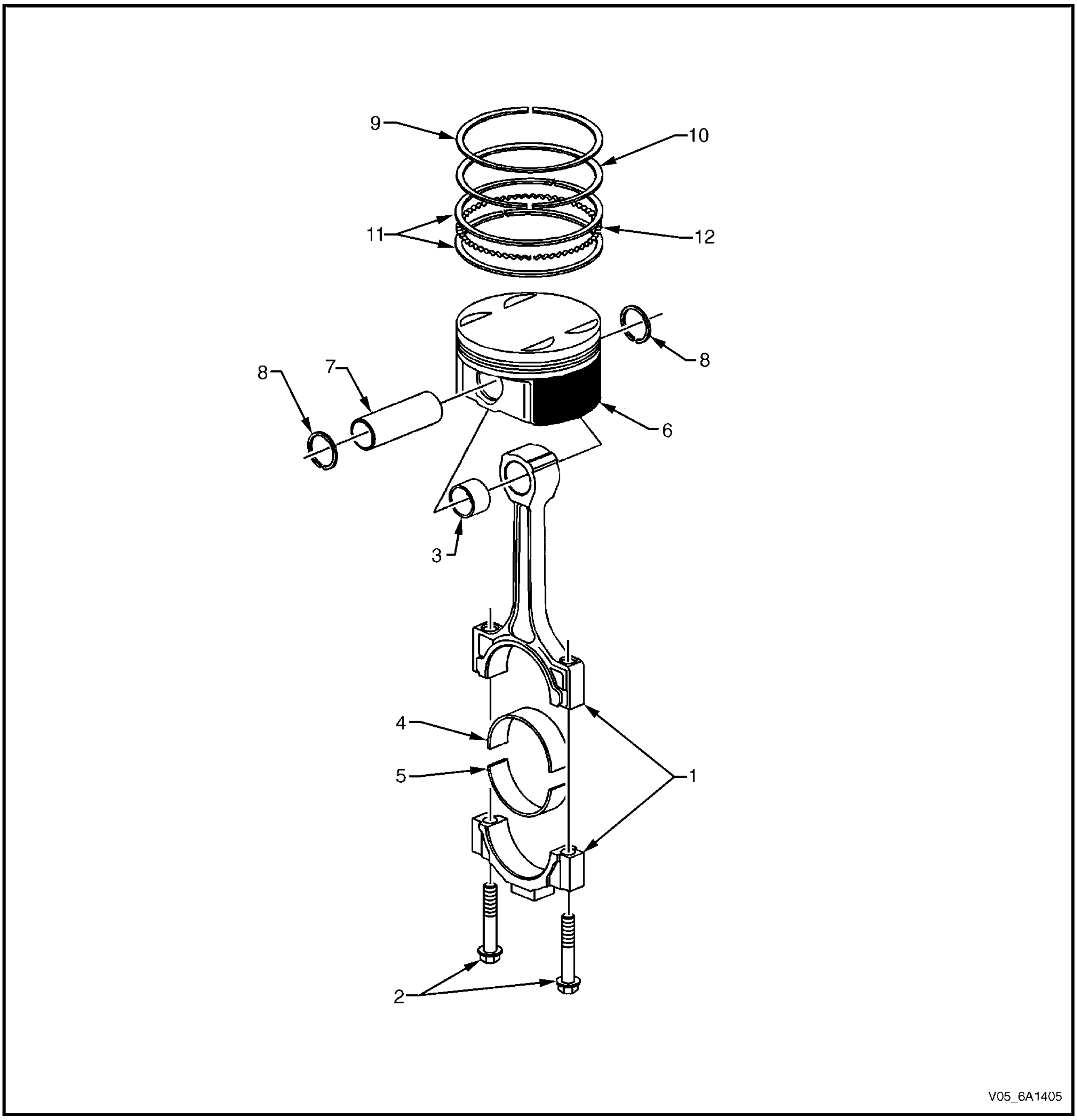


Figure 6A1 – 10

Legend

1	Connecting Rod	7	Piston Pin
2	Connecting Rod Bolt	8	Piston Pin Retainer
3	Connecting Rod Bush	9	Piston Upper Compression Ring
4	Upper Connecting Rod Bearing	10	Piston Lower Compression Ring
5	Lower Connecting Rod Bearing	11	Piston Oil Control Rail Ring
6	Piston	12	Piston Oil Control Ring Spacer

Oil Pan Assembly

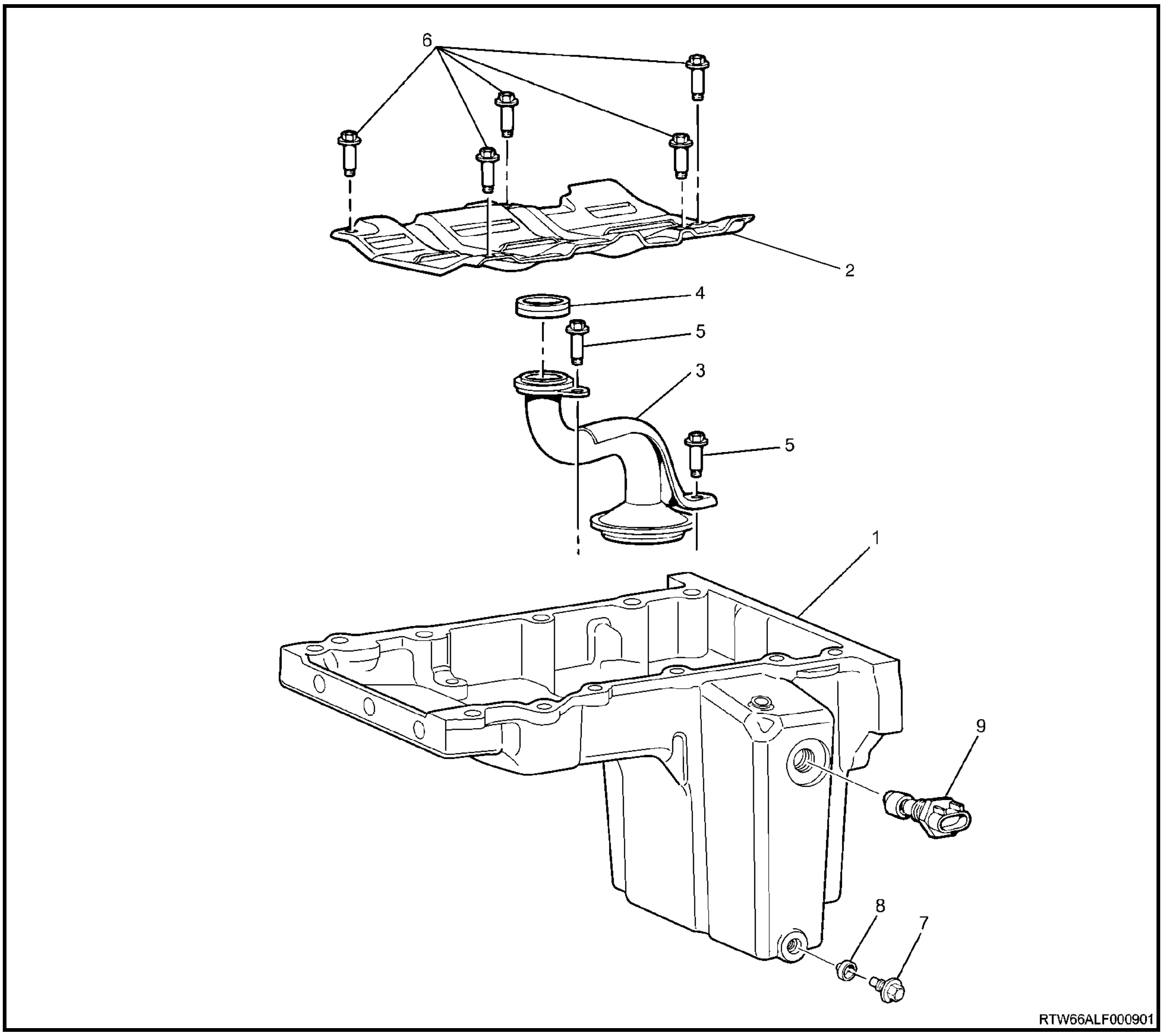


Figure 6A1 – 11

Legend

1	Oil Pan
2	Crankshaft Oil Deflector
3	Oil Pump Suction Pipe
4	Oil Pump Suction Pipe Gasket
5	Oil Pump Suction Pipe Bolt
6	Crankshaft Oil Deflector Bolt
7	Oil Pan Drain Plug
8	Oil Pan Drain Plug Sleeve
9	Engine Oil Level Sensor

Oil Filter Assembly

Legend

1 Oil Filter Gasket
2 Oil Filter Adapter
3 Oil Filter Adapter Bolt
4 Oil Filter Element

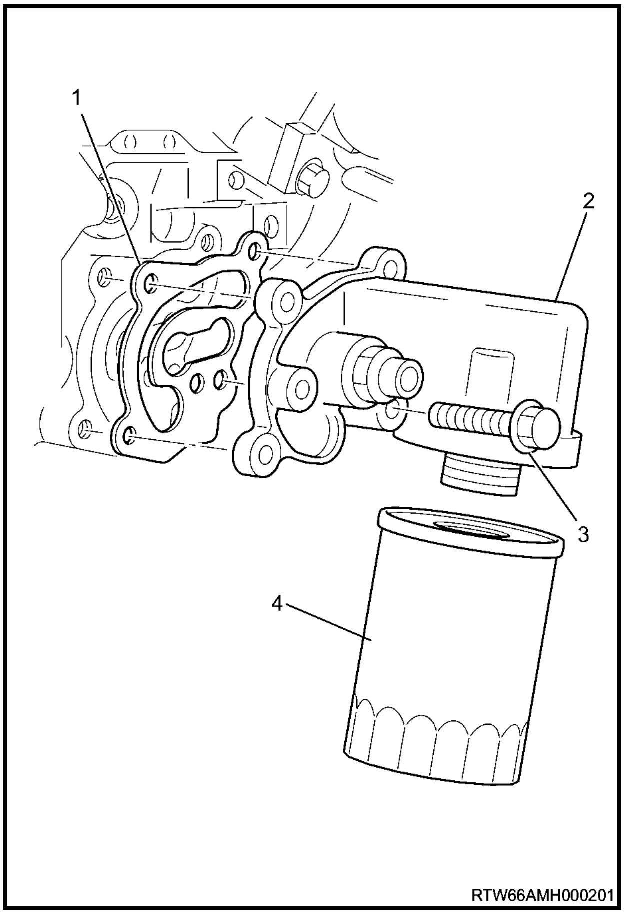


Figure 6A1 – 12

1.3 Engine Serial Number

The engine serial number is located on the machined pad (1) at the left-hand rear of the cylinder block.

The following is a breakdown of the engine serial number, using an example of 10H7E H051230001:

- 10 = Component ID (i.e. 10 = Assembly)
- H7E = Engine Broadcast Code
- H = Assembly Plant Code
- 05 = Build Year
- 123 = Julian Date
- 0001 = Four Digit Daily Sequence Number

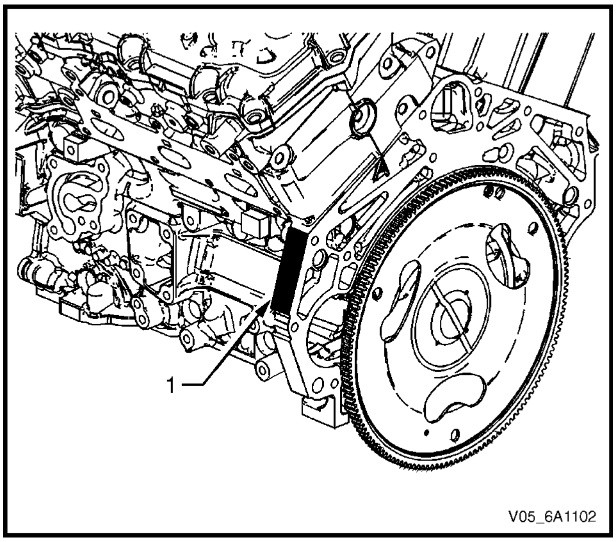


Figure 6A1 – 13

Diesel Engine model (Engine oil that meet or exceeds ACEA B3 specification)
I : Inspect and correct or replace as necessary A : Adjust
R : Replace or change T : Tighten to specified torque L : Lubricate

SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading or × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
DIESEL ENGINE																				
* Engine oil	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R
* Engine oil filter	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R	-	-	-	R
Oil leakage and contamination	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Idling speed and acceleration	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Fan belt tension and damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Exhaust system	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
All hoses and pipes in engine compartment for clog of damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Valve clearance	-	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A	-	-	-	A
* Air cleaner element	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
** Fuel filter	Replace the fuel filter when the fuel filter indicator light is lit.																			
Engine coolant concentration	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Cooling system for water leakage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
CLUTCH																				
Clutch fluid	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Clutch pedal travel and play	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
TRANSMISSION OR TRANSMISSION WITH TRANSFER CASE																				
* Manual transmission with fluid	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I	-	-	-	I
* Transfer case oil (MT)	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I	-	-	-	I
Oil leakage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Gear control mechanism for looseness	-	-	-	-	-	-	-	-	-	-	-	I	-	-	-	-	-	-	-	-
* Automatic transmission fluid	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
* Transfer case oil (AT)	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I	-	-	-	R
PROPELLER SHAFT																				
Loose connections	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Universal joints and splines for wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Universal joints and sliding sleeve (4WD)	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L	-	L
FRONT AND REAR AXLE																				
* Differential gear oil (Front and rear)	-	R	-	I	-	-	-	R	-	-	-	I	-	-	-	R	-	-	-	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Shift on the fly system gear oil	I	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Front axle shaft boot for damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle case for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Axle shafts for distortion or damage	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
STEERING																				
Power steering fluid	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	R	I	I	I	I
Oil leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Steering system for looseness or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Power steering hose	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	R	-	I	-	I
Steering wheel play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Steering function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Right and left turning radius	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Wheel alignment	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Joint ball for oil leakage or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Joint ball rubber boot for damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I

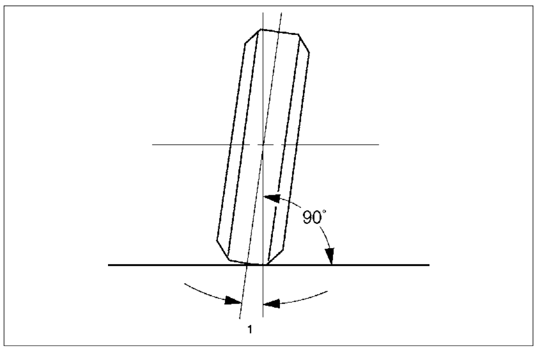
Front End Alignment Inspection and Adjustment

General Description

“Front End Alignment” refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground.

Proper front end alignment must be maintained in order to insure efficient steering, good directional stability and to prevent abnormal tire wear.

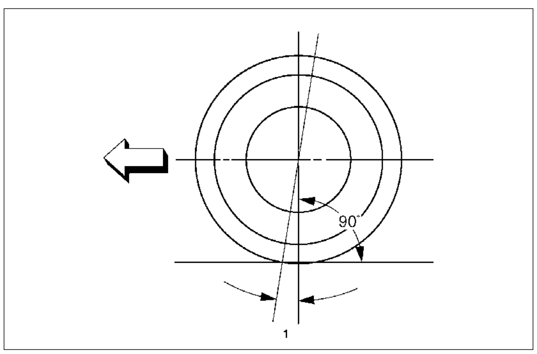
The most important factors of front end alignment are wheel toe-in, wheel camber and axle caster.



Camber:

This illustration shows a view from the front of the vehicle.

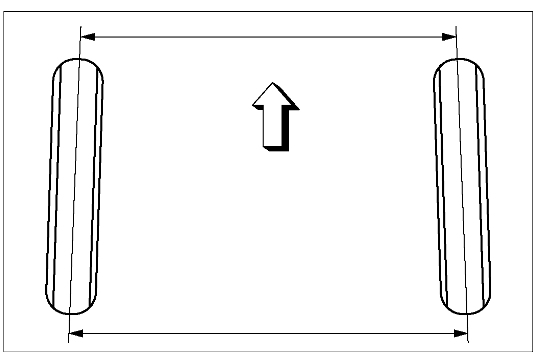
Camber is the vertical tilting inward or outward of the front wheels. When the wheels tilt outward at the top, the camber is positive (+). When the wheels tilt inward at the top, the camber is negative (-). The amount of tilt measured in degrees from the vertical is called the camber angle (1). If camber is extreme or unequal between the wheels, improper steering and excessive tire wear will result. Negative camber causes wear on the inside of the tire, while positive camber causes wear to the outside.



Caster:

This illustration shows a view from the side of the vehicle.

Caster (1) is the vertical tilting of the wheel axis either forward or backward (when viewed from the side of the vehicle). A backward tilt is positive (+) and a forward tilt is negative (-). On the short and long arm type suspension you cannot see a caster angle without a special instrument, but if you look straight down from the top of the upper control arm to the ground, the ball joints do not line up (fore and aft) when a caster angle other than 0 degrees is present. With a positive angle, the lower ball joint would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line.



Toe-in:

This illustration shows a view from the top of the vehicle.

Toe-in is the measured amount the front wheels are turned in. The actual amount of toe-in is normally a fraction of a degree. Toe-in is measured from the center of the tire treads or from the inside of the tires. The purpose of toe-in is to insure parallel rolling of the front wheels and to offset any small deflections of the wheel support system which occurs when the vehicle is rolling forward. Incorrect toe-in results in excessive toe-in and unstable steering. Toe-in is the last alignment to be set in the front end alignment procedure.

1.4 Engine Construction

Cylinder Block

The cylinder block (1) is constructed from aluminium alloy with cast-in-place iron cylinder bore liners.

Each of the four copper-infiltrated sintered steel main bearing caps are attached to the cylinder block by six bolts. Along with two outer and two inner bolts, two side bolts are used in the deep skirt block for increased block stiffness.

The crankshaft thrust bearing is mounted in the third main bearing cap.

To prevent aeration, oil return from the valve train and cylinder heads is channelled away from the reciprocating components through oil drain back passages incorporated into the cylinder heads and engine block. Pressure actuated piston oil cooling jets are mounted between opposing cylinders.

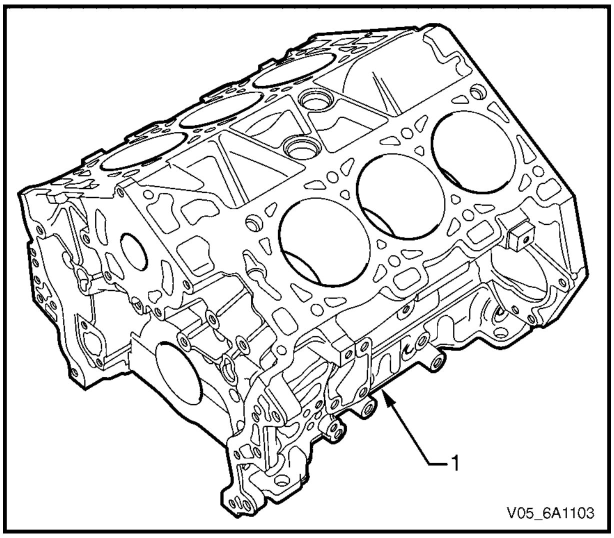


Figure 6A1 – 14

Cylinder Heads

The cylinder heads (1) are semi-permanent mould cast aluminium with powdered metal valve seat inserts and valve guides.

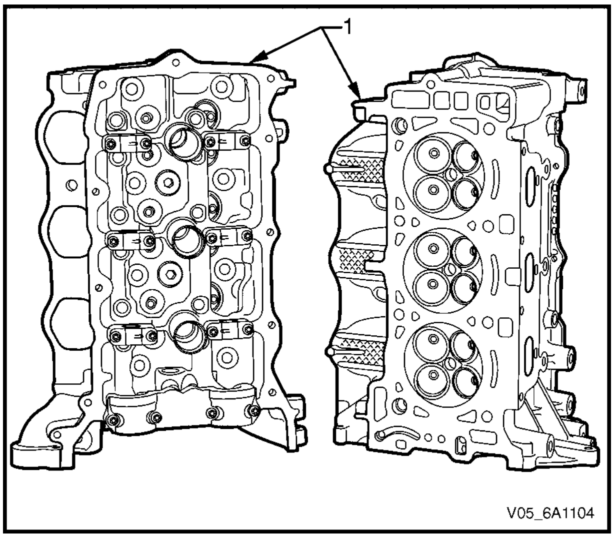


Figure 6A1 – 15

Each cylinder head contains four valves per cylinder. The valves (1) are actuated by the rocker arms (2) that pivot on stationary hydraulic lash adjusters (3), which are oil-fed to maintain valve / rocker lash.

The separate exhaust and intake camshafts are supported by four bearings machined into the cylinder head. The front camshaft bearing cap is used as a thrust control surface for each camshaft.

A tube (4) is pressed into each cylinder head in three places that shields each spark plug. An ignition coil assembly is mounted directly on each spark plug, through each spark plug tube.

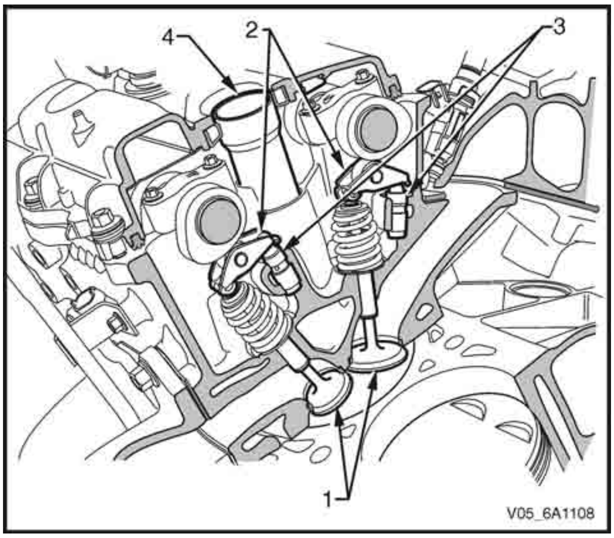


Figure 6A1 – 16

Crankshaft

The crankshaft is a forged steel design with four main bearings. The number three main bearing controls crankshaft thrust. A crankshaft position reluctor wheel is pressed onto the rear of the crankshaft, in front of the rear main journal. The crankshaft is internally balanced with an integral oil pump drive machined into the nose in front of the front main journal.

Pistons, Pins and Connecting Rods

The piston assembly (1) is fitted with two low tension compression rings and one multi-piece oil control ring. The top compression ring is plasma sprayed, while the second compression ring is cast iron Napier.

The oil control ring incorporates a steel expander and two chrome plated steel rails.

The connecting rods are sinter forged steel and have full floating piston pins. The piston pins are a slip-fit type, into the bronze bushed connecting rods. Round wire retainers are used to retain the piston pin into the piston.

The cast aluminium pistons incorporate a polymer coated skirt to reduce friction.

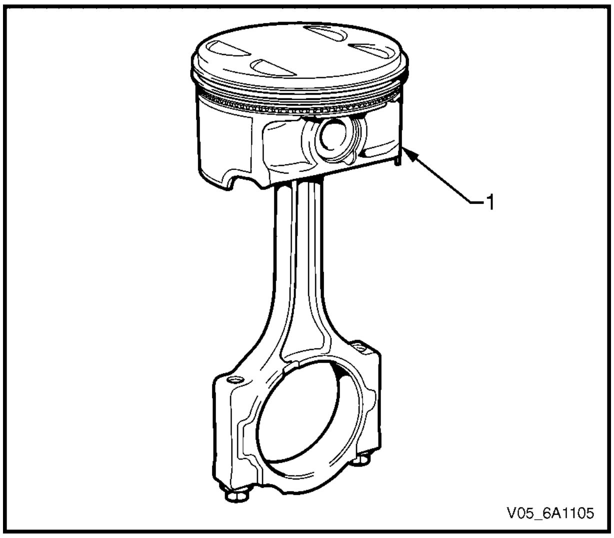


Figure 6A1 – 17

Camshaft Drive System

Three timing chains are fitted:

- primary (1),
- right-hand secondary (2), and
- left-hand secondary (3), refer to Figure 6A1 – 18 for the HFV6 engine.

The primary timing chain connects the crankshaft sprocket (4) with the left-hand and right-hand intermediate drive shaft sprockets (5).

Each oil pressure fed intermediate sprocket drives the secondary timing chains, which subsequently drive the respective cylinder head camshaft position actuators (6).

Two stationary timing chain guides (7) and movable timing chain shoes (8) control secondary timing chain backlash.

Each secondary timing chain shoe is under tension from an oil pressure hydraulically operated tensioner (9). To control backlash on the primary chain, two stationary timing chain guides (10) and an oil pressure hydraulically actuated tensioner with built in shoe (11) are fitted.

The tensioners minimise timing chain noise and provide accurate valve action by keeping slack out of the timing chains, while continuously adjusting for timing chain wear. The tensioners incorporate a plunger that adjusts outward with wear, minimising backlash. The tensioners are equipped with oiling jets to spray oil onto the timing components during engine operation. Each tensioner is sealed to the head or block using a rubber coated steel gasket. The gasket traps an adequate oil reserve to ensure quiet start-up.

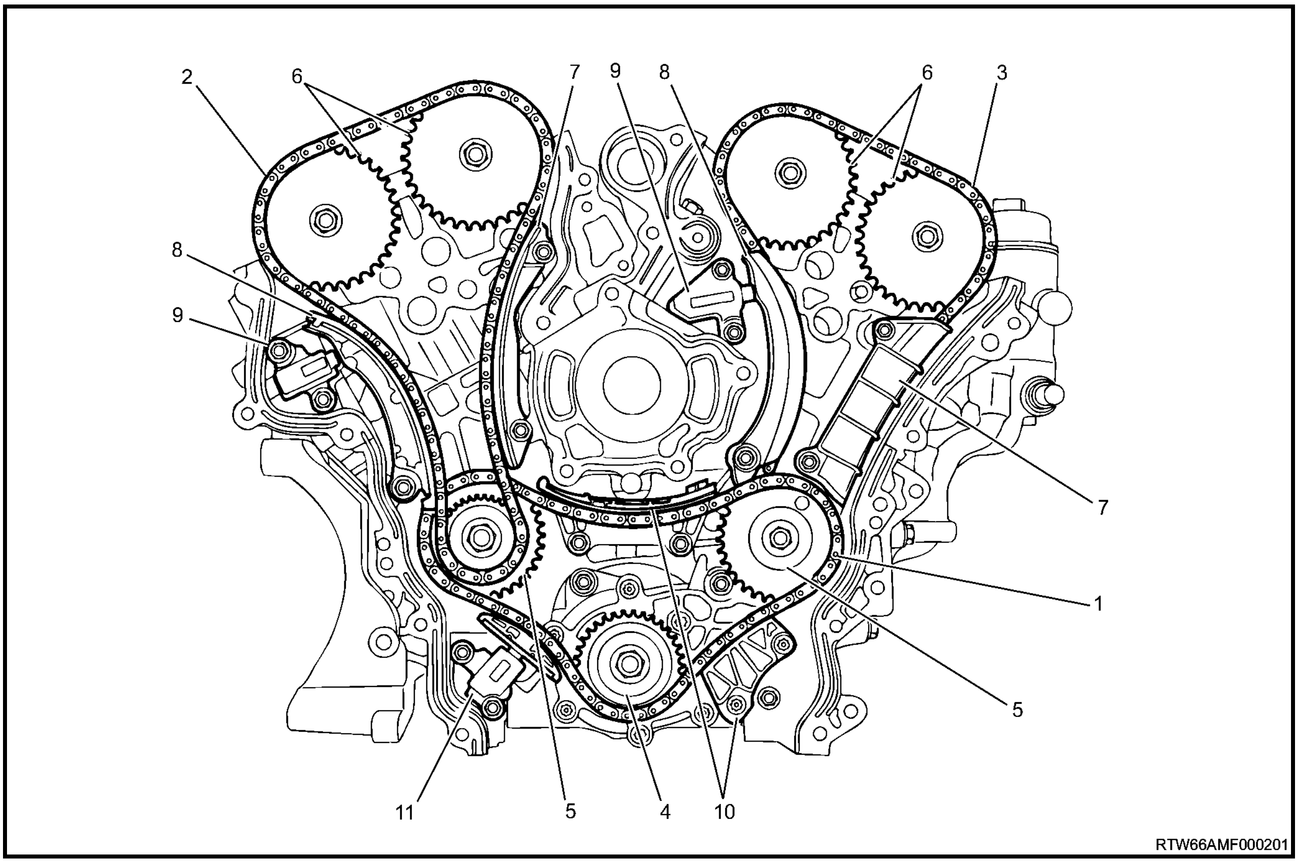


Figure 6A1 – 18

Legend

1	Primary Timing Chain	7	Secondary Timing Chain Guide
2	Secondary Timing Chain, Right-hand	8	Secondary Timing Chain Shoe
3	Secondary Timing Chain, Left-hand	9	Secondary Timing Chain Tensioner
4	Crankshaft Sprocket	10	Primary Timing Chain Guide
5	Intermediate Driveshaft Sprocket	11	Primary Timing Chain Tensioner
6	Camshaft Sprocket		

1.5 Engine Lubrication System

Lubrication Description

A structural diecast aluminium oil pan is fitted that incorporates an oil suction pipe, an oil deflector and an oil level sensor. The oil suction pipe is bolted into the oil pan and seals to the bottom of the cylinder block with a gasket. The oil deflector is bolted to the upper portion of the oil pan and ensures oil supply is maintained under all conditions. The oil level sensor is mounted through the bottom of the oil pan.

A crankshaft driven gerotor oil pump is mounted to the front of the cylinder block. The pump, which incorporates an internal pressure-relief valve, draws oil from the oil suction tube through the lower passage in the cylinder block. Oil is then directed through an upper passage to the left-hand side of the cylinder block where the oil filter adapter is mounted.

The oil filter adapter incorporates a top-access, cartridge style oil filter. The filter is accessed through a screw-on cap that incorporates an oil bypass valve. The oil filter adapter housing incorporates a drain back control valve and a threaded oil pressure sender. Oil flows through a lower passage within the oil filter adapter and through the oil filter cartridge. Filtered oil travels back through the upper passage of the adapter and into the engine block.

Oil is then directed up and across the front of the cylinder block, through several drilled passages. These front passages feed oil to each cylinder head, the passage for the main bearings and piston oil jets, the right-hand and left-hand secondary idler sprockets and to the primary timing chain tensioner.

Each cylinder head passage directs oil into oiling circuits for the stationary hydraulic lash adjusters (SHLAs) and the camshaft bearing journals. An additional passage in the cylinder head also directs oil to the secondary timing chain tensioner.

The oil passage that supplies oil to the main bearings also supplies oil to pressure actuated piston cooling oil jets. Each oil jet is mounted between opposing cylinder bores and directs oil to the two bores to provide extra cooling and control piston temperatures.

From the front passages, oil is directed to the front of the block where the right-hand and left-hand intermediate drive shaft sprockets and the primary timing chain tensioner are mounted. Each camshaft timing chain tensioner relies on a gasket to maintain an oil reserve after the engine is turned off. All camshaft timing chain tensioners incorporate a small oil jet to supply an oil spray onto the camshaft timing chain components.

Oil returns to the oil pan, either through the camshaft timing chain area or through the drain back passages on the outboard walls of the cylinder heads and cylinder block.

1.6 Service Notes

Cleanliness and Care

Throughout this Section, correct cleaning and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard workshop practice, even if not specifically stated.

When any internal engine part is serviced, care and cleanliness is extremely important.

When components are removed for service, they should be marked, organised or retained in a specific order for reassembly.

At the time of installation, components should be installed in the same location and with the same mating surface as when removed.

Any engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in thousandths of a millimetre. These surfaces should be covered or protected to avoid component damage.

A liberal coating of clean engine oil should be applied to friction areas during assembly, as the lubrication will protect and lubricate friction surfaces during the initial engine start-up.

Replacing Engine Gaskets

Re-Using Gaskets and Applying Sealants

- do not reuse any gasket unless specified,
- gaskets that can be reused will be identified in the service procedure, and
- do not apply sealant to any gasket or sealing surface unless specified in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Where required, remove all gasket and sealing material from the part using a plastic or wood scraper.
- Care must be used to avoid gouging or scraping the sealing surfaces.

- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces as these methods of cleaning can cause damage to the component sealing surfaces. Abrasive pads also produce fine grit that the oil filter cannot remove from the oil. This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Do not allow the sealant to enter into any blind threaded holes as it may prevent the bolt from clamping correctly or cause component damage when tightened.
- Only ever tighten bolts to the correct torque specification. Do not over-tighten.

Use of Room Temperature Vulcanising and Anaerobic Sealer

CAUTION

A number of sealant types are commonly used in engines. Examples are; room temperature vulcanising (RTV) sealer, anaerobic gasket eliminator sealer, and anaerobic thread sealant and pipe joint compound. The correct type of sealant and amount must be used in the specified location to prevent oil leaks. Do not interchange the different types of sealers.

Room Temperature Vulcanising Sealer

- Room temperature vulcanising (RTV) sealant hardens when exposed to air. This type of sealer is used where two non-rigid parts (such as the intake manifold and the engine block) are assembled together.
- Do not use RTV sealant in areas where extreme temperatures are experienced. These areas include the exhaust manifold, head gasket, or other surfaces where a gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply RTV to a clean surface. Use a bead size as specified in the service procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes, as it may prevent the bolt from clamping correctly or cause damage when the bolt is tightened.
- Assemble components while RTV is still wet (within 3 minutes). Do not wait for RTV to skin over.
- Tighten the bolts to the correct torque specification. Do not over-tighten.

Anaerobic Sealer

- Anaerobic gasket eliminator or thread sealant, hardens in the absence of air. This type sealer is used where two rigid parts (such as castings) are assembled together, where fasteners are subjected to vibration, or where the holes are not blind. When two rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply a continuous bead of gasket eliminator to one flange or on the bolt/stud thread. All surfaces must be clean and dry.
- Spread the sealer evenly to achieve a uniform coating on the sealing surface.
- Do not allow the sealer to enter any blind threaded holes as it may prevent the bolt from clamping correctly or cause damage when tightened.

CAUTION

Anaerobic sealed joints that are partially tightened and allowed to cure more than five minutes may result in incorrect shimming and sealing of the joint.

- Tighten the bolts to the correct torque specification. Do not over-tighten.
- After correctly tightening the fasteners, remove the excess sealer from the outside of the joint.

Pipe Joint Compound

- Pipe joint compound is a pliable sealer that does not completely harden. This type of sealer is used where two non-rigid parts (such as pressed steel and machined surfaces) are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include the exhaust manifold, head gasket, or other surfaces where gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes as it may prevent the bolt from clamping correctly or cause component damage when the bolt is tightened.
- Apply a continuous bead of pipe joint compound to one sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to the correct torque specification. Do not over-tighten.

Separating Parts

CAUTION

Many internal engine components will develop specific wear patterns on their friction surfaces. When disassembling the engine, internal components must be separated, marked and organised in a way to ensure reinstallation in their original location and position.

Separate, mark, or organise the following components:

- Piston and the piston pin.
- Piston to the specific cylinder bore.
- Piston rings to the specific piston.
- Connecting rod to the crankshaft journal.
- Connecting rod to the bearing cap.
- Crankshaft main and connecting rod bearings.
- Camshaft and rocker arms.
- Rocker arms and stationary hydraulic lash adjusters to cylinder head location.
- Valve to the valve guide.
- Valve spring and shim to the cylinder head location.
- Engine block main bearing cap location and direction.
- Oil pump drive and driven gears.

Tools and Equipment

Special tools are listed and illustrated throughout this Section with a complete listing at the end, refer to 7 Special Tools. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools will also minimise possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. A commercially available torque wrench and torque angle wrench, Tool No. EN-7115 are required for the correct tightening of various fasteners.

To correctly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves.

- A clean, well-lit, work area.
- A suitable parts cleaning tank.
- A compressed air supply.
- Trays or storage containers to keep parts and fasteners organised.
- An adequate set of hand tools.
- Approved engine repair stand.
- An approved engine lifting device that will adequately support the weight of the components.

Fasteners

Fasteners are central to the reliable operation of an engine. Whenever any bolt or any other threaded component is removed, allow the engine to cool (inset A) before attempting fastener removal.

Because of the greater thermal expansion of aluminium, bolt threads will change dimension to a greater extent when hot with this material (inset B) when compared to cast iron.

If a bolt or other threaded component is removed before the engine is allowed to cool to at least 50° C, threads could be pulled from the cylinder block or cylinder head.

Do not use impact tools to remove bolts during engine disassembly. While this may be common practice with cast iron engine components, use of these tools is more likely to pull the aluminium threads in the cylinder block or head of this engine.

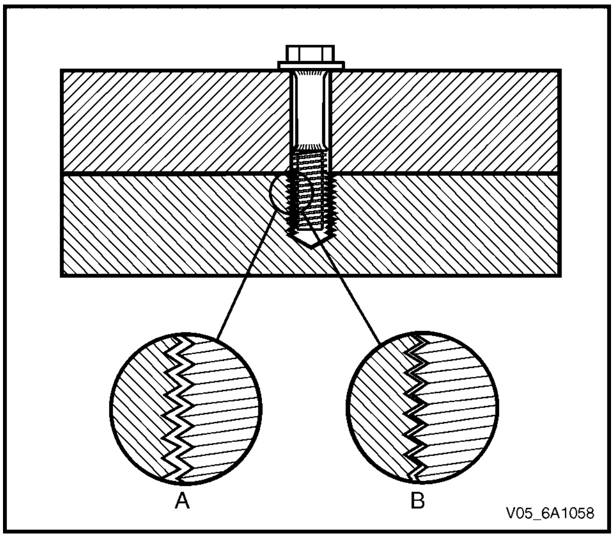


Figure 6A1 – 19

Clamp Load

When torque is applied to a fastener, the fastener stretches and the joint compresses. The force developed in the fastener due to its stretch is called tension (C), while the force applied to the joint is called clamp load (B).

As shown, only a small portion of the applied torque (A) is transferred to the clamp load (inset 1). Friction under the bolt head (inset 3) and in the threads (inset 2) absorbs much of the applied torque (A). Typically, only 10% (inset 1) of the torque is available to develop stretch (or tension) in the fastener and clamp load in the joint.

Therefore, a slight variation in friction in the thread or under the bolt head, results in a wide variation in the clamp load applied to the joint.

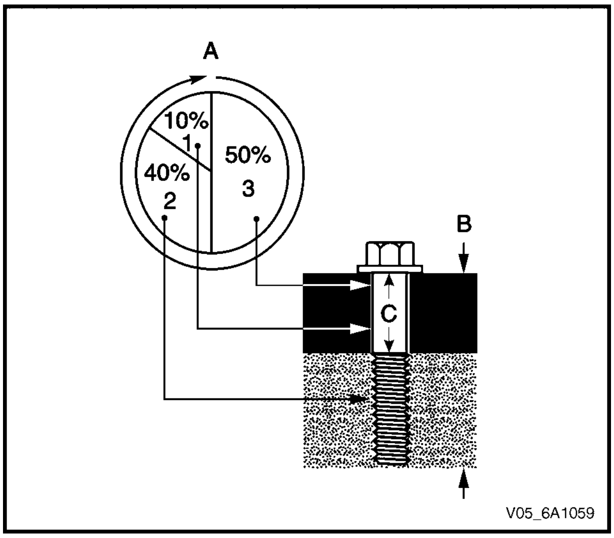


Figure 6A1 – 20

Torque Angle and Torque to Yield Fasteners

The torque angle method of applying torque to a fastener has been developed to overcome the effects of friction variation in fastener applications.

The application of the torque angle method does not always mean the fastener has to be replaced after loosening. It is only when the fastener has been angle tightened to the extent the yield point has been exceeded, that the fastener must be replaced.

Examples are the main bearing caps that are angle tightened but the bolts can be re-used, whereas the M11 cylinder head bolts that are torque to yield fasteners, must be replaced after loosening.

2 Diagnosis

2.1 Engine Diagnosis

Begin engine mechanical system diagnosis by reviewing the disassembled views provided in 1.2 Engine Components and 1.4 Engine Construction. Reviewing the description and operation information provided will assist in determining whether the condition described by the customer is a fault or normal engine operation.

2.2 Symptoms

Strategy Based Diagnosis

1 Review the system operations to familiarise yourself with the system functions, refer to 1 General Information and 6C1-1 Engine Management General Information.

2 Perform an engine management Diagnostic System Check, refer to 6C1-2 Engine Management – V6 – Diagnostics.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnosis is a uniform approach for repairing all vehicle systems. The strategy based diagnostic flow chart may always be used to resolve a system problem. The diagnostic flow chart is the place to start when repairs are required. For a detailed explanation of strategy based diagnosis and the flow chart, refer to 6C1-2 Engine Management – V6 – Diagnostics.

Visual / Physical Inspection

1 Inspect the vehicle for aftermarket accessories which may adversely affect engine operation.

2 Inspect the easily accessible or visible system components for obvious signs of damage or conditions that may cause the symptom.

3 Check the engine lubrication system for the following:

- correct oil level,
- correct lubricant viscosity,
- correct oil filter application, and
- contaminated or burnt oil.

4 Confirm the exact operating conditions under which the fault occurs. Note factors such as:

- engine speed (r.p.m.),
- ambient temperature,
- engine temperature,
- engine warm-up time, and
- vehicle road speed.

5 Compare the engine sounds, if applicable, to a known good engine, and ensure you are not trying to diagnose a normal operating condition.

Intermittent

For intermittent faults, test the vehicle under the same conditions the customer reported in order to confirm whether the system is operating correctly.

2.3 Engine Misfire without Internal Engine Noises

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt. Abnormalities in the accessory drive system and/or components may cause engine speed variations that result in a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the accessory drive belt, refer to 3.5Accessory Drive Belt. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs.
Worn, damaged or misaligned accessory drive components and excessive pulley run-out may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace as required. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs.
Loose or incorrectly fitted flexplate or crankshaft balancer assembly. A misfire DTC may be present without an actual misfire condition.	Repair or replace the flexplate or crankshaft balancer as required, refer to 3.13 Crankshaft Balancer Assembly or 4.3 Flexplate Assembly. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Restricted exhaust system. A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions in the exhaust system include collapsed/dented pipes and blocked mufflers and/or catalytic converters.	Repair or replace exhaust system components as required, refer to 8B Exhaust System. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Incorrectly installed or damaged vacuum hoses.	Repair or replace vacuum hoses as required.
Incorrect sealing between the intake manifold and cylinder heads, upper intake manifold and lower intake manifold, throttle body and intake manifold.	Repair or replace the intake manifold, throttle body gaskets, cylinder heads, throttle body as required.
Incorrectly installed or damaged barometric pressure(BARO) sensor and/or seal. The seal should not be torn or damaged.	Repair or replace the BARO sensor and/or seal as required, refer to 6C1-3 Engine Management – V6 – Service Operations.
Incorrectly installed or damaged EVAP purge solenoid and/or O-ring seal.	Repair or replace the EVAP purge solenoid and/or seal as required, refer to 6C1-3 Engine Management – V6 – Service Operations
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or rocker arms. The SHLAs, rocker arms and roller bearings should be intact and in the correct position.	Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Stuck valves. Carbon build up on the valve stems can result in the valves not closing correctly.	Repair or replace as required, refer to 3.22 Cylinder Head Assembly.
Excessively worn or misaligned timing chain/s.	Replace the timing chain/s and components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Excessive oil pressure. A lubrication system with excessive oil pressure may lead to excessive lash adjuster pump-up and loss of compression.	1 Perform an oil pressure test, refer to 3.1 Engine Oil. 2 Repair or replace the engine oil pump as required, refer to 3.17Oil Pump Assembly.

Cause	Correction
Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and cylinder block coolant passages. Coolant consumption may or may not cause the engine to overheat.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect the cylinder heads, cylinder block and/or head gaskets, refer to 3.22Cylinder Head Assembly and/or 4.7Cylinder Block. 3 Repair or replace components as required.
Worn piston rings. Oil consumption may or may not cause the engine to misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.
A damaged crankshaft reluctor wheel. A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. Systems with severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position. Systems with slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur, however, a DTC may set.	Replace the crankshaft as required, refer to 4.6 Crankshaft and Main Bearings. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs

2.4 Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt. Abnormalities in the accessory drive system and/or components may cause engine speed variations that result in a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the accessory drive belt, refer to 3.5Accessory Drive Belt. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Worn, damaged or misaligned accessory drive components and excessive pulley run-out may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace as required. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Loose or Incorrectly fitted flexplate or crankshaft balancer assembly. A misfire code may be present without an actual misfire condition.	Repair or replace the flexplate or crankshaft balancer as required, refer to 3.13 Crankshaft Balancer Assembly or 4.3 Flexplate Assembly.
Worn or broken piston rings. Oil consumption may or may not cause an actual misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.
Worn crankshaft thrust bearing. Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition being present.	Replace the crankshaft and/or bearings as required, refer to 4.6 Crankshaft and Main Bearings. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs

Inspection

Before making any adjustments affecting caster, camber or toe-in, the following front end inspection should be made.

1. Inspect the tires for proper inflation pressure. Refer to Main Data and Specifications in Wheel and Tire System section.
2. Make sure that the vehicle is in an unladen condition (With no passengers or loading).
3. Make sure that the spare tire is installed at the normal position.
4. Inspect the front wheel bearings for proper adjustment. Refer to Front Hub and Disc Overhaul in Suspension section.
5. Inspect the ball joints and tie rod ends. If excessive looseness is noted, correct before adjusting. Refer to Steering Linkage in this section.
6. Inspect the wheel and tires for run-out. Refer to Wheel Replacement in Wheel and Tire System section.
7. Inspect the trim height. If not within specifications, the correction must be made before adjusting caster.
8. Inspect the steering unit for looseness at the frame.
9. Inspect shock absorbers for leaks or any noticeable noise. Refer to Shock Absorber in Suspension section.
10. Inspect the control arms or stabilizer bar attachment for looseness. Refer to Suspension section.
11. Inspect the front end alignment using alignment equipment. Follow the manufacturer's instructions.
12. Park the vehicle on a level surface.

2.5 Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or valve rocker arms. The SHLAs, rocker arm and roller bearings should be intact and in the correct position.	Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Stuck valves. Carbon build up on the valve stems can result in the valves not closing correctly.	Repair or replace as required, refer to 3.22 Cylinder Head Assembly.
Excessively worn or misaligned timing chain/s.	Replace the timing chain/s and components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Sticking camshaft lash adjusters.	Replace the lash adjusters as required, refer to 3.21 Stationary Hydraulic Lash Adjuster.

2.6 Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gasket and/or cracking or other damage to the cylinder heads and cylinder block coolant passages. Coolant consumption may or may not cause the engine to overheat.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect the cylinder heads, cylinder block and/or head gaskets, refer to 3.22Cylinder Head Assembly and/or 4.7Cylinder Block. 3 Repair or replace components as required.

2.7 Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Repair or replace components as required, refer to 3.22 Cylinder Head Assembly.
Worn or broken piston rings. Oil consumption may or may not cause an actual misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.

2.8 Engine Noise on Start-up, but only Lasting a Few Seconds

NOTE

A cold piston knock, which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Oil filter anti-drain back valve faulty.	Replace the oil filter adaptor, refer to 3.3 Oil Filter Adaptor.
Incorrect oil viscosity.	Drain the engine oil and replace with the correct viscosity oil, refer to 3.1 Engine Oil.
High camshaft stationary hydraulic lash adjuster (SHLA) leak down rate.	Replace the SHLA as required, refer to 3.21 Stationary Hydraulic Lash Adjuster.
Worn crankshaft thrust bearing.	Inspect and replace the crankshaft and/or bearings as required, refer to 4.6 Crankshaft and Main Bearings.
Damaged or faulty oil filter by-pass valve.	1 Inspect the oil filter by-pass valve for correct operation. 2 Repair or replace the oil filter adaptor/by-pass valve as required.

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2.9 Upper Engine Noise, Regardless of Engine Speed

NOTE

A cold piston knock, which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17 Oil Pump Assembly.
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or valve rocker arms. The SHLAs, rocker arm and roller bearings should be intact and in the correct position.	1 Clean, inspect and replace the camshaft lash adjusters as required, refer to 3.21 Stationary Hydraulic Lash Adjuster. 2 Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Incorrect lubrication to the stationary hydraulic lash adjusters and valve rocker arm.	Inspect the following components and repair or replace as required: • valve rocker arms, refer to 3.20 Rocker Arm. • stationary hydraulic lash adjusters, refer to 3.21 Stationary Hydraulic Lash Adjuster. • oil filter by-pass valve, refer to 3.3 Oil Filter Adaptor. • oil pump and suction pipe, refer to 3.17 Oil Pump Assembly. • cylinder head oil galleries, refer to 3.22 Cylinder Head Assembly. • cylinder block oil galleries, refer to 4.7 Cylinder Block.
Broken Valve Spring.	Replace the valve spring, refer to 3.22 Cylinder Head Assembly.
Stretched or broken timing chain/s and/or damaged timing chain sprocket teeth.	Replace the timing chains or sprockets as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn or faulty timing chain tensioner or guide.	Replace the timing chains or sprockets as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Worn valve guides and/or valve stems.	Inspect and repair or replace valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.
Stuck valves. Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect and repair or replace valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.

2.10 Lower Engine Noise, Regardless of Engine Speed

NOTE

A cold piston knock which disappears in approximately 1.5 minutes from start up should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17Oil Pump Assembly.
Worn accessory drive components. Abnormalities such as severe cracking, bumps, stretching or missing areas on an accessory drive belt and/or misalignment of accessory drive system components.	Inspect the accessory drive system, repair or replace components as required, refer to 3.5 Accessory Drive Belt.
Loose or damaged crankshaft balancer and pulley assembly.	Repair or replace the crankshaft balancer and pulley assembly as required, refer to 3.13 Crankshaft Balancer Assembly.
Detonation or spark knock.	Confirm the correct operation of the ignition system, refer to 6C1-2 Engine Management – V6 – Diagnostics.
Loose torque converter bolts.	Inspect and tighten the torque converter bolts to the correct torque specification, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.
Loose or damaged flexplate.	Repair or replace the flexplate as required, refer to 4.3 Flexplate Assembly.
Oil pump suction pipe loose, damaged or restricted.	Clean, inspect and repair/replace the oil pump suction pipe as required, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.7 Cylinder Block.
Excessive connecting rod bearing clearance.	Inspect the connecting rod, crankshaft and bearings and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Excessive piston pin to bore clearance.	Inspect the pistons and pins and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Excessive crankshaft main bearing clearance.	Inspect the crankshaft, cylinder block journals, main bearings and main bearing caps and repair/replace components as required, refer to 4.6 Crankshaft and Main Bearings and 4.7Cylinder Block.
Incorrect piston, pin and connecting rod installation. Pistons must be installed with the mark or dimple facing the front of the engine. Piston pins must be centred in the piston pin bore.	Confirm the pistons, pins and connecting rods are installed correctly and repair if required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

2.11 Engine Noise Under Load

NOTE

A cold piston knock which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17Oil Pump Assembly.
Detonation or spark knock.	Confirm the correct operation of the ignition system, refer to 6C1-2 Engine Management – V6 – Diagnostics.
Loose torque converter bolts.	Inspect and tighten the torque converter bolts to the correct torque specification, refer to 7C1 Automatic – 4L60E – General Information – 4L60E – General Information.
Cracked flexplate.	Replace the flywheel/flex-plate as required, refer to 4.3 Flexplate Assembly.
Excessive connecting rod bearing clearance.	Inspect the connecting rod, crankshaft and bearings and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Excessive crankshaft bearing clearance	Inspect the crankshaft, cylinder block journals, main bearings and main bearing caps and repair/replace components as required, refer to 4.6 Crankshaft and Main Bearings and 4.7Cylinder Block.

2.12 Engine Will Not Crank – Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component.	1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt. 2 Rotate the crankshaft by hand at the balancer pulley or flywheel. 3 Repair or replace accessory drive system components as required.
Hydraulically locked cylinder caused by: • coolant in cylinder, • oil in cylinder, or • fuel in cylinder.	1 Remove the spark plugs and check for fluid, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect for broken head gasket/s. 3 Inspect for cracked engine block or cylinder head. 4 Inspect for sticking fuel injector. 5 Repair or replace components as required.
Seized torque converter.	1 Remove the torque converter bolts, refer to 7C1 Automatic – 4L60E – General Information – 4L60E – General Information. 2 Rotate the crankshaft by hand at the balancer pulley or flywheel. 3 Repair or replace torque converter as required.

Cause	Correction
Material in cylinder bore, caused by: • broken valve, • broken piston or ring, or • dirt or foreign matter entry during engine assembly procedure.	1 Clean and inspect the cylinder for damaged components and or foreign matter, refer to 4.7 Cylinder Block. 2 Repair or replace components as required.
Seized crankshaft or connecting rod bearings.	Inspect and repair or replace crankshaft, connecting rod and bearings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Bent or broken connecting rod.	Inspect and repair or replace connecting rod and bearings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Bent or broken crankshaft.	Inspect and repair or replace crankshaft and bearings as required, refer to 4.6 Crankshaft and Main Bearings.
Seized or broken camshaft.	1 Inspect and replace camshafts as required, refer to 3.19 Camshaft. 2 Inspect camshaft journals and cam caps on cylinder head and repair or replace components as required, refer to 3.22 Cylinder Head Assembly.
Seized or broken camshaft timing components.	1 Inspect the crankshaft, idler, intake camshaft and exhaust camshaft sprockets. 2 Inspect the timing chains. 3 Inspect the guides. 4 Inspect the tensioners. 5 Repair or replace components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Seized or broken valve train components.	1 Inspect the stationary hydraulic lash adjusters, refer to 3.21 Stationary Hydraulic Lash Adjuster. 2 Inspect the rocker arms, refer to 3.20 Rocker Arm. 3 Inspect the Valves Refer to 3.22 Cylinder Head Assembly. 4 Inspect the valve springs, refer to 3.22 Cylinder Head Assembly. 5 Repair or replace components as required.

2.13 Coolant in Combustion Chamber

Definition

Excessive white smoke and/or coolant type odour emitted from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative engine cooling fan or a faulty thermostat may lead to an over-temperature condition which may cause internal engine component damage. A slower than normal cranking speed may indicate coolant entering the combustion chamber.

1 Remove the spark plugs and inspect for spark plugs saturated by coolant and coolant in the cylinder bore.

2 Inspect by performing a cylinder leakage test, refer to 2.16 Cylinder Leakage Test. During this test, excessive air bubbles in the coolant may indicate a faulty head gasket, cracked cylinder head or cracked cylinder block.

3 Inspect by performing a cylinder compression test. Two cylinders side-by-side on the cylinder block, with low compression, may indicate a failed cylinder head gasket, refer to 2.15 Engine Compression Test.

Cause	Correction
Cracked intake manifold or faulty gasket.	Replace components as required, refer to 3.10 Intake Manifold Assembly – Complete.
Faulty cylinder head gasket.	Replace the cylinder head gasket, refer to 3.22 Cylinder Head Assembly.
Warped cylinder head.	Repair or replace the cylinder heads as required, refer to 3.22 Cylinder Head Assembly.
Cracked cylinder liner or block	Repair or replace the cylinder block and components as required, refer to 4.7 Cylinder Block.
Cylinder head or cylinder block porosity.	Repair or replace the cylinder block or cylinder heads as required, refer to 4.7 Cylinder Block or 3.22 Cylinder Head Assembly.

2.14 Coolant in Engine Oil

Definition

Foamy or discoloured oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative engine cooling fan or a faulty thermostat may lead to an over-temperature condition which may result in engine component damage. Contaminated engine oil and oil filters must be replaced.

1 Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not correctly lubricate the crankshaft bearings, resulting in component damage, refer to 2.10Lower Engine Noise, Regardless of Engine Speed.

2 Perform a cylinder leakage test, refer to 2.16 Cylinder Leakage Test. During this procedure, excessive air bubbles in the engine coolant may indicate a faulty gasket or damaged component.

3 Perform a cylinder compression test. Two cylinders side-by-side on the cylinder block, with low compression, may indicate a failed cylinder head gasket, refer to 2.15 Engine Compression Test.

Cause	Correction
Faulty cylinder head gasket.	Replace the cylinder head gasket, refer to 3.22 Cylinder Head Assembly.
Warped cylinder head.	Repair or replace the cylinder heads as required, refer to 3.22 Cylinder Head Assembly.
Cracked cylinder liner or block	Repair or replace the cylinder block and components as required, refer to 4.7 Cylinder Block.
Cylinder head, cylinder block or intake manifold porosity.	Repair or replace the cylinder block, cylinder heads or intake manifold components as required, refer to 4.7 Cylinder Block, 3.22 Cylinder Head Assembly or 3.10 Intake Manifold Assembly – Complete.

2.15 Engine Compression Test

A compression pressure test of the engine cylinders determines the condition of the rings, the valves and the head gasket.

Preliminary Steps

1 Ensure the battery is fully charged.

2 Remove the spark plugs from all cylinders, refer to 6C1-3 Engine Management – V6 – Service Operations.

NOTE

DTCs will set when the fuel system or the ignition system is disabled and the engine is cranked. Disregard DTCs that set under this condition.

3 Disable the fuel system by removing the fuel pump relay, refer to 8A Electrical Body & Chassis.

4 Start the engine to use any residual fuel from the fuel lines.

4 Disable the ignition coils by removing fuses 34 and 35, refer to 8A Electrical Body & Chassis .

5 Using Tech 2, command the throttle plate to wide open throttle.

Engine Cylinder Compression Test

1 Install the compression tester to cylinder number 1.

2 While observing the compression tester reading, turn the ignition to the START position for several seconds and then allow the ignition to return to the ON position.

3 Record the highest compression reading obtained.

4 Repeat the engine compression test for each cylinder.

Test Result Evaluation

Normal engine compression pressure builds quickly and evenly to over 965 kPa. In addition, the lowest reading of an engine cylinder should not be less than 70 percent of the highest reading. If any cylinder fails the compression test, adding 15 ml of engine oil to the suspected cylinder may help isolate the following fault condition.

1 A fault condition in the piston rings will produce the following result:

- A low compression on the first engine cycle
- The compression tends to build-up with the succeeding engine rotation.
- The compression improves with the addition of engine oil.

2 A fault condition in an intake or exhaust valve will produce the following result:

- A low compression on the first engine cycle
- The compression does not build with the succeeding engine rotation.
- The compression does not improve with the addition of engine oil.

3 A fault condition in the cylinder head gasket will produce the following result:

- A low compression on the first engine cycle
- The compression does not build with the succeeding engine rotation.
- The compression does not improve with the addition of engine oil.
- The suspected cylinders are positioned adjacent to each other.
- The engine oil may be contaminated with engine coolant.
- The engine coolant may be contaminated with engine oil.

Once the fault has been identified, refer to the relevant service procedure and reinstall the removed components.

Using Tech 2, clear DTCs.

2.16 Cylinder Leakage Test

A leakage test may be performed to measure cylinder/combustion chamber leakage. High cylinder leakage may indicate one or more of the following:

- worn or burnt valves,
- broken valve springs,
- stuck valve lifters,
- incorrect valve lash/adjustment,
- damaged piston,
- worn piston rings,
- worn or scored cylinder bore,
- damaged cylinder head gasket,
- cracked or damaged cylinder head, or
- cracked or damaged engine block.

1 Disconnect the battery ground negative cable.
2 Remove the spark plugs from all cylinders, refer to 6C1-3 Engine Management – V6 – Service Operations.
3 Rotate the crankshaft to place the piston in the cylinder being tested at top dead centre (TDC) of the compression stroke.
4 Install a commercially available cylinder head leak down tester into the spark plug hole.

NOTE

If required, hold the crankshaft balancer bolt to prevent the engine from rotating.

5 Apply shop air pressure to the cylinder head leak down tester and adjust according to the manufacturers instructions.
6 Record the cylinder leakage value. Cylinder leakage that exceeds 25 percent is considered excessive and may require component service. In excessive leakage situations, inspect for the following conditions:
   - air leakage sounds at the throttle body or air inlet duct that may indicate a worn or burnt intake valve or a broken valve spring,
   - air leakage sounds at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a broken valve spring,
   - air leakage sounds from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head, or
   - air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.
7 Perform the leakage test on the remaining cylinders and record the values.

2.17 Engine Oil Consumption Diagnosis

Definition

Excessive oil consumption (not due to leaks) is the use of 3 litres or more of engine oil within 10,000 kilometres. Prior to performing oil pressure testing, a preliminary inspection of the vehicle should be performed. During the preliminary visual inspection, the following likely causes of excessive oil usage should be investigated.

Cause	Correction
External oil leaks.	Refer to 2.18 Engine Oil Leak Diagnosis.
Incorrect oil level or reading of the oil level indicator.	Check for the correct oil level, refer to 3.1 Engine Oil.
Incorrect oil viscosity.	Replace the engine oil, using the recommended SAE grade of engine oil, refer to 3.1 Engine Oil.
Continuous high-speed driving or severe usage.	Service vehicle more frequently, refer to 0B Lubrication and Service.
Crankcase ventilation system restricted or malfunctioning.	Repair or replace crankcase ventilation system components as required, refer to 6C1-3 Engine Management – V6 – Service Operations.

Cause	Correction
Worn valve guides and or valve stems.	Inspect and repair valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.
Worn or damaged valve stem oil seal.	Replace valve stem oil seals as required, refer to 3.22 Cylinder Head Assembly.
Piston rings broken, worn or not seated correctly.	Allowing adequate time for the piston rings to seat correctly, replace piston rings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Piston rings incorrectly installed or not matched to cylinder bore oversize.	Replace piston rings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

2.18 Engine Oil Leak Diagnosis

Introduction

It is important to correctly identify the source of an engine oil leak. For example, a power steering fluid leak or spillage during servicing can travel across the valley area of the engine and run-out the weep hole, which is located at the back of the cylinder block. Failure to correctly identify the source of an engine oil leak can lead to unnecessary replacement of engine components.

Most fluid leaks can be repaired by repairing or replacing the faulty component or resealing the gasket surface. However, once a leak is identified it is important to determine and repair the cause as well as the leak itself.

Locating and Identifying the Leak

Inspect the leaking fluid and determine whether it is engine oil, transmission fluid, power steering fluid, brake fluid or some other fluid. If unsure of the source of the leaking lubricant, a quick check of fluid levels should indicate where the fluid is coming from, as one or more fluid level should be low.

Visual Inspection

Once the type of leaking fluid has been determined, a visual inspection of the affected system should be performed. When performing the visual inspection:

1 Bring the vehicle to the normal operating temperature.
2 Park the vehicle over a large sheet of paper or other clean surface.
3 Leave the vehicle idling for 2-3 minutes, then check for dripping fluid.
4 If required, identify the type of fluid leaking and the approximate location of the leak.
5 Visually inspect the suspected area. A small mirror may assist viewing areas that are difficult to see normally.
6 Check for leaks at all sealing surfaces and fittings.
7 Check for any cracked or damaged components.
8 If the leak cannot be located, completely clean the entire engine and surrounding components, drive the vehicle at normal operating temperature for several kilometres and then repeat Steps 3 to 8.
9 If the leak still cannot be located, proceed with either the Powder Method or Black Light and Dye Method as outlined below.

Powder Method

1 Completely clean the entire engine and surrounding components.
2 Apply an aerosol type powder (e.g. foot powder) to the suspected area.
3 Operate the vehicle at normal operating temperature and at varying speeds for several kilometres.
4 Identify the source of the leak from the discoloration of the powder around the suspect components.
5 If required, use a small mirror to assist in viewing areas that are difficult to see normally.
6 Refer to Possible Causes for Engine Oil Leaks in this Section, and repair or replace components as required.

Black Light and Dye Method

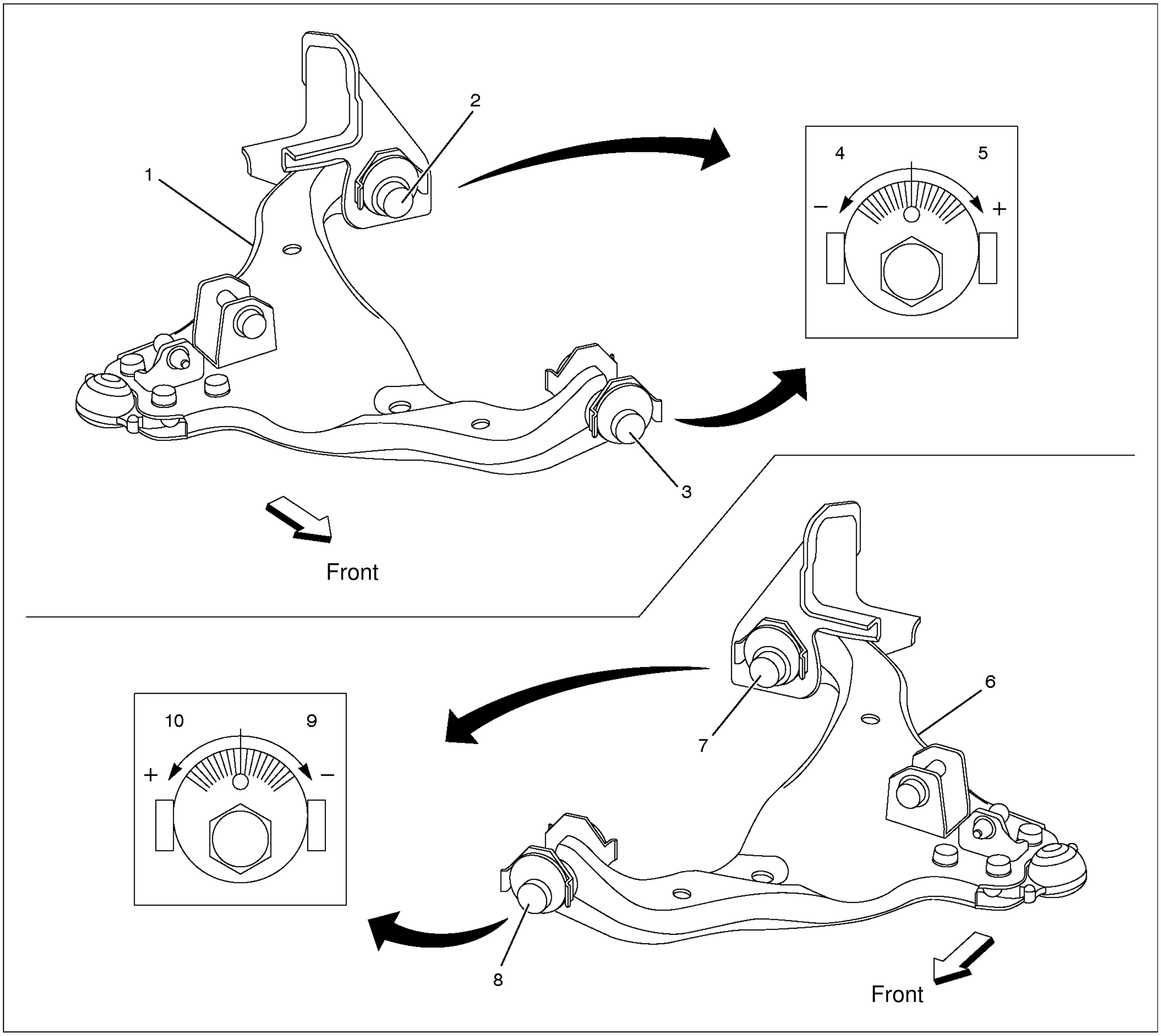
A black light and die kit Tool No. J28428-E or a commercially available equivalent is available to technicians to aid in engine oil leak diagnosis. When using a black light and die kit for the first time, it is recommended the technician read the manufacturers instructions prior to using the kit.

1 Add the specified amount of dye, as per manufacturers instructions, into the engine or suspected source of the oil leak.
2 Operate the vehicle at normal operating temperature and at varying speeds for several kilometres.

Alignment for 4×2 (except High Ride Suspension)

Caster and camber adjustment

The lower links of the 4 X2 vehicle front suspension have an adjusting cam at either end (front and rear). This permits simultaneous adjustment of camber and caster angle.



RTW340LF000301

Legend

1. Lower link ASM RH
2. Adjusting cam RR
3. Adjusting cam FRT
4. -direction The lower link ASM moves toward the inside
5. +direction The lower link ASM moves toward the outside
6. Lower link ASM LH
7. Adjusting cam RR
8. Adjusting cam FRT
9. -direction The lower link ASM moves toward the inside
10. +direction The lower link ASM moves toward the outside

3 With the vehicle parked on a flat level surface, aim the black light at the suspected component/s. The dyed fluid will appear as a yellow path leading to the oil leak source

4 Refer to Possible Causes for Engine Oil Leaks in this Section, and repair or replace components as required.

Possible Causes for Engine Oil Leaks

Common possible causes for engine oil leaks are:

- higher than recommended fluid levels,
- higher than recommended fluid pressures,
- blocked or faulty fluid filters or pressure relief valve,
- blocked or faulty engine ventilation system,
- incorrectly tightened or damaged fasteners,
- cracked or porous components,
- incorrect gaskets or sealants used,
- incorrect gaskets or sealant installation,
- damaged or worn gaskets or seals, and
- damaged or worn sealing surfaces.

2.19 Engine Oil Pressure Diagnosis

If the engine oil pressure is below the specified value, inspect the engine and components for the following:

- loose oil filter adaptor bolts,
- faulty oil filter adaptor seals,
- worn or faulty oil pump,
- loose oil pump bolts,
- loose, blocked or damaged oil pump suction pipe,
- faulty oil pump suction pipe seal,
- faulty oil pump pressure relief valve,
- faulty or incorrectly installed oil gallery plugs,
- excessive bearing clearance in one of the following:
- connecting rods big end/s,
- crankshaft main journal/s,
- camshaft/s,
- camshaft sprocket/s, and
- cracked, porous or restricted oil galleries, or broken lash adjuster/s.

2.20 Accessory Drive Belt Diagnosis

Tension Check

NOTE

An accessory drive belt that squeaks when the engine is started or stopped is considered normal and has no effect on drive belt durability.

1 Start the engine and switch off the air-conditioning system. Allow engine to run until normal operating temperature has been reached.

2 Turn the engine off and inspect the markings on the drive belt tensioner to confirm the drive belt tension is within the operating limits.

3 If the markings on the drive belt tensioner were outside the acceptable operating limits, replace the accessory drive belt, refer to 3.5 Accessory Drive Belt.

NOTE

The operating limits for acceptable drive belt tension are when the drive belt tensioner pointer (1) is aligned between the outer edge of the minimum and maximum tension marks (2).

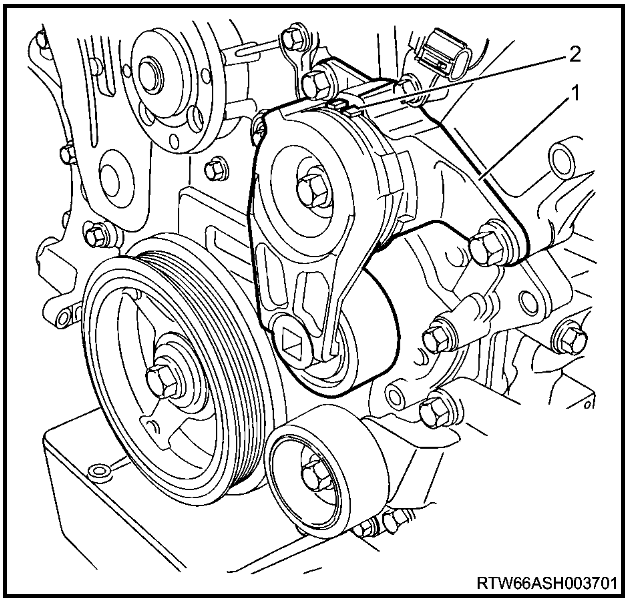


Figure 6A1 – 21

Inspect

Figure 6A1 – 22 illustrates the various stages of belt wear to aid in belt replacement decisions. Condition of the belt ribs is best judged where the belt is bent over one of the larger accessory drive system pulleys.

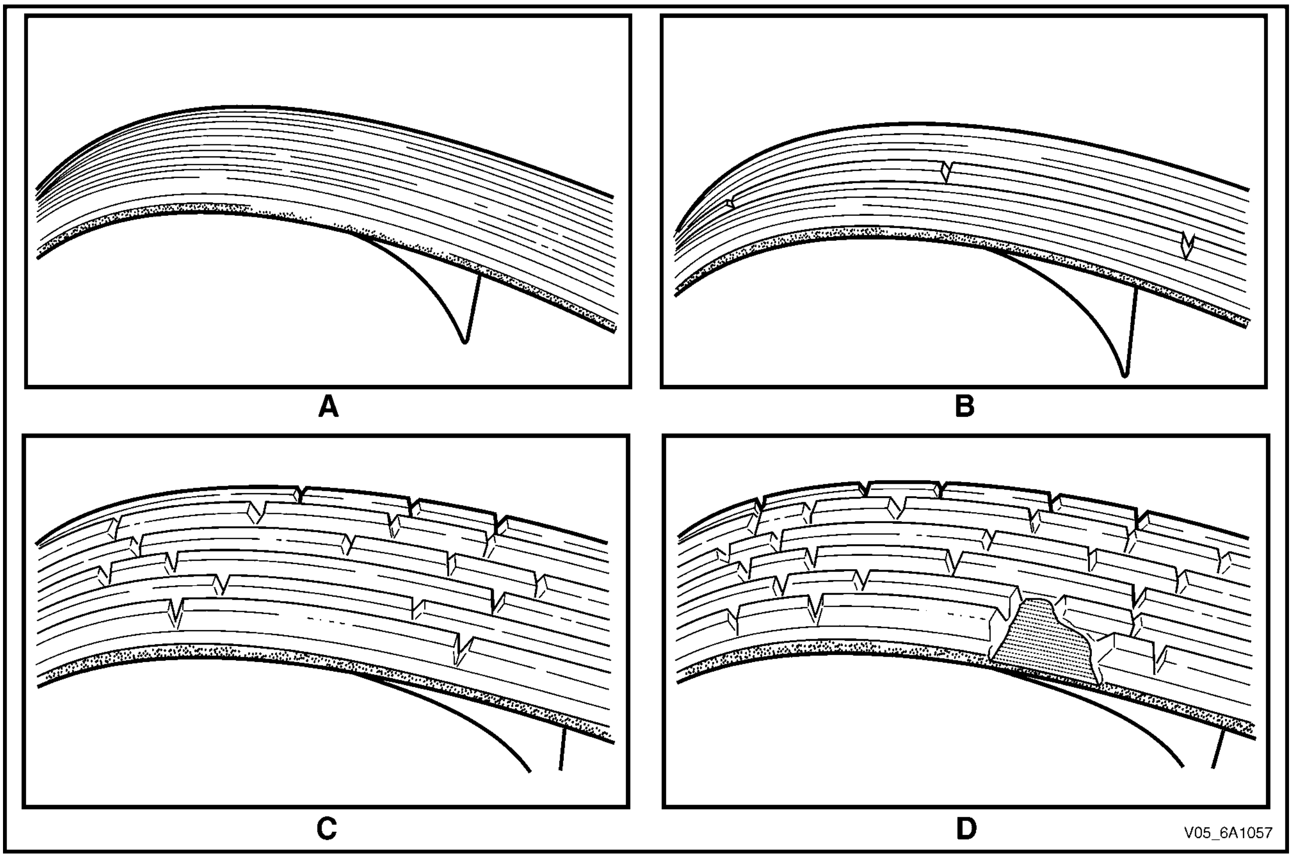


Figure 6A1 – 22

Legend

A New belt

B Moderately used belt – few cracks, some wear on ribs and in grooves. replacement is not required

C Severely used belt – several cracks per 30 mm. Should be replaced before chunking occurs.

D Failed belt – separation of rib material from the backing (chunking). Replace belt immediately.

Drive Belt Chirp

Definition

Accessory drive belt chirping can be defined as a high-pitched noise that is heard once per revolution of the drive belt or a pulley.

NOTE

Chirping during start-up in cold damp conditions that abates once the engine reaches operating temperature is considered normal.

Diagnostic Aids

The symptom may be intermittent due to moisture on the drive belts or pulleys. It may be necessary to spray a small amount of water on the drive belt to duplicate and confirm a customers concern. If spraying water onto the drive belt system duplicates the symptom, cleaning the belt pulleys may be the solution.

A loose or incorrectly installed body component, suspension component or other item may be the cause of the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 The noise may not be engine related. This step is to confirm the engine is making the noise. If the engine is not making the noise, do not proceed further with this diagnostic procedure.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Inspect all drive pump pulleys for pilling.

NOTE

Pilling is the small balls (pills) or strings of rubber in the belt grooves caused by the accumulation of rubber dust.

6 Misalignment of the accessory drive system pulleys may be caused by incorrect mounting of an accessory drive component (A/C compressor, generator etc.) or pulley. Misalignment may also be caused by incorrect installation of a pulley during a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found, refer to the relevant component service information for the correct installation and removal procedures.

10 Inspecting the fasteners can eliminate the possibility that an incorrect fastener has been installed.

12 Inspecting the pulleys for being bent should include inspecting for a dent or other damage that would prevent the drive belt from not seating correctly in all of the pulley grooves or on the smooth surface when the back end of the belt is used as the driving surface.

14 Replacing the drive belt when it is not damaged and there is no excessive pilling will only be a temporary repair.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a chirping noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the chirping noise still exist?	Accessory drive system OK. Go to 2.2 Symptoms, and restart the diagnosis of the noise	Go to Step 4
4	Inspect for severe pilling, i.e. in excess of 33% of the belt groove depth. Do the belt grooves have pilling?	Go to Step 5	Go to Step 6
5	Clean the drive belt pulleys with a wire brush. Are the belt pulleys clean?	Go to Step 15	Go to Step 6
6	Inspect for misalignment of the pulleys. Are the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace or repair misaligned pulleys. Did you complete the repair?	Go to Step 15	—
8	Inspect for any bent or damaged accessory drive component mounting brackets. Did you find any bent or damaged brackets?	Go to Step 9	Go to Step 10
9	Replace or repair any bent or damaged Brackets. Did you complete the repairs?	Go to Step 15	—

Step	Action	Yes	No
10	Inspect for missing, loose or incorrect fasteners. Did you find any missing, loose or incorrect fasteners?	Go to Step 11	Go to Step 12
11	Tighten any loose fasteners to the torque specification as provided in provided in 6. Torque Wrench Specifications. Replace any incorrect or missing fasteners. Did you complete the repairs?	Go to Step 15	—
12	Inspect for a bent pulley. Did you find any bent pulleys?	Go to Step 13	Go to Step 14
13	Replace bent pulleys as required. Did you complete the repair?	Go to Step 15	—
14	Replace the accessory drive belt, refer to 3.5Accessory Drive Belt. Did you complete the repair?	Go to Step 15	—
15	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the chirp noise?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Squeal

Definition

Accessory drive belt squealing can be defined as a loud screeching noise caused by a slipping drive belt. Belt squeal is unusual in multi-rib belts. Drive belt squeal generally occurs when a heavy load is applied to the drive belt, such as an air-conditioning compressor engagement, snapping the throttle, seized pulley or a faulty accessory drive component.

Diagnostic Aids

If the noise is intermittent, confirm the accessory drive components by varying their loads, making sure they are operated to their maximum capacity. An overcharged A/C system, restrictions in the power steering pressure circuit or a faulty generator or coolant pump are likely causes of accessory drive belt squeal.

A loose or incorrectly installed body component, suspension component or other item may be the cause of the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 The noise may not be engine related. This step is to confirm the engine is making the noise. If the engine is not making the noise, do not proceed further with this diagnostic procedure.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Confirms an accessory drive component does not have a seized bearing. With the belt removed, test the bearings in the accessory drive components spin free and smooth.

5 Confirms the drive belt tensioner is operating correctly. If the drive belt tensioner is not operating correctly, drive belt tension will not be maintained, resulting in a belt squealing noise

6 Confirms the belt is not too long, which would prevent the tensioner from working as intended. Also, if an excessively long belt has been fitted, it may also be routed incorrectly and may be turning an accessory drive component in the wrong direction.

7 Misalignment of the pulleys may be caused by one of the following:

- Incorrect mounting of an accessory drive component,
- Incorrect installation of an accessory drive pulley or,
- Bent or damaged pulley.

Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to the relevant component service information for the correct installation and removal procedures.

8 This test is to confirm the pulleys are the correct diameter and/or width. Using a known good vehicle, compare the pulley sizes.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a squealing noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the squealing noise still exist?	Accessory drive system OK. Go to 2.2 Symptoms, and restart the diagnosis of the noise	Go to Step 4
4	Inspect the accessory drive components for a seized bearing and general malfunctions. Did you find and correct any seized bearings or general malfunctions in the accessory drive system?	Go to Step 9	Go to Step 5
5	Test the accessory drive belt tensioner for correct operation, refer to Accessory Drive Belt Tensioner Diagnosis. Did you find and repair any problems with the tensioner?	Go to Step 9	Go to Step 6
6	Inspect the accessory drive belt is the correct length, refer to 3.5 Accessory Drive Belt. Did you find and repair any problems with the drive belt length?	Go to Step 9	Go to Step 7
7	Inspect the accessory drive pulleys for misalignment. Did you find and correct any misaligned accessory drive pulleys?	Go to Step 9	Go to Step 8
8	Check the accessory drive pulleys are the correct size. Did you find and replace any incorrect pulleys?	Go to Step 9	Refer to Diagnostic Aids in this Section
9	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the squeal noise?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Whine

Definition

Accessory drive belt whine can be defined as a high-pitched continuous noise that is most likely to be caused by a failed bearing in one of the accessory drive components.

Diagnostic Aids

The drive belts themselves will not cause a whine. If the noise is intermittent, confirm the accessory drive components by varying their loads, making sure they are operated to their maximum capacity. An overcharged A/C system, restrictions in the power steering pressure circuit or a faulty generator or coolant pump are likely causes of accessory drive belt whine.

Test Description

The numbers below refer to steps in the diagnostic table.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 The inspection of bearings should include the following accessory drive components:

- drive belt tensioners,
- drive belt idlers,
- generator,
- power steering pump,
- coolant pump, and
- A/C compressor.

The drive belt may need to be installed and the accessory drive components operated separately, at varying loads to confirm the location of the faulty bearing, refer to the relevant Sections for component inspection and repair procedures.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a whining noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the whining noise still exist?	Accessory drive system OK Go to 2.2 Symptoms, and restart the diagnosis	Go to Step 4
4	Inspect the accessory drive components for a faulty or seized bearings and general malfunctions. Did you find and correct any faulty/seized bearings or general malfunctions in the accessory drive system?	Go to Step 5	Refer to Diagnostic Aids in this Section
5	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the whine?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Rumble

Definition

Accessory drive belt rumble can be defined as a low pitch tapping, knocking or thumping noise heard at or just above idle, once per rotation of the drive belt or a specific component. Drive belt rumble is generally caused by one of the following:

- pilling or strings in the drive belt grooves,
- separation of the drive belt, or
- a damaged or faulty drive belt.

NOTE

Pilling is the small balls (pills) or strings of rubber in the belt grooves caused by the accumulation of rubber dust.

Diagnostic Aids

Vibration from the engine may cause a body component or other parts to emit a rumbling noise.

The drive belt may have a condition that cannot be seen or felt. Sometimes the replacement of the belt may be the only way to confirm the belt is faulty.

If the drive belt has been replaced and the diagnostic table completed, but the rumble is still present only when the drive belt is installed, an accessory drive component such as the A/C compressor may be the cause. Varying the load to each accessory drive component in turn, should help isolate which component is causing the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the symptom exists at the time of diagnosis. Other vehicle components may be causing the noise.

3 Confirms the accessory drive belt is the cause of the noise. Drive belt rumbling is often confused with an internal engine noise due to the similarity in the description. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Inspecting the drive belt is to ensure that it is not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise and are not justification alone to replace the belt. Belt separation can be identified by the ply of the belt separating and may be seen at the edge of the belt or felt as lumps under the belt.

5 Small amounts of pilling is a normal condition and is deemed acceptable. When the pilling is severe (33% of the belt groove depth), the belt does not have a smooth surface to run on and should be replaced.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a rumbling noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the rumbling noise still exist?	Accessory drive system OK Go to 2.2 Symptoms, and restart the diagnosis	Go to Step 4
4	Inspect the accessory drive belt for damage, separation or sections of missing ribs. Did you find any damaged, separated or missing ribs?	Go to Step 7	Go to Step 5
5	Inspect the accessory drive belt for severe pilling (exceeding 33% of the belt groove depth). Did you find sever pilling?	Go to Step 6	Go to Step 5

Step	Action	Yes	No
6	Clean the drive belt using a suitable wire brush and reinstall to the engine, refer to 3.5 Accessory Drive Belt. Did you complete the repairs?	Go to Step 8	—
7	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 8	—
8	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the rumbling noise?	Accessory drive system OK	Refer to Diagnostic Aids in this Section

Drive Belt Vibration

Definition

Accessory drive belt vibration can be defined as a drive belt that jumps, shakes or rattles. Accessory drive belt vibration is usually indicated by one of the following:

- the vibration is engine speed related, or
- the vibration is sensitive to accessory drive system load.

Diagnostic Aids

The accessory drive components such as the A/C compressor or generator can have an affect on engine vibration.

To aid in locating which component is causing the vibration, vary the load to each accessory drive component in turn and note the effect it has on the vibration if any.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the symptom exists at the time of diagnosis. Other vehicle components may be causing the noise.

3 Confirms the accessory drive belt is the cause of the noise. Drive belt rumbling is often confused with an internal engine noise due to the similarity in the description. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 The drive belt may cause a vibration. Inspecting the drive belt is considerably easier while the drive belt is removed.

6 Inspecting the fasteners can eliminate the possibility that an incorrect fastener has been installed.

8 This step should only be performed if the coolant pump is driven by the drive belt. Inspect the coolant pump for a bent shaft. Also inspect the coolant pump bearings for smooth operation and excessive play. Compare the coolant pump with a known good pump.

9 Accessory drive component brackets that are bent, cracked or loose may put extra strain on the accessory component causing it to vibrate.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a rumbling noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the vibration noise still exist?	Accessory drive system OK. Go to 4.2 Symptoms, and restart the diagnosis	Go to Step 4
4	Inspect the accessory drive belt for damage, wear, debris build-up or sections of missing ribs. Did you find any damage, wear, debris build-up or missing ribs?	Go to Step 5	Go to Step 6
5	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 10	—
6	Inspect for incorrect, loose, missing or damaged fasteners. Did you find any incorrect, loose, missing or damaged fasteners?	Go to Step 7	Go to Step 8
7	Tighten any loose fasteners to the correct torque specification, refer to 6 Torque Wrench Specifications. Replace any incorrect or missing fasteners. Did you complete the repairs?	Go to Step 10	—
8	Inspect the coolant pump for a bent shaft, refer to 6B1 Engine Cooling – V6. Did you find and repair a bent coolant pump shaft?	Go to Step 10	Go to Step 9
9	Inspect for bent, cracked or damaged accessory drive component mounting brackets. Did you find and repair any bent brackets?	Go to Step 10	Refer to Diagnostic Aids in this Section
10	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the vibration?	Accessory drive system OK	Refer to Diagnostic Aids in this Section

Drive Belt Falls Off

Definition

The drive belt falls off during normal operation or does not ride correctly on the accessory drive pulleys.

Diagnostic Aids

If the accessory drive belt repeatedly falls off the drive pulleys, this is most likely due to pulley misalignment.

An extra load that is quickly applied and released by an accessory drive component (e.g. A/C compressor) may cause the accessory drive belt to fall off. In this circumstance, confirm the fault by operating the accessory drive components in turn, noting which one caused the belt to fall off.

Lack of drive belt tension may also cause the belt to fall off the pulleys. Low drive belt tension could be caused by one of the following:

- an incorrect drive belt length,
- a faulty drive belt tensioner, or
- a stretched or faulty drive belt.

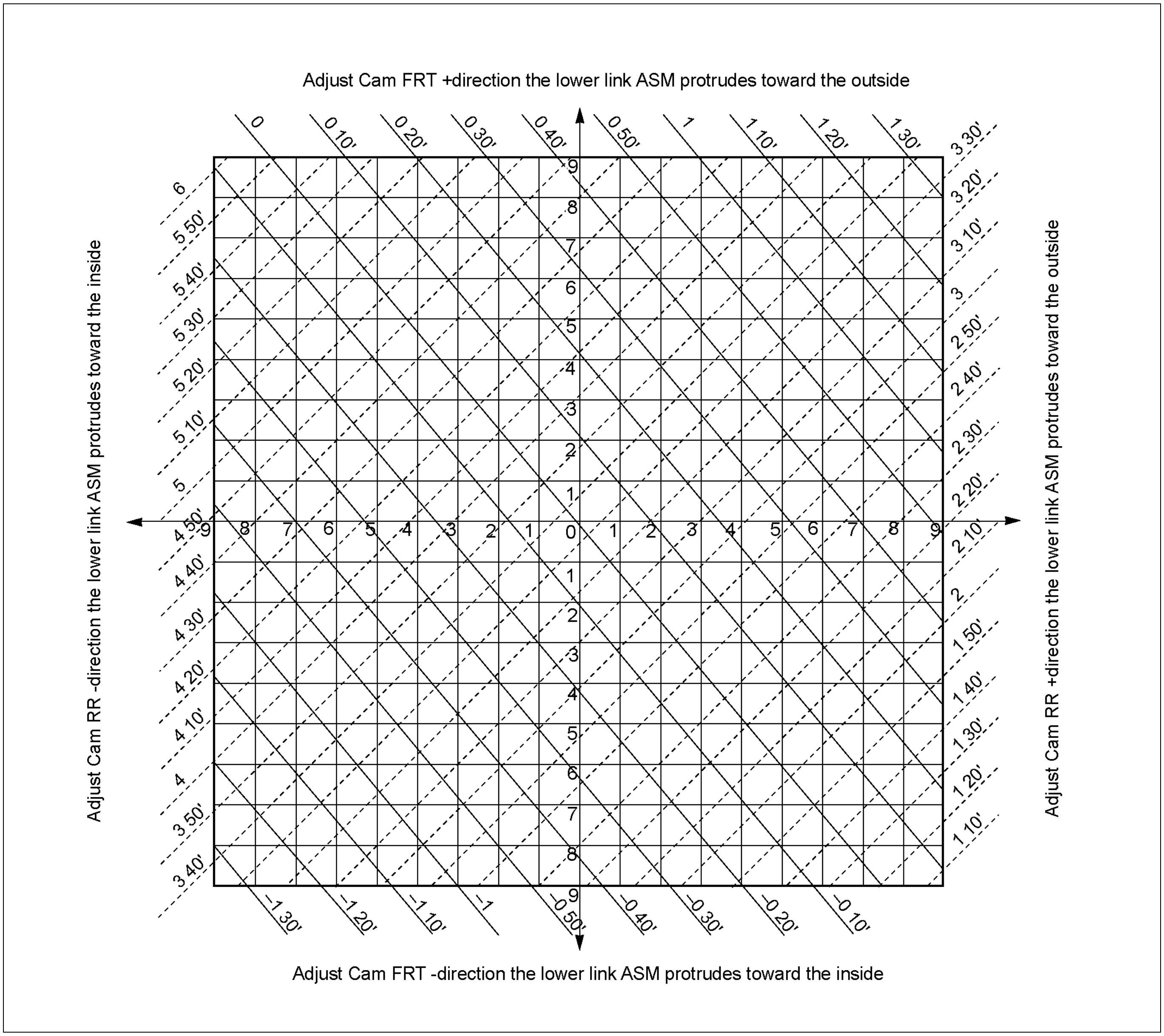
Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the condition of the drive belt. Damage may have occurred to the drive belt when it first fell off or it may have been damaged which caused the belt to fall off.

4 Misalignment of the pulleys may be caused by:

The following illustration shows the alignment procedure.



RTW340LF000401

- the incorrect installation or mounting of an accessory drive component,
- the incorrect installation of an accessory drive component pulley, or
- a damaged or bent accessory drive pulley.

Test for a misaligned pulley using a suitable straight edge in the pulley grooves across two or more pulleys. If a misaligned pulley is found, refer to the service information for the particular component, for the correct pulley replacement procedures.

5 Inspecting the pulleys should include an inspection for dents or other damage that would prevent the drive belt from seating correctly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used.

6 Accessory drive component mounting brackets that are bent will cause the drive belt to fall off.

7 Inspection of the fasteners can eliminate the possibility that an incorrect fastener was installed. Missing, loose or incorrect fasteners may cause pulley misalignment from the fasteners moving under load. Over-tightening of the fasteners may cause deflection of mounting brackets and result in misaligned accessory drive pulleys.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Inspect for a damaged accessory drive belt. Did you find any damage on the drive belt?	Go to Step 3	Go to Step 4
3	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Does the drive belt continue to fall off?	Go to Step 4	Go to Step 12
4	Inspect the accessory drive system pulleys for misalignment Did you find and repair any misaligned drive system pulleys?	Go to Step 12	Go to Step 5
5	Inspect for a dented or cracked accessory drive system pulley. Did you find and repair any dented or cracked drive system?	Go to Step 12	Go to Step 6
6	Inspect for bent accessory drive component mounting brackets. Did you find and repair any bent mounting brackets?	Go to Step 12	Go to Step 7
7	Inspect for incorrect, loose, missing or damaged fasteners. Did you find any incorrect, loose, missing or damaged fasteners?	Go to Step 8	Go to Step 9
8	Tighten any loose fasteners to the correct torque specification, refer to 6 Torque Wrench Specifications. Replace any incorrect or missing fasteners. Does the drive belt continue to fall off?	Go to Step 9	Go to Step 12
9	Test the accessory drive belt tensioner for correct operation, refer to Accessory Drive Belt Tensioner Diagnosis in this Section. Did you accessory drive belt tensioner operate correctly?	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner, refer to 3.7 Accessory Drive Belt Tensioner Assembly. Does the drive belt continue to fall off?	Go to Step 11	Go to Step 12
11	Inspect for a failed drive belt idler and drive belt tensioner bearings. Did you find and repair any failed bearings?	Go to Step 12	Refer to Diagnostic Aids in this Section
12	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Does the drive belt continue to fall off?	Go to Step 2	Accessory drive system OK

Drive Belt Excessive Wear

Definition

Excessive wear can be defined as wear at the outside ribs of the drive belt (frayed edges), usually caused by an incorrectly installed drive belt

Diagnostic Aids

Excessive wear of a drive belt is usually caused by an incorrect installation or an incorrect drive belt fitted. Minor pulley misalignment will not cause excessive wear, but will cause the drive belt to fall off. Major pulley misalignment may cause excessive wear, but would also result in the drive belt falling off.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the drive belt is correctly installed onto all of the accessory drive system pulleys. Wear on the drive belt may be caused by incorrectly positioning the drive belt by one or more grooves to a particular pulley.

3 The installation of the drive belt that is the incorrect width will cause wear on the drive belt. The drive belt ribs should match all the grooves on all the pulleys in the accessory drive system.

4 Confirms the drive belt is not contacting any parts of the engine or body while the engine is running. There should be sufficient clearance when the accessory drive component loads varies. The drive belt should not come into contact with any engine or body parts.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Inspect the accessory drive belt for correct installation. Is the drive belt installed correctly?	Go to Step 5	Go to Step 3
3	Ensure that the drive belt is the correct one for the application. Is the correct drive belt installed?	Go to Step 5	Go to Step 4
4	Is the drive belt contacting any engine or body components with the engine running?	Go to Step 6	Refer to Diagnostic Aids in this Section
5	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 6	—
6	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the excessive wear?	Accessory drive system OK	Go to Step 2

Accessory Drive Belt Tensioner Diagnosis

Diagnostic Table

Step	Action	Yes	No
1	1 Remove the accessory drive belt. 2 Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to Step 4	Go to Step 2
2	Rotate the drive belt tensioner. Does the drive belt tensioner rotate freely, without any unusual resistance or binding?	Go to Step 3	Go to Step 4
3	1 Using a suitable torque wrench, measure the torque required to lift the drive belt tensioner off the stop. 2 Using a known good tensioner, measure the torque required to lift the drive belt tensioner off the stop. Is the first torque reading within 10% of the second reading?	Accessory drive belt tensioner OK	Go to Step 4
4	Replace the drive belt tensioner, refer to 3.7 Accessory Drive Belt Tensioner Assembly. Is the repair complete?	Accessory drive belt tensioner OK	—

3 Minor Service Operations

ATTENTION

The V6 engine is a combination of numerous components, containing machined, honed, polished and lapped surfaces manufactured on the latest, high technology production equipment. Many of the components contain tolerances measured in thousandths of a millimetre. Consequently, when any engine component is to be serviced, care and cleanliness are extremely important.

Prior to re-assembly of the engine, all components must be cleaned and inspected in accordance with the relevant clean and inspect procedures throughout this Section, and replaced or repaired where required.

In addition to cleaning and inspecting components, a liberal coating of engine oil should be applied to friction surfaces during assembly to protect and lubricate the surfaces on initial operation.

When performing any service operation, it should be understood that correct cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard workshop practice, even if not specifically stated. Torque values must be used as specified during reassembly to ensure correct retention of all components.

Through out this section, fastener torque wrench specifications may be accompanied with the following identification marks:

- ■ **Fasteners must be replaced after loosening.**
- ♦ **Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.**

If one of these identification marks is present alongside a fastener torque wrench specification, the recommendation regarding that fastener must be adhered to.

3.1 Engine Oil

The procedure outlined below is typically the same for both rear wheel drive and all wheel drive vehicles.

Check

The following procedure is applicable to both rear wheel and all wheel drive vehicles

1 Run the engine to bring it to normal operating temperature.

2 Park the vehicle on a level surface. A vehicle that is not level will affect the accuracy of the level reading.

3 Stop the engine and wait 5 to 10 minutes to allow the oil to drain back into the oil pan.

4 Remove the oil level indicator (1) and wipe clean.

5 Insert the indicator, ensuring it is fully seated.

6 Slowly remove the indicator to avoid smearing. Hold it horizontally or with lower end slightly down to avoid oil running along indicator.

7 Observe the oil level where it passes over the centre line of the indicator.

8 If the level is lower than the Add mark (2), add enough oil to the engine to reach the Upper mark (3). Do not add too much oil as the reading should never be above the Upper mark.

NOTE

When topping up the oil, allow approximately 5 to 10 minutes for the added oil to fully drain into the oil pan.

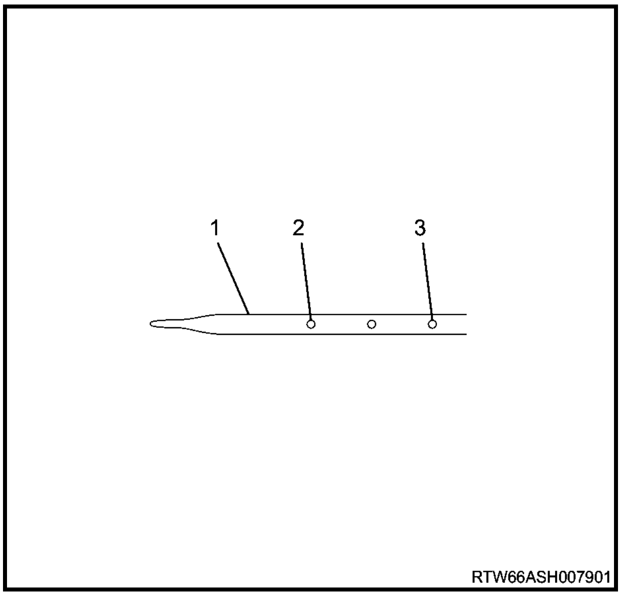


Figure 6A1 – 23

Replace

NOTE

- Quicker and more complete draining will occur if the engine oil is at normal operating temperature. However, care must be taken to avoid scalding from the hot oil.
- It recommended the oil filter be changed at each engine oil change, refer to 3.2 Oil Filter.

1 Remove the oil fill cap.

2 To ensure complete draining of the oil pan, raise the front and rear of the vehicle to maintain a level attitude. If not using a hoist, support the vehicle with safety stands, refer to 0A General Information.

3 Clean any foreign material from around the oil drain plug and place a suitable, clean drain tray under the engine.

WARNING

The oil may be hot. Avoid contact with the oil.
Ensure that eyes and skin are protected.

4 Remove the drain plug (1), taking care to avoid scalding from the hot oil. Allow the oil to drain.

5 Clean and inspect the drain plug threads. If damaged, replace the drain plug.

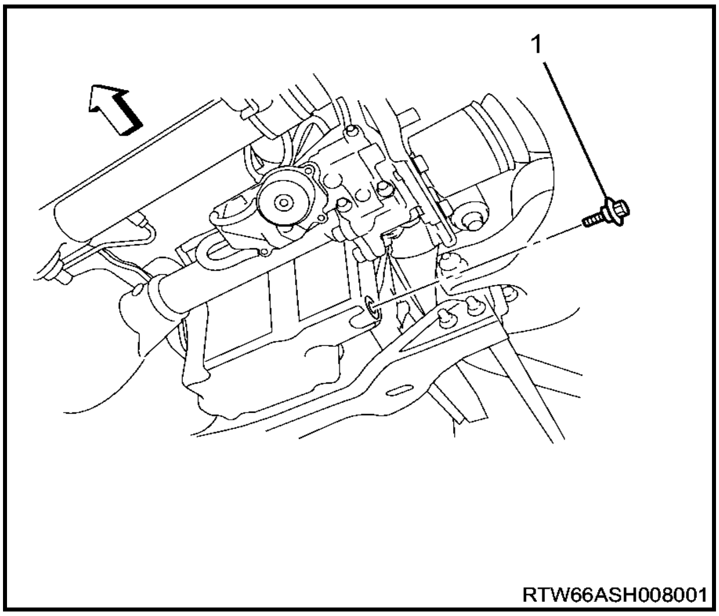


Figure 6A1 – 24

6 Once the oil has completely drained, reinstall the drain plug and tighten to the correct torque specification.

Oil pan drain plug torque specification ....25.0 Nm

7 Replace the oil filter, refer to 3.2 Oil Filter.

8 Lower the vehicle to the ground and fill with the specified amount of SAE 5W30 lubricant.

Engine Oil Capacity: With Oil Filter Change.......................................6.5 litres

9 Install the oil fill cap.

10 Start the engine and check for leaks.

Pressure Check

1 Run the engine to bring it to normal operating temperature.

2 Park the vehicle on a level surface. A vehicle not level will affect the accuracy of the level reading.

3 Stop the engine and wait 5 to 10 minutes to allow the oil to drain back into the oil pan.

4 Check the oil level and top up with the recommended engine oil as required, refer to Check, in this Section.

5 Remove the engine oil pressure sensor (1), refer to 6C1-3 Engine Management – V6 – Service Operations.

6 Install the oil pressure gauge adaptor, Tool No. J36648-A into the oil pressure sender hole in the oil filter housing.

7 Install a suitable oil pressure gauge into the adaptor.

8 Start the engine.

9 Measure and record the pressure reading on the gauge at idle and 2000 r.p.m. Compare the results with the specification.

Minimum engine oil pressure @ idle...	69 kPa
@ 2000 r.p.m.	138 kPa

10 If the engine oil pressure is not to specification, refer to 2.19 Engine Oil Pressure Diagnosis.

11 After completing the engine oil pressure check, stop the engine and remove the oil pressure gauge.

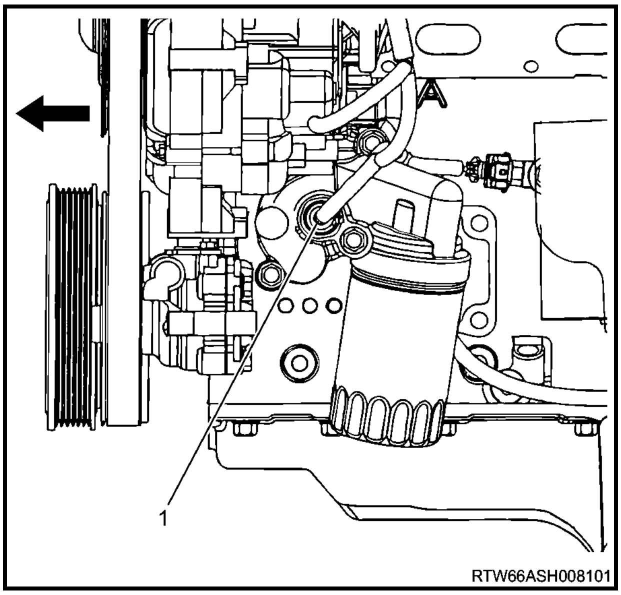


Figure 6A1 – 25

12 Reinstall the oil pressure sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

13 Start the engine and check for leaks.

3.2 Oil Filter Cartridge

Replace

NOTE

- The oil filter cartridge should be replaced at the correct time or distance intervals, refer to 0B Lubrication and Service.
- The oil filter cartridge should also be replaced whenever the engine oil is suspected to have been contaminated by foreign material.

1 Remove and discard the oil filter cartridge (1).

2 Install the new oil filter cartridge.

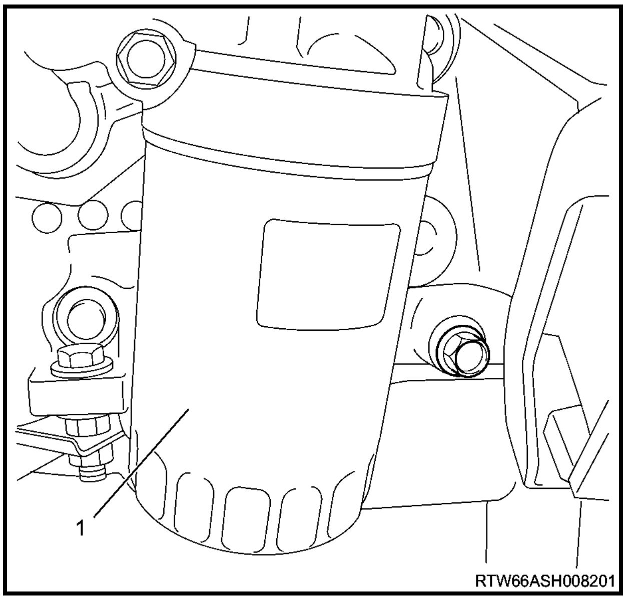


Figure 6A1 – 26

3.3 Oil Filter Adaptor

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems, refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Disconnect the wiring harness connector from the oil pressure sender.

3 Remove the oil filter adaptor attaching bolts (2), four places.

4 Remove the oil filter adaptor and discard the gasket (3).

5 Clean the surfaces of the adaptor and cylinder block.

CAUTION

- **Do not use a screwdriver or similar to prise the oil filter adapter from the engine as damage to the sealing surface may occur.**
- **If required, use a rubber mallet to tap the oil filter adapter to loosen the components prior to separating. Tapping should be done at bends, corners or reinforced areas to prevent distortion of parts.**

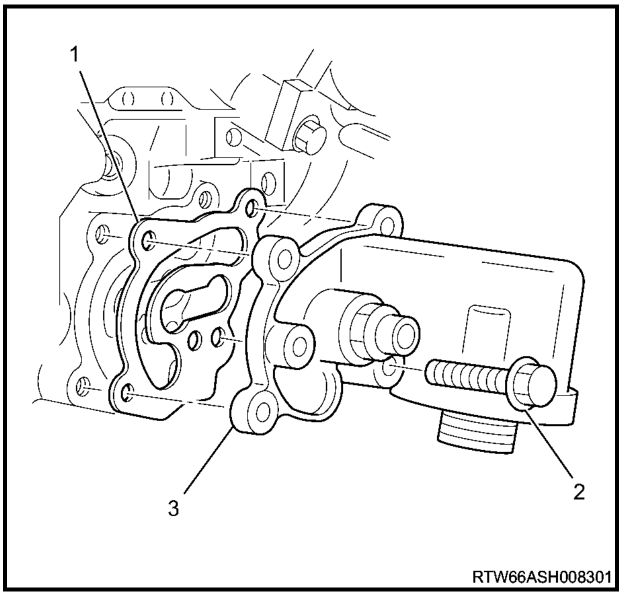


Figure 6A1 – 27

Reinstall

Reinstallation of the oil filter adaptor is the reverse of the removal procedure, noting the following:

1 A new gasket must be used.

2 Loosely install the oil filter adaptor attaching bolts, then tighten all fasteners to the correct torque specification.

Oil filter adaptor attaching bolt torque specification	20.0- 26.0 Nm

3.4 Oil Level Indicator Tube

Remove

1 Remove the oil level indicator from the oil level indicator tube.

2 Remove the bolt (2) attaching the oil level indicator tube (1) and engine wiring harness retaining bracket.

3 Withdraw the oil level indicator tube from the oil pan.

4 Remove and discard the o-ring at the bottom of the oil level indicator tube.

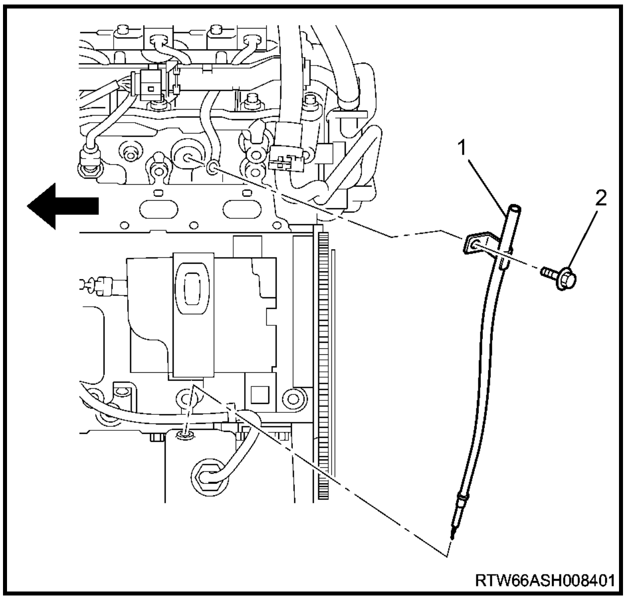


Figure 6A1 – 28

Reinstall

Reinstallation of the oil level indicator tube is the reverse of the removal procedure, noting the following:

1 Install a new oil level indicator o-ring.

2 Ensure the attaching bolt passes through the engine wiring harness retaining bracket.

3 Tighten bolt to the correct torque specification.

Oil level indicator tube attaching bolt torque specification ....8.0 – 12.0 Nm

3.5 Accessory Drive Belt

RWD Vehicle

Remove

1 Remove the air intake duct from between the air flow meter and the throttle body, refer to 6C1-3 Engine Management – V6 – Service Operations.

2 Note the accessory drive belt (1) routing.

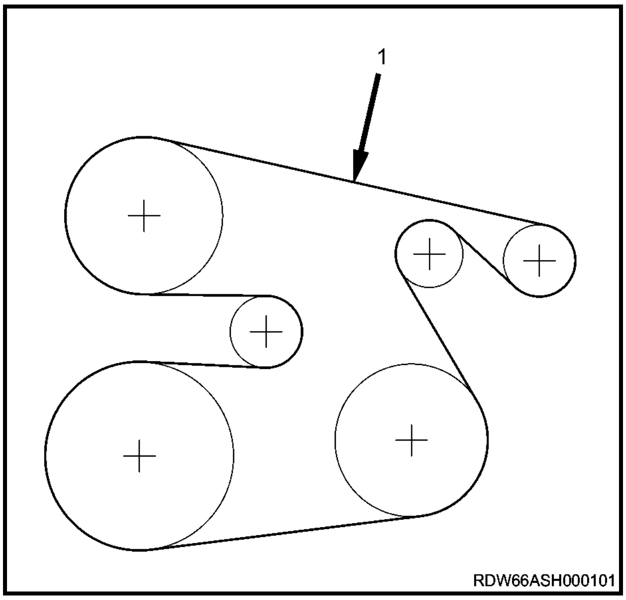


Figure 6A1 – 29

3 Using a suitable ½" drive socket bar (1), rotate the drive belt tensioner (2) clockwise, to reduce belt tension.

4 While holding the tensioner in the reduced tension position, remove the accessory drive belt (3).

NOTE

If required use an assistant to maintain the tensioner in the required position.

CAUTION

If running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

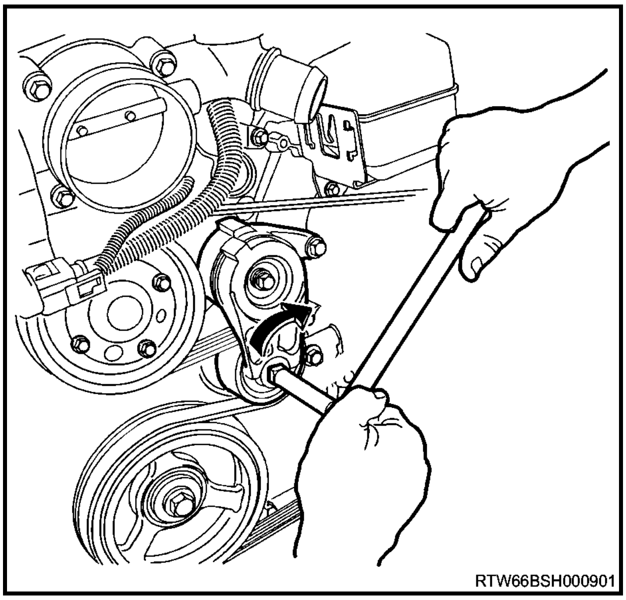


Figure 6A1 – 30

Reinstall

1 Install the drive belt over the A/C compressor, idler pulley, power steering pump, coolant pump, generator and tensioner pulleys.

2 Using a suitable ½" drive socket bar (1), rotate the drive belt tensioner (2) clockwise, refer to Figure 6A1 – 30.

3 With an assistant holding the tensioner in the required position, feed the accessory drive belt (3) over the crankshaft pulley.

4 Slowly release the drive belt tensioner mechanism.

NOTE

Ensure the drive belt ribs are correctly aligned with the grooves in the accessory drive pulleys or damage to the drive belt and accessory drive components and pulleys may occur.

5 Reinstall the air intake duct to the air flow meter and the throttle body, refer to 6C1-3 Engine Management – V6 – Service Operations.

6 Run the engine to ensure correct operation.

3.6 Accessory Drive Belt Idler Pulley

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the accessory drive belt idler pulley attaching bolt (1).

3 Remove the dished washer (2) and accessory drive belt idler pulley (3).

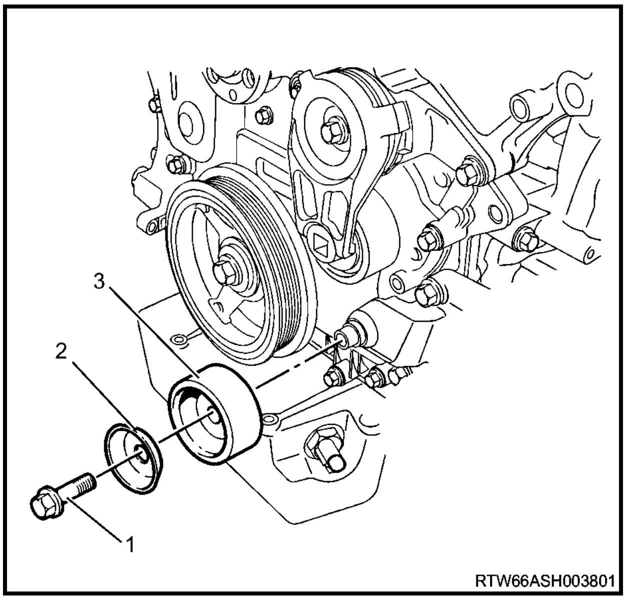


Figure 6A1 – 31

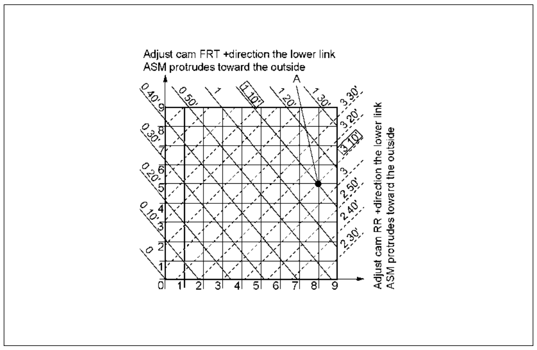
Reinstall

Reinstallation of the accessory drive belt idler pulley is the reverse of the removal procedure. Tighten the bolt to the correct torque specification.

Accessory drive belt idler pulley attaching bolt torque specification......................50.0 Nm

Example

Measured value			
Camber angle	1°10'	Caster angle	3°10'
Standard value			
Camber angle	0°±30'	Caster angle	3°35'±45'



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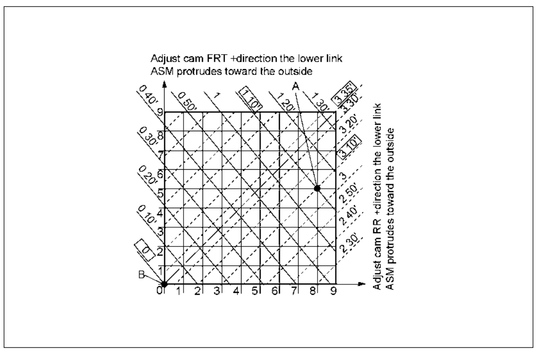
1. Mark an ‘A’ at the intersection point of the measured camber angle value (solid line) and the measured caster angle value (dotted line).



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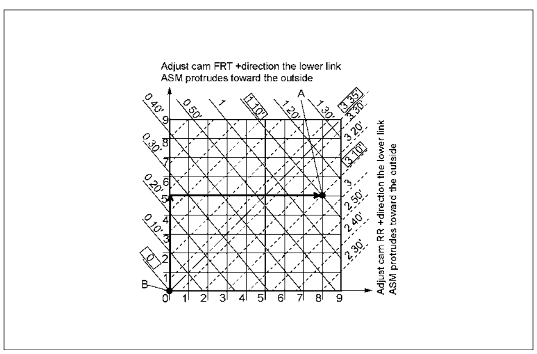
2. Mark a ‘B’ at the intersection point of the standard camber angle value (solid line) and the standard caster angle value (dotted line).



RTW340SH001201

3. The vertical distance between points ‘A’ and ‘B’ represents the adjustment required at the front cam. The horizontal distance between points ‘A’ and ‘B’ represents the adjustment required at the rear cam.
   In this example, the front cam would be moved 5 increments to the positive and the rear cam would be moved 8 increments to the positive.

CAUTION:

Maximum possible adjustment from the center point of the cams is 9 increments to either side.

3.7 Accessory Drive Belt Tensioner Assembly

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the three bolts (2) attaching accessory drive belt tensioner assembly (1).

3 Remove the accessory drive belt tensioner assembly.

NOTE

The accessory drive belt tensioner pulley is not serviced separately. If the pulley is found to be faulty, the entire tensioner assembly must be replaced.

CAUTION

Repairing a damaged accessory drive belt pulley should not be attempted under any circumstances.

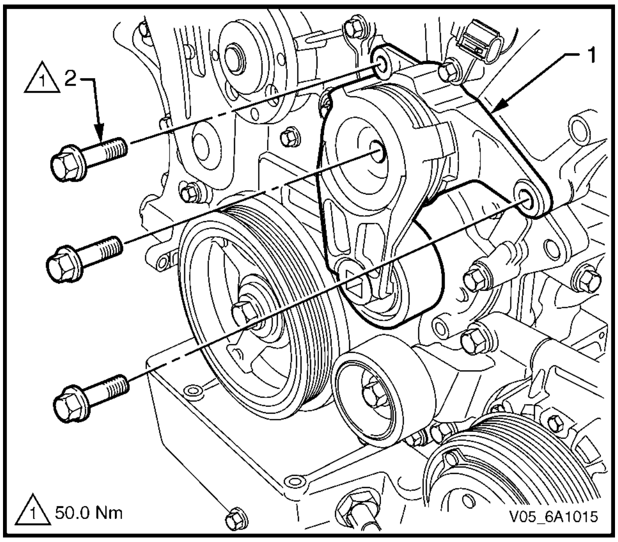


Figure 6A1 – 32

Reinstall

Reinstallation of the accessory drive belt tensioner assembly is the reverse of the removal procedure. Tighten the bolts to the correct torque specification.

Accessory drive belt tensioner attaching bolt torque specification......................50.0 Nm

3.8 Power Steering Pump Bracket

Remove

1 Remove the power steering pump and reservoir, refer to 3B_Steering.

2 Remove the three bolts (1), (3) and (4) attaching the power steering pump bracket (5) to the engine block.

3 Remove the power steering pump bracket.

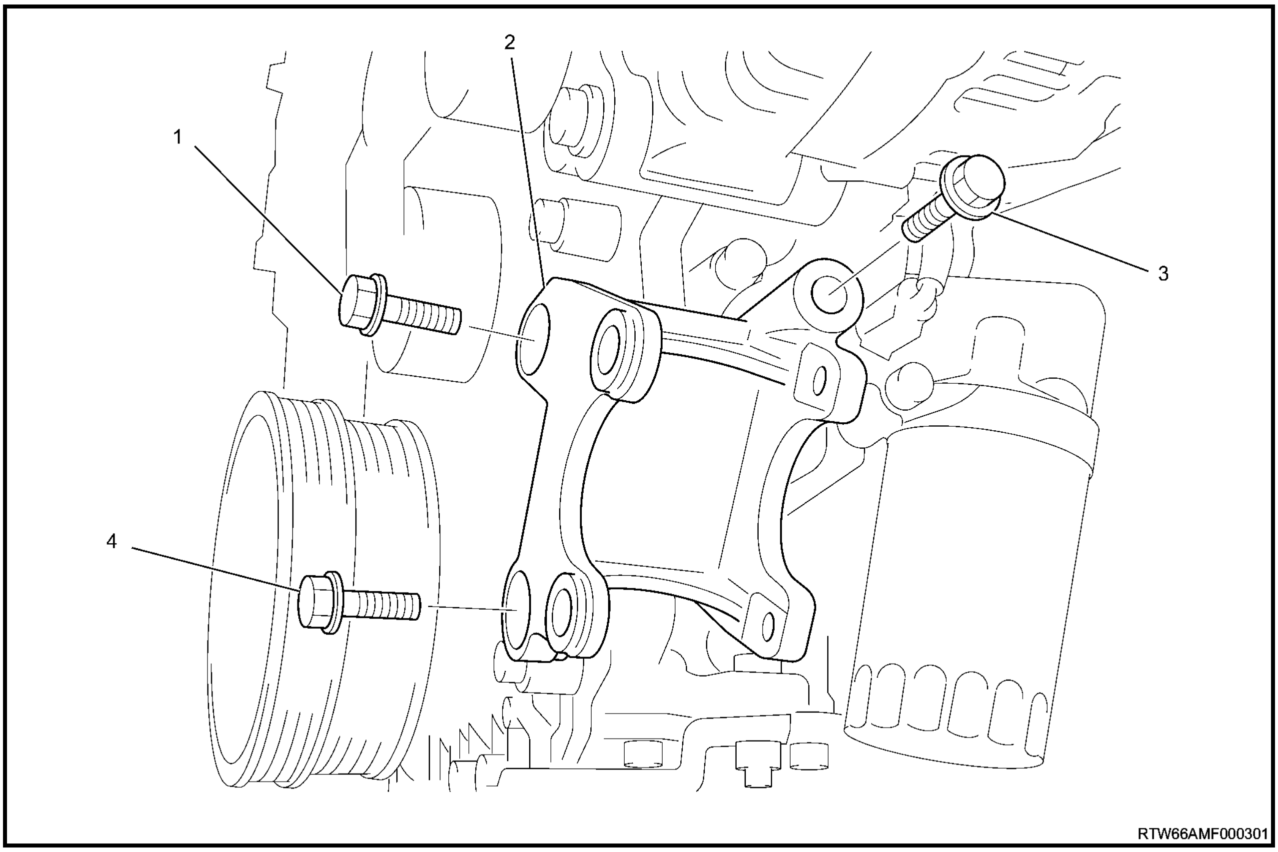


Figure 6A1 – 33

Reinstall

Reinstallation of the power steering pump and pump bracket is the reverse of the removal procedure, noting the following:

1 Hand start the bolts before tightening.

2 Tighten the bolts to the correct torque specification.

Power steering pump bracket attaching bolt torque specification.....................22.0 Nm

3.9 Upper Intake Manifold

The intake manifold comprises of an upper and lower section. Some service procedures only require the removal of the upper intake manifold (e.g. fuel injector/spark plug servicing), while other service procedures require the removal of both the upper and lower manifold as a complete assembly (e.g. cylinder head/s). If the complete assembly needs to be removed, refer to 3.10 Intake Manifold Assembly – Complete.

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Remove the air intake duct (1) and hose (2), refer to 6C1-3 Engine Management – V6 – Service Operations.

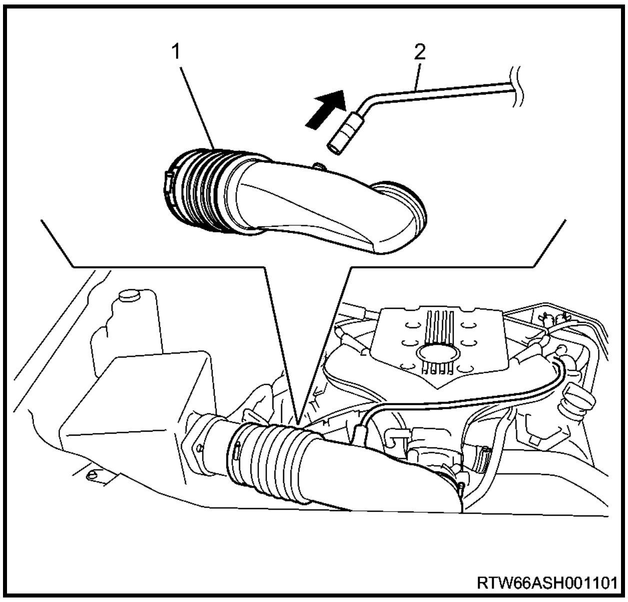


Figure 6A1 – 34

3 Retract the throttle body wiring connector lock (3).

4 While pressing the connector latch in the direction of the arrow (4), disconnect the throttle body wiring connector.

5 Disconnect the throttle body connector wiring harness from its retaining clip (5).

6 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable piece of 5 mm steel rod (or an Allen key).

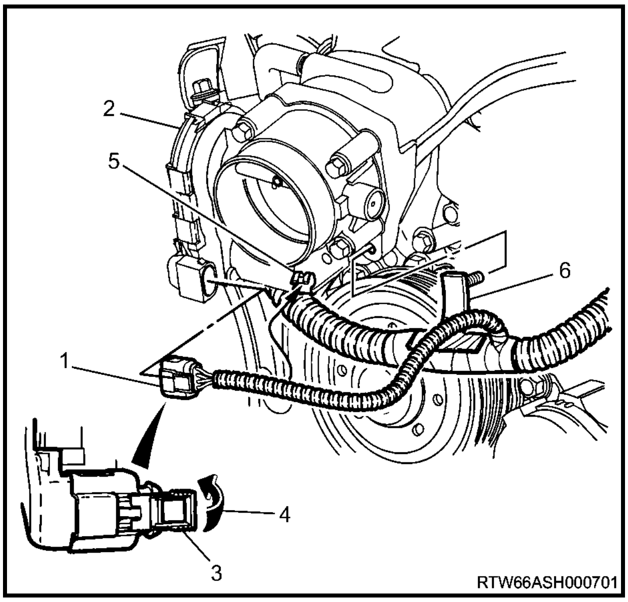


Figure 6A1 – 35

CAUTION

The following precautions must be followed when disconnecting the throttle body wiring connector:

- **Do not use any mechanical device such as a screwdriver to disengage the harness connector (1) from the throttle body (2).**
- **When retracting the throttle wiring connector lock (3), take care not to disengage the lock from the connector.**
- **Do not pull on the connector wires.**
- **Take care not to break the barbed harness retainer pin (6) while removing the harness retainer from the intake manifold.**
- **Should the pin be broken, then it is vital that a new harness retainer is fitted to the wiring harness shield. If not, the harness will foul the engine drive belt.**

7 Disconnect the brake booster hoses from the upper intake manifold:

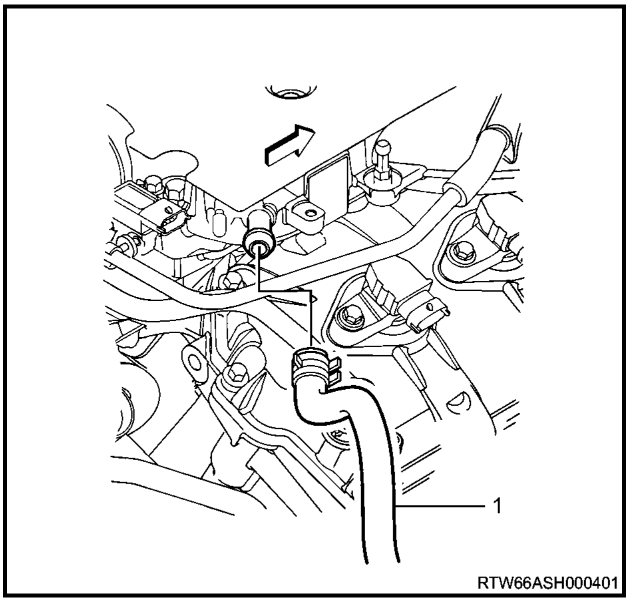


Figure 6A1 – 36

8 Disconnect the wiring harness connector from the barometric (BARO) pressure sensor (1).

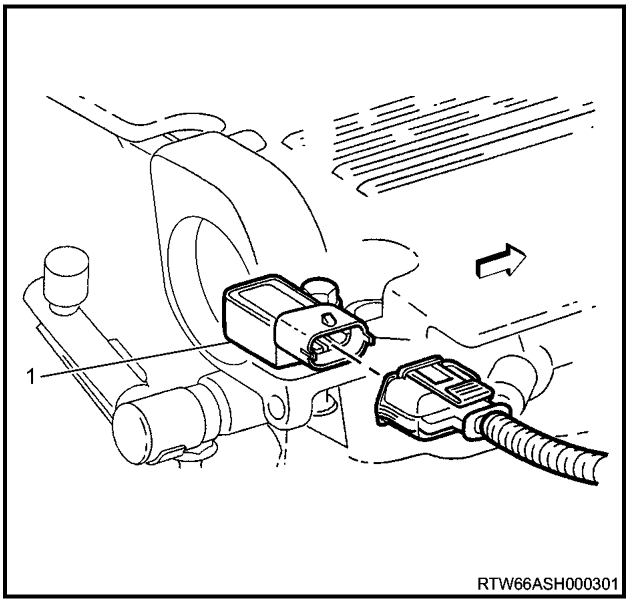


Figure 6A1 – 37

9 Disconnect the PCV tube connector (1) from the upper intake manifold assembly.

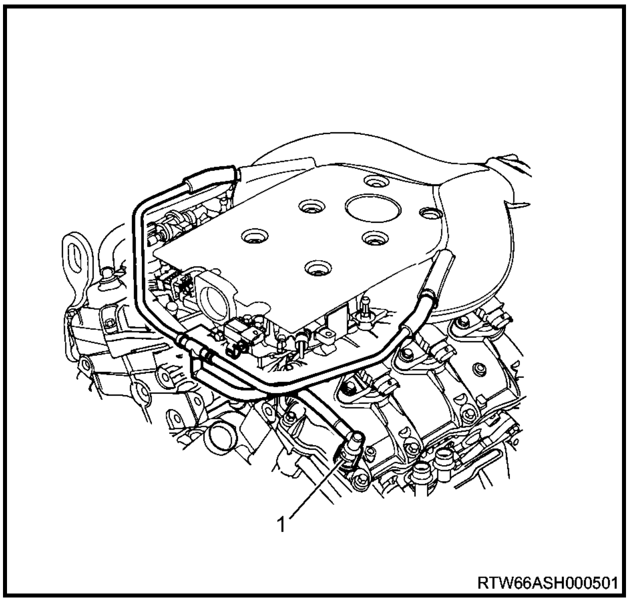


Figure 6A1 – 38

10 Remove the bolt (3) attaching the EVAP valve and the fuel injector wiring harness connector mounting bracket to the upper intake manifold assembly.

11 Move the EVAP valve and the fuel injector wiring harness connector mounting bracket clear of the upper intake manifold assembly.

12 Disconnect the PCV fresh air tube (1) from its upper intake manifold mounting clip (2).

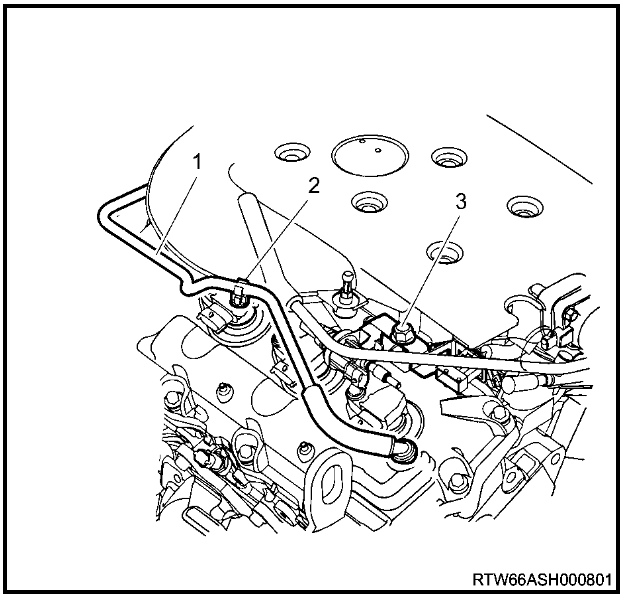


Figure 6A1 – 39

13 Disconnect the EVAP valve outlet tube (1) from the intake manifold (2).

14 Remove the four long (3) (165 mm long) and two short bolts (4) (70 mm long) attaching the upper intake manifold (2) to the cylinder heads and lower intake manifold.

15 Lift the upper intake manifold (2) clear from the lower half and then remove the upper intake manifold from the engine.

16 Remove and discard the upper to lower intake manifold gaskets (5).

CAUTION

- **When the upper intake manifold is removed, plug each of the lower intake runner openings with lint free cloth, to stop the entry of foreign material into the engine.**
- **Do not reuse the upper to lower intake manifold gaskets (5).**

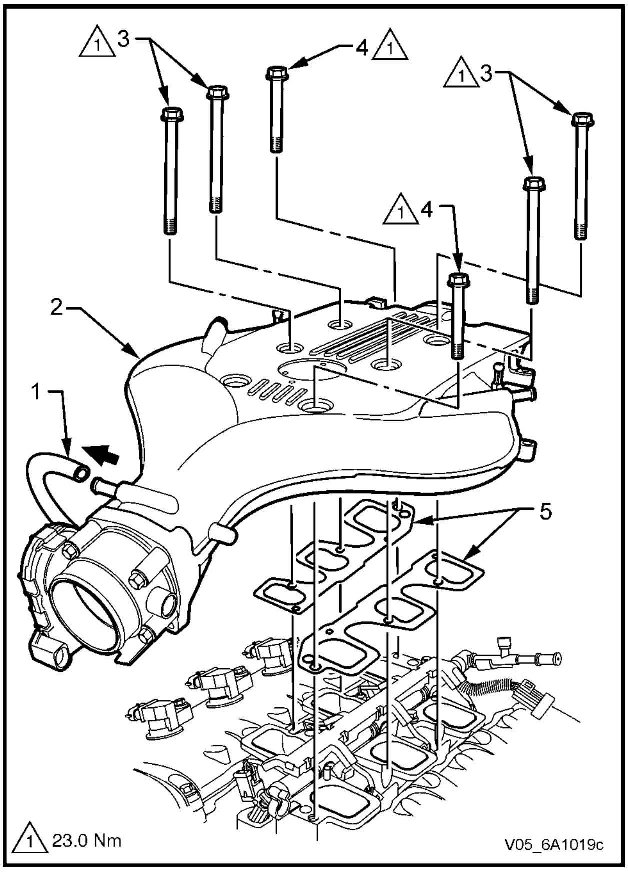


Figure 6A1 – 40

17 Remove the upper and lower intake manifold assembly from the engine.

18 Remove lower intake manifold to cylinder head gasket.

Disassemble

Remove the following from the upper intake manifold, refer to 6C1-3 Engine Management – V6 – Service Operations:

- BARO sensor and
- Throttle body assembly.

Clean

CAUTION

Due to the aluminium alloy construction of the intake manifold, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use of a wooden or plastic scraper is preferred.

1 Clean mating surfaces ensuring any gasket material is removed.

2 Clean the manifold using a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the timing components with compressed air.

Inspect

1 Inspect the intake manifold for the following fault conditions:

- Damaged sealing and mating surfaces.
- Damaged lower intake manifold gasket.
- Damage or excessive debris on the threaded and through holes.
- Cracks or damage to the intake manifold body.

NOTE

If the lower intake manifold is cracked or damaged, it must be replaced. No welding or patching of the intake manifold should be performed.

2 Place a straight edge (1) across the upper intake manifold sealing surface (2).

3 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

4 If the clearance between the upper intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Upper manifold maximum warpage	0.05 mm

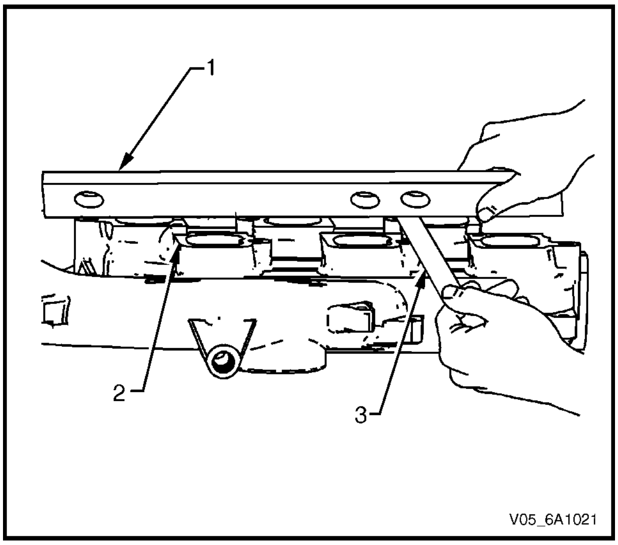


Figure 6A1 – 41

5 Place a straight edge (1) across the lower intake manifold sealing surface (2).

6 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

7 If the clearance between the lower intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Lower manifold maximum warpage	0.05 mm

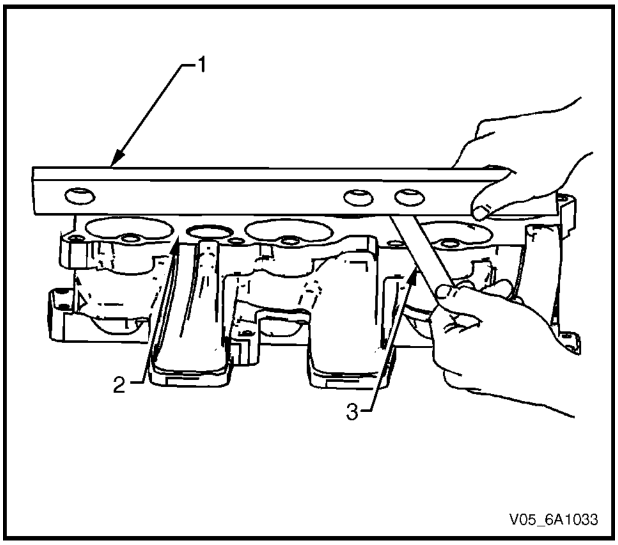


Figure 6A1 – 42

Reassemble

Reassembly of the upper manifold is the reverse of the disassembly procedure .

Reinstall

Reinstallation of the upper intake manifold and the upper and lower intake manifold assembly is the reverse of the removal procedure, noting the following:

1 Only new gaskets are to be fitted between the upper and lower intake manifolds.

CAUTION

Tighten the intake manifold bolts in a circular pattern starting at the centre bolt and moving outward.

2 Ensure that all fasteners are tightened to the correct torque specification.

Upper intake manifold to lower intake manifold attaching bolt torque specification ....23.0 Nm
Upper intake manifold to cylinder head attaching bolt torque specification ....23.0 Nm

CAUTION

Incorrect wiring connector installation may cause component malfunction or component damage.

3 Ensure all wiring connectors are fully engaged and if applicable, locked in place.

4 Ensure all wiring harnesses are correctly routed and attached securely in their retaining clips.

5 Ensure that all hoses and pipes are routed correctly and that any retaining clips are correctly installed.

6 Start and run the engine to check for correct operation.

3.10 Intake Manifold Assembly – Complete

The intake manifold comprises of an upper and lower section. Some service procedures only require the removal of the upper intake manifold (e.g. fuel injector/spark plug servicing), while other service procedures require the removal of both the upper and lower manifold as a complete assembly (e.g. cylinder head/s). If only the upper intake manifold needs to be removed, refer to 3.9 Upper Intake Manifold.

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Depressurise the fuel system.

2 Disconnect the battery negative terminal.

3 Remove the air intake duct (1) and hose (2), refer to 6C1-3 Engine Management – V6 – Service Operations.

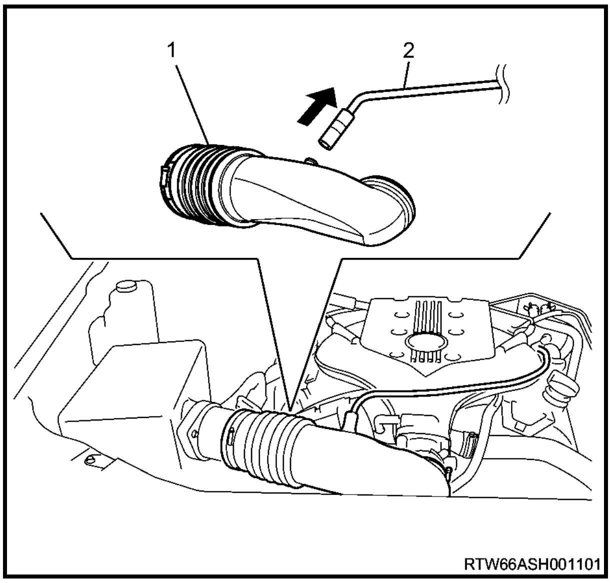


Figure 6A1 – 43

4 Retract the throttle body wiring connector lock (3).

5 While pressing the connector latch in the direction of the arrow (4), disconnect the throttle body wiring connector.

6 Disconnect the throttle body connector wiring harness from its retaining clip (5).

7 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable piece of 5 mm steel rod (or an Allen key).

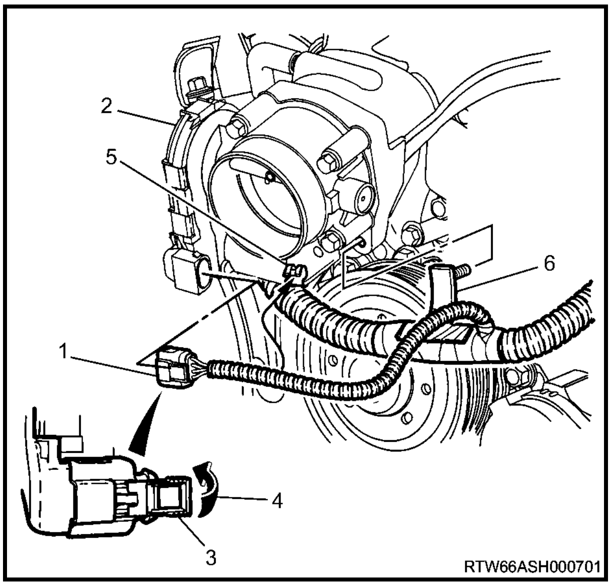


Figure 6A1 – 44

CAUTION

The following precautions must be followed when disconnecting the throttle body wiring connector:

- **Do not use any mechanical device such as a screwdriver to disengage the harness connector (1) from the throttle body (2).**
- **When retracting the throttle wiring connector lock (3), take care not to disengage the lock from the connector.**
- **Do not pull on the connector wires.**
- **Take care not to break the barbed harness retainer pin (6) while removing the harness retainer from the intake manifold.**
- **Should the pin be broken, then it is vital that a new harness retainer is fitted to the wiring harness shield. If not, the harness will foul the engine drive belt.**

8 Disconnect the brake booster hose (1), from the upper intake manifold:

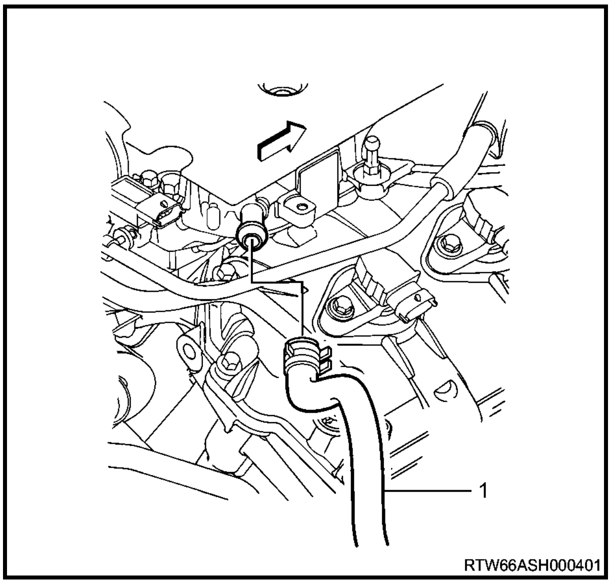


Figure 6A1 – 45

9 Disconnect the wiring harness connector from the barometric (BARO) pressure sensor (1).

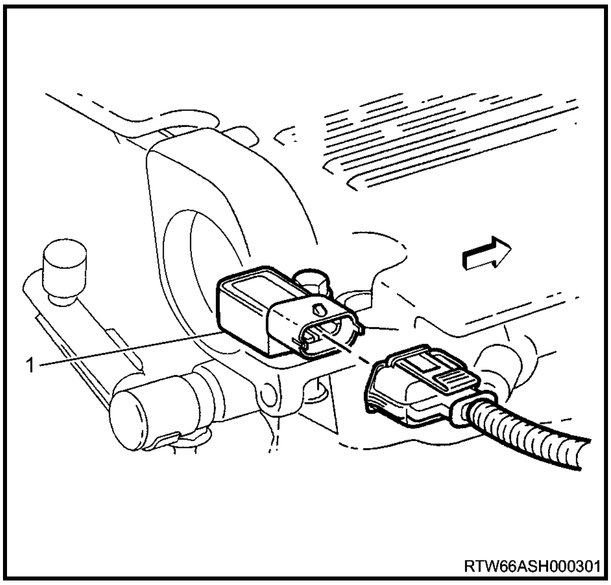


Figure 6A1 – 46

10 Disconnect the PCV tube connector (1) from the upper intake manifold assembly.

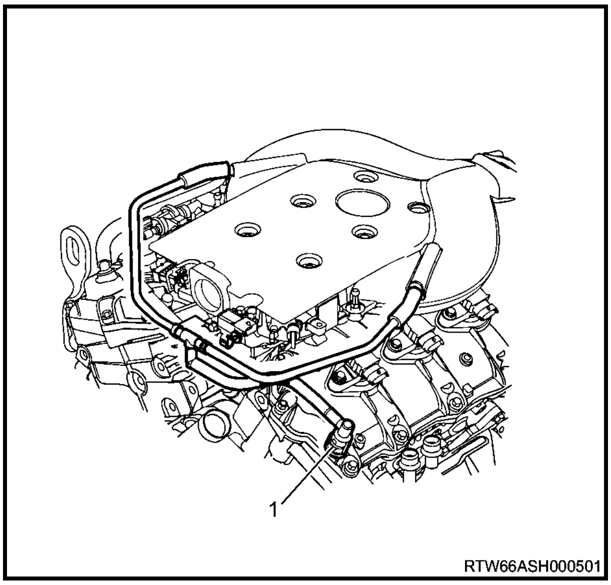


Figure 6A1 – 47

CASTER

3°35'±45'

Note:
Left and right side to be equal within 30'

CAMBER

0°±30'

Note:
Left and right side to be equal within 30'

KING PIN INCLINATION

12°30'±30'

11 Disconnect the fuel feed hose from the fuel rail (1).

12 Pull out the release bar (2) (broad arrow) of the fuel injector harness wiring connector (3).

13 Disconnect the fuel injector harness wiring connector from the fuel injector wiring harness (4).

CAUTION

Plug the fuel feed hose opening after removal to prevent dirt and other contaminants from entering the fuel system.

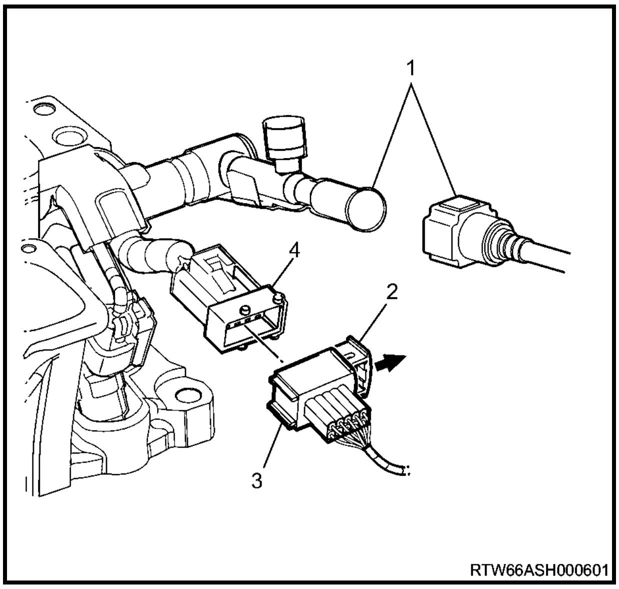


Figure 6A1 – 48

14 Remove the wiring harness connector (2) from the EVAP valve (1).

15 Disconnect the quick connect (3) from the rear of the EVAP valve, as follows:

a Squeeze the two barbed lugs together, push the quick connect into the valve, then pull out to separate the connection.

b Plug both open ends to prevent the entry of foreign matter.

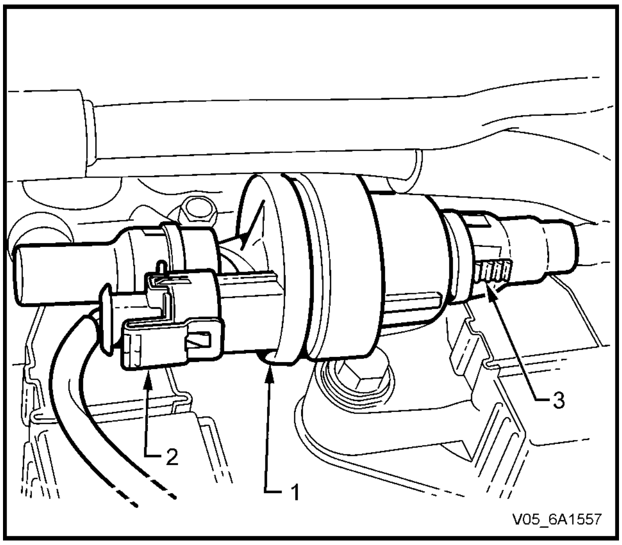


Figure 6A1 – 49

16 Remove the bolt (3) attaching the EVAP valve and the fuel injector wiring harness connector mounting bracket to the upper intake manifold assembly.

17 Move the EVAP valve and the fuel injector wiring harness connector mounting bracket clear of the upper intake manifold assembly.

18 Disconnect the PCV fresh air tube (1) from its upper intake manifold mounting clip (2).

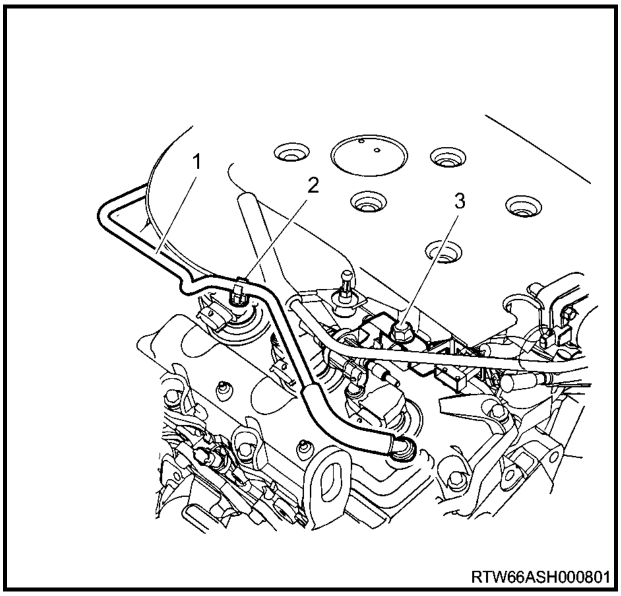


Figure 6A1 – 50

19 Remove the four long (1) bolts (165 mm) securing the complete intake manifold to the cylinder heads.

20 Remove the two short (2) bolts (45 mm) securing the lower intake manifold to the cylinder heads.

CAUTION

Do not loosen nor remove the short bolts (×) (70 mm) holding the upper intake manifold to the lower. These bolts are at the front left and rear right of the upper intake manifold.

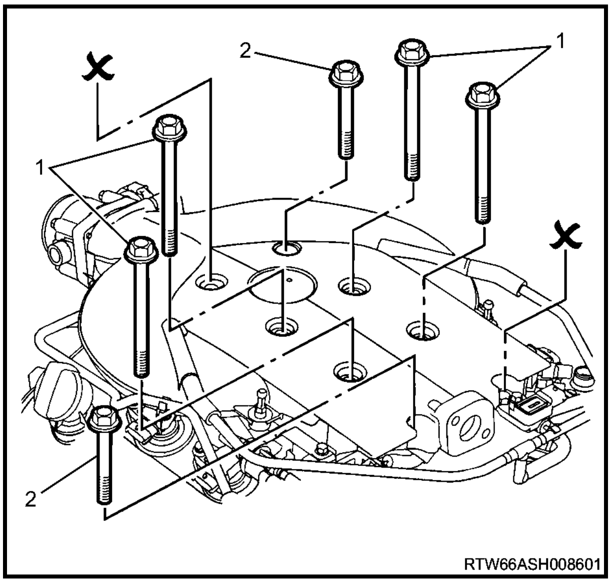


Figure 6A1 – 51

CAUTION

When the intake manifold is removed, plug each of the cylinder head intake openings with lint free cloth, to stop the entry of foreign material into the intake ports.

21 Remove the upper and lower intake manifold assembly from the engine.

22 Remove lower intake manifold to cylinder head gasket.

Disassemble

1 Disconnect the EVAP hose (1) from the upper intake manifold (2).

2 Remove the bolts (3) (70 mm long) attaching the upper intake manifold to the lower intake manifold (4).

NOTE

These bolts are located at the front left and rear right of the upper intake manifold, as shown.

3 Remove the upper intake manifold from the lower intake manifold.

4 Remove and discard the upper to lower intake manifold gaskets.

CAUTION

Do not reuse the upper to lower intake manifold gaskets (5).

5 Remove the EVAP hose from the retaining clip (6) attached to the lower intake manifold.

6 Remove the following from the upper intake manifold, refer to 6C1-3 Engine Management – V6 – Service Operations:

- BARO Sensor and
- Throttle Body assembly

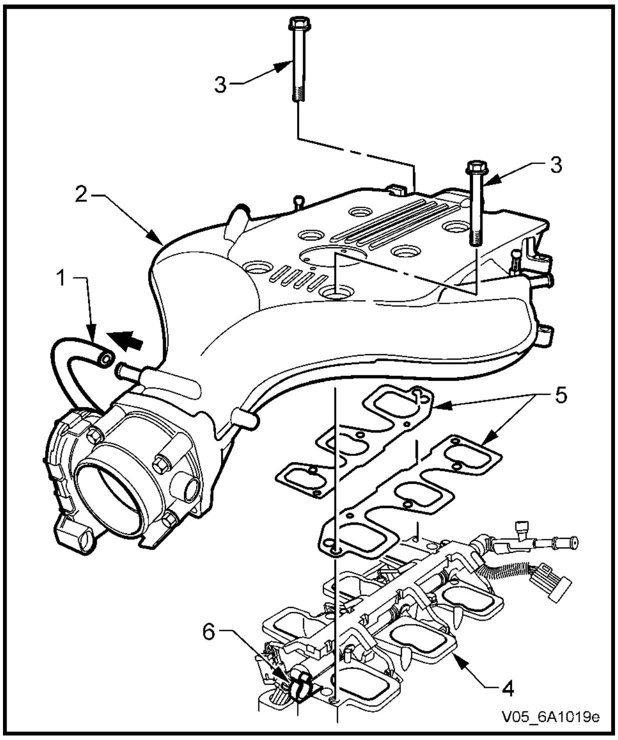


Figure 6A1 – 52

7 Remove the fuel rail and injector assembly. Refer to 6C1-3 Engine Management – V6 – Service Operations.

CAUTION

The following precautions must be followed when removing the fuel rail and injector assembly:

- **Care must be taken when removing the fuel rail and injector assembly to prevent damage to the injector spray tips and injector harness connector terminals.**
- **Support the fuel rail and injector assembly after removal.**
- **Plug all fuel line and manifold openings after removal to prevent dirt and other contaminants from entering the fuel system.**

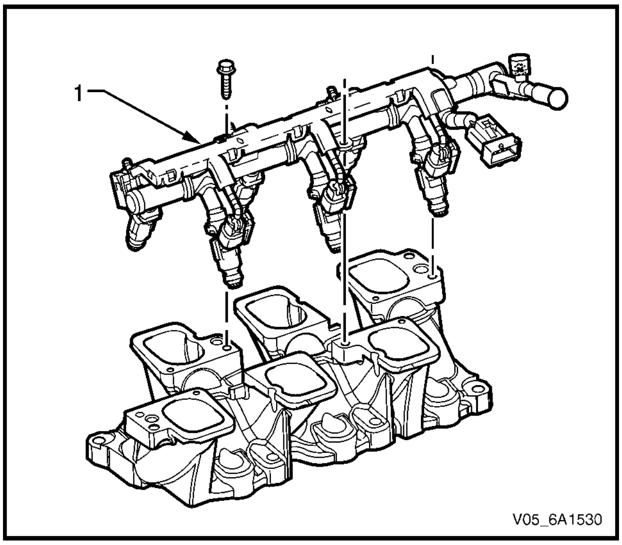


Figure 6A1 – 53

Clean

CAUTION

Due to the aluminium alloy construction of the intake manifold, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use of a wooden or plastic scraper is preferred.

1 Clean mating surfaces ensuring any gasket material is removed.

2 Clean the manifold using a suitable solvent

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the timing components with compressed air.

Inspect

1 Inspect the intake manifold for the following fault conditions:

- Damaged sealing and mating surfaces.
- Damaged lower intake manifold gasket.
- Damage or excessive debris on the threaded and through holes.
- Cracks or damage to the intake manifold body.

NOTE

If the lower intake manifold is cracked or damaged, it must be replaced. No welding or patching of the intake manifold should be performed.

2 Place a straight edge (1) across the upper intake manifold sealing surface (2).

3 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

4 If the clearance between the upper intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Upper manifold maximum warpage .... 0.05 mm

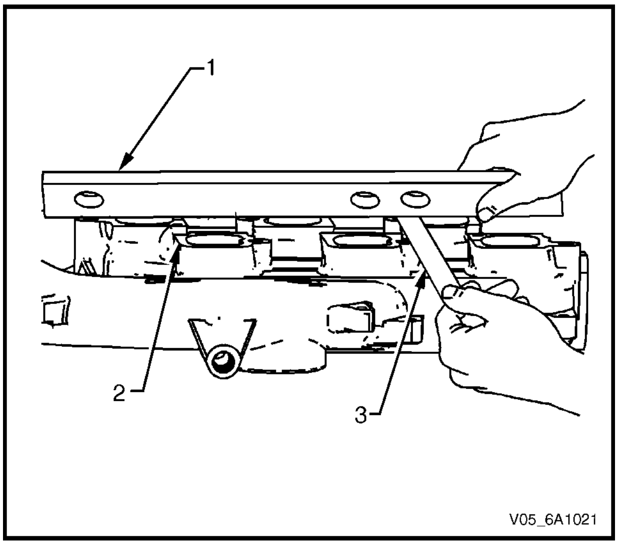


Figure 6A1 – 54

5 Place a straight edge (1) across the lower intake manifold sealing surface (2).

6 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

7 If the clearance between the lower intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Lower manifold maximum warpage .... 0.05 mm

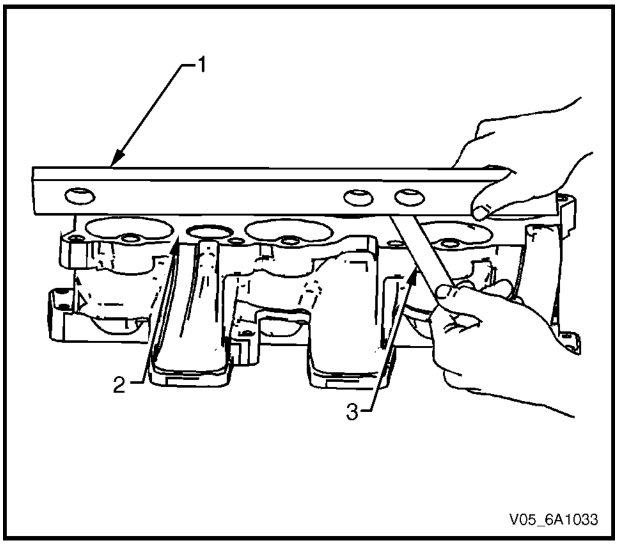


Figure 6A1 – 55

Reassemble

Reassembly of the upper to lower intake manifold is the reverse of the disassembly procedure noting the following:

1 Ensure that both the manifolds have been cleaned and inspected.

2 Ensure that the warpage of the mating surfaces is within tolerances.

3 New upper to lower intake manifold gaskets must be used.

4 Do not tighten the intake manifold to lower intake manifold attaching bolt at this stage. The intake manifold attaching bolts must be tightened at the specified sequence during the reinstallation procedure.

Reinstall

Reinstallation of the upper intake manifold and the upper and lower intake manifold assembly is the reverse of the removal procedure, noting the following:

1 Install the EVAP hose to the clip attached to the lower intake manifold.

2 Only new gaskets are to be fitted between the upper and lower intake manifolds.

3 If undamaged, the lower intake manifold to cylinder head gasket may be re-used, however its replacement is strongly recommended.

CAUTION

Tighten the intake manifold bolts in a circular pattern starting at the centre bolt and moving outward.

4 Ensure that all fasteners are tightened to the correct torque specification.

Upper intake manifold to lower intake manifold attaching bolt torque specification	23.0 Nm
Upper intake manifold to cylinder head attaching bolt torque specification	23.0 Nm
Lower intake manifold to cylinder head attaching bolt torque specification	23.0 Nm
Fuel injector wiring harness bracket attaching bolt torque specification	9.0 Nm

CAUTION

Incorrect wiring connector installation may cause component malfunction or component damage.

5 Ensure all wiring connectors are fully engaged and if applicable, locked in place.

6 Ensure all wiring harnesses are correctly routed and attached securely in their retaining clips.

7 Ensure that all hoses and pipes are routed correctly and that any retaining clips are correctly installed.

8 After installation pull on any quick connect fittings to check that each is correctly installed.

9 Start and run the engine to check for correct operation.

3.11 Exhaust Manifold Assembly

Remove

WARNING

Allow the engine to cool before commencing.

CAUTION

Disconnection of the battery affects certain vehicle electronic systems, refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Remove the oxygen sensor harness connector (1) from the retaining bracket.

3 Disconnect the oxygen sensor wiring harness connector from the engine wiring harness connector (2).

4 Unclip the oxygen sensor wiring harness retaining clip and move aside.

5 For the left-hand side:

Remove the oil level indicator tube.

6 Raise the front of the vehicle and place on stands, refer to 0A General Information.

7 Working from under the vehicle, remove the two exhaust manifold to exhaust pipe flange nuts, refer to 6F Exhaust System - V6 - V6.

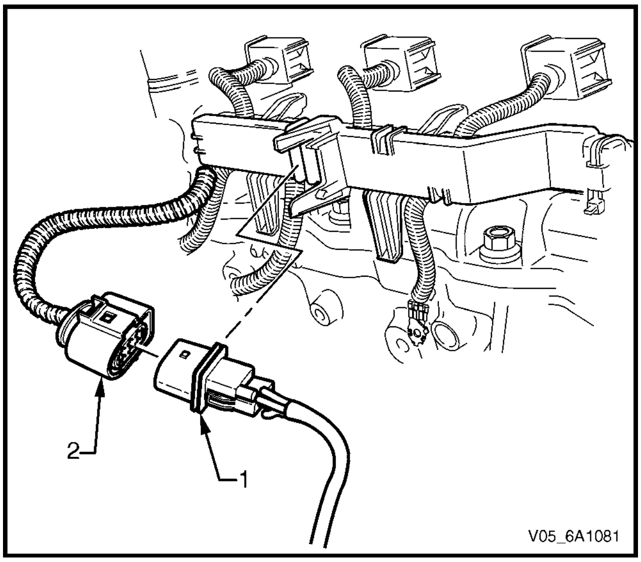


Figure 6A1 – 56

8 Remove the three bolts attaching the exhaust manifold outer heat shield (1) to the exhaust manifold (2).

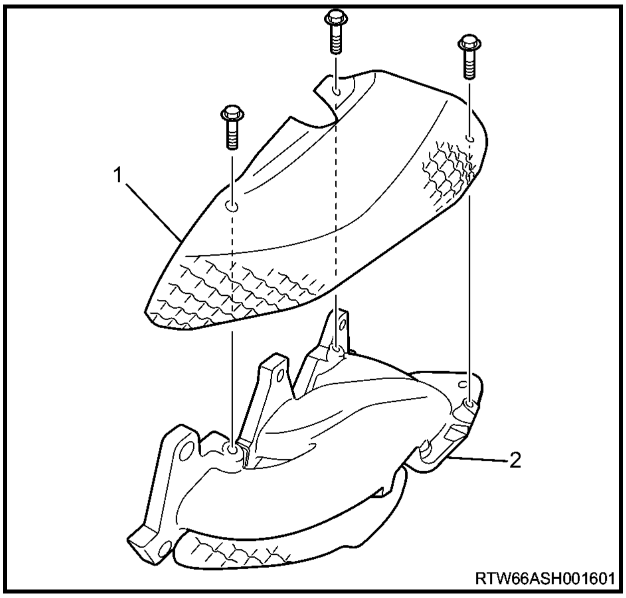


Figure 6A1 – 57

9 Progressively loosen the seven exhaust manifold attaching bolts (2), working from the outside to the centre and then remove the bolts.

10 Manoeuvre the exhaust manifold (3), away from the cylinder head.

11 Remove and discard the exhaust manifold to cylinder head gasket.

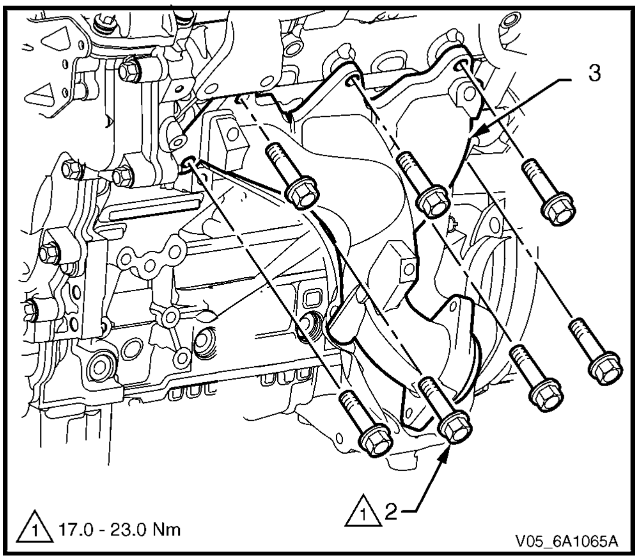


Figure 6A1 – 58

12 Remove the three bolts (1), attaching the exhaust manifold inner heat shield to the exhaust manifold.

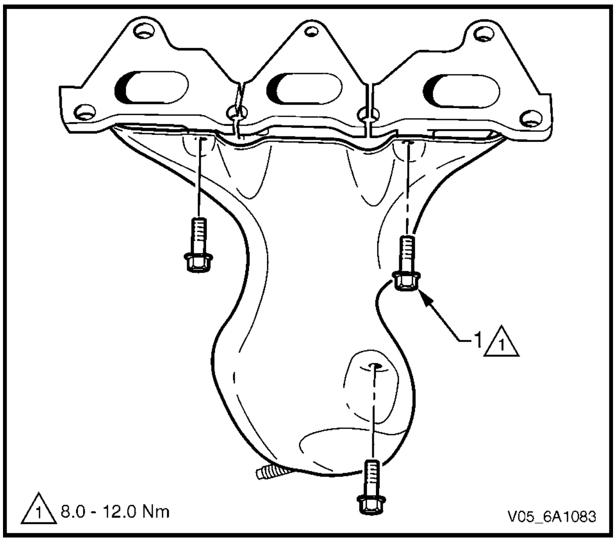


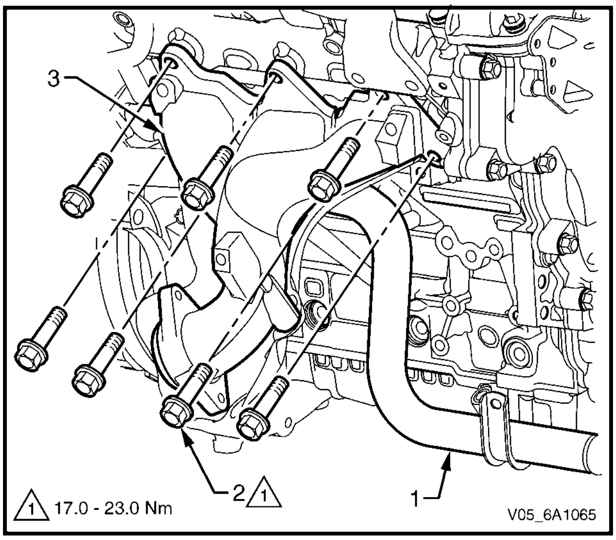
Figure 6A1 – 59

13 Using a suitable commercially available non-corrosive cleaning solvent and a soft bristled parts cleaning brush, thoroughly clean the exhaust manifold.

14 Dry the exhaust manifold using compressed air.

WARNING

Safety glasses must be worn when using compressed air.



NOTE

- The same procedure applies to the Right-hand exhaust manifold.
- To gain access to the lower rear exhaust manifold attaching bolts (2), apply a slight downward movement to the coolant inlet pipe (1).

Inspect

Inspect the exhaust manifold (1) for the following:

- Damage to the threaded holes for the heat shield mounting.
- Damage to the exhaust manifold mounting holes.
- Damage to the threads of the exhaust manifold to exhaust pipe flange studs.
- Damage to the gasket sealing surfaces.
- Using a straight edge (2) and feeler gauges (3), check the cylinder head mounting face of the exhaust manifold does not exceed the maximum distortion specification of 0.25mm.

NOTE

If the surface flatness is not within specifications, the exhaust manifold is warped and must be replaced.

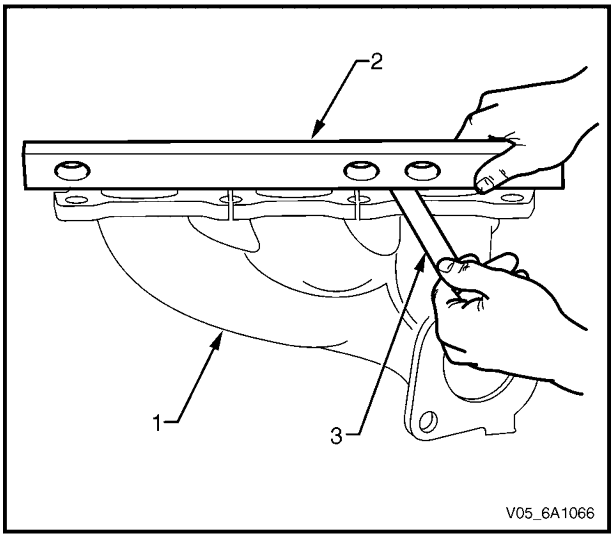


Figure 6A1 – 60

Reinstall

Reinstallation of the exhaust manifold assembly is the reverse of the removal procedure, noting the following:

1 Ensure the exhaust manifold, cylinder head and exhaust pipe flange surfaces are clean.

2 Position a new exhaust manifold gasket onto the exhaust manifold.

3 Apply a 5 mm bead of Loctite 272 thread sealant (or equivalent) to the threads of the exhaust manifold attaching bolts.

4 Install the bolts into the exhaust manifold. This will prevent the gasket from falling off the manifold.

5 Manoeuvre the exhaust manifold into position and install the exhaust manifold attaching bolts.

6 From underneath the vehicle install the exhaust manifold to exhaust pipe flange nuts.

7 Tighten the exhaust manifold attaching bolts to the correct torque specification.

NOTE

When tightening the exhaust manifold to cylinder head attaching bolts, begin with the centre bolts, then alternate from side to side to the outer bolts.

Exhaust manifold to cylinder head attaching bolt torque specification...........17.0 – 23.0 Nm

8 Apply an anti seize compound such as Caltex Kopr-Kote (or equivalent) to the cleaned heat shield bolt threads. Install the heat shield attaching bolts and tighten to the correct torque specification.

Exhaust manifold heat shield attaching bolt torque specification ....8.0 – 12.0 Nm

9 For the right-hand side, install the battery harness ground cable attaching nut through the ground terminal and lower coolant tube mounting lug, and tighten to the correct torque specification.

Battery harness ground terminal attaching nut torque specification.......................13.0 Nm

3.12 Camshaft Cover

Remove

1 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

2 For the left-hand side, remove the evaporative (EVAP) emission canister purge solenoid, refer to 6C1-3 Engine Management – V6 – Service Operations.

3 Remove the two bolts (1) attaching the engine wiring harness former to the rear of the cylinder heads.

4 Unclip the transmission vent tube (2) from the engine wiring harness.

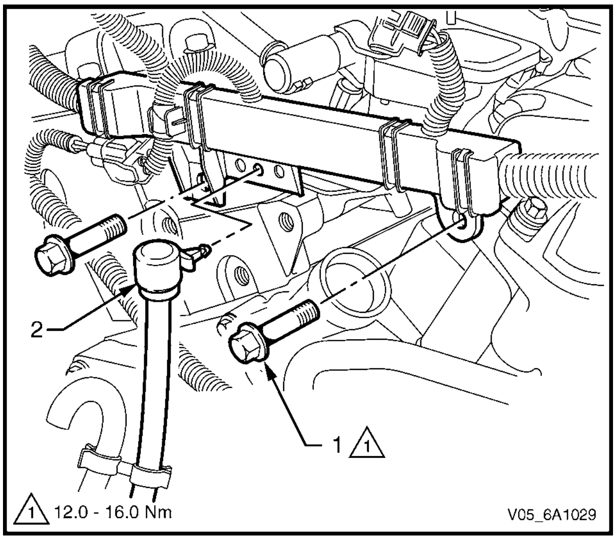


Figure 6A1 – 61

5 Disconnect the oxygen sensor wiring harness connector (1) from the engine wiring harness (2), left-hand shown, right-hand similar.

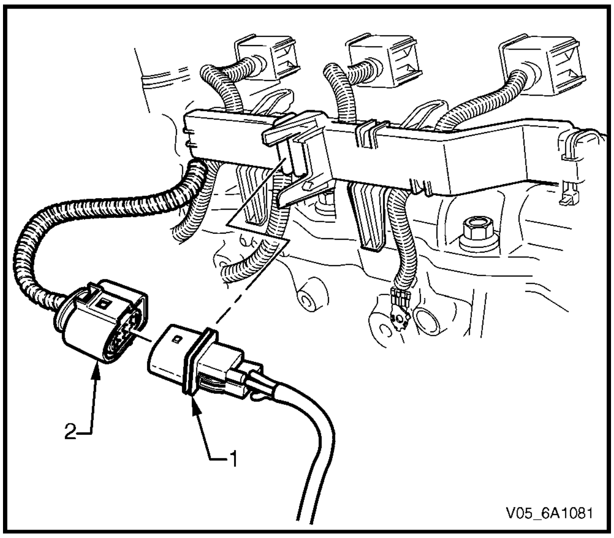


Figure 6A1 – 62

6 Remove the bolt (1) attaching the ground connector (2) to the cylinder head.

7 Fro the left-hand side, disconnect the engine coolant temperature (ECT) sensor wiring connector (3).

8 Unclip the engine wiring harness retaining lugs from the side of the camshaft cover.

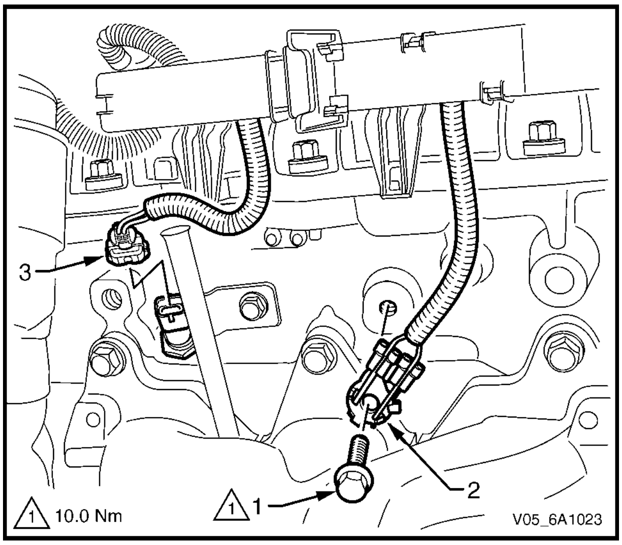


Figure 6A1 – 63

9 For the right-hand side, remove the engine wiring harness retaining clip (1) from the engine control module (ECM) bracket (2).

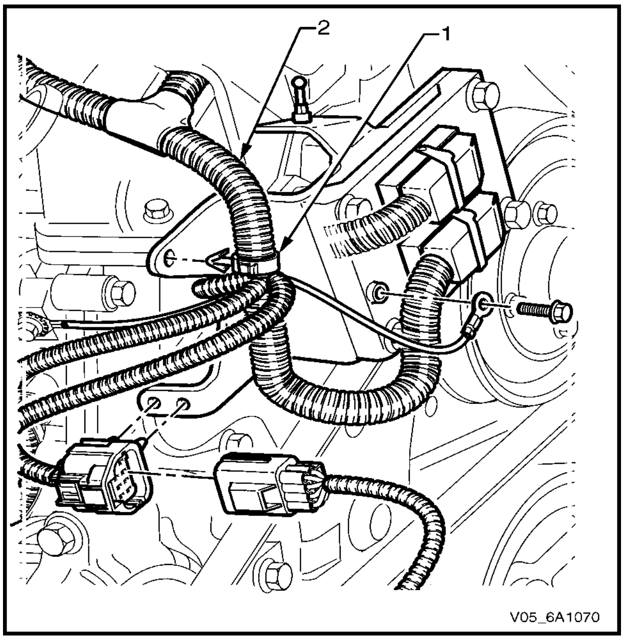


Figure 6A1 – 64

10 Disconnect the camshaft position (CMP) sensor wiring connector (1).

11 Unclip the engine wiring harness retaining lug (3) from the front of the camshaft cover.

12 Remove the ignition coil assemblies; refer to 6C1-3 Engine Management – V6 – Service Operations.

13 Move the engine wiring harness clear of the camshaft cover.

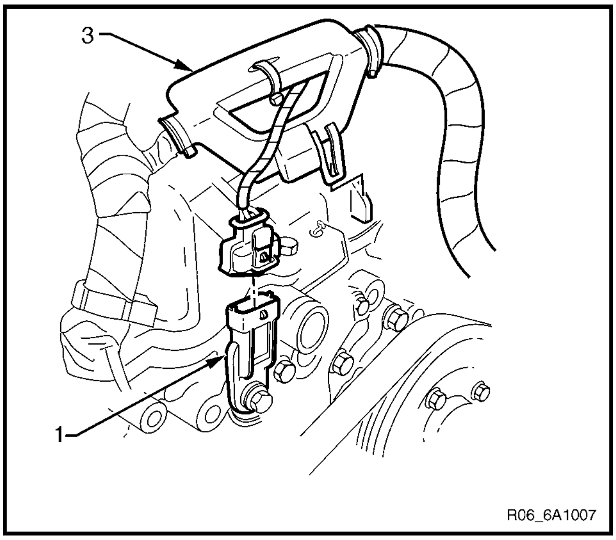
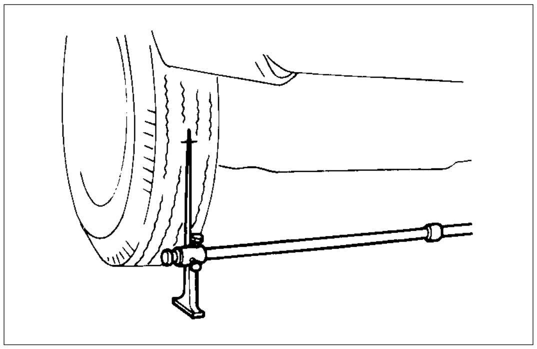


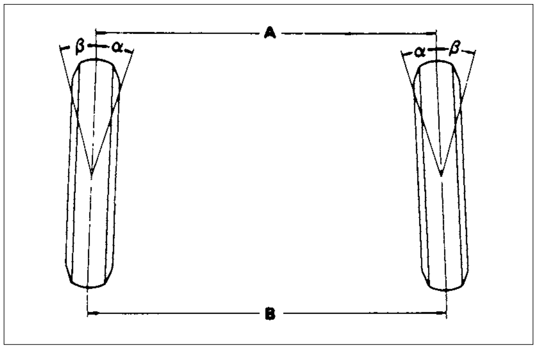
Figure 6A1 – 65



Toe-in Adjustment

Measurement should be taken with the vehicle on a surface plate.
If a surface plate is not available, toe-in should be checked with the vehicle parked on a level floor.

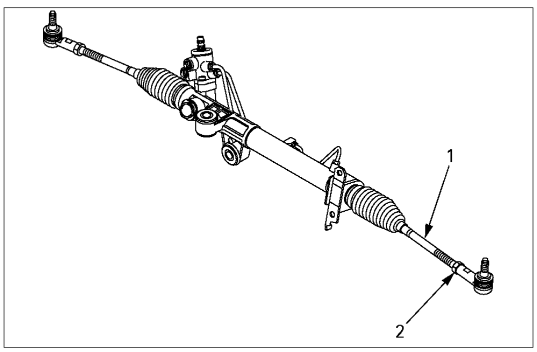
1. Set front wheels to straight ahead position.
2. Align the toe-in gauge with center height of each wheel at front end.
3. Apply center marks to each wheel, then take measurement of distance A between the center marks on each wheel.
4. Slowly move the vehicle rearward until the center marks reach the rear end position.
5. Take measurement of distance B between the center marks at rear end.



The toe-in can be calculated with the following formula.
Toe-in = B - A

Toe-in mm (in)

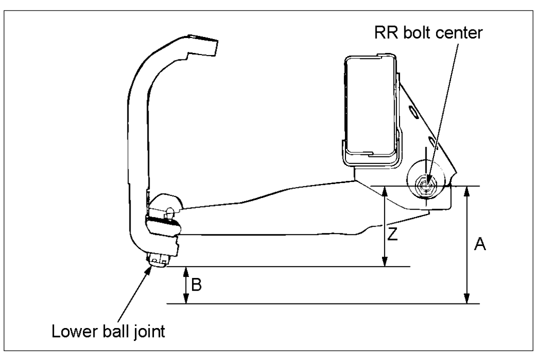
4×2 (Except high ride suspension)	0±2 (0±0.08)



To adjust the toe-in angle, loosen the lock nuts (2) on the tie rod (1) and turn the tie rod. Turn both rods the same amount, to keep the steering wheel centered.

Lock Nut Torque N·m (kgf·m/lb·ft)

98±6.0 (10.0±0.6 / 72.3±4.3)



RTW53ASH000101

Trim Height

Trim Height : at Curb Weight (Reference Data)

Trim height (Z) = A - B

Front mm (in)

Z
105(4.13)

14 Remove the bolt (1), 13 places, attaching the camshaft cover (2) to the cylinder head (3).

15 Remove the cover and discard the seal.

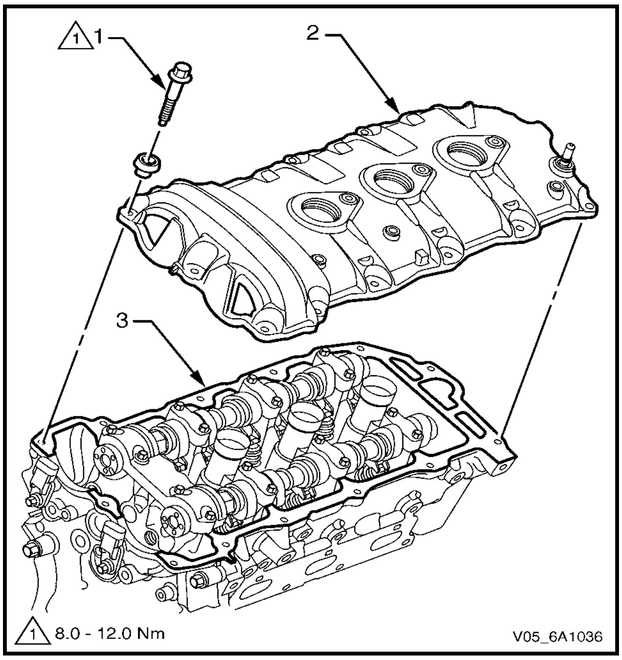


Figure 6A1 – 66

16 Install Tool No. EN-46101 (1) to the spark plug tubes of the cylinder head to prevent entry of dirt into the combustion chamber.

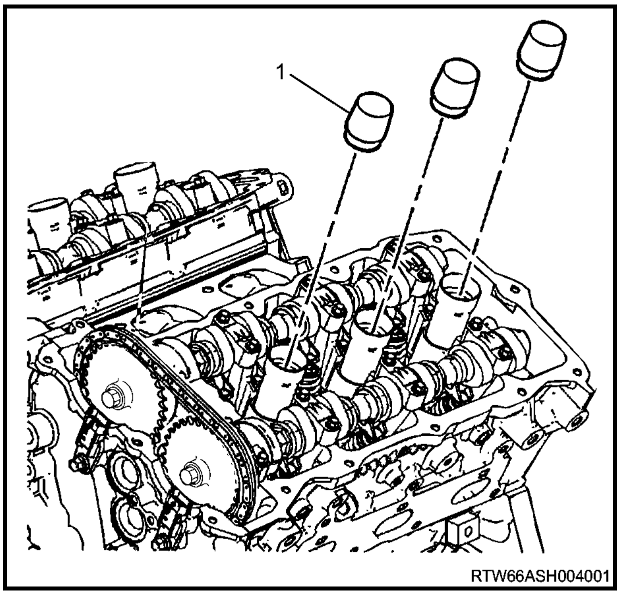


Figure 6A1 – 67

Clean and Inspect

WARNING

Safety glasses must be worn when using compressed air.

1 Clean the camshaft cover with suitable cleaning solvent and blow dry with compressed air.

2 Inspect the cover for cracking and distortion.

3 Check the spark plug tube seals for damage.

4 If the camshaft cover is damaged in any way that will affect it's performance to seal and stop the ingress of dirt, replace the camshaft cover.

Reinstall

Reinstallation of the camshaft cover assembly is the reverse of the removal procedure, noting the following:

1 If not already fitted, install Tool No. EN-46101 (1) to the spark plug tubes of the cylinder head.

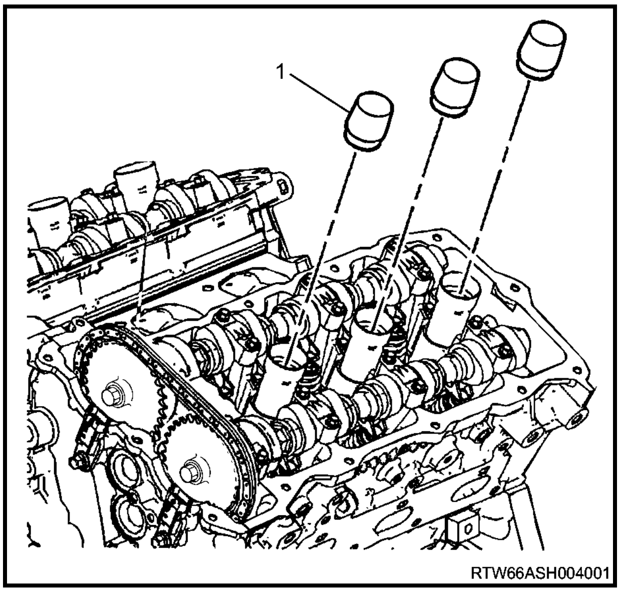


Figure 6A1 – 68

2 Ensure that the grommet (1), 13 places, is correctly seated in its hole.

3 Wipe the camshaft cover sealing surface on the cylinder head with a clean lint free cloth.

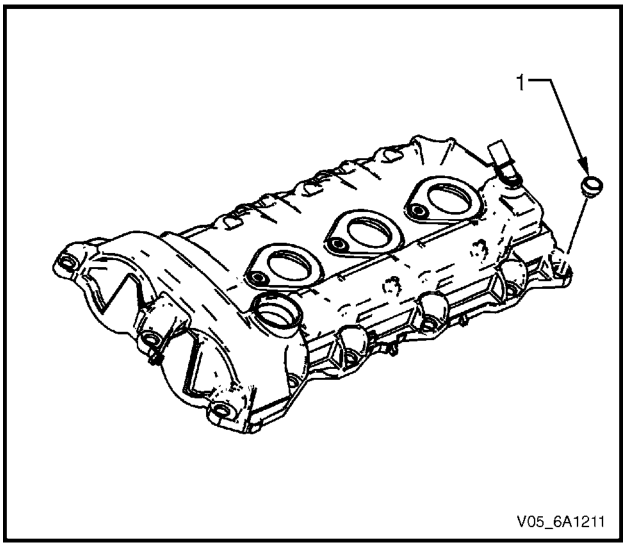


Figure 6A1 – 69

4 Ensure that a new seal is correctly fitted to the camshaft cover. Place a 3 mm bead of RTV sealant on the join line of the engine front cover (1).

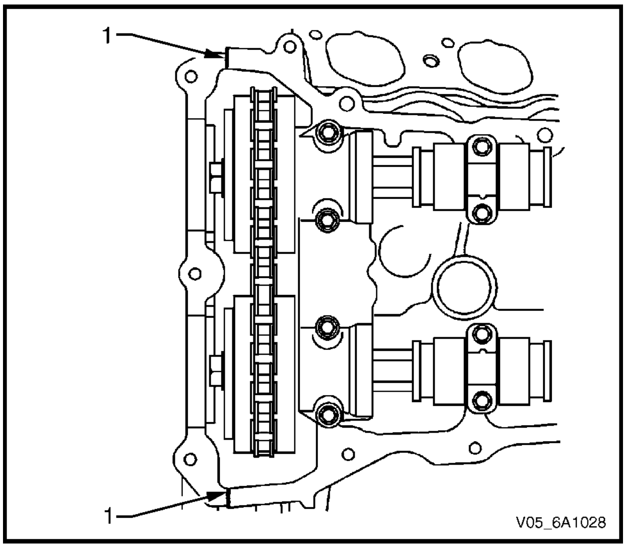


Figure 6A1 – 70

5 Place the camshaft cover (1) into position onto the cylinder head (2).

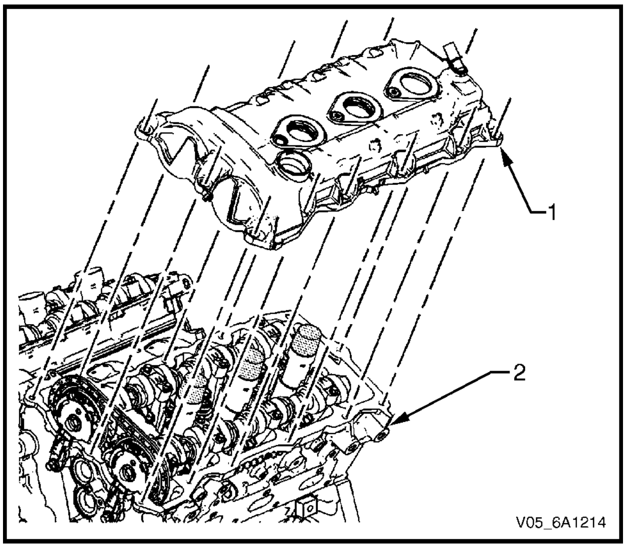


Figure 6A1 – 71

6 Loosely install the camshaft cover bolt (1), 13 places.

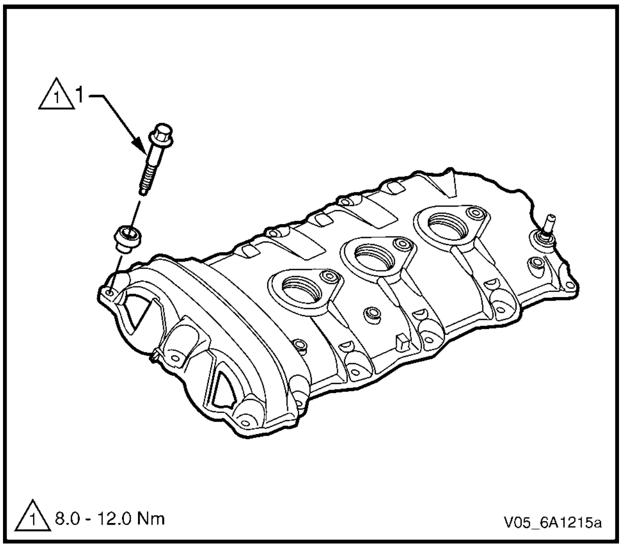


Figure 6A1 – 72

7 Tighten the camshaft cover bolts to the correct torque specification, in the sequence shown.

Camshaft cover attaching bolt torque specification	8.0 – 12.0 Nm

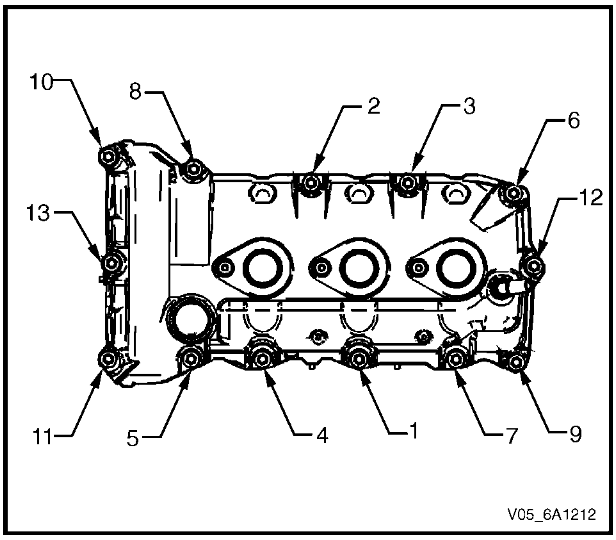


Figure 6A1 – 73

8 Remove Tool No. EN-46101 (1).

9 Tighten all remaining fasteners to the correct torque specification.

Engine ground connector bolt torque specification	10.0 Nm
Engine wiring harness former attaching bolt torque specification	12.0 – 16.0 Nm

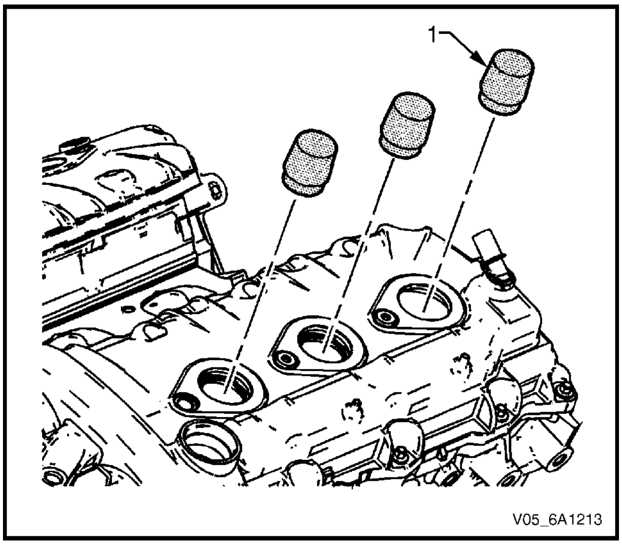


Figure 6A1 – 74

3.13 Crankshaft Balancer Assembly

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the starter motor, refer to 6D1-2_ Starting System.

3 Install Tool No. EN-46106 (1) into the starter motor opening to stop the camshaft from rotating.

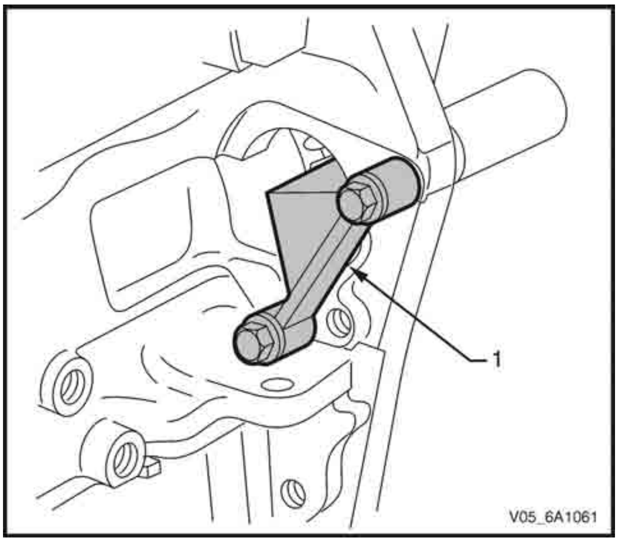


Figure 6A1 – 75

4 Remove the bolt (1) attaching the crankshaft balancer assembly (2) to the crankshaft.

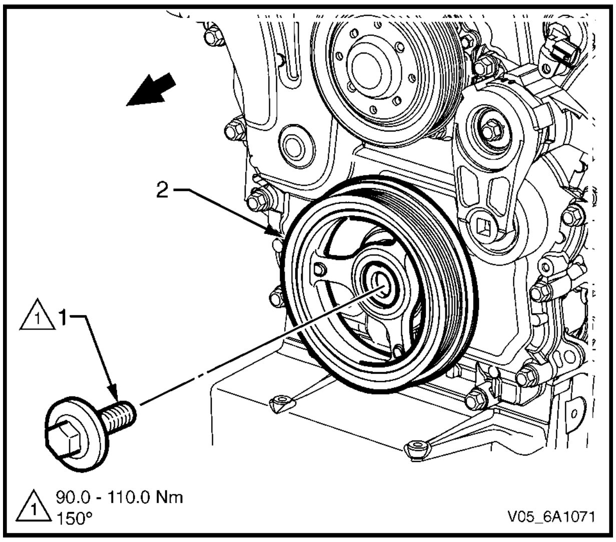


Figure 6A1 – 76

5 Remove the crankshaft balancer assembly (1) from the crankshaft using the appropriate tool:

Tool No. J-41816 (2) or equivalent.

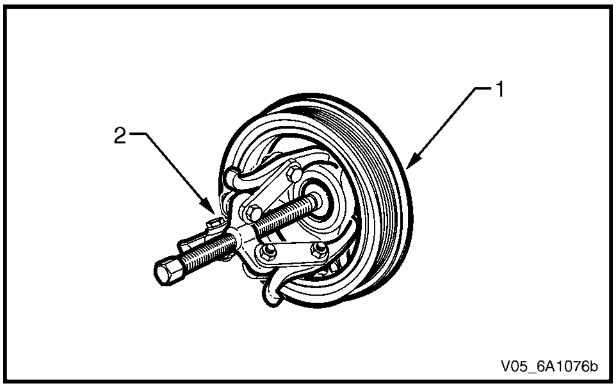


Figure 6A1 – 77

Clean and Inspect

1 Using a suitable non-corrosive cleaning solvent and a soft bristled parts cleaning brush, clean the crankshaft balancer assembly.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the crankshaft balancer assembly using compressed air.

3 Inspect the crankshaft balancer assembly for the following fault conditions:

- Hub to crankshaft inner surface for wear or damage,
- Sealing surface for wear, grooving or scoring,
- Rubber ring between the hub and the pulley for wear, chunking and general deterioration, and
- Drive belt ribs of the pulley for damage.

Reinstall

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer must be installed onto a dry seal.

1 Lubricate the crankshaft balancer assembly hub bore.

2 Partially install the crankshaft balancer assembly onto the crankshaft.

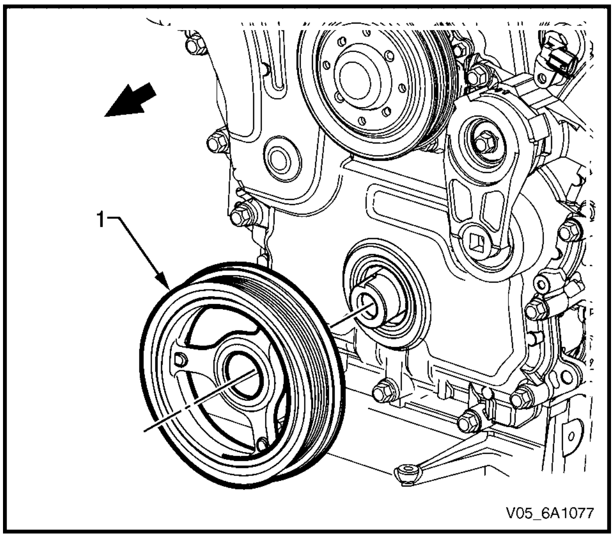


Figure 6A1 – 78

3 Using crankshaft balancer installer, Tool No. J-41998-B (1), fully install the crankshaft balancer assembly into the crankshaft.

CAUTION

To prevent damage to the crankshaft threads, fully install crankshaft balancer installer, Tool No. J-41998-B (1) into the crankshaft before pressing the pulley and balancer assembly.

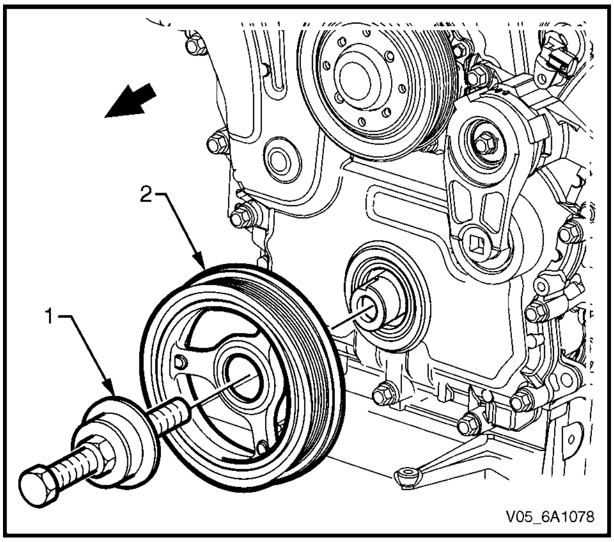


Figure 6A1 – 79

4 Apply Loctite 272 or equivalent to the thread of a new crankshaft balancer assembly retaining bolt (1).

5 Install the crankshaft balancer assembly retaining bolt and tighten to the correct torque specification.

■ ♦ Crankshaft balancer retaining bolt torque specification:
Stage 1 ....90.0 – 110.0 Nm
Stage 2 ....150°

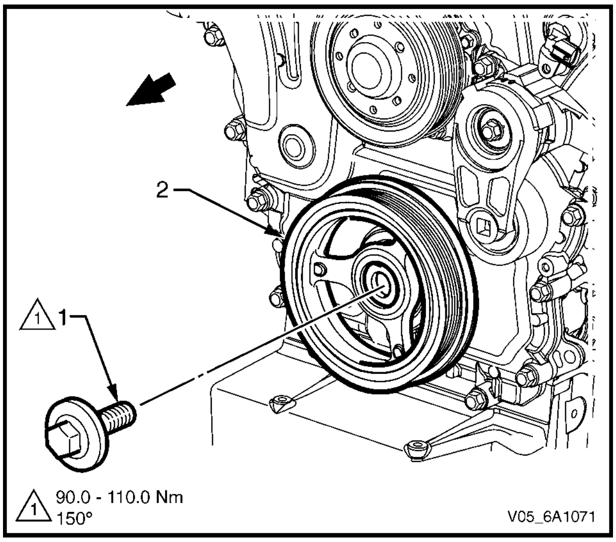


Figure 6A1 – 80

3.14 Crankshaft Front Seal

Replace

1 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

2 Using a flat bladed tool (2) or seal remover, Tool No. E-308, carefully remove the crankshaft front seal (1) from the front cover.

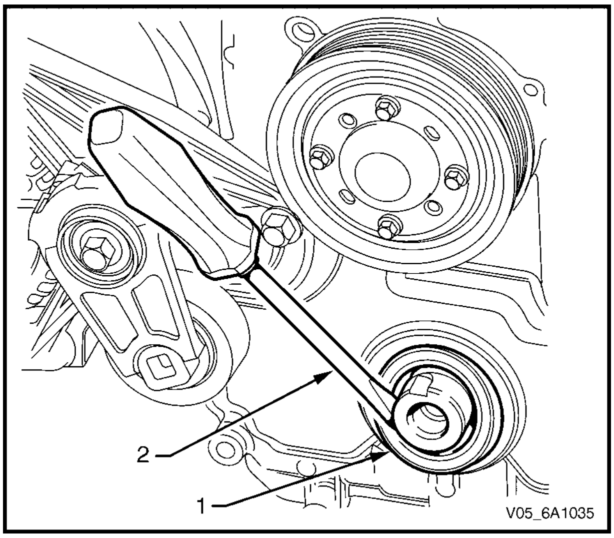


Figure 6A1 – 81

3 Using crankshaft front seal installer, Tool No. J-29184 (2) and a suitable hammer, install a new crankshaft front seal (1) until fully seated against the front cover housing.

4 Install the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

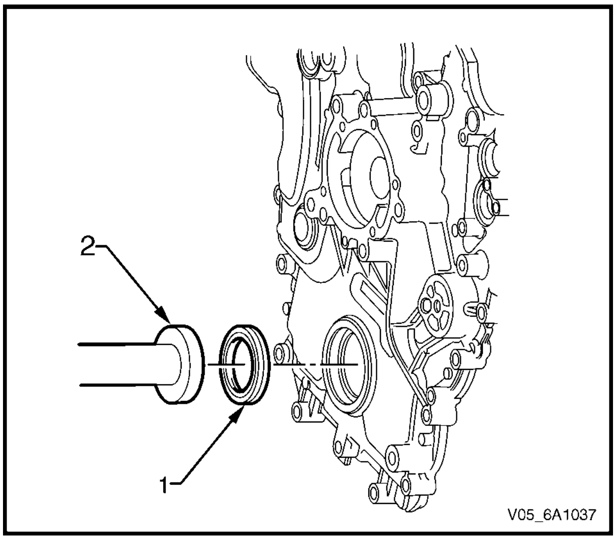


Figure 6A1 – 82

3.15 Front Cover Assembly

Remove

1 Drain the engine coolant, refer to 6B1_Engine Cooling.

2 Remove the water outlet pipe and coolant pump assembly, refer to 6B1_ Engine Cooling:

3 Remove the camshaft covers, refer to 3.12 Camshaft Cover.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Disconnect the purge vent hose from the water outlet pipe.

NOTE

Do not disconnect the power steering pipes or drain the power steering fluid.

6 Remove the power steering pump reservoir mounting bracket, refer to 3.8 Power Steering Pump Bracket.

7 Remove the camshaft position sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

NOTE

Do not disconnect the A/C compressor pipes.

8 Remove the bolt (2), 22 places, attaching the front cover assembly (1).

CAUTION

Only use the prise points and a bolt in the jackscrew hole to remove the engine front cover.

9 Loosely install a 10 x 1.5 mm bolt in the jackscrew hole (1).

10 Using the prise points (2) located at the edge of the front cover and the jackscrew, shear the RTV sealant.

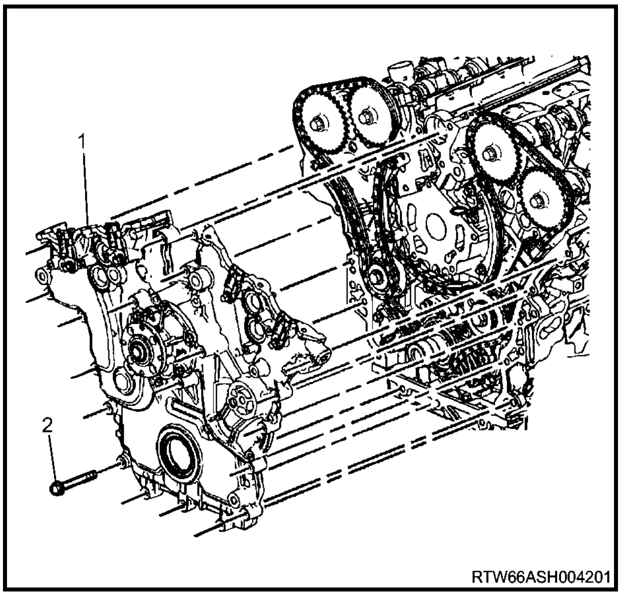


Figure 6A1 – 83

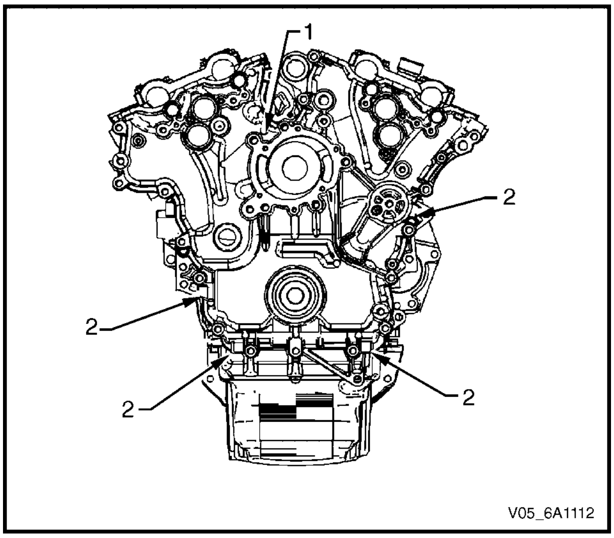


Figure 6A1 – 84

11 Remove the front cover assembly (1).

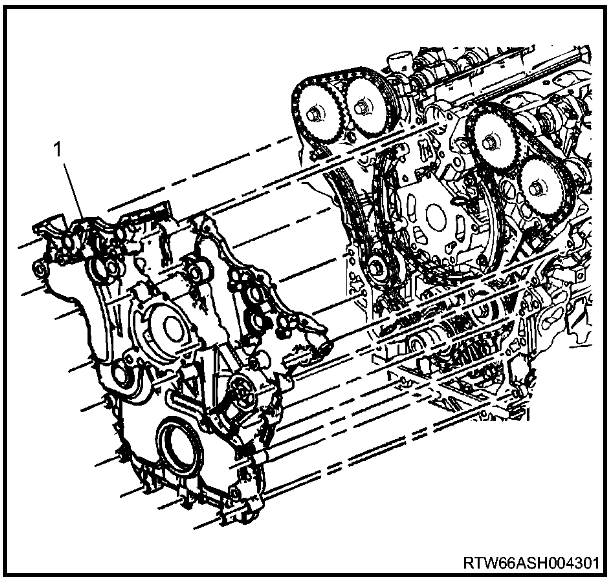


Figure 6A1 – 85

Disassemble

1 Remove the crankshaft front oil seal (1) from the engine front cover (2) using a flat bladed tool or seal remover, Tool No. E-308. Discard the seal.

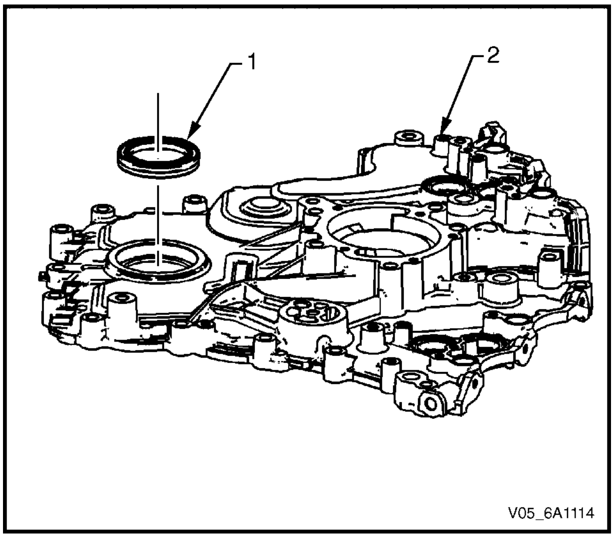


Figure 6A1 – 86

2 Remove the camshaft position actuator valve oil seals (1) from the engine front cover (2). Discard the seals.

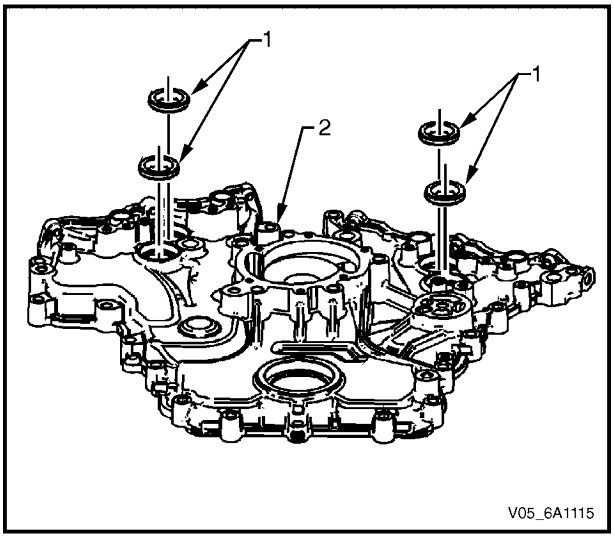


Figure 6A1 – 87

3 Remove the coolant pump seal (1) from the engine front cover (2). Discard the seal.

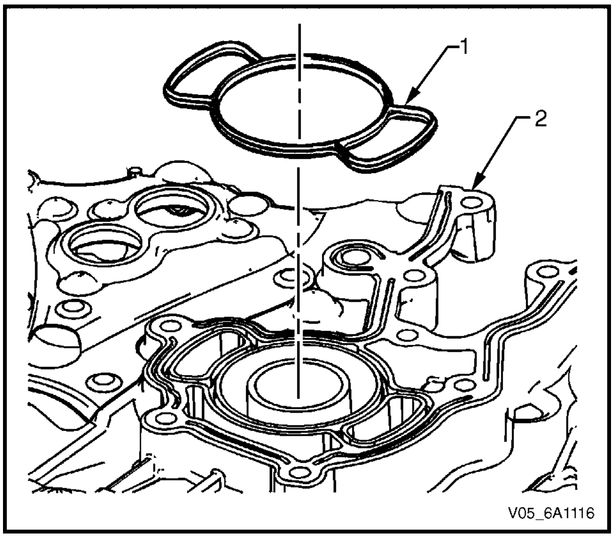


Figure 6A1 – 88

Clean

4 Remove any RTV sealant (1) from the engine front cover using a plastic or wood scraper.

CAUTION

- **Insert a piece of cardboard between the front of the oil pan and oil pump to prevent any contaminants from falling into the oil pan.**
- **Do not use a sharp or metal gasket scraper to clean the sealing surfaces.**

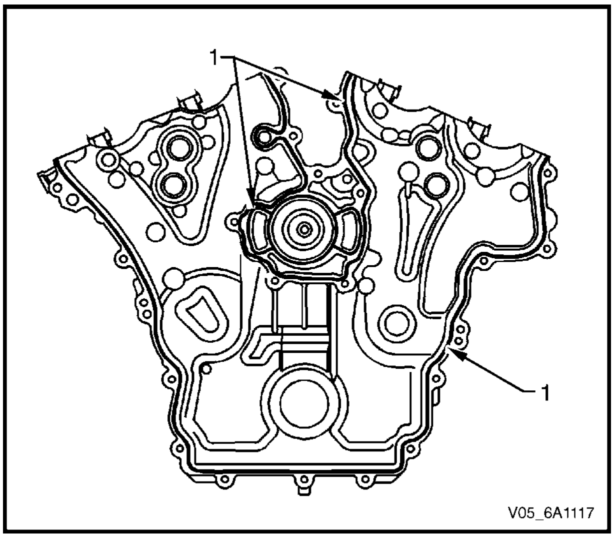


Figure 6A1 – 89

5 Clean out any debris from the bolt holes.

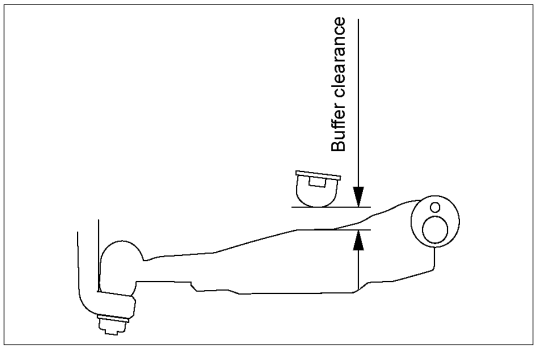
6 Clean the front cover with a suitable cleaning solvent.

7 Dry the front cover with compressed air.

WARNING

Safety glasses must be worn when using compressed air.

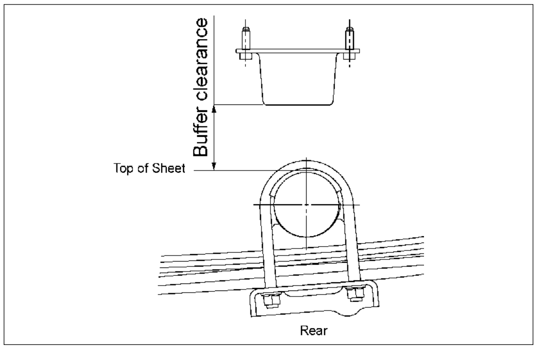
8 Use compressed air to remove any engine coolant from the engine cooling passages and from the top of the oil pan oil deflector.



RTW53ASH000201

FRT Buffer clearance (Reference Data) mm(in)

4×2 (Except high ride suspension)
25.9(1.02)



RTW340SH000101-X

RR Buffer clearance (Reference Data) mm(in)

4×2 (Except high ride suspension)
82 (3.23)

MAXIMUM STEERING ANGLE

	4×2 (Except high ride suspension)
Outside wheel	33.5°
Inside wheel	37.1°

Inspect

1 Inspect both sides of the engine front cover for the following conditions:

- damage to the camshaft position actuator valve oil seal bores (1),
- damage to the bolt holes (2),
- damage and/or corrosion to the engine coolant passage (3),
- dents or damage to the exterior (4),
- damage to the crankshaft front oil seal bore (5),
- gouges or damage to the coolant pump sealing surfaces (6), and
- damage to the coolant pump bolt hole threads (7).

2 Repair or replace the front cover as required.

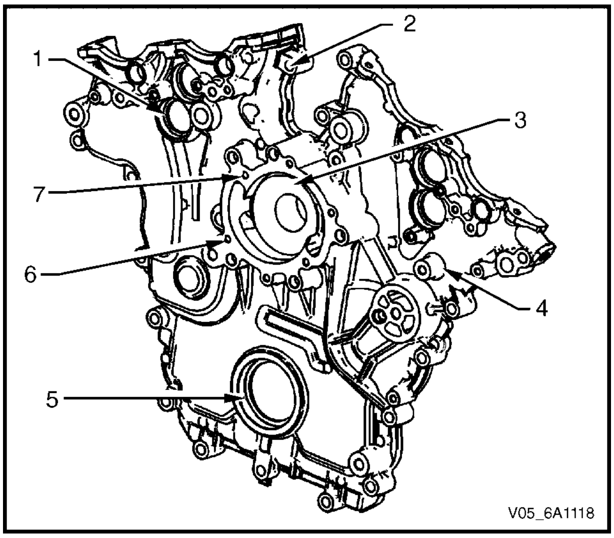


Figure 6A1 – 90

Reassemble

1 Install a new crankshaft front oil seal (1) into the front cover (2) using crankshaft front seal installer, Tool No. J-29184 (3) and a suitable hammer.

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

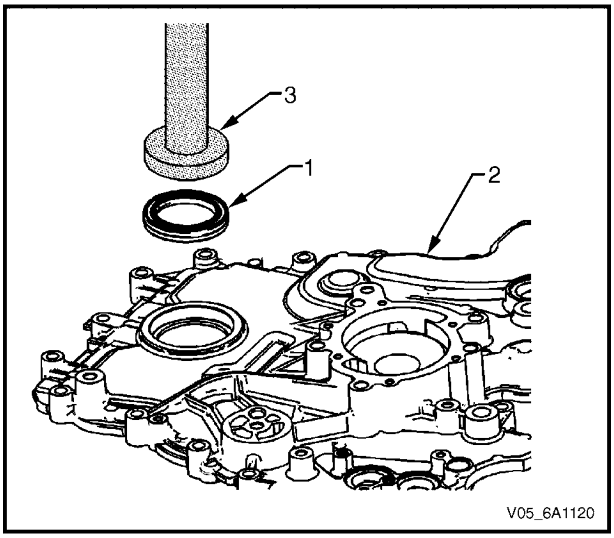


Figure 6A1 – 91

2 Install a new camshaft position actuator valve oil seal (1) into the front cover (2) using Tool No. EN-46103 (3) and a suitable hammer.

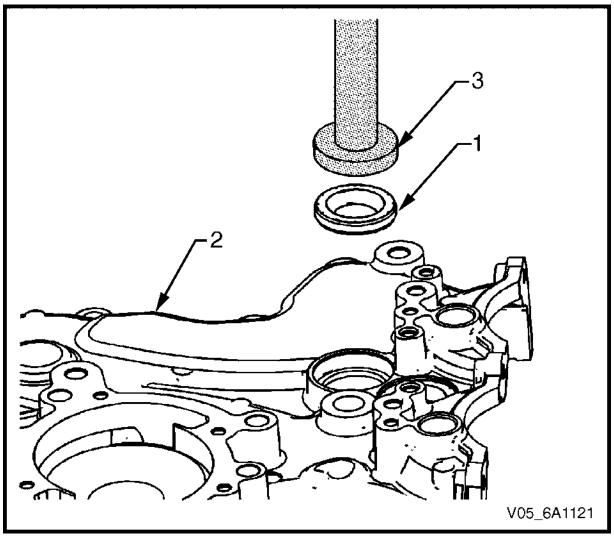


Figure 6A1 – 92

Reinstall

Reinstallation of the front cover is the reverse of the removal procedure, noting the following:

1 Install the guide pins, Tool No. EN-46109 (1) into the engine block, two places.

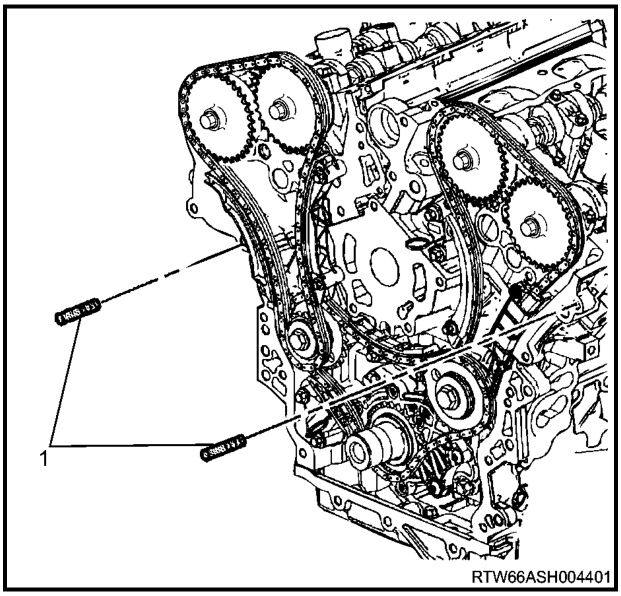


Figure 6A1 – 93

2 Install a new engine front cover to cylinder block seal (1).

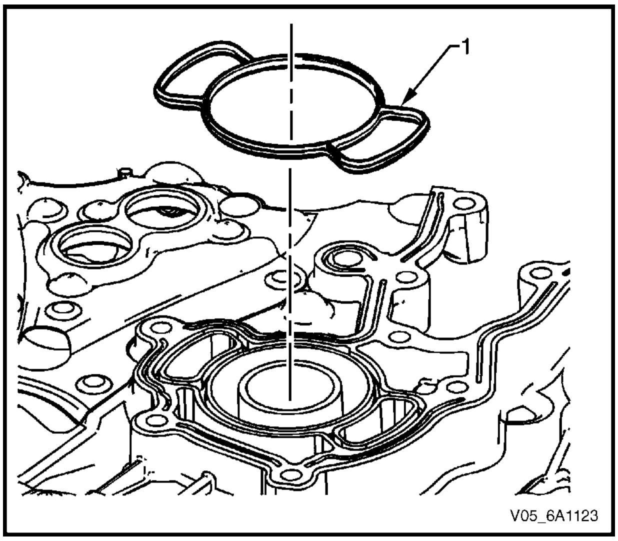


Figure 6A1 – 94

3 Apply a 3 mm bead of RTV sealant (1) to the front cover.

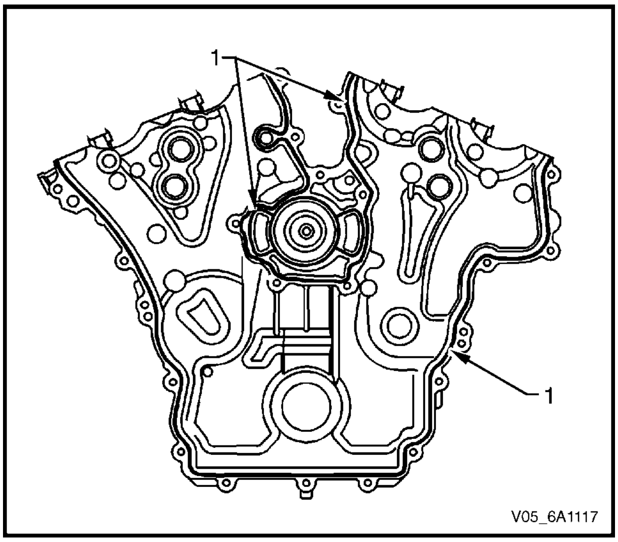


Figure 6A1 – 95

4 Place the front cover onto the special tools and slide into position.

5 Remove the special tools from the cylinder block.

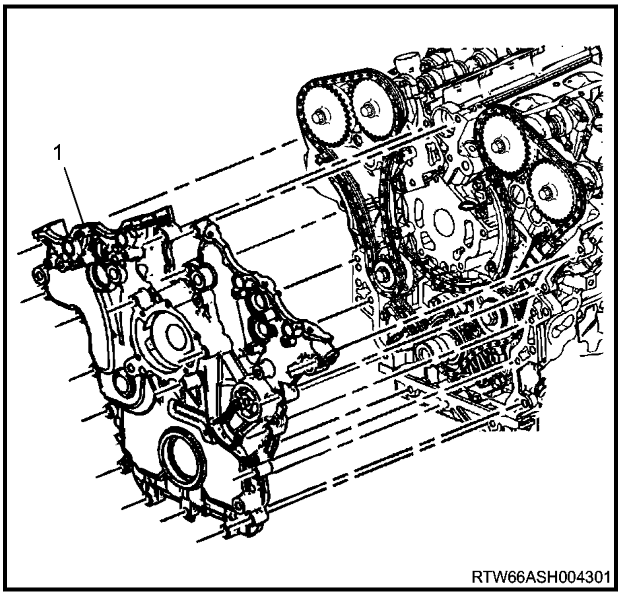


Figure 6A1 – 96

6 Hand start the front cover bolts (1).

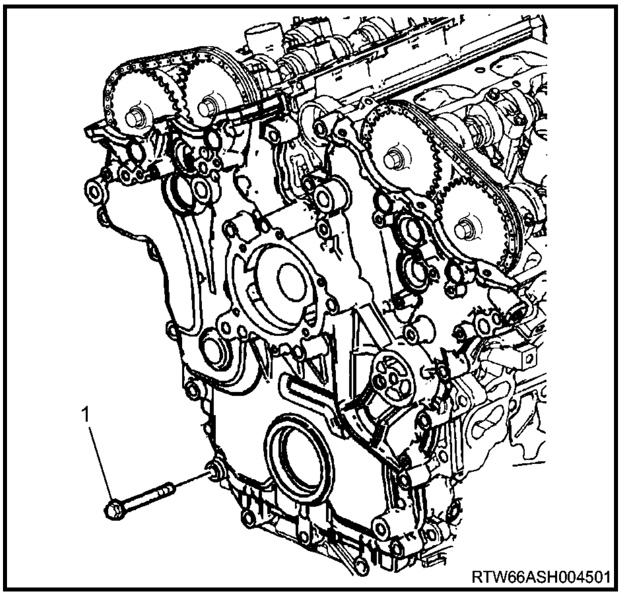


Figure 6A1 – 97

7 Tighten the engine front cover bolts to the correct torque specification, in the sequence shown.

Engine front cover assembly attaching bolt torque specification ....20.0 – 26.0 Nm

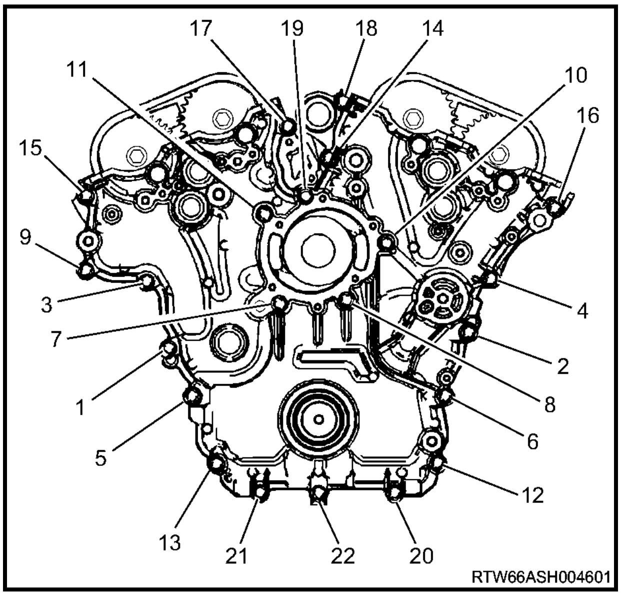


Figure 6A1 – 98

8 Fill the cooling system, refer to 6B1 Engine Cooling – V6.

9 Change the engine oil, refer to 3.1 Engine Oil.

3.16 Timing Chains, Tensioners, Shoes and Guides

CAUTION

Setting the camshaft timing is required whenever the camshaft drive system has been disturbed and the relationship between any chain and sprocket has been lost. If required, follow the left-hand secondary timing chain reinstallation procedure to reset the camshaft timing.

Primary and Left-hand Secondary Timing Chain Installation

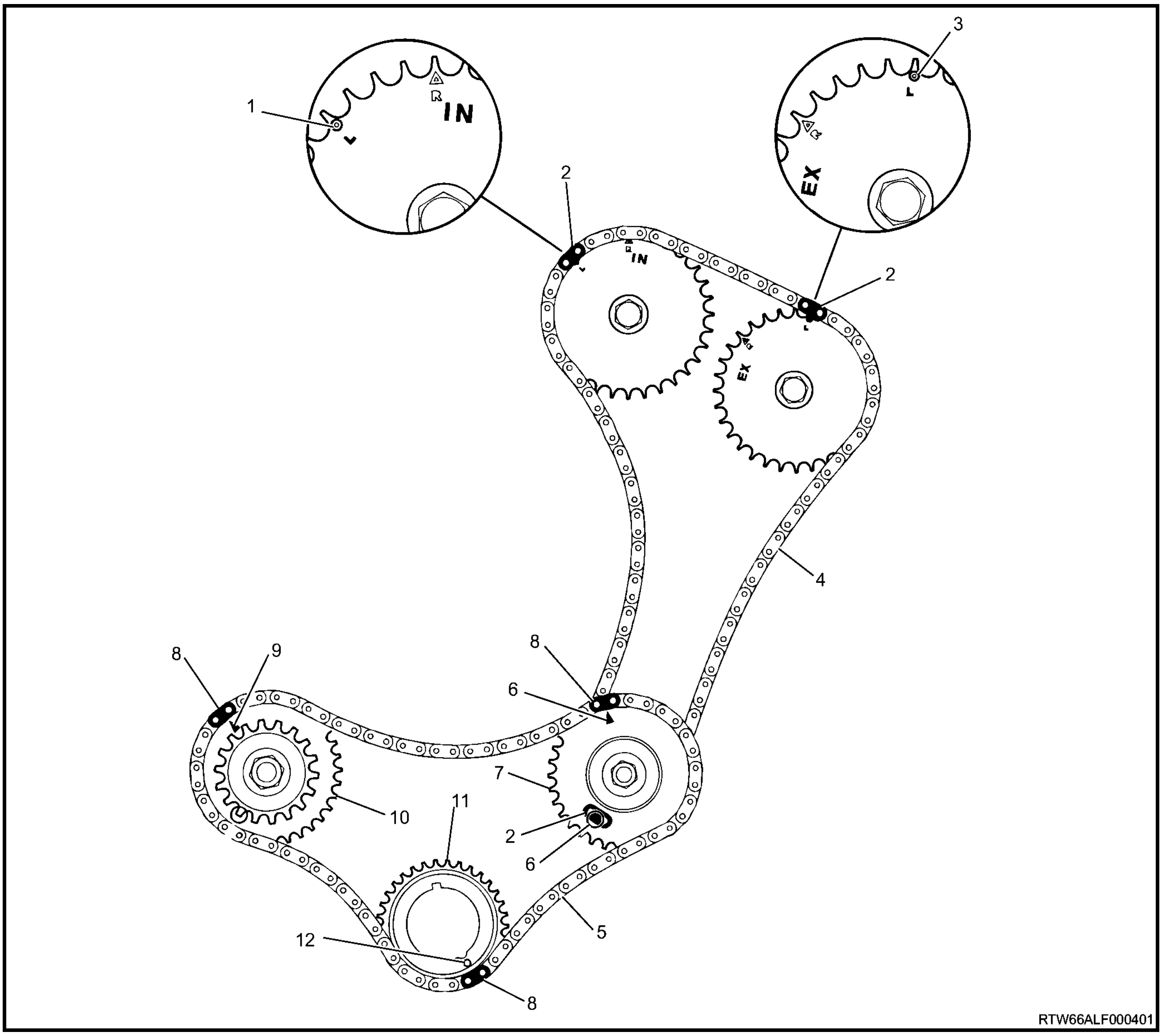


Figure 6A1 – 99

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain – Left-hand
5 Primary Timing Chain
6 Camshaft Intermediate Driveshaft Sprocket Timing Mark – Left-hand
7 Camshaft Intermediate Driveshaft Sprocket – Left-hand
8 Primary Timing Chain Bright Plated Link
9 Camshaft Intermediate Driveshaft Sprocket Timing Mark – Left-hand
10 Camshaft Intermediate Drive shaft Sprocket – Right-hand
11 Crankshaft Sprocket
12 Crankshaft Sprocket Timing Mark

Right-hand Secondary Timing Chain Installation

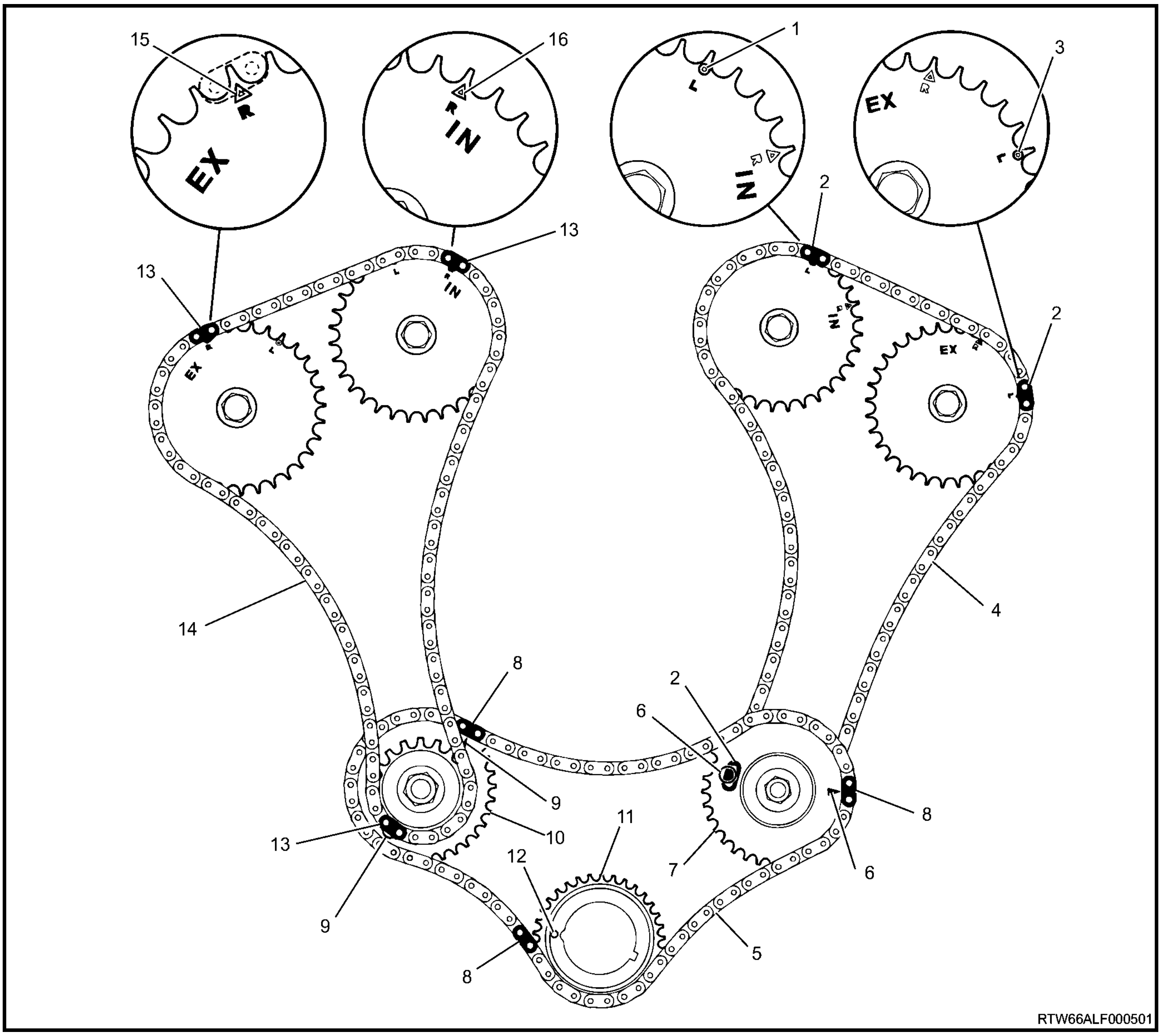


Figure 6A1 – 100

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain – Left-hand
5 Primary Timing chain
6 Camshaft Intermediate Drive Chain Sprocket Timing Mark – Left-hand
7 Primary Camshaft Intermediate Drive Chain Sprocket – Left-hand
8 Primary Timing Chain Bright Plated Link
9 Camshaft Intermediate Drive Chain Sprocket Timing Mark – Left-hand
10 Camshaft Intermediate Drive Chain Sprocket – Right-hand
11 Crankshaft Sprocket
12 Crankshaft Sprocket Timing Mark
13 Secondary Timing chain Bright Plated Link – Right-hand
14 Camshaft Intermediate Drive Chain – Right-hand
15 Exhaust Camshaft Sprocket Timing Mark - Right-side
16 Inlet Camshaft Sprocket Timing Mark - Right-side

Remove

Right-hand Secondary Timing Chain

CAUTION

After removing the upper intake manifold, and spark plugs, plug any openings to prevent dirt and other contaminants from entering.

1 Remove the engine front cover assembly, refer to 3.15 Front Cover Assembly.

2 Remove the spark plugs to aid crankshaft/engine rotation, refer to 6C1-3 Engine Management – V6 – Service Operations.

3 Install Tool No. EN46111 (1) onto the crankshaft (2).

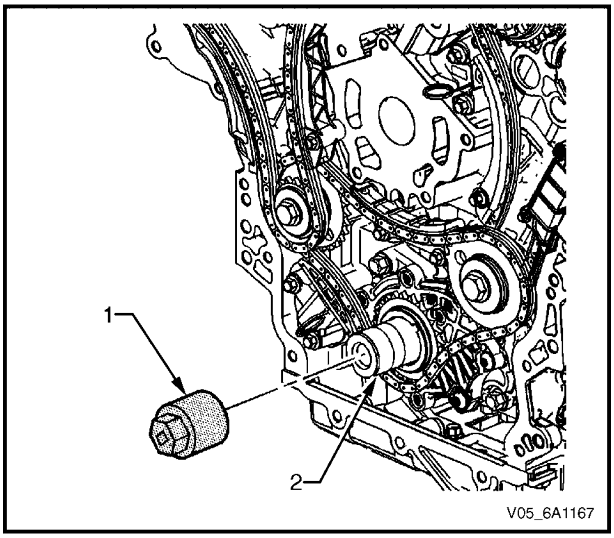


Figure 6A1 – 101

4 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

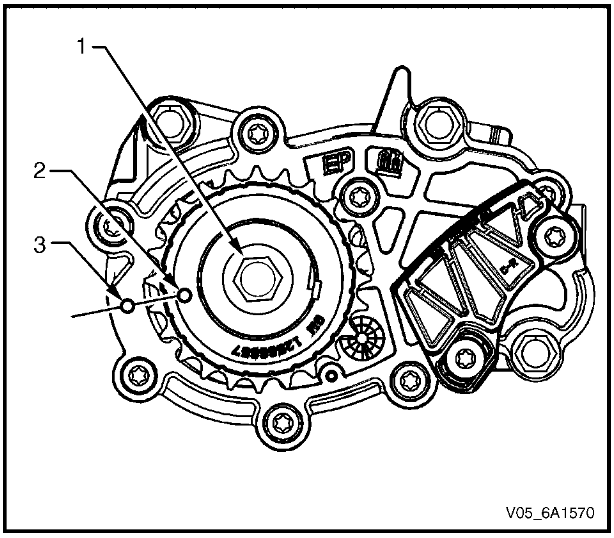


Figure 6A1 – 102

5 After aligning the crankshaft sprocket timing mark, check that the camshaft flats (1) at the rear of the right-hand cylinder head are parallel with the camshaft cover rail (2).

6 If the camshaft flats are not as shown, rotate the crankshaft 360 °.

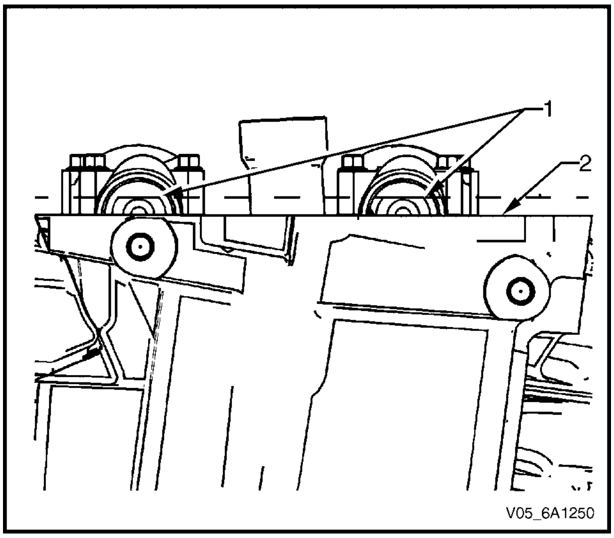


Figure 6A1 – 103

7 Install Tool No. EN 46105-1 (1) onto the rear of the right-hand cylinder head camshafts (2).

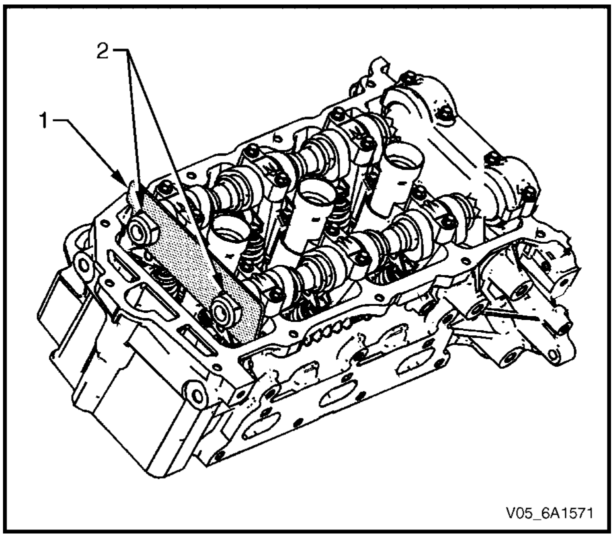


Figure 6A1 – 104

8 Install Tool No. EN 46105-2 (1) onto the rear of the left-hand cylinder head camshafts (2), and tool No

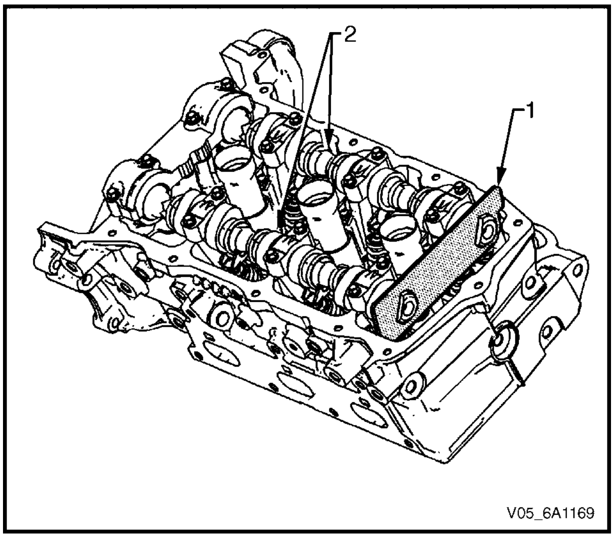


Figure 6A1 – 105

9 Remove the right-hand secondary timing chain tensioner bolts (1) and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

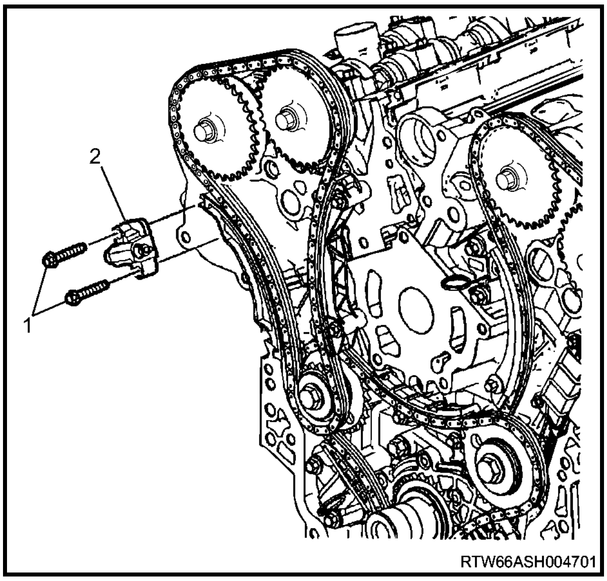


Figure 6A1 – 106

10 Remove the tensioner gasket (1) from the tensioner (2) and discard the gasket.

11 Inspect the tensioner mounting surface on the right-hand cylinder head for burrs or any defects that would affect the sealing of a new tensioner gasket.

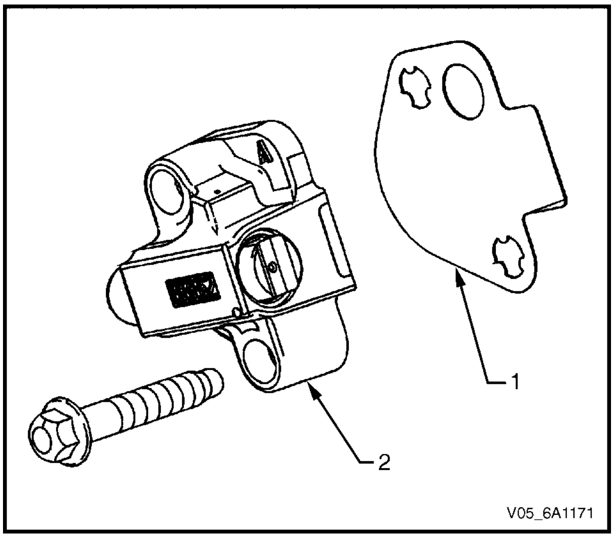


Figure 6A1 – 107

12 Remove the right-hand secondary timing chain shoe bolt (1).

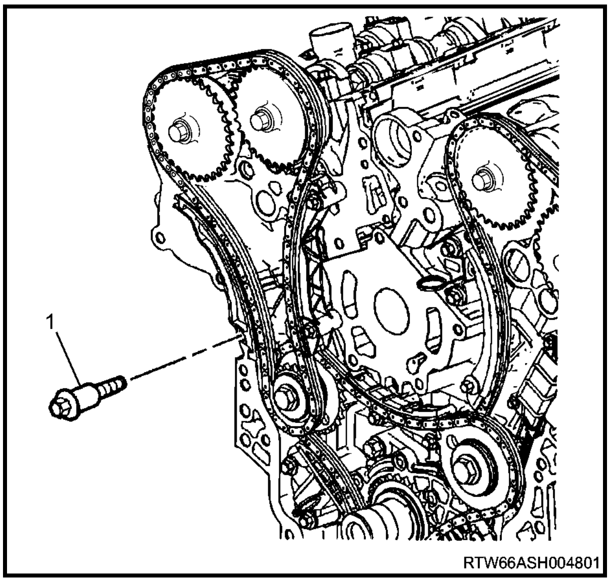


Figure 6A1 – 108

13 Remove the right-hand secondary timing chain shoe (1).

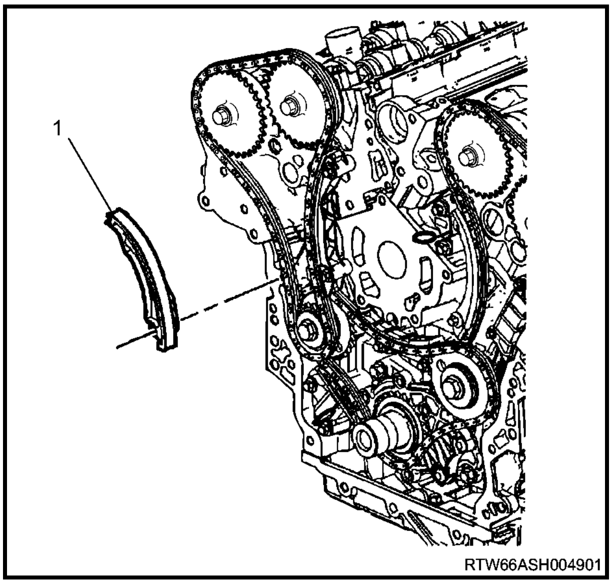


Figure 6A1 – 109

14 Remove the two right-hand secondary timing chain guide bolts (1) and remove the guide (2).

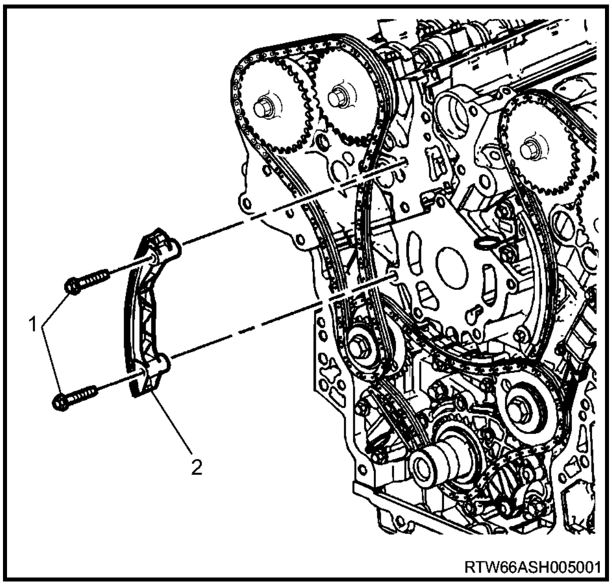


Figure 6A1 – 110

15 Remove the right-hand secondary timing chain (1) from the camshaft position actuators (2) and the camshaft intermediate driveshaft sprocket (3).

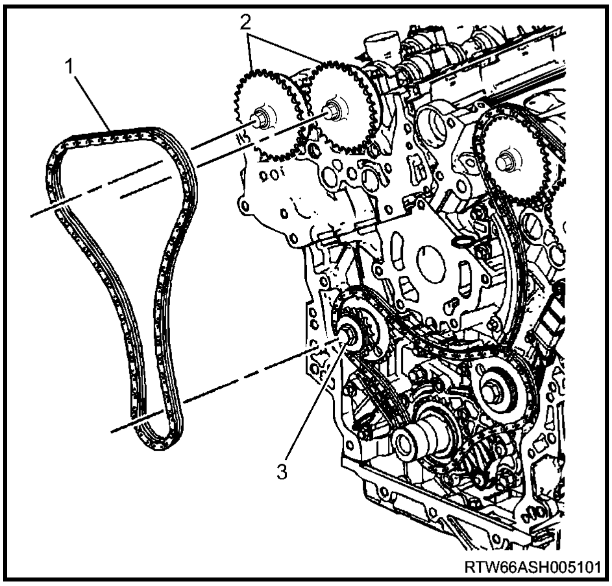


Figure 6A1 – 111

Primary Timing Chain

1 Remove the right-hand secondary timing chain, refer to Right-hand Secondary Timing Chain in this Section.

2 Remove the two primary timing chain tensioner bolts (1), and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

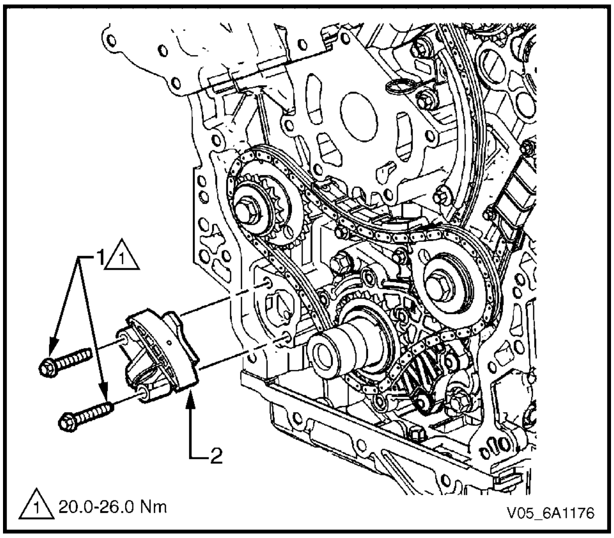


Figure 6A1 – 112

3 Remove the gasket (1) from the tensioner (2) and discard the gasket.

4 Inspect the primary timing chain tensioner mounting surface on the engine block for burrs or any defects that would affect the sealing of a new tensioner gasket.

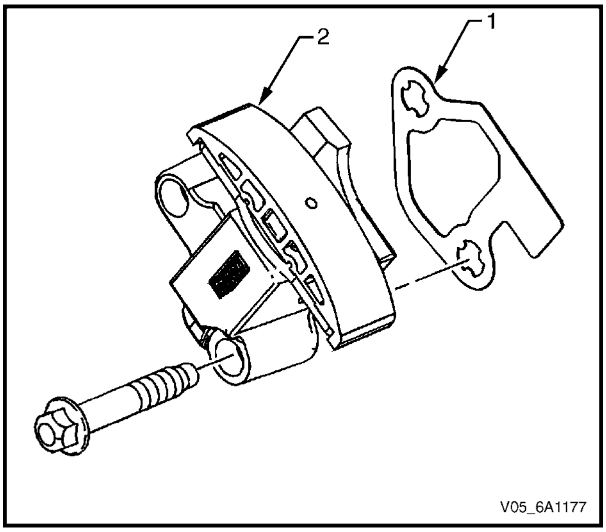


Figure 6A1 – 113

5 Remove the two primary timing chain upper guide bolts (1) and remove the guide (2).

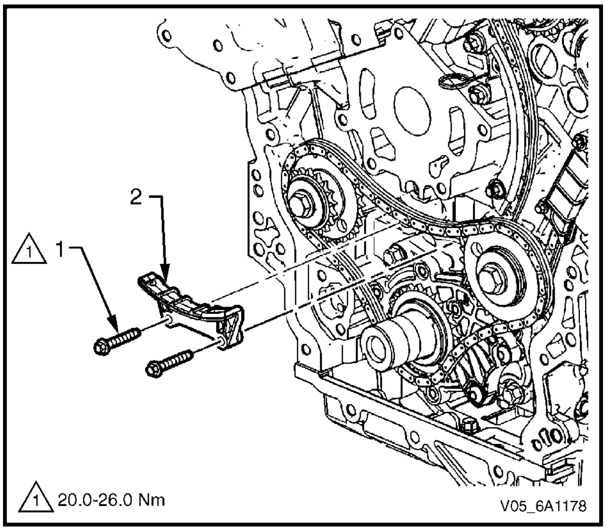
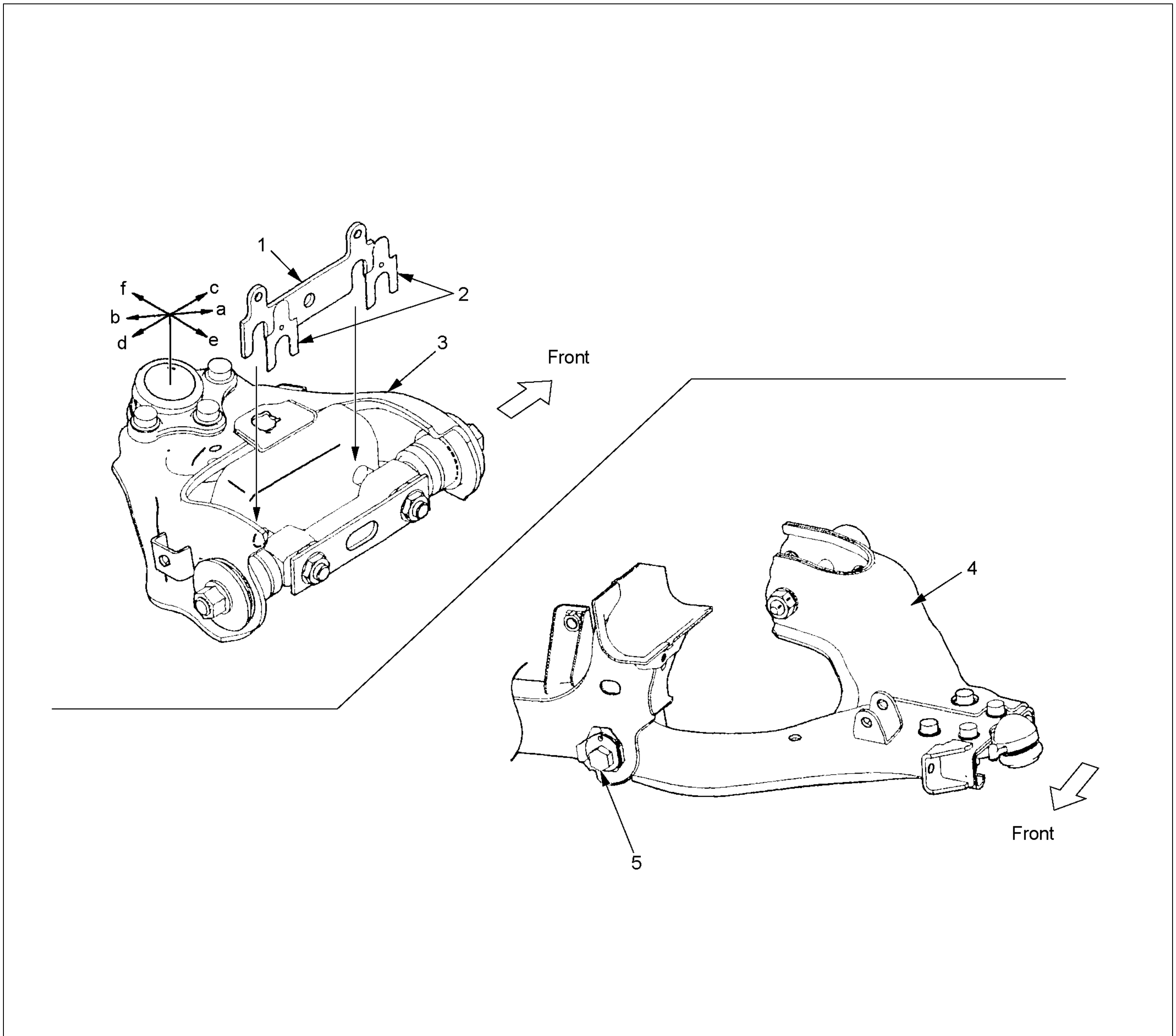


Figure 6A1 – 114

Alignment for 4×2 (High Ride Suspension) and 4×4

Caster and camber adjustment

The camber angle and caster angle can be adjusted by means of the camber shims and caster shims installed in position between the chassis frame and fulcrum pins.



RTW340LF001901

Legend

1. Camber shim
2. Caster shim
3. Upper link ASM LH
4. Lower link ASM LH
5. Adjusting cam

NOTE

Do not remove the primary timing chain lower guide (1). The primary timing chain lower guide is not serviced separately. If the primary timing chain lower guide requires replacement, the oil pump assembly (2) must be replaced.

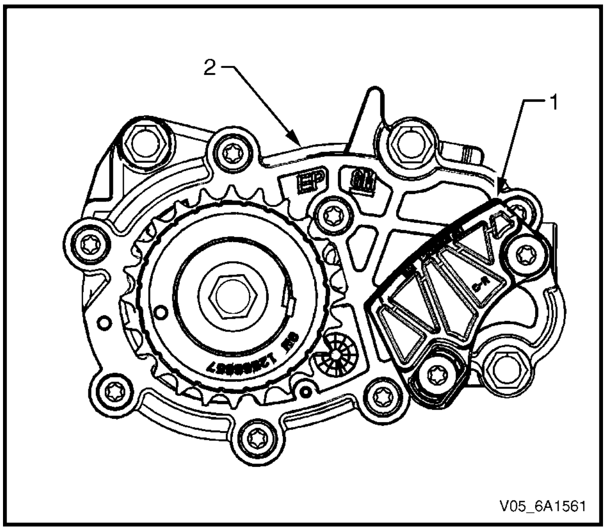


Figure 6A1 – 115

6 Remove the primary timing chain (1).

NOTE

For ease of removal, remove the chain from the crankshaft sprocket, before attempting to remove from the camshaft intermediate driveshaft sprockets.

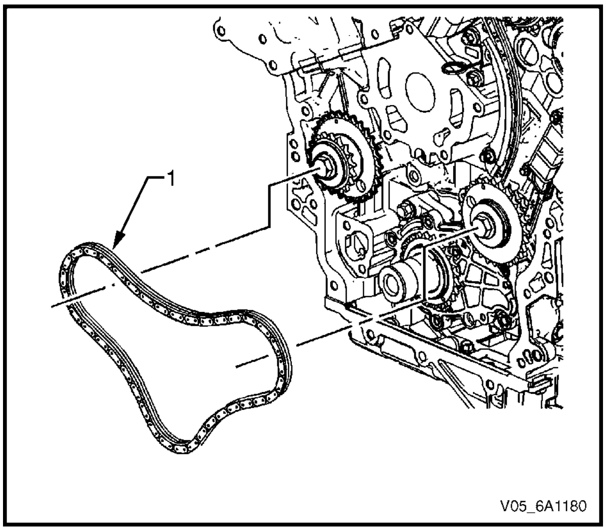


Figure 6A1 – 116

7 If required, remove the right-hand camshaft intermediate driveshaft sprocket bolt (1) and remove the sprocket (2).

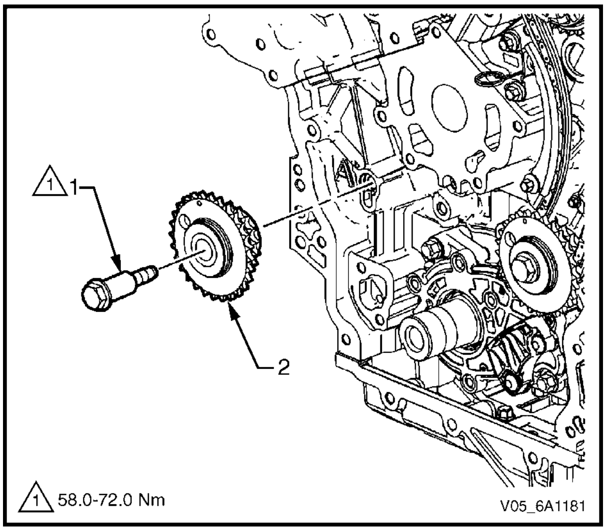


Figure 6A1 – 117

8 If required, remove the crankshaft sprocket (1) from the crankshaft (2).

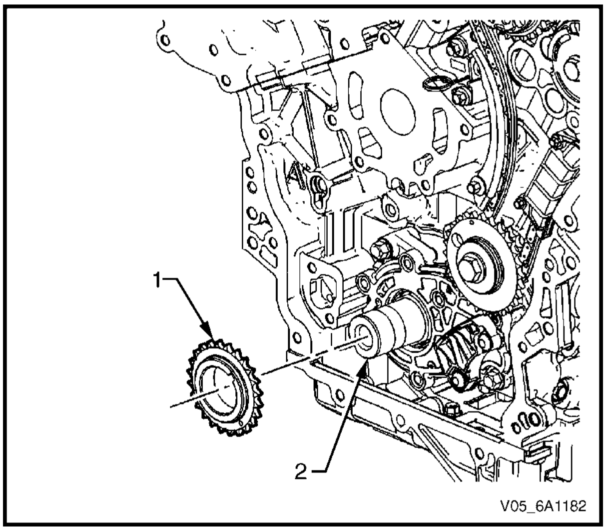


Figure 6A1 – 118

Left-hand Secondary Timing Chain

1 Remove the primary timing chain, refer to Primary Timing Chain in this Section.

2 Remove the two left-hand secondary timing chain tensioner bolts (1) and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

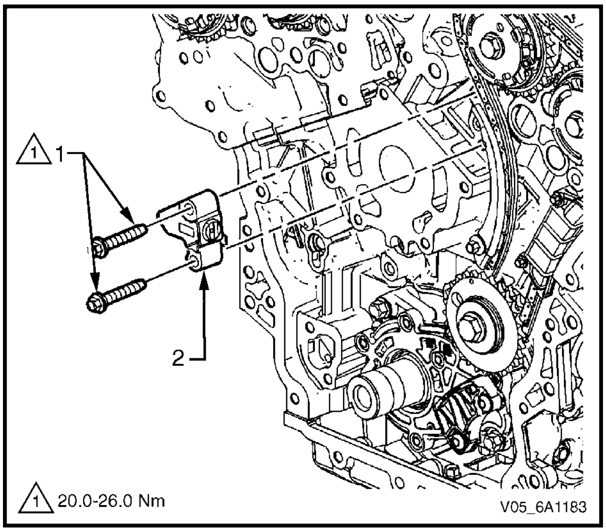


Figure 6A1 – 119

3 Remove the gasket (1) from the tensioner (2) and discard the gasket.

4 Inspect the tensioner mounting surface on the left-hand cylinder head for burrs or any defects that would affect the sealing of a new tensioner gasket.

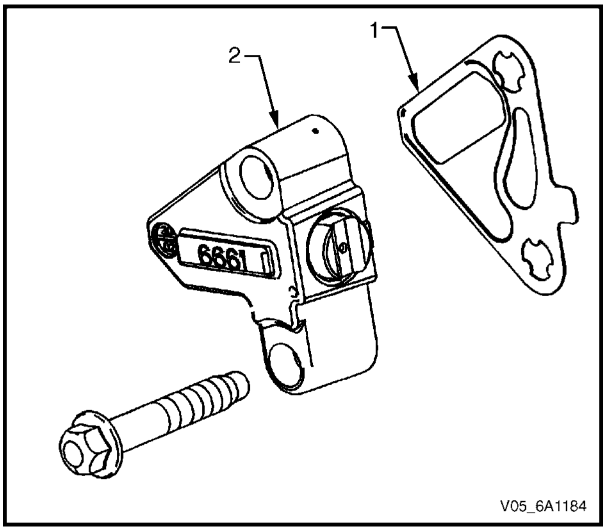


Figure 6A1 – 120

5 Remove the left-hand secondary timing chain shoe bolt (1).

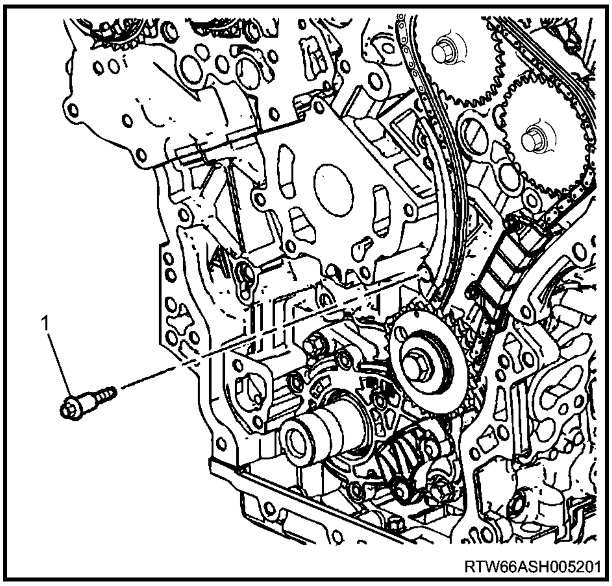


Figure 6A1 – 121

6 Remove the left-hand secondary timing chain shoe (1).

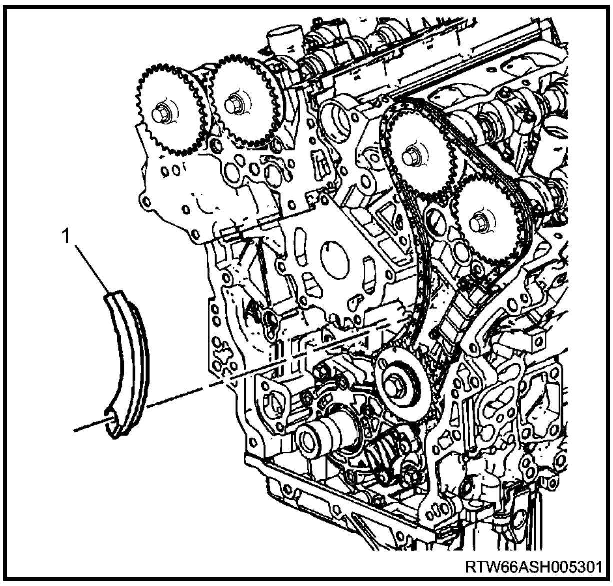


Figure 6A1 – 122

7 Remove the left-hand secondary timing chain guide bolt (1), two places, and remove the guide (2).

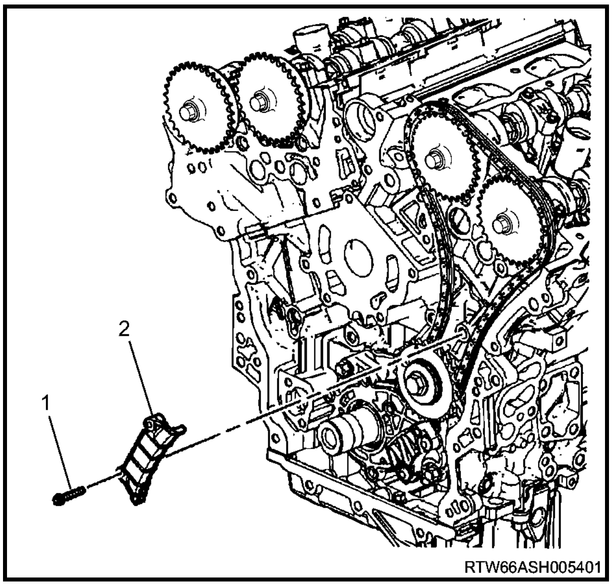


Figure 6A1 – 123

8 Remove the left-hand secondary timing chain (1) from the camshaft position actuators (2) and the camshaft intermediate driveshaft sprocket.

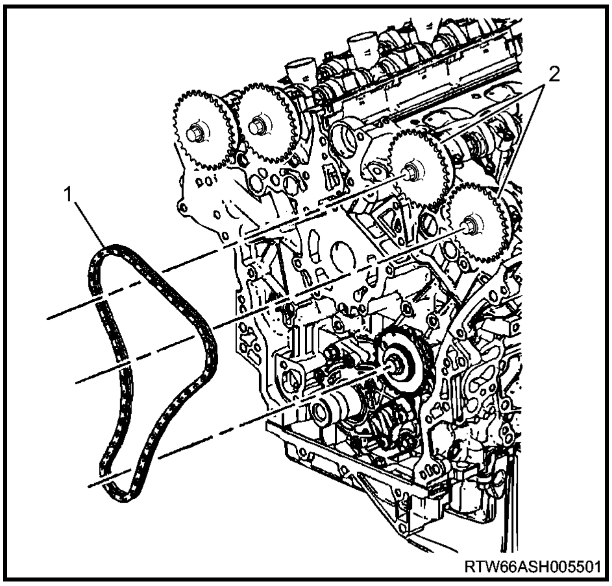


Figure 6A1 – 124

9 If required, remove the left-hand camshaft intermediate driveshaft sprocket bolt (1) and remove the sprocket (2).

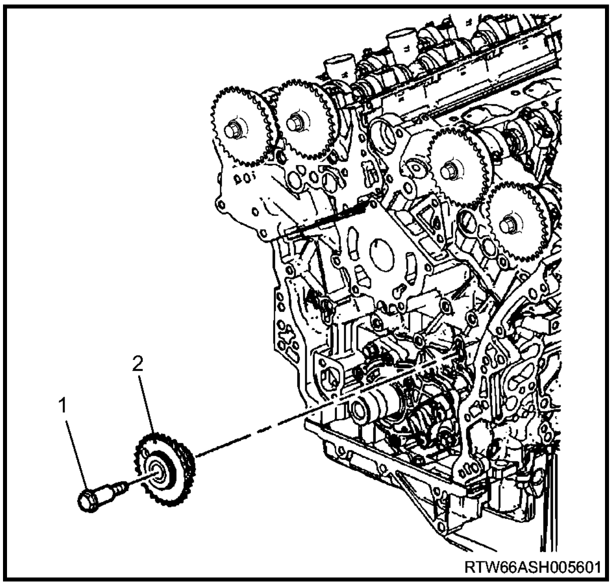


Figure 6A1 – 125

10 Remove Tool No. EN 46105-2 (1) from the left-hand cylinder head camshafts (2).

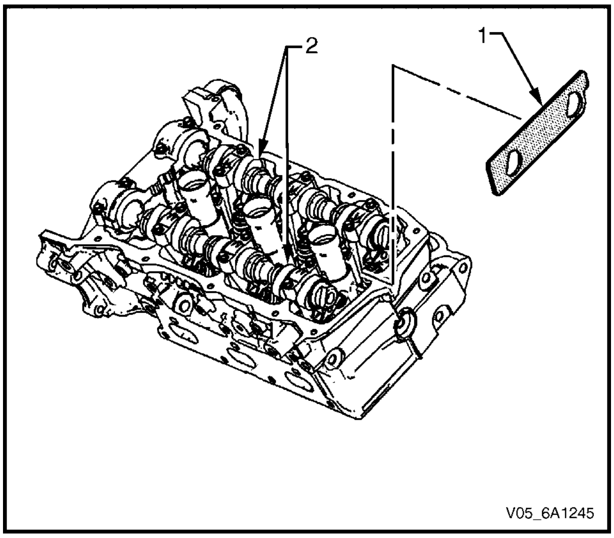


Figure 6A1 – 126

11 Remove Tool No. EN 46105-1 (1) from the right-hand cylinder head camshafts (2).

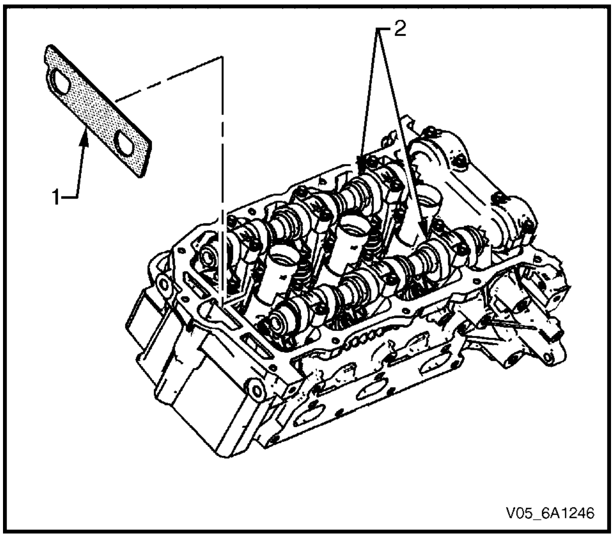


Figure 6A1 – 127

Clean

1 Clean all the following components with a suitable solvent:

- crankshaft sprocket,
- primary timing chain,
- primary timing chain guide,
- primary timing chain tensioner,
- secondary timing chains,
- secondary timing chain shoes,
- secondary timing chain guides,
- secondary timing chain tensioners, and
- bolts.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry all the components with compressed air.

Inspect

Timing Chains

1 Inspect the primary and/or secondary timing chains for the following:
   - binding or worn rollers (1),
   - loose links (2), and
   - loose pins (3).

2 Replace a damaged timing chain as required.

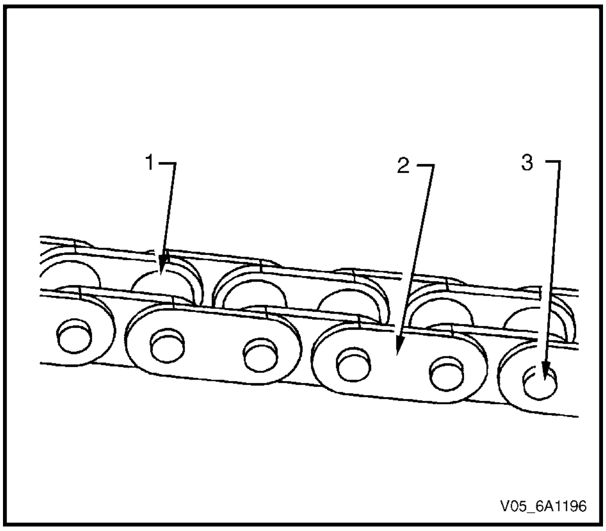


Figure 6A1 – 128

Camshaft Intermediate Driveshaft Sprockets

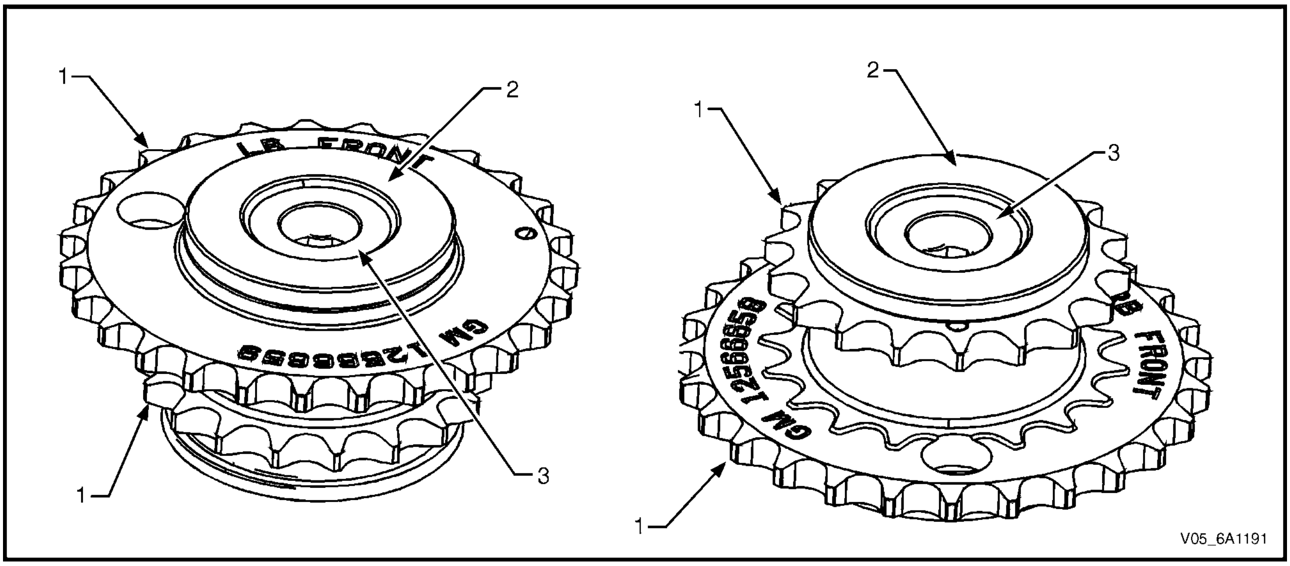


Figure 6A1 – 129

1 Inspect the camshaft intermediate driveshaft sprockets for the following:
   - Damage to the primary and secondary timing chain sprocket (1), refer to Figure 6A1 – 129.
   - Damage to the hub bearing (2). Ensure the hub bearing spins freely. If the hub bearing wobbles, is noisy or feels rough when rotated replace the camshaft intermediate sprocket, and
   - Damage to the bolt flange seating / sealing surface (3).
   - Damage to the bearing hub-to-engine block sealing surface.

Inlet and Exhaust Camshaft Sprocket

Inspect the camshaft sprocket assemblies, refer to 3.18 Camshaft Sprocket.

Crankshaft Sprocket

1 Inspect the crankshaft sprocket for the following:
- sprocket damage (1),
- bore damage (2),
- keyway damage (3), and
- damage to the cushion material (4).

2 Replace a damaged sprocket as required.

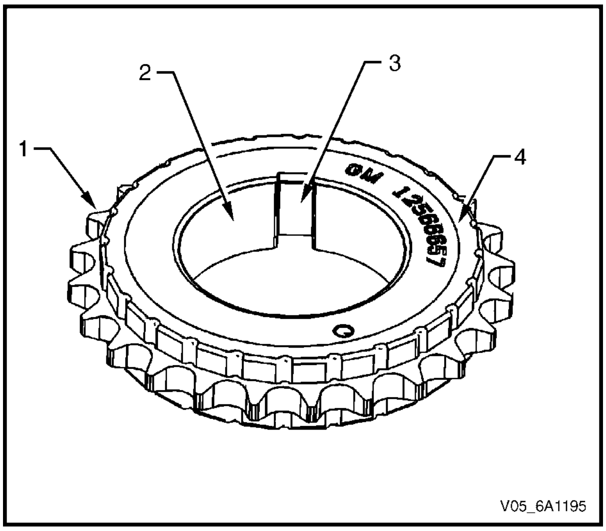


Figure 6A1 – 130

Primary Timing Chain Upper Guide

1 Inspect the primary timing chain upper guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

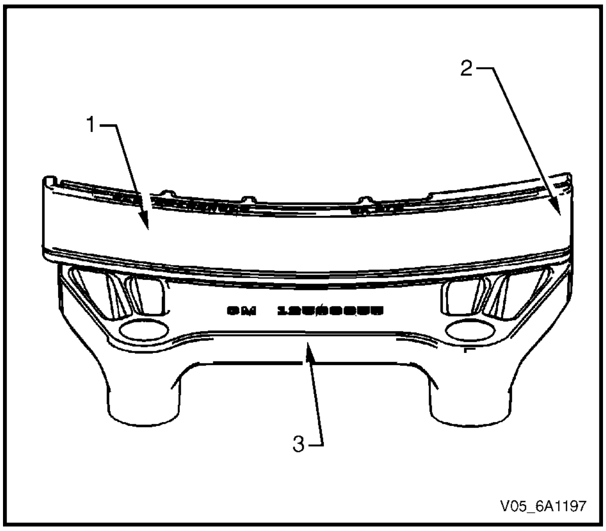


Figure 6A1 – 131

Primary Timing Chain Lower Guide

1 Inspect the primary timing chain lower guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace the primary timing chain lower guide by replacing the oil pump assembly, refer to 3.17 Oil Pump Assembly.

NOTE

The primary timing chain lower guide is not serviced separately and is part of the oil pump assembly.

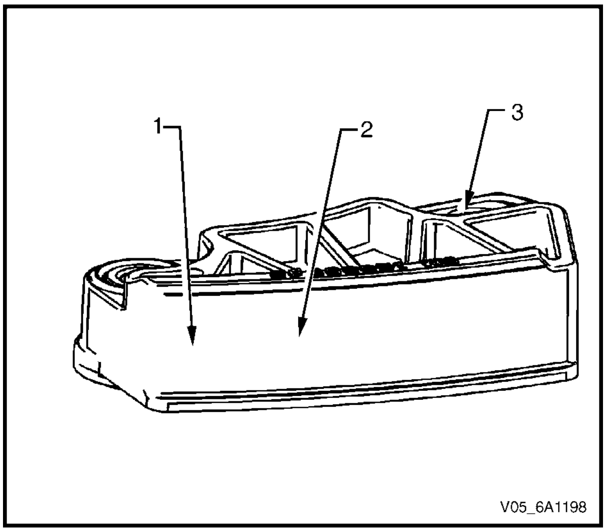


Figure 6A1 – 132

Primary Timing Chain Tensioner

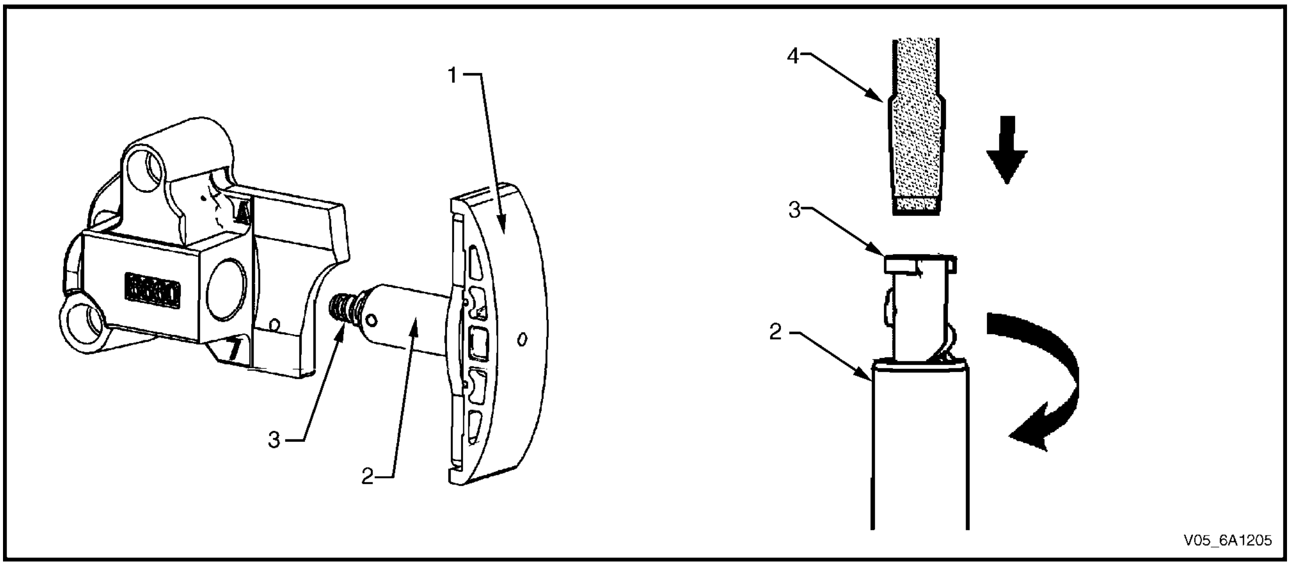


Figure 6A1 – 133

1 Inspect the primary timing chain tensioner for worn shoe surface (1), refer to Figure 6A1 – 133.

2 Inspect the tensioner for a locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

3 Replace a damaged tensioner as required.

Left-hand Secondary Timing Chain Guide

1 Inspect the left-hand secondary timing chain guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

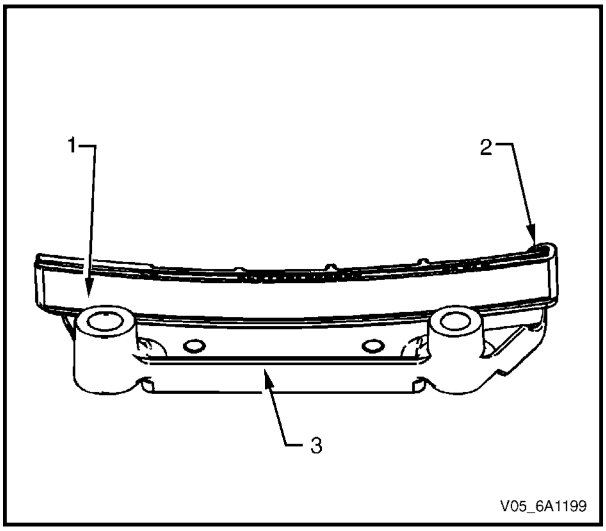


Figure 6A1 – 134

Left-hand Secondary Timing Chain Shoe

1 Inspect the front of the left-hand secondary timing chain shoe for the following:
- worn shoe surface (1),
- cracked or broken shoe surface (2), and
- cracked or damaged shoe (3).

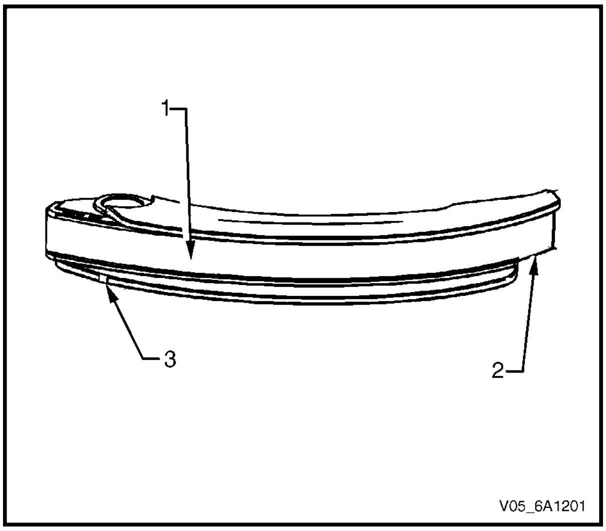


Figure 6A1 – 135

2 Inspect the back of the shoe for a damaged, worn or missing timing chain tensioner contact pad (1).

3 Replace a damaged shoe as required.

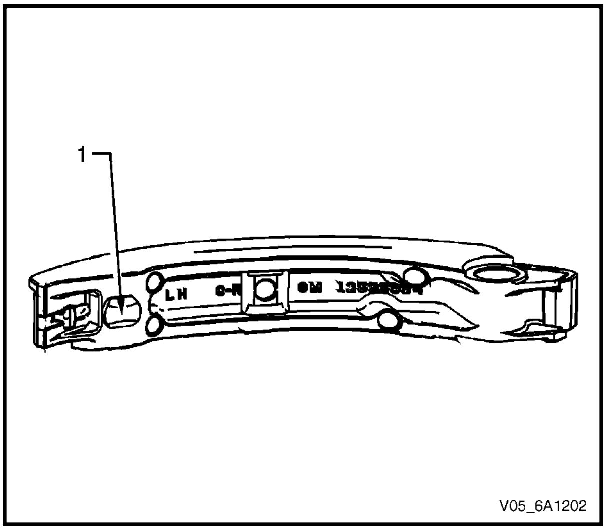


Figure 6A1 – 136

Left-hand Secondary Timing Chain Tensioner

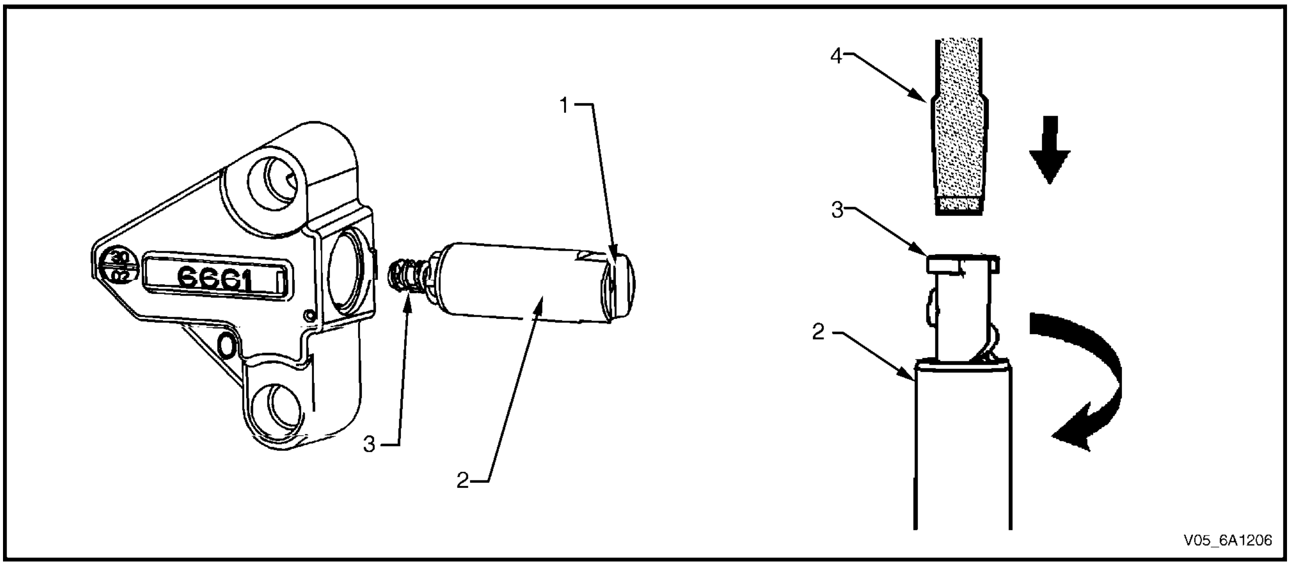


Figure 6A1 – 137

1 Inspect the left-hand secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1), refer to Figure 6A1 – 137.

2 Inspect the tensioner for locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

3 Replace a damaged tensioner as required.

Right-hand Secondary Timing Chain Guide

1 Inspect the right-hand secondary timing chain guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

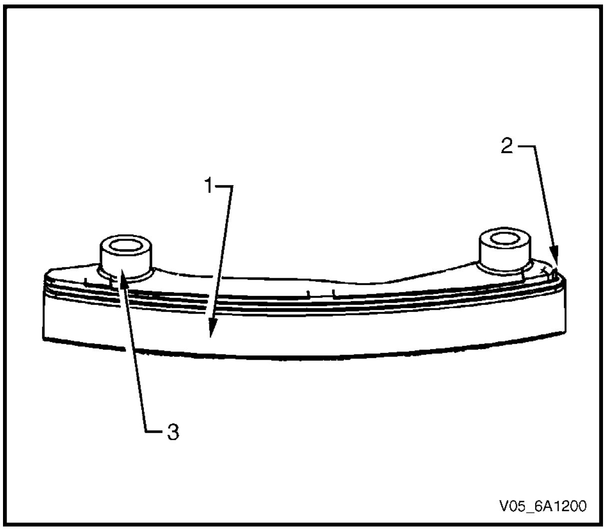


Figure 6A1 – 138

Right-hand Secondary Timing Chain Shoe

1 Inspect the front of the right-hand secondary timing chain shoe for the following:
- worn shoe surface (1),
- cracked or broken shoe surface (2), and
- cracked or damaged shoe (3).

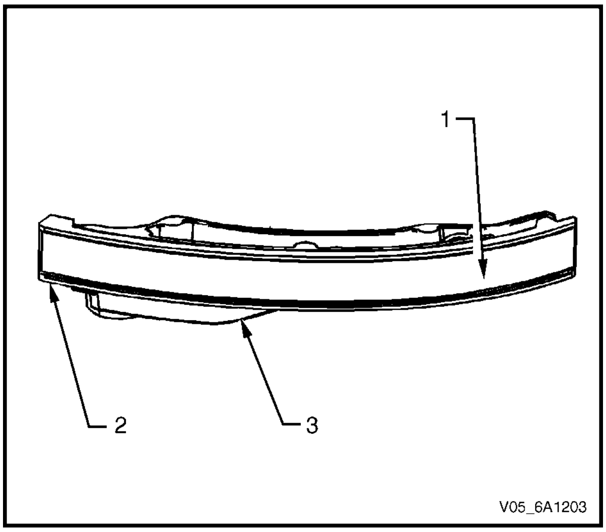


Figure 6A1 – 139

Adjustment Method

	addition / subtraction of shim		move direction of upper b/j	caster angle alteration	camber angle alteration
	front side	rear side			
caster adjustment	addition	subtraction	a	decrease	decrease (toward negative direction)
	subtraction	addition	b	increase	increase (toward positive direction)
	no change	subtraction	c	decrease	no alteration
	no change	addition	d	increase	no alteration
camber adjustment	addition		e	no alteration	decrease (toward negative direction)
	subtraction		f	no alteration	increase (toward positive direction)

Notes:

1. **Adjusting cam is at initial position (the hole & projection are upward as shown in a illustration) before a shim adjustment.**
2. **Difference of caster shim front/rear thickness should be 3.6mm(0.142in) or less.**
   Overall thickness of caster shim and camber shim should be 10.8mm(0.426in) or less.
3. **Make a combination in a such a way that the number of shims is at a minimum.**

Fulcrum Pin Bolt Torque	N·m (kgf·m/lb·ft)
152.0±15 (15.5±1.5 / 112.1±10.8)	

CASTER

3°10'±45'

Note:
Left and right side to be equal within 30'.

CAMBER

0°±30'

Note:
Left and right side to be equal within 30'.

KING PIN INCLINATION

12°30'±30'

2 Inspect the back of the shoe for a damaged, worn or missing timing chain tensioner contact pad (1).

Replace a damaged shoe as required.

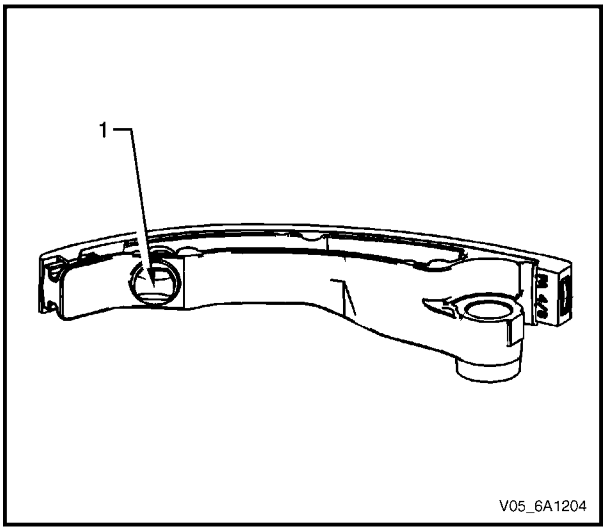


Figure 6A1 – 140

Right-hand Secondary Timing Chain Tensioner

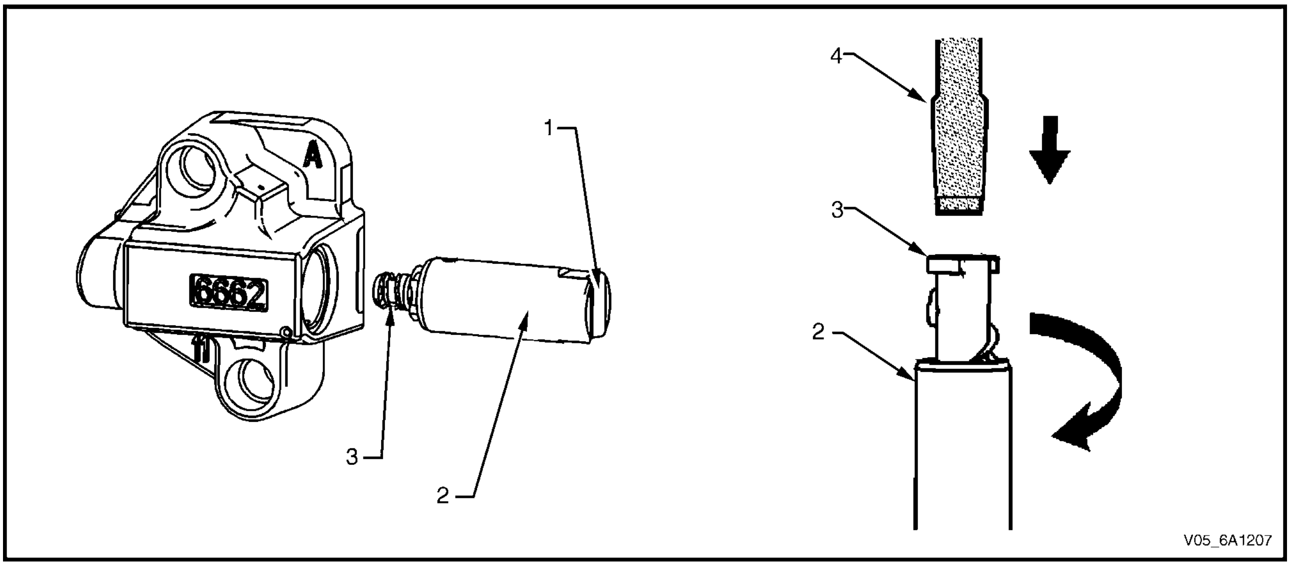


Figure 6A1 – 141

1 Inspect the right-hand secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1), refer to Figure 6A1 – 141.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

2 Inspect the tensioner for a locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

3 Replace a damaged tensioner as required.

Reinstall

Left-hand Secondary Timing Chain Components

1 Install the crankshaft sprocket (1) onto the crankshaft (2) by aligning the keyway to the key on the crankshaft.

2 Slide the crankshaft sprocket on the crankshaft until the crankshaft sprocket contacts the step in the crankshaft.

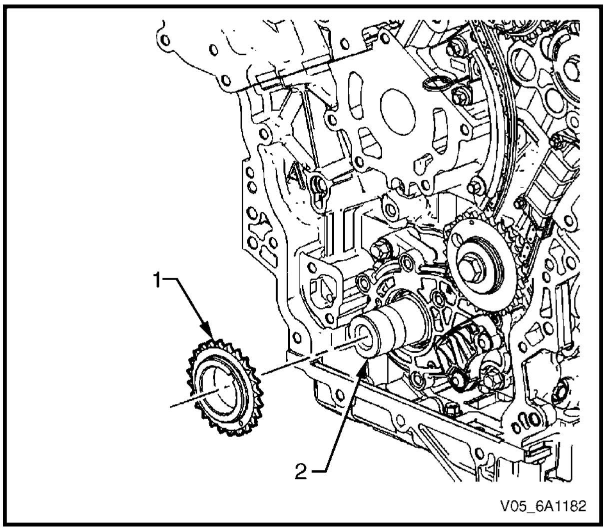


Figure 6A1 – 142

NOTE

Ensure that the crankshaft sprocket is installed with the timing mark (1) visible.

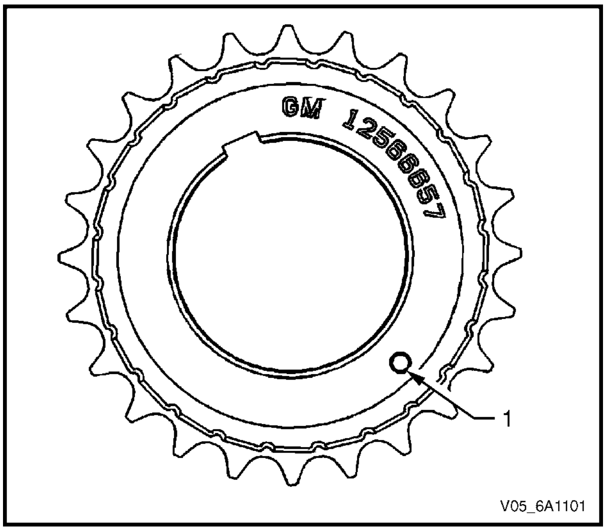


Figure 6A1 – 143

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts in an anti-clockwise direction. There should be no need to rotate the camshaft more than 45 degrees.

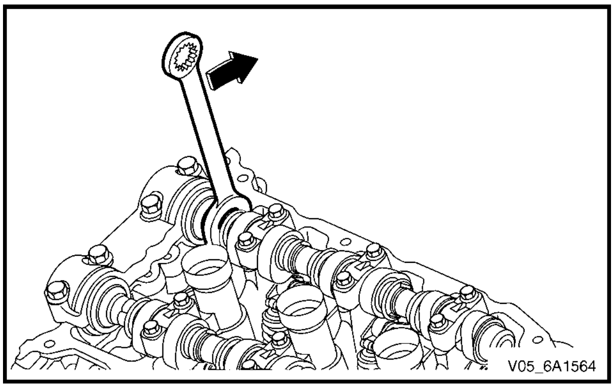


Figure 6A1 – 144

3 Install Tool No. EN 46105-1 (1) onto the rear of the left-hand cylinder head camshafts (2), and Tool No. EN 46105-2 onto the rear of the right-hand cylinder head camshafts.

4 Ensure that Tool No. EN 46105 is fully seated onto the camshafts.

CAUTION

All camshafts must be locked in place before installation of any timing chains.

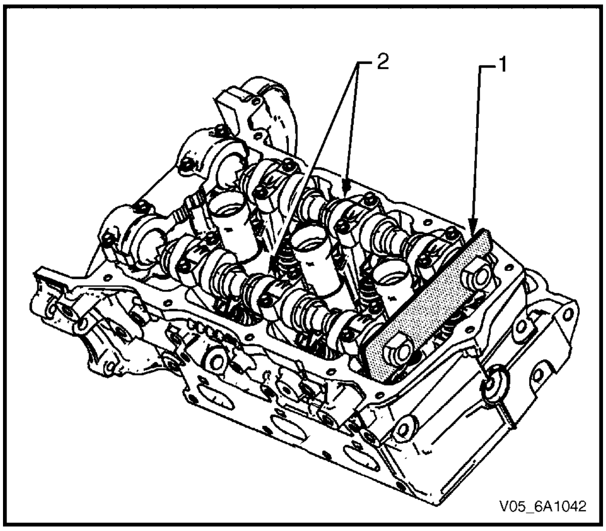


Figure 6A1 – 145

5 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

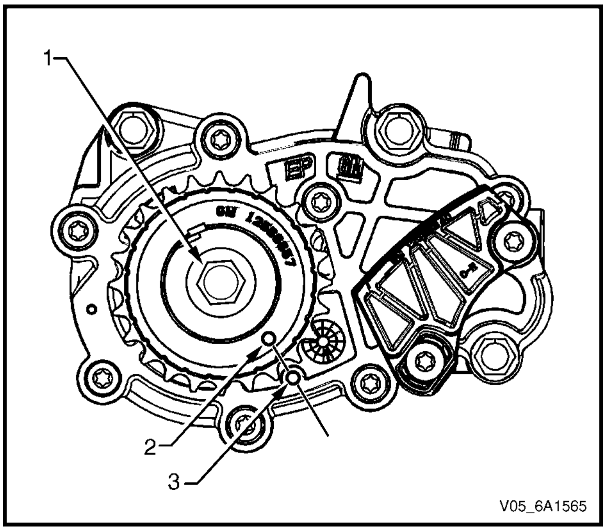


Figure 6A1 – 146

6 Install the left-hand secondary timing chain (1) aligning the chain in the following manner:

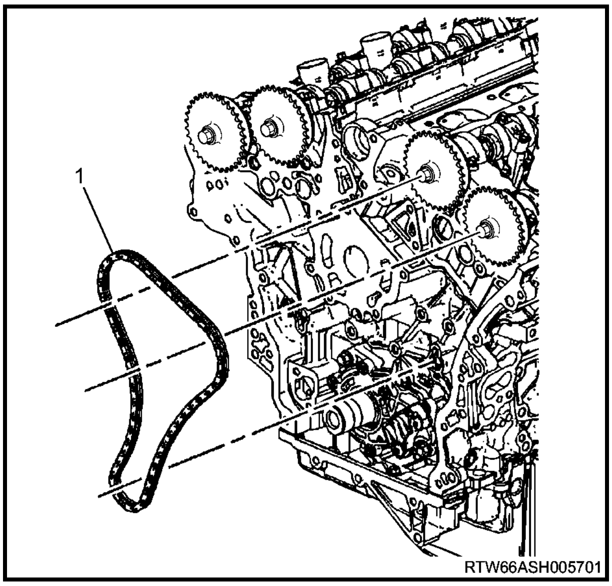


Figure 6A1 – 147

7 Wrap the secondary timing chain around both left-hand camshaft drive sprockets.

8 Ensure there are two bright links located on top of each of the camshaft actuator sprockets.

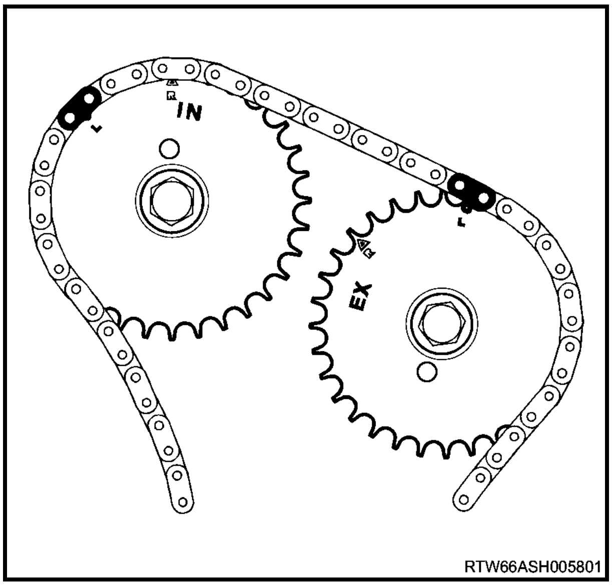


Figure 6A1 – 148

CAUTION

When aligning the left-hand secondary timing chain to the camshaft actuator sprockets, ensure the circular timing marks on the sprocket are used, NOT the triangular mark.

9 Align the bright plated timing chain link (1) with the left-hand exhaust camshaft position actuator sprocket alignment circle mark (2).

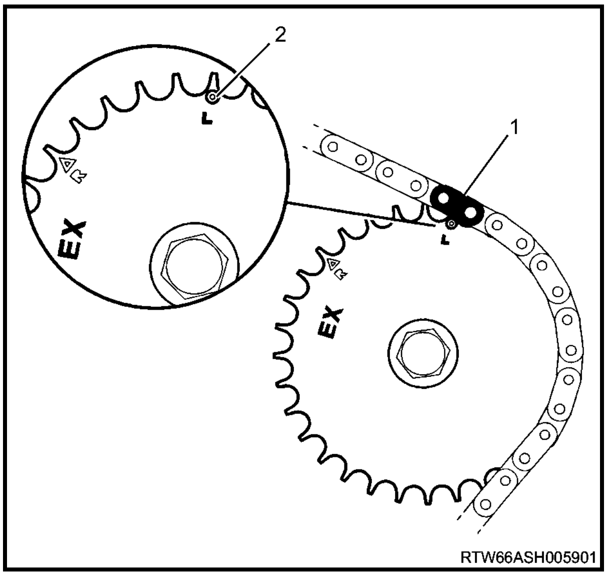


Figure 6A1– 153

10 Align the bright plated timing chain link (1) with the intake camshaft position actuator sprocket alignment circle mark (2).

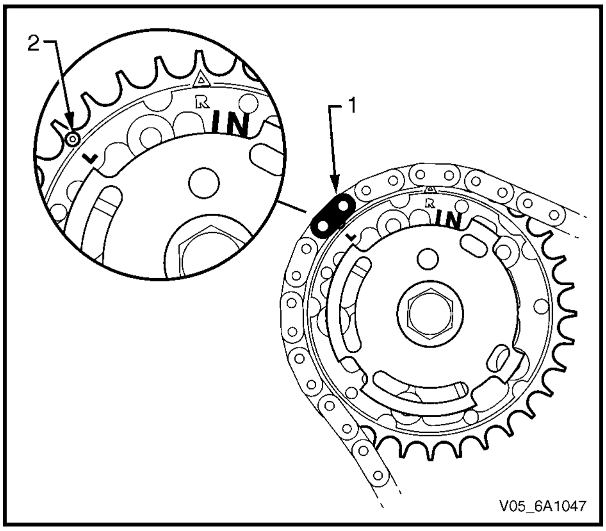


Figure 6A1 – 149

11 Ensure the left-hand camshaft intermediate driveshaft sprocket is selected and orientated correctly.

CAUTION

The left-hand camshaft intermediate driveshaft sprocket (1) is marked with the letters LB and 'FRONT', and the right-hand sprocket (2) is marked with the letters RB and 'FRONT' Ensure the correct sprocket is used and the 'FRONT' text is facing forwards when installed.

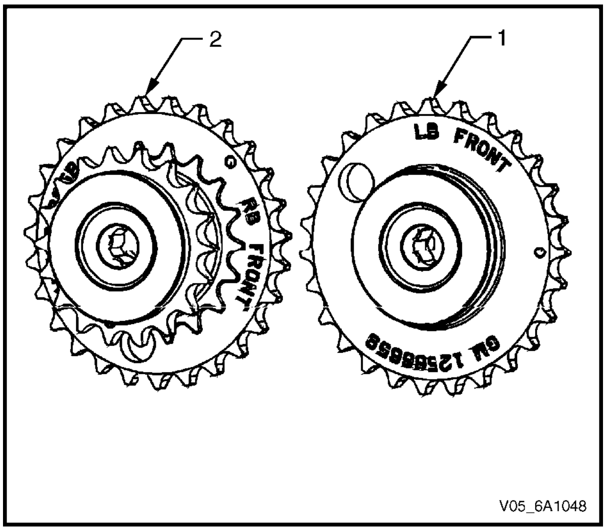


Figure 6A1 – 150

12 Place the left-hand secondary timing chain around the left-hand camshaft intermediate driveshaft inner sprocket, with the bright plated timing chain link (1) aligned with the access hole (2) in the outer sprocket.

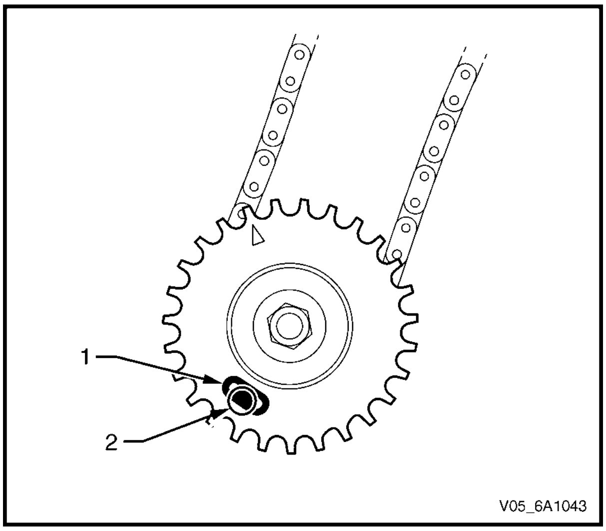


Figure 6A1 – 151

13 Install the left-hand camshaft intermediate driveshaft sprocket to the cylinder block.

14 Install the driveshaft sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate driveshaft sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

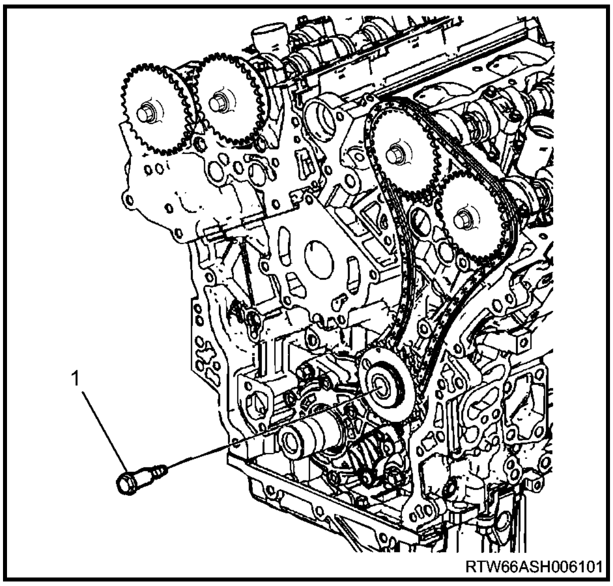


Figure 6A1 – 152

15 Verify the left-hand secondary timing chain timing mark alignments (1 to 6)

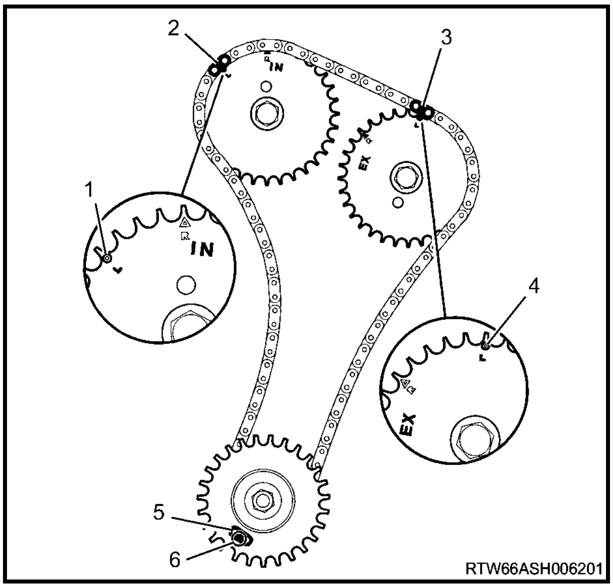


Figure 6A1 – 153

16 Ensure the left-hand secondary timing chain guide is selected and orientated correctly.

CAUTION

The left-hand secondary timing chain guide is marked with the letters LH. Ensure the correct shoe is used when installing to the left-hand side in this procedure and that the letters 'LH" are facing the front of the vehicle when installed.

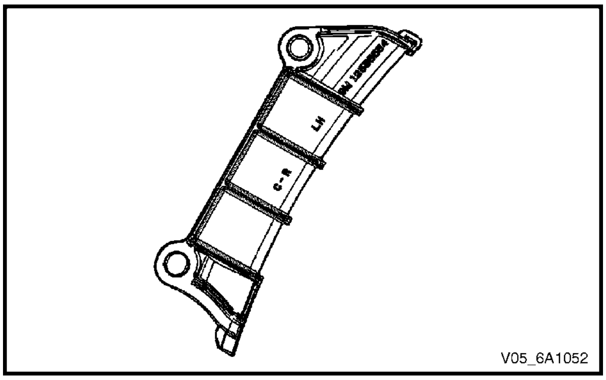


Figure 6A1 – 154

17 Install the left-hand secondary timing chain guide (1).

18 Install the secondary timing chain guide bolts (2) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification...........20.0 – 26.0 Nm

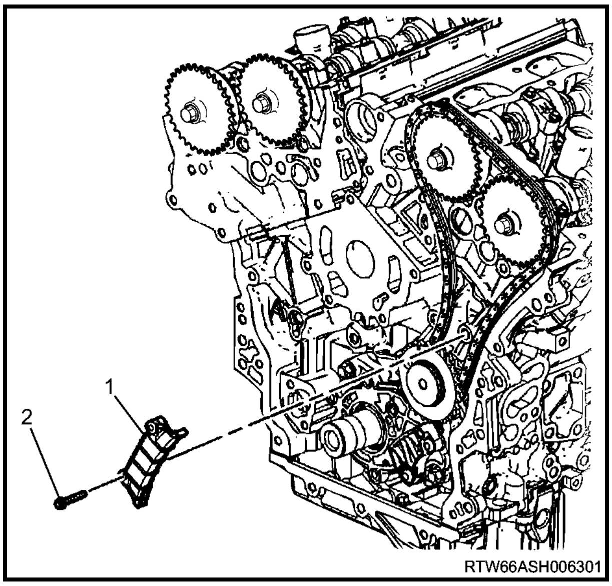


Figure 6A1 – 155

19 Ensure the left-hand secondary timing chain shoe is selected and orientated correctly.

CAUTION

The left-hand secondary timing chain shoe is marked with the letters LH on the back face of the timing chain shoe. Ensure the correct shoe is used when installing to the left-hand side.

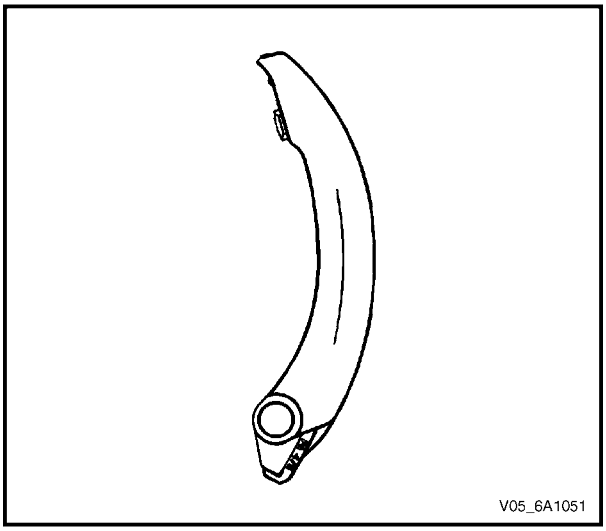


Figure 6A1 – 156

20 Install the left-hand secondary timing chain shoe (1).

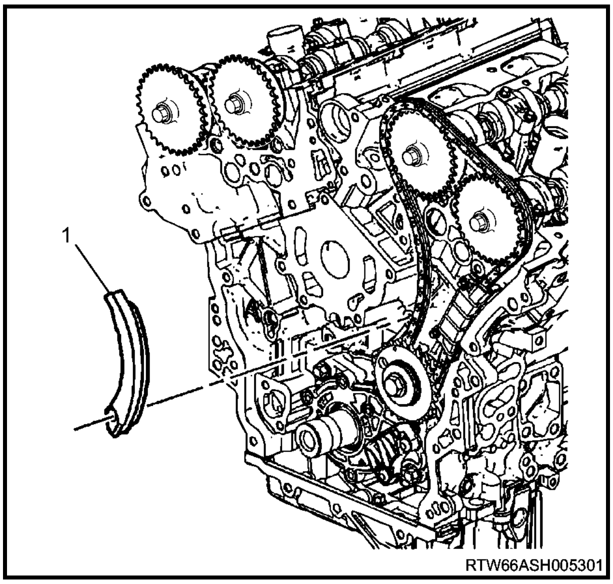


Figure 6A1 – 157

21 Install the left-hand secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

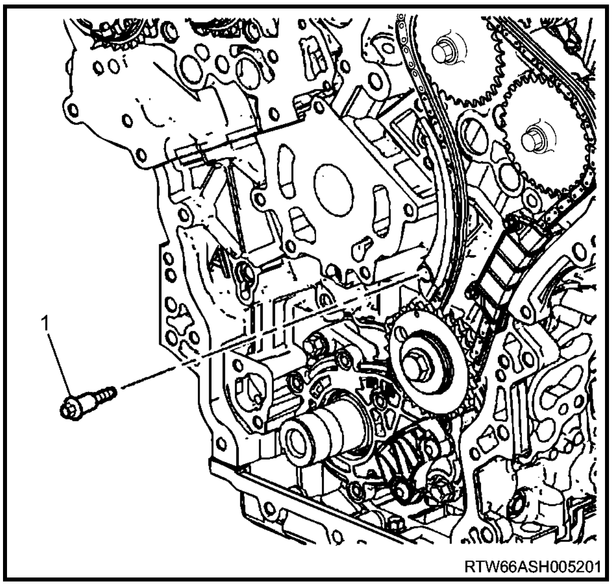


Figure 6A1 – 158

NOTE

Ensure secondary timing chain shoe is clear of the left-hand secondary timing chain tensioner mounting pad, before tightening the attaching bolt.

Secondary timing chain shoe attaching bolt torque specification ....20.0 – 26.0 Nm

22 Ensure the left-hand secondary timing chain tensioner is selected and orientated correctly.

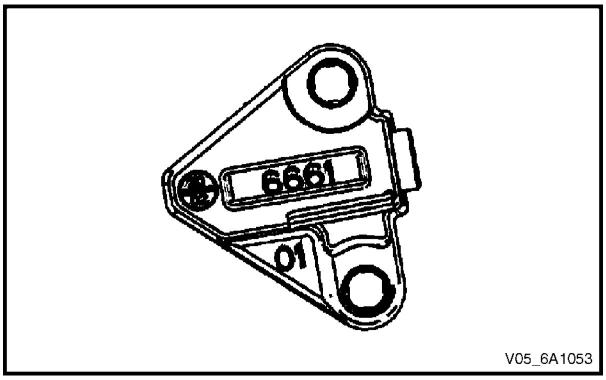


Figure 6A1 – 159

23 Reset the left-hand secondary timing chain tensioner.

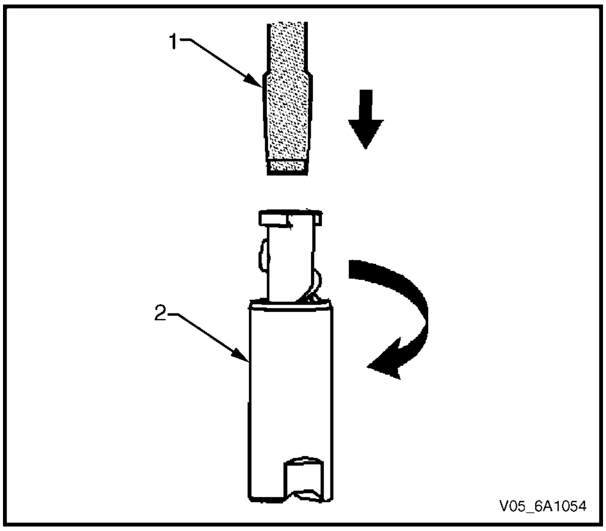


Figure 6A1 – 160

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

24 Install the tensioner shaft (1) into the left-hand secondary timing chain tensioner body (2).

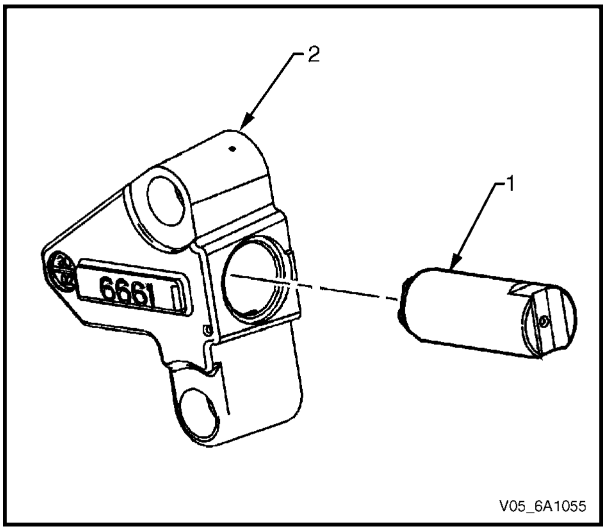


Figure 6A1 – 161

25 Compress the tensioner shaft into the body and lock the left-hand secondary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

26 Slowly release pressure on the left-hand secondary timing chain tensioner. The tensioner should remain compressed.

CAUTION

If Tool No. EN 46112 (1) is not removed from the tensioner body (2), the tensioner shaft (3) will remain in the locked position and no tension will be placed on the timing chain, this will cause damage to the engine.

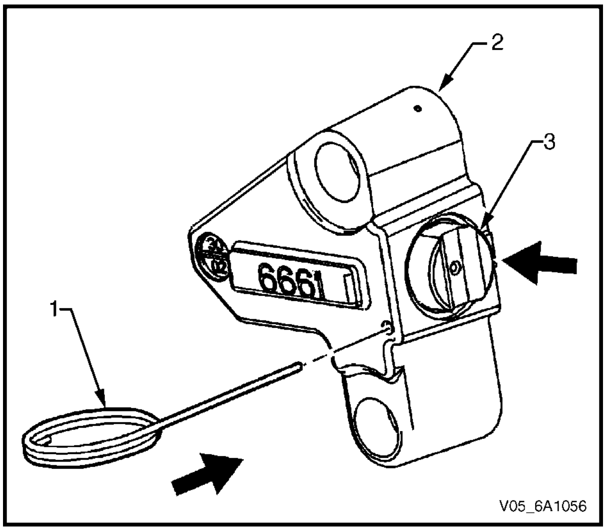


Figure 6A1 – 162

27 Install a new left-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

28 Install the left-hand secondary timing chain tensioner bolts through tensioner and gasket.

29 Ensure the left-hand secondary timing chain tensioner mounting surface on the left-hand cylinder head does not have any burrs or defects that would affect the sealing of the new gasket.

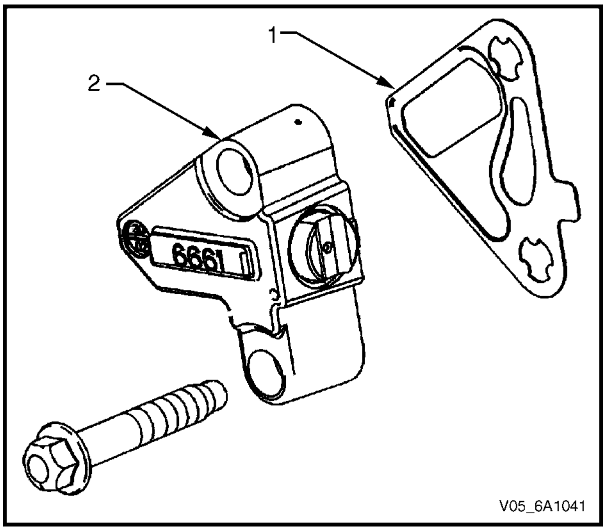


Figure 6A1 – 163

30 Place the left-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the cylinder head.

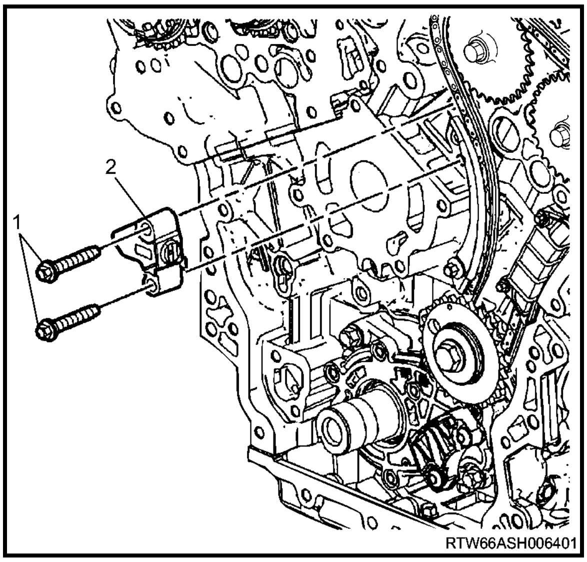


Figure 6A1 – 164

31 Verify the proper placement of the left-hand secondary timing chain tensioner gasket tab (1).

32 Tighten the left-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

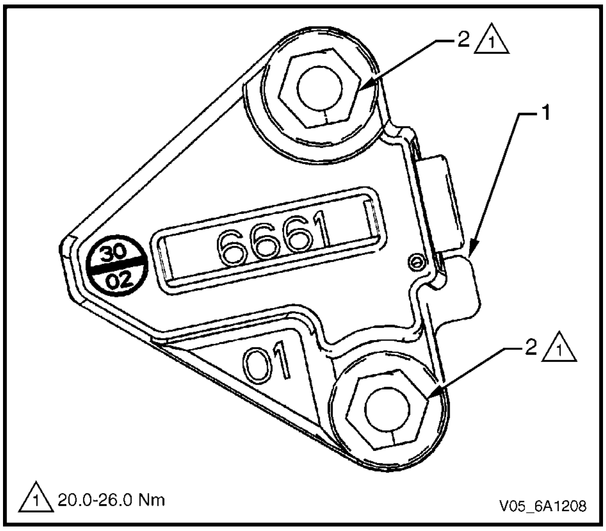


Figure 6A1 – 165

33 Release the left-hand secondary timing chain tensioner (1) by pulling out Tools No. EN 46112 (2) and unlocking the tensioner shaft.

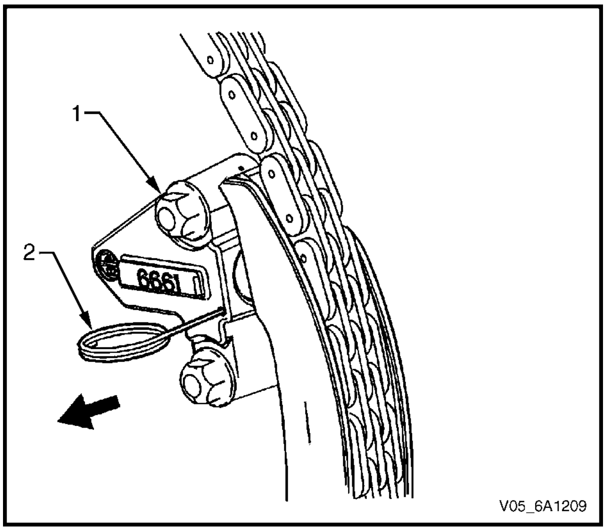
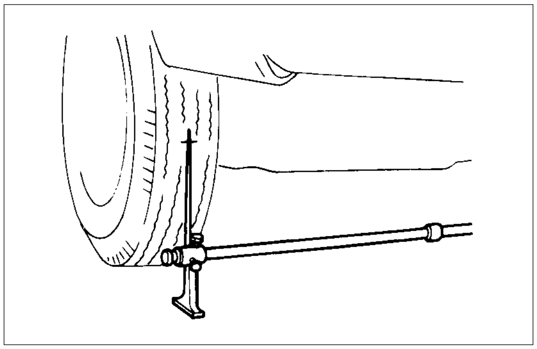


Figure 6A1 – 166

I : Inspect and correct or replace as necessary   A : Adjust
R : Replace or change   T : Tighten to specified torque   L : Lubricate

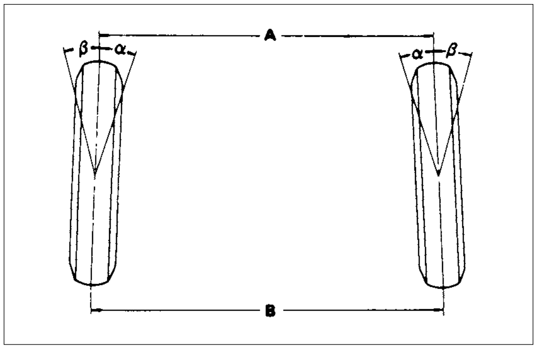
SERVICE INTERVAL: × 1,000 km	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
(Use odometer reading or × 1,000 miles	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
months whichever comes first) or months	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120
SERVICE BRAKES																				
Brake fluid	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Brake system for fluid leakage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Brake function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
* Front disc brake pads and discs wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
* Rear brake lining and drum wear	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Brake pedal travel and play	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Pipes and hoses for loose connections or damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
PARKING BRAKE																				
Parking brake function	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Parking brake lever travel	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Cables for looseness or damage and guide for damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Ratchet for wear or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
SUSPENSION																				
Leaf/Coil/Torsion bar springs for damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Mount for looseness or damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorbers for oil leakage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Shock absorbers mount for looseness	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Rubber bushes of suspension wear or damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	-	-	I
Spring action for loss of balance due to weakening	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	I	-	I
Joint ball rubber boot for damage	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
WHEELS																				
Wheel nuts	T	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T	-	T
Wheel disc for damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Front hub bearing grease	-	-	-	-	-	R	-	-	-	-	-	R	-	-	-	-	-	R	-	-
Front and rear hub bearings for looseness	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire pressure and damage	I	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
Tire rotation	(Rotate as required)																			
OTHERS																				
Bolts and nuts on chassis and body	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I	-	-	-	I
Lube front free - wheeling hubs	-	-	-	-	-	-	-	L	-	-	-	-	-	-	-	L	-	-	-	-



Toe-in Adjustment

Measurement should be taken with the vehicle on a surface plate.
If a surface plate is not available, toe-in should be checked with the vehicle parked on a level floor.

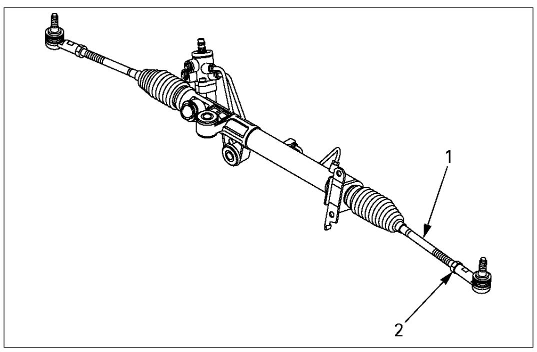
1. Set front wheels to straight ahead position.
2. Align the toe-in gauge with center height of each wheel at front end.
3. Apply center marks to each wheel, then take measurement of distance A between the center marks on each wheel.
4. Slowly move the vehicle rearward until the center marks reach the rear end position.
5. Take measurement of distance B between the center marks at rear end.



The toe-in can be calculated with the following formula.
Toe-in = B - A

Toe-in mm (in)

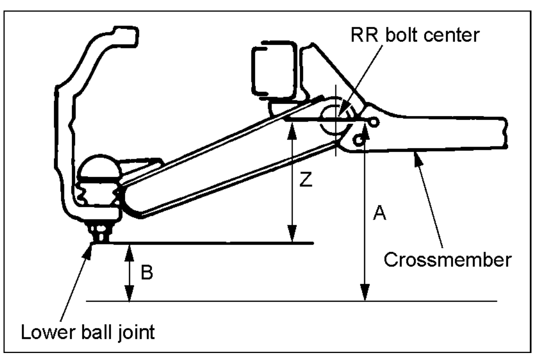
4×2 (High ride suspension) 4×4	0±2 (0±0.08)



To adjust the toe-in angle, loosen the lock nuts (2) on the tie rod (1) and turn the tie rod. Turn both rods the same amount, to keep the steering wheel centered.

Lock Nut Torque N·m (kgf·m/lb·ft)

98±6.0 (10.0±0.6 / 72.3±4.3)



RTW330SH000201

Trim Height

Trim Height : at Curb Weight
Trim height (Z) = A - B

mm (in)

Z
165±5 (6.5±0.20) (Philippine only)
140±5 (5.5±0.20) (Except Philippine)

MAXIMUM STEERING ANGLE

	4×2 (High ride suspension), 4×4
Outside wheel	32.8° (Philippine only)
Inside wheel	35.0° (Philippine only)
Outside wheel	32.1° (Except Philippine)
Inside wheel	34.4° (Except Philippine)

34 Verify the left-hand secondary timing chain timing mark alignments (1 to 6).

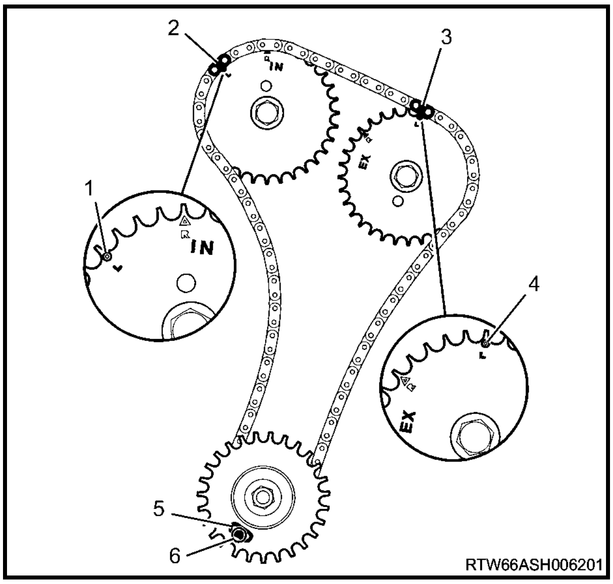


Figure 6A1 – 167

Primary Timing chain Components

1 If previously removed, install the left-hand secondary timing chain components, refer to Left-hand Secondary Timing Chain Components in this Section.

2 Ensure the right-hand camshaft intermediate driveshaft sprocket (2) is selected and orientated correctly.

CAUTION

The right-hand camshaft intermediate driveshaft sprocket (2) is marked with the letters RB and 'FRONT', and the left-hand sprocket (1) is marked with the letters LB and 'FRONT' Ensure the correct sprocket is used and the FRONT text is facing forwards when installed.

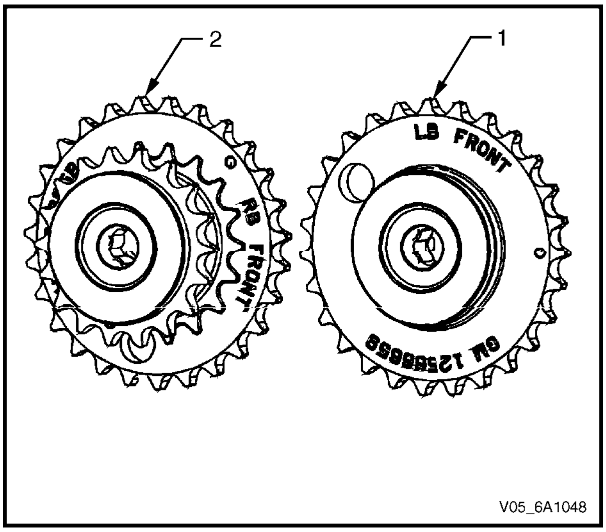


Figure 6A1 – 168

3 Install the right-hand camshaft intermediate driveshaft sprocket (2).

4 Install the driveshaft sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate driveshaft sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

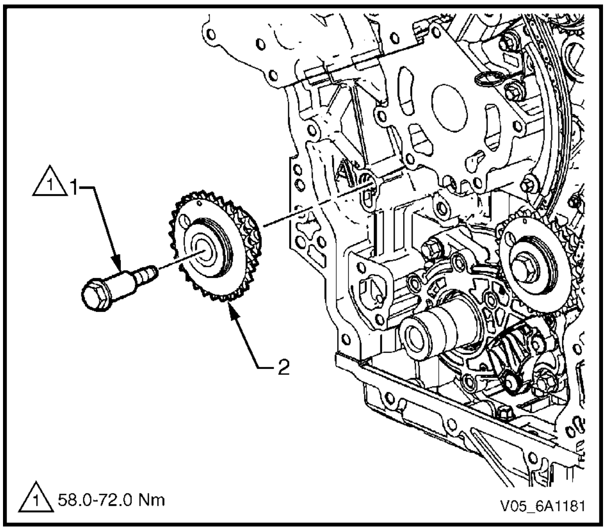


Figure 6A1 – 169

5 Ensure that the crankshaft sprocket timing mark (1) is aligned with the indexing mark (2) on the oil pump housing.

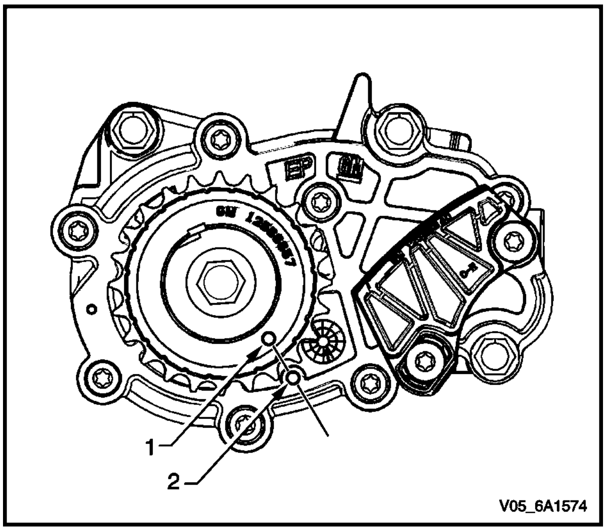


Figure 6A1 – 170

6 Install the primary timing chain (1).

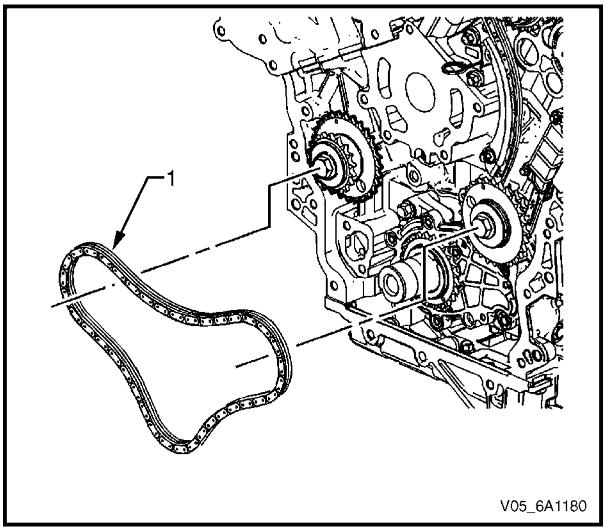


Figure 6A1 – 171

7 Wrap the primary timing chain around the large sprockets of each camshaft intermediate driveshaft sprocket and the crankshaft sprocket aligning the bright plated chain links as follows:

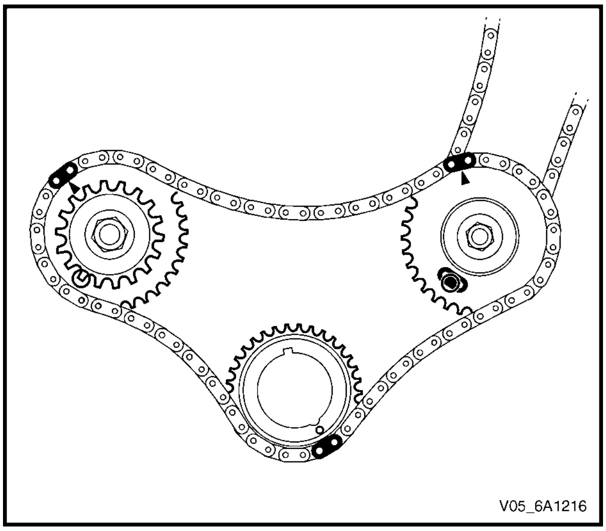


Figure 6A1 – 172

8 The left-hand camshaft intermediate driveshaft sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

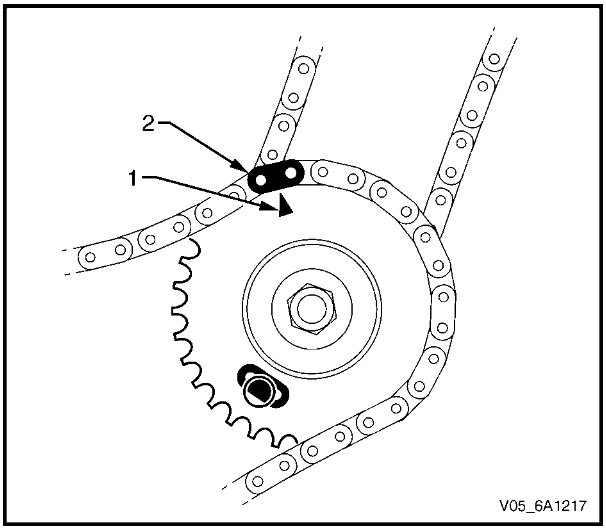


Figure 6A1 – 173

9 The right-hand camshaft intermediate driveshaft sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

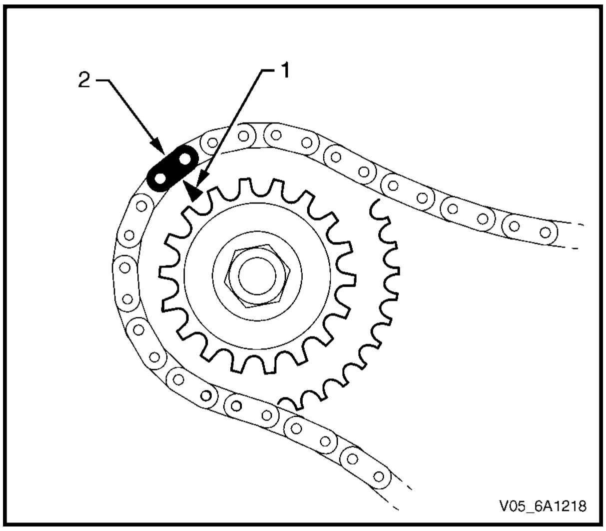


Figure 6A1 – 174

10 The crankshaft sprocket timing mark (1) will align with a bright plated timing chain link (2).

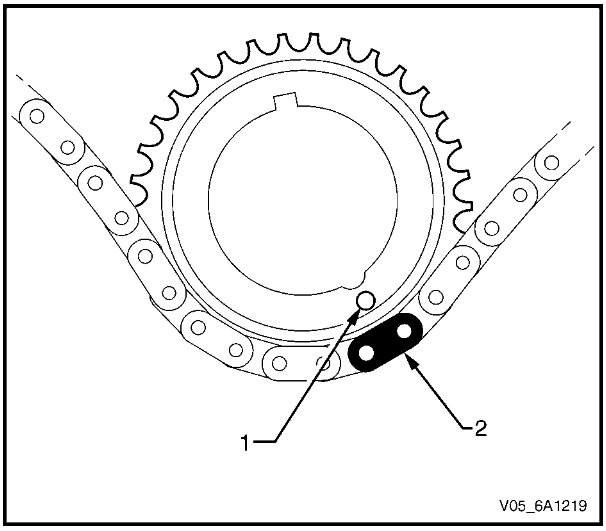


Figure 6A1 – 175

11 Ensure all the timing marks (1, 2 and 3) are properly aligned with the bright plated timing chain links (4, 5 and 6).

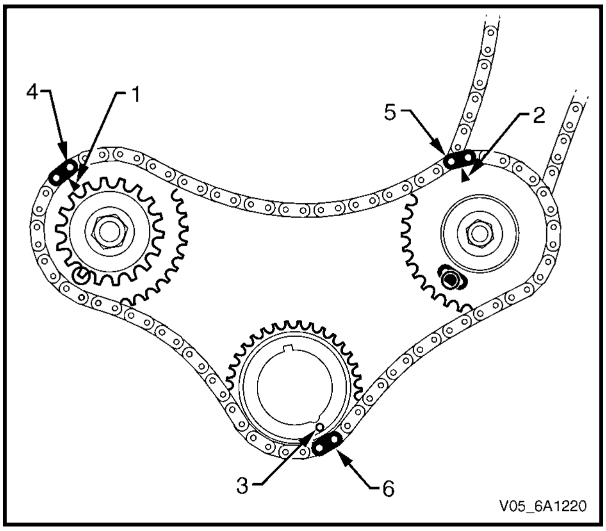


Figure 6A1 – 176

NOTE

Do not remove the primary timing chain lower guide (1). The primary timing chain lower guide is not serviced separately. If the primary timing chain lower guide must be replaced, the oil pump assembly (2) must be replaced.

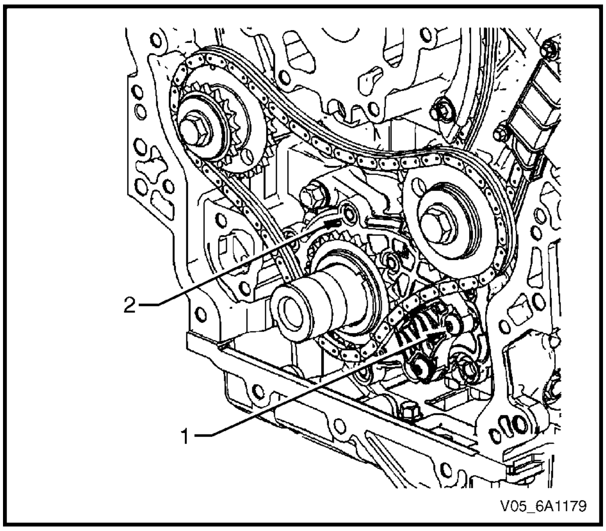


Figure 6A1 – 177

12 Ensure the primary timing chain upper guide is selected and orientated correctly.

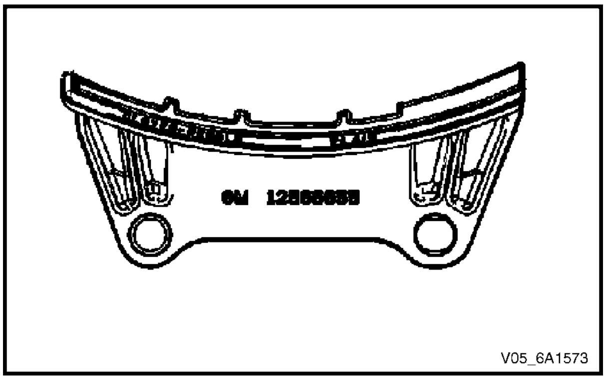


Figure 6A1 – 178

13 Install the primary timing chain upper guide (1).

14 Install the primary timing chain upper guide bolts (2) and tighten to the correct torque specification.

Primary timing chain upper guide attaching bolt torque specification...........20.0 – 26.0 Nm

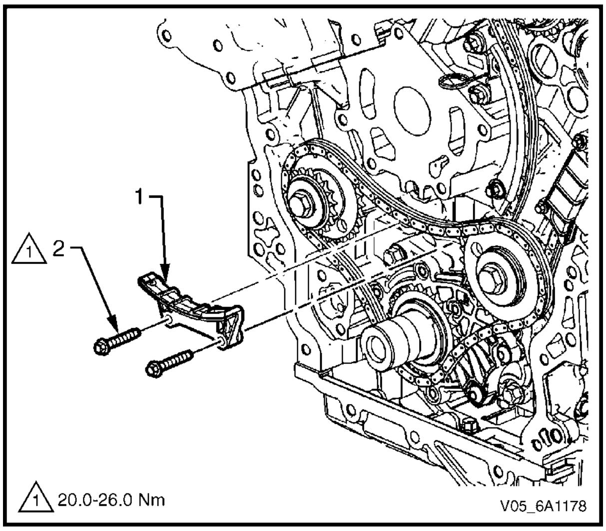


Figure 6A1 – 179

15 Ensure that the primary timing chain tensioner is being installed.

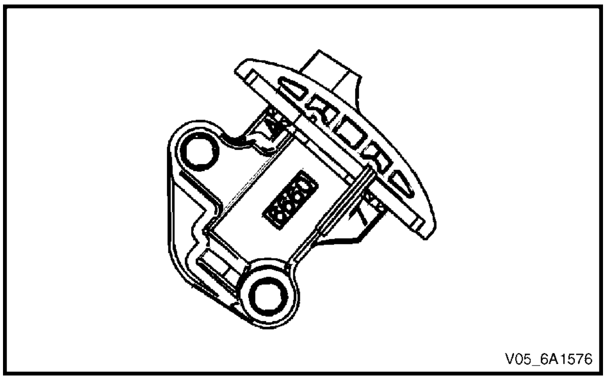


Figure 6A1 – 180

16 Reset the primary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

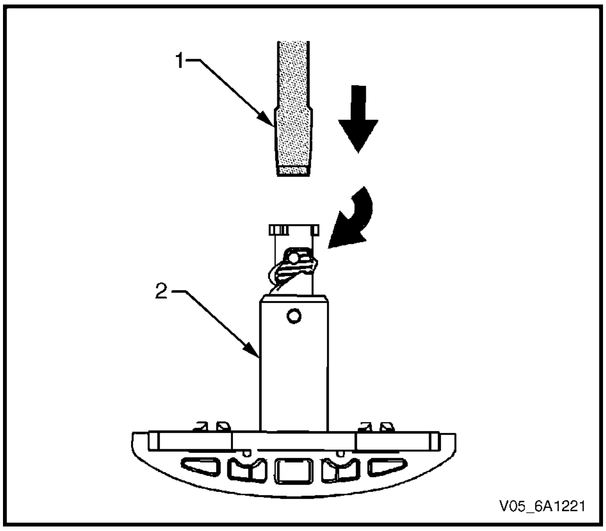


Figure 6A1 – 181

17 Install the tensioner shoe assembly (1) into the primary timing chain tensioner body (2).

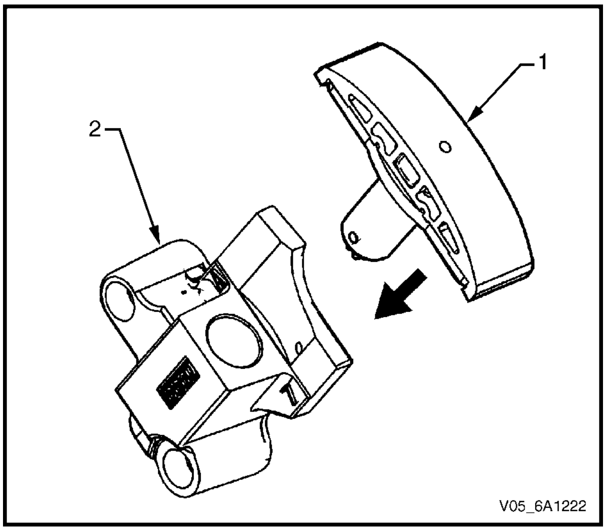


Figure 6A1 – 182

18 Compress the shoe assembly into the body (2) and lock the primary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the body.

CAUTION

If Tool No. EN 46112 (1) is not inserted into the tensioner body, the plunger will remain in the locked position and no tension will be placed on the timing chain.

19 Slowly release pressure on the primary timing chain tensioner. The primary timing chain tensioner should remain compressed.

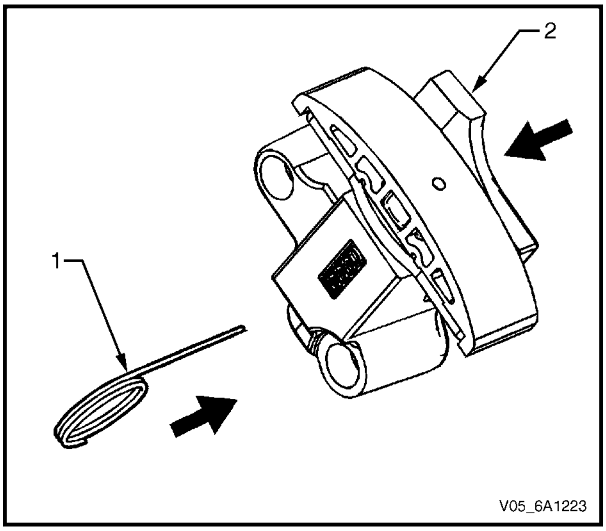


Figure 6A1 – 183

20 Install a new primary timing chain tensioner gasket (1) to the tensioner (2).

21 Install the primary timing chain tensioner bolts (3) through tensioner and gasket.

22 Ensure the primary timing chain tensioner mounting surface on the engine block does not have any burrs or defects that would affect the sealing of the new gasket.

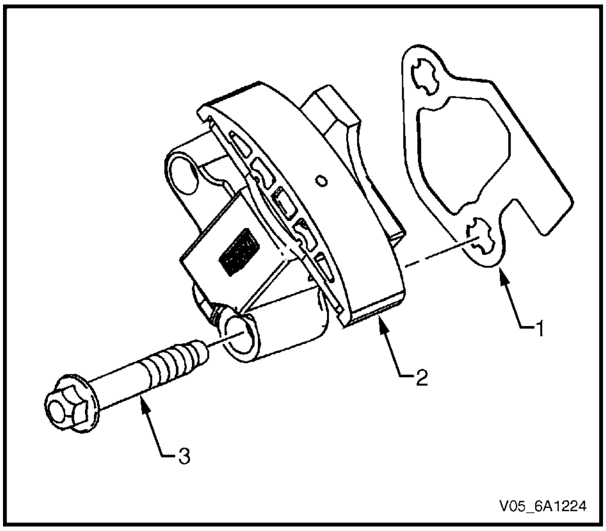


Figure 6A1 – 184

23 Place the primary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

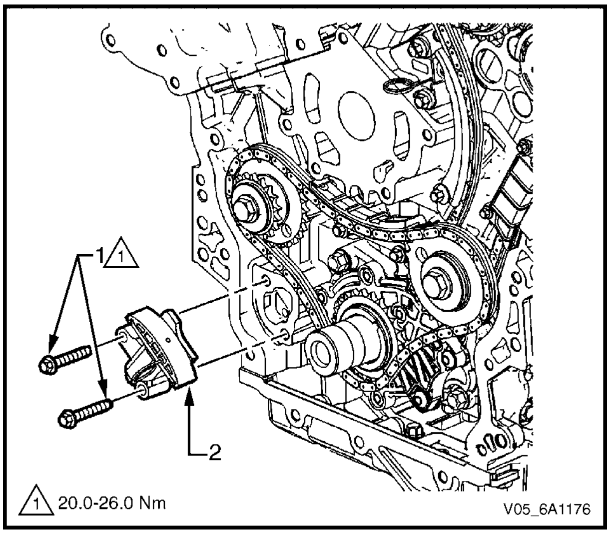


Figure 6A1 – 185

24 Verify the proper placement of the primary timing chain tensioner gasket tab (1).

25 Tighten the primary timing chain tensioner bolts (2) to the correct torque specification.

Primary timing chain tensioner attaching bolt torque specification	20.0 – 26.0 Nm

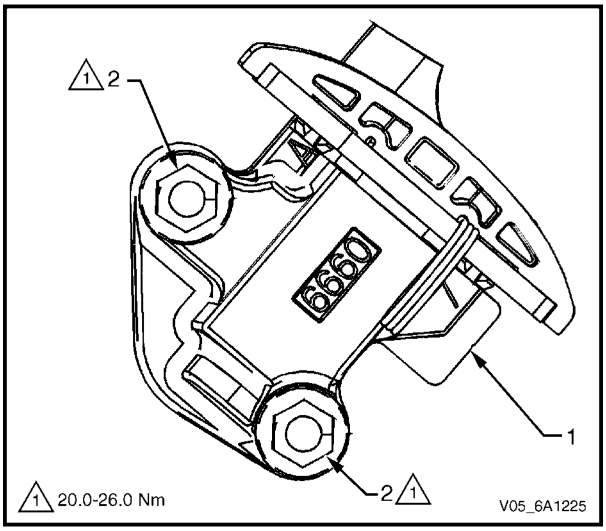


Figure 6A1 – 186

26 Release the primary timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner shaft.

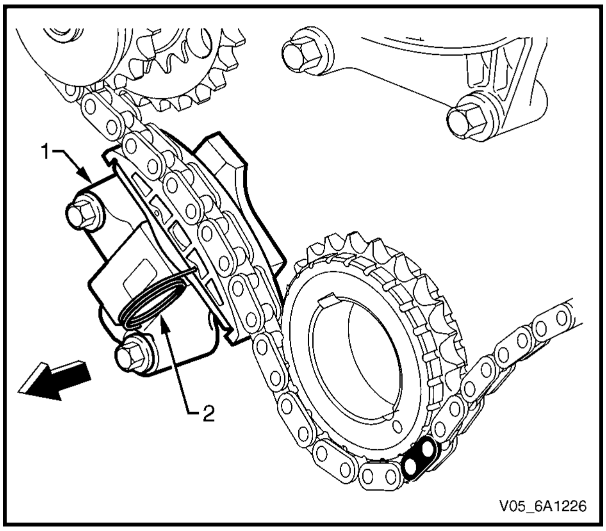


Figure 6A1 – 187

27 Verify the primary and left-hand secondary timing chain timing mark alignments (1 to 12).

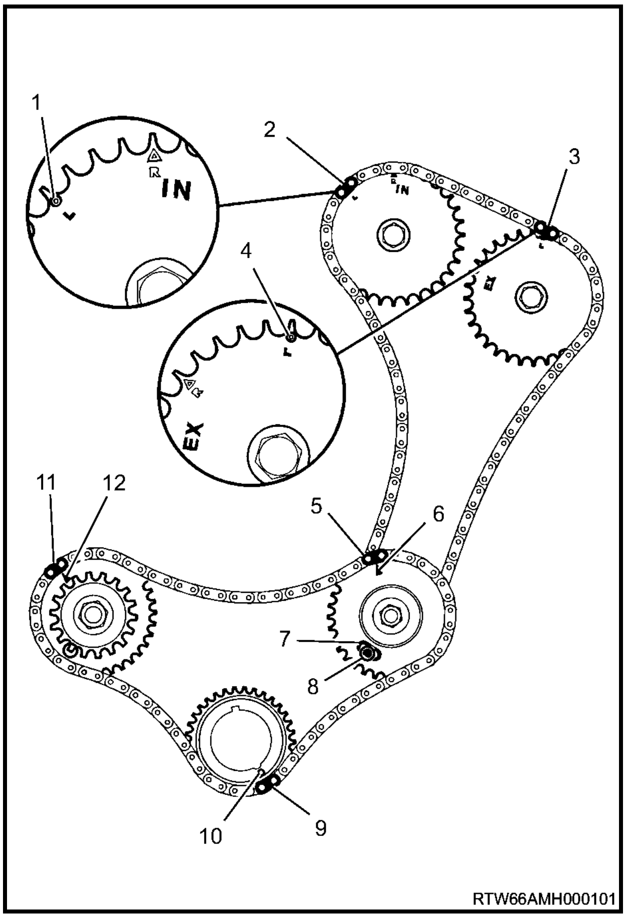


Figure 6A1 – 188

28 Remove Tool No. EN 46105 from the left-hand and right-hand cylinder head camshafts.

Right-hand Secondary Timing Chain Components

1 Install the primary timing chain components, refer to Primary Timing chain Components in this Section.

2 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

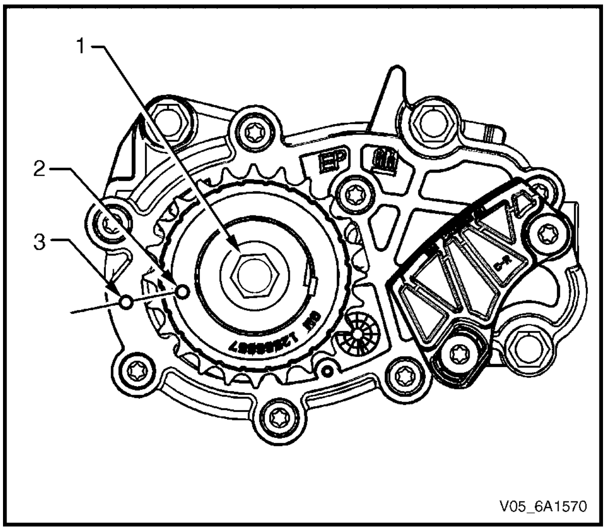


Figure 6A1 – 189

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts. There should be no need to rotate the camshaft more than 45 degrees.

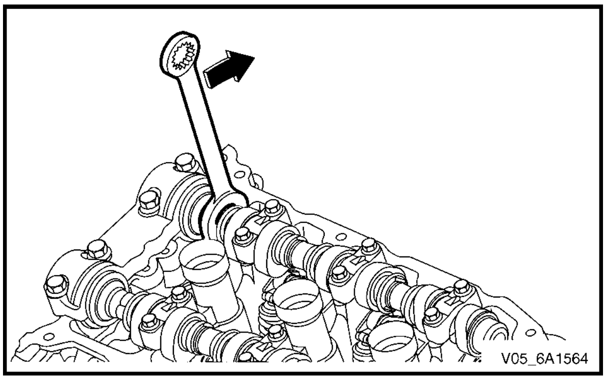


Figure 6A1 – 190

3 Install Tool No. EN 46105-1 (1) onto the rear of the right-hand cylinder head camshafts (2).

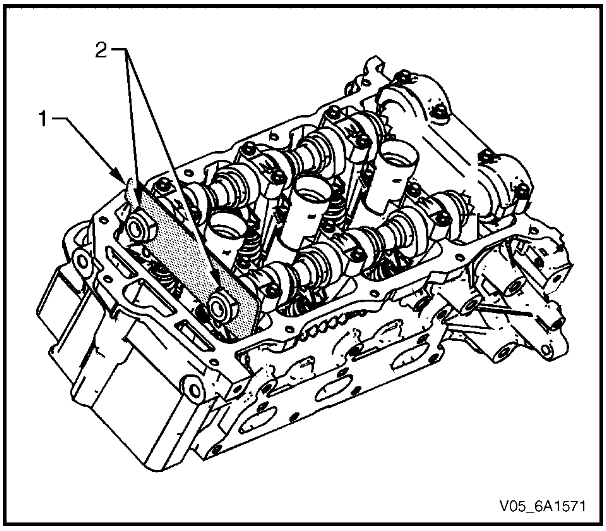


Figure 6A1 – 191

4 Install Tool No. EN 46105-2 (1) onto the rear of the left-hand cylinder head camshafts (2).

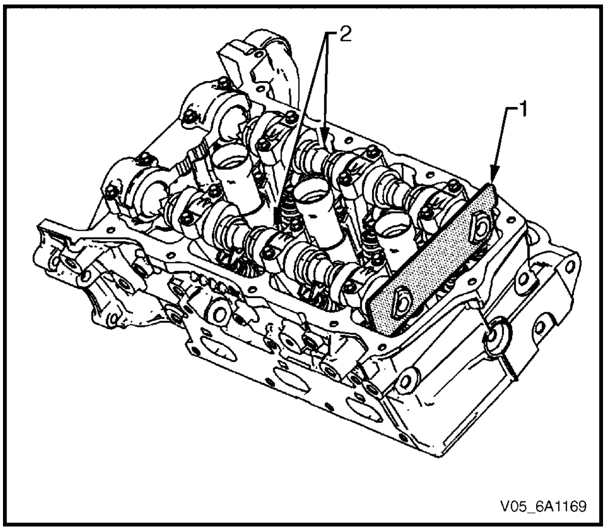


Figure 6A1 – 192

5 Install the right-hand secondary timing chain (1) onto the camshaft actuators (2) and the right hand camshaft intermediate driveshaft sprocket (3) aligning the chain in the following manner:

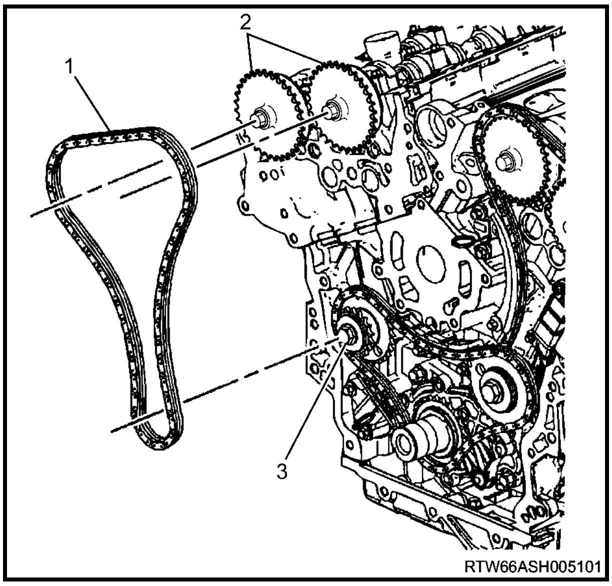


Figure 6A1 – 193

6 Place the secondary timing chain around the right-hand camshaft intermediate driveshaft outer sprocket, aligning the bright plated timing chain link (1) with the alignment access hole (2) in the inner sprocket.

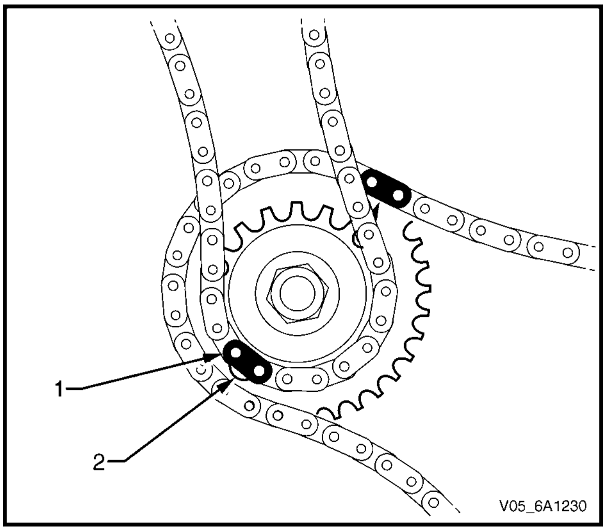


Figure 6A1 – 194

7 Wrap the secondary timing chain around both right-hand actuator drive sprockets.

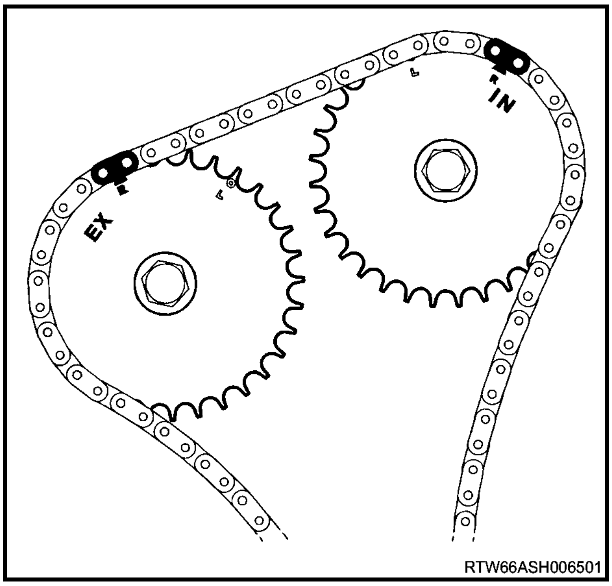
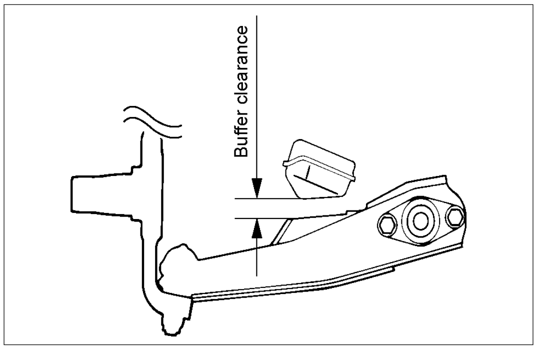


Figure 6A1 – 195



RTW53ASH000301

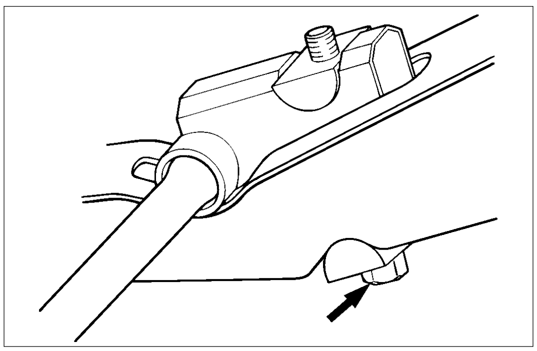
FRT Buffer clearance (Reference Data) mm(in)

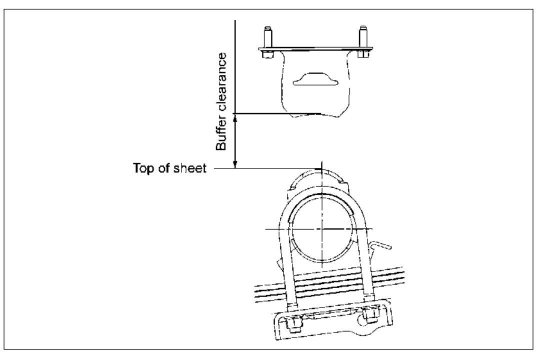
4×2 (High ride suspension), 4×4
29.7(1.17)

Adjustment

Adjust the trim height by means of the adjusting bolt on the height control arms.

1. Check and adjust the tire inflation pressures.
2. Park the vehicle on level ground and move the front of the vehicle up and down several times to settle the suspension.
3. Make necessary adjustments with the adjusting bolt on the height control arms.


410RS001



RTW63ASH000101

RR Buffer clearance (Reference Data) mm(in)

4×2 (High ride suspension), 4×4
80.0 (3.15)

8 Align the bright plated timing chain link (2) with the exhaust actuator sprocket alignment triangle mark or circular mark .

CAUTION

Ensure that when aligning the right-hand secondary timing chain to the right-hand camshaft actuator sprockets, that the triangular timing marks (1) on the sprocket are used, NOT the circular mark.

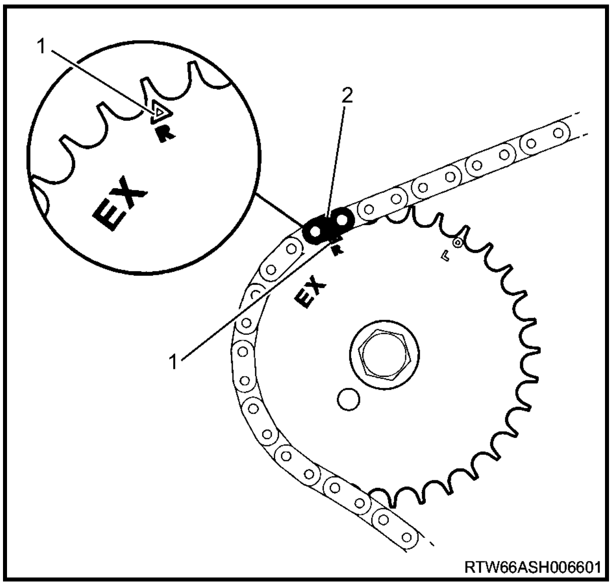


Figure 6A1 – 196

9 Align the bright plated timing chain link (1) with the intake actuator sprocket alignment triangle mark (2).

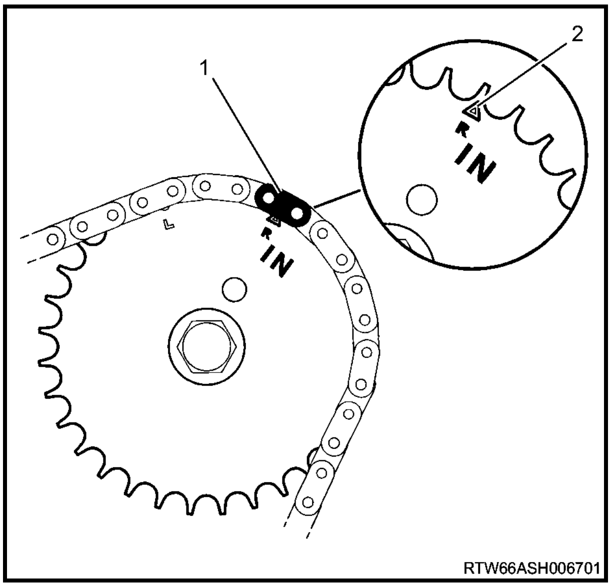


Figure 6A1 – 197

10 Ensure that the right-hand secondary timing chain guide is selected and orientated correctly.

CAUTION

Ensure that the right-hand secondary timing chain guide is used when installing to the right-hand side in this procedure.

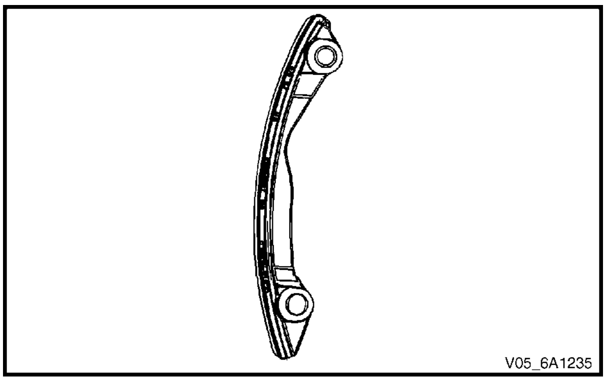


Figure 6A1 – 198

11 Position the chain guide (2).

12 Install the secondary timing chain guide bolts (1) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification...........20.0 – 26.0 Nm

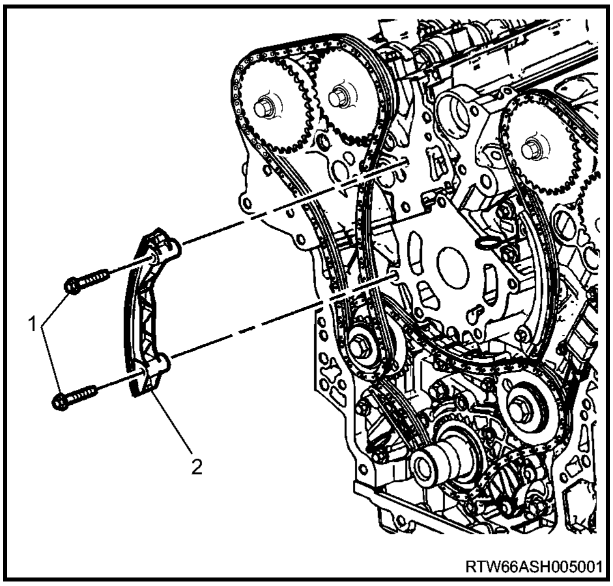


Figure 6A1 – 199

13 Ensure the right-hand secondary timing chain shoe is selected and orientated correctly.

CAUTION

The right-hand secondary camshaft drive shoe is marked with the letters ‘RH’. Ensure that the right-hand drive shoe is used when installing to the right-hand side in this procedure and that the letters ‘RH” are facing the front of the vehicle when installed.

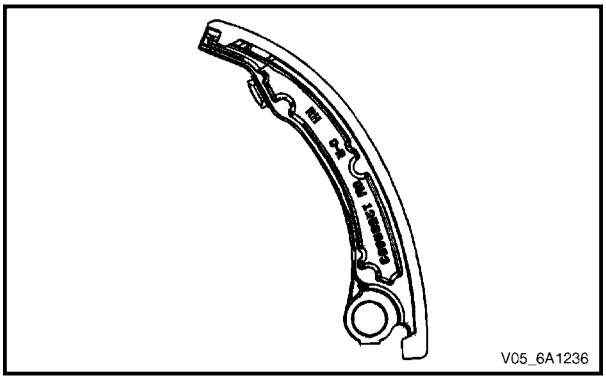


Figure 6A1 – 200

14 Position the right-hand secondary timing chain shoe (1).

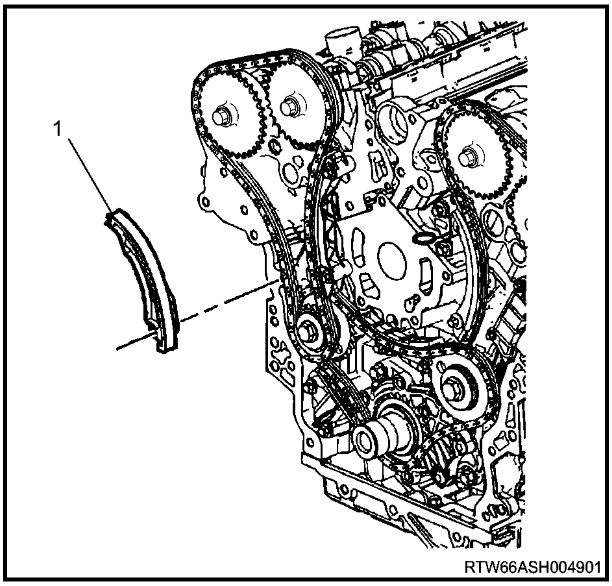


Figure 6A1 – 201

15 Install the secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

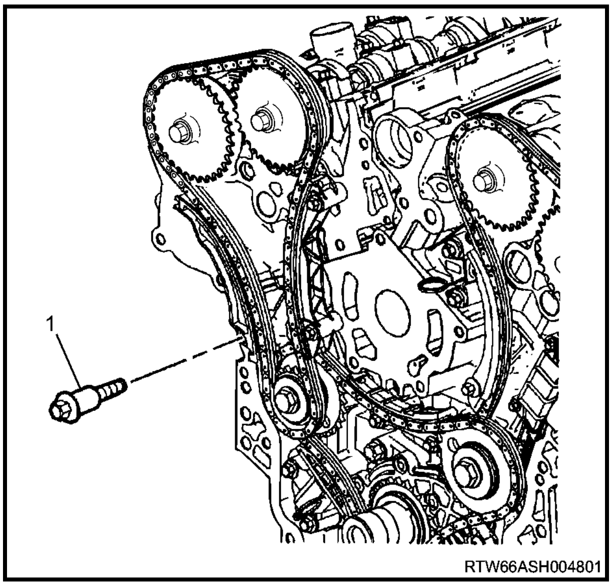


Figure 6A1 – 202

Secondary timing chain shoe attaching bolt torque specification...........20.0 – 26.0 Nm

16 Ensure the right-hand secondary timing chain tensioner is selected and orientated correctly.

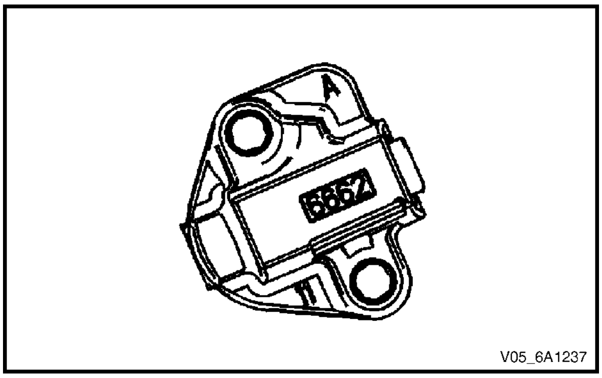


Figure 6A1 – 203

17 Reset the right-hand secondary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 to wind the plunger in a clockwise direction, into the tensioner shaft (2).

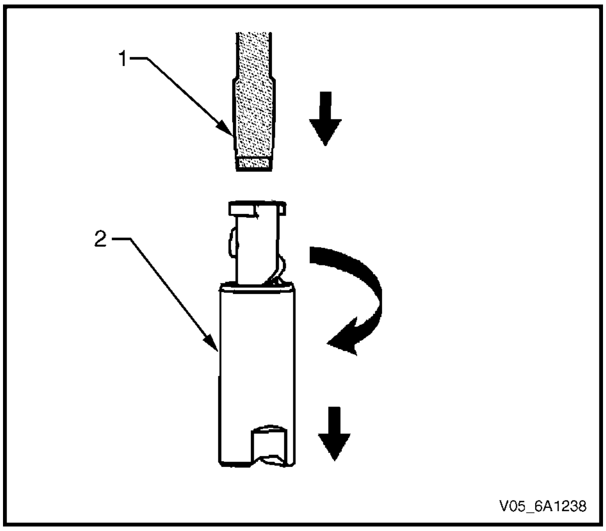


Figure 6A1 – 204

18 Install the tensioner shaft (1) into the right-hand secondary timing chain tensioner body (2).

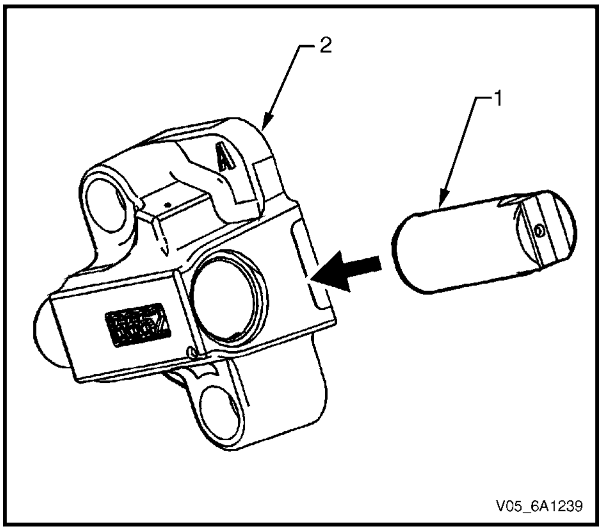


Figure 6A1 – 205

19 Compress the tensioner shaft into the body and lock the tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

20 Slowly release pressure on the right-hand secondary timing chain tensioner. The tensioner should remain compressed.

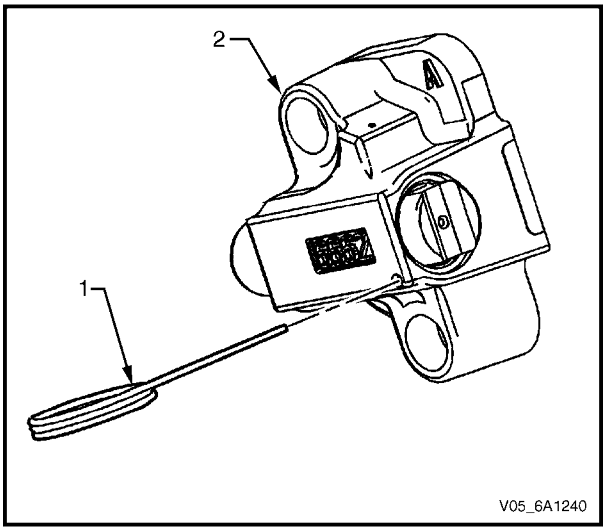


Figure 6A1 – 206

21 Install a new right-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

22 Install the right-hand secondary timing chain tensioner bolts (3) through the tensioner and gasket.

23 Ensure the right-hand secondary timing chain tensioner mounting surface on the right-hand cylinder head does not have any burrs or defects that would affect the sealing of the new tensioner gasket.

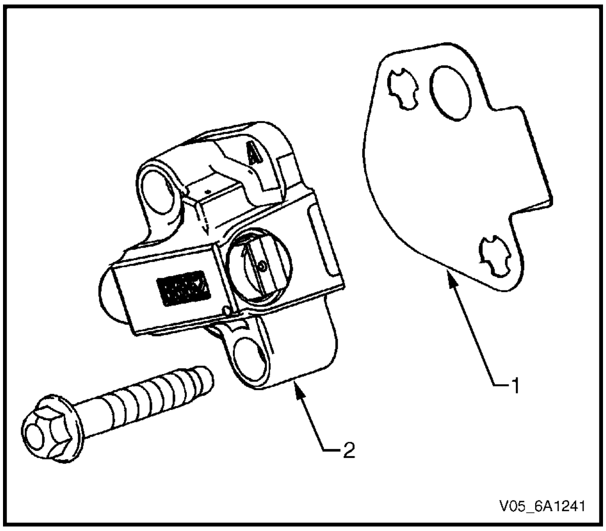


Figure 6A1 – 207

24 Place the right-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

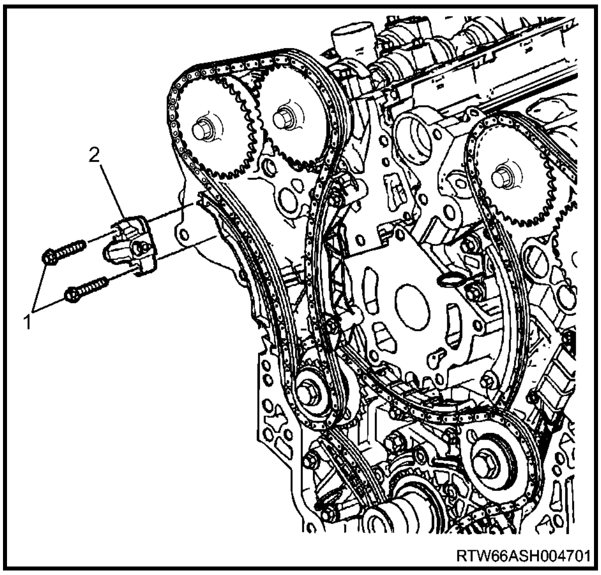


Figure 6A1 – 208

25 Verify the proper placement of the right-hand secondary timing chain tensioner gasket tab (1).

26 Tighten the right-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

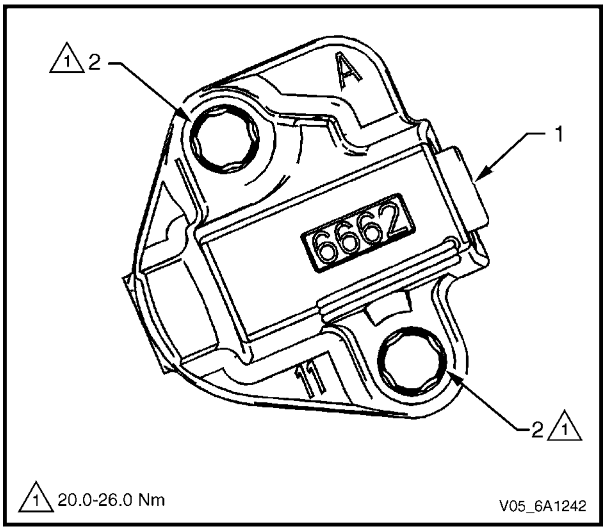


Figure 6A1 – 209

27 Release the right-hand timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner plunger.

CAUTION

If Tool No. EN 46112 (1) is not removed from the tensioner body (2), the plunger will remain in the locked position and no tension will be placed on the timing chain, this will cause damage to the engine.

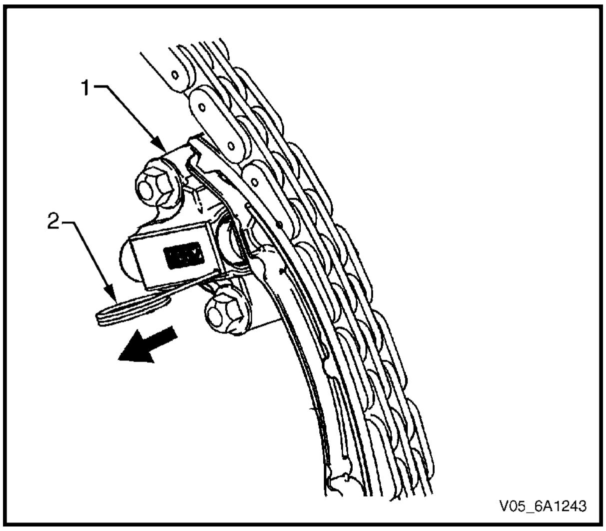


Figure 6A1 – 210

28 Verify all primary and secondary timing chain timing mark alignments (1 to 18).

29 Remove Tool No. EN 46105 and EN 46105-2 from the left and right-hand cylinder head camshafts.

30 Reinstall the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations.

31 Reinstall the engine front cover assembly, refer to 3.15 Front Cover Assembly.

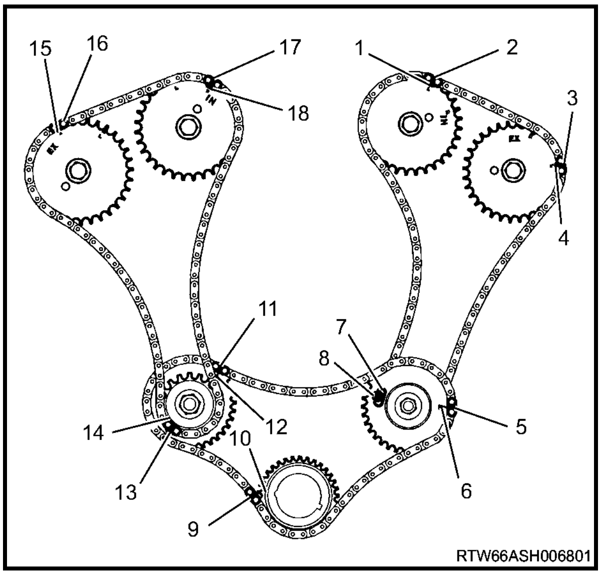


Figure 6A1 – 211

3.17 Oil Pump Assembly

Remove

NOTE

Do not remove the left-hand bank idler sprocket.

1 Remove the primary timing chain and crankshaft sprocket, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

2 Remove the three bolts (1) attaching the oil pump (2).

3 Remove the oil pump assembly.

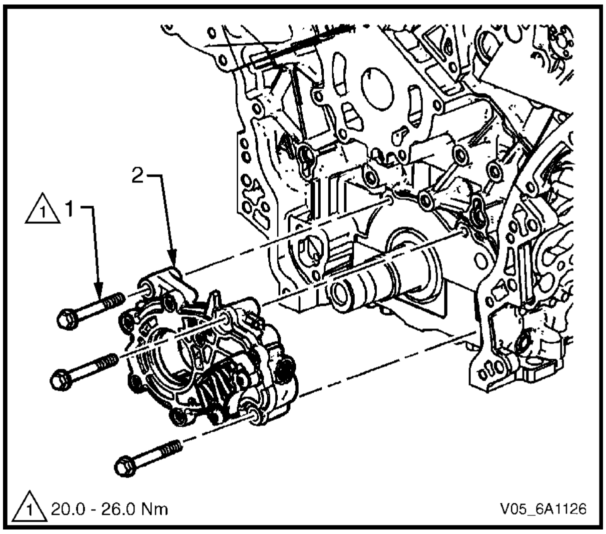


Figure 6A1 – 212

Disassemble

CAUTION

There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oil related concern. A disassembled oil pump must not be reused: it must be replaced.

1 Remove the two bolts (1) attaching the primary timing chain lower guide (2) and remove the guide.

CAUTION

The primary timing chain lower guide is not serviced separately and is part of the oil pump assembly. If it is removed from the pump assembly, the guide and the pump must be replaced.

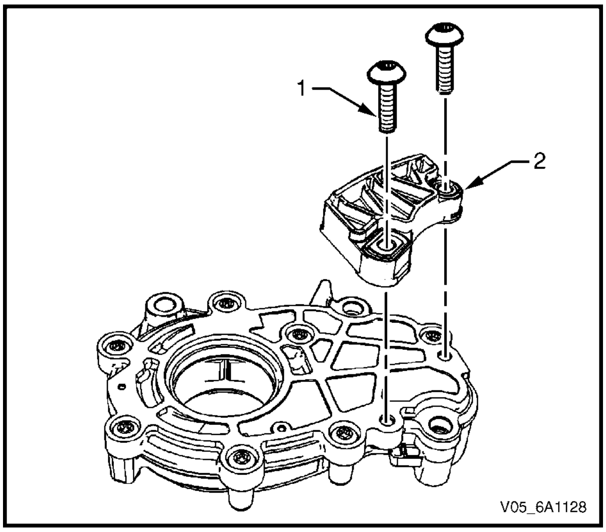


Figure 6A1 – 213

2 Remove the seven bolts (2) attaching the oil pump cover to the oil pump housing (1) and remove the cover from the housing.

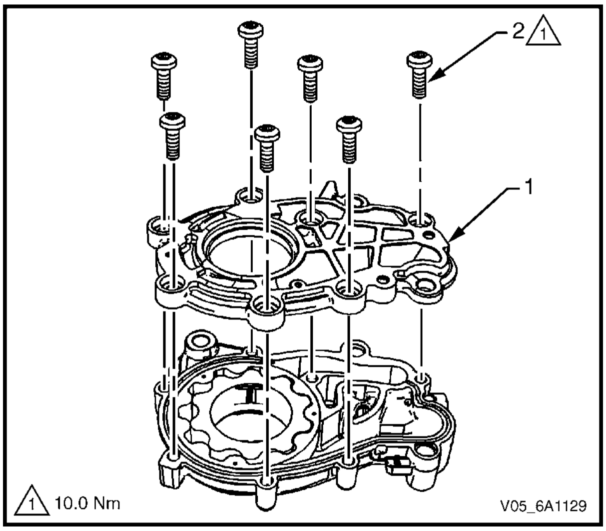


Figure 6A1 – 214

3 Remove the inner gerotor ring (1).

4 Remove the outer gerotor ring (2).

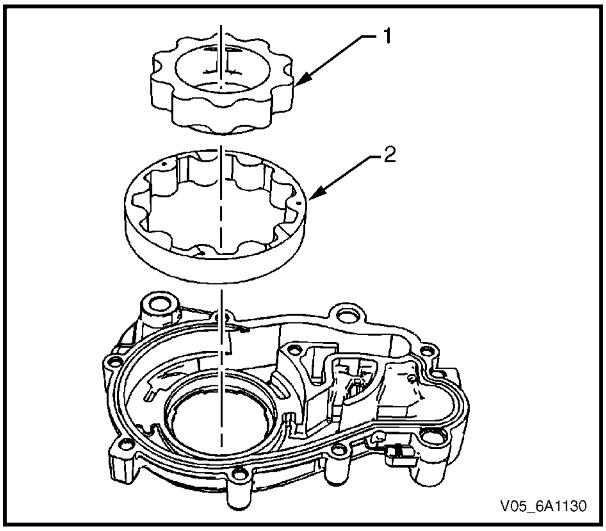


Figure 6A1 – 215

5 Remove the clip (1), retaining the oil relief valve cap (2).

6 Remove the cap, spring (3) and plunger (4) from the oil pump housing.

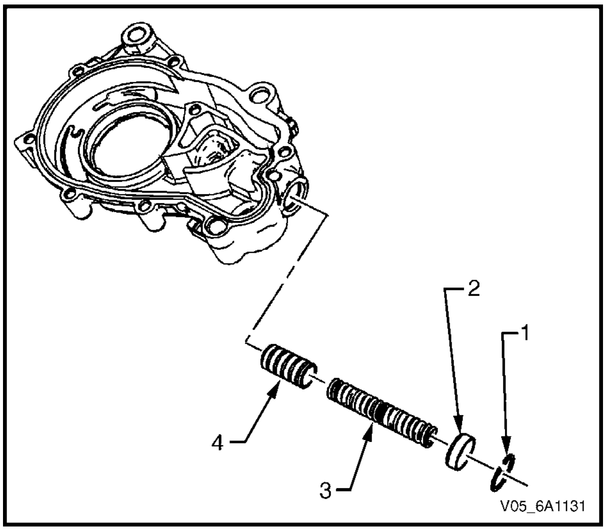


Figure 6A1 – 216

Clean

1 Clean the oil pump components with non-corrosive solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the oil pump components with compressed air.

Inspect

1 Inspect the oil pump housing for damage.

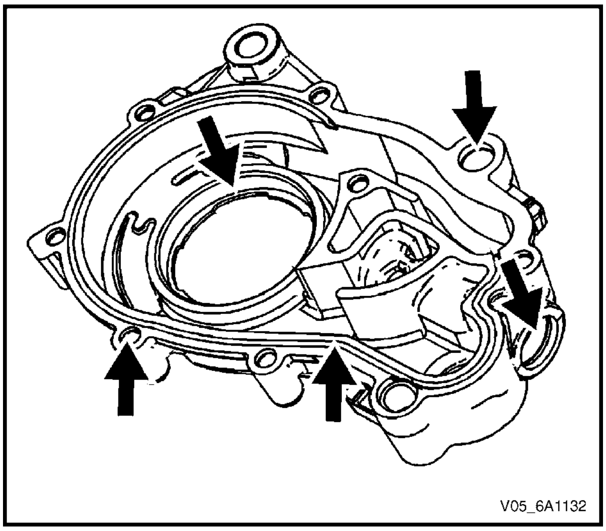


Figure 6A1 – 217

2 Inspect the oil pump cover for damage.

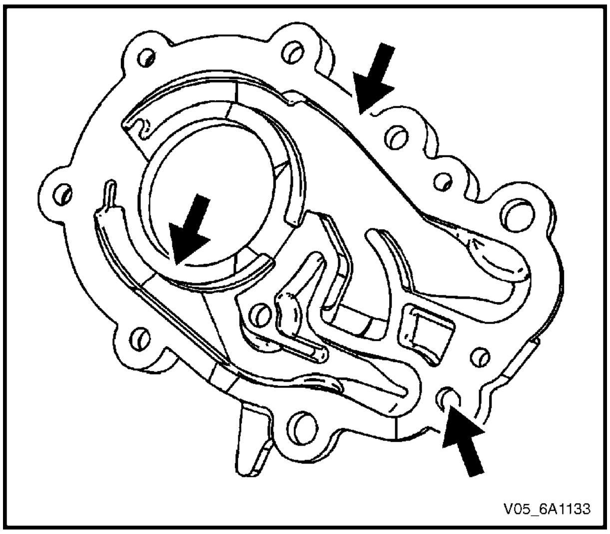


Figure 6A1 – 218

3 Inspect the inner drive gear for damage. If inner surface damage is found, ensure the crankshaft is also inspected.

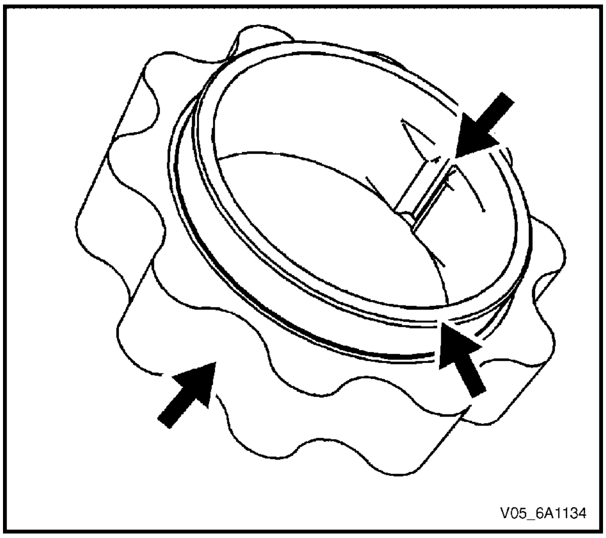


Figure 6A1 – 219

4 Inspect the outer driven gear for damage.

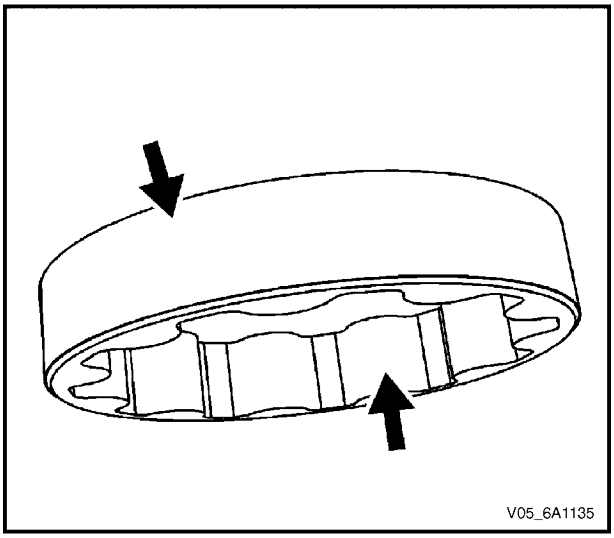


Figure 6A1 – 220

5 Inspect the oil pump relief valve components for debris or damage.

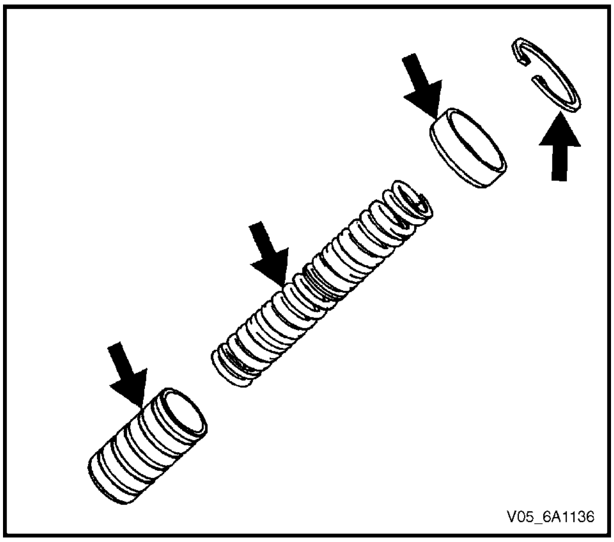


Figure 6A1 – 221

6 Inspect the primary camshaft chain lower guide for damage. If replacement of the primary camshaft chain lower guide is required, replace the entire oil pump assembly as the primary camshaft chain lower guide is not serviceable separately.

7 If debris or damage is present within the oil pump, further inspection of all of the engine components is required.

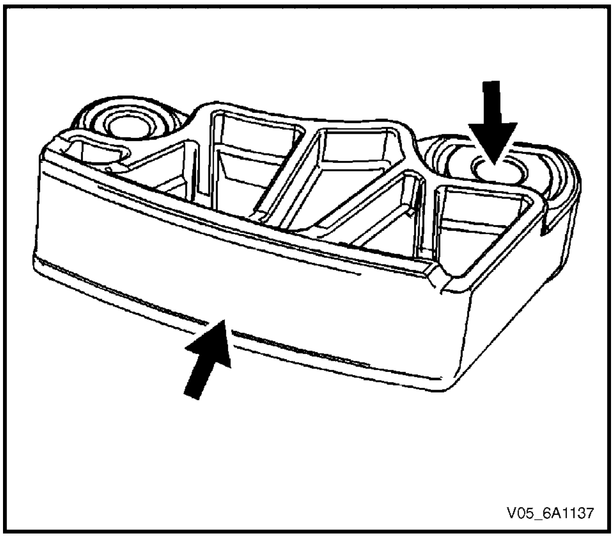


Figure 6A1 – 222

SECTION 3B

POWER-ASSISTED STEERING SYSTEM

TABLE OF CONTENTS

Reassemble

CAUTION

As there are no serviceable components within the oil pump, a disassembled oil pump must be replaced.

Reinstall

1 Align the oil pump gerotor with the crankshaft flats and fit the oil pump assembly to the engine block.

2 Align the pump body (2) with the mounting holes in the cylinder block.

3 Install the oil pump bolt (1), three places, and tighten to the correct torque specification.

4 Install the primary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

Oil pump attaching bolt torque specification ....20.0 – 26.0 Nm

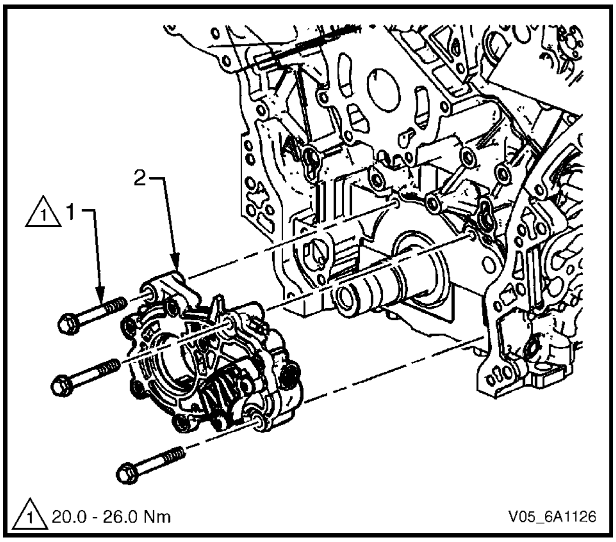


Figure 6A1 – 223

3.18 Camshaft Sprocket

CAUTION

Setting the camshaft timing is required whenever the camshaft drive system is disturbed to ensure the relationship between any chain and sprocket is not lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.

If required, follow the Left-hand Secondary Camshaft Chain Components reinstallation procedure to reset the camshaft timing.

Remove

Right-hand Side

1 Remove the right-hand camshaft cover, refer to 3.12 Camshaft Cover.

2 Remove the camshaft position sensors, refer to 6C1-3 Engine Management – Service Operations.

3 Remove the camshaft position actuator solenoids, refer to 6C1-3 Engine Management – V6 – Service Operations.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.

6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

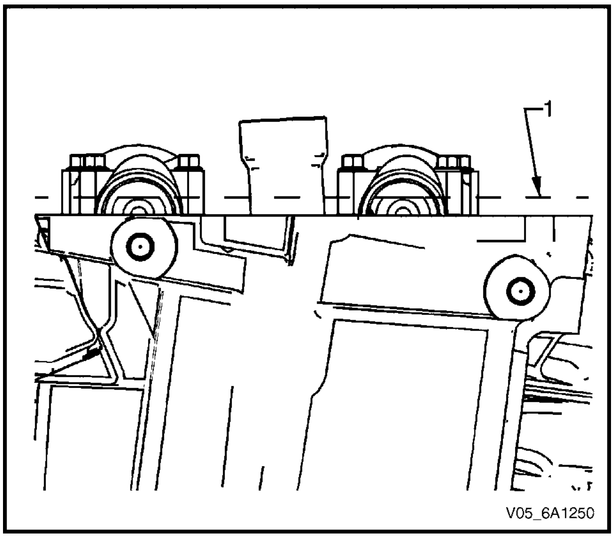


Figure 6A1 – 224

7 Install Tool No. EN-46105 – 1 (1) onto the rear of the right-hand cylinder head (3) camshafts (2).

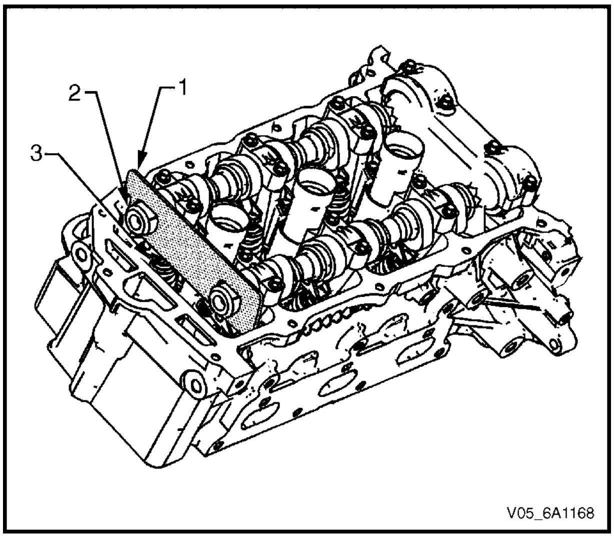


Figure 6A1 – 225

8 Loosen the camshaft sprocket bolt.

NOTE

- Use an open-end spanner (1) at the camshaft hex (2) to prevent camshaft/engine rotation.
- Do not remove the camshaft sprocket bolt at this time.
- If you have already removed the camshaft timing chain proceed to step 12

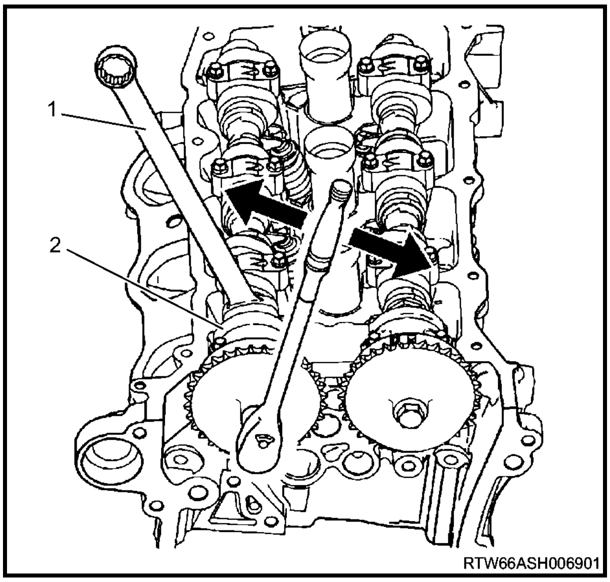


Figure 6A1 – 226

9 Install Tool No. EN-46108 (1 and 2) to retain the timing chain (3 and 4).

10 Firmly tighten the wing nuts of Tool No. EN-46108.

11 Mark the timing chain and the respective location on both camshaft sprocket.

NOTE

Ensure the camshaft timing chain and the camshaft sprocket are marked for correct reassembly.

CAUTION

Ensure the tips of Tool No. EN-46108 are fully engaged into the timing chain and the wing nuts are tight and the timing chain is taught.

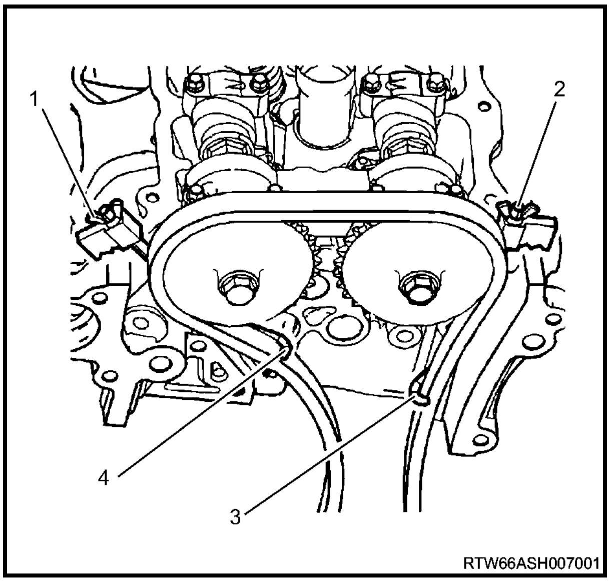


Figure 6A1 – 227

12 Remove the bolt (1) attaching the right-hand exhaust camshaft sprocket (2) and remove the sprocket.

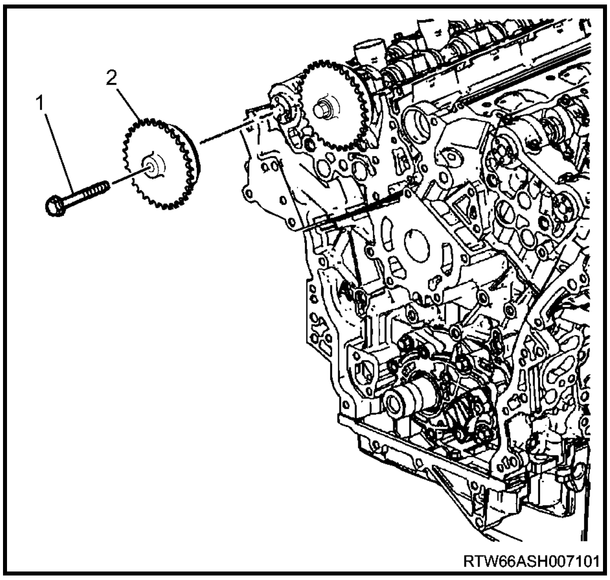


Figure 6A1 – 228

13 Remove the bolt (1) attaching right-hand intake camshaft sprocket (2) and remove the sprocket.

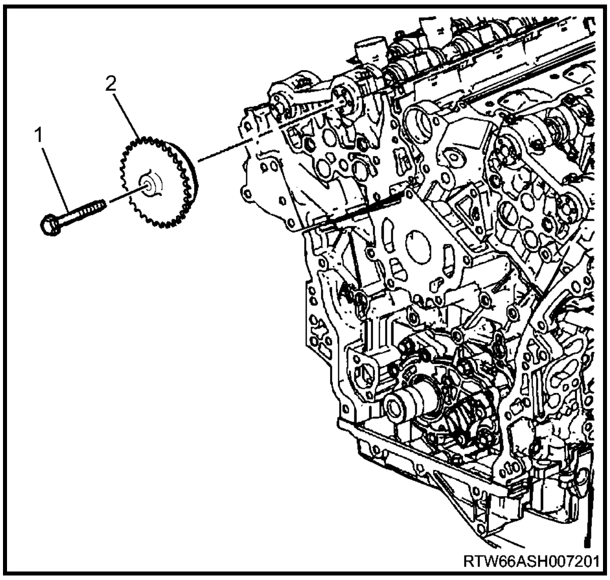


Figure 6A1 – 229

Left-hand Side

1 Remove the left-hand camshaft cover, refer to 3.12 Camshaft Cover.

2 Remove the camshaft position sensors, refer to 6C1-3 Engine Management – V6 – Service Operations.

3 Remove the camshaft position actuator solenoids, refer to 6C1-3 Engine Management – V6 – Service Operations.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.

6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

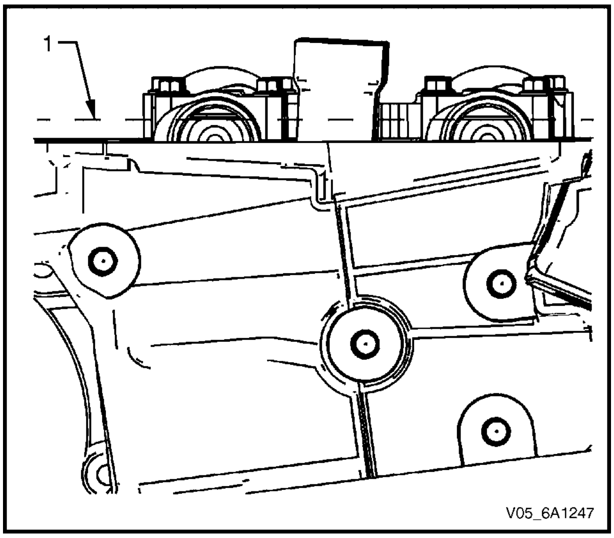


Figure 6A1 – 230

7 Install Tool No. EN-46105 – 1 (1) onto the rear of the left-hand cylinder head camshafts (2).

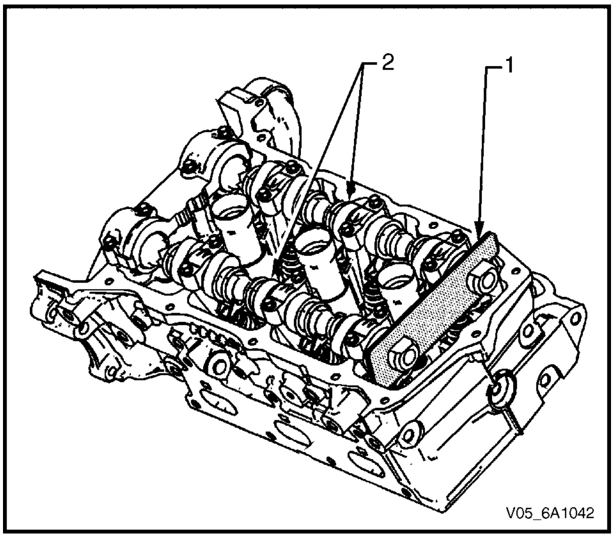


Figure 6A1 – 231

8 Loosen the camshaft sprocket bolt.

NOTE

- Use an open-end wrench (1) at the camshaft hex (2) to prevent camshaft/engine rotation.
- Do not remove the camshaft sprocket bolt at this time.
- If the camshaft timing chain has already been removed proceed to step 12.

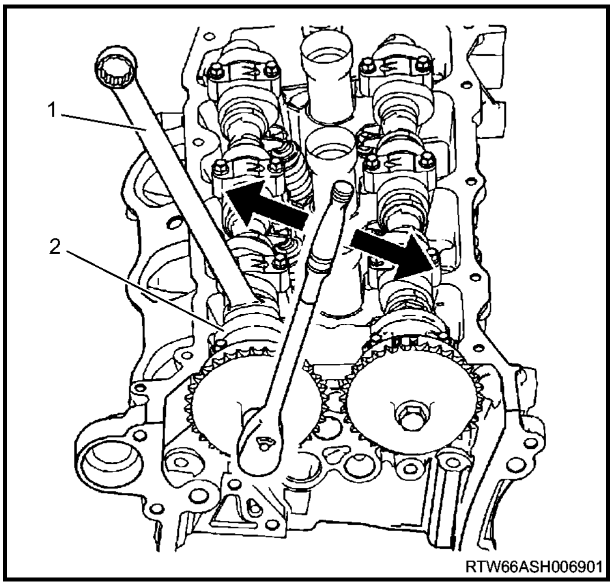


Figure 6A1 – 232

9 Install Tool No. EN-46108 (1 and 2) to retain the timing chain (3 and 4).

10 Firmly tighten the wing nuts of Tool No. EN-46108.

CAUTION

Ensure the tips of Tool No. EN-46108 are fully engaged into the timing chain and the wing nuts are tight and the timing chain is taught.

11 Mark the timing chain and the respective location on both camshaft sprocket.

NOTE

Ensure the camshaft timing chain and the camshaft sprocket are marked for correct reassembly.

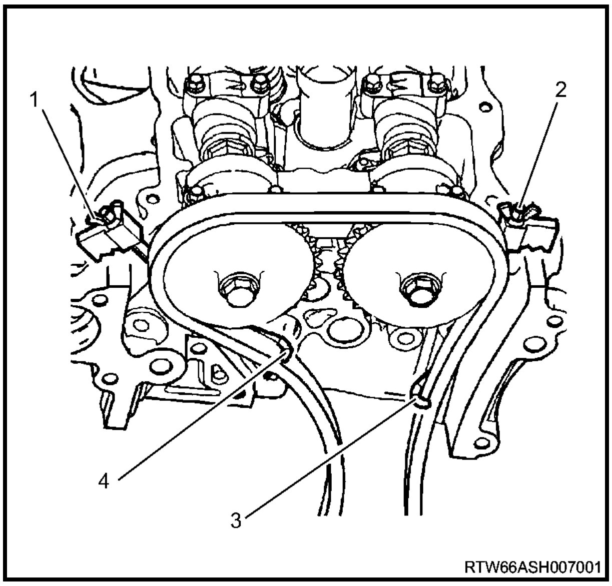


Figure 6A1 – 233

12 Remove the bolt (1) attaching the left-hand exhaust camshaft sprocket (2) and remove the sprocket.

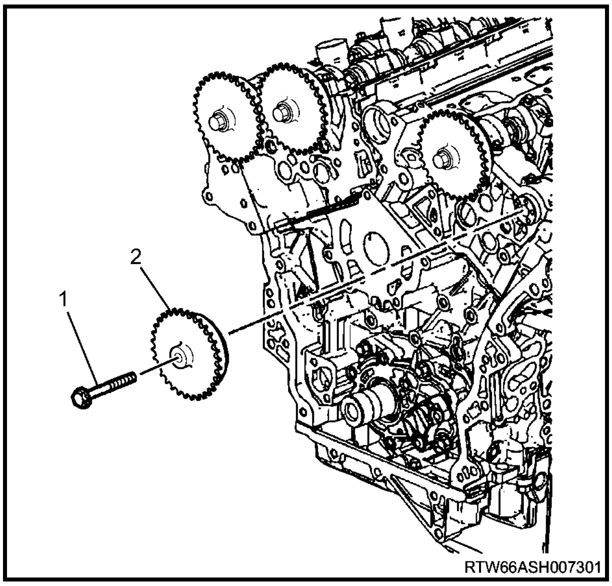


Figure 6A1 – 234

13 Remove the bolt (1) attaching left-hand intake camshaft sprocket (2) and remove the sprocket.

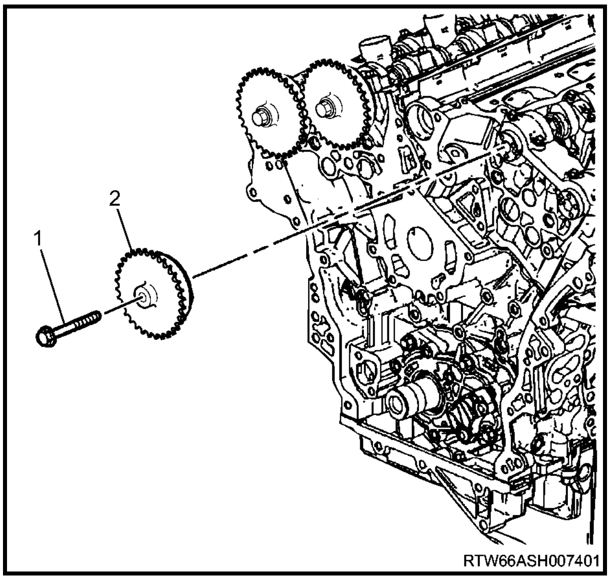


Figure 6A1 – 235

Clean

1 Clean the exterior of each camshaft sprocket with solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the timing components with compressed air.

Inspect

1 Inspect the front of each sprocket for the following:

- Sprocket damage (1), and
- Sprocket bolt seating inner hub damage (2).

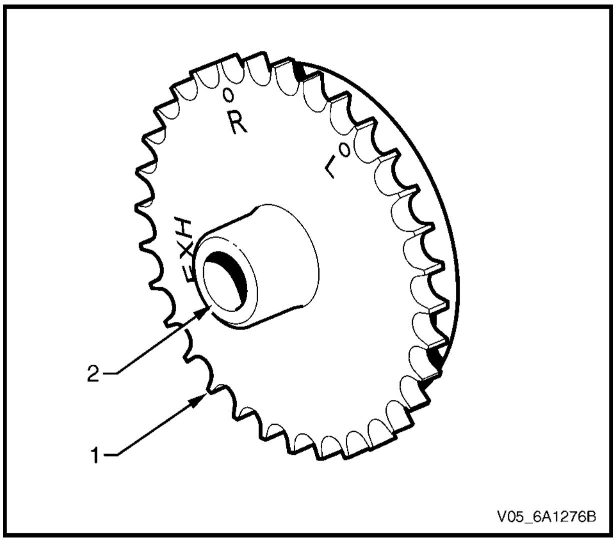


Figure 6A1 – 236

2 Inspect the back of each sprocket for the following:

- Sprocket damage (1),
- Camshaft locating pin damage (2) and,
- Camshaft seating/sealing inner hub flange damage (3),

NOTE

These checks apply to both the inlet and exhaust camshaft sprockets.

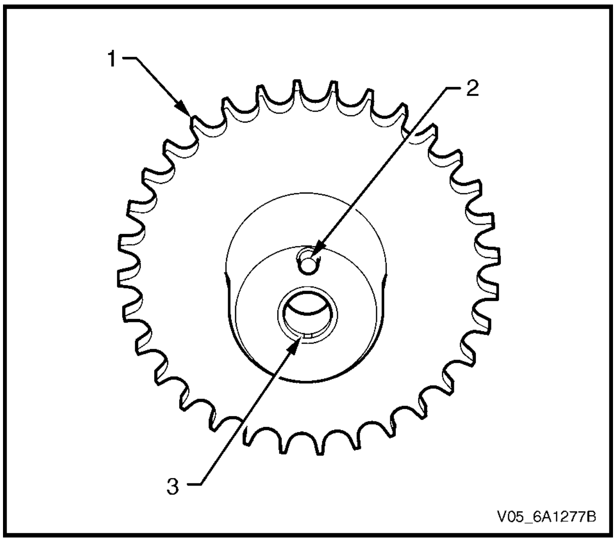


Figure 6A1 – 237

Reinstall

Reinstallation of the camshaft sprockets is the reverse of the removal procedure, noting the following:

1 Align the sprockets and timing chain with the marks made during removal.

2 Tighten the camshaft sprocket bolts to the correct torque specification.

Camshaft sprocket attaching bolt torque specification ....49.0 – 67.0 Nm

3 Remove the timing chain retention tools.

3.19 Camshaft

Remove

Right-hand Side

1 Remove the right-hand cylinder head camshaft sprockets, refer to 3.18 Camshaft Sprocket.

2 Remove the Tool No. EN-46105 – 1 (1) from the right-hand cylinder head camshafts (2).

NOTE

Tool No. EN-46105 was installed as part of the right-hand cylinder head camshaft sprocket removal procedure.

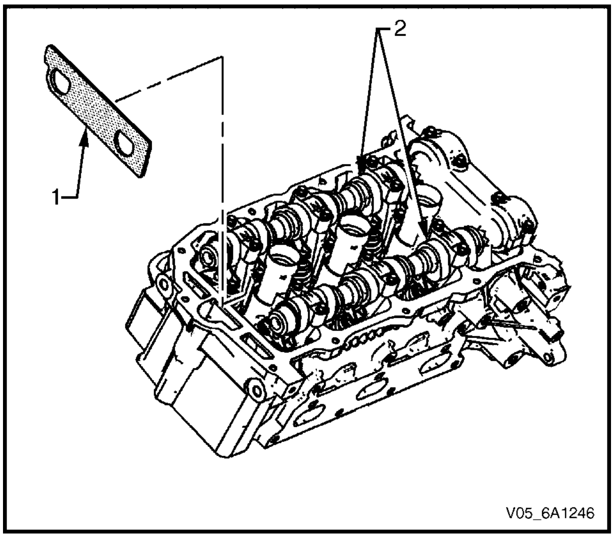


Figure 6A1 – 238

3 Observe the markings (1) on the bearing caps. Each bearing cap is marked to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- An I indicates the intake camshaft.
- An E indicates the exhaust camshaft.
- The number indicates the journal position from the front of the engine.

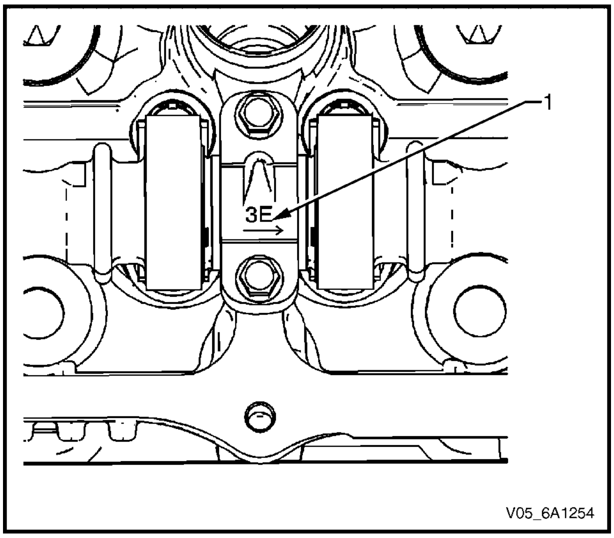


Figure 6A1 – 239

4 Remove the camshaft bearing cap bolts (1) and caps (2).

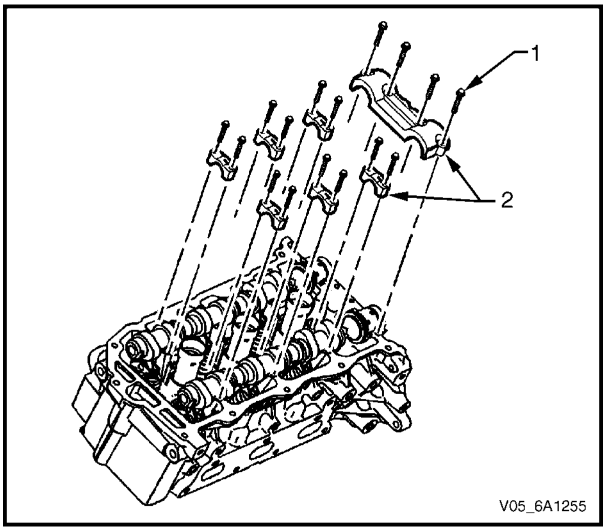


Figure 6A1 – 240

5 Remove the camshafts (1).

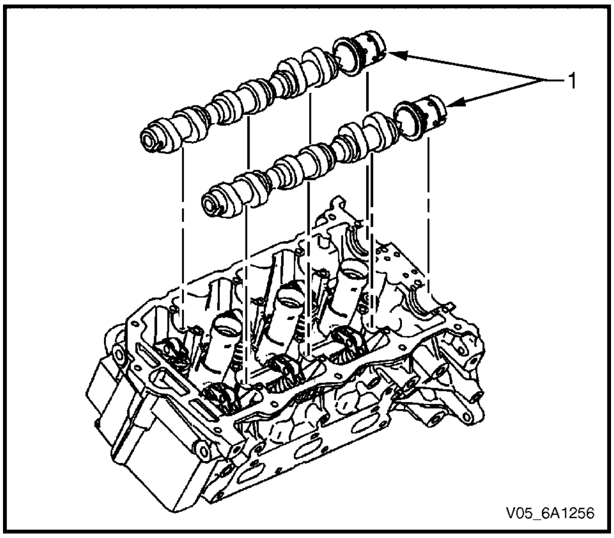


Figure 6A1 – 241

Left-hand Side

1 Remove the left-hand cylinder head camshaft position actuators, refer to 3.18 Camshaft Sprocket.

2 Remove Tool No. EN-46105 – 1 (1) from the left-hand camshafts.

NOTE

Tool No. EN-46105 was installed as part of the left-hand cylinder head camshaft position actuator removal procedure.

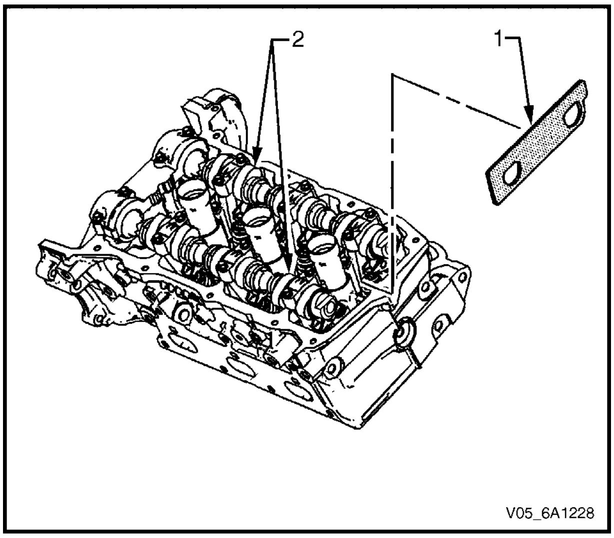


Figure 6A1 – 242

3 Observe the markings (1) on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- An I indicates the intake camshaft.
- An E indicates the exhaust camshaft.
- The number indicates the journal position from the front of the engine.

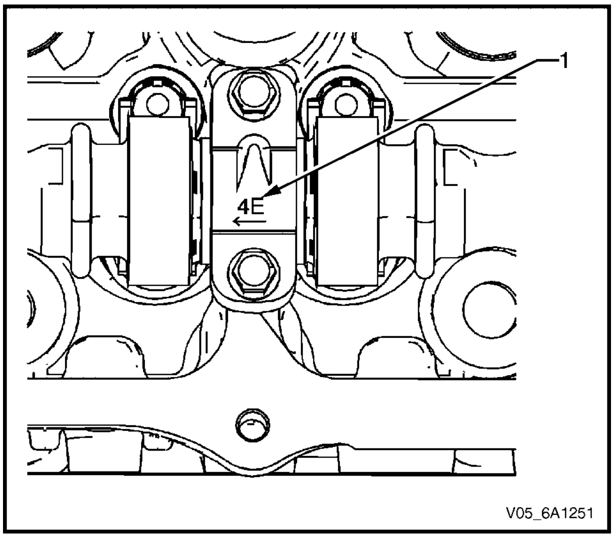


Figure 6A1 – 243

4 Remove the camshaft bearing cap bolts (1) and caps (2).

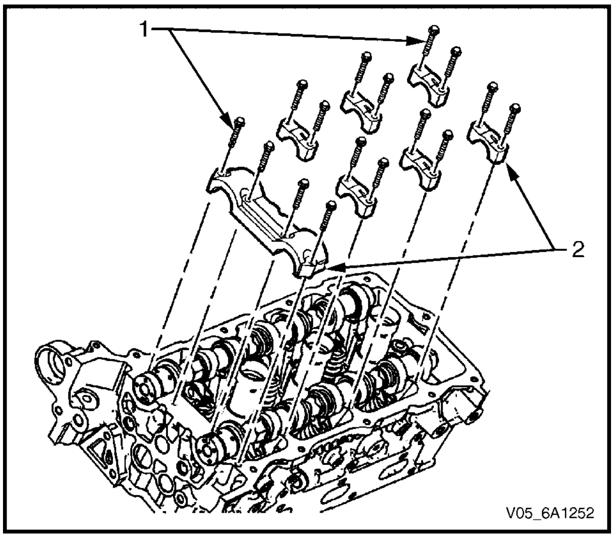


Figure 6A1 – 244

5 Remove the camshafts (1).

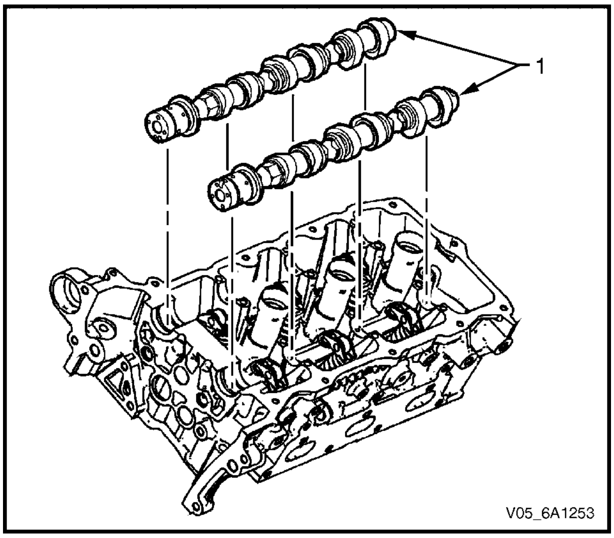


Figure 6A1 – 245

Clean

1 Clean the camshaft in solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the camshaft with compressed air.

Inspect

Camshaft Visual Inspection

1 Inspect the threaded hole (2) for damage.
2 Inspect the camshaft sprocket locating notch (3) for damage or wear.
3 Inspect the camshaft sealing grooves (4) for damage.
4 Inspect the camshaft thrust surface (5) for damage.
5 Inspect the camshaft lobes (6) and journals (7) for the following conditions:
- Excessive scoring or pitting
- Discoloration from overheating
- Deformation from excessive wear, especially the camshaft lobes

6 If any of the above conditions exist on the camshaft, replace the camshaft.

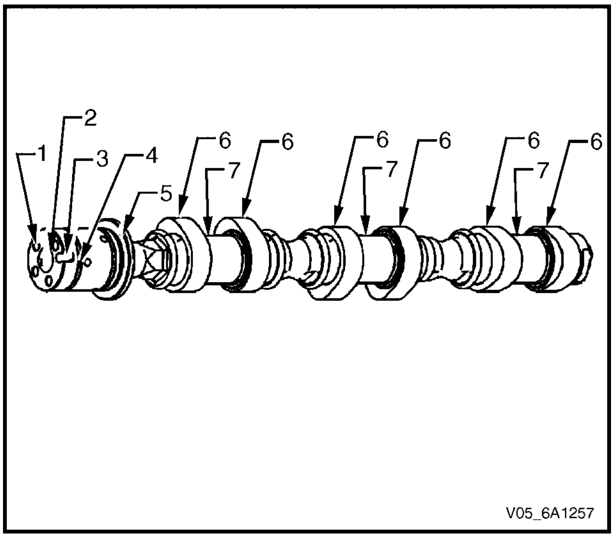


Figure 6A1 – 246

Camshaft Measurement

1 With the camshaft (1) in a suitable fixture (2), measure the camshaft for wear.

2 For camshaft measurement, refer to the following specifications, 5 Specifications.

NOTE

If the camshaft measures outside the specified range, replace the camshaft.

CAUTION

No machining of the camshaft is allowed.

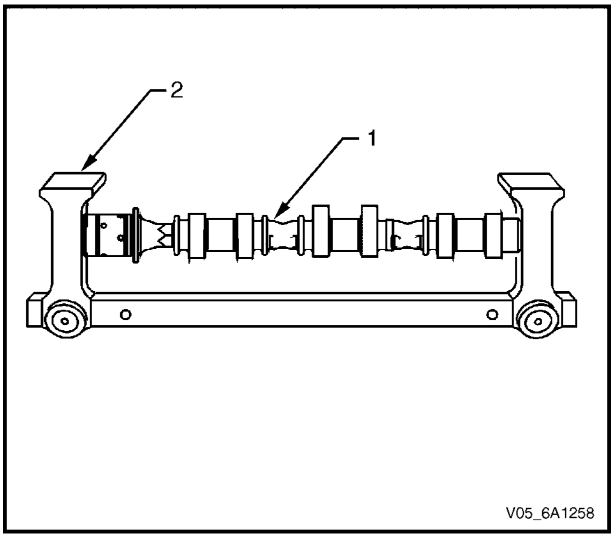


Figure 6A1 – 247

3 Measure the camshaft (2) journals for diameter and out-of-round using an outside micrometer (1).

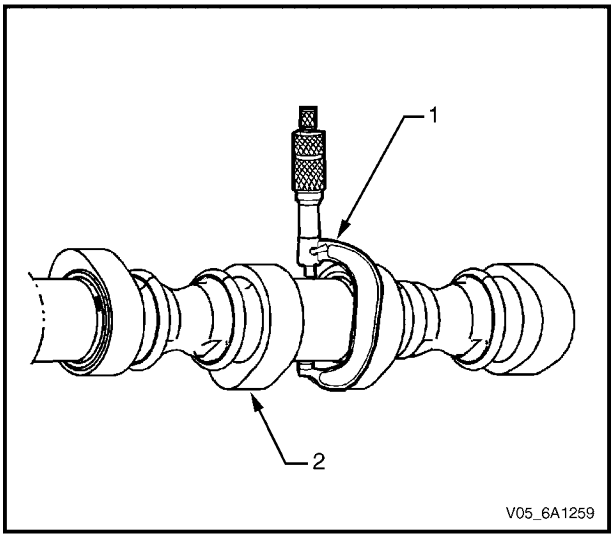


Figure 6A1 – 248

4 Measure the camshaft runout using a dial indicator (1).

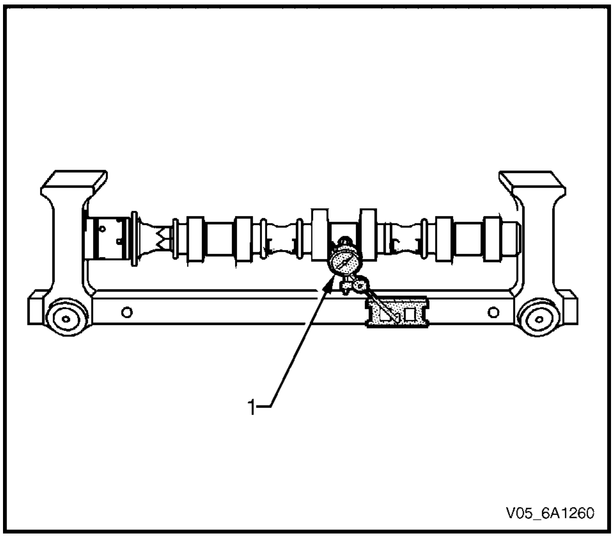


Figure 6A1 – 249

5 Measure the camshaft thrust width for wear using a depth micrometer (A).

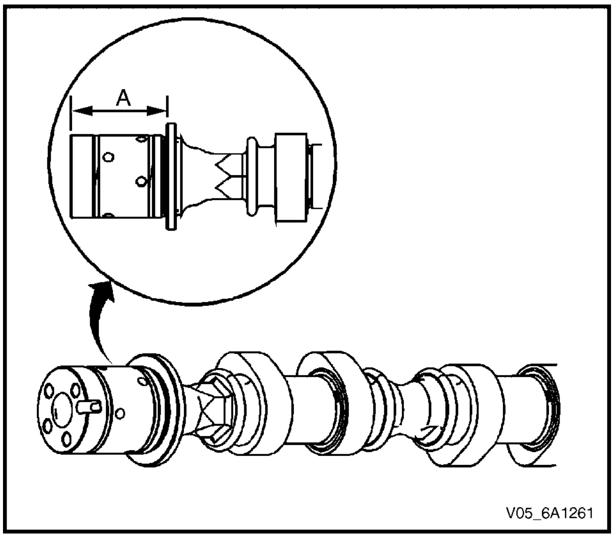


Figure 6A1 – 250

6 Measure the camshaft thrust wall surface for runout using a dial indicator (1).

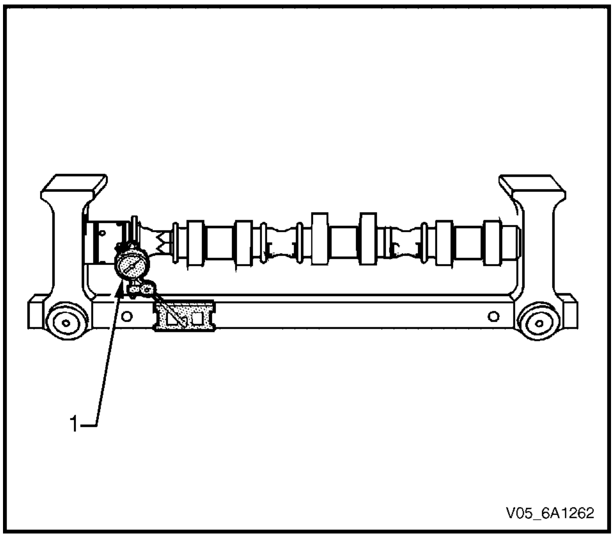


Figure 6A1 – 251

7 Measure the camshaft lobes for wear using a dial indicator (1).

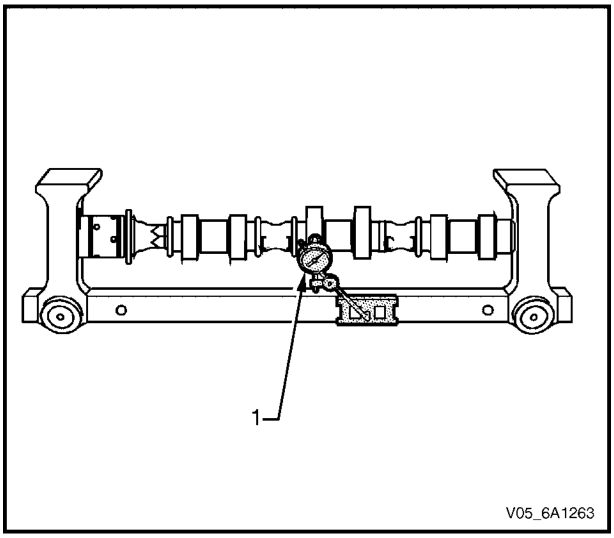


Figure 6A1 – 252

8 Place the dial indicator tip on the base circle (1) of the camshaft lobe.

9 Set the dial indicator at zero.

10 Rotate the camshaft until the indicator tip is at the highest point (2) on the lobe. This reading is the lift of the camshaft lobe.

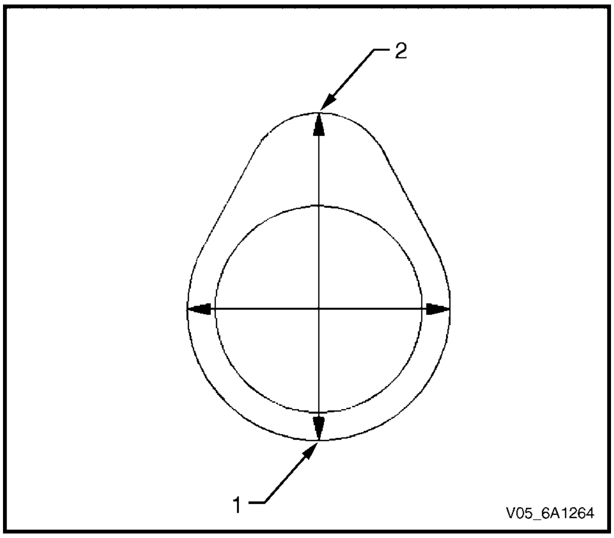


Figure 6A1 – 253

Reinstall

Right-hand Side

1 Select the correct camshaft for the particular installation location. ID markings are on the rear end of each camshaft. The ID markings are defined as follows:

- The first five digits refer to the date and time of production.
  - Example = 3L18H.
- Digits six through nine refer to engine production code.
  - LY7 = Alloytec 190 engine.
- The last two digits refer to position:
  - LI = left-hand intake.
  - LE = left-hand exhaust.
  - RI = right-hand intake.
  - RE = right-hand exhaust.

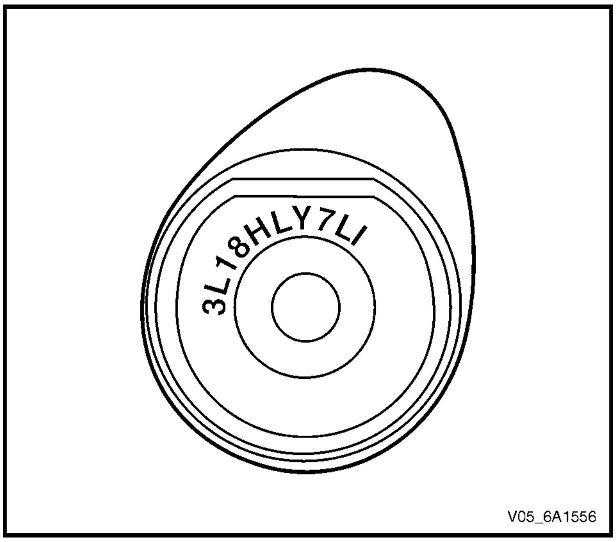


Figure 6A1 – 254

2 Apply a liberal amount of engine oil to the camshaft (1) journals and the right-hand cylinder head camshaft carriers (2).

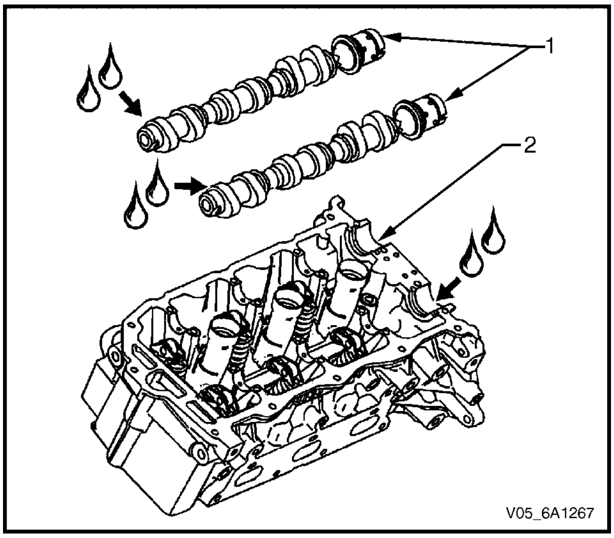


Figure 6A1 – 255

3 Position the camshafts (1) on the cylinder head and assemble the camshaft sprockets to the camshafts.

NOTE

Install the camshaft sprocket bolts but do not tighten at this stage.

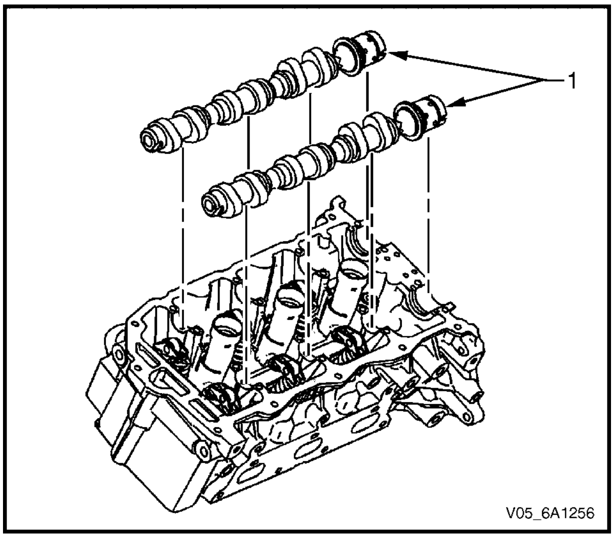


Figure 6A1 – 256

4 Ensure the camshaft lobes are in the neutral position with the flats on the back of the camshafts up and parallel (1) with the right-hand cylinder head camshaft cover rail.

5 Ensure the marks on the right-hand exhaust camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

6 Ensure the marks on the right-hand intake camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

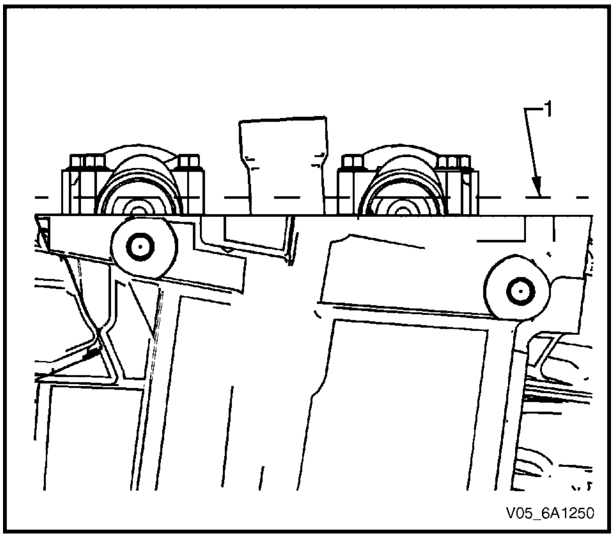


Figure 6A1 – 257

7 Observe the markings on the right-hand cylinder head camshaft bearing caps. Each bearing cap is marked (1) to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- The I indicates the intake camshaft.
- The E indicates the exhaust camshaft.
- The number 1, 3, 5 indicates the cylinder position from the front of the engine.

8 Apply a liberal amount of engine oil to the camshaft bearing caps.

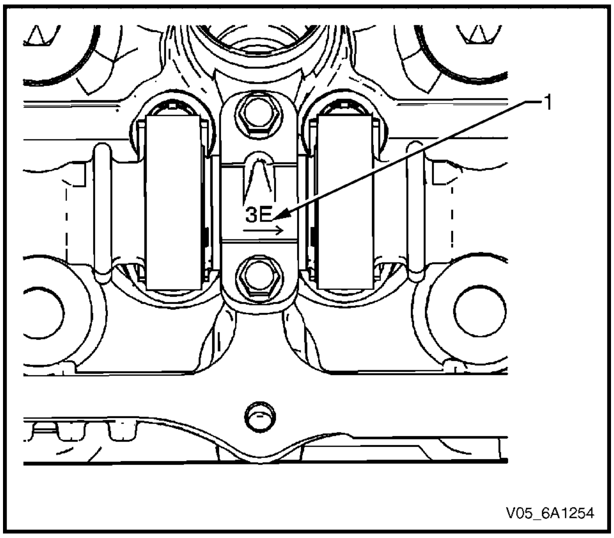


Figure 6A1 – 258

9 Install the camshaft bearing thrust cap (1) in the first journal of the right-hand cylinder head.

10 Install the remaining bearing caps (2) with their orientation mark toward the centre of the cylinder head.

11 Hand start all the camshaft bearing cap bolts (3).

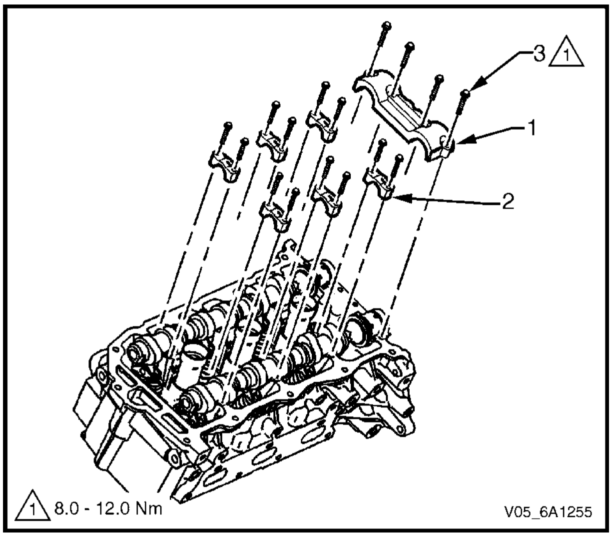


Figure 6A1 – 259

12 Tighten the camshaft bearing cap bolts to the correct torque specification and in the sequence shown.

Camshaft bearing cap attaching bolt torque specification:
Stage 1:..8.0 – 12.0 Nm

13 Loosen the centre intake camshaft bearing cap bolts 1 and 2, and the centre exhaust camshaft bearing cap bolts 3 and 4.

14 Retighten the centre camshaft bearing cap bolts 1, 2, 3 and 4 to the correct torque specification.

Camshaft bearing cap attaching bolt torque specification:
Stage 2:..8.0 – 12.0 Nm

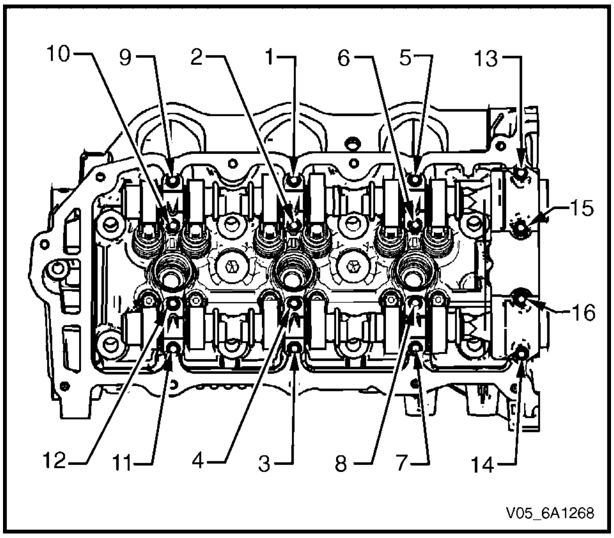


Figure 6A1 – 260

Left-hand Side

1 Select the correct camshaft for the particular installation location. ID markings can be found on the rear end of each camshaft. The ID markings are defined as follows:

- The first five digits refer to the date and time of production.
  - Example = 3L18H.
- Digits six through nine refer to engine production code.
  - LY7 = Alloytec 190 engine.
- The last two digits refer to position:
  - LI = left-hand intake.
  - LE = left-hand exhaust.
  - RI = right-hand intake.
  - RE = right-hand exhaust.

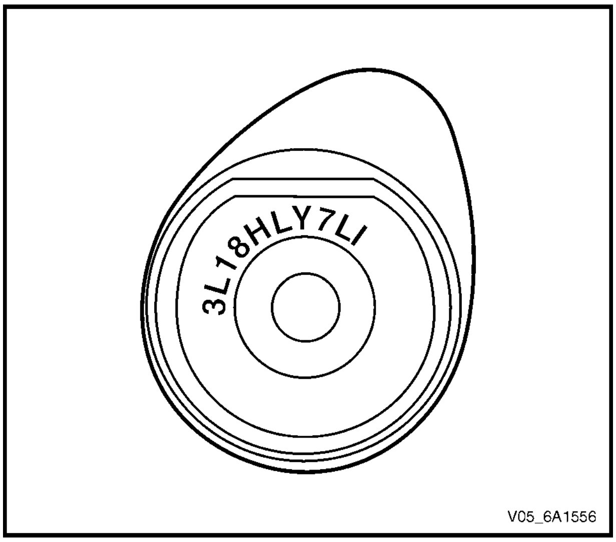


Figure 6A1 – 261

2 Apply a liberal amount of engine oil to the camshaft journals and the left-hand cylinder head camshaft carriers.

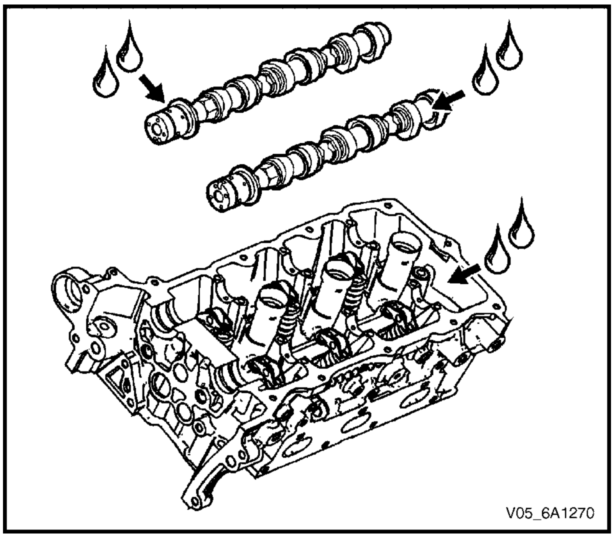


Figure 6A1 – 262

3 Position the camshafts (1) on the cylinder head and assemble the camshaft sprockets to the camshafts.

NOTE

Install the camshaft sprocket bolts but do not tighten at this stage.

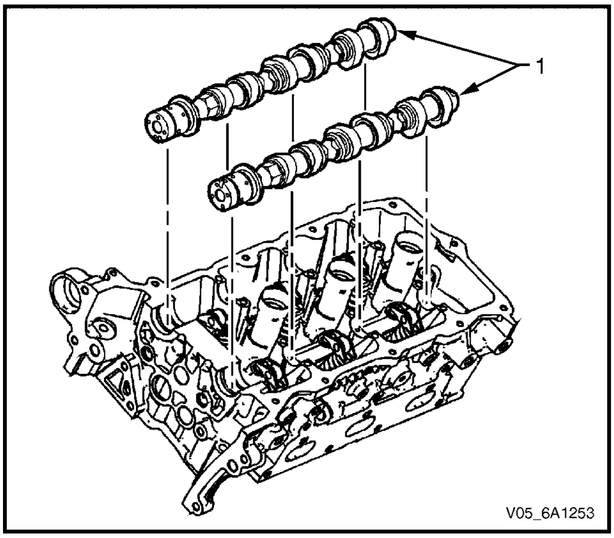


Figure 6A1 – 263

4 Ensure the camshaft lobes are in the neutral position with the flats on the back of the camshafts up and parallel (1) with the left-hand cylinder head camshaft cover rail.

5 Ensure the marks on the left-hand exhaust camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

6 Ensure the marks on the left-hand intake camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

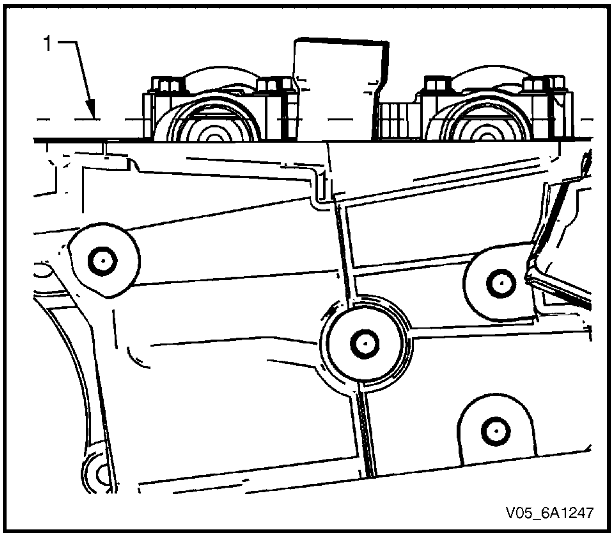


Figure 6A1 – 264

7 Observe the markings on the left-hand cylinder head camshaft bearing caps. Each bearing cap is marked (1) to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- The I indicates the intake camshaft.
- The E indicates the exhaust camshaft.
- The number 2, 4, 6 indicates the cylinder position from the front of the engine.

8 Apply a liberal amount of engine oil to the camshaft bearing caps.

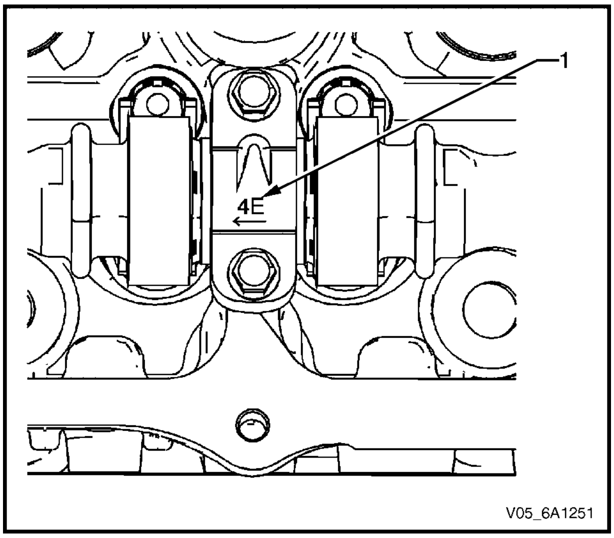


Figure 6A1 – 265

9 Install the camshaft bearing thrust cap (1) in the first journal of the left-hand cylinder head.

10 Install the remaining bearing caps (2) with their orientation mark toward the centre of the cylinder head.

11 Hand start all the camshaft bearing cap bolts (3).

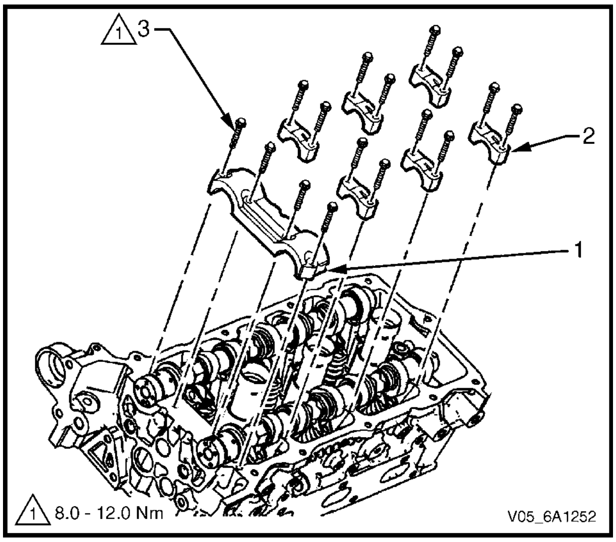


Figure 6A1 – 266

12 Tighten the camshaft bearing cap bolts to the correct torque specification and in the sequence shown.

Camshaft bearing cap bolt torque specification:
Stage 1:..8.0 – 12.0 Nm

13 Loosen the centre intake camshaft bearing cap bolts 1, and 2, and the centre exhaust camshaft bearing cap bolts 3 and 4.

14 Retighten the centre camshaft bearing cap bolts 1, 2, 3 and 4 to the correct torque specification.

Camshaft bearing cap bolt torque specification:
Stage 2:..8.0 – 12.0 Nm

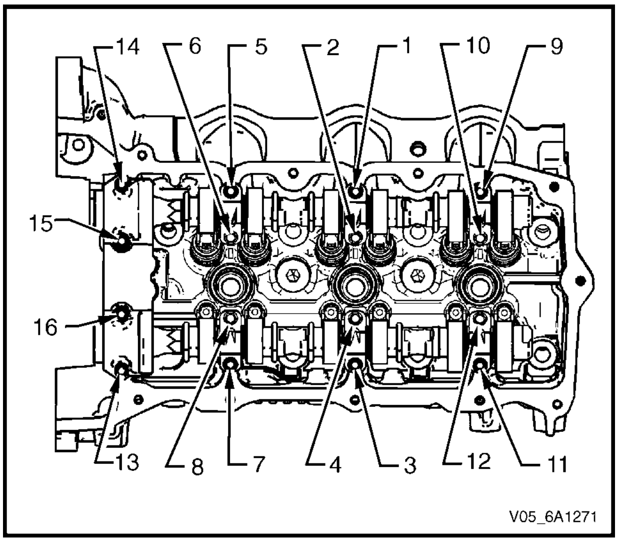


Figure 6A1 – 267

3.20 Rocker Arm

Remove

1. Remove the camshafts from the appropriate cylinder head, refer to 3.19 Camshaft.
2. Remove the rocker arm (1) from the cylinder head (2).

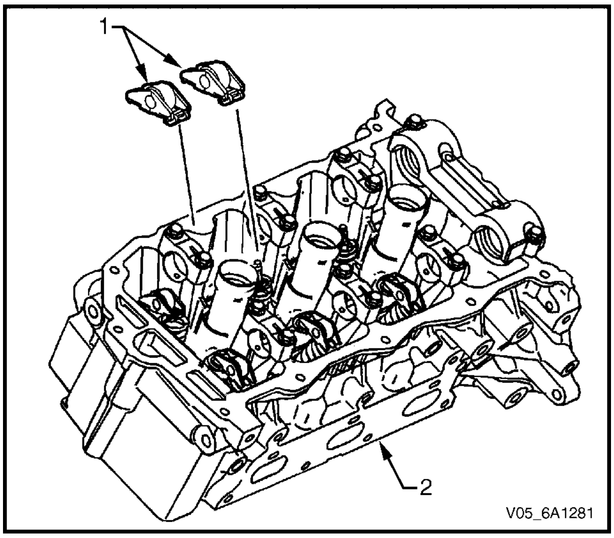


Figure 6A1 – 268

NOTE

Record the rocker arm positions during removal.

CAUTION

If the rocker arms are being reused, they must be reinstalled in their original location.

Clean and Inspect

1. Inspect the rocker arm roller (1) for the following:
   - flat spots,
   - excessive scoring and pitting, and
   - ensure the roller spins freely
2. Inspect the rocker arm valve tip area (2).
3. Inspect the rocker arm stationary hydraulic lash adjuster (SHLA) pivot area (3).
4. Replace the rocker arm as required.

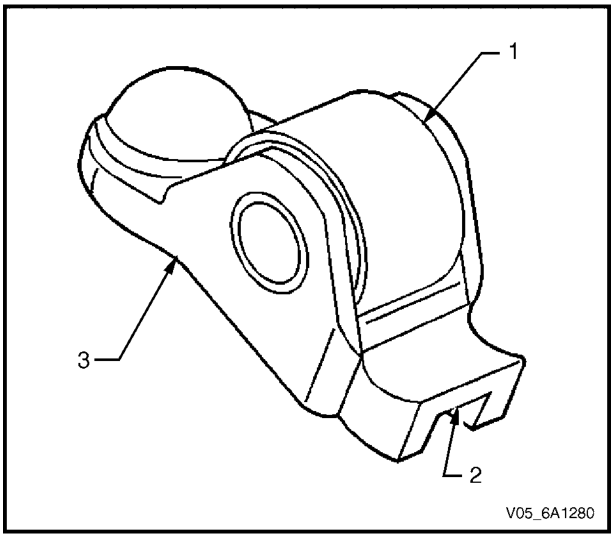


Figure 6A1 – 269

Reinstall

1 Apply a liberal amount of commercially available camshaft / lifter prelube or equivalent to the pivot pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

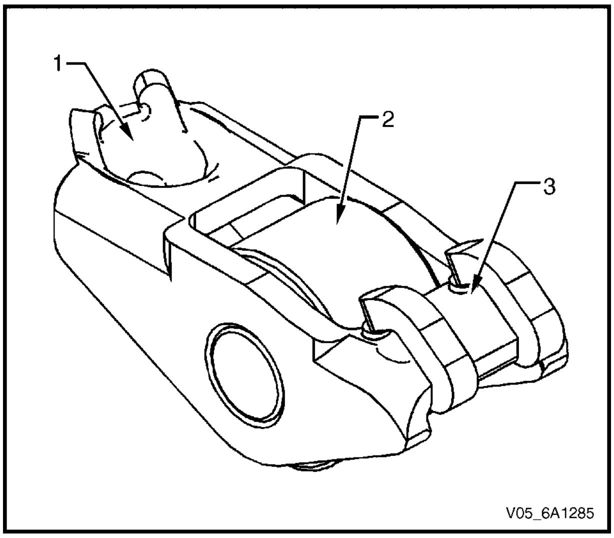


Figure 6A1 – 270

2 Place the rocker arm in position on the valve tip and stationary hydraulic lash adjuster (SHLA). The rounded head end of the arm seats on the SHLA while the flat end seats on the valve tip.

CAUTION

- **The rocker arm (1) must be positioned squarely on the valve tip so the full width of the roller will completely contact the camshaft lobe.**
- **If the rocker arms are being reused, they must be reinstalled in their original location.**

3 Clean the camshaft journals and carriers with a clean, lint-free cloth.

4 Reinstall the camshafts, refer to 3.19 Camshaft.

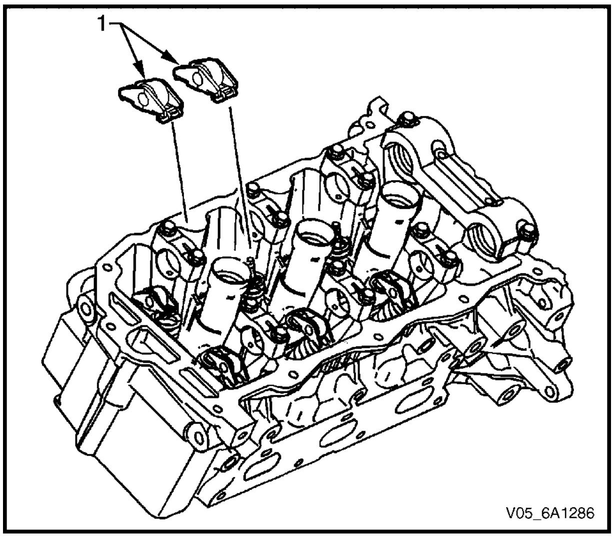


Figure 6A1 – 271

3.21 Stationary Hydraulic Lash Adjuster

Remove

1 Remove the rocker arms from the appropriate cylinder head, refer to 3.20 Rocker Arm.

2 Remove the stationary hydraulic lash adjuster (SHLA) from the cylinder head (2).

CAUTION

- **Do not stroke/cycle the stationary hydraulic lash adjuster (1) plunger without oil in the lower pressure chamber.**
- **Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.**

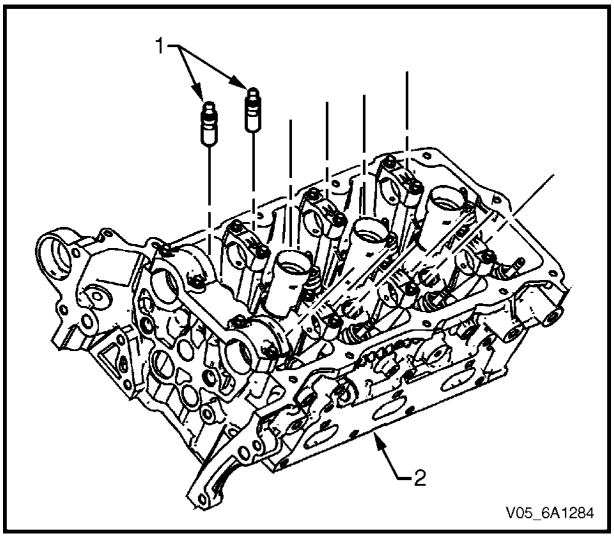


Figure 6A1 – 272

Clean and Inspect

1 Inspect the stationary hydraulic lash adjuster (SHLA) in the following areas:

- a plugged oil passage (1),
- a scored or worn camshaft follower pivot area (2),
- a damaged or broken retainer (3), and
- a severely scuffed or worn SHLA body (4).

2 Replace the SHLA as required.

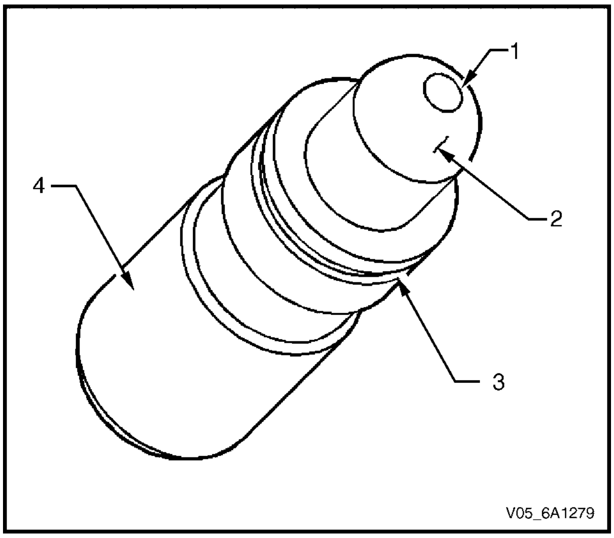


Figure 6A1 – 273

Reinstall

1 Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil. Take precautions to prevent scratching the pivot sphere area of the SHLA.

2 Lubricate the SHLA bores in the cylinder head with clean engine oil.

3 Install the SHLA in the cylinder head (2).

4 Apply a liberal amount of commercially available camshaft/lifter prelube to the SHLA pivot spheres.

5 Install the rocker arms, refer to 3.20 Rocker Arm.

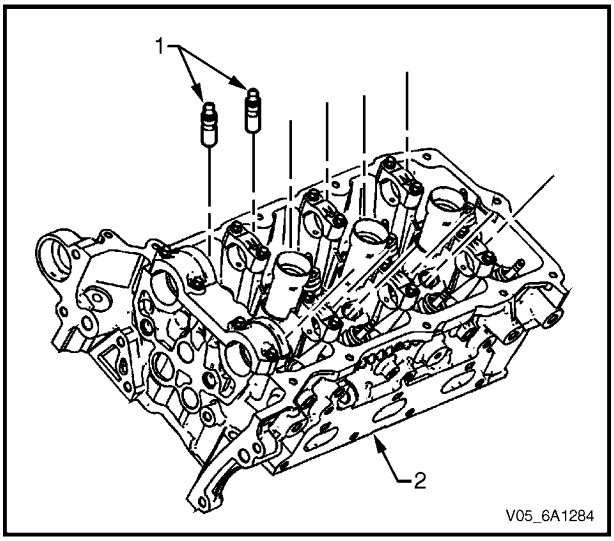


Figure 6A1 – 274

CAUTION

Ensure each lash adjuster (1) is filled with clean engine oil and the adjuster does not tip over, plunger down, before the installation. The loss of oil in the adjuster lower pressure chamber, or the dry stroking/cycling of the adjuster plunger, will allow air to enter the high pressure chamber of the valve lifter. Air in the high pressure chamber of the adjuster may not be purged causing cavitation and extensive engine component damage.

3.22 Cylinder Head Assembly

Remove

Right-hand Side (Bank 1) Cylinder Head

1 Remove the heater hoses and heater pipe assembly, refer to 6B1 Engine Cooling – V6.

2 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

3 Remove the exhaust manifold, refer to 3.11 Exhaust Manifold Assembly.

4 Remove engine harness ground terminal attaching bolts from the cylinder head, refer to 8A Electrical Body and Chassis.

5 Remove the right-hand side secondary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

6 Remove the camshaft sprockets, refer to 3.18 Camshaft Sprocket.

7 Remove the cylinder head attaching bolt (1), eight places.

8 Remove the cylinder head.

NOTE

There is no bolt fitted to the hole in the rear of the right-hand-hand cylinder head.

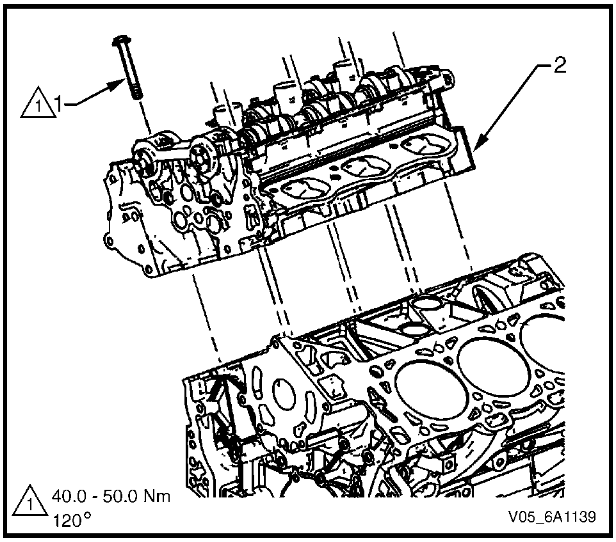


Figure 6A1 – 275

9 Remove and discard the cylinder head gasket (1).

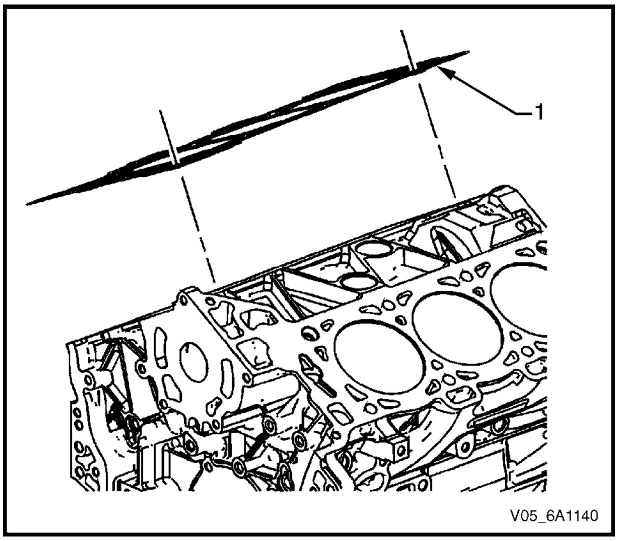


Figure 6A1 – 276

Left-hand Side (Bank 2) Cylinder Head

1 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

2 Remove the exhaust manifold, refer to 3.11 Exhaust Manifold Assembly.

3 Remove the power steering reservoir and pump mounting brackets, refer to 3.8 Power Steering Pump Bracket.

NOTE

Do not disconnect the power steering pipes and/or hoses.

4 Remove the oil filter adapter upper bolt.

NOTE

Do not remove the oil filter adapter.

5 Remove the engine coolant temperature (ECT) sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

6 Remove engine harness ground terminal attaching bolt from cylinder head, refer to 8A Electrical Body & Chassis.

7 Remove the left-hand bank secondary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

8 Remove the camshaft position actuators, refer to 3.18 Camshaft Sprocket.

9 Remove the front M8 (1) cylinder head attaching bolt, two places.

10 Remove the cylinder head attaching bolt (2), eight places.

11 Remove the cylinder head (3).

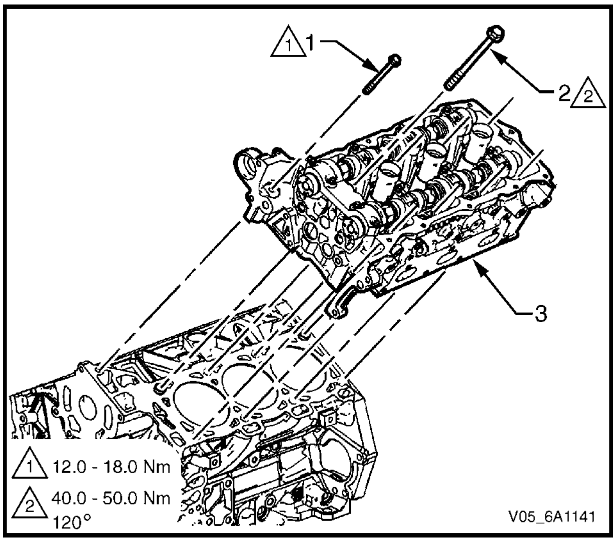


Figure 6A1 – 277

12 Remove and discard the cylinder head gasket (1).

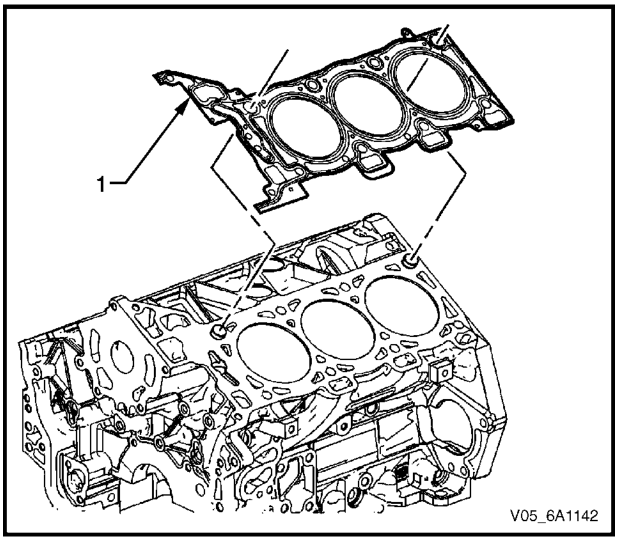


Figure 6A1 – 278

Disassemble

1 Using an appropriately sized deep socket (1) and a plastic hammer (2), lightly tap on the valve spring retainer to loosen the valve collets.

CAUTION

Ensure valve heads will not contact anything during this step in order to avoid bending or damage.

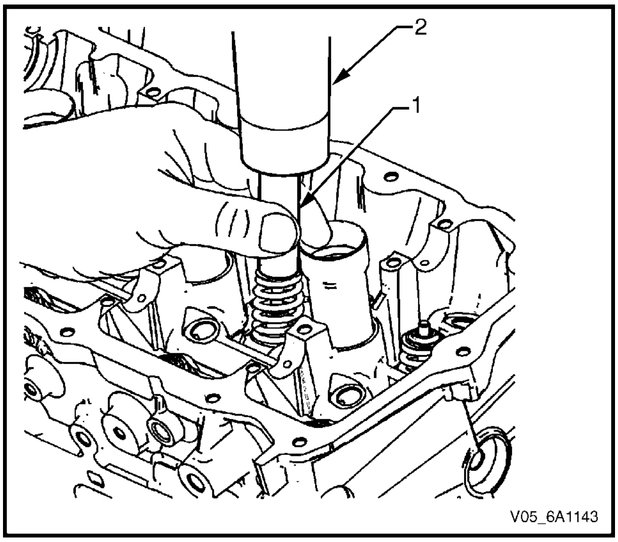


Figure 6A1 – 279

CAUTION

Do not compress the valve springs less than 24.0 mm. Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

WARNING

Compressed valve springs (1) have high tension against the valve spring compressor (2). Valve springs that are not correctly compressed by, or are released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

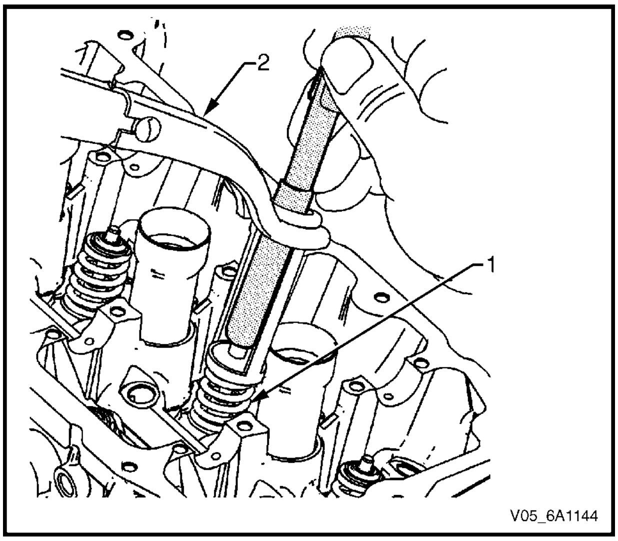


Figure 6A1 – 280

2 Compress the valve spring (1) using valve spring compressor Tool No. J-8062 (2) and adaptor Tool No. EN-46119.

3 Remove the valve collets using Tool EN-46117 (1).

4 Remove the valve spring compressor (2) and the adapter (3).

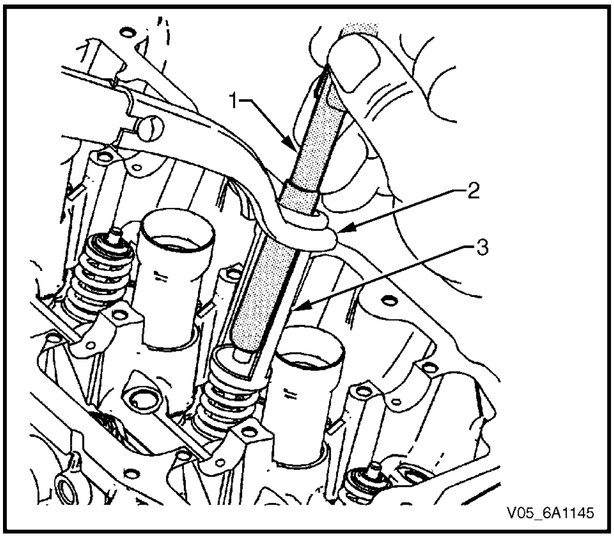


Figure 6A1 – 281

5 Remove the valve spring retainer (1).

6 Remove the valve spring (2).

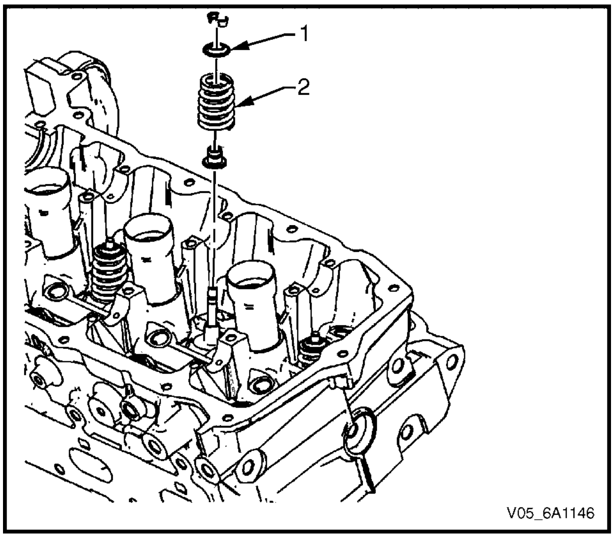


Figure 6A1 – 282

7 Remove the valves (1).

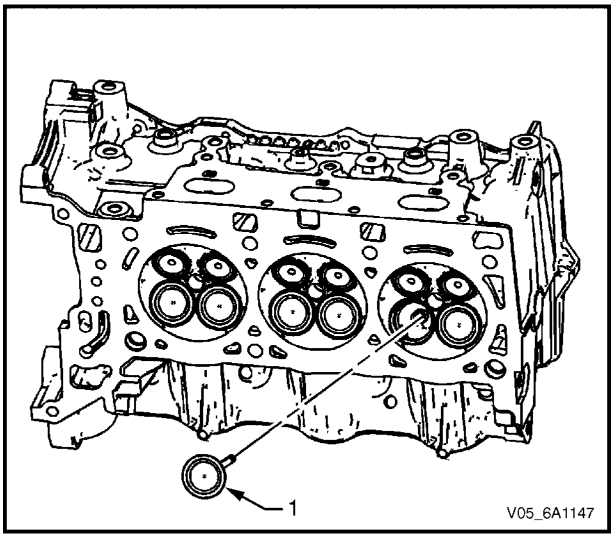


Figure 6A1 – 283

CAUTION

Never reuse a valve stem oil seal.

8 Remove the valve stem oil seal using Tool No. EN-46116 and discard.

9 Repeat these procedures for the remaining valves.

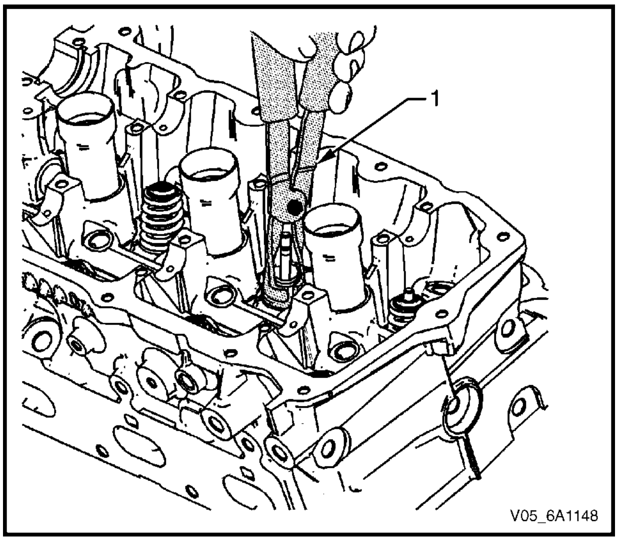


Figure 6A1 – 284

10 Remove the cylinder head oil gallery expansion plugs (1).

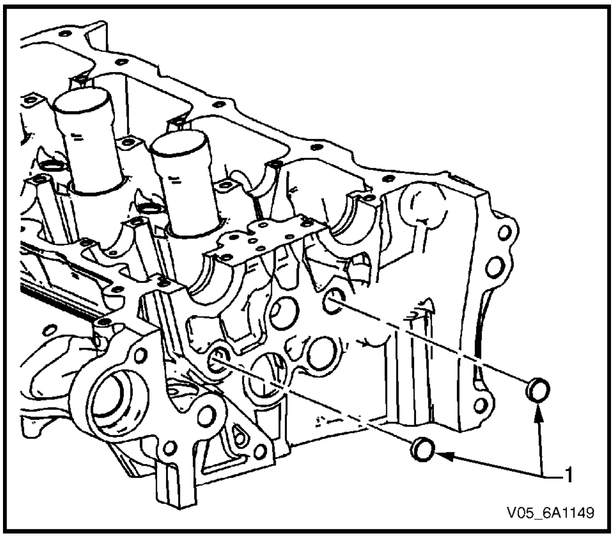


Figure 6A1 – 285

11 Remove the cylinder head coolant threaded plugs (1).

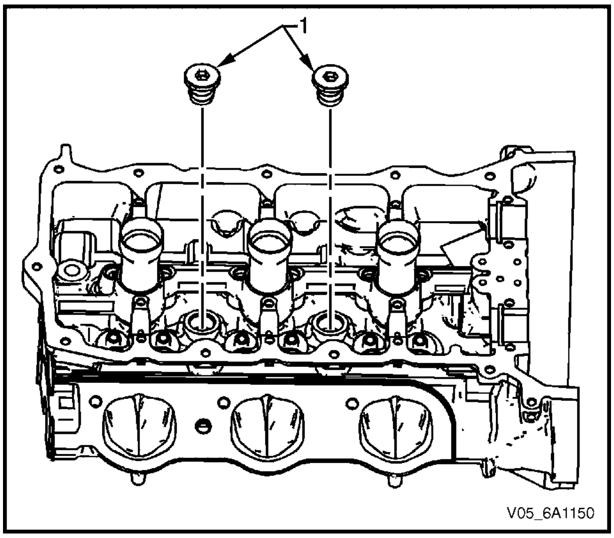


Figure 6A1 – 286

Clean

CAUTION

Due to the aluminium alloy construction of the cylinder head, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use a wood or plastic scraper as an alternative.

1 Remove any old thread sealant, gasket material or sealant using commercially available plastic or wooden scraper.
2 Clean all cylinder head surfaces with non-corrosive solvent.

WARNING

Safety glasses must be worn when using compressed air.

3 Blow out all the oil galleries using compressed air.
4 Remove any carbon deposits from the combustion chambers.
5 Clean any debris or build-up from the lifter pockets.

Inspect

Visual Inspection

1 Inspect the cylinder head (1) camshaft bearing surfaces for the following conditions:
- excessive scoring or pitting,
- discoloration from overheating, and
- deformation from excessive wear.

2 If any of the above conditions exist on the camshaft bearing surfaces, replace the cylinder head. Do not machine the camshaft bearing journals.

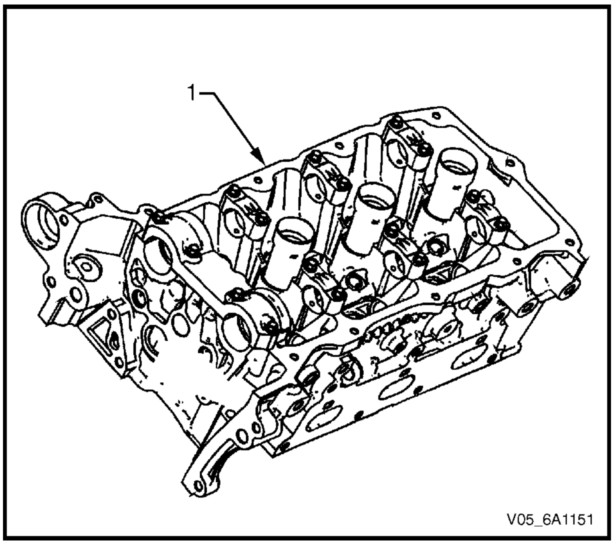


Figure 6A1 – 287

3 Inspect the cylinder head for the following:
- Cracks, damage or pitting in the combustion chambers.
- Debris in the oil galleries. continue to clean the galleries until all debris is removed.
- Coolant leaks or damage to the deck face sealing surface. if coolant leaks are present, measure the surface warpage as described under Cylinder Head Measurement within this Section.
- Burrs or any defects that would degrade the sealing of a new secondary camshaft chain tensioner gasket.
- Damage to any gasket surfaces.
- Damage to any threaded bolt holes.
- Burnt or eroded areas in the combustion chamber.
- Cracks in the exhaust ports and combustion chambers.
- External cracks in the water passages.
- Restrictions in the intake or exhaust passages.
- Restrictions in the cooling system passages.
- Rusted, damaged or leaking core plugs.

4 If the cylinder head is cracked or damaged, it must be replaced. No welding or patching of the cylinder head is recommended.

Cylinder Head Measurement

NOTE

For all cylinder head and associated component specifications, refer to 5 Specifications.

Camshaft Journal Clearance

1 Install the camshaft bearing cap in the cylinder head without the camshaft.

2 Install the camshaft cap bolts and tighten to the correct torque specification

Camshaft bearing cap attaching bolt........8.0 – 12.0 Nm.

3 Measure the camshaft bearings using an inside micrometer.

4 Subtract the camshaft journal diameter from the camshaft bearing diameter. This will provide the running clearance. If the running clearance exceeds specifications and the camshaft journals are within specification, replace the cylinder head.

Camshaft Journal Alignment

1 Ensure the camshafts are serviceable, refer to 3.19 Camshaft for measuring procedures.

2 Inspect the cylinder head camshaft bearing surfaces for any imperfections or scratches that could inhibit correct camshaft clearances. Repair minor imperfections or scratches.

3 Install the camshafts in the cylinder head.

4 Install the camshaft bearing caps.

5 Install the camshaft cap bolts and tighten to the correct torque specification.

Camshaft bearing cap attaching bolt........8.0 – 12.0 Nm.

6 Ensure the camshafts spin freely in the cylinder head. If the camshaft does not run freely, replace the cylinder head.

Deck Flatness Inspection

1 Ensure the cylinder head decks are clean and free of gasket material.

2 Inspect the surface for any imperfections or scratches that could inhibit correct cylinder head gasket sealing.

3 Place a straight-edge (1) diagonally across the cylinder head (2) deck face surface.

4 Measure the clearance between the straight-edge and the cylinder head deck face using a feeler gauge at four points along the straight-edge.

5 If the warpage is less than 0.05 mm, the cylinder head deck surface does not require resurfacing.

6 If the warpage is between 0.05±0.20 mm or any imperfections or scratches that could inhibit correct cylinder head gasket sealing are present, the cylinder head deck surface requires resurfacing.

7 If resurfacing is required the maximum amount that can be removed is 0.25 mm.

8 If the cylinder head deck surface requires more than 0.25 mm material removal the head must be replaced.

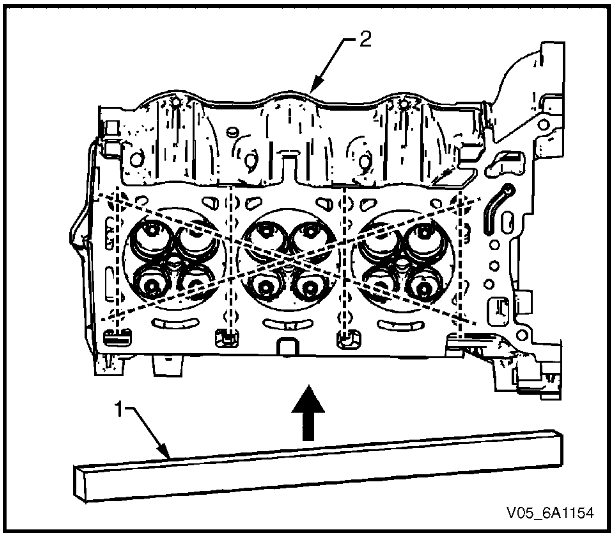


Figure 6A1 – 288

Valve Guide Measurement

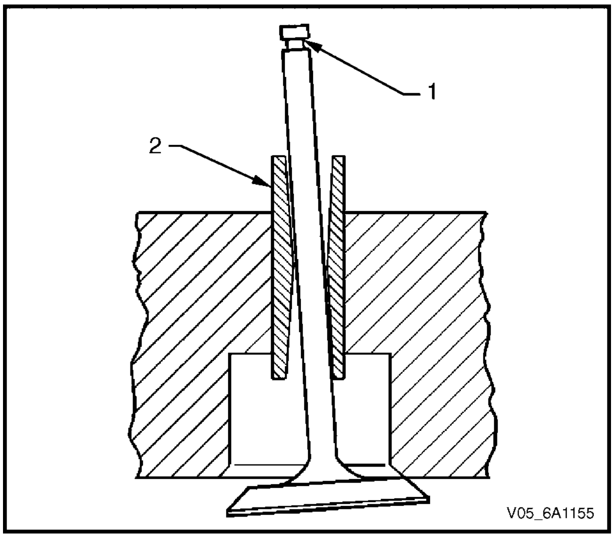


Figure 6A1 – 289

1 Measure the valve stem (1) to-guide (2) clearance. Excessive valve stem-to-guide clearance may cause excessive oil consumption and may also cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of the valve and will disturb the engine assembly smoothness.

2 Clamp a dial indicator to the cylinder head at the camshaft cover rail.

3 Locate the dial indicator so the movement of the valve stem from side to side, crossways to the cylinder head, will cause a direct movement of the indicator stem. The dial indicator stem must contact the side of the valve stem just above the valve guide.

4 Drop the valve head about 0.064 mm off the valve seat.

5 Use light pressure when moving the valve stem from side to side to obtain a clearance reading, refer to 5 Specifications.

- If the clearance for the valve is greater than specified and a new standard diameter valve stem will not bring the clearance within specifications, the valve guide may be oversized by 0.075 mm using the valve guide reamer, Tool No. J 42096 or by 0.375 mm using the valve guide reamer, Tool No. EN-46120. Two sizes of oversized valve stems are available for service.
- Valve guide wear at the bottom 10 mm of the valve guide is not significant enough to affect normal operation.
- If over sizing the guide does not bring the clearance within specifications, replace the cylinder head.

Valve Spring Inspection and Measurement

Inspection Procedure

1 Clean the valve springs in solvent.

WARNING

Safety glasses must be worn when using compressed air

2 Dry the valve springs with compressed air.

3 Inspect the valve springs for broken coils or coil ends.

Measurement Procedure

1 Use a commercially available valve spring tester to measure the valve spring tension, refer to 5 Specifications.

CAUTION

Do not use shims to increase spring load. The use of shims can cause the valve spring to bottom out before the camshaft lobe is at peak lift.

2 If low valve spring load is found, replace the valve springs.

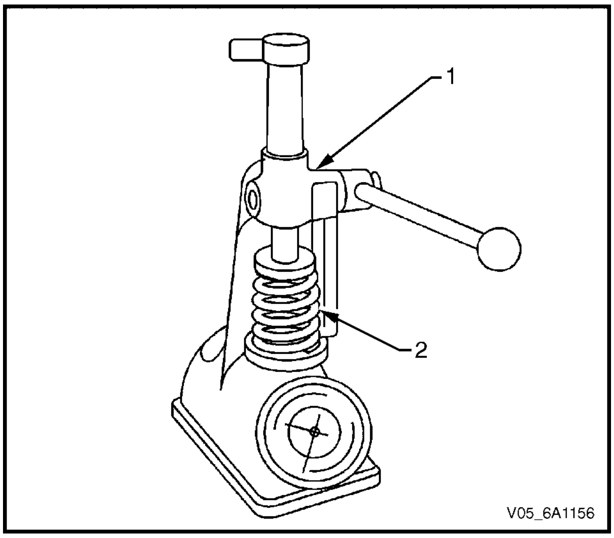


Figure 6A1 – 290

Valve and Seat Grinding

Valve Cleaning Procedure

CAUTION

Do not use a wire brush on any part of the valve stem. The valve stem is chrome plated to provide enhanced wear characteristics. Wire brushing the stem could remove the chrome plating.

1 Use soft bristle brush to clean any carbon build-up from the valve head.

2 Thoroughly clean the valve with solvent and wipe dry.

Valve Visual Inspection Procedure

1 Inspect the valve for damage from the head to tip for the following conditions:
- pitting in the valve seat area (1),
- lack of valve margin (2),
- bending in the valve stem (3),
- pitting or excessive wear in the stem (4),
- worn valve key grooves (5), and
- worn valve tip (6).

2 Replace the valve if any of these conditions exist.

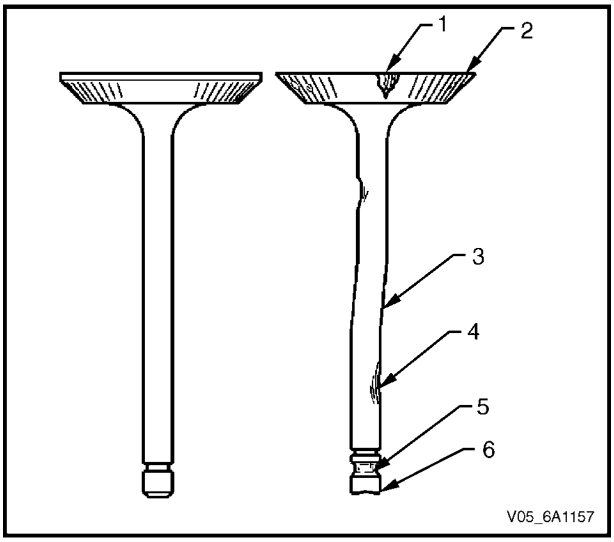


Figure 6A1 – 291

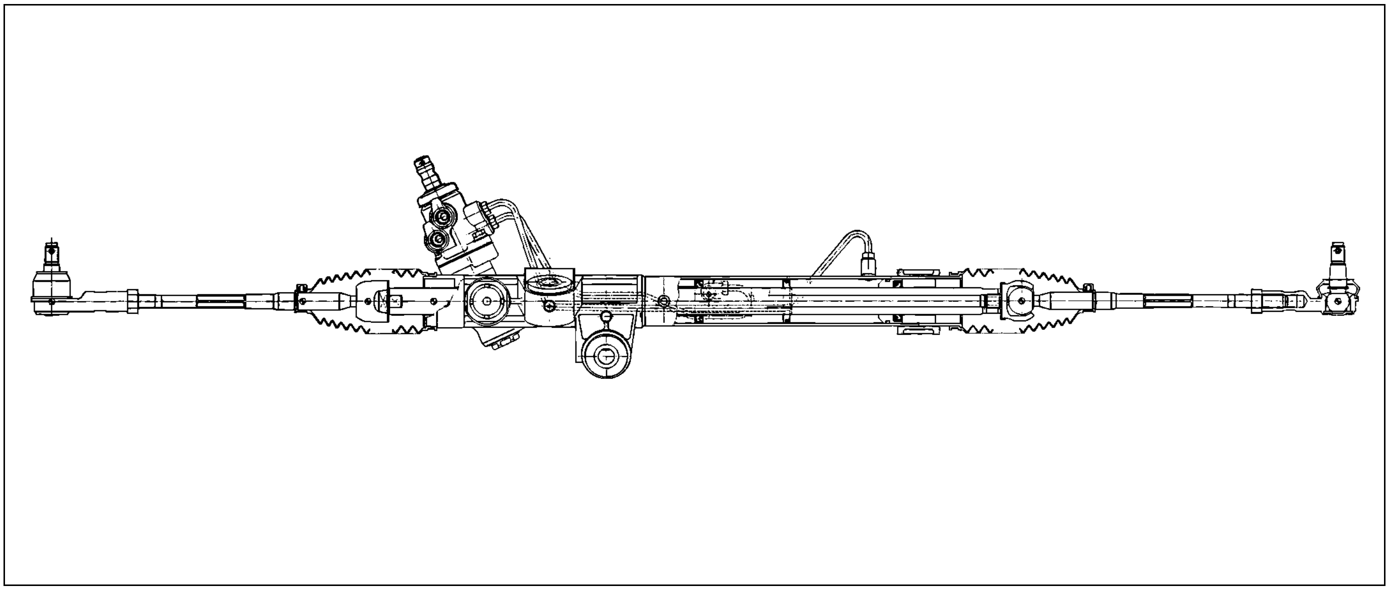
Valve Measurement and Reconditioning Overview

Correct valve service is critical to engine performance. Therefore, all detailed measurement procedures must be followed to identify components that are out of specification. If the measurement procedures reveal the valve or valve seat must be reconditioned, it is critical to perform the measurement procedures after reconditioning.

General Description

The hydraulic power steering system consists of a pump, an oil reservoir, a steering unit, a pressure hose and a return hose.

Power Steering Unit



440R300001

The power steering unit is a rack and pinion type.
The toe-in angle can be adjusted by turning the rod on each side.
The steering housing cannot be disassembled.

Valve Seat Width Measurement Procedure

1 Measure the valve seat (1) width in the cylinder head using a scale (2).

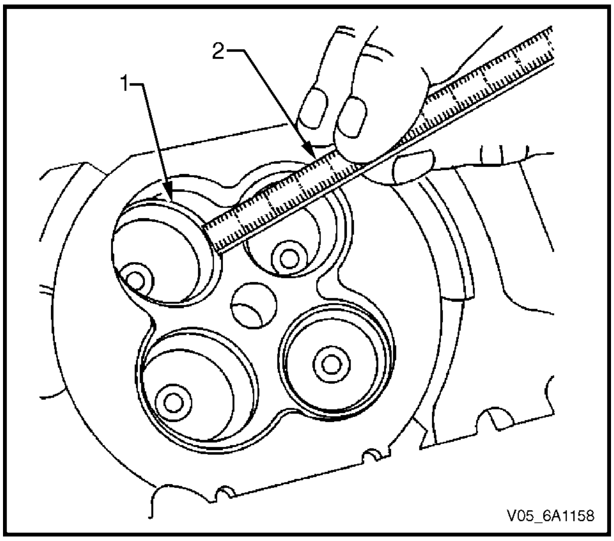


Figure 6A1 – 292

2 Measure the seat width on the valve face (1) using a correct scale.

CAUTION

The seat contact area must be at least 0.5 mm from the outer diameter (margin) of the valve. If the contact area is too close to the margins, the seat must be reconditioned to move the contact area away from the margin.

3 Compare the measurements with the specifications, refer to 5 Specifications.

4 If the seat widths are acceptable, check the valve seat roundness, refer to Valve Seat Roundness Measurement Procedure in this Section.

5 If the seat width is not acceptable, grind the valve seat to bring the width back to specification. Correct valve seat width is critical to providing the correct amount of valve heat dissipation, refer to Valve and Seat Reconditioning Procedure in this Section.

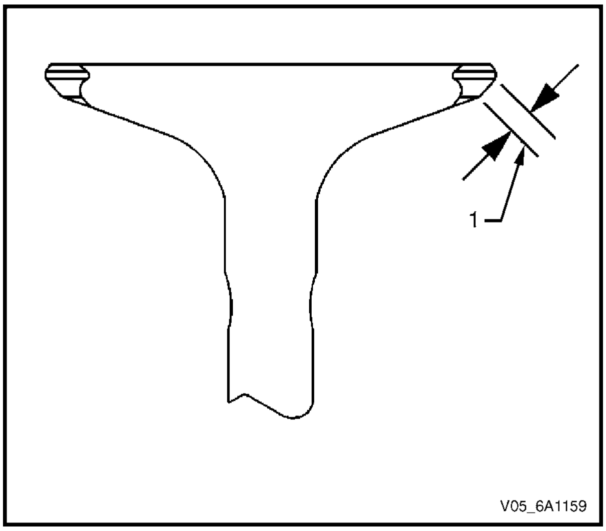


Figure 6A1 – 293

Valve Seat Roundness Measurement Procedure

1 Measure the valve seat roundness using a dial indicator attached to a tapered pilot installed in the guide. The pilot should have a slight bind when installed in the guide.

CAUTION

The correct size pilot must be used. Do not use adjustable diameter pilots. Adjustable pilots may damage the valve guides.

2 Compare your measurements with the specifications, refer to 5 Specifications.

3 If the valve seat exceeds the roundness specification, grind the valve and valve seat, refer to Valve and Seat Reconditioning Procedure in this Section.

4 If new valves are being used, the valve seat roundness must be within 0.05 mm.

Valve Margin Measurement Procedure

1 Measure the valve margin using an appropriate scale.
2 Refer to 5 Specifications for minimum valve margin and compare them to your measurements.
3 If the valve margins are beyond specification, replace the valves.
4 If the valve margins are within specification and do not require refacing, test the valve for seat concentricity, refer to Valve-to-Seat Concentricity Measurement Procedure in this Section.

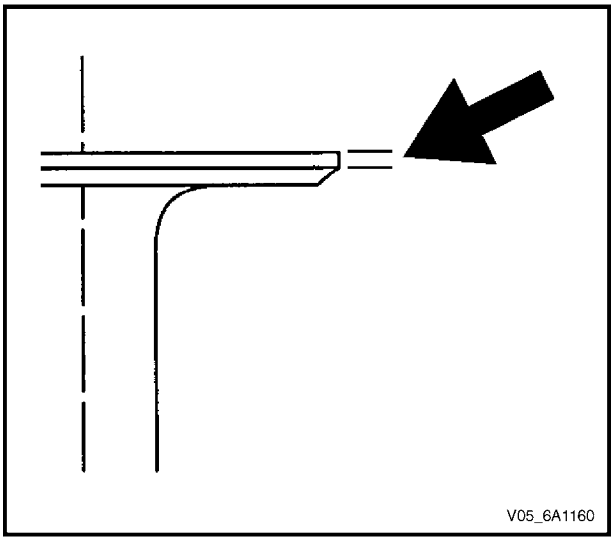


Figure 6A1 – 294

Valve-to-Seat Concentricity Measurement Procedure

Checking the valve-to-seat concentricity determines whether the valve and seat are sealing correctly.

Measure the valve face and the valve seat to ensure correct valve sealing.

1 Coat the valve face lightly with blue dye (3).
2 Install the valve in the cylinder head.
3 Turn the valve against the seat with enough pressure to wear off the dye.
4 Remove the valve from the cylinder head.
5 Inspect the valve face.

NOTE

- If the valve face is concentric, providing a correct seal, with the valve stem, a continuous mark (1) will be made around the entire face (2).
- The wear mark must be at least 0.5 mm from the margin of the valve. If the wear mark is too close to the margin, the seat must be reconditioned to move the contact area away from the margin.
- If the face is not concentric with the stem, the mark will not be continuous around the valve face. The valve should be refaced or replaced and the seat must be reconditioned, refer to Valve and Seat Reconditioning Procedure in this Section.

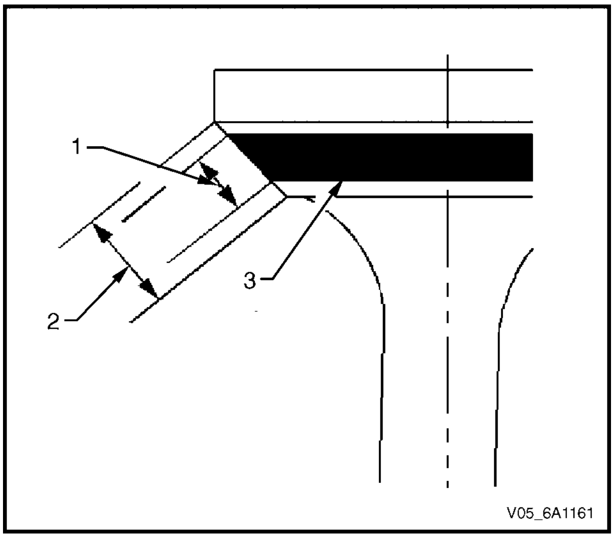


Figure 6A1 – 295

Valve and Seat Reconditioning Procedure

If the valve seat width, roundness or concentricity are beyond specifications, grind the seats in order to ensure correct heat dissipation and prevent the build up of carbon on the seats.

If valve seat reconditioning is required, reface the valve face, unless a new valve is used.

1 Grind the valve seats (2) to the correct angle specification, refer to 5 Specifications.

2 Using the correct angle specification, grind and relieve the valve seats (1) to correctly position the valve seating surface (2) to the valve.

3 Using the correct angle specification, grind and undercut the valve seats (3) to narrow the valve seat widths to the specifications, refer to 5 Specifications.

4 If the original valve is being used, grind the valve to the specifications, refer to 5 Specifications. Measure the valve margin again after grinding, refer to Valve Margin Measurement Procedure in this Section. Replace the valve if the margin is out of specification. New valves do not require grinding.

5 When grinding the valves and seats, grind off as little material as possible. Cutting valve seat results in lowering the valve spring pressure.

6 Install the valve in the cylinder head.

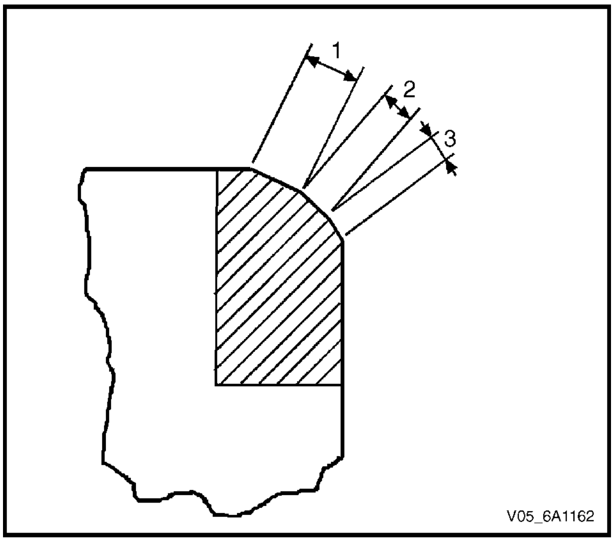


Figure 6A1 – 296

CAUTION

If using refaced valves, lap the valves into the seats with a fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that minimal lapping is required. Excessive lapping will groove the valve face and prevent a good seat when hot.

NOTE

- Clean any remaining lapping compound from the valve and seat with solvent and compressed air prior to final assembly.
- If fitting new valves, do not lap the valves under any condition.

7 After obtaining the correct valve seat width in the cylinder head, measure the valve stem height, refer to Valve Stem Height Measurement Procedure in this Section.

8 If the valve stem height is acceptable, test the seats for concentricity, refer to Valve-to-Seat Concentricity Measurement Procedure in this Section.

Valve Stem Height Measurement Procedure

CAUTION

To determine the valve stem height measurement, measure from the valve spring seat to the valve spring retainer.

1 Install the valve into the valve guide.
2 Ensure the valve is seated to the valve seat.
3 Install the valve stem oil seal.
4 Install the valve spring retainer and valve stem keys.
5 Measure the distance (1) between the cylinder head to the bottom of the valve spring retainer, refer to 5 Specifications.
6 If the maximum height specification is exceeded, a new valve should be installed and the valve stem height re-measured.

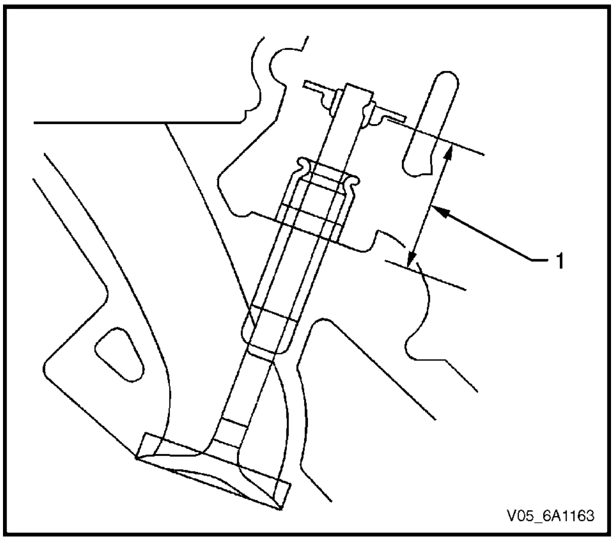


Figure 6A1 – 297

CAUTION

Do not grind the valve stem tip. The tip of the valve is hardened and grinding the tip will eliminate the hardened surface causing premature wear and possible engine damage.

CAUTION

Do not use shims to adjust valve stem height. The use of shims will cause the valve spring to bottom out before the camshaft lobe is at peak lift and engine damage could result.

7 If the valve stem height still exceeds the maximum height specification, the cylinder head must be replaced.

Assemble

1 Install the cylinder head coolant threaded plugs (1) and tighten to the correct torque specification.

Cylinder head threaded plug ....31.0 Nm

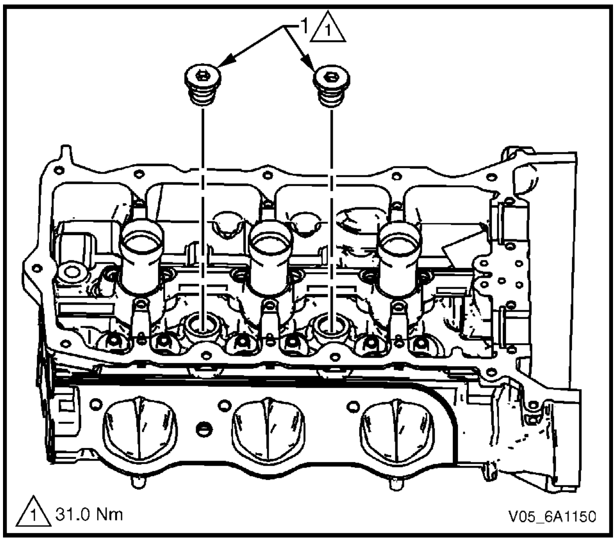


Figure 6A1 – 298

2 Install the cylinder head oil gallery expansion plugs (1).

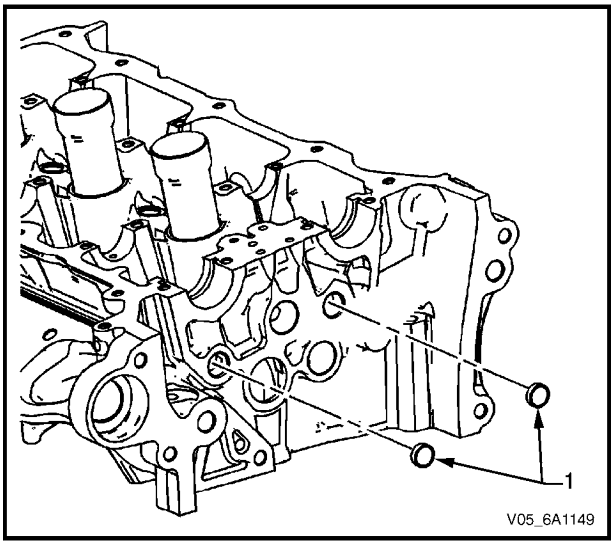


Figure 6A1 – 299

CAUTION

- **Never reuse a valve stem oil seal. Always use new seals when assembling the cylinder head.**
- **Force should only be applied to the valve spring contact area of the new valve stem oil seal during installation.**

3 Fit the valve stem oil seals onto the guides using Tool No. EN-46116 (1).

4 Push and twist the valve stem oil seal into position on the valve guide until the seal positively locks on the guide using Tool No. EN-46116.

5 Lubricate the valve stem and valve guide ID with clean engine oil.

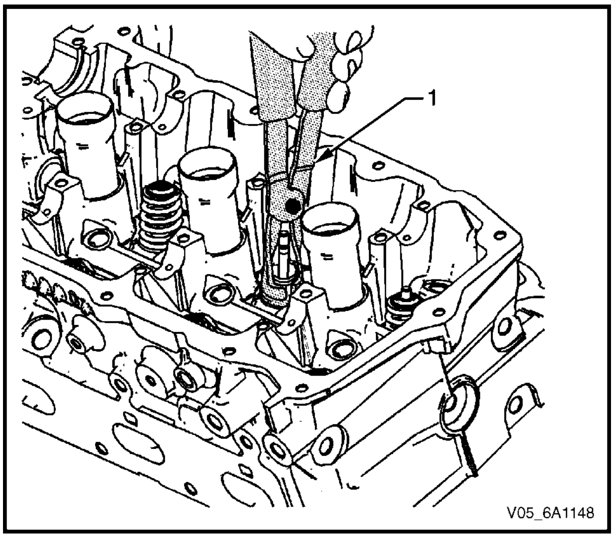


Figure 6A1 – 300

CAUTION

The valve stem oil seal must not come loose from the valve guide when the valve (1) is installed.

6 Insert the valve into the valve guide until it bottoms on the valve seat.

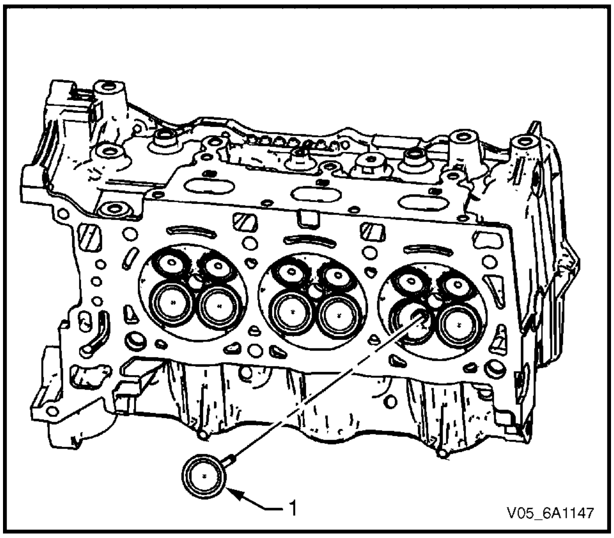


Figure 6A1 – 301

7 Position the valve spring (2) on the spring seat (1).

8 Place the valve spring retainer onto the valve spring.

CAUTION

Do not compress the valve springs less than 24.0 mm. Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

WARNING

Compressed valve springs (1) have high tension against the valve spring compressor (2). Valve springs that are not correctly compressed by, or are released from, the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

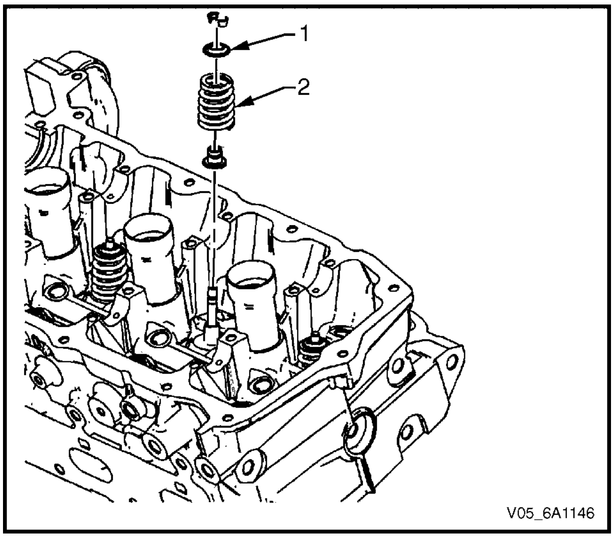


Figure 6A1 – 302

9 Compress the valve spring using valve spring compressor Tool No. J-8062 and adaptor Tool No. EN-46119.

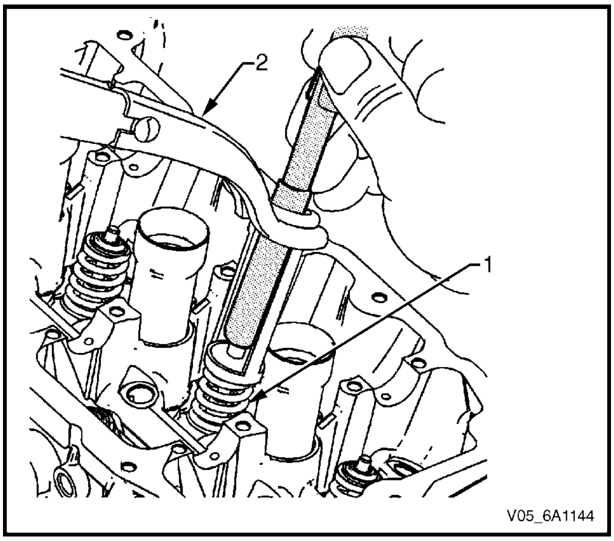


Figure 6A1 – 303

CAUTION

Ensure correct directional placement of valve collets (1) in Tool No. EN-46117 (2). The valve collets must be installed with the tapered end towards the valve stem seal.

10 With the spring compressed, install the valve collets into Tool No. EN 46117.

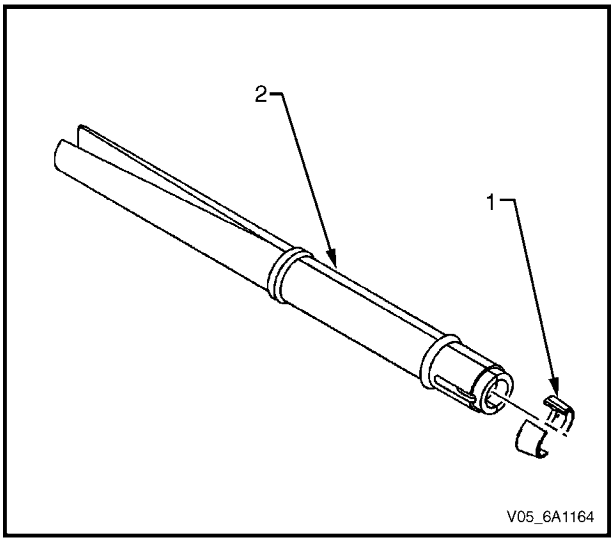


Figure 6A1 – 304

11 Place the collets into position by pushing the tool (1) downward and releasing tension on the valve spring compressor (2).

12 Verify the valve collets are installed by placing a rag over the valve tip and tapping with a dead-blow hammer. The valve collets and the spring should remain in place.

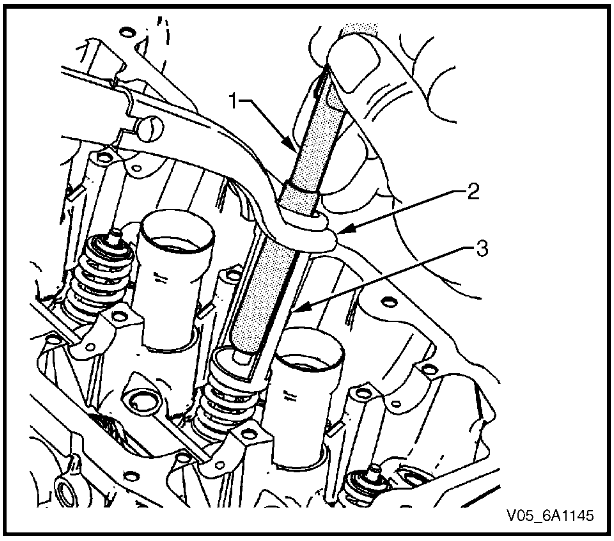


Figure 6A1 – 305

Reinstall

Right-hand Side (Bank 1) Cylinder Head

The reinstallation procedure for the right-hand side cylinder head assembly is the reverse of the removal procedure, noting the following:

1 Ensure all fasteners are tightened to the correct torque specification.

2 Using crankshaft rotation Tool No. EN-46111 (1), align the crankshaft sprocket timing mark (2) with the indexing mark (3) on the oil pump housing.

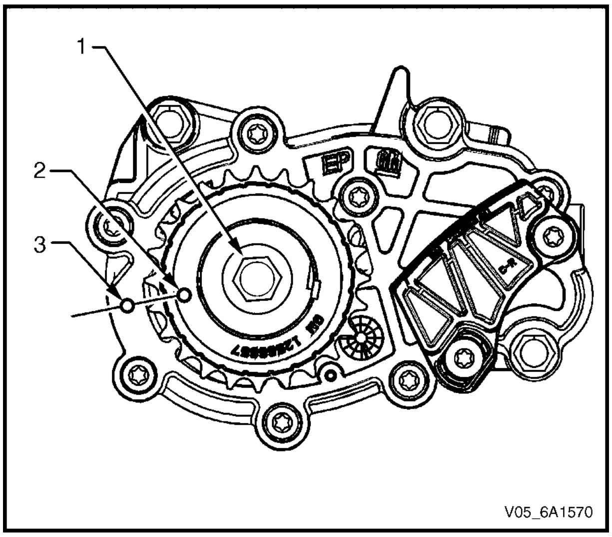


Figure 6A1 – 306

3 Ensure the deck face is clean and the cylinder head locating pins are securely mounted in the cylinder block deck face.

4 Install a new right-hand cylinder head gasket (1) using the deck face locating pins for retention.

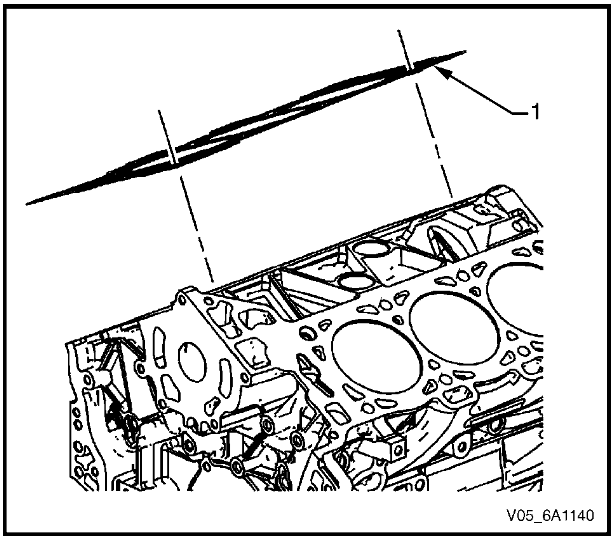


Figure 6A1 – 307

5 Align the cylinder head with the locating pins.

6 Place the cylinder head in position on the deck face.

NOTE

Do not allow oil on the cylinder head bolt bosses.

CAUTION

Do not reuse the old M11 cylinder head bolts (1 to 8 inclusive).

7 Install new M11 cylinder head bolts (1) eight places and tighten in the sequence shown and to the correct torque specification.

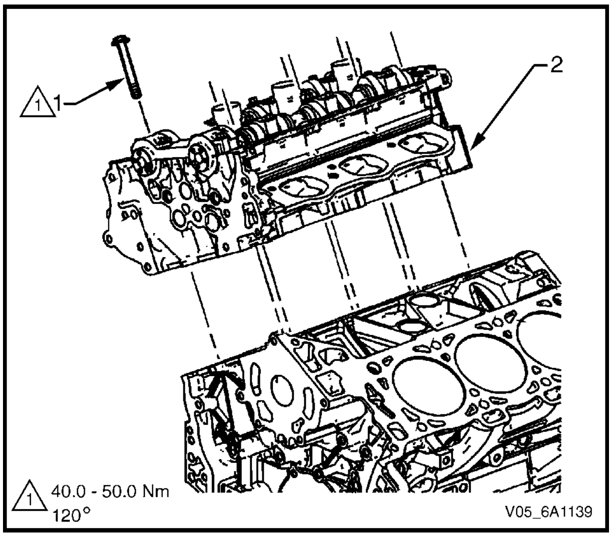


Figure 6A1 – 308

■ Cylinder head M11 attaching bolt torque specification: Stage 1: ....40.0 – 50.0 Nm Stage 2: ....120°

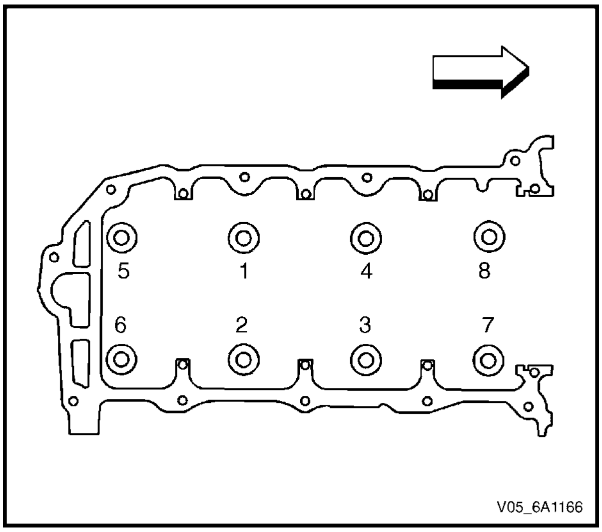


Figure 6A1 – 309

Left-hand Side (Bank 2) Cylinder Head

The reinstallation procedure for the left-hand side cylinder head assembly is the reverse of the removal procedure, noting the following:

1 Ensure all fasteners are tightened to the correct torque specification.

2 Using crankshaft rotation Tool No. EN-46111 (1), align the crankshaft sprocket timing mark (2) with the indexing mark (3) on the oil pump housing.

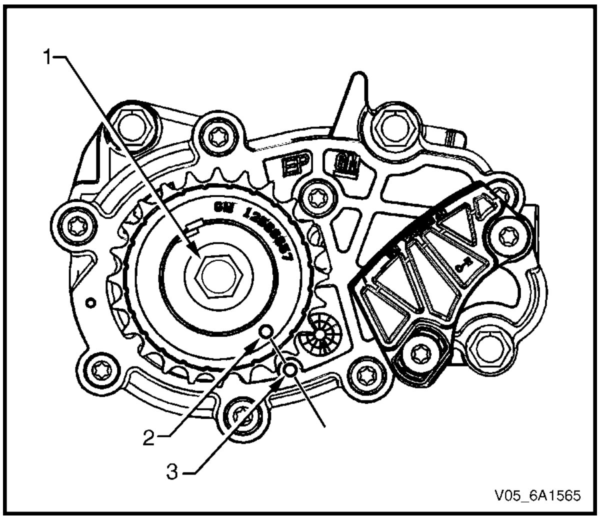


Figure 6A1 – 310

3 Ensure the deck face is clean and the cylinder head locating pins are securely mounted in the cylinder block deck face.

4 Install a new cylinder head gasket (1) using the deck face locating pins for retention.

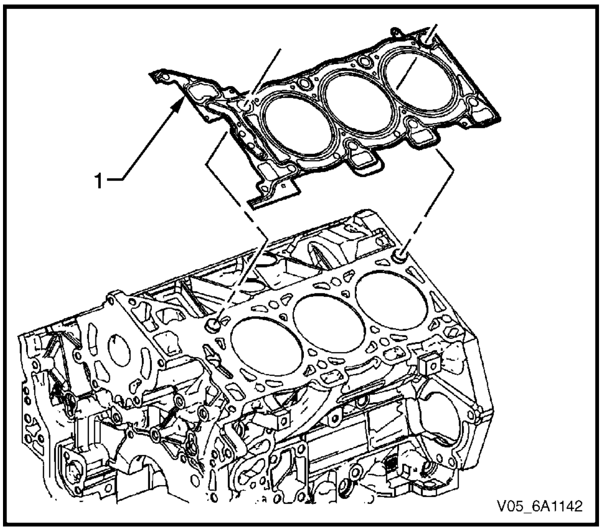


Figure 6A1 – 311

5 Align the cylinder head with the locating pins.

6 Place the cylinder head in position on the deck face.

NOTE

Do not allow oil on the cylinder head bolt bosses.

CAUTION

Do not reuse the old M11 cylinder head bolts (1 to 8 inclusive).

7 Install new M11 cylinder head bolt (1), eight places, and tighten in the sequence shown and to the correct torque specification.

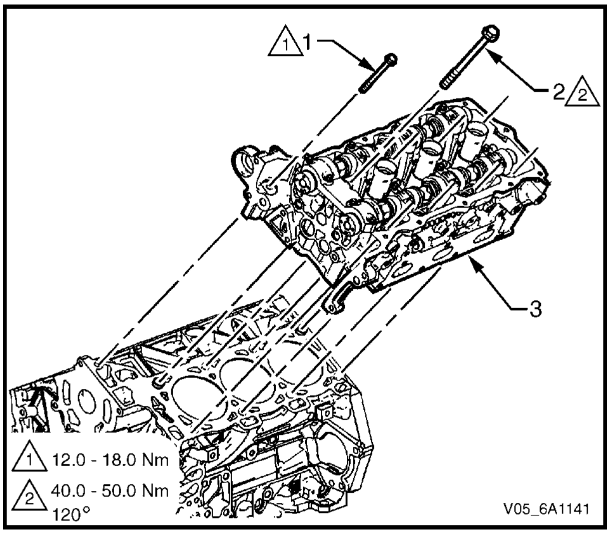


Figure 6A1 – 312

8 Install the front M8 cylinder head bolt (2), two places, and tighten in the sequence (9 and 10) and to the correct torque.

■ Cylinder head M11 attaching bolt torque specification:
Stage 1: ....40.0 – 50.0 Nm
Stage 2: ....120°

■ M8 cylinder head bolt torque specification
Stage 1: ....12.0 – 18.0 Nm
Stage 2: ....60°

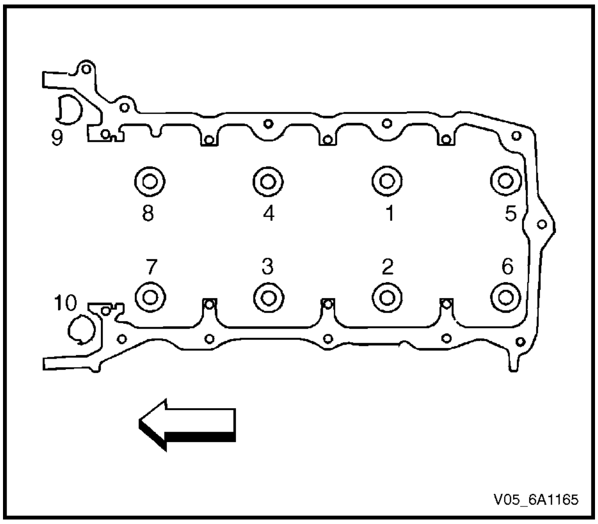
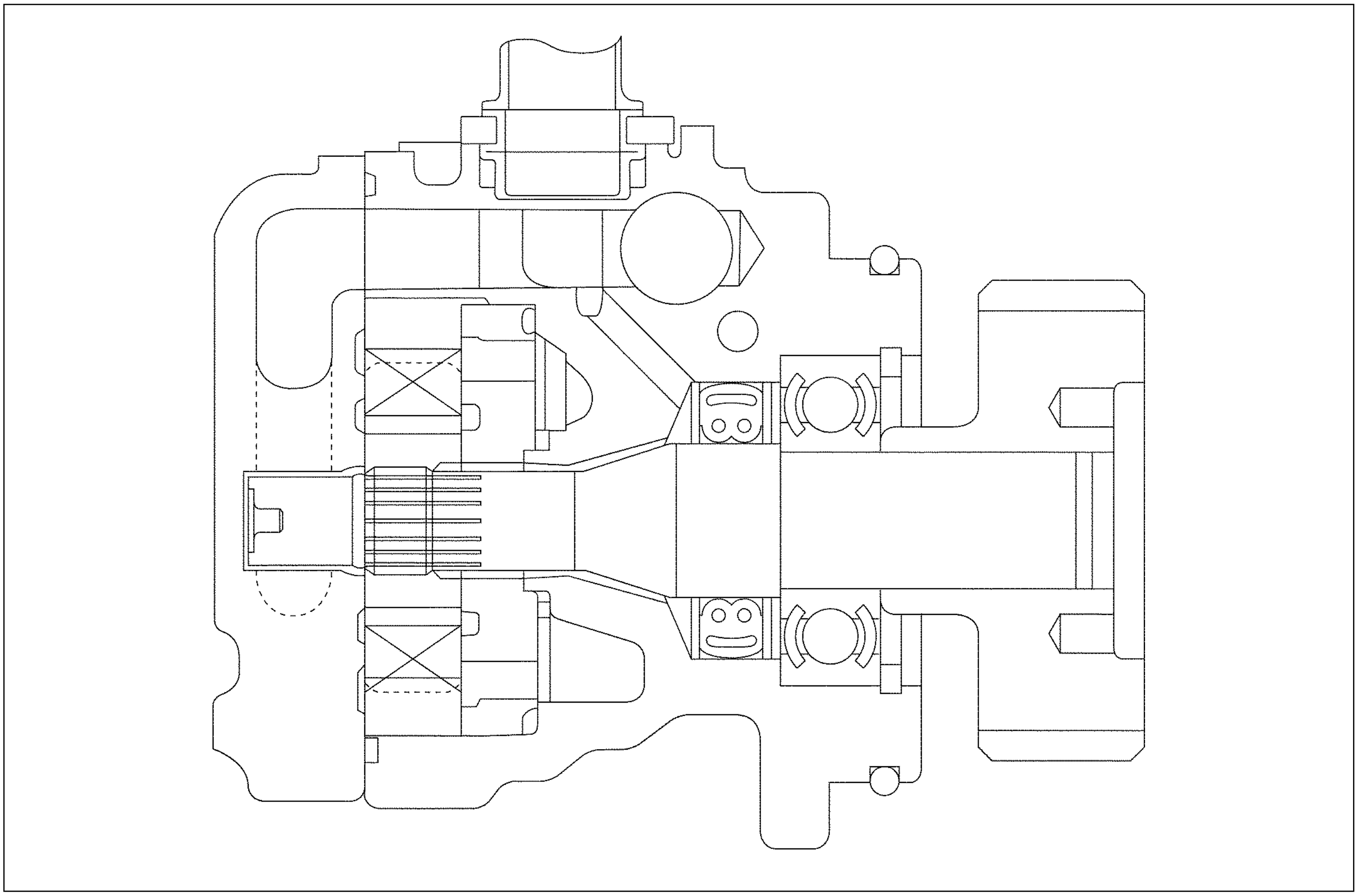


Figure 6A1 – 313

Hydraulic Pump

4JJ1-TC, 4JK1-TC



RTW53BMF0003

The hydraulic pump is vane-type design. The submerged pump has a housing and internal parts that are inside the reservoir and operate submerged in oil. There are two bore openings at the rear of the pump housing. The larger opening contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve and spring.

The flow control orifice is part of the pressure line union. The pressure relief valve inside the flow control valve limits the pump pressure.

3.23 Engine Mounts and Brackets

Remove

1 Remove the exhaust manifold assembly from the side of the engine where the engine mount is to be removed, refer to 3.11 Exhaust Manifold Assembly.

2 Fit the engine lift brackets, Tool No. EN-46114 (1) to the cylinder heads.

CAUTION

Only lift the engine far enough to take the weight off the engine mount, or damage to the mount and lifting equipment failure may occur.

3 Using an engine lifting crane, raise the side of the engine where the mount is to be removed enough to remove the weight from the engine mounts, and create a slight tension in the lifting equipment.

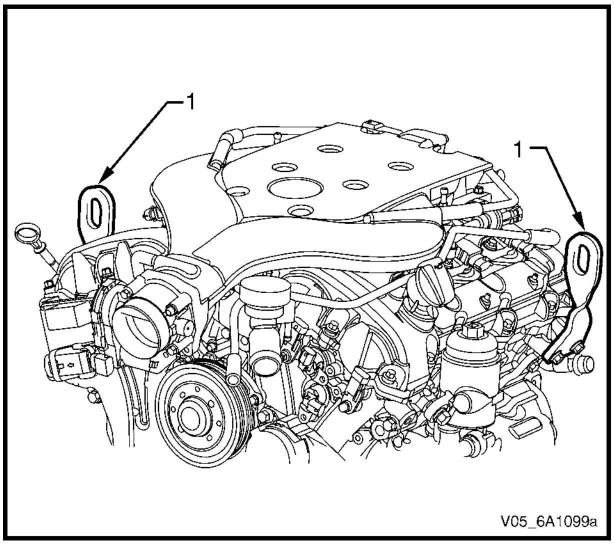


Figure 6A1 – 314

4 Remove the left-hand or right-hand side engine mount and bracket as required.

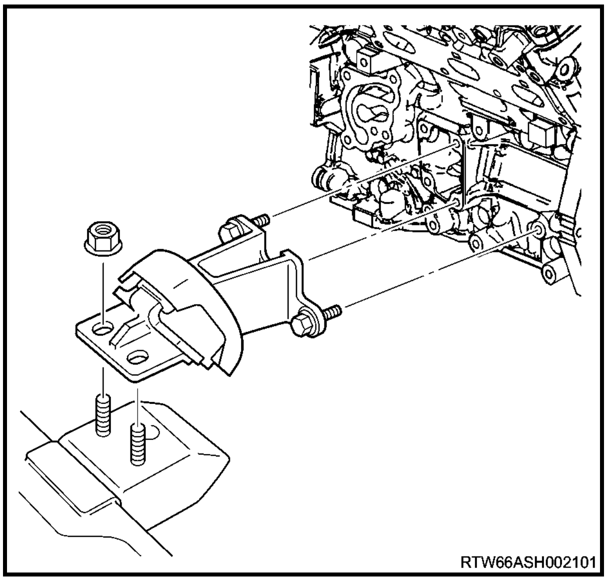


Figure 6A1 – 315

Engine Mount Location

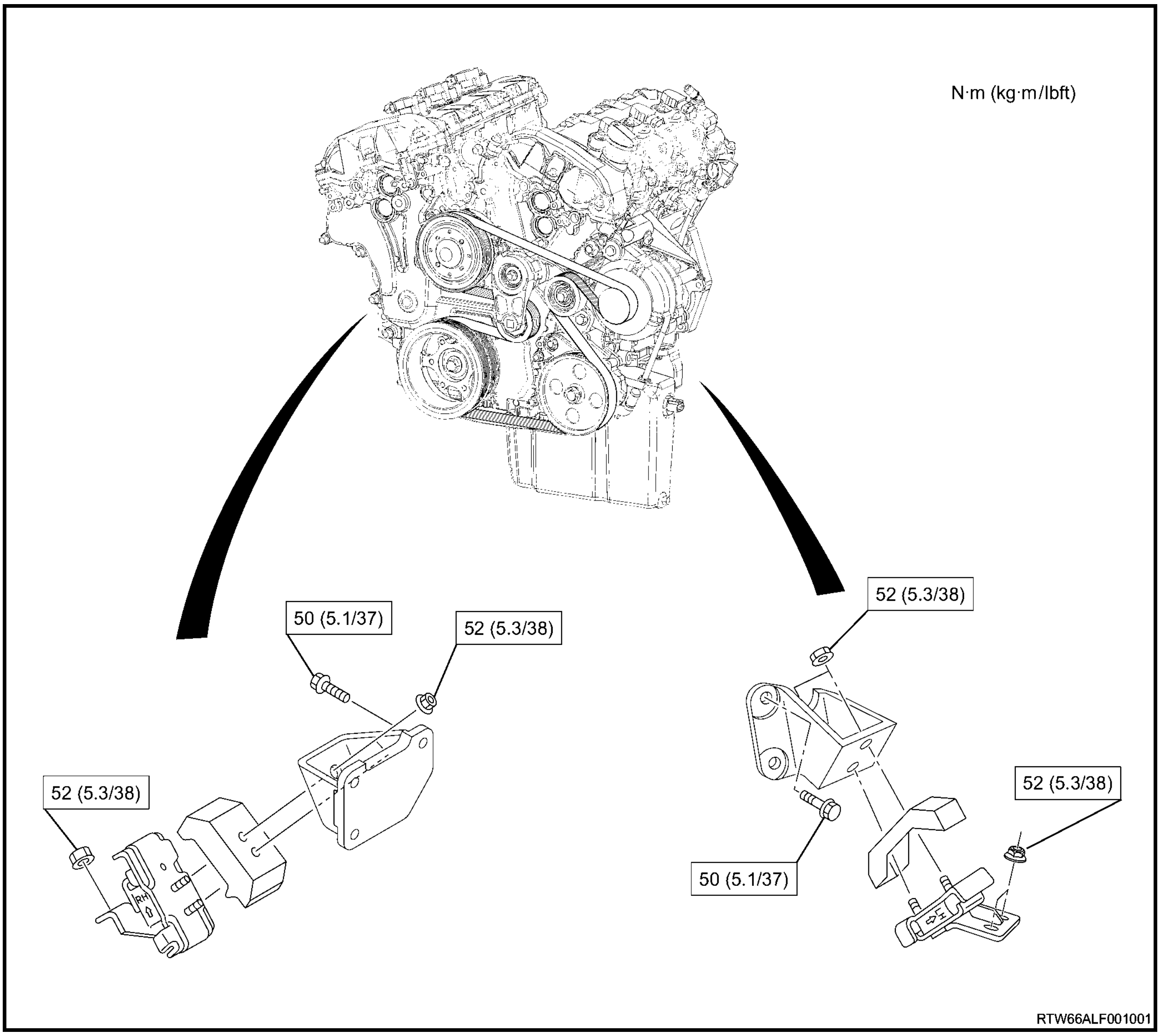


Figure 6A1 – 316

Inspect

NOTE

Although the following procedure provides information regarding on-vehicle engine mount inspections, it is preferable to inspect the engine mounts once removed from the vehicle.

1 Fit the engine lift brackets, Tool No. EN-4611 to the cylinder heads.

WARNING

Only lift the engine enough to take the weight off the engine mounts, or damage to the mounts and lifting equipment failure may occur.

2 Using a commercially available engine lifting crane, have an assistant raise the engine far enough to remove the weight on the engine mounts and create a slight tension in the rubber.

3 Observe the engine mount while raising the engine.

4 Replace the engine mount if any of the following conditions are found:

- The hard rubber surface is covered with heat check cracks,
- The rubber is split through the centre of the engine mount, or
- The rubber is separated from the metal plate portion of the engine mount.

5 Remove the engine lift brackets, Tool No. EN-46114 from the engine.

Reinstall

The reinstallation procedure for the engine mounts is the reverse of the removal procedure, noting the following:

Ensure all fasteners are tightened to the correct torque specification.

Engine mount bracket to
cylinder block attaching bolt
torque specification
....43.0 – 57.0 Nm

Engine mount to bracket attaching nut
torque specification
....70.0 – 90.0 Nm

Engine mount to frame attaching nut
torque specification
....44.0 – 60.0 Nm

4 Major Service Operations

ATTENTION

The V6 engine is a combination of numerous components, containing machined, honed, polished and lapped surfaces manufactured on the latest, high technology production equipment. Many of the components contain tolerances measured in thousandths of a millimetre. Consequently, when any engine component is to be serviced, care and cleanliness are extremely important.

Prior to re-assembly of the V6 engine, all components must be cleaned and inspected in accordance with the relevant procedures throughout this section, and replaced or repaired where required.

In addition to cleaning and inspecting components, a liberal coating of engine oil should be applied to friction surfaces during assembly to protect and lubricate the surfaces on initial operation.

When performing any service operation contained in this Section, it should be understood that correct cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard workshop practice, even if not specifically stated. Torque values must be used as specified during reassembly to ensure correct retention of all components.

Through out this section, fastener torque wrench specifications may be accompanied with the following identification marks:

■ Fasteners must be replaced after loosening.

♦ Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.

If one of these identification marks is present alongside a fastener torque wrench specification, the recommendation regarding that fastener must be adhered to.

4.1 Engine Removal

CAUTION

- **Allow the engine to cool to at least 50° C, before attempting fastener removal.**
- **As aluminium has a greater rate of thermal expansion than that of cast iron, aluminium bolt hole threads will change dimension to a larger extent than cast iron bolt threads.**
- **If a bolt or other threaded component is removed before the engine is allowed to cool to at least 50° C, threads could be pulled from the cylinder block or cylinder head.**
- **Do not use impact tools to remove bolts during engine disassembly. While this may be common practice with cast iron engine components, use of these tools is likely to pull the aluminium threads in the cylinder block or head of this engine.**

Remove

1 Remove the skid plate.
2 Drain the radiator coolant, refer to 6B1 Engine Cooling – V6.
3 Disconnect the battery negative and positive terminal, refer to 8A Electrical Body & Chassis.
4 Remove the battery from the vehicle.
5 Depressurise the fuel system pressure, refer to 6C Fuel System – V6.
6 Make alignment marks on the bonnet and hinges in order to return the bonnet to the exact original position.
7 Remove the bonnet, refer to 2B Sheet Metal.
8 Remove the rubber hose (2) and air duct (1).

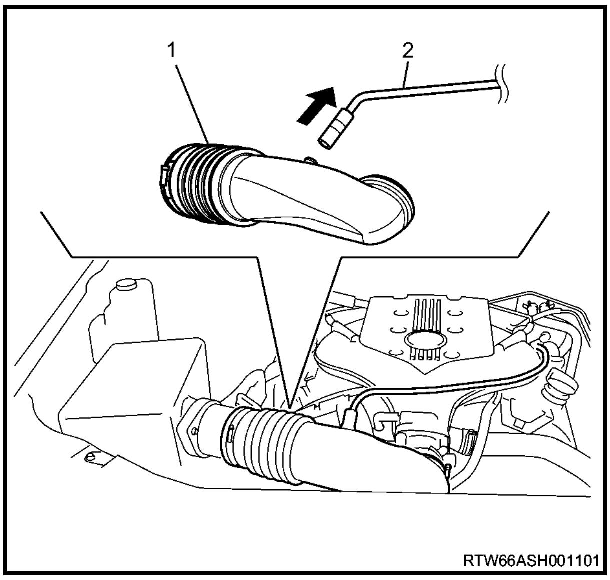


Figure 6A1 – 317

9 Disconnect the barometric sensor connector (1).

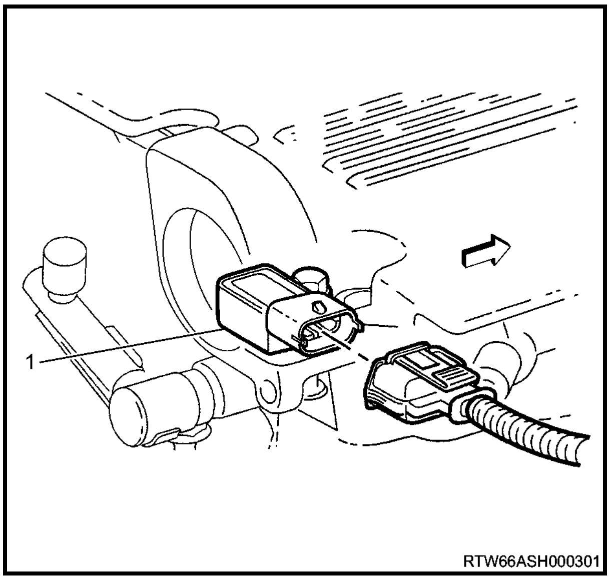


Figure 6A1 – 318

10 Disconnect the vacuum booster hose (1).

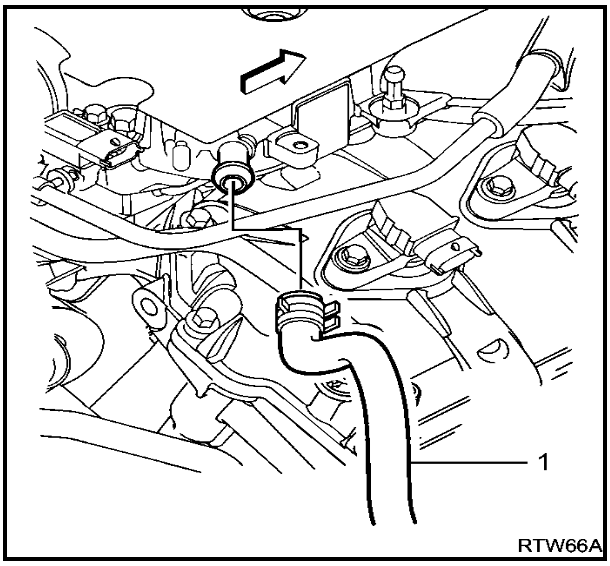


Figure 6A1 – 319

11 Disconnect the EVAP purge solenoid connector (1).

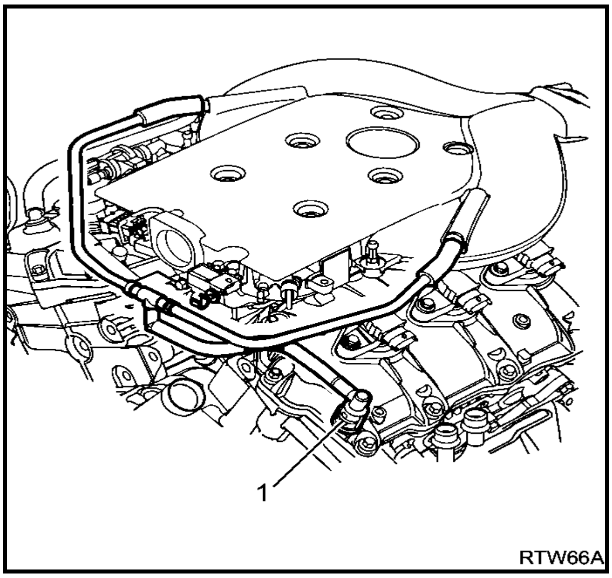


Figure 6A1 – 320

CAUTION

Plug the fuel feed hose after removal to prevent dirt entering the pipe.

12 Disconnect the fuel pipe connector and injector harness connector.

13 Disconnect the fuel feed hose from the fuel rail (1), refer to 6C Fuel system.

14 Pull out release bar (2) of the fuel injector harness wiring connector (3).

15 Disconnect the fuel injector harness wiring connector from the fuel injector wiring harness (4).

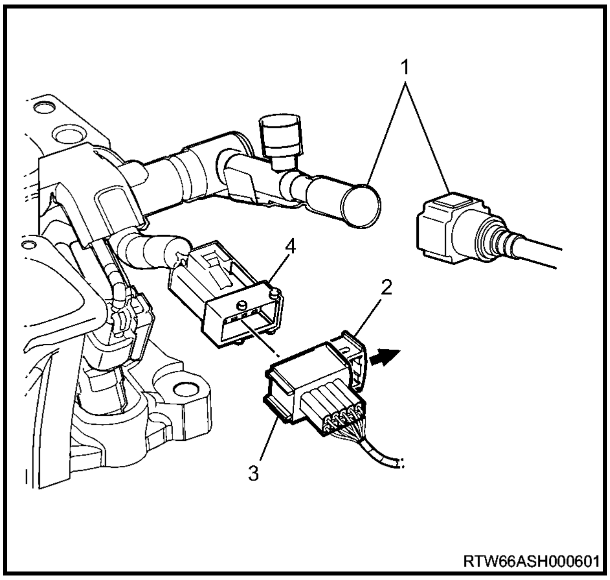


Figure 6A1 – 321

16 To disconnect the throttle body connector (1) the following procedure must be followed.

17 Retract the throttle body wiring connector lock (3) while pressing the connector latch in the direction of the arrow (4).

18 Disconnect the throttle body wiring connector (1).

19 Release the throttle body connector wiring harness from its retaining clip (5).

CAUTION

Take care not to break the barbed retainer pin (6), when removing the harness. Should the pin be damaged it is vital that a new harness retainer be fitted.

20 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable length of 5mm steel rod or an allen key.

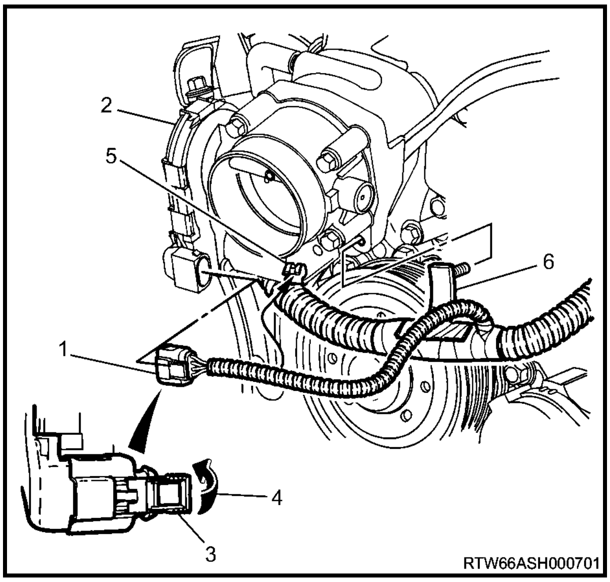


Figure 6A1 – 322

21 Disconnect the PCV fresh air tube (1) from the upper intake manifold mounting clip (2) and remove the fixing bolt (3).

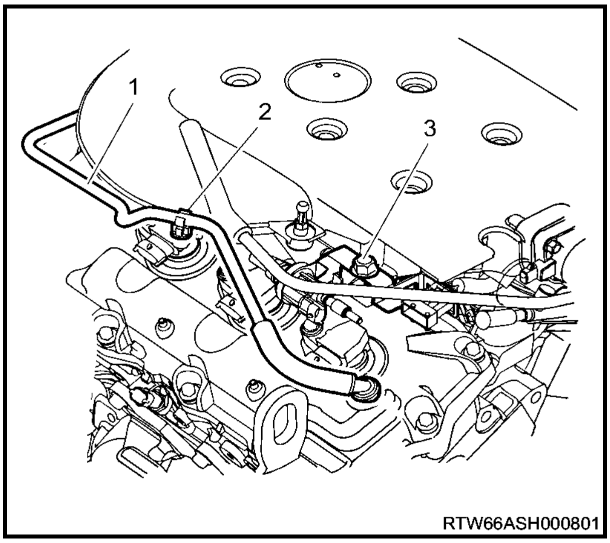


Figure 6A1 – 323

22 Disconnect the EVAP valve outlet tube, (1) from the upper intake manifold (2).

23 Remove the four long bolts, (3) attaching the upper intake manifold, (2) to the cylinder heads and lower intake manifold.

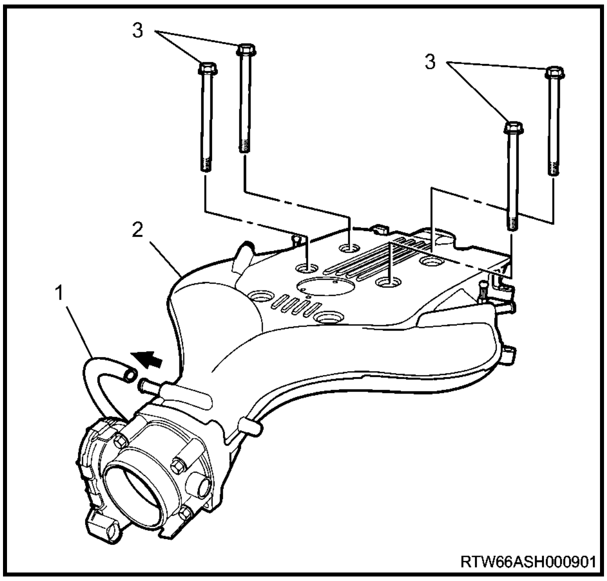


Figure 6A1 – 324

23 Remove the six bolts, (1) attaching the lower intake manifold (2), then remove the manifold from the engine.

24 Remove the following from the engine and engine compartment :

- Lower intake manifold to cylinder head gasket
- The Heater hose
- The Air Cleaner assembly

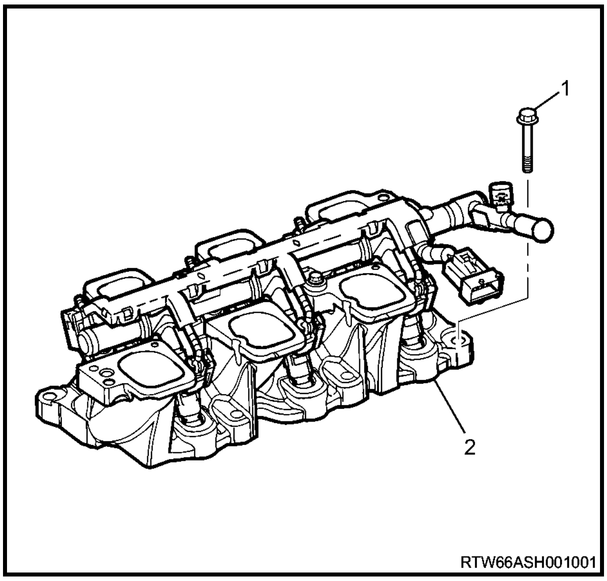


Figure 6A1 – 325

25 Remove the transmission support (1).

26 Remove the front and rear propeller shafts, (4WD Only), refer to 4C1 Front Wheel Drive and 4C2 Drive Line (For 4WD Vehicles).

27 Remove the front torsion bar springs, refer to 3C Suspension.

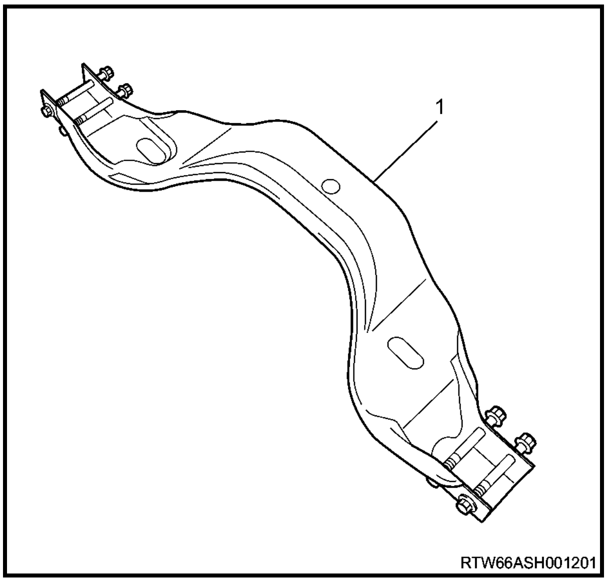


Figure 6A1 – 326

28 Remove the centre exhaust pipe (1), refer to 6F Exhaust System - V6 - V6.

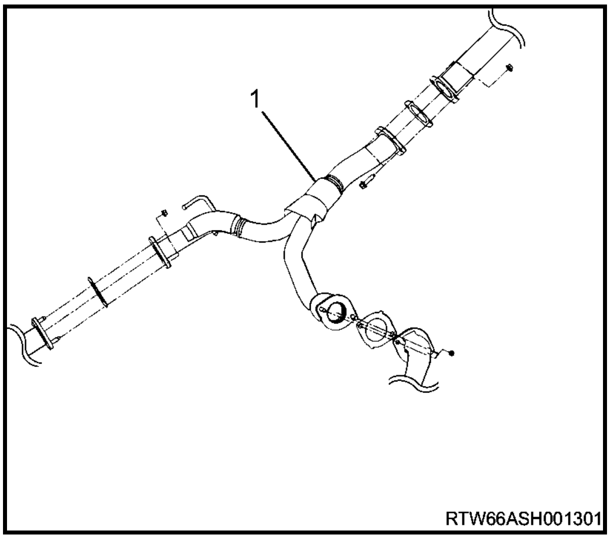


Figure 6A1 – 327

29 Disconnect the two post-catalytic converter oxygen sensor wiring harness connectors, 1 each bank.

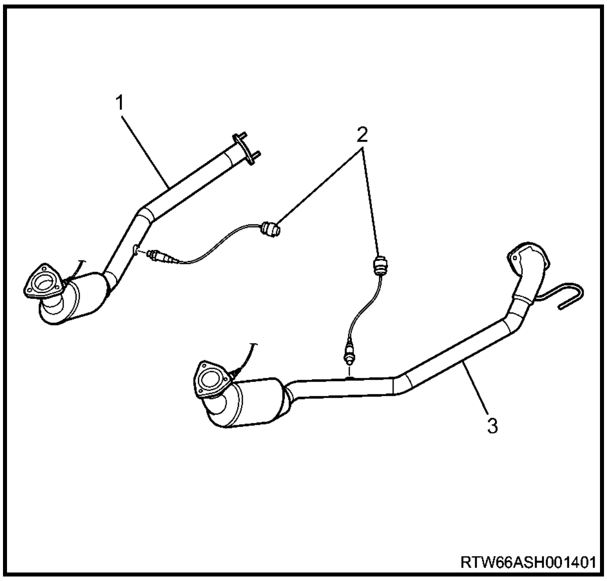


Figure 6A1 – 328

30 Disconnect the two pre-catalytic converter oxygen sensor wiring harness connectors, 1 each bank.

31 Remove the front exhaust flange nuts, three each bank.

32 Remove the front left-hand exhaust pipe from the rubber mount.

33 Remove the front exhaust pipes from the vehicle, for further information, refer to 6F Exhaust System - V6.

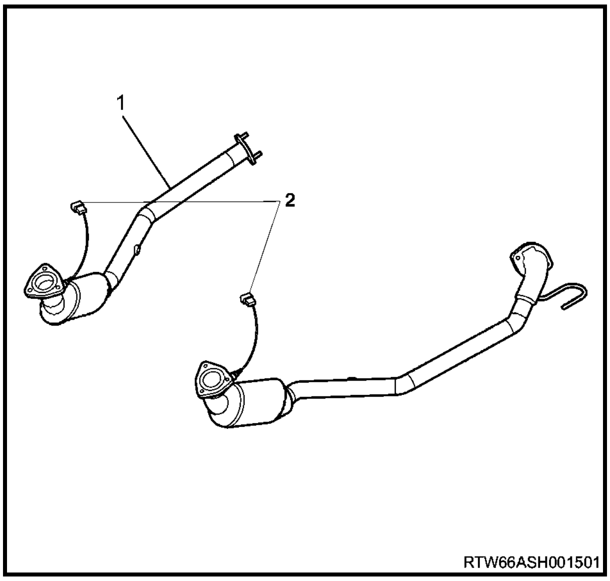


Figure 6A1 – 329

34 Remove the transfer case from the vehicle (4WD Only), refer to 7D Transfer Case and Adaptor Housing.

35 Disconnect the harness connector from the transmission, refer to 7B1 Manual Transmission – V6 or 7C1, 2, 3 or 4 for automatic transmission.

36 Remove the left-hand side exhaust manifold upper heat shield (1), (Automatic transmission only).

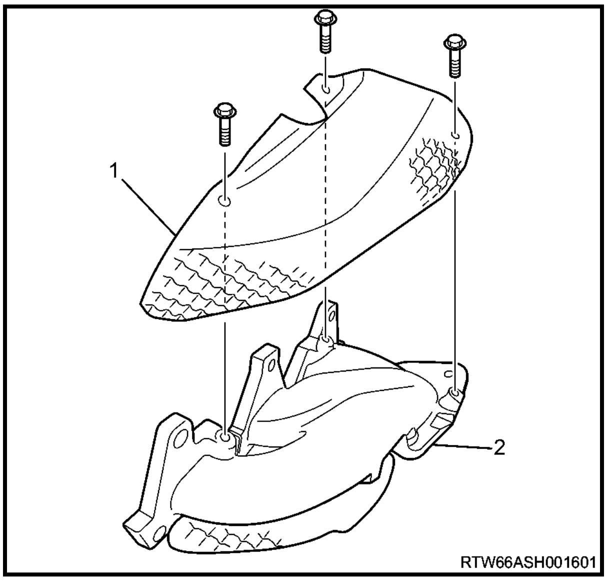


Figure 6A1 – 330

37 Progressively loosen the seven exhaust manifold attaching bolts (2), working from the outside to the centre and then remove the bolts.

38 Manoeuvre the exhaust manifold (3), away from the cylinder head.

39 Remove and discard the exhaust manifold to cylinder head gasket.

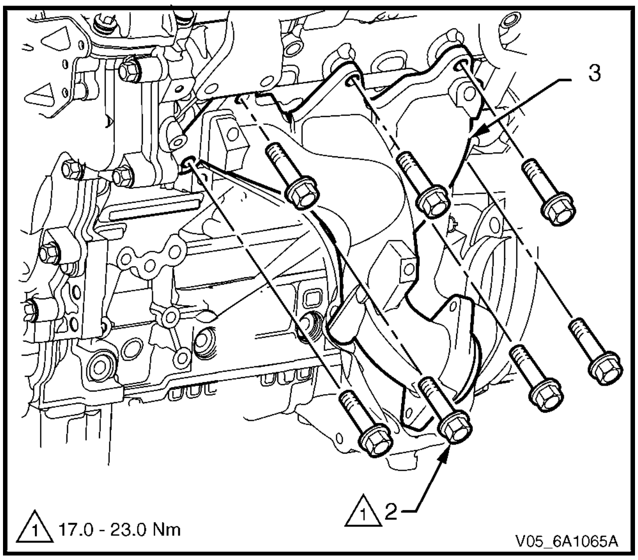
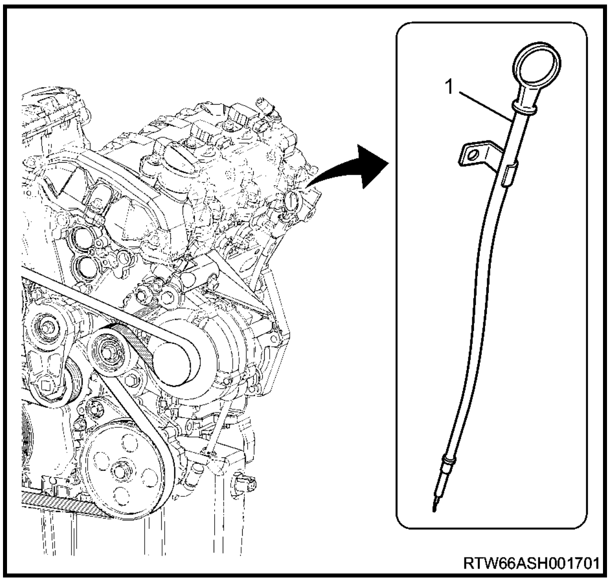


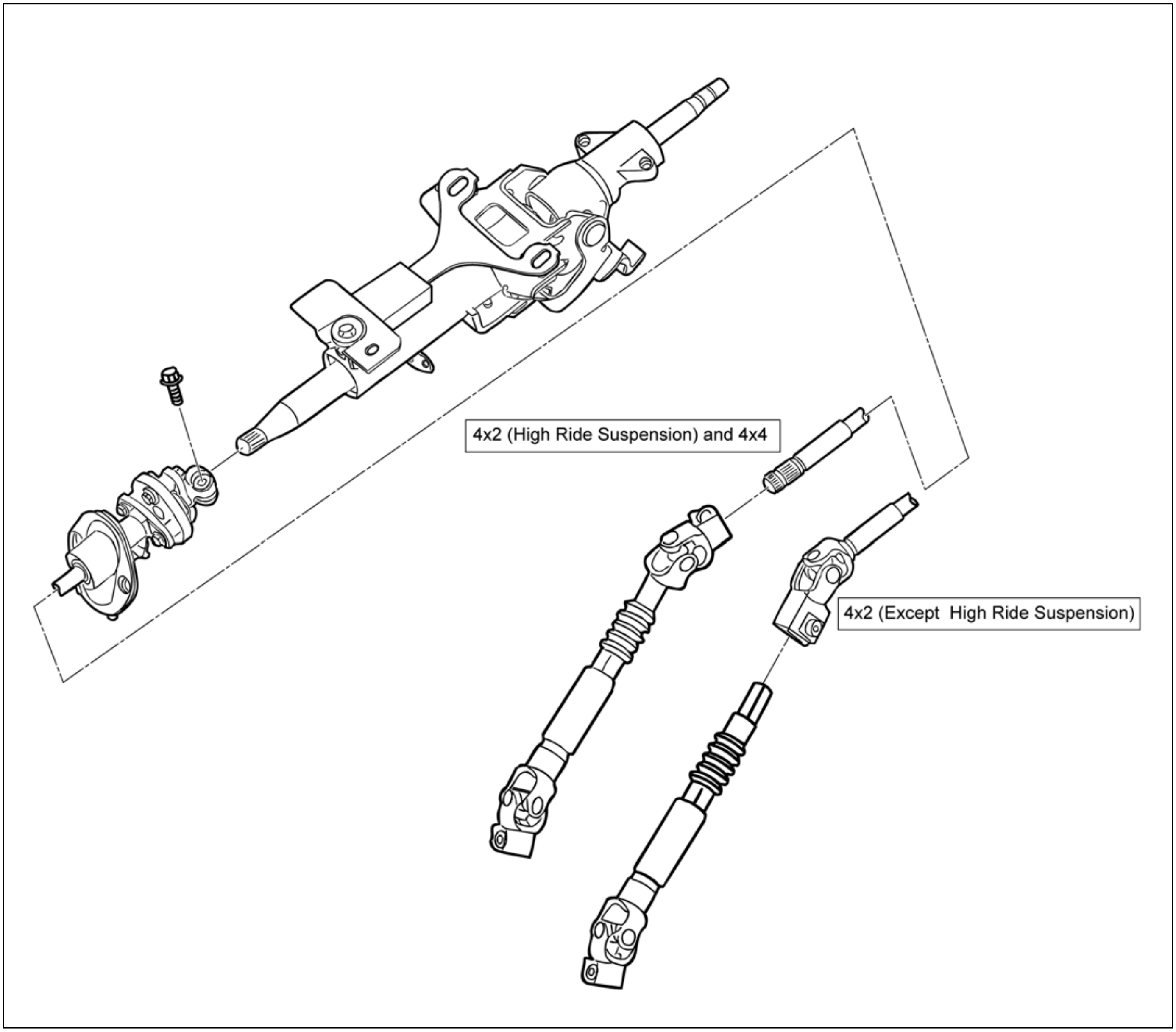
Figure 6A1 – 331

40 Remove the engine oil level indicator assembly (1), (automatic transmission only).

41 Remove the left-hand side exhaust manifold, (automatic transmission only).



Steering Column



WARNING: TO AVOID DEPLOYMENT WHEN TROUBLE-SHOOTING THE SRS SYSTEM, DO NOT USE ELECTRICAL TEST EQUIPMENT, SUCH AS A BATTERY-POWERED OR A/C-POWERED VOLTMETER, OHMMETER, ETC., OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN SPECIFIED IN THIS MANUAL. DO NOT USE A NON-POWERED PROBE-TYPE TESTER.

INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT.

When servicing a vehicle equipped with a Supplemental Restraint System, pay close attention to all WARNINGS and CAUTIONS.

For detailed explanations about SRS, refer to Restraints section.

The steering column has three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of injury to the driver of the vehicle.
2. The ignition switch and lock are mounted conveniently on the column.
3. With the column mounted lock, the ignition and steering operation can be locked to prevent theft of the vehicle.

The column can be disassembled and reassembled. However, to insure the energy absorbing action, use only the specified screws, bolts and nuts as designated, and tighten them to the specified torque.

Handle the column with care when it is removed from the vehicle. A sharp blow on the end of the steering shaft or shift lever, or dropping the assembly could shear or loosen the fasteners that maintain column rigidity.

Figure 6A1 – 332

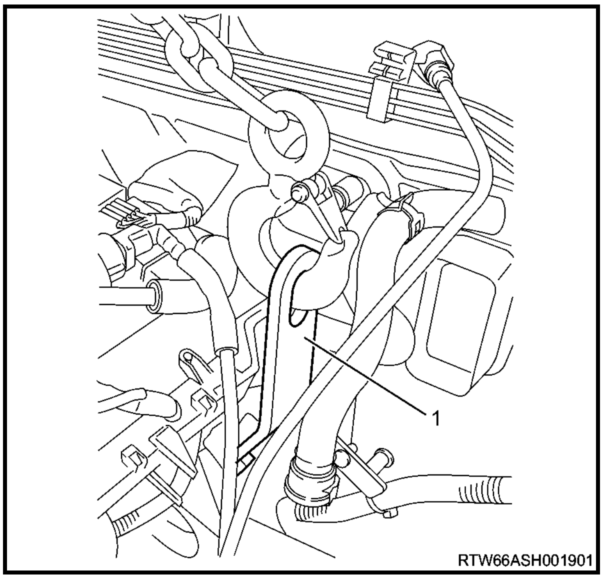


Figure 6A1 – 333

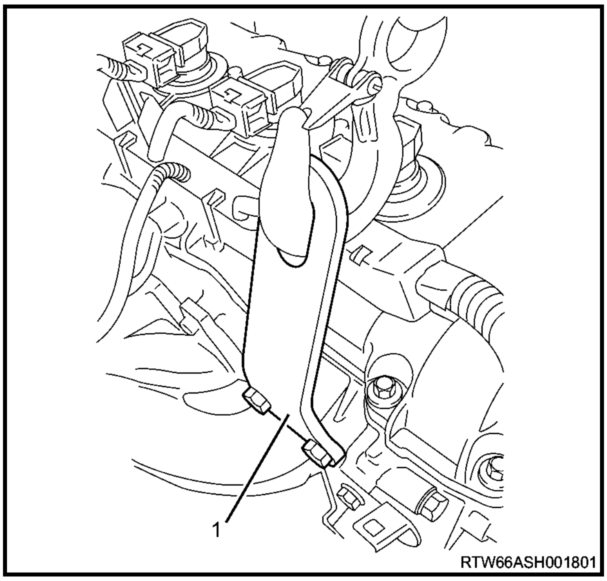


Figure 6A1 – 334

42 Fit the engine lifting brackets (1), (EN–46114) and attach the engine hoist, raise the engine to take the weight off the engine mounts.

Engine Lift Bracket Attaching Bolt torque specification ....58.0 – 72.0.0 Nm

43 Remove the left-hand side knock sensor (1).

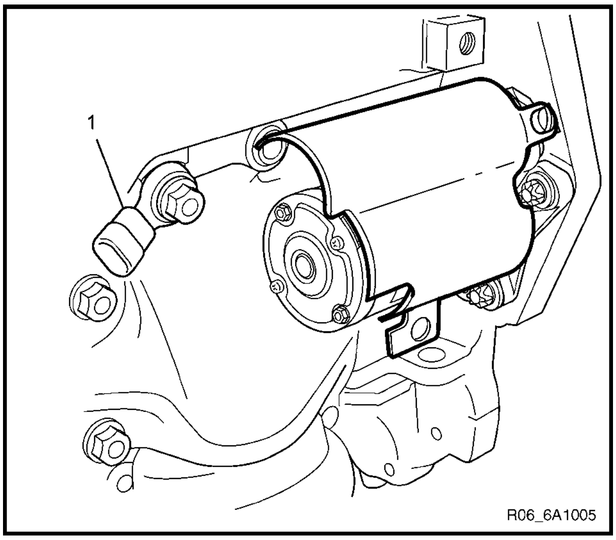


Figure 6A1 – 335

NOTE

Removal or the starter motor is only required for vehicles with an Automatic Transmission.

44 Remove the left-hand side engine mount (1), (automatic transmission only).

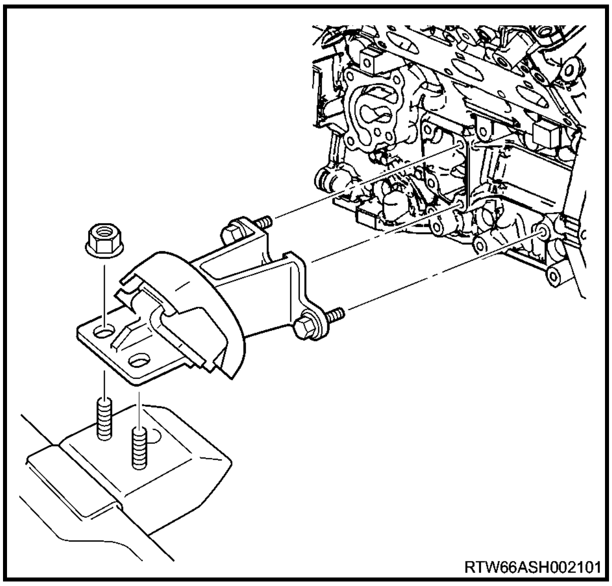


Figure 6A1 – 336

45 Unclip the oil level sensor harness from the heat shield (1).

a Remove the heat shield retaining screw (2).

b Remove the lower starter motor attaching bolt (3).

c Remove the heat shield.

d Remove the upper starter motor retaining bolt (3).

46 Remove the starter motor from the engine block and lower the starter motor as far as possible to gain access to the wiring harness connections.

47 Remove the starter motor, (automatic transmission only).

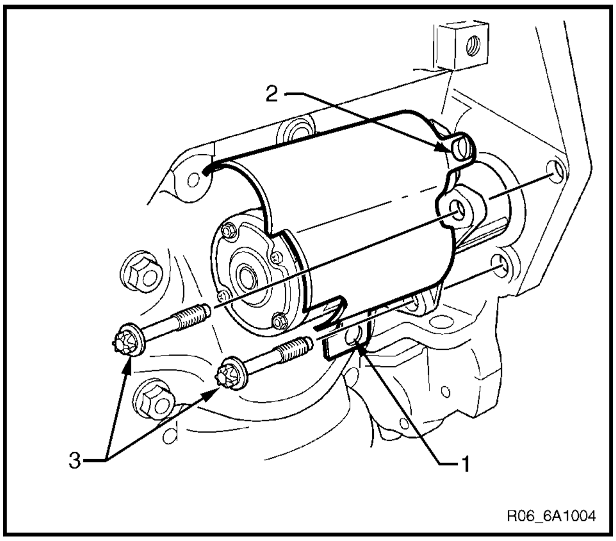


Figure 6A1 – 337

48 Reinstall the left-hand side engine mount (1), (automatic transmission only).

49 Remove the transmission assembly, refer to 7C1 Automatic – 4L60E – General Information.

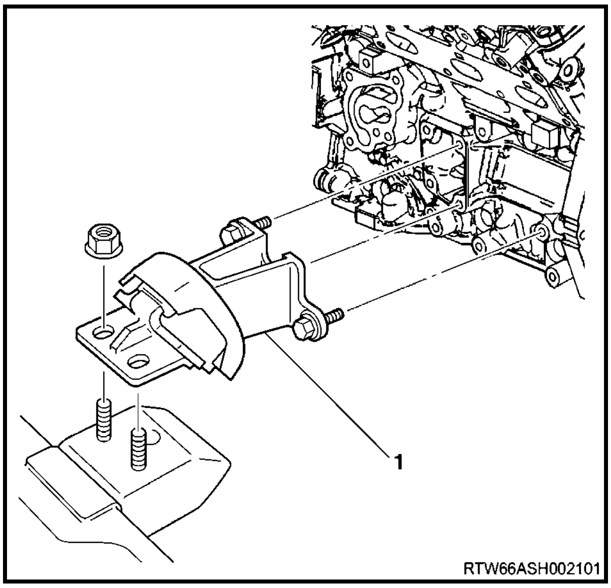


Figure 6A1 – 338

50 Unplug the connector from the oil level sensor (1).

51 Remove the attaching bolt (2) holding the ground cable to the engine block.

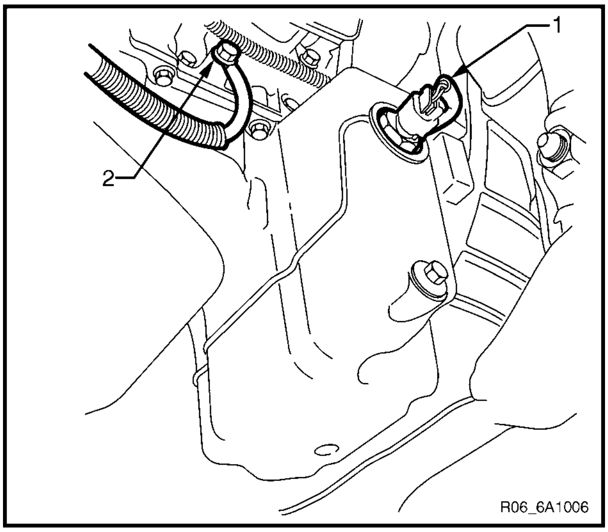


Figure 6A1 – 339

52 Remove the accessory drive belt using a socket wrench (1), to reduce tension rotate the drive belt tensioner (2) clockwise, then while holding the tensioner in the reduced tension position, remove the accessory drive belt (3).

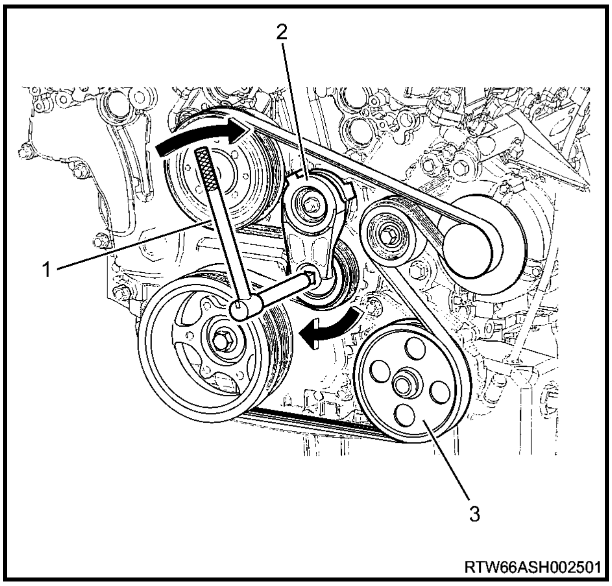


Figure 6A1 – 340

53 Remove the power steering pump bolts (two places), remove the pump (1) from the mounting bracket and disconnect the power steering hoses (two places) from the pump body.

NOTE

Plug the open ends of the power steering hoses to prevent the ingress of contaminants.

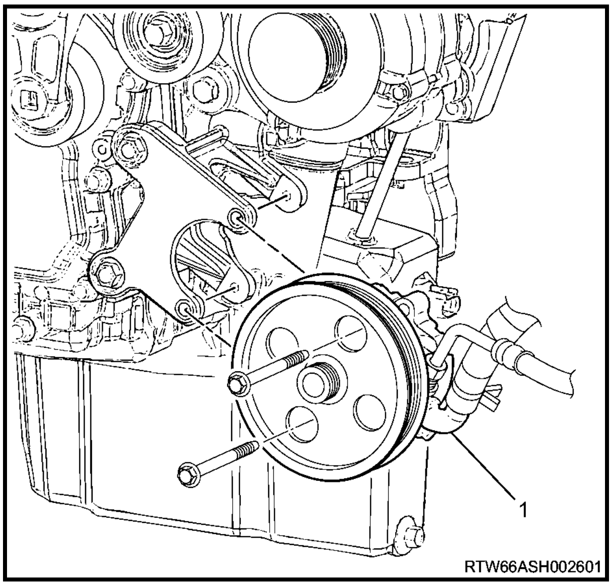


Figure 6A1 – 341

54 Remove the power steering pump bracket mounting bolts (three places) then remove the pump bracket (1).

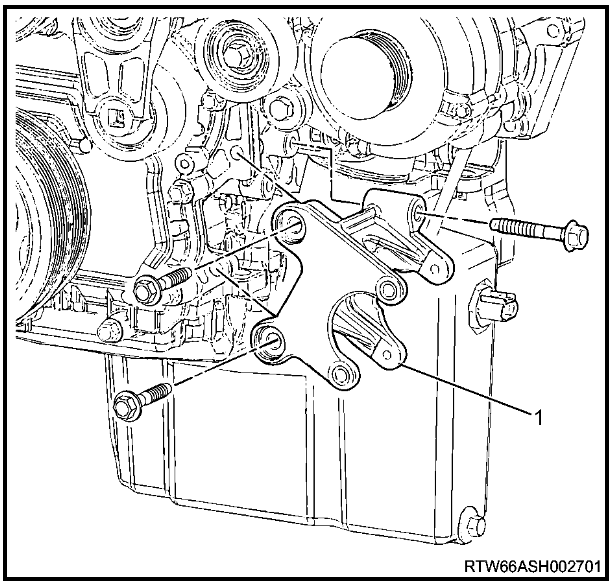


Figure 6A1 – 342

55 Release the lower radiator hose clamp (1) and remove the lower hose from the coolant pipe (2).

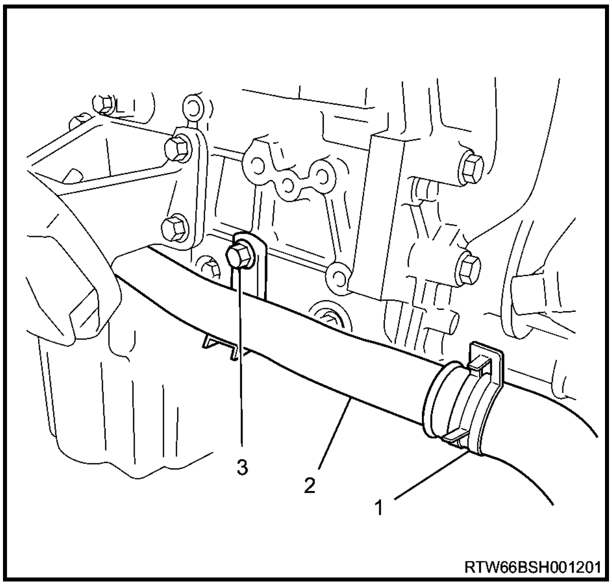


Figure 6A1 – 343

56 Release the upper radiator hose clamp (1) and remove the upper hose from the coolant pipe (2).

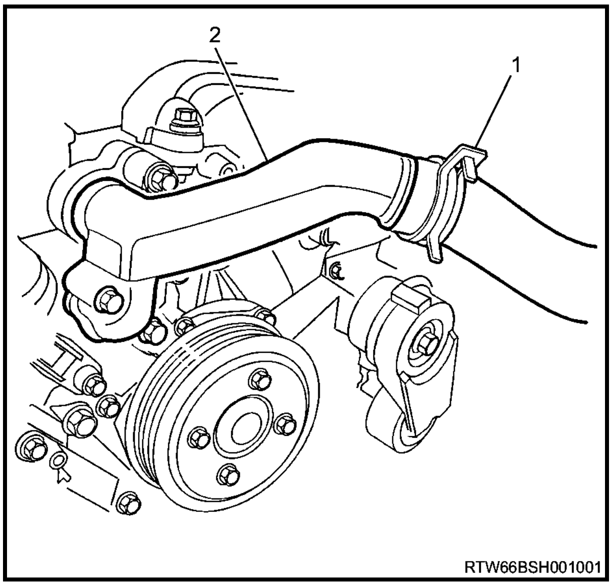


Figure 6A1 – 344

57 Unclip and remove the generator wiring harness connector (1), Remove battery connection attaching nut (4), and remove the battery harness cable (2) from the connection stud.

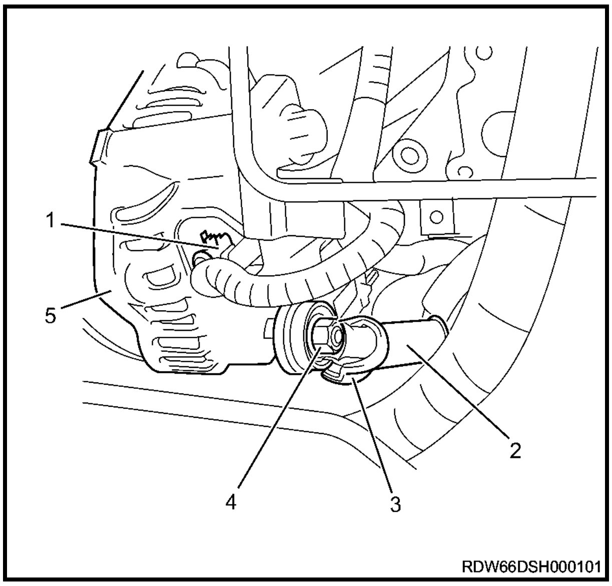


Figure 6A1 – 345

58 Remove the generator attaching bolts (1, 2, and 4) three places, then remove the generator (3) from the mounting bracket.

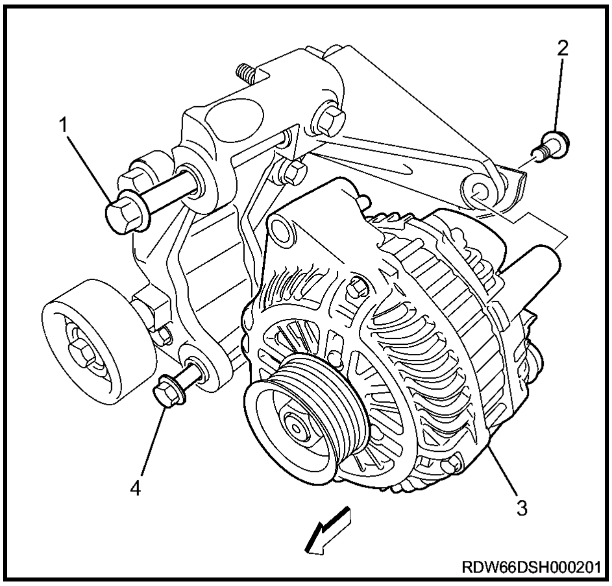


Figure 6A1 – 346

59 Remove the idler pulley attaching bolt and remove the idler pulley (1).

60 Remove the generator bracket attaching bolts, five places, and remove the generator mounting bracket (2).

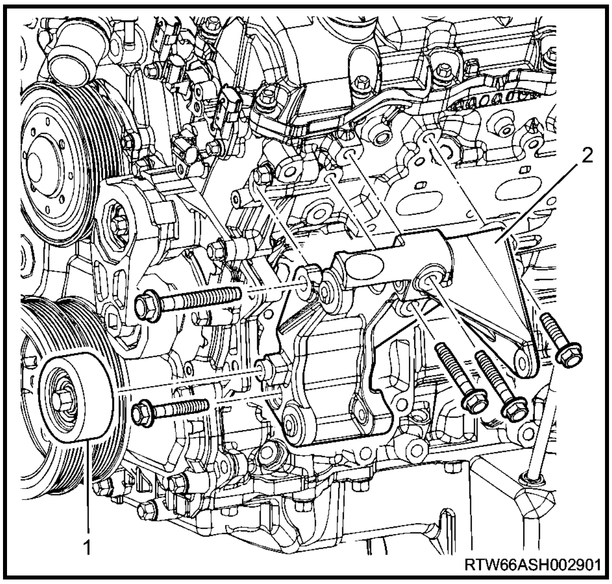


Figure 6A1 – 347

61 Remove the air cleaner cover assembly including the MAF sensor assembly (1).

62 Remove the air cleaner filter (2) from the air cleaner body assembly (3).

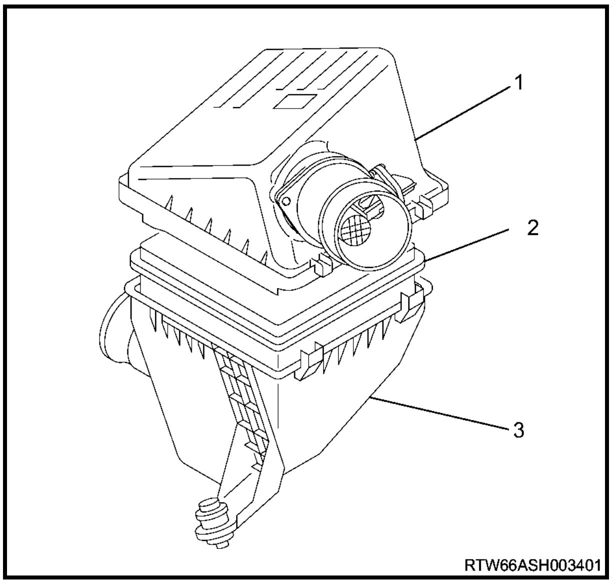


Figure 6A1 – 348

63 Disconnect the ECM connectors (1).

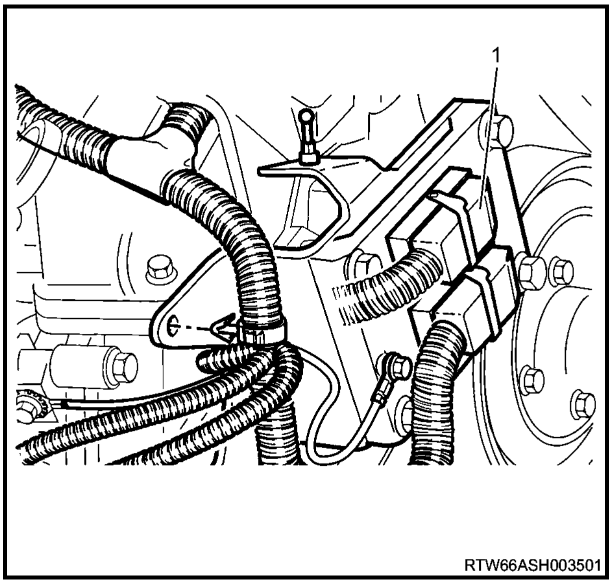


Figure 6A1 – 349

64 Disconnect the canister hose (1).

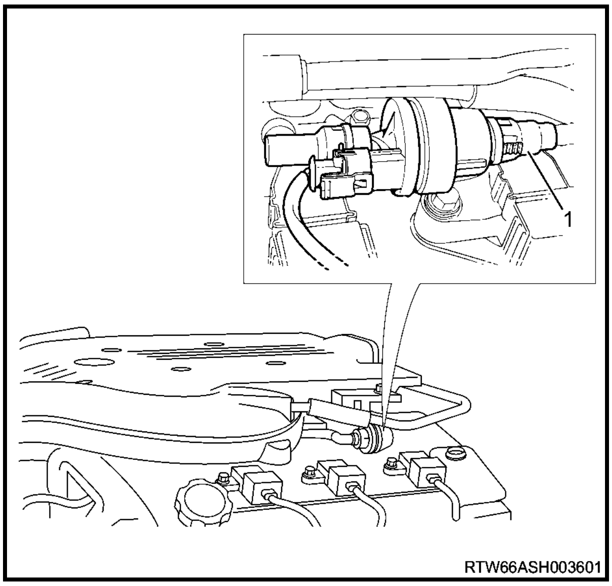


Figure 6A1 – 350

65 Remove the engine mount attaching nuts (1), (two places) on the chassis side of the left-hand and right-hand engine mounts.

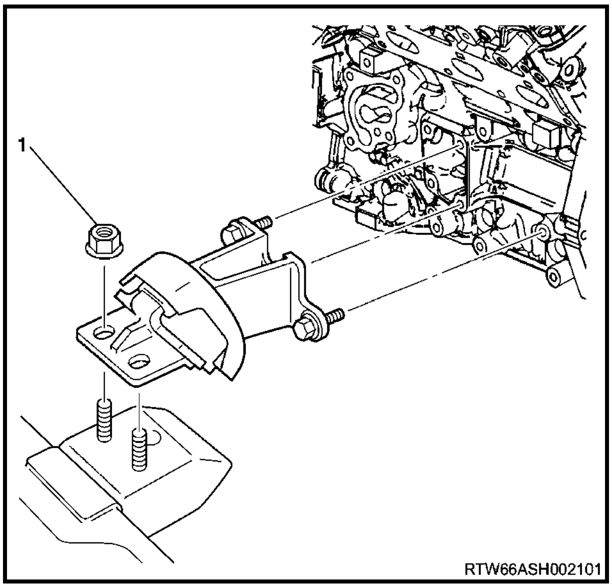


Figure 6A1 – 351

66 Slowly raise the engine using the engine hoist continue to lift and manoeuvre the engine assembly clear of the engine compartment.

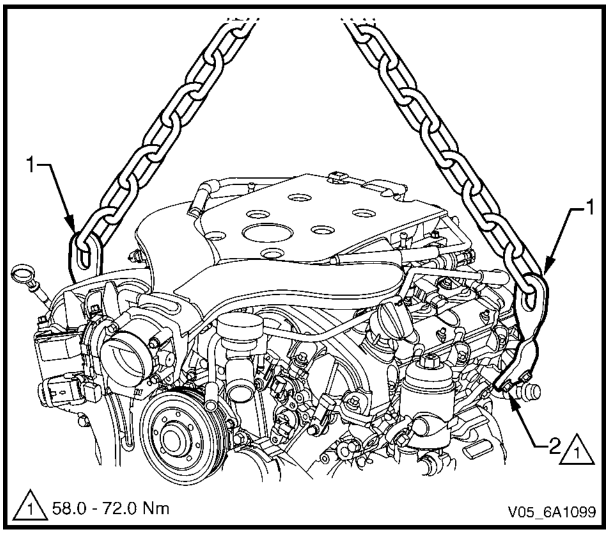


Figure 6A1 – 352

Disassemble

1 Remove the wiring harness connectors and ground connections from the engine and transmission assembly and carefully set the wiring harness to one side, refer to 8A Electrical Body & Chassis.

2 Remove the engine control module (ECM) and mounting bracket, refer to 6C1-3 Engine Management – V6 – Service Operations.

3 Mount the engine assembly on a suitable engine stand.

5 Drain the engine oil into a suitable, clean container.

6 Remove the following components:

a Oil filter adaptor, refer to 3.3 Oil Filter Adaptor.

b Engine coolant inlet pipe, refer to 6B1 Engine Cooling – V6.

c Heater pipe assembly, refer to 6B1 Engine Cooling – V6.

d Thermostat assembly, refer to 6B1 Engine Cooling – V6.

e Exhaust manifold assemblies, refer to 3.11 Exhaust Manifold Assembly.

f Engine coolant outlet pipe, refer to 6B1 Engine Cooling – V6.

g Crankshaft position sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

h Knock sensors, refer to 6C1-3 Engine Management – V6 – Service Operations.

i Engine mounts and brackets, refer to 3.23 Engine Mounts and Brackets.

j Flexplate assemblies, refer to 4.3 Flexplate Assembly.

k Timing chains, tensioners, shoes, guides & sprockets, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

l Cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.

m Oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

n Piston and connecting rod assemblies, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

o Crankshaft assembly, refer to 4.6 Crankshaft and Main Bearings.

p Piston oil nozzles, refer 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

Reassemble

Reassembly of the engine assembly is the reverse of the disassembly procedure.

Reinstall

Reinstallation of the engine assembly is the reverse to the removal procedure, noting the following:

NOTE

Refer to 6 Torque Wrench Specifications for the correct torque specifications.

1 Tighten the fasteners to the correct torque specification.

Engine ground connector bolt torque specification	10.0 Nm
Power steering high pressure line attaching bolt torque specification	8.0 – 12.0 Nm
Power steering high pressure line flare nut torque specification	25.0 – 35.0 Nm
Engine mount to frame attaching bolt torque specification	44.0 – 60.0 Nm
Knock Sensor Attaching Nut torque specification	23.0 Nm

2 Use only the specified engine lubricant type and quantity. It is recommended that a fluorescent oil dye, such as that contained in J 28481-B, be added to assist in any future oil leak diagnosis.

3 Fill the cooling system with the correct quantity and grade of coolant, refer to 6B1 Engine Cooling – V6.

4 Check transmission fluid level, replenishing as required, using the specified lubricant for the transmission fitted, refer to 7C1 Automatic – 4L60E – General Information.

5 Disable the ignition system, refer to 6C1-3 Engine Management – V6 – Service Operations.

6 Crank the engine several times. Listen for any unusual noises or evidence that parts are binding.

7 Enable the ignition system. Start the engine and listen for any unusual noises.

8 Check the vehicle oil pressure gauge or warning indicator and confirm the engine has acceptable oil pressure. If required, install an oil pressure gauge and measure the engine oil pressure, refer to 2.19 Engine Oil Pressure Diagnosis.

9 Run the engine at about 1,000 r.p.m. until the engine has reached normal operating temperature.

10 Listen for any unusual noises.

11 Check for oil, fuel, coolant and exhaust leaks while the engine is running, correcting as required.

12 Perform a final inspection for correct engine oil and coolant levels.

4.2 Oil Pan and Oil Pump Suction Pipe Assembly

Remove

1 Remove the engine assembly from the vehicle, refer to 4.1 Engine .

2 Separate the engine and transmission assemblies, refer to 7C1 Automatic – 4L60E – General Information.

3 Mount the engine assembly on a suitable engine stand.

4 Remove the engine front cover, refer to 3.15 Front Cover Assembly.

5 Remove the two long bolts (1) attaching the rear of the oil pan to the crankshaft rear oil seal housing.

6 Remove the remaining eleven bolts attaching the oil pan to the cylinder block.

7 Using the shear points located at the edge of the oil pan shear the RTV sealant.

8 Remove the oil pan from the cylinder block.

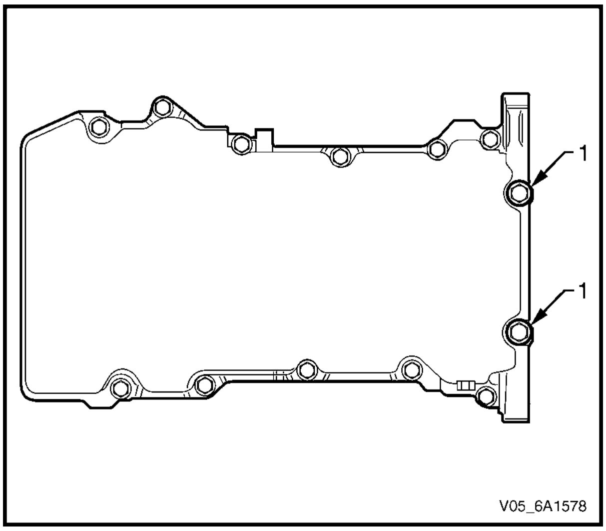


Figure 6A1 – 353

Disassemble

1 Remove the following:
2 Oil pan drain plug (7) and sleeve (8).
3 Oil level sensor (9).
4 Crankshaft oil deflector bolts (6) and remove the deflector.
5 Oil pump suction pipe bolts (5) and the suction pipe (3).
6 Oil pump suction pipe gasket (4) from the suction pipe and discard.

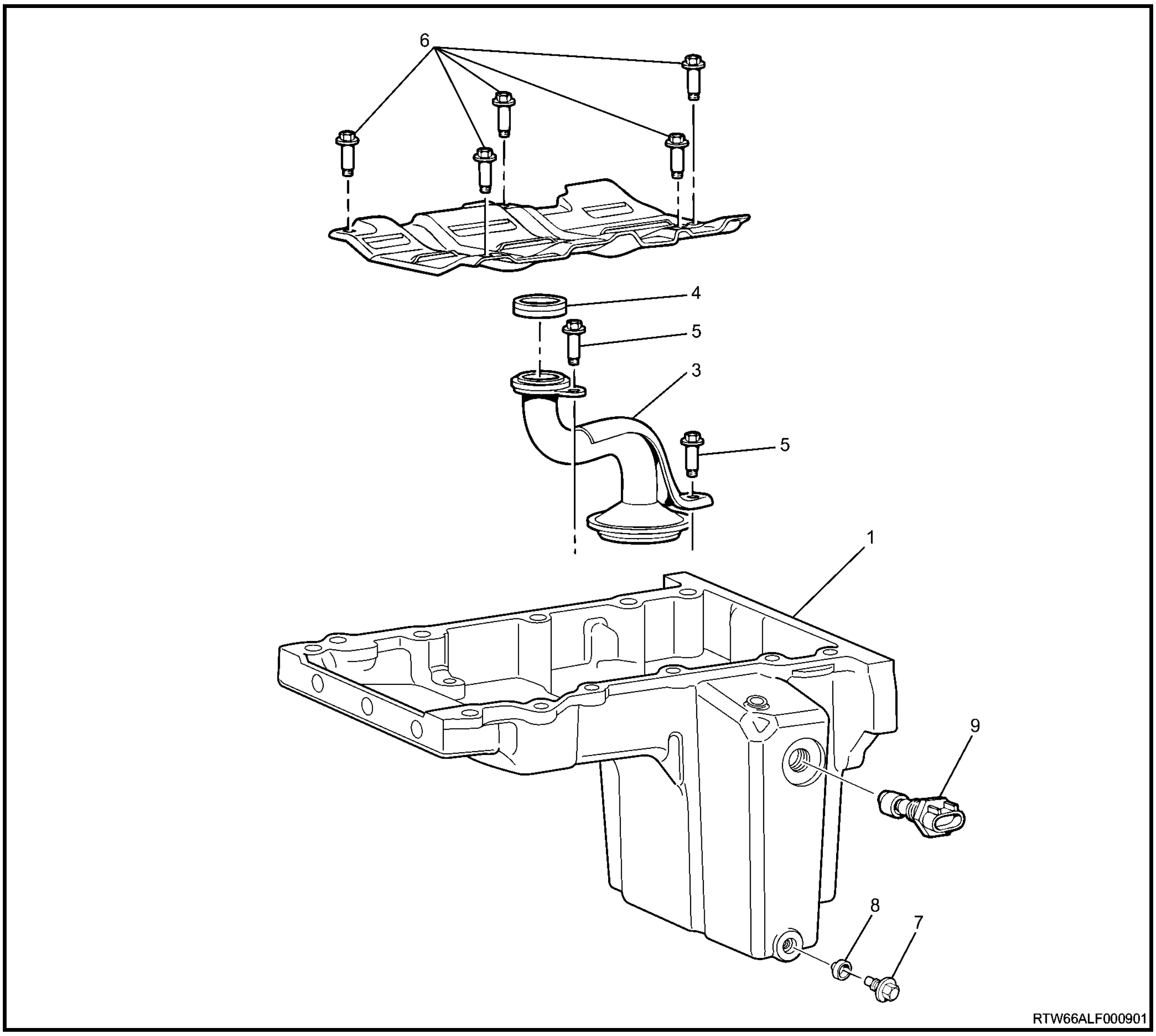


Figure 6A1 – 354

Clean

1 Remove any remaining thread sealant, gasket material or sealant using a commercially available wooden or plastic scraper.
2 Clean the oil pan and oil pan components in solvent.
3 Clean out debris from the bolt holes.

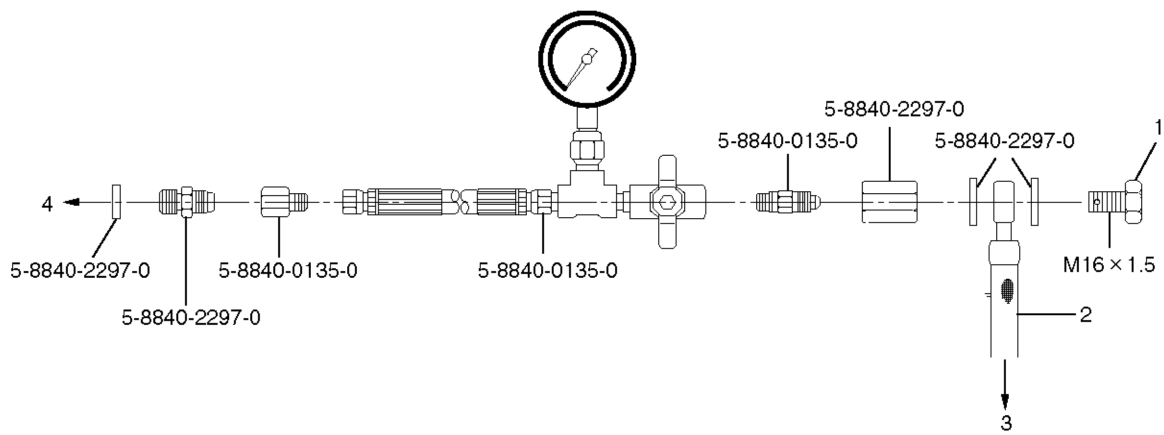
WARNING

Safety glasses must be worn when using compressed air.

4 Dry the oil pan and oil pan components with compressed air.

Power Steering System Test

Test Procedure



F02RX002

Legend

(1) Bolt
(2) Hose
(3) Power Steering Unit
(4) Power Steering Pump

The fluid pressure test in the power steering system is performed to determine whether or not the oil pump and power steering unit are functioning normally.
The power steering system test is used to identify and isolate hydraulic circuit difficulties. Prior to performing this test, the following inspections and corrections, if necessary, must be made.

- Inspect pump reservoir for proper fluid level.
- Inspect pump driver gear condition.

1. Place a container under the pump to catch the fluid when disconnecting or connecting the hoses.
2. With the engine NOT running, disconnect the pressure hose at the power steering pump and install power steering tester 5-8840-0135-0 and power steering tester adapter 5-8840-2297-0 as shown in the illustration. The gage must be between the shutoff valve and pump. Open the shutoff valve.
3. Check the fluid level. Fill the reservoir with power steering fluid, to the "Full" mark. Start the engine, then turn the steering wheel and momentarily hold it against a stop (right or left). Turn the engine off and check the connections at tester for leakage.
4. Bleed the system. Refer to Bleeding the Power Steering System in this section.
5. Start the engine and check the fluid level. Add power steering fluid if required. When the engine is at normal operating temperature, increase engine speed to 1500 rpm.

CAUTION: Do not leave shutoff valve fully closed for more than 5 seconds, as the pump could become damaged internally.

Inspect

1 Inspect the exterior of the oil pan for the following conditions:
   - Damage to the drain plug or drain plug hole,
   - Damage to the transmission mounting bosses,
   - Damage to the oil level sensor threads, and
   - Dents or damage to the exterior.
2 Inspect the interior of the oil pan for the following conditions:
   - Gouges or damage to the oil pan sealing surfaces,
   - Damage to the crankshaft oil deflector,
   - Damage to the bolt holes,
   - Damage to the oil suction tube mounting bosses, and
   - Damage to the crankshaft oil deflector mounting bosses.

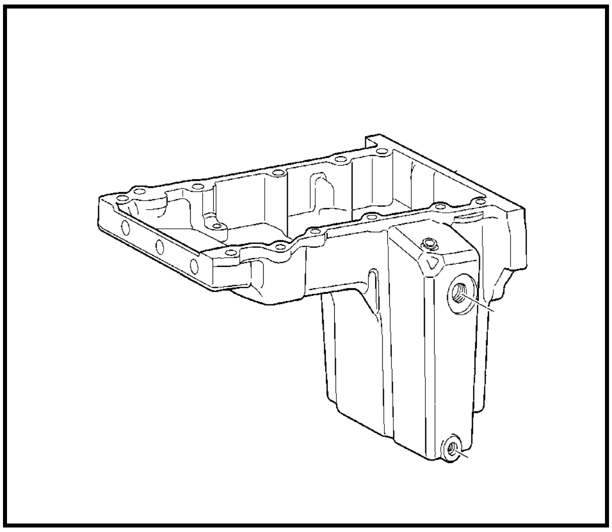


Figure 6A1 – 355

3 Inspect the oil pan deflector for damage.
4 Repair or replace the oil pan deflector and/or oil pan as required.

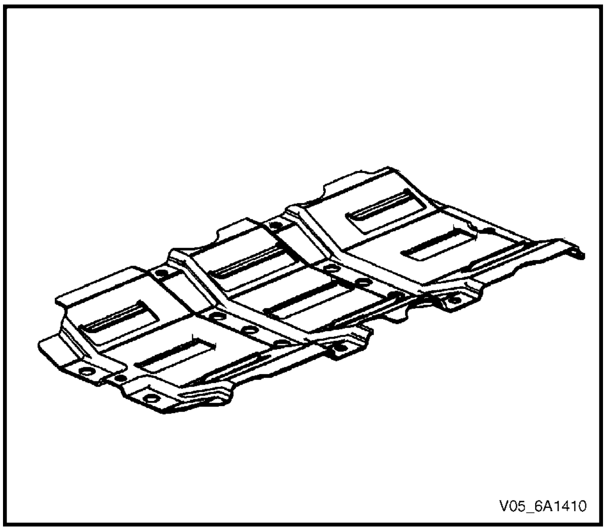


Figure 6A1 – 356

5 Inspect the following:
6 The mounting face (1) of the oil pump suction pipe for possible leakage paths.
7 The oil pump pipe support bracket (2) for cracks or damage.
8 The oil pump suction pipe tube (3) for cracks, imperfections and/or damage.
9 The oil pump screen (4) for blockage, foreign material, tears, cracks and/or damage.
10 Repair or replace the oil pan and/or oil pan components as required.

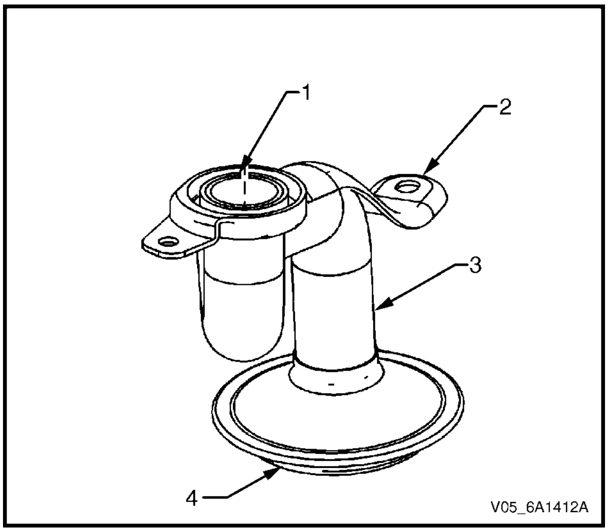


Figure 6A1 – 357

Reassemble

Reassembly of the oil pan and oil suction pipe assembly is the reverse of the disassembly procedure, noting the following:

1 Install a new oil suction tube seal onto the oil suction tube.

2 Install the oil suction pipe and tighten the attaching bolts to the correct torque specification.

Oil suction pipe attaching bolt torque specification ....10.0 Nm

3 Install the crankshaft oil deflector into the oil pan assembly and tighten the attaching bolts to the correct torque specification.

Crankshaft oil deflector attaching bolt torque specification......................10.0 Nm

4 Install the oil level sensor into the oil pan assembly and tighten to the correct torque specification.

Oil level sensor torque specification...................20.0 Nm

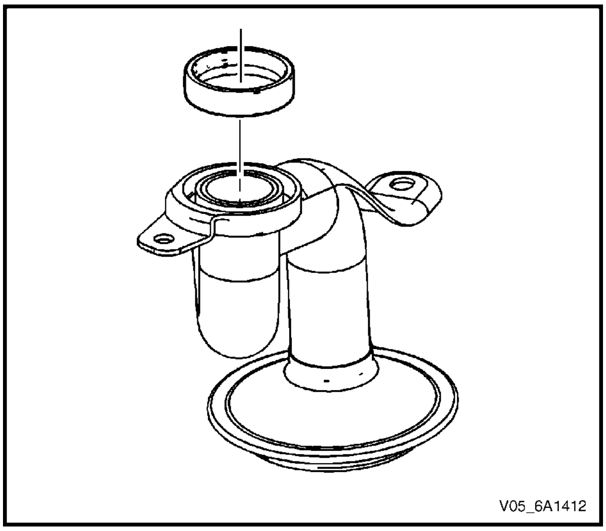


Figure 6A1 – 358

5 Install the oil pan drain plug into the oil pan assembly and tighten to the correct torque specification.

Oil pan drain plug torque specification ....25.0 Nm

Reinstall

1 Install the guide pins, Tool No. EN-46109 (1) into the oil pan rail bolt hole on each side of the engine block.

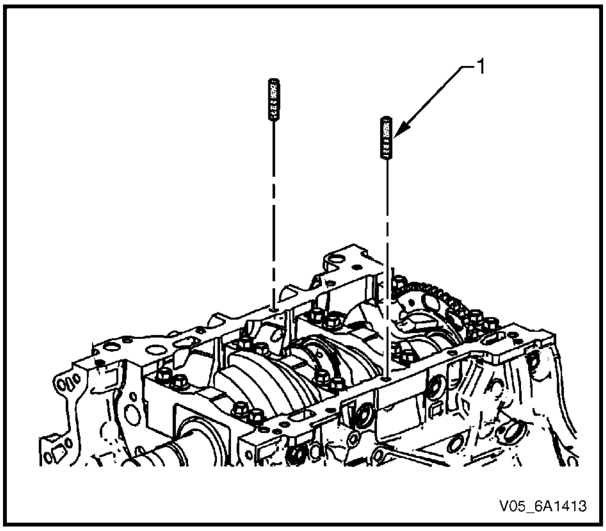


Figure 6A1 – 359

2 Place a 3mm bead (1) of RTV sealant on the cylinder block pan rail and crankshaft rear oil seal housing to oil pan mating surfaces.

3 Position the oil pan onto the cylinder block.

4 Remove the guide pins, Tool No. EN-46109 from the cylinder block.

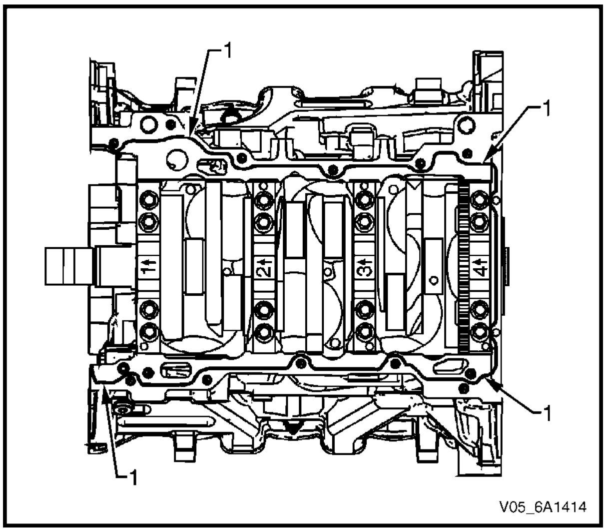


Figure 6A1 – 360

5 Loosely install the oil pan bolts.

6 Tighten the oil pan attaching bolts to the correct torque specification and in the sequence shown.

Oil pan to cylinder block attaching bolt (1 – 11) torque specification ....20.0 – 26.0 Nm
Oil pan to crankshaft rear oil seal housing attaching bolt (12 – 13) torque specification ....8.0 – 12.0 Nm

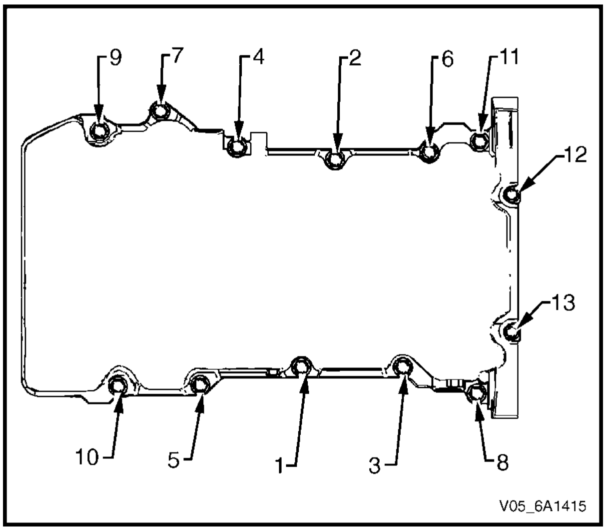


Figure 6A1 – 361

4.3 Flexplate Assembly

Remove

1 Remove the transmission, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.

2 Remove the starter motor, refer to 6D1-2 Starting System – V6.

3 Install the flexplate holding tool, Tool No. EN-46106 (1) into the starter motor mounting location.

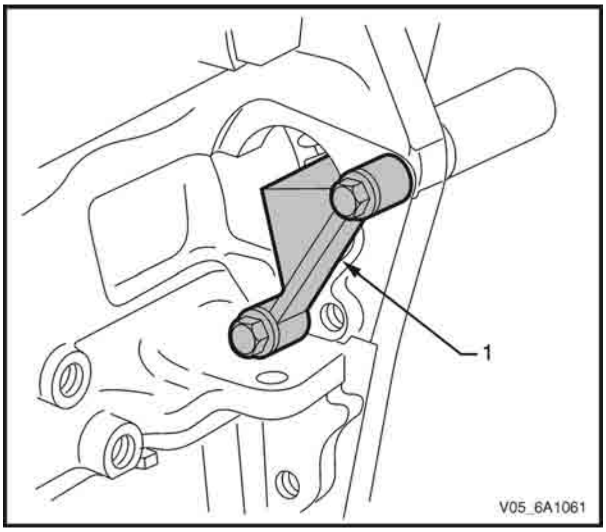


Figure 6A1 – 362

4 Loosen the eight flexplate attaching bolts (1).

5 Remove the flexplate holding tool.

6 Using a suitable permanent marker or paint pen, mark the flexplate assembly (2) to crankshaft relationship.

7 Remove the eight flexplate attaching bolts and discard.

8 Remove the flexplate assembly.

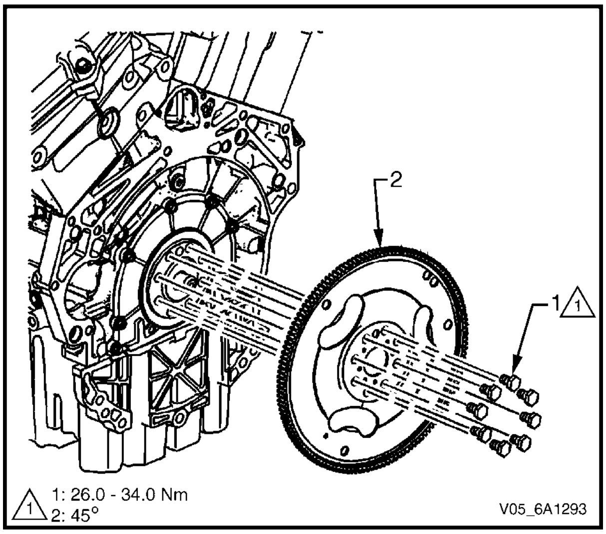


Figure 6A1 – 363

Clean

1 Clean the flexplate assembly in a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the flexplate assembly with compressed air.

Inspect

1 Inspect the flexplate assembly for the following conditions:

- Stress cracks around the flexplate to torque converter mounting bolt hole locations (1).
- Stress cracks around the flexplate to crankshaft mounting bolt hole locations (2 and 4).
- Cracks at welded areas that retain the ring gear onto the flexplate (3).
- Damaged or missing ring gear teeth (5).

2 Replace the flexplate assembly as required.

NOTE

The flexplate ring gear is not serviced separately and cannot be repaired. If found to be faulty or damaged, the flexplate assembly must be replaced.

CAUTION

Do not repair the welded areas that retain the ring gear to the flexplate. The flexplate must be replaced.

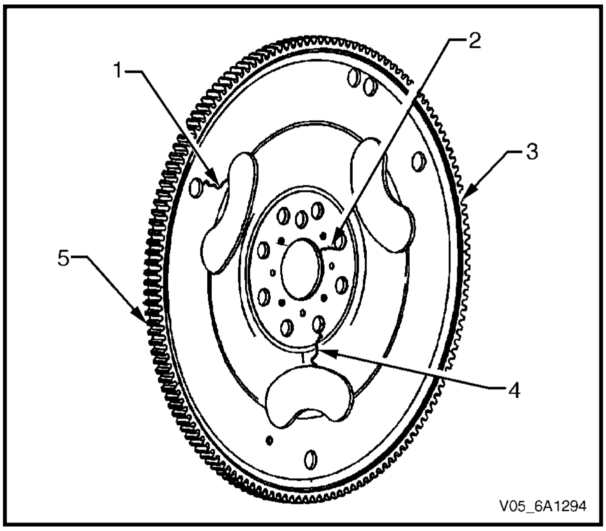


Figure 6A1 – 364

Reinstall

NOTE

The bolt holes are unevenly spaced to enable flexplate fitment in the one position only.

1 Place the flexplate assembly (2) in position on the crankshaft.

2 Install new flexplate attaching bolts (1) and hand tighten.

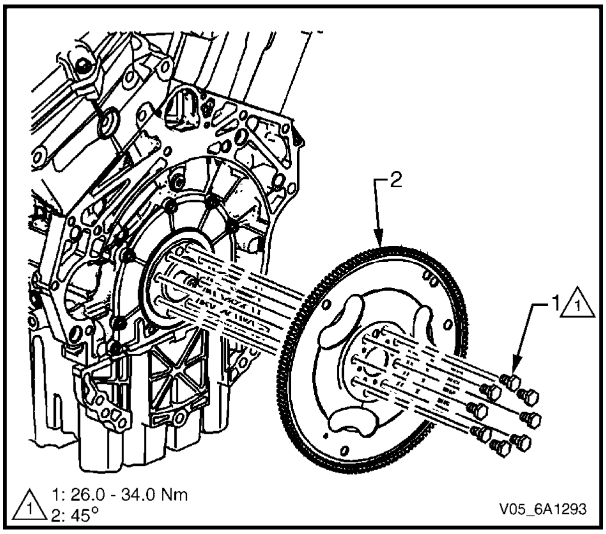


Figure 6A1 – 365

3 Install the flexplate holding tool, Tool No. EN-46106 (1) into the starter motor mounting location.

4 Tighten the eight flexplate attaching bolts to the correct torque specification.

■ ♦ Flexplate attaching bolt torque specification: Stage 1 ....26.0 – 34.0 Nm Stage 2 ....45°

5 Remove the flexplate holding tool.

6 Install the starter motor, refer to 6D1-2 Starting System – V6.

7 Install the transmission, refer to 7E4 Automatic Transmission – 4L60E – On-vehicle Servicing.

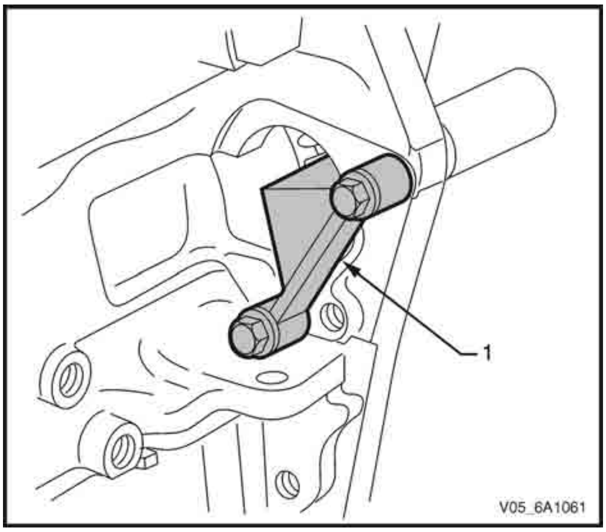


Figure 6A1 – 366

4.4 Crankshaft Rear Seal and Plate Assembly

Remove

1 Remove the engine assembly, refer to 4.1 Engine .

2 Remove the flexplate assembly, refer to 4.3 Flexplate Assembly.

3 Remove the engine oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

4 Remove the five bolts (1) attaching the crankshaft rear seal housing to the rear of the cylinder block (2).

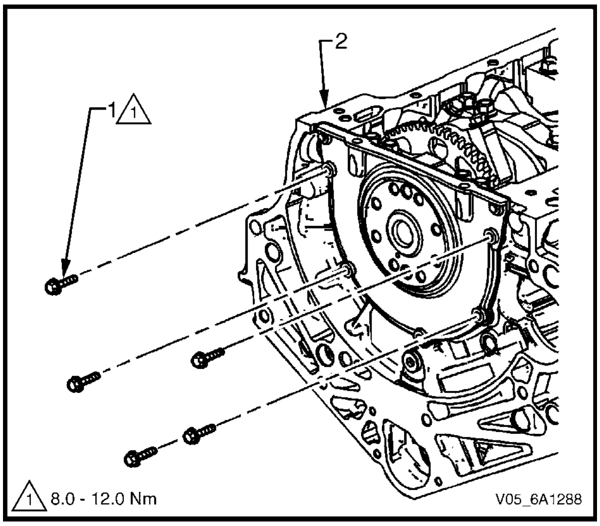


Figure 6A1 – 367

5 Shear the RTV sealant using the prise points located at the edge of the crankshaft rear oil seal housing,

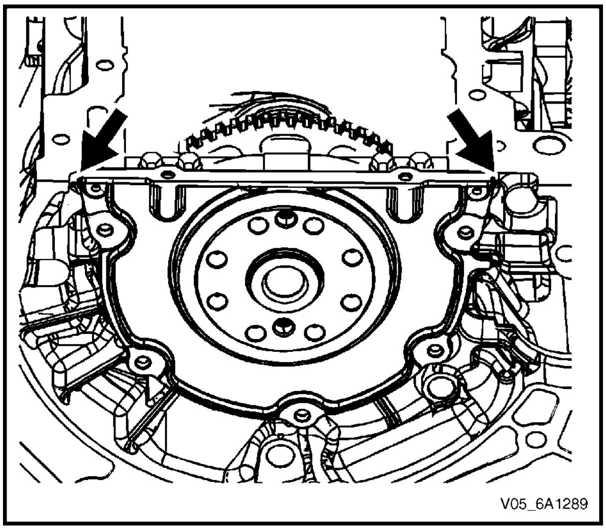


Figure 6A1 – 368

6 Remove the crankshaft rear oil seal housing (1) from the cylinder block (2).

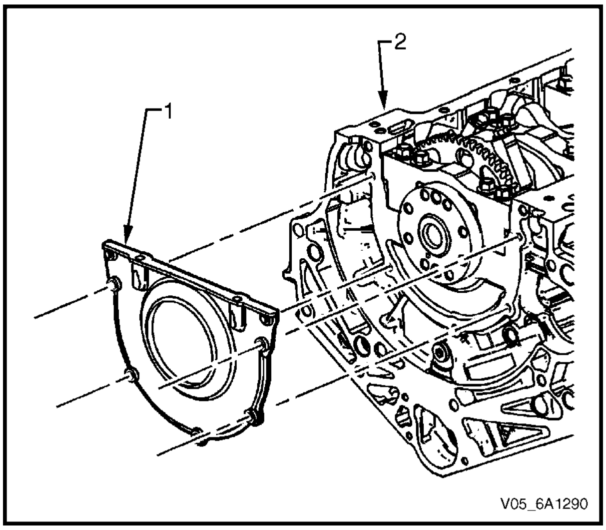


Figure 6A1 – 369

Reinstall

1 Install the guide pins, Tool No. EN-46109 (1) into the two crankshaft rear oil seal housing bolt holes of the cylinder block (2).

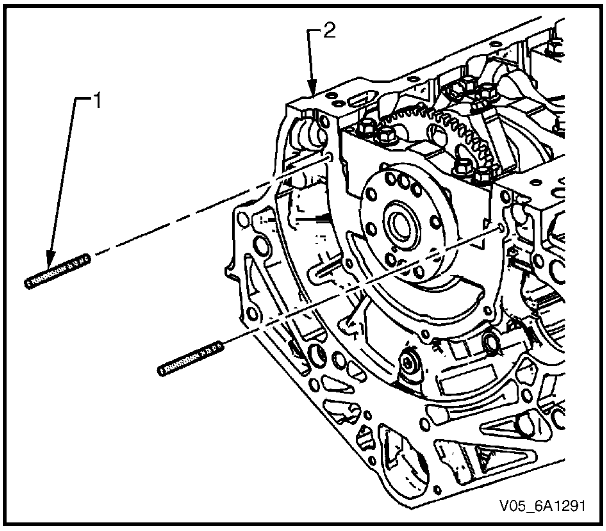


Figure 6A1 – 370

2 Apply a 3mm bead (1) of RTV sealant to the crankshaft rear oil seal housing.

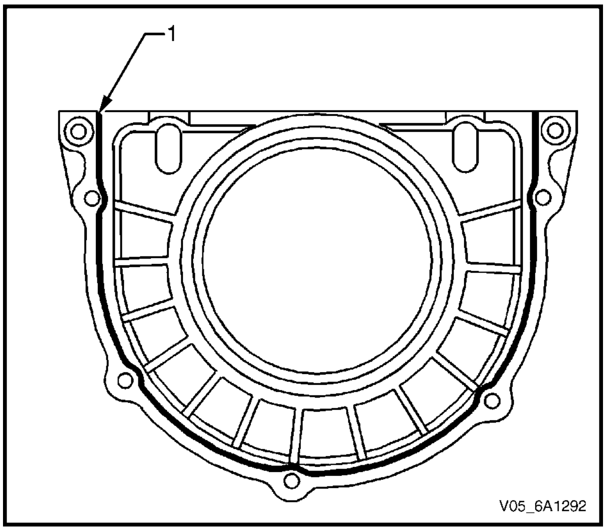


Figure 6A1 – 371

3 Install the crankshaft rear oil seal housing (1) to the cylinder block (2).

NOTE

- Do not allow any engine oil onto the cylinder block mating surface, where the crankshaft rear oil seal housing is to be installed.
- A seal-protector is provided with the new crankshaft rear seal and housing assembly. Do not remove the seal protector from the crankshaft rear oil seal housing until the crankshaft rear oil seal housing is fully in position.

4 Remove the guide pins from the cylinder block.

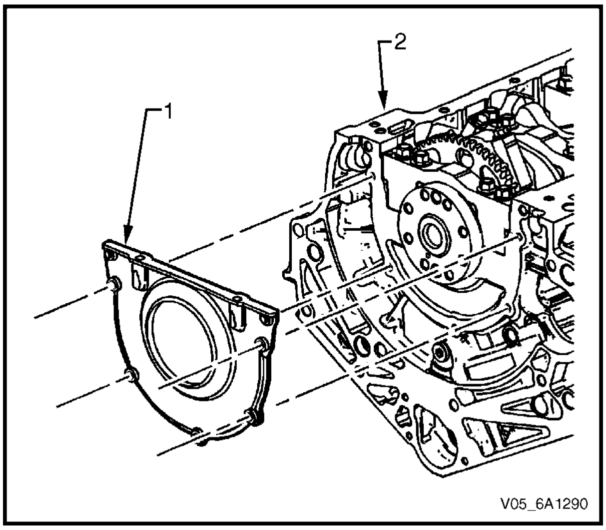


Figure 6A1 – 372

5 Install the crankshaft rear oil seal housing attaching bolts (1) to the cylinder block (2) and tighten to the correct torque specification.

Crankshaft rear oil seal housing attaching bolt torque specification.............8.0 – 12.0 Nm

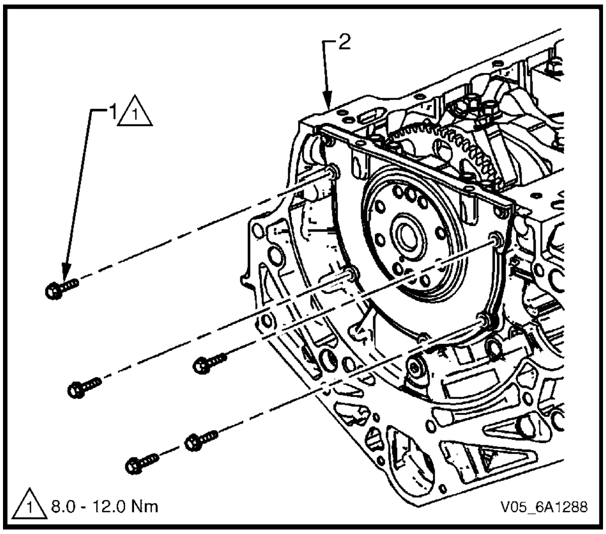


Figure 6A1 – 373

4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings

Remove

1 Remove the engine assembly, refer to 4.1 Engine .

2 Remove both cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.

3 Remove the oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

4 Mark the top of the piston being removed to identify its specific bore.

5 Install Tool No. EN-46111 (1) onto the crankshaft (2).

6 Rotate the crankshaft until the piston being removed is at the bottom of its stroke; bottom dead centre (BDC).

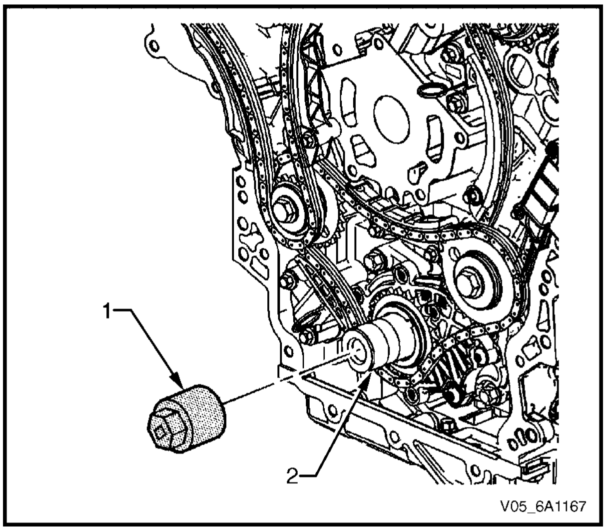


Figure 6A1 – 374

CAUTION

If the connecting rod bearings have been used in a running engine, they must be replaced with new connecting rod bearings for reassembly.

7 Before removing the connecting rods, check the connecting rod side clearance using the following procedure:

a Tap the connecting rod to one end of the crankshaft journal with a dead blow or wooden hammer.

b Using feeler gauges, measure the clearance between the crankshaft counterweight and the connecting rod.

c The connecting rod side clearance should not exceed specifications, refer to 5 Specifications.

d If the endplay exceeds the specified limits, measure the width of the crankpin end of the connecting rod, refer to 5 Specifications.

e If the connecting rod width is significantly smaller than specified and severe wear is present on the side of the connecting rod, replace the connecting rod.

f If the connecting rod width is within specification and excessive scoring is present on the crankshaft journals, replace the crankshaft.

CAUTION

Do not use a stamp, punch or any other method that may distort or stress the connecting rod and cap. Extensive engine damage may result from a connecting rod that is distorted or stressed.

8 Mark the cylinder number on the connecting rod and the connecting rod cap with a paint stick or permanent marker.

CAUTION

Powdered metal connecting rods have rod bolts which yield when tighten to the specified torque. If the bolts are loosened or removed they must be replaced. Rod bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

9 Remove the connecting rod bolts (1), loosening progressively from side to side.

CAUTION

The connecting rod caps must remain with the original connecting rod.

10 Remove the connecting rod cap (2).

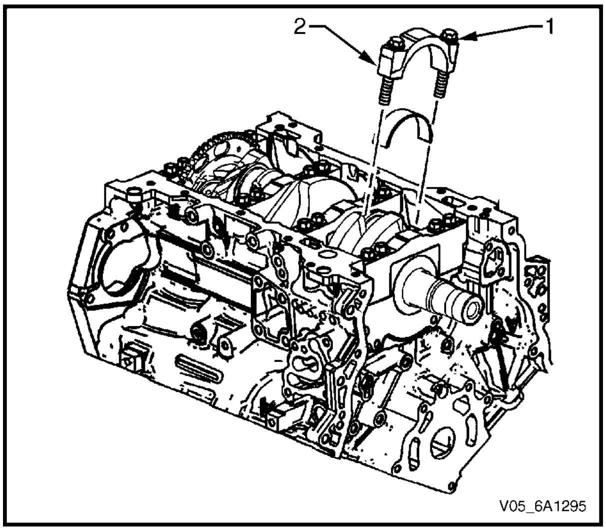


Figure 6A1 – 375

11 Install connecting rod guide pin set, Tool No. EN-46121 (1) to the connecting rod bolt holes.

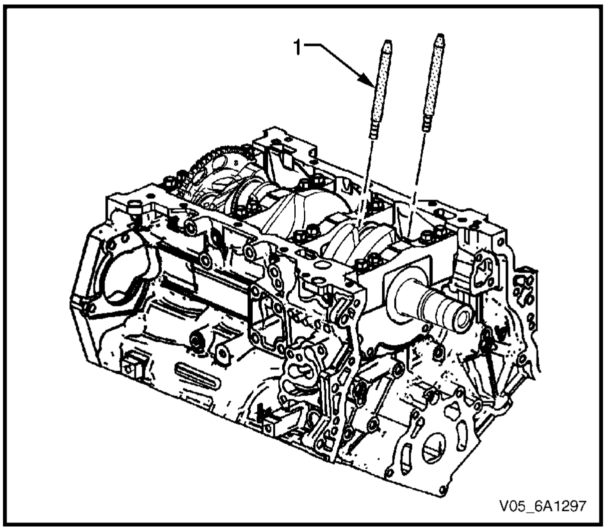


Figure 6A1 – 376

CAUTION

Do not damage the crankshaft journal, cylinder wall and piston cooling jets when removing the connecting rod and piston assembly.

12 Using connecting rod guide pin set, Tool No. EN-46121 (1), push the connecting rod and piston assembly (2) through the top of the cylinder.

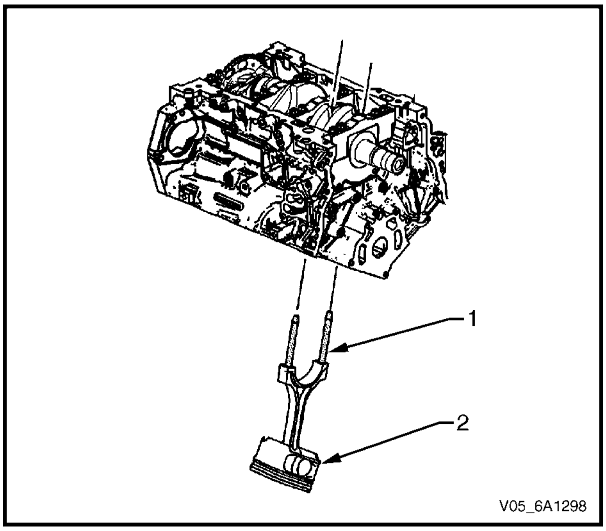


Figure 6A1 – 377

CAUTION

When dismantled, ensure the connecting rod, connecting rod cap, piston and bearings are organised in their original position and location. This will also aid engine mechanical diagnosis.

13 Remove connecting rod guide pin set, Tool No. EN-46121 (1) from the connecting rod bolt holes.

14 Remove the upper connecting rod bearing from the connecting rod (2).

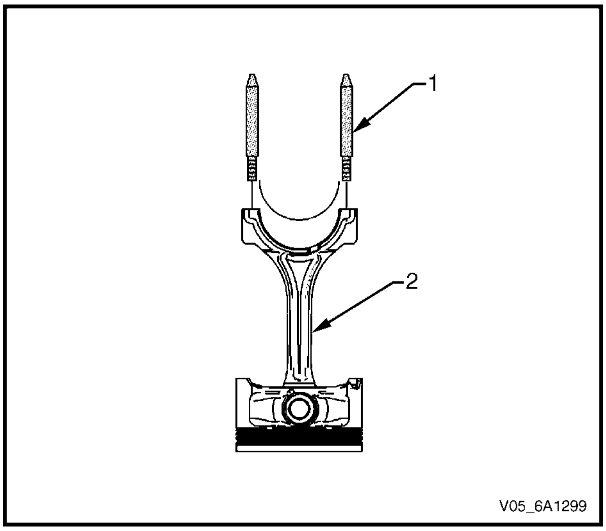


Figure 6A1 – 378

6. Fully close the shutoff valve. Record the highest pressures.
- If the pressure recorded is within 9800-10300 kPa (100-105 kg/cm^2/1422-1493psi), the pump is functioning within its specifications.
- If the pressure recorded is higher than 10300 kPa (105 kg/cm^2/1493psi), the valve in the pump is defective.
- If the pressure recorded is lower than 9800 kPa (100 kg/cm^2/1422psi), the valve or the rotating assembly in the pump is defective.
7. If the pump pressures are within specifications, leave the valve open and turn (or have someone else turn) the steering wheel fully in both directions. Record the highest pressures and compare with the maximum pump pressure recorded in step 6. If this pressure cannot be built up at either side of the power steering unit, the power steering unit is leaking internally and must be replaced.
8. Shut the engine off, remove the testing gauge.
9. Reconnect the pressure hose, check the fluid level and make the needed repairs.
10. If the problem still exists, the steering and front suspension must be thoroughly examined.

Maintenance

The hydraulic system should be kept clean, the fluid level in the reservoir should be checked at regular intervals and fluid added when required. Refer to Recommended Fluids and Lubricants in General Information section for the type of fluid to be used and the intervals for filling.

If the system contains some dirt, flush it as described in this section. If it is exceptionally dirty, the pump must be completely disassembled before further usage. (The steering unit cannot be disassembled.)

All tubes, hoses, and fittings should be inspected for leakage at regular intervals. Fittings must be tight. Make sure the clips, clamps and supporting tubes and hoses are in place and properly secured.

Power steering hoses and lines must not be twisted, kinked or tightly bent. Air in the system will cause spongy action and noisy operation. When a hose is disconnected or when fluid is lost, for any reason, the system must be bled after refilling. Refer to Bleeding the Power Steering System in this section.

- Inspect gear for looseness or damage.
- Inspect hoses to insure they are not touching any other parts of the vehicle.
- Inspect fluid level and fill to the proper level.

Fluid Level

1. Run the engine until the power steering fluid reaches normal operating temperature, about 55° C (130° F), then shut the engine off.
2. Check the level of fluid in the reservoir.
3. If the fluid level is low, add power steering fluid as specified in General Information to the proper level and install the receiver cap.
4. When checking the fluid level after the steering system has been serviced, air must be bled from the system. Refer to Bleeding the Power Steering System in this section.

Bleeding the Power Steering System

When a power steering pump or unit has been installed, or an oil line has been disconnected, the air that has entered the system must be bled out before the vehicle is operated. If air is allowed to remain in the power steering fluid system, noisy and unsatisfactory operation of the system may result.

Bleeding Procedure

When bleeding the system, and any time fluid is added to the power steering system, be sure to use only power steering fluid as specified in General Information.

1. Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two minutes.
2. Start the engine and let it run for a few seconds. Do not turn the steering wheel. Then turn the engine off.
3. Add fluid if necessary.
4. Repeat the above procedure until the fluid level remains constant after running the engine.
5. Raise and support the front end of the vehicle so that the wheels are off the ground.
6. Start the engine. Slowly turn the steering wheel right and left, lightly contacting the wheel stops.
7. Add power steering fluid if necessary.
8. Lower the vehicle, set the steering wheel at the straight forward position after turning it to its full steer positions 2 or 3 times, and stop the engine.
9. Check the fluid level and refill as required.
10. If the fluid is extremely foamy, allow the vehicle to settle for a few minutes, then repeat the above procedure.

Flushing the Power Steering System

1. Raise and support the front end of the vehicle off the ground until the wheels are free to turn.
2. Remove the fluid return line at the pump inlet connector and plug the connector port on the pump. Direct the line toward a large container to catch the draining fluid.
3. While running the engine at idle, fill the reservoir with new power steering fluid. Turn the steering wheel in both directions. Do not contact or hold the steering wheel to the wheel stops. This will cause the pump to go to pressure relief mode, which may cause a sudden fluid overflow at the reservoir.

15 Remove the lower connecting rod bearing (1) from the connecting rod cap (2).

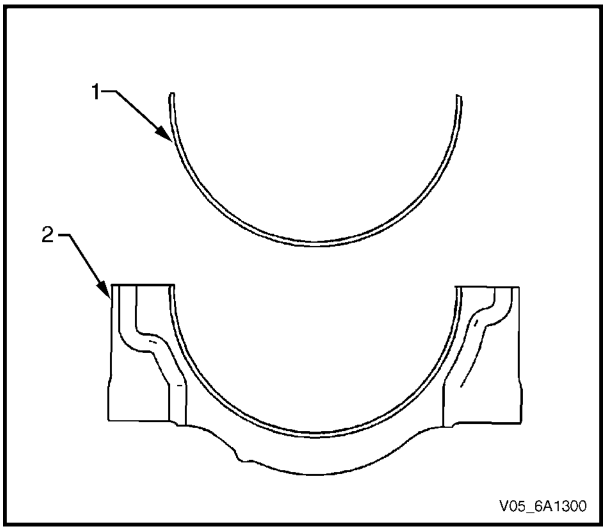


Figure 6A1 – 379

NOTE

The cap and rod are a matched set and must be kept together.

16 Reattach the connecting rod cap (1) to the connecting rod (2) to prevent damage to their mating surfaces.

17 Repeat steps 4 to 16 for the remaining piston and connecting rod assemblies.

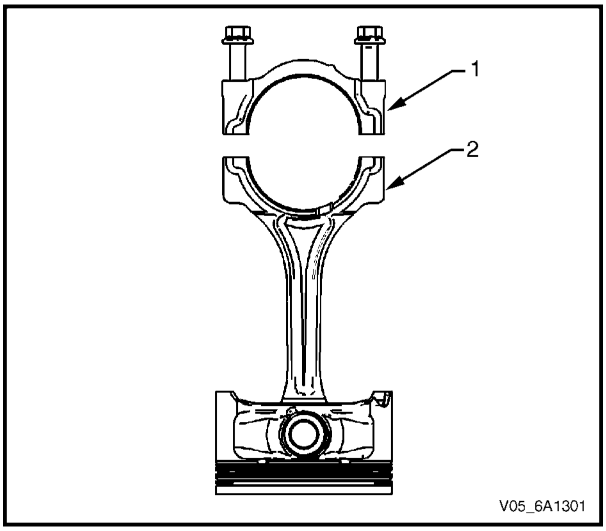


Figure 6A1 – 380

Disassemble

CAUTION

A piston ring expander must be used to remove and install the piston rings. Only expand the rings far enough to fit over the piston lands. If the rings are overexpanded, the top ring will shatter and the others will distort.

1 Remove the piston rings (2) using a piston ring expander (1). Place each ring in a clean shop towel for storage.

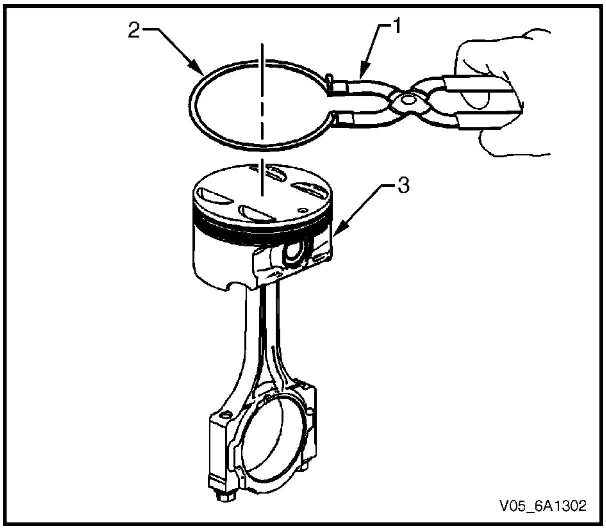


Figure 6A1 – 381

CAUTION

Do not reuse the piston pin retainers.

2 Remove the piston pin retainers by using the removal access notch (1) in the side of the piston. Discard the piston pin retainers.

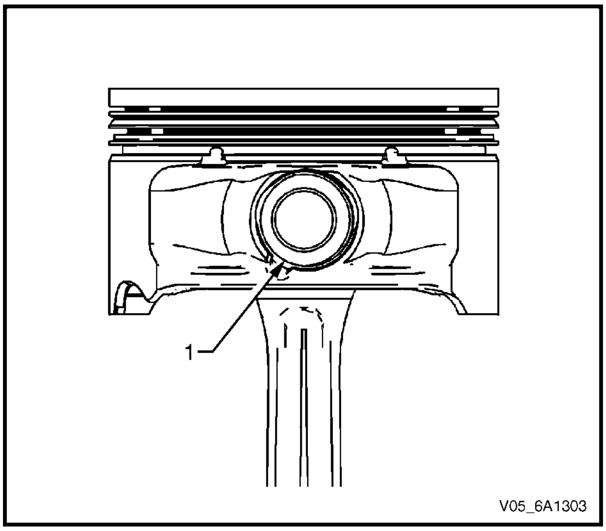


Figure 6A1 – 382

3 Slide the piston pin (1) out of the piston (2). The piston will disconnect from the connecting rod.

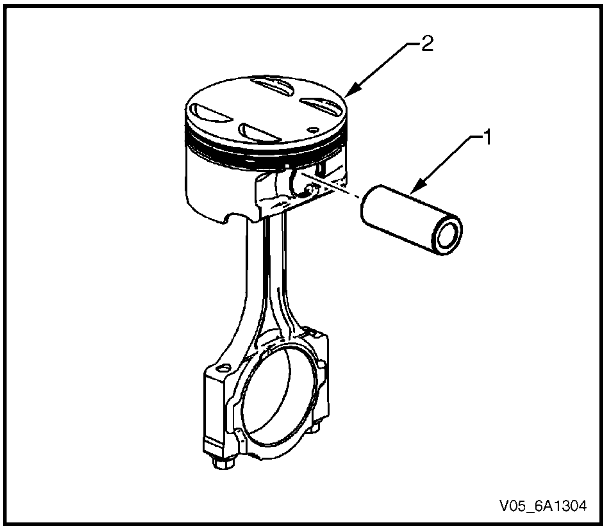


Figure 6A1 – 383

Clean and Inspect

Piston Cleaning Procedure

CAUTION

Do not use a wire brush to clean any part of the piston.

1 Clean the piston skirts and the pins with a suitable solvent.

2 Clean the piston ring grooves with a groove cleaner. Ensure the oil ring holes and slots are clean.

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the piston with compressed air.

Piston Inspection Procedure

1 Inspect the pistons for the following conditions:
- eroded areas at the top of the piston (1),
- piston pin retainer grooves for burrs (2),
- worn piston pin bores or worn piston pins (3),
- scuffed or damaged skirt coating (4),
- ring grooves for cracks, nicks or burrs that may cause binding (5), and
- warped or worn ring lands.

2 Replace pistons that show any signs of damage or excessive wear.

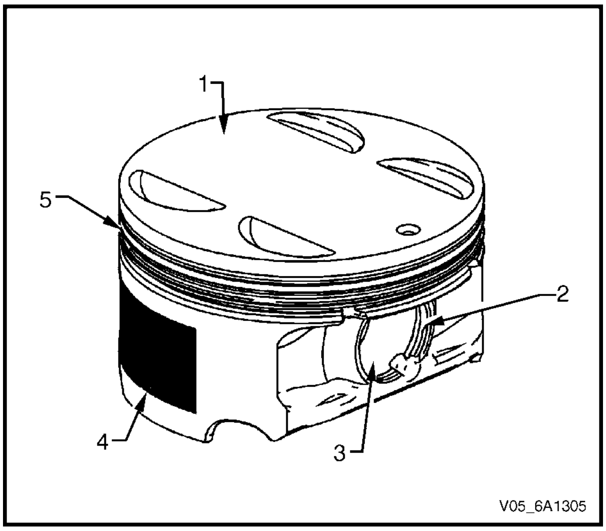


Figure 6A1 – 384

Piston Measurement

1 Measure piston width using the following procedure:

a Using an outside micrometer, measure the width of the piston at 30 mm below the crown top (1), at the thrust surfaces of the piston, perpendicular to the piston pin centreline.

b Compare the measurement of the piston to its original cylinder by subtracting the piston width from the cylinder diameter.

c Check your measurements with specifications, refer to 5 Specifications.

d If the clearance obtained through measurement is greater than the provided specifications and the cylinder bores are within specification, replace the piston.

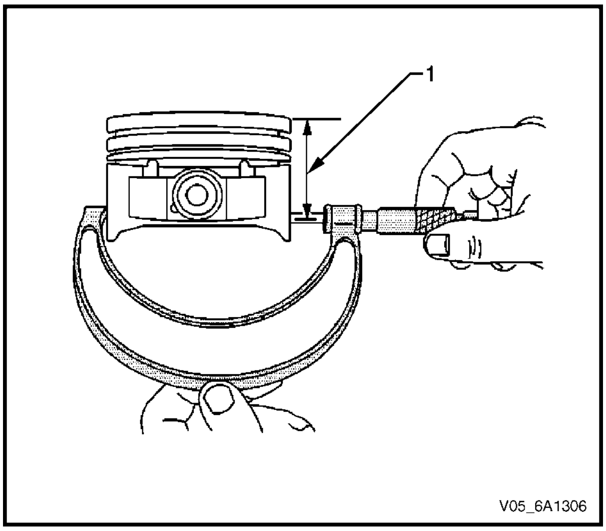


Figure 6A1 – 385

2 Measure the piston pin bore to piston pin (2) clearances using the following procedure:

a Piston pin bores and pins must be free of varnish or scuffing.

b Use an outside micrometer (1) to measure the piston pin in the piston contact areas.

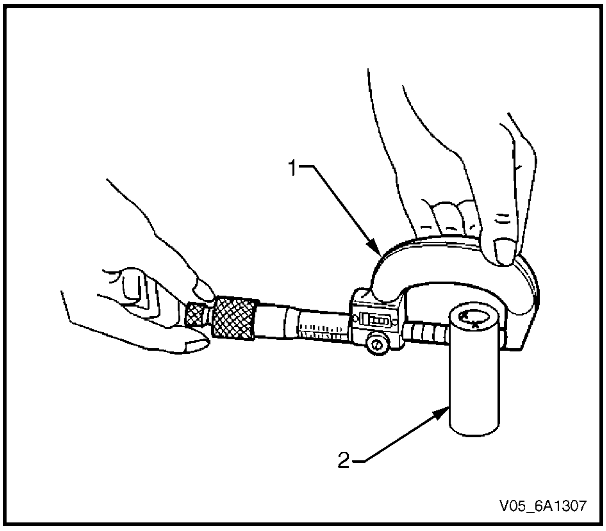


Figure 6A1 – 386

3 Using an inside micrometer, measure the piston pin bore (1). Compare the result with the piston pin diameter and piston pin to piston pin bore clearance listed in the specifications, refer to 5 Specifications.

4 If the clearance is excessive, determine which piece is out of specification and replace as required.

5 Replace the piston if any of its dimensions are out of specification.

6 If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm. There is only one size of oversized pistons and rings available for service.

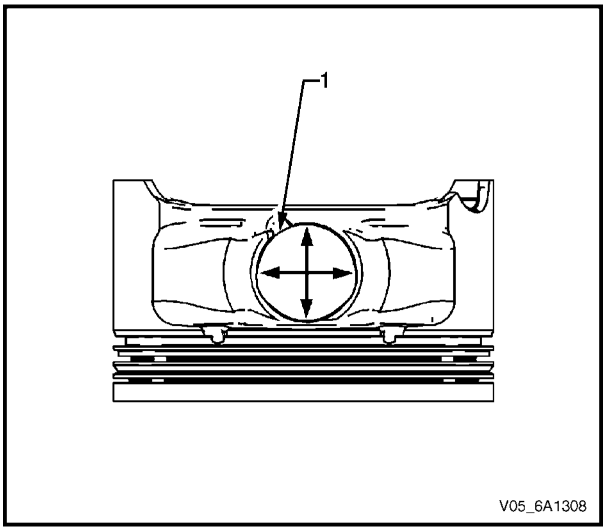


Figure 6A1 – 387

Piston Ring Measurement

1 Measure the piston ring end gap using the following procedure:

a Place the piston ring (1) in the area of the bore where the piston ring will travel, approximately 25 mm below the deck surface. Ensure the ring is square with the cylinder bore by positioning the ring with the piston head.

b Measure the end gap of the piston ring with feeler gauges (2), refer to 5 Specifications.

c If the clearance exceeds the provided specifications, the piston rings must be replaced.

d Repeat the procedure for all piston rings.

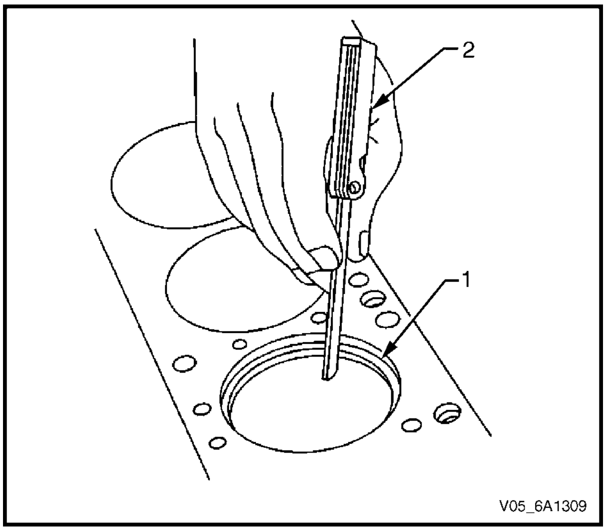


Figure 6A1 – 388

2 Measure the piston ring side clearance using the following procedure:

a Roll the piston ring (1) entirely around the piston ring groove. If any binding is caused by the ring groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring, replace the ring.

b With the piston ring on the piston, use feeler gauges (2) to check clearance at multiple locations.

c Compare the measurements with piston ring side clearance listed in the specifications, refer to 5 Specifications.

d If the clearance is greater than specifications, replace the piston rings.

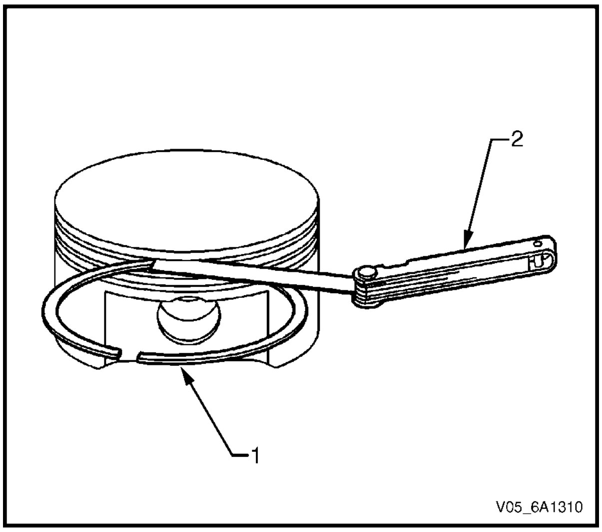


Figure 6A1 – 389

3 There is a locating dimple (1) on the compression rings. Install the compression rings with the dimple facing up.

4 If the new ring does not reduce the clearance to the correct specification, install a new piston.

5 If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm. There is only one size of oversized pistons and rings available for service.

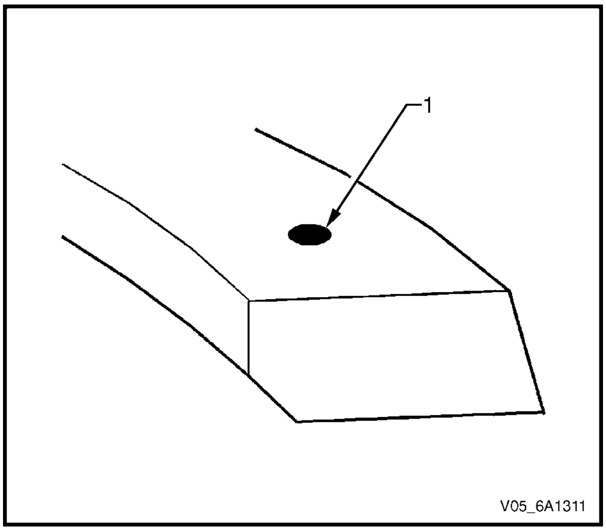


Figure 6A1 – 390

Connecting Rod Cleaning Procedure

1 Clean the connecting rods in solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the connecting rod using compressed air.

3 Remove the connecting rod cap and clean the threads.

4 Remove the connecting rod bearing and discard. Never reuse a connecting rod bearing that has been used in a running engine.

Connecting Rod Visual Inspection Procedure

1 Inspect the piston pin bushing (4) for scoring or damage.

2 Inspect the connecting rod beam (1) for twisting or bending.

3 Inspect the rod cap (2) for any nicks or damage caused by possible interference.

4 Inspect for scratches or abrasion on the rod bearing seating surface.

5 If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper.

6 Retain the original bolts (3) for preliminary assembly. They must be replaced for final assembly.

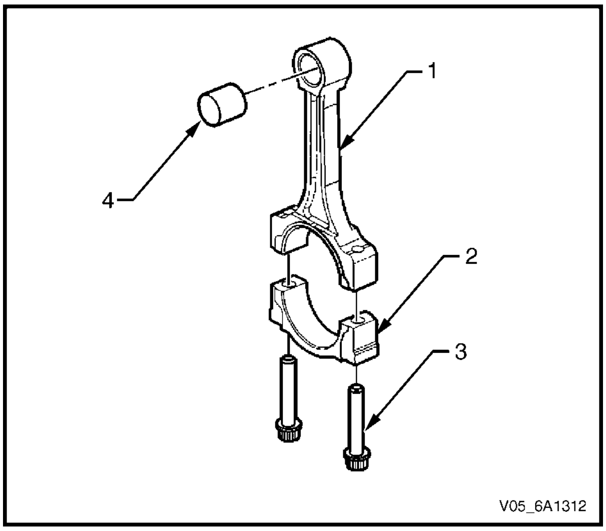


Figure 6A1 – 391

Connecting Rod Measurement Procedure

Piston Pin End

NOTE

Measurements of all components should be taken with the components at normal room temperature.

1 Using an outside micrometer (1), take two measurements of the piston pin (2) in the area of the connecting rod contact.

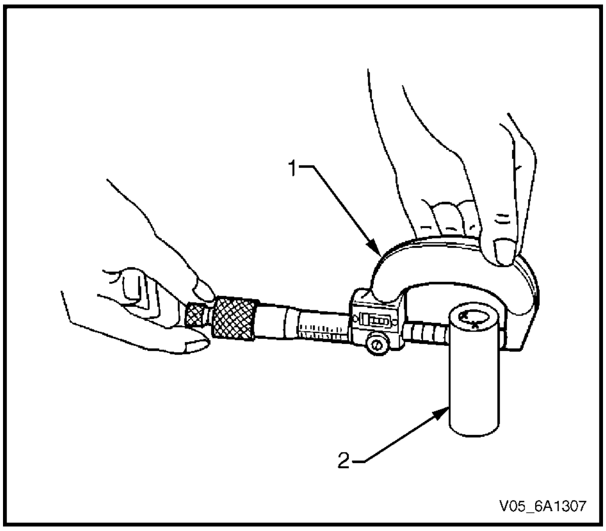


Figure 6A1 – 392

2 Using an inside micrometer, measure the connecting rod piston pin bore (1).

3 Subtract the piston pin diameter from the piston pin bore.

4 Compare the clearance measurements listed in the specifications, refer to 5 Specifications.

5 If the clearance is excessive, replace the piston pin. If a new pin does not resolve the clearance problem, replace the connecting rod.

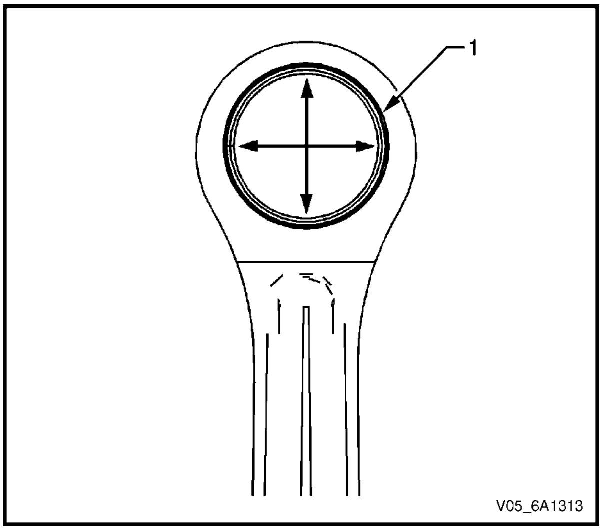


Figure 6A1 – 393

Crankshaft Bearing End

NOTE

Measurements of all components should be taken with the components at normal room temperature.

1 Using an inside micrometer, measure the connecting rod crankshaft bearing bore (1).

2 Compare the bore measurements listed in the specifications, refer to 5 Specifications.

3 Replace the connecting rod if the bore is out of specification. Do not recondition the connecting rod.

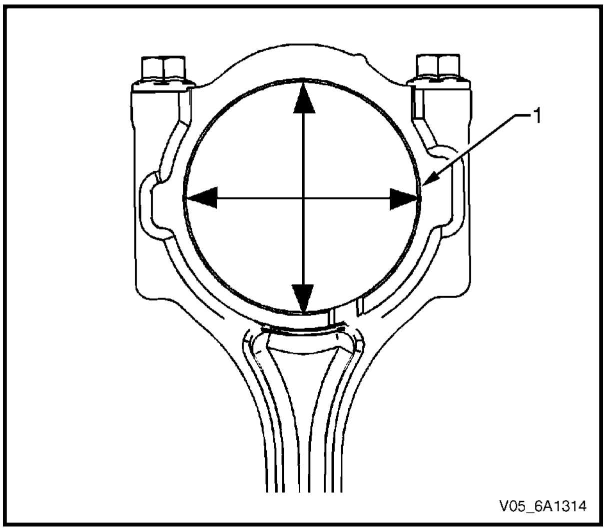


Figure 6A1 – 394

Reassemble

Piston and Piston Pin

CAUTION

The arrow located on top of the piston must point toward the front of the engine.

NOTE

The connecting rod is non-directional and may be assembled/reassembled to the piston in either direction.

1. Lubricate the piston pin (1) bores in the piston (2) and the connecting rod with clean engine oil.
2. Assemble the piston and piston pin to the connecting rod. Correctly orient the piston when reusing a marked connecting rod.
3. Align the piston pin bore with the connecting rod pin bore.
4. Slide the piston pin into the piston and the connecting rod.

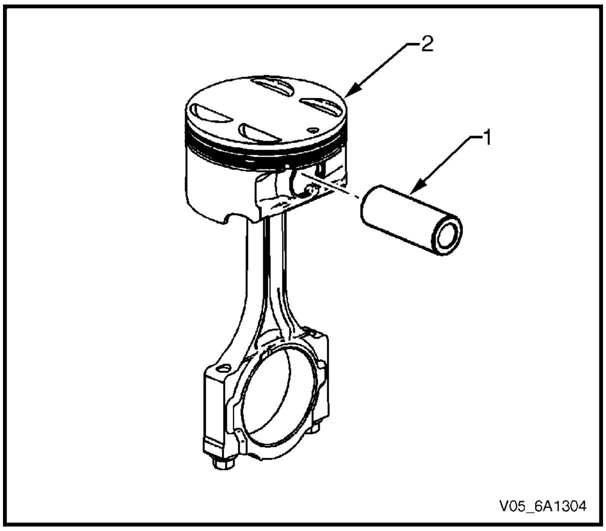


Figure 6A1 – 395

CAUTION

New piston pin retainers must be used. Never reuse the piston pin retainers.

5. Install new piston pin retainers (1).
6. Ensure the piston pin retainers are fully seated in their grooves.
7. Repeat steps 1 to 6 for the remaining pistons.

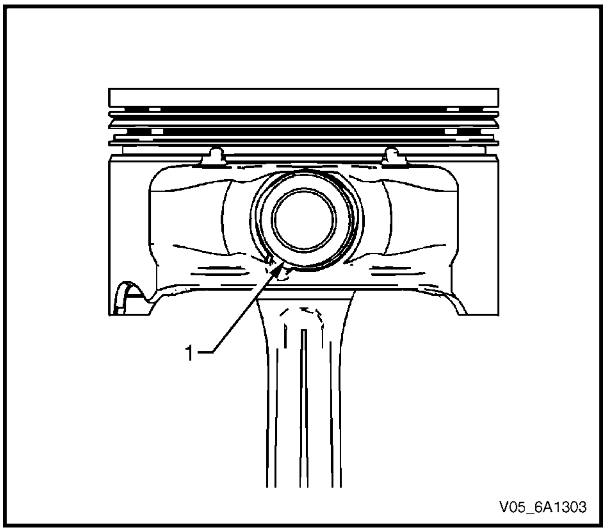


Figure 6A1 – 396

Piston Ring

NOTE

The ends of the expander must be facing toward the top of the piston.

1 Correctly orient the oil control ring expander (1) before installation.

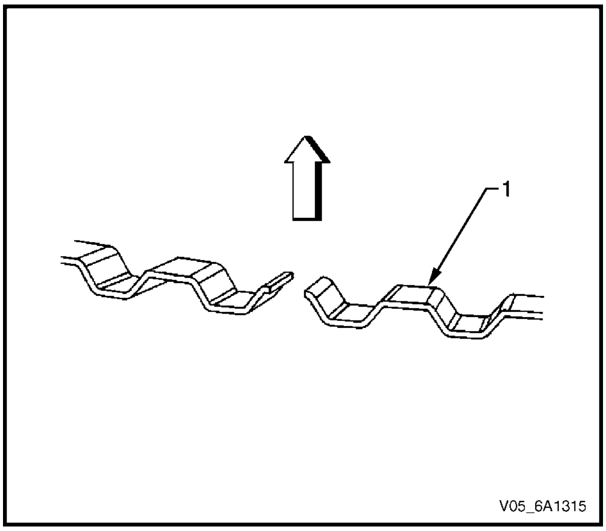


Figure 6A1 – 397

2 Using a piston ring expander, install the oil control ring assembly using the following procedure:

3 Install the expander ring (3).

4 Install the two oil scraper rings (4). Expand the rings only enough to clear the piston diameter. Over-expanding the piston rings will distort or crack the rings.

5 Install the second (2) and top (1) piston rings as follows.

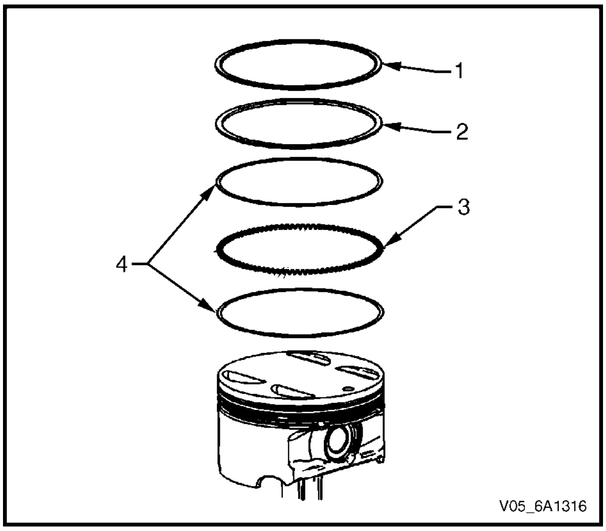


Figure 6A1 – 398

6 Using the ring expander (1), install the second piston ring (2) onto the piston (3). Do not over-expand the ring. Repeat for the top ring.

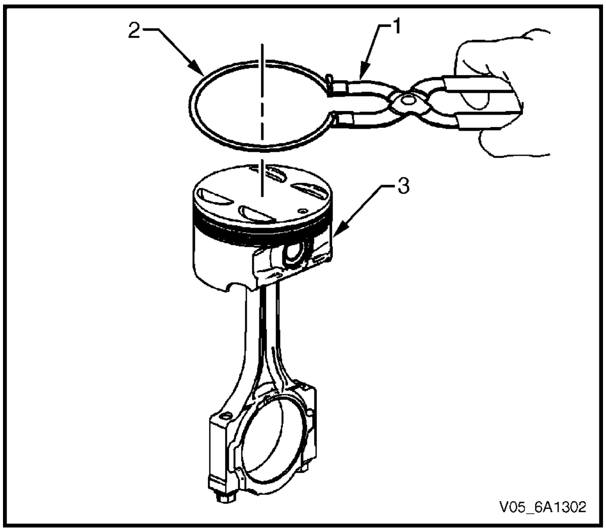


Figure 6A1 – 399

7 Once the rings are installed, set the ring gaps for the oil control, second and top ring as follows. Use the piston location arrow for reference.

- Lower oil control ring position (1).
- Upper oil control ring position (2).
- Top ring position (3).
- Oil control ring expander position (4).
- Second ring position (5).

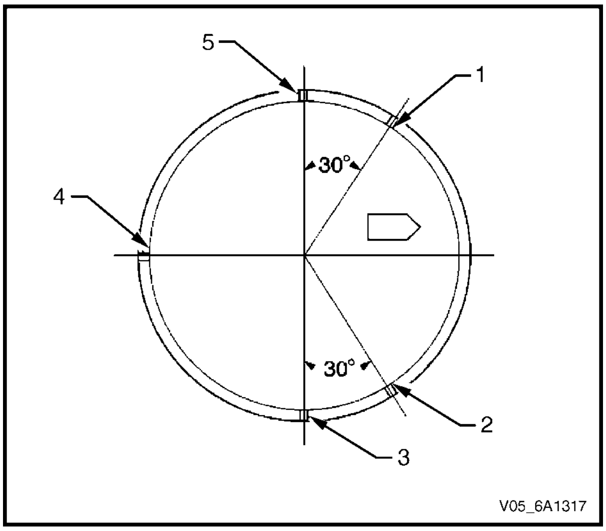


Figure 6A1 – 400

Connecting Rod Bearing

CAUTION

If the connecting rod bearings have been used in a running engine, they must be replaced with new connecting rod bearings for reassembly.

1 Clean the connecting rod (2) and the connecting rod cap bearing bore with a lint-free cloth.

2 Clean the oil from behind the connecting rod bearing halves.

3 Install a new upper connecting rod bearing (1) into position. Roll the bearing into position so the lock tang engages the alignment slot. The bearing must fit flush in the connecting rod.

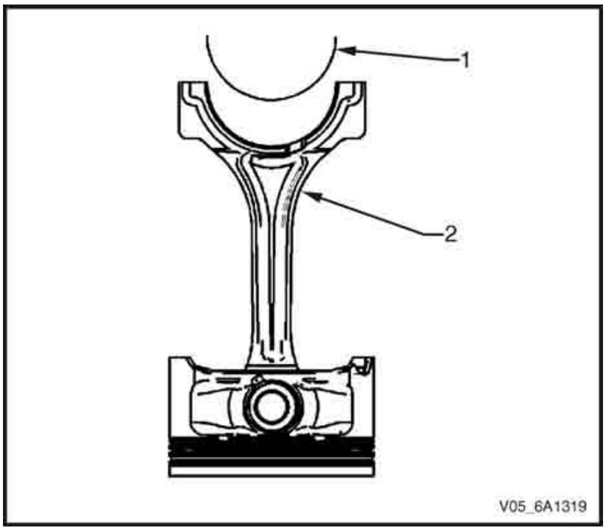


Figure 6A1 – 401

4 Install the lower connecting rod bearing (1) into position in the connecting rod cap (2).

5 Roll the bearing into position so the lock tang engages the alignment slot. The bearing must fit flush with the connecting rod cap.

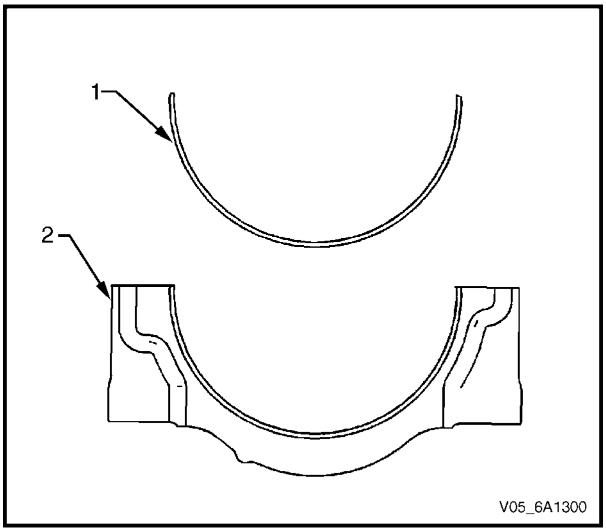


Figure 6A1 – 402

Reinstall

Piston Connecting Rod and Connecting Rod Bearing Installation

CAUTION

The piston is directional and must be installed in the engine block in the correct direction. The locating arrow on the top of each piston must be pointing toward the front of the engine.

1 Liberally lubricate the cylinder walls, piston rings and piston skirts with engine oil.

2 Select the correctly numbered piston/connecting rod assembly for the cylinder. A dot (1) showing correct piston orientation is located on the top of the piston.

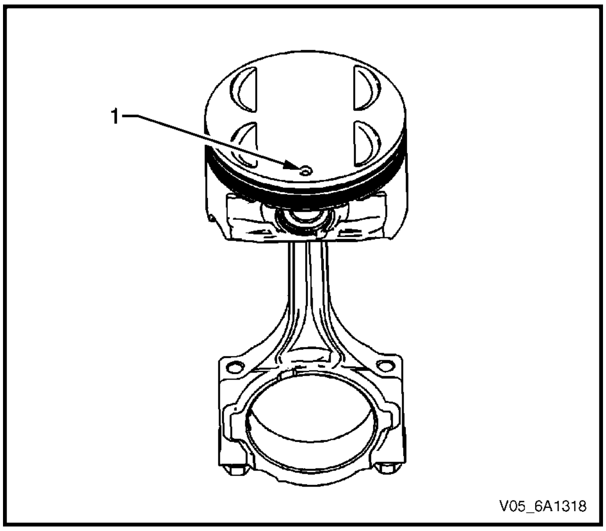


Figure 6A1 – 403

3 Install connecting rod guide pin set, Tool No. EN-46121 (1) into the connecting rod bolt holes.

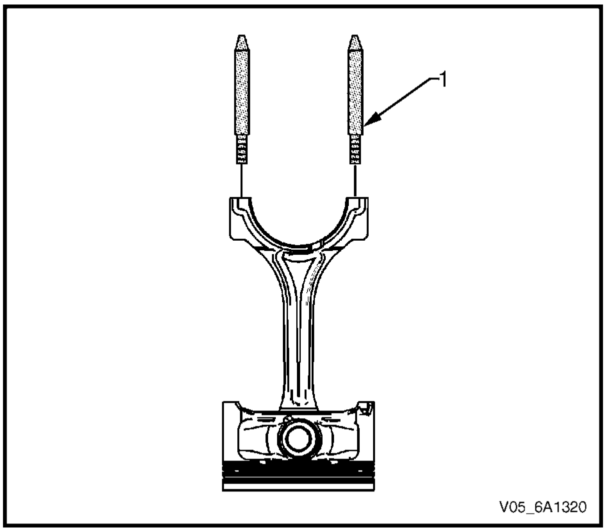


Figure 6A1 – 404

4 Compress the piston rings using a commercially available ring compressor.

CAUTION

Extreme care must be used when installing the piston and connecting rod to ensure the rod does not scrape or nick the cylinder bore, oil jets, or crankshaft surfaces.

5 Using both hands from the top and bottom of the cylinder, slowly guide the piston (2) and connecting rod assembly into the cylinder. Do not allow the connecting rod to contact the cylinder wall.

6 When the ring compressor contacts the deck surface, gently tap the piston into the cylinder using the handle end of a dead-blow hammer. Guide the connecting rod onto the crankshaft bearing journal using connecting rod guide pin set, Tool No. EN-46121 (1) while gently tapping the piston into the cylinder with a soft-blow hammer.

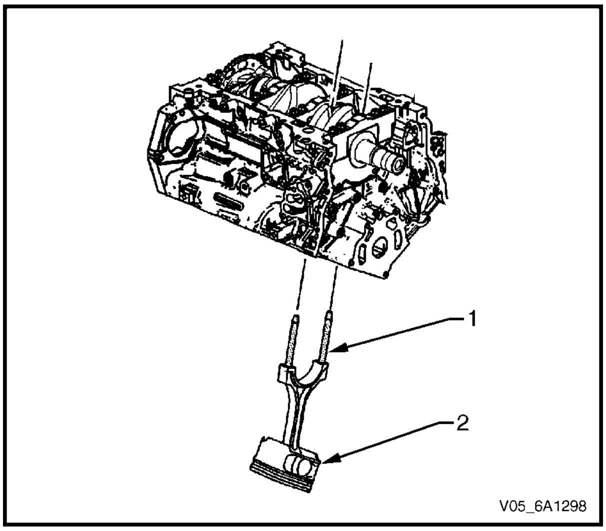


Figure 6A1 – 405

SEVERE CONDITIONS MAINTENANCE SCHEDULE (For GENERAL EXPORT)

Severe driving conditions

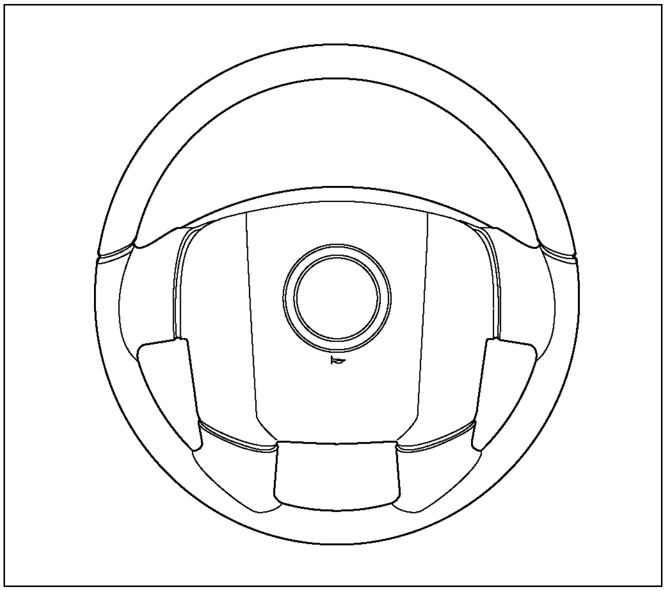
- A : Repeated short trips
- B : Driving on rough roads
- C : Driving on dusty roads
- D : Driving in extremely cold weather and/or on salted roads
- E : Towing trailer or climbing mountain frequently
- F : Operation in high ambient temperature conditions

- [C24SE] : C24SE Gasoline engine
- [HFV6] : HFV6 Gasoline engine
- [G] : Gasoline engine
- [4JA1-T] : 4JA1-T Diesel engine
- [4JH1-TC] : 4JH1-TC Diesel engine
- [4JJ1 (Standard Output)] : 4JJ1 Standard Output Diesel engine
- [4JJ1 (High Output)] : 4JJ1 High Output Diesel engine
- [D] : Diesel engine
- [MT] : Manual transmission
- [AT] : Automatic transmission
- [4WD] : Four wheel drive

Item	Interval		Condition					
		A	B	C	D	E	F	A+D
Engine oil	[G] : Change every 5,000 km (3,000 miles) or 3 month [4JA1-T] : Change every 2,500 km (1,500 miles) [4JH1-TC] [4JJ1 (Standard Output)] [4JJ1 (High Output)] : Change every 5,000 km (3,000 miles)			●				●
Engine oil filter	[G] : Replace every 5,000 km (3,000 miles) or 3 month [D] : Replace every 5,000 km (3,000 miles)			●				●
Exhaust pipes and mounting	Inspect every 5,000 km (3,000 miles)	●	●		●			
Air cleaner element	Replace every 20,000 km (12,000 miles) [D] : Inspect every 2,500 km (1,500 miles)			●				
Steering system for looseness or damage	Inspect every 5,000 km (3,000 miles)		●					
Universal joints and sleeves	Inspect for wear and lubricate every 5,000 km (3,000 miles)		●	●				
Transmission or transmission with transfer case oil	[MT] [C24SE] [D] Change every 20,000 km (12,000 miles) after changing at initial 10,000 km (6,000 miles)		●					
	[MT] [HFV6] Change every 40,000 km (24,000 miles)						●	
	[AT] Transmission: Change every 20,000 km (12,000 miles)	●	●	●		●		●
	[4WD] Transfer: Change every 20,000 km (12,000 miles)		●					
Differential oil	Change every 20,000 km (12,000 miles) after changing at initial 10,000 km (6,000 miles)		●					
Front brake pads and discs wear	Inspect every 5,000 km (3,000 miles)	●	●	●				
Rear brake lining and drum wear	Inspect every 5,000 km (3,000 miles)	●	●	●				

4. Install all the lines and hoses. Fill the system with new power steering fluid and bleed the system as described in Bleeding the Power Steering System. Operate the engine for about 15 minutes.
   Remove the pump return line at the pump inlet and plug the connection on the pump. While refilling the reservoir, check the draining fluid for contamination. If foreign matter is still evident, replace all lines, disassemble and clean or replace the power steering system components. Do not re-use any drained power steering fluid.

Steering Wheel Free Play Inspection



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1. With the tires in the straight-ahead position, check the amount of steering wheel play by turning the wheel in both directions until the tires begin to move.

NOTE: The wheel free play should be checked with the engine running.

Free play: 0 - 30 mm (0 - 1.18 in)

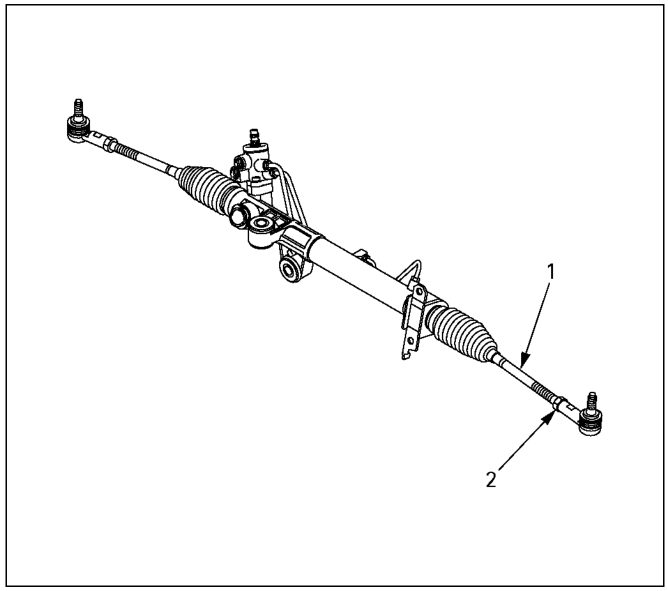
2. Also check the steering wheel for play and looseness in the mount by moving it back and forth and sideways. When test driving, check for hard steering, steering shimmy and tendency to pull to one side.

Front End Alignment Inspection and Adjustment

Toe-in Adjustment

Toe-in: Refer to Section 3A FRONT ALIGNMENT

1. To adjust the toe-in angle, loosen the lock nuts (2) on the tie rod (1) and turn the tie rod. Turn both rods the same amount, to keep the steering wheel centered .



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2. Tighten the lock nut to the specified torque.

Torque:
98 N·m (10 kgf·m/72 lb·ft)

7 Remove connecting rod guide pin set, Tool No. EN-46121 (1) from the connecting rod bolt holes.

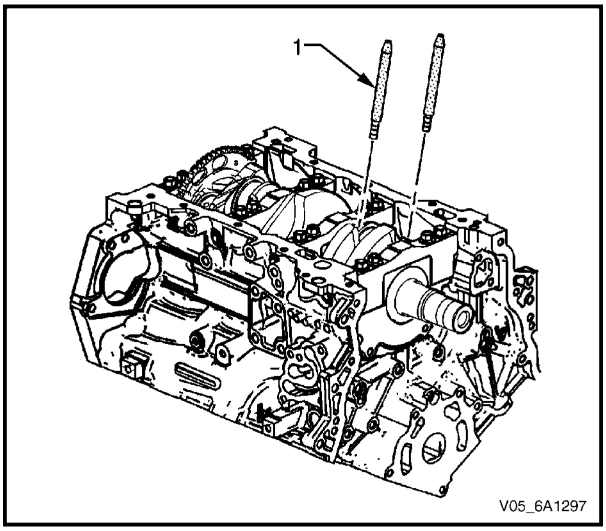


Figure 6A1 – 406

Connecting Rod Bearing Clearance Measurement Procedure

NOTE

Before final assembly, check the clearance of the new connecting rod bearings.

1 Place a length of fresh, room temperature plastic gauging material all the way across the connecting rod bearing journal.
2 Install the connecting rod bearing into the connecting rod cap.
3 Install the connecting rod end cap (1) on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

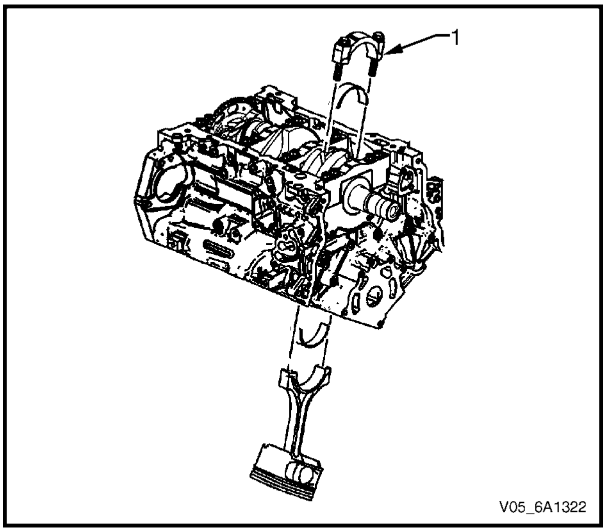


Figure 6A1 – 407

NOTE

Reuse the old connecting rod bolts only for measuring the connecting rod bearing clearance.

4 Install the connecting rod cap bolts into the connecting rod cap and tighten to the correct torque specification using torque angle wrench, Tool No. EN-7115.

Connecting rod cap attaching bolt torque specification:	
Stage 1	30.0 Nm
Stage 2	Loosen completely
Stage 3	25.0 Nm
Stage 4	110 degrees

5 Allow the assembly to sit for at least 2 minutes.
6 Remove the connecting rod cap bolts and discard.
7 Remove the connecting rod cap.

8 Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gauging (1) material at its widest point with the graduation on the gauging material container (2).

9 Compare the measurements with the specifications, refer to 5 Specifications.

10 If the new bearings do not provide the correct crankshaft to connecting rod bearing clearance, inspect the following:

11 Measure the crankshaft connecting rod journals for the correct specified size and ensure the correct new bearings are being installed. If the crankshaft connecting rod journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

12 Measure the connecting rod bearing bore diameter to ensure correct size. The connecting rod is not machineable and the connecting rod must be replaced if out of specification.

13 Clean the plastic gauging material from the connecting rod bearing journals using a soft lint-free cloth.

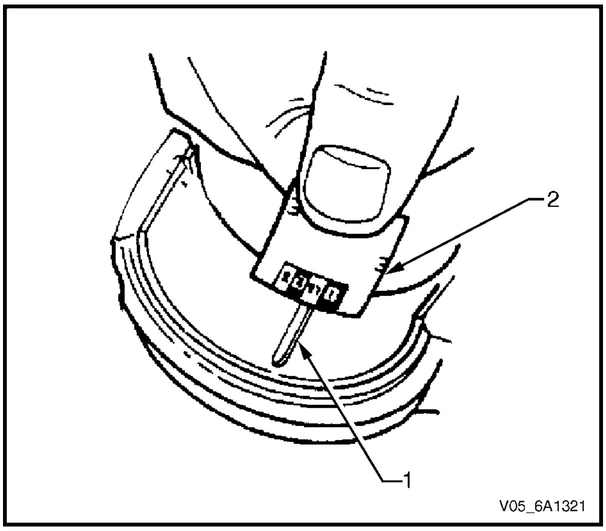


Figure 6A1 – 408

Connecting Rod Final Assembly Procedure

1 Carefully guide the connecting rod away from the crankshaft connecting rod journal slightly to lubricate the crankshaft connecting rod bearing journal.

2 Apply a liberal amount of clean engine oil to the crankshaft connecting rod bearing journal.

3 Guide the connecting rod to the crankshaft connecting rod journal.

4 Install the connecting rod end cap (1) on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

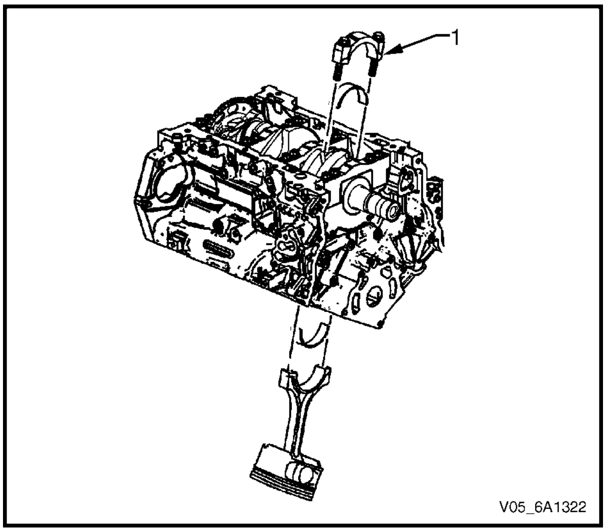


Figure 6A1 – 409

CAUTION

- **Do not lubricate the new connecting rod bolts. The new bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are tightened to the specified torque. Incorrect clamp load can lead to component failure and extensive engine damage.**
- **Do not reuse the old connecting rod bolts.**

5 Install new connecting rod bolts into the connecting rod cap and tighten to the correct torque specification.

■ Connecting rod cap attaching bolt torque specification:
Stage 1 ....30.0 Nm
Stage 2 .... Loosen completely
Stage 3 ....25.0 Nm
Stage 4 .... 110 degrees

NOTE

During and after installation, ensure each piston is positioned correctly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.

6 Repeat these procedures for the remaining piston/connecting rod assemblies.
7 Reinstall the oil pan and oil pump pick up assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
8 Reinstall the cylinder heads, refer to 3.22 Cylinder Head Assembly.
9 Reinstall the engine assembly, refer to 4.1 Engine .

4.6 Crankshaft and Main Bearings

1 Remove the engine assembly, refer to 4.1 Engine .
2 Remove both cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.
3 Remove the oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
4 Remove the piston and connecting rod assemblies, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
5 Remove the oil pump assembly, refer to 3.17 Oil Pump Assembly.
6 Remove the crankshaft rear oil seal and plate assembly, refer to 4.4 Crankshaft Rear Seal and Plate Assembly.
7 Remove the crankshaft position sensor, refer to 6C1-3 Engine Management – V6 – Service Operations.

Crankshaft End Play Measurement

1 Place a dial indicator at the end of the crankshaft nose.
2 Gently force the crankshaft towards the front and rear of the cylinder block with a lever while monitoring the movement of the dial indicator.
3 The crankshaft endplay should not exceed specifications, refer to 5 Specifications.
4 If the specifications are exceeded, inspect the thrust bearing thrust outer diameter and the crankshaft thrust wall for wear and/or excessive runout. Compare the values with the specifications, refer to 5 Specifications.
5 Replace the thrust bearing or crankshaft as required.

Remove

1 Remove the crankshaft bearing cap side bolts (3).

CAUTION

The crankshaft bearing cap outer bolts are yield tightened during assembly and must be replaced prior to reassembly. Crankshaft bearing cap outer bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

2 Remove the crankshaft bearing cap outer bolts (1).
3 Remove the crankshaft bearing cap inner bolts (2).

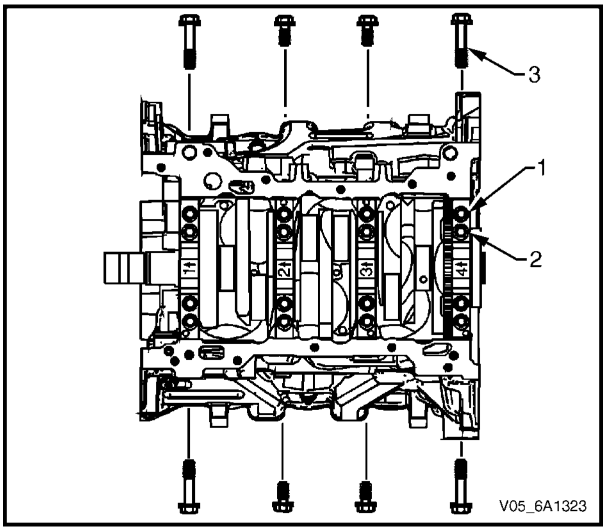


Figure 6A1 – 410

4 Loosen the nuts (1) of the crankshaft main bearing cap remover, Tool No. J-41818 (2) to separate the chamfered collets. Install the collets into the inner bolt holes of the front main bearing cap (3).

5 Tighten the remover nuts to the correct torque specification.

Crankshaft bearing cap remover nut.................11.0 Nm.

6 Install a slide hammer, Tool No. J-6125-1B (4) onto the crankshaft bearing cap remover and remove the crankshaft bearing cap.

7 Repeat steps 9 to 14 for the remaining crankshaft bearing caps.

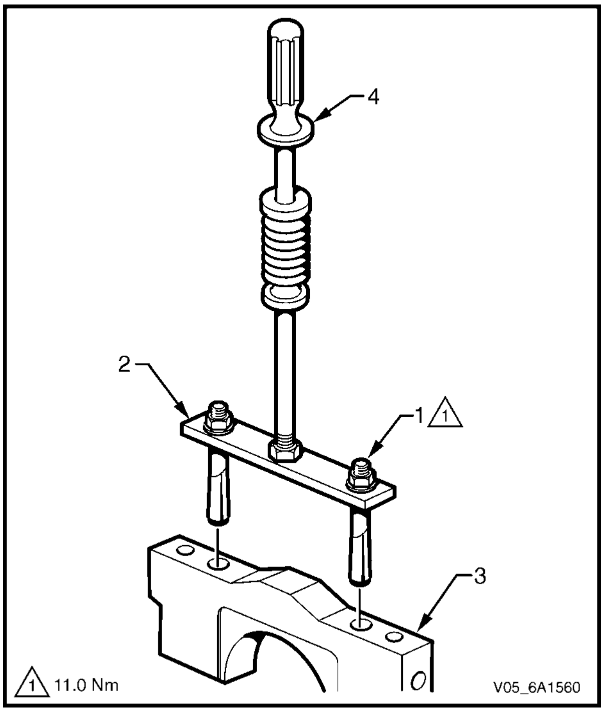


Figure 6A1 – 411

8 Remove the crankshaft (1) from the engine block (2), lifting evenly to avoid jamming against the main thrust bearing.

9 Place the crankshaft in a secure place.

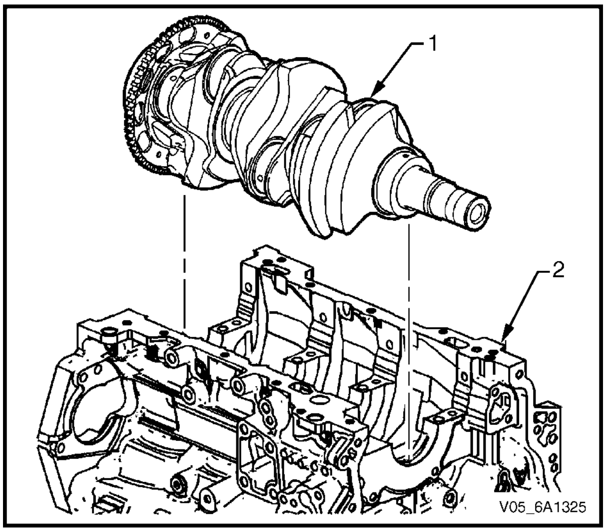


Figure 6A1 – 412

10 If required, remove the crankshaft sprocket drive pin (1) from the crankshaft (2),

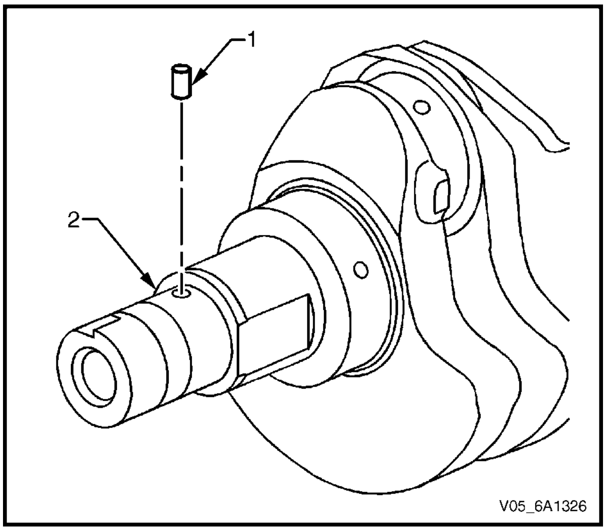


Figure 6A1 – 413

Crankshaft Bearing

1 Prepare a piece of cardboard or similar, numbered 1 – 4 for bearing identification.

NOTE

Main bearing journals are numbered from the front of the engine.

2 Remove the crankshaft upper bearing halves from the cylinder block. Note the position of the thrust bearing (1) at the number 3 journal (2).

3 Place the crankshaft upper bearing halves on the cardboard in the correct positions.

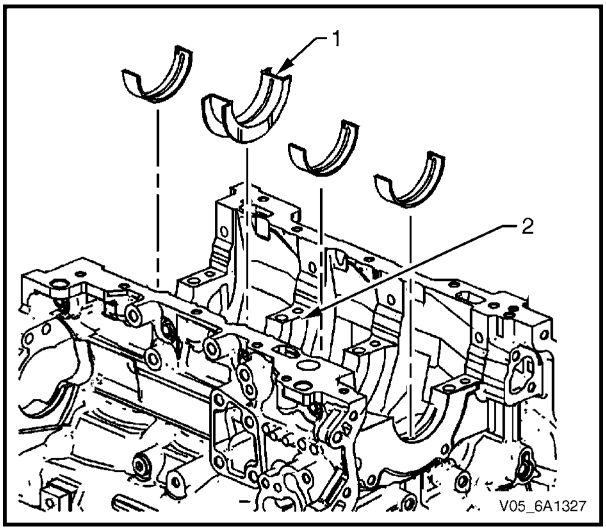


Figure 6A1 – 414

4 Remove the crankshaft lower bearing halves (2) from the crankshaft bearing caps (1).

5 Place the crankshaft lower bearing halves in the correct positions on the cardboard.

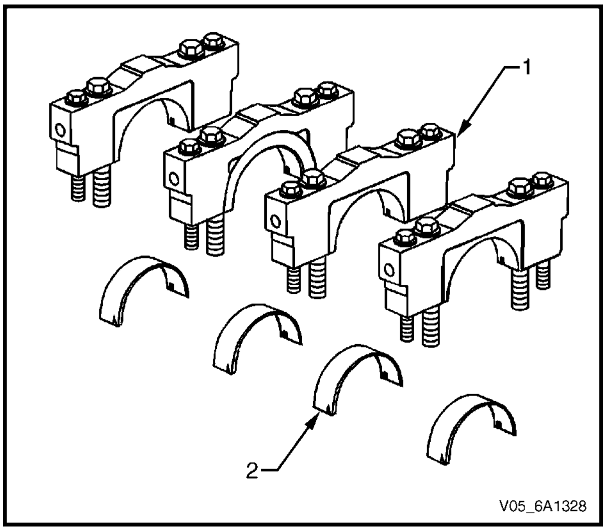


Figure 6A1 – 415

Clean and Inspect

Crankshaft and Main Bearing Cleaning

WARNING

Safety glasses must be worn when using compressed air.

Clean the following components in solvent and then dry with compressed air:

- crankshaft bearings,
- connecting rod bearings,
- crankshaft journals,
- crankpin journals,
- crankshaft oil passages, and
- crankshaft threaded holes.

Crankshaft and Main Bearing Visual Inspection

1 Perform the following visual inspections:

- Inspect the crankshaft balancer bolt hole (1) for thread damage.
- Inspect the crankshaft balancer mounting area (2) for damage.
- Inspect the crankshaft sprocket pin hole (3) for damage.
- Inspect the oil pump drive flats (4) for damage.
- Inspect the crankshaft main journals (5) for damage.
- Inspect the crankshaft connecting rod journals (6) for damage.
- Inspect the crankshaft oil passages (7) for obstructions.
- Inspect the crankshaft main bearing thrust wall surfaces (8) for damage.
- Inspect the crankshaft counterweights (9) for damage.
- Inspect the crankshaft reluctor ring teeth (10) for damage.
- Inspect the crankshaft rear main oil seal surface (11) for damage.
- Inspect the crankshaft engine flexplate mounting surface (12) for damage.
- Inspect the crankshaft pilot hole (13) for damage.
- Inspect the crankshaft engine flywheel bolt holes (14) for thread damage.

2 Repair or replace the crankshaft as required.

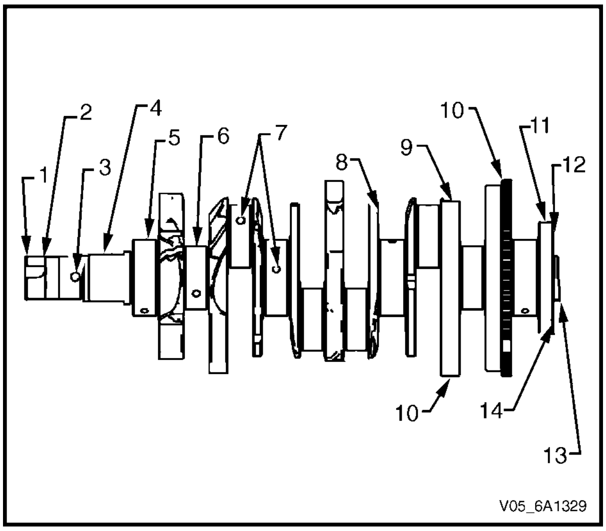


Figure 6A1 – 416

Crankshaft Main Bearing Inspection

CAUTION

All connecting rod and main journal bearings that have been used in a running engine must be replaced. Never re-use the crankshaft or connecting rod bearings.

NOTE

The following bearing wear conditions should be used to diagnose engine operating conditions or root cause of a condition.

1 Inspect for fatigue indicated by craters or pockets (2). Flattened sections on the bearing halves (1) also indicate fatigue.

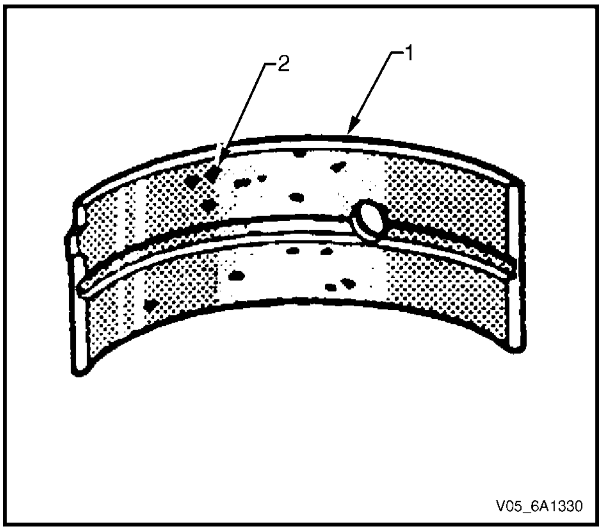


Figure 6A1 – 417

2 Inspect for excessive scoring or discoloration (2) on both front and back of the bearing halves (1).

3 Inspect the main bearings for dirt embedded into the bearing material.

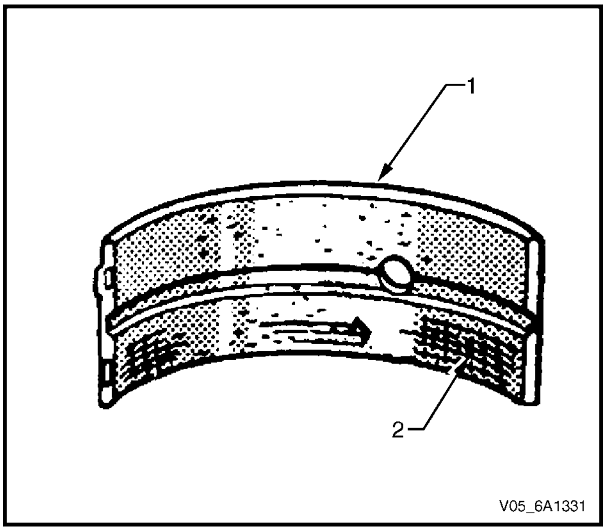


Figure 6A1 – 418

4 Inspect for incorrect seating indicated by bright, polished sections (1).

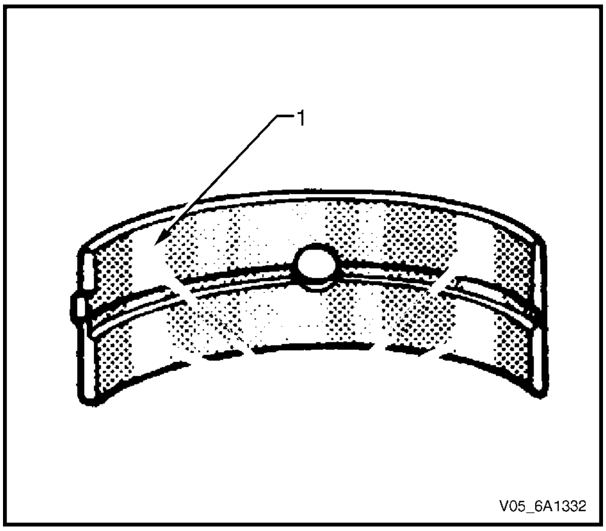


Figure 6A1 – 419

Crankshaft Measurement

1 Using a suitable fixture (1), support the crankshaft (2).

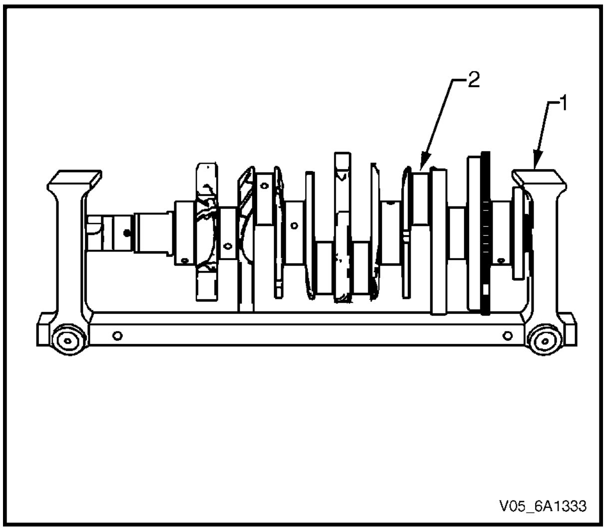


Figure 6A1 – 420

2 Using a dial indicator (1) and magnetic base (2), rotate the crankshaft (3) carefully by hand. Measure the crankshaft main journals for runout and compare with the engine specifications, refer to 5 Specifications.

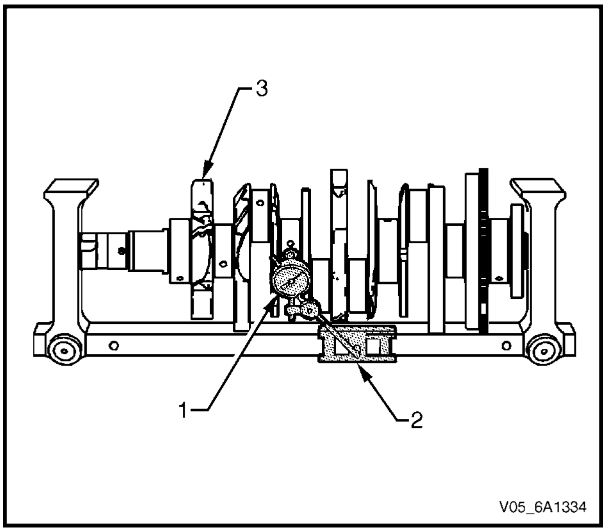


Figure 6A1 – 421

3 Measure the crankshaft thrust wall width (1) for wear using an inside micrometer and compare with the engine specifications, refer to 5 Specifications.

4 Measure the crankshaft thrust wall surface (2) for runout using a dial indicator, mounted to a magnetic stand and compare with the engine specifications, refer to 5 Specifications.

5 If the crankshaft journals are damaged or worn beyond specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized main bearings available for service.

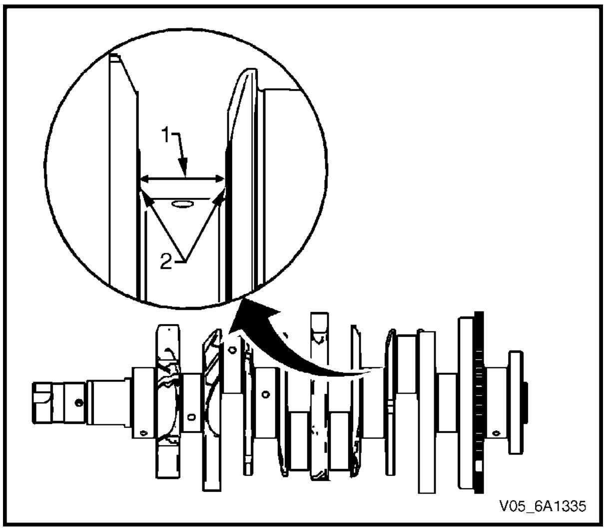


Figure 6A1 – 422

6 Inspect the crankshaft main journals (1) for undersize, using an outside micrometer (2).

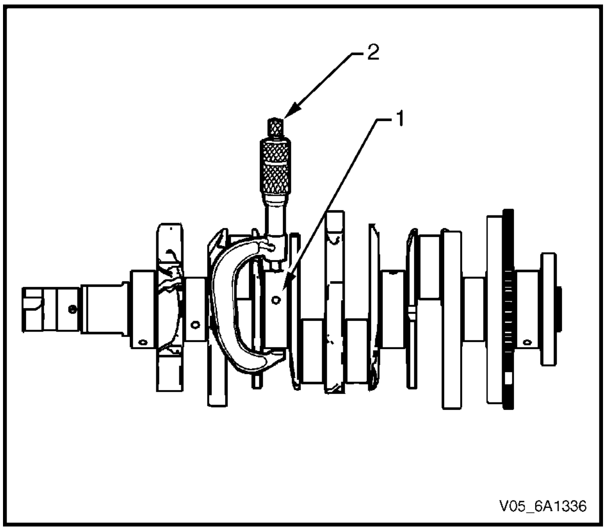


Figure 6A1 – 423

7 Inspect the crankpins (1) for undersize using an outside micrometer (2).

8 Compare your measurements with those listed in the engine specifications, refer to 5 Specifications. If the crankpin journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. Only one size of oversized connecting rod bearings available for service.

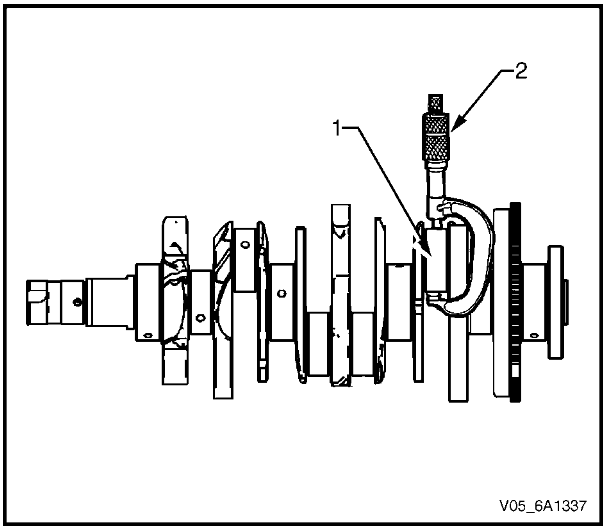


Figure 6A1 – 424

9 Measure the main bearing and crankpin journals for out-of-round using the following procedure:

a Using an outside micrometer, measure the journal at the extreme front and rear locations on the journal. Call these points A and B.

b Measure the journal in two new locations exactly 90 degrees from the first points. Call these points C and D.

c Subtract A from C and B from D. The differences will indicate journal out-of-round.

d The out-of-round should not exceed 0.004 mm maximum.

e If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized crankshaft and connecting rod bearings available for service.

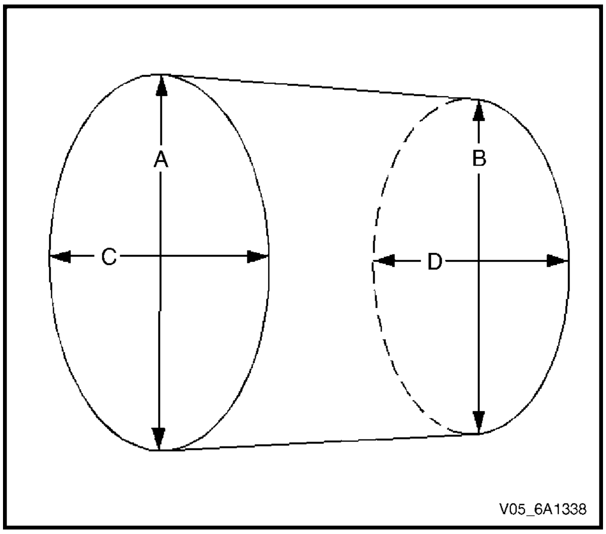


Figure 6A1 – 425

10 Measure the main bearing and crankpin journals for taper using the following procedure:

a Using an outside micrometer, measure the journal at the extreme front (A) and rear (B) of the journal parallel to the crankshaft centreline.

b Subtract the smallest from the largest measurement. The result will be the journal taper.

c If the main bearing journal taper exceeds 0.004 mm, replace the crankshaft.

d If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized crankshaft and connecting rod bearings available for service.

Reinstall

Crankshaft Bearing Installation Procedure

CAUTION

If the crankshaft bearings have been used in a running engine, replace them with new crankshaft bearings for reassembly.

1 Clean the crankcase crank bore with a lint-free cloth.

2 Clean all the oil from the backside of new bearing halves.

3 Install the new upper crankshaft bearings into position. The thrust bearing (1) belongs in the number 3 journal(2). Ensure the upper bearing insert contains the oil transfer hole and groove. Roll the bearing into position so the lock tang engages the crank slot. The bearing must fit flush with the upper crankcase.

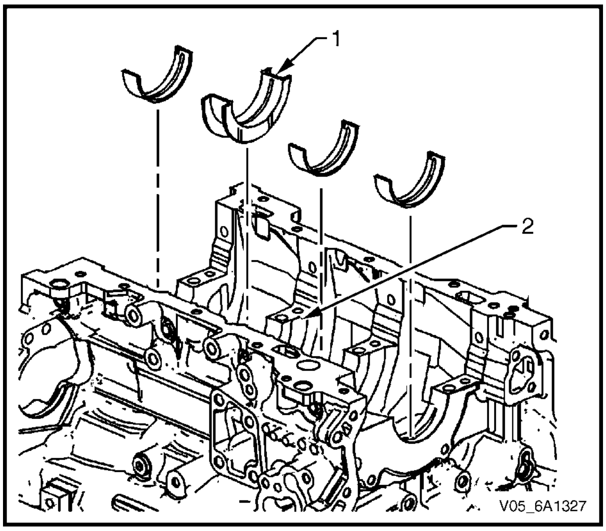
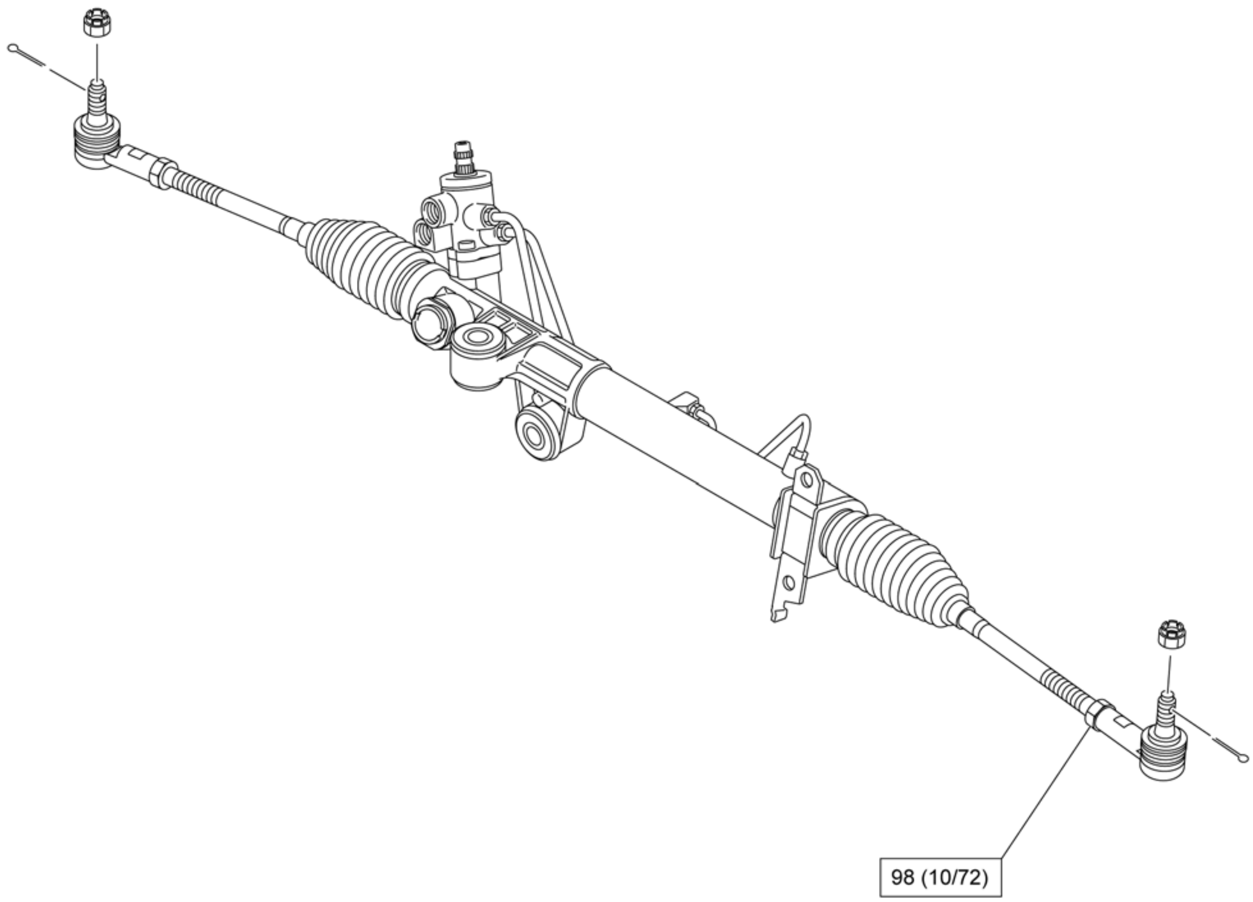


Figure 6A1 – 426

Torque Specification

N·m (kgf·m/lb·ft)



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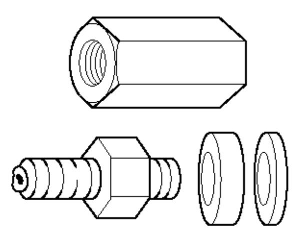
Special Tools

ILLUSTRATION	TOOL NO. TOOL NAME	ILLUSTRATION	TOOL NO. TOOL NAME
 901RS276	**5-8840-0135-0** **(J-29877-A)** Tester; Power steering	 901RS278	**5-8840-2297-0** **(J-39213)** Adapter; Power steering tester

4 Install the new lower crankshaft bearings (2) into position in the main bearing caps (1). The lower crankshaft bearings are identified by no grooves or holes. The bearings must fit flush with the crankshaft bearing caps.

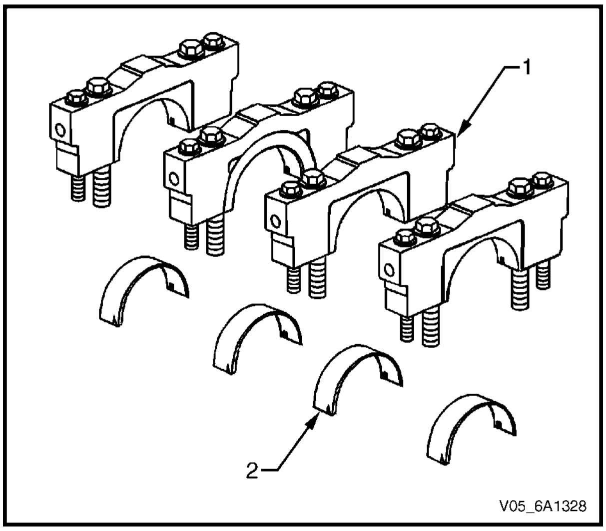


Figure 6A1 – 427

Crankshaft Main Bearing Clearance Measurement

1 Place a length of fresh, room temperature plastic gauging material all the way across all the crankshaft bearing journals.

2 Install the crankshaft main bearing caps.

3 Loosely install the original inner main cap bolts (1).

4 Loosely install the original outer main cap bolts (2).

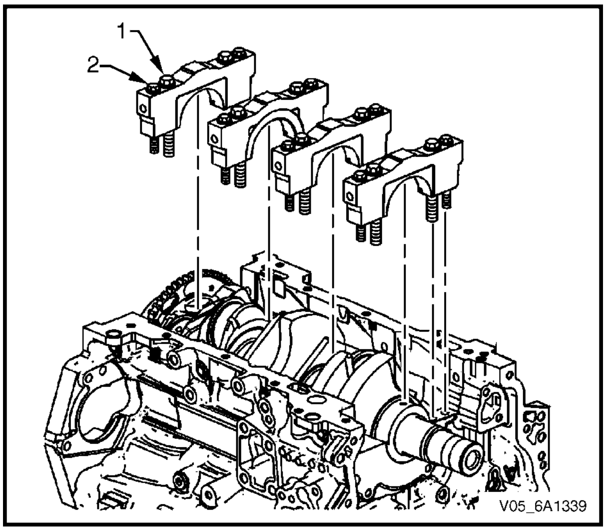


Figure 6A1 – 428

5 Loosely install the original short/inner side main cap bolts.

6 Loosely install the original long/outer side main cap bolts (3).

7 Gently tap the crankshaft main bearing caps with a soft-faced hammer to help seat the caps.

8 Tighten the main caps bolts to the correct torque specification, and in the following sequence.

Crankshaft main bearing cap inboard attaching bolt torque specification: Stage 1 ....20.0 Nm Stage 2 ....80°
Crankshaft main bearing cap outboard attaching bolt torque specification: Stage 1 ....15.0 Nm Stage 2 ....110°
Crankshaft main bearing cap side attaching bolt torque specification: Stage 1 ....30.0 Nm Stage 2 ....60°

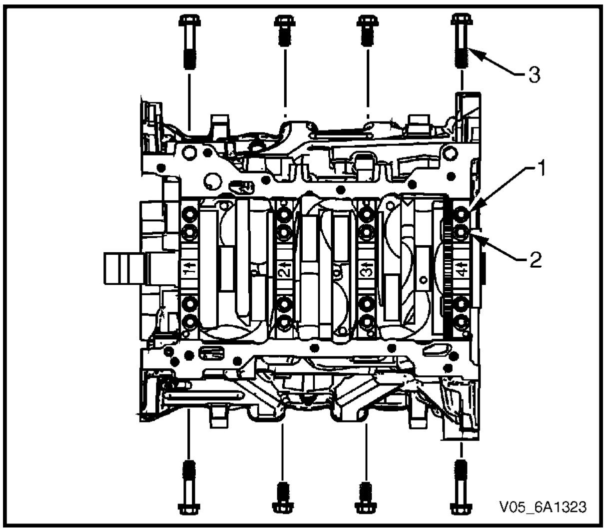


Figure 6A1 – 429

NOTE

Do not rotate the crankshaft.

9 Allow the assembly to sit for 2 minutes.

10 Remove the crankshaft bearing cap side bolts.

11 Remove the crankshaft bearing cap outer bolts (2).

12 Remove the crankshaft bearing cap inner bolts (1).

13 Install the crankshaft main bearing cap remover Tool No. J-41818 as previously described and remove the crankshaft bearing cap.

14 Repeat steps 10 to 13 for the remaining crankshaft bearing caps.

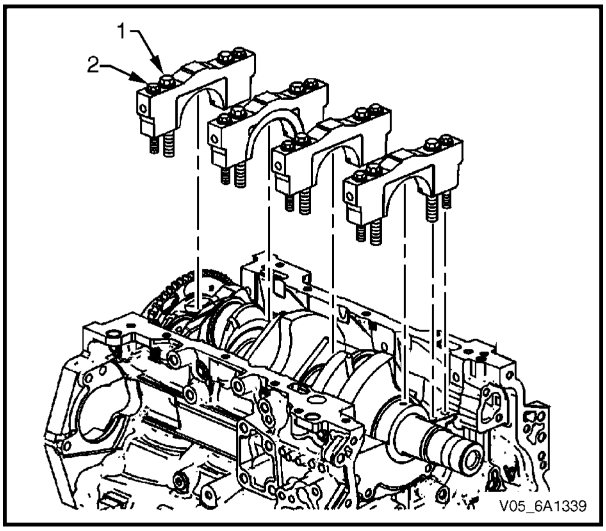


Figure 6A1 – 430

15 Determine the crankshaft bearing clearance by comparing the width of the flattened plastic gauging material (1) at its widest point with the graduation on the gauging material scale (2).

16 Compare the measurements listed in the specifications, refer to 5 Specifications. If the new bearings do not provide the correct crankshaft to bearing clearance, inspect the following:

17 Measure the crankshaft journals for the correct specified size and ensure new bearings are being installed. If the crankshaft journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

18 Measure the engine block crankshaft bearing bore diameter to ensure correct size. The engine block crankshaft bearing bore is not machineable and the block must be replaced if out of specification.

19 Clean the plastic gauging material from the crankshaft bearing journals with a soft, lint-free cloth.

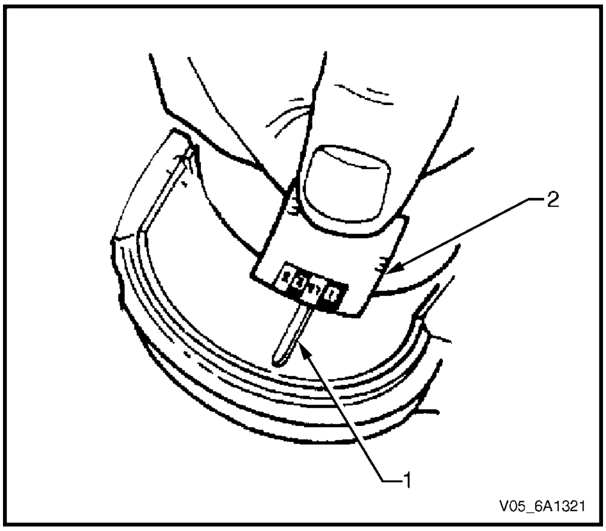


Figure 6A1 – 431

Crankshaft Final Installation Procedure

1 If removed, install the crankshaft sprocket drive pin (1). Lightly tap the pin in place with a small soft face, bronze/plastic, hammer until it bottoms in the hole.

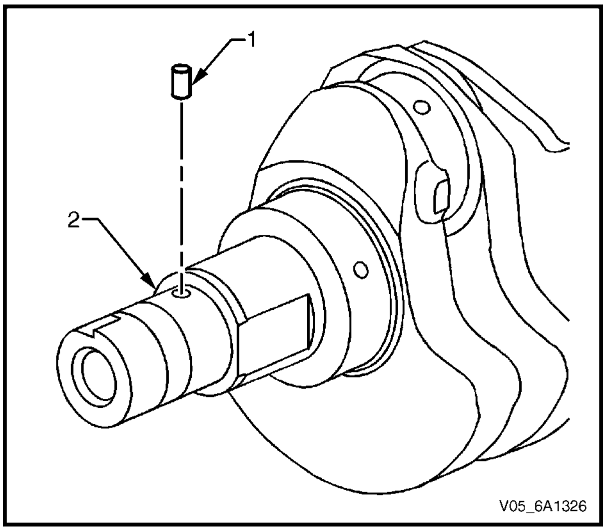


Figure 6A1 – 432

CAUTION

Ensure the crankshaft position sensor has been removed from the cylinder block prior to loading the crankshaft, as damage to the sensor may occur.

2 Apply a liberal amount of clean engine oil to the upper and lower bearing surfaces.

3 Gently lower the crankshaft (1) into position in the cylinder block (2).

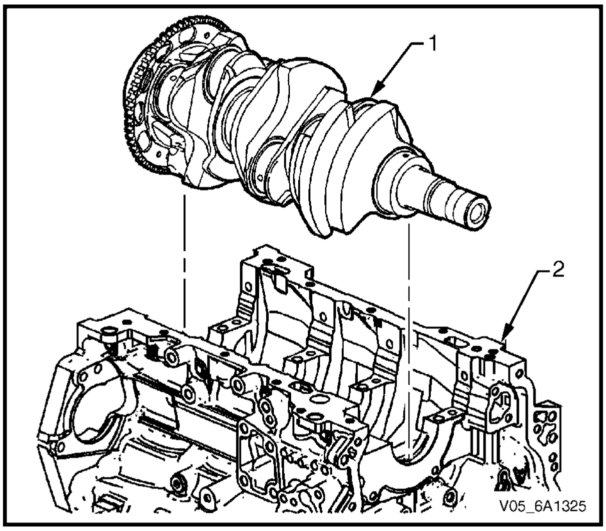


Figure 6A1 – 433

4 Install the crankshaft main bearing caps.

5 Loosely install the original inner main cap bolts (1).

CAUTION

The outer crankshaft bearing cap bolts (2) are yield tightened during assembly and must be replaced prior to reassembly. Outer crankshaft bearing cap bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

6 Loosely install the new outer main bearing cap bolts (2).

7 Gently tap the crankshaft main bearing caps with a soft-faced hammer to help seat the caps.

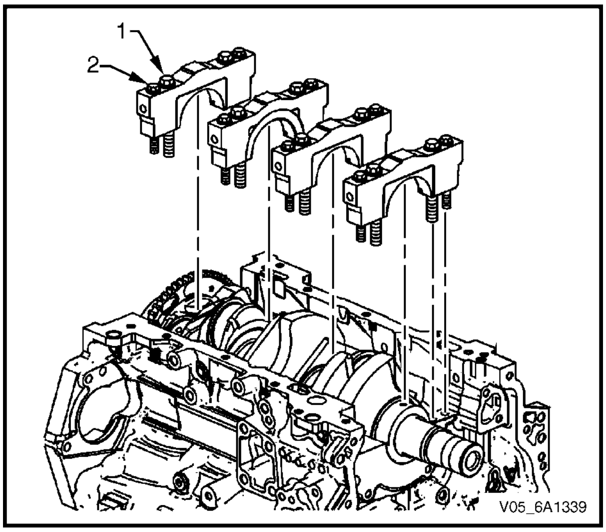


Figure 6A1 – 434

8 Loosely install new short / inner side main cap bolts (4).

CAUTION

- **The short / inner side main cap bolts originally have a sealant on the flange of the bolt head. New bolts must be used. If new bolts are not used, oil can leak from the crankcase past the bolts.**
- **The long / outer side main cap bolts originally have a sealant on the flange of the bolt head. New bolts must be used. If new bolts are not used, oil can leak from the crankcase past the bolts.**

9 Loosely install the new long / outer side main cap bolts (3).

10 Tighten the main caps bolts to the correct torque specification, and in the following sequence.

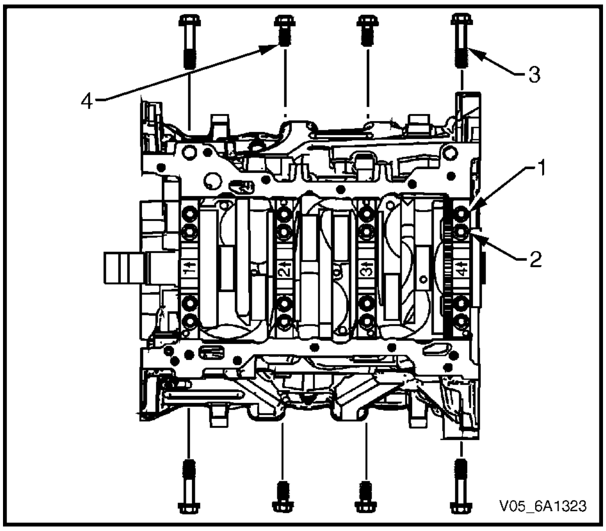


Figure 6A1 – 435

■ Crankshaft main bearing cap inboard attaching bolt torque specification:
Stage 1 ....20.0 Nm
Stage 2 ....80°

■ Crankshaft main bearing cap outboard attaching bolt torque specification:
Stage 1 ....15.0 Nm
Stage 2 ....110°

■ ♦ Crankshaft main bearing cap side attaching bolt torque specification:
Stage 1 ....30.0 Nm
Stage 2 ....60°

11 Ensure the crankshaft turns without binding or noise.

12 Install the remaining components in the reverse order to removal, refer to the appropriate Section.

4.7 Cylinder Block

Disassemble

1 Remove oil jet bolt (1) attaching the oil jet (2), three places.

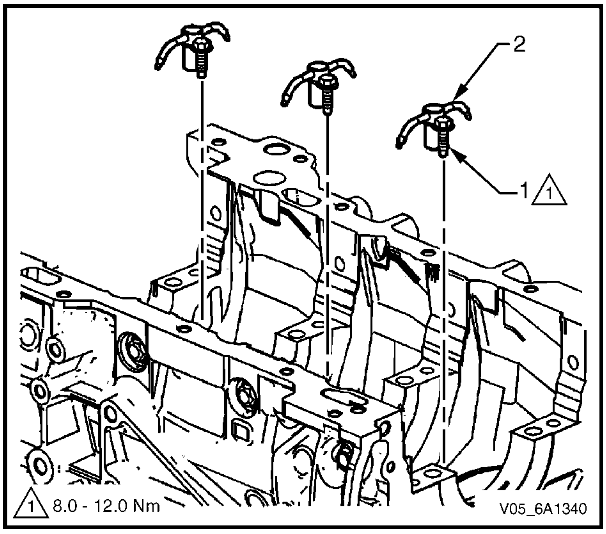


Figure 6A1 – 436

2 Remove the right-hand front oil pan rail oil gallery expansion plug (1).

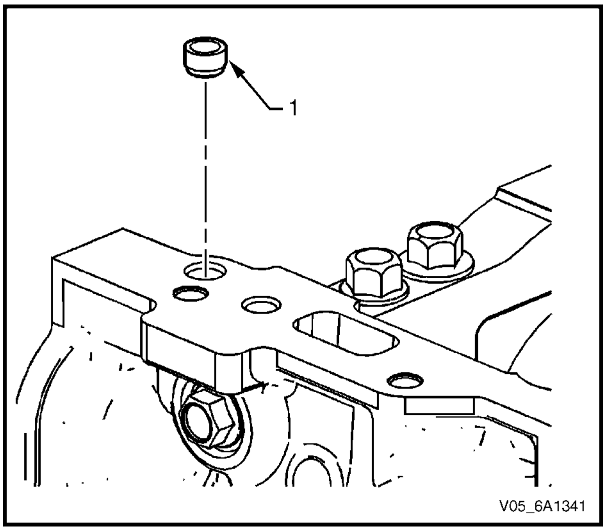


Figure 6A1 – 437

3 Remove the cylinder block-to-oil pan alignment dowels (1).

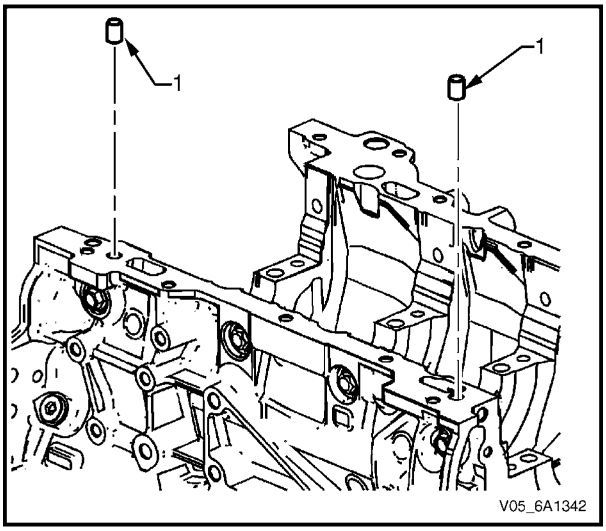


Figure 6A1 – 438

4 Remove the right-hand side M14 oil gallery threaded plug (1).

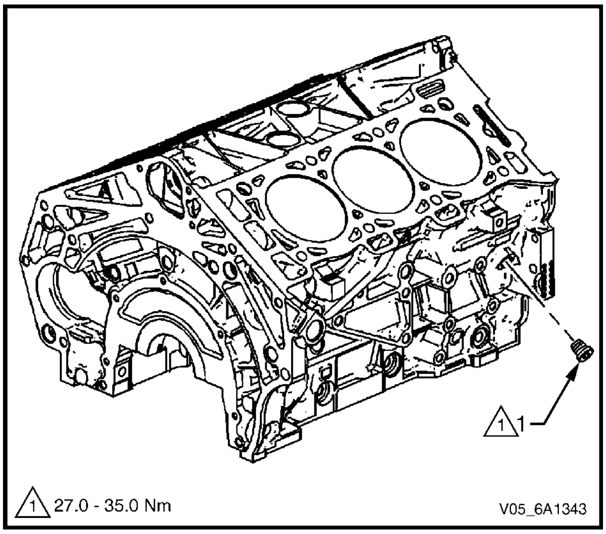


Figure 6A1 – 439

5 Remove the right-hand side M14 coolant drain threaded plug (1).

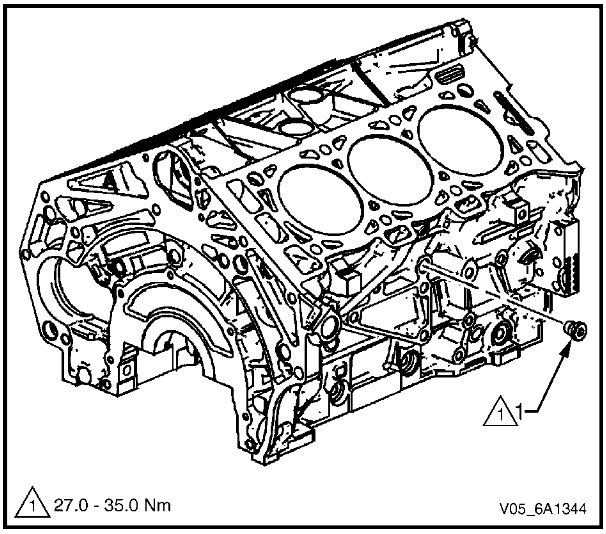


Figure 6A1 – 440

6 Remove the rear M14 oil gallery threaded plug (1).

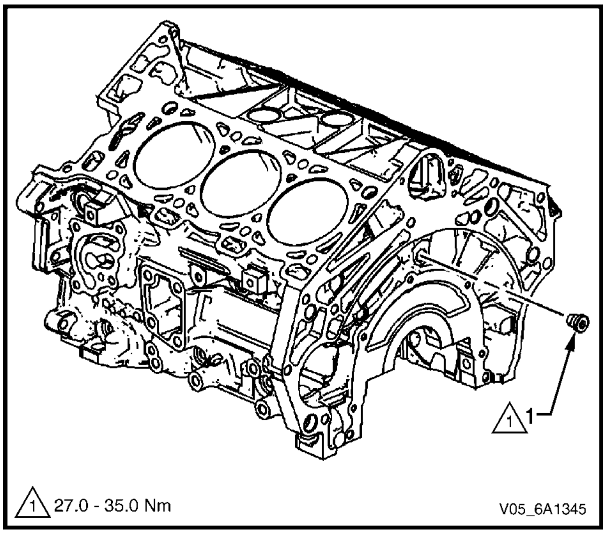


Figure 6A1 – 441

7 Remove the left-hand side M14 coolant drain threaded plug (1).

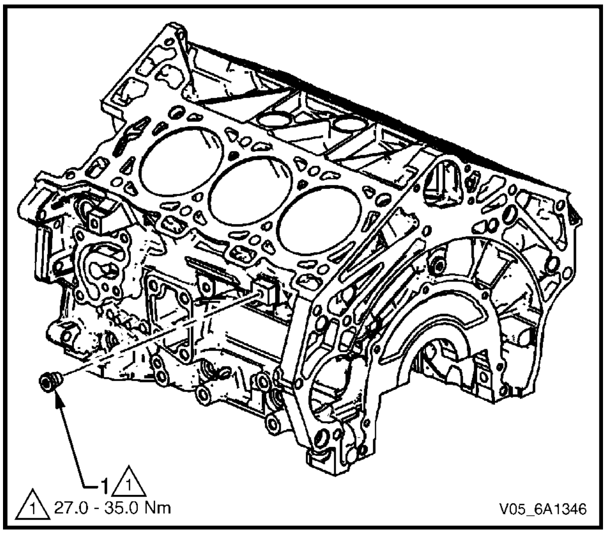


Figure 6A1 – 442

8 Remove the left-hand side M20 oil gallery threaded plug (1).

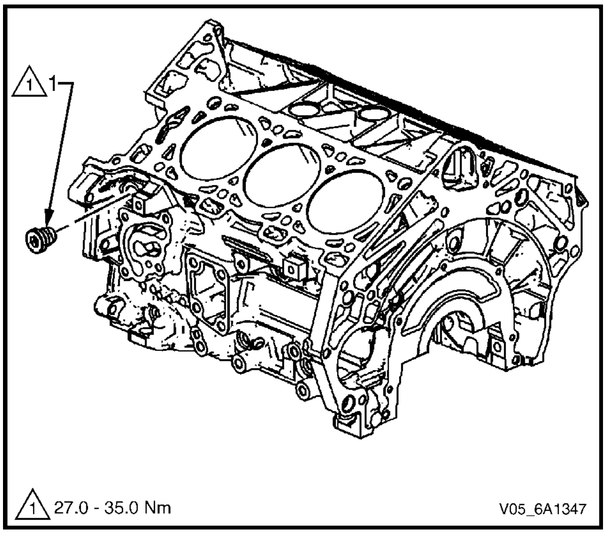


Figure 6A1 – 443

CAUTION

Do not force coolant expansion plugs downwards during removal procedure as the cylinder block will be damaged.

9 Remove the coolant expansion plugs (1).

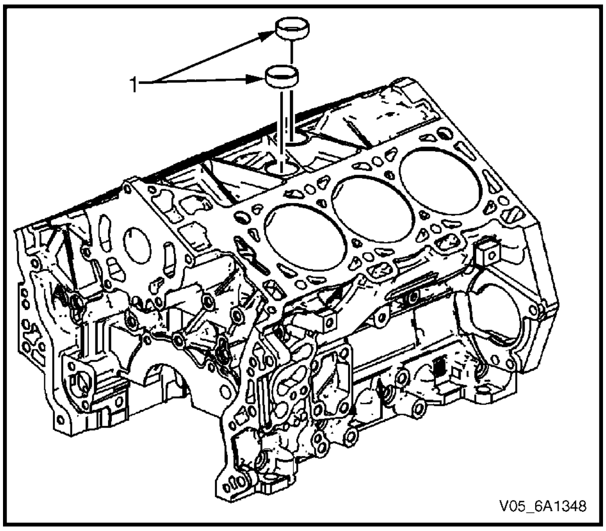


Figure 6A1 – 444

10 Remove the cylinder block-to-transmission alignment dowels (1).

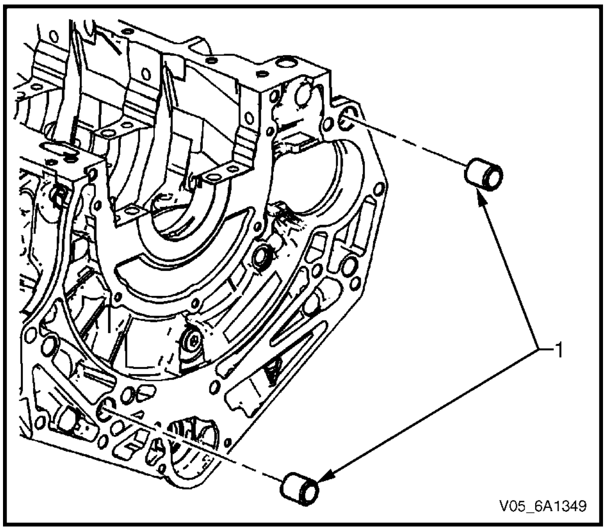


Figure 6A1 – 445

11 Remove the front oil gallery expansion plug (1).

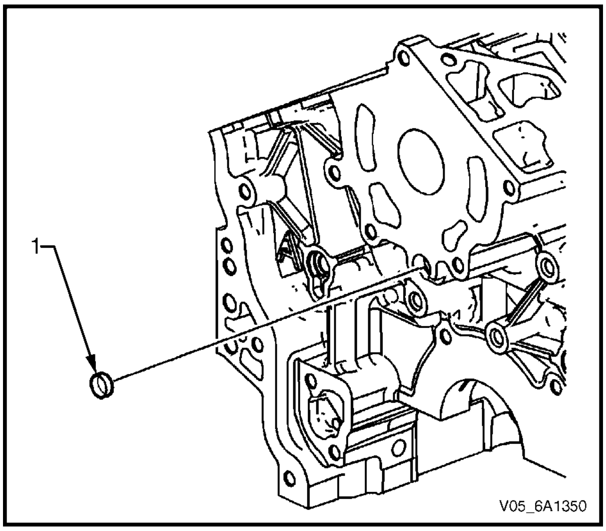


Figure 6A1 – 446

12 Remove the cylinder block-to-cylinder head alignment dowels (1).

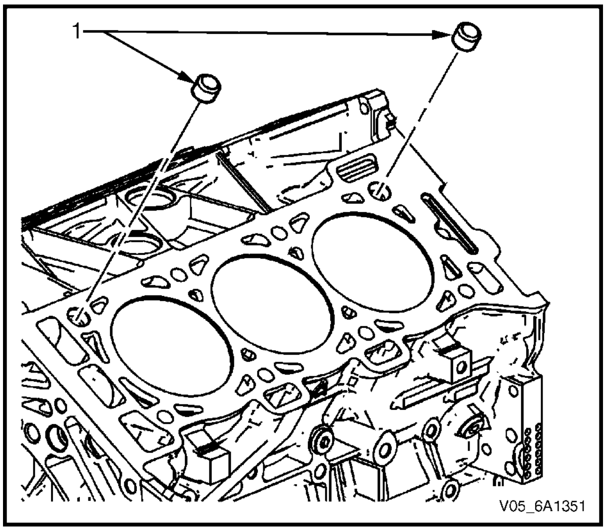


Figure 6A1 – 447

Clean

1 Remove all thread sealant, gasket material or sealant using a commercially available plastic or wood scraper.

2 Clean all the following areas with a suitable solvent:

- sealing surfaces,
- cooling passages,
- oil passages, and
- bearing journals.

3 Clean all threaded and through holes with a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

4 Dry the engine block with compressed air.

Inspect

Visual Inspection

NOTE

The following procedure assumes the engine has been disassembled and cleaned, as described above.

1 Inspect the crankshaft bearing journals for damage or spun bearings. The crankshaft bearing journals are not repairable and if damage is found, the cylinder block assembly must be replaced.
2 Inspect the primary camshaft chain tensioner mounting surface on the engine block for burrs or any defects that would affect the sealing of the new primary camshaft chain tensioner gasket.
3 Inspect all sealing and mating surfaces for damage, repair or replace the cylinder block assembly if required.
4 Inspect all threaded and through holes for damage or excessive debris.
5 Inspect all bolts for damage, if damaged replace with new bolts only.
6 Inspect the cylinder walls for cracks or damage. The cylinder sleeves are not serviced separately, if the cylinders are damaged the cylinder block assembly must be replaced.
7 Inspect the engine block for cracks. Do not repair any cracks. If cracks are found, the cylinder block assembly must be replaced. Repair any damaged threaded holes, refer to 4.9 Thread Repair Specifications.

Measuring Cylinder Bore Diameter

1 Measure the cylinder bore diameter 37 mm from the deck face (1) using a commercially available bore gauge or Tool No. J-8087 (2).
2 Record the results and compare with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

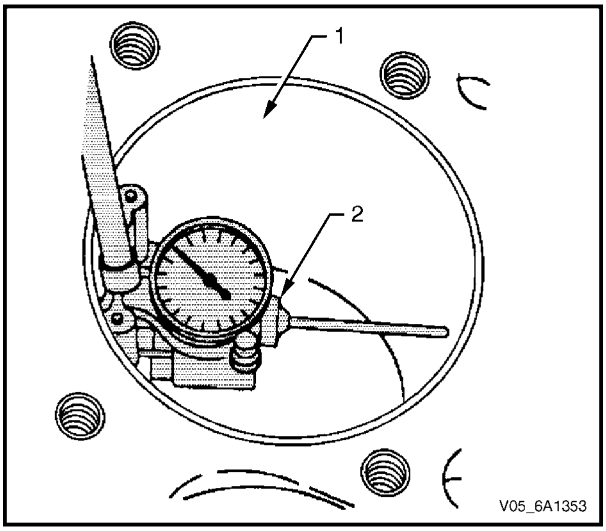


Figure 6A1 – 448

Measuring Cylinder Bore Taper

1 Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centreline, at 10 mm below the deck surface and record the measurement.
2 Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centreline, at 100 mm below the deck surface and record the measurement.
3 Calculate the difference between the two measurements. The result will be the cylinder taper.
4 Compare the results with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

Measuring Cylinder Bore Out-of-Round

1 Measure both the thrust and non-thrust cylinder diameter at 10 mm below the deck. Record your measurements.

2 Calculate the difference between the two measurements. The result will indicate out-of-round at the upper end of the cylinder.

3 Measure both the thrust and non-thrust cylinder diameter at 100 mm below the deck surface. Record your measurements.

4 Calculate the difference between the two measurements. The result will indicate out-of-round at the lower end of the cylinder.

5 Compare your results with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

Deck Flatness Inspection

1 Ensure the engine block decks are clean and free of gasket material.

2 Inspect the surface for any imperfections or scratches that could inhibit correct cylinder head gasket sealing.

3 Place a straight-edge diagonally across the cylinder block deck face surface.

4 Measure the clearance between the straight-edge and the cylinder block deck face using a feeler gauge at 4 points along the straight-edge.

5 If the warpage is less than 0.05 mm, the cylinder block deck surface does not require resurfacing.

6 If the warpage is between 0.05 ±0.20 mm or any imperfections or scratches that could inhibit correct cylinder head gasket sealing are present, the cylinder block deck surface requires resurfacing.

7 If resurfacing is required the maximum amount that can be removed is 0.25 mm.

8 If the cylinder block deck surface requires more than 0.25 mm material removal the block must be replaced.

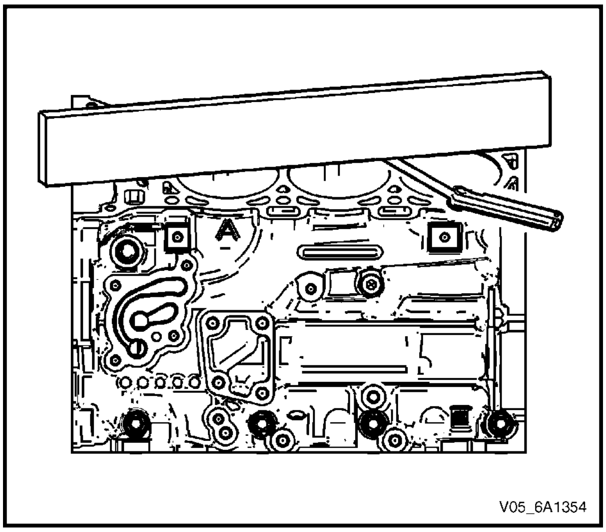


Figure 6A1 – 449

Reassemble

1 Install the cylinder block-to-cylinder head alignment dowels (1).

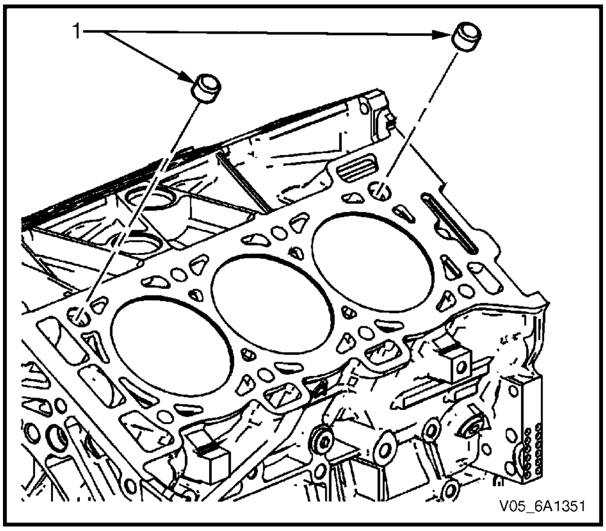
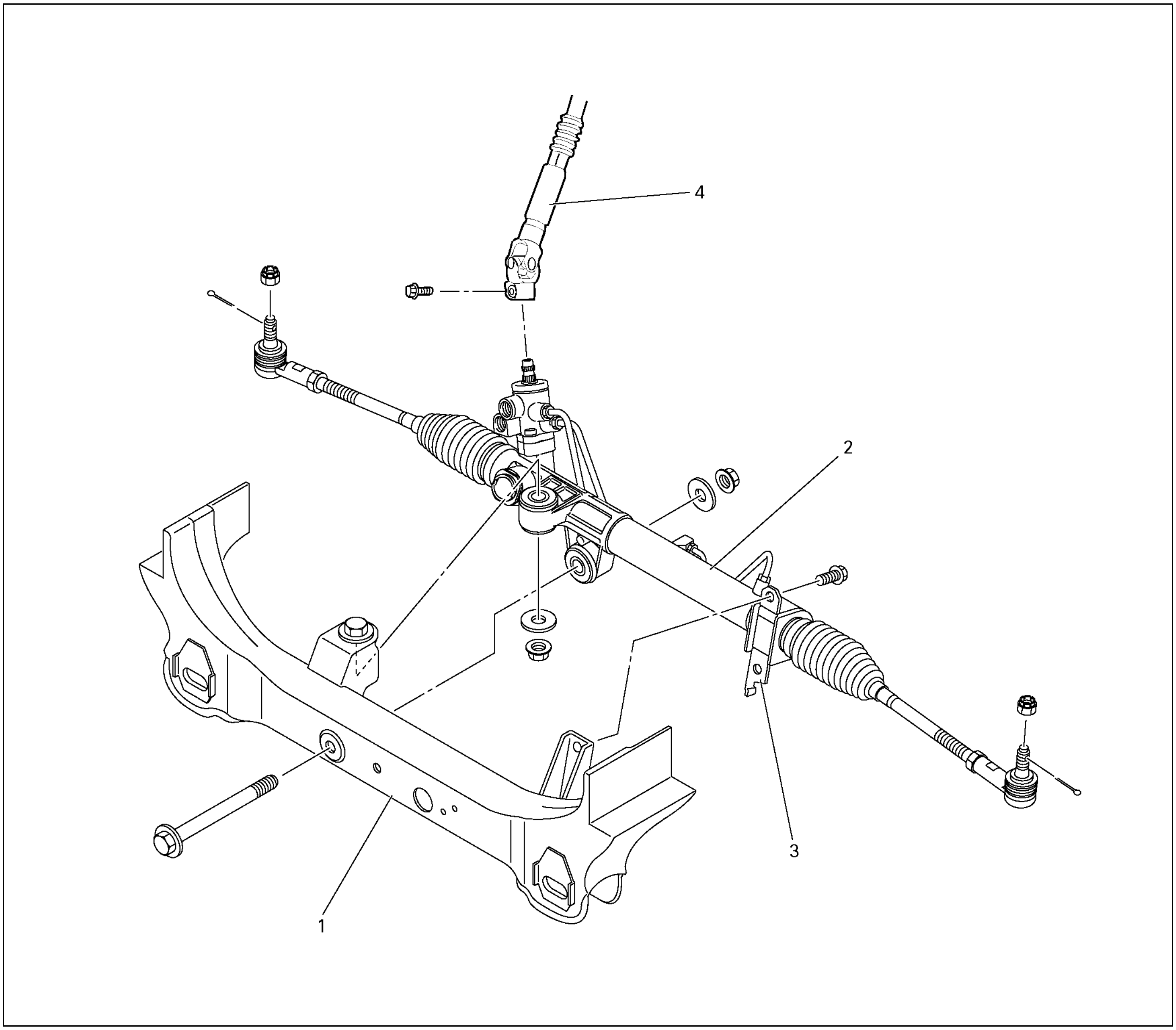


Figure 6A1 – 450

Power Steering Unit

Power Steering Unit and Associated Parts



431R300016

Legend

(1) Crossmember
(2) Power Steering Unit Assembly
(3) Bracket
(4) Universal joint (Steering shaft)

Removal

1. Remove the universal joint assembly.
   Make a setting mark across the coupling flange and steering unit to insure reassembly of the parts in the original position.
2. Drain power steering fluid.
3. Remove the tie rod end assembly from knuckle.
   Use tie rod end remover 5-8840-2005-0.

2 Install a new front oil gallery expansion plug (1).

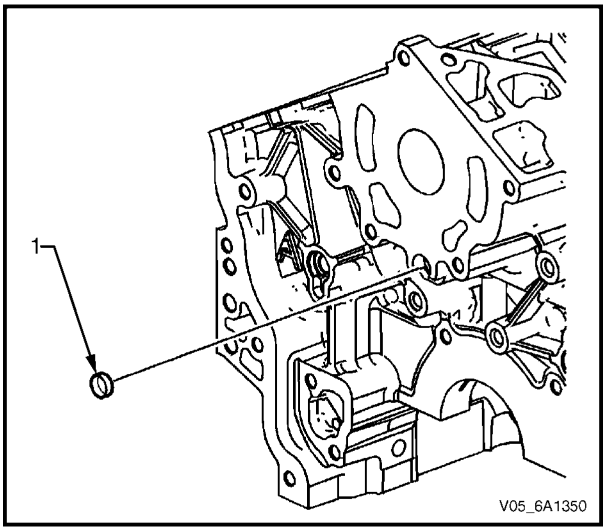


Figure 6A1 – 451

3 Install the cylinder block-to-transmission alignment dowels (1).

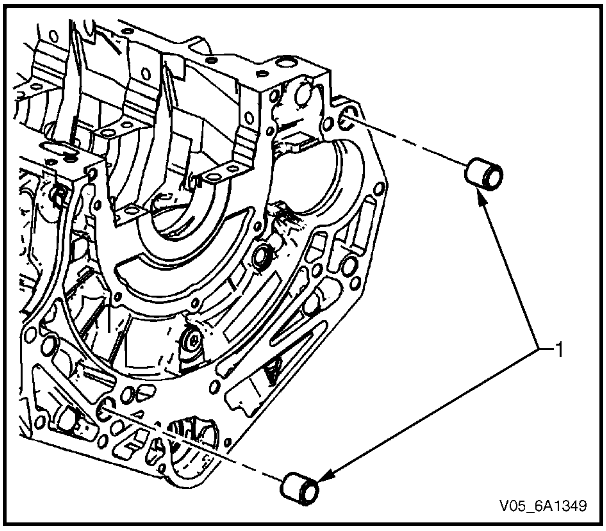


Figure 6A1 – 452

4 Place RTV sealant on new coolant expansion plugs (1) and install the new coolant expansion plugs.

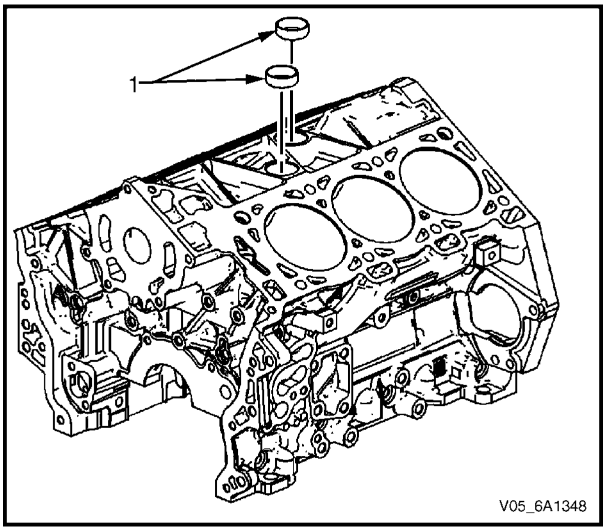


Figure 6A1 – 453

5 Install the left-hand side M20 oil gallery threaded plug (1) and tighten to the correct torque specification.

Left-hand side M20 cylinder block oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

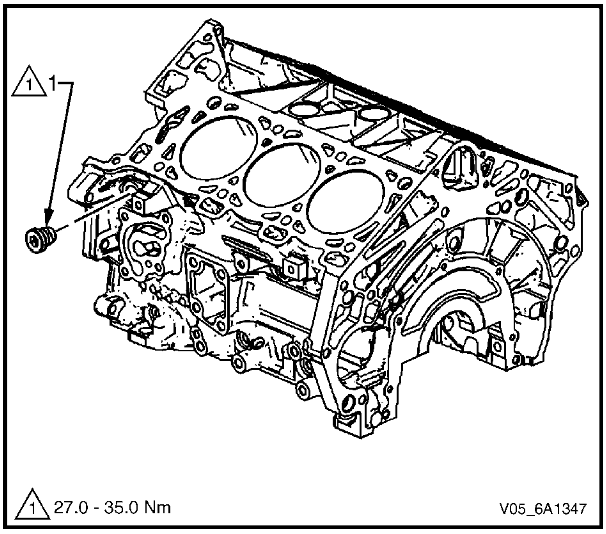


Figure 6A1 – 454

6 Install the left-hand side M14 coolant drain threaded plug (1) and tighten to the correct torque specification.

Left-hand side M14 cylinder block coolant drain threaded plug torque specification ....27.0 – 35.0 Nm

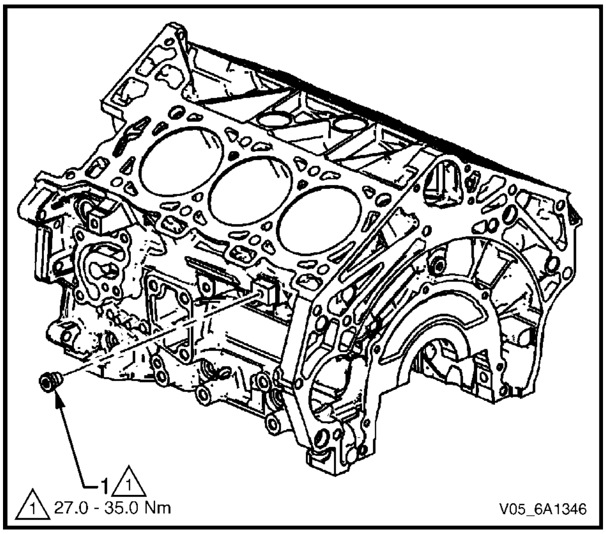


Figure 6A1 – 455

7 Install the M14 rear oil gallery threaded plug (1) and tighten to the correct torque specification.

M14 cylinder block rear oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

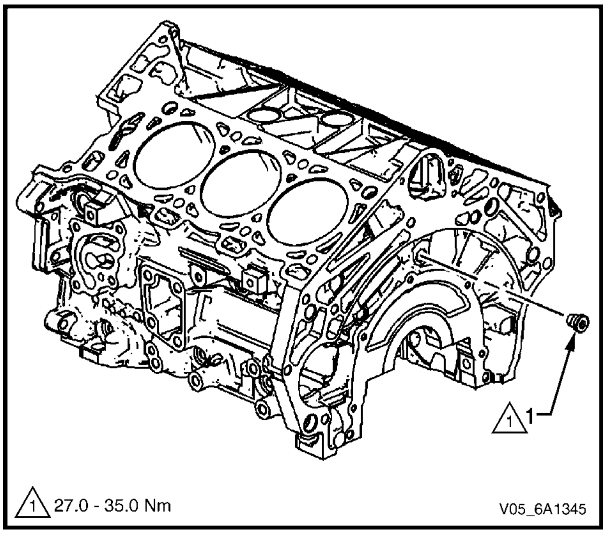


Figure 6A1 – 456

8 Install the right-hand side M14 coolant drain threaded plug (1) and tighten to the correct torque specification.

Right-hand side M14 cylinder block coolant drain threaded plug torque specification ....27.0 – 35.0 Nm

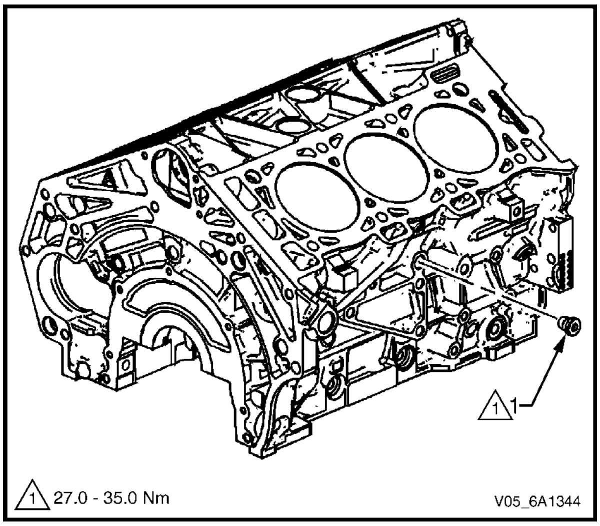


Figure 6A1 – 457

9 Install the right-hand side M14 oil gallery threaded plug (1) and tighten to the correct torque specification.

Right-hand side M14 cylinder block oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

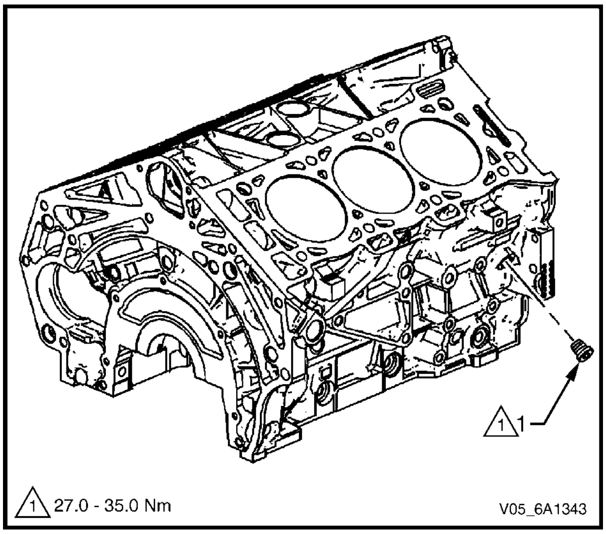


Figure 6A1 – 458

10 Install the cylinder block-to-oil pan alignment dowels (1).

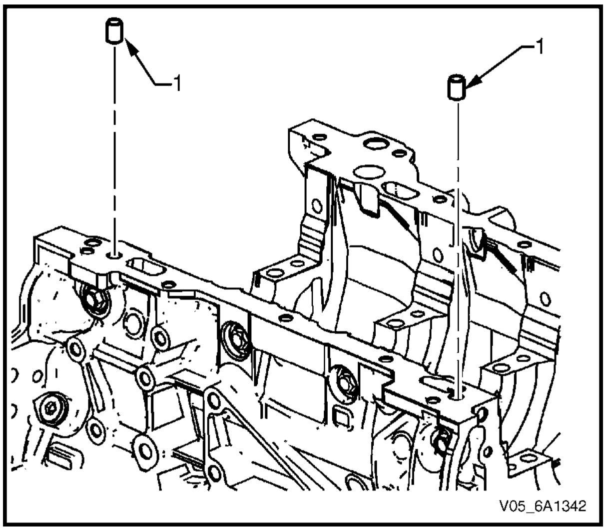


Figure 6A1 – 459

11 Install the new right-hand front oil pan rail oil gallery expansion plug (1).

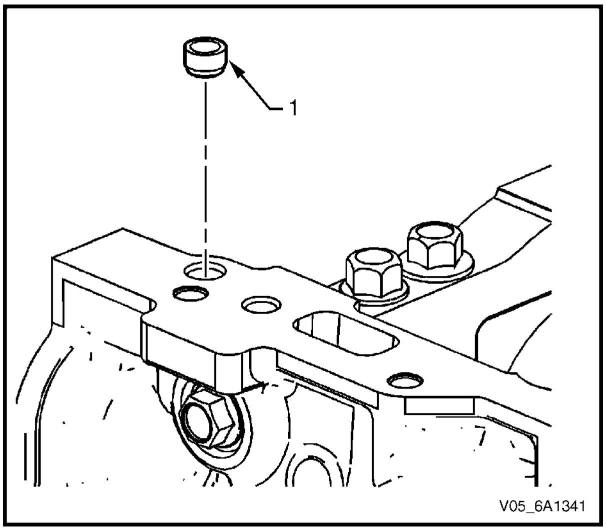


Figure 6A1 – 460

12 Install the oil jet (2), three places.

13 Install the oil jet attaching bolt (1), three places and tighten to the correct torque specification.

Oil jet attaching bolt torque specification	8.0 – 12.0 Nm

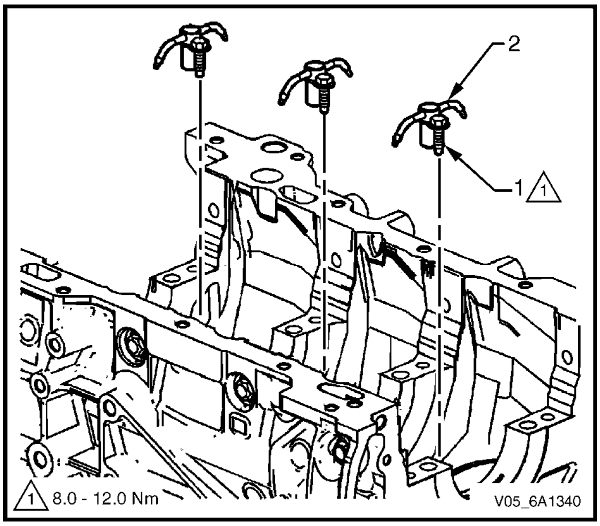


Figure 6A1 – 461

4.8 Thread Repairs

General Information

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert. During the insert installation process, the installation driver tool cold-rolls the bottom internal threads and expands the bottom external threads of the insert into the base material. This action mechanically locks the insert into place.

This Section describes the recommended method of repairing threads in three specific areas of the engine.

- general thread repair,
- cylinder block main bearing cap bolt hole thread repair, and
- cylinder head bolt hole thread repair.

For detailed descriptions of all thread specifications used refer to 4.9 Thread Repair Specifications.

The drill-bit and counter-bore tool from the thread repair kit, Tool No. J-42385-700 and J-42385-2000 are designed for use with either a suitable tap wrench or drill motor. Limited access and larger hole repair may process better using a tap wrench. An extension from Tool J 43965 may also be required to drive the thread repair tooling dependent on access to the hole being repaired. Use only a tap wrench when tapping the hole and during installation of the insert.

1 It is critical the drilling, counter boring and tapping of the hole to be repaired follows the same centreline (1) as the original hole.

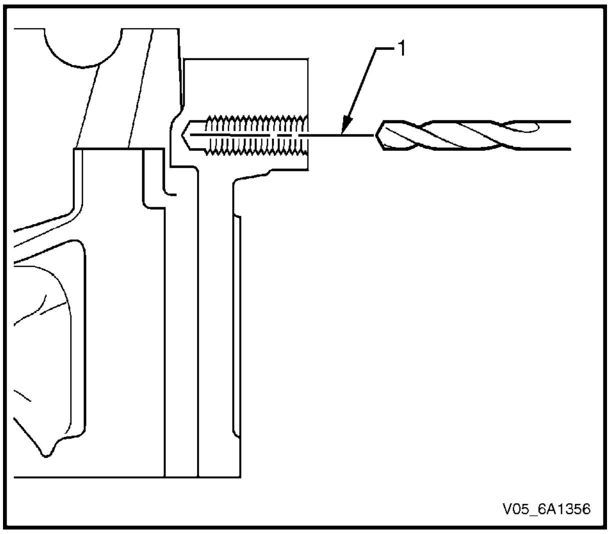


Figure 6A1 – 462

2 During the drilling and tapping of the hole being repaired, ensure the tooling is consistently machining perpendicular to the surface of the base material.

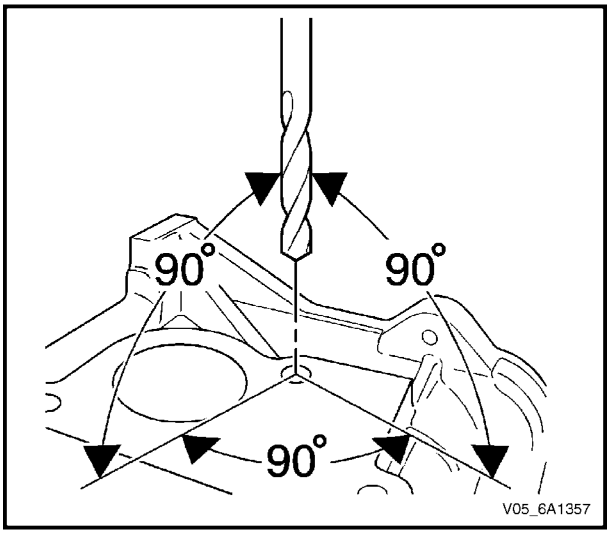


Figure 6A1 – 463

3 If the threaded hole being repaired has a base surface perpendicular to the hole centreline, tapping guides are available to aid in tapping the hole.

Tap Size	Tap Guide	Tap Size	Tap Guide	Tap Size	Tap Guide
-	J 42385	-	J 42385	-	J 42385
6 x 1.0	729	10 x 1.5	731	14 x 1.5	736
8 x 1.25	730	12 x 1.5	732	20 x 1.5	737

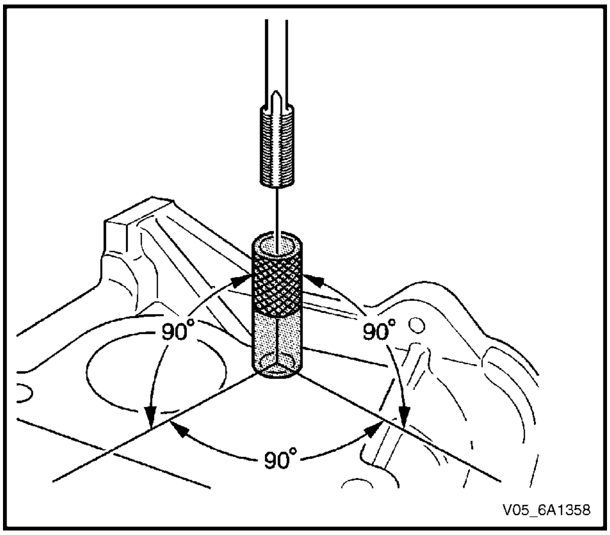


Figure 6A1 – 464

General Thread Repair

NOTE

The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures

1 When installed to the correct depth, the flange (1) of the insert will be seated against the counter bore of the drilled/tapped hole and just below the surface (2) of the base material.

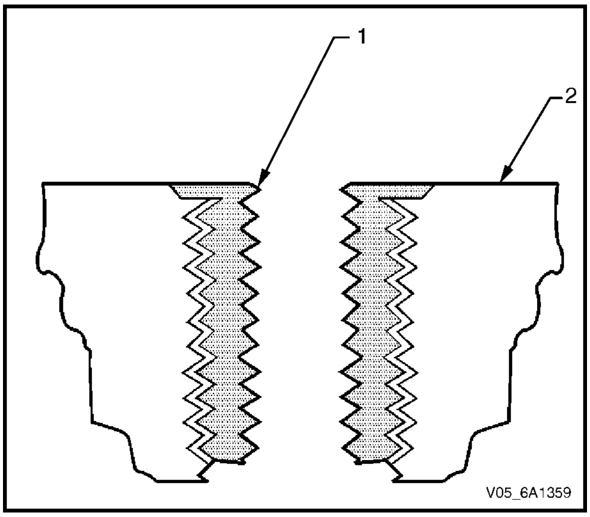


Figure 6A1 – 465

NOTE

During the drilling process, repeatedly remove the drill and clean the swarf from the hole and the flutes of the drill.

CAUTION

Do not drill any further than the original hole depth.

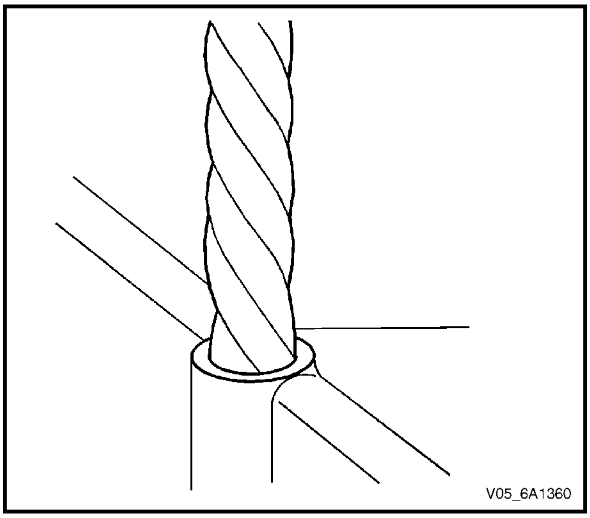


Figure 6A1 – 466

2 Drill out the threads of the damaged hole to the correct depth for the thread being repaired:

- M6 inserts require a minimum drill depth of 15 mm.
- M8 inserts require a minimum drill depth of 20 mm.
- M10 inserts require a minimum drill depth of 23.5 mm.

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

3 Using compressed air, clean out any swarf.

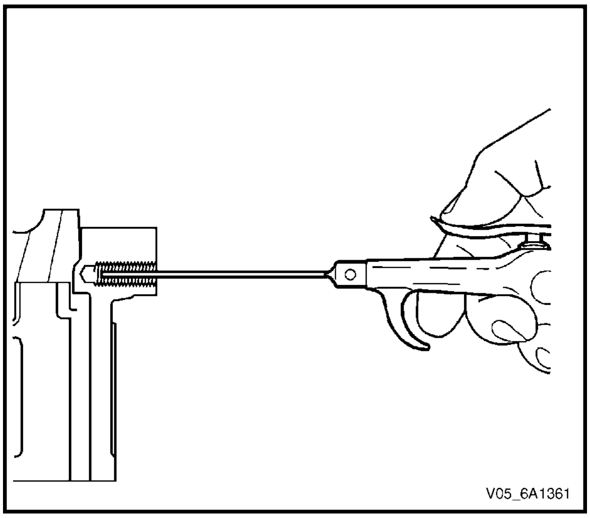


Figure 6A1 – 467

NOTE

A correctly counter bored hole will show a slight burnishing on the surface of the base material for 360 degrees around the drilled hole.

4 Counter bore the drilled hole to the full depth permitted by the tool (1).

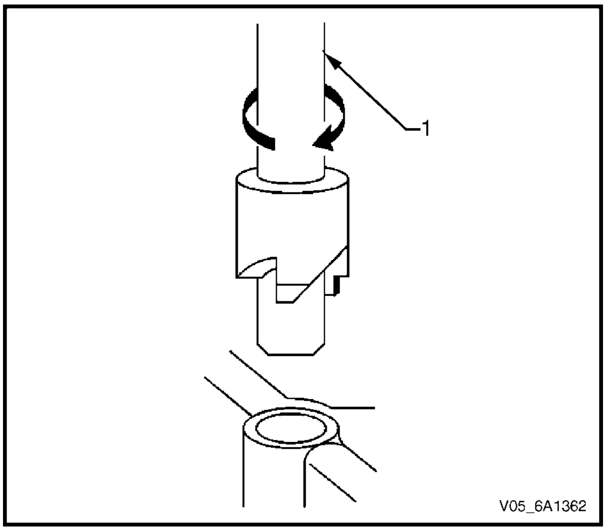


Figure 6A1 – 468

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

5 Using compressed air, clean out any swarf.

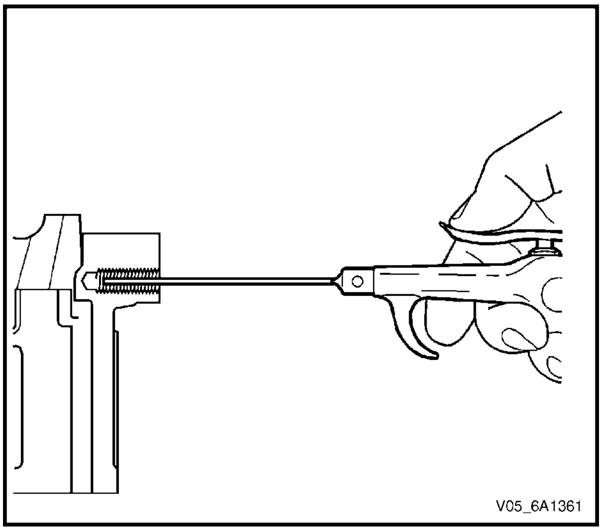


Figure 6A1 – 469

NOTE

- During the tapping process, repeatedly remove the tap and clean the swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

6 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

- M6 inserts require a minimum drill depth of 15 mm.
- M8 inserts require a minimum drill depth of 20 mm.
- M10 inserts require a minimum drill depth of 23.5 mm.

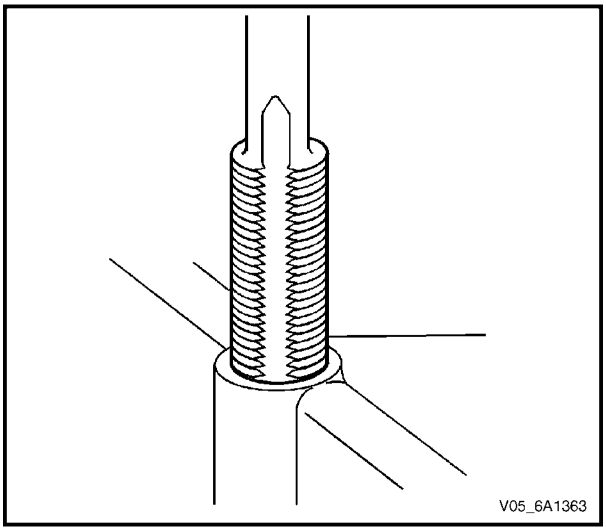


Figure 6A1 – 470

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

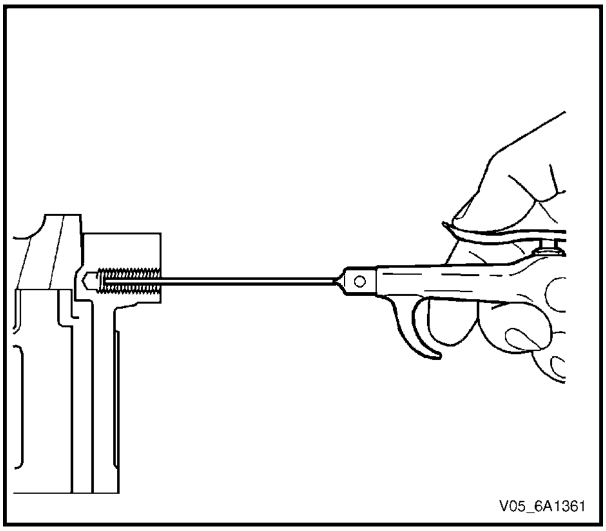


Figure 6A1 – 471

8 Spray a commercially available thread cleaner into the tapped hole.

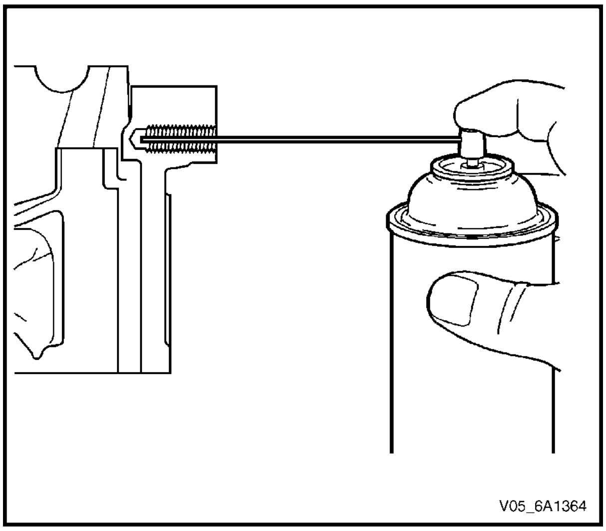


Figure 6A1 – 472

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

9 Using compressed air, clean out any swarf.

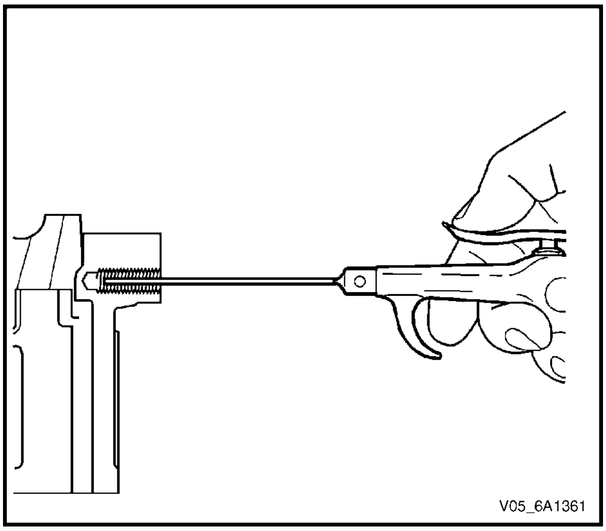


Figure 6A1 – 473

NOTE

Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

10 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

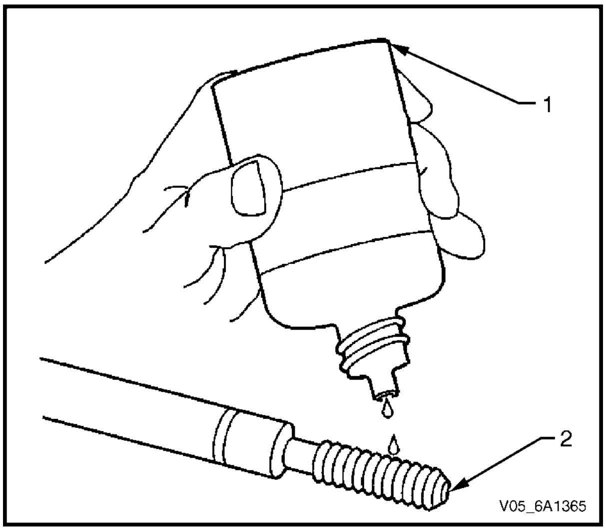


Figure 6A1 – 474

11 Install the insert (2) onto the driver installation tool (1).

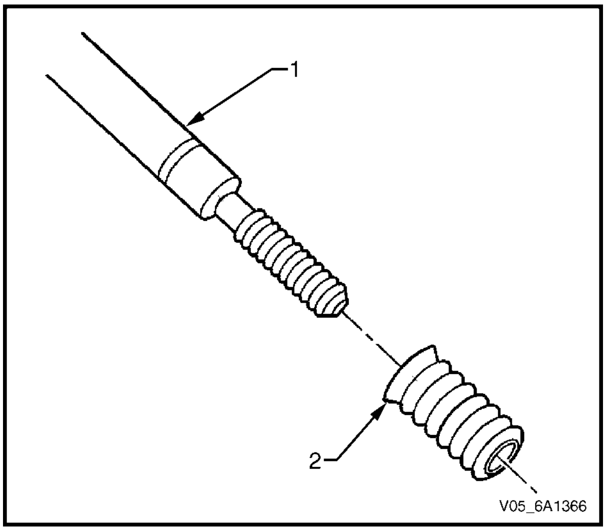


Figure 6A1 – 475

12 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

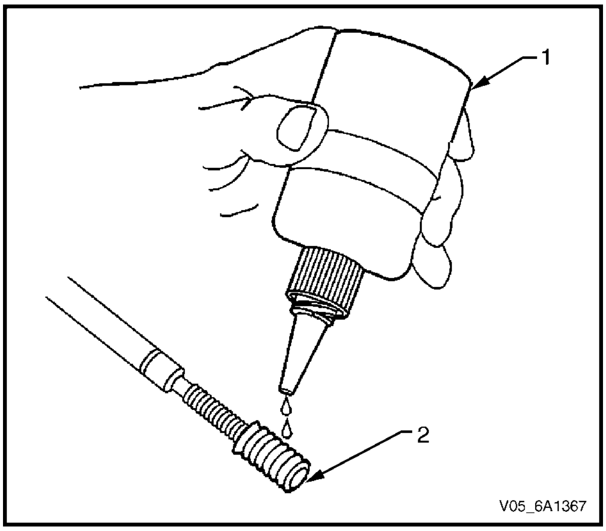


Figure 6A1 – 476

13 Install the insert (2) into the tapped hole by hand only.

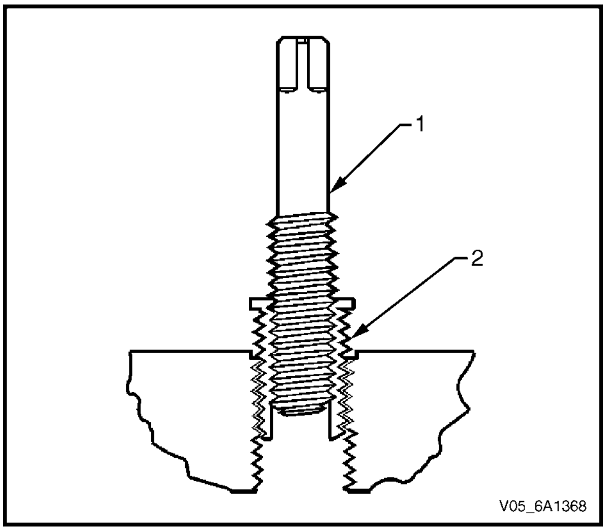


Figure 6A1 – 477

CAUTION

If the insert will not thread down until the flange contacts the counter bore surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

14 Install the insert until the flange (2) of the insert contacts the counter bore surface.

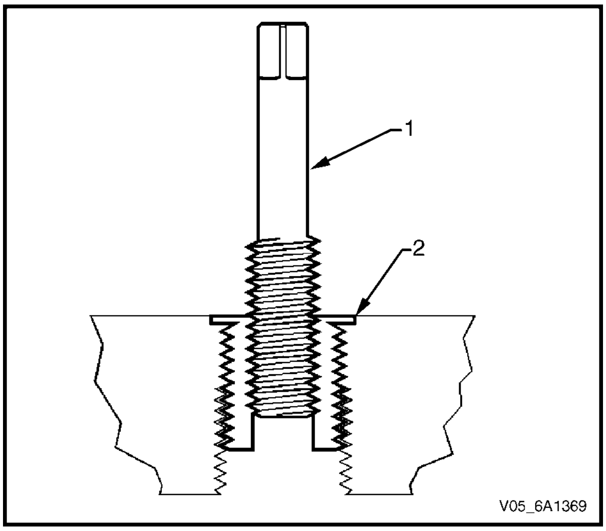


Figure 6A1 – 478

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

15 Continue to rotate the driver installation tool (1) through the insert (2)

16 Remove the driver installation tool.

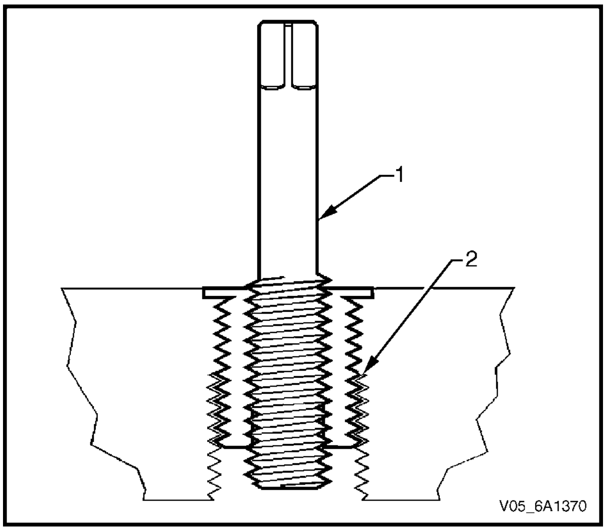
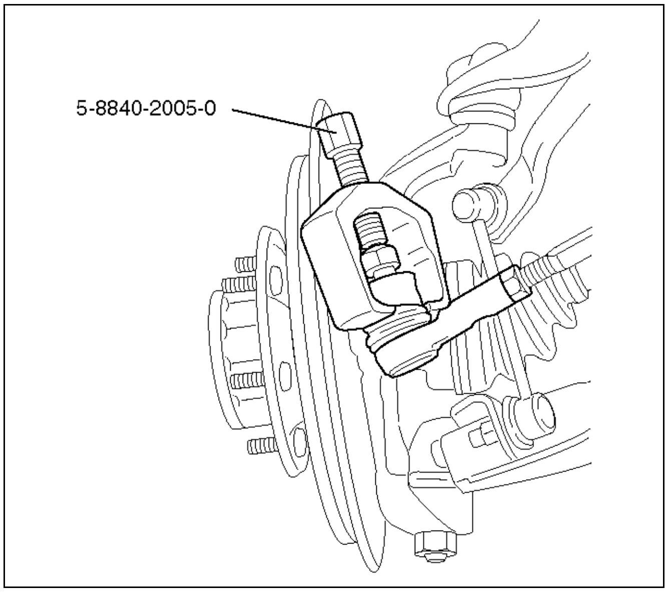


Figure 6A1 – 479



901RW270

4. Disconnect the feed line and return line from steering unit.
   Remove the clips on the crossmember and frame.
   Wire the power steering line to frame.

NOTE: Take care to prevent foreign matter from entering when disconnecting the power steering line.

5. Remove the power steering unit from the crossmember.

Installation

1. Install power steering unit on crossmember.
   Tighten fixing bolt and nut to specified torque.
   Torque:
   116 N·m (11.8 kgf·m/85 lb·ft)
   Torque:
   220 N·m (22.4 kgf·m/162 lb·ft)
2. Connect the feed line and return line.
   Torque:
   25 N·m (2.5 kgf·m/18 lb·ft)
3. Install tie-rod end assembly on knuckle.
   Torque:
   98 N·m (10 kgf·m/72 lb·ft)
4. Align the setting marks on the universal joint (applied at disassembly) with the setting marks on the power steering unit. Connect the universal joint assembly to the power steering unit.
5. Tighten the universal joint bolt to the specified torque.
   Torque:
   31 N·m (3.2 kgf·m/23 lb·ft)
6. Install the stone guard.
7. Bleed the system.
   Refer to Bleeding the Power Steering System in this section.

17 Inspect the insert for correct installation into the tapped hole. A correctly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

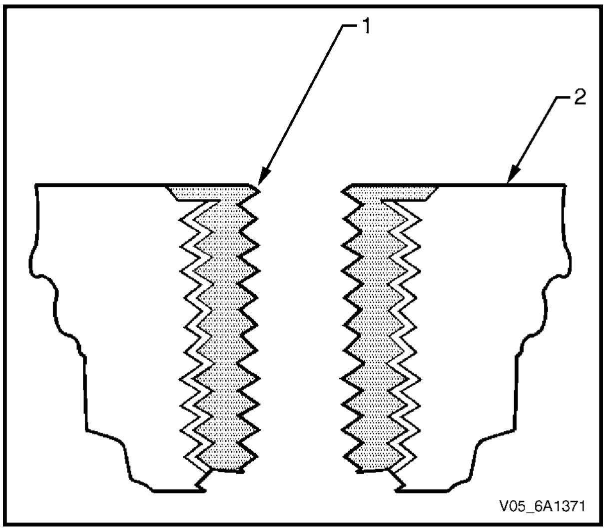


Figure 6A1 – 480

18 Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any swarf and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

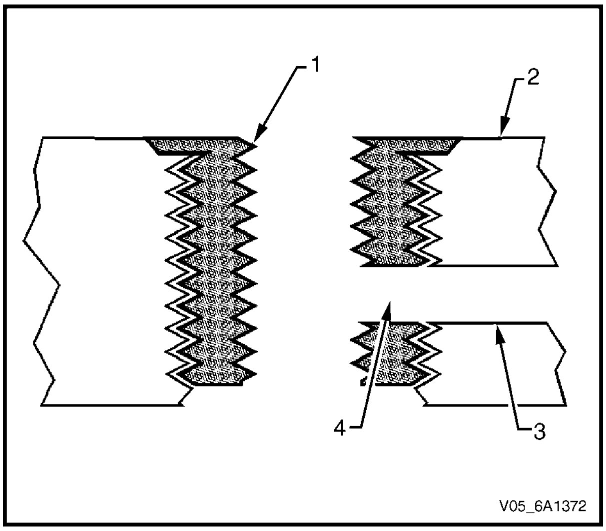


Figure 6A1 – 481

Main Bearing Cap Bolt Hole Thread Repair

The crankshaft main bearing bolt hole thread repair tools are in Tool No. J 42385-2000 and J 42385-700 which consist of the following:

- Drill (1) for outboard holes J 42385-702
- Tap (2) for outboard holes J 42385-703
- Installation driver (3) for outboard holes J 42385-704
- Bushing (4) for outboard holes J 42385-726
- Alignment pin (5) for outboard holes J 42385-727
- Bolts (6) for outboard holes J 42385-728
- Drill (7) for inboard holes J 42385-720
- Tap (8) for inboard holes J 42385-721
- Installation driver (9) for inboard holes J 42385-722
- Bushing (10) J 42385-713
- Alignment pin (11) J 42385-308
- Bolts (12) J 42385-734
- Fixture plate (13) J 42385-712

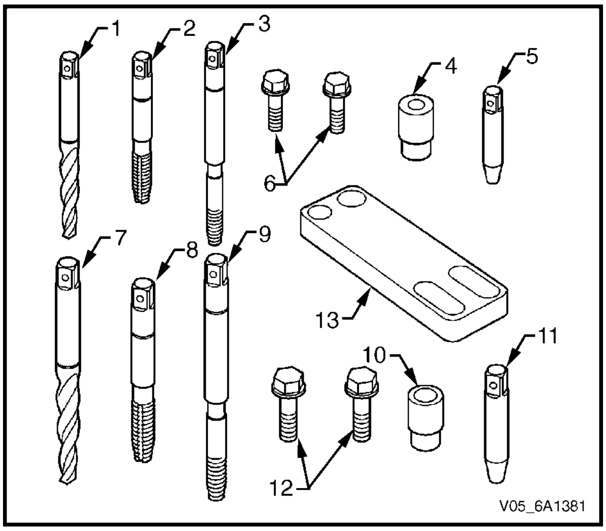


Figure 6A1 – 482

NOTE

- Ensure the fixture plate is installed during the machining and installation processes of the insert.
- The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures.
- When installed to the correct depth, the flange of the insert will be seated against the counter bore of the drilled/tapped hole.

1 Position the fixture plate (3) with the bushing (2) installed over the crankshaft main cap bolt hole to be repaired.

2 Loosely install the fixture plate bolts (1) into the remaining crankshaft main cap bolt holes.

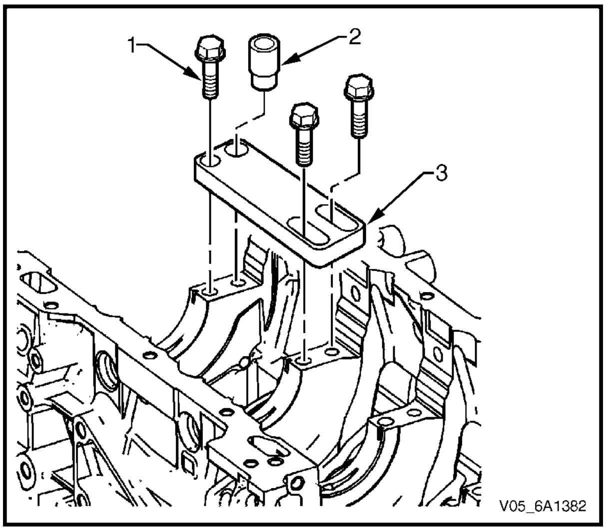


Figure 6A1 – 483

3 Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.

4 With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).

5 Remove the alignment pin.

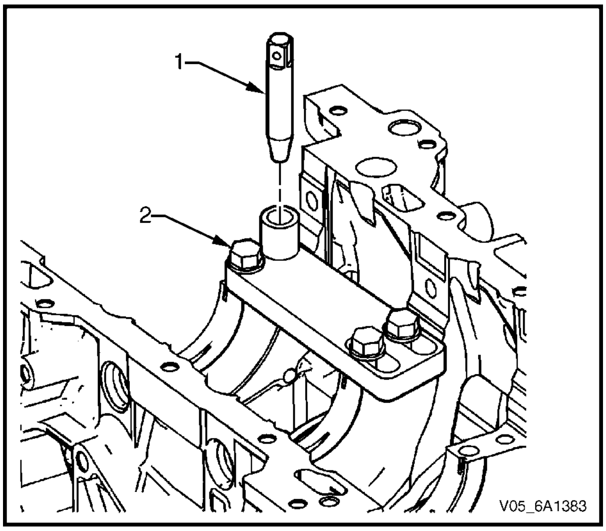


Figure 6A1 – 484

6 Drill the crankshaft main bolt hole until the mark (1) on the drill aligns with the top of the drill bushing (2).

NOTE

During the drilling process, repeatedly remove the drill and clean the swarf from the hole and the flutes of the drill.

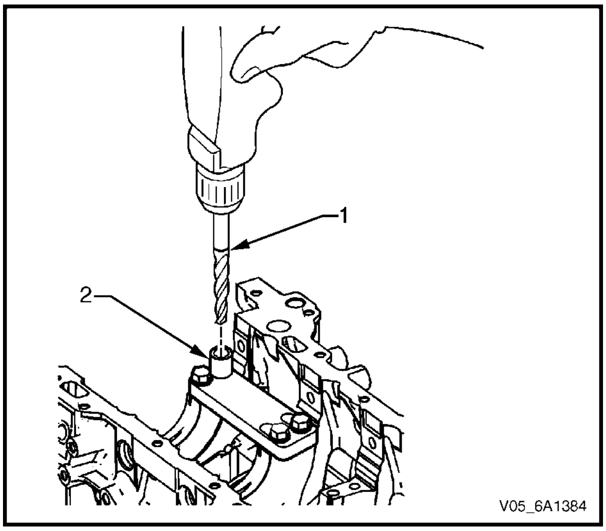


Figure 6A1 – 485

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

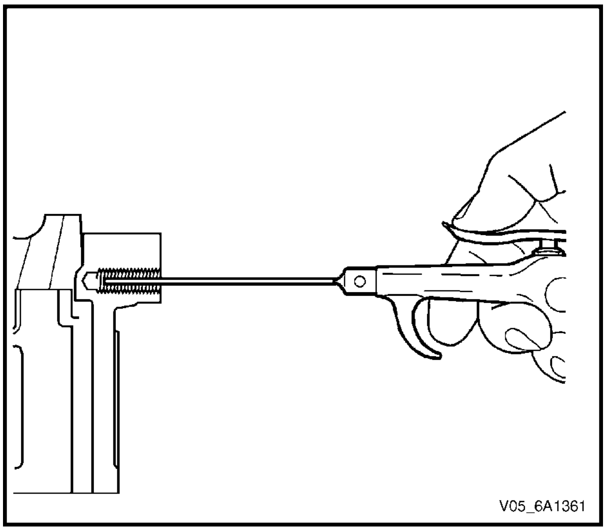


Figure 6A1 – 486

NOTE

- During the tapping process, repeatedly remove the tap and clean the swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

CAUTION

Do not remove the fixture plate during the machining and installation processes of the insert.

8 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

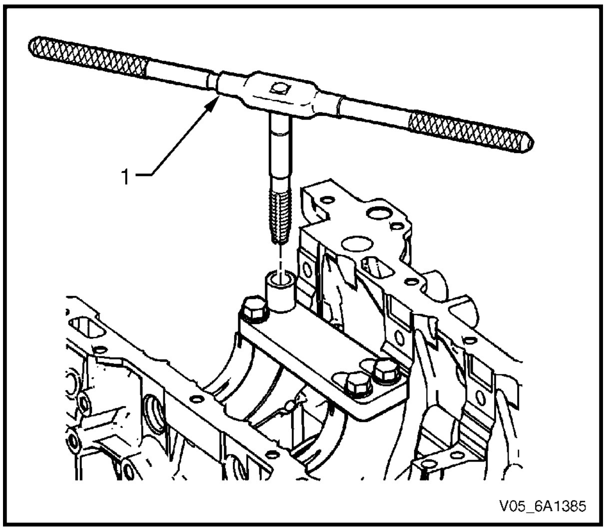


Figure 6A1 – 487

9 In order to tap the new threads for the insert to the correct depth, rotate the tap into the crankshaft main cap bolt hole until the mark (1) on the tap aligns with the top of the drill bushing (2).

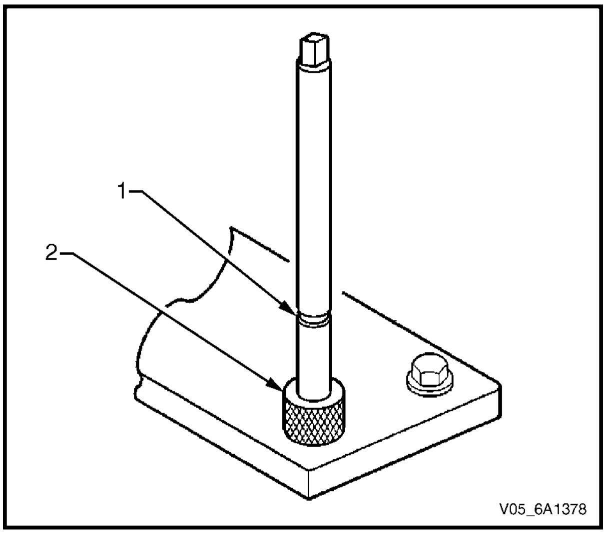


Figure 6A1 – 488

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

10 Using compressed air, clean out any swarf.

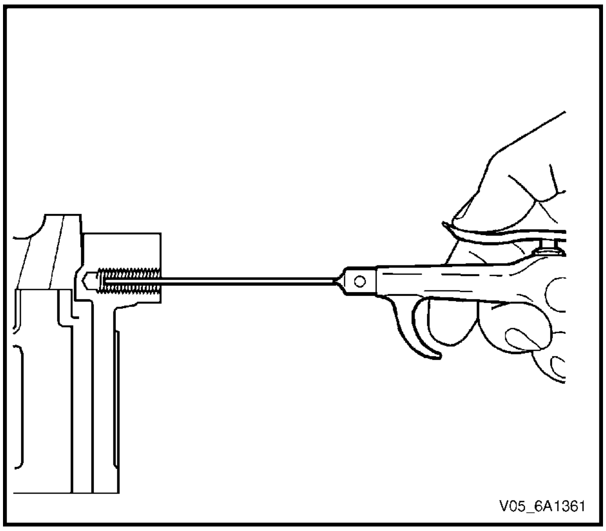


Figure 6A1 – 489

11 Spray a commercially available thread cleaner into the tapped hole.

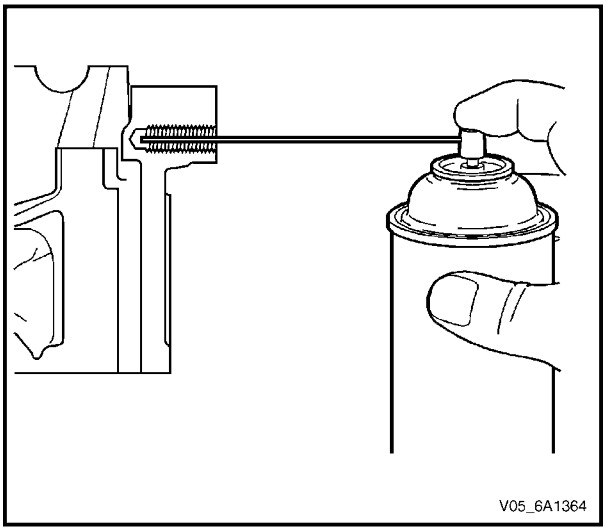


Figure 6A1 – 490

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

12 Using compressed air, clean out any swarf.

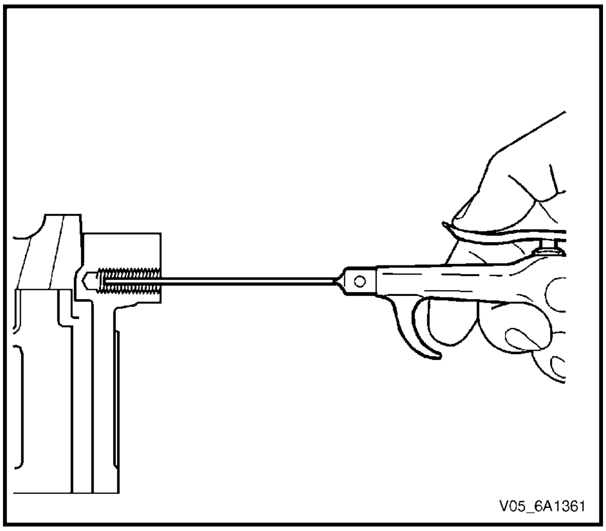


Figure 6A1 – 491

NOTE

- Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.
- Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

13 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

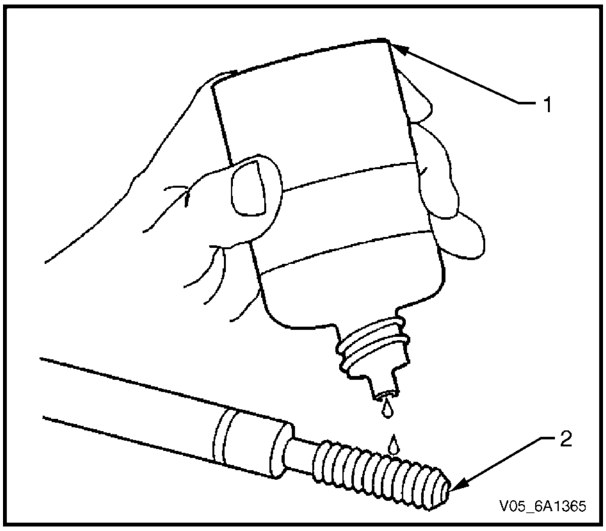


Figure 6A1 – 492

14 Install the insert (2) onto the driver installation tool (1).

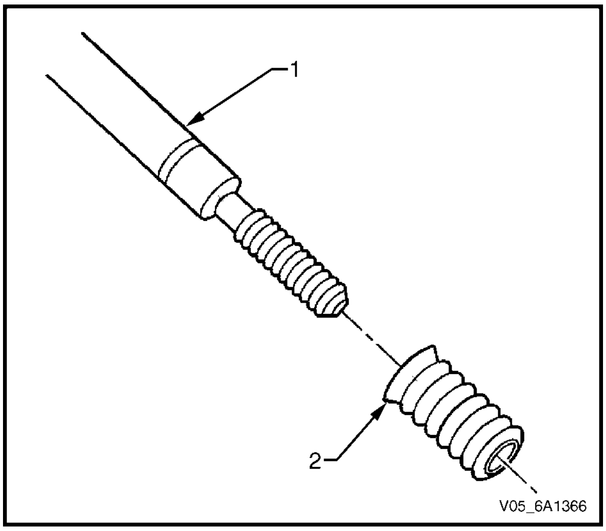


Figure 6A1 – 493

15 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

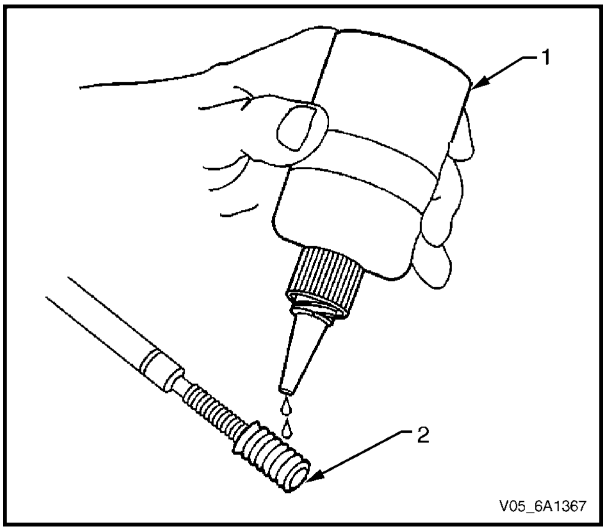


Figure 6A1 – 494

16 Install the insert and installation driver (1) to the tapped hole by hand only.

17 Start the insert into the threaded hole.

CAUTION

If the insert will not thread down until the flange contacts the counter-bored surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

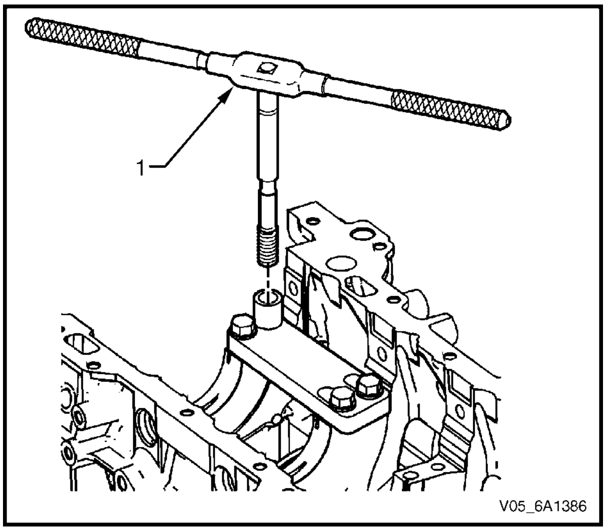


Figure 6A1 – 495

18 Install the insert until the flange of the insert contacts the counter-bored surface.

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19 Continue to rotate the driver installation tool through the insert.

20 Rotate the driver installation tool until the mark (1) on the driver installation tool aligns with the top of the drill bushing (2).

21 Inspect the insert for correct installation into the tapped hole.

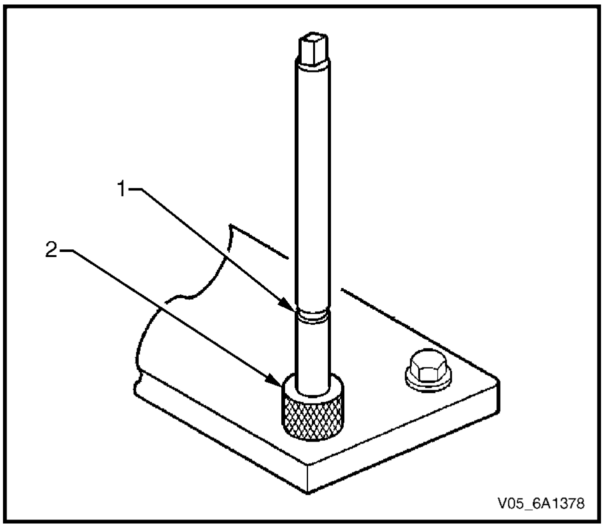


Figure 6A1 – 496

22 Remove the fixture plate bolts (1), bushing (2) and fixture plate (3).

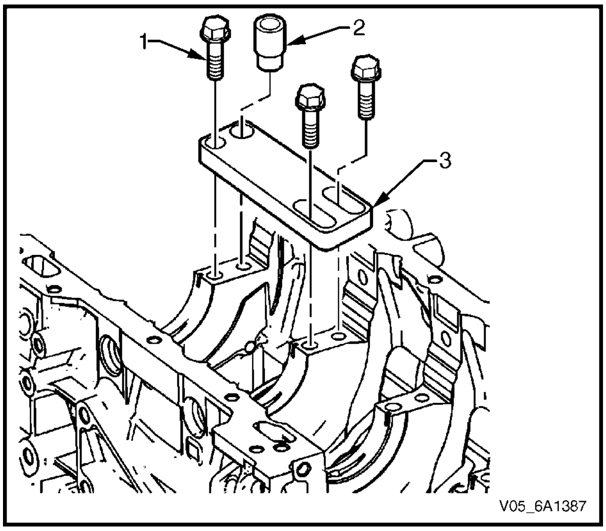


Figure 6A1 – 497

Cylinder Head Bolt Hole Thread Repair

The cylinder head bolt hole thread repair tools are in Tool No. J 42385-2000 and J 42385-700 which consist of the following:

- Drill (1) J 42385-723
- Tap (2) J 42385-724
- Installation driver (3) J 42385-725
- Alignment pin (4) J 42385-303
- Bushing (5) J 42385-302
- Bolts (6) J 42385-733
- Fixture plate (7) J 42385-401

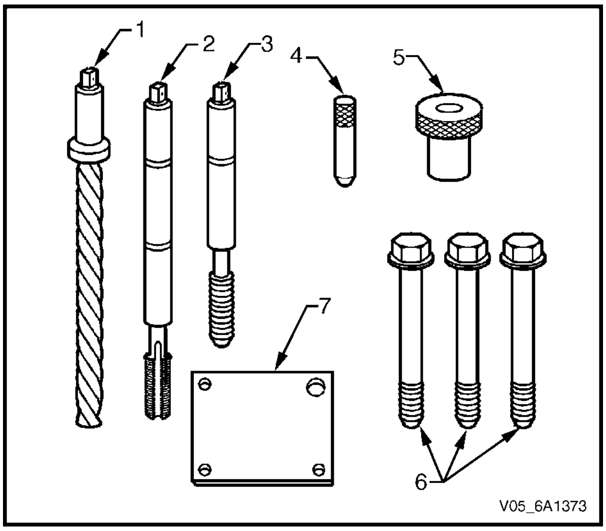


Figure 6A1 – 498

NOTE

- Ensure the fixture plate is installed during the machining and installation processes of the insert.
- The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures.
- When installed to the correct depth, the flange of the insert will be seated against the counter bore of the drilled/tapped hole.

1 Position the fixture plate (3) with the bushing (1) installed over the cylinder head bolt hole to be repaired (4).

2 Loosely install the fixture plate bolts (2) into the remaining cylinder head bolt holes.

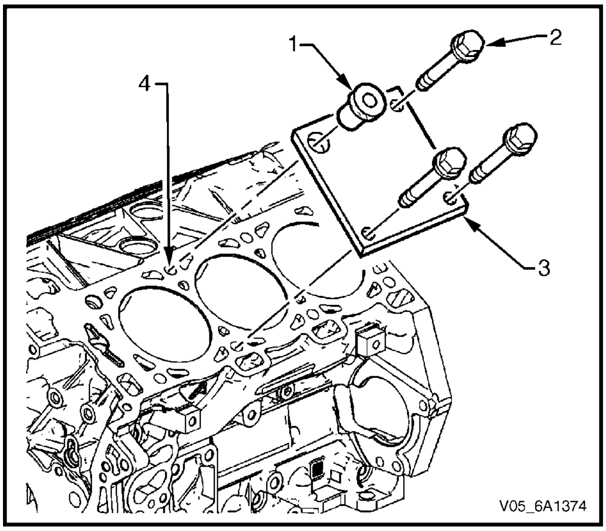


Figure 6A1 – 499

3 Position the alignment pin (1) through the bushing and into the cylinder head bolt hole.

4 With the alignment pin in the desired cylinder head bolt hole, tighten the fixture retaining bolts (2).

5 Remove the alignment pin.

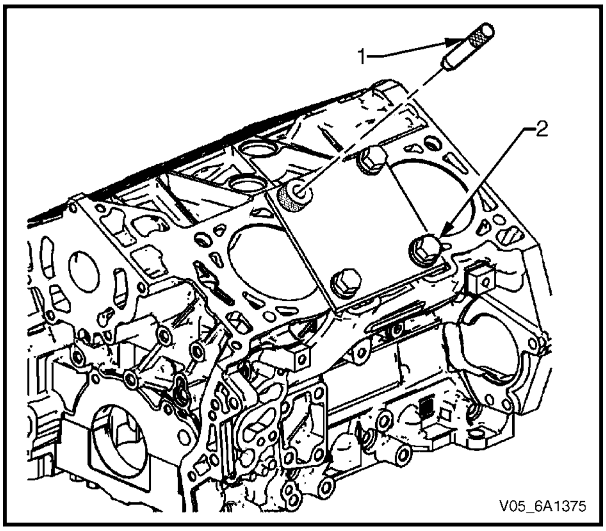


Figure 6A1 – 500

NOTE

During the drilling process, repeatedly remove the drill and clean swarf from the hole and the flutes of the drill.

6 Drill the hole until the stop collar contacts the top of the drill bushing.

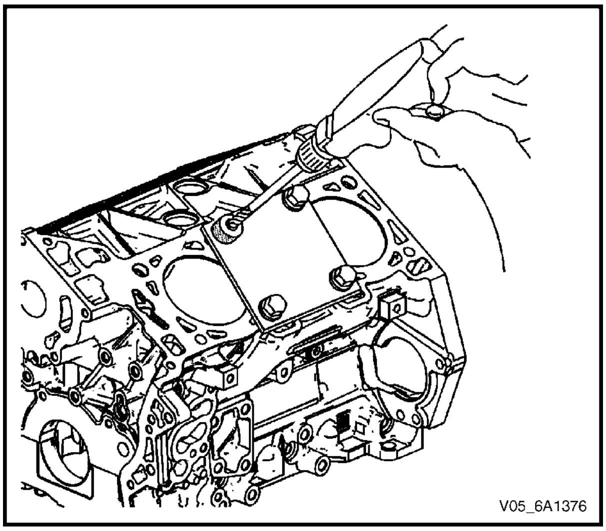


Figure 6A1 – 501

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

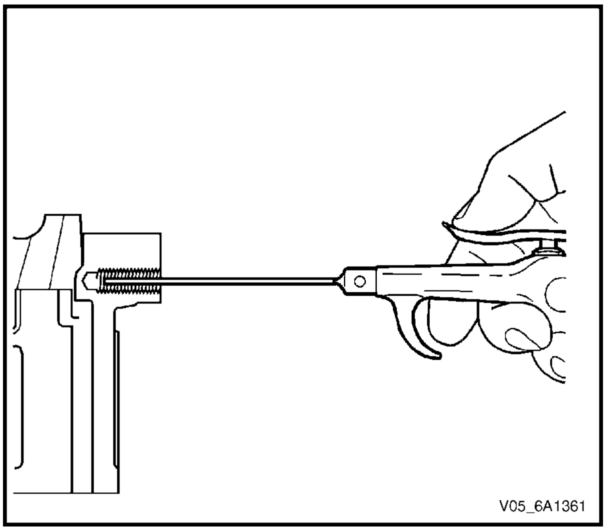


Figure 6A1 – 502

CAUTION

Do not remove the fixture plate during the machining and installation processes of the insert.

NOTE

- During the tapping process, repeatedly remove the tap and clean swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

8 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

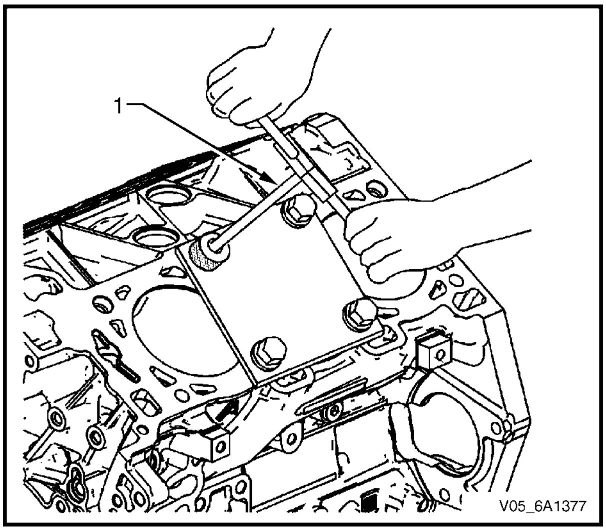


Figure 6A1 – 503

9 In order to tap the new threads for the insert to the correct depth, rotate the tap into the cylinder head bolt hole until the mark (1) on the tap aligns with the top of the drill bushing (2).

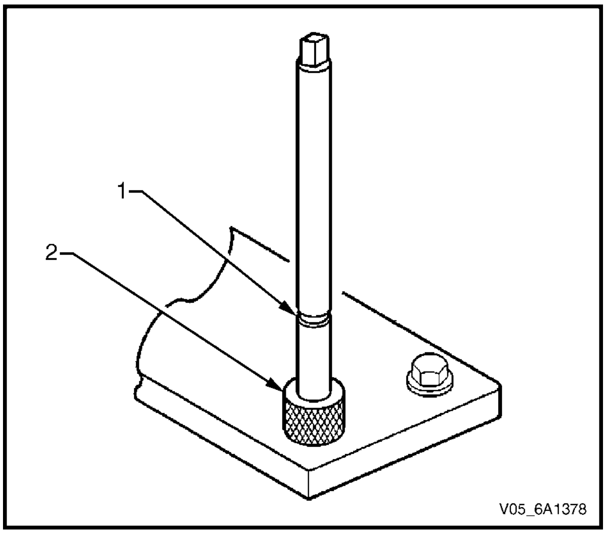


Figure 6A1 – 504

NOTE

Remove the fixture plate prior to installing the insert with the installer tool.

10 Remove the bushing (1) and fixture plate bolts (2) from the cylinder block (4) and remove the fixture plate (3).

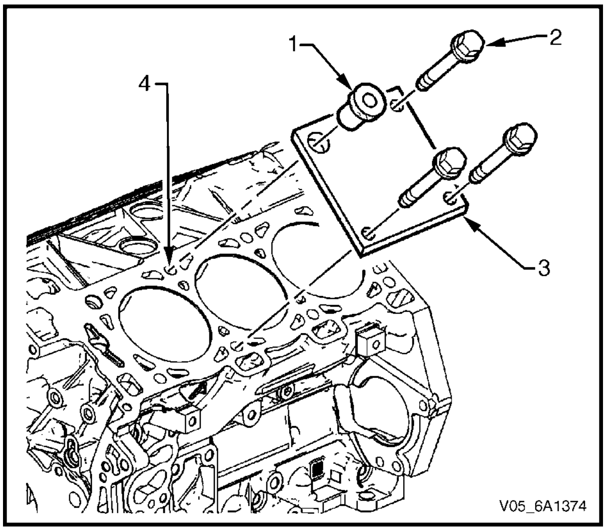


Figure 6A1 – 505

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

11 Using compressed air, clean out any swarf.

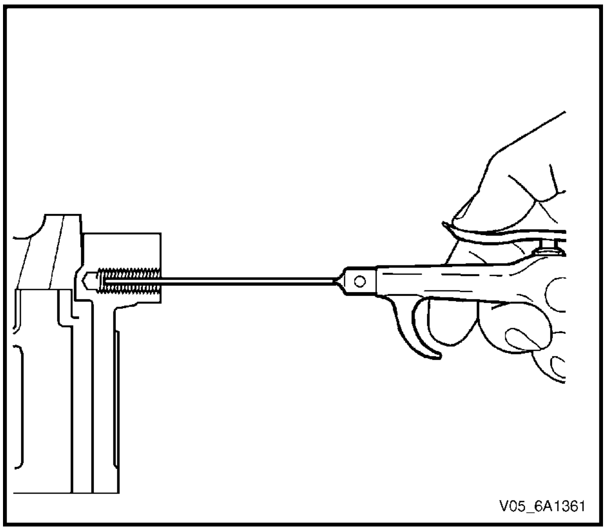


Figure 6A1 – 506

12 Spray a commercially available thread cleaner into the tapped hole.

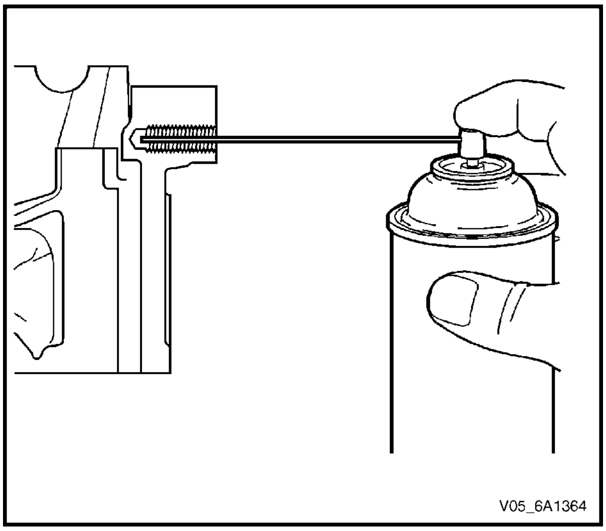
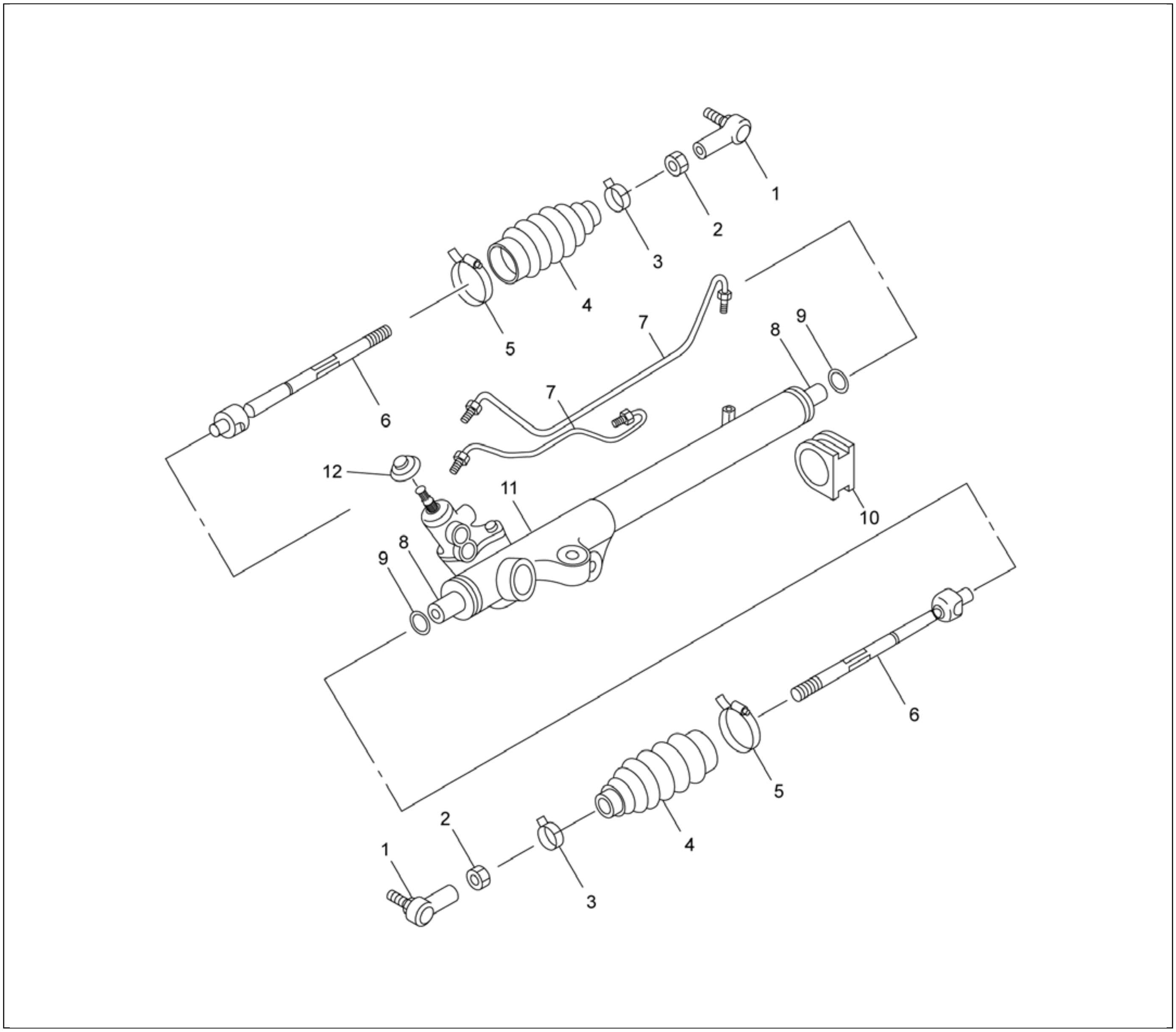


Figure 6A1 – 507

Power Steering Unit Disassembled View



RTW53BLF000401

Legend

(1) Tie-rod End
(2) Lock Nut
(3) Clip
(4) Bellows
(5) Band
(6) Tie-rod Assembly
(7) Oil Line
(8) Rack Bar
(9) Tab Washer
(10) Mounting Rubber
(11) Housing Assembly
(12) Dust Cover

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

13 Using compressed air, clean out any swarf.

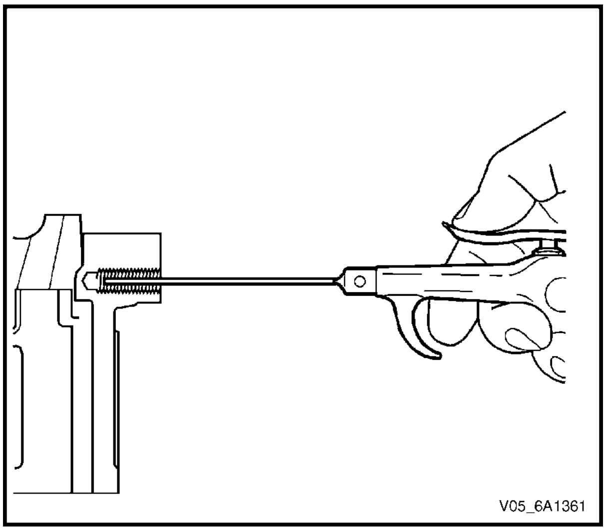


Figure 6A1 – 508

NOTE

Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

14 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

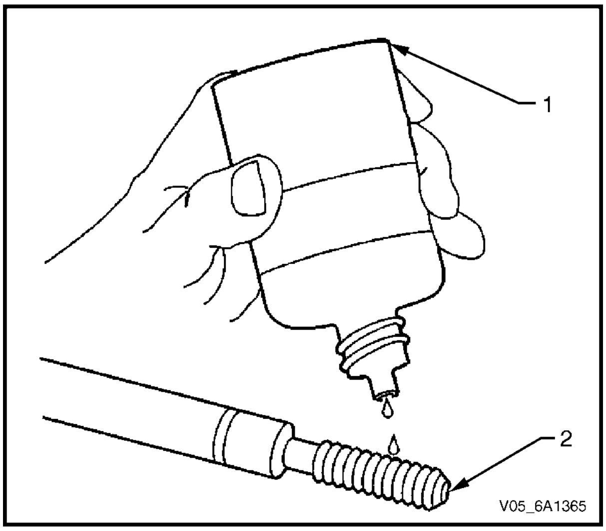


Figure 6A1 – 509

15 Install the insert (2) onto the driver installation tool (1).

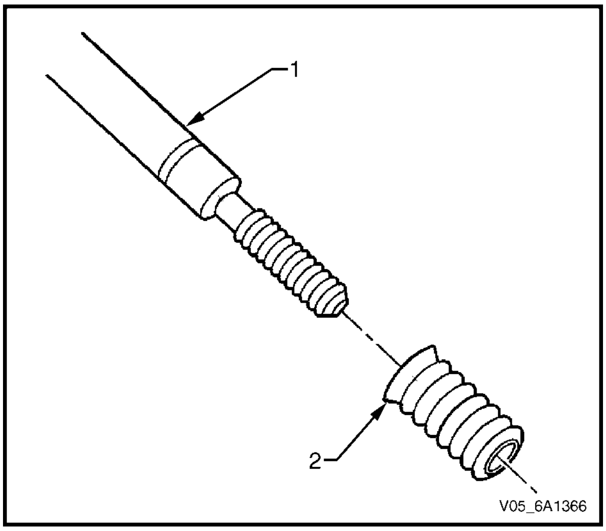


Figure 6A1 – 510

16 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

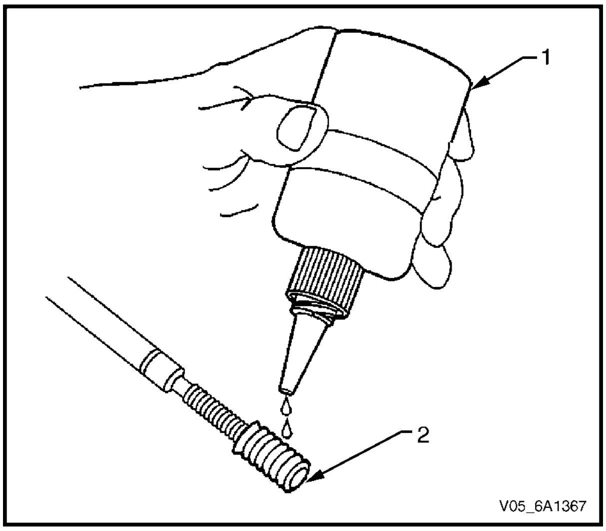


Figure 6A1 – 511

17 Install the insert and installation driver (1) into the tapped hole by hand only.

18 Start the insert into the threaded hole.

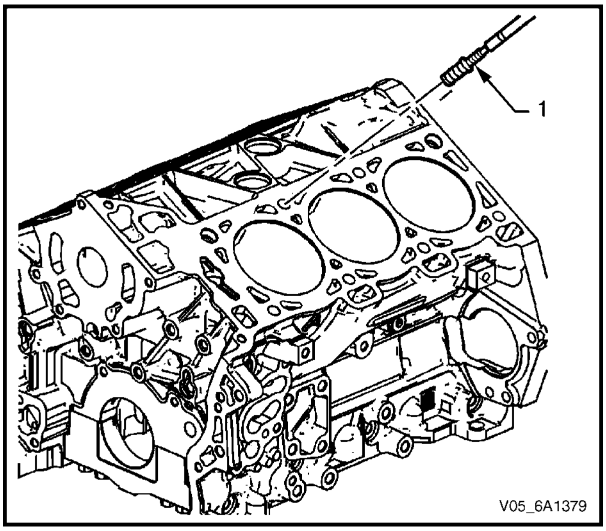


Figure 6A1 – 512

CAUTION

If the insert will not thread down until the flange contacts the counter-bored surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

19 Install the insert until the flange of the insert contacts the counter-bored surface.

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

20 Continue to rotate the driver installation tool through the insert.

21 In order to completely form the new threads in the insert, rotate the driver installation tool through the insert until the mark on the driver installation tool (1) aligns with the surface of the engine block deck (2).

22 Inspect the insert for correct installation into the tapped hole.

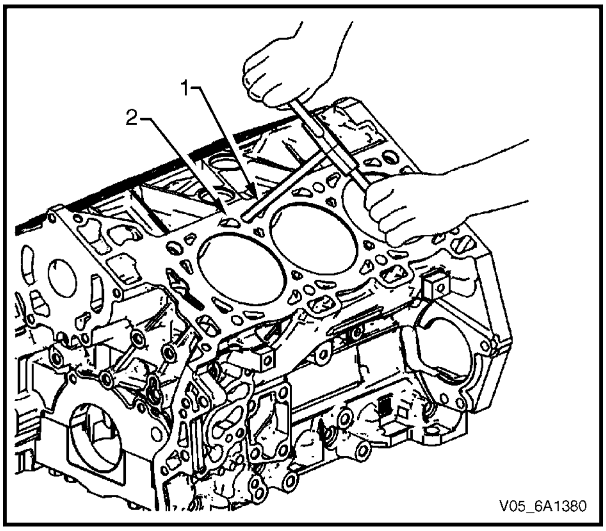


Figure 6A1 – 513

4.9 Thread Repair Specifications

Left-hand Cylinder Head Camshaft Cover Face

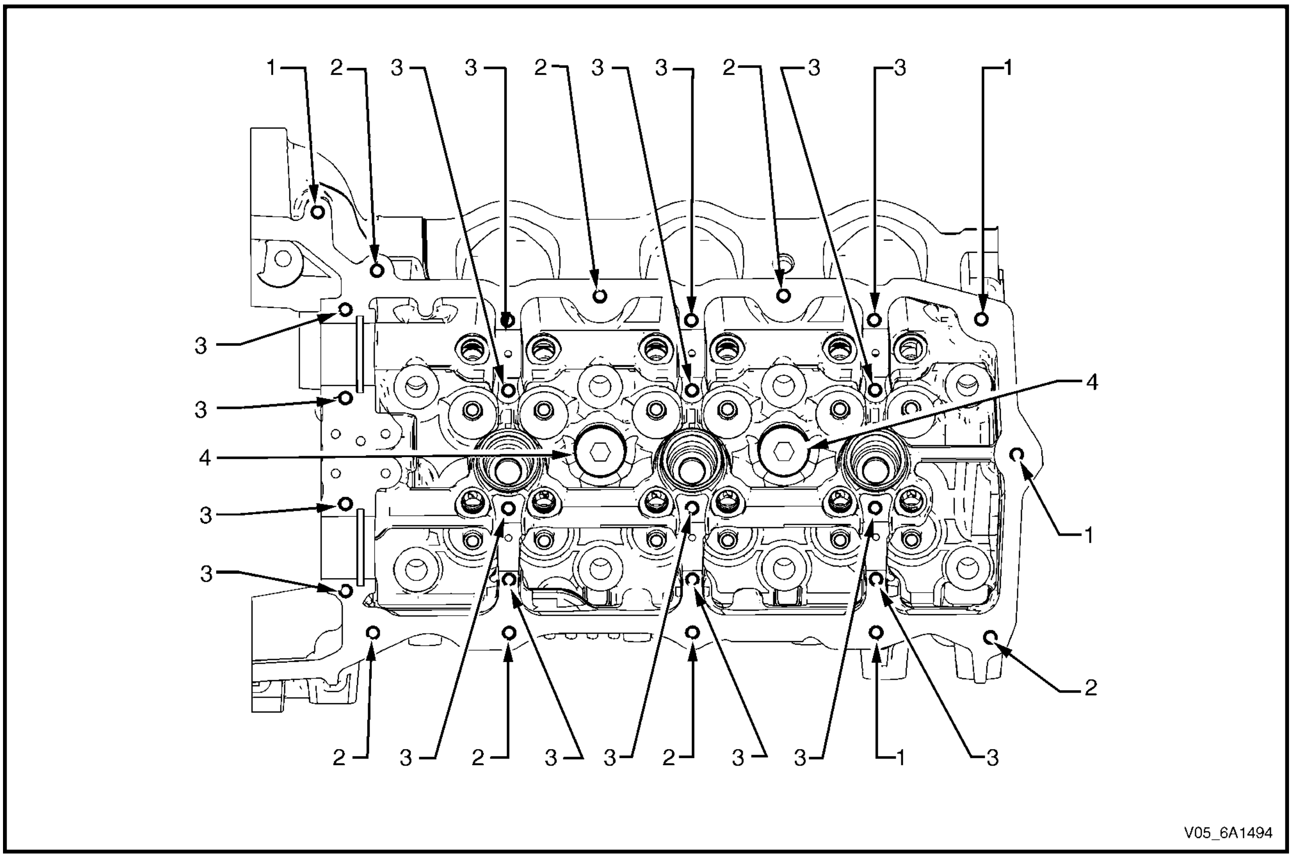


Figure 6A1 – 514

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M6 x 1.0	201	202	203	204	205	Thru	Thru
3	M6 x 1.0	701	n/a	203	204	205	28.5	24.0
4	M20 x 1.5	715	716	717	718	719	25.0	17.0

Left-hand Cylinder Head Front Face

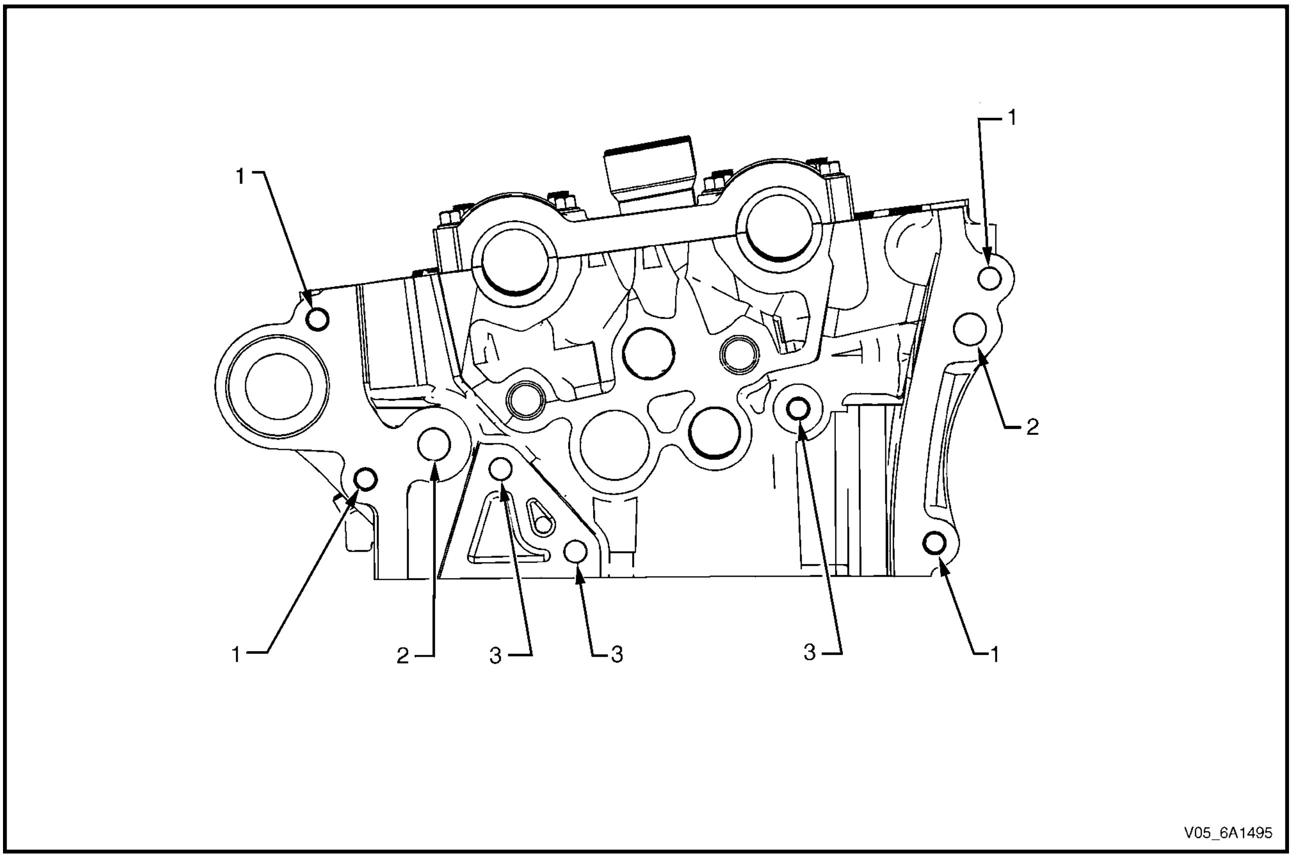


Figure 6A1 – 515

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	Thru	Thru
2	M12 x 1.75	856	857	858	859	416	40.0	32.5
3	M8 x 1.25	206	207	208	209	210	22.5	18.0

Left-hand Cylinder Head Intake Face

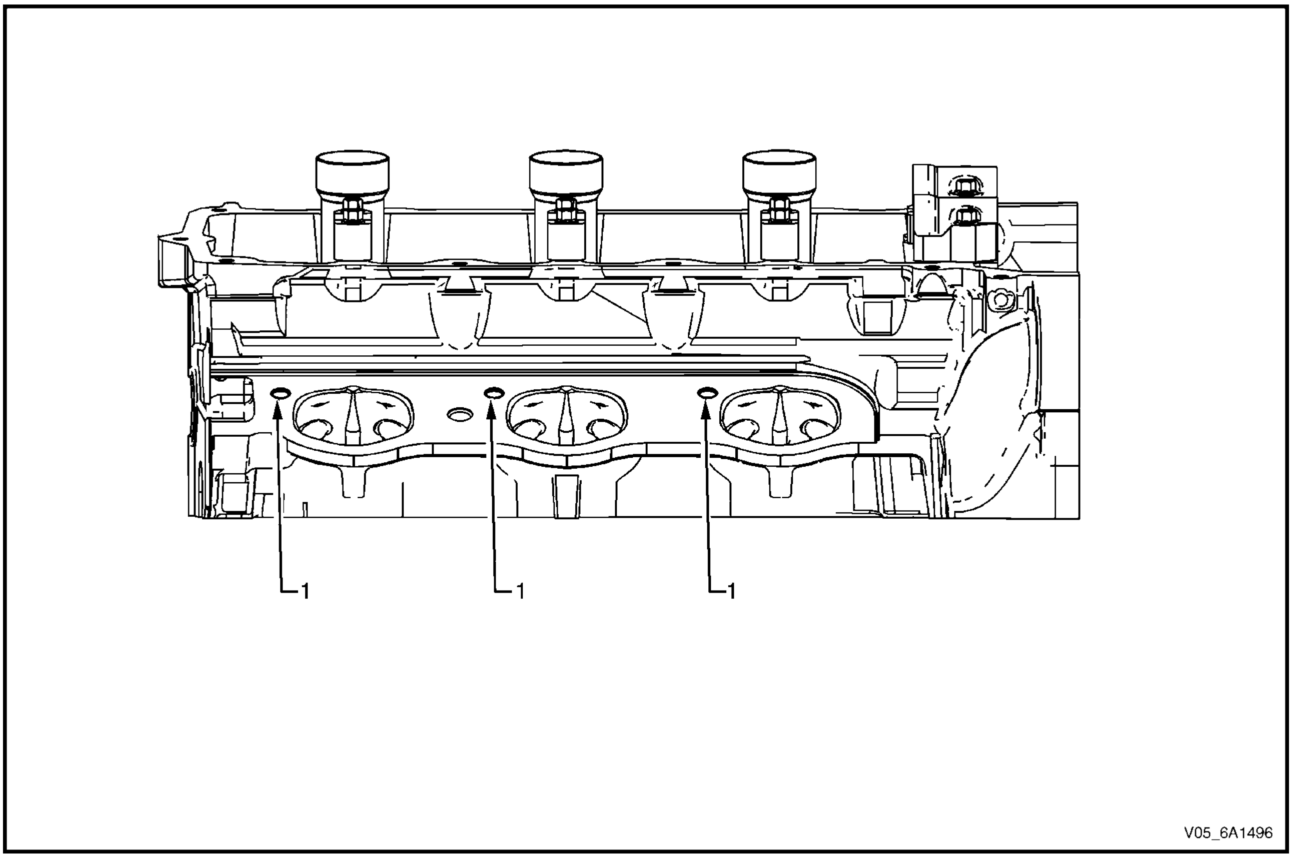


Figure 6A1 – 516

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M8 x 1.25	206	207	208	209	210	28.5	23.0

Left-hand Cylinder Head Exhaust Face

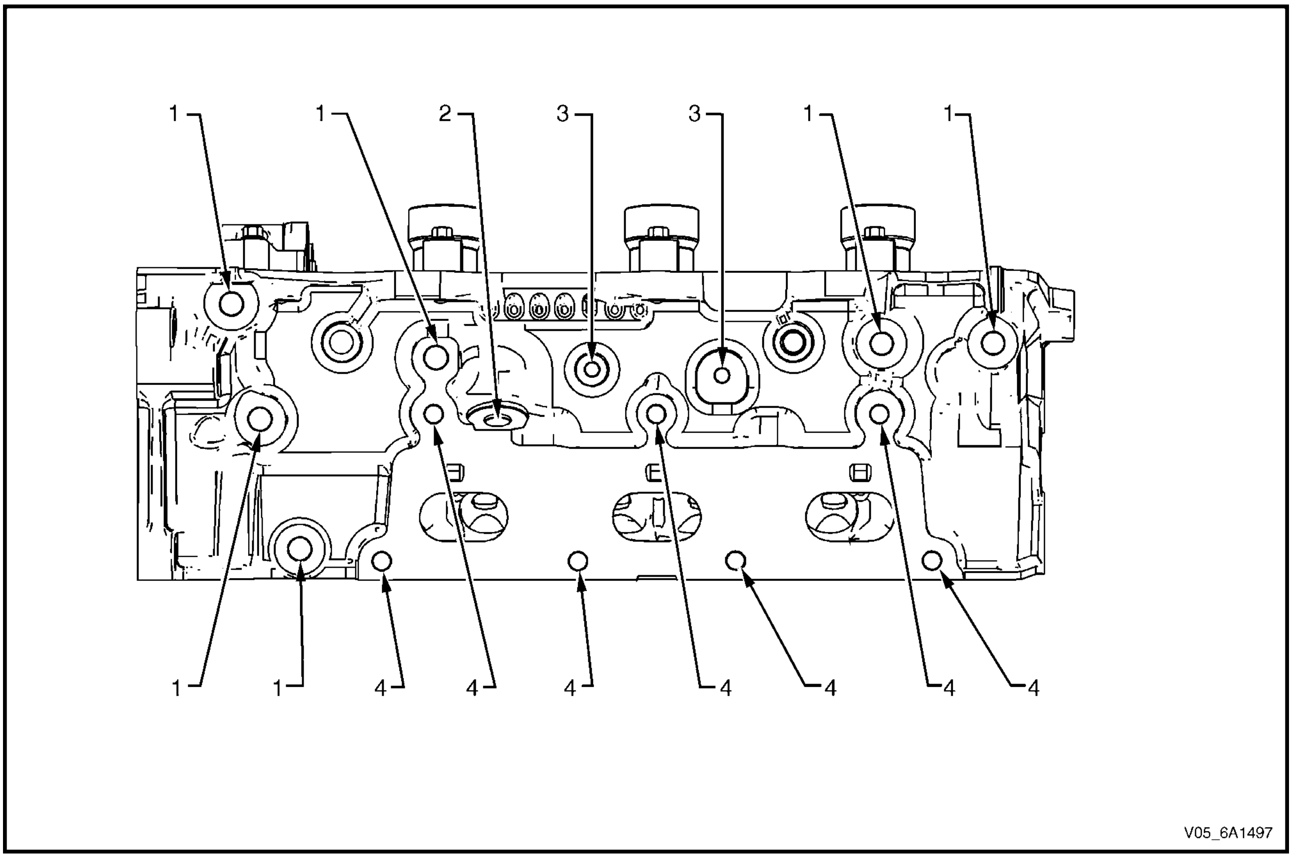


Figure 6A1 – 517

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M10 x 1.5	211	212	213	214	215	33.5	27.0
2	M12 x 1.5	705	706	707	708	709	27.5	13.0
3	M6 x 1.0	201	202	203	204	205	22.5	18.0
4	M8 x 1.25	206	207	208	209	210	28.5	23.0

Left-hand Cylinder Head Rear Face

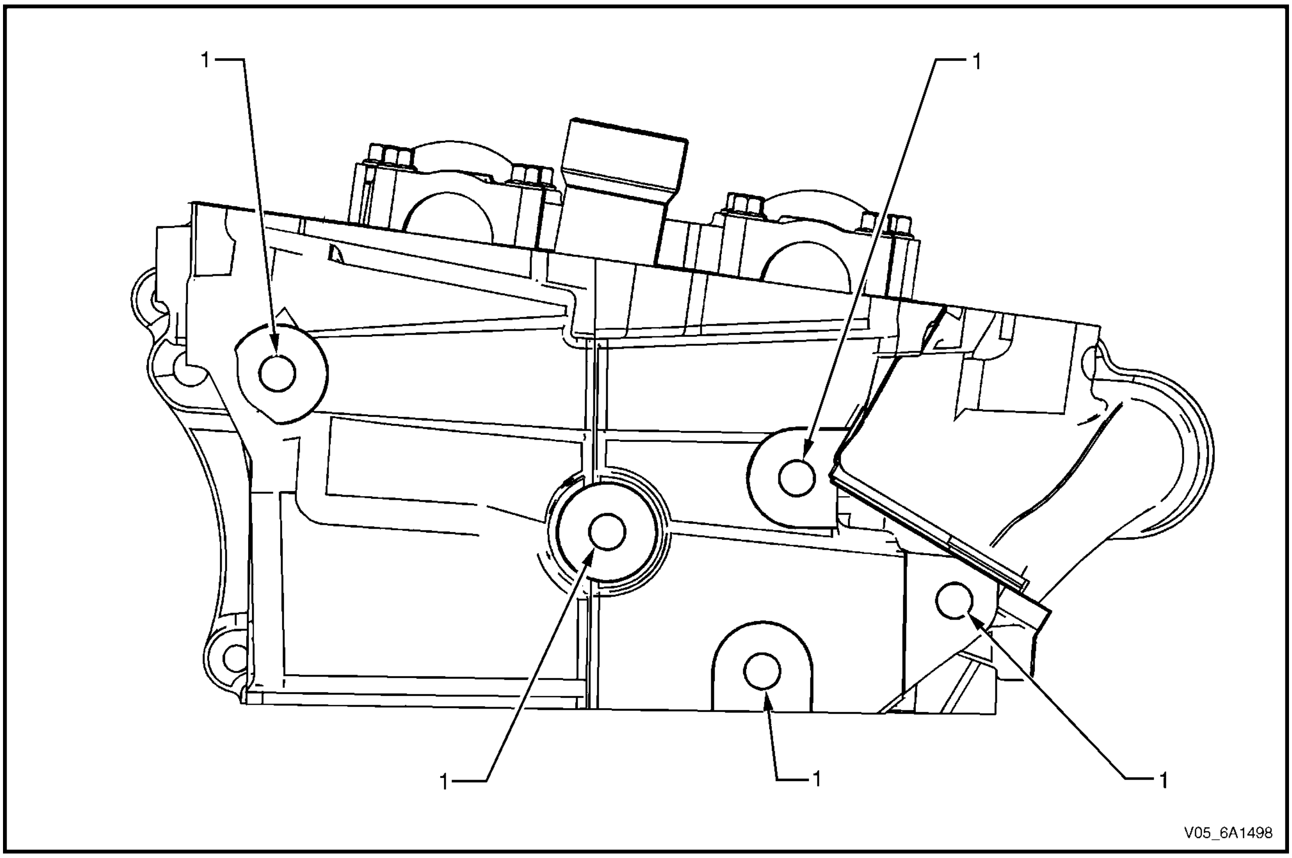


Figure 6A1 – 518

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	33.5	27

Right-hand Cylinder Head Camshaft Cover Face

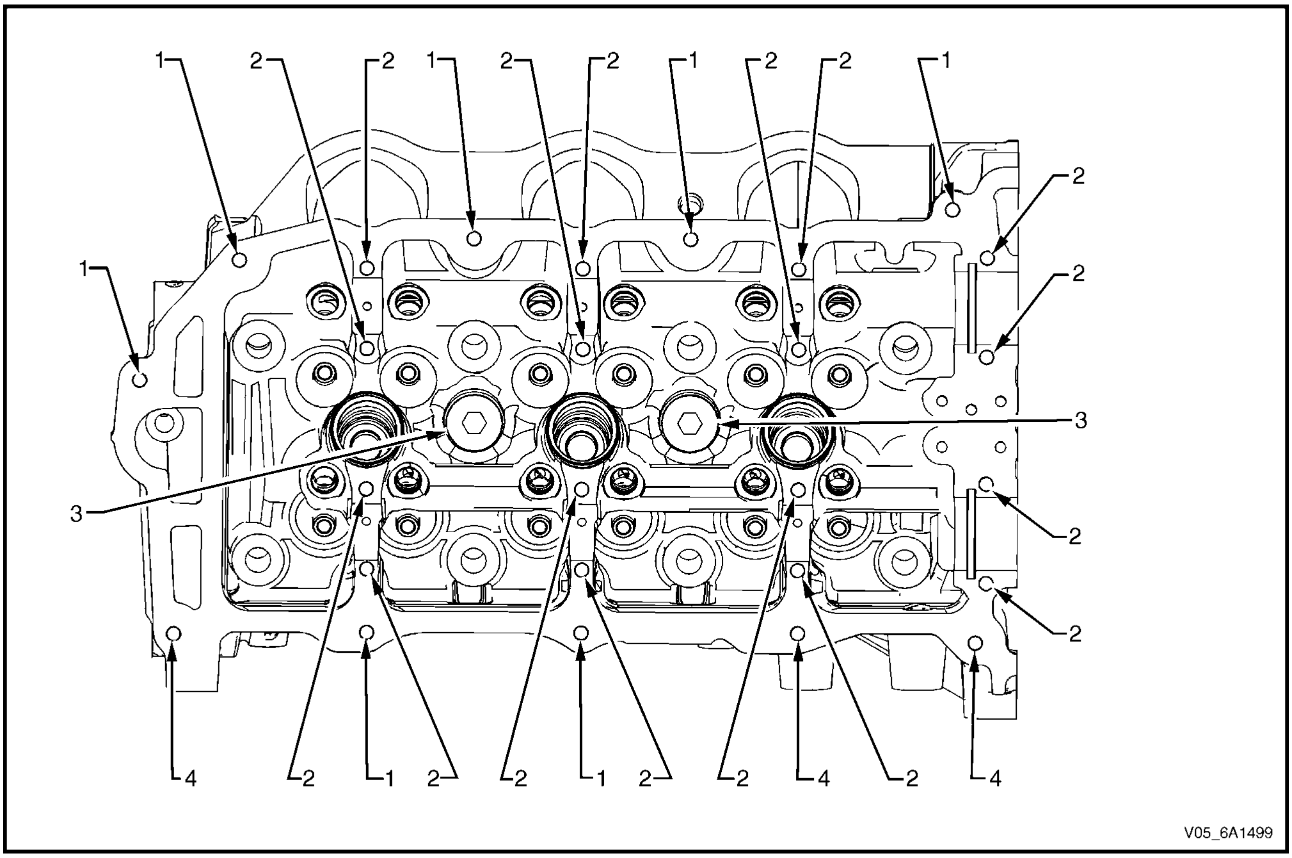


Figure 6A1 – 519

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M6 x 1.0	701	n/a	203	204	205	28.5	24.0
3	M20 x 1.5	715	716	717	718	719	25.0	17.0
4	M6 x 1.0	201	202	203	204	205	22.5	18.0

Right-hand Cylinder Head Front Face

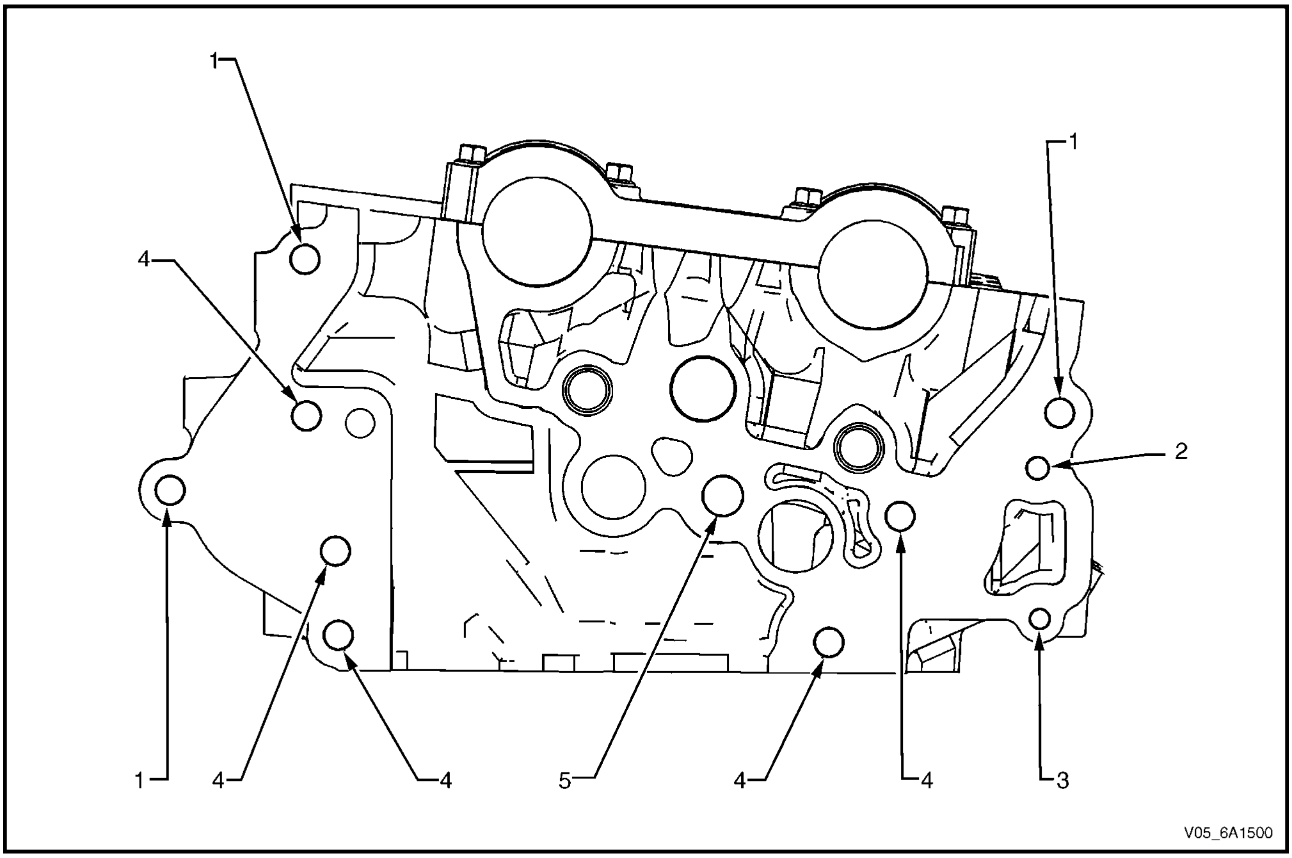


Figure 6A1 – 520

Legend

Hole		**Tool Number J 42385**					**Max. Depth in mm**	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	Thru	Thru
2	M6 x 1.0	201	202	203	204	205	22.5	18.0
3	M6 x 1.0	201	202	203	204	205	Thru	Thru
4	M8 x 1.25	206	207	208	209	210	28.5	23.0
5	M12 x 1.75	856	857	858	859	416	40.0	32.5

Right-hand Cylinder Head Intake Face

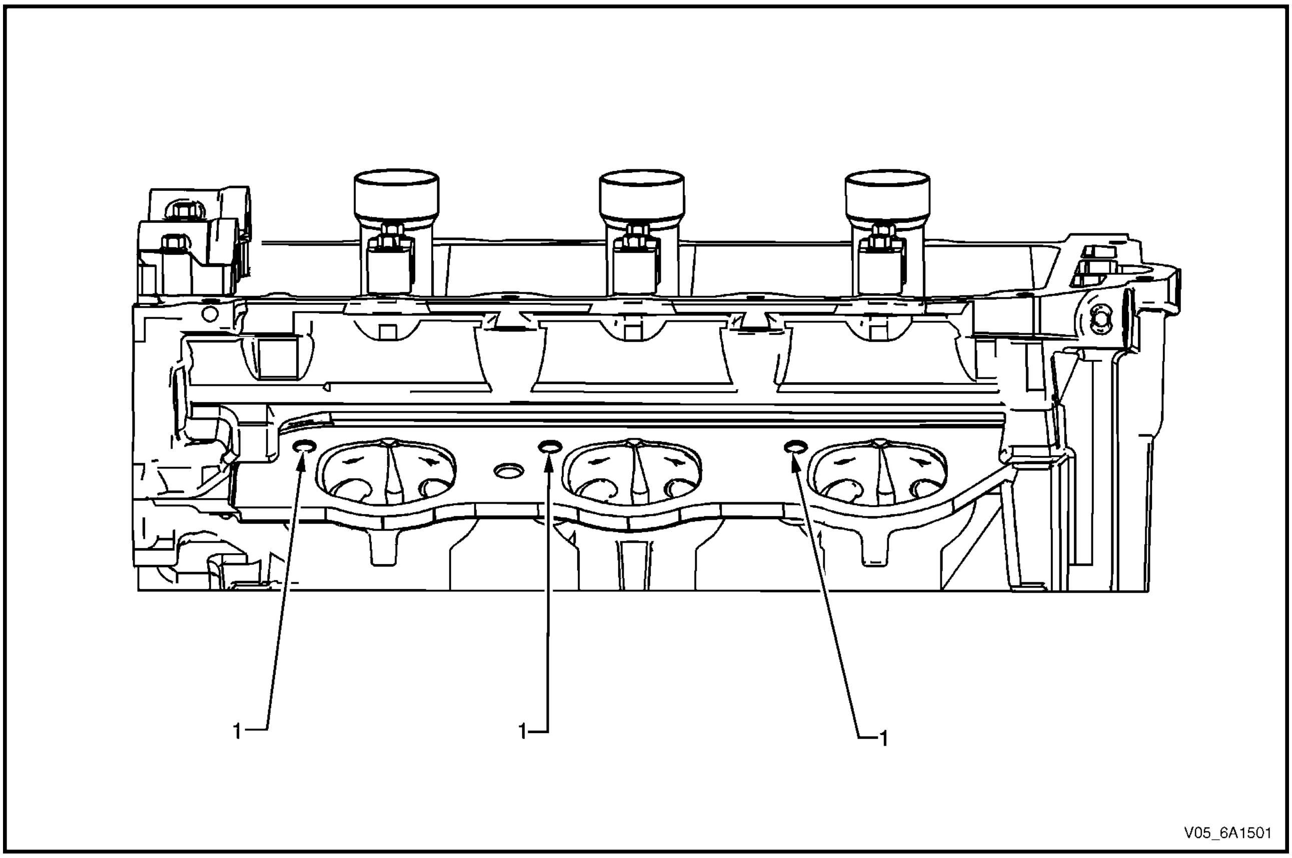


Figure 6A1 – 521

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0

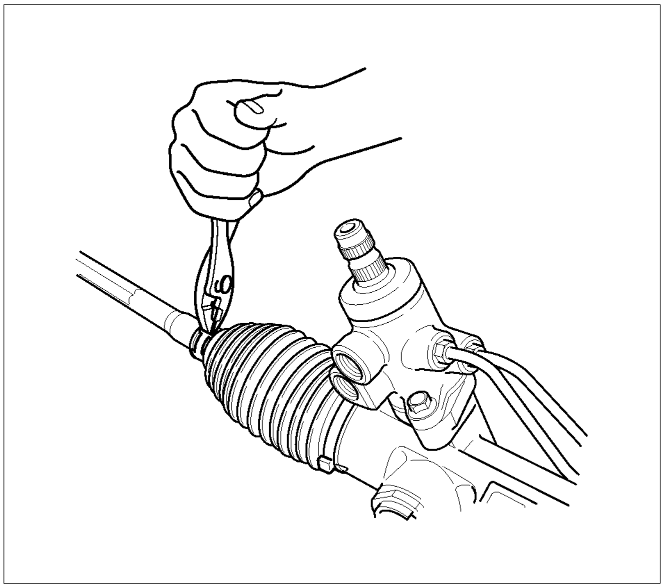
Disassembly

NOTE : The valve hosing is made of aluminum and care should be exercised when clamping in a vise, etc.

to prevent distortion or damage.

For the left side, follow the same steps as right side.

1. Loosen lock nut and remove tie-rod end.
2. Remove clip and band, then remove bellows.
   - Use a pair of pliers to open the clip. Slide the clip toward the tie-rod end.



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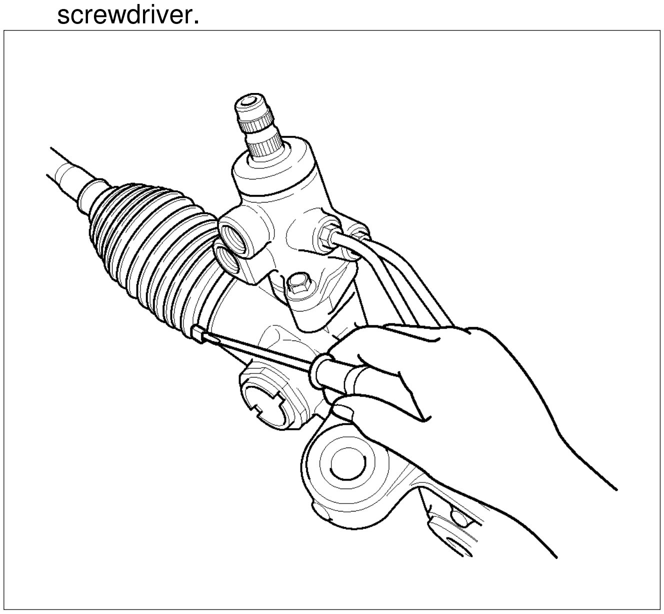
   - Remove band from the bellows by using screwdriver.



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CAUTION :

For 4×2 except High ride suspension models;

The band is not reusable. If removed, it must be replaced with a new one.

Take care not to damage the bellows during band removal.

For 4×4 and 4×2 High ride suspension models;

The band and bellows are not reusable. If removed, they must be replaced with a new one.

3. Remove tie-rod assembly.
   To remove, move the boot toward the tie-rod end, then remove tab washer.
4. Remove oil line, mounting rubber and dust cover.

Inspection and Repair

Make necessary correction or parts replacement if wear, damage, corrosion or any other abnormal condition are found during inspection.

Check the following parts.

1. Tie-rod end
2. Lock nut
3. Clip
4. Bellows
5. Band

Tie-Rod End

If looseness or play is found when checked by moving the end of ball joint at tie-rod end, replace tie-rod end.

Tie-Rod Assembly

If the resistance is insufficient or play is felt when checked by moving the ball on the tie-rod, replace the tie-rod assembly.

Rubber Parts

For 4×2 except High ride suspension models;

If wear or damage is found during inspection, replace with new ones.

For 4×4 and 4×2 High ride suspension models;

Even if wear or damage is not found after removal, replace with new ones.

Reassembly

1. Install mounting rubber and dust cover (If removed).
2. Install oil line.
   Torque: 12 N·m (1.2 kgf·m/104 lb·in)

Right-hand Cylinder Head Exhaust Face

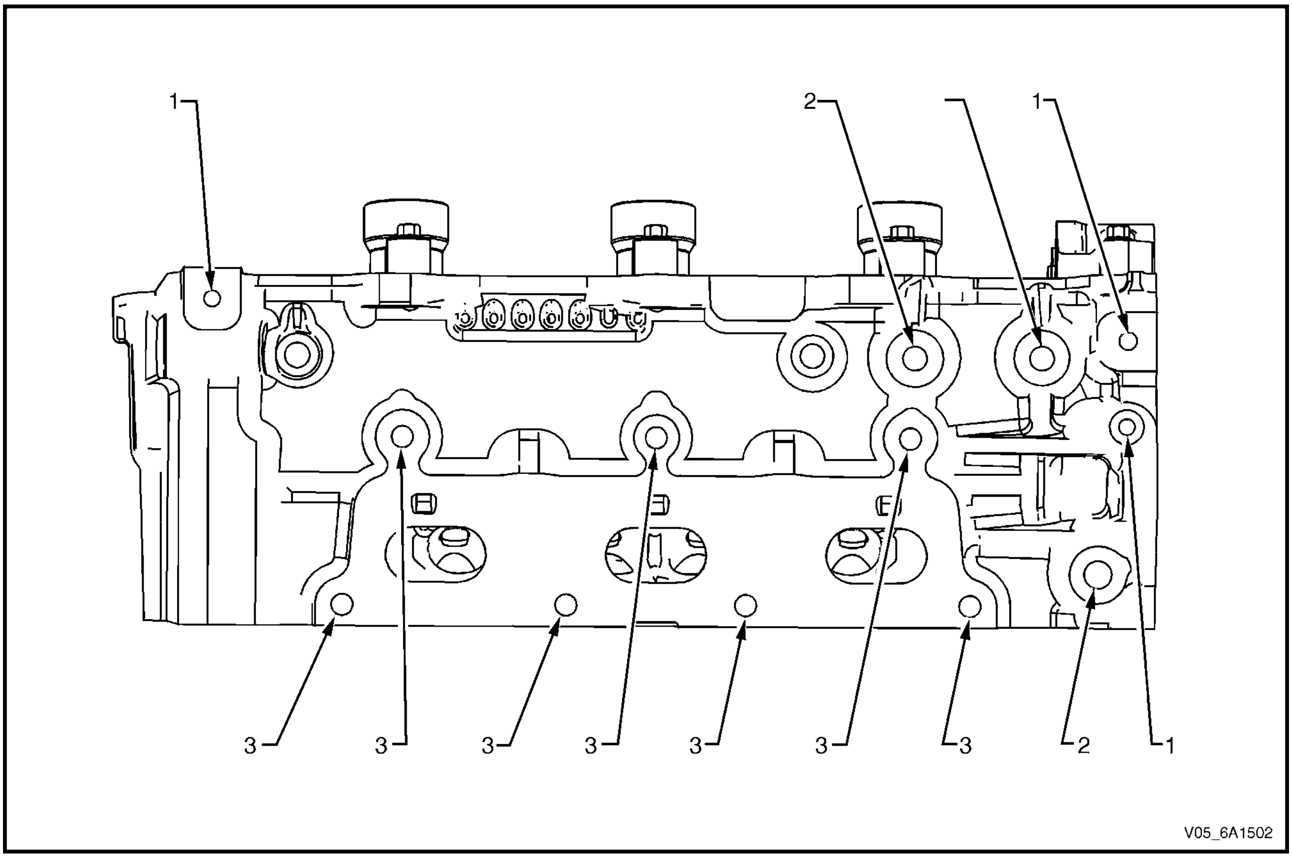


Figure 6A1 – 522

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M10 x 1.5	211	212	213	214	215	33.5	27.0
3	M8 x 1.25	206	207	208	209	210	28.5	23.0

Right-hand Cylinder Head Rear Face

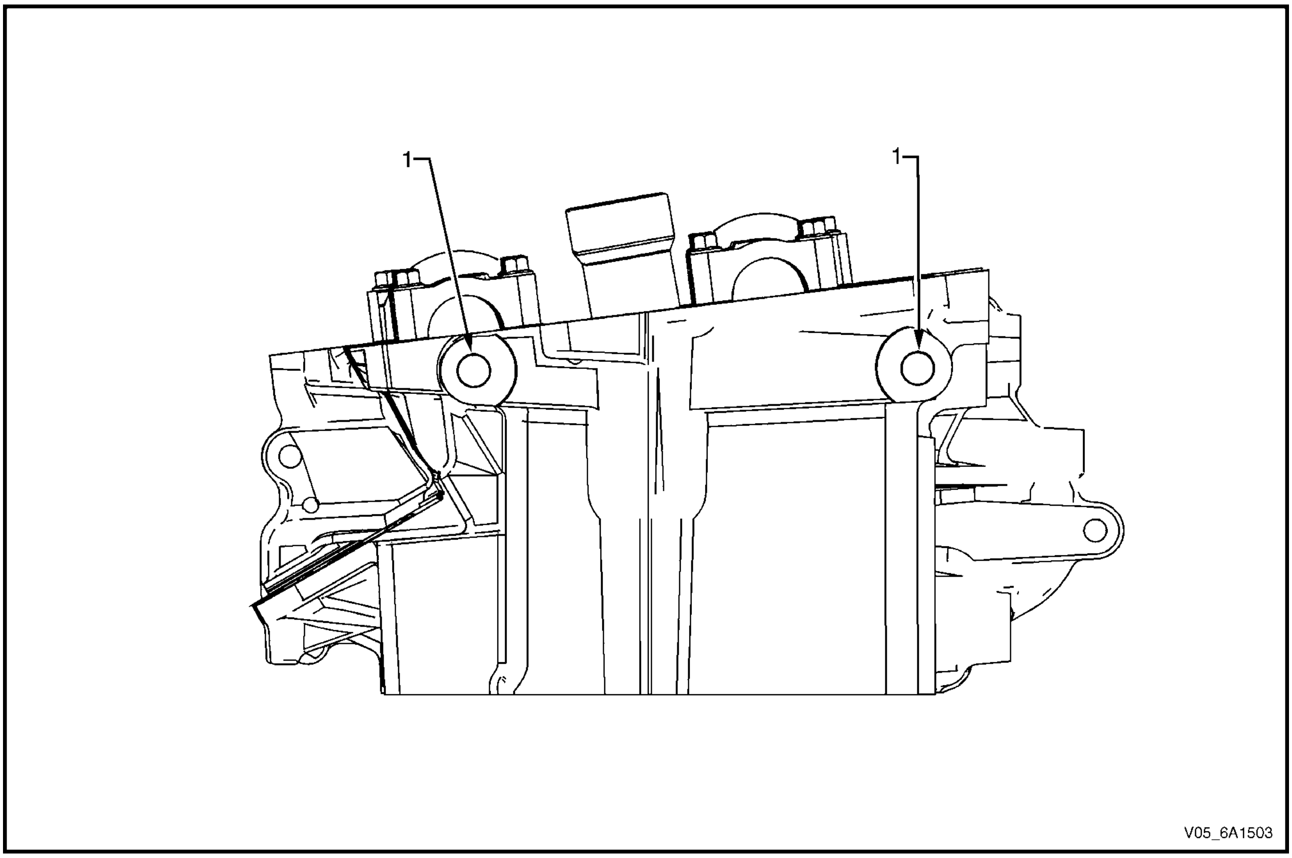


Figure 6A1 – 523

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	33.5	27

Engine Block Front

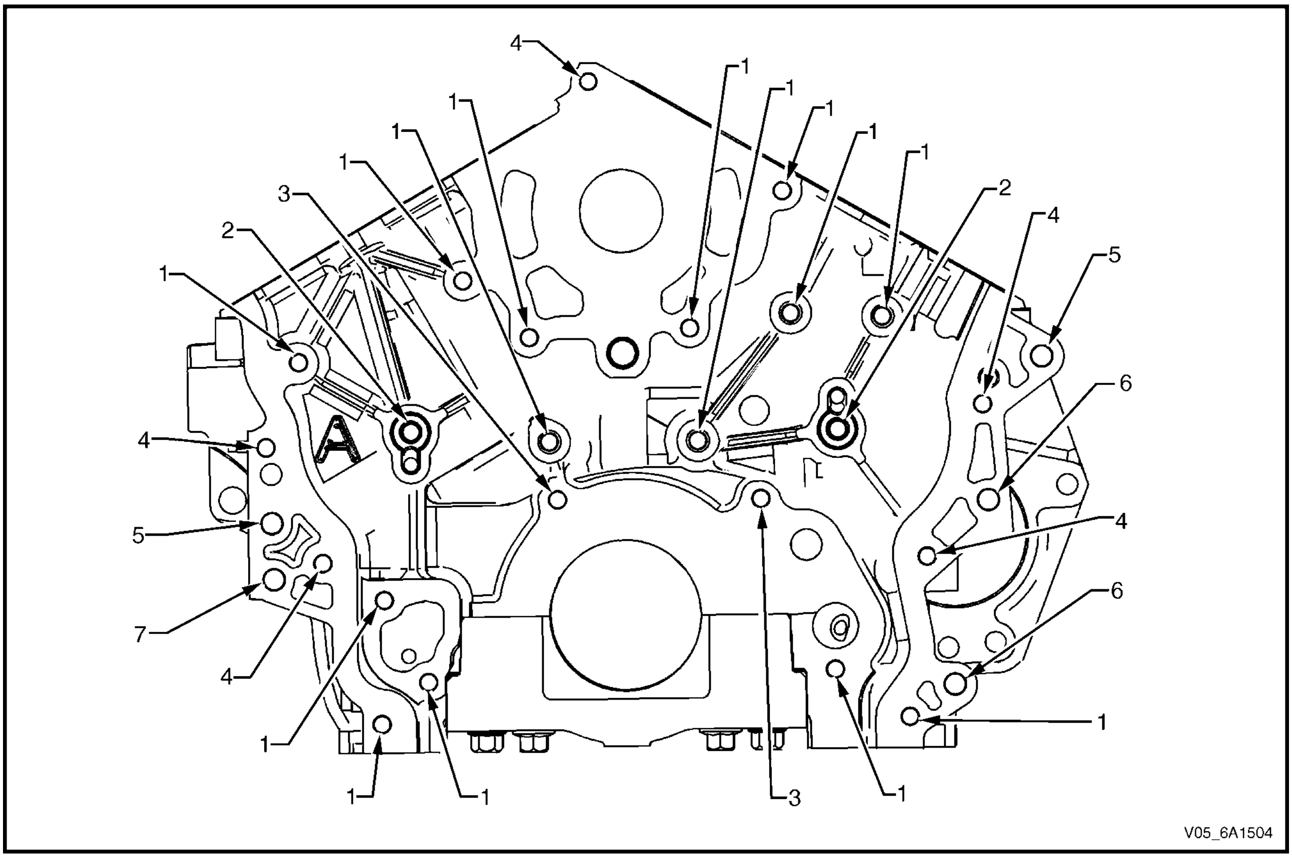


Figure 6A1 – 524

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M10 x 1.5	211	212	213	214	215	33.5	27.0
3	M8 x 1.25	207	207	208	209	210	Thru	23.0
4	M8 x 1.25	207	207	208	209	210	Thru	Thru
5	M10 x 1.5	212	212	213	214	215	28.0	28.0
6	M10 x 1.5	212	212	213	214	215	Thru	20.0
7	M10 x 1.5	212	212	213	214	215	Thru	28.8

Engine Block Left-hand Side

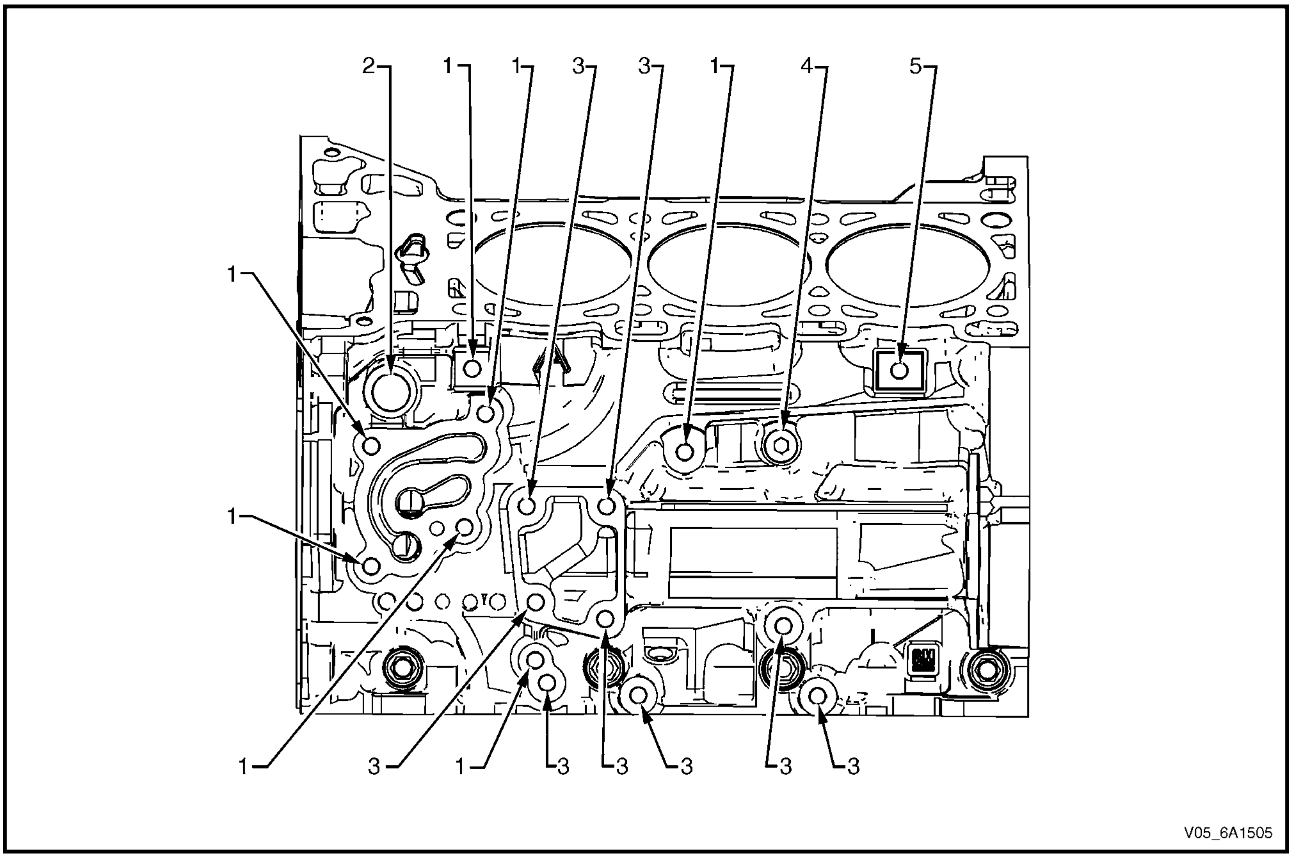


Figure 6A1 – 525

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M20 x 1.5	715	716	717	718	719	30.0	20.0
3	M10 x 1.5	211	212	213	215	205	33.5	27.0
4	M14 x 1.5	409	410	411	735	719	Thru	15.0
5	M8 x 1.25	206	207	208	415	415	16.5	11.0

Engine Block Right-hand Side

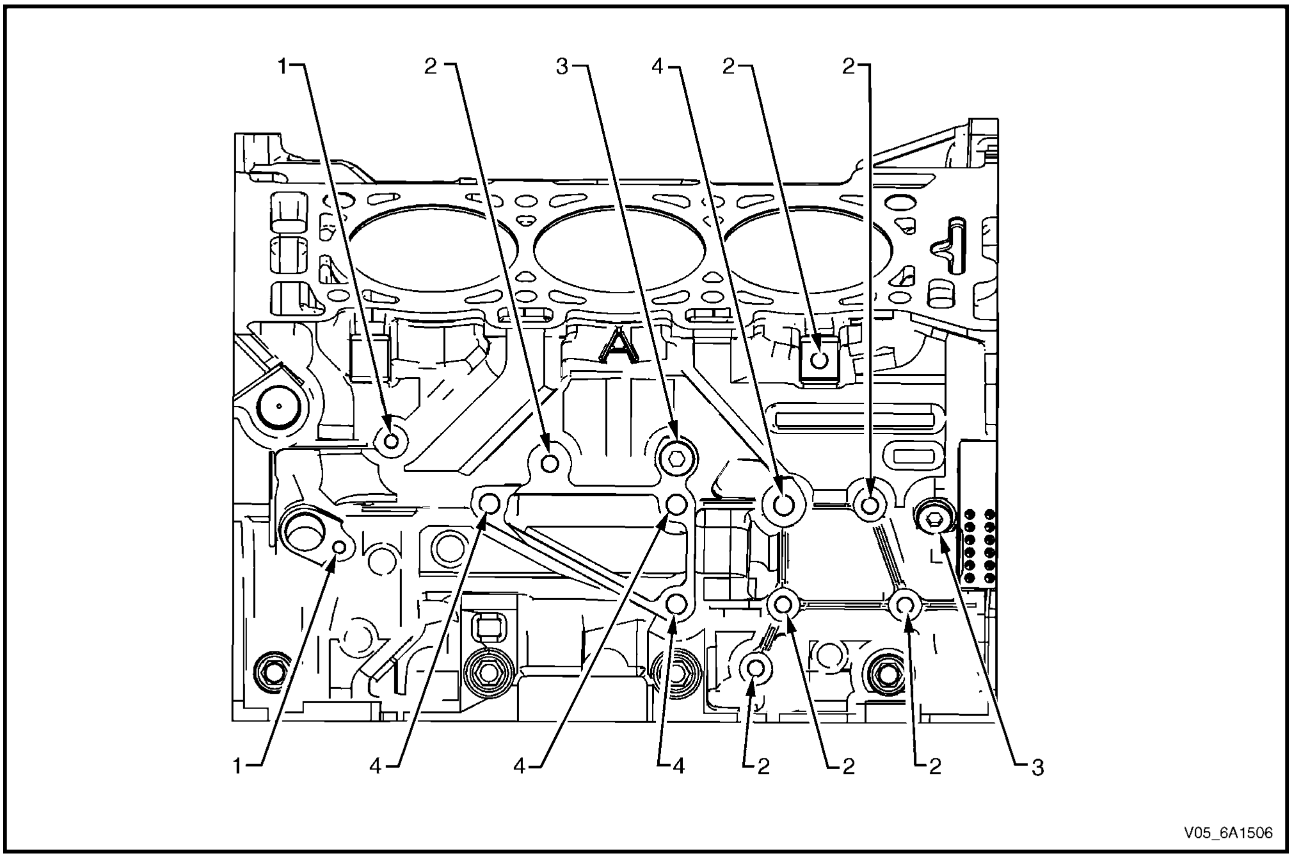


Figure 6A1 – 526

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M14 x 1.5	409	410	411	412	735	Thru	15.0
4	M10 x 1.5	211	212	213	214	215	33.5	27.0

Engine Block Rear

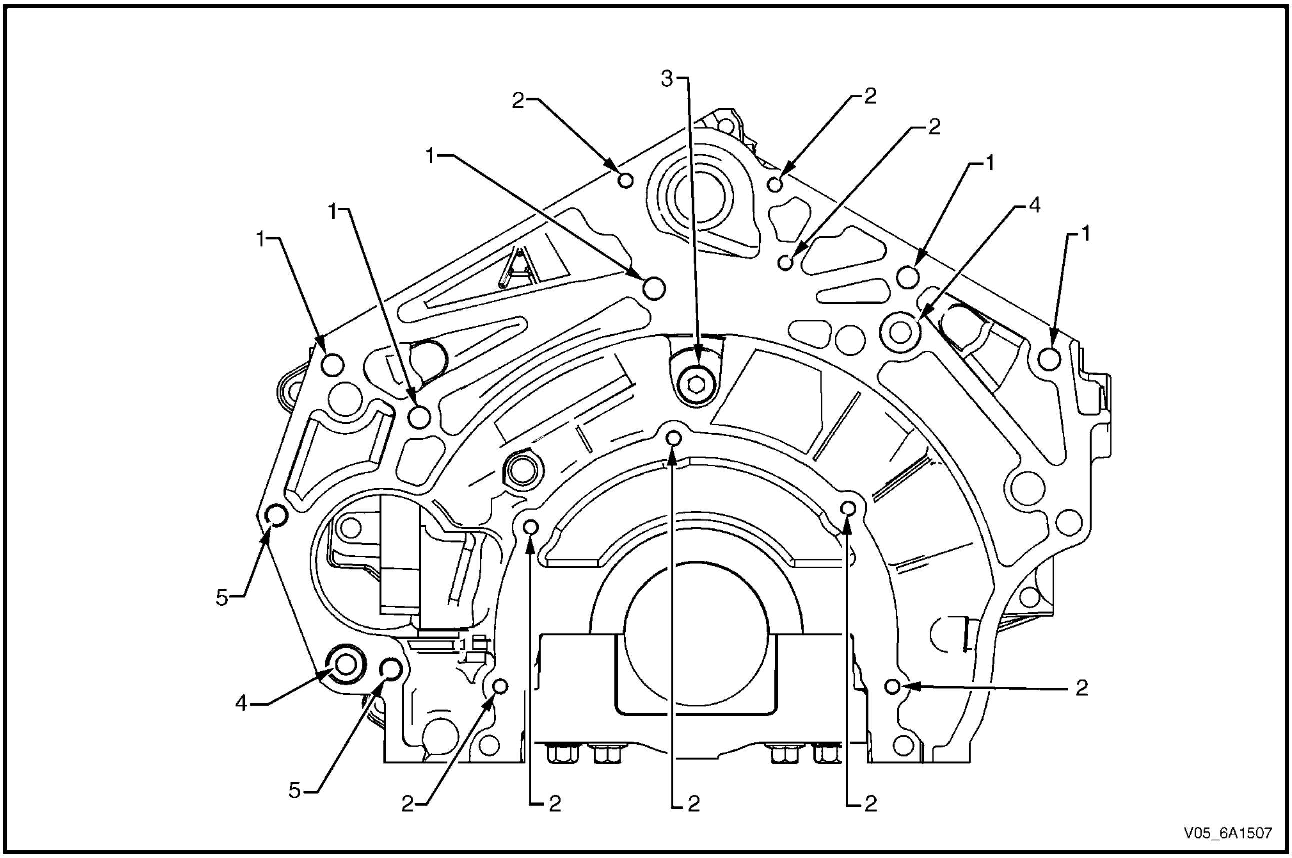


Figure 6A1 – 527

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	420	33.5	27.0
2	M6 x 1.0	201	202	203	204	205	22.5	18.0
3	M14 x 1.5	409	410	411	412	735	Thru	15.0
4	M10 x 1.5	211	212	213	214	216	39.5	33.0
5	M10 x 1.5	211	212	213	214	420	Thru	Thru

Engine Block Bottom

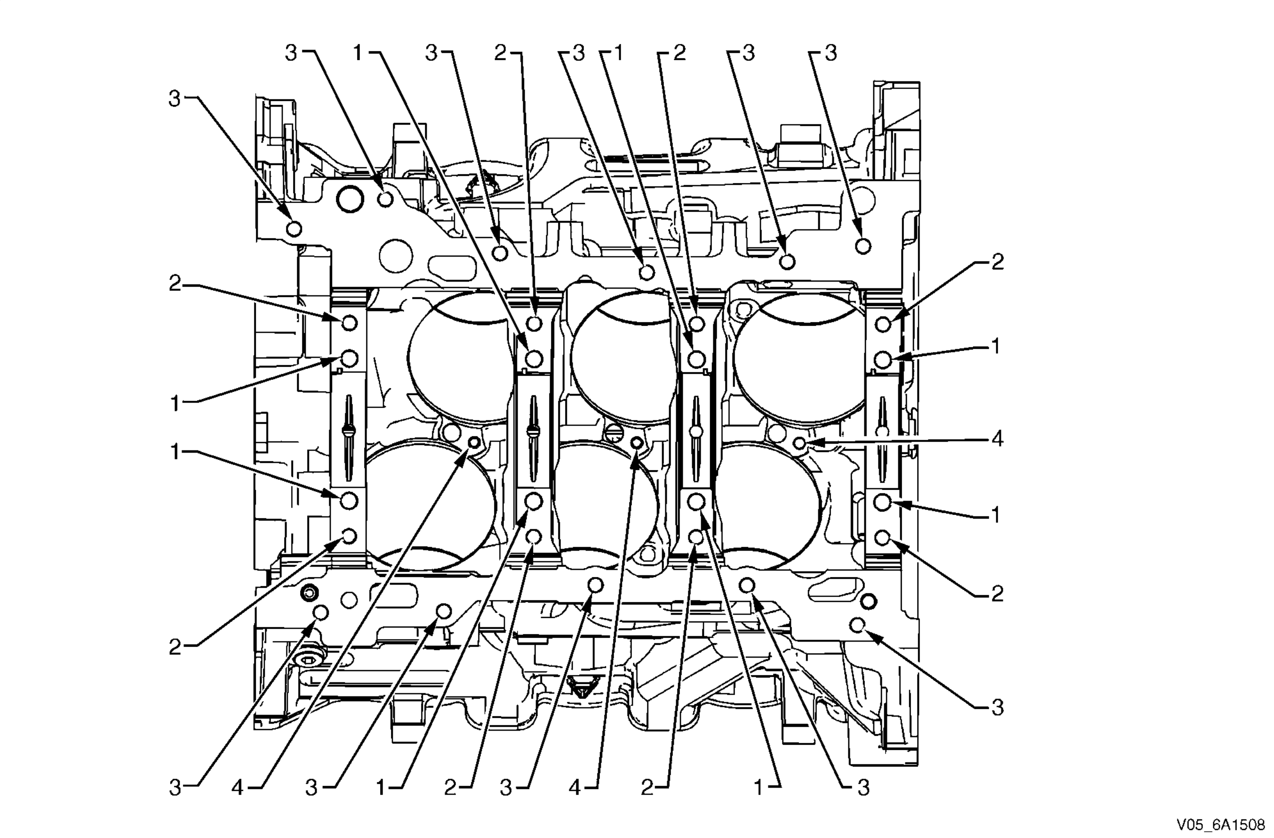


Figure 6A1 – 528

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 2.0	720	n/a	721	722	104	56.0	49.0
2	M8 x 1.25	702	n/a	703	704	620	46.0	40.5
3	M8 x 1.25	206	207	208	209	210	28.5	23.0
4	M6 x 1.0	201	202	203	204	205	Thru	Thru

Engine Block Left-hand Deck Face

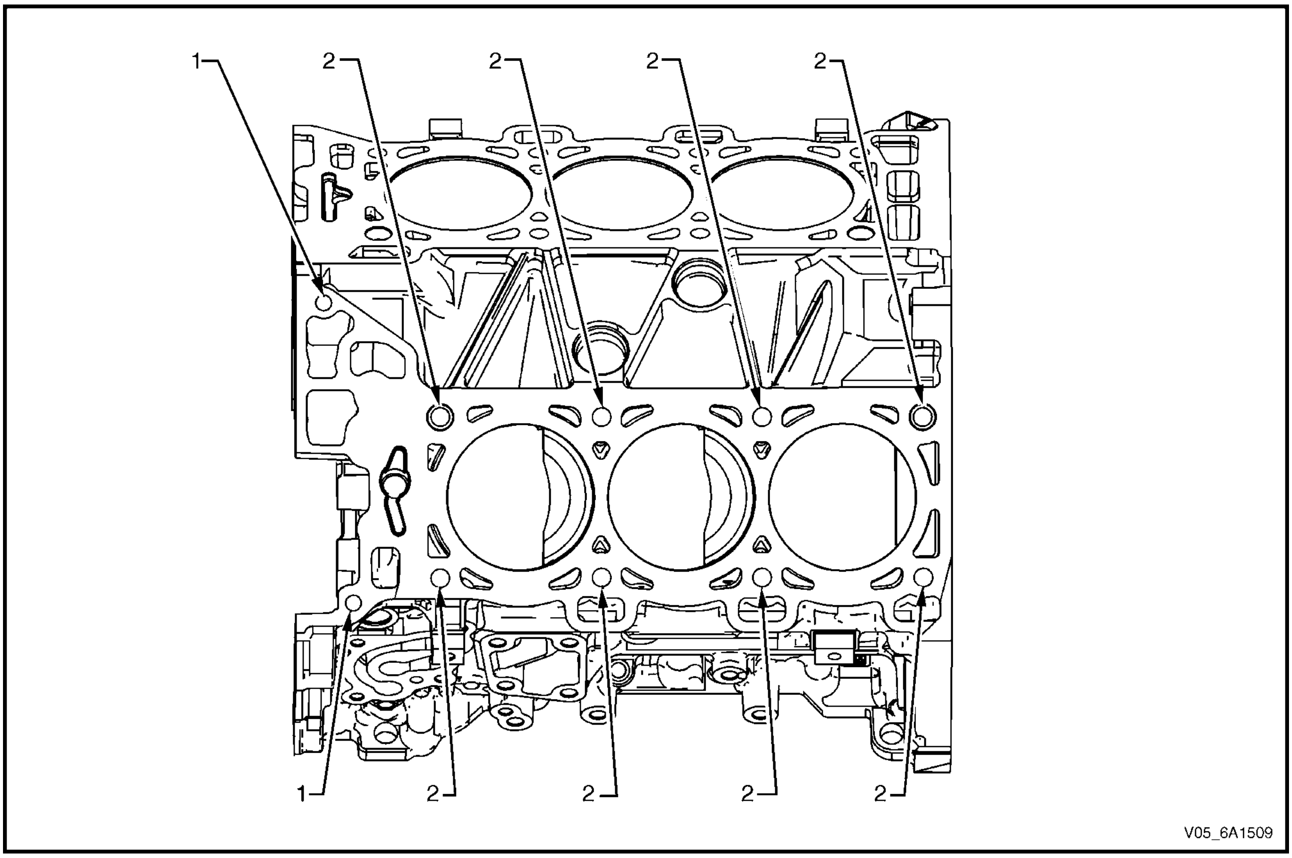


Figure 6A1 – 529

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M11 x 2.0	723	n/a	724	725	108	102.5	94.0

Engine Block Right-hand Deck Face

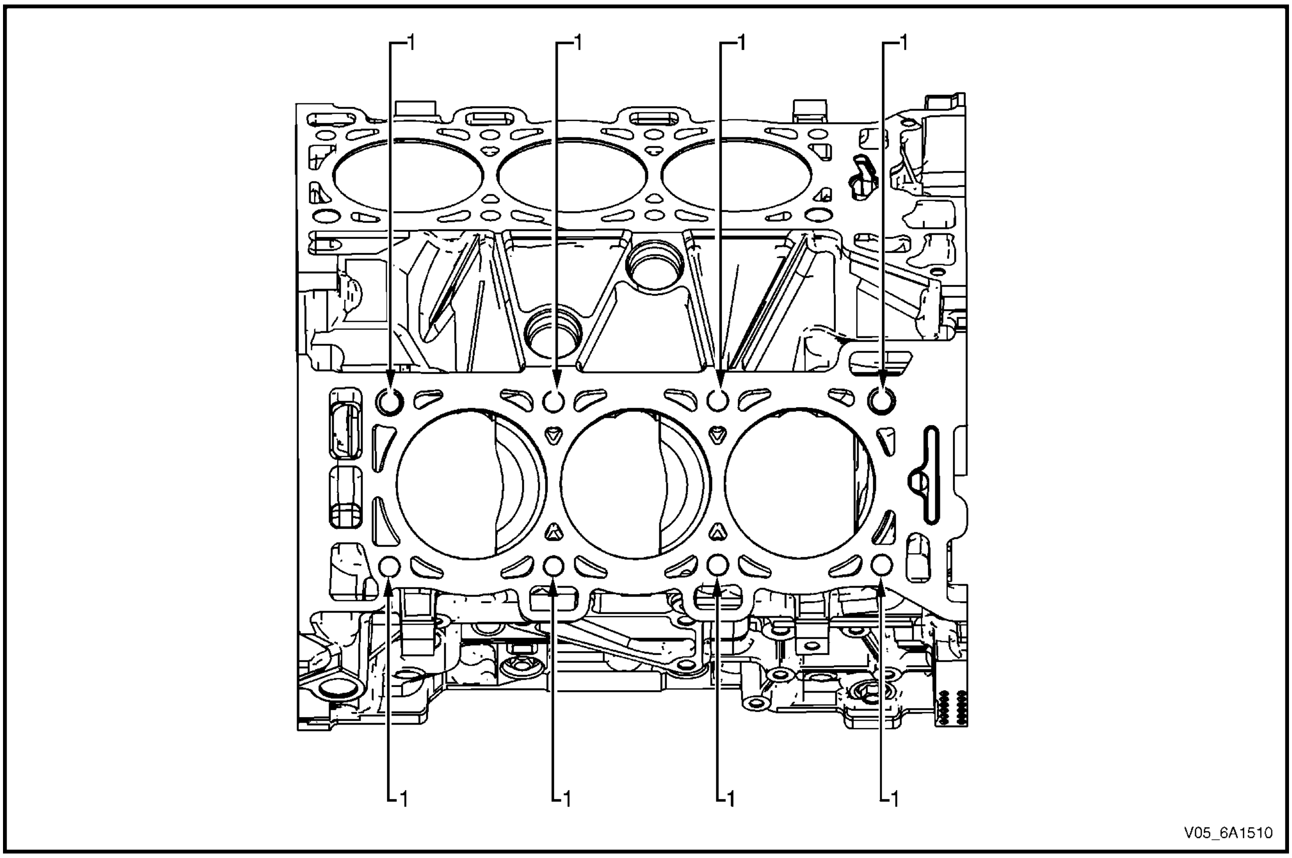


Figure 6A1 – 530

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M11 x 2.0	723	n/a	724	725	108	102.5	94.0

Engine Front Cover

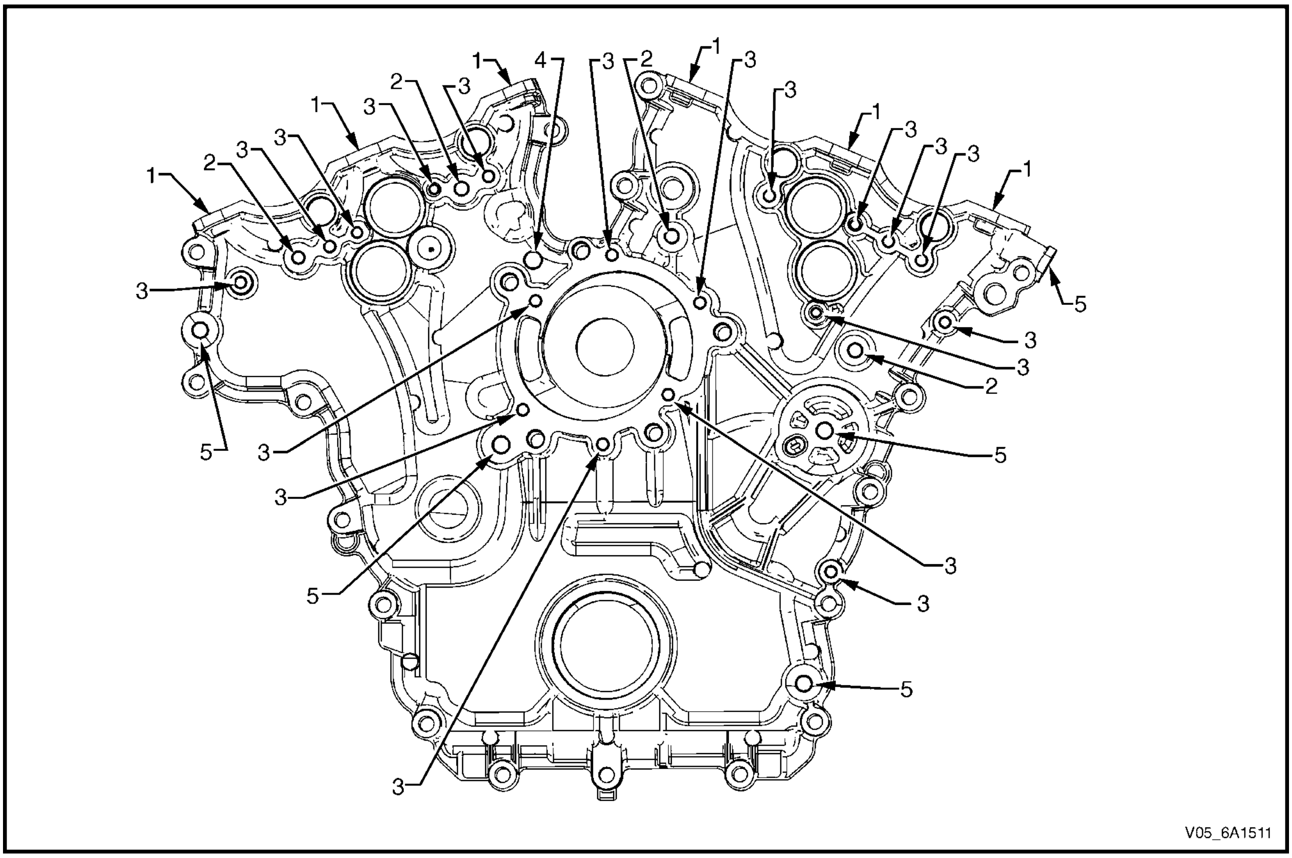


Figure 6A1 – 531

Legend

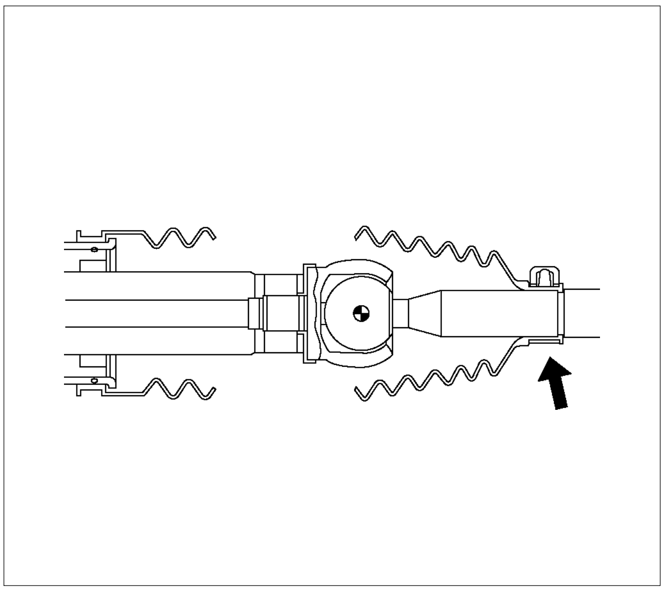
Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M6 x 1.0	201	202	203	204	205	21.5	18.0
4	M10 x 1.5	211	212	213	214	215	Thru	Thru
5	M10 x 1.5	211	212	213	214	420	32.5	27.0

3. Install tie-rod assembly with tab washer, then tighten to specified torque.
   For 4×2 except High ride suspension models;
   Torque: 83 N·m (8.5 kgf·m/61 lb·ft)
   For 4×4 and 4×2 High ride suspension models;
   Torque: 108 N·m (11.0 kgf·m/80 lb·ft)
   After tightening, bend tab washer against width across flat of inner ball joint.
4. Apply grease to the tie-rod groove. Install bellows on housing assembly.

CAUTION :

Make sure that there are no bulges or dents in the bellows.

After installation, confirm the small end of the bellows is inserted into the tie-rod groove.



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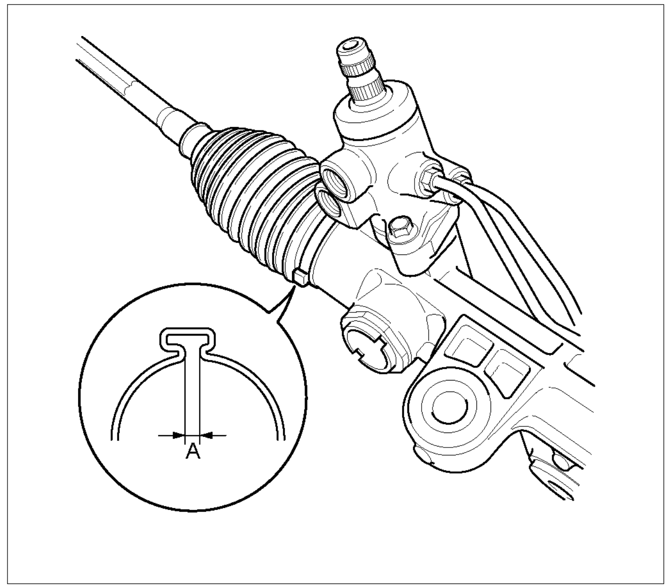
5. Caulk the band using clamp pliers 5-8840-2745-0.
   For 4×2 except High ride suspension models;
   Caulk gap(A): less than 2.0mm(0.08in).
   For 4×4 and 4×2 High ride suspension models;
   Caulk gap(A): 2.6 – 3.3mm(0.10 – 0.13in).

CAUTION :

Be sure to use a new band.



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6. Install clip.
7. Install tie-rod end and tighten lock nut.

Torque:

98 N·m (10 kgf·m/72 lb·ft)

Main Data and Specifications

General Specifications

		2WD		4WD
Steering unit	Power steering	Without	With	
	Type	Rack and pinion		
	Rack stroke mm (in)	138 (5.43)	138 (5.43)	152 (5.98)
	Lock to lock	4.84	3.38	3.23

Upper Intake Manifold Top

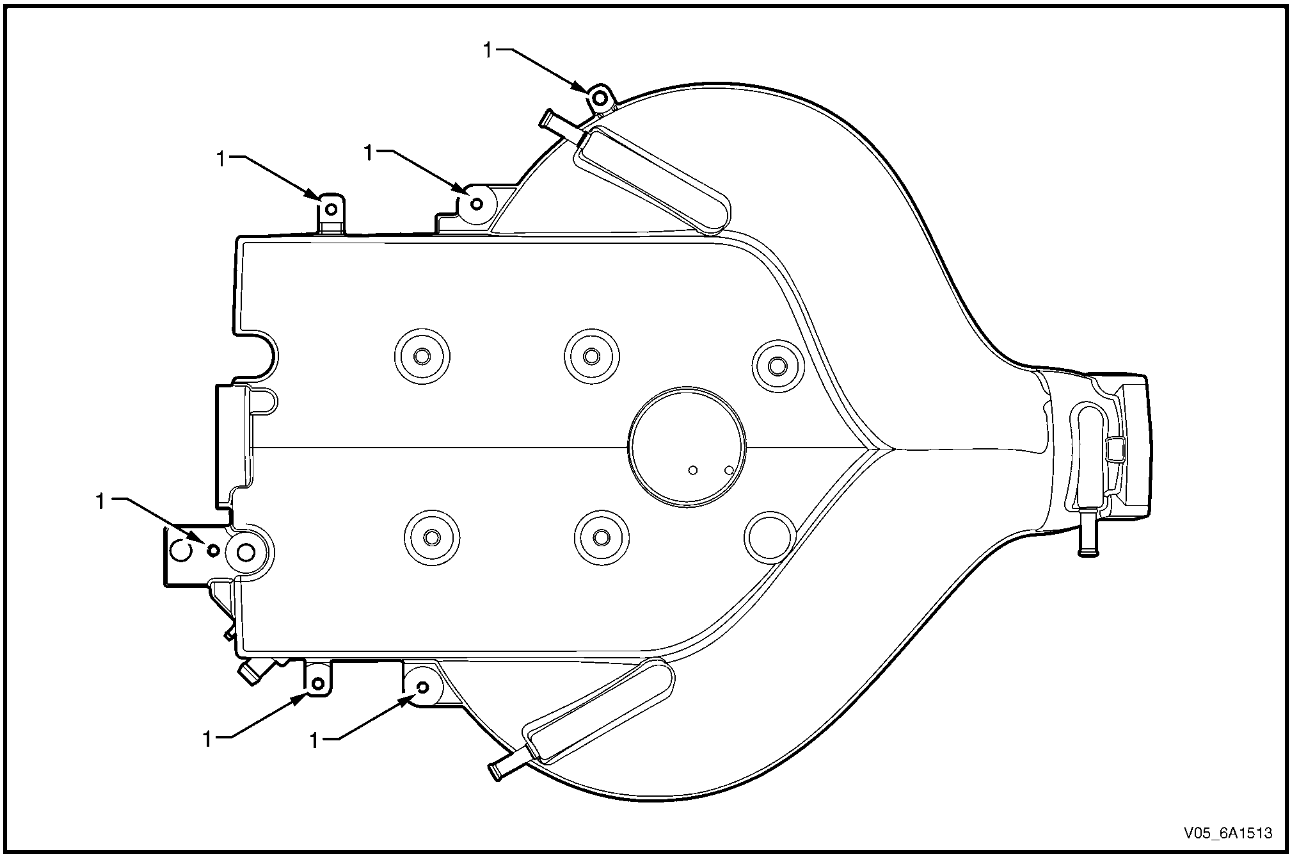


Figure 6A1 – 532

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Upper Intake Manifold Front

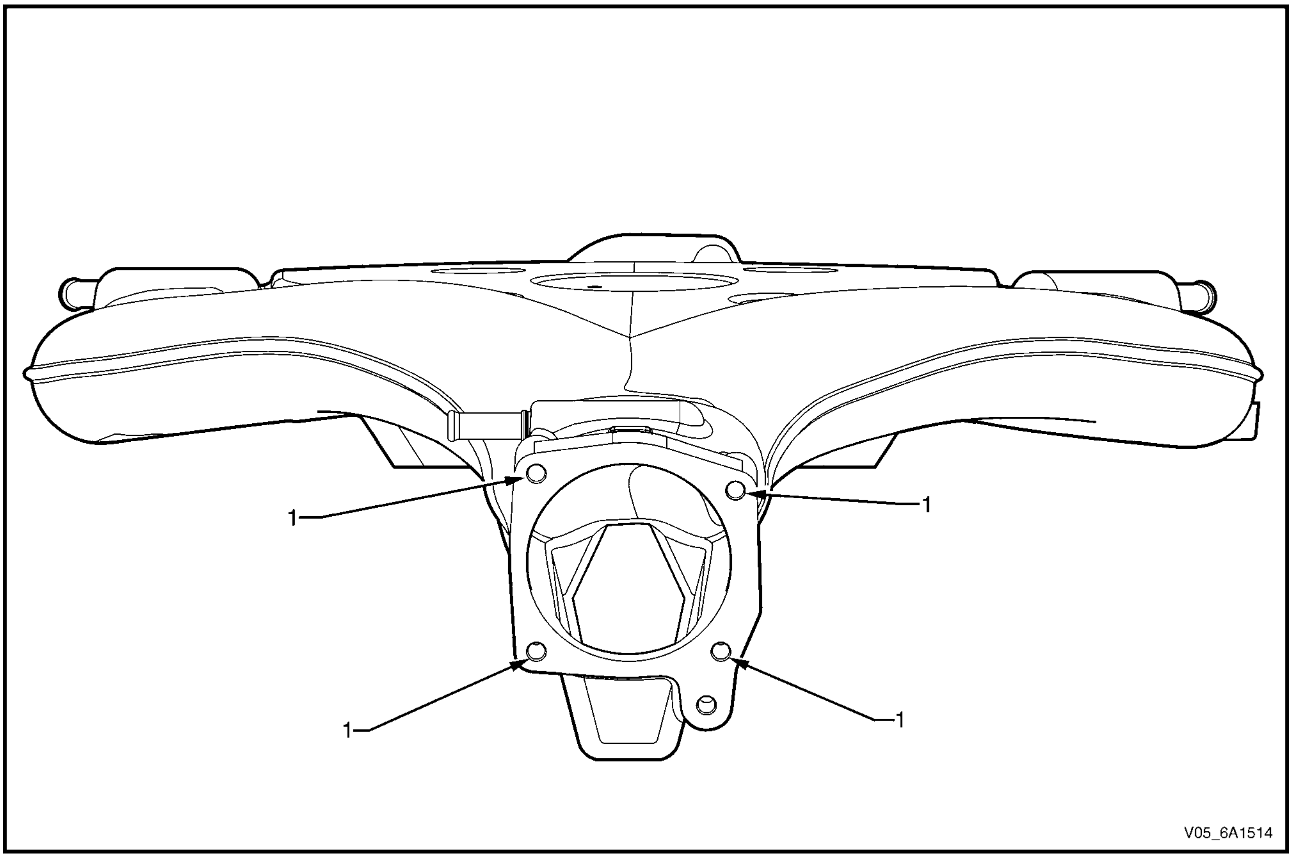


Figure 6A1 – 533

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Upper Intake Manifold Rear

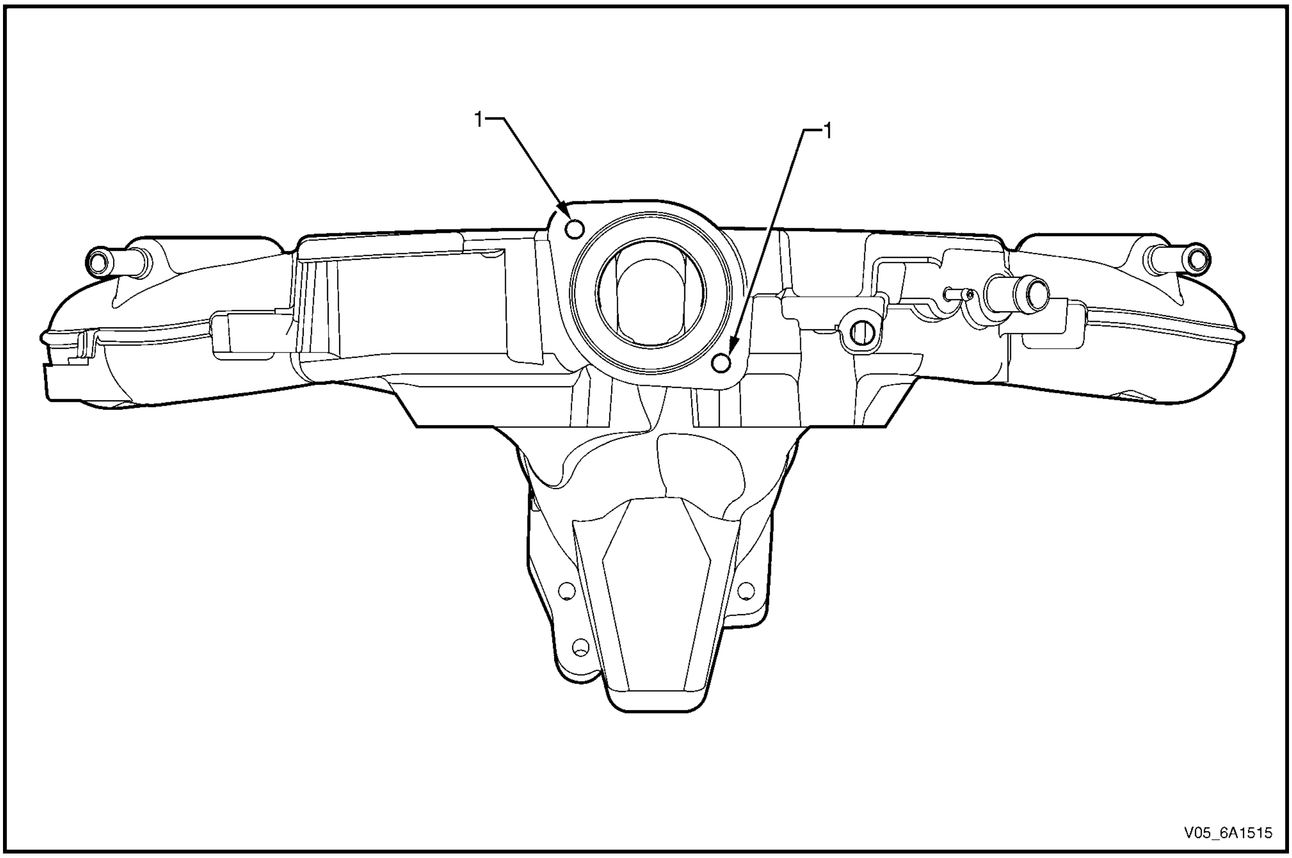


Figure 6A1 – 534

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	Thread Size	Drill	Counter-bore	Tap	Driver	Insert	Drill	Tap
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Lower Intake Manifold Top

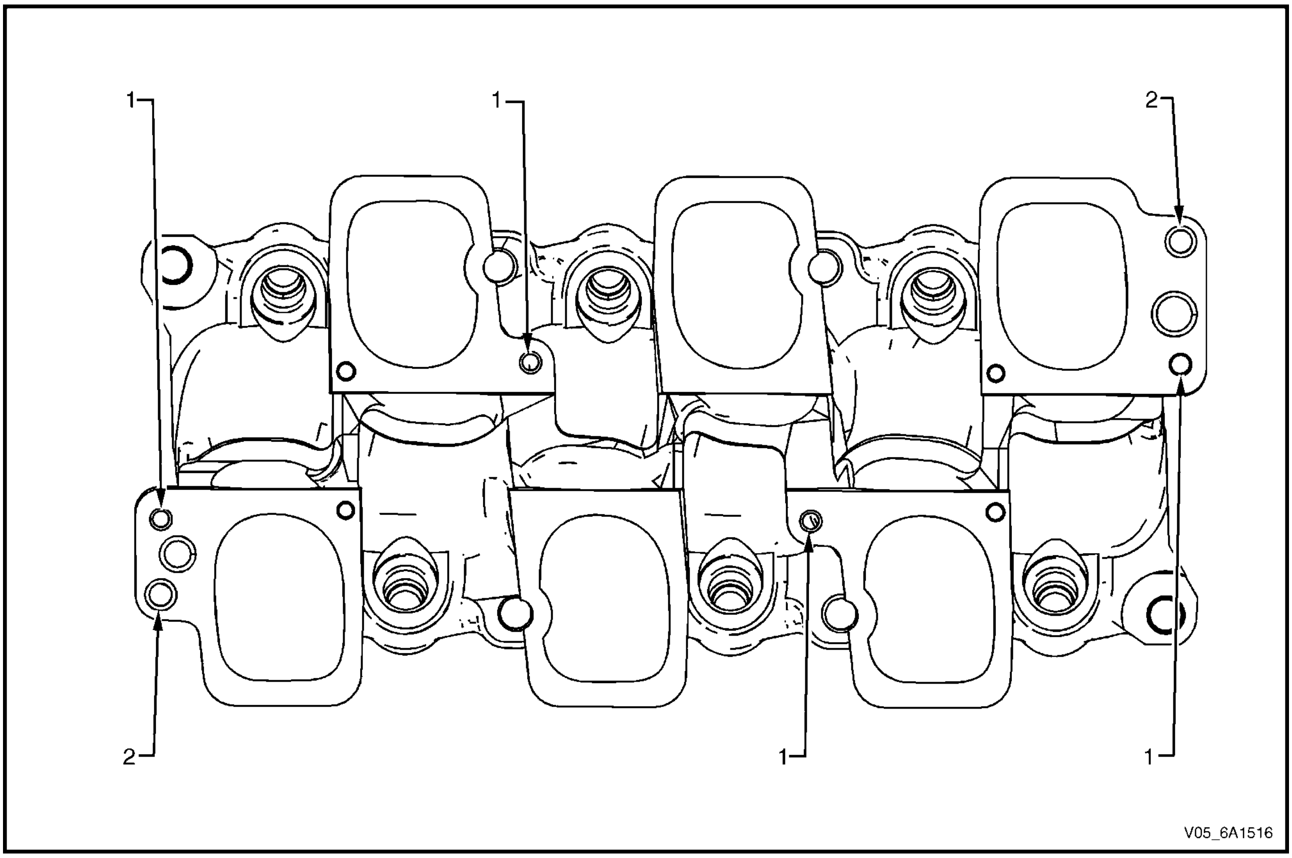


Figure 6A1 – 535

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M8 x 1.25	206	207	208	209	210	Thru	Thru

Oil Pan Front

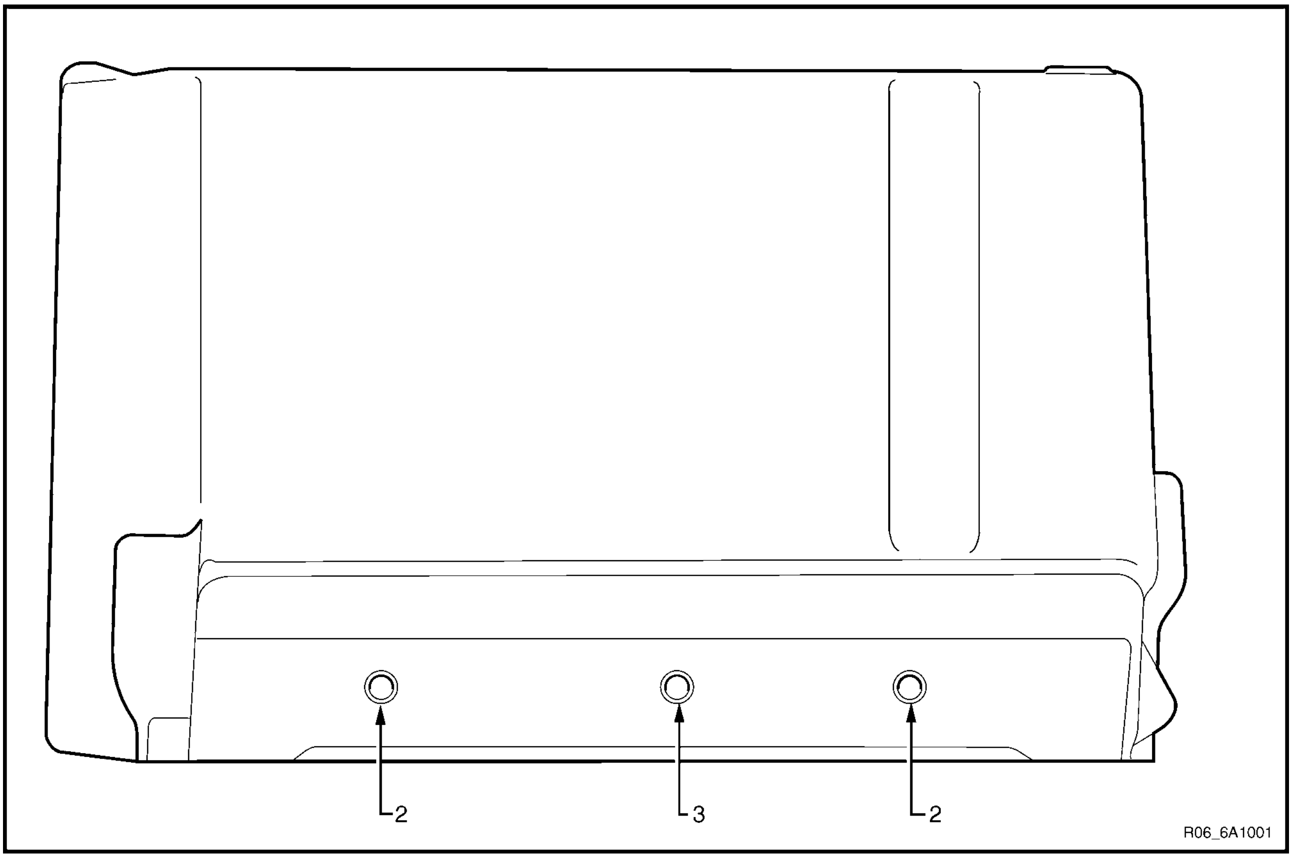


Figure 6A1 – 536

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M8 x 1.25	610	n/a	208	209	620	37.5	32.0

Oil Pan Rear

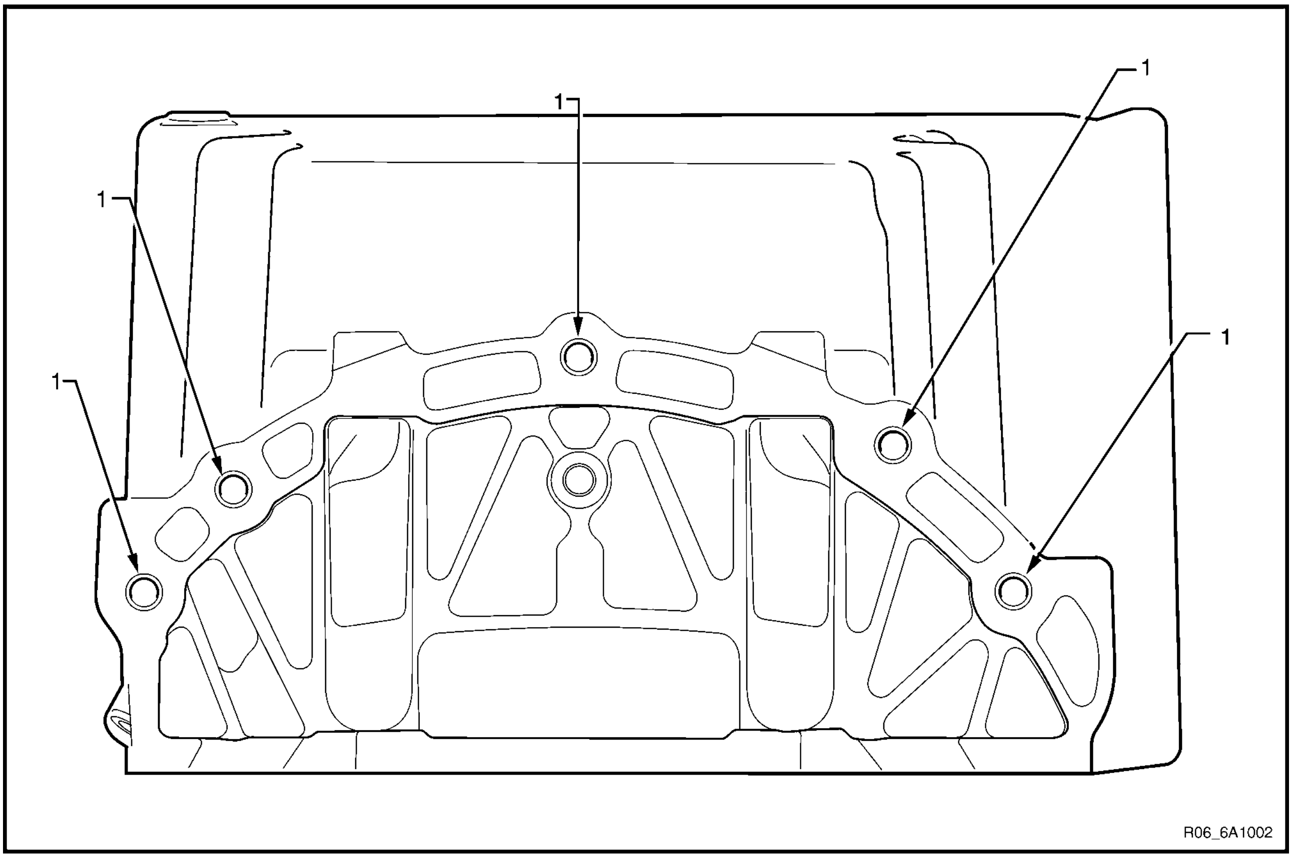


Figure 6A1 – 537

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	Thru	Thru

Oil Pan Bottom

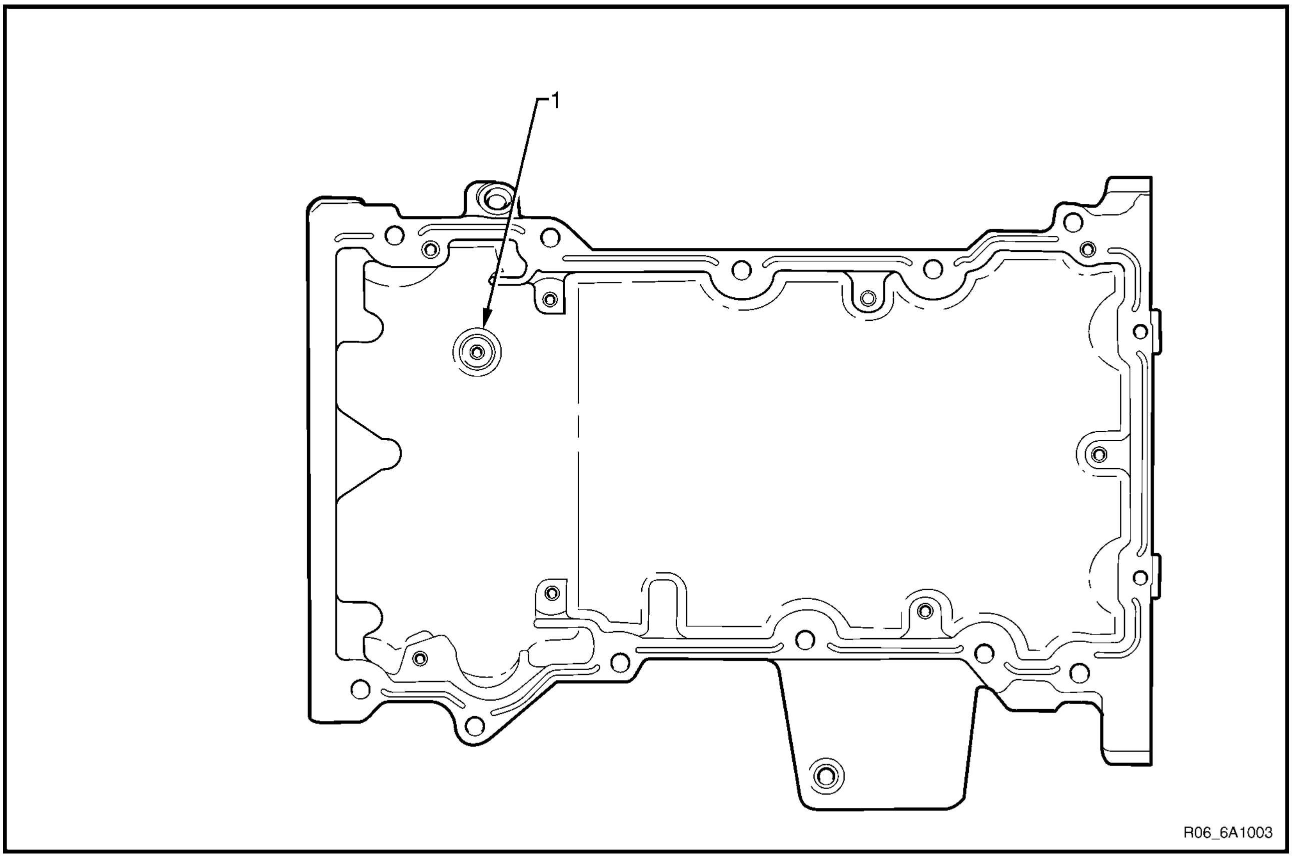


Figure 6A1 – 538

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	701	n/a	203	204	205	22.5	18.0

5 Specifications

General

Engine Type	V6
Bank Angle	60°
Displacement	3.6 litre (3,565 cm3)
Bore	94 mm
Stroke	85.6 mm
Compression Ratio	10.2:1
Cranking Speed at 40°C	80 r.p.m.
Spark Plug Gap	1.1 mm
Firing Order	1-2-3-4-5-6

Cylinder Block

Cylinder Bore Diameter	93.992 – 94.008 mm
Cylinder Out-of-Round – Production Maximum	0.013 mm
Crankshaft Main bearing bore Diameter	72.867 – 72.881 mm
Cylinder Head Deck Surface Flatness	0.05 mm

Crankshaft

Connecting Rod Journal Diameter	55.992 – 56.008 mm
Connecting Rod Journal Out-of-Round	0.005 mm
Connecting Rod Journal Taper	0.005 mm
Connecting Rod Journal Width (Production)	22.000 mm
Connecting Rod Journal Width (Service limit)	21.920 – 22.080 mm
Crankshaft End Play	0.100 – 0.330 mm
Crankshaft Main Bearing Clearance	0.010 – 0.060 mm
Crankshaft Main Journal Diameter	67.992 – 68.008 mm
Crankshaft Main Journal Out-of-Round	0.005 mm
Crankshaft Main Journal Taper	0.005 mm
Crankshaft Main Journal Width, #2, 4 (Production)	24 mm
Crankshaft Main Journal Width, #2, 4 (Service)	23.900 – 24.100 mm
Crankshaft Main Journal Width, #3 (Production)	24.400 mm
Crankshaft Main Journal Width, #3 (Service)	24.360 – 24.440 mm
Crankshaft Main Journal Thrust Wall Runout	0.000 – 0.040 mm
Crankshaft Main Journal Thrust Wall Square	0.000 – 0.010 mm
Crankshaft Rear Flange Runout	0.025 mm
Crankshaft Reluctor Ring Runout - Maximum	1.500 mm
Crankshaft Thrust Bearing Clearance	0.076 – 0.305 mm
Crankshaft Thrust Surface Runout	0.040 mm
Crankshaft Thrust Surface – Height Diameter	95.000 mm

Connecting Rod

Connecting Rod Length - Bore Centre-to-Centre	150.400 mm
Connecting Rod Bore Diameter - Bearing End	59.620 – 59.636 mm
Connecting Rod Bore Diameter - Pin End	24.007 – 24.021 mm
Connecting Rod Width	21.775 mm
Connecting Rod Side Clearance	0.095 – 0.355 mm
Connecting Rod Bearing Clearance	0.010 – 0.070 mm

Piston

Piston Diameter	93.956 – 93.974 mm
Piston Pin Bore Diameter	24.005 – 24.009 mm
Piston Ring Groove Width - First (Top) Compression Ring	1.220 – 1.240 mm
Piston Ring Groove Width - Second Compression Ring	1.510 – 1.530 mm

Piston Ring Groove Width - Oil Control Ring ....2.510 – 2.530 mm

Piston to Bore Clearance ....0.026 – 0.052 mm

Piston Pin

Piston Pin Diameter ....23.997 - 24.000 mm

Piston Pin Length....................60.600 – 61.100 mm

Piston Pin Clearance to Connecting Rod Bore ....0.007 – 0.024mm

Piston Pin Clearance to Piston Pin Bore....................0.004 – 0.012mm

Piston Rings

Piston Ring to Groove Clearance:

- First (Top) Compression Ring....................0.030 – 0.065 mm
- Second Compression Ring ....0.015 – 0.060 mm
- Oil Control Ring ....0.030 – 0.170 mm

Piston Ring End Gap:

- First (Top) Compression Ring....................0.150 – 0.300 mm
- Second Compression Ring ....0.280 – 0.480 mm
- Oil Control Ring ....0.150 – 0.600 mm

Cylinder Head

Combustion Chamber Volume.................... 53.600 cc

Valve Guide Bore Diameter – Intake ....6.000 – 6.020 mm

Valve Guide Bore Diameter – Exhaust ....6.000 – 6.020 mm

Valve Guide Installed Height....................14.050 – 14.550 mm

Stationary Hydraulic Lash Adjuster (SHLA) Bore Diameter ....12.008 – 12.030 mm

Valve Seat Angle – Seating Surface.................... 45°

Valve Seat Angle – Relief Surface.................... 30°

Valve Seat Angle – Undercut Surface .... 60°

Valve Seat Runout – Maximum ....0.050 mm

Valve Seat Width – Exhaust Seating Surface....................1.400 – 1.800 mm

Valve Seat Width – Exhaust Relief Surface....................0.700 – 0.900 mm

Valve Seat Width – Intake Seating Surface ....1.000 – 1.400 mm

Valve Seat Width – Intake Relief Surface ....0.500 – 0.700 mm

Engine Block Deck Surface Flatness....................0.05 mm

Exhaust Manifold Deck Surface Flatness ....0.25 mm

Intake Manifold Deck Surface Flatness ....0.05 mm

Valve System

Face Angle.................... 44.25°

Face Runout ....0.038 mm

Valve Face Width – Exhaust....................2.750 mm

Valve Face Width – Intake ....2.180 mm

Valve Head Diameter – Exhaust....................30.470 – 30.730 mm

Valve Head Diameter – Intake ....36.830 – 37.090 mm

Valve Installed Height ....35.26 – 36.69 mm

Valve Length – Exhaust....................97.110 mm

Valve Length – Intake ....101.230 mm

Valve Stem Diameter (standard)....................5.955 – 5.975 mm

Valve Stem Diameter (oversize) ....6.013 – 6.033 mm

Valve Stem to Guide Clearance....................0.025 – 0.065 mm

Hydraulic Lash Adjuster Diameter ....11.986 – 12.000 mm

Hydraulic Lash Adjuster to Bore Clearance ....0.037 – 0.041 mm

Rocker Arm/Camshaft Follower Ratio....................1.68:1

Rocker Arm/Camshaft Follower Roller Diameter ....17.740 – 17.800 mm

Valve Spring Free Length ....42.500 – 45.500 mm

Valve Spring Installed Height – Closed....................35.000 mm
Valve Spring Installed Height – Open....................24.000 mm
Valve Spring Load – Closed....................247 – 273 N
Valve Spring Load – Open....................598 – 662 N
Valve Spring Diameter – Inside Top....................12.200 – 12.700 mm
Valve Spring Diameter – Outside Top....................18.000 – 20.500 mm
Valve Spring Diameter – Inside Bottom....................17.950 – 18.450 mm
Valve Spring Diameter – Outside Bottom....................26.000 mm
Valve Spring Coil Thickness....................3.250 – 3.900 mm
Valve Spring Total Number of Coils....................7.1

Camshaft

Camshaft Bearing Inside Diameter – Front Number 1....................35.000 – 35.020 mm
Camshaft Bearing Inside Diameter – Middle & Rear Number 2 - 4....................27.000 – 27.020 mm
Camshaft End Play....................0.045 – 0.215 mm
Camshaft Journal Diameter – Front Number 1....................34.936 – 34.960 mm
Camshaft Journal Diameter – Middle & Rear Number 2 - 4....................26.936 – 26.960 mm
Camshaft Journal Out-of-round....................0.006 mm
Camshaft Journal to Bore Clearance....................0.040 – 0.084 mm
Camshaft Runout – Front & Rear Number 1 and 4....................0.025 mm
Camshaft Runout – Middle Number 2 and 3....................0.050 mm
Camshaft Lobe Duration – Exhaust (@ 0.150 mm Lift)....................238°
Camshaft Lobe Duration – Intake (@ 0.150 mm Lift)....................237°
Camshaft Lobe Height – Exhaust....................6.6 mm
Camshaft Lobe Height – Intake....................6.5 mm
Camshaft Lobe Overlap (@ 0.150 mm Lift)....................-5° (no overlap)
Valve Opens – Exhaust....................229° BTDC
Valve Opens – Intake....................14° ATDC
Centre-line – Exhaust....................111° BTDC
Centre-line – Intake....................132° ATDC
Valve Closes – Exhaust....................9° ATDC
Valve Closes – Intake....................252° ATDC
Valve Lift – Exhaust....................10.8 mm
Valve Lift – Intake....................10.8 mm

Oil Pump

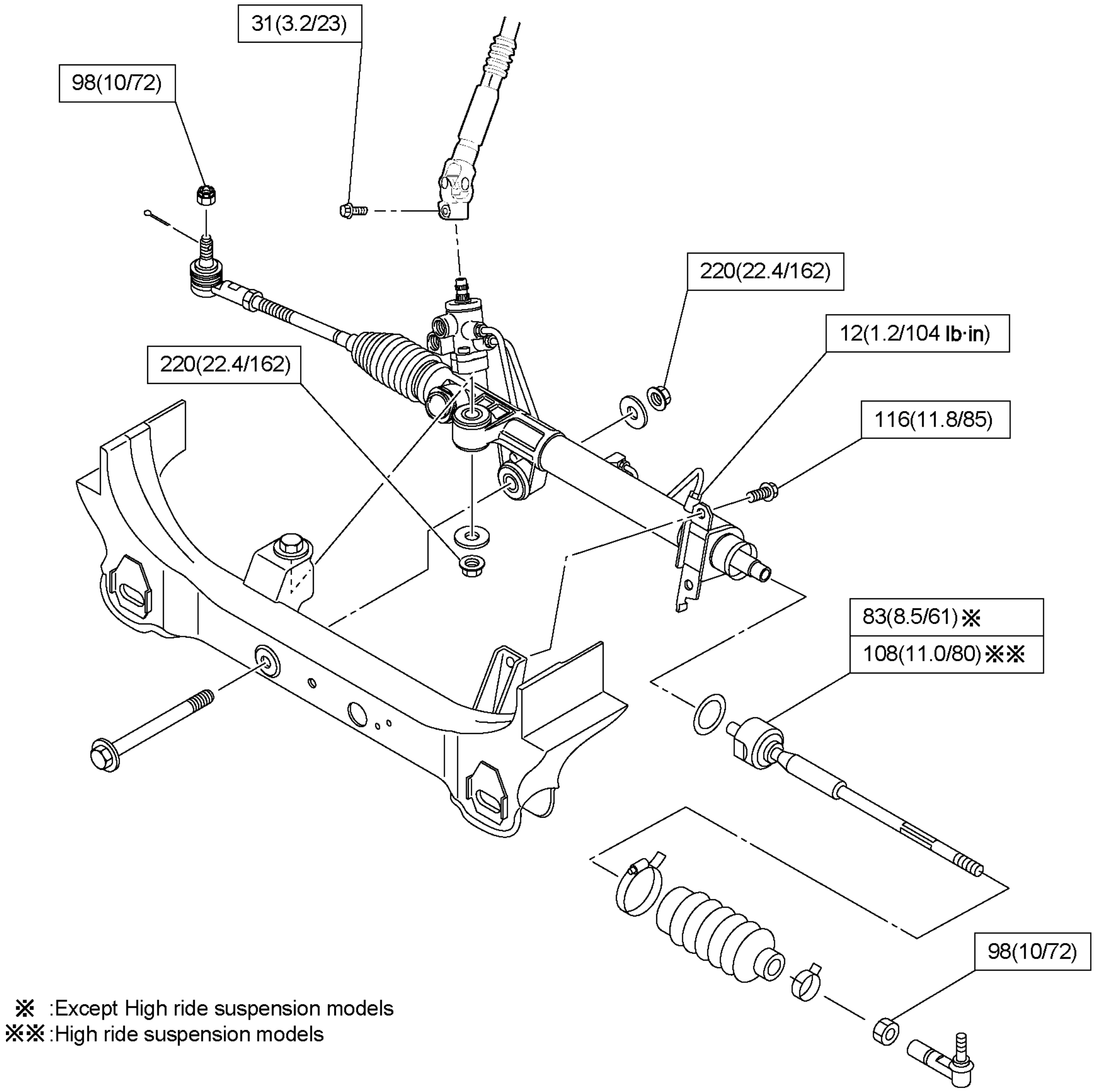
Type....................Gerotor
Gear Diameter – Outer....................87.095 – 87.175 mm
Gear Bore Depth....................15.565 – 15.600 mm
Gear Bore Diameter....................87.275 – 87.325 mm
Gear Thickness....................15.511 – 15.536 mm
Gear to Cover Clearance....................0.030 – 0.085 mm
Gear to Housing Clearance....................0.100 – 0.230 mm
Inner Gear Tip Clearance....................0.075 – 0.180 mm
Crankshaft Clearance to Housing....................0.040 – 0.130 mm
Inner Gerotor Hub Diameter....................53.310 – 53.335 mm
Housing Hub Diameter....................53.380 – 53.420 mm
Inner Gerotor Hub Clearance to Housing....................0.045 – 0.110 mm

Lubrication System

Oil Type....................SAE 5W30
Oil Capacity – with Filter....................6.5 L
Oil Pressure – Minimum at idle....................69 kPa
Oil Pressure – Minimum at 2000 r.p.m.....................138 kPa

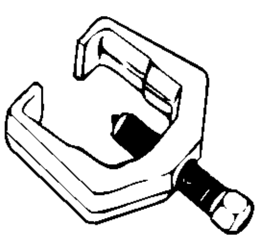
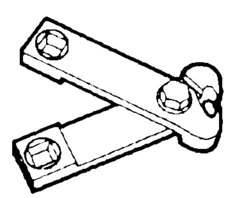
Torque Specifications

N·m (kgf·m/lb·ft)



RTW73BLF000801

Special Tools

ILLUSTRATION	TOOL NO. TOOL NAME	ILLUSTRATION	TOOL NO. TOOL NAME
 901RS279	**5-8840-2005-0** **(J-29107)** Tie rod end remover	 5884027450	**5-8840-2745-0** Clamp plier

Piston Cooling Jet Valve Opening Pressure ....170 – 230 kPa

6 Torque Wrench Specifications

ATTENTION

- ■ **Fasteners must be replaced after loosening.**
- ♦ **Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.**

Oil Pan Drain Plug .... 25.0 Nm
Oil Filter Adaptor Attaching Bolt .... 20.0 – 26.0 Nm
Oil Level Indicator Tube Attaching Bolt .... 8.0 – 12.0 Nm
Accessory Drive Belt Idler Pulley Attaching Bolt .... 50.0 Nm
Accessory Drive Belt Tensioner Attaching Bolt .... 50.0 Nm
Power Steering Reservoir Bracket Attaching Screw .... 9.0 Nm
Power Steering Pump Bracket Attaching Bolt .... 49.0 – 67.0 Nm
Upper Intake Manifold to Lower Intake Manifold Attaching Bolt .... 23.0 Nm
Upper Intake Manifold to Cylinder Head Attaching Bolt .... 23.0 Nm
Lower Intake Manifold to Cylinder Head Attaching Bolt .... 23.0 Nm
Fuel Injector Wiring Harness Bracket Attaching bolt .... 9.0 Nm
Exhaust Manifold to Cylinder Head Attaching Bolt .... 17.0 - 23.0 Nm
Exhaust Manifold Heat Shield Attaching Bolt .... 8.0 - 12.0 Nm
Battery Harness Ground Terminal Attaching Nut .... 13.0 Nm
Camshaft Cover Attaching Bolt .... 8.0 – 12.0 Nm
Engine Ground Connector Bolt .... 10.0 Nm
Engine Wiring Harness Former Attaching Bolt .... 12.0 – 16.0 Nm
■ ♦ Crankshaft Balancer Assembly Attaching Bolt:
Stage 1 .... 90.0 –110.0 Nm
Stage 2 .... 150°
Engine Front Cover Assembly Attaching Bolt .... 20.0 – 26.0 Nm
Camshaft Intermediate Driveshaft Sprocket Attaching Bolt .... 58.0 – 72.0 Nm
Secondary Timing Chain Guide Attaching Bolt .... 20.0 – 26.0 Nm
Secondary Timing Chain Shoe Attaching Bolt .... 20.0 – 26.0 Nm
Secondary Timing Chain Tensioner Attaching Bolt .... 20.0 – 26.0 Nm
Primary Timing Chain Upper Guide Attaching Bolt .... 20.0 – 26.0 Nm
Primary Timing Chain Tensioner Attaching Bolt .... 20.0 – 26.0 Nm
Oil Pump Assembly Attaching Bolt .... 20.0 – 26.0 Nm
Camshaft Sprocket Attaching Bolt .... 49.0 – 67.0 Nm
Exhaust Camshaft Sprocket Attaching Bolt .... 49.0 – 67.0 Nm
Camshaft Bearing Cap Attaching Bolt .... 8.0 – 12.0 Nm
Cylinder Head Threaded Plug .... 31.0 Nm
■ Cylinder Head M11 Attaching Bolt:
Stage 1 .... 40.0 – 50.0 Nm
Stage 2 .... 120°
■ Cylinder Head M8 Attaching Bolt:
Stage 1 .... 12.0 – 18.0 Nm
Stage 2 .... 60°
Engine Mount Bracket to Cylinder Block Attaching Bolt .... 43.0 – 57.0 Nm
Engine Mount to Bracket Attaching Nut .... 70.0 – 90.0 Nm
Engine Mount to Frame Attaching Nut .... 44.0 – 60.0 Nm
Engine Lift Bracket Attaching Bolt .... 58.0 – 72.0.0 Nm
Knock Sensor Attaching Nut .... 23.0 Nm

Power Steering High Pressure Line Attaching Bolt ....8.0 – 12.0 Nm

Power Steering High Pressure Line Flare Nut..........................25.0 – 35.0 Nm

Steering Gear Housing Mounting Nut:
Stage 1 ....60.0 Nm
Stage 2 ....40° – 50°

Oil Suction Pipe Attaching Bolt...10.0 Nm

Crankshaft Oil Deflector Attaching bolt...10.0 Nm

Oil Level Sensor ....20.0 Nm

Oil Pan to Cylinder Block Attaching Bolt..................................20.0 – 26.0 Nm

Oil Pan to Crankshaft Rear Oil Seal Housing Attaching Bolt........8.0 - 12.0 Nm

■ ♦ Flexplate Attaching Bolt:

Stage 1 ....26.0 – 34.0 Nm

Stage 2 .... 45°

Crankshaft Rear Oil Seal Housing Attaching Bolt.......................8.0 – 12.0 Nm

■ Connecting Rod Cap Attaching Bolt:

Stage 1 ....30.0 Nm

Stage 2 ....Loosen Completely

Stage 3 ....25.0 Nm

Stage 4 ....110°

Crankshaft Bearing Cap Remover Nut ....11.0 Nm

■ Crankshaft Main Bearing Cap Inboard Attaching Bolt:

Stage 1 ....20.0 Nm

Stage 2 .... 80°

■ Crankshaft Main Bearing Cap Outboard Attaching Bolt:

Stage 1 ....15.0 Nm

Stage 2 ....110°

■ ♦ Crankshaft main Bearing Cap Side Attaching Bolt:

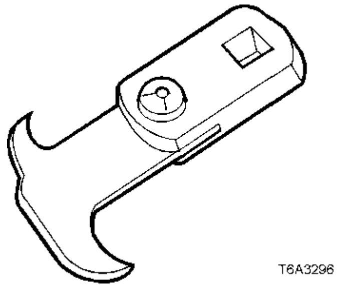
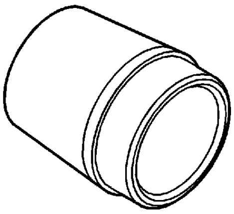
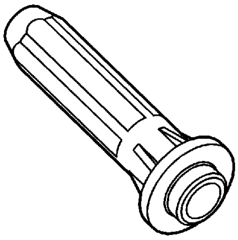
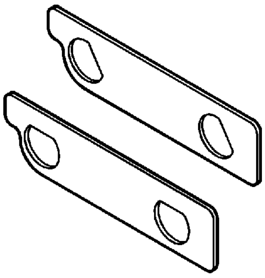
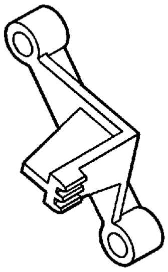
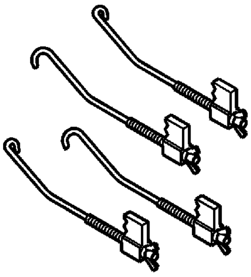
Stage 1 ....30.0 Nm

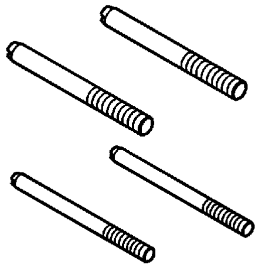
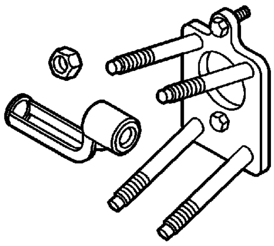
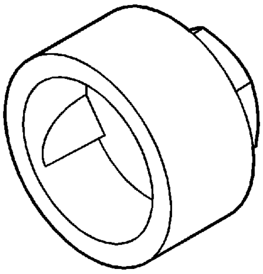
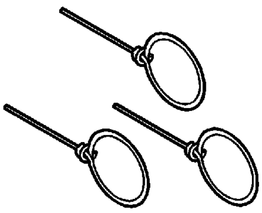
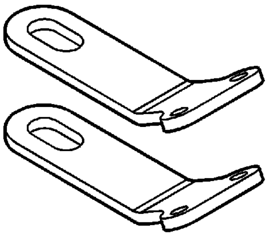
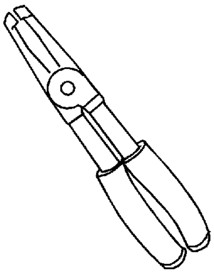
Stage 2 .... 60°

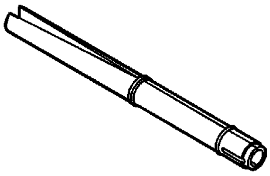
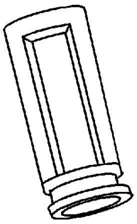
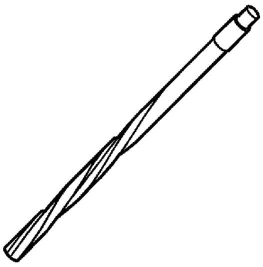
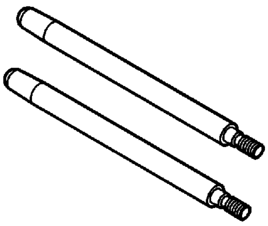
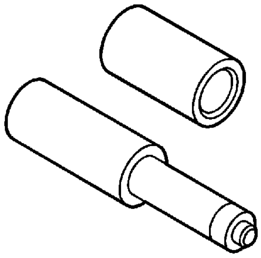
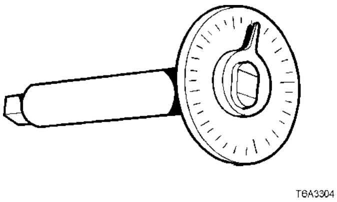
Cylinder Block Threaded Plug ....27.0 - 35.0 Nm

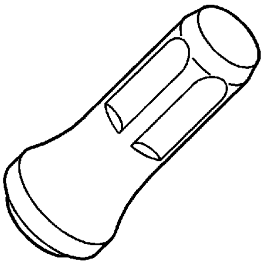
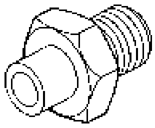
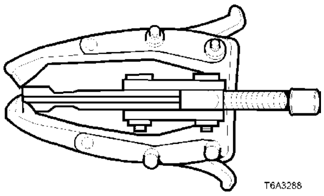
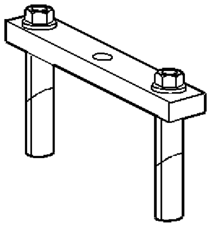
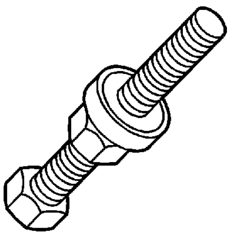
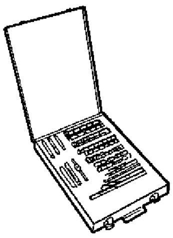
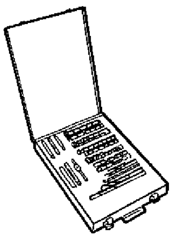
Oil Jet Attaching Bolt ....8.0 – 12.0 Nm

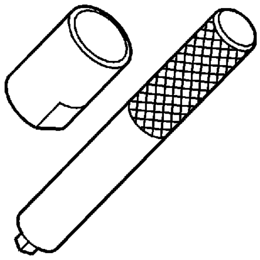
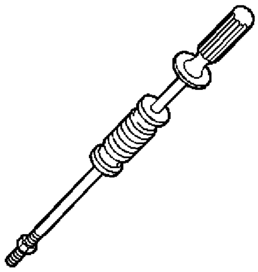
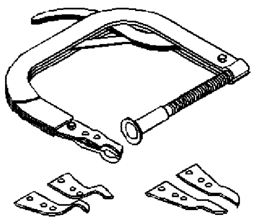
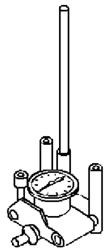
7 Special Tools

Tool Number	Illustration	Description
E-308		Seal Remover Previously released.
EN-46101		Spark Plug Tube Seal Guide Set Used to protect the spark plug lip seals when installing the camshaft cover to the cylinder head.
EN-46103		Camshaft Actuator Valve Seal Installer Used to install the camshaft actuator valve seals into the front cover.
EN-46105 – 1 and 2		Camshaft Locking Tool Set Used to retain camshaft position during timing chain or camshaft actuator replacement.
EN-46106		Flexplate Holding Tool Used to retain crankshaft position during valve-train overhaul and harmonic balancer removal.
EN-46108		Timing Chain Retention Tool Set Used to retain timing chain tension during camshaft and sprocket removal.

Tool Number	Illustration	Description
EN-46109		Engine Front Cover / Oil Pan / Crankshaft Rear Oil Seal Housing Installation Guide Pins Used to align the engine front cover/oil pan/crankshaft rear oil seal housing during engine assembly.
EN-46110		On-vehicle Valve Spring Compressor Used to remove valve springs with the cylinder heads assembled to the cylinder block.
EN-46111		Crankshaft Rotation Socket Used to rotate the crankshaft during engine overhaul.
EN-46112		Timing Chain Tensioner Retraction Springs Used to retain the timing chain tensioner plunger within the tensioner bore during assembly of timing chains to engine.
EN-46114		Engine Lift Brackets Used in conjunction with commercially available lifting equipment to lift engine.
EN-46116		Valve Stem Seal Remover / Installer Used to remove/install the valve stem seals.

Tool Number	Illustration	Description
EN-46117		Valve Stem Key Remover / Installer Used in conjunction with J-8062 or EN-46110 to remove and reinstall the valve stem keys.
EN-46119		Off-vehicle Valve Spring Compressor Adaptor Used in conjunction with J-8062 to remove valve springs with the engine disassembled.
EN-46120 and J-42096		Valve Guide Reamer Used to oversize valve guides prior to the installation of new oversized valves.
EN-46121		Connecting Rod Guide Pin Set Used to guide connecting rods onto the crankshaft journals and prevent damage to the cylinder bores, journal faces and piston cooling jets during engine assembly procedures.
EN-46122		Oil Control Valve Check Ball Remover / Installer
EN-7115		Torque Angle Wrench Used to accurately tighten fasteners when an angle torque is required.

Tool Number	Illustration	Description
J-29184		Crankshaft Front Oil Seal Installer
J-36648-A		Oil Pressure Gauge Adaptor
j-41816		three legged puller
J-41818		Main Bearing Cap Removal Tool Used in conjunction with J-6125-1B to remove the main bearing caps from the cylinder block during engine disassembly procedures.
J-41998-B		Crankshaft Balancer Installer
J-42385-2000		Thread Insert Kit Used to repair damaged threads during engine overhaul.
J-42385-700		High Feature Thread Repair Kit Used to repair damaged threads during engine overhaul.

Tool Number	Illustration	Description
J-45027		Tensioner Tool Used to reset the timing chain tensioner plunger.
J-6125-1B		Slide Hammer Used in conjunction with J-41818 to remove the main bearing caps from the cylinder block during engine disassembly.
J-8062		Valve Spring Compressor Used in conjunction with EN-46119 to remove valve springs with the engine disassembled.
J-8087		Cylinder Bore Gauge Commercial equivalent also available

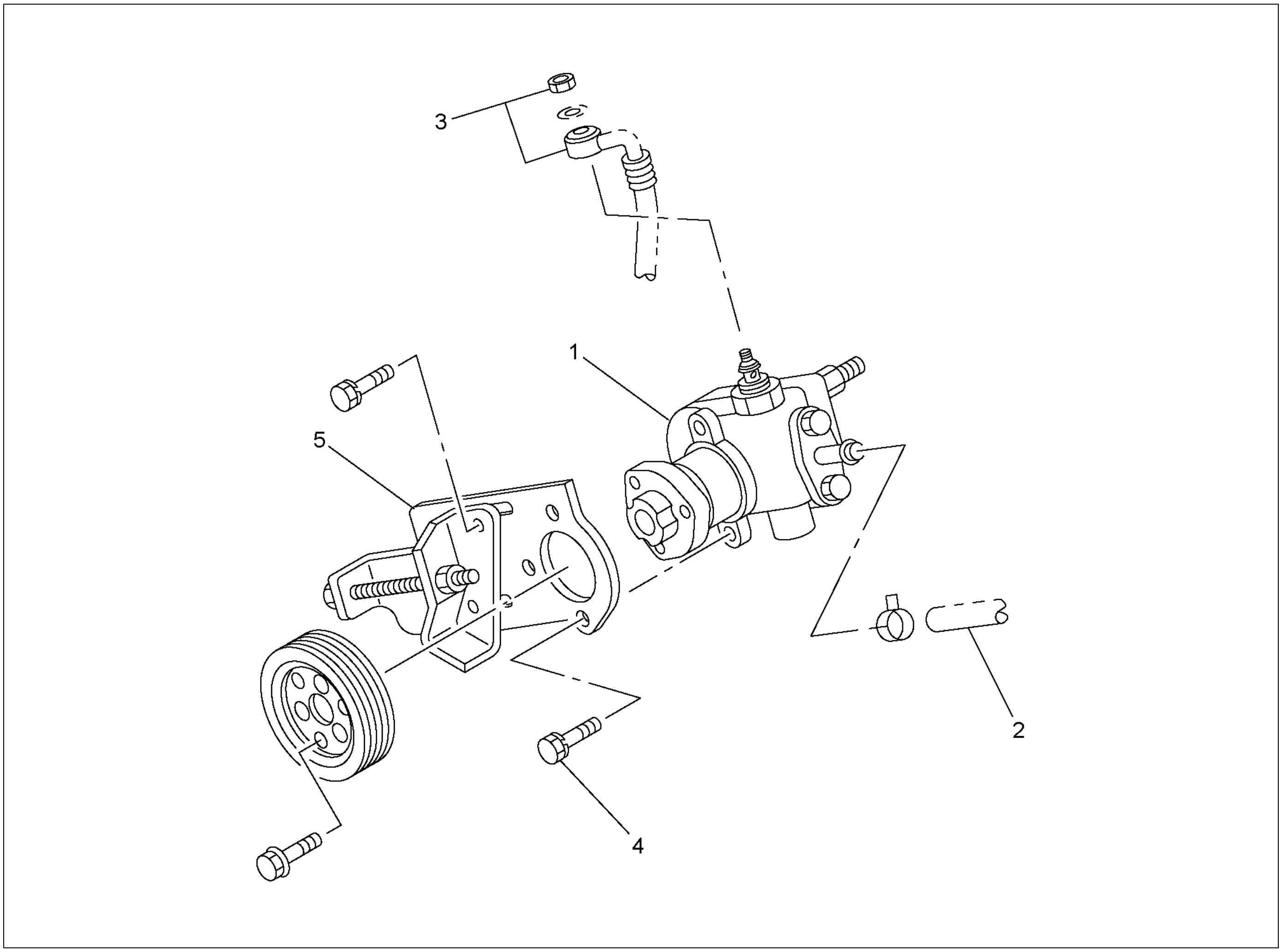
Section 6A1
Engine Mechanical – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

Power Steering Pump (4JH1-TC, 4JA1-T)

Power Steering Pump and Associated Parts



RTW53BMF000401

Legend

(1) Pump Assembly
(2) Suction Hose
(3) Flexible Hose
(4) Bolt
(5) Bracket

Removal

1. Remove the drive belt.
2. Remove the pulley
3. Place a drain pan below the pump.
4. Disconnect the suction hose.
5. Disconnect the flexible hose.
6. Remove the power steering fixing bolt and remove the pump assembly.

Installation

1. Install the pump assembly to the pump braket, tighten the fixing bolt to the specified torque.
   Torque: 40 N·m (4.1 kgf·m/30 lb·ft)
2. Install the flexible hose.
   Tighten the nut to specified torque.
   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)
3. Install the pulley and tighten the bolt to the specified torque.
   Torque: 28 N·m (2.9 kgf·m/21 lb·ft)
4. Install the drive belt.
5. Connect the suction hose, then fill and bleed system.
   Refer to Bleeding the Power Steering System in this section.

1 General Information

The HFV6 engine features a closed vee, deep skirt die cast aluminium cylinder block with cast iron cylinder liners, internally balanced crankcase, full length water jackets and six bolt main bearing caps.

The cylinders are arranged in two banks of three with a 60 degree included angle between the two banks.

The right-hand bank of cylinders consists of number 1-3-5 cylinders and the left-hand bank of cylinders consists of number 2-4-6.

The engine firing order is 1-2-3-4-5-6.

Each aluminium cylinder head is fitted with hardened valve seats and four valves per cylinder: two intake and two exhaust.

The valves are operated by two camshafts (DOHC) per cylinder bank, one each for intake and exhaust valves.

The crankshaft is manufactured from forged steel. A reluctor wheel is pressed in place onto the rear of the crankshaft for the crankshaft position sensor.

The connecting rods are manufactured from powdered metal and the rod cap is separated during the manufacturing process using the fractured method. This creates a stronger, visually seamless rod to cap union.

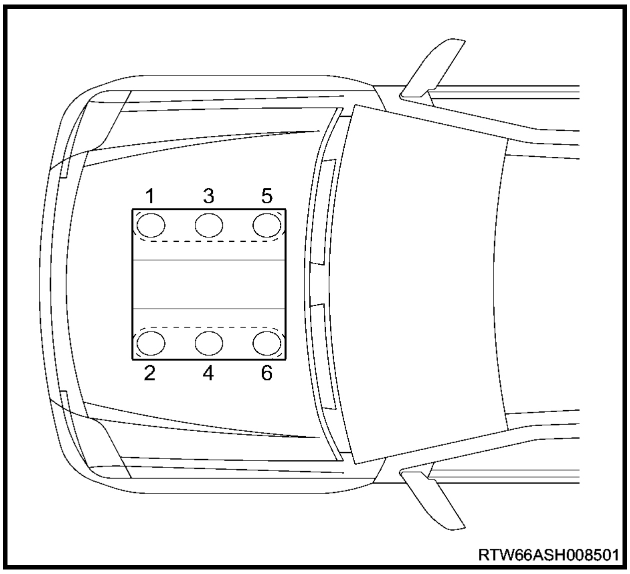


Figure 6A1 – 1

MY06 Update

Throughout this Section, reference is made to 'MY06 Update' or 'Excluding MY06 Update'.

Vehicles manufactured post 14th March 2007 are fitted with an updated version of the HFV6 engine. This engine features a different timing chain, and as a result different sprocket teeth. This change also introduces the use of a new special tool to assist in the serviceability of replacing the engine timing components.

All service procedures and descriptions specific to this update variation are qualified as 'MY06 Update'.

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,

- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or

Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 Engine Components

Major Component Assemblies

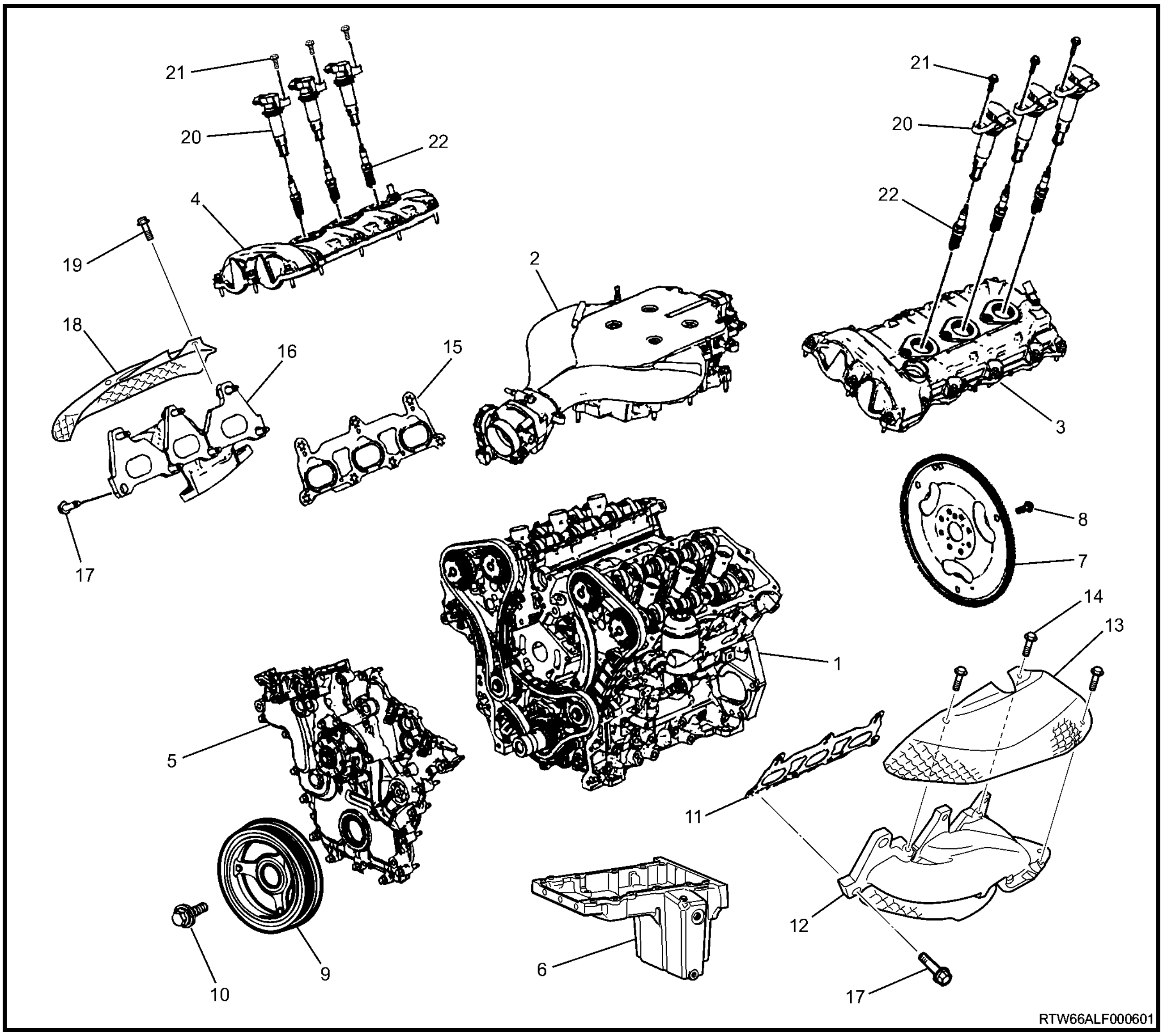


Figure 6A1 – 2

Legend

1	Engine Assembly
2	Intake Manifold Assembly
3	Camshaft Cover Assembly, Left-hand
4	Camshaft Cover Assembly, Right-hand
5	Engine Front Cover Assembly
6	Oil Pan Assembly
7	Engine Flywheel
8	Engine Flywheel Bolt
9	Crankshaft Balancer
10	Crankshaft Balancer Bolt
11	Exhaust Manifold Gasket, Left-hand
12	Exhaust Manifold, Left-hand
13	Exhaust Manifold Heat Shield, Left-hand
14	Exhaust Manifold Heat Shield Bolt, Left-hand
15	Exhaust Manifold Gasket, Right-hand
16	Exhaust Manifold, Right-hand
17	Cylinder Head Exhaust Manifold Bolt
18	Exhaust Manifold Heat Shield, Right-hand
19	Exhaust Manifold Heat Shield Bolt, Right-hand
20	Ignition Coil Assembly
21	Ignition Coil Assembly Bolt
22	Spark Plug

Intake Manifold Assembly

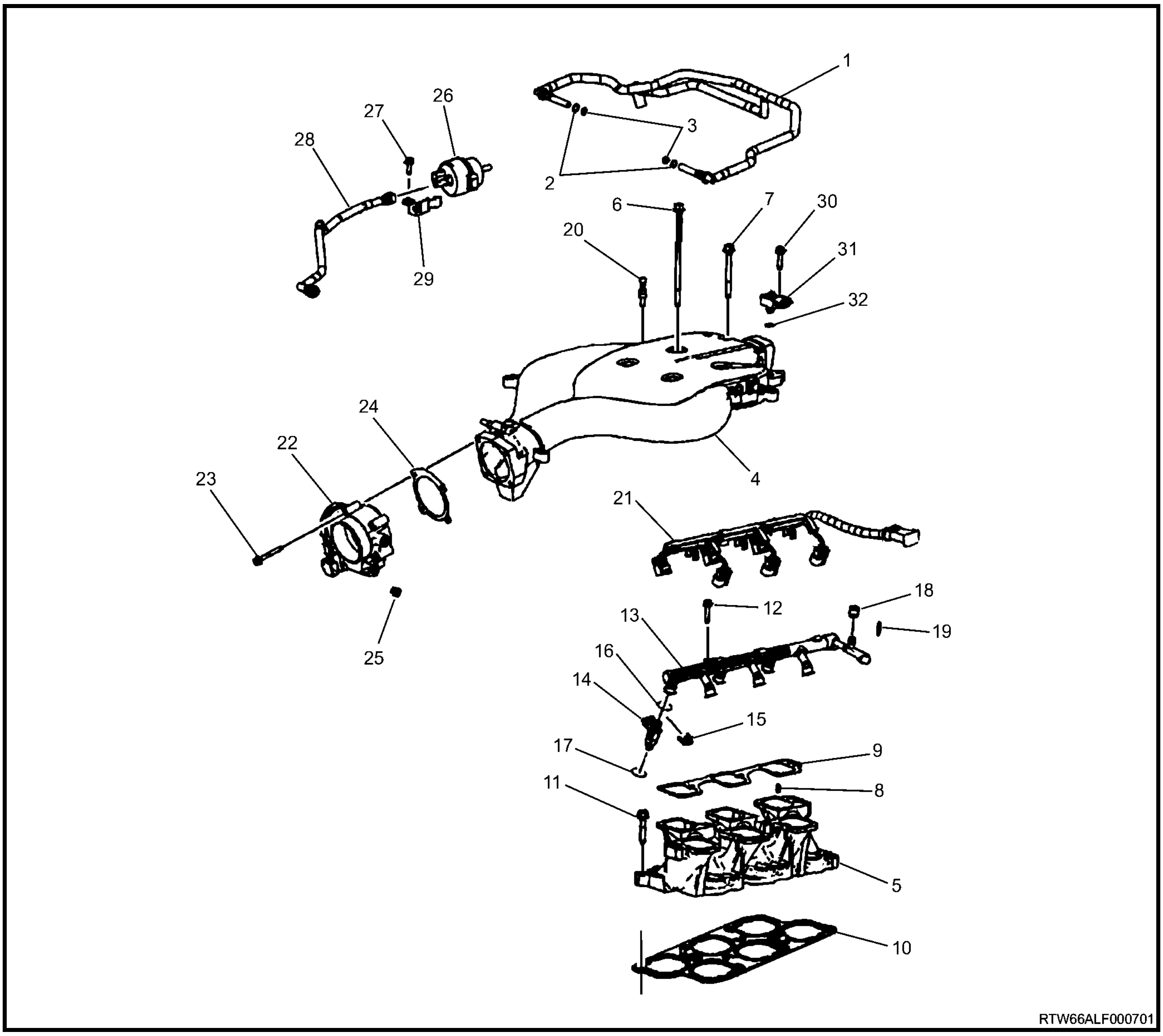


Figure 6A1 – 3

Legend

1	PCV Hose
2	PCV Hose O-Ring Outer (larger)
3	PCV Hose O-Ring Inner (smaller)
4	Upper Intake Manifold
5	Lower Intake Manifold
6	Upper Intake Manifold Bolt – Long
7	Upper Intake Manifold Bolt – Short
8	Lower Intake Manifold to Upper Intake Manifold Guide Pin
9	Upper Intake Manifold to Lower Intake Manifold Gasket
10	Lower Intake Manifold to Cylinder Head Gasket
11	Lower Intake Manifold Bolt
12	Fuel Rail Bolt
13	Fuel Rail
14	Fuel Injector
15	Fuel Injector Retainer
16	Fuel Injector Upper O-ring
17	Fuel Injector Lower O-ring
18	Fuel Pressure Service Valve Cap
19	Fuel Pressure Service Valve
20	Ball Stud
21	Fuel Injector Wiring Harness
22	Throttle Body
23	Throttle Body Bolt
24	Throttle Body Gasket
25	Throttle Body Engine Wiring Harness Clip
26	EVAP Purge Solenoid
27	EVAP Purge Solenoid Bolt
28	EVAP Purge Solenoid Tube
29	EVAP Purge Solenoid Bracket
30	BARO Sensor Bolt
31	BARO Sensor
32	BARO Sensor O-Ring

Engine Front Cover

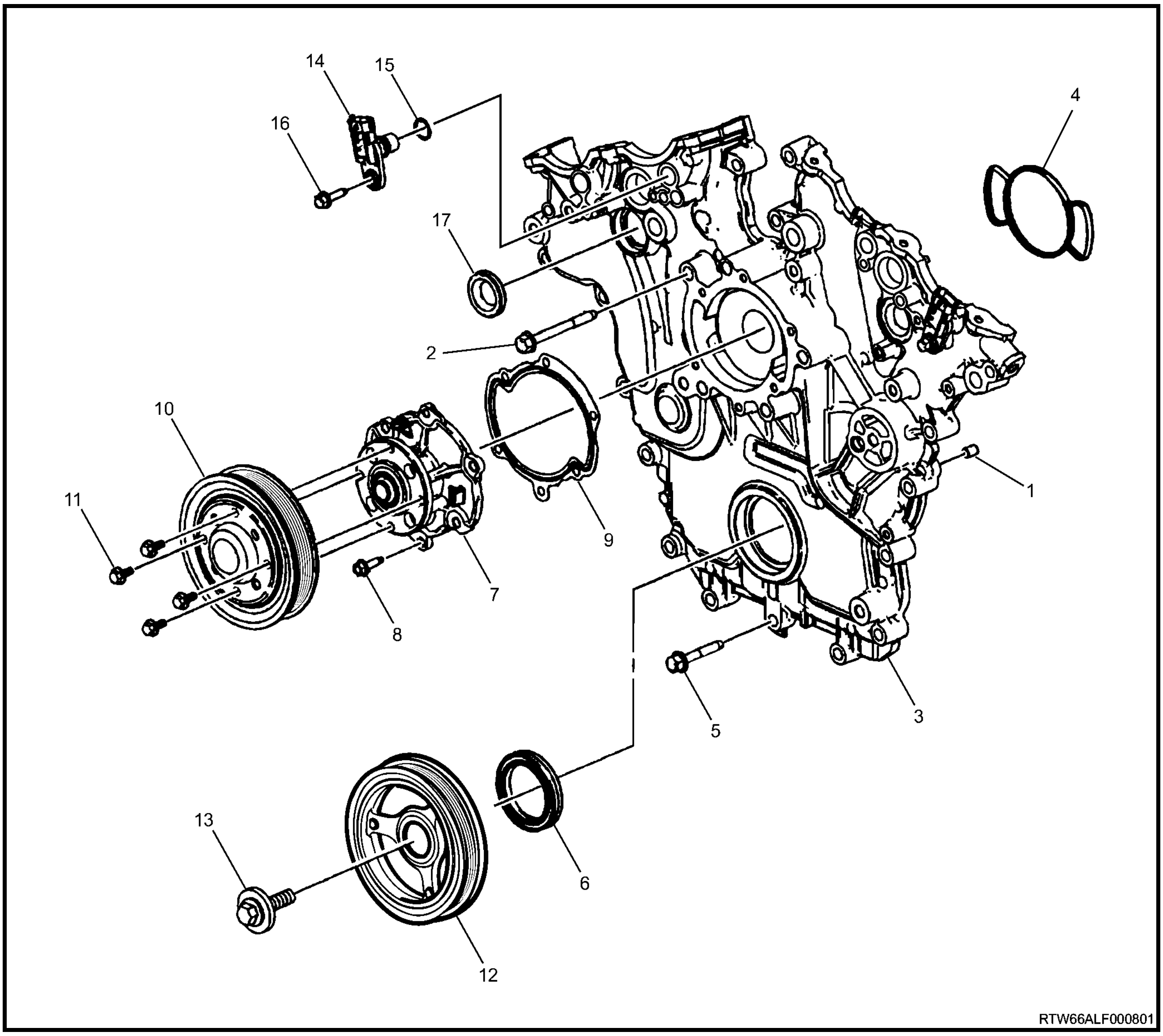
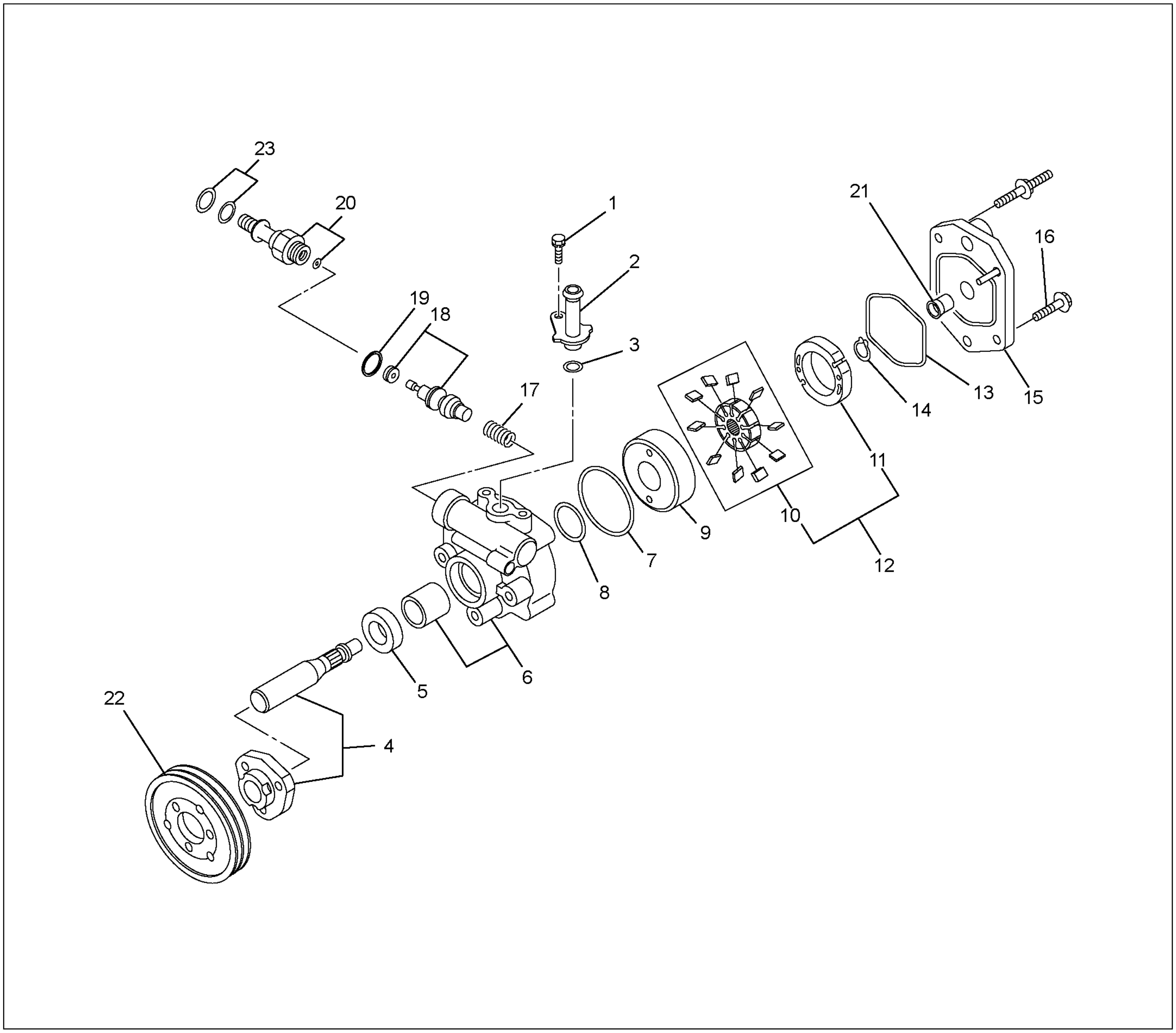


Figure 6A1 – 4

Legend

1	Engine Front Cover Locating Pin	10	Coolant Pump Pulley
2	Engine Front Cover Bolt, M10	11	Coolant Pump Pulley Bolt
3	Engine Front Cover	12	Crankshaft Balancer
4	Engine Front Cover Gasket	13	Crankshaft Balancer Bolt
5	Engine Front Cover Bolt, M8	14	Camshaft Position Sensor
6	Engine Front Cover Seal	15	Camshaft Position Sensor O-ring
7	Coolant Pump Assembly	16	Camshaft Position Sensor Bolt
8	Coolant Pump Bolt	17	Camshaft Position Actuator Solenoid Valve Seal
9	Coolant Pump Gasket		

Power Steering Pump Disassembled View



RTW63BLF000301

Legend

(1) Bolt
(2) Suction Pipe
(3) O-ring
(4) Shaft Assembly
(5) Oil Seal
(6) Front Housing
(7) O-ring
(8) O-ring
(9) Side Plate
(10) Rotor and Vane
(11) Cam
(12) Pump Cartridge Assembly
(13) O-ring
(14) Snap Ring
(15) Rear Housing
(16) Bolt
(17) Spring
(18) Relief Valve
(19) O-ring
(20) Connector
(21) Bush
(22) Pulley
(23) O-ring

Camshaft Timing Components

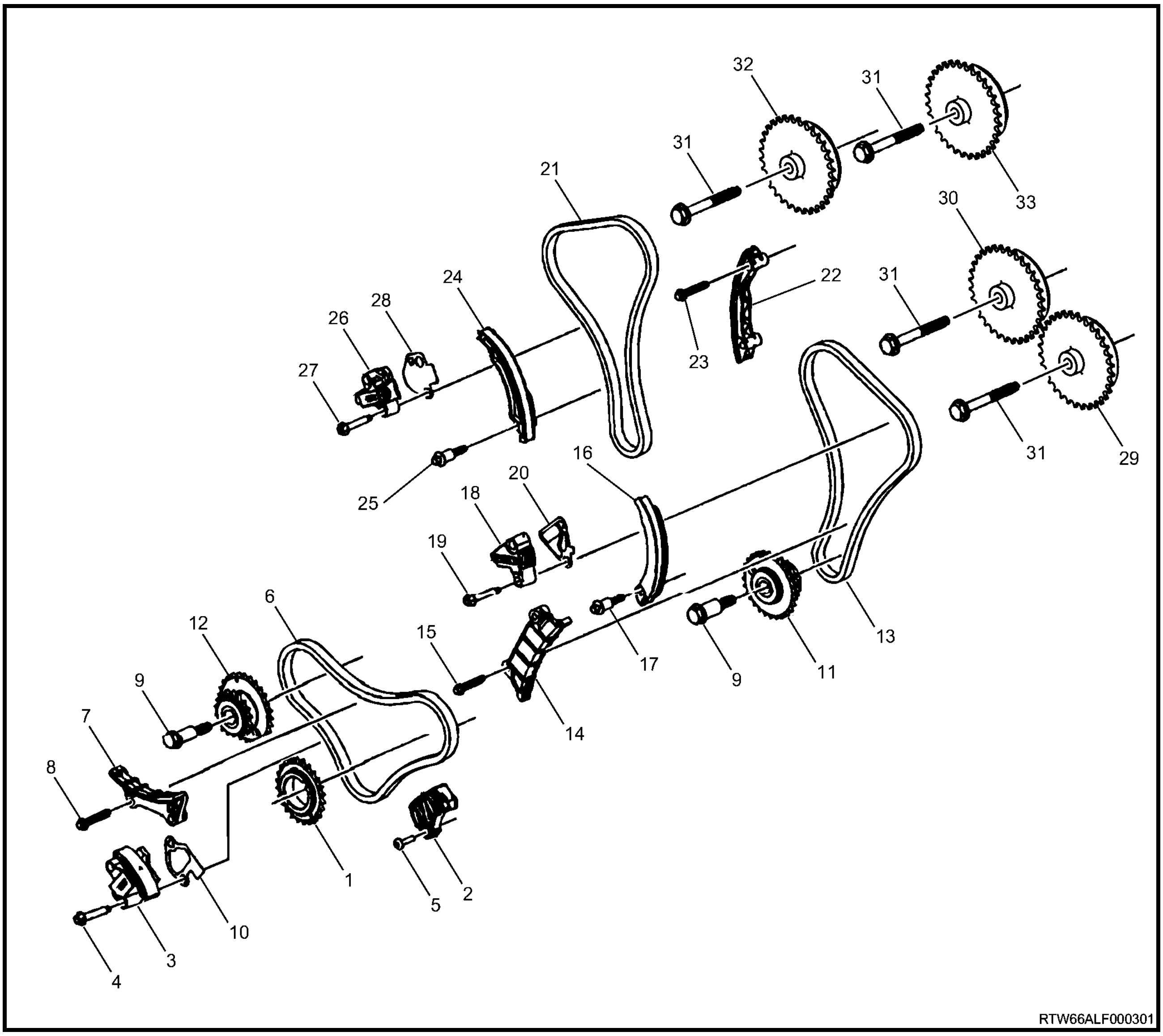


Figure 6A1 – 5

Legend

1 Crankshaft Sprocket
2 Lower Primary Timing Chain Guide
3 Primary Timing Chain Tensioner
4 Primary Timing Chain Tensioner Bolt
5 Lower Primary Timing Chain Guide Bolt
6 Primary Timing Chain
7 Upper Primary Timing Chain Guide
8 Upper Primary Timing Chain Guide Bolt
9 Camshaft Intermediate Sprocket Bolt
10 Primary Timing Chain Tensioner Gasket
11 Camshaft Intermediate Sprocket, Left-hand
12 Camshaft Intermediate Sprocket, Right-hand
13 Secondary Timing Chain, Left-hand
14 Secondary Timing Chain Guide, Left-hand
15 Secondary Timing Chain Guide Bolt, Left-hand
16 Secondary Timing Chain Shoe, Left-hand
17 Secondary Timing Chain Shoe Bolt, Left-hand
18 Secondary Timing Chain Tensioner, Left-hand
19 Secondary Timing Chain Tensioner Bolt, Left-hand
20 Secondary Timing Chain Tensioner Gasket, Left-hand
21 Secondary Timing Chain, Right-hand
22 Secondary Timing Chain Guide, Right-hand
23 Secondary Timing Chain Guide Bolt, Right-hand
24 Secondary Timing Chain Shoe, Right-hand
25 Secondary Timing Chain Shoe Bolt, Right-hand
26 Secondary Timing Chain Tensioner, Right-hand
27 Secondary Timing Chain Tensioner Bolt, Right-hand
28 Secondary Timing Chain Tensioner Gasket, Right-hand
29 Exhaust Camshaft Sprocket, Left-hand
30 Intake Camshaft Sprocket, Left-hand
31 Camshaft Sprocket Bolt
32 Exhaust Camshaft Sprocket, Right-hand
33 Intake Camshaft Sprocket, Right-hand

Camshaft Cover Assembly

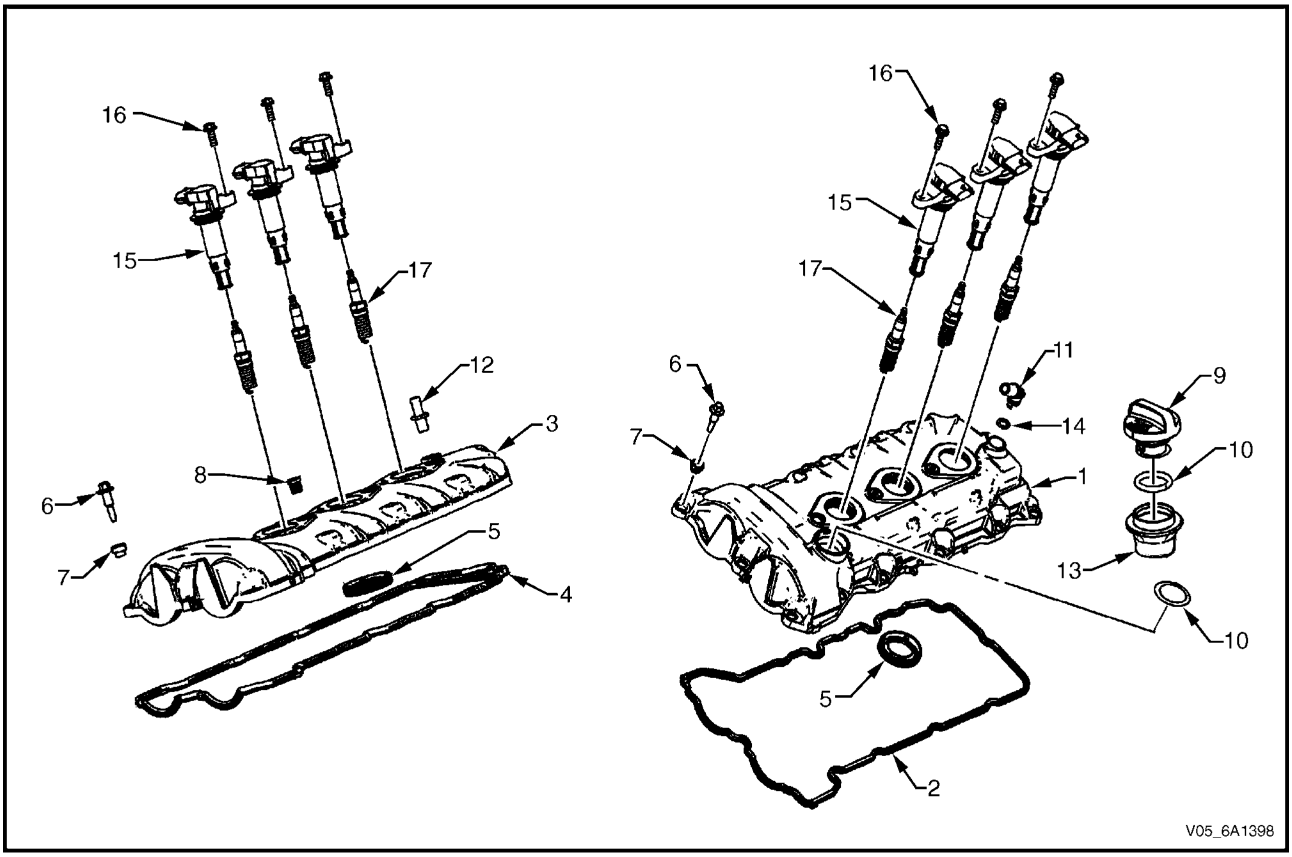


Figure 6A1 – 6

Legend

1	Camshaft Cover, Left-hand
2	Camshaft Cover Gasket, Left-hand
3	Camshaft Cover, Right-hand
4	Camshaft Cover Gasket, Right-hand
5	Camshaft Cover Spark Plug Port Seal
6	Camshaft Cover Bolt
7	Camshaft Cover Bolt Insulator
8	Ignition Coil Bolt Thread Insert
9	Oil Fill Cap
10	Oil Fill O-Ring
11	Camshaft Cover PCV Fitting, Left-hand
12	Camshaft Cover PCV Fitting Orifice, Right-hand
13	Oil Fill Tube
14	Camshaft Cover PCV Fitting O-Ring, Left-hand
15	Ignition Coil
16	Ignition Coil Bolt
17	Spark Plug

Cylinder Head Assembly

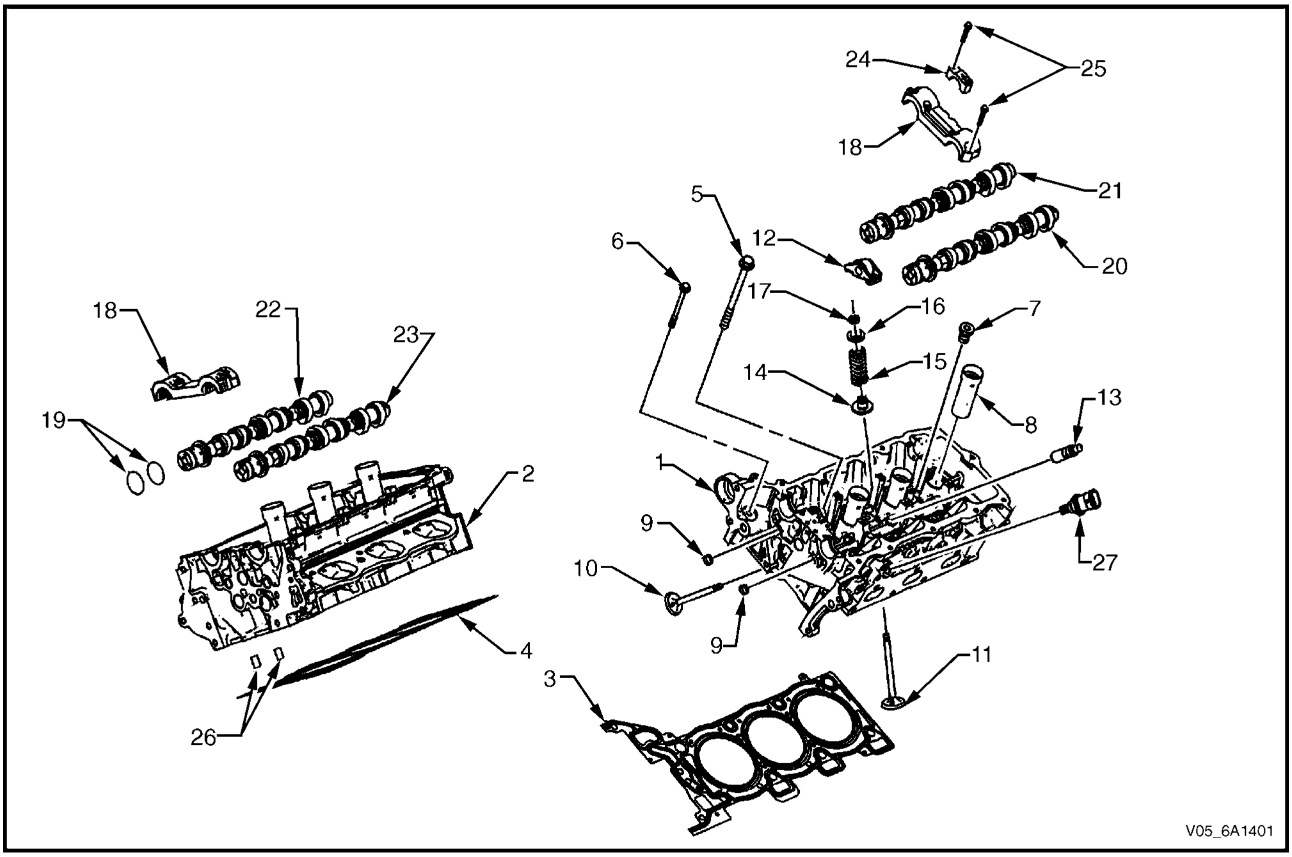


Figure 6A1 – 7

Legend

1	Cylinder Head, Left-hand
2	Cylinder Head, Right-hand
3	Cylinder Head Gasket, Left-hand
4	Cylinder Head Gasket, Right-hand
5	Cylinder Head Bolt
6	Cylinder Head Front Bolt
7	Cylinder Head Coolant Hole Threaded Plug
8	Spark Plug Sleeve
9	Cylinder Head Oil Gallery Expansion Plug
10	Exhaust Valve
11	Intake Valve
12	Valve Rocker Arm Assembly
13	Hydraulic Valve Lash Adjuster Assembly
14	Valve Stem Oil Seal
15	Valve Spring
16	Valve Spring Cap
17	Valve Stem Key
18	Cylinder Head Camshaft Front Thrust Bearing Cap
19	Camshaft Oil Seal Ring
20	Exhaust Camshaft
21	Intake Camshaft, Left-hand (bank 2)
22	Intake Camshaft, Right-hand (bank 1)
23	Exhaust Camshaft, Right-hand (bank 1)
24	Cylinder Head Camshaft Cap – Intermediate
25	Cylinder Head Camshaft Cap Bolt
26	Cylinder Head Oil Galley Check Valve
27	Engine Coolant Temperature Sensor

Oil Pump

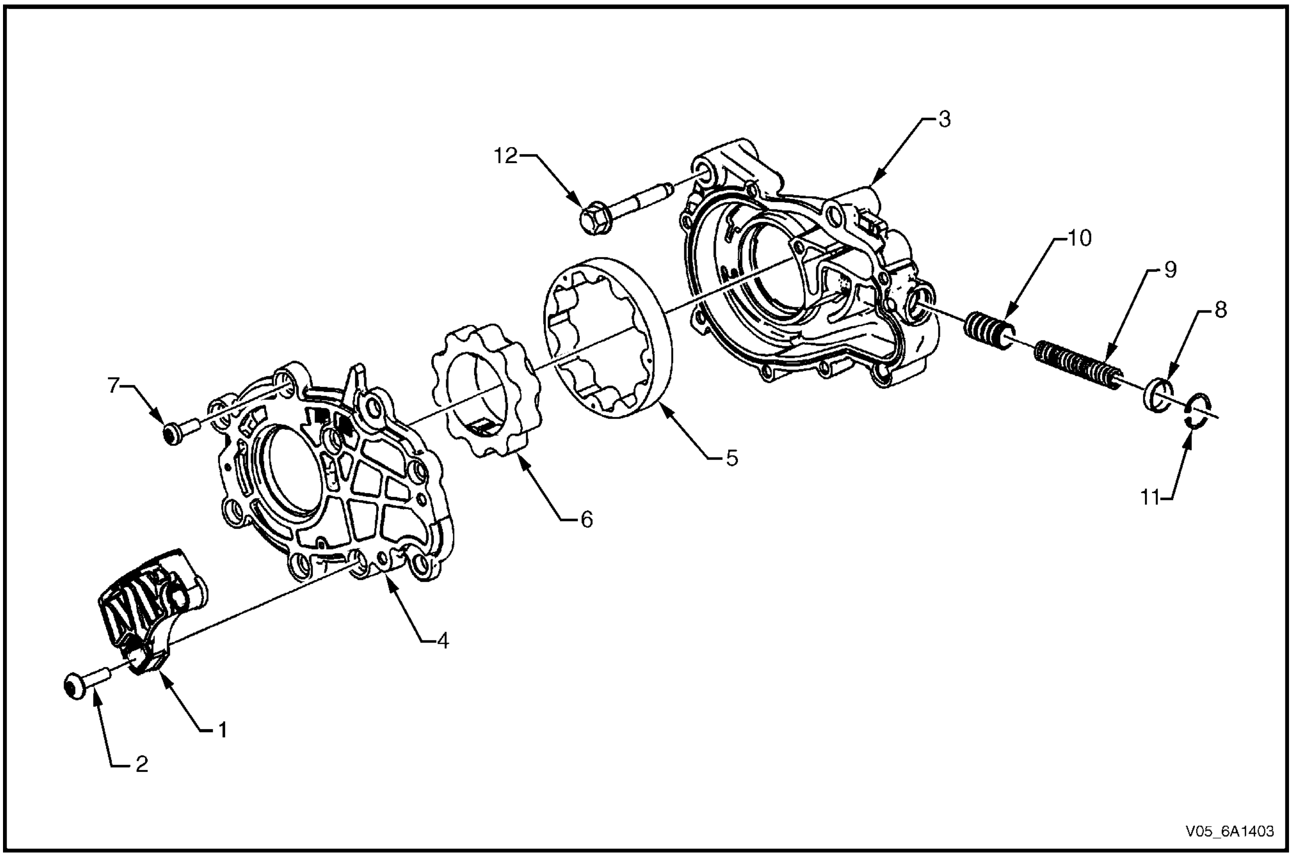


Figure 6A1 – 8

Legend

1	Lower Primary Timing Chain Guide
2	Lower Primary Timing Chain Guide Bolt
3	Oil Pump Housing
4	Oil Pump Cover
5	Oil Pump Gerotor Outer Ring
6	Oil Pump Gerotor Inner Ring
7	Oil Pump Cover Bolt
8	Oil Pressure Relief Valve Bore Plug
9	Oil Pressure Relief Valve Spring
10	Oil Pressure Relief Valve
11	Oil Pressure Relief Valve Bore Plug Retainer Clip
12	Oil Pump Bolt

NOTE

Oil pump components are not serviced individually.

Engine Block Assembly

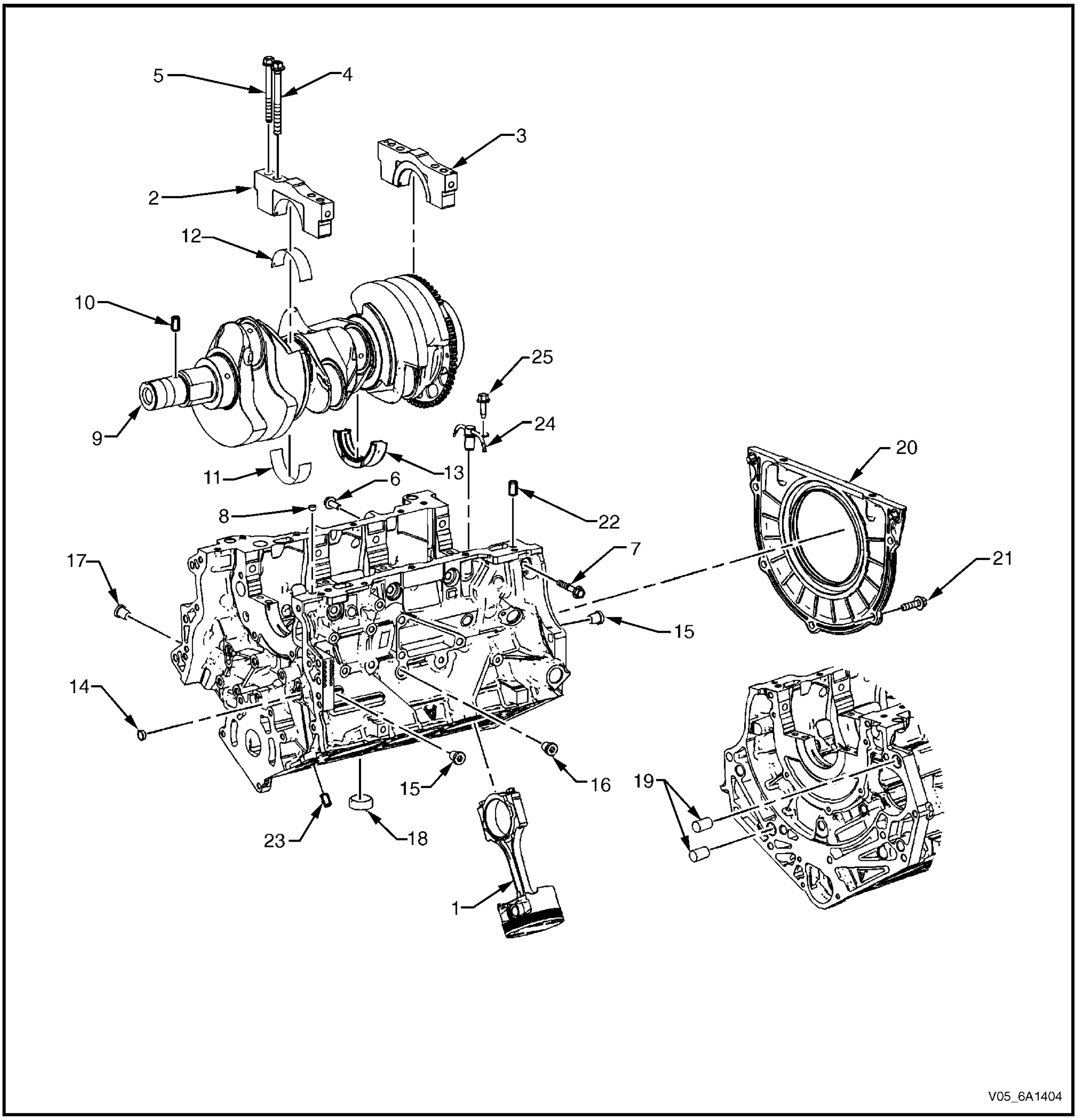


Figure 6A1 – 9

Legend

1	Piston and Connecting Rod Assembly
2	Crankshaft Bearing Cap
3	Crankshaft Bearing Thrust Cap
4	Crankshaft Bearing Cap Inboard Bolt
5	Crankshaft Bearing Cap Outboard Bolt
6	Crankshaft Bearing Cap Side Bolt, Short
7	Crankshaft Bearing Cap Side Bolt, Long
8	Engine Block Oil Gallery Expansion Plug, 10 mm
9	Crankshaft
10	Crankshaft Sprocket Locating Pin
11	Crankshaft Upper Bearing
12	Crankshaft Lower Bearing
13	Crankshaft Upper Thrust Bearing #3
14	Engine Block Oil Gallery Expansion Plug, 14 mm
15	Engine Block Oil Gallery Threaded Plug, 14 mm
16	Engine Block Coolant Drain Threaded Plug, 14 mm
17	Engine Block Oil Gallery Threaded Plug, 20 mm
18	Engine Block Core Coolant Expansion Plug, 34.3 mm
19	Transaxle Locating Pin
20	Crankshaft Rear Oil Seal Housing Assembly
21	Crankshaft Rear Oil Seal Housing Assembly Bolt
22	Oil Pan Locating Pin
23	Cylinder Head Locating Pin
24	Piston Oil Nozzle
25	Piston Oil Nozzle Bolt

Pistons, Rings, Bearing and Connecting Rod

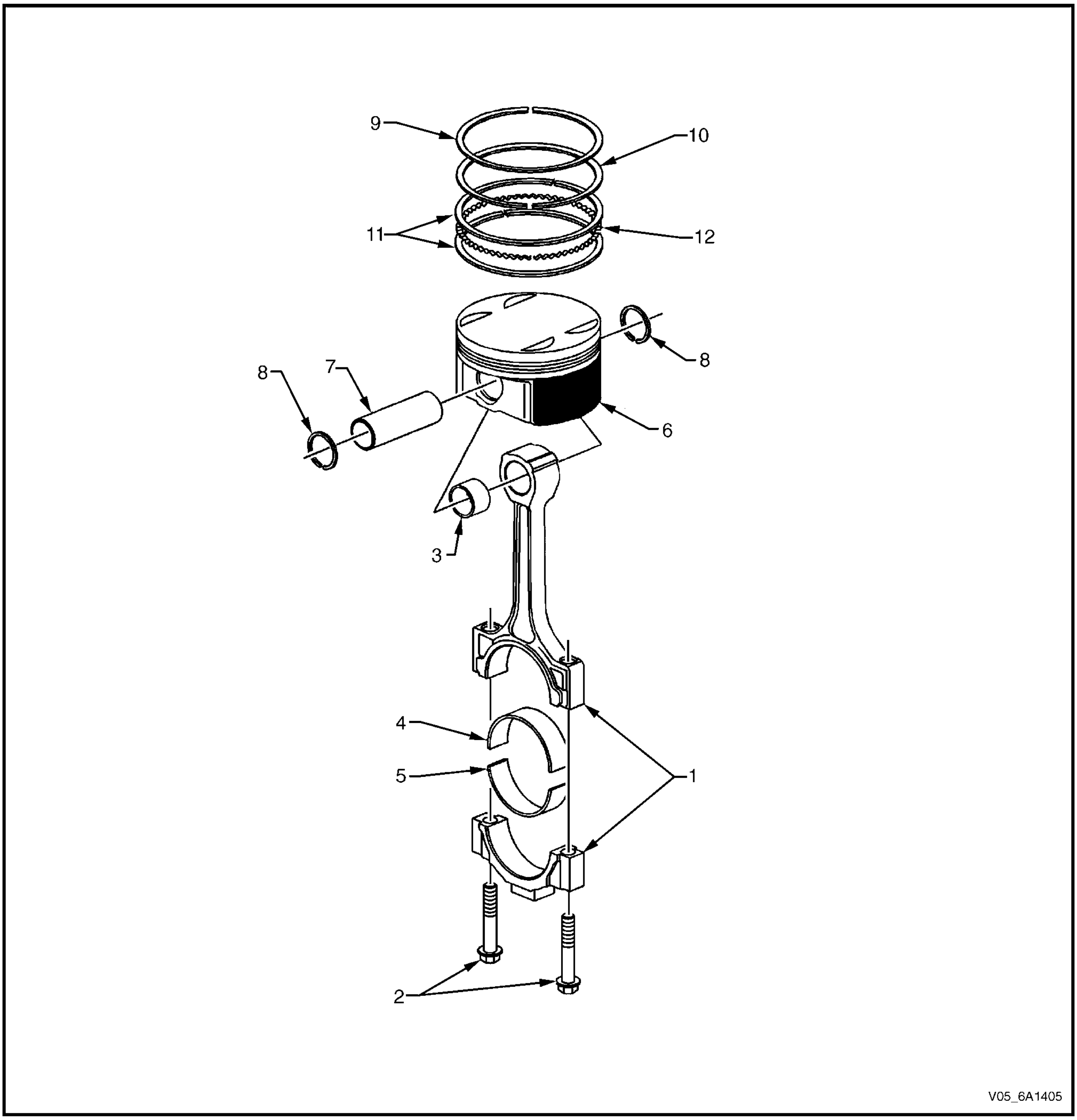


Figure 6A1 – 10

Legend

1	Connecting Rod	7	Piston Pin
2	Connecting Rod Bolt	8	Piston Pin Retainer
3	Connecting Rod Bush	9	Piston Upper Compression Ring
4	Upper Connecting Rod Bearing	10	Piston Lower Compression Ring
5	Lower Connecting Rod Bearing	11	Piston Oil Control Rail Ring
6	Piston	12	Piston Oil Control Ring Spacer

Oil Pan Assembly

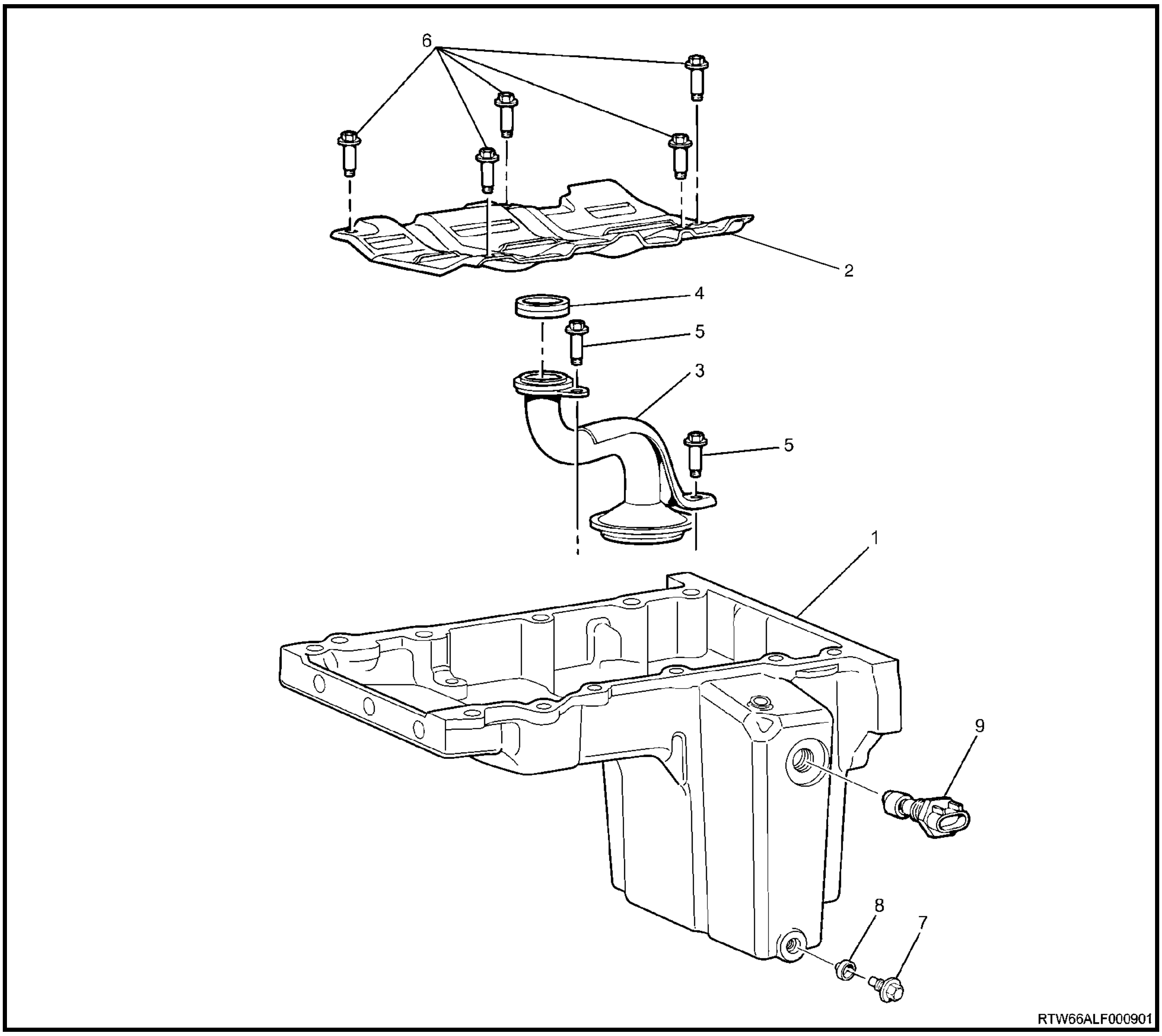


Figure 6A1 – 11

Legend

1	Oil Pan
2	Crankshaft Oil Deflector
3	Oil Pump Suction Pipe
4	Oil Pump Suction Pipe Gasket
5	Oil Pump Suction Pipe Bolt
6	Crankshaft Oil Deflector Bolt
7	Oil Pan Drain Plug
8	Oil Pan Drain Plug Sleeve
9	Engine Oil Level Sensor

Oil Filter Assembly

Legend

1 Oil Filter Gasket
2 Oil Filter Adapter
3 Oil Filter Adapter Bolt
4 Oil Filter Element

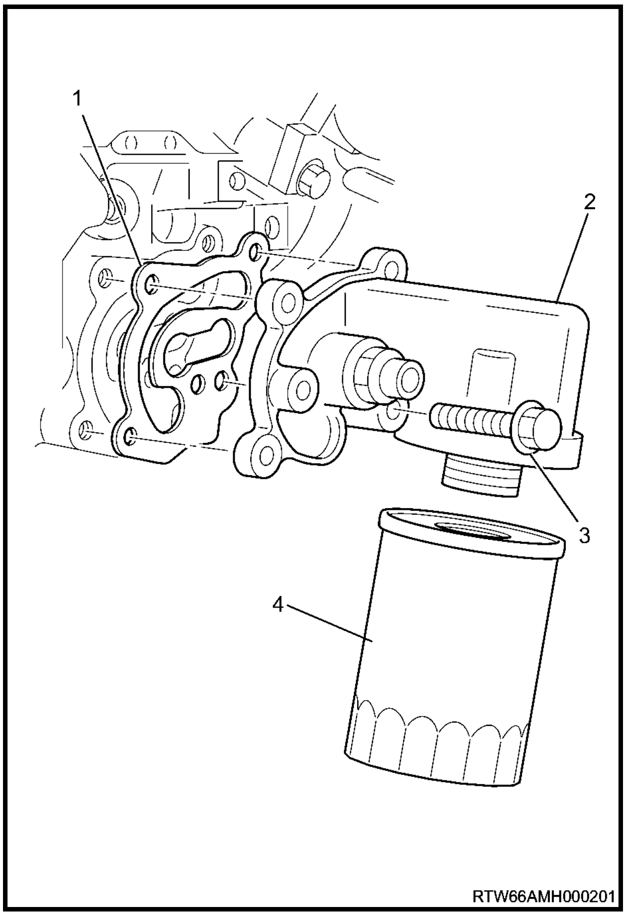


Figure 6A1 – 12

1.3 Engine Serial Number

The engine serial number is located on the machined pad (1) at the left-hand rear of the cylinder block.

The following is a breakdown of the engine serial number, using an example of 10H7E H051230001:

- 10 = Component ID (i.e. 10 = Assembly)
- H7E = Engine Broadcast Code
- H = Assembly Plant Code
- 05 = Build Year
- 123 = Julian Date
- 0001 = Four Digit Daily Sequence Number

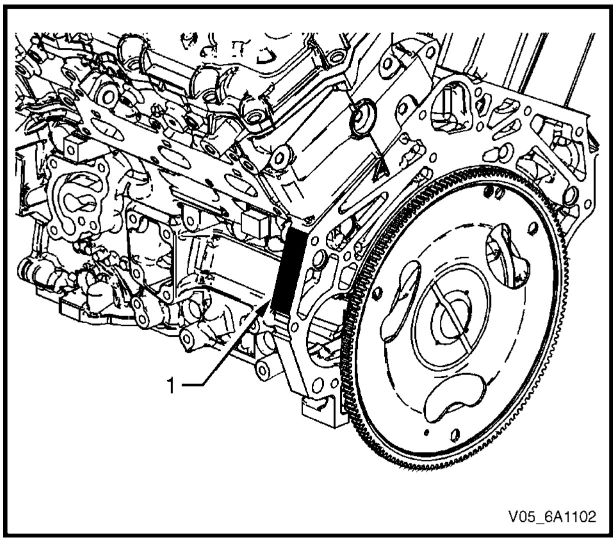


Figure 6A1 – 13

1.4 Engine Construction

Cylinder Block

The cylinder block (1) is constructed from aluminium alloy with cast-in-place iron cylinder bore liners.

Each of the four copper-infiltrated sintered steel main bearing caps are attached to the cylinder block by six bolts. Along with two outer and two inner bolts, two side bolts are used in the deep skirt block for increased block stiffness.

The crankshaft thrust bearing is mounted in the third main bearing cap.

To prevent aeration, oil return from the valve train and cylinder heads is channelled away from the reciprocating components through oil drain back passages incorporated into the cylinder heads and engine block. Pressure actuated piston oil cooling jets are mounted between opposing cylinders.

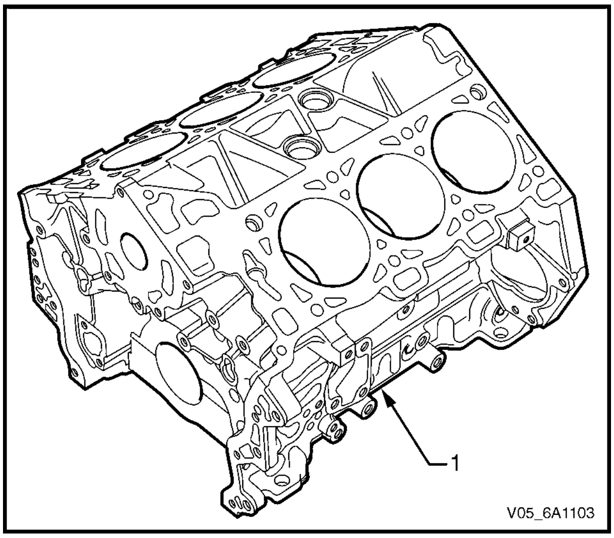


Figure 6A1 – 14

Cylinder Heads

The cylinder heads (1) are semi-permanent mould cast aluminium with powdered metal valve seat inserts and valve guides.

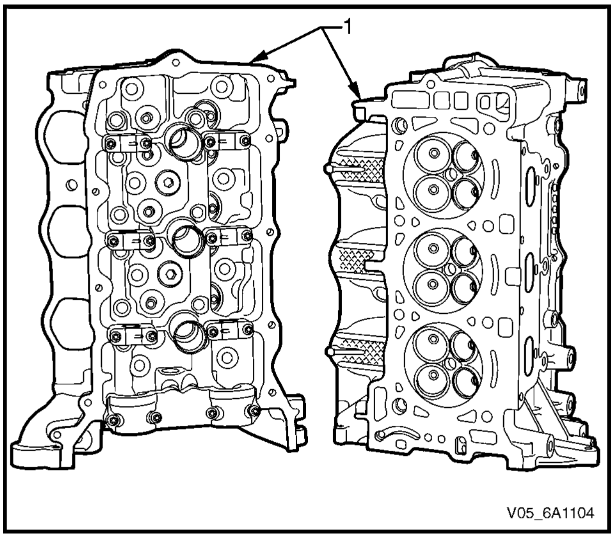


Figure 6A1 – 15

Each cylinder head contains four valves per cylinder. The valves (1) are actuated by the rocker arms (2) that pivot on stationary hydraulic lash adjusters (3), which are oil-fed to maintain valve / rocker lash.

The separate exhaust and intake camshafts are supported by four bearings machined into the cylinder head. The front camshaft bearing cap is used as a thrust control surface for each camshaft.

A tube (4) is pressed into each cylinder head in three places that shields each spark plug. An ignition coil assembly is mounted directly on each spark plug, through each spark plug tube.

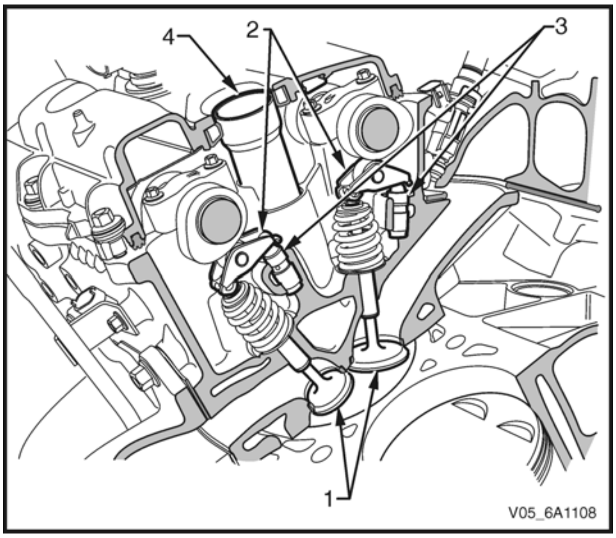


Figure 6A1 – 16

SEVERE CONDITIONS MAINTENANCE SCHEDULE (For EUROPE)

Severe driving conditions
- A: Repeated short trips
- B: Driving on rough roads
- C: Driving on dusty roads
- D: Driving in extremely cold weather and/or on salted roads
- E: Towing trailer or climbing mountein frequently

MT : Manual transmission
AT : Automatic transmission
4WD : Four wheel drive

Item	Interval		Condition					
			A	B	C	D	E	A+D
Engine oil	Change every 5,000 km (3,000 miles)				●			●
Engine oil filter	Replace every 5,000 km (3,000 miles)				●			●
Exhaust pipes and mounting	Inspect every 10,000 km (6,000 miles)		●	●		●		
Air cleaner element	Replace every 20,000 km (12,000 miles)				●			
Steering system for looseness or damage	Inspect every 5,000 km (3,000 miles)			●				
Universal joints and sleeves	Inspect for wear and lubricate every 10,000 km (6,000 miles)			●	●			
Transmission or transmission with transfer case oil	MT	Change every 30,000 km (18,000 miles) after changing at initial 10,000 km (6,000 miles)		●				
	AT	Transmission: Inspection every 20,000 km (12,000 miles)	●	●	●		●	●
	4WD	Transfer: Change every 30,000 km (18,000 miles) After changing at initial 10,000 km (6,000 miles)		●				
Differential oil	Change every 20,000 km (12,000 miles) after changing at initial 10,000 km (6,000 miles)			●				
Front brake pads and discs wear	Inspect every 5,000 km (3,000 miles)		●	●	●			
Rear brake lining and drum wear	Inspect every 5,000 km (3,000 miles)		●	●	●			

Disassembly

1. Clean the oil pump with solvent (plug the discharge and suction ports to prevent the entry of solvent).
   Be careful not to expose the oil seal of shaft assembly to solvent.
2. Remove the bolt, suction pipe and O-ring.
3. Remove the connector, O-ring, relief valve and spring.
4. Remove the bolt, rear housing and O-ring.
5. Remove the snap ring.
6. Remove the shaft assembly.
7. Remove the oil seal.

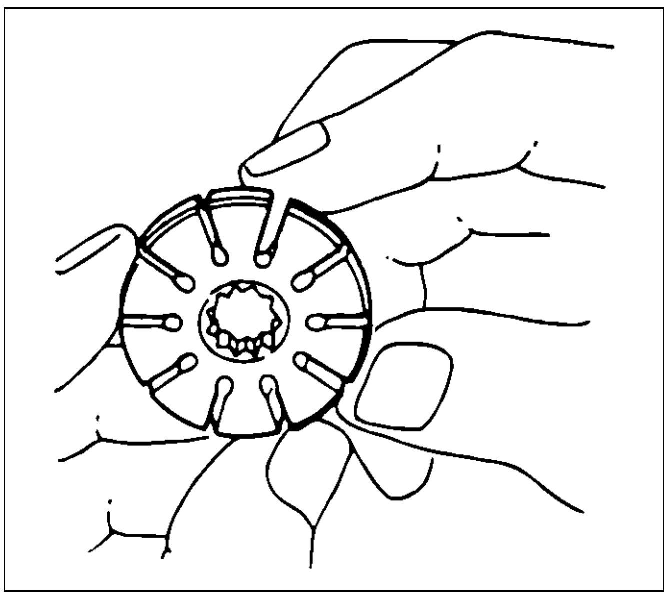
CAUTION: When removing the oil seal, be careful not to damage the housing.

8. Remove the pump cartridge assembly from the front housing.
9. Remove two O-rings.

Inspection and Repair

Make all necessary adjustments, repairs, and part replacements if wear, damage, or other problems are discovered during inspection.

Rotor



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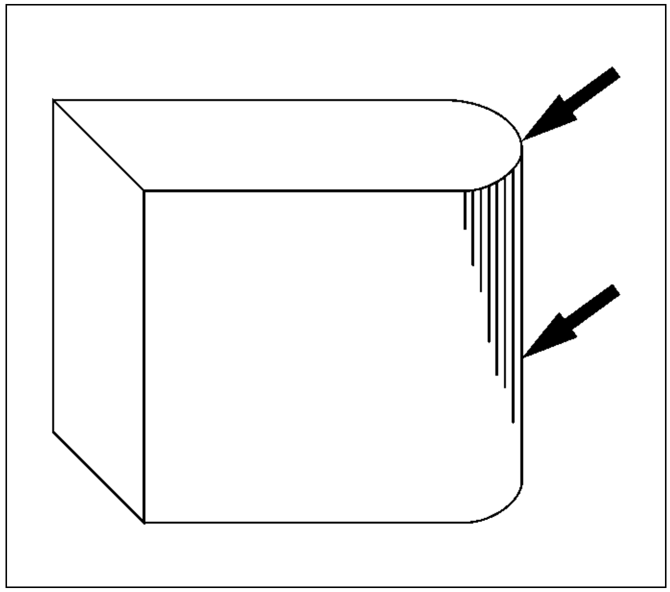
Check that the groove in the vane is free from excessive wear and that the vane slides smoothly. When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Vane



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Sliding faces of the vane should be free from wear. (Particularly the curved face at the tip that contact with the cam should be free from wear and distortion). When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Cam

The inner face of the cam should have a uniform contact pattern without a sign of step wear. When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Side Plate

The sliding faces of parts must be free from step wear (more than 0.01 mm (0.0004 in)), which can be felt by the finger nail.
The parts with minor scores may be reused after lapping the face.

Relief Valve

The sliding face of the valve must be free from burrs and damage. The parts with minor scores may be reused after smoothing with emery cloth (#800 or finer).

Shaft

Oil seal sliding faces must be free from a step wear which can be felt by the finger nail. Bushing fitting face must be free from damage and wear.

O-ring, Oil Seal, Snap Ring

Be sure to discard used parts, and always use new parts for installation. Prior to installation, lubricate all seals and rings with power steering fluid.

Crankshaft

The crankshaft is a forged steel design with four main bearings. The number three main bearing controls crankshaft thrust. A crankshaft position reluctor wheel is pressed onto the rear of the crankshaft, in front of the rear main journal. The crankshaft is internally balanced with an integral oil pump drive machined into the nose in front of the front main journal.

Pistons, Pins and Connecting Rods

The piston assembly (1) is fitted with two low tension compression rings and one multi-piece oil control ring. The top compression ring is plasma sprayed, while the second compression ring is cast iron Napier.

The oil control ring incorporates a steel expander and two chrome plated steel rails.

The connecting rods are sinter forged steel and have full floating piston pins. The piston pins are a slip-fit type, into the bronze bushed connecting rods. Round wire retainers are used to retain the piston pin into the piston.

The cast aluminium pistons incorporate a polymer coated skirt to reduce friction.

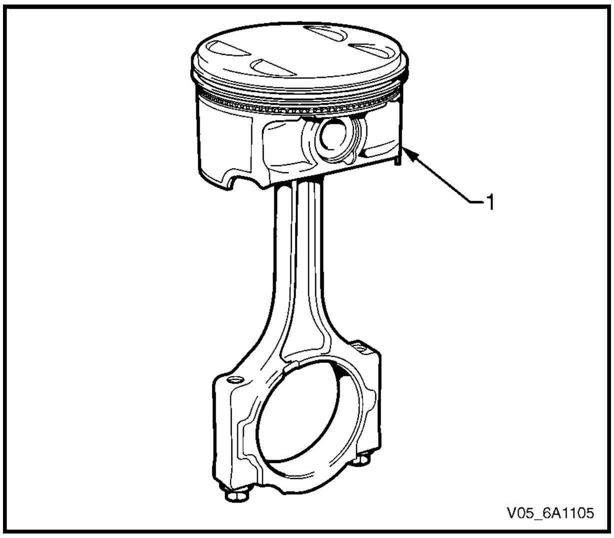


Figure 6A1 – 17

Camshaft Drive System

Three timing chains are fitted:

- primary (1),
- right-hand secondary (2), and
- left-hand secondary (3), refer to Figure 6A1 – 18 for the HFV6 engine.

The primary timing chain connects the crankshaft sprocket (4) with the left-hand and right-hand intermediate drive shaft sprockets (5).

Each oil pressure fed intermediate sprocket drives the secondary timing chains, which subsequently drive the respective cylinder head camshaft position actuators (6).

Two stationary timing chain guides (7) and movable timing chain shoes (8) control secondary timing chain backlash.

Each secondary timing chain shoe is under tension from an oil pressure hydraulically operated tensioner (9). To control backlash on the primary chain, two stationary timing chain guides (10) and an oil pressure hydraulically actuated tensioner with built in shoe (11) are fitted.

The tensioners minimise timing chain noise and provide accurate valve action by keeping slack out of the timing chains, while continuously adjusting for timing chain wear. The tensioners incorporate a plunger that adjusts outward with wear, minimising backlash. The tensioners are equipped with oiling jets to spray oil onto the timing components during engine operation. Each tensioner is sealed to the head or block using a rubber coated steel gasket. The gasket traps an adequate oil reserve to ensure quiet start-up.

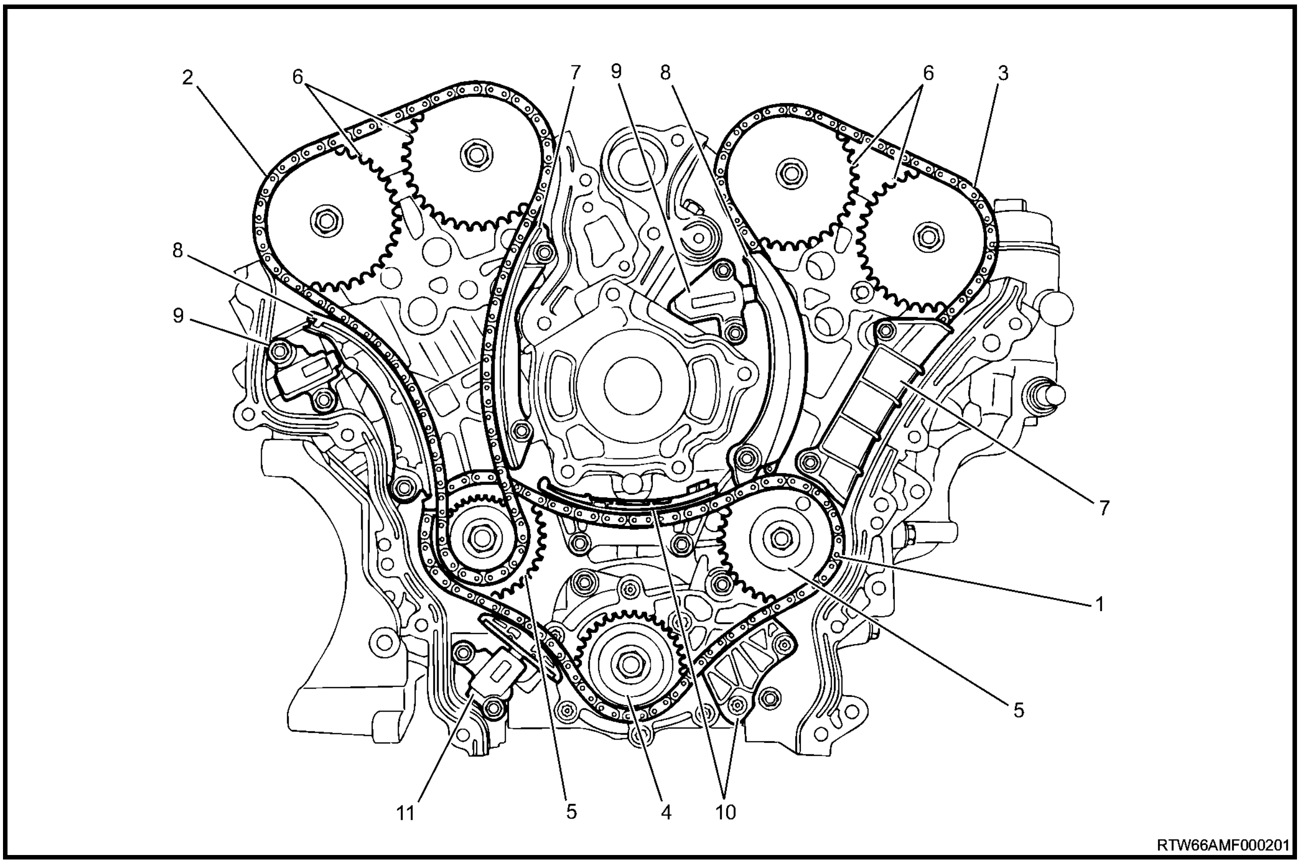


Figure 6A1 – 18

Legend

1	Primary Timing Chain	7	Secondary Timing Chain Guide
2	Secondary Timing Chain, Right-hand	8	Secondary Timing Chain Shoe
3	Secondary Timing Chain, Left-hand	9	Secondary Timing Chain Tensioner
4	Crankshaft Sprocket	10	Primary Timing Chain Guide
5	Intermediate Sprocket	11	Primary Timing Chain Tensioner
6	Camshaft Sprocket		

1.5 Engine Lubrication System

Lubrication Description

A structural diecast aluminium oil pan is fitted that incorporates an oil suction pipe, an oil deflector and an oil level sensor. The oil suction pipe is bolted into the oil pan and seals to the bottom of the cylinder block with a gasket. The oil deflector is bolted to the upper portion of the oil pan and ensures oil supply is maintained under all conditions. The oil level sensor is mounted through the bottom of the oil pan.

A crankshaft driven gerotor oil pump is mounted to the front of the cylinder block. The pump, which incorporates an internal pressure-relief valve, draws oil from the oil suction tube through the lower passage in the cylinder block. Oil is then directed through an upper passage to the left-hand side of the cylinder block where the oil filter adapter is mounted.

The oil filter adapter incorporates a top-access, cartridge style oil filter. The filter is accessed through a screw-on cap that incorporates an oil bypass valve. The oil filter adapter housing incorporates a drain back control valve and a threaded oil pressure sender. Oil flows through a lower passage within the oil filter adapter and through the oil filter cartridge. Filtered oil travels back through the upper passage of the adapter and into the engine block.

Oil is then directed up and across the front of the cylinder block, through several drilled passages. These front passages feed oil to each cylinder head, the passage for the main bearings and piston oil jets, the right-hand and left-hand secondary idler sprockets and to the primary timing chain tensioner.

Each cylinder head passage directs oil into oiling circuits for the stationary hydraulic lash adjusters (SHLAs) and the camshaft bearing journals. An additional passage in the cylinder head also directs oil to the secondary timing chain tensioner.

The oil passage that supplies oil to the main bearings also supplies oil to pressure actuated piston cooling oil jets. Each oil jet is mounted between opposing cylinder bores and directs oil to the two bores to provide extra cooling and control piston temperatures.

From the front passages, oil is directed to the front of the block where the right-hand and left-hand intermediate drive shaft sprockets and the primary timing chain tensioner are mounted. Each camshaft timing chain tensioner relies on a gasket to maintain an oil reserve after the engine is turned off. All camshaft timing chain tensioners incorporate a small oil jet to supply an oil spray onto the camshaft timing chain components.

Oil returns to the oil pan, either through the camshaft timing chain area or through the drain back passages on the outboard walls of the cylinder heads and cylinder block.

1.6 Service Notes

Cleanliness and Care

Throughout this Section, correct cleaning and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard workshop practice, even if not specifically stated.

When any internal engine part is serviced, care and cleanliness is extremely important.

When components are removed for service, they should be marked, organised or retained in a specific order for reassembly.

At the time of installation, components should be installed in the same location and with the same mating surface as when removed.

Any engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in thousandths of a millimetre. These surfaces should be covered or protected to avoid component damage.

A liberal coating of clean engine oil should be applied to friction areas during assembly, as the lubrication will protect and lubricate friction surfaces during the initial engine start-up.

Replacing Engine Gaskets

Re-Using Gaskets and Applying Sealants

- do not reuse any gasket unless specified,
- gaskets that can be reused will be identified in the service procedure, and
- do not apply sealant to any gasket or sealing surface unless specified in the service information.

Separating Components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

Cleaning Gasket Surfaces

- Where required, remove all gasket and sealing material from the part using a plastic or wood scraper.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces as these methods of cleaning can cause damage to the component sealing surfaces. Abrasive pads also produce fine grit that the oil filter cannot remove from the oil. This grit is abrasive and has been known to cause internal engine damage.

Assembling Components

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Do not allow the sealant to enter into any blind threaded holes as it may prevent the bolt from clamping correctly or cause component damage when tightened.
- Only ever tighten bolts to the correct torque specification. Do not over-tighten.

Use of Room Temperature Vulcanising and Anaerobic Sealer

CAUTION

A number of sealant types are commonly used in engines. Examples are; room temperature vulcanising (RTV) sealer, anaerobic gasket eliminator sealer, and anaerobic thread sealant and pipe joint compound. The correct type of sealant and amount must be used in the specified location to prevent oil leaks. Do not interchange the different types of sealers.

Room Temperature Vulcanising Sealer

- Room temperature vulcanising (RTV) sealant hardens when exposed to air. This type of sealer is used where two non-rigid parts (such as the intake manifold and the engine block) are assembled together.
- Do not use RTV sealant in areas where extreme temperatures are experienced. These areas include the exhaust manifold, head gasket, or other surfaces where a gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply RTV to a clean surface. Use a bead size as specified in the service procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes, as it may prevent the bolt from clamping correctly or cause damage when the bolt is tightened.
- Assemble components while RTV is still wet (within 3 minutes). Do not wait for RTV to skin over.
- Tighten the bolts to the correct torque specification. Do not over-tighten.

Anaerobic Sealer

- Anaerobic gasket eliminator or thread sealant, hardens in the absence of air. This type sealer is used where two rigid parts (such as castings) are assembled together, where fasteners are subjected to vibration, or where the holes are not blind. When two rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using a gasket eliminator.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply a continuous bead of gasket eliminator to one flange or on the bolt/stud thread. All surfaces must be clean and dry.
- Spread the sealer evenly to achieve a uniform coating on the sealing surface.
- Do not allow the sealer to enter any blind threaded holes as it may prevent the bolt from clamping correctly or cause damage when tightened.

CAUTION

Anaerobic sealed joints that are partially tightened and allowed to cure more than five minutes may result in incorrect shimming and sealing of the joint.

- Tighten the bolts to the correct torque specification. Do not over-tighten.
- After correctly tightening the fasteners, remove the excess sealer from the outside of the joint.

Pipe Joint Compound

- Pipe joint compound is a pliable sealer that does not completely harden. This type of sealer is used where two non-rigid parts (such as pressed steel and machined surfaces) are assembled together.
- Do not use pipe joint compound in areas where extreme temperatures are expected. These areas include the exhaust manifold, head gasket, or other surfaces where gasket eliminator is specified.
- Follow all safety recommendations and directions that are on the container.
- To remove the sealant or the gasket material, refer to Replacing Engine Gaskets.
- Apply the pipe joint compound to a clean surface. Use a bead size or quantity as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer to enter any blind threaded holes as it may prevent the bolt from clamping correctly or cause component damage when the bolt is tightened.
- Apply a continuous bead of pipe joint compound to one sealing surface. Sealing surfaces to be resealed must be clean and dry.
- Tighten the bolts to the correct torque specification. Do not over-tighten.

Separating Parts

CAUTION

Many internal engine components will develop specific wear patterns on their friction surfaces. When disassembling the engine, internal components must be separated, marked and organised in a way to ensure reinstallation in their original location and position.

Separate, mark, or organise the following components:

- Piston and the piston pin.
- Piston to the specific cylinder bore.
- Piston rings to the specific piston.
- Connecting rod to the crankshaft journal.
- Connecting rod to the bearing cap.
- Crankshaft main and connecting rod bearings.
- Camshaft and rocker arms.
- Rocker arms and stationary hydraulic lash adjusters to cylinder head location.
- Valve to the valve guide.
- Valve spring and shim to the cylinder head location.
- Engine block main bearing cap location and direction.
- Oil pump drive and driven gears.

Tools and Equipment

Special tools are listed and illustrated throughout this Section with a complete listing at the end, refer to 7 Special Tools. These tools (or their equivalents) are specially designed to quickly and safely accomplish the operations for which they are intended. The use of these special tools will also minimise possible damage to engine components. Some precision measuring tools are required for inspection of certain critical components. A commercially available torque wrench and torque angle wrench, Tool No. EN-7115 are required for the correct tightening of various fasteners.

To correctly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves.
- A clean, well-lit, work area.
- A suitable parts cleaning tank.
- A compressed air supply.
- Trays or storage containers to keep parts and fasteners organised.
- An adequate set of hand tools.
- Approved engine repair stand.
- An approved engine lifting device that will adequately support the weight of the components.

Fasteners

Fasteners are central to the reliable operation of an engine. Whenever any bolt or any other threaded component is removed, allow the engine to cool (inset A) before attempting fastener removal.

Because of the greater thermal expansion of aluminium, bolt threads will change dimension to a greater extent when hot with this material (inset B) when compared to cast iron.

If a bolt or other threaded component is removed before the engine is allowed to cool to at least 50° C, threads could be pulled from the cylinder block or cylinder head.

Do not use impact tools to remove bolts during engine disassembly. While this may be common practice with cast iron engine components, use of these tools is more likely to pull the aluminium threads in the cylinder block or head of this engine.

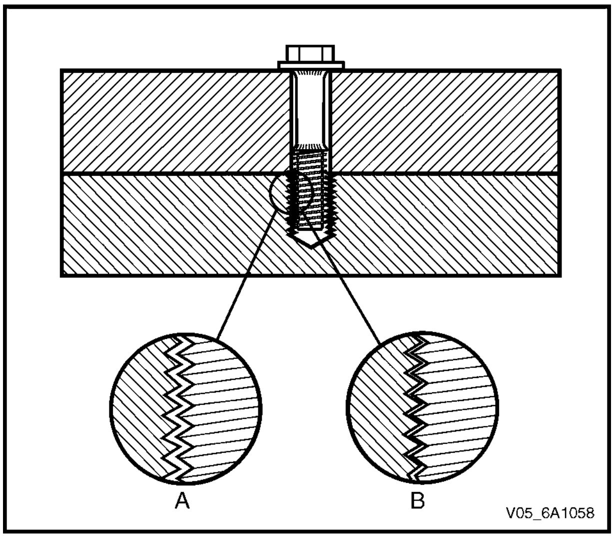


Figure 6A1 – 19

Clamp Load

When torque is applied to a fastener, the fastener stretches and the joint compresses. The force developed in the fastener due to its stretch is called tension (C), while the force applied to the joint is called clamp load (B).

As shown, only a small portion of the applied torque (A) is transferred to the clamp load (inset 1). Friction under the bolt head (inset 3) and in the threads (inset 2) absorbs much of the applied torque (A). Typically, only 10% (inset 1) of the torque is available to develop stretch (or tension) in the fastener and clamp load in the joint.

Therefore, a slight variation in friction in the thread or under the bolt head, results in a wide variation in the clamp load applied to the joint.

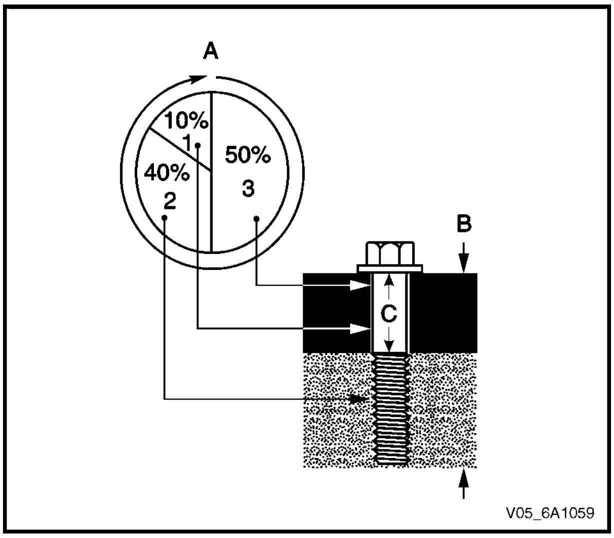


Figure 6A1 – 20

Torque Angle and Torque to Yield Fasteners

The torque angle method of applying torque to a fastener has been developed to overcome the effects of friction variation in fastener applications.

The application of the torque angle method does not always mean the fastener has to be replaced after loosening. It is only when the fastener has been angle tightened to the extent the yield point has been exceeded, that the fastener must be replaced.

Examples are the main bearing caps that are angle tightened but the bolts can be re-used, whereas the M11 cylinder head bolts that are torque to yield fasteners, must be replaced after loosening.

2 Diagnosis

2.1 Engine Diagnosis

Begin engine mechanical system diagnosis by reviewing the disassembled views provided in 1.2 Engine Components and 1.4 Engine Construction. Reviewing the description and operation information provided will assist in determining whether the condition described by the customer is a fault or normal engine operation.

2.2 Symptoms

Strategy Based Diagnosis

1 Review the system operations to familiarise yourself with the system functions, refer to 1 General Information and 6C1-1 Engine Management General Information.

2 Perform an engine management Diagnostic System Check, refer to Section 6C1-2 Engine Management – V6 – Diagnostics.

All diagnosis on a vehicle should follow a logical process. Strategy based diagnosis is a uniform approach for repairing all vehicle systems. The strategy based diagnostic flow chart may always be used to resolve a system problem. The diagnostic flow chart is the place to start when repairs are required. For a detailed explanation of strategy based diagnosis and the flow chart, refer to Section 6C1-2 Engine Management – V6 – Diagnostics.

Visual / Physical Inspection

1 Inspect the vehicle for aftermarket accessories which may adversely affect engine operation.

2 Inspect the easily accessible or visible system components for obvious signs of damage or conditions that may cause the symptom.

3 Check the engine lubrication system for the following:

- correct oil level,
- correct lubricant viscosity,
- correct oil filter application, and
- contaminated or burnt oil.

4 Confirm the exact operating conditions under which the fault occurs. Note factors such as:

- engine speed (r.p.m.),
- ambient temperature,
- engine temperature,
- engine warm-up time, and
- vehicle road speed.

5 Compare the engine sounds, if applicable, to a known good engine, and ensure you are not trying to diagnose a normal operating condition.

Intermittent

For intermittent faults, test the vehicle under the same conditions the customer reported in order to confirm whether the system is operating correctly.

2.3 Engine Misfire without Internal Engine Noises

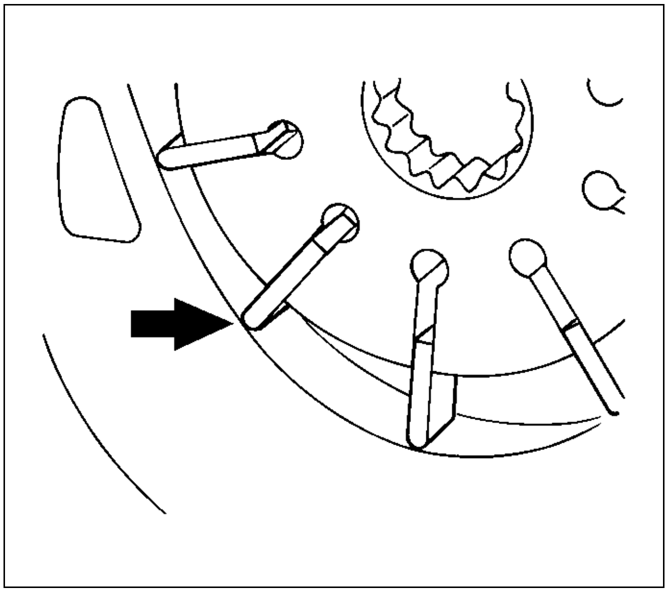
Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt. Abnormalities in the accessory drive system and/or components may cause engine speed variations that result in a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the accessory drive belt, refer to 3.5 Accessory Drive Belt. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs.
Worn, damaged or misaligned accessory drive components and excessive pulley run-out may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace as required. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs.
Loose or incorrectly fitted flexplate or crankshaft balancer assembly. A misfire DTC may be present without an actual misfire condition.	Repair or replace the flexplate or crankshaft balancer as required, refer to 3.13 Crankshaft Balancer Assembly or 4.3 Flexplate Assembly. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Restricted exhaust system. A severe restriction in the exhaust flow can cause significant loss of engine performance and may set a DTC. Possible causes of restrictions in the exhaust system include collapsed/dented pipes and blocked mufflers and/or catalytic converters.	Repair or replace exhaust system components as required, refer to 8B Exhaust System. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Incorrectly installed or damaged vacuum hoses.	Repair or replace vacuum hoses as required.
Incorrect sealing between the intake manifold and cylinder heads, upper intake manifold and lower intake manifold, throttle body and intake manifold.	Repair or replace the intake manifold, throttle body gaskets, cylinder heads, throttle body as required.
Incorrectly installed or damaged barometric pressure(BARO) sensor and/or seal. The seal should not be torn or damaged.	Repair or replace the BARO sensor and/or seal as required, refer to 6C1-3 Engine Management – V6 – Service Operations.
Incorrectly installed or damaged EVAP purge solenoid and/or O-ring seal.	Repair or replace the EVAP purge solenoid and/or seal as required, refer to 6C1-3 Engine Management – V6 – Service Operations
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or rocker arms. The SHLAs, rocker arms and roller bearings should be intact and in the correct position.	Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Stuck valves. Carbon build up on the valve stems can result in the valves not closing correctly.	Repair or replace as required, refer to 3.22 Cylinder Head Assembly.
Excessively worn or misaligned timing chain/s.	Replace the timing chain/s and components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Excessive oil pressure. A lubrication system with excessive oil pressure may lead to excessive lash adjuster pump-up and loss of compression.	1 Perform an oil pressure test, refer to 3.1 Engine Oil. 2 Repair or replace the engine oil pump as required, refer to 3.17 Oil Pump Assembly.

Reassembly

1. Install oil seal to front housing. Be sure to discard used oil seal, and always use new parts for installation.

CAUTION: When installing the oil seal, be careful not to damage the oil seal contacting surface of the housing.

2. Install shaft assembly.
3. Install the vanes to roter with curved face in contact with the inner wall of cam.



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4. Install roter and vanes to cam.
5. Install pin to front housing.
6. Install two new O-rings to front housing. Be sure to discard used O-ring.
7. Install side plate.

CAUTION: When installing side plate, be careful not to damage its inner surface. Damaged side plate may cause poor pump performance, pump seizure or oil leakage.

8. Install pump cartridge assembly to front housing.
9. Install snap ring to shaft end.
10. Install rear housing with a new O-ring. Be sure to discard used O-ring. Then install bolt and tighten it to specified torque.

    Torque: 25 N·m (2.5 kgf·m/18 lb·ft)
11. Install suction pipe with a new O-ring. Be sure to discard used O-ring. Then install bolt and tighten it to specified torque.

    Torque: 10 N·m (1.0 kgf·m/87 lb·in)
12. Install relief valve and spring.
13. Install connector with a new O-ring. Be sure to discard used O-ring. Tighten the connector to specified torque.

    Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

Main Data and Specifications

General Specifications

Oil pump	Type	Vane
	Operating fluid	ATF DEXRON®—III

Cause	Correction
Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and cylinder block coolant passages. Coolant consumption may or may not cause the engine to overheat.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect the cylinder heads, cylinder block and/or head gaskets, refer to 3.22 Cylinder Head Assembly and/or 4.7 Cylinder Block. 3 Repair or replace components as required.
Worn piston rings. Oil consumption may or may not cause the engine to misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.
A damaged crankshaft reluctor wheel. A damaged crankshaft reluctor wheel can result in different symptoms depending on the severity and location of the damage. Systems with severe reluctor ring damage may exhibit periodic loss of crankshaft position, stop delivering a signal, and then re-sync the crankshaft position. Systems with slight reluctor ring damage may exhibit no loss of crankshaft position and no misfire may occur, however, a DTC may set.	Replace the crankshaft as required, refer to 4.6 Crankshaft and Main Bearings. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs

2.4 Engine Misfire with Abnormal Internal Lower Engine Noises

Cause	Correction
Abnormalities, severe cracking, bumps or missing areas in the accessory drive belt. Abnormalities in the accessory drive system and/or components may cause engine speed variations that result in a misfire diagnostic trouble code (DTC). A misfire code may be present without an actual misfire condition.	Replace the accessory drive belt, refer to 3.5 Accessory Drive Belt. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Worn, damaged or misaligned accessory drive components and excessive pulley run-out may lead to a misfire DTC. A misfire code may be present without an actual misfire condition.	Inspect the components and repair or replace as required. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs
Loose or Incorrectly fitted flexplate or crankshaft balancer assembly. A misfire code may be present without an actual misfire condition.	Repair or replace the flexplate or crankshaft balancer as required, refer to 3.13 Crankshaft Balancer Assembly or 4.3 Flexplate Assembly.
Worn or broken piston rings. Oil consumption may or may not cause an actual misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.
Worn crankshaft thrust bearing. Severely worn thrust surfaces on the crankshaft and/or thrust bearing may permit fore and aft movement of the crankshaft and create a DTC without an actual misfire condition being present.	Replace the crankshaft and/or bearings as required, refer to 4.6 Crankshaft and Main Bearings. Refer to 6C1-2 Engine Management – V6 – Diagnostics to check for DTCs

2.5 Engine Misfire with Abnormal Valve Train Noise

Cause	Correction
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or valve rocker arms. The SHLAs, rocker arm and roller bearings should be intact and in the correct position.	Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Stuck valves. Carbon build up on the valve stems can result in the valves not closing correctly.	Repair or replace as required, refer to 3.22 Cylinder Head Assembly.
Excessively worn or misaligned timing chain/s.	Replace the timing chain/s and components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Sticking camshaft lash adjusters.	Replace the lash adjusters as required, refer to 3.21 Stationary Hydraulic Lash Adjuster.

2.6 Engine Misfire with Coolant Consumption

Cause	Correction
Faulty cylinder head gasket and/or cracking or other damage to the cylinder heads and cylinder block coolant passages. Coolant consumption may or may not cause the engine to overheat.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect the cylinder heads, cylinder block and/or head gaskets, refer to 3.22 Cylinder Head Assembly and/or 4.7 Cylinder Block. 3 Repair or replace components as required.

2.7 Engine Misfire with Excessive Oil Consumption

Cause	Correction
Worn valves, valve guides and/or valve stem oil seals.	1 Inspect the spark plugs for coolant saturation, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Repair or replace components as required, refer to 3.22 Cylinder Head Assembly.
Worn or broken piston rings. Oil consumption may or may not cause an actual misfire.	1 Inspect the spark plugs for oil deposits, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Check the cylinders for a loss of compression, refer to 2.15 Engine Compression Test. 3 Perform compression testing to identify the cause of low compression. 4 Repair or replace components as required.

2.8 Engine Noise on Start-up, but only Lasting a Few Seconds

NOTE

A cold piston knock, which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Oil filter anti-drain back valve faulty.	Replace the oil filter adaptor, refer to 3.3 Oil Filter Adaptor.
Incorrect oil viscosity.	Drain the engine oil and replace with the correct viscosity oil, refer to 3.1 Engine Oil.
High camshaft stationary hydraulic lash adjuster (SHLA) leak down rate.	Replace the SHLA as required, refer to 3.21 Stationary Hydraulic Lash Adjuster.
Worn crankshaft thrust bearing.	Inspect and replace the crankshaft and/or bearings as required, refer to 4.6 Crankshaft and Main Bearings.
Damaged or faulty oil filter by-pass valve.	1 Inspect the oil filter by-pass valve for correct operation. 2 Repair or replace the oil filter adaptor/by-pass valve as required.

2.9 Upper Engine Noise, Regardless of Engine Speed

NOTE

A cold piston knock, which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17 Oil Pump Assembly.
Worn or loose stationary hydraulic lash adjusters (SHLA) and/or valve rocker arms. The SHLAs, rocker arm and roller bearings should be intact and in the correct position.	1 Clean, inspect and replace the camshaft lash adjusters as required, refer to 3.21 Stationary Hydraulic Lash Adjuster. 2 Replace the SHLAs and/or rocker arms as required, refer to 3.21 Stationary Hydraulic Lash Adjuster or 3.20 Rocker Arm.
Incorrect lubrication to the stationary hydraulic lash adjusters and valve rocker arm.	Inspect the following components and repair or replace as required: • valve rocker arms, refer to 3.20 Rocker Arm. • stationary hydraulic lash adjusters, refer to 3.21 Stationary Hydraulic Lash Adjuster. • oil filter by-pass valve, refer to 3.3 Oil Filter Adaptor. • oil pump and suction pipe, refer to 3.17 Oil Pump Assembly. • cylinder head oil galleries, refer to 3.22 Cylinder Head Assembly. • cylinder block oil galleries, refer to 4.7 Cylinder Block.
Broken Valve Spring.	Replace the valve spring, refer to 3.22 Cylinder Head Assembly.
Stretched or broken timing chain/s and/or damaged timing chain sprocket teeth.	Replace the timing chains or sprockets as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn or faulty timing chain tensioner or guide.	Replace the timing chains or sprockets as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Worn camshaft lobes.	Replace the camshaft/s and SHLAs as required, refer to 3.19 Camshaft or 3.21 Stationary Hydraulic Lash Adjuster.
Worn valve guides and/or valve stems.	Inspect and repair or replace valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.
Stuck valves. Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect and repair or replace valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.

2.10 Lower Engine Noise, Regardless of Engine Speed

NOTE

A cold piston knock which disappears in approximately 1.5 minutes from start up should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17 Oil Pump Assembly.
Worn accessory drive components. Abnormalities such as severe cracking, bumps, stretching or missing areas on an accessory drive belt and/or misalignment of accessory drive system components.	Inspect the accessory drive system, repair or replace components as required, refer to 3.5 Accessory Drive Belt.
Loose or damaged crankshaft balancer and pulley assembly.	Repair or replace the crankshaft balancer and pulley assembly as required, refer to 3.13 Crankshaft Balancer Assembly.
Detonation or spark knock.	Confirm the correct operation of the ignition system, refer to 6C1-2 Engine Management – V6 – Diagnostics.
Loose torque converter bolts.	Inspect and tighten the torque converter bolts to the correct torque specification, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.
Loose or damaged flexplate.	Repair or replace the flexplate as required, refer to 4.3 Flexplate Assembly.
Oil pump suction pipe loose, damaged or restricted.	Clean, inspect and repair/replace the oil pump suction pipe as required, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.7 Cylinder Block.
Excessive connecting rod bearing clearance.	Inspect the connecting rod, crankshaft and bearings and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Excessive piston pin to bore clearance.	Inspect the pistons and pins and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Excessive crankshaft main bearing clearance.	Inspect the crankshaft, cylinder block journals, main bearings and main bearing caps and repair/replace components as required, refer to 4.6 Crankshaft and Main Bearings and 4.7 Cylinder Block.
Incorrect piston, pin and connecting rod installation. Pistons must be installed with the mark or dimple facing the front of the engine. Piston pins must be centred in the piston pin bore.	Confirm the pistons, pins and connecting rods are installed correctly and repair if required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

2.11 Engine Noise Under Load

NOTE

A cold piston knock which disappears in approximately 1.5 minutes from start up, should be considered acceptable. A cold engine knock usually disappears when the specific cylinder's secondary ignition circuit is grounded out during diagnosis.

A light rattle/tapping noise may indicate a valve train/upper engine concern, while a low rumble/knocking may indicate a crankshaft, piston or lower engine concern.

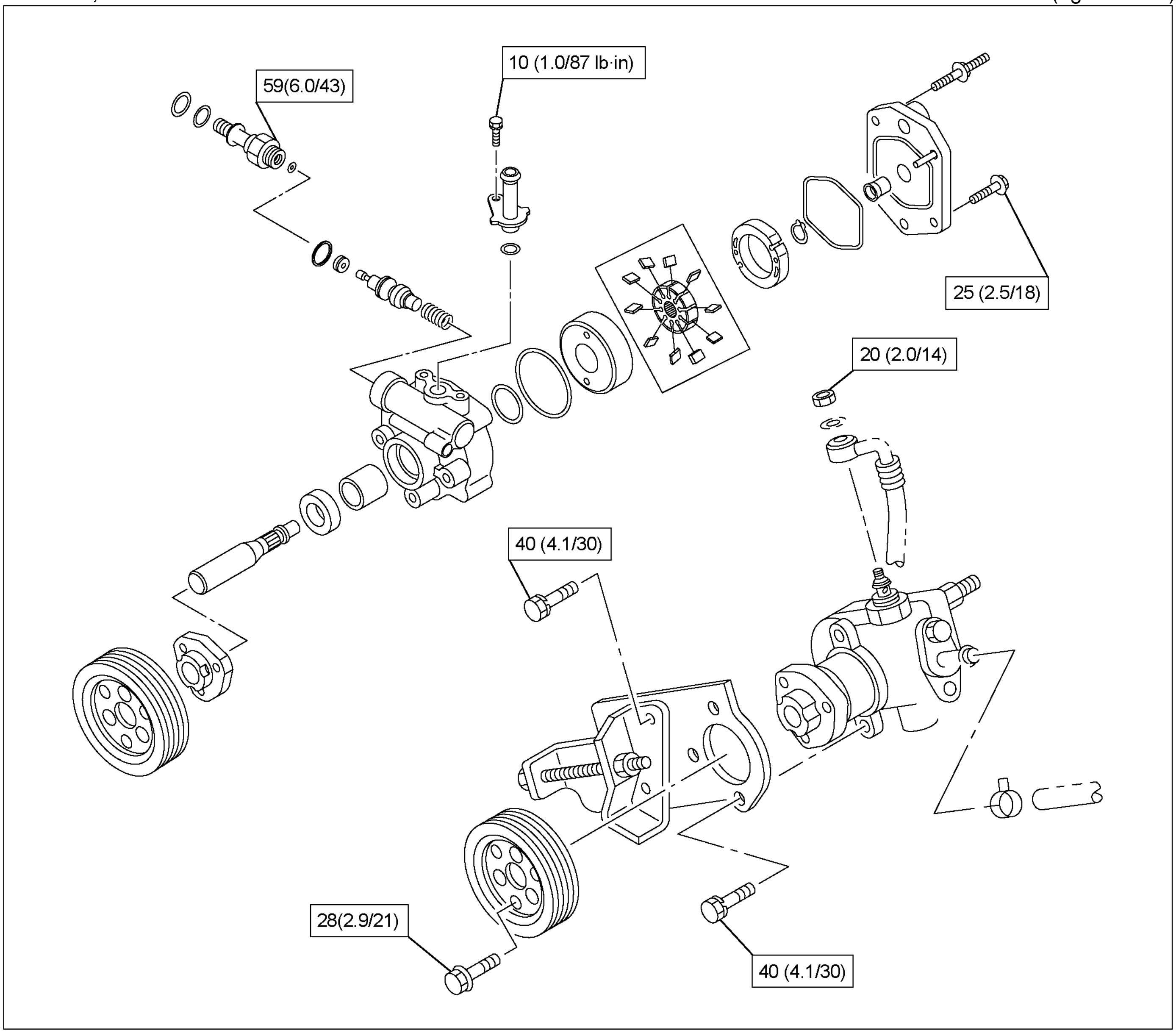
Cause	Correction
Low oil pressure.	1 Perform an oil pressure test, refer to 2.19 Engine Oil Pressure Diagnosis. 2 Repair or replace the engine oil pump as required, refer to 3.17 Oil Pump Assembly.
Detonation or spark knock.	Confirm the correct operation of the ignition system, refer to 6C1-2 Engine Management – V6 – Diagnostics.
Loose torque converter bolts.	Inspect and tighten the torque converter bolts to the correct torque specification, refer to 7C1 Automatic – 4L60E – General Information – 4L60E – General Information.
Cracked flexplate.	Replace the flywheel/flex-plate as required, refer to 4.3 Flexplate Assembly.
Excessive connecting rod bearing clearance.	Inspect the connecting rod, crankshaft and bearings and repair/replace components as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Excessive crankshaft bearing clearance	Inspect the crankshaft, cylinder block journals, main bearings and main bearing caps and repair/replace components as required, refer to 4.6 Crankshaft and Main Bearings and 4.7 Cylinder Block.

2.12 Engine Will Not Crank – Crankshaft Will Not Rotate

Cause	Correction
Seized accessory drive system component.	1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt. 2 Rotate the crankshaft by hand at the balancer pulley or flywheel. 3 Repair or replace accessory drive system components as required.
Hydraulically locked cylinder caused by: • coolant in cylinder, • oil in cylinder, or • fuel in cylinder.	1 Remove the spark plugs and check for fluid, refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Inspect for broken head gasket/s. 3 Inspect for cracked engine block or cylinder head. 4 Inspect for sticking fuel injector. 5 Repair or replace components as required.
Seized torque converter.	1 Remove the torque converter bolts, refer to 7C1 Automatic – 4L60E – General Information – 4L60E – General Information. 2 Rotate the crankshaft by hand at the balancer pulley or flywheel. 3 Repair or replace torque converter as required.
Material in cylinder bore, caused by: • broken valve, • broken piston or ring, or • dirt or foreign matter entry during engine assembly procedure.	1 Clean and inspect the cylinder for damaged components and or foreign matter, refer to 4.7 Cylinder Block. 2 Repair or replace components as required.
Seized crankshaft or connecting rod bearings.	Inspect and repair or replace crankshaft, connecting rod and bearings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings and 4.6 Crankshaft and Main Bearings.
Bent or broken connecting rod.	Inspect and repair or replace connecting rod and bearings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Bent or broken crankshaft.	Inspect and repair or replace crankshaft and bearings as required, refer to 4.6 Crankshaft and Main Bearings.
Seized or broken camshaft.	1 Inspect and replace camshafts as required, refer to 3.19 Camshaft. 2 Inspect camshaft journals and cam caps on cylinder head and repair or replace components as required, refer to 3.22 Cylinder Head Assembly.
Seized or broken camshaft timing components.	1 Inspect the crankshaft, idler, intake camshaft and exhaust camshaft sprockets. 2 Inspect the timing chains. 3 Inspect the guides. 4 Inspect the tensioners. 5 Repair or replace components as required, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.
Seized or broken valve train components.	1 Inspect the stationary hydraulic lash adjusters, refer to 3.21 Stationary Hydraulic Lash Adjuster. 2 Inspect the rocker arms, refer to 3.20 Rocker Arm. 3 Inspect the Valves Refer to 3.22 Cylinder Head Assembly. 4 Inspect the valve springs, refer to 3.22 Cylinder Head Assembly. 5 Repair or replace components as required.

Torque Specifications

4JH1-TC, 4JA1-T N・m (kgf・m/lb・ft)



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2.13 Coolant in Combustion Chamber

Definition

Excessive white smoke and/or coolant type odour emitted from the exhaust pipe may indicate coolant in the combustion chamber. Low coolant levels, an inoperative engine cooling fan or a faulty thermostat may lead to an over-temperature condition which may cause internal engine component damage. A slower than normal cranking speed may indicate coolant entering the combustion chamber.

1 Remove the spark plugs and inspect for spark plugs saturated by coolant and coolant in the cylinder bore.

2 Inspect by performing a cylinder leakage test, refer to 2.16 Cylinder Leakage Test. During this test, excessive air bubbles in the coolant may indicate a faulty head gasket, cracked cylinder head or cracked cylinder block.

3 Inspect by performing a cylinder compression test. Two cylinders side-by-side on the cylinder block, with low compression, may indicate a failed cylinder head gasket, refer to 2.15 Engine Compression Test.

Cause	Correction
Cracked intake manifold or faulty gasket.	Replace components as required, refer to 3.10 Intake Manifold Assembly – Complete.
Faulty cylinder head gasket.	Replace the cylinder head gasket, refer to 3.22 Cylinder Head Assembly.
Warped cylinder head.	Repair or replace the cylinder heads as required, refer to 3.22 Cylinder Head Assembly.
Cracked cylinder liner or block	Repair or replace the cylinder block and components as required, refer to 4.7 Cylinder Block.
Cylinder head or cylinder block porosity.	Repair or replace the cylinder block or cylinder heads as required, refer to 4.7 Cylinder Block or 3.22 Cylinder Head Assembly.

2.14 Coolant in Engine Oil

Definition

Foamy or discoloured oil or an engine oil overfill condition may indicate coolant entering the engine crankcase. Low coolant levels, an inoperative engine cooling fan or a faulty thermostat may lead to an over-temperature condition which may result in engine component damage. Contaminated engine oil and oil filters must be replaced.

1 Inspect the oil for excessive foaming or an overfill condition. Oil diluted by coolant may not correctly lubricate the crankshaft bearings, resulting in component damage, refer to 2.10 Lower Engine Noise, Regardless of Engine Speed.

2 Perform a cylinder leakage test, refer to 2.16 Cylinder Leakage Test. During this procedure, excessive air bubbles in the engine coolant may indicate a faulty gasket or damaged component.

3 Perform a cylinder compression test. Two cylinders side-by-side on the cylinder block, with low compression, may indicate a failed cylinder head gasket, refer to 2.15 Engine Compression Test.

Cause	Correction
Faulty cylinder head gasket.	Replace the cylinder head gasket, refer to 3.22 Cylinder Head Assembly.
Warped cylinder head.	Repair or replace the cylinder heads as required, refer to 3.22 Cylinder Head Assembly.
Cracked cylinder liner or block	Repair or replace the cylinder block and components as required, refer to 4.7 Cylinder Block.
Cylinder head, cylinder block or intake manifold porosity.	Repair or replace the cylinder block, cylinder heads or intake manifold components as required, refer to 4.7 Cylinder Block, 3.22 Cylinder Head Assembly or 3.10 Intake Manifold Assembly – Complete.

2.15 Engine Compression Test

A compression pressure test of the engine cylinders determines the condition of the rings, the valves and the head gasket.

Preliminary Steps

1 Ensure the battery is fully charged.

2 Remove the spark plugs from all cylinders, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

NOTE

DTCs will set when the fuel system or the ignition system is disabled and the engine is cranked. Disregard DTCs that set under this condition.

3 Disable the fuel system by removing the fuel pump relay, refer to Section 8A Electrical Body & Chassis.

4 Start the engine to use any residual fuel from the fuel lines.

4 Disable the ignition coils by removing fuses 34 and 35, refer to Section 8A Electrical Body & Chassis .

5 Using Tech 2, command the throttle plate to wide open throttle.

Engine Cylinder Compression Test

1 Install the compression tester to cylinder number 1.

2 While observing the compression tester reading, turn the ignition to the START position for several seconds and then allow the ignition to return to the ON position.

3 Record the highest compression reading obtained.

4 Repeat the engine compression test for each cylinder.

Test Result Evaluation

Normal engine compression pressure builds quickly and evenly to over 965 kPa. In addition, the lowest reading of an engine cylinder should not be less than 70 percent of the highest reading. If any cylinder fails the compression test, adding 15 ml of engine oil to the suspected cylinder may help isolate the following fault condition.

1 A fault condition in the piston rings will produce the following result:

- A low compression on the first engine cycle
- The compression tends to build-up with the succeeding engine rotation.
- The compression improves with the addition of engine oil.

2 A fault condition in an intake or exhaust valve will produce the following result:

- A low compression on the first engine cycle
- The compression does not build with the succeeding engine rotation.
- The compression does not improve with the addition of engine oil.

3 A fault condition in the cylinder head gasket will produce the following result:

- A low compression on the first engine cycle
- The compression does not build with the succeeding engine rotation.
- The compression does not improve with the addition of engine oil.
- The suspected cylinders are positioned adjacent to each other.
- The engine oil may be contaminated with engine coolant.
- The engine coolant may be contaminated with engine oil.

Once the fault has been identified, refer to the relevant service procedure and reinstall the removed components.

Using Tech 2, clear DTCs.

2.16 Cylinder Leakage Test

A leakage test may be performed to measure cylinder/combustion chamber leakage. High cylinder leakage may indicate one or more of the following:

- worn or burnt valves,
- broken valve springs,
- stuck valve lifters,
- incorrect valve lash/adjustment,
- damaged piston,
- worn piston rings,
- worn or scored cylinder bore,
- damaged cylinder head gasket,
- cracked or damaged cylinder head, or
- cracked or damaged engine block.

1 Disconnect the battery ground negative cable.
2 Remove the spark plugs from all cylinders, refer to Section 6C1-3 Engine Management – V6 – Service Operations.
3 Rotate the crankshaft to place the piston in the cylinder being tested at top dead centre (TDC) of the compression stroke.
4 Install a commercially available cylinder head leak down tester into the spark plug hole.

NOTE

If required, hold the crankshaft balancer bolt to prevent the engine from rotating.

5 Apply shop air pressure to the cylinder head leak down tester and adjust according to the manufacturers instructions.
6 Record the cylinder leakage value. Cylinder leakage that exceeds 25 percent is considered excessive and may require component service. In excessive leakage situations, inspect for the following conditions:
   - air leakage sounds at the throttle body or air inlet duct that may indicate a worn or burnt intake valve or a broken valve spring,
   - air leakage sounds at the exhaust system tailpipe that may indicate a worn or burnt exhaust valve or a broken valve spring,
   - air leakage sounds from the crankcase, oil level indicator tube, or oil fill tube that may indicate worn piston rings, a damaged piston, a worn or scored cylinder bore, a damaged engine block or a damaged cylinder head, or
   - air bubbles in the cooling system may indicate a damaged cylinder head or a damaged cylinder head gasket.
7 Perform the leakage test on the remaining cylinders and record the values.

2.17 Engine Oil Consumption Diagnosis

Definition

Excessive oil consumption (not due to leaks) is the use of 3 litres or more of engine oil within 10,000 kilometres. Prior to performing oil pressure testing, a preliminary inspection of the vehicle should be performed. During the preliminary visual inspection, the following likely causes of excessive oil usage should be investigated.

Cause	Correction
External oil leaks.	Refer to 2.18 Engine Oil Leak Diagnosis.
Incorrect oil level or reading of the oil level indicator.	Check for the correct oil level, refer to 3.1 Engine Oil.
Incorrect oil viscosity.	Replace the engine oil, using the recommended SAE grade of engine oil, refer to 3.1 Engine Oil.
Continuous high-speed driving or severe usage.	Service vehicle more frequently, refer to 0B Lubrication and Service.
Crankcase ventilation system restricted or malfunctioning.	Repair or replace crankcase ventilation system components as required, refer to 6C1-3 Engine Management – V6 – Service Operations.
Worn valve guides and or valve stems.	Inspect and repair valves and valve guides as required, refer to 3.22 Cylinder Head Assembly.
Worn or damaged valve stem oil seal.	Replace valve stem oil seals as required, refer to 3.22 Cylinder Head Assembly.
Piston rings broken, worn or not seated correctly.	Allowing adequate time for the piston rings to seat correctly, replace piston rings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
Piston rings incorrectly installed or not matched to cylinder bore oversize.	Replace piston rings as required, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

2.18 Engine Oil Leak Diagnosis

Introduction

It is important to correctly identify the source of an engine oil leak. For example, a power steering fluid leak or spillage during servicing can travel across the valley area of the engine and run-out the weep hole, which is located at the back of the cylinder block. Failure to correctly identify the source of an engine oil leak can lead to unnecessary replacement of engine components.

Most fluid leaks can be repaired by repairing or replacing the faulty component or resealing the gasket surface. However, once a leak is identified it is important to determine and repair the cause as well as the leak itself.

Locating and Identifying the Leak

Inspect the leaking fluid and determine whether it is engine oil, transmission fluid, power steering fluid, brake fluid or some other fluid. If unsure of the source of the leaking lubricant, a quick check of fluid levels should indicate where the fluid is coming from, as one or more fluid level should be low.

Visual Inspection

Once the type of leaking fluid has been determined, a visual inspection of the affected system should be performed. When performing the visual inspection:

1 Bring the vehicle to the normal operating temperature.

2 Park the vehicle over a large sheet of paper or other clean surface.

3 Leave the vehicle idling for 2-3 minutes, then check for dripping fluid.

4 If required, identify the type of fluid leaking and the approximate location of the leak.

5 Visually inspect the suspected area. A small mirror may assist viewing areas that are difficult to see normally.

6 Check for leaks at all sealing surfaces and fittings.

7 Check for any cracked or damaged components.

8 If the leak cannot be located, completely clean the entire engine and surrounding components, drive the vehicle at normal operating temperature for several kilometres and then repeat Steps 3 to 8.

9 If the leak still cannot be located, proceed with either the Powder Method or Black Light and Dye Method as outlined below.

Powder Method

1 Completely clean the entire engine and surrounding components.

2 Apply an aerosol type powder (e.g. foot powder) to the suspected area.

3 Operate the vehicle at normal operating temperature and at varying speeds for several kilometres.

4 Identify the source of the leak from the discoloration of the powder around the suspect components.

5 If required, use a small mirror to assist in viewing areas that are difficult to see normally.

6 Refer to Possible Causes for Engine Oil Leaks in this Section, and repair or replace components as required.

Black Light and Dye Method

A black light and die kit Tool No. J28428-E or a commercially available equivalent is available to technicians to aid in engine oil leak diagnosis. When using a black light and die kit for the first time, it is recommended the technician read the manufacturers instructions prior to using the kit.

1 Add the specified amount of dye, as per manufacturers instructions, into the engine or suspected source of the oil leak.

2 Operate the vehicle at normal operating temperature and at varying speeds for several kilometres.

3 With the vehicle parked on a flat level surface, aim the black light at the suspected component/s. The dyed fluid will appear as a yellow path leading to the oil leak source

4 Refer to Possible Causes for Engine Oil Leaks in this Section, and repair or replace components as required.

Possible Causes for Engine Oil Leaks

Common possible causes for engine oil leaks are:

- higher than recommended fluid levels,
- higher than recommended fluid pressures,
- blocked or faulty fluid filters or pressure relief valve,
- blocked or faulty engine ventilation system,
- incorrectly tightened or damaged fasteners,
- cracked or porous components,
- incorrect gaskets or sealants used,
- incorrect gaskets or sealant installation,
- damaged or worn gaskets or seals, and
- damaged or worn sealing surfaces.

2.19 Engine Oil Pressure Diagnosis

If the engine oil pressure is below the specified value, inspect the engine and components for the following:

- loose oil filter adaptor bolts,
- faulty oil filter adaptor seals,
- worn or faulty oil pump,
- loose oil pump bolts,
- loose, blocked or damaged oil pump suction pipe,
- faulty oil pump suction pipe seal,
- faulty oil pump pressure relief valve,
- faulty or incorrectly installed oil gallery plugs,
- excessive bearing clearance in one of the following:
- connecting rods big end/s,
- crankshaft main journal/s,
- camshaft/s,
- camshaft sprocket/s, and
- cracked, porous or restricted oil galleries, or broken lash adjuster/s.

2.20 Accessory Drive Belt Diagnosis

Tension Check

NOTE

An accessory drive belt that squeaks when the engine is started or stopped is considered normal and has no effect on drive belt durability.

1 Start the engine and switch off the air-conditioning system. Allow engine to run until normal operating temperature has been reached.

2 Turn the engine off and inspect the markings on the drive belt tensioner to confirm the drive belt tension is within the operating limits.

3 If the markings on the drive belt tensioner were outside the acceptable operating limits, replace the accessory drive belt, refer to 3.5 Accessory Drive Belt.

NOTE

The operating limits for acceptable drive belt tension are when the drive belt tensioner pointer (1) is aligned between the outer edge of the minimum and maximum tension marks (2).

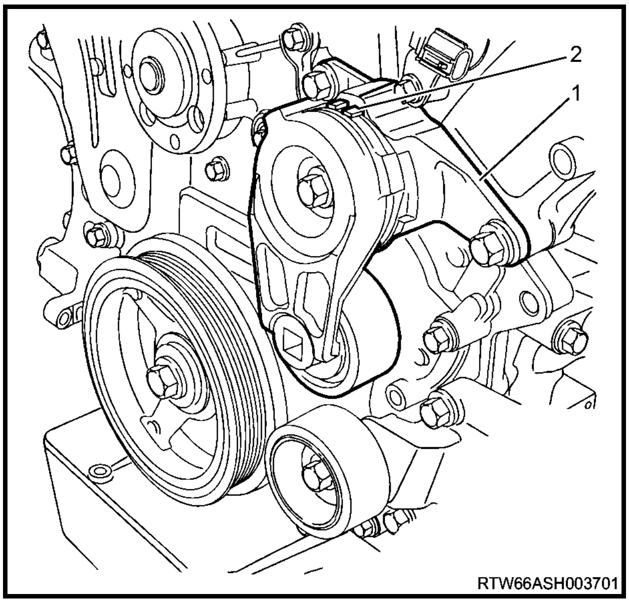


Figure 6A1 – 21

Inspect

Figure 6A1 – 22 illustrates the various stages of belt wear to aid in belt replacement decisions. Condition of the belt ribs is best judged where the belt is bent over one of the larger accessory drive system pulleys.

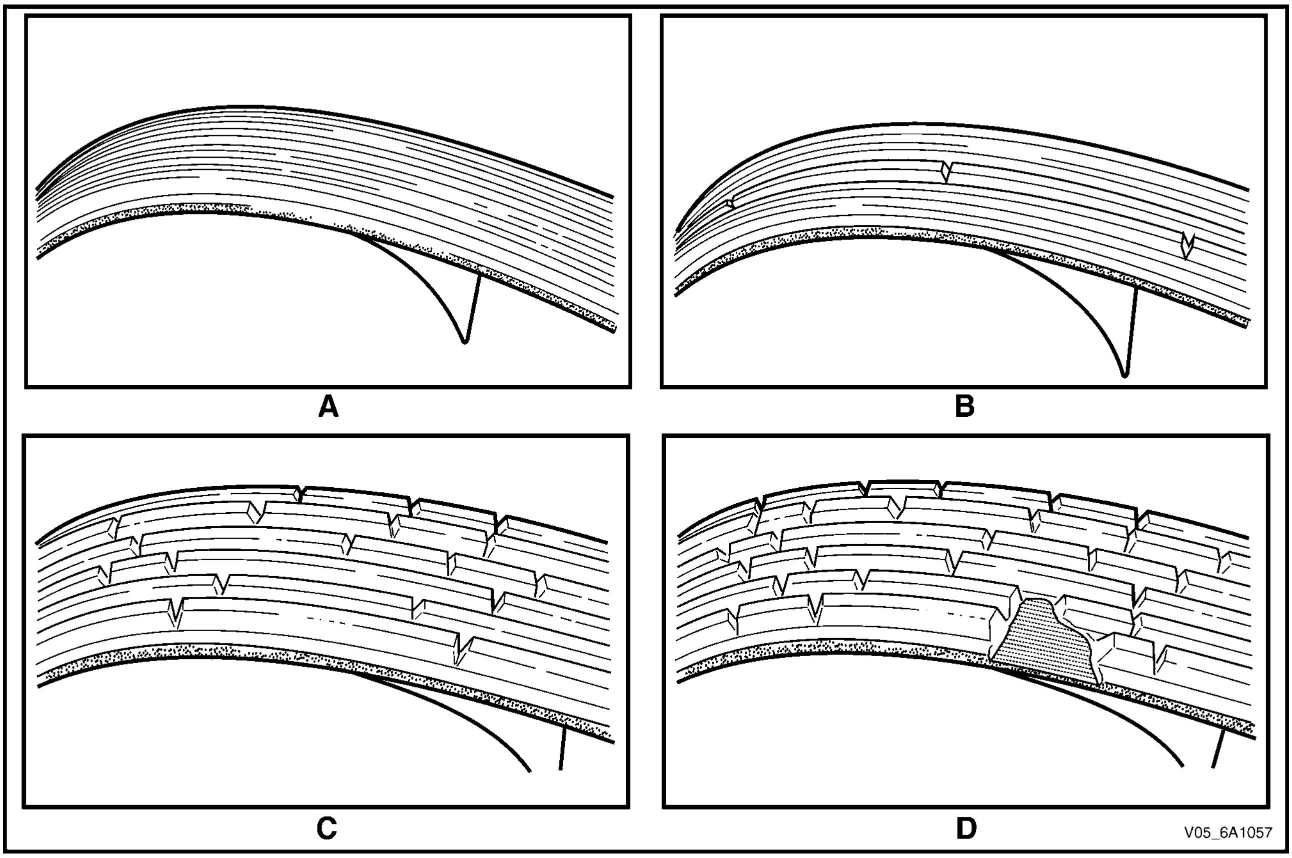


Figure 6A1 – 22

Legend

A New belt

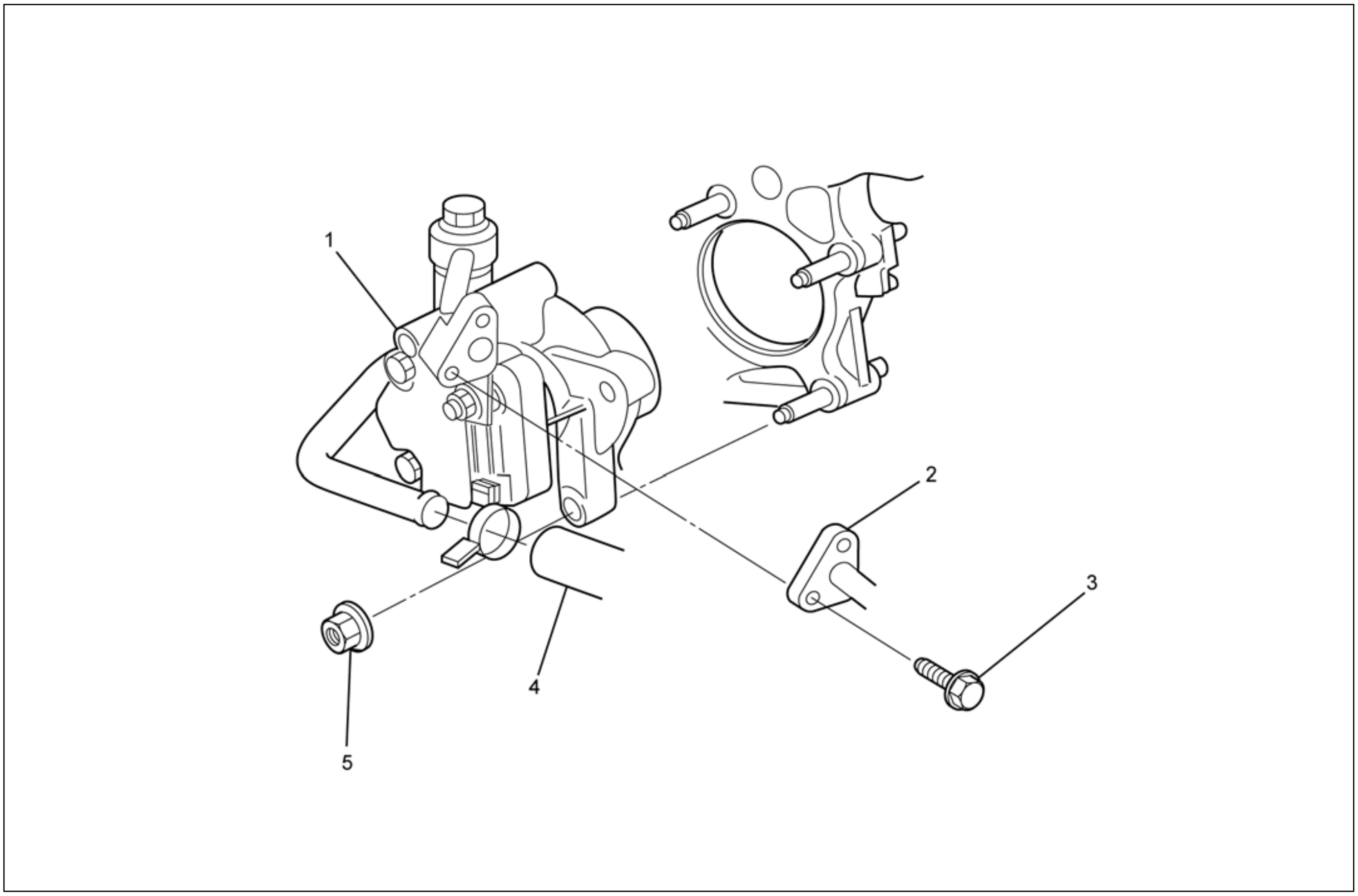
B Moderately used belt – few cracks, some wear on ribs and in grooves. replacement is not required

C Severely used belt – several cracks per 30 mm. Should be replaced before chunking occurs.

D Failed belt – separation of rib material from the backing (chunking). Replace belt immediately.

Power Steering Pump (4JJ1-TC, 4JK1-TC)

Power Steering Pump and Associated Parts



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Legend

(1) Pump Assembly
(2) Flexible Hose
(3) Bolt
(4) Suction Hose
(5) Nut

Removal

1. Remove the cooler compressor drive belt.
2. Place a drain pan below the pump.
3. Disconnect the suction hose.
4. Disconnect the flexible hose.
5. Remove the power steering fixing nut, and remove the pump assembly.

Installation

1. Install the pump assembly. Tighten the fixing nut to the specified torque.
   Torque:
   25 N·m (2.5 kgf·m/18 lb·ft)
2. Install the flexible hose.
   Tighten the bolts to the specified torque.
   Torque: 8 N·m (0.8 kgf·m/69 lb·in)
3. Install the cooler compressor drive belt.
4. Connect the suction hose, then fill the power steering fluid and bleed the power steering system.
   Refer to Bleeding the Power Steering System in this section.

Drive Belt Chirp

Definition

Accessory drive belt chirping can be defined as a high-pitched noise that is heard once per revolution of the drive belt or a pulley.

NOTE

Chirping during start-up in cold damp conditions that abates once the engine reaches operating temperature is considered normal.

Diagnostic Aids

The symptom may be intermittent due to moisture on the drive belts or pulleys. It may be necessary to spray a small amount of water on the drive belt to duplicate and confirm a customers concern. If spraying water onto the drive belt system duplicates the symptom, cleaning the belt pulleys may be the solution.

A loose or incorrectly installed body component, suspension component or other item may be the cause of the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 The noise may not be engine related. This step is to confirm the engine is making the noise. If the engine is not making the noise, do not proceed further with this diagnostic procedure.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Inspect all drive pump pulleys for pilling.

NOTE

Pilling is the small balls (pills) or strings of rubber in the belt grooves caused by the accumulation of rubber dust.

6 Misalignment of the accessory drive system pulleys may be caused by incorrect mounting of an accessory drive component (A/C compressor, generator etc.) or pulley. Misalignment may also be caused by incorrect installation of a pulley during a previous repair. Test for a misaligned pulley using a straight edge in the pulley grooves across two or three pulleys. If a misaligned pulley is found, refer to the relevant component service information for the correct installation and removal procedures.

10 Inspecting the fasteners can eliminate the possibility that an incorrect fastener has been installed.

12 Inspecting the pulleys for being bent should include inspecting for a dent or other damage that would prevent the drive belt from not seating correctly in all of the pulley grooves or on the smooth surface when the back end of the belt is used as the driving surface.

14 Replacing the drive belt when it is not damaged and there is no excessive pilling will only be a temporary repair.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a chirping noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the chirping noise still exist?	Accessory drive system OK. Go to 2.2 Symptoms, and restart the diagnosis of the noise	Go to Step 4
4	Inspect for severe pilling, i.e. in excess of 33% of the belt groove depth. Do the belt grooves have pilling?	Go to Step 5	Go to Step 6
5	Clean the drive belt pulleys with a wire brush. Are the belt pulleys clean?	Go to Step 15	Go to Step 6
6	Inspect for misalignment of the pulleys. Are the pulleys misaligned?	Go to Step 7	Go to Step 8
7	Replace or repair misaligned pulleys. Did you complete the repair?	Go to Step 15	—
8	Inspect for any bent or damaged accessory drive component mounting brackets. Did you find any bent or damaged brackets?	Go to Step 9	Go to Step 10
9	Replace or repair any bent or damaged Brackets. Did you complete the repairs?	Go to Step 15	—
10	Inspect for missing, loose or incorrect fasteners. Did you find any missing, loose or incorrect fasteners?	Go to Step 11	Go to Step 12
11	Tighten any loose fasteners to the torque specification as provided in provided in 6. Torque Wrench Specifications. Replace any incorrect or missing fasteners. Did you complete the repairs?	Go to Step 15	—
12	Inspect for a bent pulley. Did you find any bent pulleys?	Go to Step 13	Go to Step 14
13	Replace bent pulleys as required. Did you complete the repair?	Go to Step 15	—
14	Replace the accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you complete the repair?	Go to Step 15	—
15	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the chirp noise?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Squeal

Definition

Accessory drive belt squealing can be defined as a loud screeching noise caused by a slipping drive belt. Belt squeal is unusual in multi-rib belts. Drive belt squeal generally occurs when a heavy load is applied to the drive belt, such as an air-conditioning compressor engagement, snapping the throttle, seized pulley or a faulty accessory drive component.

Diagnostic Aids

If the noise is intermittent, confirm the accessory drive components by varying their loads, making sure they are operated to their maximum capacity. An overcharged A/C system, restrictions in the power steering pressure circuit or a faulty generator or coolant pump are likely causes of accessory drive belt squeal.

A loose or incorrectly installed body component, suspension component or other item may be the cause of the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 The noise may not be engine related. This step is to confirm the engine is making the noise. If the engine is not making the noise, do not proceed further with this diagnostic procedure.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Confirms an accessory drive component does not have a seized bearing. With the belt removed, test the bearings in the accessory drive components spin free and smooth.

5 Confirms the drive belt tensioner is operating correctly. If the drive belt tensioner is not operating correctly, drive belt tension will not be maintained, resulting in a belt squealing noise

6 Confirms the belt is not too long, which would prevent the tensioner from working as intended. Also, if an excessively long belt has been fitted, it may also be routed incorrectly and may be turning an accessory drive component in the wrong direction.

7 Misalignment of the pulleys may be caused by one of the following:

- Incorrect mounting of an accessory drive component,
- Incorrect installation of an accessory drive pulley or,
- Bent or damaged pulley.

Test for a misaligned pulley using a straight edge in the pulley grooves across 2 or 3 pulleys. If a misaligned pulley is found, refer to the relevant component service information for the correct installation and removal procedures.

8 This test is to confirm the pulleys are the correct diameter and/or width. Using a known good vehicle, compare the pulley sizes.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a squealing noise?	Go to Step 3	Refer to Diagnostic Aids in this Section

Step	Action	Yes	No
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the squealing noise still exist?	Accessory drive system OK. Go to 2.2 Symptoms, and restart the diagnosis of the noise	Go to Step 4
4	Inspect the accessory drive components for a seized bearing and general malfunctions. Did you find and correct any seized bearings or general malfunctions in the accessory drive system?	Go to Step 9	Go to Step 5
5	Test the accessory drive belt tensioner for correct operation, refer to Accessory Drive Belt Tensioner Diagnosis. Did you find and repair any problems with the tensioner?	Go to Step 9	Go to Step 6
6	Inspect the accessory drive belt is the correct length, refer to 3.5 Accessory Drive Belt. Did you find and repair any problems with the drive belt length?	Go to Step 9	Go to Step 7
7	Inspect the accessory drive pulleys for misalignment. Did you find and correct any misaligned accessory drive pulleys?	Go to Step 9	Go to Step 8
8	Check the accessory drive pulleys are the correct size. Did you find and replace any incorrect pulleys?	Go to Step 9	Refer to Diagnostic Aids in this Section
9	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the squeal noise?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Whine

Definition

Accessory drive belt whine can be defined as a high-pitched continuous noise that is most likely to be caused by a failed bearing in one of the accessory drive components.

Diagnostic Aids

The drive belts themselves will not cause a whine. If the noise is intermittent, confirm the accessory drive components by varying their loads, making sure they are operated to their maximum capacity. An overcharged A/C system, restrictions in the power steering pressure circuit or a faulty generator or coolant pump are likely causes of accessory drive belt whine.

Test Description

The numbers below refer to steps in the diagnostic table.

3 The noise may be an internal engine noise. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 The inspection of bearings should include the following accessory drive components:

- drive belt tensioners,
- drive belt idlers,
- generator,
- power steering pump,
- coolant pump, and
- A/C compressor.

The drive belt may need to be installed and the accessory drive components operated separately, at varying loads to confirm the location of the faulty bearing, refer to the relevant Sections for component inspection and repair procedures.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a whining noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the whining noise still exist?	Accessory drive system OK Go to 2.2 Symptoms, and restart the diagnosis	Go to Step 4
4	Inspect the accessory drive components for a faulty or seized bearings and general malfunctions. Did you find and correct any faulty/seized bearings or general malfunctions in the accessory drive system?	Go to Step 5	Refer to Diagnostic Aids in this Section
5	Reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the whine?	Accessory drive system OK	Go to 2.2 Symptoms, and restart the diagnosis

Drive Belt Rumble

Definition

Accessory drive belt rumble can be defined as a low pitch tapping, knocking or thumping noise heard at or just above idle, once per rotation of the drive belt or a specific component. Drive belt rumble is generally caused by one of the following:

- pilling or strings in the drive belt grooves,
- separation of the drive belt, or
- a damaged or faulty drive belt.

NOTE

Pilling is the small balls (pills) or strings of rubber in the belt grooves caused by the accumulation of rubber dust.

Diagnostic Aids

Vibration from the engine may cause a body component or other parts to emit a rumbling noise.

The drive belt may have a condition that cannot be seen or felt. Sometimes the replacement of the belt may be the only way to confirm the belt is faulty.

If the drive belt has been replaced and the diagnostic table completed, but the rumble is still present only when the drive belt is installed, an accessory drive component such as the A/C compressor may be the cause. Varying the load to each accessory drive component in turn, should help isolate which component is causing the noise.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the symptom exists at the time of diagnosis. Other vehicle components may be causing the noise.

3 Confirms the accessory drive belt is the cause of the noise. Drive belt rumbling is often confused with an internal engine noise due to the similarity in the description. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 Inspecting the drive belt is to ensure that it is not causing the noise. Small cracks across the ribs of the drive belt will not cause the noise and are not justification alone to replace the belt. Belt separation can be identified by the ply of the belt separating and may be seen at the edge of the belt or felt as lumps under the belt.

5 Small amounts of pilling is a normal condition and is deemed acceptable. When the pilling is severe (33% of the belt groove depth), the belt does not have a smooth surface to run on and should be replaced.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a rumbling noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the rumbling noise still exist?	Accessory drive system OK Go to 2.2 Symptoms, and restart the diagnosis	Go to Step 4

Step	Action	Yes	No
4	Inspect the accessory drive belt for damage, separation or sections of missing ribs. Did you find any damaged, separated or missing ribs?	Go to Step 7	Go to Step 5
5	Inspect the accessory drive belt for severe pilling (exceeding 33% of the belt groove depth). Did you find sever pilling?	Go to Step 6	Go to Step 5
6	Clean the drive belt using a suitable wire brush and reinstall to the engine, refer to 3.5 Accessory Drive Belt. Did you complete the repairs?	Go to Step 8	—
7	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 8	—
8	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the rumbling noise?	Accessory drive system OK	Refer to Diagnostic Aids in this Section

Drive Belt Vibration

Definition

Accessory drive belt vibration can be defined as a drive belt that jumps, shakes or rattles. Accessory drive belt vibration is usually indicated by one of the following:

- the vibration is engine speed related, or
- the vibration is sensitive to accessory drive system load.

Diagnostic Aids

The accessory drive components such as the A/C compressor or generator can have an affect on engine vibration.

To aid in locating which component is causing the vibration, vary the load to each accessory drive component in turn and note the effect it has on the vibration if any.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the symptom exists at the time of diagnosis. Other vehicle components may be causing the noise.

3 Confirms the accessory drive belt is the cause of the noise. Drive belt rumbling is often confused with an internal engine noise due to the similarity in the description. Removing the drive belt and operating the engine briefly will confirm whether or not the noise is related to the drive belt.

CAUTION

When running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

NOTE

There may also be a number of DTCs set when running the engine with the accessory drive belt removed.

4 The drive belt may cause a vibration. Inspecting the drive belt is considerably easier while the drive belt is removed.

6 Inspecting the fasteners can eliminate the possibility that an incorrect fastener has been installed.

8 This step should only be performed if the coolant pump is driven by the drive belt. Inspect the coolant pump for a bent shaft. Also inspect the coolant pump bearings for smooth operation and excessive play. Compare the coolant pump with a known good pump.

9 Accessory drive component brackets that are bent, cracked or loose may put extra strain on the accessory component causing it to vibrate.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Confirm the customer complaint. Is there a rumbling noise?	Go to Step 3	Refer to Diagnostic Aids in this Section
3	1 Remove the drive belt, refer to 3.5 Accessory Drive Belt. 2 Operate the engine for no more than 40 seconds. Does the vibration noise still exist?	Accessory drive system OK. Go to 4.2 Symptoms, and restart the diagnosis	Go to Step 4
4	Inspect the accessory drive belt for damage, wear, debris build-up or sections of missing ribs. Did you find any damage, wear, debris build-up or missing ribs?	Go to Step 5	Go to Step 6
5	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 10	—

Step	Action	Yes	No
6	Inspect for incorrect, loose, missing or damaged fasteners. Did you find any incorrect, loose, missing or damaged fasteners?	Go to Step 7	Go to Step 8
7	Tighten any loose fasteners to the correct torque specification, refer to 6 Torque Wrench Specifications. Replace any incorrect or missing fasteners. Did you complete the repairs?	Go to Step 10	—
8	Inspect the coolant pump for a bent shaft, refer to 6B1 Engine Cooling – V6. Did you find and repair a bent coolant pump shaft?	Go to Step 10	Go to Step 9
9	Inspect for bent, cracked or damaged accessory drive component mounting brackets. Did you find and repair any bent brackets?	Go to Step 10	Refer to Diagnostic Aids in this Section
10	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the vibration?	Accessory drive system OK	Refer to Diagnostic Aids in this Section

Drive Belt Falls Off

Definition

The drive belt falls off during normal operation or does not ride correctly on the accessory drive pulleys.

Diagnostic Aids

If the accessory drive belt repeatedly falls off the drive pulleys, this is most likely due to pulley misalignment.

An extra load that is quickly applied and released by an accessory drive component (e.g. A/C compressor) may cause the accessory drive belt to fall off. In this circumstance, confirm the fault by operating the accessory drive components in turn, noting which one caused the belt to fall off.

Lack of drive belt tension may also cause the belt to fall off the pulleys. Low drive belt tension could be caused by one of the following:

- an incorrect drive belt length,
- a faulty drive belt tensioner, or
- a stretched or faulty drive belt.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the condition of the drive belt. Damage may have occurred to the drive belt when it first fell off or it may have been damaged which caused the belt to fall off.

4 Misalignment of the pulleys may be caused by:

- the incorrect installation or mounting of an accessory drive component,
- the incorrect installation of an accessory drive component pulley, or
- a damaged or bent accessory drive pulley.

Test for a misaligned pulley using a suitable straight edge in the pulley grooves across two or more pulleys. If a misaligned pulley is found, refer to the service information for the particular component, for the correct pulley replacement procedures.

5 Inspecting the pulleys should include an inspection for dents or other damage that would prevent the drive belt from seating correctly in all of the pulley grooves or on the smooth surface of a pulley when the back side of the belt is used.

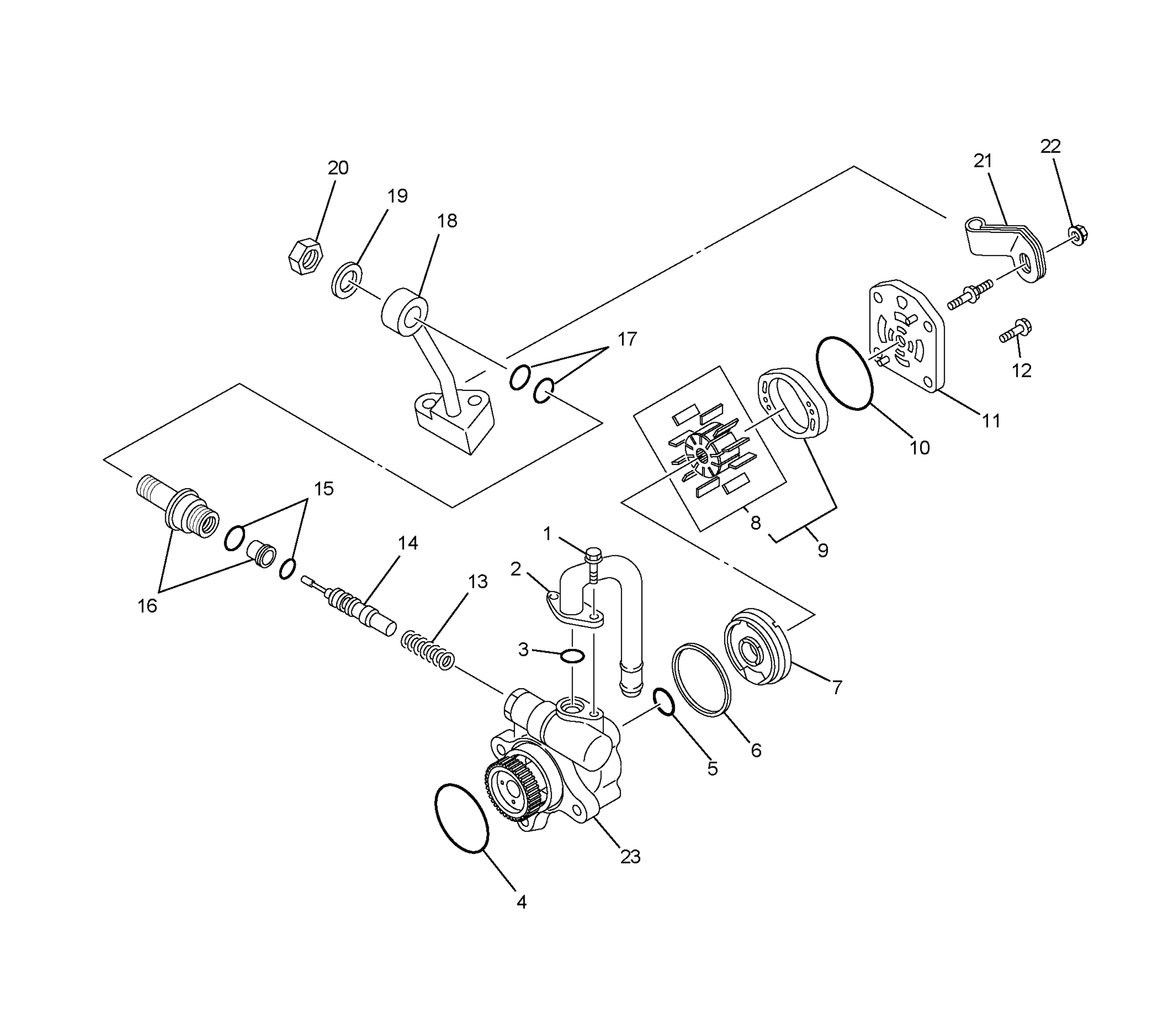
6 Accessory drive component mounting brackets that are bent will cause the drive belt to fall off.

7 Inspection of the fasteners can eliminate the possibility that an incorrect fastener was installed. Missing, loose or incorrect fasteners may cause pulley misalignment from the fasteners moving under load. Over-tightening of the fasteners may cause deflection of mounting brackets and result in misaligned accessory drive pulleys.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Inspect for a damaged accessory drive belt. Did you find any damage on the drive belt?	Go to Step 3	Go to Step 4
3	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Does the drive belt continue to fall off?	Go to Step 4	Go to Step 12
4	Inspect the accessory drive system pulleys for misalignment Did you find and repair any misaligned drive system pulleys?	Go to Step 12	Go to Step 5
5	Inspect for a dented or cracked accessory drive system pulley. Did you find and repair any dented or cracked drive system?	Go to Step 12	Go to Step 6
6	Inspect for bent accessory drive component mounting brackets. Did you find and repair any bent mounting brackets?	Go to Step 12	Go to Step 7
7	Inspect for incorrect, loose, missing or damaged fasteners. Did you find any incorrect, loose, missing or damaged fasteners?	Go to Step 8	Go to Step 9

Power Steering Pump Disassembled View



RTW53BLF002001

Legend

(1) Bolt
(2) Suction Pipe
(3) O-ring
(4) O-ring
(5) O-ring
(6) O-ring
(7) Side Plate
(8) Rotor and Vanes
(9) Pump Cartridge Assembly
(10) O-ring
(11) Rear Housing
(12) Bolt
(13) Spring
(14) Relief Valve
(15) O-ring
(16) Connector
(17) O-ring
(18) Joint
(19) Washer
(20) Nut
(21) Bracket
(22) Nut
(23) Shaft and Housing Assembly

Step	Action	Yes	No
8	Tighten any loose fasteners to the correct torque specification, refer to 6 Torque Wrench Specifications. Replace any incorrect or missing fasteners. Does the drive belt continue to fall off?	Go to Step 9	Go to Step 12
9	Test the accessory drive belt tensioner for correct operation, refer to Accessory Drive Belt Tensioner Diagnosis in this Section. Did you accessory drive belt tensioner operate correctly?	Go to Step 11	Go to Step 10
10	Replace the drive belt tensioner, refer to 3.7 Accessory Drive Belt Tensioner Assembly. Does the drive belt continue to fall off?	Go to Step 11	Go to Step 12
11	Inspect for a failed drive belt idler and drive belt tensioner bearings. Did you find and repair any failed bearings?	Go to Step 12	Refer to Diagnostic Aids in this Section
12	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Does the drive belt continue to fall off?	Go to Step 2	Accessory drive system OK

Drive Belt Excessive Wear

Definition

Excessive wear can be defined as wear at the outside ribs of the drive belt (frayed edges), usually caused by an incorrectly installed drive belt

Diagnostic Aids

Excessive wear of a drive belt is usually caused by an incorrect installation or an incorrect drive belt fitted. Minor pulley misalignment will not cause excessive wear, but will cause the drive belt to fall off. Major pulley misalignment may cause excessive wear, but would also result in the drive belt falling off.

Test Description

The numbers below refer to steps in the diagnostic table.

2 Confirms the drive belt is correctly installed onto all of the accessory drive system pulleys. Wear on the drive belt may be caused by incorrectly positioning the drive belt by one or more grooves to a particular pulley.

3 The installation of the drive belt that is the incorrect width will cause wear on the drive belt. The drive belt ribs should match all the grooves on all the pulleys in the accessory drive system.

4 Confirms the drive belt is not contacting any parts of the engine or body while the engine is running. There should be sufficient clearance when the accessory drive component loads varies. The drive belt should not come into contact with any engine or body parts.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the information provided in 2.2 Symptoms, and perform the required inspections.	Go to Step 2	Go to 2.2 Symptoms
2	Inspect the accessory drive belt for correct installation. Is the drive belt installed correctly?	Go to Step 5	Go to Step 3
3	Ensure that the drive belt is the correct one for the application. Is the correct drive belt installed?	Go to Step 5	Go to Step 4
4	Is the drive belt contacting any engine or body components with the engine running?	Go to Step 6	Refer to Diagnostic Aids in this Section
5	Install a new accessory drive belt, refer to 3.5 Accessory Drive Belt. Did you replace the accessory drive belt?	Go to Step 6	—
6	If required, reinstall the accessory drive belt and operate the system to confirm the repair. Did you correct the excessive wear?	Accessory drive system OK	Go to Step 2

Accessory Drive Belt Tensioner Diagnosis

Diagnostic Table

Step	Action	Yes	No
1	1 Remove the accessory drive belt. 2 Inspect the drive belt tensioner pulley. Is the drive belt tensioner pulley loose or misaligned?	Go to Step 4	Go to Step 2
2	Rotate the drive belt tensioner. Does the drive belt tensioner rotate freely, without any unusual resistance or binding?	Go to Step 3	Go to Step 4
3	1 Using a suitable torque wrench, measure the torque required to lift the drive belt tensioner off the stop. 2 Using a known good tensioner, measure the torque required to lift the drive belt tensioner off the stop. Is the first torque reading within 10% of the second reading?	Accessory drive belt tensioner OK	Go to Step 4
4	Replace the drive belt tensioner, refer to 3.7 Accessory Drive Belt Tensioner Assembly. Is the repair complete?	Accessory drive belt tensioner OK	—

3 Minor Service Operations

ATTENTION

The V6 engine is a combination of numerous components, containing machined, honed, polished and lapped surfaces manufactured on the latest, high technology production equipment. Many of the components contain tolerances measured in thousandths of a millimetre. Consequently, when any engine component is to be serviced, care and cleanliness are extremely important.

Prior to re-assembly of the engine, all components must be cleaned and inspected in accordance with the relevant clean and inspect procedures throughout this Section, and replaced or repaired where required.

In addition to cleaning and inspecting components, a liberal coating of engine oil should be applied to friction surfaces during assembly to protect and lubricate the surfaces on initial operation.

When performing any service operation, it should be understood that correct cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard workshop practice, even if not specifically stated. Torque values must be used as specified during reassembly to ensure correct retention of all components.

Through out this section, fastener torque wrench specifications may be accompanied with the following identification marks:

- ■ **Fasteners must be replaced after loosening.**
- ♦ **Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.**

If one of these identification marks is present alongside a fastener torque wrench specification, the recommendation regarding that fastener must be adhered to.

3.1 Engine Oil

The procedure outlined below is typically the same for both rear wheel drive and all wheel drive vehicles.

Check

The following procedure is applicable to both rear wheel and all wheel drive vehicles

1. Run the engine to bring it to normal operating temperature.
2. Park the vehicle on a level surface. A vehicle that is not level will affect the accuracy of the level reading.
3. Stop the engine and wait 5 to 10 minutes to allow the oil to drain back into the oil pan.
4. Remove the oil level indicator (1) and wipe clean.
5. Insert the indicator, ensuring it is fully seated.
6. Slowly remove the indicator to avoid smearing. Hold it horizontally or with lower end slightly down to avoid oil running along indicator.
7. Observe the oil level where it passes over the centre line of the indicator.
8. If the level is lower than the Add mark (2), add enough oil to the engine to reach the Upper mark (3). Do not add too much oil as the reading should never be above the Upper mark.

NOTE

When topping up the oil, allow approximately 5 to 10 minutes for the added oil to fully drain into the oil pan.

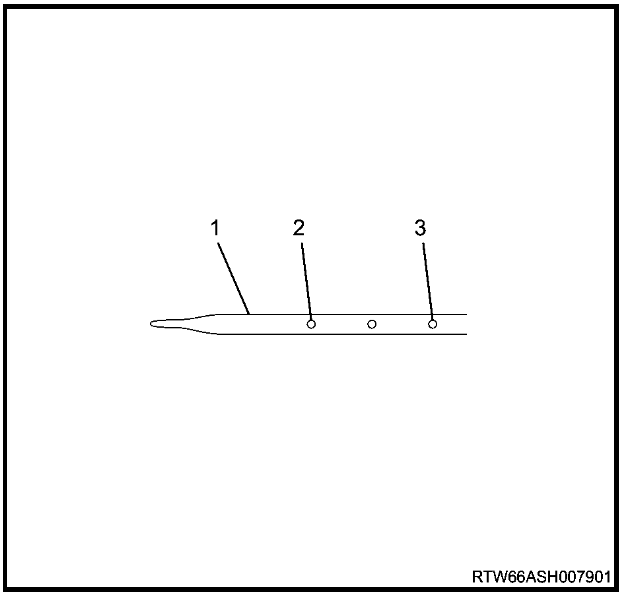


Figure 6A1 – 23

Replace

NOTE

- Quicker and more complete draining will occur if the engine oil is at normal operating temperature. However, care must be taken to avoid scalding from the hot oil.
- It recommended the oil filter be changed at each engine oil change, refer to 3.2 Oil Filter.

1 Remove the oil fill cap.

2 To ensure complete draining of the oil pan, raise the front and rear of the vehicle to maintain a level attitude. If not using a hoist, support the vehicle with safety stands, refer to Section 0A General Information.

3 Clean any foreign material from around the oil drain plug and place a suitable, clean drain tray under the engine.

WARNING

The oil may be hot. Avoid contact with the oil.
Ensure that eyes and skin are protected.

4 Remove the drain plug (1), taking care to avoid scalding from the hot oil. Allow the oil to drain.

5 Clean and inspect the drain plug threads. If damaged, replace the drain plug.

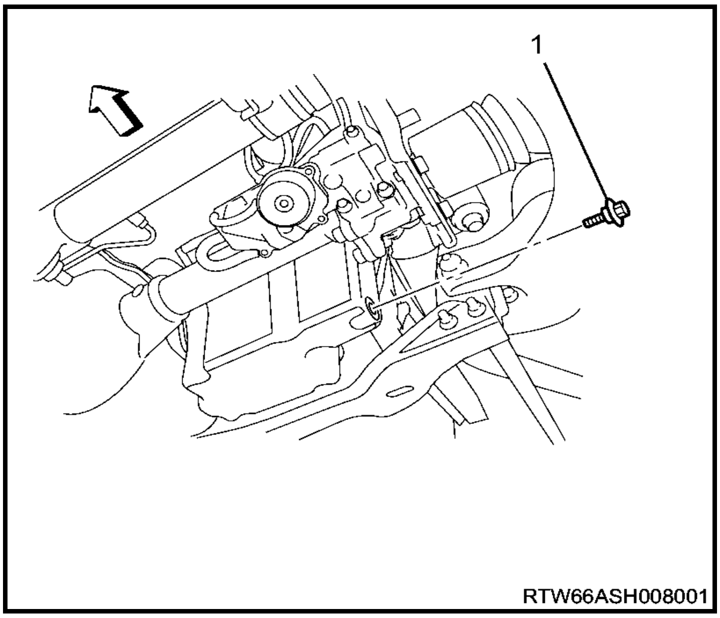


Figure 6A1 – 24

6 Once the oil has completely drained, reinstall the drain plug and tighten to the correct torque specification.

Oil pan drain plug torque specification ....25.0 Nm

7 Replace the oil filter, refer to 3.2 Oil Filter.

8 Lower the vehicle to the ground and fill with the specified amount of SAE 5W30 lubricant.

Engine Oil Capacity: With Oil Filter Change.......................................6.5 litres

9 Install the oil fill cap.

10 Start the engine and check for leaks.

Pressure Check

1 Run the engine to bring it to normal operating temperature.
2 Park the vehicle on a level surface. A vehicle not level will affect the accuracy of the level reading.
3 Stop the engine and wait 5 to 10 minutes to allow the oil to drain back into the oil pan.
4 Check the oil level and top up with the recommended engine oil as required, refer to Check, in this Section.
5 Remove the engine oil pressure sensor (1), refer to Section 6C1-3 Engine Management – V6 – Service Operations.
6 Install the oil pressure gauge adaptor, Tool No. J36648-A into the oil pressure sender hole in the oil filter housing.
7 Install a suitable oil pressure gauge into the adaptor.
8 Start the engine.
9 Measure and record the pressure reading on the gauge at idle and 2000 r.p.m. Compare the results with the specification.

Minimum engine oil pressure	
@ idle	69 kPa
@ 2000 r.p.m.	138 kPa

10 If the engine oil pressure is not to specification, refer to 2.19 Engine Oil Pressure Diagnosis.
11 After completing the engine oil pressure check, stop the engine and remove the oil pressure gauge.

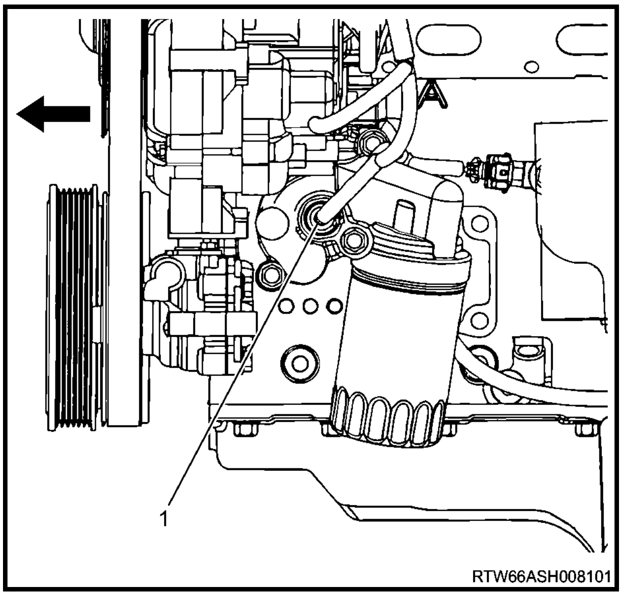


Figure 6A1 – 25

12 Reinstall the oil pressure sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.
13 Start the engine and check for leaks.

3.2 Oil Filter Cartridge

Replace

NOTE

- The oil filter cartridge should be replaced at the correct time or distance intervals, refer to Section 0B Lubrication and Service.
- The oil filter cartridge should also be replaced whenever the engine oil is suspected to have been contaminated by foreign material.

1 Remove and discard the oil filter cartridge (1).

2 Install the new oil filter cartridge.

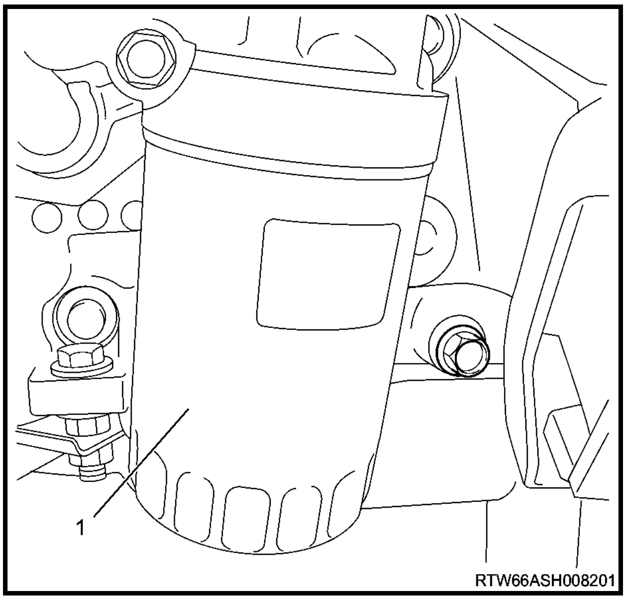


Figure 6A1 – 26

3.3 Oil Filter Adaptor

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems, refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Disconnect the wiring harness connector from the oil pressure sender.

3 Remove the oil filter adaptor attaching bolts (2), four places.

4 Remove the oil filter adaptor and discard the gasket (3).

5 Clean the surfaces of the adaptor and cylinder block.

CAUTION

- **Do not use a screwdriver or similar to prise the oil filter adapter from the engine as damage to the sealing surface may occur.**
- **If required, use a rubber mallet to tap the oil filter adapter to loosen the components prior to separating. Tapping should be done at bends, corners or reinforced areas to prevent distortion of parts.**

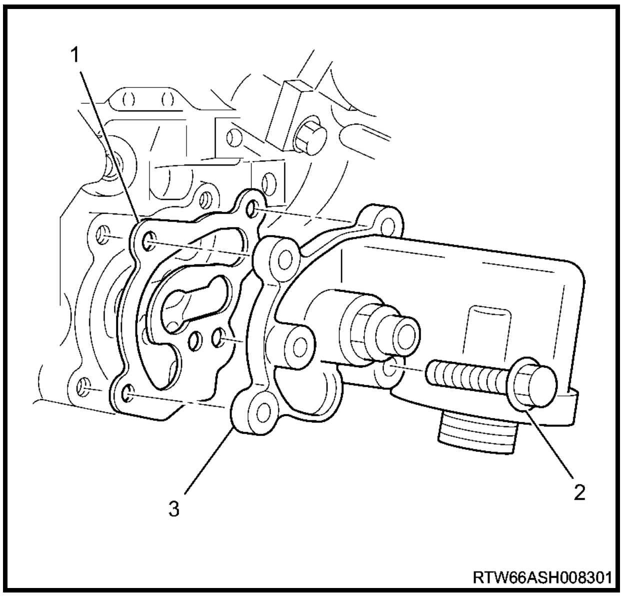


Figure 6A1 – 27

Reinstall

Reinstallation of the oil filter adaptor is the reverse of the removal procedure, noting the following:

1 A new gasket must be used.

2 Loosely install the oil filter adaptor attaching bolts, then tighten all fasteners to the correct torque specification.

Oil filter adaptor attaching bolt torque specification ....20.0- 26.0 Nm

3.4 Oil Level Indicator Tube

Remove

1 Remove the oil level indicator from the oil level indicator tube.

2 Remove the bolt (2) attaching the oil level indicator tube (1) and engine wiring harness retaining bracket.

3 Withdraw the oil level indicator tube from the oil pan.

4 Remove and discard the o-ring at the bottom of the oil level indicator tube.

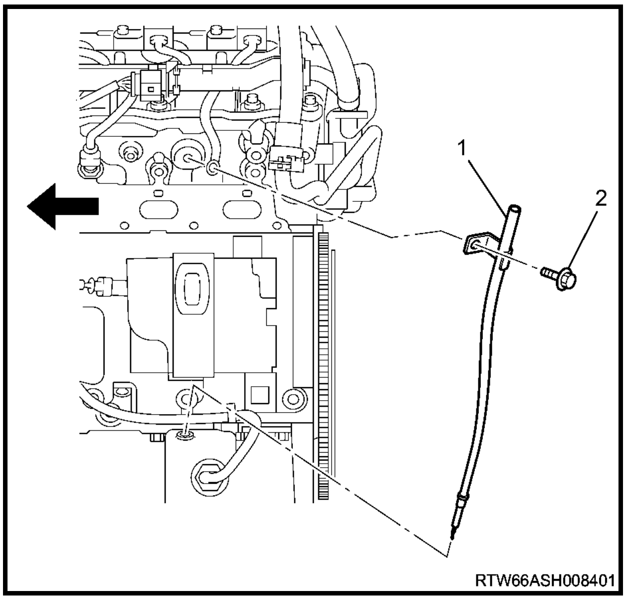


Figure 6A1 – 28

Reinstall

Reinstallation of the oil level indicator tube is the reverse of the removal procedure, noting the following:

1 Install a new oil level indicator o-ring.

2 Ensure the attaching bolt passes through the engine wiring harness retaining bracket.

3 Tighten bolt to the correct torque specification.

Oil level indicator tube attaching bolt torque specification ....8.0 – 12.0 Nm

3.5 Accessory Drive Belt

RWD Vehicle

Remove

1 Remove the air intake duct from between the air flow meter and the throttle body, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

2 Note the accessory drive belt (1) routing.

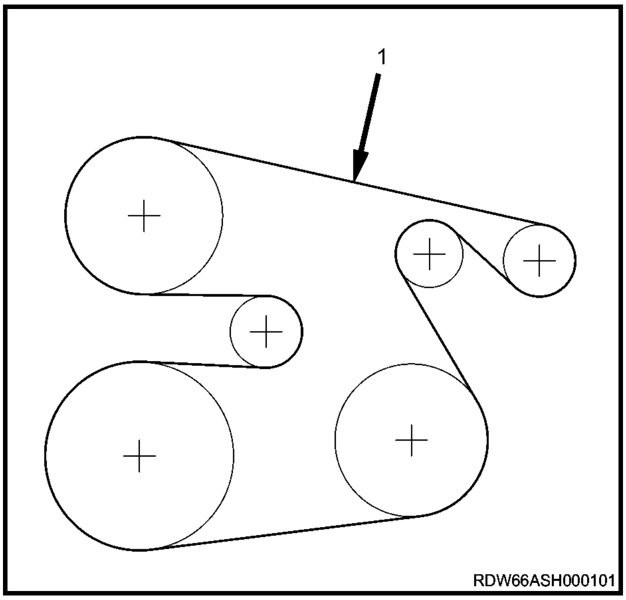


Figure 6A1 – 29

3 Using a suitable ½” drive socket bar (1), rotate the drive belt tensioner (2) clockwise, to reduce belt tension.

4 While holding the tensioner in the reduced tension position, remove the accessory drive belt (3).

NOTE

If required use an assistant to maintain the tensioner in the required position.

CAUTION

If running the engine with the accessory drive belt removed, the coolant pump will not be operating and the engine may overheat if left unsupervised even for a short period.

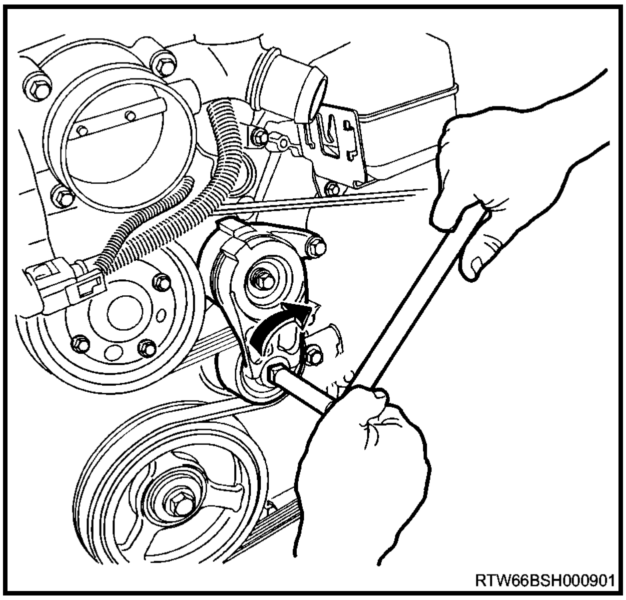


Figure 6A1 – 30

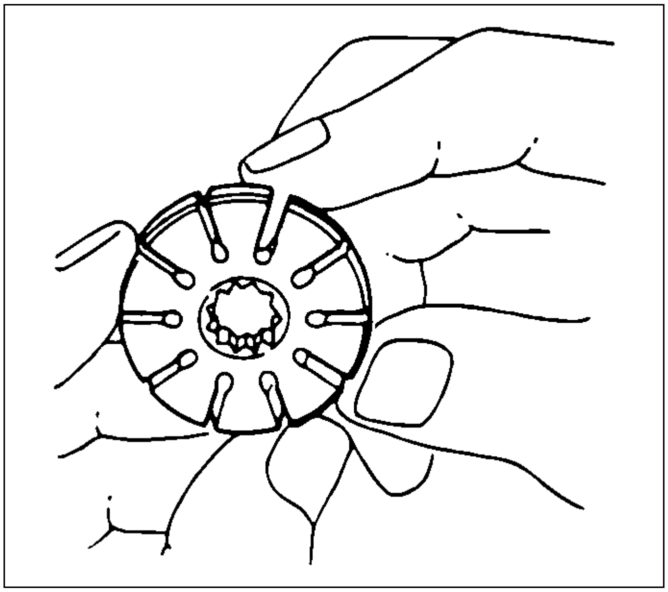
Disassembly

1. Clean the oil pump with solvent (plug the discharge and suction ports to prevent the entry of solvent).
   Be careful not to expose the oil seal of the shaft assembly to solvent.
2. Remove the bolt, suction pipe and O-ring.
3. Remove the nut and bracket.
4. Remove the nut, washer and joint.
5. Remove the connector, O-ring, relief valve and spring.
6. Remove the bolt, rear housing and O-ring.
7. Remove the pump cartridge assembly and the side plate from the shaft. Remove two O-rings.

Inspection and Repair

Make all necessary adjustments, repairs, and part replacements if wear, damage, or other problems are discovered during inspection.

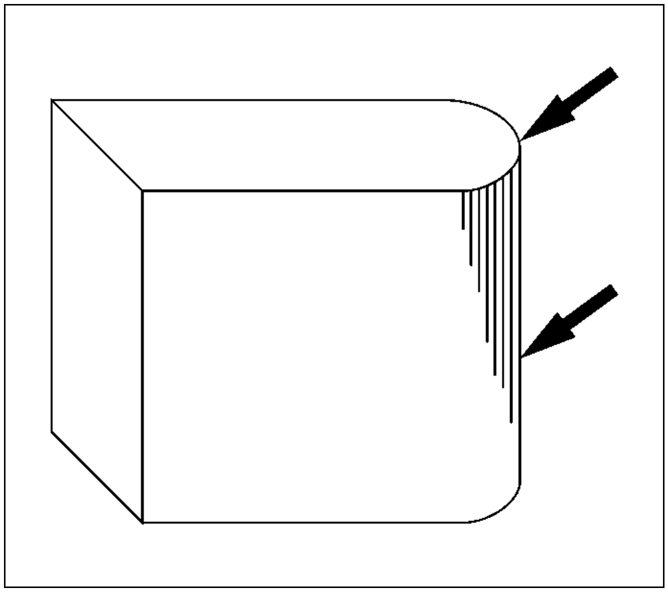
Rotor



442RS002

Check that the groove in the vane is free from excessive wear and that the vane slides smoothly. When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Vane



442RS003

Sliding faces of the vane should be free from wear. (In particular the curved face at the tip that makes contact with the cam should be free from wear and distortion). When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Cam

The inner face of the cam should have a uniform contact pattern without a sign of step wear. When part replacement becomes necessary, the pump cartridge should be replaced as a subassembly.

Side Plate

The sliding faces of parts must be free from step wear (more than 0.01 mm (0.0004 in)), which can be felt by a finger nail.
Parts with minor scores may be reused after lapping the face.

Relief Valve

The sliding face of the valve must be free from burrs and damage. Parts with minor scores may be reused after smoothing with emery cloth (#800 or finer).

Shaft and Housing Assembly

The bushing fitting face on the shaft must be free from damage and wear.

O-ring

Be sure to discard used parts, and always use new parts for installation. Prior to installation, lubricate all seals and rings with power steering fluid.

Reinstall

1 Install the drive belt over the A/C compressor, idler pulley, power steering pump, coolant pump, generator and tensioner pulleys.

2 Using a suitable ½" drive socket bar (1), rotate the drive belt tensioner (2) clockwise, refer to Figure 6A1 – 30.

3 With an assistant holding the tensioner in the required position, feed the accessory drive belt (3) over the crankshaft pulley.

4 Slowly release the drive belt tensioner mechanism.

NOTE

Ensure the drive belt ribs are correctly aligned with the grooves in the accessory drive pulleys or damage to the drive belt and accessory drive components and pulleys may occur.

5 Reinstall the air intake duct to the air flow meter and the throttle body, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

6 Run the engine to ensure correct operation.

3.6 Accessory Drive Belt Idler Pulley

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the accessory drive belt idler pulley attaching bolt (1).

3 Remove the dished washer (2) and accessory drive belt idler pulley (3).

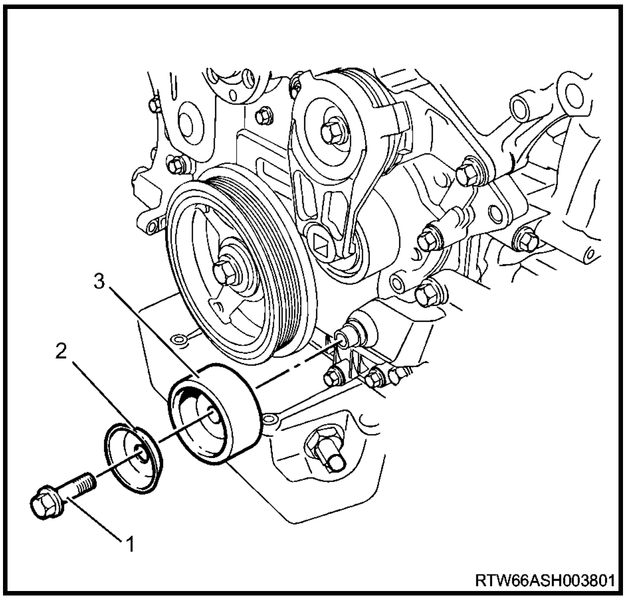


Figure 6A1 – 31

Reinstall

Reinstallation of the accessory drive belt idler pulley is the reverse of the removal procedure. Tighten the bolt to the correct torque specification.

Accessory drive belt idler pulley attaching bolt torque specification......................50.0 Nm

3.7 Accessory Drive Belt Tensioner Assembly

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the three bolts (2) attaching accessory drive belt tensioner assembly (1).

3 Remove the accessory drive belt tensioner assembly.

NOTE

The accessory drive belt tensioner pulley is not serviced separately. If the pulley is found to be faulty, the entire tensioner assembly must be replaced.

CAUTION

Repairing a damaged accessory drive belt pulley should not be attempted under any circumstances.

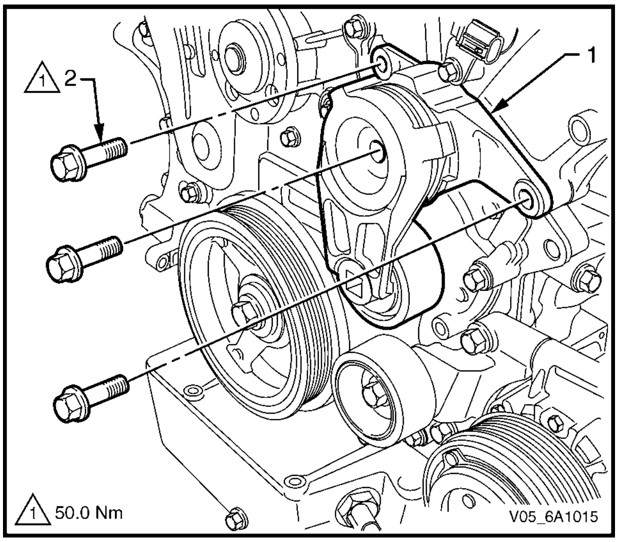


Figure 6A1 – 32

Reinstall

Reinstallation of the accessory drive belt tensioner assembly is the reverse of the removal procedure. Tighten the bolts to the correct torque specification.

Accessory drive belt tensioner attaching bolt torque specification......................50.0 Nm

3.8 Power Steering Pump Bracket

Remove

1 Remove the power steering pump and reservoir, refer to Section 3B Steering.

2 Remove the three bolts (1), (3) and (4) attaching the power steering pump bracket (5) to the engine block.

3 Remove the power steering pump bracket.

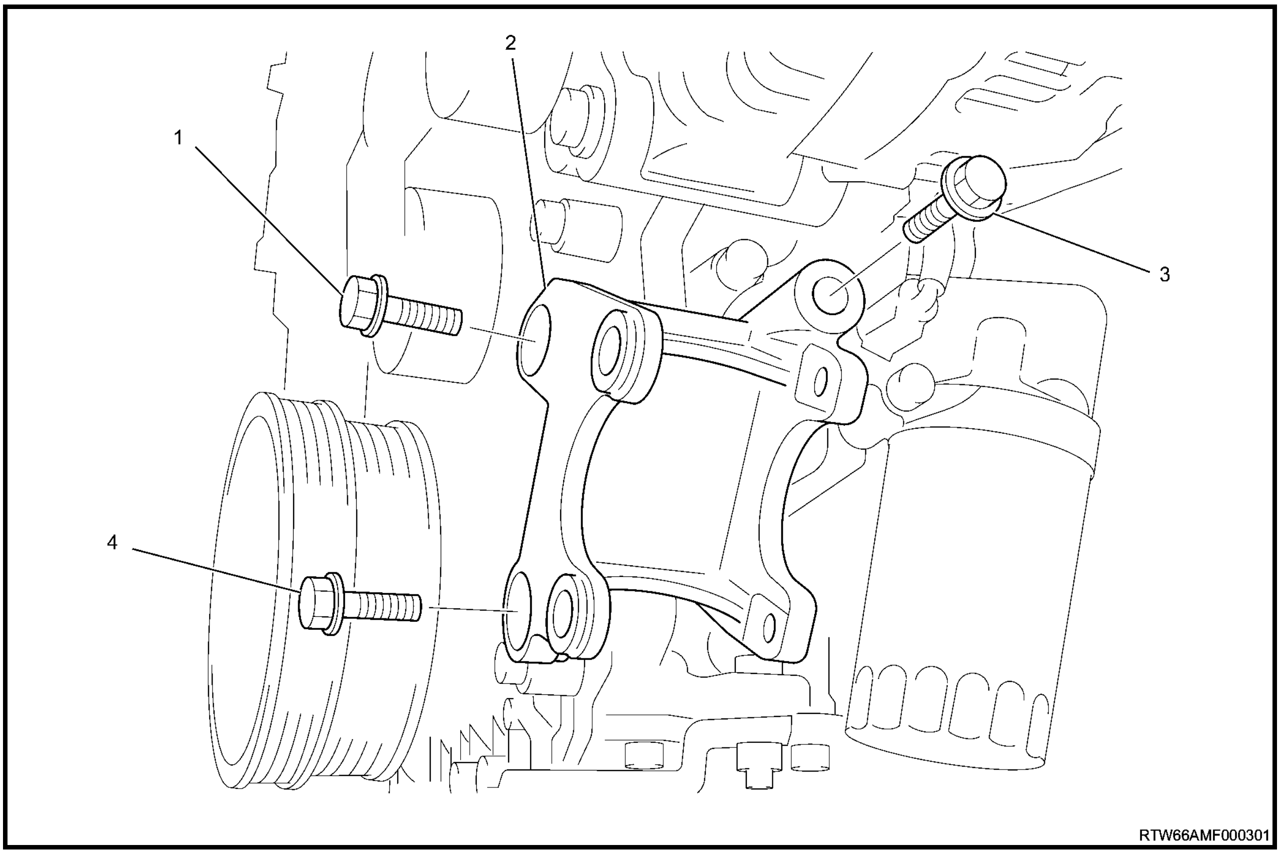


Figure 6A1 – 33

Reinstall

Reinstallation of the power steering pump and pump bracket is the reverse of the removal procedure, noting the following:

1 Hand start the bolts before tightening.

2 Tighten the bolts to the correct torque specification.

Power steering pump bracket attaching bolt torque specification......................22.0 Nm

3.9 Upper Intake Manifold

The intake manifold comprises of an upper and lower section. Some service procedures only require the removal of the upper intake manifold (e.g. fuel injector/spark plug servicing), while other service procedures require the removal of both the upper and lower manifold as a complete assembly (e.g. cylinder head/s). If the complete assembly needs to be removed, refer to 3.10 Intake Manifold Assembly – Complete.

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Remove the air intake duct (1) and hose (2), refer to Section 6C1-3 Engine Management – V6 – Service Operations.

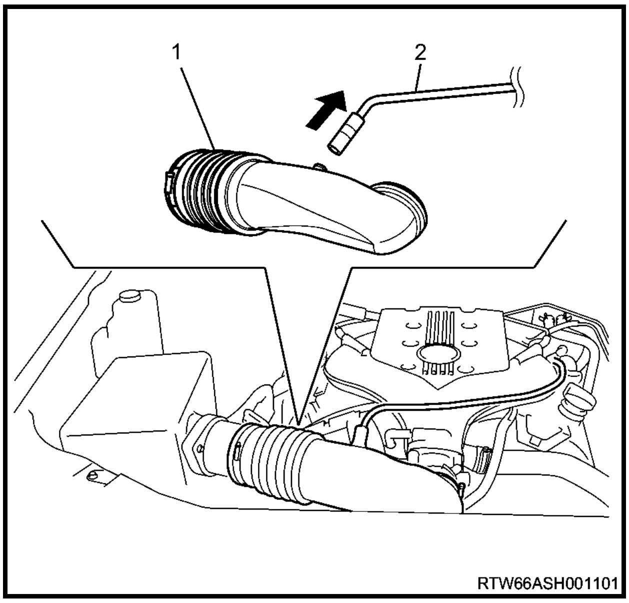


Figure 6A1 – 34

3 Retract the throttle body wiring connector lock (3).

4 While pressing the connector latch in the direction of the arrow (4), disconnect the throttle body wiring connector.

5 Disconnect the throttle body connector wiring harness from its retaining clip (5).

6 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable piece of 5 mm steel rod (or an Allen key).

CAUTION

The following precautions must be followed when disconnecting the throttle body wiring connector:

- **Do not use any mechanical device such as a screwdriver to disengage the harness connector (1) from the throttle body (2).**
- **When retracting the throttle wiring connector lock (3), take care not to disengage the lock from the connector.**
- **Do not pull on the connector wires.**
- **Take care not to break the barbed harness retainer pin (6) while removing the harness retainer from the intake manifold.**
- **Should the pin be broken, then it is vital that a new harness retainer is fitted to the wiring harness shield. If not, the harness will foul the engine drive belt.**

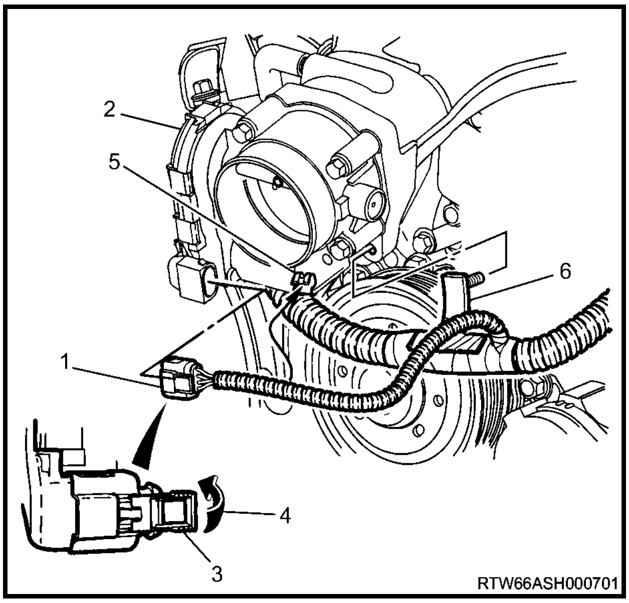


Figure 6A1 – 35

7 Disconnect the brake booster hoses from the upper intake manifold:

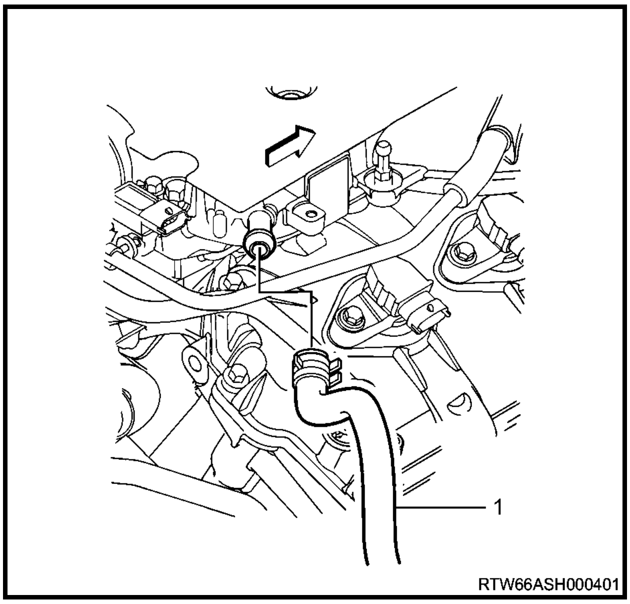


Figure 6A1 – 36

8 Disconnect the wiring harness connector from the barometric (BARO) pressure sensor (1).

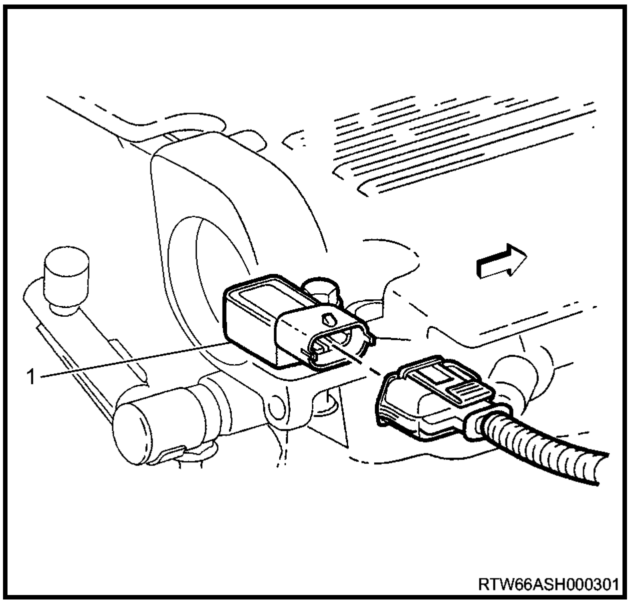


Figure 6A1 – 37

9 Disconnect the PCV tube connector (1) from the upper intake manifold assembly.

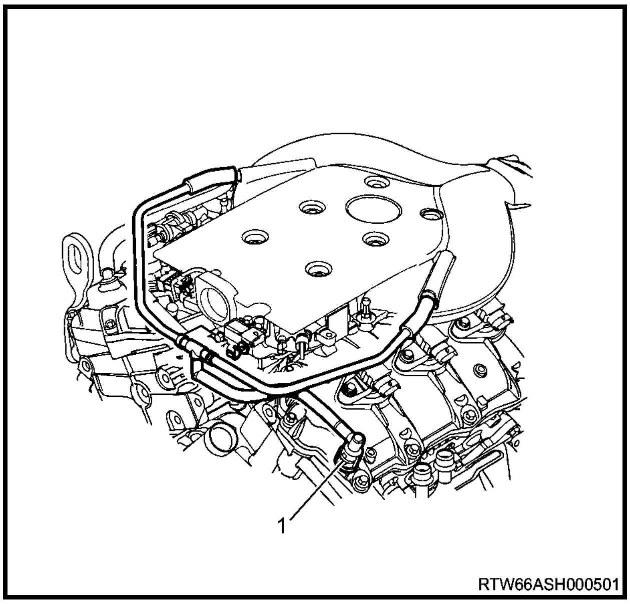


Figure 6A1 – 38

10 Remove the bolt (3) attaching the EVAP valve and the fuel injector wiring harness connector mounting bracket to the upper intake manifold assembly.

11 Move the EVAP valve and the fuel injector wiring harness connector mounting bracket clear of the upper intake manifold assembly.

12 Disconnect the PCV fresh air tube (1) from its upper intake manifold mounting clip (2).

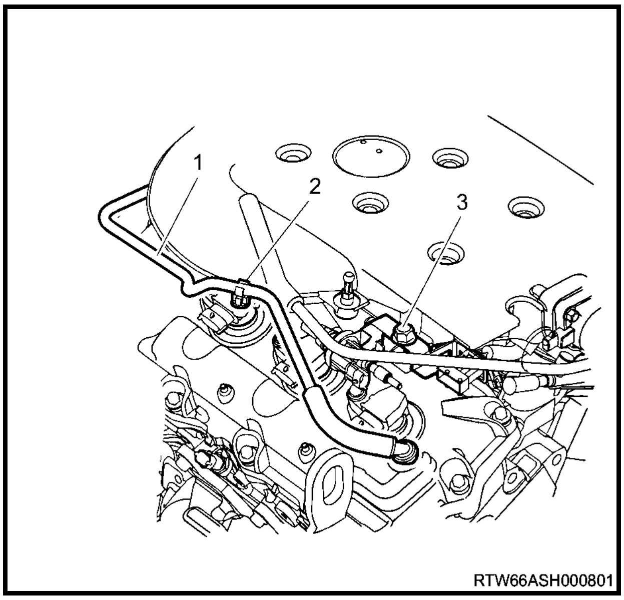


Figure 6A1 – 39

13 Disconnect the EVAP valve outlet tube (1) from the intake manifold (2).

14 Remove the four long (3) (165 mm long) and two short bolts (4) (70 mm long) attaching the upper intake manifold (2) to the cylinder heads and lower intake manifold.

15 Lift the upper intake manifold (2) clear from the lower half and then remove the upper intake manifold from the engine.

16 Remove and discard the upper to lower intake manifold gaskets (5).

CAUTION

- **When the upper intake manifold is removed, plug each of the lower intake runner openings with lint free cloth, to stop the entry of foreign material into the engine.**
- **Do not reuse the upper to lower intake manifold gaskets (5).**

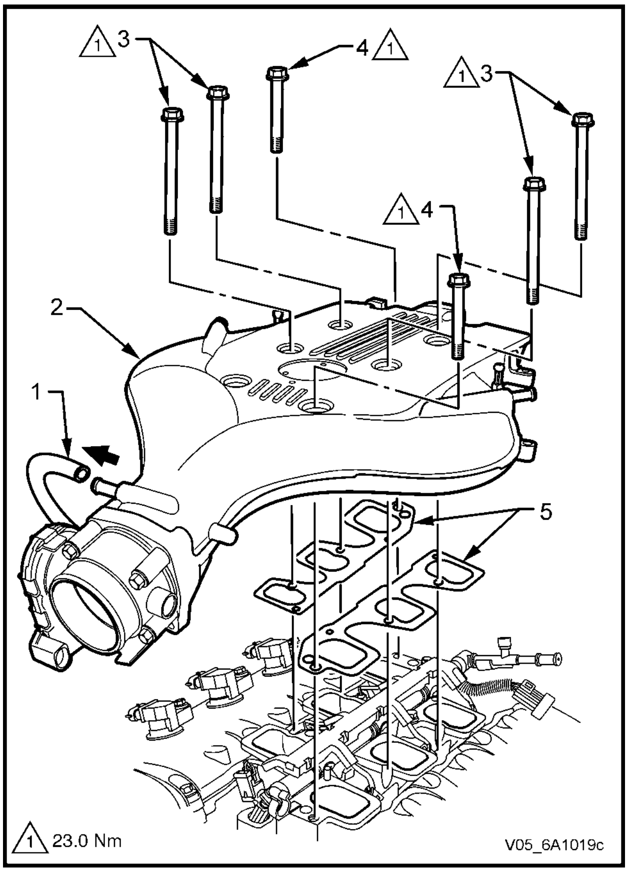


Figure 6A1 – 40

17 Remove the upper and lower intake manifold assembly from the engine.

18 Remove lower intake manifold to cylinder head gasket.

Disassemble

Remove the following from the upper intake manifold, refer to Section 6C1-3 Engine Management – V6 – Service Operations:

- BARO sensor and
- Throttle body assembly.

Clean

CAUTION

Due to the aluminium alloy construction of the intake manifold, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use of a wooden or plastic scraper is preferred.

1 Clean mating surfaces ensuring any gasket material is removed.

2 Clean the manifold using a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the timing components with compressed air.

Inspect

1 Inspect the intake manifold for the following fault conditions:

- Damaged sealing and mating surfaces.
- Damaged lower intake manifold gasket.
- Damage or excessive debris on the threaded and through holes.
- Cracks or damage to the intake manifold body.

NOTE

If the lower intake manifold is cracked or damaged, it must be replaced. No welding or patching of the intake manifold should be performed.

2 Place a straight edge (1) across the upper intake manifold sealing surface (2).

3 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

4 If the clearance between the upper intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Upper manifold maximum warpage	0.05 mm

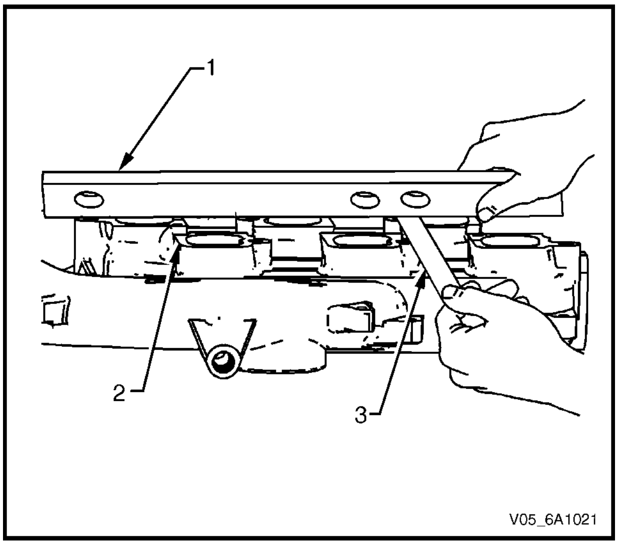


Figure 6A1 – 41

5 Place a straight edge (1) across the lower intake manifold sealing surface (2).

6 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

7 If the clearance between the lower intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Lower manifold maximum warpage	0.05 mm

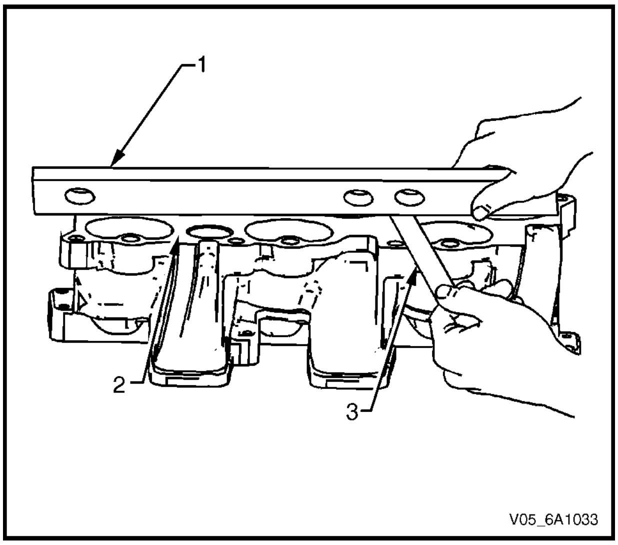


Figure 6A1 – 42

Reassemble

Reassembly of the upper manifold is the reverse of the disassembly procedure .

Reinstall

Reinstallation of the upper intake manifold and the upper and lower intake manifold assembly is the reverse of the removal procedure, noting the following:

1 Only new gaskets are to be fitted between the upper and lower intake manifolds.

CAUTION

Tighten the intake manifold bolts in a circular pattern starting at the centre bolt and moving outward.

2 Ensure that all fasteners are tightened to the correct torque specification.

Upper intake manifold to lower intake manifold attaching bolt torque specification	23.0 Nm
Upper intake manifold to cylinder head attaching bolt torque specification	23.0 Nm

CAUTION

Incorrect wiring connector installation may cause component malfunction or component damage.

3 Ensure all wiring connectors are fully engaged and if applicable, locked in place.

4 Ensure all wiring harnesses are correctly routed and attached securely in their retaining clips.

5 Ensure that all hoses and pipes are routed correctly and that any retaining clips are correctly installed.

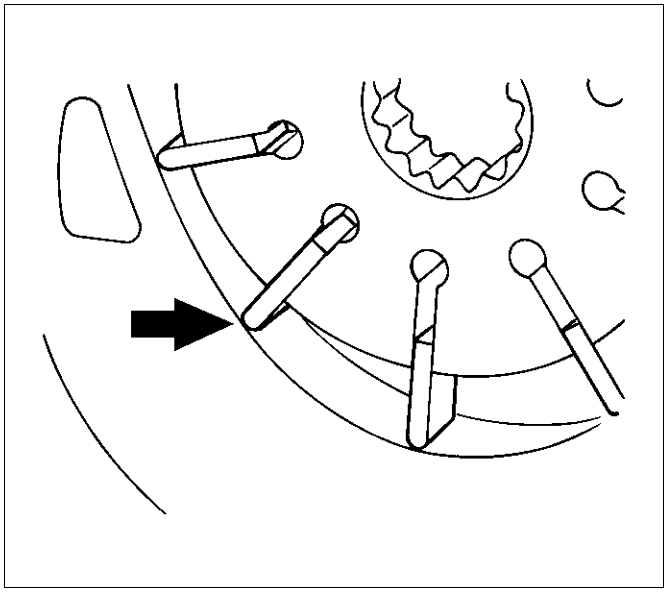
6 Start and run the engine to check for correct operation.

Reassembly

1. Install two new O-rings on shaft and housing assembly. Be sure to discard used O-ring.
2. Install side plate.

CAUTION: When installing side plate, be careful not to damage its inner surface. A damaged side plate may cause poor pump performance, pump seizure or oil leakage.

3. Install the vanes on rotor with curved face in contact with the inner wall of cam.



442RS005

4. Install rotor and vanes on cam.
5. Install pump cartridge assembly on shaft and housing assembly.
6. Install a new O-ring on rear housing. Be sure to discard used O-ring. Then install bolt and tighten it to specified torque.
   Torque: 25 N·m (2.5 kgf·m/18 lb·ft)
7. Install a new O-ring on suction pipe. Be sure to discard used O-ring. Then install bolt and tighten it to specified torque.
   Torque: 10 N·m (1.0 kgf·m/87 lb·in)
8. Install relief valve and spring.
9. Install a new O-ring on connector. Be sure to discard used O-ring. Tighten the connector to specified torque.
   Torque: 59 N·m (6.0 kgf·m/43 lb·ft)
10. Install new O-rings on joint. Be sure to discard used O-rings. Temporarily tighten the nut with washer.
11. Install bracket. Then install nut and tighten it to specified torque.
    Torque: 12 N·m (1.2 kgf·m/104 lb·in)
12. Tighten the nut to the specified torque (This nut was temporarily tightened in step 10).
    Torque: 20 N·m (2.0 kgf·m/14 lb·ft)

Main Data and Specifications

General Specifications

Oil pump	Type	Vane
	Operating fluid	ATF DEXRON®—III

3.10 Intake Manifold Assembly – Complete

The intake manifold comprises of an upper and lower section. Some service procedures only require the removal of the upper intake manifold (e.g. fuel injector/spark plug servicing), while other service procedures require the removal of both the upper and lower manifold as a complete assembly (e.g. cylinder head/s). If only the upper intake manifold needs to be removed, refer to 3.9 Upper Intake Manifold.

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Depressurise the fuel system.
2 Disconnect the battery negative terminal.
3 Remove the air intake duct (1) and hose (2), refer to Section 6C1-3 Engine Management – V6 – Service Operations.

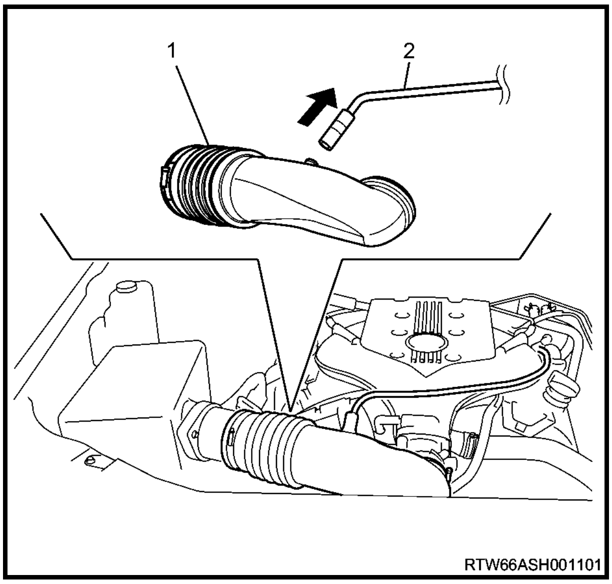


Figure 6A1 – 43

4 Retract the throttle body wiring connector lock (3).

5 While pressing the connector latch in the direction of the arrow (4), disconnect the throttle body wiring connector.

6 Disconnect the throttle body connector wiring harness from its retaining clip (5).

7 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable piece of 5 mm steel rod (or an Allen key).

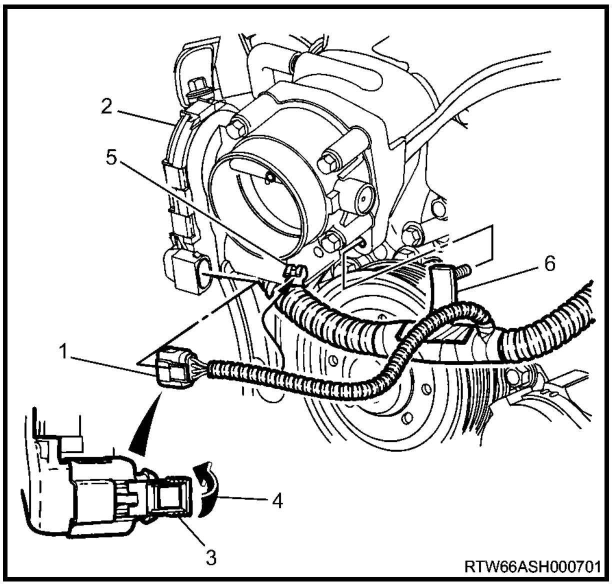


Figure 6A1 – 44

CAUTION

The following precautions must be followed when disconnecting the throttle body wiring connector:

- **Do not use any mechanical device such as a screwdriver to disengage the harness connector (1) from the throttle body (2).**
- **When retracting the throttle wiring connector lock (3), take care not to disengage the lock from the connector.**
- **Do not pull on the connector wires.**
- **Take care not to break the barbed harness retainer pin (6) while removing the harness retainer from the intake manifold.**
- **Should the pin be broken, then it is vital that a new harness retainer is fitted to the wiring harness shield. If not, the harness will foul the engine drive belt.**

8 Disconnect the brake booster hose (1), from the upper intake manifold:

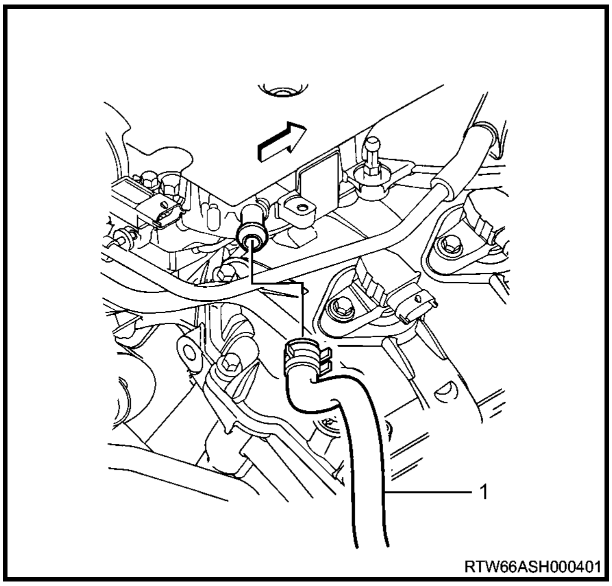


Figure 6A1 – 45

9 Disconnect the wiring harness connector from the barometric (BARO) pressure sensor (1).

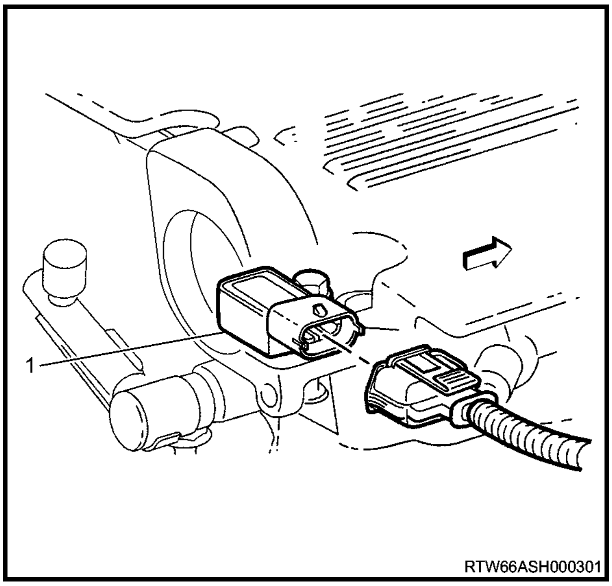


Figure 6A1 – 46

10 Disconnect the PCV tube connector (1) from the upper intake manifold assembly.

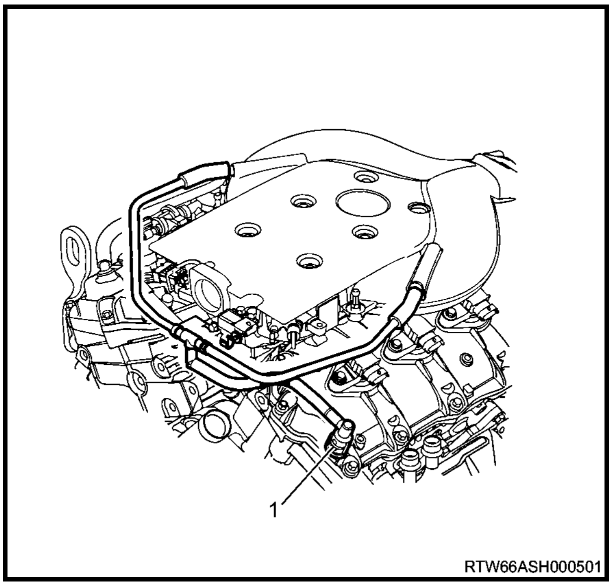


Figure 6A1 – 47

11 Disconnect the fuel feed hose from the fuel rail (1).

12 Pull out the release bar (2) (broad arrow) of the fuel injector harness wiring connector (3).

13 Disconnect the fuel injector harness wiring connector from the fuel injector wiring harness (4).

CAUTION

Plug the fuel feed hose opening after removal to prevent dirt and other contaminants from entering the fuel system.

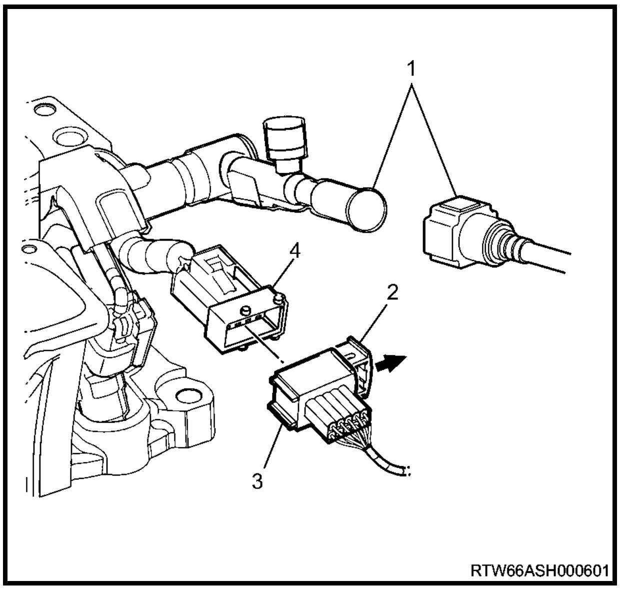


Figure 6A1 – 48

14 Remove the wiring harness connector (2) from the EVAP valve (1).

15 Disconnect the quick connect (3) from the rear of the EVAP valve, as follows:

a Squeeze the two barbed lugs together, push the quick connect into the valve, then pull out to separate the connection.

b Plug both open ends to prevent the entry of foreign matter.

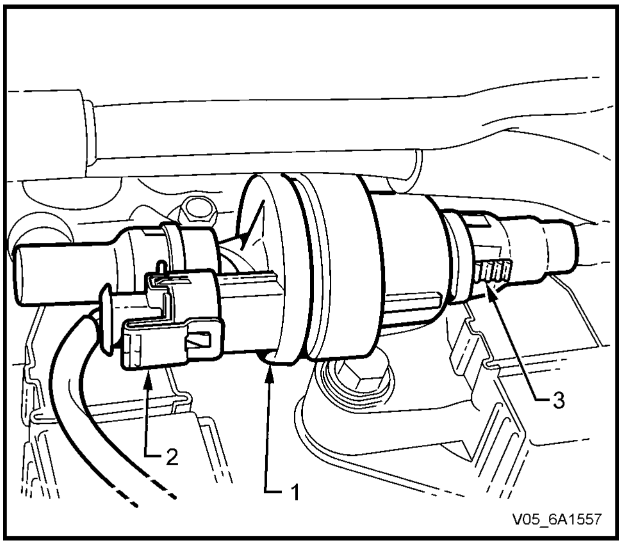


Figure 6A1 – 49

16 Remove the bolt (3) attaching the EVAP valve and the fuel injector wiring harness connector mounting bracket to the upper intake manifold assembly.

17 Move the EVAP valve and the fuel injector wiring harness connector mounting bracket clear of the upper intake manifold assembly.

18 Disconnect the PCV fresh air tube (1) from its upper intake manifold mounting clip (2).

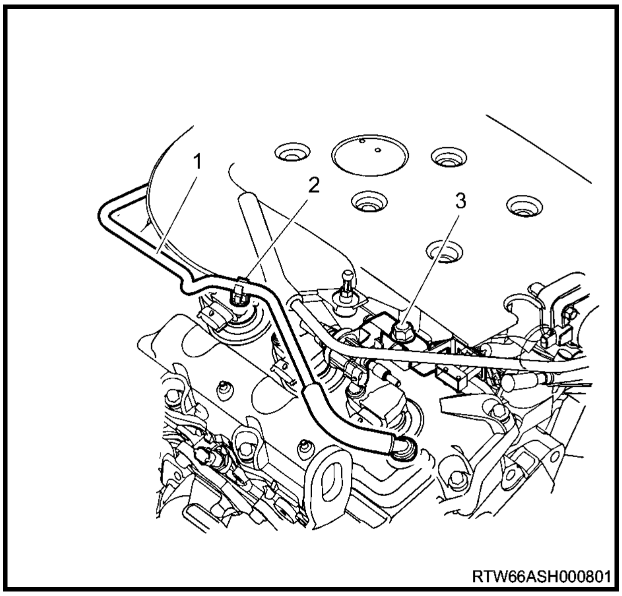


Figure 6A1 – 50

19 Remove the four long (1) bolts (165 mm) securing the complete intake manifold to the cylinder heads.

20 Remove the two short (2) bolts (45 mm) securing the lower intake manifold to the cylinder heads.

CAUTION

Do not loosen nor remove the short bolts (×) (70 mm) holding the upper intake manifold to the lower. These bolts are at the front left and rear right of the upper intake manifold.

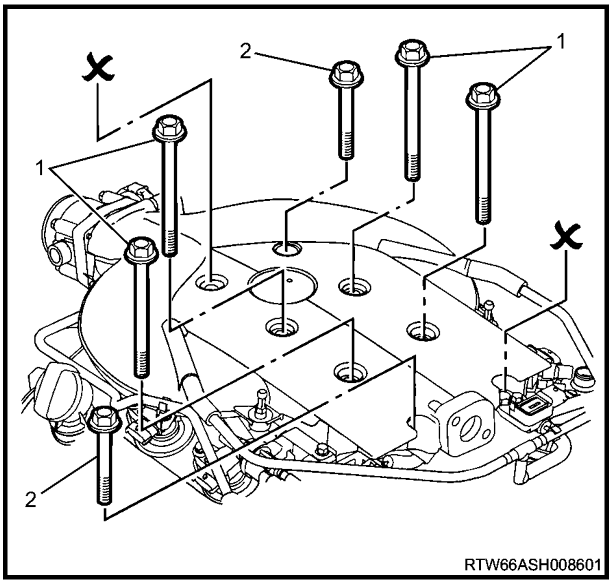


Figure 6A1 – 51

CAUTION

When the intake manifold is removed, plug each of the cylinder head intake openings with lint free cloth, to stop the entry of foreign material into the intake ports.

21 Remove the upper and lower intake manifold assembly from the engine.

22 Remove lower intake manifold to cylinder head gasket.

Disassemble

1 Disconnect the EVAP hose (1) from the upper intake manifold (2).

2 Remove the bolts (3) (70 mm long) attaching the upper intake manifold to the lower intake manifold (4).

NOTE

These bolts are located at the front left and rear right of the upper intake manifold, as shown.

3 Remove the upper intake manifold from the lower intake manifold.

4 Remove and discard the upper to lower intake manifold gaskets.

CAUTION

Do not reuse the upper to lower intake manifold gaskets (5).

5 Remove the EVAP hose from the retaining clip (6) attached to the lower intake manifold.

6 Remove the following from the upper intake manifold, refer to Section 6C1-3 Engine Management – V6 – Service Operations:

- BARO Sensor and
- Throttle Body assembly

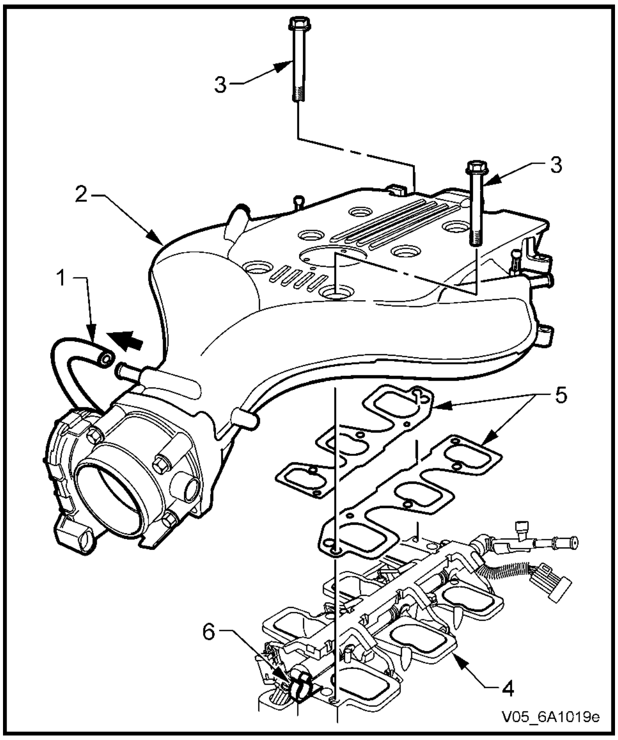


Figure 6A1 – 52

7 Remove the fuel rail and injector assembly. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.

CAUTION

The following precautions must be followed when removing the fuel rail and injector assembly:

- **Care must be taken when removing the fuel rail and injector assembly to prevent damage to the injector spray tips and injector harness connector terminals.**
- **Support the fuel rail and injector assembly after removal.**
- **Plug all fuel line and manifold openings after removal to prevent dirt and other contaminants from entering the fuel system.**

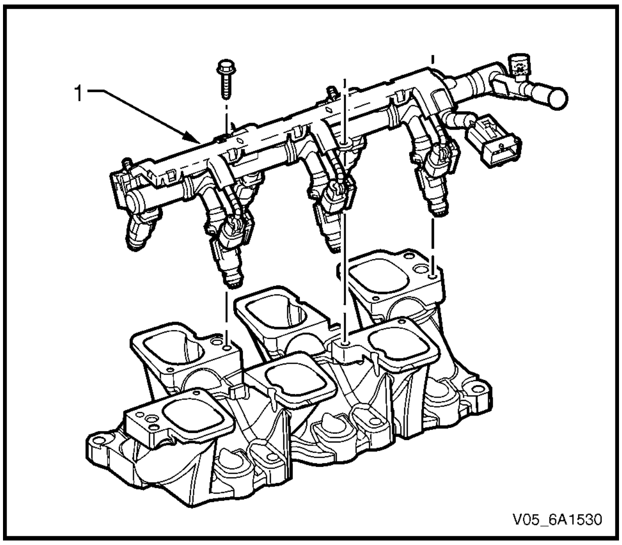


Figure 6A1 – 53

Clean

CAUTION

Due to the aluminium alloy construction of the intake manifold, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use of a wooden or plastic scraper is preferred.

1 Clean mating surfaces ensuring any gasket material is removed.

2 Clean the manifold using a suitable solvent

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the timing components with compressed air.

Inspect

1 Inspect the intake manifold for the following fault conditions:

- Damaged sealing and mating surfaces.
- Damaged lower intake manifold gasket.
- Damage or excessive debris on the threaded and through holes.
- Cracks or damage to the intake manifold body.

NOTE

If the lower intake manifold is cracked or damaged, it must be replaced. No welding or patching of the intake manifold should be performed.

2 Place a straight edge (1) across the upper intake manifold sealing surface (2).

3 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

4 If the clearance between the upper intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Upper manifold maximum warpage .... 0.05 mm

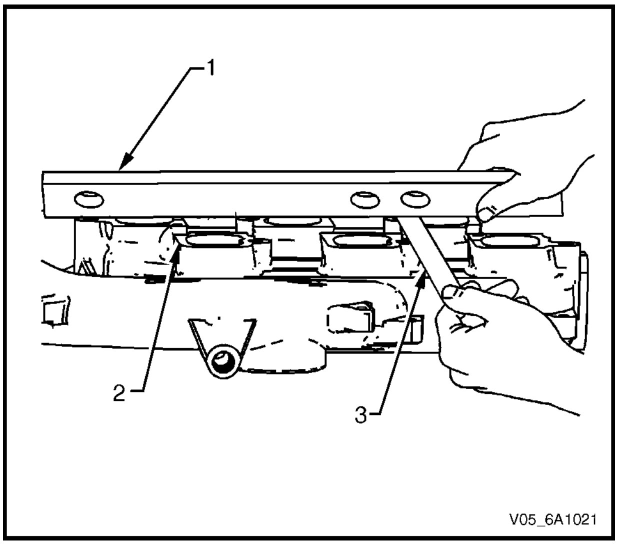


Figure 6A1 – 54

5 Place a straight edge (1) across the lower intake manifold sealing surface (2).

6 Using a feeler gauge (3), measure the clearance between the manifold and the straight edge.

7 If the clearance between the lower intake manifold sealing surface and the straight edge exceeds the specified maximum warpage, replace the manifold.

Lower manifold maximum warpage	0.05 mm

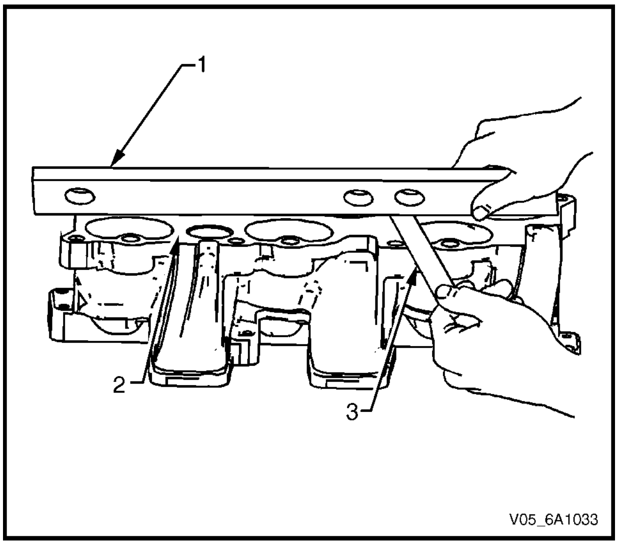


Figure 6A1 – 55

Reassemble

Reassembly of the upper to lower intake manifold is the reverse of the disassembly procedure noting the following:

1 Ensure that both the manifolds have been cleaned and inspected.

2 Ensure that the warpage of the mating surfaces is within tolerances.

3 New upper to lower intake manifold gaskets must be used.

4 Do not tighten the intake manifold to lower intake manifold attaching bolt at this stage. The intake manifold attaching bolts must be tightened at the specified sequence during the reinstallation procedure.

Reinstall

Reinstallation of the upper intake manifold and the upper and lower intake manifold assembly is the reverse of the removal procedure, noting the following:

1 Install the EVAP hose to the clip attached to the lower intake manifold.

2 Only new gaskets are to be fitted between the upper and lower intake manifolds.

3 If undamaged, the lower intake manifold to cylinder head gasket may be re-used, however its replacement is strongly recommended.

CAUTION

Tighten the intake manifold bolts in a circular pattern starting at the centre bolt and moving outward.

4 Ensure that all fasteners are tightened to the correct torque specification.

Upper intake manifold to lower intake manifold attaching bolt torque specification	23.0 Nm
Upper intake manifold to cylinder head attaching bolt torque specification	23.0 Nm
Lower intake manifold to cylinder head attaching bolt torque specification	23.0 Nm
Fuel injector wiring harness bracket attaching bolt torque specification	9.0 Nm

CAUTION

Incorrect wiring connector installation may cause component malfunction or component damage.

5 Ensure all wiring connectors are fully engaged and if applicable, locked in place.

6 Ensure all wiring harnesses are correctly routed and attached securely in their retaining clips.

7 Ensure that all hoses and pipes are routed correctly and that any retaining clips are correctly installed.

8 After installation pull on any quick connect fittings to check that each is correctly installed.

9 Start and run the engine to check for correct operation.

3.11 Exhaust Manifold Assembly

Remove

WARNING

Allow the engine to cool before commencing.

CAUTION

Disconnection of the battery affects certain vehicle electronic systems, refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery negative terminal.

2 Remove the oxygen sensor harness connector (1) from the retaining bracket.

3 Disconnect the oxygen sensor wiring harness connector from the engine wiring harness connector (2).

4 Unclip the oxygen sensor wiring harness retaining clip and move aside.

5 For the left-hand side:

Remove the oil level indicator tube.

6 Raise the front of the vehicle and place on stands, refer to Section 0A General Information.

7 Working from under the vehicle, remove the two exhaust manifold to exhaust pipe flange nuts, refer to Section 6F Exhaust System - V6.

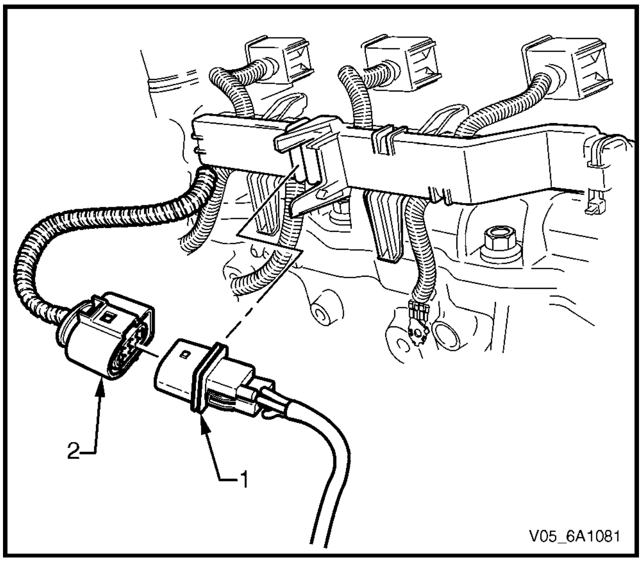


Figure 6A1 – 56

8 Remove the three bolts attaching the exhaust manifold outer heat shield (1) to the exhaust manifold (2).

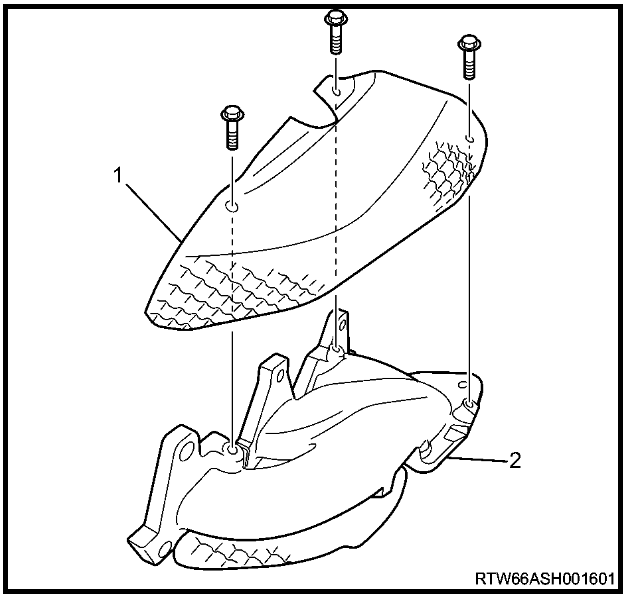


Figure 6A1 – 57

9 Progressively loosen the seven exhaust manifold attaching bolts (2), working from the outside to the centre and then remove the bolts.

10 Manoeuvre the exhaust manifold (3), away from the cylinder head.

11 Remove and discard the exhaust manifold to cylinder head gasket.

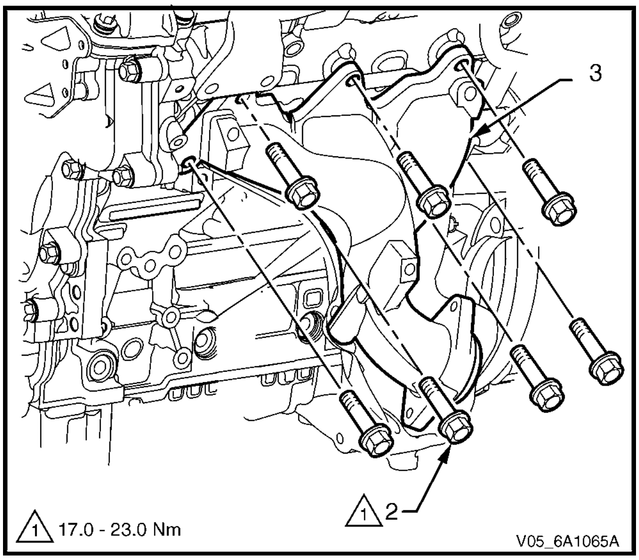


Figure 6A1 – 58

12 Remove the three bolts (1), attaching the exhaust manifold inner heat shield to the exhaust manifold.

13 Using a suitable commercially available non-corrosive cleaning solvent and a soft bristled parts cleaning brush, thoroughly clean the exhaust manifold.

14 Dry the exhaust manifold using compressed air.

WARNING

Safety glasses must be worn when using compressed air.

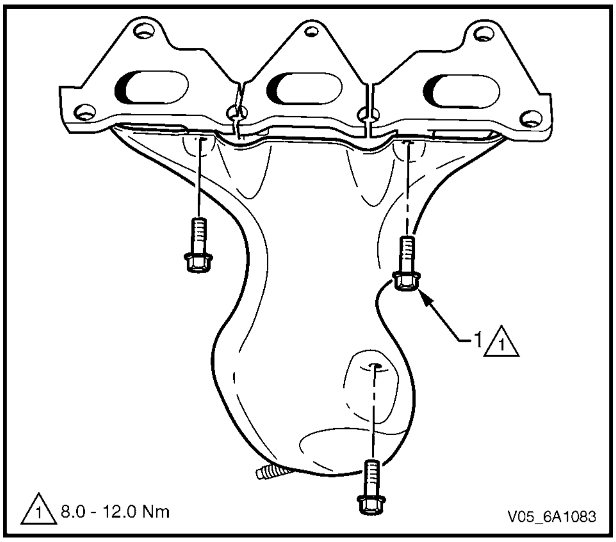
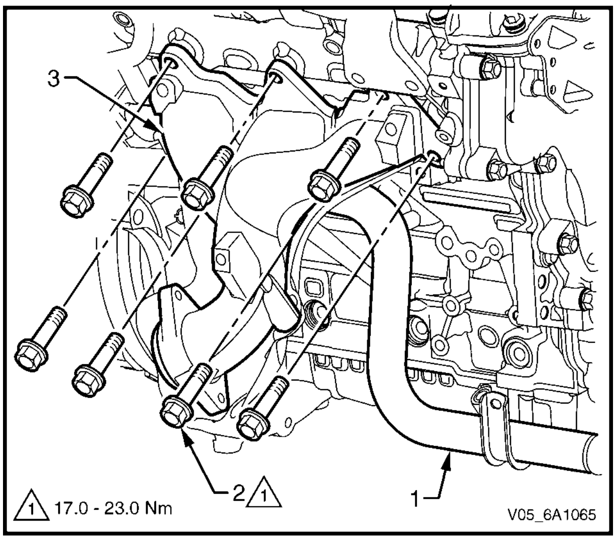


Figure 6A1 – 59

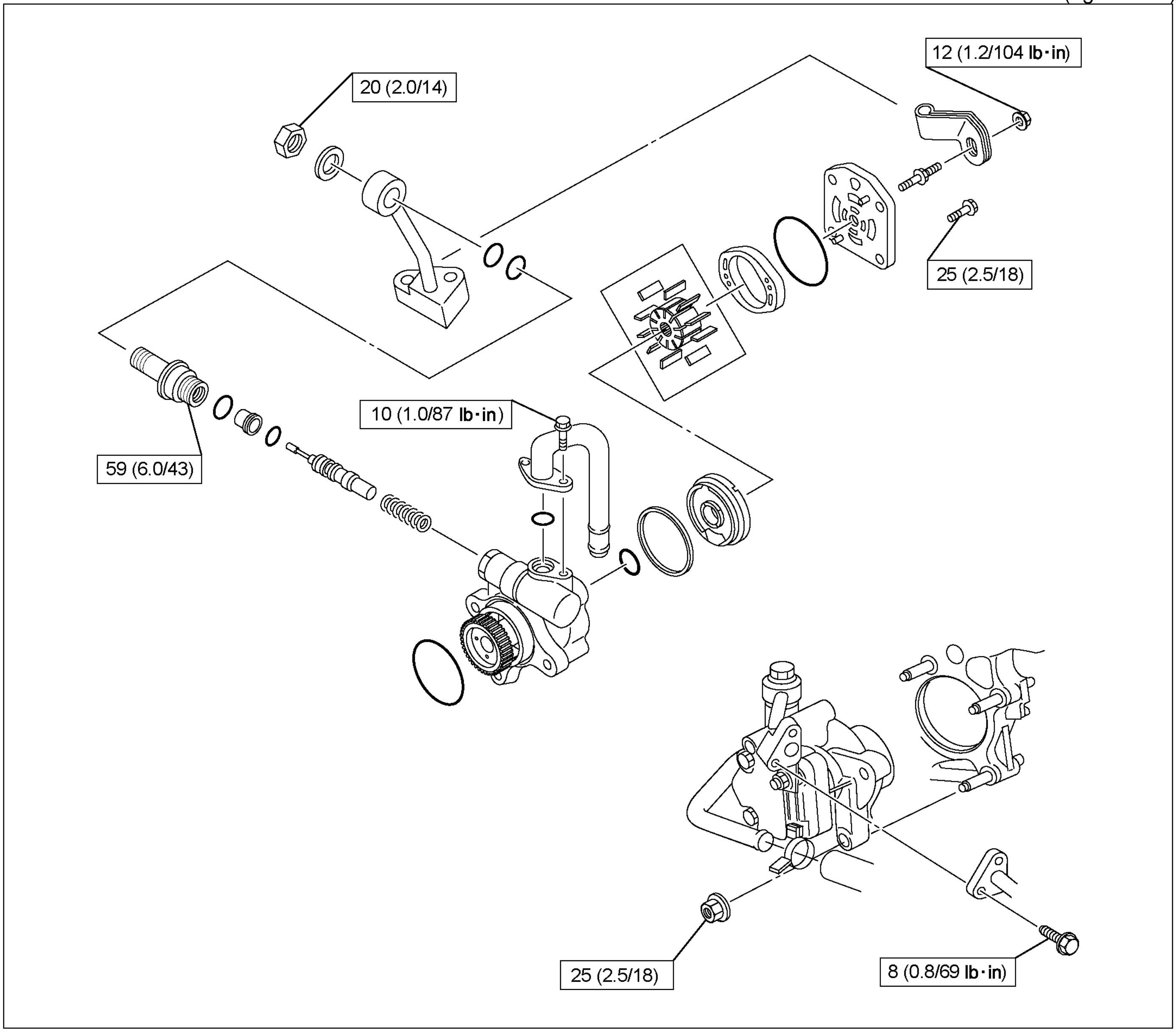
NOTE

- The same procedure applies to the Right-hand exhaust manifold.
- To gain access to the lower rear exhaust manifold attaching bolts (2), apply a slight downward movement to the coolant inlet pipe (1).



Torque Specifications

N·m (kgf·m/lb·ft)



RTW73BLF000701

Inspect

Inspect the exhaust manifold (1) for the following:

- Damage to the threaded holes for the heat shield mounting.
- Damage to the exhaust manifold mounting holes.
- Damage to the threads of the exhaust manifold to exhaust pipe flange studs.
- Damage to the gasket sealing surfaces.
- Using a straight edge (2) and feeler gauges (3), check the cylinder head mounting face of the exhaust manifold does not exceed the maximum distortion specification of 0.25mm.

NOTE

If the surface flatness is not within specifications, the exhaust manifold is warped and must be replaced.

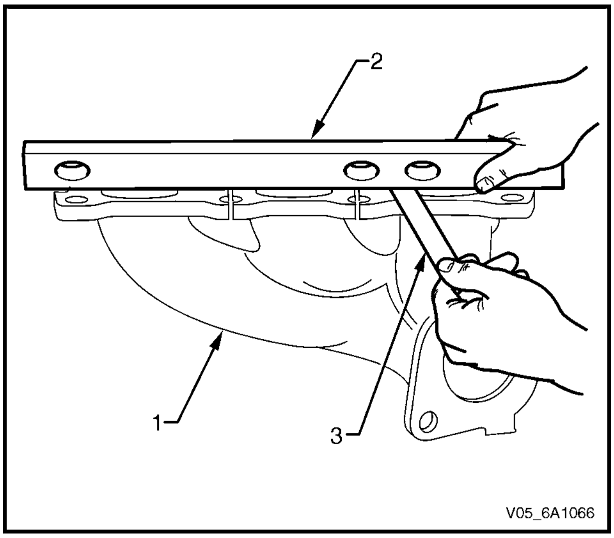


Figure 6A1 – 60

Reinstall

Reinstallation of the exhaust manifold assembly is the reverse of the removal procedure, noting the following:

1. Ensure the exhaust manifold, cylinder head and exhaust pipe flange surfaces are clean.
2. Position a new exhaust manifold gasket onto the exhaust manifold.
3. Apply a 5 mm bead of Loctite 272 thread sealant (or equivalent) to the threads of the exhaust manifold attaching bolts.
4. Install the bolts into the exhaust manifold. This will prevent the gasket from falling off the manifold.
5. Manoeuvre the exhaust manifold into position and install the exhaust manifold attaching bolts.
6. From underneath the vehicle install the exhaust manifold to exhaust pipe flange nuts.
7. Tighten the exhaust manifold attaching bolts to the correct torque specification.

NOTE

When tightening the exhaust manifold to cylinder head attaching bolts, begin with the centre bolts, then alternate from side to side to the outer bolts.

Exhaust manifold to cylinder head attaching bolt torque specification...........17.0 – 23.0 Nm

8. Apply an anti seize compound such as Caltex Kopr-Kote (or equivalent) to the cleaned heat shield bolt threads. Install the heat shield attaching bolts and tighten to the correct torque specification.

Exhaust manifold heat shield attaching bolt torque specification ....8.0 – 12.0 Nm

9. For the right-hand side, install the battery harness ground cable attaching nut through the ground terminal and lower coolant tube mounting lug, and tighten to the correct torque specification.

Battery harness ground terminal attaching nut torque specification.......................13.0 Nm

3.12 Camshaft Cover

Remove

1 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

2 For the left-hand side, remove the evaporative (EVAP) emission canister purge solenoid, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

3 Remove the two bolts (1) attaching the engine wiring harness former to the rear of the cylinder heads.

4 Unclip the transmission vent tube (2) from the engine wiring harness.

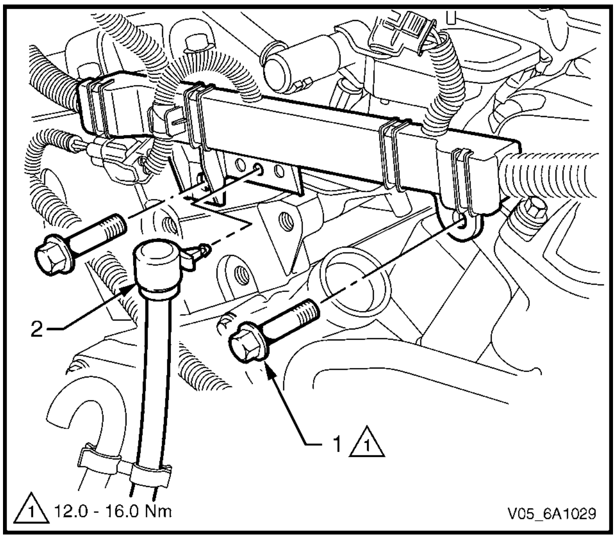


Figure 6A1 – 61

5 Disconnect the oxygen sensor wiring harness connector (1) from the engine wiring harness (2), left-hand shown, right-hand similar.

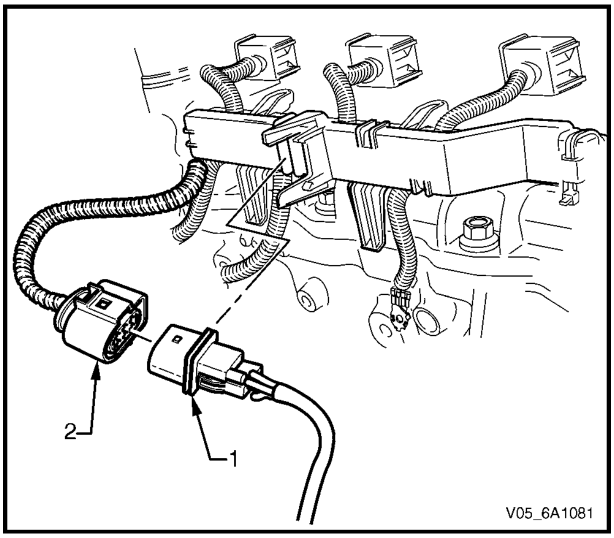


Figure 6A1 – 62

6 Remove the bolt (1) attaching the ground connector (2) to the cylinder head.

7 Fro the left-hand side, disconnect the engine coolant temperature (ECT) sensor wiring connector (3).

8 Unclip the engine wiring harness retaining lugs from the side of the camshaft cover.

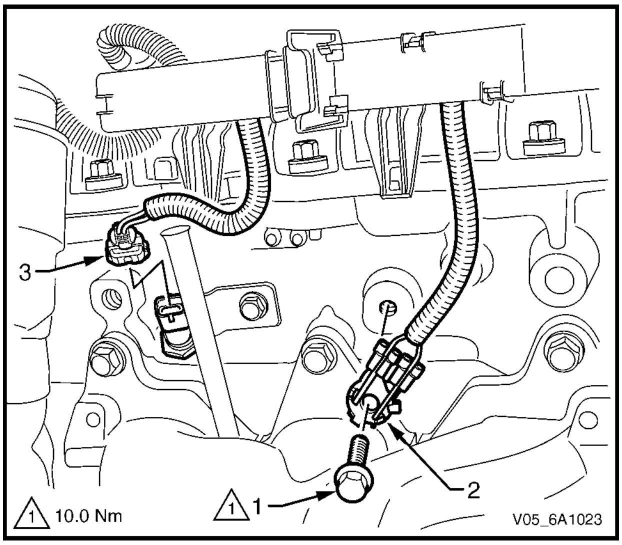


Figure 6A1 – 63

9 For the right-hand side, remove the engine wiring harness retaining clip (1) from the engine control module (ECM) bracket (2).

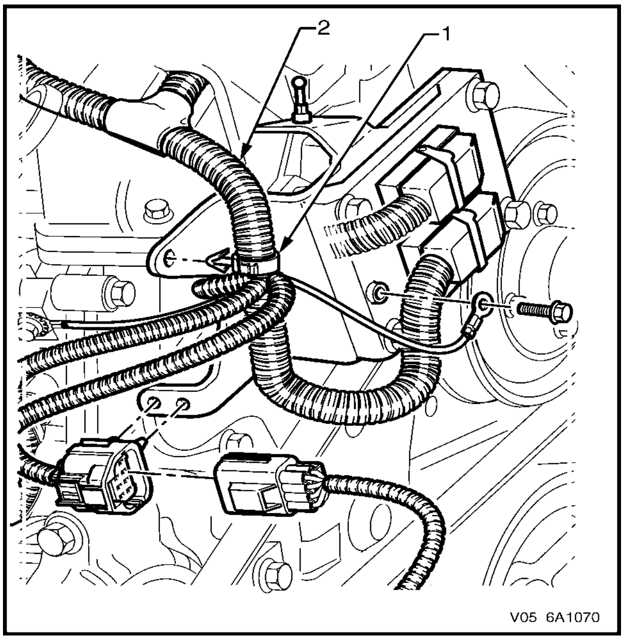


Figure 6A1 – 64

10 Disconnect the camshaft position (CMP) sensor wiring connector (1).

11 Unclip the engine wiring harness retaining lug (3) from the front of the camshaft cover.

12 Remove the ignition coil assemblies; refer to Section 6C1-3 Engine Management – V6 – Service Operations.

13 Move the engine wiring harness clear of the camshaft cover.

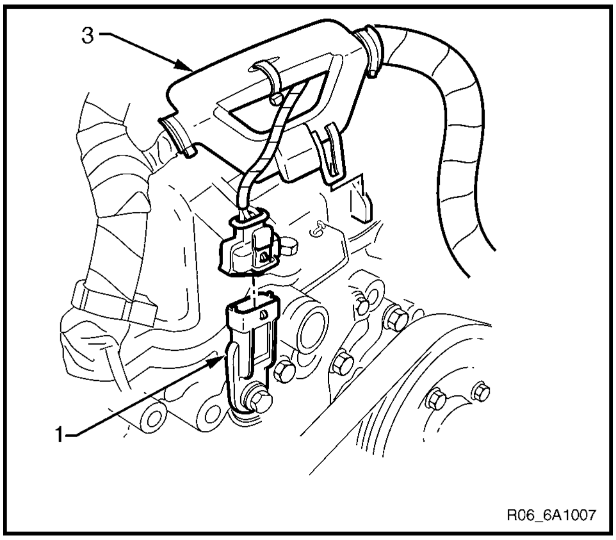


Figure 6A1 – 65

14 Remove the bolt (1), 13 places, attaching the camshaft cover (2) to the cylinder head (3).

15 Remove the cover and discard the seal.

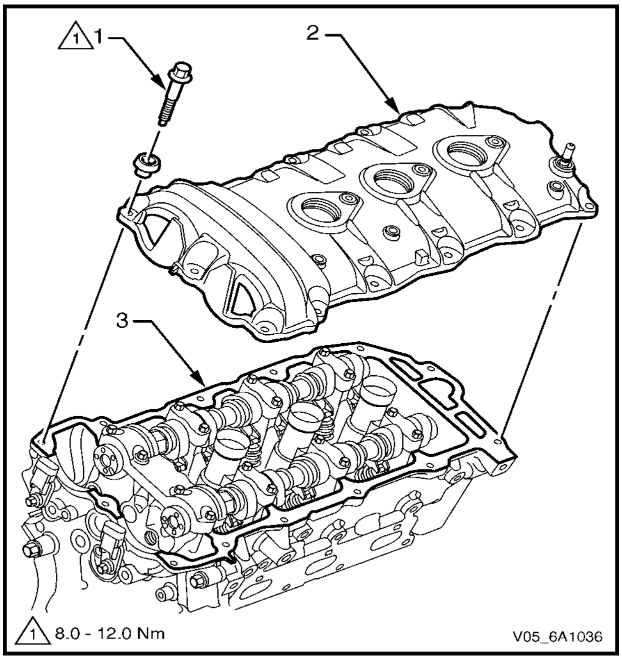


Figure 6A1 – 66

16 Install Tool No. EN-46101 (1) to the spark plug tubes of the cylinder head to prevent entry of dirt into the combustion chamber.

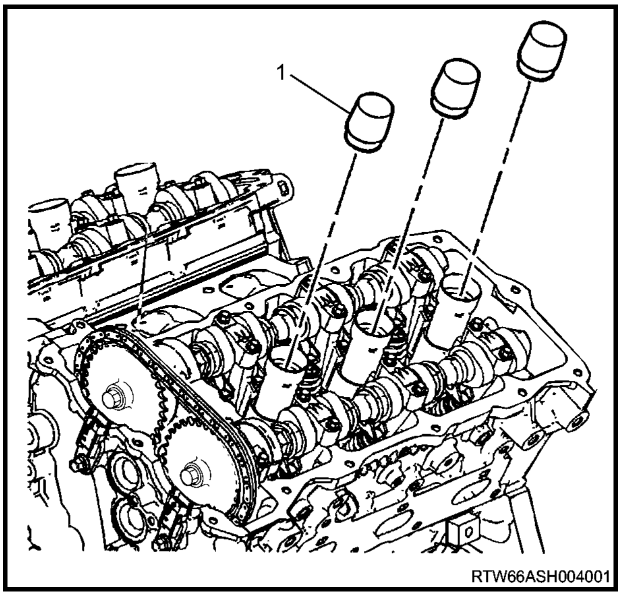


Figure 6A1 – 67

Clean and Inspect

WARNING

Safety glasses must be worn when using compressed air.

1 Clean the camshaft cover with suitable cleaning solvent and blow dry with compressed air.

2 Inspect the cover for cracking and distortion.

3 Check the spark plug tube seals for damage.

4 If the camshaft cover is damaged in any way that will affect it’s performance to seal and stop the ingress of dirt, replace the camshaft cover.

Reinstall

Reinstallation of the camshaft cover assembly is the reverse of the removal procedure, noting the following:

1 If not already fitted, install Tool No. EN-46101 (1) to the spark plug tubes of the cylinder head.

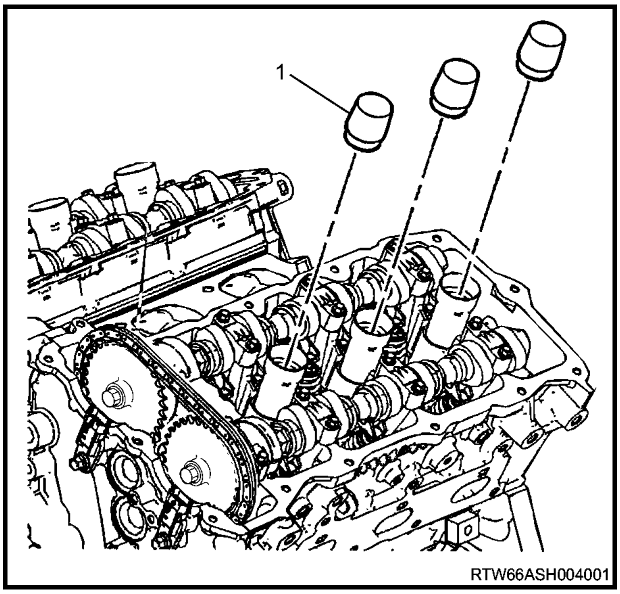


Figure 6A1 – 68

2 Ensure that the grommet (1), 13 places, is correctly seated in its hole.

3 Wipe the camshaft cover sealing surface on the cylinder head with a clean lint free cloth.

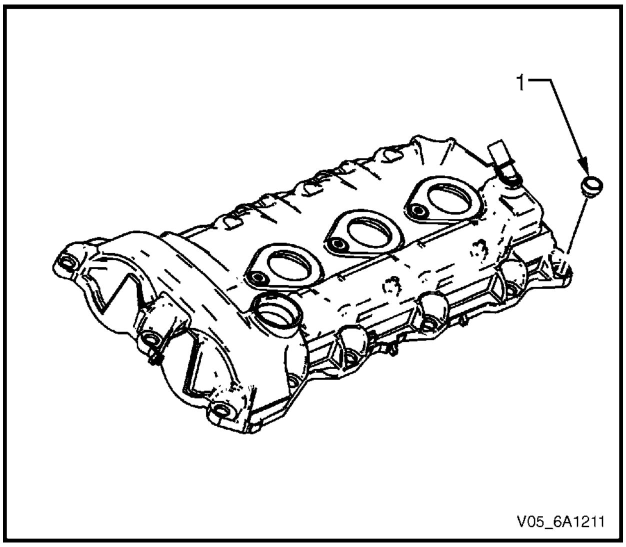


Figure 6A1 – 69

4 Ensure that a new seal is correctly fitted to the camshaft cover. Place a 3 mm bead of RTV sealant on the join line of the engine front cover (1).

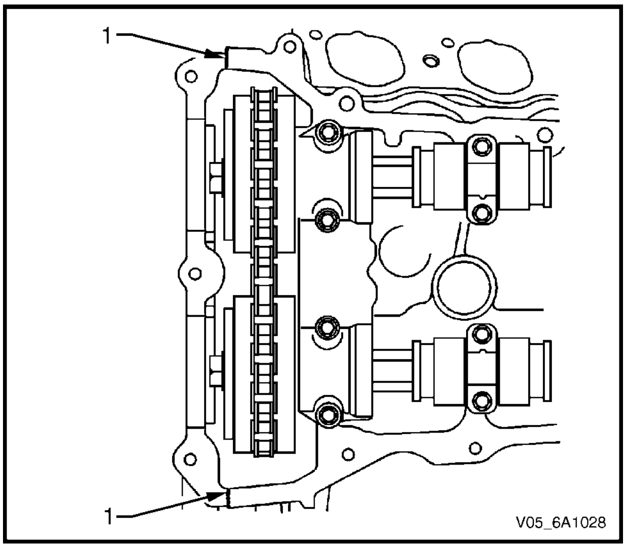


Figure 6A1 – 70

5 Place the camshaft cover (1) into position onto the cylinder head (2).

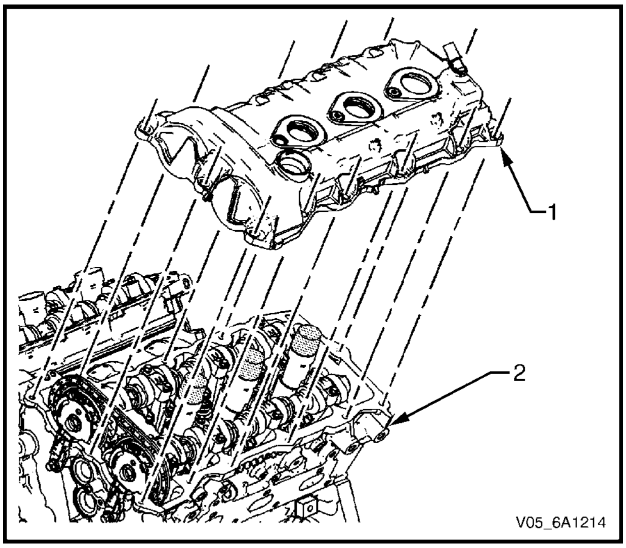


Figure 6A1 – 71

6 Loosely install the camshaft cover bolt (1), 13 places.

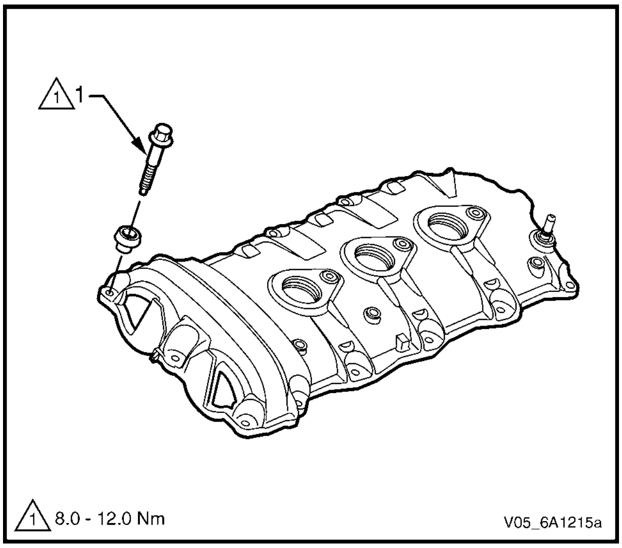


Figure 6A1 – 72

7 Tighten the camshaft cover bolts to the correct torque specification, in the sequence shown.

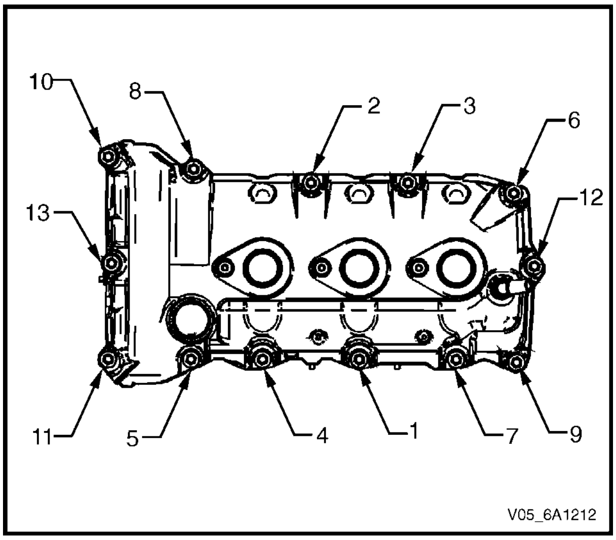


Figure 6A1 – 73

Camshaft cover attaching bolt torque specification	8.0 – 12.0 Nm

8 Remove Tool No. EN-46101 (1).

9 Tighten all remaining fasteners to the correct torque specification.

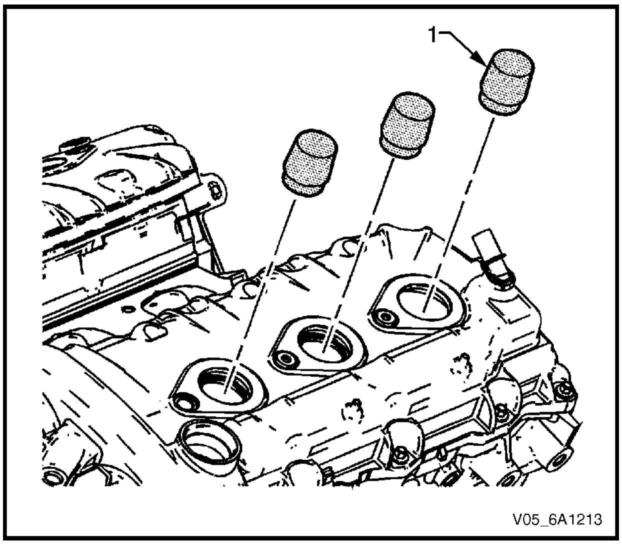


Figure 6A1 – 74

Engine ground connector bolt torque specification	10.0 Nm
Engine wiring harness former attaching bolt torque specification	12.0 – 16.0 Nm

3.13 Crankshaft Balancer Assembly

Remove

1 Remove the accessory drive belt, refer to 3.5 Accessory Drive Belt.

2 Remove the starter motor, refer to Section 6D1-2 Starting System.

3 Install Tool No. EN-46106 (1) into the starter motor opening to stop the camshaft from rotating.

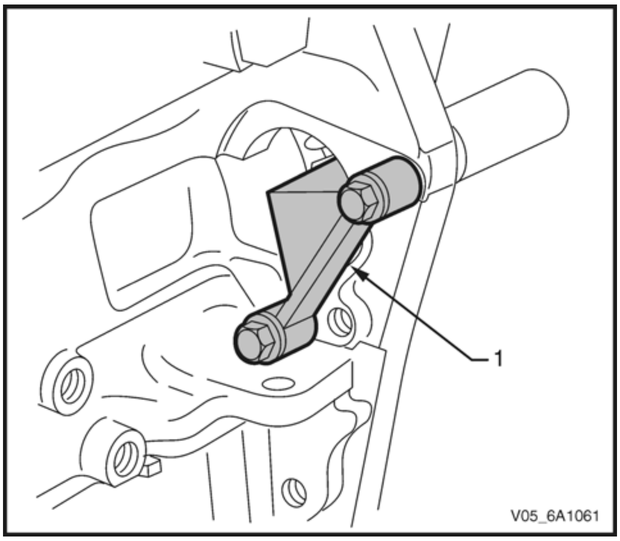


Figure 6A1 – 75

4 Remove the bolt (1) attaching the crankshaft balancer assembly (2) to the crankshaft.

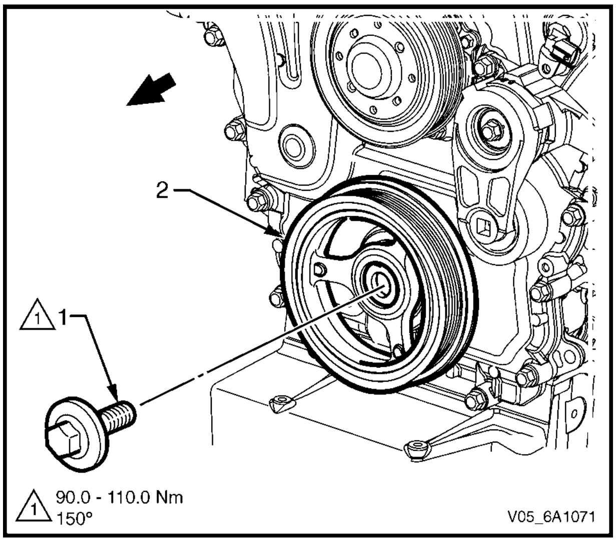


Figure 6A1 – 76

5 Remove the crankshaft balancer assembly (1) from the crankshaft using the appropriate tool:

Tool No. J-41816 (2) or equivalent.

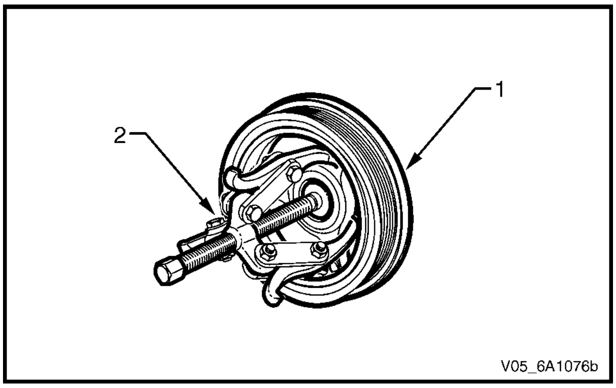


Figure 6A1 – 77

Clean and Inspect

1 Using a suitable non-corrosive cleaning solvent and a soft bristled parts cleaning brush, clean the crankshaft balancer assembly.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the crankshaft balancer assembly using compressed air.

3 Inspect the crankshaft balancer assembly for the following fault conditions:

- Hub to crankshaft inner surface for wear or damage,
- Sealing surface for wear, grooving or scoring,
- Rubber ring between the hub and the pulley for wear, chunking and general deterioration, and
- Drive belt ribs of the pulley for damage.

Reinstall

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer must be installed onto a dry seal.

1 Lubricate the crankshaft balancer assembly hub bore.

2 Partially install the crankshaft balancer assembly onto the crankshaft.

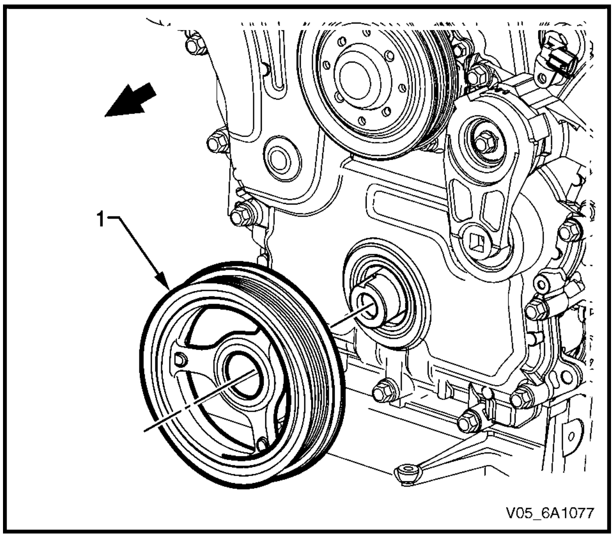


Figure 6A1 – 78

3 Using crankshaft balancer installer, Tool No. J-41998-B (1), fully install the crankshaft balancer assembly into the crankshaft.

CAUTION

To prevent damage to the crankshaft threads, fully install crankshaft balancer installer, Tool No. J-41998-B (1) into the crankshaft before pressing the pulley and balancer assembly.

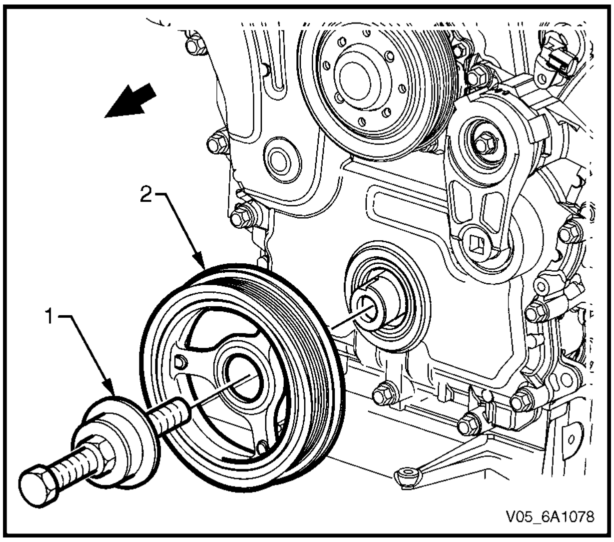


Figure 6A1 – 79

4 Apply Loctite 272 or equivalent to the thread of a new crankshaft balancer assembly retaining bolt (1).

5 Install the crankshaft balancer assembly retaining bolt and tighten to the correct torque specification.

■ ♦ Crankshaft balancer retaining bolt torque specification:	
Stage 1	90.0 – 110.0 Nm
Stage 2	150°

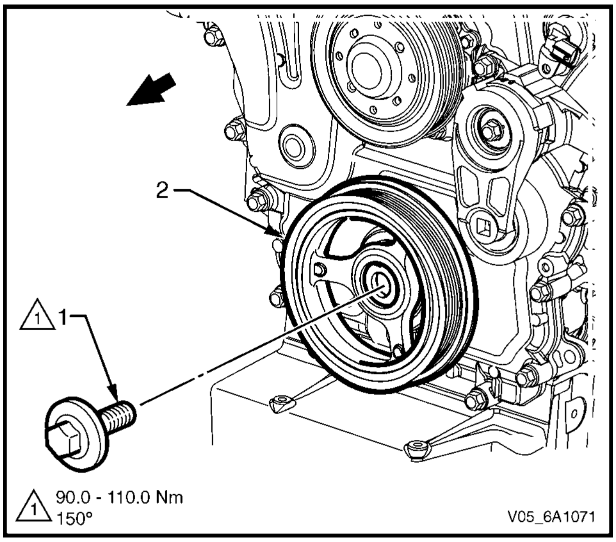


Figure 6A1 – 80

Supplemental Restraint System Steering Wheel & Column

Service Precaution

This steering wheel and column repair section covers the Supplemental Restraint System (SRS) steering column. The following repair procedures are specific to SRS components. When servicing a vehicle equipped with Supplemental Restraint System, pay close attention to all WARNINGS and CAUTIONS.

For detailed explanation about SRS, refer to Restraints section.

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

SAFE HANDLING OF INFLATOR MODULES REQUIRES THE PROCEDURES DESCRIBED BELOW TO BE FOLLOWED FOR BOTH LIVE AND DEPLOYED MODULES.

SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY (AIR BAG). AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY (AIR BAG) SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY-PRODUCT OF THE DEPLOYMENT REACTION, THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY (AIR BAG) IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY AN AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY.

WHEN PLACING A LIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE.

NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

TO AVOID DEPLOYMENT WHEN TROUBLESHOOTING THE SRS SYSTEM, DO NOT USE ELECTRICAL TEST EQUIPMENT, SUCH AS A BATTERY-POWERED OR A/C-POWERED VOLT-METER, OHMMETER, ETC., OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN SPECIFIED IN THIS MANUAL. DO NOT USE A NON-POWERED PROBE-TYPE TESTER.

INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT.

SRS Connectors

CAUTION: The special yellow color connectors are used for the supplemental restraint system-air bag circuit.

When removing the cable harness, do not pull the cables. Otherwise, cable disconnection may occur.

When connecting the SRS connector, insert the connector completely. Imperfect locking may cause malfunction of the SRS circuit.

3.14 Crankshaft Front Seal

Replace

1 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

2 Using a flat bladed tool (2) or seal remover, Tool No. E-308, carefully remove the crankshaft front seal (1) from the front cover.

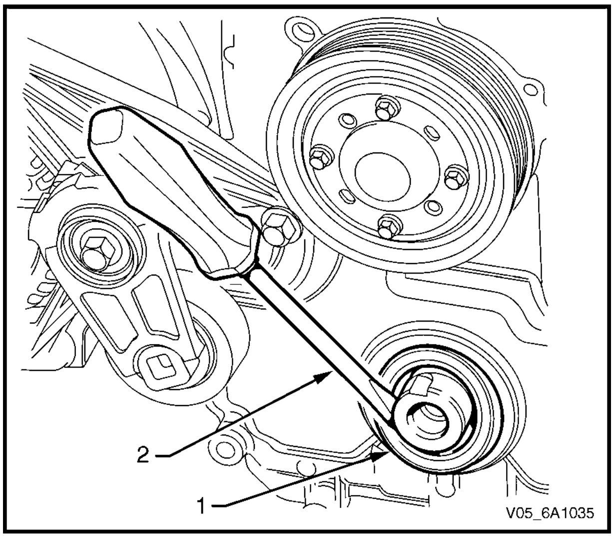


Figure 6A1 – 81

3 Using crankshaft front seal installer, Tool No. J-29184 (2) and a suitable hammer, install a new crankshaft front seal (1) until fully seated against the front cover housing.

4 Install the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

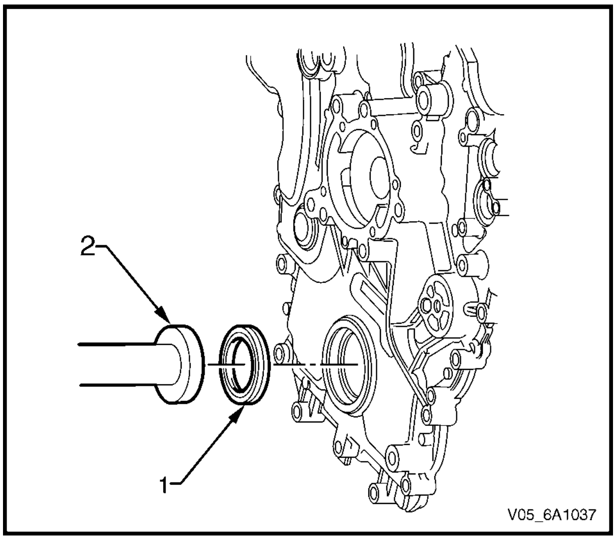


Figure 6A1 – 82

3.15 Front Cover Assembly

Remove

1 Drain the engine coolant, refer to Section 6B1 Engine Cooling.

2 Remove the water outlet pipe and coolant pump assembly, refer to Section 6B1 Engine Cooling:

3 Remove the camshaft covers, refer to 3.12 Camshaft Cover.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Disconnect the purge vent hose from the water outlet pipe.

NOTE

Do not disconnect the power steering pipes or drain the power steering fluid.

6 Remove the power steering pump reservoir mounting bracket, refer to 3.8 Power Steering Pump Bracket.

7 Remove the camshaft position sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

NOTE

Do not disconnect the A/C compressor pipes.

8 Remove the bolt (2), 22 places, attaching the front cover assembly (1).

CAUTION

Only use the prise points and a bolt in the jackscrew hole to remove the engine front cover.

9 Loosely install a 10 x 1.5 mm bolt in the jackscrew hole (1).

10 Using the prise points (2) located at the edge of the front cover and the jackscrew, shear the RTV sealant.

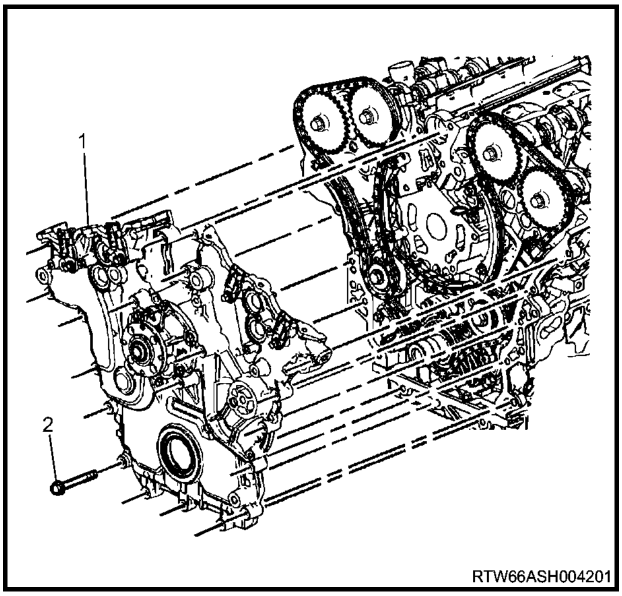


Figure 6A1 – 83

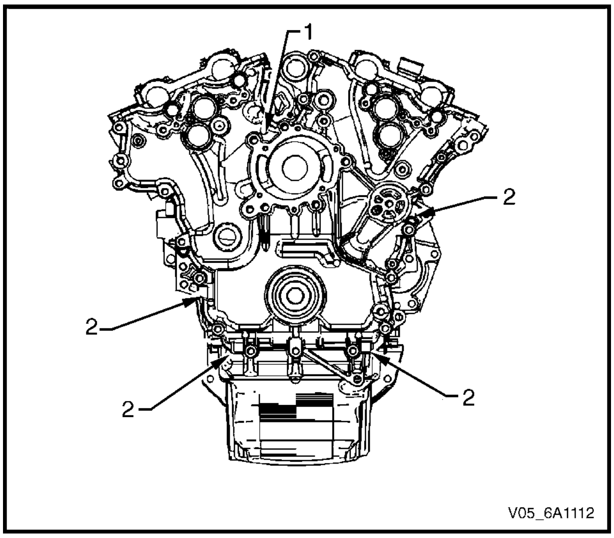


Figure 6A1 – 84

11 Remove the front cover assembly (1).

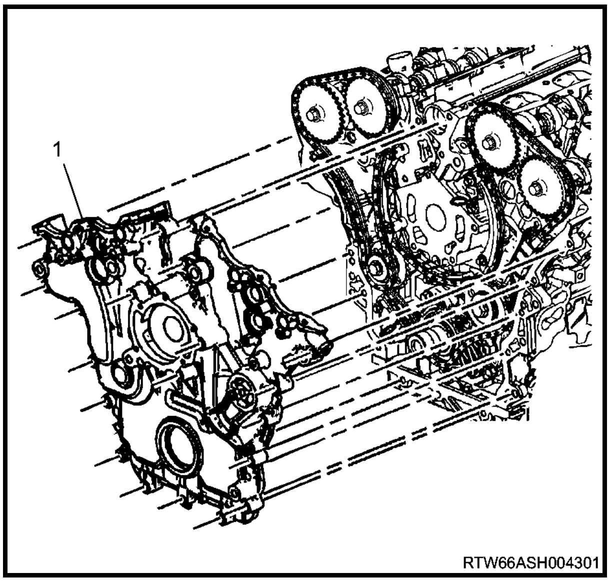


Figure 6A1 – 85

Disassemble

1 Remove the crankshaft front oil seal (1) from the engine front cover (2) using a flat bladed tool or seal remover, Tool No. E-308. Discard the seal.

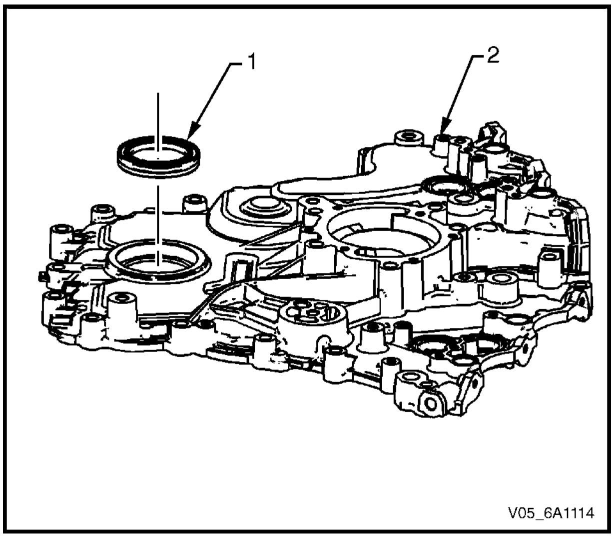


Figure 6A1 – 86

2 Remove the camshaft position actuator valve oil seals (1) from the engine front cover (2). Discard the seals.

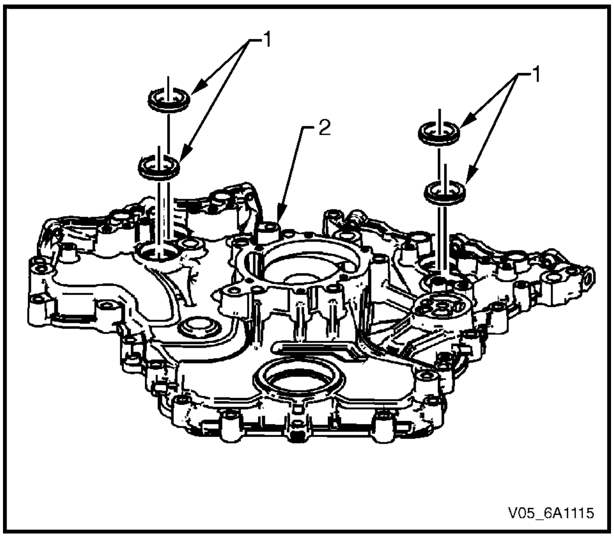


Figure 6A1 – 87

3 Remove the coolant pump seal (1) from the engine front cover (2). Discard the seal.

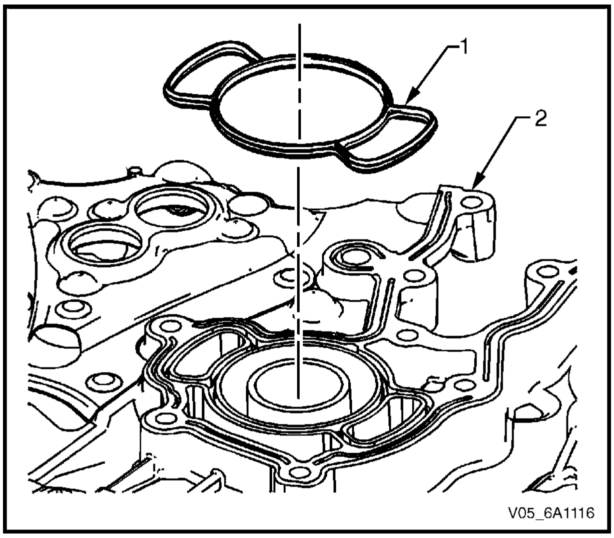


Figure 6A1 – 88

Clean

4 Remove any RTV sealant (1) from the engine front cover using a plastic or wood scraper.

CAUTION

- **Insert a piece of cardboard between the front of the oil pan and oil pump to prevent any contaminants from falling into the oil pan.**
- **Do not use a sharp or metal gasket scraper to clean the sealing surfaces.**

5 Clean out any debris from the bolt holes.

6 Clean the front cover with a suitable cleaning solvent.

7 Dry the front cover with compressed air.

WARNING

Safety glasses must be worn when using compressed air.

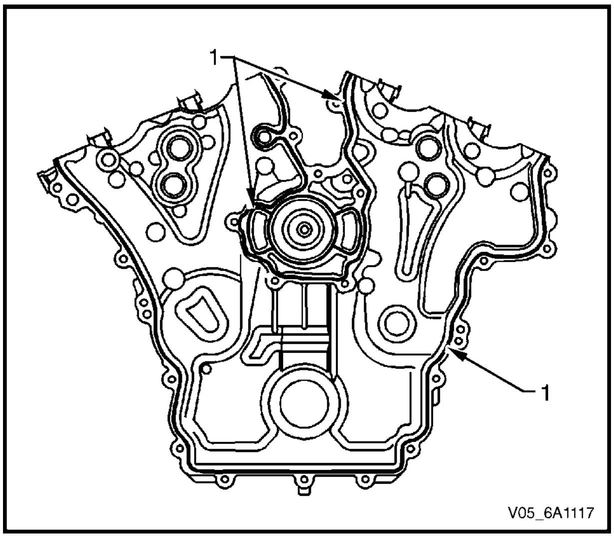


Figure 6A1 – 89

8 Use compressed air to remove any engine coolant from the engine cooling passages and from the top of the oil pan oil deflector.

Inspect

1 Inspect both sides of the engine front cover for the following conditions:

- damage to the camshaft position actuator valve oil seal bores (1),
- damage to the bolt holes (2),
- damage and/or corrosion to the engine coolant passage (3),
- dents or damage to the exterior (4),
- damage to the crankshaft front oil seal bore (5),
- gouges or damage to the coolant pump sealing surfaces (6), and
- damage to the coolant pump bolt hole threads (7).

2 Repair or replace the front cover as required.

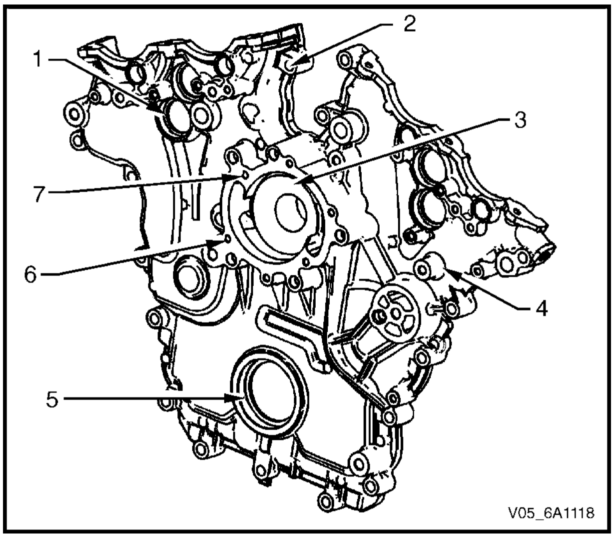


Figure 6A1 – 90

Reassemble

1 Install a new crankshaft front oil seal (1) into the front cover (2) using crankshaft front seal installer, Tool No. J-29184 (3) and a suitable hammer.

CAUTION

Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

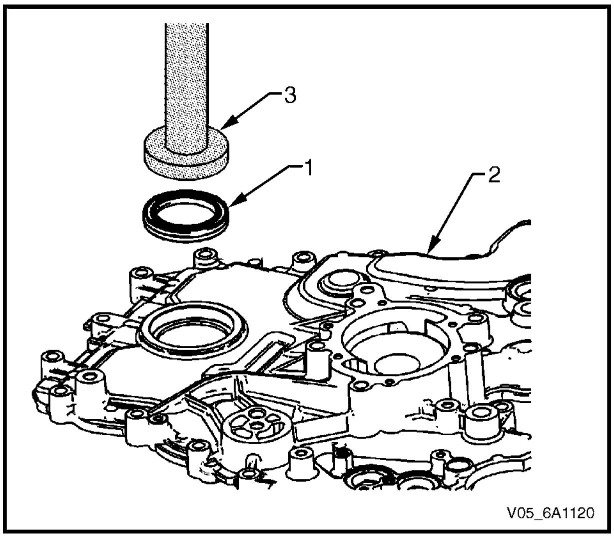


Figure 6A1 – 91

2 Install a new camshaft position actuator valve oil seal (1) into the front cover (2) using Tool No. EN-46103 (3) and a suitable hammer.

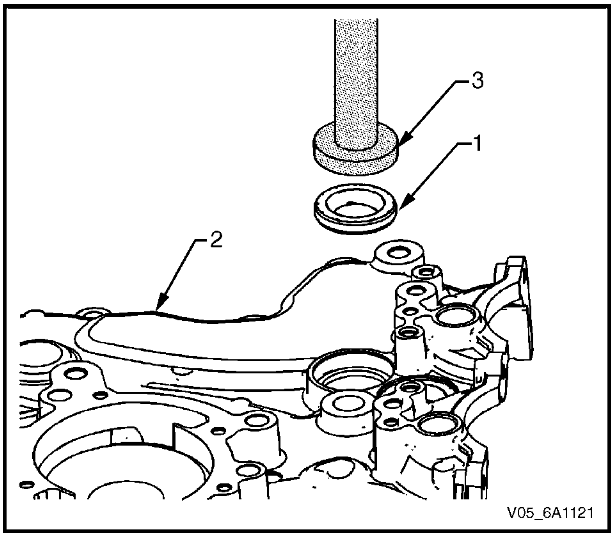


Figure 6A1 – 92

Reinstall

Reinstallation of the front cover is the reverse of the removal procedure, noting the following:

1 Install the guide pins, Tool No. EN-46109 (1) into the engine block, two places.

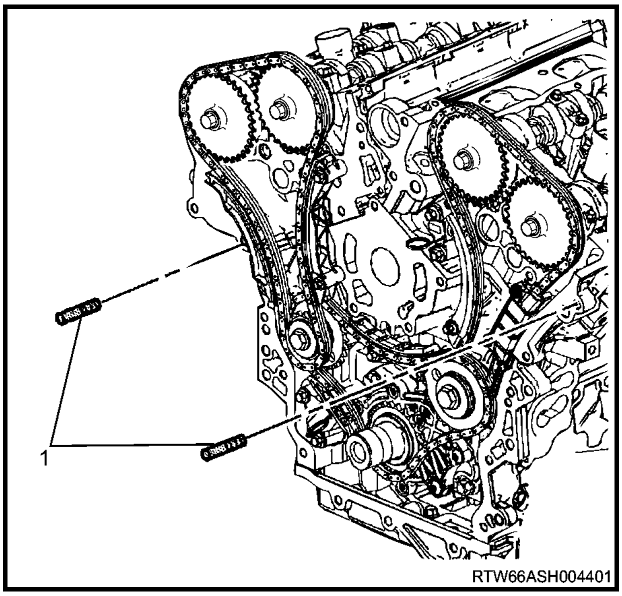


Figure 6A1 – 93

2 Install a new engine front cover to cylinder block seal (1).

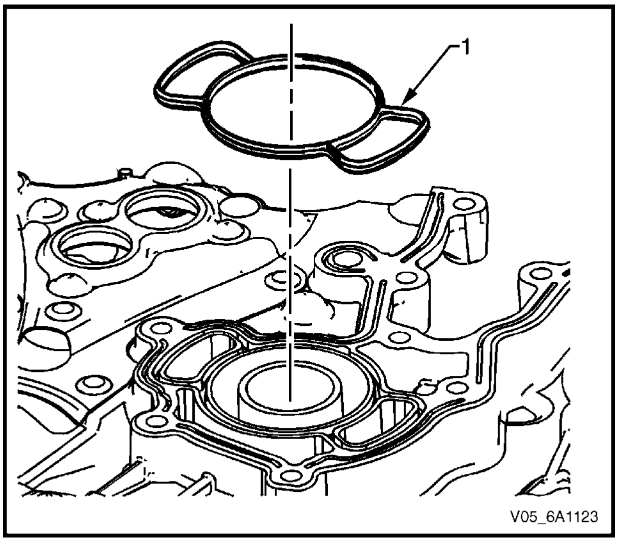


Figure 6A1 – 94

3 Apply a 3 mm bead of RTV sealant (1) to the front cover.

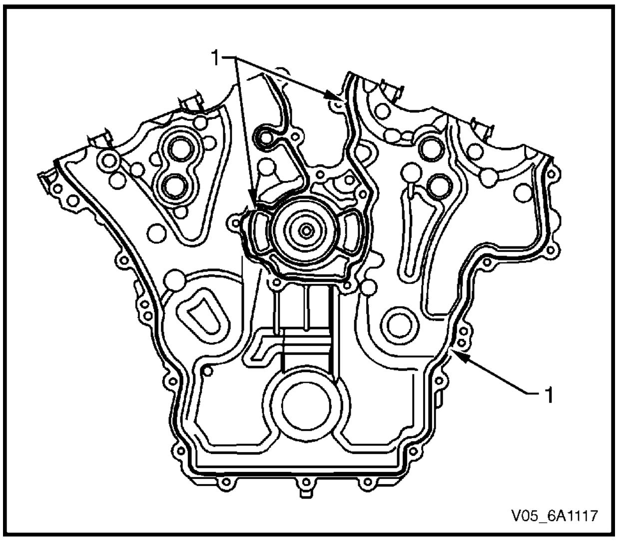


Figure 6A1 – 95

4 Place the front cover onto the special tools and slide into position.

5 Remove the special tools from the cylinder block.

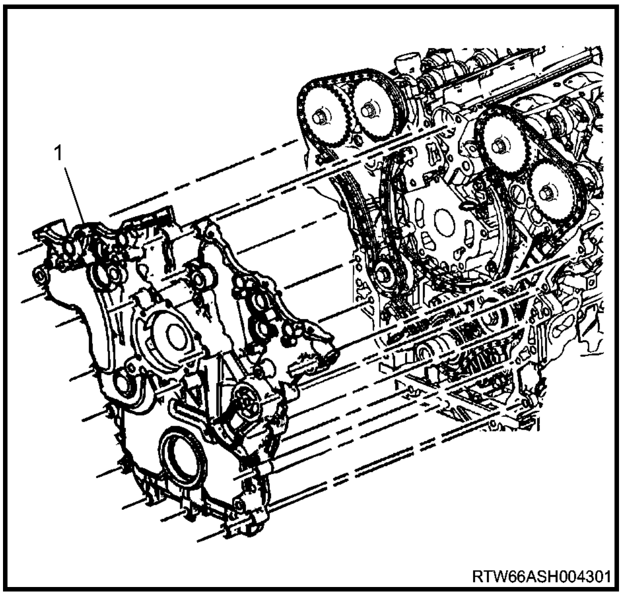


Figure 6A1 – 96

6 Hand start the front cover bolts (1).

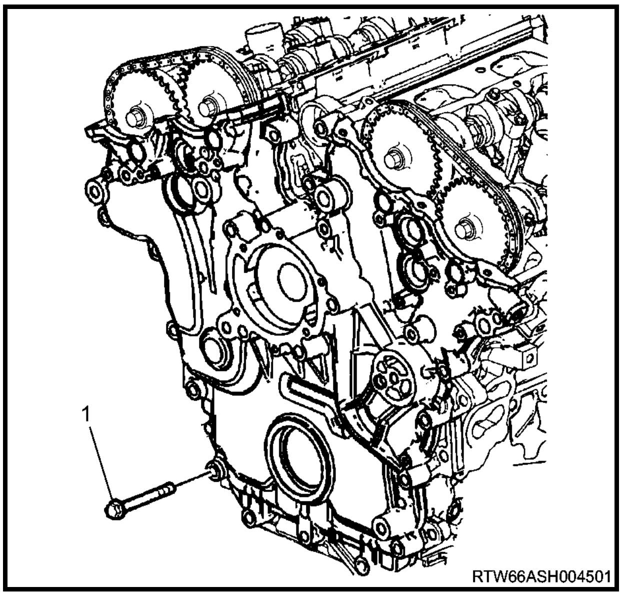


Figure 6A1 – 97

7 Tighten the engine front cover bolts to the correct torque specification, in the sequence shown.

Engine front cover assembly attaching bolt torque specification ....20.0 – 26.0 Nm

8 Fill the cooling system, refer to Section 6B1 Engine Cooling – V6.

9 Change the engine oil, refer to 3.1 Engine Oil.

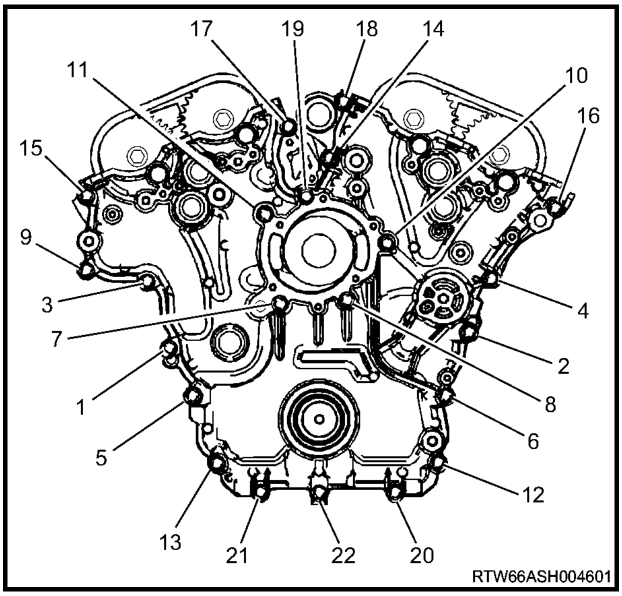


Figure 6A1 – 98

3.16 Timing Chains, Tensioners, Shoes and Guides

CAUTION

Setting the camshaft timing is required whenever the camshaft drive system has been disturbed and the relationship between any chain and sprocket has been lost. If required, follow the left-hand secondary timing chain reinstallation procedure to reset the camshaft timing.

Primary and Left-hand Secondary Timing Chain Installation

Excluding MY06 Update

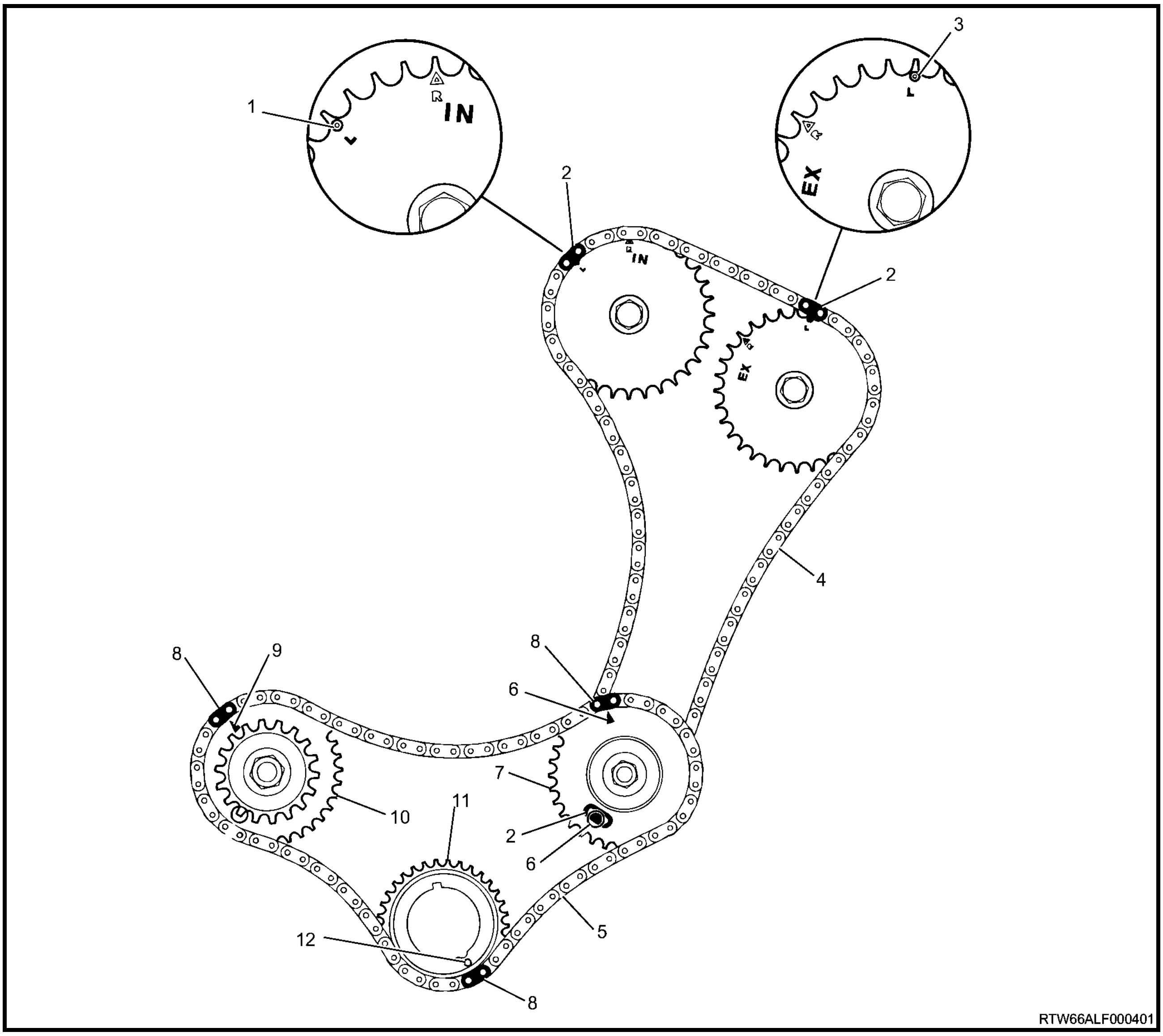


Figure 6A1 – 99

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain – Left-hand
5 Primary Timing Chain
6 Camshaft Intermediate Sprocket Timing Mark – Left-hand
7 Camshaft Intermediate Sprocket – Left-hand
8 Primary Timing Chain Bright Plated Link
9 Camshaft Intermediate Sprocket Timing Mark – Right-hand
10 Camshaft Intermediate Sprocket – Right-hand
11 Crankshaft Sprocket
12 Crankshaft Sprocket Timing Mark

MY06 Update

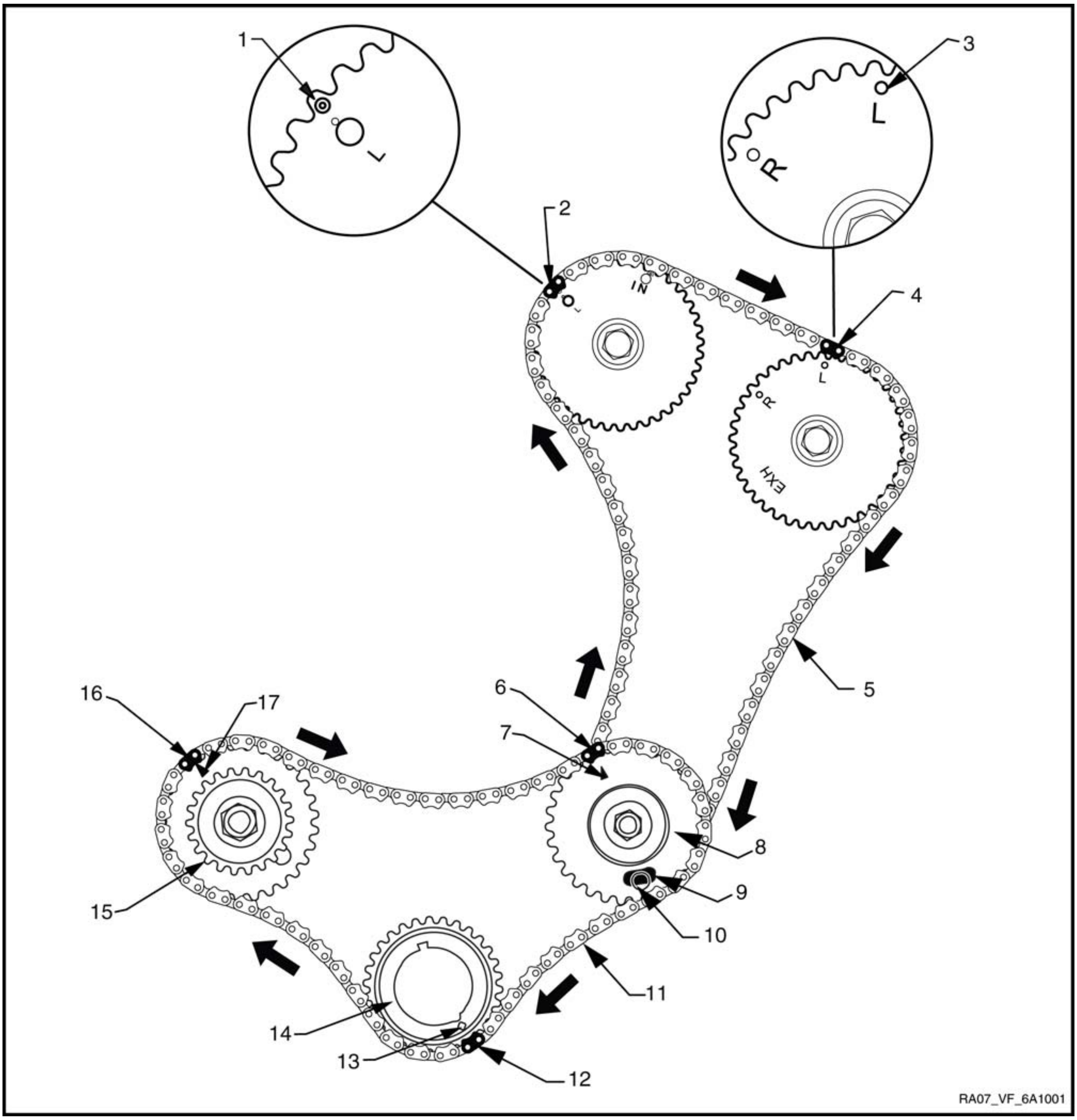


Figure 6A1 – 100

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand Intake
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain Bright Plated Link – Left-hand Exhaust
5 Secondary Timing Chain – Left-hand
6 Primary Timing Chain Bright Plated Link – Left-hand
7 Camshaft Intermediate Sprocket Timing Mark – Left-hand
8 Camshaft Intermediate Sprocket – Left-hand
9 Secondary Timing Chain Bright Plated Link – Left-hand
10 Camshaft Intermediate Sprocket Timing Mark – Left-hand
11 Primary Timing Chain
12 Primary Timing Chain Bright Plated Link – Crankshaft Sprocket
13 Crankshaft Sprocket Timing Mark
14 Crankshaft Sprocket
15 Camshaft Intermediate Sprocket – Right-hand
16 Primary Timing Chain Bright Plated Link
17 Camshaft Intermediate Sprocket Timing Mark – Right-hand

Right-hand Secondary Timing Chain Installation

Excluding MY06 Update

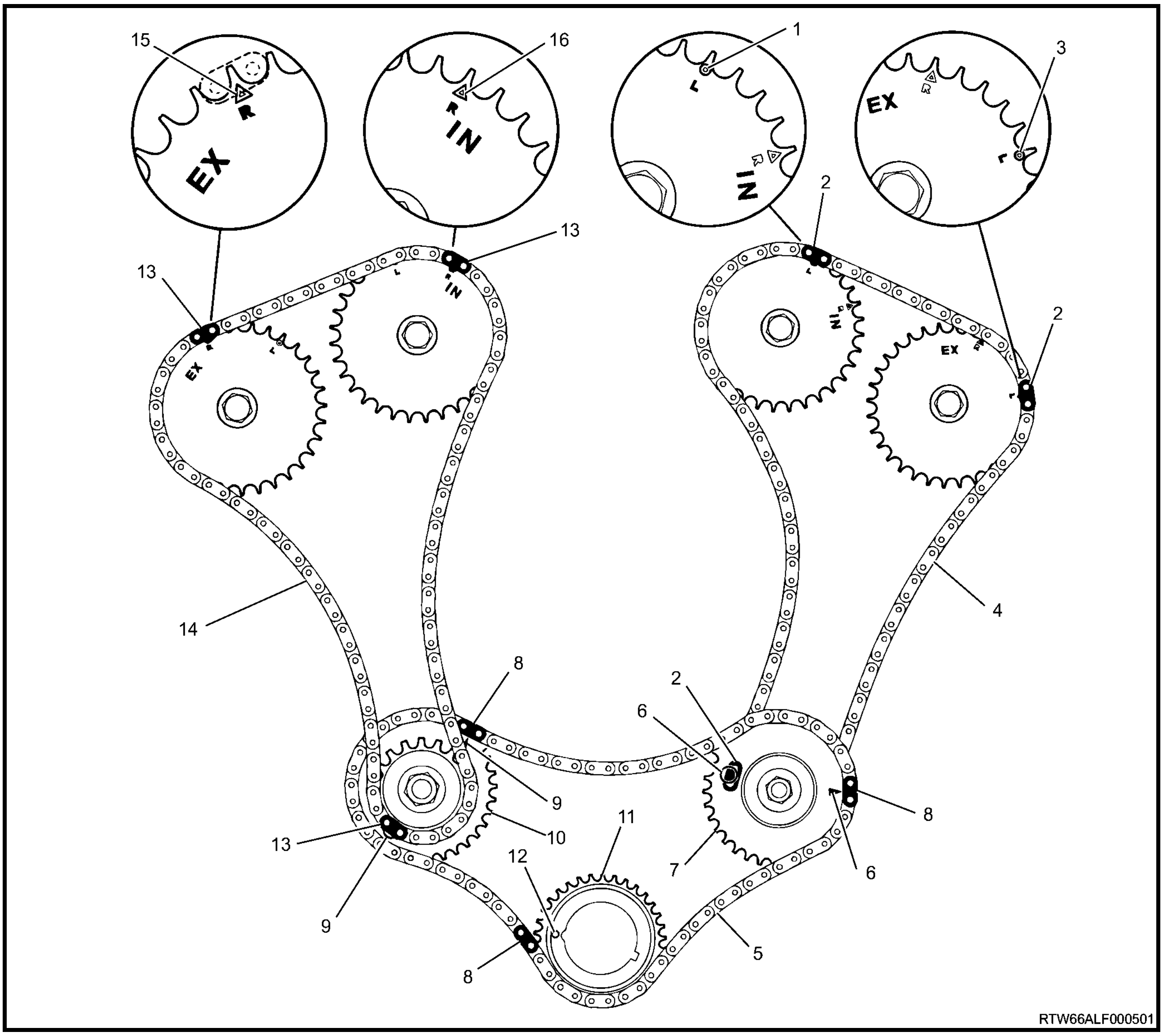


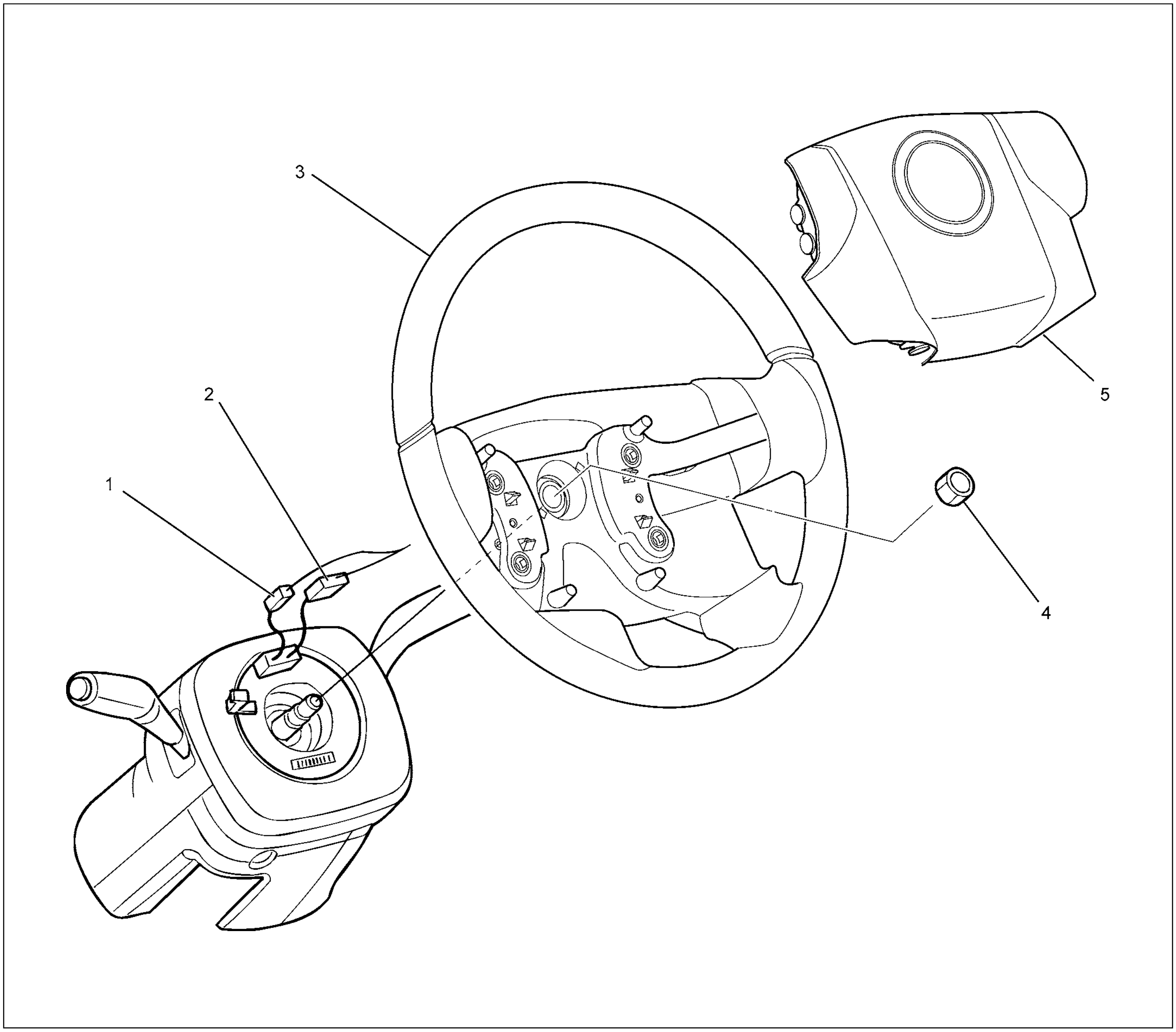
Figure 6A1 – 101

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain – Left-hand
5 Primary Timing Chain
6 Camshaft Intermediate Sprocket Timing Mark – Left-hand
7 Primary Camshaft Intermediate Sprocket – Left-hand
8 Primary Timing Chain Bright Plated Link
9 Camshaft Intermediate Sprocket Timing Mark – Left-hand
10 Camshaft Intermediate Sprocket – Right-hand
11 Crankshaft Sprocket
12 Crankshaft Sprocket Timing Mark
13 Secondary Timing Chain Bright Plated Link – Right-hand
14 Secondary Timing Chain – Right-hand
15 Exhaust Camshaft Sprocket Timing Mark - Right-side
16 Inlet Camshaft Sprocket Timing Mark - Right-side

Inflator Module

Inflator Module and Associated Parts



RTW73BLF000101

Legend

(1) Horn Lead
(2) SRS Connector
(3) Steering Wheel
(4) Steering Wheel Fixing Nut
(5) Inflator Module or Horn Pad

MY06 Update

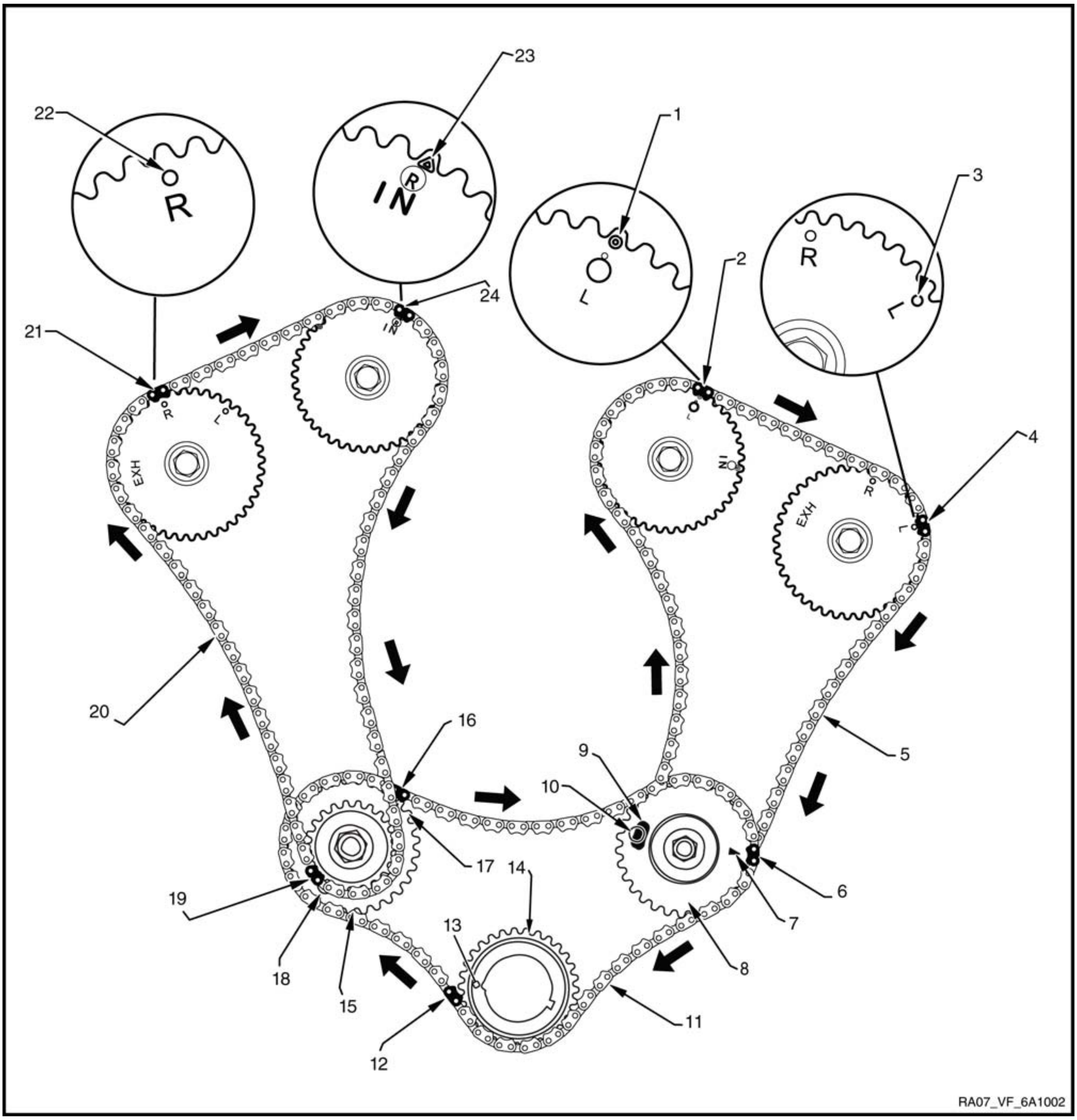


Figure 6A1 – 102

Legend

1 Intake Camshaft Sprocket Timing Mark – Left-hand
2 Secondary Timing Chain Bright Plated Link – Left-hand Intake
3 Exhaust Camshaft Sprocket Timing Mark – Left-hand
4 Secondary Timing Chain Bright Plated Link – Left-hand Exhaust
5 Secondary Timing Chain – Left-hand
6 Primary Timing Chain Bright Plated Link – Left-hand
7 Camshaft Intermediate Sprocket Timing Mark – Left-hand
8 Camshaft Intermediate Sprocket – Left-hand
9 Secondary Timing Chain Bright Plated Link – Left-hand Intermediate Camshaft
10 Camshaft Intermediate Sprocket Timing Mark – Left-hand
11 Primary Timing Chain
12 Primary Timing Chain Bright Plated Link – Crankshaft Sprocket
13 Crankshaft Sprocket Timing Mark
14 Crankshaft Sprocket
15 Camshaft Intermediate Sprocket – Right-hand
16 Primary Timing Chain Bright Plated Link - Right-hand
17 Camshaft Intermediate Sprocket Timing Mark – Right-hand
18 Window for Secondary Timing Chain – Right-hand
19 Secondary Timing Chain Bright Plated Link – Right-hand Intermediate Camshaft
20 Secondary Timing Chain – Righ-hand
21 Secondary Timing Chain Bright Plated Link – Right-hand Exhaust
22 Exhaust Camshaft Sprocket Timing Mark – Right-hand
23 Intake Camshaft Sprocket Timing Mark – Right-hand
24 Secondary Timing Chain Bright Plated Link – Right-hand Intake

Remove

Right-hand Secondary Timing Chain

CAUTION

After removing the upper intake manifold, and spark plugs, plug any openings to prevent dirt and other contaminants from entering.

1 Remove the engine front cover assembly, refer to 3.15 Front Cover Assembly.

2 Remove the spark plugs to aid crankshaft/engine rotation, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

3 Install Tool No. EN46111 (1) onto the crankshaft (2).

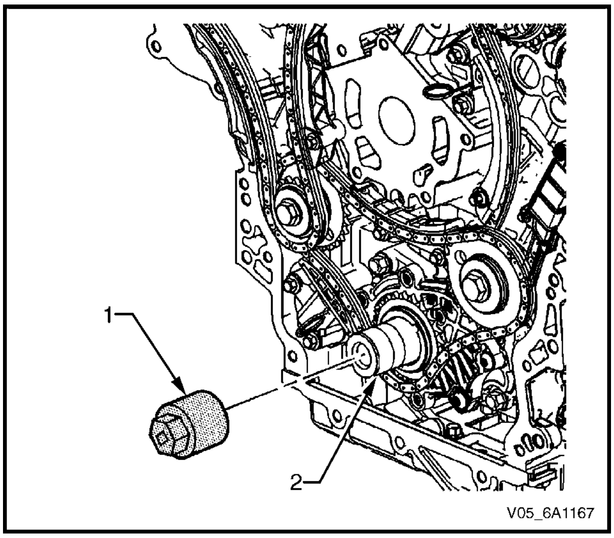


Figure 6A1 – 103

4 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

NOTE

Graphic shows 'Early Type' crankshaft sprocket, 'Late Type' similar.

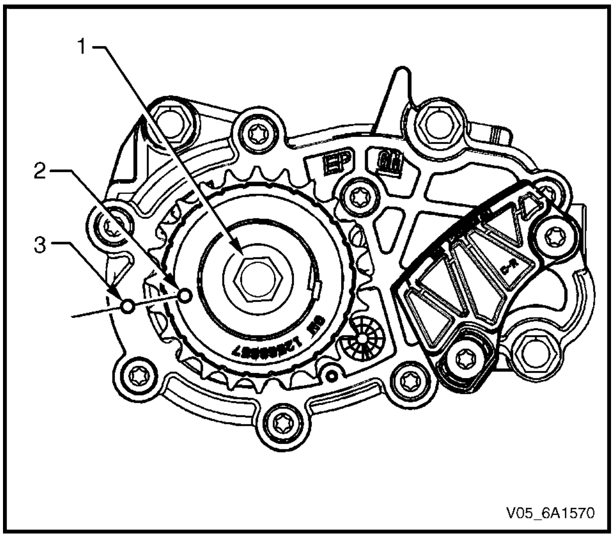


Figure 6A1 – 104

5 After aligning the crankshaft sprocket timing mark, check that the camshaft flats (1) at the rear of the right-hand cylinder head are parallel with the camshaft cover rail (2).

6 If the camshaft flats are not as shown, rotate the crankshaft 360 °.

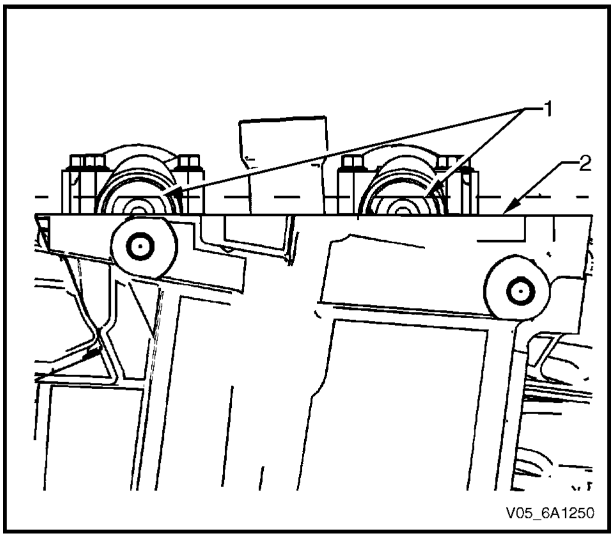


Figure 6A1 – 105

7 Install Tool No. EN 46105–1 (1) onto the rear of the right-hand cylinder head camshafts (2).

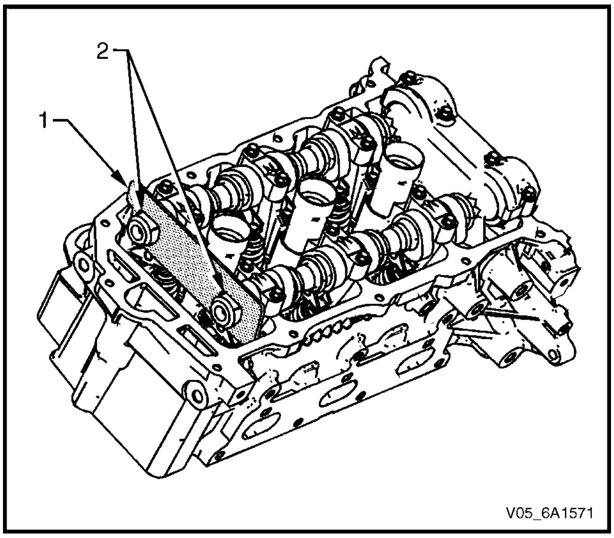


Figure 6A1 – 106

8 Install Tool No. EN 46105–2 (1) onto the rear of the left-hand cylinder head camshafts (2).

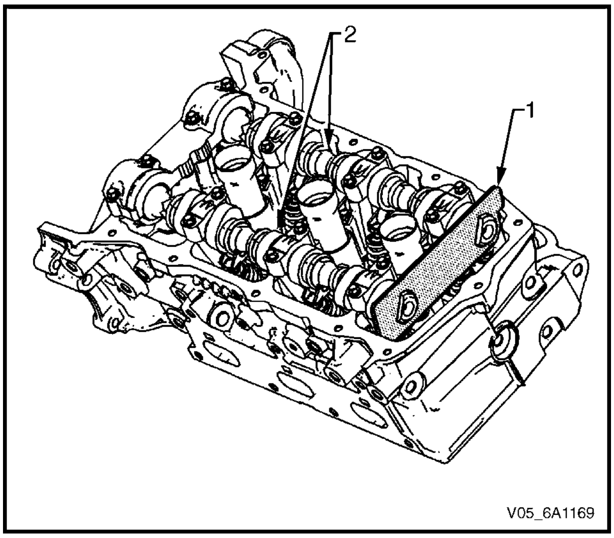


Figure 6A1 – 107

9 Remove the right-hand secondary timing chain tensioner bolts (1) and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

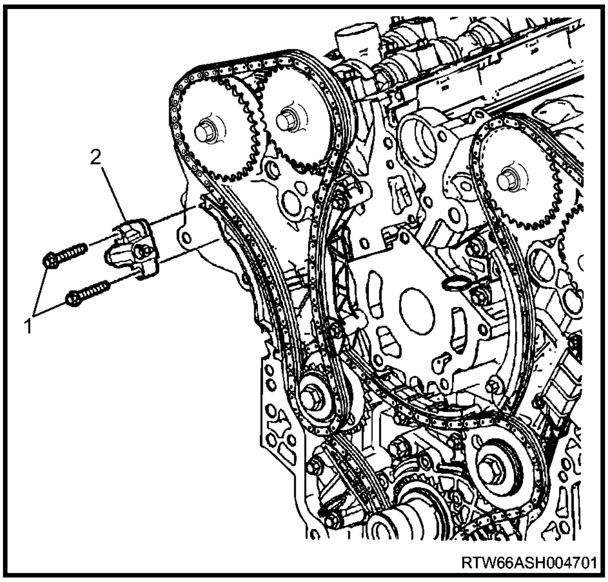


Figure 6A1 – 108

10 Remove the tensioner gasket (1) from the tensioner (2) and discard the gasket.

11 Inspect the tensioner mounting surface on the right-hand cylinder head for burrs or any defects that would affect the sealing of a new tensioner gasket.

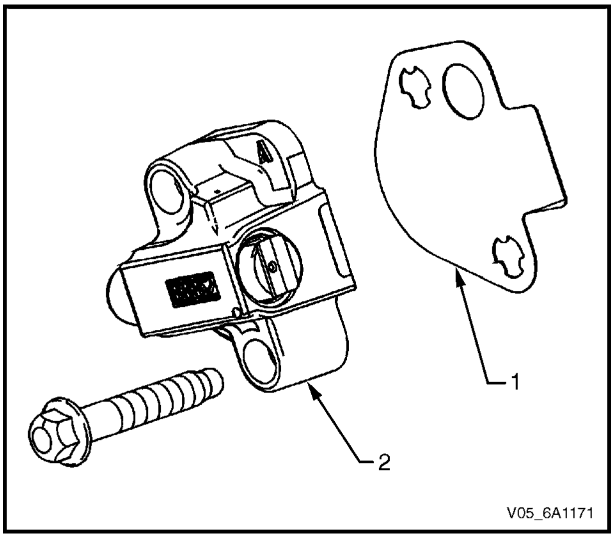


Figure 6A1 – 109

12 Remove the right-hand secondary timing chain shoe bolt (1).

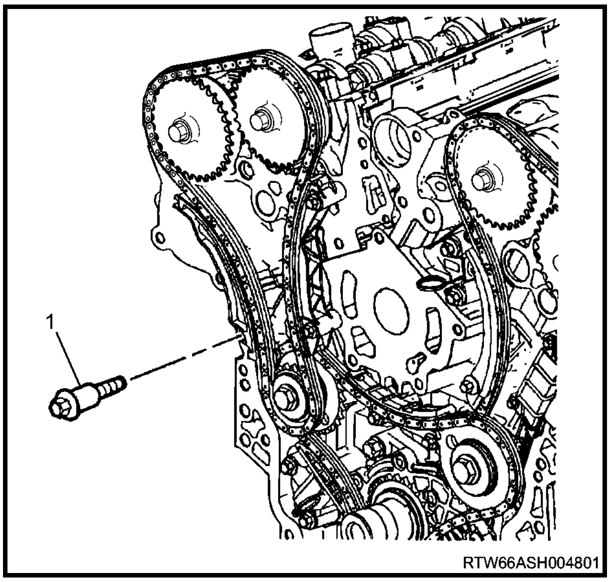


Figure 6A1 – 110

13 Remove the right-hand secondary timing chain shoe (1).

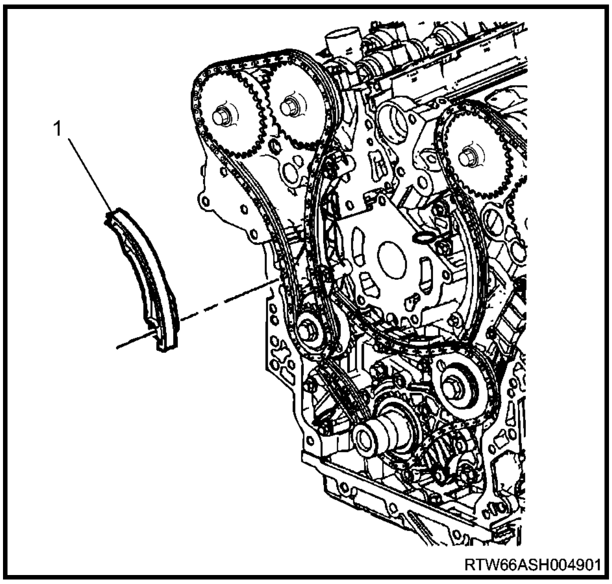


Figure 6A1 – 111

14 Remove the two right-hand secondary timing chain guide bolts (1) and remove the guide (2).

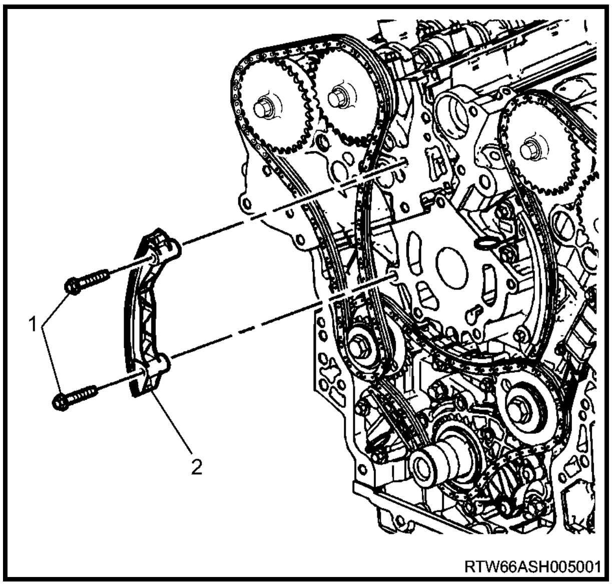


Figure 6A1 – 112

15 Remove the right-hand secondary timing chain (1) from the camshaft position actuators (2) and the camshaft intermediate sprocket (3).

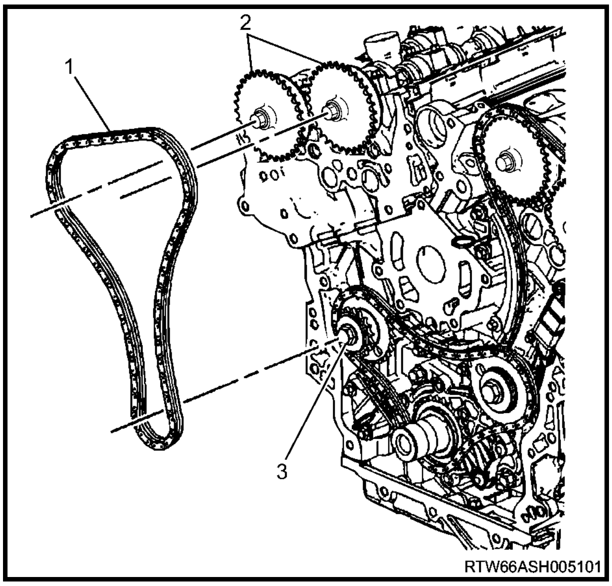


Figure 6A1 – 113

Primary Timing Chain

1 Remove the right-hand secondary timing chain, refer to Right-hand Secondary Timing Chain in this Section.

2 Remove the two primary timing chain tensioner bolts (1), and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

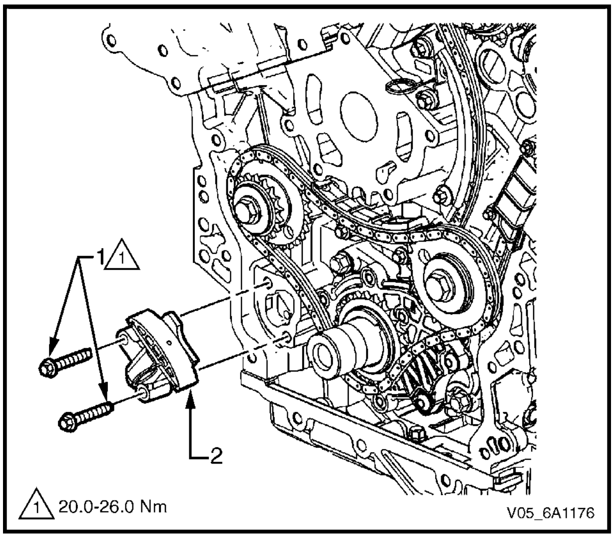


Figure 6A1 – 114

3 Remove the gasket (1) from the tensioner (2) and discard the gasket.

4 Inspect the primary timing chain tensioner mounting surface on the engine block for burrs or any defects that would affect the sealing of a new tensioner gasket.

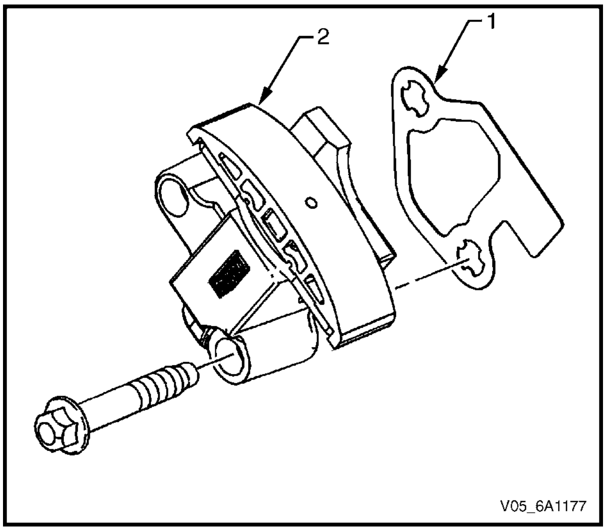


Figure 6A1 – 115

5 Remove the two primary timing chain upper guide bolts (1) and remove the guide (2).

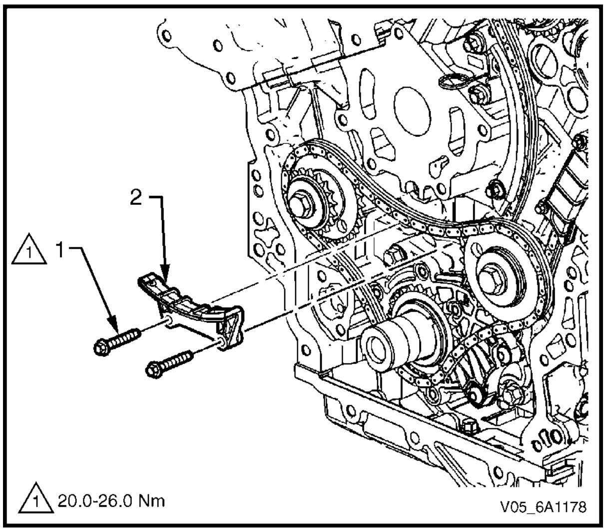


Figure 6A1 – 116

NOTE

Do not remove the primary timing chain lower guide (1). The primary timing chain lower guide is not serviced separately. If the primary timing chain lower guide requires replacement, the oil pump assembly (2) must be replaced.

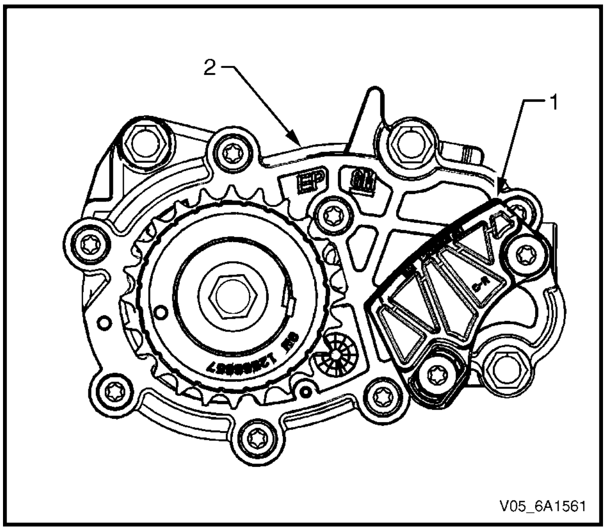


Figure 6A1 – 117

6 Remove the primary timing chain (1).

NOTE

For ease of removal, remove the chain from the crankshaft sprocket, before attempting to remove from the camshaft intermediate sprockets.

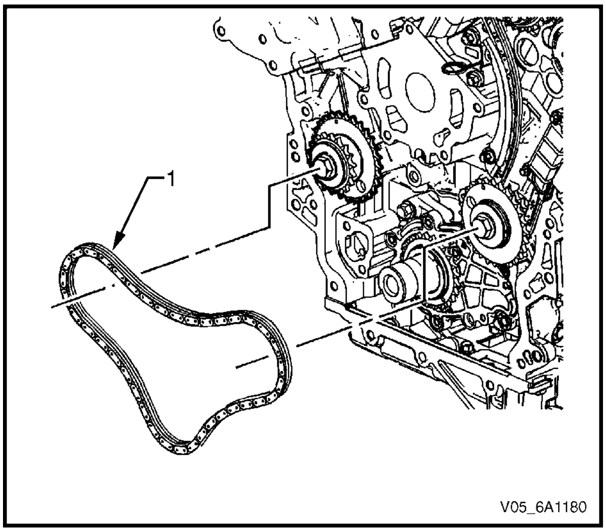


Figure 6A1 – 118

7 If required, remove the right-hand camshaft intermediate sprocket bolt (1) and remove the sprocket (2).

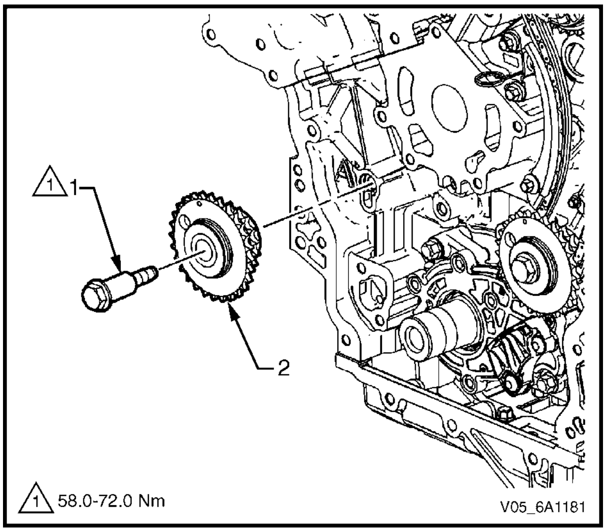


Figure 6A1 – 119

8 If required, remove the crankshaft sprocket (1) from the crankshaft (2).

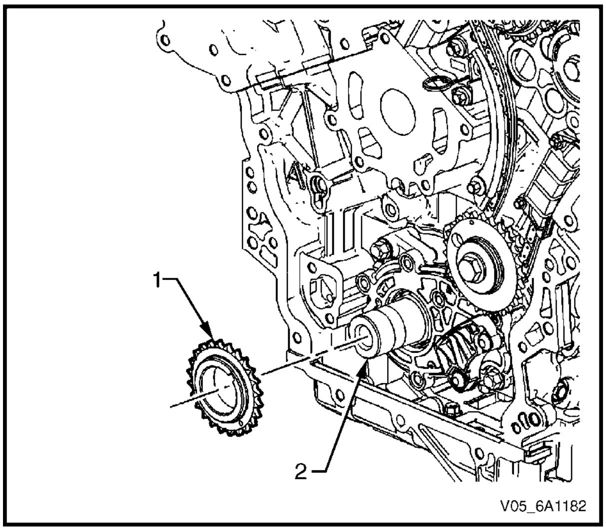


Figure 6A1 – 120

Left-hand Secondary Timing Chain

1 Remove the primary timing chain, refer to Primary Timing Chain in this Section.

2 Remove the two left-hand secondary timing chain tensioner bolts (1) and remove the tensioner (2).

NOTE

Take care when removing the tensioner bolts. The tensioner plunger is subjected to spring tension and may spring apart during tensioner removal.

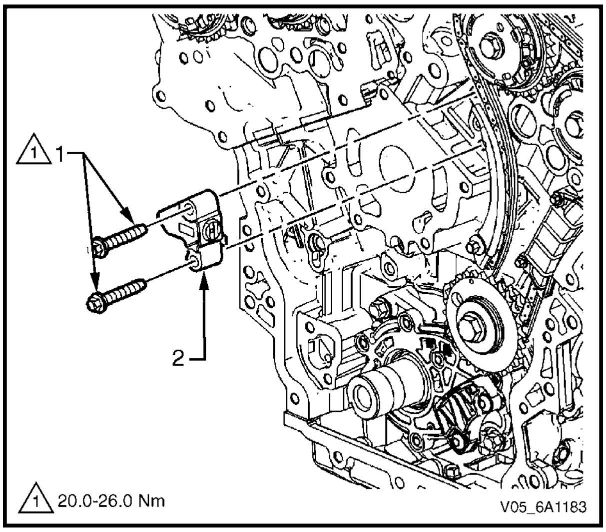


Figure 6A1 – 121

3 Remove the gasket (1) from the tensioner (2) and discard the gasket.

4 Inspect the tensioner mounting surface on the left-hand cylinder head for burrs or any defects that would affect the sealing of a new tensioner gasket.

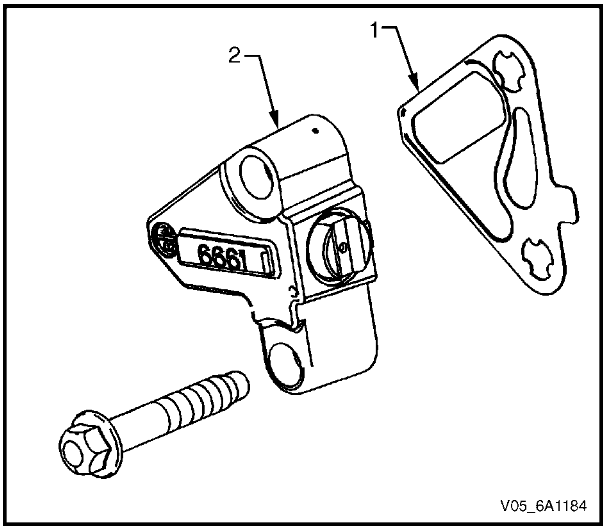


Figure 6A1 – 122

5 Remove the left-hand secondary timing chain shoe bolt (1).

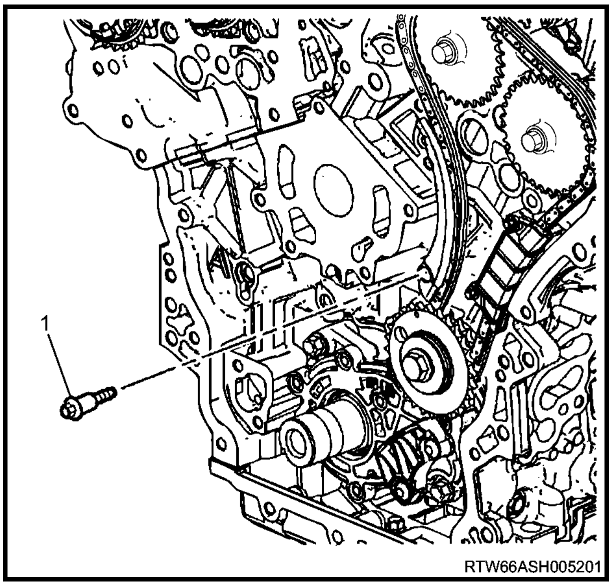


Figure 6A1 – 123

6 Remove the left-hand secondary timing chain shoe (1).

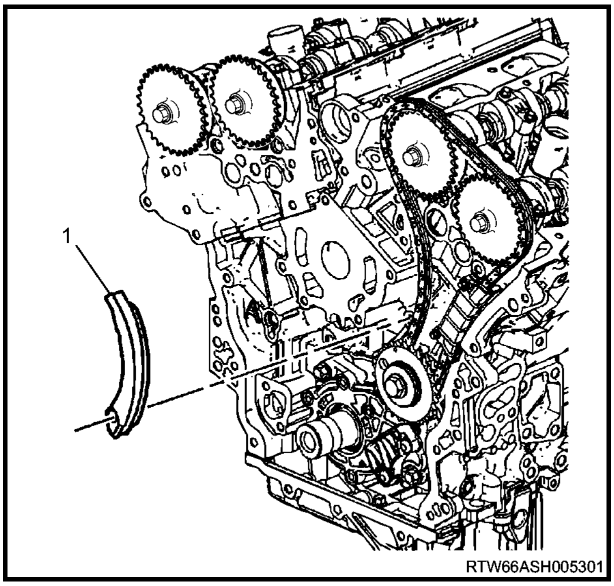


Figure 6A1 – 124

7 Remove the left-hand secondary timing chain guide bolt (1), two places, and remove the guide (2).

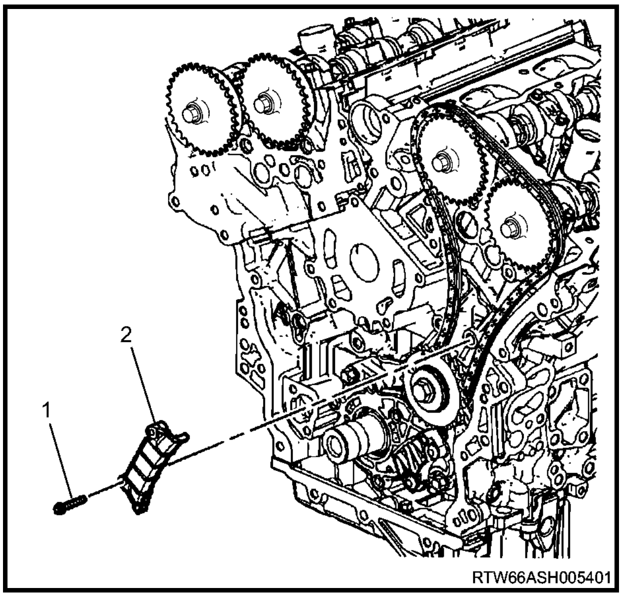


Figure 6A1 – 125

8 Remove the left-hand secondary timing chain (1) from the camshaft position actuators (2) and the camshaft intermediate sprocket.

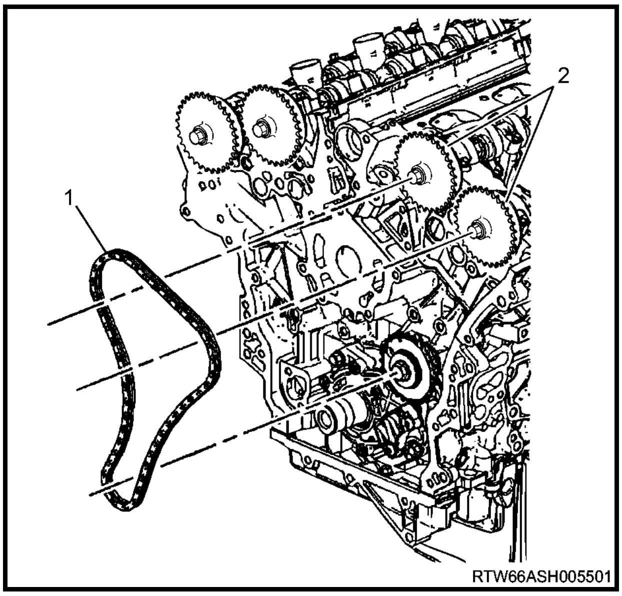


Figure 6A1 – 126

9 If required, remove the left-hand camshaft intermediate sprocket bolt (1) and remove the sprocket (2).

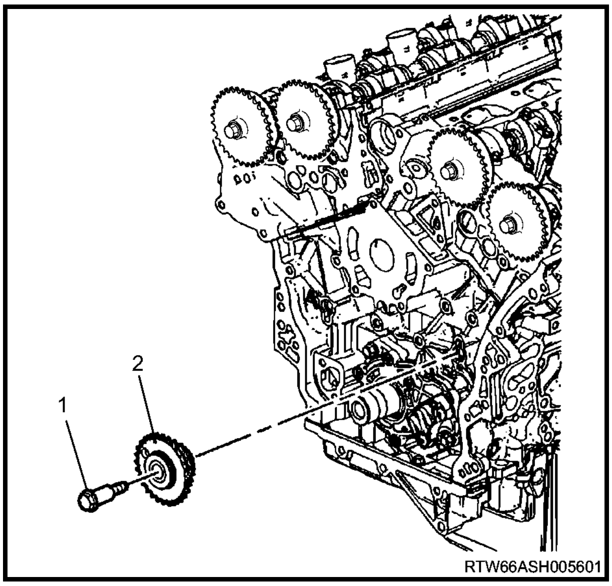


Figure 6A1 – 127

10 Remove Tool No. EN 46105–2 (1) from the left-hand cylinder head camshafts (2).

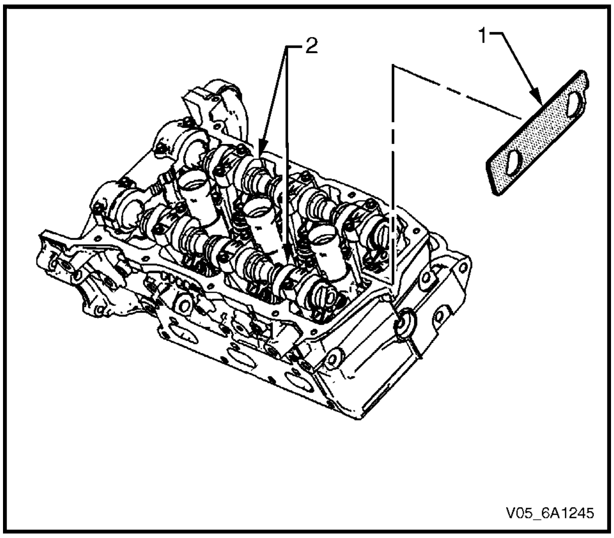


Figure 6A1 – 128

Recommended Fluids and Lubricants (For GENERAL EXPORT)

In order to obtain maximum performance and longest service life from your ISUZU vehicles, it is very important to select and use correctly the best lubricants and diesel fuels.
When lubricating, be sure to use ISUZU genuine lubricants or recommended lubricants listed below, according to the maintenance schedule for each vehicle model.
The lubrication intervals in the maintenance schedule and coverage and period of new vehicle warranty are based on the use of ISUZU genuine lubricants or recommended lubricants listed in the chart, which will serve as a guide for selecting lubricants of the correct brand name.

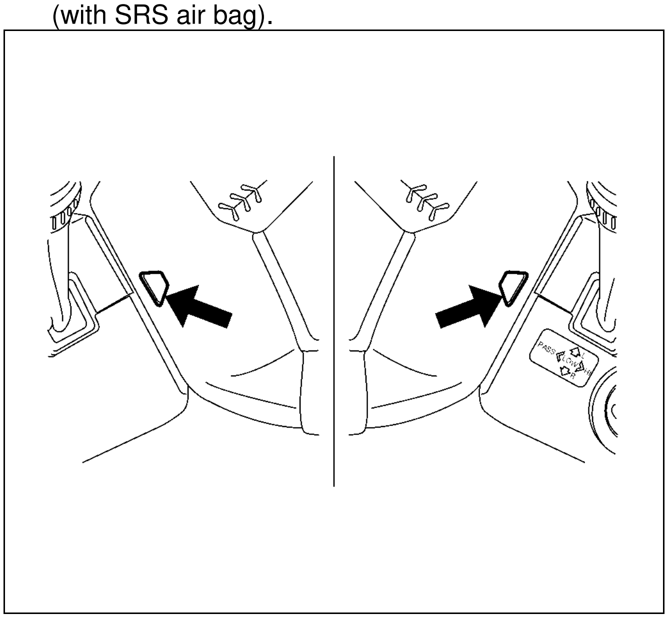
LUBRICATION	MAKE	BRAND/TYPE	GRADE		
			API	ACEA	JASO
Gasoline engine crankcase C24SE	**ISUZU GENUINE**	**BESCO RACING ACE TYPE SJ (5W-30)**	**SJ**		
	ISUZU GENUINE	**BESCO MULTI ACE (7.5W-30)**	**SG**		
	CALTEX	HAVOLINE FORMULA (15W-40, 10W-30, 20W-50)	SL		
	SHELL	HELIX PLUS (15W-50)	SJ/CF	A3/B3	
	ELF	SUPER SPORTI S (15W-40)	SG		
	TOTAL	QUARTZ 5000 (15W-40, 20W-50)	SJ/CF	A2/B2	
	CASTROL	GTX-7 (15W-40)	SG/SH		
	BP	VISCO 3000 (15W-40)	SG/SH		
Gasoline engine crankcase HFV6		10W-30	SL		
	CALTEX	HAVOLINE FORMULA (10W-30)	SL		
Diesel engine crankcase	**ISUZU GENUINE**	**BESCO MULTI-Z TYPE CF-4 (10W-30)**	**CF-4**		
	ISUZU GENUINE	**BESCO MULTI-Z SUV (5W-30)**	**CD**		
	ISUZU GENUINE	**BESCO S-3 (10W, 20W, 30, 40)**	**CD**		
	CALTEX/CHEVRON	DELO CXJ (15W-40, 20W-50, 40)	CD/CF		DH-1
	CALTEX/CHEVRON	DELO 400 MULTIGRADE (15W-40)	CD/CE/CF/CI-4	E3/E5	DH-1
	SHELL	RIMULA X (15W-40)	CH-4	E3	DH-1
	SHELL	RIMULA D (15W-40, 30, 40)	CD/CF		
	ELF	PERFO 3F (15W-40)	CF-4/CE	B2/E2	
	TOTAL	RUBIA XT (15W-40)	CF-4	E2	
	CASTROL	RX SUPER PLUS (15W-40)	CH-4	E3	
	CASTROL	TECTION J PLUS (15W-40)	CH-4	E3/B3	DH-1
	BP	BP VANELLUS C6 (15W-40)	CH-4	E3	
Manual transmission C24SE D Transfer case	**ISUZU GENUINE**	**BESCO GEAR OIL TRANSAXLE (5W-30)**	**SG**		
	CALTEX/CHEVRON	DELO 400 MULTIGRADE (15W-40)	CD/CE/CF/CI-4	E3/E5	DH-1
	SHELL	HELIX PLUS (15W-50)	SJ/CF	A3/B3	
	ELF	SUPER SPORTI (15W-40)	SG/CD		
	TOTAL	QUARTZ 5000 (15W-40, 20W-50)	SJ/CF	A2/B2	
	CASTROL	RX SUPER PLUS (15W-40)	CD/CE/CF		
	BP	BP VANELLUS C6 (15W-40)	CD/CE/CF		
Manual transmission HFV6		75W-90	GL-3		
	MOBIL	MOBIL XHP (75W-90)			
Differential Shift on the fly system (GL-5 only)	**ISUZU GENUINE**	**BESCO GEAR OIL SH (80W-90, 90, 140)**	**GL-5**		
	ISUZU GENUINE	**BESCO SHIFT ON THE FLY (75W-90)**	**GL-5**		
	CALTEX	THURBAN GL-5 EP (80W-90, 85W-140)	GL-5		
	SHELL	SPIRAX A (140)	GL-5		
	ELF	TRANSELF TYPE B (80W-90, 85W-140)	GL-5		
	TOTAL	TRANSMISSION TM (80W-90, 85W-140)	GL-5		
	CASTROL	EPX90 (90)	GL-5		
	CASTROL	DYNA DRIVE (80W-90)	GL-5		
	BP	ENERGEAR HYPO (90)	GL-5		
	BP	ENERGEAR EP (80W-90)	GL-5		
Differential (Limited Slip Differential)	**ISUZU GENUINE**	**BESCO GEAR OIL LSD (140)**	**GL-5**		
	CALTEX	GEAR OIL LSD (90)	GL-5		
	SELL	SPIRAX A LS 90 (90)	GL-5		
	ELF	TRANSELF TYPE BLS (90)	GL-5		
	TOTAL	TRANSMISSION DA (85W-90)	GL-5		
	CASTROL	HYPOY LSX (90)	GL-5		
	BP	ENERGEAR LS-M (90)	GL-5		
Automatic transmission 4JH1-TC 4JJ1 (Standard Output) Power steering	**ISUZU GENUINE**	**BESCO ATF III**			
	CALTEX/TEXACO	TEXAMATIC 1888 (DEXRON® III)			
	SHELL	SHELL DONAX TG (DEXRON® III)			
	ELF	ELFMATIC G3 (DEXRON® III)			
	TOTAL	TOTAL FLUID AT42 (DEXRON® III)			
	CASTROL	TQ DEXRON III (DEXRON® III)			
	BP	AUTORAN DX3 (DEXRON® III)			
Automatic transmission 4JJ1 (High Output)	EXXON MOBIL	MOBIL ATF 3309			
Automatic transmission HFV6		DEXRON® III			

Removal

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to "LOCK".
3. Disconnect the battery "-" terminal cable, and wait at least 5 minutes (with SRS air bag).
4. Disconnect the yellow 2-way SRS connector located under the steering column (with SRS air bag).

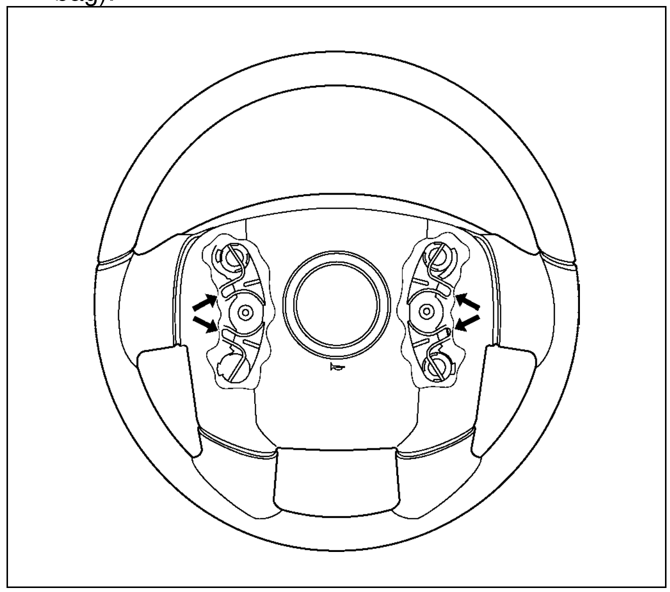
CAUTION: The wheels of the vehicle must be straight ahead and the steering column in the "LOCK" position before disconnecting the steering wheel. Failure to do so will cause the coil assembly to lose its centering which will cause damage to the coil assembly (with SRS air bag).

5. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).
6. Check the holes on both sides of the steering cover (with SRS air bag).



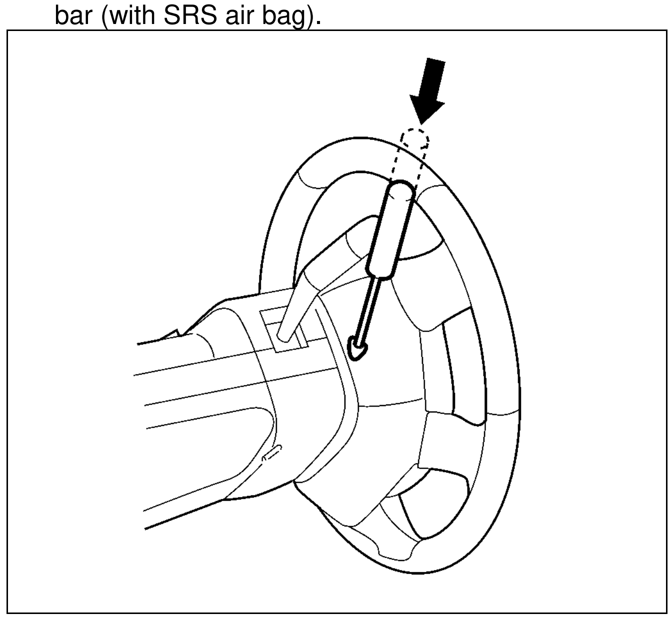
060R300025

7. Check the position of the pins in their holes. Push the pin in the direction of the arrow (with SRS air bag).



RTW73BSH000101

8. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



060R300031

9. Cancel the lock to release the four pins (with SRS air bag).

11 Remove Tool No. EN 46105–1 (1) from the right-hand cylinder head camshafts (2).

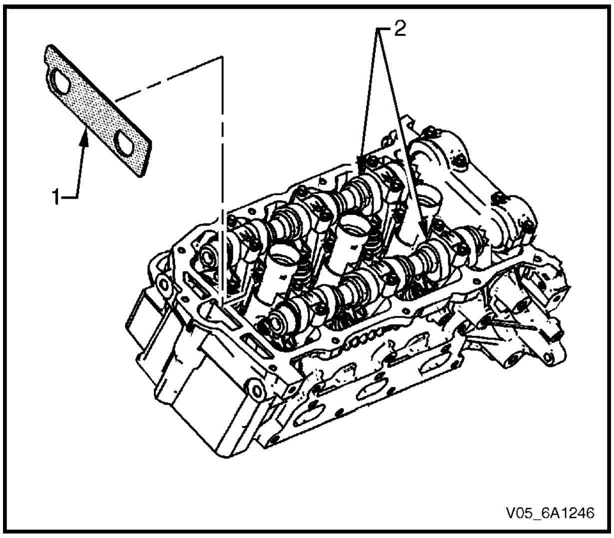


Figure 6A1 – 129

Clean

1 Clean all the following components with a suitable solvent:

- crankshaft sprocket,
- primary timing chain,
- primary timing chain guide,
- primary timing chain tensioner,
- secondary timing chains,
- secondary timing chain shoes,
- secondary timing chain guides,
- secondary timing chain tensioners, and
- bolts.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry all the components with compressed air.

Inspect

Timing Chains

1 Inspect the primary and/or secondary timing chains for the following:
- binding or worn rollers (1),
- loose links (2), and
- loose pins (3).

2 Replace a damaged timing chain as required.

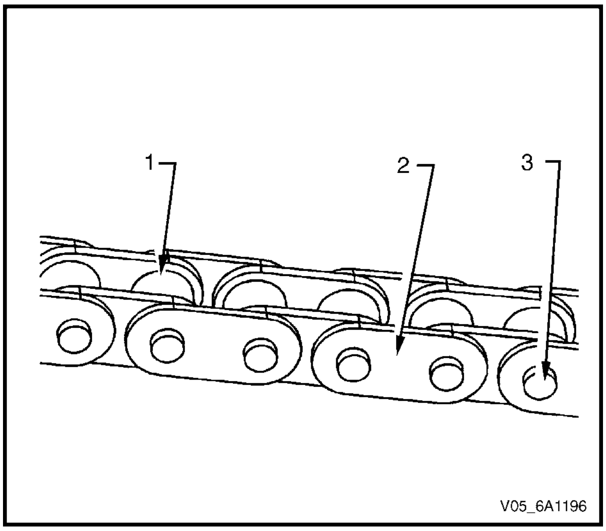


Figure 6A1 – 130

Camshaft Intermediate Sprockets

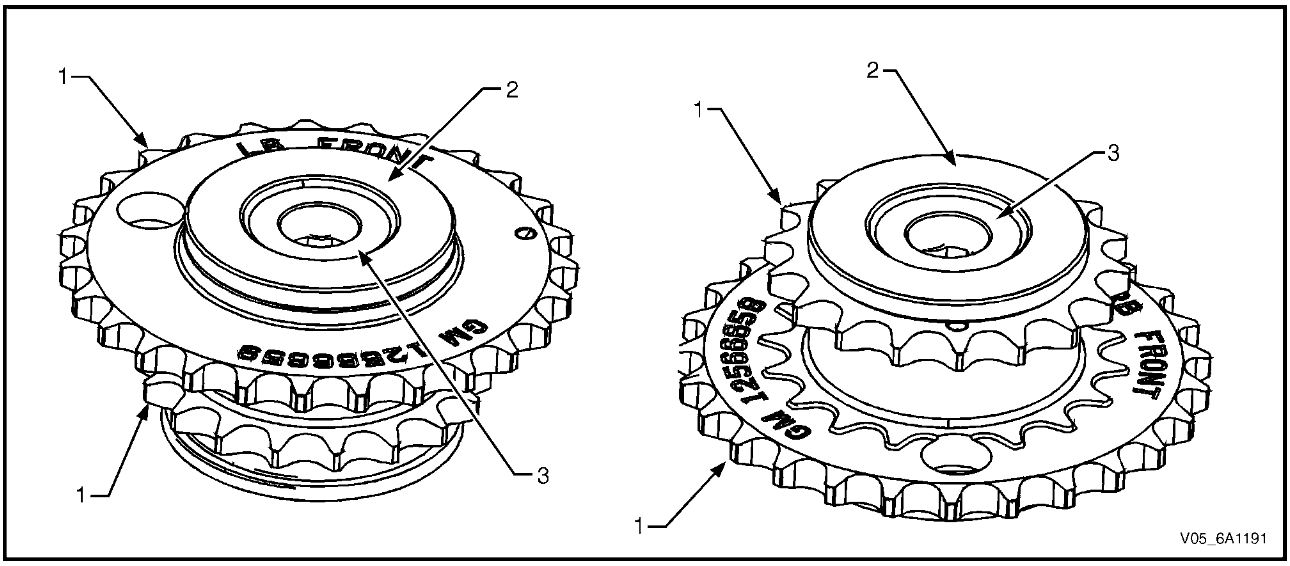


Figure 6A1 – 131

1 Inspect the camshaft intermediate sprockets for the following:
- Damage to the primary and secondary timing chain sprocket (1), refer to Figure 6A1 – 129.
- Damage to the hub bearing (2). Ensure the hub bearing spins freely. If the hub bearing wobbles, is noisy or feels rough when rotated replace the camshaft intermediate sprocket, and
- Damage to the bolt flange seating / sealing surface (3).
- Damage to the bearing hub-to-engine block sealing surface.

Inlet and Exhaust Camshaft Sprocket

Inspect the camshaft sprocket assemblies, refer to 3.18 Camshaft Sprocket.

Crankshaft Sprocket

1 Inspect the crankshaft sprocket for the following:
- sprocket damage (1),
- bore damage (2),
- keyway damage (3), and
- damage to the cushion material (4).

2 Replace a damaged sprocket as required.

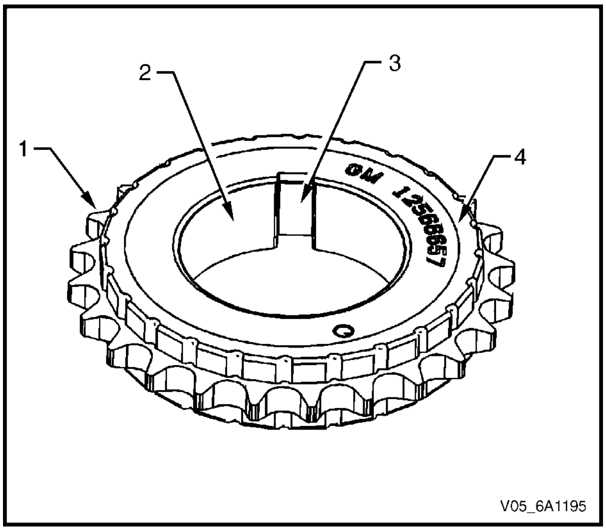


Figure 6A1 – 132

Primary Timing Chain Upper Guide

1 Inspect the primary timing chain upper guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

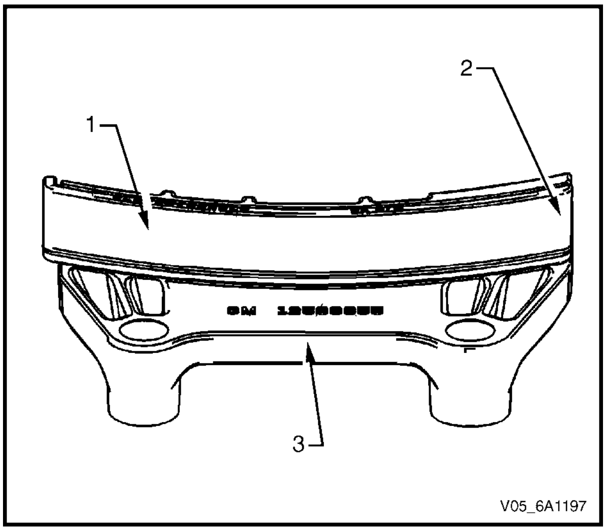


Figure 6A1 – 133

Primary Timing Chain Lower Guide

1 Inspect the primary timing chain lower guide for the following:
- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace the primary timing chain lower guide by replacing the oil pump assembly, refer to 3.17 Oil Pump Assembly.

NOTE

The primary timing chain lower guide is not serviced separately and is part of the oil pump assembly.

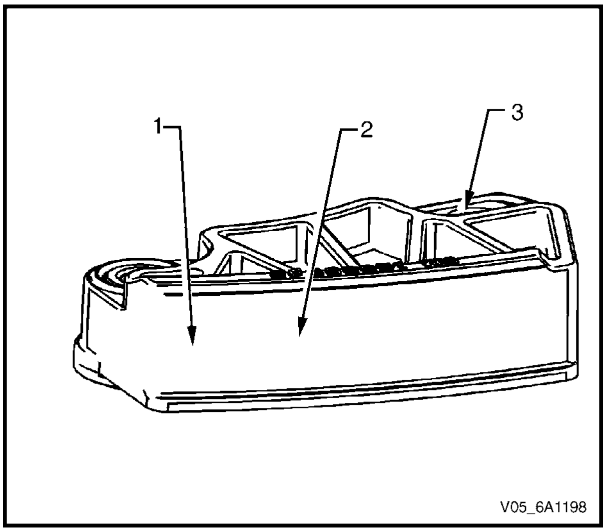


Figure 6A1 – 134

Primary Timing Chain Tensioner

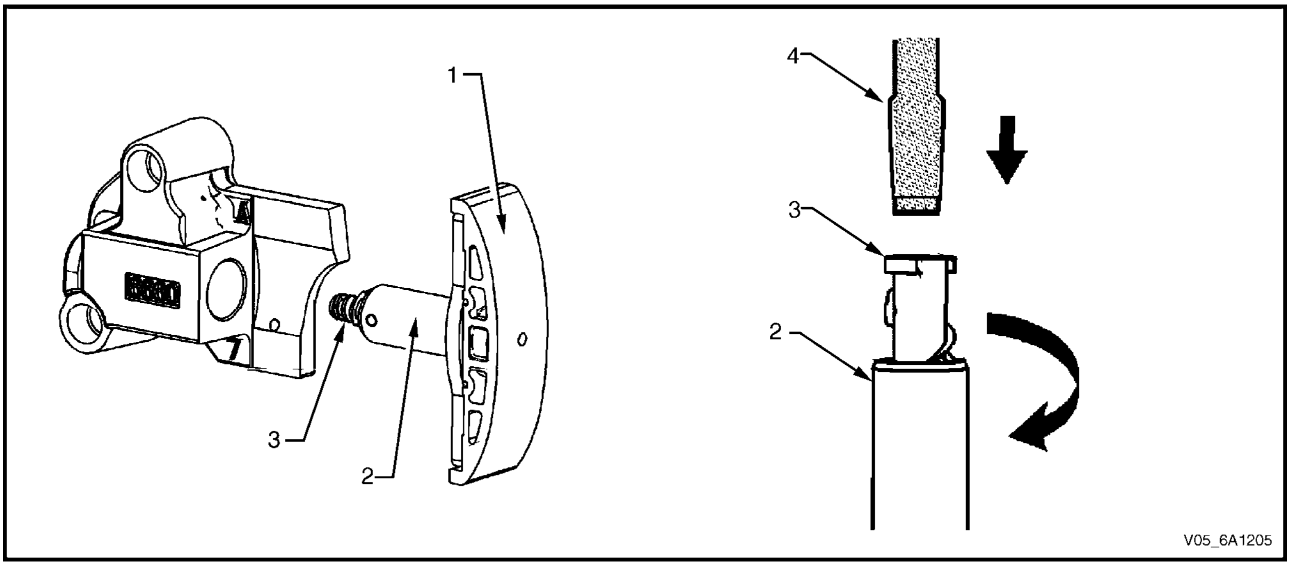


Figure 6A1 – 135

1 Inspect the primary timing chain tensioner for worn shoe surface (1), refer to Figure 6A1 – 133.

2 Inspect the tensioner for a locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

3 Replace a damaged tensioner as required.

Left-hand Secondary Timing Chain Guide

1 Inspect the left-hand secondary timing chain guide for the following:

- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

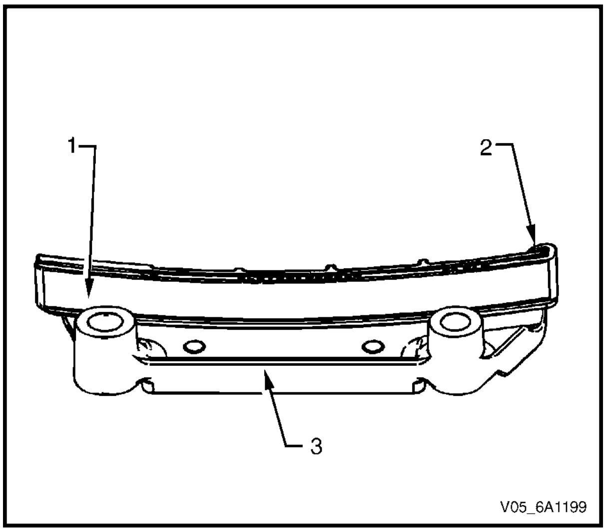


Figure 6A1 – 136

Left-hand Secondary Timing Chain Shoe

1 Inspect the front of the left-hand secondary timing chain shoe for the following:
- worn shoe surface (1),
- cracked or broken shoe surface (2), and
- cracked or damaged shoe (3).

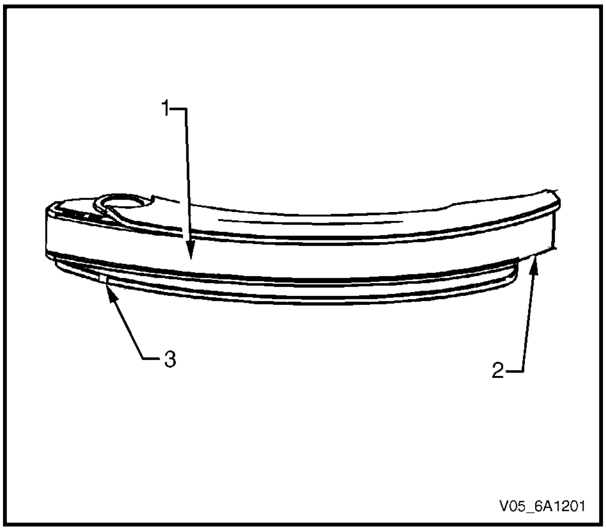


Figure 6A1 – 137

2 Inspect the back of the shoe for a damaged, worn or missing timing chain tensioner contact pad (1).

3 Replace a damaged shoe as required.

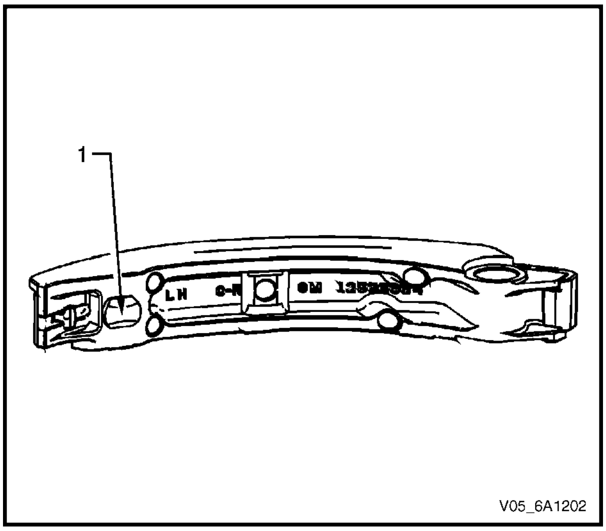


Figure 6A1 – 138

Left-hand Secondary Timing Chain Tensioner

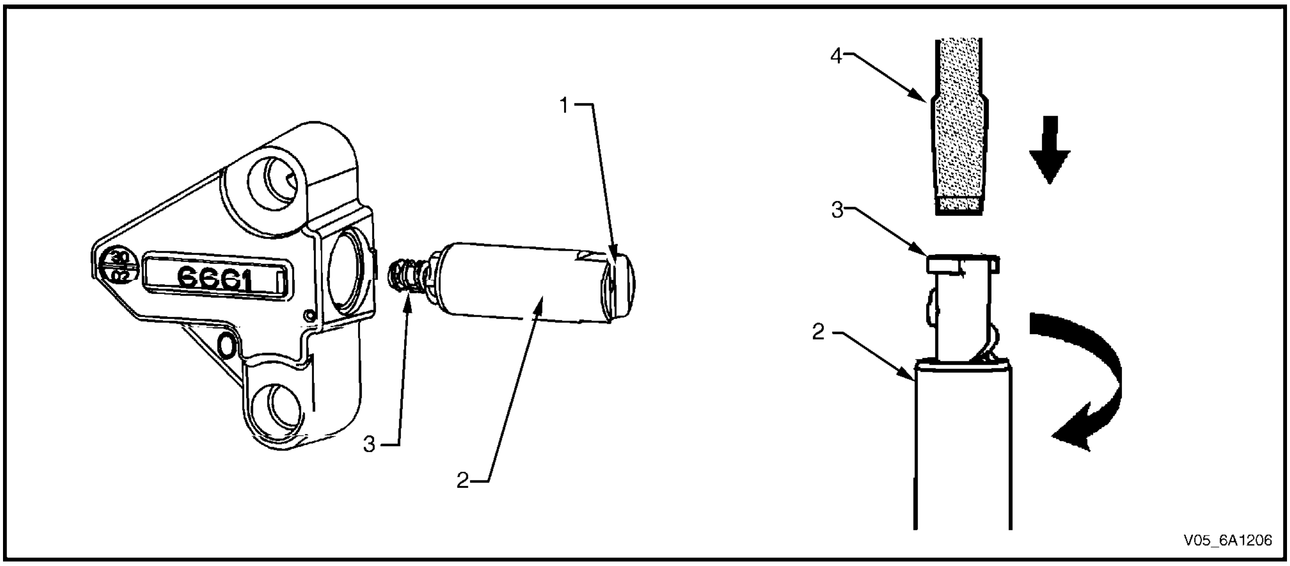


Figure 6A1 – 139

1 Inspect the left-hand secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1), refer to Figure 6A1 – 137.

2 Inspect the tensioner for locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

3 Replace a damaged tensioner as required.

Right-hand Secondary Timing Chain Guide

1 Inspect the right-hand secondary timing chain guide for the following:

- worn guide surface (1),
- cracked or broken guide surface (2), and
- cracked or damaged guide base (3).

2 Replace a damaged guide as required.

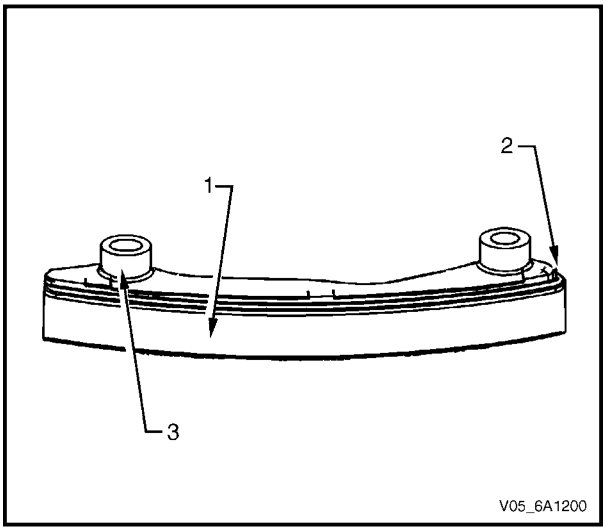


Figure 6A1 – 140

Right-hand Secondary Timing Chain Shoe

1 Inspect the front of the right-hand secondary timing chain shoe for the following:

- worn shoe surface (1),
- cracked or broken shoe surface (2), and
- cracked or damaged shoe (3).

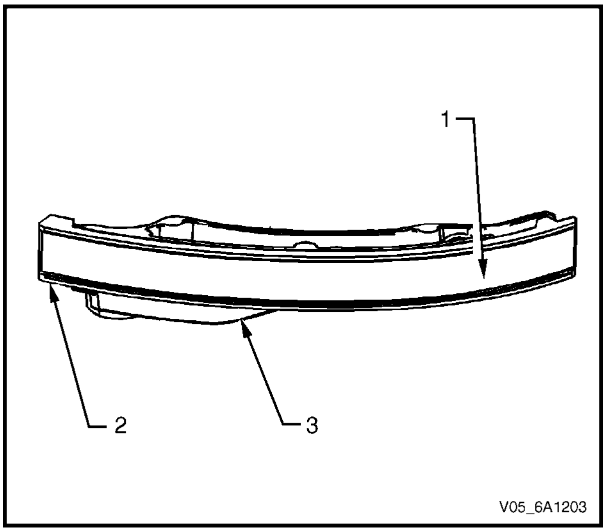


Figure 6A1 – 141

2 Inspect the back of the shoe for a damaged, worn or missing timing chain tensioner contact pad (1).

Replace a damaged shoe as required.

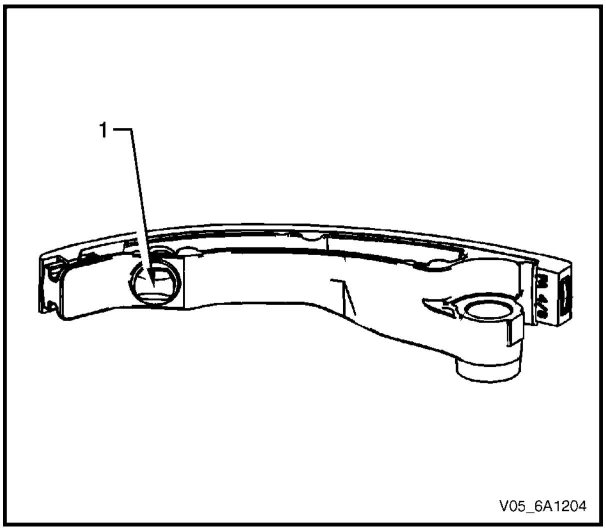


Figure 6A1 – 142

Right-hand Secondary Timing Chain Tensioner

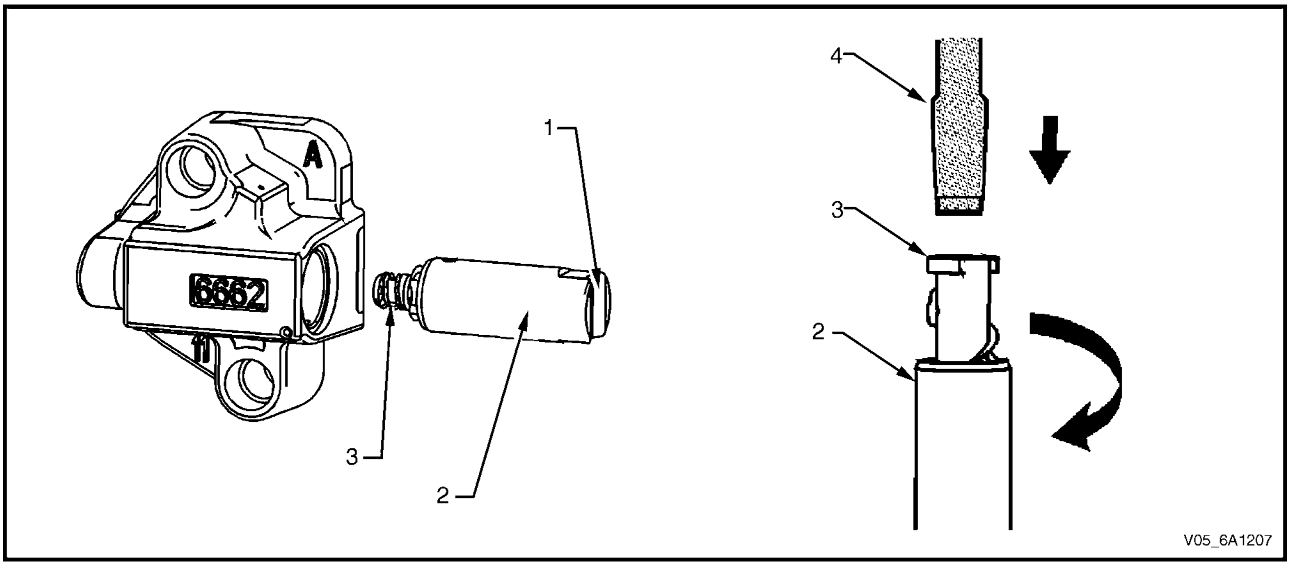


Figure 6A1 – 143

1 Inspect the right-hand secondary timing chain tensioner for damaged plunger-to-shoe contact surface (1), refer to Figure 6A1 – 141.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft.

2 Inspect the tensioner for a locked or binding tensioner shaft (2). Reset the plunger (3) and ensure the tensioner shaft moves freely in and out of the body of the tensioner.

3 Replace a damaged tensioner as required.

Reinstall

Left-hand Secondary Timing Chain Components – Excluding MY06 Update

1 Install the crankshaft sprocket (1) onto the crankshaft (2) by aligning the keyway to the key on the crankshaft.

2 Slide the crankshaft sprocket on the crankshaft until the crankshaft sprocket contacts the step in the crankshaft.

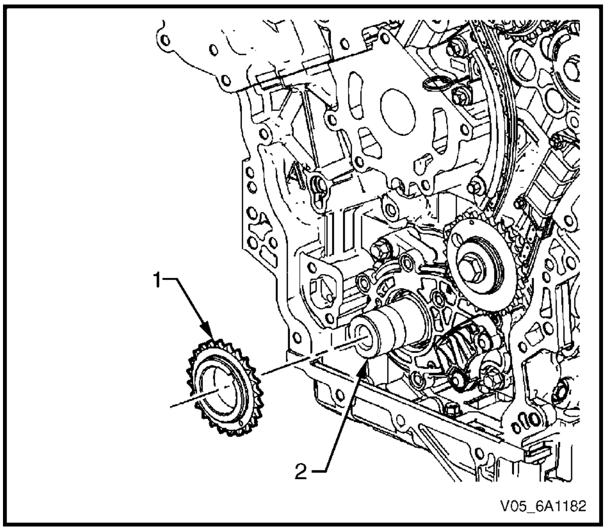


Figure 6A1 – 144

NOTE

Ensure that the crankshaft sprocket is installed with the timing mark (1) visible.

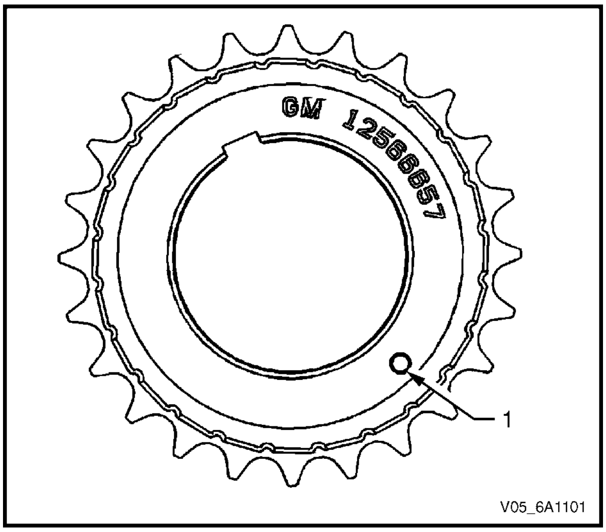


Figure 6A1 – 145

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts in an anti-clockwise direction. There should be no need to rotate the camshaft more than 45 degrees.

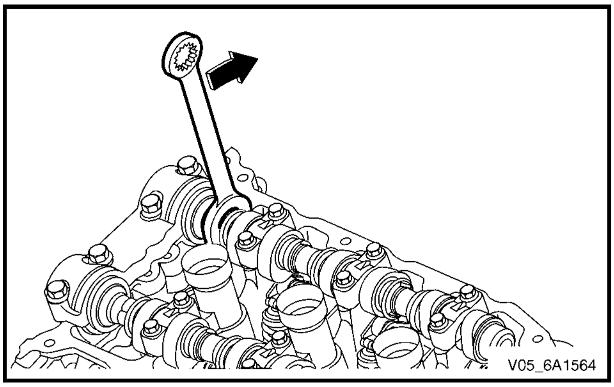


Figure 6A1 – 146

3 Install Tool No. EN 46105-1 (1) onto the rear of the left-hand cylinder head camshafts (2), and Tool No. EN 46105-2 onto the rear of the right-hand cylinder head camshafts.

4 Ensure that Tool No. EN 46105 is fully seated onto the camshafts.

CAUTION

All camshafts must be locked in place before installation of any timing chains.

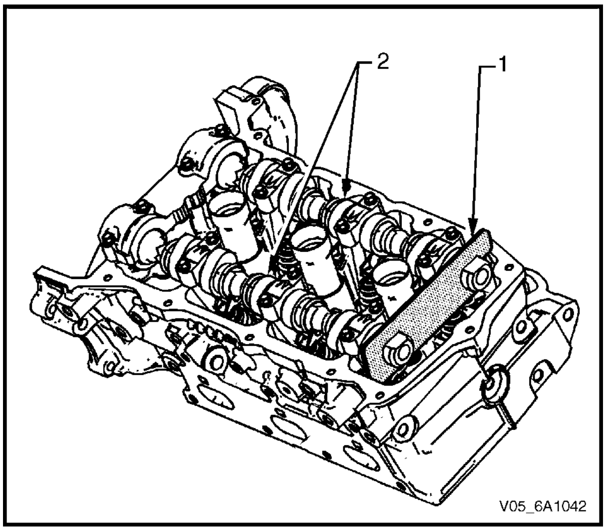


Figure 6A1 – 147

5 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

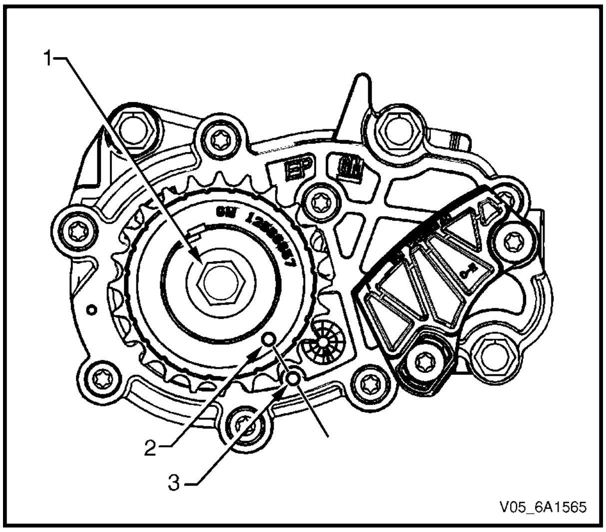


Figure 6A1 – 148

6 Install the left-hand secondary timing chain (1) aligning the chain in the following manner:

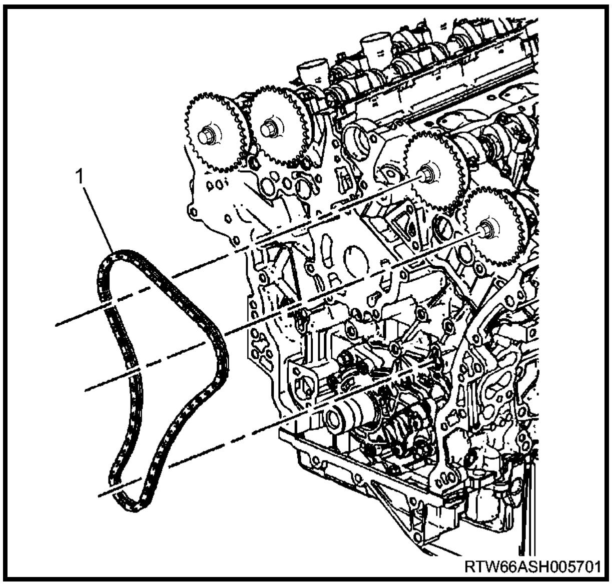


Figure 6A1 – 149

7 Wrap the secondary timing chain around both left-hand camshaft drive sprockets.

8 Ensure there are two bright links located on top of each of the camshaft sprockets.

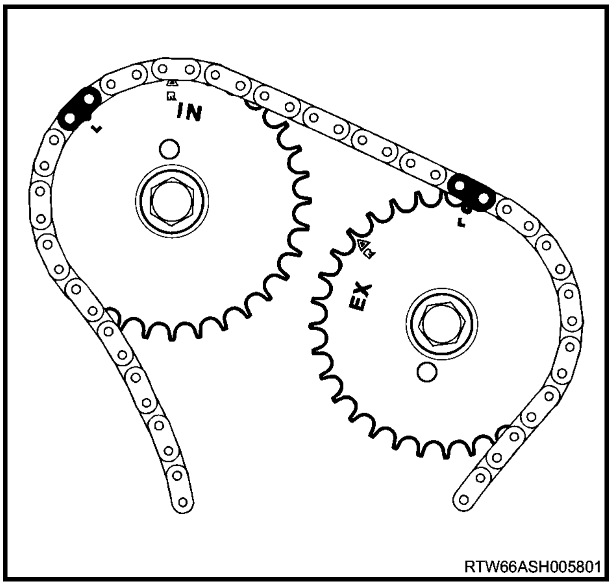


Figure 6A1 – 150

CAUTION

When aligning the left-hand secondary timing chain to the camshaft sprockets, ensure the circular timing marks on the sprocket are used, NOT the triangular mark.

9 Align the bright plated timing chain link (1) with the left-hand exhaust camshaft position sprocket alignment circle mark (2).

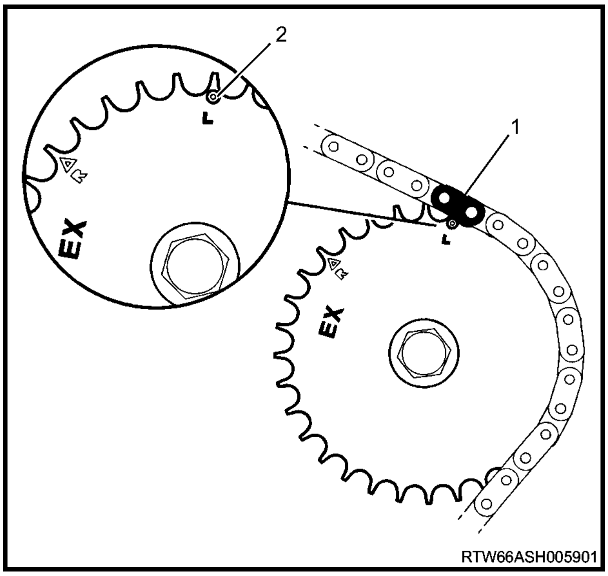
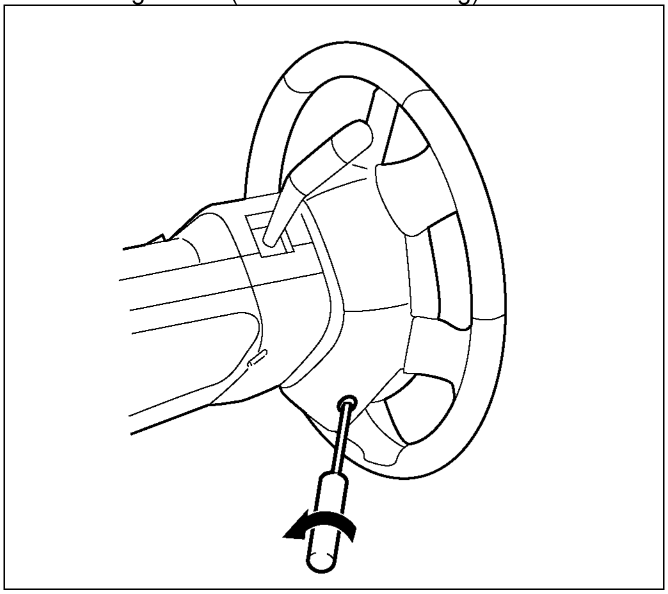


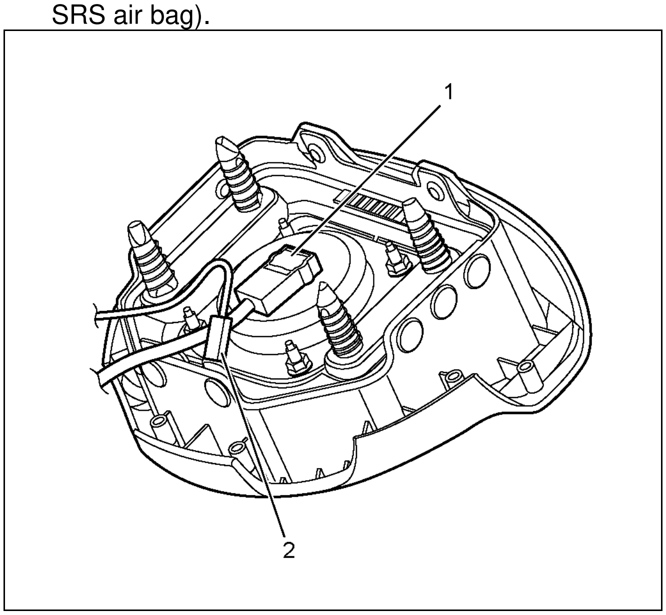
Figure 6A1 – 151

10. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



430R300009

11. Disconnect the SRS air bag connector (1) and horn lead connector (2) located behind the air bag assembly and remove the air bag assembly (with SRS air bag).



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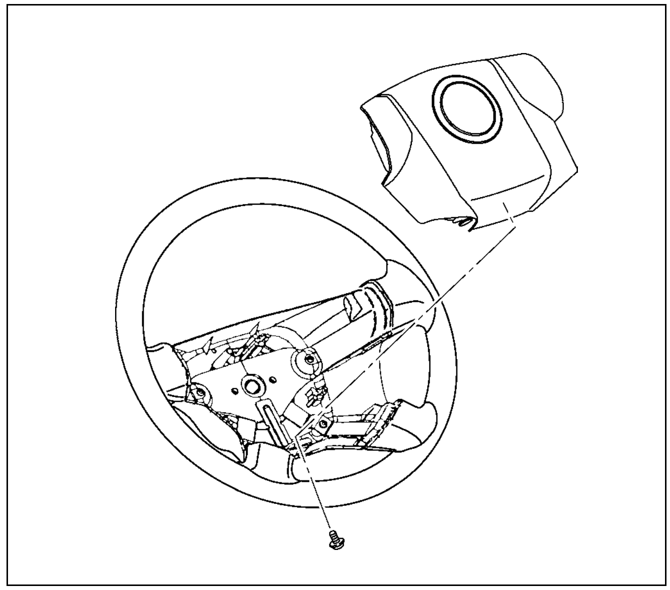
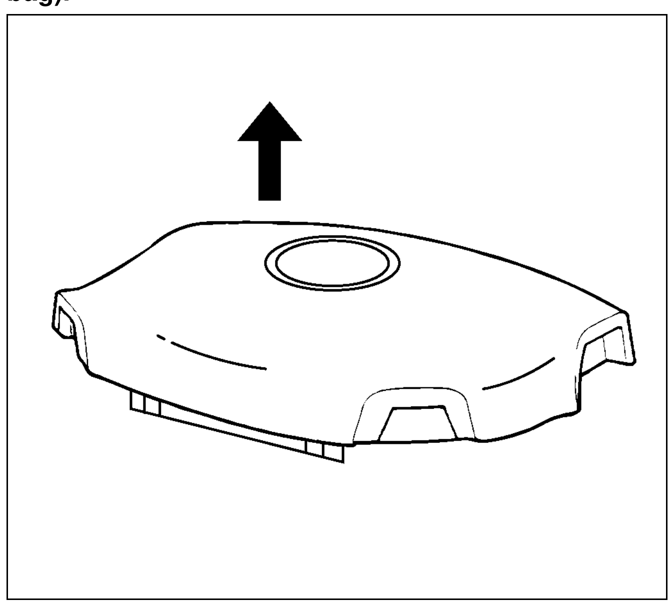
12. Remove the horn pad and the horn leads at the center of the wheel (without SRS air bag).

NOTE: It should be removed first from the bottom spokes.



RTW73BSH000601

WARNING: THE INFLATOR MODULE SHOULD ALWAYS BE CARRIED WITH THE COVER AWAY FROM YOUR BODY AND SHOULD ALWAYS BE LAID ON A FLAT SURFACE WITH THE COVER SIDE UP. THIS IS NECESSARY BECAUSE A FREE SPACE IS PROVIDED TO ALLOW THE AIR CUSHION TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY MAY RESULT (with SRS air bag).



430R300007

10 Align the bright plated timing chain link (1) with the intake camshaft position sprocket alignment circle mark (2).

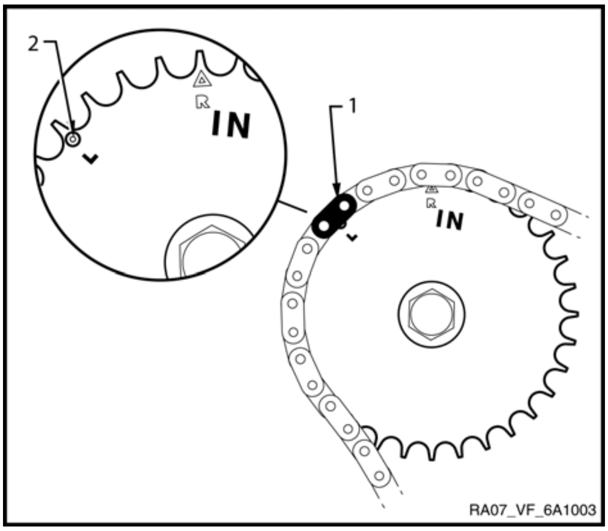


Figure 6A1 – 152

11 Ensure the left-hand camshaft intermediate sprocket is selected and orientated correctly.

CAUTION

The left-hand camshaft intermediate sprocket (1) is marked with the letters LB and 'FRONT', and the right-hand sprocket (2) is marked with the letters RB and 'FRONT' Ensure the correct sprocket is used and the 'FRONT' text is facing forwards when installed.

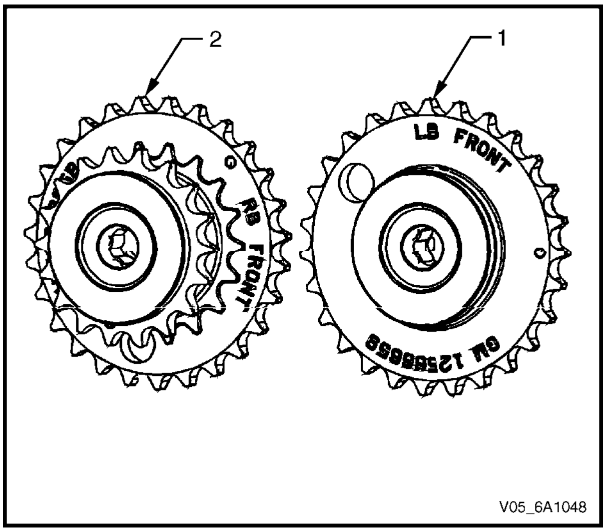


Figure 6A1 – 153

12 Place the left-hand secondary timing chain around the left-hand camshaft intermediate inner sprocket, with the bright plated timing chain link (1) aligned with the access hole (2) in the outer sprocket.

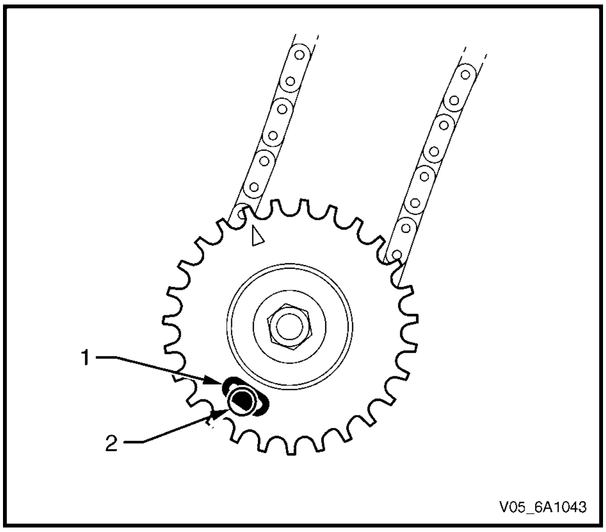


Figure 6A1 – 154

13 Install the left-hand camshaft intermediate sprocket to the cylinder block.

14 Install the sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

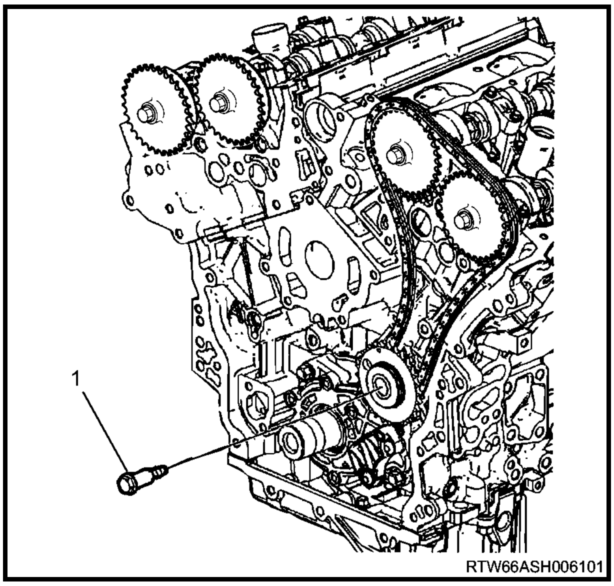


Figure 6A1 – 155

15 Verify the left-hand secondary timing chain timing mark alignments (1 to 6)

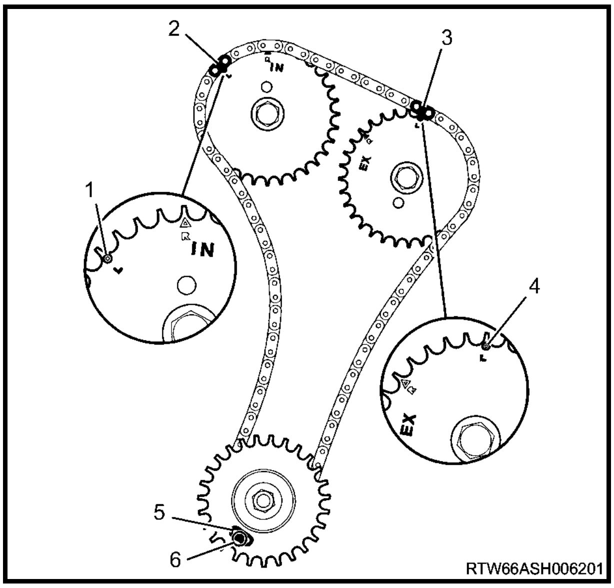


Figure 6A1 – 156

16 Ensure the left-hand secondary timing chain guide is selected and orientated correctly.

CAUTION

The left-hand secondary timing chain guide is marked with the letters LH. Ensure the correct shoe is used when installing to the left-hand side in this procedure and that the letters 'LH" are facing the front of the vehicle when installed.

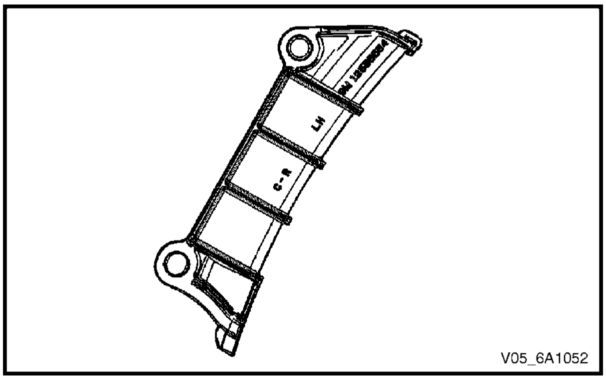


Figure 6A1 – 157

17 Install the left-hand secondary timing chain guide (1).

18 Install the secondary timing chain guide bolts (2) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification...........20.0 – 26.0 Nm

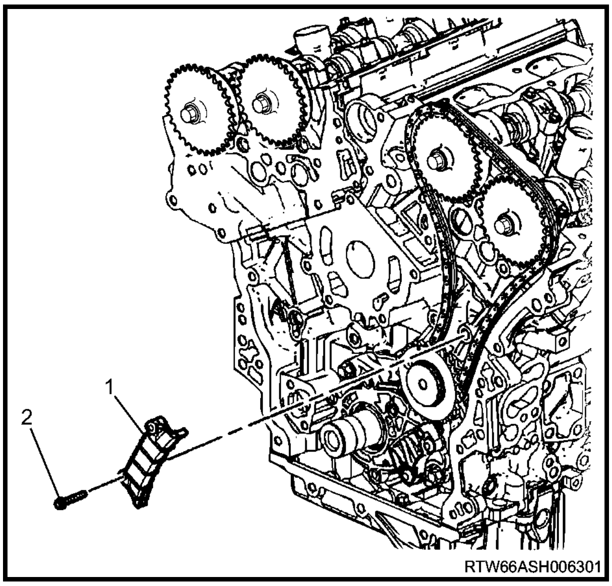


Figure 6A1 – 158

19 Ensure the left-hand secondary timing chain shoe is selected and orientated correctly.

CAUTION

The left-hand secondary timing chain shoe is marked with the letters LH on the back face of the timing chain shoe. Ensure the correct shoe is used when installing to the left-hand side.

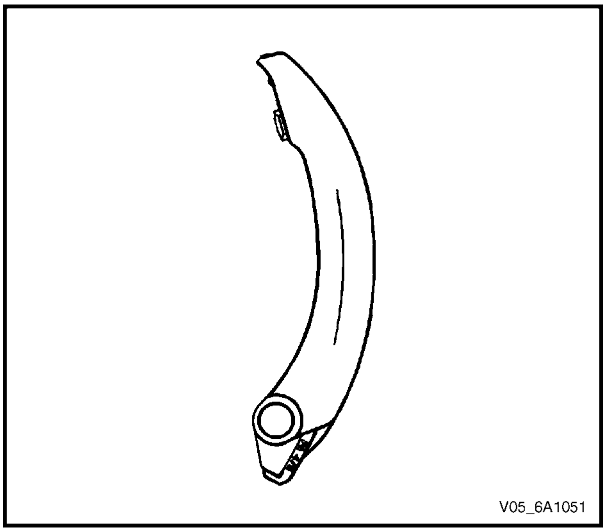


Figure 6A1 – 159

20 Install the left-hand secondary timing chain shoe (1).

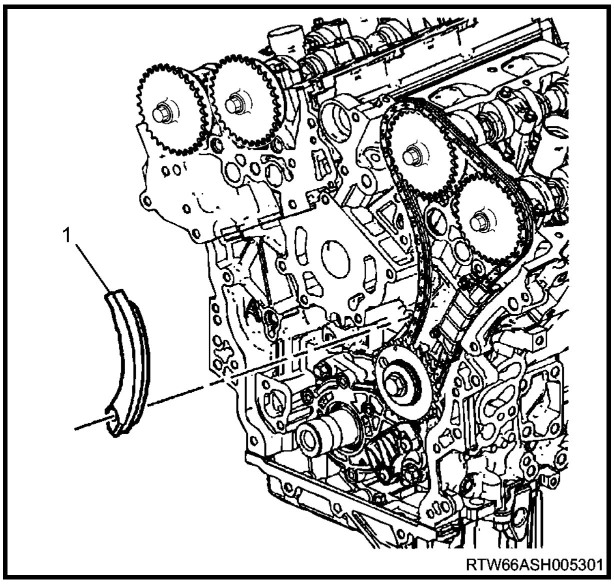


Figure 6A1 – 160

21 Install the left-hand secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

NOTE

Ensure secondary timing chain shoe is clear of the left-hand secondary timing chain tensioner mounting pad, before tightening the attaching bolt.

Secondary timing chain shoe attaching bolt torque specification ....20.0 – 26.0 Nm

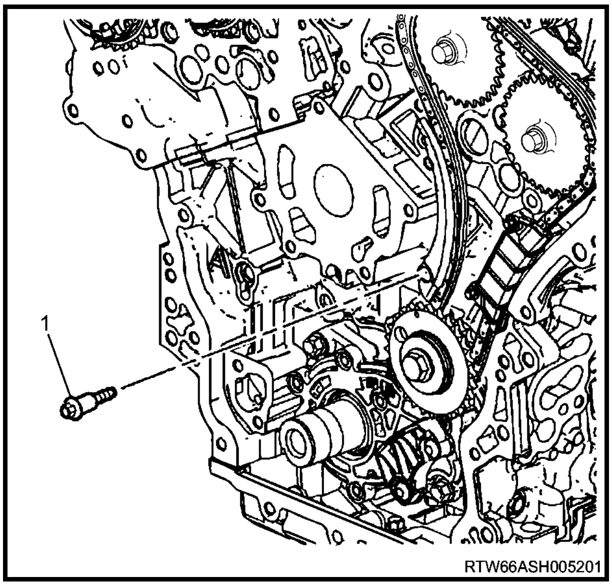


Figure 6A1 – 161

22 Ensure the left-hand secondary timing chain tensioner is selected and orientated correctly.

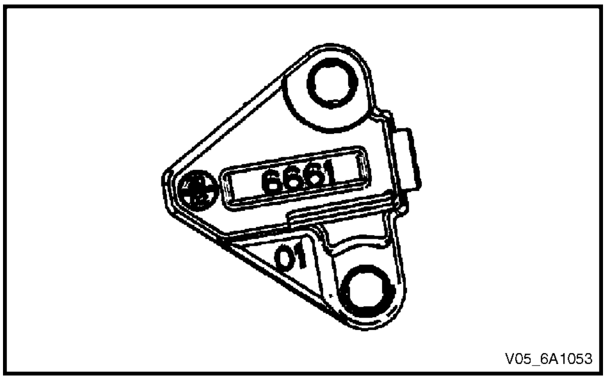


Figure 6A1 – 162

23 Reset the left-hand secondary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

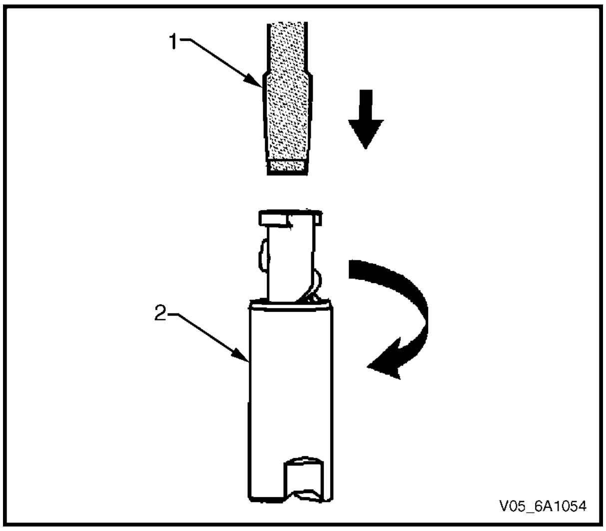


Figure 6A1 – 163

24 Install the tensioner shaft (1) into the left-hand secondary timing chain tensioner body (2).

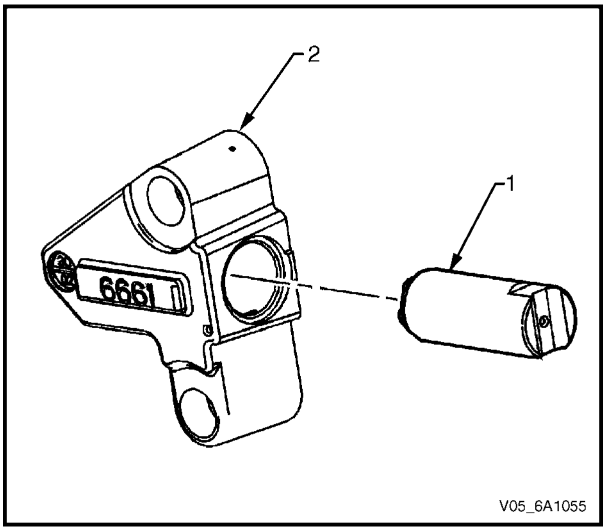


Figure 6A1 – 164

25 Compress the tensioner shaft into the body and lock the left-hand secondary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

26 Slowly release pressure on the left-hand secondary timing chain tensioner. The tensioner should remain compressed.

CAUTION

If Tool No. EN 46112 (1) is not removed from the tensioner body (2), the tensioner shaft (3) will remain in the locked position and no tension will be placed on the timing chain, this will cause damage to the engine.

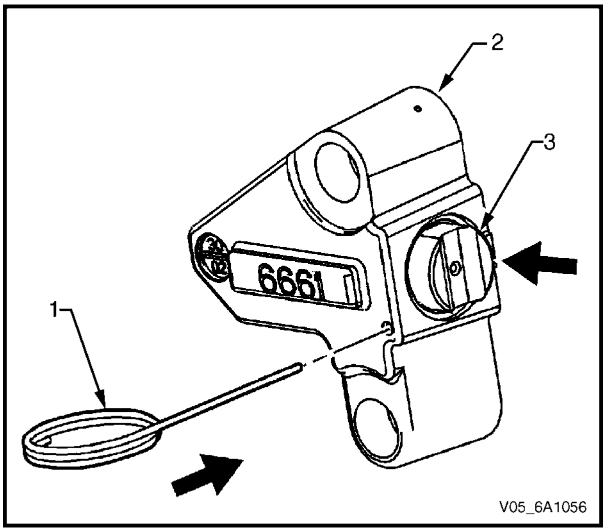


Figure 6A1 – 165

27 Install a new left-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

28 Install the left-hand secondary timing chain tensioner bolts through tensioner and gasket.

29 Ensure the left-hand secondary timing chain tensioner mounting surface on the left-hand cylinder head does not have any burrs or defects that would affect the sealing of the new gasket.

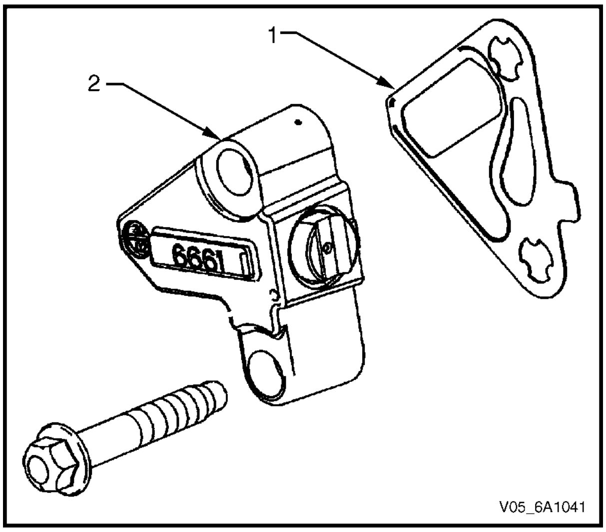


Figure 6A1 – 166

30 Place the left-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the cylinder head.

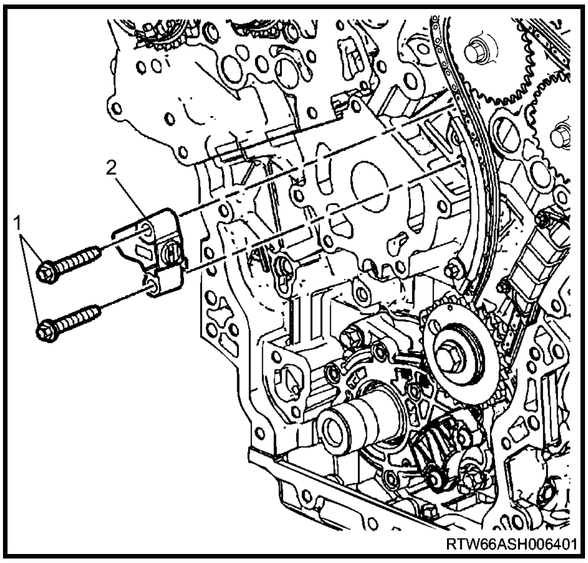


Figure 6A1 – 167

31 Verify the proper placement of the left-hand secondary timing chain tensioner gasket tab (1).

32 Tighten the left-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification	20.0 – 26.0 Nm

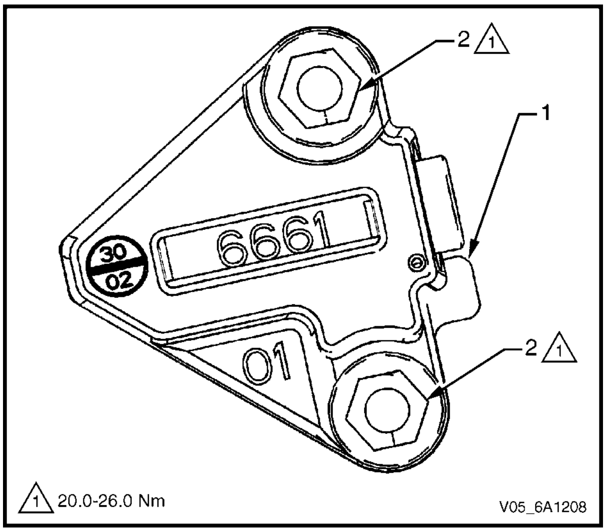


Figure 6A1 – 168

33 Release the left-hand secondary timing chain tensioner (1) by pulling out Tools No. EN 46112 (2) and unlocking the tensioner shaft.

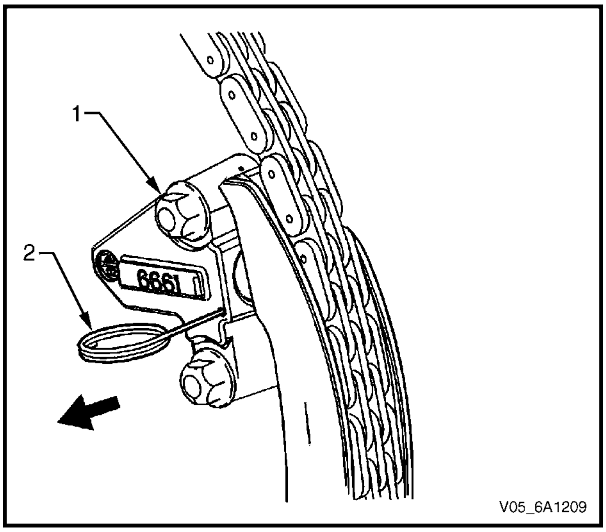


Figure 6A1 – 169

34 Verify the left-hand secondary timing chain timing mark alignments (1 to 6).

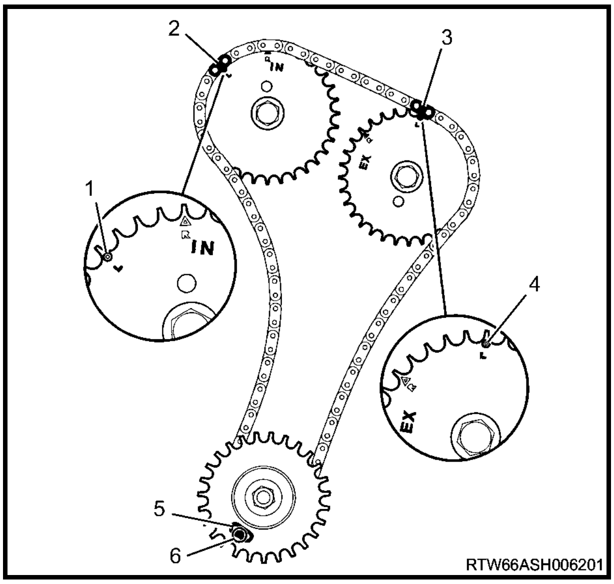


Figure 6A1 – 170

Left-hand Secondary Timing Chain Components – MY06 Update

1 Install the crankshaft sprocket (1) onto the crankshaft (2) by aligning the keyway to the key on the crankshaft.

2 Slide the crankshaft sprocket on the crankshaft until the crankshaft sprocket contacts the step in the crankshaft.

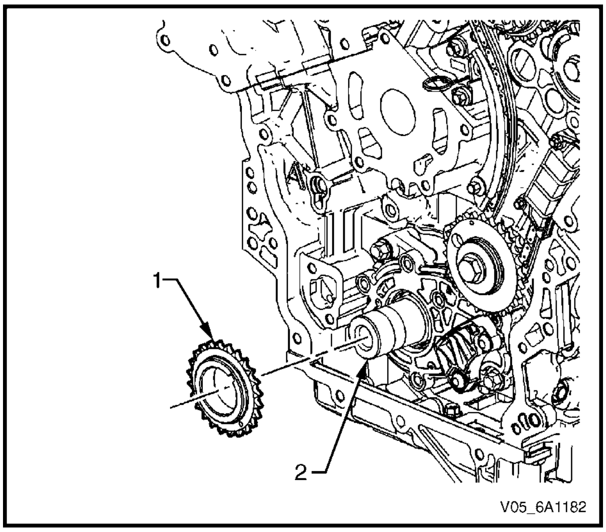


Figure 6A1 – 171

NOTE

Ensure that the crankshaft sprocket is installed with the timing mark (1) visible.

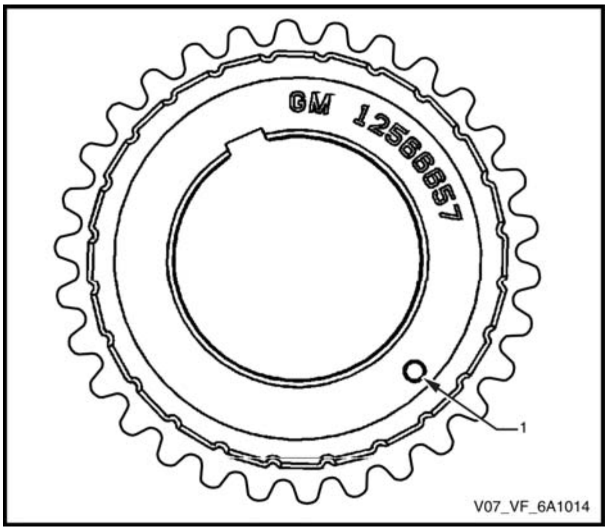


Figure 6A1 – 172

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts in an anti-clockwise direction. There should be no need to rotate the camshaft more than 45 degrees.

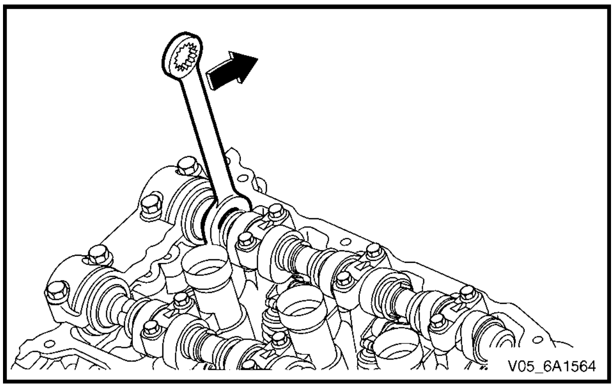


Figure 6A1 – 173

3 Install Tool No. EN 46105-1 (1) onto the rear of the left-hand cylinder head camshafts (2).

CAUTION

All camshafts must be locked in place before installation of any timing chains.

4 Ensure that Tool No. EN 46105 is fully seated onto the camshafts.

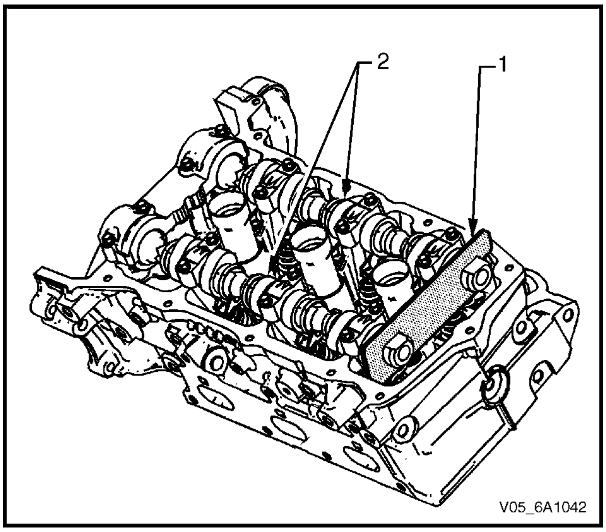


Figure 6A1 – 174

5 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

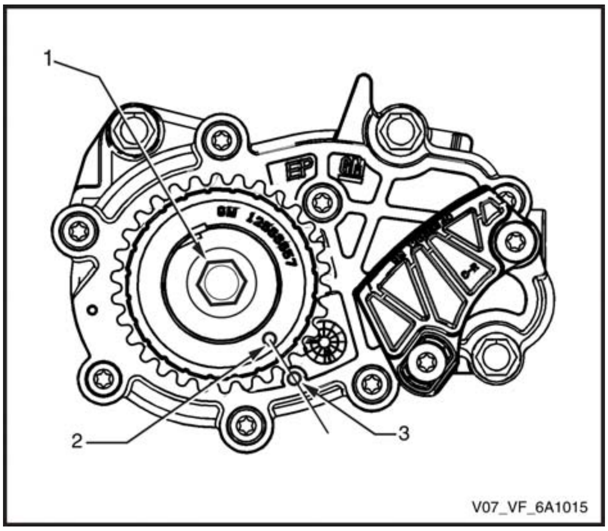


Figure 6A1 – 175

6 Install the left-hand secondary timing chain (1) aligning the chain in the following manner:

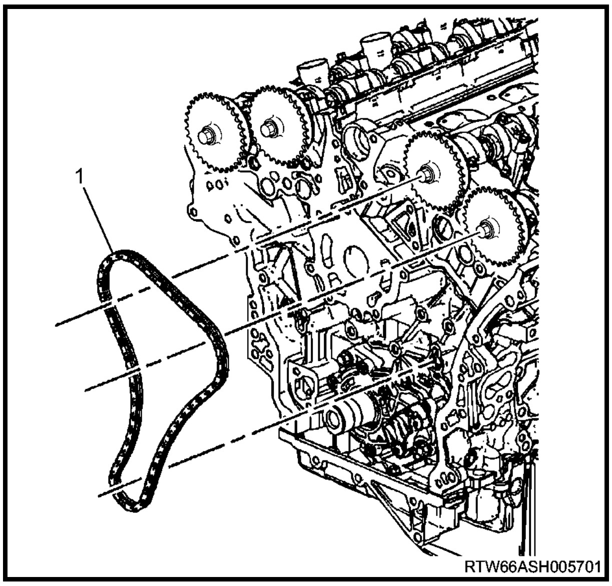


Figure 6A1 – 176

7 Wrap the secondary timing chain around both left-hand camshaft drive sprockets.

8 Ensure there are two bright links located on top of each of the camshaft sprockets.

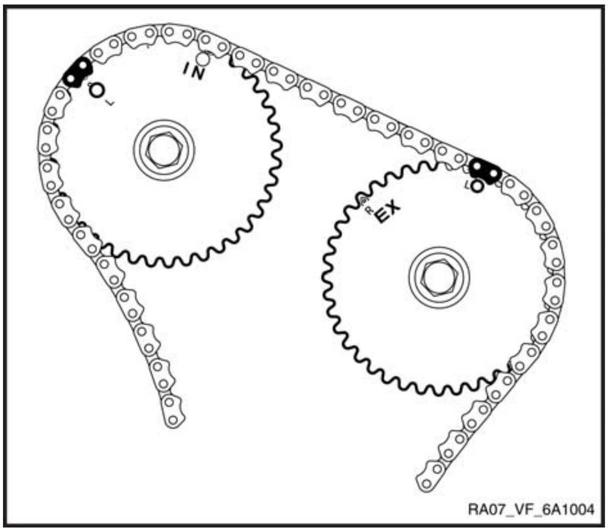


Figure 6A1 – 177

CAUTION

When aligning the left-hand secondary timing chain to the camshaft sprockets, ensure the circular timing marks on the sprocket are used, NOT the triangular mark.

9 Align the bright plated timing chain link (1) with the left-hand exhaust camshaft position sprocket alignment circle mark (2).

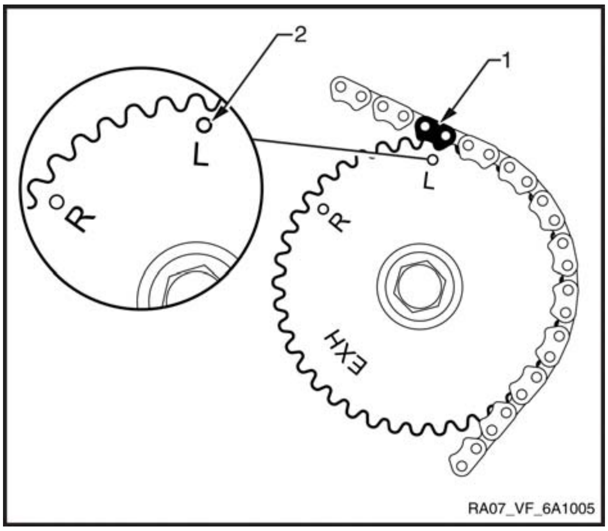


Figure 6A1 – 178

10 Align the bright plated timing chain link (1) with the intake camshaft position sprocket alignment circle mark (2).

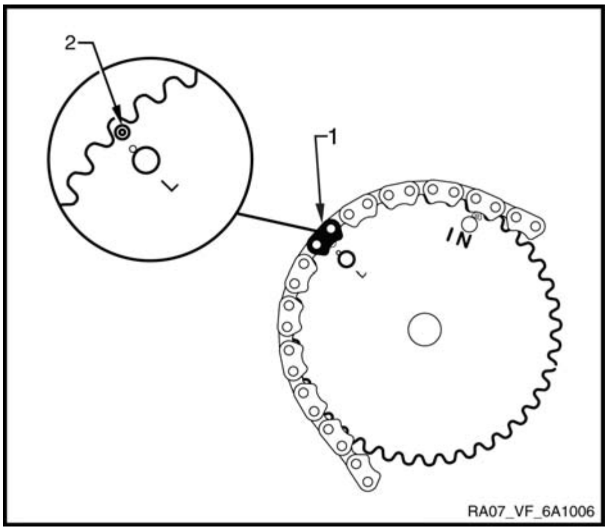


Figure 6A1 – 179

CAUTION

The left-hand camshaft intermediate sprocket (1) is marked with the letters LB and 'FRONT', and the right-hand sprocket (2) is marked with the letters RB and 'FRONT' Ensure the correct sprocket is used and the 'FRONT' text is facing forwards when installed.

11 Ensure the left-hand camshaft intermediate sprocket is selected and orientated correctly.

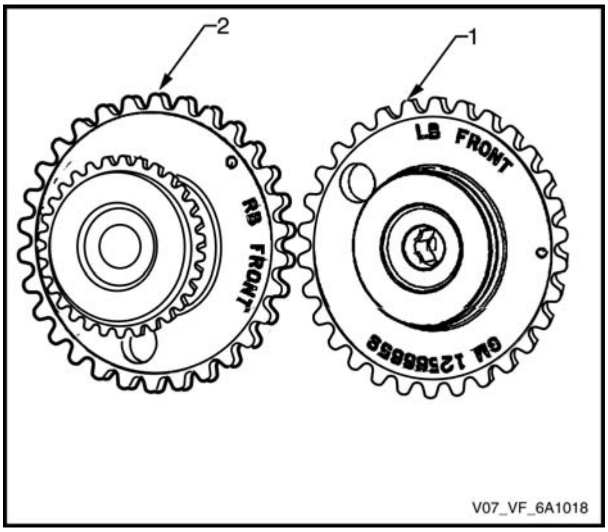


Figure 6A1 – 180

Inspection and Repair (with SRS air bag)

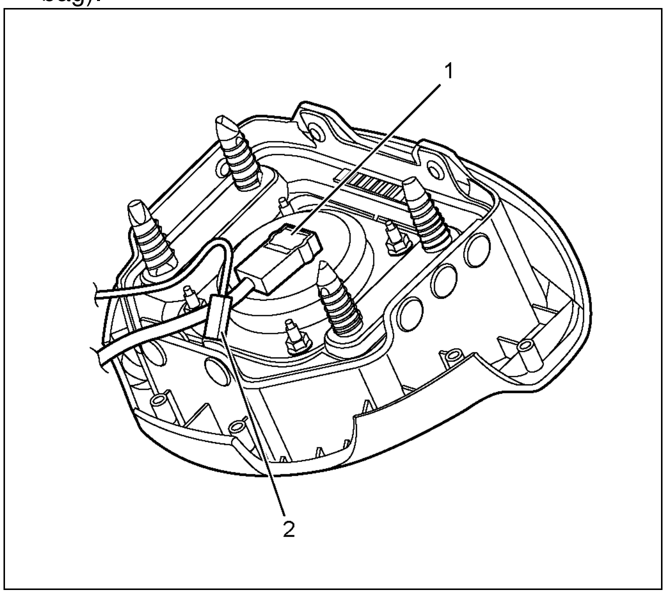
The inflator module consists of a cover, air bag, inflator, and retainer. Inspect the inflator module mainly for the following:

- Check for holes, cracks, severe blemishes and deformation on the cover.
- Check that the retainer is not deformed.
- Check for defects such as damage and breakage in the lead wire for the igniter.

If an abnormality is found as a result of the inspection, replace the inflator module with a new one.

Installation

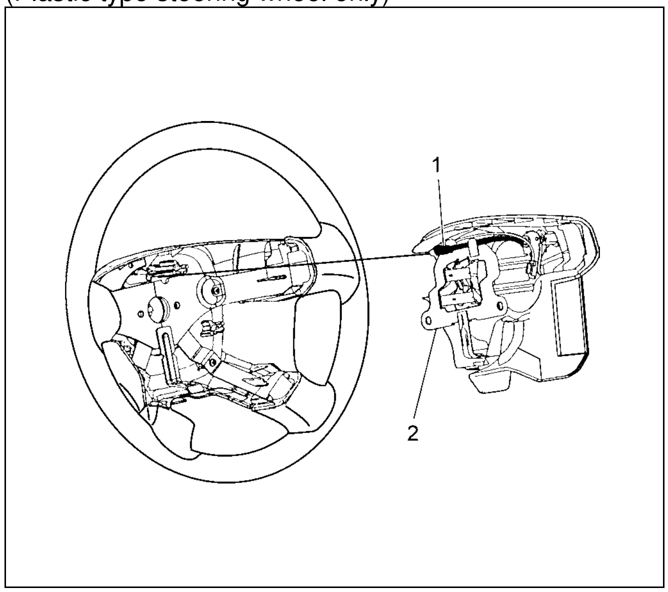
1. Support the inflator module and carefully connect the SRS connector (1) and horn lead (2) (with SRS air bag).



RTW73BSH001101

2. Connect the horn leads at center of wheel (without SRS air bag).

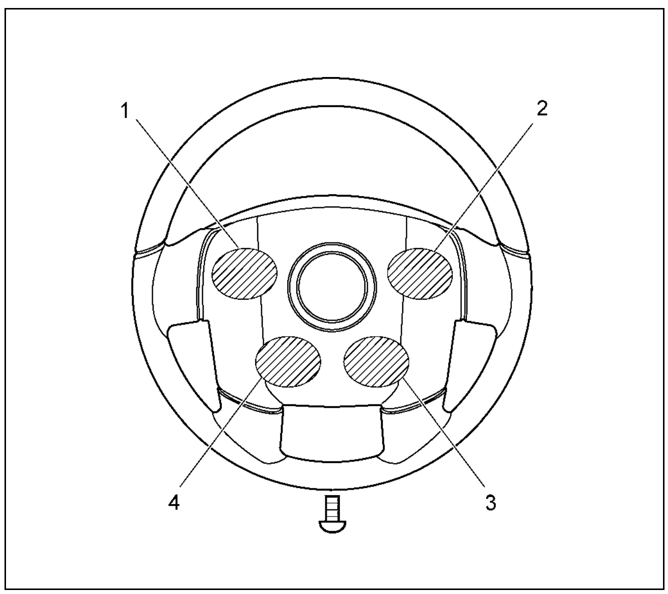
NOTE: The horn leads (1) are passed along the top of the bracket (2).
(Plastic type steering wheel only)



RTW73BSH000801

3. Push the horn pad at areas 1-4.
   Tighten the horn pad fixing screw to the specifed torque (without SRS air bag)
   Torque: 3 N·m (0.3 kgf·m/26 lb·in)

NOTE: A horn pad should not be struck during attachment.



RTW73BSH000201

12 Place the left-hand secondary timing chain around the left-hand camshaft intermediate inner sprocket, with the bright plated timing chain link (1) aligned with the access hole (2) in the outer sprocket.

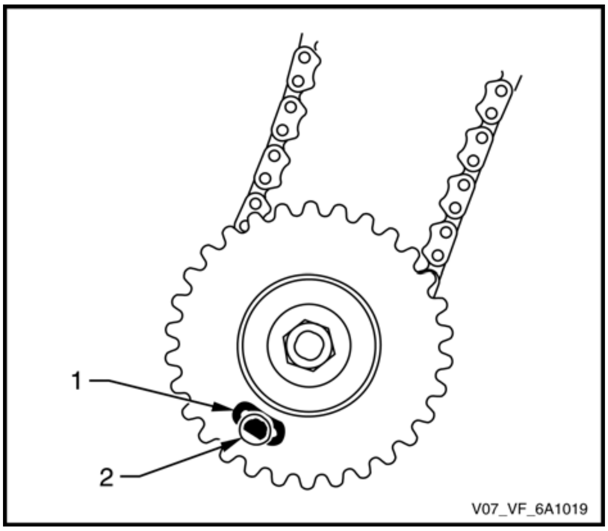


Figure 6A1 – 181

13 Install the left-hand camshaft intermediate sprocket to the cylinder block.

14 Install the sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

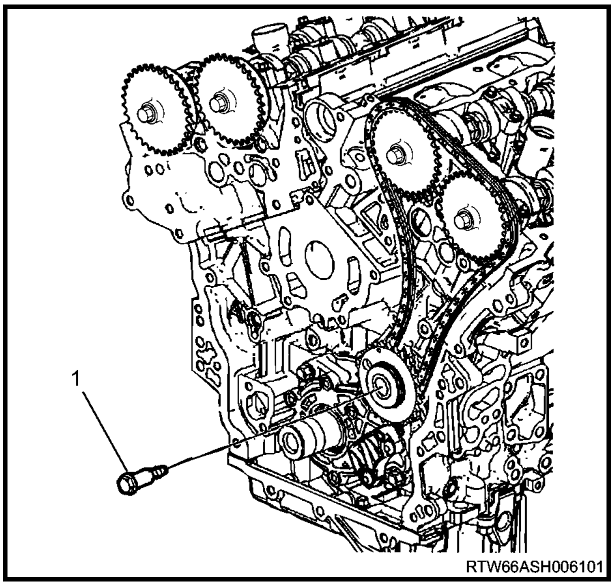


Figure 6A1 – 182

15 Verify the left-hand secondary timing chain timing mark alignments (1 to 6)

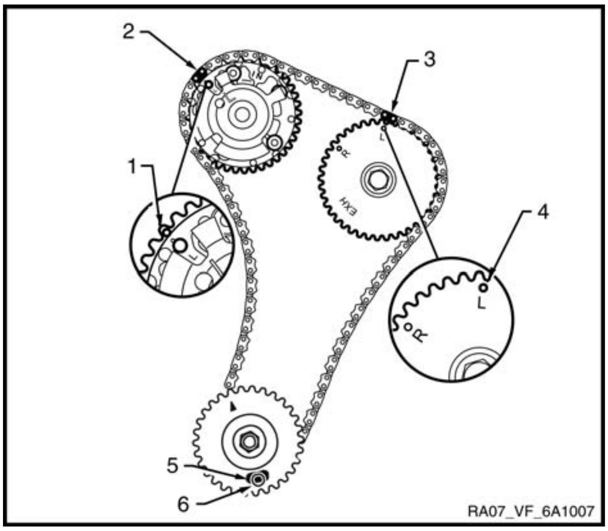


Figure 6A1 – 183

CAUTION

The left-hand secondary timing chain guide is marked with the letters LH. Ensure the correct shoe is used when installing to the left-hand side in this procedure and that the letters 'LH" are facing the front of the vehicle when installed.

16 Ensure the left-hand secondary timing chain guide is selected and orientated correctly.

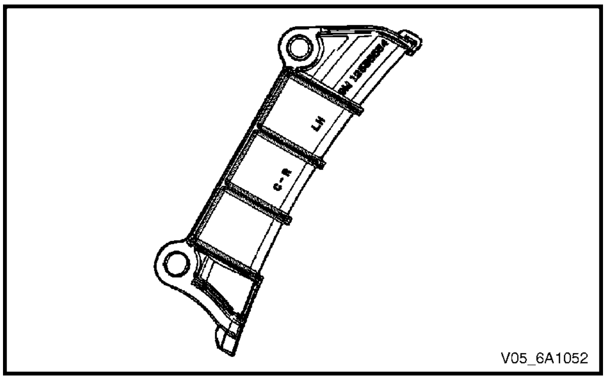


Figure 6A1 – 184

17 Install the left-hand secondary timing chain guide (1).

18 Install the secondary timing chain guide bolts (2) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification...........20.0 – 26.0 Nm

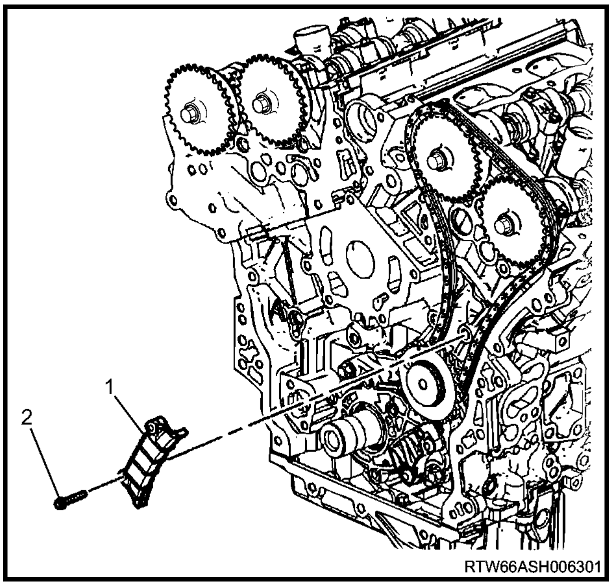


Figure 6A1 – 185

CAUTION

The left-hand secondary timing chain shoe (2) is marked with the letters LH on the back face of the timing chain shoe. Ensure the correct shoe is used when installing to the left-hand side.

19 Ensure the left-hand secondary timing chain shoe is selected and orientated correctly.

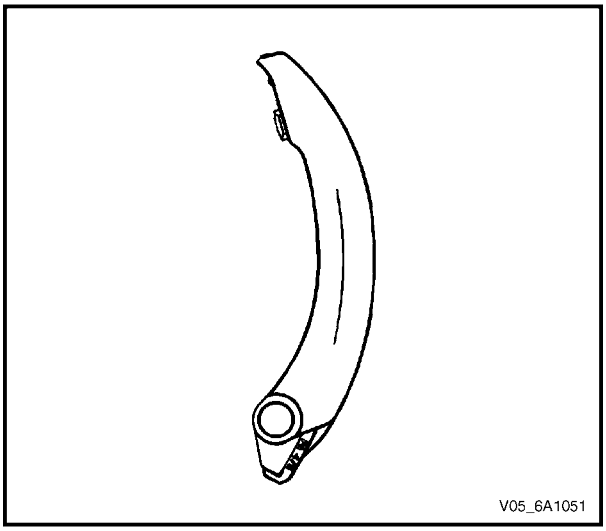


Figure 6A1 – 186

20 Install the left-hand secondary timing chain shoe (1).

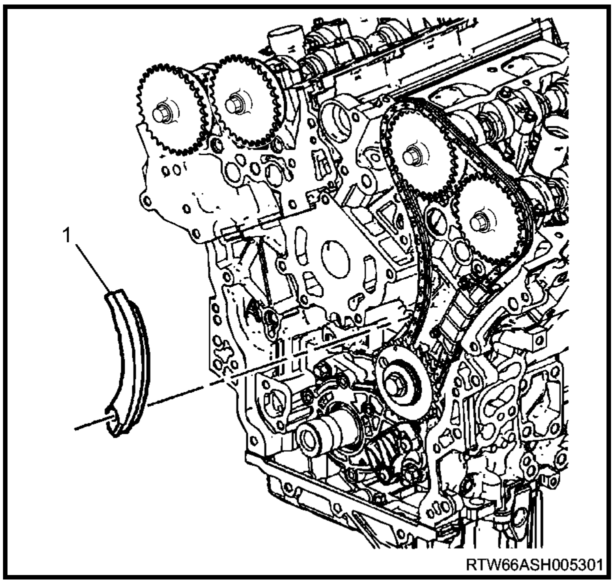


Figure 6A1 – 187

21 Install the left-hand secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

NOTE

Ensure secondary timing chain shoe is clear of the left-hand secondary timing chain tensioner mounting pad, before tightening the attaching bolt.

Secondary timing chain shoe attaching bolt torque specification ....20.0 – 26.0 Nm

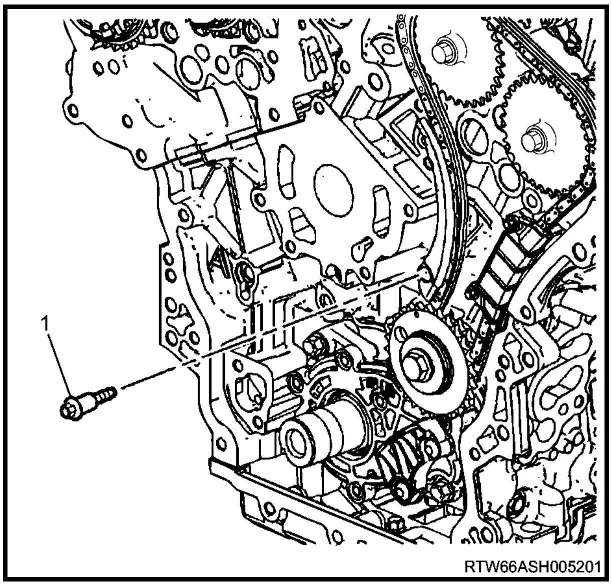


Figure 6A1 – 188

22 Ensure the left-hand secondary timing chain tensioner is selected and orientated correctly.

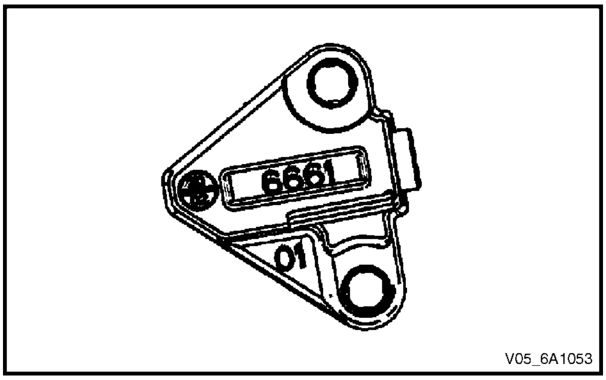


Figure 6A1 – 189

23 Reset the left-hand secondary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

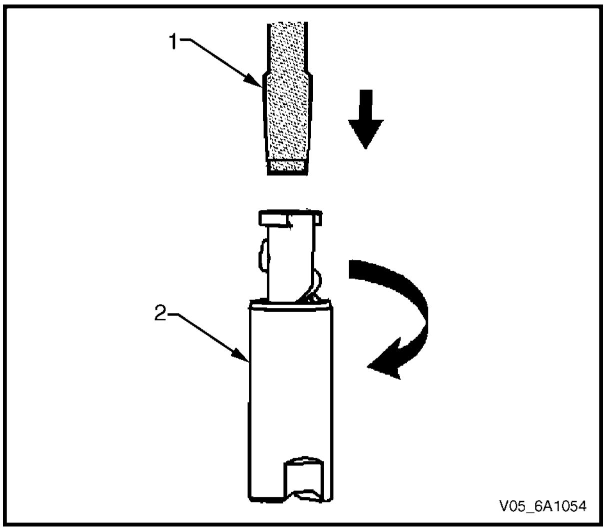


Figure 6A1 – 190

24 Install the tensioner shaft (1) into the left-hand secondary timing chain tensioner body (2).

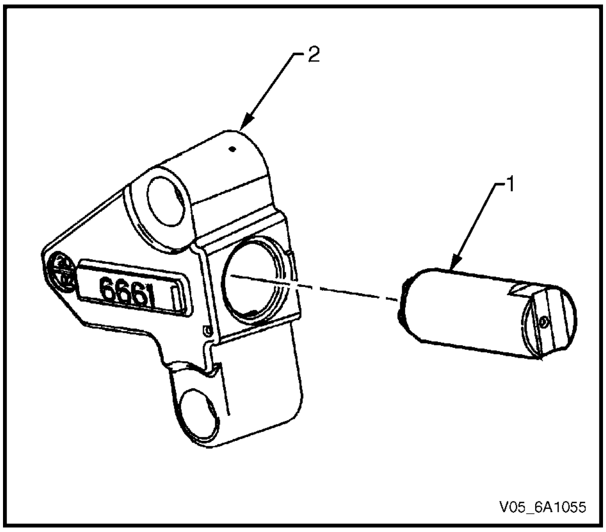


Figure 6A1 – 191

CAUTION

If Tool No. EN 46112 (1) is not removed from the tensioner body (2), the tensioner shaft (3) will remain in the locked position and no tension will be placed on the timing chain, this will cause damage to the engine.

25 Compress the tensioner shaft into the body and lock the left-hand secondary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

26 Slowly release pressure on the left-hand secondary timing chain tensioner. The tensioner should remain compressed.

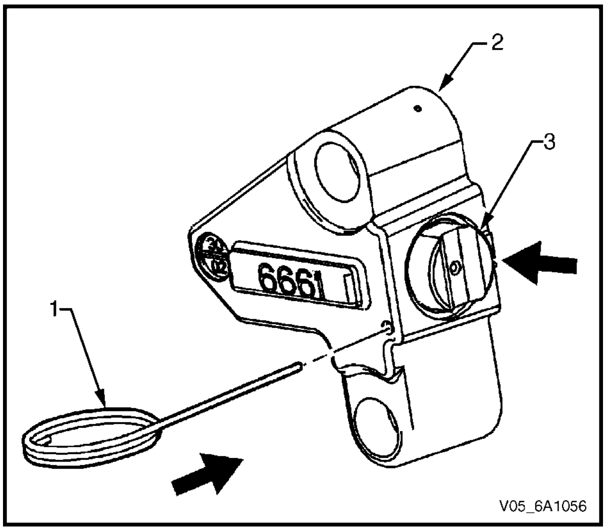


Figure 6A1 – 192

27 Install a new left-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

28 Install the left-hand secondary timing chain tensioner bolts through tensioner and gasket.

29 Ensure the left-hand secondary timing chain tensioner mounting surface on the left-hand cylinder head does not have any burrs or defects that would affect the sealing of the new gasket.

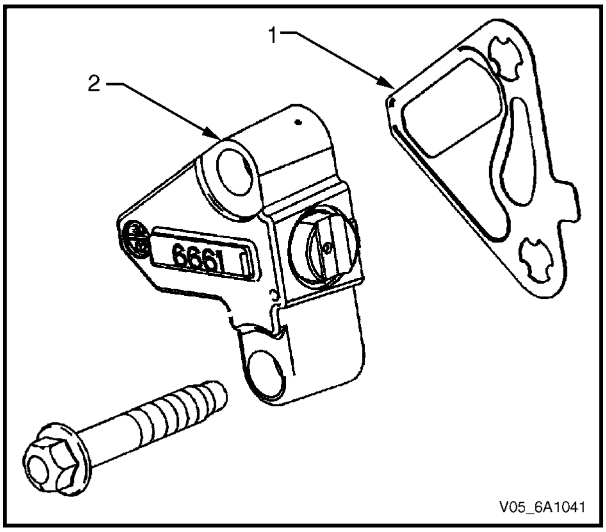


Figure 6A1 – 193

30 Place the left-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the cylinder head.

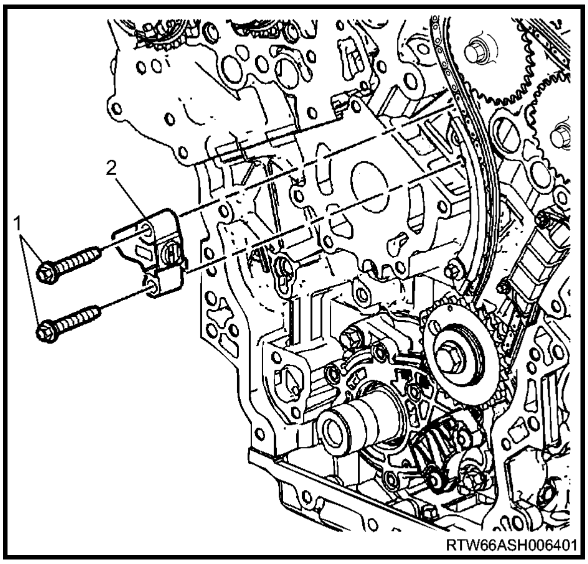


Figure 6A1 – 194

31 Verify the proper placement of the left-hand secondary timing chain tensioner gasket tab (1).

32 Tighten the left-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

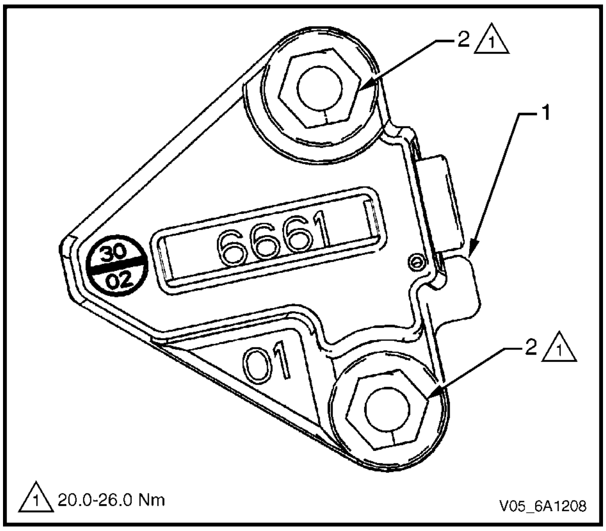


Figure 6A1 – 195

33 Release the left-hand secondary timing chain tensioner (1) by pulling out Tools No. EN 46112 (2) and unlocking the tensioner shaft.

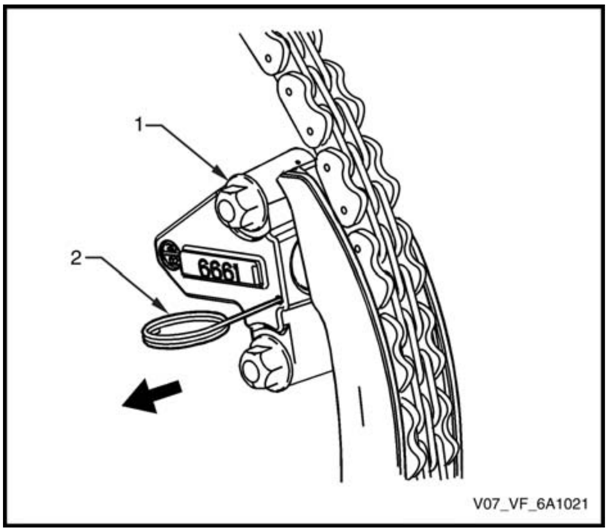


Figure 6A1 – 196

34 Verify the left-hand secondary timing chain timing mark alignments (1 to 6).

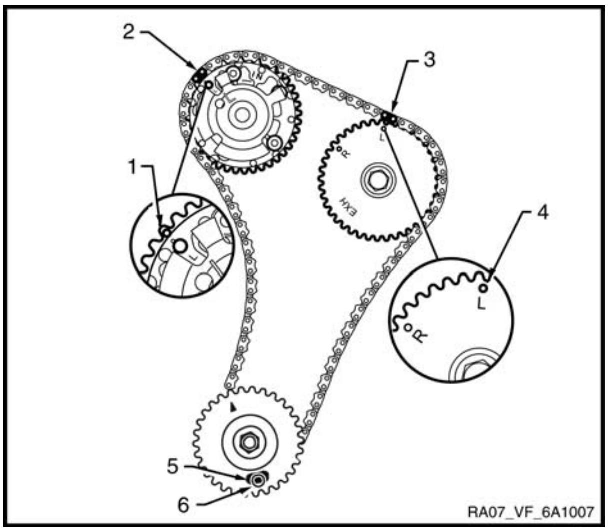


Figure 6A1 – 197

Primary Timing Chain Components – Excluding MY06 Update

1 If previously removed, install the left-hand secondary timing chain components, refer to Left-hand Secondary Timing Chain Components in this Section.

CAUTION

The right-hand camshaft intermediate sprocket (2) is marked with the letters RB and 'FRONT', and the left-hand sprocket (1) is marked with the letters LB and 'FRONT' Ensure the correct sprocket is used and the FRONT text is facing forwards when installed.

2 Ensure the right-hand camshaft intermediate sprocket (2) is selected and orientated correctly.

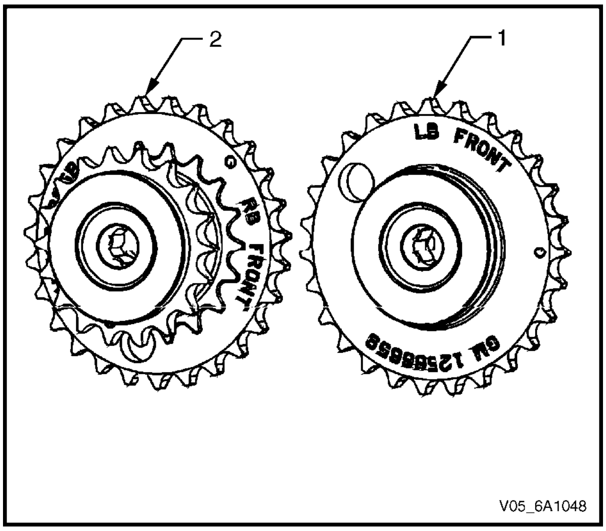


Figure 6A1 – 198

3 Install the right-hand camshaft intermediate sprocket (2).

4 Install the sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

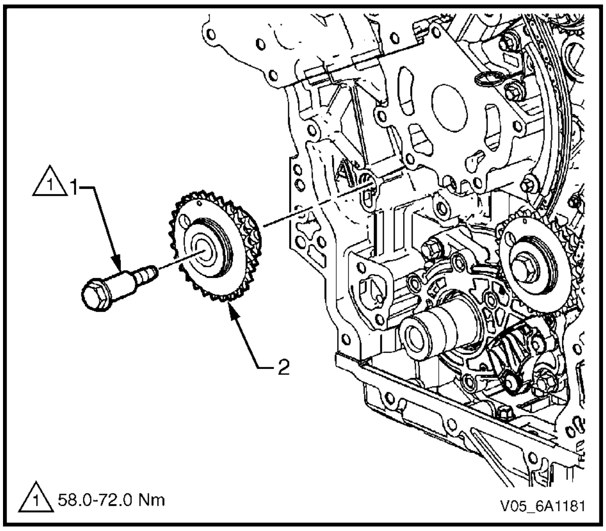


Figure 6A1 – 199

5 Ensure that the crankshaft sprocket timing mark (1) is aligned with the indexing mark (2) on the oil pump housing.

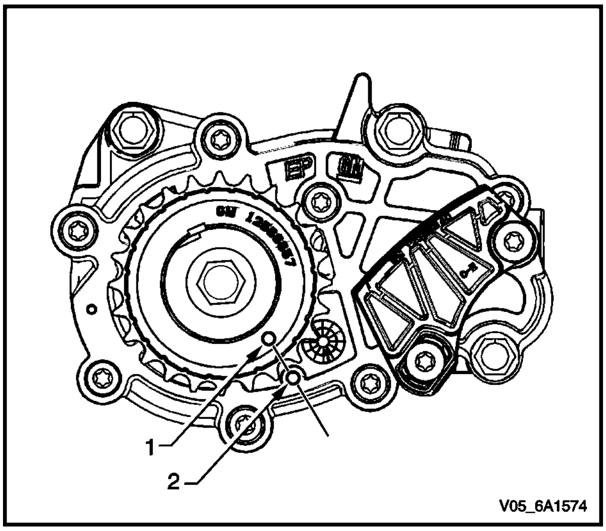


Figure 6A1 – 200

6 Install the primary timing chain (1).

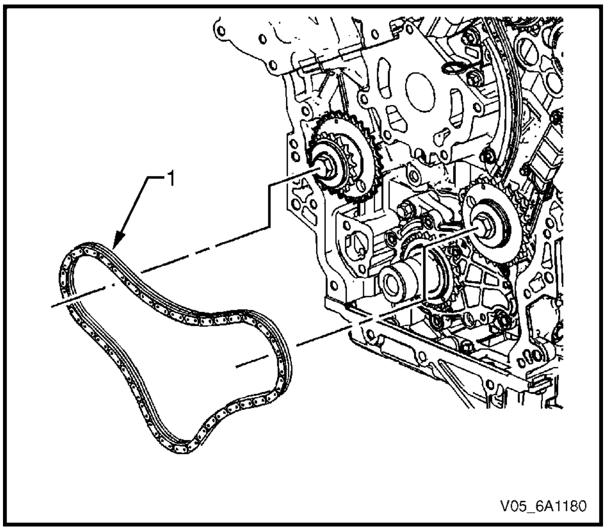


Figure 6A1 – 201

7 Wrap the primary timing chain around the large sprockets of each camshaft intermediate sprocket and the crankshaft sprocket aligning the bright plated chain links as follows:

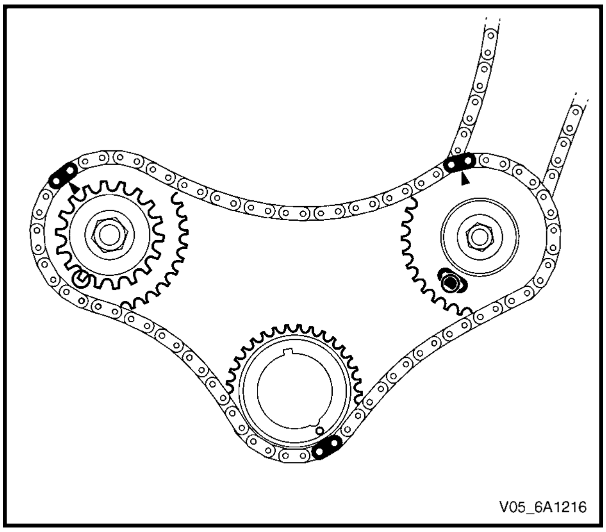


Figure 6A1 – 202

8 The left-hand camshaft intermediate sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

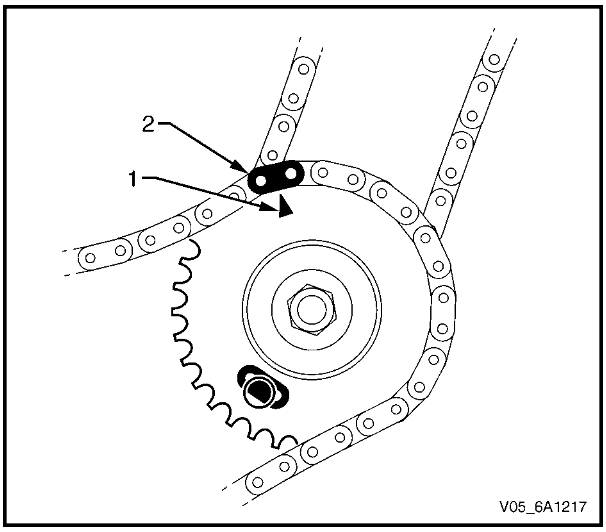


Figure 6A1 – 203

9 The right-hand camshaft intermediate sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

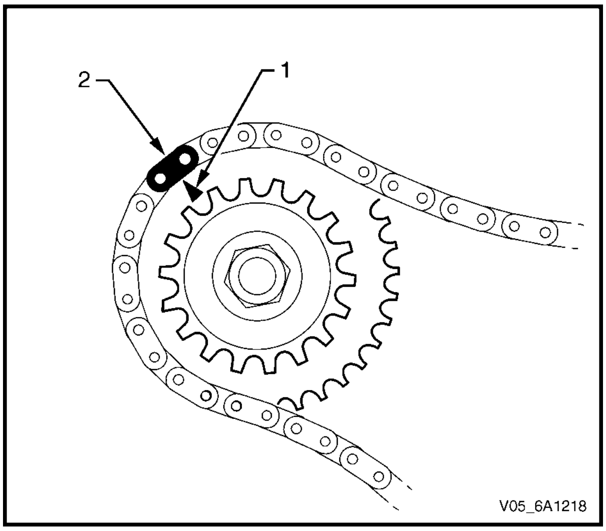


Figure 6A1 – 204

10 The crankshaft sprocket timing mark (1) will align with a bright plated timing chain link (2).

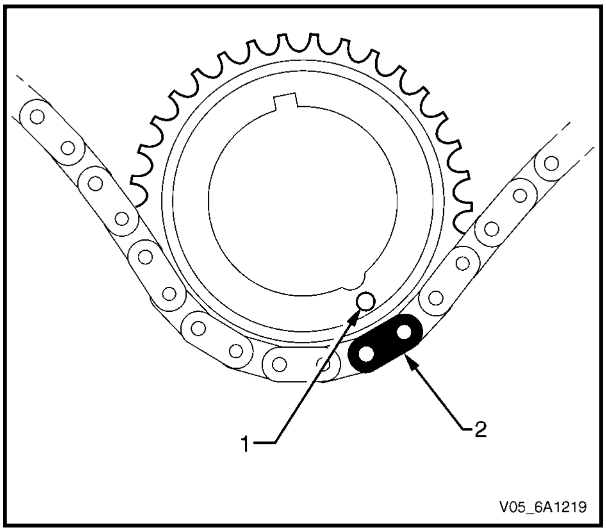


Figure 6A1 – 205

11 Ensure all the timing marks (1, 2 and 3) are properly aligned with the bright plated timing chain links (4, 5 and 6).

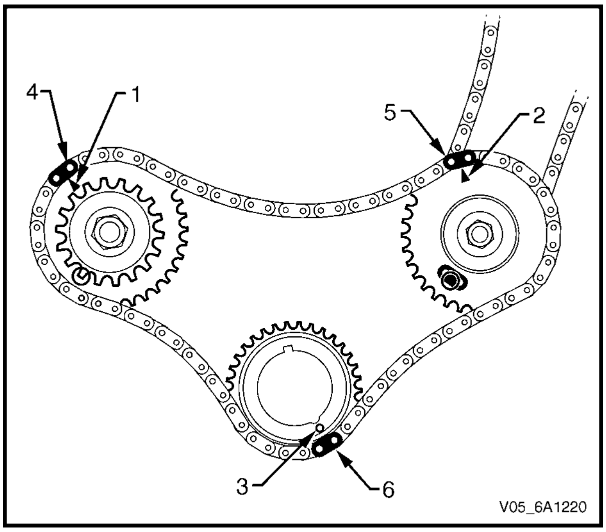


Figure 6A1 – 206

NOTE

Do not remove the primary timing chain lower guide (1). The primary timing chain lower guide is not serviced separately. If the primary timing chain lower guide must be replaced, the oil pump assembly (2) must be replaced.

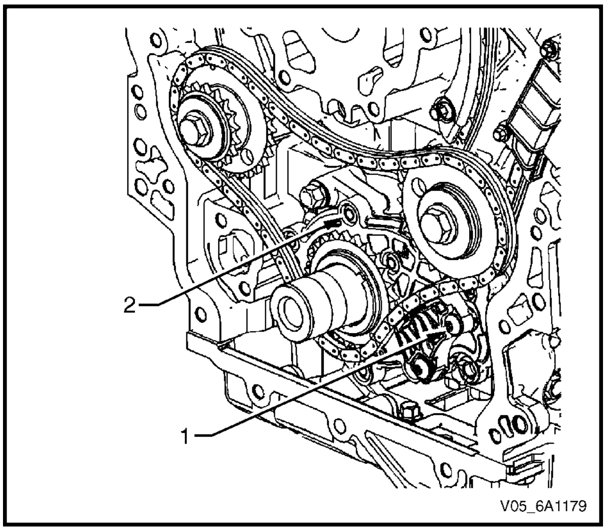


Figure 6A1 – 207

12 Ensure the primary timing chain upper guide is selected and orientated correctly.

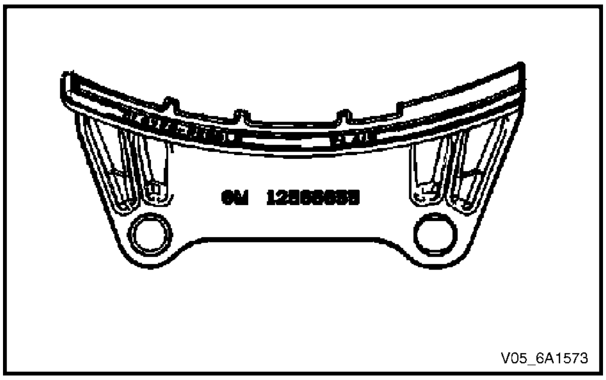


Figure 6A1 – 208

13 Install the primary timing chain upper guide (1).

14 Install the primary timing chain upper guide bolts (2) and tighten to the correct torque specification.

Primary timing chain upper guide attaching bolt torque specification...........20.0 – 26.0 Nm

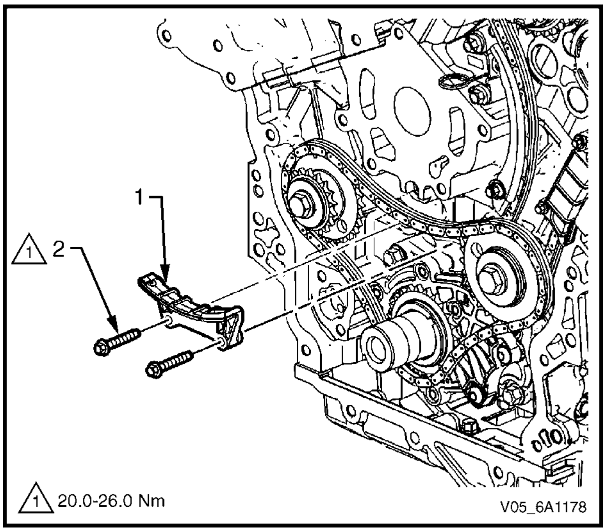
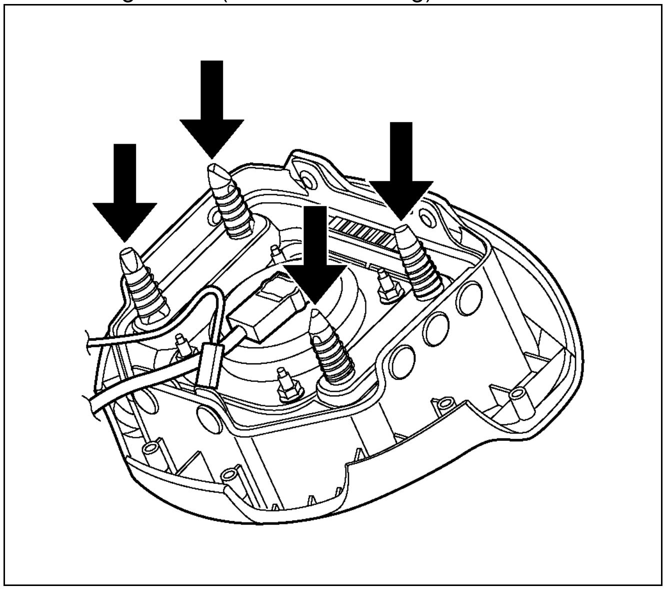
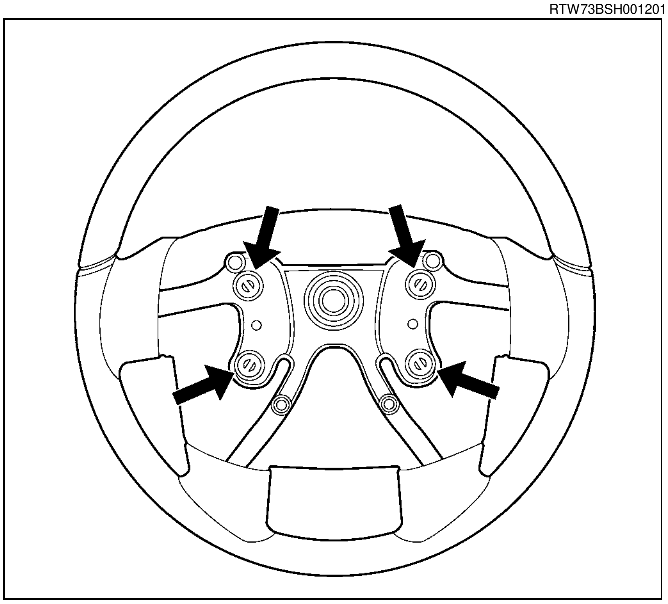


Figure 6A1 – 209

3. Align each snap stud of driver air bag to the holes on steering wheel (with SRS air bag).

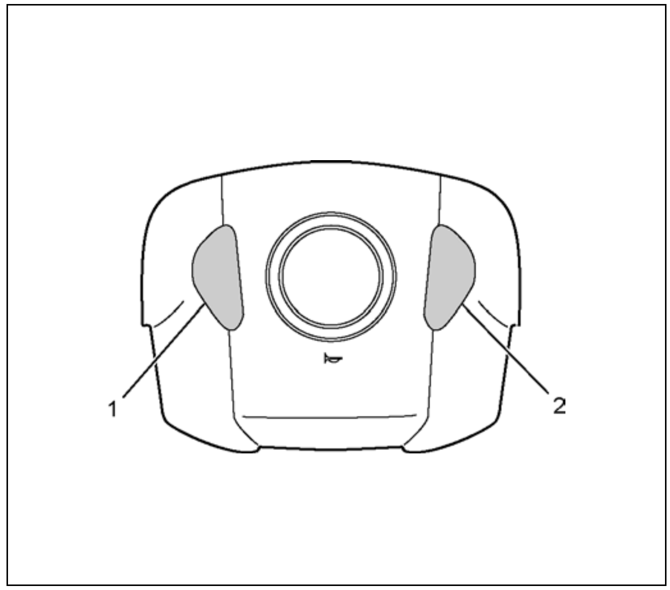


RTW73BSH001201



RTW73BSH000401

4. Push the SRS air bag at area-1 (1) and area-2 (2). At that time confirm the audible noise of each stud.



RTW73BSH000301

5. Enable the SRS (Refer to "Enabling the SRS" in this section) (with SRS air bag).
6. Connect the SRS connector (with SRS air bag).
7. Connect the battery "-" terminal cable (with SRS air bag).
8. Turn the ignition switch to "ON" while watching warning light and check - the light should flash 7 times and then go off. If lamp does not operate correctly, refer to Restraints section.

15 Ensure that the primary timing chain tensioner is being installed.

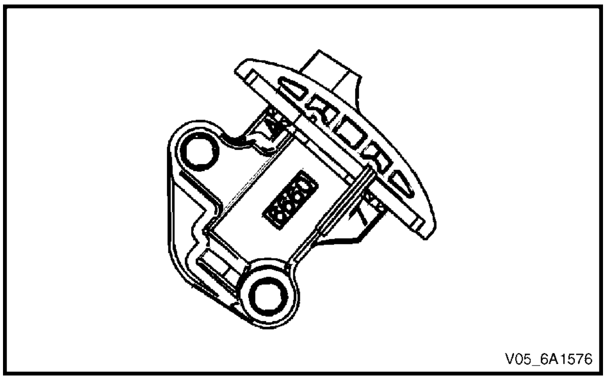


Figure 6A1 – 210

16 Reset the primary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

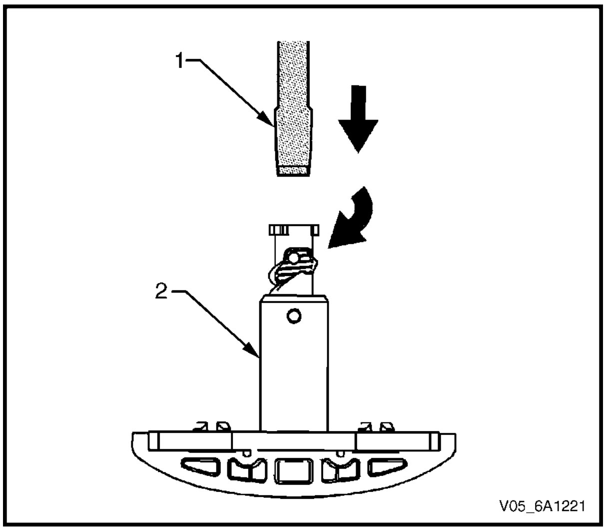


Figure 6A1 – 211

17 Install the tensioner shoe assembly (1) into the primary timing chain tensioner body (2).

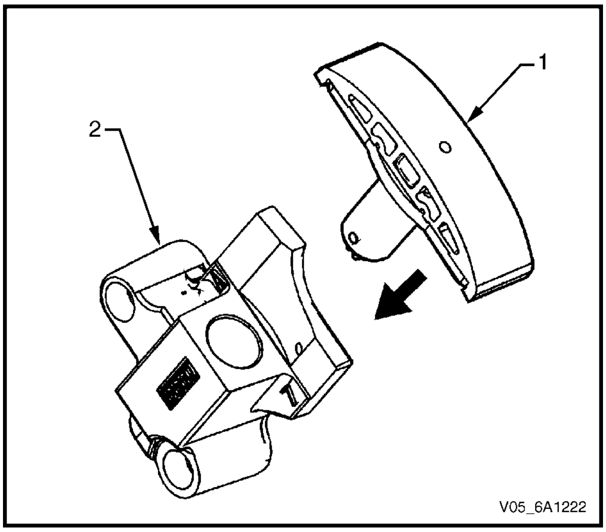


Figure 6A1 – 212

18 Compress the shoe assembly into the body (2) and lock the primary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the body.

CAUTION

If Tool No. EN 46112 (1) is not inserted into the tensioner body, the plunger will remain in the locked position and no tension will be placed on the timing chain.

19 Slowly release pressure on the primary timing chain tensioner. The primary timing chain tensioner should remain compressed.

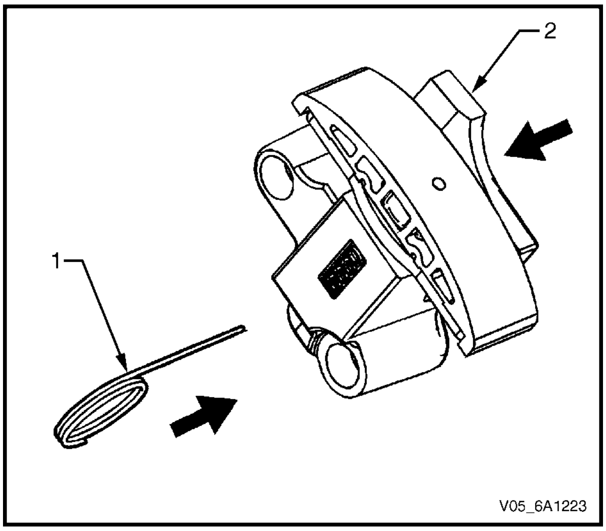


Figure 6A1 – 213

20 Install a new primary timing chain tensioner gasket (1) to the tensioner (2).

21 Install the primary timing chain tensioner bolts (3) through tensioner and gasket.

22 Ensure the primary timing chain tensioner mounting surface on the engine block does not have any burrs or defects that would affect the sealing of the new gasket.

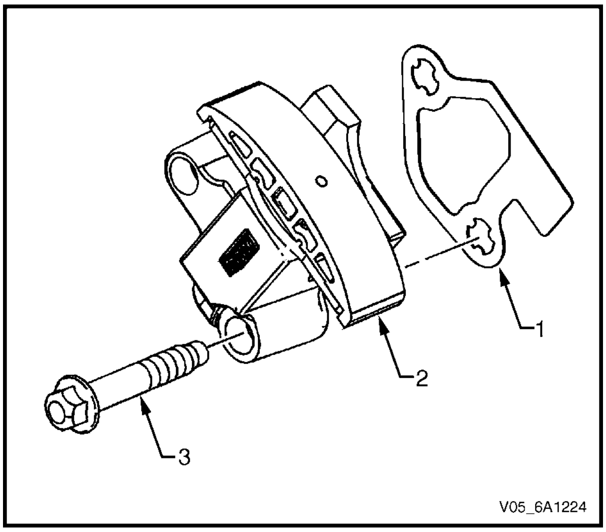


Figure 6A1 – 214

23 Place the primary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

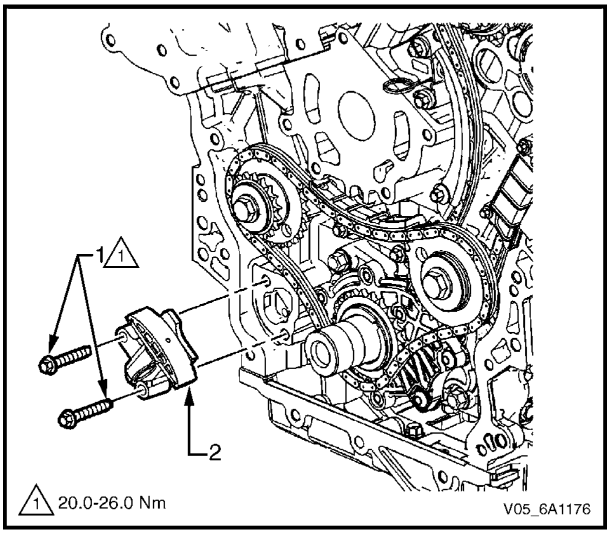


Figure 6A1 – 215

24 Verify the proper placement of the primary timing chain tensioner gasket tab (1).

25 Tighten the primary timing chain tensioner bolts (2) to the correct torque specification.

Primary timing chain tensioner attaching bolt torque specification	20.0 – 26.0 Nm

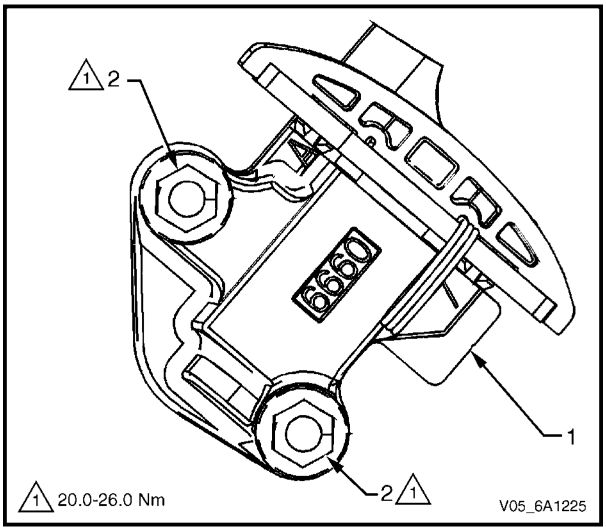


Figure 6A1 – 216

26 Release the primary timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner shaft.

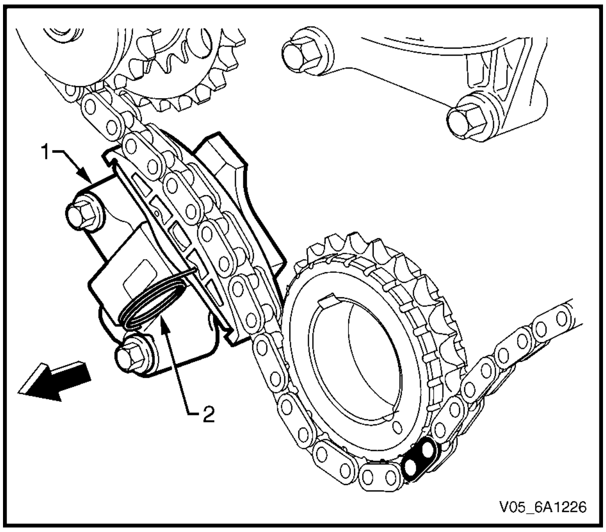


Figure 6A1 – 217

27 Verify the primary and left-hand secondary timing chain timing mark alignments (1 to 12).

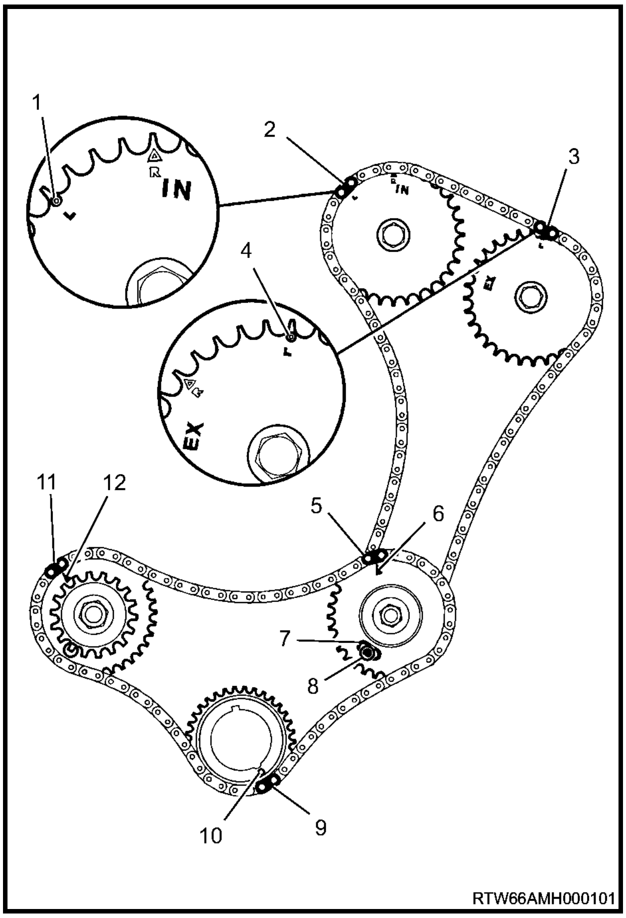


Figure 6A1 – 218

28 Remove Tool No. EN 46105 from the left-hand and right-hand cylinder head camshafts.

Primary Timing Chain Components – MY06 Update

1 If previously removed, install the left-hand secondary timing chain components, refer to Left-hand Secondary Timing Chain Components in this Section.

CAUTION

The right-hand camshaft intermediate sprocket (2) is marked with the letters RB and 'FRONT', and the left-hand sprocket (1) is marked with the letters LB and 'FRONT' Ensure the correct sprocket is used and the FRONT text is facing forwards when installed.

2 Ensure the right-hand camshaft intermediate sprocket (2) is selected and orientated correctly.

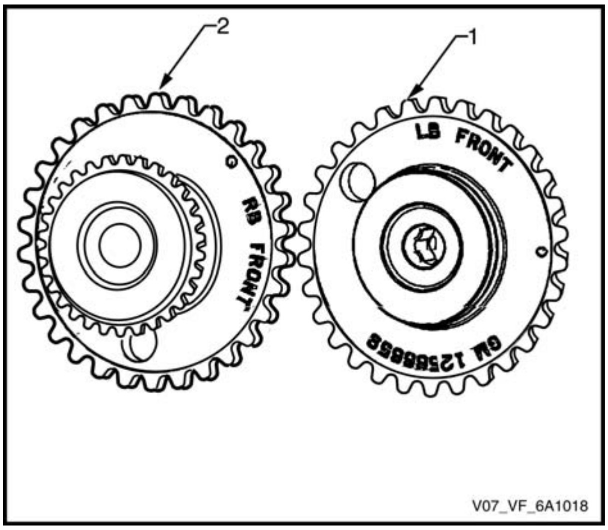


Figure 6A1 – 219

3 Install the right-hand camshaft intermediate sprocket (2).

4 Install the sprocket bolt (1) and tighten to the correct torque specification.

Camshaft intermediate sprocket attaching bolt torque specification...........58.0 – 72.0 Nm

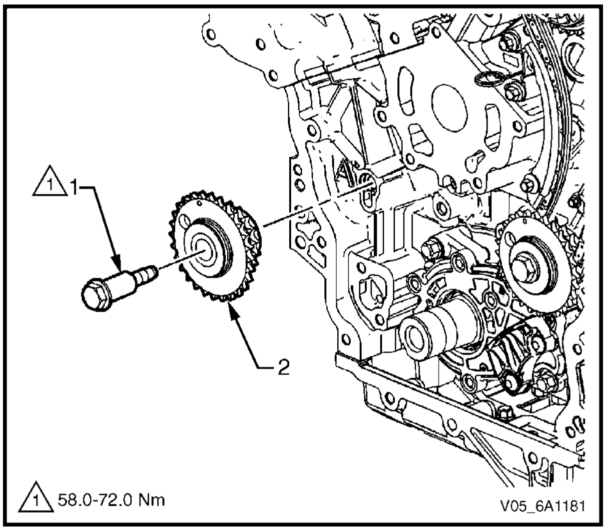


Figure 6A1 – 220

5 Ensure that the crankshaft sprocket timing mark (1) is aligned with the indexing mark (2) on the oil pump housing.

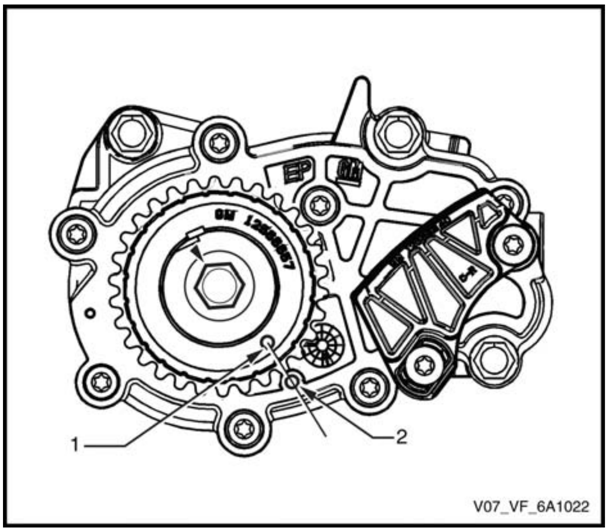


Figure 6A1 – 221

6 Install the primary timing chain (1).

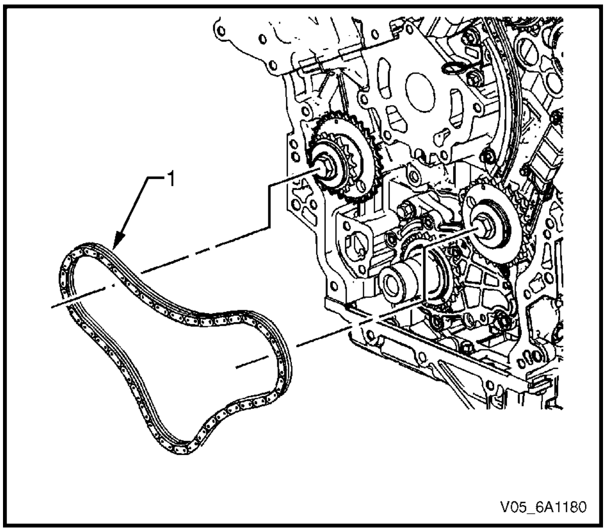


Figure 6A1 – 222

7 Wrap the primary timing chain around the large sprockets of each camshaft intermediate sprocket and the crankshaft sprocket, aligning the bright plated chain links as follows:

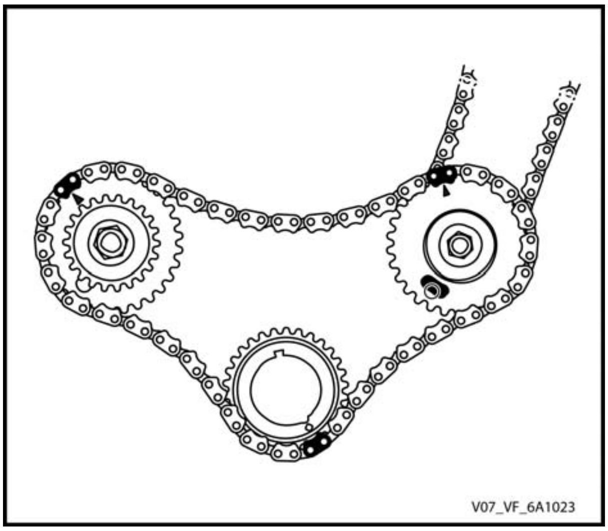


Figure 6A1 – 223

8 The left-hand camshaft intermediate sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

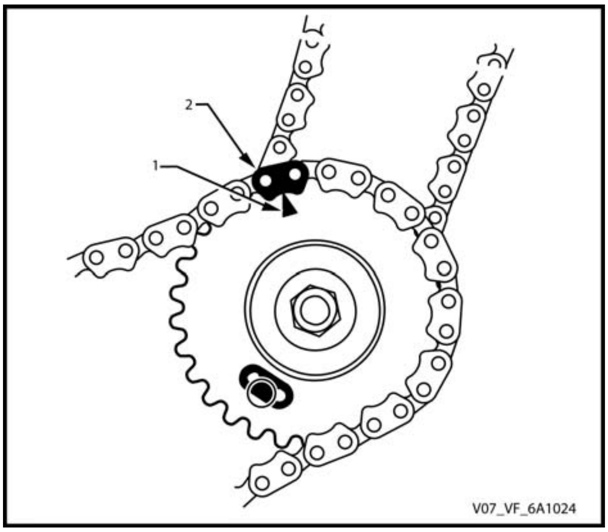


Figure 6A1 – 224

9 The right-hand camshaft intermediate sprocket timing mark (1) will align with a bright plated primary timing chain link (2).

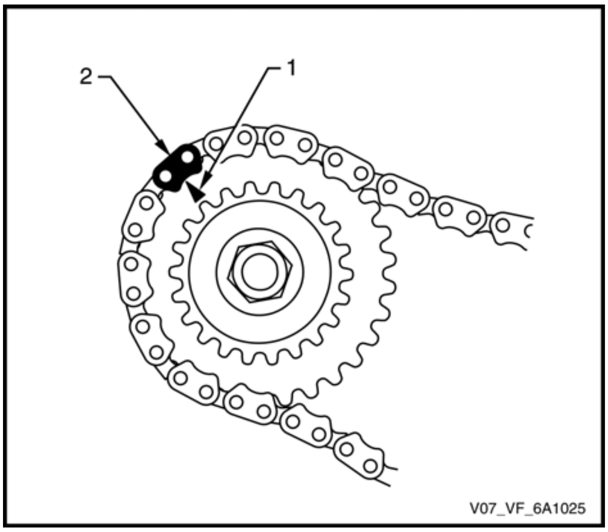


Figure 6A1 – 225

10 The crankshaft sprocket timing mark (1) will align with a bright plated timing chain link (2).

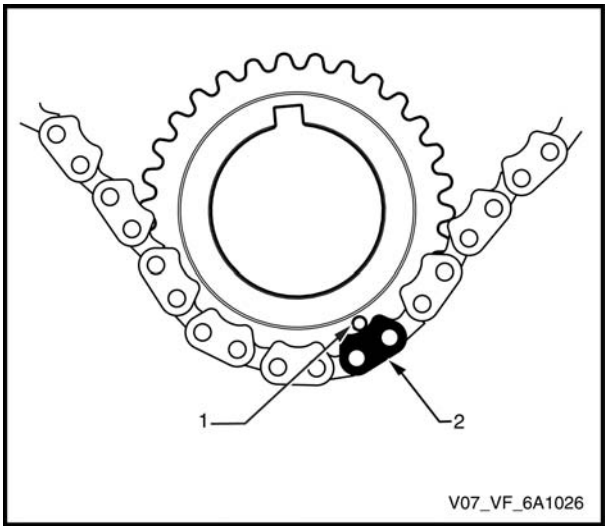


Figure 6A1 – 226

11 Ensure all the timing marks (1, 2 and 3) are properly aligned with the bright plated timing chain links (4, 5 and 6).

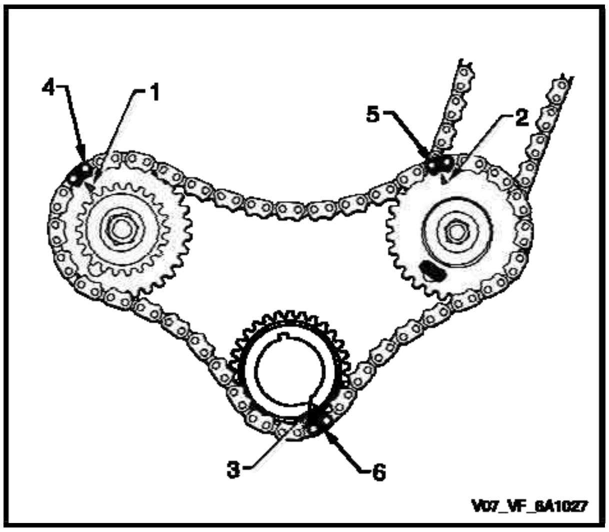


Figure 6A1 – 227

NOTE

Do not remove the primary timing chain lower guide (1). The primary timing chain lower guide is not serviced separately. If the primary timing chain lower guide must be replaced, the oil pump assembly (2) must be replaced.

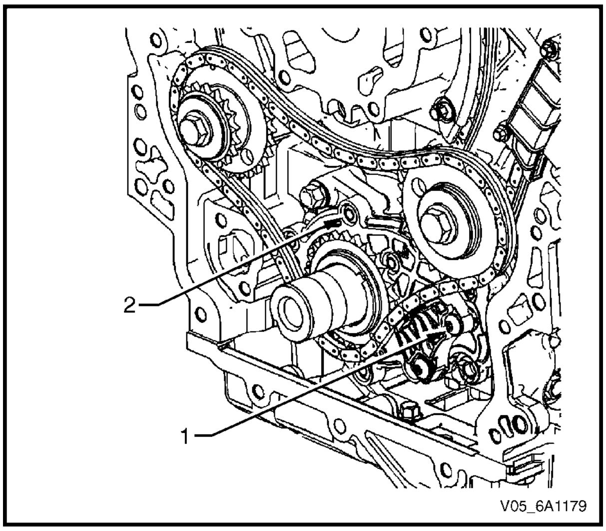


Figure 6A1 – 228

12 Ensure the primary timing chain upper guide is selected and orientated correctly.

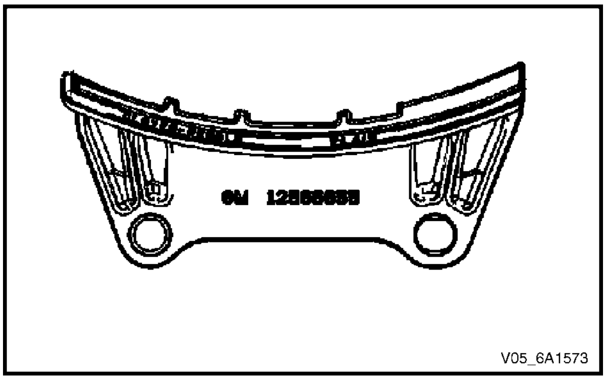


Figure 6A1 – 229

13 Install the primary timing chain upper guide (1).

14 Install the primary timing chain upper guide bolts (2) and tighten to the correct torque specification.

Primary timing chain upper guide attaching bolt torque specification	20.0 – 26.0 Nm

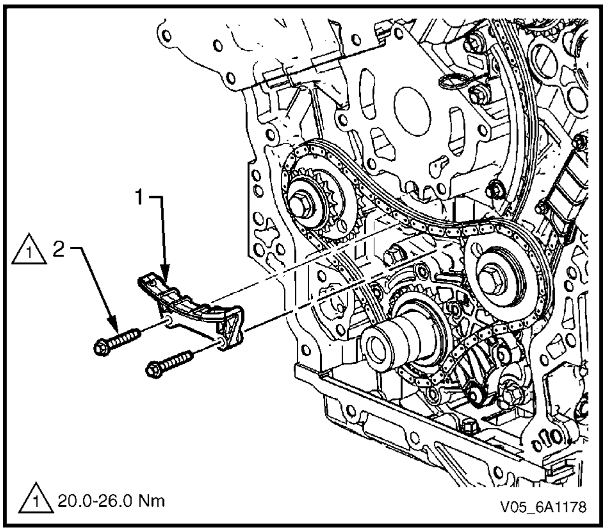


Figure 6A1 – 230

15 Ensure that the primary timing chain tensioner is being installed.

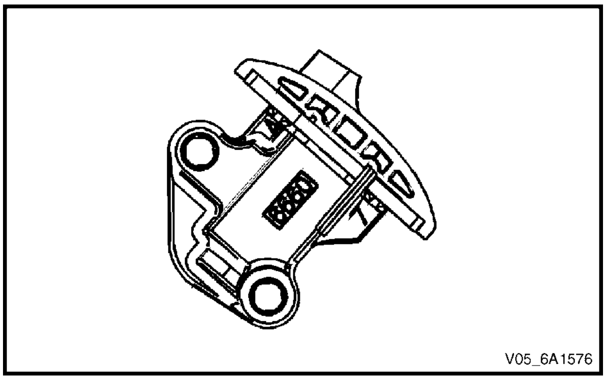


Figure 6A1 – 231

16 Reset the primary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 (4) to wind the plunger in a clockwise direction, into the tensioner shaft (2).

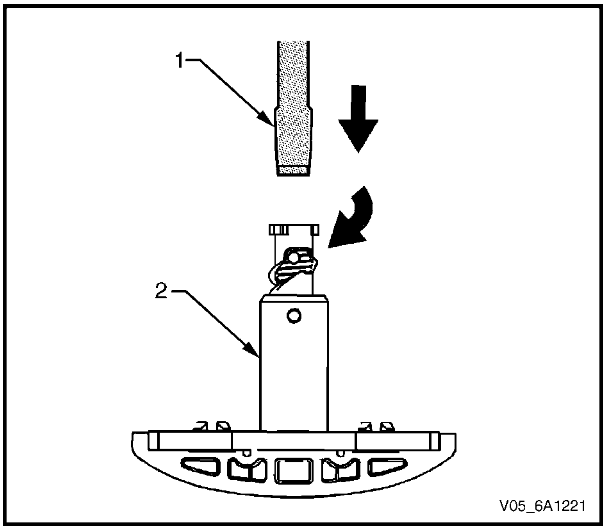


Figure 6A1 – 232

17 Install the tensioner shoe assembly (1) into the primary timing chain tensioner body (2).

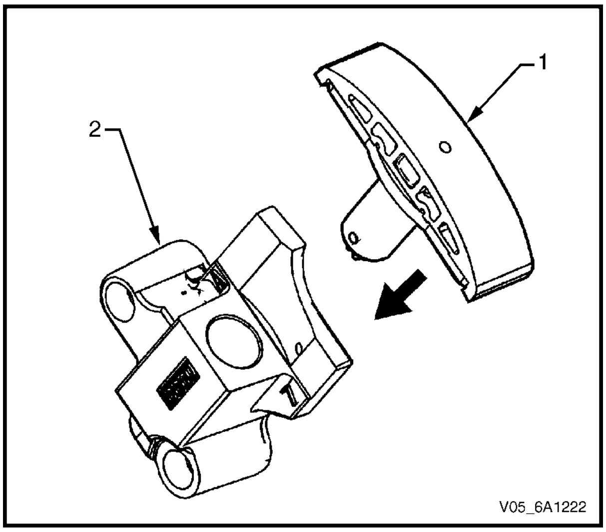


Figure 6A1 – 233

CAUTION

If Tool No. EN 46112 (1) is not inserted into the tensioner body, the plunger will remain in the locked position and no tension will be placed on the timing chain.

18 Compress the shoe assembly into the body (2) and lock the primary timing chain tensioner by inserting Tool No. EN 46112 into the access hole in the side of the body.

19 Slowly release pressure on the primary timing chain tensioner. The primary timing chain tensioner should remain compressed.

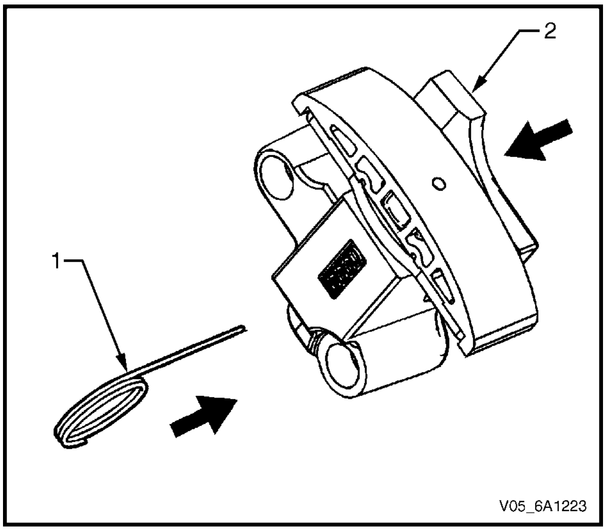


Figure 6A1 – 234

20 Install a new primary timing chain tensioner gasket (1) to the tensioner (2).

21 Install the primary timing chain tensioner bolts (3) through tensioner and gasket.

22 Ensure the primary timing chain tensioner mounting surface on the engine block does not have any burrs or defects that would affect the sealing of the new gasket.

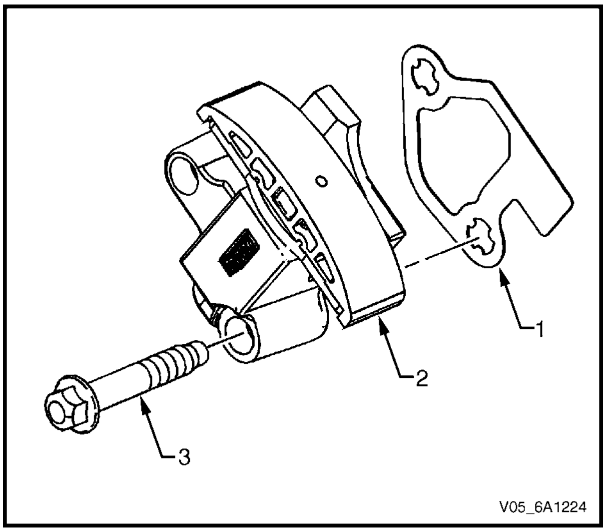


Figure 6A1 – 235

23 Place the primary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

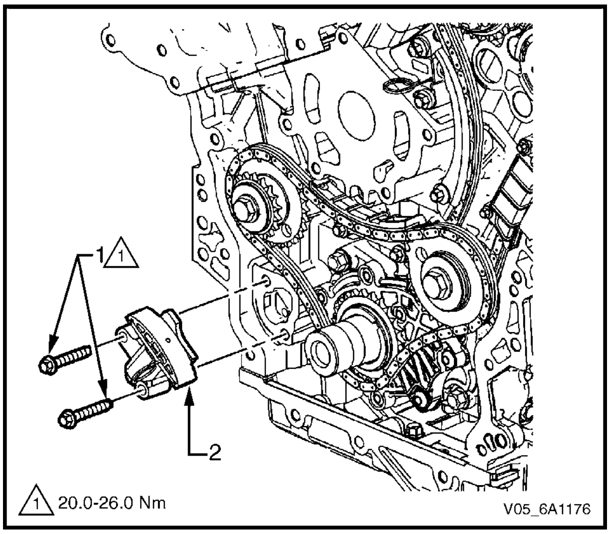
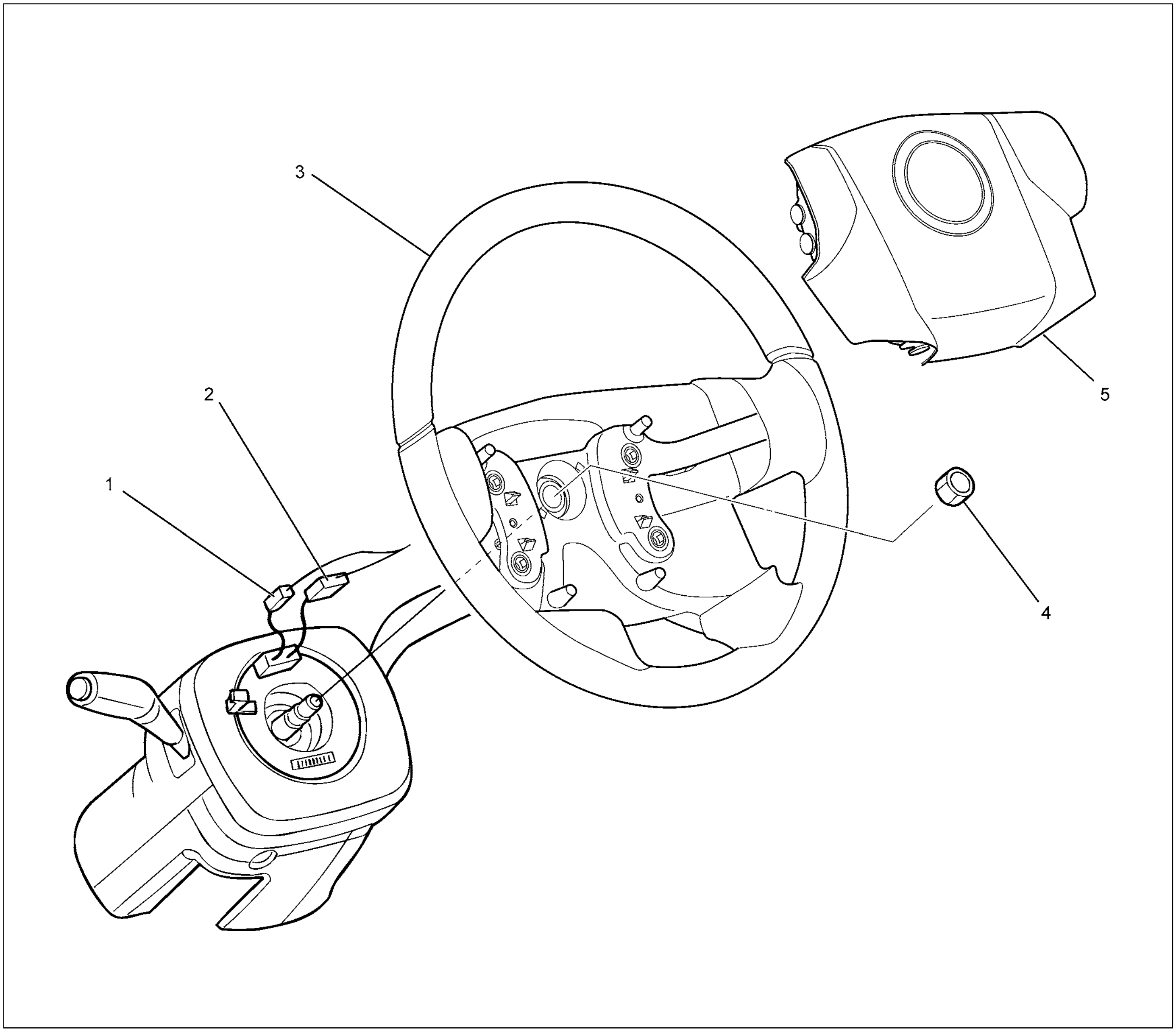


Figure 6A1 – 236

Steering Wheel

Steering Wheel and Associated Parts



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Legend

(1) Horn Lead
(2) SRS Connector
(3) Steering Wheel
(4) Steering Wheel Fixing Nut
(5) Inflator Module or Horn Pad

Removal

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to "LOCK".
3. Disconnect the battery "-" terminal cable, and wait at least 5 minutes (with SRS air bag).
4. Disconnect the yellow 2-way SRS connector located under the steering column (with SRS air bag).

CAUTION: The wheels of the vehicle must be straight ahead and the steering column in the "LOCK" position before disconnecting the steering wheel. Failure to do so will cause the coil assembly to lose its centering which will cause damage to the coil assembly (with SRS air bag).

5. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).

24 Verify the proper placement of the primary timing chain tensioner gasket tab (1).

25 Tighten the primary timing chain tensioner bolts (2) to the correct torque specification.

Primary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

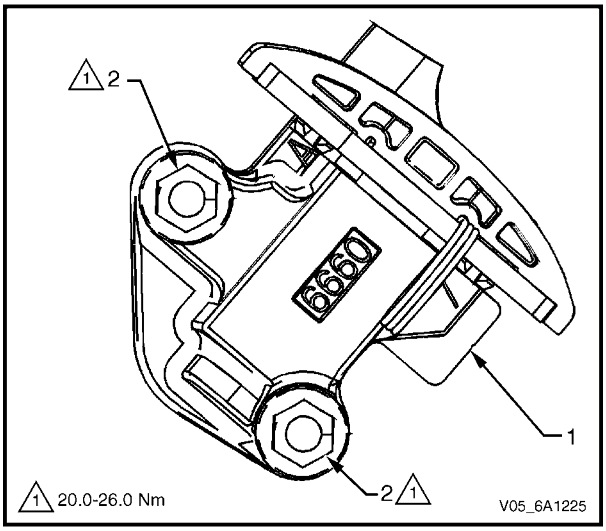


Figure 6A1 – 237

26 Release the primary timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner shaft.

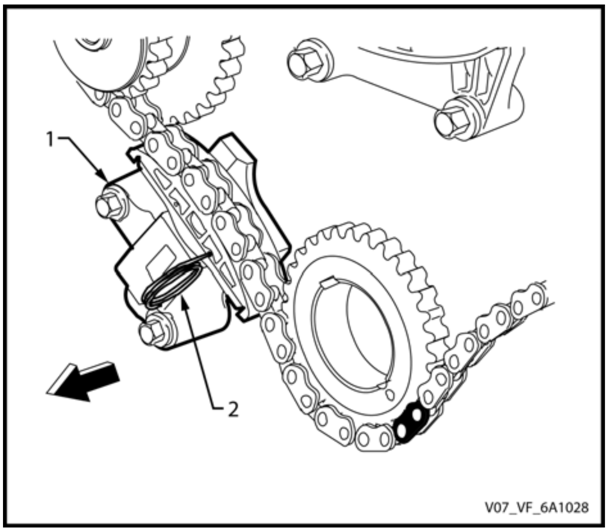


Figure 6A1 – 238

27 Verify the primary and left-hand secondary timing chain timing mark alignments (1 to 12).

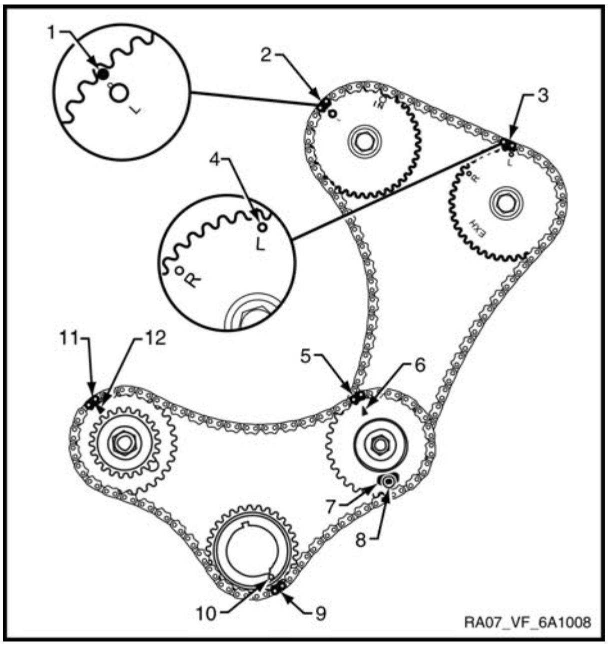


Figure 6A1 – 239

28 Remove Tool No. EN 46105–1 from the left-hand cylinder head camshafts.

Right-hand Secondary Timing Chain Components – Excluding MY06 Update

1 Install the primary timing chain components, refer to Primary Timing chain Components in this Section.

2 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

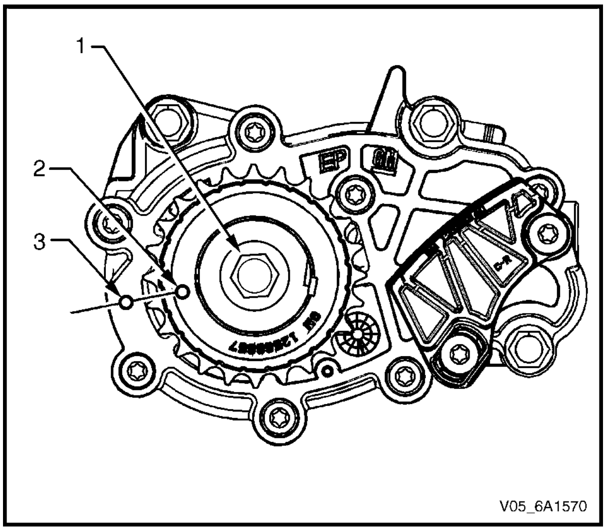


Figure 6A1 – 240

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts. There should be no need to rotate the camshaft more than 45 degrees.

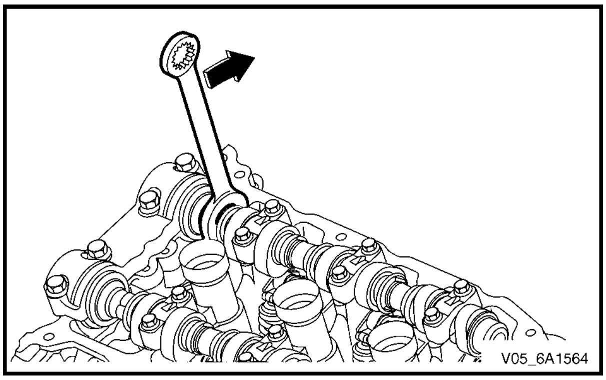


Figure 6A1 – 241

3 Install Tool No. EN 46105–1 (1) onto the rear of the right-hand cylinder head camshafts (2).

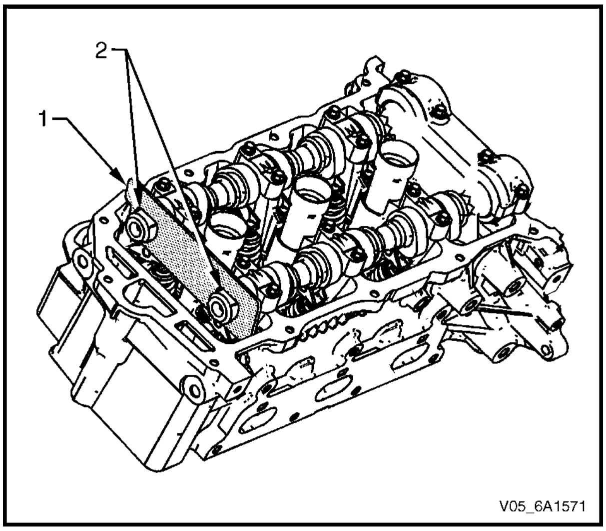


Figure 6A1 – 242

4 Install Tool No. EN 46105–2 (1) onto the rear of the left-hand cylinder head camshafts (2).

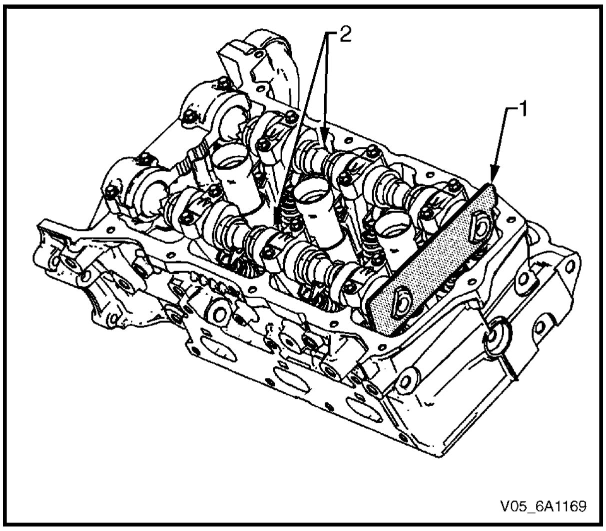


Figure 6A1 – 243

5 Install the right-hand secondary timing chain (1) onto the camshaft sprockets (2) and the right hand camshaft intermediate sprocket (3) aligning the chain in the following manner:

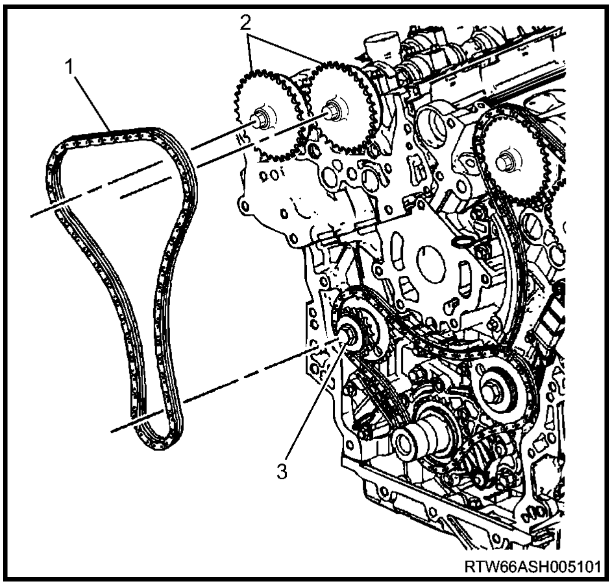


Figure 6A1 – 244

6 Place the secondary timing chain around the right-hand camshaft intermediate outer sprocket, aligning the bright plated timing chain link (1) with the alignment access hole (2) in the inner sprocket.

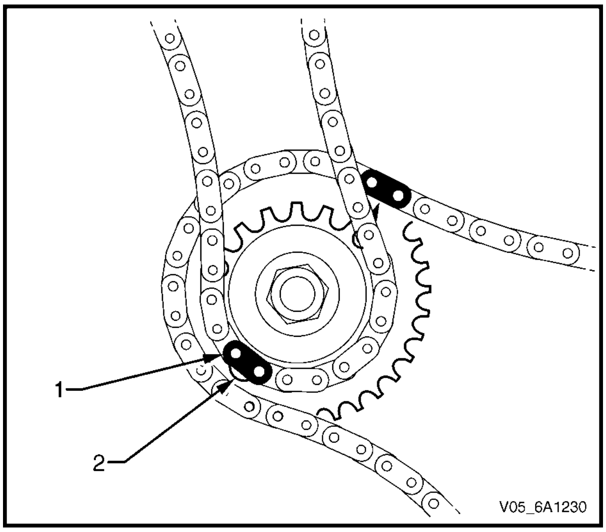


Figure 6A1 – 245

7 Wrap the secondary timing chain around both right-hand camshaft sprockets.

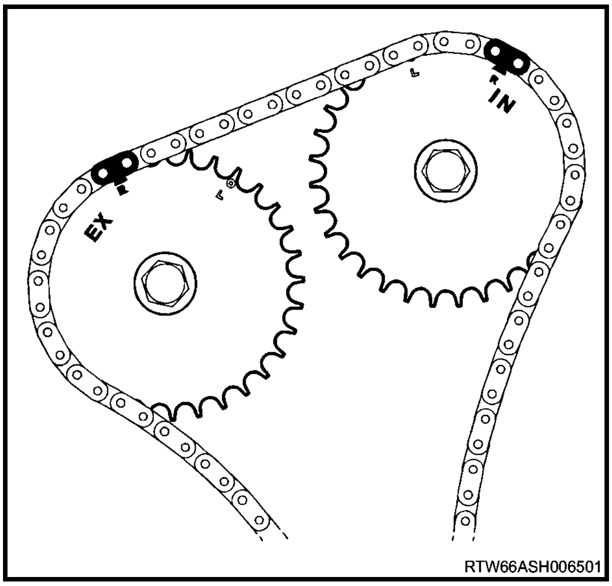


Figure 6A1 – 246

CAUTION

Ensure that when aligning the right-hand secondary timing chain to the right-hand camshaft sprockets, that the triangular timing marks (1) on the sprocket are used, NOT the circular mark.

8 Align the bright plated timing chain link (2) with the exhaust sprocket alignment triangle mark or circular mark.

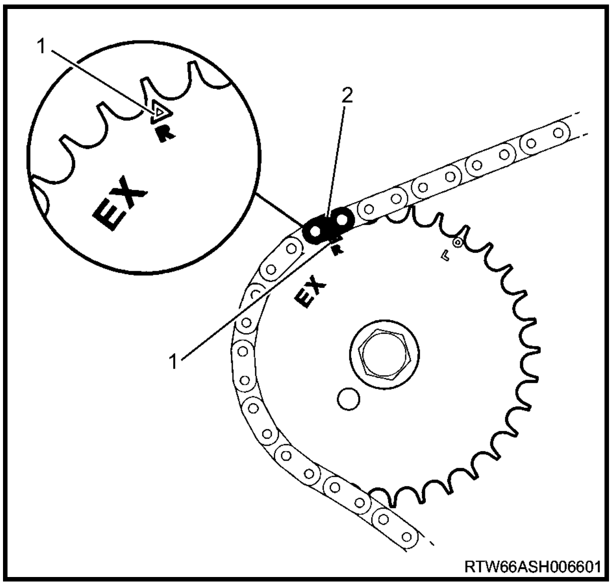


Figure 6A1 – 247

9 Align the bright plated timing chain link (1) with the intake sprocket alignment triangle mark (2).

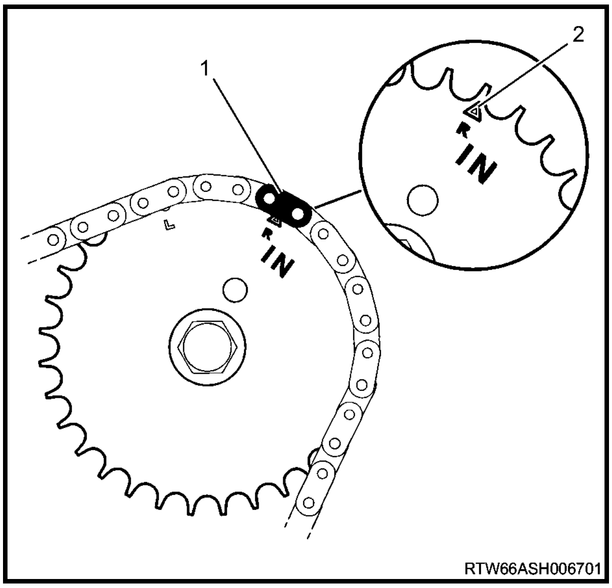


Figure 6A1 – 248

CAUTION

Ensure that the right-hand secondary timing chain guide is used when installing to the right-hand side in this procedure.

10 Ensure that the right-hand secondary timing chain guide is selected and orientated correctly.

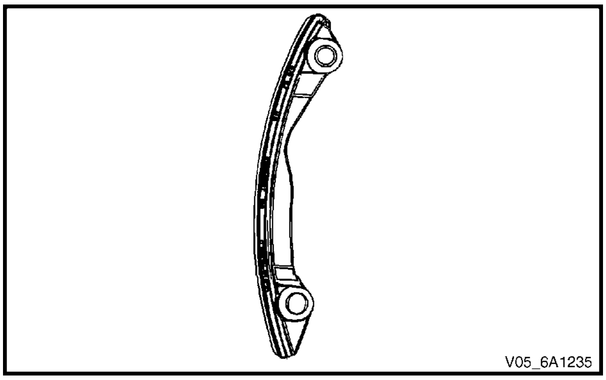


Figure 6A1 – 249

11 Position the chain guide (2).

12 Install the secondary timing chain guide bolts (1) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification...........20.0 – 26.0 Nm

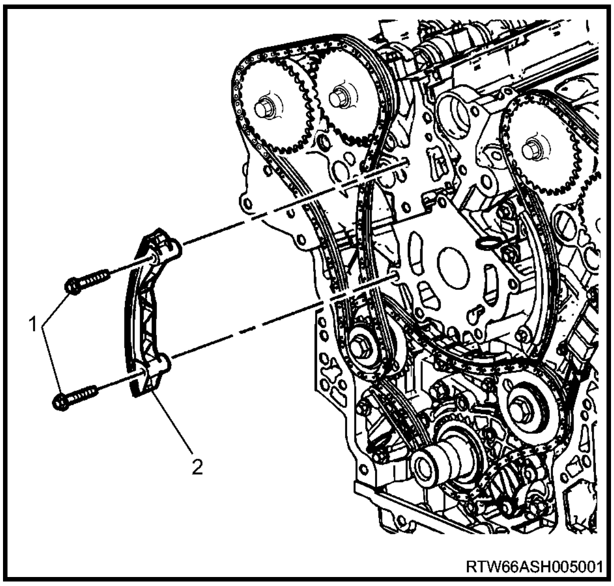


Figure 6A1 – 250

CAUTION

The right-hand secondary camshaft drive shoe is marked with the letters 'RH'. Ensure that the right-hand drive shoe is used when installing to the right-hand side in this procedure and that the letters 'RH" are facing the front of the vehicle when installed.

13 Ensure the right-hand secondary timing chain shoe is selected and orientated correctly.

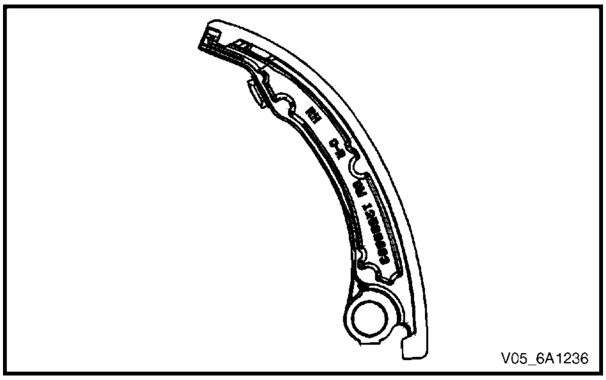


Figure 6A1 – 251

14 Position the right-hand secondary timing chain shoe (1).

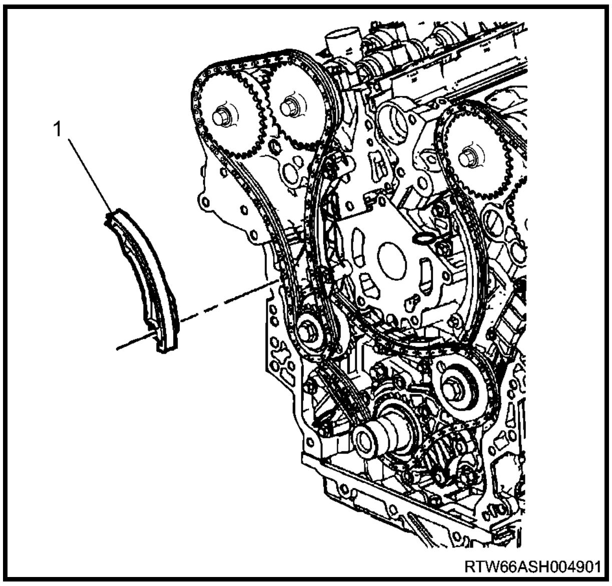


Figure 6A1 – 252

15 Install the secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

Secondary timing chain shoe attaching bolt torque specification...........20.0 – 26.0 Nm

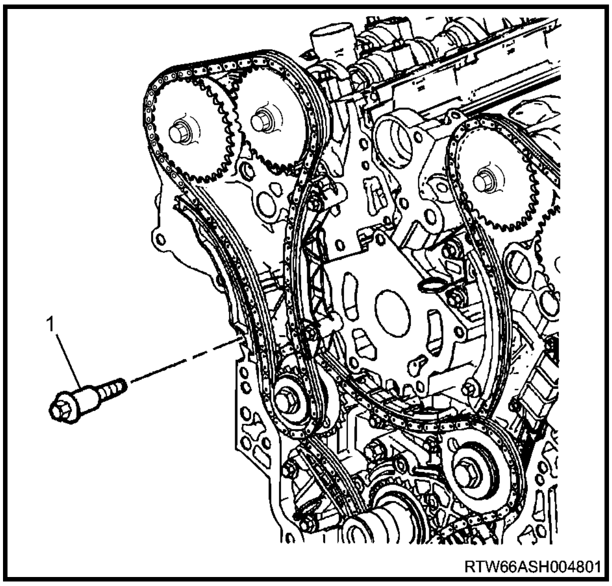


Figure 6A1 – 253

16 Ensure the right-hand secondary timing chain tensioner is selected and orientated correctly.

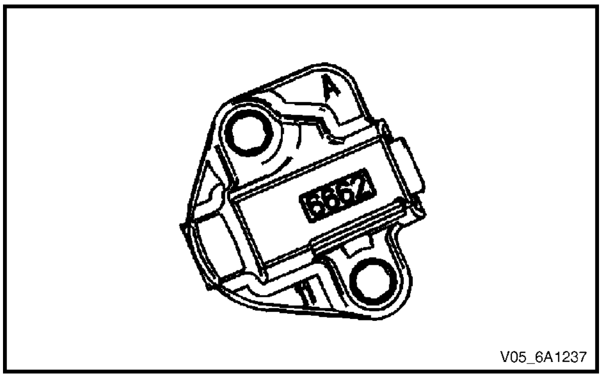


Figure 6A1 – 254

17 Reset the right-hand secondary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 to wind the plunger in a clockwise direction, into the tensioner shaft (2).

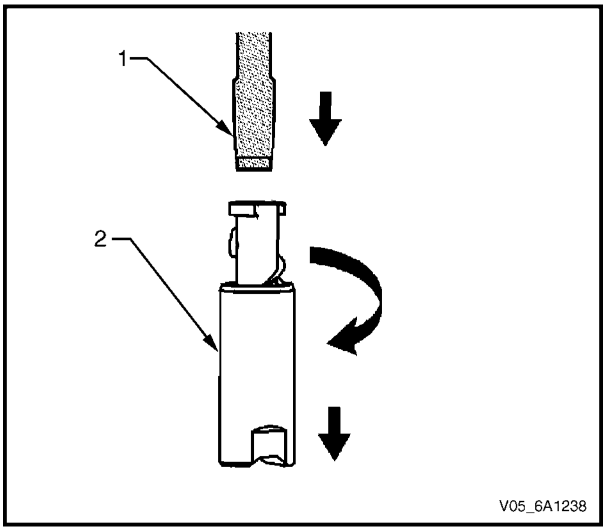


Figure 6A1 – 255

18 Install the tensioner shaft (1) into the right-hand secondary timing chain tensioner body (2).

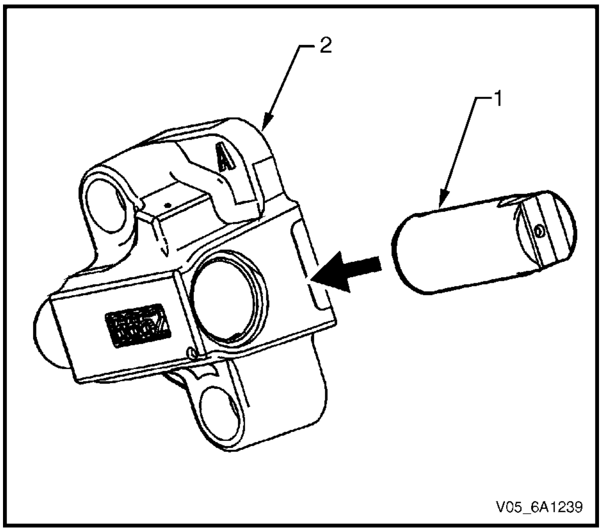


Figure 6A1 – 256

19 Compress the tensioner shaft into the body and lock the tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

20 Slowly release pressure on the right-hand secondary timing chain tensioner. The tensioner should remain compressed.

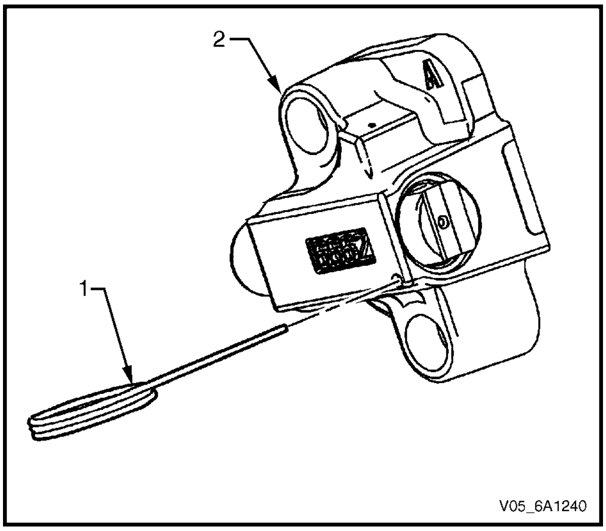


Figure 6A1 – 257

21 Install a new right-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

22 Install the right-hand secondary timing chain tensioner bolts (3) through the tensioner and gasket.

23 Ensure the right-hand secondary timing chain tensioner mounting surface on the right-hand cylinder head does not have any burrs or defects that would affect the sealing of the new tensioner gasket.

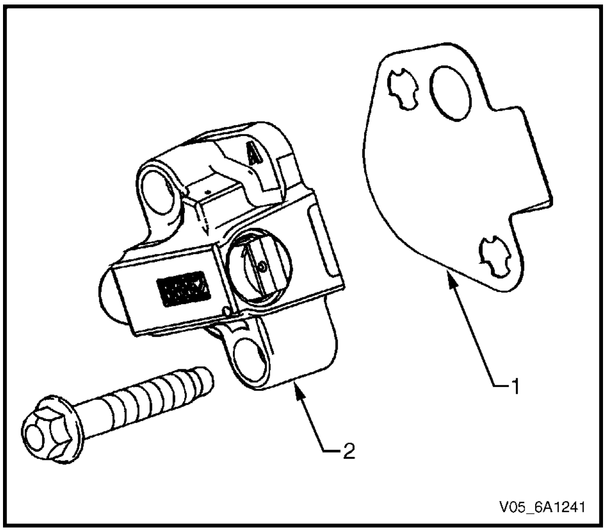


Figure 6A1 – 258

24 Place the right-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

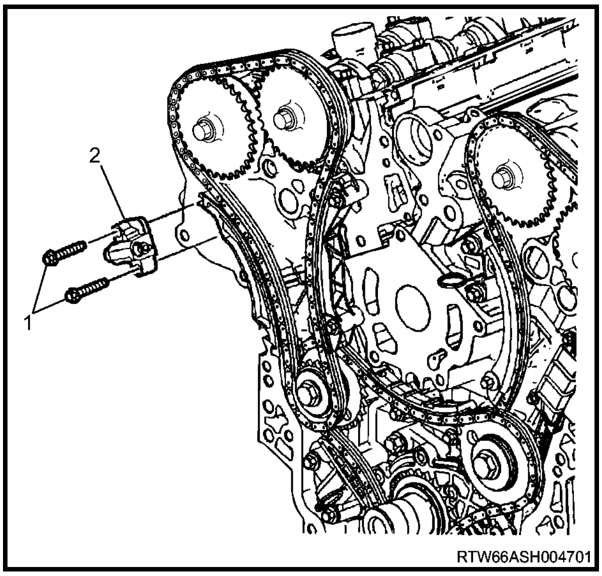


Figure 6A1 – 259

25 Verify the proper placement of the right-hand secondary timing chain tensioner gasket tab (1).

26 Tighten the right-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

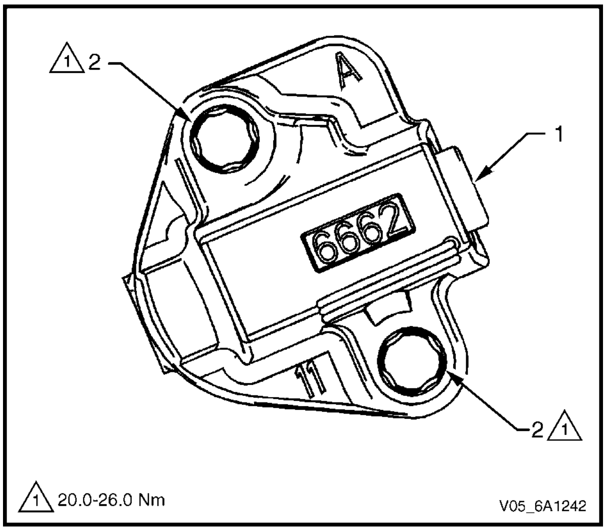


Figure 6A1 – 260

27 Release the right-hand timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner plunger.

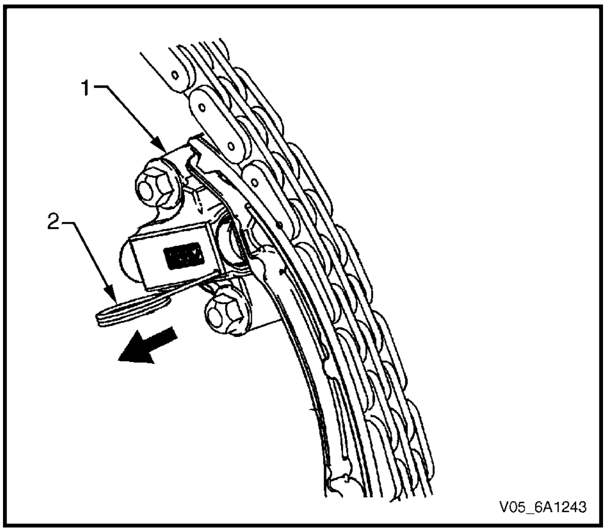


Figure 6A1 – 261

28 Verify all primary and secondary timing chain timing mark alignments (1 to 18).

29 Remove Tool No. EN 46105 and EN 46105-2 from the left and right-hand cylinder head camshafts.

30 Reinstall the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.

31 Reinstall the engine front cover assembly, refer to 3.15 Front Cover Assembly.

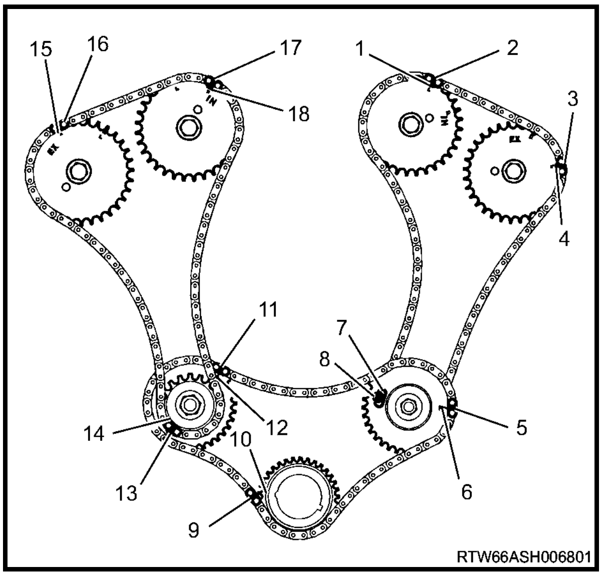


Figure 6A1 – 262

Right-hand Secondary Timing Chain Components – MY06 Update

1 Install the primary timing chain components, refer to Primary Timing chain Components in this Section.

2 Using Tool No. EN46111 (1), rotate the crankshaft in a clockwise direction until the crankshaft sprocket timing mark (2) is aligned with the indexing mark (3) on the oil pump housing.

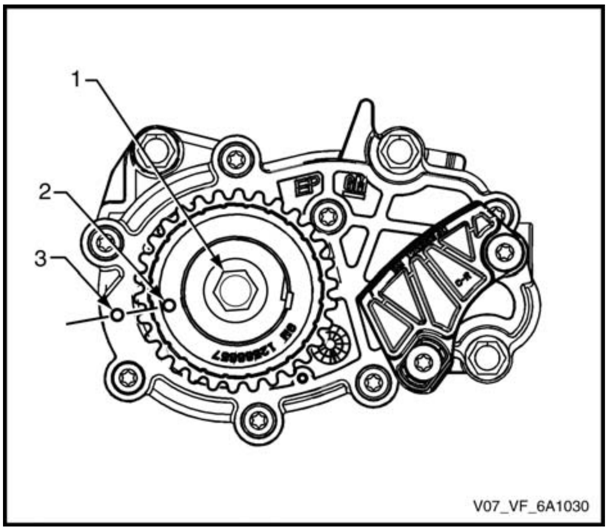


Figure 6A1 – 263

CAUTION

In order to install Tool No. EN 46105 onto the camshafts, rotate the camshafts. There should be no need to rotate the camshaft more than 45 degrees.

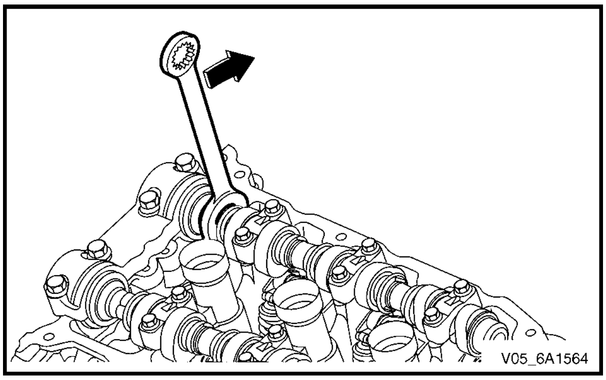


Figure 6A1 – 264

3 Install Tool No. EN 46105–1 (1) onto the rear of the right-hand cylinder head camshafts (2).

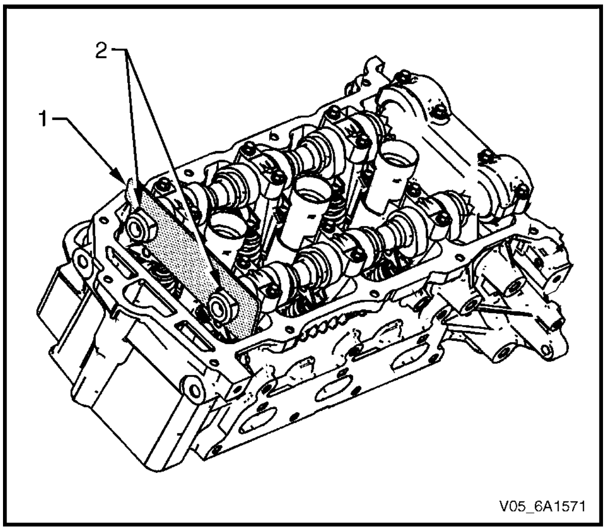
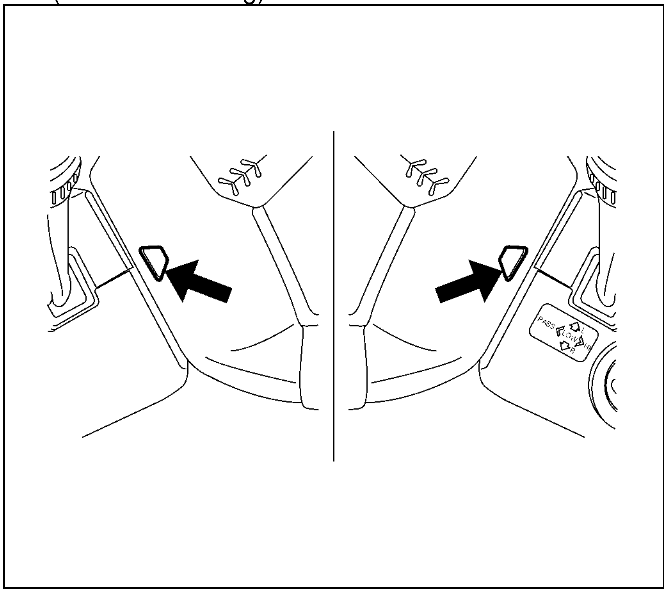


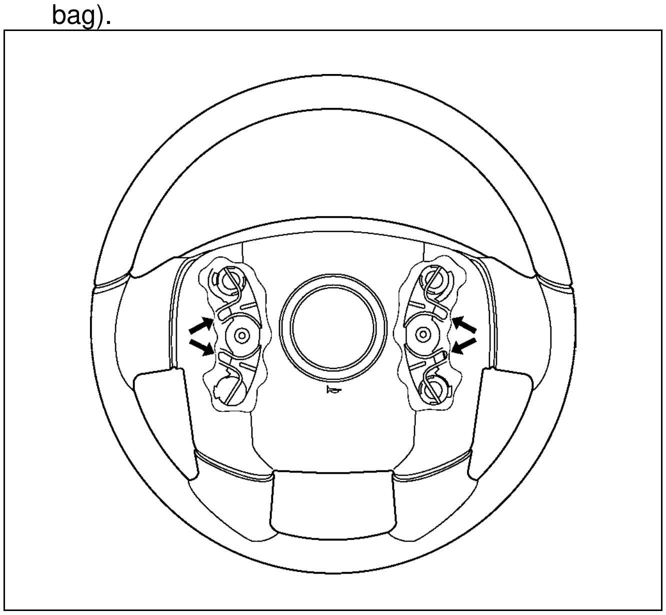
Figure 6A1 – 265

6. Check the holes on both sides of the steering cover (with SRS air bag).



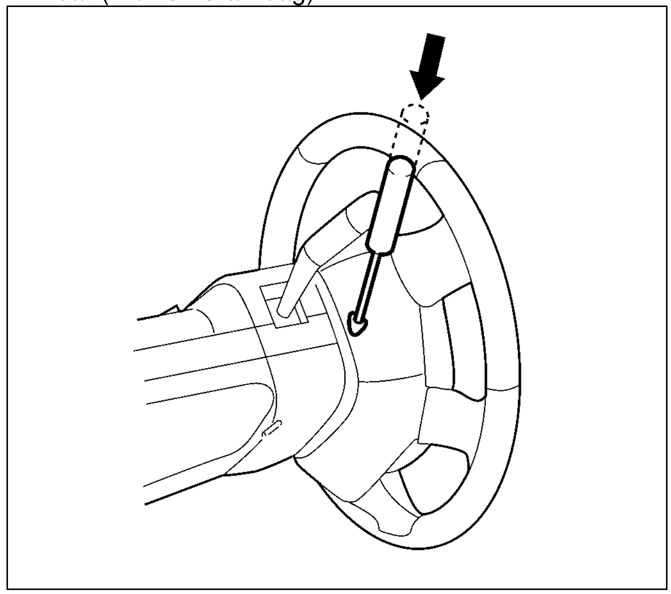
060R300025

7. Check the position of the pins in their holes. Push the pin in the direction of the arrow (with SRS air bag).



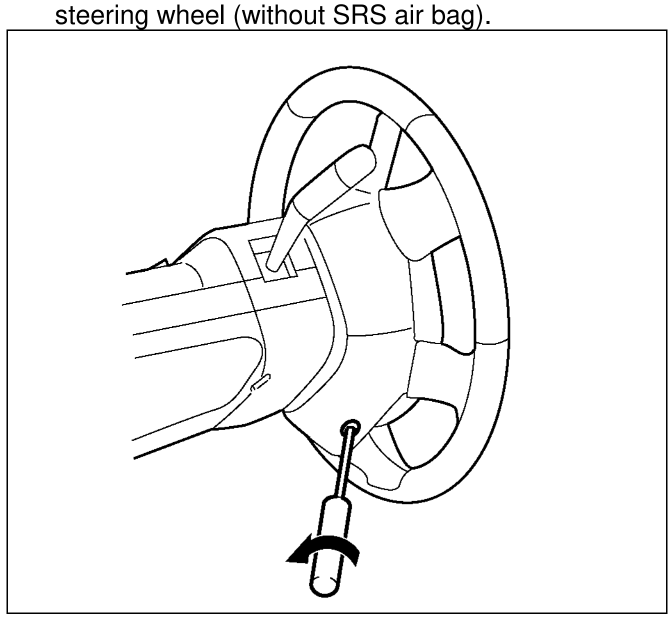
RTW73BSH000101

8. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



060R300031

9. Cancel the lock to release the four pins (with SRS air bag).
10. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



430R300009

4 Install Tool No. EN 46105–2 (1) onto the rear of the left-hand cylinder head camshafts (2).

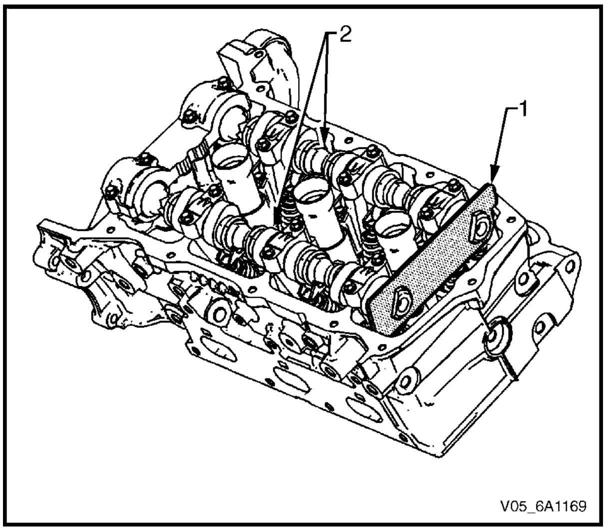


Figure 6A1 – 266

5 Install the right-hand secondary timing chain (1) onto the camshaft sprockets (2) and the right hand camshaft intermediate sprocket (3) aligning the chain in the following manner:

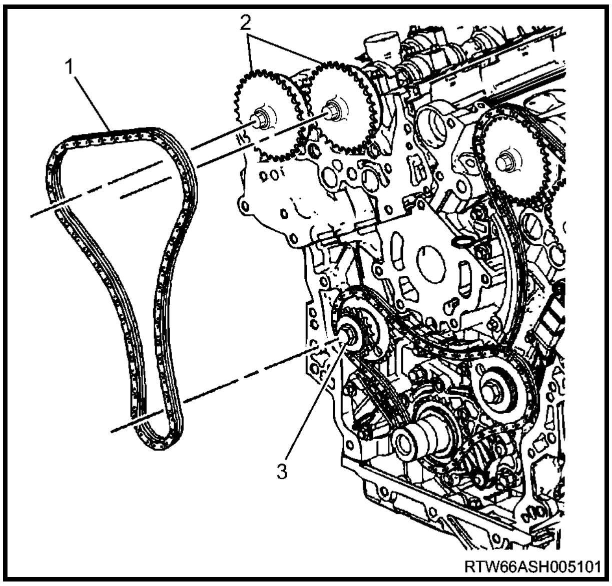


Figure 6A1 – 267

6 Place the secondary timing chain around the right-hand camshaft intermediate outer sprocket, aligning the bright plated timing chain link (1) with the alignment access hole (2) in the inner sprocket.

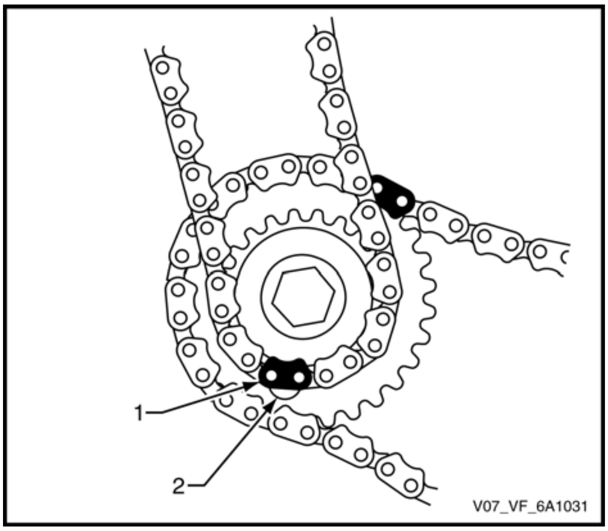


Figure 6A1 – 268

7 Wrap the secondary timing chain around both right-hand camshaft drive sprockets.

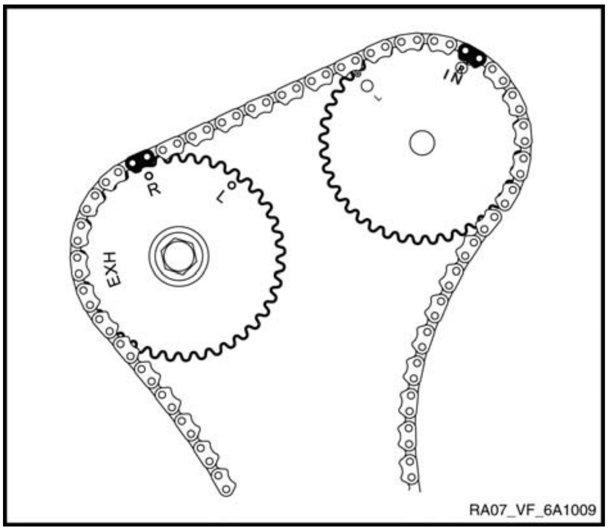


Figure 6A1 – 269

CAUTION

Ensure that when aligning the right-hand secondary timing chain to the right-hand camshaft sprockets, that the triangular timing marks (1) on the sprocket are used, NOT the circular mark.

8 Align the bright plated timing chain link (2) with the exhaust sprocket alignment triangle mark or circular mark.

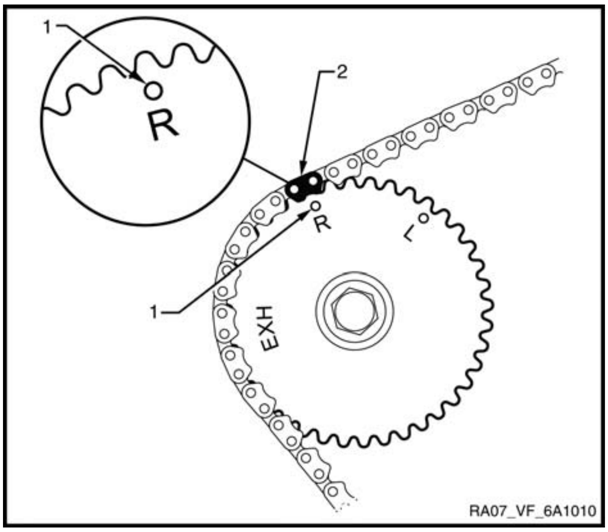


Figure 6A1 – 270

9 Align the bright plated timing chain link (1) with the intake sprocket alignment triangle mark (2).

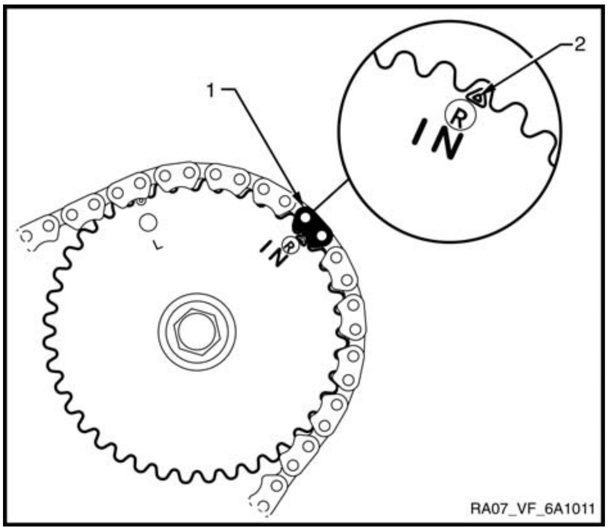


Figure 6A1 – 271

CAUTION

Ensure that the right-hand secondary timing chain guide is used when installing to the right-hand side in this procedure.

10 Ensure that the right-hand secondary timing chain guide is selected and orientated correctly.

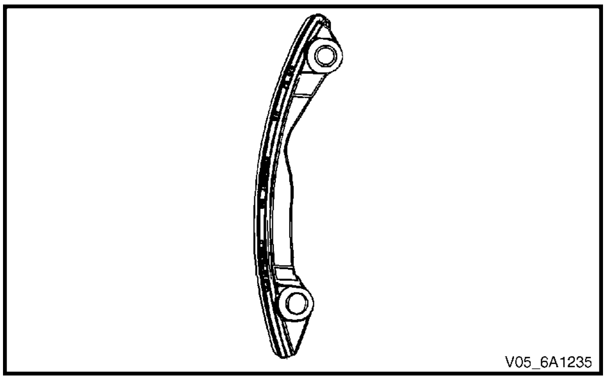


Figure 6A1 – 272

11 Position the chain guide (2).

12 Install the secondary timing chain guide bolts (1) and tighten to the correct torque specification.

Secondary timing chain guide attaching bolt torque specification	20.0 – 26.0 Nm

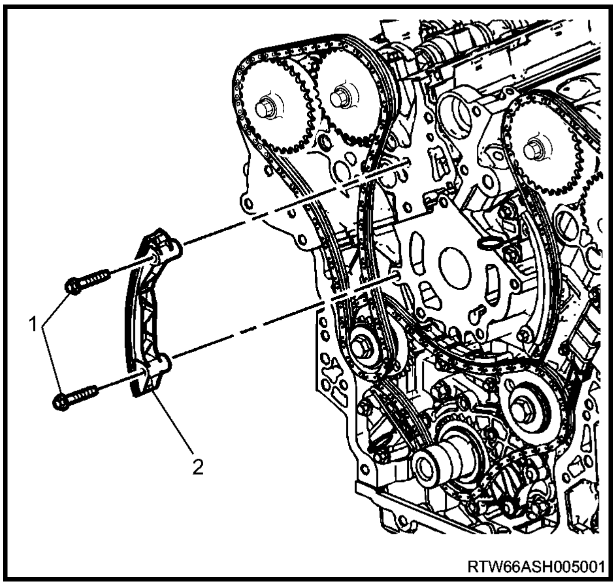


Figure 6A1 – 273

13 Ensure the right-hand secondary timing chain shoe is selected and orientated correctly.

CAUTION

The right-hand secondary camshaft drive shoe is marked with the letters 'RH'. Ensure that the right-hand drive shoe is used when installing to the right-hand side in this procedure and that the letters 'RH" are facing the front of the vehicle when installed.

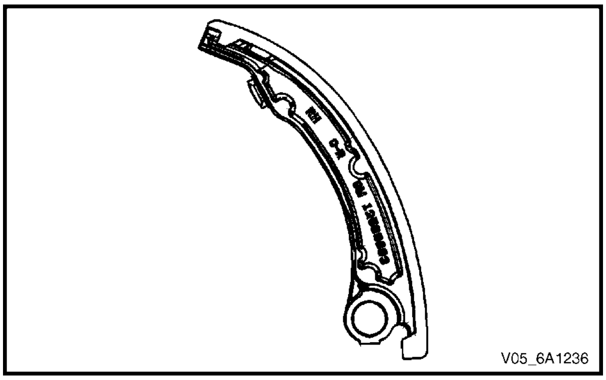


Figure 6A1 – 274

14 Position the right-hand secondary timing chain shoe (1).

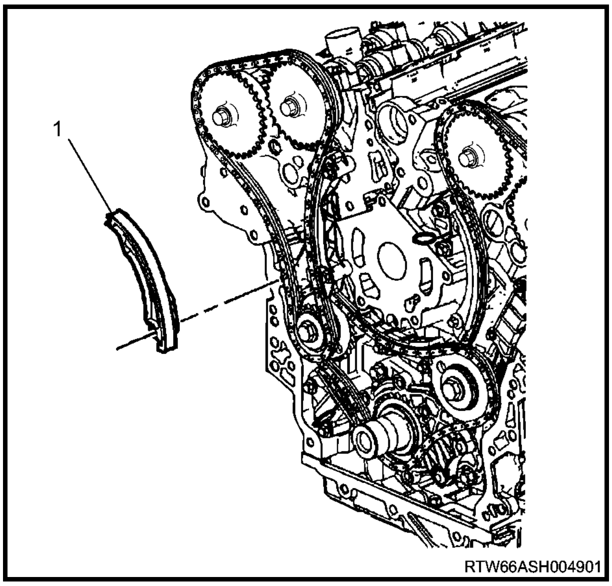


Figure 6A1 – 275

15 Install the secondary timing chain shoe bolt (1) and tighten to the correct torque specification.

Secondary timing chain shoe attaching bolt torque specification...........20.0 – 26.0 Nm

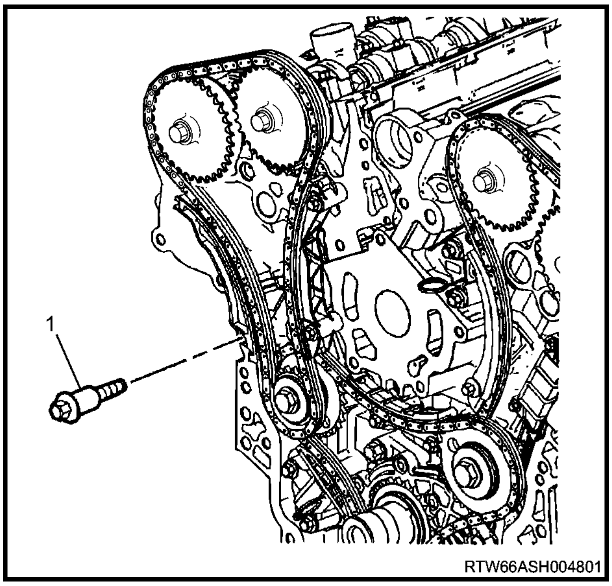


Figure 6A1 – 276

16 Ensure the right-hand secondary timing chain tensioner is selected and orientated correctly.

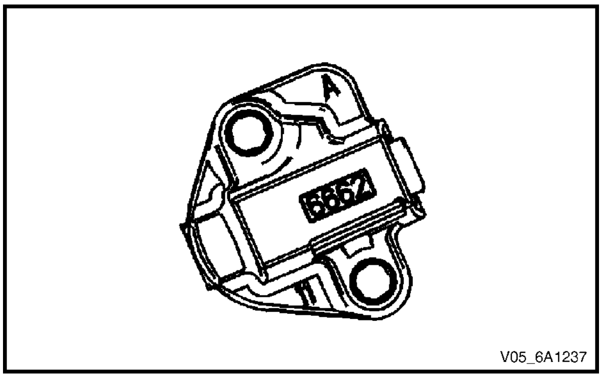


Figure 6A1 – 277

17 Reset the right-hand secondary timing chain tensioner.

NOTE

To reset the tensioner, use a suitably sized flat blade screwdriver (1) or Tool No. J 45027 to wind the plunger in a clockwise direction, into the tensioner shaft (2).

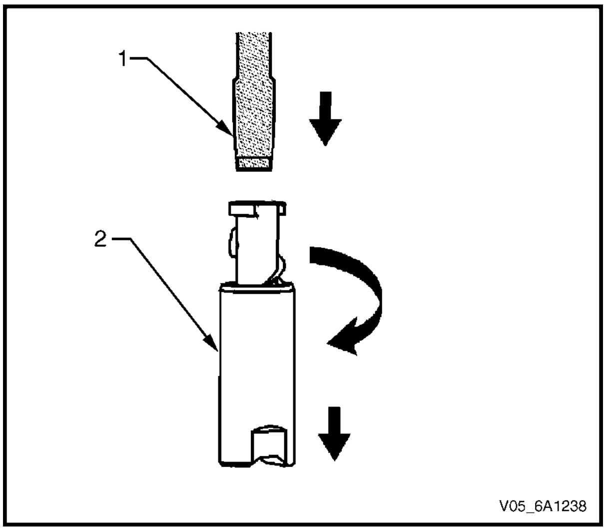


Figure 6A1 – 278

18 Install the tensioner shaft (1) into the right-hand secondary timing chain tensioner body (2).

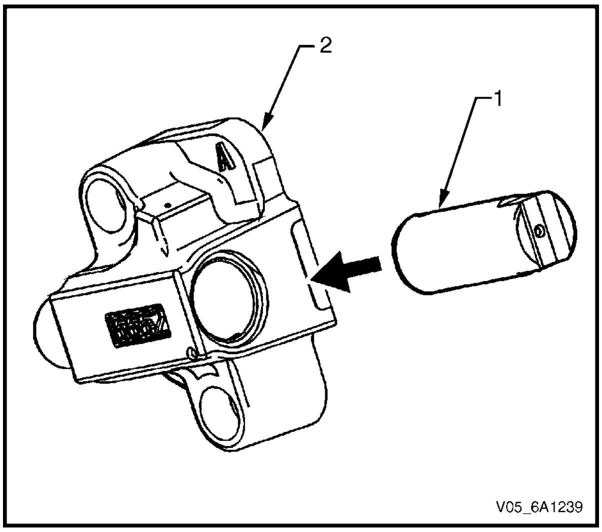


Figure 6A1 – 279

19 Compress the tensioner shaft into the body and lock the tensioner by inserting Tool No. EN 46112 into the access hole in the side of the tensioner body.

20 Slowly release pressure on the right-hand secondary timing chain tensioner. The tensioner should remain compressed.

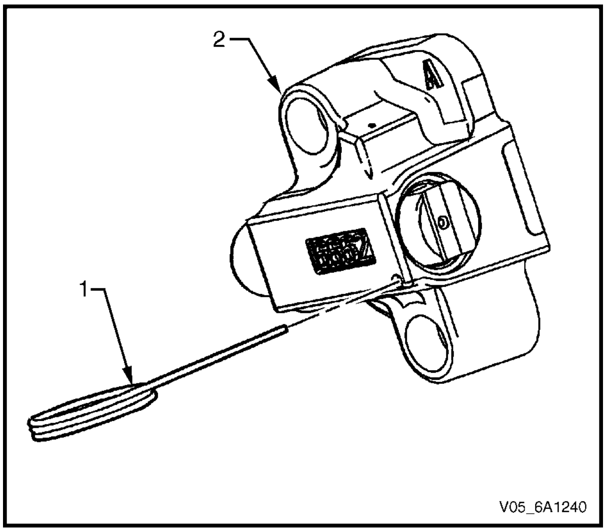


Figure 6A1 – 280

21 Install a new right-hand secondary timing chain tensioner gasket (1) to the tensioner (2).

22 Install the right-hand secondary timing chain tensioner bolts (3) through the tensioner and gasket.

23 Ensure the right-hand secondary timing chain tensioner mounting surface on the right-hand cylinder head does not have any burrs or defects that would affect the sealing of the new tensioner gasket.

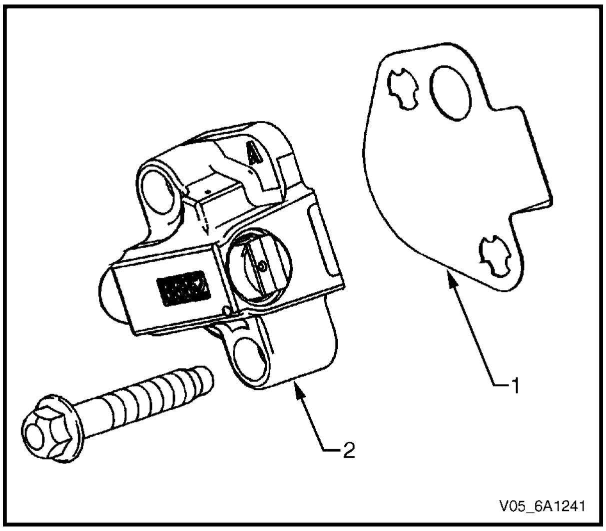


Figure 6A1 – 281

24 Place the right-hand secondary timing chain tensioner (2) into position and loosely install the bolts (1) to the engine block.

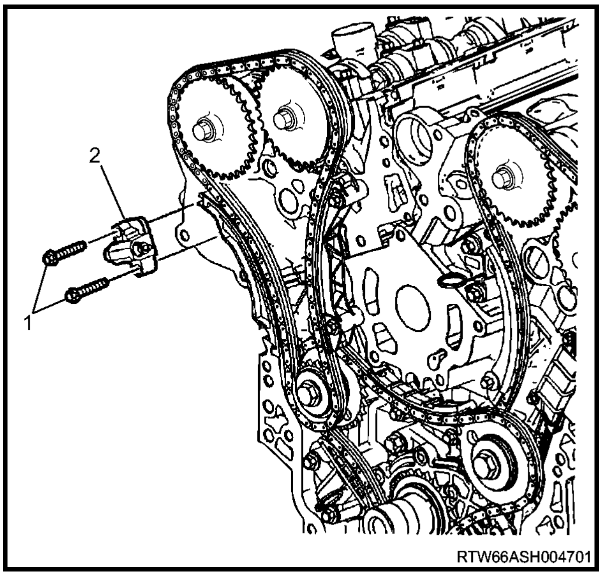


Figure 6A1 – 282

25 Verify the proper placement of the right-hand secondary timing chain tensioner gasket tab (1).

26 Tighten the right-hand secondary timing chain tensioner bolts (2) to the correct torque specification.

Secondary timing chain tensioner attaching bolt torque specification...........20.0 – 26.0 Nm

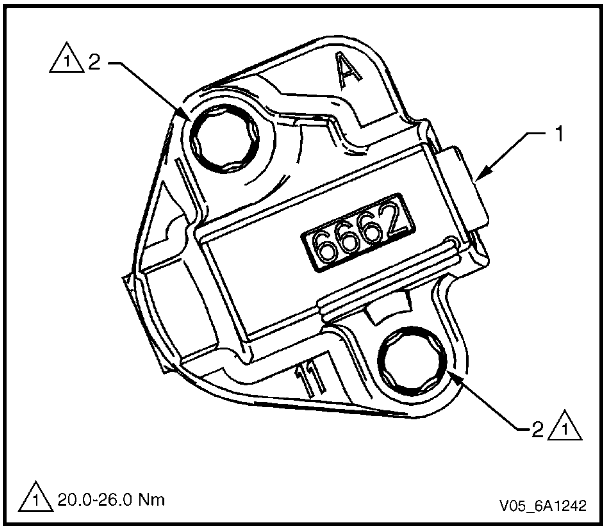


Figure 6A1 – 283

27 Release the right-hand timing chain tensioner (1) by pulling out Tool No. EN 46112 (2) and unlocking the tensioner plunger.

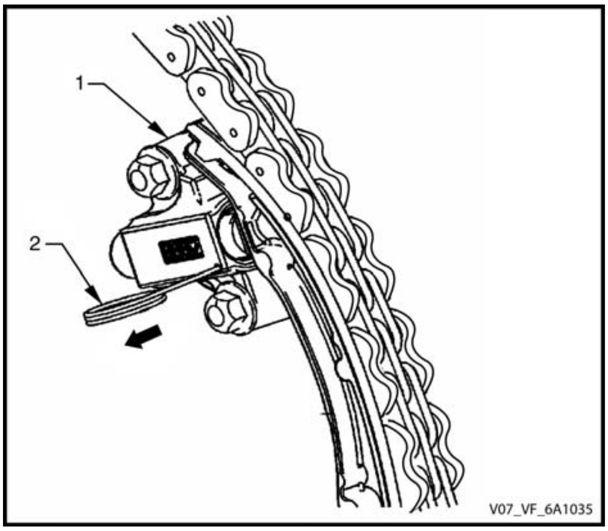


Figure 6A1 – 284

28 Verify all primary and secondary timing chain timing mark alignments (1 to 18).

29 Remove Tool No. EN 46105–1 and EN 46105-2 from the left and right-hand cylinder head camshafts.

30 Reinstall the spark plugs. Refer to Section 6C1-3 Engine Management – V6 – Service Operations.

31 Reinstall the engine front cover assembly, refer to 3.15 Front Cover Assembly.

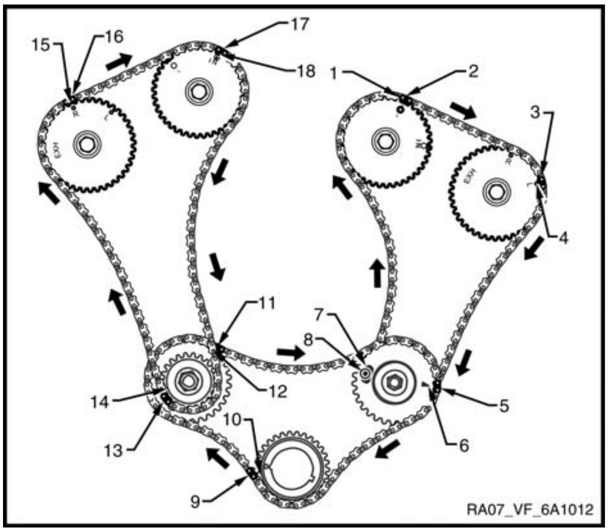


Figure 6A1 – 285

3.17 Oil Pump Assembly

Remove

NOTE

Do not remove the left-hand bank idler sprocket.

1 Remove the primary timing chain and crankshaft sprocket, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

2 Remove the three bolts (1) attaching the oil pump (2).

3 Remove the oil pump assembly.

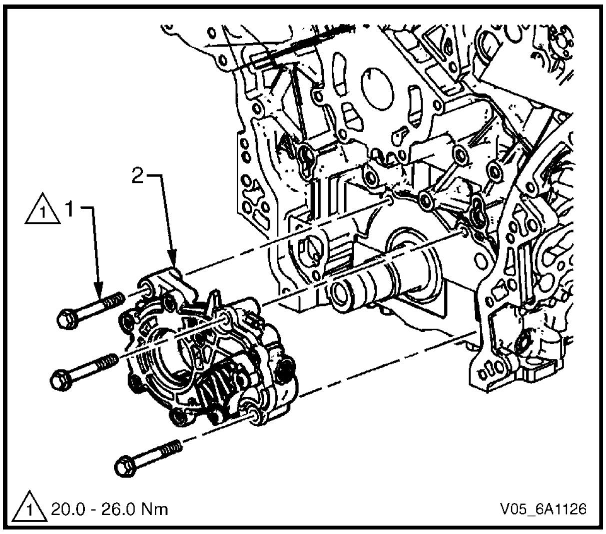


Figure 6A1 – 286

Disassemble

CAUTION

There are no serviceable components within the oil pump. Disassemble the pump only to diagnose an oil related concern. A disassembled oil pump must not be reused: it must be replaced.

1 Remove the two bolts (1) attaching the primary timing chain lower guide (2) and remove the guide.

CAUTION

The primary timing chain lower guide is not serviced separately and is part of the oil pump assembly. If it is removed from the pump assembly, the guide and the pump must be replaced.

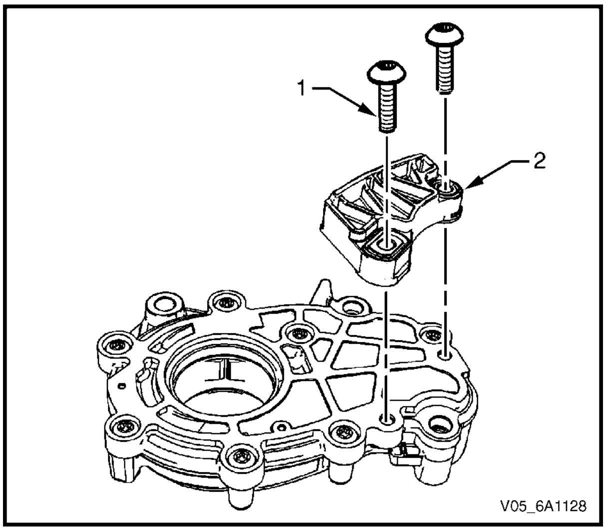


Figure 6A1 – 287

2 Remove the seven bolts (2) attaching the oil pump cover to the oil pump housing (1) and remove the cover from the housing.

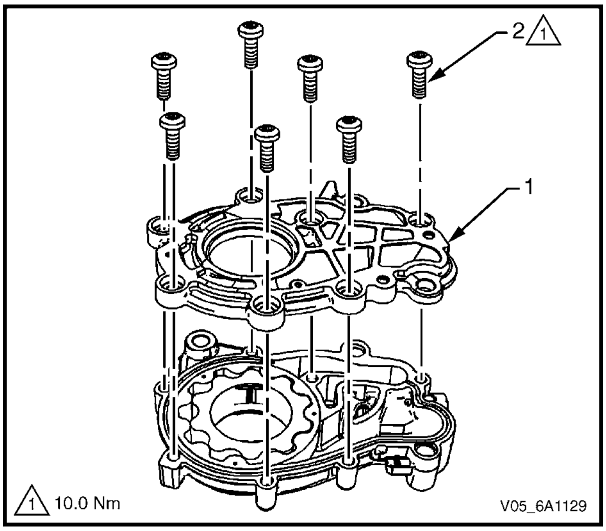


Figure 6A1 – 288

3 Remove the inner gerotor ring (1).

4 Remove the outer gerotor ring (2).

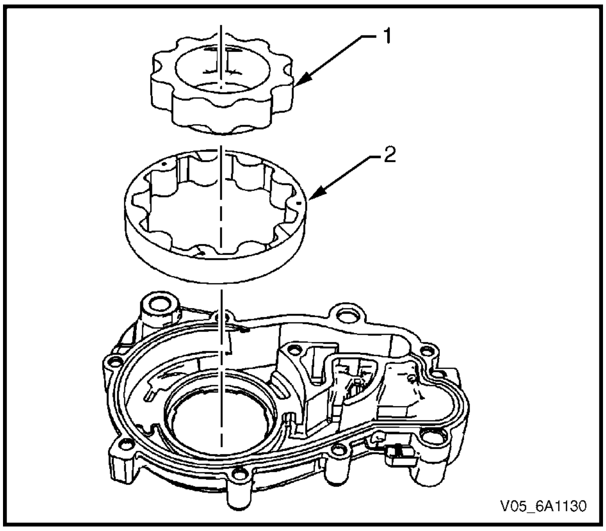


Figure 6A1 – 289

5 Remove the clip (1), retaining the oil relief valve cap (2).

6 Remove the cap, spring (3) and plunger (4) from the oil pump housing.

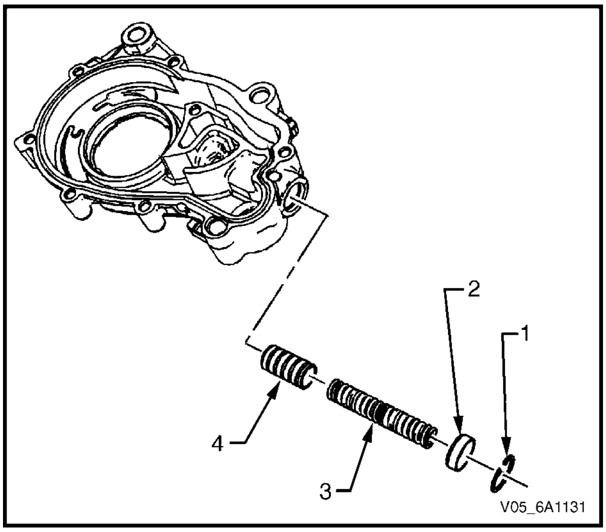


Figure 6A1 – 290

Clean

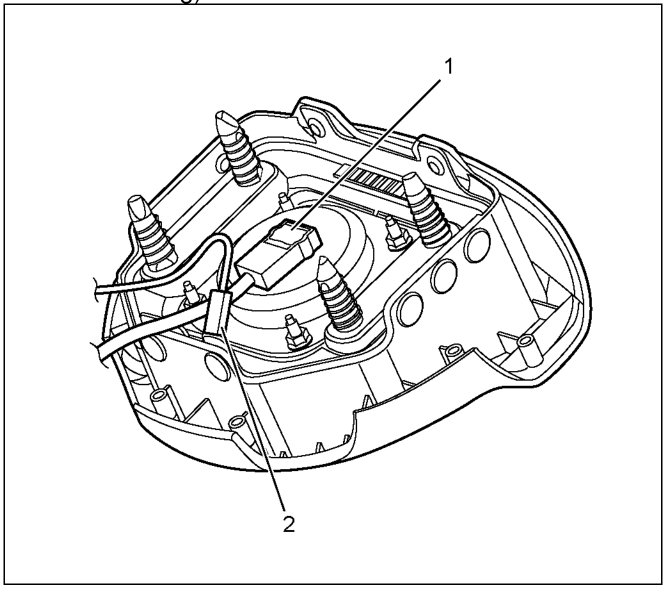
1 Clean the oil pump components with non-corrosive solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the oil pump components with compressed air.

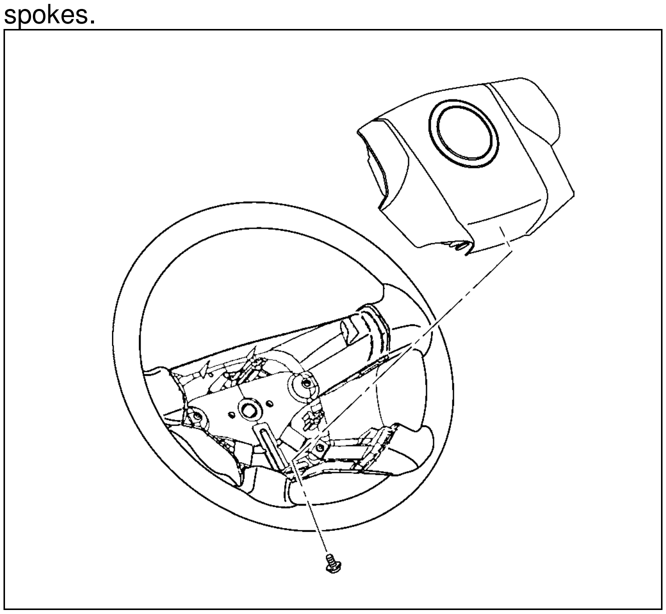
11. Disconnect the SRS air bag connector (1) and horn lead connector (2) located behind the air bag assembly and remove the air bag assembly (with SRS air bag).



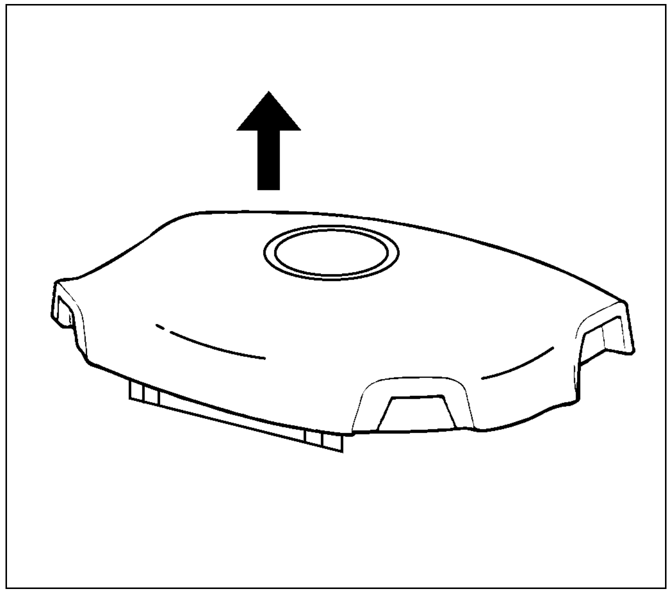
RTW73BSH001101

12. Remove the horn pad and the horn leads at the center of the wheel (without SRS air bag).

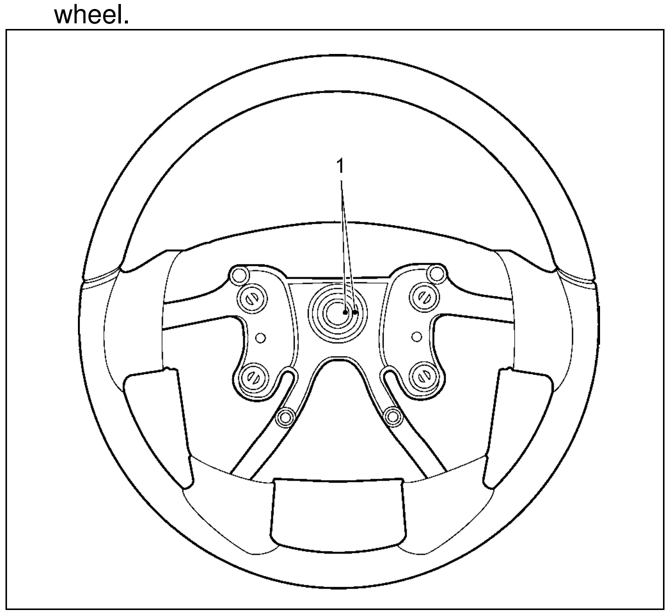
NOTE: It should be removed first from the bottom spokes.


RTW73BSH000601

WARNING: THE INFLATOR MODULE SHOULD ALWAYS BE CARRIED WITH THE COVER AWAY FROM YOUR BODY AND SHOULD ALWAYS BE LAID ON A FLAT SURFACE WITH THE COVER SIDE UP. THIS IS NECESSARY BECAUSE A FREE SPACE IS PROVIDED TO ALLOW THE AIR CUSHION TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY MAY RESULT (with SRS air bag).


430R300007

13. Apply a setting mark (1) across the steering wheel and shaft so parts can be reassembled in their original position. Move the front wheels to the straight ahead position, then use steering wheel remover 5-8521-0016-0 (2) to remove the steering wheel.



RTW73BSH000501

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

Inspect

1 Inspect the oil pump housing for damage.

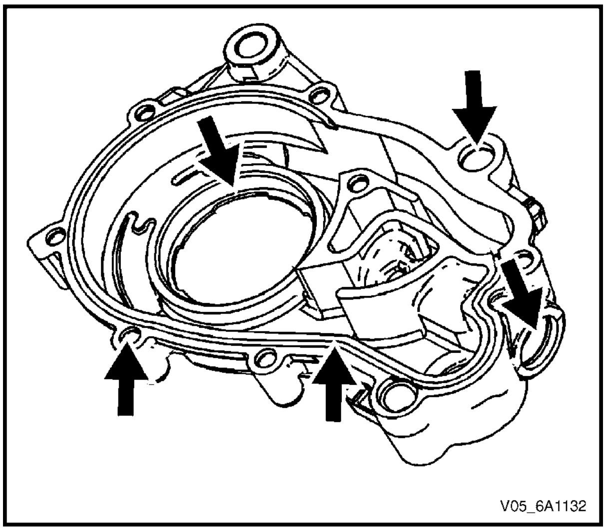


Figure 6A1 – 291

2 Inspect the oil pump cover for damage.

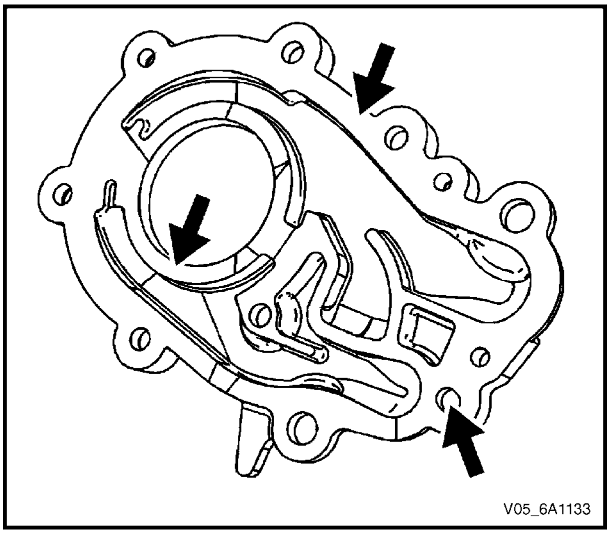


Figure 6A1 – 292

3 Inspect the inner drive gear for damage. If inner surface damage is found, ensure the crankshaft is also inspected.

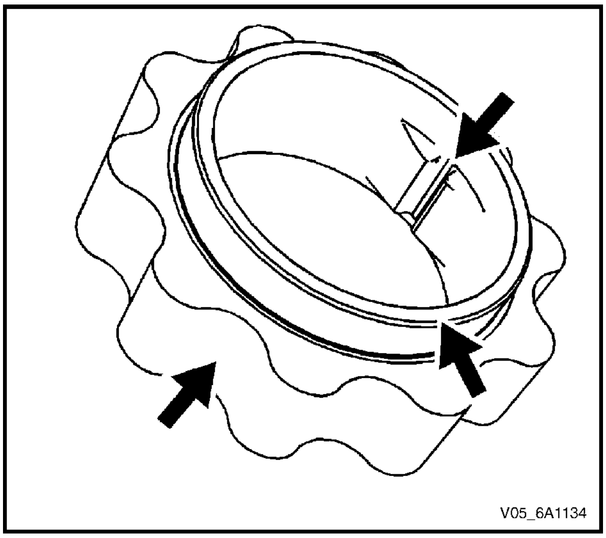


Figure 6A1 – 293

4 Inspect the outer driven gear for damage.

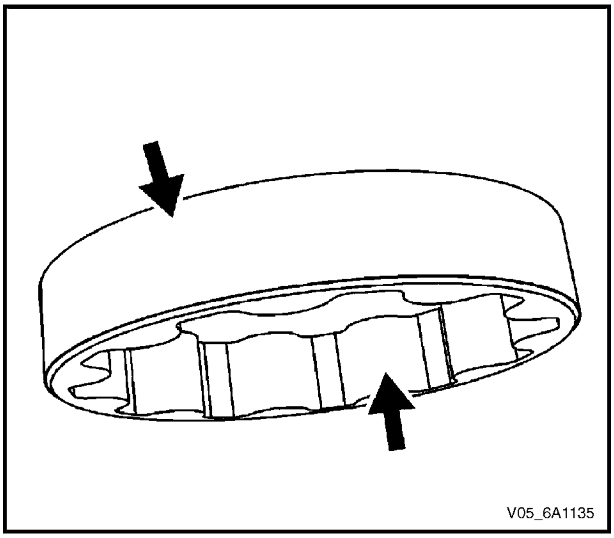


Figure 6A1 – 294

5 Inspect the oil pump relief valve components for debris or damage.

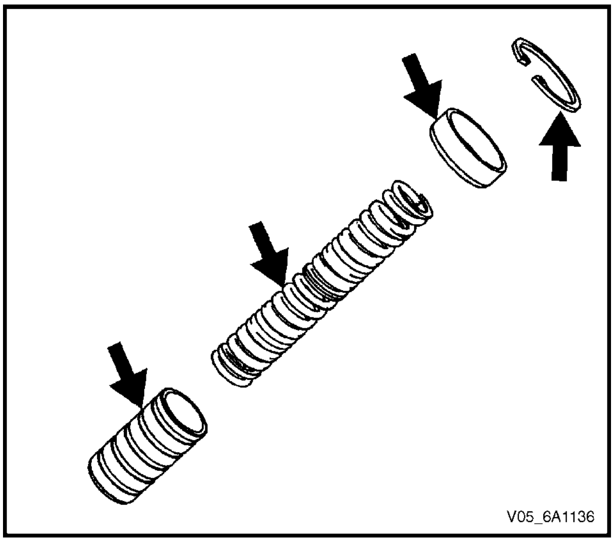


Figure 6A1 – 295

6 Inspect the primary camshaft chain lower guide for damage. If replacement of the primary camshaft chain lower guide is required, replace the entire oil pump assembly as the primary camshaft chain lower guide is not serviceable separately.

7 If debris or damage is present within the oil pump, further inspection of all of the engine components is required.

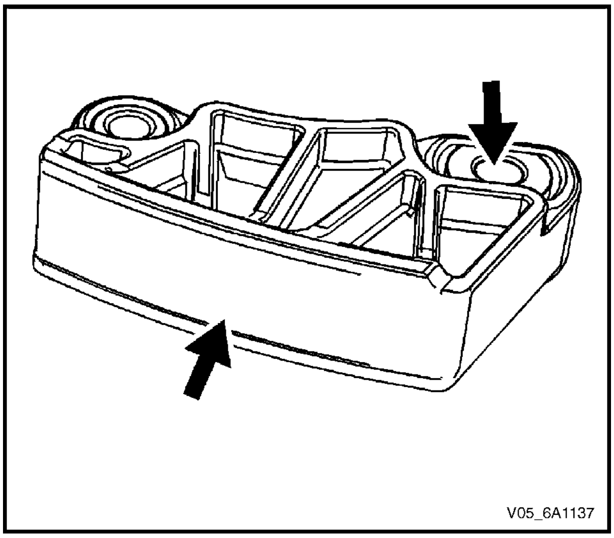


Figure 6A1 – 296

Reassemble

CAUTION

As there are no serviceable components within the oil pump, a disassembled oil pump must be replaced.

Reinstall

1. Align the oil pump gerotor with the crankshaft flats and fit the oil pump assembly to the engine block.
2. Align the pump body (2) with the mounting holes in the cylinder block.
3. Install the oil pump bolt (1), three places, and tighten to the correct torque specification.
4. Install the primary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

Oil pump attaching bolt torque specification	20.0 – 26.0 Nm

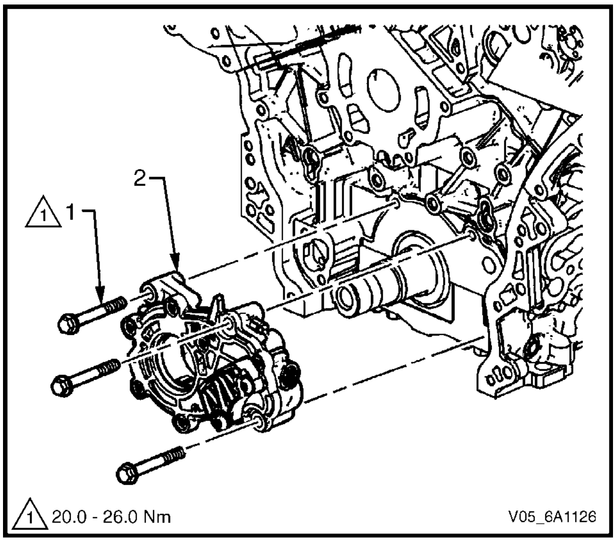


Figure 6A1 – 297

3.18 Camshaft Sprocket – Excluding MY06 Update

CAUTION

Setting the camshaft timing is required whenever the camshaft drive system is disturbed to ensure the relationship between any chain and sprocket is not lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.
If required, follow the Left-hand Secondary Camshaft Chain Components reinstallation procedure to reset the camshaft timing.

Remove

Right-hand Side

1 Remove the right-hand camshaft cover, refer to 3.12 Camshaft Cover.

2 Remove the camshaft position sensors, refer to Section 6C1-3 Engine Management – Service Operations.

3 Remove the camshaft position actuator solenoids, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.

6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

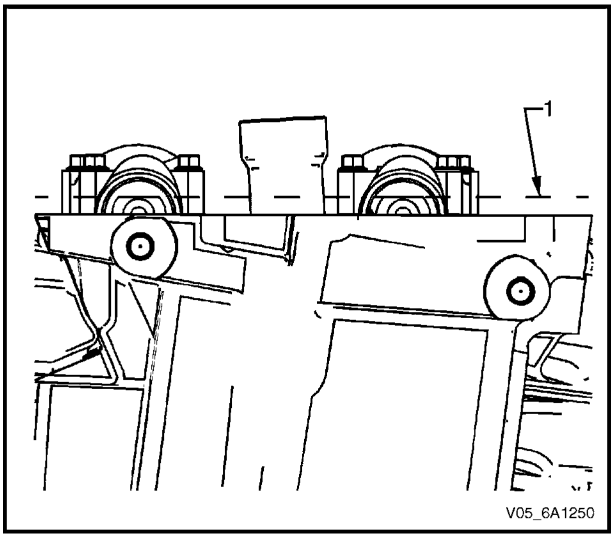


Figure 6A1 – 298

7 Install Tool No. EN-46105 – 1 (1) onto the rear of the right-hand cylinder head (3) camshafts (2).

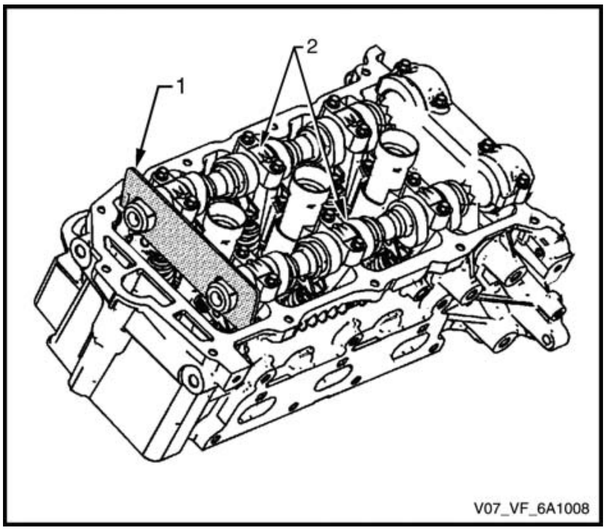


Figure 6A1 – 299

NOTE

Use an open-end spanner (1) at the camshaft hex (2) to prevent camshaft/engine rotation.

NOTE

Do not remove the camshaft sprocket bolt (3) at this time.

8 Loosen the camshaft sprocket bolt (3).

NOTE

If you have already removed the camshaft timing chain proceed to step 12

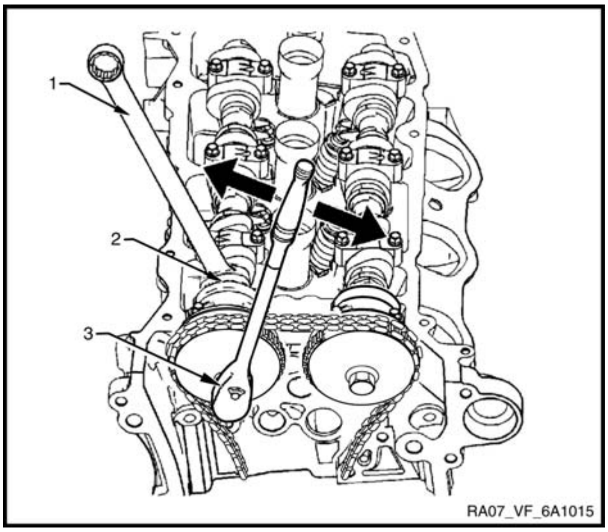


Figure 6A1 – 300

CAUTION

Ensure the tips of Tool No. EN-46108 are fully engaged into the timing chain and the wing nuts are tight and the timing chain is taught.

9 Install Tool No. EN-46108 (1 and 2) to retain the timing chain (3 and 4).

10 Firmly tighten the wing nuts of Tool No. EN-46108.

11 Mark the timing chain and the respective location on both camshaft sprocket.

NOTE

Ensure the camshaft timing chain and the camshaft sprocket are marked for correct reassembly.

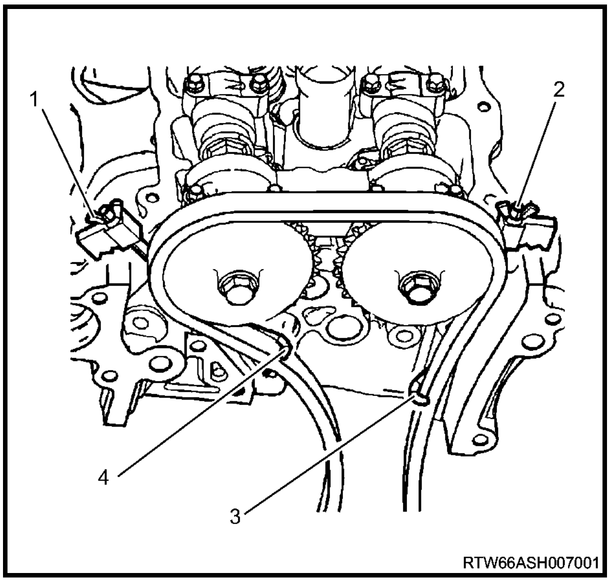


Figure 6A1 – 301

12 Remove the bolt (1) attaching the right-hand exhaust camshaft sprocket (2) and remove the sprocket.

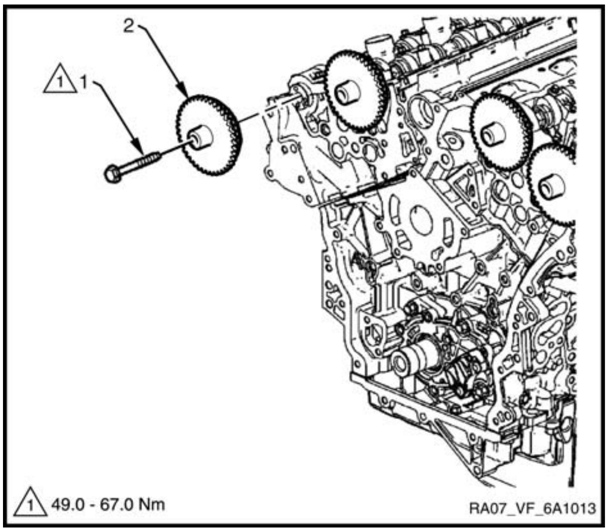


Figure 6A1 – 302

13 Remove the bolt (1) attaching right-hand intake camshaft sprocket (2) and remove the sprocket.

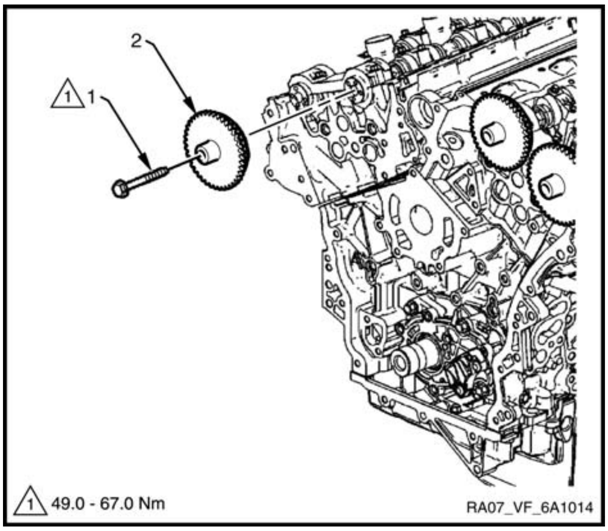


Figure 6A1 – 303

Left-hand Side

1 Remove the left-hand camshaft cover, refer to 3.12 Camshaft Cover.

2 Remove the camshaft position sensors, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

3 Remove the camshaft position actuator solenoids, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.

6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

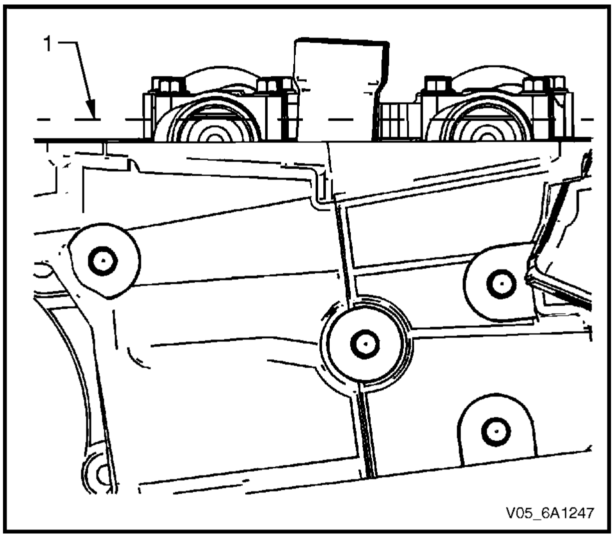


Figure 6A1 – 304

7 Install Tool No. EN-46105 – 1 (1) onto the rear of the left-hand cylinder head camshafts (2).

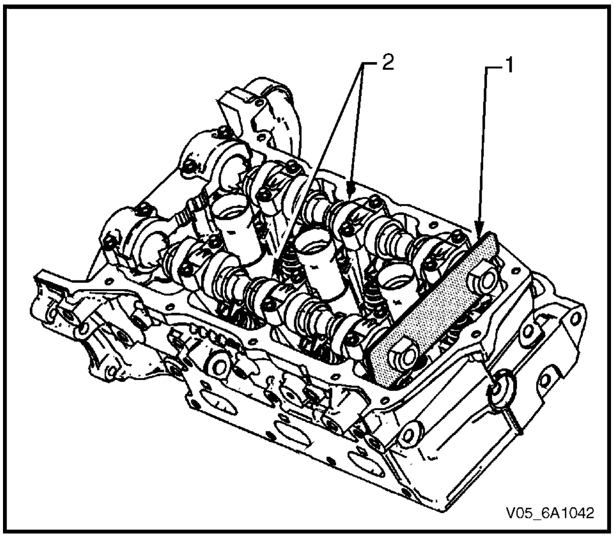


Figure 6A1 – 305

NOTE

Use an open-end wrench (1) at the camshaft hex (2) to prevent camshaft/engine rotation.

NOTE

Do not remove the camshaft sprocket bolt (3) at this time.

8 Loosen the camshaft sprocket bolt (3).

NOTE

If the camshaft timing chain has already been removed proceed to Step 12.

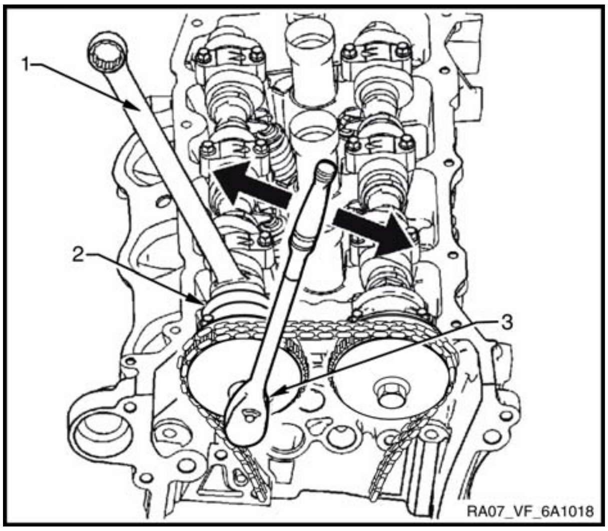


Figure 6A1 – 306

CAUTION

Ensure the tips of Tool No. EN-46108 are fully engaged into the timing chain and the wing nuts are tight and the timing chain is taught.

9 Install Tool No. EN-46108 (1 and 2) to retain the timing chain (3 and 4).

10 Firmly tighten the wing nuts of Tool No. EN-46108.

NOTE

Ensure the camshaft timing chain and the camshaft sprocket are marked for correct reassembly.

11 Mark the timing chain and the respective location on both camshaft sprocket.

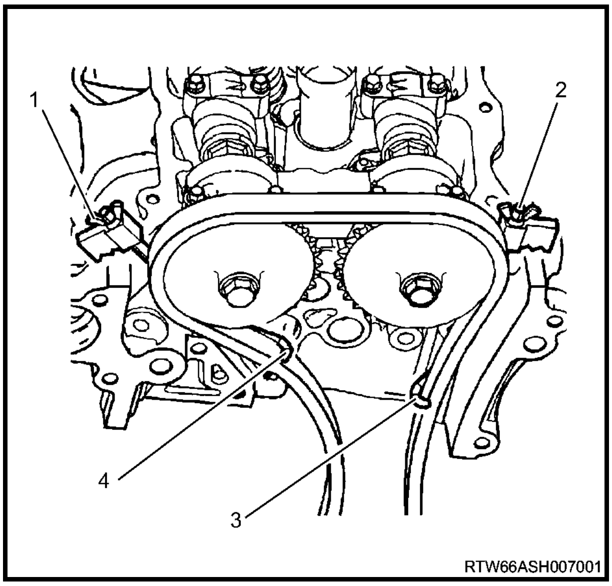


Figure 6A1 – 307

12 Remove the bolt (1) attaching the left-hand exhaust camshaft sprocket (2) and remove the sprocket.

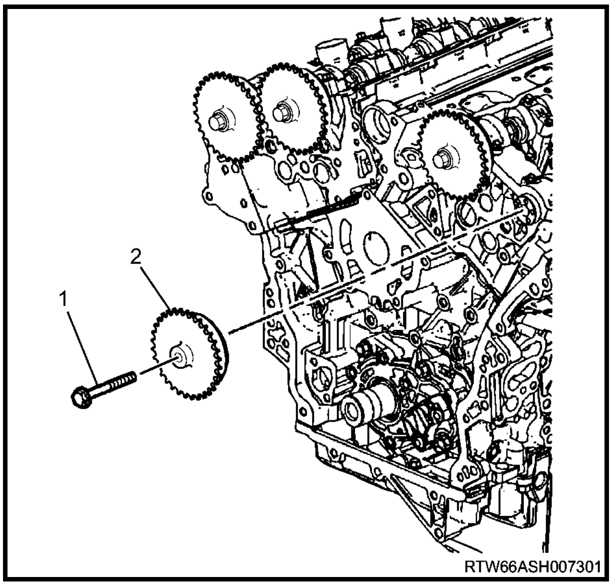


Figure 6A1 – 308

13 Remove the bolt (1) attaching left-hand intake camshaft sprocket (2) and remove the sprocket.

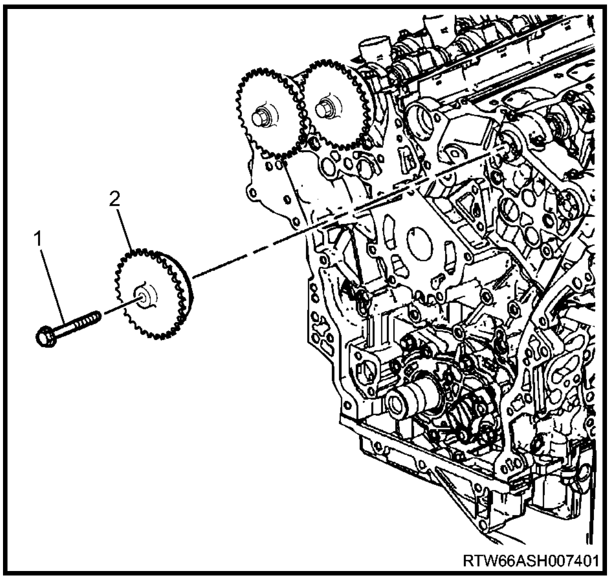


Figure 6A1 – 309

Clean

1 Clean the exterior of each camshaft sprocket with solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the timing components with compressed air.

Inspect

1 Inspect the front of each sprocket for the following:

- Sprocket damage (1), and
- Sprocket bolt seating inner hub damage (2).

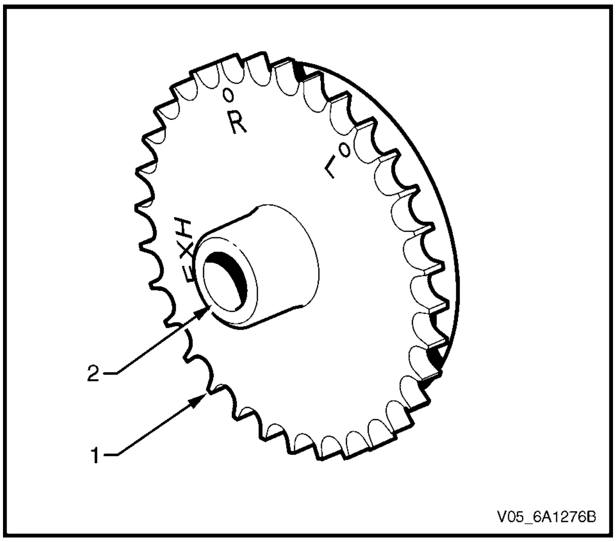


Figure 6A1 – 310

2 Inspect the back of each sprocket for the following:

- Sprocket damage (1),
- Camshaft locating pin damage (2) and,
- Camshaft seating/sealing inner hub flange damage (3),

NOTE

These checks apply to both the inlet and exhaust camshaft sprockets.

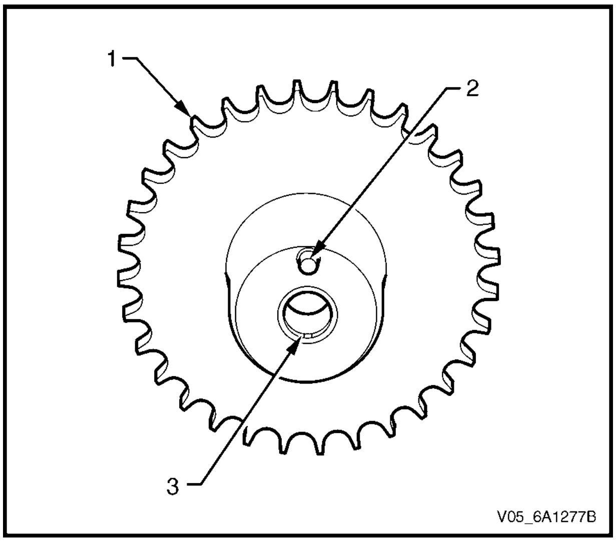


Figure 6A1 – 311

Reinstall

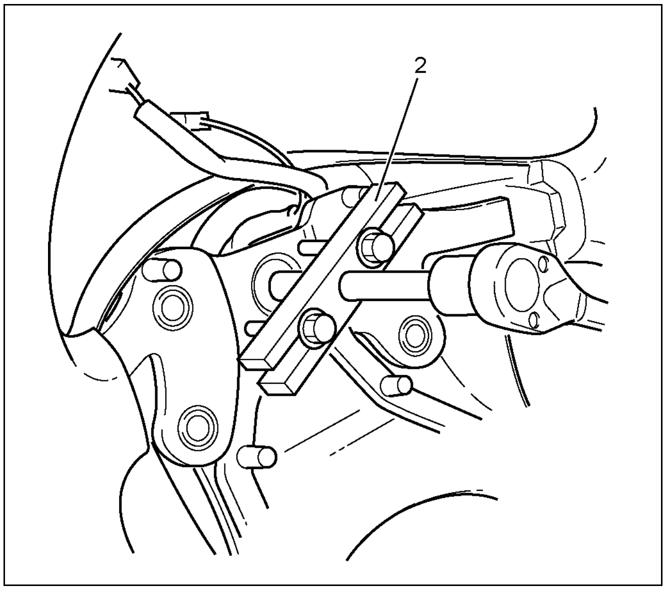
Reinstallation of the camshaft sprockets is the reverse of the removal procedure, noting the following:

1 Align the sprockets and timing chain with the marks made during removal.

2 Tighten the camshaft sprocket bolts to the correct torque specification.

Camshaft sprocket attaching bolt torque specification ....49.0 – 67.0 Nm

3 Remove the timing chain retention tools.



RTW73BSH001301

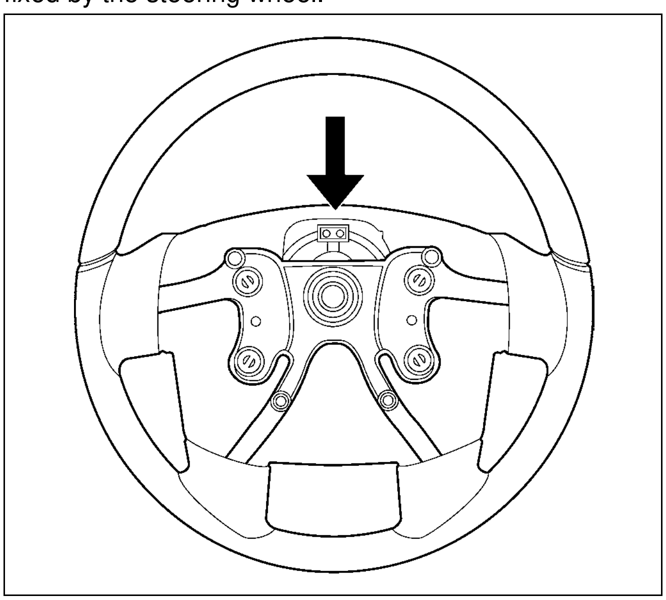
14. Remove steering column cover.
15. Disconnect the wiring harness connectors located under the steering column then remove combination switch and SRS coil assembly.

Installation

1. Align the setting marks made when removing, then install steering wheel.

   Refer to the adjustment method in case a mark has not been applied in this section.

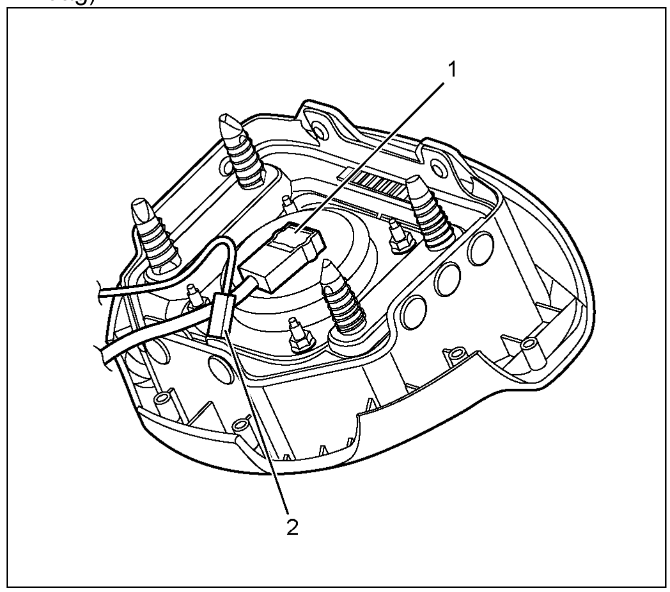
NOTE: Confirm SRS and horn harness connector is fixed by the steering wheel.


RTW73BSH000701

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

2. Tighten the steering wheel fixing nut to the specified torque.

   Torque: 35 N·m (3.6 kgf·m/26 lb·ft)
3. Support the inflator module and carefully connect the SRS connector (1) and horn lead (2) (with SRS air bag).

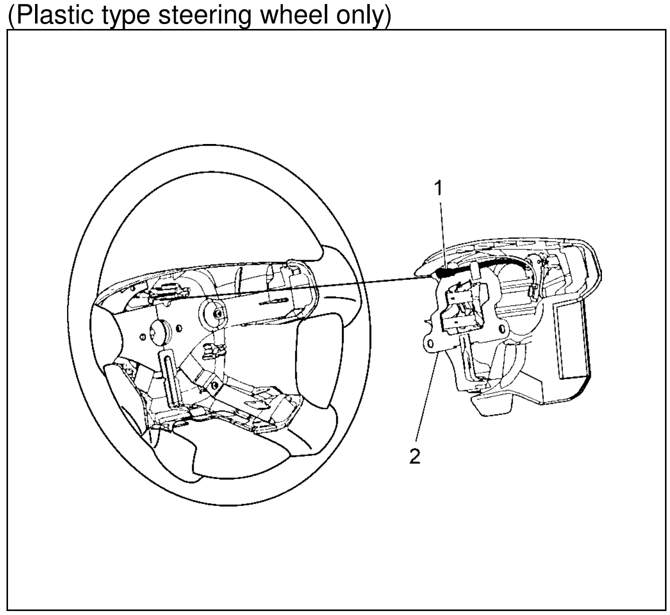


RTW73BSH001101

4. Connect the horn leads at center of wheel (without SRS air bag).

NOTE: The horn leads (1) are passed along the top of the bracket (2).

(Plastic type steering wheel only)



RTW73BSH000801

3.19 Camshaft Sprocket – MY06 Update

CAUTION

Setting the camshaft timing is required whenever the camshaft drive system is disturbed to ensure the relationship between any chain and sprocket is not lost. Even when only one sprocket is involved, multiple crankshaft rotations will not produce conditions where correct timing can be confirmed.
If required, follow the Left-hand Secondary Camshaft Chain Components reinstallation procedure to reset the camshaft timing.

Remove

Right-hand Side

1 Remove the right-hand camshaft cover, refer to 3.12 Camshaft Cover.
2 Remove the camshaft position sensors, refer to Section 6C1-3 Engine Management – Service Operations.
3 Remove the camshaft position actuator solenoids, refer to Section 6C1-3 Engine Management – V6 – Service Operations.
4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.
5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.
6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

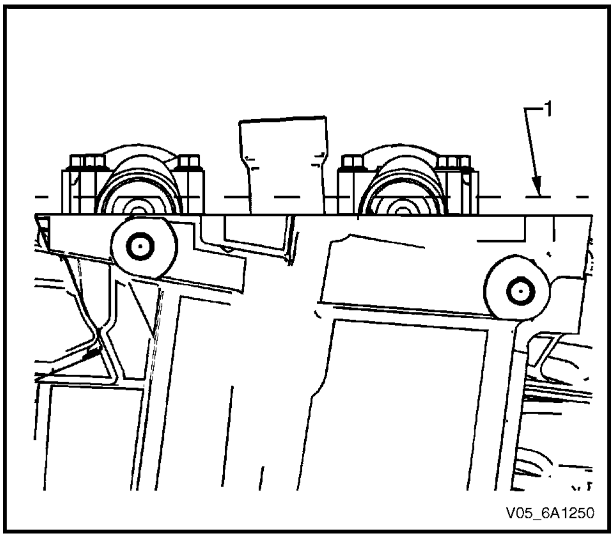


Figure 6A1 – 312

7 Install Tool No. EN-46105–1 (1) onto the rear of the right-hand cylinder head (3) camshafts (2).

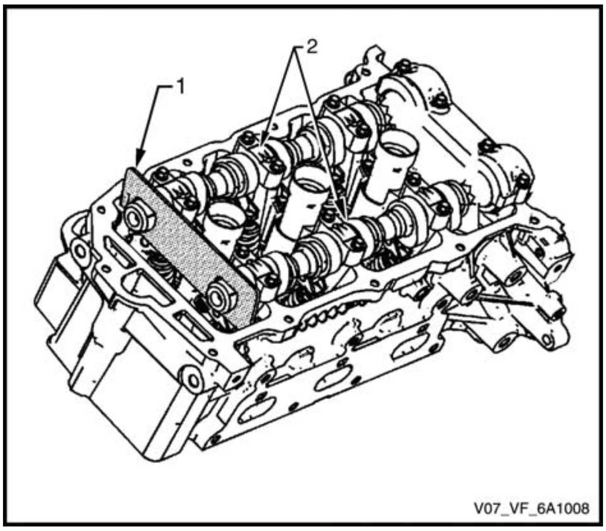


Figure 6A1 – 313

NOTE

Use an open-end spanner (1) at the camshaft hex (2) to prevent camshaft/engine rotation.

NOTE

Do not remove the camshaft sprocket bolt (3) at this time.

8 Loosen the camshaft sprocket bolt (3).

NOTE

If you have already removed the camshaft timing chain proceed to Step 12

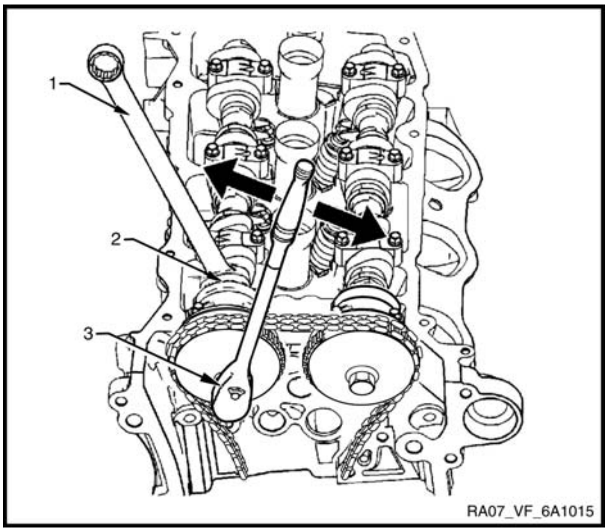


Figure 6A1 – 314

NOTE

The front engine cover is removed in the following graphic for illustration purposes and is not required to be removed to perform this procedure.

9 Loosen the timing chain retention Tool No. EN 48313 so that the legs are retracted.

10 Insert the Tool No. EN 48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed into the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.

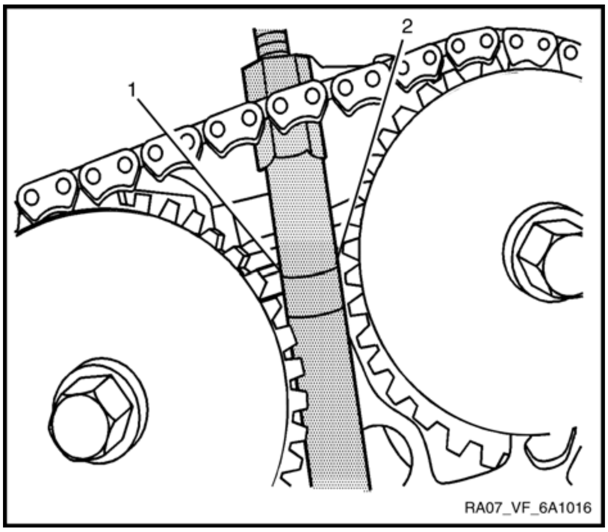


Figure 6A1 – 315

11 Ensure that the feet (2) of the Tool No. EN 48313 are facing the front of the engine.

CAUTION

DO NOT tighten the Tool No. EN 48313 at this stage.

12 Partially expand the legs (1) on the Tool No. EN 48313 by turning the T-shaped handle clockwise.

CAUTION

Ensure the feet (2) of the Tool No. EN 48313 are correctly engaged into one of the link pockets to prevent the chain from slipping during tightening.

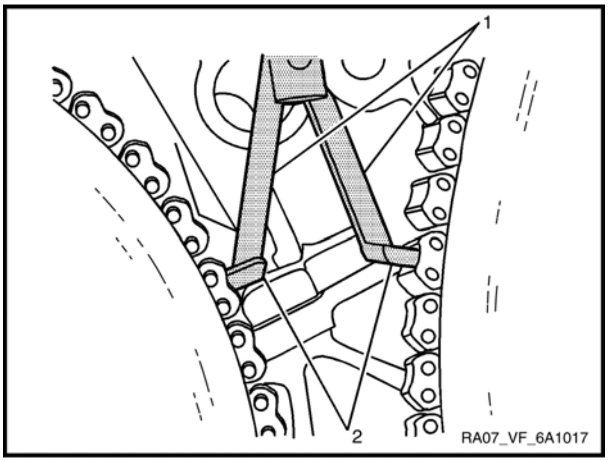


Figure 6A1 – 316

13 Continue expanding the Tool No. EN 48313 until the feet (2) contact the timing chain.

14 Hand tighten the Tool No. EN 48313. DO NOT allow the body of the Tool No. EN 48313 to rotate when tightening the T-handle.

15 Use an open-end spanner on the hex cast into both the right intake and exhaust camshafts and rotate the camshafts towards each other in order to create slack in the chain between the actuators.

16 The Tool No. EN 48313 is now correctly installed to hold the timing chain in position.

NOTE

Ensure the camshaft timing chain and the camshaft position actuators are marked for correct reassembly.

17 Mark the timing chain and the respective location on both camshaft position actuators.

18 Remove the bolt (1) attaching the right-hand exhaust camshaft sprocket (2) and remove the sprocket.

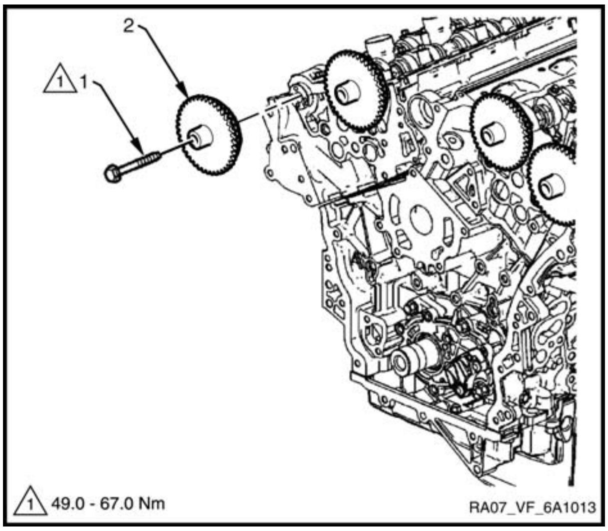


Figure 6A1 – 317

19 Remove the bolt (1) attaching right-hand intake camshaft sprocket (2) and remove the sprocket.

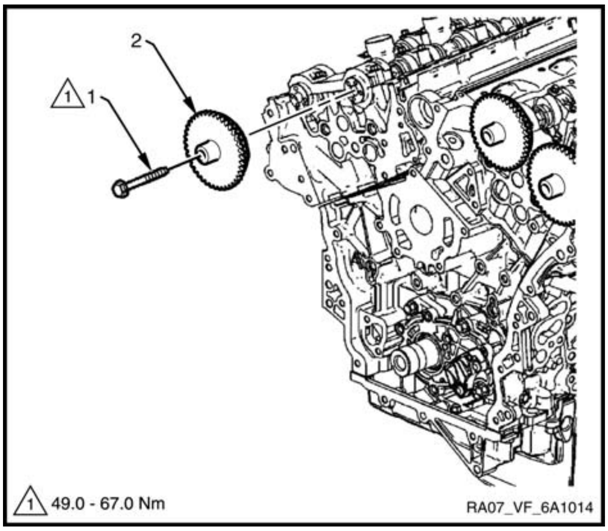


Figure 6A1 – 318

Left-hand Side

1 Remove the left-hand camshaft cover, refer to 3.12 Camshaft Cover.

2 Remove the camshaft position sensors, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

3 Remove the camshaft position actuator solenoids, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

4 Remove the crankshaft balancer assembly, refer to 3.13 Crankshaft Balancer Assembly.

5 Install the crankshaft rotation socket Tool No. EN-46111 onto the crankshaft.

6 Rotate the crankshaft until the camshafts are in a neutral low tension position. The camshaft flats will be parallel with the camshaft cover rail (1).

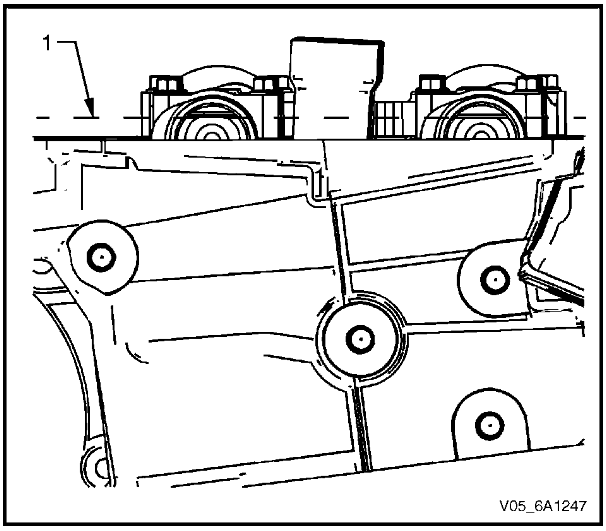


Figure 6A1 – 319

7 Install Tool No. EN-46105–1 (1) onto the rear of the left-hand cylinder head camshafts (2).

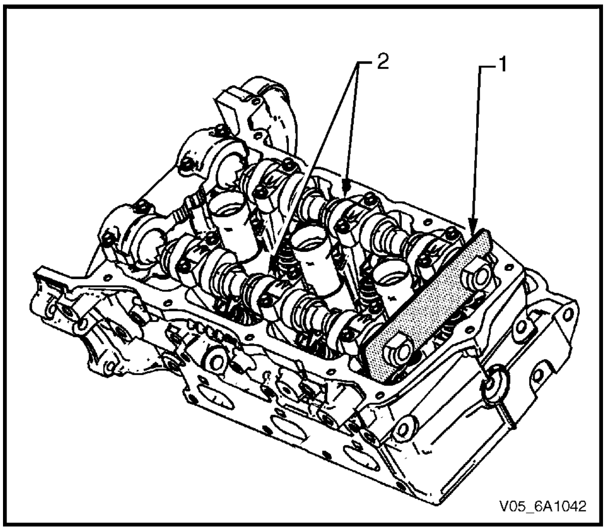


Figure 6A1 – 320

NOTE

Use an open-end wrench (1) at the camshaft hex (2) to prevent camshaft/engine rotation.

NOTE

Do not remove the camshaft sprocket bolt (3) at this time.

8 Loosen the camshaft sprocket bolt (3).

NOTE

If the camshaft timing chain has already been removed proceed to Step 12.

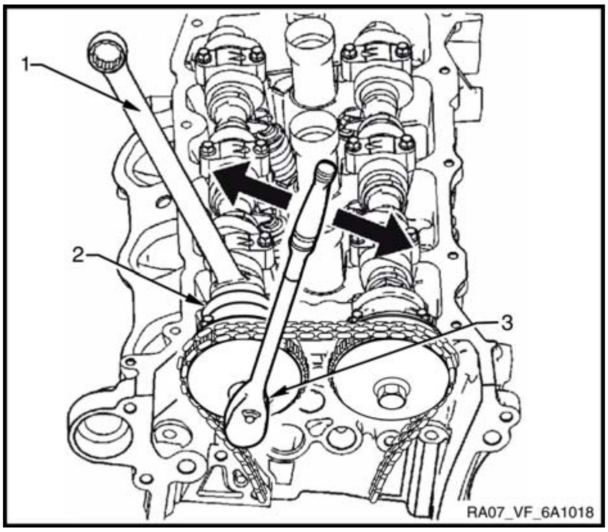


Figure 6A1 – 321

NOTE

The front engine cover is removed in the following graphic for illustration purposes and is not required to be removed to perform this procedure.

9 Loosen the timing chain retention Tool No. EN 48313 so that the legs are retracted.

10 Insert the Tool No. EN 48313 between the camshaft actuators, rearward of the timing chain until the top line that is scribed into the body of the tool (1) is adjacent to the top surface of the cylinder head (2). This is the approximate installed position.

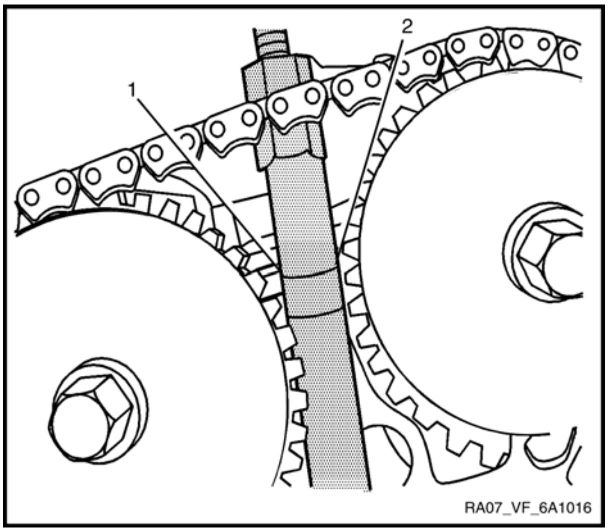


Figure 6A1 – 322

11 Ensure that the feet (2) of the Tool No. EN 48313 are facing the front of the engine.

CAUTION

DO NOT tighten the Tool No. EN 48313 at this stage.

12 Partially expand the legs (1) on the Tool No. EN 48313 by turning the T-shaped handle clockwise.

CAUTION

Ensure the feet (2) of the Tool No. EN 48313 are correctly engaged into one of the link pockets to prevent the chain from slipping during tightening.

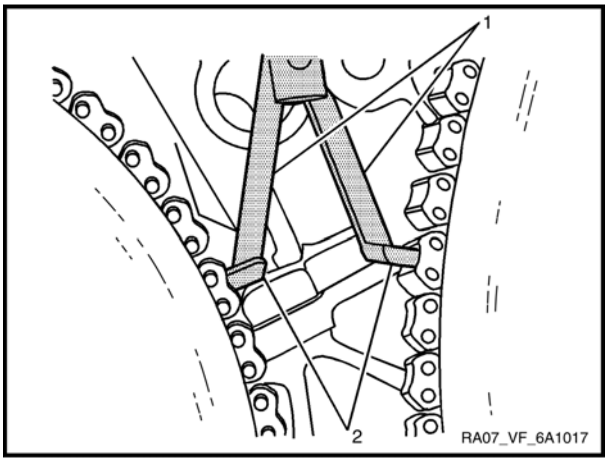


Figure 6A1 – 323

13 Continue expanding the Tool No. EN 48313 until the feet (2) contact the timing chain.

14 Hand tighten the Tool No. EN 48313. DO NOT allow the body of the Tool No. EN 48313 to rotate when tightening the T-handle.

15 Use an open-end spanner on the hex cast into both the left intake and exhaust camshafts and rotate the camshafts towards each other in order create slack in the chain between the actuators.

16 The Tool No. EN 48313 is now correctly installed to hold the timing chain in position.

NOTE

Ensure the camshaft timing chain and the camshaft position actuators are marked for correct reassembly.

17 Mark the timing chain and the respective location on both camshaft position actuators.

18 Remove the bolt (1) attaching the left-hand exhaust camshaft sprocket (2) and remove the sprocket.

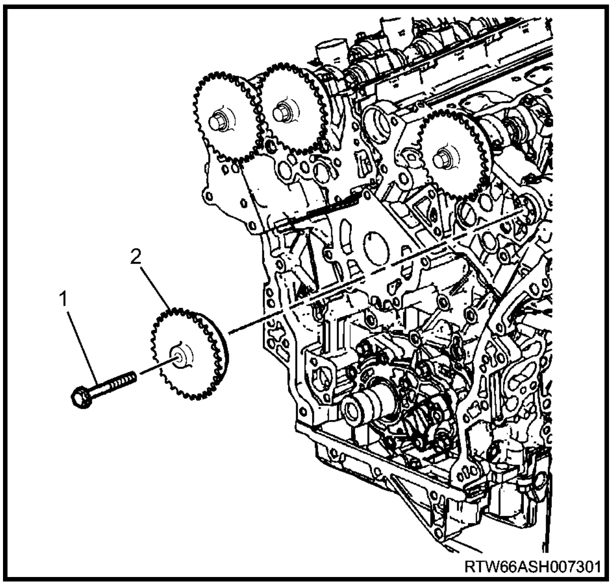


Figure 6A1 – 324

13 Remove the bolt (1) attaching left-hand intake camshaft sprocket (2) and remove the sprocket.

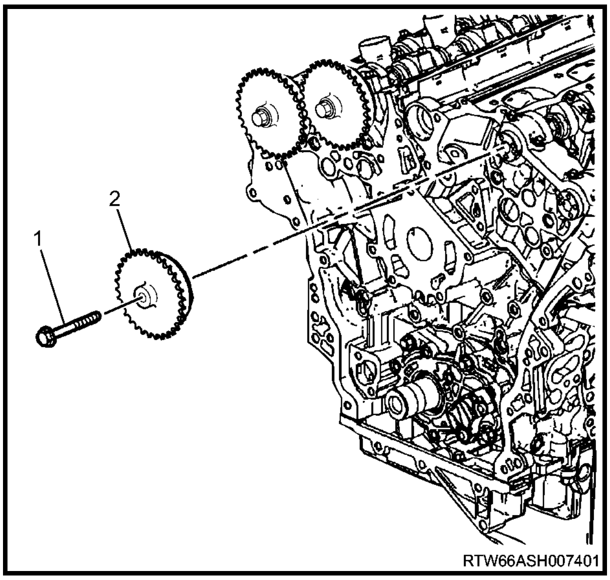


Figure 6A1 – 325

Clean

1 Clean the exterior of each camshaft sprocket with solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the timing components with compressed air.

Inspect

1 Inspect the front of each sprocket for the following:

- Sprocket damage (1), and
- Sprocket bolt seating inner hub damage (2).

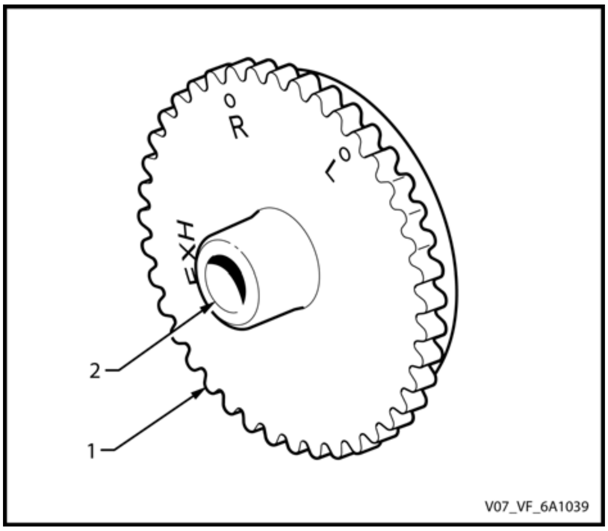


Figure 6A1 – 326

2 Inspect the back of each sprocket for the following:

- Sprocket damage (1),
- Camshaft locating pin damage (2) and,
- Camshaft seating/sealing inner hub flange damage (3),

NOTE

These checks apply to both the inlet and exhaust camshaft sprockets.

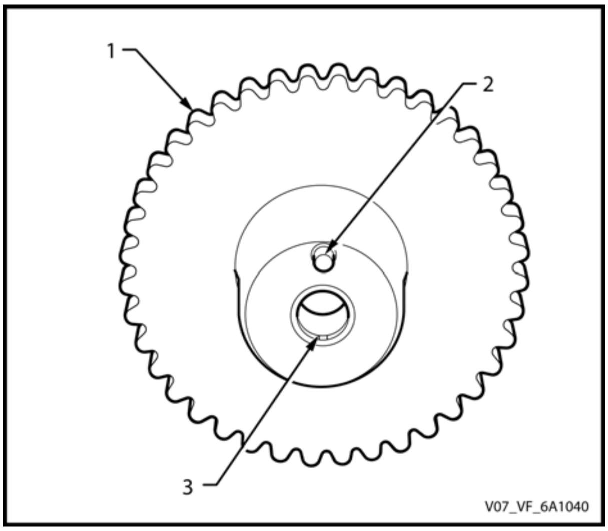


Figure 6A1 – 327

Reinstall

Reinstallation of the camshaft sprockets is the reverse of the removal procedure, noting the following:

1 Align the sprockets and timing chain with the marks made during removal.

2 Tighten the camshaft sprocket bolts to the correct torque specification.

Camshaft sprocket attaching bolt torque specification ....49.0 – 67.0 Nm

3 Remove the timing chain retention tools.

3.20 Camshaft

Remove

Right-hand Side

1 Remove the right-hand cylinder head camshaft sprockets, refer to 3.18 Camshaft Sprocket.

NOTE

Tool No. EN-46105–1 was installed as part of the right-hand cylinder head camshaft sprocket removal procedure.

2 Remove the Tool No. EN-46105–1 (1) from the right-hand cylinder head camshafts (2).

NOTE

Tool No. EN-46105 was installed as part of the right-hand cylinder head camshaft sprocket removal procedure.

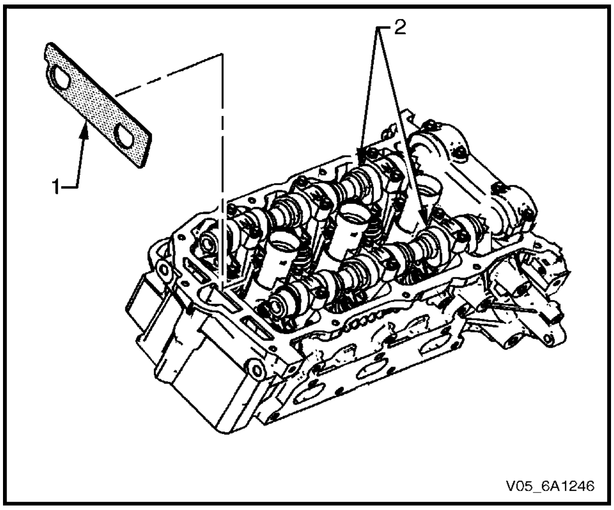


Figure 6A1 – 328

3 Observe the markings (1) on the bearing caps. Each bearing cap is marked to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- An I indicates the intake camshaft.
- An E indicates the exhaust camshaft.
- The number indicates the journal position from the front of the engine.

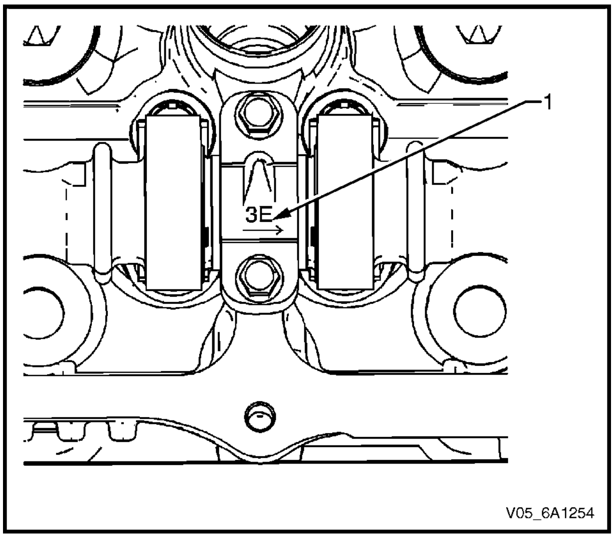


Figure 6A1 – 329

4 Remove the camshaft bearing cap bolts (1) and caps (2).

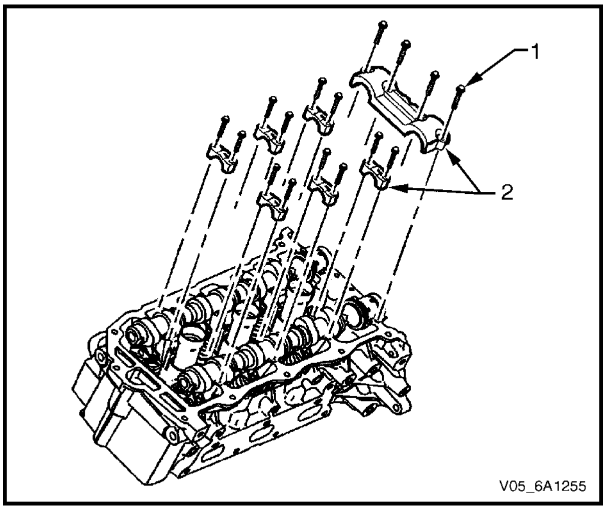


Figure 6A1 – 330

5 Remove the camshafts (1).

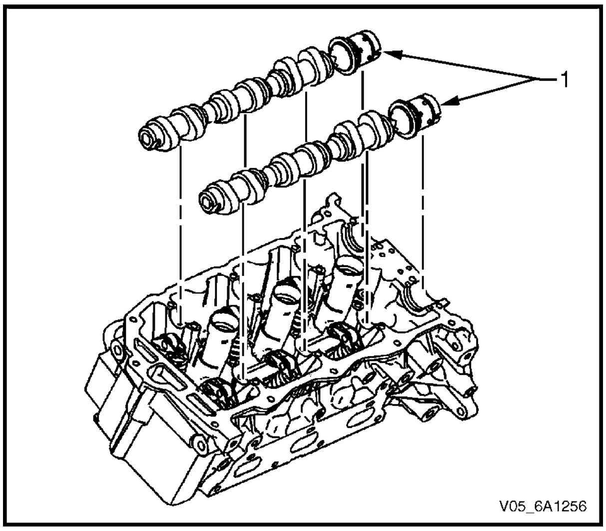
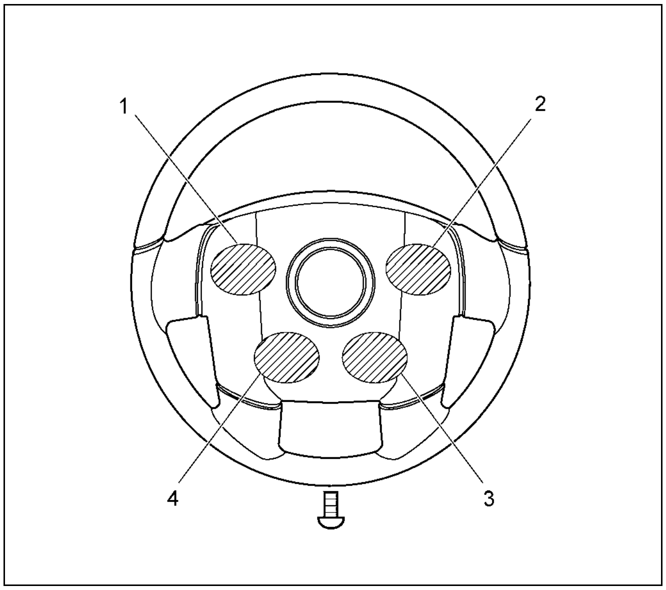


Figure 6A1 – 331

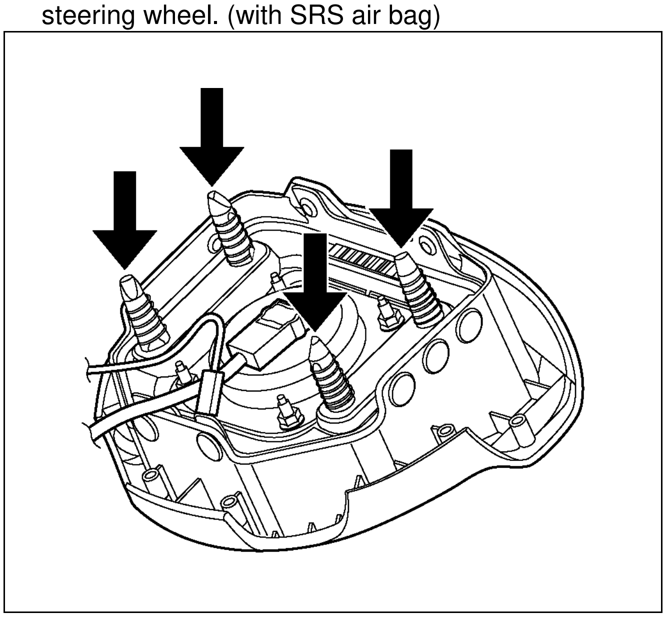
5. Push the horn pad at areas 1-4.
   Tighten the horn pad fixing screw to the specifed torque (without SRS air bag)
   Torque: 3 N·m (0.3 kgf·m/26 lb·in)

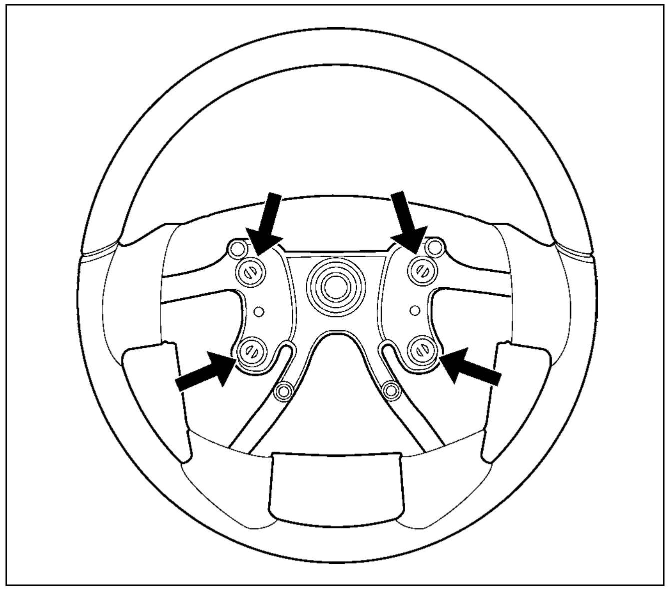
NOTE: A horn pad should not be struk during attachment.



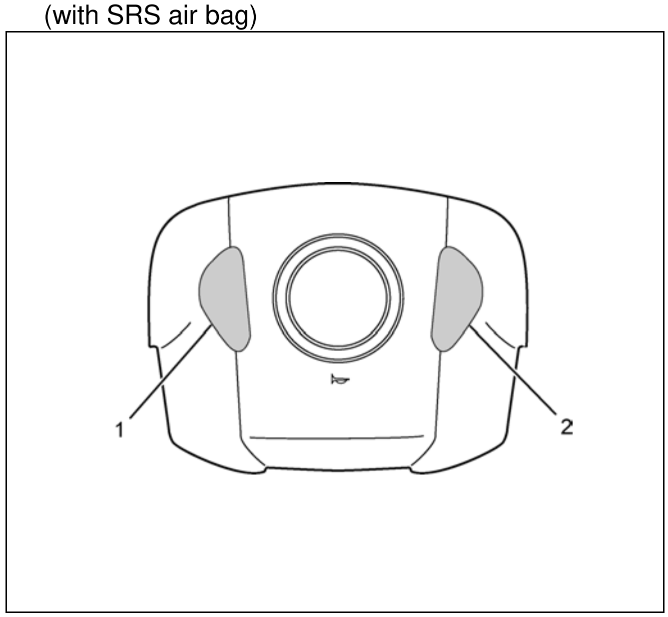
RTW73BSH000201

6. Align each snap stud of driver air bag to the holes on steering wheel. (with SRS air bag)


RTW73BSH001201


RTW73BSH000401

7. Push the SRS air at bag at area-1 (1) and area-2 (2). At that time confirm the audible noise of each stud. (with SRS air bag)



RTW73BSH000301

8. Enable the SRS (Refer to "Enabling the SRS" in this section) (with SRS air bag).
9. Connect the SRS connector (with SRS air bag).
10. Connect the battery "-" terminal cable (with SRS air bag).
11. Turn the ignition switch to "ON" while watching warning light and check - the light should flash 7 times and then go off. If lamp does not operate correctly, refer to Restraints section.

Left-hand Side

1 Remove the left-hand cylinder head camshaft sprockets, refer to 3.18 Camshaft Sprocket.

NOTE

Tool No. EN-46105–1 was installed as part of the left-hand cylinder head camshaft sprocket removal procedure.

2 Remove Tool No. EN-46105–1 (1) from the left-hand camshafts.

NOTE

Tool No. EN-46105 was installed as part of the left-hand cylinder head camshaft position actuator removal procedure.

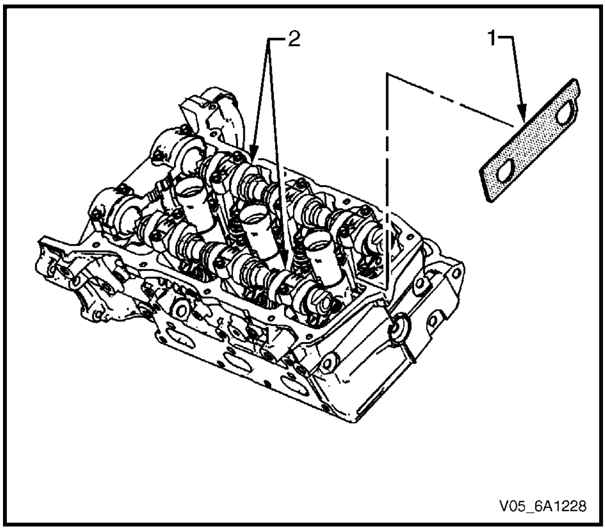


Figure 6A1 – 332

3 Observe the markings (1) on the bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- An I indicates the intake camshaft.
- An E indicates the exhaust camshaft.
- The number indicates the journal position from the front of the engine.

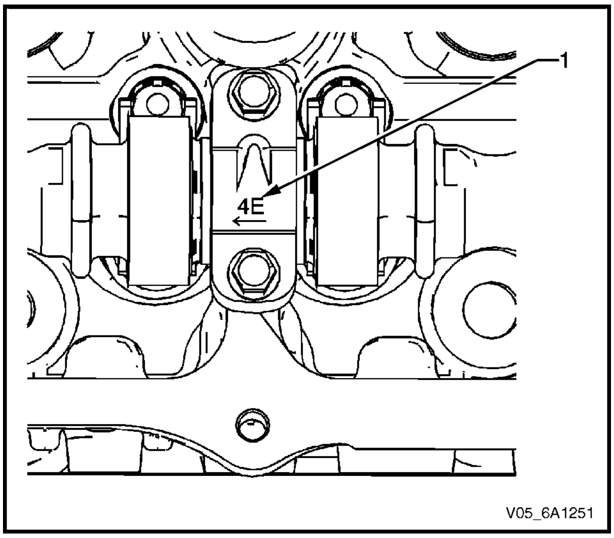


Figure 6A1 – 333

4 Remove the camshaft bearing cap bolts (1) and caps (2).

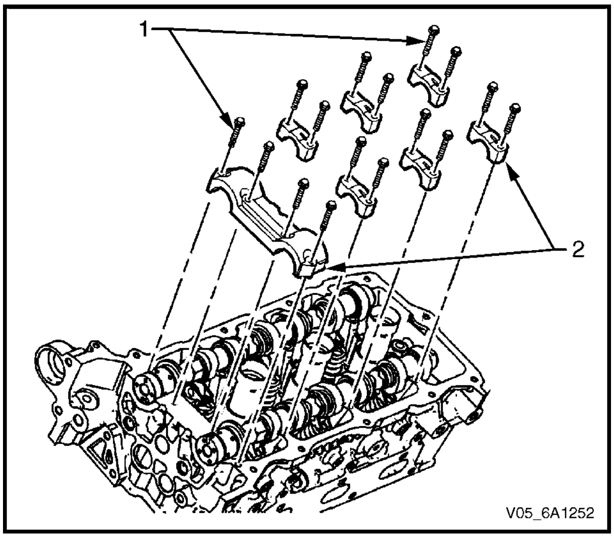


Figure 6A1 – 334

5 Remove the camshafts (1).

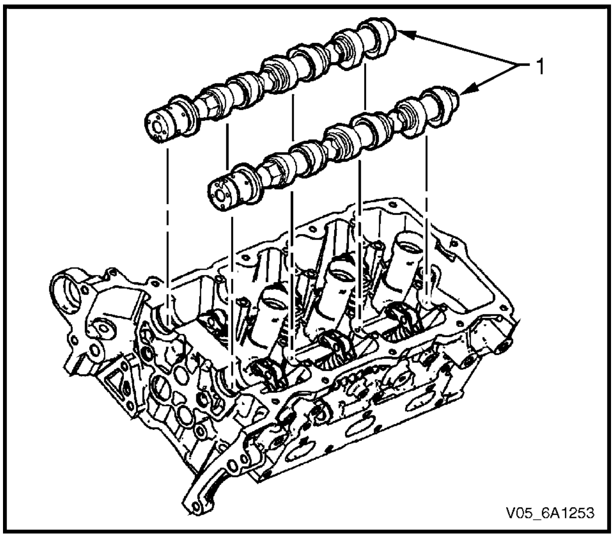


Figure 6A1 – 335

Clean

1 Clean the camshaft in solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the camshaft with compressed air.

Inspect

Camshaft Visual Inspection

1. Inspect the threaded hole (2) for damage.
2. Inspect the camshaft sprocket locating notch (3) for damage or wear.
3. Inspect the camshaft sealing grooves (4) for damage.
4. Inspect the camshaft thrust surface (5) for damage.
5. Inspect the camshaft lobes (6) and journals (7) for the following conditions:
   - Excessive scoring or pitting
   - Discoloration from overheating
   - Deformation from excessive wear, especially the camshaft lobes
6. If any of the above conditions exist on the camshaft, replace the camshaft.

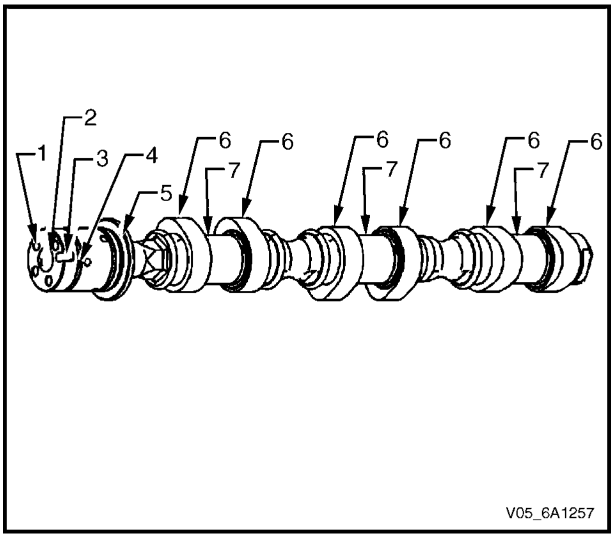


Figure 6A1 – 336

Camshaft Measurement

1. With the camshaft (1) in a suitable fixture (2), measure the camshaft for wear.
2. For camshaft measurement, refer to the following specifications, 5 Specifications.

NOTE

If the camshaft measures outside the specified range, replace the camshaft.

CAUTION

No machining of the camshaft is allowed.

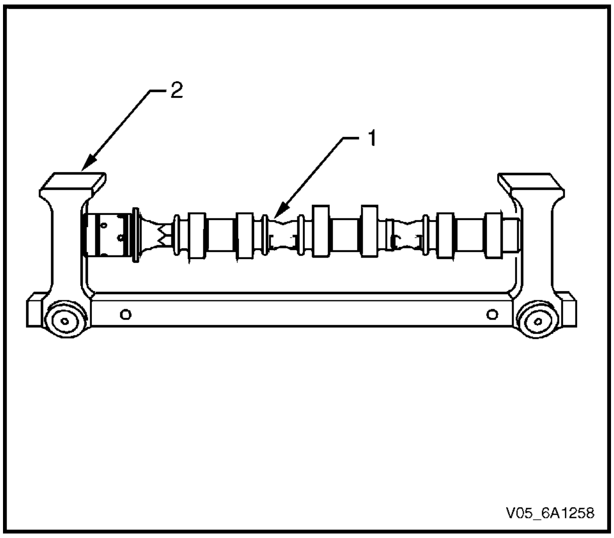


Figure 6A1 – 337

3. Measure the camshaft (2) journals for diameter and out-of-round using an outside micrometer (1).

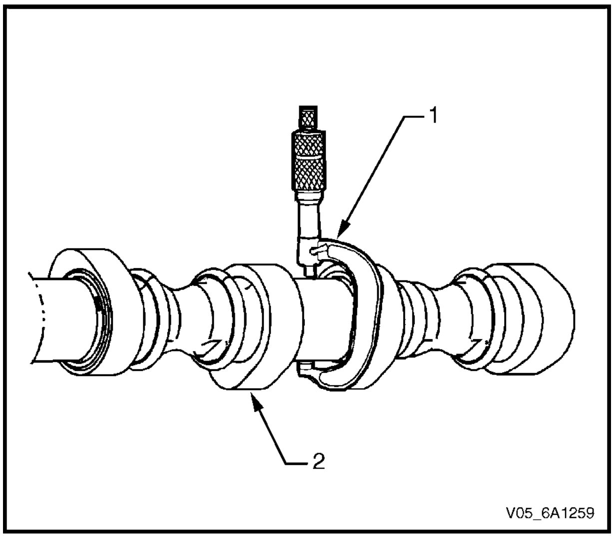


Figure 6A1 – 338

4 Measure the camshaft runout using a dial indicator (1).

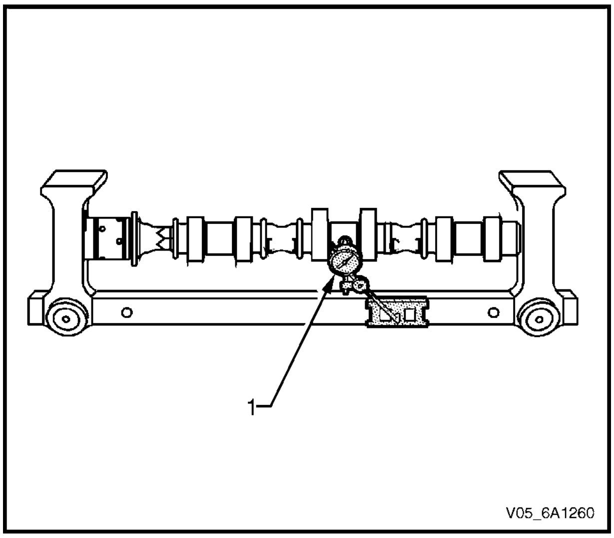


Figure 6A1 – 339

5 Measure the camshaft thrust width for wear using a depth micrometer (A).

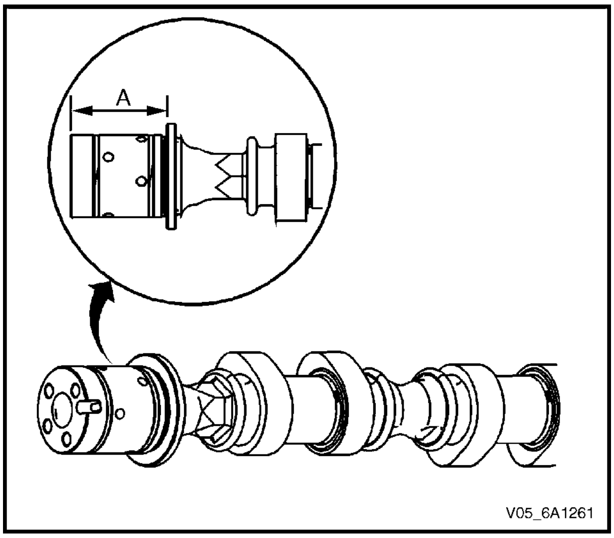


Figure 6A1 – 340

6 Measure the camshaft thrust wall surface for runout using a dial indicator (1).

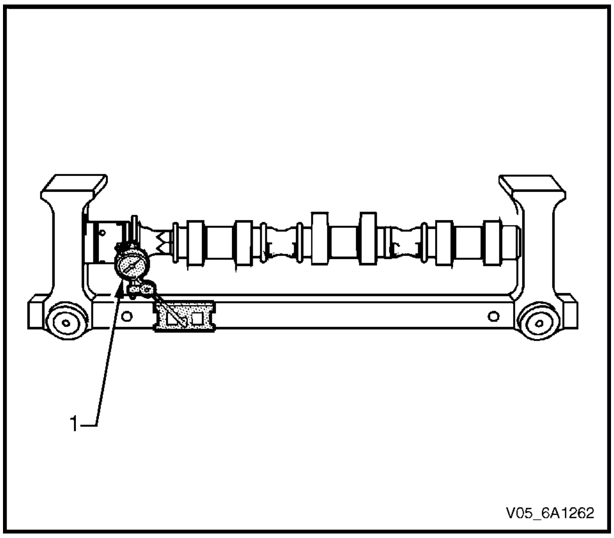


Figure 6A1 – 341

7 Measure the camshaft lobes for wear using a dial indicator (1).

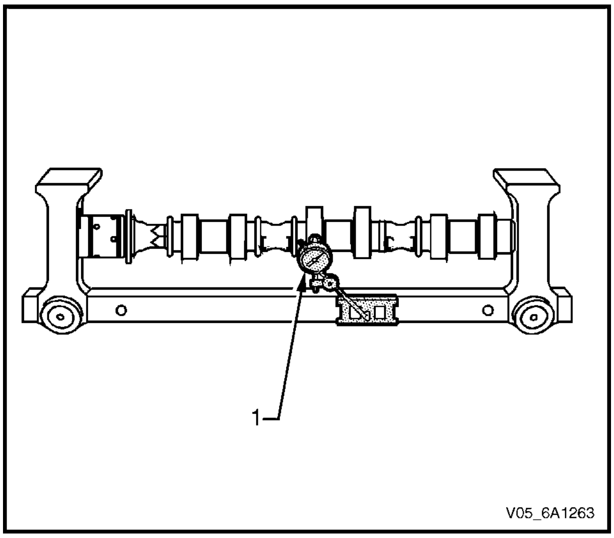


Figure 6A1 – 342

8 Place the dial indicator tip on the base circle (1) of the camshaft lobe.

9 Set the dial indicator at zero.

10 Rotate the camshaft until the indicator tip is at the highest point (2) on the lobe. This reading is the lift of the camshaft lobe.

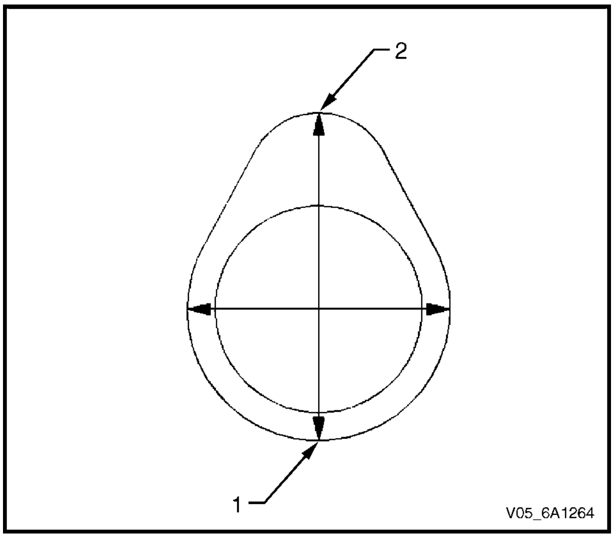


Figure 6A1 – 343

Reinstall

Right-hand Side

1 Select the correct camshaft for the particular installation location. ID markings are on the rear end of each camshaft. The ID markings are defined as follows:

- The first five digits refer to the date and time of production.
  - Example = 3L18H.
- Digits six through nine refer to engine production code.
  - LY7 = Alloytec 190 engine.
- The last two digits refer to position:
  - LI = left-hand intake.
  - LE = left-hand exhaust.
  - RI = right-hand intake.
  - RE = right-hand exhaust.

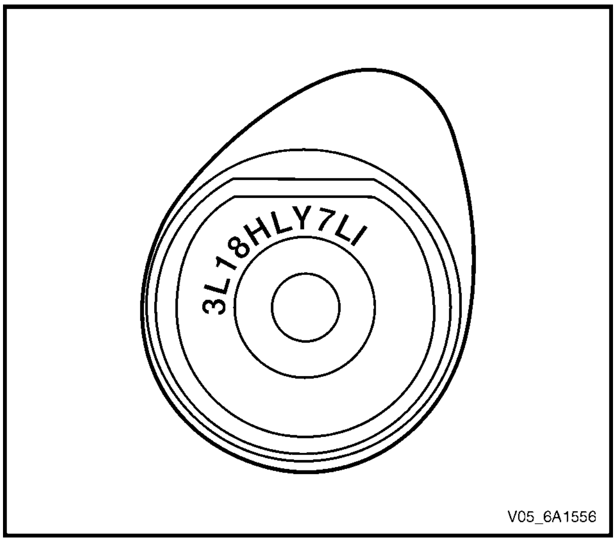


Figure 6A1 – 344

2 Apply a liberal amount of engine oil to the camshaft (1) journals and the right-hand cylinder head camshaft carriers (2).

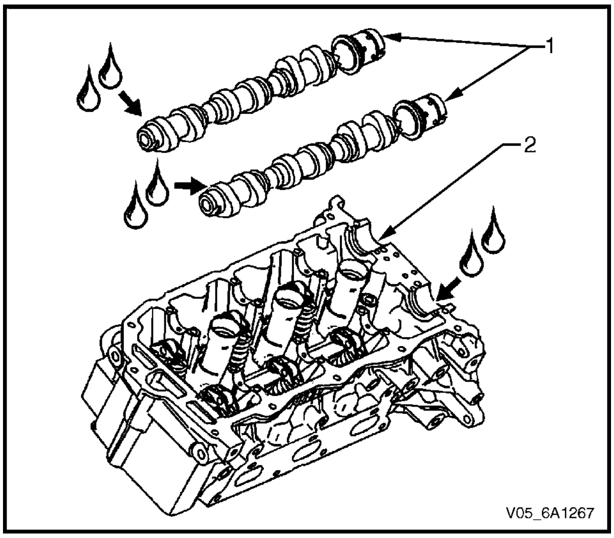


Figure 6A1 – 345

3 Position the camshafts (1) on the cylinder head and assemble the camshaft sprockets to the camshafts.

NOTE

Install the camshaft sprocket bolts but do not tighten at this stage.

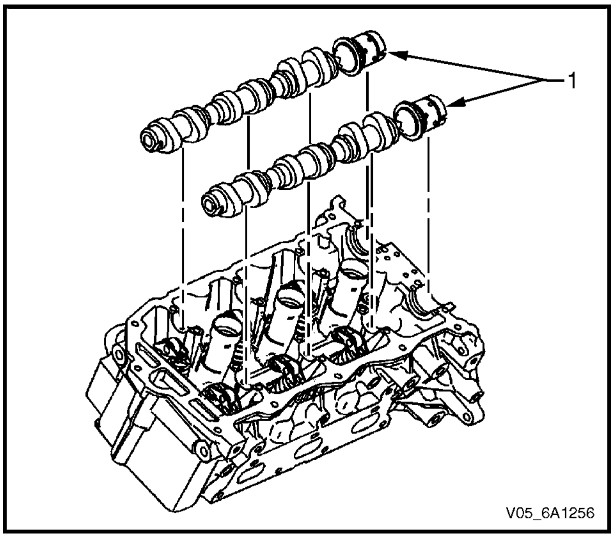


Figure 6A1 – 346

4 Ensure the camshaft lobes are in the neutral position with the flats on the back of the camshafts up and parallel (1) with the right-hand cylinder head camshaft cover rail.

5 Ensure the marks on the right-hand exhaust camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

6 Ensure the marks on the right-hand intake camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

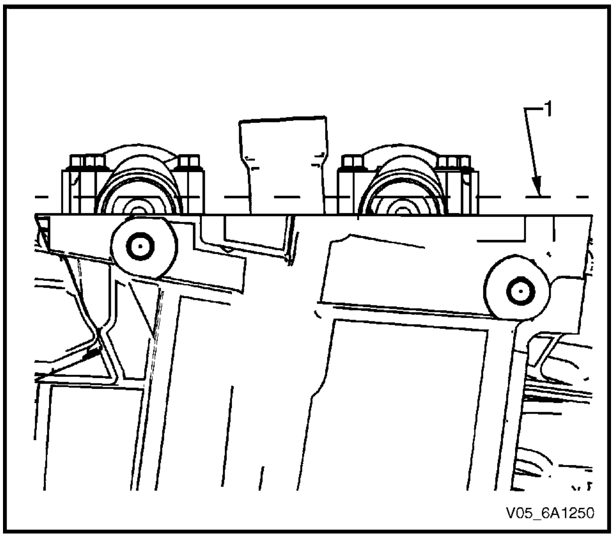


Figure 6A1 – 347

7 Observe the markings on the right-hand cylinder head camshaft bearing caps. Each bearing cap is marked (1) to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- The I indicates the intake camshaft.
- The E indicates the exhaust camshaft.
- The number 1, 3, 5 indicates the cylinder position from the front of the engine.

8 Apply a liberal amount of engine oil to the camshaft bearing caps.

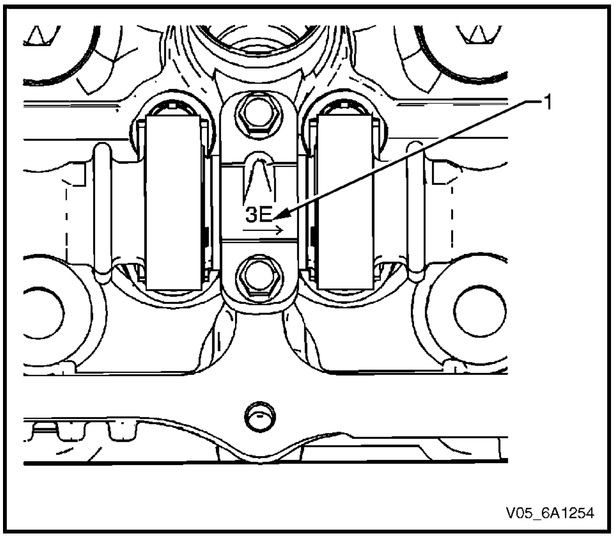


Figure 6A1 – 348

9 Install the camshaft bearing thrust cap (1) in the first journal of the right-hand cylinder head.

10 Install the remaining bearing caps (2) with their orientation mark toward the centre of the cylinder head.

11 Hand start all the camshaft bearing cap bolts (3).

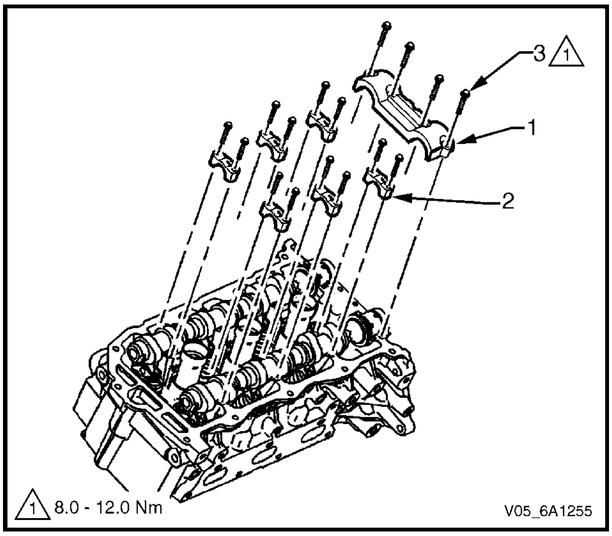


Figure 6A1 – 349

12 Tighten the camshaft bearing cap bolts to the correct torque specification and in the sequence shown.

Camshaft bearing cap attaching bolt torque specification:
Stage 1: ....8.0 – 12.0 Nm

13 Loosen the centre intake camshaft bearing cap bolts 1 and 2, and the centre exhaust camshaft bearing cap bolts 3 and 4.

14 Retighten the centre camshaft bearing cap bolts 1, 2, 3 and 4 to the correct torque specification.

Camshaft bearing cap attaching bolt torque specification:
Stage 2: ....8.0 – 12.0 Nm

15 Install the right-hand cylinder head camshaft sprocket, refer to 3.18 Camshaft Sprocket.

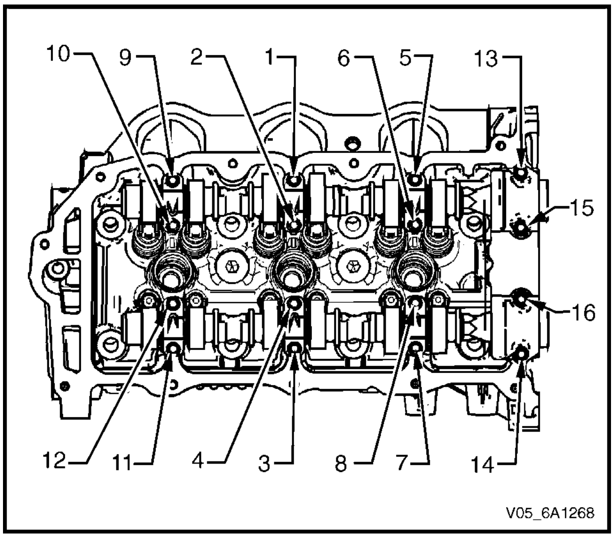


Figure 6A1 – 350

Left-hand Side

1 Select the correct camshaft for the particular installation location. ID markings can be found on the rear end of each camshaft. The ID markings are defined as follows:

- The first five digits refer to the date and time of production.
  - Example = 3L18H.
- Digits six through nine refer to engine production code.
  - LY7 = Alloytec 190 engine.
- The last two digits refer to position:
  - LI = left-hand intake.
  - LE = left-hand exhaust.
  - RI = right-hand intake.
  - RE = right-hand exhaust.

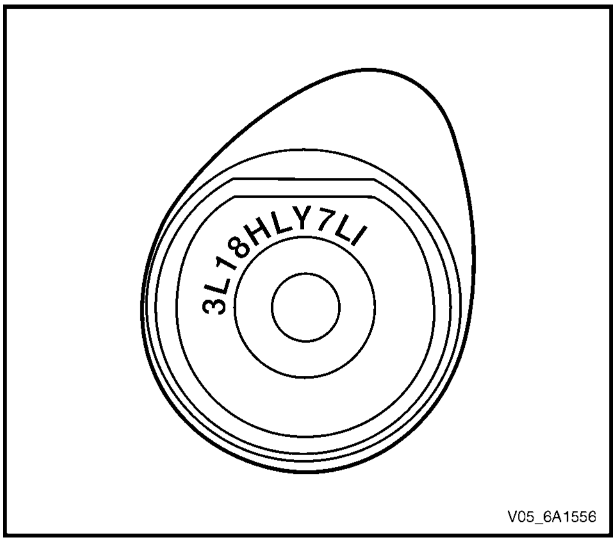


Figure 6A1 – 351

2 Apply a liberal amount of engine oil to the camshaft journals and the left-hand cylinder head camshaft carriers.

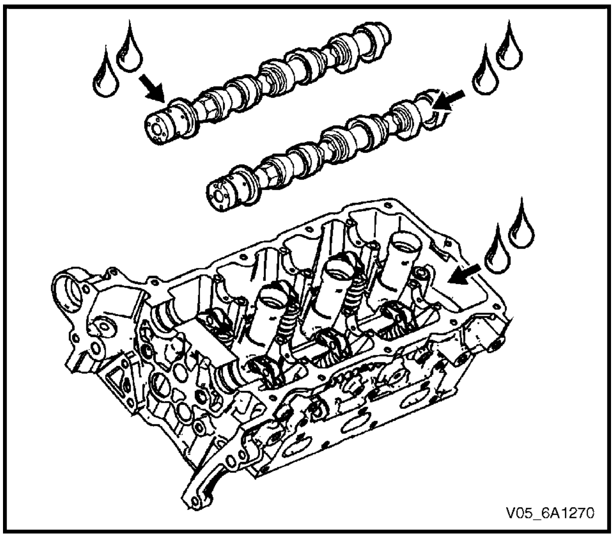


Figure 6A1 – 352

3 Position the camshafts (1) on the cylinder head and assemble the camshaft sprockets to the camshafts.

NOTE

Install the camshaft sprocket bolts but do not tighten at this stage.

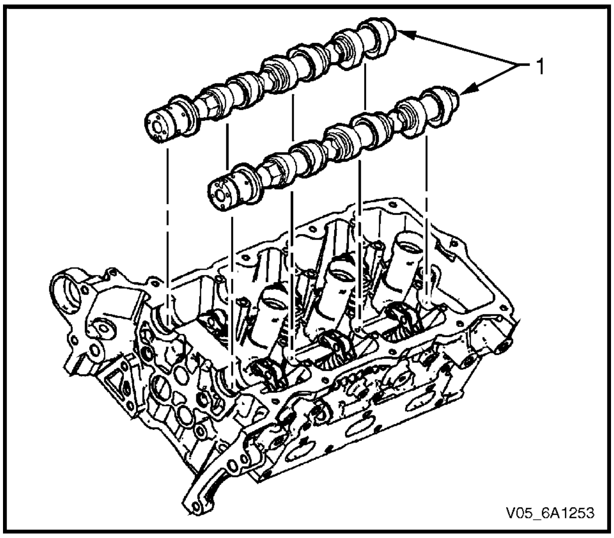


Figure 6A1 – 353

4 Ensure the camshaft lobes are in the neutral position with the flats on the back of the camshafts up and parallel (1) with the left-hand cylinder head camshaft cover rail.

5 Ensure the marks on the left-hand exhaust camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

6 Ensure the marks on the left-hand intake camshaft position actuator and timing chain, made prior to the disassemble operation are aligned.

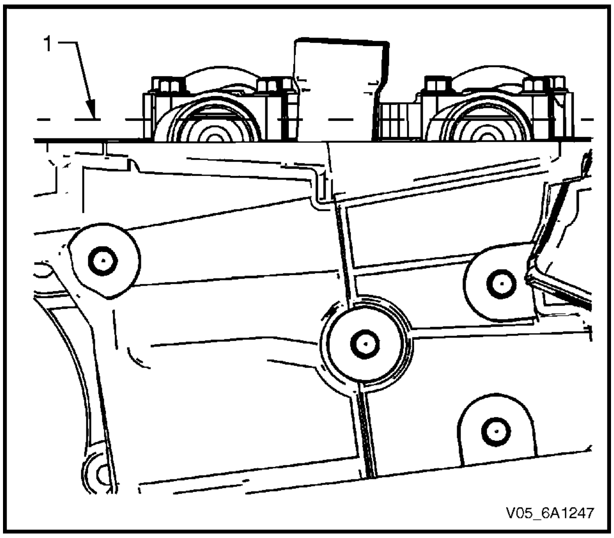


Figure 6A1 – 354

7 Observe the markings on the left-hand cylinder head camshaft bearing caps. Each bearing cap is marked (1) to identify its location. The markings have the following meanings:

- The raised feature must always be oriented toward the centre of the cylinder head.
- The I indicates the intake camshaft.
- The E indicates the exhaust camshaft.
- The number 2, 4, 6 indicates the cylinder position from the front of the engine.

8 Apply a liberal amount of engine oil to the camshaft bearing caps.

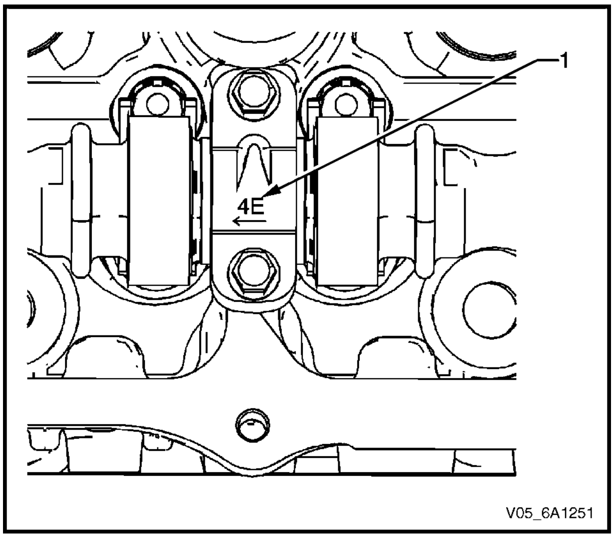


Figure 6A1 – 355

9 Install the camshaft bearing thrust cap (1) in the first journal of the left-hand cylinder head.

10 Install the remaining bearing caps (2) with their orientation mark toward the centre of the cylinder head.

11 Hand start all the camshaft bearing cap bolts (3).

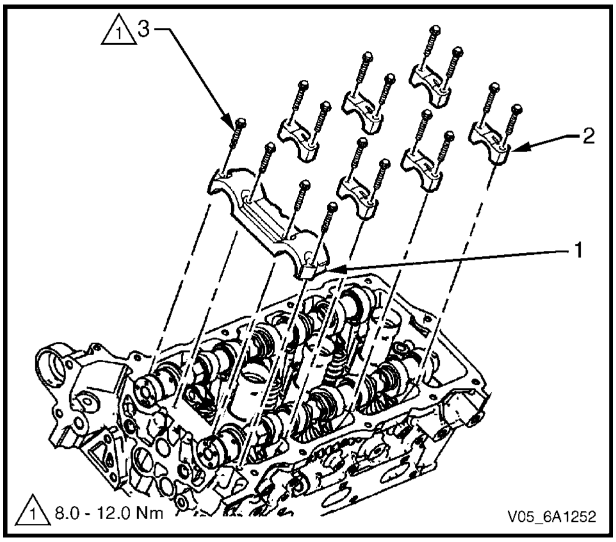


Figure 6A1 – 356

12 Tighten the camshaft bearing cap bolts to the correct torque specification and in the sequence shown.

Camshaft bearing cap bolt torque specification: Stage 1: ....8.0 – 12.0 Nm

13 Loosen the centre intake camshaft bearing cap bolts 1, and 2, and the centre exhaust camshaft bearing cap bolts 3 and 4.

14 Retighten the centre camshaft bearing cap bolts 1, 2, 3 and 4 to the correct torque specification.

Camshaft bearing cap bolt torque specification: Stage 2: ....8.0 – 12.0 Nm

15 Install the right-hand cylinder head camshaft sprocket, refer to 3.18 Camshaft Sprocket.

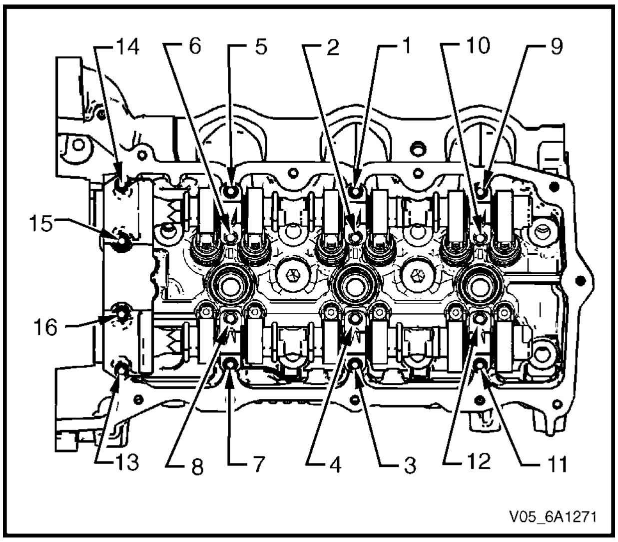
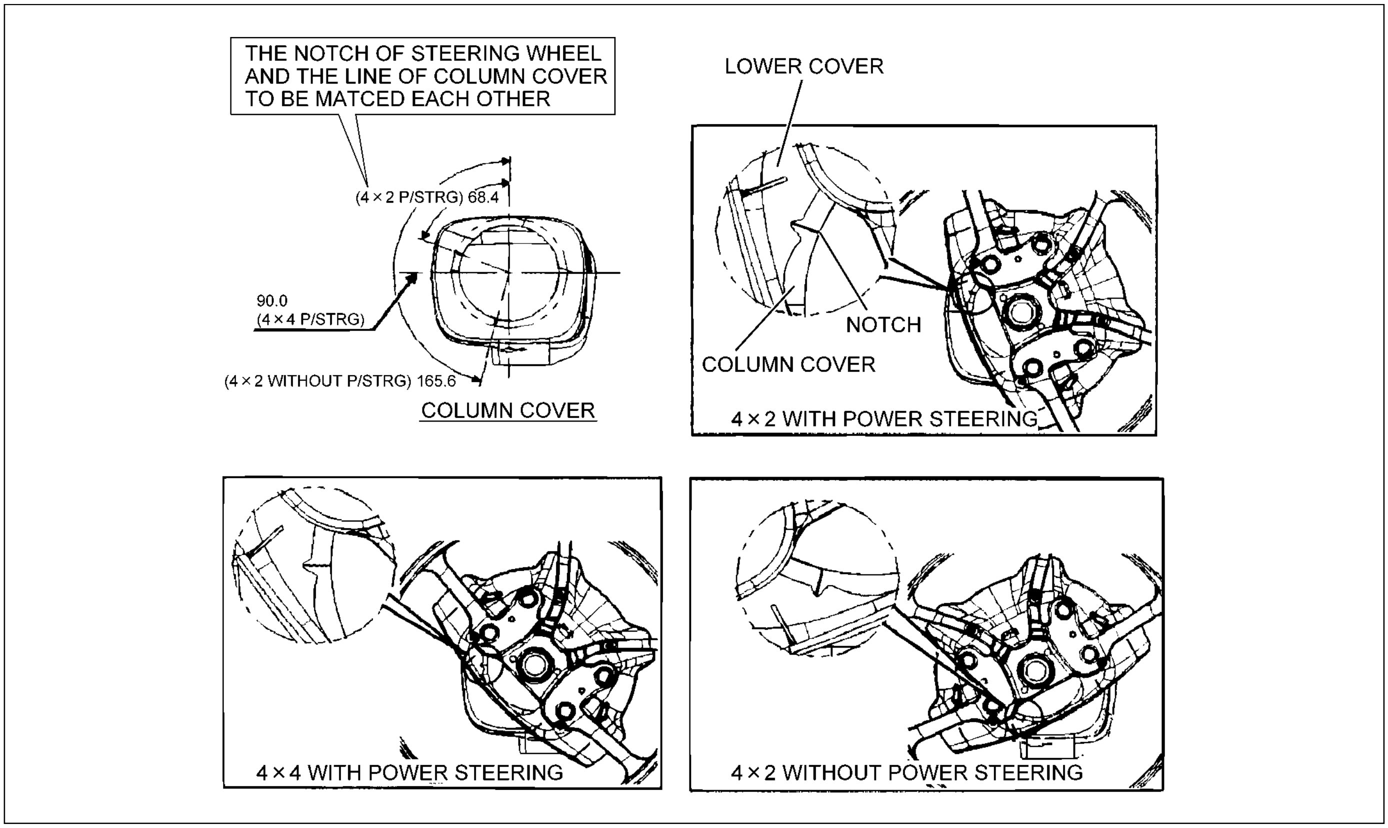


Figure 6A1 – 357

The adjustment method in case a mark has not been applied

with SRS air bag



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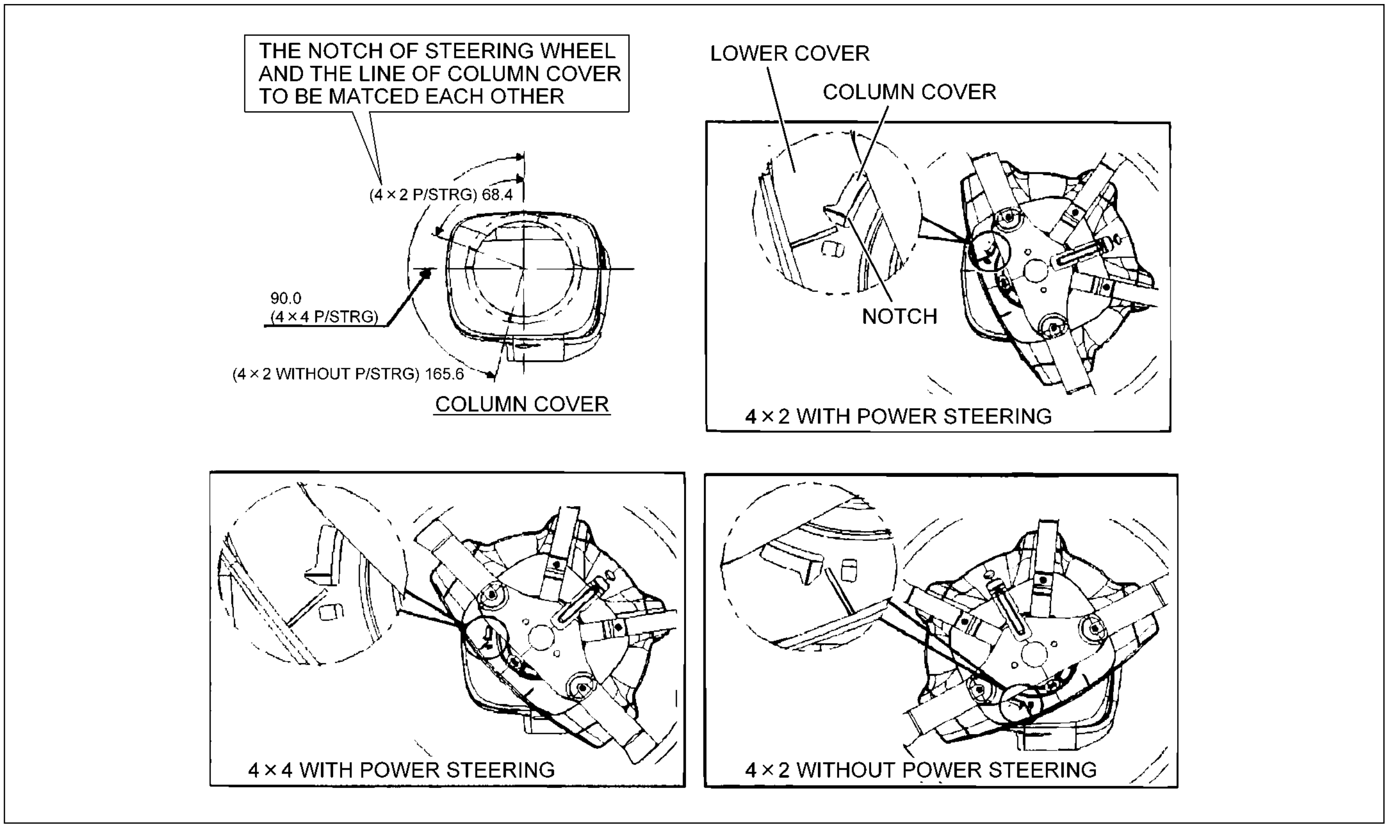
without SRS air bag



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3.21 Rocker Arm

Remove

1 Remove the camshafts from the appropriate cylinder head, refer to 3.19 Camshaft.

2 Remove the rocker arm (1) from the cylinder head (2).

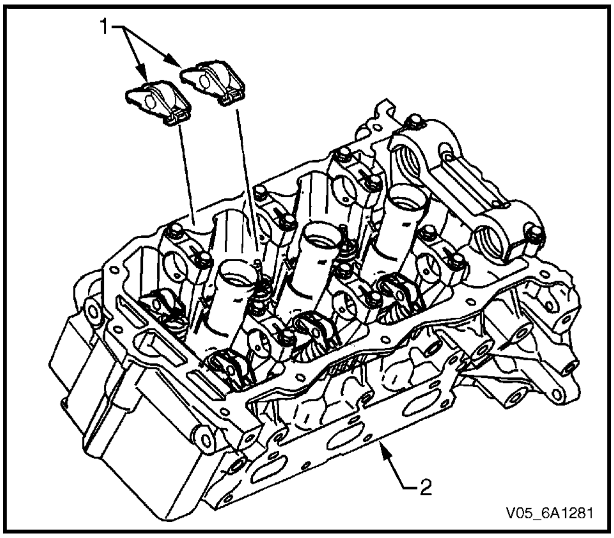

Figure 6A1 – 358

NOTE

Record the rocker arm positions during removal.

CAUTION

If the rocker arms are being reused, they must be reinstalled in their original location.

Clean and Inspect

1 Inspect the rocker arm roller (1) for the following:
- flat spots,
- excessive scoring and pitting, and
- ensure the roller spins freely

2 Inspect the rocker arm valve tip area (2).

3 Inspect the rocker arm stationary hydraulic lash adjuster (SHLA) pivot area (3).

4 Replace the rocker arm as required.

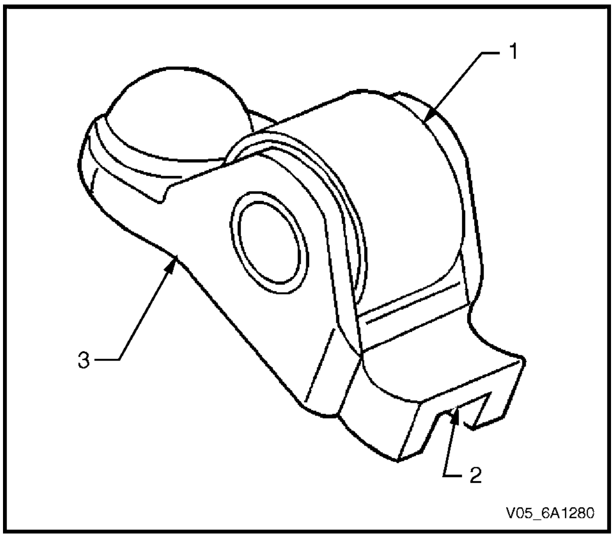

Figure 6A1 – 359

Reinstall

1 Apply a liberal amount of commercially available camshaft / lifter prelube or equivalent to the pivot pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

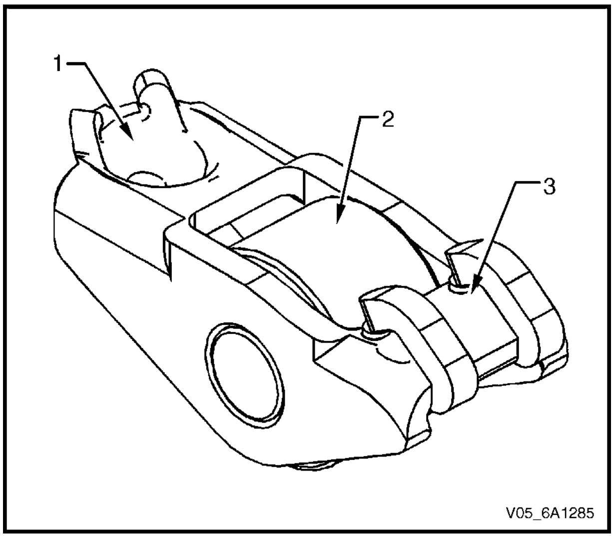

Figure 6A1 – 360

2 Place the rocker arm in position on the valve tip and stationary hydraulic lash adjuster (SHLA). The rounded head end of the arm seats on the SHLA while the flat end seats on the valve tip.

CAUTION

- **The rocker arm (1) must be positioned squarely on the valve tip so the full width of the roller will completely contact the camshaft lobe.**
- **If the rocker arms are being reused, they must be reinstalled in their original location.**

3 Clean the camshaft journals and carriers with a clean, lint-free cloth.

4 Reinstall the camshafts, refer to 3.19 Camshaft.

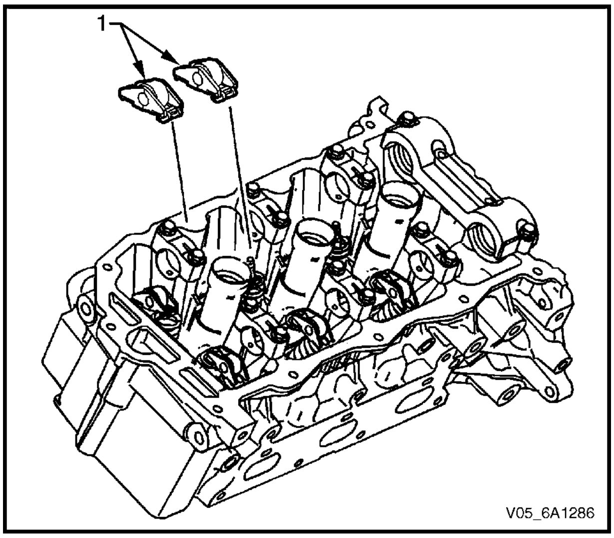

Figure 6A1 – 361

3.22 Stationary Hydraulic Lash Adjuster

Remove

1 Remove the rocker arms from the appropriate cylinder head, refer to 3.20 Rocker Arm.

2 Remove the stationary hydraulic lash adjuster (SHLA) from the cylinder head (2).

CAUTION

- **Do not stroke/cycle the stationary hydraulic lash adjuster (1) plunger without oil in the lower pressure chamber.**
- **Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.**

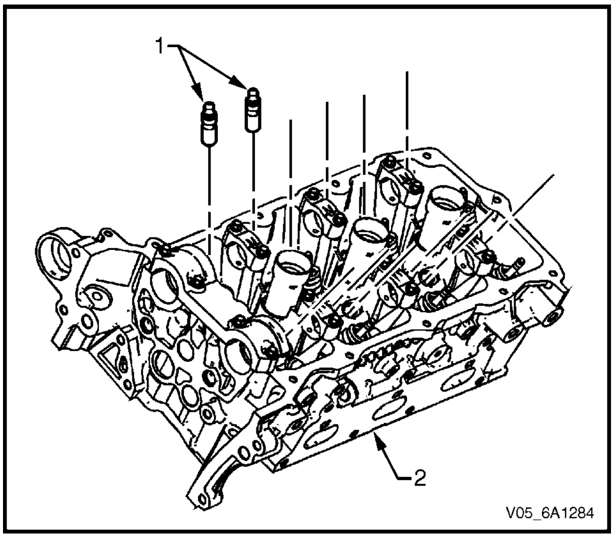

Figure 6A1 – 362

Clean and Inspect

1 Inspect the stationary hydraulic lash adjuster (SHLA) in the following areas:

- a plugged oil passage (1),
- a scored or worn camshaft follower pivot area (2),
- a damaged or broken retainer (3), and
- a severely scuffed or worn SHLA body (4).

2 Replace the SHLA as required.

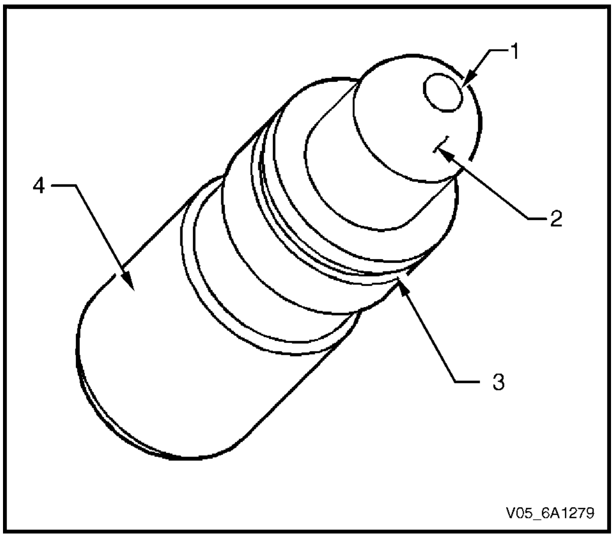

Figure 6A1 – 363

Reinstall

1 Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil. Take precautions to prevent scratching the pivot sphere area of the SHLA.

2 Lubricate the SHLA bores in the cylinder head with clean engine oil.

3 Install the SHLA in the cylinder head (2).

4 Apply a liberal amount of commercially available camshaft/lifter prelube to the SHLA pivot spheres.

5 Install the rocker arms, refer to 3.20 Rocker Arm.

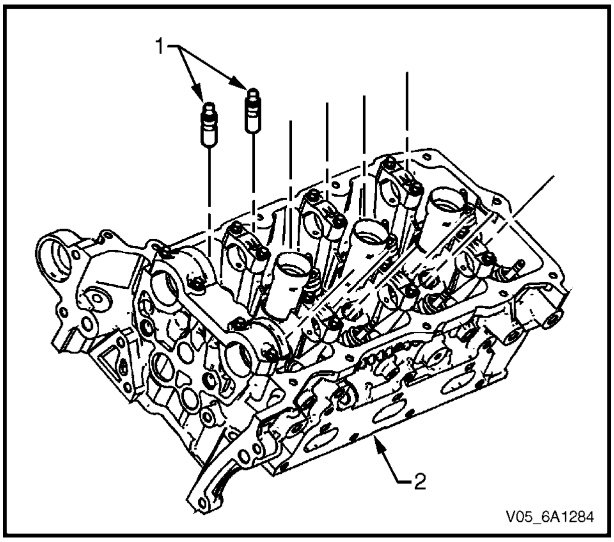

Figure 6A1 – 364

CAUTION

Ensure each lash adjuster (1) is filled with clean engine oil and the adjuster does not tip over, plunger down, before the installation. The loss of oil in the adjuster lower pressure chamber, or the dry stroking/cycling of the adjuster plunger, will allow air to enter the high pressure chamber of the valve lifter. Air in the high pressure chamber of the adjuster may not be purged causing cavitation and extensive engine component damage.

3.23 Cylinder Head Assembly

Remove

Right-hand Side (Bank 1) Cylinder Head

1 Remove the heater hoses and heater pipe assembly, refer to Section 6B1 Engine Cooling – V6.

2 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

3 Remove the exhaust manifold, refer to 3.11 Exhaust Manifold Assembly.

4 Remove engine harness ground terminal attaching bolts from the cylinder head, refer to Section 8A Electrical Body and Chassis.

5 Remove the right-hand side secondary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

6 Remove the camshaft sprockets, refer to 3.18 Camshaft Sprocket.

7 Remove the cylinder head attaching bolt (1), eight places.

8 Remove the cylinder head.

NOTE

There is no bolt fitted to the hole in the rear of the right-hand-hand cylinder head.

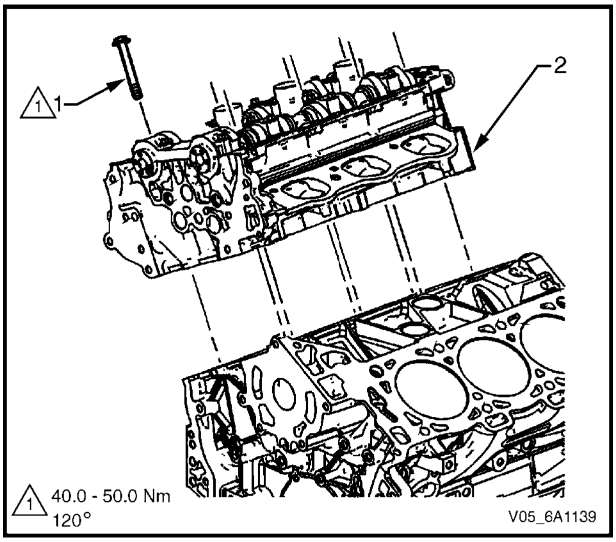

Figure 6A1 – 365

9 Remove and discard the cylinder head gasket (1).

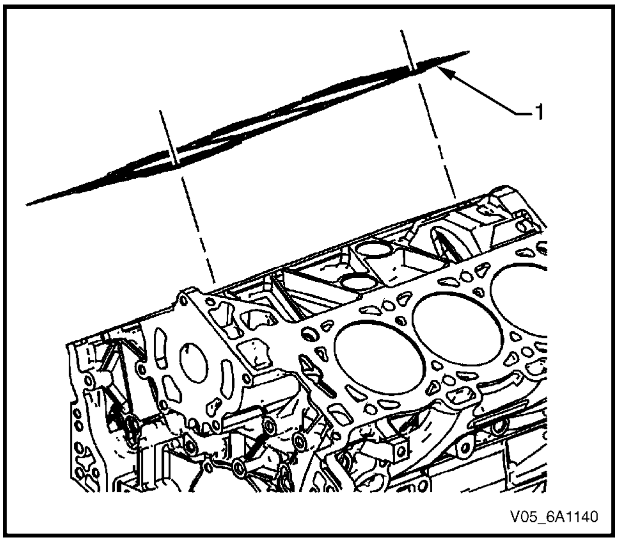

Figure 6A1 – 366

Left-hand Side (Bank 2) Cylinder Head

1 Remove the intake manifold assembly, refer to 3.10 Intake Manifold Assembly – Complete.

2 Remove the exhaust manifold, refer to 3.11 Exhaust Manifold Assembly.

3 Remove the power steering reservoir and pump mounting brackets, refer to 3.8 Power Steering Pump Bracket.

NOTE

Do not disconnect the power steering pipes and/or hoses.

4 Remove the oil filter adapter upper bolt.

NOTE

Do not remove the oil filter adapter.

5 Remove the engine coolant temperature (ECT) sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

6 Remove engine harness ground terminal attaching bolt from cylinder head, refer to Section 8A Electrical Body & Chassis.

7 Remove the left-hand bank secondary timing chain, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

8 Remove the camshaft position actuators, refer to 3.18 Camshaft Sprocket.

9 Remove the front M8 (1) cylinder head attaching bolt, two places.

10 Remove the cylinder head attaching bolt (2), eight places.

11 Remove the cylinder head (3).

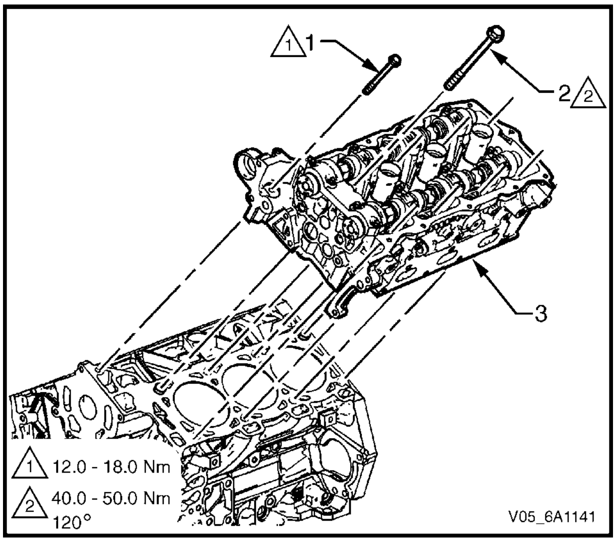

Figure 6A1 – 367

12 Remove and discard the cylinder head gasket (1).

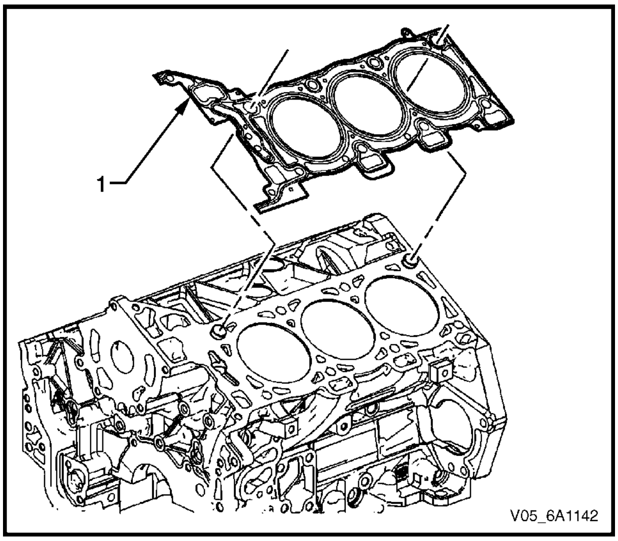

Figure 6A1 – 368

Disassemble

1 Using an appropriately sized deep socket (1) and a plastic hammer (2), lightly tap on the valve spring retainer to loosen the valve collets.

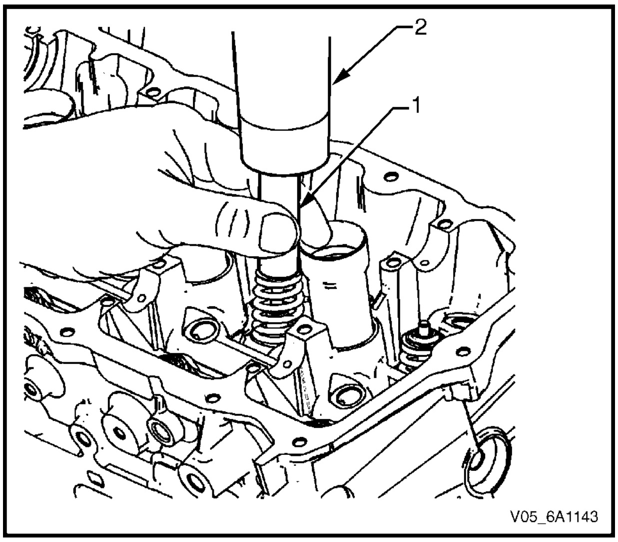

Figure 6A1 – 369

CAUTION

Ensure valve heads will not contact anything during this step in order to avoid bending or damage.

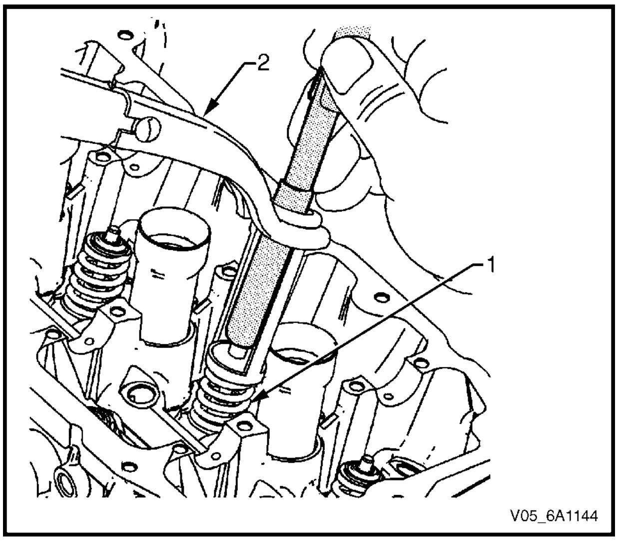

Figure 6A1 – 370

CAUTION

Do not compress the valve springs less than 24.0 mm. Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

WARNING

Compressed valve springs (1) have high tension against the valve spring compressor (2). Valve springs that are not correctly compressed by, or are released from the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

2 Compress the valve spring (1) using valve spring compressor Tool No. J-8062 (2) and adaptor Tool No. EN-46119.

3 Remove the valve collets using Tool EN-46117 (1).

4 Remove the valve spring compressor (2) and the adapter (3).

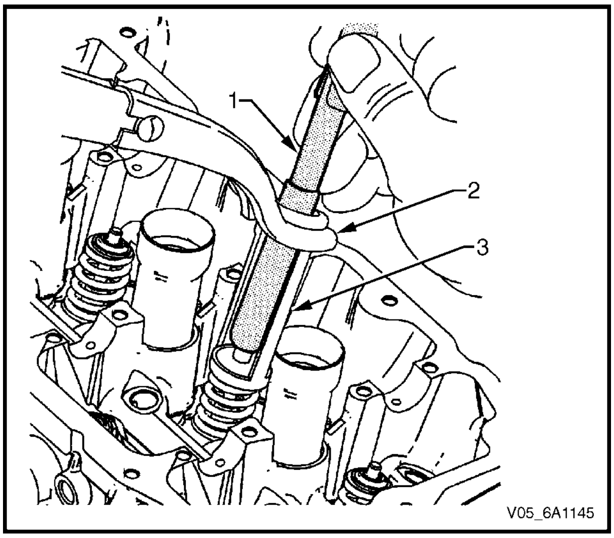

Figure 6A1 – 371

5 Remove the valve spring retainer (1).

6 Remove the valve spring (2).

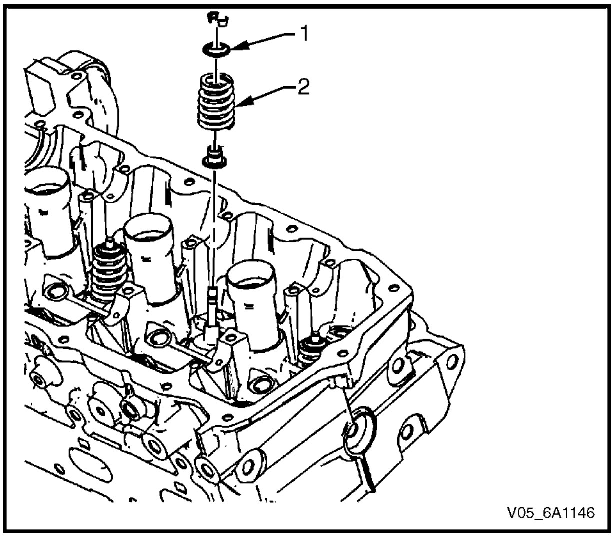

Figure 6A1 – 372

7 Remove the valves (1).

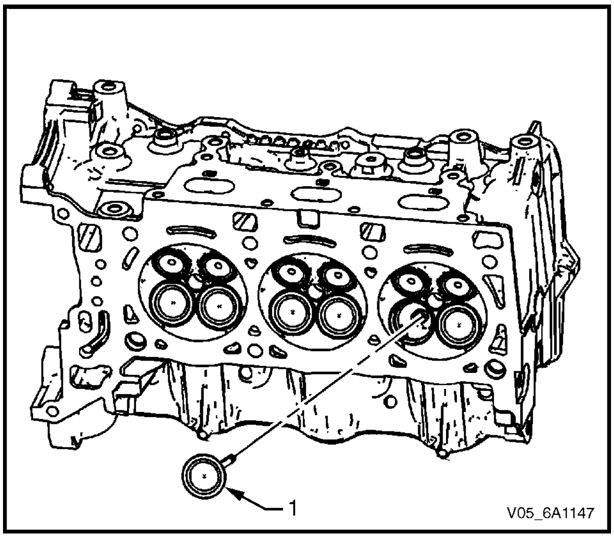

Figure 6A1 – 373

CAUTION

Never reuse a valve stem oil seal.

8 Remove the valve stem oil seal using Tool No. EN-46116 and discard.

9 Repeat these procedures for the remaining valves.

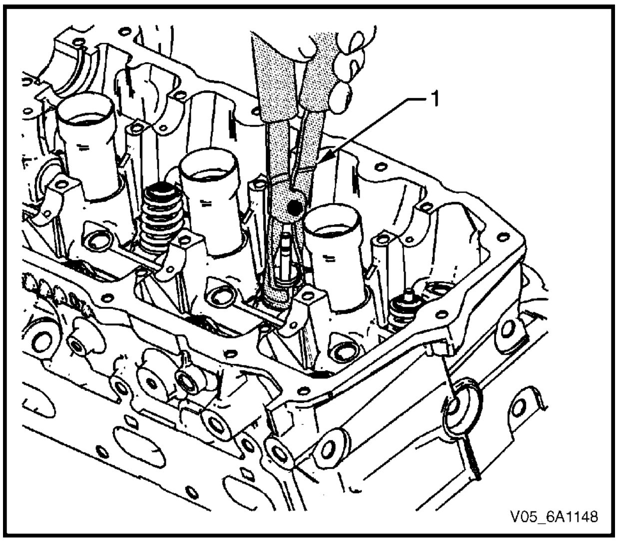

Figure 6A1 – 374

10 Remove the cylinder head oil gallery expansion plugs (1).

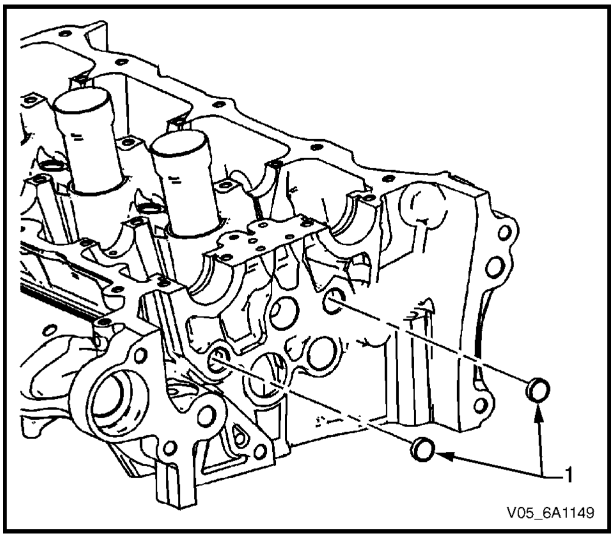

Figure 6A1 – 375

11 Remove the cylinder head coolant threaded plugs (1).

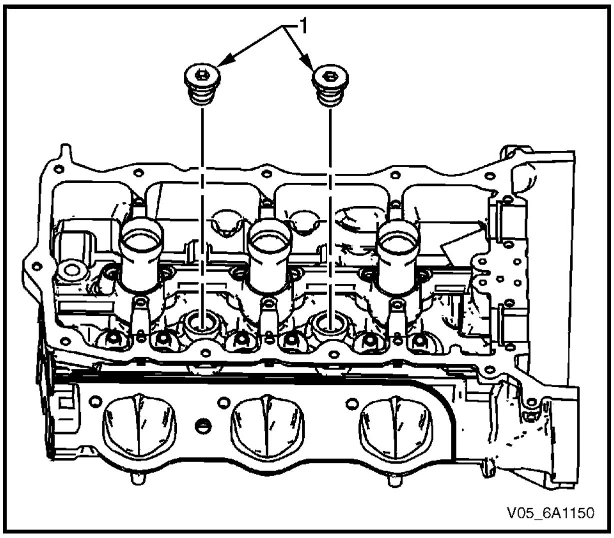

Figure 6A1 – 376

Clean

CAUTION

Due to the aluminium alloy construction of the cylinder head, wire brushes and steel scrapers must not be used during the cleaning process, as damage to sealing surfaces may occur. Use a wood or plastic scraper as an alternative.

1 Remove any old thread sealant, gasket material or sealant using commercially available plastic or wooden scraper.
2 Clean all cylinder head surfaces with non-corrosive solvent.

WARNING

Safety glasses must be worn when using compressed air.

3 Blow out all the oil galleries using compressed air.
4 Remove any carbon deposits from the combustion chambers.
5 Clean any debris or build-up from the lifter pockets.

Inspect

Visual Inspection

1 Inspect the cylinder head (1) camshaft bearing surfaces for the following conditions:
- excessive scoring or pitting,
- discoloration from overheating, and
- deformation from excessive wear.

2 If any of the above conditions exist on the camshaft bearing surfaces, replace the cylinder head. Do not machine the camshaft bearing journals.

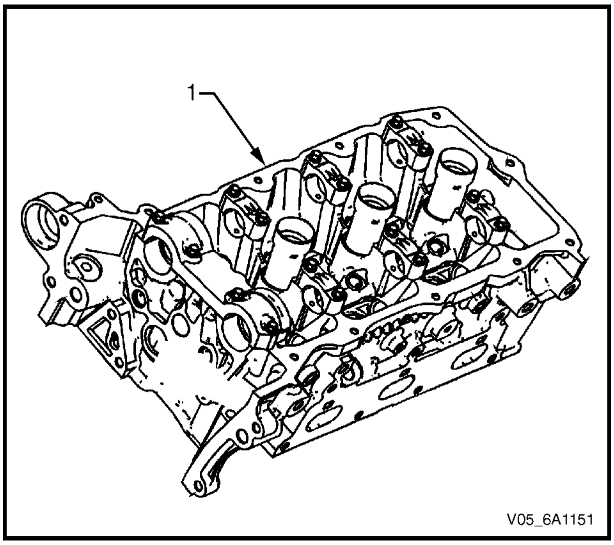

Figure 6A1 – 377

3 Inspect the cylinder head for the following:
- Cracks, damage or pitting in the combustion chambers.
- Debris in the oil galleries. continue to clean the galleries until all debris is removed.
- Coolant leaks or damage to the deck face sealing surface. if coolant leaks are present, measure the surface warpage as described under Cylinder Head Measurement within this Section.
- Burrs or any defects that would degrade the sealing of a new secondary camshaft chain tensioner gasket.
- Damage to any gasket surfaces.
- Damage to any threaded bolt holes.
- Burnt or eroded areas in the combustion chamber.
- Cracks in the exhaust ports and combustion chambers.
- External cracks in the water passages.
- Restrictions in the intake or exhaust passages.
- Restrictions in the cooling system passages.
- Rusted, damaged or leaking core plugs.

4 If the cylinder head is cracked or damaged, it must be replaced. No welding or patching of the cylinder head is recommended.

SECTION 0A

GENERAL INFORMATION

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LUBRICATION	MAKE	BRAND/TYPE	GRADE	
			API	ACEA
Grease fitting (Multi purpose grease)	**ISUZU GENUINE** CALTEX/TEXACO SHELL TOTAL CASTROL BP	**BESCO L-2 GREASE (No. 2), L-3 GREASE (No. 3)** STARPLEX-2 (No. 2) RETINAX LX2 (No. 2) MULTIS EP2, EP3 (No. 2, No. 3) LM GREASE (No. 2, No. 3) ENERGREASE LS (No.2, No3)		
Propeller shaft sliding yoke Universal joint (Multi purpose grease containing molybdenum disulfide)	**ISUZU GENUINE** CALTEX SHELL TOTAL	**ONE LUBER MO GREASE** MOLYTEX GREASE EP2 (No.2) RETINAX HDX2 (No.2) TOTAL MULTIS MS2 (No.2, No.3)		
Engine cooling system	**ISUZU GENUINE** CALTEX/TEXACO/ CHEVRON	**BESCO LLC SUPER TYPE E** EXTENDED LIFE COOLANT HAVOLINE XLC DELO XLC		

NOTE:
* If GL-5 Limited Slip Differential Lubricant is not available, use GL-5 Lubricant mixed with 1 bottle (118ml) of Limited Slip Differential Lubricant additive (Parts No. 8-01052-358-0) or equivalent.

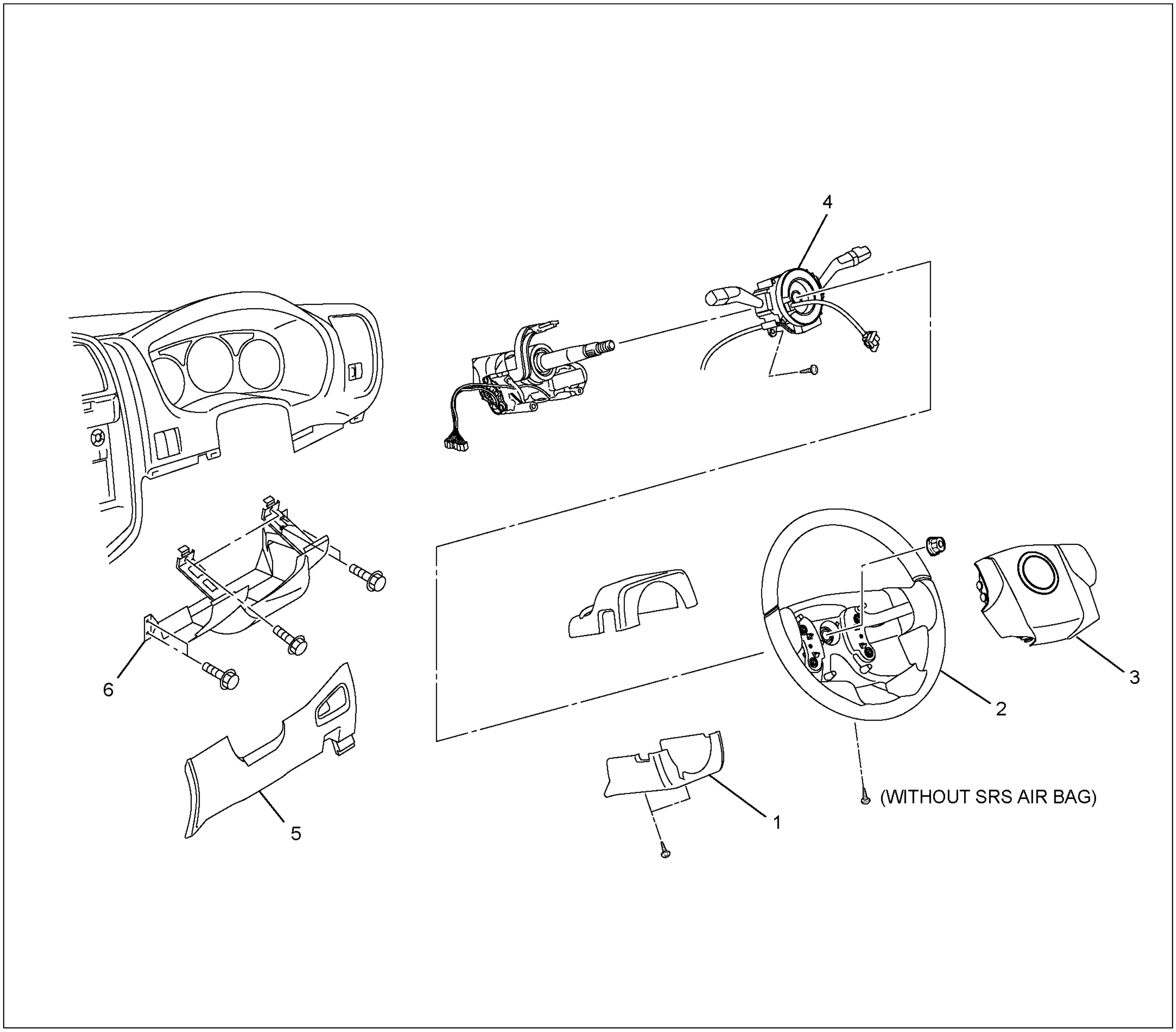
FLUID	TYPE
Clutch and brake fluid reservoir	**Besco brake fluid (For light duty)** Hydraulic brake fluid SAE J1703 FMVSS 116 DOT.3 grade

DIESEL FUEL/APPLICABLE STANDARD	
JIS (JAPANESE INDUSTRIAL STANDARD)	Based on K2204 GAS OIL
DIN (DEUTSCHE INDUSTRIE NORMEN)	Based on EN590 : 1997
SAE (SOCIETY OF AUTOMOTIVE ENGINEERS)	Based on SAE J-313C
BS (BRITISH STANDARD)	Based on BS EN590 : 1997

NOTE:
Use the applicable standard or equivalent for diesel fuels.

Combination Switch

Combination Switch and Associated Parts



RTW73BLF000201

Legend

(1) Steering Column Cover
(2) Steering Wheel
(3) Inflator Module or Horn Pad
(4) Combination Switch and SRS Coil Assembly
(5) Instrument Panel Lower Cover
(6) Driver Knee Bolster (reinforcement)

Removal

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to "LOCK".
3. Disconnect the battery "-" terminal cable, and wait at least 5 minutes (with SRS air bag).
4. Disconnect the yellow 2-way SRS connector located under the steering column (with SRS air bag).

CAUTION: The wheels of the vehicle must be straight ahead and the steering column in the "LOCK" position before disconnecting the steering wheel. Failure to do so will cause the coil assembly to lose its centering which will cause damage to the coil assembly. (with SRS air bag)

5. Remove the engine hood opening lever, then remove instrument panel lower cover.
6. Remove the driver knee bolster (reinforcement).

Cylinder Head Measurement

NOTE

For all cylinder head and associated component specifications, refer to 5 Specifications.

Camshaft Journal Clearance

1 Install the camshaft bearing cap in the cylinder head without the camshaft.

2 Install the camshaft cap bolts and tighten to the correct torque specification

Camshaft bearing cap attaching bolt........8.0 – 12.0 Nm.

3 Measure the camshaft bearings using an inside micrometer.

4 Subtract the camshaft journal diameter from the camshaft bearing diameter. This will provide the running clearance. If the running clearance exceeds specifications and the camshaft journals are within specification, replace the cylinder head.

Camshaft Journal Alignment

1 Ensure the camshafts are serviceable, refer to 3.19 Camshaft for measuring procedures.

2 Inspect the cylinder head camshaft bearing surfaces for any imperfections or scratches that could inhibit correct camshaft clearances. Repair minor imperfections or scratches.

3 Install the camshafts in the cylinder head.

4 Install the camshaft bearing caps.

5 Install the camshaft cap bolts and tighten to the correct torque specification.

Camshaft bearing cap attaching bolt........8.0 – 12.0 Nm.

6 Ensure the camshafts spin freely in the cylinder head. If the camshaft does not run freely, replace the cylinder head.

Deck Flatness Inspection

1 Ensure the cylinder head decks are clean and free of gasket material.

2 Inspect the surface for any imperfections or scratches that could inhibit correct cylinder head gasket sealing.

3 Place a straight-edge (1) diagonally across the cylinder head (2) deck face surface.

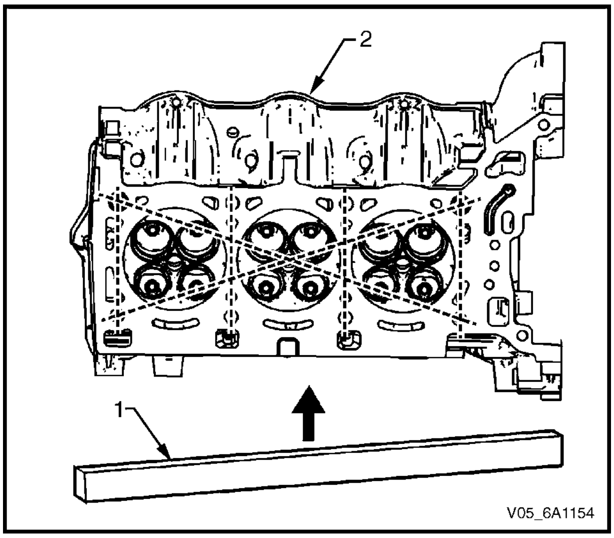
4 Measure the clearance between the straight-edge and the cylinder head deck face using a feeler gauge at four points along the straight-edge.

5 If the warpage is less than 0.05 mm, the cylinder head deck surface does not require resurfacing.

6 If the warpage is between 0.05±0.20 mm or any imperfections or scratches that could inhibit correct cylinder head gasket sealing are present, the cylinder head deck surface requires resurfacing.

7 If resurfacing is required the maximum amount that can be removed is 0.25 mm.

8 If the cylinder head deck surface requires more than 0.25 mm material removal the head must be replaced.



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Valve Guide Measurement

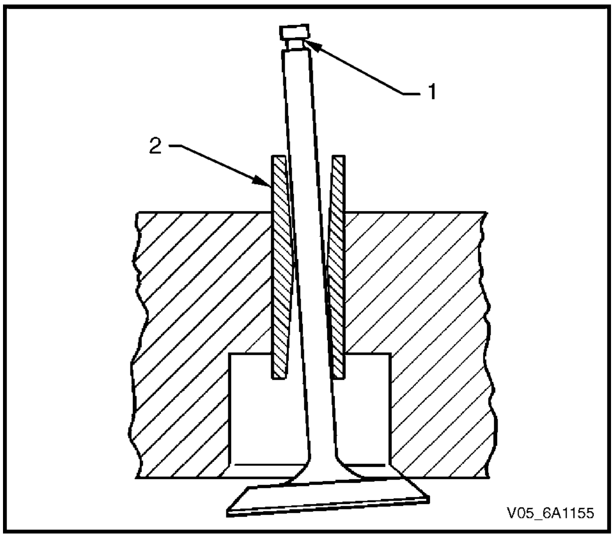


Figure 6A1 – 379

1 Measure the valve stem (1) to-guide (2) clearance. Excessive valve stem-to-guide clearance may cause excessive oil consumption and may also cause a valve to break. Insufficient clearance will result in noisy and sticky functioning of the valve and will disturb the engine assembly smoothness.

2 Clamp a dial indicator to the cylinder head at the camshaft cover rail.

3 Locate the dial indicator so the movement of the valve stem from side to side, crossways to the cylinder head, will cause a direct movement of the indicator stem. The dial indicator stem must contact the side of the valve stem just above the valve guide.

4 Drop the valve head about 0.064 mm off the valve seat.

5 Use light pressure when moving the valve stem from side to side to obtain a clearance reading, refer to 5 Specifications.

- If the clearance for the valve is greater than specified and a new standard diameter valve stem will not bring the clearance within specifications, the valve guide may be oversized by 0.075 mm using the valve guide reamer, Tool No. J 42096 or by 0.375 mm using the valve guide reamer, Tool No. EN-46120. Two sizes of oversized valve stems are available for service.
- Valve guide wear at the bottom 10 mm of the valve guide is not significant enough to affect normal operation.
- If over sizing the guide does not bring the clearance within specifications, replace the cylinder head.

Valve Spring Inspection and Measurement

Inspection Procedure

1 Clean the valve springs in solvent.

WARNING

Safety glasses must be worn when using compressed air

2 Dry the valve springs with compressed air.

3 Inspect the valve springs for broken coils or coil ends.

Measurement Procedure

1 Use a commercially available valve spring tester to measure the valve spring tension, refer to 5 Specifications.

CAUTION

Do not use shims to increase spring load. The use of shims can cause the valve spring to bottom out before the camshaft lobe is at peak lift.

2 If low valve spring load is found, replace the valve springs.

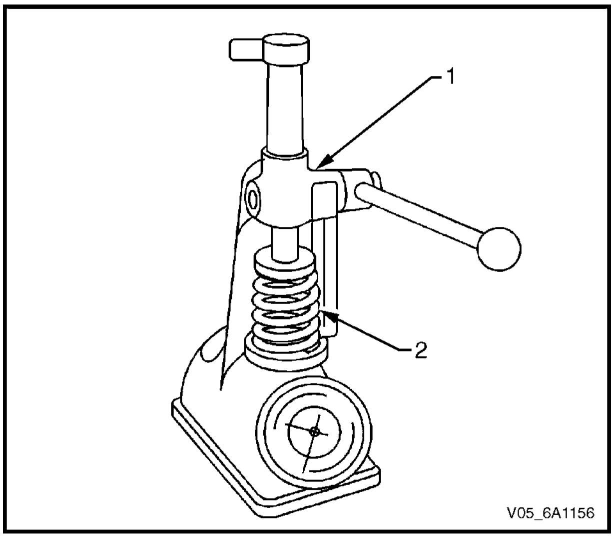


Figure 6A1 – 380

Valve and Seat Grinding

Valve Cleaning Procedure

CAUTION

Do not use a wire brush on any part of the valve stem. The valve stem is chrome plated to provide enhanced wear characteristics. Wire brushing the stem could remove the chrome plating.

1 Use soft bristle brush to clean any carbon build-up from the valve head.

2 Thoroughly clean the valve with solvent and wipe dry.

Valve Visual Inspection Procedure

1 Inspect the valve for damage from the head to tip for the following conditions:
- pitting in the valve seat area (1),
- lack of valve margin (2),
- bending in the valve stem (3),
- pitting or excessive wear in the stem (4),
- worn valve key grooves (5), and
- worn valve tip (6).

2 Replace the valve if any of these conditions exist.

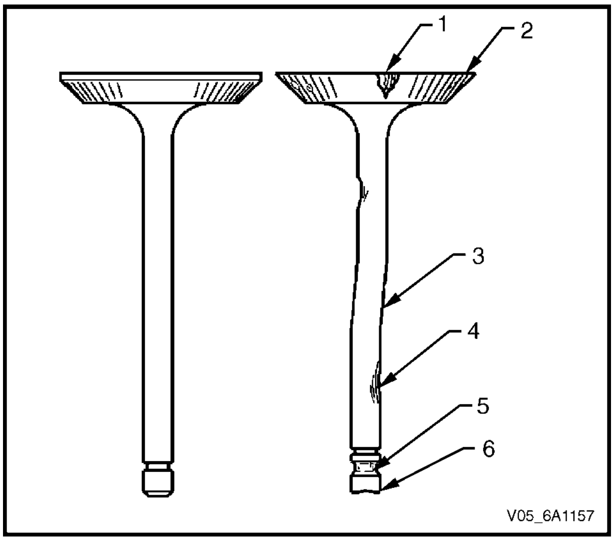


Figure 6A1 – 381

Valve Measurement and Reconditioning Overview

Correct valve service is critical to engine performance. Therefore, all detailed measurement procedures must be followed to identify components that are out of specification. If the measurement procedures reveal the valve or valve seat must be reconditioned, it is critical to perform the measurement procedures after reconditioning.

Valve Seat Width Measurement Procedure

1 Measure the valve seat (1) width in the cylinder head using a scale (2).

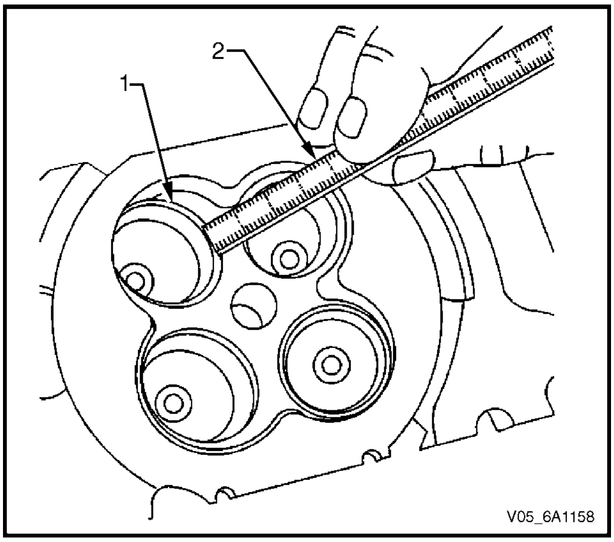


Figure 6A1 – 382

2 Measure the seat width on the valve face (1) using a correct scale.

CAUTION

The seat contact area must be at least 0.5 mm from the outer diameter (margin) of the valve. If the contact area is too close to the margins, the seat must be reconditioned to move the contact area away from the margin.

3 Compare the measurements with the specifications, refer to 5 Specifications.

4 If the seat widths are acceptable, check the valve seat roundness, refer to Valve Seat Roundness Measurement Procedure in this Section.

5 If the seat width is not acceptable, grind the valve seat to bring the width back to specification. Correct valve seat width is critical to providing the correct amount of valve heat dissipation, refer to Valve and Seat Reconditioning Procedure in this Section.

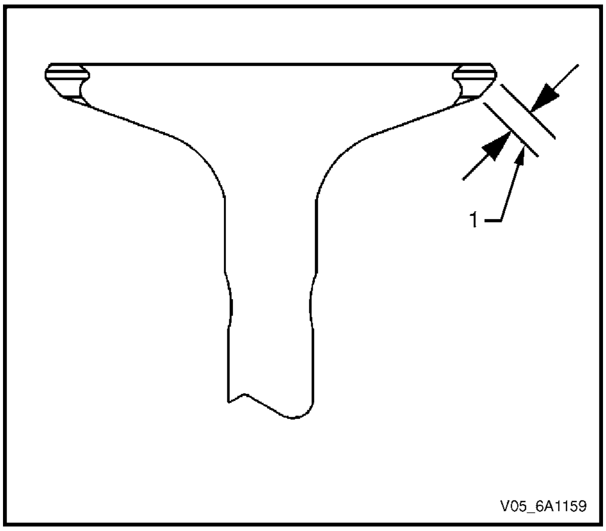


Figure 6A1 – 383

Valve Seat Roundness Measurement Procedure

1 Measure the valve seat roundness using a dial indicator attached to a tapered pilot installed in the guide. The pilot should have a slight bind when installed in the guide.

CAUTION

The correct size pilot must be used. Do not use adjustable diameter pilots. Adjustable pilots may damage the valve guides.

2 Compare your measurements with the specifications, refer to 5 Specifications.

3 If the valve seat exceeds the roundness specification, grind the valve and valve seat, refer to Valve and Seat Reconditioning Procedure in this Section.

4 If new valves are being used, the valve seat roundness must be within 0.05 mm.

Valve Margin Measurement Procedure

1 Measure the valve margin using an appropriate scale.

2 Refer to 5 Specifications for minimum valve margin and compare them to your measurements.

3 If the valve margins are beyond specification, replace the valves.

4 If the valve margins are within specification and do not require refacing, test the valve for seat concentricity, refer to Valve-to-Seat Concentricity Measurement Procedure in this Section.

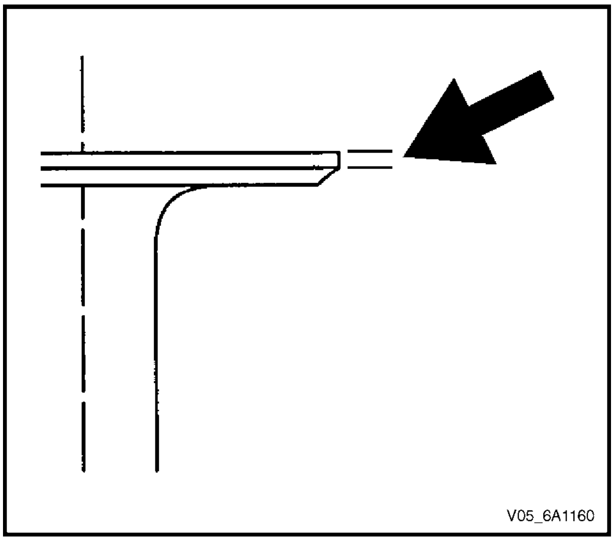


Figure 6A1 – 384

Valve-to-Seat Concentricity Measurement Procedure

Checking the valve-to-seat concentricity determines whether the valve and seat are sealing correctly.

Measure the valve face and the valve seat to ensure correct valve sealing.

1 Coat the valve face lightly with blue dye (3).
2 Install the valve in the cylinder head.
3 Turn the valve against the seat with enough pressure to wear off the dye.
4 Remove the valve from the cylinder head.
5 Inspect the valve face.

NOTE

- If the valve face is concentric, providing a correct seal, with the valve stem, a continuous mark (1) will be made around the entire face (2).
- The wear mark must be at least 0.5 mm from the margin of the valve. If the wear mark is too close to the margin, the seat must be reconditioned to move the contact area away from the margin.
- If the face is not concentric with the stem, the mark will not be continuous around the valve face. The valve should be refaced or replaced and the seat must be reconditioned, refer to Valve and Seat Reconditioning Procedure in this Section.

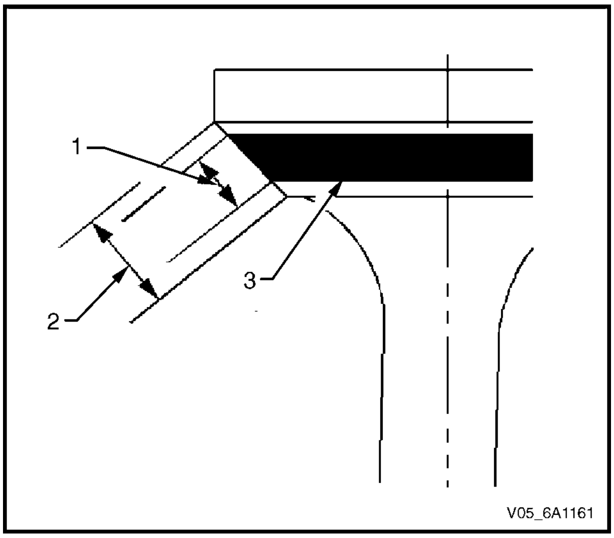


Figure 6A1 – 385

Valve and Seat Reconditioning Procedure

If the valve seat width, roundness or concentricity are beyond specifications, grind the seats in order to ensure correct heat dissipation and prevent the build up of carbon on the seats.

If valve seat reconditioning is required, reface the valve face, unless a new valve is used.

1 Grind the valve seats (2) to the correct angle specification, refer to 5 Specifications.
2 Using the correct angle specification, grind and relieve the valve seats (1) to correctly position the valve seating surface (2) to the valve.
3 Using the correct angle specification, grind and undercut the valve seats (3) to narrow the valve seat widths to the specifications, refer to 5 Specifications.
4 If the original valve is being used, grind the valve to the specifications, refer to 5 Specifications. Measure the valve margin again after grinding, refer to Valve Margin Measurement Procedure in this Section. Replace the valve if the margin is out of specification. New valves do not require grinding.
5 When grinding the valves and seats, grind off as little material as possible. Cutting valve seat results in lowering the valve spring pressure.
6 Install the valve in the cylinder head.

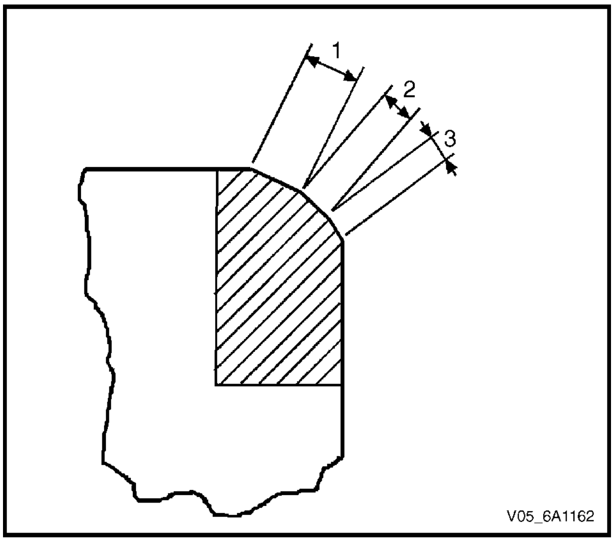


Figure 6A1 – 386

CAUTION

If using refaced valves, lap the valves into the seats with a fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that minimal lapping is required. Excessive lapping will groove the valve face and prevent a good seat when hot.

NOTE

- Clean any remaining lapping compound from the valve and seat with solvent and compressed air prior to final assembly.
- If fitting new valves, do not lap the valves under any condition.

7 After obtaining the correct valve seat width in the cylinder head, measure the valve stem height, refer to Valve Stem Height Measurement Procedure in this Section.

8 If the valve stem height is acceptable, test the seats for concentricity, refer to Valve-to-Seat Concentricity Measurement Procedure in this Section.

Valve Stem Height Measurement Procedure

CAUTION

To determine the valve stem height measurement, measure from the valve spring seat to the valve spring retainer.

1 Install the valve into the valve guide.

2 Ensure the valve is seated to the valve seat.

3 Install the valve stem oil seal.

4 Install the valve spring retainer and valve stem keys.

5 Measure the distance (1) between the cylinder head to the bottom of the valve spring retainer, refer to 5 Specifications.

6 If the maximum height specification is exceeded, a new valve should be installed and the valve stem height re-measured.

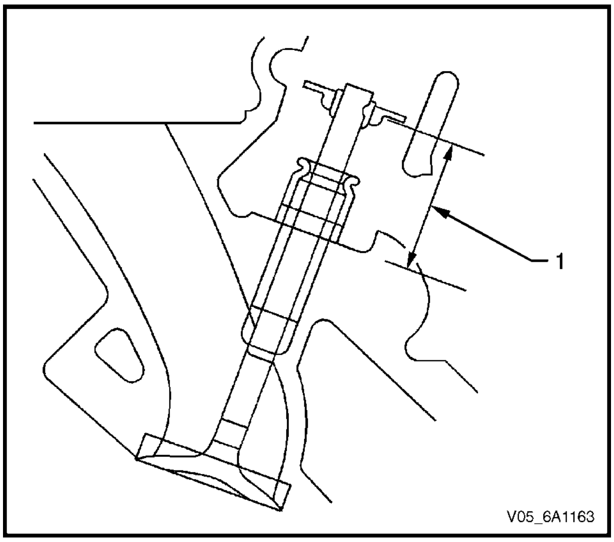


Figure 6A1 – 387

CAUTION

Do not grind the valve stem tip. The tip of the valve is hardened and grinding the tip will eliminate the hardened surface causing premature wear and possible engine damage.

CAUTION

Do not use shims to adjust valve stem height. The use of shims will cause the valve spring to bottom out before the camshaft lobe is at peak lift and engine damage could result.

7 If the valve stem height still exceeds the maximum height specification, the cylinder head must be replaced.

Assemble

1 Install the cylinder head coolant threaded plugs (1) and tighten to the correct torque specification.

Cylinder head threaded plug	31.0 Nm

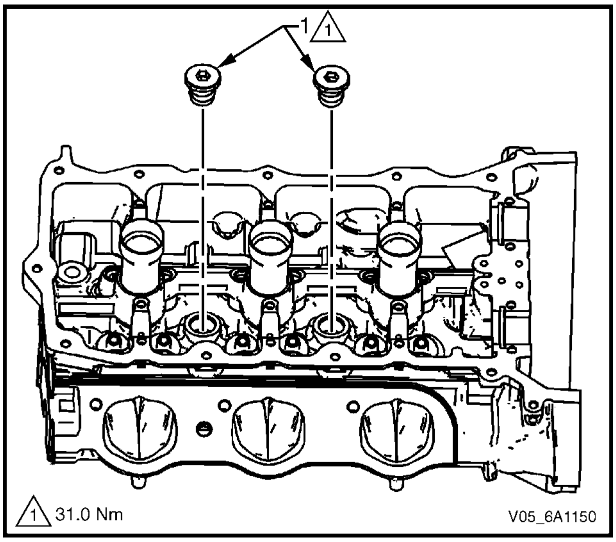


Figure 6A1 – 388

2 Install the cylinder head oil gallery expansion plugs (1).

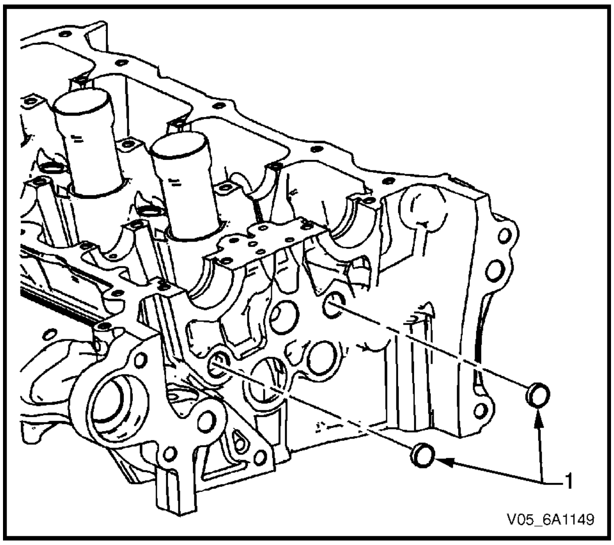


Figure 6A1 – 389

CAUTION

- **Never reuse a valve stem oil seal. Always use new seals when assembling the cylinder head.**
- **Force should only be applied to the valve spring contact area of the new valve stem oil seal during installation.**

3 Fit the valve stem oil seals onto the guides using Tool No. EN-46116 (1).

4 Push and twist the valve stem oil seal into position on the valve guide until the seal positively locks on the guide using Tool No. EN-46116.

5 Lubricate the valve stem and valve guide ID with clean engine oil.

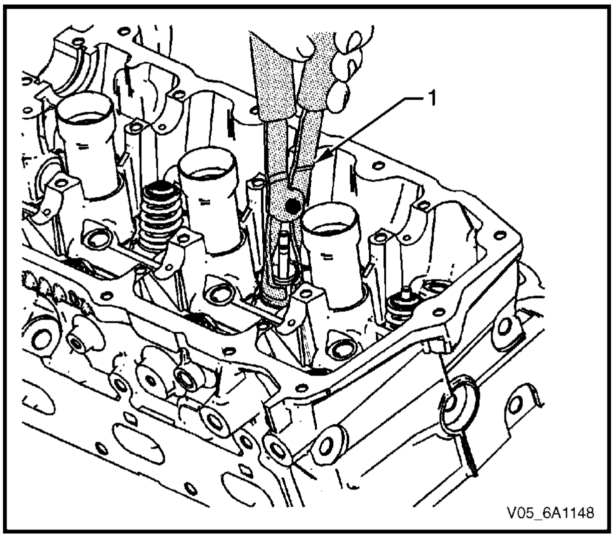


Figure 6A1 – 390

CAUTION

The valve stem oil seal must not come loose from the valve guide when the valve (1) is installed.

6 Insert the valve into the valve guide until it bottoms on the valve seat.

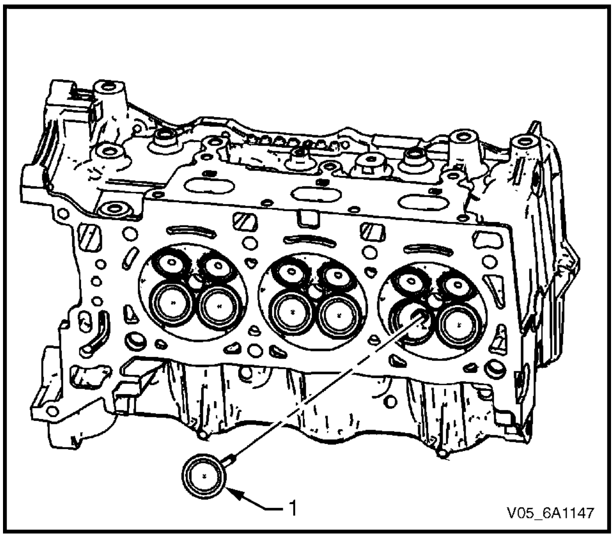


Figure 6A1 – 391

7 Position the valve spring (2) on the spring seat (1).

8 Place the valve spring retainer onto the valve spring.

CAUTION

Do not compress the valve springs less than 24.0 mm. Contact between the valve spring retainer and the valve stem oil seal can cause potential valve stem oil seal damage.

WARNING

Compressed valve springs (1) have high tension against the valve spring compressor (2). Valve springs that are not correctly compressed by, or are released from, the valve spring compressor can be ejected from the valve spring compressor with intense force. Use care when compressing or releasing the valve spring with the valve spring compressor and when removing or installing the valve stem keys. Failing to use care may cause personal injury.

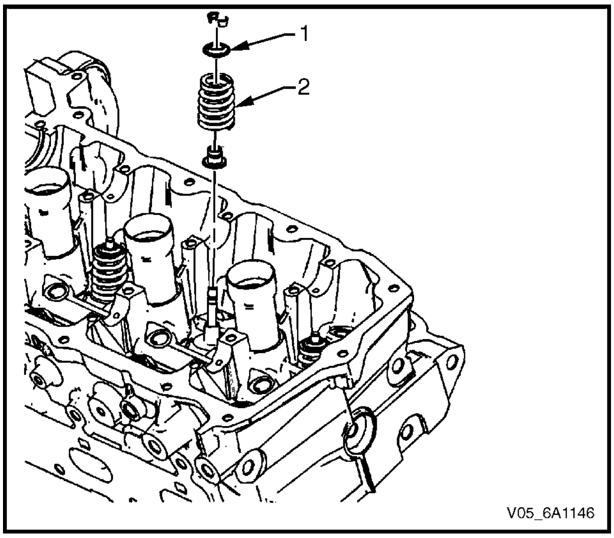


Figure 6A1 – 392

9 Compress the valve spring using valve spring compressor Tool No. J-8062 and adaptor Tool No. EN-46119.

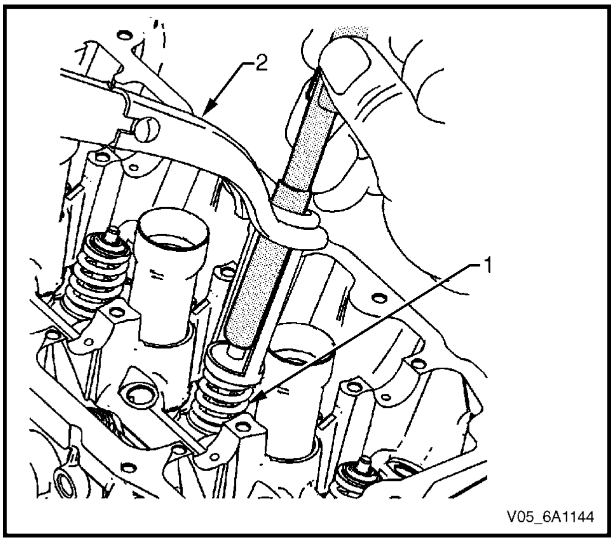


Figure 6A1 – 393

CAUTION

Ensure correct directional placement of valve collets (1) in Tool No. EN-46117 (2). The valve collets must be installed with the tapered end towards the valve stem seal.

10 With the spring compressed, install the valve collets into Tool No. EN 46117.

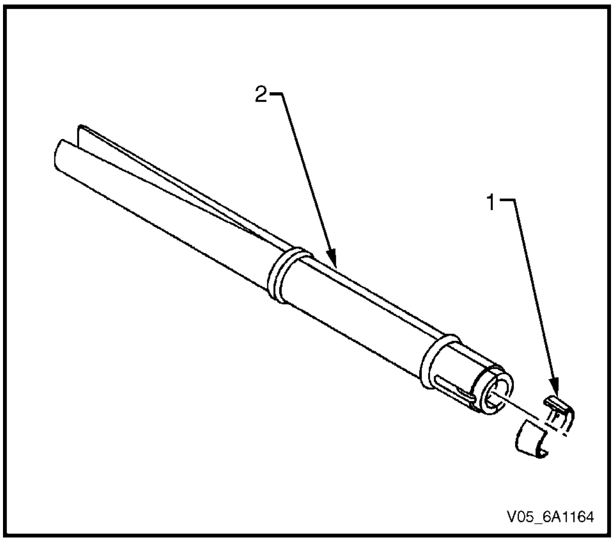


Figure 6A1 – 394

11 Place the collets into position by pushing the tool (1) downward and releasing tension on the valve spring compressor (2).

12 Verify the valve collets are installed by placing a rag over the valve tip and tapping with a dead-blow hammer. The valve collets and the spring should remain in place.

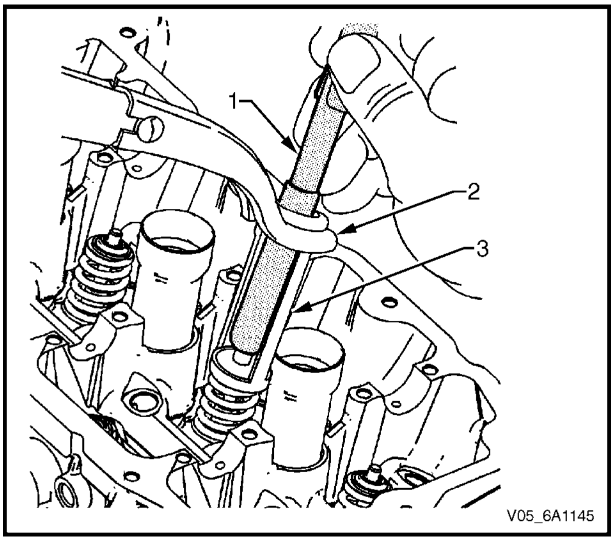
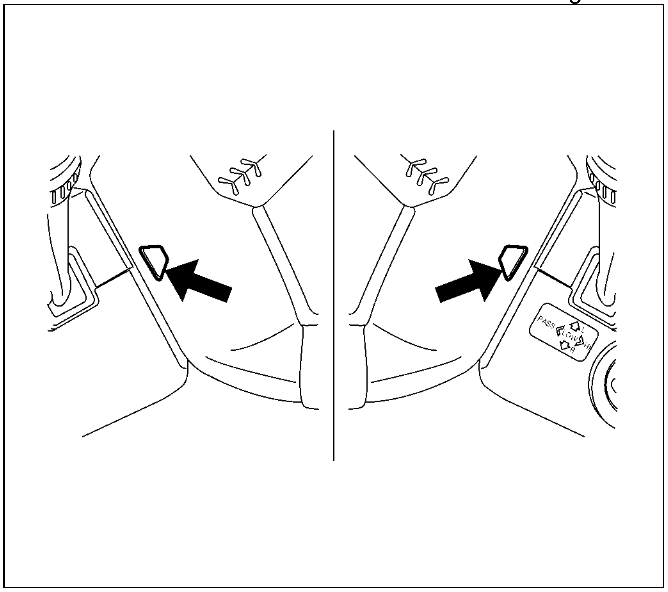


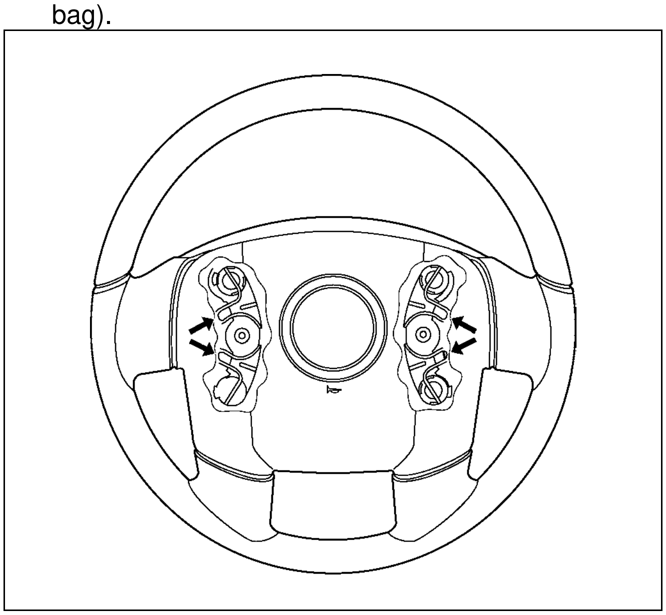
Figure 6A1 – 395

7. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).
8. Check the holes on both sides of the steering cover.



060R300025

9. Check the position of the pins in their holes. Push the pin in the direction of the arrow (with SRS air bag).



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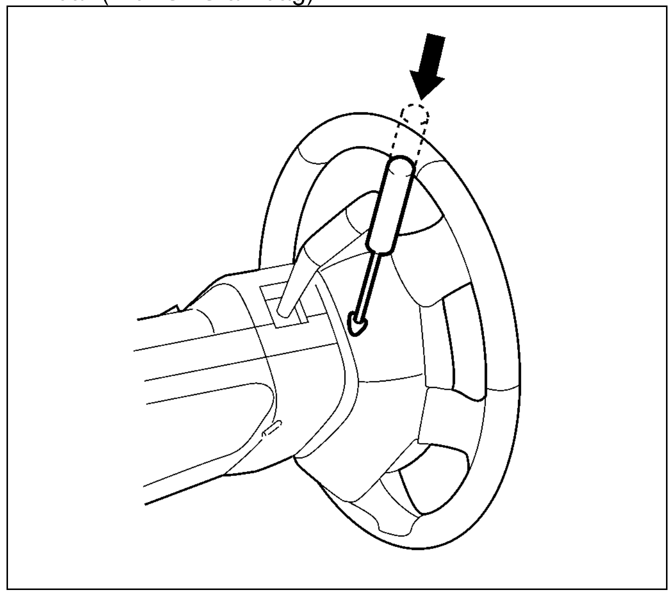
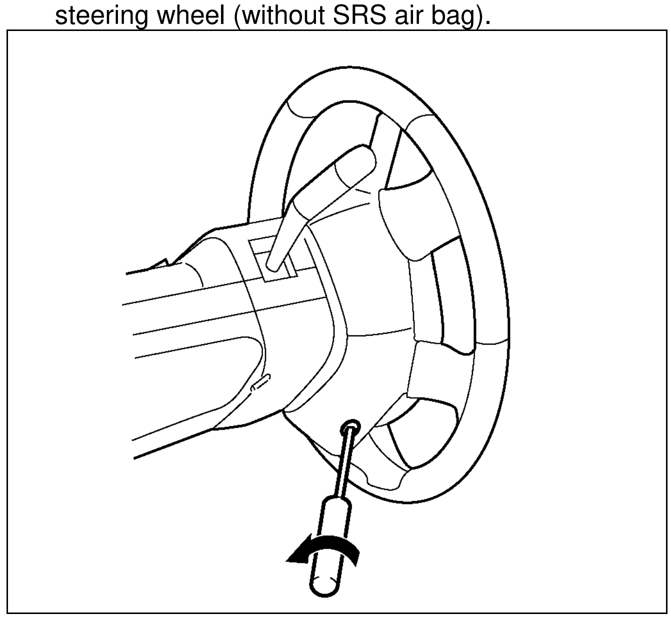
10. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



060R300031

11. Cancel the lock to release the four pins (with SRS air bag).
12. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



430R300009

Reinstall

Right-hand Side (Bank 1) Cylinder Head

The reinstallation procedure for the right-hand side cylinder head assembly is the reverse of the removal procedure, noting the following:

1 Ensure all fasteners are tightened to the correct torque specification.

2 Using crankshaft rotation Tool No. EN-46111 (1), align the crankshaft sprocket timing mark (2) with the indexing mark (3) on the oil pump housing.

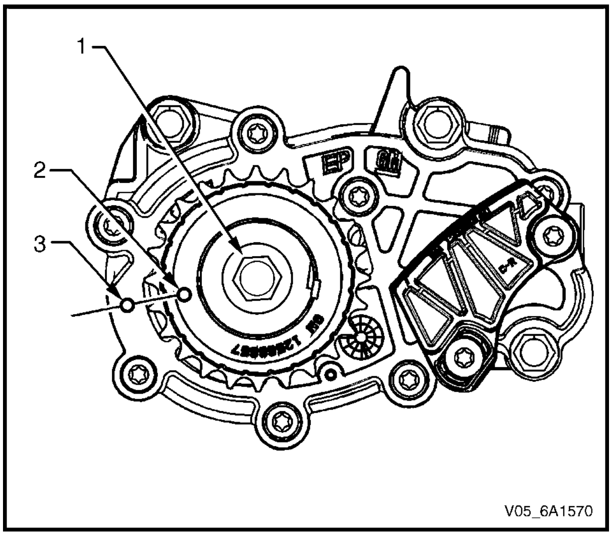


Figure 6A1 – 396

3 Ensure the deck face is clean and the cylinder head locating pins are securely mounted in the cylinder block deck face.

4 Install a new right-hand cylinder head gasket (1) using the deck face locating pins for retention.

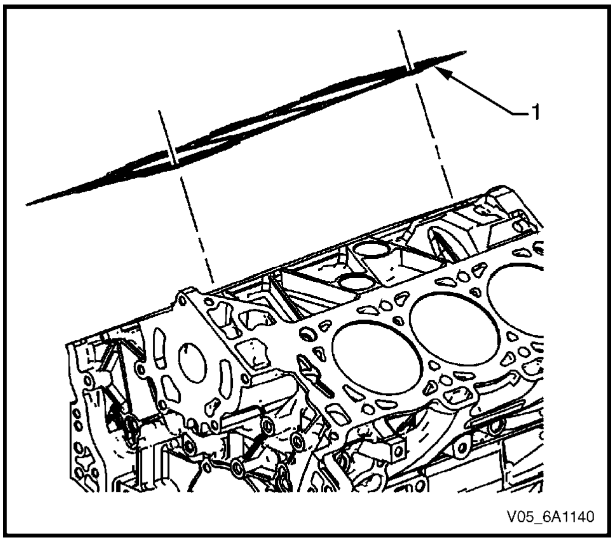


Figure 6A1 – 397

5 Align the cylinder head with the locating pins.

6 Place the cylinder head in position on the deck face.

NOTE

Do not allow oil on the cylinder head bolt bosses.

CAUTION

Do not reuse the old M11 cylinder head bolts (1 to 8 inclusive).

7 Install new M11 cylinder head bolts (1) eight places and tighten in the sequence shown and to the correct torque specification.

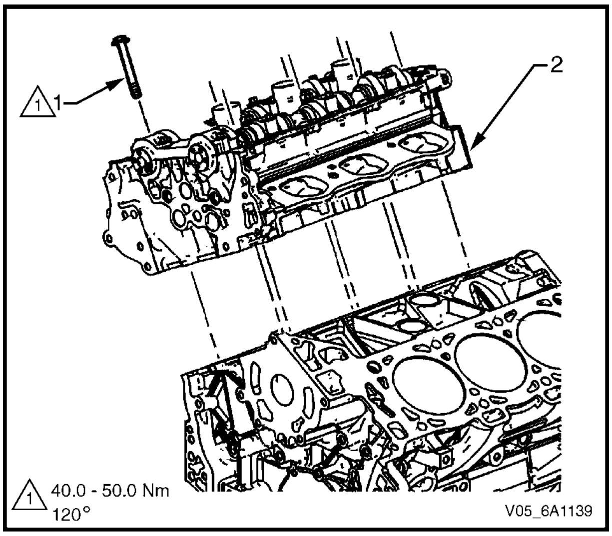


Figure 6A1 – 398

■ Cylinder head M11 attaching bolt torque specification:

Stage 1: ....40.0 – 50.0 Nm
Stage 2: ....120°

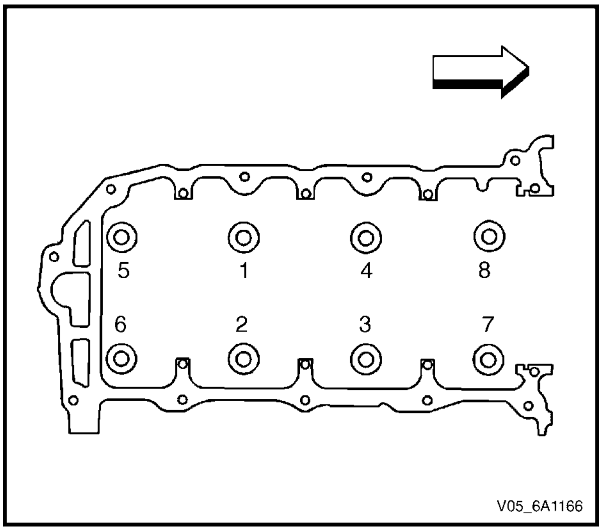


Figure 6A1 – 399

Left-hand Side (Bank 2) Cylinder Head

The reinstallation procedure for the left-hand side cylinder head assembly is the reverse of the removal procedure, noting the following:

1 Ensure all fasteners are tightened to the correct torque specification.

2 Using crankshaft rotation Tool No. EN-46111 (1), align the crankshaft sprocket timing mark (2) with the indexing mark (3) on the oil pump housing.

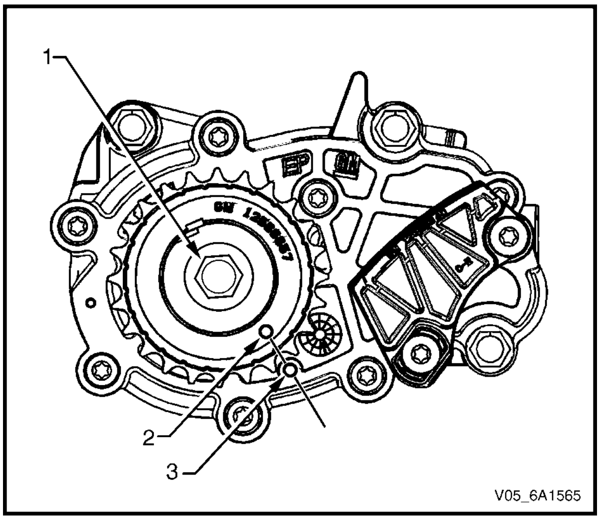


Figure 6A1 – 400

3 Ensure the deck face is clean and the cylinder head locating pins are securely mounted in the cylinder block deck face.

4 Install a new cylinder head gasket (1) using the deck face locating pins for retention.

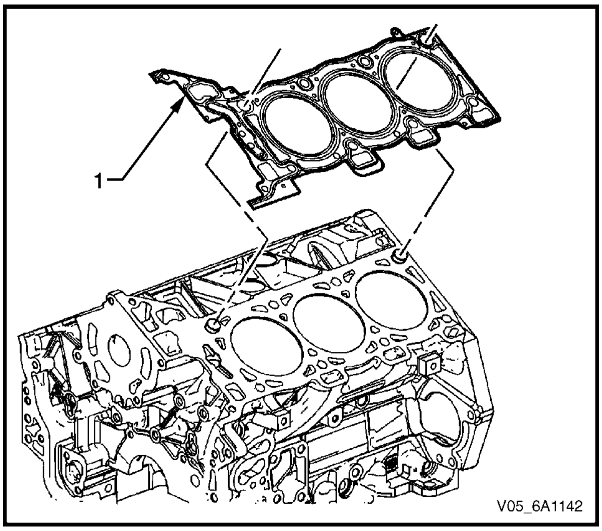


Figure 6A1 – 401

5 Align the cylinder head with the locating pins.

6 Place the cylinder head in position on the deck face.

NOTE

Do not allow oil on the cylinder head bolt bosses.

CAUTION

Do not reuse the old M11 cylinder head bolts (1 to 8 inclusive).

7 Install new M11 cylinder head bolt (1), eight places, and tighten in the sequence shown and to the correct torque specification.

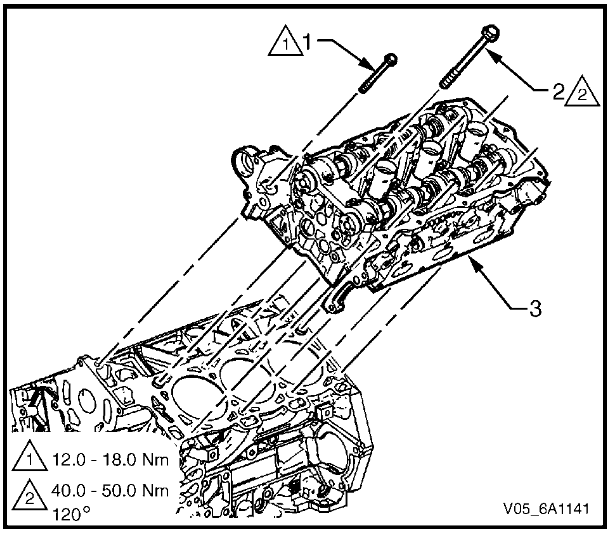


Figure 6A1 – 402

8 Install the front M8 cylinder head bolt (2), two places, and tighten in the sequence (9 and 10) and to the correct torque.

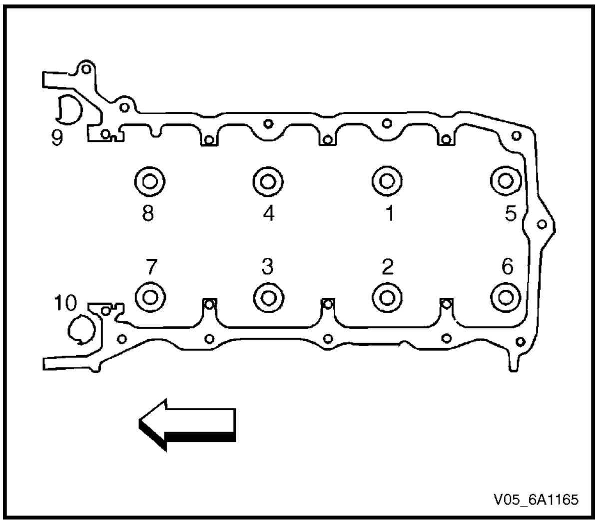


Figure 6A1 – 403

■ Cylinder head M11 attaching bolt torque specification:

Stage 1: ....40.0 – 50.0 Nm
Stage 2: ....120°

■ M8 cylinder head bolt torque specification

Stage 1: ....12.0 – 18.0 Nm
Stage 2: ....60°

3.24 Engine Mounts and Brackets

Remove

1 Remove the exhaust manifold assembly from the side of the engine where the engine mount is to be removed, refer to 3.11 Exhaust Manifold Assembly.

2 Fit the engine lift brackets, Tool No. EN-46114 (1) to the cylinder heads.

CAUTION

Only lift the engine far enough to take the weight off the engine mount, or damage to the mount and lifting equipment failure may occur.

3 Using an engine lifting crane, raise the side of the engine where the mount is to be removed enough to remove the weight from the engine mounts, and create a slight tension in the lifting equipment.

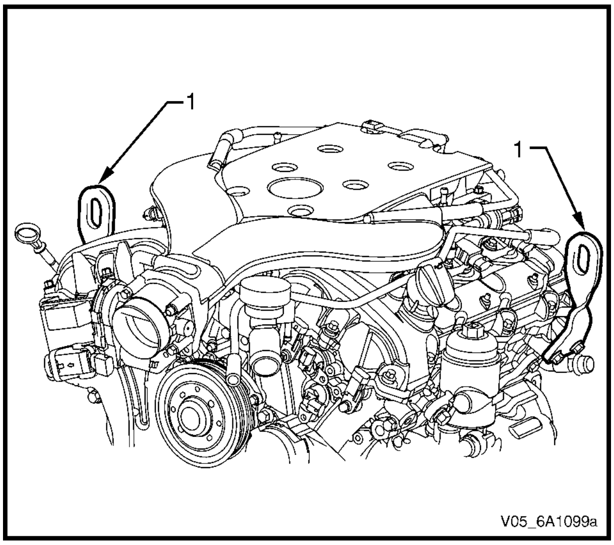


Figure 6A1 – 404

4 Remove the left-hand or right-hand side engine mount and bracket as required.

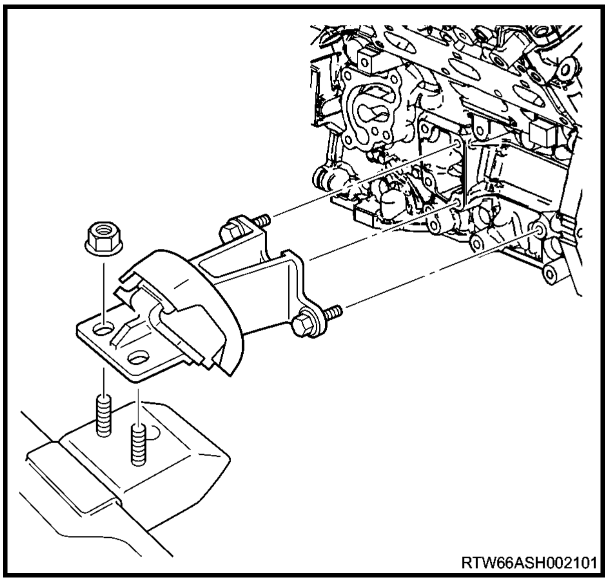


Figure 6A1 – 405

Engine Mount Location

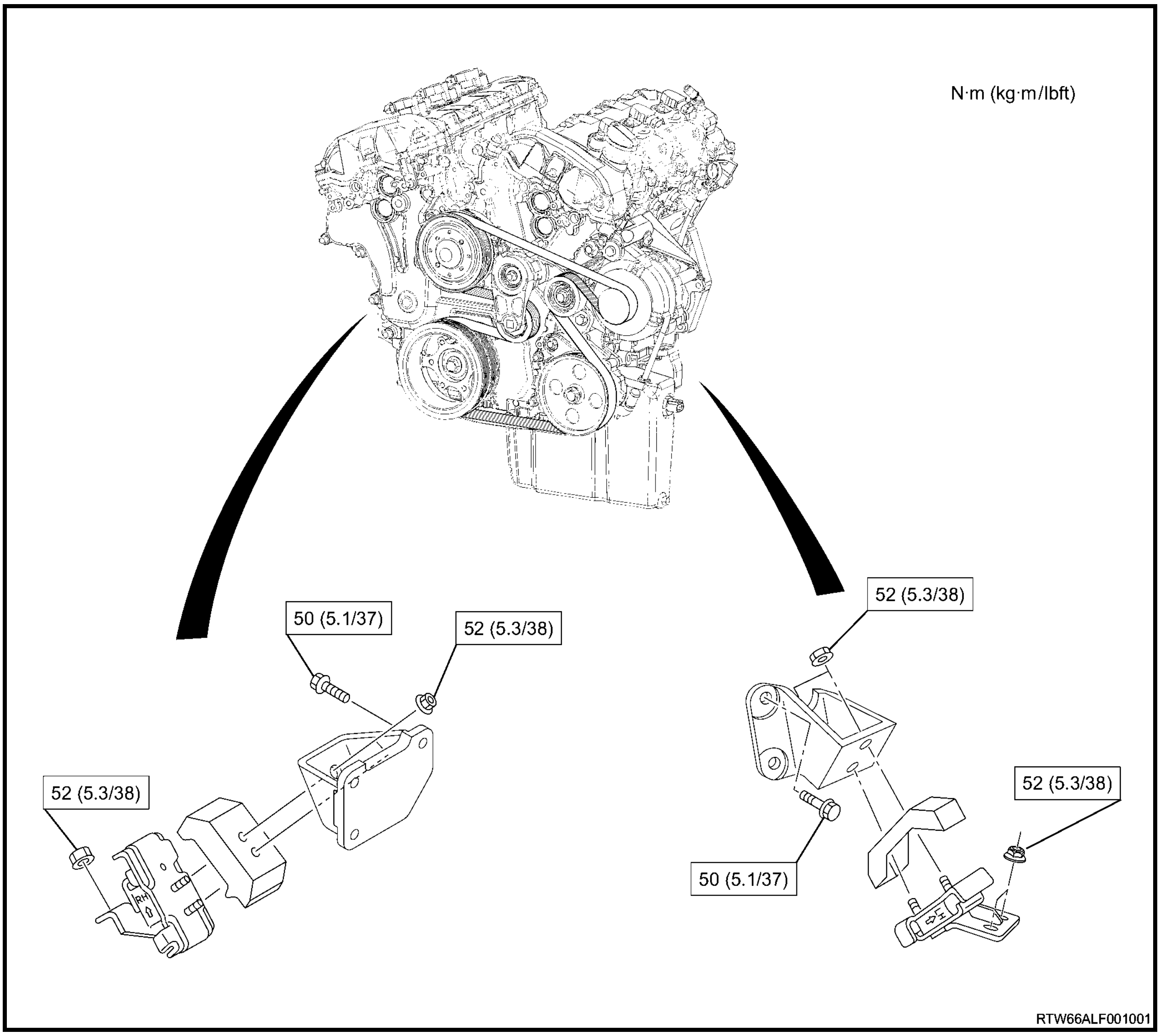


Figure 6A1 – 406

Inspect

NOTE

Although the following procedure provides information regarding on-vehicle engine mount inspections, it is preferable to inspect the engine mounts once removed from the vehicle.

1 Fit the engine lift brackets, Tool No. EN-4611 to the cylinder heads.

WARNING

Only lift the engine enough to take the weight off the engine mounts, or damage to the mounts and lifting equipment failure may occur.

2 Using a commercially available engine lifting crane, have an assistant raise the engine far enough to remove the weight on the engine mounts and create a slight tension in the rubber.

3 Observe the engine mount while raising the engine.

4 Replace the engine mount if any of the following conditions are found:

- The hard rubber surface is covered with heat check cracks,
- The rubber is split through the centre of the engine mount, or
- The rubber is separated from the metal plate portion of the engine mount.

5 Remove the engine lift brackets, Tool No. EN-46114 from the engine.

Reinstall

The reinstallation procedure for the engine mounts is the reverse of the removal procedure, noting the following:

Ensure all fasteners are tightened to the correct torque specification.

Engine mount bracket to
cylinder block attaching bolt
torque specification
....43.0 – 57.0 Nm

Engine mount to bracket attaching nut
torque specification
....70.0 – 90.0 Nm

Engine mount to frame attaching nut
torque specification
....44.0 – 60.0 Nm

4 Major Service Operations

ATTENTION

The V6 engine is a combination of numerous components, containing machined, honed, polished and lapped surfaces manufactured on the latest, high technology production equipment. Many of the components contain tolerances measured in thousandths of a millimetre. Consequently, when any engine component is to be serviced, care and cleanliness are extremely important.

Prior to re-assembly of the V6 engine, all components must be cleaned and inspected in accordance with the relevant procedures throughout this section, and replaced or repaired where required.

In addition to cleaning and inspecting components, a liberal coating of engine oil should be applied to friction surfaces during assembly to protect and lubricate the surfaces on initial operation.

When performing any service operation contained in this Section, it should be understood that correct cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard workshop practice, even if not specifically stated. Torque values must be used as specified during reassembly to ensure correct retention of all components.

Through out this section, fastener torque wrench specifications may be accompanied with the following identification marks:

■ Fasteners must be replaced after loosening.

♦ Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.

If one of these identification marks is present alongside a fastener torque wrench specification, the recommendation regarding that fastener must be adhered to.

4.1 Engine Removal

CAUTION

- **Allow the engine to cool to at least 50° C, before attempting fastener removal.**
- **As aluminium has a greater rate of thermal expansion than that of cast iron, aluminium bolt hole threads will change dimension to a larger extent than cast iron bolt threads.**
- **If a bolt or other threaded component is removed before the engine is allowed to cool to at least 50° C, threads could be pulled from the cylinder block or cylinder head.**
- **Do not use impact tools to remove bolts during engine disassembly. While this may be common practice with cast iron engine components, use of these tools is likely to pull the aluminium threads in the cylinder block or head of this engine.**

Remove

1 Remove the skid plate.
2 Drain the radiator coolant, refer to Section 6B1 Engine Cooling – V6.
3 Disconnect the battery negative and positive terminal, refer to Section 8A Electrical Body & Chassis.
4 Remove the battery from the vehicle.
5 Depressurise the fuel system pressure, refer to Section 6C Fuel System – V6.
6 Make alignment marks on the bonnet and hinges in order to return the bonnet to the exact original position.
7 Remove the bonnet, refer to Section 2B Sheet Metal.
8 Remove the rubber hose (2) and air duct (1).

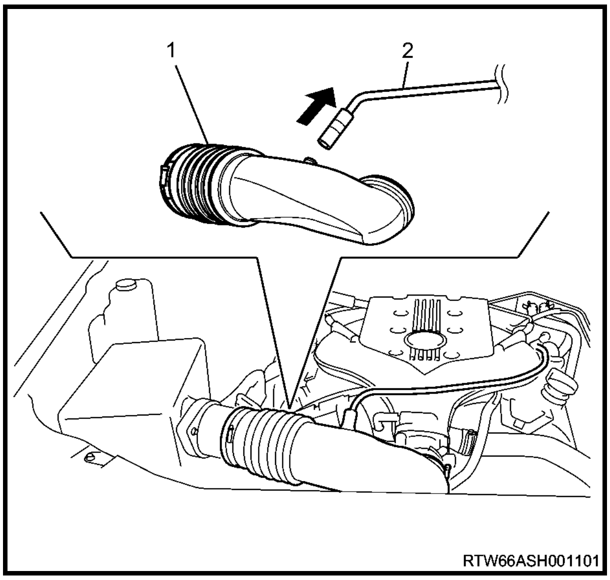


Figure 6A1 – 407

9 Disconnect the barometric sensor connector (1).

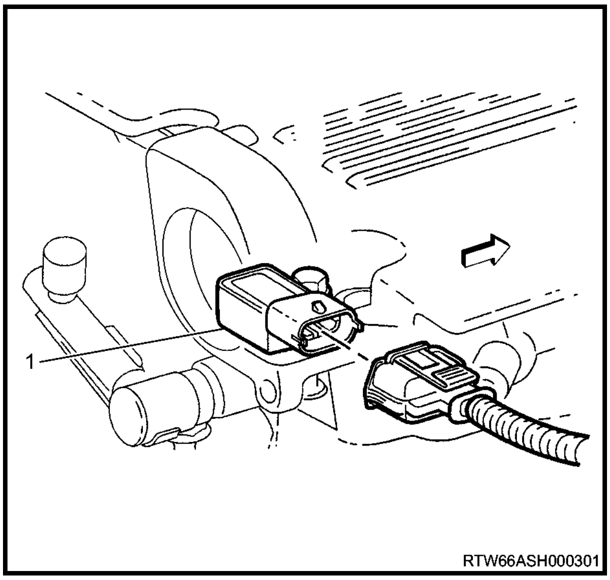


Figure 6A1 – 408

10 Disconnect the vacuum booster hose (1).

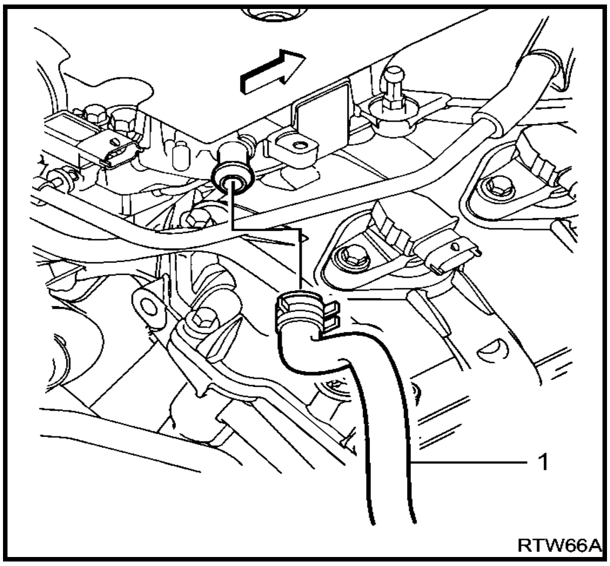


Figure 6A1 – 409

11 Disconnect the EVAP purge solenoid connector (1).

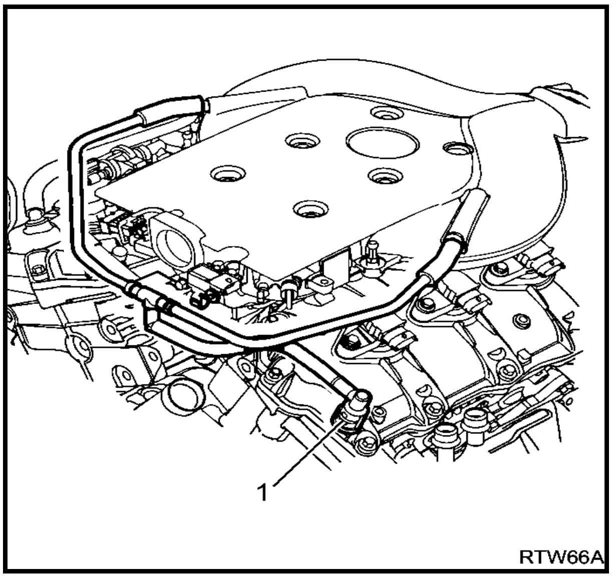


Figure 6A1 – 410

CAUTION

Plug the fuel feed hose after removal to prevent dirt entering the pipe.

12 Disconnect the fuel pipe connector and injector harness connector.

13 Disconnect the fuel feed hose from the fuel rail (1), refer to Section 6C Fuel system.

14 Pull out release bar (2) of the fuel injector harness wiring connector (3).

15 Disconnect the fuel injector harness wiring connector from the fuel injector wiring harness (4).

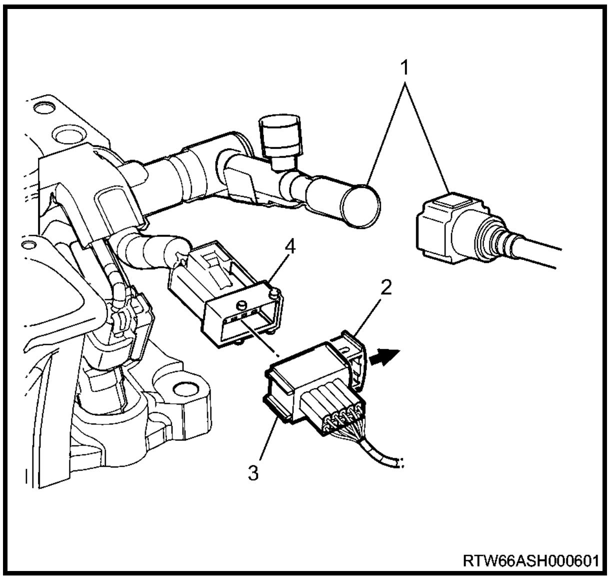


Figure 6A1 – 411

16 To disconnect the throttle body connector (1) the following procedure must be followed.

17 Retract the throttle body wiring connector lock (3) while pressing the connector latch in the direction of the arrow (4).

18 Disconnect the throttle body wiring connector (1).

19 Release the throttle body connector wiring harness from its retaining clip (5).

CAUTION

Take care not to break the barbed retainer pin (6), when removing the harness. Should the pin be damaged it is vital that a new harness retainer be fitted.

20 Remove the main wiring harness retainer pin (6) from the intake manifold by pushing from the front to the rear using a suitable length of 5mm steel rod or an allen key.

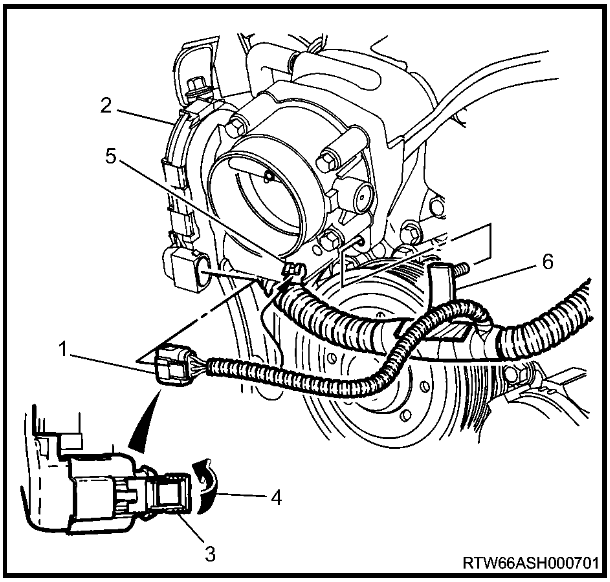


Figure 6A1 – 412

21 Disconnect the PCV fresh air tube (1) from the upper intake manifold mounting clip (2) and remove the fixing bolt (3).

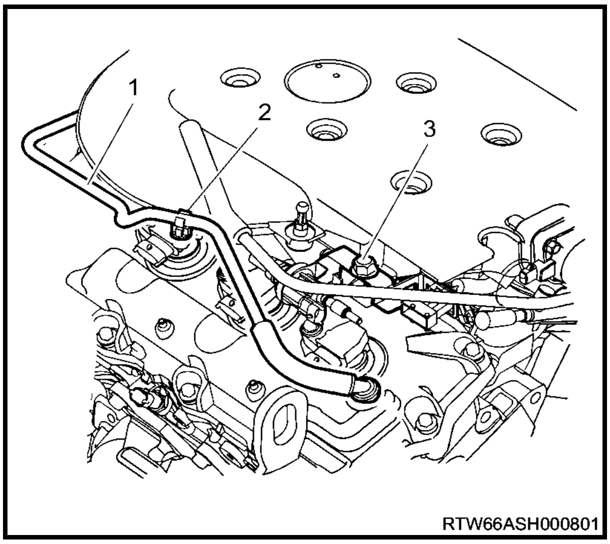
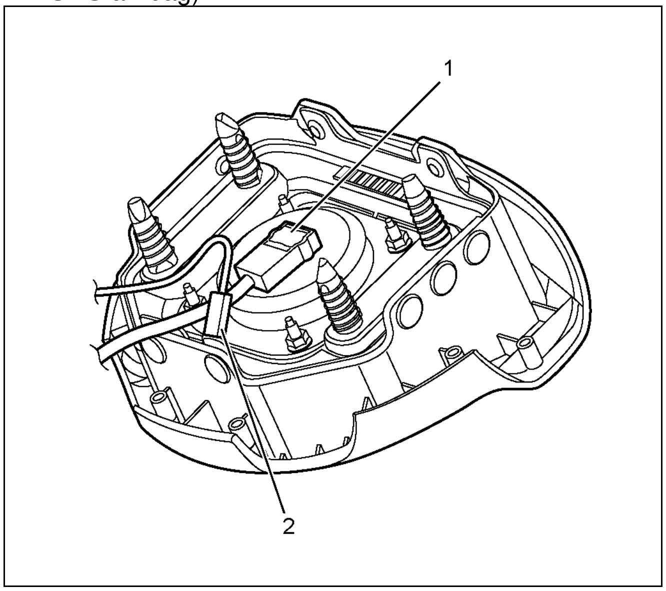


Figure 6A1 – 413

13. Disconnect the SRS air bag connector (1) and horn lead connector (2) located behind the air bag assembly and remove the air bag assembly (with SRS air bag).



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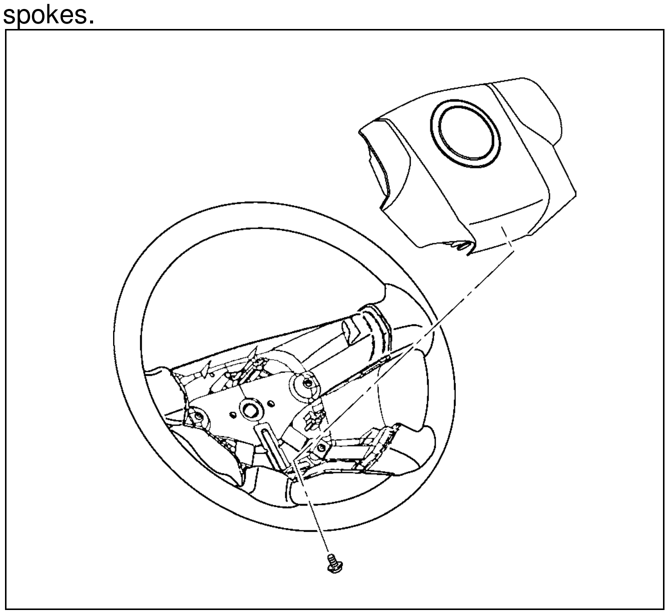
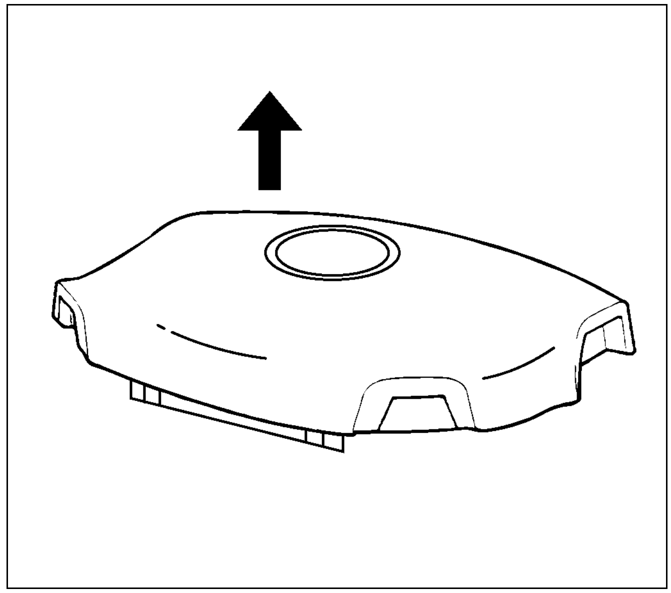
14. Remove the horn pad and the horn leads at the center of the wheel (without SRS air bag).

NOTE: It should be removed first from the bottom spokes.



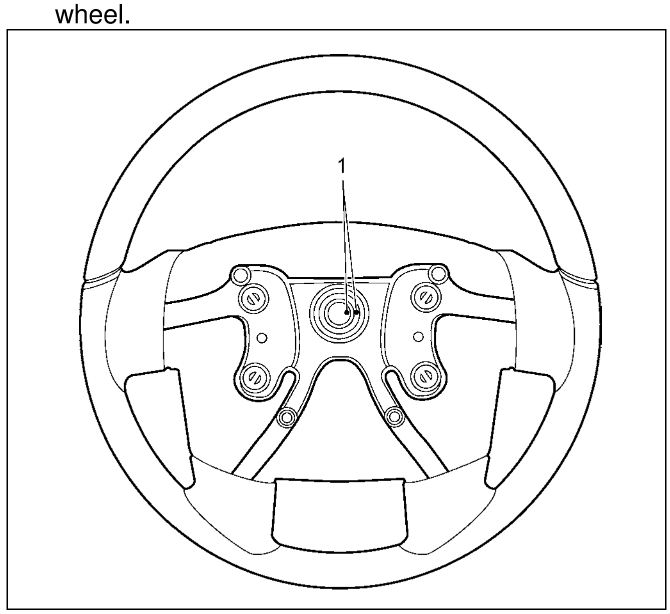
RTW73BSH000601

WARNING: THE INFLATOR MODULE SHOULD ALWAYS BE CARRIED WITH THE COVER AWAY FROM YOUR BODY AND SHOULD ALWAYS BE LAID ON A FLAT SURFACE WITH THE COVER SIDE UP. THIS IS NECESSARY BECAUSE A FREE SPACE IS PROVIDED TO ALLOW THE AIR CUSHION TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY MAY RESULT (with SRS air bag).



430R300007

15. Apply a setting mark (1) across the steering wheel and shaft so parts can be reassembled in their original position. Move the front wheels to the straight ahead position, then use steering wheel remover 5-8521-0016-0 (2) to remove the steering wheel.



RTW73BSH000501

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

22 Disconnect the EVAP valve outlet tube, (1) from the upper intake manifold (2).

23 Remove the four long bolts, (3) attaching the upper intake manifold, (2) to the cylinder heads and lower intake manifold.

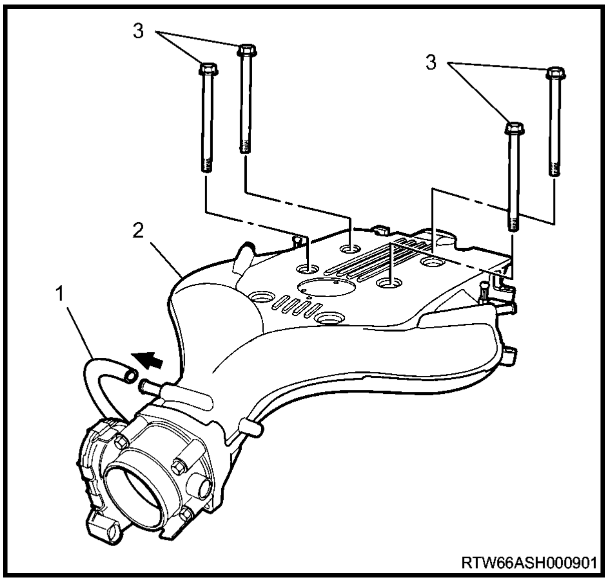


Figure 6A1 – 414

23 Remove the six bolts, (1) attaching the lower intake manifold (2), then remove the manifold from the engine.

24 Remove the following from the engine and engine compartment :

- Lower intake manifold to cylinder head gasket
- The Heater hose
- The Air Cleaner assembly

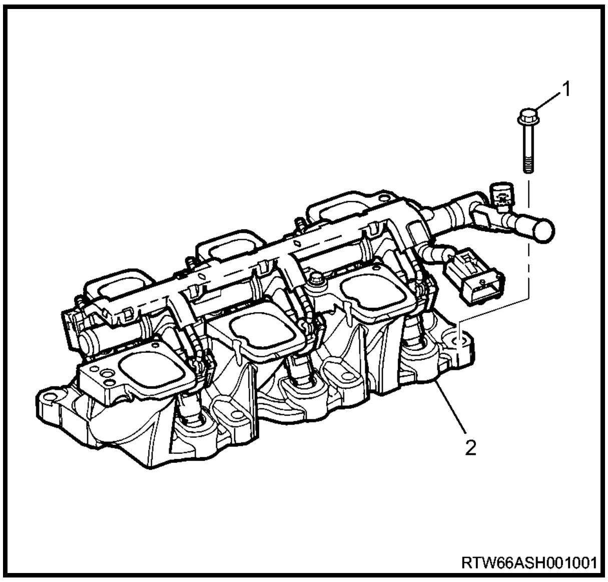


Figure 6A1 – 415

25 Remove the transmission support (1).

26 Remove the front and rear propeller shafts, (4WD Only), refer to Section 4C1 Front Wheel Drive and Section 4C2 Drive Line (For 4WD Vehicles).

27 Remove the front torsion bar springs, refer to Section 3C Suspension.

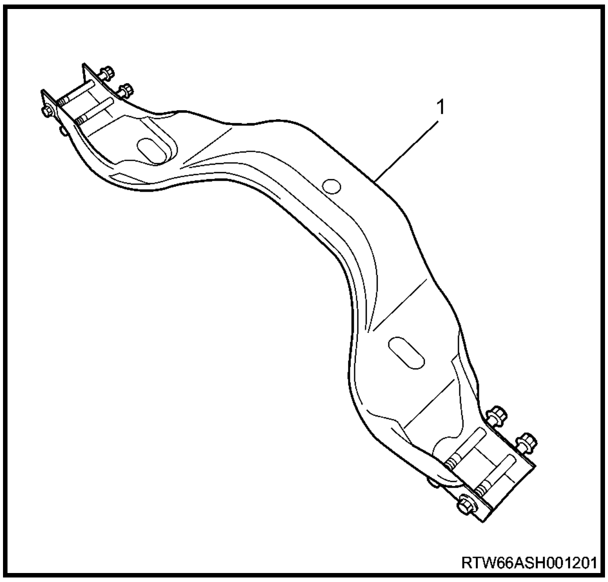


Figure 6A1 – 416

28 Remove the centre exhaust pipe (1), refer to Section 6F Exhaust System - V6.

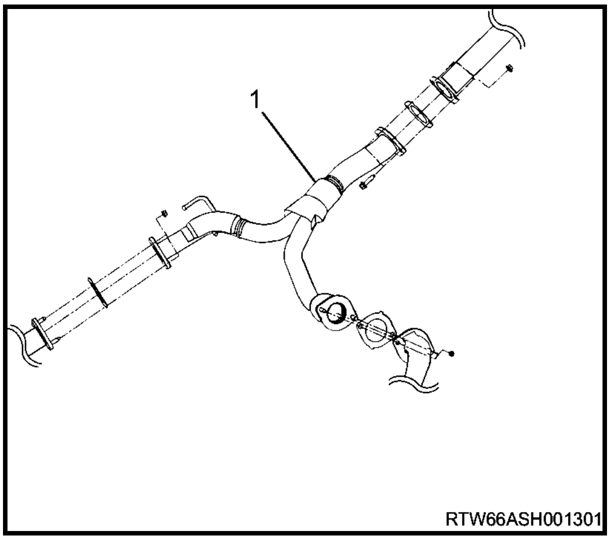


Figure 6A1 – 417

29 Disconnect the two post-catalytic converter oxygen sensor wiring harness connectors, 1 each bank.

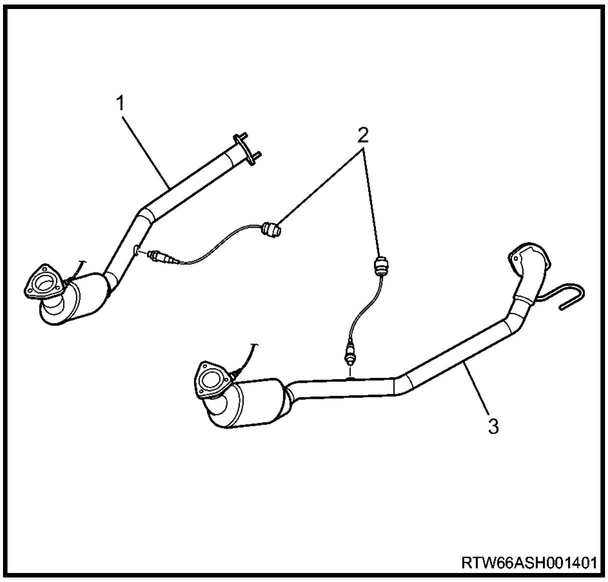


Figure 6A1 – 418

30 Disconnect the two pre-catalytic converter oxygen sensor wiring harness connectors, 1 each bank.

31 Remove the front exhaust flange nuts, three each bank.

32 Remove the front left-hand exhaust pipe from the rubber mount.

33 Remove the front exhaust pipes from the vehicle, for further information, refer to Section 6F Exhaust System - V6.

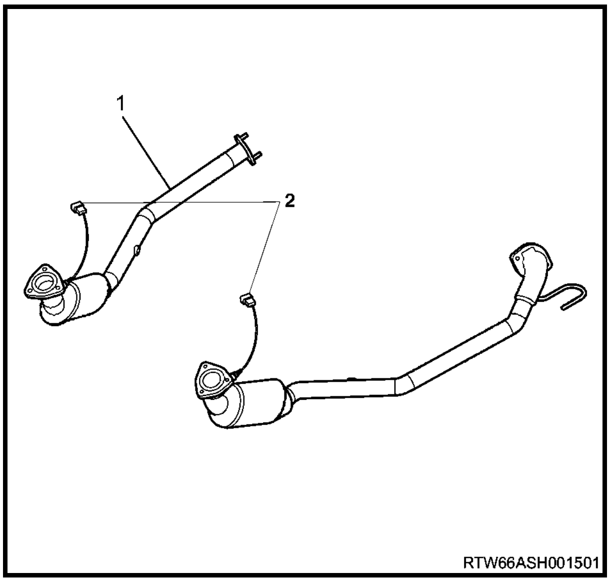


Figure 6A1 – 419

34 Remove the transfer case from the vehicle (4WD Only), refer to Section 7D Transfer Case and Adaptor Housing.

35 Disconnect the harness connector from the transmission, refer to Section 7B1 Manual Transmission – V6 or Section 7C1, Section 7C2, Section 7C3 or Section 7C4 for automatic transmission.

36 Remove the left-hand side exhaust manifold upper heat shield (1), (Automatic transmission only).

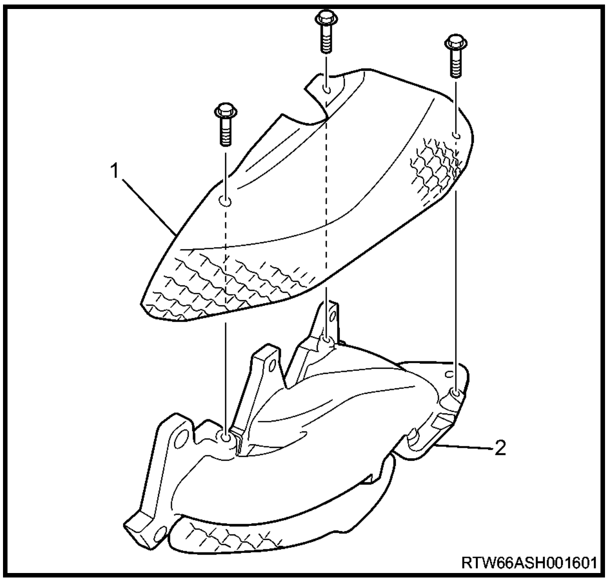


Figure 6A1 – 420

37 Progressively loosen the seven exhaust manifold attaching bolts (2), working from the outside to the centre and then remove the bolts.

38 Manoeuvre the exhaust manifold (3), away from the cylinder head.

39 Remove and discard the exhaust manifold to cylinder head gasket.

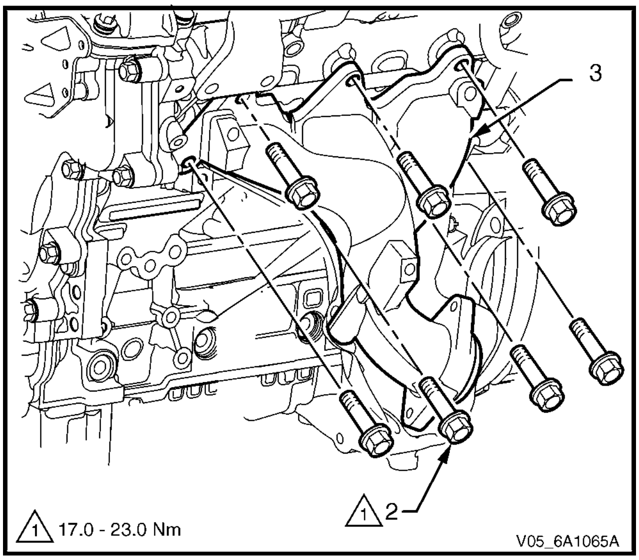


Figure 6A1 – 421

40 Remove the engine oil level indicator assembly (1), (automatic transmission only).

41 Remove the left-hand side exhaust manifold, (automatic transmission only).

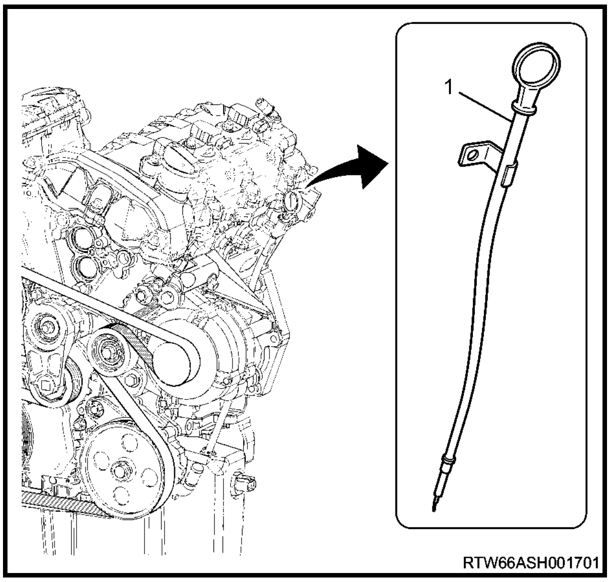


Figure 6A1 – 422

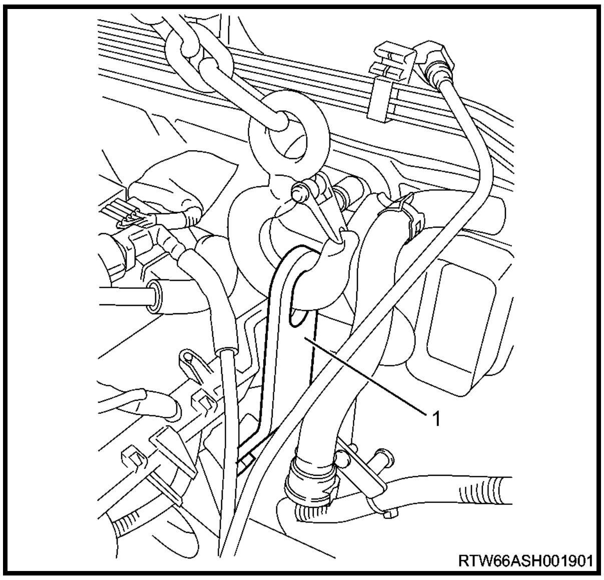


Figure 6A1 – 423

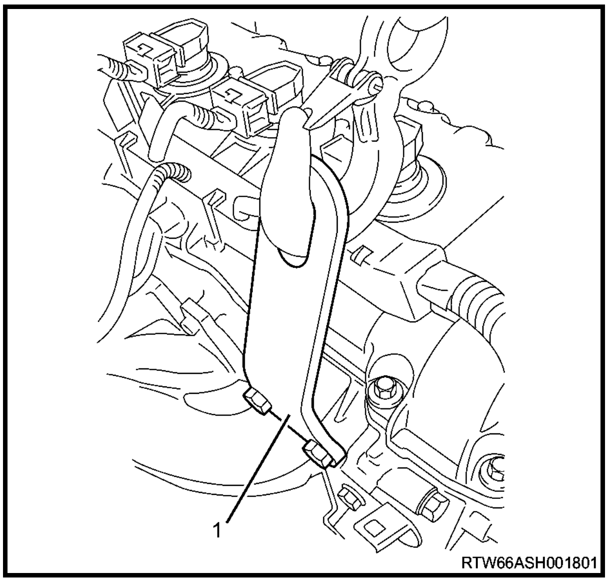


Figure 6A1 – 424

42 Fit the engine lifting brackets (1), (EN–46114) and attach the engine hoist, raise the engine to take the weight off the engine mounts.

Engine Lift Bracket Attaching Bolt torque specification ....58.0 – 72.0.0 Nm

43 Remove the left-hand side knock sensor (1).

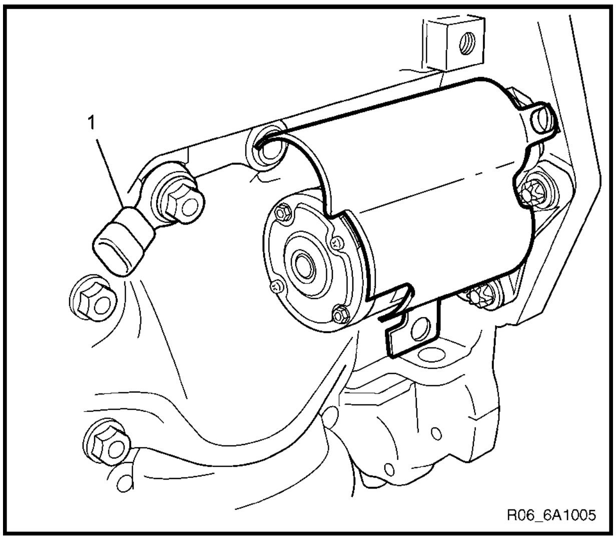


Figure 6A1 – 425

NOTE

Removal or the starter motor is only required for vehicles with an Automatic Transmission.

44 Remove the left-hand side engine mount (1), (automatic transmission only).

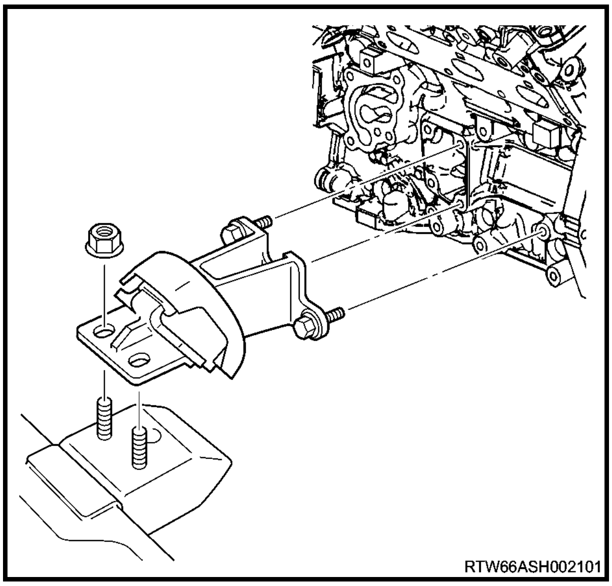


Figure 6A1 – 426

45 Unclip the oil level sensor harness from the heat shield (1).

a Remove the heat shield retaining screw (2).

b Remove the lower starter motor attaching bolt (3).

c Remove the heat shield.

d Remove the upper starter motor retaining bolt (3).

46 Remove the starter motor from the engine block and lower the starter motor as far as possible to gain access to the wiring harness connections.

47 Remove the starter motor, (automatic transmission only).

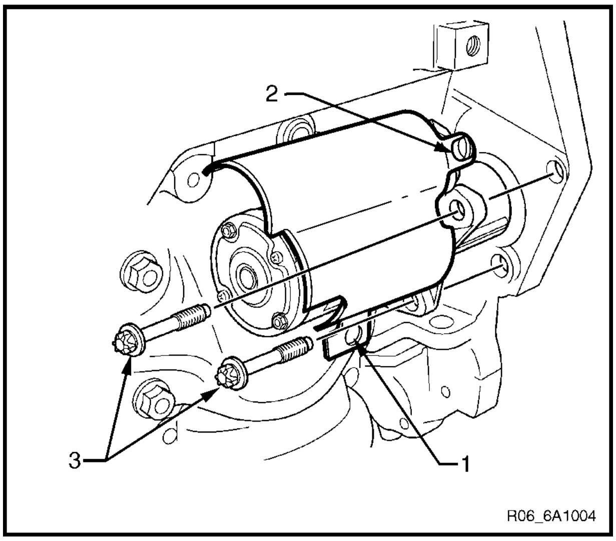


Figure 6A1 – 427

48 Reinstall the left-hand side engine mount (1), (automatic transmission only).

49 Remove the transmission assembly, refer to Section 7C1 Automatic – 4L60E – General Information.

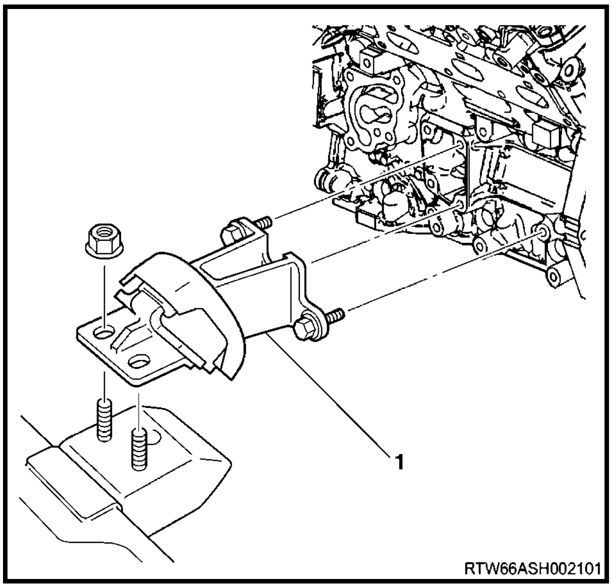


Figure 6A1 – 428

50 Unplug the connector from the oil level sensor (1).

51 Remove the attaching bolt (2) holding the ground cable to the engine block.

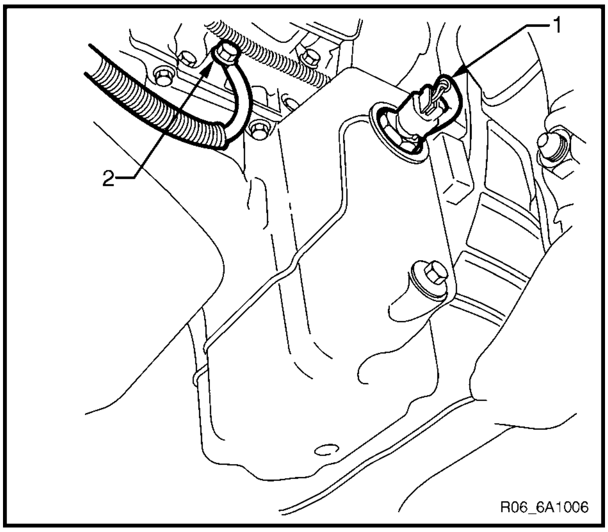


Figure 6A1 – 429

52 Remove the accessory drive belt using a socket wrench (1), to reduce tension rotate the drive belt tensioner (2) clockwise, then while holding the tensioner in the reduced tension position, remove the accessory drive belt (3).

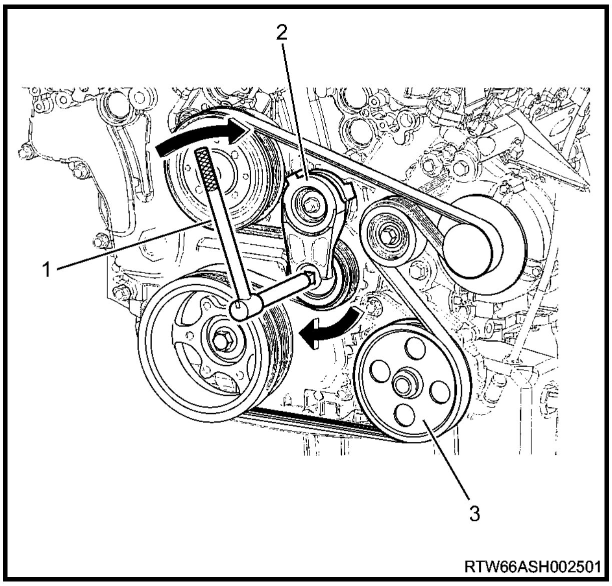


Figure 6A1 – 430

53 Remove the power steering pump bolts (two places), remove the pump (1) from the mounting bracket and disconnect the power steering hoses (two places) from the pump body.

NOTE

Plug the open ends of the power steering hoses to prevent the ingress of contaminants.

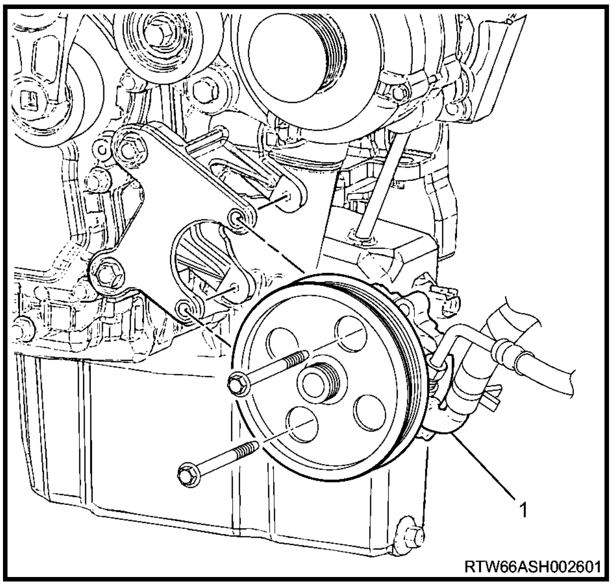


Figure 6A1 – 431

54 Remove the power steering pump bracket mounting bolts (three places) then remove the pump bracket (1).

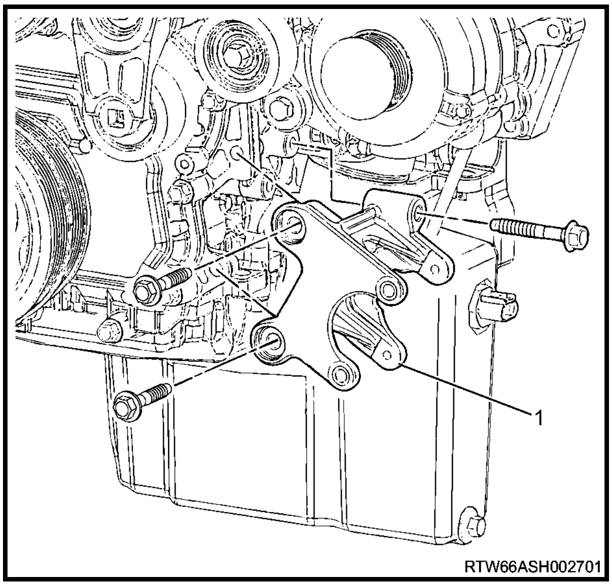


Figure 6A1 – 432

55 Release the lower radiator hose clamp (1) and remove the lower hose from the coolant pipe (2).

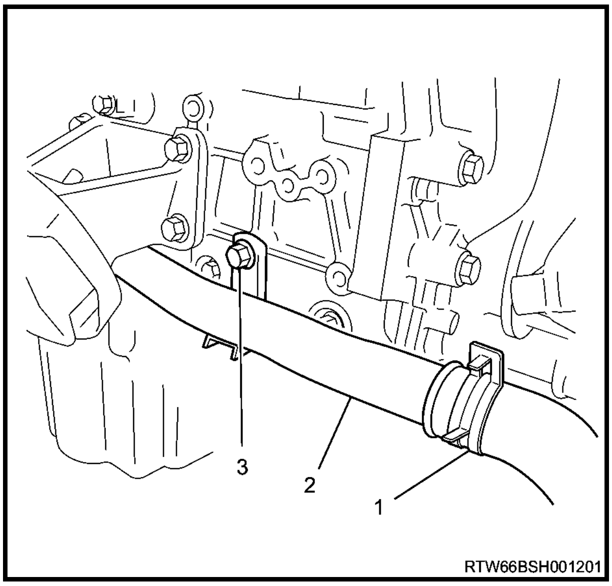


Figure 6A1 – 433

56 Release the upper radiator hose clamp (1) and remove the upper hose from the coolant pipe (2).

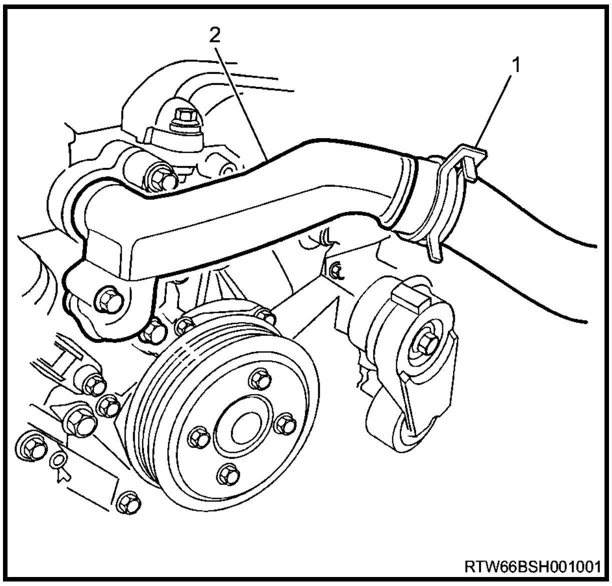


Figure 6A1 – 434

57 Unclip and remove the generator wiring harness connector (1), Remove battery connection attaching nut (4), and remove the battery harness cable (2) from the connection stud.

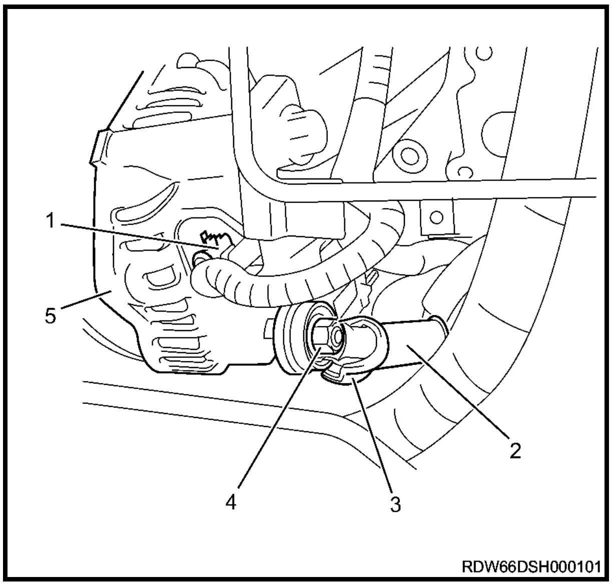


Figure 6A1 – 435

58 Remove the generator attaching bolts (1, 2, and 4) three places, then remove the generator (3) from the mounting bracket.

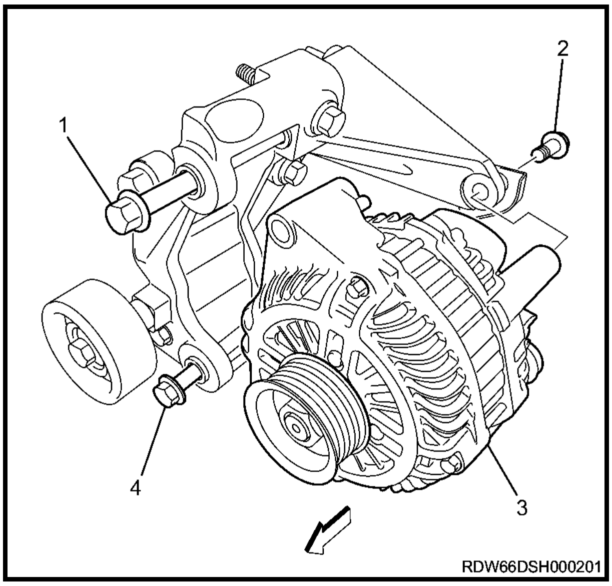


Figure 6A1 – 436

59 Remove the idler pulley attaching bolt and remove the idler pulley (1).

60 Remove the generator bracket attaching bolts, five places, and remove the generator mounting bracket (2).

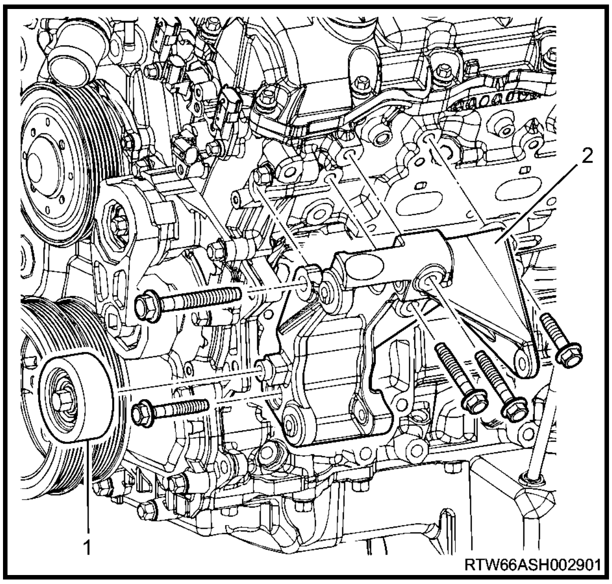


Figure 6A1 – 437

61 Remove the air cleaner cover assembly including the MAF sensor assembly (1).

62 Remove the air cleaner filter (2) from the air cleaner body assembly (3).

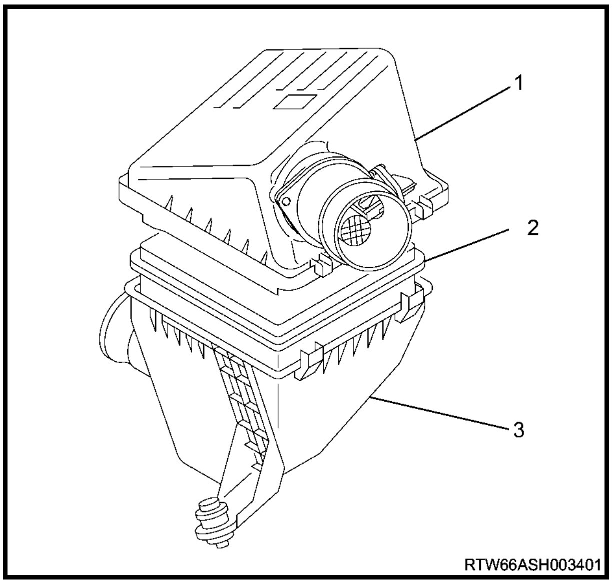


Figure 6A1 – 438

63 Disconnect the ECM connectors (1).

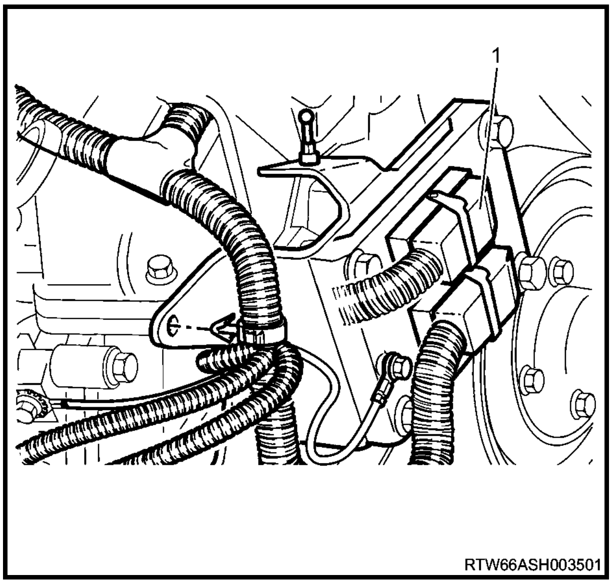


Figure 6A1 – 439

64 Disconnect the canister hose (1).

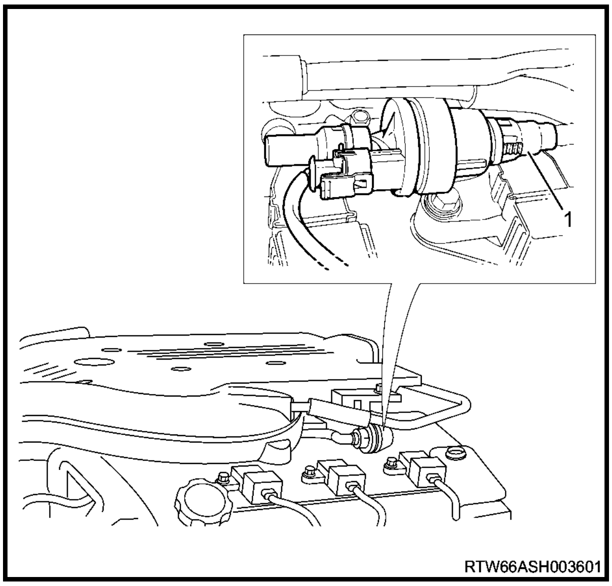


Figure 6A1 – 440

65 Remove the engine mount attaching nuts (1), (two places) on the chassis side of the left-hand and right-hand engine mounts.

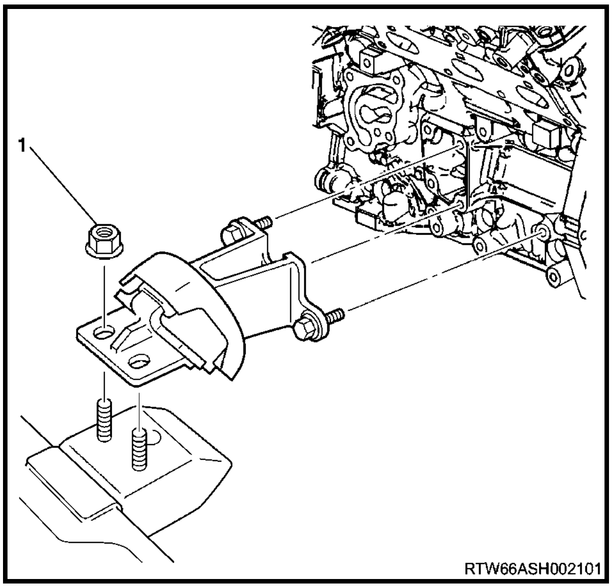


Figure 6A1 – 441

66 Slowly raise the engine using the engine hoist continue to lift and manoeuvre the engine assembly clear of the engine compartment.

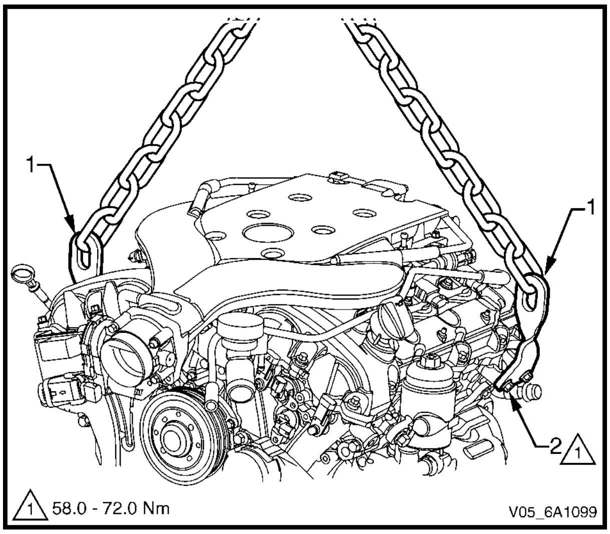


Figure 6A1 – 442

Disassemble

1 Remove the wiring harness connectors and ground connections from the engine and transmission assembly and carefully set the wiring harness to one side, refer to Section 8A Electrical Body & Chassis.

2 Remove the engine control module (ECM) and mounting bracket, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

3 Mount the engine assembly on a suitable engine stand.

5 Drain the engine oil into a suitable, clean container.

6 Remove the following components:

a Oil filter adaptor, refer to 3.3 Oil Filter Adaptor.

b Engine coolant inlet pipe, refer to Section 6B1 Engine Cooling – V6.

c Heater pipe assembly, refer to Section 6B1 Engine Cooling – V6.

d Thermostat assembly, refer to Section 6B1 Engine Cooling – V6.

e Exhaust manifold assemblies, refer to 3.11 Exhaust Manifold Assembly.

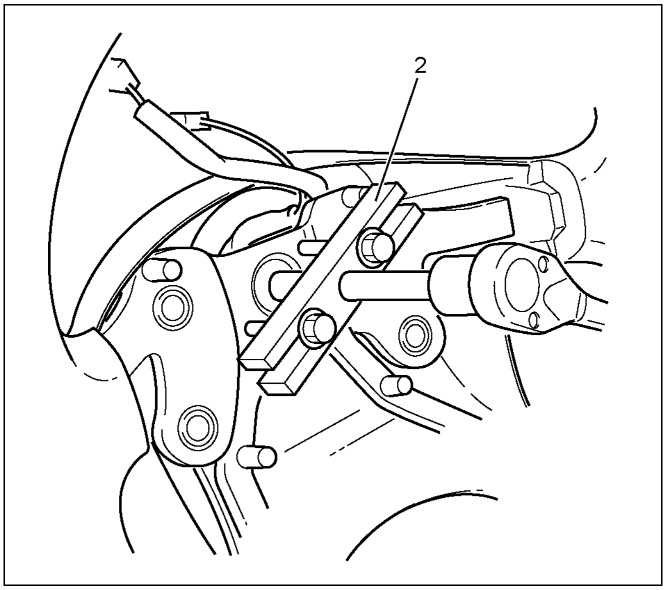
f Engine coolant outlet pipe, refer to Section 6B1 Engine Cooling – V6.

g Crankshaft position sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

h Knock sensors, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

i Engine mounts and brackets, refer to 3.23 Engine Mounts and Brackets.

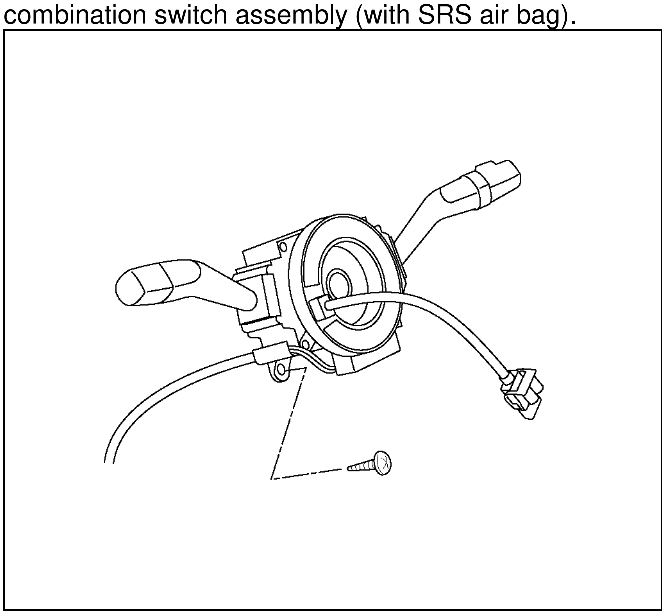
j Flexplate assemblies, refer to 4.3 Flexplate Assembly.



RTW73BSH001301

16. Remove steering column cover.
17. Disconnect the wiring harness connectors located under the steering column then remove combination switch and SRS coil assembly (with SRS air bag).

NOTE: The SRS coil is a part of the combination switch assembly, which cannot be replaced separately. Therefore, be sure not to remove the SRS coil from the combination switch assembly (with SRS air bag).

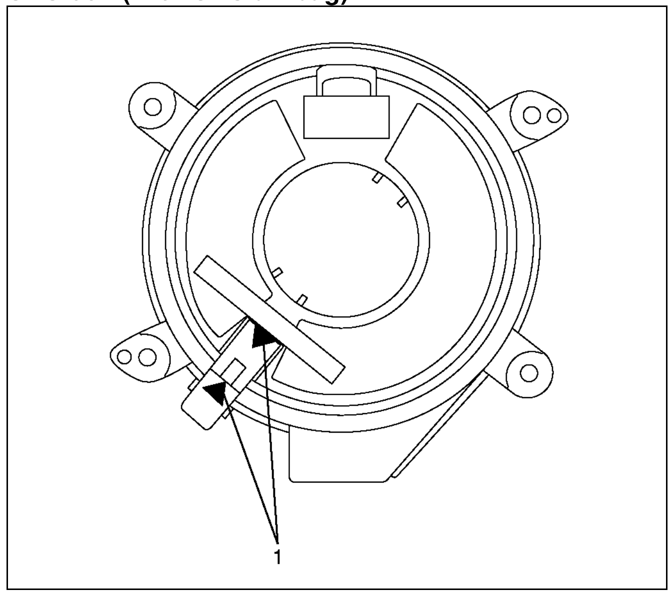


RTW73BSH001001

Installation

1. Install the combination switch assembly with SRS coil (with SRS air bag).
2. Turn the SRS coil fully counterclockwise, return about 3 turns and align the neutral mark (with SRS air bag).

CAUTION: When turning the SRS coil fully counterclockwise, stop turning if resistance is felt. Further forced turning may damage the cable in the SRS coil (with SRS air bag).



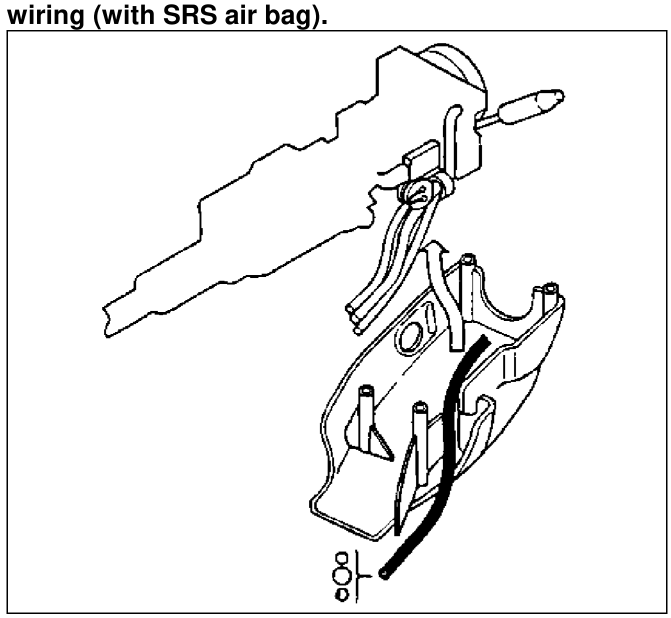
826RW014

Legend

(1) Neutral mark

3. Connect the wiring harness connectors located at the base of steering column.
4. Install the air conditioning lower duct.
5. Install the steering column cover.

CAUTION: When installing the steering column cover, be sure to wire (through each harness) as illustrated so that the harness starter switch, combination switch and SRS coil will not catch wiring (with SRS air bag).



825RS048

k Timing chains, tensioners, shoes, guides & sprockets, refer to 3.16 Timing Chains, Tensioners, Shoes and Guides.

l Cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.

m Oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

n Piston and connecting rod assemblies, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

o Crankshaft assembly, refer to 4.6 Crankshaft and Main Bearings.

p Piston oil nozzles, refer 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.

Reassemble

Reassembly of the engine assembly is the reverse of the disassembly procedure.

Reinstall

Reinstallation of the engine assembly is the reverse to the removal procedure, noting the following:

NOTE

Refer to 6 Torque Wrench Specifications for the correct torque specifications.

1 Tighten the fasteners to the correct torque specification.

Engine ground connector bolt torque specification	10.0 Nm
Power steering high pressure line attaching bolt torque specification	8.0 – 12.0 Nm
Power steering high pressure line flare nut torque specification	25.0 – 35.0 Nm
Engine mount to frame attaching bolt torque specification	44.0 – 60.0 Nm
Knock Sensor Attaching Nut torque specification	23.0 Nm

2 Use only the specified engine lubricant type and quantity. It is recommended that a fluorescent oil dye, such as that contained in J 28481-B, be added to assist in any future oil leak diagnosis.

3 Fill the cooling system with the correct quantity and grade of coolant, refer to Section 6B1 Engine Cooling – V6.

4 Check transmission fluid level, replenishing as required, using the specified lubricant for the transmission fitted, refer to Section 7C1 Automatic – 4L60E – General Information.

5 Disable the ignition system, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

6 Crank the engine several times. Listen for any unusual noises or evidence that parts are binding.

7 Enable the ignition system. Start the engine and listen for any unusual noises.

8 Check the vehicle oil pressure gauge or warning indicator and confirm the engine has acceptable oil pressure. If required, install an oil pressure gauge and measure the engine oil pressure, refer to 2.19 Engine Oil Pressure Diagnosis.

9 Run the engine at about 1,000 r.p.m. until the engine has reached normal operating temperature.

10 Listen for any unusual noises.

11 Check for oil, fuel, coolant and exhaust leaks while the engine is running, correcting as required.

12 Perform a final inspection for correct engine oil and coolant levels.

4.2 Oil Pan and Oil Pump Suction Pipe Assembly

Remove

1 Remove the engine assembly from the vehicle, refer to 4.1 Engine .
2 Separate the engine and transmission assemblies, refer to Section 7C1 Automatic – 4L60E – General Information.
3 Mount the engine assembly on a suitable engine stand.
4 Remove the engine front cover, refer to 3.15 Front Cover Assembly.
5 Remove the two long bolts (1) attaching the rear of the oil pan to the crankshaft rear oil seal housing.
6 Remove the remaining eleven bolts attaching the oil pan to the cylinder block.
7 Using the shear points located at the edge of the oil pan shear the RTV sealant.
8 Remove the oil pan from the cylinder block.

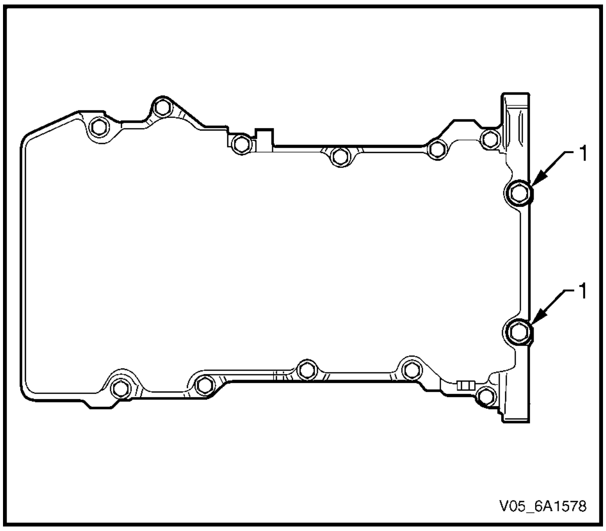


Figure 6A1 – 443

Disassemble

1 Remove the following:
2 Oil pan drain plug (7) and sleeve (8).
3 Oil level sensor (9).
4 Crankshaft oil deflector bolts (6) and remove the deflector.
5 Oil pump suction pipe bolts (5) and the suction pipe (3).
6 Oil pump suction pipe gasket (4) from the suction pipe and discard.

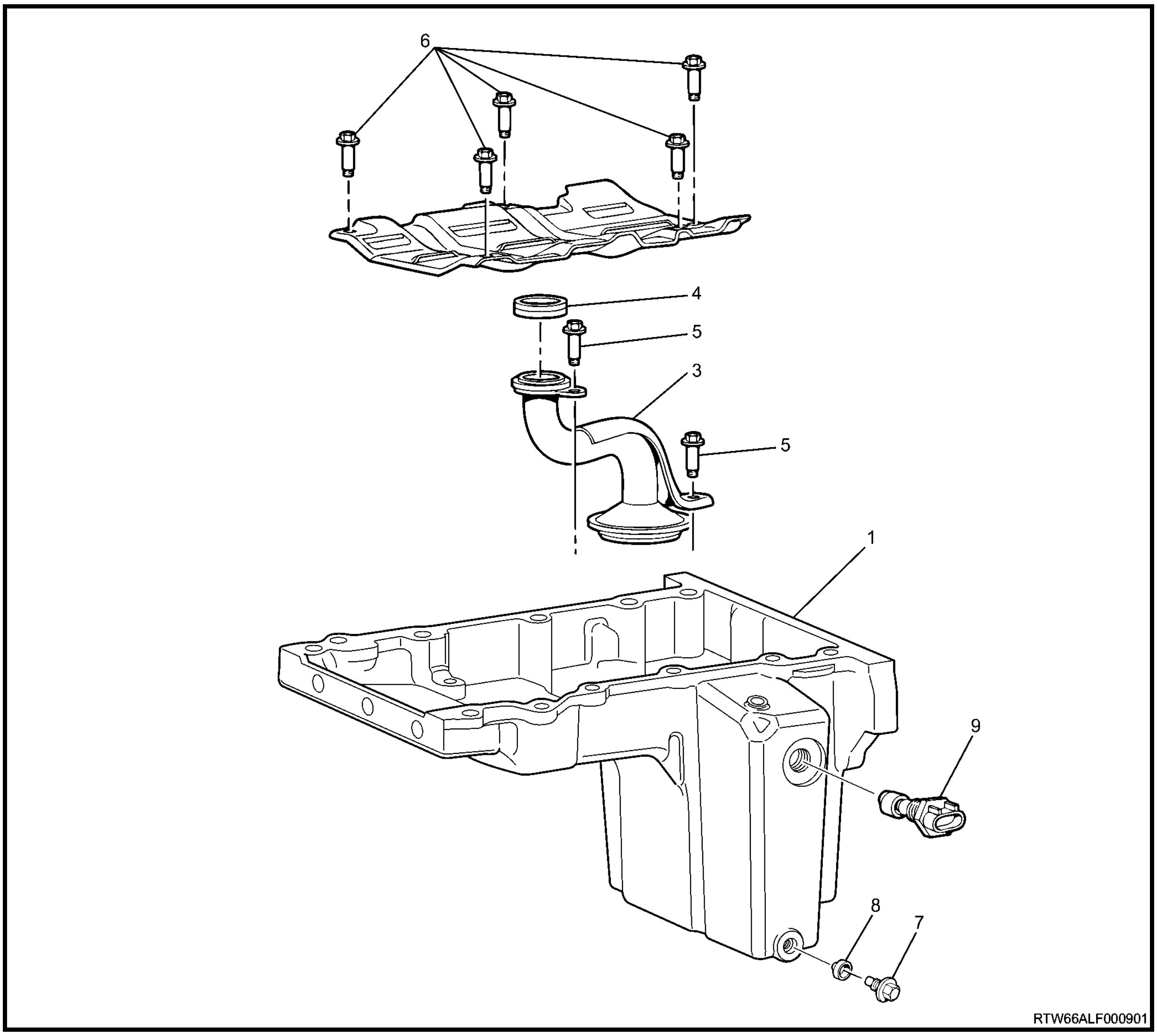


Figure 6A1 – 444

Clean

1 Remove any remaining thread sealant, gasket material or sealant using a commercially available wooden or plastic scraper.
2 Clean the oil pan and oil pan components in solvent.
3 Clean out debris from the bolt holes.

WARNING

Safety glasses must be worn when using compressed air.

4 Dry the oil pan and oil pan components with compressed air.

Inspect

1 Inspect the exterior of the oil pan for the following conditions:
   - Damage to the drain plug or drain plug hole,
   - Damage to the transmission mounting bosses,
   - Damage to the oil level sensor threads, and
   - Dents or damage to the exterior.
2 Inspect the interior of the oil pan for the following conditions:
   - Gouges or damage to the oil pan sealing surfaces,
   - Damage to the crankshaft oil deflector,
   - Damage to the bolt holes,
   - Damage to the oil suction tube mounting bosses, and
   - Damage to the crankshaft oil deflector mounting bosses.

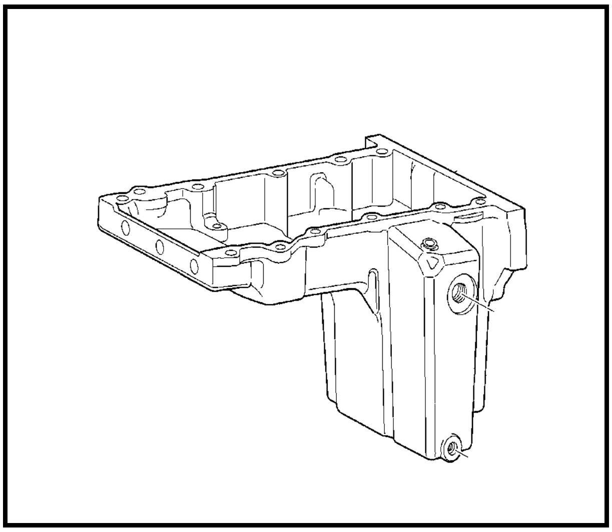


Figure 6A1 – 445

3 Inspect the oil pan deflector for damage.
4 Repair or replace the oil pan deflector and/or oil pan as required.

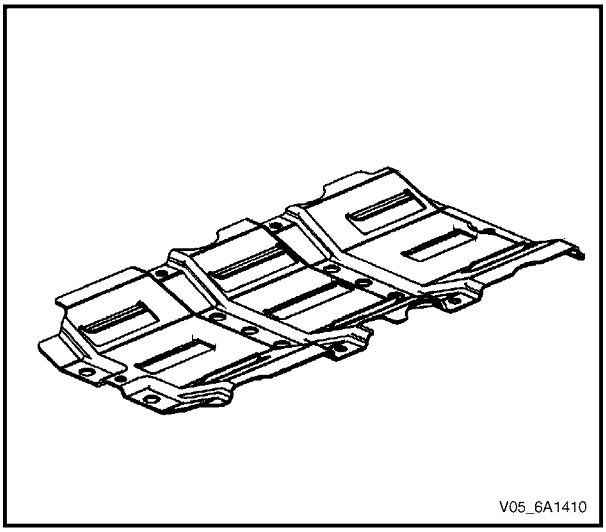


Figure 6A1 – 446

5 Inspect the following:
6 The mounting face (1) of the oil pump suction pipe for possible leakage paths.
7 The oil pump pipe support bracket (2) for cracks or damage.
8 The oil pump suction pipe tube (3) for cracks, imperfections and/or damage.
9 The oil pump screen (4) for blockage, foreign material, tears, cracks and/or damage.
10 Repair or replace the oil pan and/or oil pan components as required.

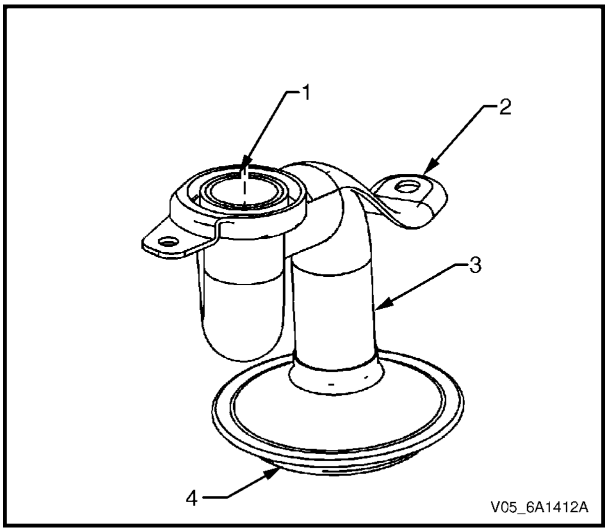


Figure 6A1 – 447

Reassemble

Reassembly of the oil pan and oil suction pipe assembly is the reverse of the disassembly procedure, noting the following:

1 Install a new oil suction tube seal onto the oil suction tube.

2 Install the oil suction pipe and tighten the attaching bolts to the correct torque specification.

Oil suction pipe attaching bolt torque specification	10.0 Nm

3 Install the crankshaft oil deflector into the oil pan assembly and tighten the attaching bolts to the correct torque specification.

Crankshaft oil deflector attaching bolt torque specification	10.0 Nm

4 Install the oil level sensor into the oil pan assembly and tighten to the correct torque specification.

Oil level sensor torque specification	20.0 Nm

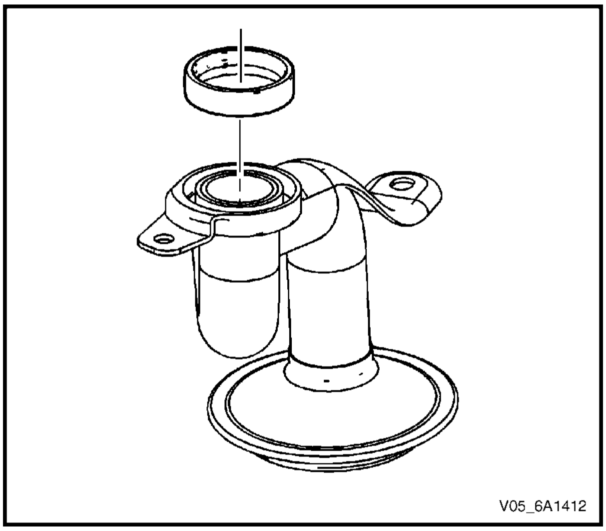


Figure 6A1 – 448

5 Install the oil pan drain plug into the oil pan assembly and tighten to the correct torque specification.

Oil pan drain plug torque specification	25.0 Nm

Reinstall

1 Install the guide pins, Tool No. EN-46109 (1) into the oil pan rail bolt hole on each side of the engine block.

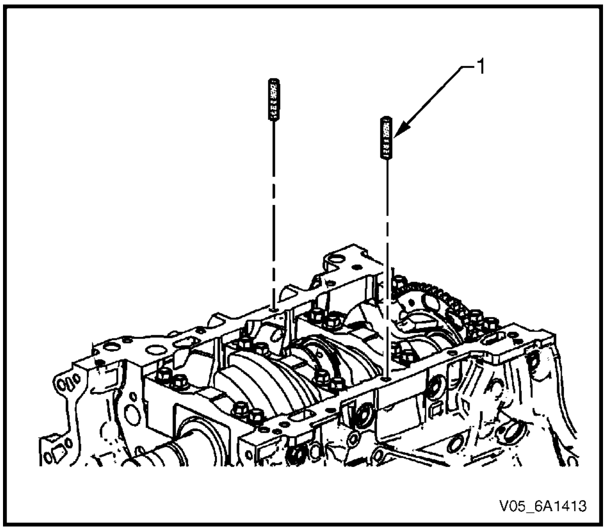


Figure 6A1 – 449

2 Place a 3mm bead (1) of RTV sealant on the cylinder block pan rail and crankshaft rear oil seal housing to oil pan mating surfaces.

3 Position the oil pan onto the cylinder block.

4 Remove the guide pins, Tool No. EN-46109 from the cylinder block.

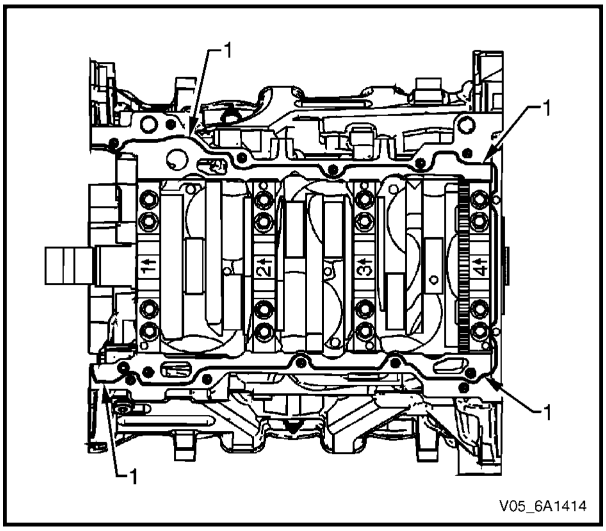


Figure 6A1 – 450

5 Loosely install the oil pan bolts.

6 Tighten the oil pan attaching bolts to the correct torque specification and in the sequence shown.

Oil pan to cylinder block attaching bolt (1 – 11) torque specification	20.0 – 26.0 Nm
Oil pan to crankshaft rear oil seal housing attaching bolt (12 – 13) torque specification	8.0 – 12.0 Nm

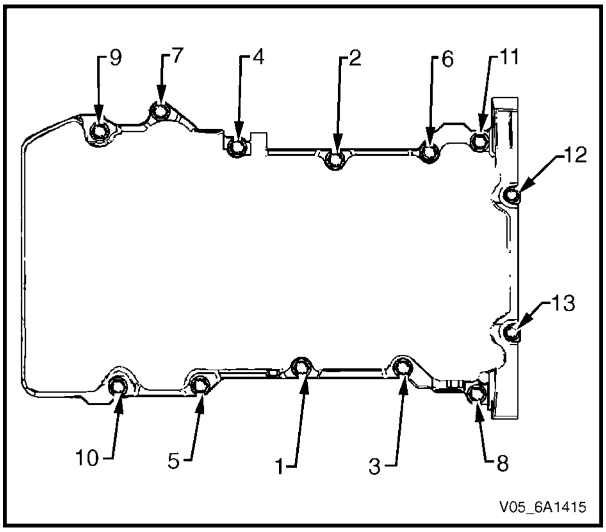


Figure 6A1 – 451

4.3 Flexplate Assembly

Remove

1 Remove the transmission, refer to Section 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.

2 Remove the starter motor, refer to Section 6D1-2 Starting System – V6.

3 Install the flexplate holding tool, Tool No. EN-46106 (1) into the starter motor mounting location.

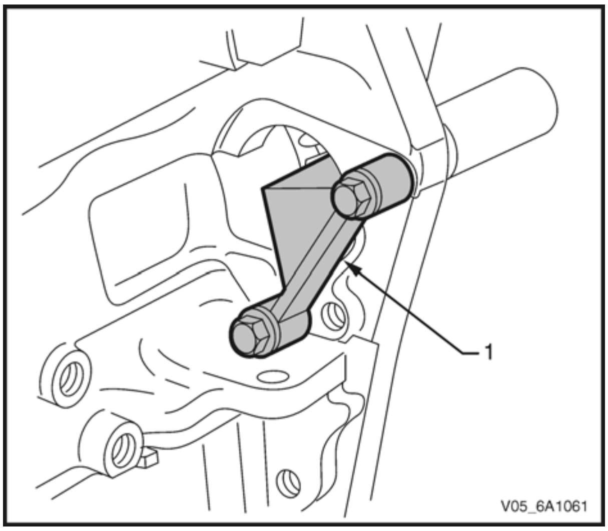


Figure 6A1 – 452

4 Loosen the eight flexplate attaching bolts (1).

5 Remove the flexplate holding tool.

6 Using a suitable permanent marker or paint pen, mark the flexplate assembly (2) to crankshaft relationship.

7 Remove the eight flexplate attaching bolts and discard.

8 Remove the flexplate assembly.

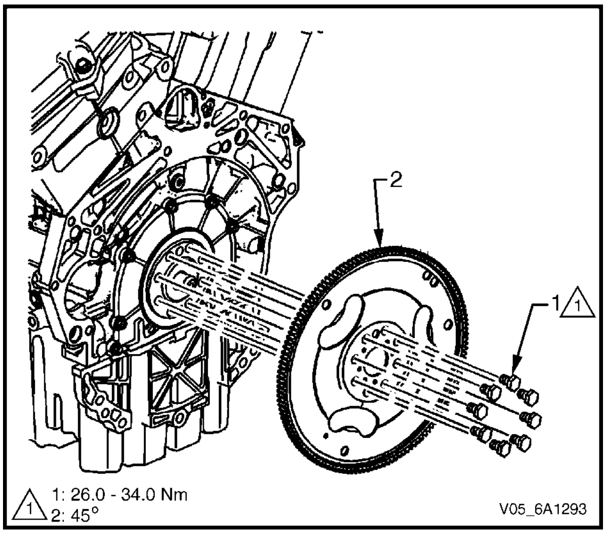


Figure 6A1 – 453

Clean

1 Clean the flexplate assembly in a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the flexplate assembly with compressed air.

Inspect

1 Inspect the flexplate assembly for the following conditions:

- Stress cracks around the flexplate to torque converter mounting bolt hole locations (1).
- Stress cracks around the flexplate to crankshaft mounting bolt hole locations (2 and 4).
- Cracks at welded areas that retain the ring gear onto the flexplate (3).
- Damaged or missing ring gear teeth (5).

2 Replace the flexplate assembly as required.

NOTE

The flexplate ring gear is not serviced separately and cannot be repaired. If found to be faulty or damaged, the flexplate assembly must be replaced.

CAUTION

Do not repair the welded areas that retain the ring gear to the flexplate. The flexplate must be replaced.

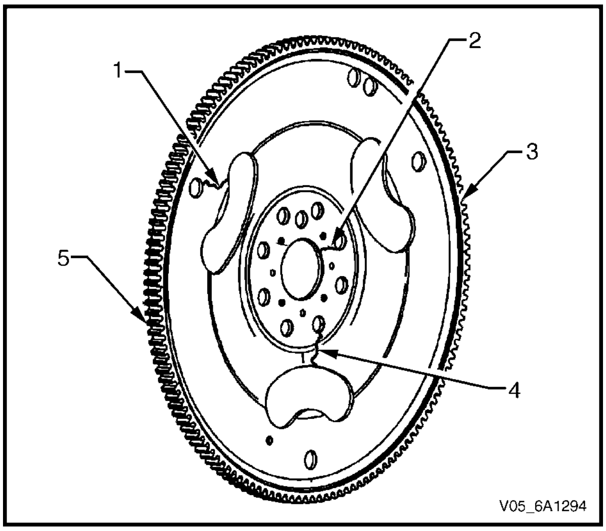


Figure 6A1 – 454

Reinstall

NOTE

The bolt holes are unevenly spaced to enable flexplate fitment in the one position only.

1 Place the flexplate assembly (2) in position on the crankshaft.

2 Install new flexplate attaching bolts (1) and hand tighten.

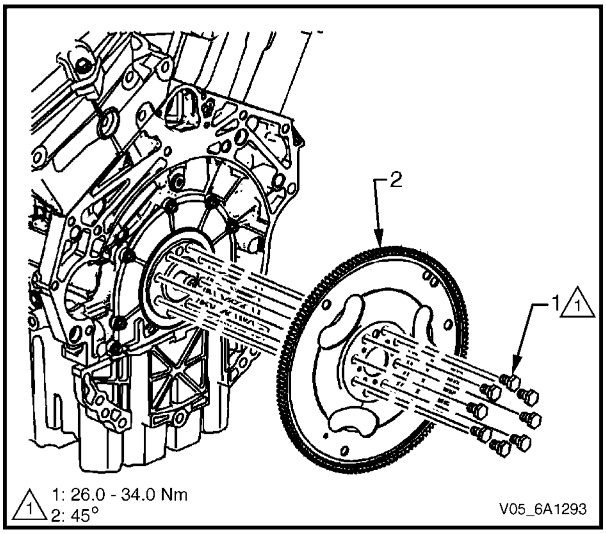


Figure 6A1 – 455

3 Install the flexplate holding tool, Tool No. EN-46106 (1) into the starter motor mounting location.

4 Tighten the eight flexplate attaching bolts to the correct torque specification.

■ ♦ Flexplate attaching bolt torque specification:	
Stage 1	26.0 – 34.0 Nm
Stage 2	45°

5 Remove the flexplate holding tool.

6 Install the starter motor, refer to Section 6D1-2 Starting System – V6.

7 Install the transmission, refer to Section 7E4 Automatic Transmission – 4L60E – On-vehicle Servicing.

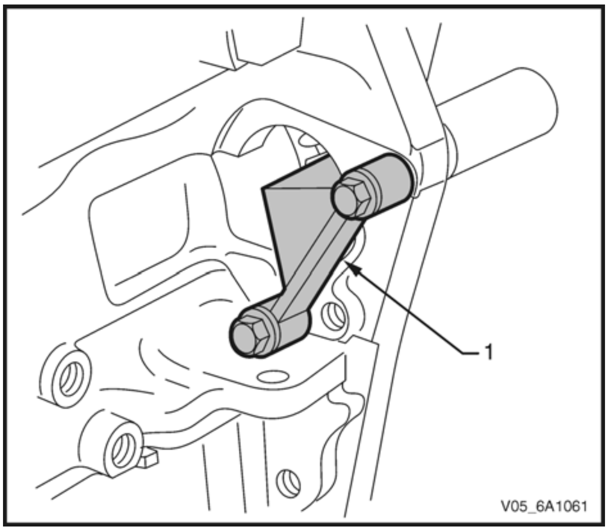


Figure 6A1 – 456

4.4 Crankshaft Rear Seal and Plate Assembly

Remove

1 Remove the engine assembly, refer to 4.1 Engine .

2 Remove the flexplate assembly, refer to 4.3 Flexplate Assembly.

3 Remove the engine oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

4 Remove the five bolts (1) attaching the crankshaft rear seal housing to the rear of the cylinder block (2).

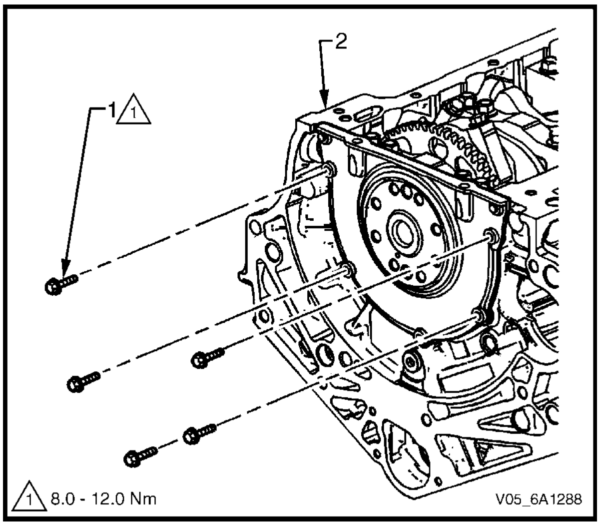


Figure 6A1 – 457

5 Shear the RTV sealant using the prise points located at the edge of the crankshaft rear oil seal housing,

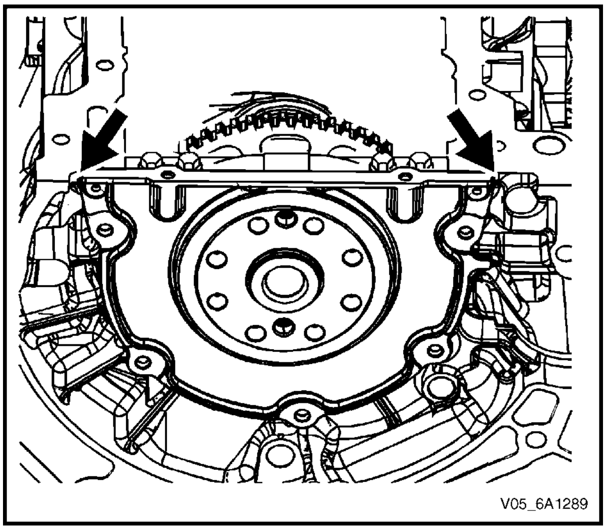
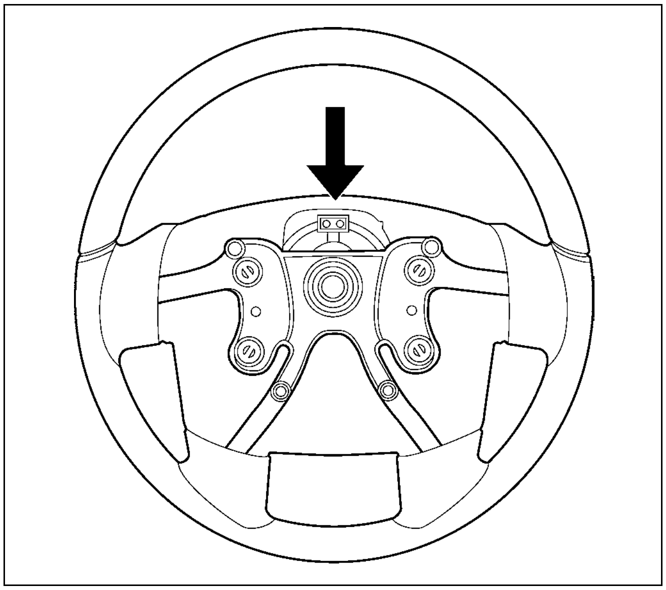


Figure 6A1 – 458

6. Install the driver knee bolster assembly.
7. Install the steering lower cover and engine hood opening lever.
8. Install the steering wheel and align the setting marks.

   Refer to the adjustment method in case a mark has not been applied in this section.

NOTE: Confirm SRS and horn harness connector is fixed by the steering wheel.

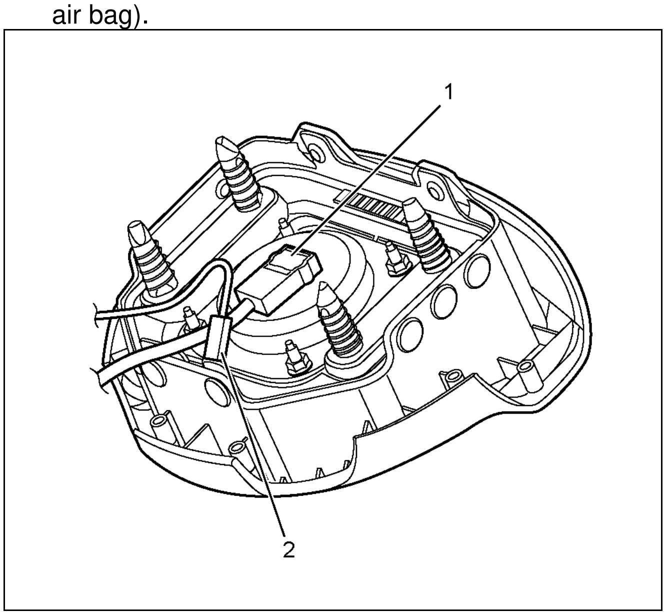


RTW73BSH000701

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

9. Tighten the steering wheel fixing nut to the specified torque.

   Torque: 35 N·m (3.6 kgf·m/26 lb·ft)
10. Support the inflator module and carefully connect the SRS connector (1) and horn lead (2) (with SRS air bag).

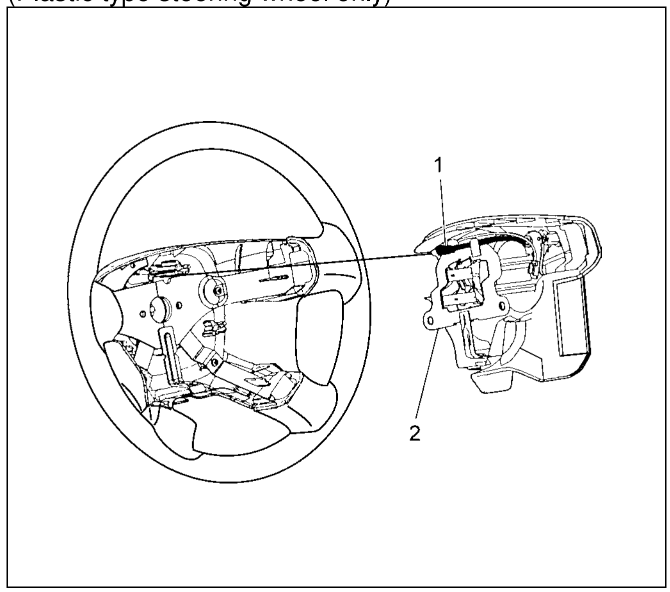


RTW73BSH001101

11. Connect the horn leads at center of wheel (without SRS air bag).

NOTE: The horn leads (1) are passed along the top of the bracket (2).

(Plastic type steering wheel only)



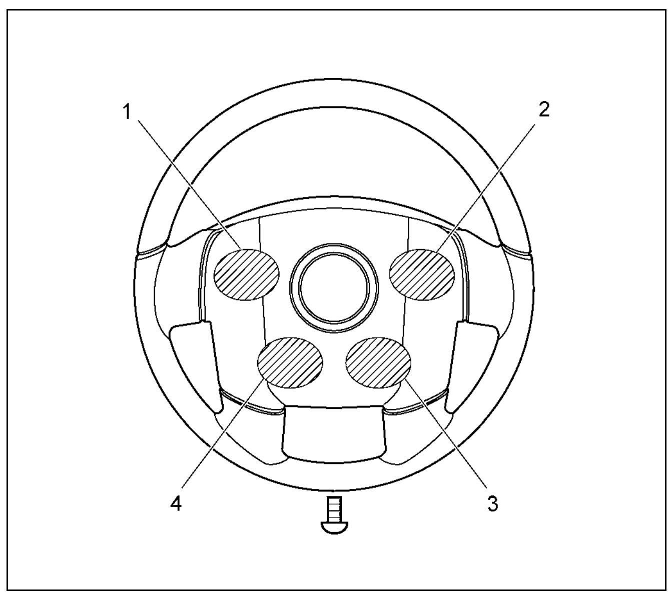
RTW73BSH000801

12. Push the horn pad at areas 1-4.

    Tighten the horn pad fixing screw to the specifed torque (without SRS air bag)

    Torque: 3 N·m (0.3 kgf·m/26 lb·in)

NOTE: A horn pad should not be struck during attachment.



RTW73BSH000201

6 Remove the crankshaft rear oil seal housing (1) from the cylinder block (2).

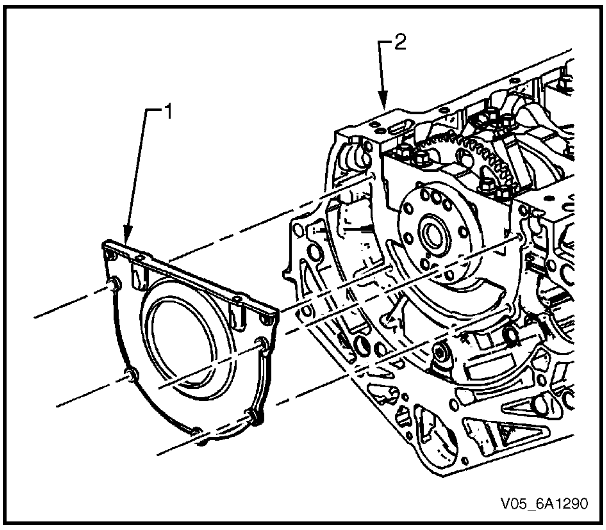


Figure 6A1 – 459

Reinstall

1 Install the guide pins, Tool No. EN-46109 (1) into the two crankshaft rear oil seal housing bolt holes of the cylinder block (2).

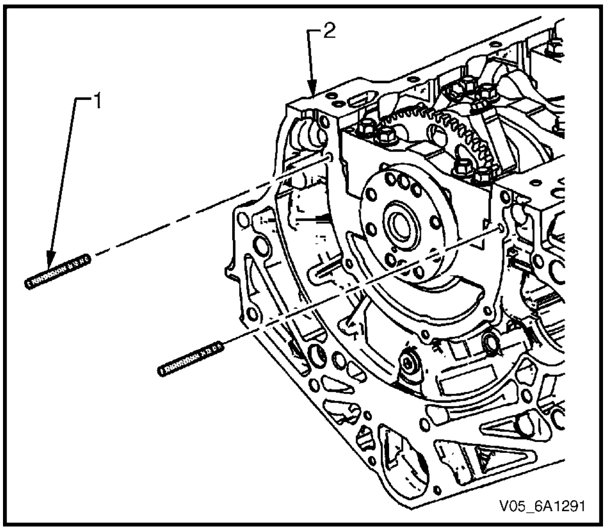


Figure 6A1 – 460

2 Apply a 3mm bead (1) of RTV sealant to the crankshaft rear oil seal housing.

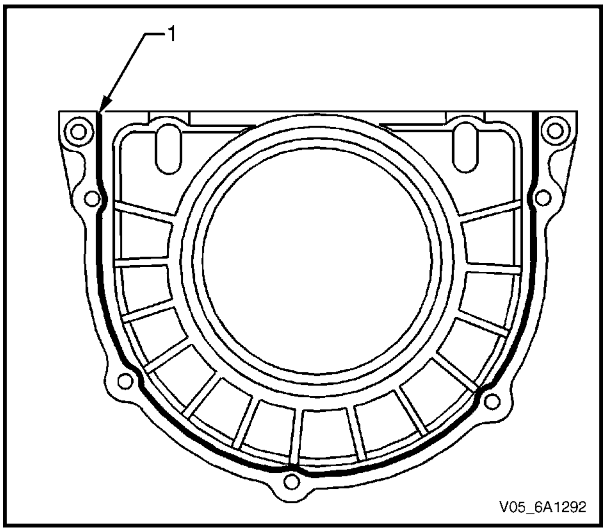


Figure 6A1 – 461

3 Install the crankshaft rear oil seal housing (1) to the cylinder block (2).

NOTE

- Do not allow any engine oil onto the cylinder block mating surface, where the crankshaft rear oil seal housing is to be installed.
- A seal-protector is provided with the new crankshaft rear seal and housing assembly. Do not remove the seal protector from the crankshaft rear oil seal housing until the crankshaft rear oil seal housing is fully in position.

4 Remove the guide pins from the cylinder block.

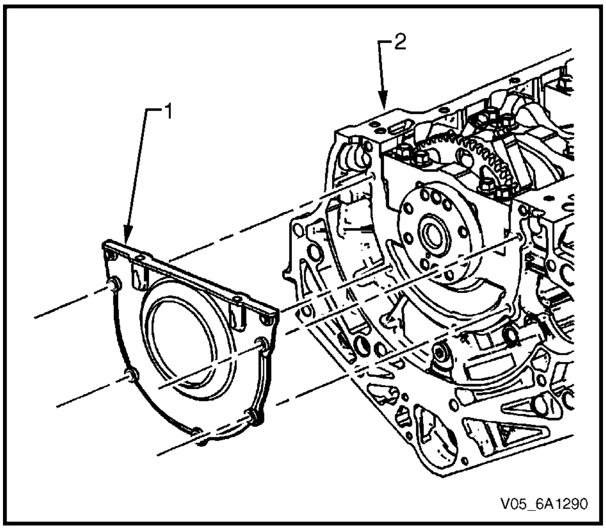


Figure 6A1 – 462

5 Install the crankshaft rear oil seal housing attaching bolts (1) to the cylinder block (2) and tighten to the correct torque specification.

Crankshaft rear oil seal housing attaching bolt torque specification.............8.0 – 12.0 Nm

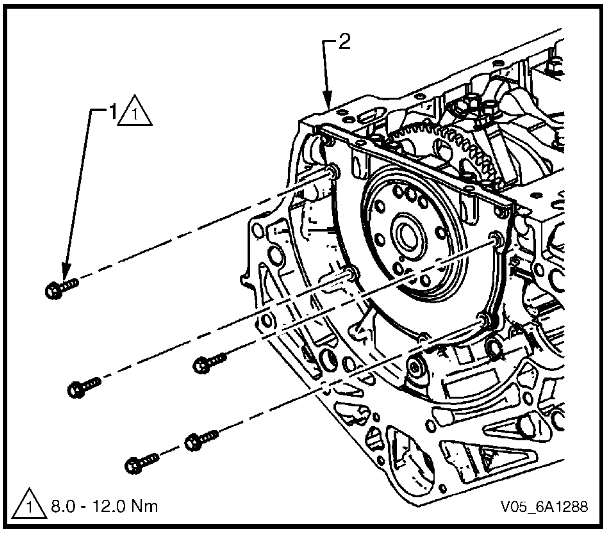


Figure 6A1 – 463

4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings

Remove

1. Remove the engine assembly, refer to 4.1 Engine .
2. Remove both cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.
3. Remove the oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
4. Mark the top of the piston being removed to identify its specific bore.
5. Install Tool No. EN-46111 (1) onto the crankshaft (2).
6. Rotate the crankshaft until the piston being removed is at the bottom of its stroke; bottom dead centre (BDC).

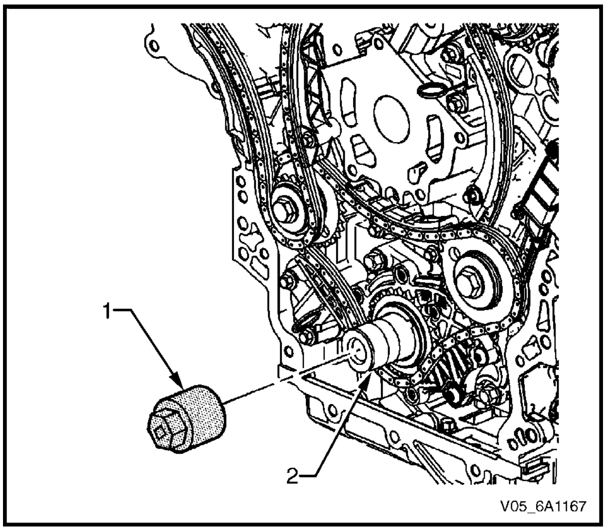


Figure 6A1 – 464

CAUTION

If the connecting rod bearings have been used in a running engine, they must be replaced with new connecting rod bearings for reassembly.

7. Before removing the connecting rods, check the connecting rod side clearance using the following procedure:
   a. Tap the connecting rod to one end of the crankshaft journal with a dead blow or wooden hammer.
   b. Using feeler gauges, measure the clearance between the crankshaft counterweight and the connecting rod.
   c. The connecting rod side clearance should not exceed specifications, refer to 5 Specifications.
   d. If the endplay exceeds the specified limits, measure the width of the crankpin end of the connecting rod, refer to 5 Specifications.
   e. If the connecting rod width is significantly smaller than specified and severe wear is present on the side of the connecting rod, replace the connecting rod.
   f. If the connecting rod width is within specification and excessive scoring is present on the crankshaft journals, replace the crankshaft.

CAUTION

Do not use a stamp, punch or any other method that may distort or stress the connecting rod and cap. Extensive engine damage may result from a connecting rod that is distorted or stressed.

8. Mark the cylinder number on the connecting rod and the connecting rod cap with a paint stick or permanent marker.

CAUTION

Powdered metal connecting rods have rod bolts which yield when tighten to the specified torque. If the bolts are loosened or removed they must be replaced. Rod bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

9 Remove the connecting rod bolts (1), loosening progressively from side to side.

CAUTION

The connecting rod caps must remain with the original connecting rod.

10 Remove the connecting rod cap (2).

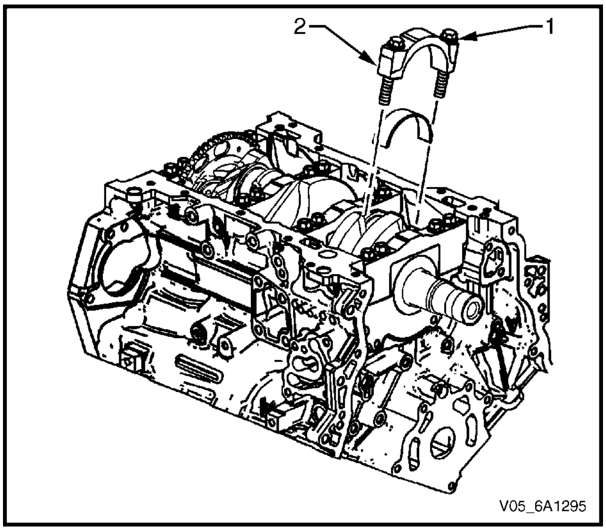


Figure 6A1 – 465

11 Install connecting rod guide pin set, Tool No. EN-46121 (1) to the connecting rod bolt holes.

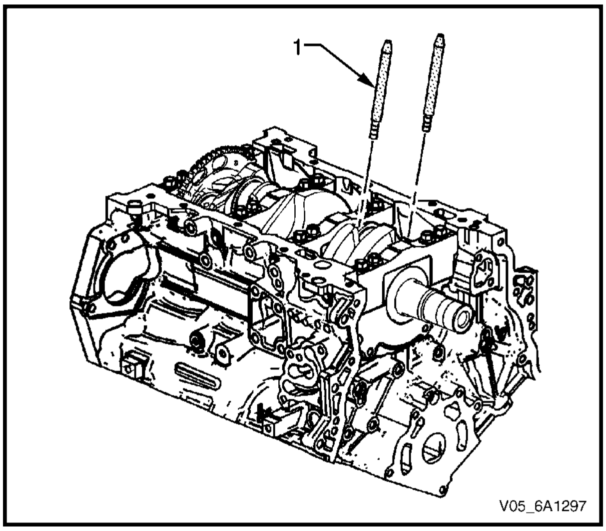


Figure 6A1 – 466

CAUTION

Do not damage the crankshaft journal, cylinder wall and piston cooling jets when removing the connecting rod and piston assembly.

12 Using connecting rod guide pin set, Tool No. EN-46121 (1), push the connecting rod and piston assembly (2) through the top of the cylinder.

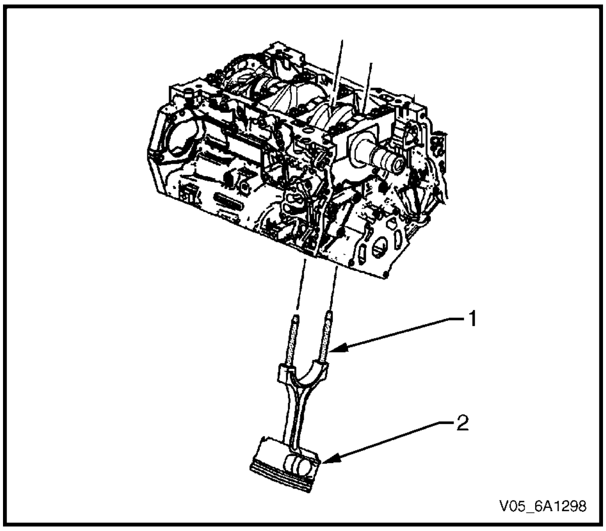


Figure 6A1 – 467

CAUTION

When dismantled, ensure the connecting rod, connecting rod cap, piston and bearings are organised in their original position and location. This will also aid engine mechanical diagnosis.

13 Remove connecting rod guide pin set, Tool No. EN-46121 (1) from the connecting rod bolt holes.

14 Remove the upper connecting rod bearing from the connecting rod (2).

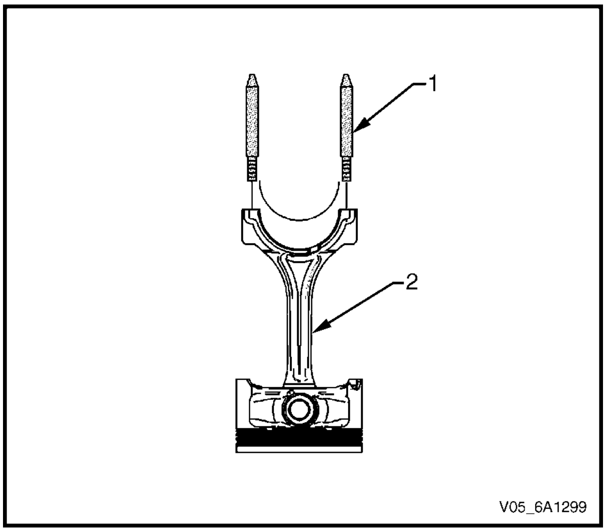


Figure 6A1 – 468

15 Remove the lower connecting rod bearing (1) from the connecting rod cap (2).

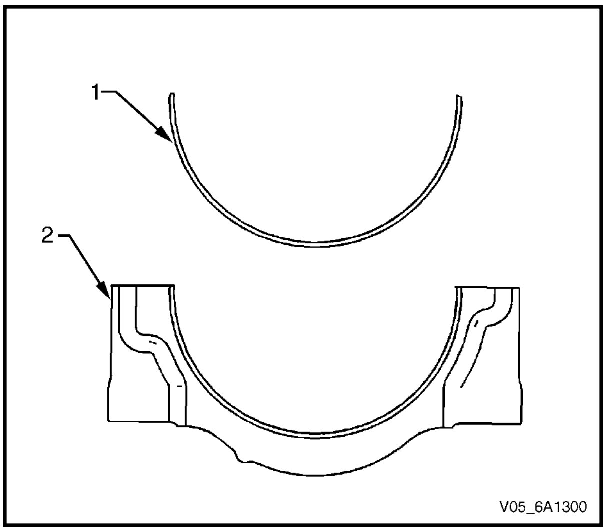


Figure 6A1 – 469

NOTE

The cap and rod are a matched set and must be kept together.

16 Reattach the connecting rod cap (1) to the connecting rod (2) to prevent damage to their mating surfaces.

17 Repeat steps 4 to 16 for the remaining piston and connecting rod assemblies.

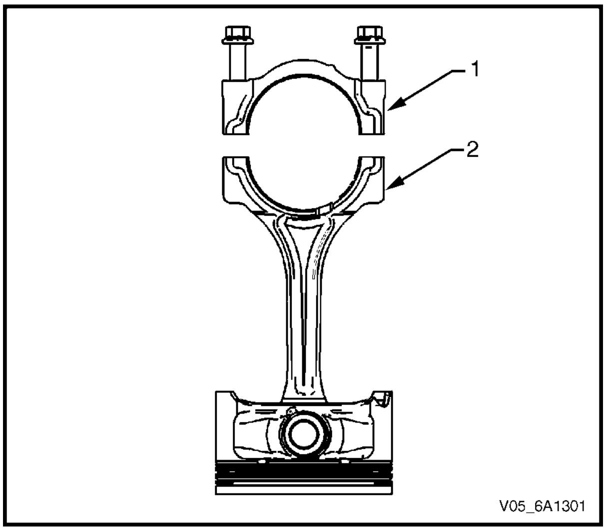


Figure 6A1 – 470

Disassemble

CAUTION

A piston ring expander must be used to remove and install the piston rings. Only expand the rings far enough to fit over the piston lands. If the rings are overexpanded, the top ring will shatter and the others will distort.

1 Remove the piston rings (2) using a piston ring expander (1). Place each ring in a clean shop towel for storage.

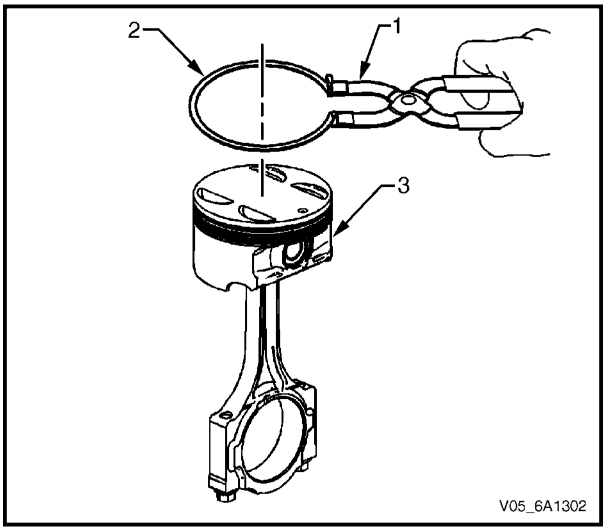


Figure 6A1 – 471

CAUTION

Do not reuse the piston pin retainers.

2 Remove the piston pin retainers by using the removal access notch (1) in the side of the piston. Discard the piston pin retainers.

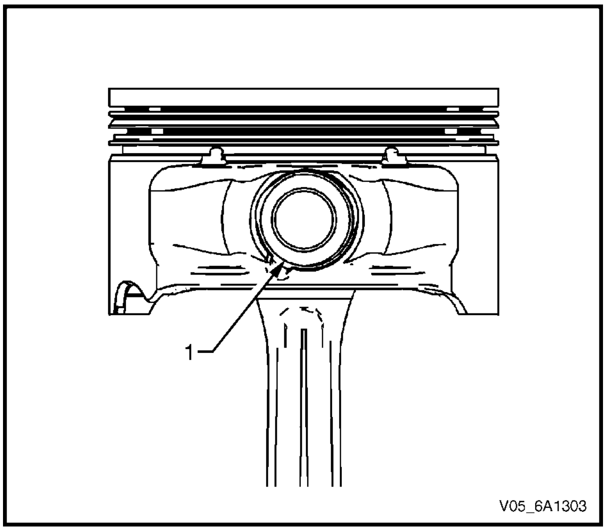


Figure 6A1 – 472

3 Slide the piston pin (1) out of the piston (2). The piston will disconnect from the connecting rod.

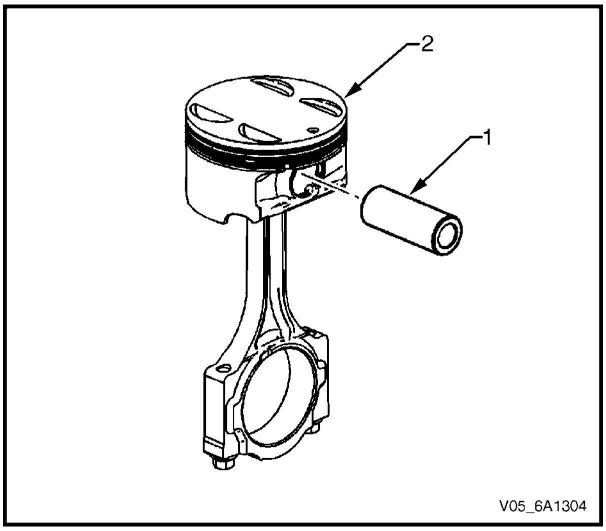


Figure 6A1 – 473

Clean and Inspect

Piston Cleaning Procedure

CAUTION

Do not use a wire brush to clean any part of the piston.

1 Clean the piston skirts and the pins with a suitable solvent.

2 Clean the piston ring grooves with a groove cleaner. Ensure the oil ring holes and slots are clean.

WARNING

Safety glasses must be worn when using compressed air.

3 Dry the piston with compressed air.

Piston Inspection Procedure

1 Inspect the pistons for the following conditions:

- eroded areas at the top of the piston (1),
- piston pin retainer grooves for burrs (2),
- worn piston pin bores or worn piston pins (3),
- scuffed or damaged skirt coating (4),
- ring grooves for cracks, nicks or burrs that may cause binding (5), and
- warped or worn ring lands.

2 Replace pistons that show any signs of damage or excessive wear.

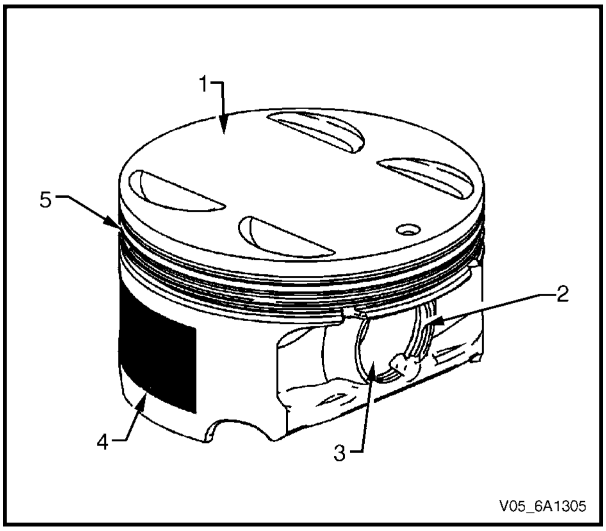


Figure 6A1 – 474

Piston Measurement

1 Measure piston width using the following procedure:

a Using an outside micrometer, measure the width of the piston at 30 mm below the crown top (1), at the thrust surfaces of the piston, perpendicular to the piston pin centreline.

b Compare the measurement of the piston to its original cylinder by subtracting the piston width from the cylinder diameter.

c Check your measurements with specifications, refer to 5 Specifications.

d If the clearance obtained through measurement is greater than the provided specifications and the cylinder bores are within specification, replace the piston.

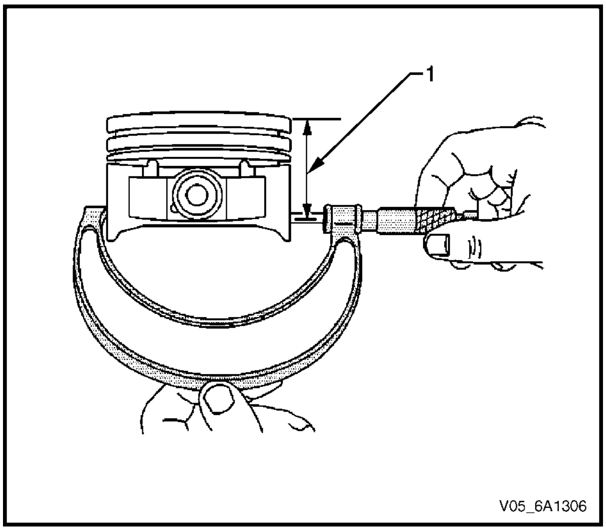


Figure 6A1 – 475

2 Measure the piston pin bore to piston pin (2) clearances using the following procedure:

a Piston pin bores and pins must be free of varnish or scuffing.

b Use an outside micrometer (1) to measure the piston pin in the piston contact areas.

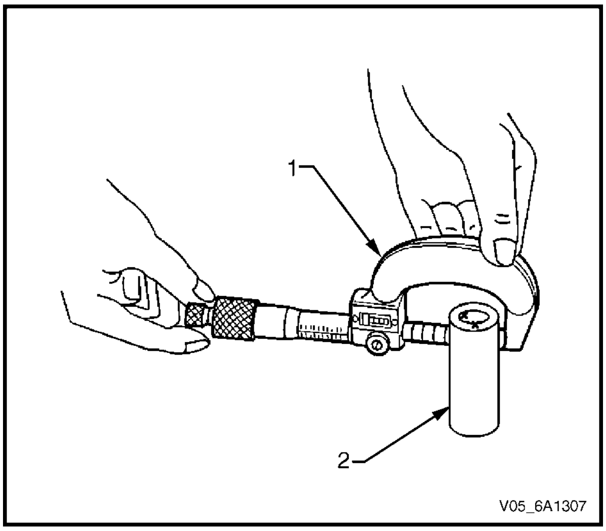


Figure 6A1 – 476

3 Using an inside micrometer, measure the piston pin bore (1). Compare the result with the piston pin diameter and piston pin to piston pin bore clearance listed in the specifications, refer to 5 Specifications.

4 If the clearance is excessive, determine which piece is out of specification and replace as required.

5 Replace the piston if any of its dimensions are out of specification.

6 If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm. There is only one size of oversized pistons and rings available for service.

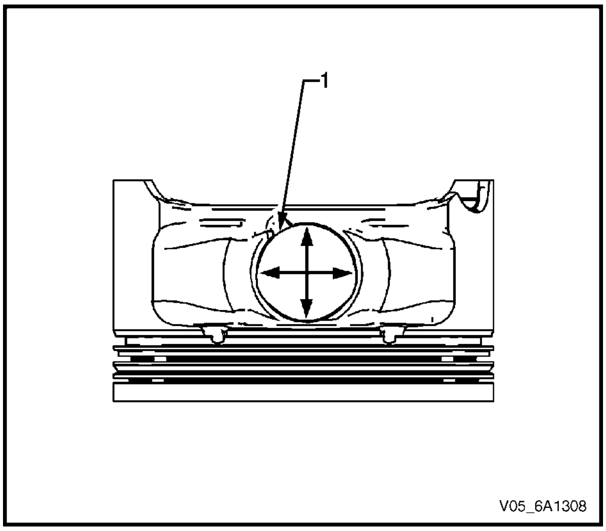


Figure 6A1 – 477

Piston Ring Measurement

1 Measure the piston ring end gap using the following procedure:

a Place the piston ring (1) in the area of the bore where the piston ring will travel, approximately 25 mm below the deck surface. Ensure the ring is square with the cylinder bore by positioning the ring with the piston head.

b Measure the end gap of the piston ring with feeler gauges (2), refer to 5 Specifications.

c If the clearance exceeds the provided specifications, the piston rings must be replaced.

d Repeat the procedure for all piston rings.

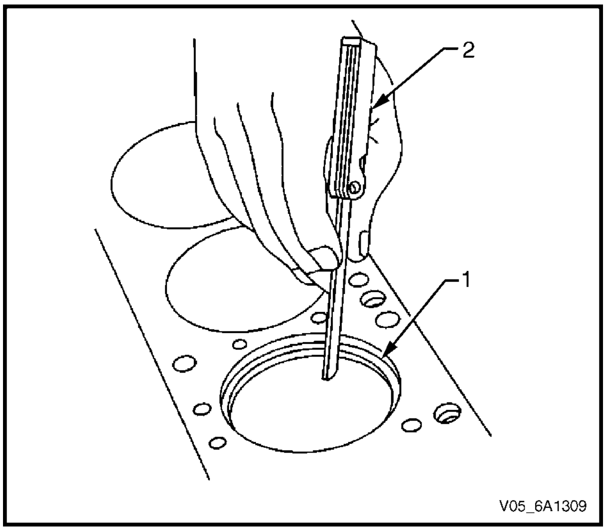


Figure 6A1 – 478

2 Measure the piston ring side clearance using the following procedure:

a Roll the piston ring (1) entirely around the piston ring groove. If any binding is caused by the ring groove, dress the groove with a fine file. If any binding is caused by a distorted piston ring, replace the ring.

b With the piston ring on the piston, use feeler gauges (2) to check clearance at multiple locations.

c Compare the measurements with piston ring side clearance listed in the specifications, refer to 5 Specifications.

d If the clearance is greater than specifications, replace the piston rings.

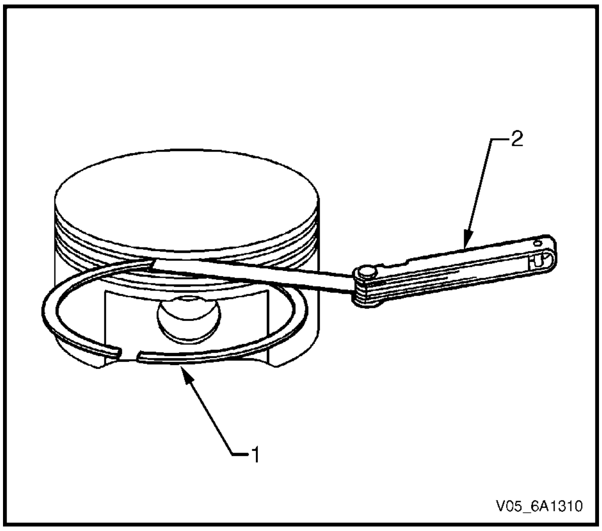


Figure 6A1 – 479

3 There is a locating dimple (1) on the compression rings. Install the compression rings with the dimple facing up.

4 If the new ring does not reduce the clearance to the correct specification, install a new piston.

5 If the new piston does not meet clearance specifications, the cylinder block may need to be oversized to 0.25 mm. There is only one size of oversized pistons and rings available for service.

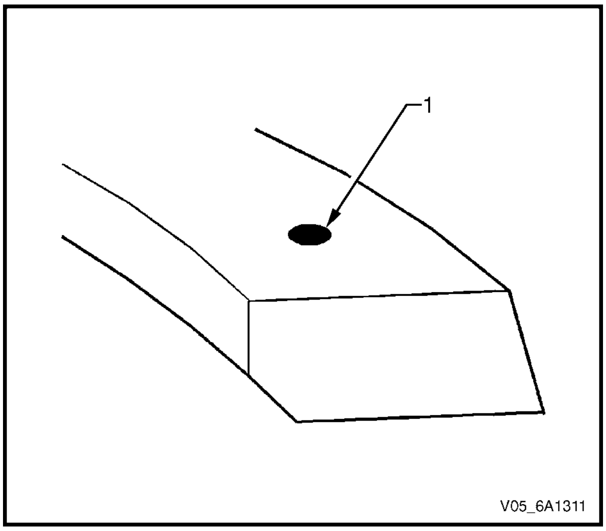


Figure 6A1 – 480

Connecting Rod Cleaning Procedure

1 Clean the connecting rods in solvent.

WARNING

Safety glasses must be worn when using compressed air.

2 Dry the connecting rod using compressed air.

3 Remove the connecting rod cap and clean the threads.

4 Remove the connecting rod bearing and discard. Never reuse a connecting rod bearing that has been used in a running engine.

Connecting Rod Visual Inspection Procedure

1 Inspect the piston pin bushing (4) for scoring or damage.

2 Inspect the connecting rod beam (1) for twisting or bending.

3 Inspect the rod cap (2) for any nicks or damage caused by possible interference.

4 Inspect for scratches or abrasion on the rod bearing seating surface.

5 If the connecting rod bores contain minor scratches or abrasions, clean the bores in a circular direction with a light emery paper.

6 Retain the original bolts (3) for preliminary assembly. They must be replaced for final assembly.

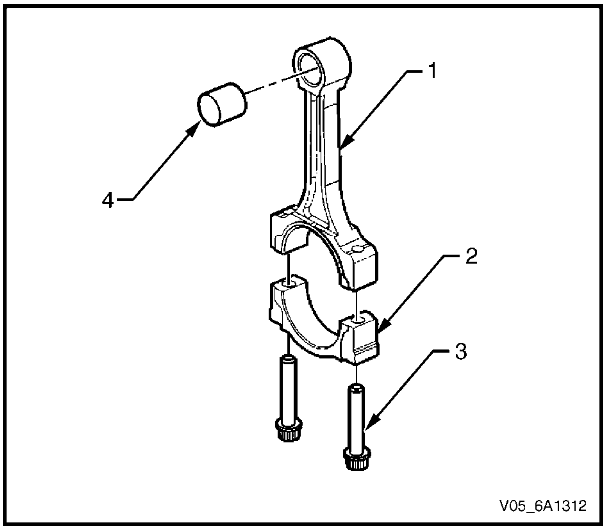


Figure 6A1 – 481

Connecting Rod Measurement Procedure

Piston Pin End

NOTE

Measurements of all components should be taken with the components at normal room temperature.

1 Using an outside micrometer (1), take two measurements of the piston pin (2) in the area of the connecting rod contact.

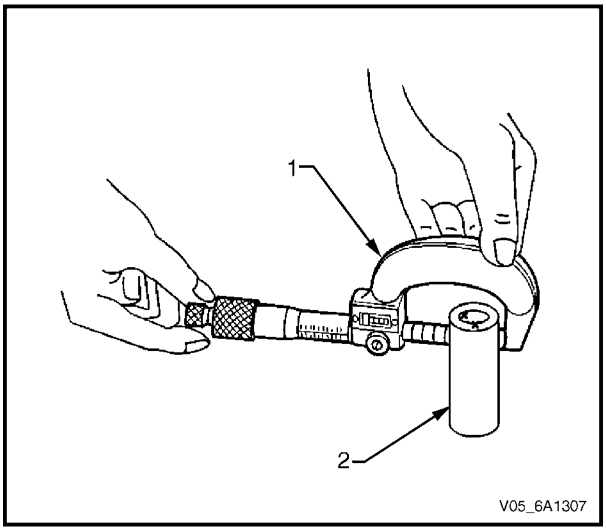
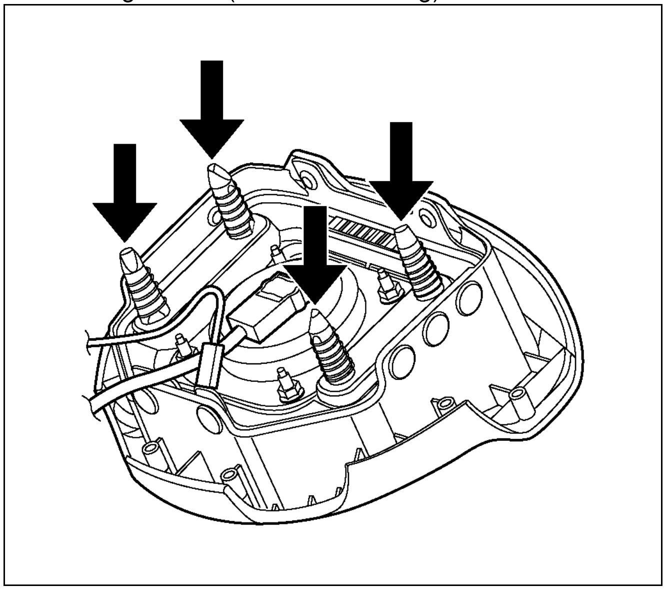


Figure 6A1 – 482

13.Align each snap stud of driver air bag to the holes on steering wheel. (with SRS air bag)



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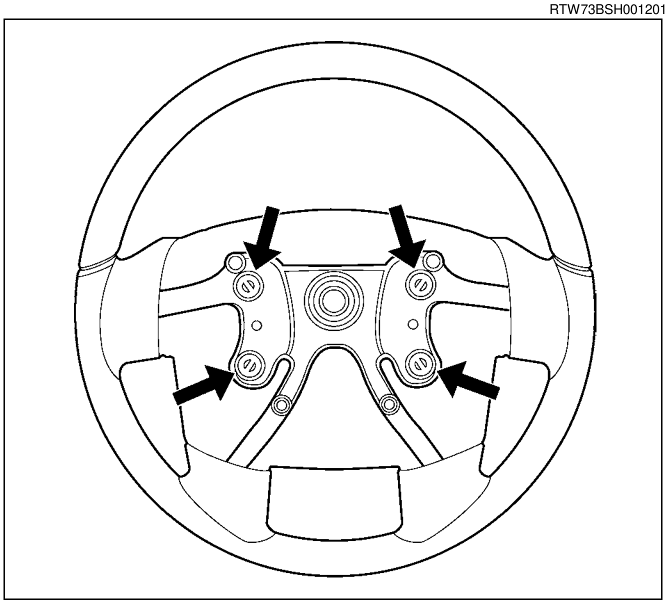
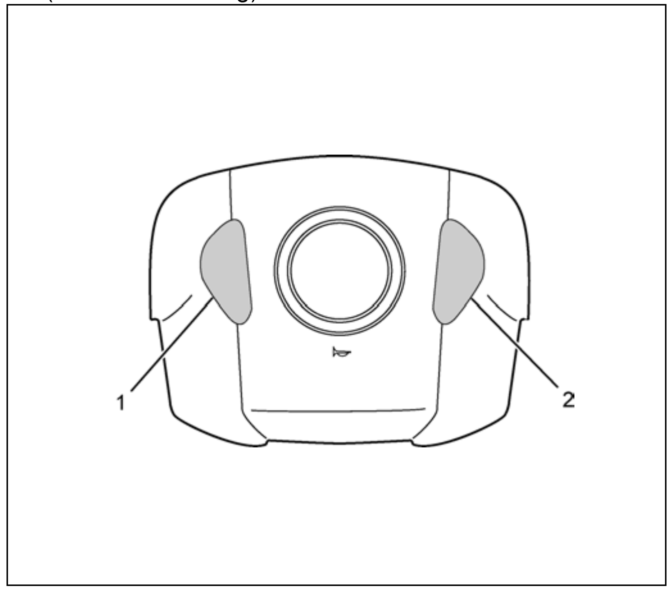


RTW73BSH000401

14.Push the SRS air bag at area-1 (1) and area-2 (2). At that time confirm the audible noise of each stud. (with SRS air bag)



RTW73BSH000301

15.Enable the SRS (Refer to "Enabling the SRS" in this section). (with SRS air bag)
16.Install driver knee bolster (reinforcement).
17.Install instrument panel lower cover then install the engine hood opening lever.
18.Connect the SRS connector (with SRS air bag).
19.Connect the battery "-" terminal cable. (with SRS air bag)
20.Turn the ignition switch to "ON" while watching warning light and check - the light should flash 7 times and then go off. If lamp does not operate correctly, refer to Restraints section.

2 Using an inside micrometer, measure the connecting rod piston pin bore (1).
3 Subtract the piston pin diameter from the piston pin bore.
4 Compare the clearance measurements listed in the specifications, refer to 5 Specifications.
5 If the clearance is excessive, replace the piston pin. If a new pin does not resolve the clearance problem, replace the connecting rod.

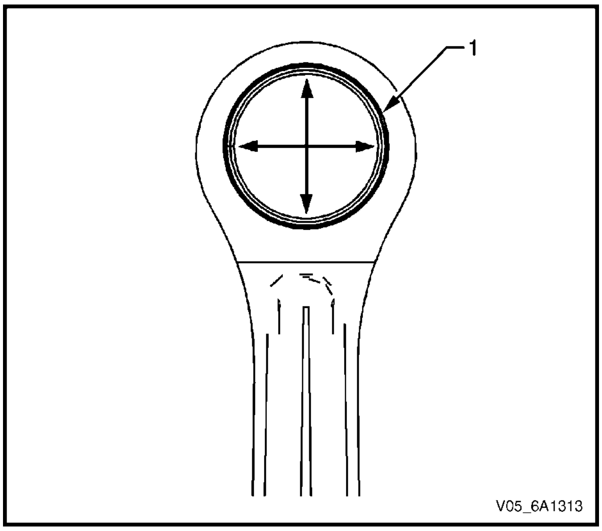


Figure 6A1 – 483

Crankshaft Bearing End

NOTE

Measurements of all components should be taken with the components at normal room temperature.

1 Using an inside micrometer, measure the connecting rod crankshaft bearing bore (1).
2 Compare the bore measurements listed in the specifications, refer to 5 Specifications.
3 Replace the connecting rod if the bore is out of specification. Do not recondition the connecting rod.

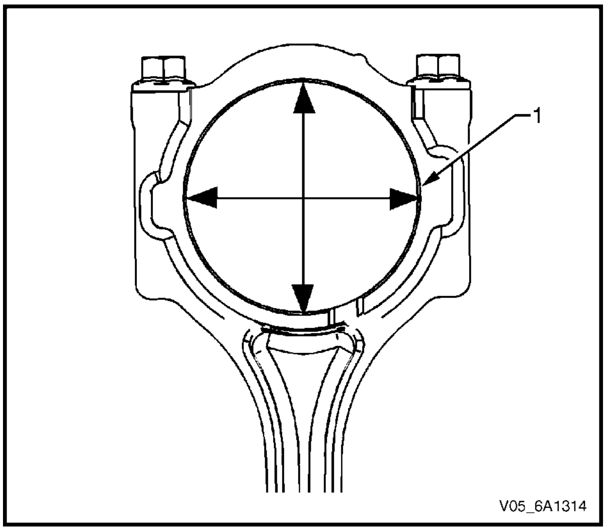


Figure 6A1 – 484

Reassemble

Piston and Piston Pin

CAUTION

The arrow located on top of the piston must point toward the front of the engine.

NOTE

The connecting rod is non-directional and may be assembled/reassembled to the piston in either direction.

1 Lubricate the piston pin (1) bores in the piston (2) and the connecting rod with clean engine oil.

2 Assemble the piston and piston pin to the connecting rod. Correctly orient the piston when reusing a marked connecting rod.

3 Align the piston pin bore with the connecting rod pin bore.

4 Slide the piston pin into the piston and the connecting rod.

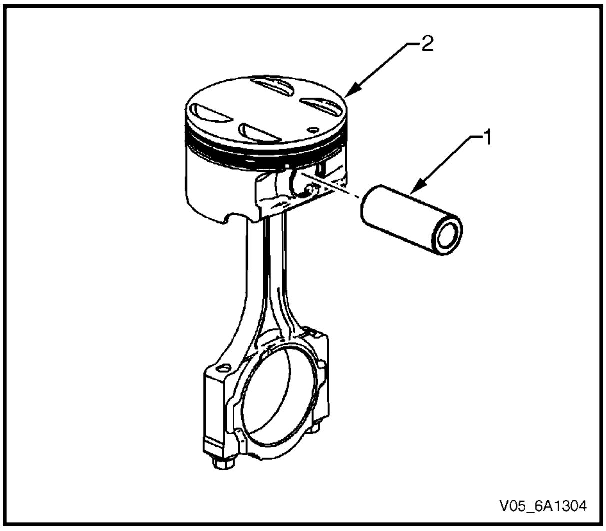


Figure 6A1 – 485

CAUTION

New piston pin retainers must be used. Never reuse the piston pin retainers.

5 Install new piston pin retainers (1).

6 Ensure the piston pin retainers are fully seated in their grooves.

7 Repeat steps 1 to 6 for the remaining pistons.

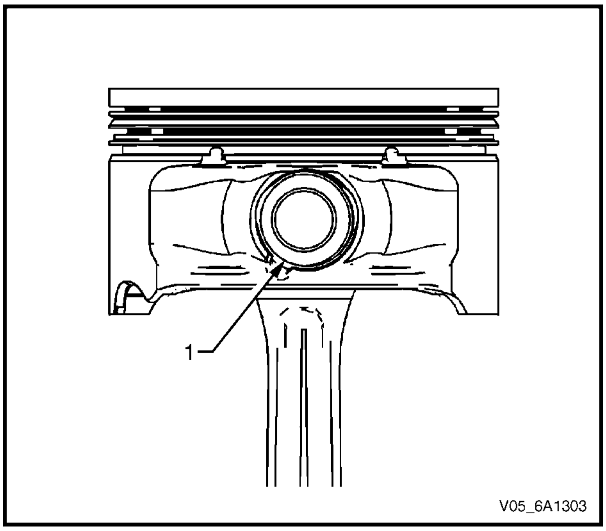


Figure 6A1 – 486

Piston Ring

NOTE

The ends of the expander must be facing toward the top of the piston.

1 Correctly orient the oil control ring expander (1) before installation.

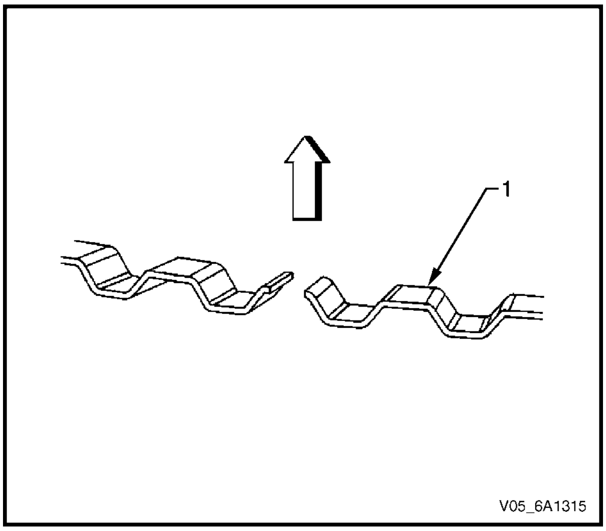


Figure 6A1 – 487

2 Using a piston ring expander, install the oil control ring assembly using the following procedure:

3 Install the expander ring (3).

4 Install the two oil scraper rings (4). Expand the rings only enough to clear the piston diameter. Over-expanding the piston rings will distort or crack the rings.

5 Install the second (2) and top (1) piston rings as follows.

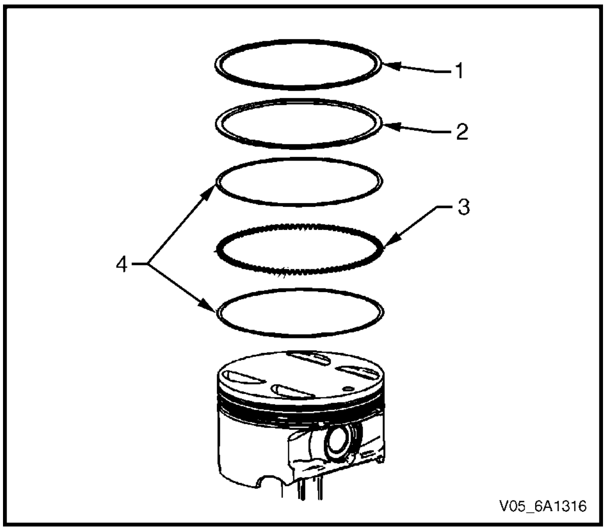


Figure 6A1 – 488

6 Using the ring expander (1), install the second piston ring (2) onto the piston (3). Do not over-expand the ring. Repeat for the top ring.

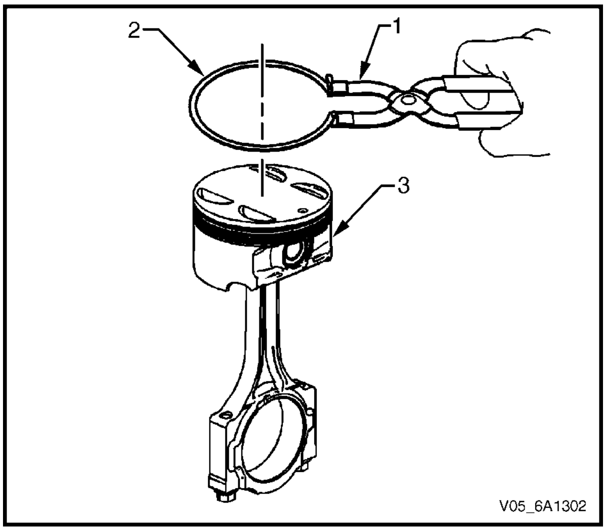


Figure 6A1 – 489

7 Once the rings are installed, set the ring gaps for the oil control, second and top ring as follows. Use the piston location arrow for reference.

- Lower oil control ring position (1).
- Upper oil control ring position (2).
- Top ring position (3).
- Oil control ring expander position (4).
- Second ring position (5).

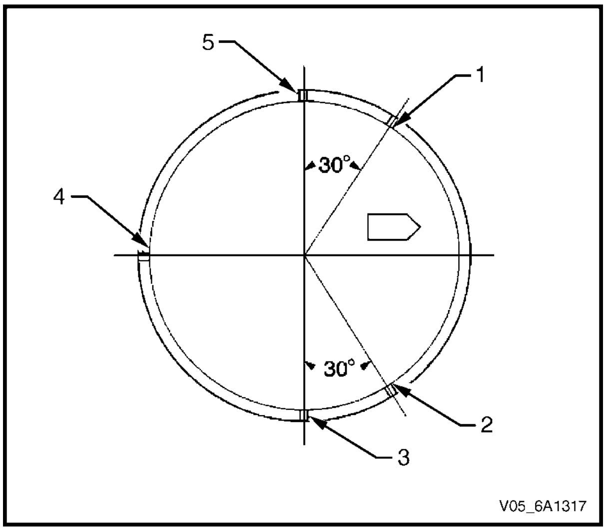


Figure 6A1 – 490

Connecting Rod Bearing

CAUTION

If the connecting rod bearings have been used in a running engine, they must be replaced with new connecting rod bearings for reassembly.

1 Clean the connecting rod (2) and the connecting rod cap bearing bore with a lint-free cloth.

2 Clean the oil from behind the connecting rod bearing halves.

3 Install a new upper connecting rod bearing (1) into position. Roll the bearing into position so the lock tang engages the alignment slot. The bearing must fit flush in the connecting rod.

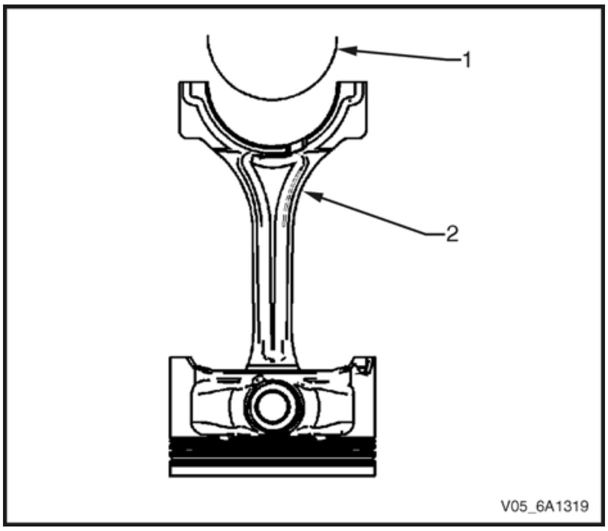


Figure 6A1 – 491

4 Install the lower connecting rod bearing (1) into position in the connecting rod cap (2).

5 Roll the bearing into position so the lock tang engages the alignment slot. The bearing must fit flush with the connecting rod cap.

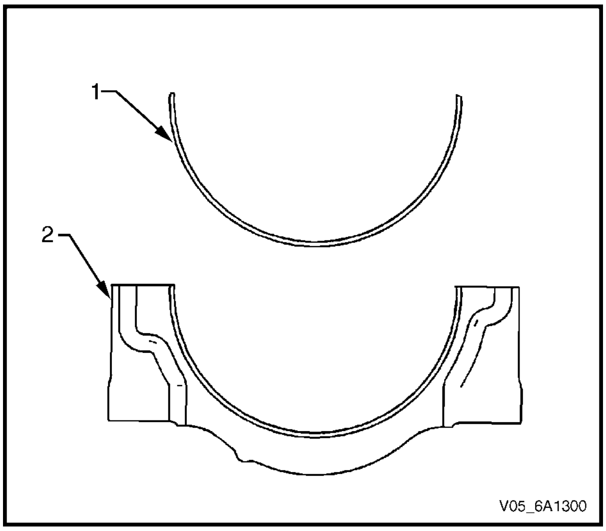


Figure 6A1 – 492

Reinstall

Piston Connecting Rod and Connecting Rod Bearing Installation

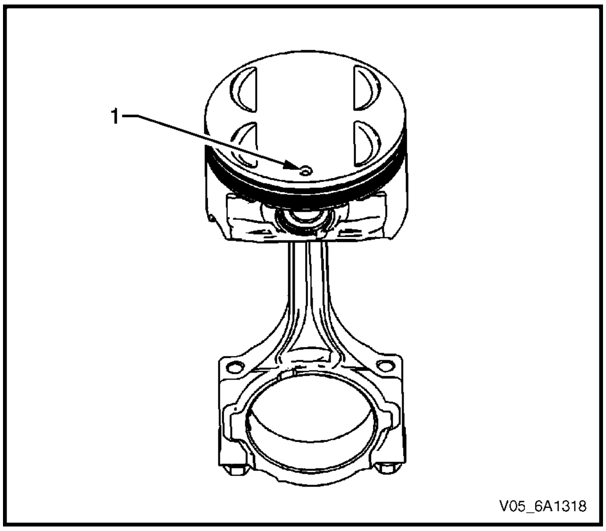


Figure 6A1 – 493

CAUTION

The piston is directional and must be installed in the engine block in the correct direction. The locating arrow on the top of each piston must be pointing toward the front of the engine.

1 Liberally lubricate the cylinder walls, piston rings and piston skirts with engine oil.

2 Select the correctly numbered piston/connecting rod assembly for the cylinder. A dot (1) showing correct piston orientation is located on the top of the piston.

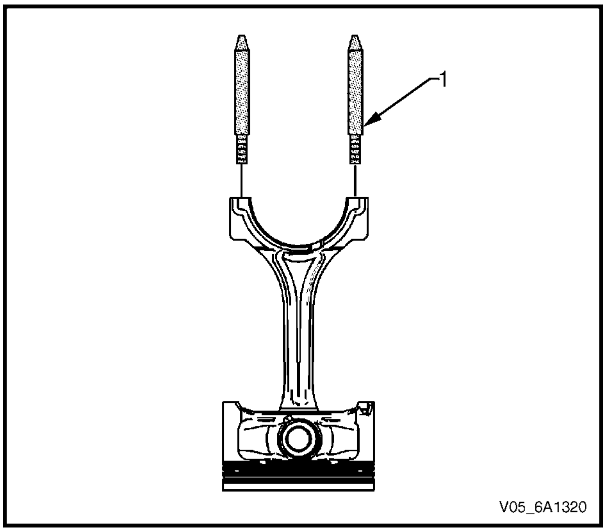


Figure 6A1 – 494

3 Install connecting rod guide pin set, Tool No. EN-46121 (1) into the connecting rod bolt holes.

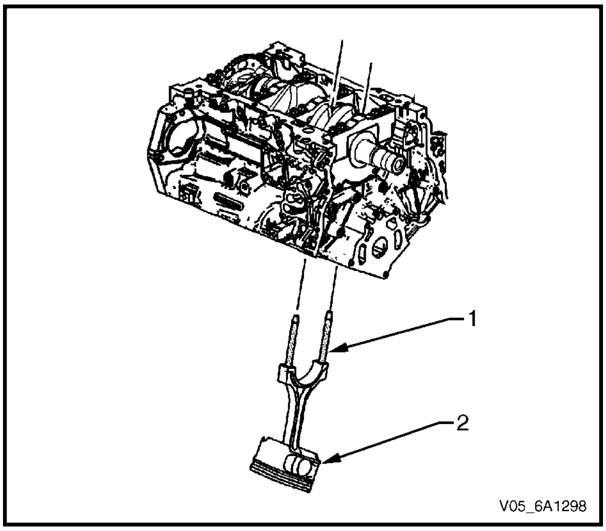


Figure 6A1 – 495

4 Compress the piston rings using a commercially available ring compressor.

CAUTION

Extreme care must be used when installing the piston and connecting rod to ensure the rod does not scrape or nick the cylinder bore, oil jets, or crankshaft surfaces.

5 Using both hands from the top and bottom of the cylinder, slowly guide the piston (2) and connecting rod assembly into the cylinder. Do not allow the connecting rod to contact the cylinder wall.

6 When the ring compressor contacts the deck surface, gently tap the piston into the cylinder using the handle end of a dead-blow hammer. Guide the connecting rod onto the crankshaft bearing journal using connecting rod guide pin set, Tool No. EN-46121 (1) while gently tapping the piston into the cylinder with a soft-blow hammer.

7 Remove connecting rod guide pin set, Tool No. EN-46121 (1) from the connecting rod bolt holes.

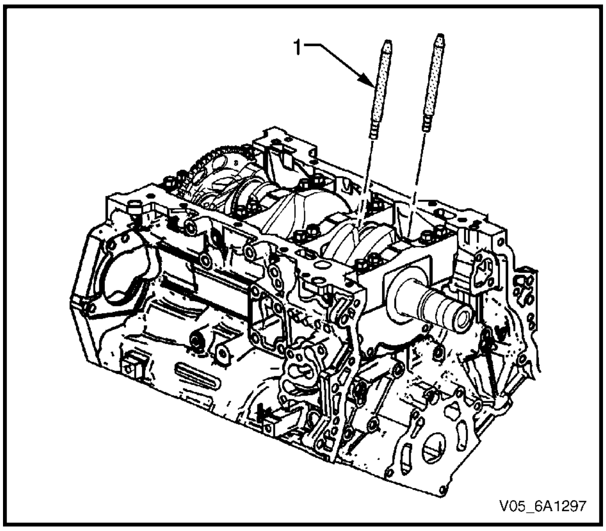


Figure 6A1 – 496

Connecting Rod Bearing Clearance Measurement Procedure

NOTE

Before final assembly, check the clearance of the new connecting rod bearings.

1 Place a length of fresh, room temperature plastic gauging material all the way across the connecting rod bearing journal.

2 Install the connecting rod bearing into the connecting rod cap.

3 Install the connecting rod end cap (1) on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

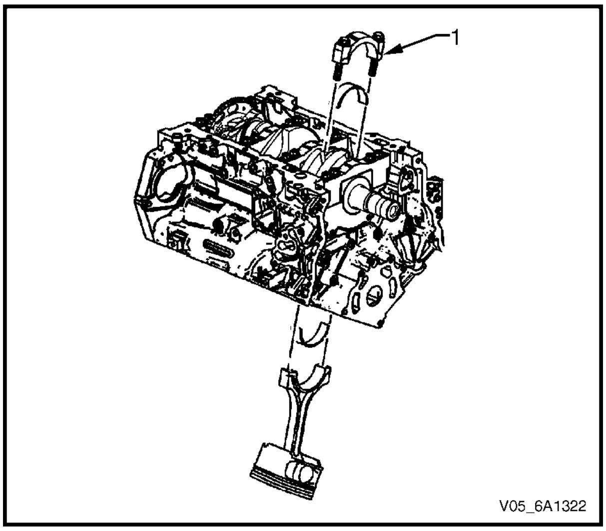


Figure 6A1 – 497

NOTE

Reuse the old connecting rod bolts only for measuring the connecting rod bearing clearance.

4 Install the connecting rod cap bolts into the connecting rod cap and tighten to the correct torque specification using torque angle wrench, Tool No. EN-7115.

Connecting rod cap attaching bolt torque specification: Stage 1 ....30.0 Nm Stage 2 .... Loosen completely Stage 3 ....25.0 Nm Stage 4 .... 110 degrees

5 Allow the assembly to sit for at least 2 minutes.

6 Remove the connecting rod cap bolts and discard.

7 Remove the connecting rod cap.

8 Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gauging (1) material at its widest point with the graduation on the gauging material container (2).

9 Compare the measurements with the specifications, refer to 5 Specifications.

10 If the new bearings do not provide the correct crankshaft to connecting rod bearing clearance, inspect the following:

11 Measure the crankshaft connecting rod journals for the correct specified size and ensure the correct new bearings are being installed. If the crankshaft connecting rod journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

12 Measure the connecting rod bearing bore diameter to ensure correct size. The connecting rod is not machineable and the connecting rod must be replaced if out of specification.

13 Clean the plastic gauging material from the connecting rod bearing journals using a soft lint-free cloth.

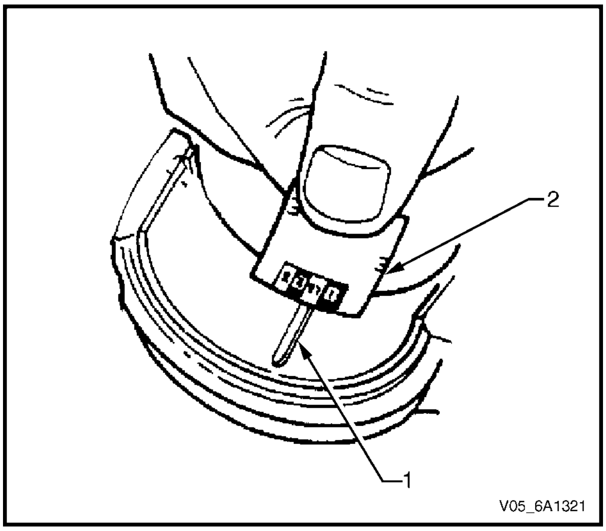


Figure 6A1 – 498

Connecting Rod Final Assembly Procedure

1 Carefully guide the connecting rod away from the crankshaft connecting rod journal slightly to lubricate the crankshaft connecting rod bearing journal.

2 Apply a liberal amount of clean engine oil to the crankshaft connecting rod bearing journal.

3 Guide the connecting rod to the crankshaft connecting rod journal.

4 Install the connecting rod end cap (1) on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

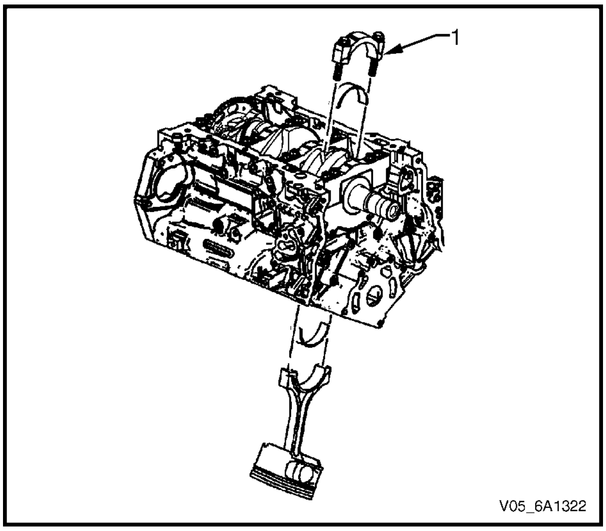


Figure 6A1 – 499

CAUTION

- **Do not lubricate the new connecting rod bolts. The new bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are tightened to the specified torque. Incorrect clamp load can lead to component failure and extensive engine damage.**
- **Do not reuse the old connecting rod bolts.**

5 Install new connecting rod bolts into the connecting rod cap and tighten to the correct torque specification.

■ Connecting rod cap attaching bolt torque specification:	
	Stage 1 ....30.0 Nm
	Stage 2 .... Loosen completely
	Stage 3 ....25.0 Nm
	Stage 4 .... 110 degrees

NOTE

During and after installation, ensure each piston is positioned correctly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.

6 Repeat these procedures for the remaining piston/connecting rod assemblies.

7 Reinstall the oil pan and oil pump pick up assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.

8 Reinstall the cylinder heads, refer to 3.22 Cylinder Head Assembly.

9 Reinstall the engine assembly, refer to 4.1 Engine .

4.6 Crankshaft and Main Bearings

1 Remove the engine assembly, refer to 4.1 Engine .
2 Remove both cylinder head assemblies, refer to 3.22 Cylinder Head Assembly.
3 Remove the oil pan assembly, refer to 4.2 Oil Pan and Oil Pump Suction Pipe Assembly.
4 Remove the piston and connecting rod assemblies, refer to 4.5 Pistons, Pins, Rings, Connecting Rods and Big-end Bearings.
5 Remove the oil pump assembly, refer to 3.17 Oil Pump Assembly.
6 Remove the crankshaft rear oil seal and plate assembly, refer to 4.4 Crankshaft Rear Seal and Plate Assembly.
7 Remove the crankshaft position sensor, refer to Section 6C1-3 Engine Management – V6 – Service Operations.

Crankshaft End Play Measurement

1 Place a dial indicator at the end of the crankshaft nose.
2 Gently force the crankshaft towards the front and rear of the cylinder block with a lever while monitoring the movement of the dial indicator.
3 The crankshaft endplay should not exceed specifications, refer to 5 Specifications.
4 If the specifications are exceeded, inspect the thrust bearing thrust outer diameter and the crankshaft thrust wall for wear and/or excessive runout. Compare the values with the specifications, refer to 5 Specifications.
5 Replace the thrust bearing or crankshaft as required.

Remove

1 Remove the crankshaft bearing cap side bolts (3).

CAUTION

The crankshaft bearing cap outer bolts are yield tightened during assembly and must be replaced prior to reassembly. Crankshaft bearing cap outer bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

2 Remove the crankshaft bearing cap outer bolts (1).
3 Remove the crankshaft bearing cap inner bolts (2).

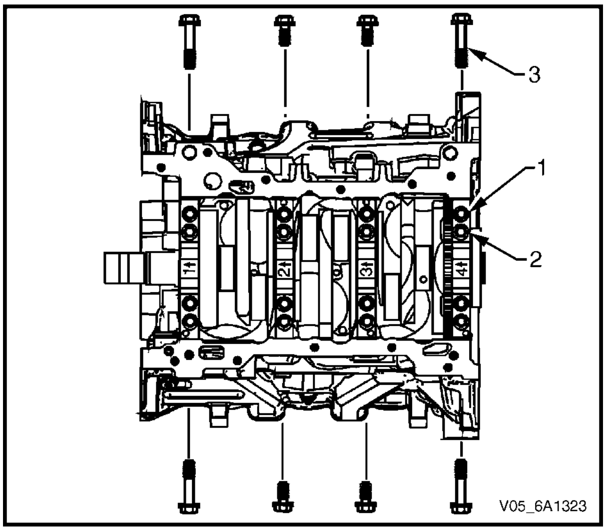


Figure 6A1 – 500

4 Loosen the nuts (1) of the crankshaft main bearing cap remover, Tool No. J-41818 (2) to separate the chamfered collets. Install the collets into the inner bolt holes of the front main bearing cap (3).

5 Tighten the remover nuts to the correct torque specification.

Crankshaft bearing cap remover nut.................11.0 Nm.

6 Install a slide hammer, Tool No. J-6125-1B (4) onto the crankshaft bearing cap remover and remove the crankshaft bearing cap.

7 Repeat steps 9 to 14 for the remaining crankshaft bearing caps.

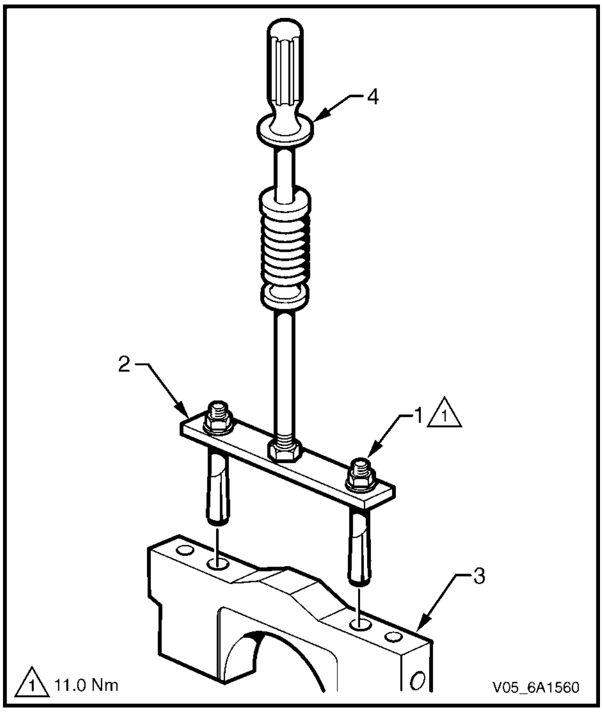


Figure 6A1 – 501

8 Remove the crankshaft (1) from the engine block (2), lifting evenly to avoid jamming against the main thrust bearing.

9 Place the crankshaft in a secure place.

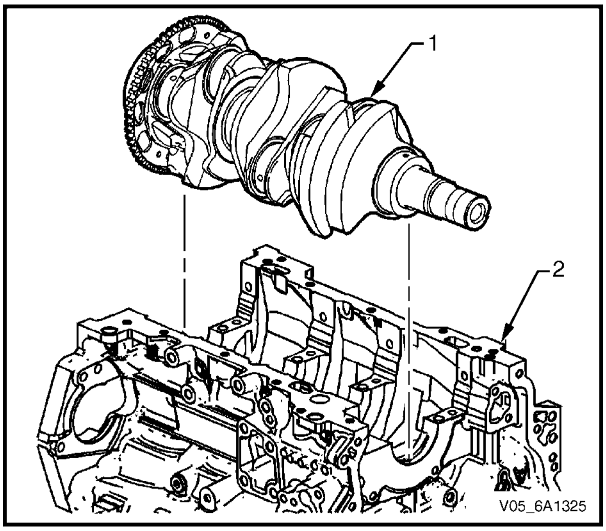


Figure 6A1 – 502

10 If required, remove the crankshaft sprocket drive pin (1) from the crankshaft (2),

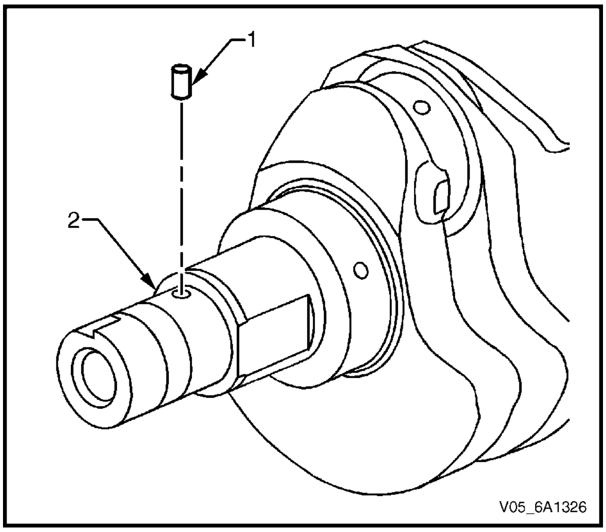
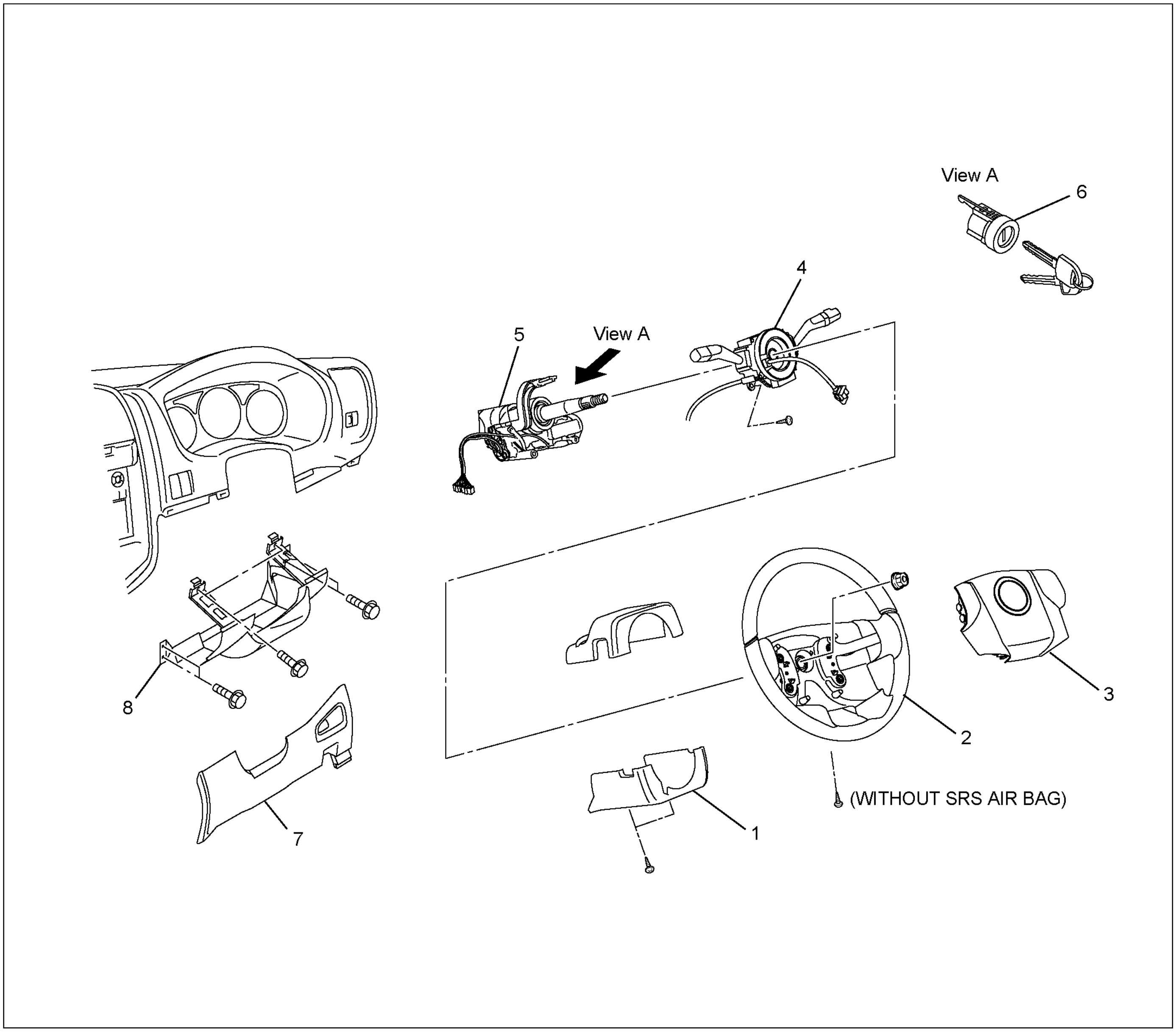


Figure 6A1 – 503

Lock Cylinder

Lock Cylinder and Associated Parts



Legend

(1) Steering Column Cover
(2) Steering Wheel
(3) Inflator Module or Horn pad
(4) Combination Switch and SRS Coil Assembly
(5) Steering Column Assembly
(6) Lock Cylinder Assembly
(7) Instrument Panel Lower Cover
(8) Driver Knee Bolster (reinforcement)

Removal

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to "LOCK".
3. Disconnect the battery "-" terminal cable, and wait at least 5 minutes (with SRS air bag).
4. Disconnect the yellow 2-way SRS connector located under the steering column (with SRS air bag).

Crankshaft Bearing

1 Prepare a piece of cardboard or similar, numbered 1 – 4 for bearing identification.

NOTE

Main bearing journals are numbered from the front of the engine.

2 Remove the crankshaft upper bearing halves from the cylinder block. Note the position of the thrust bearing (1) at the number 3 journal (2).

3 Place the crankshaft upper bearing halves on the cardboard in the correct positions.

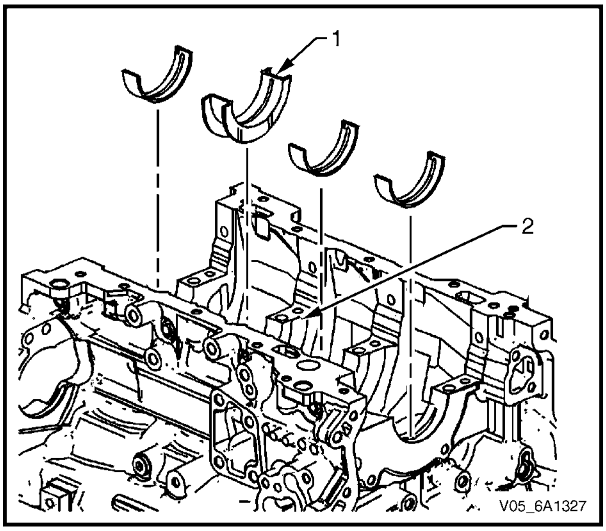


Figure 6A1 – 504

4 Remove the crankshaft lower bearing halves (2) from the crankshaft bearing caps (1).

5 Place the crankshaft lower bearing halves in the correct positions on the cardboard.

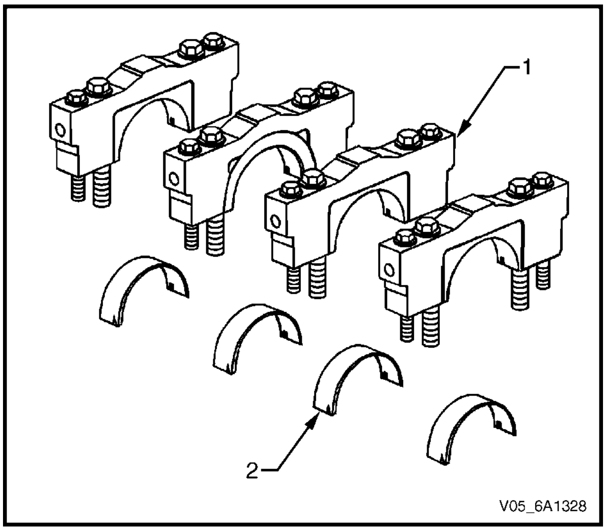


Figure 6A1 – 505

Clean and Inspect

Crankshaft and Main Bearing Cleaning

WARNING

Safety glasses must be worn when using compressed air.

Clean the following components in solvent and then dry with compressed air:

- crankshaft bearings,
- connecting rod bearings,
- crankshaft journals,
- crankpin journals,
- crankshaft oil passages, and
- crankshaft threaded holes.

Crankshaft and Main Bearing Visual Inspection

1 Perform the following visual inspections:

- Inspect the crankshaft balancer bolt hole (1) for thread damage.
- Inspect the crankshaft balancer mounting area (2) for damage.
- Inspect the crankshaft sprocket pin hole (3) for damage.
- Inspect the oil pump drive flats (4) for damage.
- Inspect the crankshaft main journals (5) for damage.
- Inspect the crankshaft connecting rod journals (6) for damage.
- Inspect the crankshaft oil passages (7) for obstructions.
- Inspect the crankshaft main bearing thrust wall surfaces (8) for damage.
- Inspect the crankshaft counterweights (9) for damage.
- Inspect the crankshaft reluctor ring teeth (10) for damage.
- Inspect the crankshaft rear main oil seal surface (11) for damage.
- Inspect the crankshaft engine flexplate mounting surface (12) for damage.
- Inspect the crankshaft pilot hole (13) for damage.
- Inspect the crankshaft engine flywheel bolt holes (14) for thread damage.

2 Repair or replace the crankshaft as required.

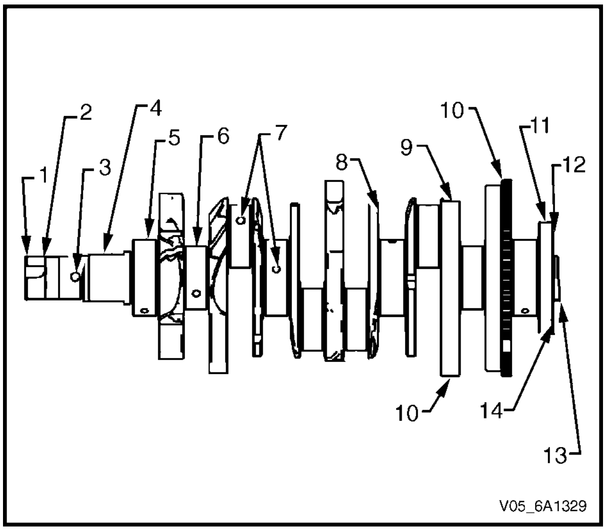


Figure 6A1 – 506

Crankshaft Main Bearing Inspection

CAUTION

All connecting rod and main journal bearings that have been used in a running engine must be replaced. Never re-use the crankshaft or connecting rod bearings.

NOTE

The following bearing wear conditions should be used to diagnose engine operating conditions or root cause of a condition.

1 Inspect for fatigue indicated by craters or pockets (2). Flattened sections on the bearing halves (1) also indicate fatigue.

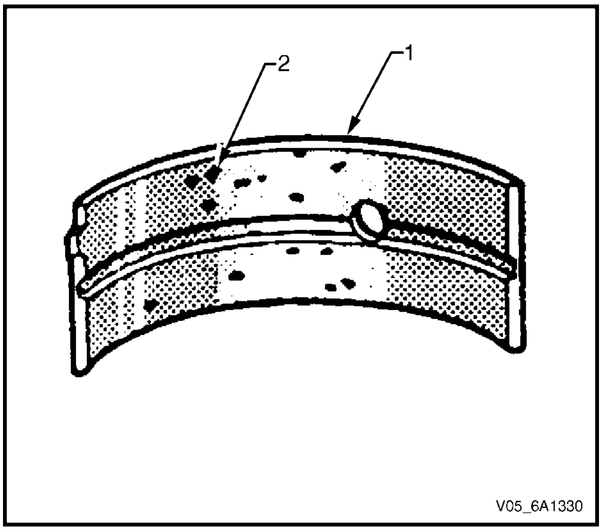


Figure 6A1 – 507

2 Inspect for excessive scoring or discoloration (2) on both front and back of the bearing halves (1).

3 Inspect the main bearings for dirt embedded into the bearing material.

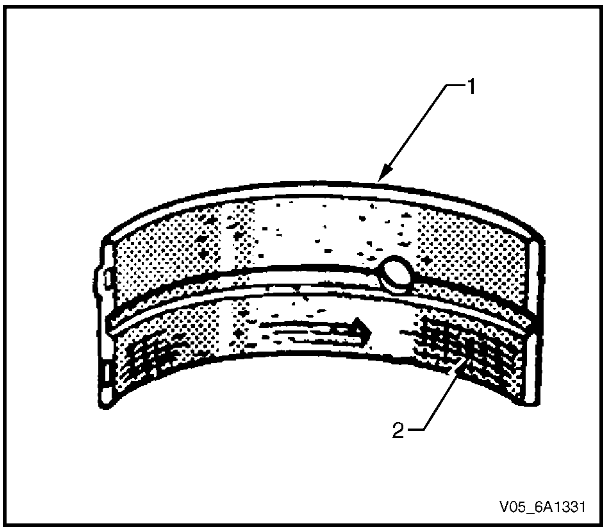


Figure 6A1 – 508

4 Inspect for incorrect seating indicated by bright, polished sections (1).

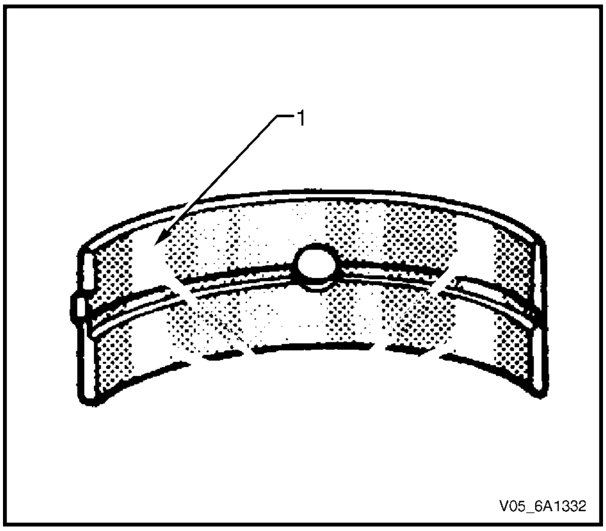


Figure 6A1 – 509

Crankshaft Measurement

1 Using a suitable fixture (1), support the crankshaft (2).

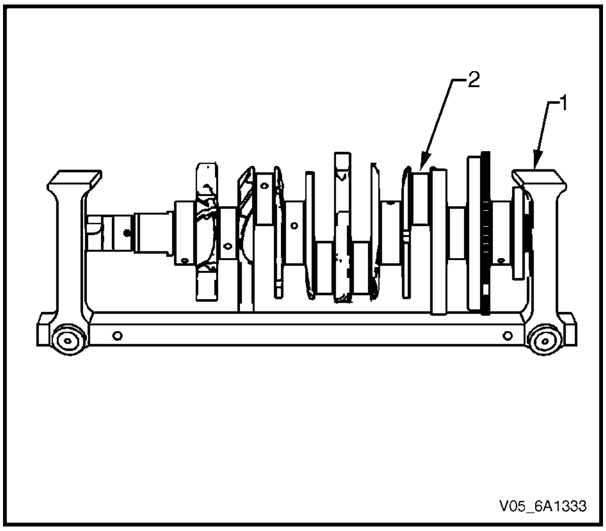


Figure 6A1 – 510

2 Using a dial indicator (1) and magnetic base (2), rotate the crankshaft (3) carefully by hand. Measure the crankshaft main journals for runout and compare with the engine specifications, refer to 5 Specifications.

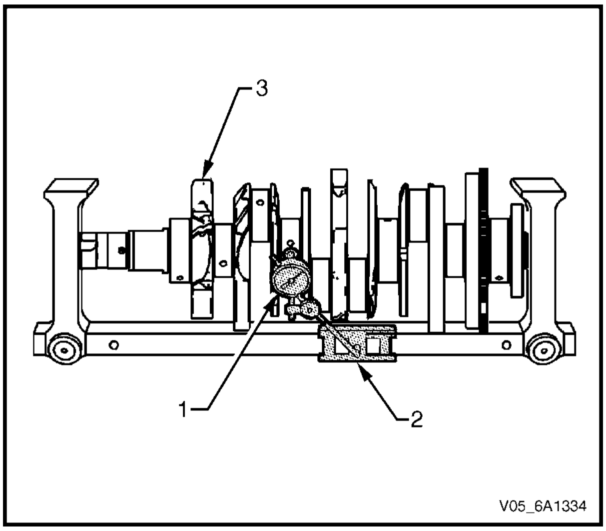


Figure 6A1 – 511

3 Measure the crankshaft thrust wall width (1) for wear using an inside micrometer and compare with the engine specifications, refer to 5 Specifications.

4 Measure the crankshaft thrust wall surface (2) for runout using a dial indicator, mounted to a magnetic stand and compare with the engine specifications, refer to 5 Specifications.

5 If the crankshaft journals are damaged or worn beyond specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized main bearings available for service.

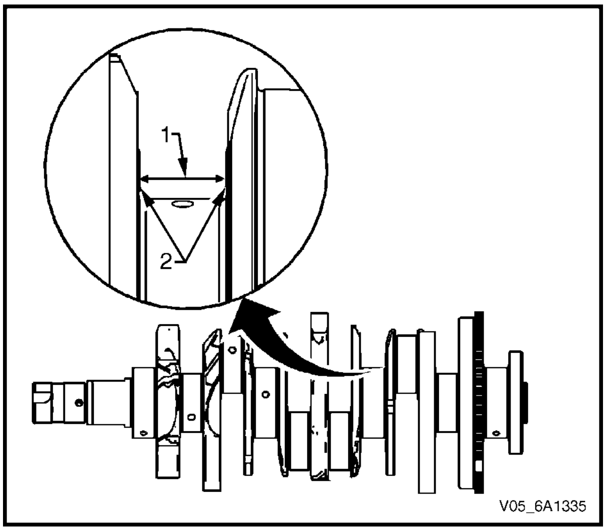


Figure 6A1 – 512

6 Inspect the crankshaft main journals (1) for undersize, using an outside micrometer (2).

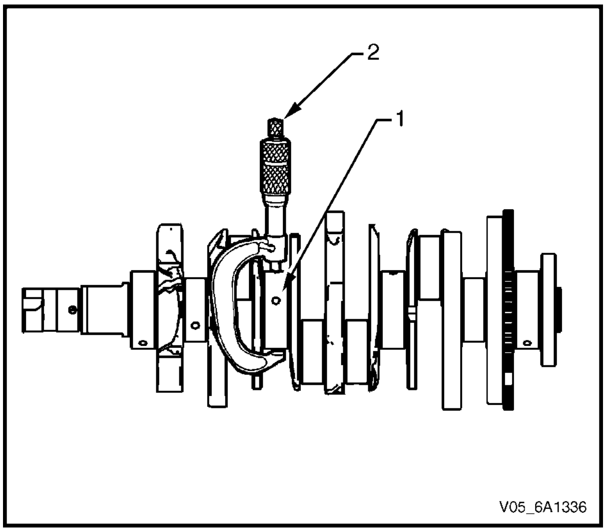


Figure 6A1 – 513

7 Inspect the crankpins (1) for undersize using an outside micrometer (2).

8 Compare your measurements with those listed in the engine specifications, refer to 5 Specifications. If the crankpin journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. Only one size of oversized connecting rod bearings available for service.

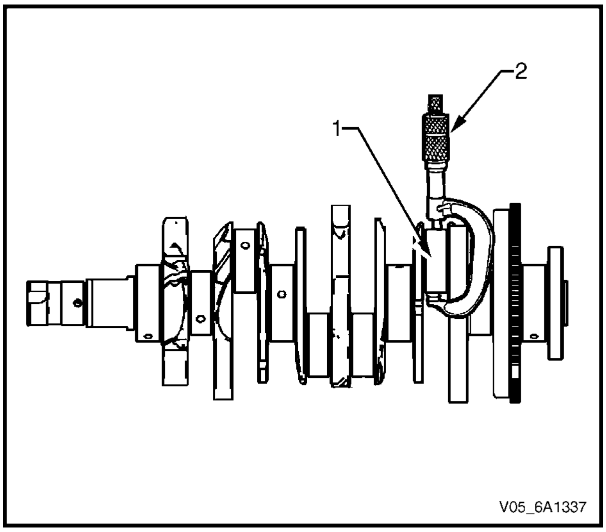


Figure 6A1 – 514

9 Measure the main bearing and crankpin journals for out-of-round using the following procedure:

   a Using an outside micrometer, measure the journal at the extreme front and rear locations on the journal. Call these points A and B.

   b Measure the journal in two new locations exactly 90 degrees from the first points. Call these points C and D.

   c Subtract A from C and B from D. The differences will indicate journal out-of-round.

   d The out-of-round should not exceed 0.004 mm maximum.

   e If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized crankshaft and connecting rod bearings available for service.

10 Measure the main bearing and crankpin journals for taper using the following procedure:

   a Using an outside micrometer, measure the journal at the extreme front (A) and rear (B) of the journal parallel to the crankshaft centreline.

   b Subtract the smallest from the largest measurement. The result will be the journal taper.

   c If the main bearing journal taper exceeds 0.004 mm, replace the crankshaft.

   d If the journals are worn beyond the specifications, the crankshaft may be ground 0.25 mm. There is only one size of oversized crankshaft and connecting rod bearings available for service.

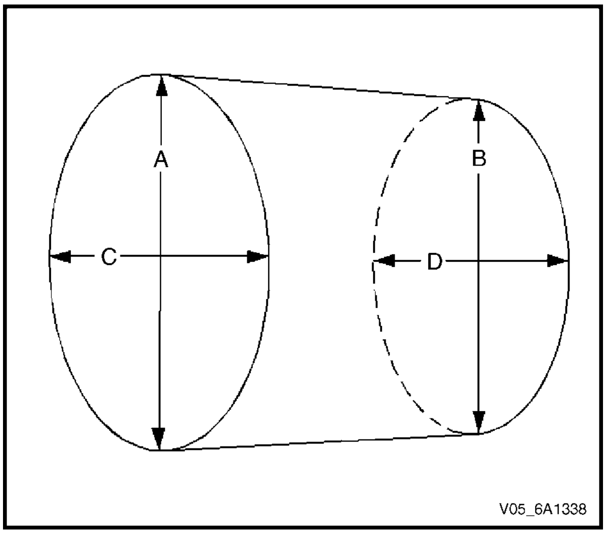


Figure 6A1 – 515

Reinstall

Crankshaft Bearing Installation Procedure

CAUTION

If the crankshaft bearings have been used in a running engine, replace them with new crankshaft bearings for reassembly.

1 Clean the crankcase crank bore with a lint-free cloth.

2 Clean all the oil from the backside of new bearing halves.

3 Install the new upper crankshaft bearings into position. The thrust bearing (1) belongs in the number 3 journal(2). Ensure the upper bearing insert contains the oil transfer hole and groove. Roll the bearing into position so the lock tang engages the crank slot. The bearing must fit flush with the upper crankcase.

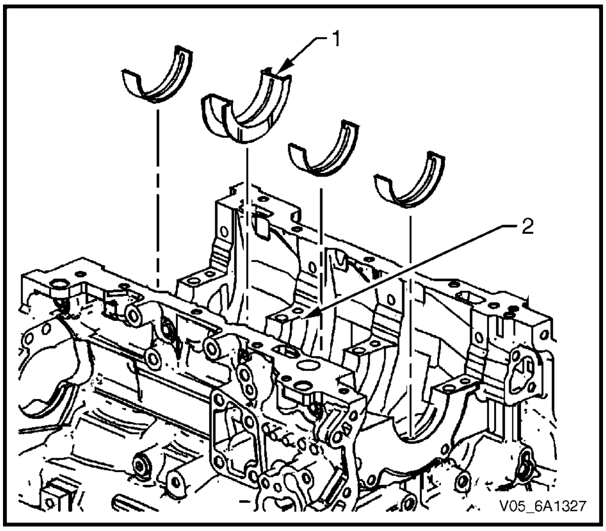


Figure 6A1 – 516

4 Install the new lower crankshaft bearings (2) into position in the main bearing caps (1). The lower crankshaft bearings are identified by no grooves or holes. The bearings must fit flush with the crankshaft bearing caps.

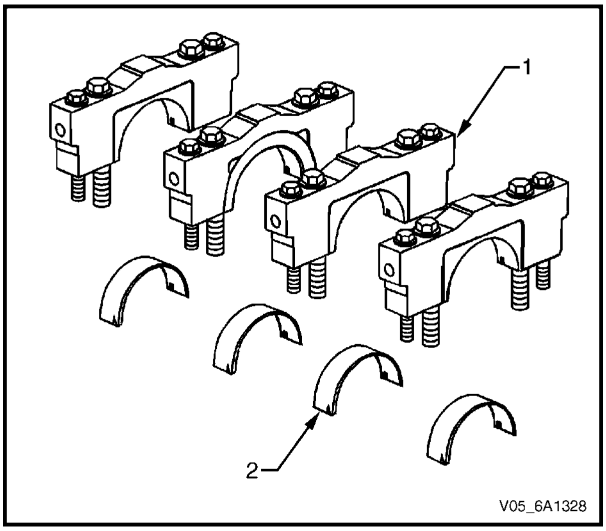


Figure 6A1 – 517

Crankshaft Main Bearing Clearance Measurement

1 Place a length of fresh, room temperature plastic gauging material all the way across all the crankshaft bearing journals.

2 Install the crankshaft main bearing caps.

3 Loosely install the original inner main cap bolts (1).

4 Loosely install the original outer main cap bolts (2).

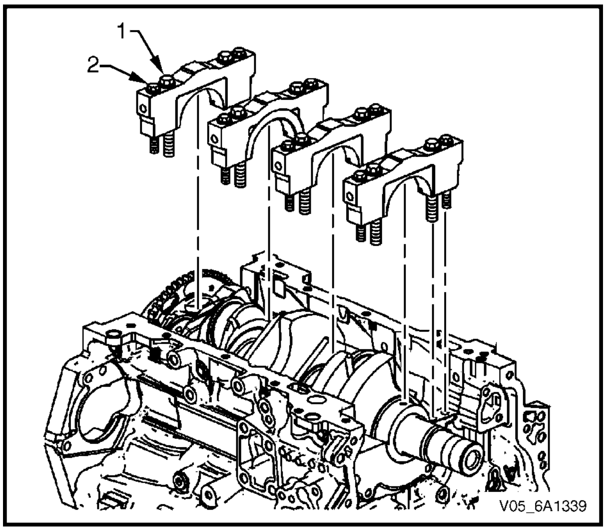


Figure 6A1 – 518

5 Loosely install the original short/inner side main cap bolts.

6 Loosely install the original long/outer side main cap bolts (3).

7 Gently tap the crankshaft main bearing caps with a soft-faced hammer to help seat the caps.

8 Tighten the main caps bolts to the correct torque specification, and in the following sequence.

Crankshaft main bearing cap inboard attaching bolt torque specification:	
Stage 1	20.0 Nm
Stage 2	80°
Crankshaft main bearing cap outboard attaching bolt torque specification:	
Stage 1	15.0 Nm
Stage 2	110°
Crankshaft main bearing cap side attaching bolt torque specification:	
Stage 1	30.0 Nm
Stage 2	60°

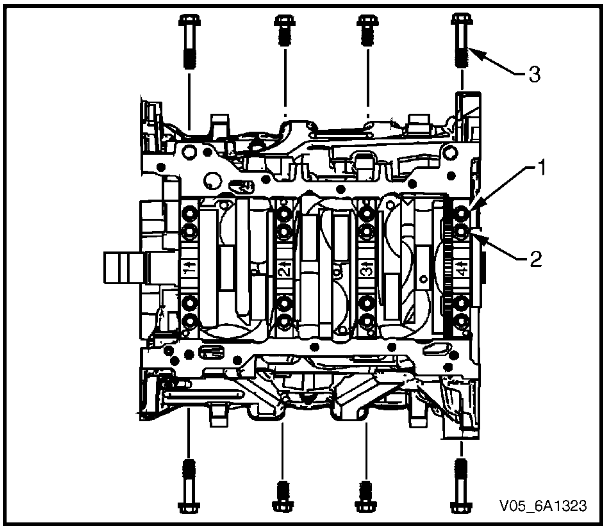


Figure 6A1 – 519

NOTE

Do not rotate the crankshaft.

9 Allow the assembly to sit for 2 minutes.

10 Remove the crankshaft bearing cap side bolts.

11 Remove the crankshaft bearing cap outer bolts (2).

12 Remove the crankshaft bearing cap inner bolts (1).

13 Install the crankshaft main bearing cap remover Tool No. J-41818 as previously described and remove the crankshaft bearing cap.

14 Repeat steps 10 to 13 for the remaining crankshaft bearing caps.

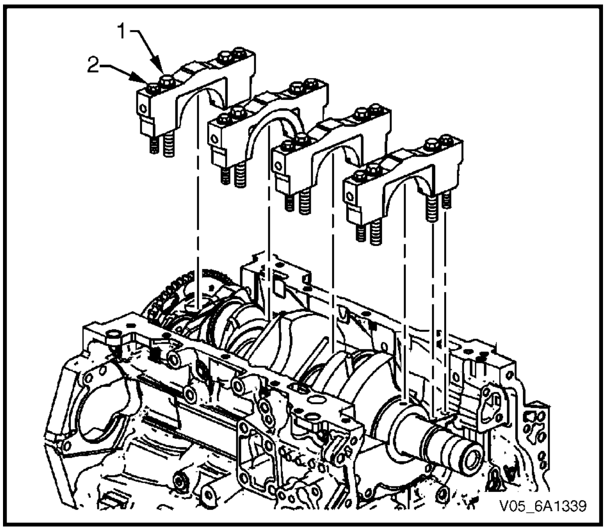


Figure 6A1 – 520

15 Determine the crankshaft bearing clearance by comparing the width of the flattened plastic gauging material (1) at its widest point with the graduation on the gauging material scale (2).

16 Compare the measurements listed in the specifications, refer to 5 Specifications. If the new bearings do not provide the correct crankshaft to bearing clearance, inspect the following:

17 Measure the crankshaft journals for the correct specified size and ensure new bearings are being installed. If the crankshaft journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

18 Measure the engine block crankshaft bearing bore diameter to ensure correct size. The engine block crankshaft bearing bore is not machineable and the block must be replaced if out of specification.

19 Clean the plastic gauging material from the crankshaft bearing journals with a soft, lint-free cloth.

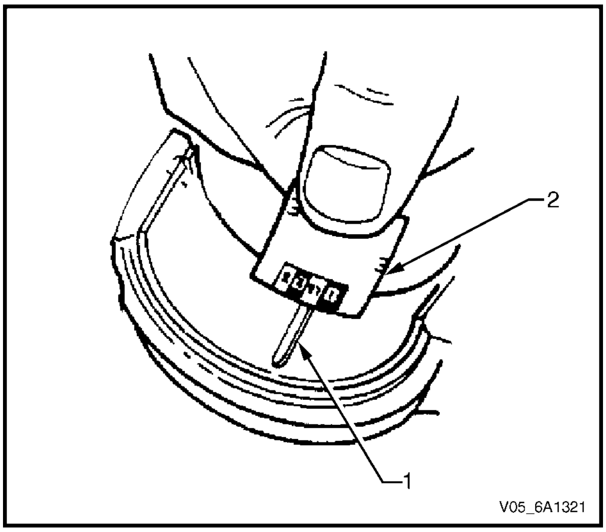


Figure 6A1 – 521

Crankshaft Final Installation Procedure

1 If removed, install the crankshaft sprocket drive pin (1). Lightly tap the pin in place with a small soft face, bronze/plastic, hammer until it bottoms in the hole.

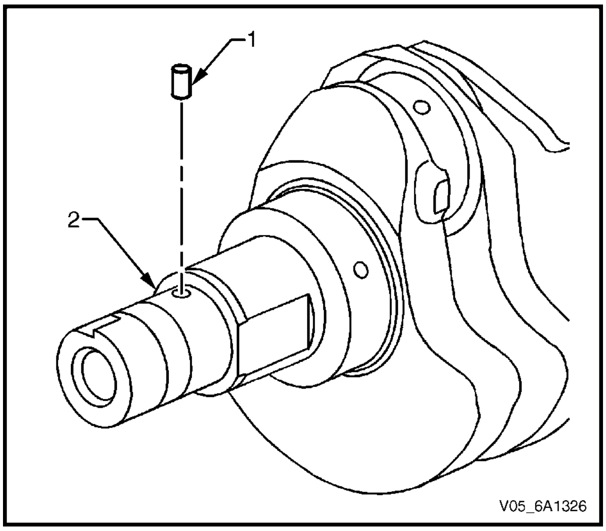


Figure 6A1 – 522

CAUTION

Ensure the crankshaft position sensor has been removed from the cylinder block prior to loading the crankshaft, as damage to the sensor may occur.

2 Apply a liberal amount of clean engine oil to the upper and lower bearing surfaces.

3 Gently lower the crankshaft (1) into position in the cylinder block (2).

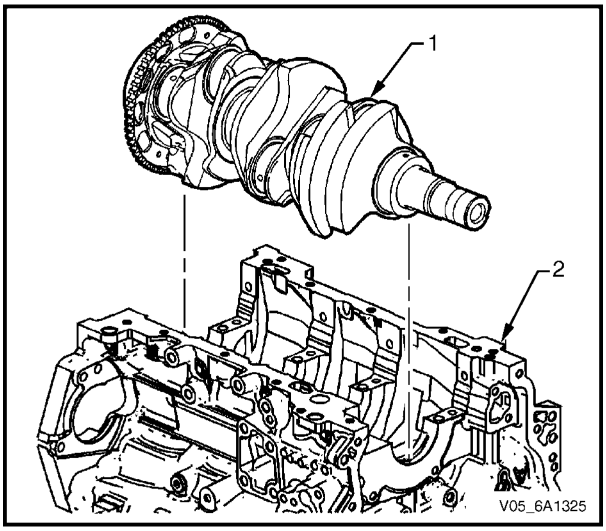


Figure 6A1 – 523

4 Install the crankshaft main bearing caps.

5 Loosely install the original inner main cap bolts (1).

CAUTION

The outer crankshaft bearing cap bolts (2) are yield tightened during assembly and must be replaced prior to reassembly. Outer crankshaft bearing cap bolts that are not replaced will not torque to the correct clamp load and can lead to serious engine damage.

6 Loosely install the new outer main bearing cap bolts (2).

7 Gently tap the crankshaft main bearing caps with a soft-faced hammer to help seat the caps.

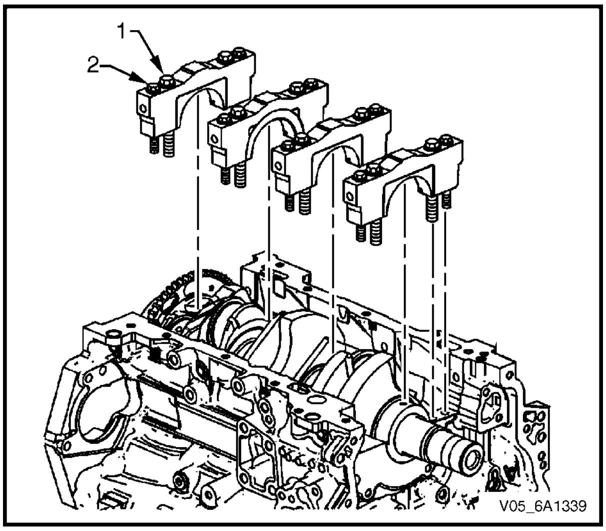


Figure 6A1 – 524

8 Loosely install new short / inner side main cap bolts (4).

CAUTION

- **The short / inner side main cap bolts originally have a sealant on the flange of the bolt head. New bolts must be used. If new bolts are not used, oil can leak from the crankcase past the bolts.**
- **The long / outer side main cap bolts originally have a sealant on the flange of the bolt head. New bolts must be used. If new bolts are not used, oil can leak from the crankcase past the bolts.**

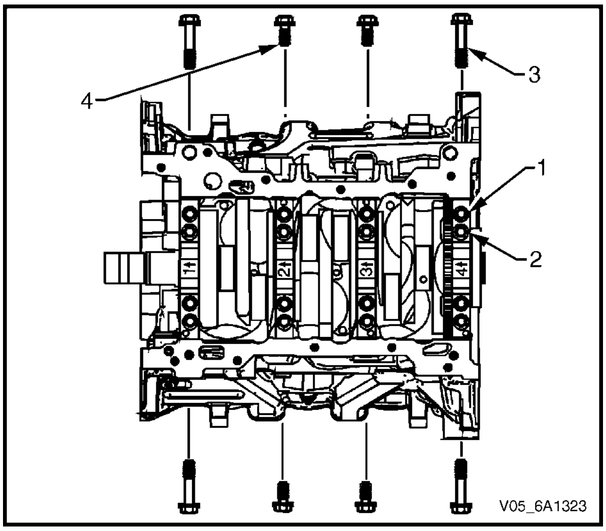


Figure 6A1 – 525

9 Loosely install the new long / outer side main cap bolts (3).

10 Tighten the main caps bolts to the correct torque specification, and in the following sequence.

■ Crankshaft main bearing cap inboard attaching bolt torque specification:
Stage 1 ....20.0 Nm
Stage 2 ....80°

■ Crankshaft main bearing cap outboard attaching bolt torque specification:
Stage 1 ....15.0 Nm
Stage 2 ....110°

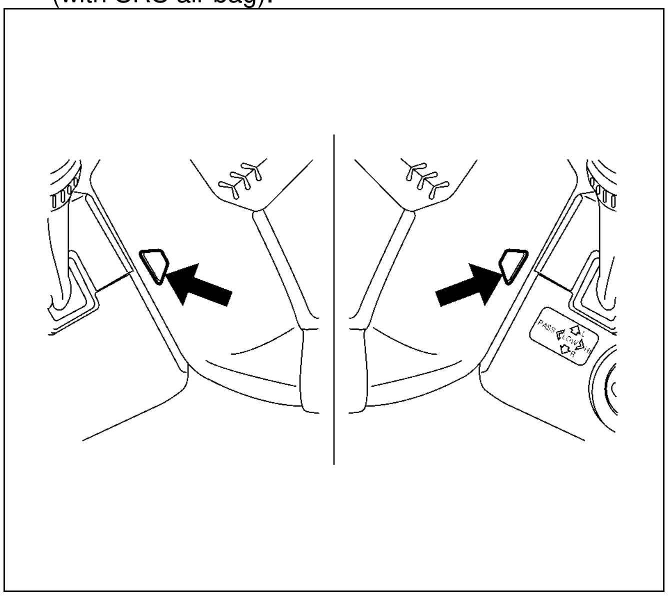
■ ♦ Crankshaft main bearing cap side attaching bolt torque specification:
Stage 1 ....30.0 Nm
Stage 2 ....60°

11 Ensure the crankshaft turns without binding or noise.

12 Install the remaining components in the reverse order to removal, refer to the appropriate Section.

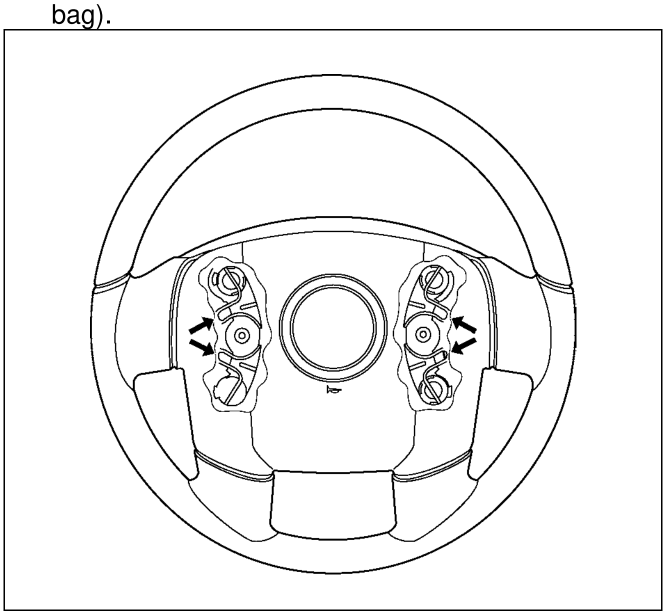
CAUTION: The wheels of the vehicle must be straight ahead and the steering column in the "LOCK" position before disconnecting the steering wheel. Failure to do so will cause the coil assembly to lose its centering which will cause damage to the coil assembly (with SRS air bag).

5. Remove the engine hood opening lever and steering lower cover.
6. Remove driver knee bolster (reinforcement).
7. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).
8. Check the holes on both sides of the steering cover (with SRS air bag).



060R300025

9. Check the position of the pins in thier holes. Push the pin in the direction of the arrow (with SRS air bag).



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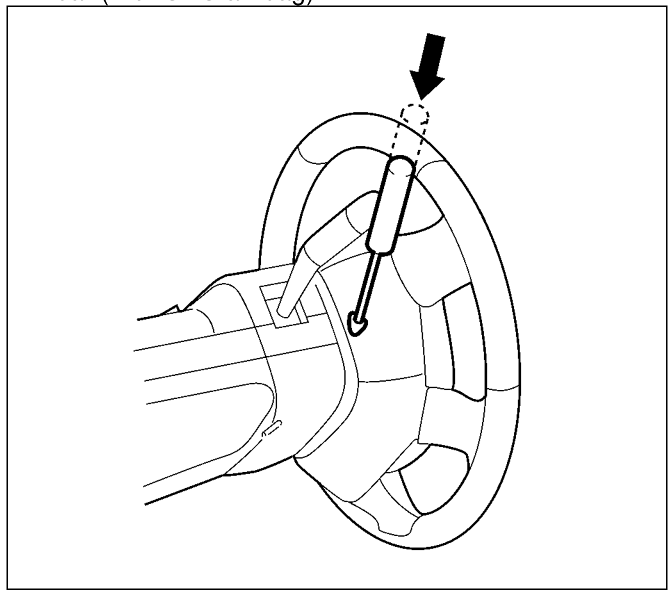
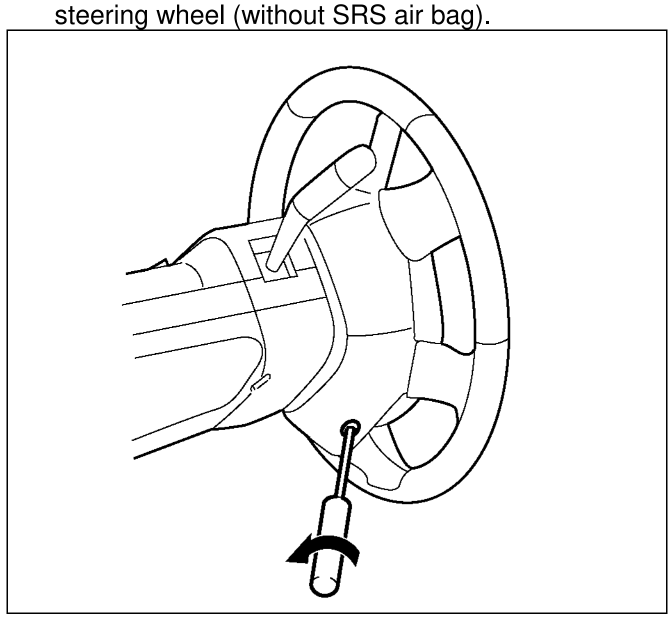
10. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



060R300031

11. Cancel the lock to release the four pins (with SRS air bag).
12. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



430R300009

4.7 Cylinder Block

Disassemble

1 Remove oil jet bolt (1) attaching the oil jet (2), three places.

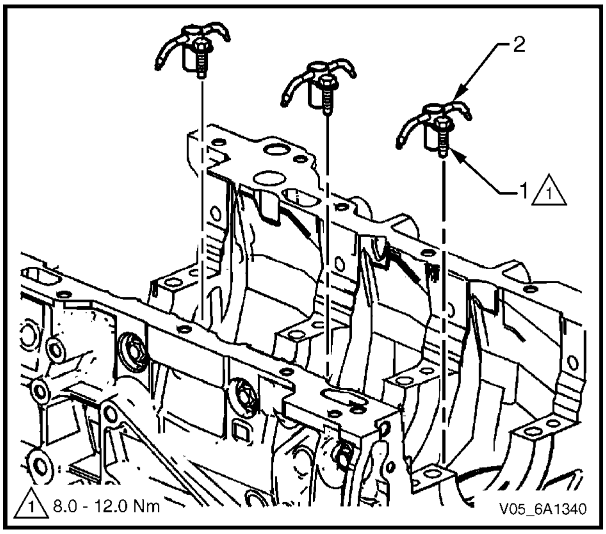


Figure 6A1 – 526

2 Remove the right-hand front oil pan rail oil gallery expansion plug (1).

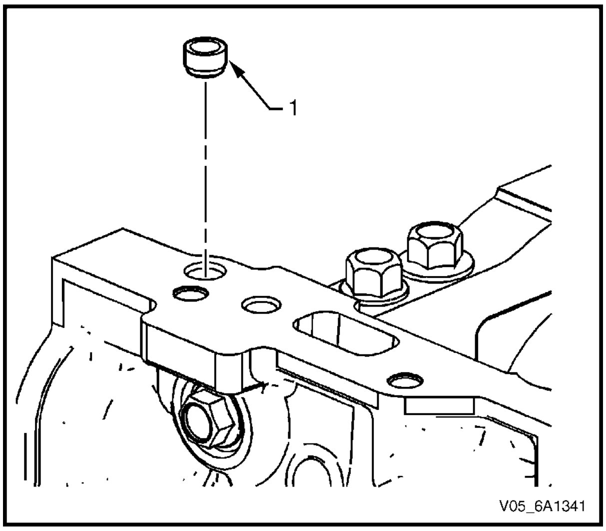


Figure 6A1 – 527

3 Remove the cylinder block-to-oil pan alignment dowels (1).

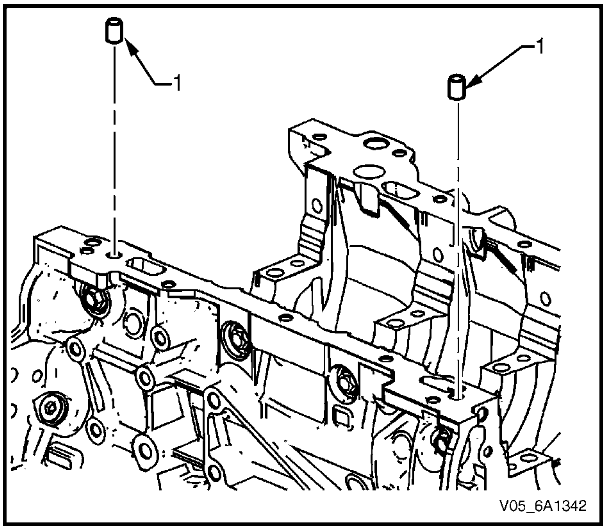


Figure 6A1 – 528

4 Remove the right-hand side M14 oil gallery threaded plug (1).

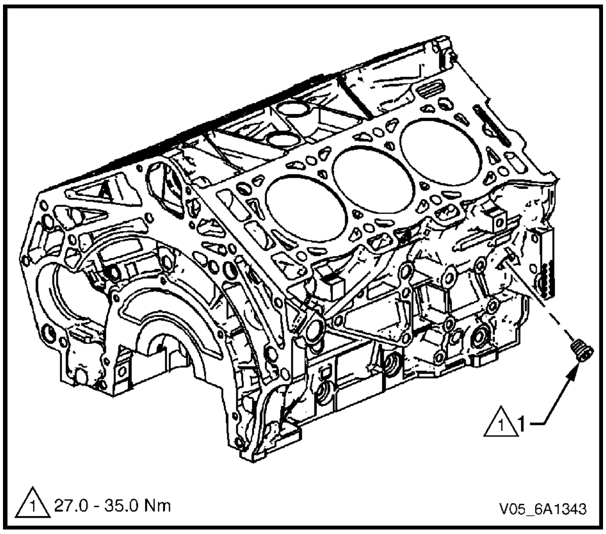


Figure 6A1 – 529

5 Remove the right-hand side M14 coolant drain threaded plug (1).

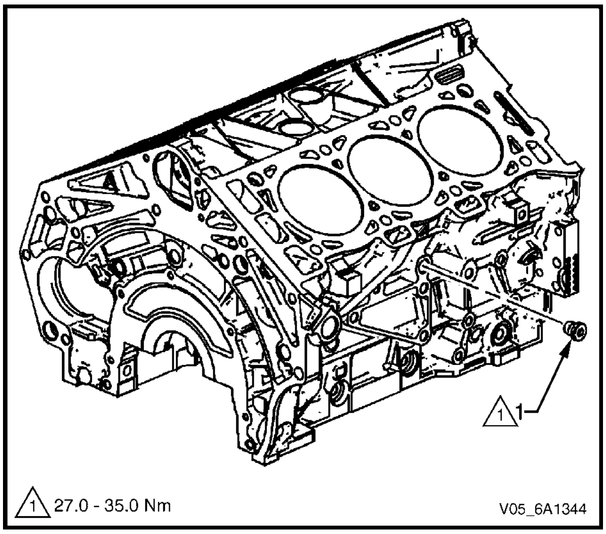


Figure 6A1 – 530

6 Remove the rear M14 oil gallery threaded plug (1).

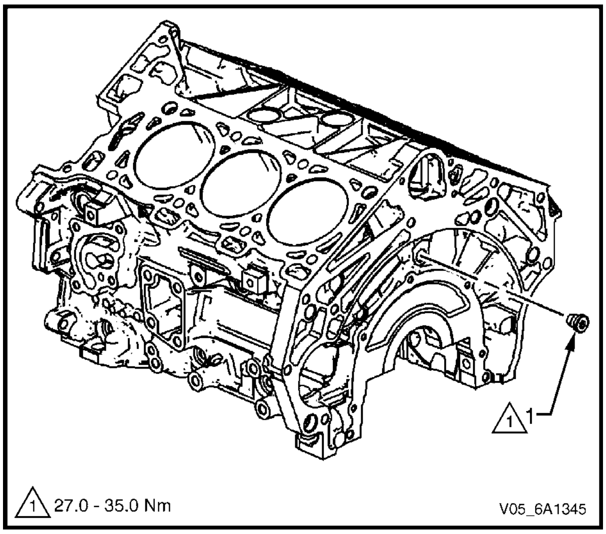


Figure 6A1 – 531

7 Remove the left-hand side M14 coolant drain threaded plug (1).

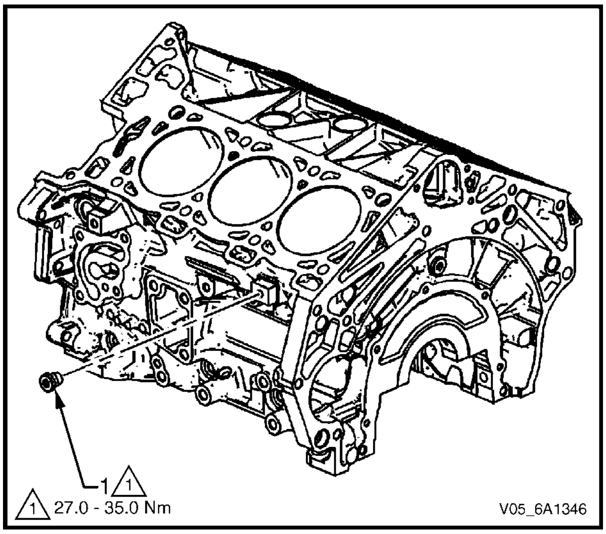


Figure 6A1 – 532

8 Remove the left-hand side M20 oil gallery threaded plug (1).

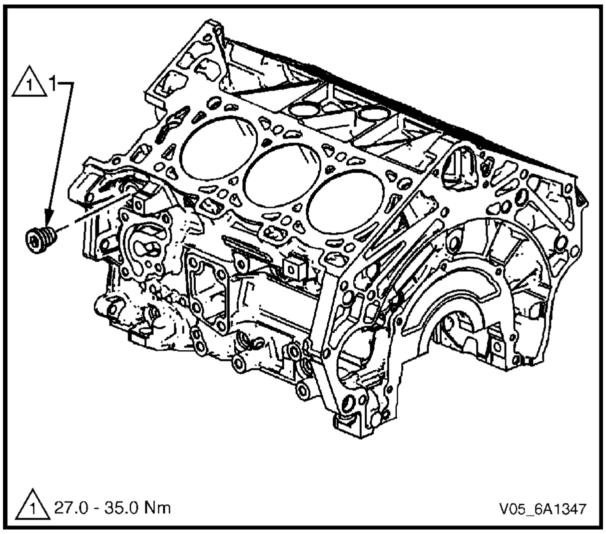


Figure 6A1 – 533

CAUTION

Do not force coolant expansion plugs downwards during removal procedure as the cylinder block will be damaged.

9 Remove the coolant expansion plugs (1).

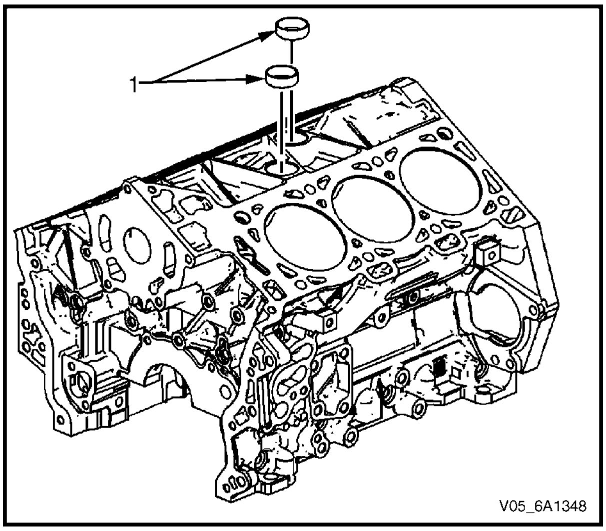


Figure 6A1 – 534

10 Remove the cylinder block-to-transmission alignment dowels (1).

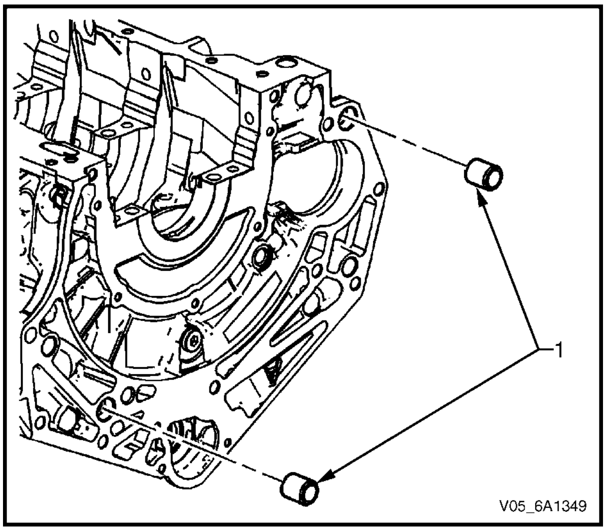


Figure 6A1 – 535

11 Remove the front oil gallery expansion plug (1).

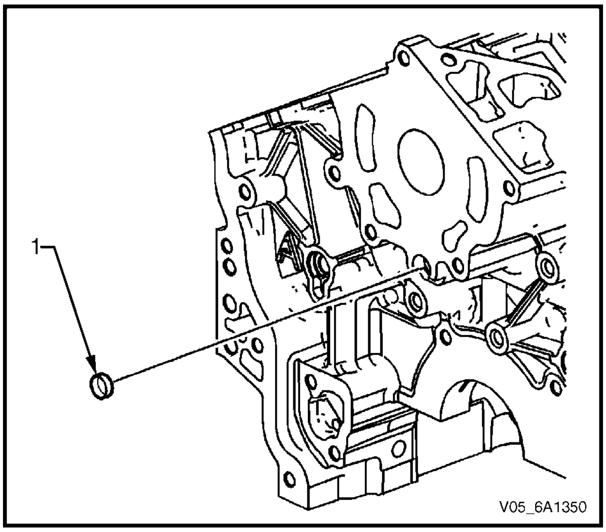


Figure 6A1 – 536

12 Remove the cylinder block-to-cylinder head alignment dowels (1).

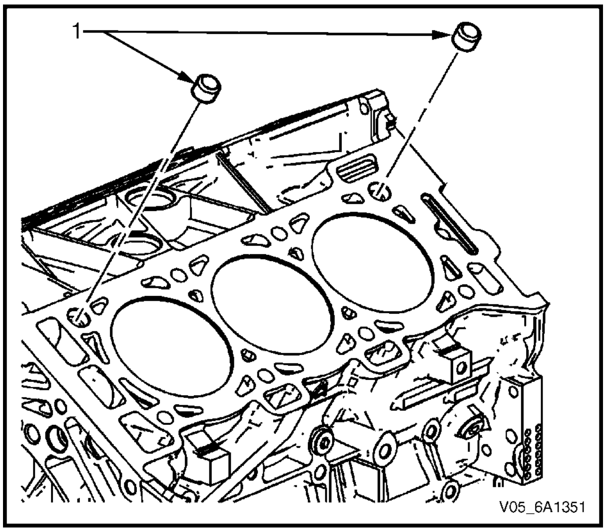


Figure 6A1 – 537

Clean

1 Remove all thread sealant, gasket material or sealant using a commercially available plastic or wood scraper.
2 Clean all the following areas with a suitable solvent:
   - sealing surfaces,
   - cooling passages,
   - oil passages, and
   - bearing journals.
3 Clean all threaded and through holes with a suitable solvent.

WARNING

Safety glasses must be worn when using compressed air.

4 Dry the engine block with compressed air.

Inspect

Visual Inspection

NOTE

The following procedure assumes the engine has been disassembled and cleaned, as described above.

1 Inspect the crankshaft bearing journals for damage or spun bearings. The crankshaft bearing journals are not repairable and if damage is found, the cylinder block assembly must be replaced.
2 Inspect the primary camshaft chain tensioner mounting surface on the engine block for burrs or any defects that would affect the sealing of the new primary camshaft chain tensioner gasket.
3 Inspect all sealing and mating surfaces for damage, repair or replace the cylinder block assembly if required.
4 Inspect all threaded and through holes for damage or excessive debris.
5 Inspect all bolts for damage, if damaged replace with new bolts only.
6 Inspect the cylinder walls for cracks or damage. The cylinder sleeves are not serviced separately, if the cylinders are damaged the cylinder block assembly must be replaced.
7 Inspect the engine block for cracks. Do not repair any cracks. If cracks are found, the cylinder block assembly must be replaced. Repair any damaged threaded holes, refer to 4.9 Thread Repair Specifications.

Measuring Cylinder Bore Diameter

1 Measure the cylinder bore diameter 37 mm from the deck face (1) using a commercially available bore gauge or Tool No. J-8087 (2).
2 Record the results and compare with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

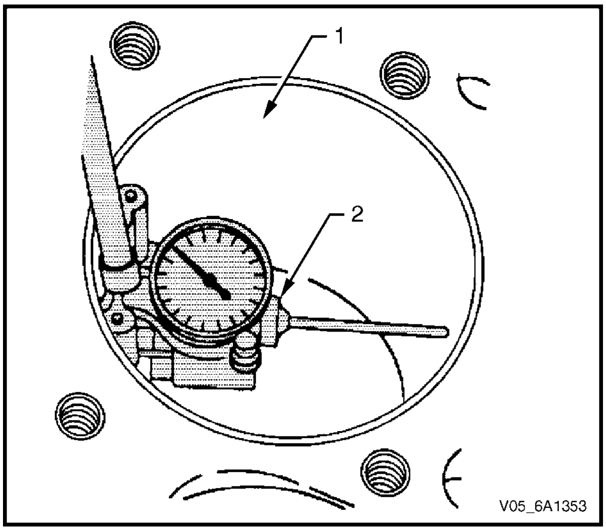


Figure 6A1 – 538

Measuring Cylinder Bore Taper

1. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centreline, at 10 mm below the deck surface and record the measurement.
2. Measure the cylinder bore along the thrust surfaces, perpendicular to the crankshaft centreline, at 100 mm below the deck surface and record the measurement.
3. Calculate the difference between the two measurements. The result will be the cylinder taper.
4. Compare the results with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

Measuring Cylinder Bore Out-of-Round

1. Measure both the thrust and non-thrust cylinder diameter at 10 mm below the deck. Record your measurements.
2. Calculate the difference between the two measurements. The result will indicate out-of-round at the upper end of the cylinder.
3. Measure both the thrust and non-thrust cylinder diameter at 100 mm below the deck surface. Record your measurements.
4. Calculate the difference between the two measurements. The result will indicate out-of-round at the lower end of the cylinder.
5. Compare your results with the dimensions listed in the specifications, refer to 5 Specifications.

NOTE

If the cylinder diameter exceeds the specifications, the cylinder block may be oversized to 0.25 mm. Only one size of oversized pistons and rings are available for service. If the cylinder bore diameter exceeds specification by more than 0.25 mm, the cylinder block must be replaced.

Deck Flatness Inspection

1. Ensure the engine block decks are clean and free of gasket material.
2. Inspect the surface for any imperfections or scratches that could inhibit correct cylinder head gasket sealing.
3. Place a straight-edge diagonally across the cylinder block deck face surface.
4. Measure the clearance between the straight-edge and the cylinder block deck face using a feeler gauge at 4 points along the straight-edge.
5. If the warpage is less than 0.05 mm, the cylinder block deck surface does not require resurfacing.
6. If the warpage is between 0.05 ±0.20 mm or any imperfections or scratches that could inhibit correct cylinder head gasket sealing are present, the cylinder block deck surface requires resurfacing.
7. If resurfacing is required the maximum amount that can be removed is 0.25 mm.
8. If the cylinder block deck surface requires more than 0.25 mm material removal the block must be replaced.

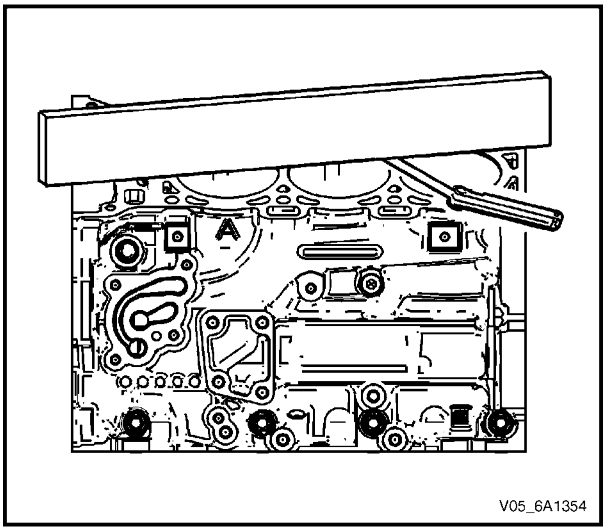


Figure 6A1 – 539

Reassemble

1 Install the cylinder block-to-cylinder head alignment dowels (1).

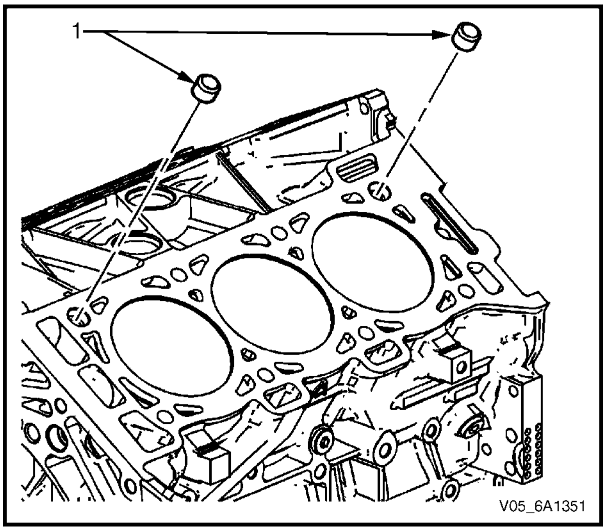


Figure 6A1 – 540

2 Install a new front oil gallery expansion plug (1).

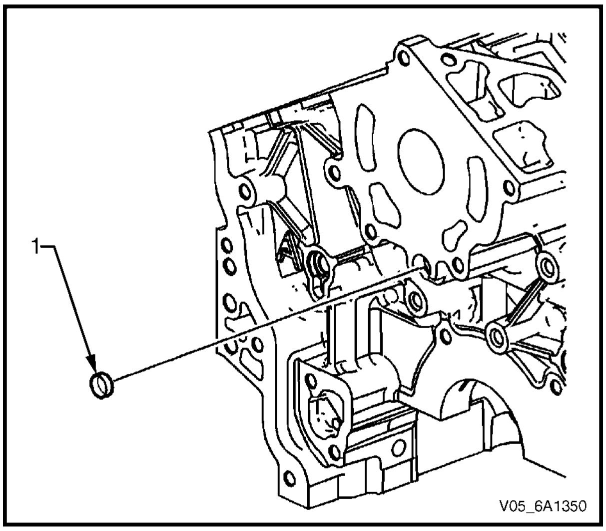


Figure 6A1 – 541

3 Install the cylinder block-to-transmission alignment dowels (1).

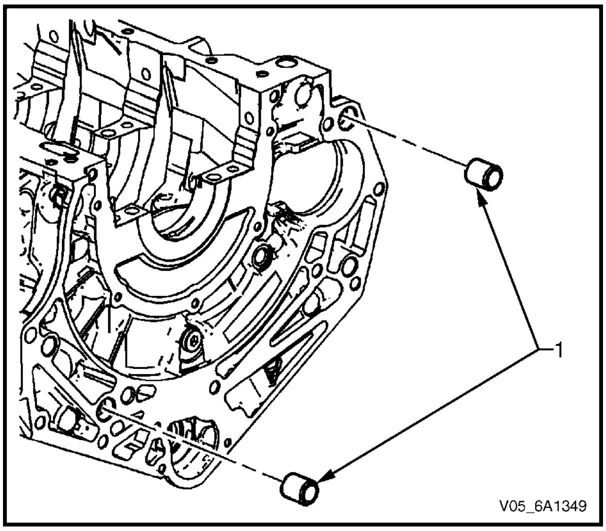


Figure 6A1 – 542

4 Place RTV sealant on new coolant expansion plugs (1) and install the new coolant expansion plugs.

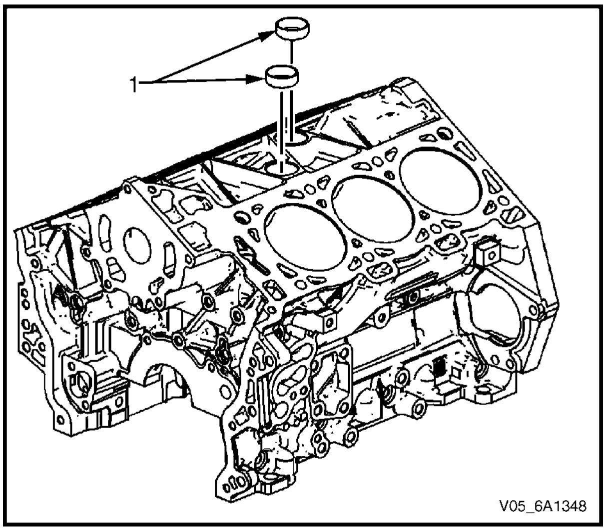


Figure 6A1 – 543

5 Install the left-hand side M20 oil gallery threaded plug (1) and tighten to the correct torque specification.

Left-hand side M20 cylinder block oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

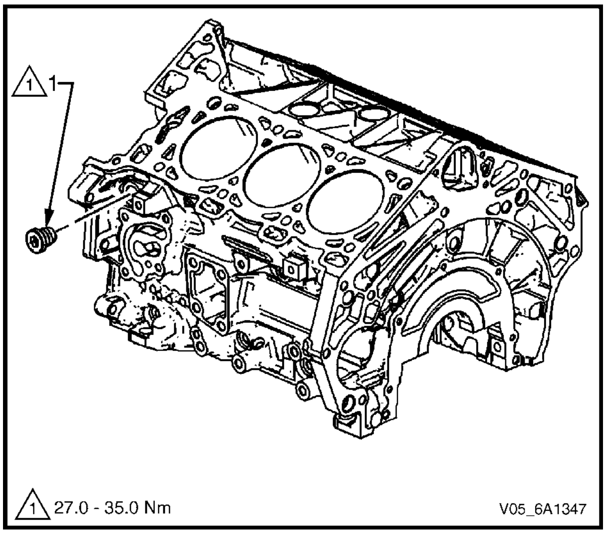


Figure 6A1 – 544

6 Install the left-hand side M14 coolant drain threaded plug (1) and tighten to the correct torque specification.

Left-hand side M14 cylinder block coolant drain threaded plug torque specification ....27.0 – 35.0 Nm

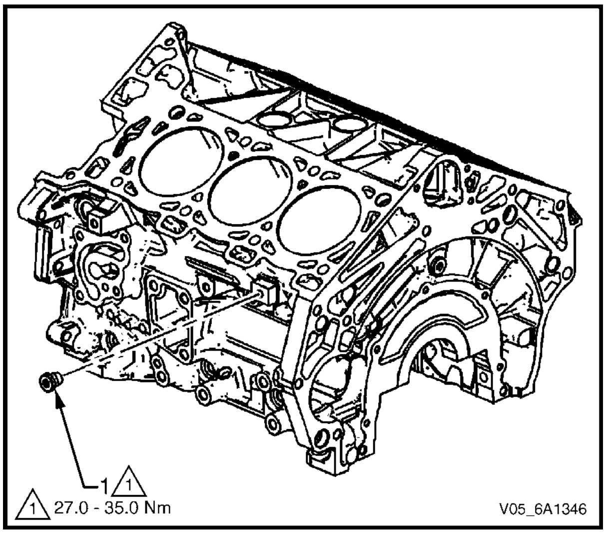


Figure 6A1 – 545

7 Install the M14 rear oil gallery threaded plug (1) and tighten to the correct torque specification.

M14 cylinder block rear oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

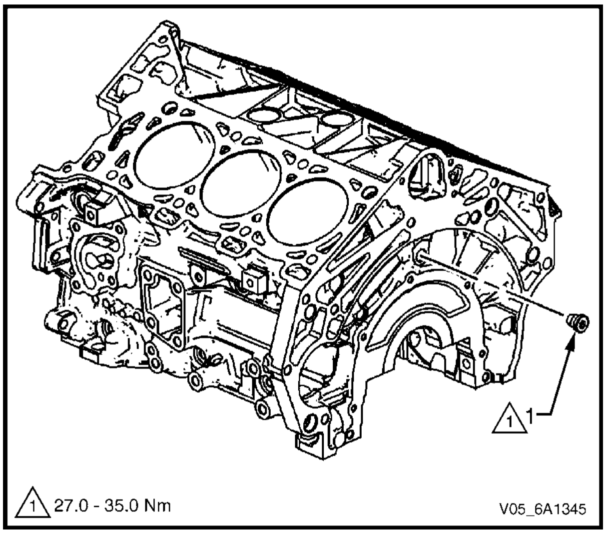


Figure 6A1 – 546

8 Install the right-hand side M14 coolant drain threaded plug (1) and tighten to the correct torque specification.

Right-hand side M14 cylinder block coolant drain threaded plug torque specification ....27.0 – 35.0 Nm

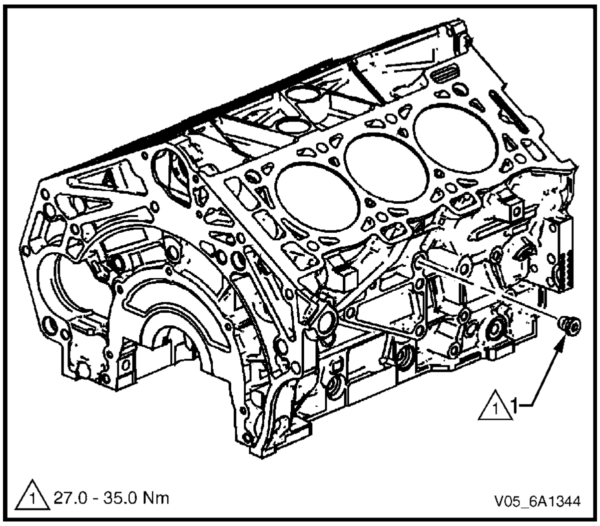


Figure 6A1 – 547

9 Install the right-hand side M14 oil gallery threaded plug (1) and tighten to the correct torque specification.

Right-hand side M14 cylinder block oil gallery threaded plug torque specification ....27.0 – 35.0 Nm

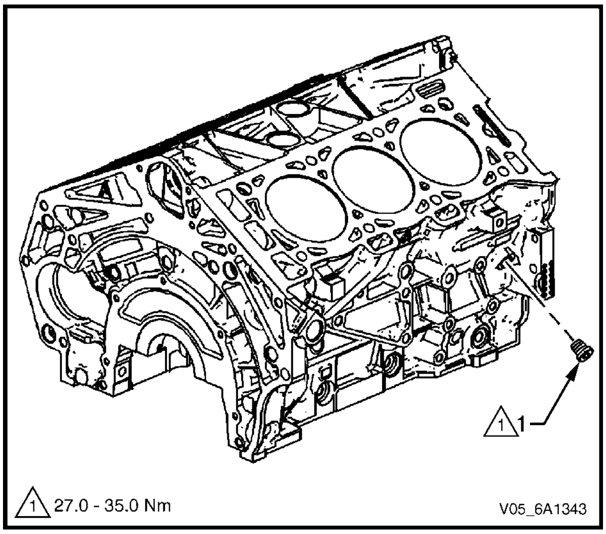


Figure 6A1 – 548

10 Install the cylinder block-to-oil pan alignment dowels (1).

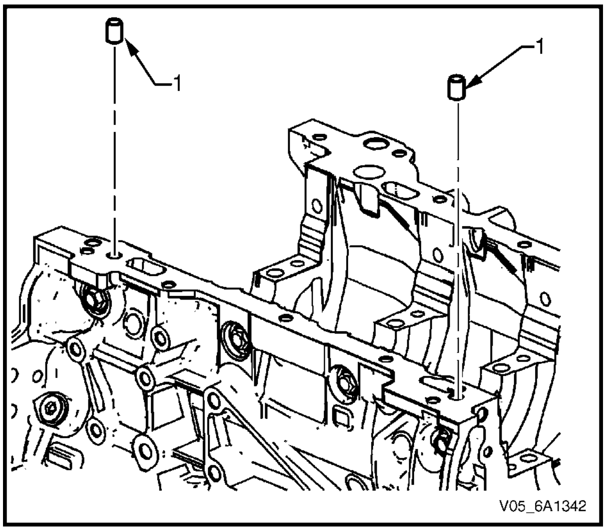


Figure 6A1 – 549

11 Install the new right-hand front oil pan rail oil gallery expansion plug (1).

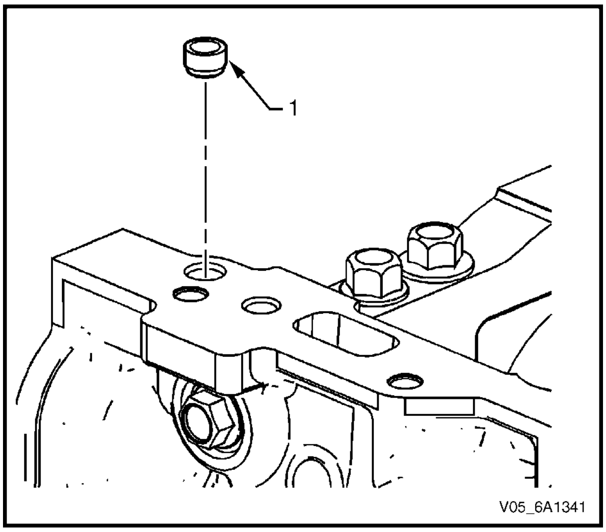


Figure 6A1 – 550

12 Install the oil jet (2), three places.

13 Install the oil jet attaching bolt (1), three places and tighten to the correct torque specification.

Oil jet attaching bolt torque specification ....8.0 – 12.0 Nm

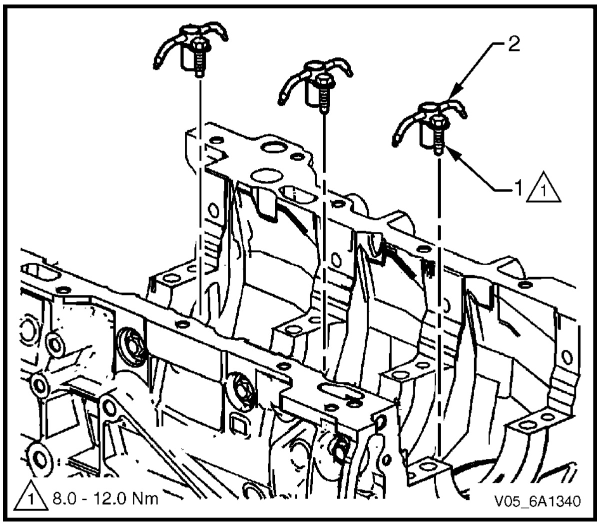
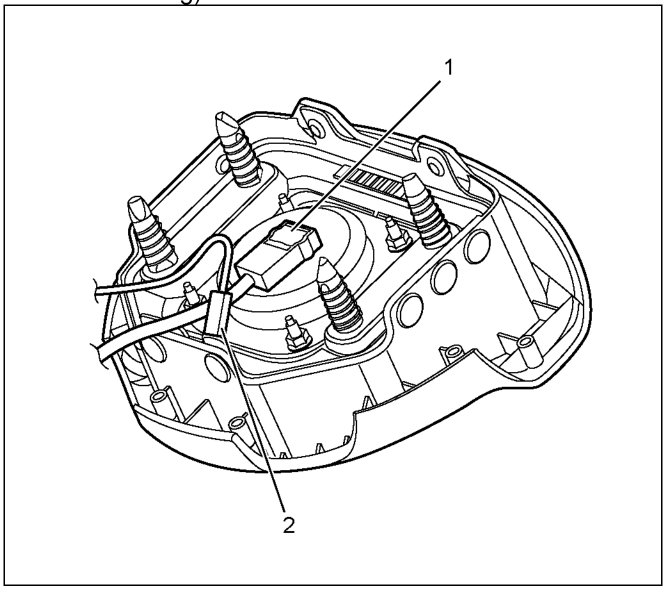


Figure 6A1 – 551

13. Disconnect the SRS air bag connector (1) and horn lead connector (2) located behind the air bag assembly and remove the air bag assembly (with SRS air bag).



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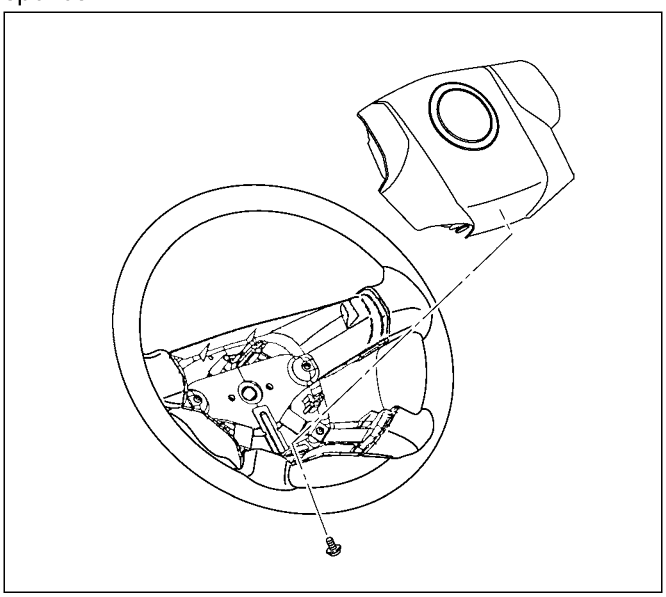
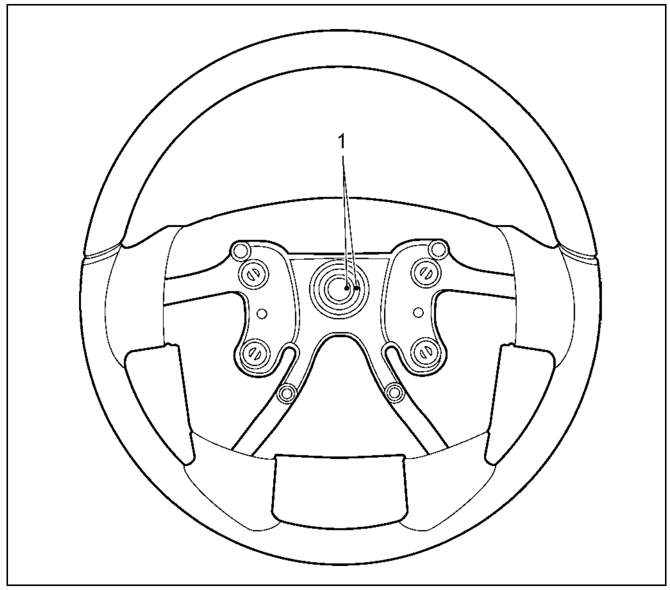
14. Remove the horn pad and the horn leads at the center of the wheel (without SRS air bag).

NOTE: It should be removed first from the bottom spokes.



RTW73BSH000601

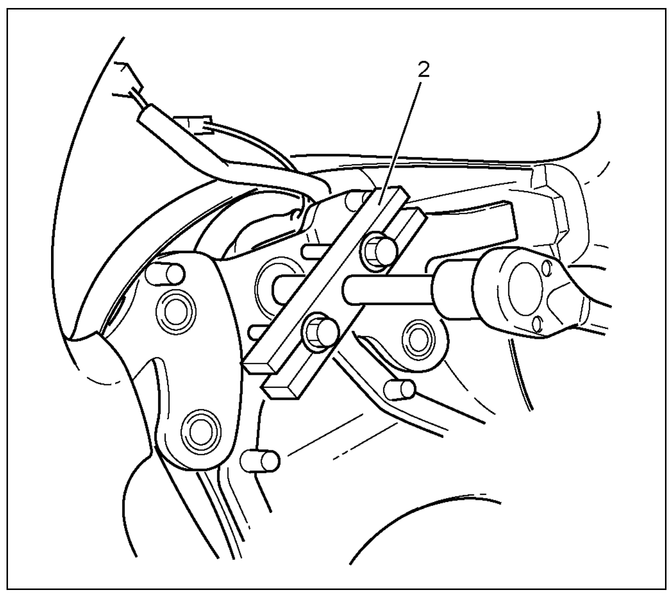
15. Apply a setting mark (1) across the steering wheel and shaft so parts can be reassembled in their original position.



RTW73BSH000501

16. Move the front wheels to the straight ahead position, then use steering wheel remover 5-8521-0016-0 (2) to remove the steering wheel.

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.



RTW73BSH001301

WARNING: THE INFLATOR MODULE SHOULD ALWAYS BE CARRIED WITH THE COVER AWAY FROM YOUR BODY AND SHOULD ALWAYS BE LAID ON A FLAT SURFACE WITH THE COVER SIDE UP. THIS IS NECESSARY BECAUSE A FREE SPACE IS PROVIDED TO ALLOW THE AIR CUSHION TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY MAY RESULT (with SRS air bag).

4.8 Thread Repairs

General Information

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert. During the insert installation process, the installation driver tool cold-rolls the bottom internal threads and expands the bottom external threads of the insert into the base material. This action mechanically locks the insert into place.

This Section describes the recommended method of repairing threads in three specific areas of the engine.

- general thread repair,
- cylinder block main bearing cap bolt hole thread repair, and
- cylinder head bolt hole thread repair.

For detailed descriptions of all thread specifications used refer to 4.9 Thread Repair Specifications.

The drill-bit and counter-bore tool from the thread repair kit, Tool No. J-42385-700 and J-42385-2000 are designed for use with either a suitable tap wrench or drill motor. Limited access and larger hole repair may process better using a tap wrench. An extension from Tool J 43965 may also be required to drive the thread repair tooling dependent on access to the hole being repaired. Use only a tap wrench when tapping the hole and during installation of the insert.

1 It is critical the drilling, counter boring and tapping of the hole to be repaired follows the same centreline (1) as the original hole.

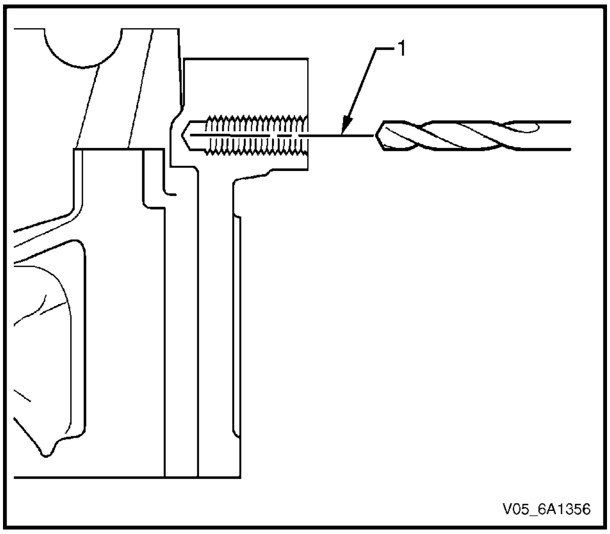


Figure 6A1 – 552

2 During the drilling and tapping of the hole being repaired, ensure the tooling is consistently machining perpendicular to the surface of the base material.

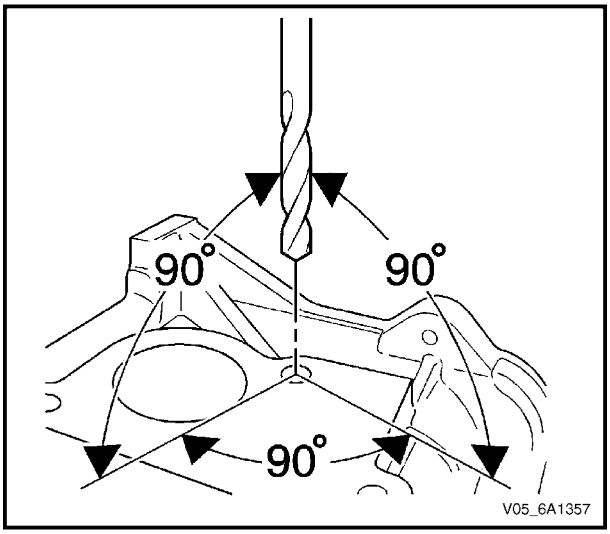


Figure 6A1 – 553

3 If the threaded hole being repaired has a base surface perpendicular to the hole centreline, tapping guides are available to aid in tapping the hole.

Tap Size	Tap Guide	Tap Size	Tap Guide	Tap Size	Tap Guide
-	J 42385	-	J 42385	-	J 42385
6 x 1.0	729	10 x 1.5	731	14 x 1.5	736
8 x 1.25	730	12 x 1.5	732	20 x 1.5	737

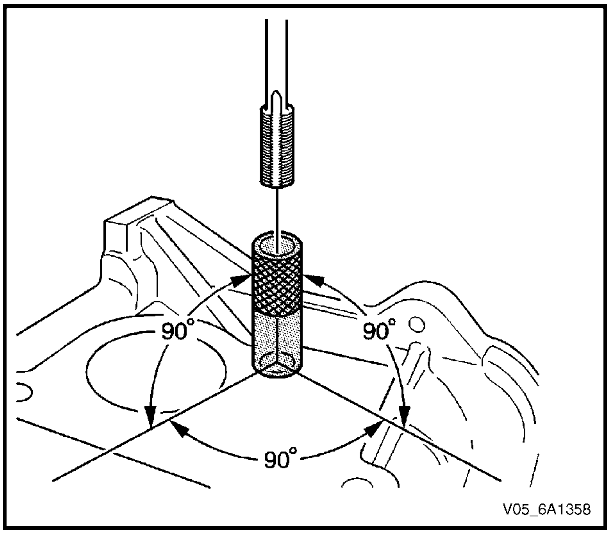


Figure 6A1 – 554

General Thread Repair

NOTE

The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures

1 When installed to the correct depth, the flange (1) of the insert will be seated against the counter bore of the drilled/tapped hole and just below the surface (2) of the base material.

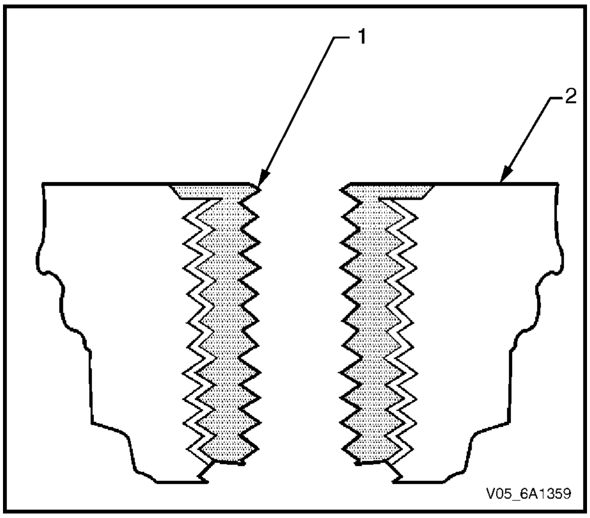


Figure 6A1 – 555

NOTE

During the drilling process, repeatedly remove the drill and clean the swarf from the hole and the flutes of the drill.

CAUTION

Do not drill any further than the original hole depth.

2 Drill out the threads of the damaged hole to the correct depth for the thread being repaired:

- M6 inserts require a minimum drill depth of 15 mm.
- M8 inserts require a minimum drill depth of 20 mm.
- M10 inserts require a minimum drill depth of 23.5 mm.

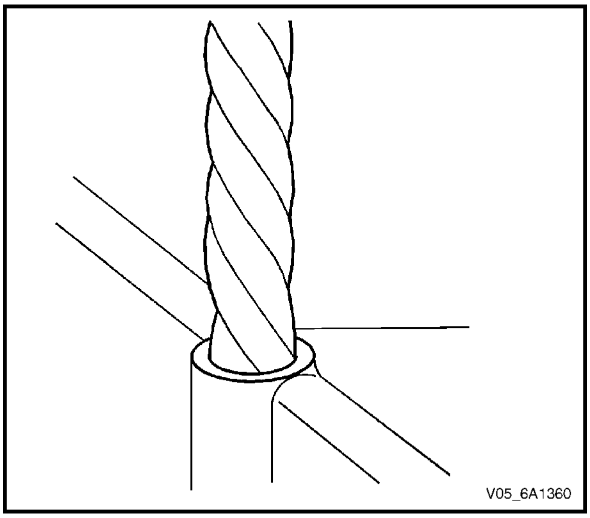


Figure 6A1 – 556

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

3 Using compressed air, clean out any swarf.

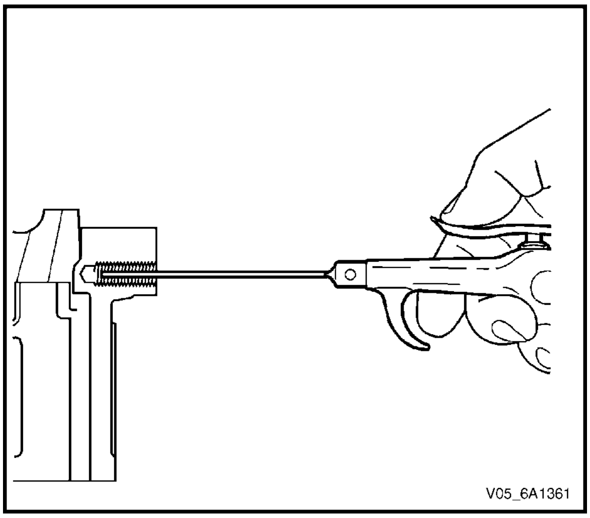


Figure 6A1 – 557

NOTE

A correctly counter bored hole will show a slight burnishing on the surface of the base material for 360 degrees around the drilled hole.

4 Counter bore the drilled hole to the full depth permitted by the tool (1).

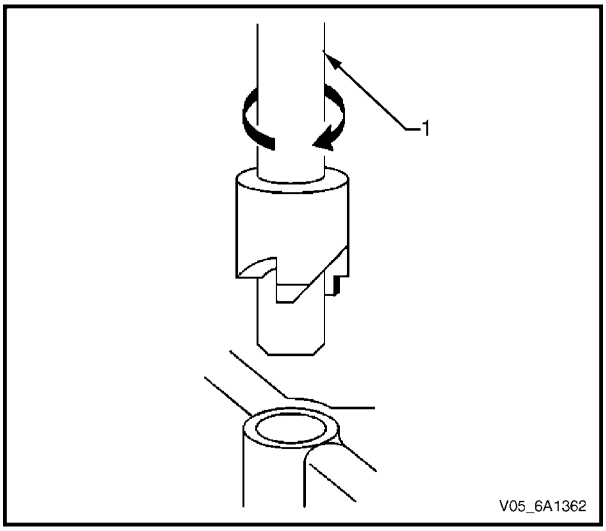


Figure 6A1 – 558

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

5 Using compressed air, clean out any swarf.

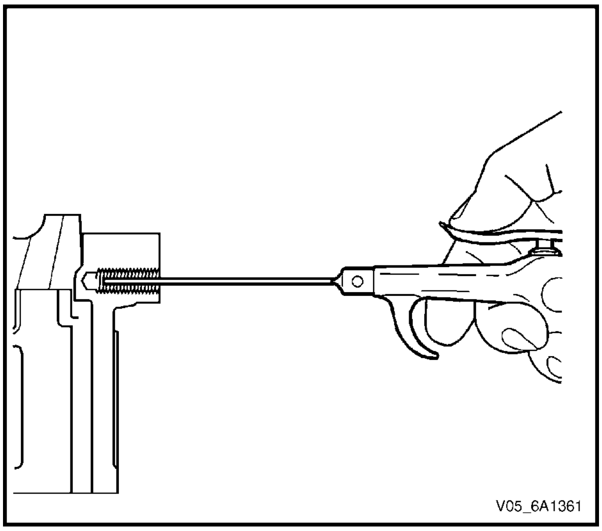


Figure 6A1 – 559

NOTE

- During the tapping process, repeatedly remove the tap and clean the swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

6 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

- M6 inserts require a minimum drill depth of 15 mm.
- M8 inserts require a minimum drill depth of 20 mm.
- M10 inserts require a minimum drill depth of 23.5 mm.

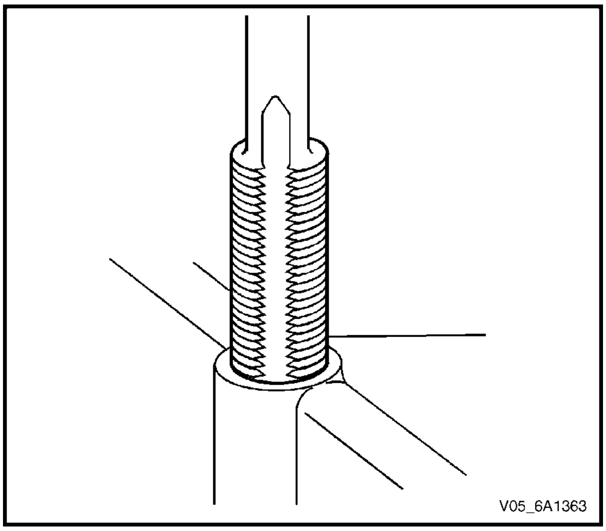


Figure 6A1 – 560

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

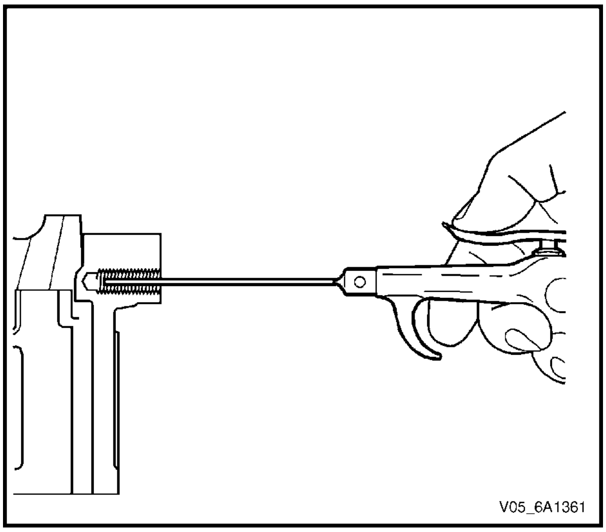


Figure 6A1 – 561

8 Spray a commercially available thread cleaner into the tapped hole.

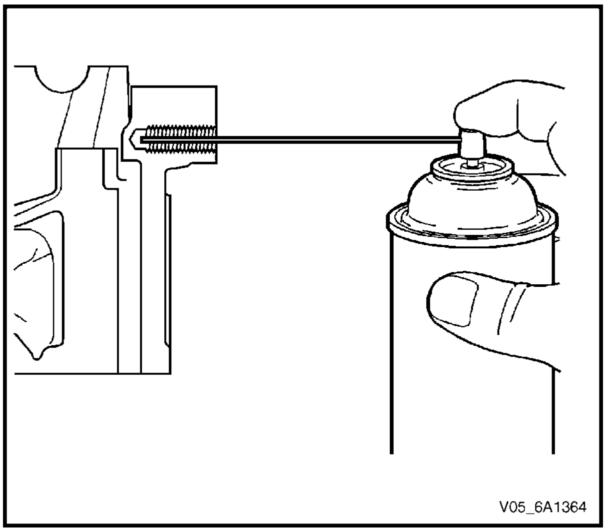


Figure 6A1 – 562

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

9 Using compressed air, clean out any swarf.

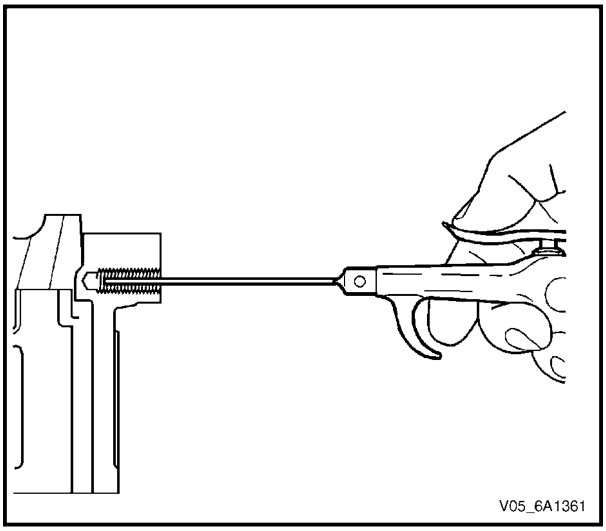


Figure 6A1 – 563

NOTE

Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

10 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

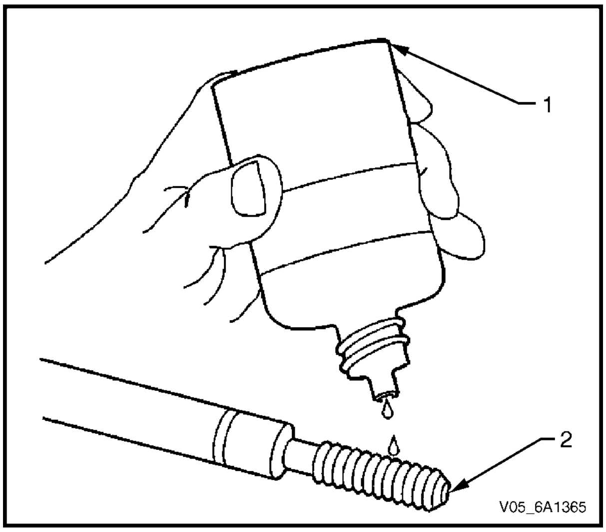


Figure 6A1 – 564

11 Install the insert (2) onto the driver installation tool (1).

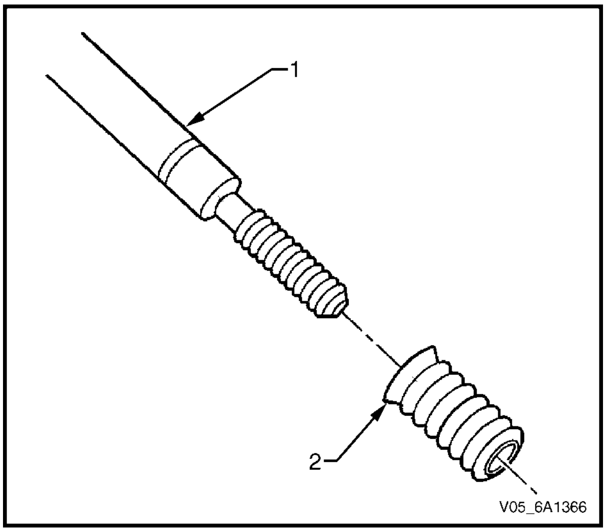


Figure 6A1 – 565

12 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

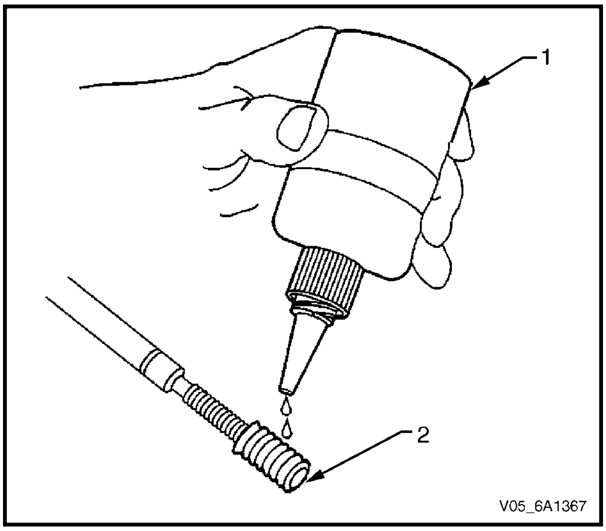


Figure 6A1 – 566

13 Install the insert (2) into the tapped hole by hand only.

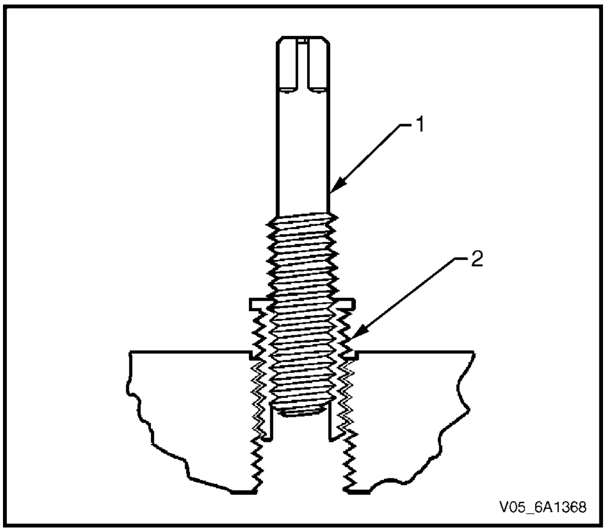


Figure 6A1 – 567

CAUTION

If the insert will not thread down until the flange contacts the counter bore surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

14 Install the insert until the flange (2) of the insert contacts the counter bore surface.

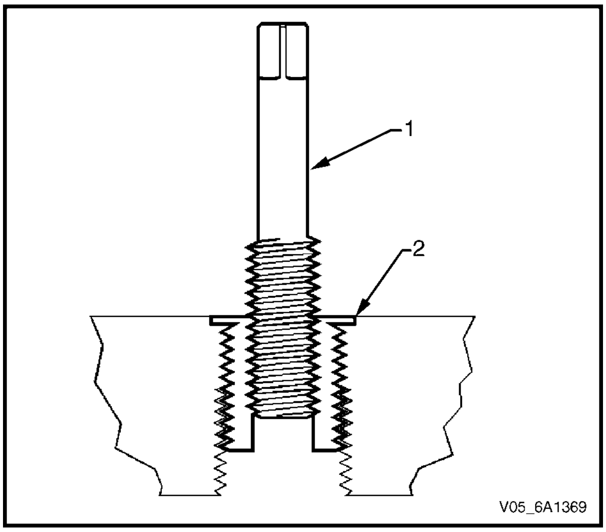


Figure 6A1 – 568

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

15 Continue to rotate the driver installation tool (1) through the insert (2)

16 Remove the driver installation tool.

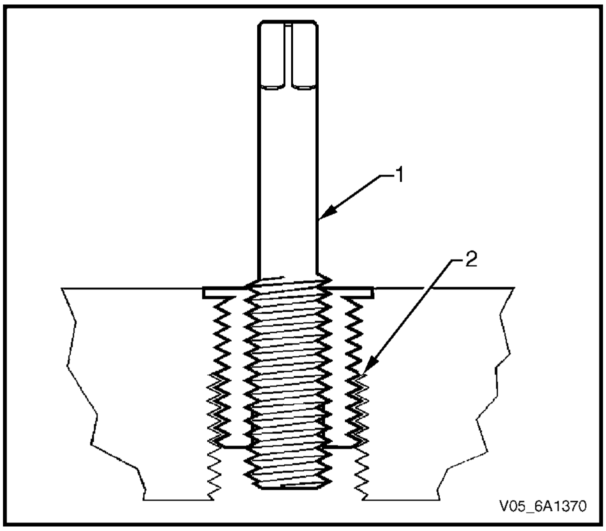


Figure 6A1 – 569

17 Inspect the insert for correct installation into the tapped hole. A correctly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

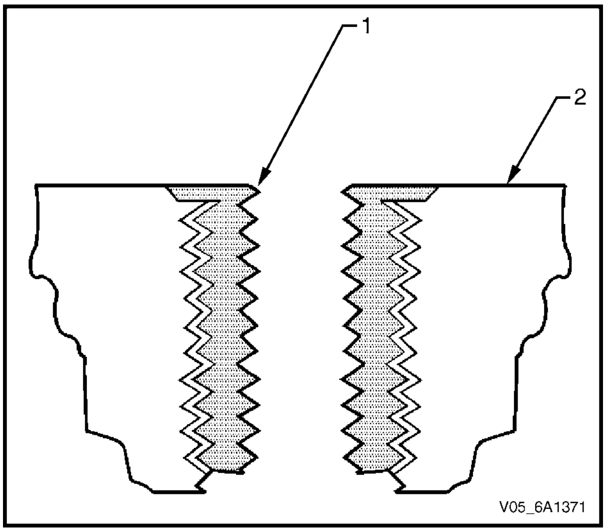


Figure 6A1 – 570

18 Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any swarf and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

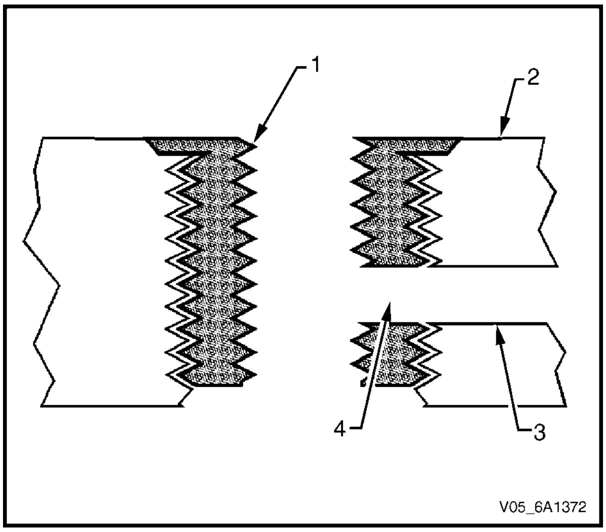


Figure 6A1 – 571

Main Bearing Cap Bolt Hole Thread Repair

The crankshaft main bearing bolt hole thread repair tools are in Tool No. J 42385-2000 and J 42385-700 which consist of the following:

- Drill (1) for outboard holes J 42385-702
- Tap (2) for outboard holes J 42385-703
- Installation driver (3) for outboard holes J 42385-704
- Bushing (4) for outboard holes J 42385-726
- Alignment pin (5) for outboard holes J 42385-727
- Bolts (6) for outboard holes J 42385-728
- Drill (7) for inboard holes J 42385-720
- Tap (8) for inboard holes J 42385-721
- Installation driver (9) for inboard holes J 42385-722
- Bushing (10) J 42385-713
- Alignment pin (11) J 42385-308
- Bolts (12) J 42385-734
- Fixture plate (13) J 42385-712

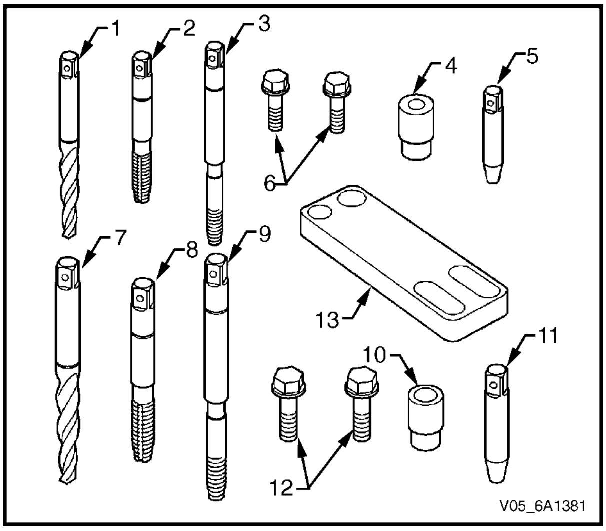


Figure 6A1 – 572

NOTE

- Ensure the fixture plate is installed during the machining and installation processes of the insert.
- The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures.
- When installed to the correct depth, the flange of the insert will be seated against the counter bore of the drilled/tapped hole.

1. Position the fixture plate (3) with the bushing (2) installed over the crankshaft main cap bolt hole to be repaired.
2. Loosely install the fixture plate bolts (1) into the remaining crankshaft main cap bolt holes.

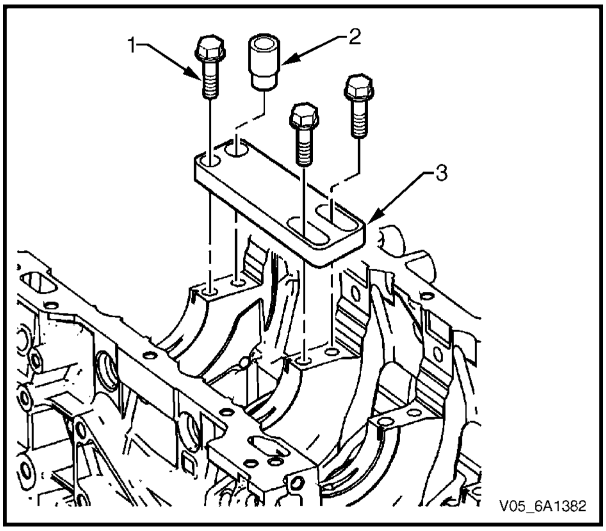


Figure 6A1 – 573

3 Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.

4 With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).

5 Remove the alignment pin.

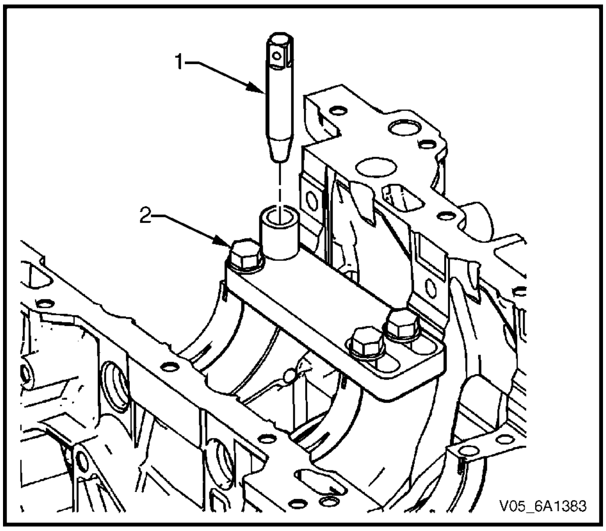


Figure 6A1 – 574

6 Drill the crankshaft main bolt hole until the mark (1) on the drill aligns with the top of the drill bushing (2).

NOTE

During the drilling process, repeatedly remove the drill and clean the swarf from the hole and the flutes of the drill.

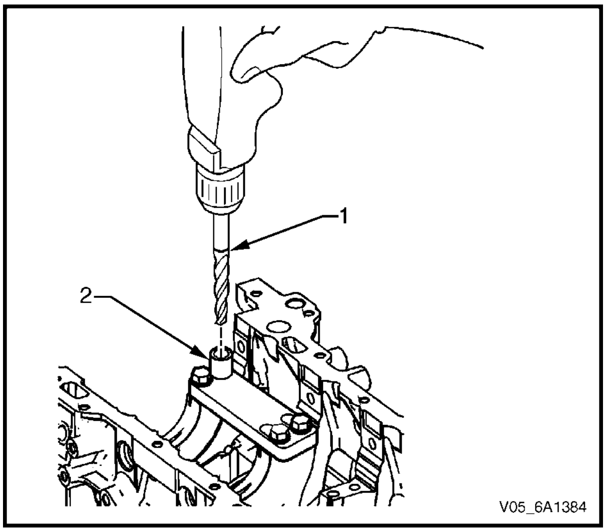


Figure 6A1 – 575

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

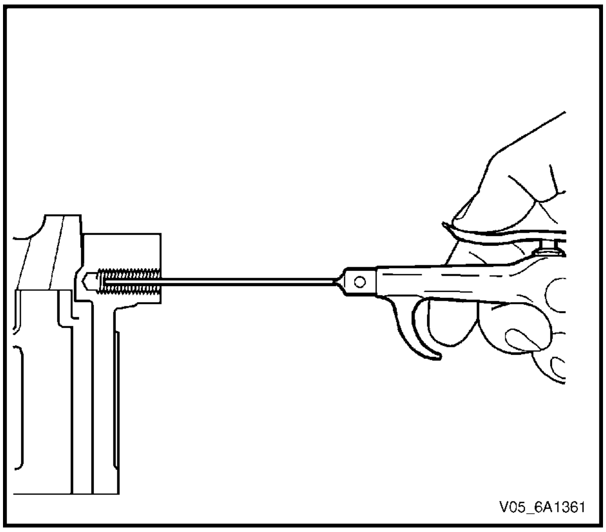


Figure 6A1 – 576

NOTE

- During the tapping process, repeatedly remove the tap and clean the swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

CAUTION

Do not remove the fixture plate during the machining and installation processes of the insert.

8 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

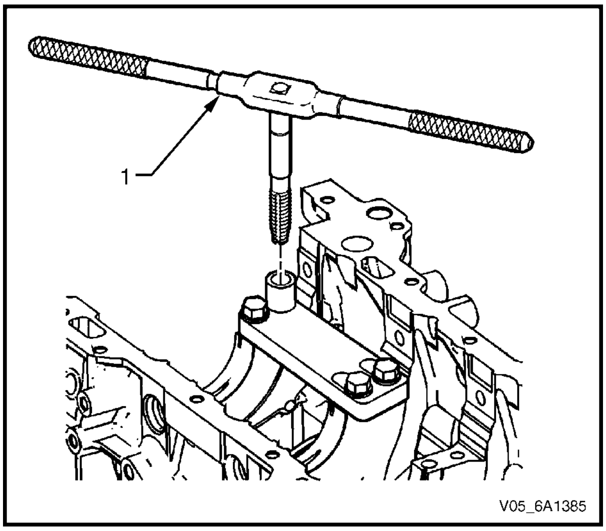


Figure 6A1 – 577

9 In order to tap the new threads for the insert to the correct depth, rotate the tap into the crankshaft main cap bolt hole until the mark (1) on the tap aligns with the top of the drill bushing (2).

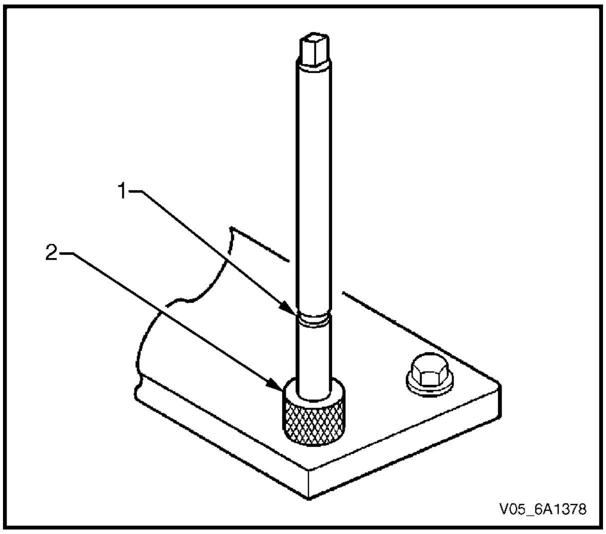


Figure 6A1 – 578

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

10 Using compressed air, clean out any swarf.

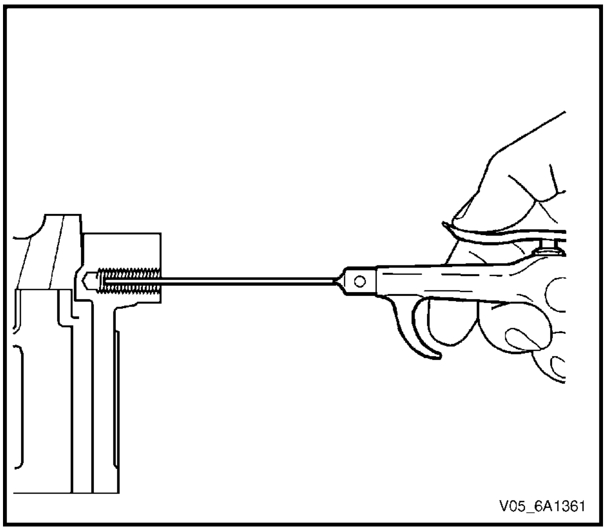
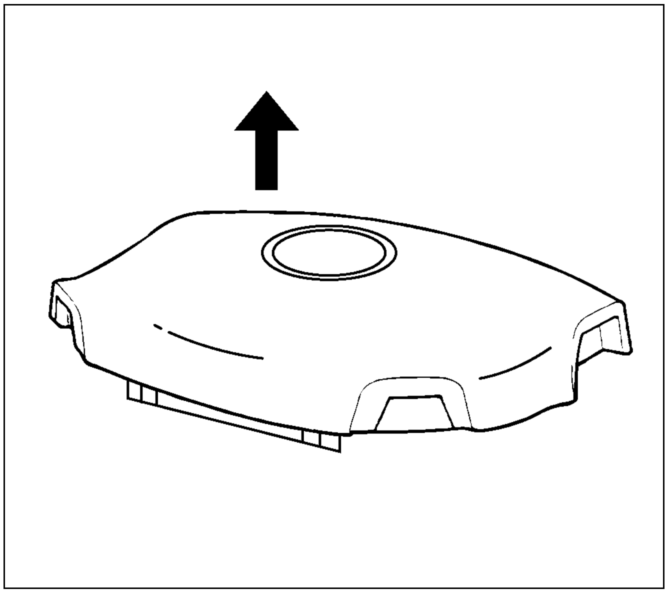


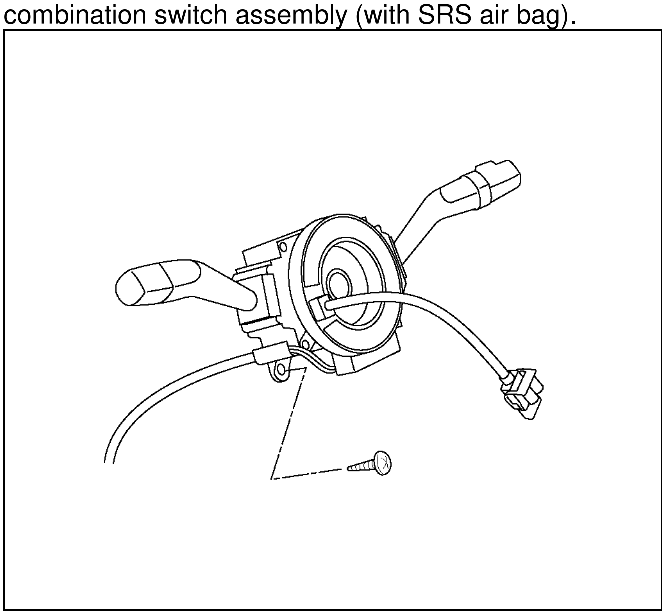
Figure 6A1 – 579



430R300007

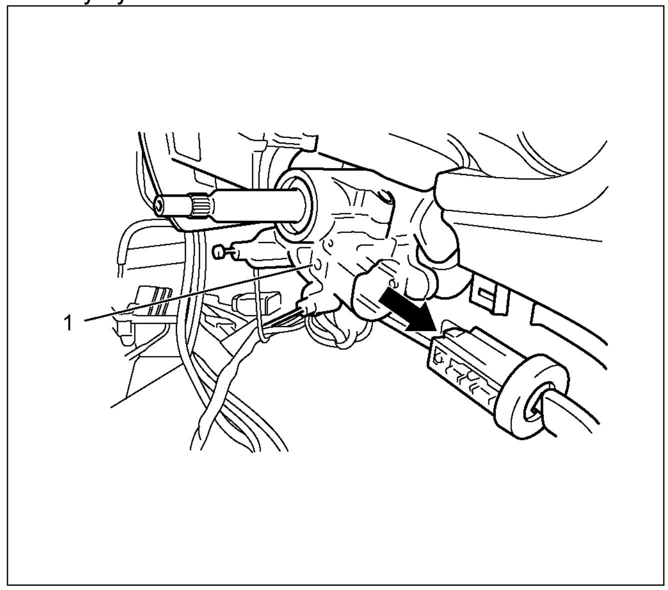
17. Remove steering column cover.
18. Disconnect the wiring harness connectors located under the steering column.
19. Remove the combination switch assembly with SRS coil.

NOTE: The SRS coil is a part of the combination switch assembly, which cannot be replaced separately. Therefore, be sure not to remove the SRS coil from the combination switch assembly (with SRS air bag).



RTW73BSH001001

20. Turn the ignition switch to the ACC position.
21. Insert a pin (1) into the hole and push on it. Pull the key cylinder free.

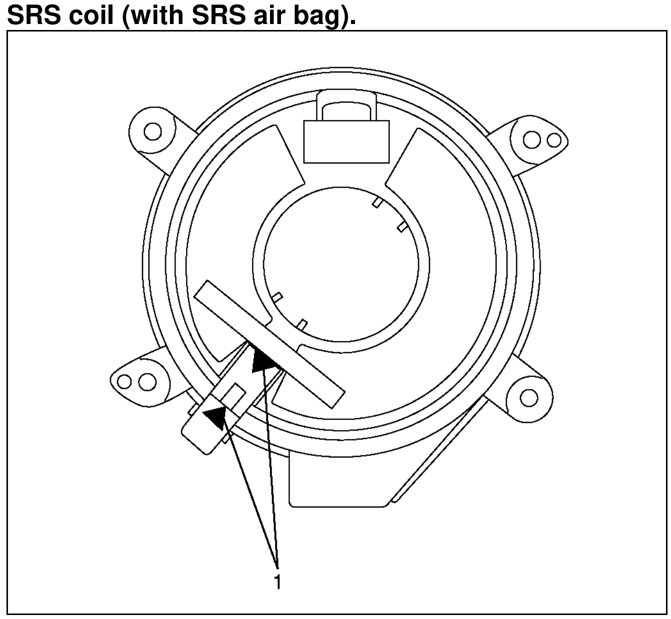


RUW53BSH000101

Installation

1. Install lock cylinder assembly.
2. Install the combination switch assembly with SRS coil (with SRS air bag).
3. Turn the SRS coil fully counterclockwise, return about 3 turns and align the neutral mark (with SRS air bag).

CAUTION: When turning the SRS coil fully counterclockwise, stop turning if resistance is felt. Further forced turning may damage the cable in the SRS coil (with SRS air bag).



826RW014

Legend

(1) Neutral mark

11 Spray a commercially available thread cleaner into the tapped hole.

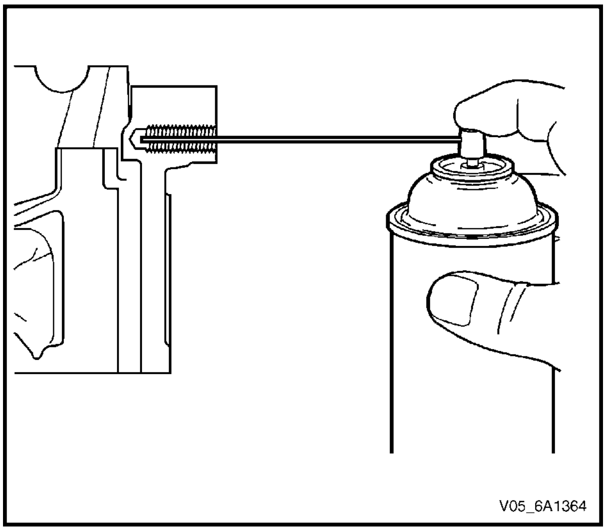


Figure 6A1 – 580

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

12 Using compressed air, clean out any swarf.

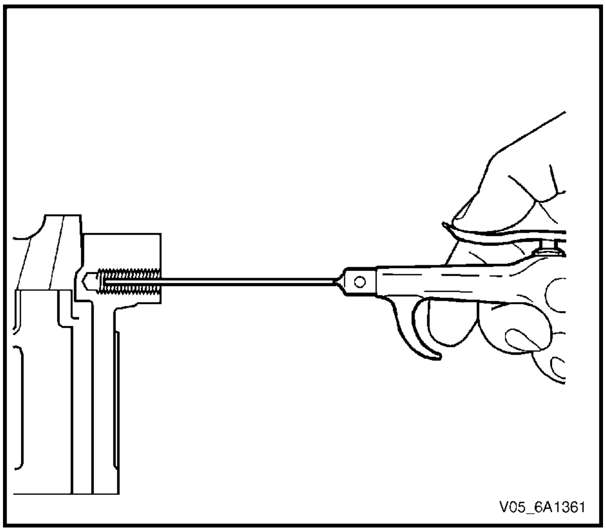


Figure 6A1 – 581

NOTE

- Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.
- Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

13 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

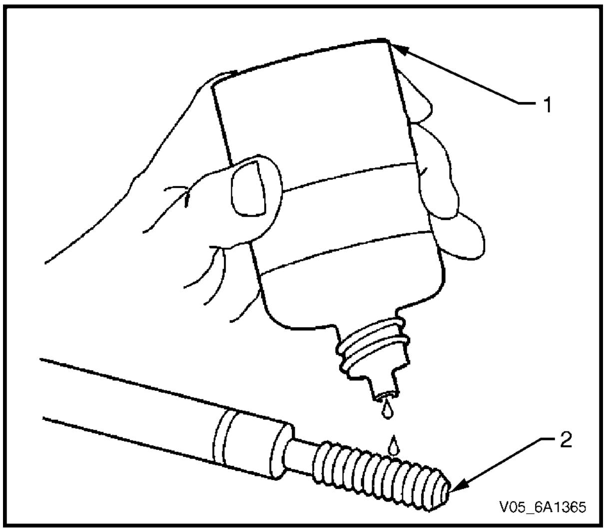


Figure 6A1 – 582

14 Install the insert (2) onto the driver installation tool (1).

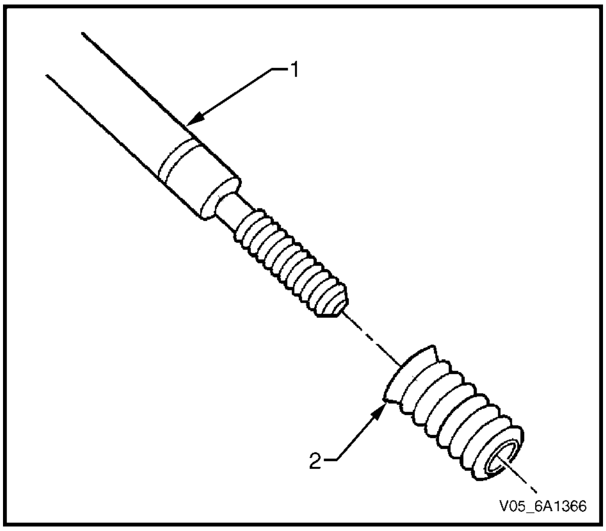


Figure 6A1 – 583

15 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

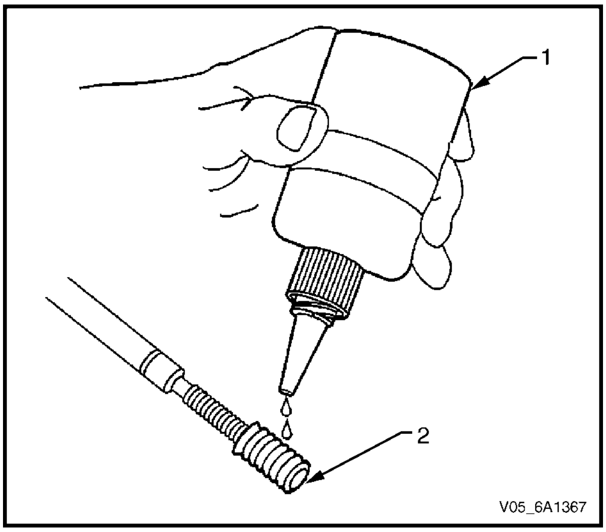


Figure 6A1 – 584

16 Install the insert and installation driver (1) to the tapped hole by hand only.

17 Start the insert into the threaded hole.

CAUTION

If the insert will not thread down until the flange contacts the counter-bored surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

18 Install the insert until the flange of the insert contacts the counter-bored surface.

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19 Continue to rotate the driver installation tool through the insert.

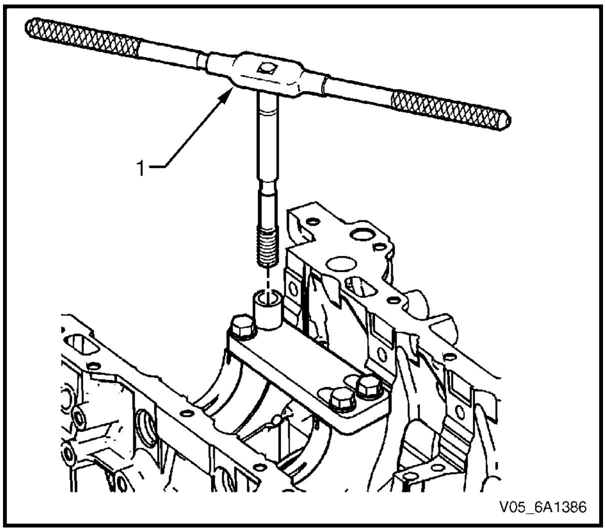


Figure 6A1 – 585

20 Rotate the driver installation tool until the mark (1) on the driver installation tool aligns with the top of the drill bushing (2).

21 Inspect the insert for correct installation into the tapped hole.

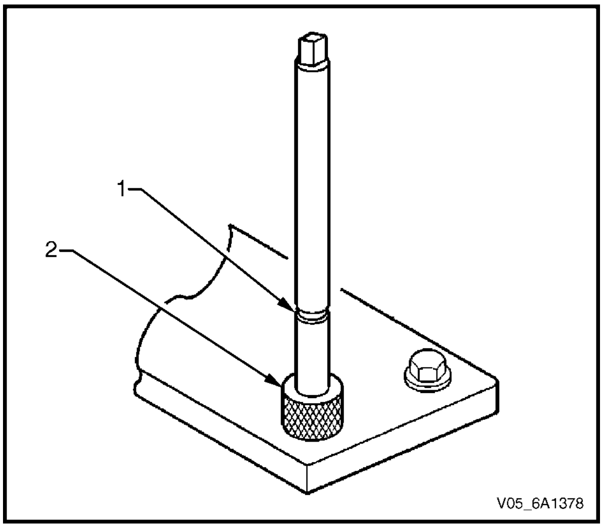


Figure 6A1 – 586

22 Remove the fixture plate bolts (1), bushing (2) and fixture plate (3).

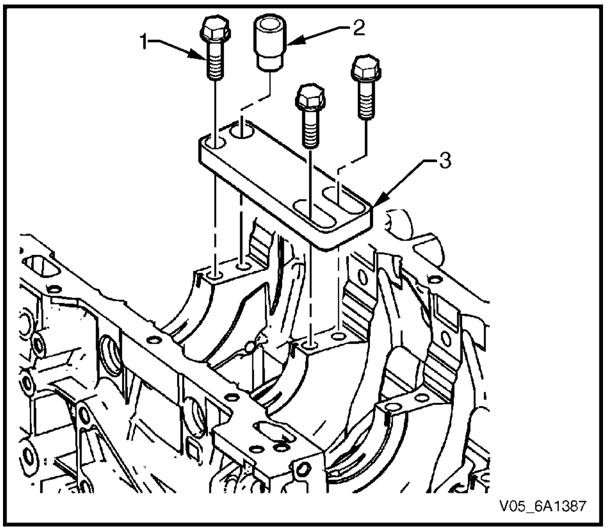


Figure 6A1 – 587

Cylinder Head Bolt Hole Thread Repair

The cylinder head bolt hole thread repair tools are in Tool No. J 42385-2000 and J 42385-700 which consist of the following:

- Drill (1) J 42385-723
- Tap (2) J 42385-724
- Installation driver (3) J 42385-725
- Alignment pin (4) J 42385-303
- Bushing (5) J 42385-302
- Bolts (6) J 42385-733
- Fixture plate (7) J 42385-401

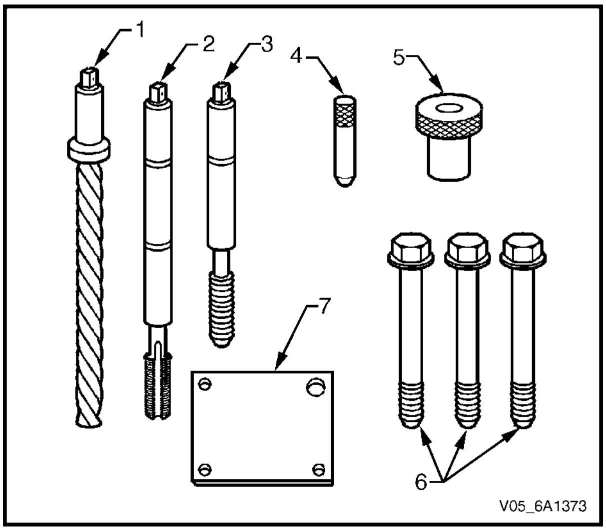


Figure 6A1 – 588

NOTE

- Ensure the fixture plate is installed during the machining and installation processes of the insert.
- The use of a cutting type fluid such as WD 40® or equivalent is recommended when performing the drilling, counter boring and tapping procedures.
- When installed to the correct depth, the flange of the insert will be seated against the counter bore of the drilled/tapped hole.

1 Position the fixture plate (3) with the bushing (1) installed over the cylinder head bolt hole to be repaired (4).

2 Loosely install the fixture plate bolts (2) into the remaining cylinder head bolt holes.

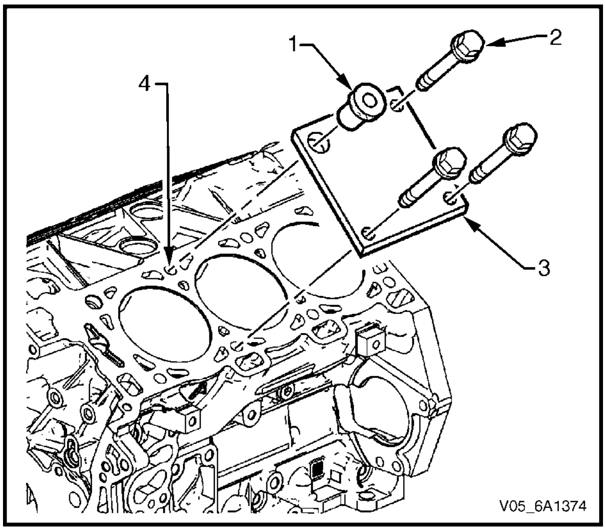


Figure 6A1 – 589

3 Position the alignment pin (1) through the bushing and into the cylinder head bolt hole.

4 With the alignment pin in the desired cylinder head bolt hole, tighten the fixture retaining bolts (2).

5 Remove the alignment pin.

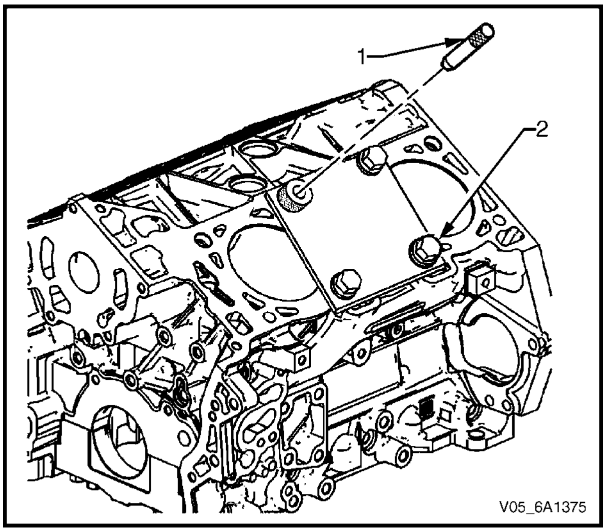


Figure 6A1 – 590

NOTE

During the drilling process, repeatedly remove the drill and clean swarf from the hole and the flutes of the drill.

6 Drill the hole until the stop collar contacts the top of the drill bushing.

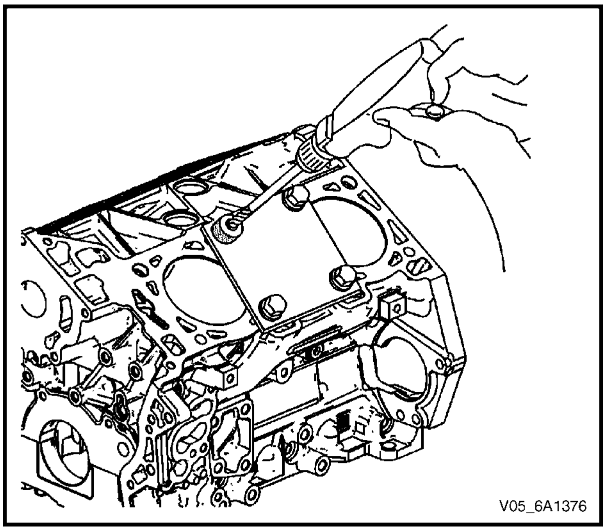


Figure 6A1 – 591

NOTE

All swarf must be removed from the drilled hole prior to tapping.

WARNING

Safety glasses must be worn when using compressed air.

7 Using compressed air, clean out any swarf.

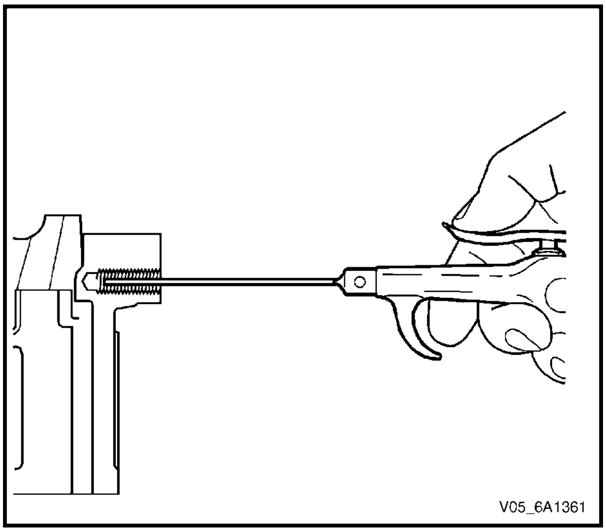


Figure 6A1 – 592

CAUTION

Do not remove the fixture plate during the machining and installation processes of the insert.

NOTE

- During the tapping process, repeatedly remove the tap and clean swarf from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

8 Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

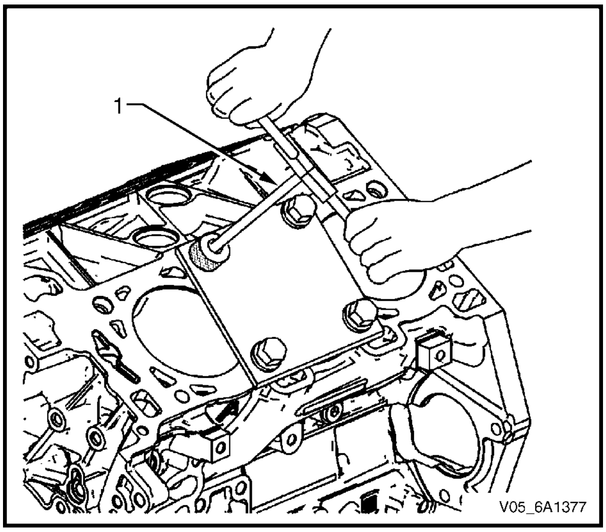


Figure 6A1 – 593

9 In order to tap the new threads for the insert to the correct depth, rotate the tap into the cylinder head bolt hole until the mark (1) on the tap aligns with the top of the drill bushing (2).

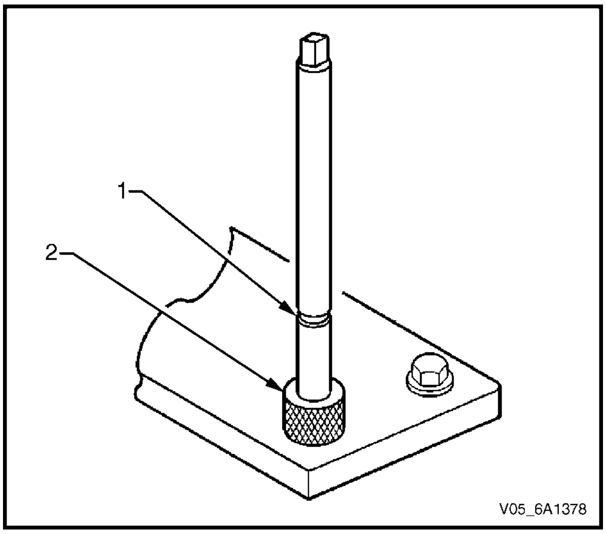


Figure 6A1 – 594

NOTE

Remove the fixture plate prior to installing the insert with the installer tool.

10 Remove the bushing (1) and fixture plate bolts (2) from the cylinder block (4) and remove the fixture plate (3).

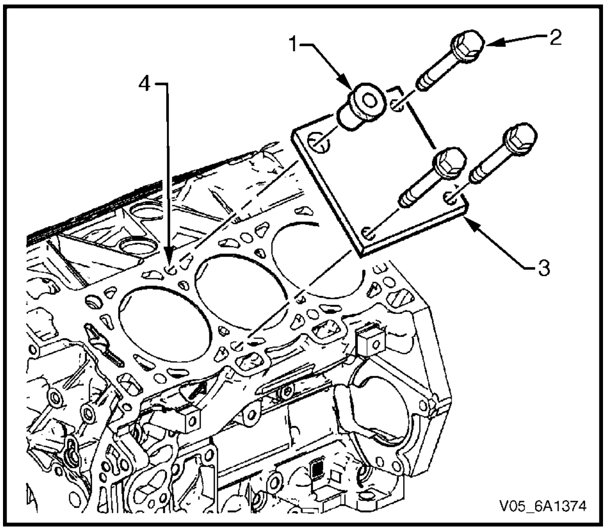


Figure 6A1 – 595

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

11 Using compressed air, clean out any swarf.

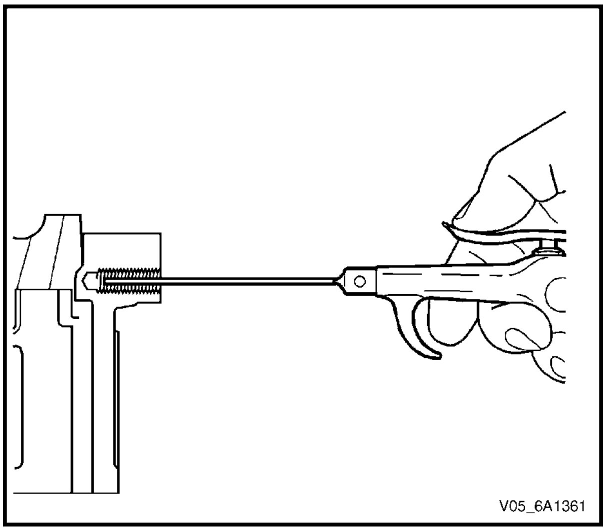


Figure 6A1 – 596

12 Spray a commercially available thread cleaner into the tapped hole.

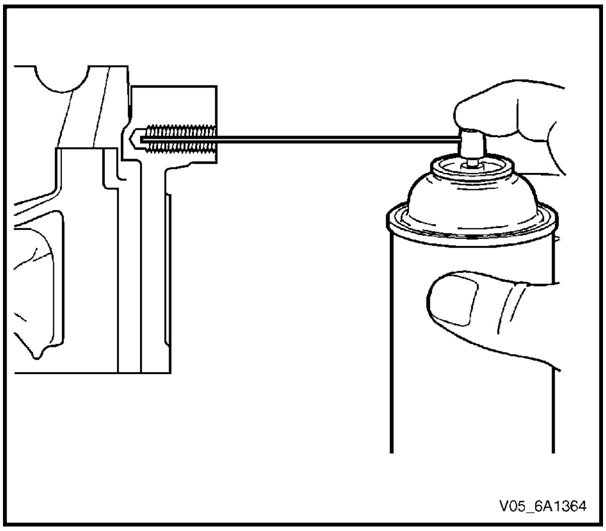


Figure 6A1 – 597

NOTE

All swarf must be removed from the tapped hole prior to insert installation.

WARNING

Safety glasses must be worn when using compressed air.

13 Using compressed air, clean out any swarf.

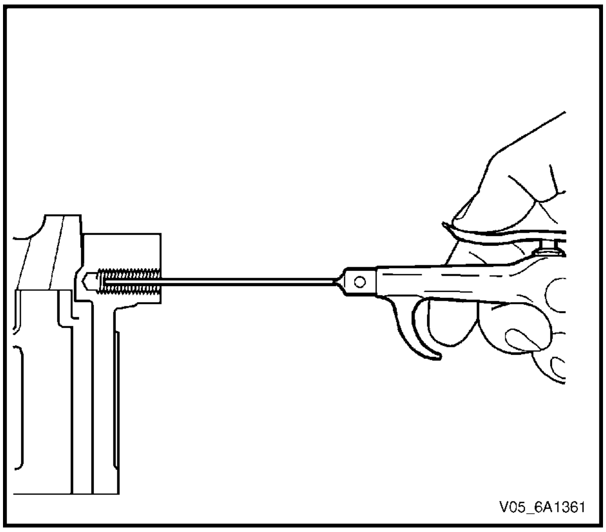


Figure 6A1 – 598

NOTE

Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

14 Lubricate the threads of the driver installation tool (2) with the driver oil (1).

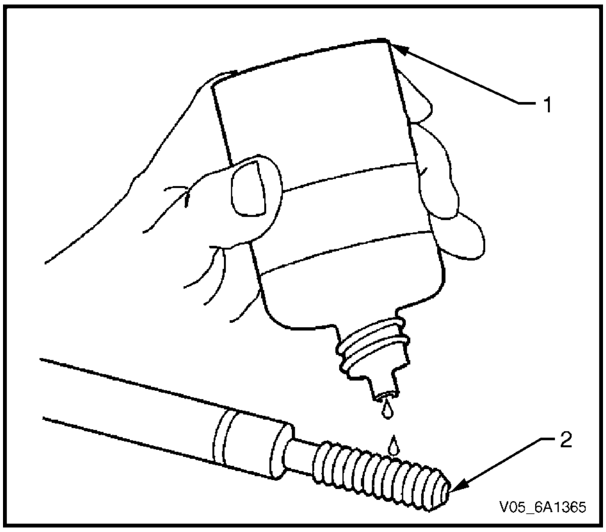


Figure 6A1 – 599

15 Install the insert (2) onto the driver installation tool (1).

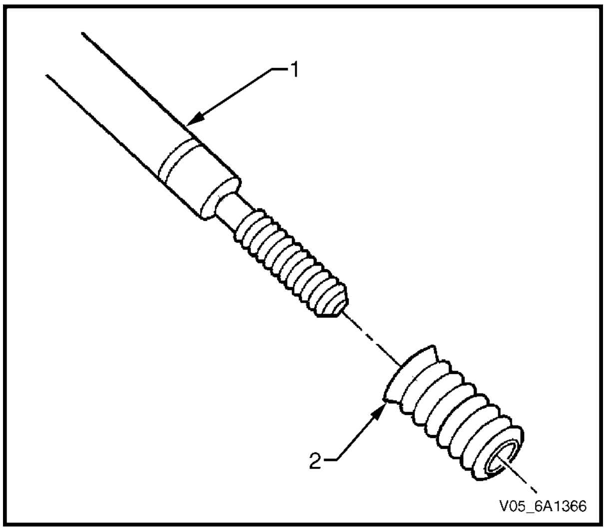


Figure 6A1 – 600

16 Apply thread lock sealant (1) such as Loctite 277® or equivalent to the insert OD threads (2).

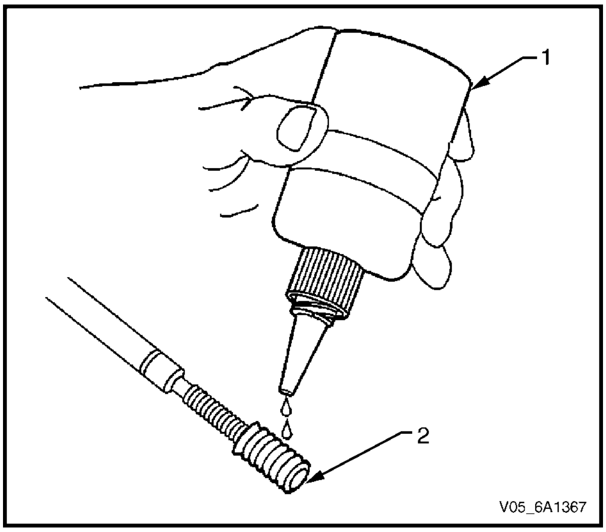


Figure 6A1 – 601

17 Install the insert and installation driver (1) into the tapped hole by hand only.

18 Start the insert into the threaded hole.

CAUTION

If the insert will not thread down until the flange contacts the counter-bored surface, remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining swarf and/or incorrect tapping.

19 Install the insert until the flange of the insert contacts the counter-bored surface.

NOTE

The driver installation tool will tighten up before cutting completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

20 Continue to rotate the driver installation tool through the insert.

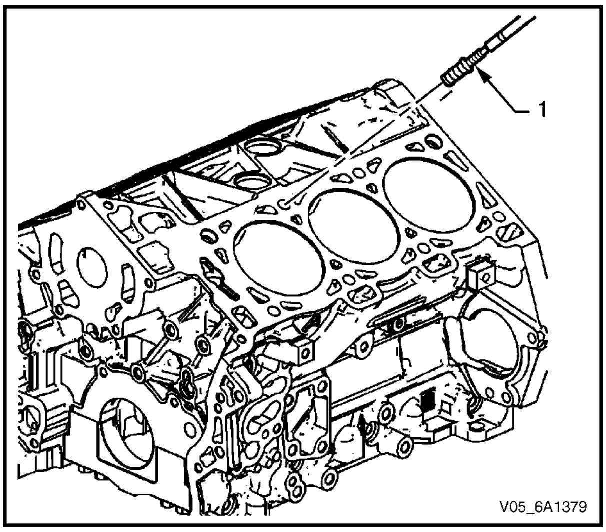


Figure 6A1 – 602

21 In order to completely form the new threads in the insert, rotate the driver installation tool through the insert until the mark on the driver installation tool (1) aligns with the surface of the engine block deck (2).

22 Inspect the insert for correct installation into the tapped hole.

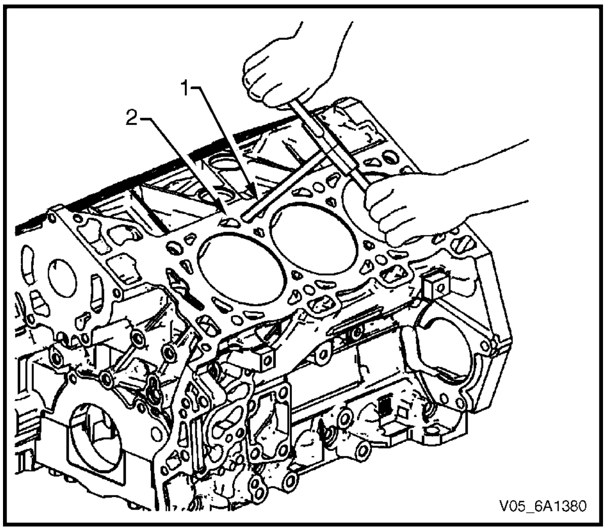


Figure 6A1 – 603

4.9 Thread Repair Specifications

Left-hand Cylinder Head Camshaft Cover Face

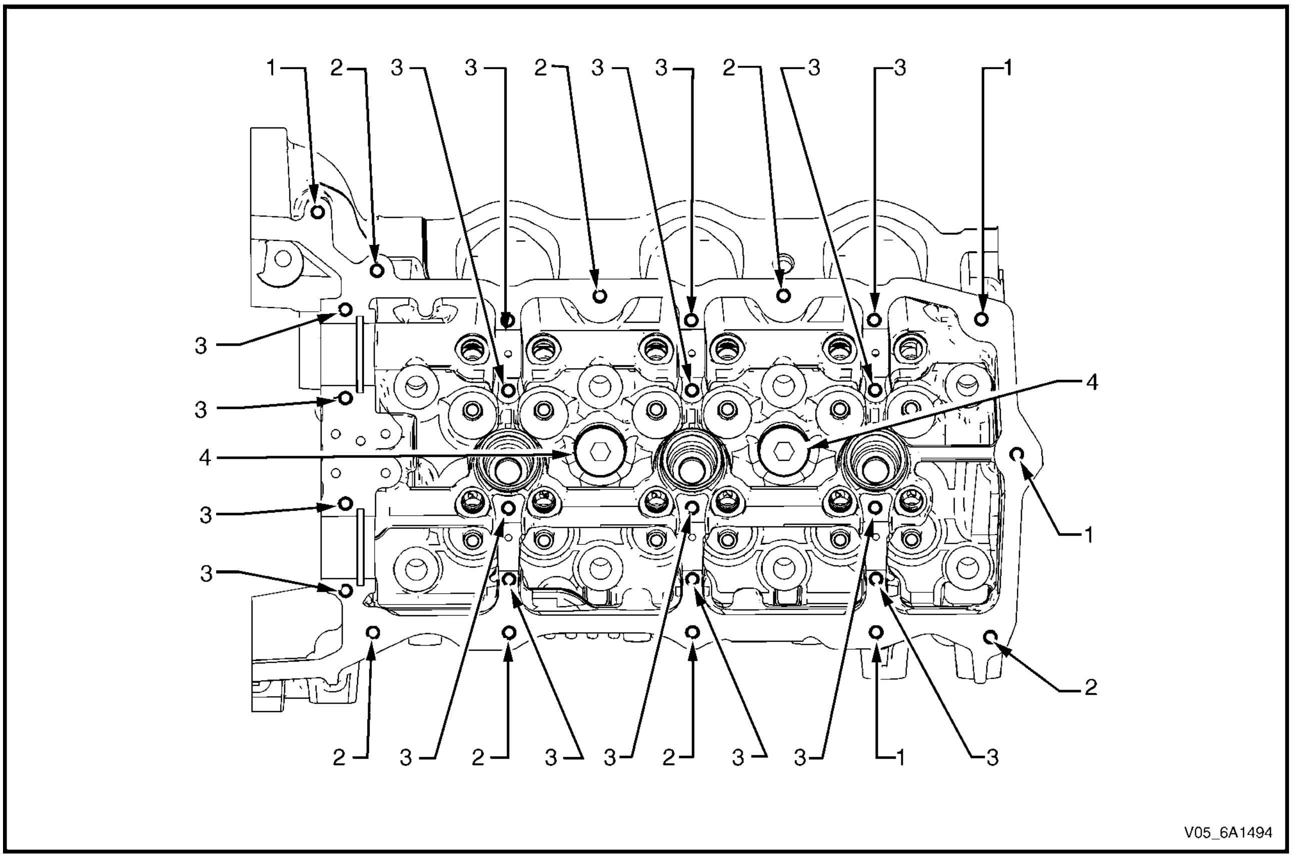


Figure 6A1 – 604

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M6 x 1.0	201	202	203	204	205	Thru	Thru
3	M6 x 1.0	701	n/a	203	204	205	28.5	24.0
4	M20 x 1.5	715	716	717	718	719	25.0	17.0

RECOMMENDED FLUIDS AND LUBRICANTS (For EUROPE)

In order to obtain maximum performance and longest service life from your ISUZU vehicles, it is very important to select and use correctly the best lubricants and diesel fuels.
When lubricating, be sure to use ISUZU genuine lubricants or recommended lubricants listed below, according to the maintenance schedule for each vehicle model.

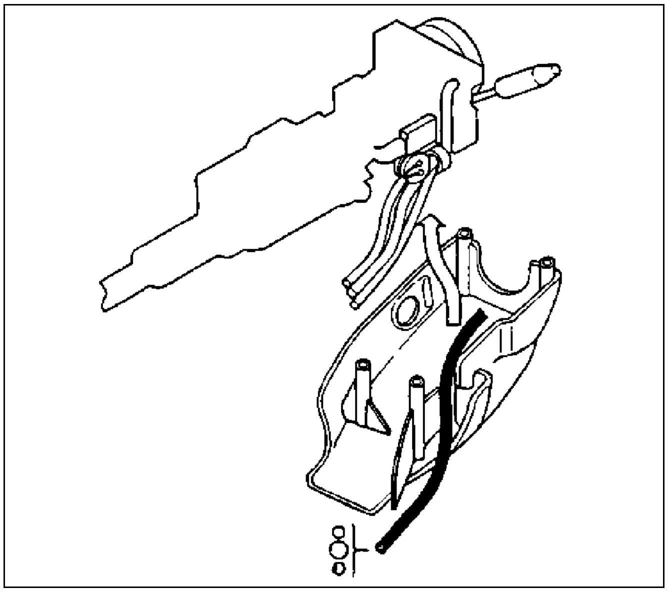
LUBRICATION/FLUID	GRADE		
	API	ACEA	OTHER
Diesel engine crankcase		B2/B3 E2/E3	
Manual transmission Transfer case		B2/B3 E2/E3	
Differential Shift on the fly system (GL-5 only)	**GL-5**		**BESCO GEAR OIL SH (80W-90, 90, 140) (ISUZU GENUINE)** **BESCO SHIFT ON THE FLY (75W-90) (ISUZU GENUINE)** THURBAN GL-5 EP (80W-90, 85W-140) (CALTEX) SPIRAX A (140) (SHELL) TRANSELF TYPE B (80W-90, 85W-140) (ELF) TRANSMISSION TM (80W-90, 85W-140) (TOTAL) EPX90 (90)(CASTROL) DYNA DRIVE (80W-90) (CASTROL) ENERGEAR HYPO (90) (BP) ENERGEAR EP (80W-90) (BP)
Differential (Limited Slip Differential) (GL-5 only)	**GL-5**		**BESCO GEAR OIL LSD (140) (ISUZU GENUINE)** GEAR OIL LSD (90) (CALTEX) SPIRAX A LS 90 (90) (SHELL) TRANSELF TYPE BLS (90) (ELF) TRANSMISSION DA (85W-90) (TOTAL) HYPOY LSX (90) (CASTROL) ENERGEAR LS-M (90) (BP)
Automatic transmission			MOBIL ATF 3309
Power steering			DEXRON® III
Propeller shaft sliding yoke Universal joint (General purpose grease in Molybdenum)			NLGI #2 or #3 multi purpose type grease containing molybdenum disulfide
Engine cooling system			Good quality ethylene glycol antifreeze or GM spec. 6033-M or equivalent

NOTE:
* If GL-5 Limited Slip Differential Lubricant is not available, use GL-5 Lubricant mixed with 1 bottle (118ml) of Limited Slip Differential Lubricant additive (Parts No. 8-01052-358-0) or equivalent.

FLUID	TYPE
Clutch and brake fluid reservoir	**Besco brake fluid (For light duty)** Hydraulic brake fluid SAE J1703 FMVSS 116 DOT.3 grade

DIESEL FUEL/APPLICABLE STANDARD	
JIS (JAPANESE INDUSTRIAL STANDARD)	Based on K2204 GAS OIL
DIN (DEUTSCHE INDUSTRIE NORMEN)	Based on EN590: 1997L
SAE (SOCIETY OF AUTOMOTIVE ENGINEERS)	Based on SAE J-313C
BS (BRITISH STANDARD)	Based on BS EN590: 1997

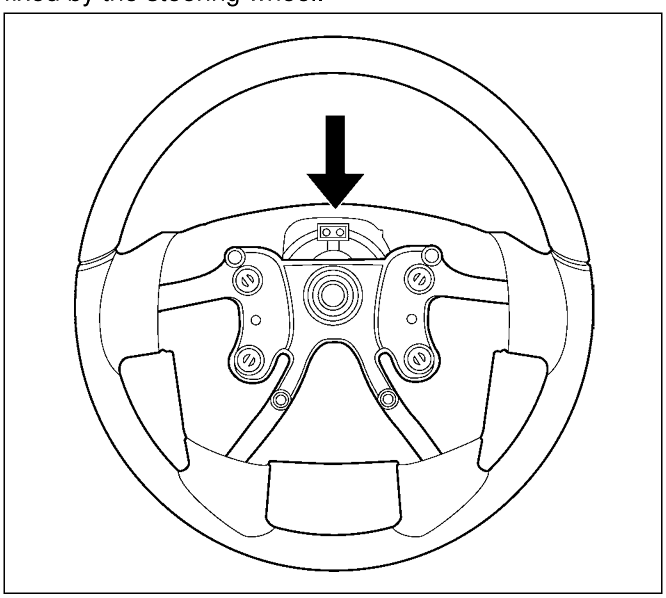
NOTE:
Use the applicable standard or equivalent for diesel fuels.



825RS048

4. Install the driver knee bolster assembly.
5. Install the steering lower cover and engine hood opening lever.
6. Install the steering wheel and align the setting marks. Refer to the adjustment method in case a mark has not been applied in this section.

NOTE: Confirm SRS and horn harness connector is fixed by the steering wheel.



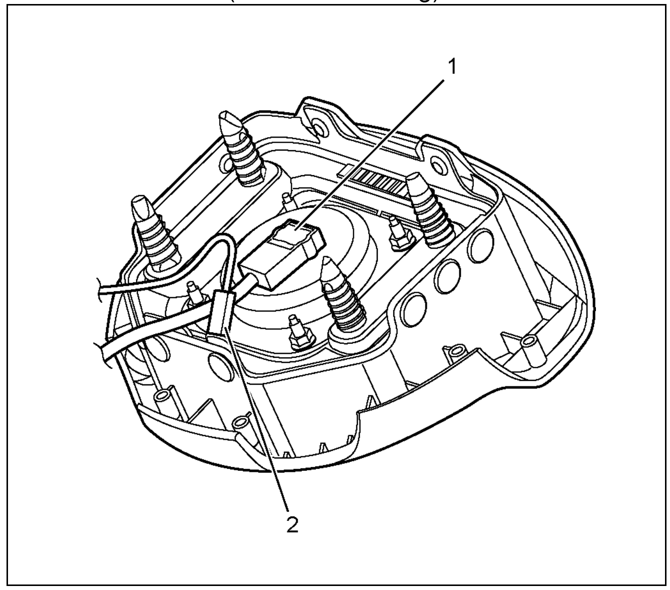
RTW73BSH000701

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

7. Tighten the steering wheel fixing nut to the specified torque.

   Torque: 35 N·m (3.6 kgf·m/26 lb·ft)

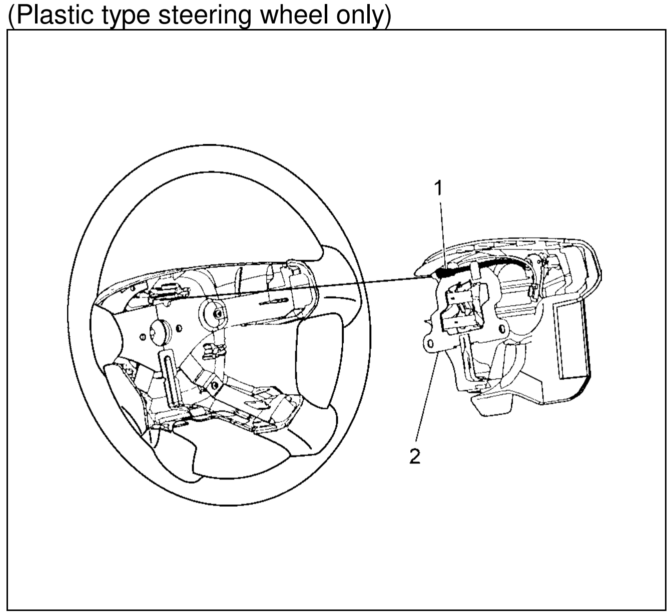
8. Support inflator module and carefully connect the SRS connector (1) and horn lead (2), then install inflator module (with SRS air bag).



RTW73BSH001101

9. Connect the horn leads at center of wheel (without SRS air bag).

NOTE: The horn leads (1) are passed along the top of the bracket (2).
(Plastic type steering wheel only)



RTW73BSH000801

Left-hand Cylinder Head Front Face

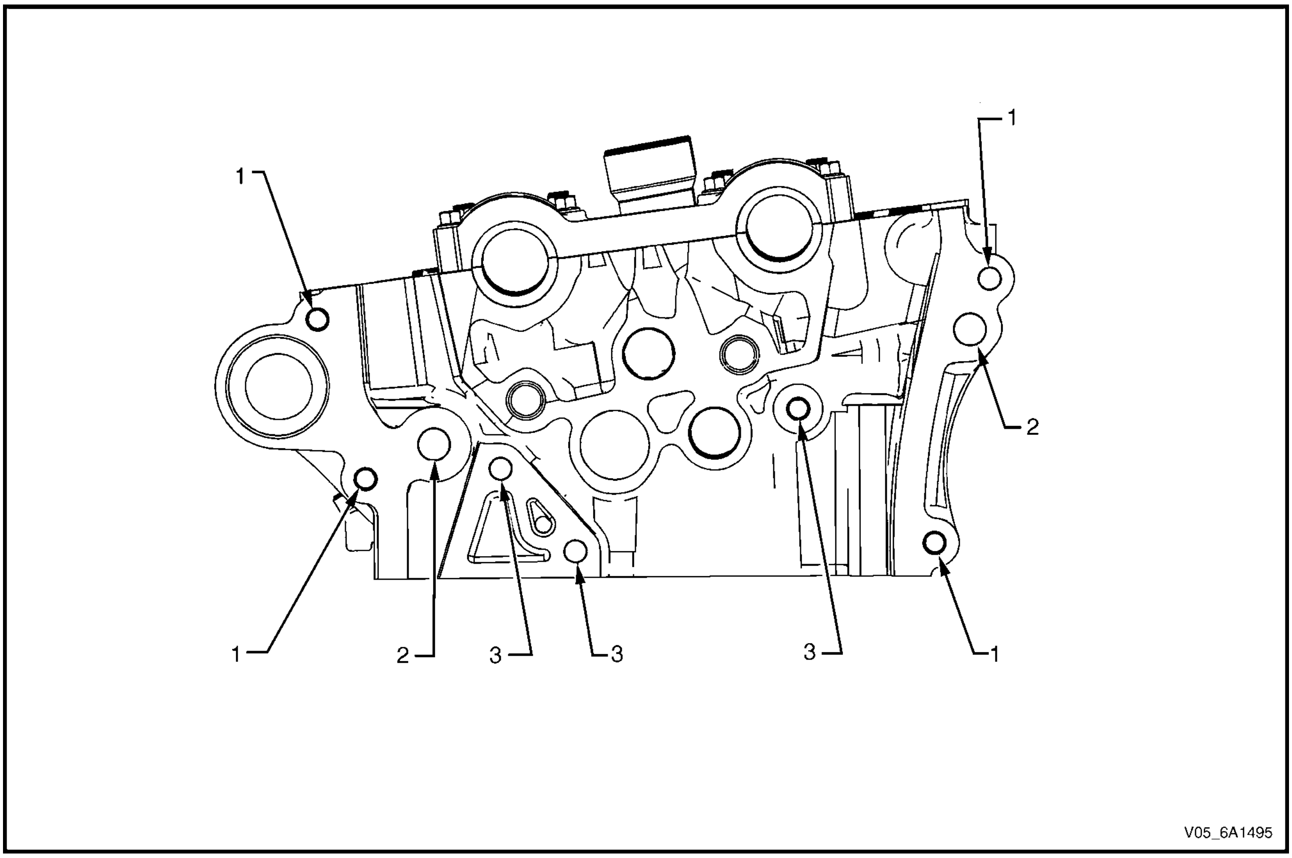


Figure 6A1 – 605

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	Thru	Thru
2	M12 x 1.75	856	857	858	859	416	40.0	32.5
3	M8 x 1.25	206	207	208	209	210	22.5	18.0

Left-hand Cylinder Head Intake Face

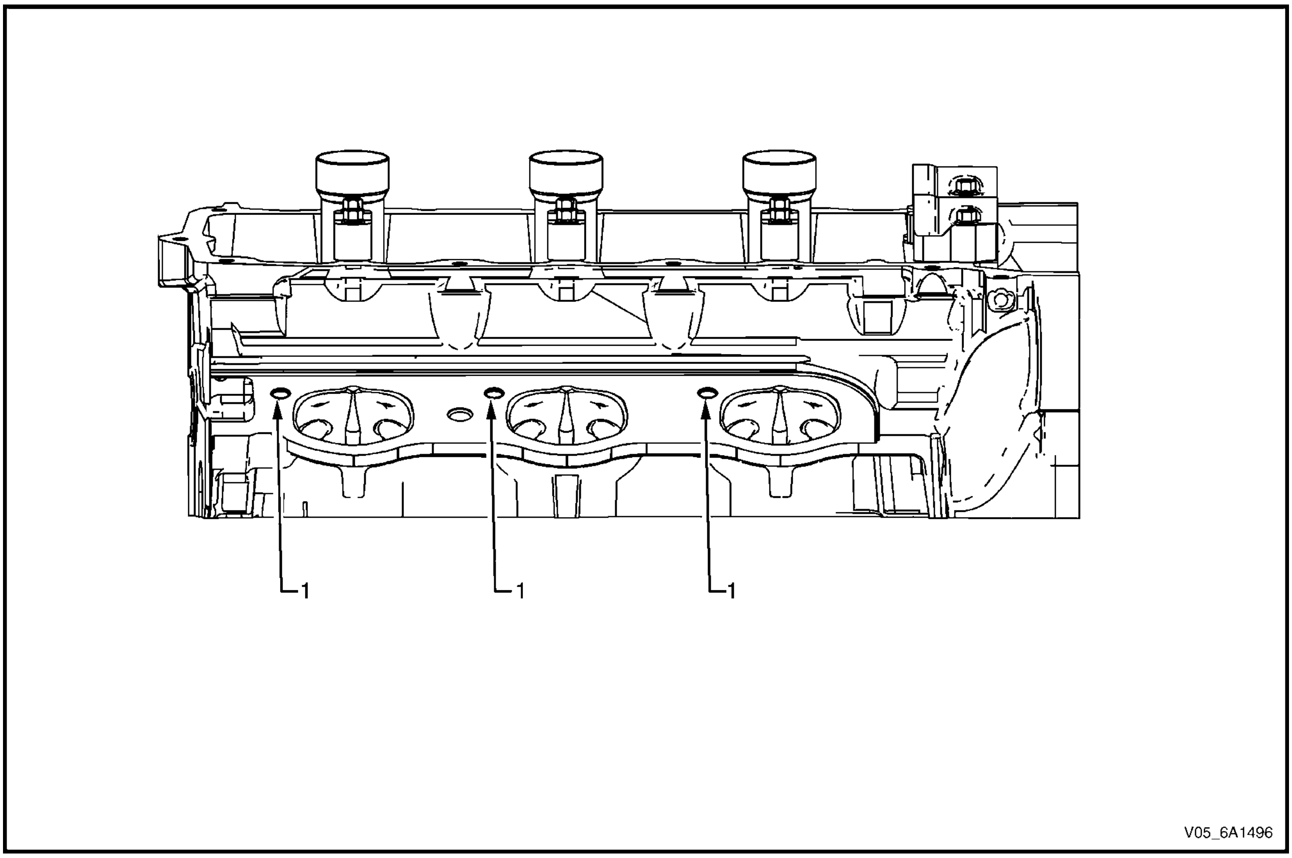


Figure 6A1 – 606

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0

Left-hand Cylinder Head Exhaust Face

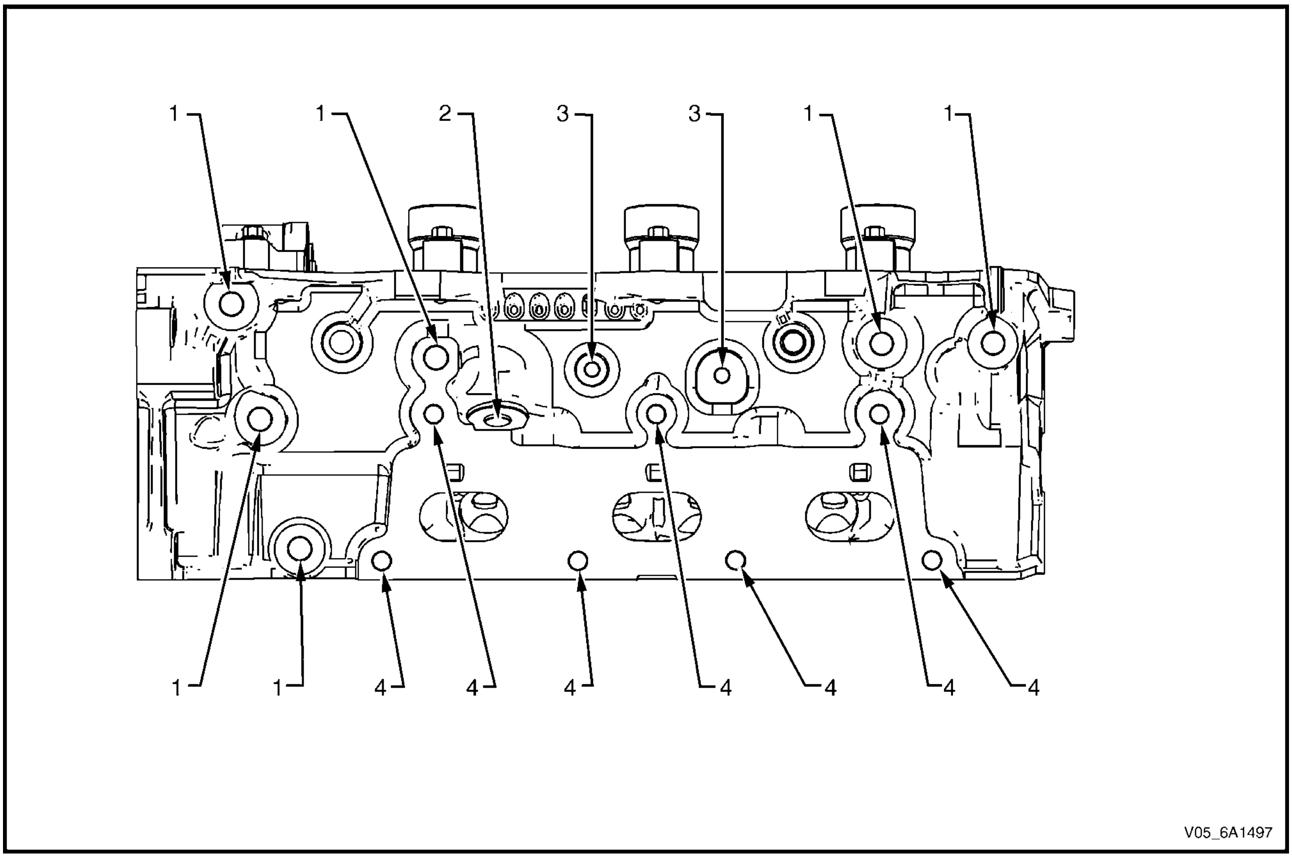


Figure 6A1 – 607

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	33.5	27.0
2	M12 x 1.5	705	706	707	708	709	27.5	13.0
3	M6 x 1.0	201	202	203	204	205	22.5	18.0
4	M8 x 1.25	206	207	208	209	210	28.5	23.0

Left-hand Cylinder Head Rear Face

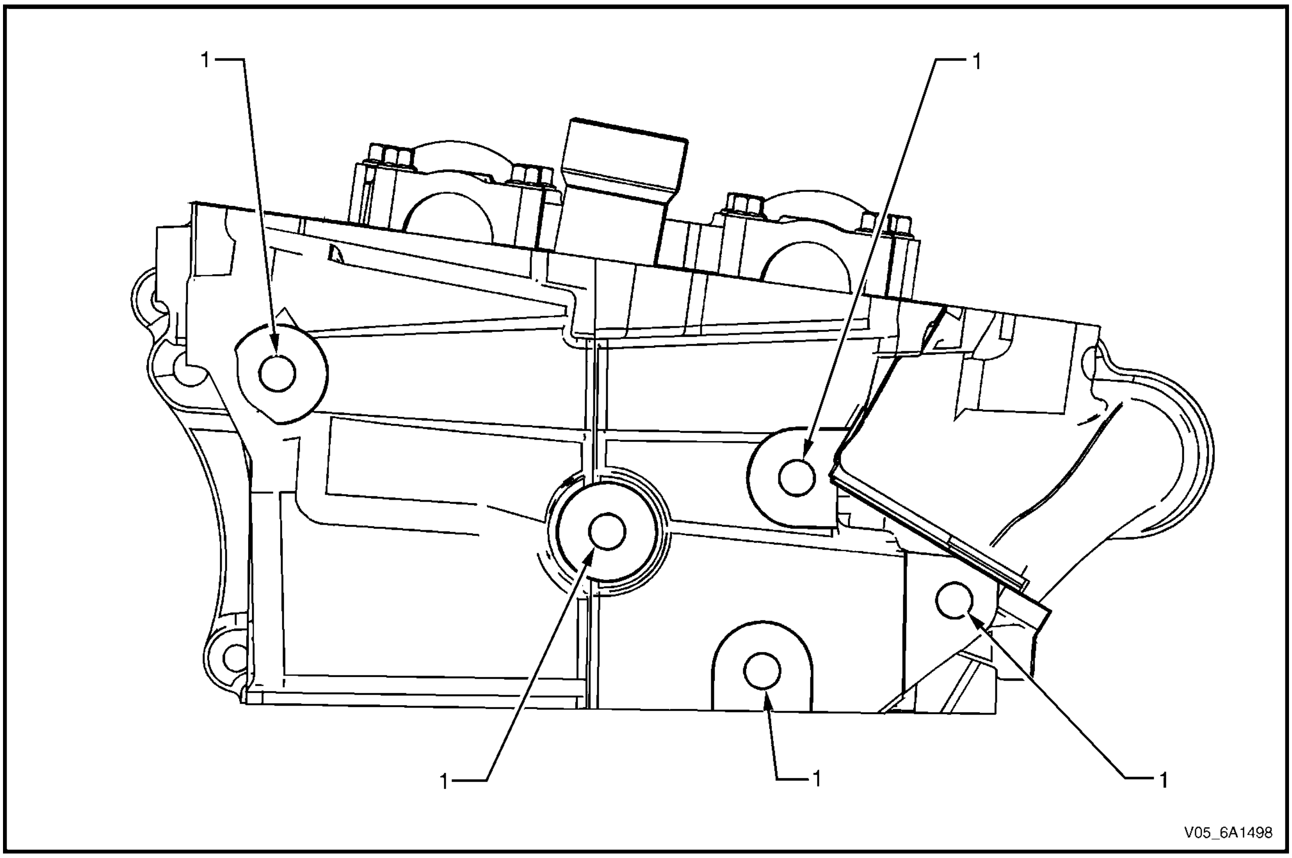


Figure 6A1 – 608

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	33.5	27

Right-hand Cylinder Head Camshaft Cover Face

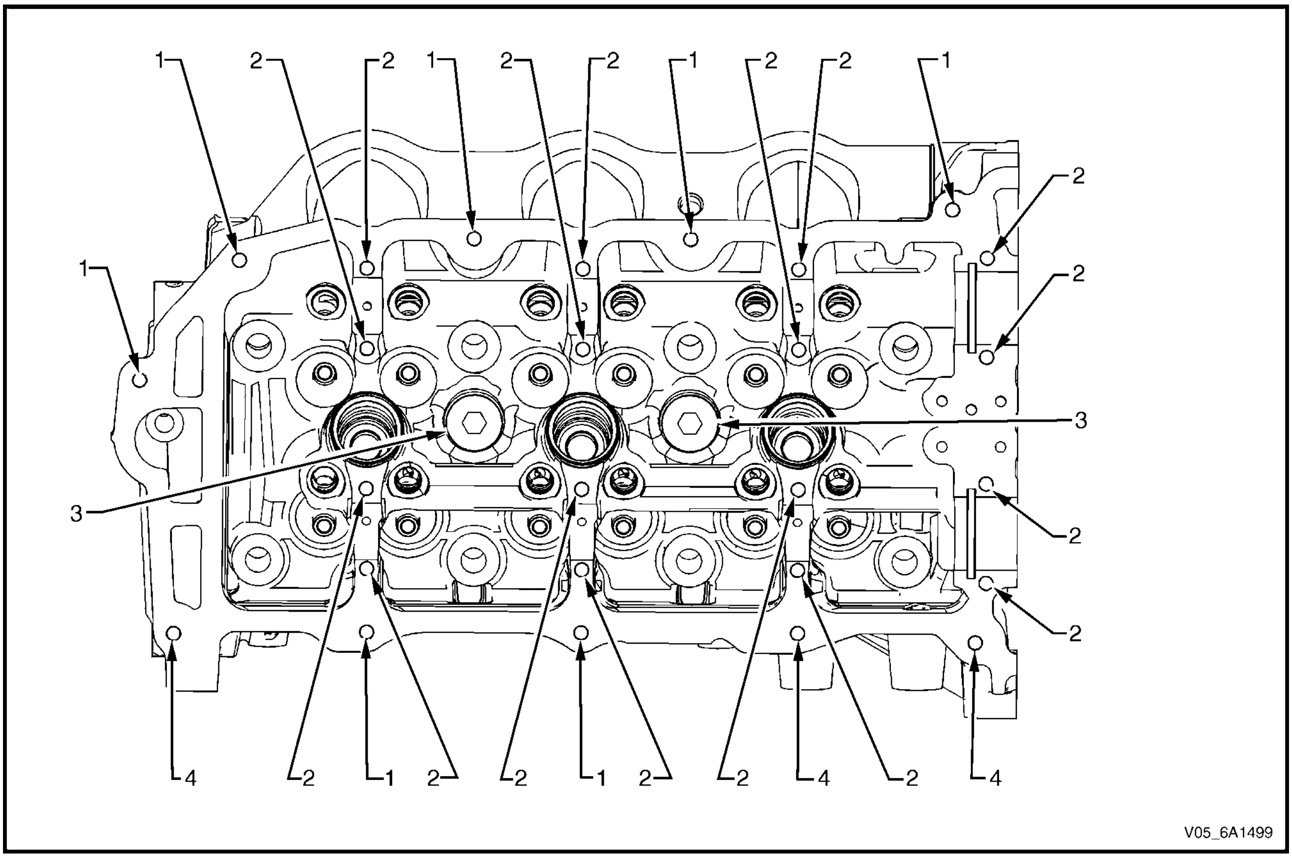


Figure 6A1 – 609

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M6 x 1.0	701	n/a	203	204	205	28.5	24.0
3	M20 x 1.5	715	716	717	718	719	25.0	17.0
4	M6 x 1.0	201	202	203	204	205	22.5	18.0

Right-hand Cylinder Head Front Face

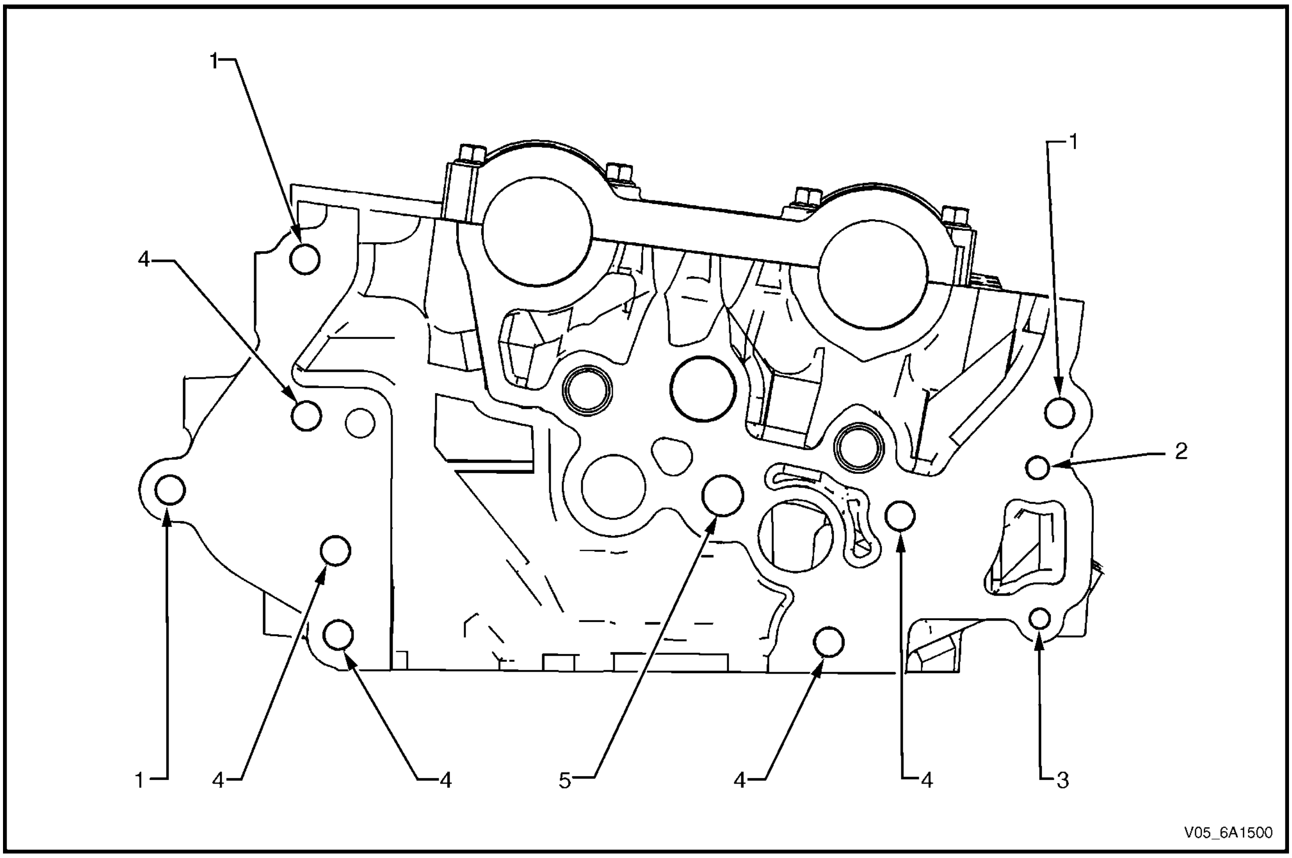


Figure 6A1 – 610

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	Thru	Thru
2	M6 x 1.0	201	202	203	204	205	22.5	18.0
3	M6 x 1.0	201	202	203	204	205	Thru	Thru
4	M8 x 1.25	206	207	208	209	210	28.5	23.0
5	M12 x 1.75	856	857	858	859	416	40.0	32.5

Right-hand Cylinder Head Intake Face

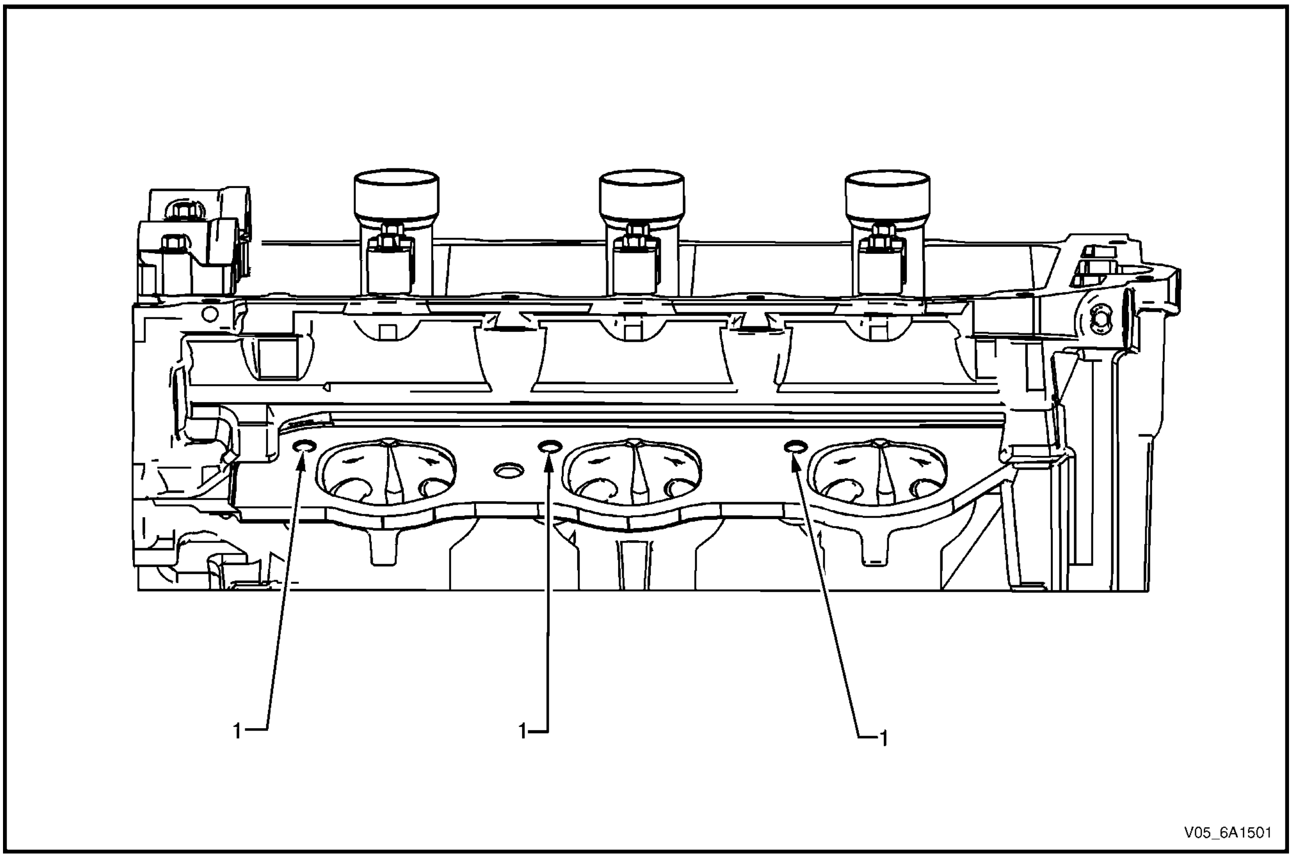


Figure 6A1 – 611

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0

Right-hand Cylinder Head Exhaust Face

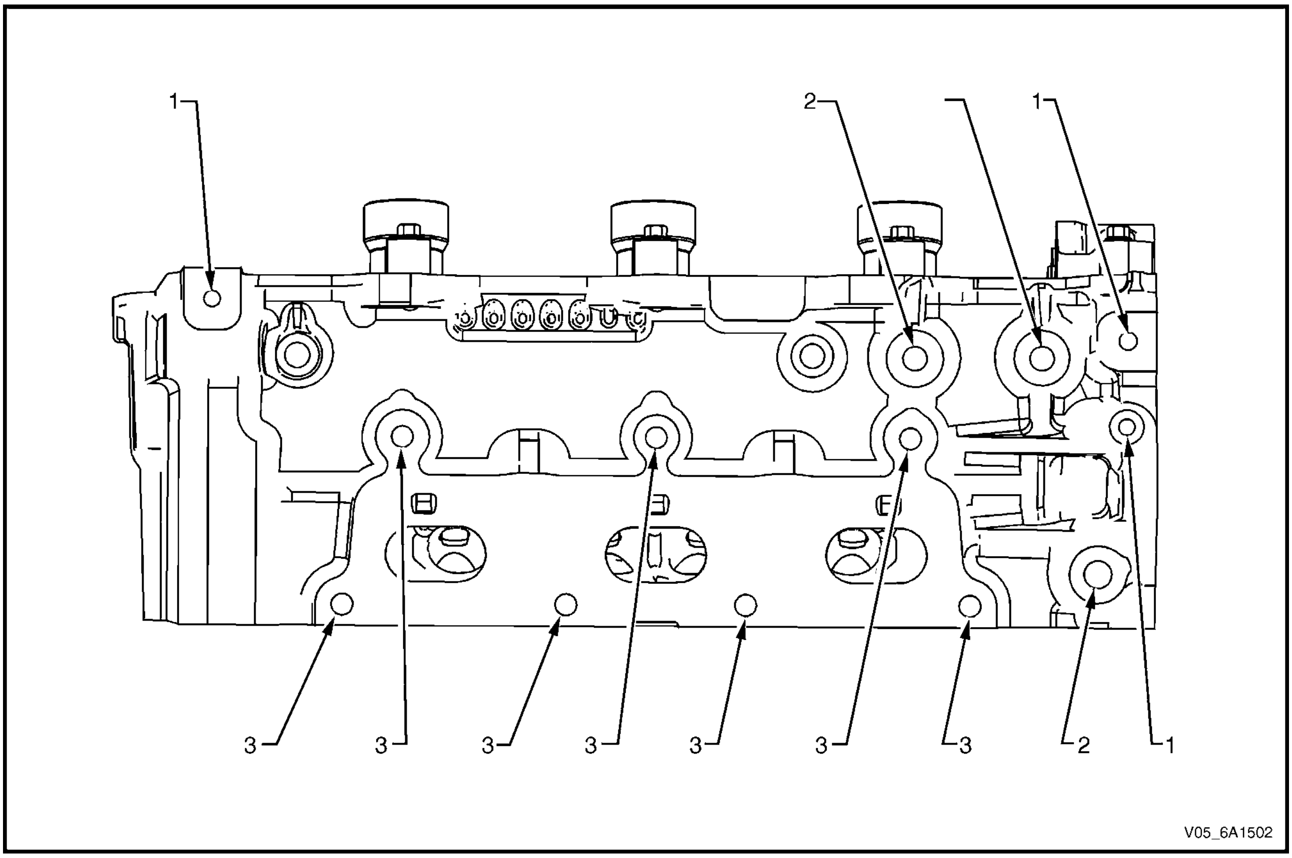


Figure 6A1 – 612

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M10 x 1.5	211	212	213	214	215	33.5	27.0
3	M8 x 1.25	206	207	208	209	210	28.5	23.0

Right-hand Cylinder Head Rear Face

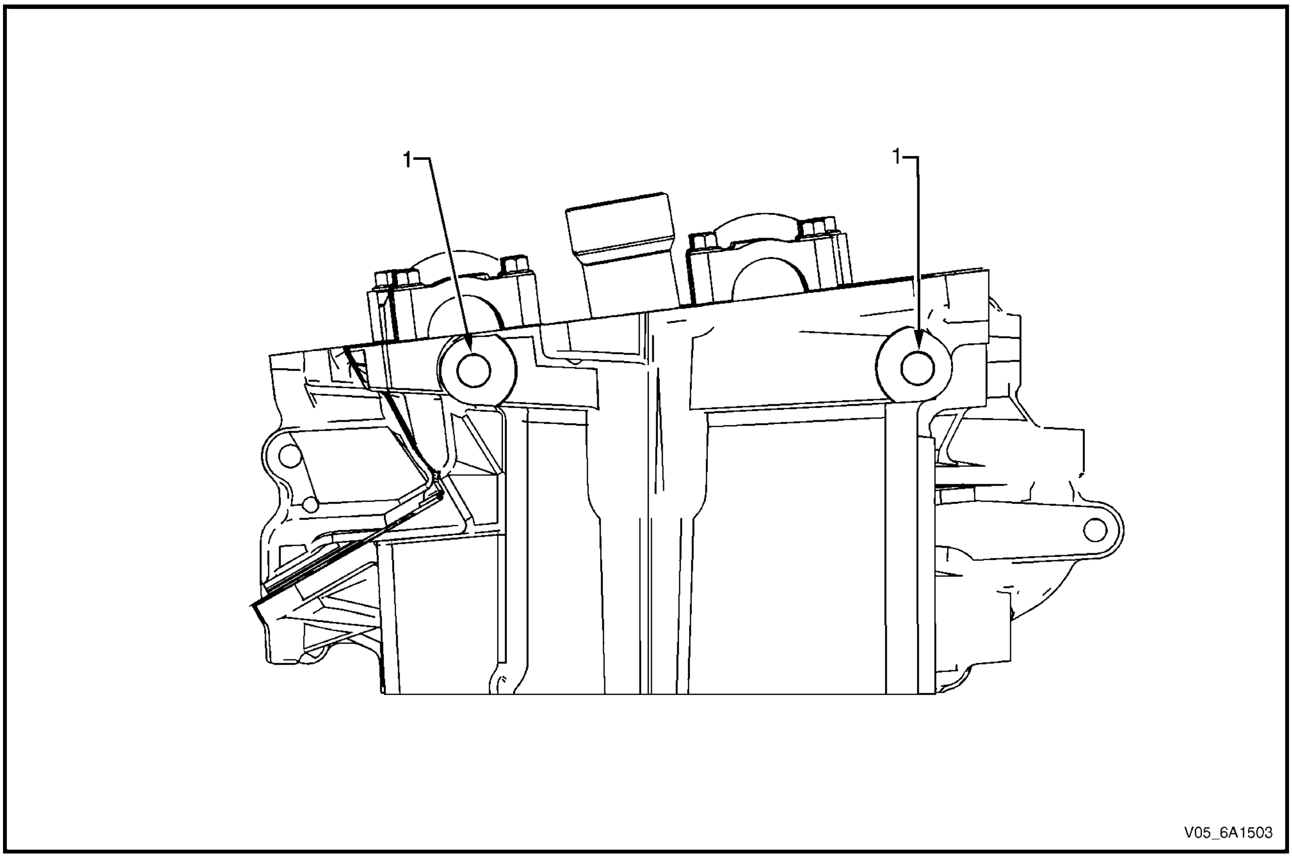


Figure 6A1 – 613

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	33.5	27

Engine Block Front

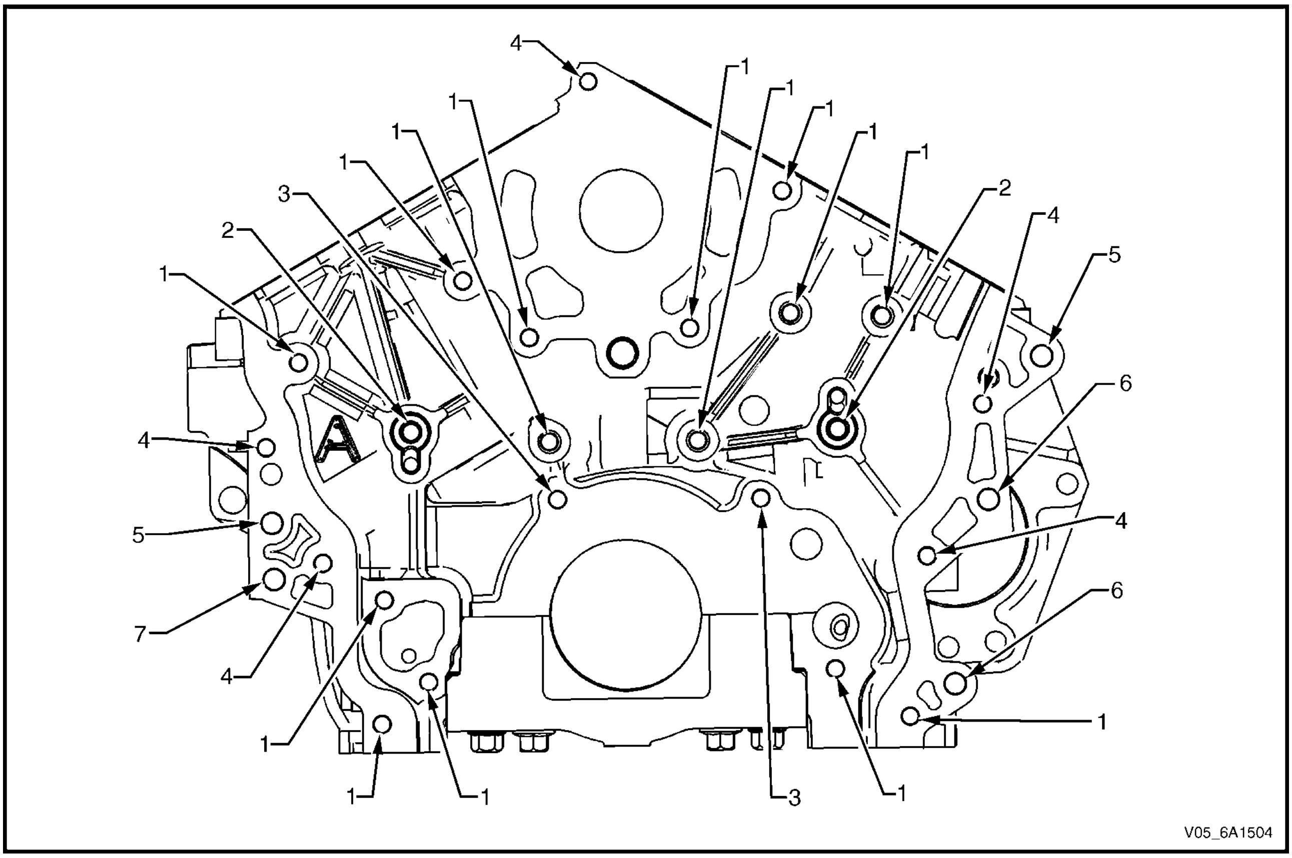


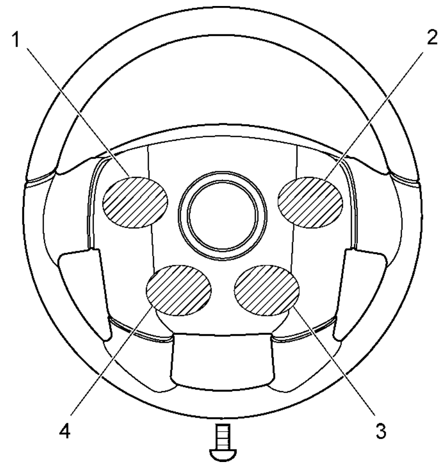
Figure 6A1 – 614

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M10 x 1.5	211	212	213	214	215	33.5	27.0
3	M8 x 1.25	207	207	208	209	210	Thru	23.0
4	M8 x 1.25	207	207	208	209	210	Thru	Thru
5	M10 x 1.5	212	212	213	214	215	28.0	28.0
6	M10 x 1.5	212	212	213	214	215	Thru	20.0
7	M10 x 1.5	212	212	213	214	215	Thru	28.8

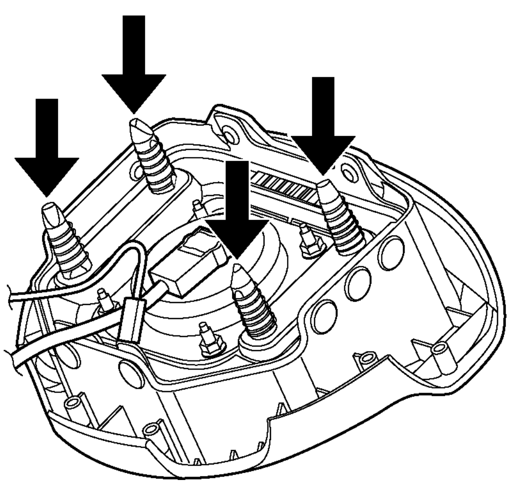
10. Push the horn pad at areas 1-4.
    Tighten the horn pad fixing screw to the specifed torque (without SRS air bag).
    Torque: 3 N·m (0.3 kgf·m/26 lb·in)

NOTE: A horn pad should not be struck during attachment.

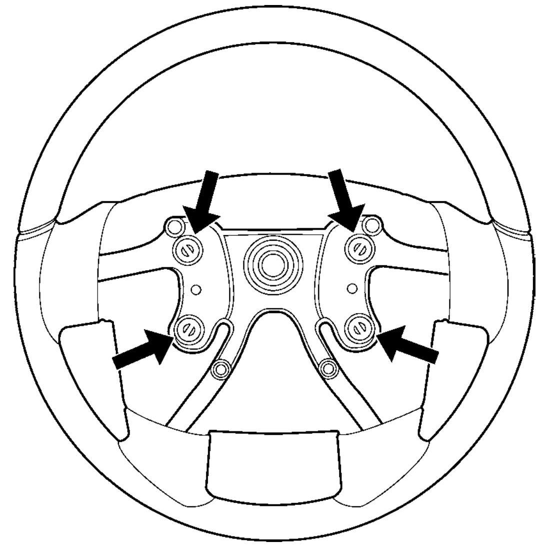


RTW73BSH000201

11. Align each snap stud of driver air bag to the holes on steering wheel (with SRS air bag).



RTW73BSH001201



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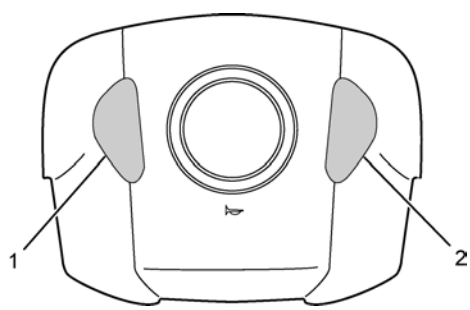
12. Push the SRS air bag at area-1 (1) and area-2 (2). At that time confirm the audible noise of each stud. (with SRS air bag)



RTW73BSH000301

13. Enable the SRS (Refer to "Enabling the SRS" in this section) (with SRS air bag).
14. Install driver knee bolster (reinforcement).
15. Install instrument panel lower cover, then install the engine hood opening lever.
16. Connect the yellow 2-way SRS connector located under the steering column (with SRS air bag).
17. Connect the battery "-" terminal cable (with SRS air bag).

System Inspection (with SRS air bag)

Turn the ignition switch to "ON" while watching warning light.

The light should flash 7 times and then go off. If lamp does not operate correctly, refer to Restraints section.

Engine Block Left-hand Side

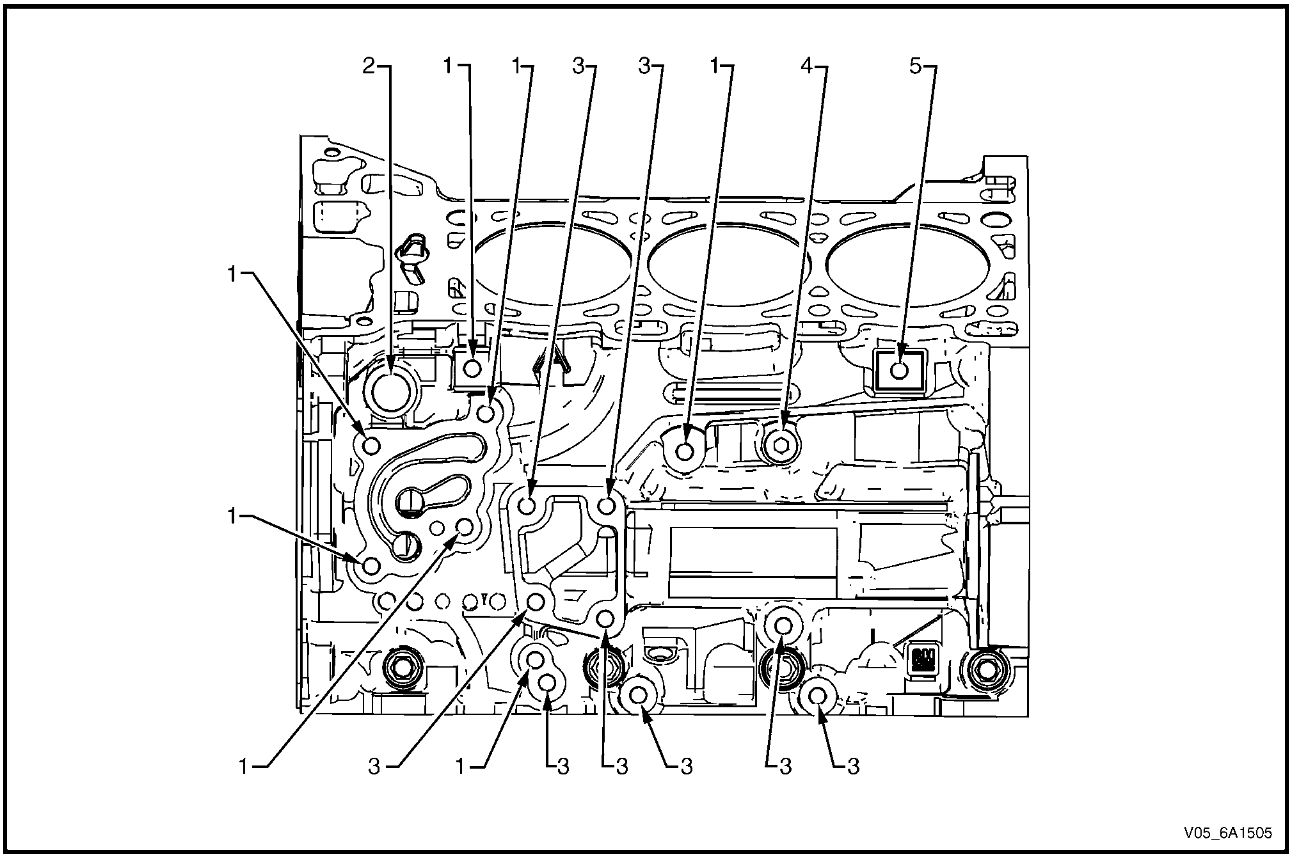


Figure 6A1 – 615

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M20 x 1.5	715	716	717	718	719	30.0	20.0
3	M10 x 1.5	211	212	213	215	205	33.5	27.0
4	M14 x 1.5	409	410	411	735	719	Thru	15.0
5	M8 x 1.25	206	207	208	415	415	16.5	11.0

Engine Block Right-hand Side

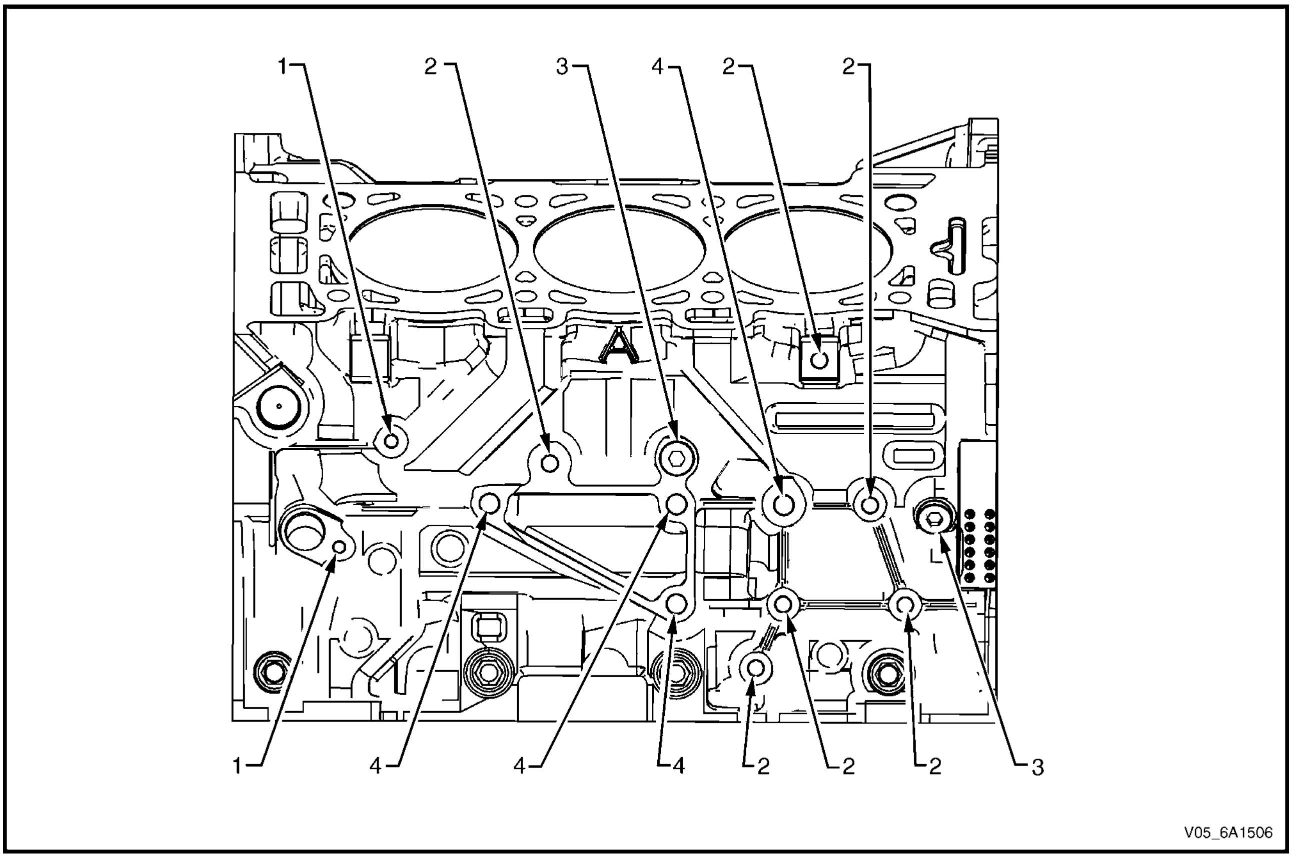


Figure 6A1 – 616

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	22.5	18.0
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M14 x 1.5	409	410	411	412	735	Thru	15.0
4	M10 x 1.5	211	212	213	214	215	33.5	27.0

Engine Block Rear

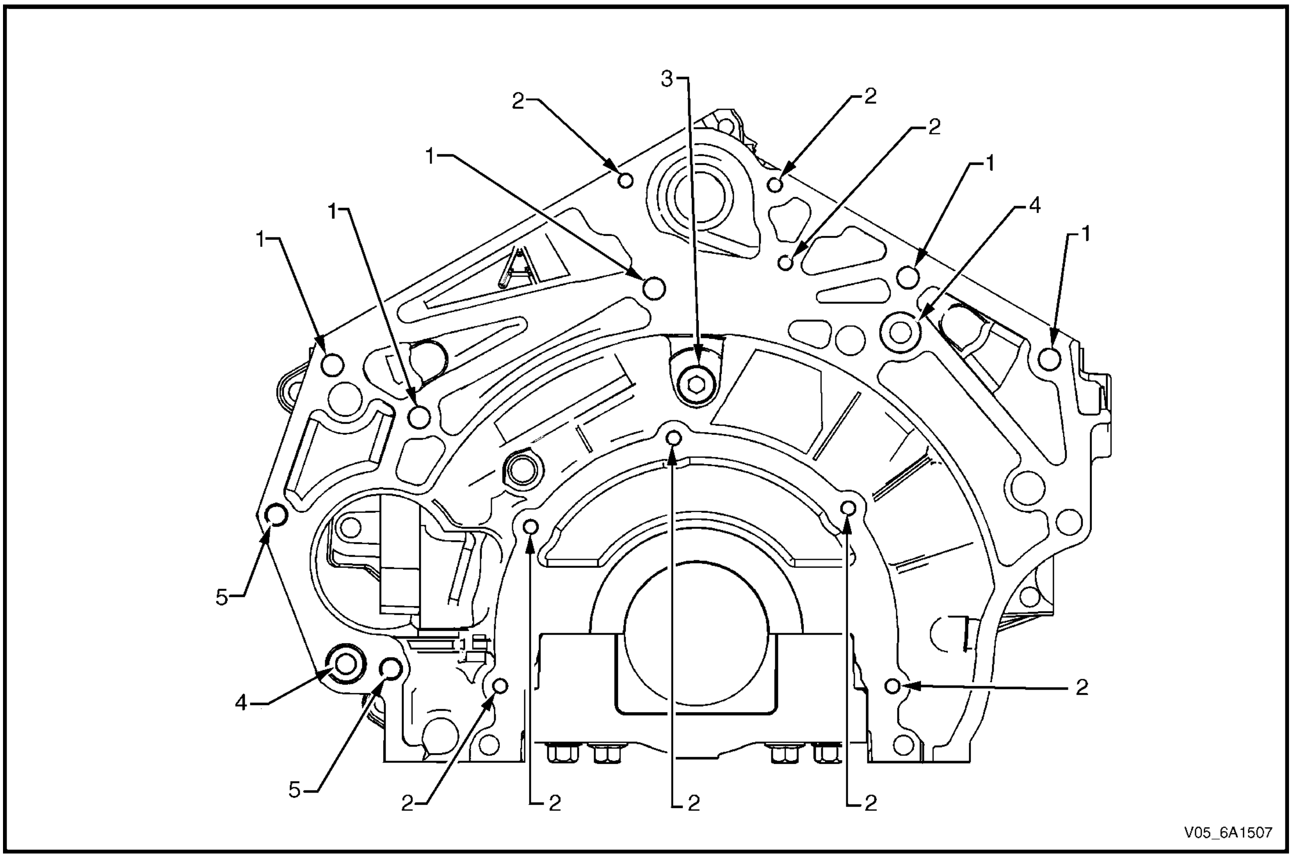


Figure 6A1 – 617

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	420	33.5	27.0
2	M6 x 1.0	201	202	203	204	205	22.5	18.0
3	M14 x 1.5	409	410	411	412	735	Thru	15.0
4	M10 x 1.5	211	212	213	214	216	39.5	33.0
5	M10 x 1.5	211	212	213	214	420	Thru	Thru

Engine Block Bottom

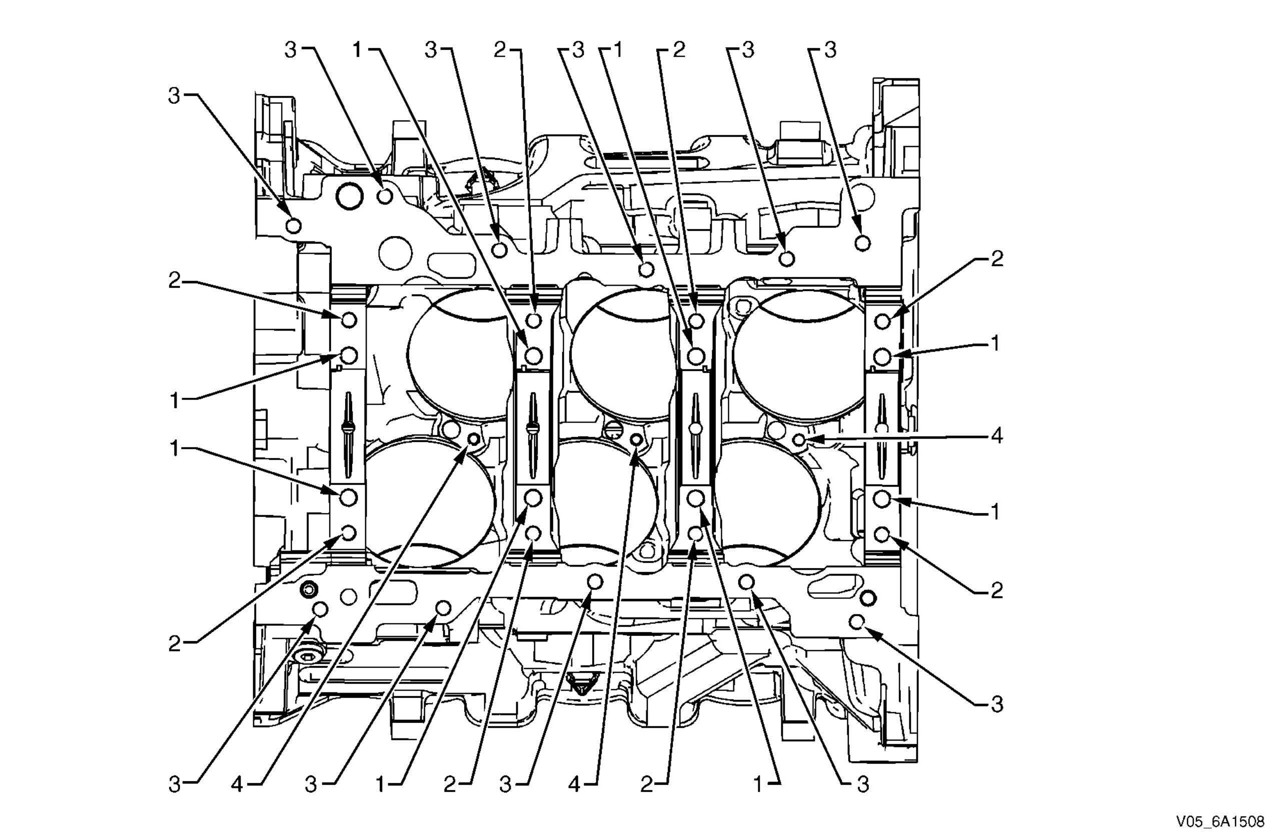


Figure 6A1 – 618

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 2.0	720	n/a	721	722	104	56.0	49.0
2	M8 x 1.25	702	n/a	703	704	620	46.0	40.5
3	M8 x 1.25	206	207	208	209	210	28.5	23.0
4	M6 x 1.0	201	202	203	204	205	Thru	Thru

Engine Block Left-hand Deck Face

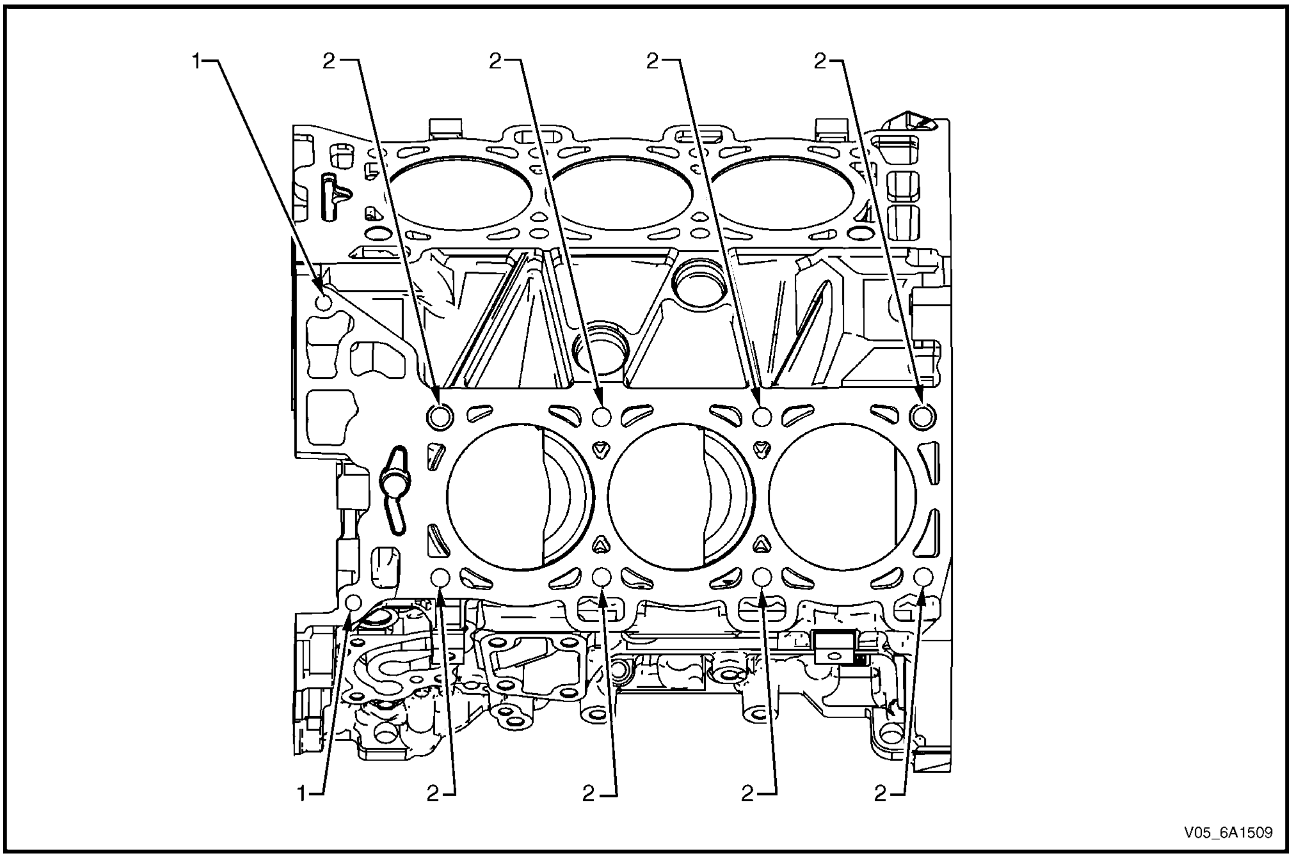


Figure 6A1 – 619

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M8 x 1.25	206	207	208	209	210	28.5	23.0
2	M11 x 2.0	723	n/a	724	725	108	102.5	94.0

Engine Block Right-hand Deck Face

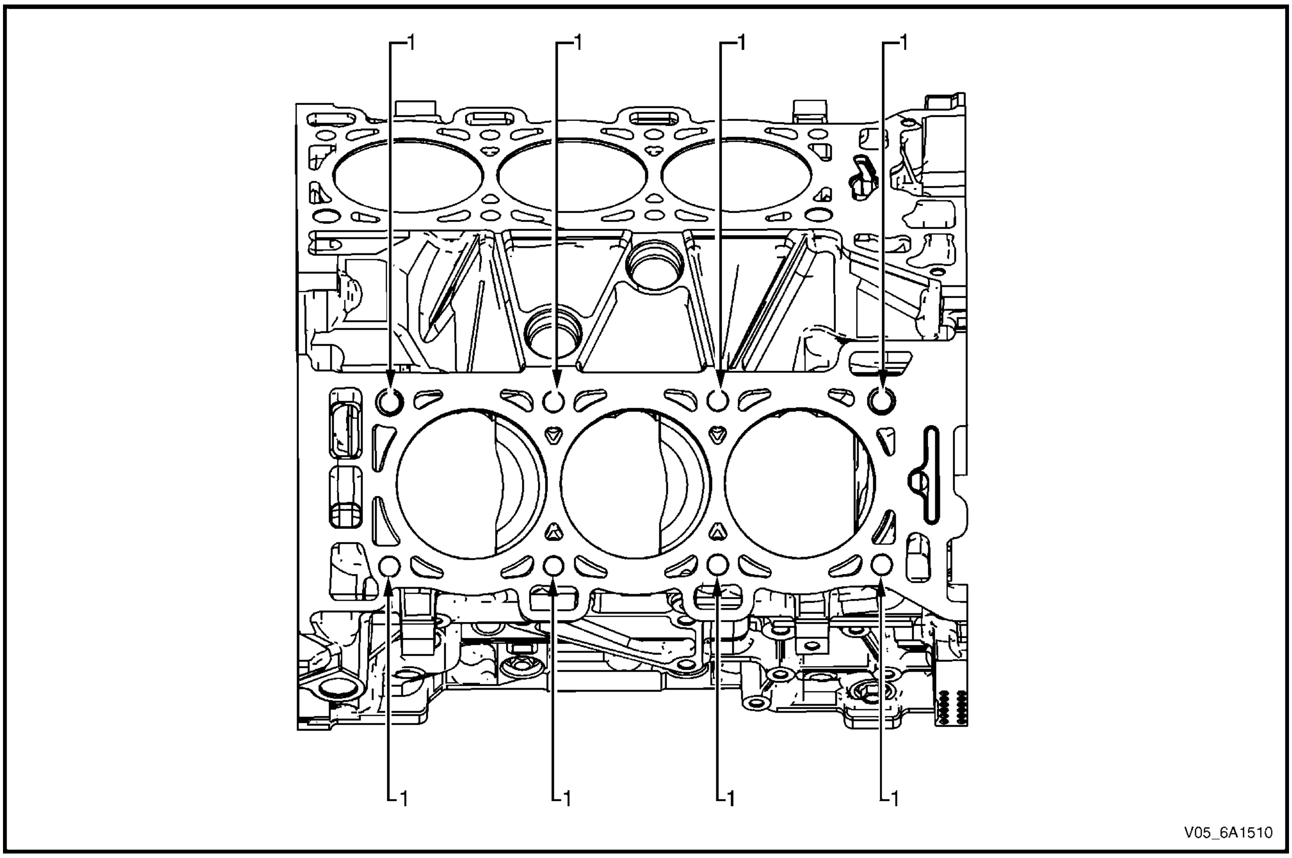


Figure 6A1 – 620

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M11 x 2.0	723	n/a	724	725	108	102.5	94.0

Engine Front Cover

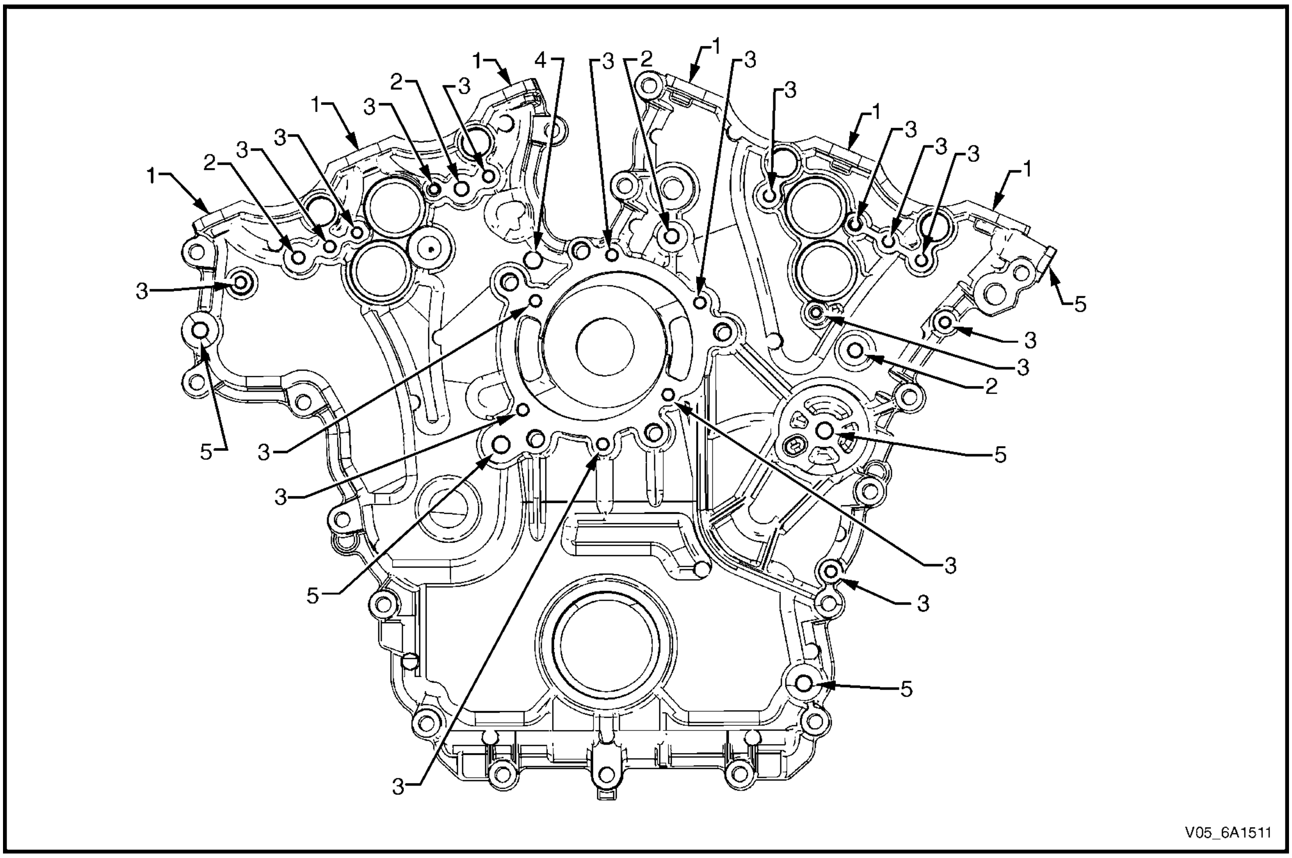


Figure 6A1 – 621

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M6 x 1.0	201	202	203	204	205	21.5	18.0
4	M10 x 1.5	211	212	213	214	215	Thru	Thru
5	M10 x 1.5	211	212	213	214	420	32.5	27.0

Upper Intake Manifold Top

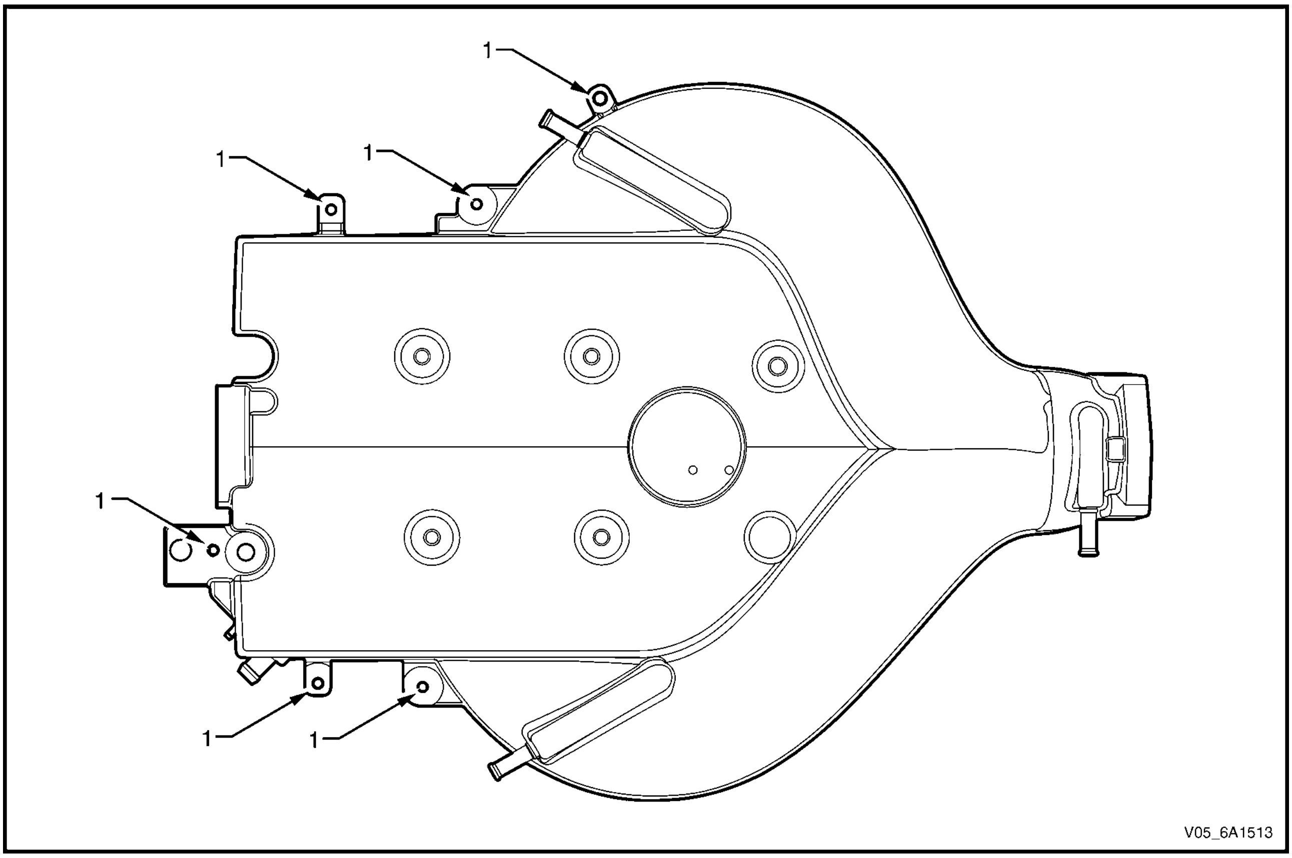


Figure 6A1 – 622

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Upper Intake Manifold Front

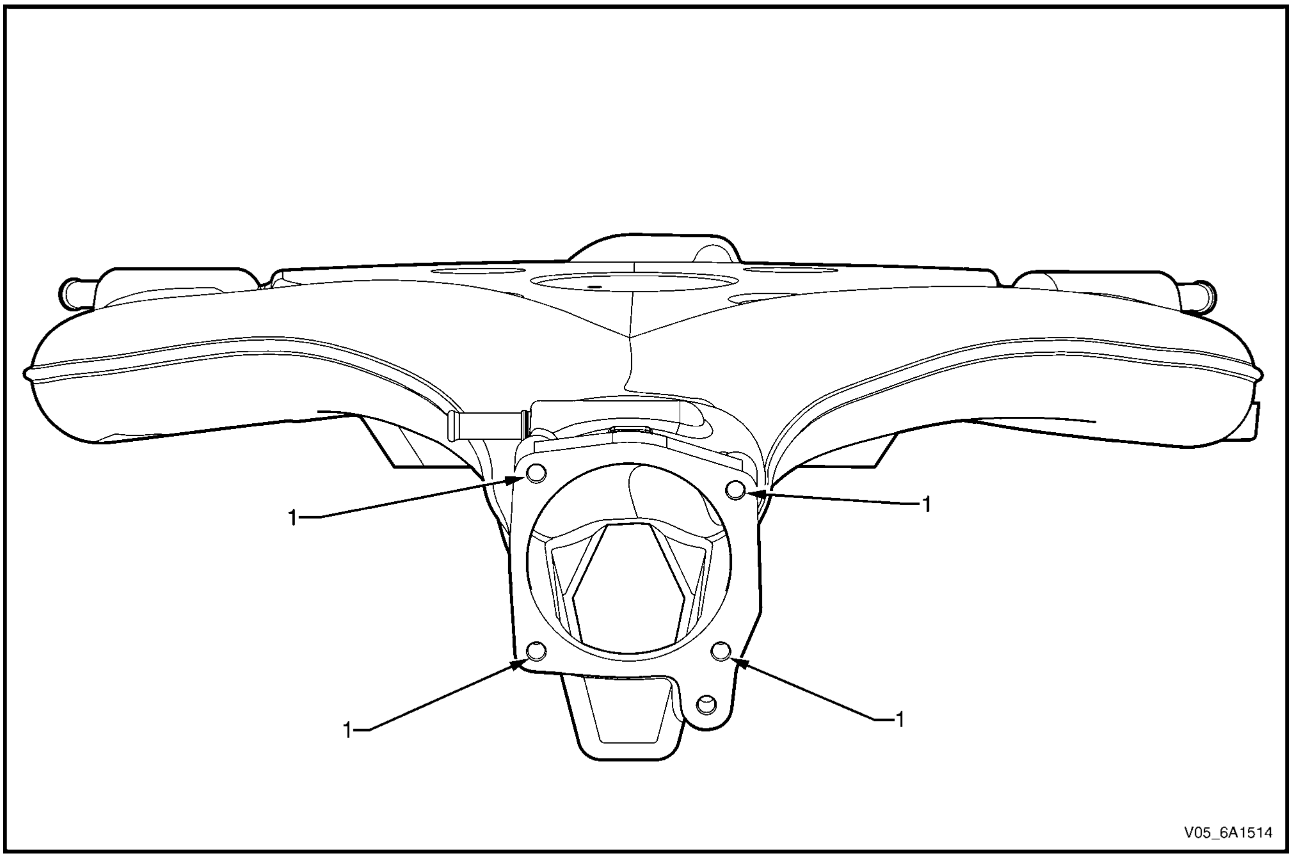


Figure 6A1 – 623

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Upper Intake Manifold Rear

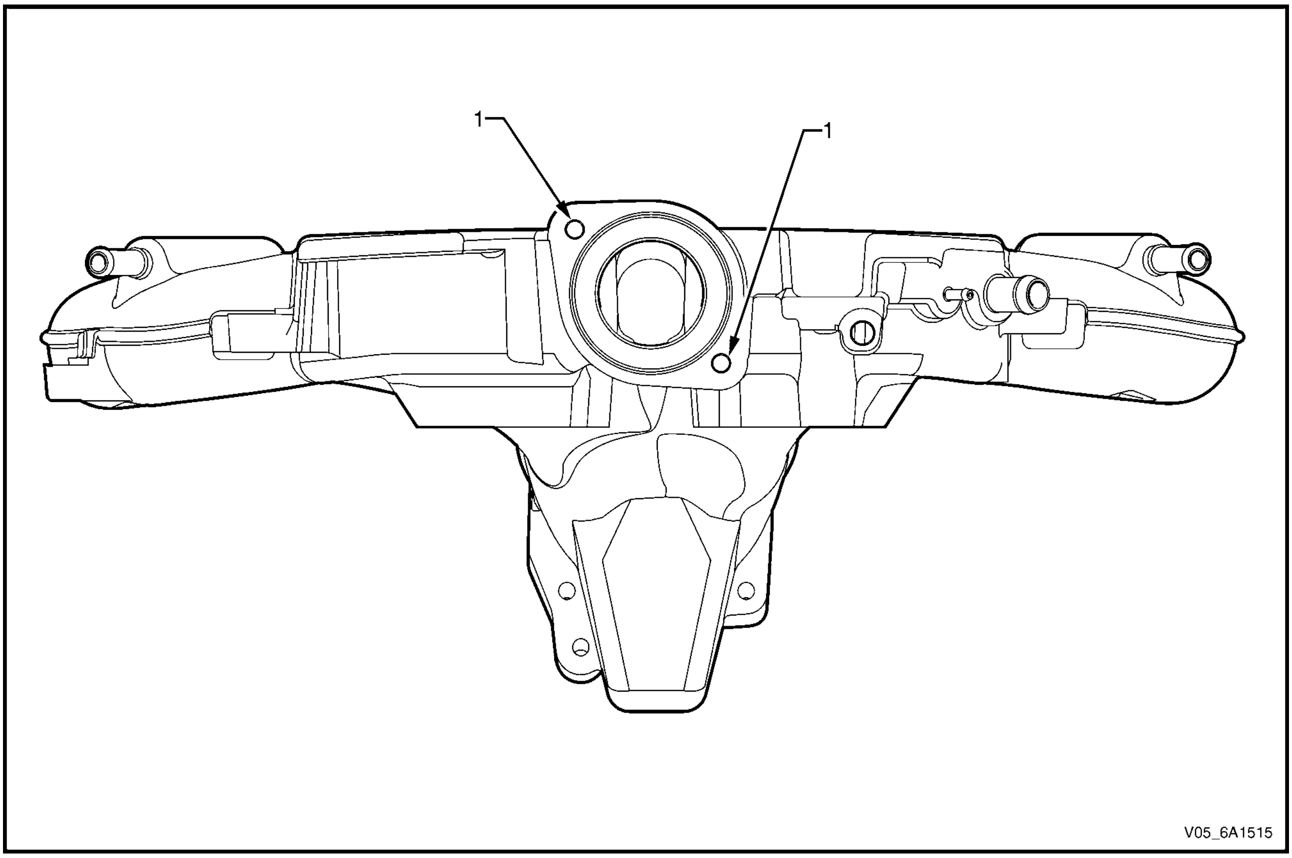


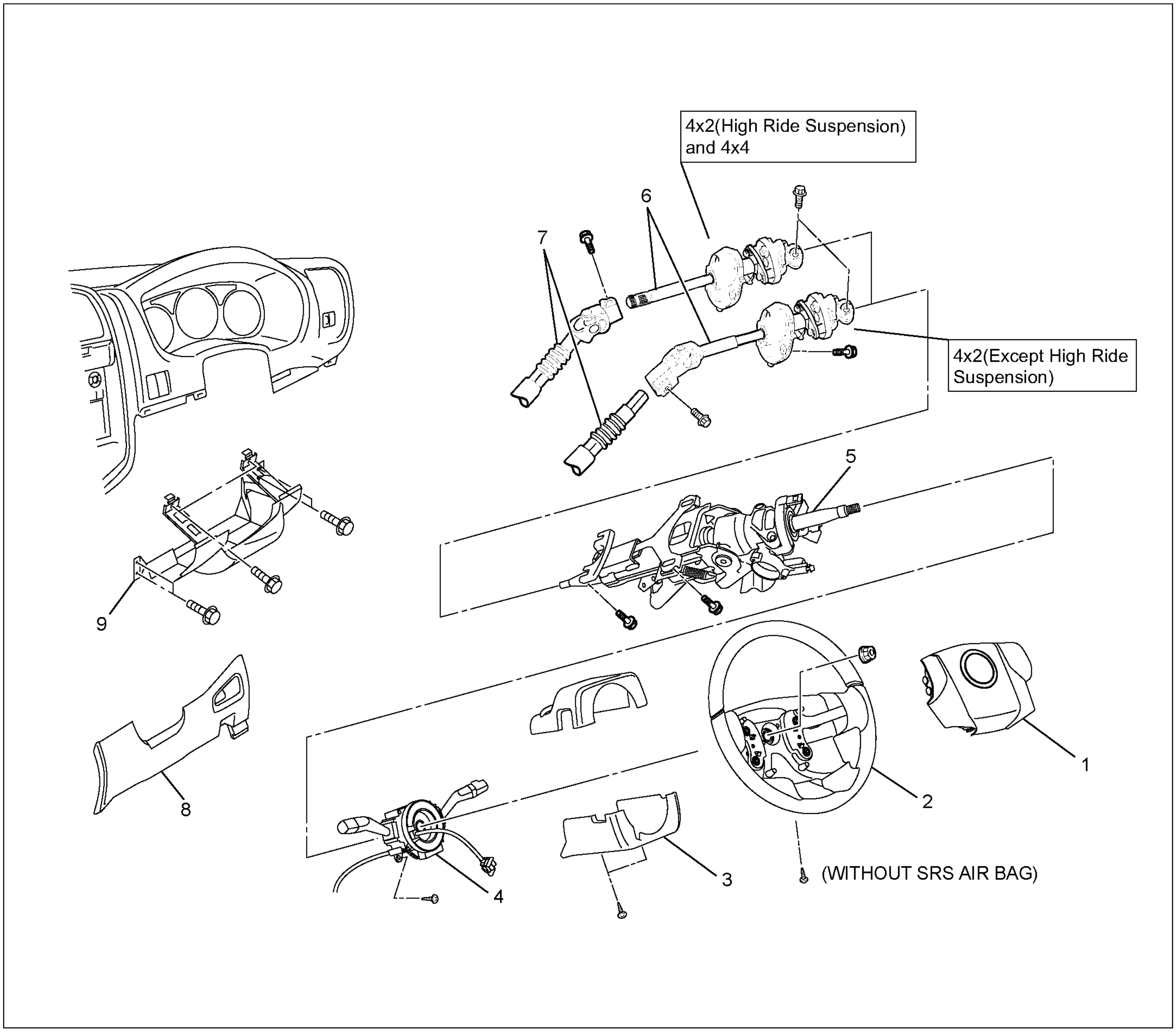
Figure 6A1 – 624

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru

Steering Column

Steering Column and Associated Parts



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Legend

(1) Inflator Module or Horn Pad
(2) Steering Wheel
(3) Steering Column Cover
(4) Combination Switch and SRS Coil Assembly
(5) Steering Column Assembly
(6) Second Steering Shaft
(7) Lower Second Steering Shaft
(8) Instrument Panel Lower Cover
(9) Driver Knee Bolster (reinforcement)

Removal

1. Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
2. Turn the ignition switch to "LOCK".
3. Disconnect the battery "-" terminal cable, and wait at least 5 minutes. (with SRS air bag)
4. Disconnect the yellow 2-way SRS connector located under the steering column. (with SRS air bag)

Lower Intake Manifold Top

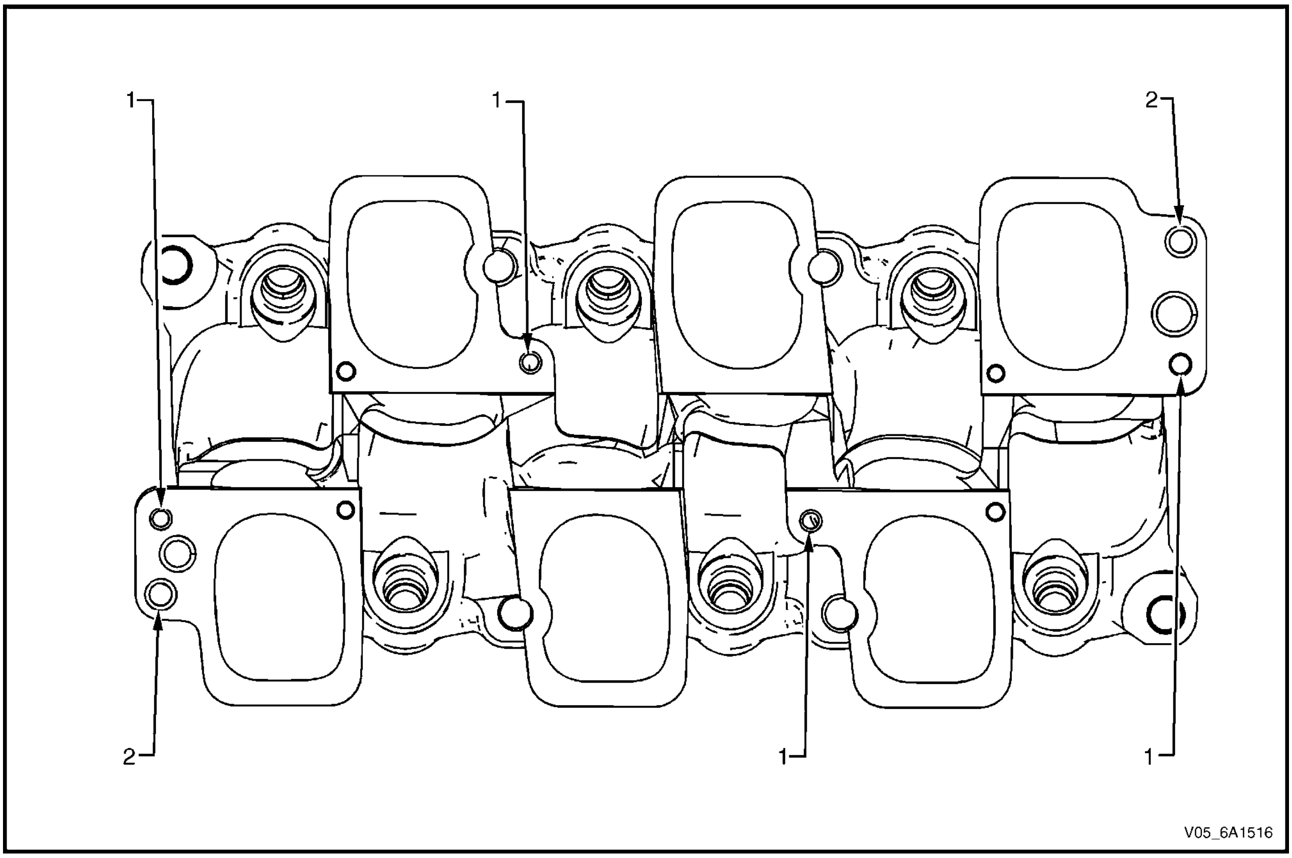


Figure 6A1 – 625

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	201	202	203	204	205	Thru	Thru
2	M8 x 1.25	206	207	208	209	210	Thru	Thru

Oil Pan Front

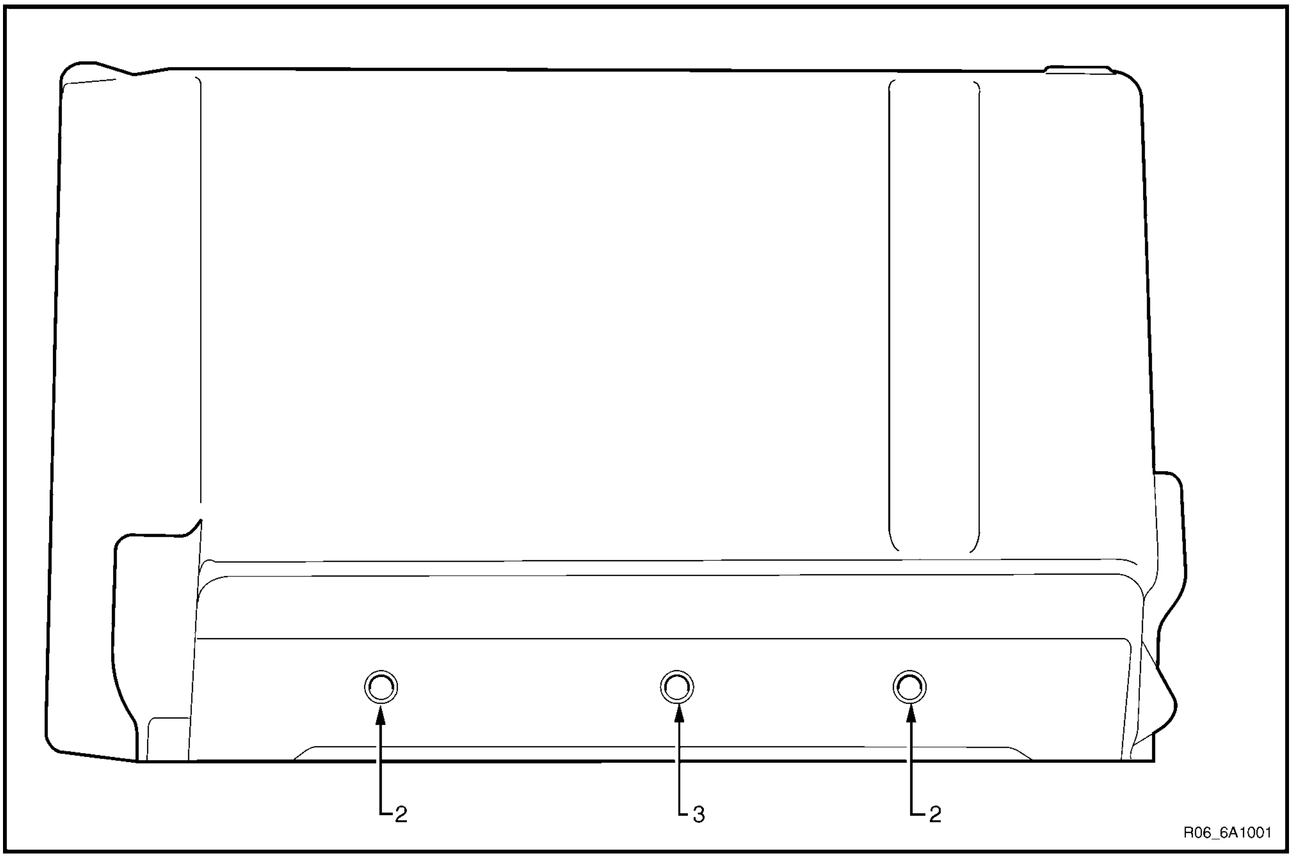


Figure 6A1 – 626

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
2	M8 x 1.25	206	207	208	209	210	28.5	23.0
3	M8 x 1.25	610	n/a	208	209	620	37.5	32.0

Oil Pan Rear

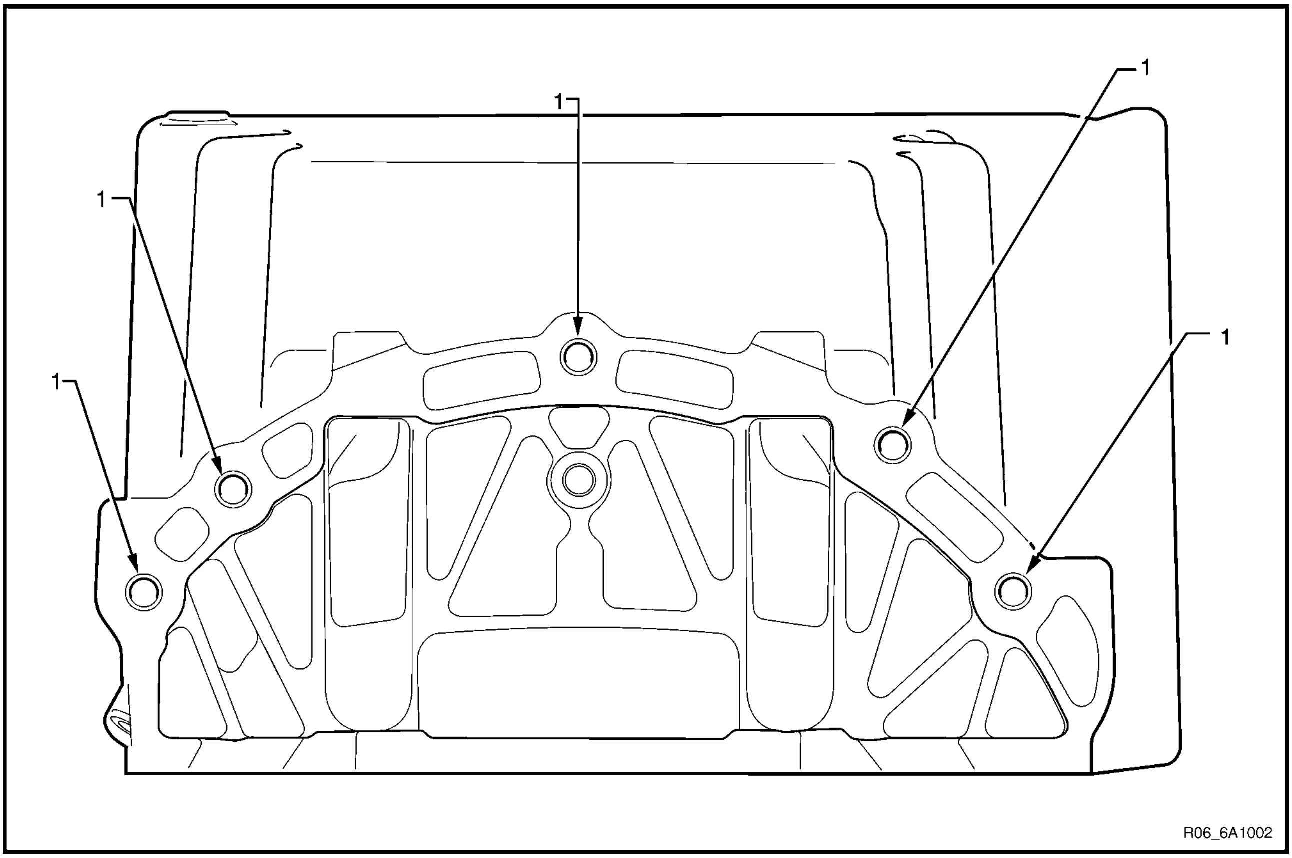


Figure 6A1 – 627

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M10 x 1.5	211	212	213	214	215	Thru	Thru

Oil Pan Bottom

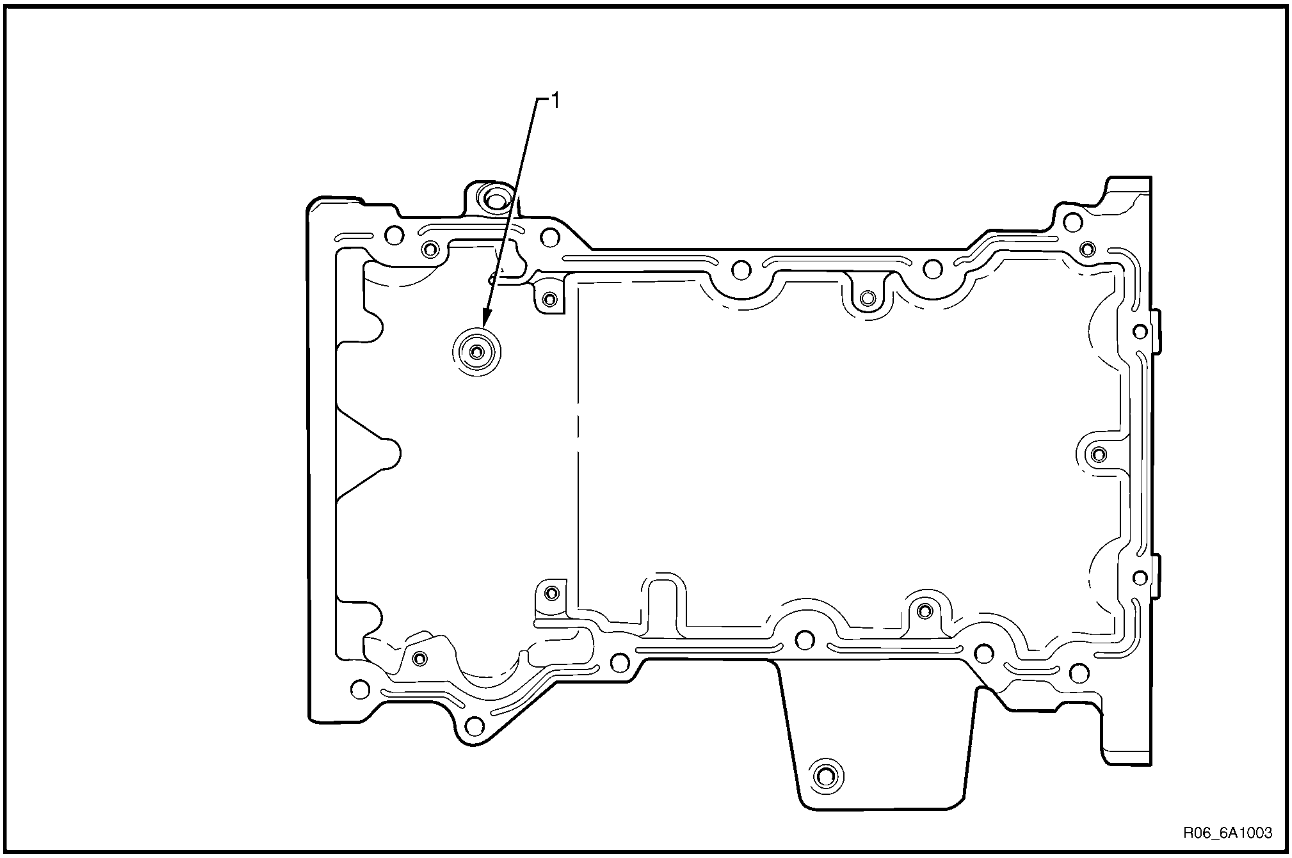


Figure 6A1 – 628

Legend

Hole		Tool Number J 42385					Max. Depth in mm	
Number	**Thread Size**	**Drill**	**Counter-bore**	**Tap**	**Driver**	**Insert**	**Drill**	**Tap**
1	M6 x 1.0	701	n/a	203	204	205	22.5	18.0

5 Specifications

General

Engine Type V6
Bank Angle .... 60°
Displacement .... 3.6 litre (3,565 cm3)
Bore .... 94 mm
Stroke .... 85.6 mm
Compression Ratio 10.2:1
Cranking Speed at 40°C .... 80 r.p.m.
Spark Plug Gap .... 1.1 mm
Firing Order 1-2-3-4-5-6

Cylinder Block

Cylinder Bore Diameter .... 93.992 – 94.008 mm
Cylinder Out-of-Round – Production Maximum .... 0.013 mm
Crankshaft Main bearing bore Diameter .... 72.867 – 72.881 mm
Cylinder Head Deck Surface Flatness .... 0.05 mm

Crankshaft

Connecting Rod Journal Diameter .... 55.992 – 56.008 mm
Connecting Rod Journal Out-of-Round .... 0.005 mm
Connecting Rod Journal Taper .... .0.005 mm
Connecting Rod Journal Width (Production) .... 22.000 mm
Connecting Rod Journal Width (Service limit) .... 21.920 – 22.080 mm
Crankshaft End Play .... 0.100 – 0.330 mm
Crankshaft Main Bearing Clearance .... 0.010 – 0.060 mm
Crankshaft Main Journal Diameter .... .67.992 – 68.008 mm
Crankshaft Main Journal Out-of-Round .... 0.005 mm
Crankshaft Main Journal Taper .... .0.005 mm
Crankshaft Main Journal Width, #2, 4 (Production) .... 24 mm
Crankshaft Main Journal Width, #2, 4 (Service) .... 23.900 – 24.100 mm
Crankshaft Main Journal Width, #3 (Production) .... 24.400 mm
Crankshaft Main Journal Width, #3 (Service) .... 24.360 – 24.440 mm
Crankshaft Main Journal Thrust Wall Runout .... 0.000 – 0.040 mm
Crankshaft Main Journal Thrust Wall Square .... 0.000 – 0.010 mm
Crankshaft Rear Flange Runout .... 0.025 mm
Crankshaft Reluctor Ring Runout - Maximum .... 1.500 mm
Crankshaft Thrust Bearing Clearance .... 0.076 – 0.305 mm
Crankshaft Thrust Surface Runout .... 0.040 mm
Crankshaft Thrust Surface – Height Diameter .... 95.000 mm

Connecting Rod

Connecting Rod Length - Bore Centre-to-Centre .... 150.400 mm
Connecting Rod Bore Diameter - Bearing End .... 59.620 – 59.636 mm
Connecting Rod Bore Diameter - Pin End .... 24.007 – 24.021 mm
Connecting Rod Width .... 21.775 mm
Connecting Rod Side Clearance .... 0.095 – 0.355 mm
Connecting Rod Bearing Clearance .... 0.010 – 0.070 mm

Piston

Piston Diameter	93.956 – 93.974 mm
Piston Pin Bore Diameter	24.005 – 24.009 mm
Piston Ring Groove Width - First (Top) Compression Ring	1.220 – 1.240 mm
Piston Ring Groove Width - Second Compression Ring	1.510 – 1.530 mm
Piston Ring Groove Width - Oil Control Ring	2.510 – 2.530 mm
Piston to Bore Clearance	0.026 – 0.052 mm

Piston Pin

Piston Pin Diameter	23.997 - 24.000 mm
Piston Pin Length	60.600 – 61.100 mm
Piston Pin Clearance to Connecting Rod Bore	0.007 – 0.024mm
Piston Pin Clearance to Piston Pin Bore	0.004 – 0.012mm

Piston Rings

Piston Ring to Groove Clearance:

• First (Top) Compression Ring	0.030 – 0.065 mm
• Second Compression Ring	0.015 – 0.060 mm
• Oil Control Ring	0.030 – 0.170 mm

Piston Ring End Gap:

• First (Top) Compression Ring	0.150 – 0.300 mm
• Second Compression Ring	0.280 – 0.480 mm
• Oil Control Ring	0.150 – 0.600 mm

Cylinder Head

Combustion Chamber Volume	53.600 cc
Valve Guide Bore Diameter – Intake	6.000 – 6.020 mm
Valve Guide Bore Diameter – Exhaust	6.000 – 6.020 mm
Valve Guide Installed Height	14.050 – 14.550 mm
Stationary Hydraulic Lash Adjuster (SHLA) Bore Diameter	12.008 – 12.030 mm
Valve Seat Angle – Seating Surface	45°
Valve Seat Angle – Relief Surface	30°
Valve Seat Angle – Undercut Surface	60°
Valve Seat Runout – Maximum	0.050 mm
Valve Seat Width – Exhaust Seating Surface	1.400 – 1.800 mm
Valve Seat Width – Exhaust Relief Surface	0.700 – 0.900 mm
Valve Seat Width – Intake Seating Surface	1.000 – 1.400 mm
Valve Seat Width – Intake Relief Surface	0.500 – 0.700 mm
Engine Block Deck Surface Flatness	0.05 mm
Exhaust Manifold Deck Surface Flatness	0.25 mm
Intake Manifold Deck Surface Flatness	0.05 mm

Valve System

Face Angle	44.25°
Face Runout	0.038 mm
Valve Face Width – Exhaust	2.750 mm
Valve Face Width – Intake	2.180 mm
Valve Head Diameter – Exhaust	30.470 – 30.730 mm
Valve Head Diameter – Intake	36.830 – 37.090 mm
Valve Installed Height	35.26 – 36.69 mm
Valve Length – Exhaust	97.110 mm
Valve Length – Intake	101.230 mm
Valve Stem Diameter (standard)	5.955 – 5.975 mm
Valve Stem Diameter (oversize)	6.013 – 6.033 mm
Valve Stem to Guide Clearance	0.025 – 0.065 mm

Hydraulic Lash Adjuster Diameter .... 11.986 – 12.000 mm
Hydraulic Lash Adjuster to Bore Clearance .... 0.037 – 0.041 mm
Rocker Arm/Camshaft Follower Ratio 1.68:1
Rocker Arm/Camshaft Follower Roller Diameter .... 17.740 – 17.800 mm
Valve Spring Free Length .... 42.500 – 45.500 mm
Valve Spring Installed Height – Closed .... 35.000 mm
Valve Spring Installed Height – Open .... 24.000 mm
Valve Spring Load – Closed .... 247 – 273 N
Valve Spring Load – Open .... 598 – 662 N
Valve Spring Diameter – Inside Top .... 12.200 – 12.700 mm
Valve Spring Diameter – Outside Top .... 18.000 – 20.500 mm
Valve Spring Diameter – Inside Bottom .... 17.950 – 18.450 mm
Valve Spring Diameter – Outside Bottom .... 26.000 mm
Valve Spring Coil Thickness .... 3.250 – 3.900 mm
Valve Spring Total Number of Coils 7.1

Camshaft

Camshaft Bearing Inside Diameter – Front Number 1 .... 35.000 – 35.020 mm
Camshaft Bearing Inside Diameter – Middle & Rear Number 2 - 4 .... 27.000 – 27.020 mm
Camshaft End Play .... 0.045 – 0.215 mm
Camshaft Journal Diameter – Front Number 1 .... 34.936 – 34.960 mm
Camshaft Journal Diameter – Middle & Rear Number 2 - 4 .... 26.936 – 26.960 mm
Camshaft Journal Out-of-round .... 0.006 mm
Camshaft Journal to Bore Clearance .... 0.040 – 0.084 mm
Camshaft Runout – Front & Rear Number 1 and 4 .... 0.025 mm
Camshaft Runout – Middle Number 2 and 3 .... 0.050 mm
Camshaft Lobe Duration – Exhaust (@ 0.150 mm Lift) .... 238°
Camshaft Lobe Duration – Intake (@ 0.150 mm Lift) .... 237°
Camshaft Lobe Height – Exhaust .... 6.6 mm
Camshaft Lobe Height – Intake .... 6.5 mm
Camshaft Lobe Overlap (@ 0.150 mm Lift) .... -5° (no overlap)
Valve Opens – Exhaust .... 229° BTDC
Valve Opens – Intake .... 14° ATDC
Centre-line – Exhaust .... 111° BTDC
Centre-line – Intake .... 132° ATDC
Valve Closes – Exhaust .... 9° ATDC
Valve Closes – Intake .... 252° ATDC
Valve Lift – Exhaust .... 10.8 mm
Valve Lift – Intake .... 10.8 mm

Oil Pump

Type .... Gerotor
Gear Diameter – Outer .... 87.095 – 87.175 mm
Gear Bore Depth .... 15.565 – 15.600 mm
Gear Bore Diameter .... 87.275 – 87.325 mm
Gear Thickness .... 15.511 – 15.536 mm
Gear to Cover Clearance .... 0.030 – 0.085 mm
Gear to Housing Clearance .... 0.100 – 0.230 mm
Inner Gear Tip Clearance .... 0.075 – 0.180 mm
Crankshaft Clearance to Housing .... 0.040 – 0.130 mm
Inner Gerotor Hub Diameter .... 53.310 – 53.335 mm
Housing Hub Diameter .... 53.380 – 53.420 mm
Inner Gerotor Hub Clearance to Housing .... 0.045 – 0.110 mm

Lubrication System

Oil Type	SAE 5W30
Oil Capacity – with Filter	6.5 L
Oil Pressure – Minimum at idle	69 kPa
Oil Pressure – Minimum at 2000 r.p.m.	138 kPa
Piston Cooling Jet Valve Opening Pressure	170 – 230 kPa

6 Torque Wrench Specifications

ATTENTION

- ■ **Fasteners must be replaced after loosening.**
- ♦ **Fasteners either have micro encapsulated sealant applied or incorporate a mechanical thread lock and should only be re-used once. If in doubt, replacement is recommended.**

Oil Pan Drain Plug .... 25.0 Nm
Oil Filter Adaptor Attaching Bolt .... 20.0 – 26.0 Nm
Oil Level Indicator Tube Attaching Bolt .... 8.0 – 12.0 Nm
Accessory Drive Belt Idler Pulley Attaching Bolt .... 50.0 Nm
Accessory Drive Belt Tensioner Attaching Bolt .... 50.0 Nm
Power Steering Reservoir Bracket Attaching Screw .... 9.0 Nm
Power Steering Pump Bracket Attaching Bolt .... 49.0 – 67.0 Nm
Upper Intake Manifold to Lower Intake Manifold Attaching Bolt .... 23.0 Nm
Upper Intake Manifold to Cylinder Head Attaching Bolt .... 23.0 Nm
Lower Intake Manifold to Cylinder Head Attaching Bolt .... 23.0 Nm
Fuel Injector Wiring Harness Bracket Attaching bolt .... 9.0 Nm
Exhaust Manifold to Cylinder Head Attaching Bolt .... 17.0 - 23.0 Nm
Exhaust Manifold Heat Shield Attaching Bolt .... 8.0 - 12.0 Nm
Battery Harness Ground Terminal Attaching Nut .... 13.0 Nm
Camshaft Cover Attaching Bolt .... 8.0 – 12.0 Nm
Engine Ground Connector Bolt .... 10.0 Nm
Engine Wiring Harness Former Attaching Bolt .... 12.0 – 16.0 Nm
■ ♦ Crankshaft Balancer Assembly Attaching Bolt:
Stage 1 .... 90.0 –110.0 Nm
Stage 2 .... 150°
Engine Front Cover Assembly Attaching Bolt .... 20.0 – 26.0 Nm
Camshaft Intermediate Sprocket Attaching Bolt .... 58.0 – 72.0 Nm
Secondary Timing Chain Guide Attaching Bolt .... 20.0 – 26.0 Nm
Secondary Timing Chain Shoe Attaching Bolt .... 20.0 – 26.0 Nm
Secondary Timing Chain Tensioner Attaching Bolt .... 20.0 – 26.0 Nm
Primary Timing Chain Upper Guide Attaching Bolt .... 20.0 – 26.0 Nm
Primary Timing Chain Tensioner Attaching Bolt .... 20.0 – 26.0 Nm
Oil Pump Assembly Attaching Bolt .... 20.0 – 26.0 Nm
Camshaft Sprocket Attaching Bolt .... 49.0 – 67.0 Nm
Exhaust Camshaft Sprocket Attaching Bolt .... 49.0 – 67.0 Nm
Camshaft Bearing Cap Attaching Bolt .... 8.0 – 12.0 Nm
Cylinder Head Threaded Plug .... 31.0 Nm
■ Cylinder Head M11 Attaching Bolt:
Stage 1 .... 40.0 – 50.0 Nm
Stage 2 .... 120°
■ Cylinder Head M8 Attaching Bolt:
Stage 1 .... 12.0 – 18.0 Nm
Stage 2 .... 60°
Engine Mount Bracket to Cylinder Block Attaching Bolt .... 43.0 – 57.0 Nm
Engine Mount to Bracket Attaching Nut .... 70.0 – 90.0 Nm
Engine Mount to Frame Attaching Nut .... 44.0 – 60.0 Nm
Engine Lift Bracket Attaching Bolt .... 58.0 – 72.0.0 Nm
Knock Sensor Attaching Nut .... 23.0 Nm

Power Steering High Pressure Line Attaching Bolt .... 8.0 – 12.0 Nm

Power Steering High Pressure Line Flare Nut.......................... 25.0 – 35.0 Nm

Steering Gear Housing Mounting Nut:
Stage 1 .... 60.0 Nm
Stage 2 .... 40° – 50°

Oil Suction Pipe Attaching Bolt.. 10.0 Nm

Crankshaft Oil Deflector Attaching bolt... 10.0 Nm

Oil Level Sensor .... 20.0 Nm

Oil Pan to Cylinder Block Attaching Bolt.................................. 20.0 – 26.0 Nm

Oil Pan to Crankshaft Rear Oil Seal Housing Attaching Bolt........ 8.0 - 12.0 Nm

■ ♦ Flexplate Attaching Bolt:

Stage 1 .... 26.0 – 34.0 Nm

Stage 2 .... 45°

Crankshaft Rear Oil Seal Housing Attaching Bolt....................... 8.0 – 12.0 Nm

■ Connecting Rod Cap Attaching Bolt:

Stage 1 .... 30.0 Nm

Stage 2 .... Loosen Completely

Stage 3 .... 25.0 Nm

Stage 4 .... 110°

Crankshaft Bearing Cap Remover Nut .... 11.0 Nm

■ Crankshaft Main Bearing Cap Inboard Attaching Bolt:

Stage 1 .... 20.0 Nm

Stage 2 .... 80°

■ Crankshaft Main Bearing Cap Outboard Attaching Bolt:

Stage 1 .... 15.0 Nm

Stage 2 .... 110°

■ ♦ Crankshaft main Bearing Cap Side Attaching Bolt:

Stage 1 .... 30.0 Nm

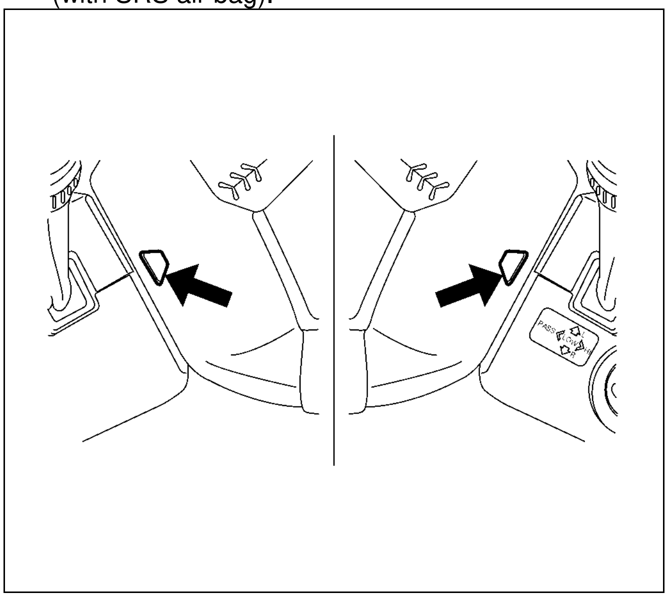
Stage 2 .... 60°

Cylinder Block Threaded Plug .... 27.0 - 35.0 Nm

Oil Jet Attaching Bolt .... 8.0 – 12.0 Nm

CAUTION: The wheel of the vehicle must be straight ahead and the steering column in the "LOCK" position before disconnecting the steering column from the steering gear. Failure to do so will cause the SRS coil assembly to lose its centering which will cause damage to the SRS coil assembly (with SRS air bag).

5. Remove the engine hood opening lever and steering lower cover.
6. Remove the driver knee bolster (reinforcement).
7. Disable the SRS (Refer to "Disabling the SRS" in this section) (with SRS air bag).
8. Check the holes on both sides of the steering cover (with SRS air bag).



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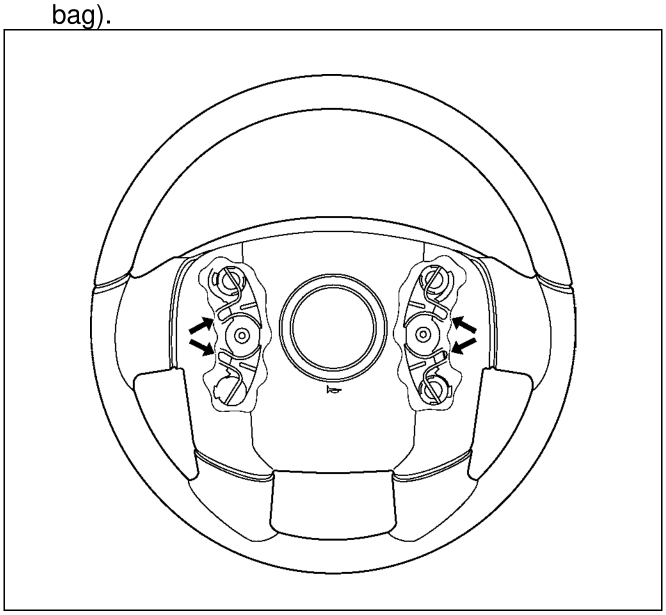
9. Check the position of the pins in thier holes. Push the pin in the direction of the arrow (with SRS air bag).



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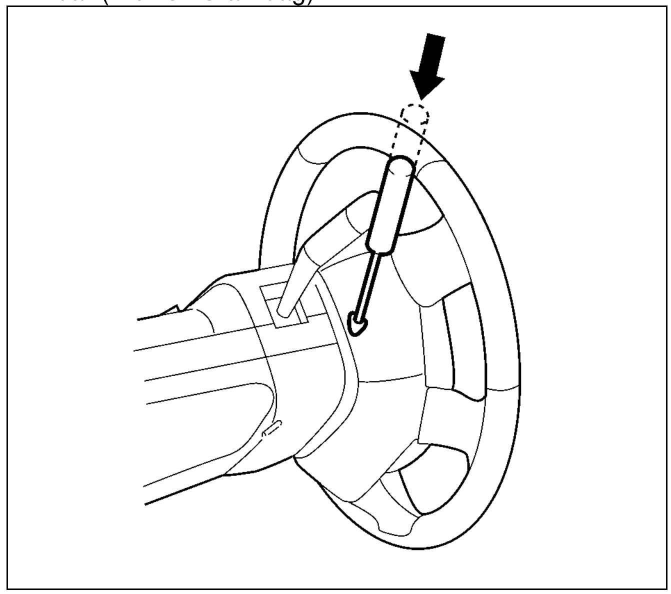
10. Push the four pins with a ϕ 5~6 mm (0.20~0.24 in) bar (with SRS air bag).



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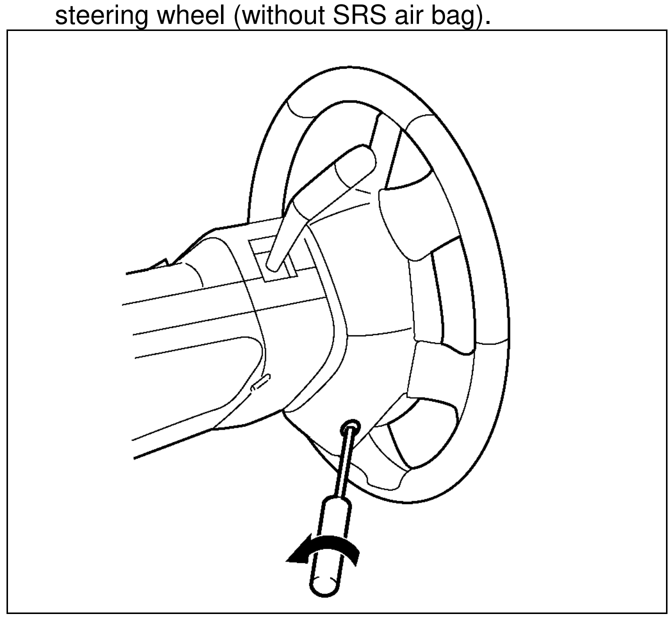
11. Cancel the lock to release the four pins (with SRS air bag).
12. Loosen the horn pad fixing screw at the rear of the steering wheel (without SRS air bag).



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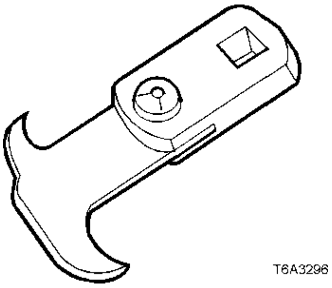
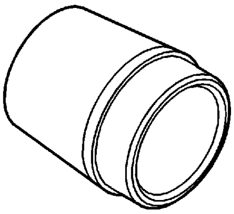
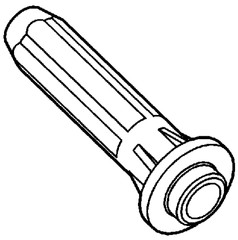
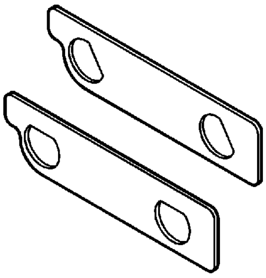
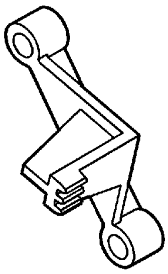
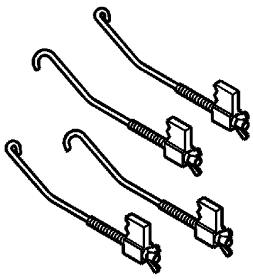
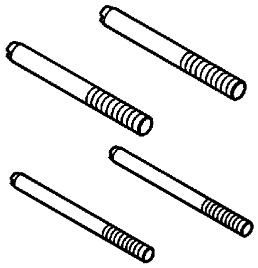
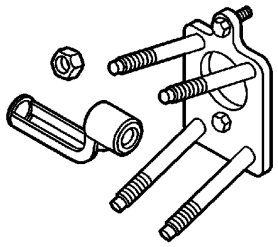
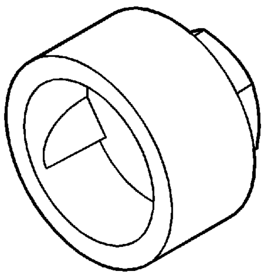
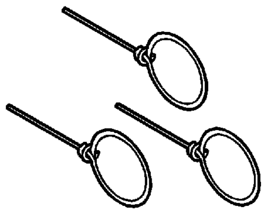
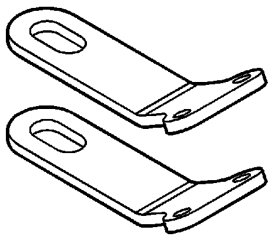
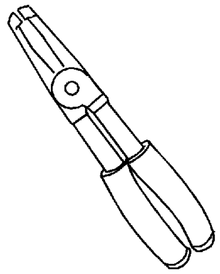
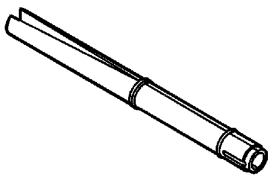
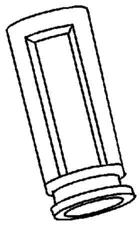
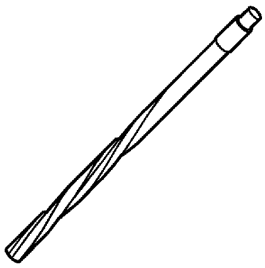
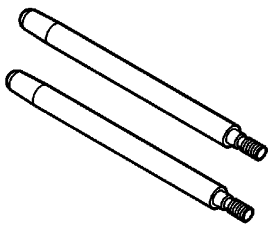
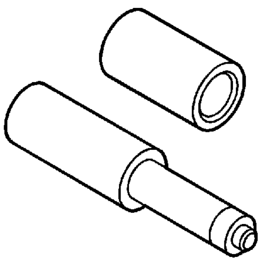
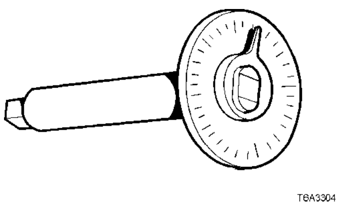
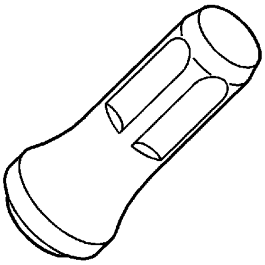
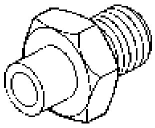
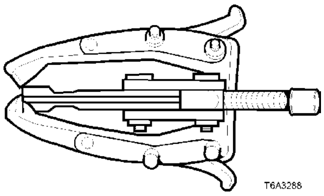
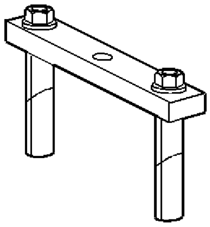
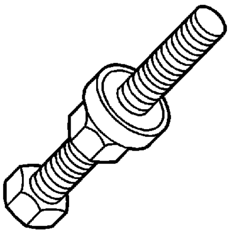
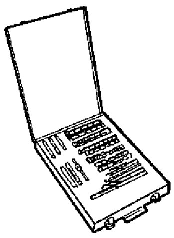
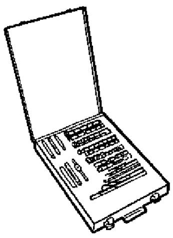
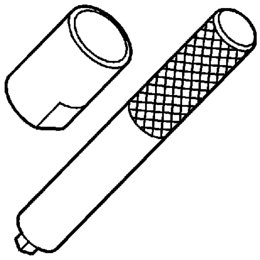
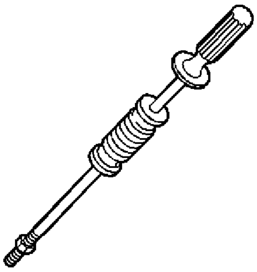
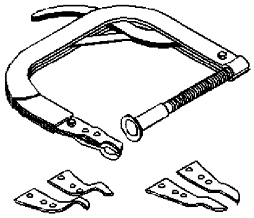
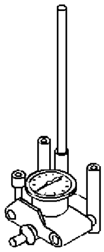
7 Special Tools

Tool Number	Illustration	Description
E-308		Seal Remover Previously released.
EN-46101		Spark Plug Tube Seal Guide Set Used to protect the spark plug lip seals when installing the camshaft cover to the cylinder head.
EN-46103		Camshaft Actuator Valve Seal Installer Used to install the camshaft actuator valve seals into the front cover.
EN-46105 – 1 and 2		Camshaft Locking Tool Set Used to retain camshaft position during timing chain or camshaft actuator replacement.
EN-46106		Flexplate Holding Tool Used to retain crankshaft position during valve-train overhaul and harmonic balancer removal.
EN-46108		Timing Chain Retention Tool Set Used to retain timing chain tension during camshaft and sprocket removal.

Tool Number	Illustration	Description
EN-46109		Engine Front Cover / Oil Pan / Crankshaft Rear Oil Seal Housing Installation Guide Pins Used to align the engine front cover/oil pan/crankshaft rear oil seal housing during engine assembly.
EN-46110		On-vehicle Valve Spring Compressor Used to remove valve springs with the cylinder heads assembled to the cylinder block.
EN-46111		Crankshaft Rotation Socket Used to rotate the crankshaft during engine overhaul.
EN-46112		Timing Chain Tensioner Retraction Springs Used to retain the timing chain tensioner plunger within the tensioner bore during assembly of timing chains to engine.
EN-46114		Engine Lift Brackets Used in conjunction with commercially available lifting equipment to lift engine.
EN-46116		Valve Stem Seal Remover / Installer Used to remove/install the valve stem seals.

Tool Number	Illustration	Description
EN-46117		Valve Stem Key Remover / Installer Used in conjunction with J-8062 or EN-46110 to remove and reinstall the valve stem keys.
EN-46119		Off-vehicle Valve Spring Compressor Adaptor Used in conjunction with J-8062 to remove valve springs with the engine disassembled.
EN-46120 and J-42096		Valve Guide Reamer Used to oversize valve guides prior to the installation of new oversized valves.
EN-46121		Connecting Rod Guide Pin Set Used to guide connecting rods onto the crankshaft journals and prevent damage to the cylinder bores, journal faces and piston cooling jets during engine assembly procedures.
EN-46122		Oil Control Valve Check Ball Remover / Installer
EN-7115		Torque Angle Wrench Used to accurately tighten fasteners when an angle torque is required.

Tool Number	Illustration	Description
J-29184		Crankshaft Front Oil Seal Installer
J-36648-A		Oil Pressure Gauge Adaptor
j-41816		three legged puller
J-41818		Main Bearing Cap Removal Tool Used in conjunction with J-6125-1B to remove the main bearing caps from the cylinder block during engine disassembly procedures.
J-41998-B		Crankshaft Balancer Installer
J-42385-2000		Thread Insert Kit Used to repair damaged threads during engine overhaul.
J-42385-700		High Feature Thread Repair Kit Used to repair damaged threads during engine overhaul.

Tool Number	Illustration	Description
J-45027		Tensioner Tool Used to reset the timing chain tensioner plunger.
J-6125-1B		Slide Hammer Used in conjunction with J-41818 to remove the main bearing caps from the cylinder block during engine disassembly.
J-8062		Valve Spring Compressor Used in conjunction with EN-46119 to remove valve springs with the engine disassembled.
J-8087		Cylinder Bore Gauge Commercial equivalent also available
EN-48313		Timing Chain Retention Tool

MY2005 VZ
6A1
Engine Mechanical – V6

Update Number

Date	Section / Subsection Affected	Brief Change Description
22 MAY 2007	Complete Document	This C1-file replaces the previous (Holden Rodeo) C-file
	THE FOLLOWING CHANGES WERE MADE:	
	Page 4 & 5	Content page change
	Page 8, 13, 110-115, 117, 119, 122, 124, 130, 132-134, 139-151, 156-166, 171-179, 186, 187, 190, 193-201, 203, 351, 355.	Text changes
	Figure 6A1 – 100, 102, 151, 152, 171-197, 219-239, 263-285, 299, 302, 303, 306, 312-327	Graphic changes
	EN-48313	New special tool (Timing Chain Retention Tool)

TEXT COLOURS TO INDICATE SPECIFIC APPLICATION

.... Text in this colour indicates that the original text has been updated and is to replace the existing, regardless of model.

Section 6B1
Engine Cooling – V6

ATTENTION

Before performing any Service Operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

1 General Information

The cooling system for the HFV6 engine has been re-designed to accommodate this engine’s unique configuration and engine cooling performance requirements. The following list is a summary of new and modified components:

- Revised radiator assembly.
- New plumbing including radiator hoses, inlet pipe, heater pipes, heater hoses and heater water valve.
- New rear mount thermostat assembly and thermostat housing.
- New coolant outlet with pressure cap.
- New coolant specification.
- New side chutes and radiator shroud.
- Modified cooling fan operating strategy.
- A four stage cooling fan operating system is used.

The cooling fan motor is controlled by duty signal from the ECM which results in the fan operating from low speed Stage 1), up to high speed (Stage 4).

Operation of the cooling fan is dependant on the engine temperature, vehicle speed, A/C request (where fitted) and A/C system pressure. Refer to 6C1 – 1 Engine management general information.

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

1.2 Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

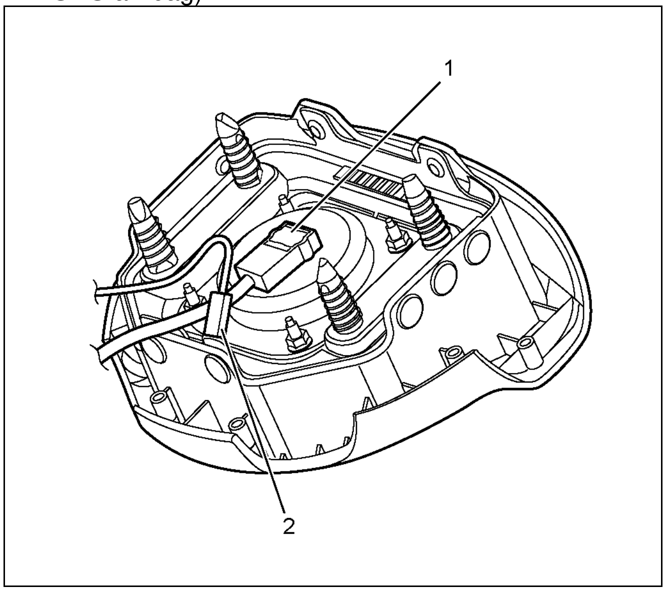
NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or

Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

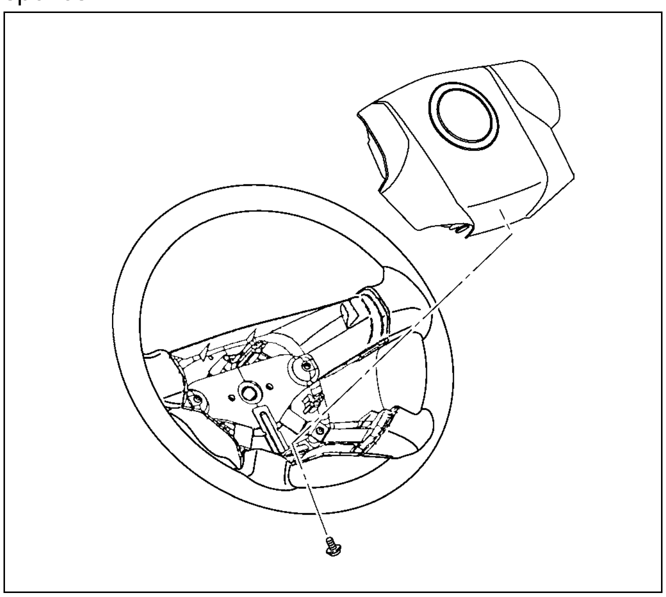
13. Disconnect the SRS air bag connector (1) and horn lead connector (2) located behind the air bag assembly and remove the air bag assembly (with SRS air bag).



RTW73BSH001101

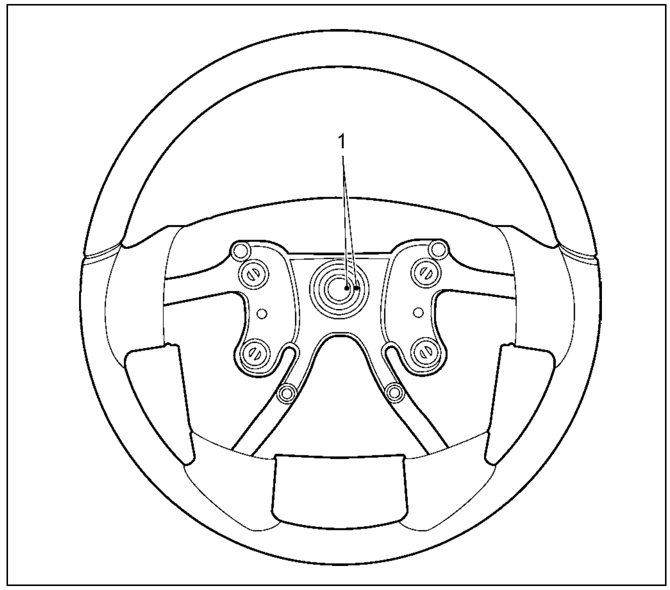
14. Remove the horn pad and the horn leads at the center of the wheel (without SRS air bag).

NOTE: It should be removed first from the bottom spokes.



RTW73BSH000601

15. Apply a setting mark (1) across the steering wheel and shaft so parts can be reassembled in their original position. Move the front wheels to the straight ahead position, then use steering wheel remover 5-8521-0016-0 (2) to remove the steering wheel.



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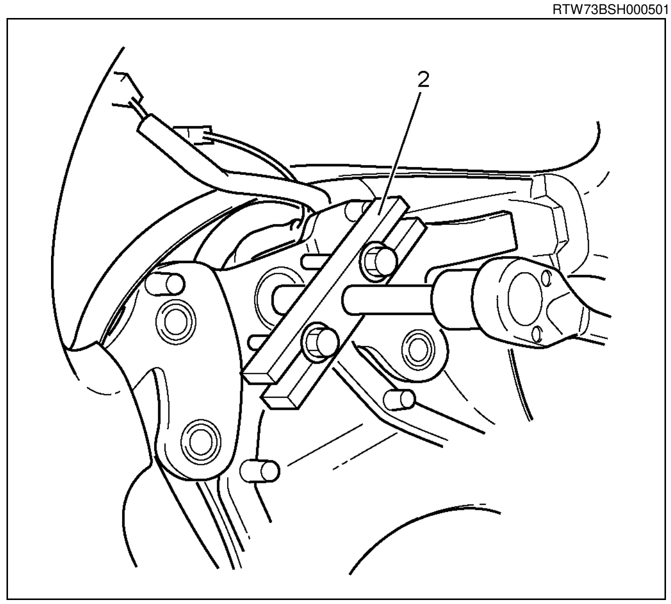


RTW73BSH001301

2 General Description

2.1 Radiator Assembly

The radiator has an aluminium core and is of the cross-flow design. Plastic side tanks are attached to the core by clinch tabs. The clinch tabs are formed as part of the core assembly.

The lower frame of the radiator assembly is attached to the vehicle frame by two bolts supported in rubber mounts, pegs are attached to the upper area of each side tank. These pegs are used to support the radiator with two rubber insert mounting brackets.

A high temperature rubber seal is used to seal the mating surface between the core and each side tank. The seal(s) must be replaced any time the side tank is removed from the core.

NOTE

The radiator core side tanks or transmission oil cooler cannot be replaced separately. If there is a fault with any of these components, the radiator assembly must be replaced. Small core repairs may be made using an aluminised silicon based liquid repair agent. Refer to 3.15 Radiator in this Section.

For vehicles with automatic transmission, a transmission oil cooler is located in the right-hand side radiator tank. The cooler pipes from and to the transmission are connected to the oil cooler flexible hoses by means of quick connect fittings.

The cooling fan motor is attached by three screws to the one-piece plastic fan shroud. In turn, the fan shroud is mounted to the rear of the radiator and is located and supported by two bolts and two locating tabs. The upper clips lock the fan shroud in place and can be released by hand to facilitate fan shroud removal. The shroud must be removed to allow fan motor and blade assembly removal.

One harness connector is mounted to the upper section of the fan shroud allowing the fan motor and blade assemblies to be removed individually from the shroud. The fan motor and blade is balanced as an assembly. These two components are serviced only as a unit and are not to be separated.

The shroud, fan assembly and transmission cooler hoses can be removed and installed individually from the vehicle. For removal and installation procedures, refer to 3.13 Cooling Fan and Shroud Assembly, 3.14 Flexible Transmission Cooler Hose and 3.15 Radiator in this Section.

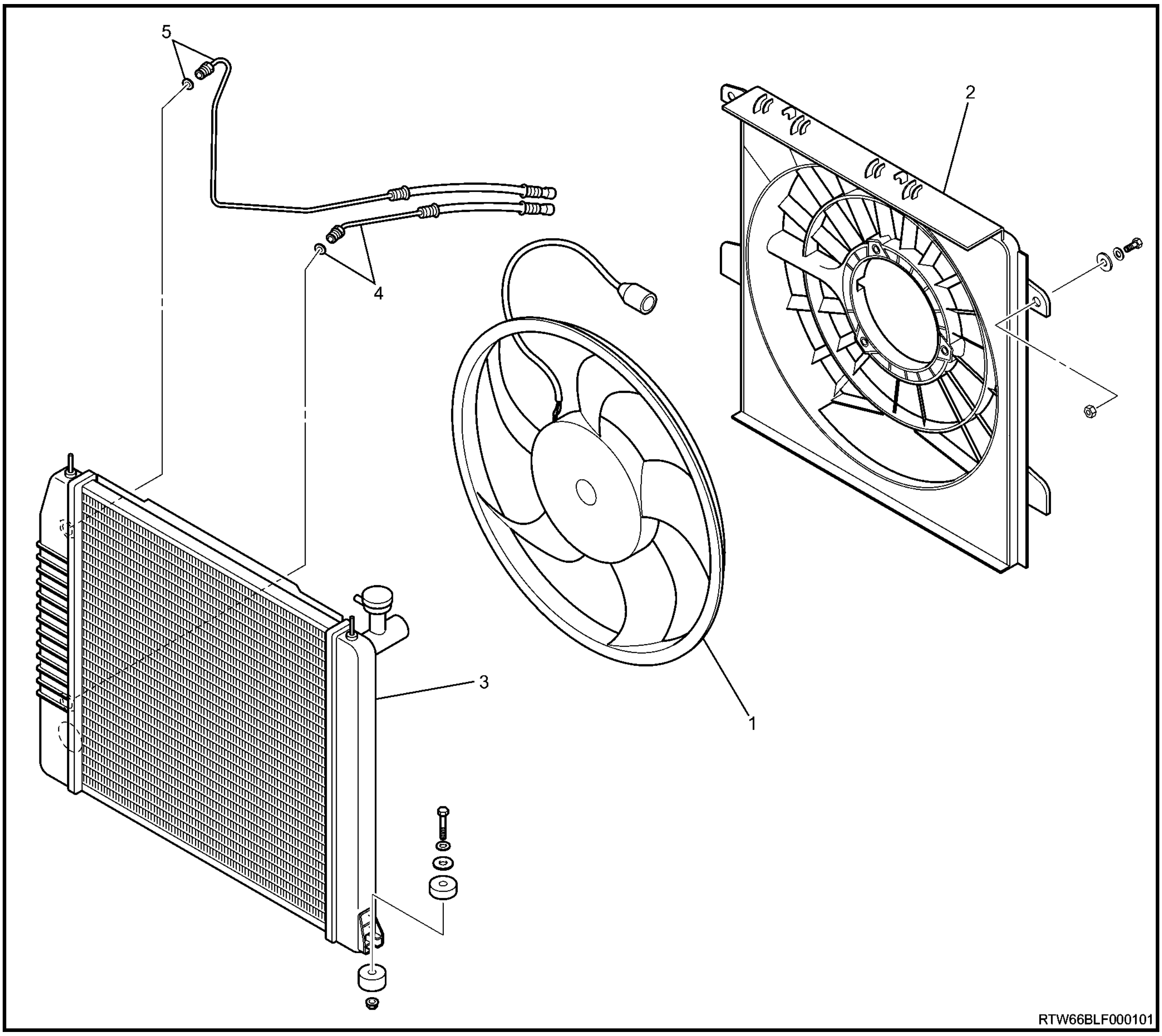


Figure 6B1 – 1

Legend

1 Fan and Motor Assembly
2 Fan Shroud
3 Radiator
4 Lower Transmission Cooling Line and Seal
5 Upper Transmission Cooling Line and Seal

2.2 Cooling Fan – Standard Specification

Overview

The fan is a standard cooling system rated at 400 Watts with a blade diameter of 500 mm, which consists of a single four speed fan. The fan motor is operated by duty signal from the ECM incorporating, low speed (Stage 1) up to high speed (Stage 4).

The following outlines the operation of the cooling system, at block level, also showing what inputs the Engine Control Module (ECM) requires.

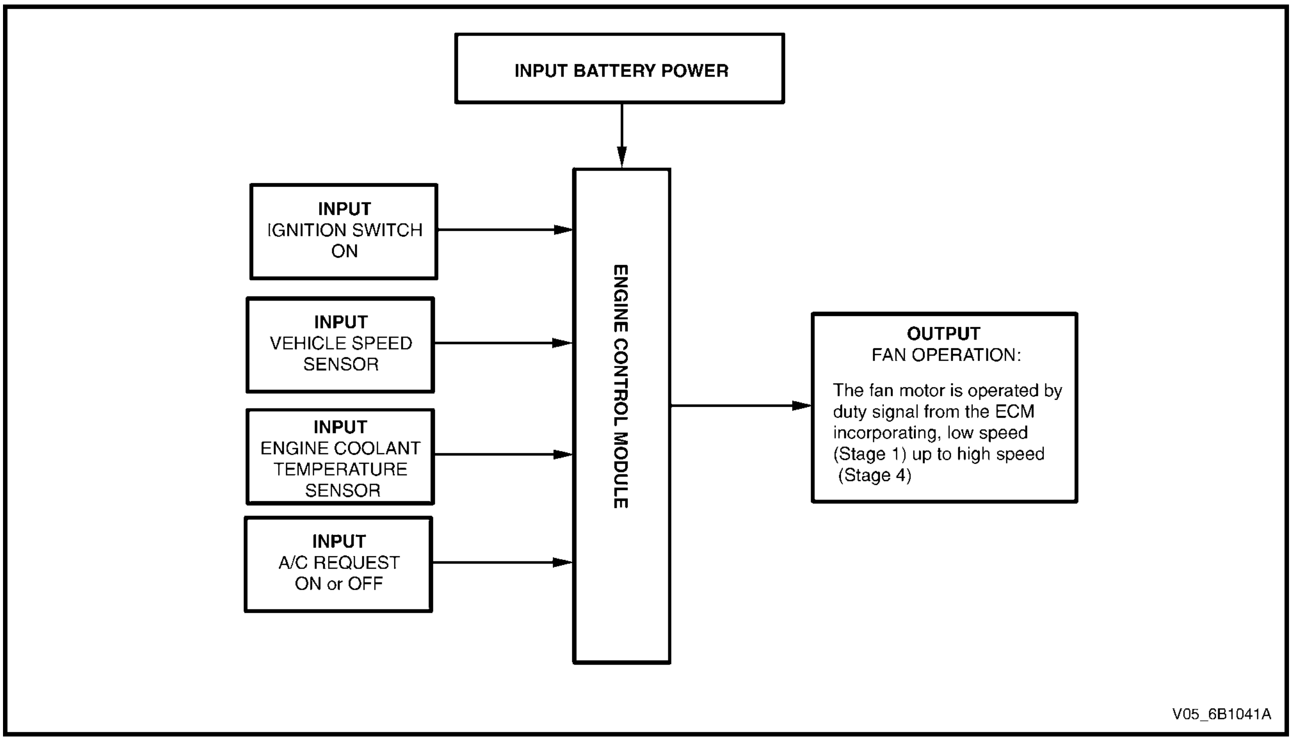


Figure 6B1 – 2

Cooling Fan and Shroud Assembly

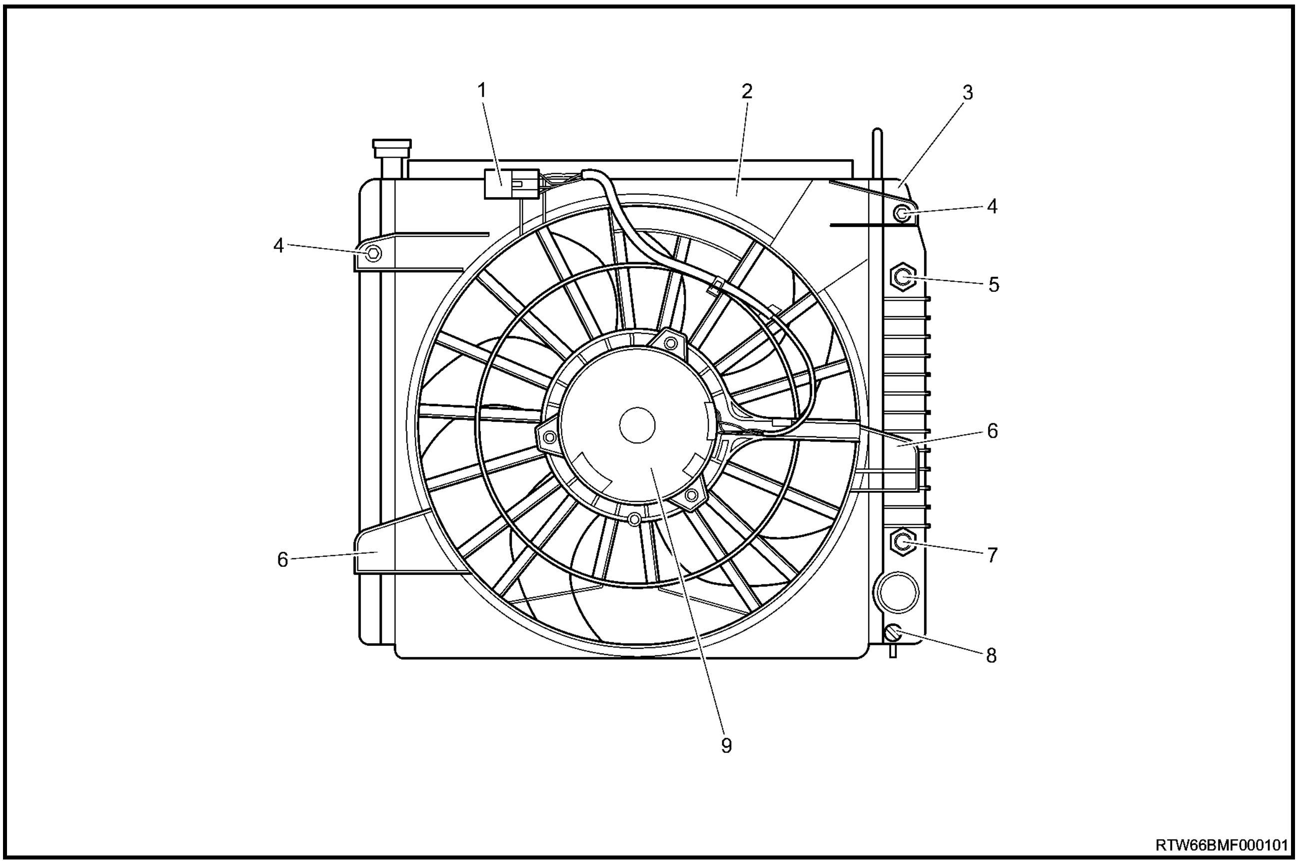


Figure 6B1 – 3

Legend

1	Fan Harness Connector	5	Oil Cooler, Upper Line Connection (Auto Trans Only)
2	Fan Shroud	6	Fan Shroud Lower Support
3	Radiator	7	Oil Cooler, Lower Line Connection (Auto Trans Only)
4	Fan Shroud Upper Support	8	Radiator Drain Tap
		9	Fan Motor

Fan Motor

When the Standard Cooling Fan System is fitted to the HFV6 engine, the fan motor is 12 Volt and variable-speed. The internal construction of the fan motor consists of two brushes and two permanent magnets. A three-wire pigtail harness is permanently connected to the motor and is attached to the polypropylene fan shroud by integral clips moulded as part of the fan shroud.

The enclosed fan motor housing is constructed of yellow zinc coated steel. A drain hole is located in the bottom of the housing to allow for breathing and draining of any moisture ingress.

The fan motor rotates in an anticlockwise direction when viewed from the fan motor side.

The motor is rated at 400 Watts and drives a (500 mm) diameter fan blade at approximately 2,400 ± 240 rpm at high speed (stage 4).

The fan and motor is balanced as a unit and the fan blade must not be separated from the motor. The fan motor and blade are serviced only as an assembled unit. However, it should be noted that the central nut attaching the fan blade to the motor shaft has a left-hand thread.

Fan Operation

On vehicles with HFV6 engines, the engine cooling fan motor has three terminals; one positive and one negative and one the drive signal from the ECM. The positive terminal is permanently connected to battery voltage, via fuse SBF –3.

The cooling fan operation is enabled when the ECM via connector C – 56, pin 20 supplies a duty signal which varies dependant on the engine temperature, vehicle speed, A/C request (where fitted) and A/C system pressure, the speed varies from low speed (Stage 1) up to high speed (Stage 4). Refer to 6C1 – 1 Engine management general information.

V6 Cooling Fan Wiring Diagram

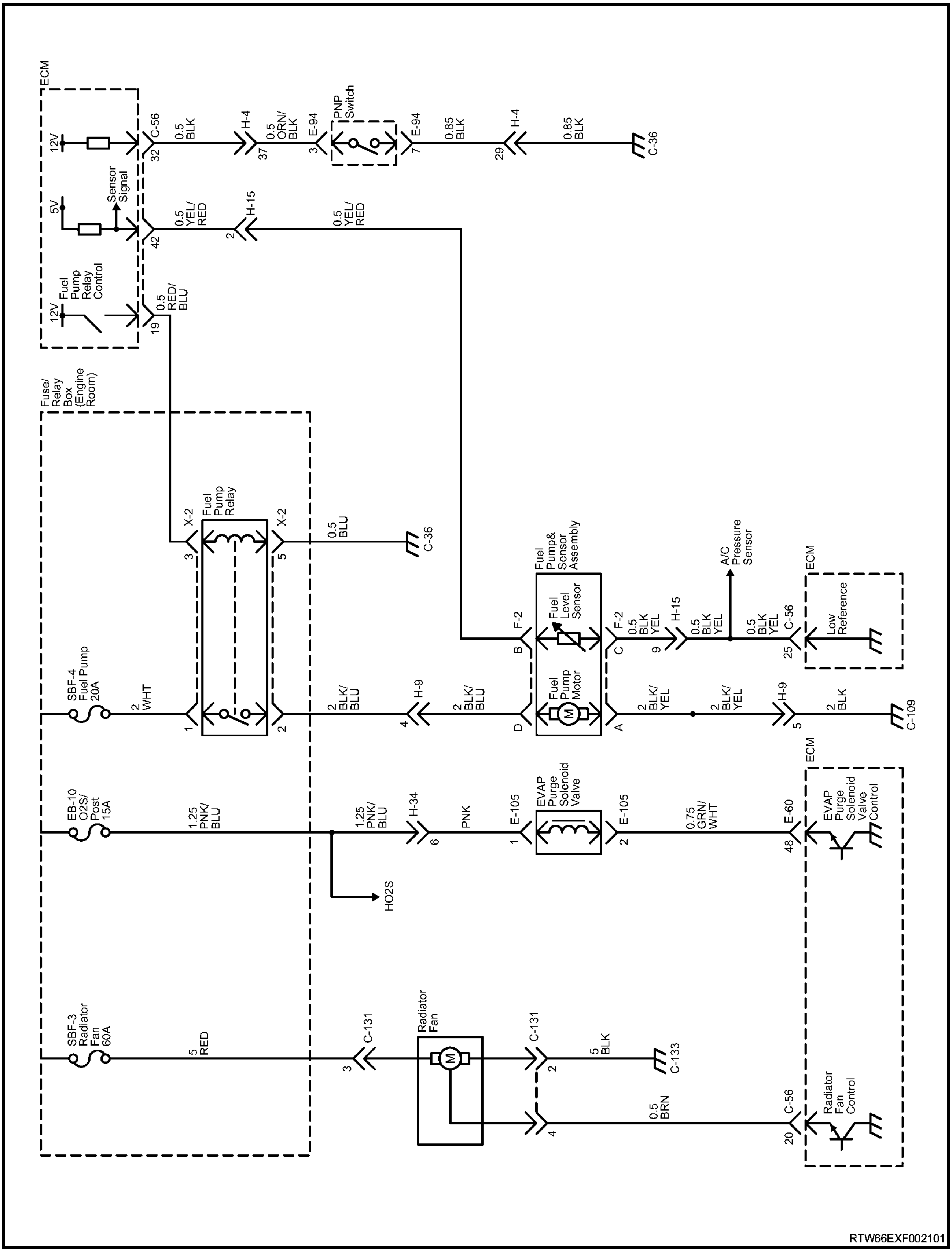


Figure 6B1 – 4

Fan Assembly connector

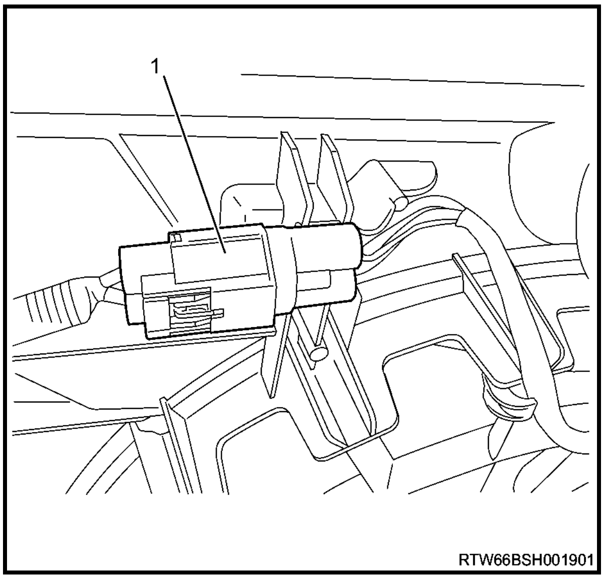


Figure 6B1 – 5

2.3 Coolant Pump

The coolant pump is a centrifugal vane impeller type pump. The pump consists of a housing and an impeller. The impeller is a flat plate mounted on the pump shaft with a series of flat or curved blades (vanes). When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force. The impeller shaft is supported by sealed bearings. The sealed bearings do not need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The coolant pump (1) is mounted to the engine front cover and is driven by the crankshaft pulley (2) via a multi-ribbed drive belt (3), turning the pump pulley (4), bolted to the coolant pump flange (5). Coolant enters the engine through the coolant inlet pipe and thermostat at the rear of engine and passes through the engine to the coolant pump on the front engine cover and exits via the coolant outlet housing (6) located at the front of the intake manifold.

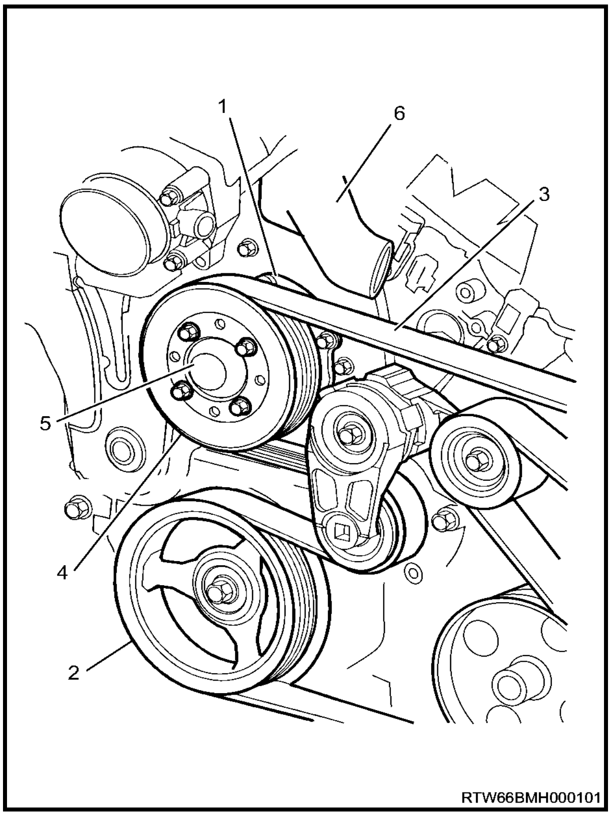


Figure 6B1 – 6

2.4 Coolant Outlet Housing

The coolant outlet housing (1) is located at the front of the intake manifold (2).

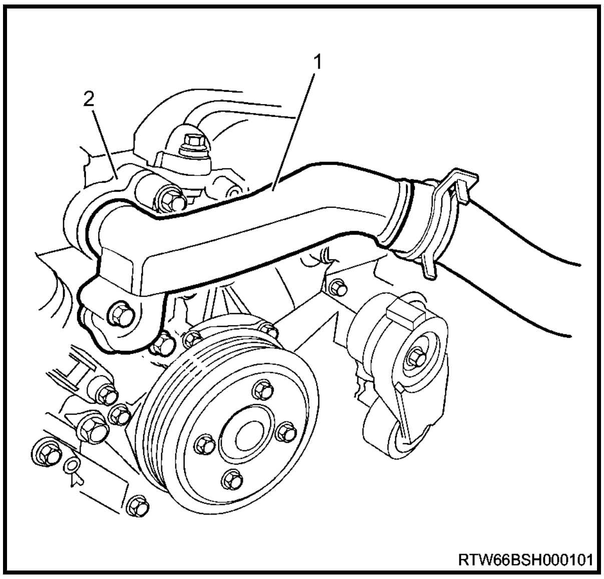


Figure 6B1 – 7

2.5 Thermostat

The thermostat housing (1) is located at the rear of the engine between the coolant inlet pipe (2) and the rear of the intake manifold, underneath the heater pipe assembly (3).

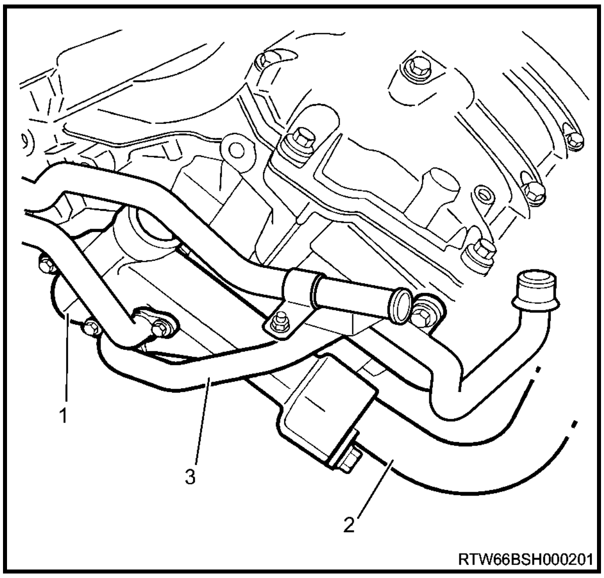


Figure 6B1 – 8

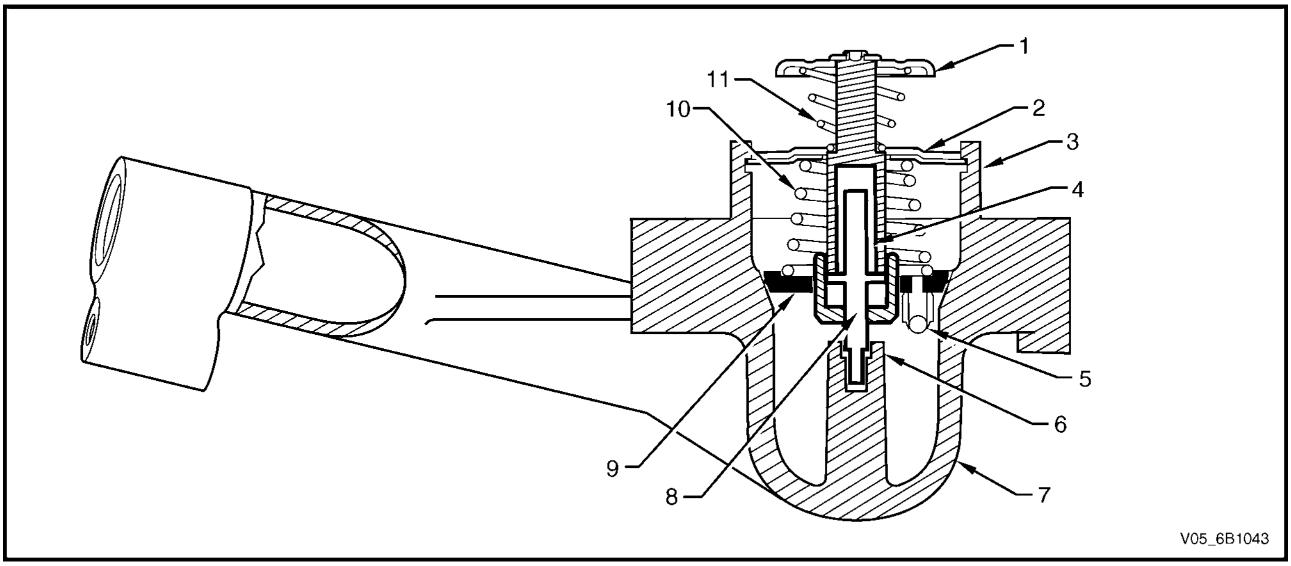


Figure 6B1 – 9

Legend

1	Bypass Valve	5	Air Bleed Valve	9	Rubber Diaphragm
2	Thermostat Retaining Bar	6	Piston Centre Support	10	Thermostat Spring
3	Thermostat Assembly Retaining Lugs	7	Thermostat Housing	11	Bypass Spring
4	Wax Pellet	8	Piston		

A wax pellet type thermostat is used in the coolant inlet passage to control the flow of coolant, providing fast engine warm up and regulating coolant temperature. The wax pellet or power element in the thermostat expands when heated and contracts when cooled. The wax pellet is connected through a piston to a valve and when the pellet is heated, pressure is exerted against a metal valve, which is forced to open.

As the pellet is cooled, the contraction allows a spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator, but allowing the coolant to circulate throughout the engine to warm it quickly and evenly. As the engine becomes warm, the pellet expands and the thermostat opens, permitting the coolant to flow through to the radiator where heat is transferred to the surrounding air, through the radiator walls.

This opening and closing of the thermostat valve permits enough coolant to enter the radiator to keep the engine within specified temperature limits.

The thermostat also provides a restriction in the cooling system, even after it has opened. This restriction creates a pressure difference, which prevents cavitation at the coolant pump and forces coolant to circulate through the engine block.

2.6 Coolant Filler Cap

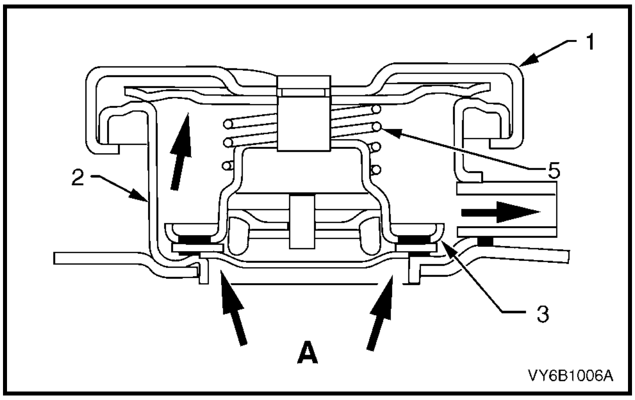


Figure 6B1 – 10

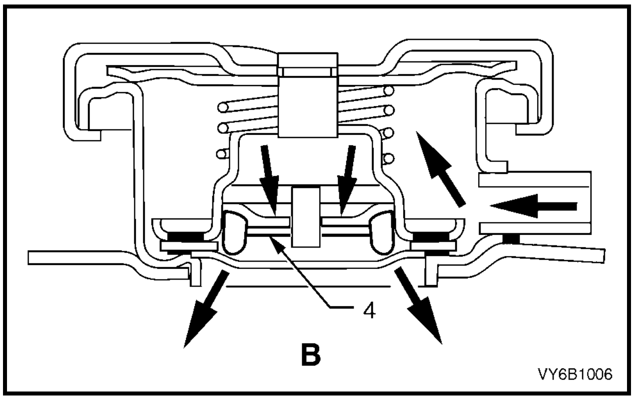


Figure 6B1 – 11

The pressurised coolant filler cap (1), fitted to the filler neck (2) on the coolant outlet housing, causes the cooling system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of the coolant, resulting in increased engine cooling efficiency. The coolant filler cap contains a pressure valve (3) and a vacuum (atmospheric) valve (4).

Referring to view ‘A’, the pressure valve is held against its seat by a spring (5), which determines the maximum operating pressure of the cooling system (120 kPa).

Referring to view ‘B’, the vacuum valve (4) is held against its seat by a light spring and opens during cool down because of the drop in pressure with contraction of the coolant volume. This pressure drop over-comes the spring force and the vacuum valve is opened, preventing the radiator hoses from collapsing. In addition, coolant can also flow back into the cooling system from the coolant recovery reservoir while this valve is open maintaining a full volume of coolant within the engine and radiator.

CAUTION

Should the radiator pressure cap require replacement, only fit the correct cap (with the correct pressure-rating) for this engine. Refer to the current release of Partfinder™ for this information.

2.7 Coolant Recovery Reservoir

The coolant is maintained at the ideal level in the radiator by the coolant filler cap and the coolant recovery reservoir, resulting in increased cooling efficiency.

The coolant recovery reservoir is located on the left-hand side front of the engine compartment, between the radiator support panel and air cleaner assembly. The coolant recovery reservoir is connected to the radiator overflow connection by a small diameter hose.

As the engine temperature rises, the coolant is heated and expands. The fluid displaced by expansion flows from the radiator into the recovery reservoir.

When the engine is turned OFF, the coolant contracts as it cools. Coolant is then drawn back into the radiator through the coolant filler cap atmospheric valve.

Coolant level should be maintained between the MAX and MIN indicator lines on the coolant recovery reservoir, as shown in Figure 6B1 – 12, when the engine is cold.

The cooling system is designed to use a coolant, DEX-COOL® long-life coolant or equivalent to GM specification 6277M (a mixture of ethylene glycol antifreeze and corrosion inhibitors and water), rather than plain water to maintain the integrity of the cooling system, and to prevent oxidation occurring within the engine.

NOTE

Some HFV6 Series vehicle markets call for DEX-COOL® long-life coolant and others for its equivalent, known as Extended Life Anti-freeze Coolant, conforming to GM specification 6277M. If in doubt regarding the correct coolant to be used, refer to the Owner's Handbook.

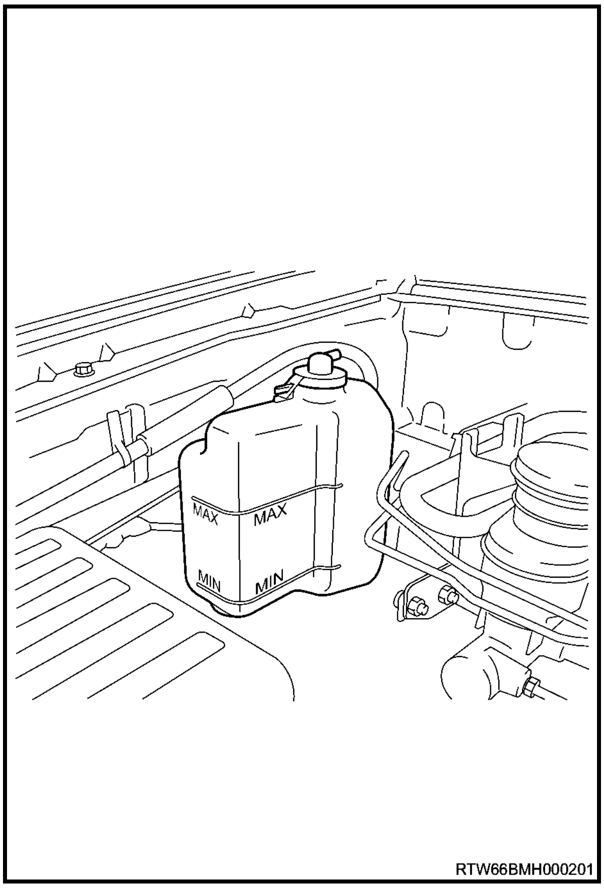
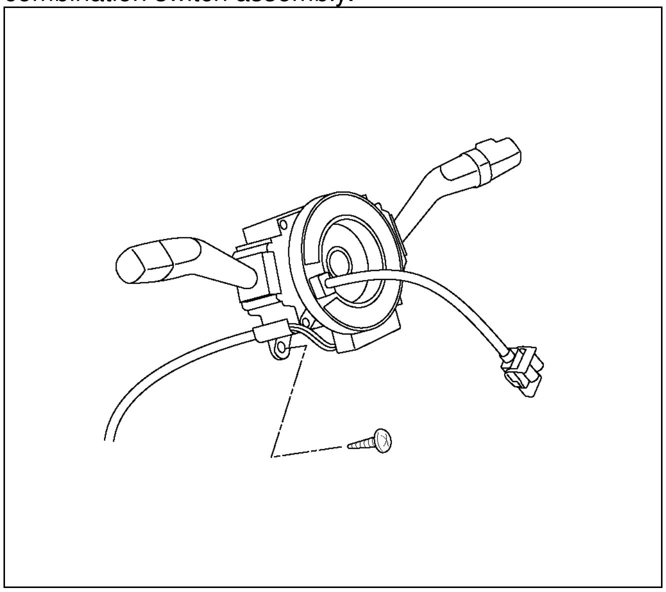


Figure 6B1 – 12

16. Remove steering column cover.
17. Disconnect the wiring harness connectors located under the steering column.
18. Remove the combination switch assembly with SRS coil.

NOTE: The SRS coil is a part of the combination switch assembly, which cannot be replaced separately. Therefore, be sure not to remove the SRS coil from the combination switch assembly.



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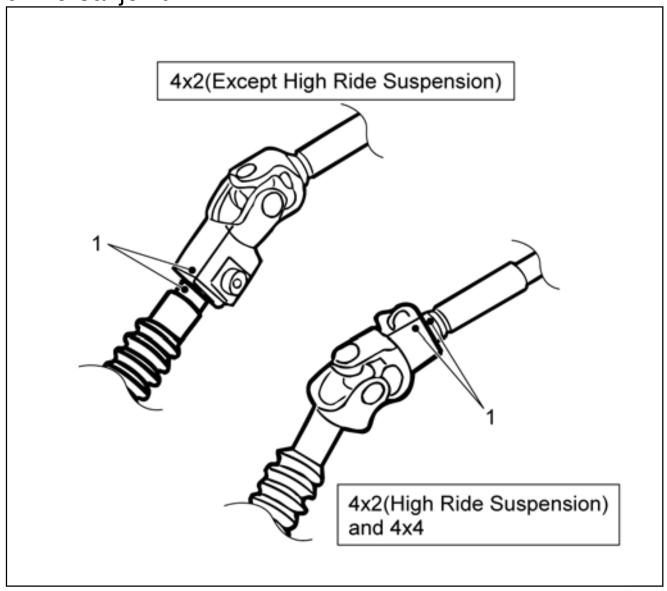
19. Disconnect the starter switch harness connector located under the steering column, then remove lock cylinder assembly.
20. Apply a setting mark (1) across the universal joint and steering shaft to reassemble the parts in their original position, then remove steering column assembly and second shaft.

NOTE: A setting mark can be easily made if the shaft is withdrawn a little by loosening the steering shaft universal joint.



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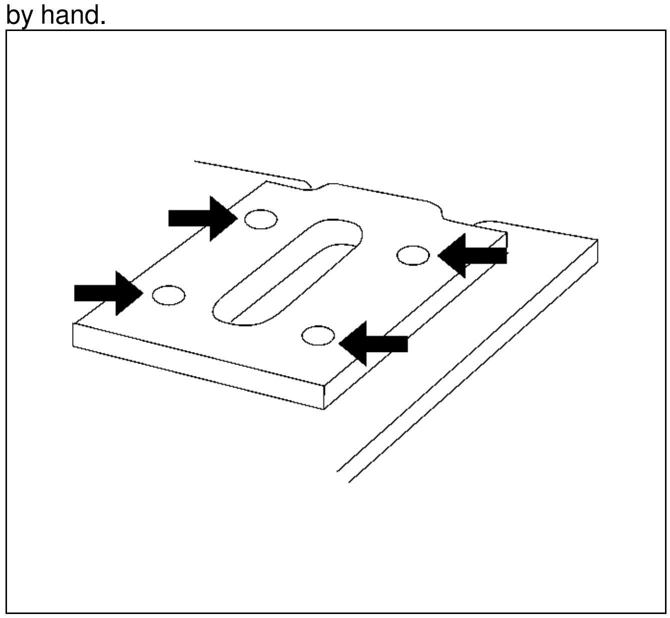
Inspection

If abnormal conditions are found during inspection, replace the steering column assembly.

Column Capsules

Check capsules on steering column bracket assembly; all must be securely seated in bracket slots and checked for any loose condition when pushed or pulled by hand.



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2.8 Engine Coolant Temperature Sensor

An Engine Coolant Temperature (ECT) sensor (2) is mounted in the left-hand side cylinder head, just above the exhaust manifold. The ECT sensor is used in conjunction with the instrument panel temperature gauge. The ECT sensor generates a signal, which is used by the engine management system for calculation of the various engine management functions.

Figure 6B1 – 13 shows the wiring harness connector (1) and the ECT sensor (2).

Refer to 6C1-1 Engine Management General Information for further information on the ECT sensor.

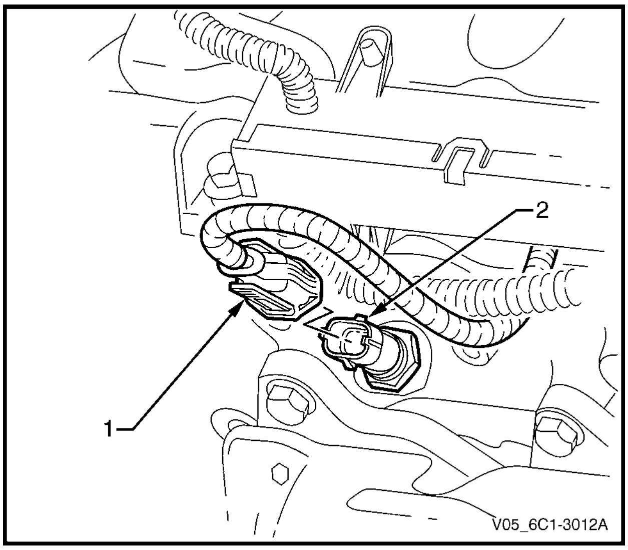

Figure 6B1 – 13

3 Service Operations

3.1 Service Notes

Safety

WARNING

- **To avoid serious personal injury, never remove the coolant filler pressure cap on the coolant outlet housing when the engine is hot, even if the cooling system should require filling. Sudden release of cooling system pressure is very dangerous.**
- **The vehicle is fitted with an electric radiator cooling fan. When working around the engine compartment, keep clear of the fan as it may start without warning.**

Before removing the coolant filler cap, allow the engine to cool, then place a shop rag over the coolant filler cap and then slowly turn the cap anticlockwise, approximately 1½ turns, until the pressure relief position is reached. The pressure relief position will allow any remaining pressure within the system to escape into the coolant recovery reservoir. Continue to rotate the cap anticlockwise until the cap can be safely removed.

Periodic Servicing

The cooling system requires little attention except for maintaining the coolant to the correct level in the recovery reservoir and periodic servicing at the time or distance intervals as outlined in 0B Lubrication and Service.

Periodic servicing includes:

1 Checking coolant level. Refer to 3.3 Draining and Filling Cooling System in this Section.

2 Checking coolant concentration. Refer to 3.2 Coolant Maintenance – Testing Coolant Concentration in this Section.

3 Pressure test cooling system and coolant filler cap. Refer to 3.7 Pressure Testing in this Section.

4 Tighten hose clamps and inspect all hoses. Refer to 3.6 Coolant Hoses in this Section. Replace hoses if swollen or deteriorated.

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

5 Clean out cooling system, refer to 3.4 Cleaning Cooling System – Cooling System Flush, in this Section and refill. Refer to 3.3 Draining and Filling Cooling System in this Section.

Environmental Issues

To reduce environmental impact and maintenance cost, whenever the coolant is drained from any engine, the service records are to be checked to determine when the coolant was last changed. If more than six months life is left before the next coolant change, then the following procedure is to be followed:

1 When draining the coolant from the engine, use a clean container to hold at least 12 litres of coolant and ensure that the coolant is not contaminated in the draining process.

2 After repairs have been completed, refill the engine cooling system with the drained coolant.

3 Top up as required, using a 50 / 50 mix of clean water and the recommended coolant, which is either DEX-COOL® long-life coolant or its equivalent, known as Extended Life Anti-freeze Coolant conforming to GM specification 6277M. Refer to 3.2 Coolant Maintenance and 3.3 Draining and Filling Cooling System in this Section, for the necessary procedures and further information.

3.2 Coolant Maintenance

CAUTION

Do not mix different types of anti-freeze or corrosion inhibitors, as they may be incompatible. If a different type has been used in the cooling system, flush the system with clean water, refer to 3.4 Cleaning Cooling System – Cooling System Flush in this Section and refill cooling system with the correct coolant. Refer to 3.3 Draining and Filling Cooling System in this Section.

The cooling system is designed to use a coolant (a mixture of ethylene glycol antifreeze with added corrosion inhibitors, and water), rather than plain water. The use of glycol also raises the boiling point and increases the cooling system efficiency. For this reason, it is of the utmost importance that the correct concentration level of ethylene glycol in the cooling system is maintained.

Addition of plain water into the cooling system when 'topping-up' may dilute the coolant mixture to a point where the antifreeze / anti-boil and corrosion inhibitor properties of ethylene glycol become ineffective.

The coolant should comprise of a mixture 50% ethylene glycol antifreeze / inhibitor with 50% clear, clean water.

Ethylene glycol conforming to the correct specification is either named DEX-COOL® long-life coolant or its equivalent, known as Extended Life Anti-freeze Coolant conforming to GM specification 6277M. Both are available in a number of different quantities. Check the current release of Partfinder™ for specific details.

Topping Up the Cooling System

Under normal operating conditions, the cooling system should not be topped up at the coolant filler cap. The level can be checked at the coolant recovery reservoir, and coolant (in the correct concentration with clear, clean water) added as necessary to bring the level between the MAX and MIN indicator lines on the coolant recovery reservoir, as shown in Figure 6B1 – 14, when the engine is cold.

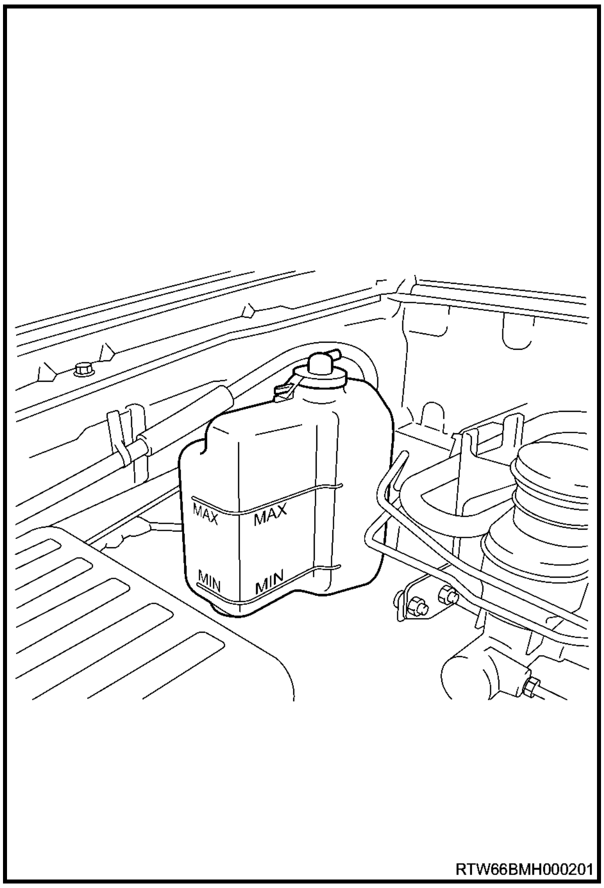

Figure 6B1 – 14

Testing Coolant Concentration

To ensure the specified ethylene glycol concentration is maintained in the engine coolant, the coolant concentration must be checked at the time or distance intervals outlined in the Owner's Handbook or Service Booklet in the glove box.

NOTE

- While a number of coolant concentration measuring devices are available, the two preferred types are as described.
- The procedures detailed, apply to either coolant type used.

Method 1 – Refractometer

NOTE

- Coolant tester, Tool No. J26568, automatically compensates for temperature.
- Ensure that the eyepiece of the tester is free of coolant before looking through it.
- Before each use, swing back the plastic cover at the slanted end of the coolant tester, exposing the measuring window and the bottom of the plastic cover. Carefully wipe the measuring window dry with a tissue or clean, soft cloth. Close the plastic cover.

1 Check the calibration of the coolant tester as follows:

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a Place a few drops of distilled water (between 21 and 29° C) onto the measuring window, then close the plastic cover.

b Point the tester toward any light source, look into the eyepiece and check that the indicated reading is zero. If not, then re-calibrate the tester as detailed at the end of this Test Method, Calibrating the Tester.

2 Release the tip of the bulb pump from under the refractometer body. It is not necessary to remove the complete pump from the tool.

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

3 Carefully remove the coolant filler cap.

4 Insert the tube of the pump into the coolant, and then press the bulb to obtain a sample.

5 Bend the tube around and insert the end into the cover plate opening.

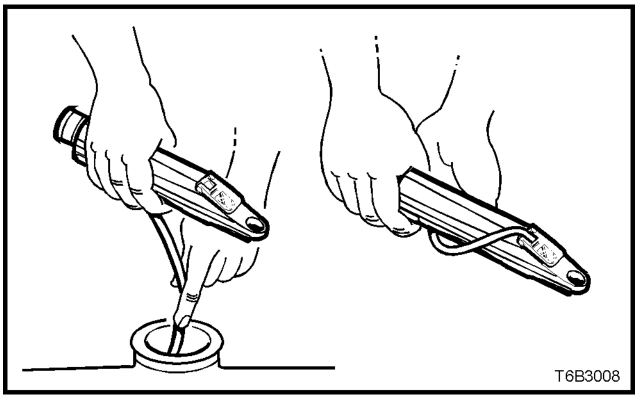


Figure 6B1 – 15

6 Press the pump bulb to deposit a few drops of coolant onto the measuring surface. Do not open the plastic cover when taking readings, as moisture evaporation will change the reading obtained.

7 Point the coolant tester toward any light source, looking into the eyepiece.

a The coolant protection reading is at the point where the dividing line between the light and dark, crosses the scale.

b The scale for ethylene glycol (bold arrow) is the reference scale for either DEX-COOL® long-life coolant or its equivalent, known as Extended Life Anti-freeze Coolant conforming to GM specification 6277M.

NOTE

The temperature scale is reversed from that of a conventional thermometer. Below zero readings are on the upper half of the scale.

8 A reading between – 30 and – 52°C (corresponding to a coolant concentration between 45 to 60%), is satisfactory for the HFV6 engine cooling system.

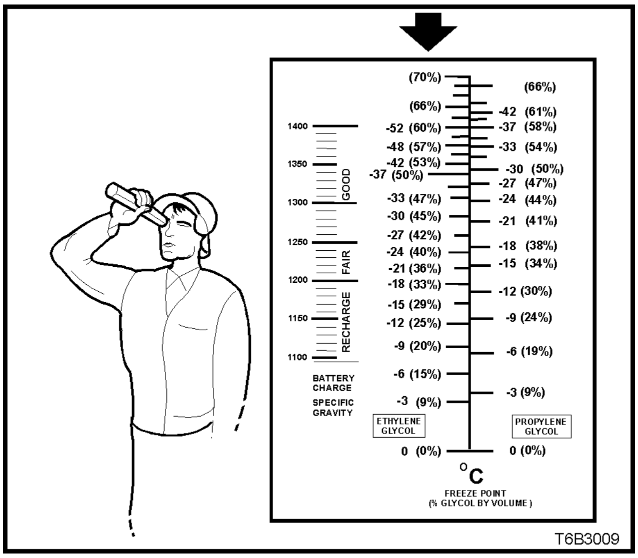


Figure 6B1 – 16

COOLANT CONCENTRATION

Concentration Reading %	Litres Of Coolant To Be Added	
	Automatic Transmission	Manual Transmission
0	4.95	5.15
5	4.46	4.62
10	3.96	4.12
15	3.47	3.61
20	2.97	3.08
25	2.48	2.57
30	1.98	2.01
35	1.48	1.54
40	0.99	1.05
45	0.50	0.52
50	0	0

NOTE

If the reading is not clear, then properly clean and dry the measuring surface, then conduct another test. Also ensure that there is sufficient fluid on the measuring prism.

9 If the reading shows that the concentration level of the coolant is inadequate, refer to the Coolant Concentration table to determine the amount of coolant that needs to be added to the coolant recovery reservoir.

10 Start and run the engine until normal operating temperature is reached, to allow the added coolant to be distributed throughout the engine cooling system.

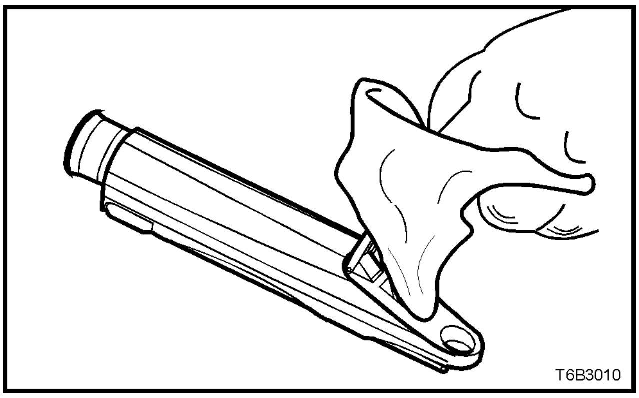


Figure 6B1 – 17

Calibrating the Tester

The coolant tester calibration is checked at manufacture. If however, the calibration check detailed in Step 1 of this method shows that the instrument is not reading correctly, then conduct the following recalibration procedure:

1 Remove the sealant covering the adjustment screw on the underneath of the tester.

2 With a distilled water sample on the measuring surface, carefully adjust the screw until a zero reading is obtained.

NOTE

DO NOT completely remove the screw.

3 After recalibration, reseal the screw with a small amount of silicone sealant.

Method 2 – Hydrometer

1 The cooling system should be at or close to ambient temperature.

2 Carefully remove the coolant filler cap from the coolant outlet housing and, while holding the rubber bulb squeezed, insert nozzle of coolant tester hydrometer, Tool No. AU505 into coolant. Releasing the rubber bulb will then draw sufficient coolant into the tester to float hydrometer bulb freely.

3 Hold tester at eye level and read scale on hydrometer bulb at coolant level.

The reading shows the percentage of ethylene glycol antifreeze contained in the engine coolant.

4 The hydrometer reading should show 50% if the coolant concentration is correct.

- If a reading of less than 50% is achieved, the cooling system requires topping up with either DEX-COOL® long-life coolant or its equivalent, known as Extended Life Anti-freeze Coolant conforming to GM specification 6277M.
- Refer to the Coolant Concentration table shown for the previous method to determine how much coolant additive of either type is required to be added to the cooling system to bring the coolant to the specified concentration.

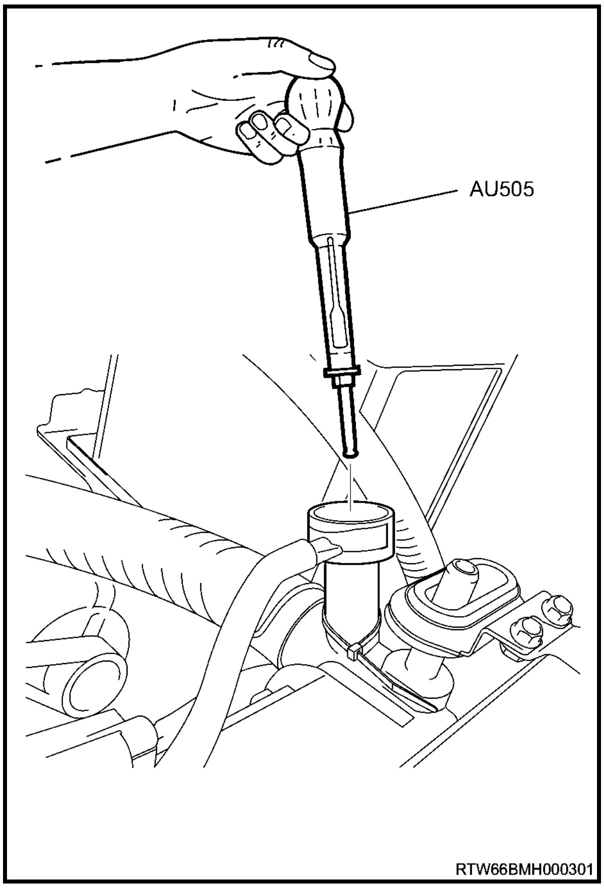


Figure 6B1 – 18

5 Drain sufficient quantity of coolant from cooling system to allow top-up with coolant additive, then add the required amount of the correct additive. Install coolant filler cap to the coolant outlet housing.

6 Start and run the engine until normal operating temperature is reached. This will allow the added coolant to be distributed throughout the engine cooling system.

3.3 Draining and Filling Cooling System

Draining

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), and then remove the coolant filler cap (located near the brake booster assembly).

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 6D1– 3 Battery – V6.

3 Drain the coolant from the system via the radiator drain tap on the lower RHS of the radiator below the lower hose outlet. Attach a suitable piece of rubber tubing to the tap outlet to help direct the flow of the coolant into a suitable container (capacity at least 12 litres).

Filling

During any service operation that requires the cooling system to be partly or completely drained, the following instructions must be followed when refilling the cooling system, to ensure that all air is bleed from system.

WARNING

- **Refer to 3.1 Service Notes in this Section, for important safety items.**
- **Before opening the radiator bleed screw, the cooling system must first be completely depressurised with the engine coolant filler cap removed.**

CAUTION

Do not mix different types of anti-freeze or corrosion inhibitors, as they may be incompatible. Always check which coolant is to be added to the particular vehicle being serviced. If a different type has been used in the cooling system (or is added accidentally), flush the system with clean water. Refer to 3.4 Cleaning Cooling System in this Section.

NOTE

Ensure that the radiator drain tap located at the bottom of right-hand side radiator tank is closed before proceeding.

1 With the engine off, remove the coolant filler cap on the coolant outlet housing, located at the front left-hand side of the engine.

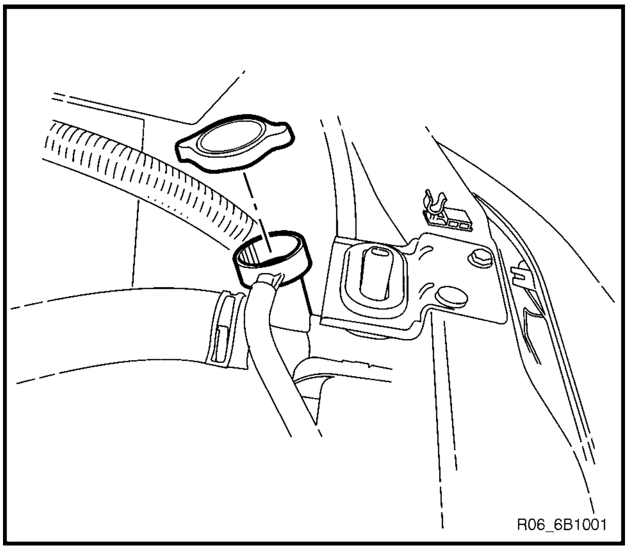


Figure 6B1 – 19

2 If filling a completely empty cooling system for automatic transmission models, mix 5 litres of clean water with 5 litres of the recommended coolant or 5.2 litres of each for manual transmission models.

3 Add coolant via the engine coolant filler neck on the coolant outlet housing.

NOTE

Do not replace the coolant filler cap before starting the engine (in step 6). Leaving the filler cap off allows the engine to warm up without pressurising.

4 Reconnect battery ground lead. Refer to 6D1 – 3 Battery – V6.

5 Start the engine and set the HVAC controls to:

- Full hot
- Low fan

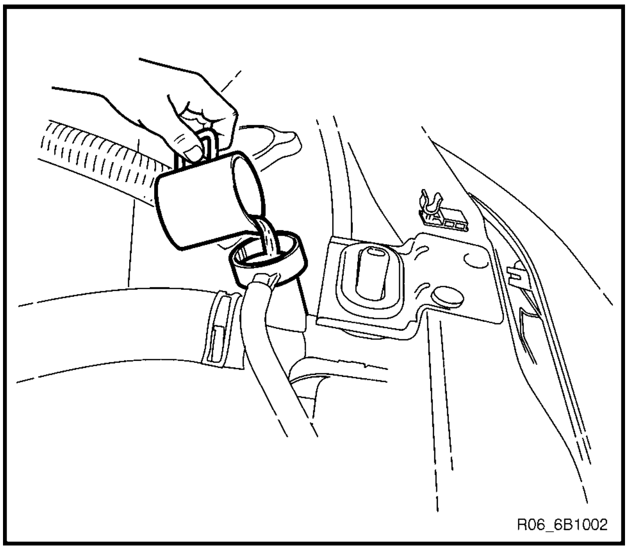


Figure 6B1 – 20

6 Run the engine at approximately 2,000 rpm to warm up the engine.

7 Wait until the radiator fan switches on.

8 When the radiator fan has switched on, let the engine rpm drop back to idle.

9 Turn the engine off when the radiator fan switches off.

10 Top up the coolant until full.

11 Replace the coolant filler cap.

CAUTION

Do not loosen or remove the radiator filler cap when the coolant temperature is high. Steam or boiling coolant will gush out and you may be burnt. To open the radiator filler cap, cover the filler cap with a thick cloth when the coolant has cooled, release the pressure by slowly turning the filler cap, and remove the cap.

12 Open the coolant reservoir tank cap.

13 Top up the radiator coolant recovery reservoir to the MAX line.

14 Reinstall the coolant recovery reservoir cap.

NOTE

This condition only applies when the cooling system is first being filled after a major loss of coolant. The level of coolant in the reservoir will then drop, once the engine is started and normal operating temperature is reached. The coolant level should then be maintained at the correct level (between the MAX and MIN Lines).

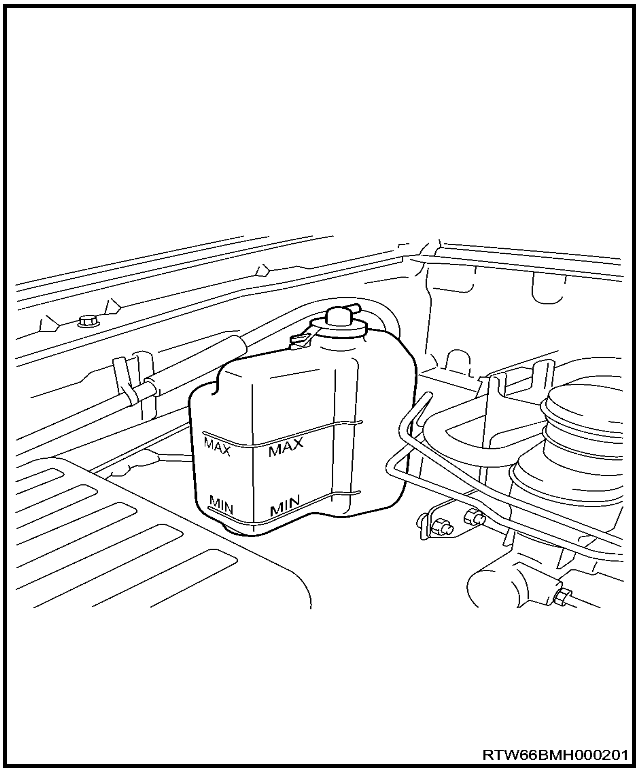
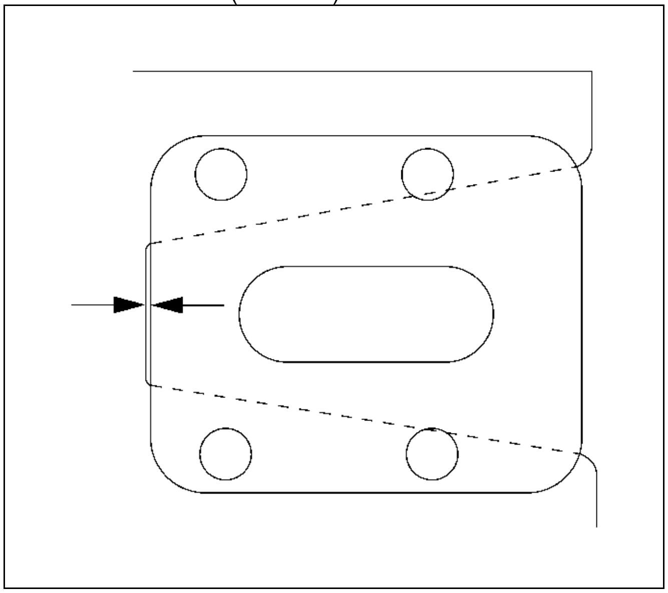


Figure 6B1 – 21

Check clearance between capsule and bracket. It must be less than 1 mm (0.039 in).



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Column Universal Joint (between the power steering unit and the steering shaft)

If resistance is felt when checked by rotating the joint, replace the lower second steering shaft.

Shaft Universal Joint (between the lower second steering shaft and the second steering shaft)

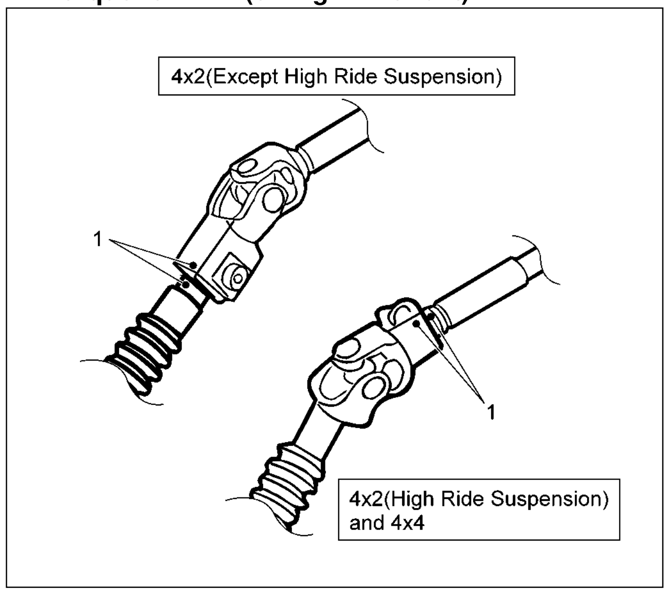
If resistance is felt when checked by rotating the joint, replace the second steering shaft assembly.

Tilt Mechanism

The tilt mechanism should move smoothly.
While locking the tilt mechanism, be sure the steering column is latched securely by pushing the steering wheel upward and downward.

Installation

1. Align the setting mark (1) on the second steering shaft and the steering column assembly (applied at disassembly).
2. Connect the steering column assembly to the second steering shaft. Tighten the bolts to the specified torque.
   Torque: 31 N·m (3.2 kgf·m/23 lb·ft)



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3. Thread the steering column assembly through the hole in the dashpanel. Temporarily tighten the steering column and the second steering shaft fixing bolts.
4. Align the setting marks (applied at disassembly) and connect the lower second steering shaft and the second steering shaft. Tighten the universal joint bolts to the specified torque.
   Torque: 31 N·m (3.2 kgf·m/23 lb·ft)
5. Tighten the steering column fixing bolt (pedal bracket side) to the specified torque (This bolt was temporarily tightened in Step 3).
   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)
6. Tighten the second steering shaft fixing bolt to the specified torque (This bolt was temporarily tightened in Step 3)
   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)
7. Tighten the steering column fixing bolt (dashpanel side) to the specified torque (This bolt was temporarily tightened in Step 3).
   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)
8. Install combination switch and SRS coil assembly. After installation of combination switch assembly, connect the combination switch wiring harness connector and the SRS 2-way connector located under the steering column.

3.4 Cleaning Cooling System

NOTE

- Before carrying out reverse flushing procedures, it is recommended that a cleaning solution be used to loosen scale and corrosion. Only use a Holden approved radiator cleaner following the instructions on the container label.
- This operation should only be carried out when the engine and radiator are at ambient temperature.
- When using specialised cooling system flushing equipment, connect the equipment as recommended by the manufacturer.

Cooling System Reverse Flush

Radiator

CAUTION

Refer to 'Environmental Issues' in 3.1 Service Notes, before draining the coolant.

1 Drain the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

WARNING

Always wear eye protection when working with spring-type hose clamps. Failure to do so may result in eye injury.

2 Remove the lower radiator outlet hose (1) at the coolant inlet pipe connection (2).

3 Remove the upper radiator inlet hose (3) at the coolant outlet housing connection (4).

4 Attach a lead-away hose to the open end of the upper radiator hose.

5 Attach a suitable piece of hose or adaptor between the flushing gun and the open end of the lower radiator hose.

6 Connect and operate the flushing equipment as recommended by the manufacturer.

CAUTION

Apply air pressure gradually and not in excess of 120 kPa, otherwise radiator damage will result.

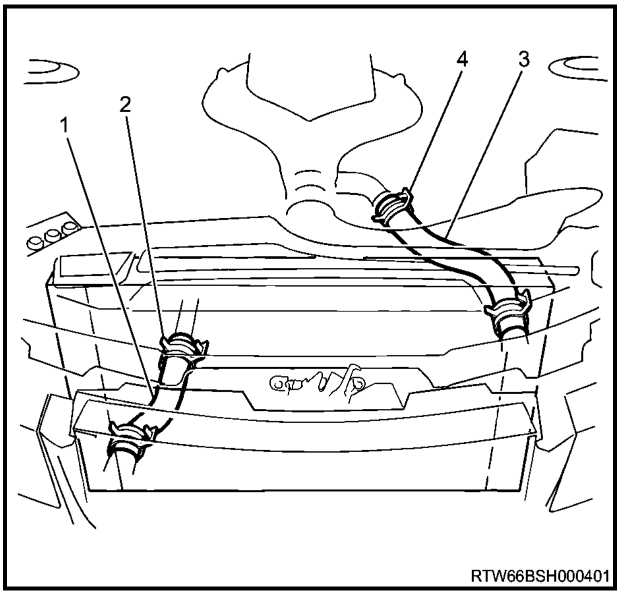


Figure 6B1 – 22

7 Continue flushing until the water from the lead-away hose runs clean and clear.

8 Install all disconnected hoses, ensuring that they are correctly positioned and securely clamped.

9 Fill the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

10 Pressure test the cooling system. Refer to 3.7 Pressure Testing in this Section.

Engine

CAUTION

Refer to ‘Environmental Issues’ in 3.1 Service Notes, before draining the coolant.

1 Drain the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

WARNING

Always wear eye protection when working with spring-type hose clamps. Failure to do so may result in eye injury.

2 Remove the upper and lower radiator hoses from the coolant outlet housing and coolant inlet pipe connections. Refer to Figure 6B1 – 22.

3 Remove the thermostat housing from the rear of the engine block. Refer to 6A1 Engine Mechanical – V6..

4 Remove the thermostat from the thermostat housing and reinstall the housing to the rear of the intake manifold. Refer to 3.8 Thermostat in this Section.

5 Remove both heater hoses (1) and (2) from their connections at the heater pipe assembly, noting which hose was connected to which connection. Seal the heater pipe assembly connections by looping the heater inlet connection to the outlet connection using a suitable piece of hose and two hose clamps.

6 Install a lead-away hose to the coolant inlet pipe connection and a length of suitable hose between the coolant outlet housing connection and the flushing equipment.

7 Connect and operate the flushing equipment as recommended by the manufacturer.

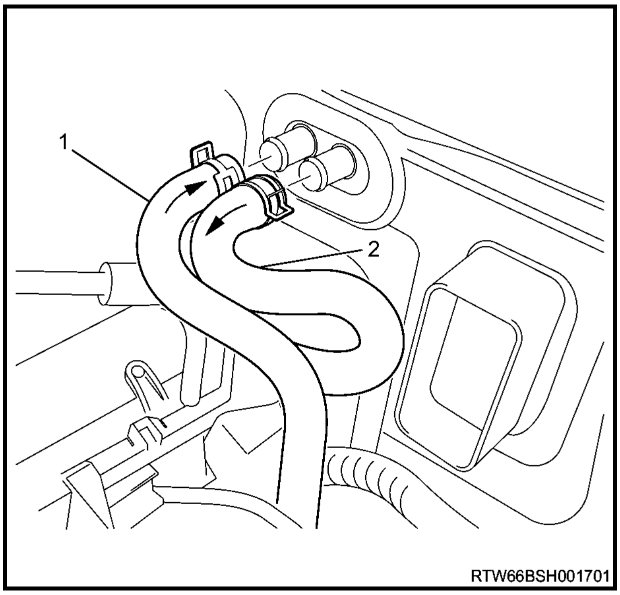


Figure 6B1 – 23

8 Continue flushing until the water from the lead-away hose runs clear.

9 Remove the coolant recovery reservoir, flush it out with clean water and install. Refer to 3.9 Coolant Recovery Reservoir in this Section.

10 Install the thermostat. Refer to 3.8 Thermostat in this Section.

11 Install all disconnected hoses, ensuring that they are correctly positioned and securely clamped.

12 Fill the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

13 Pressure-test the cooling system. Refer to 3.7 Pressure Testing in this Section.

Heater Hoses and Core

CAUTION

Refer to ‘Environmental Issues’ in 3.1 Service Notes, before draining the coolant.

1 Drain the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

WARNING

Always wear eye protection when working with spring-type hose clamps. Failure to do so may result in eye injury.

2 Remove both heater hoses (1) and (2) from their connections at the heater pipe assembly, noting which hose was connected to which connection.

3 Direct the hose (1) that was connected to the heater pipe assembly's front connection into a suitable container.

4 Attach the hose (2) from the rear-most connection to the flushing gun.

5 Cycle the heater switch to ensure that the water valve is open.

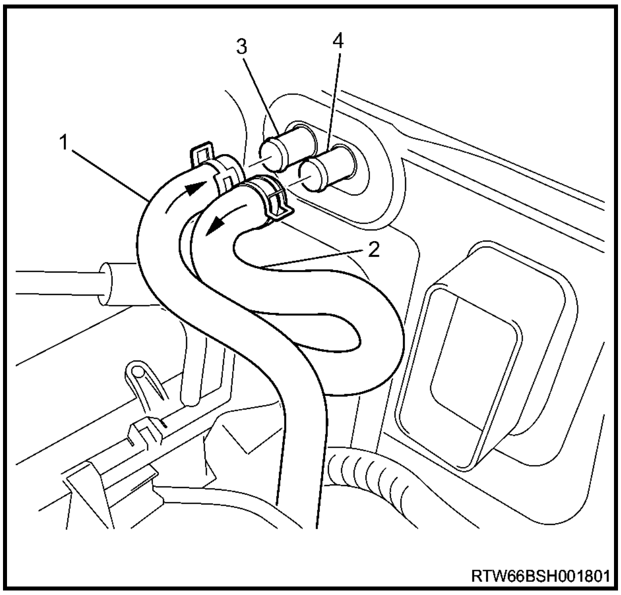


Figure 6B1 – 24

6 Connect and operate the flushing equipment as recommended by the manufacturer.

CAUTION

Apply air pressure gradually and not in excess of 130 kPa, otherwise heater core damage will result.

7 Install all disconnected hoses, ensuring that they are correctly positioned and securely clamped.

8 Fill the cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

9 Pressure test the cooling system. Refer to 3.7 Pressure Testing in this Section.

3.5 Drive Belt Tension

An automatic tensioner assembly provides drive belt tension. The tensioner is an idler pulley mounted on a spring-loaded arm that maintains the drive belt at the proper tension, without imposing undue loads on the various components.

Throughout its functional travel, the tensioner mechanism will maintain correct belt tension, using a pulley (1) mounted to a spring-loaded arm (2), which compensates for increases in belt wear and stretch.

When the indicator pointer (3) on the tensioner has reached minimum tension range (4), the tensioner has reached the full extent of its travel and replacement of the belt (5) is necessary.

The maximum tension range is shown at (6).

Drive belt tension can be checked using Tool No. BT3373-F. Refer to 6A1 Engine Mechanical.

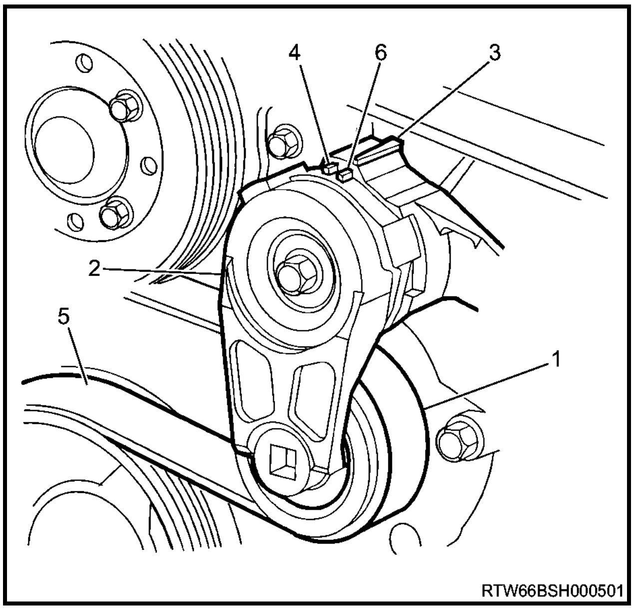


Figure 6B1 – 25

Inspect

The four views in Figure 6B1 – 26 show the various stages of drive belt wear, to assist in belt replacement decisions.

NOTE

Condition of the belt ribs can be better assessed if the belt is wrapped over the coolant pump drive pulley.

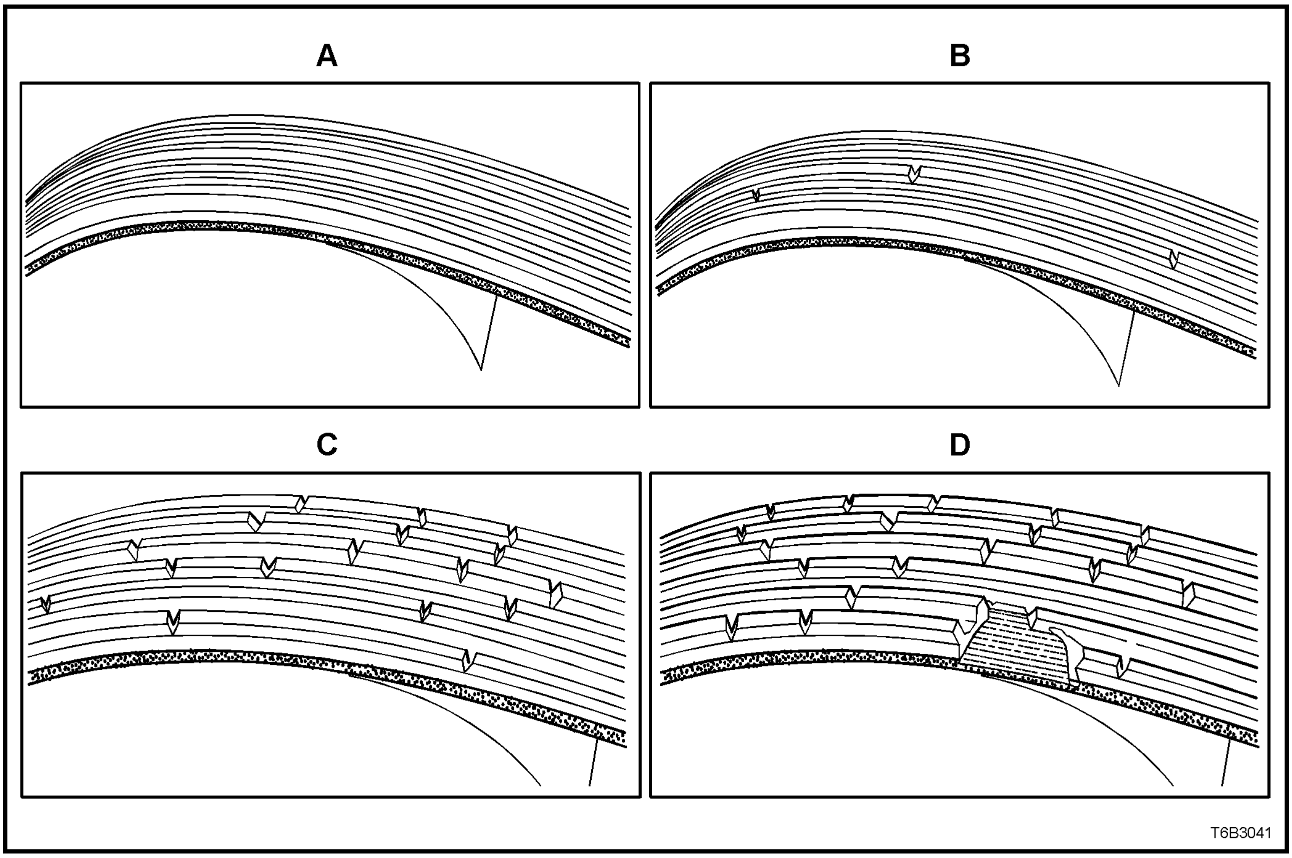


Figure 6B1 – 26

Legend

A New Belt: No cracks or chunks.

B Moderately Used Belt: Few cracks, with some wear on the ribs and in the grooves. Belt replacement not required.

C Severely Used Belt: Several cracks per 30 mm. Should be replaced before chunking occurs

D Failed Belt: Separation of rib material from backing (chunking). Belt must be replaced immediately.

3.6 Coolant Hoses

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

Coolant hoses are installed as shown in the following illustrations, taking note that there are a number of variants, depending on a specific vehicle specification.

Hose connections should be thoroughly cleaned before installing any new hose.

After all hoses are installed, always refill the cooling system with correct concentration of coolant, refer to 3.3 Draining and Filling Cooling System and pressure test cooling system, refer to 3.7 Pressure Testing in this Section.

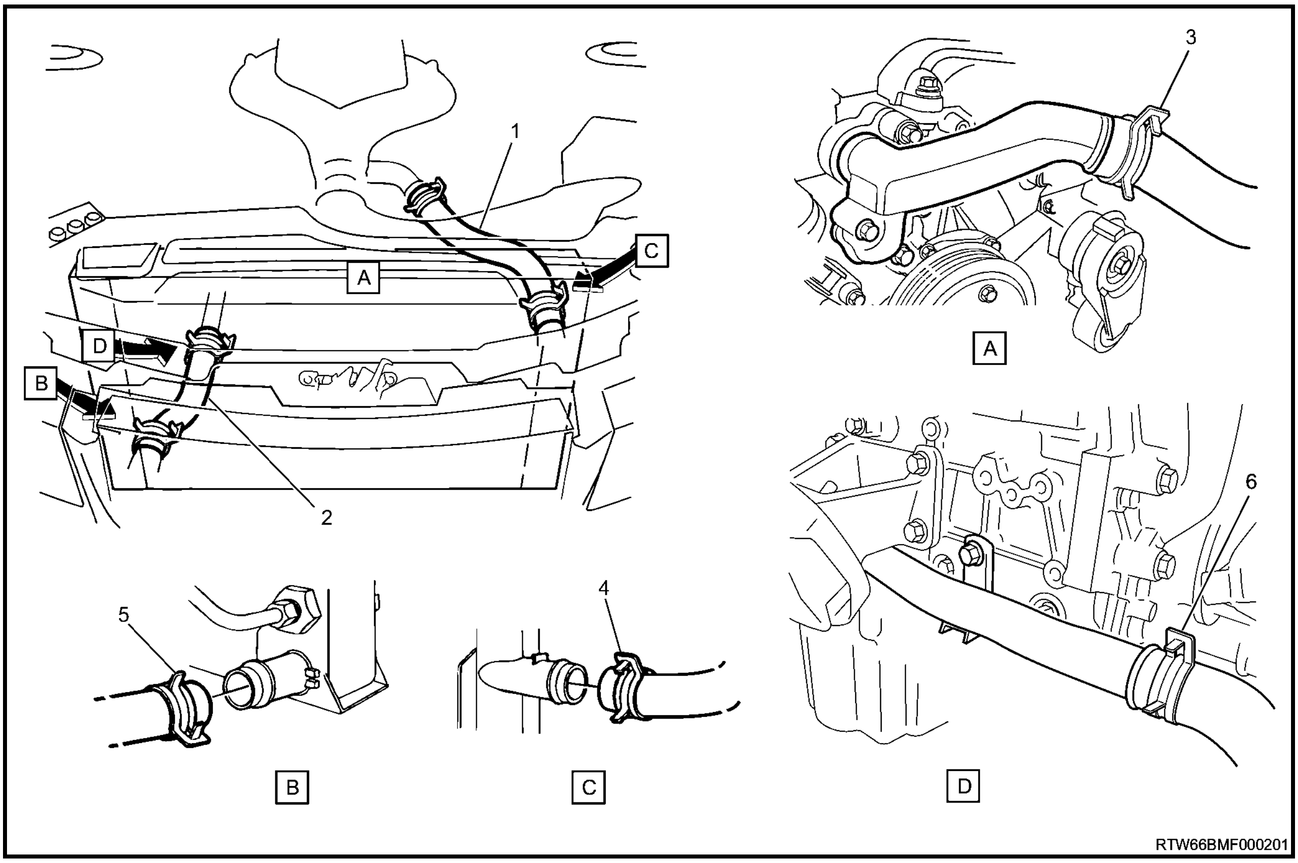


Figure 6B1 – 27

Legend

1 Radiator Hose – Upper
2 Radiator Hose – Lower
3 Hose Clamp – Upper Hose to Engine Outlet Housing
4 Hose Clamp – Upper Hose to Radiator Inlet
5 Hose Clamp – Lower Hose to Radiator Outlet
6 Hose Clamp – Lower Hose to Engine Coolant Inlet Pipe

3.7 Pressure Testing

Coolant Filler Cap Pressure Testing

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), then remove coolant filler cap.

2 Inspect and clean both sides (1) of coolant filler cap gasket with a wet cloth.

NOTE

Use only water to wet the cleaning cloth.

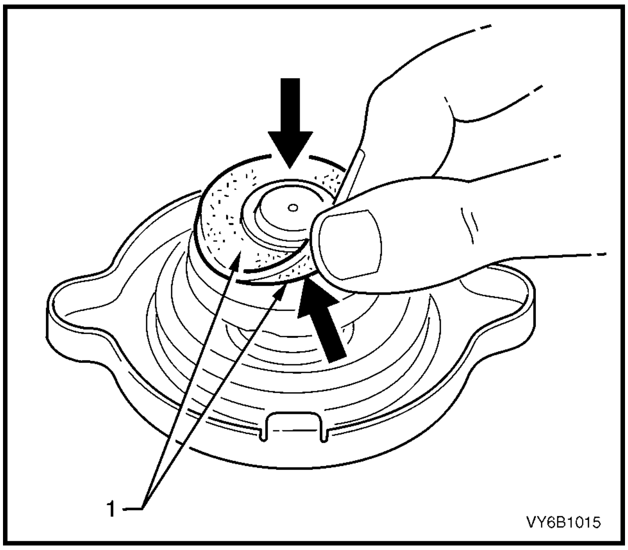


Figure 6B1 – 28

3 Lift centre vacuum valve. Clean and inspect the gasket and sealing surface under the valve (1).

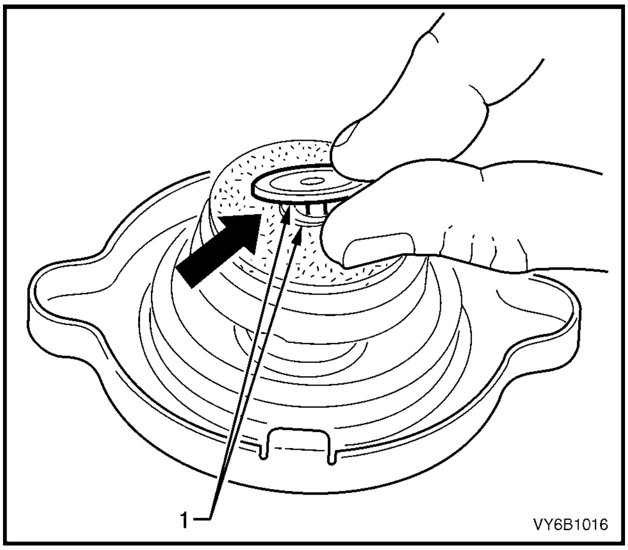


Figure 6B1 – 29

4 Attach coolant filler cap (2) to a commercially available cooling system pressure tester (1), using the pressure cap adaptor.

5 Slowly pressurise cap to 120 – 130 kPa. The cap is serviceable if it unloads slightly above this pressure range and holds pressure at 120 kPa.

NOTE

Should the cap fail to reach or hold the specified pressure, replace the cap.

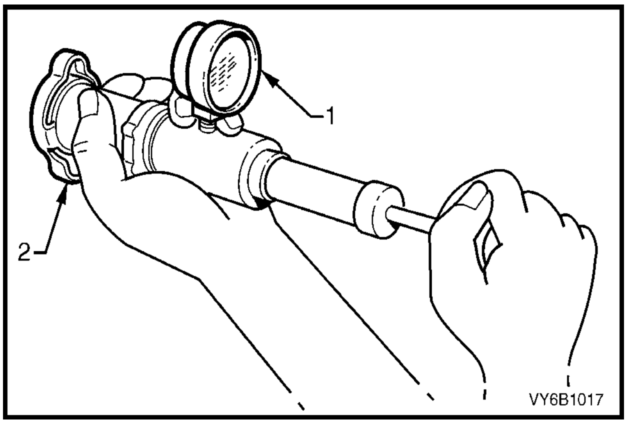


Figure 6B1 – 30

6 Prior to installing coolant filler cap ensure that the coolant filler neck cap seating surface is clean and free from obstruction.

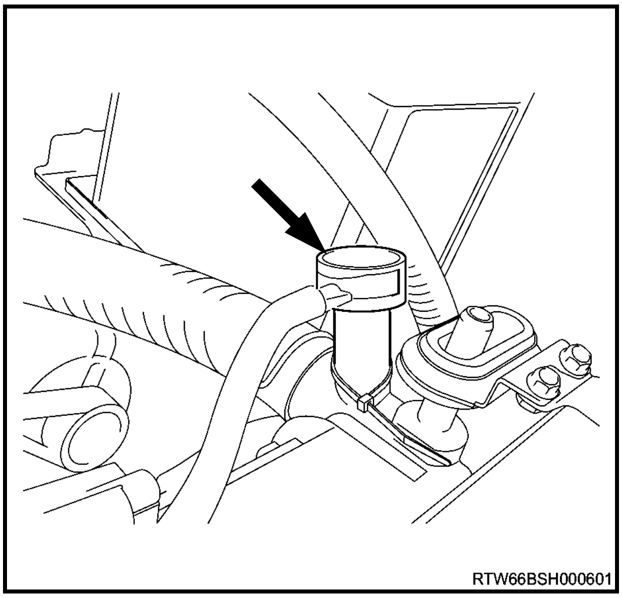


Figure 6B1 – 31

Cooling System Pressure Testing

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow the engine to cool to ambient temperature (less than 50° C), then remove coolant filler cap.

2 Ensure that the coolant level is correct.

3 Install the coolant filler neck adaptor, to a commercially available cooling system pressure tester (1).

4 Install the assembly to the engine coolant filler neck.

5 Using compressed air, blow dry any spilled coolant around coolant filler neck.

CAUTION

Do not exceed the stated pressure, as damage to the cooling system could otherwise result.

6 Using the cooling system pressure tester pump, pressurise cooling system to 130 kPa absolute maximum and check for leaks at the following points:

- All hoses and hose connections
- Overflow hose connection at coolant outlet housing connection

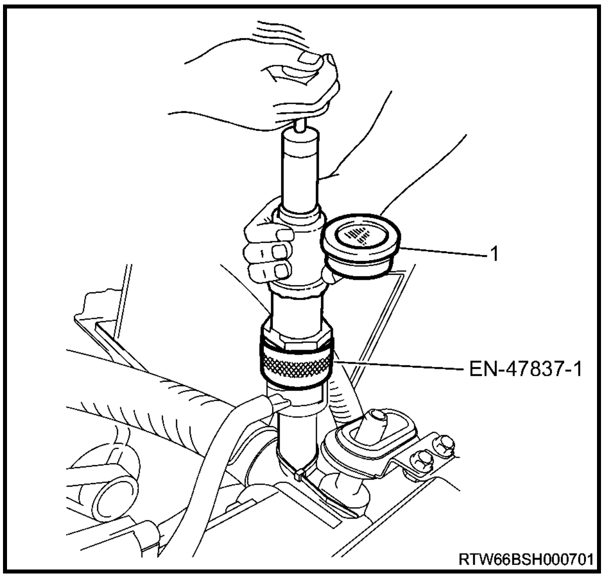


Figure 6B1 – 32

- Radiator seams and core
- Corroded or faulty engine Welch plugs
- Coolant pump and gasket
- Thermostat housing and coolant inlet pipe connection
- Radiator drain tap and bleed screw
- Vehicle heating system (e.g. heater core and water valve)

NOTE

For heater Removal and Installation, refer to 2A – Heater and Air-conditioning.

7 Check engine oil dipstick for evidence of engine oil contamination with coolant.

8 If pressure will not hold, there is a leak in the cooling system. Repair as necessary.

NOTE

If visible loss of coolant is not evident from pressure testing, then the use of a dye and black light, may be necessary. Refer to 4.7 Black Light and Dye Leak Diagnosis Method, in this Section.

3.8 Thermostat

Remove

WARNING

Do not remove coolant filler cap while the engine coolant temperature is above 50° C, as personal injury may result.

1 Allow engine to cool to ambient temperature (less than 50° C), then remove the coolant filler cap (located at the front left-hand side of the engine).

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 00 Warnings, Cautions and Notes, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 6D1-3 Battery – V6.

CAUTION

Refer to 'Environmental Issues' in 3.1 Service Notes, before draining the coolant.

3 Drain the coolant from the system. Refer to 3.3 Draining and Filling Cooling System in this Section.

4 Remove the complete intake manifold assembly. Refer to 6A1 Engine Mechanical – V6.

5 Plug each of the exposed intake ports with lint free cloth to prevent the entry of foreign matter.

6 Remove the coolant inlet pipe. Refer to 3.12 Coolant Inlet Pipe in this Section.

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

7 Use a straight-blade screwdriver (3) to release the heater hose quick connect clips (4).

8 Disconnect the heater hoses (1) from the heater pipes (2) in two places.

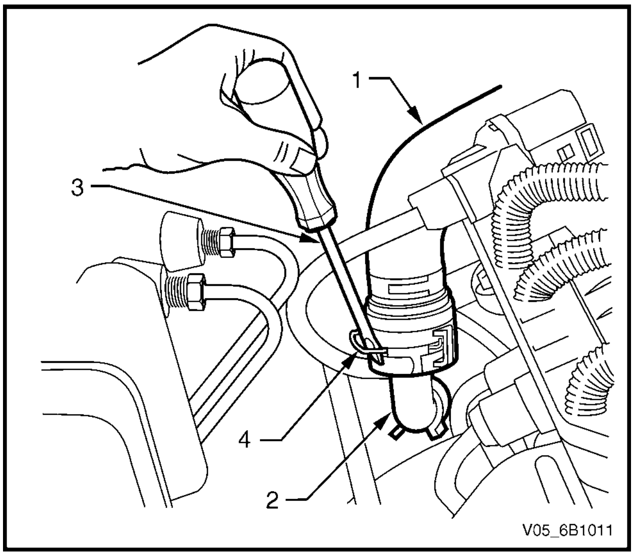
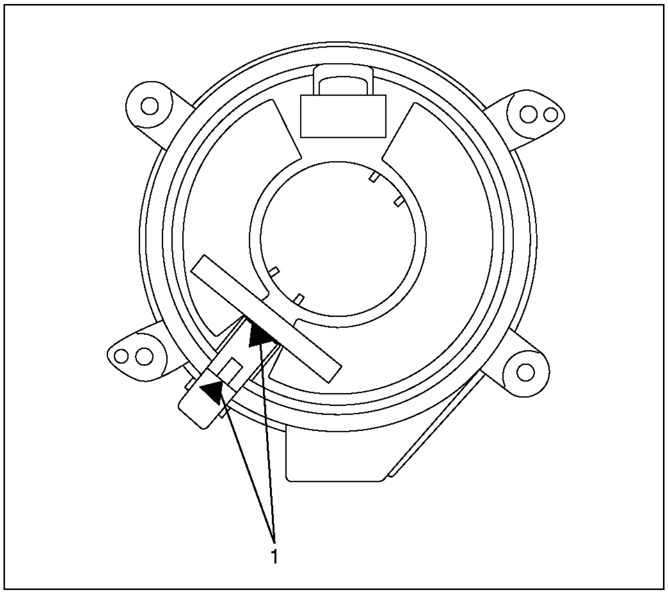


Figure 6B1 – 33

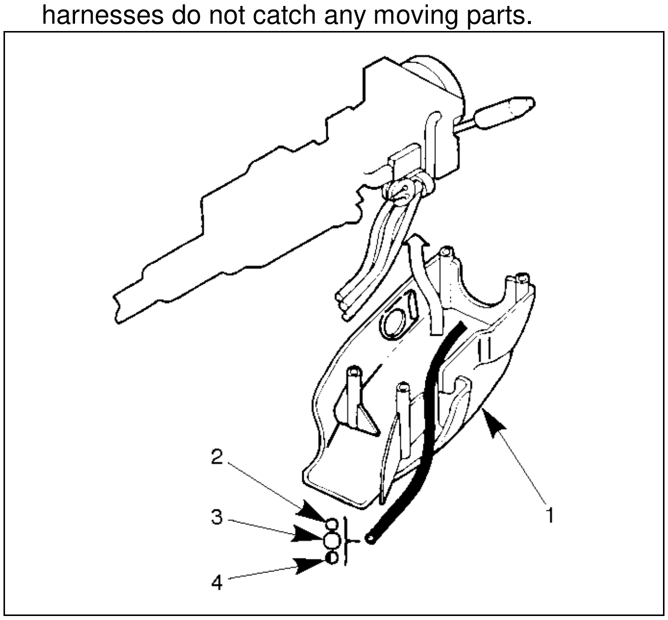
9. Turn the SRS coil fully counterclockwise, return about 3 turns and align the neutral mark (1). (with SRS air bag)

CAUTION: When turning the SRS coil fully counterclockwise, stop turning if resistance is felt. Further forced turning may damage to the cable in the SRS coil.



826RW014

10. When installing the steering column cover, be sure to route each wiring harness as illustrated so that the harnesses do not catch any moving parts.



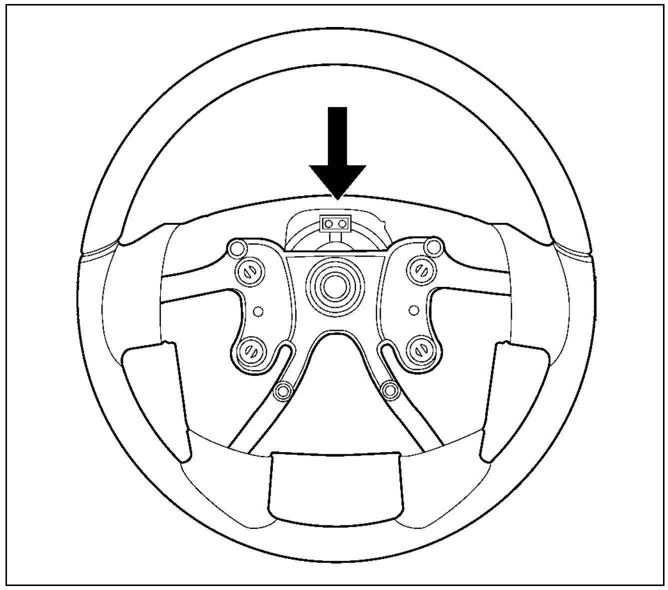
825RW017

Legend

(1) Steering Column Cover
(2) Starter Switch Harness
(3) Combination Switch Harness
(4) Inflator Module Harness

11. Install steering wheel and align the setting marks made when removing.
Refer to the adjustment method in case a mark has not been applied in this section.

NOTE: Confirm SRS and horn harness connector is fixed by the steering wheel.


RTW73BSH000701

CAUTION: Never apply force to the steering wheel in the direction of the shaft by using a hammer or other impact tools in an attempt to remove the steering wheel. The steering shaft is designed as an energy absorbing unit.

12. Tighten the steering wheel fixing nut to the specified torque.
Torque: 35 N·m (3.6 kgf·m/26 lb·ft)
13. Support the module and carefully connect the module connector and horn lead, then install inflator module.

NOTE: Pass the lead wire through the tabs on the plastic cover (wire protector) of inflator to prevent lead wire from being pinched.

14. Tighten bolts to specified torque.
Torque: 3 N·m (0.3 kgf·m/26 lb·in)
15. Install driver knee bolster (reinforcement).
16. Install instrument panel lower cover.
17. Install the engine hood opening lever.
18. Connect the yellow 2-way SRS connector and horn lead located under the steering column.
19. Connect the battery "-" terminal cable (with SRS air bag).

9 To gain easier access to the heater pipe flange and thermostat housing bolts, disconnect the engine harness and lay back on the right side of the engine bay. Apart from those harness connectors removed during the intake manifold removal, this involves the removal of wiring harness connectors and fasteners, as detailed:

a Pull out the release bar (arrows) on each of the ignition coil packs (1) on cylinders 2, 4 and 6, before disconnecting each connector.

b The coolant temperature sensor.

c The left side Pre-O2 sensor connector, 2, 4 & 6.

NOTE

Refer to 8A – Electrical Body & Chassis for the location of harness connectors, not shown.

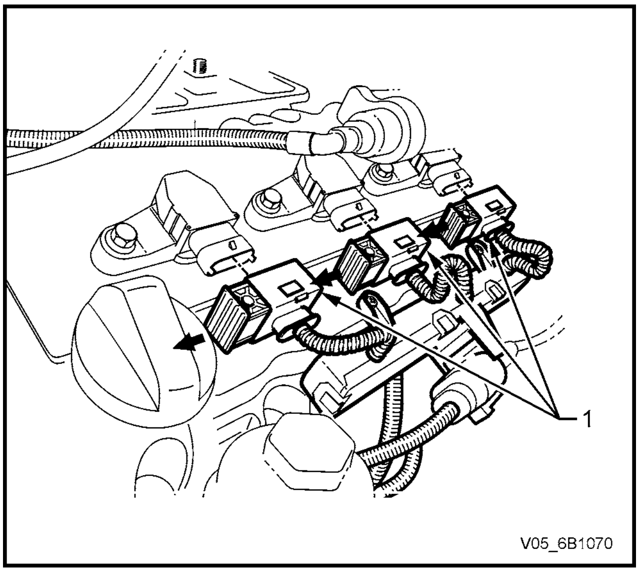


Figure 6B1 – 34

10 Remove the bolt (1) securing the engine harness ground terminal (2), to the cylinder block.

11 Prise both locking legs of the left side engine harness former (4), free, then lift up on the harness former to release.

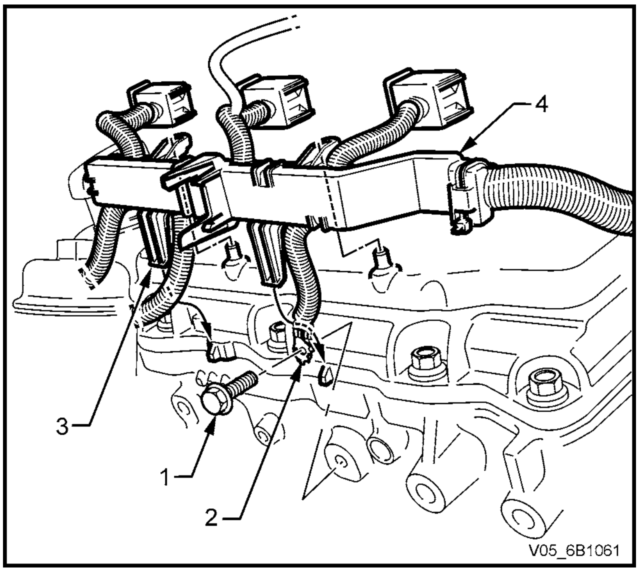


Figure 6B1 – 35

12 Working at the rear of the engine, disconnect the engine harness to transmission harness connector (1), as required.

13 Remove the two bolts (2) securing the engine harness former (3) to the rear of the engine.

14 Carefully lift the engine harness free and drape on the right side of the engine.

NOTE

For further information on removing the thermostat housing and associated components, refer to 6A1 Engine Mechanical – V6.

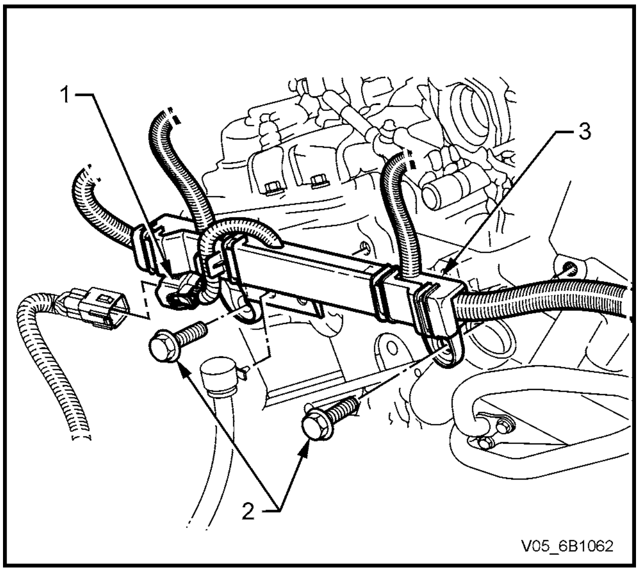


Figure 6B1 – 36

15 Remove the heater pipe assembly (1) to right-hand side cylinder head (2) attaching bolt (3).

16 Remove the heater pipe assembly to thermostat housing (4) attaching bolts (5), then remove the heater pipe assembly.

17 Remove and discard the heater pipe assembly to thermostat housing O-ring seals (6).

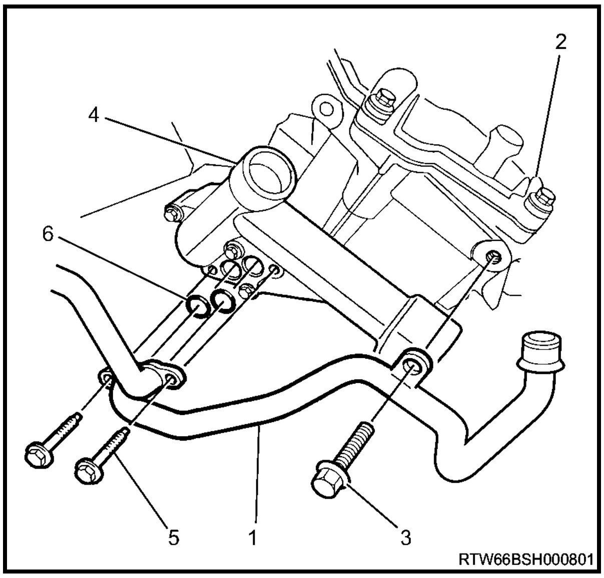


Figure 6B1 – 37

18 Remove the three thermostat housing attaching bolts (1), rubber grommets (2), then remove the thermostat housing (3).

NOTE

The upper thermostat housing attaching bolt is longer than the two lower bolts.

19 Remove and discard the thermostat housing to engine block gasket (4).

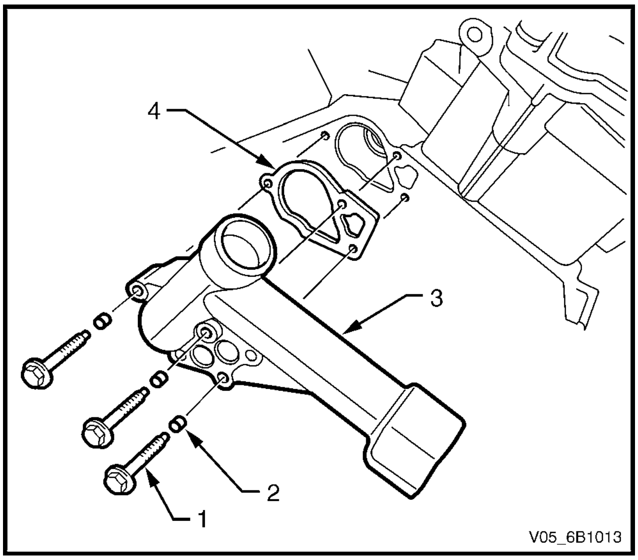


Figure 6B1 – 38

Test

1 With the thermostat (1) installed in the housing, suspend it and a suitable thermometer (2) in a container of 50% clean fresh water and 50% Dexron ® long life coolant, (conforming to GM 6277M).

NOTE

Neither the thermostat assembly (1) nor the thermometer (2) should rest on the bottom of the container because of uneven concentration of heat at this point when the container is heated.

2 Heat container until thermostat begins to open. Agitate solution to ensure uniform temperature. Note temperature and ensure thermostat opens within specified temperature range.

Thermostat Opening Specifications	
Opening Temperature	82° C
Fully Open Temperature	95° C

3 Replace thermostat if it does not meet these operating conditions.

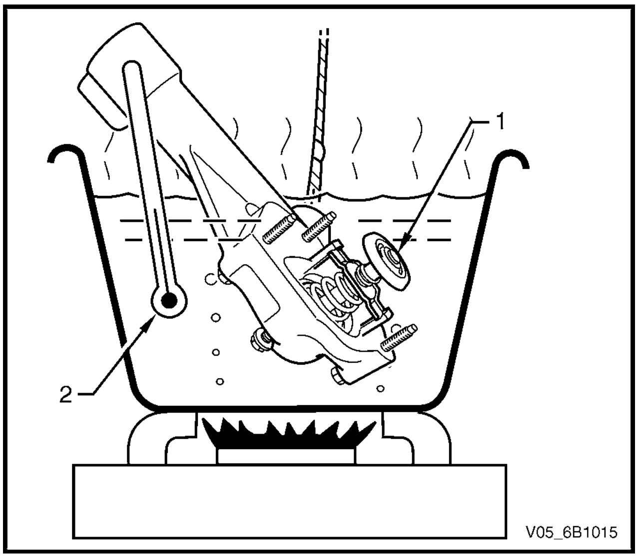


Figure 6B1 – 39

Dismantle

CAUTION

Only dismantle the thermostat if a reverse flushing operation of the cylinder block is to be carried out. If the testing operation indicates that the thermostat is faulty, then the housing and thermostat are only serviced as an assembly.

Remove thermostat (1) from thermostat housing (2) as follows:

a Secure the thermostat housing by gripping in a vice fitted with soft jaws.

WARNING

Always wear protective safety glasses when working with spring-loaded devices. Failure to do so could result in eye injury.

b Depress the retaining bar (3) on both sides of the thermostat and rotate the thermostat until it clears the retaining lugs (4) on the thermostat housing (2).

c Release the thermostat spring force.

d Remove the thermostat assembly from the thermostat housing.

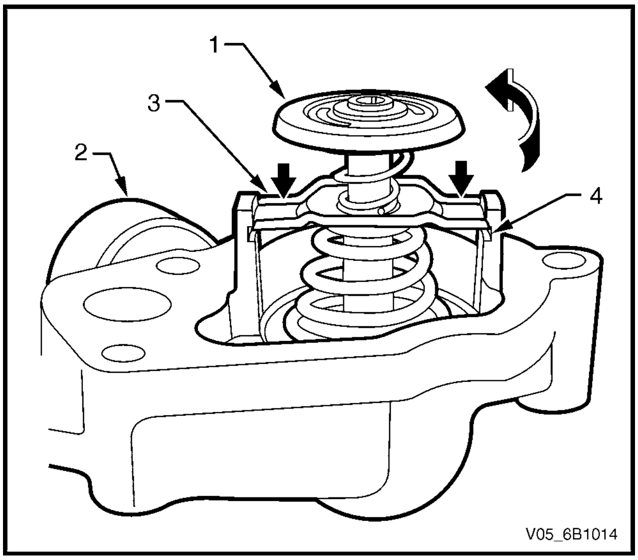


Figure 6B1 – 40

Reassembly

The reassembly process is the reverse to that used for disassembly, with the following exceptions:

1 Check that the valve sealing surface is undamaged.

2 Wipe the valve sealing surface to ensure a clean surface.

Install

WARNING

Always wear protective safety glasses when working with spring-loaded devices. Failure to do so could result in eye injury.

1 Install the thermostat into the housing (reverse to removal procedure).

2 Ensure that the engine block and thermostat housing mating surfaces are clean and dry.

3 Install a new gasket to the thermostat housing.

4 Install the thermostat housing to the engine block and secure with the attaching bolts (with rubber grommets installed). Tighten all bolts to the correct torque specification.

Thermostat housing to engine block bolt torque specification.............................10 N.m

5 Ensure that the heater pipe assembly and thermostat housing mating surfaces are clean and dry.

6 Install new O-rings to the heater pipe assembly.

7 Install heater pipe assembly to thermostat housing and secure with the attaching bolts. Tighten all bolts to the correct torque specification.

Heater pipe assembly to thermostat housing bolt torque specification.........................10 N.m

8 Install heater pipe assembly to right-hand cylinder head bolt. Tighten bolt to the correct torque specification.

Heater pipe assembly to cylinder head bolt torque specification ....35 N.m

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

9 Reinstall the engine wiring harness, securing the rear harness former to the rear of the engine with the two retaining bolts, tightened to the correct torque specification.

Rear engine harness former retaining bolts torque specification......................15 N.m

10 Reinstall the left side engine harness former to the two locating pegs, then push inward to secure.

11 Reinstall the bolt securing the engine harness ground terminal, to the left side of the cylinder block and tighten to the correct torque specification.

Engine harness ground terminal attaching bolt torque specification.......................12 N.m

12 Reinstall each wiring harness connector to its correct location, ensuring that all security clips are installed correctly.

13 Connect the heater hoses to the heater pipe assembly.

14 Install the coolant inlet pipe. Refer to 3.12 Coolant Inlet Pipe in this Section.

15 Close the radiator drain tap on the lower LHS of the radiator and remove the piece of rubber tubing to the tap outlet.

16 Reinstall the complete intake manifold assembly. Refer to 6A1 Engine Mechanical.

17 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

18 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

19 Install the radiator shroud.

20 Install the engine dress covers. Refer to 6A1 Engine Mechanical.

21 Reconnect battery ground lead. Refer to 8A_ Electrical Body & Chassis.

22 Road test the vehicle to check for correct operation.

3.9 Coolant Recovery Reservoir

Remove

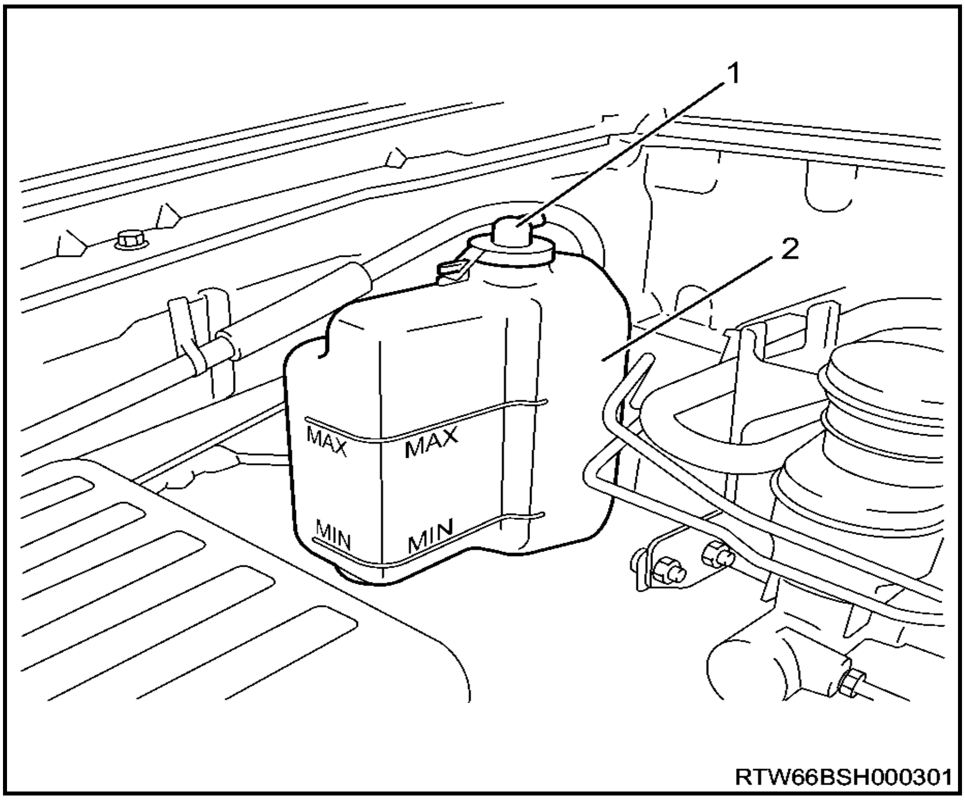


Figure 6B1 – 41

Legend

1 Filler Cap
2 Reservoir

Remove the reservoir assembly attaching screws, and remove the reservoir assembly from the vehicle.

Inspect

1 Drain contents from reservoir assembly.

2 Clean the reservoir assembly with water and dry using compressed air.

3 Check reservoir and assembly for damage, for example abrasions, cracks or distortion. Replace if required.

Install

Installation of the reservoir assembly is the reverse of removal procedures, noting the following points:

1 Refill cooling recovery reservoir and cooling system with the correct concentration of coolant. Refer to 3.3 Draining and Filling Cooling System in this Section.

2 Check coolant recovery system for leaks.

3.10 Coolant Pump

Remove

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

NOTE

The coolant pump is not to be disassembled and is replaced only as an assembly.

1 Allow engine to cool to ambient temperature (less than 50° C), and then remove the coolant filler cap (located at the front left-hand side of the engine).

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 8A – Electrical Body & Chassis.

3 Loosen coolant pump pulley to hub bolts (1).

NOTE

While the view shows the drive belt removed, it will be easier to loosen the four pulley bolts, with the belt installed.

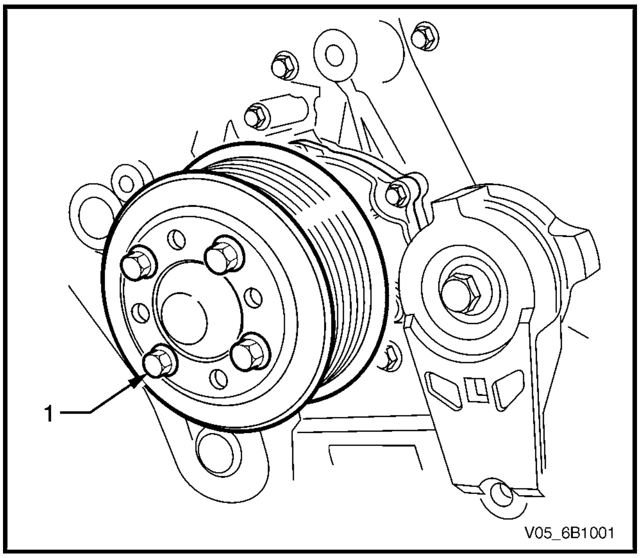


Figure 6B1 – 42

Figure 6B1 – 42 shows the drive belt routing for the HFV6 engine without air conditioning.

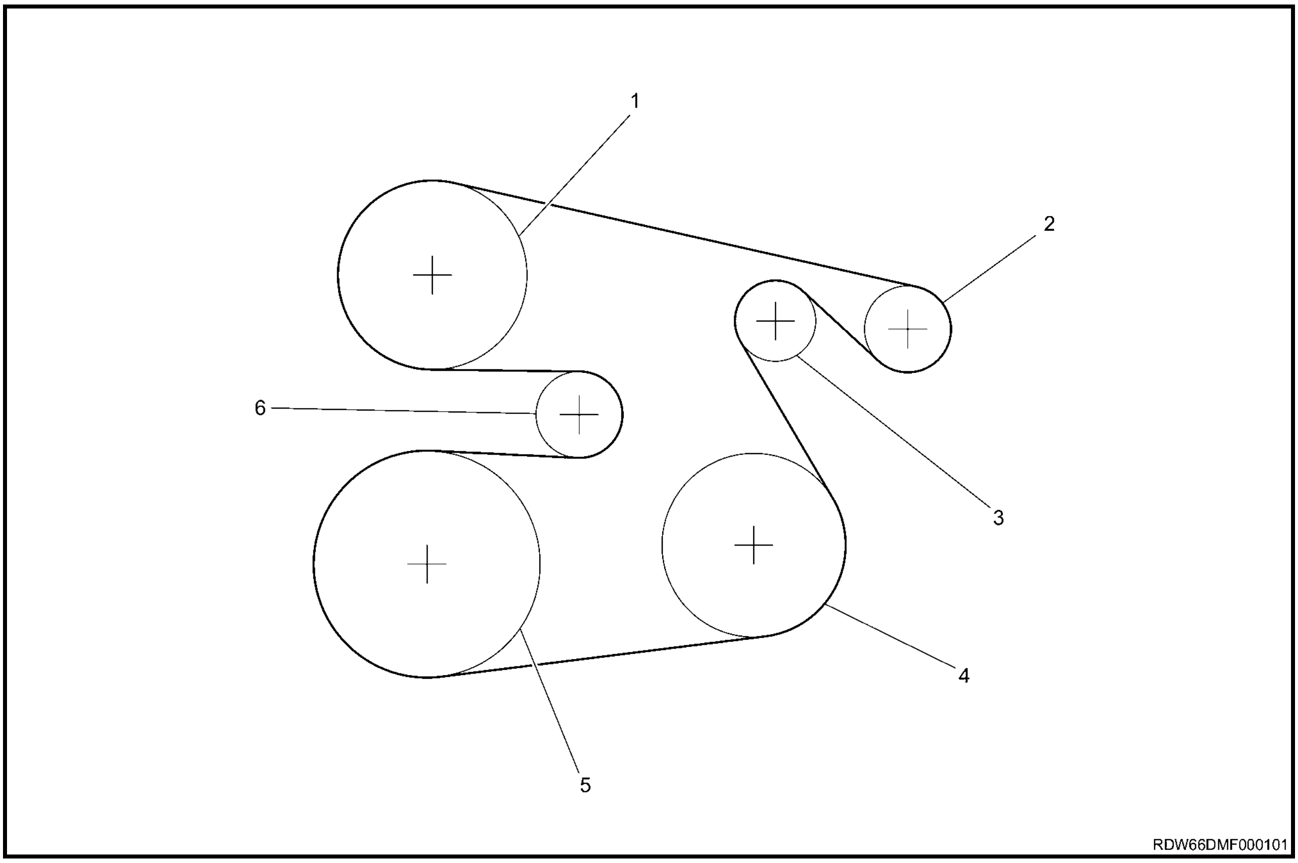


Figure 6B1 – 43

Legend

1	Coolant Pump	4	Power Steering
2	Generator	5	Crankshaft
3	Idler	6	Tensioner

4 Remove the drive belt from the coolant pump pulley:

a Rotate the drive belt tensioner pulley clockwise (arrow) using a 1/2” drive extension in order to release the drive belt tension.

b Remove the drive belt from the coolant pump pulley.

c Slowly release the drive belt tensioner.

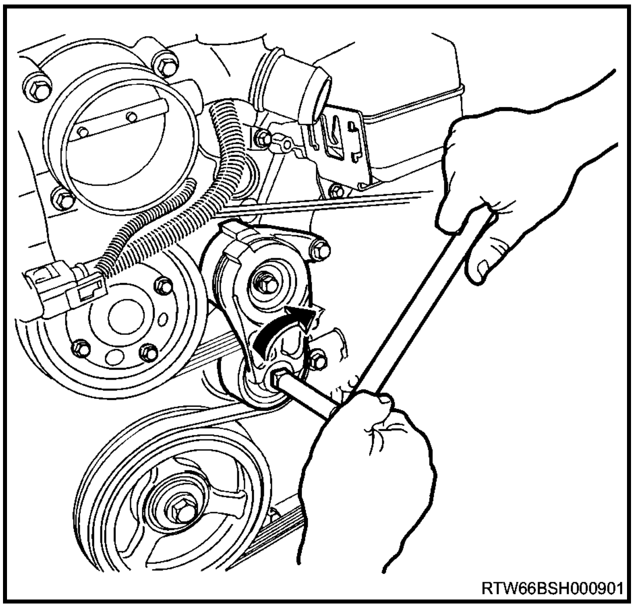


Figure 6B1 – 44

5 Drain the coolant from the system. Refer to 3.3 Draining and Filling Cooling System in this Section.

6 Remove the four coolant pump pulley attaching bolts (1), then remove the pulley (2) from the hub (3).

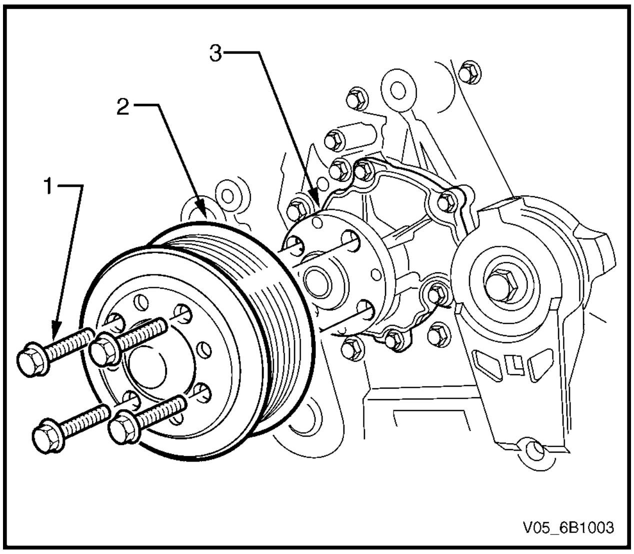


Figure 6B1 – 45

7 Remove the six coolant pump attaching bolts (1) from the coolant pump (2).

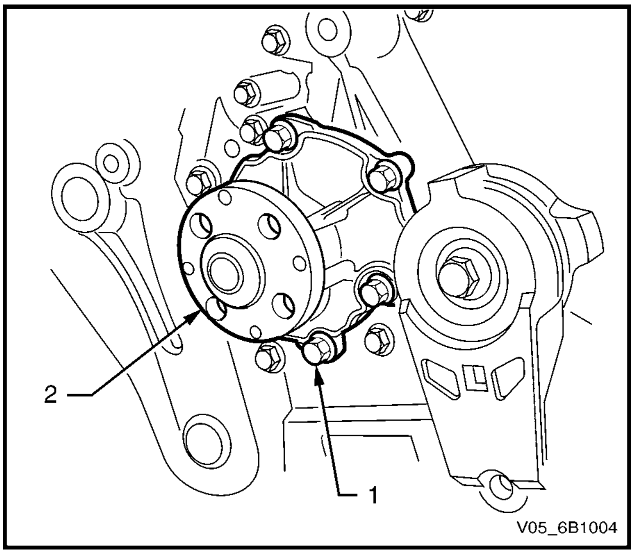


Figure 6B1 – 46

8 Remove the coolant pump (1) from the engine front cover.

NOTE

If necessary, use a soft-faced hammer to lightly tap coolant pump housing to separate it from front cover.

9 Remove coolant pump to front cover gasket (2) and discard.

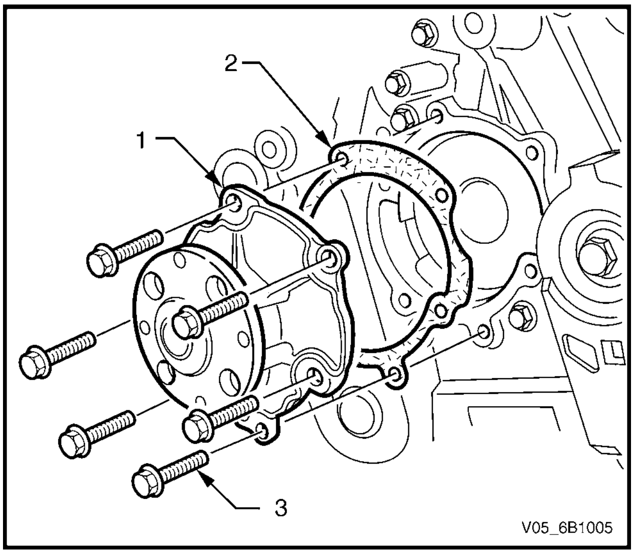


Figure 6B1 – 47

Inspect

1 Rotate the coolant pump hub (1). The hub and impeller (2) should turn straight and smoothly. If the hub wobbles, is noisy or feels rough when rotated, replace the coolant pump.

2 Inspect the exterior of the coolant pump for the following:

- Damage to the coolant pump hub bolt threads for the coolant pump pulley
- Damage to the coolant pump bolt holes

3 Examine the coolant pump shaft (3) and the weep hole (4) in the coolant pump housing (5) for signs of leakage. If coolant leakage is evident, replace the coolant pump.

4 Inspect the interior of the coolant pump for the following:

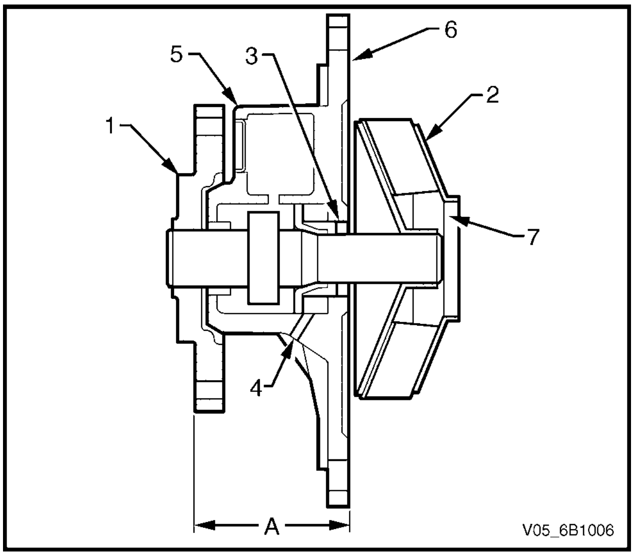


Figure 6B1 – 48

- Damage to the coolant pump gasket-sealing flange surface (6)
- Damage, corrosion or restrictions to the coolant pump impeller
- Damage, corrosion or restrictions to the coolant passages (7)

NOTE

Hub Flange to rear of Pump Housing measurement (A) should be 44 ± 0.25 mm.

5 Replace the coolant pump as necessary.

Reinstall

1 Ensure that the coolant pump and front cover mating surfaces are clean and dry.

2 Install a new gasket to the front cover.

3 Clean threads of coolant pump to front cover and cylinder block attaching bolts.

4 Install coolant pump and attaching bolts. Tighten all bolts to the correct torque specification.

Coolant pump to front cover bolt torque specification ....10 N.m

5 Install coolant pump pulley and attaching bolts (1).

6 Install drive belt (reverse to removal procedures) and ensure that the drive belt is aligned with all accessory pulleys and crankshaft balancer drive belt grooves.

NOTE

Refer to Figure 6B1 – 43, as required for the correct drive belt routing.

7 Tighten coolant pump pulley attaching bolts (1) to the correct torque specification.

Coolant pump pulley to hub bolt torque specification	12 N.m

8 Close the radiator drain tap on the lower LHS of the radiator and remove the piece of rubber tubing to the tap outlet.

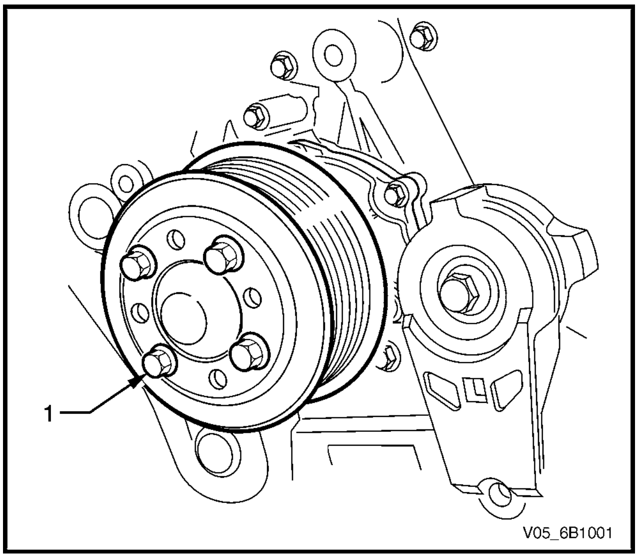


Figure 6B1 – 49

9 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

10 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

11 Install the radiator shroud.

12 Reconnect battery ground lead. Refer to 8A – Electrical Body & Chassis.

System Inspection (with SRS air bag)

Turn the ignition switch to "ON" while watching warning light.

The light should flash 7 times and then go off. If lamp does not operate correctly, refer to Restraints section.

3.11 Coolant Outlet Housing

Remove

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), and then remove the coolant filler cap (located at the front left-hand side of the engine).

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 8A – Electrical Body & Chassis Battery.

3 Drain the coolant from the system. Refer to 3.3 Draining and Filling Cooling System.

4 Remove the complete intake manifold assembly. Refer to 6A1 Engine Mechanical.

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

5 Remove upper radiator hose clamp (1) at the coolant outlet housing connection (2), disconnect hose from coolant outlet.

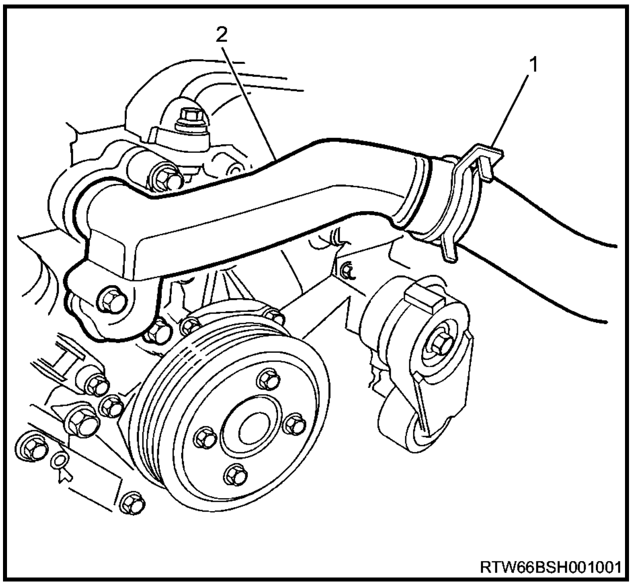


Figure 6B1 – 50

6 Remove the two coolant outlet housing attaching bolts (1), and remove coolant outlet housing (2).

7 Remove and discard coolant outlet housing O-ring (3) and seal (4).

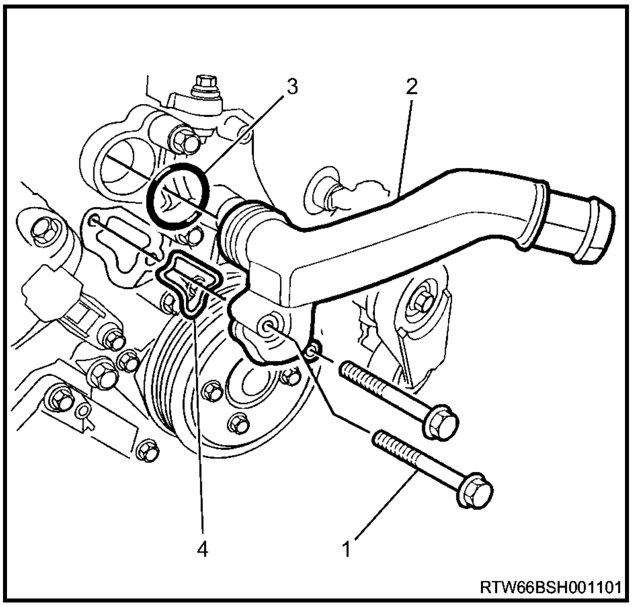


Figure 6B1 – 51

Reinstall

1 Ensure that the coolant outlet housing and front outlet mating surfaces are clean and dry.

2 Install new O-ring and seal to coolant outlet housing.

3 Install coolant outlet housing and attaching bolts. Tighten all bolts to the correct torque specification.

Coolant outlet housing to front outlet bolt torque specification..............................10 N.m

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

4 Connect the upper radiator hose and clamp to the coolant outlet housing connection.

5 Close the radiator drain tap on the lower RHS of the radiator and remove the piece of rubber tubing to the tap outlet.

6 Reinstall the intake manifold assembly. Refer to 6A1 Engine Mechanical.

7 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

8 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

9 Reconnect battery ground lead. Refer to 8A – Electrical Body & Chassis.

3.12 Coolant Inlet Pipe

Remove

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), and then remove the coolant filler cap (located at the front left-hand side of the engine).

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 8A – Electrical Body & Chassis.

CAUTION

Refer to ' Environmental Issues ' in 3.1 Service Notes, before draining the coolant.

3 Draining the coolant from the system. Refer to 3.3 Draining and Filling Cooling System in this Section.

4 Raise the front of the vehicle and support on safety stands. Refer to 0A General Information for the location of jacking and support points.

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

5 Remove lower radiator outlet hose clamp (1) at the coolant inlet pipe connection, then disconnect the hose from coolant inlet pipe (2).

6 Remove the coolant inlet pipe from the engine block by removing the attaching bolt (3).

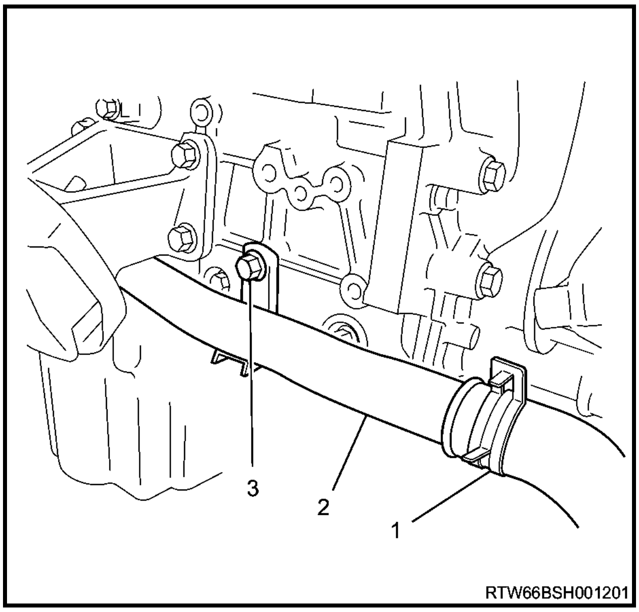


Figure 6B1 – 52

7 Remove the coolant inlet pipe (1) to thermostat housing (2) attaching bolt (3).

8 Remove the coolant inlet pipe by manoeuvring the pipe to the front of the vehicle and withdrawing the pipe from below the vehicle, between the cross member and radiator.

9 Remove and discard coolant inlet pipe O-ring (4) from the thermostat end of the coolant inlet pipe.

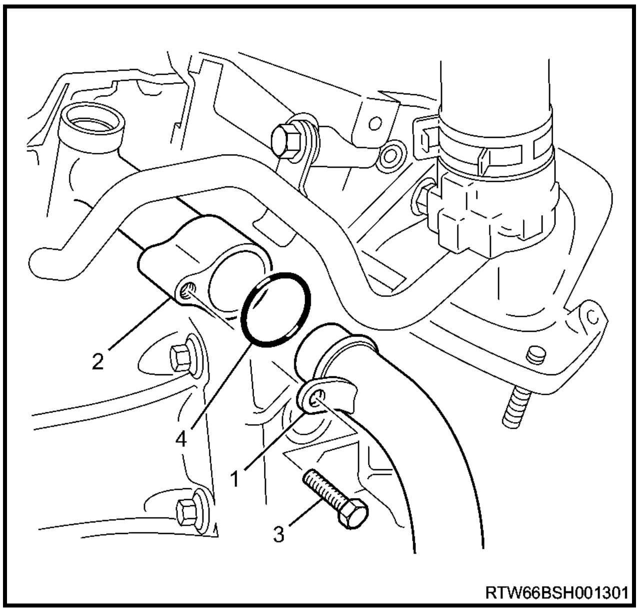


Figure 6B1 – 53

Install

1 Ensure that the coolant inlet pipe and thermostat housing mating surfaces are clean and dry.

2 Install new O-ring to the coolant inlet pipe.

3 Install coolant inlet pipe at the thermostat housing and secure with the attaching bolt. Tighten all bolts to the correct torque specification.

Coolant inlet pipe to thermostat housing bolt torque specification..........................23 N.m

4 Raise the front of the vehicle and support on safety stands. Refer to 0A General Information for the location of jacking and support points.

5 Reinstall the coolant inlet pipe to the engine block and secure with the bolt tightened to the correct torque specification.

Coolant inlet pipe to engine block bolt torque specification..25 N.m

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

6 Connect the lower radiator outlet hose and clamp to the coolant inlet pipe connection.

7 Close the radiator drain tap on the lower RHS of the radiator and remove the piece of rubber tubing to the tap outlet.

8 Lower the front of the vehicle.

9 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

10 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

11 Reconnect battery ground lead. Refer to 8A – Electrical Body & Chassis.

3.13 Cooling Fan and Shroud Assembly

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES, before removing the ground lead.

1 Disconnect the battery ground lead. Refer to 8A – Electrical Body & Chassis.

2 Remove the intake duct and mass air flow as an assembly. Refer to 6A1 Engine Mechanical.

3 Remove the coolant recovery hose from the fan shroud retaining clip.

4 Depress tang on main wiring harness to cooling fan motor wiring harness connector and separate connector (1).

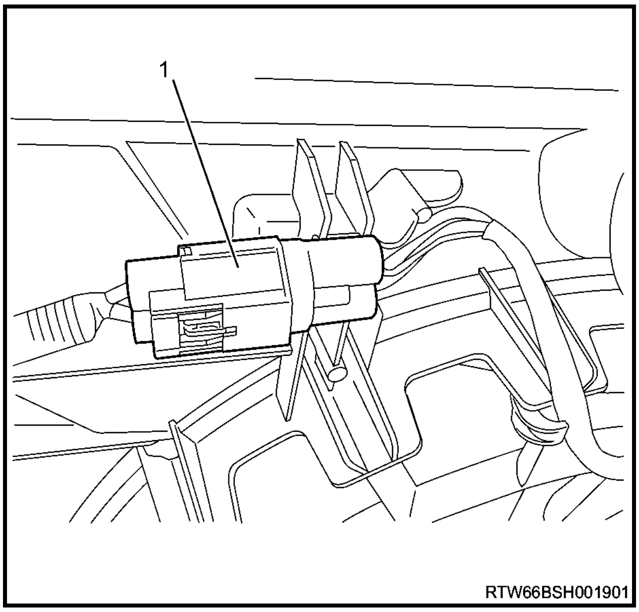


Figure 6B1 – 54

7 Remove the attaching bolt (1), from both sides of the radiator fan and shroud assembly.

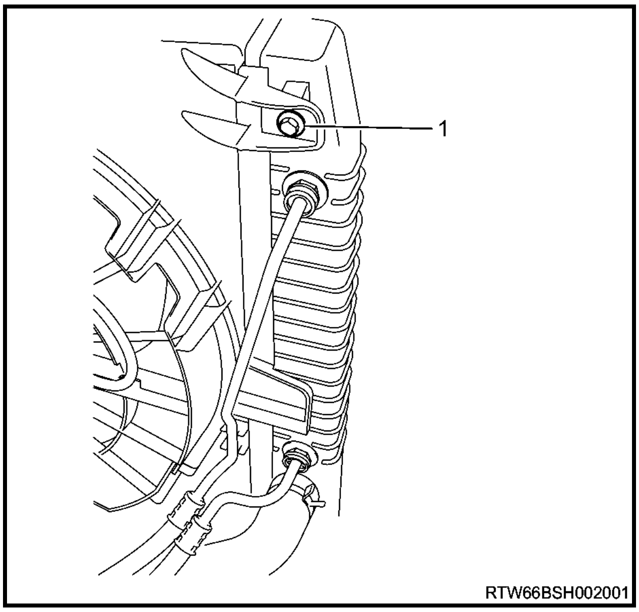


Figure 6B1 – 55

CAUTION

When removing, transporting or installing the fan and shroud assembly, do not grasp the assembly by the fan rings (1) as this may bend the fan motor shaft and cause fan vibrations

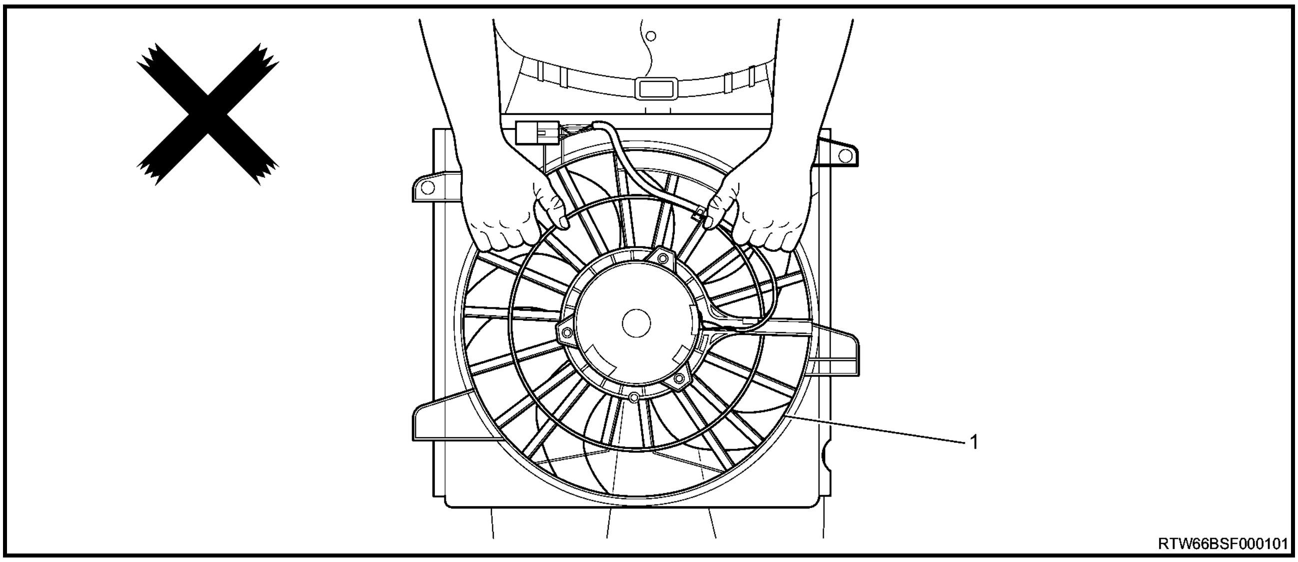


Figure 6B3 – 56

When handling the fan assembly, always hold the assembly at the fan shroud (1).

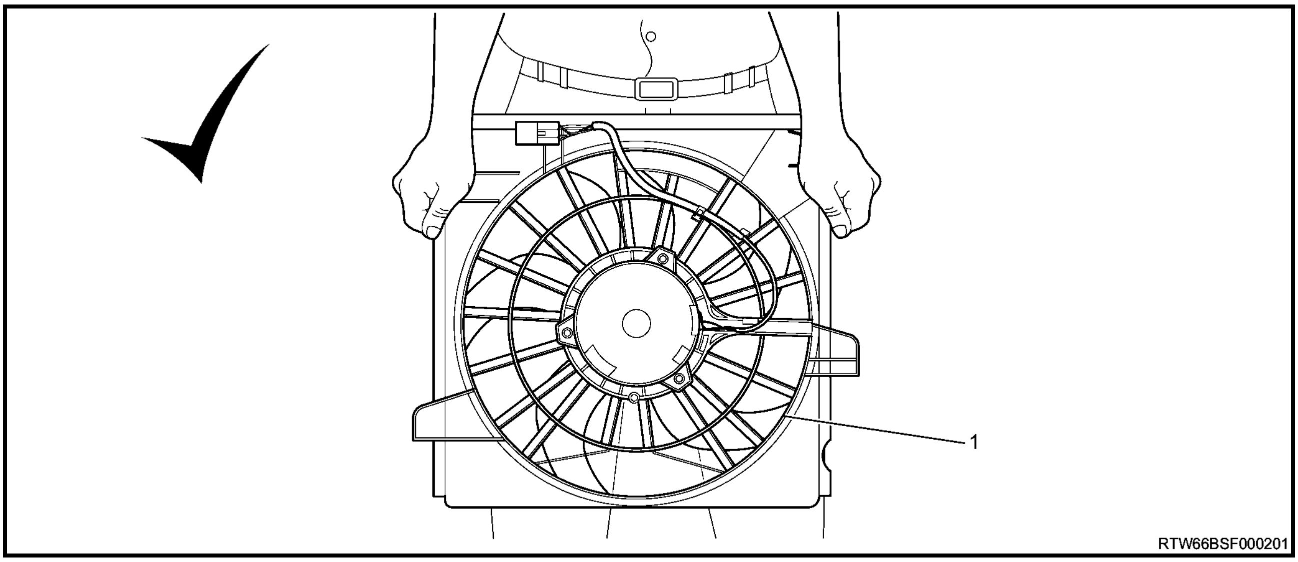


Figure 6B3 – 57

Install

Installation of the cooling fan and shroud assembly is the reverse of removal procedures, noting the following points:

1. Ensure that fan and shroud assembly to radiator attaching clips are fully engaged.
2. Ensure that the top automatic transmission cooling pipe (if fitted) is installed to the integral shroud clip.
3. Check cooling fan operation. Refer to 6C1-2 Engine Management Diagnostics. Also check for correct rotational direction of the cooling fan.

Disassemble

1 Remove cooling fan and shroud assembly as previously described.

NOTE

Neither fan is to be separated from its fan motor. The assembly is carefully balanced during manufacture and duplicating this balance on reassembly, is not possible.

2 Remove the motor assembly wiring harness (1) from the integral clips that form a part of the shroud (2).

3 Remove screws (3) attaching the motor assembly (to the shroud, then remove each motor, fan and wiring assembly (4) from the shroud.

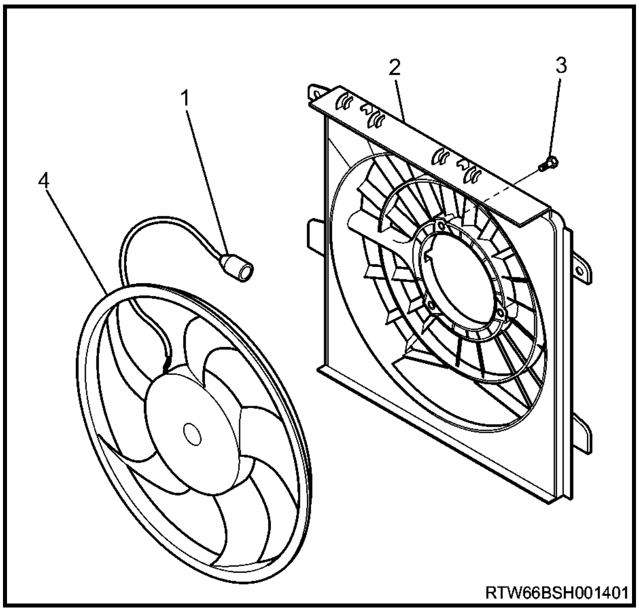


Figure 6B1 – 58

Reassemble

Reassembly is the reverse of disassembly procedures, noting the following points:

1 Tighten motor to shroud attaching screws to the correct torque specification. Do not over-tighten.

Fan motor to shroud screw torque specification	5 N.m

2 Ensure that all wiring is routed correctly and secured by the shroud clips.

3 Install cooling fan and shroud assembly to the radiator, as previously described.

3.14 Flexible Transmission Cooler Hose

Replace

NOTE

The flexible hoses are not serviced separately. Therefore, should a hose require replacement, then the hose and radiator to hose cooler pipe assembly must be fitted.

1 Place a drip tray beneath the engine and radiator section.

2 Disconnect the transmission cooler pipes from the transmission.

- Release the verifier disk (2) by pulling back with the fingers, then slide back down the cooler line (1).
- Open the cooler line release tool J-41623-B and slip over cooler line to be disconnected from the transmission, above the verifier disk (2), as shown.
- Slide the release tool along the line to engage with the quick-connect fitting.
- While pushing inwards, rotate the tool about one sixth of a turn to release the spring clip holding the line.
- With the release tool held in this position, pull back on the cooler line to release.
- Repeat this process with the remaining line and quick-connect fitting.

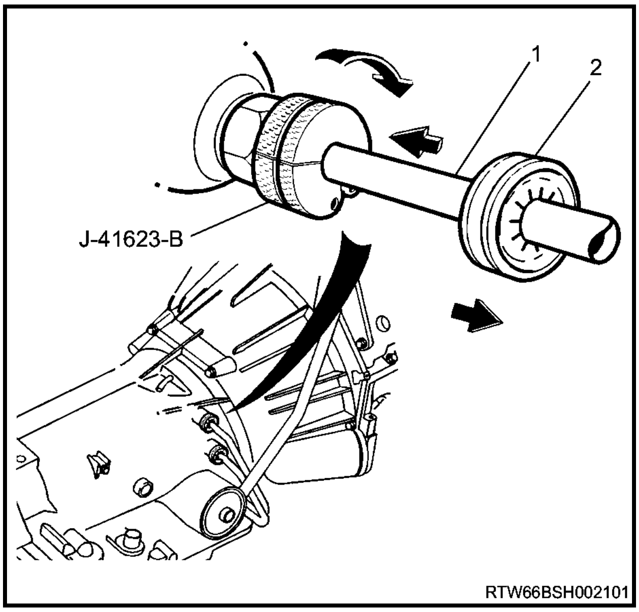


Figure 6B1 – 59

3 Plug both pipe openings and hoses to minimise fluid loss and prevent foreign matter entry.

4 Disconnect the transmission cooler hose/line assemblies from the radiator quick connect fittings as follows:

- Pull back the verifier disc (1) from the quick connect fitting (2) and slide it back along the line.
- Open the release tool, Tool No J-41623-B (3), slip it over the cooler line to be disconnected from the radiator, ahead of the verifier disc.
- Slide the release tool along the cooler line and engage it with the quick-connect fitting (2).
- While pushing inwards, rotate the release tool clockwise, about one sixth of a turn to release the spring clip holding the cooler line.
- With the release tool held in this position, pull back on the cooler line to release it.
- Plug the openings to prevent fluid loss and/or contamination.
- Repeat the procedure to remove the remaining cooler line.

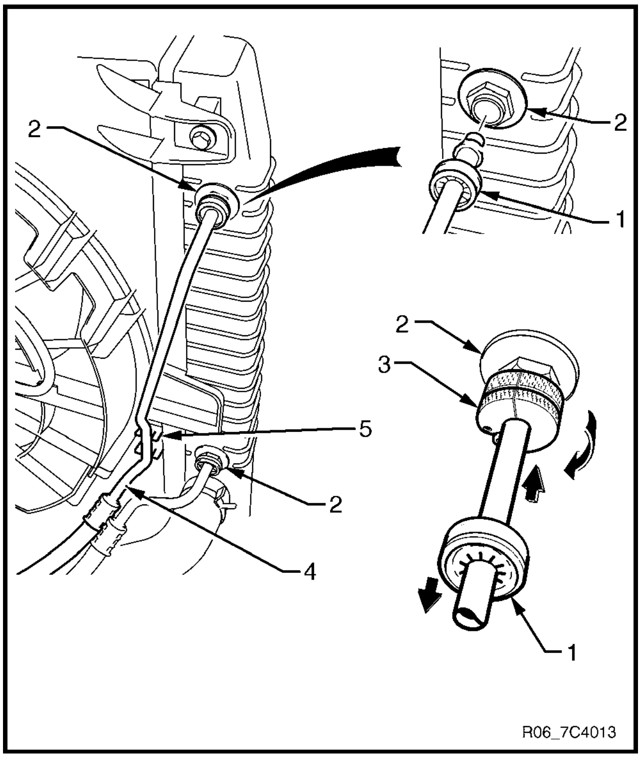


Figure 6B1 – 60

NOTE

If the spring clip and/or O-ring seal in the quick-connect fitting is damaged during the removal process, the complete fitting must be replaced.

5 Unclip the outlet cooler line (4) from the radiator fan shroud (5).

NOTE

Should the spring clip or the O-ring seal in the quick connect fitting be damaged during the line removal process, then the complete fitting must be replaced.

Reinstall

1 Remove the plugs installed in the transmission cooler line and hose openings and wipe all exposed parts with a clean shop rag.

- Smear clean automatic transmission fluid on each cooler line end, then push into the radiator quick connect fittings. As a security check gently pull on the connector to ensure correct engagement.
- As a security check, push and clip each verification disc into place over the quick-connect fittings. If difficulty is experienced, repeat the installation process until the verification disc can be clipped into place over the radiator quick-connect fitting.

CAUTION

If the verifier disc does not clip into place, the quick-connect fitting is not engaged, rectify this before proceeding.

- Snap the outlet cooler line (4) in the clip (5) of the radiator fan shroud
- At the transmission end, again clean the line ends and proceed as detailed in step 2. As a further security check ensure that each verification disc can be pushed into place over the quick connect fitting. If difficulty is experienced, then the line has not been completely installed. Remove and repeat the installation process again until the verification disc can be clipped into place over the transmission quick connect fitting
- Ensure that all line clamps are fitted correctly and that the lines and hoses are correctly routed and free of obstructions
- Tighten the screw attaching the cooler lines bracket to the correct torque specifications
- If required, top up the transmission fluid level (cold)
- Start the engine and check for any fluid leak at the fittings. If a leak is found, stop the engine and rectify the leak

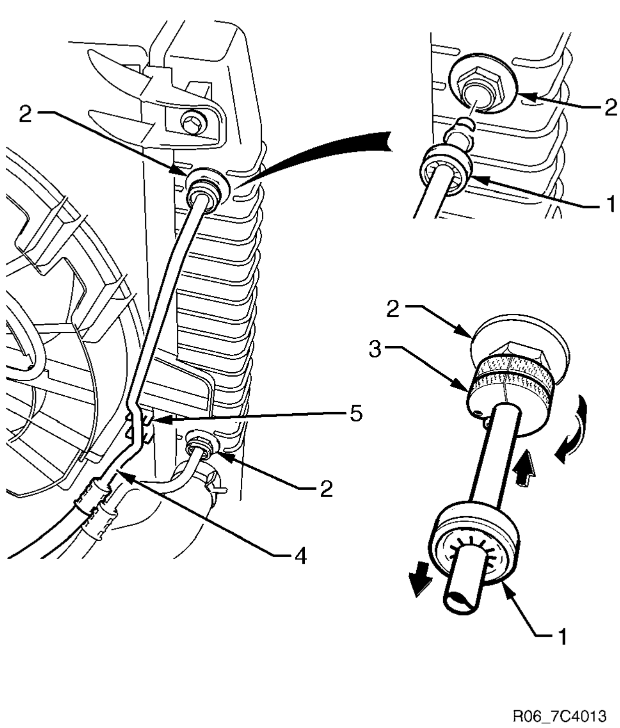


Figure 6B1 – 61

Transmission cooler lines bracket attaching screw torque specification ....23.0 Nm

3.15 Radiator

Remove

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items.

1 Allow engine to cool to ambient temperature (less than 50° C), then remove coolant filler cap.

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 00 Warnings, Cautions and Notes, before removing the ground lead.

2 Disconnect the battery ground lead. Refer to 8A – Electrical Body & Chassis.

3 Depress the tang on the main wiring harness to the cooling fan motor wiring harness connector (1) and separate the connector.

4 Remove the radiator cooling fan and shroud assembly. Refer to 3.13 Cooling Fan and Shroud Assembly in this Section.

5 Drain the coolant from the system. Refer to 3.3 Draining and Filling Cooling System in this Section.

CAUTION

Refer to 'Environmental Issues' in 3.1 Service Notes, before draining the coolant.

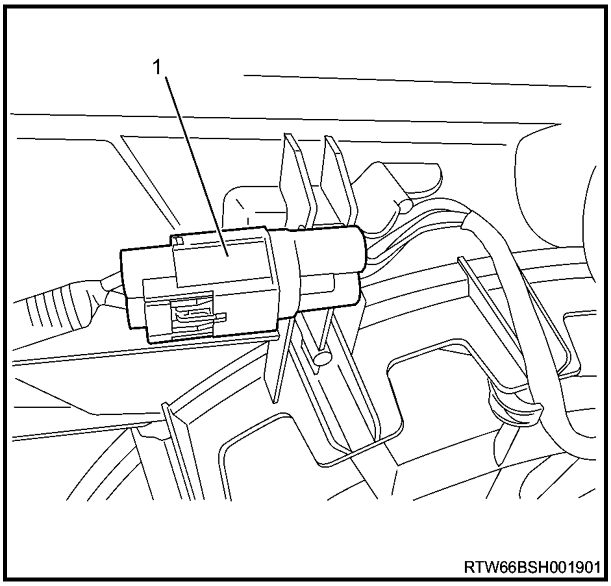


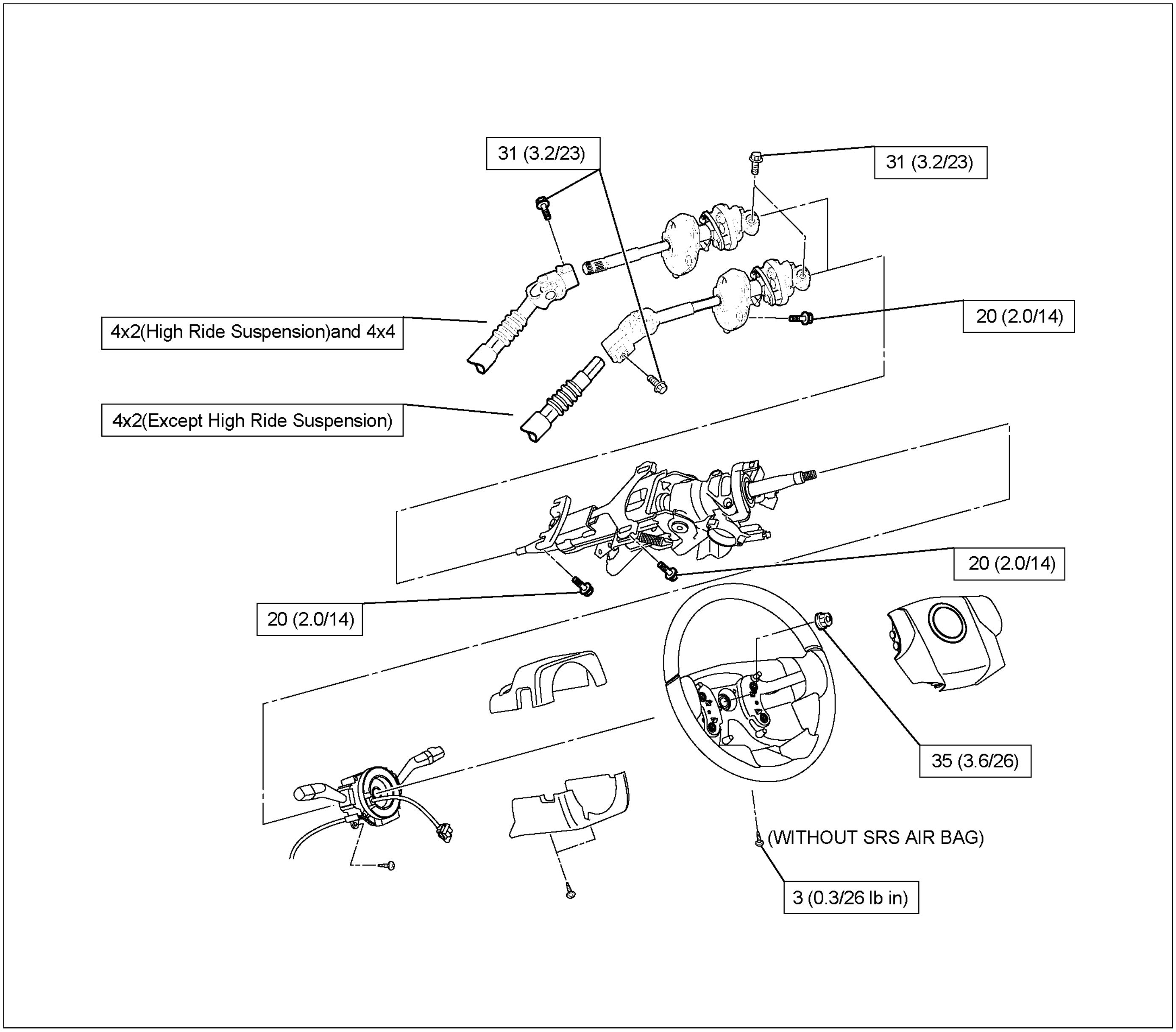
Figure 6B1 – 62

Supplemental Restraint System Steering Wheel & Column and Associated Parts

Main Data and Specifications

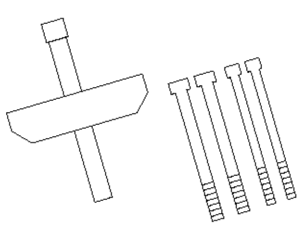
Torque Specifications

N·m (kgf·m/lb·ft)



RTW73BLF000501

Special Tools

ILLUSTRATION	TOOL NO. TOOL NAME
 901RS294	**5-8521-0016-0** **(J-29752)** Steering wheel remover

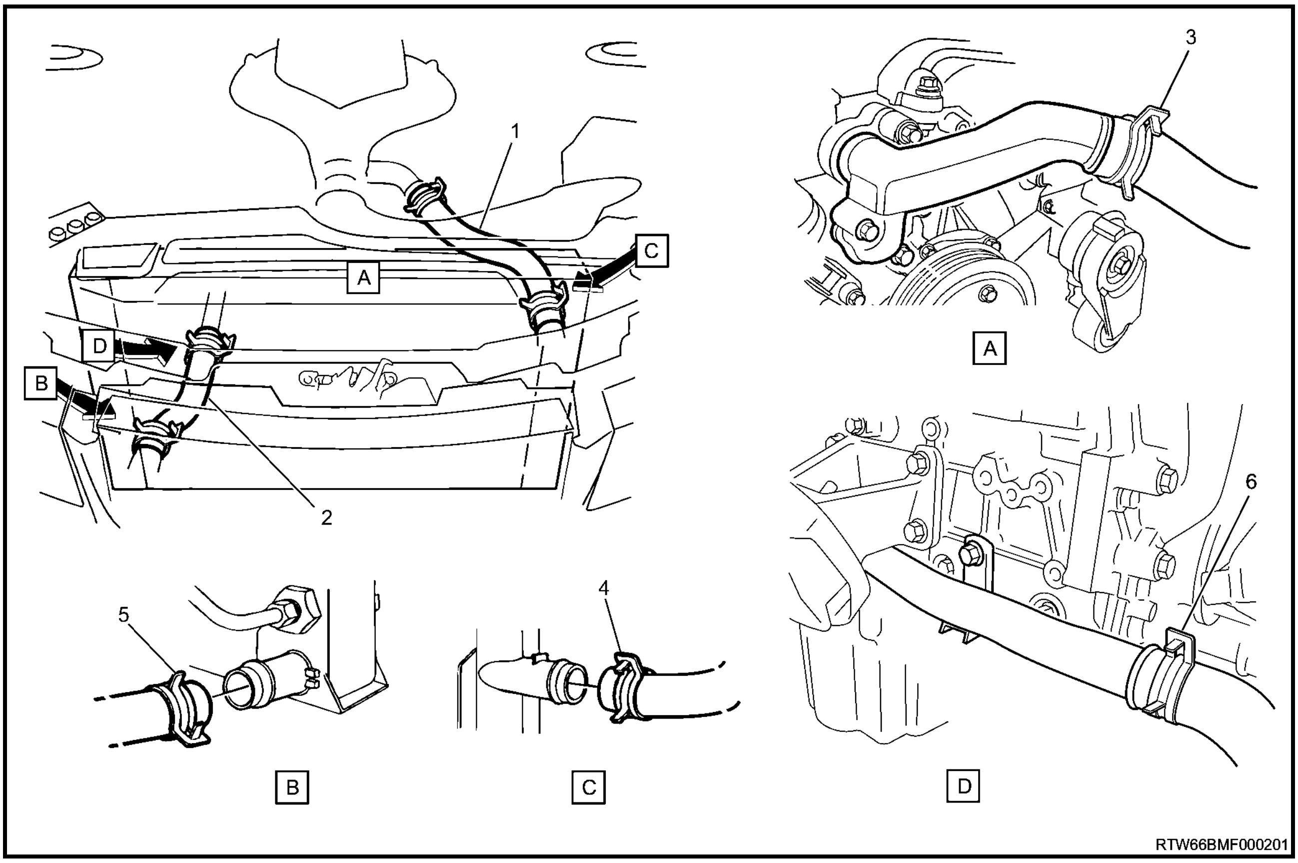


Figure 6B1 – 63

Legend

1	Radiator Hose – Upper	4	Hose Clamp – Upper Hose to Radiator Inlet
2	Radiator Hose – Lower	5	Hose Clamp – Lower Hose to Radiator Outlet
3	Hose Clamp – Upper Hose to Engine Outlet Housing	6	Hose Clamp – Lower Hose to Engine Coolant Inlet Pipe

6 Remove radiator upper hose (1) from radiator connection.

7 Remove radiator lower hose (2) from radiator connection.

8 Remove the two rubber insert mounting brackets supporting the top of the radiator.

9 Remove the two lower attaching bolts (either side) and the rubber mounts.

10 Remove the radiator from the vehicle.

WARNING

Always wear protective safety glasses when working with spring type hose clamps. Failure to do so could result in eye injury.

Reinstall

Installation of the radiator is the reverse of removal procedures, noting the following points:

1 Before installing radiator, inspect core to ensure that there is no foreign matter in core fins. Clean out between core fins with compressed air, blowing from rear to front.

2 If the vehicle is fitted with an automatic transmission, remove plugs from the removed cooling pipe ends and the two quick connect fittings.

3 After wiping cooler line ends and smearing clean automatic transmission fluid over each flared line end, push into the quick connect fitting to engage. As a security check, tug on each line to ensure correct engagement.

4 Check the transmission fluid level. Refer to the following references as required:

- 7C4 Automatic Transmission
- 4L60E On-vehicle Servicing

5 Install the following hoses:

a. Lower radiator hose, securing with the hose clamp.

b. Upper radiator hose, securing with the hose clamp.

6 Install the radiator cooling fan and shroud assembly. Refer to 3.13Cooling Fan and Shroud Assembly in this Section. Ensure that electrical connectors and the transmission cooler lines are seated correctly in the integral retainer clips before install upper radiator shroud.

7 Refill cooling system. Refer to 3.3 Draining and Filling Cooling System in this Section.

8 Check for coolant leaks. Refer to 3.7 Pressure Testing in this Section.

9 Reconnect battery ground lead. Refer to 8A Electrical Body & Chassis.

10 Check cooling fan operation. Refer to 6C1-2 Engine Management Diagnostics. Also check for correct rotational direction of cooling fan.

Radiator Repair Procedure

Repairable Leaks

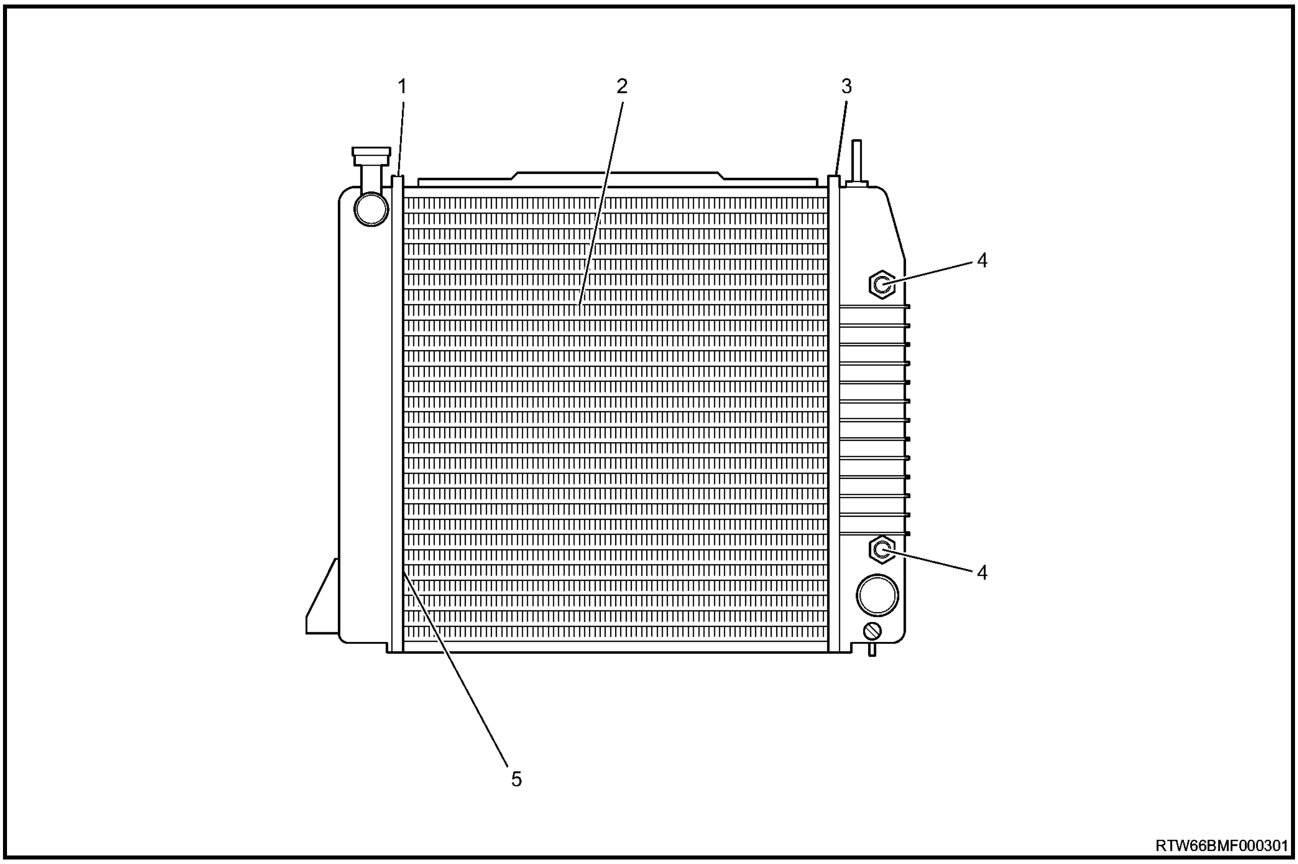


Figure 6B1 – 64

Legend:

1 Left-hand Side Tank Seal
2 Core Tubes
3 Right-hand Side Tank Seal
4 Oil Cooler Pipe Fittings
5 Joint Between Tube and Header

There are two types of leaks that can be repaired on the aluminium-plastic radiator; core leaks and automatic transmission oil cooler seal leaks. Leaks in the plastic tanks or the seals between the side tanks and the headers cannot be repaired; therefore the radiator must be replaced.

Core leaks may occur in a tube or in the joints between the tubes and the headers. Seal leaks may occur in the joints between the plastic tanks and the headers or in the joints between the oil cooler fittings and the tank (vehicles with automatic transmission).

While some leaks can be repaired while the radiator is installed in the vehicle, it is strongly recommended that the radiator is first removed from the vehicle.

NOTE

Minor damage to tubes, or tube to header joint (holes up to 1 mm diameter max.) can be repaired. Core replacement is necessary if damage is any greater.

Repair Method

Repairs to the aluminium radiator core should only be made using the recommended 'Aluminised Silicon' based liquid repair agent, in accordance with the recommended procedure outlined in General Core Repair in this Section. Refer to the current Partfinder™ for Aluminised Silicon base liquid part number.

For damaged areas that are between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than is necessary. Usually 6 mm (distance ‘A’) beyond the leak or damage area, up to a maximum of 25 mm of total fin material, is enough to make an effective repair.

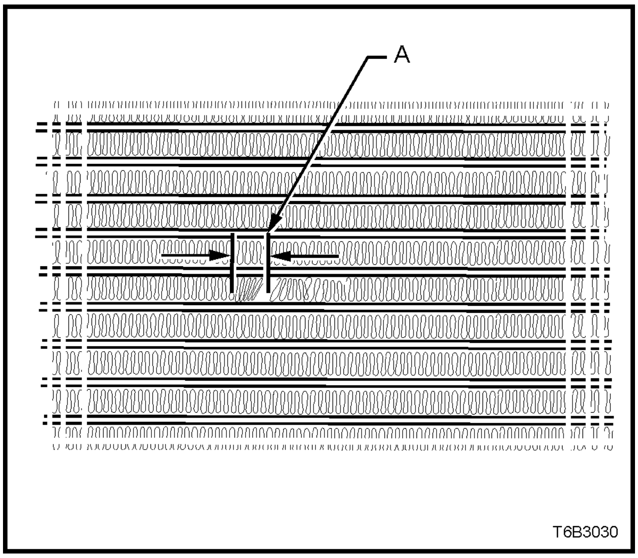


Figure 6B1 – 65

Tube Blocking

If a tube is severely damaged, it can be blocked off.

NOTE

Do not block off more than two tubes in a radiator. Blocking off more than two tubes will reduce the cooling capacity and efficiency of the system and possibly result in an overheated engine.

The tube should be cut off 6 mm from the header (1) and pinched shut before it is cleaned and sealed. Refer to General Core Repair in this Section.

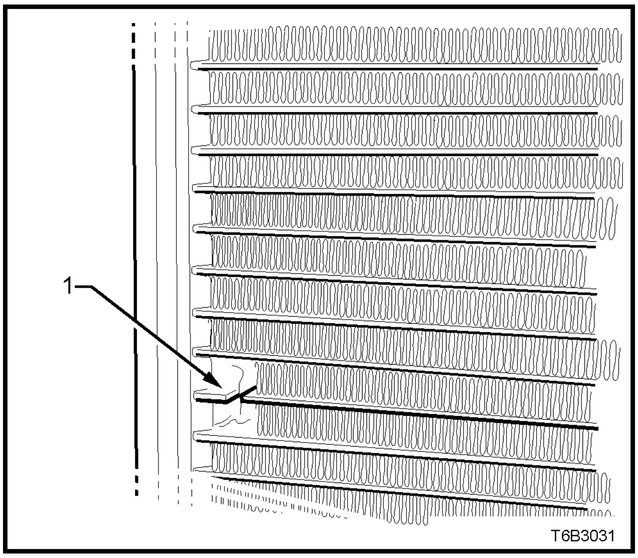


Figure 6B1 – 66

Header Repair

If the header or a tube near the header requires a repair, the side tank does not have to be removed. If the repair requires the removal of the header tank, then the radiator must be replaced.

General Core Repair

NOTE

The need for careful preparation of the surface in the repair area cannot be over-emphasised. If the leak area surface is not clean, the repair material will not adhere to the surface.

CAUTION

Refer to 'Environmental Issues' in 3.1 Service Notes, before draining the coolant.

1 Drain the coolant from the system. Refer to 3.3 Draining and Filling Cooling System in this Section.

2 Remove the radiator. Refer to 3.15 Radiator in this Section.

3 If necessary, carefully cut away fins to expose the damaged area.

NOTE

Do not cut away more than 25 mm total fin material.

4 Clean away dirt etc. with water. Dry the affected area using hot air from a hair drier.

CAUTION

Do not apply flame to dry damaged area.

5 Clean affected area with petrol to remove any traces of oil.

6 Thoroughly stir contents of repair agent.

NOTE

In cases of extended shelf life, the silicon in solution may separate from the thinner base. Should this occur, mix contents well until agent is again homogeneous.

7 Apply repair agent sparingly to damaged area. Do not apply an excessive amount, as this will cause blockage of the radiator tube.

NOTE

Use a clean, dry wooden applicator to 'DRIP' agent onto damaged area of radiator.

8 Allow radiator to stand in a clean, dry area for a minimum of 3 hours (at ambient temperature of 20 – 30° C) with adequate ventilation.

NOTE

Do not apply heat or flame to promote drying.

9 Reinstall the radiator. Refer to 3.15 Radiator in this Section.

Transmission Oil Cooler Leak Test

If the transmission oil cooler is suspected of leaking oil, test it before the radiator is replaced, as follows:

1 Disconnect oil cooler pipes at the flexible hose connections. Refer to 3.14 Flexible Transmission Cooler Hose, in this Section.

2 Plug one of the connections, using a blocked pipe fitting and attach an air supply to the other flexible hose.

3 Remove coolant filler cap and check that the coolant is filled to the coolant filler cap filler neck.

4 Apply air pressure gradually, increasing up to an absolute maximum of 110 kPa. If bubbles appear in radiator neck, the oil cooler is leaking and the radiator assembly must be replaced.

Transmission Oil Cooler Seal Replacement.

It is strongly recommended that the transmission oil cooler connector fittings to the right-hand side radiator header tank, not be disturbed. If coolant is found to leak from either of these two areas, then the radiator should be replaced.

4 Engine Cooling System Diagnosis

4.1 Poor Heater Operation

Little or no heat coming from the heater, especially at idle could be an indication of a cooling system problem.

As the coolant level begins to get lower than normal, air enters the system to replace the missing coolant. The heater core is one of the highest parts of the cooling system and therefore, the first area to lose coolant circulation.

At first, with a small amount of coolant loss, lack of heat will be most noticeable at idle. As driving speed increases, the engine pumps more coolant and more heat is now able to pass through the heater core.

If coolant level drops even lower, heater operation will become less effective, even during normal driving. Cooling and engine systems can be adversely affected if problem is not corrected before overheating occurs.

4.2 Leaking Cylinder Head Gasket

Combustion gases leaking past the cylinder head gasket can pressurise the cooling system, forcing coolant out of the system and into the coolant recovery reservoir.

Indications are air bubbles in the coolant or an overflow condition of the recovery reservoir.

4.3 Question the Customer

To avoid needless time and cost in diagnosing cooling system complaints, the customer should be questioned about driving conditions that place abnormal loads on the cooling system.

1 Is overheating occurring after prolonged idle, in gear, with air conditioning system operating?

   If answer is YES – instruct owner on driving techniques that would avoid overheating such as:

   - Idle in neutral as much as possible – increase engine rpm to get higher air flow (due to an increase in voltage to the fan) and coolant flow through the radiator
   - Turn air conditioning system off during extended idling periods if overheating is indicated on temperature gauge. Further diagnostic checks should not be required

2 Is overheating occurring after prolonged driving in slow city traffic, traffic jams, parades, etc?

   If answer is YES, explain driving technique to the customer, that would avoid overheating – same as for prolonged idle – No.1. Further diagnostic checks should not be required.

4.4 Diagnostic Chart

If none of the above conditions apply, refer to the following Diagnosis Chart.

To effectively use this chart, question the customer to determine which of the following three categories apply to the complaint:

1 If complaint is hot indication on temperature gauge.

   Was temperature reading accompanied by boiling?

   - If answer is YES, go to overheating on diagnosis chart
   - If answer is NO, check temperature gauge and sender

2 If complaint is boiling – go to overheating on diagnosis chart.

3 If complaint is coolant loss. Determine if customer is filling the system correctly.

4 If incorrect filling is not the problem, go to coolant loss in the diagnosis chart.

WARNING

Refer to 3.1 Service Notes in this Section, for important safety items before removing the coolant filler pressure cap or servicing the system.

CAUTION

The cooling system is designed to operate at 120 – 130 kPa and a maximum temperature not above 130°C.

Cooling System Diagnosis

Step	Action	Result	Yes	No
1	Check Temperature gauge reading	High Temp. Low Temp.	Go to Step 2 Go to Step 6	–
2	Check drive belt condition and tension. Refer to 6A1 Engine Mechanical.	To Specification	Go to Step 3	Replace drive belt or tensioner.
3	Check coolant	Boiling	Go to Step 4	Go to Step 5
4	Check coolant level. Refer to 3.2 Coolant Maintenance in this Section.	Low	Go to Step 10	Go to Step 6
5	Check coolant filler cap. Refer to 3.7 Pressure Testing – Coolant Filler Cap Pressure Testing in this Section	OK?	Go to Step 8	Replace Coolant filler cap
6	Check thermostat. Refer to 3.8 Thermostat in this Section.	OK?	Go to Step 9	Go to Step 13
7	Check Engine Coolant Temperature (ECT) sensor. Refer to 6C1 Engine Management General Information.	Faulty	Replace	Go to Step 12
8	Check cooling fan operation. Refer to 6C1 Engine Management General Information.	Operational	Go to Step 10	Repair
9	Check for collapsed upper or lower radiator hose.	Collapsed	Replace	Go to Step 13
10	Visual system check	Leaks	Go to Step 13	Go to Step 11
11	Check coolant concentration. Refer to 3.2 Coolant Maintenance.	To Specification	Go to Step 12	Correct Concentration Level
12	Check radiator core for bent fins, dirt, bugs or other obstructions.	Obstructed	Clean or straighten	Go to Step 14
13	Pressure Test cooling system. Refer to 3.7 Pressure Testing in this Section.	Leaks	Repair	System OK
14	If none of the above require repair, the problem is complex or of a major nature. Refer to 4.5 Problems Not Requiring Disassembly of Cooling System or 4.6Problems Requiring Disassembly of Cooling System.	–	–	–

4.5 Problems Not Requiring Disassembly of Cooling System

1 Large obstructions blocking radiator or condenser airflow.

- Auxiliary oil coolers
- License plate
- Obstruction of radiator grille, for example, driving lights or mud

2 Loose, damaged or missing air chute side panels.

3 Missing or damaged air baffle.

4 Cracked or loose coolant recovery system hose.

5 Leaking heater component such as the heater core or water valve.

4.6 Problems Requiring Disassembly of Cooling System

1 Damaged cooling fan or faulty motor operation.

2 Pressure test cooling system.

3 Defective coolant pump.

- Eroded or broken impeller vanes
- Failed bearing or seal – check for shaft or bearing end play

4 Internally blocked radiator core.

5 Obstruction of coolant recovery system.

6 Internal system leaks.

- Head gaskets
- Cracked cylinder block
- Engine front cover
- Intake manifold gaskets

7 Blocked coolant passages in cylinder heads or block – remove cylinder heads and check.

4.7 Black Light and Dye Leak Diagnosis Method

It is strongly recommended that this diagnostic method be used to diagnose fluid leaks. This method is a proven and reliable method that identifies the specific leak source.

The black light kit can be used for the leak detection of a number of fluids, when used with the appropriate tracer dye.

Examples are: Coolant, Engine Oil, Automatic Transmission Fluid and Air Conditioning Refrigerant (R134A).

The following is a summary of the steps involved in detecting a cooling system fluid leak using black light and dye:

1 Pour specified amount of dye into the cooling system via the coolant filler cap on the outlet housing. Refer 3.1 Service Notes in this Section.

2 Road test the vehicle under normal operating conditions.

3 Direct the light towards the suspect area. The fluid leak will appear as a brightly coloured path leading from the source.

4 Repair fluid leak and recheck to ensure that leak has been rectified.

5 Refer to the manufacturer's directions when using this method.

5 Specifications

General

Coolant Filler Cap Pressure Rating ....120 kPa

Cooling System Capacity

Automatic Transmission... 9.9 litres

Manual Transmission .... 10.3 litres

Coolant Corrosion Inhibitor Quantity When Refilling System

Automatic Transmission Models... 5 litres

Manual Transmission Models... 5.2 litres

NOTE

DEX-COOL® long life coolant or equivalent such as Extended Life Anti-freeze Coolant, conforming to GM Specification 6277M, must be used when changing coolant.

Thermostat

Type..Power element (wax pellet)

Start to Open at ....82 ± 2° C

Fully Open at .... 95° C max.

Coolant Pump

Type.. Centrifugal

Drive .... Multi-Vee Serpentine Belt

Bearing Type .... Double Row Ball Bearing

Radiator

Core type .... Aluminium crossflow core

Overall width ....664 mm

Core width...510 mm

Overall height...602 mm

Core height ....512 mm

Core thickness ....27 mm

Plastic Tanks .... Nylon 6.6 (30% Glass Filled)

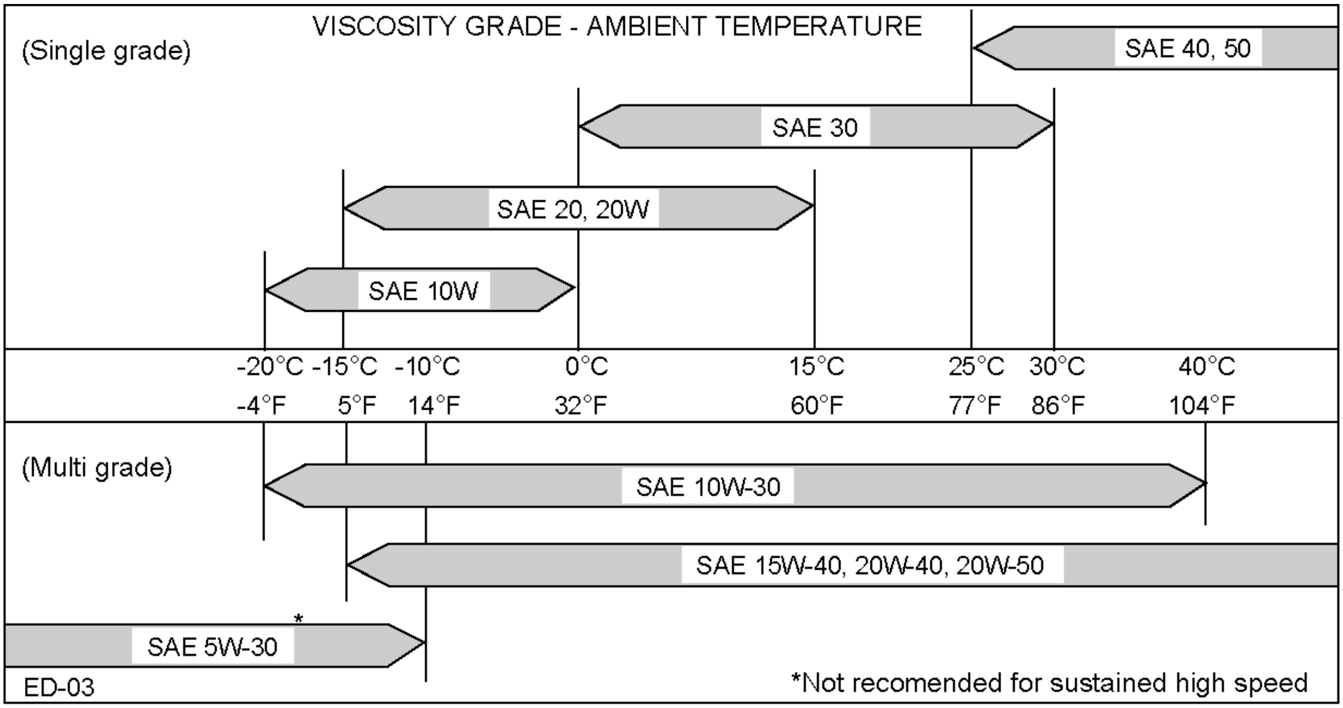
Radiator Hoses

	Lower	Upper
Number	One	One
Type	Moulded	Moulded
Inside diameter	34 mm	34 mm

OIL VISCOSITY CHART

Lubricants should be carefully selected according to the lubrication chart. It is also important to select the viscosity of lubricants according to the ambient temperature by referring to the following table.

OIL VISCOSITY CHART FOR DIESEL ENGINE
APPLY DIESEL ENGINE OIL



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SECTION 3C

FRONT SUSPENSION

TABLE OF CONTENTS

Engine Cooling Fan

Rotational Speed (with 13 ± 0.26 volts negative polarity duty signal applied)

– Stage 1 (25% Duty)	1,100 ± 110 rpm	(3 ± 0.3A)
– Stage 2 (25% Duty)	1,600 ± 160 rpm	(7 ± 0.7A)
– Stage 3 (25% Duty)	2,100 ± 210 rpm	(15 ± 1.5A)
– Stage 4 (25% Duty)	2,400 ± 240 rpm	(22 ± 2.2A)

Number of Blades 5

Fan – Design .... Asymmetrical spaced, curved blades

Material .... Nylon Glass, Mineral reinforced

Diameter .... 500 mm

Fan Motor – Type .... Brushless

Fan Motor – Power 400W

Fan Motor – Input signal 100Hz

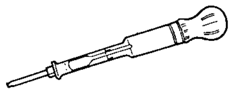
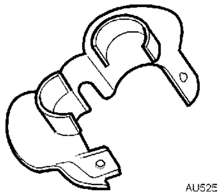
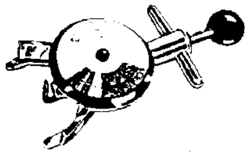
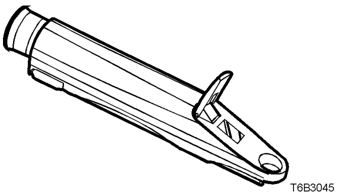
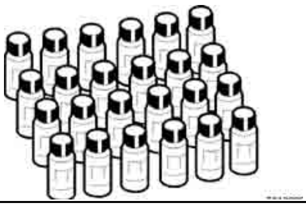
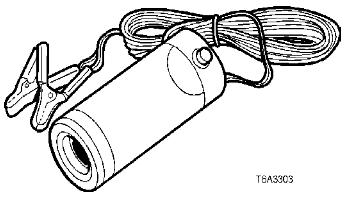
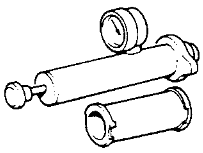
Housing .... Semi-sealed, zinc-coated steel with drain hole

Direction of Rotation .... Counter clockwise (as viewed from drivers seat)

6 Torque Wrench Specifications

	N.m
Coolant Outlet housing to Engine Outlet Attaching Bolts	10
Coolant Pump to Front Cover Attaching Bolts	10
Coolant Pump Pulley Attaching Bolts	12
Coolant Inlet Pipe to Thermostat Housing Attaching Bolt	23
Fan Motor Assembly to Shroud Attaching Screws	5
Heater Pipe Assembly to Thermostat Housing Attaching Bolts	10
Heater Pipe Assembly to Cylinder Head Attaching Bolt	35
Thermostat Housing to Engine Block Attaching Bolts	10
Rear Engine Harness	15
Engine Harness Ground Terminal	12
Coolant Inlet Pipe To Engine Block Bolt	25
Transmission Cooler Lines Bracket	23

7 Special Tools

Tool number	Illustration	Description	Classification
AU505		**Coolant Tester** Used for testing the coolant concentration level. Previously released.	Mandatory
AU525		**Quick Connect Release Tool** Used to release the quick connect fittings on automatic transmission fluid cooler lines at the radiator end, when fitted. Previously released.	Mandatory
BT3373–F		**Belt Tension Gauge** Used when checking drive and accessory belt tension and adjustments. Previously released.	Desirable
J 26568		**Refractometer** Used for testing coolant concentration level. Previously released, as AU 435.	Mandatory
J28431–B		**Fluid Dye** Available in 24 x 1-ounce bottles. Used in conjunction with a black light such as J42220 to locate the source of various fluid leaks. Previously released.	Desirable
J42220		**Black Light, Leak Detection Lamp** Used with dye, J28431–B to locate the source of various vehicle fluid leaks. Previously released.	Desirable
N/A		**Cooling System Pressure Tester** Previously released. Commercially available.	Mandatory

6C
Fuel System – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

1 General Information

Description

Fuel is injected into the engine by separate fuel injectors that are mounted in the intake manifold (common chamber). Fuel is supplied to the injectors under pressure from the fuel tank through the fuel lines and the fuel rail, which is attached to the top of the common chamber.

A fuel pressure control valve is installed on the fuel rail to maintain fuel line pressure across the injectors under all operating conditions. Fuel pressure is maintained by controlling the amount of fuel that is supplied from the fuel tank, based on the demand of the engine via the engine control module (ECM).

Two interchangeable “O” rings are used on the fuel injector and must be replaced when the injectors are removed.
The Multiport Fuel Injection system utilizes an injection system where the injectors turn on at every crankshaft revolution.
The ECM controls the injector on time so that the correct amount of fuel is metered depending on driving conditions.
The V6 engine is designed to use only unleaded petrol.

Unleaded petrol must be used for correct emission control system operation and its use will also minimize spark plug fouling and extend engine oil life.

Using leaded petrol can damage the emission control system and could void the vehicle warranty. All vehicles are equipped with an Evaporative Emission Control System. The purpose of the system is to minimize the escape of fuel vapours into the atmosphere.

Service Precautions

- Use extreme care when working on the fuel system and follow all safety precautions.
- When working on the fuel system, disconnect the battery ground cable except for tests where battery voltage is required.
- Always keep a dry chemical (class B) fire extinguisher near the work area.
- Relace all fuel lines and fittings with the same type of line and fitting as those removed.
- Clean and inspect “O” rings carefully and replace if required.
- Always depressurize the fuel lines before servicing any fuel system components.
- Do not attempt any repairs on the fuel system until, all warnings and instructions, relating to that repair have been read and ensure all notices and cautions are adhered to.
- Do not allow any naked frames or sparks near the work area when working on the fuel system.
- If draining of the fuel system is required, this should be done in a well ventilated area.
- Protect the fuel lines and associated parts from thermal damage, spattering when welding.

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 System Components

Fuel System

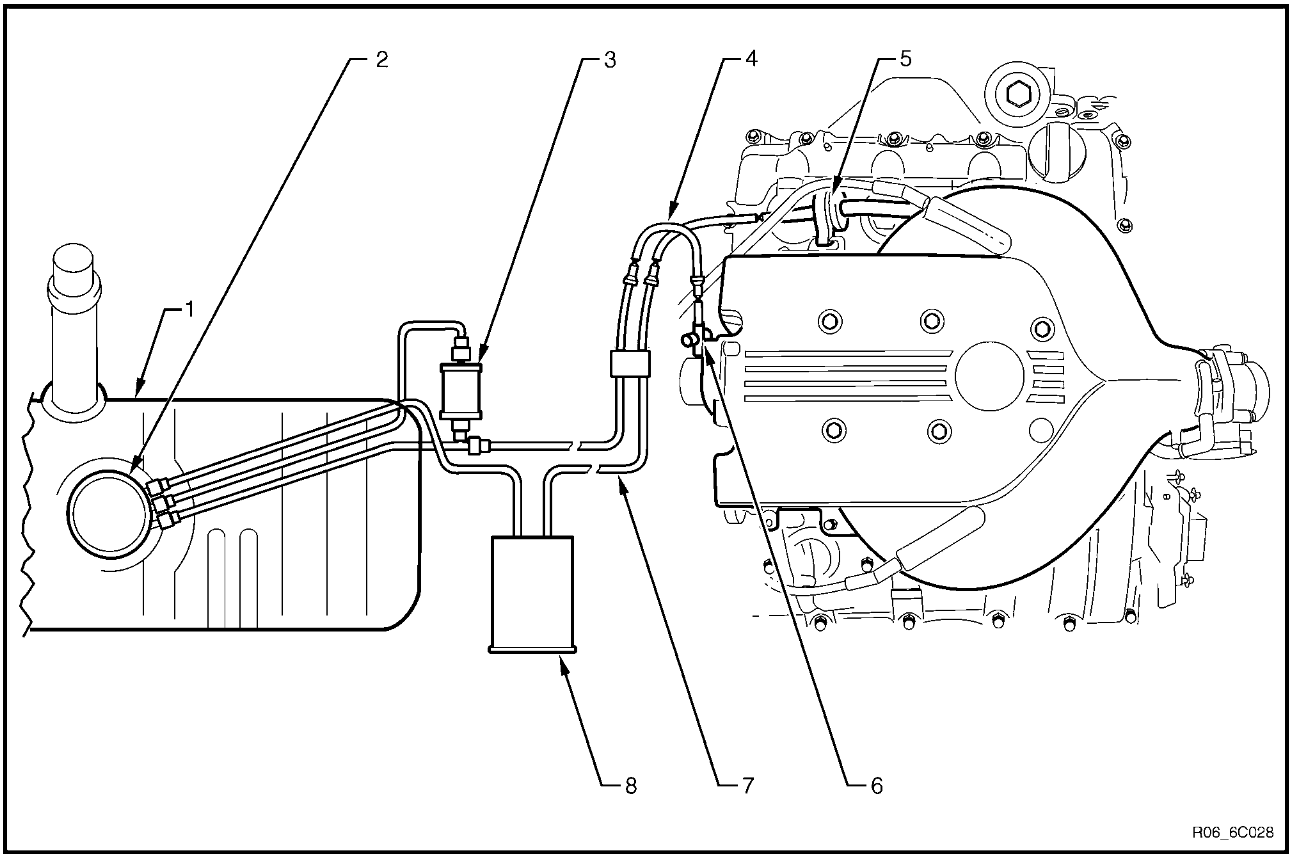


Figure 6C – 1

Legend

1	Fuel Tank
2	Fuel Pump and Sender Assembly
3	Fuel Filter
4	Fuel Feed Line
5	Evaporative Control Valve
6	Fuel Pressure Test Point
7	Evaporative Return Line
8	Evaporative Canister

Description

The modular fuel pump and sender assembly maintains an optimum fuel level in the reservoir. This ensures a continuous fuel flow under all fuel level conditions and vehicle attitudes. The modular fuel pump and sender assembly also provides an accurate means of measuring the fuel level within the fuel tank.

Fuel Pump

Single Turbine Fuel Pump

The fuel pump is an integral part of the Fuel Pump and Sender Assembly, refer to Figure 6C – 3.

Figure 6C– 2 details the fuel flow through the single turbine fuel pump.

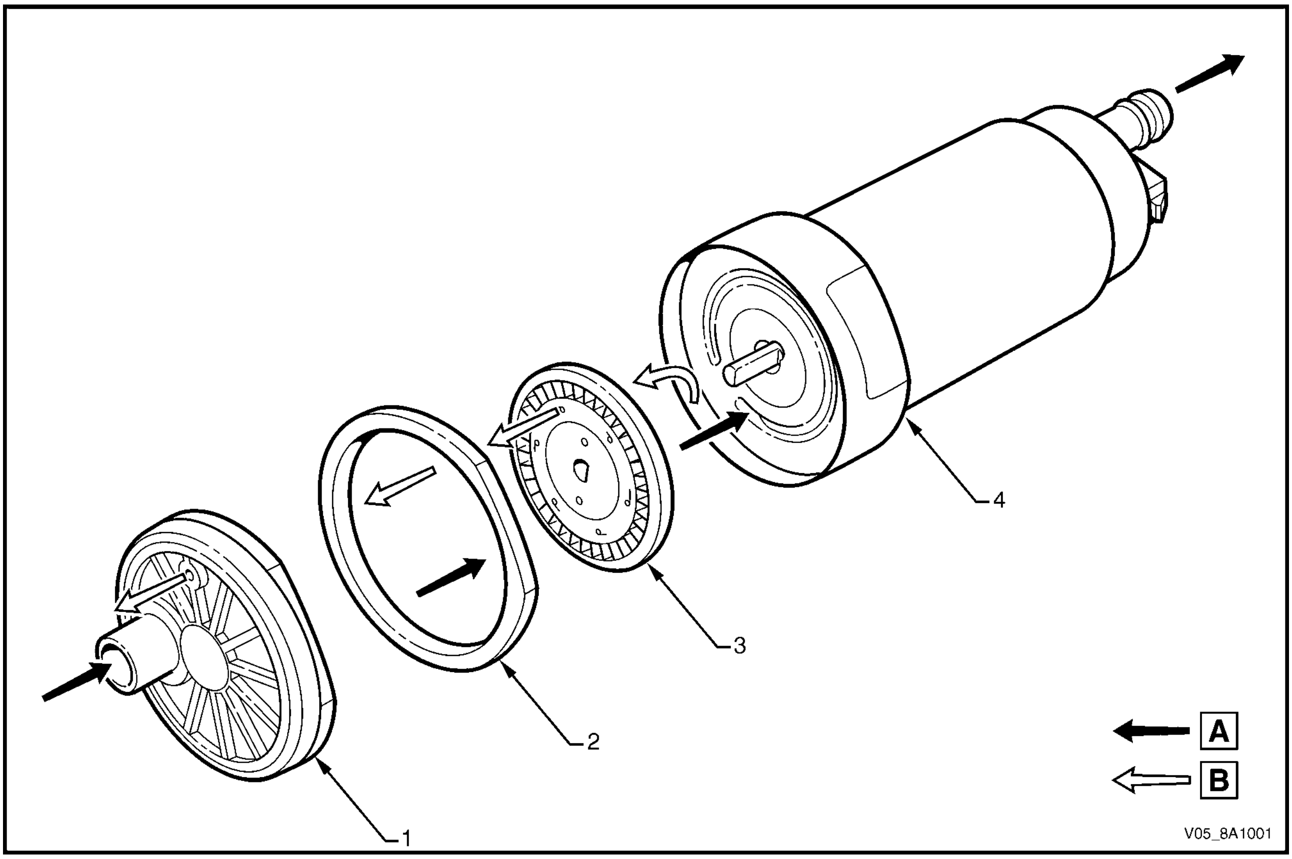


Figure 6C– 2

Legend

A	Fuel
B	Vapour out

1	Inlet Body
2	Impeller Housing
3	Impeller
4	Fuel Pump Housing

Fuel Flow

Fuel (A) is drawn into the modular fuel pump and sender assembly reservoir from the fuel tank, through the primary umbrella valve (5) and into the fuel pump impeller, via the internal strainer (4) at the fuel pump (1) inlet. At the impeller, vapour (C) is separated from the fuel. The vapour is ejected from the fuel pump into the reservoir via a port next to the fuel pump inlet.

High-pressure fuel then flows through the end cap, the lower connector and the flexible line. From the flexible line, fuel exits the modular fuel pump and sender assembly through the fuel feed port and flows on to the externally-mounted fuel filter and the engine.

A fuel pressure regulator is located in the modular fuel pump and sender assembly; fuel not used by the engine (B) is returned to the modular fuel pump and sender assembly via the fuel return line and the fuel return port in the modular fuel pump and sender assembly cover. The return fuel enters the jet pump standpipe (3) of the reservoir via the return fuel tube.

Vehicle fuel line pressure is maintained by a pressure regulator (2) located within the modular fuel pump and sender assembly.

When the engine is switched off, the reservoir remains full of fuel, due to the action of the primary umbrella valve. At high fuel levels, fuel tank overflow enters the reservoir over the top of the reservoir. Fuel level in the reservoir is also maintained by returned engine fuel.

Electrical power is supplied to the fuel pump by a connector secured to the modular fuel pump and sender assembly cover. An internal harness (not shown) assembly completes the connection to the pump.

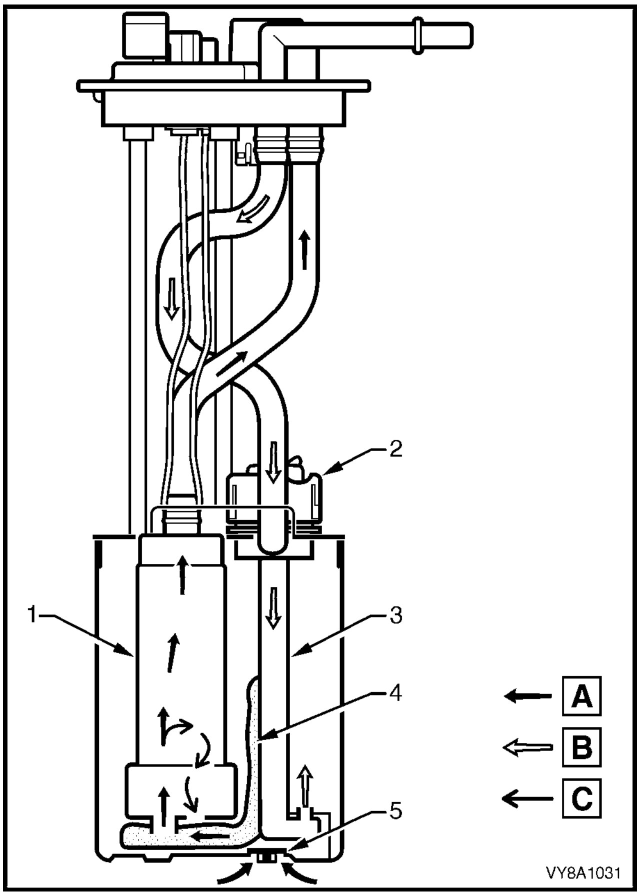


Figure 6C – 3

MAIN DATA AND SPECIFICATIONS

4×2 (Except High Ride Suspension) Model

Front suspension	**Type**	**Independent wishbone arms, coil spring with stabilizer bar.**
Coil spring	Spring Rate	9.62 kg/mm (94.3 N/mm)
Front shock absorber	Type	Gas-sealed, twin tube
	Stroke	116.5 mm (4.59 in)
	Compressed length	284.0 mm (11.18 in)
	Extended length	400.5 mm (15.77 in)
Stabilizer bar	Diameter	25.0 mm (0.98 in)

4×2 (High Ride Suspension) Model

Front suspension	**Type**	**Independent wishbone arms, torsion bar spring with stabilizer bar.**
Torsion bar spring	Length	1,142 mm (44.96 in)
	Diameter	29.0 mm (1.14 in)
Front shock absorber	Type	Gas-sealed, twin tube
	Stroke	121.0 mm (4.76 in)
	Compressed length	257.0 mm (10.12 in)
	Extended length	378.0 mm (14.88 in)
Stabilizer bar	Diameter	26.0 mm (1.02 in)

4×4 Model

Front suspension	**Type**	**Independent wishbone arms, torsion bar spring with stabilizer bar.**
Torsion bar spring	Length	1,142 mm (44.96 in)
	Diameter	29.0 mm (1.14 in)
Front shock absorber	Type	Gas-sealed, twin tube
	Stroke	121.0 mm (4.76 in)
	Compressed length	257.0 mm (10.12 in)
	Extended length	378.0 mm (14.88 in)
Stabilizer bar	Diameter	26.0 mm (1.02 in)

BACK TO CHAPTER INDEX

3 System Checks

3.1 Fuel Pump Flow Test

If a reduction of the fuel supply is suspected, perform the following checks.

1 Ensure there is sufficient fuel in the tank.

2 With the engine running, check the fuel lines from the fuel tank to the injectors for evidence of leakage. Retighten, if the lines or the connections are loose. Also, check the fuel lines for restrictions such as squashed or clogged fuel line.

3 Depressurize the fuel system, refer to 3.4 Fuel System Depressurisation.

4 Disconnect the fuel line at the fuel rail.

5 Connect a hose from the fuel line and place the open end into a clean container.

6 Connect the fuel pump relay terminals (2) with a jumper wire (1) as shown, then turn the ignition to the ON position to operate the fuel pump, then check the fuel pump flow rate.

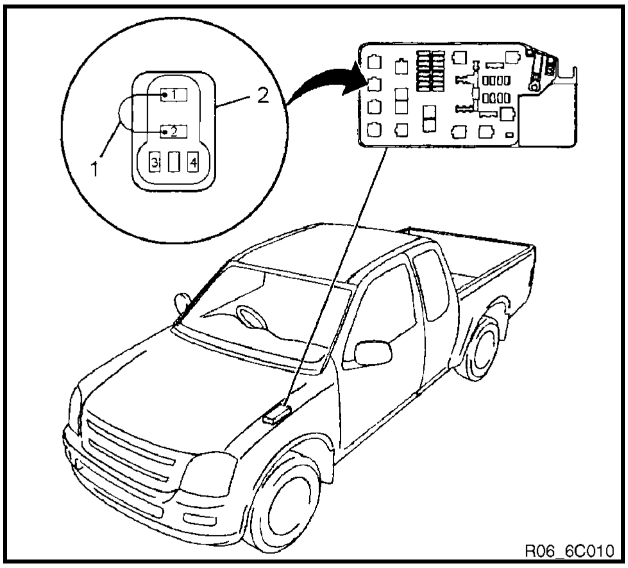


Figure 6C – 4

CAUTION

Do not generate any sparks when connecting the jumper wire.

Fuel delivery test time	15.0 Sec
Fuel delivery rate	0.38 Litres Min

NOTE

If the fuel flow rate is below the minimum value, conduct a fuel pressure test, refer to 3.2 Fuel Pressure Test.

3.2 Fuel Pressure Test

WARNING

To reduce the risk of fire or personal injury, depressurise the fuel system before servicing any fuel system components, refer to 3.4 Fuel System Depressurisation.

Gauge Installation

1 Turn the ignition switch off.

2 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

WARNING

A small amount of fuel may be released when connecting the fuel pressure gauge to the fuel pressure test point. Cover the fittings with a shop towel to absorb any fuel spillage before connecting the fuel pressure gauge. After the fuel pressure test procedure, place the soiled towel in an approved container for disposal.

3 At the fuel pressure test point, remove the Schrader valve sealing cap.

4 Connect the fuel pressure gauge (1) (tool No. J 34730–1A) to the fuel gauge Schrader fitting adapter (2) (tool No. AU453), then install to the fuel pressure test port (3). Wrap a shop towel around the fitting while connecting the fuel pressure gauge to avoid and/or capture any fuel spillage.

5 Route the bleed hose of the fuel gauge into an approved fuel container.

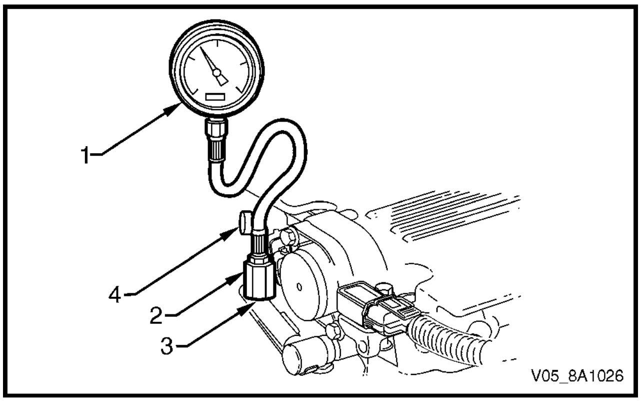


Figure 6C – 5

CAUTION

After connecting the fuel pressure gauge and pressurising the fuel system, inspect for fuel leaks at the fuel pressure gauge and the fuel pressure test point.

6 Either:
Using Tech 2, enable the fuel pump to pressurise the fuel system, refer to 0C Tech 2. Inspect for fuel leaks at the fuel pressure gauge and fuel pressure test point, then bleed the air from the fuel pressure gauge.

or:
Reinstall the fuel pump relay and fuel pump fuse, then open the fuel gauge bleed valve (4) to bleed the air from the fuel pressure gauge, refer to Figure 6C – 5.

7 Remove and place the soiled shop towel in an approved container.

Test

1 Start the engine and record the fuel pressure.

2 Turn the ignition switch off.

3 If required, perform any tests and/or diagnostic procedures:

- For the fuel system leak test, refer to 3.3 Fuel Leak Test.
- For the fuel injector leak-down test (for vehicles fitted with a V6 engine, refer to 6C1-3 Engine Management – V6 – Service Operations.

4 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

Removal

1 Turn the ignition switch off.

2 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

WARNING

After relieving the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. Cover the fittings with a shop towel before disconnecting. This catches any leaking fuel. Place the soiled towel in an approved container when disconnection is completed.

3 Wrap a shop towel around the fuel pressure test point to absorb any fuel spillage.

4 Remove the fuel pressure gauge and drain any fuel remaining in the fuel pressure gauge into an approved fuel container.

5 Remove the soiled shop towel and place in an approved container.

6 Repressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

7 Road-test the vehicle and check for correct operation.

3.3 Fuel Leak Test

CAUTION

After installing any fuel system component and before starting the engine, check the fuel system for leaks.

NOTE

For the fuel injector leak-down test (for vehicles fitted with a V6 engine), refer to 6C1-3 Engine Management – V6 – Service Operations.

1 Turn the ignition switch on for two seconds.

2 Turn the ignition switch off for 10 seconds.

3 Turn the ignition switch on.

4 Check for fuel leaks, particularly at points marked ● (that is, quick-connect fittings, fuel rails, fuel injectors, Schrader valve and evaporative emission control canister purge solenoid, refer to Figure 6C – 6.

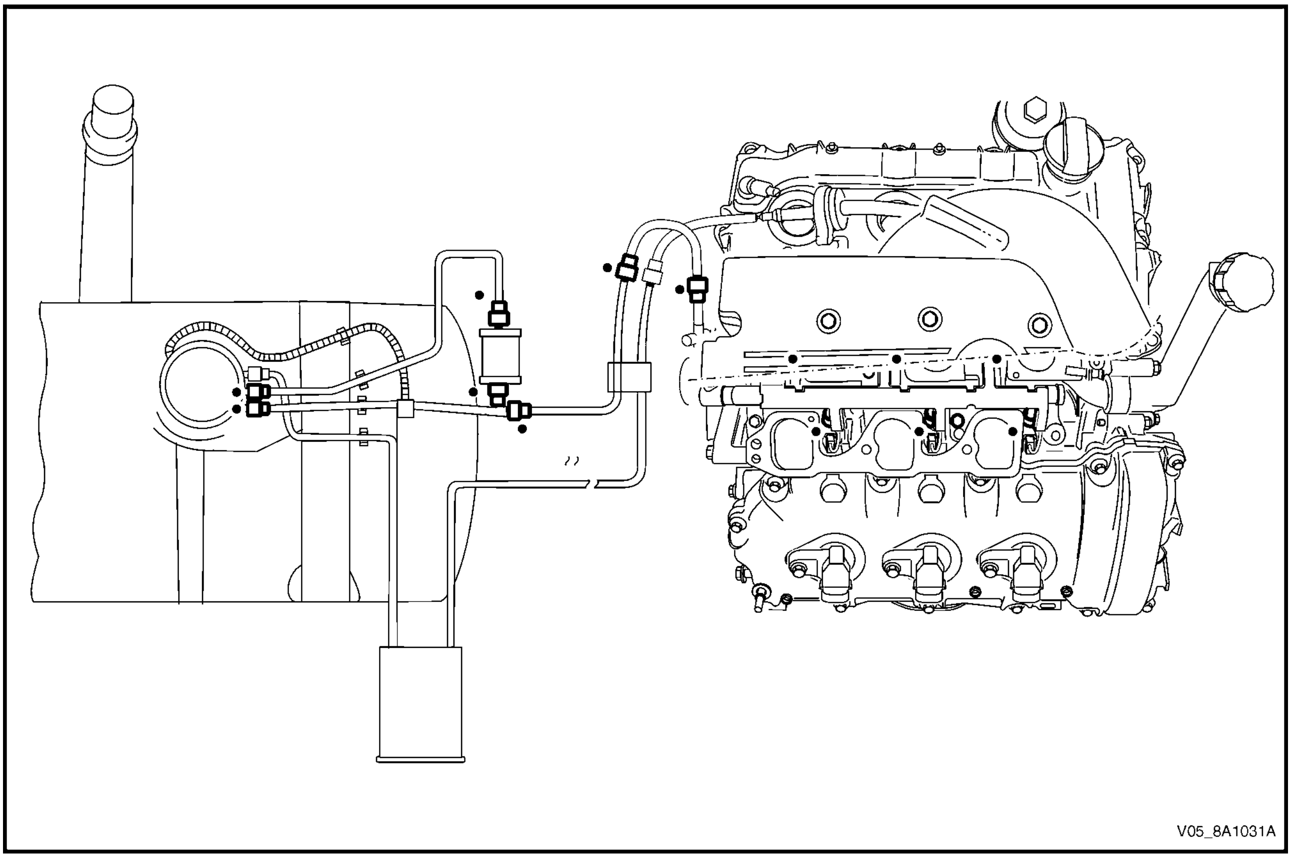


Figure 6C – 6

5 Replace any faulty components and repeat step 2 to step 5 inclusive.

6 Replace all engine components removed to perform the fuel leak test, refer to 6C1-3 Engine Management – V6 – Service Operations.

3.4 Fuel System Depressurisation

WARNING

To reduce the risk of fire or personal injury, depressurise the fuel system before servicing any fuel system components.

1 Turn the ignition switch off.

2 Remove the fuel pump fuse and fuel pump relay, refer to 8A Electrical Body and Chassis.

3 Loosen the fuel filler cap to relieve the fuel tank vapour pressure.

4 With the throttle closed, crank the engine.

NOTE

The engine may start and operate until the fuel remaining in the fuel delivery system depletes.

5 When the engine stops, crank the engine for another 10 seconds to ensure the fuel feed line pressure has been fully relieved.

6 Clean the area around the fuel pressure test point.

CAUTION

A small amount of fuel may be released when pressing on the Schrader valve. Cover the fitting with a shop towel to absorb any fuel spillage before removing the Schrader valve sealing cap. Place the soiled towel in an approved container for disposal.

7 At the fuel pressure test point (2), remove the Schrader valve sealing cap (1), refer to Figure 6C – 7.

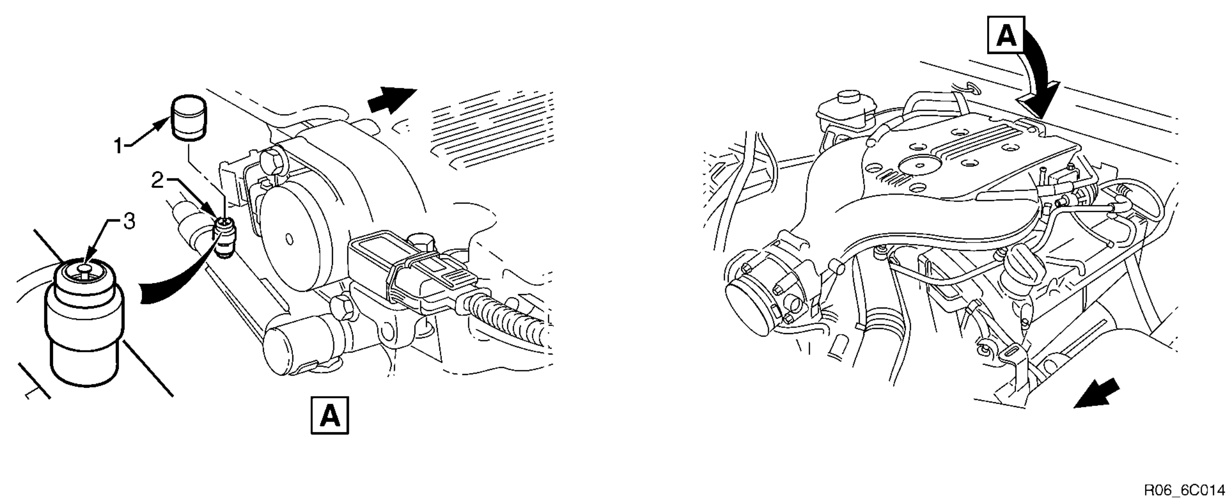


Figure 6C – 7

Legend

1 Schrader Valve Sealing Cap
2 Pressure Test Point
3 Schrader Valve

WARNING

Wear safety glasses when performing the fuel pressure relief procedure.

8 Place a shop towel around the Schrader valve to soak up the expelled petrol.

9 Use a small screwdriver to press the Schrader valve down (3).

10 Remove the soiled shop towel and place in an approved container.

Repressurise

1 Reinstall the fuel pump relay and fuel pump fuse.

2 Perform the following procedure to inspect for leaks at the fuel pressure test point:

a Turn the ignition switch on for two seconds.

b Turn the ignition switch off for 10 seconds.

c Turn the ignition switch on.

d Check for leaks at the fuel pressure test point.

3 Tighten the fuel filler cap.

4 Start the engine and recheck for leaks.

5 Reinstall the Schrader valve sealing cap.

4 Service Operations

4.1 Fuel Lines And Quick Connect Fittings

Description

The fuel line connector fittings contain the following components:

1 O-rings

2 Fuel line port

3 Connector

4 Plastic fuel line tube

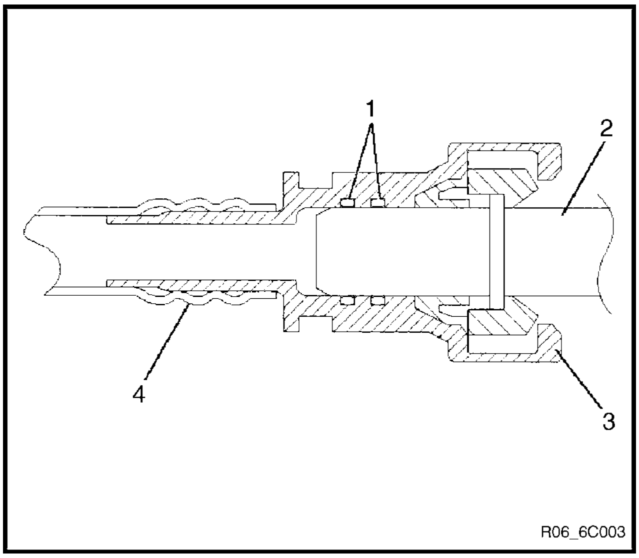


Figure 6C – 8

Leak Test and Inspection

1. Turn the ignition key to the ON position and ensure the fuel pump runs for a short time by listening for the pump start up sound. The fuel pressure will increase when the fuel pump is actuated.

2 Perform a preliminary check of the system by inspecting the system for any leaks around the connections and fittings.

3 Perform steps 1 and 2 several times.

4 If the preliminary check of the system produces no leaks, start the engine and check the system again for any sign of leaks around the connections and lines.

CAUTION

Ensure all service precautions have been observed prior to removing any connector fittings.

Removal

1 Depressurize the fuel system, refer to 3.4 Fuel System Depressurisation.

2 Use compressed air to remove any dirt around the fuel line quick connect fittings prior to disconnecting the fittings.

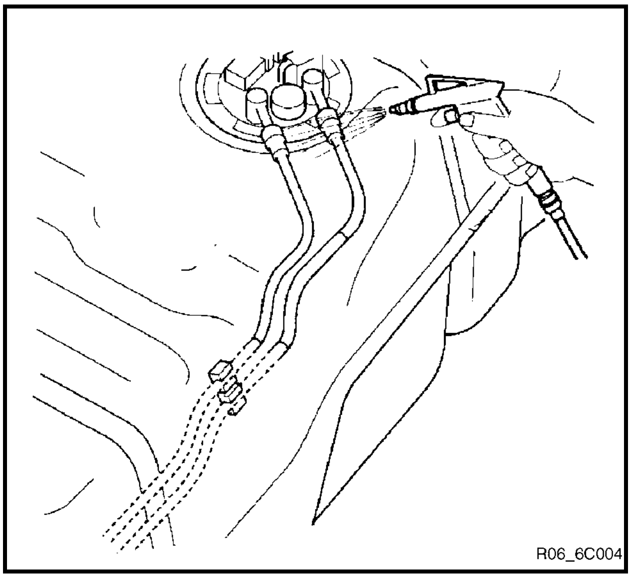


Figure 6C – 9

3 Hold the connector in one hand and depress the square release buttons on the connector body while gently pulling the quick connector and the fuel line apart with the other hand.

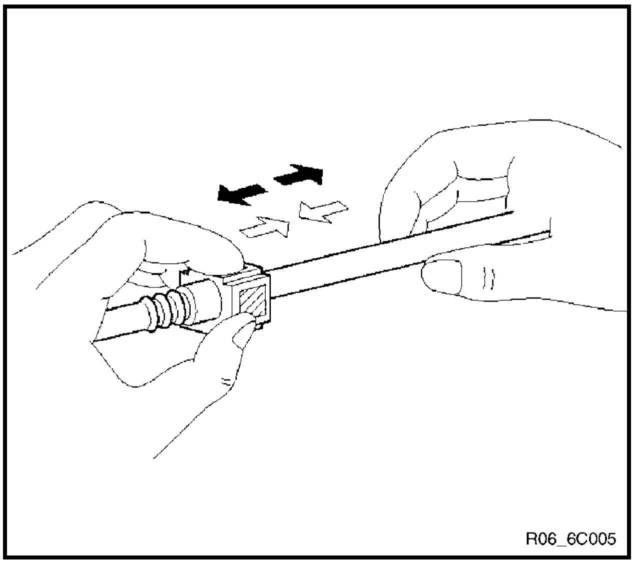


Figure 6C – 10

4 Cover the quick connect fittings to prevent dirt or other foreign material from entering the system.

NOTE

- Check the fuel lines and connector fittings for any scratches, rust, dents, or cracks. Replace the connector or the fuel line if found to be defective.
- Inspect the O-rings in the quick connectors and replace the connector if found to be defective.

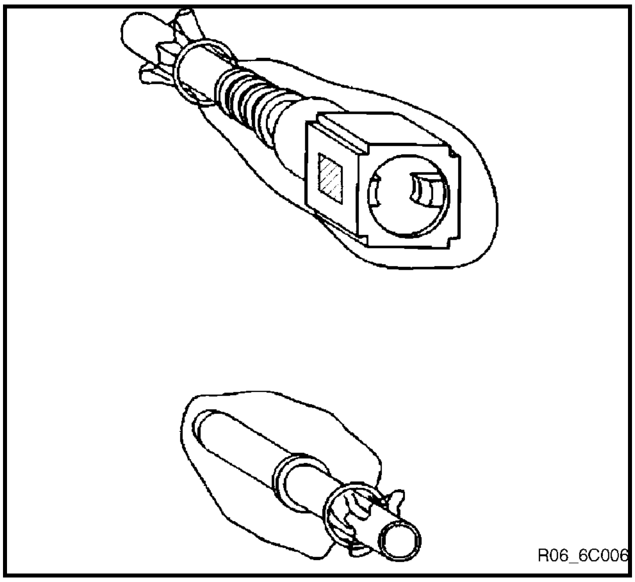


Figure 6C – 11

Reinstall

1 Apply a small amount of engine oil or light oil to the fuel line to assist in the assembly of the connector.

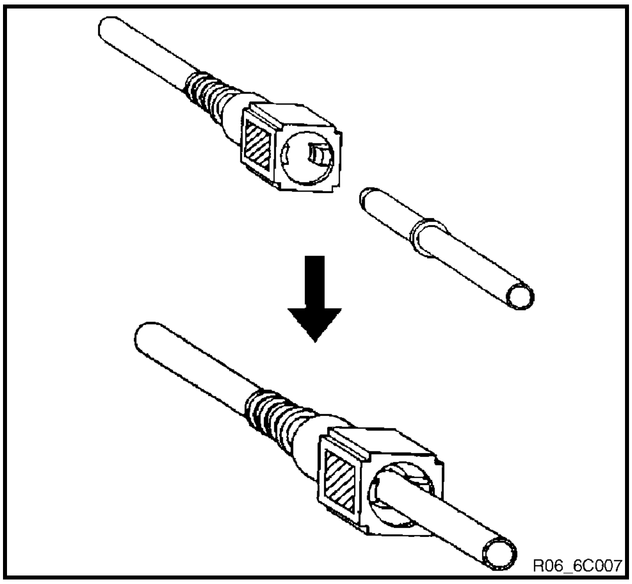


Figure 6C – 12

NOTE

Assembly of the fuel line and quick connectors should take place immediately after applying the oil to prevent any dust from sticking to the surface, which may cause the connector to leak.

4.2 Fuel Filter

Removal

1 Depressurize the fuel system, refer to 3.4 Fuel System Depressurisation.

2 Disconnect the battery ground cable.

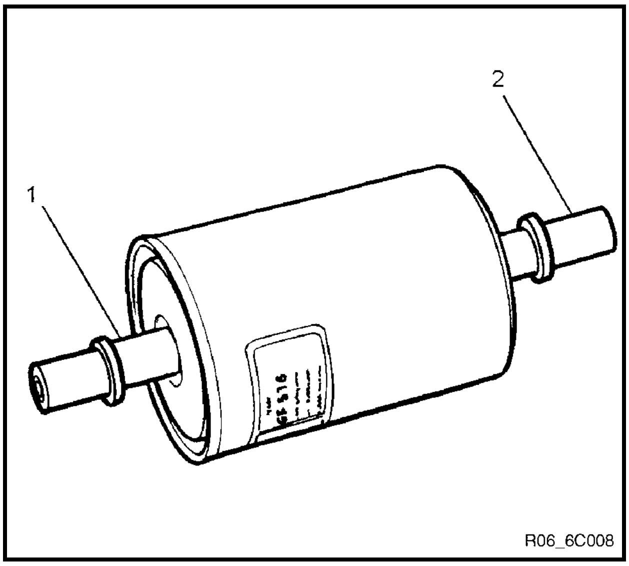


Figure 6C – 13

CAUTION

A small amount of fuel will flow out of the fuel lines and filter when disconnected.

3 Locate the fuel filter attached to the front of the fuel tank, place a drain tray below the fuel filter and remove the fuel line quick connectors from the inlet (2) and the outlet (1) of the fuel filter, refer to 4.1 Fuel Lines And Quick Connect Fittings.

4 Release the 3 clips (1) on the passenger side of the fuel filter holder and slide the fuel filter from the holder in the direction of the arrow.

NOTE

Cover the quick connectors to prevent any dirt from entering the fuel system.

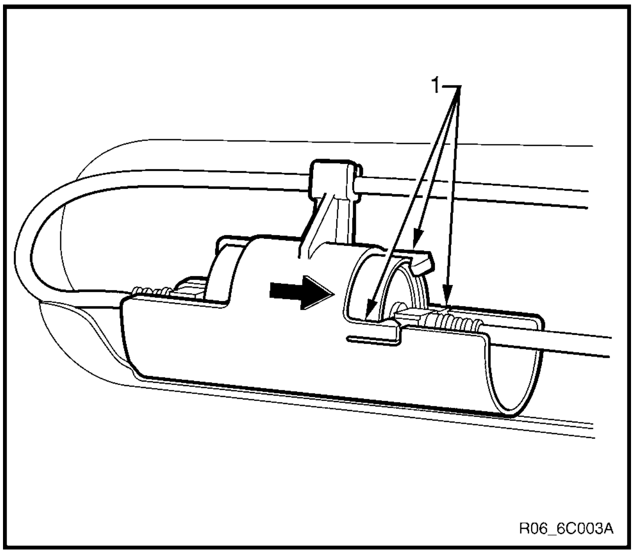


Figure 6C – 14

Inspection

1 Replace the fuel filter if fuel leaks from the filter body or if the fuel filter body itself is damaged.

2 Replace the fuel filter if it is clogged with dirt or sediment or the filter shows signs of being contaminated with water or other foreign materials.

Reinstallation

1 Slide the fuel filter into the holder attached to the front of the fuel tank, make sure the three plastic locking clips secure the filter in place.

NOTE

- Ensure the fuel filter inlet line is facing the drivers side if the vehicle and the outlet line is facing the passengers side of the vehicle.
- The direction arrow indicates the direction of fuel flow.

2 Connect the inlet and outlet fuel line quick connectors to the fuel filter, refer to 4.1 Fuel Lines And Quick Connect Fittings.

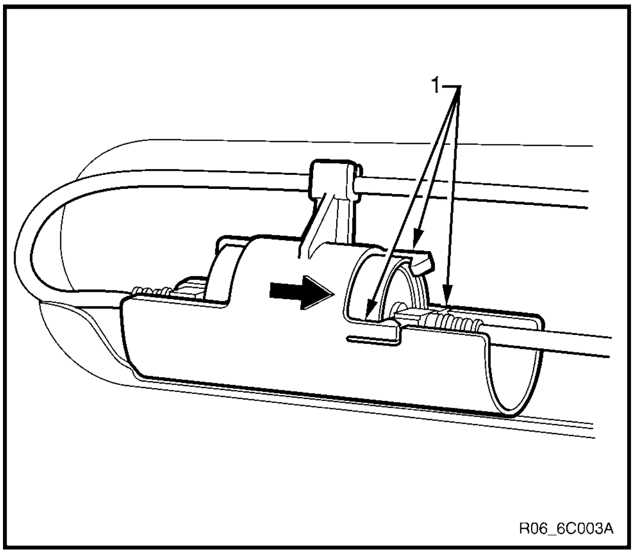


Figure 6C – 15

4.3 Fuel Tank and Pump Assembly

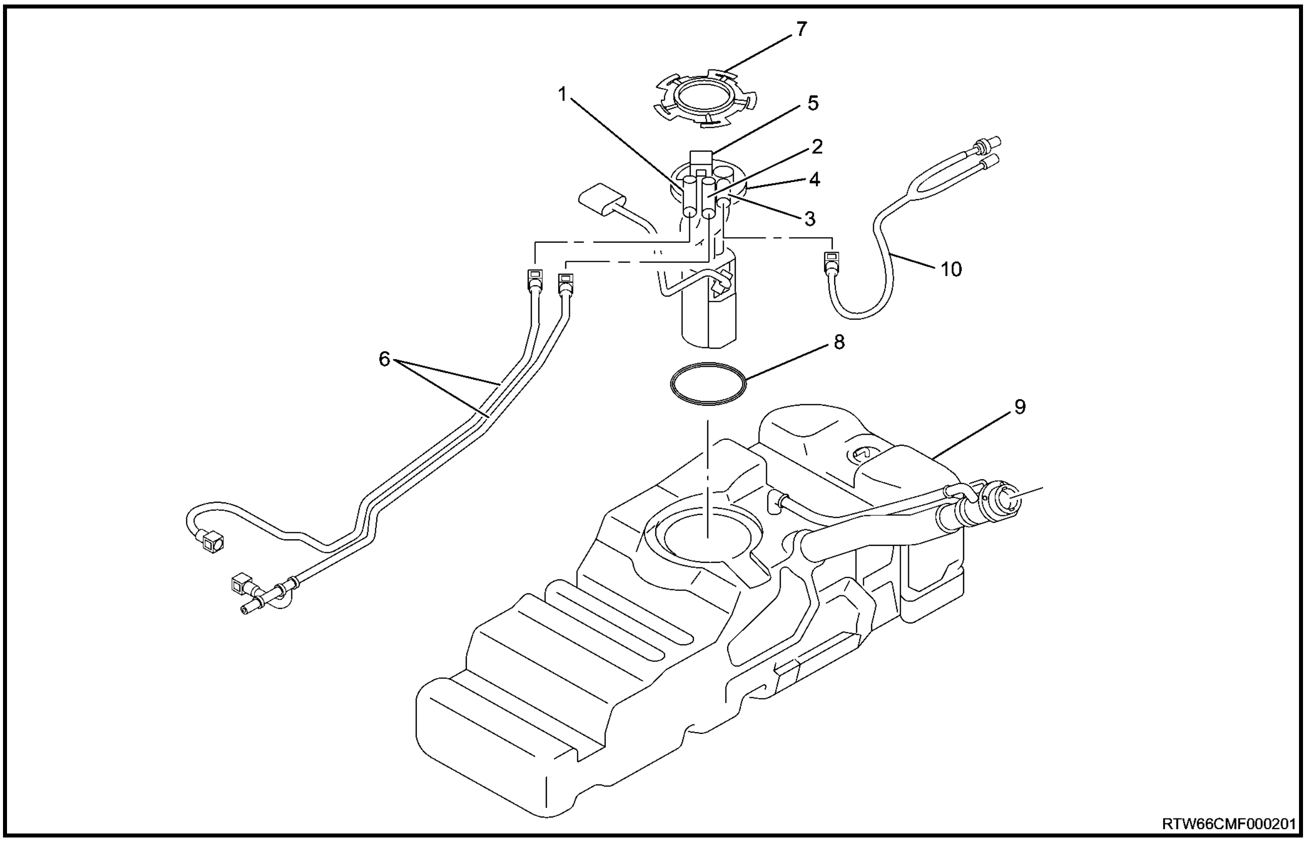


Figure 6C – 16

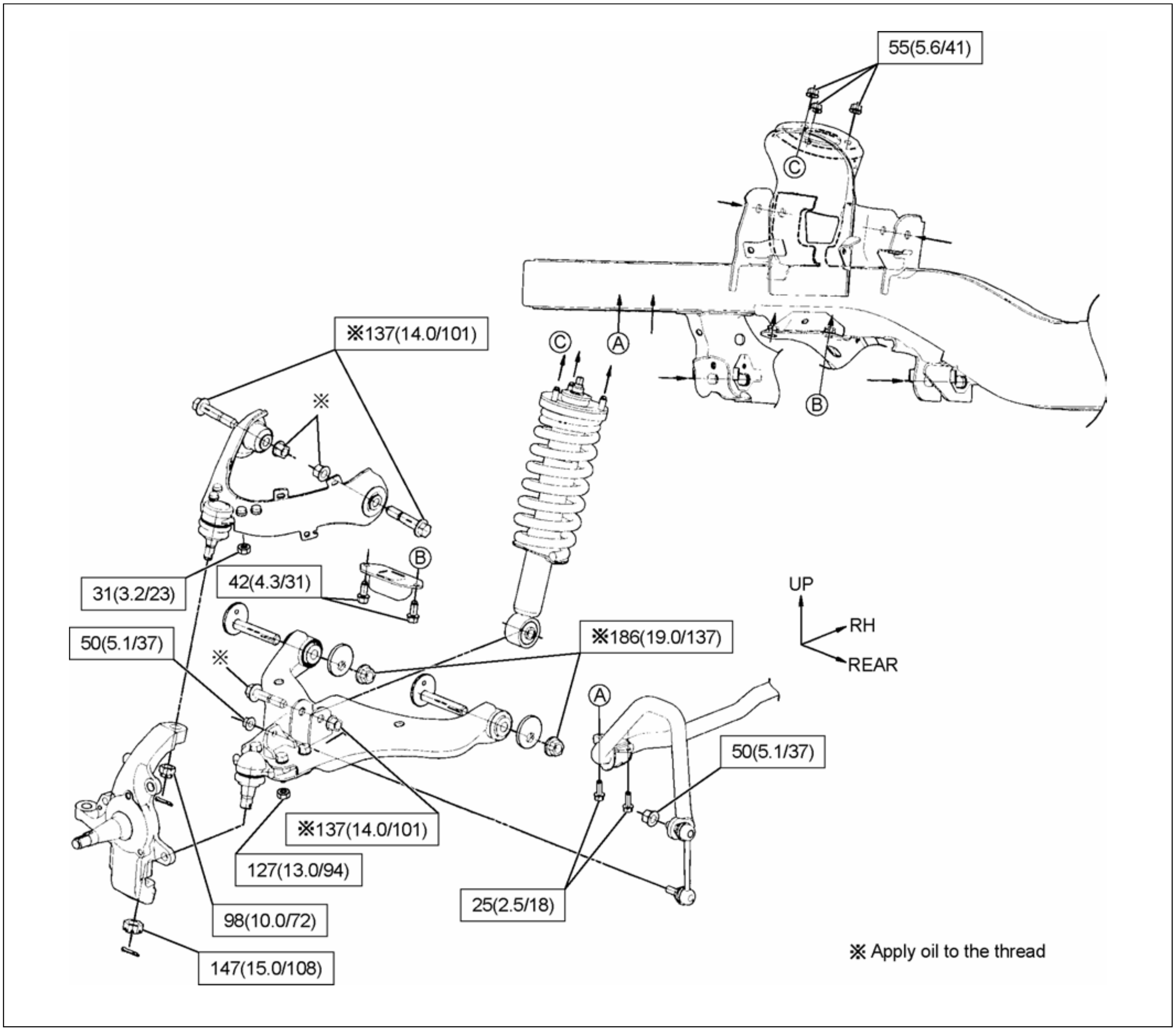
Legend

1	Fuel Feed Line	4	Fuel Pump and Sender Assembly	7	Retainer Ring (Fuel Pump Lock)
2	Fuel Return Line	5	Connector; Fuel Pump and Sender	8	O-Ring
3	Fuel Emission Line	6	Fuel Lines	9	Fuel Tank Assembly
				10	Evaporative Line

TORQUE SPECIFICATIONS

SPECIAL PARTS FIXING NUTS AND BOLTS

4×2 (Except High Ride Suspension) Model N·m (kgf·m/lb·ft)



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4.4 Fuel Tank Assembly

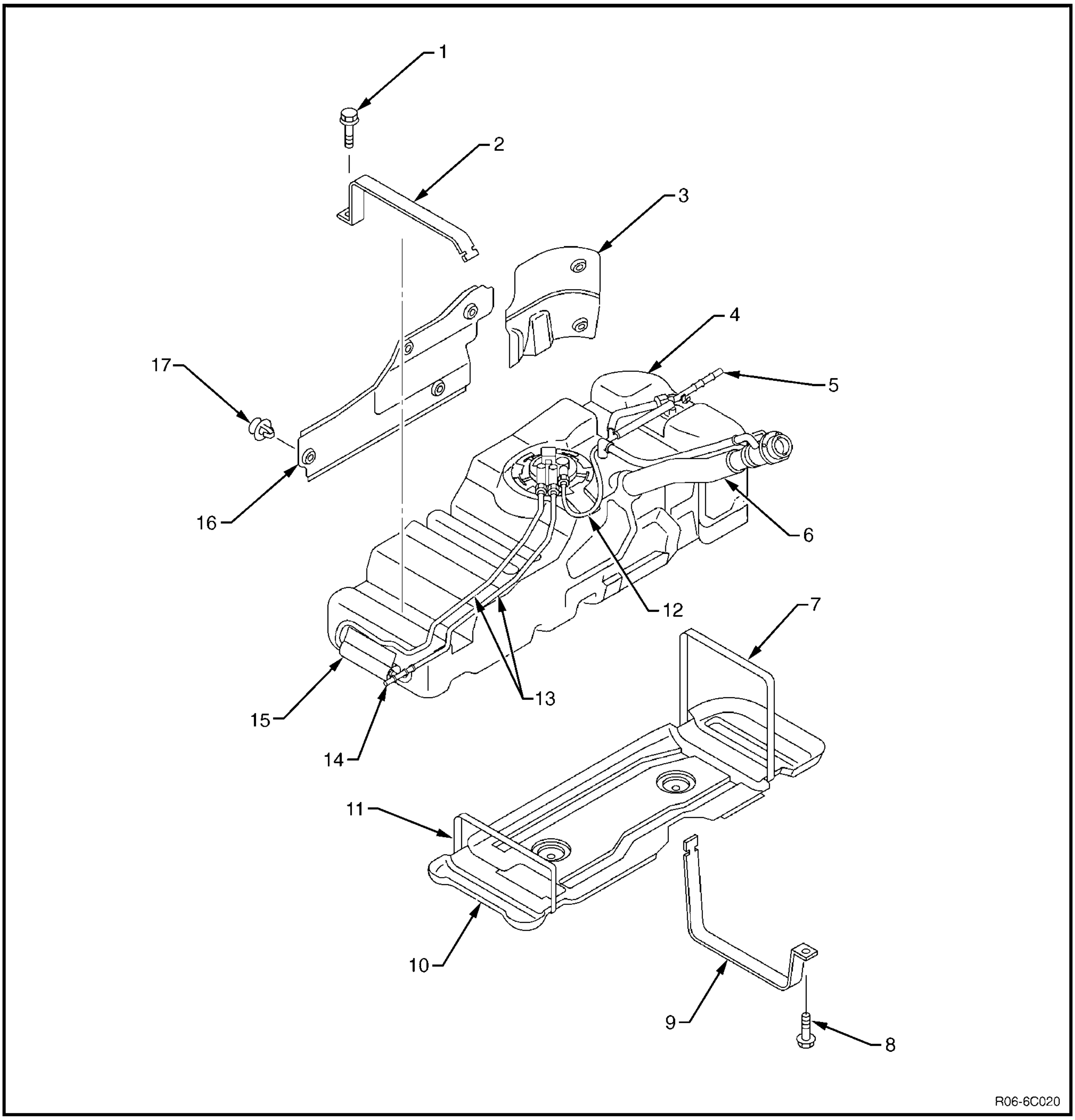


Figure 6C – 17

Legend

1	Front Fuel Tank Strap Bolt	7	Rear Under Shield Plastic Strap	13	Fuel Lines and Quick Connector
2	Front Fuel Tank Strap	8	Rear Fuel Tank Strap Bolt	14	Main Fuel Supply Line
3	Rear Side Shield	9	Rear Fuel Tank Strap	15	Fuel Filter
4	Fuel Tank	10	Under Shield	16	Side Shield
5	Evaporative Line	11	Front Under Shield Plastic Strap	17	Retainer
6	Fuel Filler Hose	12	Evaporative Line and Quick Connector		

Remove

WARNING

- **A depressurised fuel system contains fuel in the fuel filter and fuel lines that can be spilled during service operations.**
- **Fuel vapour remains in the fuel tank even when completely empty. Seal all openings in the fuel tank using suitable material or a plastic plug. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.**
- **Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.**

1 Remove the fuel pump relay, refer to 8A Electrical Body and Chassis.

2 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

WARNING

Never drain or store fuel into an open container, due to the possibility of fire or explosion.

3 Siphon the fuel tank, using commercially-available equipment.

CAUTION

Before proceeding, clean all traces of dirt and other foreign material from the top of the fuel tank, near the modular fuel pump and sender assembly.

7 Place a drain tray under the fuel filter area.

WARNING

Fuel can spill from the disconnected filter.

8 From behind the fuel filler door (1), unscrew the fuel filler cap (4) and cover the end of the fuel filler neck with a suitable material to prevent foreign objects from entering the fuel tank.

9 Remove the screw (2) securing the fuel filler neck (3) to the fuel filler pocket.

10 Remove the front half of the right-hand rear wheelhouse liner, refer to 10 Cab.

Fuel filler neck attaching screw torque specification ....5.0 Nm

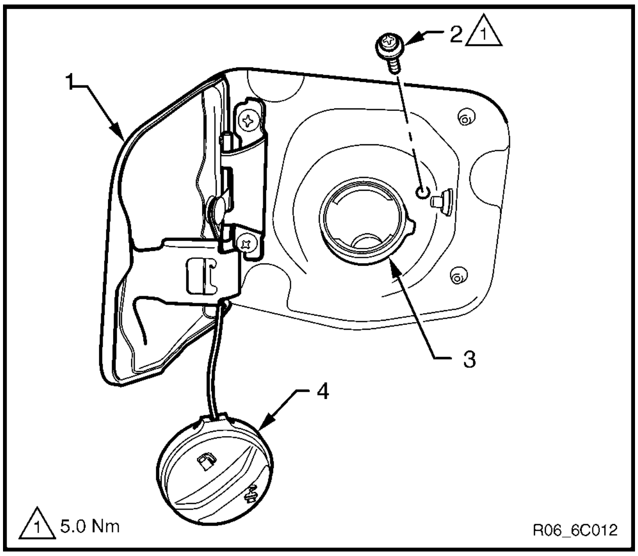


Figure 6C – 18

11 Unclip the fuel filler door release cable (1) from the retainer on the fuel filler neck (2).

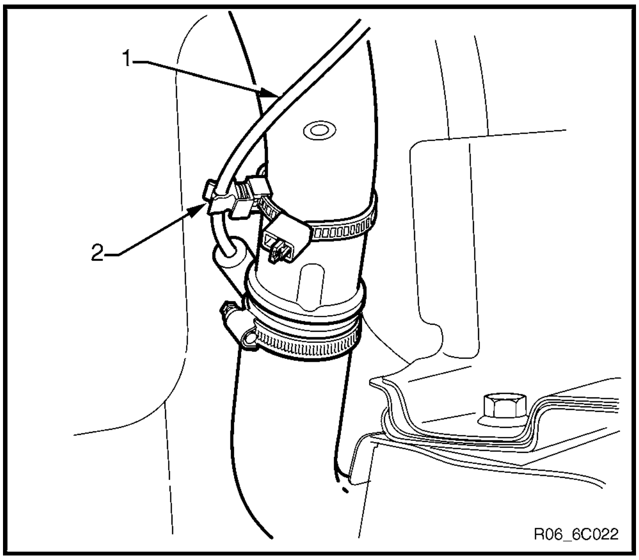


Figure 6C – 19

12 Lower the fuel filler neck and breather hose assembly.

13 Loosen the clamp (2) and disconnect the fuel tank breather hose (3) from the fuel filler neck (1).

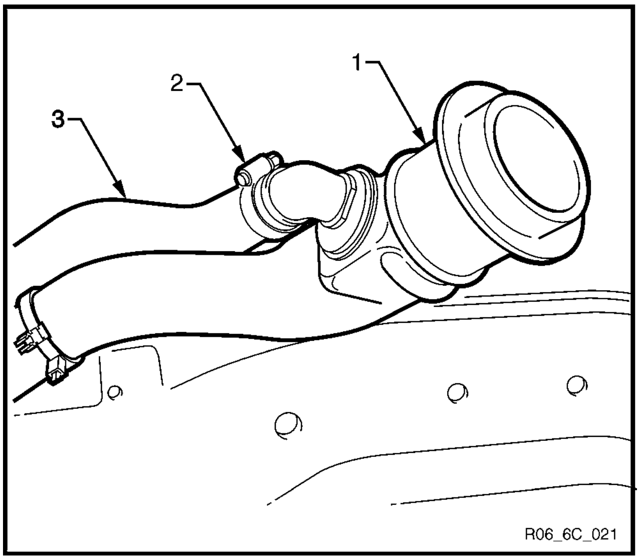


Figure 6C – 20

14 Remove the clamp (1) from the fuel filler neck and disconnect from the rubber fuel tank inlet hose (2), place the removed filler neck (3) in a safe location.

15 Raise the vehicle, preferably on a hoist, refer to 0A General Information.

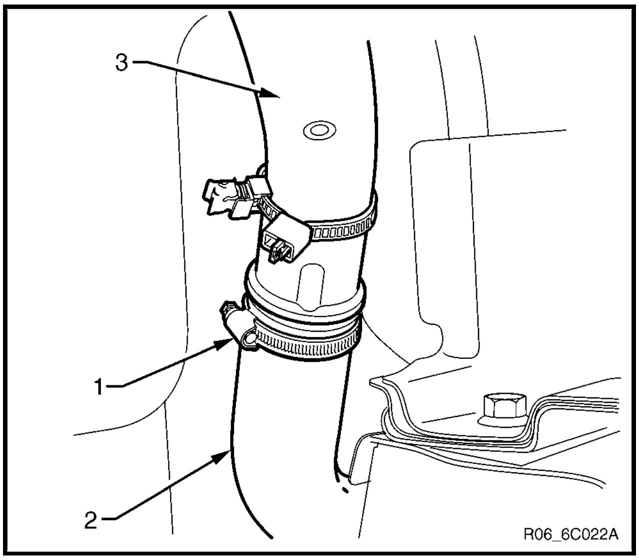


Figure 6C – 21

WARNING

Wear safety glasses when using compressed air. Do not blow compressed air onto any body part.

16 Use compressed air to ensure that all dirt and foreign materials are removed from all fuel connections before the parts are disconnected.

17 Disconnect the quick-connect fitting from the fuel supply line at the front of the fuel tank (1) and the evaporative line quick-connect fitting at the rear of the fuel tank (2), refer to 4.1 Fuel Lines And Quick Connect Fittings.

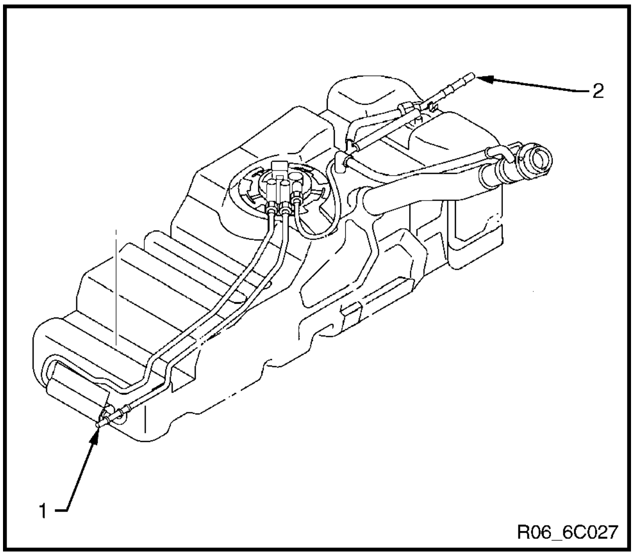


Figure 6C – 22

18 Remove the bolt securing the front fuel tank strap (1) to the crossmember and remove the strap (2), refer to Figure 6C – 17.

CAUTION

Support the fuel tank with stands or have an assistant on hand to help in the fuel tank removal.

19 Remove the bolt from the rear fuel tank strap (8) then remove the strap (9) refer to Figure 6C – 17.

20 Lower the rear of the fuel tank enough to allow access to the fuel pump electrical connector, release the connector clip and remove the connector from the socket.

21 Lower the fuel tank from the vehicle, ensuring the fuel tank inlet and breather hoses do not foul on any obstruction during the process.

22 Remove the fuel tank from the vehicle.

Reinstall

Reinstallation of the fuel tank is the reverse of the removal procedure, noting the following:

1 Lift the fuel tank into position reinserting the fuel tank inlet and breather hoses into the body opening. Raise the fuel tank into place and rest the front of the tank on the crossmember.

2 Replace the fuel pump electrical connector, be sure to engage the locking tab.

3 Fit the fuel tank mounting straps in the following order, refer to Figure 6C – 17,

  a Loosely reattach the rear fuel tank mounting strap and bolt (8 & 9), refer to Figure 6C – 17.

  b Loosely attach the front mounting strap and bolt (1 & 2), refer to Figure 6C – 17.

  c Ensure that the fuel tank is located in the correct position then,

  d Tighten the rear mounting strap bolt (8), Figure 6C – 17.

  e Tighten the front mounting strap bolt (1), Figure 6C – 17.

4 Tighten all fuel tank mounting strap bolts to the correct torque specification.

Fuel tank mounting strap bolts torque specification ....68.0 Nm

WARNING

Install the fuel filter with the flow arrow on its body pointing in the same direction as the fuel flow to the front of the vehicle.

5 Install the disconnected quick-connect fittings to the fuel supply line at the front of the fuel tank and the evaporative line quick-connect fitting at the rear of the fuel tank. Refer to 4.1 Fuel Lines And Quick Connect Fittings, for the correct component routeing.

6 Lower the vehicle to a comfortable working height and reinstall the clamp (1) to the fuel filler neck and reconnect the rubber fuel tank inlet hose (2) and tighten the clamp, refer to Figure 6C – 21.

7 Reinstall the fuel tank breather hose (3) to the fuel filler neck (1) and tighten the clamp (2), refer to Figure 6C – 20.

8 Clip the fuel filler door release cable (1) to the retainer on the fuel filler neck (2), refer to Figure 6C – 19.

9 Locate the fuel filler neck (3) to the filler pocket and attach with the securing screw (2), remove the cover material from the fuel filler neck inlet and refit the fuel filler cap (4), refer to Figure 6C – 18.

10 Reinstall the front half of the right-hand rear wheelhouse liner, refer to 10 Cab.

11 Before starting the vehicle, perform a fuel system leak test, refer to 3.3 Fuel Leak Test.

4.5 Modular Fuel Pump and Sender Assembly

NOTE

If the modular fuel pump and sender assembly develops a fault it must be replaced as a complete unit. The only serviced parts are the retainer locking ring and the O-ring seal.

Remove

WARNING

- **A depressurised fuel system contains fuel in the fuel filter and fuel lines that can be spilled during service operations.**
- **Fuel vapour remains in the fuel tank even when completely empty. Seal all openings in the fuel tank using suitable material or a plastic plug. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.**
- **Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.**
- **Wear safety glasses when using compressed air. Do not blow compressed air directly onto any body part.**

1 Remove the fuel pump relay, refer to 8A Engine Body and Chassis.

2 Remove the fuel tank assembly from the vehicle, refer to 4.4 Fuel Tank.

CAUTION

Before proceeding, clean all traces of dirt and other foreign material from the top of the fuel tank, near the modular fuel pump and sender assembly.

3 Use compressed air to ensure all dirt and foreign materials are removed from all fuel connections before disconnecting the parts.

WARNING

Fuel can spill from the disconnected modular fuel pump and sender assembly.

4 Tag the fuel feed line connecting the fuel feed port (1) on the modular fuel pump and sender assembly cover.

5 Tag the fuel return port (2) on the modular fuel pump and sender assembly cover.

6 Tag the evaporative line on the modular fuel pump and sender assembly cover (3).

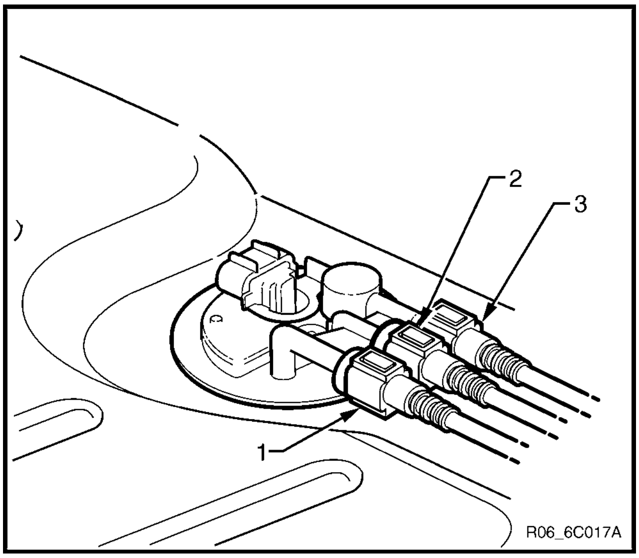


Figure 6C – 23

7 Disengage the fuel feed line quick-connect fitting (1).

8 Disengage the fuel return line quick-connect fitting (2).

9 Disengage the evaporative line quick-connect fitting (3).

Refer to 4.1 Fuel Lines And Quick Connect Fittings.

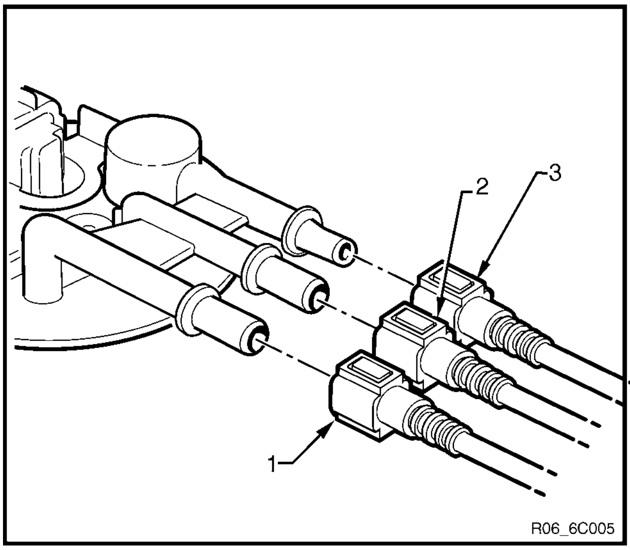


Figure 6C – 24

CAUTION

- **Ensure tool No. AU469 is seated firmly and positively in the modular fuel pump and sender assembly cover retainer lock ring while removing the modular fuel pump and sender assembly.**
- **Assistance will be required to hold the tank in position during this procedure; if not held adequately, you may slip and damage the modular fuel pump and sender assembly.**

10 Using tool No. AU469 (3) and a half-inch breaker bar (1), remove the modular fuel pump and sender assembly cover retainer lock ring (2) by turning it anticlockwise.

11 Remove the modular fuel pump and sender assembly cover retainer lock ring.

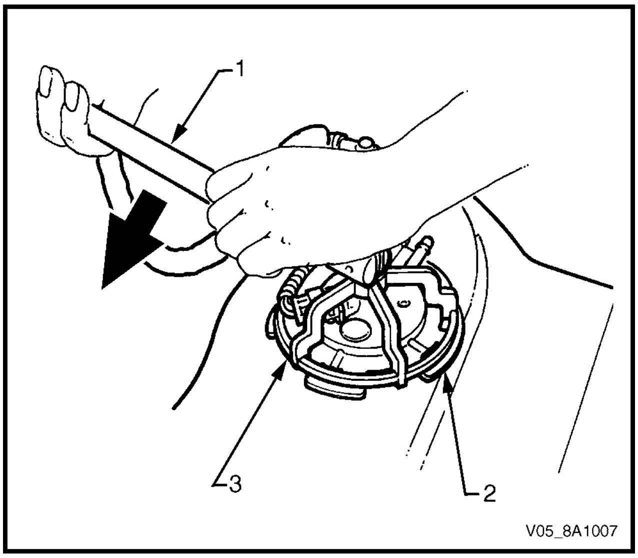


Figure 6C – 25

WARNING

The reservoir will be full of fuel. When the modular fuel pump and sender assembly is removed from the fuel tank, pour any remaining fuel in the reservoir into a suitable container. Do not drain or store fuel into an open container, due to the possibility of fire or explosion.

12 Place the modular fuel pump and sender assembly cover retainer lock ring (1) in a safe location away from the immediate worksite.

13 Carefully lift the modular fuel pump and sender assembly from the fuel tank, taking care not to:

- damage the fuel level sender float and arm (2), or
- spill any fuel remaining in the reservoir

NOTE

The fuel sender float arm is not serviced separately. If damaged, the modular fuel pump and sender assembly is replaced as a complete assembly.

14 Remove and discard the O-ring (3).

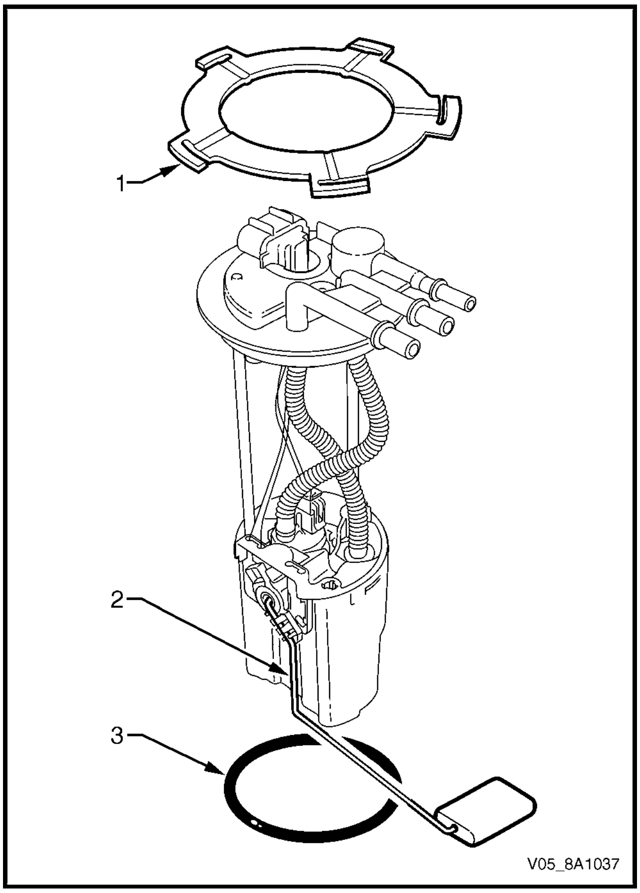


Figure 6C – 26

WARNING

Fuel vapour remains in the fuel tank even when completely empty. Seal all openings in the fuel tank using suitable material or a plastic plug. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.

15 Place a suitable material over the opening in the fuel tank to prevent any foreign matter from entering the fuel system.

Fuel Level Sender Assembly

Test

1 Measure the resistance across terminals 2 and 3 of the fuel pump connector. Take the following measurements:

a With the float arm assembly in the empty position, the resistance should be approximately 250 Ω.

b With the float arm assembly rotated to the full position, the resistance should be approximately 40 Ω.

2 If the resistance at either of these positions is not within tolerance, replace the modular fuel pump and sender assembly.

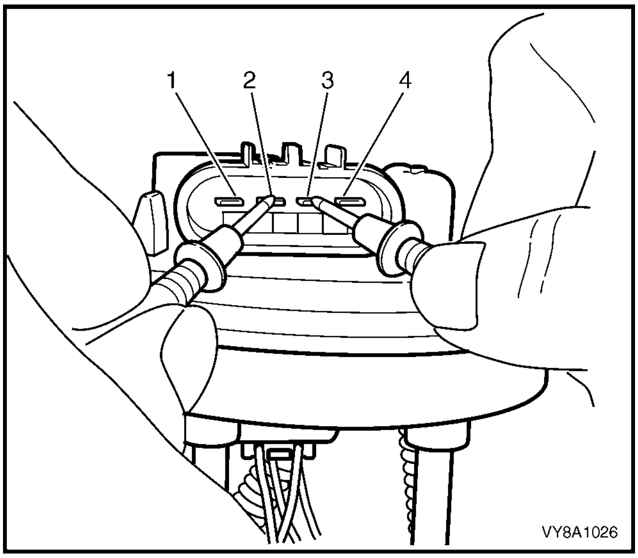


Figure 6C – 27

Reinstall

Reinstallation of the modular fuel pump and sender assembly is the reverse of the removal procedure, noting the following:

1 Fit a new O-ring (3) to the modular fuel pump and sender assembly.

2 Install the modular fuel pump and sender assembly into the fuel tank, taking care not to damage the fuel sender float or arm.

3 Ensure the locator in the pump cover engages in the slot in the fuel tank opening.

4 Using tool No. AU469 and a half-inch breaker bar, install the modular fuel pump and sender assembly cover retainer lock ring by turning it clockwise.

5 Refit the three quick connect fittings.

4.6 Evaporative Emission Control Canister

Remove

1 Raise the vehicle on a hoist to give access to the evaporative emission control canister, located above the spare wheel , refer to 0A General Information.

2 Disconnect the evaporative emission control canister purge line (3) by using the following procedure:

a Grasp both sides of the quick-connect fitting. Twist the connector 1/4 turn in each direction in order to loosen any dirt within the quick-connect fitting.

WARNING

Wear safety glasses when using compressed air. Do not blow compressed air onto any body part.

b Using compressed air, blow any dirt out of the quick-connect fitting.

c Grasp the quick-connect fitting and push it towards the canister.

d Squeeze the quick-connect fitting to release the retaining tabs, then pull back on the connector to remove the canister purge line from the canister.

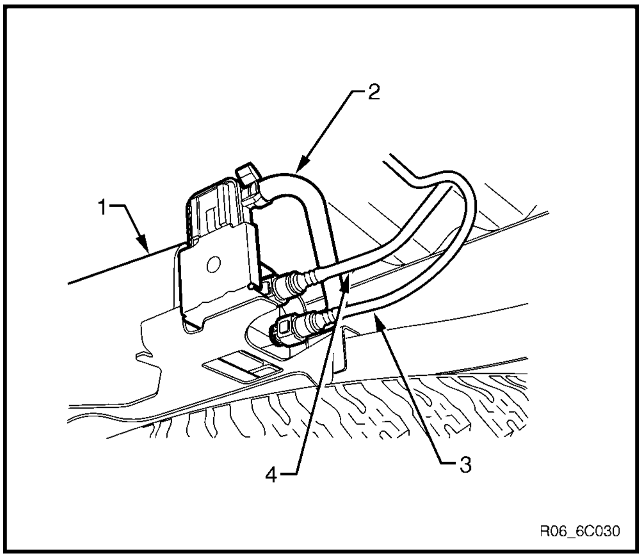


Figure 6C – 28

3 Disconnect the fuel tank vent line (4) by using the following procedure:

a Grasp both sides of the quick-connect fitting. Twist the connector 1/4 turn in each direction in order to loosen any dirt within the quick-connect fitting.

WARNING

Wear safety glasses when using compressed air. Do not blow compressed air onto any body part.

b Using compressed air, blow any dirt out of the quick connect fitting.

c Grasp the quick-connect fitting and push it towards the canister.

d Squeeze the quick-connect fitting to release the retaining tabs, then pull back on the connector to remove the tank vent line from the canister.

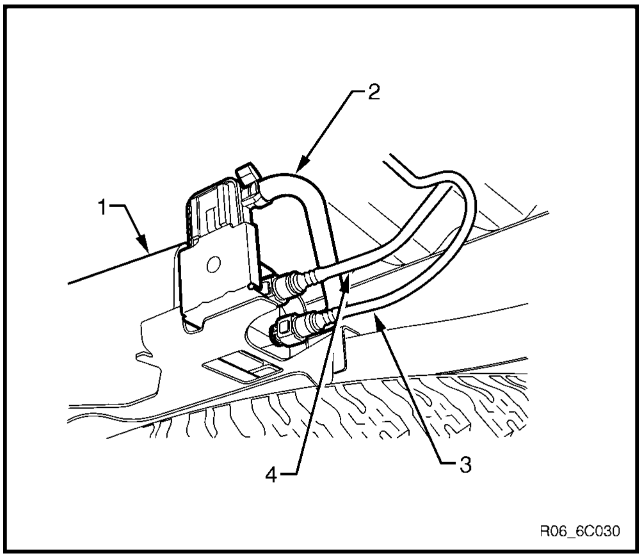
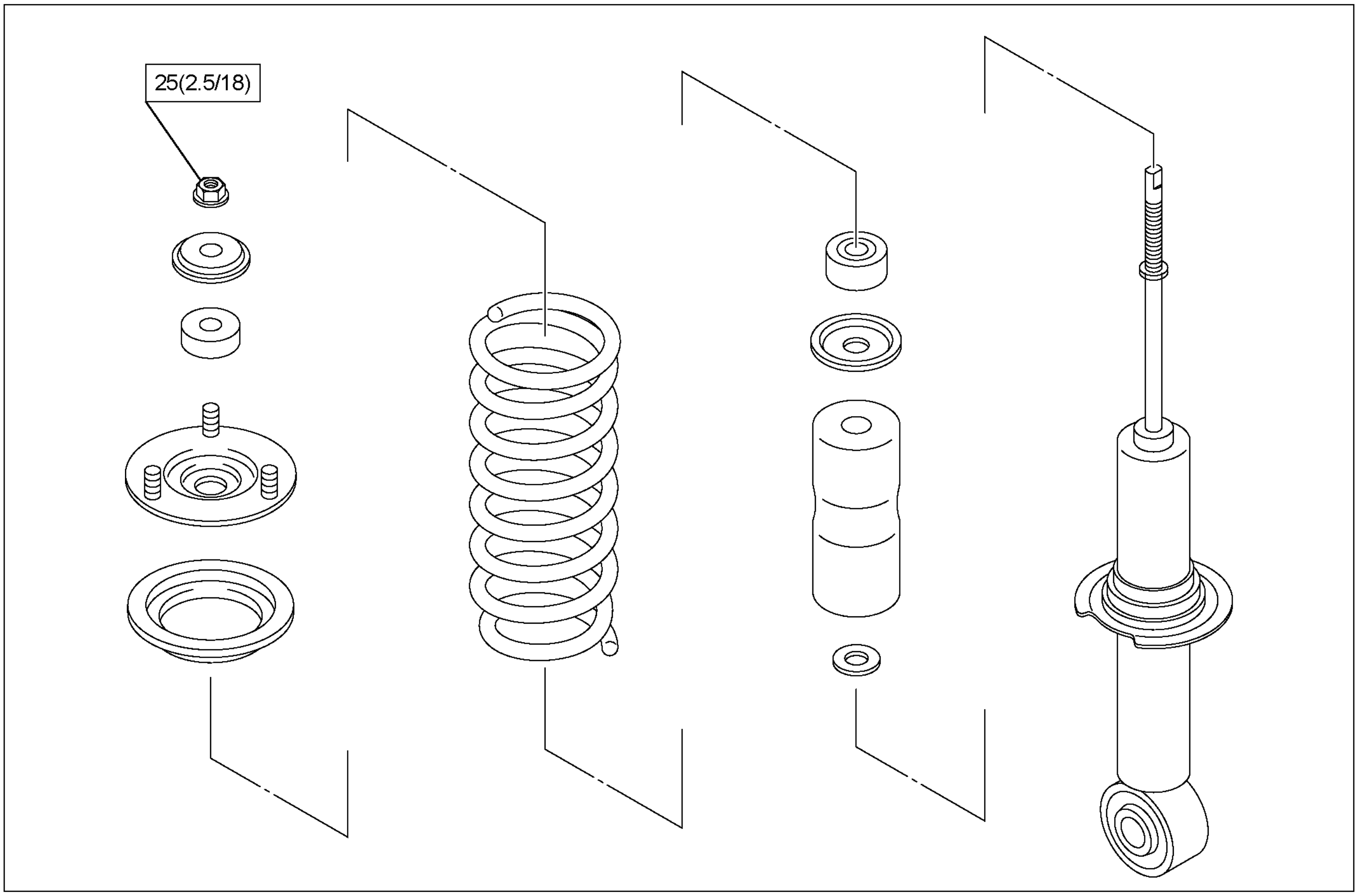


Figure 6C – 29

4×2 (Except High Ride Suspension) Model N·m (kgf·m/lb·ft)



RTW440MF000201

4 Remove the canister vent line (2) from the canister (1) by twisting and pulling it off.

Refer to 4.1 Fuel Lines And Quick Connect Fittings for further information.

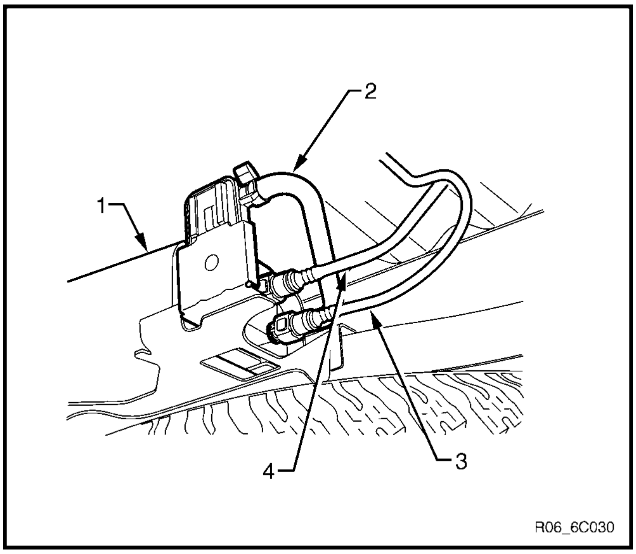


Figure 6C – 30

5 Remove the canister retaining nut (2).

6 Remove the canister from the retaining stud and then slide the canister (3) out of the retaining bracket (1).

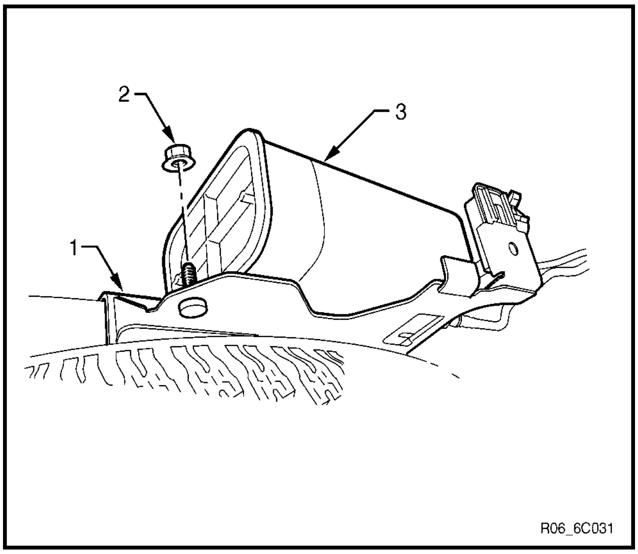


Figure 6C – 31

Service Check

1 Remove the canister.

2 Shake the canister. There should be no audible sound of carbon movement.

3 Using low pressure compressed air (20–35 kPa), blow into the tank vent port (3). Check that air flows freely from the canister vent port (1). Block the canister vent port (1); air should flow from the canister purge port (2).

4 If airflow through the canister vent port (1) is limited, clean the atmospheric filter by blocking off the fuel tank vent port (3) and blow compressed air at approximately 300 kPa through the canister purge port (2).

5 Check airflow through the filter as in step 3. If airflow through the canister vent port (1) is still limited, replace the canister.

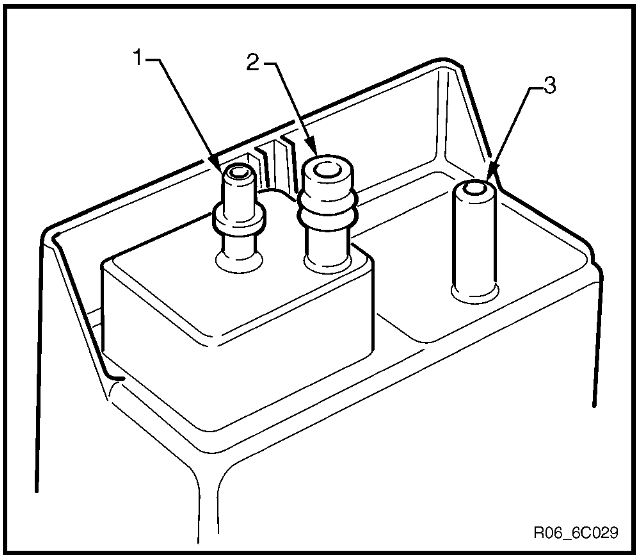


Figure 6C – 32

6 Block the canister vent port (1) and the canister purge port (2). Apply low-pressure compressed air (20–35 kPa) to the tank vent port (3). If any air leaks from the canister (that is, around the ports or seams), replace the canister.

NOTE

In dusty areas, an alternative is to block the canister purge port (2). Blow air through the canister vent (1) port and check that air is expelled through the tank vent port (3).

Reinstall

Reinstallation of the evaporative emission control canister is the reverse of the removal procedure.

1 Reinstall the canister into the retainer (1) and over the retaining stud.

2 Reinstall the canister retaining nut (2), then hand-tighten.

3 Ensure the canister is located correctly and tighten the canister retaining nut (2) to the specified torque.

Evaporative emission control canister retaining nut torque specification ....2.0 – 5.0 Nm

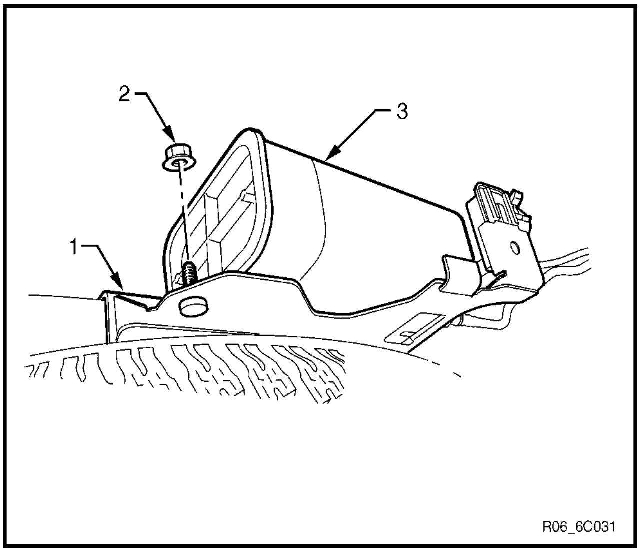


Figure 6C – 33

4 Reinstall the canister vent line (2).

5 Align the canister purge line quick-connect (3) with the canister purge line port. Push the quick-connect firmly onto the port.

6 Align the fuel tank vent line quick-connect (4) with the fuel tank vent port. Push the quick-connect firmly onto the port.

7 After installation, pull on each quick-connect to ensure the connections are secure and locked in position.

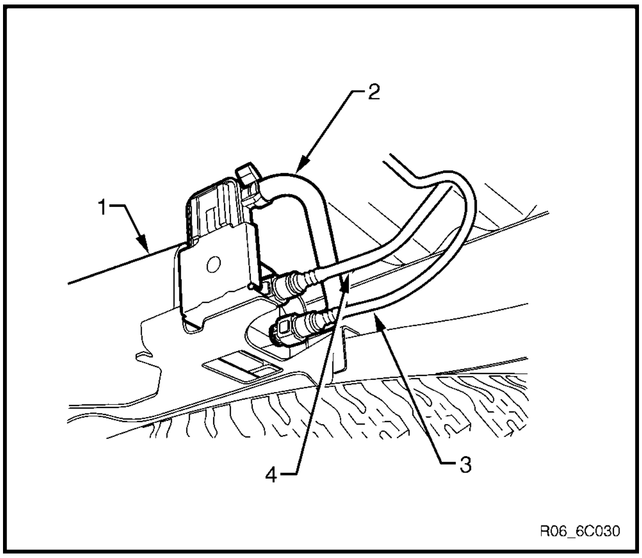


Figure 6C – 34

4.7 Fuel Tank Siphon Procedure

WARNING

- **Fuel vapour remains in the modular fuel pump and sender assembly and fuel lines that can be spilled during service operations. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.**
- **Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.**

For an exploded view of fuel tank components, refer Figure 6C – 17.

1 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

2 Reinstall the fuel pump relay, refer to 8A Electrical Body and Chassis.

CAUTION

Disconnecting the battery affects certain vehicle electronic systems. 1.1 WARNING, CAUTION and NOTES.

3 Disconnect the negative battery terminal.

4 Remove the fuel filler cap.

NOTE

Lubricate the fuel siphon hose with J36850 TransJel Transmission Assembly Lubricant or equivalent to aid hose insertion. Use only an approved lubricant.

5 Install J44284–2 flapper door holder (2) into the fuel filler neck to hold the door open.

WARNING

Do not siphon, drain or store fuel into an open container, due to the possibility of fire or explosion, or contamination. Always use and approved fuel storage container.

6 Insert the J45004–1 fuel tank siphon hose (1) into the fuel tank filler neck and gradually twist it until the tip of the hose meets the fuel tank check valve (3) and continues to the bottom of the fuel tank.

7 Use a hand-operated or air-operated pump device to siphon as much fuel through the fuel fill pipe as possible.

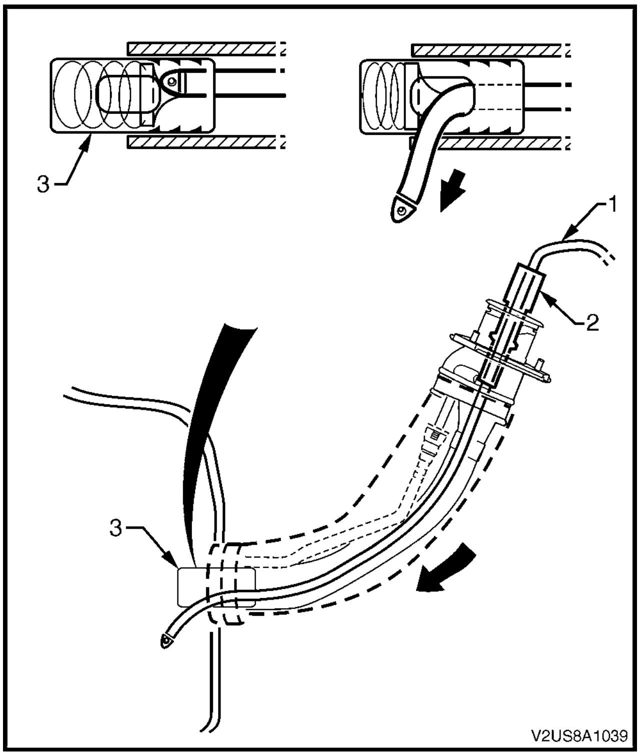


Figure 6C – 35

WARNING

Fuel vapour remains in the fuel tank even when completely empty. Seal all openings in the fuel tank using suitable material or a plastic plug. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.

CAUTION

Do not use excessive force when removing the fuel siphon hose from the fuel filler neck. If the fuel siphon hose gets stuck upon removal, gently twist and tug the fuel siphon hose back and forth until it releases.

NOTE

- If fuel does not siphon from the fuel tank, the fuel siphon hose may have entered the fuel tank through a roof-facing check valve opening. If required, insert the J45004–1 fuel siphon hose (1) into the fuel tank filler neck, refer to Figure 6C – 35, but twist the fuel siphon hose 90° as it slides down the filler neck. This enables the fuel siphon hose to enter the fuel tank through a floor-facing check valve opening.
- The siphon procedure will not remove all fuel from the fuel tank. If required, fuel remaining in the fuel tank may be siphoned out through the top of the fuel tank, once the modular fuel pump and sender assembly is removed from the tank, refer to 4.4 Fuel Tank.

8 Remove the siphon equipment.

4.8 Fuel Filler Cap

The fuel filler cap is a 'screw on' type, with an integrated tightening torque limiting mechanism. When installing the fuel filler cap, tighten it until a ratcheting (clicking) sound is audible, indicating the fuel filler cap is properly tightened. The fuel filler cap is tethered to the fuel filler pocket.

Remove

The fuel filler cap requires a quarter of a turn anticlockwise to be removed.

Vacuum and pressure valves are built into the fuel filler cap which regulate the pressure in the fuel tank and prevent fuel tank and system damage.

Inspection

Inspect the fuel filler cap and seal for any signs of damage. Replace the fuel filler cap if found to be defective.

1 Pressure Valve

2 Vacuum Valve

3 Seal Ring

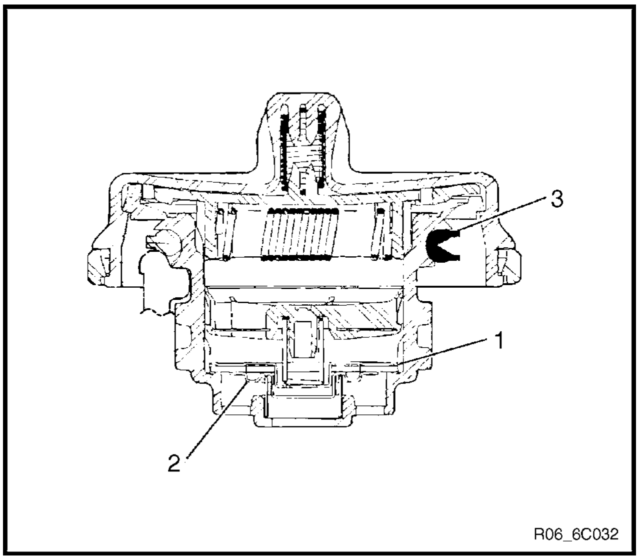


Figure 6C – 36

CAUTION

A replacement fuel filler cap must be the same type as the original. The fuel filler cap pressure and vacuum valves are specific to a particular application and must be replaced with the same type or fuel system damage may occur.

WARNING

If the fuel filler cap needs replacing, use only a 'screw on' fuel tank filler cap with an integrated tightening torque limiting mechanism. Failure to use the correct fuel tank filler cap can result in a serious malfunction of the emission control or fuel system.

1. Untwist and remove the fuel filler cap (2) from the fuel filler neck opening.
2. Cover the fuel filler opening with a suitable material to prevent foreign objects from entering the fuel tank.
3. To remove the fuel filler cap tether line use a flat-bladed screwdriver to prise the tether line fastener (2) from it's mounting hole.

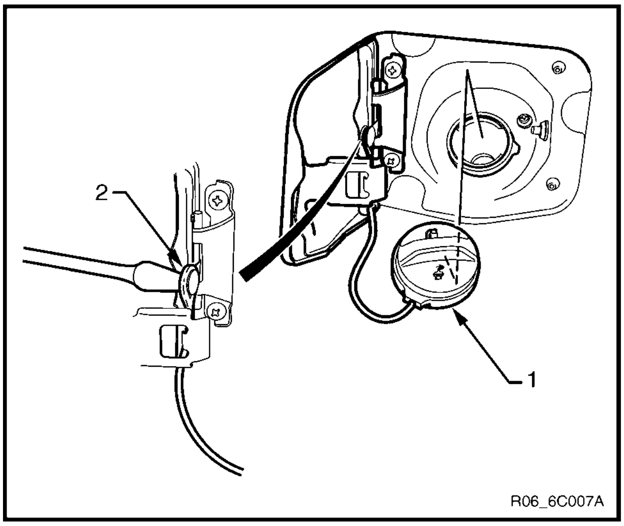


Figure 6C – 37

NOTE

Check the fuel filler cap for serviceability and replace if required.

Reinstall

Reinstallation of the fuel filler cap is the reverse of the removal procedure.

4.9 Fuel Lines

Remove

WARNING

- **A depressurised fuel system contains fuel in the fuel filter and fuel lines that can be spilled during service operations.**
- **Fuel vapour remains in the fuel tank even when completely empty. Seal all openings in the fuel tank using suitable material or a plastic plug. Ensure no naked flames or other ignition sources are nearby. Ensure all cellular phones (and transmission devices that may cause any metal objects to become unintentional receiving antennas) are switched off.**
- **Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.**
- **Wear safety glasses when using compressed air. Do not blow compressed air onto any body part.**

1 Remove the fuel pump relay, refer to 8A Electrical Body and Chassis.

2 Depressurise the fuel system, refer to 3.4 Fuel System Depressurisation.

WARNING

Never drain or store fuel into an open container, due to the possibility of fire or explosion.

3 Raise the vehicle, preferably on a hoist, refer to 0A General Information.

CAUTION

Before proceeding, clean all traces of dirt and other foreign material from the fuel lines.

4 Use compressed air to ensure that all dirt and foreign materials are removed from all fuel connections before the parts are disconnected.

5 If required, remove the stone guard, refer to Figure 6C – 17 and fuel lines. Use the following illustrations showing the fuel line layout and location of other items relating to the fuel system as a guide, also refer to 4.1 Fuel Lines And Quick Connect Fittings and 4.6 Evaporative Emission Control Canister.

Fuel Tank Lines

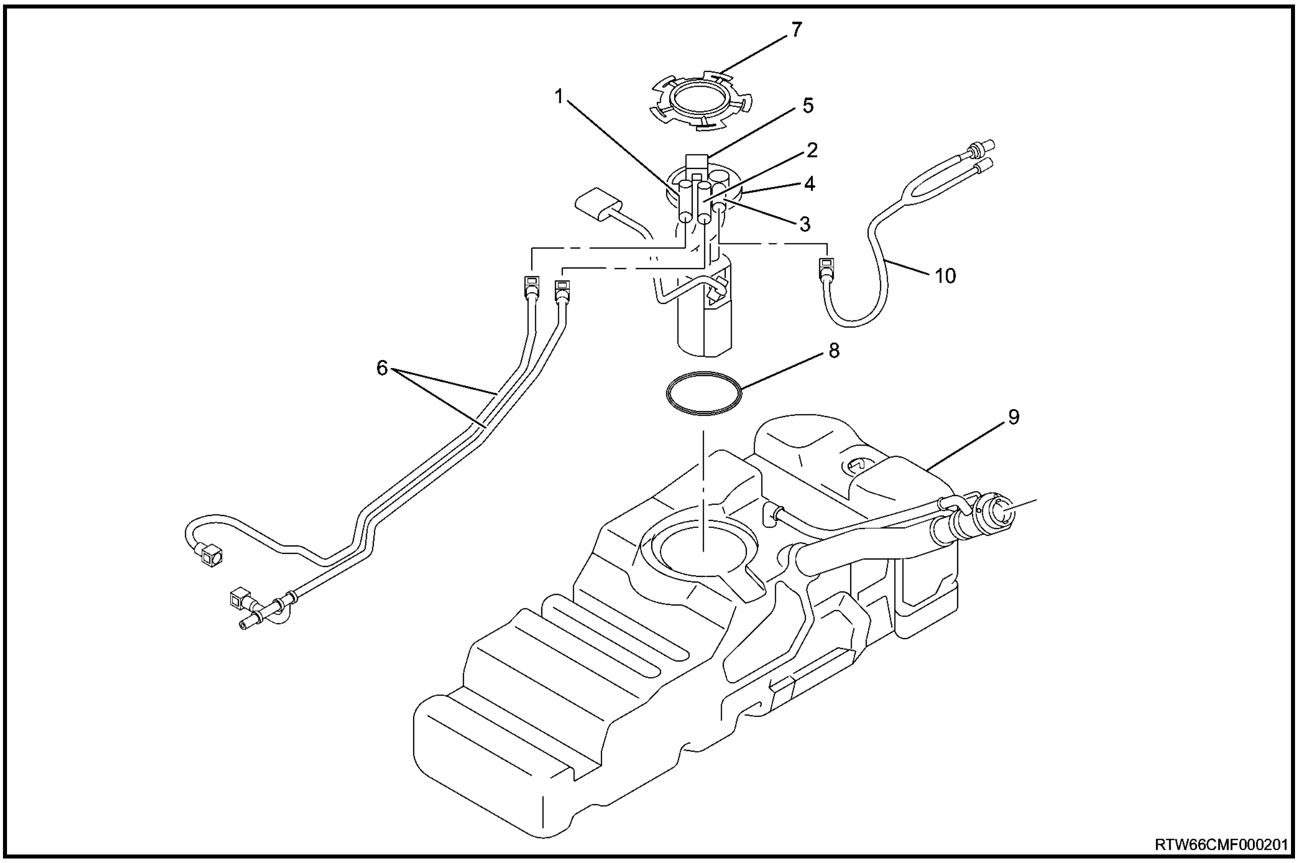


Figure 6C – 38

Legend

1	Fuel Feed Line	6	Fuel Lines
2	Fuel Return Line	7	Retainer Ring (Fuel Pump Lock)
3	Fuel Vapour emission port	8	"O" Ring Seal
4	Fuel Pump and Sender Assembly	9	Fuel Tank Assembly
5	Connector; Fuel Pump and Sender	10	Fuel Vapour Vent Line

Reinstall

CAUTION

Ensure the plastic fuel line clips are in good condition before proceeding. If not, replace the defective clips.

Reinstallation of the stone guard and fuel lines is the reverse of the removal procedure, noting the following:

1 Tighten the Fuel line securing nut to the correct torque specification, refer to Figure 6C – 39.

Fuel line securing nut torque specification ....8 – 12 Nm

2 Tighten the stone guard securing bolts to the correct torque specification.

Stone guard securing bolt torque specification ....5.0 – 7.0 Nm

Fuel Line Routing

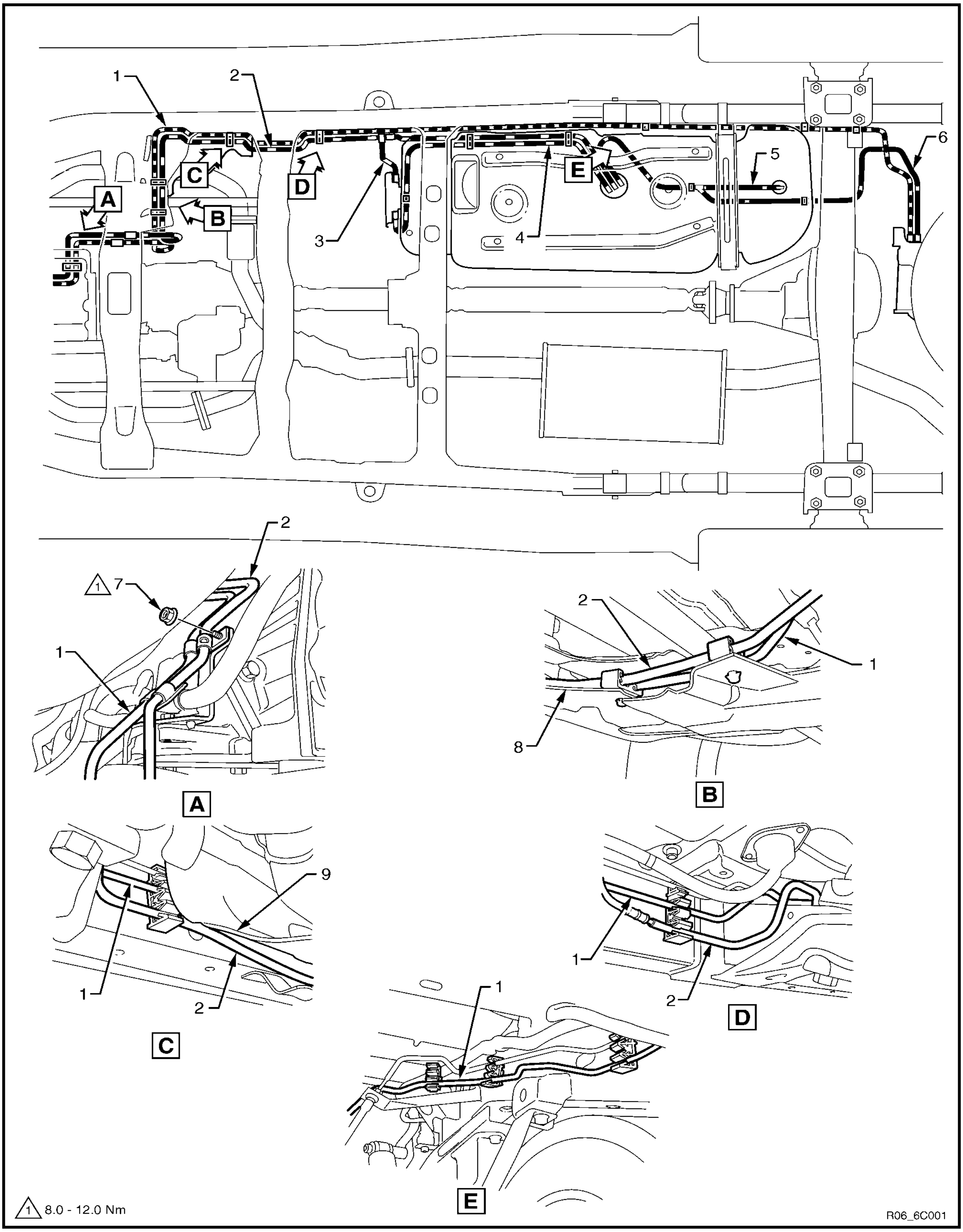


Figure 6C – 39

Legend

1 Evaporative Emission Control Canister Purge Line

2 Fuel Feed Line

3 Fuel Line From Fuel Filter

4 Fuel Feed Line To Fuel Filter

5 Evaporative Line To Rollover Valve

6 Evaporative Line To Canister

7 Fuel Line Securing Nut

8 Stone Guard

9 Side Stone Guard

Bell Housing Fuel Lines

1 Remove the bolt (1) securing the fuel line bracket to the upper left-hand side of the bell housing, refer to 7B1 Transmission.

NOTE

The left-hand front exhaust pipe may need to be moved aside to gain access to the fuel line retaining bracket bolt (1), refer to 6F Exhaust System – V6.

Fuel line bracket bolt torque specification ....8.0 – 12.0 Nm

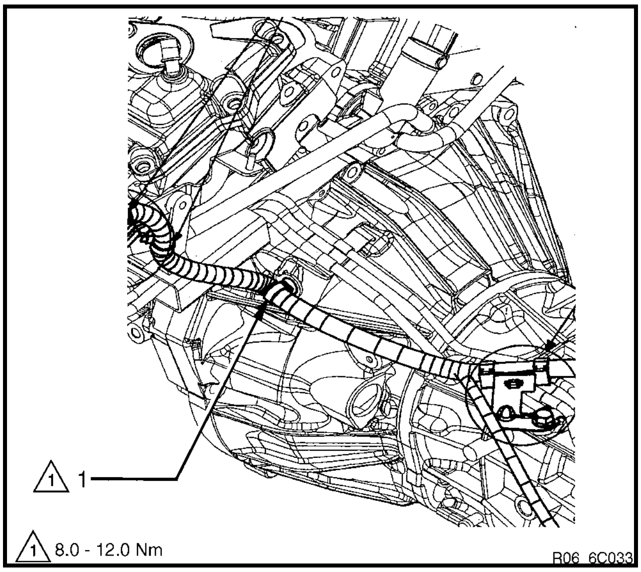


Figure 6C – 40

Engine Bay Fuel Lines

1 Remove the nut (5) from the fuel line bracket (4).

2 Unclip the fuel lines from the engine, refer to 4.1 Fuel Lines And Quick Connect Fittings.

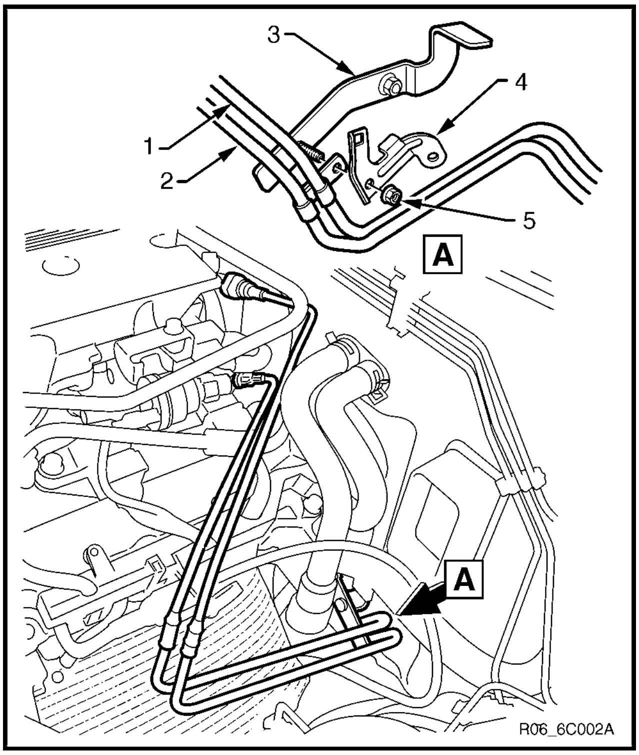


Figure 6C – 41

4.10 Rollover Valve

The fuel tank incorporates two rollover valves. The rollover valve limits vapour venting to the evaporative emission control canister using a fixed-sized orifice that is normally open (View A). If the vehicle rolls over (View B), the fuel tank vent line to the evaporative emission control canister is safely shut off by the rollover valve, preventing liquid fuel from flooding the evaporative emission control canister.

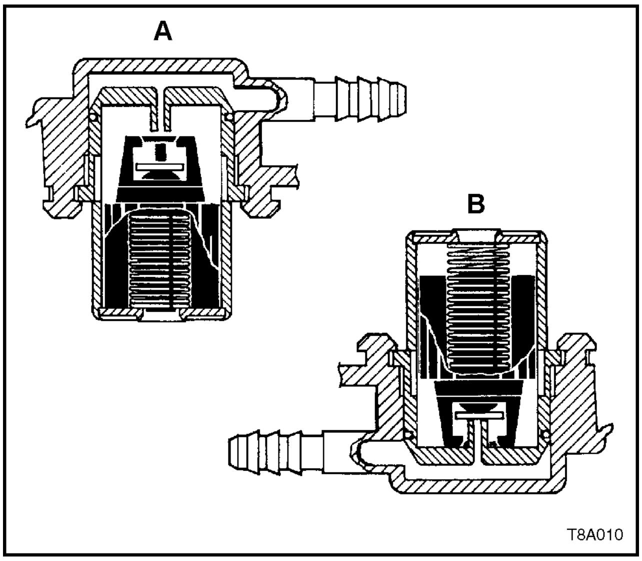


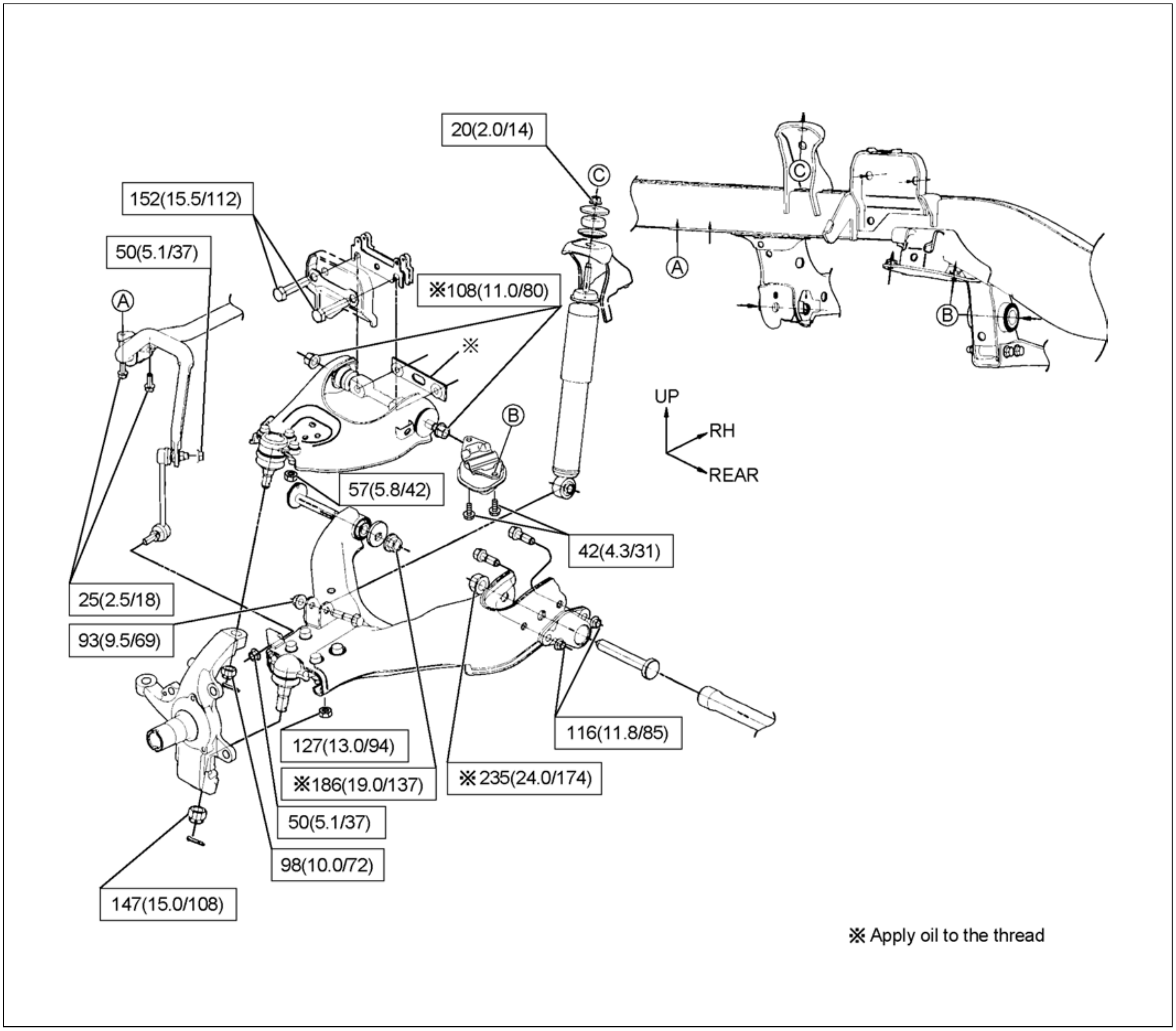
Figure 6C – 42

NOTE

The rollover valve is welded to the top of the fuel tank and is not a serviceable item. If the rollover valve becomes unserviceable, the fuel tank must be replaced, refer to 4.4 Fuel Tank.

4×2 (High Ride Suspension) and 4×4 Model

N·m (kgf·m/lb·ft)



RTW73CLF000201

5 Specifications

Fuel Tank Capacity:

.... 76 litres

Fuel Tank Material:

.... 'W'-type high-density multi-layer polyethylene

Fuel Filler Location:

.... Attached to the left side of tray

Fuel Pump Type:

.... Single turbine

Pressure Regulator Location:

.... Engine bay

Fuel Pump Location:

.... In fuel tank

Fuel Pump Regulated Pressure:

.... approx. 410 kPa at idle

Minimum Fuel Pump Flow Capacity (at Regulated Pressure):

.... 2.95 L/min @ 13.5 volts

Fuel Pump Current Draw (Steady State at Regulated Pressure):

.... 11.0 Amps maximum

6 Torque Wrench Specifications

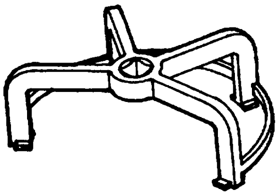
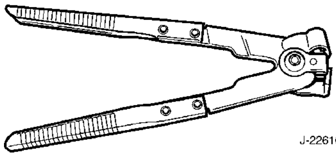
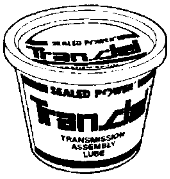
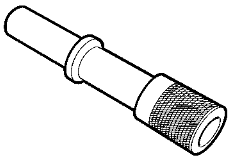
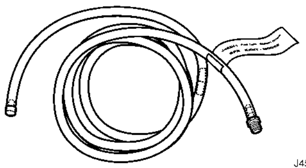
Fuel Tank Mounting Strap Bolts .... 68.0 Nm

Evaporative Emission Control Canister Mounting Nut .... 2.0 – 5.0 Nm

Fuel Line Securing Nut .... 8.0 – 12.0 Nm

Stone Guard Securing Bolt .... 5.0 – 7.0 Nm

7 Special Tools

Tool Number	Illustration	Description	Tool Classification
AU469 (J39765)		**Modular Fuel Pump and Sender Assembly Remover / Installer. (Sedan, Wagon and Utility)** Previously released.	Mandatory
J22610	 J-22610	**Keystone Clamp Pliers** Used to remove and fasten ear-type clamps.	Available
J36850	 J36850	**TransJel Lubricant** Used to lubricate fuel tank siphon hose during fuel tank drain/siphon procedures.	Desirable
J44284–2	 J44284-2	**Fuel Flapper Door Holder** Holds open the fuel filler neck flapper door to allow the fuel tank siphon hose to be fed down into the fuel filler neck.	Mandatory
J45004–1	 J45004	**Fuel Tank Siphon Hose** Flexible fuel siphoning hose with grounding wire and threaded vacuum pump fitting.	Mandatory

6C1-1 Engine Management – V6 General Information

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.3 Warning Caution and Notes for correct workshop practices with regard to safety and / or property damage.

1 General Information

WARNING

The V6 engine management system incorporates functions and components that could cause personal injury or vehicle damage. Refer to 6C1-2 Engine Management – V6 – Diagnostics, and 6C1-3 Engine Management – V6 – Service Operations, before attempting any diagnosis or repairs.

1.1 Introduction

The V6 engine management system is designed to improve engine performance and increase vehicle safety while meeting the stringent Euro 3 vehicle emission standard. This is achieved by the introduction of the following engine management sub-systems and components:

- Throttle actuator control (TAC) System – the TAC system allows the engine control module (ECM) to electronically control the throttle plate opening eliminating the need for the following components:
  - mechanical link between the throttle plate and accelerator pedal,
  - cruise control module, and
  - idle air control motor.

  Refer to 3.5 Throttle Actuator Control System for details of the TAC System operation and to 3.6 Cruise Control System for details of the cruise control operation.

  This feature results in improved driveability, better fuel economy and emission control.
- Wide band heated oxygen sensor provides a more accurate measurement of the oxygen concentration in the exhaust gas. Refer to 4.14 Heated Oxygen Sensors.
- Dual spray fuel injectors are now used. The use of this spray pattern is used in engines with two intake valves per cylinder. The dual spray is achieved by having two openings in the spray orifice disc that are arranged in such a way that two fuel sprays result, being aimed at each intake valve port. Refer to 4.12 Fuel Injectors.
- Pencil Coil – allows the ignition coil to be fitted directly on the spark plug eliminating the need for spark plug wires. Refer to 4.15 Ignition Coil and Spark Plug.

The engine management system has a self diagnostic capability, as well as connections to enable diagnosis of faults. If the ECM recognises operational problems it can alert the driver via the malfunction indicator lamp (MIL) in the instrument cluster. The ECM also interfaces with other systems in the vehicle as required.

For further information on the air-conditioning system refer to 2A Heater and Air-conditioning,

For the location of fuses, fusible links and relays, refer to 8A Electrical-Body and Chassis.

1.2 Emission Control

ADR 79/01 Emissions Standards

MY2006 I190 Rodeo has been configured to comply with Australian Design Rule 79/01, that adopts the technical requirements of the European Council Directive 98/69/EC. Commonly referred to as “Euro 3”, the new legislation modifies the exhaust emissions, compared to the existing ADR 37/01 (or ‘Euro 2’) vehicle emissions standards.

Australian Design Rule 79/01 implements the 'Euro 3' exhaust and evaporative emissions requirements for petrol fuelled passenger cars, forward control vehicles and passenger off-road vehicles with a gross vehicle mass (GVM) up to 3.5 tonnes. All new vehicles within these categories and first registered from January 1, 2006 must comply with ADR 79/01.

The next table shows a comparison between the existing ADR 37/01 (‘Euro 2’) and ADR 79/01 (‘Euro 3’)

	Carbon Monoxide (g/km)	Hydrocarbons		Oxides of Nitrogen (g/km)	Particulate Matter (g/test)
		Exhaust (g/km)	Evaporative (g/test)		

ADR 37/01 (Petrol)	2.1	0.26	2	0.63	Not Applicable
ADR 79/01 (Petrol, LPG, CNG)	2.3	0.2	2	0.15	0.05

1.3 Warning Caution and Notes

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM Holden LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM Holden LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 Component Locations

2.1 Cylinder Numbering

Engine cylinder identification follows the international standard OBD II. This standard calls for the engine cylinder bank number one to be identified by the location of cylinder number one. Therefore the numbering for the V6 engine is:

The V6 engine cylinders are numbered as follows:

- 1, 3, 5 – Right-hand side (Bank 1),
- 2, 4, 6 – Left-hand side (Bank 2).

The engine firing order is 1, 2, 3, 4, 5, 6.

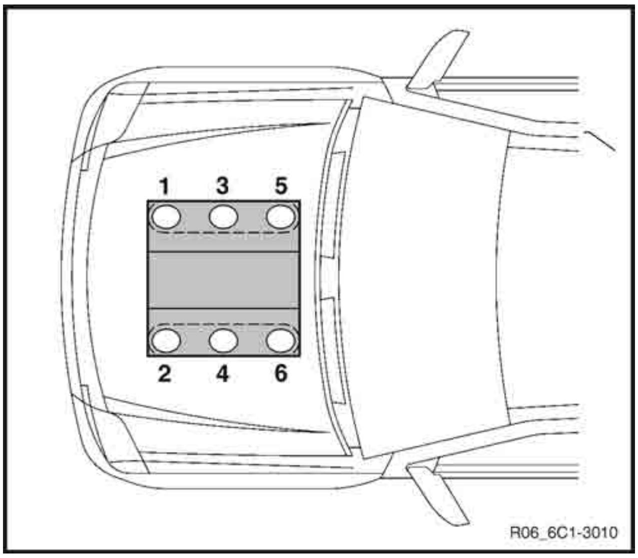


Figure 6C1-1 – 1

2.2 Engine Compartment

Legend

1 Mass Air Flow (MAF) Sensor

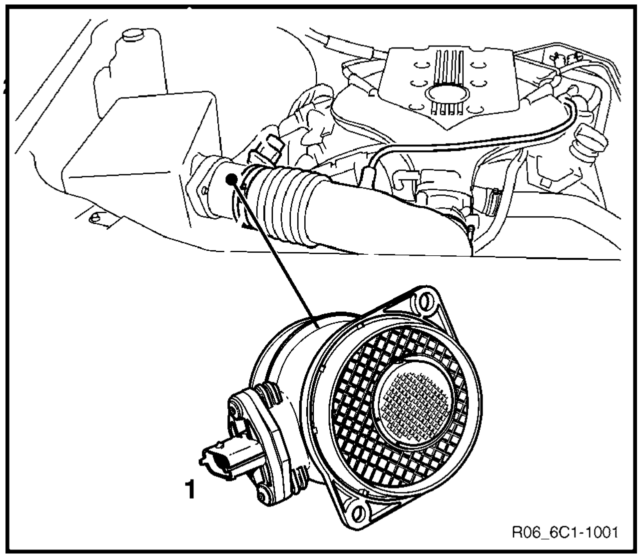


Figure 6C1-1 – 2

2.3 Engine

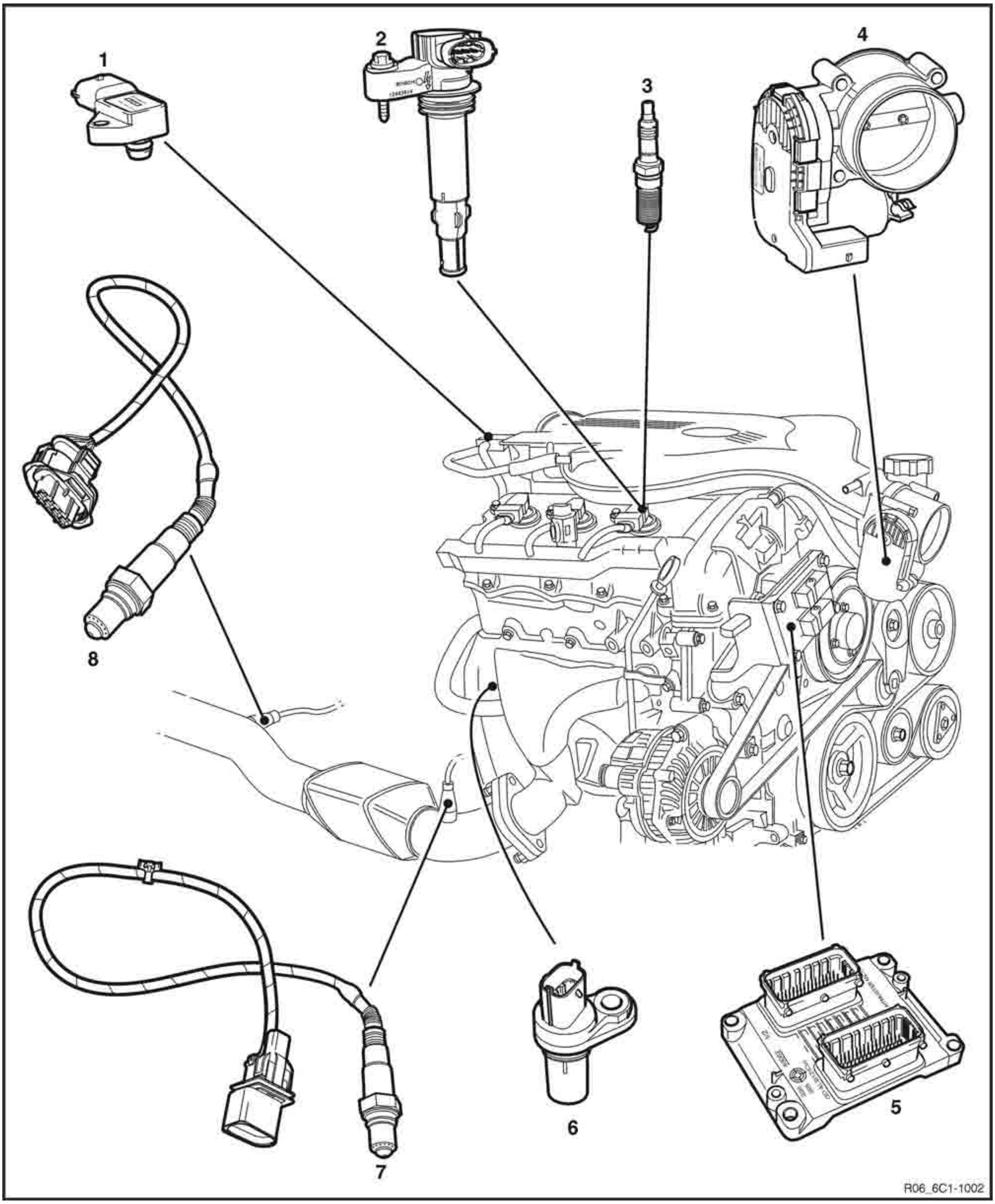


Figure 6C1-1 – 3

Legend

1 Barometric Pressure (BARO) Sensor
2 Ignition Coil Assembly (six places)
3 Spark Plug (six places)
4 Throttle Body Assembly
5 Engine Control Module (ECM)
6 Crankshaft Position (CKP) Sensor
7 Heated Oxygen Sensor (HO2S), Pre-Catalyst (two places)
8 Heated Oxygen Sensor (HO2S), Post-Catalyst (two places)

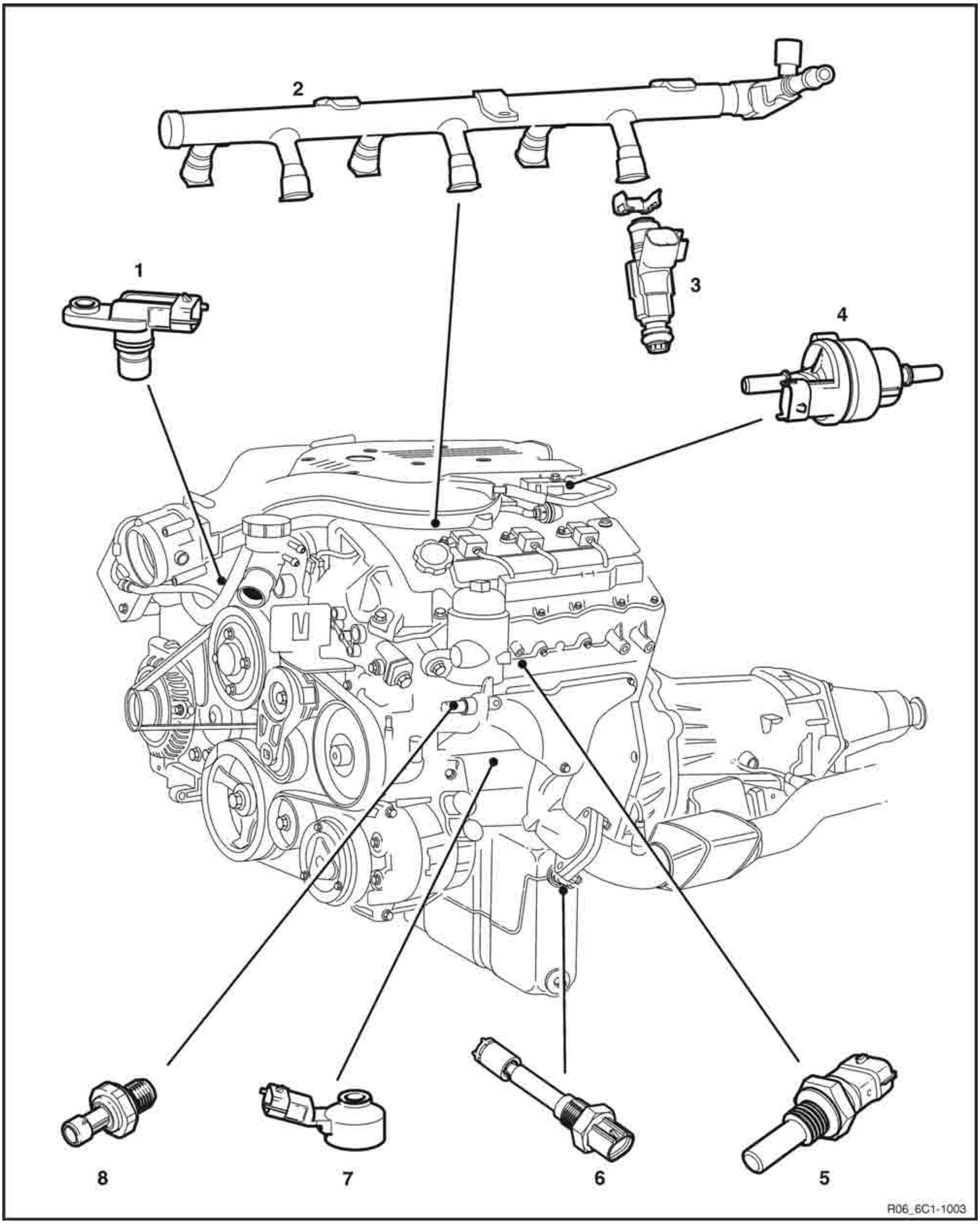


Figure 6C1-1 – 4

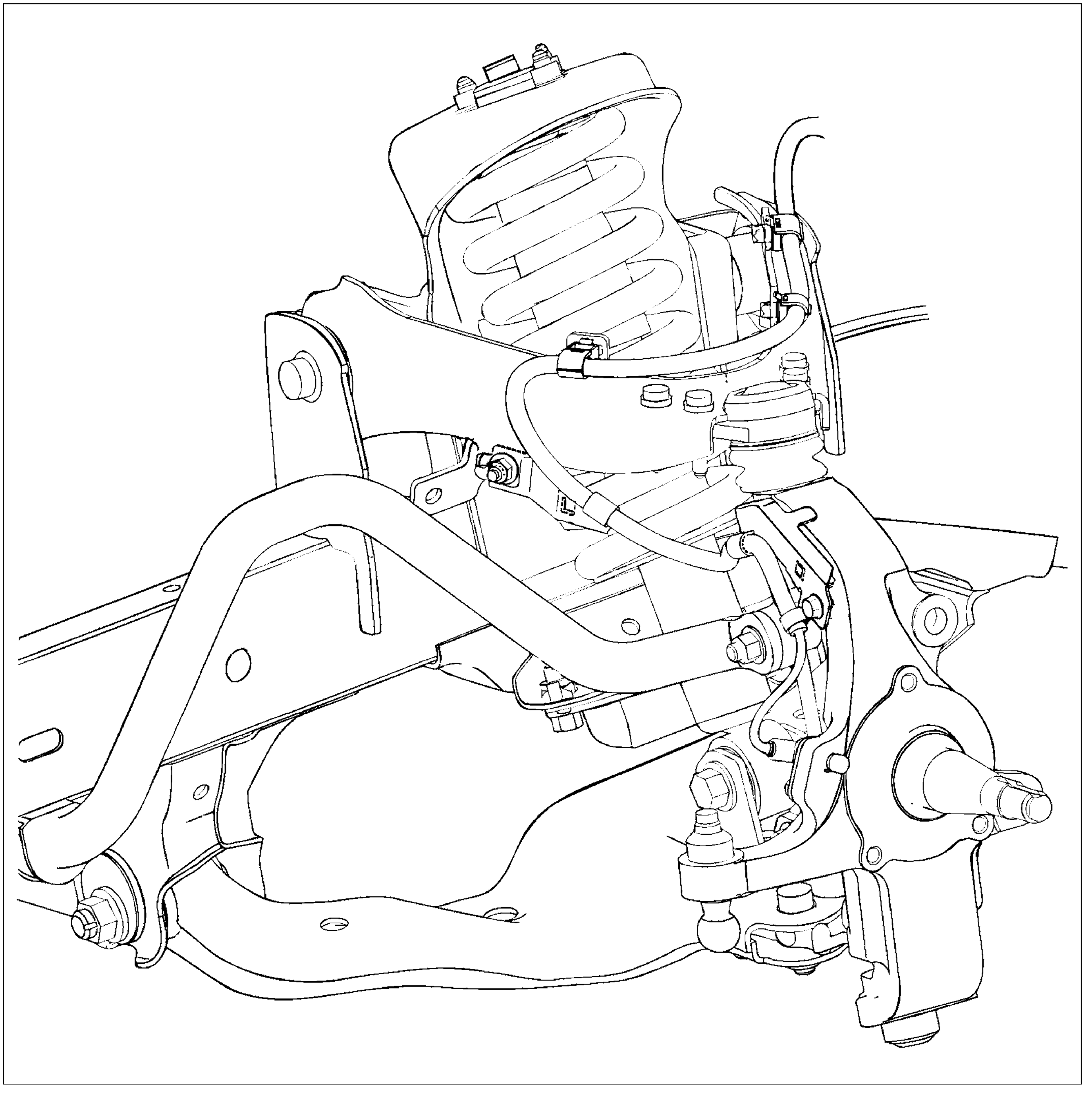
Legend

1	Camshaft Position (CMP) Sensor	5	Engine Coolant Temperature (ECT) Sensor
2	Fuel Rail Assembly	6	Engine Oil Level / Temperature Sensor
3	Fuel Injector (six places)	7	Knock (KS) Sensor (two places)
4	Evaporative Canister Purge (EVAP) Valve	8	Engine Oil Pressure Sensor

FRONT SUSPENSION

GENERAL DESCRIPTION

4×2 (Except High Ride Suspension) Model



2.4 Interior

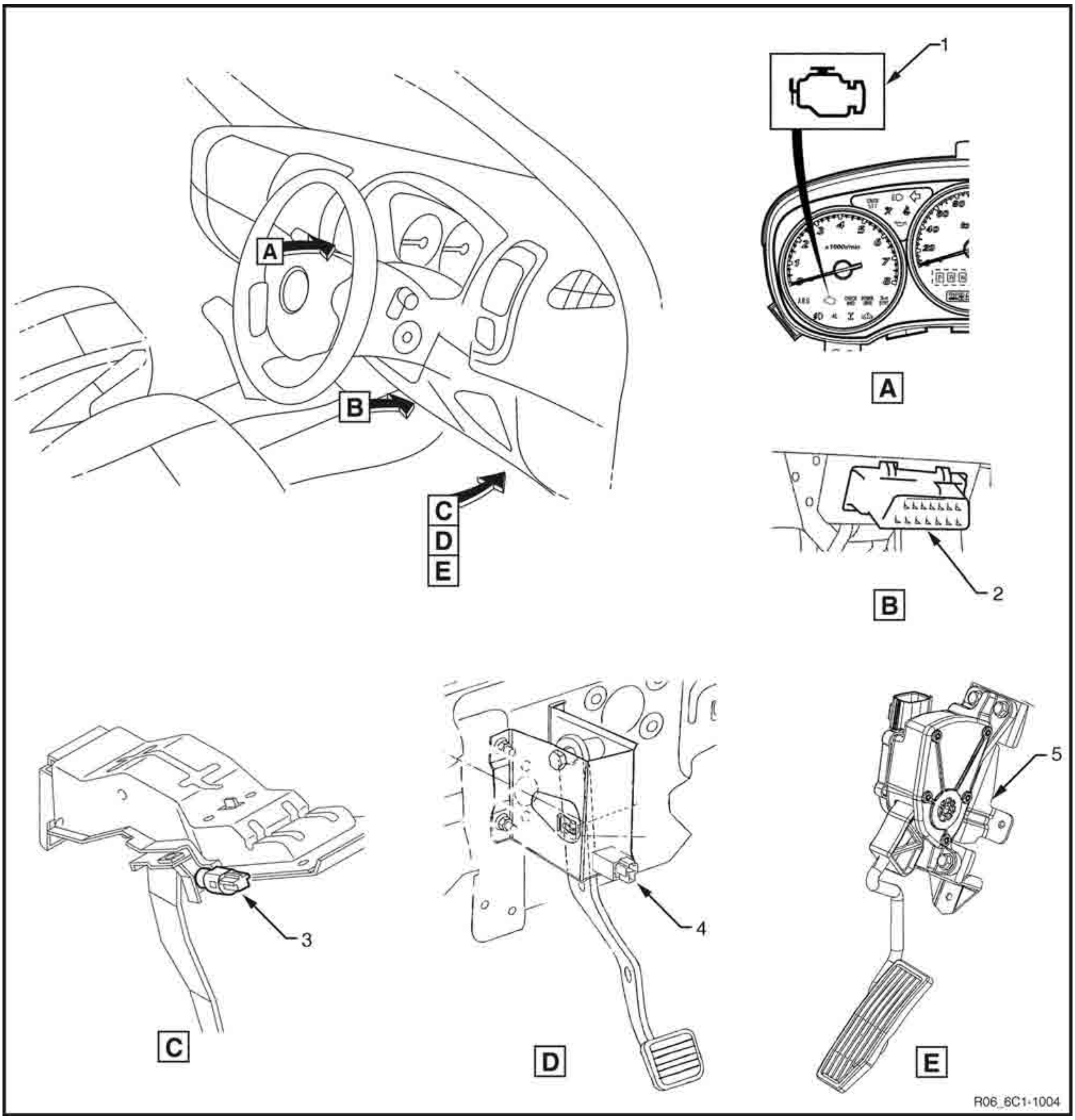


Figure 6C1-1 – 5

Legend

1	Malfunction Indicator Lamp (MIL)
2	Data Link Connector (DLC)
3	Brake Pedal Switch Assembly
4	Clutch Pedal Switch Assembly
5	Accelerator Pedal Assembly

3 System Operation

The engine control module (ECM) is the control centre of the V6 engine management system. The ECM constantly monitors and evaluates inputs from various sensors and switches. Based on these inputs, the ECM controls the operation of the engine management system. Refer to Figure 6C1-1 – 6 for the illustration of the inputs and outputs of the ECM.

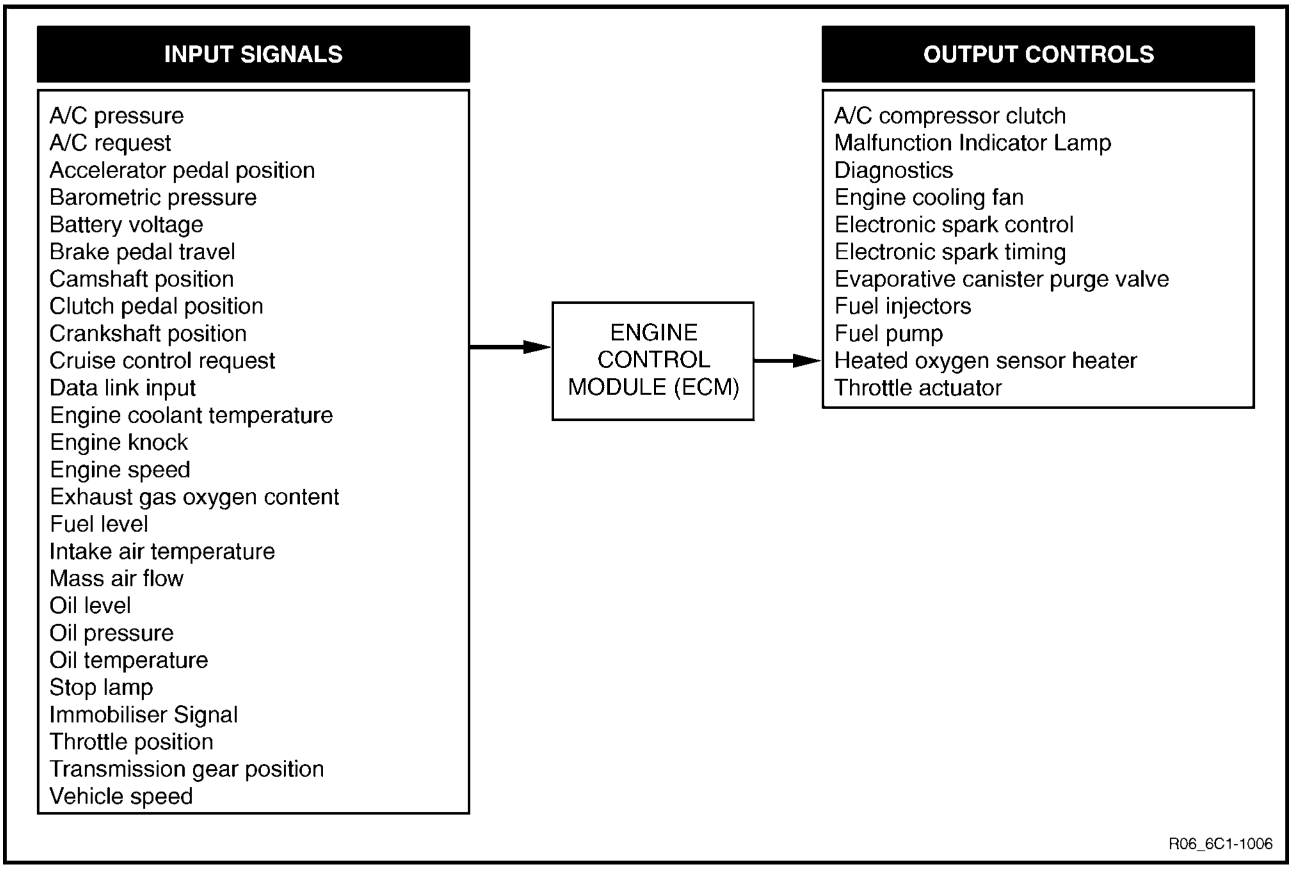


Figure 6C1-1 – 6

3.1 Fuel Delivery System

Fuel System Pressure

When the ignition switch is turned on, the ECM energises the fuel pump circuit and the fuel pump runs and builds up pressure in the fuel system. The fuel pump will continue to operate if the engine is started or as long as the engine is cranking or running and the ECM detects crankshaft position (CKP) sensor signal pulses. If the CKP sensor signal pulses stop, the ECM de-energises the fuel pump circuit within two seconds, which stops the fuel pump operation.

The vehicle is fitted with a modular fuel pump and sender assembly that provides delivery of fuel from the fuel tank and information on the fuel level. The fuel delivery system is a single line, on-demand design. With the fuel pressure regulator incorporated into the modular fuel pump and sender assembly, the need for a return pipe from the engine is eliminated.

The electric fuel pump contained in the modular fuel pump and sender assembly provides fuel at a pressure greater than the regulated pressure which is supplied to the fuel rail. The fuel is then distributed through the fuel rail to six injectors located directly above each cylinder's two intake valves.

Having a single line fuel supply system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine. In reducing the internal temperature of the fuel tank, lower evaporative emissions are achieved.

Unleaded fuel must be used to ensure correct emission parameters and engine operation. Leaded fuel damages the emission control system and use of leaded fuel can result in loss of emission warranty. Using unleaded fuel will also minimise any spark plug fouling and extend engine oil life.

Fuel Injection System

Each cylinder of the V6 engine is fitted with one fuel injector. The engine control relay applies ignition positive voltage to the fuel injector ignition circuit. The ECM controls the operation of the fuel injectors by applying a pulse width modulated (PWM) ground to the fuel injector control circuit to control each fuel injector on-time.

While the engine is running, the ECM constantly monitors the various inputs and recalculates the appropriate on-time for each injector. The calculation is based on the following:

- The injector flow rate,
- Mass of fuel passed by the energised injector per unit of time,
- The desired air / fuel ratio, and
- Actual air mass in each cylinder.

The ECM calculates the duration of the fuel injector on-time to deliver the correct amount of fuel for optimum drivability and emission control. The period of time the fuel injector is energised is called the injector on-time and is measured in milliseconds (thousandths of a second).

The V6 engine uses the sequential fuel injection system. Each fuel injector is energised individually at the correct moment during its firing stroke as the cylinder's intake valves are closing to provide enough time for the fuel to atomise completely and mix with the intake air.

Short Term Fuel Trim

The short term fuel trim (STFT) represents the duration of the fuel injector on-time as calculated by the ECM, while the ECM is in Closed Loop mode. The STFT allows the ECM to calculate the fuel injector on-time based on the heated oxygen sensor (HO2S) signal input to the ECM. Therefore, the STFT is disabled when the ECM is in Open Loop mode.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1) or when the STFT is disabled, the STFT value is 0%.
- When the HO2S sends an input signal to the ECM indicating the air / fuel mixture is rich, the STFT will be less than 0%, which indicates the ECM is decreasing the fuel injector on-time to reduce the amount of fuel in the air / fuel mixture.
- When the HO2S sends an input signal to the ECM indicating the air / fuel mixture is lean, the STFT will be greater than 0%, which indicates the ECM is increasing the fuel injector on-time to increase the amount of fuel in the air / fuel mixture.

The percentage values of the STFT range from –25% to +25% and are directly proportional to the duration of the fuel injector on-time.

Long Term Fuel Trim

The ECM stores the long term fuel trim (LTFT) in its memory to adjust the fuel injector on-time according to the long term changes or deterioration in the engine components. The normal LTFT value is 0%.

The following describes the LTFT operation when the engine air filter is dirty that causes a restricted intake airflow fault condition:

1. The HO2S sends an input signal to the ECM the air / fuel mixture is rich because of the reduced airflow. The STFT may reduce to a value of –10%, which decreases the fuel injector on-time to reduce the amount of fuel in the air / fuel mixture supplied to the engine.

   Without the use of the LTFT, the restricted airflow caused by the dirty air filter may reduce the STFT value to –10% until the air filter is replaced. This will decrease the range of negative adjustment available to the STFT to compensate for other factors.

2. When the ECM detects the STFT has remained at –10% for a specific period, the ECM switches to the LTFT. The LTFT adjusts the duration of the fuel injector on-time until the air / fuel mixture in the exhaust is balanced (lambda = 1) and the STFT value returns to 0%.

3. The ECM stores this Long Term FT value in its memory, which is used to calculate the base fuel injector on-time.

The percentage values of the Long Term FT range from –100% to +100%. If the ECM detects the LTFT values are outside the specified percentage range for a predetermined period, the ECM will set a Diagnostic Trouble Code and switch to Open Loop mode.

3.2 Air / Fuel Control System

The engine control module (ECM) controls the amount of air and fuel delivered into each of the engine cylinders. Based on the various ECM inputs, the ECM switches to the following air / fuel control system mode to provide the optimum air / fuel ratio under all engine operating conditions.

Starting Mode

When the ignition switch is moved to the START position and the engine begins to turn, a prime pulse may be injected to speed starting. As soon as the ECM receives an input signal from the camshaft position (CMP) and crankshaft position (CKP) sensor and determines which cylinder is in the firing stroke, the ECM applies a pulse width modulated (PWM) ground to the injector control circuit. The ECM monitors mass air flow, intake air temperature, engine coolant temperature, and throttle position to determine the required fuel injector on-time required for starting the engine.

Run Mode

The engine switches to run mode when the engine speed reaches 480 rpm after being started. The run mode has two sub-modes called Open Loop and Closed Loop.

Open Loop Mode

The heated oxygen sensor (HO2S) does not produce a usable signal voltage output until it reaches operating temperature. Therefore, while the HO2S is below its operating temperature, the ECM switches to open loop mode.

In open loop, the ECM ignores the signals from the HO2S and calculates the required injector pulse width based primarily on inputs from the mass air flow (MAF), intake air temperature (IAT), and engine coolant temperature sensors. The system will stay in the open loop mode until the HO2S produce a usable output.

Closed Loop Mode

Once the HO2S reaches operating temperature and starts producing its own signal voltage output, the ECM switches to the closed loop mode.

In closed loop mode, the ECM initially calculates injector pulse width based on the same sensors used in open loop, and additionally the ECM uses the oxygen sensor signals to modify and fine tune the fuel pulse width calculations to precisely maintain the ideal 14.7 to 1 air / fuel ratio.

Acceleration Mode

The ECM monitors and calculates input signals from the accelerator pedal position (APP) and MAF sensor signals to determine when the vehicle is being accelerated. If the ECM detects the accelerator pedal is depressed and there is a demand for the vehicle to accelerate, the ECM switches to acceleration mode. In acceleration mode, the ECM increases the fuel injector on-time to provide more fuel accordingly.

Deceleration Mode

The ECM monitors and calculates input signals from the APP and MAF sensor signals to determine when the vehicle is being decelerated. If the ECM detects the vehicle is decelerating, the ECM switches to deceleration mode. In deceleration mode, the ECM decreases the fuel injector on-time, or disables the fuel injectors for short periods, to reduce exhaust emissions and improve fuel economy.

Fuel Shut-off Mode

To protect the engine from damage or to improve the vehicle's driveability, the ECM switches to the fuel shut-off mode. In fuel shut-off mode, the ECM performs the following:

- The ECM disables the six fuel injectors under the following conditions:
  - Ignition off – to prevent engine dieseling,
  - Ignition on but no ignition reference signal – prevents flooding or backfiring,
  - At high engine speed – greater than the red line (rev limiter),
  - At high vehicle speed – greater than the rated tire speed (vehicle speed limiter), or
  - Extended high speed closed throttle coast-down – reduces engine emissions and increases engine braking.
- The ECM selectively disables the appropriate number of fuel injectors when torque management has been enabled.

Battery Voltage Correction Mode

The ECM monitors the battery voltage circuit to ensure the voltage available to the engine management system stays within the specified range. A low system voltage changes the voltage across the fuel injectors, which affects the fuel injector flow rate. In addition, a low system voltage fault condition may cause other engine management system components to malfunction.

The ECM switches to battery voltage correction mode when the ECM detects a low battery voltage fault condition. While in battery voltage correction mode, the ECM performs the following functions to compensate for the low system voltage:

- Increases the injector on-time to maintain the correct amount of fuel being delivered, and
- Increases the idle speed to increase the generator output.

Limp Mode

The programming in the ECM software allows the engine to run in a back-up fuel strategy or limp mode when the ECM fails to receive signal inputs from critical sensors or when a critical engine management fault condition exists.

The ECM switches to limp mode to enable the vehicle to be driven until service operations can be performed.

Engine Protection Mode

Engine protection mode is engaged to protect engine components from friction damage in the event of an engine over-temperature condition being detected by the ECM.

When the ECM is in engine protection mode, fuel injectors are systematically disabled and re-activated. The injectors that have been shut down allow the air being drawn into the engine to assist with engine cooling.

Clear Flood Mode

If the engine is flooded with fuel during starting and will not start, the clear flood mode can be manually selected by depressing the accelerator pedal to wide open throttle (WOT). In this mode, the ECM will completely disable the fuel injectors, and will maintain this state during engine cranking as long as the ECM detects a WOT condition with engine speed less than 1,000 rpm.

3.3 Ignition Control System

The electronic ignition system provides a spark to ignite the compressed air / fuel mixture at the correct time. The ECM maintains correct spark timing and dwell for all engine operating conditions. The ECM calculates the optimum spark parameters from information received from the various sensors and triggers the appropriate ignition module / coil to fire the spark plug.

3.4 Starter Motor Operation

The engine control module controls the activation of the start relay in response to inputs from:

- Ignition switch,
- Battery,
- Immobiliser system, and
- Automatic transmission gear selector position / clutch pedal position switch for vehicles with manual transmissions.

3.5 Throttle Actuator Control System

Description

The throttle actuator control (TAC) system is used to improve emissions, fuel economy and driveability. The TAC system eliminates the mechanical link between the accelerator pedal and the throttle plate and eliminates the need for a cruise control module and idle air control motor. The TAC system comprises of:

- The accelerator pedal assembly which includes:
  - The accelerator pedal,
  - The accelerator pedal position (APP) sensor one, and
  - The accelerator pedal position (APP) sensor two.

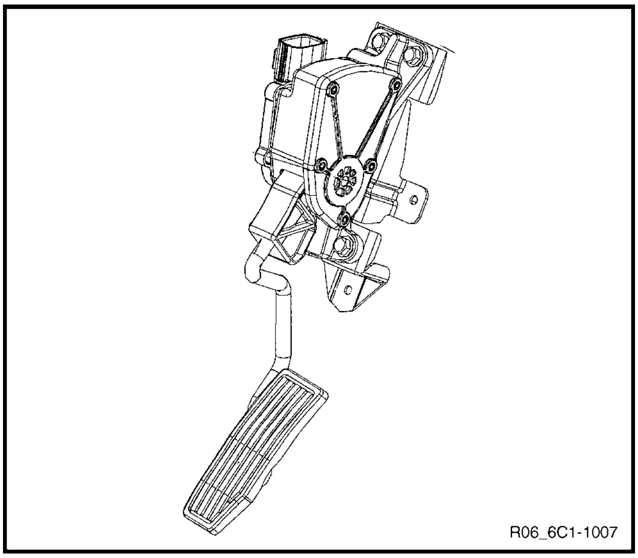


Figure 6C1-1 – 7

WARNING

To avoid serious personal injury, never attempt to rotate the throttle plate manually whilst the throttle body harness connector is connected to the throttle body.

- The throttle body assembly which includes:
  - the throttle position (TP) sensor one
  - the throttle position (TP) sensor two
  - the throttle actuator control (TAC) motor, and
  - the throttle plate.
- The engine control module (ECM).

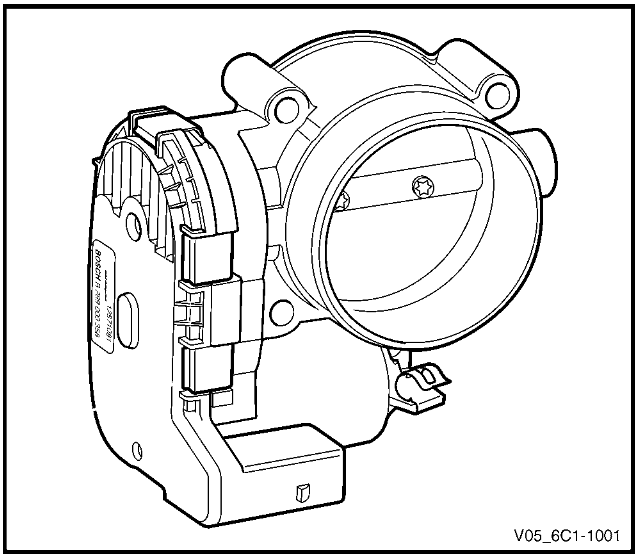


Figure 6C1-1 – 8

The ECM monitors the accelerator pedal position through the two APP sensors and processes this information, along with other system sensor inputs, to command the throttle plate to a certain position.

The throttle plate is controlled by a direct current motor called the throttle actuator control motor. The ECM operates this motor in the forward or reverse direction by controlling battery voltage and / or ground to two internal drivers. The throttle plate is held at a rest position of seven percent open using a constant force return spring. This spring holds the throttle plate to the rest position when there is no current flowing to the actuator motor.

The ECM monitors the throttle plate angle through two TP sensors. Using this information, the ECM can precisely adjust the throttle plate.

The ECM performs diagnostics that monitor the voltage levels of both APP sensors, both TP sensors and the throttle actuator control motor circuit. It also monitors the spring return rate. These diagnostics are performed at different times based on whether the engine is running, not running, or whether the ECM is currently in a throttle body relearn procedure.

Two sensors within the accelerator pedal assembly and throttle body assembly are used to provide redundancy. If a malfunction is detected, the throttle plate is moved to a pre-determined position.

Every ignition cycle, the ECM performs a quick throttle return spring test to ensure the throttle plate can return to the seven percent rest position from the zero percent position. This is to ensure the throttle plate can be brought to the rest position in case of an actuator motor circuit failure.

Throttle Body Relearn Procedure

The ECM stores values that include the lowest possible TP sensor positions (zero percent), the rest positions (seven percent), and the spring return rate. These values will only be erased or overwritten if the ECM is reprogrammed or if a throttle body relearn procedure is performed.

NOTE

If the battery has been disconnected, the ECM performs a throttle body relearn procedure once the battery has been reconnected and the ignition turned on.

The ECM performs a throttle body relearn procedure anytime the ignition is turned on and the following conditions have been met:

- The engine has been off for greater than 29 seconds,
- The engine speed is less than 40 rpm,
- The vehicle speed is 0 km/h,
- The engine coolant temperature (ECT) is 5 – 60°C; if Tech 2 is used to perform the relearn procedure, the ECT is 5 – 100°C,
- The intake air temperature (IAT) is greater than 5 – 60°C; if Tech 2 is used to perform the relearn procedure, the IAT is 5 – 100°C,
- The APP sensor angle is less than 15 percent, and
- Ignition voltage is greater than 10 V.

The throttle body relearn procedure is performed 29 seconds after the ignition is turned on. The ECM commands the throttle plate from the rest position (seven percent open) to full closed (zero percent), then to around 10 percent open. This procedure takes about six – eight seconds. If any faults occur in the TAC system, a DTC sets. At the start of this procedure, the Tech 2 TAC Learn Counter parameter should display 0, then count up to 11 after the procedure is completed. If the counter did not start at 0, or if the counter did not end at 11, a fault has occurred and a DTC should set.

TAC System Default Actions / Reduce Power Modes

The ECM switches to the following reduce power modes if the ECM detects a fault condition in the TAC system:

- If an APP sensor circuit fault or TP sensor circuit fault is detected, the ECM limits engine torque so the vehicle cannot reach speeds of greater than 100 km/h. The ECM remains in this reduce power mode during the entire ignition cycle, even if the fault is corrected.
- If there is a fault condition with the throttle actuator control circuits, a throttle actuator command vs. actual position fault, a return spring check fault, or a TP sensor one circuit fault, the ECM limits engine speed to 2500 rpm and three – six fuel injectors are randomly disabled. At this time the reduce power indicator is commanded on. The ECM remains in the reduce power mode during the entire ignition cycle even if the fault is corrected.

NOTE

If a TP sensor one or throttle actuator control circuit fault is present at the time the vehicle is at idle, with no accelerator pedal angle, the engine may stall.

Forced Engine Shutdown

A further safety feature which is built into the TAC system is the ECM will initiate an engine shut down if, the ECM's internal monitoring functions detects a serious internal fault, the fuel injectors will be turned off.

3.6 Cruise Control System

The cruise control system integrates with the engine control module (ECM) through the powertrain interface module (PIM), to control the electronic throttle actuator and maintain the vehicle at the speed set by the driver.

When the cruise control ON-OFF switch, located on the right hand side of the dash panel, is pressed, the PIM, on receiving the input from the switch, turns on the cruise ON-OFF switch warning lamp to inform the user that the cruise control has been engaged.

When the cruise control switch assembly is pressed to SET/COAST, the PIM on receiving the input, sends a signal via the serial data bus to the ECM. Providing the pre-conditions for cruise control operation have been met, the ECM activates cruise control and commands the PIM to turn on the instrument cluster cruise set warning lamp, to inform the user that cruise control is active. The ECM receives all the various inputs required to maintain the correct speed and then controls the throttle plate depending on the load on the engine (ascending or descending hills, etc).

The cruise control is deactivated by either pressing the brake pedal, clutch pedal, cruise CANCEL or by the cruise control ON-OFF button. In each of these instances, the ECM receives an input when any of these switches are activated. For further information on the cruise control system, refer to 8C Cruise Control – HFV6.

3.7 Brake Torque Management

Brake torque management places limits on engine torque when the brakes are applied, regardless of the accelerator pedal position (APP). The conditions under which brake torque management occur are as follows:

- The accelerator has been depressed before the brakes are applied,
- The brakes are applied and the ECM receives an input from the stop lamp switch,
- Vehicle speed is greater than 5 km/h,
- Engine speed is greater than 1200 rpm and
- Conditions exist for greater than 2.5 seconds.

When brake torque management has been implemented, the torque is reduced by altering the throttle plate opening by 25%. The ECM will monitor the rate at which the vehicle is slowing and adjust the throttle plate opening accordingly.

3.8 Emission Control Systems

Evaporative Emission Control System

The evaporative emission control system used is the activated carbon (charcoal) canister storage method. Fuel vapour is drawn from the fuel tank into the canister where it is held by the activated carbon until the ECM commands the evaporative emission (EVAP) purge solenoid valve to open.

The ECM energises the EVAP purge solenoid valve by applying a pulse width modulated (PWM) ground to the EVAP purge solenoid valve control circuit.

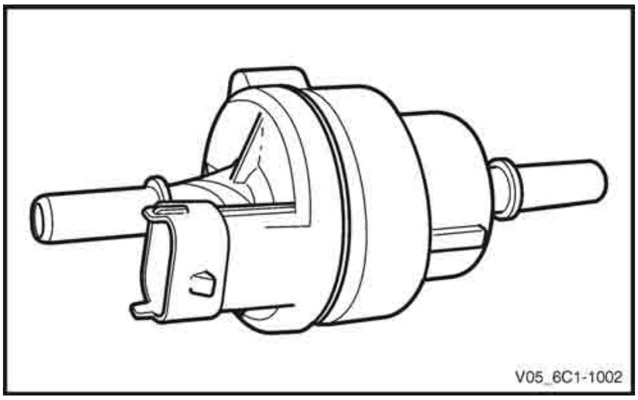


Figure 6C1-1 – 9

When ECM commands the EVAP valve (1) to open, the fuel vapours are drawn from the canister line (2) into the intake manifold where it is consumed in the normal combustion process.

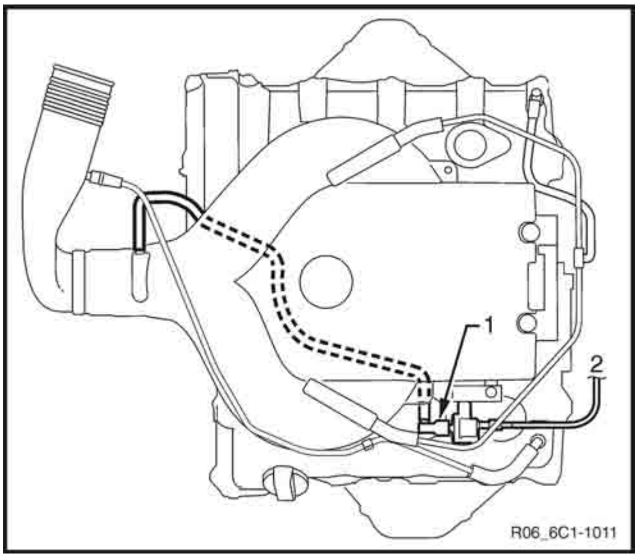


Figure 6C1-1 – 10

The ECM energises the EVAP valve when the appropriate conditions have been met, such as:

- Engine coolant temperature is less than 20°C at cold start up and the engine has been running longer than three minutes and 10 seconds, or
- Engine coolant temperature is greater than 80°C and the engine has been running longer than five seconds, or
- Engine is not in decel fuel cut-off mode and the throttle opening is less than 96%, or
- The engine is in closed loop fuel mode.

A higher purge rate is used under conditions that are likely to produce large amounts of vapour, when the following conditions have been met:

- Intake air temperature is greater than 50°C, or
- Engine coolant temperature is greater than 100°C, or
- The engine has been running for greater than 15 minutes.

The EVAP purge PWM duty cycle varies according to operating conditions determined by mass air flow, fuel trim and intake air temperature. The EVAP canister purge valve is re-enabled when throttle position angle decreases below 96%. For further information on the evaporative emission control system, refer to 6C Fuel System.

Engine Ventilation System

The engine ventilation system contains a Positive crankcase ventilation (PCV) valve (1) located in the right-hand camshaft cover. A hose is routed from the PCV valve to each side of the intake manifold which provides an even distribution of crankcase fumes, thereby improving spark plug reliability and a reduction in emissions.

A breather pipe is routed from the intake manifold to the left-hand camshaft cover and provides fresh filtered air from the intake duct to the engine.

For further information of the engine ventilation system, refer to 6A1 Engine Mechanical – V6.

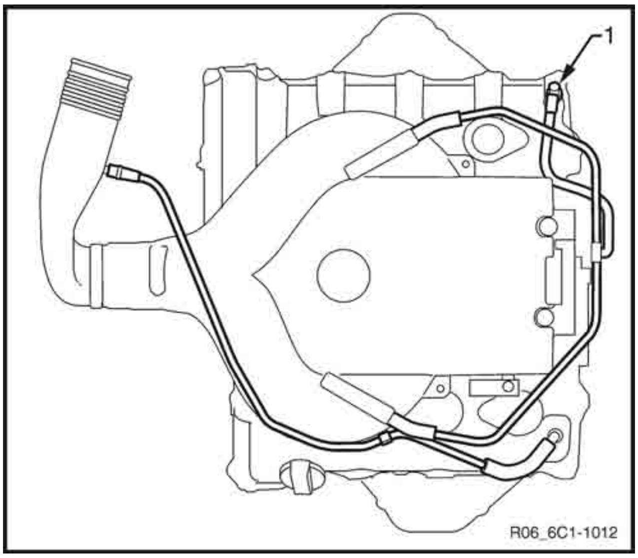


Figure 6C1-1 – 11

3.9 Serial Data Communication System

The engine control module (ECM) communicates directly with the following control units using the General Motors local area network (GM LAN) serial data communication protocol:

- Transmission control module (TCM) (if fitted)
- Powertrain interface module (PIM)

The immobiliser control unit (ICU) communicates directly with the PIM using Keyword 2000 serial data communication protocol. Refer to 11A Immobiliser for further information

As the GM LAN serial data communication protocol is not compatible with the Keyword 2000 serial data communication protocol, a powertrain interface module (PIM) is integrated to the serial data communication system to perform the following tasks (Refer to 6E1 Powertrain Interface Module – V6):

- Translate the GM LAN serial data transmitted by the ECM into a Keyword 2000 serial data that can be received and recognised by the ICU.
- Translate the cruise control switch, automatic transmission power mode switch and 3rd start switch signal into a GM LAN serial data that can be received and recognised by the ECM.

3.10 Self Diagnostics System

The ECM constantly performs self-diagnostic tests on the engine management system. When the ECM detects a malfunction, it also stores a diagnostic trouble code (DTC). A stored DTC will identify the problem area(s) and is designed to assist the technician in rectifying the fault. In addition, DTCs are classified as either Current or History DTC.

Depending on the type of DTC set, the ECM may turn on the malfunction indicator lamp (MIL) (1) to warn the driver there is a fault in the Engine Management System.

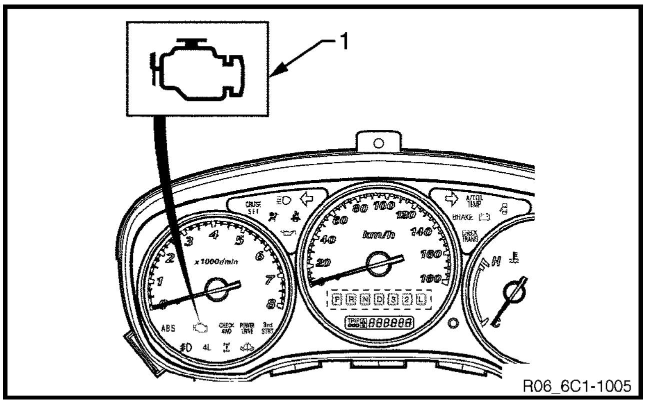


Figure 6C1-1 – 12

3.11 Service Programming System

The ECM has an Electronically erasable programmable read only memory (EEPROM) where the software and calibration information required to operate the engine management system are stored.

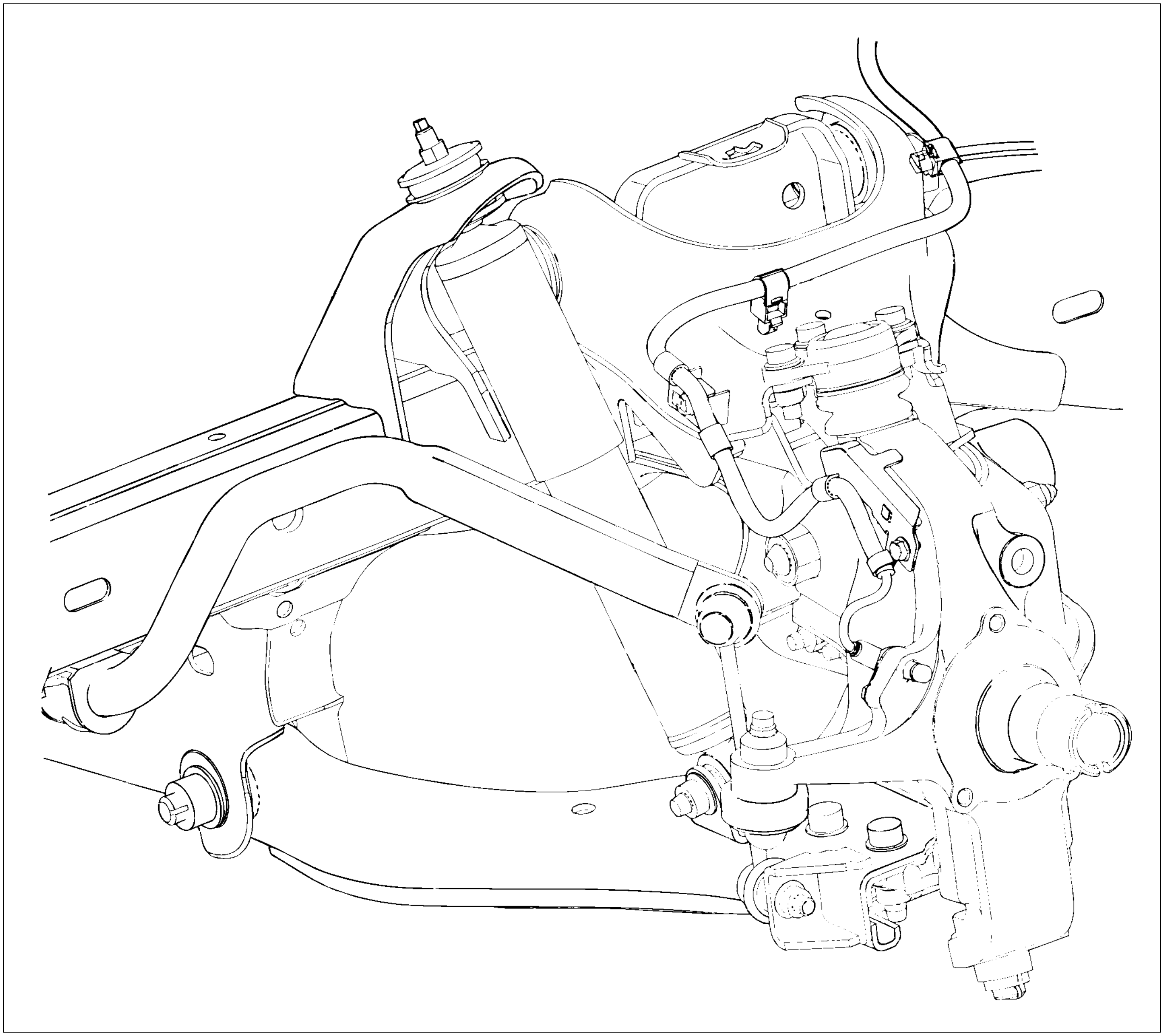
The ECM features a service programming system (SPS) to flash program the EEPROM in the ECM with the latest ECM software to provide optimum performance, driveability and emissions control or to program a new ECM.

Flash programming refers to the SPS used to transfer (or download) ECM data from a computer terminal to the vehicle's ECM. The system is designed so the vehicle verification procedures are required to eliminate EEPROM tampering that could increase engine emission levels.

There are three main flash programming techniques:

1. Direct programming (pass through). This is where the vehicle's data link connector (DLC) is connected directly to a computer terminal. On screen directions are then followed for downloading.
2. Remote Programming. Reprogramming information is downloaded from a computer terminal to Tech 2. Tech 2 is then connected to the vehicle's DLC. On screen directions are then followed for downloading.
3. Off-board Programming. The off-board programming method is used when a re-programmable ECM must be programmed while it is removed from the vehicle. For example, an independent repair facility may find it necessary to replace a faulty ECM. On flash programming equipped vehicles, the replacement ECM must be programmed with data for the specific vehicle identification number (VIN) or the vehicle may not operate properly.

4×2 (High Ride Suspension) and 4×4 Model



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The links attach to the vehicle with bolts and bushings at their inner pivot points and to the steering knuckle, which is part of the front wheel spindle, at their outer points.

The knuckle is mounted to the upper and lower links each of which has a ball joint to permit pivoting of the knuckle for steering operations. The hub is supported in position on the knuckle spindle by means of the two bearings and the rotor is mounted on the hub.

The front suspension is an independent type utilizing torsion bar springs (4×4, 4×2 (High ride suspension)) and coil springs (4×2 (except High ride suspension)).

The torsion bar spring has splines on each end. Height control is provided on the third crossmember. Both the upper and lower links are pressed steel and the torsion bar is supported at the ends by lower link in front and by height control arm in rear.

3.12 Immobiliser System

The vehicle incorporates an immobiliser system. After the ignition switch is turned to the ON position, and the powertrain interface module (PIM) has authenticated the immobiliser control unit (ICU), the PIM sends an encrypted security code to the engine control module (ECM). The ECM compares the received security code with its own security code, and if it is valid, the ECM enables the vehicle to be started. For further information and diagnosis of the immobiliser system, refer to 11A Immobiliser.

For further information on the PIM, refer to 6E1 Powertrain Interface Module – V6.

4 Component Description and Operation

4.1 A/C Refrigerant Pressure Sensor

The engine control module (ECM) applies a positive 5 V reference voltage and ground to the air-conditioner (A/C) refrigerant pressure sensor. The A/C refrigerant pressure sensor provides signal voltage to the ECM that is proportional to the A/C refrigerant pressure. The ECM monitors the A/C refrigerant pressure sensor signal voltage to determine the refrigerant pressure.

- The A/C refrigerant pressure sensor voltage increases as the refrigerant pressure increases.
- When the ECM detects the refrigerant pressure exceeds a predetermined value, the ECM activates the cooling fans to reduce the refrigerant pressure.
- When the ECM detects the refrigerant pressure is too high or too low, the ECM disables the A/C clutch to protect the A/C compressor from damage.

4.2 Brake Pedal Switch Assembly

Stop Lamp and Initial Brake Apply Switch

The stop lamp and initial brake apply switch assembly (1) is located on the brake pedal support.

The engine control module (ECM) uses the brake pedal switch inputs to determine when the brake pedal is depressed.

The ECM uses the two break pedal switch inputs for:-

- Enabling cruise control,
- Brake torque management,
- Cross referencing the stop lamp switch against the initial brake apply switch for correct operation.

For further information on brake torque management, refer to 3.7 Brake Torque Management.

For further information on the cruise control system, refer to 3.6 Cruise Control System.

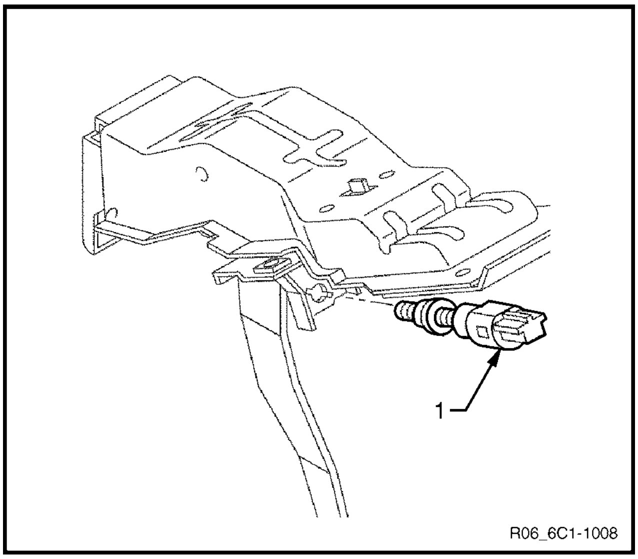

Figure 6C1-1 – 13

Stop Lamp Switch

The stop lamp switch contacts are normally open with the brake pedal at rest and closed when the brake pedal is depressed.

Initial Brake Apply Switch

The initial brake apply switch contacts are normally closed with the brake pedal at rest and open when the brake pedal is depressed.

4.3 Barometric Pressure Sensor

The barometric pressure (BARO) sensor measures barometric (atmospheric) pressure. The ECM uses this signal to make corrections to the operating parameters of the system based on changes in air density, since the oxygen content of atmospheric air varies proportionally to air density (barometric / atmospheric pressure). Barometric pressure is affected mainly by altitude and climate.

The BARO sensor provides a voltage signal to the ECM that is a function of barometric pressure. It does this through a series of deformation resistors, which change resistance when a mechanical force is applied. This force is applied to the resistors by a diaphragm on which the atmospheric pressure acts.

The ECM supplies the BARO sensor with a 5 V reference and a ground circuit.

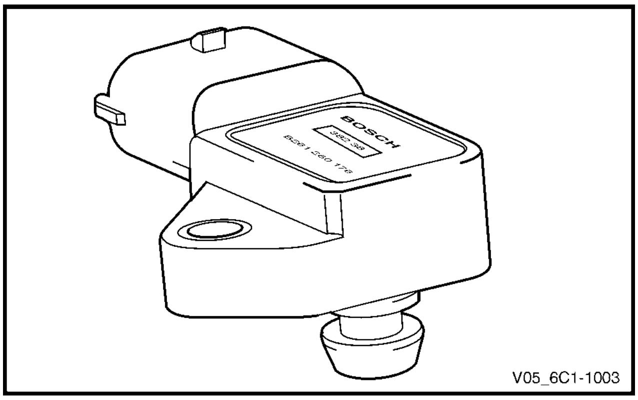

Figure 6C1-1 – 14

4.4 Camshaft Position Sensor

The HFV6 engine is fitted with an inlet camshaft position (CMP) sensor.

The CMP sensor is used by the ECM to determine the position of the camshafts. In conjunction with the crankshaft position sensor, the CMP enables the ECM to determine engine rotational position.

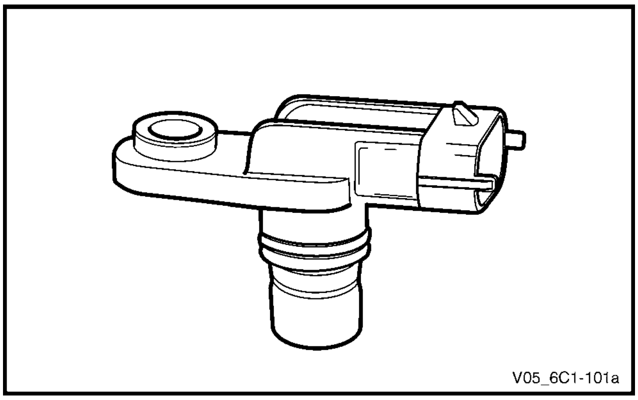

Figure 6C1-1 – 15

The CMP sensor operates on the dual-Hall sensing principle. The sensor contains two hall elements (1) which operate in conjunction with a two-track trigger wheel (2) mounted on the camshaft.

As the tracks (3) on the trigger wheel pass the elements, magnetic flux affects a voltage in the Hall elements. The integrated circuit inside the sensor conditions the signal generated by the Hall elements to provide a rectangular wave on / off signal to the ECM.

The ECM supplies the CMP sensors with a 5 V reference and ground circuit.

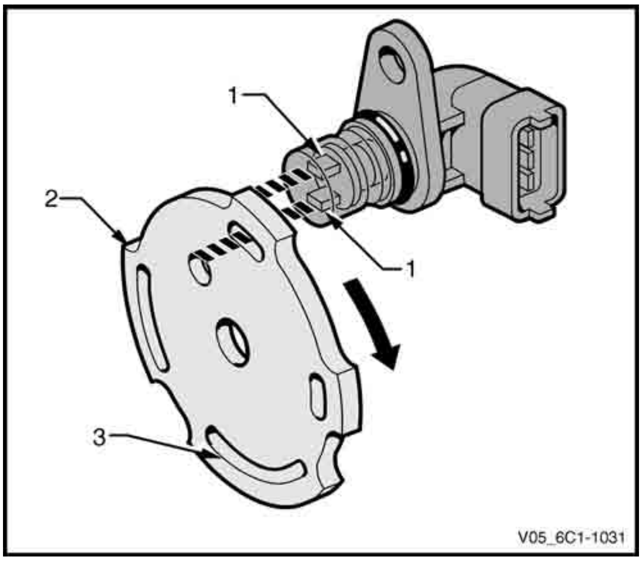

Figure 6C1-1 – 16

4.5 Crankshaft Position Sensor

In conjunction with the camshaft position sensor, the crankshaft position (CKP) sensor enables the ECM to determine engine rotational position. The CKP is also used to determine engine speed (rpm).

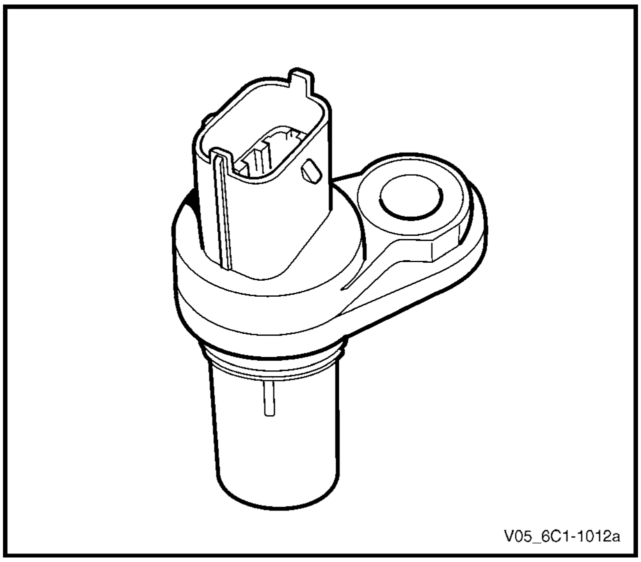

Figure 6C1-1 – 17

The CKP sensor (1) operates on the variable reluctance (pulse generator) sensing principle. It contains a magnet and pickup coil and is used in conjunction with a 58 tooth ferromagnetic reluctor wheel (2) attached to the crankshaft (3).

As the crankshaft rotates, the reluctor wheel revolves past the CKP, causing fluctuations in the magnetic field inside the sensor. This action creates an AC voltage across the pickup coil which is processed by the ECM. An increase in engine speed will increase the output voltage and frequency.

The reluctor wheel teeth are placed six degrees apart. Having only 58 teeth leaves a 12 degree open span, which creates a signature pattern that enables the ECM to determine the crankshaft position. The ECM determines which two cylinders are approaching the top dead centre based on the crankshaft position sensor signal. The CMP sensor signals are used by the ECM to determine which cylinder is on the firing stroke.

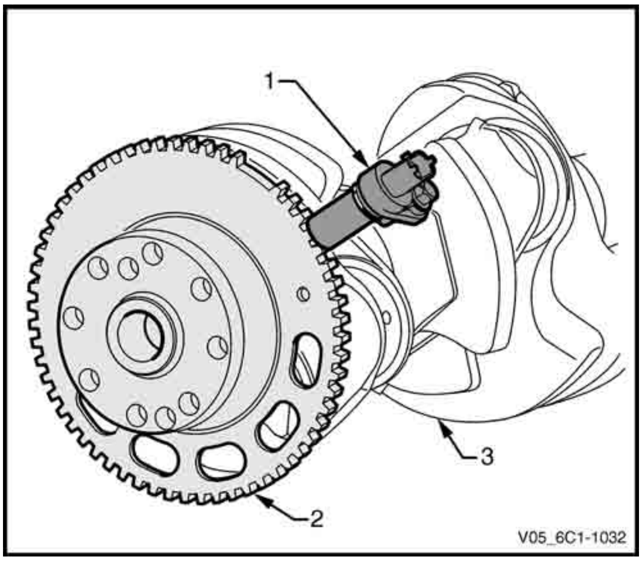

Figure 6C1-1 – 18

4.6 Clutch Pedal Switch Assembly – Manual Vehicles Only

The cruise control cancel switch (1) is normally closed when the clutch pedal is at rest, opening when the pedal is pressed. Activation of this switch removes the signal to the ECM which will then deactivate the cruise control. For further information on the cruise control system, refer to 7A1 Clutch – V6.

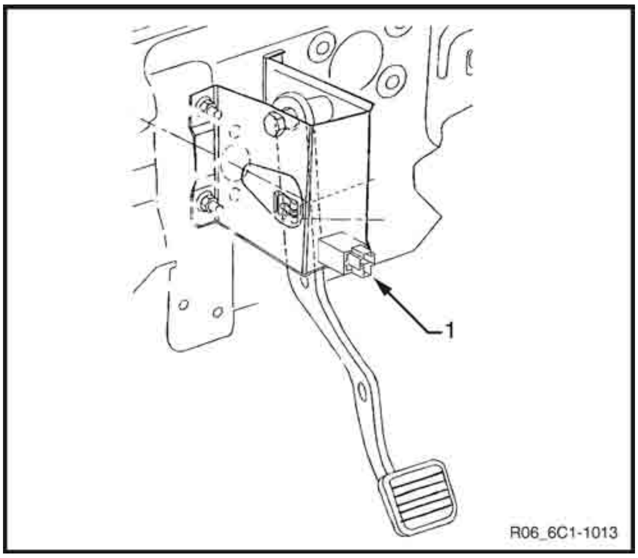

Figure 6C1-1 – 19

4.7 Engine Control Module

Located at the right front of the engine assembly, the engine control module (ECM) monitors input signals from the various sensors and switches connected to the engine management system. The ECM processes this information, to control the following:

- fuel delivery and injection system,
- throttle actuation system,
- ignition system,
- on-board diagnostics,
- the engine cooling fan, and
- the air-conditioner compressor clutch (where fitted).

The ECM supplies 5 V to the various sensors through pull-up resistors to the internal regulated power supplies.

The ECM controls output circuits such as the injectors, etc. by applying control signal to the ground circuits of the components through transistors or a device inside the ECM called a driver. The exception to this is the fuel pump relay control circuit. The fuel pump relay is the only ECM controlled circuit where the ECM controls the 12 V sent to the coil of the relay. The ground side of the fuel pump relay coil is connected to engine ground.

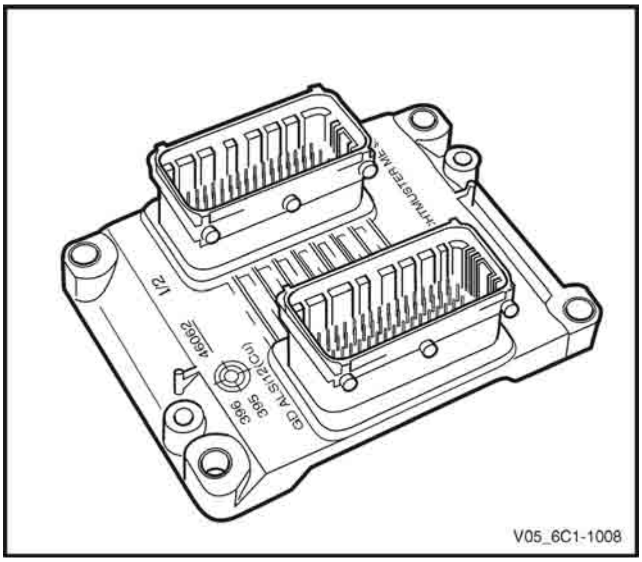

Figure 6C1-1 – 20

The ECM communicates directly with the various control units within the vehicle using the General Motors local area network (GM LAN) serial data communication protocol. Refer to 3.9 Serial Data Communication System.

4.8 Engine Coolant Temperature Sensor

The engine coolant temperature (ECT) sensor is a thermistor, which is a resistor that changes it's resistance value based on temperature.

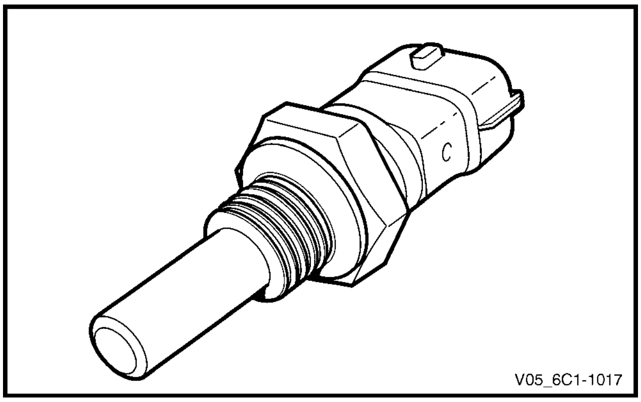

Figure 6C1-1 – 21

The ECT is mounted in the engine coolant stream and as it is a negative temperature coefficient (NTC) type, low engine coolant temperature produces a high sensor resistance while high engine coolant temperature causes low sensor resistance.

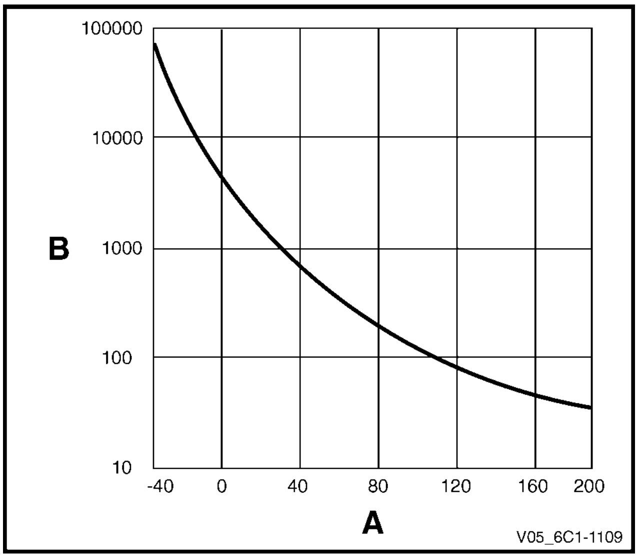

Figure 6C1-1 – 22

Legend

A Temperature

B Resistance

The ECM provides a 5 V reference signal to the ECT and monitors the return signal which enables it to calculate the engine temperature.

The ECM uses this signal to make corrections to the operating parameters of the system based on changes in engine coolant temperature.

4.9 Electric Cooling Fan

The ECM controls the operation of the electric engine cooling fan. The ECM applies a pulse width modulated (PWM) signal to the cooling fan motor to control the fan speed based on current vehicle conditions. For further information on cooling fan operation, refer to 6B1 Engine Cooling – V6.

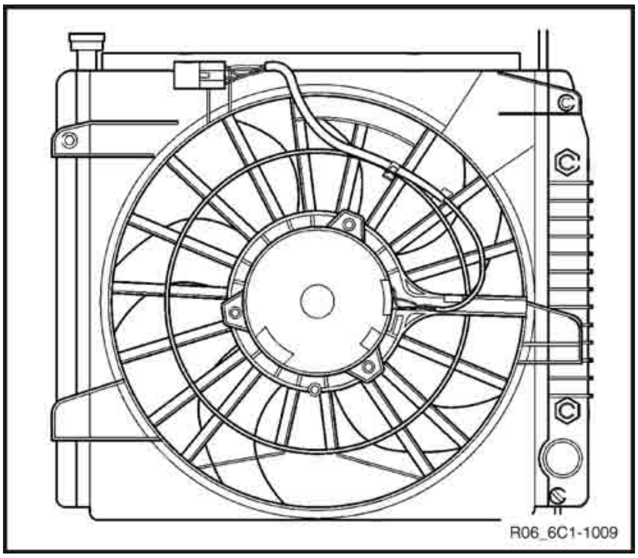

Figure 6C1-1 – 23

4.10 Engine Oil Level and Temperature Sensor

The engine oil level (EOL) and temperature sensor is a dual purpose sensor and is fitted in the engine sump. It combines a switch to signal oil level and a thermistor type temperature sensor to provide oil temperature signal to the ECM.

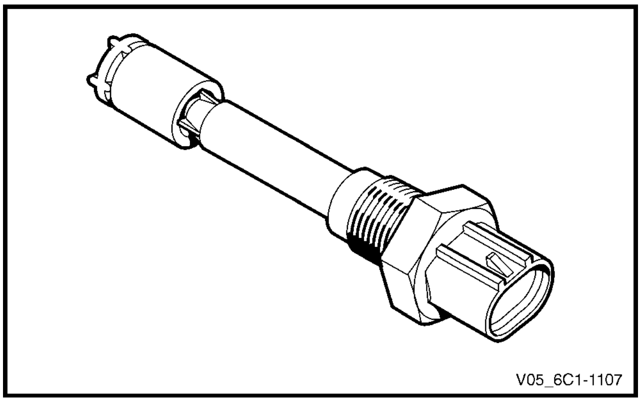

Figure 6C1-1 – 24

Engine Oil Temperature Sensor

The engine oil temperature sensor is a negative temperature coefficient (NTC) type. At low engine oil temperature, the sensor produces a high resistance, whilst at high temperature the sensor produces a low resistance.

Legend

A Temperature

B Resistance

The ECM provides a 5 V reference signal to the engine oil temperature sensor and monitors the return signal which enables it to calculate the engine oil temperature.

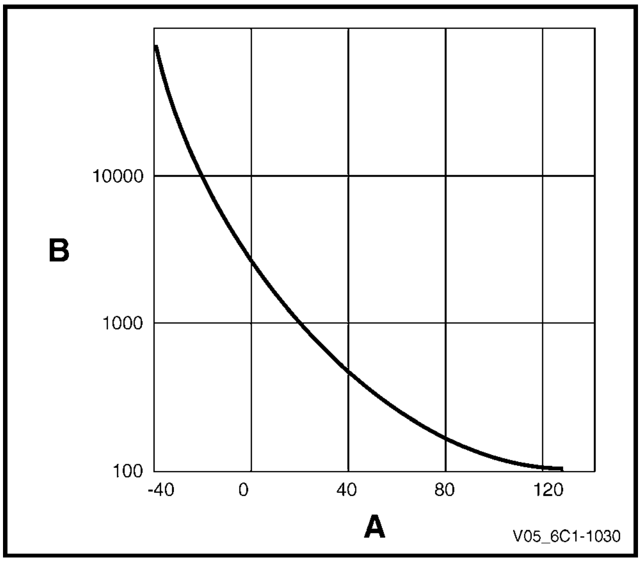

Figure 6C1-1 – 25

Engine Oil Level Sensor

The engine oil level sensor is comprised of a magnetic reed switch (1) contained within the sensor, a float (2) and a magnetic pin (3). The magnetic reed switch is a normally open switch, which closes when a magnet field is present.

When the engine oil level is within specifications, the pin on the inside of the float is pushed up against the reed switch (view A). When the oil level drops and the magnetic pin moves away from the reed switch (view B), the switch contacts opens.

The ECM provides a 5 V reference signal to the engine oil temperature sensor and monitors the return signal. The ECM only monitors the oil level signal prior to engine start-up, and once the engine is cranking, the ECM disregards the oil level sensor signal.

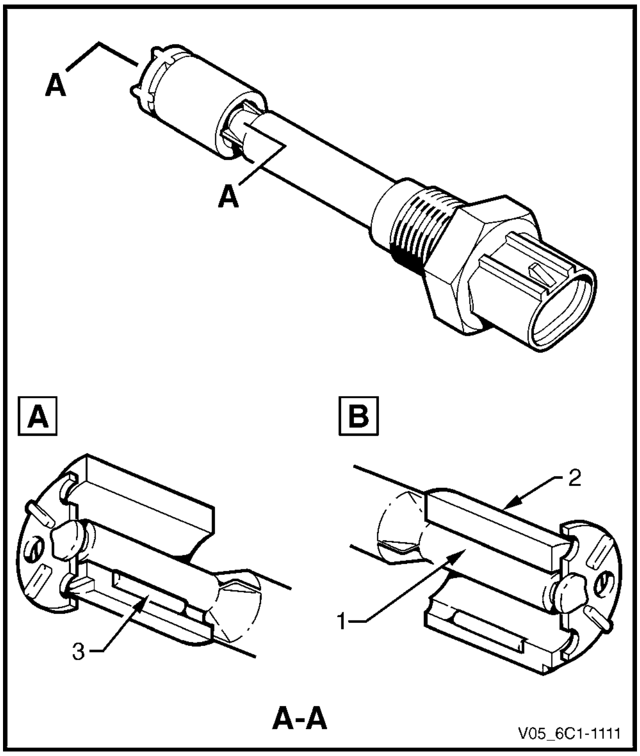

Figure 6C1-1 – 26

4.11 Engine Oil Pressure Sensor

The engine oil pressure (EOP) sensor measures engine oil pressure. When the EOP sensor signal is below a certain value, the ECM sends a serial data message to the powertrain interface module (PIM) requesting the PIM to turn on the engine oil pressure warning lamp.

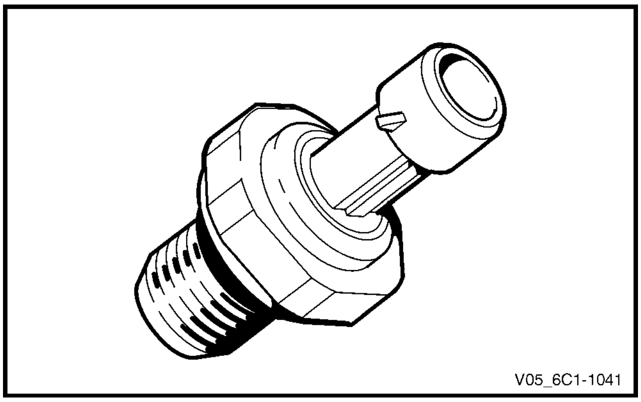

Figure 6C1-1 – 27

The EOP sensor provides a voltage signal to the ECM that is a function of engine oil pressure. It does this through a series of deformation resistors (1), which change resistance when a mechanical force is applied. This force is applied to the resistors by a diaphragm on which the engine oil pressure acts (2).

The sensor has an internal evaluation circuit (3) and is provided with a 5 V reference voltage, a ground and a signal circuit.

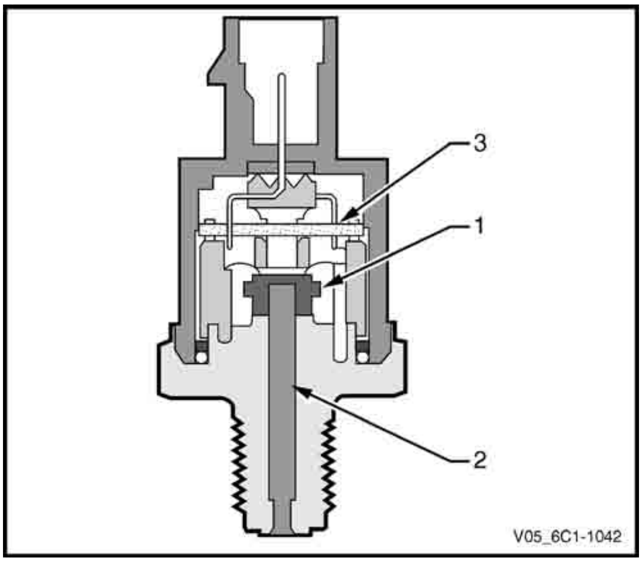

Figure 6C1-1 – 28

4.12 Fuel Injectors

A fuel injector is a solenoid device that is controlled by the ECM. The six injectors deliver a precise amount of fuel into each of the intake ports as required by the engine.

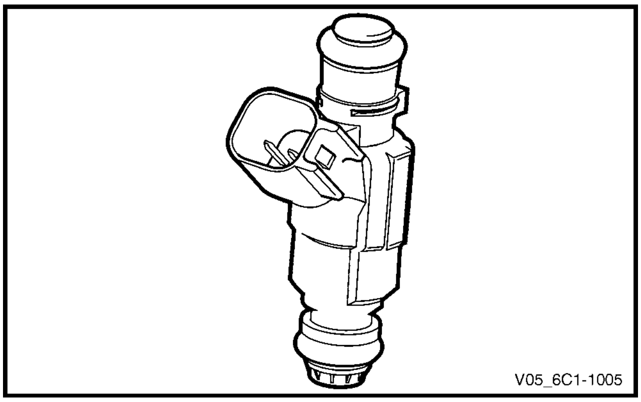

Figure 6C1-1 – 29

The fuel port (1) connects to the fuel rail. A strainer (2) is provided in the port to protect the injector from fuel contamination.

In the de-energised state (no voltage), the valve needle and sealing ball assembly (3) are held against a cone-shaped valve seat (4) by spring force (5) and fuel pressure.

When the injector is energised by the ECM, the valve needle, which has an integral armature, is moved upward by the injector solenoids magnetic field, un-seating the ball.

An orifice plate (6), located at the base of the injector has openings that are arranged in such a way that two fuel sprays emerge from the injector.

Each fuel spray is then directed at one of the intake valves, causing the fuel to become further vaporised before entering the combustion chamber.

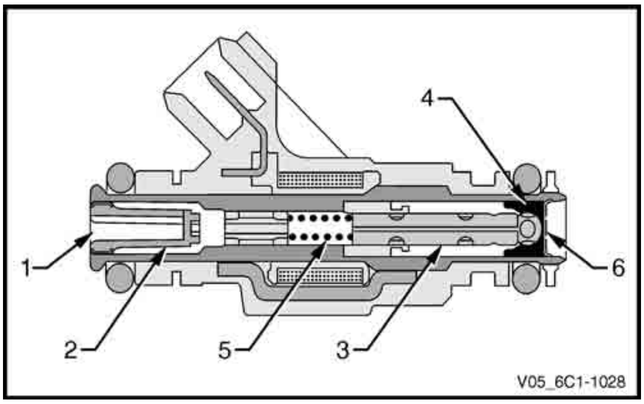

Figure 6C1-1 – 30

4.13 Fuel Rail Assembly

The fuel rail assembly is mounted on the lower intake manifold and distributes the fuel to each cylinder through individual fuel injectors. The fuel rail assembly consists of:

- the pipe that carries fuel to each injector,
- a fuel pressure test port,
- six individual fuel injectors,
- wiring harness, and
- wiring harness tray.

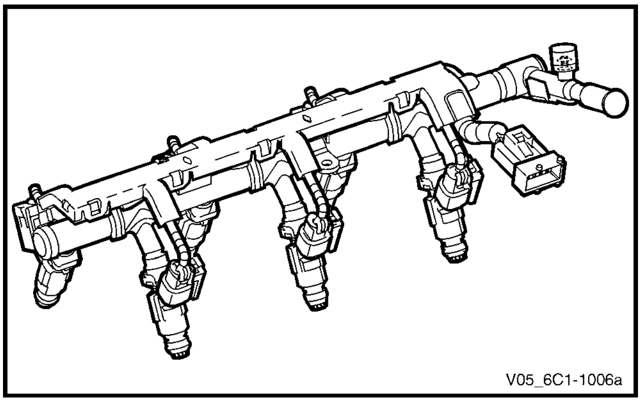

Figure 6C1-1 – 31

4.14 Heated Oxygen Sensors

The heated oxygen sensors (HO2S) are mounted in the exhaust system and enable the ECM to measure oxygen content in the exhaust stream. The ECM uses this information to accurately control the air / fuel ratio, because the oxygen content in the exhaust gas is indicative of the air / fuel ratio of engine combustion.

When the sensor is cold, it produces little or no signal voltage, therefore the ECM only reads the HO2S signal when the HO2S sensor is warm. As soon as the HO2S are warm and outputting a usable signal, the ECM begins making fuel mixture adjustments based on the HO2S signals. This is known as closed loop mode.

The HFV6 engine has four HO2S, one LSU 4.2 wide-band planar type HO2S upstream of the catalytic converter in each exhaust pipe, and one LSF 4.2 two-step planar type HO2S in each exhaust pipe downstream of the catalytic converter.

LSF 4.2 Two-step Planar Heated Oxygen Sensors

The LSF 4.2 two-step planar heated oxygen sensors have four wires:

- The internal heater element supply, which has 12 V continually applied whenever the ignition is on.
- Heater element ground – The ECM applies pulse width modulated (PWM) ground to the HO2S heater control circuit to control the rate at which the sensor heats up. This reduces the risk of the sensor being damaged from heating up too quickly under certain conditions such as extreme cold temperatures. Once the sensor has reached the desired operating temperature, the ECM will monitor and continue to maintain the sensor temperature.
- Sensor signal to the ECM.
- Sensor ground.

Legend

1	Protective Tube
2	Ceramic Seal Packing
3	Sensor Housing
4	Ceramic Support Tube
5	Planar Measuring Element
6	Protective Sleeve
7	Connection Cable

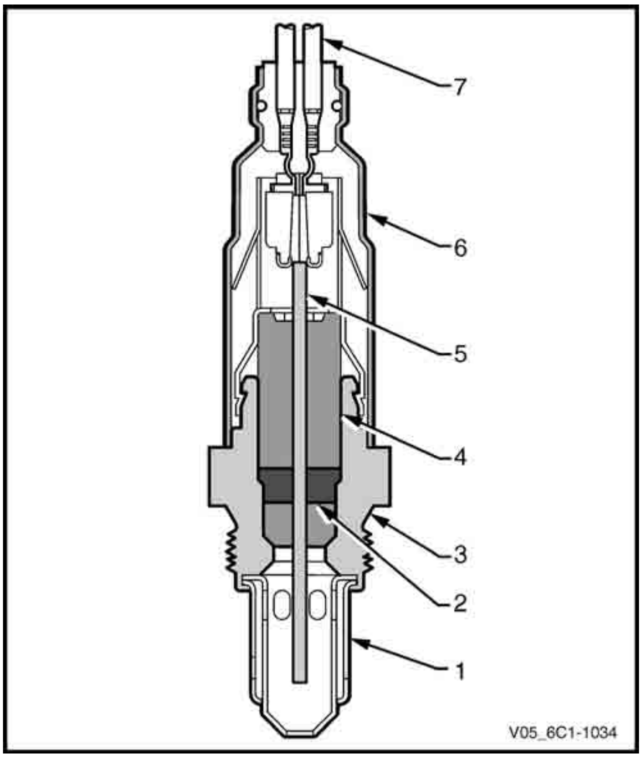

Figure 6C1-1 – 32

SECTION 3C

FRONT SUSPENSION
(4×2 Except High Ride Suspension)

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Measurement is achieved by comparing the oxygen content of the exhaust gas to the oxygen content of a reference gas (outside air) using the Nernst principle. Oxygen molecules from the exhaust gas will accumulate on the outer electrode, while oxygen molecules from the reference gas will accumulate on the inner electrode. This creates a voltage difference across the Nernst cell, between the two electrodes, which is the signal voltage to the ECM.

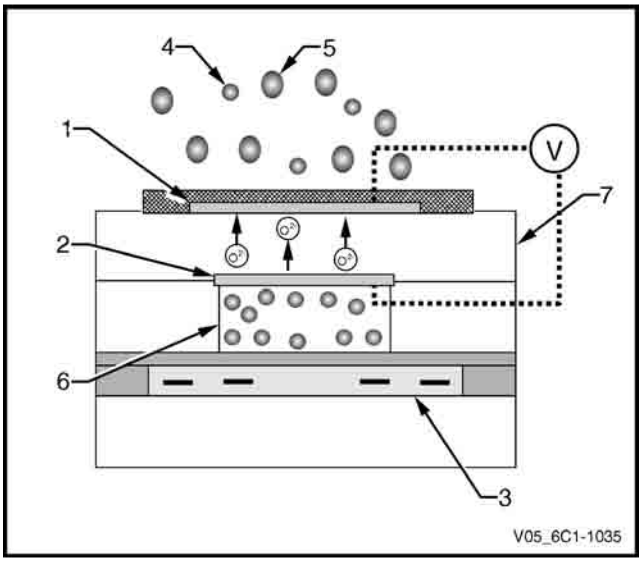


Figure 6C1-1 – 33

Legend

1 Outer Electrode
2 Inner Electrode
3 Heater Element
4 Oxygen Molecule (in exhaust stream)
5 Other Molecules (in exhaust stream)
6 Reference Gas (outside air)
7 Nernst Cell
V Signal Voltage

When the fuel system is correctly operating in the closed-loop mode, the oxygen sensor voltage output is rapidly changing several times per second, fluctuating from approximately 100mV (high oxygen content – lean mixture) to 900mV (low oxygen content – rich mixture). The transition from rich to lean occurs quickly at about 450-500 mV (air flow (A/F) ratio 14.7:1, or lambda = 1). Due to this, two-step HO2S sensors are also known as switching type HO2S sensors.

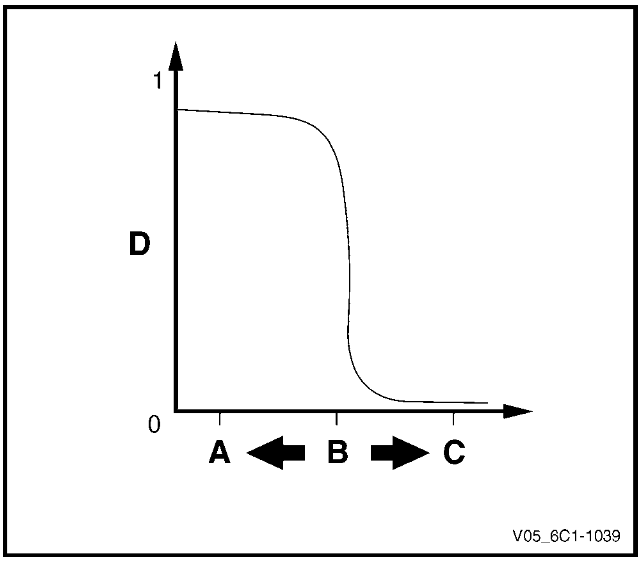


Figure 6C1-1 – 34

Legend

A Rich Mixture
B A/F Ratio 14.7:1 (Lambda = 1)
C Lean Mixture
D Sensor Voltage

LSU 4.2 Wide-band Planar Heated Oxygen Sensors

The LSU 4.2 wide-band planar heated oxygen sensors have six wires:

- The internal heater element supply, which has 12 V continually applied whenever the ignition is on.
- Heater element ground – The ECM applies pulse width modulated (PWM) ground to the HO2S heater control circuit to control the rate at which the sensor heats up. This reduces the risk of the sensor being damaged from heating up too quickly under certain conditions such as extreme cold temperatures. Once the sensor has reached the desired operating temperature, the ECM will monitor and continue to maintain the sensor temperature.
- Output voltage.
- Sensor ground.
- Trim current.
- Pumping current.

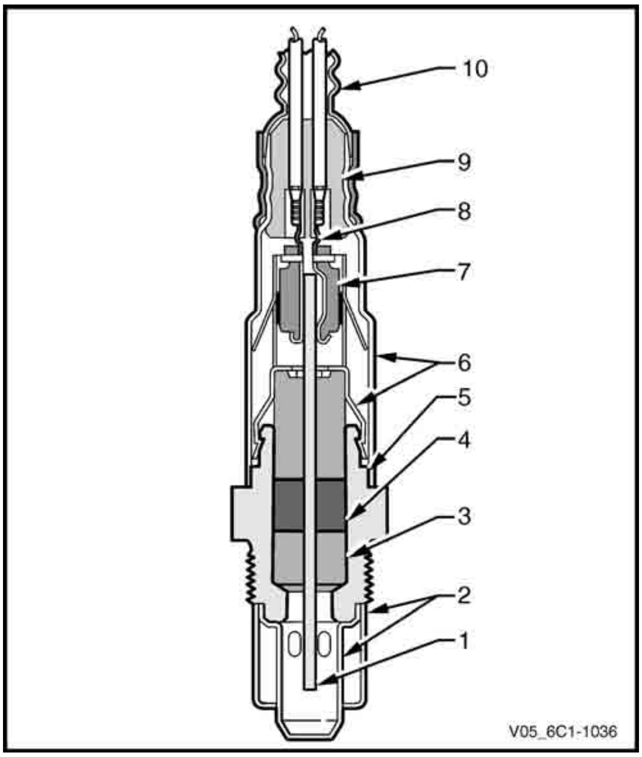


Figure 6C1-1 – 35

Legend

1 Measuring Cell (Nernst cell and pump cell)
2 Double Protective Tube
3 Seal Ring
4 Seal Packing
5 Sensor Housing
6 Protective Sleeve
7 Contact Holder
8 Contact Clip
9 PTFE Sleeve (Teflon)
10 PTFE Shaped Sleeve

Similar to the two-step HO2S, measurement is achieved by comparing the oxygen content of the exhaust gas to the oxygen content of a reference gas. However, the way in which the ECM calculates the exhaust oxygen content is different, and results in a continual signal. This allows the ECM to monitor not only whether the fuel mixture is rich or lean, but exactly how rich or how lean. The wide-band HO2S is basically a two-step HO2S with the addition of a pump cell.

The ECM applies a pump voltage across the pump cell, which causes oxygen to be pumped from the exhaust gas into or out of the diffusion gap through the diffusion barrier. While monitoring the Nernst cell, the ECM varies the pump current so the gas in the diffusion gap remains constant at an A/F ratio of 14.7:1 (Nernst cell output of 450 mV).

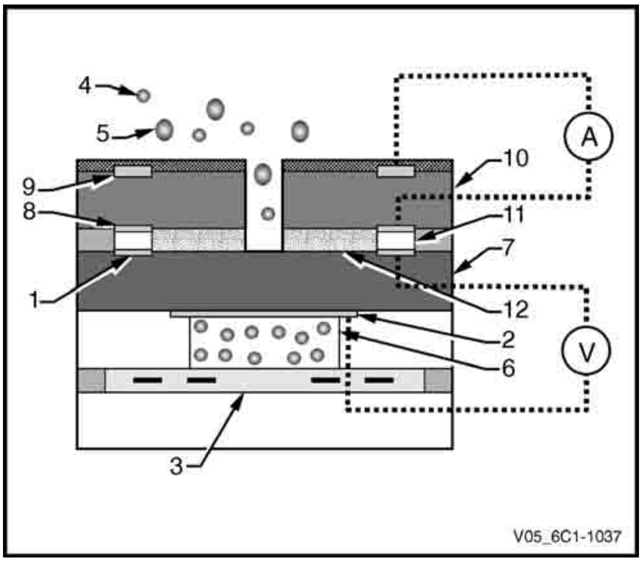


Figure 6C1-1 – 36

Legend

1	Outer Electrode
2	Inner Electrode
3	Heater Element
4	Oxygen Molecule (in exhaust stream)
5	Other Molecules (in exhaust stream)
6	Reference Gas (outside air)
7	Nernst Cell
8	Pump Cell Electrode
9	Pump Cell Electrode
10	Pump Cell
11	Diffusion Gap
12	Porous Diffusion Barrier
A	Pump Current
V	Nernst Cell Voltage

If the exhaust gas is lean, the pump cell pumps oxygen to the outside (positive pump current). If the exhaust gas is rich, oxygen is pumped from the exhaust gas into the diffusion gap (negative pump current). By monitoring how much it has to vary the pumping current, the ECM determines the exact A/F ratio.

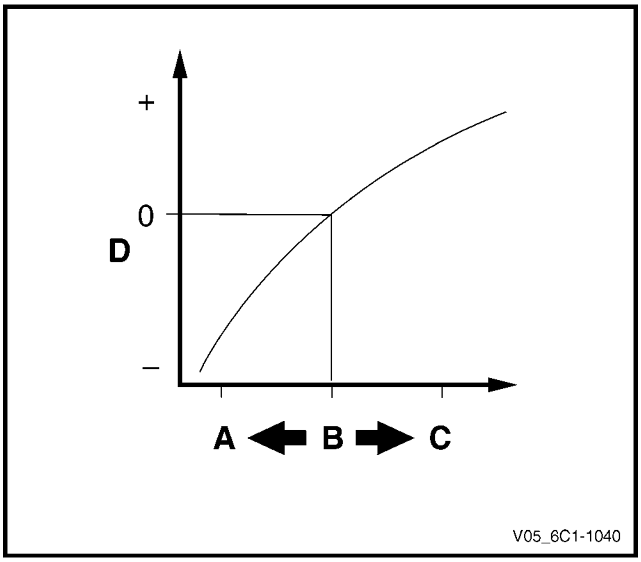


Figure 6C1-1 – 37

Legend

A	Rich Mixture
B	A/F Ratio 14.7:1 (Lambda = 1)
C	Lean Mixture
D	Sensor Current

4.15 Ignition Coil and Spark Plug

Long-life platinum tip spark plugs are used which, along with the ignition coil spark plug boot and spring, require replacement at 100,000 kilometre service intervals. The spark plugs, featuring a J-gap and a conical seat, do not require inspection between services, and must not be re-gapped.

Individual pencil-type ignition coils, one for each cylinder, are mounted in the centre of the camshaft covers, and have short boots connecting the coils directly to the spark plugs.

The pencil coil makes use of the space available in the spark plug cavity in the cylinder head and camshaft cover. As a pencil coil is always mounted directly on to the spark plug, no high-tension ignition leads are required, further enhancing reliability.

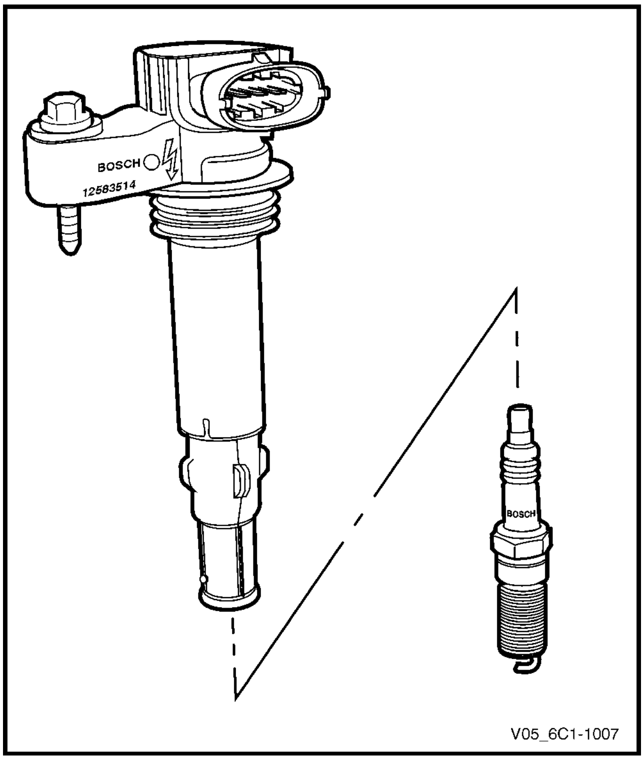


Figure 6C1-1 – 38

Pencil coils operate similarly to other compact coils, however due to their shape, the structure differs considerably.

The central rod core (1) consists of laminations of varying widths, stacked in packs that are nearly spherical. A yoke plate (2), made from layered electrical sheet steel, provides the magnetic circuit. The primary winding (3) is located around the secondary winding (4), which supports the core.

A printed circuit board, or driver module, (5) is located at the top of the coil and controls the firing of the coil based on input from the ECM.

The ECM is responsible for maintaining correct spark timing and dwell for all driving conditions. The ECM calculates the optimum spark parameters from information received from the various sensors, and triggers the appropriate ignition module which then operates the coil.

The ignition coil / modules are supplied with the following circuits:

- Ignition feed circuit.
- Ground circuit.
- Ignition control circuit.
- Reference low circuit.

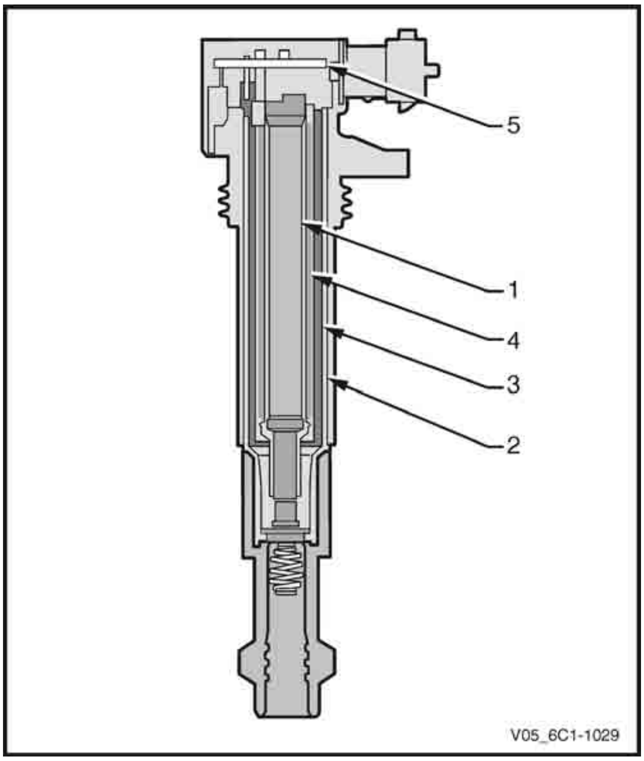


Figure 6C1-1 – 39

4.16 Intake Air Temperature Sensor

The intake air temperature (IAT) sensor is a thermistor, which is a resistor that changes it's resistance value based on temperature.

The IAT sensor is part of the air mass sensor and is not a serviceable item. The sensor is a negative temperature coefficient (NTC) type, intake air temperature produces a high sensor resistance while high engine coolant temperature causes low sensor resistance.

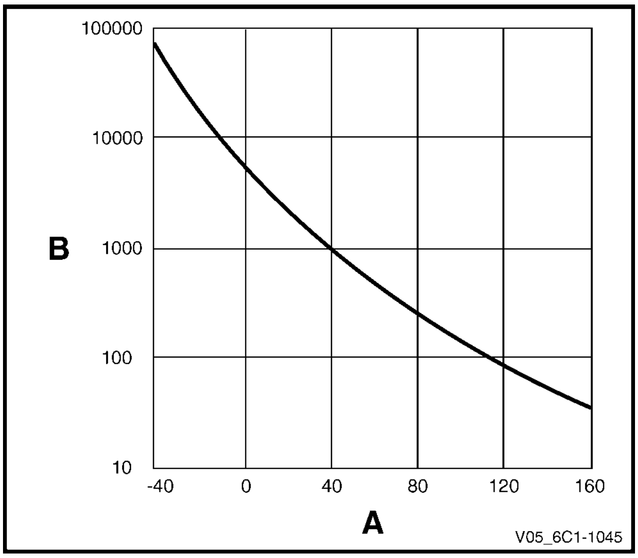


Figure 6C1-1 – 40

Legend

A Temperature

B Resistance

The ECM provides a 5 V reference signal to the IAT and monitors the return signal which enables it to calculate the intake air temperature.

The ECM uses this signal to make corrections to the operating parameters of the system based on changes in air intake temperature.

4.17 Knock Sensor

The knock sensor (KS) signal is used by the ECM to provide optimum ignition timing while minimising engine knock or detonation.

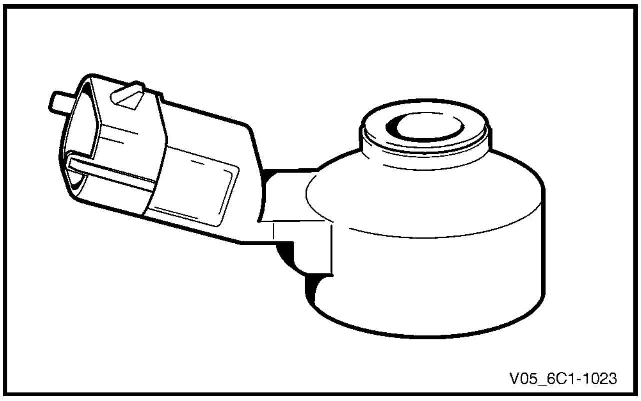


Figure 6C1-1 – 41

The ECM monitors the voltage of the left-hand (Bank 2) sensor during the 45 degrees after cylinder 2, 4, or 6 has fired and the voltage of the right-hand (Bank 1) sensor during the 45 degrees after cylinder 1, 3, or 5 has fired.

If knock occurs in any of the cylinders, the ignition will be retarded by three degrees for that particular cylinder. If the knocking then stops, the ignition will be restored to what it was before in steps of 0.75 degrees.

Should knocking continue in the same cylinder despite of the ignition being retarded, the ECM will retard the ignition an additional step of three degrees, and so on, up to a maximum of 12.75 degrees. The ignition will also be retarded at high ambient temperatures to counteract knocking tendencies provoked by high intake air temperatures.

Should either Bank 1 or Bank 2 sensor fail to work, or should an open circuit occur, the ignition timing will then be set at a default strategy that will retard the ignition much more than normal.

The knock sensor is tuned to detect the frequency of the vibration created by combustion knock. The vibration is transferred to the knock sensor through the cylinder block (1).

Inside the sensor is a mass (2) that is excited by this vibration, and the mass exerts a compressive force onto a piezo-ceramic element (3). The compressive force causes a charge transfer inside the element, so that an AC voltage appears across the two outer faces (4) of the element. The amount of the AC voltage produced is proportional to the amount of knock.

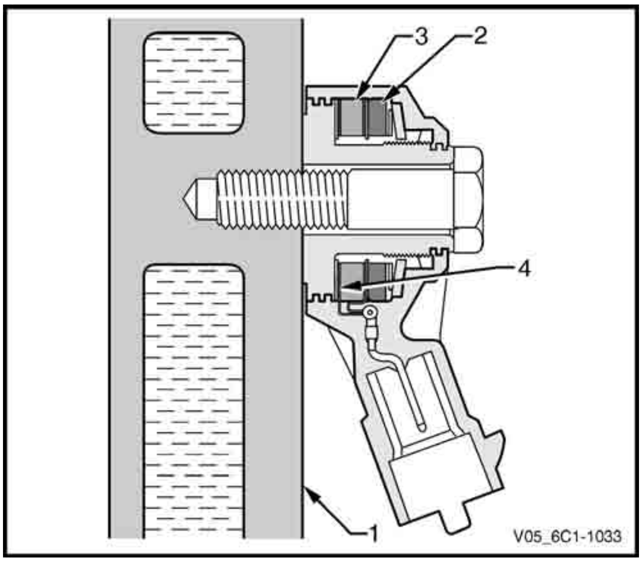


Figure 6C1-1 – 42

4.18 Mass Air Flow Sensor

Air Intake System

The air intake system draws outside air through an air cleaner assembly (1). The air is then routed through a mass air flow (MAF) sensor (2) and into the throttle body and intake manifold. The air is then directed into the intake manifold runners, through the cylinder heads and into the cylinders.

An arrow marked on the body of the MAF sensor indicates correct air flow direction. The arrow must point toward the engine.

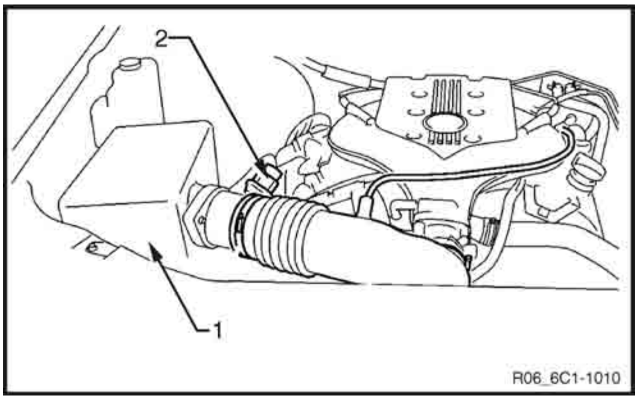


Figure 6C1-1 – 43

Mass Air Flow Sensor

A hot film type mass air flow (MAF) sensor is used which measures the air mass inducted into the engine, regardless of the engine's operating state. The MAF precisely measures a portion of the total airflow and takes into account the pulsation and reverse flows generated by the engine's inlet and exhaust valves.

Changes in intake air temperature have no effect on measuring accuracy.

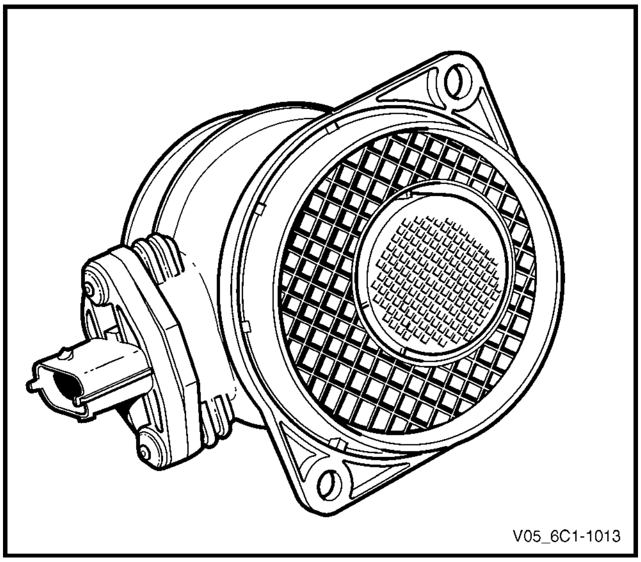


Figure 6C1-1 – 44

Construction

Projecting into the MAF sensor body is the compact design sensor assembly (1), which consists of:

- the sensor element (2),
- partial airflow measuring tube (3), and
- integrated evaluation electronics (4).

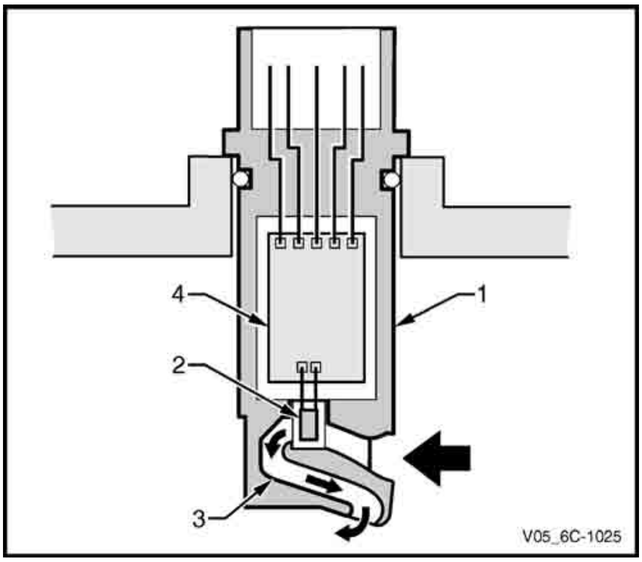


Figure 6C1-1 – 45

Operation

A diaphragm (1) on the sensor element (2) is heated by a centrally mounted heater resistor (3), which is held at a constant temperature. The temperature drops sharply each side of the heating zone.

Temperature of the diaphragm is registered to the evaluation electronics by two temperature-dependent resistors located on the upstream (4) and downstream (5) side of the resistor.

With no air flow through the air flow measuring tube and over the sensor element, the temperature characteristic is the same each side of the heating zone and the resistance values are identical.

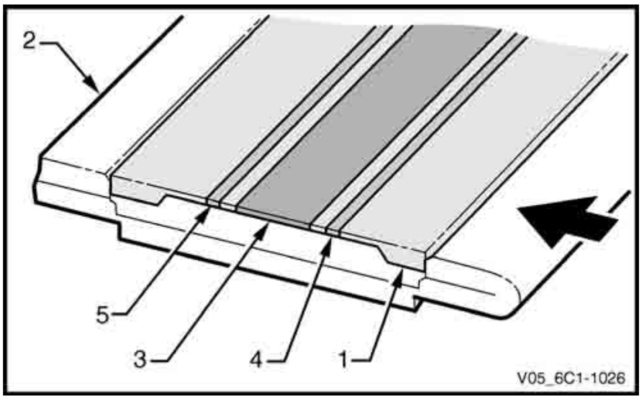


Figure 6C1-1 – 46

As air flows over the sensor element, the upstream resistor value alters due to the cooling effect of the air flow. As the air flows over the heating zone the air temperature is increased.

The air then passes over the downstream resistor and alters the resistance value, but as the air temperature is higher, the value is different to the upstream resistor. This change in temperature creates a temperature differential between the two resistors.

It is this differential that is used to calculate the air mass flow, which is independent of absolute temperature. The differential is also directional, which means the MAF not only measures the mass of the incoming air, but also its direction.

As the evaluation electronics are measuring the resistance differential between the resistors, the air mass flow for the entire amount of air passing through the MAF is calculated and sent to the ECM as an analogue signal of 0 – 5 V.

The ECM can also detect air flow that is inappropriate for a given operating condition based on the signal voltage, or a signal that appears to be fixed based on the lack of normal signal fluctuations expected during engine operation.

Tech 2 can display the MAF value in grams per second (g/s). Values should change rather quickly on acceleration, but should remain fairly stable at any given engine speed.

5 Abbreviations and Glossary of Terms

Abbreviations and terms used in this Section are listed below in alphabetical order with an explanation of the abbreviation or term.

Abbreviation	Description
A/C	Air-conditioning
AC	Alternating Current – An electrical current where the polarity is constantly changing between positive and negative
A/F	Air / Fuel (A/F Ratio)
Analogue Signal	An electrical signal that constantly varies in voltage within a given parameter
Barometric Pressure	Barometric absolute pressure (atmospheric pressure)
CAN	Controller Area Network – A type of serial data for communication between electronic devices.
Catalytic Converter	A muffler-shaped device fitted in the exhaust system, usually close to the engine. Through chemical reaction, a catalytic converter converts harmful gases produced by the combustion process such as HC, CO, and NOx, into environmentally safe water vapour, carbon dioxide, and nitrogen.
CKT	Circuit
Closed Loop	A fuel control mode of operation that uses the signal from the exhaust oxygen sensor(s), to control the air / fuel ratio precisely at a 14.7 to 1 ratio. This allows maximum efficiency of the catalytic converter.
CO	Carbon Monoxide. One of the gases produced by the engine combustion process.
DC	Direct Current
Digital Signal	An electrical signal that is either on or off.
DLC	Data Link Connector. Used at the assembly plant to evaluate the engine management system. For service, it allows the use of Tech 2 in performing system checks.
DLC Data Stream	An output from the ECM initiated by Tech 2 and transmitted via the Data Link Connector(DLC).
DMM (10 MΩ)	Digital Multimeter. A multipurpose meter that has capability of measuring voltage, current flow and resistance. A digital multimeter has an input impedance of 10 MΩ (megohms), which means they draw very little power from the device under test, they are very accurate and will not damage delicate electronic components
Driver	An electronic device, usually a power transistor, that operates as an electrical switch.
DTC	Diagnostic Trouble Code. If a fault occurs in the engine management system, the ECM may set a four digit diagnostic trouble code (DTC) which represents the fault condition. Tech 2 is used to interface with the ECM and access the DTC(s). The ECM may also operate the malfunction indicator lamp in the instrument cluster.
Duty Cycle	The time, in percentage, that a circuit is on versus off.
ECT Sensor	Engine Coolant Temperature sensor. A device that provides a variable voltage to the ECM based on the temperature of the engine coolant.
EEPROM	Electrically Erasable Programmable Read Only Memory. A type of read only memory (ROM) that can be electrically programmed, erased and reprogrammed using Tech 2. Also referred to as Flash Memory
EMI or Electrical Noise	An unwanted signal interfering with a required signal. A common example is the effect of high voltage power lines on an AM radio.
Engine Braking	A condition where the engine is used to slow the vehicle on closed throttle or low gear.
EPROM	Erasable Programmable Read Only Memory. A type of Read Only Memory (ROM) that can be erased with ultraviolet light and then reprogrammed.
ESD	Electrostatic Discharge. The discharge of static electricity which has built up on an insulated material
EVAP	Evaporative emission control system. Used to prevent fuel vapours from the fuel tank from entering into the atmosphere. The vapours are stored in a canister that contains an activated charcoal element. The fuel vapours are purged from the canister into the manifold to be burned in the engine.
GM LAN	General Motors Local Area Network - A type of serial data for communication between electronic devices.
Fuse	A thin metal strip which melts when excessive current flows through it, creating an open circuit and protecting a circuit from damage.
HC	Hydrocarbon. Result of unburned fuel produced by incomplete combustion.
Heavy Throttle	Approximately 3/4 of accelerator pedal travel (75% throttle position)
IAT Sensor	Intake Air Temperature sensor. A device that provides a variable voltage to the ECM based on the temperature of air entering the intake system.
Ideal Mixture	The air / fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions, typically 14.7 to 1 on spark ignition engines
IGN	Ignition
Inputs	Information from sensors (MAF, TP, etc.) and switches (A/C request, etc.) used by the ECM to determine how to control its outputs.

Intermittent	An electrical signal that occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground in a circuit
Light Throttle	Approximately 1/4 of accelerator pedal travel (25% throttle position)
Low	A voltage less than a specific threshold. Operates the same as a ground and may, or may not, be connected to chassis ground.
MAF Sensor	Mass Air Flow Sensor. A device that provides a variable voltage to the ECM based on the amount of air flow entering in the intake system.
Medium Throttle	Approximately 1/2 of accelerator pedal travel (50% throttle position)
N.C	Normally Closed. Switch contacts that are closed when they are in the normal operating position
N.O	Normally Open. Switch contacts that are normally open when in the normal operating position
NOx	Nitrogen Oxide. One of the pollutants found in spark ignition engine exhaust that is formed from normal combustion and increases in severity with combustion temperature.
O2 Sensor	Oxygen Sensor. A device located in the exhaust system that provides a variable voltage to the ECM based on the oxygen content of exhaust gas. May also include a heating circuit to provide faster initial warm-up (HO2 sensor).
OBD	On Board Diagnostic
Open Loop	ECM control of the fuel control system without the use of the oxygen sensor signal.
Output	Functions that are controlled by the ECM, typically these can include solenoids and relays, etc.
ECM	Engine Control Module. An electronic device which controls the engine management system.
ECU	Electronic Control Unit. An electronic device which controls specific system functions
PCV	Positive Crankcase Ventilation. Method of reburning crankcase fumes rather than passing them directly into the atmosphere
PIM	Powertrain Interface Module – The PIM acts as a communication translator between the ECM and other on-board controllers that use a different serial data protocol.
PM	Permanent Magnet
PWM	Pulse Width Modulated. A digital signal turned on and off for a percentage of available cycle time. A signal that is 30% on and 70% of would be termed a 30% on PWM signal.
Quad Driver	A transistor in the ECM capable of operating four separate outputs. Outputs can be either on-off or pulse width modulated.
RAM	Random Access Memory. A microprocessor can write into or read from this memory as needed. This memory is volatile and needs a constant power supply to be retained. If the power is lost or removed, RAM data is lost.
r.p.m.	Revolutions Per Minute
Serial Data	Serial data is a series of rapidly changing voltage signals pulsed from high to low. These signals are typically transmitted through a wire often referred to as the Serial Data Circuit.
SFI	Sequential Fuel Injection. Method of injecting fuel into the engine one cylinder at a time in relation to the engines firing order.
Solenoid	An electromagnetic coil which creates a magnetic field when current is applied, causing a plunger or ball to move.
Switch	Device to opens and close a circuit, thereby controlling current flow.
Tech 2	Tech 2 is a peripheral device that aids in the diagnosis and repair of electronic systems such as engine management, transmission control etc. Tech 2 connects to the vehicle's Data Link Connector (DLC).
TP Sensor	Throttle Position sensor. A device that provides a variable voltage to the ECM based on the position of the throttle plate.
Vacuum – manifold	Vacuum sourced downstream of the throttle plate.
Vacuum – ported	Vacuum sourced upstream of the throttle plate.
VSS	Vehicle Speed Sensor. A permanent magnet type device that provides a digital voltage to the ECM.
WOT	Wide Open Throttle – Full travel of the accelerator pedal (100% throttle position).

6C1-2 Engine Management – V6 Diagnostics

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.5 Warning Caution and Notes for correct workshop practices with regard to safety and/or property damage.

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will indicate those fasteners that require replacement after removal. ISUZU/GM will also indicate the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

1 General Information

1.1 Diagnostic System Check

The engine management diagnostic procedure is organised in a logical structure that begins with the Diagnostic System Check. The Diagnostic System Check directs the diagnostic procedure to the logical steps necessary to diagnose an engine driveability fault condition.

1.2 Diagnostic Trouble Code Tables

The Diagnostic System Check directs the diagnostic procedure to the appropriate diagnostic trouble code (DTC) tables if there is a DTC currently stored in the engine control module (ECM).

The diagnostic tables locate a faulty circuit or component through a logic based on the process of elimination. These diagnostic tables are developed with the following assumptions:

- the vehicle functioned correctly at the time of assembly,
- there are no multiple faults, and
- the problem currently exists.

Understanding and the correct use of the diagnostic tables are essential to reduce diagnostic time and to prevent misdiagnosis.

Multiple DTC Fault Conditions

Some fault conditions trigger multiple component DTCs even if the fault condition exists only on a single component. If there are multiple DTCs stored in the ECM, the service technician must view and record all DTCs logged.

The relationship between the logged DTCs can then be analysed to determine the source of the fault condition. Always begin the diagnostic process with the DTC table of the fault condition that may trigger other DTCs to set.

The following fault conditions may trigger multiple DTCs:

- a fault in the serial data communication circuit,
- a system voltage that is too low may cause incorrect engine management system operation or engine management component malfunction,
- a system voltage that is too high may damage the ECM and/or other engine management components,
- fault condition in the ECM read only memory (ROM) or random access memory (RAM),
- fault condition in the ECM internal circuitry or programming,
- improperly connected sensor or component wiring connector, or
- an electrical fault condition in the following shared ECM electrical circuits trigger DTCs on components or sensors that share in the faulty shared circuit. Test the electrical circuit of the appropriate sensors or components to isolate the fault condition. Refer to 3 Wiring Diagrams and Connector Charts in this Section.
  - 5 V Reference Circuit,
  - Low Reference Circuit, or
  - Ignition Control Voltage Circuit.

If there are no obvious faults to begin a multiple DTC fault condition diagnostic procedure, diagnose the DTCs in the following order unless directed otherwise:

1 Always start with the lowest numbered component level DTCs such as:
   - sensor DTCs,
   - solenoid DTCs, or
   - relay DTCs.
2 Then follow with system level DTCs such as:
   - misfire DTCs,

- fuel trim DTCs, or
- catalyst DTCs.

1.3 Symptoms Diagnostics

The Diagnostic System Check directs the service technician to the symptoms diagnostics if the following conditions exist:

- a vehicle driveability fault condition exists,
- there is no current diagnostic trouble code presently stored in the ECM, and
- all Tech 2 engine data parameters are within normal operating range.

1.4 Diagnostic Trouble Codes

The ECM constantly performs self-diagnostic tests on the engine management system. When the ECM detects a fault condition in the engine operating parameters, the ECM sets a diagnostic trouble code (DTC) to represent that fault condition. The following are the types of DTCs programmed in the ECM. In addition, DTCs are classified as either a current or history DTC.

- Type A – emission related DTCs,
- Type B – emission related DTCs, and
- Type C – non-emission related DTCs.

NOTE

Depending on the type of DTC set, the ECM may command the malfunction indicator lamp (MIL) to illuminate and warn the driver there is a fault in the engine management system.

Type A – Emission Related DTCs

The ECM takes the following action when a Type A DTC runs and fails:

- sets a current Type A DTC that represents the fault condition,
- illuminates the instrument cluster malfunction indicator lamp (MIL), and
- records the operating condition at the time the diagnostic fails and stores this information in the freeze frame failure record.

Type B – Emission Related DTCs

The ECM takes the following action when a Type B DTC runs and fails:

- On the first time a Type B DTC fails, the ECM takes the following actions:
  - sets a current Type B DTC that represents the fault condition, and
  - records the operating conditions at the time the fault sets and stores this information in the failure records.
- On the second consecutive ignition cycle that a Type B DTC fails, the ECM takes the following actions:
  - activates the instrument cluster malfunction indicator lamp (MIL), and
  - records the operating condition at the time the diagnostic fails and stores this information in the freeze frame failure record.

Conditions for Clearing Type A or Type B DTCs

- The current DTC clears when there is no fault condition in the current ECM self-diagnostics.
- If there are no DTCs logged after three or four consecutive ignition cycles, the ECM deactivates the instrument cluster malfunction indicator lamp (MIL).
- Type A or Type B History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.

- Use Tech 2 to clear DTC/s.

Type C – Non-Emission Related DTCs

The ECM takes the following action when a Type A DTC runs and fails:

- sets a current Type C DTC that represents the fault condition, and
- records the operating conditions at the time the DTC is logged and stores this information in the Failure Record, and:

NOTE

The instrument cluster malfunction indicator lamp (MIL) is not activated when a Type C DTC sets.

Conditions for Clearing Type C DTCs

- The current DTC clears when there is no fault condition in the current ECM self-diagnostics.
- Type C History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.
- Use Tech 2 to clear DTCs.

Current DTCs

A DTC is a Current DTC if the fault condition that triggers that DTC is present during the last ECM self-diagnostics.

History DTCs

A DTC is a History DTC if the fault condition that triggers that DTC is not present during the last ECM self-diagnostics.

1.5 Warning Caution and Notes

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM Holden LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM Holden LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 GM LAN Serial Communication Circuit

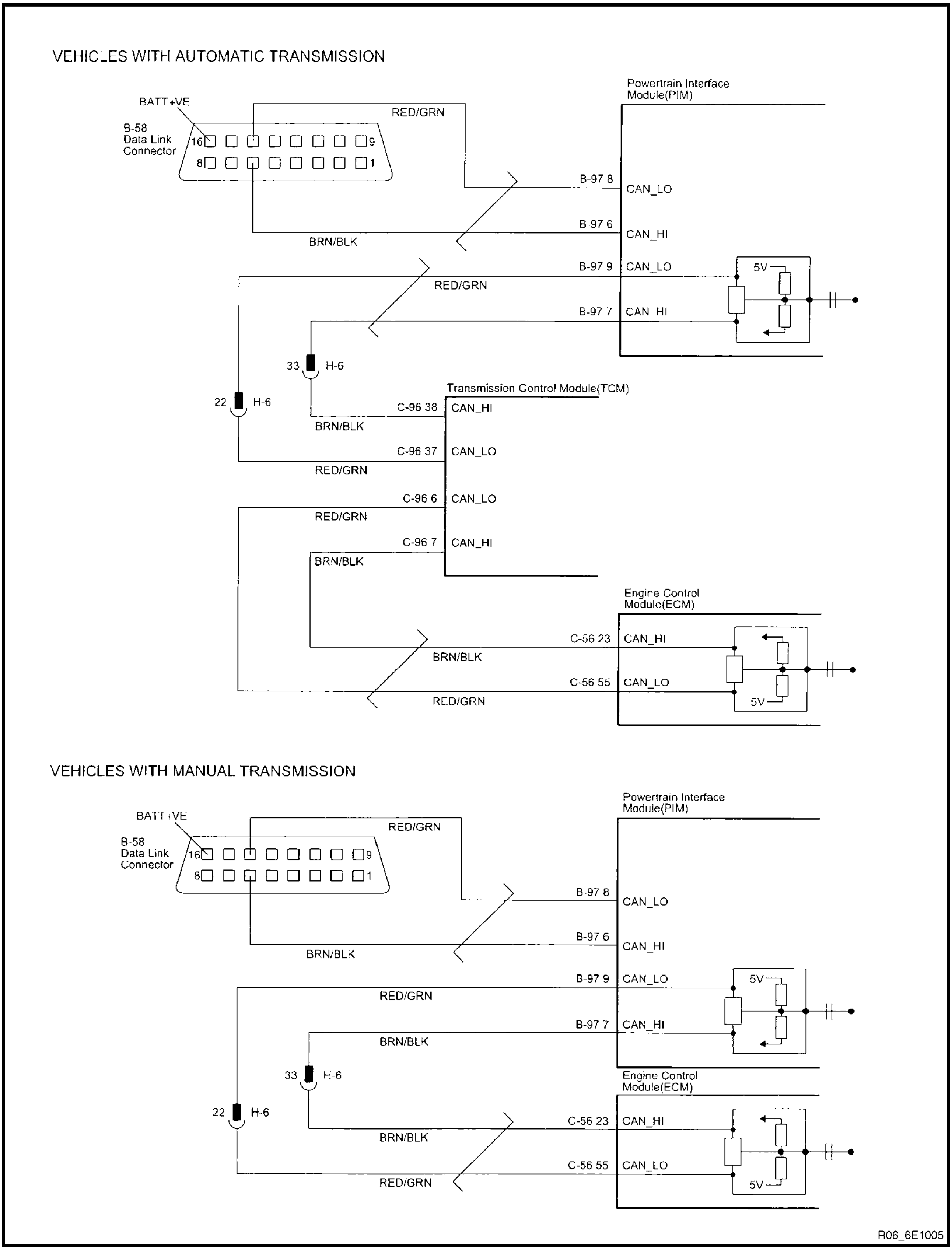


Figure 6C1-2 – 1

3 Wiring Diagrams and Connector Charts

3.1 Wiring Diagrams

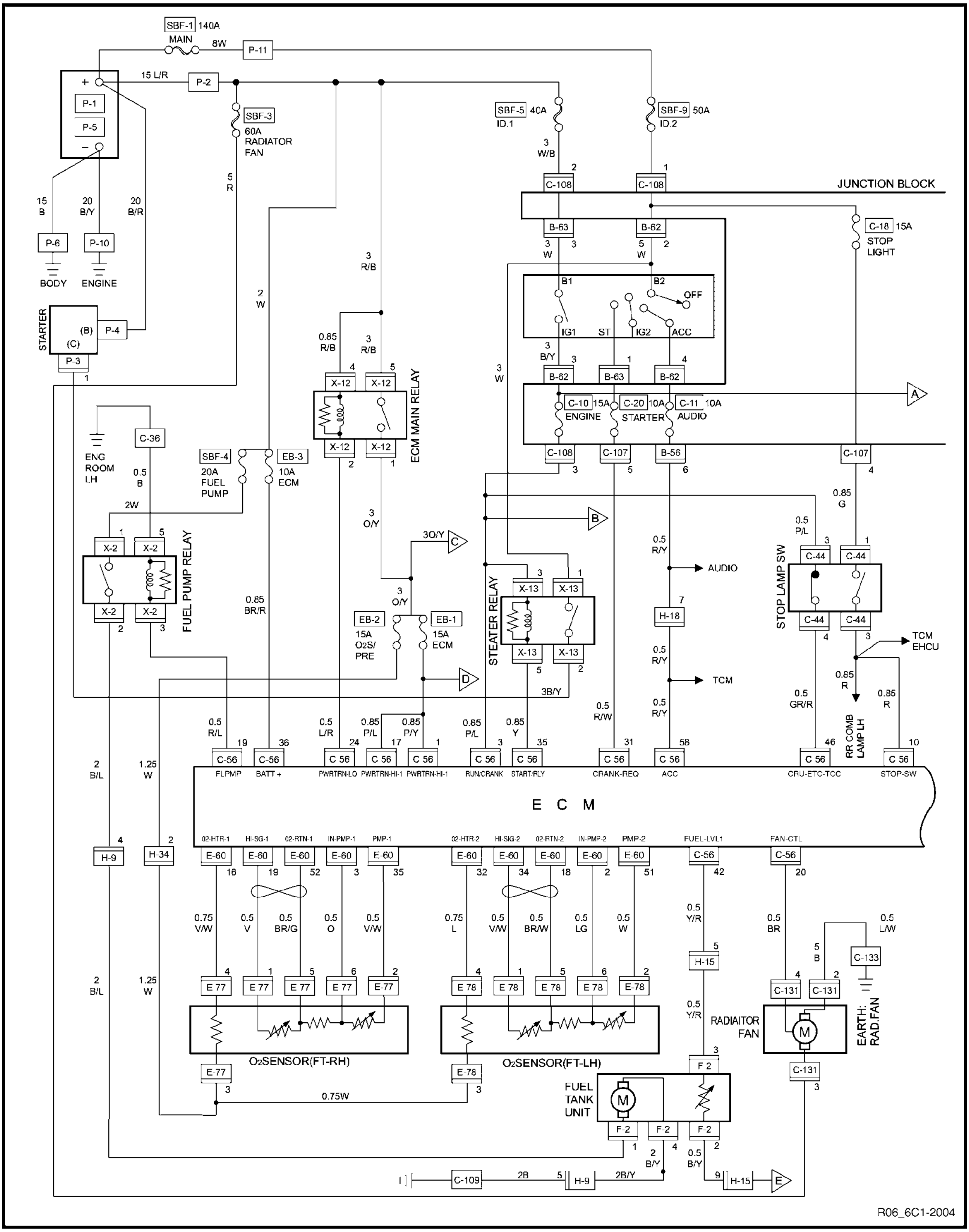


Figure 6C1-2 – 2

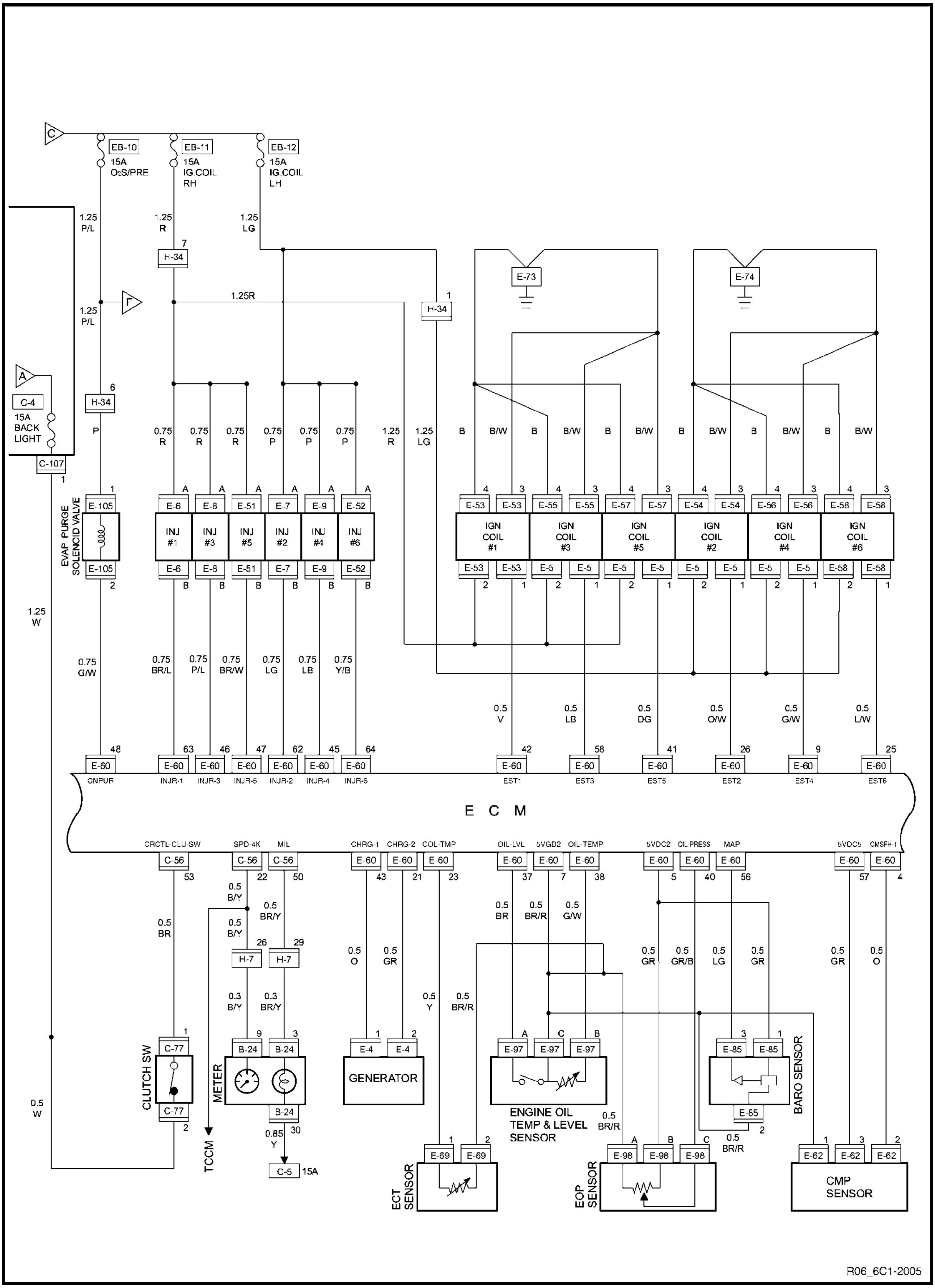


Figure 6C1-2 – 3

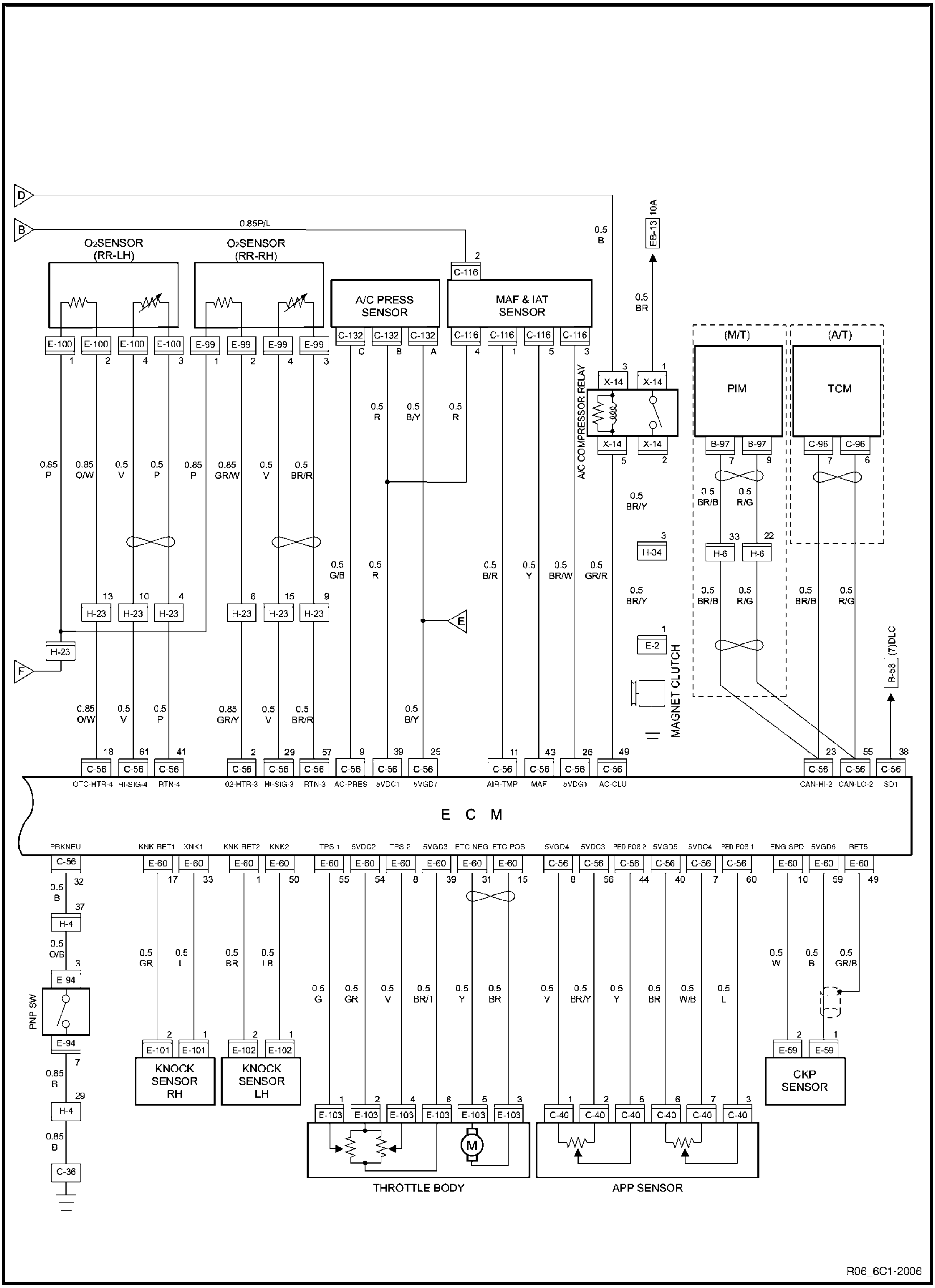
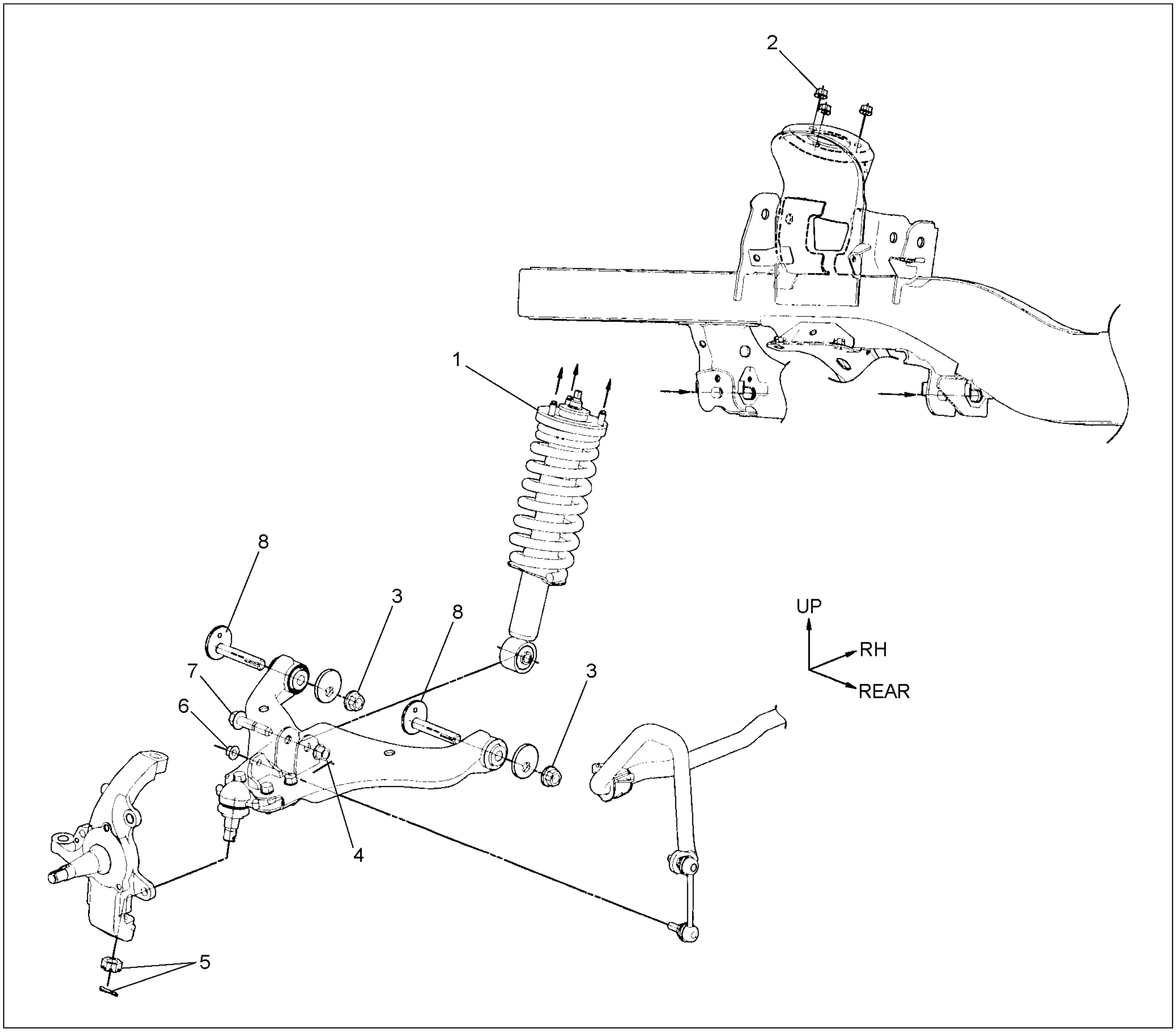


Figure 6C1-2 – 4

Shock Absorber

Shock Absorber and Associated Parts



RTW440LF001201

Legend

(1) Shock Absorber ASM with coil
(2) Shock Absorber Nut
(3) Lower Control Arm Nut
(4) Shock Absorber Nut
(5) Lower Ball Joint Nut and Cotter Pin
(6) Link Nut
(7) Shock Absorber Bolt
(8) Cam bolt

3.2 ECM Connector End Views

Engine Control Module Connector E-60

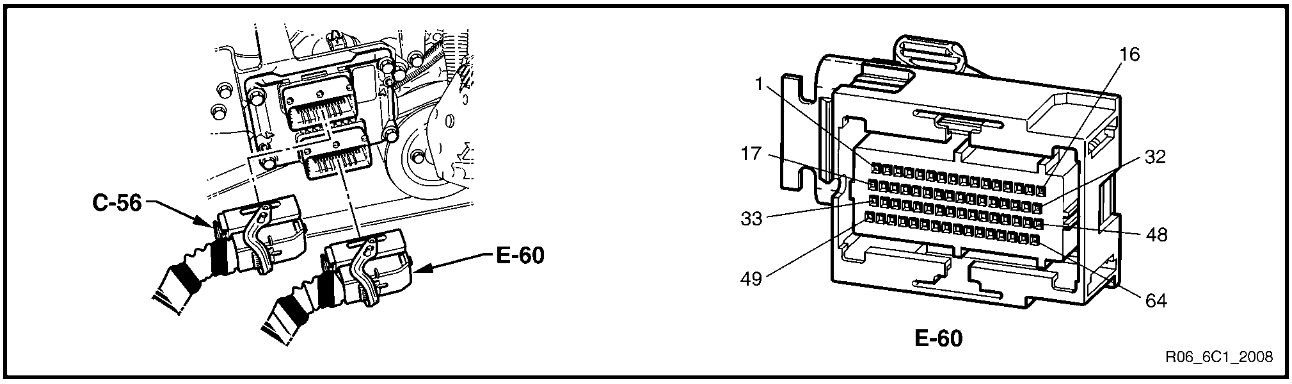


Figure 6C1-2 – 5

Terminal / Pin	Wire Colour	Circuit Description	Function
E-60–1	BR	KNK_RET2	Low Reference – Knock Sensor Bank 2
E-60–2	LG	IN_PMP_2	B2S1 HO2S Input Pump Current (Bank 2 Sensor 1)
E-60–3	O	IN_PMP_1	B1S1 HO2S Input Pump Current (Bank 1 Sensor 1)
E-60–4	O	CMSFH_1	CMP Sensor Signal – Intake Bank 1
E-60–5	GR	5VDC2	5 Volt Reference – 6
E-60–6			Not Used
E-60–7	BR/R	5VGD2	Low Reference – Ground 2
E-60–8	V	TPS_2	TP Sensor 2 Signal
E-60–9	G/W	EST4	EST 4 Control
E-60–10	W	ENG_SPD	CKP Sensor High
E-60–11			Not Used
E-60–12			Not Used
E-60–13			Not Used
E-60–14			Not Used
E-60–15	BR	ETC_POS	TAC Motor Control (Positive)
E-60–16	V/W	O2_HTR_1	B1S1 HO2S Heater Low Reference (Bank 1 Sensor 1)
E-60–17	GR	KNK_RET1	Low Reference – Knock Sensor Bank 1
E-60–18	BR/W	O2_RTN_2	B2S1 HO2S Low Signal (Bank 2 Sensor 1)
E-60–19	V	HI_SIG_1	B1S1 HO2S High Signal (Bank 1 Sensor 1)
E-60–20			Not Used
E-60–21	GR	CHRG_2	Generator Field Duty Cycle Signal (‘F’ Terminal)
E-60–22			Not Used
E-60–23	Y	COL_TMP	ECT Sensor Signal
E-60–24			Not Used
E-60–25	L/W	EST6	EST 6 Control
E-60–26	O/W	EST2	EST 2 Control

E-60–27			Not Used
E-60–28			Not Used
E-60–29			Not Used
E-60–30			Not Used
E-60–31	Y	ETC_NEG	TAC Motor Control (Negative)
E-60–32	L	O2_HTR_2	B2S1 HO2S Heater Low Control (Bank 2 Sensor 1)
E-60–33	L	KNK1	Knock Sensor 1 Signal (Bank 1)
E-60–34	V/W	HI_SIG_2	B2S1 HO2S High Signal (Bank 2 Sensor 1)
E-60–35	V/W	PMP_1	B1S1 HO2S Pump Current (Bank 1 Sensor 1)
E-60–36			Not Used
E-60–37	BR	OIL_LVL	Oil Level Switch Signal
E-60–38	G/W	OIL_TMP	Oil Temperature Sensor Signal
E-60–39	BR/T	5VGD3	Low Reference – Ground 3
E-60–40	GR/B	OIL_PRESS	Oil Pressure Sensor Signal
E-60–41	DG	EST5	EST 5 Control
E-60–42	V	EST1	EST 1 Control
E-60–43	O	CHRG_1	Generator Turn On Signal ('L' Terminal)
E-60–44			Not Used
E-60–45	LB	INJR_4	Fuel Injector 4 Control
E-60–46	P/L	INJR_3	Fuel Injector 3 Control
E-60–47	BR/W	INJR_5	Fuel Injector 5 Control
E-60–48	G/W	CNPUR	EVAP Canister Purge Solenoid Control
E-60–49	GR/B	RET5	CKP Sensor Shield Return
E-60–50	LB	KNK2	Knock Sensor 2 Signal (Bank 2)
E-60–51	W	PMP_2	B2S1 HO2S Pump Current (Bank 2 Sensor 1)
E-60–52	BR/G	O2_RTN_1	B1S1 HO2S Low Signal (Bank 1 Sensor 1)
E-60–53			Not Used
E-60–54	GR	5VDC2	5 Volt Reference – 2
E-60–55	G	TPS-1	TP Sensor 1 Signal
E-60–56	LG	MAP	MAP Sensor Signal
E-60–57	GR	5VDC5	5 Volt Reference – 5
E-60–58	LB	EST3	EST 3 Control
E-60–59	B	5VGD6	CKP Sensor Low – Ground 6
E-60–60			Not Used
E-60–61			Not Used
E-60–62	LG	INJR_2	Fuel Injector 2 Control
E-60–63	BR/L	INJR_1	Fuel Injector 1 Control
E-60–64	Y/B	INJR_6	Fuel Injector 6 Control

Engine Control Module Connector C-56

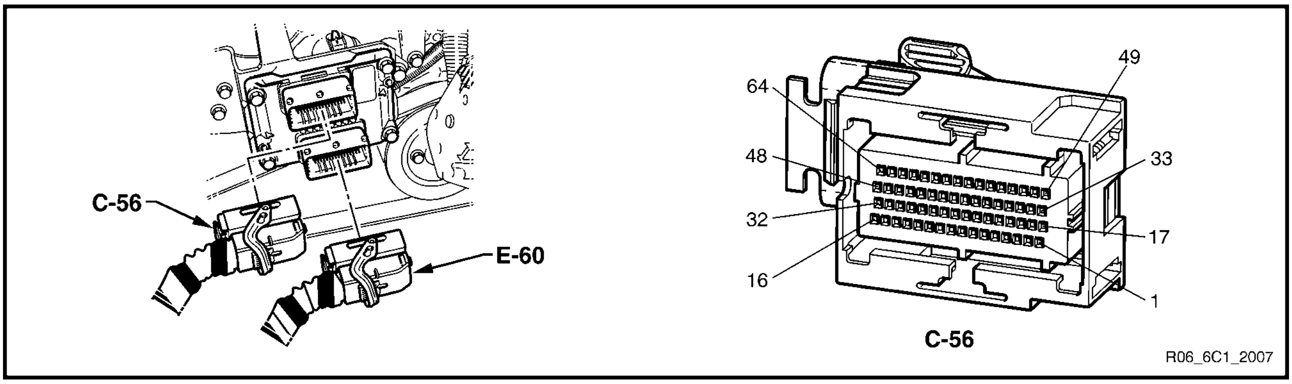


Figure 6C1-2 – 6

Terminal / Pin	Wire Colour	Circuit Description	Function
C-56–1	P/Y	PWRTRN_HI_2	Ignition Voltage 1
C-56–2	GR/Y	O2_HTR_3	B1S2 O2 Sensor Heater Control (Bank 1 Sensor 2)
C-56–3	P/L	RUN/CRANK	Ignition Voltage 1
C-56–4			Not Used
C-56–5			Not Used
C-56–6			Not Used
C-56–7	W/B	5VDC4	5 Volt Reference 4
C-56–8	V	5VGD4	Low Reference Ground 4
C-56–9	G/B	AC-PRES	A/C Refrigerant Pressure Sensor Signal
C-56–10	R	STOP_SW	Stop Lamp Switch Signal
C-56–11	B/R	AIR_TMP	IAT Sensor Signal
C-56–12			Not Used
C-56–13			Not Used
C-56–14			Not Used
C-56–15			Not Used
C-56–16			Not Used
C-56–17	P/L	PWRTRN_HI_1	Ignition Voltage 1
C-56–18	O/W	O2_HTR_4	B2S2 O2 Sensor Heater Control (Bank 2 Sensor 2)
C-56–19	R/L	FLPMP	Fuel Pump Relay Control
C-56–20	BR	FAN_CTL	Cooling Fan Control
C-56–21			Not Used
C-56–22	B/Y	SPD_4K	Vehicle Speed (VSS)
C-56–23	BR/B	CAN_HI_2	GMLAN Serial Data Bus – High
C-56–24	L/R	PWRTRN_LO	Engine Control Relay Control
C-56–25	B/Y	5VGD7	Low Reference – Ground 7
C-56–26	BR/W	5VDG1	Low Reference – Ground 1
C-56–27			Not Used

C-56–28			Not Used
C-56–29	V	HI_SIG_3	B1S2 O2 Sensor High Signal (Bank 1 Sensor 2)
C-56–30			Not Used
C-56–31	R/W	CRANK_REQ	Crank Voltage
C-56–32	B	PRKNEU	Park/Neutral Switch Signal
C-56–33			Not Used
C-56–34			Not Used
C-56–35	Y	START_RLY	Starter Relay Coil Control
C-56–36	BR/R	BATT +	Battery Positive Voltage
C-56–37			Not Used
C-56–38	PU	SDI	Data Link Connector (DLC) Serial Data
C-56–39	R	5VDC1	5 Volt Reference 1
C-56–40	BR	5VGD5	Low Reference – Ground 5
C-56–41	P	RTN_4	B2S2 O2 Sensor Low Signal (Bank 2 Sensor 2)
C-56–42	Y/R	FUEL_LVL1	Fuel Level Sensor Signal
C-56–43	Y	MAF	MAF Sensor Signal
C-56–44	Y	PED_POS_2	APP Sensor 2 Signal
C-56–45			Not Used
C-56–46	GR/R	CRU_ETC_TCC	Brake Switch (S220 – ‘C’) Cruise Cancel Signal
C-56–47			Not Used
C-56–48			Not Used
C-56–49	GR/R	AC_CLU	A/C Compressor Clutch Relay Control
C-56–50	BR/Y	MIL	Malfunction indicator Lamp
C-56–51			Not Used
C-56–52			Not Used
C-56–53	BR	CRCTL_CLU_SW	Clutch Switch (S42) Cruise Cancel Signal
C-56–54			Not Used
C-56–55	R/G	CAN_LO_2	GMLAN Serial Data Bus – Low
C-56–56	BR/Y	5VDC3	5 Volt Reference 3
C-56–57	BR/R	RTN_3	B1S2 O2 Sensor Low Signal (Bank 1 Sensor 2)
C-56–58	R/Y	ACC	Accessory Voltage
C-56–59			Not Used
C-56–60	L	PED_POS_1	APP Sensor 1 Signal
C-56–61	V	HI_SIG_4	B2S2 O2 Sensor High Signal (Bank 2 Sensor 2)
C-56–62			Not Used
C-56–63			Not Used
C-56–64			Not Used

3.3 Engine Control Connector End Views

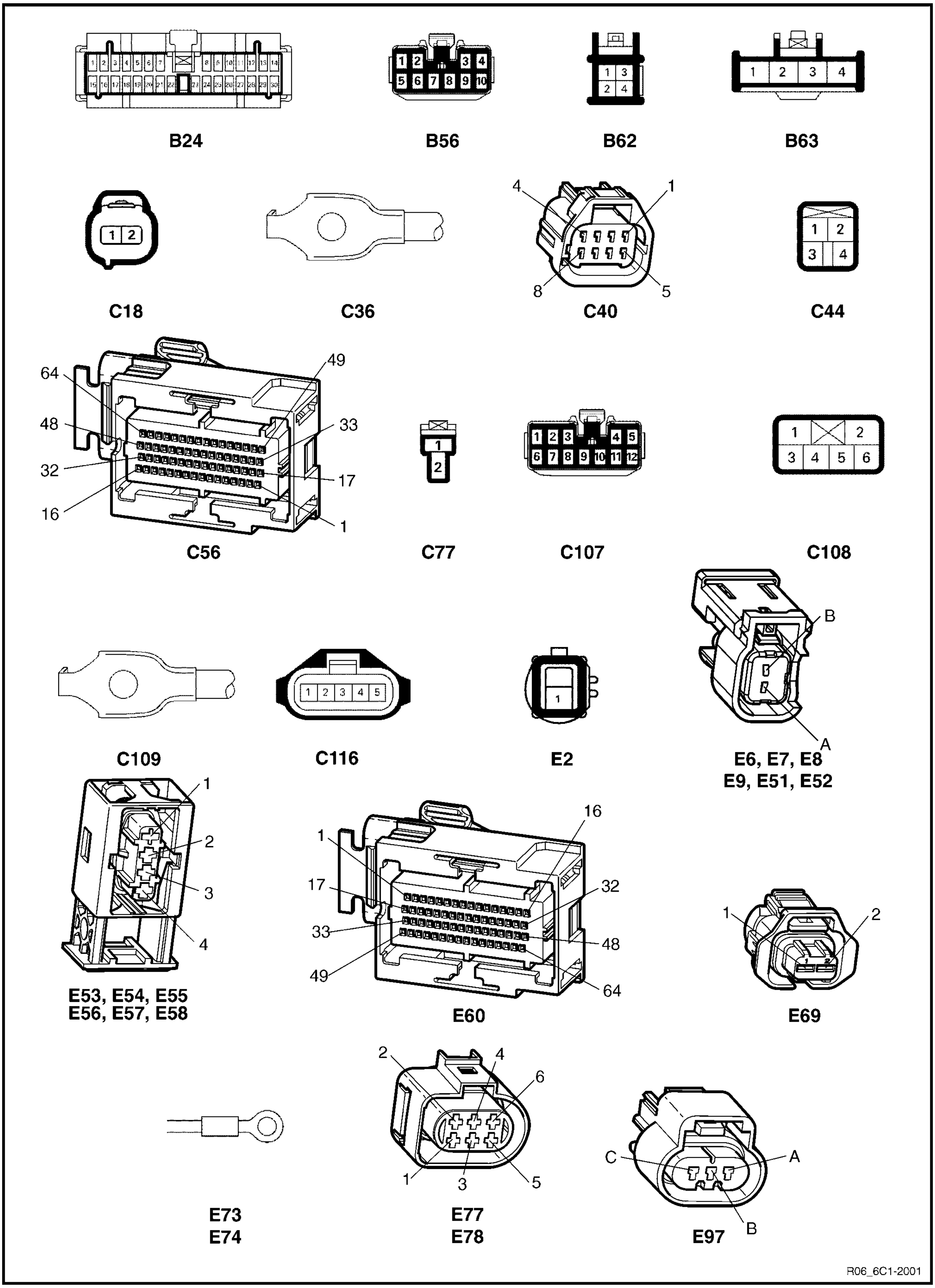


Figure 6C1-2 – 7

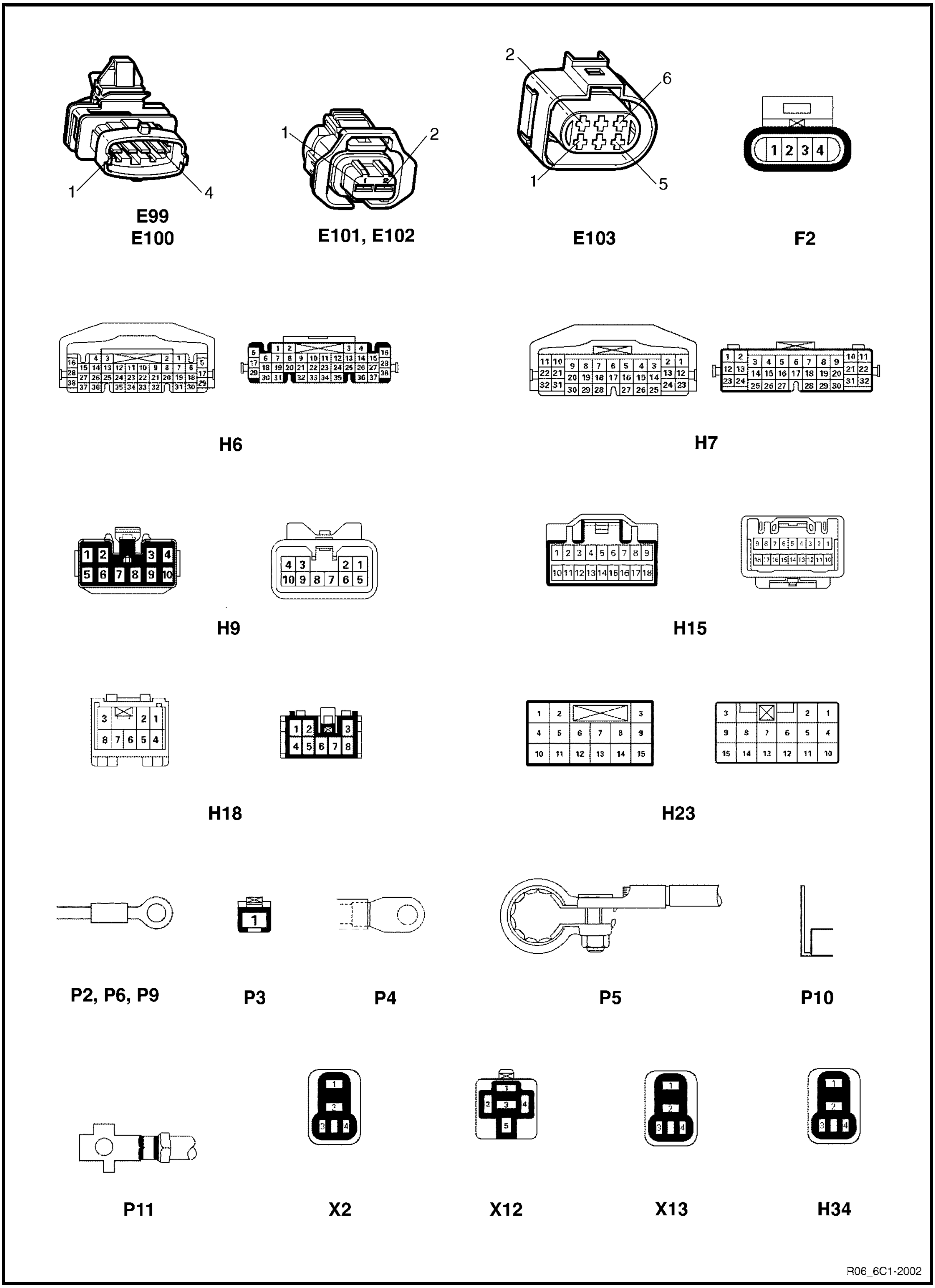


Figure 6C1-2 – 8

4 Diagnostics Starting Point

4.1 Basic Requirements

Basic Knowledge Required

CAUTION

A lack of basic understanding regarding electronics, electrical wiring circuits and use of electrical circuit testing tools when performing an engine management system diagnostic procedure could result in incorrect diagnostic results or damage to engine management system components.

Understanding of the following is required to perform the diagnostic procedures detailed in this Section. Refer to 8A Electrical - Body and Chassis and to Basic Tools Required.

- Basic electronics,
- Electrical wiring circuits,
- Electrical circuits testing, and
- Correct use of the basic engine management system diagnostic tools.

In addition, understanding of the engine management system is essential to prevent misdiagnosis and component damage. Refer to 6C1-1 Engine Management – V6 – General Information.

Basic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the Engine Management diagnostic procedures could result in incorrect diagnostic results or damage to engine management system components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section.

- Tech 2,
- Test lamp, refer to 8A Electrical - Body and Chassis, and
- Digital multimeter with 10 MΩ impedance, refer to 8A Electrical - Body and Chassis.

4.2 Diagnostic Precautions

The following precautions must be observed when performing the powertrain diagnostic procedure, otherwise incorrect diagnostic results or damage to engine management system components will occur:

- Disconnection of the battery affects certain vehicle electronic systems. Refer to 6D1-3 Battery – V6 before disconnecting the battery.
- Disconnect the battery negative lead when performing the following procedures:
  - Disconnecting the ECM connectors, or
  - Charging the battery.
- Disconnect the battery terminal lead and the ECM connectors before attempting any electric arc welding on the vehicle.

- Do not start the engine if the battery terminal is not properly secured to the battery.
- Do not disconnect or reconnect the following while the ignition is switched on or when the engine is running:
  - Any engine management system component electrical wiring connector, or
  - Battery terminal leads.
- Ensure the correct procedure for disconnecting and connecting engine management system electrical wiring connectors is always followed. For information on the correct procedure for disconnecting and connecting specific wiring connectors, refer to 6C1-3 Engine Management – V6 – Service Operations.
- Ensure that all wiring harness connectors are fitted correctly.
- When steam or pressure cleaning engines, do not direct the cleaning nozzle at engine management system components.
- Do not clear any DTCs unless instructed.
- The fault must be present when using the diagnostic trouble code (DTC) diagnostic tables. Otherwise, misdiagnosis or replacement of good parts may occur.
- Do not touch the ECM connector pins or soldered components on the ECM circuit board to prevent ECM Electrostatic Discharge damage. Refer to 8A Electrical - Body and Chassis for information on Electrostatic Discharge.
- Use only the test equipment specified in the diagnostic tables as other test equipment may give incorrect results or damage good components.
- The ECM is designed to withstand normal current draw associated with vehicle operations. However, the following fault conditions or incorrect test procedure may overload the ECM internal circuit and damage the ECM:
  - A short to voltage fault condition in any of the ECM low reference circuits may cause internal ECM and / or sensor damage. Therefore, any short to voltage fault condition in the ECM low reference circuits must be rectified before replacing a faulty component.
  - A short to ground fault condition in any of the ECM 5 V reference circuits may cause internal ECM and / or sensor damage. Therefore, any short to ground fault condition in the ECM 5 V reference circuits must be rectified before replacing a faulty component.
  - When using a test lamp to test an electrical circuit, do not use any of the ECM low reference circuits or 5 V reference circuits as a reference point. Otherwise, excessive current draw from the test lamp may damage the ECM.
- Disregard DTCs that set while performing the following diagnostic Steps:
  - Using Tech 2 actuator tests, or
  - Disconnecting an engine management system sensor connector then switching on the ignition.
- After completing the required diagnostics and service operations, road test the vehicle to ensure correct engine management system operation.

4.3 Preliminary Checks

The preliminary checks are a set of visual and physical checks or inspections that may quickly identify engine management system fault condition.

- Refer to the appropriate Service Techlines for relevant information regarding the fault condition.
- Ensure the battery is fully charged.
- Inspect the battery connections for corrosion or a loose terminal.
- Ensure that all engine management system related fuses are serviceable.
- Inspect for incorrect aftermarket theft deterrent devices, lights or mobile phone installation.
- Ensure there is no speaker magnet positioned too close to any electronic module that contains relays.
- Inspect the engine wiring harness for proper connections, pinches or cuts.
- Ensure that all engine management related electrical wiring connectors are fitted correctly.
- Inspect the ECM ground connections for corrosion, loose terminal or incorrect position.

- Ensure the resistance between the ECM housing and the battery negative cable is less than 0.5 Ω.
- Check the ECM bracket fasteners for correct torque value.
- Check all engine management related components for correct installation.
- Inspect the vacuum hoses for splits, kinks, oil contamination and proper connections, refer to the vehicle emission control information label. Check the hoses thoroughly for any type of leak or restriction.
- Inspect the air intake ducts for being collapsed, split or for having damaged areas.
- Inspect for air leaks at the throttle body mounting area, mass air flow (MAF) sensor, intake manifold and intake manifold sealing surfaces.
- Check for wiring harness routing that may be positioned too close to a high voltage or high current device such as the following:
  - Secondary ignition components, and
  - Motors and generators.

NOTE

High voltage or high current devices may induce electrical noise on a circuit, which can interfere with normal circuit operation.

4.4 Diagnostic System Check

Description

The engine management diagnostic procedure is organised in a logical structure that begins with the Diagnostic System Check. The Diagnostic System Check directs the diagnostic procedure to the logical steps necessary to diagnose an engine driveability fault condition.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

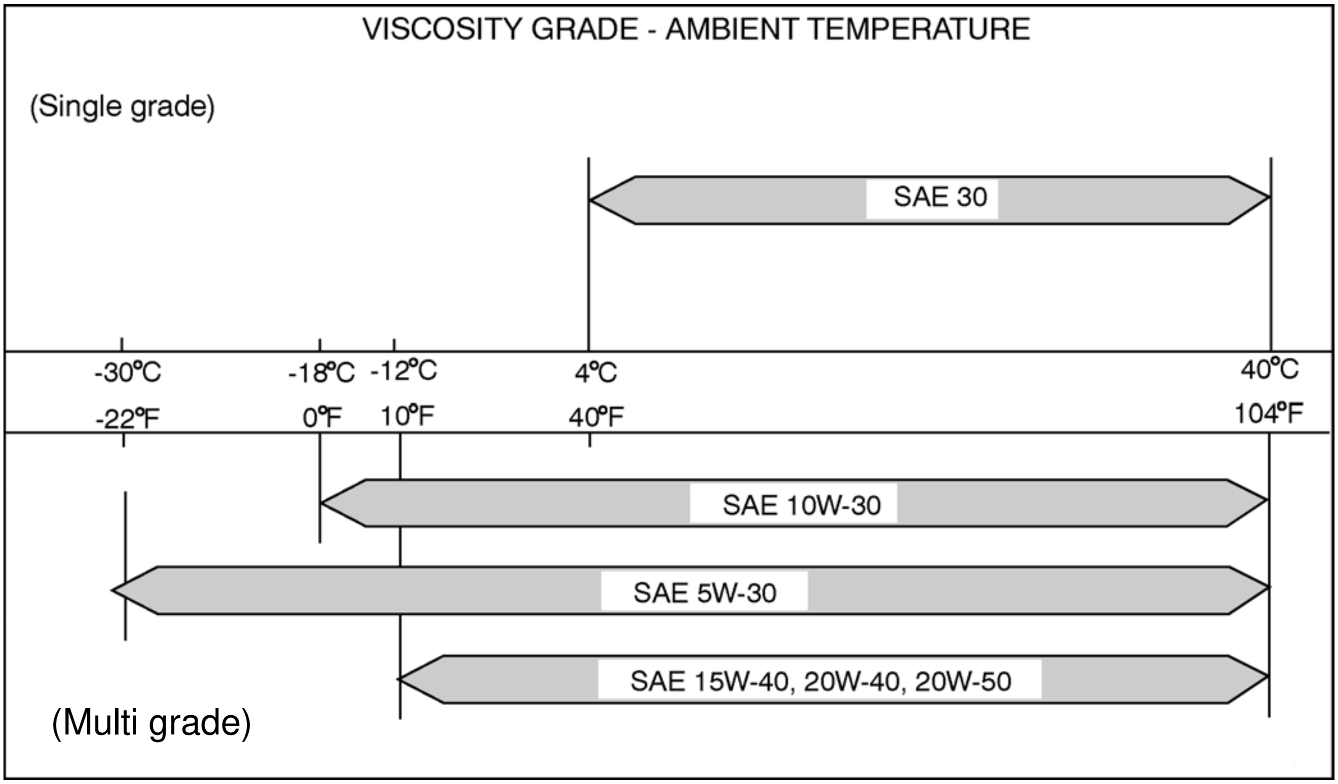
6 Tests the integrity of the GM LAN serial data communication circuit. A PIM DTC sets if the PIM detects a fault condition in the communication circuit. A fault condition on the serial data communication circuit may trigger multiple DTCs on other sensors and components.

Step	Action	Yes	No
1	Have you read the basic requirements?	Go to Step 2	Refer to 4.1 Basic Requirements
2	Have you read the diagnostic precautions?	Go to Step 3	Refer to 4.2 Diagnostic Precautions
3	Have you performed the preliminary checks?	Go to Step 4	Refer to 4.3 Preliminary Checks
4	Using Tech 2, attempt to communicate with the PIM. Does the PIM fail to communicate?	Refer to 6E1 Powertrain Interface Module – V6	Go to Step 5
5	Does DTC B3902, C0550, U2100, U2105, U2106, P0633, or P1611 also set in the PIM?	Refer to 6E1 Powertrain Interface Module – V6	Go to Step 6
6	Using Tech 2, view and record DTCs set at the ECM and TCM. Does Tech 2 display any DTC?	Go to Step 7	Refer to 5.1 Symptoms Diagnosis Table

Step	Action	Yes	No
7	Does Tech 2 display multiple DTCs?	Go to Step 8	Go to the diagnostic table of the DTC displayed. Refer to 7.1 DTC List
8	Does Tech 2 display any serial data communication circuit DTC?	Go to the appropriate serial data communication circuit DTC table. Refer to 7.1 DTC List	Go to Step 9
9	Does Tech 2 display any immobiliser circuit DTC?	Go to the appropriate immobiliser circuit DTC table. Refer to 7.1 DTC List	Go to Step 10
10	Refer to the DTC Table of the fault condition that is most likely to trigger multiple DTCs. Refer to 1.2 Diagnostic Trouble Code Tables in this Section.	—	—
When all diagnosis and repairs are completed, check the system for correct operation.			

OIL VISCOSITY CHART FOR GASOLINE ENGINE
APPLY GASOLINE ENGINE OIL

C24SE



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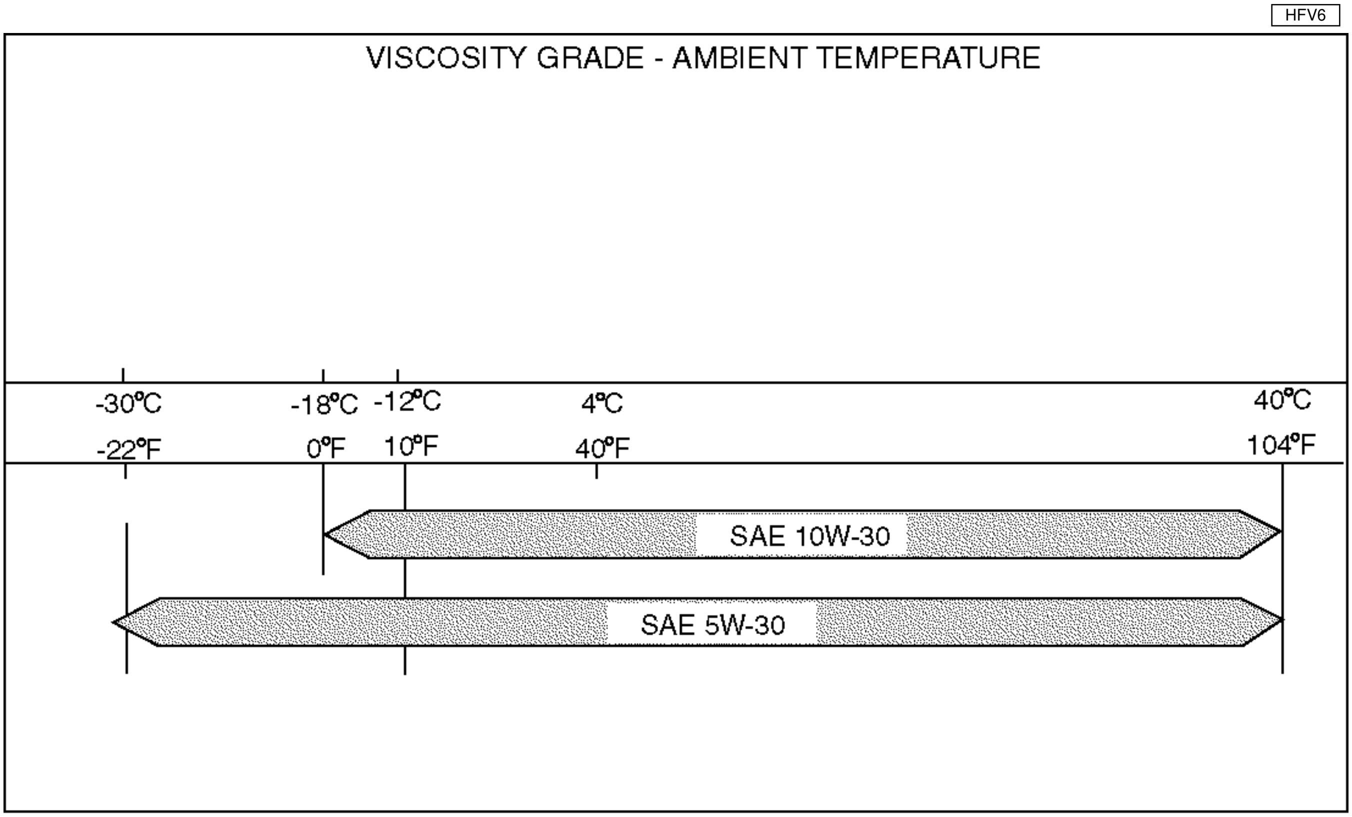
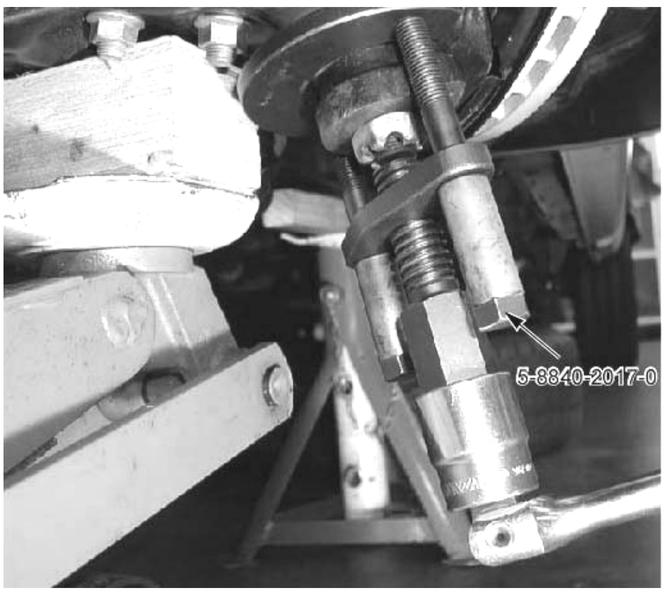


Removal

1. Raise the vehicle and support it with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel Replacement in this section.
3. Remove link nut.

CAUTION: Be careful not to damage the ball joint boot.

4. Support lower control arm with a jack.
5. Remove the shock absorber bolt and nut.
6. Remove lower ball joint nut and cotter pin, then use remover 5-8840-2017-0 to remove the lower ball joint from the knuckle.



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7. Apply the setting marks to the front and rear cam bolt and crossmember, then loosen nut, and cam bolt.
8. Remove the shock absorber nut.
9. Remove the shock absorber asm.

5 Symptoms Diagnostics

5.1 Symptoms Diagnosis Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check
2	Is the fault intermittent?	Refer to 5.2 Intermittent Fault Conditions	Go to Step 3
3	Does the engine backfire?	Refer to 5.3 Backfire	Go to Step 4
4	Does the engine crank but does not run?	Refer to 5.4 Cranks But Does Not Run	Go to Step 5
5	Does the engine cut-out or miss?	Refer to 5.5 Cuts Out, Misses	Go to Step 6
6	Is there a detonation or spark knock noise coming from the engine?	Refer to 5.6 Detonation / Spark Knock	Go to Step 7
7	Is there an engine dieseling or run-on condition?	Refer to 5.7 Dieseling, Run-on	Go to Step 8
8	Is there an engine hard starting condition?	Refer to 5.8 Hard Start	Go to Step 9
9	Is there an engine hesitation, sag or stumble condition?	Refer to 5.9 Hesitation, Sag and Stumble	Go to Step 10
10	Does the engine suffer from lack of power, sluggishness or sponginess?	Refer to 5.10 Lack of Power, Sluggishness or Sponginess	Go to Step 11
11	Does the engine suffer from poor fuel economy?	Refer to 5.11 Poor Fuel Economy	Go to Step 12
12	Does the engine suffer from rough, unstable or incorrect idle and engine stalling?	Refer to 5.12 Rough, Unstable, Incorrect Idle or Stalling	Go to Step 13
13	Does the engine surge or chuggle?	Refer to 5.13 Surges / Chuggles	Go to Step 14
When all diagnosis and repairs are completed, check the system for correct operation.			

5.2 Intermittent Fault Conditions

Description

A fault condition is intermittent if one of the following conditions exists:

- the fault condition is not always present,
- the fault condition cannot be presently duplicated, or

- there is no Current DTC but a History DTC is stored.

Diagnostic Table

Checks	Actions

Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section.
	• Gather information from the customer regarding the conditions that trigger the intermittent fault such as:
	  • At what engine or ambient temperature range does the fault occur?
	  • Does the fault occur when operating aftermarket electrical equipment inside the vehicle?
	  • Does the fault occur on rough roads or in wet road conditions?
	• If the intermittent fault is a start and then stall condition, check the immobiliser system. Refer to 11A Immobiliser.

Tech 2 Tests	The following are lists of Tech 2 diagnostic tests that may be used to diagnose intermittent faults: • Wriggle test the suspected wiring harness and connectors while observing Tech 2 operating parameters. If Tech 2 read-out fluctuates during this procedure, check the tested wiring harness circuit for a loose connection. • Observe the freeze frame / failure records for the suspected history DTC and then operate the vehicle in the conditions that triggers the intermittent fault while an assistant observes the suspected Tech 2 operating parameter data. • Capture and store data in the snapshot mode when the fault occurs. The stored data may be played back at a slower rate to aid diagnostics. Refer to Tech 2 User Instructions for further information on the Snapshot function. • Compare the engine operating parameters of the engine being diagnosed to the engine operating parameters of a known good engine.

Malfunction Indicator Lamp	The following conditions may cause an intermittent Malfunction Indicator Lamp fault with no DTC listed:
	• Electromagnetic interference (EMI) caused by a faulty relay, ECM controlled solenoid, switch or other external source.
	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • lights, or
	  • radio equipment.
	• ECM grounds are loose.

Checks	Actions

Temperature Related	Temperature related intermittent fault condition occurs only when the engine or ambient temperature is hot, or only when it is cold.
	• If the intermittent fault is heat related, review Tech 2 data in relationship to the following:
	  • high ambient temperature,
	  • engine generated heat,
	  • circuit generated heat due to a poor electrical connection or high electrical load, and
	  • higher than normal load conditions (towing, etc.).
	• If the intermittent fault is related to cold ambient or engine temperature, review Tech 2 data in relationship to the following:
	  • low ambient temperature, and
	  • the fault condition that occurs only on a cold start situation.

Additional Tests	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • theft deterrent alarms,
	  • lights, or
	  • radio equipment.
	• Electromagnetic interference (EMI) caused by a faulty relay, ECM controlled solenoid or switch. The fault is triggered when the relay or solenoid is activated.
	• Test the A/C compressor clutch and some relays that contain a clamping diode or resistor for an open circuit.
	• Test the generator for a faulty rectifier bridge that may allow the A/C noise into the ECM electrical circuit.

When all diagnosis and repairs are completed, check the system for correct operation.	

5.3 Backfire

Description

The air / fuel mixture in the intake manifold or in the exhaust system ignites which produces a loud popping noise.

Checks	Actions
Preliminary	Perform the Preliminary Checks. Refer to 4.3 Preliminary Checks in this Section.
Sensor / System	• Check the air intake system and crankcase for air leaks. • Check the PCV System for correct operation. Refer to 6A1 Engine Mechanical – V6. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity.

Checks	Actions
Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6 – V6. • restricted fuel filter, • incorrect fuel pressure, and • contaminated fuel. • Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section. • Check the items that can cause an engine to run lean. • Check the items that cause an engine to run rich.
Ignition System	• Check for an intermittent ignition circuit malfunction. • Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	Check the engine for over-heating. Refer to 6B1 Engine Cooling – V6.
Engine Mechanical	Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical – V6. • low compression, and • worn valve train components.
Additional Checks	• Check the exhaust system for possible restrictions. Refer to 6F Exhaust System – V6. • Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition. Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present. Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI: • secondary ignition components, or • motors and generators. Dirty starter motor commutator or brushes can mask the crankshaft position sensor signal. • Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to 7C1 Automatic Transmission – 4L60E – General Information.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.4 Cranks But Does Not Run

Definition

The engine cranks normally but does not start.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the immobiliser system for correct operation. Refer to 11A Immobiliser.
Sensor / System	• Check the engine coolant temperature (ECT) sensor for an incorrect value. Compare the engine coolant temperature against the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C of each other. Refer to 6C1-3 Engine Management – V6 – Service Operations for details of the Temperature vs. Resistance Table. • Check the mass air flow (MAF) sensor installation. Incorrect installation of the MAF sensor may cause hard start condition. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for a dirty starter motor commutator or brushes that can mask the crankshaft position sensor signal.

Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
	  • restricted fuel filter,
	  • incorrect fuel pressure,
	  • contaminated fuel, and
	  • incorrect fuel pump relay operation.
	• Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. Check for loose ignition coil ground circuit.

Engine Mechanical	• Check for excessive oil in combustion chamber. Refer to 6A1 Engine Mechanical – V6.
	• Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical – V6.
	  • low compression, and
	  • worn valve train components.

When all diagnosis and repairs are completed, check the system for correct operation.	

5.5 Cuts Out, Misses

Description

Steady pulsation or jerking that is usually more severe as the engine load increases. This condition is not normally felt greater than 1500 rpm or 48 km/h. The exhaust has a steady spitting sound at idle or low speed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages. • Check for intake manifold vacuum leak.
Sensor / System	• Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. Refer to 7.19 DTC P0327, P0328, P0332 or P0333.

Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that cause an engine to run rich or to run lean.

Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil grounds.
Engine Mechanical	Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical –V6. • low compression, and • worn valve train components.

Checks	Actions

Additional Checks	• Check the exhaust system for possible restrictions. Refer to 6F Exhaust System – V6.
	• Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition.
	Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an electromagnetic interference fault may be present.
	• Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI:
	  • secondary ignition components, or
	  • motors and generators.

When all diagnosis and repairs are completed, check the system for correct operation.	

5.6 Detonation / Spark Knock

Description

The engine produces sharp rapid metallic knocks that are more audible during acceleration.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section.
Sensor System	Use Tech 2 to monitor the knock sensor system.

Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section.
	• Ensure the fuel tank is filled with petrol that has a minimum octane reading of 92.
	• Check for fault conditions that can cause an engine to run lean.

Ignition System	Check the spark plugs for proper heat range. Refer to 6C1-3 Engine Management – V6 – Service Operations.
Engine Mechanical	• Check the combustion chambers for excessive carbon build-up. Refer to 6A1 Engine Mechanical – V6. • Check the camshaft timing. Refer to 6A1 Engine Mechanical – V6.
Additional Checks	• Check the torque converter clutch (TCC) operation. The TCC applying too soon can cause the engine to spark knock. Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.7 Dieseling, Run-on

Description

The engine continues to run after the ignition is switched off but runs very roughly and then stalls.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section.
Fuel System	Inspect the injectors for leaking condition. Refer to 6C1-3 Engine Management – V6 – Service Operations.
Engine Cooling System	• Check for engine overheating. Refer to 6B1 Engine Cooling – V6. • Check the engine thermostat for proper operation and correct heat range. Refer to 6B1 Engine Cooling – V6.
Engine Mechanical	• Check for build up of carbon deposit in the combustion chamber, which may cause hot spots and increased compression ratio. Refer to 6A1 Engine Mechanical – V6. • Using Tech 2, check for incorrect engine idle speed.
Additional	• If the engine continues to run after the ignition is switched off but the engine runs normally, check the following: • ignition switch operation, • voltage feedback from alternator L terminal to ignition switch, and • sticking ignition control relay.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.8 Hard Start

Definition

The engine cranks normally but takes longer to start than usual. As soon as the engine runs, the engine may stall immediately.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the immobiliser system for correct operation. Refer to 11A Immobiliser.
Sensor / System	• Check the engine coolant temperature (ECT) sensor for an incorrect value. Compare the engine coolant temperature against the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within ± 3°C of each other. Refer to 6C1-3 Engine Management – V6 – Service Operations for details of the Temperature vs. Resistance Table. • Check the mass air flow (MAF) sensor installation. Incorrect installation of the MAF sensor may cause hard start condition. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Test the resistance of the crankshaft position (CKP) sensor. The CKP sensor resistance must be within 700 – 1,200 Ω at all temperatures. • Check for dirty starter motor commutator or brushes that can mask the crankshaft position sensor signal.
Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6. • restricted fuel filter, • incorrect fuel pressure, and • contaminated fuel. • Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.

Checks	Actions
Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.

Engine Mechanical	• Check for excessive oil in combustion chamber. Refer to 6A1 Engine Mechanical – V6.
	• Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical – V6.
	  • low compression, and
	  • worn valve train components.

When all diagnosis and repairs are completed, check the system for correct operation.	

5.9 Hesitation, Sag and Stumble

Description

Momentary lack of response or hesitation as the accelerator is depressed. This condition is usually more severe when first trying to make the vehicle move from a standing start but can occur at any vehicle speed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. • Inspect the accelerator pedal position (APP) sensor harness connector for correct connection. Poor connection of this connector will not set a DTC.

Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to 6C Fuel System – V6.
	• Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that cause an engine to run rich or to run lean.

Checks	Actions
Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	Check the engine thermostat for correct operation and heat range. Refer to 6B1 Engine Cooling – V6.
Additional Checks	• Check the generator output voltage. Refer to 6D1-1 Charging System – V6.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.10 Lack of Power, Sluggishness or Sponginess

Description

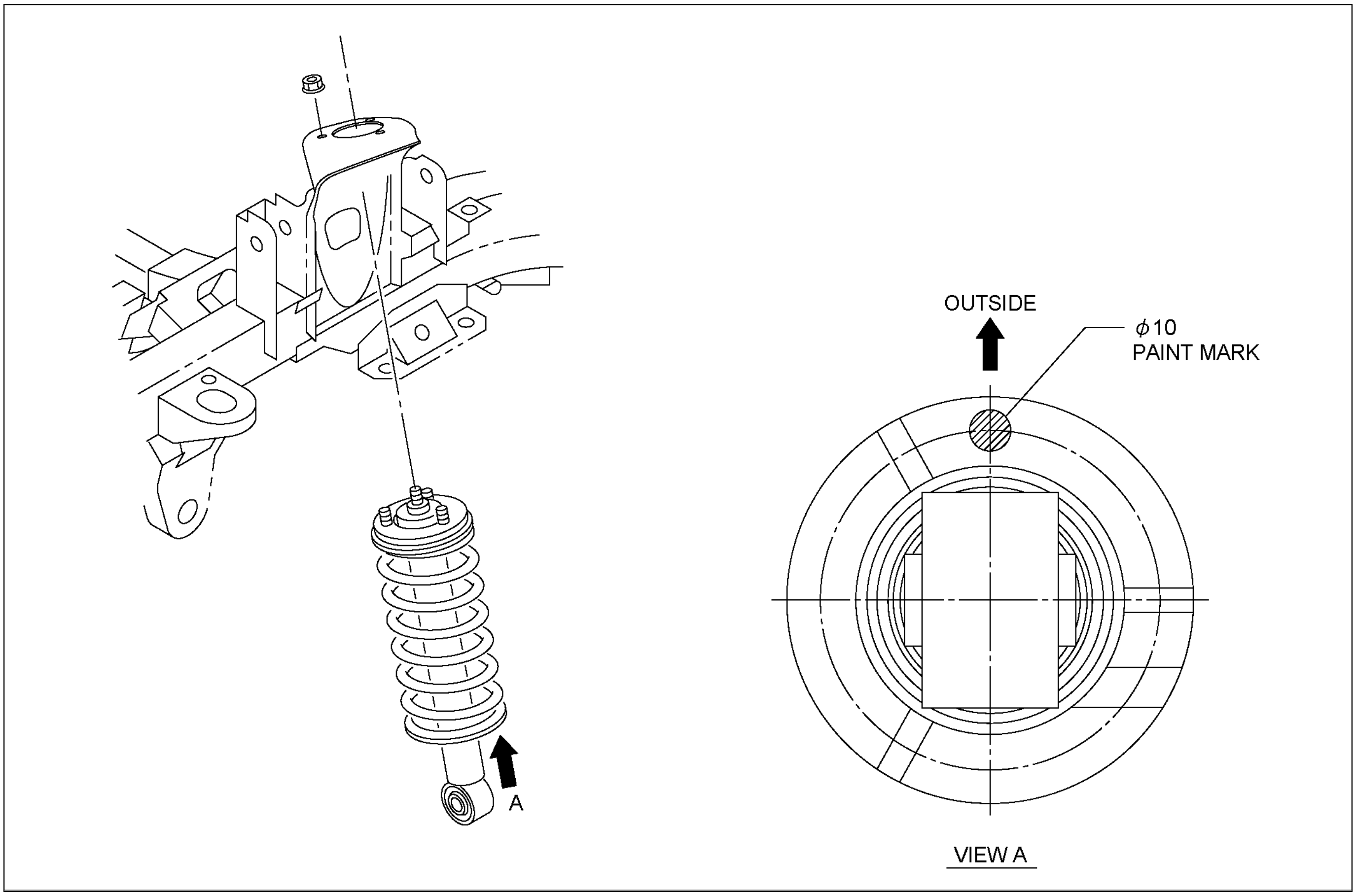
The engine delivers less than normal power. There is little or no increase in vehicle speed when the accelerator pedal is partially depressed.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Inspect the accelerator pedal position (APP) sensor harness connector for correct connection. Poor connection of this connector will not set a DTC.

Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
	  • restricted fuel filter,
	  • incorrect fuel pressure, and
	  • contaminated fuel.
	• Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.
	• Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section.
	• Check for fault conditions that can cause the engine to run rich or run lean.

Installation

1. Install shock absorber.



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NOTE: Paint mark to be on outer side after assembly to vehicle.

2. Install shock absorber nut, then tighten it to the specified torque.

   Torque: 55 N·m (5.6 kgf·m/41lb·ft)

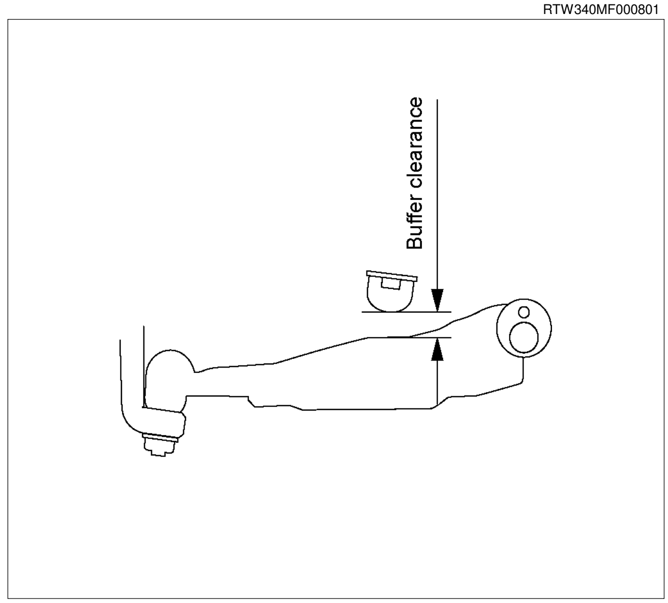
3. Install shock absorber bolt and nut, and then tighten to the specified torque.

   Buffer clearance: 25.9 mm (1.02 in)

   Torque: 137 N·m (14.0 kgf·m/101 lb·ft)

NOTE: Apply oil to the thread.

NOTE: Tighten the bolt and nut with the parts in the position shown in the illustration below.



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Checks	Actions
Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs, refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Mechanical	• Check for the following engine mechanical fault condition. Refer to 6A1 Engine Mechanical – V6. • low engine compression, and • worn valve train components.
Additional Checks	• Check the exhaust system for possible restrictions. Refer to 6F Exhaust System – V6. • Test for other TCM related faults that may cause the transmission to operate in the default mode. • Check for transmission mechanical faults that may produce similar symptoms such as slipping clutch.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.11 Poor Fuel Economy

Description

As confirmed by an actual road test, the fuel economy as compared to the previous fuel consumption of the same vehicle is noticeably lower.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages. • Check for correct tyre pressure. Refer to the Owners Manual. • Check the recent driving conditions are the same compared to the previous when the fuel consumption is normal. The following are list of driving conditions that may affect fuel consumption: – vehicle load, – acceleration rate, – A/C or other electrical equipment use, and – vehicle used for towing.

Checks	Actions
Sensor / System	• Check the air intake system and crankcase for air leaks. • Check the PCV System for correct operation. Refer to 6A1 Engine Mechanical – V6. • Check for the correct calibration of the speedometer. Refer to 8A Electrical-Body. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions.
Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6. – restricted fuel filter, – incorrect fuel pressure, and – contaminated fuel. • Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section. • Check the items that cause an engine to run rich. • Check for foreign material accumulation in the throttle bore, carbon build-up on the throttle valve or on the throttle shaft. • Check the throttle body for tampering.
Ignition System	• Inspect for moisture or corrosion around the spark plug / ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil ground circuit.
Engine Cooling System	• Check the engine thermostat for proper operation and correct heat range. Refer to 6B1 Engine Cooling – V6.
Engine Mechanical	Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical – V6. • low compression, and • worn valve train components.

Checks	Actions
Additional Checks	• Check the exhaust system for possible restrictions. Refer to 6F Exhaust System – V6. • Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition. Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present. Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI: • secondary ignition components, and • motors and generators. • Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis. • Test for other TCM related faults that may cause the transmission to operate in the default mode. Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis. • Check for transmission mechanical faults such as slipping clutch. Refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. • Check the brake system including the parking brake for sticking or incorrect operation.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.12 Rough, Unstable, Incorrect Idle or Stalling

Description

Engine idle speed fluctuates causing the engine to run unevenly. If the engine idle speed drops too low, the engine may stall.

Checks	Actions
Preliminary	• Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section. • Check the air filter element and intake air ducts for blockages.
Sensor / System	• Check the throttle actuator control (TAC) system. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check the air intake system and crankcase for air leaks. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check the PCV System for correct operation. Refer to 6A1 Engine Mechanical – V6. • Use Tech 2 to monitor the knock sensor system for excessive spark retard activity. Check for items that cause spark retard activity. • Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s sensor should respond quickly to different throttle positions.

Checks	Actions
Fuel System	• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6. – restricted fuel filter, – incorrect fuel pressure, and – contaminated fuel. • Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section. • Check the items that cause an engine to run rich.
Ignition System	• Inspect for moisture or corrosion around the spark plug and ignition coil area. • Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management –V6 – Service Operations. **NOTE** If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Check for loose ignition coil grounds.
Engine Mechanical	• Parasitic load on the engine such as the following: • automatic transmission fault condition, or • a belt driven accessory fault condition. • Check for the following engine fault conditions. Refer to 6A1 Engine Mechanical – V6. • low compression, or • worn valve train components.
When all diagnosis and repairs are completed, check the system for correct operation.	

5.13 Surges / Chuggles

Description

With the accelerator pedal in a steady position, the vehicle speeds up and slows down or the engine power fluctuates.

Checks	Actions
Preliminary	Perform the preliminary checks. Refer to 4.3 Preliminary Checks in this Section.
Sensor / System	• Using Tech 2, check the heated oxygen sensor (HO2s) operating parameters. The HO2s should respond quickly to different throttle positions. • Test the resistance of the crankshaft position (CKP) sensor. The CKP sensor resistance must be 700 – 1,200 Ω at all temperatures.

<table>
<tr><th>Checks</th><th>Actions</th></tr>
<tr><td>Fuel System</td><td>• Check the fuel system for the following fault conditions. Refer to 6C Fuel System – V6.
• restricted fuel filter,
• incorrect fuel pressure, and
• contaminated fuel.
• Check the operation of the fuel injectors. Refer to 6C1-3 Engine Management – V6 – Service Operations.
• Perform the fuel injector balance test, refer to 6.3 Fuel Injector Balance Test in this Section.
• Check the items that cause an engine to run rich.
• Check for fault conditions that can cause an engine to run lean.</td></tr>
<tr><td>Ignition System</td><td>• Inspect for moisture or corrosion around the spark plug / ignition coil area.
• Test the ignition coil voltage output. Refer to 6C1-3 Engine Management – V6 – Service Operations.
• Remove and inspect the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations.
NOTE
If the spark plugs are fouled, determine the cause of the fouling before replacing the spark plugs. Refer to 6C1-3 Engine Management – V6 – Service Operations.
• Check for loose ignition coil ground circuit.</td></tr>
<tr><td>Additional Checks</td><td>• Check the torque converter clutch (TCC) operation. A TCC that applies too soon can cause engine detonation, which will trigger spark retard activity. Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis.
• Test the A/C clutch for correct operation. Refer to 2A Heater and Air-conditioning.
• Check the evaporative emission (EVAP) canister purge solenoid for the following conditions: Refer to 6C1-3 Engine Management – V6 – Service Operations.
– stuck open condition, and
– charcoal contamination.
• Check the exhaust system for possible restrictions. Refer to 6F Exhaust System – V6.
• Electromagnetic interference (EMI) on the crankshaft position (CKP) sensor can cause an engine misfire condition.
Using Tech 2, monitor the engine speed parameter. A sudden increase in the engine speed parameters without moving the throttle position indicates that an Electromagnetic Interference fault may be present.
Wiring harness routing which may be positioned very close to a high voltage or high current device such as the following may induce EMI:
• secondary ignition components, or
• motors and generators.</td></tr>
<tr><td colspan="2">When all diagnosis and repairs are completed, check the system for correct operation.</td></tr>
</table>

6 Functional Checks

6.1 General Information

The items detailed in the following pages are to be used when there is a customer complaint and there are no diagnostic trouble codes set, or one or more of the Tech 2 data values are not within the typical values. They are also to be used when instructed from a DTC table. Before using these tables, you should refer to 5 Symptoms Diagnostics in this Section, which may direct you to using the following functional checks.

The purpose of these tables is to diagnose engine control module (ECM) controlled components or sub-systems that do not have diagnostic trouble codes assigned to them. Another purpose of these tables is for Technicians who feel confident that a particular part of the sub-system is not operating properly and wants only to check that particular item for proper operation without going through lengthy diagnostic procedures.

6.2 Fuel Injector Coil Test

The fuel injector coil test is divided into two parts. Begin by performing the fuel injector coil quick test. Then only perform the Injector Coil Test – With Special Tool J39021 procedure if the quick test determines that there is a faulty fuel injector.

Fuel Injector Coil Quick Test

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step checks if the engine coolant temperature is within the correct range.

2 This step tests each fuel injector resistance within a specific temperature range.

3 This step determines if all of the fuel injectors are within 3 ohms of each other.

Step	Action	Value(s)	Yes	No
1	Using Tech 2, observe the engine coolant temperature (ECT). Is the ECT within the specified range?	10 – 32°C	Go to Step 2	Go to Step 3
2	1 Disconnect the fuel injector harness connector, refer to 2.13 Fuel Rail Assembly, in 6C1-3 Engine Management – V6 – Service Operations. 2 Using a digital ohmmeter and connector test adaptor kit J 35616-A, measure the resistance of each fuel injector between the ignition voltage circuit and the fuel injector control circuit. Refer to 8A Electrical - Body and Chassis for information on testing for continuity and to Figure 6C1-2 – 9 and Figure 6C1-2 – 10 for the fuel injector harness connector. Do any of the fuel injectors display a resistance outside the specified range?	11 – 14 Ω	Refer to Injector Coil Test – With Special Tool J39021 in this Section	Injectors OK

Step	Action	Value(s)	Yes	No
3	1 Disconnect the fuel injector harness connector, refer to 2.13 Fuel Rail Assembly, in 6C1-3 Engine Management – V6 – Service Operations. 2 Using a digital ohmmeter and connector test adaptor kit J 35616-A, measure the resistance of each fuel injector between the ignition voltage circuit and the fuel injector control circuit. Refer to 8A Electrical - Body and Chassis for information on testing for continuity and to Figure 6C1-2 – 9 and Figure 6C1-2 – 10 for the fuel injector harness connector. 3 Record each fuel injector value. 4 Subtract the lowest resistance value from the highest. Is the difference equal to, or less than, the specified value?	3 Ω	Injectors OK	Refer to Injector Coil Test – With Special Tool J39021 in this Section.

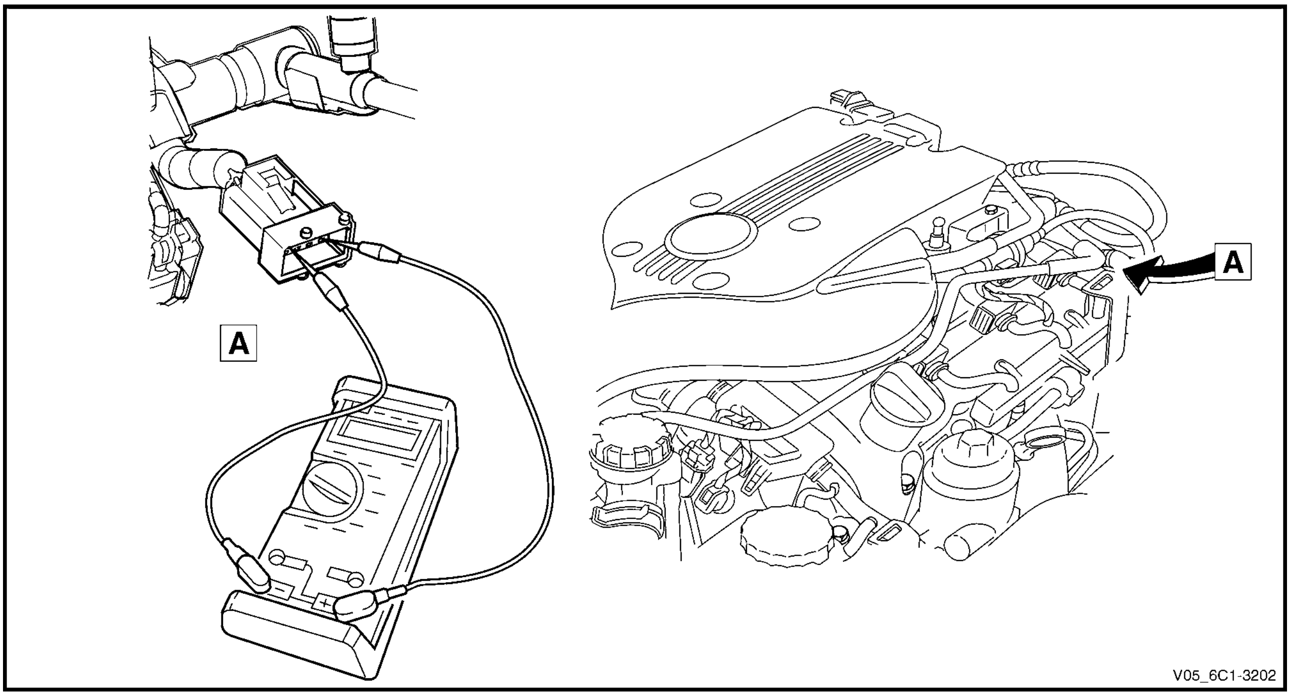


Figure 6C1-2 – 9

Fuel Injector Harness to Engine Harness Connector

Pin Description

Pin	Function	Circuit Number
1	Ignition Voltage Circuit – Cyl. 1, 3, 5	639
2	Ignition Voltage Circuit – Cyl. 2, 4, 6	1039
3	Injector 1 Control Circuit	1744
4	Injector 3 Control Circuit	1746
5	Injector 5 Control Circuit	845
6	Injector 2 Control Circuit	1745
7	Injector 4 Control Circuit	844
8	Injector 6 Control Circuit	846

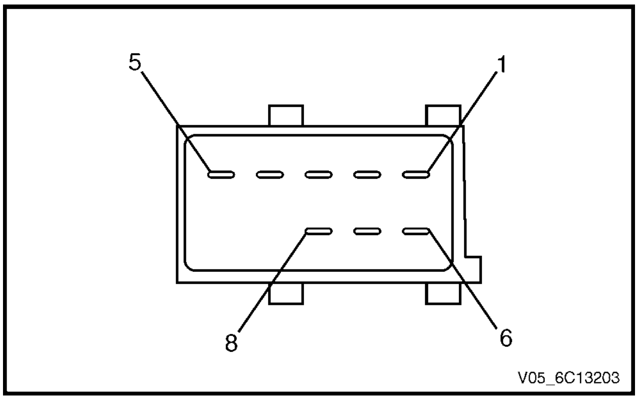


Figure 6C1-2 – 10

Injector Coil Test – With Special Tool J39021

1 Depressurise the fuel system, refer to 6C Fuel System – V6.

2 Turn the ignition OFF.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

3 Remove the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

4 Using Tech 2, observe the engine coolant temperature (ECT). If the ECT is 10 – 32°C, refer to Engine Coolant Temperature Between 10 – 32°C, or if the ECT is outside this range, refer to Engine Coolant Temperature Outside 10 – 32°C.

Engine Coolant Temperature Between 10 – 32°C

Step	Action	Value(s)	Yes	No
1	1 Set the amperage supply selector switch on the fuel injector tester (1), special tool J 39021 to the Coil Test 0.5 A position. Refer to Figure 6C1-2 – 11. 2 Connect the fuel injector tester leads (4 and 5) to B+ and ground. 3 Connect the digital multimeter (2) positive and negative lead to the fuel injector tester. Set the multimeter to read DC Voltage. 4 Connect the fuel injector tester, using fuel injector harness adapter, special tool J44602 to a fuel injector. 5 Press the Push to Start Test button on the fuel injector tester. 6 Observe and record the voltage reading on the digital multimeter. **NOTE** The voltage reading may rise during the test. Record the voltage reading after one second of the test. 7 Repeat steps 4 through 6 for each fuel injector. **NOTE** The table in Figure 6C1-2 – 12 shows an example of the results from a fuel injector coil test. Did any fuel injector have an erratic voltage reading (large fluctuations in voltage that did not stabilise), or voltage readings outside of the specified value?	5.5 – 6.6 V	Replace the faulty fuel injector/s. Refer to 2.13 Fuel Rail Assembly, in 6C1-3 Engine Management – V6 – Service Operations.	System OK
When all repairs are completed, check the system for fuel leaks and correct operation.				

Engine Coolant Temperature Outside 10 – 32°C

Step	Action	Value(s)	Yes	No
1	1 Set the amperage supply selector switch on the fuel injector tester (1), special tool J 39021 to the Coil Test 0.5 A position. Refer to Figure 6C1-2 – 11. 2 Connect the fuel injector tester leads (4 and 5) to B+ and ground. 3 Connect the digital multimeter (2) positive and negative lead to the fuel injector tester. Set the multimeter to read DC Voltage. 4 Connect the fuel injector tester, using injector harness adapter, special tool J44602 to a fuel injector. 5 Press the Push to Start Test button on the fuel injector tester. 6 Observe and record the voltage reading on the digital multimeter. **NOTE** The voltage reading may rise during the test. Record the voltage reading after one second of the test. 7 Repeat steps 4 through 6 for each fuel injector. 8 Identify the highest voltage reading recorded from the six fuel injectors tested that is 9.5 V or less. **NOTE** Disregard those voltage readings that are greater than 9.5 V. Voltage readings greater than 9.5 V indicate a faulty fuel injector. 9 Subtract the remaining voltage readings recorded in Step 8, from the highest voltage reading. Are any of the values recorded in Step 9 greater than the specified value?	0.6 V	Go to Step 2	System OK
2	1 Replace any fuel injector that has any of the following: – a subtracted value exceeding 0.6 V, – an initial reading greater than 9.5 V, and – an erratic reading. **NOTE** The table in Figure 6C1-2 – 13 shows an example of the results from a fuel injector coil test. Has the repair been completed?	–	System OK.	–
When all repairs are completed, check the system for fuel leaks and correct operation.				

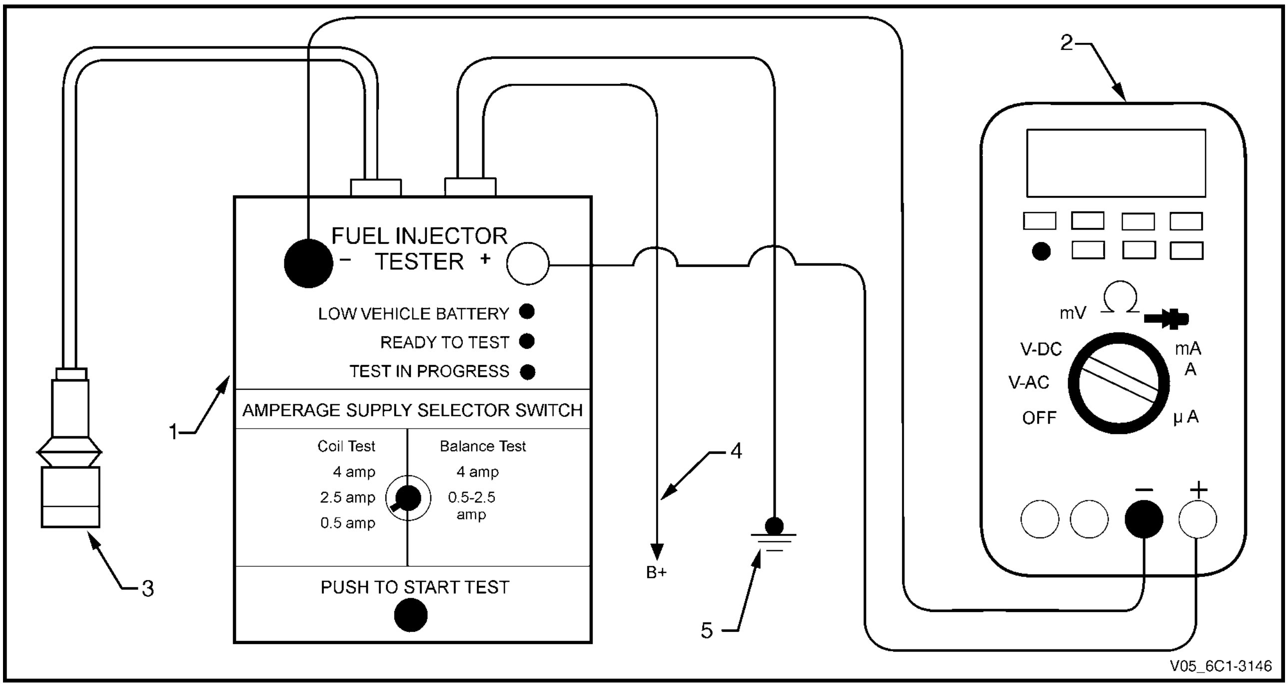


Figure 6C1-2 – 11

Legend

1 Fuel Injector Tester – Special Tool J39021
2 Digital Multimeter
3 Fuel Injector Harness Adapter – Special Tool J44602
4 To Battery Positive Terminal
5 Battery Earth

Fuel Injector Coil Test Example – Engine Coolant Temperature 10 – 32°C (Typical Values Shown)		
Fuel Injector No.	Voltage Reading	Pass / Fail (acceptable range 5.5 - 6.6 V)
1	6.6	Pass
2	5.4	Fail
3	6.2	Pass
4	6.1	Pass
5	6.7	Fail
6	6.0	Pass

Figure 6C1-2 – 12

Fuel Injector Coil Test Example – Engine Coolant Temperature Greater / Less Than 10 – 32°C (Typical Values Shown)				
Fuel Injector No.	Voltage Reading	Highest Voltage Reading (9.5 V or less)	Subtracted Value (acceptable voltage 0.6 V)	Pass / Fail
1	9.8	–	–	Fail
2	6.4	7.0	0.6	Pass
3	6.9	7.0	0.1	Pass
4	5.8	7.0	1.2	Fail
5	7.0	7.0	0.0	Pass
6	6.3	7.0	0.7	Fail

Figure 6C1-2 – 13

4. Install link nut, then tighten it to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

5. Tighten the cam bolt and lower control arm nut, setting it to the interim torque, then turn the cam bolt to the setting mark applied during disassembly.
6. Install ball joint nut, then tighten it to the specified torque with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 147 N·m (15.0 kgf·m/108 lb·ft)

NOTE: Check the trim height. Refer to Front Alignment Inspection and Adjustment.

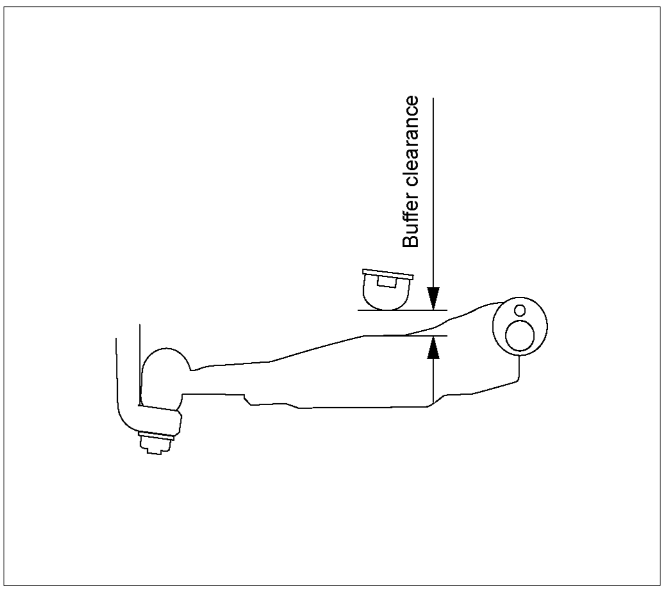
7. Lower control arm nut tightens it to the specified torque.

Buffer clearance: 25.9 mm (1.02 in)

Torque: 186 N·m (19.0 kgf·m/137 lb·ft)

NOTE: Apply oil to the thread.

NOTE: Tighten the bolt and nut with the parts in the position shown in the illustration below.



RTW53ASH000201

8. Install wheel and tire assembly. Refer to wheel in this section.

6.3 Fuel Injector Balance Test

CAUTION

To avoid irregular fuel pressure readings, do not perform this procedure if the engine coolant temperature is greater than 94° C.

Fuel Injector Balance Test – With Tech 2

1 Check the engine coolant temperature is less than 94°C.

2 Perform the fuel injector coil test and replace any fuel injectors that are not functioning correctly before proceeding. Refer to 6.2 Fuel Injector Coil Test.

3 Perform the fuel system pressure check and ensure the fuel system is functioning correctly before proceeding with the fuel injector balance test. Refer to 6C Fuel System – V6.

4 While the fuel pressure gauge is still connected to the fuel pressure test point, pressurise the fuel system. Refer to 6C Fuel System – V6.

5 When the fuel pressure reading stabilises, record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure reading taken in Step 5 is known as the first pressure reading.

6 Connect Tech 2 to the data link connector (DLC) and turn the ignition on.

7 On Tech 2 select **Engine** / **V6 Engine** / **Actuator Test** / **Fuel Injector Balance**.

8 Follow the Tech 2 prompts, recording the fuel pressure gauge reading for each injector.

NOTE

The fuel pressure readings taken in Step 8 are known as the second pressure reading

9 Perform the Fuel Injector Pressure Drop Calculation in this Section.

Fuel Injector Balance Test – Without Tech 2

1 Check the engine coolant temperature is less than 94°C.

2 Perform the fuel injector coil test and replace any fuel injectors that are not functioning correctly before proceeding. Refer to 6.2 Fuel Injector Coil Test.

3 Perform the fuel system pressure check and ensure the fuel system is functioning correctly before proceeding with the fuel injector balance test. Refer to 6C Fuel System – V6.

4 While the fuel pressure gauge is still connected to the fuel pressure test point, pressurise the fuel system. Refer to 6C Fuel System – V6.

5 When the fuel pressure reading stabilises, record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure reading taken in Step 5 is known as the first pressure reading.

6 Remove the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

7 Connect Tool No. J 39021 Fuel Injector Tester (1), and Tool No. J 44602 (3) to the fuel injector connector. Refer to Figure 6C1-2 – 14.

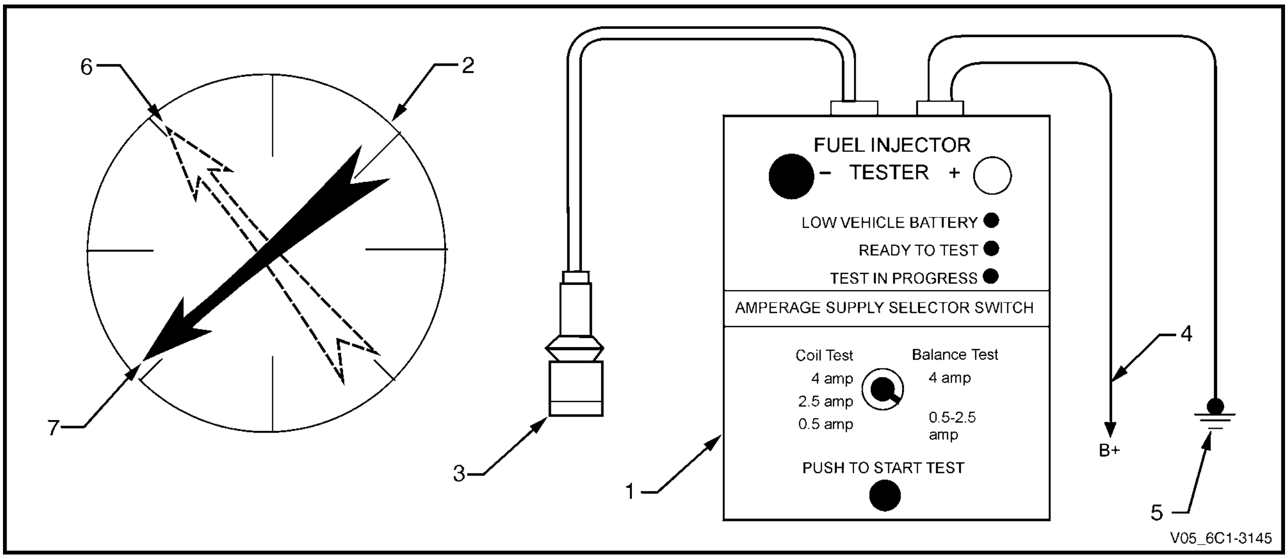


Figure 6C1-2 – 14

Legend

1 Fuel Injector Tester – Special Tool J39021
2 Fuel Pressure Gauge – Special Tool SD28018
3 Fuel Injector Harness Adapter – Special Tool J44602
4 To Battery Positive Terminal
5 Battery Earth
6 First Pressure Reading
7 Second Pressure Reading

8 Connect the fuel injector tester battery positive lead (4) and battery negative lead (5) to the battery, refer to Figure 6C1-2 – 14.

9 Set the amperage supply selector of the fuel injector tester to the Balance Test 0.5 – 2.5 A position.

CAUTION

As the fuel pressure tends to increase after the fuel injector stops fuel delivery, record the fuel pressure value immediately after the fuel injector stops fuel delivery. Do not record the higher fuel pressure value.

10 Press the Push to Start Test Button on the fuel injector tester to activate the fuel injector.

11 Record the fuel pressure reading indicated by the fuel pressure gauge.

NOTE

The fuel pressure readings taken in Step 10 is known as the second pressure reading

12 Repeat the balance test pressure reading for each fuel injector.

13 Perform the Fuel Injector Pressure Drop Calculation in this Section.

Fuel Injector Pressure Drop Calculation

Fuel Injector Balance Test Example – Typical Values Shown						
Cylinder	1	2	3	4	5	6
1st Pressure Reading	360 kPa	360 kPa	360 kPa	360 kPa	360 kPa	360 kPa
2nd Pressure Reading	155 kPa	131 kPa	155 kPa	200 kPa	146 kPa	150 kPa
Amount of Pressure Drop	205 kPa	229 kPa	205 kPa	160 kPa	214 kPa	210 kPa
Average Range 194 - 214 kPa	Injector OK	Replace fuel injector – too much pressure drop	Injector OK	Replace fuel injector – too little pressure drop	Injector OK	Injector OK

Figure 6C1-2 – 15

1 Subtract the second pressure reading from the first pressure reading to calculate the pressure drop value. Refer to the table in Figure 6C1-2 – 15, typical results.

2 Calculate the pressure drop value for each fuel injector.

3 Add all the individual pressure drop values of each fuel injector to calculate the total pressure drop.

4 Divide the total pressure drop by the number of fuel injectors to calculate the average pressure drop.

Fuel Injector Pressure Drop Analysis

1 A fuel injector is faulty if its pressure drop value deviates from the average pressure drop by more than 10 kPa.

CAUTION

Do not repeat any portion of the test before running the engine to prevent the engine from flooding.

2 Re-test any fuel injector that does not meet the specification.

3 Replace all faulty fuel injectors, refer to 2.13 Fuel Rail Assembly, in 6C1-3 Engine Management – V6 – Service Operations.

6.4 Fuel Injector Leak Down Test

1 Turn the ignition switch OFF.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

2 Remove the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

CAUTION

Clean around the area where the fuel injectors enter the lower intake manifold.

3 Remove the bolt (1), three places, attaching the fuel rail to the lower intake manifold.

CAUTION

Care must be taken when removing the fuel rail and injector assembly to prevent damage to the injector spray tips and injector harness connector terminals.

Support the fuel rail and injector assembly after removal.

4 Lift up and support the fuel rail and injector assembly.

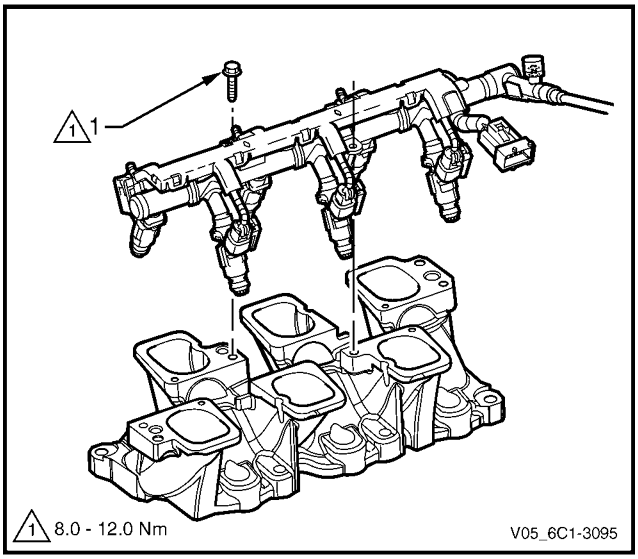


Figure 6C1-2 – 16

NOTE

Do not disconnect the fuel feed hose from the fuel rail.

5 Place a board (1) with a sheet of clean paper (2), preferably white, onto the lower intake manifold.

6 Using Tech 2, enable the fuel pump to pressurise the fuel system.

7 Whilst the fuel system is pressurised, check the following:

- Signs of fuel stains on the paper (3).
- Signs of weeping at the fuel injector spray tips (4).

8 If any of the above conditions are present, replace the leaking fuel injector/s, refer to 2.13 Fuel Rail Assembly, in 6C1-3 Engine Management – V6 – Service Operations.

9 Carefully reinstall the fuel rail and injector assembly.

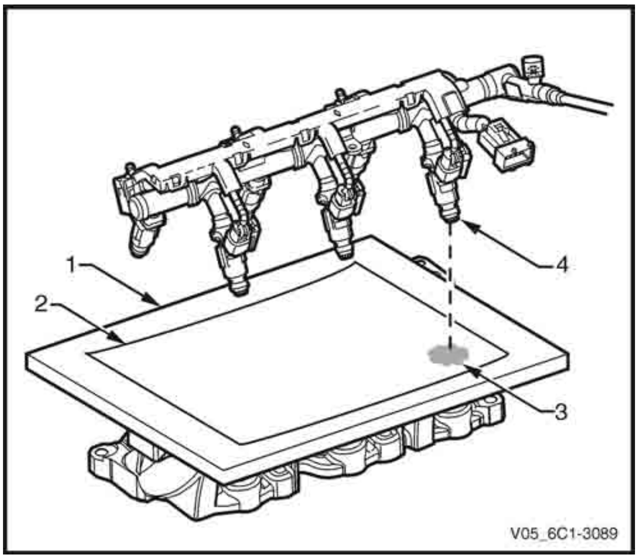


Figure 6C1-2 – 17

CAUTION

Ensure the fuel injectors are correctly seated in the lower intake manifold, and the fuel rail attaching brackets are correctly located prior to tightening the attaching bolts.

10 Tighten the fuel rail bolts to the correct torque specification.

Fuel rail attaching bolt torque specification ....8.0 – 12.0 Nm

11 Reinstall the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

12 Inspect the fuel rail and quick connect fitting for leaks, refer to 6C Fuel System – V6.

13 Road test the vehicle and check for correct operation.

6.5 Alcohol / Contaminants in Fuel Diagnosis

Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel rail, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust, or deterioration.

Alcohol (e.g. Ethanol) concentrations more than 10% in the fuel can be detrimental to fuel system components. Alcohol contamination may cause fuel system corrosion, deterioration of rubber components, and subsequent fuel filter restriction. Fuel contaminated with alcohol may cause driveability conditions such as hesitation, lack of power, stalling, or no start. Some types of alcohol are more detrimental to fuel system components than others.

Alcohol in Fuel Testing Procedure

NOTE

The procedures detailed are not intended to be accurate but rather, indicative of a contamination situation.

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If alcohol contamination is suspected, then use the following procedure to test the fuel quality.

- Using a 100 ml graduated cylinder with 1 ml marks, fill the cylinder with fuel to the 90 ml mark.
- Add 10 ml of water to bring the total fluid volume to 100 ml and install a stopper.
- Shake the cylinder vigorously for 10 – 15 seconds.
- Carefully loosen the stopper to release the pressure.
- Re-install the stopper and shake the cylinder vigorously again for 10 – 15 seconds.
- Put the cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, that now contains both alcohol and water, will be more than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel. To obtain an accurate determination of the amount of alcohol contamination in a given fuel sample, then professional analysis should be sought.

Particulate Contaminants in Fuel Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any contaminants present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy or contaminated with water as indicated by a water layer at the bottom of the sample, use the following procedure to diagnose the fuel.

- Using an approved fuel container, draw approximately 0.5 litre of fuel.
- Place the cylinder on a level surface for approximately 5 minutes to allow settling of the particulate contamination.

Particulate contamination will show up in various shapes and colours. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles. If particles are found, clean the entire fuel system thoroughly. Refer to 6C Fuel System – V6.

6.6 Crankshaft Position (CKP) System Variation Learn Procedure

Description

The crankshaft position system variation learn feature is carried out automatically on the HFV6 engine under decel with fuel cut. The road speed and duration of the self-learn process varies with different vehicle equipment levels such as transmission, final drive ratio etc.

The variation learn procedure cannot be over-written, nor can it be accessed with Tech 2.

6.7 Throttle Body Relearn

A throttle body relearn procedure is performed in one of two ways:

- Engine Control Module initiated throttle body relearn, or
- Tech 2 initiated throttle body relearn.

Engine Control Module Throttle Body Relearn

The engine control module (ECM) will automatically perform a throttle body relearn procedure if either of the following conditions exist:

- The battery has been disconnected, or
- The ignition switch is in the ON position for greater than 29 seconds, and the following conditions are met:
  - Engine speed is less than 40 rpm,
  - Vehicle speed is 0 km/h,
  - Engine coolant temperature is 5 – 60°C,
  - Intake air temperature is 5 – 60°C,
  - Accelerator pedal position sensor angle is less than 14.9%, and
  - Ignition voltage is greater than 10 V.

Tech 2 Throttle Body Relearn

To perform a throttle body relearn using Tech 2, complete the following procedure:

NOTE

Tech 2 will not initiate a throttle body relearn if the engine is running.

1. Connect Tech 2 to the data link connector (DLC) and turn the ignition on.
2. On Tech 2 select Engine / Programming / Throttle Body Relearn.
3. When Tech 2 displays ‘Do you really want to Reset?’, press the ‘Yes’ soft key.
4. When Tech 2 displays ‘Programming Completed’, and the electronic throttle control value displayed by Tech 2 is ‘11’, press the ‘Confirm’ soft key to return to the Tech 2 Programming screen.
5. The throttle body relearn is now complete.

6.8 Electronic Ignition (EI) System Diagnosis

Circuit Description

The engine control module (ECM) controls the ignition coils by pulsing the ignition control (IC) circuits, which triggers an ignition coil and fires the spark plug. The ECM controls the sequencing and the timing of each ignition coil. The ignition system consist of the following components:

- The six ignition coils
- The crankshaft position (CKP) sensor
- The four camshaft position (CMP) sensors
- The ECM

The ignition coils use the following circuits:

- An IC circuit
- An ignition 1 voltage circuit
- Two ground circuits

Additional Information

- Use the J 35616-B Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- Inspect the ignition coils for aftermarket devices. An aftermarket device connected to the ignition coil circuits, may cause a condition with the ignition coils.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4 The ignition coils for each bank are fused separately. If a fuse opens or the ignition 1 voltage circuit opens between the fuse and the splice, all the ignition coils for one bank of the engine would be inoperative. If the ground circuit opens at the engine block, the ignition coils would be inoperative for one bank of the engine.

5 This step tests for an open or a high resistance in the ignition 1 voltage circuit of the ignition coil. If the DMM does not display near battery voltage there is an open or a high resistance in the circuit.

6 This step determines if the ground circuit is open. If the circuit is open, the ignition coils would be inoperative for one bank of the engine.

7 This step determines if the ignition 1 voltage circuit is shorted to ground. If the fuse is open, the ignition coils would be inoperative for one bank of the engine.

Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been performed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check
2	Were you sent here from DTC P0300 or P0301-P0306?	—	Go to Step 3	Go to DTC P0300 or DTC P0301 – P0306
3	1 Start the engine. 2 Allow the engine to reach operating temperature. 3 Operate the engine at 2,000 rpm. 4 Monitor all of the Misfire Current Counters with a scan tool. There are a total of 6 counters, 1 counter per cylinder. Are any of the Misfire Current Counters incrementing?	—	Go to Step 4	Go to 5.2 Intermittent Fault Conditions
4	Are all the misfire counters incrementing for one bank of the engine?	—	Go to Step 7	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate ignition coil. 3 Ignition ON, engine OFF. 4 Connect a test lamp between the battery voltage circuit of the ignition coil and a good ground. 5 Measure the voltage between the probe of the test lamp and a good ground with a DMM. Refer to 8A Electrical - Body and Chassis for the procedure to measure voltage drop. Is the voltage at the specified value?	B+	Go to Step 6	Go to Step 9

6	1 Connect the test lamp between the battery voltage circuit of the ignition coil and to each ground circuit of the ignition coil. Does the test lamp illuminate at each ground circuit?	—	Go to Step 8	Go to Step 10
7	1 Test the battery voltage circuit for an open or high resistance at the splice of the affected bank of ignition coils. Refer to 8A Electrical - Body and Chassis for circuit testing procedures. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
8	1 Test for an intermittent and for a poor connection at the ignition coil. Refer to 8A Electrical - Body and Chassis for circuit testing procedures. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
9	**NOTE** The battery voltage circuit is shared with other components. Disconnecting a component on the shared battery voltage circuit may isolate a shorted component. Review the electrical schematic and diagnose the shared circuits and components. 1 Repair a short to ground, an open or high resistance in the ignition 1 voltage circuit. Refer to Refer to 8A Electrical - Body and Chassis for wiring repair procedures. 2 Replace the fuse as necessary. Did you complete the repair?	—	Go to Step 12	—
10	1 Repair the open or high resistance in the ground circuit. Refer to 8A Electrical - Body and Chassis for wiring repair procedures. Did you complete the repair?	—	Go to Step 12	—
11	1 Replace the ignition coil. Refer to 2.15 Ignition Coils, in 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 12	—
12	1 Connect all disconnected components. 2 Use Tech 2 to clear the DTC/s. 3 Start the engine. 4 Observe the Capture Info with Tech 2. Do any of the misfire counters increment?	—	Go to Step 2	Go to Step 13
13	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7 Diagnostic Trouble Code Tables

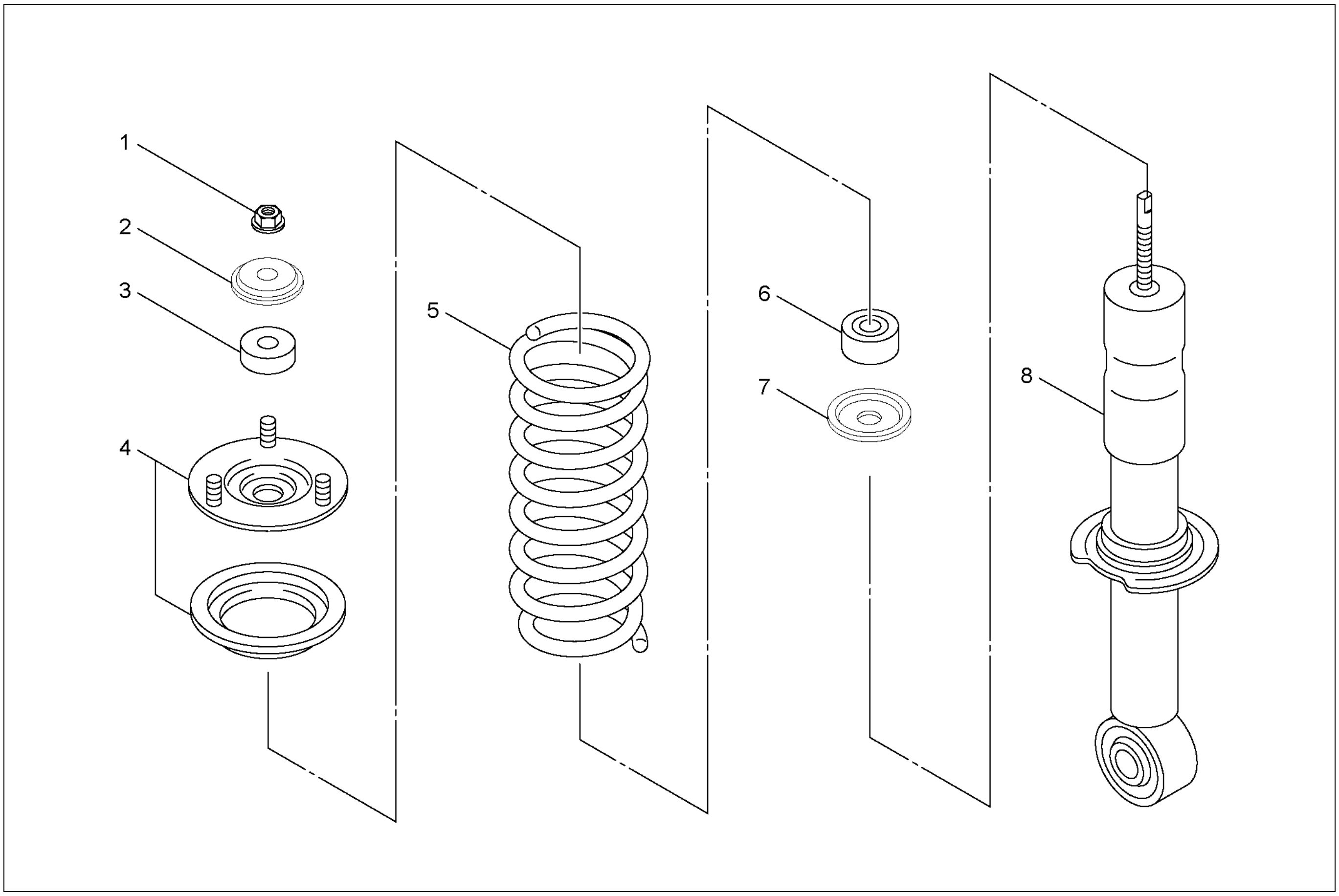
7.1 DTC List

As a number of diagnostic tables cater for multiple DTC numbers, a specific DTC table may be difficult to locate. To make a specific DTC diagnostic table easier to find, the next list is arranged in numerical ascending order. The actual diagnostic table can be located by selecting the link provided.

DTC	Description	Diagnostic Table
P0008	Engine Position System Performance (Bank 1)	7.2 DTC P0008, P0009 or P0016
P0009	Engine Position System Performance (Bank 2)	7.2 DTC P0008, P0009 or P0016
P0016	Crankshaft / Intake Camshaft Position not Plausible (Bank 1)	7.2 DTC P0008, P0009 or P0016
P0030	O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0031	O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0032	O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0036	O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0037	O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0038	O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0040	O2 Sensor Signals Not Plausible (Bank 1, Sensor 1 & Bank 2, Sensor 1)	7.4 DTC P0040 or P0041
P0041	O2 Sensor Signals Not Plausible (Bank 1, Sensor 2 & Bank 2, Sensor 2)	7.4 DTC P0040 or P0041
P0050	O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0051	O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0052	O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 1)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0053	O2 Sensor Heater Resistance Range / Performance (Bank 1, Sensor 1)	7.5 DTC P0053 or P0059
P0056	O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0057	O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058

DTC	Description	Diagnostic Table
P0058	O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 2)	7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058
P0059	O2 Sensor Heater Resistance Range / Performance (Bank 2, Sensor 1)	7.5 DTC P0053 or P0059
P0101	Mass Air Flow Sensor Circuit Range / Performance	7.6 DTC P0101, P0102 or P0103
P0102	Mass Air Flow Sensor Voltage Low	7.6 DTC P0101, P0102 or P0103
P0103	Mass Air Flow Sensor Voltage High	7.6 DTC P0101, P0102 or P0103
P0112	Intake Air Temperature Sensor Circuit Low Voltage	7.7 DTC P0112 or P0113
P0113	Intake Air Temperature Sensor Circuit High Voltage	7.7 DTC P0112 or P0113
P0116	Engine Coolant Temperature Sensor Circuit Range / Performance	7.8 DTC P0116, P0117, P0118, P0125 or P1258
P0117	Engine Coolant Temperature Sensor Circuit Low Voltage	7.8 DTC P0116, P0117, P0118, P0125 or P1258
P0118	Engine Coolant Temperature Sensor Circuit High Voltage	7.8 DTC P0116, P0117, P0118, P0125 or P1258
P0121	Throttle Position Sensor 1 Circuit Range / Performance	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0122	Throttle Position Sensor 1 Circuit Low Voltage	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0123	Throttle Position Sensor 1 Circuit High Voltage	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0125	Insufficient Engine Coolant Temperature For Closed Loop Fuel Control	7.8 DTC P0116, P0117, P0118, P0125 or P1258
P0130	O2 Sensor Circuit Malfunction (Bank 1, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0131	O2 Sensor Circuit Low Voltage (Bank 1, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0132	O2 Sensor Circuit High Voltage (Bank 1 Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0133	O2 Sensor Circuit Slow Response (Bank 1 Sensor 1)	7.11 DTC P0133 or P0153
P0135	O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0137	O2 Sensor Circuit Low Voltage (Bank 1, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

Shock Absorber with Coil Spring



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Legend

1. Nut
2. Washer
3. Bushing; Rubber
4. Mounting Bracket
5. Coil Spring
6. Bushing; Rubber
7. Washer
8. Shock Absorber ASM

DTC	Description	Diagnostic Table
P0138	O2 Sensor Circuit High Voltage (Bank 1, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0139	O2 Sensor Slow Response (Bank1 Sensor 2)	7.12 DTC P0139 or P0159
P0140	O2 Sensor Circuit No Activity Detected (Bank 1 Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0141	O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0150	O2 Sensor Circuit Malfunction (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0151	O2 Sensor Circuit Low Voltage (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0152	O2 Sensor Circuit High Voltage (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0153	O2 Sensor Circuit Slow Response (Bank 2 Sensor 1)	7.11 DTC P0133 or P0153
P0155	O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0157	O2 Sensor Circuit Low Voltage (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0158	O2 Sensor Circuit High Voltage (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0159	O2 Sensor Slow Response (Bank1 Sensor 2)	7.12 DTC P0139 or P0159
P0160	O2 Sensor Circuit No Activity Detected (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P0161	O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

DTC	Description	Diagnostic Table
P0196	Engine Oil Temperature Sensor Range / Performance	7.13 DTC P0196, P0197 or P0198
P0197	Engine Oil Temperature Voltage Low	7.13 DTC P0196, P0197 or P0198
P0198	Engine Oil Temperature Voltage High	7.13 DTC P0196, P0197 or P0198
P0201	Injector 1 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0202	Injector 2 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0203	Injector 3 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0204	Injector 4 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0205	Injector 5 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0206	Injector 6 Control Circuit Malfunction	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0219	Engine Overspeed Condition	7.15 DTC P0219
P0221	Throttle Position Sensor 2 Circuit Range / Performance	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0222	Throttle Position Sensor 2 Circuit Low Voltage	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0223	Throttle Position Sensor 2 Circuit High Voltage	7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223
P0261	Injector 1 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0262	Injector 1 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0264	Injector 2 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0265	Injector 2 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0267	Injector 3 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277

DTC	Description	Diagnostic Table
P0268	Injector 3 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0270	Injector 4 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0271	Injector 4 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0273	Injector 5 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0274	Injector 5 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0276	Injector 6 Control Circuit Low Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0277	Injector 6 Control Circuit High Voltage	7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277
P0300	Engine Misfire Detected	7.16 DTC P0300
P0301	Cylinder 1 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0302	Cylinder 2 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0303	Cylinder 3 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0304	Cylinder 4 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0305	Cylinder 5 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0306	Cylinder 6 Misfire Detected	7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306
P0324	Knock Sensor Module Performance	7.18 DTC P0324
P0327	Knock Sensor Circuit Low Frequency (Bank 1)	7.19 DTC P0327, P0328, P0332 or P0333
P0328	Knock Sensor Circuit High Frequency (Bank 1)	7.19 DTC P0327, P0328, P0332 or P0333
P0332	Knock Sensor Circuit Low Frequency (Bank 2)	7.19 DTC P0327, P0328, P0332 or P0333
P0333	Knock Sensor Circuit High Frequency (Bank 2)	7.19 DTC P0327, P0328, P0332 or P0333
P0335	Crankshaft Position Sensor Circuit Malfunction	7.20 DTC P0335, P0336, P0337 or P0338
P0336	Crankshaft Position Sensor Signal Range / Performance	7.20 DTC P0335, P0336, P0337 or P0338
P0337	Crankshaft Position Sensor Circuit Low Duty Cycle	7.20 DTC P0335, P0336, P0337 or P0338
P0338	Crankshaft Position Sensor Circuit High Duty Cycle	7.20 DTC P0335, P0336, P0337 or P0338

DTC	Description	Diagnostic Table
P0341	Intake Camshaft Position Sensor Range / Performance (Bank 1)	7.21 DTC P0341, P0342 or P0343
P0342	Intake Camshaft Position Sensor Low Voltage (Bank 1)	7.21 DTC P0341, P0342 or P0343
P0343	Intake Camshaft Position Sensor High Voltage (Bank 1)	7.21 DTC P0341, P0342 or P0343
P0351	Ignition Coil Cylinder 1 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0352	Ignition Coil Cylinder 2 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0353	Ignition Coil Cylinder 3 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0354	Ignition Coil Cylinder 4 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0355	Ignition Coil Cylinder 5 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0356	Ignition Coil Cylinder 6 Circuit Malfunction	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P0420	Catalytic System – Low Efficiency (Bank 1)	7.23 DTC P0420 or P0430
P0430	Catalytic System – Low Efficiency (Bank 2)	7.23 DTC P0420 or P0430
P0443	Evaporative Emission Control System Purge Solenoid Circuit Malfunction	7.24 DTC P0443, P0458 or P0459
P0458	Evaporative Emission Control System Purge Solenoid Circuit Low Voltage	7.24 DTC P0443, P0458 or P0459
P0459	Evaporative Emission Control System Purge Solenoid Circuit High Voltage	7.24 DTC P0443, P0458 or P0459
P0460	Fuel Level Sensor Range / Performance	7.25 DTC P0460, P0461, P0462 or P0463
P0461	Fuel Level Sensor Range / Performance	7.25 DTC P0460, P0461, P0462 or P0463
P0462	Fuel Level Sensor Low Voltage	7.25 DTC P0460, P0461, P0462 or P0463
P0463	Fuel Level Sensor High Voltage	7.25 DTC P0460, P0461, P0462 or P0463
P0480	Cooling Fan Relay 1 Circuit Malfunction	7.26 DTC P0480, P0691 or P0692
P0500	Vehicle Speed Sensor Circuit Malfunction	7.27 DTC P0500
P0504	Brake Switch Circuit Malfunction	7.28 DTC P0504 or P0571
P0506	Idle Speed Control rpm Too Low	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0507	Idle Speed Control rpm Too High	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0513	Wrong Transponder Key	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P0521	Oil Pressure Sensor Range / Performance	7.31 DTC P0521, P0522 or P0523

DTC	Description	Diagnostic Table
P0522	Oil Pressure Sensor Voltage Low	7.31 DTC P0521, P0522 or P0523
P0523	Oil Pressure Sensor Voltage High	7.31 DTC P0521, P0522 or P0523
P0532	A/C Pressure Sensor Voltage Low	7.32 DTC P0532 or P0533
P0533	A/C Pressure Sensor Voltage High	7.32 DTC P0532 or P0533
P0560	System Voltage Malfunction	7.33 DTC P0560, P0562 or P0563
P0562	System Voltage Low Voltage	7.33 DTC P0560, P0562 or P0563
P0563	System Voltage High Voltage	7.33 DTC P0560, P0562 or P0563
P0571	Cruise Control Brake Switch Circuit	7.28 DTC P0504 or P0571
P0601	Replace Electronic Control Unit (ECU)	7.34 DTC P0601, P0602, P0604 or P0606
P0602	Program Electronic Control Unit (ECU)	7.34 DTC P0601, P0602, P0604 or P0606
P0604	Replace Electronic Control Unit (ECU)	7.34 DTC P0601, P0602, P0604 or P0606
P0606	Replace Electronic Control Unit (ECU)	7.34 DTC P0601, P0602, P0604 or P0606
P0615	Starter Relay Circuit Malfunction	7.35 DTC P0615, P0616 or P0617
P0616	Starter Relay Circuit Low Voltage	7.35 DTC P0615, P0616 or P0617
P0617	Starter Relay Circuit High Voltage	7.35 DTC P0615, P0616 or P0617
P0625	Alternator F Terminal Low Voltage	7.36 DTC P0625 or P0626
P0626	Alternator F Terminal High Voltage	7.36 DTC P0625 or P0626
P0627	Fuel Pump Relay Circuit Malfunction	7.37 DTC P0627, P0628 or P0629
P0628	Fuel Pump Relay Voltage Low	7.37 DTC P0627, P0628 or P0629
P0629	Fuel Pump Relay Voltage High	7.37 DTC P0627, P0628 or P0629
P0633	Immobiliser Function Not Programmed	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P0638	Commanded Versus Actual Throttle Position Correlation	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P0645	A/C Relay Circuit Malfunction	7.38 DTC P0645, P0646 or P0647
P0646	A/C Relay Voltage Low	7.38 DTC P0645, P0646 or P0647
P0647	A/C Relay Voltage High	7.38 DTC P0645, P0646 or P0647
P0685	Engine Control Ignition Relay Circuit Malfunction	7.39 DTC P0685, P0686 or P0687
P0686	Engine Control Ignition Relay Circuit Low Voltage	7.39 DTC P0685, P0686 or P0687
P0687	Engine Control Ignition Relay Circuit High Voltage	7.39 DTC P0685, P0686 or P0687
P0691	Cooling Fan Relay 1 Circuit Low Voltage	7.26 DTC P0480, P0691 or P0692
P0692	Cooling Fan Relay 1 Circuit High Voltage	7.26 DTC P0480, P0691 or P0692
P0700	Malfunction Indicator (MI) Request from Transmission Control Module (TCM)	7.40 DTC P0700
P0704	Clutch Switch Input Circuit Malfunction	7.41 DTC P0704
P0850	Park / Neutral Signal Circuit Incorrect Signal	7.42 DTC P0850
P1258	Engine Coolant Over Temperature – Protection Mode Active	7.8 DTC P0116, P0117, P0118, P0125 or P1258
P1551	Throttle Control Lower Position Not Reached during Learning Mode	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176

DTC	Description	Diagnostic Table
P1629	Immobiliser Fuel Enable Signal Not Received	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1632	Immobiliser Fuel Disable Signal Received	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1648	Wrong Security Code Entered	7.43 DTC P1648
P1668	Alternator L Terminal Circuit Malfunction	7.44 DTC P1668, P2500 or P2501
P1677	Immobiliser Function not Enabled	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1678	Engine Control Module Identification Failed	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1679	Immobiliser Environment Identification Failed	7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679
P1845	Engine Torque Reduction Malfunction	7.45 DTC P1845
P2096	Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 1)	7.46 DTC P2096 or P2098
P2097	Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 1)	7.47 DTC P2097 or P2099
P2098	Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 2)	7.46 DTC P2096 or P2098
P2099	Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 2)	7.47 DTC P2097 or P2099
P2100	Throttle Control Motor Malfunction	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2101	Throttle Control Position Range / Performance	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2105	Throttle Control Forced Engine Shutdown	7.48 DTC P2105
P2107	Throttle Control Malfunction	7.49 DTC P2107
P2119	Closed Throttle Position Range / Performance	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2122	Accelerator Pedal Position Sensor 1 Voltage Low	7.50 DTC P2122, P2123, P2127, P2128 or P2138
P2123	Accelerator Pedal Position Sensor 1 Voltage High	7.50 DTC P2122, P2123, P2127, P2128 or P2138
P2127	Accelerator Pedal Position Sensor 2 Voltage Low	7.50 DTC P2122, P2123, P2127, P2128 or P2138
P2128	Accelerator Pedal Position Sensor 2 Voltage High	7.50 DTC P2122, P2123, P2127, P2128 or P2138
P2138	Accelerator Pedal Position Sensor 1-2 Correlation	7.50 DTC P2122, P2123, P2127, P2128 or P2138
P2176	Throttle Control Lower Position not Learned	7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176
P2177	Fuel Trim Lean during Cruising/Acceleration (Bank 1)	7.51 DTC P2177 or P2179
P2178	Fuel Trim Rich during Cruising/Acceleration (Bank 1)	7.52 DTC P2178 or P2180
P2179	Fuel Trim Lean during Cruising/Acceleration (Bank 2)	7.51 DTC P2177 or P2179
P2180	Fuel Trim Rich during Cruising/Acceleration (Bank 2	7.52 DTC P2178 or P2180
P2187	Fuel Trim Lean during Idling/Deceleration (Bank 1)	7.53 DTC P2187 or P2189
P2188	Fuel Trim Rich during Idling/Deceleration (Bank 1)	7.54 DTC P2188 or P2190

DTC	Description	Diagnostic Table
P2189	Fuel Trim Lean during Idling/Deceleration (Bank 2)	7.53 DTC P2187 or P2189
P2190	Fuel Trim Rich during Idling/Deceleration (Bank 2)	7.54 DTC P2188 or P2190
P2195	B1S1 O2 Sensor – System Too Lean (Bank 1 Sensor 1)	7.55 DTC P2195 or P2197
P2196	B1S1 O2 Sensor – System Too Rich (Bank 1 Sensor 1)	7.56 P2196 or P2198
P2197	B2S1 O2 Sensor – System Too Lean (Bank 2 Sensor 1)	7.55 DTC P2195 or P2197
P2198	B2S1 O2 Sensor – System Too Rich (Bank 2 Sensor 1)	7.56 P2196 or P2198
P2227	Barometric Pressure Sensor Range / Performance	7.57 DTC P2227, P2228 or P2229
P2228	Barometric Pressure Sensor Voltage Low	7.57 DTC P2227, P2228 or P2229
P2229	Barometric Pressure Sensor Voltage High	7.57 DTC P2227, P2228 or P2229
P2231	O2 Sensor Signal Interference by Heater Circuit (Bank 1, Sensor 1)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2232	O2 Sensor Signal Short to Heater Circuit (Bank 1 Sensor 2)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2234	O2 Sensor Signal Interference by Heater Circuit (Bank 2, Sensor 1)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2235	O2 Sensor Signal Short to Heater Circuit (Bank 2 Sensor 2)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2237	O2 Sensor Pump Current Circuit Malfunction (Bank 1, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2238	O2 Sensor Pump Current Circuit Low Voltage (Bank 1, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2239	O2 Sensor Pump Current Circuit High Voltage (Bank 1, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2240	O2 Sensor Pump Current Circuit Malfunction (Bank 2, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2241	O2 Sensor Pump Current Circuit Low Voltage (Bank 2, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2242	O2 Sensor Pump Current Circuit High Voltage (Bank 2, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2243	O2 Sensor Voltage Signal Circuit Malfunction (Bank 1, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2247	O2 Sensor Voltage Signal Circuit Malfunction (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2251	O2 Sensor Ground Circuit Malfunction (Bank 1, Sensor 1)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2254	O2 Sensor Ground Circuit Malfunction (Bank 2, Sensor 1)	7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254
P2270	O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 1, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

DTC	Description	Diagnostic Table
P2271	O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 1, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2272	O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2273	O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 2, Sensor 2)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2297	O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 1, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2298	O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 2, Sensor 1)	7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298
P2300	Ignition Coil Cylinder 1 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2301	Ignition Coil Cylinder 1 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2303	Ignition Coil Cylinder 2 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2304	Ignition Coil Cylinder 2 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2306	Ignition Coil Cylinder 3 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2307	Ignition Coil Cylinder 3 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2309	Ignition Coil Cylinder 4 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2310	Ignition Coil Cylinder 4 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316

DTC	Description	Diagnostic Table
P2312	Ignition Coil Cylinder 5 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2313	Ignition Coil Cylinder 5 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2315	Ignition Coil Cylinder 6 Circuit Low Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2316	Ignition Coil Cylinder 6 Circuit High Voltage	7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316
P2500	Alternator L Terminal Low Voltage	7.44 DTC P1668, P2500 or P2501
P2501	Alternator L Terminal High Voltage	7.44 DTC P1668, P2500 or P2501
P2626	O2 Sensor Pump Current Trim Circuit Malfunction (Bank 1, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
P2629	O2 Sensor Pump Current Trim Circuit Malfunction (Bank 2, Sensor 1)	7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242
U0001	No Communication with CAN-Bus (High Speed)	7.61 DTC U0001
U0101	CAN-Bus No Communication With TCM (Transmission Control Module)	7.62 DTC U0101
U0155	CAN-Bus No Communication With Gateway	7.63 DTC U0155 or U0423
U0423	CAN-Bus Invalid Data From Gateway	7.63 DTC U0155 or U0423

7.2 DTC P0008, P0009 or P0016

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0008 – Engine Position System Performance (Bank 1)
- DTC P0009 – Engine Position System Performance (Bank 2)
- DTC P0016 – Crankshaft / Intake Camshaft Position Not Plausible (Bank 1)

Circuit Description

The engine control relay applies ignition positive battery voltage to the camshaft position (CMP) actuator solenoids through the ignition voltage circuit.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the individual CMP solenoid control circuit. This controls the oil pressure that advances or retards each camshaft position.

The ECM compares the camshaft position to the crankshaft position to detect CMP system malfunction. A CKP / CMP sensor correlation DTC sets if the ECM detects a deviation between the target position of the camshaft and the crankshaft position.

Conditions for Running the DTC

DTC P0008 or P0009

Run continuously once the following conditions are met.

- DTCs P0341, P0342, P0343, ran and passed:
- The engine is running.
- The ECM has learned the camshafts position.

DTC P0016

Run continuously once the following conditions are met.

- DTCs P0335, P0336, P0338, P0341, P0342 and P0343 ran and passed:
- The calculated engine oil temperature is less than 95°C.
- The engine coolant temperature is 20 – 90°C.
- The engine is running for greater than 5 seconds.

Conditions for Setting the DTC

DTC P0008

The ECM detects that both camshafts on bank 1 of the engine are misaligned with the crankshaft.

DTC P0009

The ECM detects that both camshafts on bank 2 of the engine are misaligned with the crankshaft.

DTC P0016

The ECM detects the following deviation in the correlation between the camshaft position and the crankshaft position for greater than 10 minutes:

- a camshaft position is too advanced in relationship to the crankshaft, or
- a camshaft position is too retarded in relationship to the crankshaft.

Conditions for Clearing DTC

The CKP / CMP sensor correlation DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the CMP system operation.
- Inspect the engine for recent engine mechanical repairs. Incorrect camshaft, camshaft actuator or timing chain installation will trigger these DTCs.
- The engine oil condition has a major impact on the operation of the camshaft actuator.
- A low oil level may set these DTCs.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

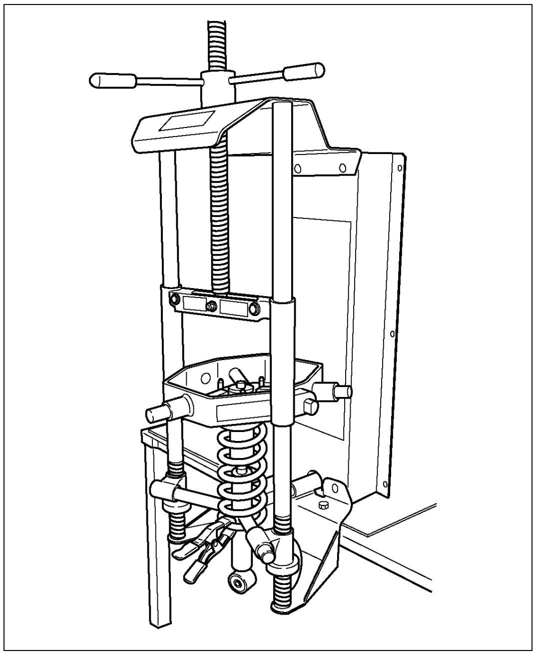
Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 A fault condition in any of the listed sensors will trigger these DTCs.

5 Incorrect camshaft, camshaft actuator or timing chain installation will trigger these DTCs.

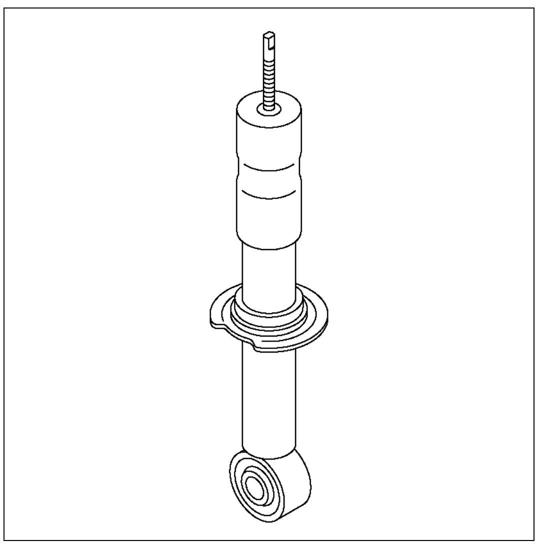
Disassembly



RTW73CMH000101

1. Install the shock absorber assembly on the strut spring compressor (5-8840-2842-0).
   For the details of the actual operation, follow the steps the strut spring compressor manufacturer's instructions.
2. Remove the nut with spring in place.

CAUTION:
Take care not to apply excessive force to the nut during removal.



CAUTION:
The shock absorbers have been charged with gas at the factory. Exposure to high temperatures or an open flame can result in a dangerous explosion.
Keep the shock absorbers away from high temperatures and open flames.

INSPECTION AND REPAIR

Make all necessary adjustments, repairs, and part replacements if wear, damage, or other problems are discovered during inspections.

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

- Shock absorber
- Rubber bushing
- Coil spring

DTC P0008, P0009 or P0016 Diagnostic Table

Step	Action	Yes	No
1	1 Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P0008, P0009 or P0016 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Are DTCs relating to the following DTCs also set: • Camshaft actuator circuit • CMP sensor circuit • CKP sensor circuit	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Inspect the engine for the following fault conditions. Refer to 6A1 Engine Mechanical – V6: • incorrect installation of the CMP sensor, • incorrect installation of the CKP sensor, • timing chain tensioner fault condition, • incorrectly installed timing chain, • excessive play in the timing chain, and • timing chain that jumped teeth. Was any fault found and rectified?	Go to Step 5	Refer to Additional Information in this DTC
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the crankshaft / camshaft position correlation DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.3 DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0030 – O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 1)
- DTC P0031 – O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 1)

- DTC P0032 – O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 1)
- DTC P0036 – O2 Sensor Heater Circuit Malfunction (Bank 1, Sensor 2)
- DTC P0037 – O2 Sensor Heater Circuit Low Voltage (Bank 1, Sensor 2)
- DTC P0038 – O2 Sensor Heater Circuit High Voltage (Bank 1, Sensor 2)
- DTC P0050 – O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 1)
- DTC P0051 – O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P0052 – O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 1)
- DTC P0056 – O2 Sensor Heater Circuit Malfunction (Bank 2, Sensor 2)
- DTC P0057 – O2 Sensor Heater Circuit Low Voltage (Bank 2, Sensor 2)
- DTC P0058 – O2 Sensor Heater Circuit High Voltage (Bank 2, Sensor 2)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The driver has a feedback circuit that is pulled-up when the voltage is approximately 3.3 V. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An HO2S heater control circuit DTC sets if the ECM detects a high resistance, open circuit, short to ground or short to voltage fault condition in the HO2S heater control circuit.

Conditions for Running the DTC

Runs continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- Engine speed is greater than 80 rpm

Conditions for Setting the DTC

DTC P0030, P0036, P0050 or P0056

The ECM detects an open circuit fault condition in the HO2S heater control circuit when the HO2S heater is commanded off.

DTC P0031, P0037, P0051 or P0057

The ECM detects a short to ground fault condition in the HO2S heater control circuit when the HO2S heater is commanded off.

DTC P0032, P0038, P0052 or P0058

The ECM detects a short to voltage fault condition in the HO2S heater control circuit for five seconds when the HO2S heater is commanded on.

Conditions for Clearing the DTC

The HO2S heater control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- A faulty HO2S heater element may cause an open heater circuit condition. This fault may be intermittent or only show up after the sensor has operated for a period.

- Inspect the HO2S wiring harness for contact with the exhaust system.
- The front and the rear HO2Ss have a separate fuse connection. If both front or both the rear DTCs are set, the appropriate HO2S ignition voltage circuit may be open.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 The ECM monitors the driver feedback circuit to determine if the heater control circuit is open, shorted to ground or shorted to a positive voltage. If the voltage is outside the specified range, there is a fault condition with the heater control circuit.

DTC P0030 to P0032, P0036 to P0038, P0050 to P0052 and P0056 to P0058 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to run at idle speed for at least 30 seconds. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the appropriate HO2S wiring connector. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the HO2S heater ignition voltage circuit and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	Using a digital multimeter, measure the voltage between the HO2S heater control circuit and a good ground. Does the multimeter display: • HO2S 1: 4.6 – 5.2 V? • HO2S 2: 2.8 – 4.2 V?	Go to Step 7	Go to Step 6
5	**NOTE** The HO2S ignition voltage circuit is shared with other sensors. Ensure that all circuits and components that share this ignition voltage circuit are tested for a short to ground. Repair the high resistance open circuit or short to ground fault condition in the HO2S heater ignition voltage circuit. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—

Step	Action	Yes	No
6	Test the HO2S heater control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the appropriate HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S heater control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.4 DTC P0040 or P0041

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0040 – O2 Sensor Signals Not Plausible (Bank 1, Sensor 1 & Bank 2, Sensor 1)
- DTC P0041 – O2 Sensor Signals Not Plausible (Bank 1, Sensor 2 & Bank 2, Sensor 2)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S while the sensor temperature is less than the operating range.

Once the HO2S reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

- The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.
- The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

An HO2S signal not plausible or wire connector swapped DTC sets if the ECM detects the HO2S signal voltages are heading in the opposite direction of what was commanded.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.

- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- The engine is running.
- The O2 Sensors are in closed loop.
- The ECM is commanding the HO2Ss fuel trim.

Conditions for Setting the DTC

The ECM detects the HO2S signal voltages are heading in the opposite direction of what was commanded.

Conditions for Clearing the DTC

The HO2S signal not plausible DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

DTC P0040 and P0041 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does P0040 or P0041 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check the HO2S 2 wiring connectors for a swapped connector fault condition. Was any fault found and rectified?	Go to Step 5	Go to Step 4
4	Are DTCs relating to other circuits of the HO2S also set?	Go to the appropriate DTC in this Section	Refer to Additional Information in this DTC
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S signal not plausible or wire connector swapped DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6

Step	Action	Yes	No
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.5 DTC P0053 or P0059

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0053 – O2 Sensor Heater Resistance Range / Performance (Bank 1, Sensor 1)
- DTC P0059 – O2 Sensor Heater Resistance Range / Performance (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S internal heater resistance performance DTC sets if the ECM detects an internal fault condition in the ECM HO2S heater circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0101, P0121, P012, P0123, P0131, P0132, P0133, P0221, P0222, P0223, P0336, P0338, P2237, P2243 and P2626 ran and passed.
- The calculated exhaust temperature is greater than 400ºC.
- The engine does not misfire.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is commanded on.
- The engine is running at speed greater than 25 rpm

Conditions for Setting the DTC

There is an internal fault condition in the ECM HO2S heater circuit.

Conditions for Clearing the DTC

The HO2S internal heater resistance performance DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0053 and P0059 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does P0053 or P0059 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to other circuits of the HO2S also set?	Go to the appropriate DTC Table in this Section	Go to Step 4
4	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 5	—
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S internal heater resistance performance DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.6 DTC P0101, P0102 or P0103

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0101 – Mass Air Flow Sensor Circuit Range / Performance
- DTC P0102 – Mass Air Flow Sensor Voltage Low
- DTC P0103 – Mass Air Flow Sensor Voltage High

Circuit Description

The ignition control relay applies ignition positive voltage to the mass airflow (MAF) sensor. The ECM applies 5 V reference voltage and ground through the low reference circuit.

A heater resistor on the MAF sensor heats a micro-mechanical sensor diaphragm at a constant temperature. Two temperature dependent resistors positioned at each side of the heater resistor measure the intake air temperature:

- The first is located at a position before the intake air passes through the heater resistor. This temperature dependent resistor measures the temperature of the intake air before the air is heated.
- The second is located at a position after the intake air has passed through the heater resistor. This sensor measures the temperature of the intake air after the air is heated.

The evaluation circuit on the MAF sensor converts the difference in the resistance value of these two temperature dependent resistors into an analogue signal voltage. The ECM monitors this signal voltage through the MAF sensor signal to calculate the engine intake air mass.

A MAF sensor circuit DTC sets if the ECM detects the actual MAF sensor signal is not within the predetermined range of the calculated MAF sensor value.

Conditions for Running the DTC

DTC P0101

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running.
- The ignition voltage is 10.0 – 16.0 V.
- The MAF sensor signal is -11.6 to +295 grams per second.
- The ECM detects greater than 150 crankshaft revolutions.

DTC P0102

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running.
- The ignition voltage is 10.0 – 16.0 V.

DTC P0103

Runs continuously once the following conditions are met:

- DTCs P0121, P0122, P0123, P0221, P0222 and P0223 ran and passed.
- The engine is running at speed greater than 320 rpm
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0101

The ECM detects the MAF sensor signal is not within the predetermined range of the calculated MAF value for 2 seconds.

DTC P0102

The ECM detects the MAF sensor signal is less than -11.7 grams per second.

DTC P0103

The ECM detects the MAF sensor signal is greater than 294 grams per second.

Additional Information

- The MAF sensor circuit DTCs is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTC.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the MAF sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Inspect the MAF sensor for an incorrectly routed harness or if the harness is too close to the following:
  – ignition coil,
  – solenoids,
  – relays, and
  – motors.
- A low minimum air rate may cause this DTC to set during deceleration. Inspect for the following conditions:
  – a plugged or a collapsed intake air duct, or a dirty air filter element,
  – objects that block the MAF sensor air inlet screen, and
  – sticking or dirty throttle plate or throttle bore.
- Any un-metered air that enters the engine may cause this DTC to set. Inspect for vacuum leaks in the following:
  – intake manifold,
  – throttle body,
  – barometric pressure (BARO) sensor seal,
  – EVAP canister purge valve seal,
  – brake booster system,
  – air induction system, and
  – crankcase ventilation system.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0101, P0102 or P0103 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0101, P0102 or P0103 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

Step	Action	Yes	No
3	Inspect for the following fault conditions: • engine vacuum leak, • air leak in the intake air duct between the MAF sensor and the throttle body, • plugged or collapsed intake air duct, • objects that block the MAF sensor inlet screen, • restricted air filter element, • restricted throttle plate or carbon build-up around the throttle plate, • unseated engine oil dipstick, • loose or missing engine oil cap, and • over filled crankcase. Was any fault found and rectified?	Go to Step 14	Go to Step 4
4	1 Disconnect the MAF sensor wiring connector. 2 Connect a test lamp between the MAF sensor ignition voltage circuit and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 11
5	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the MAF sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 6	Go to Step 8
6	1 Switch off the ignition. 2 Connect a 3 A fused jumper wire between the MAF sensor 5 V reference circuit and signal circuit. 3 Switch on the ignition with the engine not running. 4 Using Tech 2, observe the MAF sensor voltage parameter. Does Tech 2 display 4.8 – 5.2 V?	Go to Step 7	Go to Step 9
7	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the MAF sensor low reference circuit and the ECM housing. **NOTE** Install ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5 Ω?	Go to Step 12	Go to Step 10

Reassembly

1. Reassemble the parts inside the strut spring compressor.
2. When tightening the drive screw shaft, compress the spring so that it does not apply pressure to the spring seat.
3. Install the nut, and then tighten to the specified torque.

   Torque: 25 N·m (2.5 kgf·m/18 lb·ft)

Step	Action	Yes	No
8	Test the MAF sensor 5 V reference circuit for a high resistance, open circuit or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The MAF sensor shares the 5 V reference circuit with other sensors. A fault condition in the 5 V reference circuit will trigger DTCs on sensors that share this circuit. Was any fault found and rectified?	Go to Step 14	Go to Step 13
9	Test the MAF sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 14	Go to Step 13
10	Test the MAF sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 14	Go to Step 13
11	Repair the high resistance or open circuit fault condition in the MAF sensor circuit ignition voltage. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
12	Replace the MAF sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
13	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
14	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the MAF Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 15
15	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.7 DTC P0112 or P0113

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0112 – Intake Air Temperature Sensor Circuit Low Voltage
- DTC P0113 – Intake Air Temperature Sensor Circuit High Voltage

Circuit Description

The ECM applies a reference 5 V to the intake air temperature (IAT) sensor signal circuit and ground through the low reference circuit. The IAT sensor is a variable resistor that measures the engine intake air temperature.

- Increased temperature in the intake air decreases the resistance value of the IAT sensor. This increases the IAT sensor pull-down rate to ground. Therefore, the higher the intake air temperature, the lower the signal voltage output of the IAT sensor.
- Decreased temperature in the intake air increases the resistance value of the IAT sensor. This reduces the IAT sensor pull-down rate to ground. Therefore, the lower the intake air temperature, the higher the signal voltage output of the IAT sensor.

An IAT sensor circuit DTC sets if the ECM detects the intake air temperature is outside the specified range.

Conditions for Running the DTC

Runs continuously once the following conditions are met:

- The engine is running for longer than 3.0 minutes.
- The engine is idling for longer than 10.0 seconds

Conditions for Setting the DTC

DTC P0112

The ECM detects the intake air temperature is greater than 132°C for longer than 3.0 seconds.

DTC P0113

The ECM detects the intake air temperature is less than - 38°C for longer than 3.0 seconds.

Conditions for Clearing the DTC

The IAT sensor DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the IAT Sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Test the IAT sensor using the IAT Temperature vs. Resistance in 6C1-3 Engine Management – V6 – Service Operations. If the engine has sat overnight, the IAT sensor should display within 3°C of the ECT sensor values.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Tests the signal circuit of the IAT sensor.

4 Measures the integrity of the IAT sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0112 or P0113 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

Step	Action	Yes	No
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Using Tech 2, select the DTC display function. Does DTC P0112 or P0113 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the IAT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the IAT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the IAT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 7	Go to Step 6
5	Test the IAT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
6	Test the IAT sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The IAT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the IAT sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations Was the repair completed?	Go to Step 9	—

Step	Action	Yes	No
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the IAT sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.8 DTC P0116, P0117, P0118, P0125 or P1258

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0116 – Engine Coolant Temperature Sensor Circuit Range / Performance
- DTC P0117 – Engine Coolant Temperature Sensor Circuit Low Voltage
- DTC P0118 – Engine Coolant Temperature Sensor Circuit High Voltage
- DTC P0125 – Insufficient Engine Coolant Temperature For Closed Loop Fuel Control
- DTC P1258 – Engine Coolant Over Temperature - Protection Mode Active

Circuit Description

The ECM applies a reference 5 V to the engine coolant temperature (ECT) sensor signal circuit and ground through the low reference circuit. The ECT sensor is a variable resistor that measures the temperature of the engine coolant.

- Increased temperature in the engine coolant decreases the resistance value of the ECT sensor. This increases the ECT sensor pull-down rate to ground. Therefore, the higher the engine coolant, the lower the signal voltage output of the ECT sensor.
- Decreased temperature in the engine coolant increases the resistance value of the ECT sensor. This reduces the ECT sensor pull-down rate to ground. Therefore, the lower the engine coolant temperature, the higher the signal voltage output of the ECT sensor.

An ECT sensor DTC sets if the ECM detects the engine coolant temperature is outside the predetermined range.

Conditions for Running the DTC

DTC P0116

Runs continuously when the engine is running.

DTC P0117, P0118 and P1258

Runs continuously when the ignition is switched on.

DTC P00125

Runs continuously once the following conditions are met:

- DTCs P0112, P0113, P0117 or P0118 are not set.
- The engine is running.

Conditions for Setting the DTC

DTC P0116

The ECM detects the engine coolant temperature sensor value is 10°C less than the minimum calculated engine temperature.

DTC P0117

The ECM detects the engine coolant temperature is greater than 140°C for longer than 3 seconds.

DTC P0118

The ECM detects the engine coolant temperature is less than -39°C for longer than 3 seconds.

DTC P0125

The ECM determines the calculated engine temperature by measuring the amount of airflow into the engine. This DTC sets if the ECM detects the actual ECT sensor is not within 10ºC of the calculated engine temperature for approximately 2 – 5 minutes.

DTC P1258

The ECM detects the engine coolant temperature is greater than 131°C for longer than 2 seconds.

Conditions for Clearing the DTC

The ECT sensor DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECT sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- DTCs P0116, P0117, P0118 and P0125 diagnostic table is developed with the assumption the engine cooling system is functioning correctly. Therefore, rectify any engine cooling system fault conditions before proceeding with this diagnostic table.
- Test the ECT sensor using the ECT Temperature vs. Resistance in 6C1-3 Engine Management –V6 – Service Operations. If the engine has sat overnight, the ECT sensor should display within 3°C of the IAT sensor values. When the engine is first started, the ECT should rise steadily to about 90°C then stabilise when thermostat opens.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 A fault condition in the engine cooling system may trigger these DTCs.

7 The ECT sensor low reference circuit is shared with other components. DTC P0118 may set if the shared low reference circuit is shorted to voltage. Test the low reference circuit of all components that share this circuit to find the source of the fault condition.

DTC P0116, P0117, P0118, P0125 and P1258 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

Step	Action	Yes	No
2	Test the engine cooling system for correct operation. Refer to 6B1 Engine Cooling – V6. Was any fault found and rectified?	Go to Step 10	Go to Step 3
3	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0116, P0117, P0118, P0125 or P1258 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	1 Switch off the ignition. 2 Disconnect the ECT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the ECT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 6
5	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the ECT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 8	Go to Step 7
6	Test the IAT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
7	Test the ECT sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The ECT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the ECT sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—

Step	Action	Yes	No
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECT sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.9 DTC P0121, P0122, P0123, P0221, P0222,or P0223

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0121 – Throttle Position Sensor 1 Circuit Range / Performance
- DTC P0122 – Throttle Position Sensor 1 Circuit Low Voltage
- DTC P0123 – Throttle Position Sensor 1 Circuit High Voltage
- DTC P0221 – Throttle Position Sensor 2 Circuit Range / Performance
- DTC P0222 – Throttle Position Sensor 2 Circuit Low Voltage
- DTC P0223 – Throttle Position Sensor 2 Circuit High Voltage

Circuit Description

The ECM applies 5 V to the throttle position (TP) sensor 1 through the 5 V reference circuit and the ground through the low reference circuit. TP sensor 1 and TP sensor 2 share common 5 V reference circuit and low reference circuit.

The TP sensor 1 and TP sensor 2 have individual signal circuits with opposite functionality. These signal circuits provide the ECM with a signal voltage that is proportional to the throttle plate movement.

- The TP sensor 1 signal voltage is less than 1 V when the throttle plate is in closed position, which increases to greater than 4 V when the throttle plate is moved to wide-open throttle.
- The TP sensor 2 signal voltage is greater than 4 V when the throttle plate is in closed position, which decreases to less than 1 V when the throttle plate is moved to wide-open throttle.

The ECM monitors and compares the TP sensor 1 signal voltage to the TP sensor signal voltage 2. In addition, the ECM compares the TP sensor signal to the MAF sensor signal to determine a calculated TP sensor signal.

A TP sensor DTC sets if the ECM detects a fault condition in the TP sensor signal output.

Conditions for Running the DTC

DTC P0121 runs continuously once the following conditions are met:

- The ignition voltage is greater than 7 V.
- The TP sensor 1 signal voltage is 0.17 – 4.6 V.

DTC P0122, P0123, P0222 and P0223 runs continuously once the following conditions are met:

- The ignition voltage is greater than 7 V.
- The ignition is switched on.

DTC P0221 runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.

- The TP sensor 2 signal voltage is 0.15 – 4.8 V.

DTC P0222 runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.
- The ignition is switched on.

Conditions for Setting the DTC

DTC P0121

The following conditions exist:

- The TP sensor 1 signal voltage and the TP sensor 2 signal voltage have a difference of greater than 9 percent.
- The TP sensor signal voltage has a difference of greater than 9 percent from the calculated TP sensor signal voltage.

DTC P0122

The ECM detects the TP sensor 1 signal voltage is less than 0.18 volt.

DTC P0123

The ECM detects the TP sensor 1 signal voltage is greater than 4.6 V.

DTC P0221

The following conditions exist:

- The TP sensor 2 signal voltage and the TP sensor 1 signal voltage have a difference of greater than 9 percent.
- The TP sensor 2 signal voltage has a difference of greater than 9 percent from the calculated TP sensor signal voltage.

DTC P0222

The ECM detects the TP sensor 2 signal voltage is less than 0.16 volt.

DTC P0223

The ECM detects the TP sensor 2 signal voltage is greater than 4.8 V.

Conditions for Clearing the DTC

DTCs P0121, P0122, P0123, P0221, P0222 are P0223 are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the TP sensor operation.
- The ECM defaults to a reduced power mode if there is a fault condition in the TP sensor circuits for the entire ignition cycle, even if the fault condition is corrected.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- The TP sensors share a common 5 V reference circuit, test for a fault condition in the 5 V reference circuit if both DTCs P0122 and P0222 are set.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

6 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0121, P0122, P0123, P0221, P0222 or P0223 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times or operate the vehicle within the conditions for running the DTC. 4 Using Tech 2, select the DTC display function. Does DTC P0121, P0122, P0123, P0221, P0222 or P0223 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the throttle actuator wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the TP sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 7
4	1 Connect a 3 A fused jumper wire between the TP sensor 5 V reference circuit and the TP sensor 1 signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the TP sensor 1 voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 5	Go to Step 8
5	1 Connect a 3 A fused jumper wire between the TP sensor 5 V reference circuit and the TP sensor 2 signal circuit. 2 Using Tech 2, observe the TP sensor 2 voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 6	Go to Step 9
6	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the TP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5 Ω?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
7	**NOTE** TP sensor 1 share the 5 V reference circuit with TP sensor 2. A fault condition in the TP sensor 5 V reference circuit may trigger DTCs on both sensors. Test the TP sensor 5 V reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
8	Test the TP sensor 1 signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
9	Test the TP sensor 2 signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
10	Test the TP sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
11	Replace the throttle body assembly. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
12	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the TP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298

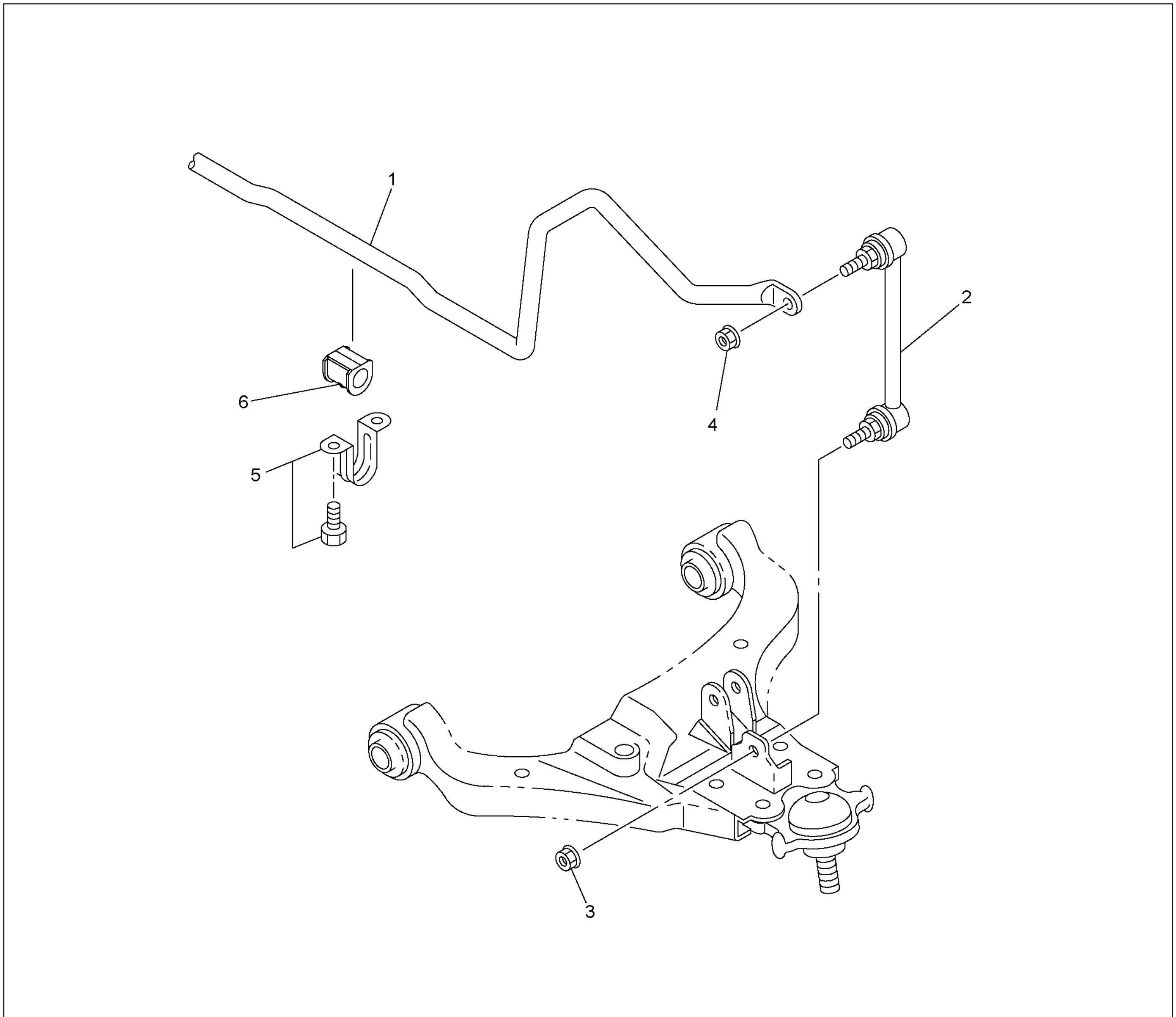
DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0130 – O2 Sensor Circuit Malfunction (Bank 1, Sensor 1)

Stabilizer Bar

Stabilizer Bar and Associated Parts



RTW340LF000901

Legend

(1) Stabilizer Bar
(2) Link
(3) Link Nut
(4) Link Nut
(5) Bracket and Bolt
(6) Rubber Bushing

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel Replacement in this section.
3. Remove link nut.

CAUTION: Be careful not to damage the ball joint boot.

4. Remove link.
5. Remove bracket and bolt.
6. Remove stabilizer bar.
7. Remove rubber bushing.

- DTC P0131 – O2 Sensor Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P0132 – O2 Sensor Circuit High Voltage (Bank 1, Sensor 1)
- DTC P0133 –
- DTC P0135 – O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 1)
- DTC P0137 – O2 Sensor Circuit Low Voltage (Bank 1, Sensor 2)
- DTC P0138 – O2 Sensor Circuit High Voltage (Bank 1, Sensor 2)
- DTC P0140 – O2 Sensor Circuit No Activity Detected (Bank 1, Sensor 2)
- DTC P0141 – O2 Sensor Heater Circuit Range / Performance (Bank 1, Sensor 2)
- DTC P0150 – O2 Sensor Circuit Malfunction (Bank 2, Sensor 1)
- DTC P0151 – O2 Sensor Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P0152 – O2 Sensor Circuit High Voltage (Bank 2, Sensor 1)
- DTC P0155 –O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 1)
- DTC P0157 – O2 Sensor Circuit Low Voltage (Bank 2, Sensor 2)
- DTC P0158 – O2 Sensor Circuit High Voltage (Bank 2, Sensor 2)
- DTC P0160 – O2 Sensor Circuit No Activity Detected (Bank 2, Sensor 2)
- DTC P0161 – O2 Sensor Heater Circuit Range / Performance (Bank 2, Sensor 2)
- DTC P2243 – O2 Sensor Voltage Signal Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2247 – O2 Sensor Voltage Signal Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2270 – O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 1, Sensor 2)
- DTC P2271 – O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 1, Sensor 2)
- DTC P2272 – O2 Sensor Lean / Rich Switch Signal Malfunction (Bank 2, Sensor 2)
- DTC P2273 – O2 Sensor Rich / Lean Switch Signal Malfunction (Bank 2, Sensor 2)
- DTC P2297 – O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 1, Sensor 1)
- DTC P2298 – O2 Sensor Range / Performance During Deceleration Fuel Cutoff (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

HO2 Sensor 2

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S while the sensor temperature is less than the operating range.

Once the HO2S reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

- The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.
- The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

HO2 Sensor 1

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas.

- If the air/fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S reference circuit DTC sets if the ECM detects the HO2S signal voltage is outside the predetermined range for a specified period.

Conditions for Running the DTC

DTC P0130, P0131, P0132, P0137, P0138, P0140, P0150, P0151 or P0152

Run continuously once the following conditions are met:

- The ignition voltage is 10.0 – 16.0 V.
- The engine is running.

DTC P0135 and P0155

Condition 1

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.

Condition 2

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0101, P103, P0121, P0122, P0123, P0131, P0132, P0151, P0152, P0221, P0222, P0223, P0335, P0336, P0338, P2237, P2240, P2243, P2247, P2251 and P2254 ran and passed.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The ECM internal sensing element resistance test is enabled.
- The fuel injectors are not disabled.
- If the engine is operating and the ignition is turned off, the engine must be off for at least 5 minutes for this DTC to run.

DTC P0137 and P0157

Run continuously once the following conditions are met:

- DTCs P0117, P0118, P0125 and P0128 ran and passed.
- The engine is operating for longer than two minutes.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.

- The calculated exhaust temperature is 250ºC – 800ºC.
- The engine coolant temperature is less than 40ºC at start-up and greater than 60ºC when the ignition was turned off last ignition cycle.
- The fuel tank level is greater than 25 percent.

DTC P0138 and P0158

Run continuously once the following conditions are met:

- The engine is operating for longer than two minutes.
- The ignition voltage is 10.0 – 16.0 V.
- The HO2S is at operating temperature.
- The calculated exhaust temperature is 250ºC – 800ºC.

DTC P0140 and P0160

Run continuously once the following conditions are met for longer than 90 seconds:

- The engine is operating.
- The ignition voltage is 10.0 – 16.0 V.
- The calculated exhaust temperature is 250º C – 800º C.

DTC P0141 and P0161

Run continuously once the following conditions are met:

- DTCs P0036, P0037, P0038, P0056, P0057, and P0058 ran and passed.
- DTCs P0137, P0138, P0140, P0157, P0158, or P0160 are not set.
- The engine is operating.
- The ECM internal sensing element resistance is valid.
- The fuel system is not in decel fuel shut-off.
- The intake air temperature is greater than -7ºC.
- If the engine is operating and the ignition is turned off, the engine must be off for at least 5 minutes for this DTC to run.
- The ignition voltage is 10.0 – 16.0 V.
- The calculated exhaust temperature is 360ºC – 500ºC.

DTC P2243 and P2247

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051 and P0052 ran and passed.
- The ECM internal sensing element resistance is greater than 570 Ω.
- The HO2S is at operating temperature.

DTC P2270 and P2272

Run continuously once the following conditions are met:

- DTCs P0036, P0037, P0038, P0056, P0057, P0058, P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P0342, P0343, P0443, P0458 and P0459 ran and passed.
- The engine is running.
- The HO2S 2 are at operating temperature for longer than 10 seconds.
- The long term fuel control is enabled.

- The MAF sensor is greater than 10 g/s.

DTC P2297 and P2298

Condition 1

Run continuously once the following conditions are met:

- DTCs P0130 and P0150 ran and passed.
- The HO2S 1 are at operating temperature.
- The desired HO2S 1 signal is less than 1.6 lambda.
- The internal ECM HO2S 1 signal voltage is less than 4.81 V.
- The fuel injectors are enabled.

Condition 2

Run continuously once a decel fuel cut-off has occurred 11 times with successful adjustments

Conditions for Setting the DTC

DTC P0130 and P0150

The ECM detects the HO2S signal voltage is out of range.

DTC P0131 and P0151

The ECM internal HO2S voltage is less than the specified threshold.

DTC P0132 and P0152

The ECM internal HO2S voltage is less than the specified threshold.

DTC P0135 and P0155

Condition 1

The ECM internal HO2S sensing element resistance is less than the specified threshold for longer than 15 seconds.

Condition 2

The ECM detects the calculated HO2S temperature is greater than a predetermined threshold.

DTC P0137 and P0157

The ECM detects the HO2S signal voltage is less than 60 mV.

DTC P0138 and P0158

The ECM detects the HO2S signal voltage is greater than 1050 mV.

DTC P0140 and P0160

The ECM detects one of the following conditions:

- The HO2S signal voltage is 400 – 500 mV for longer than 5 minutes, or
- the internal resistance of the HO2S is greater than 40,000 Ω when the calculated exhaust temperature is greater than 600ºC.

DTC P0141 and P0161

The ECM detects the HO2S internal resistance is not within the expected range for longer than 6 seconds.

DTC P2243 and P2247

The ECM detects the internal HO2S signal voltage is not 0.2 – 4.7 V.

DTC P2270 and P2272

When the ECM detects the HO2S 2 is less than 650 mV for 100 seconds, the ECM enriches the fuel mixture up to 30 percent for 10 seconds. This DTC sets if the ECM detects the HO2S 2 is still less than 650 mV.

DTC P2271 and P2273

When the ECM detects the HO2S 2 is greater than 650 mV for 100 seconds, the ECM leans the fuel mixture up to -7 percent for 10 seconds. If this signal voltage is still greater than 650 mV, the ECM tests the HO2S at the next decel fuel cut-off. This DTC sets if the ECM detects the HO2S 2 signal voltage is greater than 200 mV after 4 seconds in decel fuel cu-off mode.

DTC P2297 and P2298

The ECM detects the internal HO2S 1 signal voltage is greater than 3.7 V for longer than 10 seconds.

Conditions for Clearing the DTC

The HO2S reference circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- A fault condition in the fuel delivery system, air intake system or exhaust system may trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0130 to P0132, P0135 to P0138, P0140, P0141, P0150 to P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270 to P2273, P2297 or P2298 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds or operate the vehicle within the conditions for setting the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150, P0151, P0152, P0155, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to the heater circuit of the O2 sensor, also set? (e.g. P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057 or P0058)	Go to the appropriate DTC Table in this Section	Go to Step 4

Step	Action	Yes	No
4	1 Disconnect the appropriate HO2S wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the HO2S reference signal circuit and low reference circuit. Does the multimeter display 350 – 550 mV?	Go to Step 7	Go to Step 5
5	1 Test the reference signal circuit of the HO2S for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 6
6	1 Test the low reference circuit of the HO2S for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
7	1 Test or inspect for the following conditions that may cause the HO2S to detect an incorrect air / fuel mixture: – lean or rich fuel injector fuel delivery, – restricted air intake system, – contaminated fuel, – low fuel line pressure, – exhaust leak near the HO2S, and – leak in the crankcase or vacuum line. Was any fault found and rectified?	Go to Step 10	Go to Step 8
8	1 Replace the appropriate HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
9	1 Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any HO2S reference circuit DTC fail this ignition cycle?	Go to Step 2	Go to Step 11
11	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.11 DTC P0133 or P0153

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0133 – HO2S Circuit Slow Response – Bank 1 Sensor 1

- DTC P0153 – HO2S Circuit Slow Response – Bank 2 Sensor 1

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater.

The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell to maintain a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell.

By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P0133 or P0153 failed, DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0336, P0338, P2237, and P2240 must run and pass.
- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0053, P0059, P0130, P0131, P0132, P0135, P0150, P0151, P0151, P0152, P0155, P0442, P0443, P0446, P0455, P0458, P0459, P0496, P167A, P167B, P2096, P2097, P2098, P2099, P2231, P2234, P2243, P2247, P2251, P2254, P2297, P2298, P2626, and P2629 are not set.
- The HO2S is at operating temperature.
- The HO2S is between 0.94 – 1.06 lambda.
- The engine speed is between 1,480 – 2,040 rpm.
- The volumetric efficiency is between 16.5 – 38.3 percent.
- The change in volumetric efficiency is less than 3 percent.
- The evaporative emission (EVAP) purge is not active, or the ECM determines the EVAP hydrocarbon (HC) concentration is less than a predetermined amount when EVAP purge is active.
- The long term fuel trim correction is active.
- DTCs P0133 and P0153 run continuously once the above conditions are met for 10 minutes.

Conditions for Setting the DTC

- The ECM has determined that the dynamic value of the affected HO2S is less than a predetermined threshold.
- The above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.

- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL/DTC.

Additional Information

- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The lower connector of the ECM is connector A43-X1 and the upper connector of the ECM is connector A43-X2. Refer to 3 Wiring Diagrams and Connector Charts in this Section.
- The front wide band sensors do not toggle or switch like a switching HO2S. The front HO2S signals will be relatively stable for an idling engine.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical-Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V
Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if the condition exists.

4 This step determines if the fuel system is contaminated.

DTC P0133 or P0153 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 4.4 Diagnostic System Check

Step	Action	Yes	No
2	**NOTE** • DTC P0133 is for bank 1 sensor 1 and DTC P0153 is for bank 2 sensor 1. • DTC P0132 causes DTC P0153 to set. If DTC P0132 is set with DTC P0153, refer to 7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298 in this Section. • Inspect the heated oxygen sensor (HO2S) for being secure before proceeding with this DTC. A sensor that is loose could cause this DTC to set. 1 Start engine and allow to reach operating temperature. 2 Observe the diagnostic trouble code (DTC) information with Tech 2. Did DTC P0133 and / or DTC P0153 fail this ignition cycle?	Go to Step 4	Go to Step 3
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	Go to Step 4	Go to Additional Information in this DTC
4	Did DTC P0133 and DTC P0153 fail this ignition cycle?	Go to Step 7	Go to Step 5
5	1 Inspect for an exhaust leak near the HO2S. Refer to 6F Exhaust System – V6. After you inspect the exhaust system, return to this diagnostic. Did you find and correct the condition?	Go to Step 8	Go to Step 6
6	1 Inspect or test for the following conditions: • Inspect that the HO2S is securely installed. • Inspect for corrosion on the HO2S terminals. • Inspect the terminal tension at the HO2S and at the engine control module (ECM). Refer to 8A Electrical-Body and Chassis. • Inspect the HO2S wiring for damage. Did you find and correct the condition?	Go to Step 8	Go to Step 7

Step	Action	Yes	No
7	**NOTE** If both DTCs are set, determine and correct the cause of the contamination before replacing a sensor. 1 Inspect for the following conditions: • Fuel contamination – refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. • The correct RTV sealant. • Engine oil consumption – refer to 6A1 Engine Mechanical – V6. • Engine coolant consumption – refer to 6B1 Engine Cooling – V6. 2 Replace the HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 8	—
8	1 Use Tech 2 to Clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

7.12 DTC P0139 or P0159

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0139 – O2 Sensor Circuit Slow Response (Bank 1 Sensor 2)
- DTC P0159 – O2 Sensor Circuit Slow Response (Bank 2 Sensor 2)

Circuit Description

The post catalytic converter heated oxygen sensor (HO2S) produces a voltage that varies between 100 – 900 mV under normal operating conditions. The engine control module (ECM) produces a bias voltage on the HO2S signal circuit of 420 – -480 mV. The reference ground for the sensor is provided through the ECM.

The ECM monitors the signal voltage to determine if the exhaust is lean or rich. The oxygen sensor voltage is high when the exhaust is rich, and low when the exhaust is lean. The ECM constantly monitors the HO2S signal during the Closed Loop operation. If the ECM detects that the decel fuel cut-off rich-to-lean transition time is too long, DTC P0139 will set for bank 1 sensor 2, or DTC P0159 will set for bank 2 sensor 2.

Conditions for Running the DTC

- DTCs P0021, P0024, P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0056, P0057, P0058, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0121, P0122, P0123, P0125, P0128, P0131, P0132, P0135, P0137, P0138, P0139, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0159, P0160, P0161, P0201-P0208, P0221, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300, P0301-P0308, P0335, P0336,

Inspection and Repair

Make the necessary adjustments or parts replacement if wear, damage, corrosion or any other abnormal condition is found during inspection.

Check the following parts:

- Stabilizer bar
- Rubber bushing
- Link ball joint

Installation

1. Install rubber bushing.
2. Install stabilizer bar.
3. Install bracket and bolt then tighten it to the specified torque.

Torque: 25 N·m (2.5 kgf·m/18 lb·ft)

4. Install link.
5. Install link nut, then tighten it to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

P0340, P0341, P0345, P0346, P0351-P0358, P0365, P0366, P0390, P0391, P0442, P0443, P0446, P0449, P0453, P0454, P0455, P0458, P0459, and P0496 are not set.

- The ECT Sensor parameter is more than 66° C.
- The Vehicle Speed Sensor parameter is between 5 – 180 km/h.
- The calculated catalytic converter temperature is more than 520° C.
- DTC P0139 or P0159 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The ECM detects that the decel fuel cut-off and rich-to-lean transition time has exceeded 1 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure.
- The ECM writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the malfunction indicator lamp (MIL) after three consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

DTC P0139 or P0159 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check
2	1 Start and run the engine until normal operating temperature is reached. 2 Quickly cycle the throttle from closed throttle to wide open throttle (WOT) 3 times within 5 seconds while observing the HO2S Bank 1 Sensor 2 or HO2S Bank 2 Sensor 2 voltage parameter with Tech 2. Does the voltage react immediately when performing the above action?	—	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 4	Go to 5.2 Intermittent Fault Conditions in this Section.

4	1 Ignition OFF. 2 Disconnect the affected heated oxygen sensor (HO2S) 2 3 Connect a 3 Amp fused jumper wire between the HO2S high signal circuit, on the engine harness side connector, and a good ground. 4 Ignition ON, engine OFF. 5 Use Tech 2 to observe the affected HO2S 2 parameter Is the voltage less than the specified value?	25 mV	Go to Step 5	Go to Step 7
5	1 Remove the jumper wire from the previous step. 2 Connect a 3 Amp fused jumper wire between the HO2S high signal circuit and the HO2S low signal circuit, on the engine harness side connector. 3 Use Tech 2 to observe the HO2S 2 parameter. Is the voltage less than the specified value?	25 mV	Go to Step 6	Go to Step 8
6	1 Remove the jumper wire from the previous step. 2 Measure the resistance of the following circuits with a DMM: • The HO2S heater low control circuit. • The ignition voltage circuit Refer to 8A Electrical-Body and Chassis. Is the resistance of either circuit more than the specified value?	5 Ω	Go to Step 12	Go to Step 9
7	1 Test the HO2S high signal circuit for an open or high resistance. Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
8	1 Test the HO2S low signal circuit for an open or high resistance. Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11

9	1 The HO2S is detecting a rich or lean exhaust condition or may be contaminated. Inspect for one of the following conditions: • HO2S connector water intrusion. • A silicon-contaminated HO2S. • Fuel-contaminated engine oil – refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis. • Rich fuel injectors. • Lean fuel injectors. Refer to 6C Fuel System – V6 • An exhaust leak between the HO2S and the engine. Refer to 6F Exhaust System – V6. • Vacuum leaks. • Fuel contamination. Water, even in small amounts, can be delivered to the fuel injectors, causing a lean exhaust to be indicated. Excessive alcohol in the fuel can also cause this condition. Refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. • An inaccurate mass air flow (MAF) sensor. 2 Repair any of the above or similar engine conditions, as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10
10	1 Test for intermittent and poor connections at the HO2S. Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
11	1 Test for intermittent and poor connections at the engine control module (ECM). Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
12	1 Repair the circuit with high resistance. Refer to 8A Electrical-Body and Chassis. Did you complete the repair?	—	Go to Step 15	—
13	1 Replace the affected HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 15	—
14	1 Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 15	—
15	1 Use Tech 2 to clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 16

16	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.13 DTC P0196, P0197 or P0198

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0196 – Engine Oil Temperature Sensor Range / Performance
- DTC P0197 – Engine Oil Temperature Voltage Low
- DTC P0198 – Engine Oil Temperature Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the engine oil temperature (EOT) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The EOT sensor is a variable resistor that measures the temperature of the engine oil. This sensor provides signal voltage to the ECM that is proportional to the oil temperature off the engine.

The ECM monitors and compares the EOT sensor signal voltage against a specified range. An EOT sensor circuit DTC sets if the ECM detects the EOT sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P0196, P0197 and P0198 run continuously when the engine is running.

Conditions for Setting the DTC

DTC P0196

The ECM detects the engine oil temperature sensor is not within 100°C of the modelled temperature

NOTE

The modelled temperature is the temperature that the ECM expects to see given current engine operating conditions.

DTC P0197

The ECM detects the engine oil temperature is less than -35°C for longer than 3 seconds.

DTC P0198

The ECM detects the engine oil temperature is greater than 170°C for longer than 3 seconds.

Conditions for Clearing DTC

The EOT sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the EOT sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.

- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

5 Test signal circuit of the EOT sensor. This circuit should display a voltage within the specified range.

6 Measures the integrity of the EOT sensor low reference circuit. Removal of the Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0196, P0197 or P0198 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	Test the engine cooling system for correct operation. Refer to 6B1 Engine Cooling – V6. Was any fault found and rectified?	Go to Step 11	Go to Step 3
3	Inspect the engine oil condition. Refer to 6A1 Engine Mechanical – V6. Was any fault found and rectified?	Go to Step 11	Go to Step 4
4	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0196, P0197 or P0198 fail this ignition cycle?	Go to Step 5	Refer to Additional Information in this DTC
5	1 Switch off the ignition. 2 Disconnect the EOT sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the EOT sensor signal circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 6	Go to Step 7
6	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the EOT sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
7	Test EOT sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
8	Test the EOT sensor low reference circuit for a high resistance and open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The EOT sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the EOT sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the conditions for the engine oil pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.14 DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0201 – Injector 1 Control Circuit Malfunction
- DTC P0202 – Injector 2 Control Circuit Malfunction
- DTC P0203 – Injector 3 Control Circuit Malfunction
- DTC P0204 – Injector 4 Control Circuit Malfunction
- DTC P0205 – Injector 5 Control Circuit Malfunction
- DTC P0206 – Injector 6 Control Circuit Malfunction
- DTC P0261 – Injector 1 Control Circuit Low Voltage
- DTC P0262 – Injector 1 Control Circuit High Voltage
- DTC P0264 – Injector 2 Control Circuit Low Voltage
- DTC P0265 – Injector 2 Control Circuit High Voltage
- DTC P0267 – Injector 3 Control Circuit Low Voltage

- DTC P0268 – Injector 3 Control Circuit High Voltage
- DTC P0270 – Injector 4 Control Circuit Low Voltage
- DTC P0271 – Injector 4 Control Circuit High Voltage
- DTC P0273 – Injector 5 Control Circuit Low Voltage
- DTC P0274 – Injector 5 Control Circuit High Voltage
- DTC P0276 – Injector 6 Control Circuit Low Voltage
- DTC P0277 – Injector 6 Control Circuit High Voltage

Circuit Description

The engine control relay applies ignition positive voltage to the fuel injector ignition circuit. The ECM applies a pulse width modulated (PWM) ground to the injector control circuit through a device within the ECM called a driver to control each fuel injector on time.

The driver has a feedback circuit that is pulled-up when the voltage is approximately 3.3 V. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

A fuel injector control circuit DTC sets if the ECM detects a fault condition in a fuel injector control circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the battery voltage is 10.0 – 16.0 V, and
- engine speed is greater than 80 rpm

Conditions for Setting the DTC

DTC P0201,P0202, P0203, P0204, P0205 or P0206

The ECM detects an open circuit fault condition in a fuel injector circuit.

DTC P0261, P0264, P0267, P0270, P0273 and P0276

The ECM detects a short to ground fault condition in the control circuit a fuel injector.

DTC P0262, P0265, P0268, P0271, P0274 and P0277

The ECM detects a short to voltage fault condition in the control circuit of a fuel injector.

Conditions for Clearing the DTC

The fuel injector control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the fuel injector operation.
- Using Tech 2, observe the appropriate fuel injector status parameter while wriggle testing related harness and connectors. Tech 2 reading will change from Ok to Fault if there is an intermittent fault condition in the harness or connector being tested.
- Perform the fuel injector coil test to help isolate an intermittent condition. Refer to 6.2 Fuel Injector Coil Test in this Section.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Determines if there is a fault condition in the ignition voltage supply circuit. The fuel injectors for each bank of the engine are fused separately. If all DTCs for a single bank are set, there may be a fault in one of the ignition supply circuits.

5 Verifies the ECM is sending control voltage to the fuel injector.

6 Tests if the feed back voltage circuit within the ECM is providing the correct voltage.

DTC P0201 to P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 and P0277 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0201, P0202, P0203, P0204, P0205, P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276 or P0277 set?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the fuel injector interconnect harness connector. Refer to 6C1-3 Engine Management – V6 – Service Operations. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the ignition voltage circuit of the appropriate fuel injector, ECM side of the interconnect connector, and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the appropriate fuel injector control circuit, ECM side of the interconnect connector, and the ECM housing. Does the multimeter display 2.6 – 4.6 mV?	Go to Step 7	Go to Step 6
5	Repair the open circuit or short to ground fault condition in the ignition voltage circuit of the appropriate fuel injector. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
6	Test the control circuit of the appropriate fuel injector, between the interconnect connector and the ECM, for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9

Step	Action	Yes	No
7	1 Remove the upper intake manifold. Refer to 6A1-Engine Mechanical – V6. 2 Test the control circuit and the ignition voltage circuit of the appropriate fuel injector, between the interconnect connector and the appropriate fuel injector connector, for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 8
8	Replace the appropriate fuel injector. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the fuel injector control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.15 DTC P0219

DTC Descriptor

This diagnostic procedure supports DTC P0219 – Engine Overspeed Condition.

Circuit Description

The ECM continually monitors the engines operating environment. A engine over-speed condition DTC sets if the ECM detects an engine speed in excess of 7200 RPM.

NOTE

An over-speed condition will occur when a low gear on a manual transmission vehicle has been selected whilst the vehicle is travelling at high road speed. This DTC will not set if the engine is free-revved as the ECM will limit engine speed.

Conditions for Running the DTC

DTC P0219 runs continuously when the following conditions are met:

- The vehicle is fitted with a manual transmission
- The engine is running.
- The ignition voltage is between 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects an engine speed in excess of 7200 RPM for 1 second or longer.

Conditions for Clearing the DTC

The engine over-speed DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0219 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0219 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0219 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.16 DTC P0300

DTC Descriptor

This diagnostic procedure supports the following DTC:

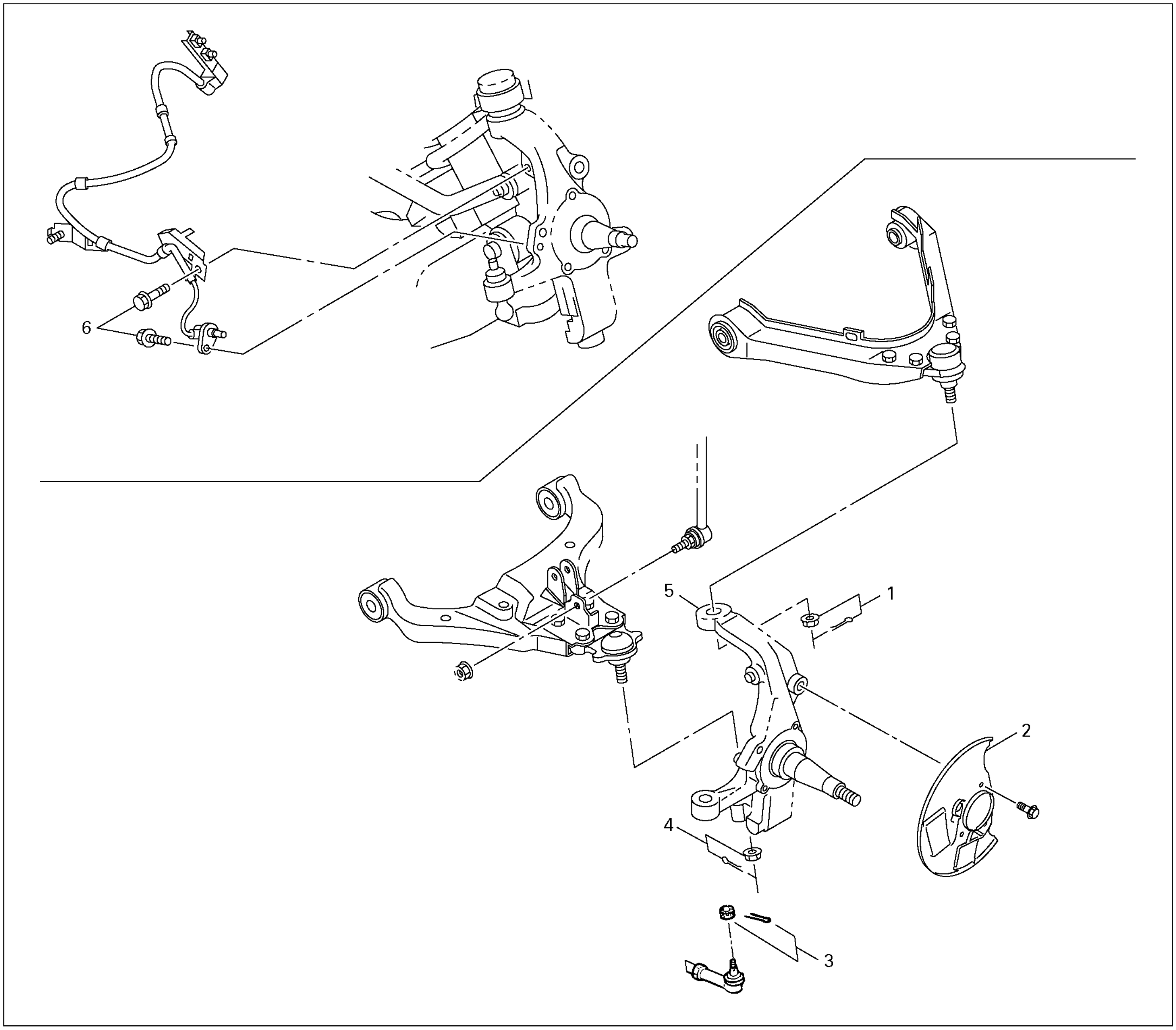
DTC P0300 Engine Misfire Detected.

Circuit Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensors to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause

Knuckle

Knuckle and Associated Parts



Legend

(1) Nut and Cotter Pin
(2) Back Plate
(3) Nut and Cotter Pin
(4) Nut and Cotter Pin
(5) Knuckle
(6) Bolt

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the brake caliper. Refer to Disc Brakes in Brake section.
4. Remove the hub assembly. Refer to Front Hub and Disk in this section.
5. Remove tie-rod end from the knuckle. Refer to Power Steering Unit in Steering section.

3-way catalytic converter damage. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are present. DTCs P0301 through P0306 correspond to cylinders 1 through 6. If the ECM is able to determine that a specific cylinder is misfiring, the DTC for that cylinder will set. If the misfire rate is sufficient to cause emission levels to exceed a predetermined value, this DTC sets.

Conditions for Running the DTC

- DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0335, P0336, or P0338 are not set.
- The engine speed is between 400 – 7,000 rpm and steady.
- The delivered torque signal is more than 10 percent at idle.
- The delivered torque signal is between 9 – 30 percent with the transmission in drive.
- The intake air temperature (IAT) is more than –30° C.
- The fuel level is more than 12 percent.
- The torque management is not active.
- DTC P0300 runs continuously when the above conditions exist for at least 1,000 engine revolutions.

Conditions for Setting the DTC

- The ECM detects a crankshaft rotation speed variation indicating a misfire rate sufficient to cause emissions levels to exceed mandated standards.
- The condition above exists for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the MIL on the second ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Inspect for the following possible sources:
  - A tyre or wheel that is out of round or out of balance
  - Variable thickness brake rotors
  - An unbalanced drive shaft
  - Certain rough road conditions
  - A damaged accessory drive component or belt
- A misfire DTC could be caused by a camshaft actuator stuck in the full advance or retard position.
- For an intermittent condition, refer to 5.2 Intermittent Fault Conditions in this Section.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If the Misfire Current Counters are incrementing, but the engine is NOT misfiring, this indicates a mechanical condition. For example, an accessory drive belt could cause this condition.

DTC P0300 - Engine Misfire Detected

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	**NOTE** The engine may only misfire when the engine is under a load. An engine load may be necessary to verify the condition. 1 Start the engine. 2 Use Tech 2 to monitor the Misfire Current Cyl 1 – 6 parameters. Are any of the Misfire Current Counters incrementing?	Go to Step 4.	Go to Step 3
3	1 Clear the DTC. 1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0300 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	Is the engine misfiring?	Go to Step 5	Go to Symptoms Diagnostics in this Section
5	1 Observe the DTC information using Tech 2. Is DTC P0201-P0206, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0335, P0336, P0338, P0351-P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, or P2316 also set?	Go to the appropriate DTC Table in this Section	Go to Step 6
6	Is there an engine mechanical noise?	Go to Symptoms in 6A1 Engine Mechanical	Go to Step 7
7	Is there more than one cylinder specific misfire DTC set?	Go to Step 8	Go to DTC 301 – 306
8	Are there any heated oxygen sensor (HO2S) DTCs set?	Go to the appropriate DTC Table in this Section	Go to Step 9

Step	Action	Yes	No
9	1 Inspect or test for the following conditions: • Inspect the vacuum hoses for splits, kinks, and proper connections. • Inspect the throttle body and the intake manifold for vacuum leaks. • Inspect the crankcase ventilation valve and / or system for any vacuum leaks. • Test for the correct fuel pressure. Refer to 6C Fuel System – V6. • Inspect the fuel system for any restrictions, leaks or fuel contamination. Refer to 6C Fuel System – V6. • Inspect for fouled or damaged spark plugs. Determine what caused the spark plugs to foul. Refer to 6C1-3 Engine Management – Service Operations. • Inspect the exhaust system for restrictions. Refer to 6F Exhaust System – V6. • Inspect the engine control grounds for being clean, tight, and in the correct location. • Inspect for a camshaft actuator stuck in the full advance or retard position. 2 Repair as required. Did you find and correct the condition?	Go to Step 10	Go to Symptoms in 6A1 Engine Mechanical – V6
10	1 Use Tech 2 to clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running DTC 300. Did the DTC fail this ignition?	Go to Step 2	Go to Step 11
11	1 Using Tech 2, select the DTC display function. Does Tech display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
	When all diagnosis and repairs are completed, clear all DTCs and verify correct operation		

7.17 DTC P0301, P0302, P0303, P0304, P0305 or P0306

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0301 – Cylinder 1 Misfire Detected
- DTC P0302 – Cylinder 2 Misfire Detected
- DTC P0303 – Cylinder 3 Misfire Detected
- DTC P0304 – Cylinder 4 Misfire Detected
- DTC P0305 – Cylinder 5 Misfire Detected
- DTC P0306 – Cylinder 6 Misfire Detected

Circuit Description

The engine control module (ECM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the ECM is able to detect individual misfire events. A misfire rate that is high enough can cause 3-way catalytic converter damage. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for catalytic converter damage are preset. DTCs P0301 – P0306 correspond to cylinders 1 to 6. If the ECM is able to determine that a specific cylinder is misfiring, the DTC for that cylinder sets.

Conditions for Running the DTC

- DTCs P0121, P0122, P0123, P0221, P0222, P0223, P0335, P0336, or P0338 are not set.
- The engine speed is between 400 – 7,000 rpm and steady.
- The delivered torque signal is more than 10 percent at idle with the transmission in neutral.
- The delivered torque signal is between 10 – 30 percent with the transmission in drive.
- The intake air temperature (IAT) is more than –30° C.
- The engine run time is more than 45 seconds.
- The fuel level is more than 12 percent.
- The torque management is not active.
- DTCs P0301, P0302, P0303, P0304, P0305, and P0306 run continuously when the above conditions exist for at least 1,000 engine revolutions.

Conditions for Setting the DTC

- The ECM detects a crankshaft rotation speed variation indicating a single cylinder misfire rate sufficient to cause emissions levels to exceed mandated standards.
- The condition exists for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the MIL on the second ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The ECM turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A misfire DTC could be caused by an excessive vibration from sources other than the engine. Check for the following possible sources:
  - Tyre or wheel out of round or balance
  - Variable thickness brake rotor or drum
  - Drive shaft not balanced
  - Certain rough road conditions

– Damaged accessory drive belt

- For an intermittent condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0301, P0302, P0303, P0304, P0305 or P0306 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	Were you sent here from DTC P0300?	Go to Step 3	Go to 7.16 DTC P0300 in this Section
3	1 Ignition OFF. 2 Remove the ignition coil of the misfiring cylinder, but leave the electrical connector connected. Refer to 6C1-3 Engine Management – V6 – Service Operations. 3 Inspect the ignition coil boot for the following conditions: – Holes. – Tears. – Carbon tracking. – Oil contamination or water intrusion. Did you find a condition with the ignition coil boot?	Go to Step 12	Go to Step 4
4	1 Remove the fuel pump fuse from the under-hood fuse and relay centre. 2 Install the J 26792 Spark Tester to the ignition coil boot and a good ground. 3 Crank the engine while observing J 26792. Does the spark tester spark and is the spark consistent?	Go to Step 5	Go to Electronic Ignition System Diagnosis
5	1 Ignition OFF. 2 Remove the spark plug from the cylinder that indicated a misfire. 3 Inspect the spark plug. Refer to 6C1-3 Engine Management – V6 – Service Operations. Does the spark plug appear to be OK?	Go to Step 9	Go to Step 6
6	Is the spark plug oil or coolant fouled?	Inspect the spark plugs. Go to 6C1-3 Engine Management – V6 – Service Operations	Go to Step 7
7	Is the spark plug gas fouled?	Go to Step 10	Go to Step 9
8	Does the spark plug show any signs of being cracked, worn, or incorrectly gap?	Go to Step 11	Go to Step 9

Step	Action	Yes	No
9	1 Swap the suspected spark plug with another cylinder that is operating correctly. 2 Start the engine. 3 Operate the engine within the conditions that the misfire occurred. 4 Use Tech 2 to monitor the Misfire Current Counters. Did the misfire move with the spark plug?	Go to Step 11	Go to Step 10
10	**NOTE** • Make sure all the fuel injectors operate. High resistance in a fuel injector circuit causes the fuel injector to be inoperative without setting a fuel injector DTC. • Return to this diagnostic after you complete the Fuel Injector Coil Test. 1 Perform the fuel injector coil test. Refer to 6.2 Fuel Injector Coil Test in this Section. Did you find and correct the condition?	Go to Step 13	Go to 5 Symptoms Diagnostics in this Section
11	1 Replace the spark plug. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 13	—
12	1 Replace the ignition coil. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running DTC P0301 to P0306. Do any Cylinder Engine Misfire DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

7.18 DTC P0324

DTC Descriptor

This diagnostic procedure supports DTC P0324 – Knock Sensor Module Performance

Circuit Description

The ECM supplies the ground to the knock sensor (KS) low reference circuit. The KS produces a signal voltage, which is proportional to the level of the engine vibration or spark knock.

When the ECM detects an excessive spark knock, it retards the ignition timing until the spark knock stops.

The KS circuitry within the ECM receives, amplifies, filters and evaluates the KS signal voltage. The ECM performs the following tests to determine if the ECM internal KS circuitry is functioning correctly.

Test One

The ECM performs the following:

1 Turns off the knock sensor signal circuits.

2 Applies different test signals to the ECM internal KS circuitry.

3 Verifies each test signal output response is within range.

4 If the ECM detects any of the tested signals are not within the normal range, DTC P0324 sets.

Test Two

The ECM performs the following:

1 Turns off the knock sensor signal circuits.

2 Tests for any output response when no test signals are applied.

3 If the ECM detects an output response, DTC P0324 sets.

Test Three

1 Turns off the knock sensor signal circuits.

2 Generates an internal test pulse then monitors the return signal.

3 If the return test pulse is less than a calibrated threshold, DTC P0324 sets.

DTC P0324 sets if the ECM detects an incorrect response to the ECM internal KS circuitry tests.

Conditions for Running the DTC

Condition One

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is less than 2,300 rpm and steady.
- The volumetric efficiency is steady.

Condition Two

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is 1,000 – 4,000 rpm
- The engine coolant temperature is greater than 60° C.
- The volumetric efficiency is steady.

Condition Three

Runs continuously once the following conditions are met:

- The ECM is controlling the ignition spark.
- The engine speed is less than 2,300 rpm and steady.
- The engine coolant temperature is greater than 40° C.
- The volumetric efficiency is steady.

Conditions for Setting the DTC

The ECM detects an incorrect response to an internal ECM KS circuitry test.

Conditions for Clearing the DTC

DTC P0324 – Knock Sensor (KS) Module Performance is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the knock sensor (KS) system operation.
- The ECM turns off the KS signal circuits when performing the ECM internal KS circuitry tests. DTC P0324 sets if there is a fault condition in the internal ECM KS circuitry. Therefore, the KS and the KS signal circuits are not tested in DTC P0324 Diagnostic Table.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

3 A crankshaft sensor DTC may trigger DTC P0324.

DTC P0324 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0324 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are DTCs relating to the CKP Sensor Circuit also set?	Refer to 7.20 DTC P0335, P0336, P0337 or P0338 in this Section	Go to Step 4
4	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 5	—
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running DTC P0324. Does DTC P0324 fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.19 DTC P0327, P0328, P0332 or P0333

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0327 – Knock Sensor Circuit Low Frequency (Bank 1)
- DTC P0328 – Knock Sensor Circuit High Frequency (Bank 1)
- DTC P0332 – Knock Sensor Circuit Low Frequency (Bank 2)
- DTC P0333 – Knock Sensor Circuit High Frequency (Bank 2)

Circuit Description

The ECM supplies the ground to the knock sensor (KS) low reference circuit. The KS produces a signal voltage, which is proportional to the level of the engine vibration or spark knock.

When the ECM detects an excessive spark knock, it retards the ignition timing until the spark knock stops.

To differentiate between a normal engine vibration and the vibration created by a spark knock, the ECM samples the KS signal under different engine speeds and load condition. The ECM uses this samples to determine maximum and minimum KS signal voltage produced when the engine is running under normal conditions.

A knock sensor circuit DTC sets if the ECM detects the KS signal voltage is outside the normal range.

Conditions for Running the DTC

DTC P0327 and P0332

Run continuously once the following conditions are met:

- DTCs P0324, P0335, P0342 and P0343 ran and passed.
- The ECM controls the ignition spark.
- Engine speed is greater than 2000 rpm and steady.
- The engine coolant temperature is greater than 60ºC.
- The volumetric efficiency is steady.

DTC P0328 or P0333

Run continuously once the following conditions are met:

- The ECM controls the ignition spark.
- Engine speed is greater than 2,000 rpm and steady.
- The engine coolant temperature is greater than 60°C.
- The volumetric efficiency is steady.

Conditions for Setting the DTC

DTC P0327 and P0332

The ECM detects the KS signal voltage is less than the minimum KS signal normal range for at least 10 seconds.

DTC P0328 and P0333

The ECM detects the KS signal voltage is greater than the maximum KS signal normal range.

Conditions for Clearing DTC

The knock sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the knock sensor (KS) system operation.
- Preconditions for running knock sensor circuit DTCs requires that DTC P0324 has ran and passed. Therefore, the diagnostic table for the knock sensor circuit DTCs is developed with the assumption the ECM internal KS circuitry is functioning correctly.
- Excessive engine mechanical noise or engine knocking condition may trigger knock sensor circuit DTCs.
- The knock sensor must be tightened correctly. Refer to 6C1-3 Engine Management – V6 – Service Operations.
- The mounting between the knock sensor and engine must be free of burrs, casting flash and foreign material.
- The knock sensor head must be clear from hoses, brackets and engine wiring.
- If the knock sensor lead is damaged in any way, the sensor must be replaced.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Identifies engine mechanical fault conditions that may trigger knock sensor circuit DTCs.

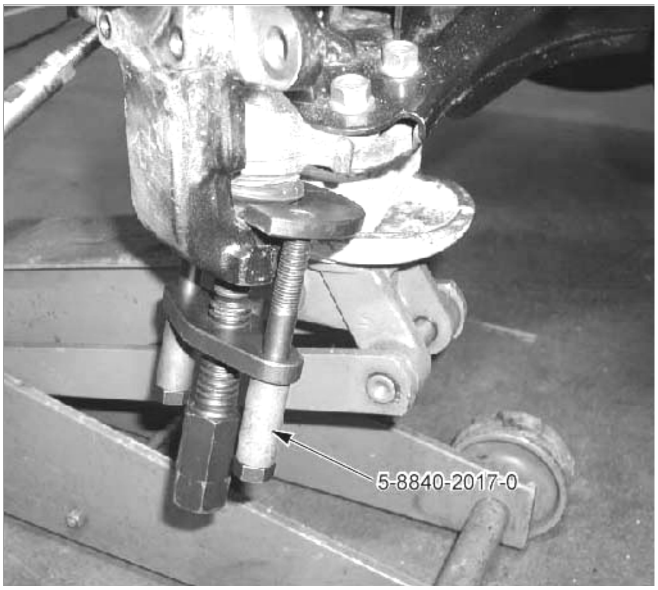
4 Identifies KS fault conditions that may trigger knock sensor circuit DTCs.

DTC P0327, P0328, P0332 and P0333 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0327, P0328, P0332 or P0333 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check the engine for excessive mechanical engine noise or engine knocking fault condition. Refer to 6A1 Engine Mechanical – V6. Was any fault found and rectified?	Go to Step 7	Go to Step 4
4	Inspect the appropriate KS for the following fault condition. Refer to 6C1-3 Engine Management – V6 – Service Operations. • incorrect KS attaching bolt torque value, • burrs, casting flash or foreign material between the knock sensor and engine, • hoses, brackets or engine wiring touching the KS, and • damaged KS wiring harness. • sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 5.2 Intermittent Fault Conditions in this Section. Was any fault found and rectified?	Go to Step 7	Go to Step 5

6. Remove the stabilizer link nuts. Right and left.
7. Remove the wheel speed sensor from the knuckle.
8. Remove back plate.
9. Remove lower ball joint by using remover 5-8840-2017-0.

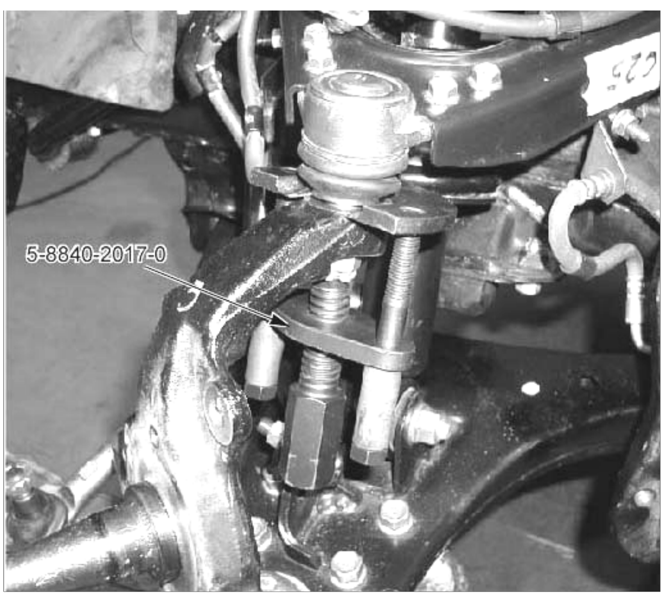
CAUTION: Be careful not to damage the ball joint boot.



P1010009

10. Remove upper ball joint by using remover 5-8840-2017-0.

CAUTION: Be careful not to damage the ball joint boot.



P1010011

11. Remove knuckle.

Inspection and Repair

Make the necessary adjustments or parts replacement if wear, damage, corrosion or any other abnormal condition is found during inspection.

Check the following parts:

- Knuckle
- Knuckle arm

Installation

1. Install knuckle assembly.
2. Install upper ball joint and tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

   Torque: 98 N·m (10.0 kgf·m/72 lb·ft)
3. Install lower ball joint and tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

   Torque: 147 N·m (15.0 kgf·m/108 lb·ft)
4. Install back plate.
5. Install wheel speed sensor.
6. Install stabilizer link nut. Right and left.

Step	Action	Yes	No
5	Test the appropriate KS signal circuit and low reference circuit for a high resistance, open circuit, short to ground or short to voltage or shorted together fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 7	Go to Step 6
6	Replace the faulty KS. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the knock sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.20 DTC P0335, P0336, P0337 or P0338

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0335 – Crankshaft Position Sensor Circuit Malfunction
- DTC P0336 – Crankshaft Position Sensor Signal Range / Performance
- DTC P0337 – Crankshaft Position Sensor Circuit Low Duty Cycle
- DTC P0338 – Crankshaft Position Sensor Circuit High Duty Cycle

Circuit Description

The ECM applies the ground to the crankshaft position (CKP) sensor low reference circuit.

The CKP sensor in conjunction with the 58X reluctor wheel generates an AC signal voltage. The amplitude and frequency of the signal generated is proportional to the engine speed. The ECM uses this signal from the CKP sensor signal circuit to determine the engine rpm

In addition, the CKP sensor sends a signal to the ECM when piston No. 1 and piston No. 4 are at the top dead centre position. The ECM monitors both the CKP signal and the camshaft position (CMP) sensor signal to determine the compression stroke of piston No. 1.

A CKP sensor DTC sets if the ECM detects a fault condition in the CKP sensor signal circuit.

Conditions for Running the DTC

DTC P0335

Runs continuously once the following conditions are met:

- The engine is cranking or running.
- The ECM detects greater than 8 CMP sensor pulses.

DTC P0336

Runs continuously once the following conditions are met:

- DTCs P0341, P0342 and P0343 ran and passed.
- The engine is cranking or running.
- The ECM detects a valid CMP signal.

DTC P0337 and P0338

Runs continuously once the following conditions are met:

- DTCs P0341, P0342 and P0343 ran and passed.
- The engine is cranking or running.
- The ECM detects a valid CMP signal.

Conditions for Setting the DTC

DTC P0335

The ECM does not detect a signal from the CKP sensor for 5 seconds.

DTC P0336

The ECM loses the crankshaft reference position and has to re-synchronise the crankshaft to camshaft one or more times during six consecutive crankshaft revolutions.

DTC P0337

The ECM detects less than 58 reference signal pulses from the CKP sensor in the last eight consecutive crankshaft revolutions.

DTC P0338

The ECM detects more than 58 reference signal pulses from the CKP sensor in the last eight consecutive crankshaft revolutions.

Conditions for Clearing DTC

The CKP sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the CKP sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- If the ECM has stored and learned the camshafts reference position, the ECM will utilise the camshaft position (CMP) sensor signal in place of the CKP signal when there is fault condition in the CKP circuit. This will enable the engine to operate in a limp mode when there is a CKP circuit fault condition.
- During a limp mode, the following DTCs may set and should be ignored.
  - DTC P0324 – Knock Sensor Module Performance
  - DTC P01011 – Intake Camshaft Position Actuator Park Position Bank 1
- The following fault condition may trigger DTC P0338:
  - Fault condition in the CMP sensor circuits.
  - Misaligned CKP sensor reluctor wheel or incorrect reluctor wheel installation.
  - Excessive crankshaft end play that alters the alignment of the reluctor wheel.
  - Obstruction between the CKP sensor and the reluctor wheel.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 The ECM supplies 2.5 V to signal circuit of the CKP sensor circuit to reduce the electro-magnetic interference (EMI). If the voltage is not within range, this indicates there is an ECM or an ECM circuit fault condition.

4 The ECM supplies 2.5 V to low reference circuit of the CKP sensor circuit to reduce the electro-magnetic interference (EMI). If the voltage is not within range, this indicates there is an ECM or an ECM circuit fault condition.

DTC P0335 to P0338 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Increase the engine speed to 1000 rpm for 30 seconds. 4 Using Tech 2, select the DTC display function. Does DTC P0335, P0336, P0337 or P0338 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the CKP sensor connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the signal circuit of the sensor connector and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 4	Go to Step 7
4	Using a digital multimeter, measure the voltage between the CKP sensor low reference circuit and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 5	Go to Step 7
5	Using a digital multimeter, measure the resistance between the ground shield circuit of the CKP sensor at the ECM connector and the ECM housing. Does the multimeter display 5 Ω?	Go to Step 6	Go to Step 7
6	Perform the following CKP sensor inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 5.2 Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching bolt torque value. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was any fault found and rectified?	Go to Step 11	Go to Step 9
7	Test the CKP sensor signal circuit and low reference circuit for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
8	Repair the open or high resistance fault condition in the CKP sensor ground shield circuit. Refer to 8A Electrical - Body and Chassis for information on electrical repair procedures. Was the repair completed?	Go to Step 11	—
9	Replace CKP sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the CKP sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.21 DTC P0341, P0342 or P0343

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0341 – Intake Camshaft Position Sensor Range / Performance (Bank 1)
- DTC P0342 – Intake Camshaft Position Sensor Low Voltage (Bank 1)
- DTC P0343 – Intake Camshaft Position Sensor High Voltage (Bank 1)

Circuit Description

The ECM applies 5 V to the camshaft position (CMP) sensors through the 5 V reference and ground through the low reference circuit.

The CMP sensor is a Hall effect switch. In conjunction with a 4X reluctor wheel, the CMP sensors provide a signal voltage to the ECM. The ECM uses this signal voltage to determine the position of the camshafts.

The ECM compares the CMP signal voltage to the number of crankshaft revolutions. A CMP sensor DTC sets if the ECM detects a fault condition in the CMP sensor circuits.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

DTC P0342

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is low in correlation with the number of crankshaft revolutions.

DTC P0341

The ECM detects a signal from the CMP sensor signal circuit and the sensor signal range is not within the predetermined parameter or the when the CMP sensor does not correlate with the crankshaft position.

DTC P0343

The ECM detects no pulses from the CMP sensor signal circuit and the CMP sensor signal voltage is always high.

Conditions for Clearing the DTC

The CMP sensor circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the CMP sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Tests the signal circuit of the CMP sensor. This circuit is pulled-up to about 5 V.

4 Measures the integrity of the CMP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0341, P0342 or P0343 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Increase the engine speed to 1000 rpm for 30 seconds. 4 Using Tech 2, select the DTC display function. Does P0341, P0342, P0343 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the appropriate CMP sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the signal circuit of the appropriate CMP sensor and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 7

Step	Action	Yes	No
4	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the CMP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 5	Go to Step 8
5	Test the signal circuit of the CMP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 6
6	Perform the following CMP sensor inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to 5.2 Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching bolt torque value. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Inspect the CMP sensor reluctor wheel for damage or conditions that causes misalignment. Was any fault found and rectified?	Go to Step 11	Go to Step 9
7	Test the CMP sensor 5 V reference circuit for a high resistance, open circuit, short to voltage or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** Each CMP sensor shares a common 5 V reference circuit. A fault condition in the 5 V reference circuit may trigger DTCs on all CMP sensors. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Test the CMP sensor low reference circuit for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The CMP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to aid diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the appropriate CMP sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—

Step	Action	Yes	No
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the CMP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.22 DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0351 – Ignition Coil Cylinder 1 Circuit Malfunction
- DTC P0352 – Ignition Coil Cylinder 2 Circuit Malfunction
- DTC P0353 – Ignition Coil Cylinder 3 Circuit Malfunction
- DTC P0354 – Ignition Coil Cylinder 4 Circuit Malfunction
- DTC P0355 – Ignition Coil Cylinder 5 Circuit Malfunction
- DTC P0356 – Ignition Coil Cylinder 6 Circuit Malfunction
- DTC P2300 – Ignition Coil Cylinder 1 Circuit Low Voltage
- DTC P2301 – Ignition Coil Cylinder 1 Circuit High Voltage
- DTC P2303 – Ignition Coil Cylinder 2 Circuit Low Voltage
- DTC P2304 – Ignition Coil Cylinder 2 Circuit High Voltage
- DTC P2306 – Ignition Coil Cylinder 3 Circuit Low Voltage
- DTC P2307 – Ignition Coil Cylinder 3 Circuit High Voltage
- DTC P2309 – Ignition Coil Cylinder 4 Circuit Low Voltage
- DTC P2310 – Ignition Coil Cylinder 4 Circuit High Voltage
- DTC P2312 – Ignition Coil Cylinder 5 Circuit Low Voltage
- DTC P2313 – Ignition Coil Cylinder 5 Circuit High Voltage
- DTC P2315 – Ignition Coil Cylinder 6 Circuit Low Voltage
- DTC P2316 – Ignition Coil Cylinder 6 Circuit High Voltage

Circuit Description

The engine control relay applies positive voltage to the ignition voltage circuit of the ignition coil and the ignition coil dual line ground circuits are directly connected to ground.

The ECM applies control voltage to the control circuit of the ignition coil during the calculated dwell period that allows current flow to the ignition coil primary winding to generate a magnetic flux field. At the appropriate firing point, the ECM interrupts the control voltage applied to the ignition coil.

Interruption of voltage applied to the control circuit of the ignition coil primary winding induces the transfer of electrical energy from the ignition coil primary winding to the ignition coil secondary winding, which triggers the ignition coil to produce a spark at the spark plug.

An ignition coil control circuit DTC sets if the ECM detects a fault condition in the control circuit of an ignition coil.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The engine is running.
- The engine speed is 480 – 5,000 rpm
- The battery voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0351, P0352, P0353, P0354, P0355 or P0356

The ECM detects an open circuit fault condition in the ignition coil control circuit.

DTC P2300, P2303, P2306, P2309, P2312 or P2315

The ECM detects a short to ground fault condition in the ignition coil control circuit.

DTC P2301, P2304, P2307, P2310, P2313 and P2316

The ECM detects a short to voltage fault condition in the ignition coil control circuit.

Conditions for Clearing the DTC

The ignition coil control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ignition coil operation.
- A short to voltage fault condition damages the ignition coil. Do not replace the ignition until this fault condition is rectified.
- The ignition coils for each bank of the engine are fused separately. If all DTCs for a single bank are set, there may be a fault in one of the ignition supply circuits.
- The ignition coils for each bank of the engine have a separate ground connections. If all DTCs for a single bank are set, there may be a fault in one of the ground circuits.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Determines if there is a fault condition in the ignition voltage supply circuit.

5 Determines if there is a fault condition in the ground circuits of the ignition coil.

6 Tests if the ECM is commanding the ignition coil on and off.

DTC P0351 to P0356, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315 or P2316 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0351, P0352, P0353, P0354, P0355, P0356, P2300, P2301, P2303, P2304, P2306, P2037, P2309, P2310, P2312, P2313, P2315 or P2316 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the wiring connector of the appropriate ignition coil. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the ignition voltage circuit of the appropriate ignition coil connector and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 6
4	Connect a test lamp between a 12 V and each of the ground circuits of the ignition coil connector. Does the test lamp illuminate?	Go to Step 5	Go to Step 7
5	1 Start the engine. 2 Using a digital multimeter, measure the frequency at the control circuit of the ignition coil. Does the multimeter display 3 – 20 Hz?	Go to Step 9	Go to Step 8
6	Repair the high resistance or open circuit fault condition at the ignition voltage circuit of the ignition coil. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 11	—
7	Repair the high resistance or open circuit fault condition at the ignition coil ground circuits. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 11	—
8	Test the appropriate ignition coil control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	CAUTION **A short to voltage fault condition damages the ignition coil. Do not replace the ignition until this fault condition is rectified.** Replace the faulty ignition coil. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—

Step	Action	Yes	No
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ignition coil control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.23 DTC P0420 or P0430

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0420 Catalyst System Low Efficiency Bank 1
- DTC P0430 Catalyst System Low Efficiency Bank 2

Circuit Description

To maintain a reasonably low emission level of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) a 3-way catalytic converter (TWC) is used. The catalyst within the converter promotes a chemical reaction that oxidizes the HC and CO present in the exhaust gas. This reaction converts the gases into harmless water vapour and carbon dioxide. The catalyst also reduces the NOx, converting the NOx into nitrogen. The engine control module (ECM) monitors this process using the post catalyst heated oxygen sensor (HO2S) signal. The post-catalyst HO2S located in the exhaust stream after the TWC, produces an output signal that indicates the oxygen storage capacity of the catalyst. The oxygen storage capacity (OSC) determines the ability of the catalyst to convert the exhaust emissions effectively. If the catalyst is functioning correctly, the post-catalyst HO2S signal will be far less active than the signal produced by the pre-catalyst HO2S.

To determine OSC, the ECM commands a rich air / fuel mixture until all oxygen is removed from the catalyst. The ECM then commands a lean air / fuel mixture and monitors the rear heated oxygen sensors to calculate the oxygen storage capacity. The catalyst is operated in this mode until one of the following conditions occur:

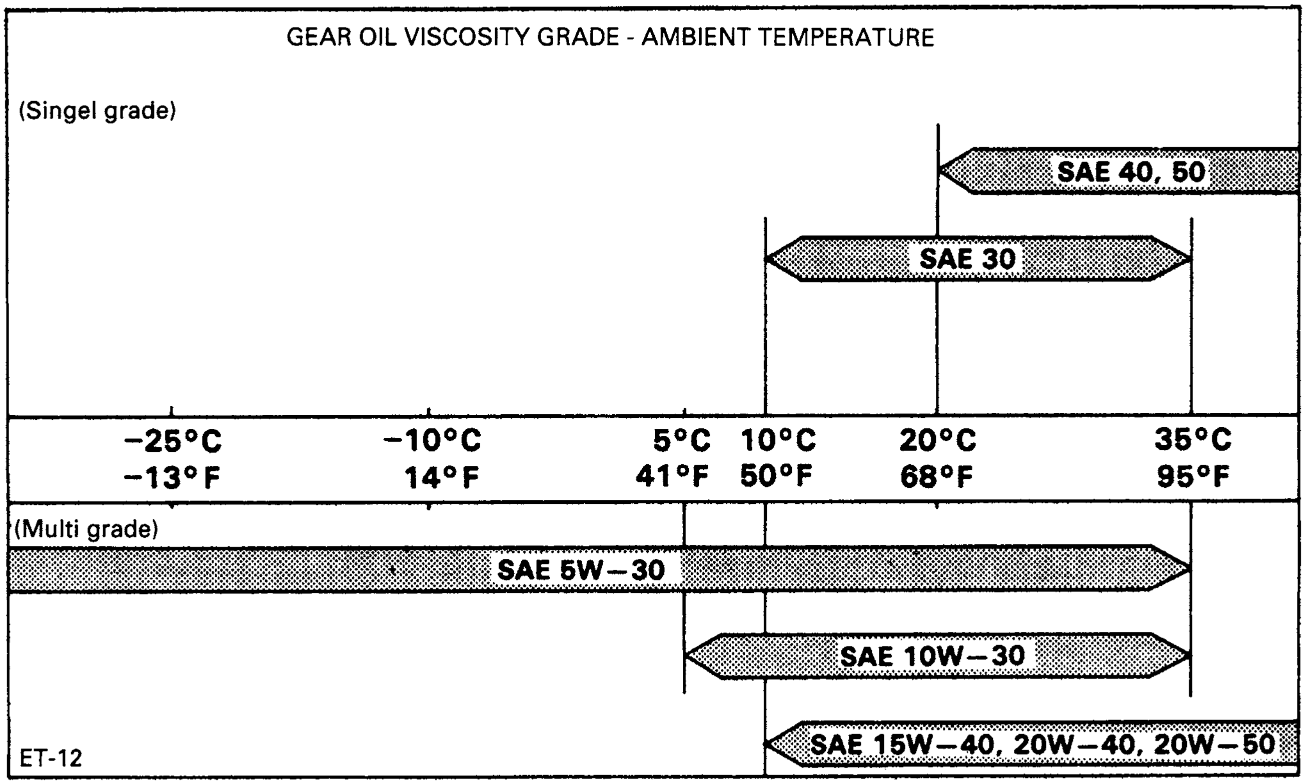
- The oxygen stored in the catalyst exceeds a calibrated threshold, which is determined from the rear HO2S signal.
- The rear HO2S indicates the catalyst to be completely saturated with oxygen, which is determined from the rear HO2S signal.

If the ECM detects the average OSC is less than a threshold, this DTC sets. This indicates that the TWC oxygen storage capacity is below a threshold considered acceptable.

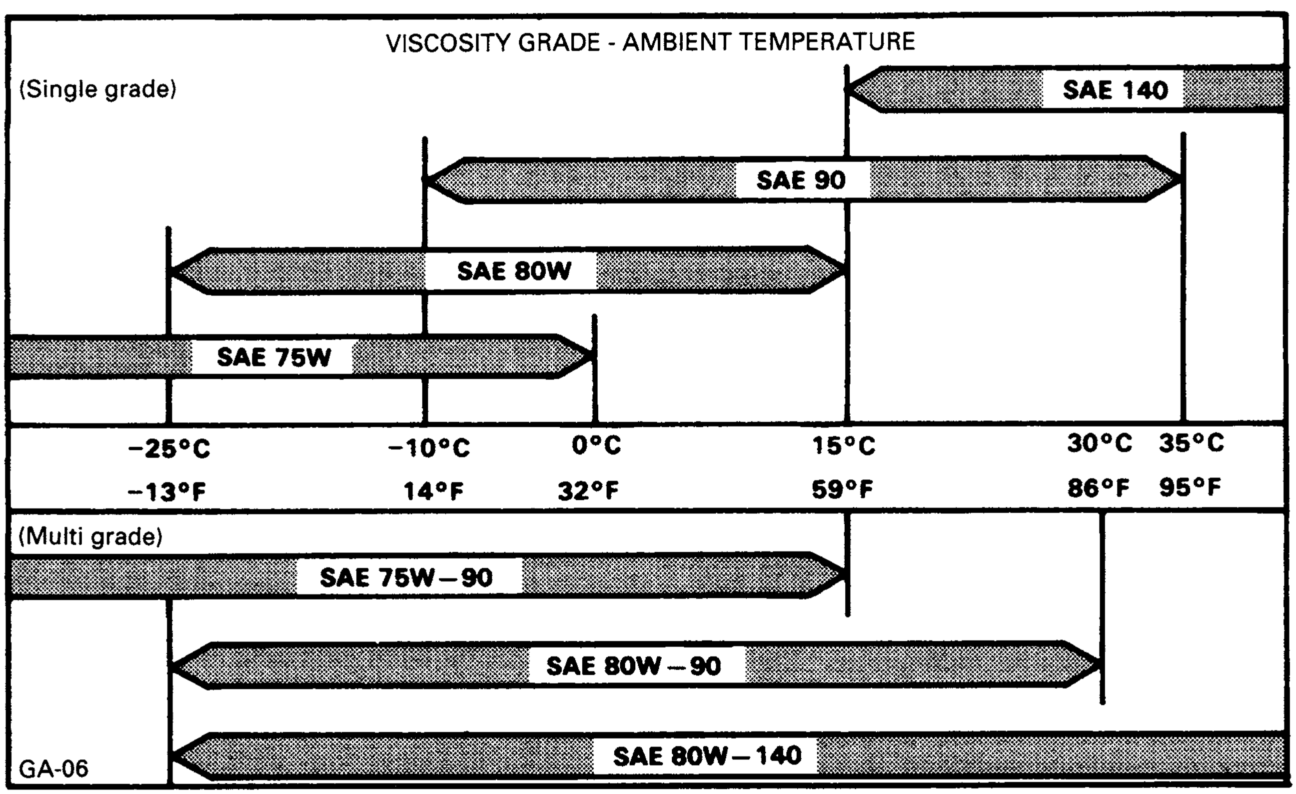
Conditions for Running the DTC

- Before the ECM can report, the following DTCs must run and pass:
  DTC P0420 or P0430 failed, DTCs P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0053, P0056, P0057, P0058, P0059, P0101, P0102, P0103, P0121, P0122, P0123, P0130, P0131, P0132, P0133, P0135, P0137, P0138, P0139, P0140, P0141, P0150, P0151, P0152, P0153, P0155, P0157, P0158, P0159, P0160, P0161, P0221, P0222, P0223, P0335, P0336, P0338, P167A, P167B, P2096, P2097, P2098, P2099, P2195, P2196, P2197, P2198, P2232, P2235, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2272, P2273, P2297, P2298, P2626, and P2629.
- The following DTCs are not set:
  DTCs P0030, P0031, P0032, P0036, P0037, P0038, P0050, P0051, P0052, P0053, P0056, P0057, P0058, P0059, P0101, P0102, P0103, P0116, P0117, P0118, P0119, P0121, P0122, P0123, P0125, P0130, P0131, P0132, P0133, P0135, P0137, P0138, P0139, P0140, P0141, P0150, P0151, P0152, P0153, P0155, P0157,

OIL VISCOSITY CHART FOR TRANSMISSION CASE

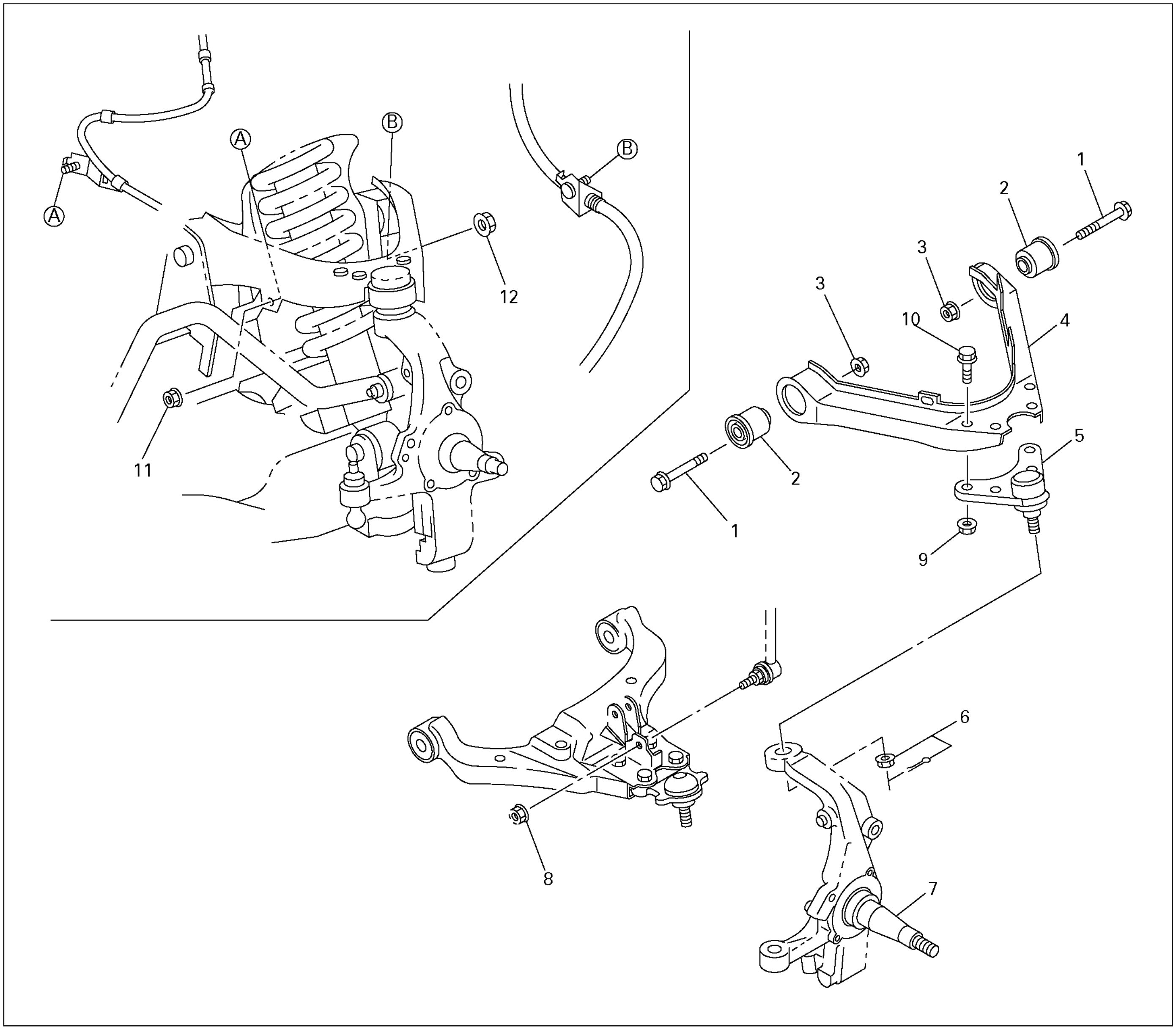


OIL VISCOSITY CHART FOR FRONT AXLE AND REAR AXLE



Upper Control Arm

Upper Control Arm and Associated Parts



450R300038

Legend

(1) Upper Control Arm Bolt
(2) Bushing
(3) Upper Control Arm Nut
(4) Upper Control Arm Assembly
(5) Upper Ball Joint
(6) Nut and Cotter Pin
(7) Knuckle
(8) Link Nut
(9) Upper Ball Joint Nut
(10) Upper Ball Joint Bolt
(11) Speed Sensor Harness Nut
(12) Brake Fluid Hose Nut

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove speed sensor harness nut.
4. Remove brake fluid hose nut.

P0158, P0159, P0160, P0161, P0221, P0222, P0223, P0300, P0301-P0306, P0443, P0458, P0459, P0496, P167A, P167B, P2096, P2097, P2098, P2099, P2100, P2101, P2107, P2119, P2122, P2123, P2127, P2128, P2138, P2176, P2177, P2178, P2179, P2180, P2187, P2188, P2189, P2190, P2195, P2196, P2197, P2198, P2232, P2235, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2272, P2273, P2297, P2298, P2626, and P2629.

- The engine speed is 1,040 – 3,000 rpm.
- The air flow into the engine is between 7.0 – 16.0 g/s and not changing more than 3.0 g/s
- The engine intake air temperature (IAT) at engine start-up is more than –30° C.
- The engine is operating for more than 7 minutes.
- The engine is operating in Closed Loop.
- The calculated TWC temperature is between 500 – 750° C and steady.
- The above conditions exist for approximately 17 minutes.
- DTCs P0420 and P0430 run once a drive cycle. The ECM will attempt to run this diagnostic up to three times a drive cycle.

Conditions for Setting the DTC

The ECM determines that the catalyst efficiency has degraded below a calibrated threshold for more than 4 seconds.

Action Taken When the DTC Sets

- The control module activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the DTC

The EVAP Purge Solenoid Valve Control Circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

P0420 or P0430 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been completed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	Are any other DTCs set?	Go to the appropriate DTC Table in this Section	Go to Step 3
3	1 Inspect for the following conditions: • The catalytic converter is an original equipment part. • Inspect the exhaust system for leaks, damage, loose or missing hardware in the area from the converter to the heated oxygen sensor 2. • The HO2S 2 is secure and the wiring is not damaged or contacting the exhaust. Did you find and correct the condition?	Go to Step 5	Go to Step 4

Step	Action	Yes	No
4	**NOTE** Before replacing the 3-way catalytic converter (TWC), correct any conditions that may have damaged the converter. 1 Replace the catalytic converter. Refer to the appropriate procedure in 6F Exhaust System – V6. Did you complete the replacement?	Go to Step 5	—
5	1 Using Tech 2, clear the DTC/s. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the EVAP purge solenoid valve control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation			

7.24 DTC P0443, P0458 or P0459

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0443 – Evaporative Emission Control System Purge Solenoid Circuit Malfunction
- DTC P0458 – Evaporative Emission Control System Purge Solenoid Circuit Low Voltage
- DTC P0459 – Evaporative Emission Control System Purge Solenoid Circuit High Voltage

Circuit Description

The Engine control relay applies ignition positive battery voltage to the evaporative emission (EVAP) purge solenoid.

Using a device called a driver, the ECM applies a pulse width modulated (PWM) ground to the EVAP solenoid control circuit to purge the fuel vapour from the EVAP canister into the intake manifold.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An EVAP purge solenoid valve control circuit DTC sets if the ECM detects the voltage on the EVAP solenoid control circuit outside the predetermined range when the solenoid is commanded off.

Conditions for Running the DTC

DTC P0443 and P0458

Runs continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The ECM has commanded the EVAP Purge Solenoid Valve on and off at least once during the ignition cycle.

DTC P0459

Runs continuously once the following conditions are met:

- The engine speed is greater than 80 rpm
- The ignition voltage is 10.0 – 16.0 V.
- The fuel system is in closed loop.
- The engine speed is above idle.
- The engine is at operating temperature.
- The ECM has commanded the EVAP Purge Solenoid Valve on and off with a duty cycle of greater than 2.5%.

Conditions for Setting the DTC

DTC P0443

The ECM detects the voltage on the EVAP solenoid control circuit is not within the predetermined range when the solenoid is commanded off.

DTC P0458

The ECM detects the voltage on the EVAP solenoid control circuit is less than 2.6 V when the solenoid is commanded off.

DTC P0459

The ECM detects the voltage on the EVAP solenoid control circuit is greater than 4.6 V when the solenoid is commanded on.

Conditions for Clearing the DTC

The EVAP Purge Solenoid Valve Control Circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the EVAP Purge Solenoid Valve operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Tests the feedback voltage from the ECM.

DTC P0443, P0458 or P0459 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

Step	Action	Yes	No
2	1 Switch off the ignition for 30 seconds. 2 Allow the engine to reach the normal operating temperature or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0443, P0458 or P0459 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the EVAP solenoid valve wiring connector. 2 Switch on the ignition with the engine not running. 3 Connect a test lamp between the EVAP solenoid valve ignition voltage circuit and the ECM housing. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the EVAP solenoid valve control circuit and the ECM housing. Does the multimeter display 2.6 – 4.6 V?	Go to Step 7	Go to Step 6
5	Repair the high resistance, open circuit or short to ground fault condition at the EVAP solenoid valve ignition voltage circuit. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the EVAP solenoid valve for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the EVAP solenoid valve. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the EVAP purge solenoid valve control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.25 DTC P0460, P0461, P0462 or P0463

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0460 – Fuel Level Sensor Range / Performance

- DTC P0461 – Fuel Level Sensor Range / Performance
- DTC P0462 – Fuel Level Sensor Low Voltage
- DTC P0463 – Fuel Level Sensor High Voltage

Circuit Description

The fuel level sensor changes resistance based on the fuel level in the fuel tank. The engine control module (ECM) monitors changes in the resistance of the sensor to determine the fuel level. This information is then sent to the instrument cluster via the GM LAN serial data circuit.

When the fuel tank is full, the sensor resistance is high and the ECM senses high signal voltage. When the fuel tank is empty, the sensor resistance is low and the ECM senses a low signal voltage.

When the ECM senses a signal voltage outside the normal operating range of the sensor, a fuel level sensor DTC will set.

Conditions for Running the DTC

The ignition is on.

Conditions for Setting the DTC

DTC P0461

The ECM detects that greater than 170 km have been accumulated and the fuel level in the fuel tank has not changed by at least 3.0 litres.

DTC P0462

The ECM detects the fuel level signal voltage is less than 0.5 V for 20 seconds.

DTC P0463

The ECM detects the fuel level signal voltage is greater than 4.5 V for 20 seconds.

Conditions for Clearing the DTC

The fuel level sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to 8A Electrical-Body and Chassis for further information on the fuel gauge system.
- Depending on the current fuel level, it may be difficult to locate a malfunctioning sending unit. The malfunction may only occur when the fuel level is full or near empty. The fuel sender unit may need to be removed for further diagnosis. A fuel level sensor that has an intermittent condition may cause a DTC to set. Remove the fuel level sensor to test the resistance of the sensor, refer to 6C Fuel System – V6 for this procedure. Replace the sensor if the resistance is not within the specified range.
- The following may occur with a fuel level sensor DTC set:
  - The vehicle fuel gauge displays empty.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0461, P0462 or P0463 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC or road test the vehicle under various driving condition. 3 Using Tech 2, select the DTC display function. Does DTC P0461, P0462, P0463 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the fuel level sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the fuel level signal circuit and the ECM housing. Does the multimeter indicate 4.8 – 5.2 V?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove ECM Fuse F29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the fuel level sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse F29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter indicate less than 5 Ω?	Go to Step 7	Go to Step 6
5	Test the fuel level sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
6	Test the fuel level sensor low reference circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the fuel level sensor. Refer to 6C Fuel System – V6s. Was the repair completed?	Go to Step 9	–
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	–
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any fuel level sensor DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10

Step	Action	Yes	No
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.26 DTC P0480, P0691 or P0692

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0480 – Cooling Fan Relay 1 Circuit Malfunction
- DTC P0691 – Cooling Fan Relay 1 Circuit Low Voltage
- DTC P0692 – Cooling Fan Relay 1 Circuit High Voltage

Circuit Description

The engine control relay applies ignition positive battery voltage to the ignition circuit of the engine cooling fan relay 1 and relay 2. Using a device called a driver, the ECM performs the following tasks:

- grounds the engine cooling fan relay 1 control signal circuit to operate the small engine cooling fan, or
- grounds the engine cooling fan relay 2 control signal circuit to operate both the small engine cooling fan and the large engine cooling fan.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

A cooling fan relay control circuit DTC sets if the ECM detects a fault condition in the engine cooling fan relay control circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the ignition voltage is 10 – 16 V,
- the engine speed is greater than 40 rpm, and
- the ECM driver transitions from on to off or from off to on.

Conditions for Setting the DTC

DTC P0480

The ECM detects an open circuit fault condition in the control circuit of the engine cooling fan relay 1.

DTC P0691

The ECM detects a short to ground fault condition in the control circuit of the engine cooling fan relay 1.

DTC P0692

The ECM detects a short to voltage fault condition in the control circuit of the engine cooling fan relay 1.

Conditions for Clearing DTC

The cooling fan relay control circuit DTCs are Type B DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTCs set and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6B1 – Engine Cooling – V6 for details of the engine cooling fan operation.

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical-Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0480, P0691 & P0692 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds or operate the vehicle within the conditions for setting the DTC. 5 Using Tech 2, select the DTC display function. Does DTC P0480, P0691 or P0692 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the appropriate engine cooling fan relay. Refer to 8A Electrical-Body and Chassis. 2 Connect a test lamp between the ignition voltage circuit of the engine cooling fan relay and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Connect a test lamp between the control circuit of the appropriate engine cooling fan relay and a 12 V. 3 Switch on the ignition with the engine not running. 4 Using Tech 2, command the appropriate engine cooling fan relay on and then off. Does the test lamp turn on and off when the engine cooling fan relay is commanded on and off?	Go to Step 7	Go to Step 6
5	Repair the high resistance or open circuit fault condition in the ignition voltage circuit of the engine cooling fan relay. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the engine cooling fan relay control circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the faulty engine cooling fan relay. Refer to 8A Electrical-Body and Chassis. Was the repair completed?	Go to Step 9	—

Step	Action	Yes	No
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the cooling fan relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.27 DTC P0500

DTC Descriptor

This diagnostic procedure supports DTC P0500 – Vehicle Speed Sensor Circuit Malfunction (Manual Transmission).

Circuit Description

Vehicle speed information is provided to the engine control module (ECM) by the vehicle speed sensor (VSS). The ignition control relay applies ignition positive voltage to the VSS, and the ground circuit of the VSS is directly connected to ground.

The VSS is a Hall effect switch. In conjunction with an 18 tooth reluctor wheel, the VSS provide a signal voltage to the ECM. The ECM uses this signal voltage to determine vehicle speed.

If the ECM detects no vehicle speed, while other sensors indicate that the vehicle is moving, then DTC P0500 sets.

Conditions for Running the DTC

Runs once the following conditions are met:

- The engine coolant temperature is greater than 40º C,
- the ECM is in fuel shut-off mode, and
- the engine speed is between 1,520 and 3,520 rpm

Conditions for Setting the DTC

The ECM detects a speed of less than 0 km/h for 8 seconds continuously, or 50 seconds cumulative.

Conditions for Clearing the DTC

The vehicle speed sensor circuit malfunction DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details on:
  - VSS operation, and
  - fuel shut-off mode.

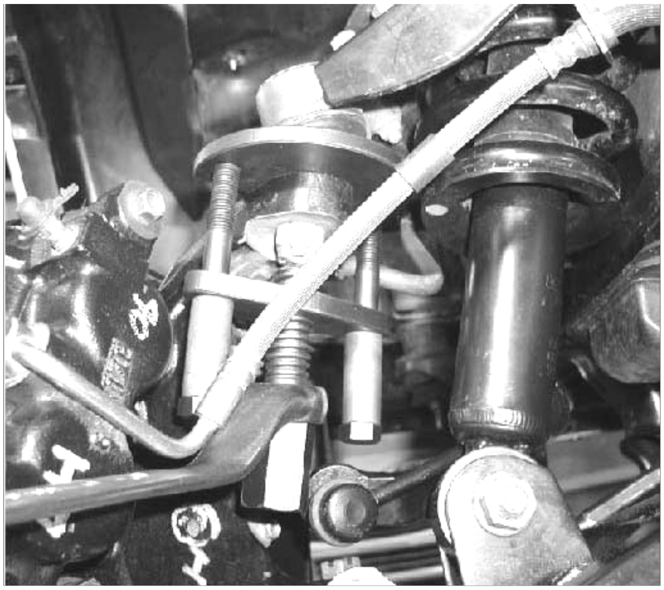
- Refer to 7B1 Manual Transmission – V6 for VSS replacement procedures.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0500 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0500 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the wiring connector from the VSS. 3 Connect a test lamp between the ignition circuit of the VSS and ground. 4 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 4
4	Repair the high resistance or open circuit fault condition in the ignition circuit of the VSS. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 12	—
5	1 Connect a test lamp between the ground circuit and ignition circuit of the VSS. 2 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 7	Go to Step 6
6	Repair the high resistance or open circuit fault condition in the ground circuit of the VSS. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 12	—

5. Remove link nut.
6. Remove upper ball joint by using remover 5-8840-2017-0.

CAUTION: Be careful not to damage the ball joint boot.



P1010005

7. Remove upper control arm nut.
8. Remove upper control arm bolt.
9. Remove upper ball joint bolt and nut.
10. Remove upper ball joint.
11. Remove upper control arm assembly.
12. Remove bushing.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal conditions are found during inspection.

Check the following parts:

- Upper control arm
- Bushing

Installation

1. Install bushing by using installer 5-8840-0257-0 and 5-8840-2327-0.

P1010062

2. Install upper ball joint and tighten it to the specified torque.

   Torque: 31 N·m (3.2 kgf·m/23 lb·ft)

3. Install nut and cotter pin then tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

   Torque: 98 N·m (10.0 kgf·m/72 lb·ft)

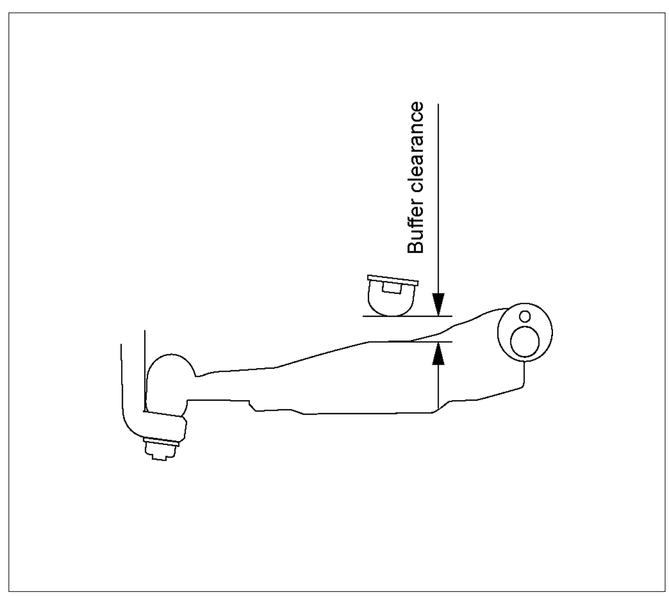
4. Install upper control arm assembly.
5. Install upper control arm bolt and nut.

NOTE: Apply oil to the thread.

NOTE: Tighten the bolt with the parts in the position shown in the illustration below.

Buffer clearance: 25.9 mm (1.02 in)

Torque: 137 N·m (14.0 kgf·m/101 lb·ft)



RTW53ASH000201

6. Install brake fluid hose nut.
7. Install speed sensor harness nut.

Step	Action	Yes	No
7	**CAUTION** **To avoid damage to the drive axles, support the lower control arms in the normal horizontal position. Do not run the vehicle in gear with the wheels hanging down at full travel.** 1 Raise the vehicle and support the drive axles with safety stands. Refer to 0A General Information for the location of jacking and support points. 2 Connect a fused jumper wire between the ground circuit of the connector and the ground circuit of the VSS. 3 Connect a fused jumper wire between the ignition circuit of the connector and the ignition circuit of the VSS. 4 Using connector test adaptor kit J 35616-A, connect a digital multimeter between the VSS signal circuit and ground. 5 Place the transmission in neutral. 6 Rotate the rear wheels by hand while observing the multimeter. Does the multimeter indicate greater than 0.15 V AC?	Go to Step 10	Go to Step 8
8	Perform the following VSS inspection: • Inspect the VSS wiring harness for conditions that may induce electromagnetic interference. Refer to 5.2 Intermittent Fault Conditions in this Section. • Inspect the VSS for incorrect installation or incorrect attaching bolt torque value. Refer to 6C1-3 Engine Management – V6 – Service Operations. • Inspect the VSS sensor reluctor wheel for damage or conditions that causes misalignment. Was any fault found and rectified?	Go to Step 12	Go to Step 9
9	Replace the VSS. Refer to 7B1 Manual Transmission – V6. Was the repair completed?	Go to Step 12	—
10	Test the VSS signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
11	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0500 fail this ignition cycle?	Go to Step 2	Go to Step 13

Step	Action	Yes	No
13	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.28 DTC P0504 or P0571

DTC Descriptor

This diagnostic procedure supports:

- DTC P0504 – Brake Switch Circuit Malfunction.
- DTC P0571 – Cruise Control Brake Switch Circuit

Circuit Description

The brake switch assembly is comprised of two individual switches, a stop lamp switch and cruise control cancel switch. The ECM uses inputs from both of these switches for enabling cruise control, brake torque management etc. For further information on the brake switch assemblies, refer to 6C1–1 Engine Management – V6 – General Information.

The ECM monitors both switches, and if the signals do not correlate, DTC P0504 will set. If the ECM determines that a fault exists in the cruise control cancel circuit, DTC0571 will set.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects one of the following conditions:

- Only one switch signal is present when the vehicle accelerates or decelerates rapidly ten times.

NOTE
The ECM will count over several drive cycles.

- A signal is seen from the stop lamp switch and cruise control cancel switch when the vehicle accelerates rapidly.
- The ECM does not detect a signal from the switches during braking.

Conditions for Clearing the DTC

The brake switch circuit DTC is a Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type B DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the brake switch operation.
- Refer to 8C Cruise Control – HFV6 for brake pedal switch operation and testing.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

3 A fault condition in the stop lamp switch assembly may trigger these DTCs.

DTC P0504 or P0571 Diagnostic Table

Step	Action	Yes	No
1	Has the diagnostic system check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0504 or DTC P0571 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Ignition ON, engine OFF. 2 On Tech 2 select: **Engine** / **V6 Engine** / **Data Display** / **Cruise Control Data**. 3 Observe the status of the brake lamp switch and cruise control cancel switch. 4 Fully depress the brake pedal. Does Tech 2 display change from **Inactive** to **Active** in all switches when the pedal is pressed?	Refer to Additional Information in this DTC	Go to Step 4
4	Did the brake lamp switch Tech 2 status fail to change?	Go to Step 5	Go to Step 9
5	1 Disconnect the wiring connector from the brake switch assembly. Refer to 8C Cruise Control. 2 Ignition ON. 3 Connect a test lamp between the voltage circuit of the stop lamp switch and a good ground. Does the test lamp illuminate?	Go to Step 7	Go to Step 6
6	1 Repair the high resistance or open circuit fault condition in the voltage circuit of the stop lamp switch. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
7	1 Test the stop lamp switch. Refer to 8C Cruise Control – HFV6. Was any fault found and rectified?	Go to Step 14	Go to Step 8
8	1 Test the control circuit of the stop lamp switch for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was the repair completed?	Go to Step 14	Go to Step 13
9	1 Disconnect the wiring connectors from the brake switch assembly. Refer to 8C Cruise Control – HFV6. 2 Ignition ON. 3 Connect a test lamp between the voltage circuit of the cruise control cancel switch and a good ground. Does the test lamp illuminate?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
10	1 Repair the high resistance or open circuit fault condition in the voltage circuit of the cruise control cancel switch. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 14	—
11	1 Test the cruise control cancel switch. Refer to 8C Cruise Control – HFV6. Was any fault found and rectified?	Go to Step 14	Go to Step 12
12	1 Test the control circuits of the cruise control cancel switch for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was the repair completed?	Go to Step 14	Go to Step 13
13	1 Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 14	—
14	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0504 or P571 fail this ignition cycle?	Go to Step 2	Go to Step 2
15	1 Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.29 DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0506 – Idle Speed Control rpm Too Low
- DTC P0507 – Idle Speed Control rpm Too High
- DTC P0638 – Commanded Versus Actual Throttle Position Correlation
- DTC P1551 – Throttle Control Lower Position Not Reached During Learning Mode
- DTC P2100 – Throttle Control Motor Malfunction
- DTC P2101 – Throttle Control Position Range / Performance
- DTC P2119 – Closed Throttle Position Range / Performance
- DTC P2176 – Throttle Control Lower Position not Learned

Circuit Description

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.

- To control the throttle opening, the ECM applies PWM voltage to the throttle actuator motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.
- To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the throttle actuator motor control circuit then applies a PWM voltage to the throttle actuator motor.

In addition, the ECM monitors the signal voltage applied to the throttle actuator motor control circuit. A TAC motor control circuit DTC sets if the ECM detects a fault condition in the TAC circuits or motor performance.

Conditions for Running the DTC

DTC P0506 and P0507

Runs continuously once the following conditions are met:

- DTCs P0112, P0113, P0117, P0118, P0121, P0122, P0123, P0221, P0222, P0223, P0443, P0446, P0455, P0458 and P0459 are not set.
- The ignition is switched on.
- The vehicle speed is 0 km/h.
- The engine coolant temperature is greater than 60°C.
- The intake air temperature is greater than -10.5°C.
- The volumetric efficiency is less than 35 percent.
- The EVAP purge solenoid is off.

DTC P0638

Runs continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is greater than 7 V.

DTC P2100

Runs continuously once the following conditions are met:

- DTC P2101 ran and passed.
- The ignition is switched on.

DTC P2101

Runs continuously once the following conditions are met:

- The battery voltage is greater than 7 V.
- The ignition is switched on.

DTC P1551, P2119 and P2176

Runs continuously once the following conditions are met:

- The ignition is switched on.
- The vehicle speed is 0 km/h.
- The engine speed is less than 40 rpm
- The engine coolant temperature is 5 – 60°C.
- The intake air temperature is 5 – 60°C.
- The ignition voltage is greater than 10 V.
- The APP is less than 15 percent.

Conditions for Setting the DTC

DTC P0506

The actual engine speed is less than the desired idle speed by at least 100 rpm for 10 seconds.

DTC P0507

The actual engine speed is greater than the desired idle speed by at least 200 rpm for 10 seconds or the ECM detects three fuel cut-offs due to an engine over speed condition while the engine is idling.

DTC P0638

The ECM detects the commanded duty cycle is greater than 80 percent for longer than 0.6 second.

DTC P1551

The ECM detects the TP sensor angle is outside the predetermined range of 1.8 – 13.0 percent when the TAC motor is deactivated.

DTC 2100

The ECM detects that its internal TAC motor output driver does not deactivate when commanded off.

DTC P2101

The ECM detects the difference between the commanded and the actual throttle opening is greater than 10 percent.

DTC P2119

The ECM determines the throttle plate didn't return to the rest position within 720 milliseconds.

DTC P2176

One of the following conditions exist:

- The TP sensor 1 voltage is outside the range of 0.2 – 0.9 V during the throttle learn procedure.
- The TP sensor 2 voltage is outside the range of 4.2 – 4.8 V during the throttle learn procedure.
- The throttle learn procedure is not learned after an ECM replacement.

Conditions for Clearing DTC

The TAC motor control circuit DTCs are Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the Throttle Actuator Control System operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 A constant force return spring holds the throttle plate at a constant seven percent throttle opening position and should move in either direction under spring pressure and without binding.

8 When the ignition is switched on, the ECM operates the throttle actuator motor to verify the integrity of the TAC system prior to start up. This can be seen by the momentary flash of the test lamp as the ignition is switched on.

P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Start the engine. 4 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times. 5 Using Tech 2, select the DTC display function. Does DTC P0506, P0507, P0638, P1551, P2100, P2101, P2119 or P2176 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Is DTC P0121, P0122, P0123, P0221, P0222 or P0223 also set?	Go to the appropriate DTC table.	Go to Step 4
4	1 Disconnect the throttle actuator wiring connector. **WARNING** **Accidental operation of the TAC motor while performing throttle plate inspection may cause severe personal injury. Refer to 6C1-3 Engine Management – V6 – Service Operations for additional precautions on throttle body service procedure.** 2 Inspect the throttle plate for the following: • excessive dirt build-up in the throttle body, • not in rest position, • binding open or binding close, • binding when moving from open to close or close to open position, and • free to move open or close without spring pressure. Was any fault found and rectified?	Go to Step 13	Go to Step 5
5	Inspect the engine for fault conditions that causes incorrect idle speed. Refer to 5.12 Rough, Unstable, Incorrect Idle or Stalling in this Section. Was any fault found and rectified?	Go to Step 13	Go to Step 6
6	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the TAC positive circuit and the ECM housing. Does the multimeter display 2 – 4 V?	Go to Step 7	Go to Step 9
7	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the TAC negative control circuit and the ECM housing. Does the multimeter display 2 – 4 V?	Go to Step 8	Go to Step 9

Step	Action	Yes	No
8	1 Switch off the ignition. 2 Connect Tool No. J34730-405 injector test lamp between the positive and negative control circuit of the TAC. 3 Switch on the ignition for about 5 seconds then switch off while observing the test lamp. Does the test lamp illuminate briefly each time the ignition cycles?	Go to Step 11	Go to Step 10
9	Test the TAC control circuit that measured outside the specified value for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
10	Test the positive and negative control circuits of the TAC for a shorted together fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 13	Go to Step 12
11	Replace the throttle body assembly. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
12	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 13	—
13	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the TAC motor control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 14
14	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.30 DTC P0513, P0633, P1629, P1632, P1677, P1678 or P1679

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0513 – Wrong Transponder Key
- DTC P0633 – Immobiliser Function Not Programmed
- DTC P1629 – Immobiliser Fuel Enable Signal Not Received
- DTC P1632 – Immobiliser Fuel Disable Signal Received
- DTC P1677 – Immobiliser Function Not Enabled
- DTC P1678 – Engine Control Module Identification Failed
- DTC P1679 – Immobiliser Environment Identification Failed

Circuit Description

The engine control module (ECM), the powertrain interface module (PIM) and the immobiliser control unit (ICU) are integral parts of the vehicle immobiliser system. The immobiliser system authenticates the security code programmed into each of these modules to prevent unauthorised vehicle operation. This authentication process includes the following steps:

1 At predetermined situations, the ICU sends a security code to the PIM.

2 When the ignition is switched ON, the PIM receives and compares this security code from the ICU against the security code programmed into the PIM.

3 Once the PIM receives the correct security code from the ICU, it sends a security code to the ECM.

4 The ECM receives and compares this security code from the PIM against the security code programmed into the ECM.

5 The authentication process is complete once the ECM receives the correct security code from the PIM within the specified time frame.

6 The ECM allows normal vehicle operation.

NOTE

If any of these authentication processes fail, the vehicle will not start and DTCs will set. For further information on the immobiliser system, refer to 11A Immobiliser.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

P0513

The ECM receives an incorrect response from the PIM during the immobiliser authentication process.

P0633

An attempt is made to start the engine before the immobiliser function has been programmed into a new PIM.

P1629

The ECM has not received a fuel enable password from the ICU.

P1632

The ECM receives an incorrect response from the PIM during the immobiliser authentication process.

P1677

An attempt is made to start the vehicle after the ECM was reset.

P1678

The ECM does not receive a valid response from the PIM when an attempt is made to start the engine.

P1679

The ECM receives a message from the PIM stating that it can't authenticate to the ICU.

Conditions for Clearing the DTC

Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

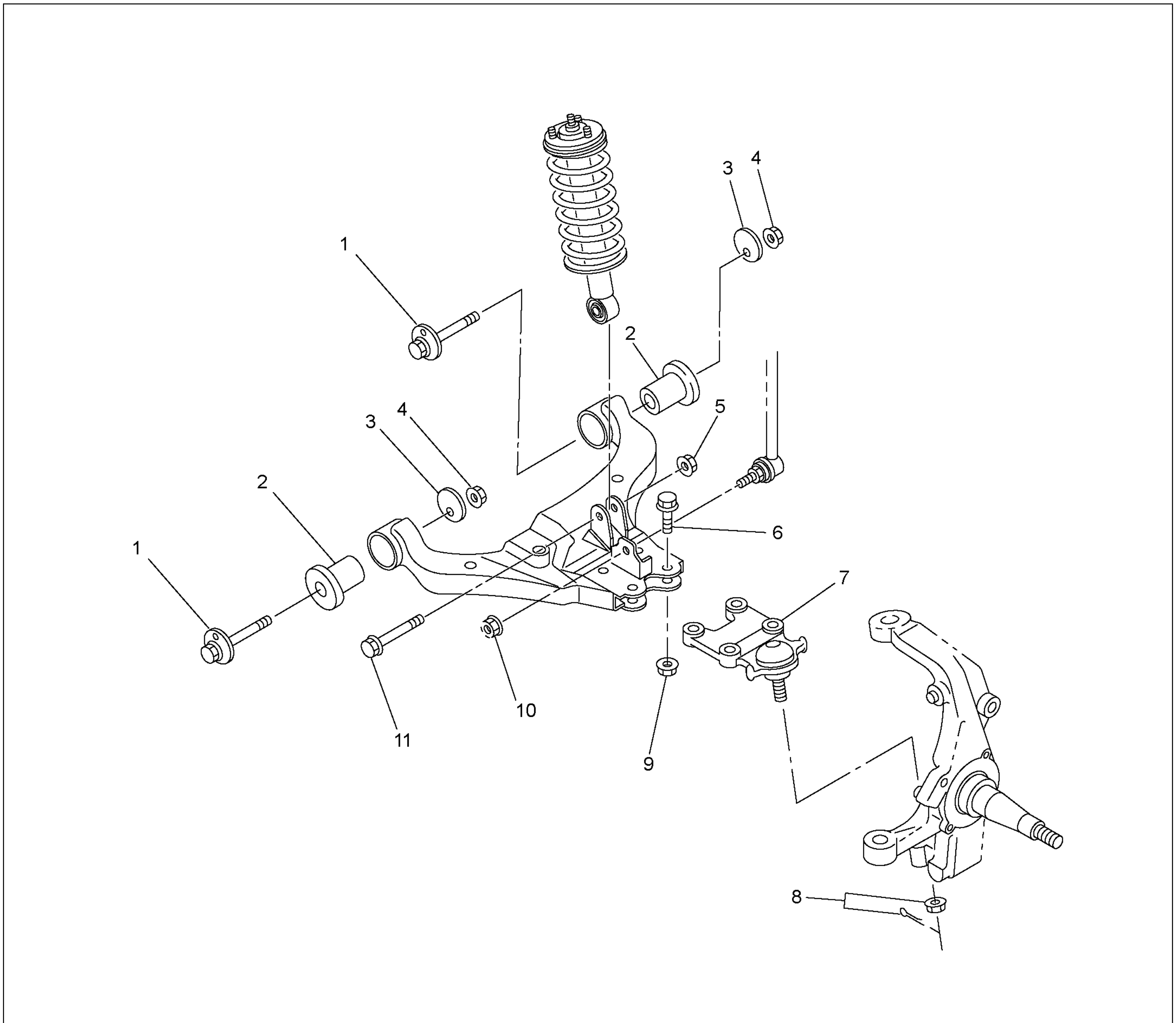
- Refer to 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to 11A Immobiliser for the following information:
  - ICU link to PIM, and
  - Immobiliser System.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0513, P0633, P1629, P1632, P0633, P1677, P1678, P1679 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for setting the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0513, P1629, P1632, P0633, P1677, P1678 or P1679 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Using Tech 2, perform the ICU Link to ECM / PIM procedure. Refer to 6E1 Powertrain Interface Module – V6. Has the linking procedure been performed correctly?	Go to Step 7	Go to Step 4
4	Test the Immobiliser system. Refer to 11A Immobiliser. Has any fault been found and rectified?	Go to Step 7	Go to Step 5
5	1 Test all ground circuits of the PIM for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the PIM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 7	Go to Step 6
6	Replace the PIM. Refer to 6E1 Powertrain Interface Module – V6. Has the repair been completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any of the immobiliser DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8

Lower Control Arm

Lower Control Arm and Associated Parts



Legend

(1) Cam bolt
(2) Bush
(3) Cam plate
(4) Lower Control Arm Nut
(5) Shock Absorber Nut
(6) Lower Ball Joint Bolt
(7) Lower Ball Joint
(8) Nut and cotter pin
(9) Lower Ball Joint Nut
(10) Link Nut
(11) Shock Absorber Bolt

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the tie-rod end from the knuckle. Refer to Power Steering Unit in Steering section.

Step	Action	Yes	No
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

7.31 DTC P0521, P0522 or P0523

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0521 – Oil Pressure Sensor Range / Performance
- DTC P0522 – Oil Pressure Sensor Voltage Low
- DTC P0523 – Oil Pressure Sensor Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the engine oil pressure (EOP) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The EOP sensor provides signal voltage to the ECM that is proportional to the oil pressure generated by the engine oil pump. The ECM monitors the EOP sensor signal voltage. If the ECM detects a low oil pressure condition, it sends a serial data communication signal to the instrument cluster to illuminate the check oil warning icon.

The ECM monitors and compares the EOP sensor signal voltage against a specified range. An EOP sensor circuit DTC sets if the ECM detects the EOP sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P0521, P0522 and P0523 run continuously when the engine is running.

Conditions for Setting the DTC

P0521

The ECM detects engine oil pressure is:

- greater than 800 kPa at idle, or
- engine rpm is greater than 2000 rpm and oil pressure is less than 8 kPa.

P0522

The oil pressure sensor signal voltage is less than 0.2 V for more than 10 seconds.

P0523

The oil pressure sensor signal voltage is more than 4.9 V for more than 10 seconds.

Conditions for Clearing DTC

The EOP sensor circuit DTCs are Type B DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type B DTC sets and conditions for clearing Type B DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the EOP sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Test signal circuit of the EOP sensor. This circuit should display a voltage within the specified range.

5 Measures the integrity of the EOP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

P0521 to P0523 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0521, P0522 or P0523 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch off the ignition. 2 Disconnect the EOP sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the EOP sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 6
4	1 Connect a 3 A fused jumper wire between the EOP sensor 5 V reference circuit and the EOP sensor signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the EOP sensor parameter. Does Tech 2 display 780 – 980 kPa?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the EOP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test the EOP sensor 5 V reference circuit for an open, short to ground or high resistance fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test EOP sensor signal circuit for short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
8	1 Disconnect the ECM wiring connector. 2 Test the EOP sensor low reference circuit for a high resistance and open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The EOP sensor shares the low reference circuit with other sensors. A fault condition in the low reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the EOP sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the for the engine oil pressure sensor circuit DTCs s fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.32 DTC P0532 or P0533

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0532 – A/C Pressure Sensor Voltage Low
- DTC P0533 – A/C Pressure Sensor Voltage High

Circuit Description

The ECM supplies a positive 5 V reference voltage to the air-conditioning (A/C) refrigerant pressure sensor through reference circuit and the ground through the low reference circuit.

The A/C pressure sensor provides signal voltage to the ECM through the signal circuit that is proportional to the A/C refrigerant pressure. The ECM monitors the signal voltage of the A/C pressure sensor to determine the refrigerant pressure.

- The A/C pressure sensor voltage increases as the refrigerant pressure increases.
- When the ECM detects the refrigerant pressure exceeds a predetermined value, the ECM activates the cooling fans to reduce the refrigerant pressure.
- When the ECM detects the refrigerant pressure is too high or too low, the ECM disables the A/C clutch to protect the A/C compressor from damage.

An A/C refrigerant pressure sensor circuit DTC sets if the ECM detects the A/C pressure sensor signal is not within the specified range for 3 seconds.

Conditions for Running the DTC

DTC P0532 and P0533 run continuously when the engine is running or when the A/C is switched on.

Conditions for Setting the DTC

DTC P0532

The A/C refrigerant pressure signal voltage is less than 0.2 V for longer than 3 seconds.

DTC P0533

The A/C refrigerant pressure signal voltage is greater than 4.9 V for longer than 3 seconds.

Conditions for Clearing the DTC

The A/C refrigerant pressure sensor circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the A/C Refrigerant Pressure Sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- The A/C refrigerant pressure sensor circuit diagnostic table is developed with the assumption the A/C refrigerant system is functioning correctly. Therefore, rectify any A/C refrigerant system fault conditions before proceeding with this diagnostic procedure.
  - An A/C refrigerant low-pressure fault condition may cause DTC P0532 to set.
  - An A/C refrigerant high-pressure fault condition may cause DTC P0533 to set.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Determines if there is an A/C refrigerant system fault condition.

6 Measures the integrity of the A/C Refrigerant Pressure Sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0532 or P0533 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	Test the A/C refrigerant system. Refer to 2A Heater and Air-conditioning. Was any fault found and rectified?	Go to Step 12	Go to Step 3

Step	Action	Yes	No
3	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0532 or P0533 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	1 Switch off the ignition. 2 Disconnect the A/C pressure sensor connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the A/C pressure sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 7
5	1 Connect a 3 A fused jumper wire between the A/C pressure sensor 5 V reference circuit and signal circuit. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the ECM A/C pressure voltage parameter. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 6	Go to Step 8
6	1 Switch off the ignition. 2 Remove ECM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the A/C refrigerant pressure low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing the test. Does the multimeter display 5Ω?	Go to Step 10	Go to Step 9
7	Test the A/C pressure sensor 5 V reference circuit for a high resistance, open circuit, short to ground, or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
8	Test the A/C pressure sensor signal circuit for a high resistance, open circuit, short to ground, or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
9	Test the A/C pressure sensor low reference circuit for a high resistance or open circuit condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 12	Go to Step 11
10	Replace the A/C pressure sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—
11	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 12	—

Step	Action	Yes	No
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the A/C refrigerant pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 13
13	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.33 DTC P0560, P0562 or P0563

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0560 – System Voltage Malfunction
- DTC P0562 – System Voltage Low Voltage
- DTC P0563 – System Voltage High Voltage

Circuit Description

Battery voltage is supplied continuously to the engine control module (ECM) through the continuous battery supply circuit and the ground through the ground connection of the ECM housing to the engine.

Turning the ignition switch on activates the ignition control relay, which directs ignition positive voltage from the battery to the ECM switched battery supply circuit which activates the ECM. The ECM then applies control voltage to the control circuit of the engine control relay to activate the engine control relay. The engine control relay supplies ignition voltage to the various engine management system components.

The ECM monitors the battery voltage circuits to ensure the voltage available to the engine management system stays within the specified range. Incorrect system voltage may cause incorrect engine management system operation or component malfunction.

An ECM system voltage DTC sets if the ECM detects the voltage available to any of the ECM voltage supply circuit is outside the specified range.

Conditions for Running the DTC

DTCs P0560, P0563 and P0563 runs continuously when the engine is running at speeds greater than 1500 rpm

Conditions for Setting the DTC

DTC P0560

The ECM detects the ignition 1, ignition 2 or switched battery supply voltage is out of the specified range for 30 seconds.

DTC P0562

The ECM detects the ECM system voltage is less than 11 V for 5 seconds.

DTC P0563

The ECM detects the ECM system voltage is greater than 16 V.

Conditions for Clearing the DTC

The ECM system voltage DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0560, P0562 or P0563 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Increase the engine speed to 1500 rpm or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0560, P0562, or P0563 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the battery condition. Refer to 6D1-3 Battery – V6. Was any fault found and rectified?	Go to Step 9	Go to Step 4
4	Test the charging system operation. Refer to 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 9	Go to Step 5
5	Test all the ECM fuses. Refer to 8A Electrical - Body and Chassis. Was any fault found and rectified?	Go to Step 9	Go to Step 6
6	Check the ECM ground connections for corrosion, loose terminal or incorrect position. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 7
7	Test the following circuits for a high resistance or open circuit fault condition. • Continuous battery supply circuit, • switched battery supply circuit, • ignition 1 circuit, and • ignition 2 circuit. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—

Step	Action	Yes	No
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECM system voltage DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.34 DTC P0601, P0602, P0604 or P0606

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC P0601 – Replace Electronic Control Unit (ECU)
- DTC P0602 – Program Electronic Control Unit (ECU)
- DTC P0604 – Replace Electronic Control Unit (ECU)
- DTC P0606 – Replace Electronic Control Unit (ECU)

Circuit Description

The engine control module (ECM) is the control centre of the engine management system. The programming and calibration needed by the ECM to control the functionality of the engine management system are stored in the ECM read only memory (ROM).

An ECM internal circuit, programming or memory fault DTC sets if there is an internal microprocessor integrity fault condition with the ECM or if the ECM is not programmed.

Conditions for Running the DTC

DTC P0601

Runs once when the checksum calculation at power down is completed in the last ignition cycle.

DTC P0602 and P0606

Runs continuously when the ignition is switched on with the engine not running.

DTC P0604

Runs once when the read / write test at power-down is completed in the last ignition cycle.

Conditions for Setting the DTC

DTC P0601

The ECM detects an incorrect ROM checksum for greater than 30 seconds.

DTC P0602

The ECM programming is incomplete.

DTC P0604

The ECM detects an error in the RAM for 6 seconds.

DTC P0606

There is an internal ECM circuit fault condition for 6 seconds.

Conditions for Clearing the DTC

The ECM Internal Circuit, Programming or Memory Fault DTCs are Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0601, P0602, P0604 and P0606 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0601, P0602, P0604 or P0606 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test all ECM fuses and ground connections. Refer to 8A Electrical - Body and Chassis. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Attempt to program the ECM. Was the programming successful?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the ECM internal circuit, programming or memory fault DTCs fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.35 DTC P0615, P0616 or P0617

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0615 – Starter Relay Circuit Malfunction
- DTC P0616 – Starter Relay Circuit Low Voltage
- DTC P0617 – Starter Relay Circuit High Voltage

Circuit Description

The engine control relay applies battery voltage to the coil circuit of the starter relay through the ignition circuit. When the ignition switched is turned to the Start position and all the conditions required to enable an engine cranking is met, the ECM grounds the starter relay control circuit to activate the starter relay. When active, the starter relay applies battery voltage to the starter motor solenoid control circuit to operate the starter motor. Refer to 6D1-2 Starting System – V6 for information on the cranking system operation.

The ECM monitors the control circuit of the starter relay for conditions that are incorrect for the commanded state. A starter relay control circuit DTC sets if the ECM detects a fault condition in the starter relay control circuit.

Conditions for Running the DTC

DTCs P0615, P0616 and P0617 run continuously once the following conditions are met:

- The ignition is switched on
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that is incorrect for the starter relay commanded state.

Conditions for Clearing the DTC

The starter relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to 6D1-2 Starting System – V6 for information on the cranking system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

3 A fault condition in the starting system or immobiliser system may trigger this DTC.

DTC P0615, P0616 or P0617 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

4. Support lower control arm with a jack.
5. Remove the link nut.
6. Remove the nut and cotter pin.
7. Remove the shock absorber lower end from the lower control arm.
8. Remove the lower ball joint from the lower control arm.
9. Remove lower control arm nut and cam plate.
10. Remove cam bolt.
11. Remove lower control arm.
12. Remove bushing.

Inspection and Repair

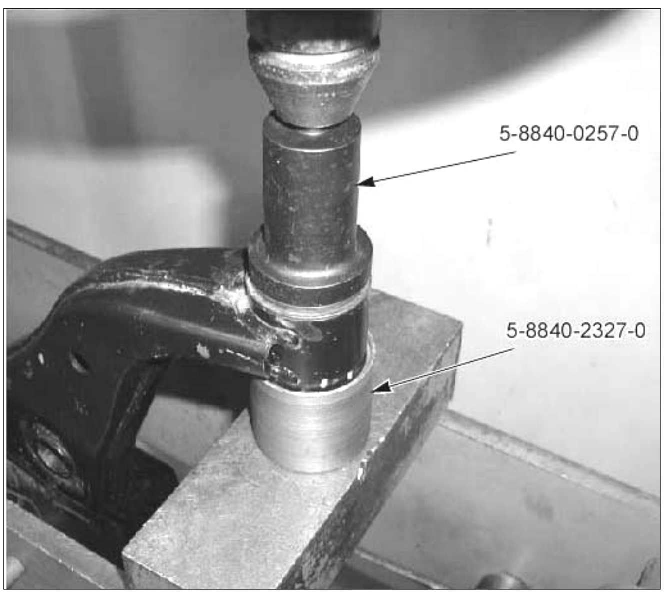
Make the necessary adjustments or parts replacement if wear, damage, corrosion or any other abnormal condition is found during inspection.

Check the following parts:

- Lower control arm
- Bushing

Installation

1. Install rear bushing by using installer 5-8840-0257-0 and 5-8840-2327-0.



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2. Install lower control arm.
3. Install cam bolt.
4. Install lower ball joint and tighten it to the specified torque.

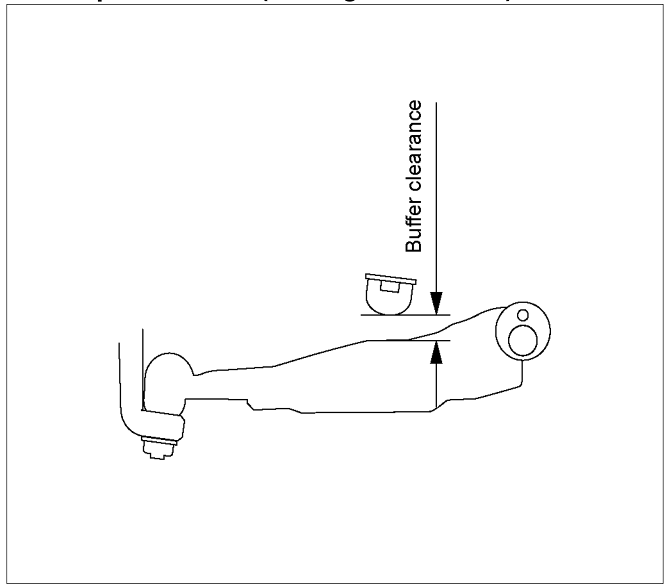
Torque: 127 N·m (13.0 kgf·m/94 lb·ft)

5. Install shock absorber and tighten it to the specified torque.

NOTE: Apply oil to the thread.

NOTE: Tighten the lower control arm nut with the parts in the position shown in the illustration below.

Torque: 137 N·m (14.0 kgf·m/101 lb·ft)



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6. Install stabilizer link and tighten it to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

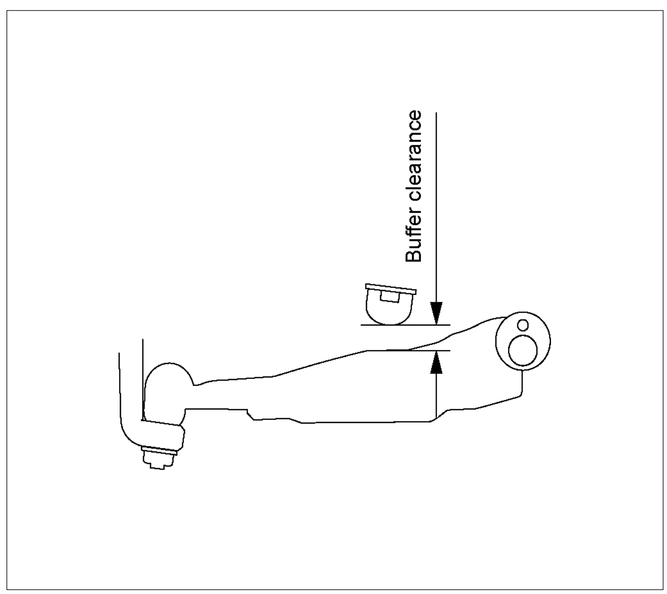
7. Install lower control arm nut and cam plate and tighten lower link nut finger-tight.

NOTE: Apply oil to the thread.

NOTE: Tighten the lower control arm nut with the parts in the position shown in the illustration below.

Buffer clearance: 25.9 mm (1.02 in)

Torque: 186 N·m (19.0 kgf·m/137 lb·ft)



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8. Install nut and cotter pin then tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 147 N·m (15.0 kgf·m/108 lb·ft)

Step	Action	Yes	No
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0615, P0616 and P0617 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check for a fault condition in the following systems which can disable the starting system: • Starting System, refer to 6D1-2 Starting System – V6. • Immobiliser System, refer to 11A Immobiliser. Was any fault found and rectified?	Go to Step 10	Go to Step 4
4	1 Remove the starter relay. Refer to 8A Electrical - Body and Chassis. 2 Connect a test lamp between the ignition circuit of the starter relay and a good ground. 3 Switch on the ignition. Does the test lamp illuminate when the ignition switch is turned to the on position?	Go to Step 5	Go to Step 6
5	1 Connect a test lamp between the control circuit of the starter relay and a 12 V. 2 Turn the ignition switch to the Start position and then release it back to the on position. Does the test lamp turn on when the ignition switch is turned to the Start position and then turn off when the ignition switch returns to the on position?	Go to Step 8	Go to Step 7
6	Repair the ignition voltage circuit of the starter relay for a high resistance or open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the control circuit of the starter relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the starter relay. Refer to 8A Electrical - Body and Chassis. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the starter relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK

Step	Action	Yes	No
When all diagnosis and repairs are completed, check the system for correct operation.			

7.36 DTC P0625 or P0626

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0625 – Alternator F Terminal Low Voltage
- DTC P0626 – Alternator F Terminal High Voltage

Circuit Description

The voltage regulator within the generator regulates the generator charge output by increasing or decreasing the generator on time. The generator field (Gen F) duty cycle output signal represents the generator on time. Refer to 6D1-1 Charging System – V6 for details of the charging system operation.

The ECM monitors the Gen F terminal output signal to calculate Gen F duty cycle percentage. This enables the ECM to provide engine idle compensation based on electrical loads and to detect a fault condition in the generator operation.

A Generator F-terminal circuit DTC sets if the ECM detects the Gen F duty cycle is outside the specified range for a predetermined set of parameters.

Conditions for Running the DTC

DTC P0625

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The engine speed is less than 3000 rpm
- The generator is not commanded off.

DTC P0626

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The ignition is switched on with the engine not running

Conditions for Setting the DTC

DTC P0625

The ECM detects the Gen F Terminal Signal parameter is less than five percent for 15 seconds.

DTC P0626

The ECM detects the Gen F Terminal Signal parameter is greater than five percent for 15 seconds.

Conditions for Clearing DTC

The Generator F-terminal circuit are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.

- Refer to 6D1-1 Charging System – V6 for details of the charging system operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0625 or P0626 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0625 or P0626 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the charging system for any fault condition that may cause incorrect generator operation. Refer to 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Test the Gen F signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the Generator F-terminal circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.37 DTC P0627, P0628 or P0629

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0627 – Fuel Pump Relay Circuit Malfunction
- DTC P0628 – Fuel Pump Relay Voltage Low
- DTC P0629 – Fuel Pump Relay Voltage High

Circuit Description

The ground circuit of the fuel pump relay coil is directly connected to ground. When the ignition switch is turned on and all the conditions required to enable fuel pump operation are met, the ECM applies battery voltage to the fuel pump relay control circuit to operate the fuel pump. Refer to 6C Fuel System – V6 for further information.

The ECM monitors the control circuit of the fuel pump relay for conditions that are incorrect for the commanded state. A fuel pump relay control circuit DTC sets if the ECM detects a fault condition in this circuit.

Conditions for Running the DTC

Run continuously once the following conditions are met:

- the ignition is switched on, and
- the ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that are incorrect for the fuel pump relay commanded state.

Conditions for Clearing the DTC

The fuel pump relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- Refer to 6C Fuel System – V6 for details of the fuel pump operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0627 to P0629 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0627, P0628 and P0629 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the fuel pump relay. Refer to 8A Electrical - Body and Chassis. 2 Connect a test lamp between the ground circuit of the fuel pump relay and a 12 V. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Connect a test lamp between the control circuit and ground circuit of the fuel pump relay. 2 Using Tech 2, command the fuel pump relay on. Does the test lamp switch from off to on as Tech 2 commands the fuel pump relay from off to on?	Go to Step 7	Go to Step 6

Step	Action	Yes	No
5	Repair the high resistance or open circuit fault condition in the ground circuit of the fuel pump relay. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the fuel pump relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the fuel pump relay. Refer to 8A Electrical - Body and Chassis. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the fuel pump relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.38 DTC P0645, P0646 or P0647

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0645 – A/C Relay Circuit Malfunction.
- DTC P0646 – A/C Relay Voltage Low.
- DTC P0647 – A/C Relay Voltage High.

Circuit Description

The engine control relay applies battery voltage to the coil circuit of the air-conditioning (A/C) clutch relay through the ignition circuit. Using a device called a driver, the ECM grounds control circuit of the A/C relay to activate the A/C clutch and operate the A/C compressor. Refer to 2A Heater and Air-conditioning for details of the A/C compressor operation.

The driver has a feedback circuit that is pulled-up to a voltage. The ECM monitors the driver feedback circuit to determine if the control circuit is open, shorted to ground or shorted to a positive voltage.

An A/C relay control circuit DTC sets if the ECM detects a fault condition in the A/C relay control circuit.

Conditions for Running the DTC

DTC P0645, P0646 or P0647 runs continuously once the following conditions are met:

- The ignition voltage is 10 – 16 V.
- The engine speed is greater than 80 rpm

Conditions for Setting the DTC

Conditions for Setting DTC P0645

The ECM detects an open circuit fault condition in the A/C relay control circuit.

Conditions for Setting DTC P0646

The ECM detects a short to ground fault condition in the A/C relay control circuit.

Conditions for Setting DTC P0647

The ECM detects a short to voltage fault condition in the A/C relay control circuit.

Conditions for Clearing the DTC

The A/C relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 2A Heater and Air-conditioning for details of the A/C system operation.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

3 A fault condition in the HVAC system may trigger this DTC.

DTC P0645, P0646 or P0647 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Switch on the A/C system or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0645 P0646 or P0647 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Check for a fault condition in the HVAC system, which can disable the AC compressor clutch. Refer to 2A Heater and Air-conditioning for details of the A/C compressor operation. Was any fault found and rectified?	Go to Step 10	Go to Step 4
4	1 Remove the A/C relay. Refer to 8A Electrical - Body and Chassis. 2 Connect a test lamp between the ignition circuit of the A/C relay coil and the ECM housing. 3 Switch on the ignition with the engine not running. Does the test lamp illuminate?	Go to Step 5	Go to Step 6

Step	Action	Yes	No
5	1 Connect a test lamp between the control circuit of the A/C relay and a 12 V. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, command the A/C relay on and then off. Does the test lamp turn on and off when the A/C relay is commanded on and off?	Go to Step 8	Go to Step 7
6	Repair the high resistance or open circuit fault condition in the ignition voltage circuit of the A/C relay. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the control circuit of the A/C relay for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the A/C relay. Refer to 8A Electrical - Body and Chassis. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the A/C relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.39 DTC P0685, P0686 or P0687

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P0685 – Engine Control Ignition Relay Circuit Malfunction
- DTC P0686 – Engine Control Ignition Relay Circuit Low Voltage
- DTC P0687 – Engine Control Ignition Relay Circuit High Voltage

Circuit Description

The supply voltage circuit of the engine control relay is directly connected to battery voltage. When the ignition switch is turned on, the ECM grounds the relay control circuit to provide ignition voltage to various sensors and components that controls the engine operation.

The ECM monitors the control circuit of the engine control relay for conditions that are incorrect for the commanded state. An engine control relay circuit DTC sets if the ECM detects a fault condition in this circuit.

Conditions for Running the DTC

DTCs P0685, P0686 and P0687 run continuously once the following conditions are met:

- The ignition is switched on
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM detects a condition that is incorrect for the engine control relay commanded state.

Conditions for Clearing the DTC

The engine control relay control circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P0685, P0686 or P0687 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Turn the ignition switch to the Start position or operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0685, P0686 and P0687 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the engine control relay. Refer to 8A Electrical - Body and Chassis. 2 Connect a test lamp between the battery voltage circuit of the engine control relay and a good ground. Does the test lamp illuminate?	Go to Step 4	Go to Step 5
4	1 Switch off the ignition. 2 Remove and reinstall the ECM fuse 29 from the engine compartment fuse and relay panel assembly. 3 Connect a test lamp between the control circuit and the battery voltage circuit of the engine control relay. 4 Switch on the ignition. Does the test lamp switches from off to on when the ignition switch is turned form off to on?	Go to Step 7	Go to Step 6

Step	Action	Yes	No
5	Repair the high resistance or open circuit fault condition in the battery voltage circuit of the engine control relay. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the control circuit of the engine control relay for a high resistance, open circuit, short to ground or a short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
7	Replace the engine control relay. Refer to 8A Electrical - Body and Chassis. Was the repair completed?	Go to Step 9	—
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the engine control relay control circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 10
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.40 DTC P0700

DTC Descriptor

This diagnostic procedure supports DTC P0700 – Malfunction Indicator (MI) Request from Transmission Control Module (TCM).

Circuit Description

The engine control module (ECM) communicates directly with the transmission control module (TCM) and other control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

DTC P0700 – Malfunction Indicator Request from TCM sets if the following condition exists:

- The TCM detects an emission related fault condition and sets a TCM DTC that represent the fault condition.
- The ECM receives a serial data signal from the TCM requesting the illumination of the malfunction indicator.

Conditions for Running the DTC

DTC P0700 runs continuously when the ignition is switched on.

Conditions for Setting the DTC

The ECM receives a serial data signal from the TCM requesting the illumination of the malfunction indicator lamp (MIL).

Conditions for Clearing the DTC

DTC P0700 – Malfunction Indicator Request from TCM is a Type A DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type A DTC sets and conditions for clearing Type A DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Secion, for the system wiring diagram and connector charts.

DTC P0700 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0700 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are other powertrain DTCs also set?	Go to the appropriate DTC Table in this Section	Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis
When all diagnosis and repairs are completed, check the system for correct operation.			

7.41 DTC P0704

DTC Descriptor

This diagnostic procedure supports DTC P0704 – Clutch Switch Input Circuit Malfunction.

Circuit Description

The clutch pedal switch disengages the cruise control when the clutch is depressed, in much the same way that the brake pedal switch is used to disengage the cruise control feature.

The cruise control cancel switch is normally closed when the clutch pedal is at rest, opening when the pedal is pressed. Activation of this switch removes the signal to the ECM which will then deactivate the cruise control.

Conditions for Running the DTC

Runs continuously when the ignition is switched and the engine is running.

Conditions for Setting the DTC

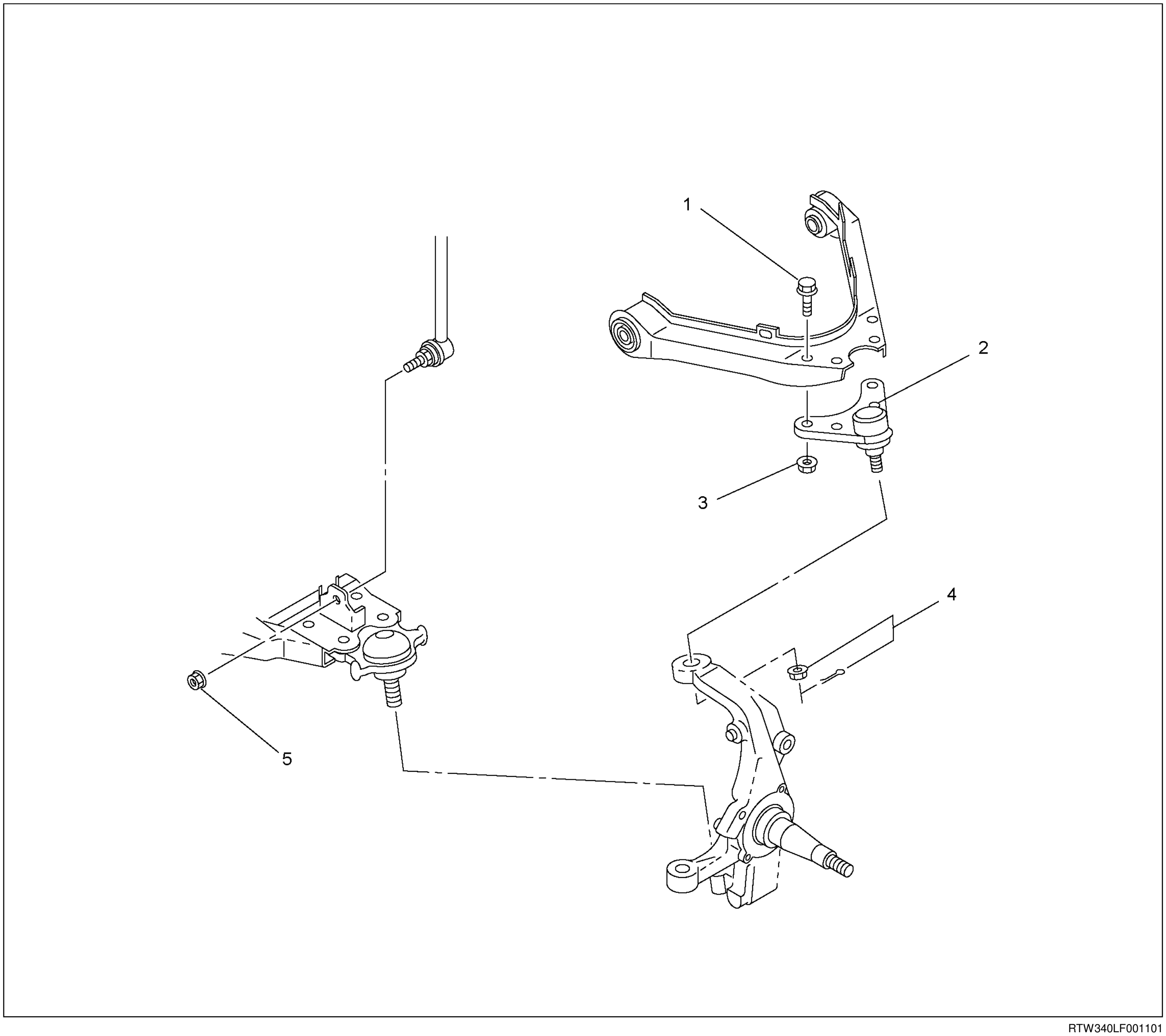
The ECM detects 15 gear changes with less than three clutch switch inputs.

NOTE

The ECM determines that a gear change has been performed by the engine speed / vehicle speed ratio.

Upper Ball Joint

Upper Ball Joint and Associated Parts



Legend

(1) Upper Ball Joint Bolt
(2) Upper Ball Joint
(3) Upper Ball Joint Nut
(4) Nut and Cotter Pin
(5) Link Nut

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to wheel in this section.
3. Remove link nut.
4. Remove upper ball joint nut and cotter pin, then use remover 5-8840-2017-0 to remove the upper ball joint from the knuckle.

CAUTION: Be careful not to damage the ball joint boot and brake hose.

Conditions for Clearing the DTC

The clutch switch circuit DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type C DTCs set and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the clutch switch operation.
- Refer to 8C Cruise Control for clutch pedal switch operation and testing.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0704 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0704 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch on the ignition with the engine not running. 2 On Tech 2 select: **Engine** / **V6 Engine** / **Data Display** / **Engine Data 1**. 3 Observe the status of the cruise control cancel switch. 4 Depress the clutch pedal. Does Tech 2 display change from Inactive to Active when the pedal is pressed?	Refer to Additional Information in this DTC	Go to Step 4
4	1 Disconnect the wiring connector from the cruise control cancel switch. Refer to 8C Cruise Control – HFV6. 2 Switch on the ignition. 3 Connect a test lamp between the voltage circuit of cruise control cancel clutch switch and a ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 5
5	Repair the high resistance or open circuit fault condition in the voltage circuit of the clutch switch. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 9	—
6	Test the cruise control cancel clutch switch. Refer to 8C Cruise Control – HFV6. Was any fault found and rectified?	Go to Step 9	Go to Step 7

7	Test the control circuit of the cruise control clutch switch, which failed for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 9	Go to Step 8
8	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 9	—
9	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0704 fail this ignition cycle?	Go to Step 2	Go to Step 11
10	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.42 DTC P0850

DTC Descriptor

This diagnostic procedure supports DTC P0850 – Park / Neutral Signal Circuit Incorrect Signal.

Circuit Description

The Park / Neutral (P / N) switch is a part of the automatic transmission gear selector position switch assembly.

The P / N switch is a normally open switch that closes when the transmission is shifted to Park or Neutral position. The ECM applies a reference 12 V to the signal circuit of the P / N switch when it is open. When the transmission is shifted to the Park or Neutral position, the P / N switch closes and pulls the P/ N switch signal circuit to ground.

DTC P0850 sets when the ECM detects a fault condition in the P / N switch circuit.

Conditions for Running the DTC

DTC P0850 runs continuously when the ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC P0850 sets when the ECM detects one of the following fault conditions:

- The P / N switch signal circuit is pulled to ground for 100 seconds while the TCM sends a signal that the transmission is in gear.
- The P / N switch signal circuit is 12 V for 100 seconds while the TCM sends a signal the transmission is in park or neutral.

Conditions for Clearing the DTC

DTC P0850 is a Type 'C' DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type 'C' DTCs set and conditions for clearing Type 'C' DTCs.

Additional Information

- The ECM uses the transmission range data to enable engine cranking when DTC P0850 sets.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the park / neutral switch operation.

- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P0850 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch on the ignition. 2 Using Tech 2, observe the status of the automatic transmission gear position. 3 Shift the transmission lever across all gear levels. Does Tech 2 display **P/N** when the transmission is in park or neutral and **In Gear** when the transmission lever is in other positions?	Go to Step 3	Go to Step 4
3	1 Switch off the ignition for 30 seconds. 2 Switch on the ignition. 3 Shift the transmission lever across all gear levels. Does DTC P0850 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this DTC
4	1 Remove the transmission position switch wiring connector. Refer to 7C4 Automatic Transmission_4L60E – On-vehicle Servicing. 2 Connect a test lamp between the ground circuit of the transmission switch and a 12 V source. Does the test lamp illuminate?	Go to Step 5	Go to Step 6
5	1 Connect a 3 A jumper wire between the signal circuit of the park / neutral signal circuit and a good ground. 2 Using Tech 2, observe the status of the transmission gear. Does Tech 2 display a change from **In Gear** to **P/N** when the jumper wire is connected?	Go to Step 8	Go to Step 7
6	Repair the high resistance or open circuit fault condition in the ground circuit of the transmission position switch. Refer to 8A Electrical - Body and Chassis for information on electrical wiring repair procedures. Was the repair completed?	Go to Step 10	—
7	Test the signal circuit of the park / neutral switch for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 10	Go to Step 9
8	Replace the transmission position switch. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Was the repair completed?	Go to Step 10	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 10	—

Step	Action	Yes	No
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P0850 fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.43 DTC P1648

DTC Descriptor

This diagnostic procedure supports DTC P1648 – Wrong Security Code Entered.

Circuit Description

Tech 2 is used to program the engine control module (ECM). Before any programming, a security code must be entered into Tech 2. The ECM will check if the code entered is correct before continuing. If the security code is incorrect, DTC P1648 sets.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

An incorrect security code is entered into Tech 2 when attempting to program the ECM.

Action Taken When the DTC Sets

When the DTC sets, the malfunction indicator lamp (MIL) is not displayed.

Conditions for Clearing the DTC

The immobiliser security code is a Type ‘C’ DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTCs.

Additional Information

- Refer to 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to 6C1-3 Engine Management –V6 – Service Operations for details on resetting the ECM.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 This step tests the ECM ground circuits and supply voltage.

DTC P1648 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Using Tech 2, select the DTC display function. **NOTE** Do not attempt to perform any Tech 2 function that requires the ECM security code to be entered. Does DTC P1648 fail this ignition cycle?	Go to Step 4	Go to Step 3
3	Using Tech 2, attempt a programming function that requires the ECM security code to be entered. Refer to 6C1-3 Engine Management –V6 – Service Operations for details on resetting the ECM. Has the programming function been successfully performed?	System OK	Go to Step 4
4	1 Test all ECM ground circuits for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the ECM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to 6C1-3 Engine Management –V6 – Service Operations for details on replacing the ECM. Has the repair been completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. Does DTC P1648 fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

7.44 DTC P1668, P2500 or P2501

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P1668 – Generator L Terminal Circuit Malfunction
- DTC P2500 – Generator L Terminal Low Voltage
- DTC P2501 – Generator L Terminal High Voltage

Circuit Description

The engine control module (ECM) applies a signal voltage to the Generator L (GEN L) terminal circuit to control the load of the generator on the engine. Refer to 6D1-1 Charging System for details of the charging system operation.

A GEN L terminal circuit DTC sets if the ECM detects the Gen L circuit voltage is outside the specified range for a predetermined set of parameters.

Conditions for Running the DTC

DTC P1668

Runs continuously when one of the following conditions are met:

- Ignition on Test – The ignition is switched on with the engine not running for 5 seconds.
- Engine Run Test – The engine is running at speed less than 3,000 rpm

DTC P2500

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The engine is running.
- The generator is not commanded off.

DTC P2501

Runs continuously when the following conditions are met:

- There is no generator, CKP sensor or CMP sensor DTC set.
- The ignition is switched on with the engine not running.

Conditions for Setting the DTC

DTC P1668

- Ignition on Test – the ECM detects a high signal voltage on the Gen L for 5 seconds.
- Engine Run Test – the ECM detects a low signal voltage on the Gen L for 5 seconds.

DTC P2500

The ECM detects a low signal voltage on the Gen L for 15 seconds.

DTC P2501

The ECM detects a high signal voltage on the Gen L for 5 seconds.

Conditions for Clearing DTC

The Generator L-terminal circuit are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Refer to 6D1-1 Charging System – V6 for details of the charging system operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P1668, P2500 or P2501 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P1668, P2500 or P2501 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Test the charging system for any fault condition that may cause incorrect generator operation. Refer to 6D1-1 Charging System – V6. Was any fault found and rectified?	Go to Step 6	Go to Step 4
4	Test the Gen L signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the Generator L terminal circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.45 DTC P1845

DTC Descriptor

This diagnostic procedure supports DTC P1845 – Engine Torque Reduction Malfunction

Circuit Description

The ECM monitors and compares the engine torque output against the maximum allowable engine torque. Refer to 6C1-1 Engine Management – V6 – General Information for details of the engine torque limit management operation.

If the requested torque is higher than the maximum allowable torque, the ECM applies engine torque limitation and DTC P1845 – Engine Torque Reduction Malfunction sets.

Conditions for Running the DTC

DTC P1845 runs continuously when the engine is running at speeds greater than 40 rpm.

Conditions for Setting the DTC

The engine torque output exceeds the maximum allowable torque output for 10 minutes.

Conditions for Clearing the DTC

DTC P1845 – Engine Torque Reduction Malfunction is a Type 'C' DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type 'C' DTC sets and conditions for clearing Type 'C' DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the Engine Torque Limit Management operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step number in the diagnostic table:

4 Fault conditions that apply excessive load on the engine may trigger this DTC.

DTC P1845 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC or road test the vehicle under various driving condition. 3 Using Tech 2, select the DTC display function. Does DTC P1845 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Are there any other ECM or TCM DTCs set?	Refer to the appropriate DTC table.	Go to Step 4
4	Inspect for fault conditions in the engine or transmission that applies excessive load on the engine. Was any fault found and rectified?	Go to Step 6	Go to Step 5
5	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P1845 fail this ignition cycle?	Go to Step 2	Go to Step 7

Step	Action	Yes	No
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.46 DTC P2096 or P2098

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2096 Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 1)
- DTC P2098 Post Catalyst O2 Sensor Fuel Trim Below Lower Limit (Bank 2)

Circuit Description

The wide band heated oxygen sensor 1 measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Fuel trim biasing is used by the ECM to keep the post catalyst HO2S voltage within a range of 580 – 665 mV as possible. This allows optimal catalyst efficiency under light load conditions, such as at idle or a steady cruise. The ECM constantly monitors how lean or rich the fuel trim bias is commanded. If the ECM detects that the fuel trim bias is commanded lean for more than a calibrated amount, DTC P2096 or P2098 sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2096 or P2098 failed, DTCs P0030, P0031, P0032, P0041, P0050, P0051, P0052, P0101, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2231, P2234, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2273, P2626, and P2629 must run and pass.
- The engine is operating for more than 2 seconds.
- The post catalyst fuel trim control is enabled.
- The front and rear HO2S are in Closed Loop.
- DTCs P2096and P2098 run continuously once the above conditions are met for more than 40 seconds.

Conditions for Setting the DTC

The post catalyst fuel trim correction factor is biased lean by more than 3 percent of the HO2S lambda value for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

These post catalyst fuel trim system DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type 'C' DTC sets and conditions for clearing Type 'B' DTCs.

Use Tech 2 to clear the MIL and the DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the post catalyst oxygen sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.
- The lower connector of the ECM is connector X1 and the upper connector of the ECM is connector X2. Refer to 3.2 ECM Connector End Views in this Section, for pin and circuit identification.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

4 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

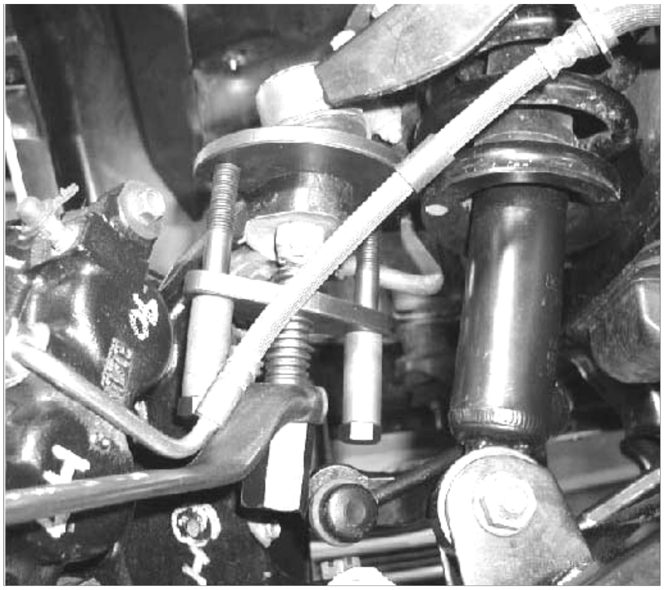
7 This step inspects for the rear sensors being connected to the correct bank of the engine. This condition causes this DTC to set.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2096 or P2098 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	**WARNING** **Refer to Road-testing, in 1.5 Warning Caution and Notes in this Section.** 1 Switch off the ignition for 30 seconds. **NOTE** The rear heated oxygen sensors (HO2S) must be in Closed Loop for this diagnostic to run. A road load condition is necessary to obtain Closed Loop. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2096 or P2098 fail this ignition cycle?	—	Go to Step 3	Refer to Additional Information in this DTC



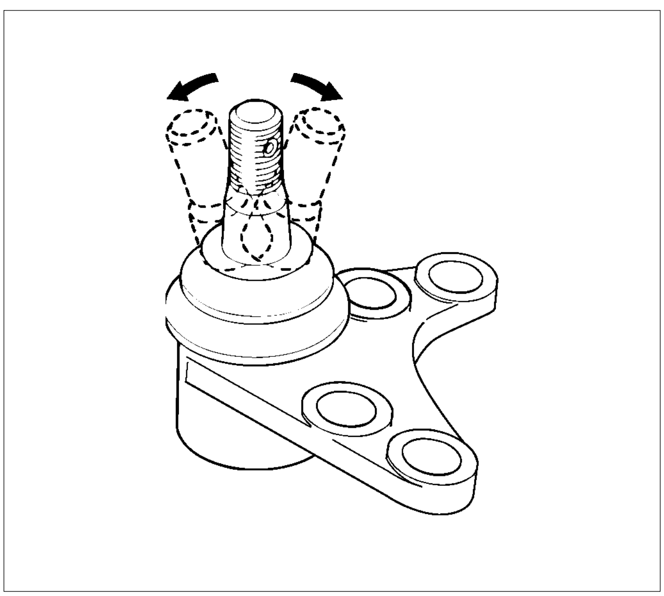
P1010005

5. Remove upper ball joint bolt and nut.
6. Remove upper ball joint.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal conditions are found during inspection.

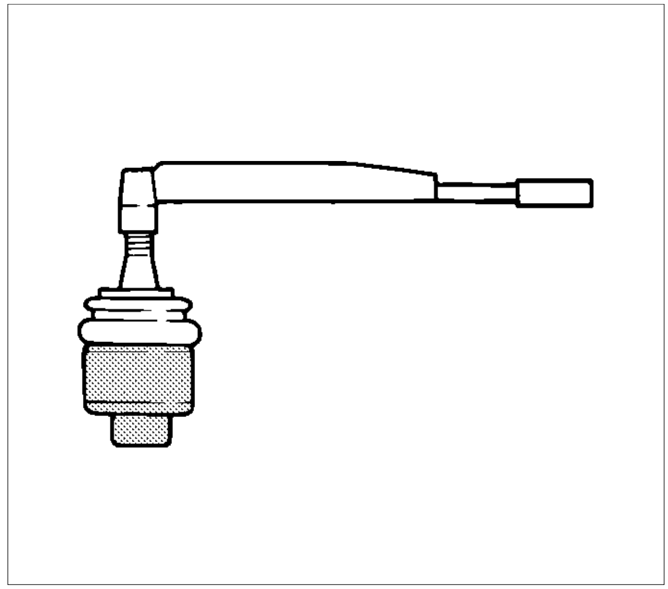
- Inspect the lower end of the boot for damage or grease leaks. Move the ball joint as shown in the figure to confirm its normal movement.
- Inspect screw/taper area of ball for damage.
- If any defects are found by the above inspections, replace the ball joint assembly with new one.



450R300030

- After moving the ball joint 4 or 5 times, attach nut then measure the preload.

Starting torque: 1.3-3.2 N·m (0.13-0.33 kgf·m/0.9-2.4 lb·ft)



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If the above limits specified are exceeded, replace the ball joint assembly.

Installation

1. Install upper ball joint.
2. Install upper ball joint bolt and nut, and then tighten them to the specified torque.

Torque: 31 N·m (3.2 kgf·m/23 lb·ft)

3. Install nut and cotter pin then tighten the nut to the specified torque with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 98 N·m (10.0 kgf·m/72 lb·ft)

4. Install link nut, then tighten to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

3	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Operate the engine above 1,200 rpm for 30 seconds. 2 Use Tech 2 to observe appropriate rear heated oxygen sensor (HO2S) voltage Is the voltage more or less than the specified value?	60 mV	Go to Step 7	Go to Step 5
5	1 Turn OFF the ignition. 2 Disconnect the appropriate HO2S. 3 Ignition ON, engine OFF. 4 Use Tech 2 to observe the oxygen sensor (HO2S) voltage parameter. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 6
6	1 Test the appropriate HO2S signal circuit for a short to ground. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
7	1 Inspect the rear HO2S for being connected to the correct bank of the engine. If the sensors are connected to the incorrect bank, swap the connectors as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10

10	1 Ignition OFF. 2 Disconnect the front and rear HO2S. 3 Inspect the front and rear HO2S for the following conditions: – Damaged wiring between the HO2S and the ECM – An intermittent circuit condition causes this DTC to set. – Terminal corrosion or water intrusion in the HO2S harness connectors. – The correct terminal tension. – The HO2S is securely installed. – Any exhaust leaks – Refer to 6F Exhaust System – V6. 4 Repair as necessary. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front HO2S circuits for being shorted together between the HO2S connector and the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to 8A Electrical - Body and Chassis. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 1 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 2 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

19	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2096 or P2098 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.47 DTC P2097 or P2099

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2097 Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 1)
- DTC P2099 Post Catalyst O2 Sensor Fuel Trim Above Upper Limit (Bank 2)

Circuit Description

The wide band heated oxygen sensor 1 measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Fuel trim biasing is used by the ECM to keep the post catalyst HO2S voltage within a range of 580 – 665 mV as possible. This allows optimal catalyst efficiency under light load conditions, such as at idle or a steady cruise. The ECM constantly monitors how lean or rich the fuel trim bias is commanded. If the ECM detects that the fuel trim bias is commanded rich for more than a calibrated amount, DTC P2097 or P2099 sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2096 or P2098 failed, DTCs P0030, P0031, P0032, P0041, P0050, P0051, P0052, P0101, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2231, P2234, P2237, P2240, P2243, P2247, P2251, P2254, P2270, P2271, P2273, P2626, and P2629 must run and pass.
- The engine is operating for more than 2 seconds.
- The post catalyst fuel trim control is enabled.
- The front and rear HO2S are in Closed Loop.
- DTCs P2097 and P2099 run continuously once the above conditions are met for more than 40 seconds.

Conditions for Setting the DTC

The post catalyst fuel trim correction factor is biased rich by more than –3 percent of the HO2S lambda value for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

These post catalyst fuel trim system DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type 'C' DTC sets and conditions for clearing Type 'B' DTCs.

Use Tech 2 to clear the MIL and the DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the post catalyst oxygen sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.
- The lower connector of the ECM is connector X1 and the upper connector of the ECM is connector X2. Refer to 3 Wiring Diagrams and Connector Charts in this Section, for pin and circuit identification.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

4 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

7 This step inspects for the rear sensors being connected to the correct bank of the engine. This condition causes this DTC to set.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2096 or P2098 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

2	**WARNING** **Refer to Road-testing, in 1.5 Warning Caution and Notes in this Section.** 1 Switch off the ignition for 30 seconds. **NOTE** The rear heated oxygen sensors (HO2S) must be in Closed Loop for this diagnostic to run. A road load condition is necessary to obtain Closed Loop. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2097 or P2099 fail this ignition cycle?	—	Go to Step 3	Refer to Additional Information in this DTC
3	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Operate the engine above 1,200 rpm for 30 seconds. 2 Use Tech 2 to observe appropriate rear heated oxygen sensor (HO2S) voltage. Is the voltage less than the specified value?	1,050 mV	Go to Step 7	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate HO2S. 3 Ignition ON, engine OFF. 4 Use Tech 2 to observe the oxygen sensor (HO2S) voltage parameter. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 6
6	1 Test the appropriate HO2S signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
7	1 Inspect the rear HO2S for being connected to the correct bank of the engine. If the sensors are connected to the incorrect bank, swap the connectors as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 8
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10

10	1 Ignition OFF. 2 Disconnect the front and rear HO2S. 3 Inspect the front and rear HO2S for the following conditions: – Damaged wiring between the HO2S and the ECM – An intermittent circuit condition causes this DTC to set. – Terminal corrosion or water intrusion in the HO2S harness connectors. – The correct terminal tension. – The HO2S is securely installed. – Any exhaust leaks – Refer to 6F Exhaust System – V6. 4 Repair as necessary. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front HO2S circuits for being shorted together between the HO2S connector and the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to 8A Electrical - Body and Chassis. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 1 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the appropriate HO2S. Refer to the Oxygen Sensor 2 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

19	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2097 or P2099 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.48 DTC P2105

DTC Descriptor

This diagnostic procedure supports DTC P2105 – Throttle Control Forced Engine Shutdown.

Circuit Description

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator control (TAC) motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.
- To control the throttle opening, the ECM applies PWM voltage to the TAC motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.

To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the TAC motor control circuit then applies a PWM voltage to the TAC motor.

The ECM monitors the ignition supply voltage to ensure the correct operation of the engine management components and sensors. DTC P2105 sets if the ECM detects an incorrect ignition voltage.

Conditions for Running the DTC

DTC P2105 runs continuously when the ECM completed the power-down process in the last ignition cycle.

Conditions for Setting the DTC

The ECM detects an incorrect voltage level at the ignition supply circuits.

Conditions for Clearing the DTC

DTC P2105 – Throttle Actuator Control (TAC) Module Internal Circuit is a Type A DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type A DTC sets and conditions for clearing Type A DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the TP actuator operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P2105 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2105 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Remove the ECM / TCM Fuse 32 from the engine compartment relay panel assembly. **NOTE** Voltage may be available at both terminals of Fuse 32 because of normal voltage feed back condition. Therefore, the fuse must be removed prior to testing. 2 Inspect the ECM / TCM Fuse 32 for an open circuit fault condition. Was any fault found and rectified?	Go to Step 7	Go to Step 4
4	1 Remove the engine control relay from the engine compartment relay panel assembly. 2 Test the ignition circuit of the ECM, from the fuse terminal to the Engine control relay for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The engine control relay supplies ignition voltage to other components and sensors through the ECM ignition circuit. A fault condition in this ignition circuit may trigger DTCs on components or sensors connected to this circuit. Was any fault found and rectified?	Go to Step 7	Go to Step 5
5	Disconnect the vehicle side wiring connector of the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Test both ignition circuits of the ECM, from the fuse terminal to the ECM wiring connector for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 7	Go to Step 6
6	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2105 fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK

Step	Action	Yes	No
When all diagnosis and repairs are completed, check the system for correct operation.			

7.49 DTC P2107

DTC Descriptor

This diagnostic procedure supports DTC P2107 – Throttle Control Malfunction.

Circuit Description

The ECM applies 5 V to the throttle position (TP) sensor 1 through the 5 V reference circuit 2701 and the ground through the low reference circuit 2752. TP sensor 1 and TP sensor 2 share a common 5 V reference circuit and a common low reference circuit.

The TP sensor 1 and TP sensor 2 have individual signal circuits with opposite functionality. These signal circuits provide the ECM with a signal voltage that is proportional to the throttle plate movement.

- The TP sensor 1 signal voltage is less than 1 V when the throttle plate is in closed position, which increases to greater than 4 V when the throttle plate is moved to wide-open throttle.
- The TP sensor 2 signal voltage is greater than 4 V when the throttle plate is in closed position, which decreases to less than 1 V when the throttle plate is moved to wide-open throttle.

The ECM monitors and evaluates the accelerator pedal position (APP) sensors signal voltage along with other sensor inputs to determine the desired throttle opening. To control the throttle plate movement, the ECM applies a pulse width modulated (PWM) signal voltage to the throttle actuator motor through the throttle actuator motor control circuits.

- At engine idle speed or when no current is flowing into the throttle actuator control (TAC) motor, a constant force return spring holds the throttle plate at a constant seven percent throttle opening position.
- To control the throttle opening, the ECM applies PWM voltage to the TAC motor. The ECM increases this PWM voltage duty cycle to increase the throttle opening.

To decrease the throttle opening from the seven percent rest position, the ECM reverses the polarity of the TAC motor control circuit then applies a PWM voltage to the TAC motor.

If the ECM detects the TP sensor 1 amplification output does not correlate with the TP sensor 1 signal voltage during a predetermined sets of conditions, DTC P2107 sets.

Conditions for Running the DTC

DTC P2107 runs continuously once the following conditions are met:

- The vehicle speed is 0 km/h.
- The engine speed is less than 40 rpm
- The engine coolant temperature is 5 – 60° C.
- The intake air temperature is 5 – 60° C.
- The ignition voltage is greater than 10 V.
- The APP is less than 15 percent.
- The ECM is performing the closed throttle test with the ignition switched on and the engine not running.

Conditions for Setting the DTC

The ECM detects that its internal TP sensor 1 amplification output does not correlate with the TP sensor 1 signal voltage.

Conditions for Clearing the DTC

DTC P2107 – Throttle Actuator Control Module Internal Circuit is a Type 'C' DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type 'C' DTC sets and conditions for clearing Type 'C' DTC.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the TP sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P2107 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2107 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2107 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.50 DTC P2122, P2123, P2127, P2128 or P2138

DTC Descriptors

This diagnostic procedure supports the following DTCs:

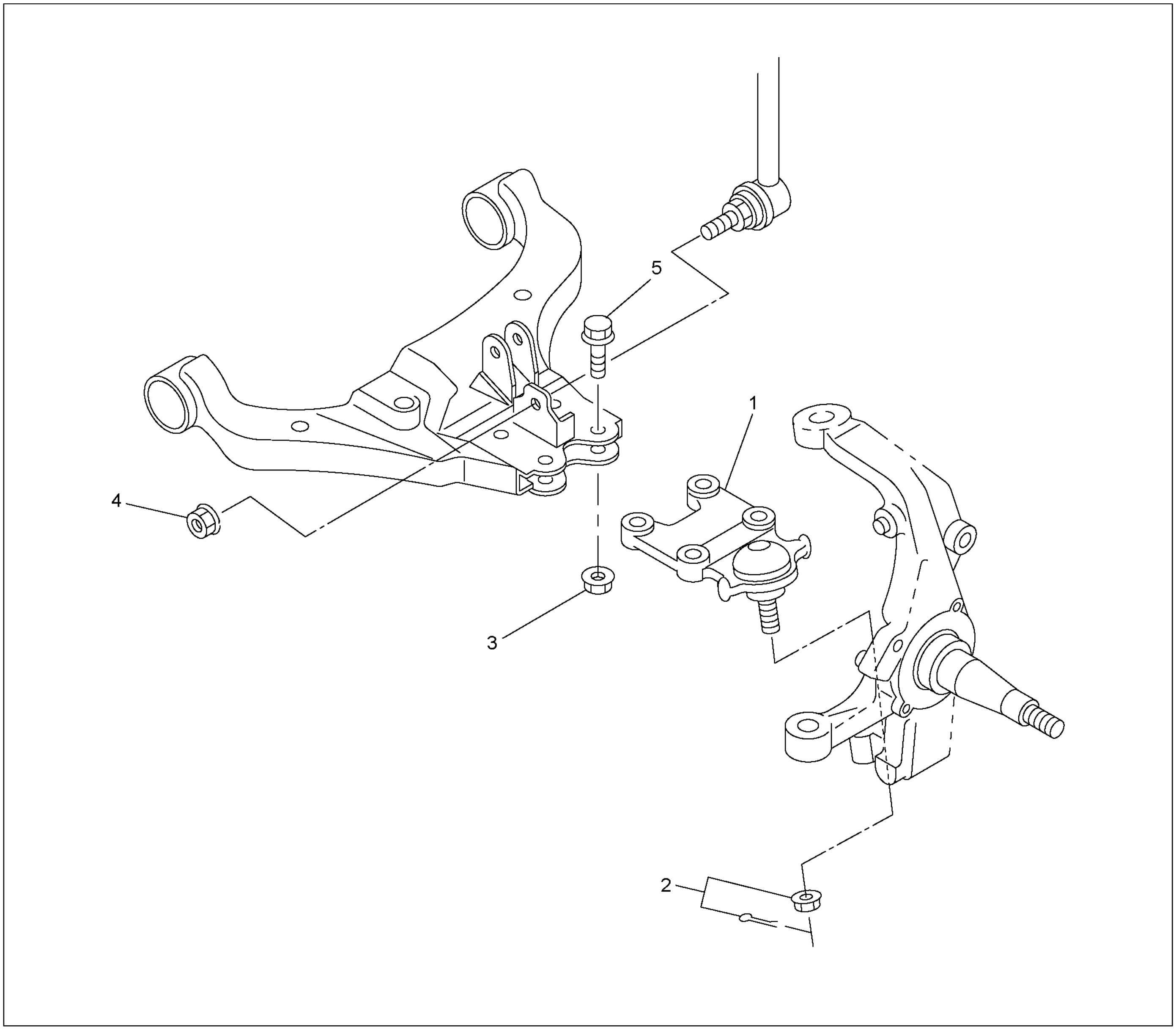
- DTC P2122 – Accelerator Pedal Position Sensor 1 Voltage Low
- DTC P2123 – Accelerator Pedal Position Sensor 1 Voltage High
- DTC P2127 – Accelerator Pedal Position Sensor 2 Voltage Low
- DTC P2128 – Accelerator Pedal Position Sensor 2 Voltage High
- DTC P2138 – Accelerator Pedal Position Sensor 1 – 2 Correlation

Circuit Description

The ECM applies a separate 5 V reference circuit and low reference circuit to the accelerator pedal position (APP) sensor 1 and sensor 2. The APP sensors produce a signal voltage that represents the accelerator pedal position.

Lower Ball Joint

Lower Ball Joint and Associated Parts



RTW340LF002201

Legend

(1) Lower Ball Joint
(2) Nut and Cotter Pin
(3) Lower Ball Joint Nut
(4) Link Nut
(5) Lower Ball Joint Bolt

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the link nut.
4. Support lower control arm with a jack.
5. Remove lower ball joint nut and cotter pin, then use remover 5-8840-2017-0 to remove the lower ball joint from the knuckle.

- The APP sensor 1 signal voltage increases from 1 V at rest position to greater than 4 V when the accelerator pedal is fully depressed.
- The APP sensor 2 signal voltage increases from 0.5 V at rest position to greater than 2 V when the accelerator pedal is fully depressed.

The ECM monitors and evaluates the APP sensors signal voltage along with other sensor inputs to determine the desired throttle opening. An APP sensor circuit DTC sets if the signal voltage of the APP sensor is outside the predetermined range.

Conditions for Running the DTC

DTC P2122, P2123, P2127, P2128 and P2138 runs continuously once the following conditions are met:

- The ignition is switched on.
- The ignition voltage is greater than 7 V.

Conditions for Setting the DTC

DTC P2122

The ECM determines the APP sensor 1 signal voltage is less than 0.84 V.

DTC P2123

The ECM determines the APP sensor 1 signal voltage is greater than 4.82 V.

DTC P2127

The ECM determines the APP sensor 2 signal voltage is less than 0.66 V.

DTC P2128

The ECM determines the APP sensor 2 signal voltage is greater than 4.82 V.

DTC P2138

The ECM detects the difference between the APP sensor 1 and sensor 2 signal voltage is greater than the predetermined value.

Conditions for Clearing DTC

The APP sensor circuit DTCs are Type ‘A’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type ‘A’ DTC sets and conditions for clearing Type ‘A’ DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the APP sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Tests the APP sensor internal circuits throughout its range of motion. If the DTC fails while performing this test, there is an internal fault condition in the APP sensor internal circuitry.

5 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P2122, P2123, P2127, P2128 or P2138 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Quickly depress the accelerator pedal to wide-open throttle then release pedal. Repeat this procedure several times or operate the vehicle within the conditions for running the DTC. 4 Using Tech 2, select the DTC display function. Does DTC P2122, P2123, P2127, P2128 or P2138 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the APP sensor wiring connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the 5 V reference circuit of the appropriate APP sensor and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 4	Go to Step 6
4	1 Connect a 3 A fused jumper wire between the 5 V reference circuit and the signal circuit of the appropriate APP sensor. 2 Switch on the ignition with the engine not running. 3 Using Tech 2, observe the voltage parameter appropriate APP sensor. Does Tech 2 display **4.8 – 5.2 V**?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a DMM, measure the resistance between the appropriate TP sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test the 5 V reference circuit of the appropriate APP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test the signal circuit of the appropriate APP sensor for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Test the low reference circuit of the appropriate APP sensor for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10

Step	Action	Yes	No
9	Replace the accelerator pedal assembly. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the APP Sensor Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.51 DTC P2177 or P2179

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2177 Fuel Trim System Lean at Cruise or Accel Bank 1
- DTC P2179 Fuel Trim System Lean at Cruise or Accel Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicate a lean condition, fuel trim values will be above 0 percent. If the HO2S indicate a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively lean condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2177 or P2179 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7,000 grams.
- DTC P2177 and P2179 runs continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is more than 23 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A fuel system delivery condition causes this DTC to set. Thoroughly inspect all items that cause a lean condition.
- Any un-metered air into the engine causes this DTC to set. Thoroughly inspect all areas of the engine for vacuum leaks.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If DTC P2177 and P2179 are set at the same time, this indicates that both banks of the engine are operating lean. Inspect for items that would cause both banks of the engine to operate lean.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

6 A vacuum leak causes DTC P2177 and P2179 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect the PCV valve for being the correct one for this application. Make sure that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.

DTC P2177 or P2179 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

2	**NOTE** If any DTCs are set, except P2177 or P2179, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is operating in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for bank 1 or bank 2 with a scan tool. Is the Total Fuel Trim Avg. less than the specified value indicated?	23%	Go to Step 3	Go to Step 4
3	1 Use Tech 2 to clear the DTC/s. 2 Ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC
4	Are both banks of the engine operating lean?	—	Go to Step 5	Go to Step 7
5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for bank 1 and bank 2, using Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 7.6 DTC P0101, P0102 or P0103in this Section	Go to Step 6

6	1 Inspect for the following conditions: – The vacuum hoses for splits, kinks, and proper connections. – The throttle body and the intake manifold for vacuum leaks. – The crankcase ventilation valve and system for leaks. – The air intake system after the MAF sensor for vacuum leaks. – Contaminated fuel. Refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – Lean injectors – refer to 6.2 Fuel Injector Coil Test in this Section. – The engine control ground points for being clean, tight, and in the correct locations. – A high engine oil level condition. A high engine oil level causes oil residue to form on the mass air flow (MAF) sensor, causing a lean indication. The MAF sensor does not need to be replaced. – An engine mechanical condition. Did you find and correct the condition?	—	Go to Step 8	Go to Additional Information in this DTC
7	1 Inspect for the following conditions: – Vacuum leaks that only affect one bank of the engine--For example, the intake manifold, the injector O-rings. – Lean injectors--Refer to 6.2 Fuel Injector Coil Test in this Section. – Exhaust leaks, missing or loose exhaust hardware. Refer to 6F Exhaust System – V6. – The heated oxygen sensors (HO2S) are installed securely and the electrical connectors are not contacting the exhaust system. – An engine mechanical condition. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information in this DTC
8	Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Did DTC P2177 or P2179 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

When all diagnosis and repairs are completed, clear all DTCs and verify correct operation

7.52 DTC P2178 or P2180

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2178 Fuel Trim System Rich at Cruise or Accel Bank 1
- DTC P2180 Fuel Trim System Rich at Cruise or Accel Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicates a lean condition, fuel trim values will be above 0 percent. If the HO2S indicates a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively rich condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2178 or P2180 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7,000 grams.
- DTC P2178 and P2180 run continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is less than –22 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The Fuel Trim System circuit DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type ‘B’ DTC sets and conditions for clearing Type ‘B’ DTCs.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that could cause a rich condition.

- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines whether the fault is present.

4 If DTC P2178 and DTC P2180 set at the same time, then both banks of the engine are operating rich. Inspect items that would cause both banks of the engine to operate rich.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

DTC P2178 or P2180 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	**NOTE** If any DTCs are set, except P2178 and DTC P2180, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for bank 1 and / or bank 2 with Tech 2. Is the Total Fuel Trim Avg. less than the specified value?	–22%	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC.
4	Are both banks of the engine operating rich?	—	Go to Step 5	Go to Step 7

5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor is disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and bank 2 with Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 7.6 DTC P0101, P0102 or P0103 in this Section	Go to Step 6
6	1 Inspect for the following conditions: – A collapsed air intake duct – A restricted air filter element – The MAF sensor for foreign objects – Excessive fuel in the crankcase – Change the oil as necessary. – Contaminated fuel. Refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – The ECM grounds for being clean, tight, and in the correct locations – An engine mechanical condition – refer to 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to 6C Fuel System – V6
7	1 Inspect for the following conditions: – Rich injectors – refer to 6.2 Fuel Injector Coil Test in this Section – Restricted exhaust system – refer to 6F Exhaust System – V6 – An engine mechanical condition – refer to 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to Additional Information in this Section.
8	1 Switch off the ignition for 30 seconds. 2 Using Tech 2, clear the DTCs and reset the fuel trim system. 3 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did DTC P2178 and / or P2180 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

7.53 DTC P2187 or P2189

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2187 Fuel Trim System Lean at Idle Bank 1
- DTC P2189 Fuel Trim System Lean at Idle Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicate a lean condition, fuel trim values will be above 0 percent. If the O2S indicate a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively lean condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2187 or P2189 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in closed loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60° C.
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60° C.
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7000 grams.
- DTC P2187 and P2189 runs continuously once the above conditions are met for at least 300 seconds.

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is more than 40 percent.
- The LT FT Idle / Decel is more than seven percent.
- The condition exists for four seconds.

Action Taken When the DTC Sets

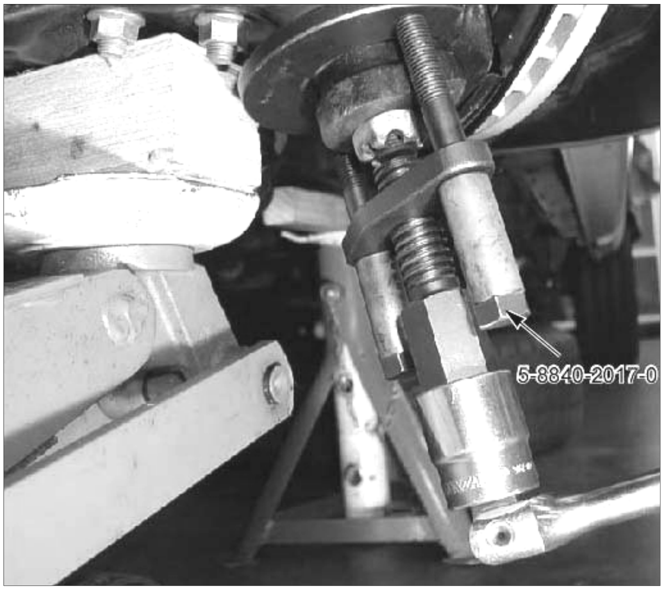
The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The Fuel Trim System circuit DTCs are Type ‘B’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type ‘B’ DTC sets and conditions for clearing Type ‘B’ DTCs.
- Use Tech 2 to clear the MIL and the DTC.

CAUTION: Be careful not to damage the ball joint boot.



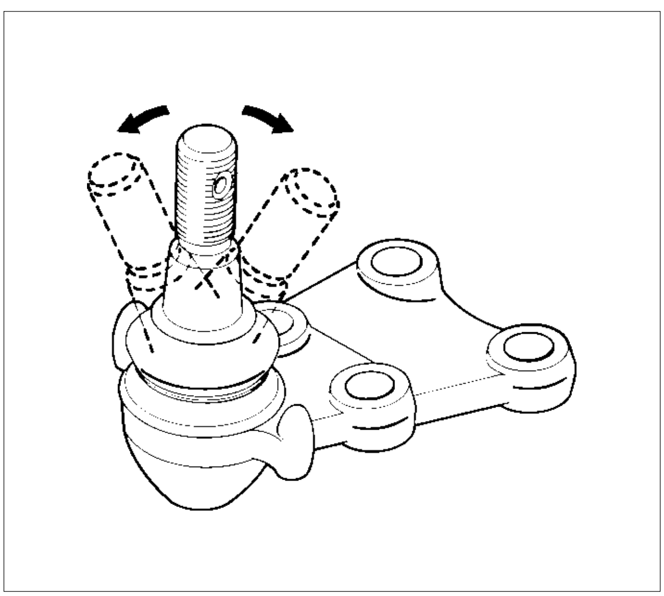
P1010003

6. Remove lower ball joint nut.
7. Remove lower ball joint bolt.
8. Remove lower ball joint.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal condition is found during inspection.

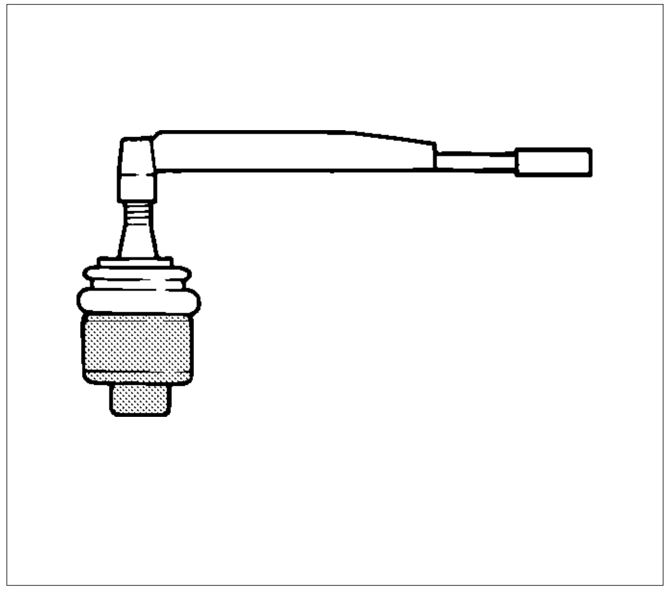
- Inspect the lower end of the boot for damage or grease leaks. Move the ball joint as shown in the figure to confirm its normal movement.
- Inspect screw/taper area of ball for damage.
- If any defects are found by the above inspections, replace the ball joint assembly with new one.



450RS026

- After moving the ball joint 4 or 5 times, attach nut then measure the preload.

Starting torque: 2.5-6.4 N·m (0.26-0.65 kgf·m/1.9-4.7 lb·ft)



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- If the above limits specified are exceeded, replace the ball joint assembly.

Installation

1. Install lower ball joint.
2. Install lower ball joint bolt.
3. Install lower ball joint nut and tighten it to the specified torque.

Torque: 127 N·m (13.0 kgf·m/94 lb·ft)

4. Install ball joint nut, then tighten it to the specified torque with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 147 N·m (15.0 kgf·m/108 lb·ft)

5. Install link nut, then tighten to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that could cause a rich condition.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if there is a current condition.

4 If DTC P2187 and P2189 are set at the same time, this indicates that both banks of the engine are operating lean. Inspect for items that would cause both banks of the engine to operate lean.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

6 A vacuum leak causes DTC P2187 and P2189 to set at the same time. Inspect all areas of the engine for a vacuum leak. Also inspect the positive crankcase ventilation (PCV) valve for being the correct one for this application. Make sure that the engine oil fill cap is in place and that it is tight. Verify that the engine oil dip stick is fully seated.

DTC P2187 or P2189 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	**NOTE** If any DTCs are set, except P2187 and DTC P2189, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 The fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for bank 1 and / or bank 2 with a scan tool. Is the Total Fuel Trim Avg. less than the specified value?	40%	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC.
4	Are both banks of the engine operating lean?	—	Go to Step 5	Go to Step 7

5	1 Start the engine. **NOTE** Additional DTCs will set when the MAF sensor is disconnected. 2 Disconnect the mass air flow (MAF) sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for bank 1 and bank 2 with Tech 2. 4 Reconnect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 7.6 DTC P0101, P0102 or P0103 in this Section	Go to Step 6
6	1 Inspect for the following conditions: – Vacuum hoses for splits, kinks, and proper connections. – The throttle body and the intake manifold for vacuum leaks. – The crankcase ventilation valve and system for leaks. – Air intake system after the MAF sensor for vacuum leaks. – Contaminated fuel – Refer to 6.5 Alcohol / Contaminants in Fuel Diagnosis in this Section. – Lean injectors – Refer to 6.2 Fuel Injector Coil Test in this Section. – The ECM grounds for being clean, tight, and in the correct locations – A high engine oil level condition. A high engine oil level causes oil residue to form on the MAF sensor, causing a lean indication. The MAF sensor does not need to be replaced. – An engine mechanical condition – refer to 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information and Test Descriptionin this DTC
7	1 Inspect for the following conditions: – Vacuum leaks that only affect one bank of the engine – For example, the intake manifold, the injector O-rings. – Lean injectors – refer to 6.2 Fuel Injector Coil Test in this Section – Exhaust leaks, missing or loose exhaust hardware. – The heated oxygen sensor (HO2S) is installed securely and the electrical connector is not contacting the exhaust system. – An engine mechanical condition – 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Refer to Additional Information in this DTC.

8	Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Did DTC P2179 or P2189 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

7.54 DTC P2188 or P2190

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2188 Fuel Trim System Rich at Idle Bank 1
- DTC P2190 Fuel Trim System Rich at Idle Bank 2

Circuit Description

The engine control module (ECM) controls the air / fuel metering system to provide the best possible combination of driveability, fuel economy, and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop, the ECM determines fuel delivery based on sensor signals without heated oxygen sensor (HO2S) input. During Closed Loop, the HO2S inputs are added and used by the ECM to calculate short and long term fuel trim fuel delivery adjustments. If the HO2S indicate a lean condition, fuel trim values will be above 0 percent. If the O2S indicate a rich condition, fuel trim values will be below 0 percent. Short term fuel trim values change rapidly in response to the HO2S signals. Long term fuel trim makes coarse adjustments to maintain an air / fuel ratio of 14.7:1. If the ECM detects an excessively rich condition, this DTC sets.

Conditions for Running the DTC

- Before the ECM can report DTC P2188 or P2190 failed, DTCs P0101, P0121, P0122, P0123, P0133, P0153, P0221, P0222, P0223, P0336, P0338, P0443, P0458, P0459, P0461, P0462, P0463, P2066, P2067, and P2068 must run and pass.
- The fuel system is in Closed Loop.
- The long fuel trim is active.
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The evaporative emission (EVAP) canister purge solenoid valve is not enabled.
- The intake air temperature (IAT) is less than 60°C (140°F).
- The fuel level is more than 11.6 percent.
- The amount of air flow into the engine is more than 7 000 grams.
- DTC P2188 and P2190 runs continuously once the above conditions are met for at least 300 seconds

Conditions for Setting the DTC

- The Total Fuel Trim Avg. is less than –40 percent.
- The LT FT Idle / Decel is less than -7 percent.
- The condition exists for 4 seconds.

Action Taken When the DTC Sets

- The control module activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A fuel delivery condition causes this DTC to set. Thoroughly inspect all items that cause a rich condition.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines whether the fault is present.

4 If DTC P2188 and P2190 set at the same time, then both banks of the engine are operating rich. Inspect items that would cause both banks to operate rich.

5 Disconnecting the mass air flow (MAF) sensor determines if the MAF sensor signal is skewed. If the Short Term FT parameter changes more than the specified value, there is a condition with the MAF sensor. A MAF sensor condition can cause this DTC without setting a MAF DTC. If there is a MAF sensor condition, the MAF sensor parameters will appear to be within range.

DTC P2188 or P2190 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	**NOTE** If any DTCs are set, except P2188 and P2190, refer to those DTCs before proceeding with this diagnostic. 1 Idle the engine at the normal operating temperature. 2 Check that the fuel system is in Closed Loop. 3 Observe the Total Fuel Trim Avg. parameter for bank 1 and / or bank 2 with Tech 2. Is the Total Fuel Trim Avg. less than the specified value?	–40%	Go to Step 3	Go to Step 4

3	1 Observe the Freeze Frame and / or the Failure Records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure Records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Go to Additional Information in this DTC.
4	Are both banks of the engine operating rich?	—	Go to Step 5	Go to Step
5	1 Start the engine. **NOTE** Additional DTCs will set with the mass air flow (MAF) sensor disconnected. 2 Disconnect the MAF sensor harness connector while the engine is operating. 3 Observe the Short Term FT parameter for Bank 1 and Bank 2 with Tech 2. 4 Connect the MAF sensor after completing this step. Does the Short Term FT parameter for both banks of the engine change more than the specified value with the MAF sensor disconnected?	20%	Go to 7.6 DTC P0101, P0102 or P0103	Go to Step 5
6	1 Inspect for the following conditions: – A collapsed air intake duct – A restricted air filter element – Inspect the MAF sensor for foreign objects. – Excessive fuel in the crankcase – Change the oil as necessary. – Contaminated fuel. Refer to 6.5 Alcohol / Contaminants in Fuel Diagnosisin this Section. – The engine control grounds for being clean, tight, and in the correct locations – An engine mechanical condition – refer to 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step 8	Go to 6C Fuel System – V6
7	1 Inspect for the following conditions: – Rich injectors – Refer to 6.2 Fuel Injector Coil Test in this Section – Restricted exhaust system – Refer to 6F Exhaust System – V6. – An engine mechanical condition – refer to 6A1 – Engine Mechanical V6. Did you find and correct the condition?	—	Go to Step	Go to Additional Information in this DTC

8	1 Turn OFF the ignition for 30 seconds. 2 Using Tech 2, clear the DTCs and reset the fuel trim system. 3 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did DTC P2188 and / or P2190 fail this ignition cycle?	—	Go to Step 2	Go to Step 9
9	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK

7.55 DTC P2195 or P2197

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2195 – B1S1 O2 Sensor – System Too Lean (Bank 1 Sensor 1)
- DTC P2197 – B2S1 O2 Sensor – System Too Lean (Bank 2 Sensor 1)

Circuit Description

The wide band heated oxygen sensor 1 (HO2S1) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell.

The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1.

Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2195 or P2197 failed, DTCs P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P2270, P2271, P2272, and P2273 must run and pass.
- The front and rear heated oxygen sensors are at operating temperature.
- The rear HO2S voltage signal is more than 850 mV.
- The front HO2S is more than 1.08 lambda.
- The Loop Status for both the front and rear sensors is Closed Loop.
- DTCs P2195 and P2197 run continuously once the above conditions are met.

Conditions for Setting the DTC

Condition 1

- The ECM detects that the front HO2S is operating too lean while the rear HO2S is operating too rich and the ECM detects that the fuel trim is at maximum control,

  OR

- The rear fuel trim, long and short term, is more than a threshold.
- This DTC sets after the air flow coming into the engine accumulates to more than 200 grams and the above conditions are met for more than 4 seconds.

Condition 2

- The ECM detects that the rear HO2S is operating too rich while the ECM is commanding a lean air / fuel mixture.
- This DTC sets after the air flow coming into the engine accumulates to more than 800 grams and the above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A HO2S fault condition may cause this DTC to set. Thoroughly inspect all items that could cause a lean condition.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

5 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2195 or P2197 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

2	1 Allow the engine to reach operating temperature. 2 Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3 Observe the diagnostic trouble code (DTC) information, using Tech 2. Did DTC P2195 or DTC P2197 fail this ignition?	—	Go to Step 4	Go to Step 3
3	1 Observe the Freeze Frame and/or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC.
4	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Operate the engine above 1,200 RPM for 30 seconds. 2 Observe the appropriate rear HO2S voltage, using Tech 2. Is the voltage more than the specified value?	60 mV	Go to Step 8	Go to Step 6
6	1 Ignition OFF. 2 Disconnect the appropriate rear heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Observe the appropriate rear HO2S voltage parameter with Tech 2. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 7
7	1 Test the appropriate rear HO2S signal circuit for a short to ground. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9
9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10

10	1 Ignition OFF. 2 Disconnect the front and rear heated oxygen sensors. 3 Inspect the front and rear heated oxygen sensors for the following conditions: – For damaged wiring between the HO2S and the ECM – An intermittent circuit condition may cause this DTC to set. – For terminal corrosion or water intrusion in the HO2S harness connectors. – For the correct terminal tension. – The HO2S is securely installed and not damaged. – For any exhaust leaks – Refer to 6F Exhaust System – V6. 8 Repair as necessary. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front heated oxygen sensor circuits for being shorted together between the HO2S connector and the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to 8A Electrical - Body and Chassis. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the HO2S 1. Refer to the Oxygen Sensor 1 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
17	1 Replace the HO2S 2. Refer to the Oxygen Sensor 2 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Clear the DTCs, using Tech 2. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2195 or P2197 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTC?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.56 P2196 or P2198

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2196 – B1S1 O2 Sensor – System Too Rich (Bank 1 Sensor 1)
- DTC P2198 – B2S1 O2 Sensor – System Too Rich (Bank 2 Sensor 1)

Circuit Description

The wide band heated oxygen sensor 1 (HO2S1) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S2. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system. An electronic circuit within the ECM controls the pump current through the oxygen pumping cell, maintaining a constant voltage in the oxygen sensing cell.

The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust. The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1.

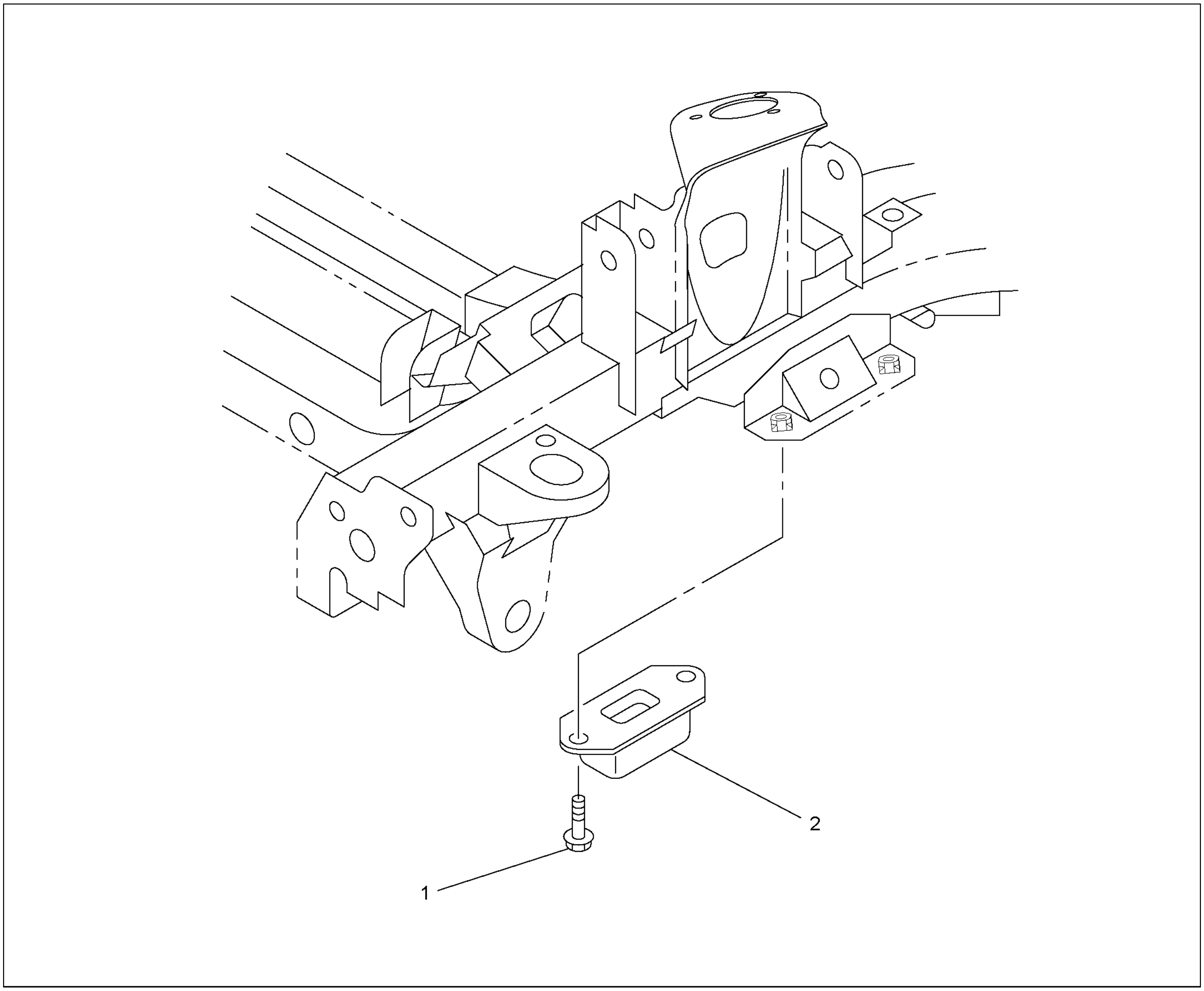
Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2196 or P2198 failed, DTCs P0137, P0138, P0140, P0141, P0157, P0158, P0160, P0161, P2270, P2271, P2272, and P2273 must run and pass.
- The front and rear heated oxygen sensors are at operating temperature.
- The rear HO2S voltage signal is more than 150 mV.
- The front HO2S is more than 0.92 lambda.
- The Loop Status for both the front and rear sensors is Closed Loop.
- DTCs P2196 and P2198 run continuously once the above conditions are met.

Bump Rubber

Bump Rubber and Associated Parts



Legend

(1) Bolt

(2) Bump Rubber

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove bolt.
3. Remove bump rubber.

Inspection and Repair

Make the necessary adjustments or parts replacement if wear, damage, corrosion or any other abnormal condition is found during inspection.

Check the following parts:

- Bump Rubber

Installation

1. Install bump rubber.
2. Install bolt, then tighten it to the specified torque.

Torque: 42 N·m (4.3 kgf·m/31 lb·ft)

Conditions for Setting the DTC

Condition 1

- The ECM detects that the front HO2S is operating too rich while the rear HO2S is operating too lean and the ECM detects that the fuel trim is at minimum control,

  OR
- The rear fuel trim, long and short term, is less than a threshold.
- This DTC sets after the air flow coming into the engine accumulates to more than 200 grams and the above conditions are met for more than 4 seconds.

Condition 2

- The ECM detects that the rear HO2S is operating too lean while the ECM is commanding a rich air / fuel mixture.
- This DTC sets after the air flow coming into the engine accumulates to more than 800 grams and the above condition is met for more than 4 seconds.

Action Taken When the DTC Sets

- The ECM activates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- A HO2S fault condition may cause this DTC to set. Thoroughly inspect all items that could cause a rich condition.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if a condition exists.

5 This step is testing for a rear HO2S sensor circuit condition. A circuit condition sets this DTC.

8 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

9 This step is testing for an intermittent circuit condition. Thoroughly inspect the HO2S circuits for an intermittent circuit condition.

DTC P2196 or P2198 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Allow the engine to reach operating temperature. 2 Operate the vehicle within the parameters specified in Conditions for Running the DTC. 3 Observe the diagnostic trouble code (DTC) information, using Tech 2. Did DTC P2196 or DTC P2198 fail this ignition?	—	Go to Step 4	Go to Step 3
3	1 Observe the Freeze Frame and / or the Failure records data for this DTC. 2 Turn the ignition OFF for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame and / or the Failure records data. Does the DTC fail this ignition cycle?	—	Go to Step 4	Refer to Additional Information in this DTC.
4	Is DTC P0041, P0137, P0138, P0140, P0157, P0158, or P0160 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Operate the engine above 1,200 RPM for 30 seconds. 2 Observe the appropriate rear HO2S voltage, using Tech 2. Is the voltage less than the specified value?	1,050 mV	Go to Step 8	Go to Step 6
6	1 Ignition OFF. 2 Disconnect the appropriate rear heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Observe the appropriate rear HO2S voltage parameter with Tech 2. Is the voltage within the specified range?	350 – 550 mV	Go to Step 12	Go to Step 7
7	1 Test the appropriate rear HO2S signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
8	1 Shake the related HO2S harnesses for the front sensor between the HO2S harness connector and the engine control module (ECM) while monitoring the appropriate HO2S lambda parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 9

9	1 Shake the related HO2S harnesses for the rear sensor between the HO2S harness connector and the ECM while monitoring the appropriate HO2S voltage parameter. Does the HO2S parameter change abruptly while moving the related harnesses?	—	Go to Step 15	Go to Step 10
10	1 Ignition OFF. 2 Disconnect the front and rear heated oxygen sensors. 3 Inspect the front and rear heated oxygen sensors for the following conditions: – For damaged wiring between the HO2S and the ECM – An intermittent circuit condition may cause this DTC to set. – For terminal corrosion or water intrusion in the HO2S harness connectors. – For the correct terminal tension. – The HO2S is securely installed and not damaged. – For any exhaust leaks – Refer to 6F Exhaust System – V6. 8 Repair as necessary. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1 Disconnect the ECM. 2 Test the appropriate front heated oxygen sensor circuits for being shorted together between the HO2S connector and the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 13
12	1 Test for shorted terminals and for poor connections at the HO2S. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
13	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
14	1 Test for shorted terminals and for poor connections at the ECM. Refer to 8A Electrical - Body and Chassis. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
15	1 Repair the circuit as necessary. Refer to 8A Electrical - Body and Chassis. Did you complete the repair?	—	Go to Step 19	—
16	1 Replace the HO2S 1. Refer to the Oxygen Sensor 1 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—

17	1 Replace the HO2S 2. Refer to the Oxygen Sensor 2 procedure, in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
18	1 Replace the ECM. Refer to Engine Control Module (ECM) Remove, Reinstall and ECM Reset in 6C1- Engine Management – V6 Service Operations. Did you complete the replacement?	—	Go to Step 19	—
19	1 Clear the DTCs, using Tech 2. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC P2196 or P2198 fail this ignition cycle?	—	Go to Step 2	Go to Step 20
20	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTC?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.57 DTC P2227, P2228 or P2229

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P2227 – Barometric Pressure Sensor Circuit Range / Performance
- DTC P2228 – Barometric Pressure Sensor Voltage Low
- DTC P2229 – Barometric Pressure Sensor Voltage High

Circuit Description

The ECM applies a positive 5 V reference voltage to the barometric pressure (BARO) sensor through the 5 V reference circuit and the ground through the low reference circuit.

The BARO sensor provides signal voltage to the ECM that is proportional to the atmospheric pressure changes through the signal circuit. The ECM uses the BARO signal voltage to maintain the correct fuel delivery at different altitudes.

The ECM monitors and compares the BARO sensor signal voltage against a specified range. A BARO pressure sensor circuit DTC sets if the ECM detects the BARO sensor signal voltage is outside the specified range.

Conditions for Running the DTC

DTC P2227

Runs continuously once the following conditions are met for 3 seconds:

- DTCs P0121, P0122, P0123, P0221, P0222 or P0223 are not set.
- The engine is running.

DTC P2228 and P2229

Runs continuously once the following conditions are met for 3 seconds:

- DTCs P0101, P0102 or P0103 are not set.

- The engine is running.

Conditions for Setting the DTC

DTC P2227

The ECM detects the BARO pressure changed greater than 5 kPa within 20 seconds or the BARO pressure changed greater than 30 kPa since the last ignition cycle.

DTC P2228

The ECM detects the BARO sensor signal voltage is less than 0.20 V.

DTC P2229

The ECM detects the BARO sensor signal voltage is greater than 4.8 V for longer than 2.0 seconds.

Conditions for Clearing DTC

The BARO pressure sensor circuit DTCs are Type 'B' DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type 'B' DTC sets and conditions for clearing Type 'B' DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the BARO Sensor operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Test signal circuit of the BARO sensor. This circuit should display a voltage within the specified range.

5 Measures the integrity of the TP sensor low reference circuit. Removal of the ECM Fuse 29 enables the ECM to power down completely prior to the test procedure.

DTC P2227 P2228 or P2229 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P2227, P2228 or P2229 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC

Step	Action	Yes	No
3	1 Switch off the ignition. 2 Disconnect the BARO sensor wiring connector. 3 Switch on the ignition with the engine not running. 4 Using a digital multimeter, measure the voltage between the BARO sensor signal circuit and the ECM housing. Does the multimeter display 4.5 – 5.5 V?	Go to Step 4	Go to Step 6
4	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the BARO sensor 5 V reference circuit and the ECM housing. Does the multimeter display 4.8 – 5.2 V?	Go to Step 5	Go to Step 7
5	1 Switch off the ignition. 2 Remove ECM / TCM Fuse 29 from the engine compartment fuse and relay panel assembly. 3 Using a digital multimeter, measure the resistance between the BARO sensor low reference circuit and the ECM housing. **NOTE** Install the ECM Fuse 29 to the engine compartment fuse and relay panel assembly after completing this test. Does the multimeter display 5 Ω?	Go to Step 9	Go to Step 8
6	Test BARO sensor signal circuit for a high resistance, open circuit, short to ground or short to voltage fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
7	Test the BARO sensor 5 V reference circuit for an open, short to ground or high resistance fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. **NOTE** The BARO sensor shares the 5 V reference circuit with other sensors. A fault condition in the 5 V reference circuit may trigger DTCs on sensors that share this circuit. Refer to 3 Wiring Diagrams and Connector Charts in this Section, to assist diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	1 Disconnect the ECM wiring connector. 2 Test the BARO sensor low reference circuit for a high resistance and open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
9	Replace the BARO sensor. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—
10	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 11	—

Step	Action	Yes	No
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the BARO pressure sensor circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.58 DTC P2231, P2232, P2234, P2235, P2251 or P2254

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC P2231 – O2 Sensor Signal Interference by Heater Circuit (Bank 1, Sensor 1)
- DTC P2232 – O2 Sensor Signal Short to Heater Circuit (Bank 1, Sensor 2)
- DTC P2234 – O2 Sensor Signal Interference by Heater Circuit (Bank 2, Sensor 1)
- DTC P2235 – O2 Sensor Signal Short to Heater Circuit (Bank 2, Sensor 2)
- DTC P2251 – O2 Sensor Ground Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2254 – O2 Sensor Ground Circuit Malfunction (Bank 2, Sensor 1)

Circuit Description

The Engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a driver, to control the HO2S rate of heating.

O2 Sensor 1

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S 1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S 1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S 1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S 1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S signal circuit shorted to heater control circuit DTC sets if the ECM detects the HO2S signal voltage is increasing or decreasing at the same rate as the HO2S heater control circuit.

O2 Sensor 2

The ECM applies a voltage of approximately 450 mV between the reference signal circuit and low reference circuit of the HO2S 2 while the sensor temperature is less than the operating range.

Once the HO2S 2 reaches operating temperature, the sensor varies this reference signal voltage, which constantly fluctuates between the high voltage output and the low voltage output.

The low voltage output is 0 – 450 mV, which occurs if the air fuel mixture is lean.

The high voltage output is 450 – 1,000 mV, which occurs if the air fuel mixture is rich.

The ECM monitors, stores and evaluates the HO2S 2 voltage fluctuation information to determine the level of oxygen concentration in the exhaust.

Conditions for Running the DTC

DTC P2231 or P2234

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051, P0052, P0053, P0059, P0130, P0135, P0150 or P0155 are not set.
- The HO2S heater control is enabled.
- The HO2S heater duty cycle is greater than 5 percent.
- The HO2S is at operating temperature for 10 seconds.
- The ECM does not detect an engine misfire fault condition.
- The fuel injectors are enabled.
- The ignition voltage is 10.5 – 18 V.
- The calculated exhaust temperature is less than 800°C.
- The MAF sensor signal output is steady within 3 percent of the airflow into the engine.

DTC P2232 and P2235

Run continuously once the following conditions are met:

- The engine is running.
- The HO2S is at operating temperature for longer than 90 seconds.
- The fuel injectors are enabled.
- The ignition voltage is greater than 10.5 V.
- The calculated exhaust temperature is 250 – 800°C.

DTC P2251 and P2254

Run continuously once the following conditions are met:

- DTCs P0030, P0031, P0032, P0050, P0051 and P0052 ran and passed.
- The HO2S heater control is enabled.
- The ECM internal sensing element resistance is greater than 570 Ω.
- The ECM detects the internal HO2S signal voltage is 1.47 – 1.53 V.
- The HO2S is at operating temperature.

Conditions for Setting the DTC

DTC P2231 or P2234

The ECM detects the following conditions:

- The internal HO2S signal voltage changes greater than 100 mV as the heater control switches.
- The above condition occurs 18 times in the last 10 seconds.

DTC P2232 or P2235

The ECM detects the following conditions:

- The internal HO2S signal voltage switches at the same rate as the heater circuit.
- The above condition occurs 4 times out of 6 as the heater is turned off.

DTC P2251 or P2254

The ECM detects the following conditions:

- The internal HO2S signal voltage changes greater than 10 mV as the heater control switches.
- The above condition occurs 20 times in the last 10 seconds.

Conditions for Clearing the DTC

The HO2S signal circuit shorted to heater control circuit DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when Type 'B' DTC sets and conditions for clearing Type 'B' DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

DTC P2231, P2232, P2234, P2235, P2251or P2254 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P2231, P2232, P2234, P2235, P2251 or P2254 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the appropriate HO2S connector. 2 From the HO2S to the sensor wiring connector, test the following circuit for a shorted to the sensor heater control circuit fault condition: • Reference signal circuit, • low reference circuit, • pump current, • input pump current. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found?	Go to Step 6	Go to Step 4

Step	Action	Yes	No
4	1 Disconnect the ECM and the appropriate HO2S connector. 2 From the HO2S wiring connector to the ECM wiring connector, test the following circuit for a shorted to the sensor heater control circuit fault condition: • Reference signal circuit, • low reference circuit, • pump current, • input pump current. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 8	Go to Step 7
6	Replace the appropriate HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 8	—
7	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the O2 Sensor Signal Circuit Shorted to Heater Control Circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.59 DTC P2237, P2238, P2239, P2240, P2241 or P2242

DTC Descriptors

This diagnostic procedure supports the following DTCs:

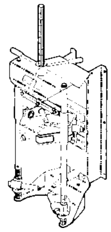
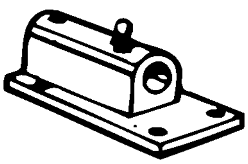
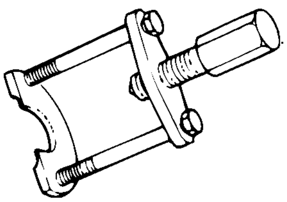
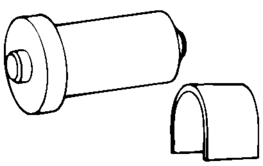
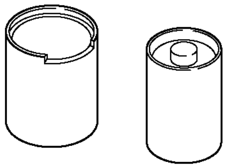
- DTC P2237 – O2 Sensor Pump Current Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2238 – O2 Sensor Pump Current Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P2239 – O2 Sensor Pump Current Circuit High Voltage (Bank 1, Sensor 1)
- DTC P2240 – O2 Sensor Pump Current Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2241 – O2 Sensor Pump Current Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P2242 – O2 Sensor Pump Current Circuit High Voltage (Bank 2, Sensor 1)

Circuit Description

The engine control relay applies positive voltage to the heater ignition voltage circuits of the HO2S #1. The ECM applies a pulse width modulated (PWM) ground to the heater control circuit of the HO2S through a device within the ECM called a Driver, to control the HO2S rate of heating.

The ECM maintains the voltage between the reference signal circuit and low reference circuit of the HO2S #1 to about 450 mV by increasing or decreasing the oxygen content in the HO2S diffusion gap. To achieve this, the ECM controls the current applied to the oxygen pumping cell in the HO2S.

Special Tools (4×2 Except High Ride Suspension)

ILLUSTRATION	PART NO. PART NAME
	**5-8840-2842-0** **(J-45400)** Spring compressor; Strut
	**5-8840-0003-0** **(J-3289-20)** Base
	**5-8840-2017-0** **(J-35707)** Ball joint remover
	**5-8840-0257-0** **(J-29756)** Installer; Upper and lower arm bushing
	**5-8840-2327-0** **(J-39792)** Installer; Upper and lower arm bushing

- If the air / fuel mixture in the exhaust is balanced (lambda = 1), the oxygen pumping cell current is zero.
- If the exhaust gas in the HO2S #1 diffusion gap is lean, the ECM applies a positive current to the oxygen pumping cell to discharge oxygen from the diffusion gap.
- If the exhaust gas in the HO2S #1 diffusion gap is rich, the ECM applies a negative current to the oxygen pumping cell to draw oxygen into the diffusion gap.

The pumping current required to maintain the HO2S #1 signal circuit voltage to about 450 mV is proportional to the level of oxygen concentration in the exhaust gas. The ECM monitors and evaluates the oxygen pumping current to determine the level of oxygen concentration in the exhaust.

An HO2S pumping current control circuit DTC sets if the ECM detects the HO2S #1 signal voltage is outside the predetermined range.

Conditions for Running the DTC

Condition 1

Run continuously once the following conditions are met:

- DTCs P0101, P0121, P0122, P0123, P0133, P0135, P0153, P0155, P0221, P0222, P0223, P0336 and P0338 ran and passed.
- The ECM is commanding the lambda outside the range of 0.97 – 1.03.
- The engine is operating in closed loop.
- The HO2S heater is at operating temperature.

Condition 2

Run continuously once the following conditions are met:

- DTCs P0101, P0121, P0122, P0123, P0133, P0135, P0153, P0155, P0221, P0222, P0223, P0336 and P0338 ran and passed.
- The ECM is commanding the lambda rich and then lean periodically with a change of greater than 2 percent.
- The ECM detects the internal HO2S signal voltage is 1.48 – 1.52 V.
- The HO2S is 0.97 – 1.03 lambda.
- The engine is operating in closed loop.
- The HO2S heater is at operating temperature.

Condition 3

Run continuously once the following conditions are met:

- DTCs P0133 and P0153 ran and passed.
- The HO2S heater is at operating temperature.

Conditions for Setting the DTC

Condition 1

The ECM detects the following conditions:

- The internal HO2S signal voltage change is 1.52 – 1.48 V.
- The above condition exists and 200 grams of exhausts gas has passed.

Condition 2

The ECM stores the fuel trim control values. This DTC sets if the ECM detects a deviation of greater than 10 percent within 1.5 seconds between the stored value and the current value of the fuel trim.

Condition 3

The ECM detects that 5 seconds after decel fuel shut-off, the internal HO2S signal voltage is less than 1.7 V.

Conditions for Clearing the DTC

The HO2S pumping current control circuit DTCs are Type 'B' DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section for action taken when Type 'B' DTC sets and conditions for clearing Type 'B' DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the HO2S system operation.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Inspect the HO2S wiring harness for contact with the exhaust system.
- The HO2S must be tightened correctly. A loose HO2S will trigger these DTCs.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical-Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V
Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 When performing this test, the HO2S should react immediately.

4 Connecting a jumper wire between the HO2S reference signal circuit and the low reference circuit causes the ECM to apply signal voltage to the pumping current and input pumping current.

DTC P2237, P2238, P2239, P2240 or P2242 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Allow the engine to reach the normal operating temperature. 4 Increase the engine speed to 2,000 rpm for 10 seconds. 5 Using Tech 2, select the DTC display function. Does DTC P2237, P2238, P2239, P2240, P2241, P2242, fail this ignition cycle?	—	Go to Step 3	Refer to Additional Information in this DTC

3	Are DTCs relating to the reference circuit of the HO2S also set? (e.g. 7.10 DTC P0130, P0131, P0132, P0135, P0137, P0138, P0140, P0141, P0150 P0151, P0152, P0155, P0157, P0158, P0160, P0161, P2243, P2247, P2270, P2271, P2272, P2273, P2297 or P2298)	—	Go to the appropriate DTC Table in this Section	Go to Step 4
4	1 Disconnect the appropriate HO2S wiring connector. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the input pump current circuit and a good ground. Is the voltage more than the specified value?	50 mV	Go to Step 8	Go to Step 5
5	1 Ignition ON, engine OFF. 2 Using a digital multimeter, measure the voltage between the pump current circuit and a good ground. is the voltage display more than the specified value?	50 mV	Go to Step 8	Go to Step 6
6	1 Connect a 3 A fused jumper wire between the HO2S reference signal circuit and the low reference circuit. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the input pump current circuit and a good ground. Is the voltage reading within the specified range?	4.8 – 5.2 V	Go to Step 7	Go to Step 8
7	1 Connect a 3 A fused jumper wire between the HO2S reference signal circuit and the low reference circuit. 2 Ignition ON, engine OFF. 3 Using a digital multimeter, measure the voltage between the pump current circuit and a good ground. Is the voltage reading within the specified range?	4.8 – 5.2 V	Go to Step 9	Go to Step 10
8	1 Test the input pump current and the pump current circuit of the HO2S for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to 8A Electrical-Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	—	Go to Step 12	Go to Step 11
9	1 Test or inspect for the following conditions that may cause the HO2S to detect an incorrect air / fuel mixture: • Lean or rich fuel injector fuel delivery, • Contaminated fuel, • Low fuel line pressure, • Exhaust leak near the HO2S, and • Leak in the crankcase or vacuum line. Was any fault found and rectified?	—	Go to Step 12	Go to Step 10

10	1 Replace the appropriate HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	—	Go to Step 12	—
11	1 Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	—	Go to Step 12	—
12	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the HO2S pumping current control circuit DTCs fail this ignition cycle?	—	Go to Step 2	Go to Step 13
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.60 DTC P2626, P2627, P2628, P2629, P2630 or P2631

DTC Descriptors

- DTC P2626 – O2 Sensor Pump Current Trim Circuit Malfunction (Bank 1, Sensor 1)
- DTC P2627 – O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 1, Sensor 1)
- DTC P2628 – O2 Sensor Pump Current Trim Circuit High Voltage (Bank 1, Sensor 1)
- DTC P2629 – O2 Sensor Pump Current Trim Circuit Malfunction (Bank 2, Sensor 1)
- DTC P2630 – O2 Sensor Pump Current Trim Circuit Low Voltage (Bank 2, Sensor 1)
- DTC P2631 – O2 Sensor Pump Current Trim Circuit High Voltage (Bank 2, Sensor 1)

Circuit Description

The wide band heated oxygen sensor (HO2S) measures the amount of oxygen in the exhaust system and provides more information than the switching style HO2S. The wide band sensor consists of an oxygen sensing cell, an oxygen pumping cell, and a heater. The exhaust gas sample passes through a diffusion gap between the sensing cell and the pumping cell. The engine control module (ECM) supplies a voltage to the HO2S and uses this voltage as a reference to the amount of oxygen in the exhaust system.

An electronic circuit within the ECM controls the pump current through the oxygen pumping cell in order to maintain a constant voltage in the oxygen sensing cell. The ECM monitors the voltage variation in the sensing cell and attempts to keep the voltage constant by increasing or decreasing the amount of current flow, or oxygen ion flow, to the pumping cell. By measuring the amount of current required to maintain the voltage in the sensing cell, the ECM can determine the concentration of oxygen in the exhaust.

The HO2S voltage is displayed as a lambda value. A lambda value of 1 is equal to a stoichiometric air fuel ratio of 14.7:1. Under normal operating conditions, the lambda value will remain around 1. When the fuel system is lean, the oxygen level will be high and the lambda signal will be high or more than 1. When the fuel system is rich, the oxygen level will be low, and the lambda signal will be low or less than 1. The ECM uses this information to maintain the correct air / fuel ratio.

Conditions for Running the DTC

- Before the ECM can report DTC P2626 or P2629 failed, DTCs P0101, P0121, P0122, P0123, P0221, P0222, P0223, P0336, and P0338 must run and pass.
- The engine is operating.

- The ignition voltage is between 10.7 – 18.0 volts.
- The fuel system is in fuel shut-off mode.
- The calculated exhaust temperature is less than 750°C.
- The heated oxygen sensors are at operating temperature.
- DTC P2626 and P2629 runs continuously once the above conditions are met.

Conditions for Setting the DTC

- The ECM internal HO2S voltage is more than 4.81 volts.
- The condition exists for more than 4 seconds or 600 seconds if the fuel level is less than 12 percent.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the DTC

- The ECM turns OFF the malfunction indicator lamp (MIL) after four consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Use Tech 2 to clear the MIL and the DTC.

Additional Information

- Use the J 35616 Connector Test Adapter Kit for any test that requires probing the ECM harness connector or a component harness connector.
- The lower connector of the ECM is connector A43-X1 and the upper connector of the ECM is connector A43-X2. Refer to 3 Wiring Diagrams and Connector Charts.
- The front wide band sensors do not toggle or switch like a switching HO2S. The front HO2S signals will be relatively stable for an idling engine.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical-Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section for the system wiring diagram and connector charts.
- The following table illustrates the typical voltages for the HO2S circuits:

HO2S Voltages	
Conditions: • Ignition ON, Engine OFF • HO2S Disconnected	
HO2S Circuit	**Voltage**
Heater Control	4.6 – 5.0 V
Heater Supply Voltage	B+
Reference Voltage	2.6 – 3.1 V

Low Reference	2.2 – 2.7 V
Pump Current	Less than 0.5 A
Input Pump Current	Less than 0.5 A

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2 This step determines if the condition exists. The HO2S lambda parameter should react immediately to the changes in throttle position when performing this test.

5 This step determines if there is a condition with the pumping current circuit. Connecting a jumper wire between the reference voltage and the low reference circuits causes the ECM to command the pumping current and the input pumping current circuits.

DTC P2626, P2627, P2628, P2629, P2630 or P2631 Diagnostic Table

Step	Action	Value(s)	Yes	No
1	Has the Diagnostic System Check been completed?	—	Go to Step 2	Refer to 4.4 Diagnostic System Check
2	1 Start engine and allow to reach operating temperature. 2 Cycle the throttle from idle to wide open throttle (WOT), 3 times within 5 seconds. 3 Use Tech 2 to observe the affected HO2S lambda value Does the affected HO2S lambda value react immediately to the above action?	—	Go to Step 3	Go to Step 4
3	1 Observe the Freeze Frame / Failure Records for this DTC. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Does P2626 P2627, P2628, P2629, P2630 or P2631 fail this ignition?	—	Go to Step 4	Go to Additional Information in this DTC
4	Is DTC P0131, P0132, P0151 or P0152 also set?	—	Go to the appropriate DTC Table in this Section	Go to Step 5
5	1 Ignition OFF. 2 Disconnect the appropriate heated oxygen sensor (HO2S). 3 Ignition ON, engine OFF. 4 Connect a 3-amp fused jumper wire between the reference voltage circuit and the low reference circuit of the HO2S. 5 Measure the voltage between the pump current circuit and a good ground. Is the voltage more than the specified value?	1.0 V	Go to Step 7	Go to Step 6

6	1 Test the pump current circuit of the HO2S for an open. Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 11	Go to Step 8
7	1 Test for an intermittent and for a poor connection at the appropriate HO2S. Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
8	1 Test for an intermittent and for a poor connection at the engine control module (ECM). Refer to 8A Electrical-Body and Chassis. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	1 Replace the HO2S. Refer to 6C1-3 Engine Management – V6 – Service Operations. Did you complete the replacement?	—	Go to Step 11	—
10	1 Replace the ECM. Refer to 6C1-3 Engine Management –V6 – Service Operations for details on replacing the ECM. Did you complete the replacement?	—	Go to Step 11	—
11	1 Use Tech 2 to clear the DTCs. 2 Turn OFF the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame / Failure Records. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12
12	1 Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	—	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and verify correct operation				

7.61 DTC U0001

DTC Descriptor

This diagnostic procedure supports DTC U0001 – No Communication with CAN-Bus (High Speed).

Circuit Description

The engine control module (ECM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the immobiliser control unit (ICU) communicates with the ECM using the keyword 2000 protocol. Since the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to serve as a gateway. This gateway allows communication between the two protocols. Refer to 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

DTC U0001 sets if the ECM detects a fault condition in the serial data communication circuit.

Conditions for Running the DTC

DTC U0001 runs continuously when the following conditions are met:

The ignition voltage is 10.0 – 16.0 V.

The vehicle power mode requires serial data communication.

Conditions for Setting the DTC

The ECM detects a specified number of transmitted messages are not valid.

Conditions for Clearing the DTC

The Serial Data Communication Circuit DTCs are Type ‘C’ DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type ‘C’ DTC sets and conditions for clearing Type ‘C’ DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

- Tests the integrity of the GM LAN serial data communication circuit.
- Tests for fault conditions on the vehicle immobiliser system stored in the ICU.

DTC U0001 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0001 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC U0001 fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Are there any DTCs displayed?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.62 DTC U0101

DTC Description

This diagnostic procedure supports the following DTC:

- DTC U0101 – CAN-Bus No Communication With TCM (Transmission Control Module)

Circuit Description

The Engine Control Module (ECM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the immobiliser control unit (ICU) communicates with the ECM using the keyword 2000 protocol. Since the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to serve as a gateway. This gateway allows communication between the two protocols. Refer to 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit.

A serial data communication circuit – TCM DTC sets if the ECM detects an invalid signal from the TCM.

Conditions for Running the DTC

DTC U0101 runs continuously when the following conditions are met:

- The ignition is on for longer than 3 seconds.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM did not receive a valid signal from the TCM within the specified time frame.

Conditions for Clearing the DTC

This Serial Data Communication Circuit DTC is a Type C DTC. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and the conditions required for clearing Type C DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

  - Tests the integrity of the GM LAN serial data communication circuit.
  - Tests for fault conditions on the vehicle immobiliser system stored in the ICU.

DTC P0864 and U0101 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section

Step	Action	Yes	No
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0101 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	Using Tech 2, attempt to communicate with the PIM. Does the PIM failed to communicate?	Refer to the 6E1 Powertrain Interface Module – V6	Go to Step 4
4	Are DTCs also set in the PIM?	Refer to 6E1 Powertrain Interface Module – V6	Go to Step 5
5	Are DTCs that may trigger a fault condition in the serial data communication circuit also set in the TCM?	Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis	Go to Step 6
6	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Was the repair completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the serial data communication circuit – TCM DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

7.63 DTC U0155 or U0423

DTC Descriptors

This diagnostic procedure supports the following DTCs:

- DTC U0155 – CAN-Bus No Communication With Gateway
- DTC U0423 – CAN-Bus Invalid Data From Gateway

Circuit Description

The Engine Control Module (ECM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol.

However, the immobiliser control unit (ICU) communicates with the ECM using the keyword 2000 protocol. Since the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to serve as a gateway. This gateway allows communication between the two protocols. Refer to 6E1 Powertrain Interface Module – V6 for further information on the GM LAN serial data communication circuit

A PIM serial data communication circuit DTC sets if the ECM detects an invalid signal from the PIM.

Conditions for Running the DTC

DTCs U0155 and U0423 run continuously when the following conditions are met:

- The engine is running.

SECTION 1
HEATER AND AIR CONDITIONING

TABLE OF CONTENTS

SECTION 3C

FRONT SUSPENSION
(4×2 High Ride Suspension, 4×4)

TABLE OF CONTENTS

- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The ECM did not receive a valid signal from the PIM within the specified time frame.

Conditions for Clearing the DTC

The PIM serial data communication circuit DTCs are Type C DTCs. Refer to 1.4 Diagnostic Trouble Codes in this Section, for action taken when a Type C DTC sets and conditions for clearing Type C DTCs.

Additional Information

- Refer to 6C1-1 Engine Management – V6 – General Information for details of the ECM operation.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to 5.2 Intermittent Fault Conditions in this Section.
- To assist diagnosis, refer to 3 Wiring Diagrams and Connector Charts in this Section, for the system wiring diagram and connector charts.

Test Description

The following number refers to the step numbers in the diagnostic table:

1 The following tests are included in the Diagnostic System Check.

- Tests the integrity of the GM LAN serial data communication circuit.
- Tests for fault conditions on the vehicle immobiliser system stored in the ICU.

DTC U0155 or U0423 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.4 Diagnostic System Check in this Section
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for running the DTC. 3 Using Tech 2, select the DTC display function. Does DTC U0155, or U0423 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	Replace the PIM. Refer to 6E1 Powertrain Interface Module – V6. Was the repair completed?	Go to Step 4	—
4	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the PIM serial data communication circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 5
5	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

8 HFV6 Engine – Tech 2 Functions

8.1 Introduction

CAUTION

Do not use a Tech 2 that displays faulty data; have the Tech 2 repaired. The use of a faulty Tech 2 can result in misdiagnosis and the unnecessary replacement of parts.

From the Main Menu, having selected **Diagnostics** / **2006** / **RA Rodeo** / **Engine**, the Tech 2 functions for the HFV6 engine, include:

F0: Diagnostic Trouble Codes

F1: Data Display

F2: OBD Data

F3: Snapshot

F4: Actuator Test

F5: Additional Functions

F6: Programming

8.2 Tech 2 Functions

F0: Diagnostic Trouble Codes

When this test mode is initiated, DTCs stored by the ECM can be displayed or cleared. When entered, there are three additional modes for selection:

F0: Read DTC Information: All DTCs stored in the ECM will be displayed.

F1: Clear Engine & Transmission DTCs: Clears all current DTCs in the ECM and TCM memories.

F2: Freeze Frame/Failure Records: Shows the Freeze Frame information. Freeze Frames are types of snapshots stored in the ECM memory.

F1: Data Display

- Use the Tech 2 Data List under the following conditions:
- The Diagnostic System Check – HFV6 Engine has been completed.
- The On-Board Diagnostics are functioning correctly.
- No DTCs are present.

NOTE

- Tech 2 values from an engine that is operating correctly may be used for comparison with the engine you are diagnosing. The Tech 2 engine data lists represent typical values that would be seen on a normal operating engine.
- The Tech 2 Data Definitions list that follows the Data Lists, is arranged in alphabetical order and contains a brief description of all of the engine related parameters that are available.

The following 'typical' Tech 2 values were recorded under the following conditions:

Ignition ON:	Engine Running
• Engine stopped, ignition in the ON position.	• Engine running.
• Closed throttle.	• Closed throttle.
• Transmission selector in the Park position (Automatic Transmission) or Neutral (Manual Transmission.	• Transmission selector in the Park position (Automatic Transmission) or Neutral (Manual Transmission.
• Engine, transmission at ambient temperature.	• Engine, transmission at normal operating temperature.
• Accessories are OFF.	• Accessories are OFF.
• Brake pedal is not applied.	• Brake pedal not applied.

NOTE

The values quoted in the following data lists are only intended to provide the Technician with an indication of the values to be expected.

When 'F1 Data Display' is selected, there are 12 data lists provided, that can save time when diagnosing symptomatic conditions.

Engine Data 1

Engine Data 2

EVAP Data

Fuel Trim Data

O2 Sensor Data

TAC Data (Throttle Actuator Control)

Cooling/HVAC Data

Cruise Control Data

Electrical/Theft Data

Instrument Data

ODM Data (Output Driver Module)

Misfire Data

F2: OBD Data

In this test mode, Tech 2 displays engine management data parameters relating to the OBD (On Board Diagnostic) for the engine being diagnosed. Refer to 8.5 OBD Data for specific detail.

F3: Snapshot

In this test mode, Tech 2 captures data before and after a snapshot triggering event that may or may not set a DTC.

F4: Actuator Test

In this test mode, Tech 2 performs software override commands to the ECM, to assist in problem isolation during diagnostics. When entering this mode, there are 9 actuators that can be tested for operational integrity. The 9 tests available are:

F0: Fuel Pump Relay Test

F1: Electronic Throttle Control Test

F2: A/C Relay Test

F3: Cooling Fan PWM

F4: Alternator L Terminal

F5: EVAP Purge Solenoid

F6: Engine Speed Control

F7: Starter Relay Test

F8: Fuel Injector Balance

F5: Additional Functions

When this selection is made from the Tech 2 screen, an additional two choices are provided:

F0: System Identification: In this mode, Tech 2 will display the engine identification screen.

F1: Security Information: When selected, this mode displays various engine management data parameters relating to the security system.

F6: Programming

Within this selection, there are five programming selections available:

F0: Immobiliser Link to ECM/PIM

F1: Reset ECU

F2: Fuel Trim Reset

F3: Reset Engine Oil Life

F4: Throttle Body Relearn

8.3 HFV6 Engine Data Lists

Engine Data 1

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Engine Speed	RPM	0	1077
Desired Engine Idle Speed	RPM	830	1090
Coolant Temperature	°C	21	27
Intake Air Temperature	°C	31	24
Mass Air Flow	g/s	0.00	7.28
Engine Load	%	100	30
Volumetric Efficiency	%	99	23
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	4
Calculated Throttle Position	%	6	4
Barometric Pressure	kPa	100	100
Barometric Pressure	V	4.78	4.78
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	1.0	1.0
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	442	460
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	1.0	1.0
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	442	477
B1 Short Term Fuel Trim (Bank 1)	%	0	-1
B1 LTFT Idle/Deceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 LTFT Cruise/Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B2 Short Term Fuel Trim (Bank 2)	%	0	–1
B2 LTFT Idle/Deceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 LTFT Cruise/Acceleration (Bank 2 Long Term Fuel Trim)	%	0	0
(2) Transmission Gear	P-N / In Gear	P-N	P-N
EVAP Purge Solenoid (Evaporative Emission)	%	0	0
Fuel Level	L	21	20
Spark Advance	°CA	0	9
B1 Knock Sensor Signal (Bank 1)	V	3.6	0.3
B2 Knock Sensor Signal (Bank 2)	V	3.6	0.3
Knock Retard	°CA	0	0
Knock Retard Cylinder 1	°CA	0	0
Knock Retard Cylinder 2	°CA	0	0

Knock Retard Cylinder 3	°CA	0	0
Knock Retard Cylinder 4	°CA	0	0
Knock Retard Cylinder 5	°CA	0	0
Knock Retard Cylinder 6	°CA	0	0
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
Malfunction Indicator (MI)	Off / On / Flashing	On	Off
Fuel Pump Relay	Off / On	Off	On
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	11.5	14.1
(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Reduced Engine Power	Inactive / Active	Inactive	Inactive
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:05:20
(2) Clutch Pedal Switch	Inactive / Active	Inactive	Inactive
(1) Automatic Transmission Only (2) Manual Transmission Only			

Engine Data 2

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Engine Speed	RPM	0	751
Desired Engine Idle Speed	RPM	830	750
Coolant Temperature	°C	21	78
Cooling Fan	On/Off	Off	On
Calculated ECT – Closed Loop Fuel Control (Engine Coolant Temperature)	°C	21	37
Calculated ECT – Thermostat Diagnosis (Engine Coolant Temperature)	°C	22	78
Intake Air Temperature	°C	31	27
Start Up ECT (Engine Coolant Temperature)	°C	21	21
Start Up IAT (Intake Air Temperature)	°C	–48	30
Mass Air Flow Sensor	V	1.00	1.3
Mass Air Flow	g/s	0.00	5.47
Engine Load	%	100	25
Volumetric Efficiency	%	99	19
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0

Desired Throttle Position	%	4	3
Calculated Throttle Position	%	6	3
Barometric Pressure	kPa	100	100
Barometric Pressure	V	4.78	4.80
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1 Short Term Fuel Trim (Bank 1)	%	0	–3
B1 LTFT Idle/Deceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 LTFT Cruise/Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B2 Short Term Fuel Trim (Bank 2)	%	0	–1
B2 LTFT Idle/Deceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 LTFT Cruise/Acceleration (Bank 2 Long Term Fuel Trim)	%	0	0
Injection Time Cylinder 1	ms	0.0	2.5
Injection Time Cylinder 2	ms	0.0	2.5
Injection Time Cylinder 3	ms	0.0	2.5
Injection Time Cylinder 4	ms	0.0	2.5
Injection Time Cylinder 5	ms	0.0	2.5
Injection Time Cylinder 6	ms	0.0	2.5
Spark Advance	°CA	0	12
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
(1) Transmission Gear	P-N / In Gear	P-N	P-N
(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Fuel Pump Relay	Off / On	Off	On
A/C Relay (Air Conditioning)	Off / On	Off	Off
(1) Transmission Gear Selector Signal	Valid / Invalid	Valid	Valid
Distance Since DTC Cleared	km	0	0
Reduced Engine Power	Inactive / Active	Inactive	Inactive
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:09:20
(1) Automatic Transmission Only (2) Manual Transmission Only			

EVAP Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
EVAP Purge Solenoid (Evaporative Emission)	%	0	31
Fuel Level	L	21	20
Fuel Level Sensor	V	1.24	1.25
Time Since Engine Off	h:m:s	00:00:01	00:00:01
Engine Speed	RPM	0	748
Desired Engine Idle Speed	RPM	830	750
Coolant Temperature	°C	21	91
Start Up ECT (Engine Coolant Temperature)	°C	21	21
Start Up IAT (Intake Air Temperature)	°C	–48	30
Intake Air Temperature	°C	31	30
Mass Air Flow Sensor	V	1.0	1.3
Engine Load	%	100	23
Volumetric Efficiency	%	99	18
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	2
Calculated Throttle Position	%	6	2
Barometric Pressure	kPa	100	100
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (=Lambda)	1.0	23
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (=Lambda)	1.0	16
B1 Short Term Fuel Trim (Bank 1)	%	0	–2
B1 LTFT Idle/Deceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 LTFT Cruise/Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	0	-4
B2 Short Term Fuel Trim (Bank 2)	%	0	0
B2 LTFT Idle/Deceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 LTFT Cruise/Acceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 Total Fuel Trim (Bank 2)	%	0	1
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC

Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:10:25
Fuel Pump Relay	Off / On	Off	On
(1) Automatic Transmission Only (2) Manual Transmission Only			

Fuel Trim Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
B1 Short Term Fuel Trim (Bank 1)	%	0	–1
B1 LTFT Idle/Deceleration (Bank 1 Long Term Fuel Trim)	%	0	1
B1 LTFT Cruise/Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	0	4
B2 Short Term Fuel Trim (Bank 2)	%	0	0
B2 LTFT Idle/Deceleration (Bank 2 Long Term Fuel Trim)	%	0	1
B2 LTFT Cruise/Acceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 Total Fuel Trim (Bank 2)	%	0	4
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
Injection Time Cylinder 1	ms	0.0	2.5
Injection Time Cylinder 2	ms	0.0	2.5
Injection Time Cylinder 3	ms	0.0	2.5
Injection Time Cylinder 4	ms	0.0	2.5
Injection Time Cylinder 5	ms	0.0	2.5
Injection Time Cylinder 6	ms	0.0	2.5
Requested Torque	%	99	99
Catalyst Protection Mode	Inactive / Active	Inactive	Inactive
B1 Catalyst Temperature (Bank 1)	°C	300	300
B2 Catalyst Temperature (Bank 2)	°C	300	300
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.99
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	438	520
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	0.99	0.99
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	438	516
B1 Average Injection Time (Bank 1)	ms	0.0	2.5
B2 Average Injection Time (Bank 2)	ms	0.0	2.5
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
EVAP Purge Solenoid (Evaporative Emission)	%	0	32

Engine Speed	RPM	0	592
Coolant Temperature	°C	39	91
Intake Air Temperature	°C	32	26
Start Up ECT (Engine Coolant Temperature)	°C	39	34
Start Up IAT (Intake Air Temperature)	°C	–48	30
Mass Air Flow Sensor	V	1.0	1.2
Engine Load	%	100	22
Volumetric Efficiency	%	99	15
Calculated Pedal Position	%	0	0
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	102	102
Barometric Pressure	V	4.88	4.88
Spark Advance	°CA	0	12
Ignition On Signal	Off / On	On	On
(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:12:30
Ignition Accessory Signal	Off / On	On	On
Mass Air Flow	g/s	0.00	3.33
(1) Automatic Transmission Only (2) Manual Transmission Only			

O2 Sensor Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Loop Status B1S1 (Bank 1 Sensor 1)	Open / Closed	Open	Closed
Loop Status B2S1 (Bank 2 Sensor 1)	Open / Closed	Open	Closed
Commanded B1S1 O2 Sensor Value (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.94
Commanded B2S1 O2 Sensor Value (Bank 2 Sensor 1)	:1 (= Lambda)	0.99	0.94
B1S1 O2 Sensor (Bank 1 Sensor 1)	:1 (= Lambda)	0.99	0.94
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	438	538
B2S1 O2 Sensor (Bank 2 Sensor 1)	:1 (= Lambda)	0.99	0.99
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	438	486
B1S1 O2 Sensor Heater (Bank 1 Sensor 1)	Ohm	540	80
B2S1 O2 Sensor Heater (Bank 2 Sensor 1)	Ohm	540	80
Commanded B1S1 O2 Sensor Heater (Bank 1 Sensor 1)	%	0.0	42.0
Commanded B2S1 O2 Sensor Heater (Bank 2 Sensor 1)	%	0.0	42.0
B1 Short Term Fuel Trim (Bank 1)	%	0	–1
B1 LTFT Idle/Deceleration (Bank 1 Long Term Fuel Trim)	%	0	1

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

B1 LTFT Cruise/Acceleration (Bank 1 Long Term Fuel Trim)	%	0	0
B1 Total Fuel Trim (Bank 1)	%	0	4
B2 Short Term Fuel Trim (Bank 2)	%	0	0
B2 LTFT Idle/Deceleration (Bank 2 Long Term Fuel Trim)	%	0	1
B2 LTFT Cruise/Acceleration (Bank 2 Long Term Fuel Trim)	%	0	0
B2 Total Fuel Trim (Bank 2)	%	0	4
Fuel Trim Learn	Disabled / Enabled	Disabled	Disabled
Power Enrichment	No / Yes	No	No
Dec. Fuel Cutoff (Deceleration)	Inactive / Active	Inactive	Inactive
Engine Speed	RPM	0	600
Coolant Temperature	°C	39	93
Intake Air Temperature	°C	32	28
Start Up ECT (Engine Coolant Temperature)	°C	39	34
Start Up IAT (Intake Air Temperature)	°C	–48	30
Mass Air Flow Sensor	V	1.0	1.1
Mass Air Flow	g/s	0.00	3.17
Engine Load	%	100	20
Volumetric Efficiency	%	99	14
Calculated Pedal Position	%	0	0
Calculated Throttle Position	%	5	1
Barometric Pressure	kPa	102	102
Barometric Pressure	V	4.88	4.88
Spark Advance	°CA	0	12
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:14:40
(1) Automatic Transmission Only (2) Manual Transmission Only			

TAC Data (Throttle Actuator Control)

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Reduced Engine Power	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
APP Sensor 1-2 Correlation (Accelerator Pedal Position Sensor)	Okay / Fault	Okay	Okay
TP Sensor 1-2 Correlation (Throttle Position)	Okay / Fault	Okay	Okay
APP Sensor 1 (Accelerator Pedal Position)	V	1.02	1.02

APP Sensor 2 (Accelerator Pedal Position)	V	0.47	0.47
TP Sensor 1 (Throttle Position)	V	0.73	0.57
TP Sensor 2 (Throttle Position)	V	4.27	4.43
TP Sensor 1 Learned Lower Position (Throttle Position)	V	0.53	0.53
TP Sensor 2 Learned Lower Position (Throttle Position)	V	4.49	4.49
Electronic Throttle Control Learn Counter	Counts	11	11
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Brake Switch Signal Status	Valid / Invalid	Valid	Valid
Initial Brake Apply Signal	Inactive / Active	Inactive	Inactive
Engine Speed	RPM	0	598
Desired Engine Idle Speed	RPM	680	600
Coolant Temperature	°C	38	96
Intake Air Temperature	°C	32	29
Mass Air Flow Sensor	V	1.0	1.1
Mass Air Flow	g/s	0.00	3.11
Barometric Pressure	kPa	102	102
Barometric Pressure	V	4.88	4.88
Engine Load	%	100	20
Volumetric Efficiency	%	99	14
Ignition Accessory Signal	Off / On	On	On
Ignition On Signal	Off / On	On	On
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	11.7	14.0
DTC Set This Ignition	No DTC / DTC Set	No DTC	No DTC
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:16:25
(1) Automatic Transmission Only (2) Manual Transmission Only			

Cooling/HVAC Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Coolant Temperature	°C	37	100
Cooling Fan	Off / On	Off	Off
Intake Air Temperature	°C	32	30
A/C Request	No / Yes	No	No
A/C Relay (Air Conditioning)	Off / On	Off	Off
A/C Pressure Sensor (Air Conditioning)	V	1.0	1.5
A/C Pressure Sensor (Air Conditioning)	kPa	732.55	1121.25
A/C Cutoff Mode (Air Conditioning)	Inactive / Pressure / Max. Acceleration / Active	Inactive	Inactive

A/C Disengagement 1st History	Refer List Below	High Pressure	Engine Speed
A/C Disengagement 2nd History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 3rd History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 4th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 5th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 6th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 7th History	Refer List Below	High Pressure	High Pressure
A/C Disengagement 8th History	Refer List Below	High Pressure	High Pressure
Start Up ECT (Engine Coolant Temperature)	°C	37	34
Start Up IAT (Intake Air Temperature)	°C	–48	30
Engine Load	%	100	19
Volumetric Efficiency	%	99	13
Spark Advance	°CA	0	13
Knock Retard	°CA	0	0
Engine Speed	RPM	0	601
Vehicle Speed	km/h	0	0
Engine Runtime	h:m:s	00:00:00	00:19:15
A/C Disengagement History Units High Pressure / Engine Speed / Low Battery / Stall Prevention / Full Load / Performance / Engine Temp / Not Present			

Cruise Control Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Cruise Control Switch	Inactive / Active	Inactive	Inactive
Cruise Control Active	No / Yes	No	No
Cruise Set / Decel Switch	Inactive / Active	Inactive	Inactive
Cruise Resume/Acceleration Switch	Inactive / Active	Inactive	Inactive
Cruise Control Disengagement Reason	Refer List Below	Brake	Brake
CC Disengagement 1st History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 2nd History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 3rd History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 4th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 5th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 6th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 7th History (Cruise Control)	Refer List Below	Brake	Brake
CC Disengagement 8th History (Cruise Control)	Refer List Below	Brake	Brake

Vehicle Speed	km/h	0	0
Brake Lamp Switch	Inactive / Active	Inactive	Inactive
Brake Switch Signal Status	Valid / Invalid	Valid	Valid
Initial Brake Apply Signal	Inactive / Active	Inactive	Inactive
Calculated Pedal Position	%	0	0
Desired Throttle Position	%	4	1
Calculated Throttle Position	%	5	1
Engine Speed	RPM	0	599
(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Cruise Control Disengagement Reason Units Brake / Cancel / Clutch Diseng / Coasting / Throttle Control / Max. Acceleration / High Decel / High Speed / Illegal Mode / Low Speed / Not Present / Off / OverSpeed / PCM / Command Error / Ignition Off / Data Error / System Error / Engine Runtime / Engine Speed / DTCs Set / Injection Stop / First Gear / Accel Pedal Pos / Voltage Low / Manual Neutral / Over Limit			
(1) Automatic Transmission Only (2) Manual Transmission Only			

Electrical/Theft Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Ignition On Signal	Off / On	On	On
Ignition Accessory Signal	Off / On	On	On
Engine Control Ignition Relay	Off / On	On	On
Engine Control Ignition Relay Feedback	V	11.6	14.2
Crank Request	Inactive / Active	Inactive	Inactive
Starter Relay	Off / On	Off	Off
(1) Transmission Gear	P/N / In Gear	P-N	P-N
(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
1) Actual Gear	Valid / Invalid	Valid	Valid
Alternator L Terminal Duty Cycle	%	0	99
Engine Speed	RPM	0	599
ECM Immobilized	No / Yes	No	No
(1) Automatic Transmission Only (2) Manual Transmission Only			

Instrument Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Ignition On Signal	Off / On	On	On
Ignition Accessory Signal	Off / On	On	On
Vehicle Speed	km/h	0	0
Engine Speed	RPM	0	593

(1) Actual Gear	-1- / -2- / -3- / -4- / -5- / -P/N- / -R- / -Invalid-	-P/N-	-P/N-
Coolant Temperature	°C	36	105
Fuel Level	L	17	11
Fuel Level Sensor	V	2.37	2.39
Engine Oil Pressure Sensor	Low / High	High	High
Engine Oil Pressure	kPa	24	120
Oil Level	Normal / Low	Normal	Normal
Oil Temperature Sensor	°C	34	89
Malfunction Indicator (MI)	Off / On / Flashing	On	Off
Cruise Control Active	No / Yes	No	No
Reduced Engine Power	Inactive / Active	Inactive	Inactive
ECM Immobilized	No / Yes	No	No
(1) Automatic Transmission Only (2) Manual Transmission Only			

ODM Data (Output Driver Module)

Tech 2 Display	Units Displayed	Ignition On	Engine Running
A/C Relay Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Cylinder 1 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 2 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 3 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 4 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 5 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
Cylinder 6 Injector Circuit Status	OK / Fault / Undefined Status	Undefined Status	OK
EVAP Purge Solenoid Valve Circuit Status (Evaporative Emission)	OK / Fault / Undefined Status	Undefined Status	OK
Fuel Pump Relay Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B1S1 O2 Sensor Heater Circuit Status (Bank 1 Sensor 1)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B1S2 O2 Sensor Heater Circuit Status (Bank 1 Sensor 2)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B2S1 O2 Sensor Heater Circuit Status (Bank 2 Sensor 1)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
B2S2 O2 Sensor Heater Circuit Status (Bank 2 Sensor 2)	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Malfunction Indicator (MI) Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status

Starter Relay Circuit Status	OK / Fault / Undefined Status	Undefined Status	Undefined Status
Engine Runtime	h:m:s	00:00:00	00:23:02
(1) Automatic Transmission Only (2) Manual Transmission Only			

Misfire Data

Tech 2 Display	Units Displayed	Ignition On	Engine Running
Cycles of Misfire	Counts	0	0 – 3000 (Increments)
Total Misfire	Counts	0	0
Misfire Current Cyl. #1	Counts	0	0
Misfire Current Cyl. #2	Counts	0	0
Misfire Current Cyl. #3	Counts	0	0
Misfire Current Cyl. #4	Counts	0	0
Misfire Current Cyl. #5	Counts	0	0
Misfire Current Cyl. #6	Counts	0	0
Misfire History Cyl. #1	Counts	0	0
Misfire History Cyl. #2	Counts	0	0
Misfire History Cyl. #3	Counts	0	0
Misfire History Cyl. #4	Counts	0	0
Misfire History Cyl. #5	Counts	0	0
Misfire History Cyl. #6	Counts	0	0
A/C Relay (Air Conditioning)	Off / On	Off	Off
Barometric Pressure	kPa	102	102
B1 Catalyst Temperature (Bank 1)	°C	300	300
B2 Catalyst Temperature (Bank 2)	°C	300	300
Catalyst Protection Mode	Inactive / Active	Inactive	Inactive
(1) Transmission Gear	P-N / In Gear	P-N	P-N
Coolant Temperature	°C	36	101
Engine Load	%	100	19
Engine Oil Pressure	kPa	24	120
Engine Runtime	h:m:s	00:00:00	00:37:48
Ignition On Signal	Off / On	On	On
Injection Time Cylinder 1	ms	0.0	1.9
Injection Time Cylinder 2	ms	0.0	1.9
Injection Time Cylinder 3	ms	0.0	1.9
Injection Time Cylinder 4	ms	0.0	1.9
Injection Time Cylinder 5	ms	0.0	1.9
Injection Time Cylinder 6	ms	0.0	1.9
B1 Average Injection Time (Bank 1)	ms	0.0	1.9

B2 Average Injection Time (Bank 2)	ms	0.0	1.9
Mass Air Flow Sensor	V	1.0	1.1
Mass Air Flow	g/s	0.00	2.92
Power Enrichment	No / Yes	No	No
Spark Advance	°CA	0	13
Calculated Throttle Position	%	5	1
Vehicle Speed	km/h	0	0
Volumetric Efficiency	%	99	13
(1) Automatic Transmission Only (2) Manual Transmission Only			

8.4 Tech 2 Data Definitions

NOTE

This listing is arranged in alphabetical order and defines each parameter shown in the Data Lists.

A/C Cutoff Mode (Air Conditioning): This parameter displays whether the control module is commanding the A/C compressor clutch relay OFF for a number of reasons, among which is; operating pressure outside given parameters or throttle position at wide open throttle (WOT).

A/C Disengagement 1 – 8 History: The parameter displays the last 8 air conditioning (A/C) compressor disengages in order from 1 to 8 with 8 being the most recent. There are 8 possible causes listed for the A/C compressor to disengage; High Pressure, Engine Speed, Battery Voltage, Stall Prevention, Full Load, Performance, Engine Temperature or Signal not Present. Any of these causes need to be outside calibrated values, to cause the A/C to disengage.

A/C Pressure Sensor (Air Conditioning): This parameter displays the voltage from the A/C high side pressure sensor signal circuit to the control module.

A/C Pressure Sensor (Air Conditioning): This parameter displays the pressure in kPa from the A/C high side pressure sensor signal circuit to the control module.

A/C Relay (Air Conditioning): This parameter displays the state of the A/C clutch relay control circuit, either as ‘ON’ or ‘OFF’.

A/C Relay Status: This parameter displays the state of the A/C request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls.

A/C Request: Represents the commanded state of the A/C clutch control relay. Clutch should be engaged when ON is displayed.

Actual Gear: This parameter displays the transmission range input to the control module, determined directly from the decoding of the PRNDL – A, B, C, and P inputs from the transmission internal mode switch (IMS).

Actual Gear: Based on the evaluation of the PRNDL – A, B, C, and P inputs, the ECM determines whether the parameter is valid or invalid.

Actual Intake Camshaft Position (Bank 1 or Bank 2): This parameter displays the actual intake camshaft position in degrees of crankshaft angle.

Alternator L Terminal Duty Cycle: This parameter displays the ECM commanded state of the voltage regulator on the alternator, expressed as a percentage from 0 to 100.

APP Sensor 1 (Accelerator Pedal Position): This parameter displays the actual voltage on the APP sensor 1 signal circuit as measured by the ECM, that can range from 0.9 – 4.5 volts.

APP Sensor 2 (Accelerator Pedal Position): This parameter displays the actual voltage on the APP sensor 1 signal circuit as measured by the ECM, that can range from 0.45 – 2.25 volts.

APP Sensor 1 and 2 Correlation (Accelerator Pedal Position): This parameter displays ‘Okay’ under normal operating conditions or ‘Fault’ if the control module detects the signal voltage from APP sensor 1 that is not in the correct relationship to APP sensor 2.

Average Injection Time (Bank 1 or Bank 2): This parameter displays the average pulse width of the fuel injectors for each bank of the engine as determined by the ECM.

B1/B2 S1 O2 Sensor 1 (Bank 1 or Bank 2 Sensor 1): This parameter displays the lambda output from the HO2S to the ECM. A lambda below 1.0 indicates a rich exhaust, while a lambda above 1.0 indicates a lean exhaust.

B1/B2 S2 O2 Sensor 2 (Bank 1 or Bank 2 Sensor 2): This parameter displays the mV output from the HO2S to the ECM. A lower voltage indicates a lean exhaust, while a higher voltage indicates a rich exhaust.

B1/B2 S1 O2 Sensor Heater (Bank 1 or Bank 2 Sensor 1): This parameter displays the resistance of the sensing element within the ECM. The front sensors are normally regulated to 80 ohms.

B1/B2 S1/S2 O2 Sensor Heater Circuit Status (Bank 1 or Bank 2 Sensor 1 or Sensor 2): The parameter displays 'Fault' if the oxygen sensor heater control circuit is open, shorted to ground, or shorted to voltage. The parameter displays 'Undefined' until the circuit has been commanded ON.

Barometric Pressure: This parameter displays the barometric pressure in kPa. The ECM uses the barometric pressure for fuel control to compensate for altitude differences.

Barometric Pressure: This parameter displays the barometric pressure voltage. The control module uses the barometric pressure for fuel control to compensate for altitude differences.

Brake Lamp Switch: This parameter displays the status of the brake lamp switch. When the brake pedal is pressed the switch contacts close causing the vehicles brake lamps to illuminate.

Brake Switch Signal Status: This parameter displays the position of the torque converter clutch (TCC) brake pedal switch input to the ECM.

Calculated ECT – Closed Loop Fuel Control (Engine Coolant Temperature): This parameter displays the modelled temperature that the control module calculates from air entering the engine, coolant temperature, and ambient air temperature. If the actual engine coolant temperature does not reach this calculated temperature within a predetermined amount of time, a DTC will set.

Calculated ECT – Thermostat Diagnosis (Engine Coolant Temperature): This parameter displays the modelled temperature that the control module calculates from air entering the engine, coolant temperature, and ambient air temperature. If the actual engine coolant temperature does not reach this calculated temperature within a predetermined amount of time, a DTC will set.

Calculated Pedal Position: This parameter displays the angle of the accelerator pedal position (APP) as calculated by the ECM, using the signals from the APP sensors, as a percentage of throttle opening.

Calculated Throttle Position: This parameter displays the percentage of throttle opening, based on the two TP sensor inputs to the ECM.

Catalyst Protection Mode: This parameter displays if the control module is commanding catalytic converter protection or not.

Catalyst Temperature (Bank 1 or Bank 2): This parameter displays the catalytic converter temperature as calculated by the control module.

Clutch Pedal Switch: This parameter displays the state of the clutch pedal as determined by the ECM from the clutch start switch position.

Clutch Pedal Switch: This parameter displays the state of the clutch pedal as determined by the ECM from the clutch pedal switch.

Commanded Exhaust Camshaft Position (Bank 1 or Bank 2): This parameter displays the exhaust camshaft position in percent of range as commanded by the control module.

Commanded Exhaust Camshaft Position (Bank 1 or Bank 2): This parameter displays the exhaust camshaft position in crankshaft degrees, as commanded by the ECM.

Commanded Intake Camshaft Position (Bank 1 or Bank 2): This parameter displays the intake camshaft position in crankshaft degrees, as commanded by the ECM.

Commanded B1/B2 S1 O2 Sensor Heater (Bank 1 or Bank 2 Sensor 1): This parameter displays the state of the oxygen sensor heater control circuit, as a percentage.

Commanded B1/B2 S1 O2 Sensor Value (Bank 1 or Bank 2 Sensor 1): This parameter displays the lambda output from the HO2S to the ECM. A lambda below 1.0 indicates a rich exhaust, while a lambda above 1.0 indicates a lean exhaust.

Coolant Temperature: This parameter displays the temperature of the engine coolant based on input to the control module from the engine coolant temperature (ECT) sensor.

Crank Request: This parameter displays whether the ignition switch has been cycled to the crank position, requesting the ECM to activate the starter relay.

Cruise Control Active: This parameter displays the status of the cruise control system as determined by the ECM.

Cruise Control Switch: This parameter displays the state of the cruise control on/off switch input to the control module.

Cruise Control Disengagement Reason: The parameter displays which of a possible 28 causes for the cruise control to disengage.

CC Disengagement 1 – 8 History (Cruise Control): The parameter displays the last 8 cruise control disengages in order from 1 to 8, with 8 being the most recent. There are about 28 possible causes for the cruise control to disengage.

Cruise Resume/Acceleration Switch: This parameter displays the state of the cruise control resume/accel switch position input to the ECM.

Cruise Set / Coast Switch: This parameter displays the state of the cruise controls set/decel. switch position input to the ECM.

Cycles of Misfire: This parameter displays the number of misfire tests during 200 engine revolutions.

Cylinder 1 – 6 Injector Circuit Status: This parameter displays the state of the fuel injector control circuit. The parameter displays 'Fault' if the fuel injector control circuit is open, shorted to ground, or shorted to voltage. This parameter displays 'Undefined Status' until the control circuit has been commanded 'On'.

Dec. Fuel Cutoff (Deceleration): This parameter displays the status of the ECM operating mode, used to turn off the fuel injectors and the evaporative emission (EVAP) canister purge valve during certain deceleration conditions.

Desired Engine Idle Speed: This parameter displays the desired engine idle speed as commanded by the ECM.

Desired Throttle Position: This parameter displays the desired throttle position (TP) angle commanded by the ECM.

Distance Since DTC Cleared: This parameter displays the distance (km) travelled since any diagnostic trouble code (DTC) has been cleared from the ECM memory.

DTC Set This Ignition: This parameter displays Yes if a DTC set on the current ignition cycle.

ECM Immobilized: This parameter displays 'Yes' when an internal control module reset occurs. Tech 2 will display 'No' under normal operating conditions.

Electronic Throttle Control Learn Counter: When the ECM performs a throttle body relearn procedure, the throttle plate is commanded to move from the rest position (7% open) to full closed (0%), then to around 10% open.
At the start of this procedure, the Tech 2 'TAC Learn Counter' parameter should display 0, then count up to 11 after the procedure is completed. If the counter did not start at 0 or if the counter did not end at 11, a fault has occurred and a DTC should set.

Engine Control Ignition Relay: This parameter displays the state of the control circuit for control module power relay as commanded by the ECM.

Engine Control Ignition Relay Feedback: This parameter displays the voltage available at the engine control ignition relay pin of the control module.

Engine Load: This parameter displays the calculated engine load in percent based on inputs to the control module from various engine sensors.

Engine Oil Life Remaining: This parameter displays the percentage of engine oil life remaining. The controller calculates the engine oil life by monitoring engine load, collant temperature and engine speed.

Engine Oil Pressure: This parameter displays the oil pressure in kPa from the ECM, developed from the engine oil pressure (EOP) sensor input.

Engine Oil Pressure Sensor: This parameter displays 'High' if the engine oil pressure is within the correct range. If the ECM detects that the engine oil pressure is not within the correct range, Tech 2 will display 'Low'.

Engine Runtime: This parameter displays the time elapsed since the engine was started.

Engine Speed: This parameter displays the speed of the engine crankshaft rotation from information received from the CKP sensor. If there is a CKP sensor DTC, the ECM calculates the engine speed from one of the camshaft position (CMP) sensors.

EVAP Purge Solenoid (Evaporative Emission): This parameter displays the on-time or duty cycle of the EVAP canister purge solenoid commanded by the ECM. Zero percent indicates no purge. One hundred percent indicates full purge.

EVAP Purge Solenoid Valve Circuit Status (Evaporative Emission): This parameter displays the state of the EVAP purge solenoid control circuit. The parameter displays 'Fault' if the EVAP purge solenoid control circuit is open, shorted to ground, or shorted to voltage. The parameter displays 'Undefined Status' until the circuit has been established as 'OK'.

Cooling Fan Relay: This parameter displays the control module commanded state of the fan relay control circuit.

Cooling Fan Relay Circuit Status: This parameter displays the state of the fan relay control circuit. The parameter displays ‘Fault’ if the fan relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the relay control circuit has been determined as being ‘OK’.

Fuel Level: This parameter displays the amount of fuel in the fuel tank in litres, as calculated by the ECM from data received from the fuel level sensor.

Fuel Level Sensor: This parameter displays the voltage received from the fuel level sensor in the fuel tank, by the ECM.

Fuel Pump Relay Circuit Status: This parameter displays the state of the fuel pump relay control circuit. The parameter displays ‘Fault’ if the fuel pump relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays ‘Undefined’ until the relay control circuit has been determined as being ‘OK’.

Fuel Pump Relay: This parameter displays the ECM commanded state of the fuel pump relay control circuit.

Fuel Trim Learn: This parameter displays ‘Enabled’ when conditions are appropriate for enabling long term fuel trim corrections. This indicates that the long term fuel trim is adapting continuing amounts of short term fuel trim. If Tech 2 displays ‘Disabled’, then long term fuel trim will not respond to changes in short term fuel trim.

Ignition Accessory Signal: This parameter displays ‘On’ when the control module detects a voltage at the ignition ‘ACC’ terminal, X1-4 of the ignition switch.

Ignition On Signal: This parameter displays ‘On’ when the control module detects a voltage at the ignition ‘IGN’ terminal X1-3 of the ignition switch.

Initial Brake Apply Signal: This parameter displays the status of the brake lamp switch. Before the cruise control can be activated, this switch contact must be open circuit when the brake pedal is pressed.

Injection Time Cylinder 1 – 6: This parameter displays the amount of fuel injector On-time or pulse width as commanded by the ECM.

Intake Air Temperature: This parameter displays the temperature of the air entering the air induction system based on input to the ECM from the intake air temperature (IAT) sensor.

Knock Sensor Signal (Bank 1 or Bank 2): This parameters displays the voltage input to the control module from the knock sensor (KS).

Knock Retard: This parameter indicates the amount of spark advance in crankshaft degrees, that the ECM removes from the ignition control (IC) spark advance in response to the signal from the knock sensors.

Knock Retard Cylinder 1 – 6: This parameter displays the knock retard as commanded by the ECM for cylinders 1-6. Each cylinder is controlled individually based on both knock sensor signal inputs.

Loop Status B1S1 / B2S1 (Bank 1 or Bank 2 Sensor 1): This parameter displays the state of the fuel control system as commanded by the ECM. ‘Closed’ Loop operation indicates that the ECM is controlling the fuel delivery based on the oxygen sensors input signal. In ‘Open’ Loop operation the ECM ignores the oxygen sensor input signal and bases the amount of fuel to be delivered on other sensor inputs.

LTFT Idle/Deceleration (Bank 1 or Bank 2) (Long Term Fuel Trim): This parameter displays the commanded Long Term Fuel Trim correction by the ECM for bank 1 or bank 2 for idle and deceleration conditions.

LTFT Cruise/Acceleration (Bank 1 or Bank 2) (Long Term Fuel Trim): This parameter displays the commanded Long Term Fuel Trim correction by the ECM for bank 1 or bank 2 for cruise and acceleration conditions.

Malfunction Indicator (MI): This parameter displays the commanded (‘On, ‘Off’ or ‘Flashing’) state of the malfunction indicator lamp (MIL) control circuit by the ECM.

Malfunction Indicator (MI) Circuit Status: This parameter displays the state of the MIL control circuit. The parameter displays ‘Fault’ if the MIL control circuit is open, shorted to ground, or shorted to voltage. This parameter displays ‘Undefined Status’ until the circuit has been determined as being ‘OK’.

Mass Air Flow: This parameter displays the measured quantity (g/s) of air flowing into the engine during all operating conditions.

Mass Air Flow Sensor: This parameter displays the signal voltage from the mass air flow (MAF) sensor to the ECM.

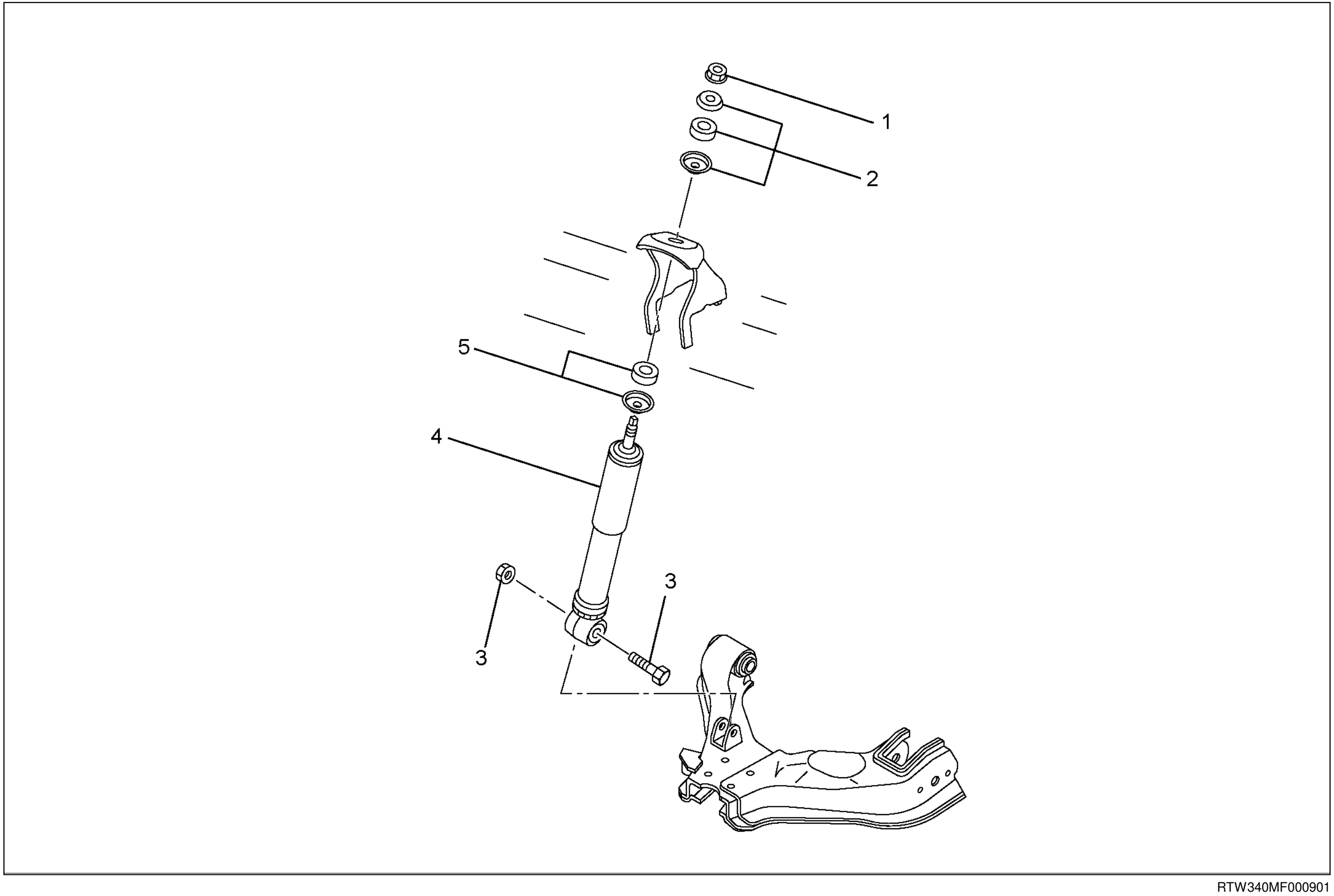
Misfire Current Cyl. #1 – #6: Tech 2 displays a range of 0 – 200 counts. This parameter displays the number of misfires that have been detected during the last 200 cylinder firing events. The counters may normally display some activity, but the activity should be nearly equal for all of the cylinders, and in low numbers.

Misfire History Cyl. #1 – #6: Tech 2 displays a range of 0 – 65,535 counts. The misfire history counters display the total level of misfire that has been detected on each cylinder. The misfire history counters will not update or show any activity until a misfire DTC P0300 has become active. The misfire history counters will update every 200 cylinder firing events.

Oil Level: When the ECM receives information from the engine oil level switch, where the engine oil level is within preset parameters, Tech 2 will display ‘Normal’. If not within preset parameters, the display will show ‘Low’.

Shock Absorber

Shock Absorber and Associated Parts



Legend

(1) Shock Absorber Nut
(2) Rubber Bushing and Washer
(3) Shock Absorber Bolt and Nut
(4) Shock Absorber
(5) Rubber Bushing and Washer

Removal

1. Raise the vehicle and support it with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel Replacement in this section.
3. Remove bolt and nut.
4. Remove nut.
5. Remove rubber bushing and washer.
6. Remove shock absorber.
7. Remove rubber bushing and washer.

Inspection and Repair

Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.

Check the following parts:

- Shock absorber
- Rubber bushing

Installation

1. Install rubber bushing and washer.
2. Install shock absorber.
3. Install rubber bushing and washer.
4. Install shock absorber nut, then tighten it to the specified torque.

Torque: 20 N·m (2.0 kgf·m/14 lb·ft)

5. Install shock absorber bolt and nut, and then tighten to the specified torque.

Torque: 93 N·m (9.5 kgf·m/69 lb·ft)

Oil Temperature Sensor: This parameter displays the engine oil temperature in degrees C.

Power Enrichment: This parameter displays the status of the operating mode of the ECM used to increase fuel delivery during certain acceleration conditions.

Reduced Engine Power: This parameter displays when the ECM is commanding reduced engine power due to a throttle actuator control (TAC) system condition.

Requested Torque: This parameter displays the calculated amount torque requested of the ECM by the Transmission Control Module (TCM).

Short Term Fuel Trim (Bank 1 or Bank 2): This parameter displays the short-term correction to the fuel delivery by the ECM in response to oxygen sensor 1 or 2. If the oxygen sensor indicates a lean air/fuel mixture, the control module will add fuel, increasing the short term fuel trim above 0. If the oxygen sensor indicates a rich air/fuel mixture, the control module will reduce fuel decreasing the short term fuel trim below 0.

Spark Advance: This parameter displays the amount of spark advance the ECM is commanding on the ignition control circuits. The ECM determines the desired advance.

Starter Relay: This parameter displays the Em's commanded state of the starter motor relay control circuit.

Starter Relay Circuit Status: This parameter displays the state of the starter relay control circuit. The parameter displays 'Fault' if the starter relay control circuit is open, shorted to ground, or shorted to voltage. The parameter displays Undefined Status' until the circuit has been determined as being 'OK'. This parameter may not change if Tech 2 is used to command the relay control circuit ON.

Start Up ECT (Engine Coolant Temperature): This parameter displays the temperature of the engine coolant on start up based on input to the ECM from the ECT sensor.

Start Up IAT (Intake Air Temperature): This parameter displays the temperature of the intake air at start in the air induction system based on input to the ECM from the IAT sensor.

Time Since Engine Off: This parameter displays the amount of time (hours:minutes:seconds) that has elapsed since the engine was last cycled OFF.

Total Fuel Trim (Bank 1 or Bank 2): This parameter displays the overall fuel trim from the idle/decel cell and the cruise/accel cell.

Total Misfire: This parameter displays the total number of cylinder firing events that the control module detected as misfires for the last 200 crankshaft revolution sample period.

TP Sensor 1 (Throttle Position): This parameter displays the actual voltage on the TP sensor 1 signal circuit as measured by the ECM.

TP Sensor 1 Learned Lower Position (Throttle Position): This parameter displays the learned minimum value of TP sensor 1 as recorded by the ECM during the last learn procedure.

TP Sensor 2 (Throttle Position): This parameter displays the actual voltage on the TP sensor 2 signal circuit as measured by the ECM.

TP Sensor 2 Learned Lower Position (Throttle Position): This parameter displays the learned minimum value of TP sensor 2 as recorded by the ECM during the last learn procedure.

TP Sensor 1-2 Correlation (Throttle Position): This parameter displays 'Fault' when the ECM detects that TP sensor 1 voltage signal is not within the correct relationship to TP sensor 2. Tech 2 displays 'Okay' under normal operating conditions.

Transmission Gear: This parameter displays the position of the transmission gear selector that is transmitted over the serial data circuit from the TCM.

Transmission Gear Selector Signal: This parameter displays the position of the transmission gear selector that is transmitted over the serial data circuit from the TCM.

Vehicle Speed: This parameter displays the speed of the vehicle as calculated by the TCM from information received from the vehicle speed sensor (VSS).

Volumetric Efficiency: This parameter displays the volumetric efficiency of the engine as calculated by the control module.

8.5 OBD Data

Tech 2 Display	Units Displayed	Typical Values	
		Ignition On	Engine Running
B1S1 O2 Sensor (Bank 1 Sensor 1)	mA	0.008	0

B1S1 Lambda Value (Bank 1 Sensor 1)	:1 (= Lambda)	1.000	1.003
B1S2 O2 Sensor (Bank 1 Sensor 2)	mV	440	445
B1S2 Short Term Fuel Trim (Bank 1 Sensor 2)	%	99.2%	99.2%
B2S1 O2 Sensor (Bank 2 Sensor 1)	mA	0.000	0.024
B2S1 Lambda Value (Bank 2 Sensor 1)	:1 (= Lambda)	1.003	0.995
B2S2 O2 Sensor (Bank 2 Sensor 2)	mV	440	475
B2S2 Short Term Fuel Trim (Bank 2 Sensor 2)	%	99.2	99.2
Fuel System 1 Automatic Control Loop	—	—	—
Fuel System 2 Automatic Control Loop	—	—	—
Calculated Load	%	100.0	18.8
Engine Coolant Temperature	°C	56	90
B1 Short Term Fuel Trim (Bank 1)	%	0.0	–0.8
B1 Long Term Fuel Trim (Bank 1)	%	0.0	0.0
B2 Short Term Fuel Trim (Bank 2)	%	0.0	0.8
B2 Long Term Fuel Trim (Bank 2)	%	0.0	0.0
Engine Speed	RPM	0	588
Vehicle Speed	km/h	0	0
Ignition Timing Advance for Cylinder 1	°CA	0	13
Intake Air Temperature	°C	47	32
Mass Air Flow	g/s	0.00	2.75
Absolute TP (Throttle Position)	%	14.5	
OBD Requirements to which Vehicle is Designed	EOBD	—	—
Distance While MIL is Activated	km	0	0

8.6 Actuator Tests

Fuel Pump Relay Test

This test allows the Technician to turn the fuel pump on and off.

NOTE

To avoid the possibility of engine flooding and subsequent catalytic converter damage, Tech 2 will deactivate the fuel pump relay after 2 seconds.

Precondition: Ignition 'On', engine 'Off'.

Electronic Throttle Control Test

This selection from the Tech 2 Actuator Test menu, provides two parameters; the Calculated Throttle Position and the Desired Throttle Position. As the Technician increases or decreases the throttle opening in 10% increments, each of the two parameters should be the same.

Preconditions: Ignition 'On', engine 'Off', vehicle speed is 0 km/h, there are no vehicle speed DTCs set and the ECM is not performing a throttle learn procedure.

A/C Relay Test

Allows the Technician to turn the air conditioning relay 'On' and 'Off'.

Precondition: Ignition 'On'.

Cooling Fan (PWM)

WARNING

Take care that no-one can access the engine compartment during these tests!

This test allows the Technician to turn the cooling fan on in increments to its maximum speed.

Precondition: Ignition 'On' Air conditioning is 'Off'..

Alternator L Terminal

This test allows the Technician to turn 'On' and 'Off', the commanded state of the voltage regulator in the alternator. 'On' displays a commanded state of 99%, while 'Off' displays a commanded state of 0%.

Precondition: Engine running.

EVAP Purge Solenoid

This test allows the Technician to control the EVAP purge solenoid valve. The normal commanded state is '0%'. The system will increase or decrease the amount of purge by changing the duty cycle of the purge valve in 10% increments within a range of 0 – 100%. The system will remain in the commanded state until cancelled by Tech 2.

NOTE

The EVAP Purge Solenoid Command parameter may not change states when using this output control.

Precondition: Ignition 'On', engine 'Off'.

Engine Speed Control

CAUTION

Other DTCs may set when the Engine Speed Control function is used. Disregard those DTCs that set under this condition.

Allows the increase / decrease of the engine speed in 20 – 30 rpm increments from the base idle speed, up to 1,600 rpm.

NOTE

If the engine coolant temperature is below the prescribed minimum, a message to that effect is displayed and access to engine speed control is blocked.

Preconditions: Engine running, engine temperature above 80°C, transmission in Park or Neutral.

Starter Motor Relay Test

WARNING

The engine will crank and start during the starter relay test.

Allows the Technician to turn the starter relay 'On', thereby activating the starter motor and cranking the engine.

Preconditions: Apply park brake, firmly apply foot brake, ignition 'On', engine 'Off', transmission in Park or Neutral.

Fuel Injector Balance

This test allows the Technician to check the fuel flow through each injector when the engine is not running. The sequence of events are:

1 Install a fuel pressure gauge to the fuel rail.

2 Select 'Fuel Injector Balance Test', from the 'Actuator Test' menu on Tech 2

3 Activate the fuel injector balance test with Tech 2. This action activates the fuel pump and stabilises the fuel delivery system fuel pressure. The fuel pump is then turned off.

4 Note the stabilised fuel rail pressure.

5 When the pump is turned 'Off', the injector is activated for a pre-determined time.

6 The fuel pressure drop is then noted from the fuel pressure gauge.

NOTE

For a detailed procedure and analysis of fuel injector condition, refer to 5.3 Fuel Injector Balance Test.

8.7 Programming

F0: ICU Link to ECM/PIM: Should the ECM, PIM or ICU be replaced, the modules must be security linked to each other. If this linking procedure is not performed, the vehicle will not crank nor run. For additional information relating to Tech 2 and the linking procedure, refer to 11A – Immobiliser.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: TIS approval (TIS 2000 Security Access) must be obtained, the four digit security number entered into Tech 2 and the theft deterrent system disarmed. Then the ignition must be turned 'On', using a programmed remote coded key.

F1: Reset ECU: This function erases the security link between the Engine Control Module (ECM) and the Powertrain Interface Modules (PIM). If this procedure is performed, the engine will not crank nor run. A ICU Link to ECM/PIM procedure will need to be performed. For additional information relating to the ICU Link to ECM/PIM procedure, refer to 11A – Immobiliser.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: The four digit security code must be entered into Tech 2 and the theft deterrent system must be disarmed and the ignition switched 'On' with a programmed remote coded key.

F2: Fuel Trim Reset: This function resets the fuel trim data values learned by the ECM.

F3: Throttle Body Relearn: In this mode, Tech 2 commands the throttle plate from its rest position to full closed then to about 10% open. This procedure takes approximately 6 – 8 seconds. At the start of this procedure, the Tech 2, 'Electronic Throttle Control Learn Counter' parameter should display '0' then count up to 11, after the procedure is completed. If the counter does not start at '0', nor display a count of '11' at the conclusion of the procedure, a fault has occurred and a DTC will set.

6C1-3
Engine Management – V6 – Service Operations

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.4 Warning Caution and Notes for correct workshop practices with regard to safety and / or property damage.

1 General Information

1.1 General Description

This Section describes the correct service procedures to repair and test components of the V6 engine management system. Emphasis is placed on the proper procedures and repair of components related to this specific system.

For component description, operation and location, refer to 6C1-1 Engine Management – V6 – General Information.

Engine cylinder identification follows the international standard OBD II. This standard calls for the engine cylinder bank number one to be identified by the location of cylinder number one. Therefore the numbering for the V6 engine is:

- 1, 3, 5 – Right-hand side (Bank 1).
- 2, 4, 6 – Left-hand side (Bank 2).

The engine firing order is 1, 2, 3, 4, 5, 6.

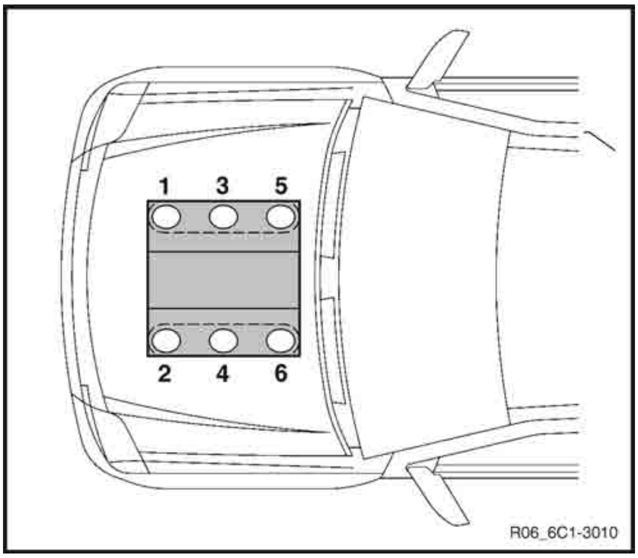


Figure 6C1-3 – 1

1.2 Service Precautions and Requirements

Service Precautions

WARNING

The following safety and precautionary directions must be followed when servicing the engine management system otherwise personal injury and / or improper system operation may occur:

- If working on a vehicle which has been subjected to an under bonnet thermal incident (fire), wear appropriate protective clothing to prevent personal injury. Components that contain fluoro-elastomer may produce a corrosive bi-product when subjected to extreme heat.
- Disconnection of the battery affects certain vehicle electronic systems. Refer to the battery disconnection procedure in 6D1-3 Battery – V6 before disconnecting the battery.
- Disconnect the battery negative lead when performing the following procedures:
  - disconnecting the engine control module (ECM) connectors, or
  - charging the battery.
- Disconnect the battery negative lead and the ECM connectors before attempting any electric welding on the vehicle.
- Do not start the engine if the battery terminal is not properly secured to the battery.
- Do not disconnect or reconnect the following while the ignition is switched on or when the engine is running:
  - any engine management system component wiring connector, or
  - battery terminal leads.

- Ensure the correct procedure for disconnecting and connecting engine management system wiring connectors is always followed.
- Ensure that all wiring connectors are fitted correctly.
- The engine management system wiring connectors are designed to fit only one way; there are indexing tabs and slots on both halves of the connector. Forcing the connector into place is not necessary if it is being installed with the correct orientation. Failure to take care to match the indexing tabs and slots correctly can cause damage to the connector, the module, or other vehicle components or systems.
- Never touch the connector pins of any electronic component, such as an ECM, as electrostatic discharge (ESD) damage may result.
- When steam or pressure cleaning engines, do not direct the cleaning nozzle at engine management system components.
- Never subject the ECM to temperatures less than -40° C and greater than 125° C.
- Prior to disconnection or removal of any components associated with the fuel system, clean the area around any connection points to avoid possible contamination of the fuel system.
- A depressurised fuel system contains fuel in the fuel system and fuel lines that can be spilled during service operations. To reduce the chance of personal injury, cover the fittings with a shop towel to absorb any fuel spillage prior to performing the service operation. Once the service operation has been completed, place the towel in an approved container for disposal.
- To avoid accidental fuel discharge, it is advisable to disconnect the battery and remove the fuel pump relay if the fuel line between the fuel pump and the fuel rail is to be disconnected / open for an indefinite period.
- Always tighten fasteners to the correct tightening torque, and where indicated in the service procedure, follow the correct tightening sequence, precautions and recommendations to prevent premature failure of the fastener or component.
- After removing components, such as the upper or lower intake manifold, front engine pipe, heated oxygen sensor, etc. always plug any openings to prevent dirt and other contaminants from entering.
- Do not use silicone based assembly lubricants as damage to the heated oxygen sensors may result.

CAUTION

Use of incorrect electrical test equipment when performing engine management service procedures could result in incorrect results or component damage.

- Use only the test equipment specified in the diagnostic tables. Use of other test equipment may either give incorrect results or damage serviceable components, refer to, 6C1-2 Engine Management – V6 – Diagnostics.
- After completing the required service operations, road test the vehicle to ensure correct engine management system operation.

Service Requirements

Basic Knowledge Required

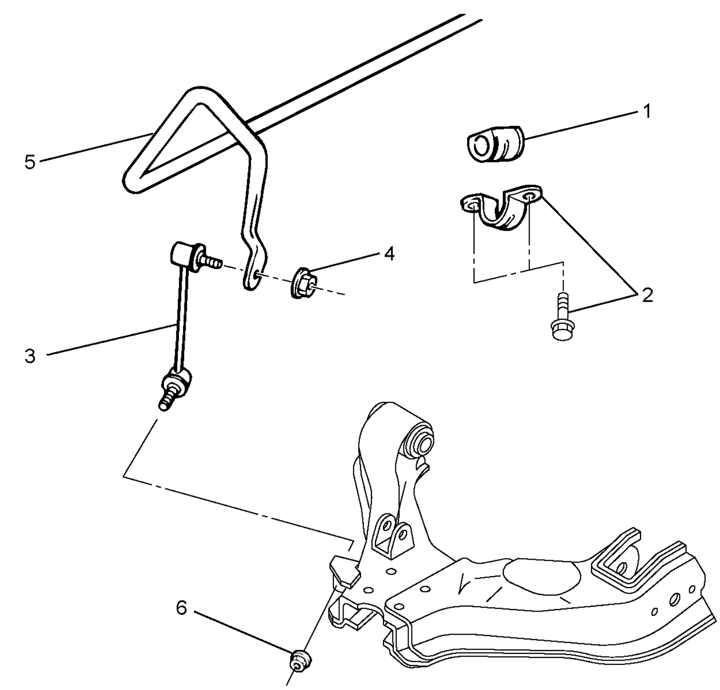
CAUTION

A lack of basic understanding of electronics, electrical wiring circuits and use of electrical circuit testing tools when performing certain service procedures could result in incorrect results or damage to components.

In addition, a general understanding of the engine management system and its component operation is essential to prevent misdiagnosis and component damage.

Stabilizer Bar

Stabilizer Bar and Associated Parts



RTW340MF000401

Legend

(1) Rubber Bushing
(2) Bracket and Bolt
(3) Link
(4) Link Nut
(5) Stabilizer Bar
(6) Link Nut

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove the stone guard.
3. Remove wheel and tire assembly. Refer to Wheel Replacement in this section.
4. Remove link nut.

CAUTION: Be careful not to break the ball joint boot.

5. Remove link.
6. Remove bracket.
7. Remove stabilizer bar.
8. Remove rubber bushing.

Inspection and Repair

Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.
Check the following parts:

- Stabilizer bar
- Rubber bushing
- Link ball joint

Basic Diagnostic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing certain service procedures could result in incorrect diagnostic results or damage to components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section:

- Test lamp, refer to 8A Electrical – Body and Chassis for further information.
- Digital multimeter with 10 MΩ ohms impedance, refer to 8A Electrical – Body and Chassis for further information.
- Connector test adapter kit Tool No. J35616-A.

1.3 Service Operations Not Covered In This Section

There are situations where components and/or procedures related to the powertrain management system are covered in other Sections of the service documentation. To aid technicians in locating the necessary service procedures for these components and/or procedures, refer to the stated references.

Air-conditioning System

For A/C pressure switch replacement procedure, refer to 2A Heater and Air-conditioning.

Electrical Components

For the following electrical system component replacement procedures, refer to the appropriate Sections as follows:

- Extended brake pedal travel switch and stop lamp switch service operations, refer to 5C Brakes.
- Fuse and relay locations, refer to 8A Electrical-Body and Chassis.
- Cruise control switch assembly service operations, refer to 8C Cruise Control – HFV6.
- Powertrain interface module PIM removal and installation procedure, refer to 6E1 Powertrain Interface Module – V6.
- Neutral start and back-up lamp switch, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.
- Vehicle speed sensor service operations, refer to:
  - 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing
  - 7B1 Manual Transmission – V6

Fuel System

For the following fuel system component replacement procedures, refer to 6C Fuel System – V6.

- Fuel system cleaning,
- Fuel system leak and pressure test,
- Fuel feed hose to fuel rail replacement,
- Fuel line quick connect fittings,
- Evaporative emission control canister,
- Fuel filter,
- Fuel hose / pipes layout,
- Fuel pump motor assembly and fuel pressure regulator assembly,
- Fuel sender assembly service operations.

Transmission – Automatic

For automatic transmission sensors and components, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.

Transmission – Manual

For manual transmission sensors and other components, refer to 7B1 Manual Transmission – V6.

1.4 Warning Caution and Notes

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM Holden LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM Holden LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,

- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 General Service Operations

2.1 Accelerator Pedal Position Sensor

Remove

1 Turn the ignition switch off.

2 Disconnect the wiring harness connector (1) from the accelerator pedal position (APP) sensor (2) by depressing the latch in the direction of the arrow.

NOTE

If difficulty is experienced in disconnecting the harness connector from the APP sensor, remove the sensor and mounting bracket assembly and then disconnect the harness connector.

3 Remove the nut (3), two places, attaching the APP sensor and bracket assembly to the dash panel.

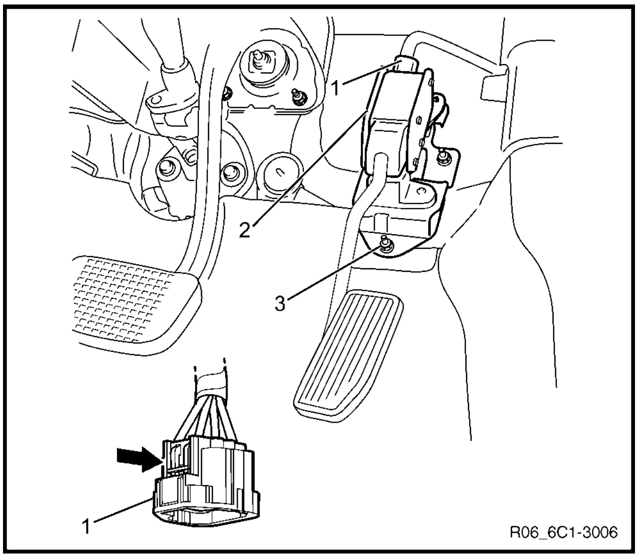


Figure 6C1-3 – 2

Reinstall

Reinstallation of the accelerator pedal position (APP) sensor is the reverse of the removal procedure, noting the following:

1 Reinstall the bolts attaching the APP sensor to the support bracket and tighten to the correct torque specification.

Accelerator pedal position sensor attaching bolt torque specification ....8.5 – 11.5 Nm

2 Road test the vehicle and check for correct operation.

2.2 Air Cleaner Assembly

Air Cleaner Upper Housing

Remove

1 Turn the ignition switch off.

2 Remove the mass air flow (MAF) sensor, refer to 2.20 Mass Air Flow Sensor.

3 Release the retaining clip (1), two places, attaching the air cleaner upper housing (2) to the air cleaner lower housing (3).

4 Rotate the upper housing in the direction of the arrow and withdraw the housing while disengaging the two outer retaining lugs (4).

5 If necessary, remove the air cleaner element (5).

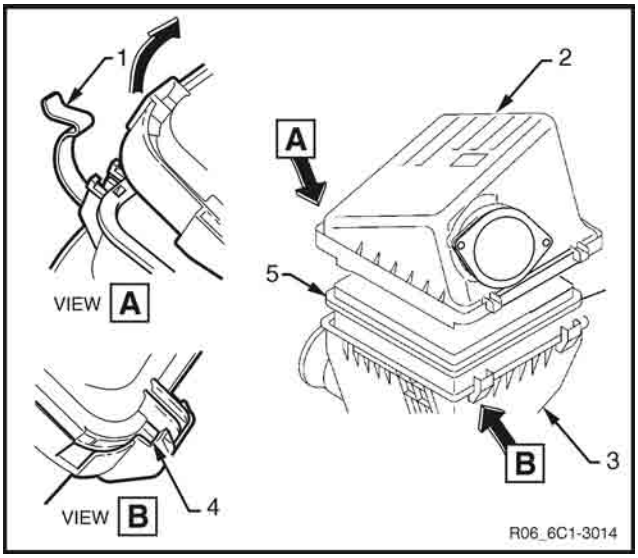


Figure 6C1-3 – 3

Reinstall

Reinstallation of the air cleaner upper housing is the reverse of the removal procedure, noting the following:

CAUTION

Ensure the air cleaner sealing rubber is correctly located in the air cleaner lower housing. Failure to do this may result in engine damage due to unfiltered air entering the engine intake system.

1 Reinstall the air cleaner element.

2 Reinstall the air cleaner upper housing aligning the outer retaining lugs.

3 Reinstall the air cleaner upper housing ensuring the upper housing retaining clips are correctly located.

4 Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

Air Cleaner Lower Housing Assembly

Remove

1 Turn the ignition switch off.

2 Remove the air cleaner upper housing as described previously.

3 Using a suitable lever, gently lever the locking tangs (1) of the lower housing insulator sleeve back to clear the lower housing retaining bolt (2). Repeat this process for each of the remaining two sleeves.

4 Remove the three bolts retaining the lower housing (3) to the fender inner panel and remove the housing.

5 If required, remove the insulator sleeve and air cleaner lower housing insulator (4).

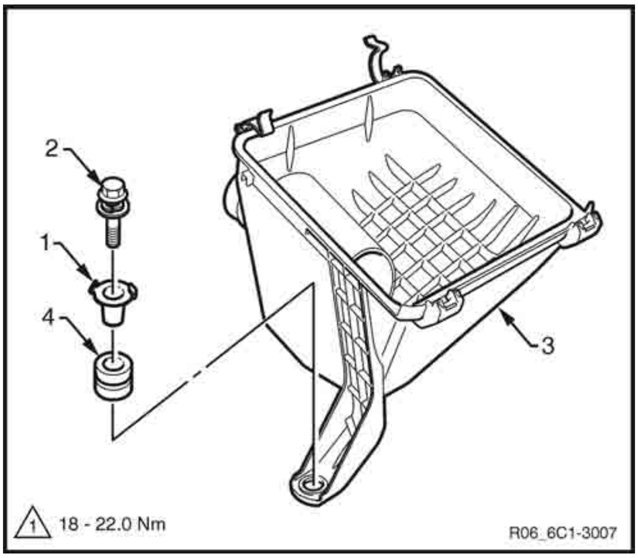


Figure 6C1-3 – 4

Reinstall

1 Reinstall the air cleaner lower housing attaching bolt and tighten to the correct torque specification.

Air cleaner lower housing attaching bolt torque specification ....18.0 – 22.0 Nm

2 Using a suitable hammer and pin punch, position the locking tang against the bolt head.

3 Road test the vehicle and check for correct operation.

2.3 Barometric Pressure Sensor

Remove

1 Turn the ignition switch off.

2 Disconnect the wiring harness connector (1) from the barometric pressure (BARO) sensor (2).

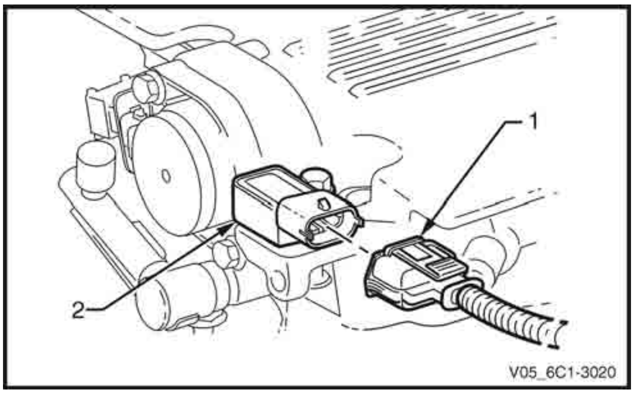


Figure 6C1-3 – 5

3 Remove the bolt (1) attaching the BARO sensor (2) to the upper intake manifold (3).

4 Remove the BARO sensor from the manifold by first, twisting the sensor to release it, and then pulling it upwards to remove it.

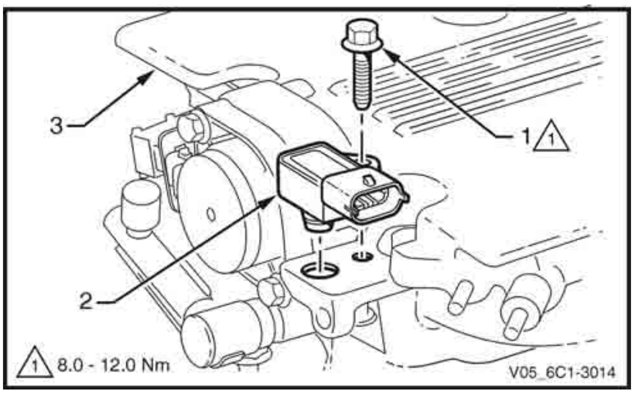


Figure 6C1-3 – 6

Reinstall

Reinstallation of the barometric pressure (BARO) sensor is the reverse of the removal procedure, noting the following:

CAUTION

Ensure the BARO sensor is fully seated before tightening the attaching bolt to the specified torque.

1 Reinstall the BARO sensor bolt and tighten to the correct torque specification.

Barometric pressure sensor attaching bolt torque specification ....8.0 – 12.0 Nm

2 Road test the vehicle and check for correct operation.

2.4 Camshaft Position Sensor

Remove

1 Turn the ignition switch off.

2 Disconnect the wiring harness connector (1) from the CMP sensor (2).

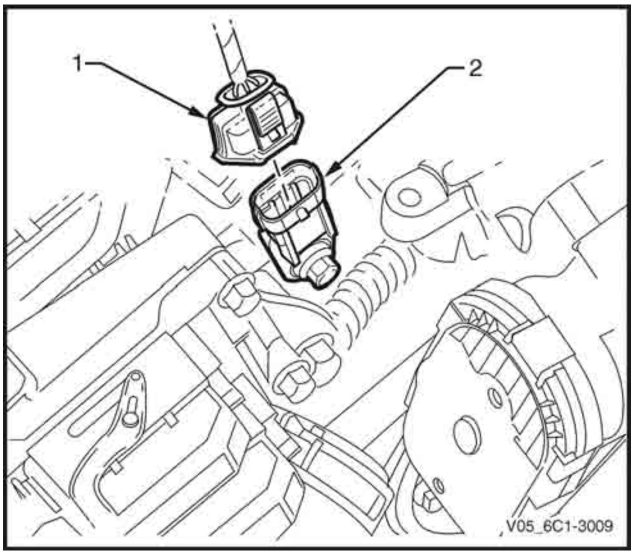


Figure 6C1-3 – 7

CAUTION

Clean the area around the CMP sensor before removal to avoid debris from entering the engine.

3 Remove the CMP sensor attaching bolt (1).

4 Remove the CMP sensor (2) by first twisting the sensor to release it, and then pulling it away from the front engine cover to remove it.

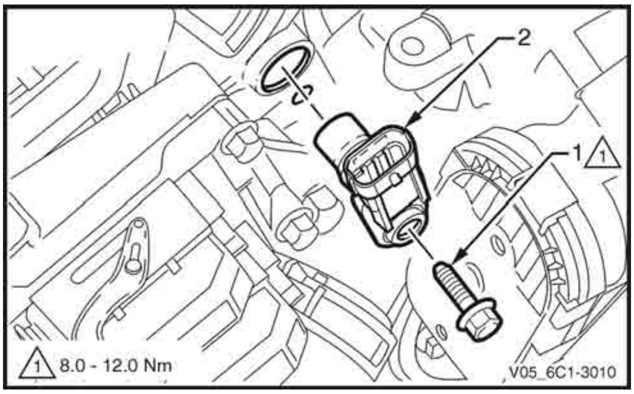


Figure 6C1-3 – 8

Reinstall

Reinstallation of the camshaft position (CMP) sensor is the reverse of the removal procedure, noting the following:

1 Lubricate the CMP sensor O-ring with clean engine oil.

2 Reinstall the CMP sensor by pushing in on the sensor to engage the sensor O-ring in the front engine cover.

CAUTION

Ensure the CMP sensor is fully seated before tightening the attaching bolt to the specified torque.

3 Reinstall the CMP sensor bolt and tighten to the correct torque specification.

Camshaft position sensor attaching bolt torque specification ....8.0 – 12.0 Nm

4 Road test the vehicle and check for correct operation, taking particular note there is no engine oil leak from the CMP sensor.

2.5 Crankshaft Position Sensor

Remove

1 Turn the ignition switch off.

2 Raise the front of the vehicle and support on safety stands, refer to 0A General Information for location of the jacking points.

3 Disconnect the wiring harness connector (1) from the crankshaft position (CKP) sensor (2).

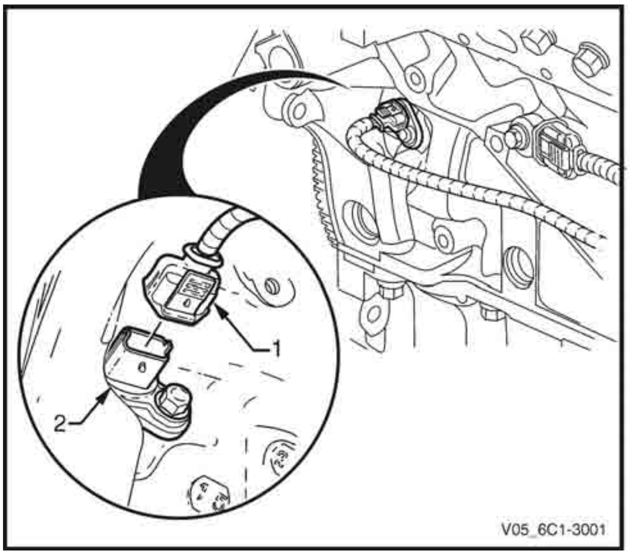


Figure 6C1-3 – 9

CAUTION

Clean the area around the CKP sensor before removal to avoid debris from entering the engine.

4 Remove the CKP sensor attaching bolt (1).

5 Remove the CKP sensor (2), by first twisting the sensor to release it, and then pulling it away from the engine block to remove it.

6 If required, test the CKP sensor, refer to the Test in this Section.

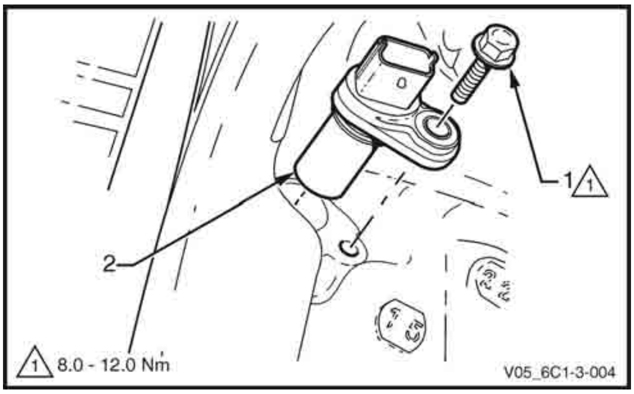


Figure 6C1-3 – 10

Test

CAUTION

To prevent component and damage use connector test adaptor kit J 35616-A.

Resistance Check

1 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the crankshaft position (CKP) sensor.

2 Measure the resistance across terminals 1 and 2.

3 Compare the reading against the specification.

CKP sensor resistance @ 20°C .... 850 – 1040 Ω

4 If the resistance is not within specification, replace the CKP sensor.

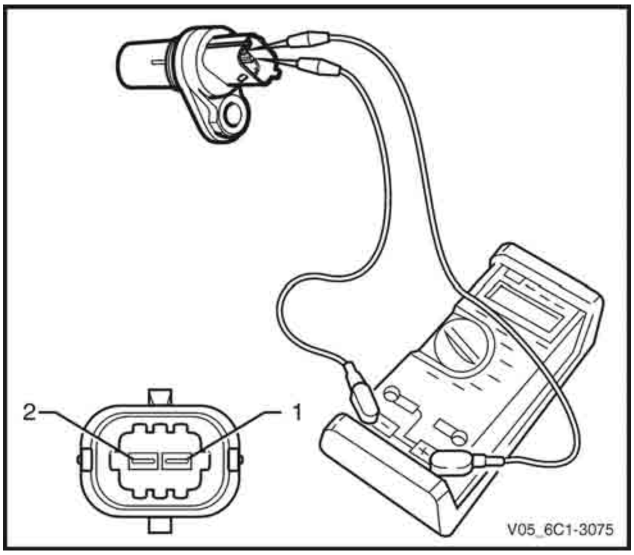


Figure 6C1-3 – 11

Reinstall

Reinstallation of the crankshaft position (CKP) sensor is the reverse of the removal procedure, noting the following:

1 Lubricate the CKP sensor O-ring with clean engine oil.

2 Reinstall the CKP sensor by pushing down on the sensor to engage the sensor O-ring in the engine block.

CAUTION

Ensure the CKP sensor is fully seated before tightening the attaching bolt to the specified torque.

3 Reinstall the CKP sensor bolt and tighten to the correct torque specification.

Crankshaft position sensor attaching bolt torque specification ....8.0 – 12.0 Nm

4 Road test the vehicle and check for correct operation, taking particular note there is no engine oil leak from the CKP sensor.

Installation

1. Install rubber bushing.
2. Install stabilizer bar.
3. Install bracket and bolt then tighten it to the specified torque.

Torque: 25 N·m (2.5 kgf·m/18 lb·ft)

4. Install link.
5. Install link nut, then tighten it to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

2.6 Engine Coolant Temperature Sensor

Remove

WARNING

To avoid serious personal injury, never remove the engine coolant temperature (ECT) sensor when the engine is hot. Allow the engine to cool to ambient temperature (less than 50°C) before performing this procedure.

1 Turn the ignition switch off.

WARNING

To avoid serious personal injury, never remove the coolant filler cap when the engine is hot. Allow the engine to cool to ambient temperature (less than 50°C) before performing this procedure.

2 Allow the engine to cool to ambient temperature less than 50°C, and slowly remove coolant filler cap located on the coolant outlet housing.

3 Drain approximately two litres of coolant into a suitable container, refer to 6B1 – Engine Cooling – V6.

4 Disconnect the wiring harness connector (1) from the ECT sensor (2).

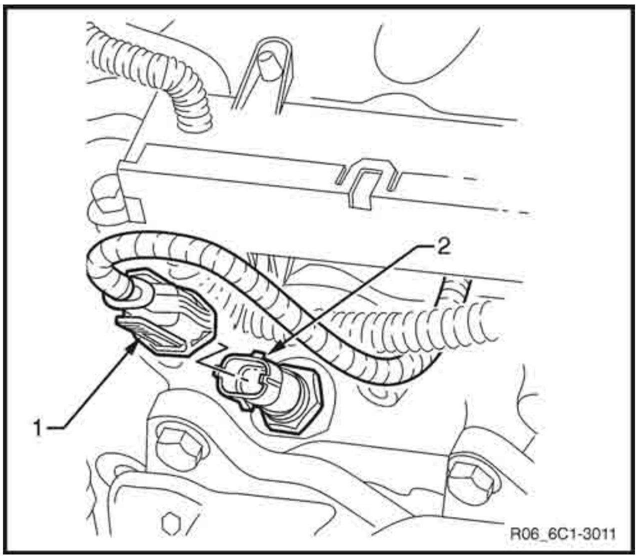


Figure 6C1-3 – 12

CAUTION

Clean the area around the ECT before removal to avoid debris from entering the engine.

5 Remove the ECT sensor (1).

NOTE

If coolant leaks from the cylinder head as the sensor is removed, screw the sensor back into the cylinder head and drain more coolant from the cooling system.

6 If required, test the ECT sensor, refer to the Test in this Section.

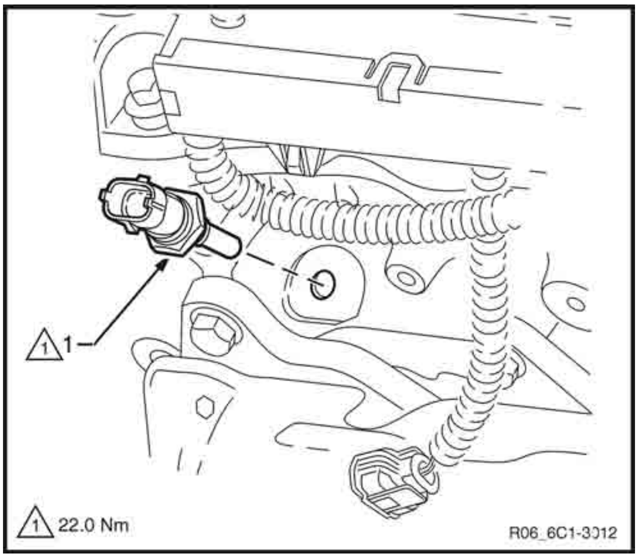


Figure 6C1-3 – 13

Test

CAUTION

To prevent component damage, use connector test adaptor kit J 35616-A.

Resistance Check

1 Suspend the engine coolant temperature (ECT) sensor and a suitable thermometer in a container of 50/50 DEX-COOL® long life coolant or equivalent and water.

NOTE

Neither the ECT sensor or thermometer should rest on the bottom of the container due to an uneven concentration of heat at this point when the container is heated.

2 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the ECT sensor.

3 Measure the resistance across terminals 1 and 2.

4 Whilst heating the container, observe the resistance values as the temperature increases and compare the temperature / resistance change to the specifications.

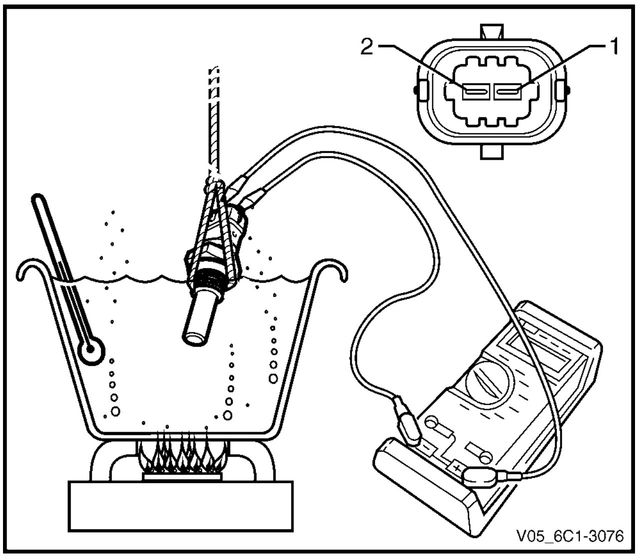


Figure 6C1-3 – 14

5 If the resistance is not within specifications, replace the ECT sensor.

Engine Coolant Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
-40	40490 – 50136
-20	14096 – 16827
-10	8642 – 10152
0	5466 – 6326
20	2351 – 2649
25	1941 – 2173
40	1118 – 1231
60	573 – 618
80	313 – 332
100	182 – 191
120	109 – 116
140	68 – 74

Reinstall

Reinstallation of the engine coolant temperature (ECT) sensor is the reverse of the removal procedure, noting the following:

1 Tighten the ECT sensor to the correct torque specification.

Engine coolant temperature sensor
torque specification..22.0 Nm

2 Refill the cooling system, refer to 6B1 Engine Cooling – V6.

3 Road test the vehicle and check for correct operation, taking particular note there is no coolant leakage.

2.7 Engine Control Module

Service of the engine control module (ECM) should normally consist of either replacement or ECM programming. If the diagnostic procedures call for the ECM to be replaced, it should be first checked to ensure it is the correct part. If it is, replace the faulty ECM.

CAUTION

Do not touch the ECM connector pins as electrostatic discharge (ESD) damage may result.

CAUTION

When removing or reinstalling the ECM wiring harness connector/s, ensure the ignition switch is in the OFF position and the battery has been disconnected. Failure to do so may result in damage to the ECM and / or associated componentry.

Disconnection of the battery affects certain vehicle electronic systems. Refer to 6D1-3 Battery - V6 before disconnecting the battery.

Remove

CAUTION

If replacing the ECM, it must be reset prior to removal. Failure to perform this procedure will result in the inability to test the ECM for warranty purposes, refer to ECM Reset in this Section.

1 Turn the ignition switch off.

2 Disconnect the battery.

3 Disconnect the engine harness connector (1) and the front body harness connector (2) from the ECM (3). To release each connector, lift the connector locking lever (4) whilst simultaneously pushing the connector locking slide (5), refer to Figure 6C1-3 – 15.

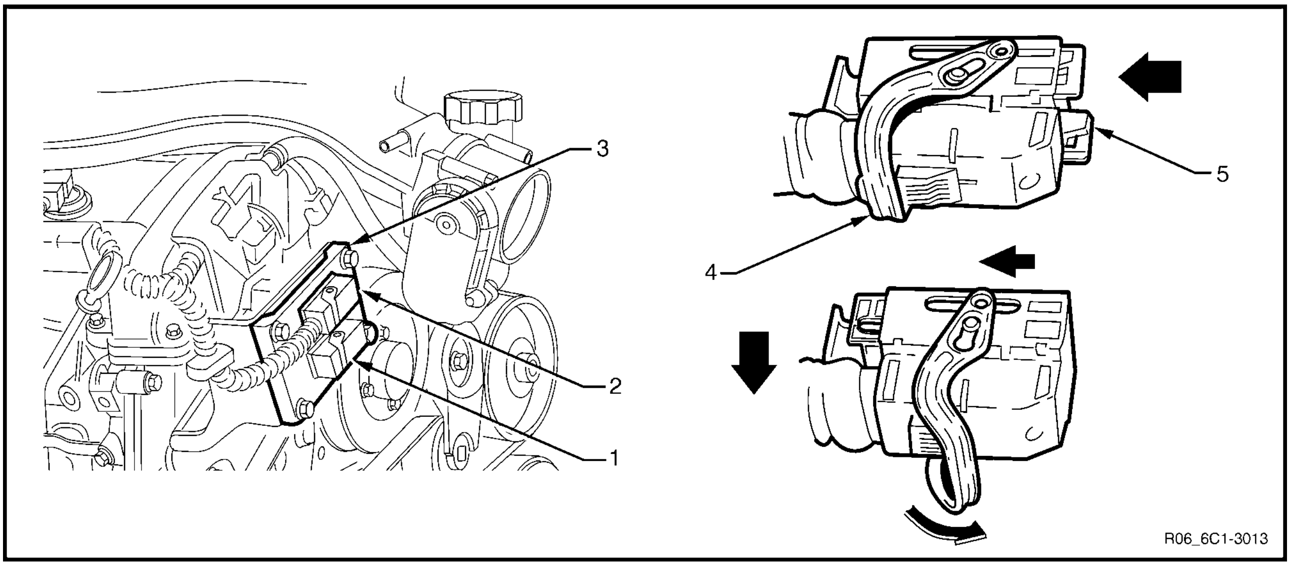


Figure 6C1-3 – 15

4 Remove the screw (1) attaching the ground terminal (2) to the ECM (3).

5 Remove the bolt (4), four places, attaching the ECM to the mounting bracket (5) and remove the ECM.

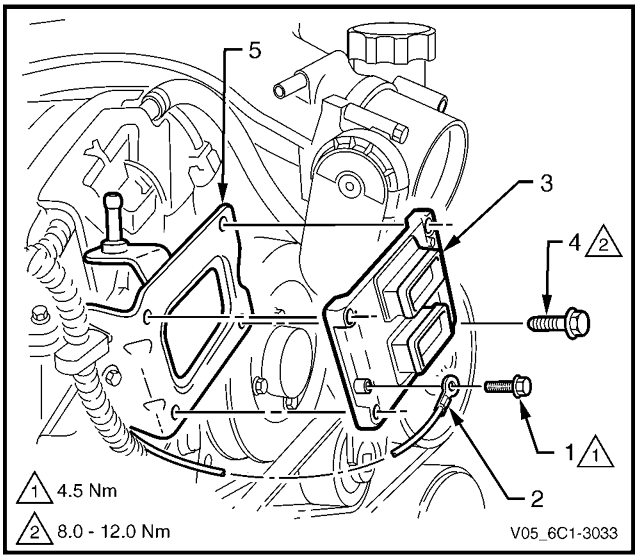


Figure 6C1-3 – 16

Reinstall

Reinstallation of the engine control module (ECM) is the reverse of the removal procedure, noting the following:

NOTE

During installation of the ECM, the SICHTMUSTER ME 9.6 label (1) is positioned at the top right-hand corner.

1 Reinstall ECM attaching bolts and tighten to the correct torque specification.

Engine control module attaching bolt torque specification ....8.0 – 12.0 Nm

2 Reinstall the ground terminal screw and tighten to the correct torque specification.

Ground terminal attaching screw torque specification ....4.5 Nm

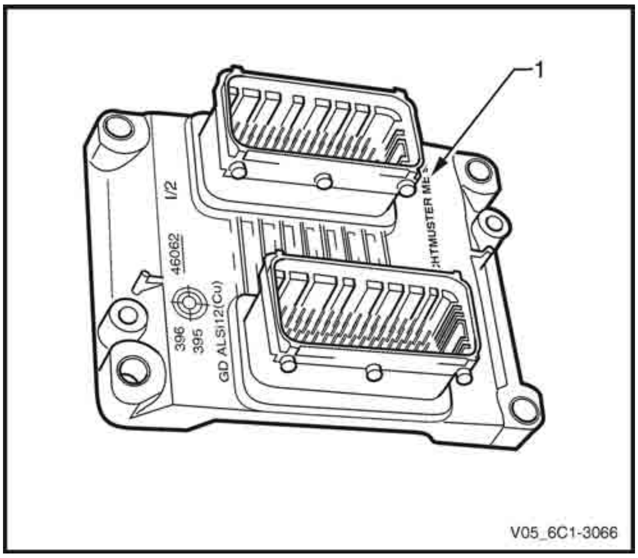


Figure 6C1-3 – 17

3 Reinstall the main vehicle wiring harness connector, and engine wiring harness connector, ensuring the connector locking lever is fully seated, refer to Figure 6C1-3 – 15.

4 If the ECM has been replaced, perform the following procedures:

- ECM service programming, 6E1 Powertrain Interface Module – V6.
- ECM / PIM / ICU security link, refer to 6E1 Powertrain Interface Module – V6.
- Main diagnostic table functional check, refer to 6C1-2 Engine Management – V6 – Diagnostics.

5 If the ECM has been removed, but not replaced, perform the main diagnostic table functional check, refer to 6C1-2 Engine Management – V6 – Diagnostics.

6 Start the vehicle and allow to idle.

ECM Reset

CAUTION

Do not perform the reset procedure within sixty seconds of turning the ignition on. Failure to comply may result in the ECM failing to reset.

When an ECM is installed onto a vehicle, it is security linked to the Immobiliser Control Unit (ICU) and powertrain interface module (PIM). Once this linking has been performed, the ECM cannot be installed in any other vehicle unless the security linking between the ICU and the PIM has been reset using the following procedure.

NOTE

Prior to resetting the ECM, obtain the Security Code. This information is found on the vehicle security card issued with the vehicle when new. For further information on the vehicle security card, refer to 6E1 Powertrain Interface Module – V6.

1 Connect Tech 2 to the data link connector (DLC) and turn the ignition on.

2 On Tech 2 select **Engine** / **V6 Engine** / **Programming** / **Reset ECU**.

NOTE

When Tech 2 requests programming approval, obtain TIS approval.

3 When Tech 2 displays **Enter Security Code**, enter the security code, press the **Enter** key and then the **Okay** soft key.

CAUTION

The engine will not start after the ECM has been reset.

4 When Tech 2 displays **Do you really want to Reset?**, press the **Reset** soft key.

5 When Tech 2 displays **Stop Engine - Turn Off Ignition**, turn the ignition off and press the **Confirm** soft key.

6 When Tech 2 displays **Turn Ignition On**, turn the ignition on and press the **Confirm** soft key.

7 When Tech 2 displays **Reset Completed Successfully**, press the **Confirm** soft key to return to the Tech 2 Programming screen.

2.8 Engine Control Module Bracket Assembly

Remove

1 Remove the engine control module (ECM), refer to 2.7 Engine Control Module.

2 Remove the bolt (1) and the two bolts (2), attaching the ECM bracket assembly (3) to the front engine cover and remove.

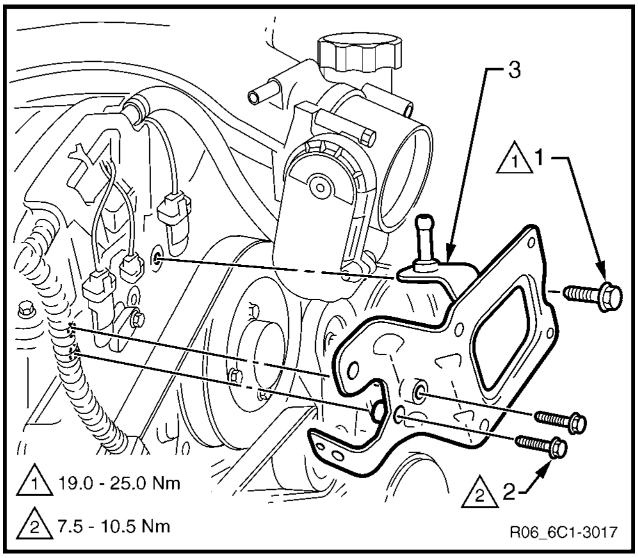


Figure 6C1-3 – 18

Reinstall

Reinstallation of the engine control module (ECM) bracket assembly is the reverse of the removal procedure, noting the following:

1 Tighten the ECM bracket assembly bolts to the correct torque specification.

Engine control module bracket assembly attaching bolt torque specification (6mm)........................7.5 – 10.5 Nm
Engine control module bracket assembly attaching bolt bolt torque specification (8mm)...............19.0 – 25.0 Nm

2 Perform the main diagnostic table functional check, refer to 6C1-2 Engine Management – V6 – Diagnostics.

3 Road test the vehicle and check for correct operation.

2.9 Engine Oil Level and Temperature Sensor

WARNING

To avoid personal injury, take care when draining the engine oil or removing the engine oil level and temperature sensor whilst the engine is hot. Allow the engine to cool before performing this procedure.

Remove

1 Turn the ignition switch off.

2 Raise the front and rear of the vehicle and support on safety stands, refer to 0A General Information for location of the jacking points.

3 Drain the engine oil, refer to 6A1 Engine Mechanical – V6.

CAUTION

Clean the area around the engine oil level and temperature sensor (1) before removal to avoid debris from entering the engine.

4 Disconnect the wiring harness connector (2) from the engine oil level and temperature sensor.

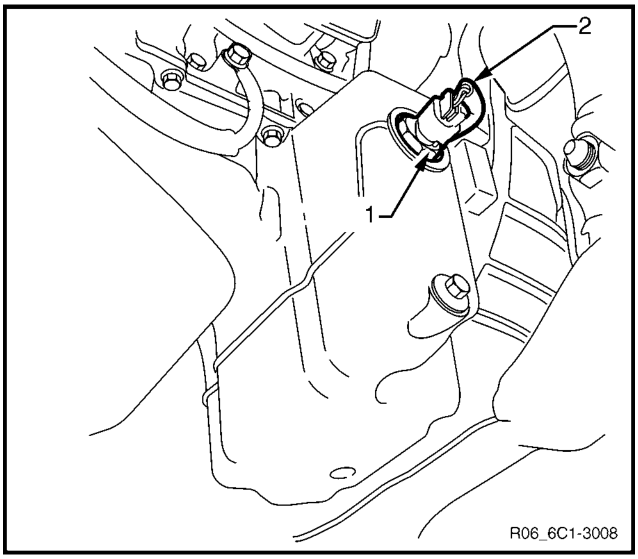


Figure 6C1-3 – 19

5 Using a 11/8" deep socket and socket bar, remove the engine oil level and temperature sensor (1).

6 If required, test the Engine Oil Level and Temperature sensor as follows, refer to the Test in this Section.

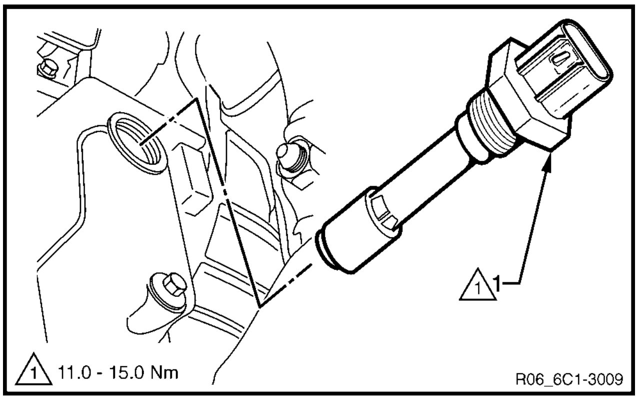


Figure 6C1-3 – 20

Test

Engine Oil Level Sensor Check

1 With the aid of an assistant, perform the following:

   a Whilst holding the engine oil level and temperature sensor (1) in a level position, connect a digital ohmmeter using connector test adaptor kit J 35616-A to terminals A and C, refer to Figure 6C1-3 – 21.

   b With the flat surface of the float (2) positioned at the bottom, ensure continuity does not exist.

   c Push the float upwards so the magnetic pin (3), on the inside of the float (the side of the float with the flat side) contacts the engine oil level sensor. Check for continuity whilst holding the float in this position.

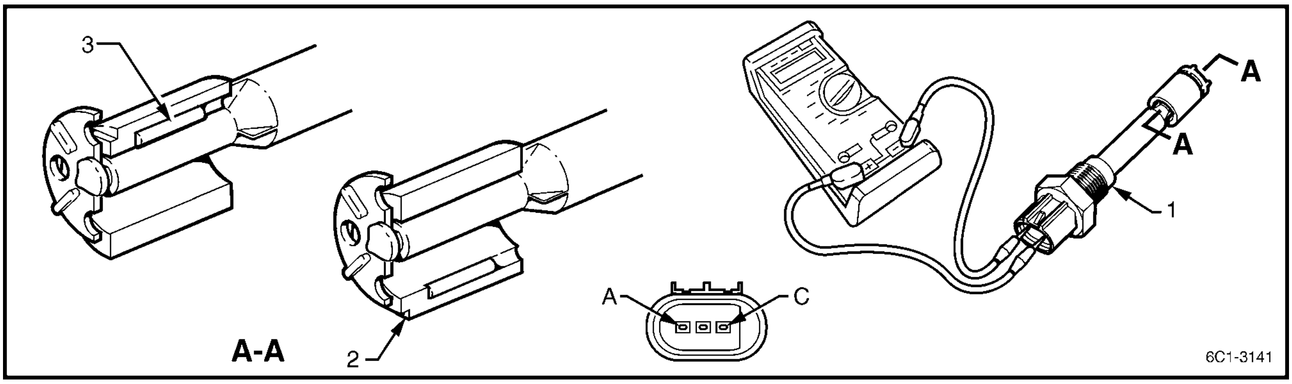


Figure 6C1-3 – 21

2 If any of the above tests fail, replace the engine oil level sensor.

Reinstall

Reinstallation of the engine oil level and temperature sensor is the reverse of the removal procedure, noting the following:

1 Lubricate the O-ring and threaded portion of the sensor with clean engine oil.

2 Tighten the engine oil level and temperature sensor to the correct torque specification.

Engine oil level and temperature sensor torque specification – wet........................11.0 – 15.0 Nm

3 Refill the engine with engine oil, refer to 6A1 Engine Mechanical – V6.

4 Road test the vehicle and check for correct operation, taking particular note there is no engine oil leakage from the oil level and temperature sensor.

2.10 Engine Oil Pressure Sensor

WARNING

To avoid personal injury, take care when removing the engine oil pressure sensor when the engine is hot. Allow the engine to cool before performing this procedure.

Remove

1 Turn the ignition switch off.

CAUTION

Clean the area around the engine oil pressure sensor before removal to avoid debris from entering the engine.

2 Disconnect the wiring harness connector (1) from the engine oil pressure sensor.

NOTE

A small amount of oil will drain from the oil filter housing when the engine oil pressure sensor is removed. Use a shop towel to absorb the oil.

3 Using special tool J 41712 or a 11/16" deep socket and socket bar, remove the engine oil pressure sensor (1).

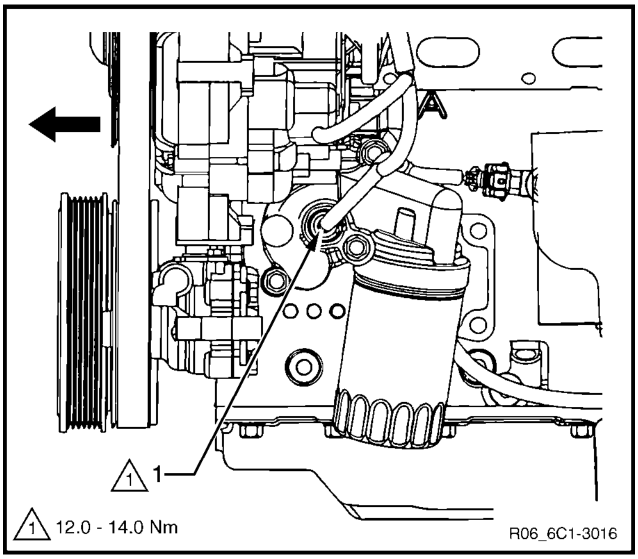


Figure 6C1-3 – 22

Reinstall

Reinstallation of the engine oil pressure sensor is the reverse of the removal procedure, noting the following:

1 Tighten the engine oil pressure sensor to the correct torque specification.

Engine oil pressure sensor torque specification ....12.0 – 14.0 Nm

2 Check the engine oil level and top up if necessary, refer to 6A1 Engine Mechanical – V6.

2.11 Evaporative Emission (EVAP) Canister Purge Valve Quick Connect Fittings

Disconnect

CAUTION

Clean the area around the evaporative emission (EVAP) canister purge valve before disconnecting the quick connect fitting to avoid debris from entering EVAP canister purge valve.

Locking Lever Type

1 Rotate the quick connect locking lever (1) in the direction of the arrow.

2 Whilst holding the lever against its stop (2), pull the hose away from the EVAP canister purge valve.

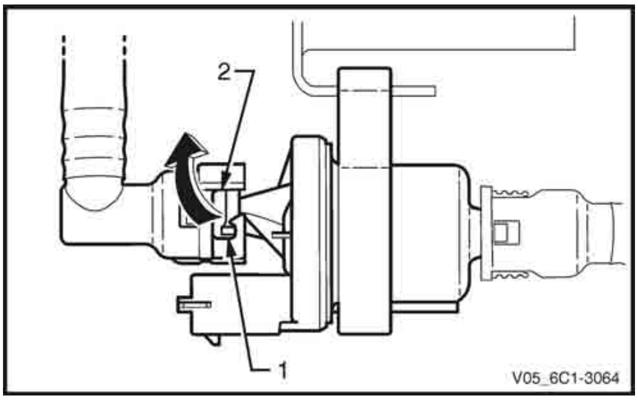


Figure 6C1-3 – 23

Latch Type

1 Push the quick connect fitting (1) in the direction of arrow.

2 Whilst pressing the two latches (2) in the direction of the arrows, pull the quick connect fitting (3) away from the EVAP canister purge valve.

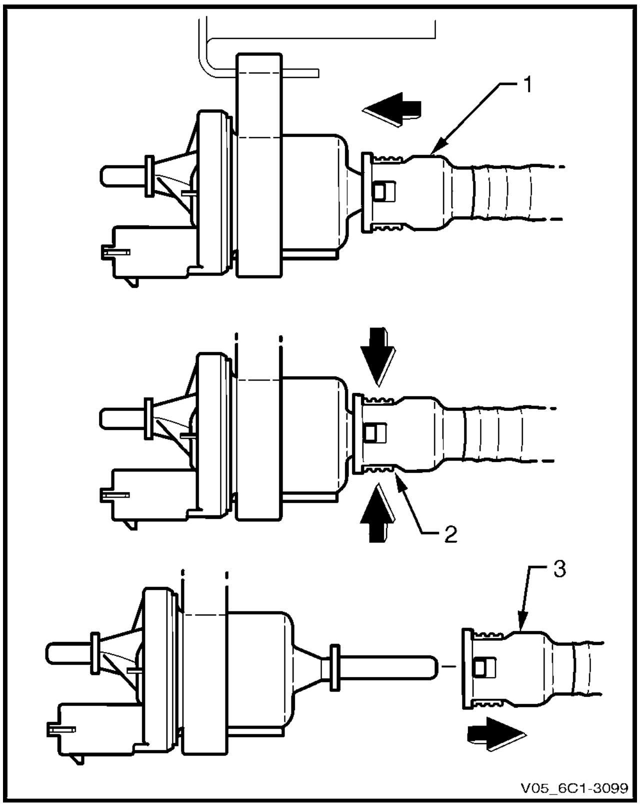


Figure 6C1-3 – 24

Connect

1 Lubricate the evaporative emission (EVAP) canister purge valve with clean engine oil.

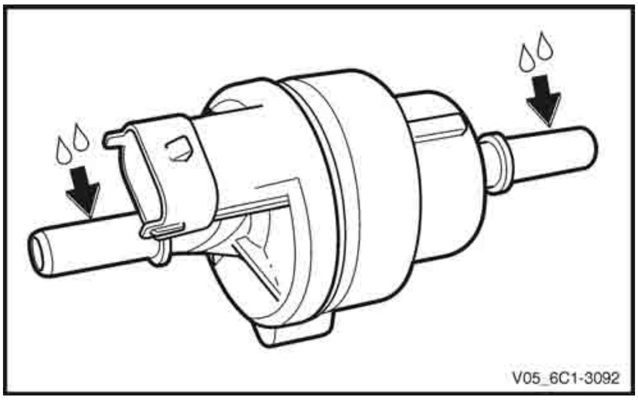
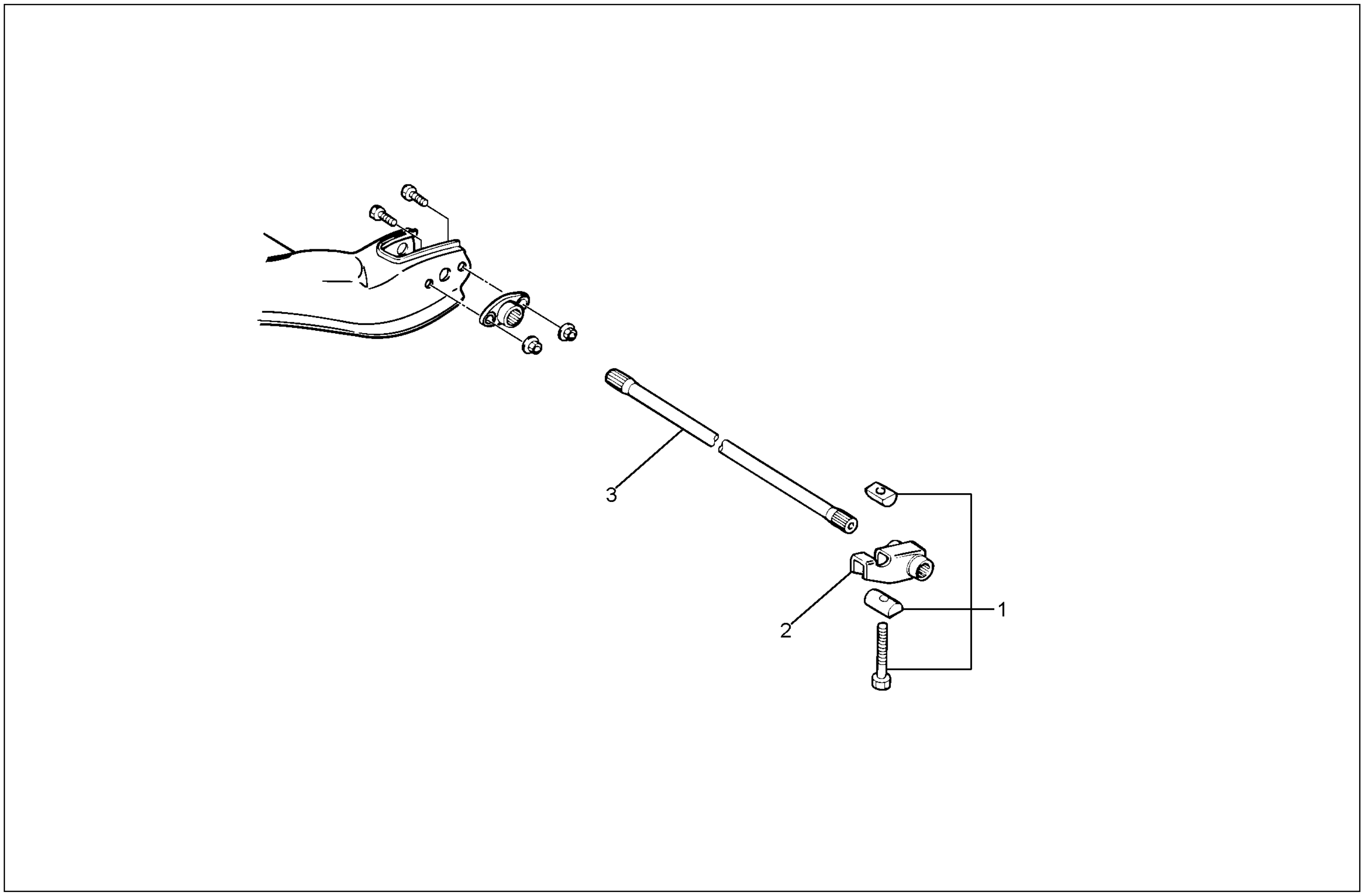


Figure 6C1-3 – 25

Torsion Bar

Torsion Bar and Associated Parts



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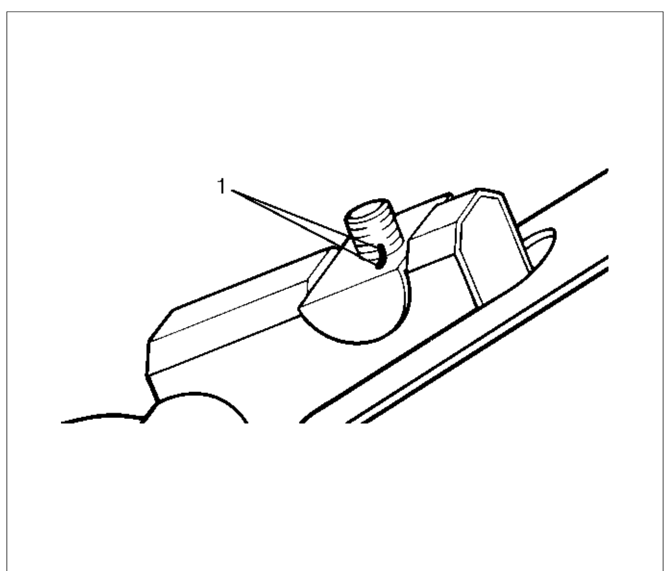
Legend

(1) Adjust Bolt, End Piece and Seat
(2) Height Control Arm
(3) Torsion Bar

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Apply the setting marks (1) to the adjust bolt and end piece, then remove adjust bolt, end piece and seat.



410RS004

2 Push the hose quick connect fitting onto the purge valve fitting. There will be an audible click as the quick connect fitting engages.

3 Check the locking lever has returned to its rest position.

4 Check the quick connect fittings have fully engaged by gently pulling the quick connect fitting away from the purge valve.

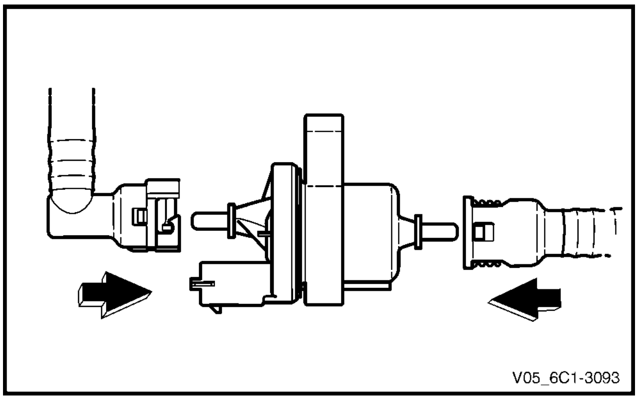


Figure 6C1-3 – 26

2.12 Evaporative Emission Canister Purge Valve

Remove

1 Turn the ignition switch off.

2 Disconnect the wiring harness connector (1) from the evaporative emission (EVAP) canister purge valve (2).

3 Disconnect the two EVAP canister purge valve hoses (3 and 4), refer to 2.11 Evaporative Emission (EVAP) Canister Purge Valve Quick Connect Fittings.

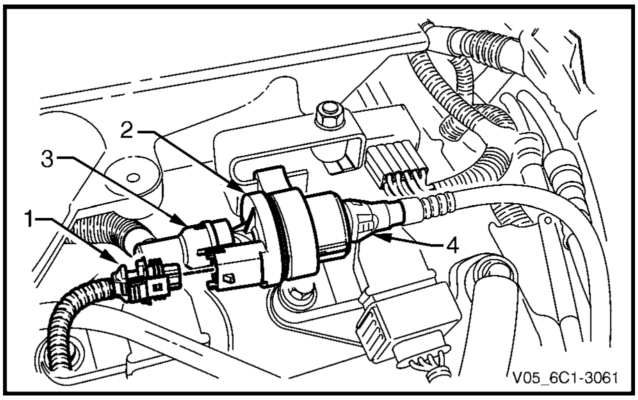


Figure 6C1-3 – 27

4 Slide the EVAP canister purge valve (1) from the purge valve mounting bracket (2).

5 If required, test the EVAP canister purge valve, refer to the Test in this Section.

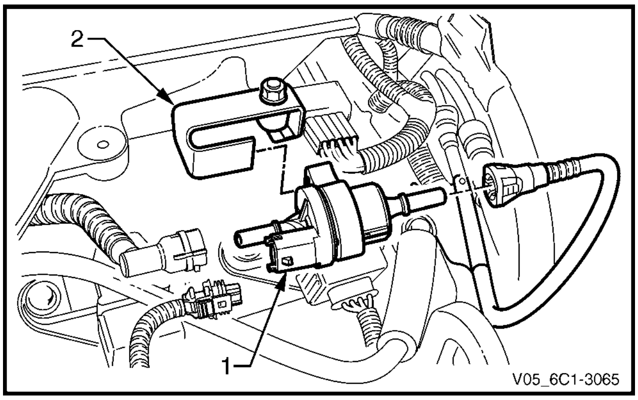


Figure 6C1-3 – 28

Test

CAUTION

To prevent component damage:

- **Use connector test adaptor kit J 35616-A.**
- **When applying 12 V to a component, always use a 3 A fused wire.**

Resistance Check

1 Using a digital ohmmeter and connector test adaptor kit J 35616-A, measure the resistance across terminals 1 and 2.

2 Compare the reading against the specification.

3 If the resistance is not within specification, replace the EVAP canister purge valve.

EVAP canister purge valve resistance @ 20°C	24.0 – 28.0 Ω

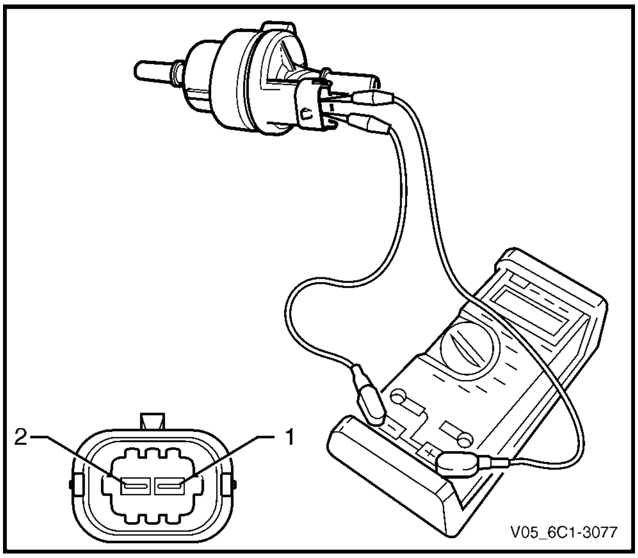


Figure 6C1-3 – 29

Functional Test

1 Attempt to blow air through the EVAP canister purge valve inlet port (1). If air passes through the valve, the valve is faulty and should be replaced.

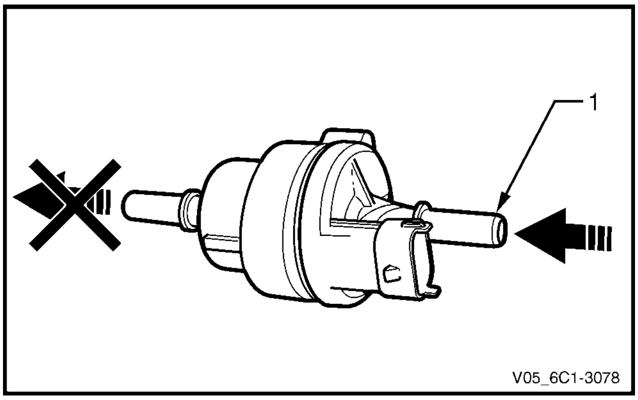


Figure 6C1-3 – 30

2 Using connector test adaptor kit J 35616-A, connect a 12 V battery, an on / off switch and a 3 A fused wire to the EVAP canister purge valve terminals as follows:

- Positive lead to terminal 1.
- Negative lead to terminal 2.

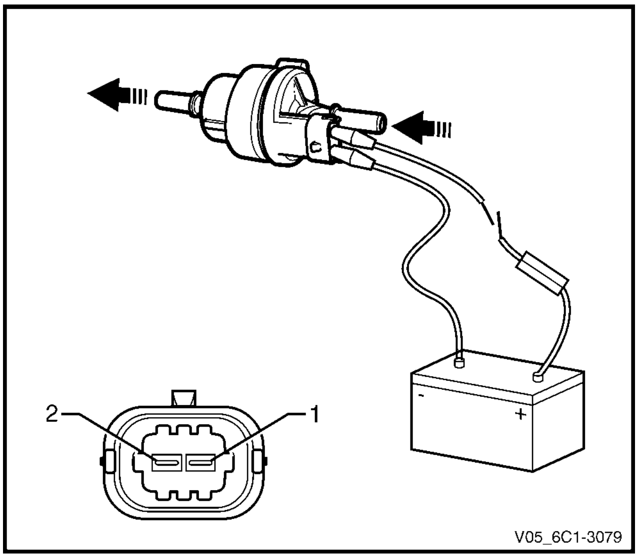


Figure 6C1-3 – 31

CAUTION

Do not apply 12 V to the EVAP canister purge valve continuously for more than three seconds as the EVAP canister purge valve will be damaged.

3 Turn the switch on, and listen for an audible click as the EVAP canister purge valve operates. Whilst the switch is in the on position, blow air through the inlet port.

4 If no air passes through the EVAP canister purge valve, check the valve inlet and outlet ports for any obstructions and rectify if necessary. If there are no obstructions, replace the valve.

Reinstall

Reinstallation of the evaporative emission canister purge valve is the reverse of the removal procedure, noting the following:

1 Connect the purge valve hose quick connect fittings, refer to 2.11 Evaporative Emission (EVAP) Canister Purge Valve Quick Connect Fittings.

2 Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

2.13 Fuel Rail Assembly

WARNING

A depressurised fuel system contains residual fuel that can be spilled during service operations, refer to 6C Fuel System – V6 for further information on handling fuel.

Remove

1 Depressurise the fuel system, refer to 6C Fuel System - V6.

2 Turn the ignition switch off.

NOTE

After removing the upper intake manifold, plug the lower manifold opening to prevent dirt and other contaminants from entering.

3 Remove the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

4 Disconnect the fuel feed hose from the fuel rail, refer to 6C Fuel System - V6. Plug the fuel line openings to prevent dirt and other contaminants from entering.

5 Slide the engine wiring harness connector retaining latch (1) in the direction of the arrow to disconnect the connector from the fuel injector harness.

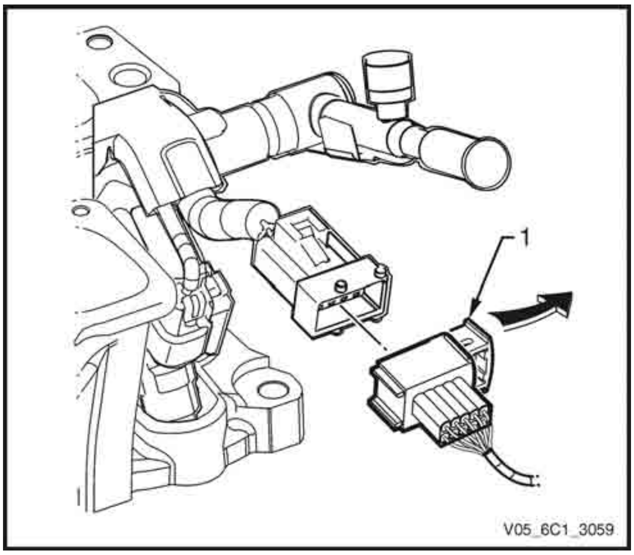


Figure 6C1-3 – 32

CAUTION

Clean around the area where the fuel injectors enter the lower intake manifold.

6 Remove the bolt (1), three places, attaching the fuel rail to the lower intake manifold.

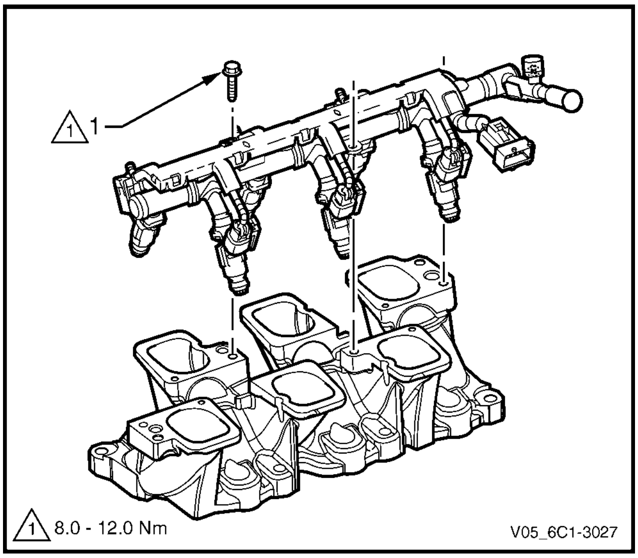


Figure 6C1-3 – 33

CAUTION

Care must be taken when removing the fuel rail and injector assembly to prevent damage to the injector spray tips and injector harness connector terminals.

Support the fuel rail and injector assembly after removal.

7 Remove the fuel rail and injector assembly.

8 Plug all fuel line and manifold openings after removal to prevent dirt and other contaminants from entering.

Disassemble

Fuel Injector

Remove

For each fuel injector:

1 Slide the fuel injector wiring connector locking tab (1) upwards in the direction of the arrow.

2 Disconnect the connector from the fuel injector.

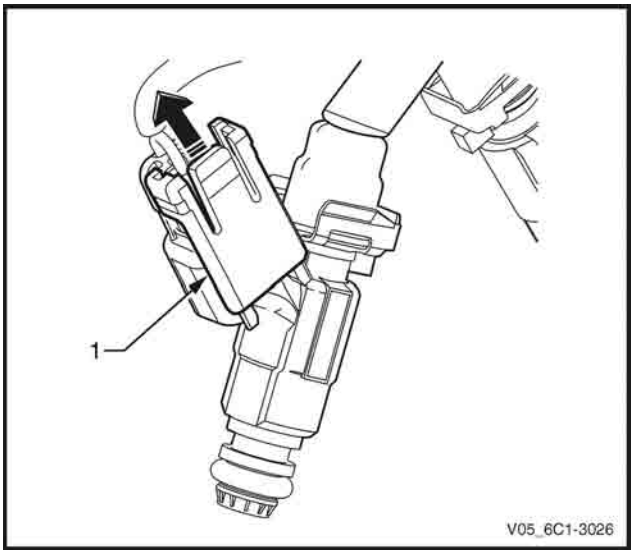


Figure 6C1-3 – 34

3 Using a flat blade screwdriver, remove the fuel injector retaining clip (1) from the fuel injector (2). Discard the retaining clip.

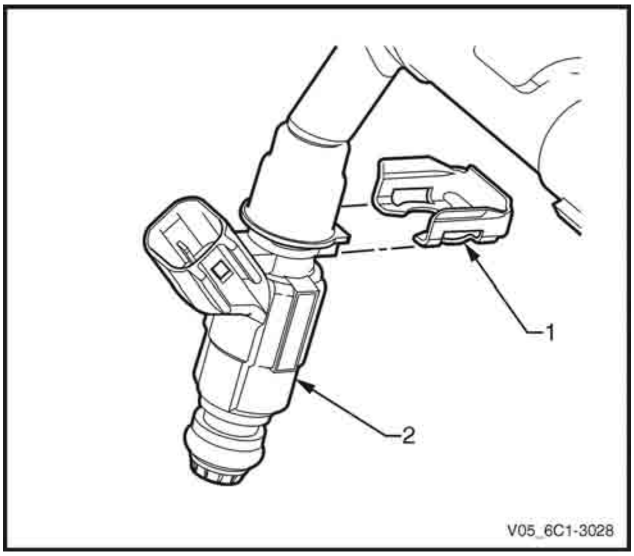


Figure 6C1-3 – 35

4 Remove the fuel injector (1) from the fuel rail.

5 Remove and discard the fuel injector seals (2).

6 As required, repeat for the remaining injectors and test each fuel injector, refer to the Test in this Section.

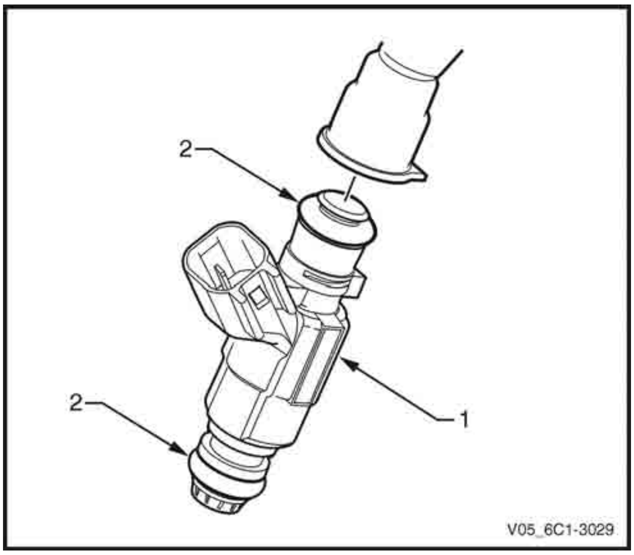


Figure 6C1-3 – 36

Test

CAUTION

To prevent component damage use connector test adaptor kit J 35616-A.

1 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the fuel injector.

2 Measure the resistance across terminals A and B.

3 Compare the reading against the specification.

Fuel injector resistance @ 20°C .... 11.4 – 12.6 Ω

4 If the resistance is not within specifications, replace the fuel injector.

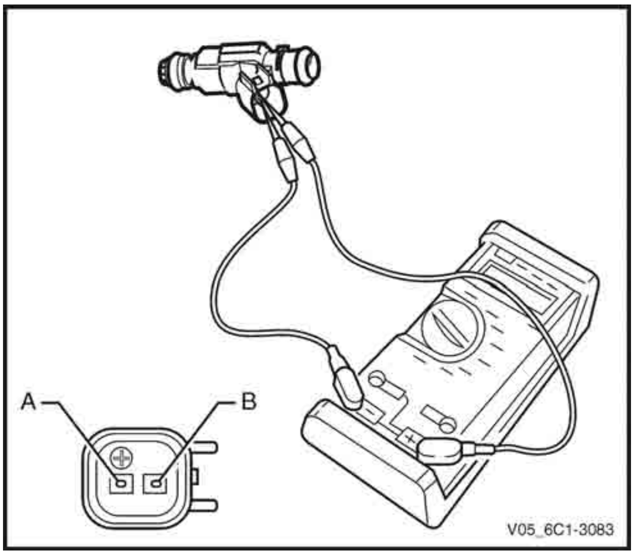


Figure 6C1-3 – 37

Reinstall

Reinstallation of the fuel injector is the reverse of the removal procedure, noting the following:

1 Install new fuel injector seals and lubricate with clean engine oil.

2 Install a new fuel injector retaining clip, refer to Figure 6C1-3 – 35.

Fuel Injector Wiring Harness Assembly

Remove

1 For each fuel injector wiring harness connector, slide the locking tab (1) upwards in the direction of the arrow and disconnect the connector from the fuel injector.

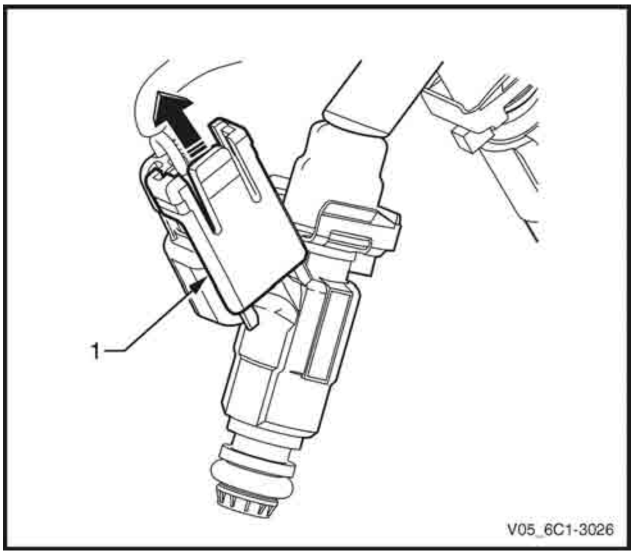


Figure 6C1-3 – 38

2 Unclip the fuel injector harness assembly (1), three places, from the fuel rail.

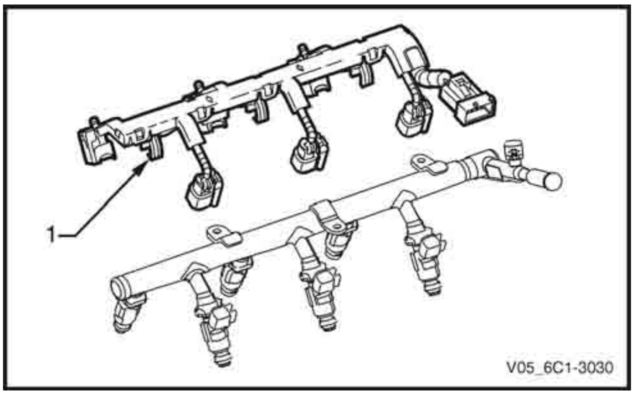


Figure 6C1-3 – 39

3 Using a flat blade screwdriver, prise the fuel injector harness upper tray retainer (1), eight places, from the lower tray locking tang (2).

4 Remove the fuel injector harness from the lower tray.

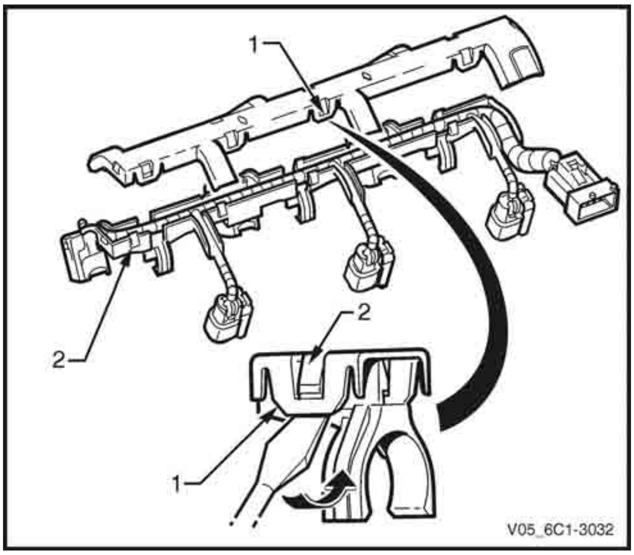


Figure 6C1-3 – 40

Reinstall

Reinstallation of the fuel injector wiring harness assembly is the reverse of the removal procedure, noting the following:

CAUTION

Ensure there is no undue strain placed on the fuel injector wiring harness (1) once it has been positioned in the tray (2).

1 Lay the fuel injector wiring harness in the lower tray.

2 Clip the upper and lower fuel injector harness trays together, ensuring that all eight retainers are correctly seated.

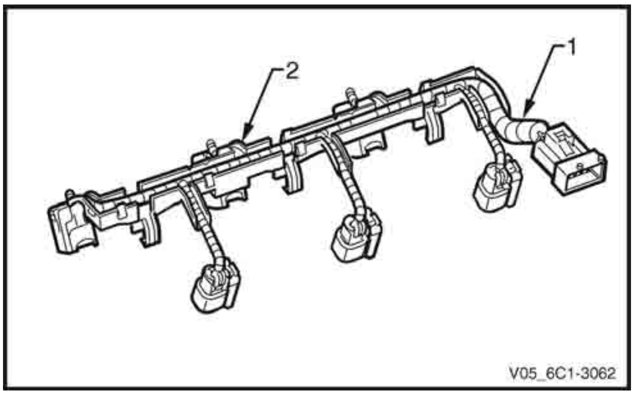


Figure 6C1-3 – 41

Reinstall

Reinstallation of the fuel rail assembly is the reverse of the removal procedure, noting the following:

1 Lubricate the fuel injector O-rings with engine oil.

2 Carefully reinstall the fuel rail and injector assembly.

CAUTION

Ensure the fuel injectors are correctly seated in the lower intake manifold, and the fuel rail attaching brackets are correctly located prior to tightening the attaching bolts.

3 Reinstall the fuel rail attaching bolts and tighten to the correct torque specification.

Fuel rail attaching bolt torque specification ....8.0 – 12.0 Nm

4 Reconnect the fuel feed hose to the fuel rail, refer to 6C Fuel System - V6.

5 Inspect the fuel rail and quick connect fitting for leaks, refer to 6C Fuel System - V6.

6 Road test the vehicle and check for correct operation.

2.14 Heated Oxygen Sensor

WARNING

To avoid the possibility of personal injury, allow the exhaust pipe to cool to ambient temperature (less than 50°C) before attempting to remove the oxygen sensor.

Service Precautions

- Handle the HO2S carefully. Do not drop it, and keep it free of grease, dirt and other contaminants. Do not use cleaning solvents of any type on the HO2S.
- Do not repair the HO2S or any of its parts. Replace the HO2S if any damage is evident.
- The HO2S may be difficult to remove when the engine is cold. Excessive force may damage the threads in the exhaust manifold or exhaust pipe.

- If the HO2S has been removed, but not replaced, anti-seize compound must be applied to the threads prior to installation. New HO2S will already have the anti-seize compound applied.
- For vehicles with the six wire HO2S sensor, under no circumstances should the protective cover (1) be removed, or the gortex filter (2) be covered and / or sealed.

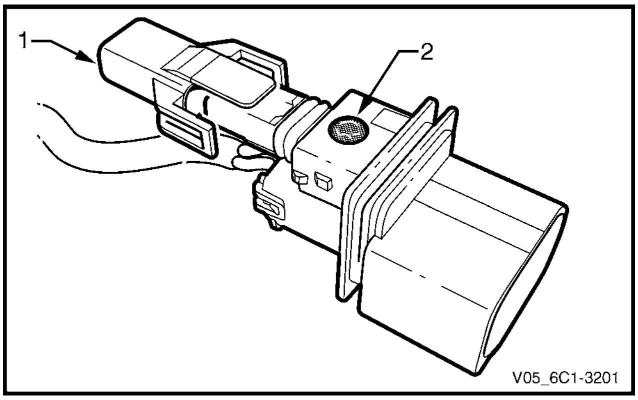


Figure 6C1-3 – 42

Six Wire Sensor

The replacement procedure for Bank 1 and Bank 2 six wire heated oxygen sensor (HO2S) are typically the same, with the following procedure being specific to Bank 1.

Remove

1 Turn the ignition switch off.

2 Unclip the HO2S wiring harness connector assembly (1) from the ignition coil wiring harness tray, refer to Figure 6C1-3 – 43. View A refers to Bank 1, and View B refers to Bank 2.

3 Slide the connector locking tang (2) away from the harness connector.

4 Separate the harness connector (3).

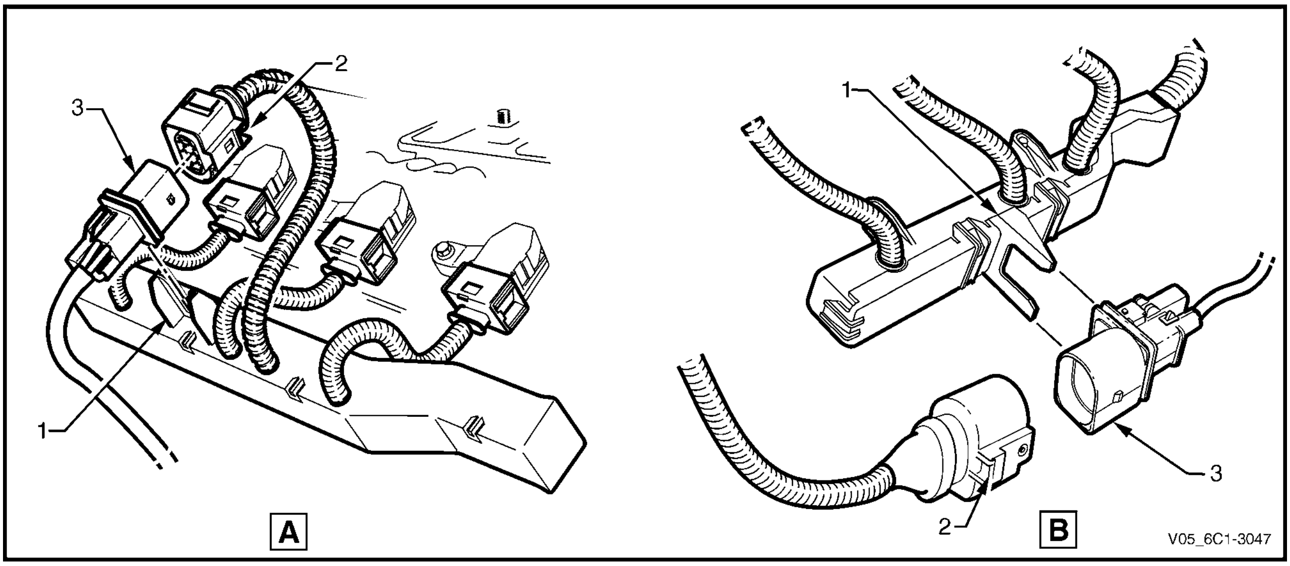


Figure 6C1-3 – 43

5 Raise the front of the vehicle and support on safety stands. Refer to 0A General Information for location of the jacking points.

6 Unscrew the HO2S (1) from the exhaust pipe and remove.

7 If required, test the HO2S, refer to the Test in this Section.

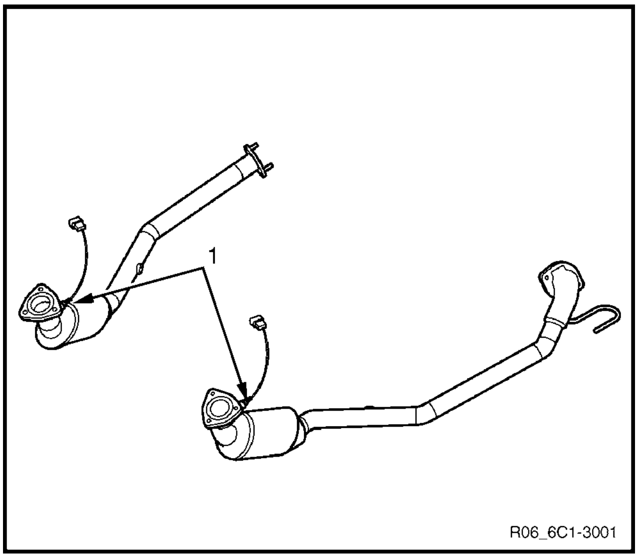


Figure 6C1-3 – 44

Reinstall

Reinstallation of the heated oxygen sensor (HO2S) is the reverse of the removal procedure, noting the following:

1 Ensure the protective cover (1) is securely in place, and the gortex filter (2) has not been covered or sealed.

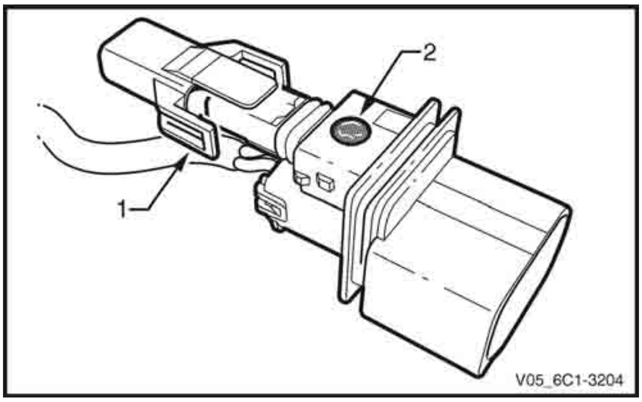


Figure 6C1-3 – 45

CAUTION

A special anti-seize compound is used on the HO2S threads. A new HO2S will already have the anti-seize compound applied to the threads.

If a HO2S has been removed, but not replaced, an anti-seize compound must be applied to the threads prior to installation.

2 Coat the cleaned threads of the HO2S with anti-seize compound.

3 Tighten the HO2S to the correct torque specification.

Heated oxygen sensor torque specification ....40.0 – 50.0 Nm

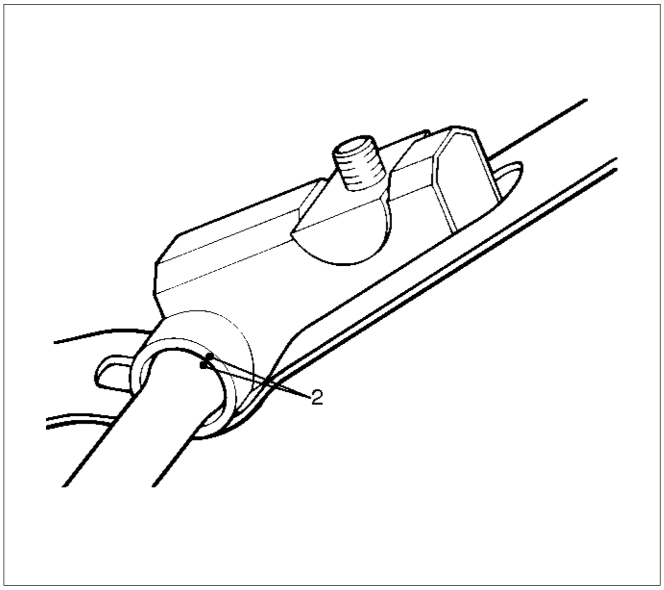
4 Road test the vehicle and check for correct operation, taking particular note that no exhaust leakage is evident.

Four Wire Sensor

The replacement procedure for Bank 1 (RHS) and Bank 2 (LHS) four wire heated oxygen sensor (HO2S) are typically the same, with the following procedure being specific to Bank 2.

3. Apply the setting marks (2) to the height control arm and torsion bar, then remove height control arm.

NOTE: “Besco chassis grease” should be applied on contact area of height control arm with frame.
(RH & LH Both side)



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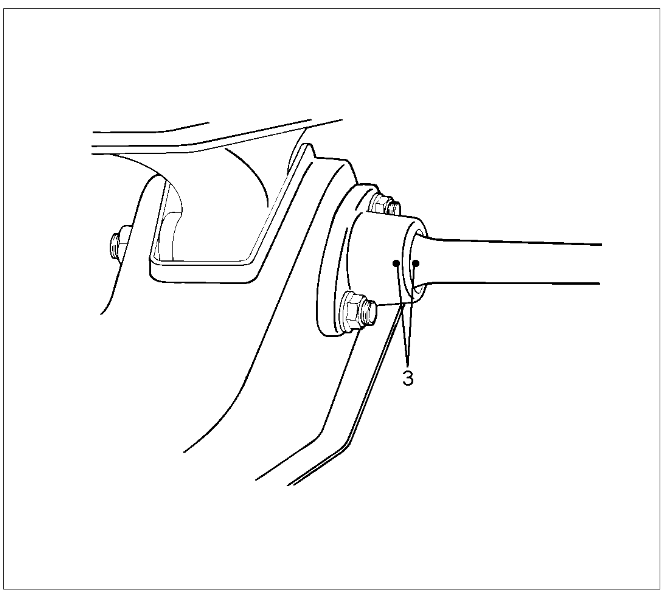
4. Apply the setting marks (3) to the torsion bar and lower control arm, and then remove torsion bar.



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Inspection and Repair

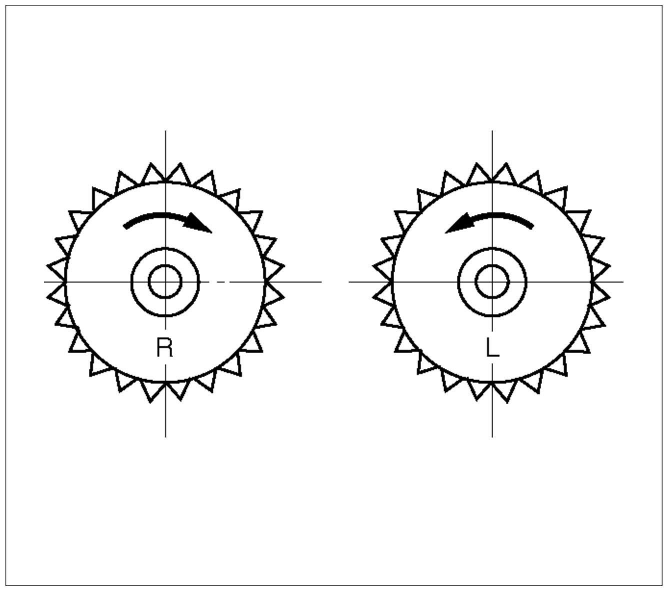
Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.

Check the following parts:

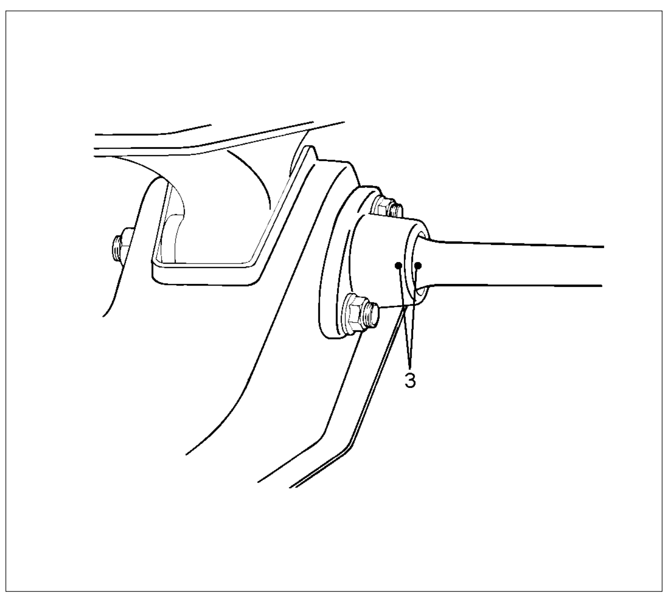
- Torsion bar
- Height control arm
- Adjust bolt
- Rubber seat

Installation

1. Apply grease to the serrated portions, then install torsion bar. Make sure the bars are on their correct respective sides and align the setting marks (3).



410RS007



RTW340SH000301

Remove

1 Turn the ignition switch off.

2 Raise the vehicle and support on safety stands, refer to 0A General Information for location of the jacking points.

3 Unclip the HO2S wiring harness (1) from the transmission.

4 Depress the harness connector retaining clip (2) and separate the harness connectors.

5 Unscrew the HO2S (3) from the exhaust pipe and remove.

6 If required, test the HO2S, refer to the Test in this Section.

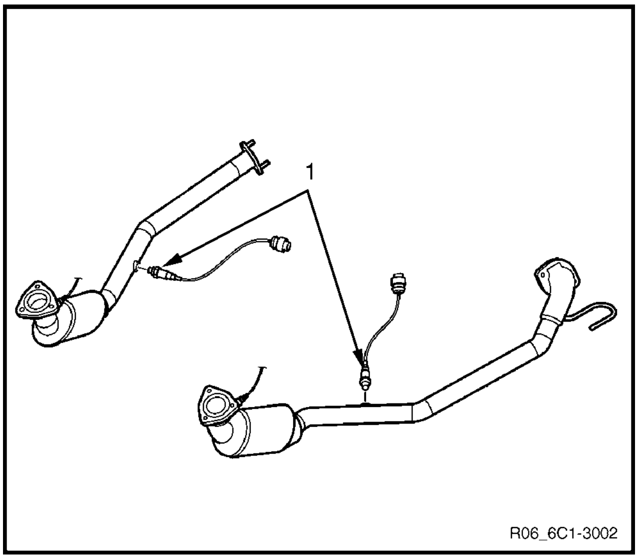


Figure 6C1-3 – 46

Reinstall

Reinstallation of the heated oxygen sensor (HO2S) is the reverse of the removal procedure, noting the following:

CAUTION

A special anti-seize compound is used on the HO2S threads. A new HO2S will already have the anti-seize compound applied to the threads.

If a HO2S has been removed, but not replaced, then anti-seize compound must be applied to the threads prior to installation.

1 Coat the cleaned threads of the sensor with anti-seize compound.

2 Tighten the HO2S to the correct torque specification.

Heated oxygen sensor torque specification ....40.0 – 50.0 Nm

3 Road test the vehicle and check for correct operation, taking particular note that no exhaust leakage is evident.

Test

CAUTION

Under no circumstances should battery voltage be applied to the heated oxygen sensor (HO2S) heater.

CAUTION

To prevent component damage use connector test adaptor kit J 35616-A.

Heater Resistance Check – Six Wire HO2S

1 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the HO2S.

2 Measure the resistance across terminals 3 and 4.

3 Compare the reading against the specification.

HO2S heater resistance @ 20°C .... 8.0 – 10.0 Ω

4 If the resistance is not within specification, replace the HO2S.

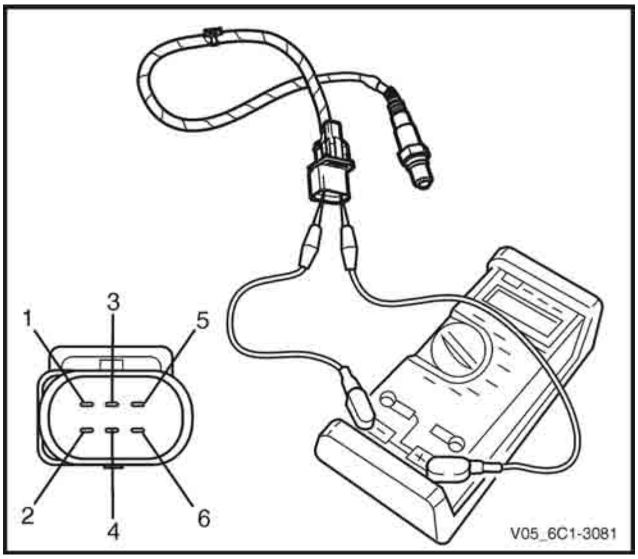


Figure 6C1-3 – 47

Heater Resistance Check – Four Wire HO2S

1 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the HO2S.

2 Measure the resistance across terminals 1 and 2.

3 Compare the reading against the specification.

HO2S heater resistance @ 20°C .... 8.0 – 10.0 Ω

4 If the resistance is not within specification, replace the HO2S.

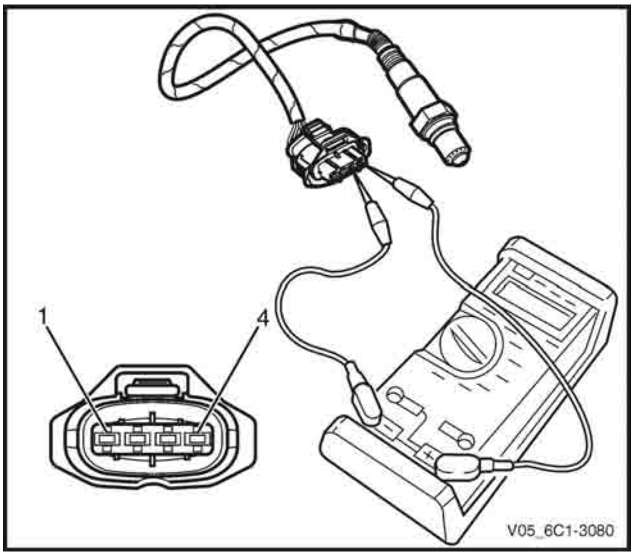


Figure 6C1-3 – 48

2.15 Ignition Coil

Ignition Coils

The replacement procedure for all ignition coils is the same except for the removal of the ignition coil on cylinder No's 1, 3 and 4, it is necessary to remove the upper intake manifold assembly.

Remove

1 Turn the ignition switch off.

NOTE

If the upper intake manifold has been removed, plug the lower manifold openings to prevent dirt and other contaminants from entering.

2 If required, remove the upper intake manifold assembly, refer to 6A1 Engine Mechanical – V6.

3 Using a flat-blade screwdriver, slide the connector retaining latch (1) in the direction of the arrow.

4 Remove the wiring harness connector from the ignition coil (2).

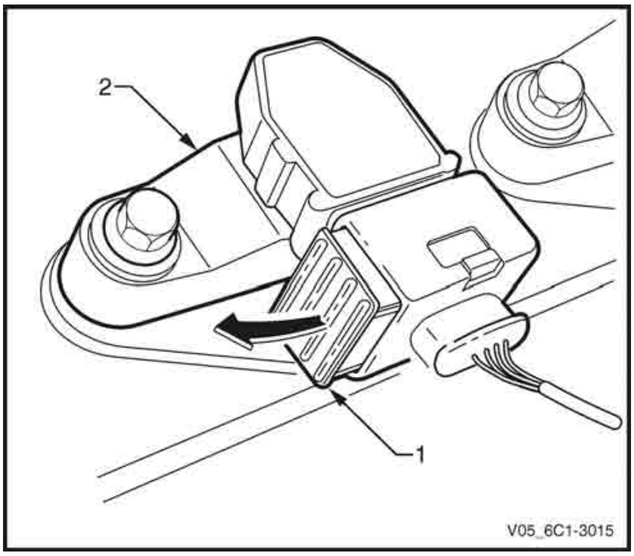


Figure 6C1-3 – 49

CAUTION

Clean the area around the ignition coil before removal to avoid debris from entering the engine.

5 Fully loosen the bolt (1) attaching the ignition coil (2) to the camshaft cover.

NOTE

The ignition coil bolts are captive. Do not attempt to remove the bolts from the ignition coil.

6 Remove the ignition coil by first, twisting the coil to release it, and then pulling the ignition coil upwards to remove it.

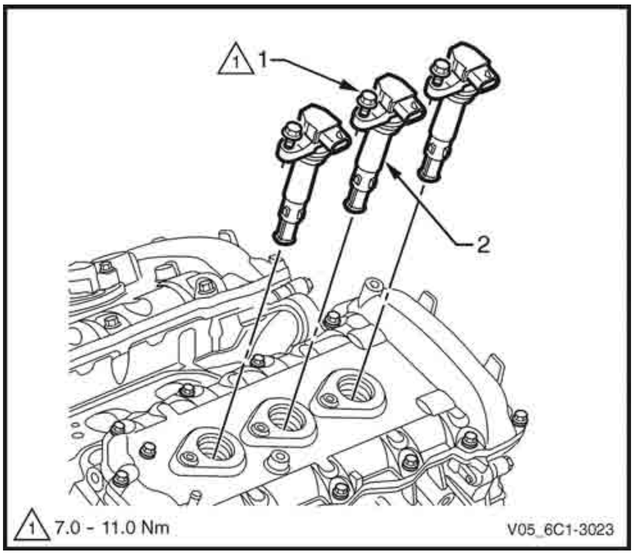


Figure 6C1-3 – 50

Disassemble

CAUTION

Do not use a sharp implement such as a knife to cut the ignition coil boot (1) from the ignition coil. Using a sharp implement may damage the ignition coil insulator (2).

1 Using your thumb, work the ignition coil boot off the ignition coil insulator.

NOTE

Take care the spring (3) does not become dislodged as the boot is removed.

To aid removal of the boot, use a blunt instrument to lift the boot edge away from the coil insulator and spray a release agent between the boot and the coil insulator.

2 Remove the spring from the ignition coil insulator.

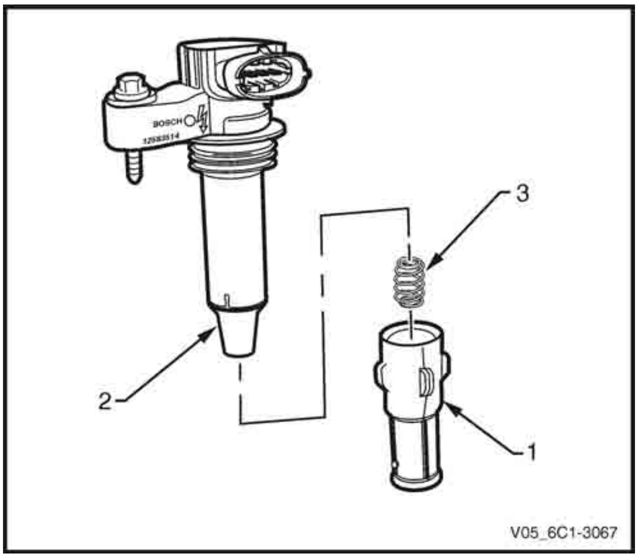


Figure 6C1-3 – 51

Reassemble

1 Position the spring (3) in the insulator recess, refer to Figure 6C1-3 – 51.

2 Lubricate the ignition coil insulator (1) with talcum powder.

3 Fit the ignition coil boot, ensuring it is fully seated at the top of the insulator.

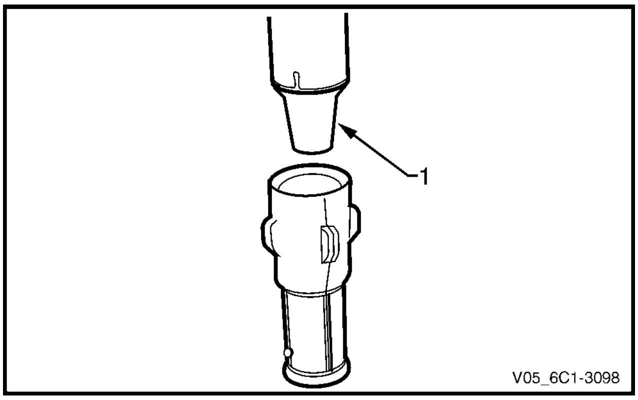


Figure 6C1-3 – 52

Test

CAUTION

Never probe the ignition coil with a 12 V tester as the ignition coil will be damaged.

Due to the internal components of the ignition coil assembly, it is not possible to perform any primary and / or secondary resistance checks. For further information on the ignition coil operation, refer to 6C1-1 Engine Management – V6 – General Information.

Reinstall

Reinstallation of the ignition coil is the reverse of the removal procedure, noting the following:

1 Lubricate the ignition coil sealing rubber (1) with clean engine oil, and the inside of the ignition coil boot (2) with talcum powder.

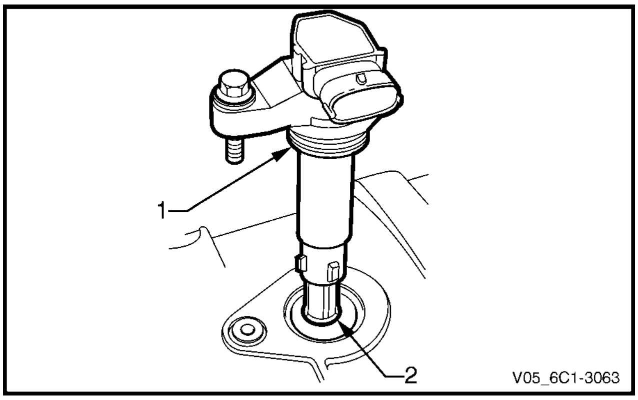


Figure 6C1-3 – 53

2 Reinstall the ignition coil by pushing down on the ignition coil to engage the sealing rubber in the camshaft cover.

CAUTION

Ensure the ignition coil is fully seated before tightening the attaching bolt to the specified torque.

3 Reinstall the ignition coil bolt and tighten to the correct torque specification.

Ignition coil attaching bolt torque specification ....7.0 – 11.0 Nm

4 Road test the vehicle and check for correct operation.

2.16 Intake Air Duct Assembly

Remove

1 Turn the ignition switch off.

2 Disconnect the crankcase ventilation hose (1) from the air intake duct (2).

3 Loosen the two air intake duct retaining clamps (3),

4 Pull the air intake duct away from the throttle body.

5 Pull the air intake duct away from the mass air flow sensor.

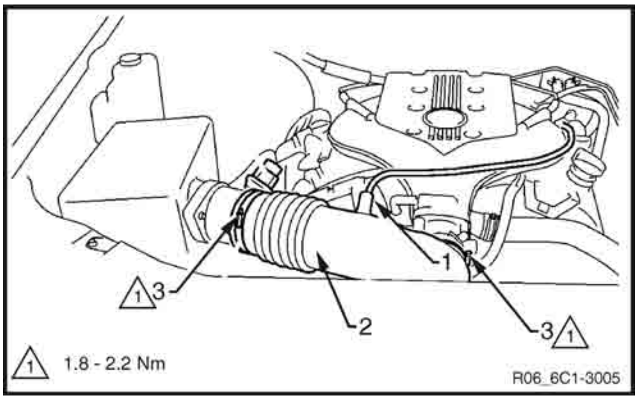


Figure 6C1-3 – 54

Reinstall

Reinstallation of the air intake duct is the reverse of the removal procedure, noting the following:

CAUTION

Ensure the air intake duct sealing rubber is correctly positioned on the throttle body. Failure to do this may result in engine damage due to unfiltered air entering the engine intake system.

1 Reinstall the air intake duct and tighten the retaining clamps to the correct torque specification.

Air intake duct retaining clamp torque specification ....1.8 – 2.2 Nm

2 Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

2.17 Intake Air Temperature Sensor

The intake air temperature (IAT) sensor is part of the mass air flow (MAF) sensor assembly, refer to 2.20 Mass Air Flow Sensor for the replacement procedure.

Test

CAUTION

To prevent component damage use connector test adaptor kit J 35616-A.

Resistance Check

CAUTION

Do not use a high temperature heat gun as damage to the MAF sensor will result.

1 Connect a digital ohmmeter using connector test adaptor kit J 35616-A to the MAF sensor.

2 Whilst holding a thermometer (3), use a commercially available hair dryer (4) to blow warm air through the MAF sensor.

3 Measure the resistance across terminals 1 and 2.

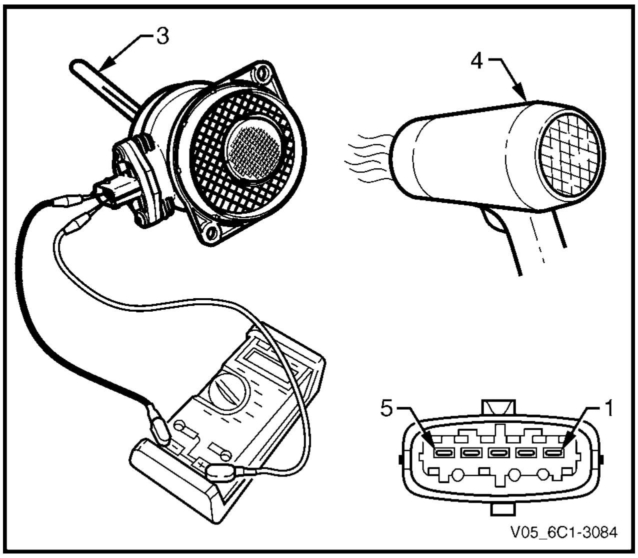


Figure 6C1-3 – 55

4 Observe the resistance values as the temperature increases and compare the temperature / resistance change to the specifications.

5 If the resistance is not within specifications, replace the MAF sensor.

Intake Air Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
-40	35140 – 43760
-20	12660 – 15120
-10	7943 – 9307
0	5119 – 5892
20	2290 – 2551
25	1900 – 2100
40	1096 – 1238
60	565 – 654
80	312 – 370
100	184 – 222
120	114 – 141
140	74 – 93

2.18 Knock Sensor, Bank 2 (LHS)

Remove

1 Turn the ignition switch off.

2 Disconnect Bank 2 pre-catalytic converter HO2S wiring harness connector, refer to 2.14 Heated Oxygen Sensor.

3 Raise the front of the vehicle and support on safety stands. Refer to 0A General Information for location of the jacking points.

4 Remove the starter motor heat shield, refer to 6D1-2 Starting System – V6.

5 Disconnect the wiring harness connector (1) from the knock sensor (2).

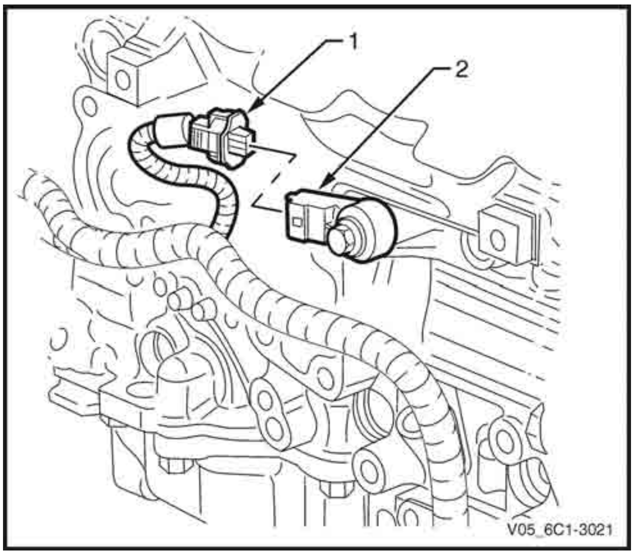


Figure 6C1-3 – 56

6 Remove the bolt (1) attaching the knock sensor (2) to the engine block and remove the knock sensor.

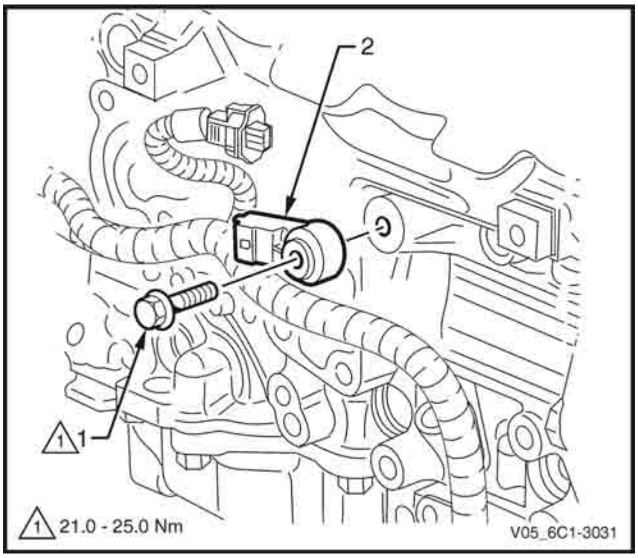


Figure 6C1-3 – 57

Reinstall

Reinstallation of the knock sensor is the reverse of the removal procedure, noting the following:

1 Ensure the knock sensor mounting surface is flat and free of any dirt, oxidisation, etc.

CAUTION

Ensure the knock sensor is fully seated and correctly aligned before tightening the attaching bolt.

Do not over-tighten the attaching bolt as incorrect operation of the knock sensor may result.

2 Reinstall the knock sensor and bolt (1). Align the knock sensor so that it is parallel to the engine oil pan mounting surface (2), ± 3° (3).

3 Tighten the knock sensor bolt to the correct torque specification.

Knock sensor attaching bolt torque specification	21.0 – 25.0 Nm

4 Road test the vehicle and check for correct operation, taking particular note that no exhaust leaks are evident.

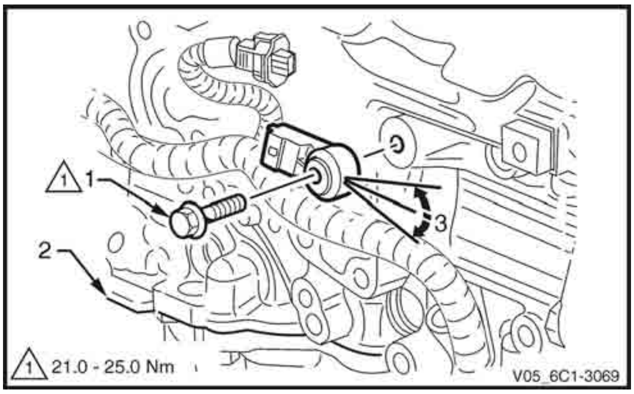


Figure 6C1-3 – 58

2.19 Knock Sensor, Bank 1 (RHS)

Remove

1 Turn the ignition switch off.

2 Raise the front of the vehicle and support on safety stands, refer to 0A General Information for location of the jacking points.

3 Disconnect the wiring harness connector (1) from the knock sensor (2).

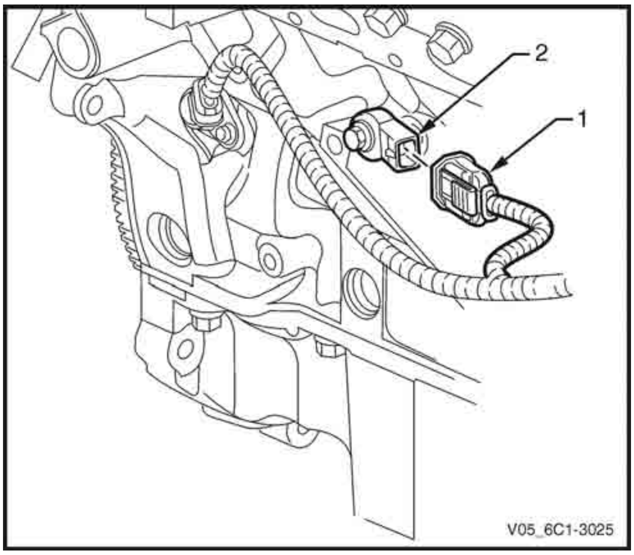


Figure 6C1-3 – 59

4 Remove the bolt (1) attaching the knock sensor (2) to the engine block, and remove the knock sensor.

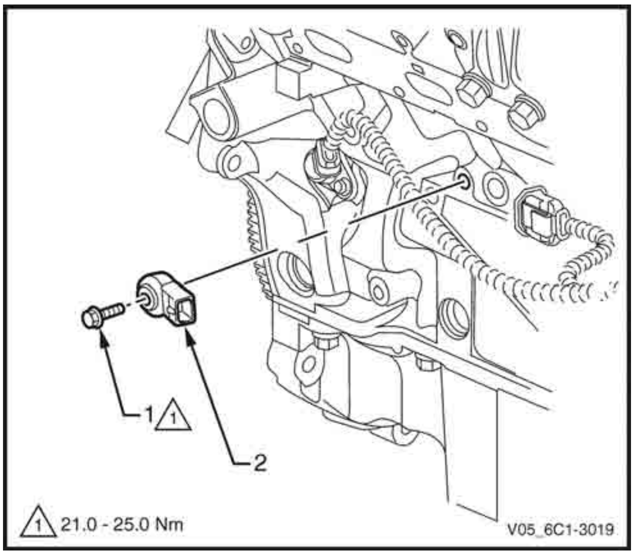


Figure 6C1-3 – 60

Reinstall

Reinstallation of the knock sensor is the reverse of the removal procedure, noting the following:

1 Ensure the knock sensor mounting surface is flat and free of any dirt, oxidisation, etc.

CAUTION

Ensure the knock sensor is fully seated before tightening the attaching bolt.

Do not over-tighten the attaching bolt as incorrect operation of the knock sensor may result.

2 Reinstall the knock sensor and bolt (1). Align the knock sensor so that it is parallel to the engine oil pan mounting surface (2), ± 3° (3).

3 Tighten the knock sensor bolt to the correct torque specification.

Knock sensor attaching bolt torque specification ....21.0 – 25.0 Nm

4 Road test the vehicle and check for correct operation.

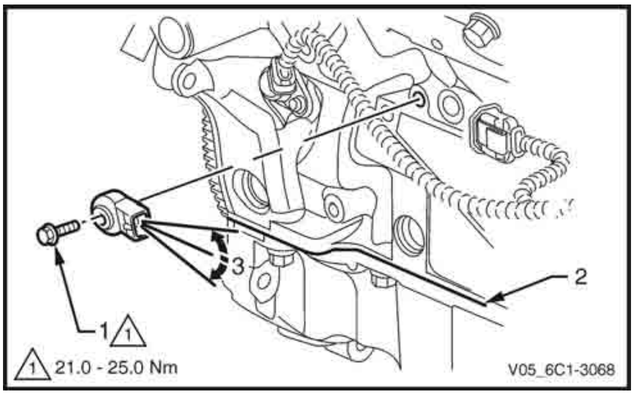


Figure 6C1-3 – 61

2.20 Mass Air Flow Sensor

The intake air temperature (IAT) sensor is part of the mass air flow (MAF) Sensor. For the IAT sensor test procedure refer to 2.17 Intake Air Temperature Sensor.

Handling Precautions

WARNING

Under no circumstances should the MAF sensor retaining screws (1) be loosened or removed as the MAF will become unserviceable and will require replacement.

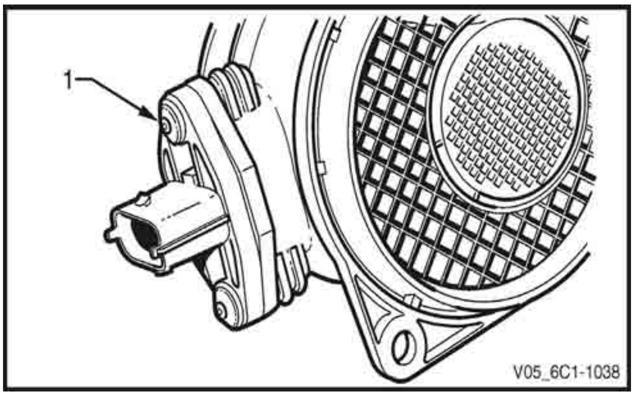
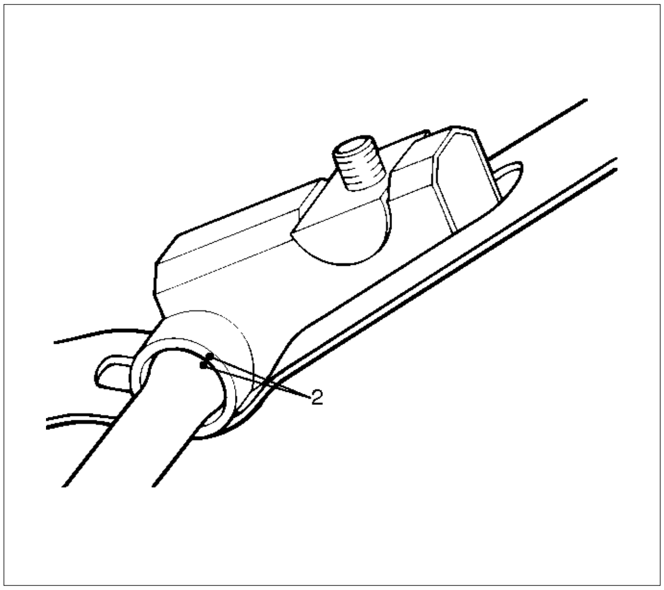


Figure 6C1-3 – 62

Remove

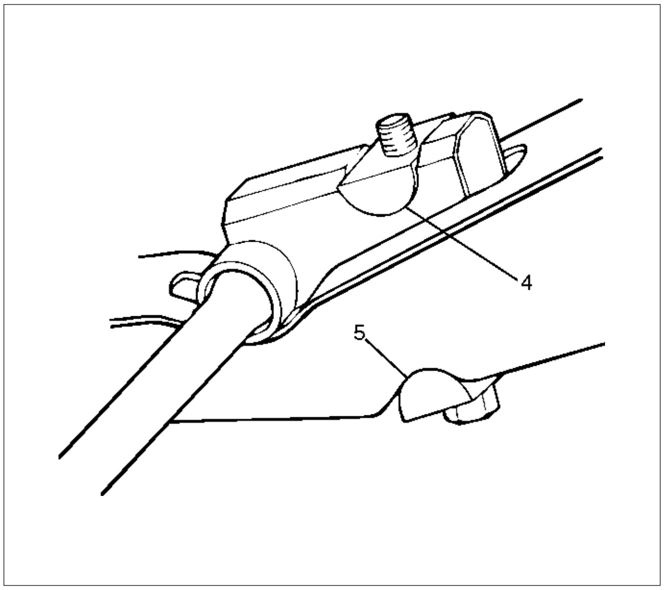
1 Turn the ignition switch off.

2. Apply grease to the portion that fits into the bracket then install height control arm and align the setting marks (2).



410RS005

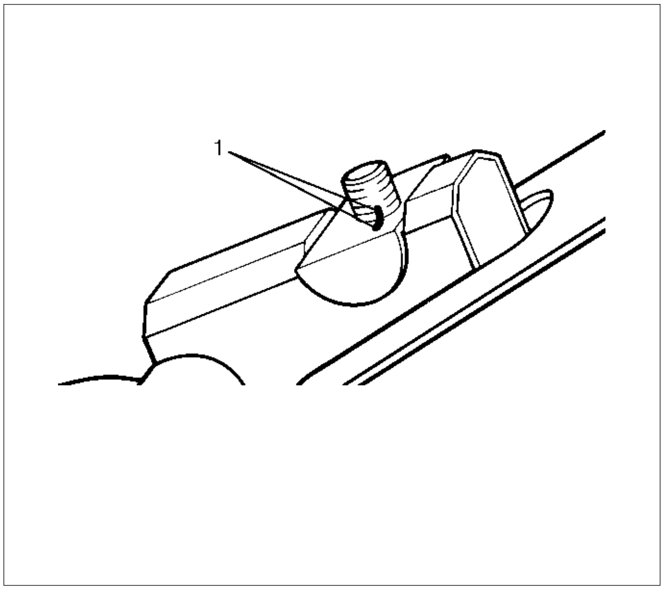
3. Apply grease to the bolt portion of the end piece (4). Apply grease to the portion of the seat (5) that fits into the bracket.



410RS008

4. Apply grease to the serrated portions.
5. Install adjust bolt and seat, then turn the adjust bolt to the setting mark (1) applied during disassembly.

NOTE: Adjust the trim height. Refer to Front End Alignment Inspection and Adjustment in Steering section.



410RS004

2 Disconnect the wiring harness connector (1) from the MAF sensor.

3 Remove the air intake duct, refer to 2.16 Intake Air Duct Assembly.

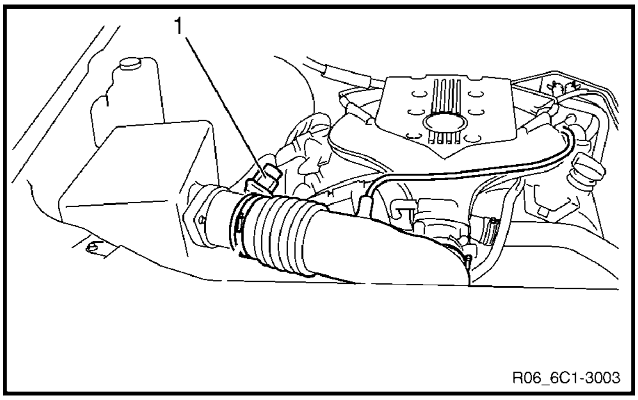


Figure 6C1-3 – 63

5 Remove the nut (1), two places, attaching the MAF sensor (2) to the upper air cleaner housing (3).

6 Position the flexible air intake duct away from the MAF sensor and remove the MAF sensor.

NOTE

The MAF sensor seal (4) is part of the air cleaner upper housing and is not serviced as a separate item.

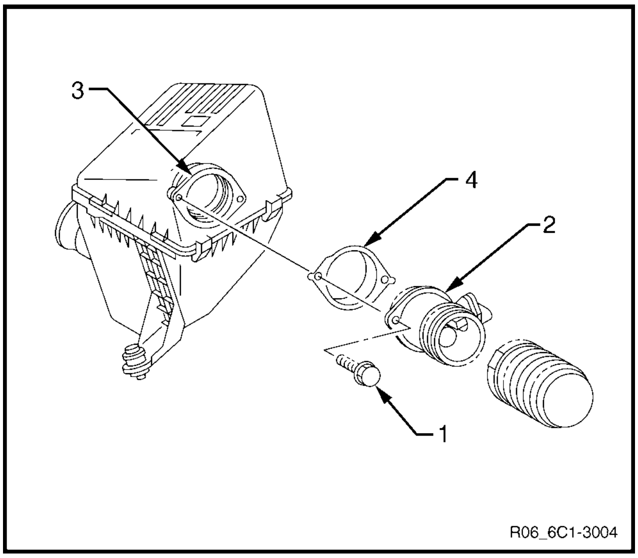


Figure 6C1-3 – 64

Reinstall

Reinstallation of the mass air flow (MAF) sensor is the reverse of the removal procedure, noting the following:

WARNING

Care must be taken not to over tighten the MAF sensor attaching nuts. Over tightening the nuts may cause damage to the MAF sensor seal and allow unfiltered air to enter the air intake system.

1 Tighten the MAF sensor nuts to the correct torque specification.

Mass air flow sensor attaching nut torque specification ....1.8 – 2.2 Nm

2 Tighten the air intake duct retaining clamp screw to the correct torque specification.

Air intake duct retaining clamp torque specification ....1.8 – 2.5 Nm

3 Start the engine and check for any air leaks between the air intake duct, the MAF and the upper air cleaner housing.

4 Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

2.21 Schrader Valve – Fuel Pressure Gauge Connection Point

CAUTION

If the Schrader valve is to be removed but not replaced immediately, it is advisable to disconnect the battery to avoid possible fuel discharge if an accidental attempt is made to start the engine.

Disconnection of the battery affects vehicle electronic systems. Refer to 6D1-3 Battery – V6 before disconnecting the battery.

Remove

1 Depressurise the fuel system, refer to 6C Fuel System - V6.

2 Turn the ignition off.

CAUTION

A small amount of fuel may be released when servicing the fuel pressure test point. To reduce the chance of personal injury, cover the fuel pressure test point with a shop towel to absorb any fuel spillage when the Schrader valve sealing cap and Schrader valve are removed. After the procedure, place the towel in an approved container for disposal.

3 Remove the Schrader valve sealing cap (1).

4 Remove the Schrader valve (2) using a standard valve core removal tool.

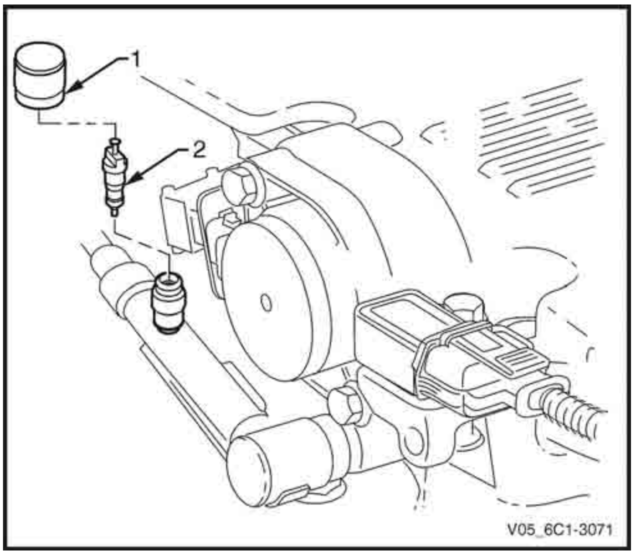


Figure 6C1-3 – 65

Reinstall

Reinstallation of the Schrader valve is the reverse of the removal procedure, noting the following:

1 Inspect the fuel rail and quick connect fitting for leaks, refer to 6C Fuel System - V6.

2 Road test the vehicle and check for correct operation.

2.22 Spark Plugs

Service Precautions

1 Allow the engine to cool (to at least 50°C) before attempting to remove spark plugs. Attempting to remove spark plugs from a hot engine may cause the plug / cylinder head threads to bind, resulting in tearing of the alloy cylinder head threads.

2 Clean the spark plug recess area before removing any spark plug. Failure to do so could result in engine damage because of dirt or other foreign material entering the cylinder head or by the contamination of the cylinder head threads. The contaminated threads may then prevent the correct seating of the new or replaced plug. If required, use a thread chaser to clean the threads of any contamination where this is suspected.

3 Under no circumstances should the spark plug/s gap be adjusted. If the gap is not within specifications, replace the spark plug.

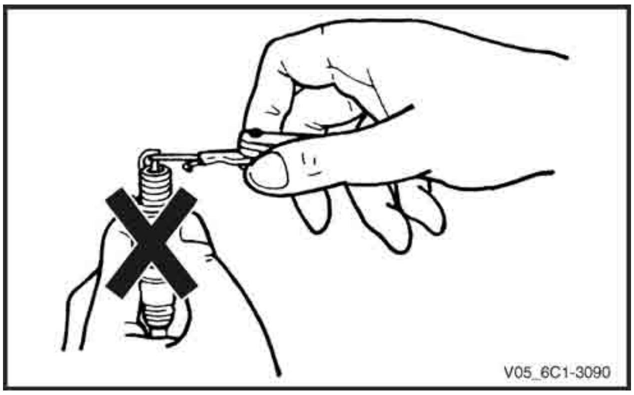


Figure 6C1-3 – 66

Remove

1 Turn the ignition switch off.

2 Remove the ignition coil/s, refer to 2.15Ignition Coil.

3 Using a suitable spark plug socket, loosen the spark plug slightly and then re-tighten to break away any carbon deposits on the threads.

WARNING

Wear eye protection to avoid injury.

4 Loosen the spark plug once again one or two turns, then use compressed air to remove any foreign material that may otherwise enter the combustion chamber.

5 Remove the spark plug (1).

6 Repeat as required for the remaining spark plugs.

NOTE

Place each spark plug in the same order as that of removal. This will enable any abnormal spark plug condition to be identified with the cylinder.

NOTE

If the spark plugs are removed for an indefinite period before installation, plug the spark plug openings to prevent foreign particle ingress.

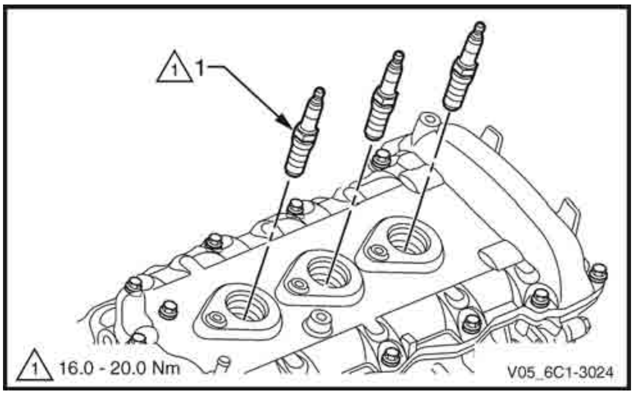


Figure 6C1-3 – 67

7 Repeat steps 2 to 5 for the remaining spark plugs as required.

Inspect

The spark plugs must not be re-gapped. If the gap of a spark plug is outside the specified range, replace the spark plug. In addition, replace spark plugs that shows excessive dirt deposit or broken insulators.

1 Replace any plug that has cracked and / or broken insulation or loose electrodes.

2 Inspect the spark plugs for defects. Refer to Analysis of Spark Plug Condition in this Section for identification of the condition of spark plugs.

3 Ensure the threads are clean and in good order.

4 Use a round wire feeler gauge to check the spark plug gap. If the gap is not within specifications, replace the spark plug.

Spark plug gap	1.1 – 1.2 mm

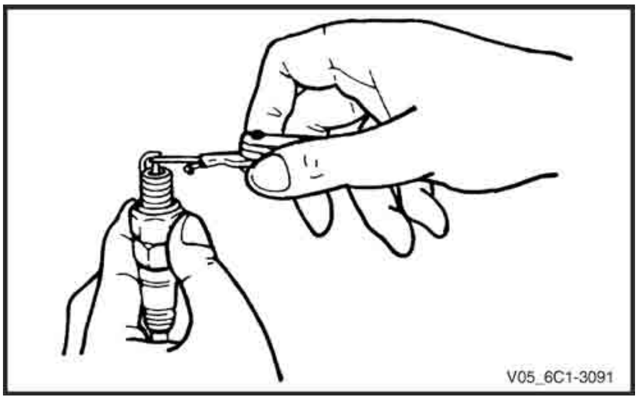


Figure 6C1-3 – 68

Spark Plug Inspection

Poor Spark Plug Performance

A spark plug can perform poorly due to wear, dirt, carbon fouling, excessive electrode wear, a broken insulator or excessive gap.

Worn or Dirty Plugs

Worn or dirty plugs can give satisfactory operation while the vehicle is idling, but break down under load.

This can cause:

- poor fuel economy,
- power loss,
- acceleration loss,
- difficult starting, or
- poor engine performance.

Carbon Fouling

Carbon fouling is indicated by black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs. In these circumstances, the optimum engine operating temperature is seldom reached.

Fouling can also be caused by:

- worn piston rings,
- faulty ignition,
- rich fuel mixture, or
- spark plugs that are rated too cold.

Excessive Electrode Wear

This often indicates:

- the engine is operating at high speeds,
- the engine is operating at levels that are consistently greater than normal,
- a plug that is rated too hot,
- excessively lean fuel mixture, or

- plug/s overheating due to insufficient tightening (caused by combustion gases leaking past the threads).

Broken Insulator

Broken insulators are usually the result of improper installation or carelessness.

Breaks in the upper insulator can result from a poor fitting spark plug socket or impact. The cracked insulator may not show up until oil or moisture penetrates the crack. The crack is often just below the crimped part of the shell and may not be visible.

Breaks in the lower insulator often result from careless re-gapping and are usually visible.

This can also result from the plug operating too hot. For example, in periods of high speed operation or under heavy loads.

Analysis of Spark Plug Condition

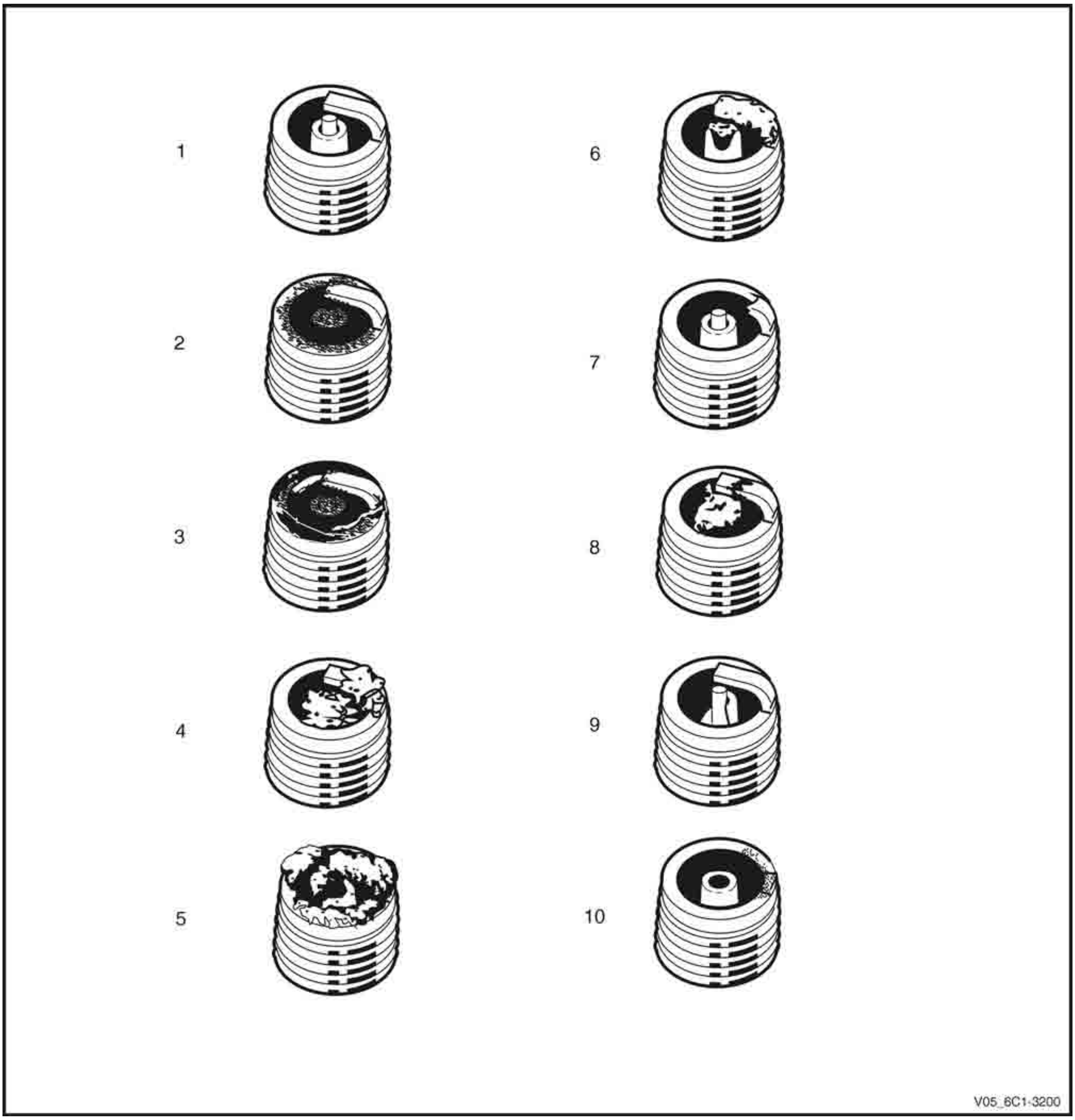


Figure 6C1-3 – 69

Legend

1 Normal
2 Carbon Fouled
3 Oil Fouled
4 Deposit Fouling A
5 Deposit Fouling B
6 Deposit Fouling C
7 Detonation
8 Pre-ignition
9 Heat Shock Failure
10 Insufficient Installation Torque

Normal Operation (1)

Brown or greyish-tan deposits and slight electrode wear indicate correct spark plug heat range and mixed periods of high and low speed driving.

Carbon Fouled (2)

Dry, fluffy black carbon deposits possibly due to poor ignition output, a weak coil, excessive idling or slow speeds under light load. If spark plug temperatures remain too low for normal combustion, the deposits are not burned off.

Oil Fouled (3)

Wet, oily deposits with minor electrode wear possibly due to oil leaking past worn piston rings.

Breaking in a new or recently overhauled engine before the rings are fully seated may also result in this condition.

Deposit Fouling A (4)

Red brown, yellow and white coloured coatings on the insulator tip which are by-products of combustion. They come from fuel and lubricating oil which generally contain additives. Most powdery deposits have no adverse effect on spark plug operation, however, they may cause intermittent missing under severe operating conditions.

Deposit Fouling B (5)

Deposits similar to those identified in deposit fouling A (4). These are also by-products of combustion from fuel and lubricating oil. Excessive valve stem clearances and / or defective intake valve seals allow too much oil to enter the combustion chamber. The deposits will accumulate on the portion of the spark plug that projects into the chamber and will be heaviest on the side facing the intake valve. If this condition is only detected in one or two cylinders, check the valve stem seals.

Deposit Fouling C (6)

Most powdery deposits identified in deposit fouling A (4) have no adverse effect on the operation of the spark plug as long as they remain powdery.

Under certain conditions of operation however, these deposits melt and form a shiny glaze coating on the insulator. When hot, this acts as a good electrical conductor allowing the current to flow along the deposit instead of sparking across the gap.

Detonation (7)

Commonly referred to as engine knock or pinging, detonation causes severe shocks inside the combustion chamber causing damage to parts.

Pre-ignition (8)

Burnt or blistered insulator tip and badly eroded electrodes probably due to the excessive heat.

This is often caused by a cooling system blockage, sticking valves, improperly installed spark plugs or plugs that are the wrong heat rating (too hot).

Sustained high speed with a heavy load can produce temperatures high enough to cause pre-ignition.

Heat Shock Failure (9)

A rapid increase in spark plug tip temperature under severe operating conditions can cause heat shock and result in fractured insulators. This is a common cause of broken and cracked insulator tips.

Insufficient Installation Torque (10)

Poor contact between the spark plug and the cylinder head seat.

The lack of proper heat transfer that results from poor seat contact causes overheating of the spark plug. In many cases, severe damage occurs. Dirty threads in the cylinder head can cause the plug to seize before it is seated.

Ensure the cylinder head and spark plug threads are free of deposits, burrs and scale before installation.

Reinstall

Reinstallation of the spark plug is the reverse of the removal procedure, noting the following:

CAUTION

- **Discard the spark plug if it has been dropped.**
- **Do not use anti-seize compound or similar lubricant on the spark plug threads.**

1 Using a suitably sized rubber tube attached to the spark plug terminal post, hand start each spark plug into the cylinder head thread.

CAUTION

Failure to tighten a spark plug to the correct torque specification may result in premature spark plug failure, and / or engine damage.

2 Tighten the spark plug/s to the correct torque specification.

Spark plug torque specification...............16.0 – 20.0 Nm

3 Road test the vehicle and check for correct operation.

2.23 Throttle Body Assembly

Handling Precautions

CAUTION

Under no circumstances should the clip (1), six places, retaining the cover plate (2) to the throttle body be removed. If the cover is removed, the vacuum seal between the cover plate and the throttle body will be broken. This will allow the ingress of foreign particles and / or moisture and render the throttle body unserviceable

The throttle body must not be subjected to any form of shock such as dropping it. If the throttle body is subjected to shock, damage may result to the fragile motor magnets within the throttle body.

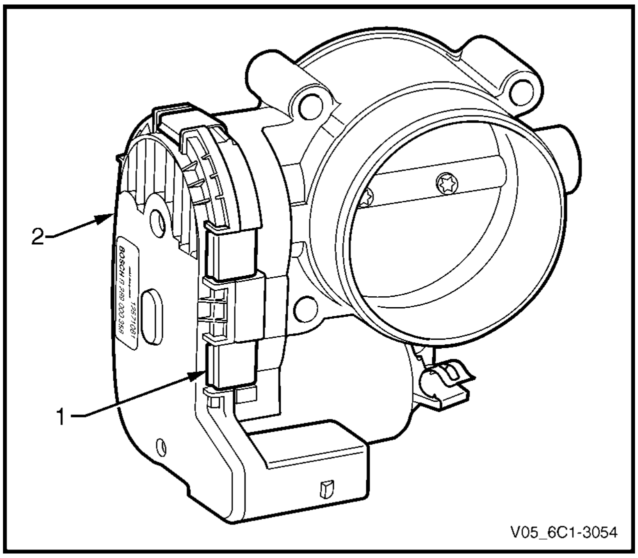


Figure 6C1-3 – 70

Remove

1 Turn the ignition switch off.

2 Loosen the air intake duct to throttle body assembly retaining clamp (1).

3 Pull the air intake duct (2) away from the throttle body assembly.

NOTE

If difficulty is experienced in removing the air intake duct from the throttle body, completely remove the air intake duct assembly, refer to 2.16 Intake Air Duct Assembly.

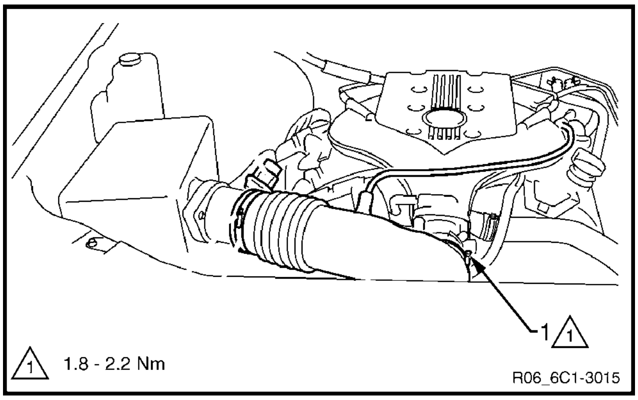


Figure 6C1-3 – 71

4 Unclip the wiring harness from the retaining clip (1).

CAUTION

Do not use any mechanical device such as a screwdriver to disengage the harness connector (2) from the throttle body.

5 Disconnect the wiring harness connector by:

NOTE

When sliding the connector lock, take care not to disengage it from the connector.

- Sliding the connector lock (3) in the direction of the arrow, then
- press the connector latch in the direction of the arrow (4), and remove the connector from the throttle body.

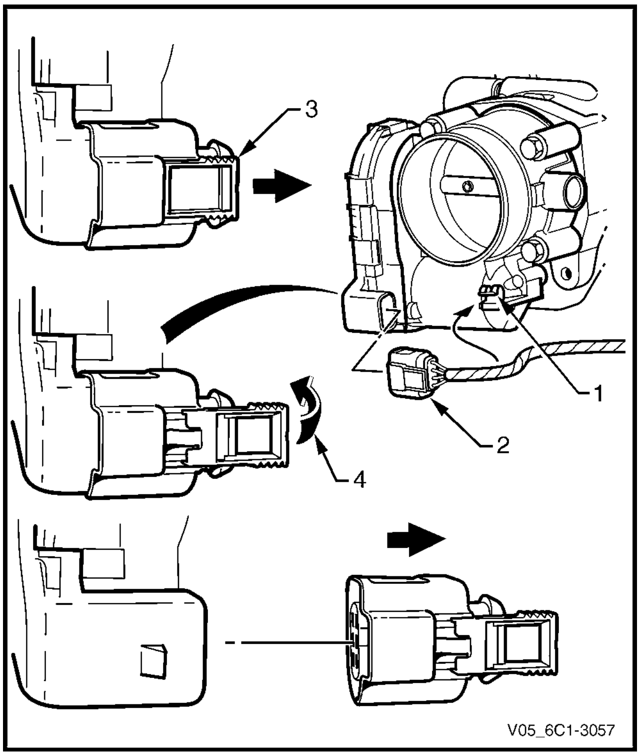


Figure 6C1-3 – 72

6 Remove the four bolts (1), attaching the throttle body (2) to the upper intake manifold (3).

7 Remove the throttle body and gasket (4).

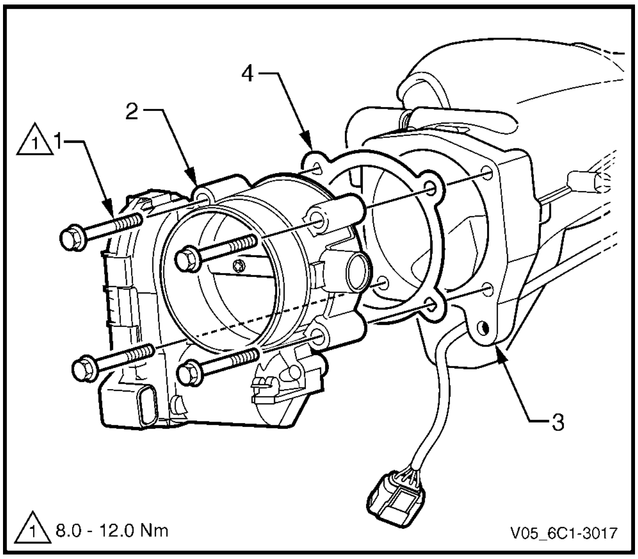


Figure 6C1-3 – 73

Inspect

The following throttle body inspection procedure may be carried out with the throttle body installed on the vehicle. Prior to performing a throttle body on-vehicle inspection:

- Turn the ignition switch off.
- Disconnect the throttle body wiring harness connector. Refer to Remove in this Section.
- Remove the air intake duct, refer to 2.16 Intake Air Duct Assembly.

WARNING

To avoid serious personal injury, never attempt to rotate the throttle plate manually whilst the throttle body harness connector is connected to the throttle body.

1 Fully open the throttle plate by hand and inspect the throttle body bore and throttle plate for any deposits.

CAUTION

When cleaning / inspecting the throttle body:

- **Do not subject the throttle body assembly to an immersion cleaner or a strong solvent. Damage to the throttle position sensor and / or sealed throttle shaft bearings will result.**
- **Never use a wire brush or scraper to clean the throttle body. A wire brush or sharp tool may damage the throttle body components.**

2 Use a clean shop towel and a spray type hydro-carbon cleaner to clean the throttle body bore and throttle plate. If necessary, use a parts cleaning brush to remove heavy deposits.

3 Inspect the throttle body for a binding throttle plate by fully opening and closing the throttle plate by hand. It should open and close smoothly.

4 Inspect the throttle body for a bent or damaged throttle plate, cracks, corrosion, or distortion in the throttle body housing.

NOTE

The throttle body contains no serviceable parts and should not be disassembled. If the throttle body is damaged it must be replaced as an assembly.

5 If the throttle body is affected by any of the above conditions, it must be replaced.

6 If an on-vehicle throttle body inspection was performed, perform the following:

- Reinstall the air intake duct, refer to 2.16 Intake Air Duct Assembly.
- Reconnect the throttle body wiring harness connector, refer to Reinstall in this Section.
- Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

Reinstall

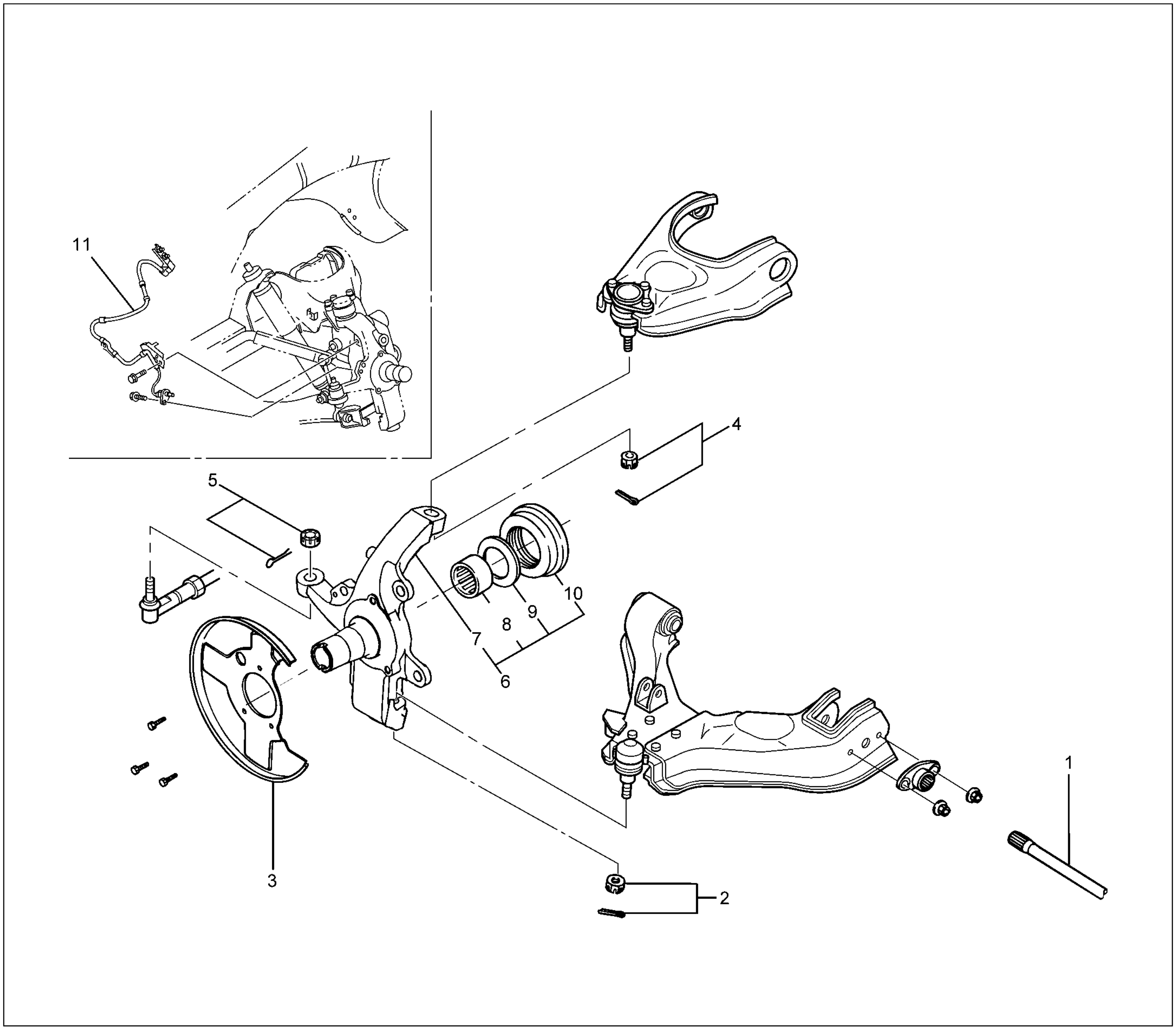
Reinstallation of the throttle body assembly is the reverse of the removal procedure, noting the following:

1 Ensure the throttle body and upper intake manifold mating surfaces are clean and free of foreign material.

2 Install a new throttle body to upper intake manifold gasket.

Knuckle

Knuckle and Associated Parts



RUW63CLF000101

Legend

(1) Torsion Bar
(2) Nut and Cotter Pin, Lower Ball Joint
(3) Back Plate
(4) Nut and Cotter Pin, Upper Ball Joint
(5) Nut and Cotter Pin, Tie-rod End
(6) Knuckle Assembly
(7) Knuckle
(8) Needle Bearing (4×4 Model Only)
(9) Thrust Washer (4×4 Model Only)
(10) Oil Seal (4×4 Model Only)
(11) Speed Sensor harness

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the brake caliper. Refer to Disc Brakes in Brake section.

3 Reinstall the throttle body bolts and tighten to the correct torque specification.

Throttle body assembly attaching bolt torque specification ....8.0 – 12.0 Nm

CAUTION

After reinstalling the wiring harness connector, ensure the connector latch (1) and connector lock (2) have fully engaged.

4 Reinstall the wiring harness connector to the throttle body, ensuring the connector latch and connector slide have fully engaged.

5 Ensure the wiring harness is correctly routed and attached securely in the throttle body harness retaining clip (3).

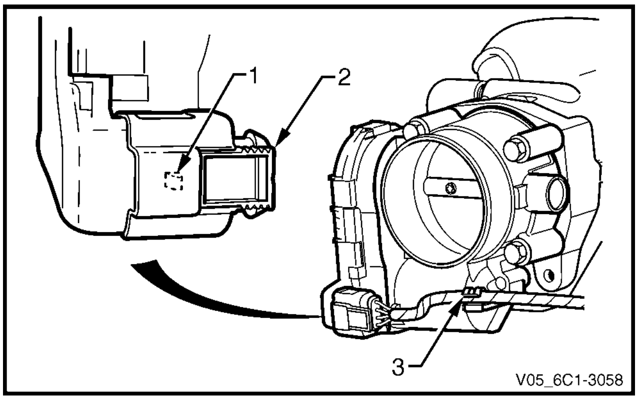


Figure 6C1-3 – 74

6 Road test the vehicle and check for correct operation, taking particular note that no air leaks are evident.

3 Specifications

Accelerator Pedal Position Sensor 1

Type .... Three wire potentiometer
Accelerator pedal at rest .... Less than 1.25 V
Accelerator pedal fully depressed .... 5.0 V maximum

Accelerator Pedal Position Sensor 2

Type .... Three wire potentiometer
Accelerator pedal at rest .... Less than 1.25 V
Accelerator pedal fully depressed .... 5.0 V maximum

Camshaft Position (CMP) Sensor

Type .... Hall effect, interrupted ring triggered
Air gap .... 0.1 – 1.8 mm
Air gap adjustment .... No adjustment

Crankshaft Position (CKP) Sensor

Type .... Inductive magnetic type
Coil resistance @ 20°C .... 850 – 1040 Ω
Air gap .... 0.1 – 1.5 mm
Air gap adjustment .... No adjustment

Engine Coolant Temperature Sensor

Type .... Negative temperature
.... coefficient thermistor

Engine Coolant Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
-40	40490 – 50136
-20	14096 – 16827
-10	8642 – 10152
0	5466 – 6326
20	2351 – 2649
25	1941 – 2173
40	1118 – 1231
60	573 – 618
80	313 – 332
100	182 – 191
120	109 – 116
140	68 – 74

Engine Oil Level and Temperature Sensor

Level sensor type.......................................Magnetic reed switch
Temperature sensor type..........................Negative temperature
.... coefficient thermistor

Engine Oil Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
0	7570 – 8000
20	2351 – 2649
30	2225 – 2375
40	1118 – 1231
50	1050 – 1150
80	380 – 470
100	270 – 290

Evaporative Emission (EVAP) Canister Purge Valve

Type.. Solenoid
Resistance @ 20°C...24 – 28 Ω
Operating voltage... 12.0 – 16.0 V

Engine Firing Order 1, 2, 3, 4, 5, 6

Fuel Injector

Type.. Solenoid
Fuel Injector Resistance @ 20°C..........................11.4 – 12.6 Ω

Heated Oxygen Sensor (HO2S) – Four wire

Type...Four wire, planar sensor
Operating range (greater than 360°C) .... 10 – 1000 mV
Closed loop operating range................................. 300 – 600 mV
Heater resistance @ 20°C ....8.0 – 10.0 Ω

Heated Oxygen Sensor (HO2S) – Six Wire

Type....................................Six wire, wide band planar sensor
Heater resistance @ 20°C ....8.0 – 10.0 Ω

Intake Air Temperature (IAT) Sensor

Type...Negative temperature
.... Coefficient thermistor

Intake Air Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
-40	35140 – 43760
-20	12660 – 15120
-10	7943 – 9307
0	5119 – 5892
20	2290 – 2551
25	1900 –2100
40	1096 –1238
60	565 – 654
80	312 – 370
100	184 – 222
120	114 –141

Intake Air Temperature Vs Resistance	
Temperature °C	**Resistance – Ohms (Ω)**
140	74 –93

Knock Sensor

Type .... Piezo ceramic element

Mass Air Flow Sensor

Type ....Hot film air-mass sensor

Spark Plug

Type ....J gap
Gap .... 1.1 – 1.2 mm
Adjustment .... No adjustment

Throttle Position Sensor 1

Type ....Three wire potentiometer
Closed throttle.. Less than 1.25 V
Wide open throttle..5.0 V maximum

Throttle Position Sensor 2

Type ....Three wire potentiometer
Closed throttle.. Less than 1.25 V
Wide open throttle..5.0 V maximum

4 Assembly Lubricants

Camshaft Position (CMP) Sensor O-ring .... Engine Oil

Crankshaft Position (CKP) Sensor .... Engine Oil

Evaporative Emission (EVAP) Canister Purge Valve
Quick Connect Fitting .... Engine Oil

Fuel Feed Hose Quick Connect Fitting... Engine Oil

Fuel Injector Seals... Engine Oil

Heated Oxygen Sensor (HO2S) – All .... Anti-seize Compound

Ignition Coil Boot .... Talcum Powder

Ignition Coil Sealing Rubber .... Engine Oil

5 Torque Specifications

Fuel Rail Attaching Bolt ....8.0 – 12.0 Nm

Accelerator Pedal Position Sensor Support Bracket
Attaching Nut...8.5 – 11.5 Nm

Air Cleaner Lower Housing Attaching Bolt................................18.0 – 22.0 Nm

Barometric Pressure Sensor Attaching Bolt ....8.0 – 12.0 Nm

Camshaft Position Sensor Attaching Bolt..................................8.0 – 12.0 Nm

Crankshaft Position Sensor Attaching Bolt.................................8.0 – 12.0 Nm

Engine Coolant Temperature Sensor ....22.0 Nm

Engine Control Module Attaching Bolt..8.0 – 12.0 Nm

Ground Terminal Attaching Screw..4.5 Nm

Engine Control Module Bracket Assembly
Attaching bolt (6mm Bolt) ....8.0 – 12.0 Nm

Engine Control Module Bracket Assembly
Attaching bolt (8mm Bolt) ....20.0 – 25.0 Nm

Engine Oil Pressure Sensor ....12.0 – 14.0 Nm

Heated Oxygen Sensor ....40.0 – 50.0 Nm

Ignition Coil Attaching Bolt...7.0 – 11.0 Nm

Air Intake Duct Retaining Clamp ....1.5 – 2.5 Nm

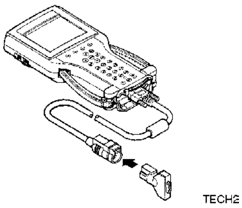
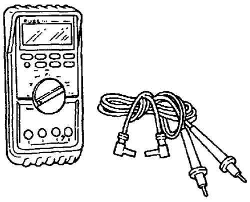
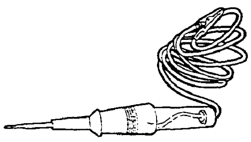
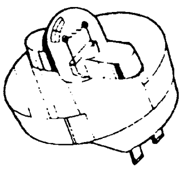
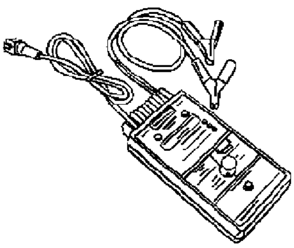
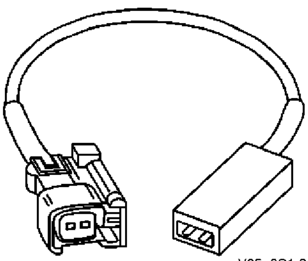
Knock Sensor Attaching Bolt ....21.0 – 25.0 Nm

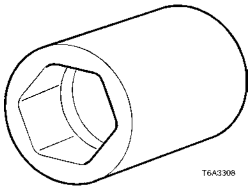
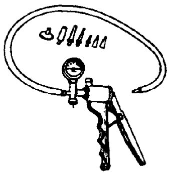
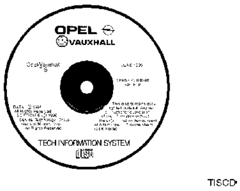
Mass Air Flow Sensor Attaching Nut ....1.8 – 2.2 Nm

Spark Plug...16.0 – 20.0 Nm

Throttle Body Assembly Attaching Bolt.......................................8.0 – 12.0 Nm

6 Special Tools

Tool Number	Illustration	Description	Tool Classification
7000086i		**Tech 2 scan tool** Used for diagnosis of vehicle electrical systems. Previously released.	Mandatory
3588		**Digital Multimeter** Previously released as j 39200, 3545 GM.	Available
J 35616		**Connector Test Adaptor Kit** Used when carrying out electrical diagnostic circuit checks. Previously released.	Desirable
J 34142-a		**Un-powered Test Lamp** Previously released as CT-40-C and also commercially available. Must have a current draw less than 0.3 A.	Mandatory
J 34730-2C		**Injector Test Light** Used to check for power and the control circuit of the fuel injector, for proper operation. Also previously released as ST- 8329	Mandatory
J 39021		**Fuel Injector Coil / Balance Tester** Used in conjunction with a DMM for testing the fuel injector coil windings and for injector balance testing. Previously released	Mandatory
J 44602		**Injector Test Adapter**	Mandatory

J 41712		**Oil Pressure Sensor Socket** Used in conjunction with 3/8" drive socket equipment to remove / reinstall oil pressure sensor. Previously released	Desirable
J 23738-A		**Vacuum Pump (20 in. Hg Minimum)** Used for many applications where a controlled vacuum is required to be applied. Previously released and also commercially available	Mandatory
N/A		**Technical Information System (TIS) CD ROM** Available to Authorised Dealers.	Mandatory

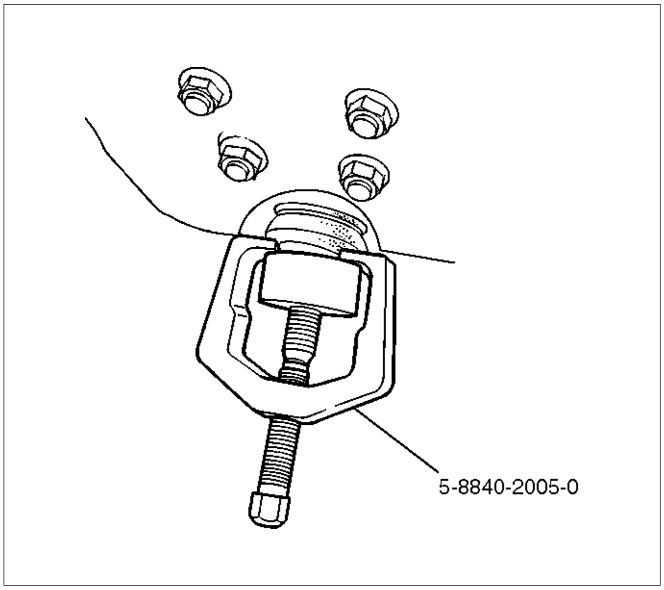
6D1-1
Charging System – V6

ATTENTION

Before performing any service operations or other procedure described in this Section, refer to 1.2 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and / or property damage.

4. Remove the hub assembly. Refer to Front Hub and Disk in this section.
5. Remove tie-rod end from the knuckle. Refer to Power Steering Unit in Steering section.
6. Remove the speed sensor from the knuckle.
7. Loosen torsion bar by height control arm adjust bolt, and then remove torsion bar. Refer to Torsion Bar in this section.
8. Remove speed sensor harness.
9. Remove back plate.
10. Remove lower ball joint by using remover 5-8840-2005-0.

CAUTION: Be careful not to damage the ball joint boot.



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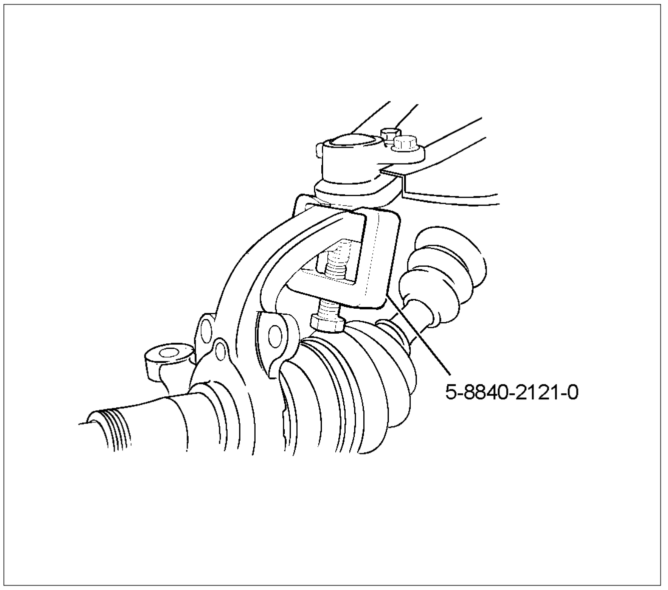
11. Remove upper ball joint by using remover 5-8840-2121-0.

CAUTION: Be careful not to damage the ball joint boot.



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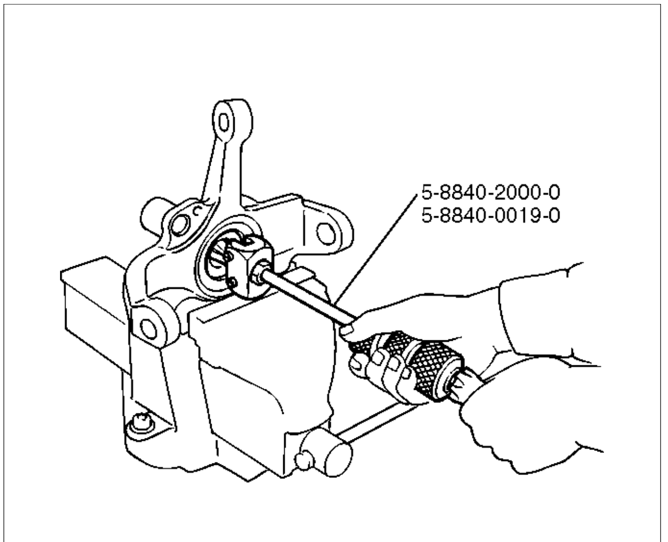
12. Remove knuckle assembly.
13. Remove oil seal. If replacement required. (4×4 Model Only)
14. Remove washer. If replacement required. (4×4 Model Only)
15. Remove needle bearing by using remover 5-8840-2000-0 and sliding hammer 5-8840-0019-0. If replacement required. (4×4 Model Only)



(4×4 Model Only)

RTW340SH00401

1 General Information

1.1 Components

Generator

The Mitsubishi generator can be identified visually by its two lower and one upper mounting lugs.

It is mounted to the lower right-hand side of the engine block. It is driven by the same drive belt that drives other engine ancillaries and requires no periodic drive belt adjustment.

The generator has three phases, incorporating a rotor with six pole pairs fitted and two internal cooling fans; one on the drive-end and one on the slip-ring end. The rotor is supported by ball bearings in both the drive and slip-ring end housings. Surrounding the rotor is a stator, which has a three phase delta connected output winding construction on a ring shaped lamination pack.

The output of the stator winding is rectified by eight diodes that are contained within the slip-ring end housing. Excitation current is supplied to the rotor field coil via the voltage regulator, the brushes and slip-rings. The electronic voltage regulator requires no adjustment in service.

The generator has four external connections (refer to Figure 6D1-1 1):

- Generator – Terminal P-9 to the battery positive terminal P-1 via fuse SBF1,
- Generator – E-4 pin 1 to the ECM connection E-60 pin 43 – regulator monitoring,
- Generator – E-4 pin 2 to the ECM connection E60 pin 21 – battery voltage sensing, and
- ground connection via the installation bolts.

Generator Types

The vehicle is fitted with a 120 amp generator.

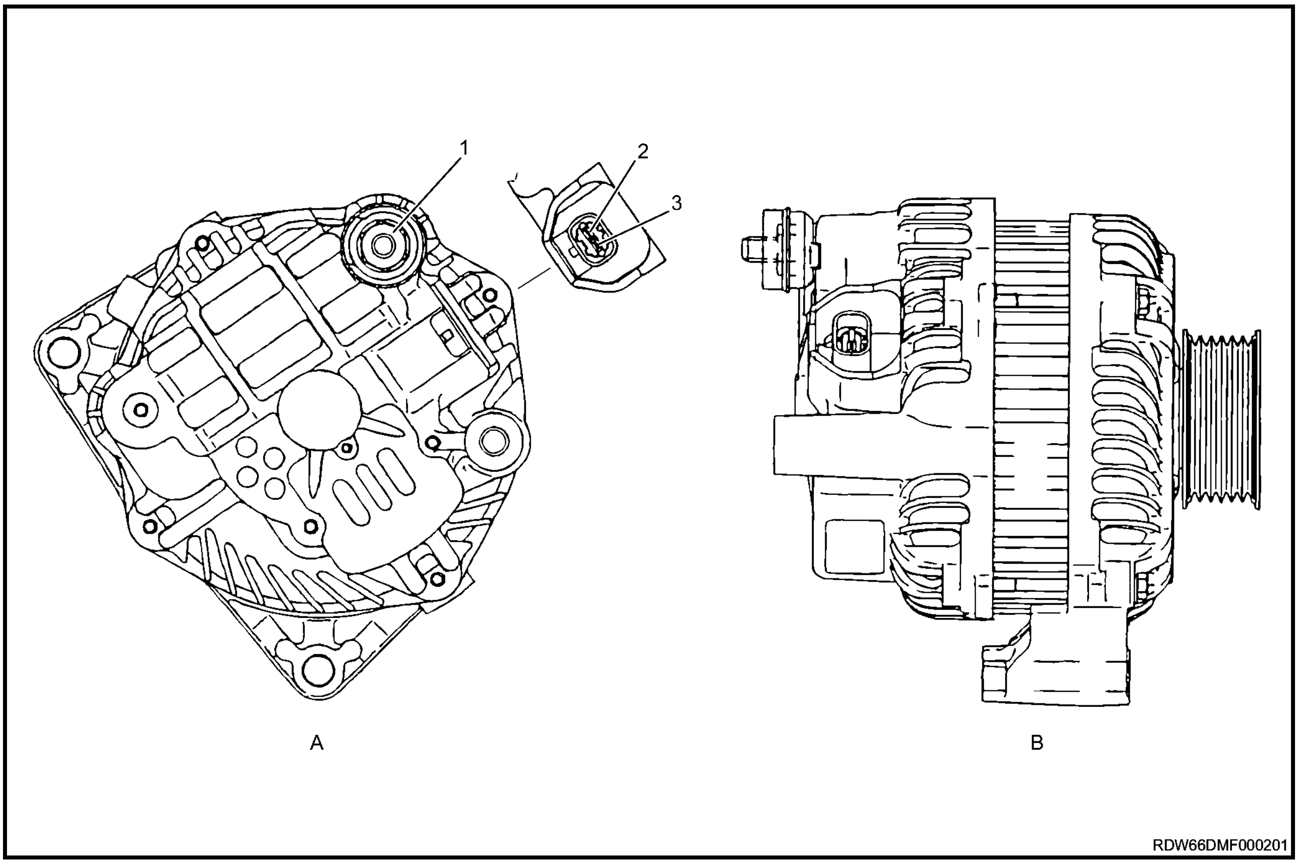


Figure 6D1-1 1

Legend

A	Rear View of Generator	1	Generator –Terminal P-9
B	Side View of Generator	2	Generator – E-4 pin 2
		3	Generator – E-4 pin 1

Voltage Regulator

The electronic voltage regulator requires no adjustment in service.

1.2 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,

- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.3 System Operation

Operation

With the ignition switch in the ON position and the engine at rest, current is supplied via the regulator to generator connector E-4 pin 1 and to the engine control module ECM connector E-60 pin 43. This initiates current flow (within the regulator) from the generator connection P-9, to the brushes and rotor winding, to ‘excite’ the circuit.

The current in the rotor winding creates magnetic fields between adjacent rotor poles.

With the engine running, the rotor spins, the stator windings cut through this field and induce voltage. As the engine speed is increased, this induced voltage increases. Current then flows through the three-phase diode bridge in the rectifier to convert the AC voltage to DC. This is supplied to the generator connector P-9 output and then to the battery terminal via fuse SBF1.

The regulator monitors the voltage to the battery. When this voltage reaches approximately 14.5 V, the regulator opens the circuit through the rotor winding, causing the generator output voltage to drop. When the regulator senses a voltage below a preset voltage, the regulator closes the circuit through the rotor winding and voltage to the battery again increases. This cycle repeats very rapidly.

Alternator Warning

NOTE

All generator faults are displayed as Check Alternator Warning on the instrument cluster MFD, refer to 8A Electrical Body and Chassis.

The ECM monitors the voltage on connector E-60 pin 21 and pin 43.

The voltage at the generator connector E-4 pin 2 will remain low when a fault condition is detected in the generator or associated external circuits. The voltage remains low (while the ignition switch is on) until the fault is repaired.

NOTE

For more information on the alternator warning refer to 8A Electrical Body and Chassis.

Fault conditions include the following:

- open circuit or excessive voltage drop in circuit 1,
- open circuit in the generator phase connection,
- overcharging conditions,
- short circuit in the regulator output stage,
- open circuit in the rotor winding,
- poor contact between the rectifier and the regulator, and / or
- high resistance in the fusible link assembly.

2 Diagnosis

2.1 Diagnostic General Information

Basic Diagnostic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the generator diagnostic procedures could result in incorrect diagnostic results or damage to components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section:

- digital multimeter with 10 mega ohms impedance, and
- connector test adapter kit Tool No. KM609.

For further information on the use of these tools, refer to 8A Electrical Body and Chassis.

2.2 Tech 2 Data List

The Tech 2 displays the status of certain charging system parameters.

To view the data list:

1 Connect Tech 2 to the DLC.

2 On Tech 2 select:
Engine / **V6 Engine** / **Data Display** / **Data List** / **Electrical/Theft Data**.

Tech 2 Parameter	Units Displayed	Typical Display Values
Alternator L Terminal D	Percentage	Various

2.3 Diagnostic Systems Check

Step	Action	Yes	No
1	1 Connect Tech 2 to the DLC. 2 Ignition ON, engine OFF. 3 On Tech 2 select: **Engine** / **V6 Engine** / **Diagnostic Trouble codes** / **Read DTC's.** Are there any set DTC's?	Go to the appropriate DTC table in 6C1-2 Engine Management – V6 – Diagnostics.	Refer to 2.5 Charging System Inoperative / Malfunctioning

Reference to following information will assist when diagnosing charging circuit faults:

- for battery testing, refer to 6D1-3 Battery – V6,
- for wiring diagram details, refer to Figure 6D1-1 2, and
- for electrical component locations, refer to 8A Electrical Body and Chassis.

2.4 Wiring Diagram

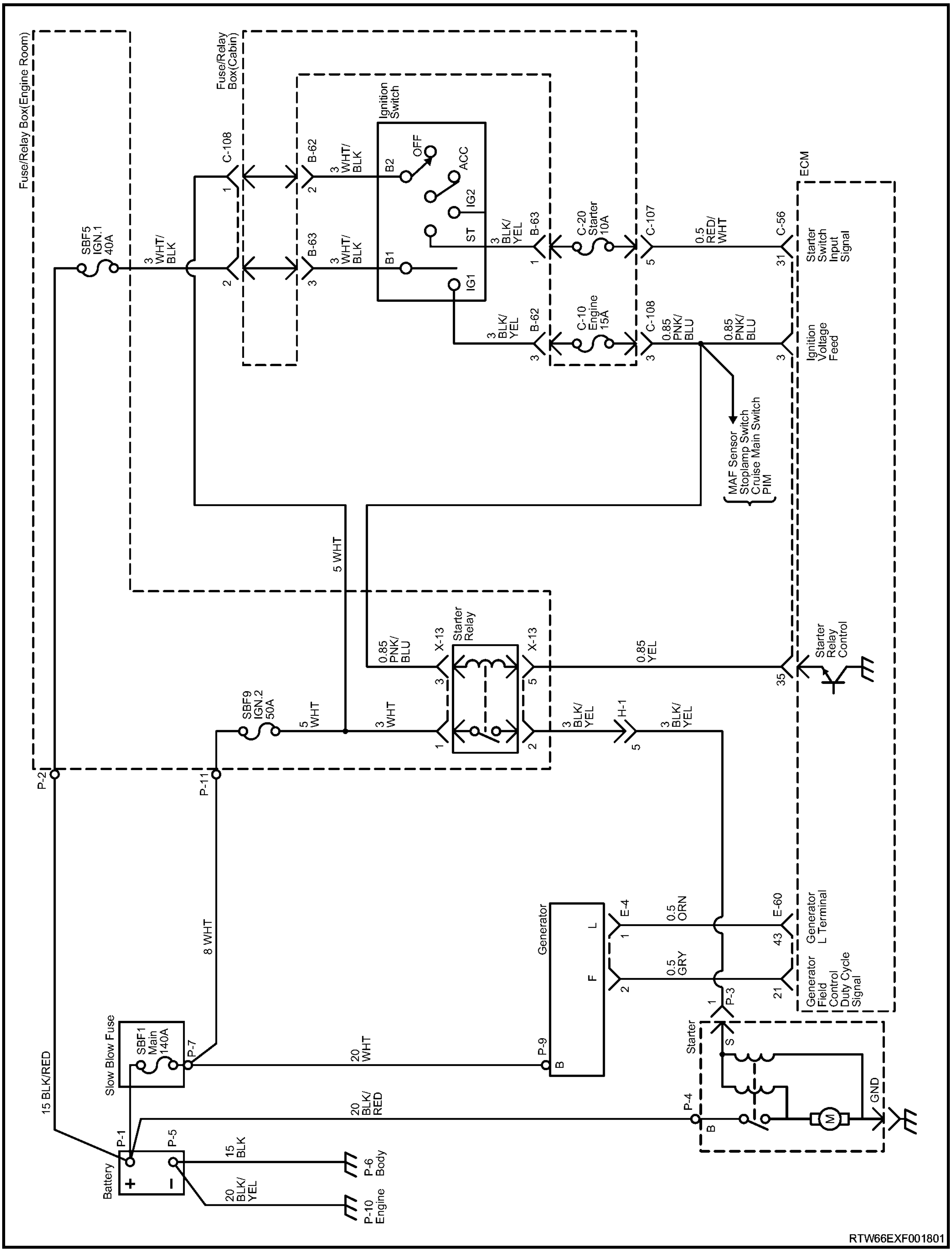


Figure 6D1-1 2

2.5 Charging System Inoperative / Malfunctioning

Diagnostic Table Notes

Reference to following information will assist when diagnosing charging system faults.

1 For all wiring harness fault diagnoses, refer to 8A Electrical Body and Chassis.

2 For wiring harness repairs, refer to 8A Electrical Body and Chassis.

3 Refer to 8A Electrical Body and Chassis for harness routing.

4 Ensure the battery, cables and connections are in good order. Refer to 6D1-3 Battery – V6.

Diagnostic Table 120A Generator

Step	Action	Yes	No
1	Did you review 1.3 System Operation?	Go to Step 2	Go to 1.3 System Operation
2	Did you read 2.3 Diagnostic Systems Check	Go to Step 3	Go to 2.3 Diagnostic Systems Check
3	Perform the Generator On-vehicle Checks Was the generator serviceable?	Go to step 4	Replace the generator. Go to Step 5
4	Perform the Charging Circuit Voltage Drop Test. Was the wiring serviceable?	Go to 8A Electrical Body and Chassis Go to Step 5	Repair as required (refer to Note 2). Go to Step 5
5	Operate the system to verify the repair. Did you correct the condition?	System OK	Go to Step 2
When all diagnosis and repairs are completed, check the system for correct operation.			

3 Minor Service Operations

3.1 Safety Precautions

Observe the following precautions. Failure to observe these precautions will result in serious damage to the generator.

- Only use the generator and voltage regulator in a negative ground system.
- Always refer to 1.2 WARNING, CAUTION and NOTES before disconnecting the battery.
- When installing a battery, fit the positive (+) cable to the battery before fitting the negative cable.
- When a slave battery is used for starting purposes, ensure that both batteries are connected in parallel. That is, positive terminals connected and negative terminals connected.
- Only use jumper leads that have surge protection.
- Disconnect both battery cables when charging the battery. This isolates the generator from the battery and from the external charging equipment.
- Do not operate the generator within an open circuit or without a battery in the circuit.
- Do not disconnect the battery while the generator is running.
- Do not attempt to polarise the generator.
- Do not connect generator connector E-4 pin 1 to 12 V (the battery or ignition circuits).
- Some battery powered timing lights can produce high transient voltages when connected or disconnected. Only disconnect or connect timing lights when the engine is switched off.

CAUTION

Ensure the generator connector E-4 pin 1 has a maximum sinking current of 50mA.

3.2 Maintenance

Regular Checks

Check the following at regular intervals:

- generator terminals – for corrosion and loose connections,
- wiring – for continuity and damaged insulation,
- mounting bolts – for tightness,
- drive belt – for alignment and wear, and
- drive pulley – for damage and warping.

NOTE

The drive-belt adjustment for the engine ancillaries (i.e. generator and water pump) is provided by a spring-loaded tensioner. Therefore, the drive belt does not require manual adjustment.

Lubrication

High tolerance bearings are used in this generator. If the bearings are removed during the generator disassembly, new bearings must be installed to restore the generator to original specification. The ball bearings supporting the rotor shaft are pre-lubricated and sealed. Do not attempt to lubricate these during servicing.

3.3 On-vehicle Testing

Generator On-vehicle Checks

Prerequisites

Before testing the generator output, ensure that:

- all generator circuit connections are clean and tight,
- the generator is always connected to the battery during testing (to prevent damage to the diodes),
- the battery is fully charged, and
- the specific gravity does not vary more than 0.025 between cells. (It is recommended the average specific gravity is 1.260 or higher). Refer to 6D1-3 Battery – V6.

Carry out a load test on the battery to determine its ability to supply and accept current. This is a good indicator of the general condition of the battery. For details of battery testing, refer to 6D1-3 Battery – V6.

Inspect the drive belt and tensioner markings to determine if the drive belt is within operating limits. Replace the belt if it is excessively worn or outside the operating range of the tensioner.

For further details, refer to 6A1 Engine Mechanical – V6.

Generator Test

Regulating Voltage Test

NOTE

Leave the generator E-4 wiring harness connector connected, as it provides initial field excitation.

1 Ensure the ignition switch is in the OFF position and all electrical equipment is turned off.

CAUTION

Refer to 1.2 WARNING, CAUTION and NOTES before disconnecting the battery.

2 Disconnect the battery ground cable P-5 at the battery.

3 Disconnect the generator positive lead P-9 from the generator . Connect the positive lead of a multimeter set to measure current (1) to P-9 (2).

4 Connect that multimeter's negative lead to the disconnected generator positive lead (3).

5 Connect the positive lead of a multimeter set to measure voltage (4) to P-9 (5).

6 Connect that multimeter's negative lead to a good ground connection on the generator housing (6).

CAUTION

Insulate the terminal of the generator positive lead P-9 to prevent contact with any metal part of the vehicle. If the terminal is grounded, damage to the charging circuit can result when the battery is reconnected.

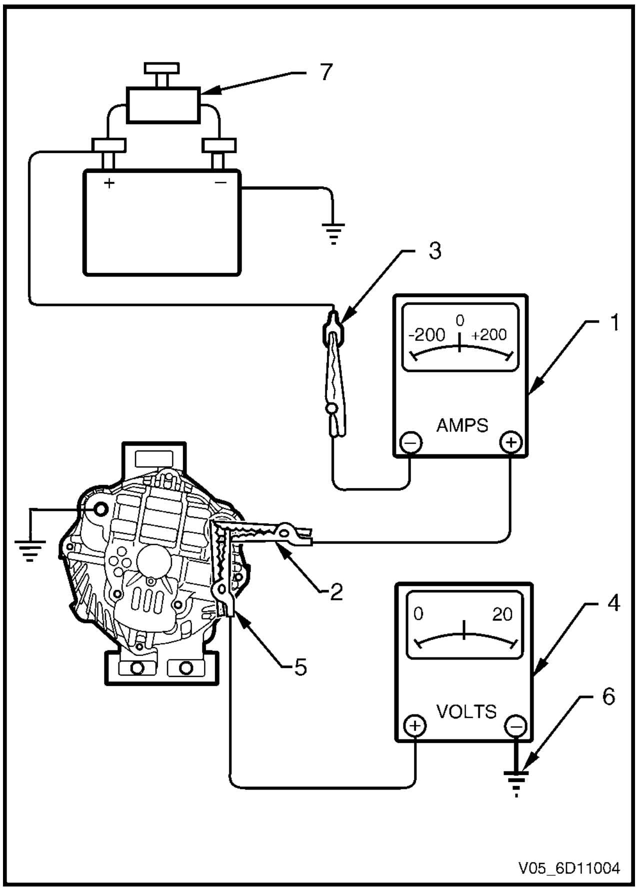


Figure 6D1-1 3

7 Reconnect the battery ground cable P-5.

8 Fit a loading device (7) across the battery terminals, e.g. an adjustable carbon pile.

CAUTION

The loading device must have a minimum power consumption of 1000 W.

9 Record the voltage reading before starting the engine. (This reading should increase when the engine is running, indicating generator output.).

10 Start the engine.

11 Increase the engine speed to the value outlined in the chart below.

12 Using the reading from the multimeter set to measure current, adjust the loading device to apply a load within the range outlined in the chart below.

13 Using the multimeter set to measure voltage, check the generator output voltage against the specification.

Engine RPM	1300
Load	5.0 – 10 A
Output Voltage	13.8 – 15.4 V

Load Regulation Test

NOTE

The decrease in the voltage recorded during this test should not exceed 0.5 V from the readings obtained for the Regulating Voltage Test. If the decrease in the regulating voltage is greater than 0.5 V, the regulator is defective. Replace the regulator.

14 Increase the engine speed to the value outlined in the chart below.

15 Using the reading from the multimeter set to measure current, adjust the loading device to apply a load of about 90% of the generator's full output.

16 Using the multimeter set to measure voltage, check the generator output voltage against the specification.

Engine RPM	1900
Load	90 A
Output Voltage	13.8 – 15.4 V

Full Load Output Test

CAUTION

Keep the time for this test to a minimum to avoid undue heating and high engine speeds.

17 Increase the engine speed to the value outlined in the chart below .

18 Using the reading from the multimeter set to measure voltage, adjust the loading device to increase the load until the generator output voltage drops to 13.5 V. Full generator output, outlined in the chart below, is required.

19 Record the current reading displayed on the multimeter set to measure current.

PAGE

Inspection and Repair

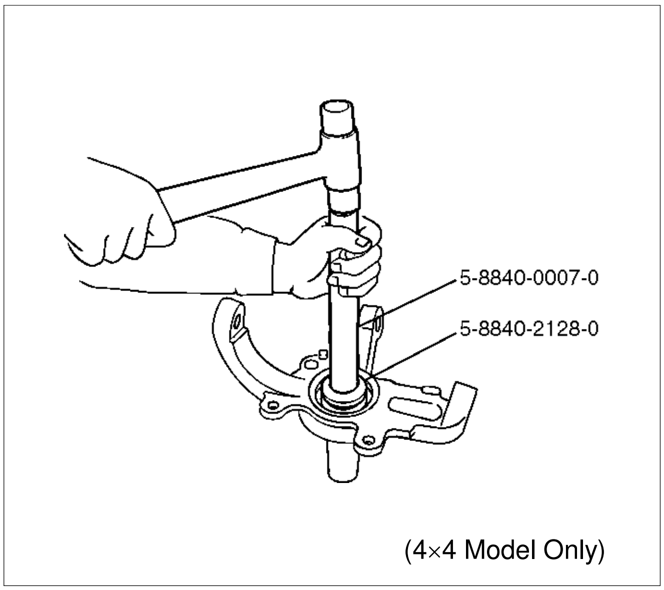
Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.

Check the following parts:

- Knuckle
- Thrust washer (4×4 Model Only)

Installation

1. Apply appropriate amount of multipurpose type grease to the new bearing (Approx. 5 g (0.18 oz)) and install needle bearing by using installer 5-8840-2128-0 and grip 5-8840-0007-0. (4×4 Model Only)



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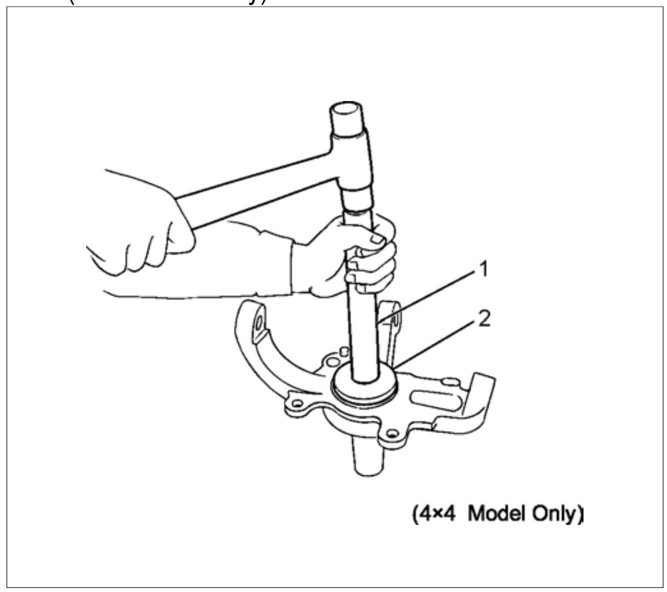
2. Apply multipurpose type grease to the thrust washer, and install washer with chamfered side facing knuckle. (4×4 Model Only)
3. Use a new oil seal, and apply multipurpose type grease to the area surrounded by the lip (approx. 2 g (0.07 oz)). Then use installer 5-8840-2851-0 (2) and grip 5-8840-0007-0 (1) to install oil seal. After fitting the oil seal to the installer, drive it to the knuckle using a hammer or bench press until the tool front face contacts with the thrust washer. (4×4 Model Only)



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4. Install knuckle assembly.
5. Install upper ball joint and tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 98 N·m (10.0 kgf·m/72 lb·ft)

6. Install lower ball joint and tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 147 N·m (15.0 kgf·m/108 lb·ft)

7. Install back plate.
8. Install speed sensor harness.
9. Install torsion bar; refer to *Torsion Bar in this section.*

NOTE: Adjust the trim height. Refer to *Front End Alignment Inspection and Adjustment in Steering.*

20 Reduce the engine speed to idle.

CAUTION

On completion of the generator output test, return the engine to idle and disconnect the loading device from the battery terminals. This prevents excessive battery discharge.

21 Stop the engine.

22 Disconnect the battery ground cable P-5 at the battery.

23 Remove the multimeters.

24 Reconnect the generator positive lead P-9.

25 Reconnect the battery ground cable P-5 to the battery.

Engine RPM	1900
Load	5.0 – 10 A
Output Voltage	13.8 – 15.4 V

Charging Circuit Voltage Drop Test

Prerequisites

Before testing the generator output, ensure that:

- all generator circuit connections are clean and tight,
- the generator is always connected to the battery during testing (to prevent damage to the diodes),
- the battery is fully charged, and
- the specific gravity does not vary more than 0.025 between cells. (It is recommended the average specific gravity is 1.260 or higher). Refer to 6D1-3 Battery – V6.

Carry out a load test on the battery to determine its ability to supply and accept current. This is a good indicator of the general condition of the battery. For details of battery testing, refer to 6D1-3 Battery – V6.

Inspect the drive belt and tensioner markings to determine if the drive belt is within operating limits. Replace the belt if it is excessively worn or outside the operating range of the tensioner.

For further details, refer to 6A1 Engine Mechanical – V6.

Voltage Drop Test

CAUTION

Ensure the generator connections are clean and tight.

1 Connect the positive lead of a multimeter set to measure voltage to the generator terminal P-9.

2 Connect the negative lead of the multimeter to the battery positive post.

3 Switch the headlamps on.

4 Start the engine.

5 Increase the engine speed to approximately 2500 r.p.m.

6 Record the voltage reading.

7 Reduce the engine speed to idle.

8 Connect the positive lead of a multimeter set to measure voltage to the battery negative post.

9 Connect the negative lead of the multimeter to the generator housing.

9 Increase the engine speed to approximately 2500 r.p.m.

10 Record the voltage reading.

11 Reduce the engine speed to idle.

12 Check the two readings. If the readings exceed 0.3 V, there is a high resistance in the charging circuit.

13 Trace the cause and correct the problem, refer to 8A Electrical Body and Chassis.

4 Major Service Operations

4.1 Generator

Remove

CAUTION

Refer to 1.2 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Disconnect the battery ground lead P-5. Refer to 8A Electrical Body and Chassis.

2 Insert a ½ inch drive socket bar into the tensioner arm and rotate the tensioner arm clockwise.

3 Remove the drive belt from the generator pulley and release the tensioner. Refer to 6A1 Engine Mechanical – V6 for further details as required.

4 Pull the battery harness cap back from generator terminal P-9 (3), remove the nut (4) and remove the positive lead (2) from the generator (5).

5 Disengage the connector retaining clip and remove the connector E-4, (1) from the generator.

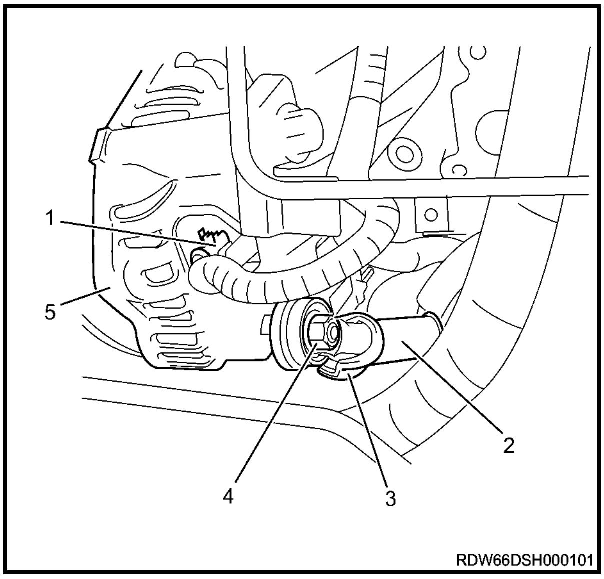


Figure 6D1-1 4

6 Remove the three bolts (1, 2, 4) retaining the generator (3) to the generator bracket.

7 Remove the generator assembly from the vehicle.

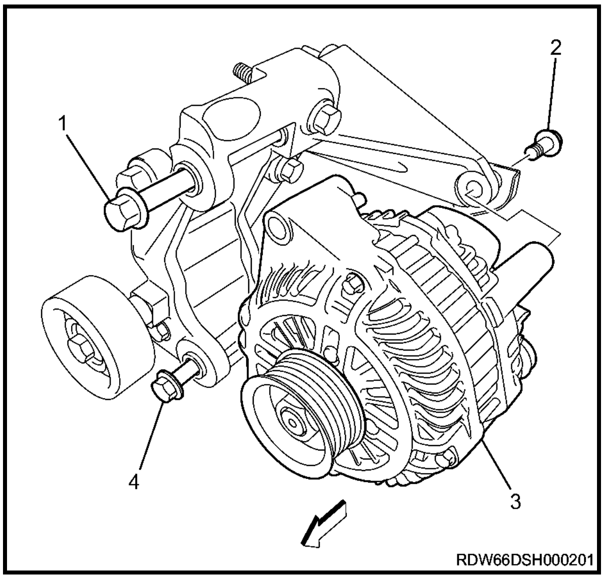


Figure 6D1-1 5

Reinstall

Reinstallation of the generator is the reverse of the removal procedure, noting the following:

1 Tighten all fasteners to the correct torque specification.

2 Reconnect the battery ground lead.

3 Start the engine.

4 Check the generator warning indicator operation.

5 Check the drive belt is correctly routed and aligned.

6 Check the generator output. Refer to 3.3 On-vehicle Testing.

7 Check the voltage regulator operation. Refer to 3.3 On-vehicle Testing.

8 Turn the ignition switch off.

Generator mounting bolts .... (1)	58.0 Nm
Generator mounting bolts .... (2)	58.0 Nm
Generator mounting bolts .... (4)	58.0 Nm
Battery harness to P-9 pin B nut torque specification..................................	7.1 – 13.3 Nm

4.2 Generator Mounting Bracket

Remove

1 Remove the idler pulley bolt (7) then the idler pulley (6), Refer to 4.1 Generator.

2 Remove the bolts (1, 2, 3 ,4); five places attaching the generator mounting bracket (5) to the engine block.

3 Remove the generator mounting bracket from the vehicle.

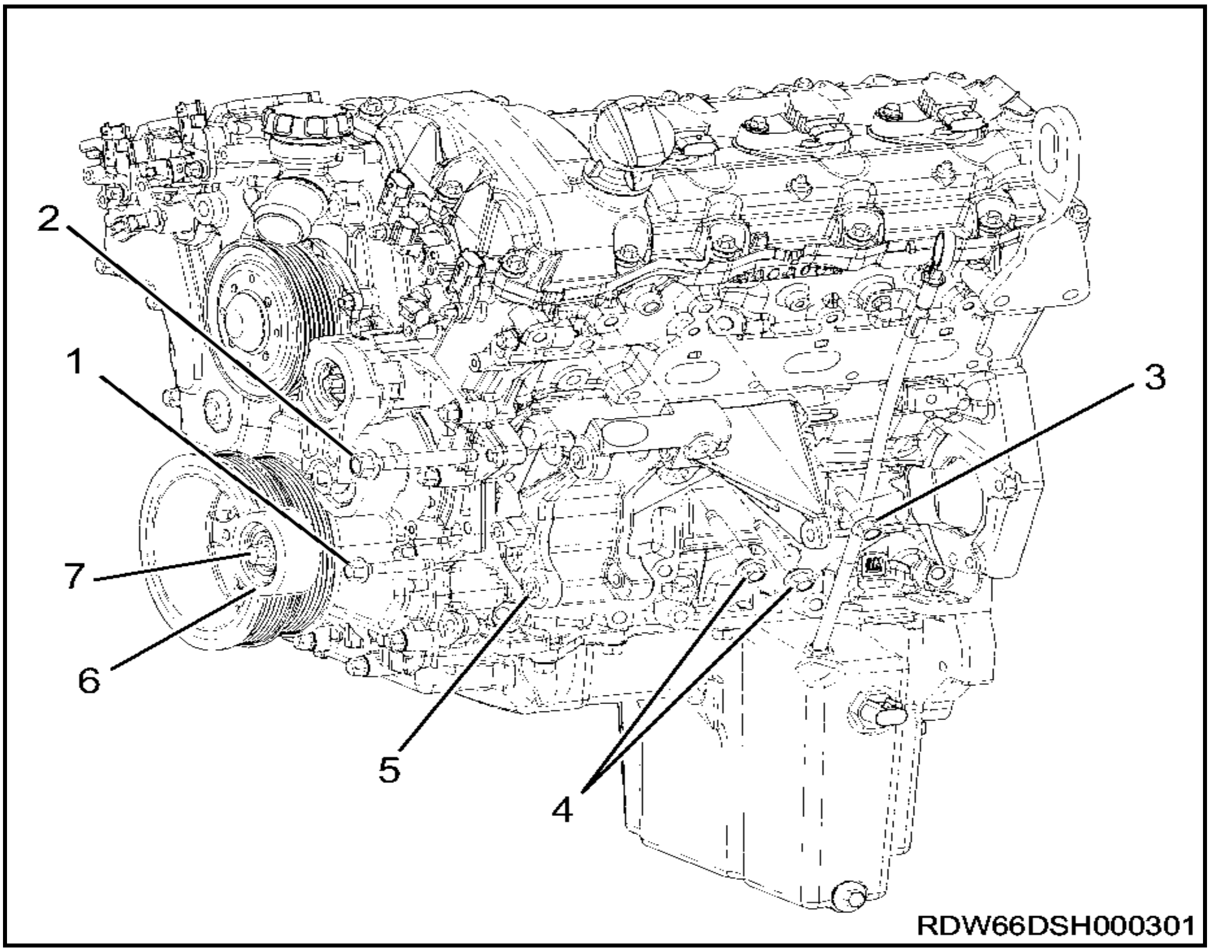


Figure 6D1-1 6

Reinstall

Reinstallation of the generator mounting bracket and generator is the reverse of the removal procedure, noting the following:

1 Tighten all fasteners to the correct torque specification.

2 Reinstall the generator, refer to 4.1 Generator.

Generator mounting bracket bolts ...	(1)	40.0 – 60.0 Nm
Generator mounting bracket bolts ...	(2)	100.0 Nm
Generator mounting bracket bolts ...	(3)	40.0 – 60.0 Nm
Generator mounting bracket bolts ...	(4)	40.0 – 60.0 Nm
Idler pulley bolt................................	(7)	58.0 Nm

4.3 Drive Belt Routing

Without Air Conditioning

Ensure the drive belt ribs are correctly positioned in all pulleys and the crankshaft balancer.

NOTE

For detailed information relating to drive belt service procedure, refer to 6A1 Engine Mechanical.

Figure 6D1-1 7 shows the drive belt routing for the HFV6 engine without air-conditioning.

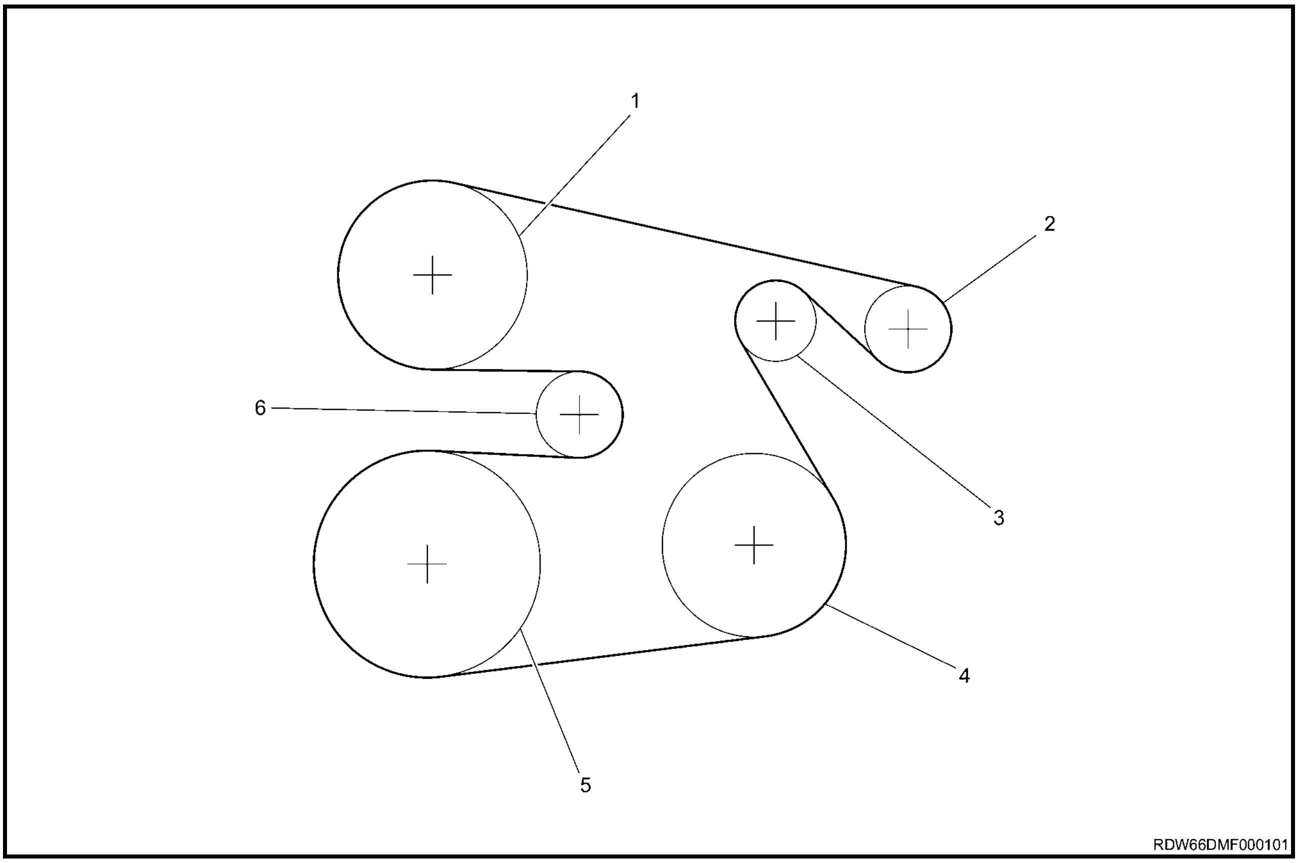


Figure 6D1-1 7

Legend

1	Water Pump	4	Power Steering
2	Generator	5	Crankshaft
3	Idler	6	Tensioner

6 Specifications

Ground Polarity....................Negative

Nominal Voltage....................12 V

Nominal Output....................120 A

Stator Phases....................3

Stator Winding Connections....................Delta

Voltage Regulator Setting....................14.2 – 14.8 V

Rotor Winding Resistance @ 20°C....................2.1 V

Slip-ring Outer Diameter....................22.7 mm

Slip-ring Service Limit....................22.1 mm

Stator Winding Resistance @ 20°C....................0.098 Ω

Brush Length New....................18.5 mm

Minimum Brush Length....................5.0 mm

Direction of Rotation (viewed from pulley)....................Clockwise

7 Torque Wrench Specifications

....Nm

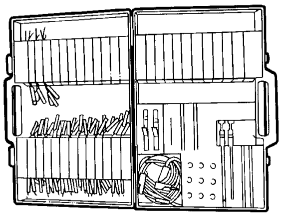
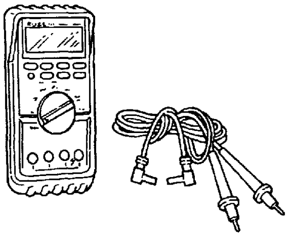
Generator Mounting Bolts (1, 2, 4) 58.0

Generator Mounting Bracket Bolts (1, 3, 4).....................................40.0 – 60.0

Generator Mounting Bracket Bolts (2)...0.0

Battery Harness to G8 – X1 pin A Nut...5.0 – 12.0

8 Special Tools

TOOL NUMBER	ILLUSTRATION	DESCRIPTION	TOOL CLASSIFICATION
J35616-A (KM609)		**CONNECTOR TEST ADAPTOR KIT** Used when carrying out electrical diagnostic circuit checks. Previously released.	Desirable
3588 (J39200)		**DIGITAL MULTIMETER** Must have at least 10 MΩ input impedance and be capable of reading frequencies. Previously released.	Available

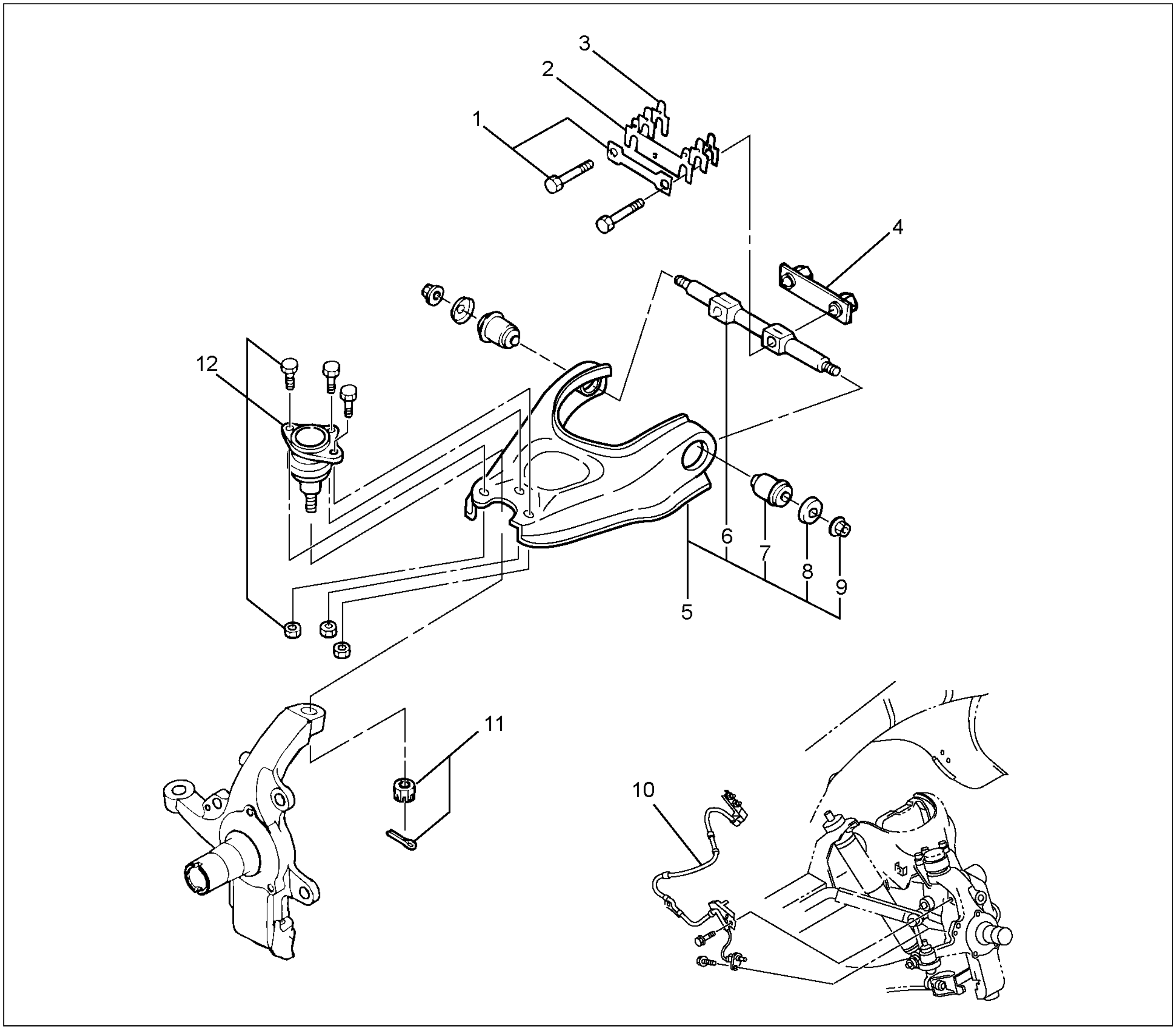
6D1-2
Starting System – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

Upper Control Arm

Upper Control Arm and Associated Parts



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Legend

- (1) Bolt and Plate
- (2) Camber Shims
- (3) Caster Shims
- (4) Nut Assembly
- (5) Upper Control Arm Assembly
- (6) Fulcrum Pin
- (7) Bushing
- (8) Plate
- (9) Upper Control Arm Nut
- (10) Speed Sensor harness
- (11) Nut and Cotter Pin
- (12) Upper Ball Joint, Bolt and Nut

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the brake caliper and disconnect brake pipe. Refer to Disc Brakes in Brake section.

1 General Information

All HFV6 engines are fitted with a Mitsubishi starter motor. This consists of a solenoid switch on a DC motor. The motor has permanent magnet excitation, which has the advantage of low weight a with high output torque and is visually identifiable by the absence of pole-shoe retaining screws.

The starter motor does not have field coil windings or pole shoes. These parts have been replaced by six permanent magnets that are held in the pole housing by clips. The positive brushes are now part of the brush plate assembly.

The solenoid switch is the only component of the starter motor assembly that is serviced separately. If any other parts require replacement, the starter motor must be replaced.

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or

Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 Components

Starting System Components

The main components of the starting system are:

- battery,
- wiring,
- ignition switch,
- theft deterrent engine crank inhibitor (a function of the theft deterrent system),
- park / neutral and back-up switch (on vehicles with 4 speed automatic transmission),
- engine control module (ECM),
- start relay,
- solenoid switch, and
- starter motor.

Starter Motor and Solenoid Switch Components

Solenoid Switch

The solenoid switch is used to activate the DC motor and has two windings; the pull-in winding and the hold-in winding. The pull-in winding has heavier wire and is grounded through the DC motor winding and brushes. The hold-in winding is grounded through the solenoid casing.

Planetary Drive Train

The planetary drive train consists of an internally toothed ring gear and three planetary gear wheels, which rotate on sleeve bearings on the planetary drive shaft. The ring gear is keyed into the drive-end housing and is made from high-grade polyamide with mineral additives.

When the starter motor operates, the armature turns the planetary gears inside the fixed planetary ring gear. This drives the planetary shaft at a reduced speed ratio which turns the drive assembly. A fork lever in the drive-end housing forces the drive assembly forward to engage with the flexplate / flywheel ring gear on the engine and transmit cranking torque.

An internal clutch allows the drive assembly pinion gear to rotate freely when the engine starts. This prevents the armature from being driven at excessive speed by the engine.

Armature

The armature shaft is supported at each end by oil absorbent, sintered metal bushes; one in the commutator end shield and one in the planetary drive shaft. The front end of the armature has a gear profile. This meshes with the three planetary gear wheels. These in turn, mesh with the internal teeth of the ring gear.

Brushes

A brush plate supports four commutator brushes. This plate is fixed to the commutator end shield with two retaining screws. Two negative brushes are grounded to the pole housing. The two positive brushes are insulated from the pole housing and connected to the solenoid switch M terminal, refer to Figure 6D1-2 – 1.

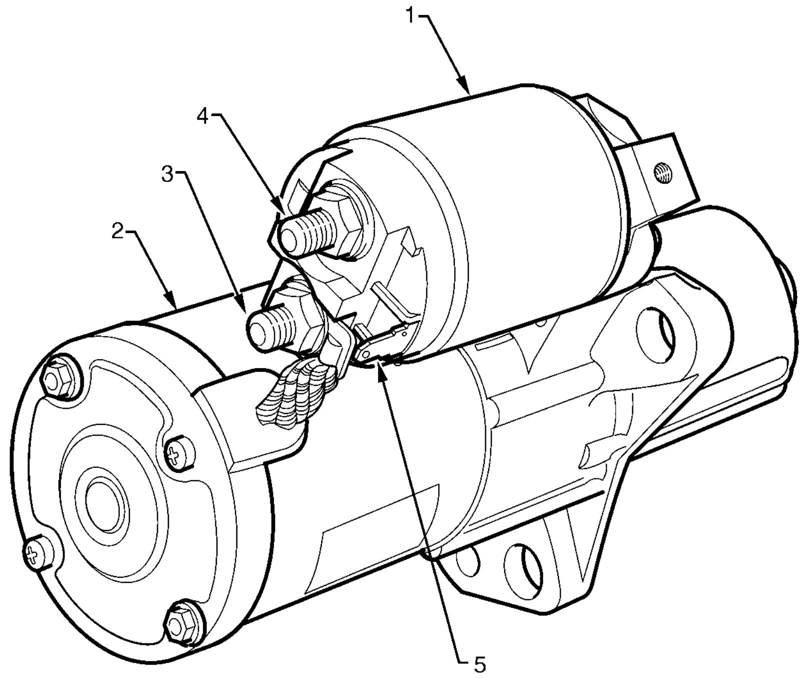


Figure 6D1-2 – 1

Legend

1	Solenoid Switch	4	Connector P-4
1	Starter Motor	5	Connector P-3 – pin 1
3	Starter Motor terminal M		

1.3 System Operation

Operation

The ECM controls the activation of the start relay in response to inputs from:

- ignition switch,
- battery,
- theft deterrent engine crank inhibitor (a function of the theft deterrent system),
- park / neutral and back-up switch (on vehicles with 4 speed automatic transmission),

The start relay controls the operation of the start solenoid.

The start solenoid controls operation of the starter motor and the drive assembly.

Sequence of Operation

1 When the ignition switch is turned to the START position, a signal is also sent to the ECM to request the engine to crank.

- For automatic vehicles the transmission must be in either park (P) or neutral (N) for the ECM to allow cranking to commence.
- The ECM will only allow cranking if the battery voltage is above the minimum battery voltage threshold value, refer to 6C1-1 Engine Management – V6 – General Information for further information.

2 The ECM operates the start relay which provides power to the pull-in winding of the start solenoid.

3 Current flow to the pull-in winding develops powerful magnetism which pulls in the solenoid switch plunger.

4 The plunger closes the switch contacts connecting battery voltage to the DC motor and pivots the fork lever to engage the drive assembly to the flexplate / flywheel ring gear. Closing the solenoid switch contacts deactivates the pull-in winding, the hold-in winding remains active.

5 With the solenoid switch contacts closed, current flows from the battery through the DC motor, which rotates the armature at high speed and provides cranking torque.

2 Diagnostics

2.1 Diagnostic General Information

NOTE

There is a minimum battery voltage threshold value. If the battery voltage is below the set value, the ECU will inhibit cranking. Refer to 6C1-1 Engine Management – V6 – General Information for further information.

Basic Diagnostic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the cruise control diagnostic procedures could result in incorrect diagnostic results or damage to components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section:

- digital multimeter with 10 meg ohms impedance, and
- connector test adapter kit Tool No. KM609.

For further information on the use of these tools, refer to 8A Electrical Body and Chassis.

2.2 Tech 2 Data List

The Tech 2 displays the status of certain starting system parameters.

To view the data list:

1 Connect Tech 2 to the DLC.

2 On Tech 2 select:
Engine / **V6 Engine** / **Data Display** / **Data List** / **Electrical** / **Theft Data**.

Tech 2 Parameter	Units Displayed	Typical Display Values
Crank Request	Inactive / Active	Inactive
Starter Relay	Off / On	Off

2.3 Diagnostic Systems Check

Step	Action	Yes	No
1	Is the fault specifically isolated to this system / module?	Go to Step 2	Go to 0D Vehicle Diagnostics
2	1 Connect Tech 2 to the DLC. 2 Ignition ON, engine OFF. 3 On Tech 2 select: **Engine** / **V6 Engine** / **Diagnostic Trouble codes** / **Read DTC's.** Are there any set DTC's?	Go to the appropriate DTC table in 6C1-2 Engine Management – V6 – Diagnostics.	Refer to 2.5 Starting System Inoperative / Malfunctioning

2.4 Wiring Diagram

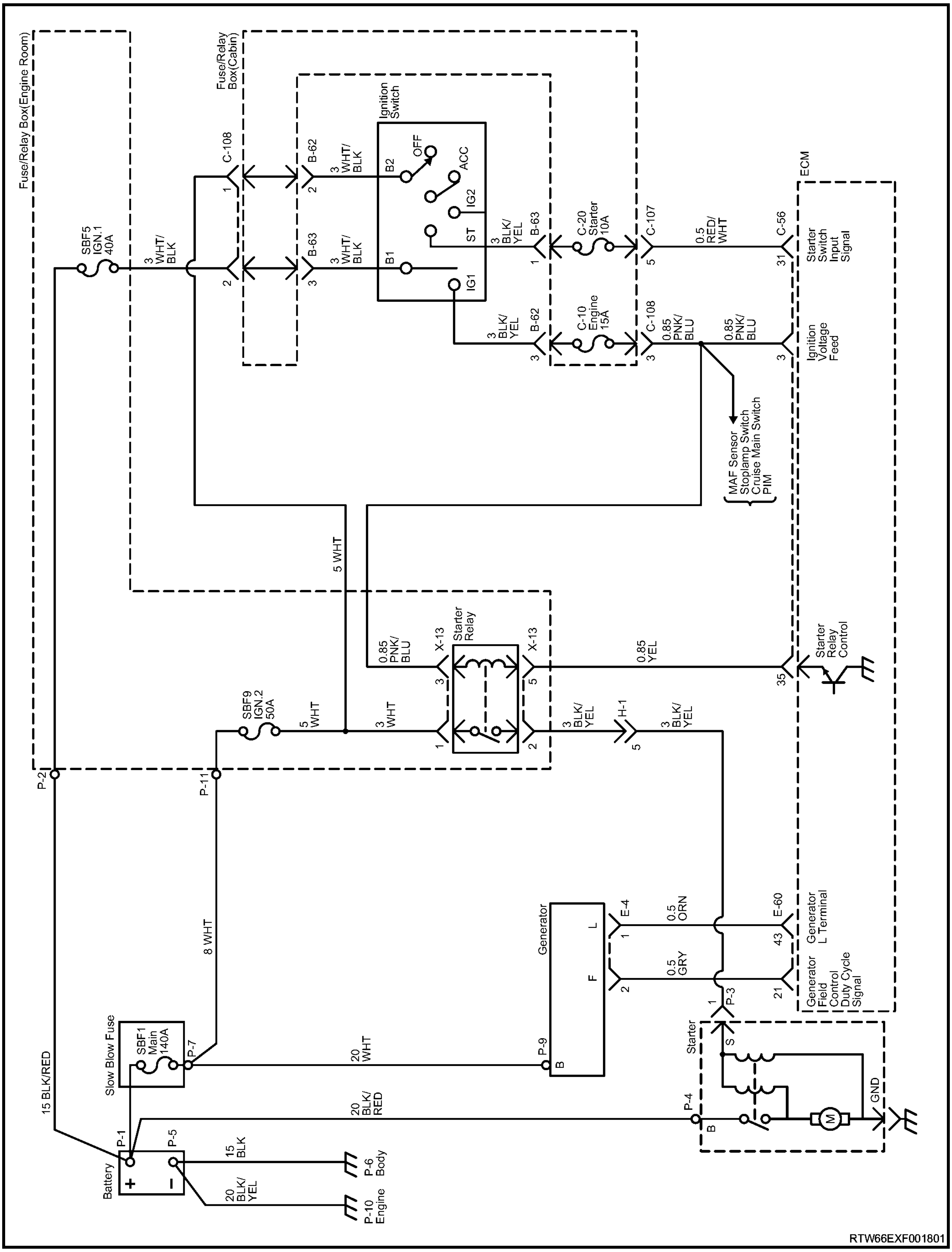


Figure 6D1-2 – 2

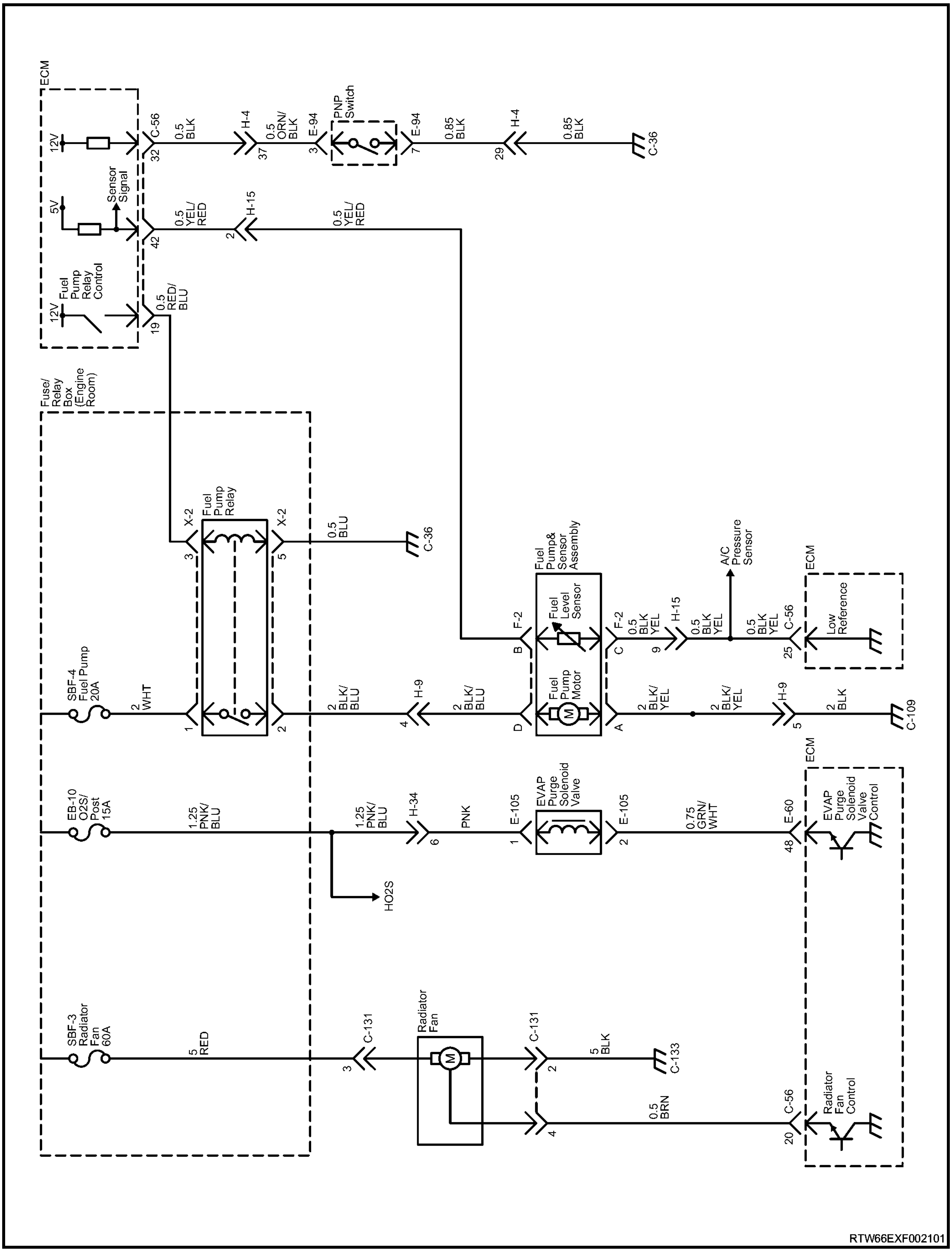


Figure 6D1-2 – 3

2.5 Starting System Inoperative / Malfunctioning

Circuit Description

The battery cable supplies a constant connection from the battery to starter solenoid connector P – 4.

When the ignition switch is turned to the START position, 12 V is applied to the ECM connector C – 56 pin 31.

For vehicles with 4 speed automatic transmission, when the transmission is in park (P) or neutral (N), the park / neutral and back-up switch grounds ECM connector C – 56 pin 32.

The ECM provides a ground for the start relay, ECM connector C – 56 pin 35 to start relay connector X – 13 pin 5.

When activated the start relay provides 12 V to starter solenoid connector P – 3 pin 1.

The solenoid closes its switch contacts to connect the battery voltage at the solenoid switch terminal P – 4 terminal B to the DC motor. The pull-in winding of the solenoid switch is grounded through the DC motor winding and brushes. The hold-in winding is grounded through the solenoid casing. The DC motor is grounded through the starter motor casing.

Refer to 2.4 Wiring Diagram to aid in diagnosis.

Diagnostic Table Notes

Reference to following information will assist when diagnosing starting circuit faults:

1 If the battery, starter motor and fuel system are deemed as serviceable and a ‘no crank’ and / or ‘no start’ condition exists, refer to the following Sections as required:

  a 11A Immobiliser for theft deterrent engine crank inhibitor related faults

  b 6C1-2 Engine Management V6 Diagnostics, for starter relay circuit faults

2 For all wiring harness fault diagnoses, refer to 8A Electrical Body and Chassis.

3 For wiring harness repairs, refer to 8A Electrical Body and Chassis.

4 Refer to 8A Electrical Body and Chassis for harness routing.

5 Ensure the battery, cables and connections are in good order. Refer to 8A Electrical Body and Chassis.

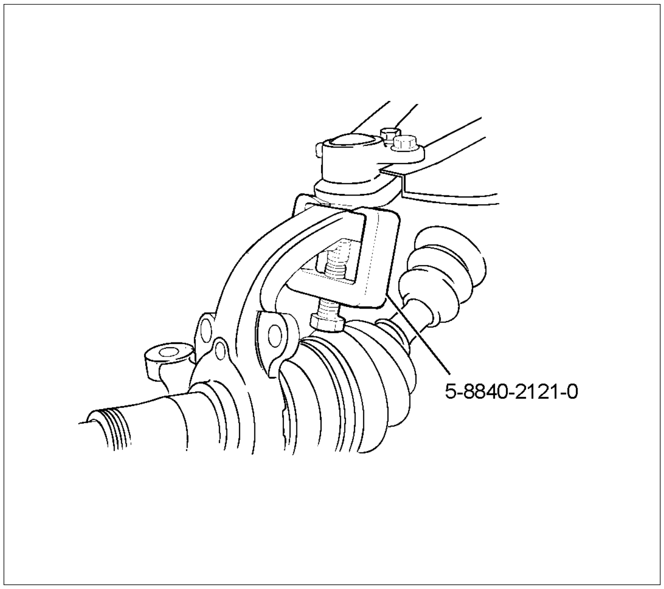
Diagnostic Table

Step	Action	Yes	No
1	Did you review 1.3 System Operation?	Go to Step 2	Go to 1.3 System Operation
2	Did you read 2.3 Diagnostic Systems Check	Go to Step 3	Go to 2.3 Diagnostic Systems Check
3	Turn the ignition switch to the START position and then release it. Did the engine crank or were there any clicking or chattering sounds from the solenoid?	Go to Diagnostic Table – Slow Cranking, Solenoid Clicks or Chatters	Go to Step 4
4	Inspect fusible link SBF9, refer to 8A Electrical Body and Chassis. Is fusible link SBF9 blown?	Replace the faulty fusible link (refer to Note 3). If the fusible link blows again, repair or replace the circuit from SBF9 to the starter relay X – 13 pin 1 or ignition switch B – 62 pin 2 (refer to Note 2)	Go to Step 5

Step	Action	Yes	No
5	Inspect fusible link SBF1, refer to 8A Electrical Body and Chassis. Is fusible link SBF1 blown?	Replace the faulty fusible link (refer to Note 3). If the fusible link blows again, repair or replace the circuit from SBF1 connection P – 7 and engine compartment fuse panel connector B – 63 pin 3, (refer to Note 2)	Go to Step 6
6	Inspect fuse SBF5, refer to 8A Electrical Body and Chassis. Is fuse SBF5 blown?	Replace the faulty fuse (refer to Note 3). If the fuse blows again, repair or replace the circuit from SBF5 to the cabin fuse panel connector C – 108 pin 2 (refer to Note 2)	Go to Step 7
7	Inspect fuse C20, refer to 8A Electrical Body and Chassis. Is fuse F15 blown?	Replace the faulty fuse (refer to Note 3). If the fuse blows again, repair or replace the circuit from fuse C20 to the ECM connector C – 56 pin 31 (refer to Note 2)	Go to Step 8
8	**NOTE** On automatic vehicles ensure that park (P) or neutral (N) is selected. Turn the headlamps on. Turn the dome lamps on. Turn the ignition switch to the START position. Do the lamps dim?	Go to Step 9	Go to Step 10
9	Perform the 3.3 On-Vehicle Testing. Did you correct the condition?	Go to Step 21	Go to Step 2

4. Support lower control arm with a harness.
5. Remove speed sensor harness.
6. Remove nut and cotter pin then remove knuckle using remover 5-8840-2121-0.

CAUTION: Be careful not to damage the ball joint boot.



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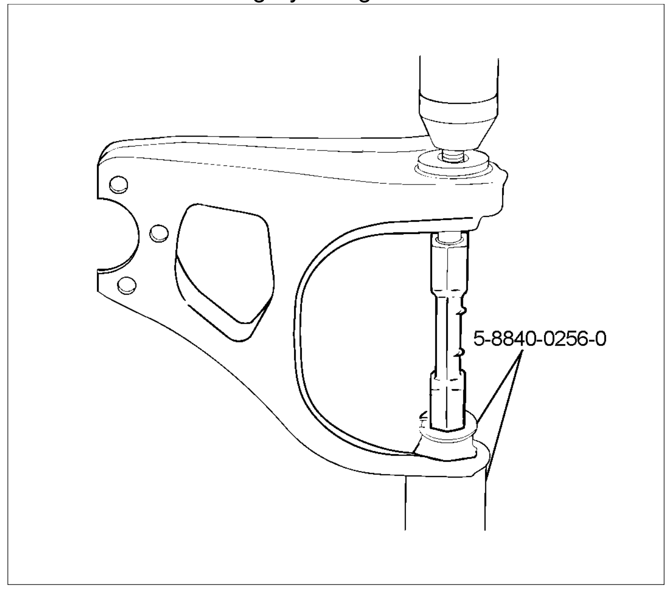
7. Remove upper ball joint.
8. Remove bolt and plate.
9. Remove nut assembly.
10. Remove camber shims and note the positions and number of shims.
11. Remove caster shims and note the positions and number of shims.
12. Remove upper control arm assembly.
13. Remove upper control arm nut.
14. Remove plate.
15. Remove bushing by using remover 5-8840-0256-0.



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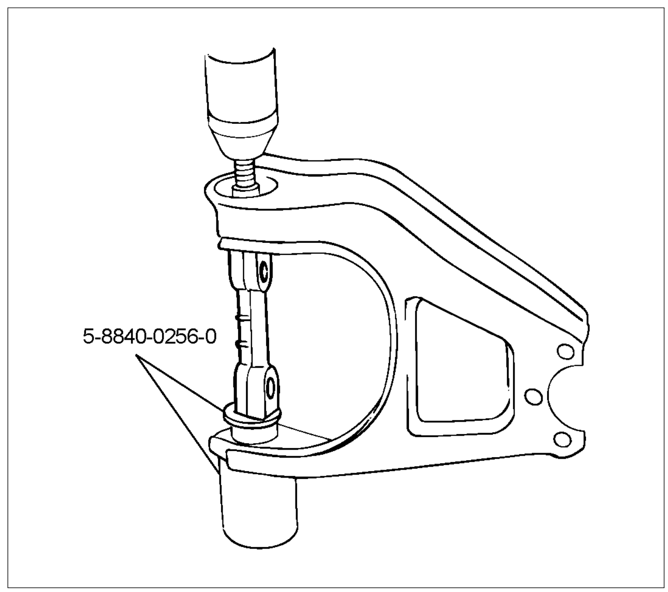

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16. Remove fulcrum pin.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal conditions are found through inspection.

Check the following parts:

- Upper control arm
- Bushing
- Fulcrum pin

Step	Action	Yes	No
10	1 Connect Tech 2 to the DLC. 2 Ignition on, engine off. 3 On Tech 2 select: **Engine** / **V6 Engine** / **Data Display** / **Data List** / **Electrical/Theft Data.** 4 On Tech 2 scroll to **Crank Request.** 5 While monitoring Tech 2, turn the ignition switch to START. Does Tech 2 display the following: **Inactive** with the ignition switch in the ON position, **Active** with the ignition switch in the START position?	Go to Step 15	Go to Step 11
11	1 Disconnect the ECM connector C – 56. 2 Using a multimeter set to measure voltage, back probe between the harness connector C56 – X2 pin 31 and ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and turn the ignition switch to START. • With the ignition switch in the START position, the multimeter should display battery voltage • With the ignition switch in the ON position, the multimeter should display 0 V Does the multimeter display as described?	Refer to 6C1 - 3 Engine Management – V6 – Service Operations for further diagnosis. Go to Step 21	Go to Step 12
12	Test the ignition switch, refer to 3B Steering. Is the ignition switch serviceable?	Go to Step 13	Replace the faulty ignition switch. Refer to 3B Steering Go to Step 21
13	Check for short to ground or open circuit from the ignition switch start terminal to the ECM connector C – 56 pin 31. Was the circuit serviceable?	Go to Step 14	Repair as required (refer to Note 2). Go to Step 21
14	Check for short to ground or open circuit from the ignition switch terminal B1 to the fuse SBF5. Was the circuit serviceable?	Go to Step 2	Repair as required (refer to Note 2). Go to Step 21
15	**NOTE** This procedure is only required on vehicles fitted with manual transmissions. If the vehicle is fitted with an automatic transmission, go to Step 16 1 Scroll to **Starter Relay** 2 While monitoring Tech 2, turn the ignition switch to START. Does Tech 2 display the following: **Off** with the ignition switch in the ON position, **On** with the ignition switch in the START position?	Go to Step 21	Go to Step 16

Step	Action	Yes	No
16	1 Scroll to **Starter Relay** 2 Ensure the transmission is in park (P) or neutral (N). 3 While monitoring Tech 2, turn the ignition switch to START. Does Tech 2 display the following: **Off** with the ignition switch in the ON position, **On** with the ignition switch in the START position?	Go to Step 18	Go to Step 17
17	1 Disconnect the ECM connector C – 56. 2 Using a multimeter set to measure voltage, back probe between the harness connector C – 56 pin 32 and ground. 3 With the aid of an assistant, monitor the voltage on the multimeter. • Place the transmission in park (P), the multimeter should display 0 V • Place the transmission in neutral (N), the multimeter should display 0 V Does the multimeter display as described?	Refer to 6C1 - 3 Engine Management – V6 – Service Operations for further diagnosis. Go to Step 21	For vehicles fitted with the 4 speed automatic transmission refer to 7C2 Automatic Transmission – 4L60E – On-vehicle Servicing for further diagnosis of the park / neutral and back-up switch. Go to Step 21
18	Test the starter relay. Refer to 6C1-2 Engine Management – V6 – Diagnostics. Is the starter relay serviceable?	Go to Step 19	Repair or replace as required Go to Step 21
19	1 Using a multimeter set to measure voltage, back probe between the harness connector P – 3 pin 1 and ground. 2 With the aid of an assistant, monitor the voltage on the multimeter. • Turn the ignition switch to START, the multimeter should display 7.0 V Does the multimeter display as described?	Repair or replace the starter motor as required. Refer to 4 Major Service Operations. Go to Step 21	Go to Step 20
20	Check for short to ground or open circuit from connector P – 3 pin 1 and the starter relay connector X-13 pin 2. Was the circuit serviceable?	Go to Step 2	Repair as required (refer to Note 2). Go to Step 21
21	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
When all diagnosis and repairs are completed, check the system for correct operation.			

Diagnostic Table – Slow Cranking, Solenoid Clicks or Chatters

Step	Action	Yes	No
1	Did you review 1.3 System Operation?	Go to Step 2	Go to 1.3 System Operation.
2	Did you read 2.3 Diagnostic Systems Check	Go to Step 3	Go to 2.3 Diagnostic Systems Check.
3	Perform the 3.3 On-Vehicle Testing. Did you correct the condition?	Go to Step 4	Repair or replace the starter motor. Refer to 4 Major Service Operations. Go to Step 4
4	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2
When all diagnosis and repairs are completed, check the system for correct operation.			

3 Minor Service Operations

3.1 Safety Precautions

Observe the following precautions. Failure to observe these precautions can result in serious damage to components.

- Refer to 1.1 WARNING, CAUTION and NOTES in this Service Information before disconnecting the battery.
- Use the starter motor on a negative ground system only.
- When installing a battery, attach the positive (+) cable to the battery first. Then attach the negative cable.
- When using a slave battery for starting purposes, ensure that both batteries are connected in parallel, that is. positive to positive terminals and negative to negative terminals.
- Only use jumper leads that have surge protection.

3.2 Maintenance

Regular Checks

Check the following at regular intervals:

- Starter motor terminals – for corrosion and loose connectors.
- Wiring – for damaged insulation.
- Mounting bolts – for tightness.
- Battery terminals – for clean and secure connections.

3.3 On-Vehicle Testing

NOTE

The battery must be fully charged and in serviceable condition before beginning these tests, refer to 8A Electrical Body and Chassis.

Engine Compartment Relay And Fuse Panel

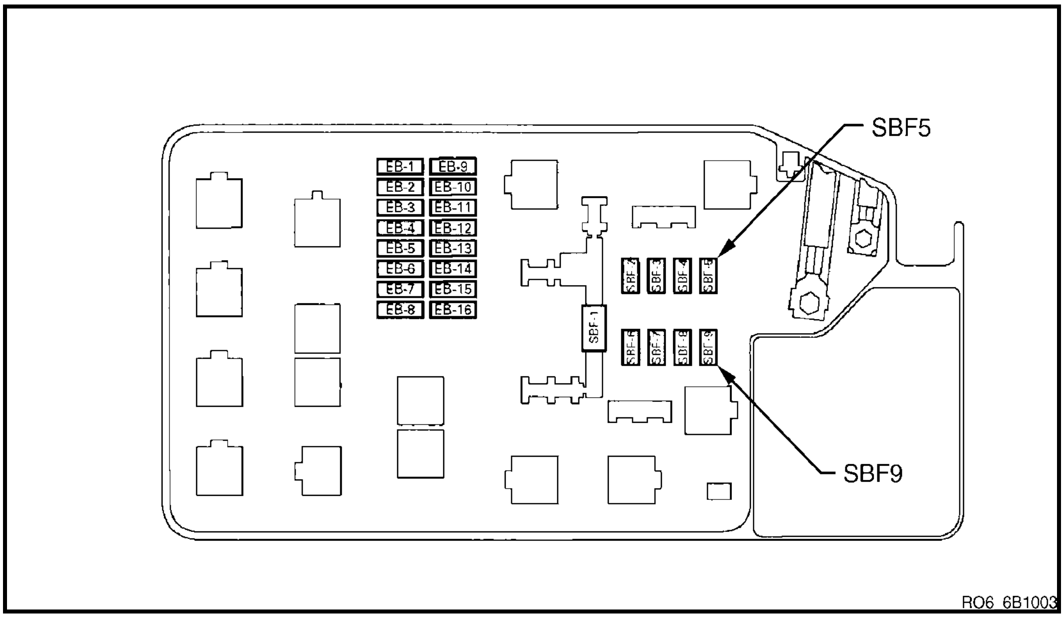


Figure 6D1-2 – 4

1 Remove fuses SBF5 and SBF9 from the engine compartment fuse panel to disable the ignition and prevent the engine from starting, refer to 8A Electrical Body and Chassis.

2 Chock the wheels.

3 For vehicles fitted with automatic transmission ensure the transmission is in P (park) or N (neutral) and the hand brake is applied.

4 Ensure the engine is at room temperature or normal operating temperature and in good working order.

Bad Connection Test

A bad connection appears as a voltage reading when the multimeter leads are connected to two different positive (or negative) connections.

1 Using a multimeter set to measure voltage, connect the multimeter's positive lead to the positive battery post.

2 Connect the multimeter's negative lead to the starter motor M terminal.

3 Record the voltage that displayed during cranking.

4 Repeat this with the multimeter's negative lead connected to the solenoid switch connector P – 4 pin B (circuit 1).

5 Also repeat this connecting the multimeter's negative lead to the battery cable strands.

6 Restore all connections that show a significant resistance (voltage reading).

Starter Motor Ground Test

1 Using a multimeter set to measure voltage, connect the multimeter's positive lead (1) to the negative battery post.

CAUTION

Connect the lead to the actual battery post and not to the cable or connector.

2 Connect the multimeter's negative lead (2) to the starter motor housing.

3 Record the voltage that displayed during cranking.

4 Repeat this connecting the multimeter's negative lead to the battery cable strands.

5 Restore all ground connections that show a significant resistance.

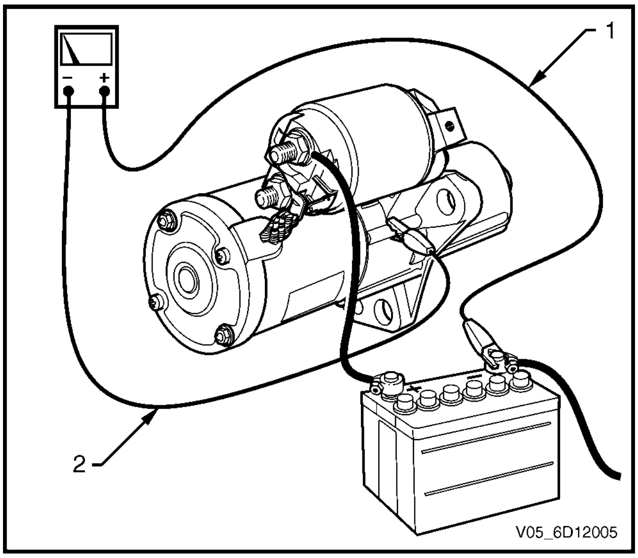


Figure 6D1-2 – 5

Switching Circuit Test

1 Using a multimeter set to measure voltage, connect the multimeter's negative lead (1) to the solenoid switch connector P – 3 pin 1.

2 Connect the multimeter's positive lead (2) to the positive battery post.

3 Crank the engine.

4 Record the voltage that displayed during cranking.

Maximum switching circuit voltage difference	2.5 V

5 If the voltage is above the specification, test the solenoid switching circuit to locate the cause of the high resistance and restore the connection.

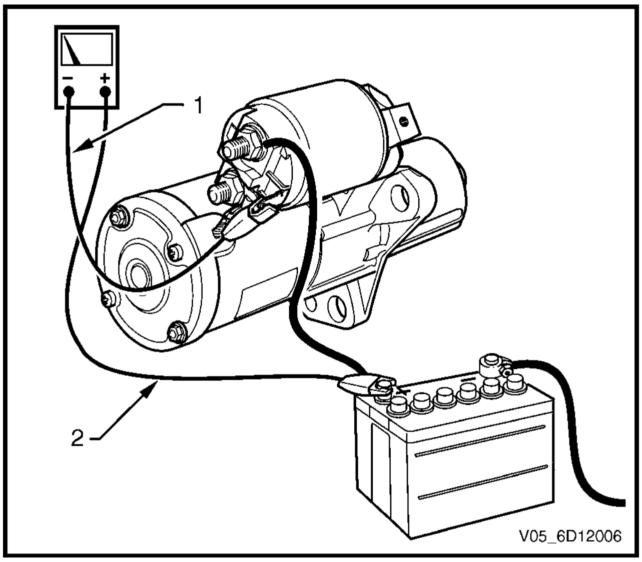


Figure 6D1-2 – 6

Cranking Voltage Test

1 Using a multimeter set to measure voltage, attach the multimeter's negative lead to ground and the multimeter's positive lead to starter solenoid connector P – 3 pin 1 (3) of the solenoid switch.

CAUTION

Do not crank the engine for more than 30 seconds at a time. Allow 2 minutes for the starter motor to cool down between tests.

3 Crank the engine.

4 Record the voltage that displayed during cranking.

Minimum cranking voltage	9.0 V

5 Remove and repair or replace the starter motor and solenoid switch if the voltage is below the specifications and cranks poorly. Refer to 4 Major Service Operations.

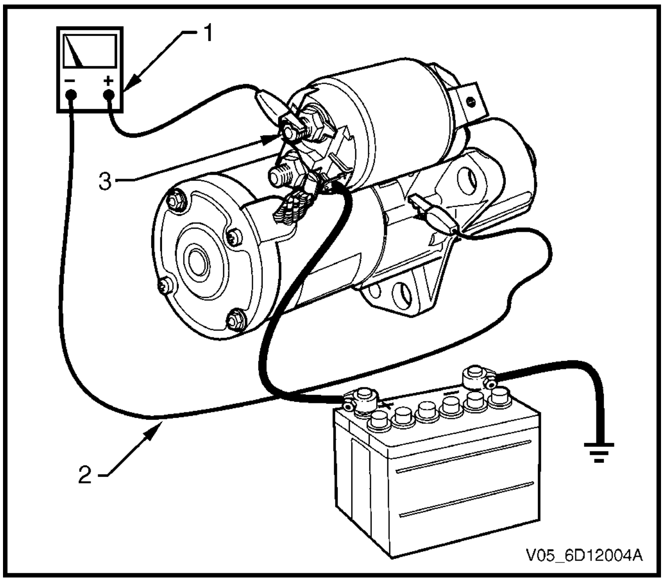


Figure 6D1-2 – 7

Current Draw Test

1 Using a multimeter set to measure voltage, attach the multimeter's positive lead to the positive battery post.

2 Attach the same multimeter's negative lead to the negative battery post.

3 Using a multimeter set to measure current, attach the multimeter's positive lead to the battery post.

4 Connect the negative lead of the multimeter set to measure current to a battery loading device, for example a carbon pile.

5 Connect the free lead of the battery loading device to the negative battery terminal.

6 Set the battery loading device to maximum resistance (open).

7 Crank the engine.

8 Record the voltage that displayed during cranking.

9 With the ignition in the OFF position, adjust the battery loading device so the reading of the multimeter set to measure voltage matches the reading recorded in the last step.

10 Record the current draw from the battery loading device.

11 Set the battery loading device back to 'open'.

12 Check the current draw is within specifications.

Cranking current range	100 – 140 A

13 Remove and repair or replace the starter motor and solenoid switch if the current draw is outside the specification. Refer to 4 Major Service Operations.

4 Major Service Operations

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 00 Warnings, Cautions and Notes before disconnecting the battery.

4.1 Starter Motor

Remove

WARNING

The starter motor is in close proximity to the left-hand side exhaust manifold and engine pipe. Allow the engine to cool before attempting to remove the starter motor.

1 Refer to 1.1 WARNING, CAUTION and NOTES in this Service Information before disconnecting the battery.

2 Disconnect the battery ground lead.

3 Raise the front of the vehicle. For jacking locations, refer to 0A General Information.

4 Put safety stands in place.

5 Fit the front lifting bracket: EN–46114 (1) to the engine, then hook the chains from the engine hoist onto the front lifting bracket.

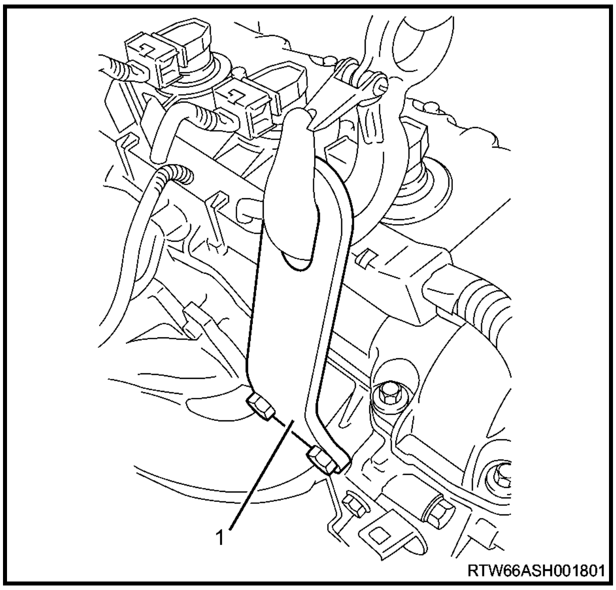


Figure 6D1-2 – 8

6 Fit the rear lifting brackets: EN–46114 (1) to the engine, then hook the chains from the engine hoist onto the rear lifting bracket.

7 Remove the oil level indicator tube, Refer to 6A1 Engine Mechanical – V6.

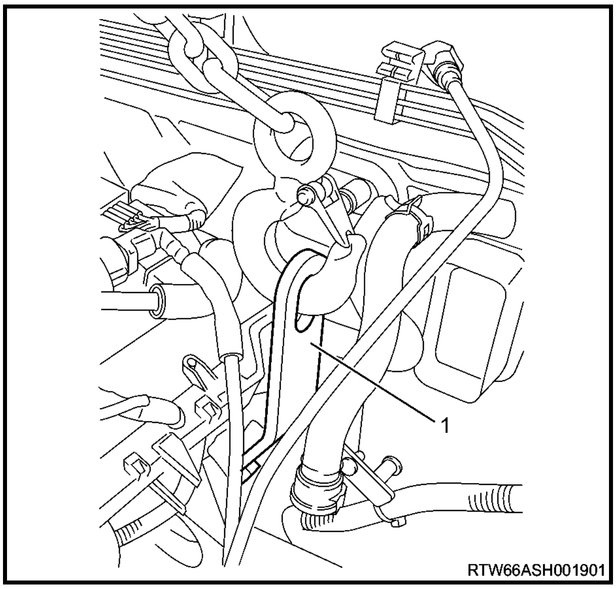


Figure 6D1-2 – 9

8 Remove the left hand side knock sensor (1) from the engine block.

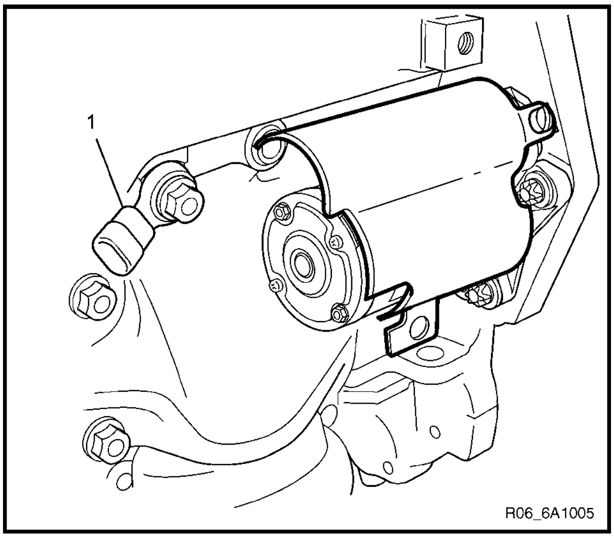


Figure 6D1-2 – 10

9 Remove the left hand side engine mount, then using the engine hoist raise the engine to give sufficient clearance to remove the starter motor.

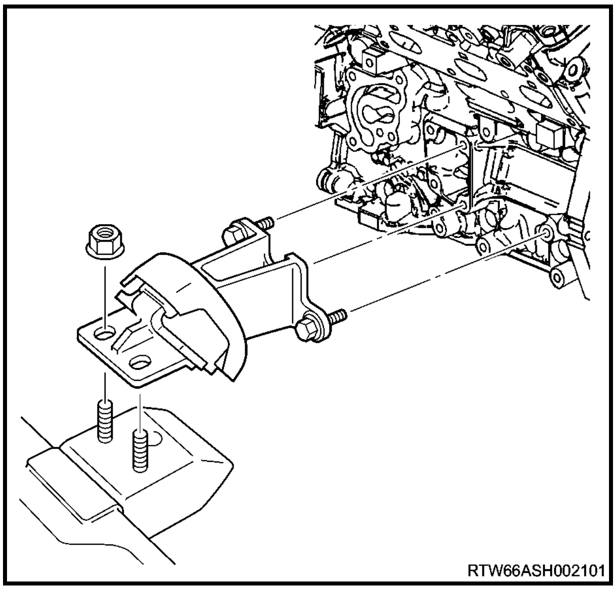


Figure 6D1-2 – 11

10 Unclip the oil level sensor harness from the heat shield (1).

11 Remove the heat shield attaching screw (2).

12 Remove the lower starter motor attaching bolt (3).

13 Remove the heat shield.

14 Remove the upper starter motor retaining bolt (3).

15 Remove the starter motor from the engine block and lower the starter motor as far as possible to gain access to the wiring harness connections.

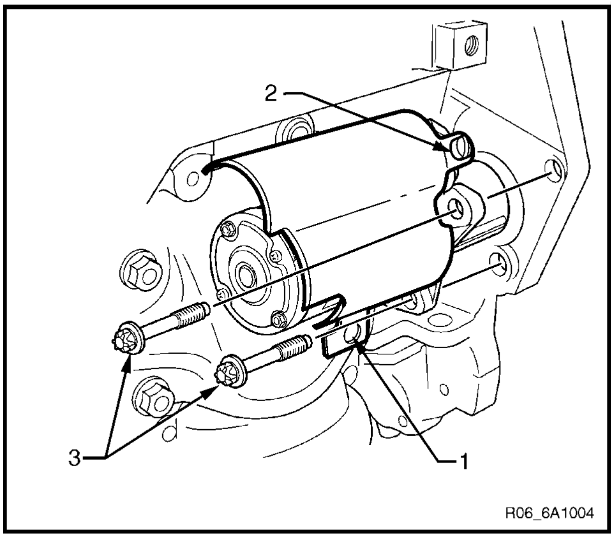


Figure 6D1-2 – 12

16 Remove the wiring harness connector P – 3 (1) from the solenoid switch (2).

17 Remove the flange nut (3) and battery connector P – 4 (4) from the solenoid switch.

18 Remove the starter motor from the vehicle.

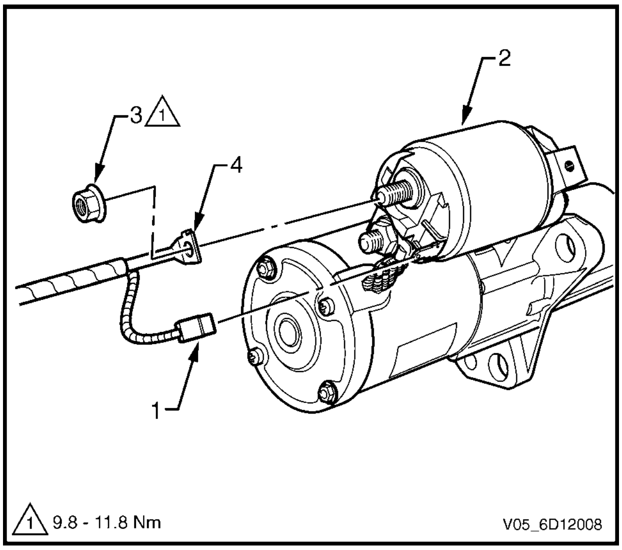


Figure 6D1-2 – 13

Reinstall

Reinstallation of the starter motor is the reverse of the removal procedure noting the following:

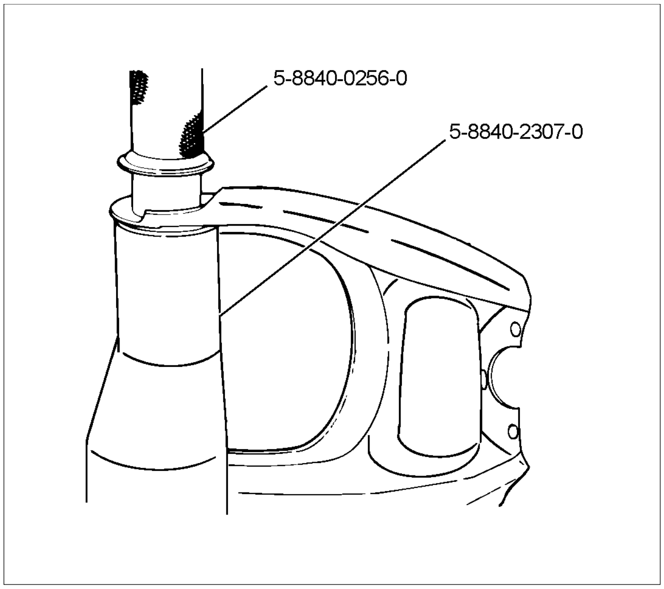
1 Tighten all fasteners to the correct torque specification.

Solenoid switch connector P – 4 nut (B+) torque specification	10.0 Nm
Starter motor heat shield lower bolts torque specification	23.0 Nm
Starter motor heat shield upper screw torque specification	3.0 – 5.0 Nm
Starter motor mounting bolt torque specification	45.0 Nm
Knock sensor bolt torque specification	23.0 Nm

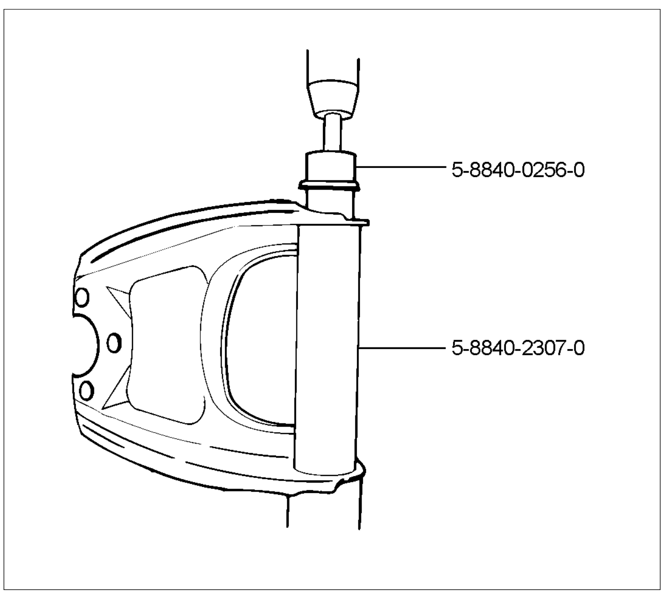
2 Check the starter motor operates correctly.

Installation

1. Install fulcrum pin.
2. Install bushing by using installer 5-8840-0256-0 and 5-8840-2307-0.



RTW340SH000701



RTW340SH000801

3. Install upper ball joint and tighten it to the specified torque.

Torque: 57 N·m (5.8 kgf·m/42 lb·ft)

4. Install nut and cotter pin then tighten the nut to the specified torque, with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 98 N·m (10.0 kgf·m/72 lb·ft)

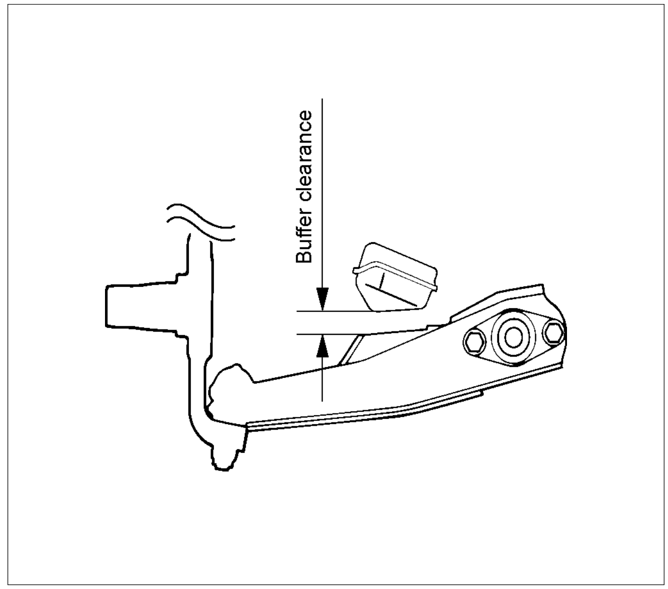
5. Install plate.
6. Install upper control arm nut and tighten fulcrum pin nut finger-tight.

NOTE: Apply oil to the thread.

NOTE: Tighten the nut with the parts in the position shown in the illustration below.

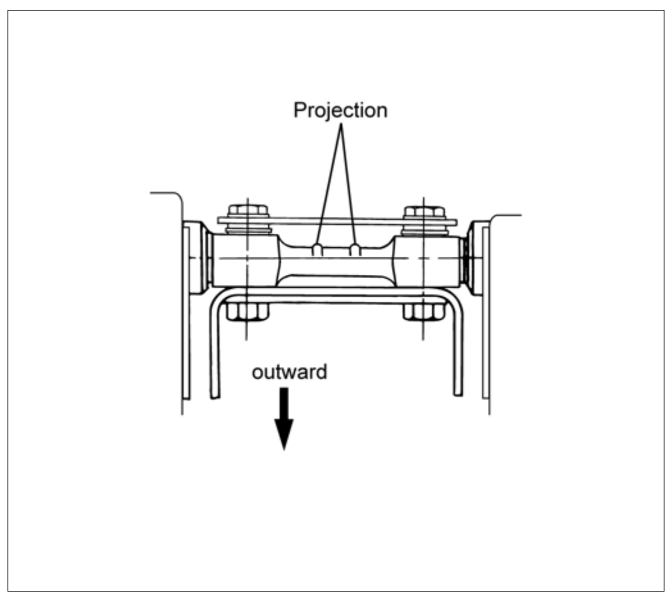
Buffer clearance: 29.7 mm (1.17 in)

Torque: 108 N·m (11.0 kgf·m/80 lb·ft)



RTW53ASH000301

7. Install upper control arm assembly with the fulcrum pin projections turned inward.



RTW53CSH000101-X

8. Install the caster shims (b) between the chassis frame and fulcrum pin.

4.3 Starter Motor Bench Tests

Preliminary Checks

1. Check the drive assembly is fully retracted.
2. Check the drive assembly pinion turns freely on the planetary drive shaft.
3. Perform the No Load Test (as outlined in this Section) if the drive assembly is not fully retracted.
4. Disassemble and service the starter motor if it fails the No Load test, refer to 4.4 Starter Motor Disassemble and Reassemble in this Section.

Pull-in Test

1. Clamp the starter motor, by the mounting lug in the drive-end housing, in a vice with soft jaws.
2. Remove the nut (1) and washer (2) from the solenoid switch M terminal (3).
3. Remove the braided cable (4) from the solenoid switch M terminal.

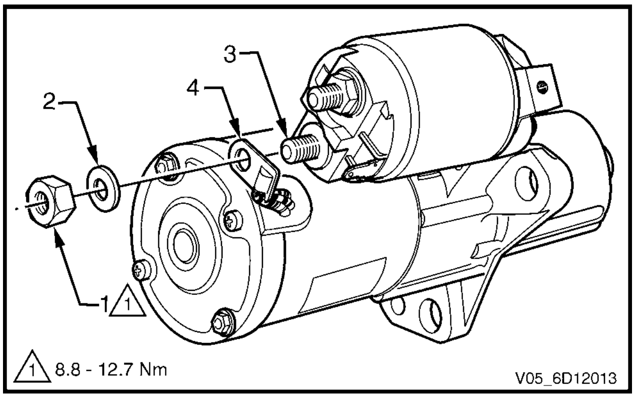


Figure 6D1-2 – 14

4. Connect the starter motor to an auxiliary battery, as follows:
   a. Connect the test lead (1) between the battery negative post to the solenoid switch M terminal (3).
   b. Connect the test lead (2) battery positive post.
5. Momentarily hold the free end of test lead (2) to solenoid switch terminal P – 3.
6. Check the solenoid switch activates and the drive assembly moves outward.
7. Disassemble and service the starter motor if the solenoid switch activates but the drive assembly does not move, refer to 4.4 Starter Motor Disassemble and Reassemble in this Section.
8. Replace the solenoid switch if it does not activate (there is no sound or movement).

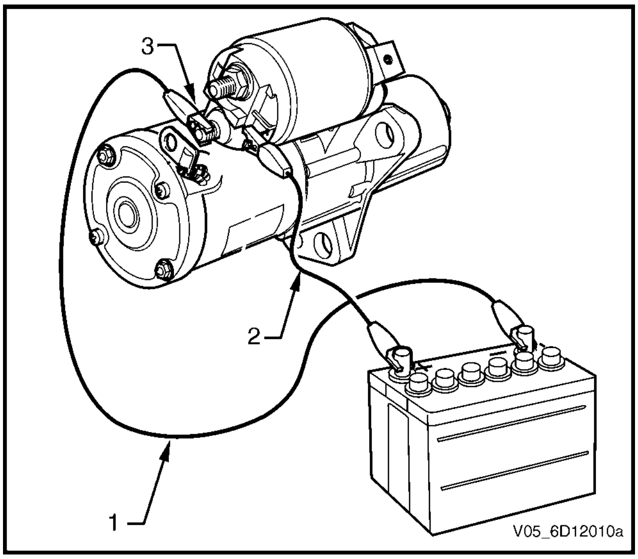


Figure 6D1-2 – 15

Hold-in Test

1 Connect the starter motor to an auxiliary battery, as follows:

   a Connect the test lead (1) between the battery negative post to the solenoid switch M terminal.

   b Connect the test lead (2) from the battery positive post to solenoid switch terminal P – 3.

   c Connect the test lead (3) to the starter motor casing.

2 Disconnect the test lead (1) from the M terminal of the solenoid switch.

3 Check the drive assembly remains extended.

4 Replace the solenoid switch if the drive assembly returns back into the starter motor.

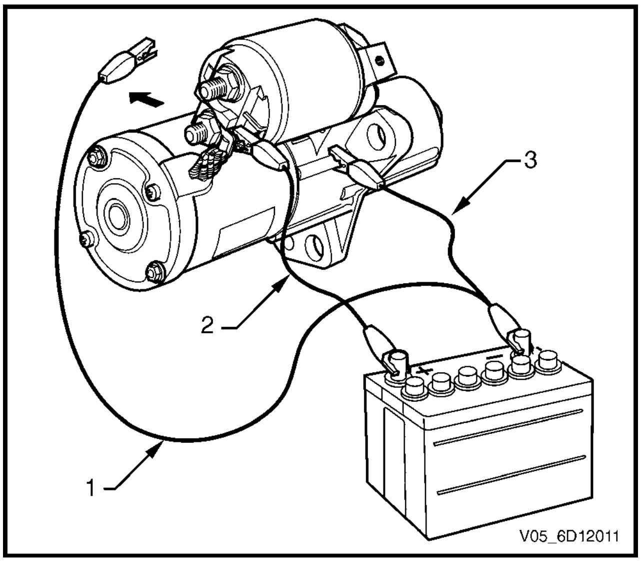


Figure 6D1-2 – 16

Drive Assembly Return Test

1 Connect the starter motor to an auxiliary battery, as follows:

   a Connect the test lead (1) between the battery negative post to the solenoid switch M terminal.

   b Connect the test lead (2) from the battery positive post to solenoid switch terminal P – 3.

   c Connect the test lead (3) to the starter motor casing.

2 Disconnect the test lead (1) from the M terminal of the solenoid switch.

3 Disconnect the negative lead (2) from the starter motor casing.

4 Check the drive assembly returns back into the starter motor.

5 Replace the solenoid switch if the drive assembly does not retract.

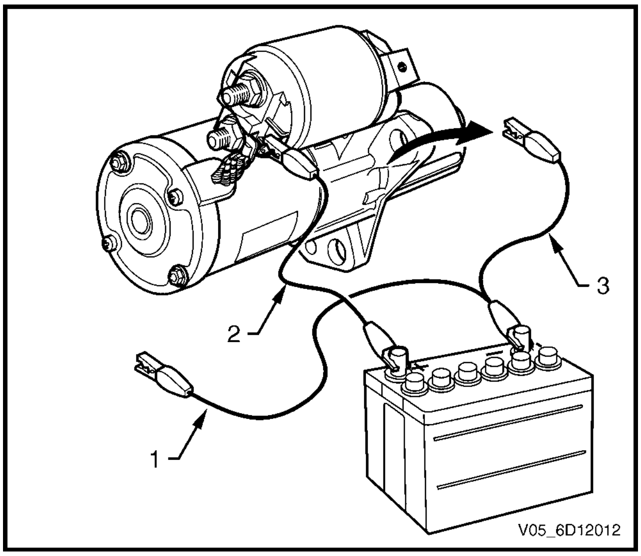


Figure 6D1-2 – 17

No Load Test

1 Clamp the starter motor securely to a test bench.

2 Connect the starter motor as shown in Figure 6D1-2 – 18, Close the start switch to activate the starter motor.

4 Record the speed of the planetary drive shaft, current draw and the voltage.

5 Check the readings are within the specifications.

Minimum r.p.m.	2370
Maximum current draw	90 A
M Terminal voltage	12 ± 0.1 V

6 Disassemble and service the starter motor if the readings are not within the specifications, refer to 4.4 Starter Motor Disassemble and Reassemble.

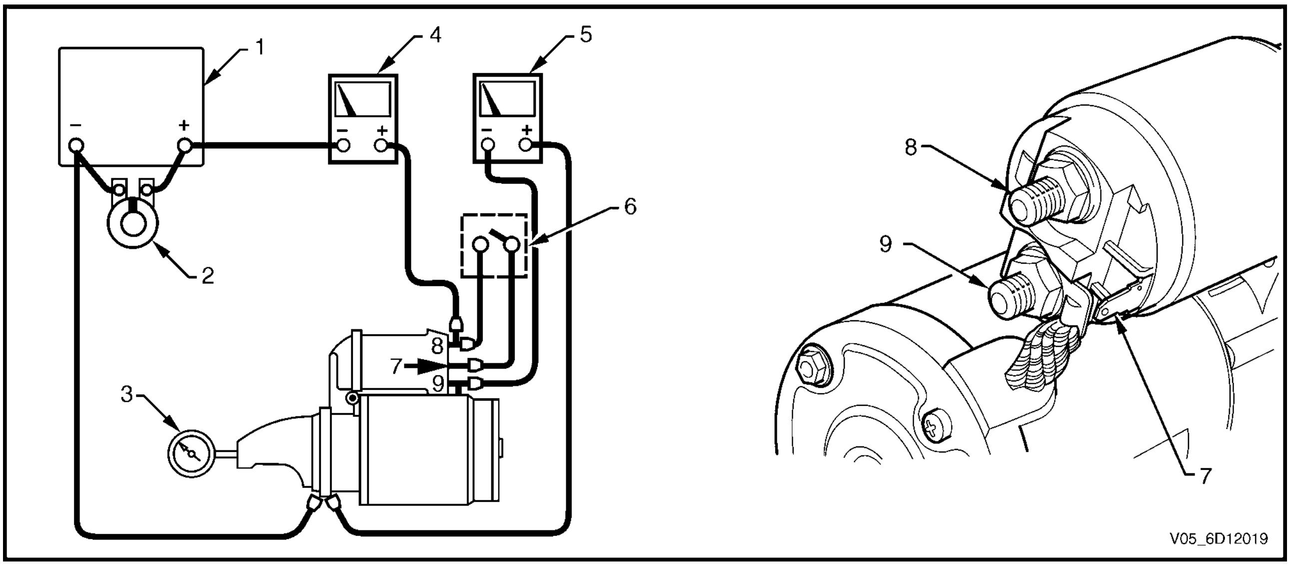


Figure 6D1-2 – 18

Legend

1 Battery
2 Carbon Pile
3 Shaft Speed Indicator
4 Multimeter set to measure current
5 Multimeter set to measure voltage
6 Start Switch
7 Solenoid Switch P – 3 pin 1
8 Solenoid Switch P – 4 pin B
9 Solenoid Switch M terminal

4.4 Starter Motor Disassemble and Reassemble

Disassemble

1 Clamp the starter motor, by the mounting lug in the drive-end housing, in a vice with soft jaws.

2 Remove the nut (1) and washer (2) from the solenoid switch M terminal (3).

3 Remove the braided cable (4) from the M terminal.

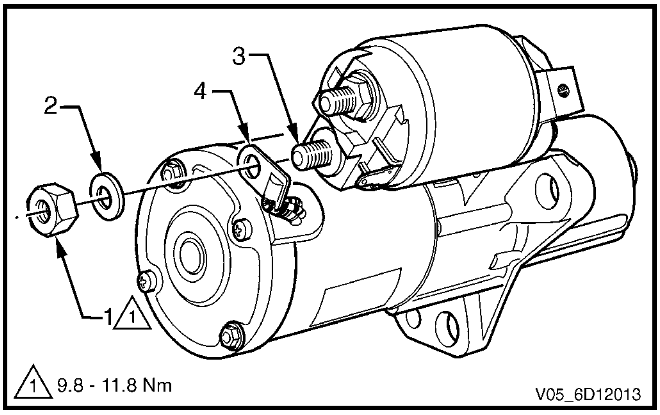


Figure 6D1-2 – 19

4 Scribe aligning marks (1) on the drive-end housing (2) and the solenoid switch housing (3) to aid reassembly.

CAUTION

When using an impact driver, avoid damaging the drive-end housing or rounding the screw slots of the solenoid switch mounting screws.

5 Remove the two solenoid switch mounting screws (4). It may be necessary to loosen the mounting screws using an impact driver.

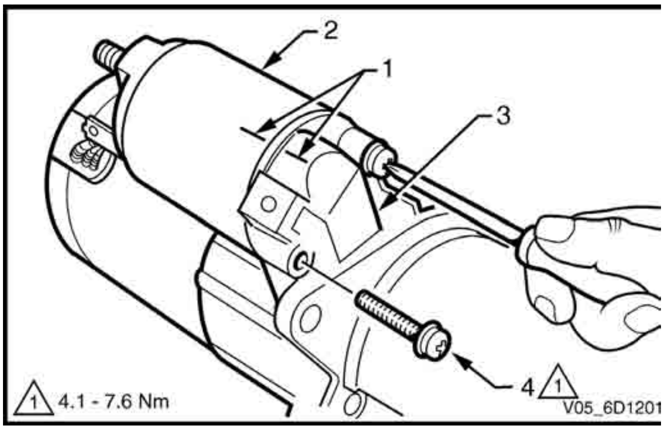


Figure 6D1-2 – 20

6 Remove the solenoid switch from the drive-end housing.

CAUTION

Do not lose the plunger return spring.

7 Unhook and remove the solenoid switch plunger (1) from the drive assembly fork lever (2).

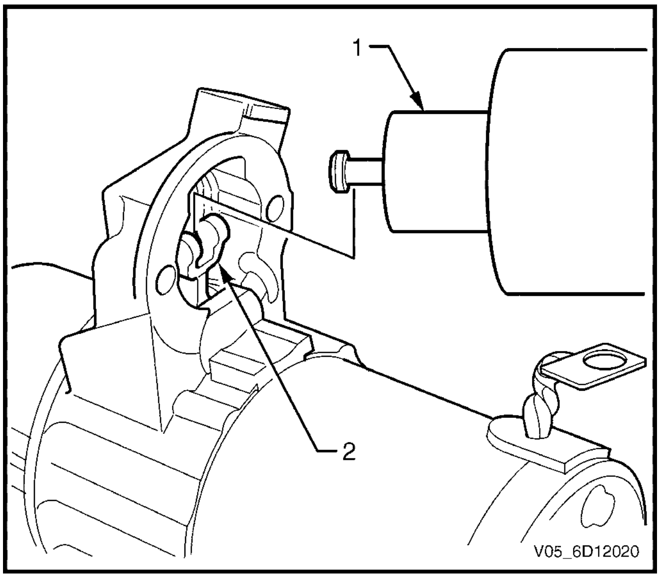


Figure 6D1-2 – 21

Reassemble

1 Reassemble the solenoid in the reverse order of the disassembly procedure noting the following points.

WARNING

Dry all parts thoroughly before assembly, taking care not to breathe in any vapours.

2 Lightly coat the solenoid switch plunger with 10% molybdenum disulphide grease.

CAUTION

Excess grease can enter the contact chamber of the solenoid switch and cause contact problems. Do not use too much grease.

3 Hook the plunger over the fork lever.

4 Insert the return spring into the plunger.

5 Slide solenoid switch over the plunger.

6 Align the solenoid switch with drive-end housing ensuring the solenoid switch terminal P – 4 faces away from the pole housing.

7 Install and tighten the solenoid switch mounting screws.

Solenoid switch mounting screw torque specification ....4.1 – 7.6 Nm

8 With the starter motor reassembled, perform a No Load Test, refer to 4.3 Starter Motor Bench Tests.

9 If the starter motor fails the No Load Test specification, replace the starter motor.

4.5 Solenoid Switch Tests

Test the Solenoid Switch

1 Inspect the solenoid switch for any external damage.

2 Replace the solenoid switch if it displays significant damage.

3 Install the return spring and plunger into the solenoid switch.

4 Check the movement of the plunger, as follows:

a Depress the plunger fully.

b Release the plunger.

c If the plunger sticks or binds in the switch bore, clean or replace the solenoid switch assembly as required.

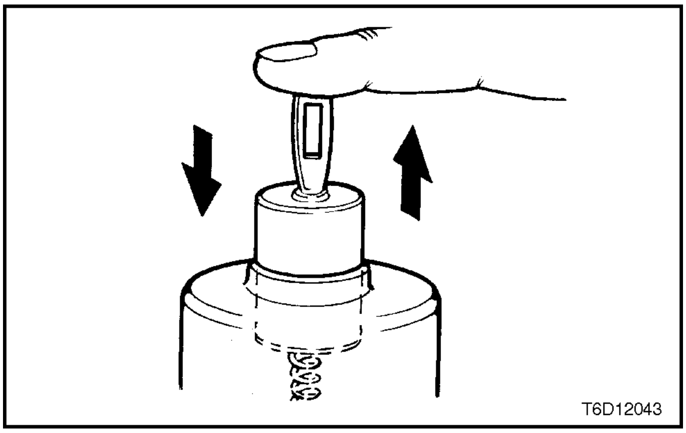


Figure 6D1-2 – 22

5 Connect a multimeter set to measure resistance between the solenoid switch M terminal (1) and the solenoid switch terminal P – 3 (2).

6 Record the resistance reading.

7 Replace the solenoid switch if the resistance is outside the specification.

Pull-in winding resistance @ 20°C................................0.33 – 0.37 Ω

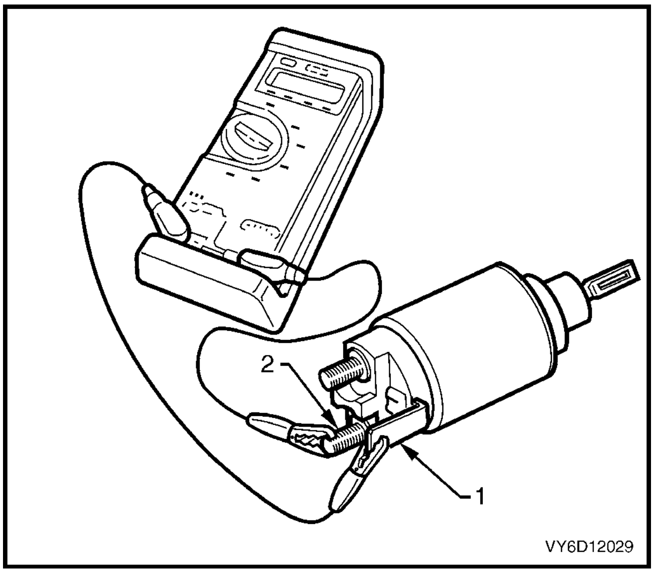


Figure 6D1-2 – 23

8 Connect a multimeter set to measure resistance between the solenoid switch housing (1) and the solenoid switch terminal P – 3 (2).

9 Replace the solenoid switch if the resistance is outside the specification.

Hold-in winding resistance @ 20°.................................0.75 – 0.87 Ω

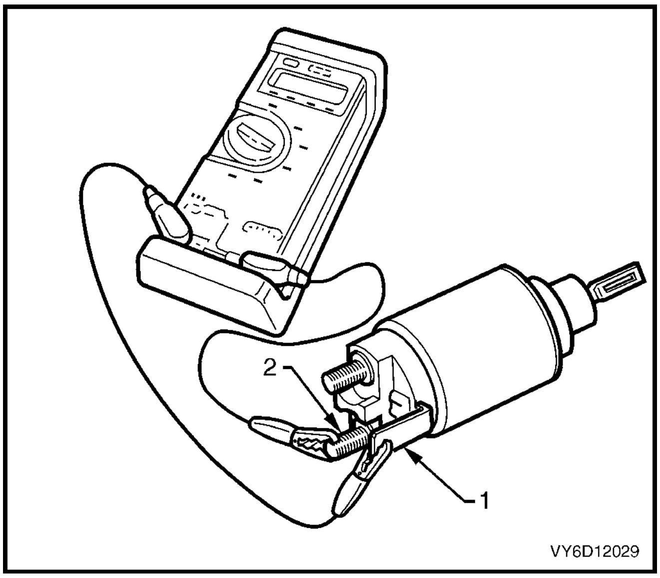


Figure 6D1-2 – 24

10 Fit a rubber band (1) around the plunger and switch housing to avoid ejecting the plunger.

11 Hold the solenoid switch vertically with the plunger pointing upwards.

12 Use a power supply (2) capable of supplying 30 A or use a battery and a variable resistor.

13 Set the power supply to 3.0 V.

14 Connect the power supply negative lead to the solenoid switch body.

15 Connect the power supply positive lead to the solenoid switch terminal P – 3 (5).

16 Connect a test lamp (3) between the solenoid switch terminal P – 4 (7) and the battery.

17 Connect a multimeter set to measure voltage (4) between the solenoid switch terminal P – 3 (5) and the solenoid switch housing.

18 Press the solenoid plunger in until the test lamp illuminates.

19 Allow the plunger to move out by 8 – 10 mm.

20 Hold the plunger in this position.

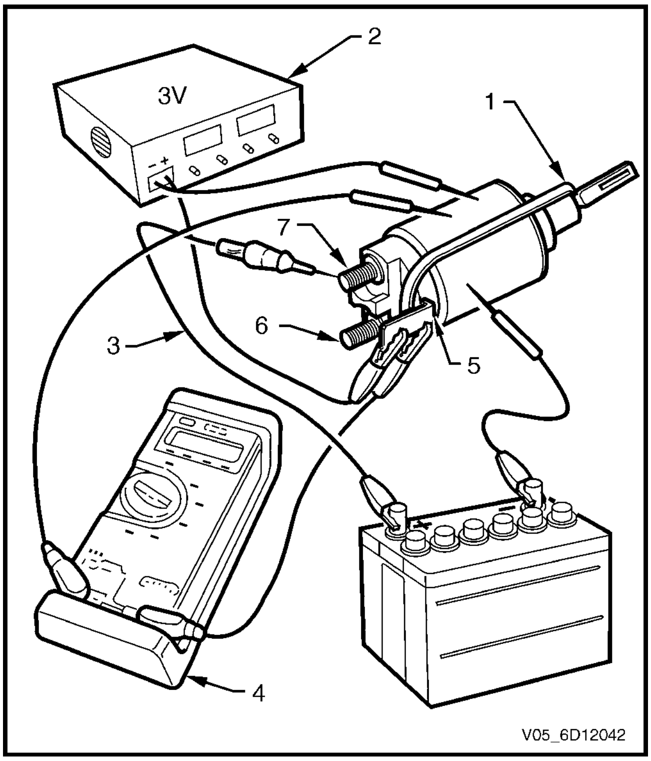


Figure 6D1-2 – 25

CAUTION

The test duration for the following step should be no more than 2 seconds.

21 Slowly increase the power supply voltage on the solenoid switch terminal P – 3 until the plunger pulls in.

22 Record the multimeter reading and reduce the voltage applied to the solenoid switch terminal P – 3.

23 Replace the solenoid switch if the voltage reading is significantly higher than the specification.

Pull-in voltage @ 20°C..8.0 V

24 Check the continuity across the main contacts in the switch.

25 Increase the voltage on the solenoid switch terminal P – 3 (5) until the plunger pulls in.

26 Ensure the test lamp illuminates fully.

27 Replace the solenoid switch if the test lamp illuminates poorly.

28 Set the power supply to 12 V (1).

29 Connect the power supply positive lead to the solenoid switch terminal P – 3 (2).

30 Connect the power supply negative lead to the solenoid switch housing (3).

31 Press the plunger in fully.

32 Release the plunger. The hold-in winding should hold the plunger in.

33 Replace the solenoid switch if the winding does not hold the plunger in.

34 Decrease the voltage until the plunger releases.

35 Record the multimeter reading.

36 Replace the solenoid switch if the voltage reading is significantly higher than the specification.

Hold-in voltage @ 20°C..........................1.7 – 3.0 V

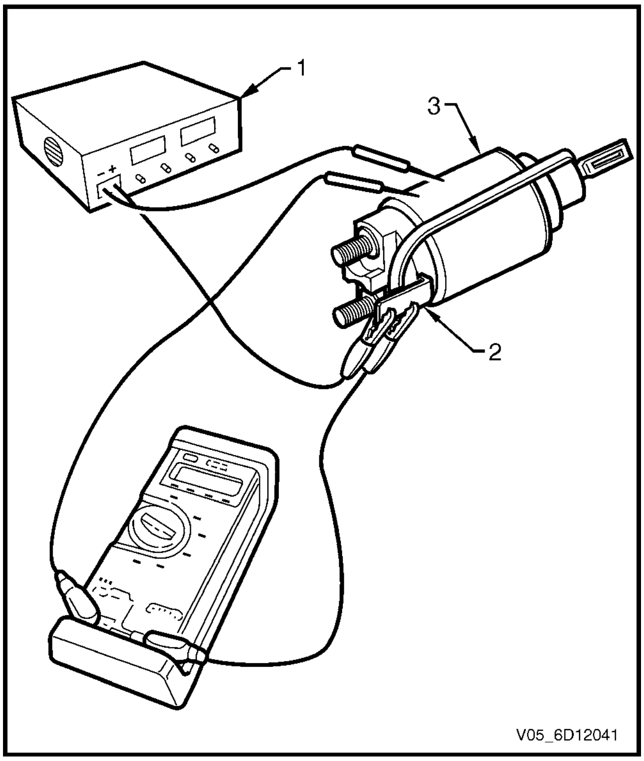


Figure 6D1-2 – 26

37 Connect a test lamp between the solenoid switch terminal P – 4 and the 12 volt power supply.

38 Press the plunger in until the test lamp illuminates.

39 Attempt to press the plunger into the solenoid switch housing a further 1 mm.

40 Replace the solenoid switch if the plunger cannot move at least a further 1 mm.

41 Connect the positive lead of a 24 volt power supply (1) to the positive lead of a multimeter set to measure voltage.

42 Connect the negative lead of a 24 volt power supply to the solenoid switch housing (2).

43 Connect the multimeter negative lead to the solenoid switch terminal P – 4 (3).

44 Press the plunger (4) in fully.

45 Release the plunger. The plunger should return to its rest position.

46 Replace the solenoid switch if the plunger does not return.

NOTE

This indicates the windings have an internal winding short circuit. When the solenoid switch is connected in this way, the winding fields are in opposition to each other.

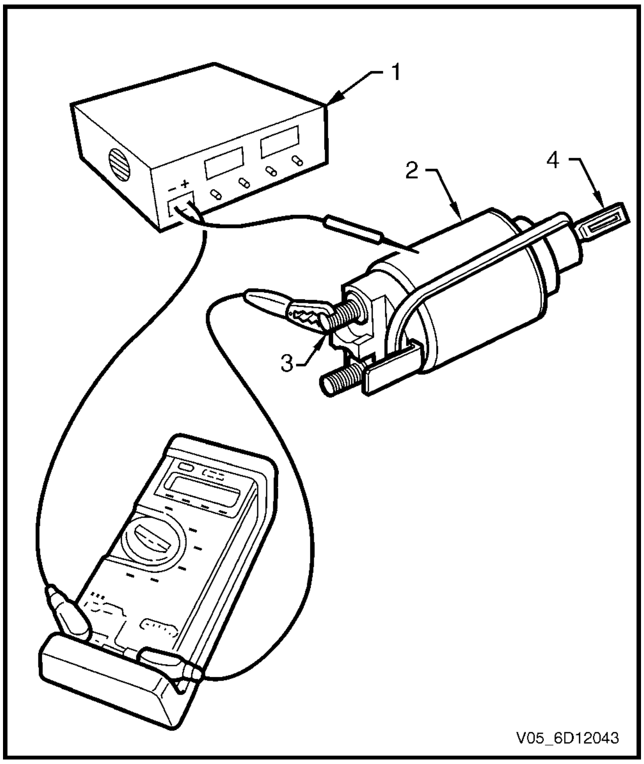


Figure 6D1-2 – 27

5 Specifications

Type..Six Pole Permanent Magnet, Four Brush, Planetary Drive

Rotation (Drive-End View) .... Clockwise

Number of Pinion Teeth...10

No load:

Minimum RPM 2370

Maximum Current Draw...65 A at 12.0 ± 0.1 V

M Terminal Voltage.. 12 ± 1 V

Locked:

Maximum Current (Including Solenoid Switch) .... 780 A

M Terminal Voltage.. 4 V

Minimum Torque.. 20 Nm

Solenoid detached:

Pull-in Winding Resistance @ 20°C ....0.33 – 0.37 Ω

Hold-in Winding Resistance @ 20°C ....0.75 – 0.87 Ω

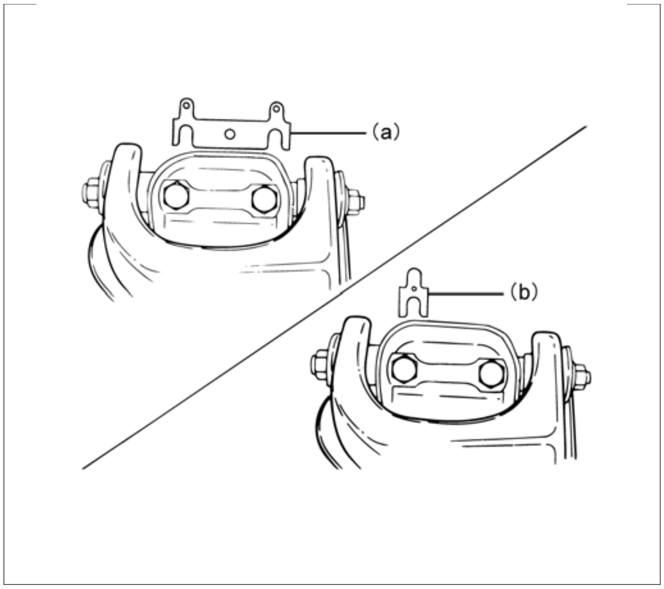
Pull-in Voltage @ 20°C ....8 V @ 20°C

Hold-in Voltage @ 20°C.. 1.7 – 3.0 V

6 Torque Wrench Specifications

	Nm
Solenoid Switch Mounting Screw	4.1 – 7.6
Solenoid Switch Terminal M Nut	10.0
Solenoid Switch Terminal P – 3 Nut	10.0
Starter Motor Mounting Bolt	45.0
Knock Sensor Bolt	23.0 Nm
Starter Motor Heat Shield Lower Bolt	23.0 Nm
Starter Motor Heat Shield Upper Screw	3.0 – 5.0 Nm

9. Install the camber shims (a) between the chassis frame and fulcrum pin.



RTW53CSH000201

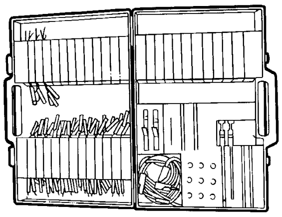
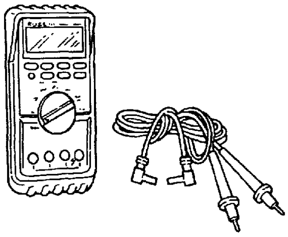
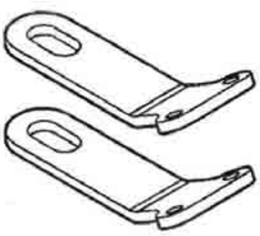
10. Install nut assembly.
11. Install bolt and plate (a), and then tighten the bolt to the specified torque.

Torque: 152 N·m (15.5 kgf·m/112 lb·ft)

NOTE: Apply oil to the thread.

12. Install speed sensor harness.

7 Special Tools

Tool Number	Illustration	Description	Tool Classification
KM609		**Connector Test Adaptor Kit** Used when carrying out electrical diagnostic circuit checks. Previously released	Desirable
3588 (J39200)		**Digital Multimeter** Must have at least 10 MΩ input impedance and be capable of reading frequencies. Previously released.	Available
EN – 46114		**Engine Lifting Brackets**	Available

6D1-3
Battery – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.1 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and/or property damage.

1 General Information

The vehicle is fitted with a 12 V battery located in the front right-hand corner of the engine compartment. The battery provides:

- power for cranking the engine,
- power for a limited time when the electrical load exceeds the generator output,
- power for the accessories when the engine is not running, and
- a voltage stabilising load for the electrical system.

1.1 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or

Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 Battery Terminals and Cables

The cables attached to the battery posts provide power and ground connections for the vehicle electrical system. These battery cables attach to the battery posts via nut-tightened terminals. The battery is held in position by a hold-down bracket and bolts. Refer to Figure 6D1-3 – 1.

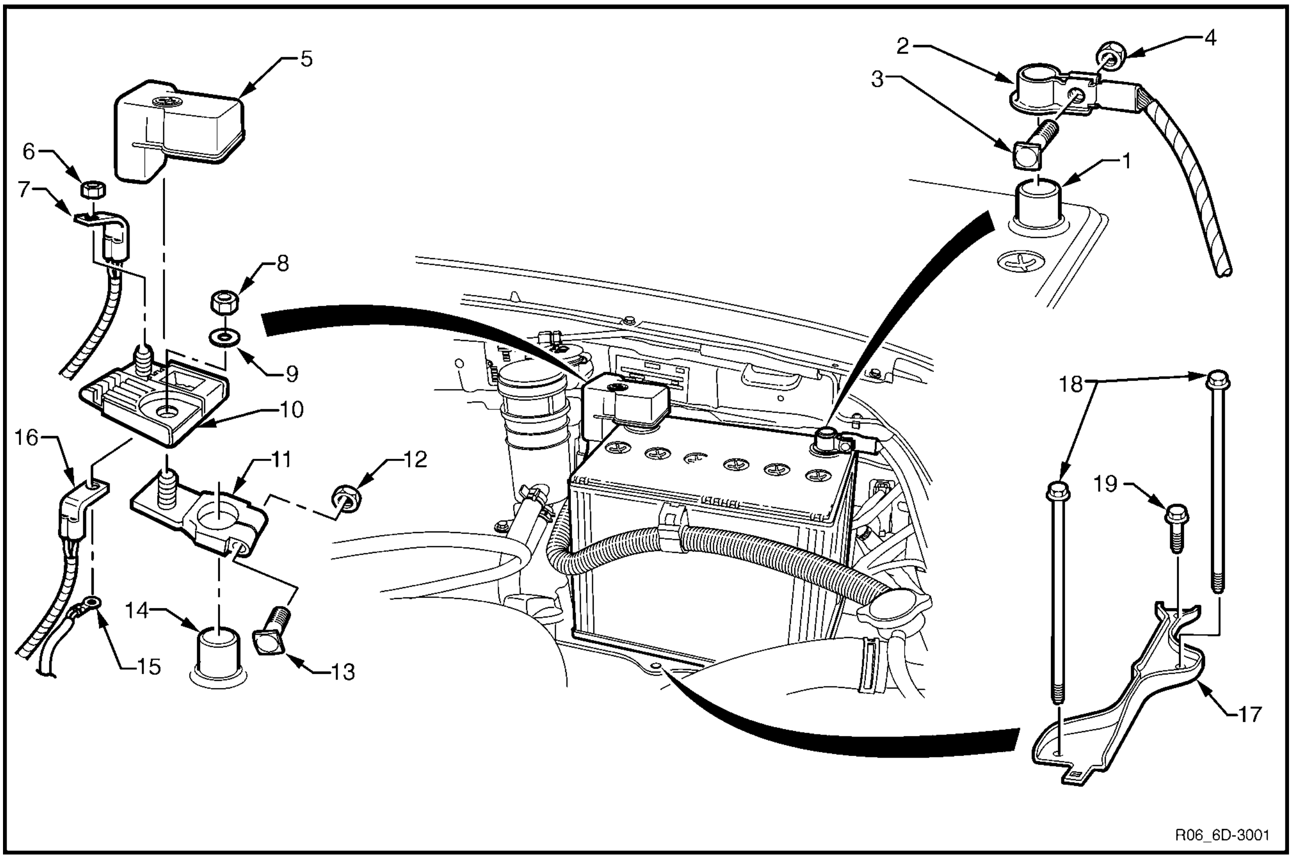


Figure 6D1-3 – 1

Legend

1	Negative Battery Post	7	Battery Positive Cable Assembly	13	Positive Battery Terminal Bolt
2	Negative Battery Terminal	8	Battery Fuse Box Nut	14	Positive Battery Post
3	Negative Battery Terminal Bolt	9	Battery Fuse Box Washer	15	Battery Positive Cable Assembly
4	Negative Battery Terminal Nut	10	Main Fuse Box Supply	16	Battery Positive Cable Assembly
5	Positive Connection Cover	11	Positive Battery Terminal	17	Battery Hold Down Bracket
6	Battery Positive Cable Nut	12	Positive Battery Terminal Nut	18	Battery Hold Down Bolts
				19	Battery Hold Down Bolt

1.3 Battery Ratings

There are two battery ratings to consider when replacing a battery, reserve capacity (RC) and cold cranking amps (CCA). Ensure the replacement battery meets or exceeds these rating specifications.

Reserve Capacity

The RC of a battery is the amount of time (measured in minutes) the vehicle will travel at night with minimum electrical load and no generator input.

This time is measured as the time taken for the battery voltage to reduce to 10.5 V from the following initial conditions:

- a fully charged battery at 25°C, and
- discharged at a constant current of 25 A.

Cold Cranking Amps

The CCA rating indicates the ability of the battery to maintain enough voltage for ignition requirements while supplying engine cranking current for long enough to start the engine under severely cold conditions.

The rating is the minimum amperage maintained when the engine is cranked for 30 seconds. The battery must maintain at least 7.2 V at 18°C.

Ratings

A specification label on the top of the battery displays the original equipment part number.

All vehicles are fitted with a low maintenance, 85 minute RC and 430 CCA battery.

2 Safety Precautions

WARNING

- **Battery fluid contains sulphuric acid, which can cause serious injury. Do not allow liquid from the battery to contact eyes or skin. If contact occurs, flush the area immediately with running water and contact a physician.**
- **Lead acid batteries produce explosive gases. Keep sparks, flames and lighted cigarettes away from the battery, especially when the battery is being charged. Failure to follow this warning could result in a battery explosion.**
- **Metal objects that touch a battery terminal can produce sparks that can cause serious burns. When working near a battery, take extra care with metal objects including tools and items of jewellery, especially rings and metal watchbands.**

CAUTION

Do not allow liquid from the battery to contact clothing or painted surfaces. If contact occurs, flush the area immediately with running water.

When working with or near the battery, always:

- Wear safety glasses and work gloves.
- Remove items of jewellery such as rings and metal watchbands.
- Ensure the ignition is switched off when connecting or disconnecting battery cables, battery charging equipment or battery jumper cables. Failing to do so can damage the vehicle electronic components.
- Disconnect the negative battery cable before disconnecting the positive cable from the battery. Inversely, connect the positive battery cable to the battery before connecting the negative cable. This reduces the possibility of shorting the battery to ground while working near the positive connections.

3 Diagnosis

3.1 Diagnostic Procedures

Introduction

This test is used to aid in diagnosing faults with the vehicle where the battery seems to be at fault.

With the increased use of electronic sensors and computer control, the battery is much more than just a component used to start a car. Low battery voltage can:

- affect the operation of the vehicle control modules and cause driveability problems, and
- cause the control modules to set diagnostic trouble codes (DTCs).

For example if a control module senses low battery voltage, it may increase fuel injector timing to increase engine rpm to increase the generator output.

Therefore consider the state of charge of the battery any time a customer complains of a driveability related problem.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 Checks the operator understands the safety precautions for working with batteries.

2 Checks if the vehicle is fitted with a battery of the correct specification.

3 Checks if the battery appears serviceable by performing the battery inspection procedure.

4 Checks if the battery loses charge over an extended period. If so the likely problem is excess current draw while the vehicles ignition is in the off position.

5 Checks the state of charge of the battery.

6 Checks if the battery is capable of delivering the required load by performing the load test procedure.

Diagnostic Table Notes

1 For all wiring harness fault diagnosis, refer to 8A Electrical Body & Chassis.

2 For wiring harness repairs, refer to 8A Electrical Body & Chassis.

3 Refer to 6D1 – 3 Battery – V6.

Diagnostic Table

Step	Action	Yes	No
1	Have you read and understood the safety precautions for working with batteries?	Go to Step 2	Refer to 2 Safety Precautions
2	Check the battery fitted is the correct specification recommended for the vehicle? Refer to 5 Specifications. Is the battery the correct specification?	Go to Step 3	Replace the battery with the correct specification
3	Perform the battery inspection, refer to 3.2 Battery Inspection. Does the battery appear serviceable?	Go to Step 4	Replace the battery, refer to 4.1 Battery
4	Does the customer complain the battery loses charge if the engine is not started for an extended period?	Preform the battery current draw test, refer to 3.5 Battery Current Draw Test	Go to Step 5

Step	Action	Yes	No
5	Perform the hydrometer test, refer to 3.3 Hydrometer Test. Is the battery fully charged?	Go to Step 6	Fully charge the battery, refer to 4.2 Battery Charge
6	Load test the battery, refer to 3.4 Load Test. Does the battery pass the load test?	Battery Serviceable. Refer to: 6D1–1 Charging System – V6.	Replace the battery, refer to 4.1 Battery
When all diagnosis and repairs are completed, check the system for correct operation.			

3.2 Battery Inspection

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 Check the battery terminals and around the battery area for corrosion deposits. Remove any deposits as follows:

a Scrub the area with a stiff brush.

b Treat the area with a solution of warm water and baking soda or ammonia.

c Rinse with clean water.

3 Check the battery posts, if they are loose, burned, pitted or damaged in any way replace the battery. Refer to 4.1 Battery.

4 Check the battery case, if it is cracked or damaged replace the battery. Refer to 4.1 Battery.

5 Remove each filler cap (1) and check the electrolyte level is at the bottom of the filler-neck tube (2).

6 If the level is low, carefully add distilled water to the cell until the level reaches the bottom of the filler-neck tube.

NOTE

Do not overfill the cells, but maintain the level at least 20 mm above the separator plates (3).

7 If the electrolyte usage seems excessive, check the battery case is not faulty.

NOTE

Normal electrolyte usage is less than 30 ml per 10,000 kilometres (or slightly more for long, continuous running or in high temperatures).

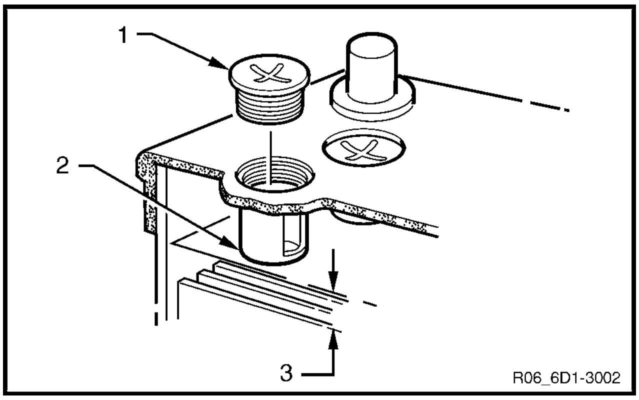


Figure 6D1-3 – 2

8 Ensure the battery hold-down bolts (2 & 3) and bracket (1) firmly secure the battery.

Battery hold-down bolt torque specification ....8.0 – 10.0 Nm

9 Check the cable insulation for damage or wear along the cable. Replace the cable as required.

10 Check the cables do not have broken or frayed strands and are secure in the terminals. Repair as required.

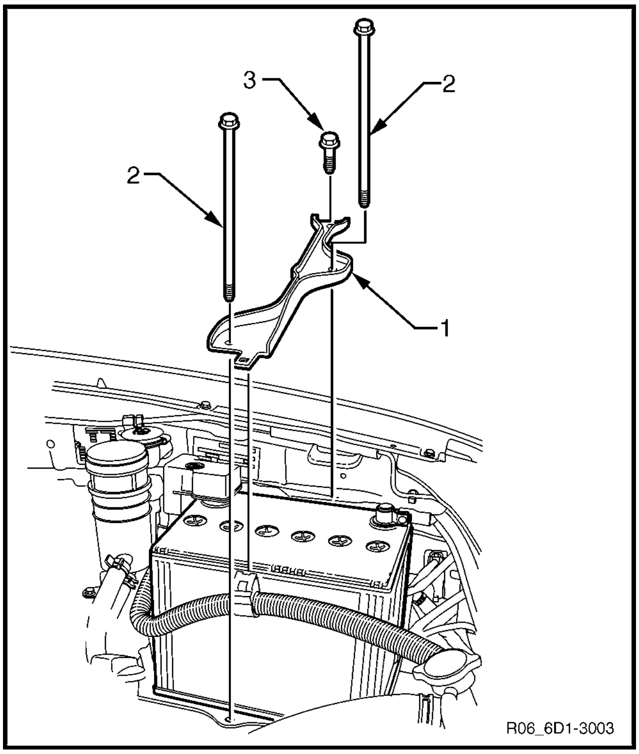


Figure 6D1-3 – 3

11 Ensure the terminal clamp (2) sits below the top of the battery post (1).

12 Check the terminal clamps are attached to the battery posts securely. Replace the terminals as required.

13 Tighten the terminal clamp nuts to the correct torque specification.

Battery terminal nut torque specification ....2.0 – 5.0 Nm

14 Smear the battery posts and terminals with petroleum jelly to resist corrosion.

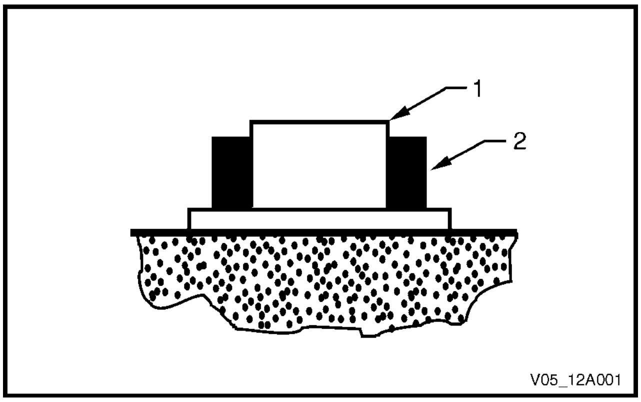


Figure 6D1-3 – 4

3.3 Hydrometer Test

As a lead-acid battery discharges, sulphur elements in the electrolyte move from the electrolyte solution into the lead battery plates. This removes the sulphuric acid from the electrolyte and changes it to water. Therefore the concentration of sulphuric acid in the electrolyte indicates the state of charge.

The concentration of sulphuric acid can be measured using a hydrometer. The state of charge is measured in terms of specific gravity; the lower the specific gravity reading, the lower the state of charge.

NOTE

If distilled water has been added to the battery, do not use the hydrometer until the battery has been charged for at least 30 minutes.

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 Remove the battery filler caps.

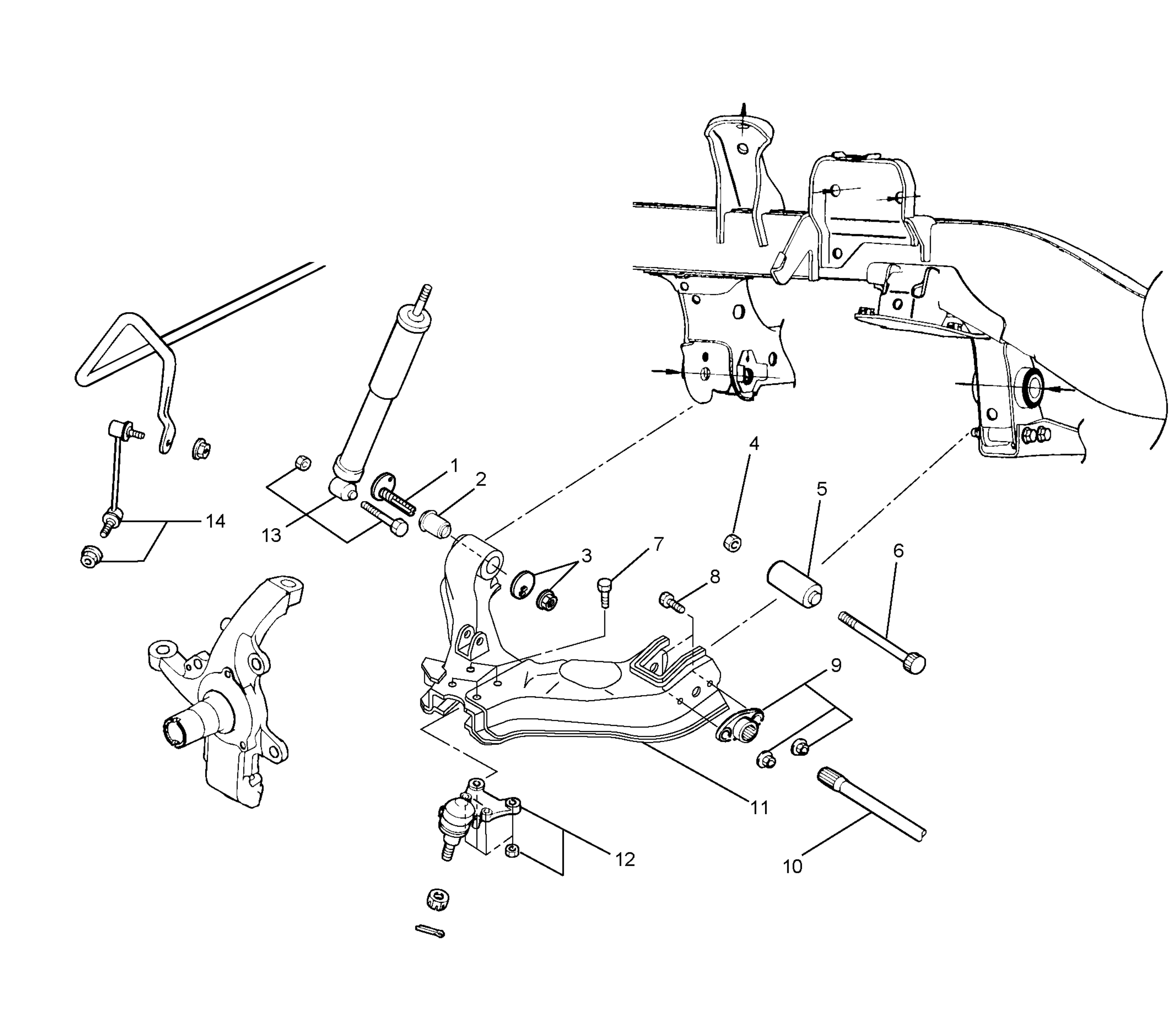
3 Force the air out of the hydrometer bulb.

4 Hold the hydrometer vertically in the cell with the pick-up tube submerged.

5 Draw in sufficient liquid to lift the hydrometer float freely when the bulb is fully released.

Lower Control Arm

Lower Control Arm and Associated Parts



RTW33CLF000201

Legend

- (1) Cam Bolt
- (2) Bush, Front
- (3) Cam Plate and Nut
- (4) Nut, Rear
- (5) Bush, Rear
- (6) Bolt, Rear
- (7) Bolt, Lower Ball Joint
- (8) Bolt, Torsion Bar Arm
- (9) Torsion Bar Arm Bracket and Nut
- (10) Torsion Bar
- (11) Lower Control Arm
- (12) Lower Ball Joint and Nut
- (13) Shock Absorber, Bolt and Nut
- (14) Stabilizer Link and Nut

6 Still holding the hydrometer vertically, record the reading.

7 Put the electrolyte back into the cell.

8 Repeat steps 3 to 7 for each cell.

9 Determine the temperature of the battery by temporarily placing a thermometer (1) into one of the cells (2).

10 Install the battery filler caps.

11 Calculate the temperature-compensated readings: add 0.004 for every 5°C above 27°C or subtract 0.004 for every 5°C below 27°C.

12 Determine the state of charge of the battery using the temperature-compensated readings and the table below.

NOTE

The specific gravity of a charged battery should not vary more than 0.025 between cells. Larger variations indicate defective cells and the battery must be replaced, refer to 4.1 Battery.

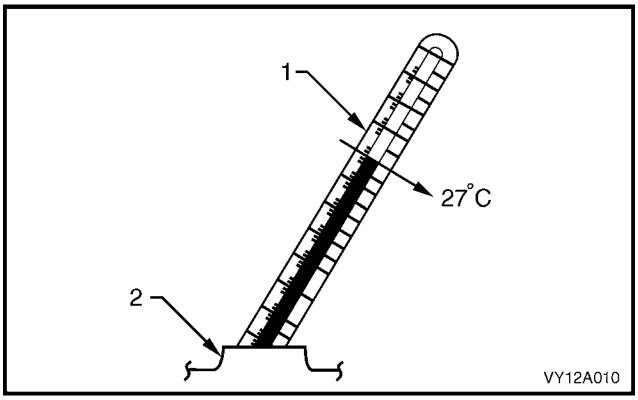


Figure 6D1-3 – 5

Battery Condition	Specific Gravity Reading
Fully charged	1.240 to 1.260
Requires charging	< 1.190
Fully discharged	1.110 to 1.130

3.4 Load Test

Load testing the battery with a high rate discharge (HRD) tester simulates using the starter motor and checks if the battery is in serviceable condition. The battery must be at least 65% charged before commencing this test.

NOTE

HRD testers are available with either fixed or variable loads. The operating procedures may vary from brand to brand, therefore follow the manufacturer's instructions.

High Rate Discharge Load Test

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 Ensure the state of the battery is at least 65% charged. Refer to 3.3 Hydrometer Test.

3 Refer to Warning, Caution and Notes in this section, before disconnecting the battery.

4 Disconnect the battery negative terminal.

5 Disconnect the battery positive terminal.

6 Connect the HRD tester to the battery terminals ensuring correct polarity.

7 Set the tester switches to suit the battery size.

Fixed load tester:

a Apply the load for approximately 10 seconds to remove any surface charge.

b Wait 15 seconds for the battery to recover.

Variable load tester:

a Apply a 300 A load for approximately 15 seconds to remove any surface charge.

b Wait 15 seconds for the battery to recover.

8 If possible, set the selector to 50% of rapid discharge current (or three times the 20 hour discharge rate).

9 Apply the load test for 10 seconds and record the battery voltage. If one cell is faulty it will gas excessively or overheat. This indicates a faulty battery.

10 Recharge the battery if the voltage is at or below the minimum voltage specified by the HRD manufacturer (or 9.6 V).

11 Replace the battery if the voltage is below the minimum voltage specified by the HRD manufacturer (or below 9.6 V after the battery is charged and the test is repeated). Refer to 4.1 Battery.

12 Connect the battery positive terminal.

13 Connect the battery negative terminal.

Alternate Load Test

If HRD test equipment is not available, test the battery as follows:

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 Ensure the state of the battery is at least 65% charged. Refer to 3.3 Hydrometer Test.

3 Connect a voltmeter (1) between the battery terminals.

4 Turn the headlights on to high-beam for 10 seconds to remove any surface charge from the battery.

5 Remove fuses EB11 and EB12 from the engine compartment fuse and relay housing. This prevents vehicle ignition and fuel injection while cranking the engine.

6 Crank the engine and read the voltmeter. At temperatures above 5°C, the voltage of a fully charged battery should not fall below 9.6 V.

NOTE

- If the battery and engine temperatures are below 5°C, the voltage may fall to 9 V.
- Try to avoid activating the starter motor continuously for more than 30 seconds. If activating the starter motor for 30 seconds, allow the starter motor to cool for 3 minutes.

7 Replace the battery if a cell gasses excessively or overheats or if the voltage falls away quickly.

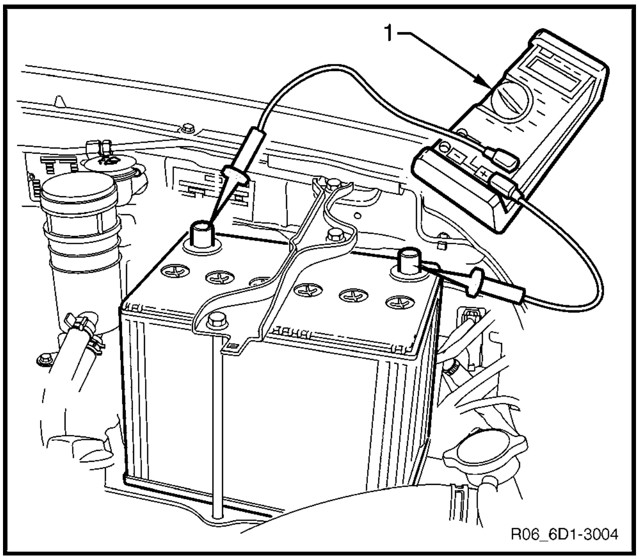


Figure 6D1-3 – 6

3.5 Battery Current Draw Test

The following test determines if excess current is being drawn from the battery whilst the vehicle has all accessories turned off. Excess current draw will cause the battery to go flat if the vehicle is not started for an extended period.

Test Preparation

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 If the battery is flat, temporarily install a good battery for the duration of the test.

3 Ensure the vehicle starts and the accessories operate normally.

4 Ensure the theft deterrent system operates normally. Refer to 11A Immobiliser.

5 Open all the side windows for access purposes.

6 Switch the ignition off.

7 Check that all interior illumination is off, including any compartment lighting.

8 Close all doors.

9 Lock the doors and activate the theft deterrent system to arm the vehicle.

10 If the multimeter contains fuses, check they are serviceable.

Test Procedure

1 Switch the multimeter to the mA current range (1).

2 Connect the positive test lead (2) to the fused mA terminal of the multimeter.

3 Connect the negative test (3) lead to the common terminal of the multimeter.

4 Connect large alligator clips to the ends of both test leads.

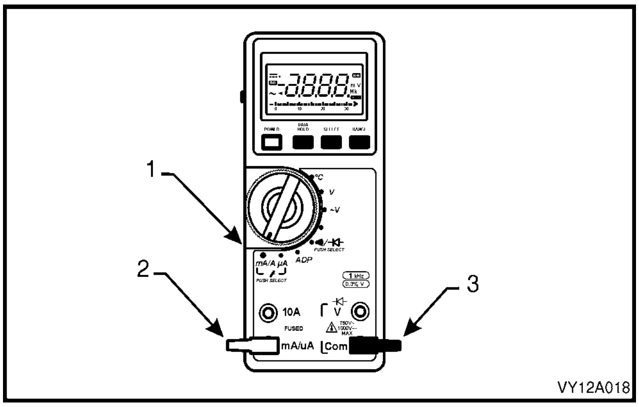


Figure 6D1-3 – 7

5 Connect the negative test lead clip to the threads of the battery negative terminal clamp (1).

6 Connect the positive lead's clip to the threads of a convenient engine bolt (2).

CAUTION

Do not turn on the ignition switch while this test is in progress. It will blow the multimeter's low current fuse.

7 Check the multimeter connections are secure.

8 Disconnect the vehicle's main electrical earth by removing the battery negative terminal cable retaining nut (3) and separating the cable from the battery clamp.

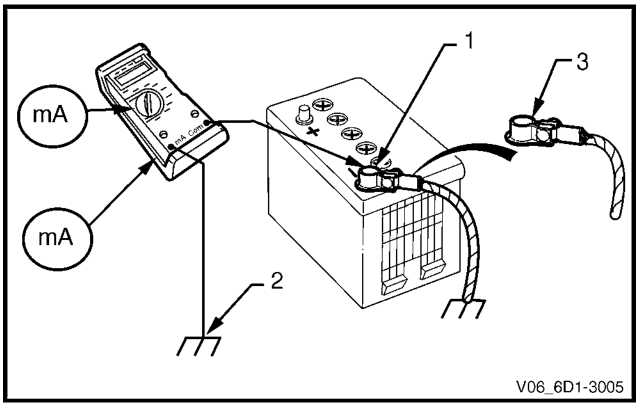


Figure 6D1-3 – 8

9 Read the vehicle's battery saver current on the multimeter. The multimeter reading should be within 16 – 30 mA (fluctuating).

10 If the multimeter reading is higher than specified, refer to Fault Diagnosis in this Section, otherwise restore the vehicle to its prior condition, refer to Restore in this Section.

Fault Diagnosis

CAUTION

Do not open any doors during this inspection. If the doors must be opened, reinstall the battery terminal to the battery clamp to protect the multimeter's fuse from blowing. Alternatively, use the higher (10 A) fuse rated terminal on the multimeter until the source of the higher current draw has been found.

1 Visually inspect the vehicle for illuminated lamps and components activated by energised relays.

2 If the cause of the excessive current draw is not apparent, remove one fuse (or circuit breaker) at a time to determine the circuit group that is drawing excess current. Refer to 8A Electrical Body & Chassis for fuse grouping location.

3 When the circuit group is determined, install the fuse / circuit breaker and identify the specific circuit within this group that is drawing the excess current. Disconnect the wiring harness connectors in this circuit group one at a time. Refer to 8A Electrical Body & Chassis.

4 When the cause is disconnected, the multimeter reading should drop to the correct reading as outlined in Step 9 of the Test Procedure in this Section.

5 If required, remove the components in this circuit one at a time to determine the cause of the excessive standing current. Refer to 8A Electrical Body & Chassis.

6 Repair the fault, refer to 8A Electrical Body & Chassis.

7 Ensure any fuses, circuit breakers and connectors that have been removed are secure.

Restore

1 Reconnect the electrical earth cable to the battery terminal and tighten the nut to the correct torque specification.

Battery terminal nut torque specification ....2.0 – 5.0 Nm

2 Disconnect the multimeter connections.

4 Service Operations

4.1 Battery

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 1.1 WARNING, CAUTION and NOTES before disconnecting the battery.

1 Read and obey the safety precautions for working with batteries, refer to 2 Safety Precautions.

2 Disconnect the negative battery terminal (1).

3 Disconnect the positive battery terminal (2).

4 Remove the battery hold-down bolts (3 & 4) three places, and the battery hold-down bracket (5).

5 Lift the battery out of the engine compartment.

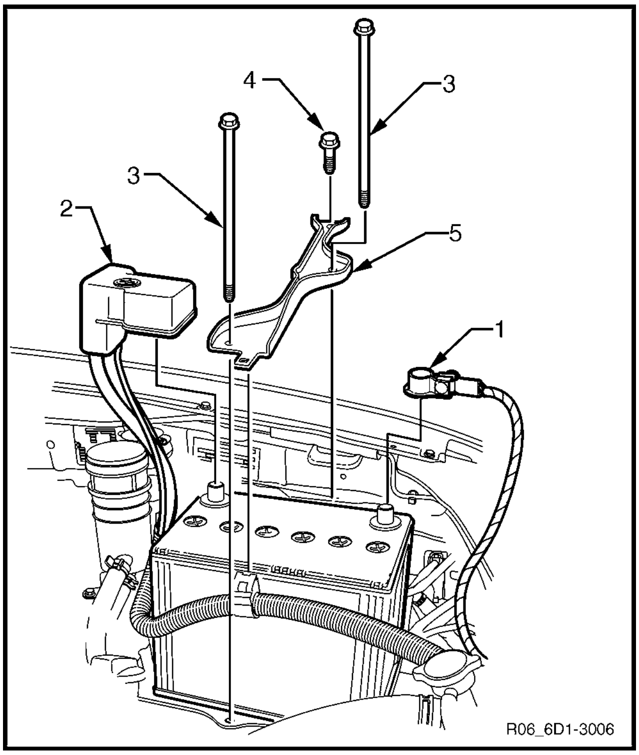


Figure 6D1-3 – 9

Reinstall

NOTE

Before installing a used battery perform steps 1 to 10 of the battery inspection, refer to 3.2 Battery Inspection.

1 Ensure the battery tray, cables and terminals are clean and free from corrosion and moisture.

2 Ensure that no foreign objects such as loose nuts or stones are located in the battery tray.

3 Place the battery onto the battery tray and ensure the battery sits level.

4 Install the battery hold down bracket and tighten the bolt to the specified torque.

Battery hold-down bolt torque specification	8.0 – 10.0 Nm

5 Install the positive terminal onto the positive battery post. Ensure the terminal sits below the top of the post and tighten the terminal nut to the correct specification.

Battery terminal nut torque specification	2.0 – 5.0 Nm

6 Install the negative terminal onto the negative battery post. Ensure the terminal sits below the top of the post and tighten the terminal nut to the correct specification.

Battery terminal nut torque specification	2.0 – 5.0 Nm

7 Smear the battery posts and cable terminals with petroleum jelly to inhibit corrosion.

4.2 Battery Charge

Safety Precautions

Read and obey the general safety precautions for working with batteries, refer to 2 Safety Precautions.

The battery releases an explosive hydrogen and oxygen gas mixture during charging. Ensure there are no naked flames or sparks near the battery.

Flat batteries can be safely boost-charged, however avoid excessive charging current if the battery is more than half charged. Slow charging is best.

Fast charging can substantially boost a battery, but slow charging is required to fully charge the battery.

Do not use a fast charger:

- for starting the vehicle,
- if the specific gravity readings are not uniform between battery cells, refer to 3.3 Hydrometer Test,
- if the specific gravity readings are above 1.20, refer to 3.3Hydrometer Test,
- if the electrolyte is discoloured with brown sediment, and
- if any of the above three conditions develop after beginning a fast charge.

Battery Charge Procedure

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to Warning, Caution and Notes in this section before disconnecting the battery.

1 Perform steps 1 to 10 of the battery inspection, refer to 3.2 Battery Inspection.

2 Remove the battery from the vehicle. Refer to 4.1 Battery.

3 If required remove the battery filler caps. Let the caps rest loosely on top of the filler tubes.

CAUTION

Always ensure the connections are to the correct polarity and follow the manufacturer's recommendations for battery charging.

4 Connect the battery to the battery charger.

5 Set the charging current using the following table as a guide.

NOTE

Charging a battery at higher current rates can significantly reduce the life of the battery.

Charge Rate	Initial Current	Maximum Time Required
Slow charge	4 A	24 hours
Fast charge	35 A	2 hours

6 After a few minutes, check the colour and specific gravity of the electrolyte. Refer to 3.3 Hydrometer Test.

7 Monitor the electrolyte temperature while the battery is charging. If the electrolyte temperature reaches 55°C:

a switch the charging current off,

b allow the battery to cool,

c reduce the charging current, and

d restart charging the battery.

NOTE

For the best results, charge the battery with the electrolyte and plates at room temperature. An extremely cold battery may not appear to accept current for several hours after starting the battery charger. If the battery does not appear to accept charge after several hours replace the battery.

8 For slow charging check the voltage and specific gravity each hour or more regularly for fast charging. Stop the charging when there is no change in voltage or electrolyte specific gravity over three checks.

9 If the battery was fast charged connect the battery to a slow-charger for a few hours to bring the battery to the fully charged condition. Ensure the last few hours of charge do not exceed 1 A.

10 Tighten the filler caps. Ensure they are secure.

11 Install the battery in the vehicle. Refer to 4.1 Battery.

4.3 Emergency Jump Starting Procedure

Safety Precautions

- Read and obey the general safety precautions for working with batteries, refer to 2 Safety Precautions.
- Do not allow the vehicles to touch each other during the jump starting procedure.
- Ensure the assisting vehicle battery has the same voltage rating and connects negative to ground. If this is not the case, serious injury and damage to electrical equipment can result.
- Do not push or tow the vehicle to start it. Damage can result when unburnt fuel reaches the catalytic converter and ignites.
- Do not start the vehicle using a fast charger.
- When using jumper leads, treat both the booster battery and the discharged battery with care.
- Do not allow sparks, flame or smoking near the battery.
- Ensure that metal tools or jumper cables do not simultaneously contact the battery positive terminal and any other metal part of the vehicle.

Jump Starting Procedure

1 Position the assisting vehicle so the batteries of both vehicles are close together, refer to Figure 6D1-3 – 10.

2 Apply the park brake on both vehicles.

3 Ensure that P (park) is selected for automatic transmission and N (neutral) is selected for manual transmissions.

4 Turn off the ignition, lights and all other electrical loads.

5 Check the battery filler caps on both batteries are tight.

6 Place a wet cloth over the battery filler caps of each battery.

7 Attach one end of the red jumper cable to the positive terminal of the booster battery.

8 Attach the other end of the same cable to the positive terminal of the discharged battery.

9 Attach one end of the black jumper cable to the negative terminal of the booster battery.

10 Attach the other end to a solid stationary, metallic point on the engine of the disabled vehicle.

NOTE

Do not connect this end directly to the negative post of the discharged battery.

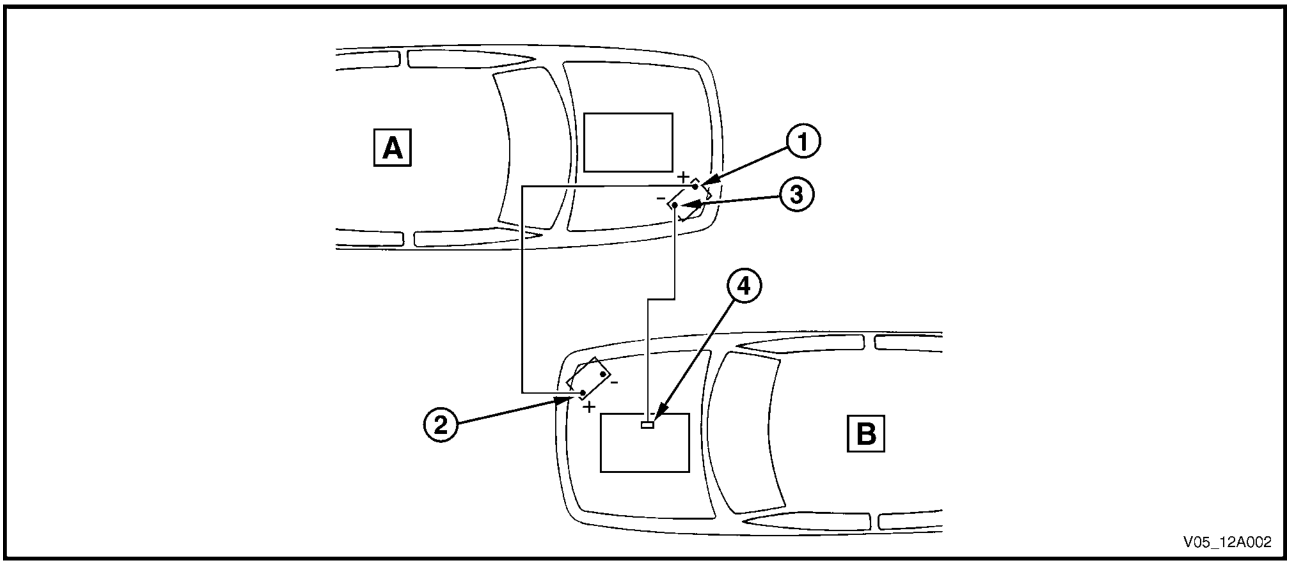


Figure 6D1-3 – 10

Legend

Order of hook-up:

1 Booster vehicle, positive terminal
2 Disabled vehicle, positive terminal
3 Booster vehicle, negative terminal
4 Disabled vehicle, engine ground point

A Booster vehicle
B Disabled vehicle

11 Ensure the jumper cables are not on or near drive pulleys, cooling fans or other points that will move when the engine is started.

12 Start the engine in the booster vehicle and run the engine at a moderate speed for a few minutes.

13 Start the engine in the disabled vehicle.

NOTE

If the engine in the disabled vehicle does not start within 30 seconds, stop cranking the engine and fix the cause. Refer to 3 Diagnosis.

14 When the engine starts, allow both engines to idle for approximately seven minutes. This allows the voltage levels in both vehicles to balance.

15 Leave the vehicles running and remove the jumper cables in the reverse sequence to attaching them. When removing each clamp, take care to ensure that it does not touch any other metal.

16 Discard the wet cloths covering the battery filler caps of both batteries.

4.4 Dry Charged Batteries

Storage

Dry charged batteries are fully charged when manufactured and contain no electrolyte until activated. The dry charged can be stored indefinitely with no servicing until activated.

Activation

1 Remove the battery filler caps.

2 Add 1.265 specific gravity electrolyte to each cell to the correct level.

3 Wait several minutes.

4 Check the electrolyte level and add more electrolyte (not water) as required. After a dry charged battery is activated, it becomes a wet battery.

Post Activation Tests

Although a dry charged battery can be put into service immediately after activation, the following tests are recommended:

1 Check the voltage of the battery after adding the electrolyte.

2 If the reading is less than 10 V, replace the battery.

3 Check the specific gravity of the electrolyte in each cell, refer to 3.3 Hydrometer Test.

4 If any reading shows more than a 0.030 drop from the initial electrolyte reading, slow-charge the battery before use. Refer to 4.2 Battery Charge.

5 Check the cells for violent gassing. If violent gassing is detected evenly across all cells, slow-charge the battery before use. If violent gassing is not even across all cells, replace the battery.

5 Specifications

Rated Voltage .... 12 V

Cold Cranking Amps .... 430 A minimum

Reserve Capacity .... 85 minutes minimum

20 Hour Discharge .... 55 A / hour minimum

5 Second Voltage @ 25° C .... 150 A 10.4 + / – 0.2 V

.... 400 A 8.4 + / – 0.2 V

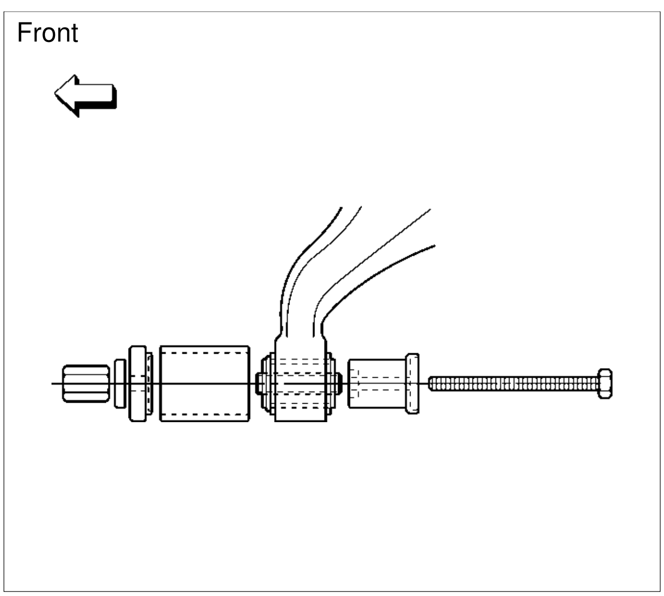
Number of Plates (per cell) 11

NOTE

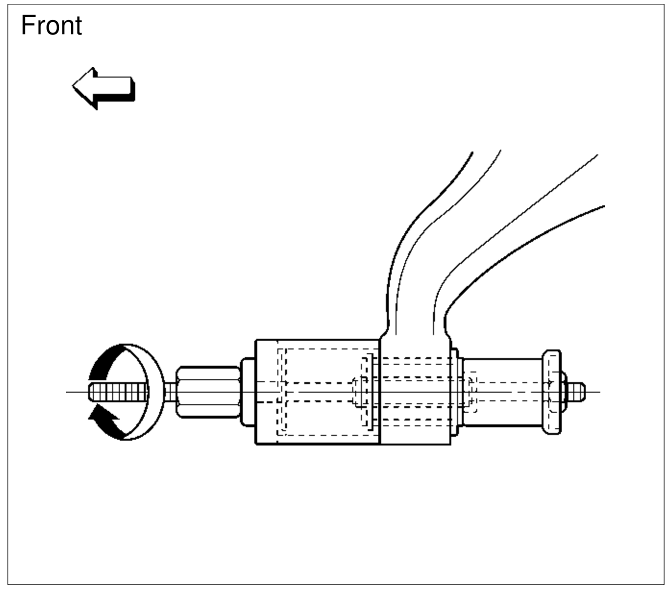
Specified ratings when tested in accordance with Australian Standard AS 2149-1990

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the tie-rod end from the knuckle. Refer to Power Steering Unit in Steering section.
4. Remove the retaining ring from the front axle driving shaft to release the shaft from hub. Refer to Front Hub and Disc in Driveline/Axle section.
5. Support lower control arm with a jack.
6. Remove cam plate and nut.
7. Remove rear nut.
8. Remove torsion bar; refer to Torsion Bar in this section.
9. Remove torsion bar arm bracket.
10. Disconnect the stabilizer link at the lower control arm.
11. Remove the shock absorber lower end from the lower control arm.
12. Remove the lower ball joint from the lower control arm.
13. Remove cam bolt.
14. Remove rear bolt.
15. Remove lower control arm.
16. Remove torsion bar arm bolt.
17. Remove lower ball joint bolt.
18. Remove front bushing by using remover 5-8840-2123-0.

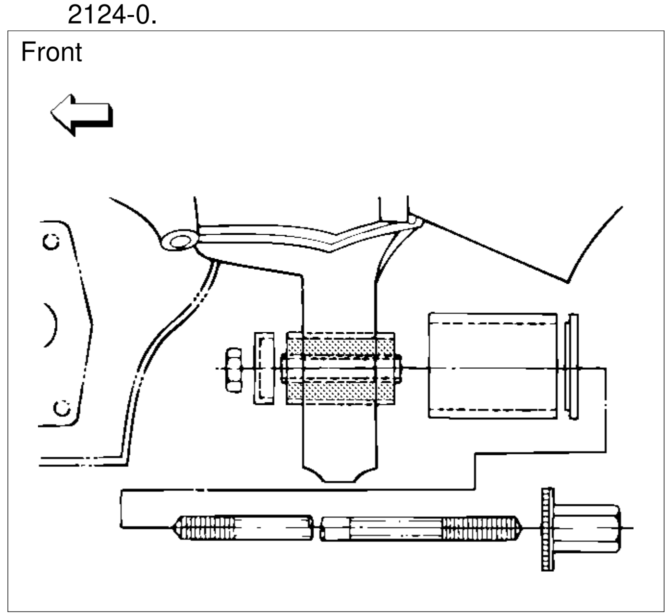


901RW154

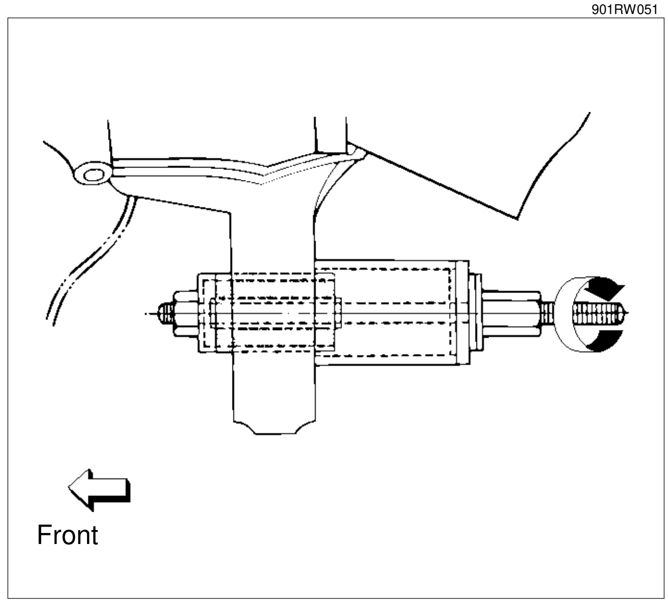


901RW155

19. Remove rear bushing by using remover 5-8840-2124-0.



901RW051



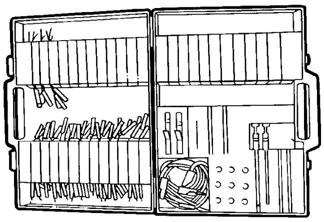
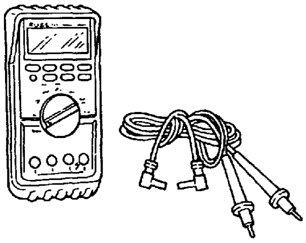
901RW052

6 Torque Wrench Specifications

Battery Hold-Down Bolts ....8.0 – 10.0 Nm

Battery Terminal Nut..2.0 – 5.0 Nm

7 Special Tools

Tool Number	Illustration	Description	Tool Classification
KM609		**Connector Test Adaptor Kit** Used when carrying out electrical diagnostic circuit checks. Previously released.	Desirable
J39200		**Digital Multimeter** Must have at least 10 MΩ input impedance and be capable of reading frequencies. Previously released.	Available

6E1
Powertrain Interface Module – V6

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 1.2 Warning Caution and Notes for correct workshop practices with regard to safety and / or property damage.

1 General Information

A powertrain interface module (PIM) is fitted that incorporates the following functionality:

- Communication protocol between the engine control module (ECM) and transmission control module (TCM) is General Motors Local Area Network (GM LAN).
- Communication protocol between the PIM and immobiliser control unit is keyword 2000.
- ECM to PIM and PIM to immobiliser control unit (ICU) authentication for vehicle security.
- The following switches, where fitted, input directly into the PIM:
    - Automatic transmission power mode switch.
    - Automatic transmission 3rd gear start switch.
    - Cruise control switch.

1.1 General Description

Serial Data Communication

The various electronic control modules communicate with each other through the serial data bus. The ECM and TCM communicate on the serial data bus using the GM LAN communication protocol. Figure 6E1 – 2 shows the serial data layout.

NOTE

Serial data components shown in Figure 6E1 – 2 will vary depending on vehicle options.

Bus

A bus is a physical circuit or circuits which provides a communication path between two or more control modules.

GM LAN Serial Data Bus

The GM LAN bus is a two wire circuit (1), refer to Figure 6E1 – 1. The GM LAN bus circuits are terminated with cut-off resistors (2) which are located inside the two control modules at either end of the bus circuit. The purpose of these cut-off resistors is to prevent data from returning as an echo after reaching the end of the GM LAN bus circuit.

NOTE

- For illustration purposes, the cut-off resistors are shown outside of the control modules.
- The two control modules with the cut-off resistors are the PIM and the ECM.

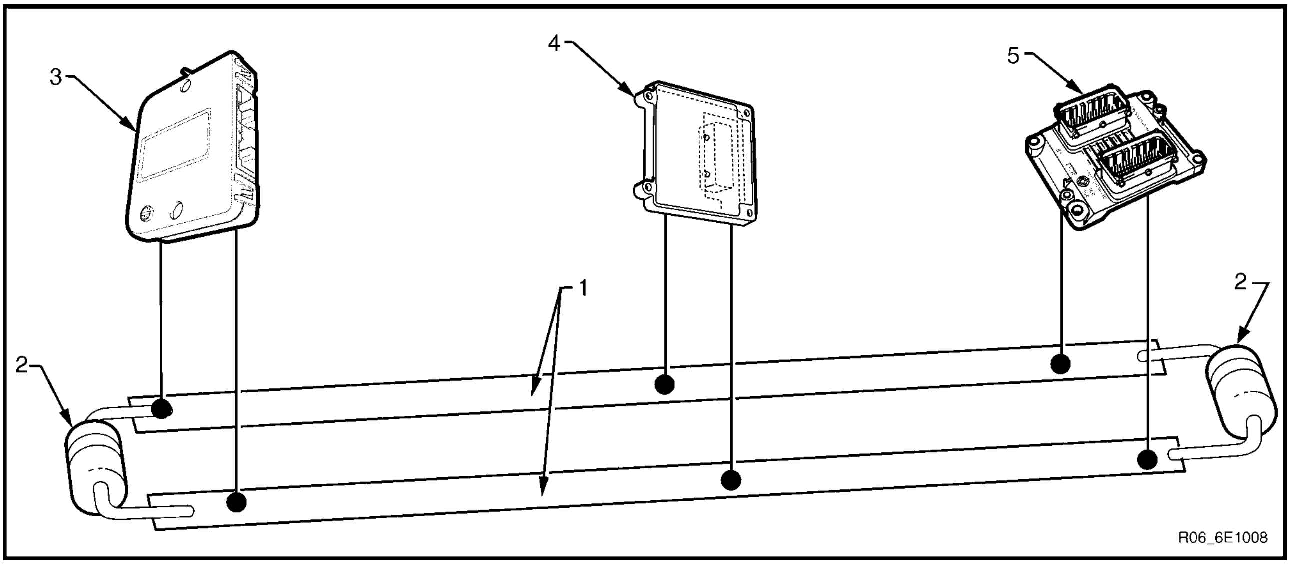


Figure 6E1 – 1

Legend

1	CAN Bus Lines	4	Transmission Control Module (TCM)
2	Cut-off Resistors (resistors are integrated into the PIM and ECM)	5	Engine Control Module (ECM)
3	Powertrain Interface Module (PIM)		

Serial Data

When information is sent from one control module to another via the serial data bus, the information sent is known as serial data. Serial data in its electronic form, is made up of rapidly changing high to low voltage pulses strung together. Each string of voltage pulses represents a message.

- GM LAN serial data has two data lines along which serial data is sent. These lines are known as CAN_HI and CAN_LO.
  - CAN HI – The CAN HI data line is a 3.6 V data line that toggles the voltage between 2.5 V and 3.6 V (referenced to ground). When there is no communication on the CAN HI data line, the system voltage is 2.5 V.
  - CAN LO – The CAN LO data line is a 2.5 V data line that toggles the voltage between 2.5 V and 1.4 V (referenced to ground). When there is no communication on the CAN LO data line, the system voltage is 2.5 V.

Serial Data Communication Protocols

General Motors Local Area Network (GM LAN)

GM LAN is a communication protocol based on the Controller Area Network physical layer. The main difference between GM LAN and CAN is the way in which the messages are structured.

Serial Data Layout

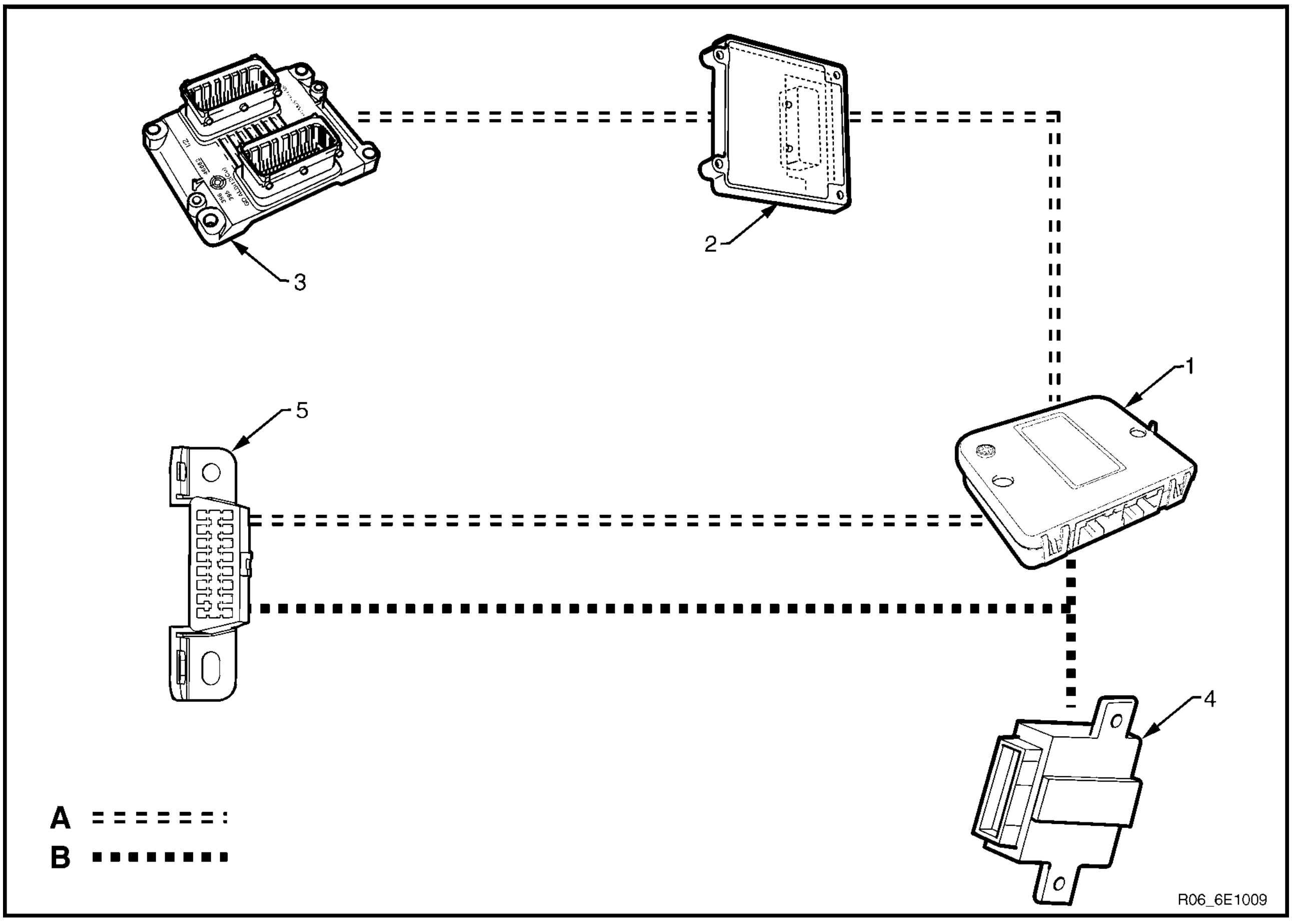


Figure 6E1 – 2

Legend

1	Powertrain Interface Module (PIM)	5	Data Link Connector
2	Transmission Control Module (TCM)	A	GM LAN Serial Data Circuit
3	Engine Control Module (ECM)	B	Keyword 2000 Serial Data Circuit
4	Immobiliser Control Unit (ICU)		

NOTE

Serial data Components shown in Figure 6E1 – 2 will vary depending on vehicle options.

1.2 Warning Caution and Notes

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

Inspection and Repair

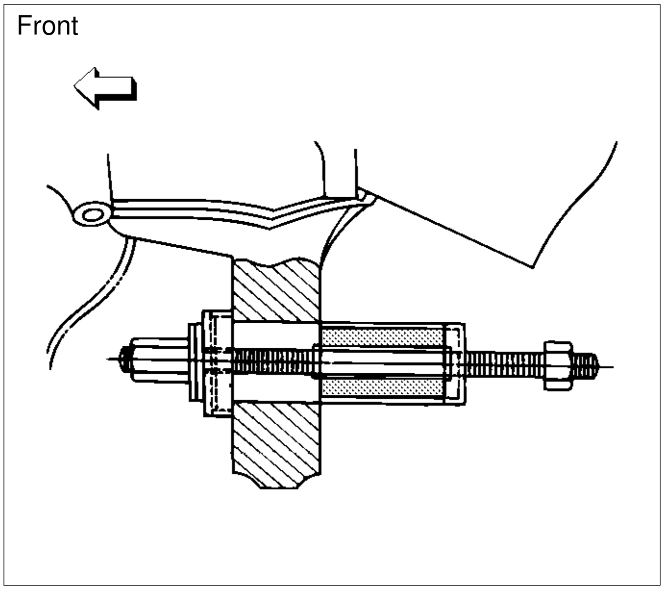
Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.

Check the following parts:

- Lower control arm
- Bushing

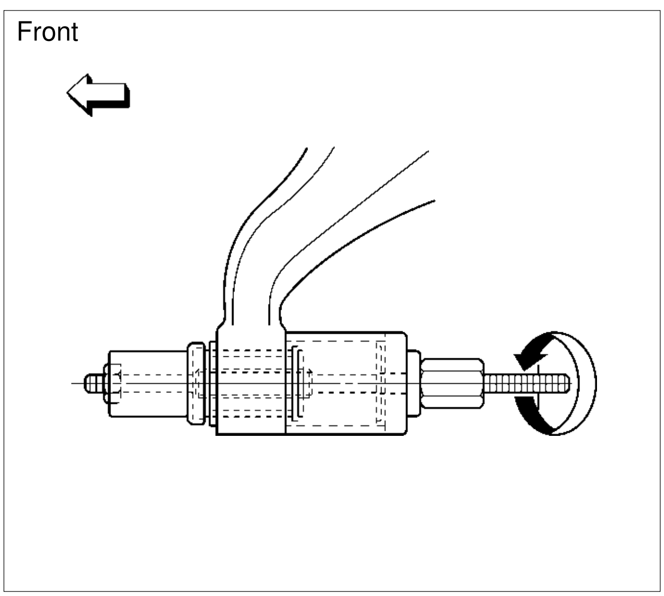
Installation

1. Install rear bushing by using installer 5-8840-2124-0.



901RW053

2. Install front bushing by using installer 5-8840-2123-0.



901RW156

3. Install lower ball joint bolt.
4. Install torsion bar arm bolt.
5. Install lower control arm.
6. Install rear bolt.
7. Install cam bolt so the hole and projection are upward.
8. Install lower ball joint and tighten it to the specified torque.

Torque: 127 N·m (13.0 kgf·m/94 lb·ft)

9. Install shock absorber and tighten it to the specified torque.

Torque: 93 N·m (9.5 kgf·m/69 lb·ft)

10. Install stabilizer link and tighten it to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

11. Install torsion bar arm bracket and tighten it to the specified torque.

Torque: 116 N·m (11.8 kgf·m/85 lb·ft)

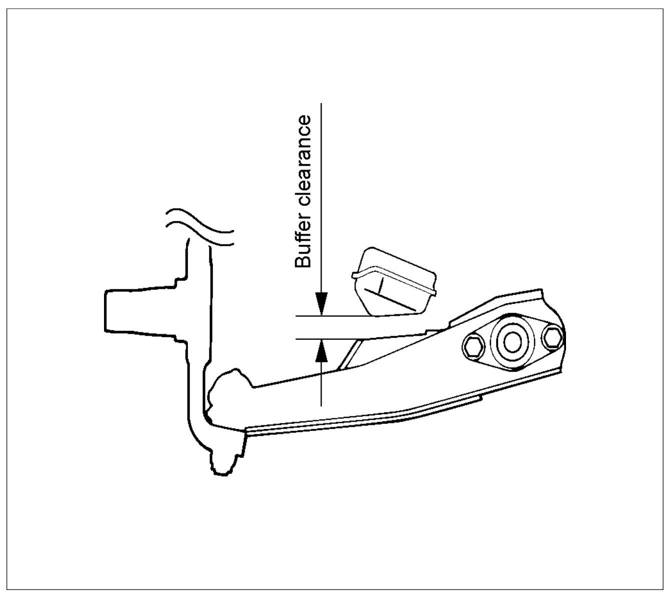
12. Install Torsion bar; refer to Torsion Bar in this section.
13. Install rear nut and tighten nut finger-tight.

NOTE: Apply oil to the thread.

NOTE: Tighten the nut or bolt with the parts in the position shown in the illustration below.

Buffer clearance: 29.7 mm (1.17 in)

Torque: 235 N·m (24.0 kgf·m/174 lb·ft)



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WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 Component Location

2.1 Engine Compartment

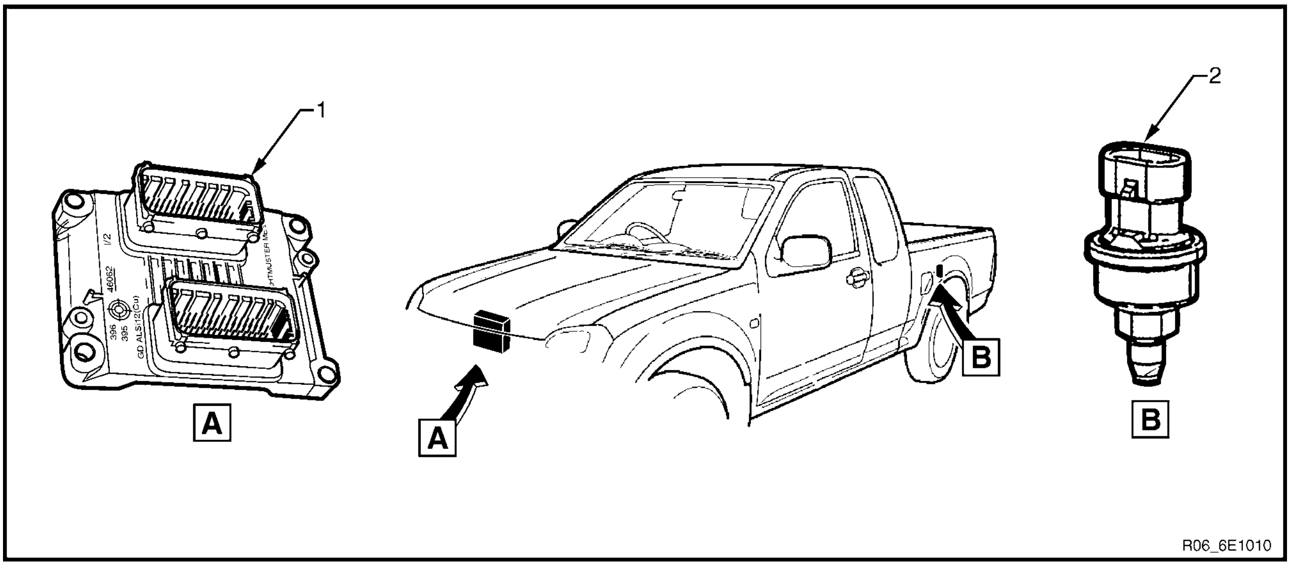


Figure 6E1 – 3

Legend

1 Engine Control Module (ECM)

2 Vehicle Acceleration Sensor

2.2 Interior

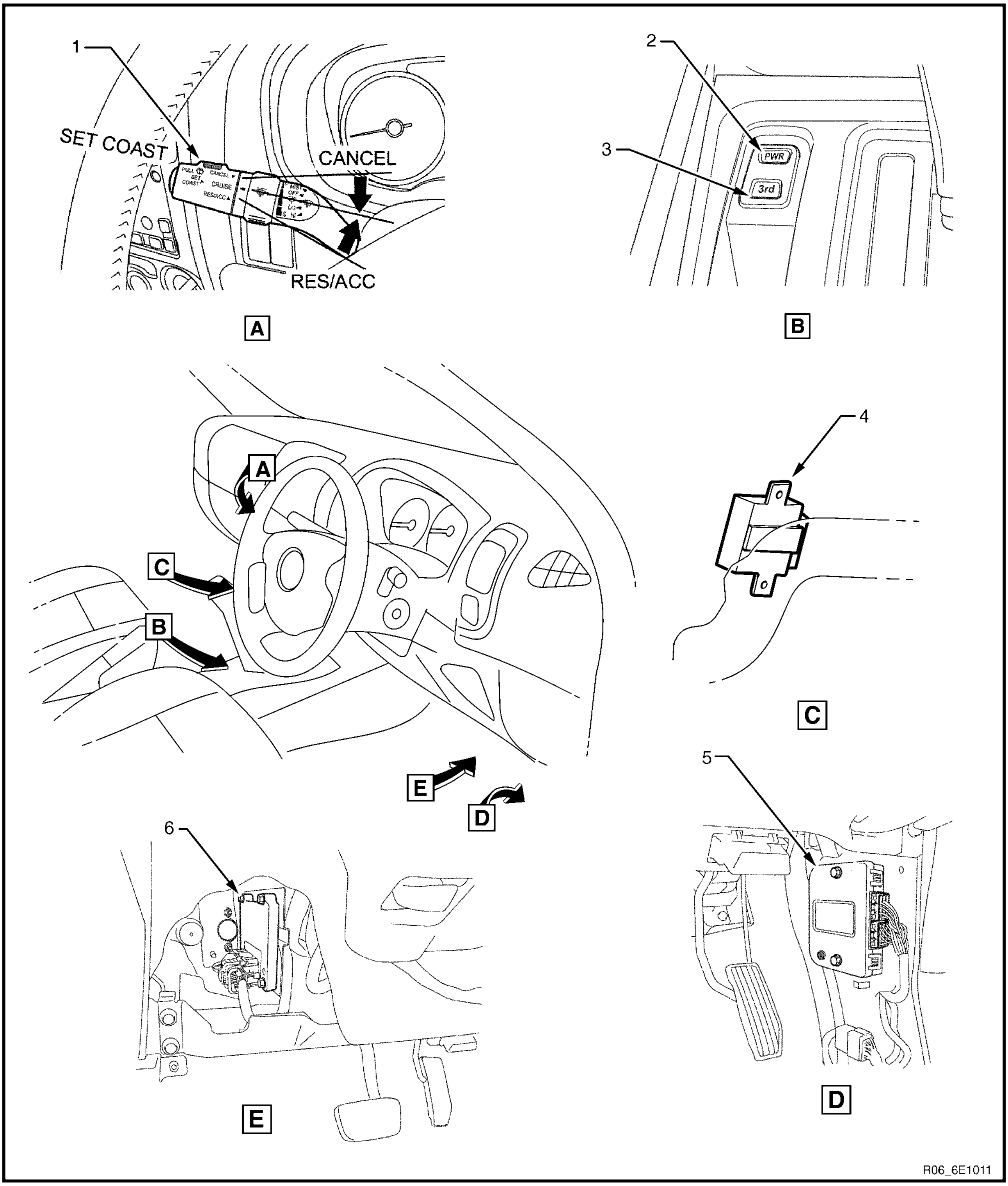


Figure 6E1 – 4

Legend

1	Cruise Control Switch Assembly	4	Immobiliser Control Unit (ICU)
2	Power Mode Switch – Automatic Transmission	5	Powertrain Interface Module (PIM)
3	3rd Start Switch – Automatic Transmission	6	Transmission Control Module (TCM)

NOTE

Components shown in Figure 6E1 – 4 will vary depending on vehicle options.

3 Component Description and Operation

3.1 Powertrain Interface Module

The powertrain interface module (PIM) is located behind the right-hand lower hinge pillar trim.

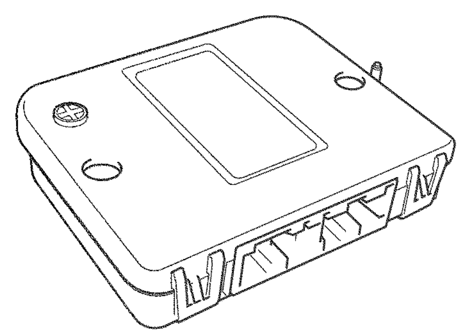


Figure 6E1 – 5

The PIM performs the following functions:

- The PIM acts as the communication gateway between the GM LAN communications protocol and keyword 2000 protocol.
- The PIM converts analogue signals from the cruise control switches into digital serial data.
- The PIM upon inputs received from the engine control module (ECM), transmission control module (TCM) and immobiliser control unit (ICU) controls the operation of the following instruments and warning lamps:
  - Speedometer
  - Tachometer
  - Check Transmission Lamp
  - 3rd Gear Start Lamp
  - Power Mode Switch Lamp
  - Automatic Transmission Oil Temp Lamp
  - Cruise Set Lamp
  - Oil Pressure Lamp
  - Service Vehicle Soon (SVS) Lamp
  - Charge Warning Lamp
  - PRNDL Lamps
- The PIM is responsible for authenticating the immobiliser control unit (ICU) prior to the engine control module (ECM) authenticating the PIM. If any of these authentication processes fail, the vehicle will not start. For further information on the immobiliser system, refer to 11A Immobiliser System.

3.2 Powertrain Interface Module Gateway Components

Engine Control Module

The ECM is located at the right front of the engine assembly.

The ECM communicates directly with the transmission control module (TCM) and PIM via the serial data network.

The ECM is also an integral part of the vehicle security system. For further information on vehicle security, refer to 11A Immobiliser System.

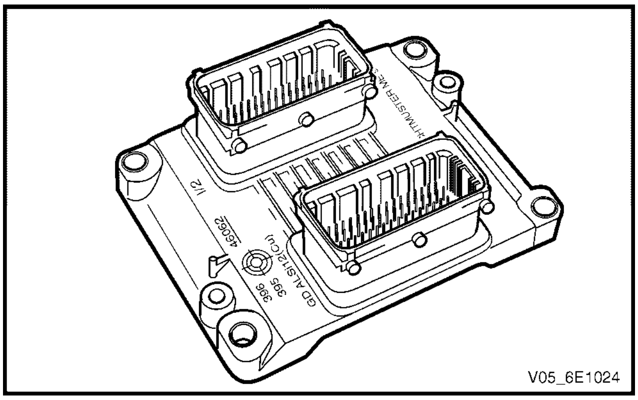


Figure 6E1 – 6

Immobiliser Control Unit

The immobiliser control unit (ICU) is mounted to the left of the steering column.

The ICU in conjunction with the, powertrain interface module (PIM) and engine control module (ECM) immobilises the engine. The ICU communicates with the ECM via the PIM. Refer to 11A Immobiliser for further information on the immobiliser system.

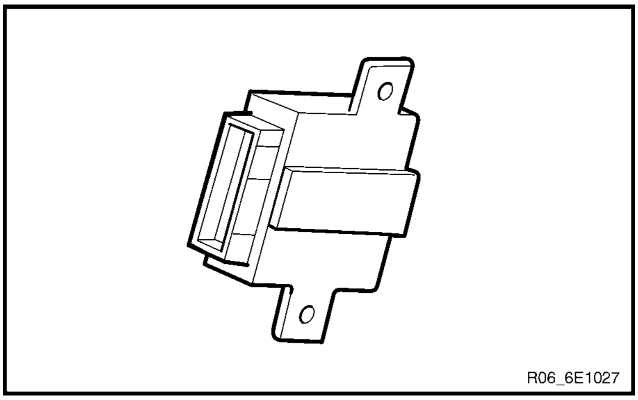


Figure 6E1 – 7

Automatic Transmission Control Module

The transmission control module (TCM) is located under the right-hand rear drivers seat, beneath the carpet.

The TCM's primary role is to efficiently control transmission shift points according to current driving and vehicle operating conditions. To effectively do this, the TCM requires information from other vehicle systems such as the engine management and automatic transmission systems.

This information exchanged is achieved by connecting the various system control modules via the serial data network. For further information on the serial data network, refer to 1 General Information.

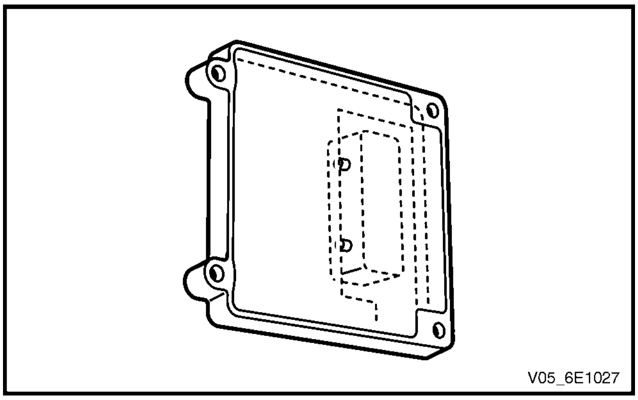


Figure 6E1 – 8

3.3 Powertrain Interface Module Direct Input Switches

The following switches are direct wired to the PIM. These switches use the PIM to convert their input signals into serial data, which is then used by the various vehicle control modules to perform varying functions.

Cruise Control Switch

The cruise control switch is located on the left-hand side of the steering column.

The switch is comprised of three momentary contact switches which control the following functions:

- cruise control push button switch (ON–OFF),
- cruise control resume – accelerate (RES–ACCEL), and
- cruise control set – decelerate (SET–DECEL).

The three cruise control switches directly input into the PIM. When any of these switches are activated, the PIM sends a message on the serial data bus to the ECM. For further information on the cruise control system, refer to 8C Cruise Control – HFV6.

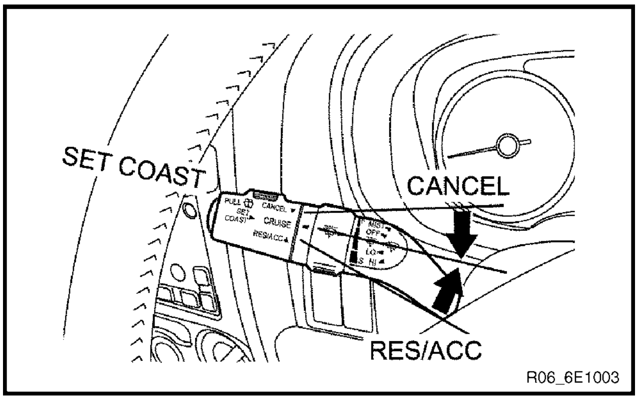


Figure 6E1 – 9

Power Mode Switch – Automatic Transmission

The power mode switch is located at the front of the floor console, forwards of the 3rd start switch.

The power mode switch is an on-off rocker type switch that changes the transmission shift points. The power mode switch inputs directly into the PIM. When the switch is in the on position, the PIM sends a message on the serial data bus to the Transmission Control Module (TCM). For further information on the automatic transmission, refer to:

7C1 Automatic Transmission – 4L60E – General Information.

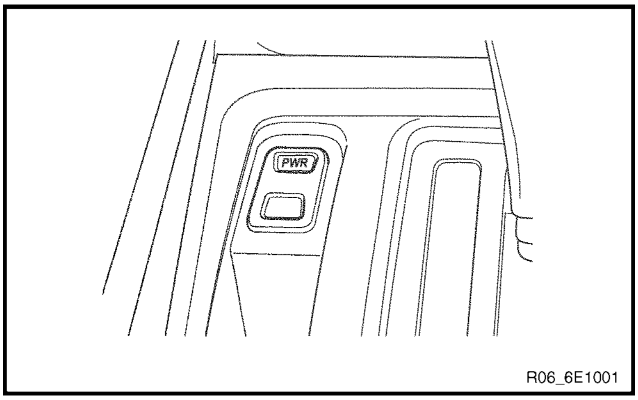


Figure 6E1 – 10

3rd Start Switch – Automatic Transmission

The 3rd start switch is located at the front of the floor console, behind the power mode switch.

The 3rd start switch is a momentary contact switch that enables the vehicle to be driven from the stationery position in 3rd. The 3rd start switch inputs directly into the PIM. When the switch is pressed, the PIM sends a message on the serial data bus to the transmission control module (TCM). For further information on the automatic transmission, refer to 7C1 Automatic Transmission – 4L60E – General Information.

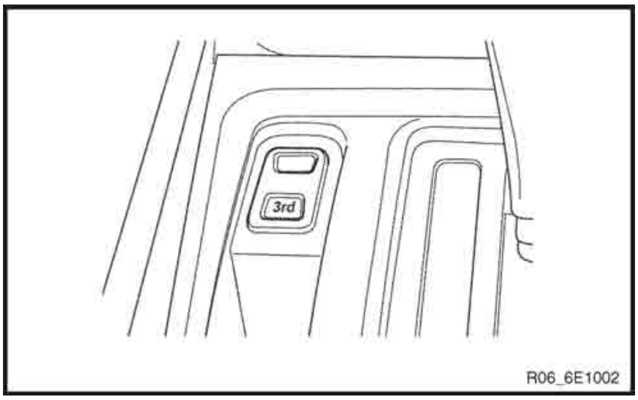


Figure 6E1 – 11

4 Diagnostics

4.1 Diagnostic General Descriptions

The powertrain interface module (PIM) diagnostic procedure is organised in a logical structure that begins with the Diagnostic System Check. The Diagnostic System Check directs the diagnostic procedure to the logical steps or appropriate diagnostic table required to diagnose a PIM fault condition.

The diagnostic tables locate a faulty circuit or component through a logical based process of elimination. Correct use of the diagnostic tables is essential to reduce diagnostic time and to prevent misdiagnosis.

In addition, the Diagnostic System Check provides the following information:

- identification of the PIM,
- condition of the diagnostic circuit, and
- identification and status of the DTCs if present.

Diagnostic Trouble Code (DTC) Tables

The diagnostic procedure is directed to a diagnostic trouble code (DTC) table if there are DTCs currently stored in the PIM.

The diagnostic tables are designed to locate a faulty circuit or component through a logical based process of elimination. The diagnostic tables are developed with the following assumptions:

- the vehicle functioned correctly at the time of assembly,
- there are no multiple faults, and
- the problem currently exists.

Multiple DTCs

When performing a DTC check and there are multiple DTCs, the diagnostic process must begin with the most likely DTC that may trigger other DTCs.

Knowledge of the PIM and Tech 2 limitations are important to reduce diagnostic time and to prevent misdiagnosis. Refer to 7.1 Diagnostic Requirements, Precautions and Preliminary Checks.

Diagnostic Trouble Codes (DTCs)

When the ignition switch is turned on, the PIM performs an internal integrity check that detects and isolates any internal faults. The PIM also monitors the direct input switches such as the cruise control and the serial data bus for messages from the control modules on the GM LAN bus. If a fault is detected by the PIM, it will log a Diagnostic Trouble Code (DTC) that represents the fault detected. The DTCs stored in the PIM may be accessed using Tech 2.

Status of DTCs

The PIM designates the DTCs logged into a Current or History DTC.

Current DTCs

If the fault condition that triggers the DTC is present during the last PIM self test, that DTC will be designated as a current DTC.

History DTCs

If the fault condition that triggers the DTC is not present during the last PIM self test, that DTC will be designated as a history DTC.

Conditions for Clearing DTCs

- If there is no DTC logged in the current PIM self test, the current DTC will be cleared.
- If there is no DTC logged after 100 consecutive drive cycles, the history DTC will be cleared.

Tech 2 PIM Diagnostic Tests

Tech 2 Limitations

Some DTCs trigger other DTCs to set, which causes Tech 2 to display multiple DTCs. In those situations, Tech 2 may display more DTCs than is needed to rectify a fault.

When Tech 2 displays an output function, it displays only the command given by the PIM. If a connector is disconnected, that fault will not register in the PIM output function. Tech 2 does not verify the command action.

The service technician must understand the system being diagnosed as well as the correct use and limitations of Tech 2 to be able to perform diagnostic procedures efficiently and successfully.

Tech 2 Intermittent Fault Tests

The following are lists of Tech 2 diagnostic tests that may be used to diagnose intermittent faults:

- Wiggle test the suspected PIM wiring harness and connector while observing Tech 2 operating parameters of the circuit being tested. If Tech 2 read-out fluctuates during this procedure, check the wiring harness circuit for loose connection.
- Road test the vehicle in conditions that trigger the intermittent fault while an assistant observes the suspected Tech 2 operating parameter data.
- Capture and store data in the Snapshot mode when the fault occurs. The stored data may be replayed at a slower rate to aid in diagnostics. Refer to Tech 2 User Instructions for more information on the Snapshot function.
- Operate suspected components to test their operation using Tech 2 Output Control Data.

5 GM LAN Serial Communication Circuit

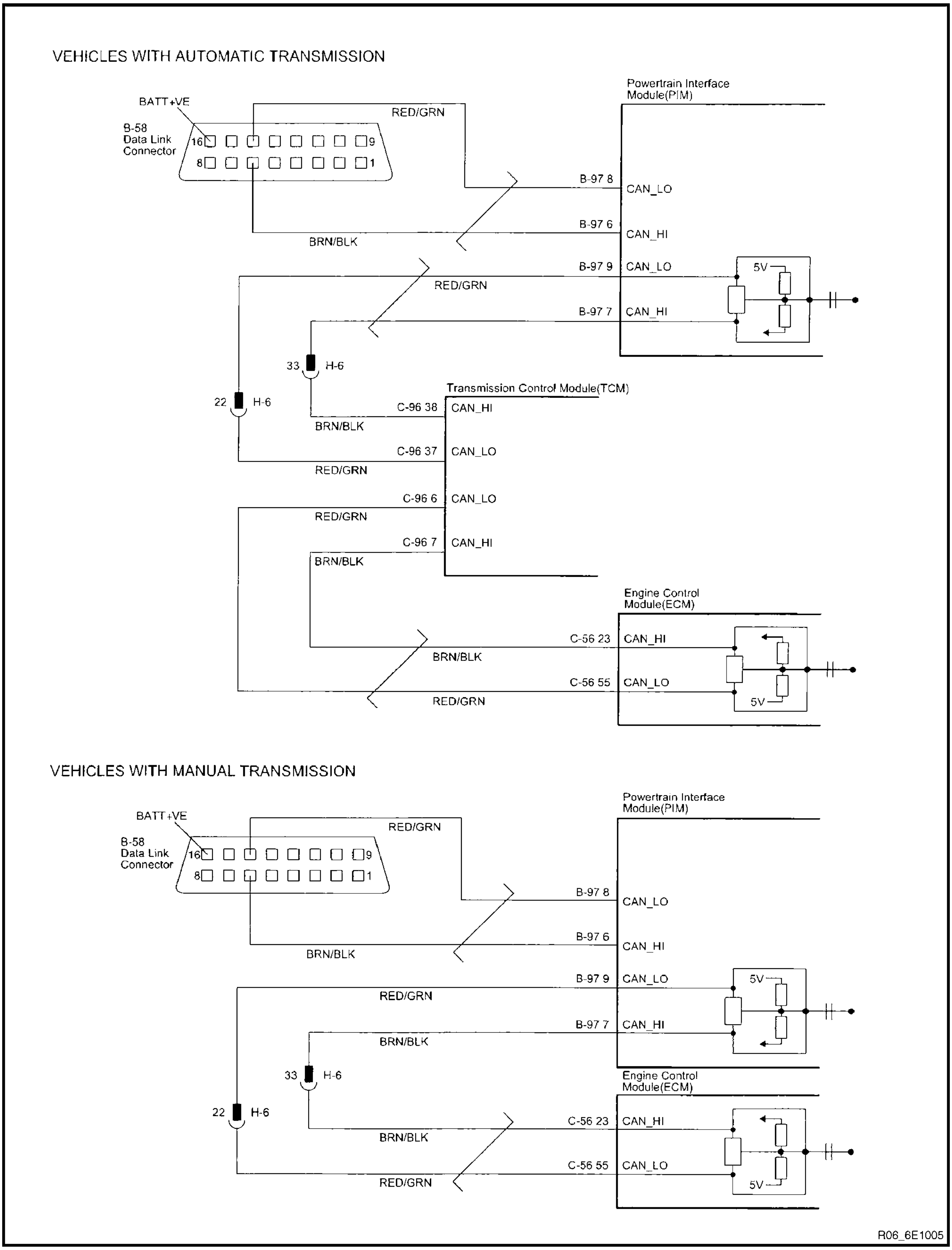


Figure 6E1 – 12

6 Wiring Diagram and Connector Chart

6.1 Wiring Diagrams

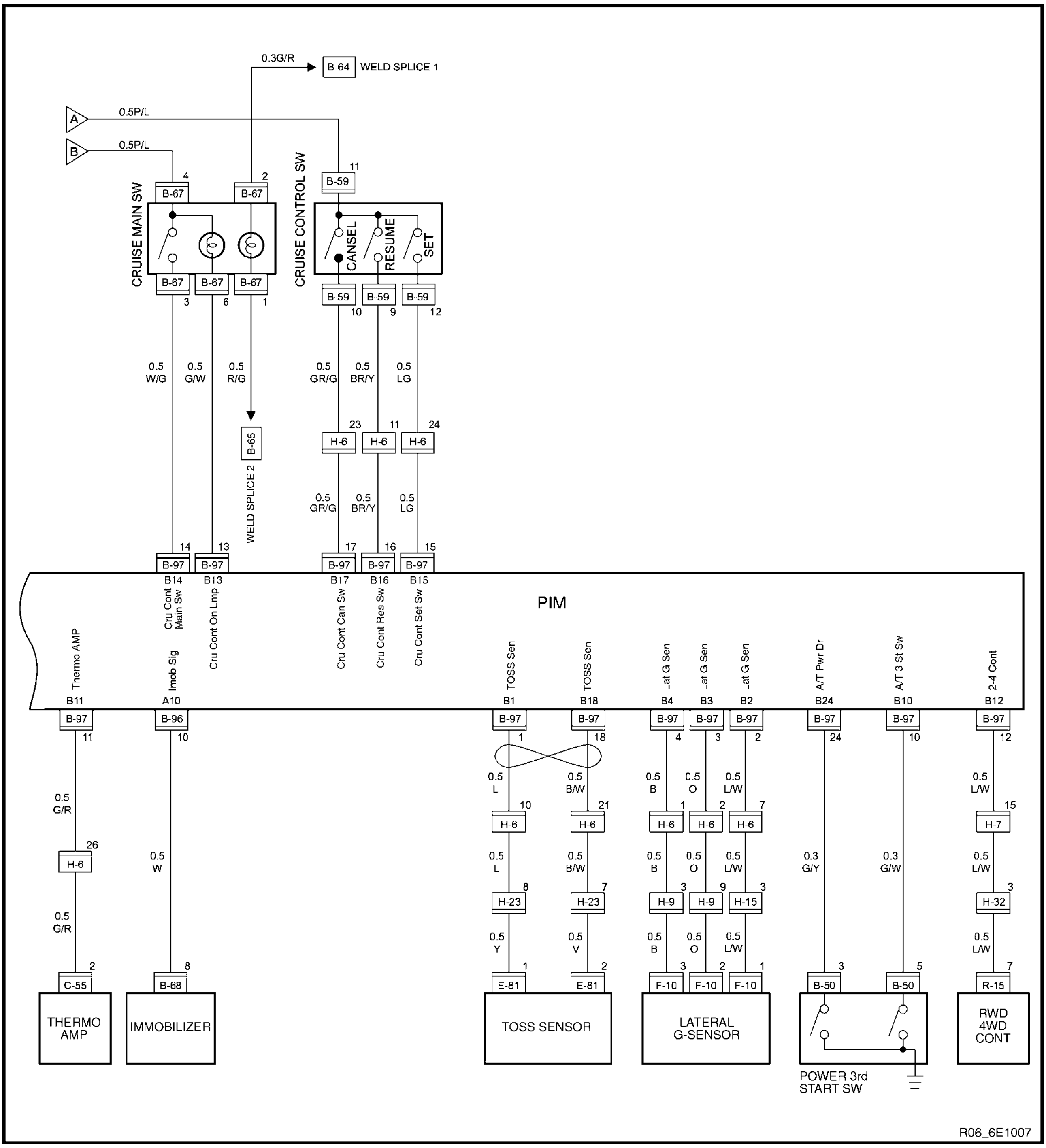


Figure 6E1 – 13

14. Install cam plate and nut then tighten lower link nut finger-tight.

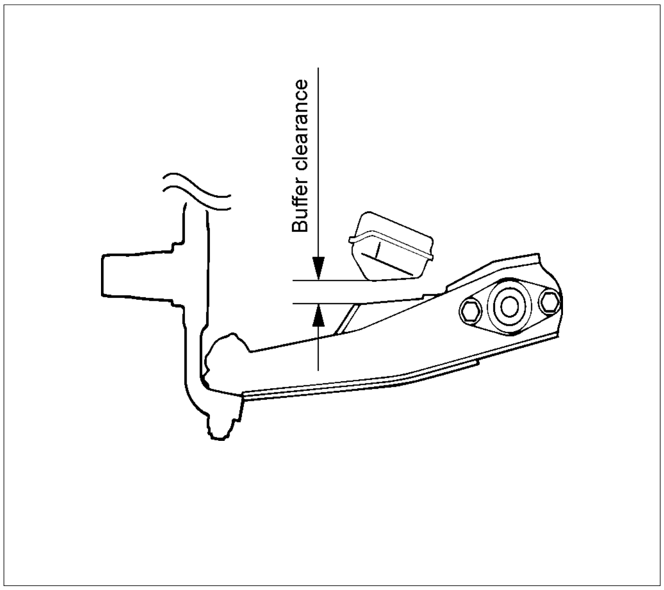
NOTE: Apply oil to the thread.

NOTE: Tighten the nut or bolt with the parts in the position shown in the illustration below.

Buffer clearance: 29.7 mm (1.17 in)

Torque: 186 N·m (19.0 kgf·m/137 lb·ft)

NOTE: Adjust the trim height. Refer to Front End Alignment Inspection and Adjustment in Steering section.



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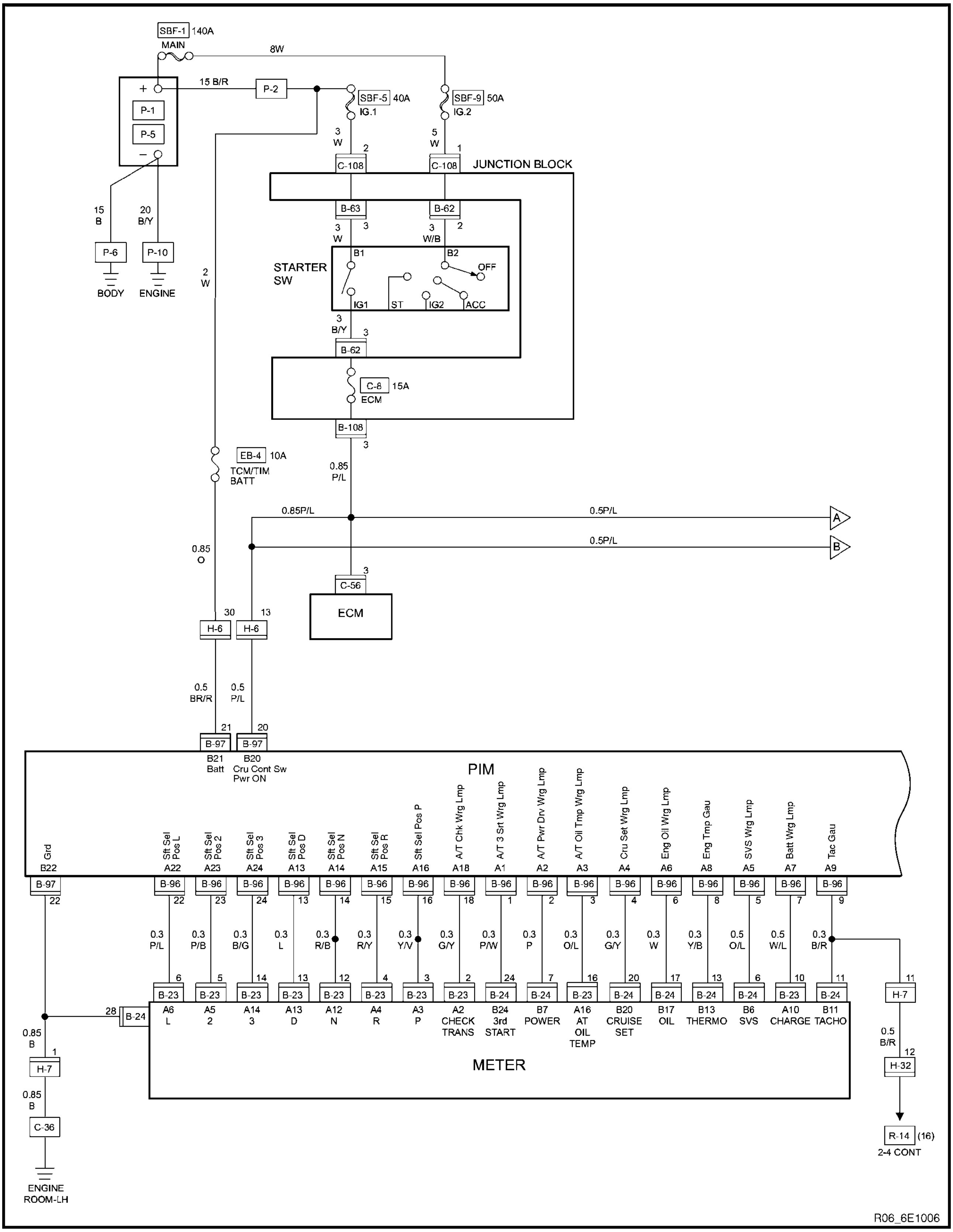


Figure 6E1 – 14

6.2 Connector Chart

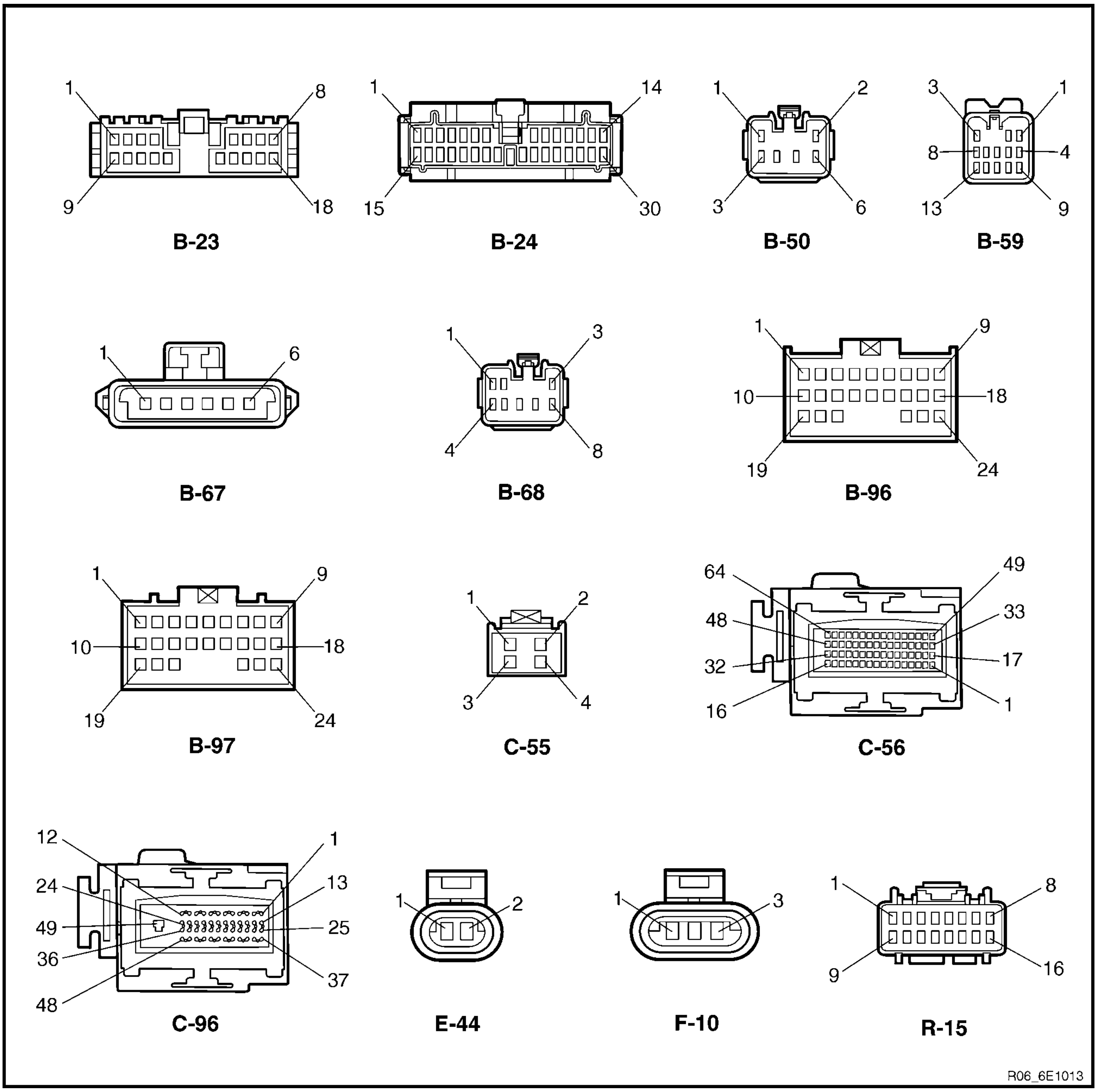


Figure 6E1 – 15

6.3 Connector Information

PIM Connector Pin Specifications

Pin Description – Connector B-96

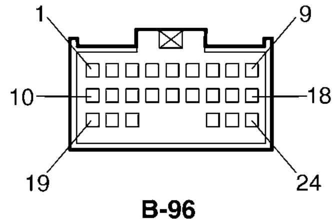


Figure 6E1 – 1

Pin No.	Wire Colour	Circuit Description	Function
1	P/W	A/T 3 Srt Wrg Lmp	Auto Transmission 3rd Start Warning Lamp
2	P	A/T Pwr Dr Wrg Lmp	Auto Transmission Power Drive Warning Lamp
3	O/L	A/T Oil Tmp Wrg Lmp	Auto Transmission Oil Temperature Warning Lamp
4	G/Y	Cru Set Wrg Lmp	Cruise Set Warning Lamp
5	O/L	SVS Wrg Lmp	Service Vehicle Soon Warning Lamp
6	W	Eng Oil Wrg Lmp	Engine Oil Pressure Warning Lamp holidays
7	W/L	Batt Wrg Lmp	Battery Charge Warning Lamp
8	Y/B	Eng Tmp Gau	Engine Coolant Gauge
9	B/R	Tac Gau	Tacho Gauge – RWD/4WD (2-4) Control
10	W	Imob Sig	Immobiliser
11	—	—	Not Connected
12	—	—	Not Connected
13	L	Sft Sel Pos D	Shift Selector Position D
14	R/B	Sft Sel Pos N	Shift Selector Position N
15	R/Y	Sft Sel Pos R	Shift Selector Position R
16	Y/V	Sft Sel Pos P	Shift Selector Position P
17	—	—	Not Connected
18	G/Y	A/T Chk Wrg Lmp	Auto Transmission Check Warning Lamp
19	—	—	Not Connected
20	—	—	Not Connected

Pin No.	Wire Colour	Circuit Description	Function
21	—	—	Not Connected
22	P/L	Sft Sel Pos L	Shift Selector PRNDL Position L
23	P/B	Sft Sel Pos 2	Shift Selector Position 2
24	B/G	Sft Sel Pos 3	Shift Selector Position 3

Pin Description – Connector B-97

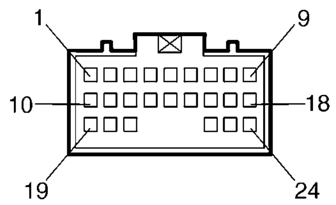


Figure 6E1 – 2

Pin No.	Wire Colour	Circuit Description	Function
1	L	TOSS Sen	IND Speed Sensor
2	L/W	Lat G Sen	Lateral G-sensor
3	O	Lat G Sen	Lateral G-sensor
4	B	Lat G Sen	Lateral G-sensor
5	—	—	Not Connected
6	—	—	Not Connected
7	—	—	Not Connected
8	—	—	Not Connected
9	—	—	Not Connected
10	G/W	A/T 3 Srt Sw	Auto Transmission 3rd Start Switch
11	G/R	Thermo AMP	Thermo AMP
12	L/W	2-4 Cont	RWD/4WD (2-4) Control
13	G/W	Cru Cont ON Lmp	Cruise Control ON Lamp
14	W/G	Cru Cont Main Sw	Cruise Control Main Switch
15	LG	Cru Cont Set Sw	Cruise Control Set Switch
16	BR/Y	Cru Cont Res Sw	Cruise Control Resume Switch
17	GR/G	Cru Cont Can Sw	Cruise Control Cancel Switch
18	B/W	TOSS Sen	IND Speed Sensor
19	—	—	Not Connected

Pin No.	Wire Colour	Circuit Description	Function
20	P/L	Cru Cont Sw Pwr ON	Cruise Control Switch Power ON
21	BR/R	Batt	Battery Supply
22	B	Grd	Ground Engine Bay – L/H
23	—	—	Not Connected
24	G/Y	A/T Pwr Dr Sw	Auto Transmission Power Drive

7 Diagnostics Starting Point

7.1 Diagnostic Requirements, Precautions and Preliminary Checks

Basic Knowledge Required

CAUTION

A lack of basic understanding of electronics, electrical wiring circuits and use of electrical circuit testing tools when performing the PIM diagnostic procedures could result in incorrect diagnostic results or damage to components.

In addition, understanding of the Engine Management System is essential to prevent misdiagnosis and component damage. Refer to 6C1-1 Engine Management – V6 – General Information.

Basic Diagnostic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the PIM diagnostic procedures could result in incorrect diagnostic results or damage to components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section:

- Tech 2.
- Test lamp, refer to 8A Electrical - Body and Chassis for further information.
- Digital multimeter with 10 MΩ impedance, refer to 8A Electrical - Body and Chassis for further information.
- Connector test adapter kit Tool No. J35616-A.

Diagnostic Precautions

CAUTION

In addition to the safety and precautionary measures listed in 11.1 Safety and Precautionary Measures, the following diagnostic precautions must be observed when performing any PIM diagnostic procedure:

- Use only the test equipment specified in the diagnostic tables. Other test equipment may either give incorrect results or damage serviceable components.
- Do not clear any DTCs unless instructed.
- The fault must be present when using the DTC Diagnostic Tables. Otherwise, misdiagnosis or replacement of serviceable parts may occur.
- Always use connector adapters such as those contained in connector test adapter kit Tool No. J35616-A to prevent connector terminal damage.

- Thorough inspection of the wiring circuits and connectors listed in the diagnostic procedures must be performed, otherwise misdiagnosis may occur.
- Inspect the electrical circuitry or connector terminals that are suspected to be causing the complaint for the following conditions:
  - backed-out connector terminals,
  - improper wiring connector mating,
  - broken wiring connector locks,
  - damaged connector terminals, and
  - physical damage to the wiring harness.
- Before replacing a component, inspect its connector terminal for corrosion or deformation that may cause the fault condition.

Preliminary Checks

The PIM preliminary check examines easily accessible components which may cause problems with the PIM. This visual and physical inspection procedure may quickly identify the fault condition and eliminate the need for additional diagnosis.

- Refer to Service Techlines for relevant information regarding the fault condition.
- Ensure the battery is fully charged.
- Check the battery connections for corrosion or a loose terminal.
- Perform a visual and physical inspection of the following:
  - PIM component wiring harness and terminals for proper connections, pinches or cuts, and
  - PIM wiring harness routing which may be positioned very close to a high voltage or high current devices such as aftermarket audio systems.

NOTE

High voltage or high current devices may induce electrical noise on a circuit, which can interfere with normal circuit operation.

  - The PIM is sensitive to Electro Magnetic Interference (EMI). Check for incorrect aftermarket theft deterrent devices, lights or mobile phone installations if an intermittent malfunction is suspected.

7.2 Diagnostic System Check

Step	Action	Yes	No
1	Have you met the basic diagnostic requirements listed in the PIM Diagnostic Starting Point?	Go to Step 2	Refer to 7.1 Diagnostic Requirements, Precautions and Preliminary Checks
2	Have you read the Diagnostic Precautions?	Go to Step 3	Refer to 7.1 Diagnostic Requirements, Precautions and Preliminary Checks
3	Have you performed the Preliminary Checks?	Go to Step 4	Refer to 7.1 Diagnostic Requirements, Precautions and Preliminary Checks

Step	Action	Yes	No
4	Using Tech 2, attempt to communicate with the PIM. Does Tech 2 communicate with the PIM?	Go to Step 5	Refer to 7.3 Powertrain Interface Module – Module Communication Check Failure Diagnostic Table
5	Using Tech 2, view and record all DTCs. Does Tech 2 display any DTCs?	Go to Step 6	Refer to Intermittent Fault Conditions.
6	Does DTC C0550 fail this ignition cycle?	Refer to 9.1 DTC C0550 – PIM Internal Fault Diagnostic Table	Go to Step 7
7	Does DTC U2100 fail this ignition cycle?	Refer to 9.2 DTC U2100 – No Communication With CAN Bus (High Speed) Diagnostic Table	Go to Step 8
8	Does DTC U2106 fail this ignition cycle?	Refer to 9.4 DTC U2106 – CAN Bus No Communication With Transmission Control Module	Go to Step 9
9	Does DTC U2105 fail this ignition cycle?	Refer to 9.3 DTC U2105 – CAN Bus No Communication With Engine Control Module Diagnostic Table	Go to Step 10
10	Does Tech 2 display multiple DTCs?	Refer to the DTC Table of the fault condition that is most likely to trigger multiple DTCs. Refer to 4.1 Diagnostic General Descriptions for information on multiple DTCs fault condition	Refer to the relevant DTC table
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

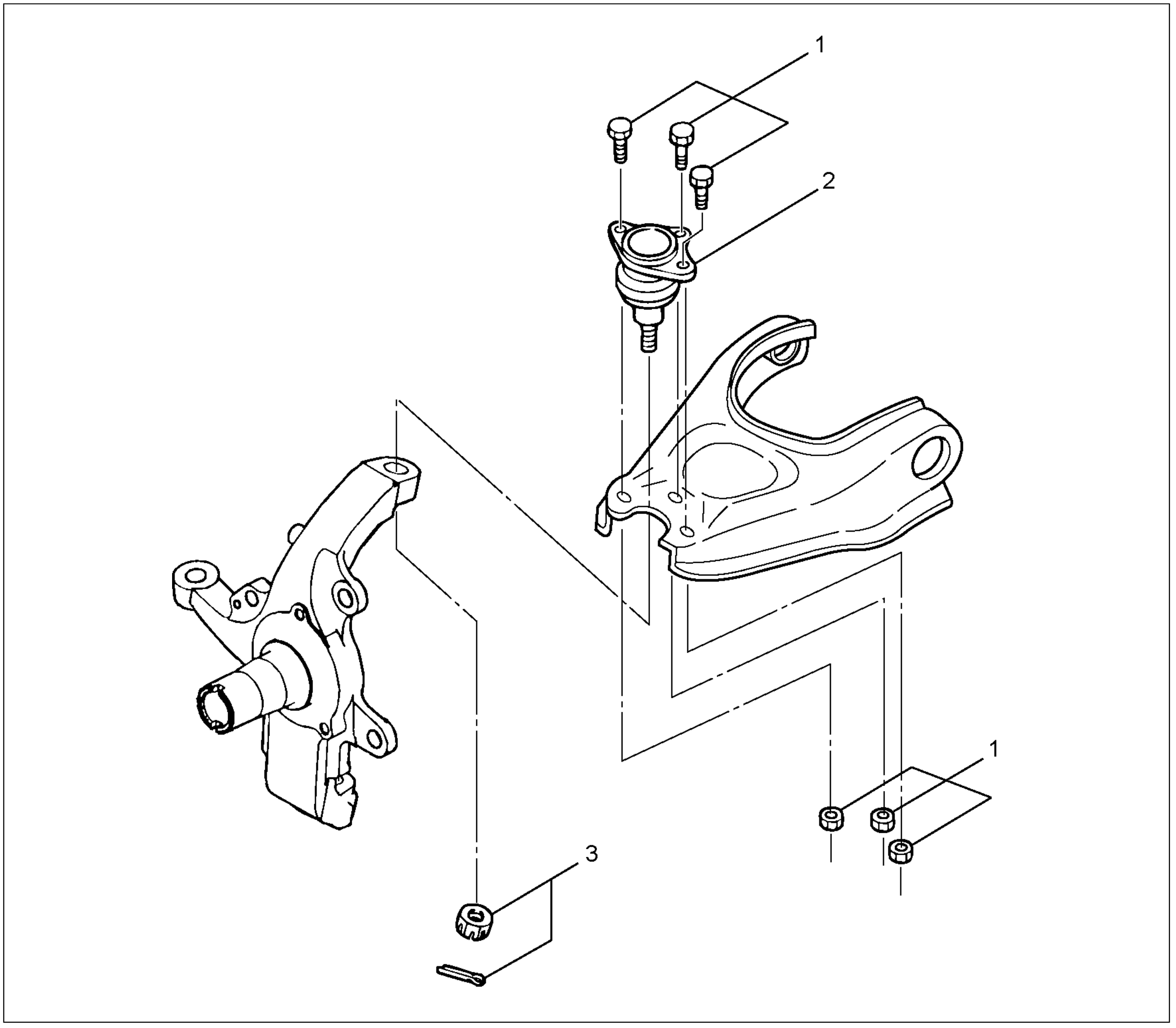
7.3 Powertrain Interface Module – Module Communication Check Failure Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Test the following PIM circuits for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical diagnosis: • 12 V battery supply circuit, • 12 V ignition circuit, and • ground circuit. Has any fault been found and rectified?	Go to Step 10	Go to Step 3
3	1 Disconnect the ECM harness connector. 2 Switch off the ignition for 10 seconds. 3 Using Tech 2, attempt to communicate with the PIM. **NOTE** Other DTCs may set when the ECM connector is disconnected and the ignition is switched on. Disregard DTCs that set under this condition on this DTC Table. Does Tech 2 communicate with the PIM?	Go to Step 4	For vehicles with automatic transmissions, go to Step 5. For vehicles with manual transmission go to Step 8
4	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Has the repair been completed?	Go to Step 10	—
5	1 Disconnect the TCM harness connector. 2 Switch off the ignition for 10 seconds. 3 Using Tech 2, attempt to communicate with the PIM. Does Tech 2 communicate with the PIM?	Go to Step 6	Go to Step 8
6	Test serial data circuits between the TCM and ECM for a short to voltage, short to ground or short together condition. Has any fault been found and rectified?	Go to Step 10	Go to Step 7
7	Replace the TCM. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Has the repair been completed?	Go to Step 10	—
8	Test serial data circuits between the PIM and ECM for vehicles with manual transmission, or between the PIM and TCM for vehicles with automatic transmission for a high resistance or open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 10	Go to Step 9
9	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 10	—
10	Using Tech 2, attempt to communicate with the PIM. Does Tech 2 communicate with the PIM?	Go to Step 11	Refer to 7.2 Diagnostic System Check

Step	Action	Yes	No
11	1 Using Tech 2, clear all DTCs. 2 Switch off the ignition for 30 seconds. 3 Check for DTCs. Does Tech 2 display any PIM DTCs?	Refer to 7.2 Diagnostic System Check	Go to Step 7
12	Does Tech 2 display any other DTCs?	Refer to the appropriate Section	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

Upper Ball Joint

Upper Ball Joint and Associated Parts



RTW440LF001401

Legend

(1) Bolt and Nut

(2) Upper Ball Joint

(3) Nut and Cotter Pin

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove the speed sensor from the knuckle.
3. Remove upper ball joint nut and cotter pin, then use remover 5-8840-2121-0 to remove the upper ball joint from the knuckle.

Intermittent Fault Conditions

8.1 Intermittent Conditions Diagnostic Table

Description

A fault condition is intermittent if one of the following conditions exists:

- The fault condition is not always present.
- The fault condition cannot be presently duplicated.
- There is no Current DTC but a History DTC is stored.

Diagnostic Table

Checks	Actions

Preliminary	• Perform the Preliminary Checks, refer to 7.1 Diagnostic Requirements, Precautions and Preliminary Checks.
	• Gather information from the customer regarding the conditions that trigger the intermittent fault such as:
	  • At what engine or ambient temperature range does the fault occur?
	  • Does the fault occur when operating aftermarket electrical equipment inside the vehicle?
	  • Does the fault occur on rough roads or in wet road conditions?
	• If the intermittent fault is a start and then stall condition, check immobiliser system. Refer to 11A Immobiliser.

Harness / Connector	Install Tech 2 and perform the Tech 2 Intermittent Fault Tests. Refer to 4.1 Diagnostic General Descriptions for information on Tech 2 ECU diagnostic tests.

Warning Indicator	The following conditions may cause an intermittent Malfunction Indicator Lamp fault with no DTC listed:
	• Electromagnetic Interference (EMI) caused by a faulty relay, ECM controlled solenoid, switch or other external source.
	• Incorrect installation of aftermarket electrical equipment such as the following:
	  • mobile phones,
	  • theft deterrent alarms,
	  • lights, or
	  • radio equipment.
	• Loose PIM ground connections.

Checks	Actions
Temperature Related	The Tech 2 Freeze Frame / Failure Records or Snapshot data may be used if applicable to the fault condition. Refer to 4.1 Diagnostic General Descriptions for information on Tech 2 ECU diagnostic tests. • If the intermittent fault is heat related, review the Tech 2 data in relationship to the following: • high ambient temperature, • underhood / engine generated heat, • circuit generated heat due to a poor electrical connection or high electrical load, and • higher than normal load conditions (towing, etc.). • If the intermittent fault is related to cold ambient or engine temperature, review the Tech 2 data in relationship to the following: • low ambient temperature, and • the fault condition that occurs only on a cold start situation.
Additional Tests	• Check for incorrect installation of aftermarket electrical equipment such as the following: • mobile phones, • theft deterrent alarms, • lights, or • radio equipment. • Check for electromagnetic Interference (EMI) caused by a faulty relay, ECM controlled solenoid or switch. The fault is triggered when the relay or solenoid is activated. • Check the A/C compressor clutch and some relays that contain a clamping diode or resistor for an open circuit. • Check the generator for a faulty rectifier bridge that may allow A/C noise into the PIM electrical circuit.
When all diagnosis and repairs are completed, check the engine management system for correct operation.	

9 DTC Tables

9.1 DTC C0550 – PIM Internal Fault

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC C0550 – EEPROM Error.
- DTC C0550 – Internal Control Module Read Only Memory (ROM Error).
- DTC C0550 – Internal Control Module Random Access Memory (RAM) Error.

Circuit Description

The powertrain interface module (PIM) is the control centre for the communication language conversion between GM LAN serial data and keyword 2000 serial data. If there is an internal microprocessor integrity fault condition with the PIM, DTC C0550 will set.

Additional Information

- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

- Conditions for running the DTC are:
  - The ignition is switched on.
  - The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

An internal PIM fault exists.

Action Taken When the DTC Sets

The action taken when any of these DTCs set will depend on the severity of the error. This may vary from no visual or audible warnings to a Malfunction Indicator Lamp and / or Service Vehicle Soon warning lamp displayed on the instrument cluster.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step checks if the DTC is current, and if so, indicates the PIM has an internal problem.

3 This step checks the PIM ground and 12 V battery supply.

DTC C0550 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for setting DTC C0550. 3 Using Tech 2, select the DTC display function. Does C0550 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	1 Test all ground circuits of the PIM for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the PIM fuses and replace as required. Refer to 8A Electrical-Body and Chassis. 3 Test the PIM battery supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 5	Go to Step 4
4	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 5	—
5	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC C0550 fail this ignition cycle?	Go to Step 2	Go to Step 6
6	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.2 DTC U2100 – No Communication With CAN Bus (High Speed)

DTC Description

This diagnostic procedure supports DTC U2100 – CAN Bus-off.

Circuit Description

The transmission control module (TCM) and engine control module (ECM) transmit and receive data using the GM LAN serial data protocol, while the immobiliser control unit (ICU) uses Keyword 2000 serial data protocol.

As the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to enable communication between the two different protocols. The PIM also integrates with the instrument cluster assembly.

The PIM will detect if a short to ground or a short to voltage condition occurs on GM LAN circuits. If either of these conditions occur, DTC U2100 sets.

Additional Information

- Refer to 6 Wiring Diagram and Connector for the following information:

- PIM connector illustration and terminal assignment, and
- PIM wiring diagram.

- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects a short to ground or short to voltage on the GM LAN circuits when the ignition is switched on and the short condition exists for greater than five seconds.

NOTE

This DTC will only set when the ignition has initially been turned to the ON position, and will not set when the vehicle is being driven.

Action Taken When the DTC Sets

- When the DTC sets, the following warning lamps are displayed on the instrument cluster:
  - Malfunction Indicator Lamp, and
  - Service Vehicle Soon.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 This step establishes if there is a fault with the ECM.

6 This step tests GM LAN serial data circuits between the TCM and the ECM.

8 This step tests GM LAN serial data circuits between the PIM and ECM (vehicles with manual transmission) or PIM and TCM (vehicles with automatic transmission).

9 This step tests GM LAN serial data circuits between the PIM and the data link connector.

DTC U2100 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check

Step	Action	Yes	No
2	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC U2100. 3 Using Tech 2, select the DTC display function. Does DTC U2100 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	1 Disconnect the ECM harness connector. 2 Switch off the ignition for 10 seconds. 3 Operate the vehicle within the conditions for setting DTC U2100. 4 Using Tech 2, select the DTC display function and check if DTC U2100 fails this ignition cycle. **NOTE** Other DTCs may set when the ECM connector is disconnected and the ignition is switched on. Disregard DTCs that set under this condition on this DTC Table. Does DTC U2100 fail this ignition cycle?	For vehicles with automatic transmissions, go to Step 5. For vehicles with manual transmission go to Step 8	Go to Step 4
4	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Has the repair been completed?	Go to Step 11	—
5	1 Disconnect the TCM harness connector. 2 Switch off the ignition for 10 seconds. 3 Using Tech 2, attempt to communicate with the PIM. Does Tech 2 communicate with the PIM?	Go to Step 6	Go to Step 8
6	Test serial data circuits between the TCM and ECM for a short to voltage, short to ground or short together condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 11	Go to Step 7
7	Replace the TCM. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Has the repair been completed?.	Go to Step 11	—
8	Test serial data circuits between the PIM and ECM for vehicles with manual transmission, or between the PIM and TCM for vehicles with automatic transmission for a high resistance or open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 11	Go to Step 9
9	Test serial data circuits and between the PIM and the data link connector for a short to voltage, short to ground or short together condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 11	Go to Step 10
10	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 11	—

Step	Action	Yes	No
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC U2100 fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.3 DTC U2105 – CAN Bus No Communication With Engine Control Module

DTC Description

This diagnostic procedure supports DTC U2105 – CAN Bus No Communication From ECM (Engine Control Module).

Circuit Description

The transmission control module (TCM) and engine control module (ECM) transmit and receive data using the GM LAN serial data protocol, while the immobiliser control unit (ICU) uses Keyword 2000 serial data protocol.

As the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to enable communication between the two different protocols. The PIM also integrates with the instrument cluster assembly.

The PIM continuously receives messages from the ECM. If the PIM does not receive a message within a predetermined time, DTC U2105 sets.

Additional Information

- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- Refer to 6C1-2 Engine Management – V6 – Diagnostics for diagnostic information.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM does not receive a message from the ECM for 100 milliseconds.

Action Taken When the DTC Sets

- When the DTC sets, the following warning lamps may be displayed on the instrument cluster:

- Malfunction Indicator Lamp,
- Service Vehicle Soon

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 This step tests GM LAN serial data circuits and the GM LAN component closest to the ECM.

5 This step tests the integrity of the ECM 12 V ignition circuit and ground connections.

6 This step tests the internal GM LAN CAN_HI circuit in the GM LAN component.

7 This step tests the internal GM LAN CAN_LO circuit in the GM LAN component.

DTC U2105 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC U2105. 3 Using Tech 2, select the DTC display function. Does DTC U2105 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	Using Tech 2, attempt to communicate with the ECM. Does Tech 2 communicate with the ECM?	Go to Step 10	Go to Step 4
4	Test serial data circuits between the ECM and PIM (vehicles with manual transmission), or ECM and TCM (vehicles with automatic transmission) for a high resistance or open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 11	Go to Step 5
5	Test the following ECM circuits for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical diagnosis: • 12 V battery supply circuit, • 12 V accessory supply circuit, and • all ECM ground connections. Has any fault been found and rectified?	Go to Step 11	Go to Step 6

Step	Action	Yes	No
6	1 Disconnect the PIM harness connector (vehicles with manual transmission), or TCM harness connector (vehicles with automatic transmission). 2 Using a digital multimeter, measure the resistance between the two CAN_LO terminals of either the PIM or TCM. **NOTE** Refer to 5 GM LAN Serial Communication Circuit and 6 Wiring Diagram and Connector for the appropriate GM LAN component terminal identification. Does the digital multimeter display infinity?	Go to Step 8	Go to Step 7
7	Using a digital multimeter, measure the resistance between the two CAN_HI terminals of either the PIM (vehicles with manual transmission) or TCM (vehicles with automatic transmission). Does the digital multimeter display infinity?	Go to Step 8	Go to Step 9
8	Replace the PIM (vehicles with manual transmission) or TCM (vehicles with automatic transmission). Refer to one of the following for the component replacement procedure: • 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing, or • 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 11	—
9	Replace the ECM. Refer to 6C1-3 Engine Management – V6 – Service Operations. Has the repair been completed?	Go to Step 11	—
10	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC U2105 fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK

When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.

9.4 DTC U2106 – CAN Bus No Communication With Transmission Control Module

DTC Description

This diagnostic procedure supports DTC U2106 – CAN Bus No Communication With TCM (Transmission Control Module).

Circuit Description

The transmission control module (TCM) and engine control module (ECM) transmit and receive data using the GM LAN serial data protocol, while the immobiliser control unit (ICU) uses Keyword 2000 serial data protocol.

As the GM LAN and keyword 2000 protocols are not compatible, a powertrain interface module (PIM) is integrated into the serial data system to enable communication between the two different protocols. The PIM also integrates with the instrument cluster assembly.

The PIM continuously receives messages from the TCM. If the PIM does not receive a message within a predetermined time, DTC U2106 sets.

Additional Information

- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM does not receive a message from the TCM for 1000 milliseconds, during the current ignition cycle.

Action Taken When the DTC Sets

- When the DTC sets, the following warning lamps may be displayed on the instrument cluster:
  - Malfunction Indicator Lamp,
  - Service Vehicle Soon.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

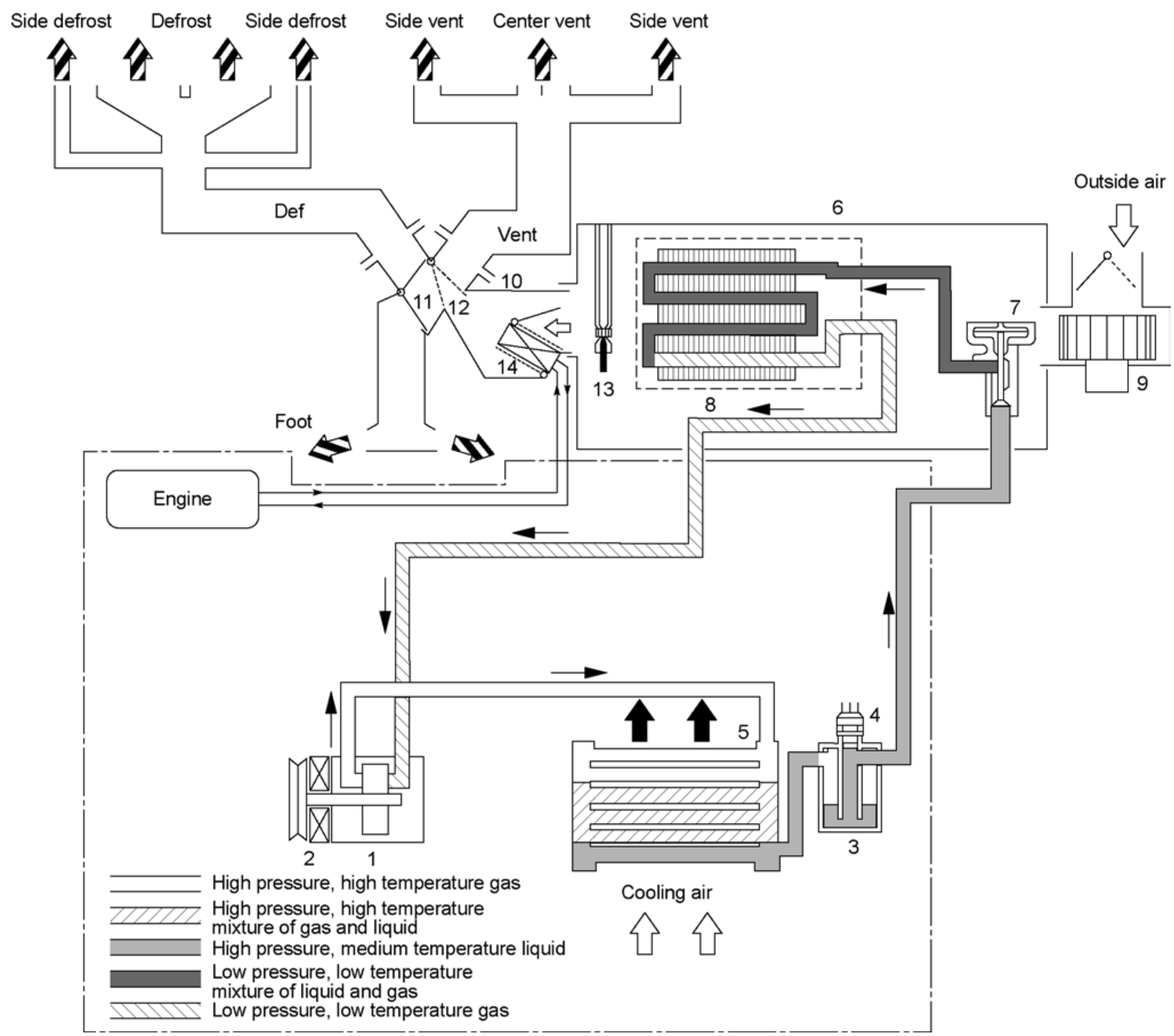
The following numbers refer to the step numbers in the diagnostic table:

4 This step tests the TCM power and ground circuits.

5 This step tests GM LAN serial data circuits between the TCM and the PIM.

GENERAL DESCRIPTION

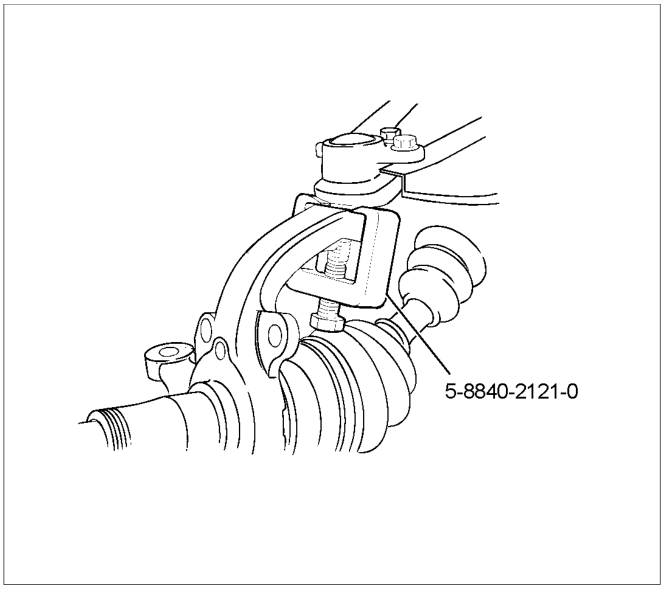
COOLING SYSTEM



1.	Compressor	8.	Evaporator core
2.	Magnetic clutch	9.	Blower motor
3.	Receiver/Drier	10.	Heater unit
4.	Triple pressure switch	11.	Mode (DEF/FOOT) control door
5.	Condenser	12.	Mode (VENT) control door
6.	Evaporator assembly	13.	Electronic thermostat
7.	Expansion valve	14.	Heater core

RTW610LF000101

CAUTION: Be careful not to damage the ball joint boot.



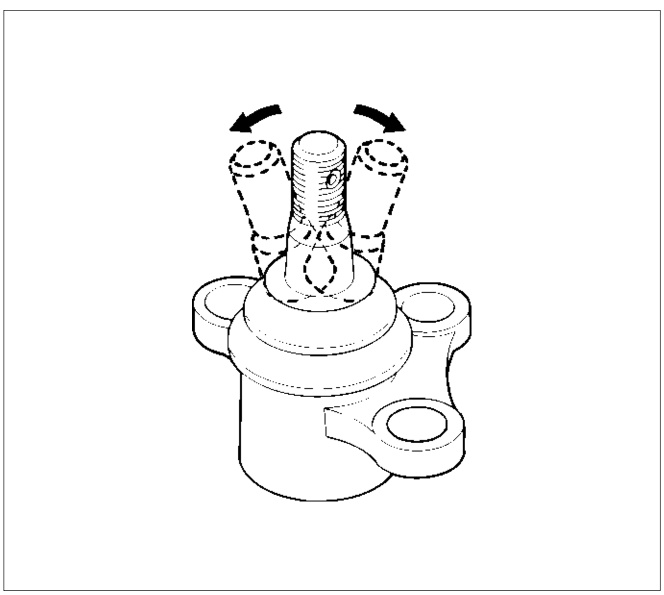
RTW340SH000401

4. Remove bolt and nut.
5. Remove upper ball joint.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal conditions are found through inspection.

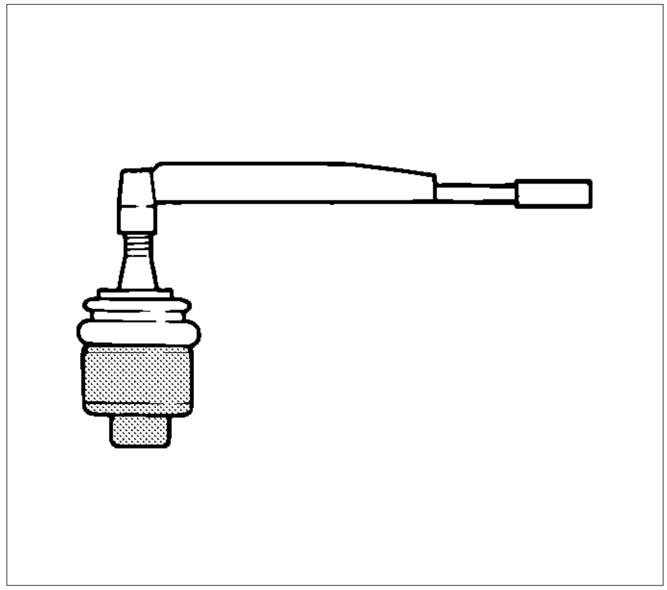
- Inspect the lower end boot for damage or grease leak. Move the ball joint as shown in the figure to confirm its normal movement.
- Inspect screw/taper area of ball for damage.
- If any defects are found by the above inspections, replace the ball joint assembly with new one.



450RS023

- After moving the ball joint 4 or 5 times, attach nut, then measure the preload.

Starting torque: 1.3-3.2 N·m (0.13-0.33 kgf·m/0.9-2.4 lb·ft)



450RS024

If the above limits specified are exceeded, replace the ball joint assembly.

Installation

1. Install upper ball joint.
2. Install bolt and nut, and then tighten them to the specified torque.

Torque: 57 N·m (5.8 kgf·m/42 lb·ft)

3. Install nut and cotter pin, and then tighten the nut to the specified torque with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 98 N·m (10.0 kgf·m/72 lb·ft)

6 This step tests the internal GM LAN CAN_HI circuit in the PIM.

7 This step tests the internal GM LAN CAN_LO circuit in the PIM.

DTC U2106 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC U2106. 3 Using Tech 2, select the DTC display function. Does DTC U2106 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	Using Tech 2, attempt to communicate with the TCM. Does Tech 2 communicate with the TCM?	Go to Step 9	Go to Step 4
4	Test the following TCM circuits for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical diagnosis: • 12 V battery supply voltage circuit, • 12 V accessory supply circuit, • Ignition Control Relay 12 V supply circuit, and • all TCM ground connections. Has any fault been found and rectified?	Go to Step 10	Go to Step 5
5	Test serial data circuits between the TCM and PIM for a high resistance or open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on wiring circuit testing and repair. Has any fault been found and rectified?	Go to Step 10	Go to Step 6
6	1 Disconnect the PIM harness connector. 2 Using a digital multimeter, measure the resistance between the two CAN_LO terminals of the PIM. **NOTE** Refer to 5 GM LAN Serial Communication Circuit and 6 Wiring Diagram and Connector for the appropriate GM LAN component terminal identification. Does the digital multimeter display infinity?	Go to Step 9	Go to Step 7
7	Using a digital multimeter, measure the resistance between the two CAN_HI terminals of the PIM. Does the digital multimeter display infinity?	Go to Step 9	Go to Step 8
8	Replace the TCM. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Has the repair been completed?	Go to Step 10	—
9	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 10	—

Step	Action	Yes	No
10	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC U2106 fail this ignition cycle?	Go to Step 2	Go to Step 11
11	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.5 DTC B0565 – Coolant Temperature Gauge Circuit High Current

Information not available at time of publication

9.6 DTC B0575 – Fuel Gauge Circuit High Current

Information not available at time of publication

9.7 DTC B3598 – Cruise Control Cancel Signal Malfunction

DTC Description

This diagnostic procedure supports DTC B3628 – Cruise Control Cancel Switch Stuck.

Circuit Description

The cruise control cancel switch is a normally open switch that closes when the switch is activated. When activated, the switch supplies signal voltage to the cruise control cancel signal circuit. The powertrain interface module (PIM) converts the signal voltage input into serial data, which is used by the engine control module (ECM) to cancel cruise control operation.

Additional Information

- Refer to 8C Cruise Control – HFV6 for the following information:
  - Cruise control switch description, operation and inspection procedures, and
  - Cruise control wiring diagram.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects the cruise control cancel function of the cruise control switch assembly is in the CANCEL position for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

If the cruise control is active at the time the DTC sets, the PIM will disable cruise control.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

NOTE

If the fault is not evident for greater than 120 seconds, the DTC will become a history DTC and cruise control can be resumed.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the cruise control cancel switch using Tech 2.

6 This step tests the cruise control cancel switch signal circuit.

DTC B3628 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the cruise control cancel switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC B3628. 3 Using Tech 2, select the DTC display function. Does DTC B3628 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector B-59 from the cruise control switch assembly. 2 Using Tech 2, view the cruise control cancel switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 6	Go to Step 5
5	Replace the cruise control switch assembly, refer to 8C Cruise Control – HFV6. Has the repair been completed?	Go to Step 8	—
6	Test the cruise control cancel switch signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC B3628 fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.8 DTC B3627 – Cruise Control Resume Signal Malfunction

DTC Description

This diagnostic procedure supports DTC B3627 – Cruise Control Resume Switch Stuck.

Circuit Description

The cruise control resume switch is a normally open switch that closes when the switch is activated. When activated, the switch supplies signal voltage to the cruise control resume signal circuit. The powertrain interface module (PIM) converts the signal voltage input into serial data, which is used by the engine control module (ECM) to resume cruise control operation.

Additional Information

- Refer to 8C Cruise Control – HFV6 for the following information:
  - Cruise control switch description, operation and inspection procedures, and
  - Cruise control wiring diagram.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects the cruise control resume function of the cruise control switch assembly is in the RESUME position for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

If the cruise control is active at the time the DTC sets, the PIM will disable cruise control.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

NOTE

If the fault is not evident for greater than 120 seconds, the DTC will become a history DTC and cruise control can be resumed.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the cruise control resume switch using Tech 2.

6 This step tests the cruise control resume switch signal circuit.

DTC B3627 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the cruise control resume switch status parameter in the PIM data list. Does Tech 2 display **Res** / **Accel**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC B3627. 3 Using Tech 2, select the DTC display function. Does DTC B3627 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector B-59 from the cruise control switch assembly. 2 Using Tech 2, view the cruise control resume switch status parameter in the PIM data list. Does Tech 2 display **Res** / **Accel**?	Go to Step 6	Go to Step 5
5	Replace the cruise control switch assembly, refer to 8C Cruise Control – HFV6. Has the repair been completed?	Go to Step 8	—
6	Test the cruise control resume switch signal circuit for a short to voltage. 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC B3627 fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.9 DTC B3628 – Cruise Control Set Signal Malfunction

DTC Description

This diagnostic procedure supports DTC 3598 – Cruise Control Set Switch Stuck.

Circuit Description

The cruise control set switch is a normally open switch that closes when the switch is activated. When activated, the switch supplies signal voltage to the cruise control set signal circuit. The powertrain interface module (PIM) converts the signal voltage input into serial data, which is used by the engine control module (ECM) to set the vehicle speed.

Additional Information

- Refer to 8C Cruise Control – HFV6 for the following information:
  - Cruise control switch description, operation and inspection procedures, and
  - Cruise control wiring diagram.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects the cruise control set function of the cruise control switch assembly is in the SET position for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

If the cruise control is active at the time the DTC sets, the PIM will disable cruise control.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

NOTE

If the fault is not evident for greater than 120 seconds, the DTC will become a history DTC and cruise control can be resumed.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the cruise control set switch using Tech 2.

6 This step tests the cruise control set switch signal circuit.

DTC 3598 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the cruise control set switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC 3598. 3 Using Tech 2, select the DTC display function. Does DTC 3598 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector B-59 from the cruise control switch assembly. 2 Using Tech 2, view the cruise control set switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 6	Go to Step 5
5	Replace the cruise control switch assembly, refer to 8C Cruise Control – HFV6. Has the repair been completed?	Go to Step 8	—
6	Test the cruise control set switch signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC 3598 fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.10 DTC B3794 – Cruise Control On/Off Signal Malfunction

DTC Description

This diagnostic procedure supports DTC B3794 – Cruise Control On/Off Switch Stuck.

Circuit Description

The cruise control on / off switch is a normally open switch that closes when the switch is activated. When activated, the switch supplies signal voltage to the cruise control on signal circuit. The powertrain interface module (PIM) converts the signal voltage input into serial data, which is used by the engine control module (ECM) to enable or disable the cruise control system, and by the instrument cluster to display cruise control status.

Additional Information

- Refer to 8C Cruise Control – HFV6 for the following information:
  - Cruise control switch description, operation and inspection procedures, and
  - Cruise control wiring diagram.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects the cruise control on / off function of the cruise control on/off switch is in the ON position for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

If the cruise control is active at the time the DTC sets, the PIM will disable cruise control.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

NOTE

If the fault is not evident for greater than 120 seconds, the DTC will become a history DTC and cruise control can be resumed.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the cruise control on / off switch using Tech 2.

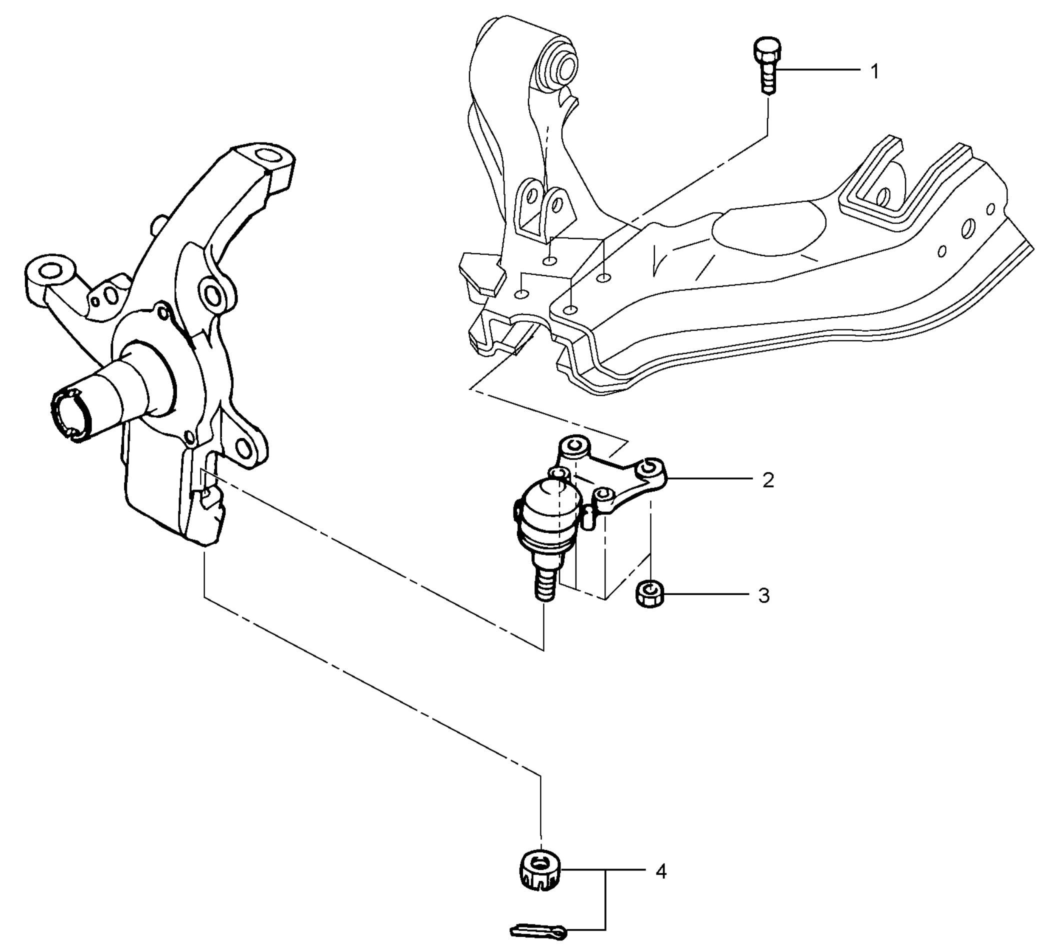
6 This step tests the cruise control on / off switch signal circuit.

DTC B3794 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the cruise control on / off switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC B3794. 3 Using Tech 2, select the DTC display function. Does DTC B3794 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector B-67 from the cruise control on/off switch. 2 Using Tech 2, view the cruise control on / off switch status parameter in the PIM data list. Does Tech 2 display **Active**?	Go to Step 6	Go to Step 5
5	Replace the cruise control on/off switch, refer to 8C Cruise Control – HFV6. Has the repair been completed?	Go to Step 8	—
6	Test the cruise control on / off switch signal circuit for a short to voltage. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC B3794 fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

Lower Ball Joint

Lower Ball Joint and Associated Parts



RTW340LF001601

Legend

(1) Lower Ball Joint Bolt
(2) Lower Ball Joint
(3) Lower Ball Joint Nut
(4) Nut and Cotter Pin

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove wheel and tire assembly. Refer to Wheel in this section.
3. Remove the tie-rod end from the knuckle. Refer to Power Steering Unit in Steering section.
4. Remove the retaining ring from the front axle driving shaft to release the shaft from hub. Refer to Front Hub and Disc in Driveline/Axle section.
5. Support lower control arm with a jack.
6. Remove lower ball joint nut and cotter pin, then use remover 5-8840-2005-0 to remove the lower ball joint from the knuckle.

9.11 DTC B3902 – Immobiliser Malfunction

DTC Descriptors

This diagnostic procedure supports DTC B3902 – Immobiliser Malfunction.

Circuit Description

The engine control module (ECM), the powertrain interface module (PIM) and the immobiliser control unit (ICU) are integral parts of the vehicle immobiliser system. The immobiliser system authenticates the security code programmed into each of these modules to prevent unauthorised vehicle operation. This authentication process includes the following steps:

1 At predetermined situations, the ICU sends a security code to the PIM.

2 When the ignition is switched ON, the PIM receives and compares this security code from the ICU against the security code programmed into the PIM.

3 Once the PIM receives the correct security code from the ICU, it sends a security code to the ECM.

4 The ECM receives and compares this security code from the PIM against the security code programmed into the ECM.

5 The authentication process is complete once the ECM receives the correct security code from the PIM within the specified time frame.

6 The ECM allows normal vehicle operation.

NOTE

If any of these authentication processes fail, the vehicle will not start and DTCs will set. For further information on the immobiliser system, refer to 11A Immobiliser.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

B3902

Ignition set to the ON position.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Additional Information

- Refer to 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to 11A Immobiliser for immobiliser system information:
- Refer to 12.4 Immobiliser Link to ECM / PIM for immobiliser link to ECM / PIM.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to Intermittent Fault Conditions in this section.

- To assist diagnosis, refer to 6 Wiring Diagram and Connector Chart for the system wiring diagram and connector charts in this section.

DTC B3902 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, perform the ICU ID check procedure. Is the ID number displayed by Tech 2?	Go to Step 3	Go to Step 5
3	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for setting the DTC. 3 Using Tech 2, select the DTC display function. Does DTC B3902 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	Test the Immobiliser system. Refer to 11A Immobiliser. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
5	1 Test all ground circuits of the ICU for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the ICU ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 6
6	Replace the ICU. Refer to 11A Immobiliser. Was the repair completed?	Go to Step 8	—
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Was the repair completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any of the immobiliser DTCs fail this ignition cycle?	Go to Step 2	Go to Step 9
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.12 DTC P0318 – Vertical Acceleration Sensor

DTC Description

This diagnostic procedure supports the Vertical Acceleration Sensor (VAS).

Circuit Description

The vertical acceleration sensor monitors vertical movement of the vehicle. The powertrain interface module (PIM) converts the signal voltage input into serial data, which is used by.

Additional Information

- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The DTC will set when the PIM detects a low voltage of <0.41 volts for one second.

The DTC will set when the PIM detects a high voltage of >4.59 volts for one second.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

Conditions for Clearing the DTC

The DTC is cleared at the next ignition cycle.

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the vertical acceleration sensor using Tech 2.

6 This step tests the ground circuit.

Vertical Acceleration Sensor Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to additional information
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0318 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Switch on the ignition with the engine not running. 2 Using a digital multimeter, measure the voltage between the VAS reference circuit and a good ground. Refer to 6 Wiring Diagram and Connector Chart. Does the multimeter display approximately 5.0 V?	Go to Step 4	Go to Step 7

Step	Action	Yes	No
4	Using a digital multimeter, measure the resistance between the VAS earth circuit and a good ground. Refer to 6 Wiring Diagram and Connector Chart. Does the multimeter display approximately 5.0 Ω?	Go to Step 5	Go to Step 8
5	1 Remove the VAS from its mounting bracket on the vehicle chassis. 2 Switch on the ignition with the engine not running. 3 While rapidly moving the sensor in a vertical up and down motion, Use a digital multimeter to measure the voltage between the VAS output signal circuit and a good ground. Does the multimeter display 1.8 – 3.3 V?	Go to Step 6	Go to Step 9
6	Perform the following VAS inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching nut torque value. Refer to 11.3 Vertical Acceleration Sensor. Was any fault found and rectified?	Go to Step 11	Go to Step 7
7	Test the VAS signal circuit and 5V reference circuit for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 9
8	Repair the open or high resistance fault condition in the VAS ground circuit. Refer to 8A Electrical - Body and Chassis for information on electrical repair procedures. Was the repair completed?	Go to Step 11	—
9	Replace the VAS. Refer to 11.3 Vertical Acceleration Sensor. Was the repair completed?	Go to Step 11	—
10	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does the VAS circuit DTC fail this ignition cycle?	Go to Step 2	Go to Step 13
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

9.13 DTC P0500, P0502 or P0503 – Vehicle Speed Sensor Signal Malfunction

DTC Descriptors

This diagnostic procedure supports the following DTC's:

- DTC P0500 – Vehicle speed sensor open circuit, short circuit to battery voltage, short circuit to ground, or undefined error
- DTC P0502 – Vehicle speed sensor sensor low voltage
- DTC P0503 – Vehicle speed sensor intermittant fault

Circuit Description

The PIM applies the ground to the vehicle speed sensor (VSS) low reference circuit.

The VSS in conjunction with the 40X reluctor wheel generates an AC signal voltage. The amplitude and frequency of the signal generated is proportional to the vehicle speed. The PIM uses this signal from the VSS signal circuit to determine the vehicle speed.

A VSS DTC sets if the PIM detects a fault condition in the VSS signal circuit.

Conditions for Running the DTC

DTC P0500

Runs continuously once the following condition is met:

- The ignition is on and the vehicle is stationary.

DTC P0502

Runs continuously once the following condition is met:

- The first time the ignition is on and the vehicle starts to move from the stationary position.

DTC P0503

Runs continuously once the following condition is met:

- The ignition is on and the vehicle is mobile.

Conditions for Setting the DTC

DTC P0500

When the PIM reads back the 15 consecutive readings within 0.5 seconds.

DTC P0502

If the reading is >9.1 Km/Hr the DTC will be set.

DTC P0503

The DTC will set when the sensor detects an occurance of 15 times within 0.5 seconds.

Conditions for Clearing DTC

The DTC's will clear on the next ignition cycle.

Additional Information

- Refer to 7B1_Manual Transmission.

- For an intermittent fault condition, refer to Intermittent Fault Conditions in this Section.
- The VSS in conjunction with the 40X reluctor wheel generates an AC signal voltage. The amplitude and frequency of the signal generated is proportional to the vehicle speed. The PIM uses this signal from the VSS signal circuit to determine the vehicle speed.
- Since fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- To assist diagnosis, refer to 6 Wiring Diagram and Connector Chart in this Section, for the system wiring diagram and connector charts.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 The PIM supplies 2.5 V to signal circuit of the VSS circuit to reduce the Electro Magnetic interference (EMI). If the voltage is not within range, this indicates there is an PIM fault or a PIM circuit fault condition.

4 The PIM supplies 2.5 V to low reference circuit of the VSS circuit to reduce the Electro Magnetic interference (EMI). If the voltage is not within range, this indicates there is a PIM fault or a PIM circuit fault condition.

DTC P0335 to P0338 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to additional information
2	1 Switch off the ignition for 30 seconds. 2 Start the engine. 3 Using Tech 2, select the DTC display function. Does DTC P0500, P0502, P0503 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this DTC
3	1 Disconnect the VSS connector. 2 Switch on the ignition with the engine not running. 3 Using a digital multimeter, measure the voltage between the signal circuit of the sensor connector and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 4	Go to Step 7
4	Using a digital multimeter, measure the voltage between the VSS low reference circuit and a good ground. Does the multimeter display 2 – 3 V?	Go to Step 5	Go to Step 7
5	Using a digital multimeter, measure the resistance between the ground shield circuit of the VSS at the PIM connector and the PIM housing. Does the multimeter display approximately 5 Ω?	Go to Step 6	Go to Step 7
6	Perform the following VSS inspection: • Inspect the sensor wiring harness for conditions that may induce electromagnetic interference. Refer to Intermittent Fault Conditions in this Section. • Inspect the sensor for incorrect sensor installation or incorrect attaching bolt torque value. Refer to 7B1_Manual Transmission. Was any fault found and rectified?	Go to Step 11	Go to Step 9

Step	Action	Yes	No
7	Test the VSS signal circuit and low reference circuit for a high resistance, open circuit, short to ground, short to voltage or shorted together fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Was any fault found and rectified?	Go to Step 11	Go to Step 10
8	Repair the open or high resistance fault condition in the VSS ground shield circuit. Refer to 8A Electrical - Body and Chassis for information on electrical repair procedures. Was the repair completed?	Go to Step 11	—
9	Replace the VSS. Refer to 7B1_Manual Transmission. Was the repair completed?	Go to Step 11	—
10	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Was the repair completed?	Go to Step 11	—
11	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the VSS circuit DTCs fail this ignition cycle?	Go to Step 2	Go to Step 12
12	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table in this Section	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

9.14 DTC P0633 – Immobiliser Function Not Programmed

DTC Descriptors

This diagnostic procedure supports DTC P0633 – Immobiliser Function Not Programmed.

Circuit Description

The engine control module (ECM), the powertrain interface module (PIM) and the immobiliser control unit (ICU) are integral parts of the vehicle immobiliser system. The immobiliser system authenticates the security code programmed into each of these modules to prevent unauthorised vehicle operation. This authentication process includes the following steps:

1. At predetermined situations, the ICU sends a security code to the PIM.
2. When the ignition is switched ON, the PIM receives and compares this security code from the ICU against the security code programmed into the PIM.
3. Once the PIM receives the correct security code from the ICU, it sends a security code to the ECM.
4. The ECM receives and compares this security code from the PIM against the security code programmed into the ECM.
5. The authentication process is complete once the ECM receives the correct security code from the PIM within the specified time frame.
6. The ECM allows normal vehicle operation.

NOTE

If any of these authentication processes fail, the vehicle will not start and DTCs will set. For further information on the immobiliser system, refer to 11A Immobiliser.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

P0633

An attempt is made to start the engine before the immobiliser function has been programmed into a new PIM.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Additional Information

- Refer to 6C1-1 Engine Management –V6 – General Information for details of the ECM operation.
- Refer to 11A Immobiliser for immobiliser system information:
- Refer to 12.4 Immobiliser Link to ECM / PIM for immobiliser link to ECM / PIM.
- Since a fault condition in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.
- For an intermittent fault condition, refer to Intermittent Fault Conditions.
- To assist diagnosis, refer to 6 Wiring Diagram and Connector Chart for the system wiring diagram and connector charts.

DTC P0633 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Operate the vehicle within the conditions for setting the DTC. 3 Using Tech 2, select the DTC display function. Does DTC P0513, P1629, P1632, P0633, P1677, P1678 or P1679 fail this ignition cycle?	Go to Step 3	Refer to Additional Information in this Section
3	Using Tech 2, perform the ICU Link to ECM / PIM procedure. Refer to 12.4 Immobiliser Link to ECM / PIM. Has the linking procedure been performed correctly?	Go to Step 7	Go to Step 4
4	Test the Immobiliser system. Refer to 11A Immobiliser. Has any fault been found and rectified?	Go to Step 7	Go to Step 5

Step	Action	Yes	No
5	1 Test all ground circuits of the PIM for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the PIM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 7	Go to Step 6
6	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 7	—
7	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Do any of the immobiliser DTCs fail this ignition cycle?	Go to Step 2	Go to Step 8
8	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.15 DTC P1611 – Wrong Security Code Entered

DTC Description

This diagnostic procedure supports DTC P1611 – Wrong Security Code Entered.

Circuit Description

Tech 2 is used to program the powertrain interface module (PIM). Before any programming, a security code must be entered into Tech 2. The PIM will check if the code entered is correct before continuing. If the security code is incorrect, DTC P1611 sets.

After an incorrect security code is entered, the PIM prevents any further attempts to enter a code until a predetermined wait time elapses. There are several wait time stages, and for each stage, an incorrect security code may be entered three times before the lockout time is escalated to the next stage. The lockout stages are as follows:

- Stage 1 wait time is 10 seconds.
- Stage 2 wait time is 10 seconds.
- Stage 3 wait time is 10 minutes.
- Stage 4 wait time is 20 minutes.
- Stage 5 wait time is 40 minutes.
- Stage 6 wait time is 80 minutes.

Additional Information

- Refer to 12.4 Immobiliser Link to ECM / PIM for PIM Security Code.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.

- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

An incorrect security code is entered into Tech 2 when attempting to program the PIM.

Action Taken When the DTC Sets

When the DTC sets, the following action is taken:

- The vehicle will not start whilst the PIM is in a lock-out state.

NOTE

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

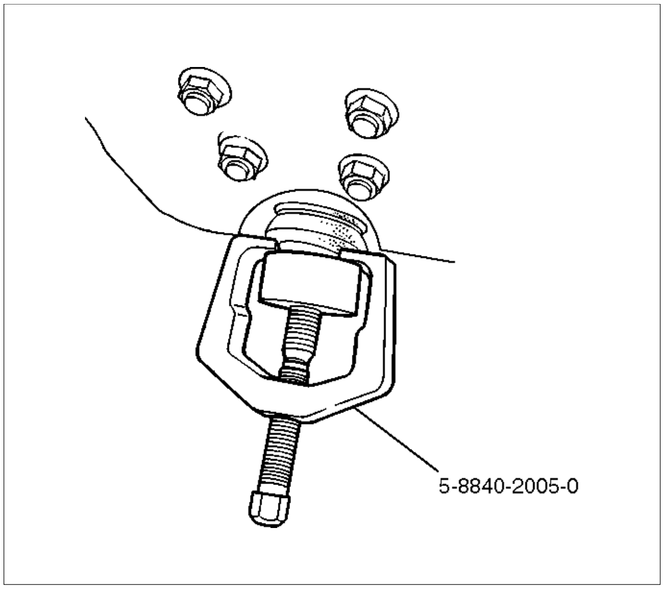
The following number refers to the step numbers in the diagnostic table:

4 This step tests the PIM ground circuits and supply voltage.

DTC P1611 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	1 Switch off the ignition for 30 seconds. 2 Using Tech 2, select the DTC display function. **NOTE** Do not attempt to perform any Tech 2 function that requires the PIM security code to be entered. Does DTC P1611 fail this ignition cycle?	Go to Step 5	Go to Step 3
3	Using Tech 2, attempt a programming function that requires the PIM security code to be entered. Refer to 12 PIM Security and Programming. Has the programming function been successfully performed?	System OK	Go to Step 4

CAUTION: Be careful not to damage the ball joint boot.



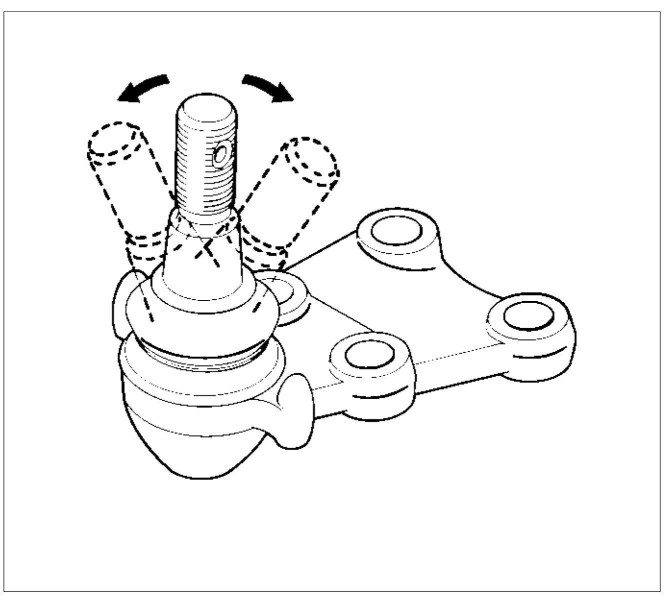
901RW271

7. Remove lower ball joint nut.
8. Remove lower ball joint bolt.
9. Remove lower ball joint.

Inspection and Repair

Make necessary parts replacement if wear, damage, corrosion or any other abnormal condition is found through inspection.

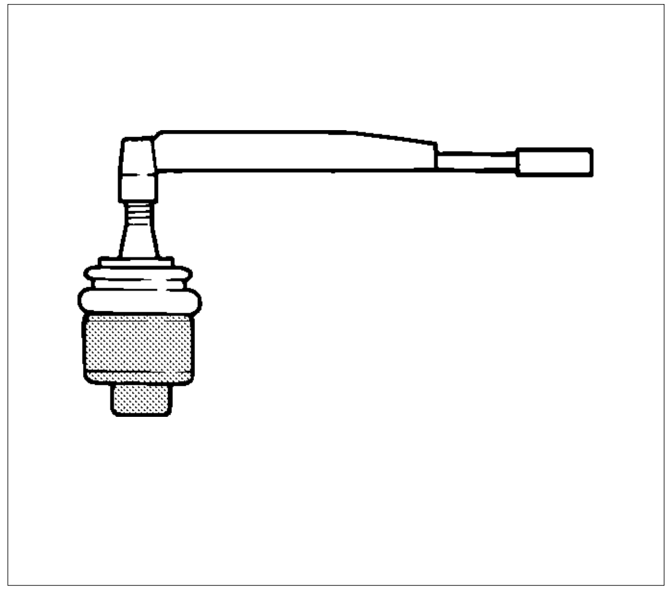
- Inspect the lower end boot for damage or grease leak. Move the ball joint as shown in the figure to confirm its normal movement.
- Inspect screw/taper area of ball for damage.
- If any defects are found by the above inspections, replace the ball joint assembly with a new one.



450RS026

- After moving the ball joint 4 or 5 times, attach nut then measure the preload.

Starting torque: 2.5-6.4 N·m (0.25-0.65 kgf·m/1.8-4.7 lb·ft)



450RS024

- If the above limits specified are exceeded, replace the ball joint assembly.

Installation

1. Install lower ball joint.
2. Install lower ball joint bolt.
3. Install lower ball joint nut and tighten it to the specified torque.

Torque: 127 N·m (13.0 kgf·m/94 lb·ft)

4. Install ball joint nut, then tighten it to the specified torque with just enough additional torque to align cotter pin holes. Install new cotter pin.

Torque: 147 N·m (15.0 kgf·m/108 lb·ft)

Step	Action	Yes	No
4	1 Test all ground circuits of the PIM for a high resistance or an open circuit fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. 2 Test the PIM ignition supply voltage circuit for a high resistance, open circuit or short to ground fault condition. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 6	Go to Step 5
5	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. Does DTC P1611 fail this ignition cycle?	Go to Step 2	Go to Step 7
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

9.16 DTC B0981 – 3rd Start Switch Signal Malfunction

DTC Description

This diagnostic procedure supports DTC B0981 – 3rd Start Switch Signal Malfunction.

Circuit Description

The 3rd start mode switch is a normally open switch that closes when the switch is activated. When activated, the switch supplies signal ground to the 3rd start ground signal circuit. The powertrain interface module (PIM) converts the signal ground input into serial data, which is used by the automatic transmission control module (TCM) to enable or disable the 3rd start mode, and by the instrument cluster to display power mode status.

Additional Information

- For the 4L60E automatic transmission, refer to 7C1 Automatic Transmission – 4L60E – General Information:
  - Power mode switch description, operation and inspection procedure, and
  - TCM wiring diagram.
- Refer to 6 Wiring Diagram and Connector for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent fault conditions, refer to Intermittent Fault Conditions.
- Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Conditions for Running the DTC

Conditions for running the DTC are:

- The ignition is switched on.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

The PIM detects the power mode switch is activated for 120 seconds or more.

Action Taken When the DTC Sets

When the DTC sets, there is no warning lamp displayed on the instrument cluster.

Conditions for Clearing the DTC

Refer to 4.1 Diagnostic General Descriptions for information on the conditions for clearing DTCs.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the power mode switch using Tech 2.

6 This step tests the power mode switch signal circuit.

DTC B0980 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 7.2 Diagnostic System Check
2	Using Tech 2, view the power mode switch status parameter in the PIM data list. Does Tech 2 display **Power**?	Go to Step 4	Go to Step 3
3	1 Switch off the ignition for 10 seconds. 2 Operate the vehicle within the conditions for setting DTC B0980. 3 Using Tech 2, select the DTC display function. Does DTC B0980 fail this ignition cycle?	Go to Step 4	Refer to Additional Information in this Section
4	1 Disconnect connector S22 – X1 from the power mode switch. 2 Using Tech 2, view the power mode switch status parameter in the PIM data list. Does Tech 2 display **Power**?	Go to Step 6	Go to Step 5
5	Replace the power mode switch. Refer to 10 Cab. Has the repair been completed?	Go to Step 8	—
6	Test the power mode switch ground signal circuit for a short to ground. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis. Has any fault been found and rectified?	Go to Step 8	Go to Step 7
7	Replace the PIM. Refer to 11.2 Powertrain Interface Module. Has the repair been completed?	Go to Step 8	—
8	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does DTC B0980 fail this ignition cycle?	Go to Step 2	Go to Step 9

Step	Action	Yes	No
9	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

10 Diagnostics For Non DTC Faults

10.1 PRND32L Display Diagnostics

Circuit Description

The powertrain interface module (PIM) receives transmission gear status via the GM Lan serial data bus from the transmission control module (TCM) it is then sent to the instrument cluster by the PIM via a series of hard wired connections to illuminate the appropriate gear position indicator within the instrument cluster. Some of these components do not set a DTC, in the event of a component failure. The following diagnostic procedures are devised to assist in these cases.

Additional Information

- Refer to 7.2 Diagnostic System Check to monitor DTC's.
- Refer to 8A Electrical Body and Chassis for the following information:
  - Automatic transmission Neutral Start and Back-up Lamp Switch and wiring,
  - TCM wiring diagram.
- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent faults, refer to Intermittent Fault Conditions.
- Check for an intermittent fault in the wiring harness or connectors, if a fault cannot be found the system is serviceable.

Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step tests for DTC's in the overall system.

2 This step manually tests the PRND32L display.

4 This step uses Tech 2 to drive each indicator on.

7 This step tests for shorts to voltage.

8 This step tests neutral start and back-up lamp switch and automatic transmission.

12 This step tests the instrument cluster circuits.

15 This step manually tests the PRND32L display.

PRND32L Display Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to Diagnostic System Check in this section
2	1 Turn the ignition to the ON position. 2 Move the gear select lever through each gear position and check the instrument cluster PRND32L display. Does each indicator display an off to on condition?	Refer to Additional Information in this section	Go to Step 3
3	Are any of the indicators permanently illuminated?	Go to Step 5	Go to Step 4
4	1 Using Tech 2 select, **Body** / **PIM** / **Miscellaneous Tests** / **Status Indicators** / **PRNDL Lamps.** 2 Using the Tech 2 soft keys step through the sequence of illuminating each PRND32L indicator in turn. Does each indicator display an off to on condition?	Go to Step 8	Go to Step 10
5	Disconnect the TCM harness connector. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Is the indicator in Step 3 still permanently illuminated?	Go to Step 6	Go to Step 8
6	Disconnect the PIM harness connector. Refer to 11.2 Powertrain Interface Module in this Section. Is the indicator in Step 3 still permanently illuminated?	Go to Step 7	Go to Step 14
7	Turn the ignition to the ON position, test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to step 15	Go to step 12
8	Check the neutral start and back-up lamp switch and automatic transmission for correct operation. Refer to 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis. Was any fault found and rectified?	Go to Step 15	Go to 9
9	Replace the TCM. Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Has the repair been completed?	Go to Step 15	—
10	1 Disconnect the instrument cluster harness connector. 2 Turn the ignition to the ON position. 3 While sequencing each PRND32L indicator, back probe the relevant connector pins at the rear of the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Does the multimeter display a change from 0 to 10 Volts as each PRND32L indicator position is selected?	Go to Step 12	Go to 11
11	Test for high resistance, open circuit, a short to ground of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 15	Go to Step 14

Step	Action	Yes	No
12	Test the following instrument cluster circuits for a high resistance, open circuit or short to ground fault condition: • all 12 V battery supply circuits • all instrument cluster ground connections Was any fault found and rectified?	Go to Step 15	Go to Step 13
13	Replace the instrument cluster. Has the repair been completed?	Go to Step 15	—
14	Replace the PIM. Has the repair been completed?	Go to step 15	—
15	1 Turn the ignition to the ON position. 2 Move the gear select lever through each gear position and check the PRND32L display. Does each indicator display an off to on condition?	System OK	Go to step 2
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

10.2 Warning Signal and Status Indicators Diagnostics

Circuit Description

The powertrain interface module (PIM) is connected to the instrument cluster by a series of hard wired connections to illuminate the appropriate warnings and indicators within the instrument cluster. Some of these components do not set a DTC, in the event of a component failure. The following diagnostic procedures are devised to assist in these cases.

Additional Information

- Refer to 7.2 Diagnostic System Check to monitor DTC's.
- Refer to 8A Electrical Body and Chassis for the following information:
  - Automatic transmission PRND32L switch and wiring,
  - TCM wiring diagram.
- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent faults, refer to Intermittent Fault Conditions.
- Check for an intermittent fault in the wiring harness or connectors, if a fault cannot be found the system is serviceable.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step tests for DTC's in the overall system.

2 This step manually tests the warning indicators.

5 This step uses Tech 2 to drive each status indicator on.

6 This step uses Tech 2 to drive each warning indicator on.

9 This step tests the wiring harness between the PIM and the Instrument Cluster.

Hard-wired Warning Signals

Display	Indicator
CHECK TRANS	Lamp
3rd START	Lamp
POWER	Lamp
A/T OIL TEMP	Lamp
CRUISE SET	Lamp
OIL	Lamp
THERMO	Gauge
SVS	Lamp
CHARGE	Lamp
TACHO	Gauge

Warning Signal and Status Indicator Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to Additional Information
2	Turn the Ignition to the ON position, observe if all warning and status indicators illuminate during the Instrument Cluster start up sequence. Do all indicators illuminate?	Go to Step 3	Go to step 4
3	1 Start the vehicles engine. 2 Are any of the warning or status indicators permanently illuminated?	Go to Step 7	Go to Step 4
4	Using Tech 2. Are any DTC's set which may cause incorrect operation of the warning or status indicators?	Refer to the relevant DTC's section	Go to Step 5
5	1 Using Tech 2 select, **Body** / **PIM** / **Miscellaneous Tests** / **Status Indicators.** 2 Select and activate in turn **Cruise Control ON Lamp** / **Cruise Control Set Lamp** / **Power Drive Lamp.** Does each indicator illuminate?	Go to Step 6	Go to Step 8
6	1 Using Tech 2 select, **Body** / **PIM** / **Miscellaneous Tests** / **Warnings.** 2 Select and activate in turn, **ALT** / **Oil Pressure** / **Service Soon** / **A/T Oil Temp** / **Check Trans.** Does each warning illuminate?	Go to Step 15	Go to Step 8
7	Disconnect the PIM harness connector. Refer to 11.2 Powertrain Interface Module in this section. Is the indicator/warning in Step 3 still permanently illuminated?	Go to Step 9	Go to Step 12
8	Remove and test the lamp from the malfunctioning warning. Was the lamp found to be faulty and replaced?	Go to Step 15	Go to Step 14

Step	Action	Yes	No
9	Test for high resistance, open circuit, a short to ground of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 16	Go to step 10
10	Turn the ignition to the ON position, test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 16	Go to Step 11
11	Disconnect the PIM. Test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Was any fault found and rectified?	Go to Step 13	Go to Step 12
12	Disconnect the instrument cluster. Test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Was any fault found and rectified?	Go to Step 16	Go to Step 14
13	Replace the PIM. Has the repair been completed?	Go to Step 16	—
14	Test the following instrument cluster circuits for a high resistance, open circuit or short to ground fault condition: • all 12 V battery supply circuits • all instrument cluster ground connections Was any fault found and rectified?	Go to Step 16	Go to Step 15
15	Replace the instrument cluster. Has the repair been completed?	Go to Step 16	—
16	Turn the Ignition to the ON position, observe if all warning indicators illuminate during the Instrument Cluster start up sequence. Do all indicators function correctly?	System serviceable	Go to step 3
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

10.3 Tachometer Diagnostics

Circuit Description

The powertrain interface module (PIM) receives the tachomer signal from the engine control module (ECM), it is then sent to the instrument cluster by the PIM via a hard wired connection to drive the tachometer which displays the engine RPM. Some of these components do not set a DTC, in the event of a component failure. The following diagnostic procedures are devised to assist in these cases.

Additional Information

- Refer to 7.2 Diagnostic System Check to monitor DTC's.
- Refer to 8A Electrical Body and Chassis for the following information:
  - ECM wiring diagram.
- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent faults, refer to Intermittent Fault Conditions.
- Check for an intermittent fault in the wiring harness or connectors, if a fault cannot be found the system is serviceable.

Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step tests for DTC's in the overall system.

2 This step uses the instrument cluster self test to check the function of the tachometer.

3 This step uses Tech 2 to drive the tachometer.

6 This step tests for tachometer drive frequency.

10 This step tests the in-vehicle function of the tachometer.

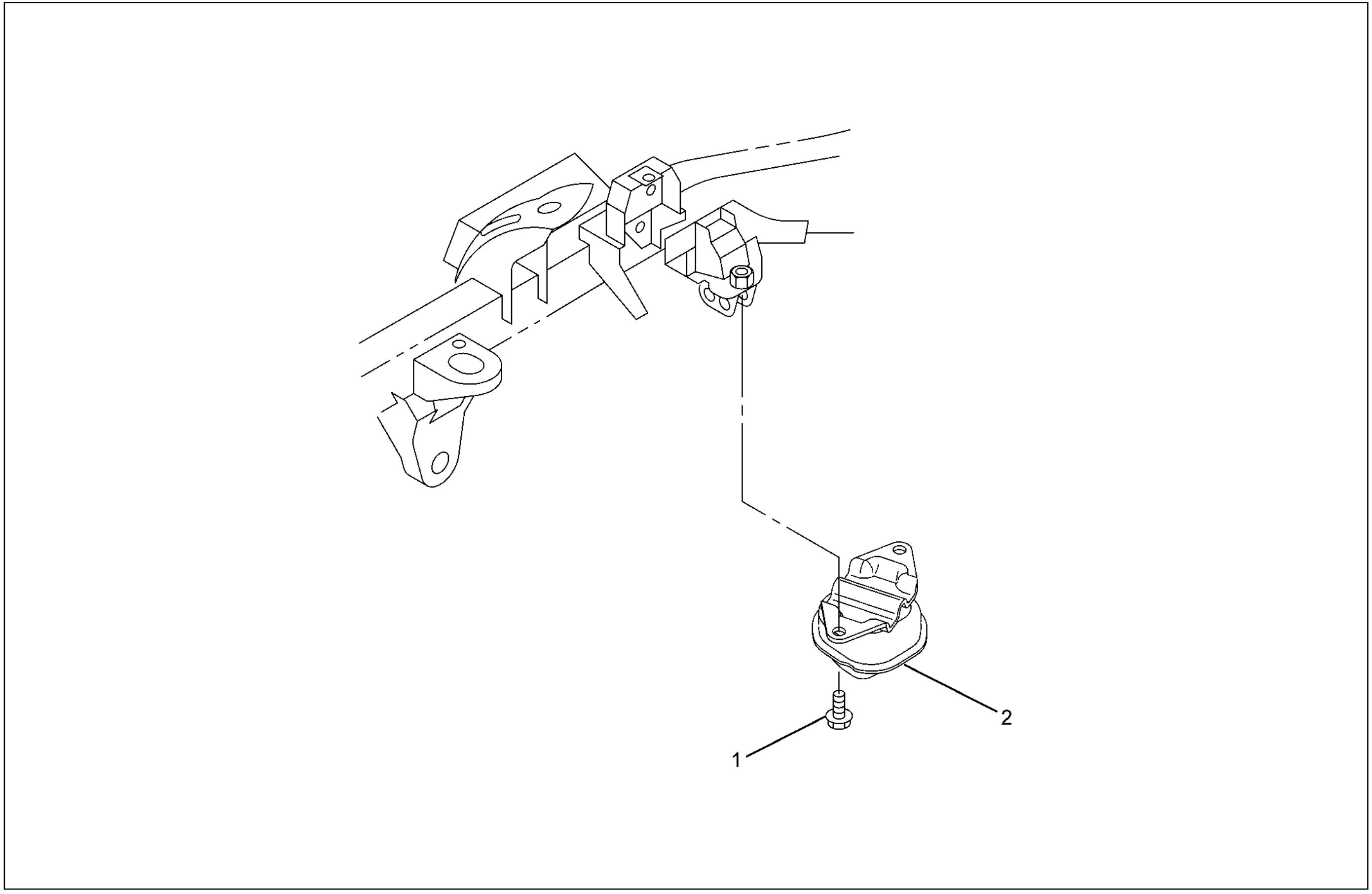
Tachometer Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to Additional Information
2	Test the function of the tachometer using the instrument cluster self diagnostic test procedure, refer to 8A Electrical Body and Chassis. Does the tachometer display 3000 RPM?	Go to Step 3	Go to Step 7
3	1 Using Tech 2 select, **Body / PIM / Miscellaneous Tests / Gauge Control Tests / Tachometer.** 2 Using the Tech 2 soft keys step the tacho through different RPM ranges. Does the tachometer respond to the Tech 2 commands?	Go to Step 5	Go to Step 4

4	Test for high resistance, open circuit, a short to ground of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 10	Go to Step 5
5	Turn the ignition to the ON position, test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 10	Go to Step 6
6	Measure the frequency at the tachometer signal output from the ECM, refer to 8A Electrical Body and Chassis. Is the tachometer frequency present?	Go to Step 7	Refer to 6C1-2 Engine Management Diagnostics
7	Replace the PIM. Has the repair been completed?	Go to Step 10	—
8	Test the following instrument cluster circuits for a high resistance, open circuit or short to ground fault condition: • all 12 V battery supply circuits • all instrument cluster ground connections Was any fault found and rectified?	Go to Step 10	Go to Step 9
9	Replace the instrument cluster. Has the repair been completed?	Go to Step 10	—
10	Start the vehicles engine. Does the tachometer function normally?	System OK	Go to Step 2
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

Bump Rubber

Bump Rubber and Associated Parts



RTW63CMF000101

Legend

(1) Bolt

(2) Bump Rubber

Removal

1. Raise the vehicle and support the frame with suitable safety stands.
2. Remove bolt.
3. Remove bump rubber.

Inspection and Repair

Make necessary correction or replace parts if wear, damage, corrosion or any other abnormal condition is found through inspection.

Check the following parts:

- Bump Rubber

Installation

1. Install bump rubber.

NOTE: Arrow points to the outer side of vehicle after assembly to vehicle.

2. Install bolt, then tighten it to the specified torque.

Torque: 42 N·m (4.3 kgf·m/31 lb·ft)

10.4 Temperature Gauge Diagnostics

Circuit Description

The powertrain interface module (PIM) receives engine temperature status via the GM Lan serial data bus from the engine control module (ECM) it is then sent to the instrument cluster by the PIM via a hard wired connection to drive the temperature gauge to the appropriate position. Some of these components do not set a DTC, in the event of a component failure. The following diagnostic procedures are devised to assist in these cases.

Additional Information

- Refer to 7.2 Diagnostic System Check to monitor DTC's.
- Refer to 8A Electrical Body and Chassis for the following information:
  - ECM wiring diagram.
- Refer to 6 Wiring Diagram and Connector Chart for the following information:
  - PIM connector illustration and terminal assignment, and
  - PIM wiring diagram.
- For intermittent faults, refer to Intermittent Fault Conditions.
- Check for an intermittent fault in the wiring harness or connectors, if a fault cannot be found the system is serviceable.

Since fault conditions in a wiring connector may trigger DTCs, always test the connectors related to this diagnostic procedure for shorted terminals or poor wiring connection before replacing any component. Refer to 8A Electrical - Body and Chassis for information on electrical fault diagnosis.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 This step tests for DTC's in the overall system.

2 This step uses the instrument cluster self test to check the function of the temperature gauge.

3 This step uses Tech 2 to drive the temperature gauge.

6 This step tests for set DTC's in the ECM.

11 This step tests the in-vehicle function of the temperature gauge.

Temperature Gauge Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to Additional Information
2	Test the function of the temperature gauge using the instrument cluster self diagnostic test procedure, refer to 8A Electrical Body and Chassis. Does the temperature gauge display a mid point reading on the dial?	Go to Step 3	Go to Step 9
3	1 Using Tech 2 select, **Body** / **PIM** / **Miscellaneous Tests** / **Gauge Control Tests** / **Temperature Gauge.** 2 Using the Tech 2 soft keys step the temperature gauge through the different ranges. Does the temperature gauge respond to the Tech 2 commands?	Go to Step 6	Go to Step 4
4	Test for high resistance, open circuit, a short to ground of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 11	Go to Step 5
5	Turn the ignition to the ON position, test for a short to voltage of the relevant circuits from the PIM to the instrument cluster. Refer to 6 Wiring Diagram and Connector Chart. Was any fault found and rectified?	Go to Step 11	Go to Step 6
6	Using Tech 2 select, **Body** / **ECM** / **Diagnostic Trouble Codes.** Are any DTC's set that will effect the operation of the temperature gauge?	Go to Step 7	Go to Step 8
7	Was any fault found and rectified?	Go to Step 11	—
8	Replace the PIM. Has the repair been completed?	Go to Step 11	—
9	Test the following instrument cluster circuits for a high resistance, open circuit or short to ground fault condition: • all 12 V battery supply circuits • all instrument cluster ground connections Was any fault found and rectified?	Go to Step 11	Go to Step 10
10	Replace the instrument cluster. Has the repair been completed?	Go to Step 11	—
11	Start the vehicles engine. Does the temperature gauge function normally?	System OK	Go to Step 2
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

11 Service Operations

11.1 Safety and Precautionary Measures

WARNING

The following safety and precautionary measures must be followed when servicing and diagnosing the powertrain interface module (PIM) System. Otherwise, personal injury and / or improper braking system operation may occur:

- When using electric welding equipment, disconnect the wiring harness connector from the PIM.
- Never disconnect or reconnect the PIM wiring harness connector when the ignition is switched ON.
- Do not touch the PIM connector pins or soldered components on the PIM circuit board to prevent possible Electrostatic Discharge damage.
- To avoid wiring connector terminal damage, always use suitable wiring harness test leads (such as those in Tool No, J35616) when performing tests on the PIM wiring connector.
- The PIM is extremely sensitive to Electro Magnetic Interference (EMI). Ensure the PIM wiring harness is routed correctly and securely fitted to mounting clips when performing service procedures.
- Due to the sensitive nature of the PIM circuitry, specific wiring repair procedures have been developed. These procedures and instructions are detailed in 8A Electrical - Body and Chassis and are the only recommended and approved wiring repair methods.
- Ensure that all wiring harness connectors are seated correctly.
- Never disconnect the battery from the vehicle electrical system while the engine is running.
- Always disconnect the battery from the vehicle electrical system before charging.
- Do not use a fast charger for starting the vehicle.
- Ensure the battery cable terminals are secure.
- Before installing a new PIM, ensure the correct type is fitted. Always refer to the latest spare parts information.

11.2 Powertrain Interface Module

CAUTION

Do not touch the powertrain interface module pins as Electrostatic Discharge (ESD) damage may result. For further information on ESD, refer to 1.2 Warning Caution and Notes.

CAUTION

When replacing the PIM, the PIM must be reset prior to removal. Failure to perform this procedure will result in the inability to:

- **Test the PIM for warranty purposes.**
- **Install the PIM into other vehicles.**

Remove

1 If replacing the PIM, reset the PIM prior to PIM removal. Refer to PIM Reset in this Section.

2 Turn the ignition switch off.

3 Remove Fuse EB-4, refer to 8A Electrical-Body and Chassis.

4 Remove the right-hand front body hinge pillar trim assembly, refer to 10 Cab.

5 Disconnect the wiring harness connector (1) from the powertrain interface module (PIM) (2).

6 Remove the bolt (3) attaching the PIM to the hinge pillar inner panel.

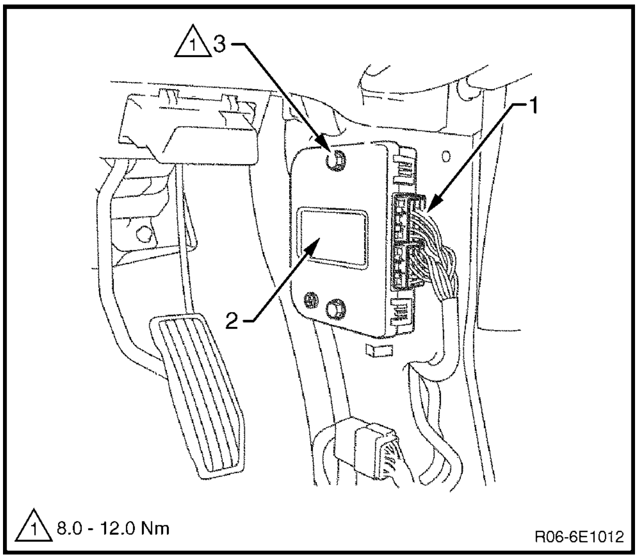


Figure 6E1 – 16

Reinstall

Reinstallation of the PIM is the reverse of the removal procedure, noting the following:

1 Tighten the attaching bolt to the correct torque specification.

PIM attaching bolt torque specification	8.0 – 12.0 Nm

2 If the PIM has been replaced, perform the following procedures:

- PIM service programming, refer to 12.4 Immobiliser Link to ECM / PIM.
- PIM Configuration, refer to 12.3 PIM Configuration.
- Diagnostic system check, refer to 7.2 Diagnostic System Check.

3 Road test the vehicle and check for correct vehicle operation.

11.3 Vertical Acceleration Sensor

Remove

1 Turn the ignition switch off.

2 Using a hoist raise the vehicle to a suitable working height.

3 Remove the VAS connector.

4 Remove the nut (1) securing the VAS to the mounting bracket.

5 Remove the VAS (2) from the mounting bracket.

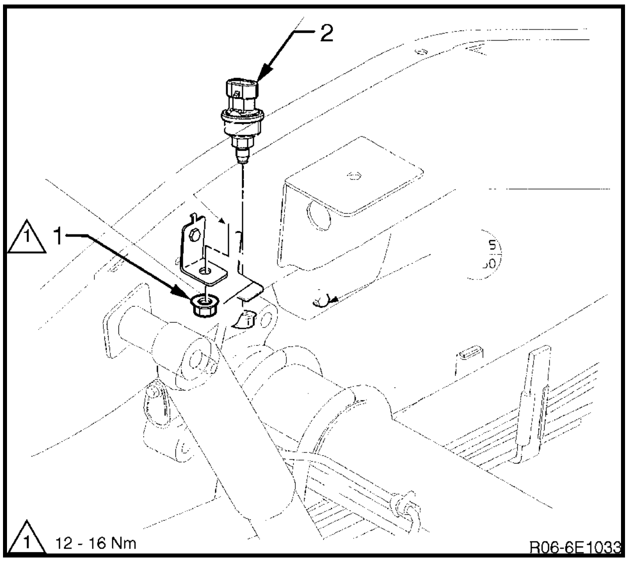


Figure 6E1 – 17

Reinstall

Reinstallation of the VAS is the reverse of the removal procedure, noting the following:

1 Tighten the attaching nut to the correct torque specification.

VAS attaching nut torque specification	12.0 – 16.0 Nm

2 Check the system for correct operation, refer to 7.2 Diagnostic System Check.

3 Road test the vehicle and check for correct vehicle operation.

12 PIM Security and Programming

12.1 Security and Programming Information

Car Pass Card

When performing certain powertrain interface module (PIM) programming functions using Tech 2, you may be prompted to enter a four digit Security Code (1). This information is found on the car pass card issued with the vehicle when new. If the card is unavailable, contact the GM Holden Technical Assistance (TAS) centre to obtain the relevant Security Code.

Security Code

The security code is required when performing certain PIM, ICU and ECM programming functions. When Tech 2 requests the security code to be entered, and an incorrect code is entered, the PIM will go into a security wait time stage. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed.

Should a second incorrect security code be entered after the initial wait time has elapsed, the PIM will go into a second wait time stage. The wait time will increase each time an incorrect code is entered. When the correct code is entered the wait time will reset back to its original value of 10 seconds.

NOTE

The ignition switch must be in the ON position with the battery connected during the wait time period.

The wait time stages are as follows:

- Stage 1 = 10 seconds.
- Stage 2 = 10 seconds.
- Stage 3 = 10 minutes.
- Stage 4 = 20 minutes.
- Stage 5 = 40 minutes.
- Stage 5 = 80 minutes.

Tech 2 PIM Security Information Data List

The Tech 2 PIM Security Information Data List displays the PIM's current security status.

To view the data list:

1 Connect Tech 2 to the data link connector (DLC) and turn the ignition switch on.

2 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Security** / **Security Information**.

NOTE

The Tech 2 PIM Security Information Data List typical display values are obtained from a correctly operating vehicle under the following conditions:

- ignition switched on,
- engine not running, and
- vehicle is stationary.

Tech 2 Parameter	Units Displayed	Typical Display Values
ICU / PIM Status	Yes / No	Yes
Security Code Programmed	Yes / No	Yes
Security Wait Time	Inactive / Active	Inactive
Security Wait Time	Inactive / 0:00:00	Inactive
Security Code Correct Enter	Yes / No	Yes
Security Code Reset Counter	0	0

12.2 PIM Reset Procedure

CAUTION

Do not perform the reset procedure within sixty seconds of turning the ignition switch on. Failure to comply may result in the PIM failing to reset.

When a PIM has been installed into a vehicle, it is security linked to the immobiliser control unit (ICU) and engine control module (ECM). Once this linking has been performed, the PIM cannot be installed in any other vehicle, unless the security linking between the ICU and the ECM has been reset using the following procedure:

1 Prior to resetting the PIM, obtain the Security Code. For further information, refer to 12.1 Security and Programming Information.

2 Connect Tech 2 to the data link connector (DLC) and turn the ignition switch on.

3 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Security** / **Reset PIM**.

NOTE

When Tech 2 requests programming approval, obtain TIS approval.

NOTE

If a Tech 2 screen displaying **Security Wait Time Active, Please Wait!** appears after selecting the Reset PIM option, an incorrect security code has been previously entered. Refer to 12.1 Security and Programming Information for further information.

4 When Tech 2 displays **Enter Security Code,** enter the security code, press the **Enter** key and then the **Okay** soft key.

CAUTION

The engine will not start after the PIM has been reset.

5 When Tech 2 displays **Do you really want to Reset?**, press the **Reset** soft key.

CAUTION

Do not turn the ignition switch off within 60 seconds of performing the PIM reset procedure. Failure to comply may result in the PIM failing to reset.

6 When Tech 2 displays **Reset Completed Successfully**, press the **Confirm** soft key to return to the Tech 2 **Security** screen.

12.3 PIM Configuration

Configuring the PIM

Programming Transmission Variant

1 Connect Tech 2 to the data link connector (DLC).

2 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Program** / **Program Variant Configuration.**

3 Press the **Modify** soft key.

4 Using the up or down arrow selection keys, select either manual or automatic transmission.

5 Press the **Confirm** soft key. Tech 2 reverts to the main Tech 2 **Program Variant Configuration** screen where the selection made in the previous step is displayed.

6 Press the **Program** soft key. The changes are now programmed into the PIM.

CAUTION

Do not turn the ignition switch off within 60 seconds of configuring the PIM. Failure to comply may result in the changes failing to be programmed into the PIM.

7 When notified that the programming was successful, press the **Confirm** soft key to return to the Tech 2 **Program** screen.

Programming the VIN

1 Connect Tech 2 to the data link connector (DLC).

2 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Program** / **Program VIN**.

3 Enter the VIN using the Tech 2 arrow selection keys.

NOTE

The left and right arrow selection keys move the Tech 2 cursor along the VIN number, whilst the up and down selection arrows change the character value.

Numbers can also be entered by pressing the number key's on Tech 2.

4 After entering the VIN number, press the **Enter** key. The changes are now programmed into the PIM.

CAUTION

Do not turn the ignition switch off within 60 seconds of programming the VIN. Failure to comply may result in the changes failing to be programmed into the PIM.

5 When notified that the programming was successful, press the **Confirm** soft key to return to the Tech 2 **Program** screen.

12.4 Immobiliser Link to ECM / PIM

CAUTION

Do not perform the Immobiliser Link to ECM / PIM procedure within sixty seconds of turning the ignition switch on. Failure to comply may result in the PIM failing to link.

When the powertrain interface module (PIM) has been replaced, it is necessary to security link the PIM to the immobiliser control unit (ICU) and engine control module (ECM) before the vehicle will start.

NOTE

This linking procedure between the ECM and PIM is also known as the Immobiliser Function Programming.

1 Prior to performing the linking procedure, obtain the security code. For further information, refer to 12.1Security and Programming Information.

2 Connect Tech 2 to the data link connector (DLC).

3 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Security** / **Immobiliser Link to ECM** / **PIM**.

4 When Tech 2 displays **Immobiliser Replaced**, press the **No** soft key.

5 When Tech 2 displays **PIM or ECM Replaced?**, press the **Yes** soft key.

NOTE

When Tech 2 requests programming approval, obtain TIS approval.

6 When Tech 2 displays **Enter Security Code**, enter the security code and press the **Enter** key and then the **Okay** soft key.

7 When Tech 2 displays **Confirm Security Code,** re-enter the security code, press the **Enter** key and then the **Okay** soft key.

8 When Tech 2 displays **Select Immobiliser Programming Routine**, use the up or down arrow selection keys, to select the **PIM Replaced** option and press the **Enter** key.

9 When Tech 2 displays **Stop Engine – Turn Off Ignition**, turn the ignition switch off and press the Confirm soft key.

10 When Tech 2 displays **Turn Ignition On**, turn the ignition switch on and press the **Confirm** soft key.

CAUTION

Do not turn the ignition switch off within 60 seconds of performing the ICU Link to ECM / PIM procedure. Failure to comply may result in the PIM failing to link with the ICU / ECM.

11 When Tech 2 displays **Programming Successful**, press the **Confirm** soft key to return to the Tech 2 **Security** screen.

Special Tools (4×2 High Ride Suspension, 4×4)

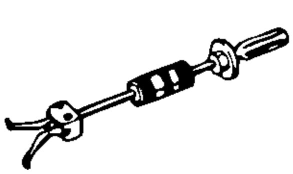
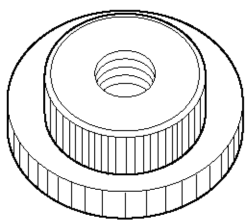
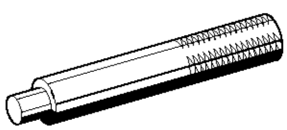
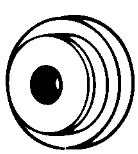
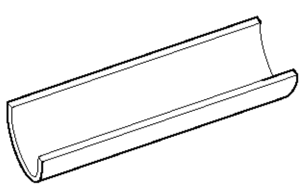
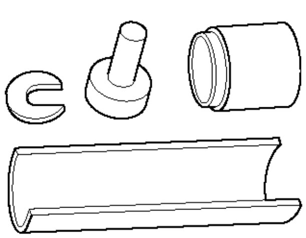
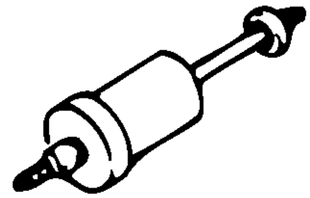
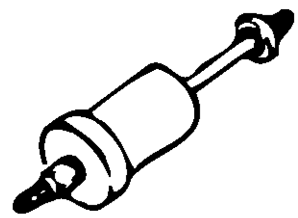
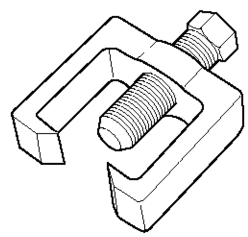
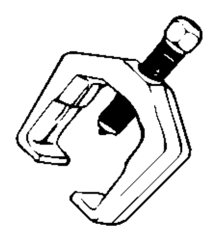
ILLUSTRATION	PART NO. PART NAME
 901RS283	**5-8840-2000-0** **(J-5822)** Remover; Needle bearing **5-8840-0019-0** **(J-23907)** Sliding hammer (4×4 Model Only)
 901RS284	**5-8840-2128-0** **(J-36838)** Installer; Needle bearing (4×4 Model Only)
 901RS285	**5-8840-0007-0** **(J-8092)** Grip (4×4 Model Only)
 5884028510	**5-8840-2851-0** Installer; Oil seal (4×4 Model Only)
 901RS286	**5-8840-2307-0** **(J-39376)** Installer; Upper arm bushing
 901RS287	**5-8840-0256-0** **(J-29755)** Remover and Installer Upper arm bushing

ILLUSTRATION	PART NO. PART NAME
 901RS288	**5-8840-2123-0** **(J-36833)** Remover and Installer kit; Lower arm front bushing
 901RS289	**5-8840-2124-0** **(J-36834)** Remover and Installer kit; Lower arm rear bushing
 901RS290	**5-8840-2121-0** **(J-21677-2)** Ball joint remover
 901RS279	**5-8840-2005-0** **(J-29107)** Tie-rod end remover

13 Powertrain Interface Module – Tech 2 Functions

13.1 Introduction

CAUTION

Do not use a Tech 2 that displays faulty data; have the Tech 2 repaired. The use of a faulty Tech 2 can result in misdiagnosis and the unnecessary replacement of parts.

From the Main Menu, having selected **Diagnostics** / **2006** / **RA Rodeo** / **Body**, the Tech 2 functions for the Powertrain Interface, include:

F0: Diagnostic Trouble Codes

F1: Diagnostic Data Display

F2: Snapshot

F3: Miscellaneous Tests

F4: Additional Functions

F5: Program

F6: Security

13.2 Tech 2 Functions

F0: Diagnostic Trouble Codes

When this test mode is initiated, DTCs stored by the ECM can be displayed or cleared. When entered, there are two additional modes for selection:

F0: Read DTC Info Ordered By Priority: All DTCs stored in the ECM will be displayed.

F1: Clear DTC Information: Clears all current DTCs in the ECM and TCM memories.

F1: Diagnostic Data Display

- Use the Tech 2 Data List under the following conditions:
- The Diagnostic System Check – V6 Engine has been completed.
- The On-Board Diagnostics are functioning correctly.
- No DTCs are present.

NOTE

The values quoted in the following data list are only intended to provide the Technician with an indication of the values to be expected.

F2: Snapshot Options

In this test mode, Tech 2 captures data before and after a snapshot triggering event that may or may not set a DTC.

Trigger Type : Manual Trigger

F0: Manual Trigger

Trigger Point : Centre

F4: Beginning

F5: Centre

F6: End

F3: Miscellaneous Tests

F0: Warnings

F1: Status Indicators

F2: Gauge Control Tests

F4: Additional Functions

When this selection is made from the Tech 2 screen, an additional choice is provided:

F0: Read PIM Information

F5: Program

Within this selection, there are two programming selections available:

F0: Program Variant Configuration

F1: Program VIN

F6: Security

F0: Immobiliser Link To ECM/PIM

F1: Reset PIM

F2: Security Information

13.3 Powertrain Interface Module Data List

Diagnostic Data Display

Tech 2 Display	Units Displayed	Switch On	Switch Off
AC Switch	On/Off	On	Off
Cruise Cancel Switch	Active/Inactive	Active	Inactive
Cruise Resume Switch	Active/Inactive	Active	Inactive
Cruise Set Switch	Active/Inactive	Active	Inactive
Cruise Main Switch	Active/Inactive	Active	Inactive
Cruise Control Set Lamp	On/Off	On	Off
Cruise Control On Lamp	On/Off	On	Off
Power Drive Switch	On/Off	On	Off
Power Drive Lamp	On/Off	On	Off
3rd Start Switch	On/Off	On	Off
3rd Start Lamp	On/Off	On	Off
4WD Low Gear	Active/Inactive	Active	Inactive
G-Sensor	V	2.43	2.43
G-Sensor	Pa	0.027	0.027
Engine Speed	RPM	152	1093
Coolant temperature Input	°C	35	25
Coolant Temperature	%	70	70
Fuel Level Input	%	26	26
Fuel Level	%	43	43
Alternator Lamp	On/Off	On	Off
Oil Pressure Lamp	On/Off	On	Off
SVS Lamp (Service Vehicle soon)	On/Off	On	Off
Check transmission MIL	On/Off	On	Off
Transmission Oil Temperature Lamp	On/Off	On	Off
LED [- P -]	On/Off	On	Off
LED [- R -]	On/Off	On	Off
LED [- N -]	On/Off	On	Off
LED [- D -]	On/Off	On	Off
LED [- 3 -]	On/Off	On	Off
LED [- 2 -]	On/Off	On	Off
LED [- 1 -]	On/Off	On	Off

13.4 Miscellaneous Tests

F0: Warnings

F0: Alternator

This test checks the alternator warning lamp turns On and Off when selected on Tech 2.

F1: Oil Pressure Telltale Test

This test checks the Oil Pressure warning lamp turns On and Off when selected on Tech 2.

F2: Service Vehicle Soon Lamp Test

This test checks the Service Vehicle Soon warning lamp turns On and Off when selected on Tech 2.

F3: AT Oil Temperature Lamp

This test checks the Oil Temperature warning lamp turns On and Off when selected on Tech 2.

F4: AT Telltale Test

This test checks the Automatic Transmission warning lamp turns On and Off when selected on Tech 2.

F1: Status Indicators

F0: Cruise Control On Lamp

This test checks the Cruise Control On status lamp turns On and Off when selected on Tech 2.

F1: Cruise Control Set Lamp

This test checks the Cruise Control Set status lamp turns On and Off when selected on Tech 2.

F2: PRNDL Lamps

This test checks the all the Automatic Transmission status lamps turn On and Off when selected on Tech 2.

F3: Power Drive Lamp

This test checks the Power Drive status lamp turns On and Off when selected on Tech 2.

F2: Gauge Control Tests

F0: Tachometer

This test checks the operation of the Tachometer by driving the pointer in 1000 rpm steps to 6000 rpm when selected on Tech 2.

F1: Temperature Gauge

This test checks the operation of the Temperature gauge by driving the pointer to the Cold, Mid and High positions when selected on Tech 2.

F2: Fuel Gauge

This test checks the operation of the Fuel gauge by driving the pointer from zero in 20% increments to full when selected on Tech 2.

13.5 Security

F0: Immobiliser Link To ECM/PIM

Should the ECM, PIM or ICU be replaced, the modules must be security linked to each other. If this linking procedure is not performed, the vehicle will not crank nor run. For additional information relating to Tech 2 and the linking procedure, refer to 11A – Immobiliser.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: TIS approval (TIS 2000 Security Access) must be obtained, the four digit security number entered into Tech 2 and the theft deterrent system disarmed. Then the ignition must be turned 'On', using a programmed remote coded key.

F1: Reset PIM

This function erases the security link between the Engine Control Module (ECM) and the Powertrain Interface Modules (PIM). If this procedure is performed, the engine will not crank nor run. A ICU Link to ECM/PIM procedure will need to be performed. For additional information relating to the ICU Link to ECM/PIM procedure, refer to 11A – Immobiliser.

NOTE

After an ECU reset, the ignition switch must be turned Off for at least 10 seconds and then turned On for at least one minute, before attempting communication between Tech 2 and the ECU.

Preconditions: The four digit security code must be entered into Tech 2 and the ignition switched 'On' with a programmed remote coded key.

F2: Security Information

The security code is required when performing certain PIM, ICU and ECM programming functions. When Tech 2 requests the security code to be entered, and an incorrect code is entered, the PIM will go into a security wait time stage. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed.

Should a second incorrect security code be entered after the initial wait time has elapsed, the PIM will go into a second wait time stage. The wait time will increase each time an incorrect code is entered. When the correct code is entered the wait time will reset back to its original value of 10 seconds.

NOTE

The ignition switch must be in the ON position with the battery connected during the wait time period.

The wait time stages are as follows:

- Stage 1 = 10 seconds.
- Stage 2 = 10 seconds.
- Stage 3 = 10 minutes.
- Stage 4 = 20 minutes.
- Stage 5 = 40 minutes.
- Stage 5 = 80 minutes.

Tech 2 PIM Security Information Data List

The Tech 2 PIM Security Information Data List displays the PIM's current security status.

To view the data list:

1 Connect Tech 2 to the data link connector (DLC) and turn the ignition switch on.

2 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Security** / **Security Information**.

NOTE

The Tech 2 PIM Security Information Data List typical display values are obtained from a correctly operating vehicle under the following conditions:

- ignition switched on,
- engine not running, and
- vehicle is stationary.

Tech 2 Parameter	Units Displayed	Typical Display Values
Security Code Programmed	Yes / No	Yes
Security Wait Time	Inactive / Active	Inactive
Security Wait Time	Inactive / 0:00:00	Inactive
Security Code Reset Counter	0	0

14 Specifications

Powertrain Interface Module Bus Cut-off Resistor....................................120 Ω

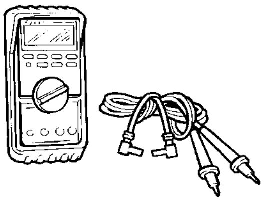
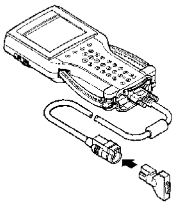
Engine Control Module Bus Cut-off Resistor ....120 Ω

15 Torque Wrench Specifications

Powertrain Interface Module Attaching Screw............................8.0 – 12.0 Nm

Vertical Acceleration Sensor attaching nut ....12.0 – 16.0 Nm

16 Special Tools

Tool Number	Illustration	Description	Tool Classification
3588		**Digital Multimeter** Previously released as J39200 or equivalent. **NOTE:** The instrument must have 10 mega ohms impedance and be capable of reading frequencies.	Mandatory
J35616		**Connector Test Adaptor Kit** Used when carrying out electrical diagnostic circuit checks.	Desirable
70000861	 TECH2	**Tech 2 Diagnostic Scan Tool** Previously released.	Mandatory
N/A	 TISCD	**Technical Information System (TIS) CD ROM** Available to Authorised Dealers.	Mandatory

6F
Exhaust System – V6

ATTENTION

Before performing any service operations or other procedure described in this Section, refer to 1.3 WARNING, CAUTION and NOTES for correct workshop practices with regard to safety and / or property damage.

TROUBLESHOOTING

1. VIBRATION, SHOCK, AND SHIMMY OF STEERING WHEEL

Checkpoint		Problem	Countermeasure
Check vehicle trim height	NG	Incorrect	Adjust
OK			
Check shock absorber or attaching nut and bolt	NG	Malfunction or loose	Replace or retighten
OK			
Check upper and lower link bushings	NG	Worn	Replace
OK			
Check suspension ball joint	NG	Worn	Replace
OK			
Check wheel alignment	NG	Faulty	Adjust
OK			
Check front axle	NG	Check steering unit and linkage	Replace

- Improperly adjusted or worn front wheel bearing.
- Worn or incorrectly adjusted wheel bearing.

Replace; refer to Section 4C "Front Wheel Drive"

- Insufficiently tightened steering gear housing.
- Wear of steering linkage.
- Excessive backlash due to improper adjustment of the steering gear box.
- Worn column bearing, weakened column bearing spring, or loose clamp.

Replace; refer to Section 3B "Steering"

- Improper tire pressure.
- Imbalance and deformation of frond wheel.
- Unevenly worn tire or insufficient tightening of wheel nuts.

Replace; refer to Section 3E "Wheel and Tires"

1 General Information

Information contained within this section describes the general exhaust system.

1.1 Emission Reductions

Through developments in various vehicle emissions reduction systems, significant reductions in emissions have been achieved. The developments have been primarily concerned with refinements in engine calibration and the optimisation of exhaust system catalytic converter configurations.

The catalytic converter is similar to a muffler in appearance however, within the outer stainless steel shell (4), there is a ceramic monolith (1) which is honeycombed in the direction of exhaust flow, as shown. The ceramic monolith is surrounded by a mat (2), which has the primary function of holding the monolith firmly in place to prevent any contact with the inner shell (3). A mesh seal (5 and 6) at each end of the converter prevents exhaust gases from fouling and eroding the mat.

Surfaces of the ceramic monolith that are exposed to exhaust gases are coated with a catalytic material. This material contains rhodium and platinum, which act to facilitate the chemical reactions necessary to oxidise carbon monoxide and hydrocarbons into harmless carbon dioxide.

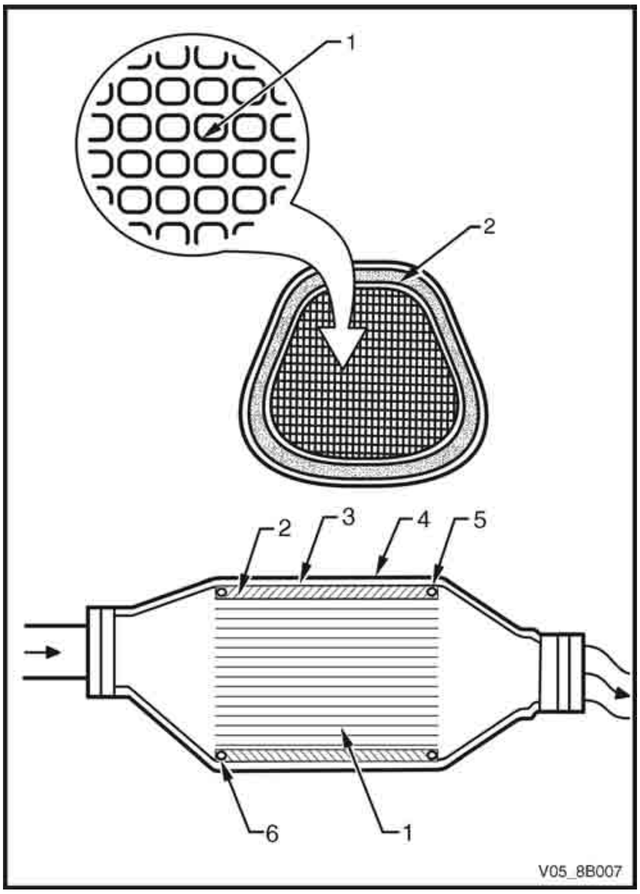


Figure 6F– 1

The catalytic converter is a substance that accelerates a chemical reaction without itself being changed. Engine exhaust gases contain carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NO_x). When the exhaust gases flow through the monolith, reactions with the catalytic converter occur. CO and HC are converted by oxidation with oxygen (O_2) in the exhaust gases to produce carbon dioxide (CO_2) and water vapour (H_2O). NO_x is converted by reduction with CO to produce nitrogen (N_2) and CO_2. The converter is called a three-way type because it simultaneously converts three components of exhaust gas (CO, HC and NO_x) to harmless natural gases, refer to Figure 6F– 2

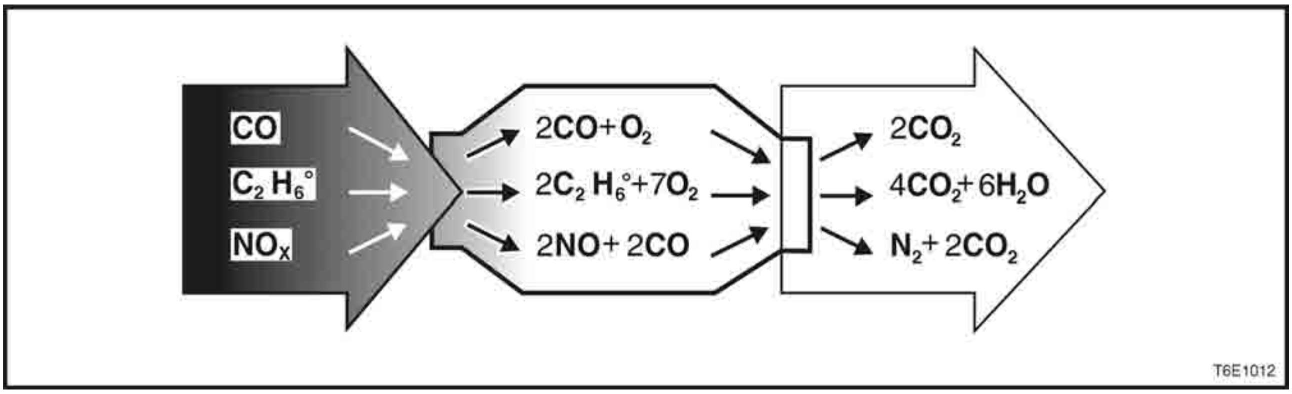


Figure 6F– 2

CAUTION

The Catalytic converter can be damaged or rendered ineffective, if:

- **operated outside the limits of the closed loop mixture control system**
- **the engine burns excessive amount of oil**
- **the exhaust temperature at the converter is too high (exceeds 840°C).**

The catalytic material is very sensitive to the effects of a rich or lean fuel mixture, which may cause the temperature of the converter to rise rapidly. The catalytic converter normally operates at approximately 600°C.

The catalytic converter is also sensitive to the use of leaded petrol. Using leaded fuel can cause deposits to form in the converter, which restrict exhaust flow and prevent the catalyst from working. This will result in an increase in exhaust backpressure and converter temperature.

NOTE

The use of unleaded petrol results in black tailpipe deposits rather than the grey colour that some people may normally associate with an acceptable combustion condition. This black colour resulting from the use of unleaded fuel does not necessarily indicate a state of poor engine tune. For V6 engines, Refer to: 6C1 – 1 Engine Management General Information.

Euro 3 Emissions Standards

The Euro 3 emissions standard is a European standard which aims at setting vehicle emissions targets to encourage vehicle manufacturers to reduce harmful vehicle emissions such as Carbon Monoxide (CO), Hydrocarbons (HC) and the various oxides of Nitrogen (NOx).

WARNING

This vehicle is fitted with a supplemental restraint system (SRS). Refer to section 9A Restraints, in order to determine whether you are performing service on or near the SRS components or the SRS wiring.

CAUTION

Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. Isuzu will identify those fasteners that require a replacement after removal and fasteners that require thread lockers or thread sealant. Unless otherwise specified, do not use supplemental coatings (Paints, greases or corrosion inhibitors) on thread fasteners or fastener joints. Generally such coatings adversely effect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and torque specifications.

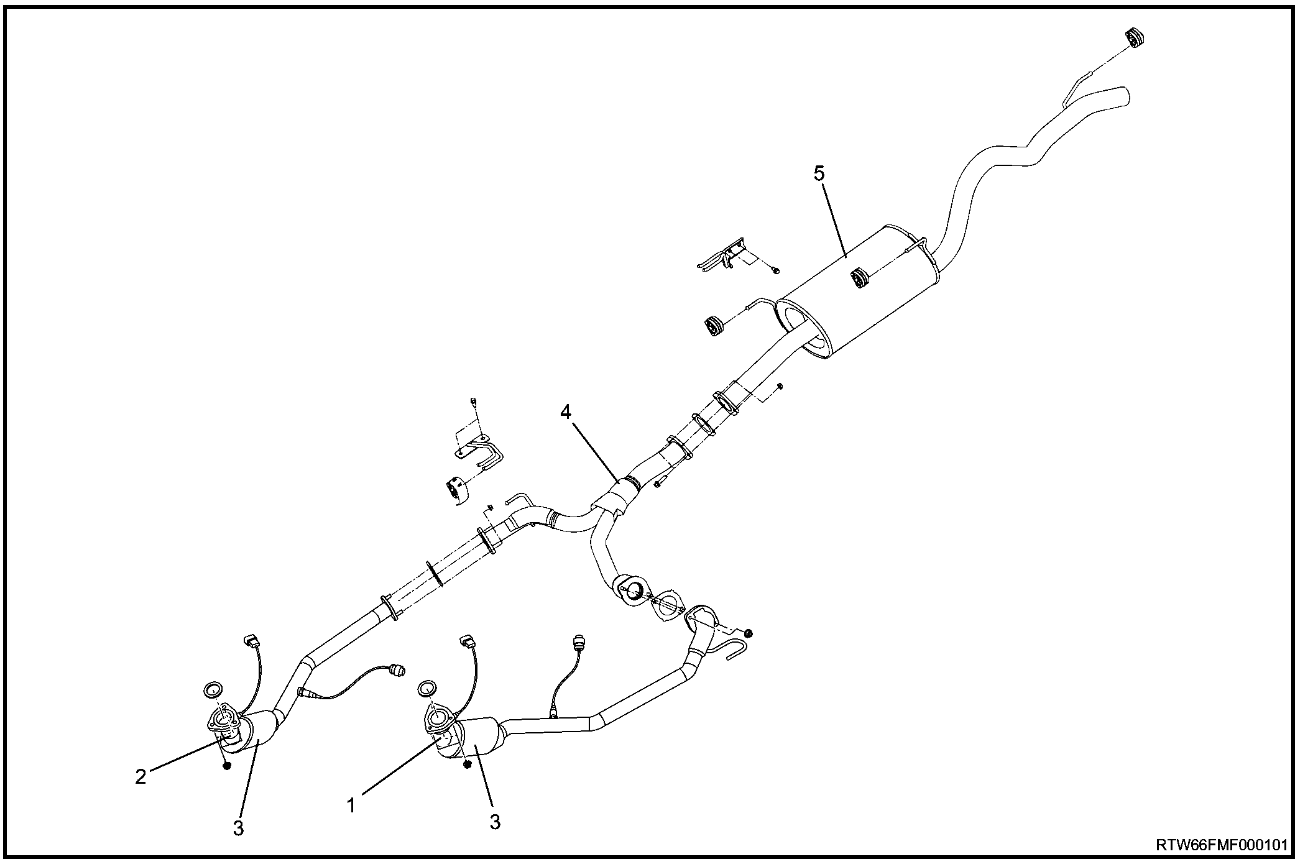


Figure 6F– 3

Legend

1 Front Exhaust Pipe LH side
2 Front Exhaust Pipe RH side
3 Three Way Catalytic Converter
4 Centre Exhaust Pipe
5 Exhaust Silencer and Tail Pipe

1.2 General Description

When inspecting or replacing the exhaust system components, make sure there is adequate clearance from all points on the underbody to prevent overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials. Check complete exhaust system and nearby body areas and rear compartment lid for broken , damaged, missing or misaligned components, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the rear compartment or passenger compartment. Dust or water in the rear compartment may be an indication of a problem in one of these areas. Any faulty areas should be corrected immediately.

Various types of hangers are used to support exhaust systems, these include conventional rubber straps, rubber rings or rubber blocks. The installation of exhaust system supports is very important, Improperly installed supports can cause annoying vibrations which can be difficult to diagnose.

Service Notes

1. Vehicles fitted with catalytic converters should not be operated with leaded petrol. Lead will contaminate the ceramic monolith.
2. Do not drop the catalytic converter as it will damage the ceramic monolith.
3. Replace the catalytic converter if it is damaged.
4. Do not allow water, oil or fuel to enter the converter as the ceramic monolith will be contaminated.
5. Do not use engine and/or fuel additives unless approved by General Motors. Many additives contain phosphorous that will contaminate the ceramic monolith.
6. The vehicle must not be started by pushing or towing, as unburned fuel could reach the catalytic converter and destroy the ceramic monolith. Always use jumper leads to start a vehicle that has a flat or defective battery.
7. When carrying out a compression test, for V6 engines use Tech 2 to ensure the output control Engine Compression Test is set to enable, refer to 6A1 Engine Mechanical. This prevents fuel injection and ignition during engine cranking.
8. Do not drive the vehicle with the engine misfiring or with any of the spark plug leads disconnected, as the catalytic converter will overheat.
9. Do not coast downhill with the engine misfiring or with any of the spark plug leads disconnected.
10. The catalytic converter is serviceable as part of the front exhaust assembly only. Refer to the service operations in this section for details of front exhaust pipe assembly removal and reinstallation.
11. The exhaust flange gaskets must be replaced whenever a new exhaust pipe, muffler or catalytic converter is installed.

1.3 WARNING, CAUTION and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

1.1 Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,

- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 Front and Centre Exhaust Pipe

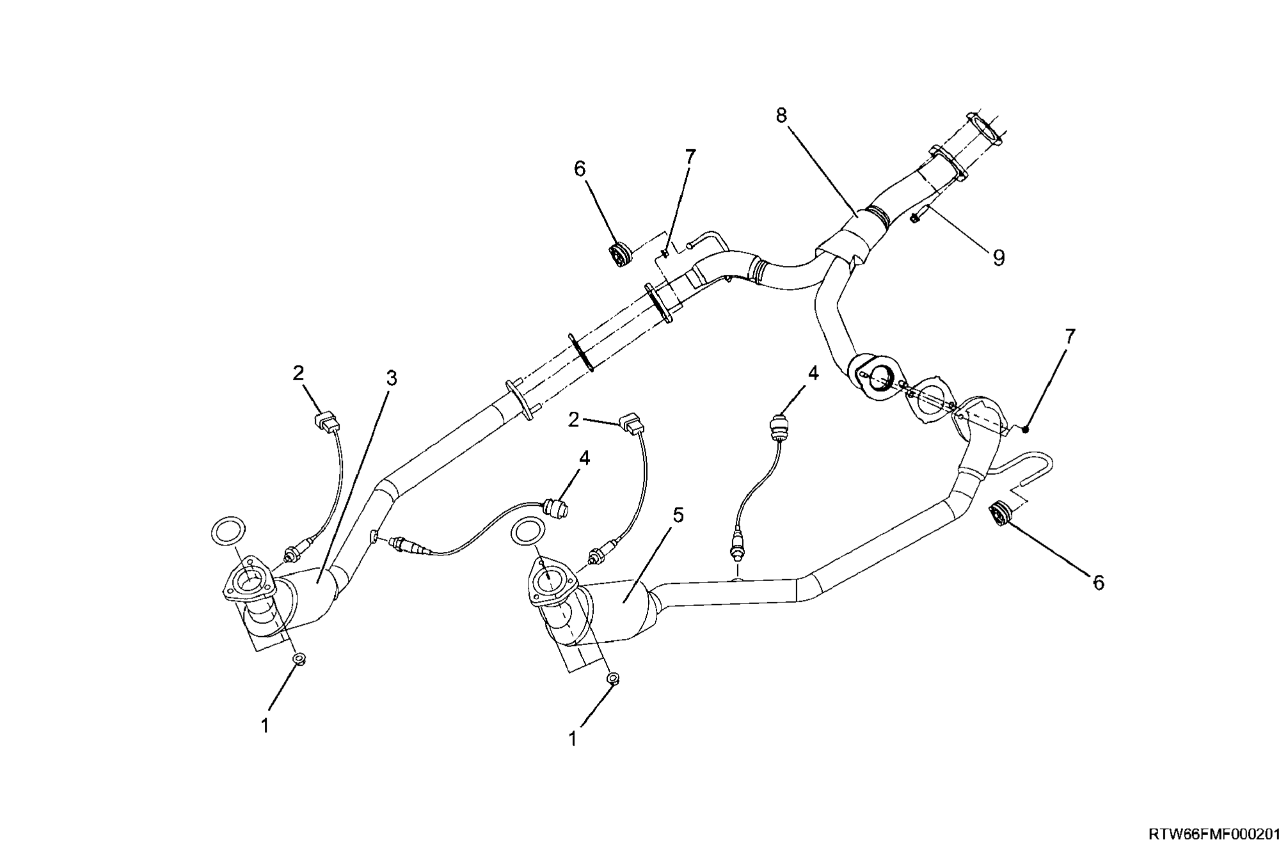


Figure 6F– 4

1	Front Exhaust Flange Nuts	6	Front Exhaust Pipe Mounting Rubber
2	Front O2 Sensor	7	Centre Exhaust Flange Attaching Nuts
3	Three Way Catalytic Converter RH side	8	Centre Exhaust Pipe
4	Rear O2 Sensor	9	Rear Exhaust Flange Nuts
5	Three Way Catalytic Converter LH side		

Removal

1. Disconnect the battery ground cable.
2. Remove the suspension cross member, Refer to 7B1 Manual transmission.
3. Remove the two front torsion bar springs, Refer to 3C Suspension.
4. Disconnect the O2 sensor harness connectors (2 and 4), two each bank.
5. Remove the front exhaust flange attaching nuts (1), three each bank.
6. Remove the centre exhaust pipe flange nuts (7), two each bank.
7. Remove the centre exhaust pipes from the rubber mounts (6).
8. Remove the front left and right hand exhaust pipes from the vehicle.
9. Remove the two rear exhaust flange nuts and bolts (9).
10. Remove the centre exhaust pipe from the vehicle.
11. Remove the O2 sensors if required, Refer to 6C1 – 1 Engine Management General Info.

NOTE:

- Support the exhaust system at all times.
- Clean the threads of the attaching bolts, nuts, studs and flanges with a suitable cleaning solvent.
- Apply a high temperature anti-seize compound to the manifold front pipe flange joint studs, then align the flange over the studs.

Reinstallation

1. Install any removed O2 sensors, Refer to 6C1 – 1 Engine Management General Info.
2. Position the centre exhaust pipe into location under the vehicle.
3. Install the two rear exhaust flange nuts and bolts (9).
4. Position the front exhaust pipes into location under the vehicle.
5. Install the centre exhaust pipes into the rubber mounts (6).
6. Install the exhaust flange fixing nuts (1), three each bank.
7. Install the rear exhaust pipe flange nuts (7), two each bank.
8. Reconnect the O2 sensor harness connectors (4), two each bank.
9. Install the two front torsion bar springs, Refer to 3C Suspension.
10. Install the suspension cross member, Refer to 7B1 Manual transmission.
11. Reconnect the battery ground cable.

O2 Sensor
tightening torque..50 Nm

Front Exhaust Flange Nuts
tightening torque......................................40.0 – 60.0 Nm

Centre Exhaust Flange Nuts
tightening torque..43 Nm

Rear Exhaust Flange Nuts
tightening torque..43 Nm

3 Silencer and Rear Exhaust Pipe

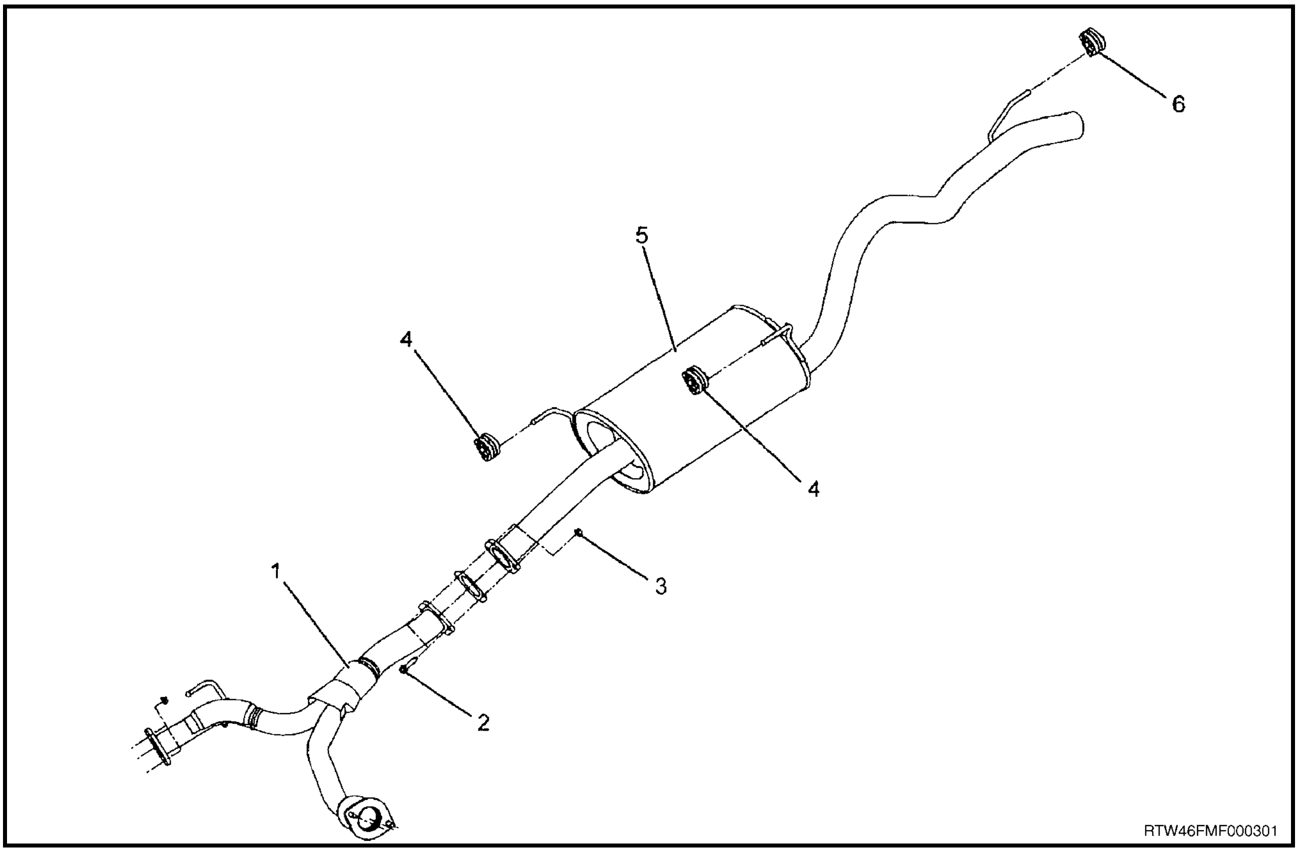


Figure 6F– 5

1	Centre Exhaust Pipe	4	Exhaust Silencer Mounting Rubber
2	Exhaust Flange Bolts	5	Exhaust Silencer and Tail Pipe
3	Exhaust Flange Nuts	6	Rear Exhaust Pipe Mounting Rubber

Removal

1. Disconnect the battery ground cable.
2. Remove the exhaust flange bolts (2) and nuts (3).
3. Remove the silencer and rear exhaust pipe mounting rubbers (4 and 6).
4. Remove the silencer and exhaust pipe from the vehicle.

NOTE:

- Support the exhaust system at all times.
- Clean the threads of the attaching bolts, nuts, studs and flanges with a suitable cleaning solvent.

Reinstallation

1. Position the silencer and exhaust pipe into the vehicle.
2. Install the silencer and rear exhaust pipe mounting rubbers (4 and 6).
3. Install the exhaust pipe flange bolts (2) and nuts (3).
4. Reconnect the battery ground cable.

Rear Exhaust Flange Nuts tightening torque..43 Nm

4 Torque Wrench Specifications

	Nm
Front Exhaust Flange Nuts	40.0 – 60.0
Centre Exhaust Flange Nuts	43.0
Rear Exhaust Flange Nuts	43.0
O2 Sensor	50.0

SECTION 7

TRANSMISSION

TABLE OF CONTENTS

2. VEHICLE PULLS TO RIGHT OR LEFT

Checkpoint		Problem	Countermeasure
Coil spring (4×2 Except high ride suspension) Torsion bar (4×4, 4×2 High ride suspension)	NG	Collapsed or break (4×2 Except high ride suspension) Collapsed or twisted (4×4, 4×2 High ride suspension)	Replace
OK			
Vehicle trim height	NG	Incorrect	Adjust
OK			
Brake adjustment (binding)	NG	Incorrect	Adjust
OK			
Wheel alignment	NG	Incorrect	Adjust
OK			
Rubber bushing for upper and lower link	NG	Worn	Replace
OK			
Steering linkage, and upper and lower link	NG	Deformed	Replace
OK			
Front wheel bearing	NG	Incorrect adjustment or abrasion	Adjust or replace

Continued on the next page

SECTION 7C

AUTOMATIC TRANSMISSION

4L60E MODEL

TABLE OF CONTENTS

PAGE

7C1
Automatic Transmission – 4L60E – General Information

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to Warnings, Cautions and Notes for correct workshop practices with regard to safety and/or property damage.

1 Section Descriptions

Service information for the Hydra-matic 4L60E Automatic transmission has been divided into five Sections to assist the technician to quickly locate the correct service, maintenance and diagnostic information.

The following provides a brief outline of each of the Sections.

- 7C1 Automatic Transmission – 4L60E – General Information
- 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis
- 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis
- 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing

The following provides a brief outline of each of the Sections.

1.1 WARNINGS, CAUTIONS and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

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WARNING Defined

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- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION Defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE Defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 7C1 Automatic Transmission – 4L60E – General Information

This section provides general information about the automatic transmission, including:

- A glossary of terms,
- Transmission identification information,
- Electrical overview of the Transmission Control Module (TCM),
- Some notes that address safe workshop practices,
- Service notes relating to fasteners and consumable items used at various stages throughout this section,
- Special tools required to work on the transmission,
- Fastener torque specifications, and
- Transmission specifications.

For all information relating to the mechanical construction and function of the 4L60E automatic transmission, refer to the General Motors Powertrain Group Electronically Controlled Automatic Transmission Technician's Guide.
This guide includes such information as:

- Transmission Cutaway Views,
- Principles of Operation,
- Power Flow,
- Complete Hydraulic Circuits,
- Bushing and Bearing Locations,
- Seal Locations and
- Illustrated Parts List.

NOTE

Specifications quoted in this General Motors Powertrain Group Electronically Controlled Automatic Transmission Technician Guide may not be for the vehicle you are working on. For correct specifications refer to
7 Transmission Specifications.

Recommendations

When servicing the transmission, all parts should be cleaned and inspected. Individual units should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.

a Thoroughly clean the transmission exterior before removal of any component.

b Disassembly and reassembly must be made on a clean work bench. Cleanliness is of the utmost importance, the bench tools and parts must be kept clean at all times.

c Before installing screws and other fasteners into aluminium parts, dip screw threads into transmission fluid to prevent galling aluminium threads and to prevent screws from seizing.

d To prevent thread stripping, always use a torque wrench when installing screws or nuts.

e If threads in aluminium parts are stripped or damaged, the parts can be made serviceable by the use of commercially available thread inserts.

f Protective tools must be used when assembling seals to prevent damage. The slightest flaw in the sealing surface of the seal can cause an oil leak.

g Aluminium castings and valve parts are very susceptible to nicks, burrs, etc. and should be handled with care.

h Expand Internal snap rings and compress external snap rings if they are to be re-used to ensure proper seating when reinstalled.

i Do not re-use removed O-rings, gaskets and oil seals.

j Teflon oil seal rings should not be removed unless damaged.

k During assembly of each unit, all internal moving parts must be lubricated with transmission fluid.

Oil Cooler Pipes

Should any transmission fluid cooling pipe suffer accidental damage, a genuine replacement pipe must be fitted. Refer to the current release of PartFinder™ to determine the correct part number for the particular engine and pipe involved. Reworking of damaged pipes or hand made replacements are not permitted.

Clean and Inspect

CAUTION

Do not use solvents on neoprene seals, composition faced clutch plates or thrust washers as damage to parts may occur.

After complete disassembly of a component, wash all metal parts in a clean solvent and dry with compressed air. Blow oil passages out and check to make sure they are not obstructed, small passages should be checked with tag wire. All parts should be inspected to determine if replacement is required.

Pay particular attention to the following:

- Inspect linkage and pivot points for excessive wear.
- Bearing and thrust surfaces of all parts should be checked for excessive wear and scoring.
- Check for broken seal rings, damaged ring lands and damaged threads.
- Inspect seals for damage.
- Mating surfaces of castings should be checked for burrs. Irregularities may be removed by lapping the surface with emery paper laid on a flat surface, such as a piece of plate glass.
- Castings should be checked for cracks and porosity.

1.3 7C2 Automatic Transmission – 4L60E – Electrical Diagnosis

For transmissions fitted to V6 engines, the electrical diagnosis is in this Section. A new electrical circuit and control module has been introduced for automatic transmissions fitted to the V6 engines.

1.4 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis

Information contained in 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis will assist in the diagnosis of the mechanical and hydraulic components in the 4L60E automatic transmission, while the transmission remains installed on the vehicle.

Examples of the type of diagnostic information contained within this section are:

- transmission functional test,
- line pressure information,
- transmission fluid diagnosis,
- symptom diagnosis and
- shift speed charts.

1.5 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing

Information in 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing covers transmission fluid level checking, as well as specific information for servicing some components while the transmission remains installed on the vehicle. This Section also covers the transmission removal and reinstallation to the vehicle.

2 General information

The hydra-matic 4L60E automatic transmission is fitted to vehicles with HFV6 engine. The mechanical and internal electrical operation of the transmission unit is controlled by the transmission control module (TCM) for HFV6 engine.

- For information on the mechanical operation of the transmission, refer to General Motors Powertrain Group Electronically Controlled Automatic Transmission Technician's Guide.
- For further information on the TCM, refer to 3.1 Transmission Control Module.

2.1 Transmission Control Module – HFV6

Vehicles fitted with a V6 engine and the 4L60E transmission have a new control module and data bus architecture from previous models. This is due to the introduction of the new V6 engine. Mechanically, the transmission has not changed. V6 equipped vehicles are now fitted with T42 – Delphi with GMPT software, transmission control module (TCM) to control all transmission operations. For further information on the TCM and its operation, refer to 3 Transmission Control Module Operation Overview.

2.2 Transmission Identification

The 4L60E automatic transmission application and identification can be determined from the stamping at the rear of the transmission , in the location (7) as shown in Figure 7C1 – 1.

Identification is as follows:

(1) model year,

- (6 = 2006).

(2) Broad Cast Code Identifier,

- HHD = RWD – 3.6 litre HFV6
- HLD = 4WD – 3.6 litre HFV6

(D = model 4L60E).

(3) Manufacturer Source Code,

- (4 = Ramos).

(4) Julian date (day of the year).

(5) Shift Build,

- 'A','B','J' = First shift,
- 'C','H','W' = Second shift.

(6) Individual transmission serial number.

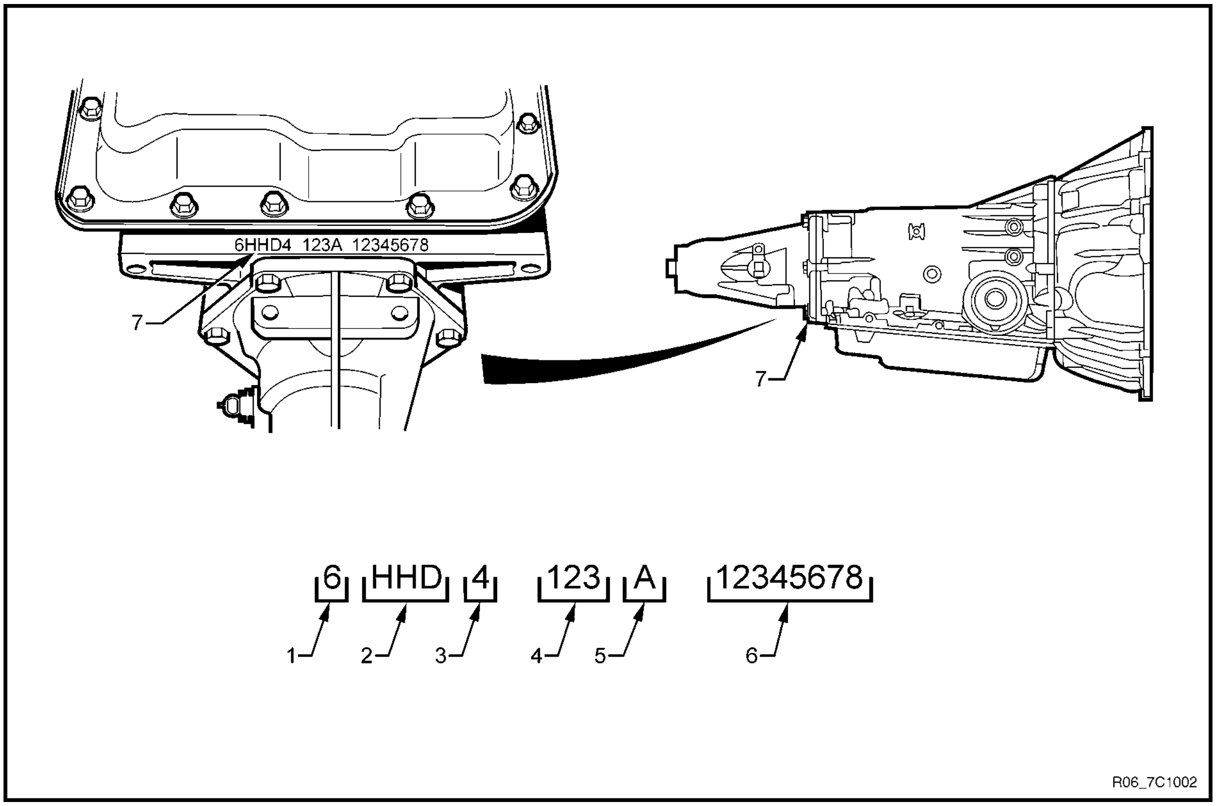


Figure 7C1 – 1

Legend

1 Model year
2 Broad Cast Code Identifier
3 Manufacturer Source Code
4 Julian Date
5 Shift Build
6 Individual Transmission Serial Number
7 Identification Stamping Location

2.3 Economy, Power and Cruise Modes

The programming in the transmission control module (TCM) allows for different shift patterns, which are driver controllable through the use of the power (PWR) button. The power button is located in the centre console.

Economy Mode

The calibration for this mode is for maximum comfort, with minimal intrusion of engine noise and smooth shifts under all driving conditions. When additional power is required for acceleration, full throttle upshifts are similar to those calibrated for the power mode.

Power Mode

When activated, the TCM modifies the transmission calibration in the following ways:

1 When the throttle is less than 80% open, later upshift points are provided.

2 Shift time is reduced.

3 The torque converter clutch (TCC) will be applied in both the third and fourth speed ranges.

Cruise Mode

When the driver activates the cruise control (where fitted), the power icon in the instrument clusters multi-function display (MFD) will be deactivated (provided the vehicle was operating in power mode) and the transmission shift pattern will switch to the cruise control pattern. When in this mode, the TCM modifies the shift pattern so that earlier downshift and later upshift points are provided.

Through the electronic programming of the logic processes contained in the TCM, the frequency of gear shifting and torque converter clutch application and release is minimised. The end result of these logic processes, is that a quick series of upshifts and downshifts (e.g. a '4 – 3 – 4' shift pattern) is minimised.

2.4 System Protection Devices

Should 1st gear be selected and left in that range, the TCM will protect the engine from an over-speeding condition by upshifting to 2nd gear at a pre-determined point. Similarly, the TCM provides high speed, downshift protection by preventing a manual shift into 1st gear above pre-determined engine speeds.

Under severe operating conditions such as towing in high ambient temperatures, fluid temperatures can rise to a point where lubrication breakdown can occur. In addition to having an oil cooler fitted to the vehicle, the 4L60E transmission is also fitted with a transmission fluid temperature sensor located in the Transmission Range (TR) Pressure Switch Assembly (PSA).

When fluid temperatures in excess of 135°C are sensed, the torque converter clutch is applied as programmed, in 3rd or 4th gear. This action reduces further the fluid temperature during normal operation of the torque converter. While these high fluid temperatures are sensed however, torque converter clutch apply is not available when the throttle opening is above 50%.

Similarly, when the fluid temperature is below 29°C, the TCM prevents torque converter clutch apply.

If a condition occurs, preventing electronic control of the transmission's functions, a 'Fail Safe' mode will default the transmission to 3rd gear when either Drive or 3 is selected, applying also maximum line pressure. While in this mode, the vehicle operator can still manually select 2, 1, Reverse, Park or Neutral, should the need arise.

2.5 Self Diagnosis

If any transmission operation controlled by the TCM begins to operate outside its pre-set parameters, the TCM has the ability to store a range of diagnostic codes which can be accessed by the servicing technician, thereby localising the problem.

2.6 TCM Sensors and Actuators

As indicated earlier, there are a number of sensors and switches providing input information for the TCM programming that will allow the TCM to change the shift pattern, shift feel and torque converter clutch operation.

The TCM does this by comparing this input information with its predetermined values on shift pattern, fluid pressure maps, shift duration parameters, extreme heat protection programming and adaptive controls.

In addition, each input signal and output actuator operation is also monitored and if outside its pre-set parameters, a diagnostic code is logged for future reference by the servicing technician.

3 Transmission Control Module Operation Overview

3.1 Transmission Control Module

With the introduction of the new HFV6 engine, the powertrain architecture has been redesigned to accommodate this introduction. With this design, a new bus architecture and protocol has also been introduced. The new bus connects the following modules:

- engine control module (ECM),
- transmission control module (TCM),
- powertrain interface module (PIM) and
- ABS module.

The protocol used to communicate between these modules is called General Motors Local Area Network (GM LAN) which is based on Controller Area Network (CAN) communication protocol. For further information on GM LAN protocol and data bus structure, refer to 6E1 Powertrain Interface Module – V6.

Component Location

The TCM (1) is located under the instrument panel, it is attached to a bracket mounted to the firewall as shown in Figure 7C1 – 2.

For the other components using the GM LAN databus, refer to 6E1 Powertrain Interface Module – V6.

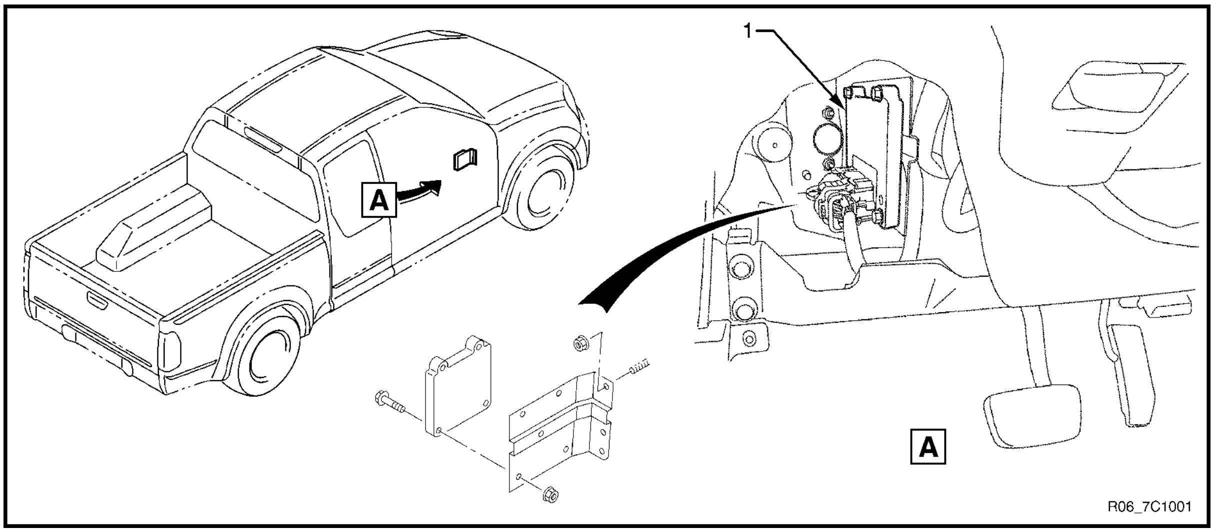


Figure 7C1 – 2

Transmission Control Module Data Transfer

The TCM uses various information to control the shift of the transmission. Besides the direct inputs from the various transmission sensors directly into the TCM, the TCM uses data from the GM LAN databus.
The inputs/outputs directly connected to the TCM from the transmission are:

- shift solenoids,
- torque converter clutch control,
- pressure control solenoid,
- transmission fluid temperature sensor and
- vehicle speed sensor.

Refer to 3.2 TCM Wiring Diagrams.

The transmission also receives inputs from the park/neutral position and back up lamp switch assembly.

The TCM needs other various data parameters to control the transmission correctly. These include throttle plate angle, whether cruise control is engaged and active or not, engine RPM etc. These are provided to the TCM from the ECM via serial data using GM LAN communication protocol.

The TCM also supplies information that is used by other components and systems within the vehicle such as the engine control module (ECM) and instrument cluster. Any information that is required on the body side of the data bus (UART protocol) is translated by the powertrain interface module (PIM). For further information on the data bus structure, the PIM and its operation, refer to 6E1 Powertrain Interface Module – V6.

Continued from the previous page

Checkpoint		Problem	Countermeasure
Tire pressure or wheel nuts	NG	Improper or instufficient tightening	Adjust or tighten
OK			
Tire tread (right and left)	NG	Difference in wear and tear	Replace (tire)

Transmission Control Module Operation

The TCM processes data every 10 milliseconds from various sensors, such as throttle position, vehicle speed, gear range, temperature, engine load and other inputs. The TCM compares all its various inputs with the internal programming and calibration of the TCM using this data, a signal is transmitted to the valve body shift solenoids, which activate the shift valves for precise shift control. Shift points are therefore precisely controlled and are identical from vehicle to vehicle. The TCM also control torque converter clutch apply and release.

Shift feel is also electronically controlled by the TCM, by signals sent to the variable force solenoid, which controls fluid line pressure and it is this pressure that precisely determines how the shifts will feel. In this way, the TCM electronically synchronises the engine and transmission into a single integrated powertrain system for optimum performance, shift timing, fuel efficiency and emission control.

3.2 TCM Wiring Diagrams

For details of the transmission control module (TCM) wiring diagrams, refer to 8A Electrical-Body and Chassis.

4 Transmission Definitions and Abbreviations

The following definitions and abbreviations are provided to establish a common language and assist the user in describing transmission related conditions. The use of these terms and/or conditions can be found in the various parts of the automatic transmission sections, but more particularly in 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis.

4.1 Throttle Position Related Definitions

Throttle Position	Definition
Minimum Throttle	The least amount of throttle opening required for an upshift.
Light Throttle	Approximately 1/4 of accelerator pedal travel (25% Throttle Position).
Medium Throttle	Approximately 1/2 of accelerator pedal travel (50% Throttle Position).
Heavy Throttle	Approximately 3/4 of accelerator pedal travel (75% Throttle Position).
Wide Open Throttle (WOT)	Full travel of the accelerator pedal (100% Throttle Position).
Full Throttle Detent Downshift	A quick apply of the accelerator pedal to its full travel, forcing a downshift.
Zero Throttle Coast Down	A full release of the accelerator pedal while the car is in motion and in drive range.
Engine Braking	A condition where the engine is used to slow the car by manually downshifting during a zero throttle coast down.

4.2 Noise Condition Related Definitions

Noise Condition	Definition
Planetary Gear Noise	A whine related to car speed most noticeable in first gear or reverse. Becomes less noticeable after an upshift.
Pump Noise	A high pitch whine increasing with engine r.p.m.

4.3 General Definitions

General	Definition
Accumulator	A component of the transmission that absorbs hydraulic pressure during the apply of a clutch or band. Accumulators are designed to control the quality of a shift from one gear range to another.
Adaptive Learning	Programming within the TCM that automatically adjusts hydraulic pressures in order to compensate for changes in the transmission (i.e. component wear).
Applied	An 'Applied Component' is holding another component to which it is splined or assembled to. Also referred to as "engaged".
Apply Components	Hydraulically operated clutches, servo’s, bands and mechanical one-way roller or sprag clutches that drive or hold members of a planetary gear set.
Apply Plate	A steel clutch plate in a clutch pack, located next to the (apply) piston.
Backing Plate	A steel plate in a clutch pack that is usually the last plate in that clutch assembly (furthest from the clutch piston).
Band	An apply component that consists of a flexible strip of steel and friction material that wraps around a drum. When applied, it tightens around the drum and prevents the drum from rotating.
Brake Switch	An electrical device that provides signals to the transmission control module (TCM), based on the position of the brake pedal. The TCM uses this information to apply or release the torque converter clutch (TCC).
Centrifugal Force	A force that is imparted on an object (due to rotation) that increases as that object moves further away from a centre-point of rotation.

General	Definition
Check Ball	A spherical, hydraulically controlled component (usually of steel) that either seals or opens fluid circuits. It is also referred to as a check valve.
Clutch Pack	An assembly of components generally consisting of clutch plates, an apply plate and a backing plate.
Clutch Plate	A hydraulically activated component that has two basic designs: (1) all steel, or (2) a steel core with friction material bonded to one or two sides of the plate.
Control Valve Body	A machined metal casting that contains valve trains and other hydraulically controlled components that shift the transmission.
Coupling Speed	The speed at which a vehicle is travelling and no longer requires torque multiplication through the torque converter. At this point, the stator 'free wheels' to allow fluid leaving the turbine to flow directly to the pump. (Also see Torque Converter).
De-energise(d)	To interrupt the electrical current that flows to an electronically controlled device, making it electrically inoperable.
Direct Drive	A condition in a gears set where the input speed and input torque equals the output speed and output torque. The gear ratio through the gear set is 1:1.
Downshift	A change in a gear ratio where both input speed and torque increases.
Duty Cycle	In reference to an electronically controlled solenoid, it is the amount of time (expressed as a percentage) that current flows through the solenoid coil.
Energise(d)	To supply a current to an electronically controlled device, enabling it to perform its designed function.
Engine Compression Braking	A condition where compression from the engine is used with the transmission to decrease vehicle speed.
Exhaust	The release of fluid pressure from a hydraulic circuit. (The words 'exhausts' and 'exhausting' are also used and have the same intended meaning.)
Fail-safe Mode	A condition whereby a component (i.e. engine or transmission) will partially function even if its electrical circuit is disabled.
Fluid	In this Section of the Service Manual, 'fluid' refers primarily to automatic transmission fluid (or ATF) and, for the Hydra-matic 4L60E transmission, the only recommended fluid is Dexron® III.
Fluid Pressure	A pressure that is consistent throughout a given fluid circuit.
Force	A measurable effort that is exerted on an object (component).
Freewheeling	A condition where power is lost through a driving or holding device (i.e. roller or sprag clutches).
Friction Material	A heat and wear resistant fibrous material, bonded to clutch plates and bands.
Gear	A round, toothed device that is used for transmitting torque through other components.
Gear Range	A specific speed to torque ratio at which the transmission is operating (i.e. 1st gear, 2nd gear etc.).
Gear Ratio	Revolutions of an input gear as compared to the revolutions of an output gear. It can also be expressed as the number of teeth on a gear as compared to the number of teeth on a gear that it is in mesh with.
Hydraulic Circuit	A fluid passage which often includes the mechanical components in that circuit designed to perform a specific function.
Input	A starting point for torque, revolutions or energy into another component of the transmission.
Internal Gear	The outermost member of a gear set that has gear teeth in constant mesh with the planetary pinion gears of the gear set.
Land (Valve Land)	The larger diameters of a spool valve that contact the valve bore or bushing.

General	Definition
Line Pressure	The main fluid pressure in a hydraulic system created by the pump and pressure regulator valve.
Manual Valve	A spool valve that distributes fluid to various hydraulic circuits and is mechanically linked to the gear selector lever.
Orifice	A restricting device (usually a hole in the spacer plate) for controlling pressure build up into another circuit.
Overdrive	An operating condition in the gear set allowing output speed to be higher than input speed and output torque to be lower than input torque.
Overrunning	The function of a one-way mechanical clutch that allows the clutch to freewheel during certain operating conditions of the transmission.
Pedal Position	The percentage angle of the accelerator pedal as displayed by Tech 2.
Pinion Gears	Pinion gears (housed in a carrier) that are in constant mesh with a circumferential internal gear and centralised sun gear.
Planetary Gear Set	An assembly of gears that consists of an internal gear, planet pinion gears with a carrier, and a sun gear.
Pressure	A measurable force that is exerted on an area and expressed as kilopascals (kPa).
Pulse Width Modulated (PWM)	An electronic signal that continuously cycles the On and Off time of a device (such as a solenoid) while varying the amount of On time.
Race (Inner or Outer)	A highly polished steel surface that contacts bearings or sprag or roller elements.
Reduction (Gear Reduction)	An operating condition in the gear set allowing output speed to be lower than input speed and output torque to be higher than input torque.
Residual Fluid Pressure	Excess pressure contained within an area after the supply pressure has been terminated.
Roller Clutch	A mechanical clutch (holding device) consisting of roller bearings assembled between inner and outer races.
Servo	A spring loaded device consisting of a piston in a bore that is operated (stroked) by hydraulic pressure to apply or release a band.
Spool Valve	A round hydraulic control valve often containing a variety of land and valley diameters.
Sprag Clutch	A mechanical clutch (holding device consisting of "figure eight" like elements assembled between inner and outer races.
Staking	The effect of deforming, peening over or riveting a shaft to provide a solid mounting.
Throttle Position	The travel of the throttle plate that is expressed in percentages and measured by Tech 2.
Torque	A measurable twisting force expressed in terms of Newton metres (Nm).
Torque Converter	A component of an automatic transmission, (attached to the engine flex plate) that transfers torque from the engine to the transmission through a fluid coupling.
Torx® Plus Bit	A special tool used for the removal of the bell housing. Precision tip fit means that cam out of the bolt head is virtually eliminated. **NOTE** Torx® Plus Bits are different from normal Torx® Bits
Transmission Control Module (TCM)	An electronic device that manages the vehicle's engine and automatic transmission functions.
Variable Capacity Pump	The device that provides fluid for operating the hydraulic circuits in the transmission. The amount of fluid supplied varies depending on vehicle operating conditions.

4.4 Abbreviations

Abbreviation	Definition
2WD	Two Wheel Drive.
AC	Alternating Current
A/C	Air Conditioning
AFL	Actuator Feed Limit
4WD	Four Wheel Drive
DC	Direct Current
D.C	Duty Cycle
DLC	Diagnostic Link Connector
DTC	Diagnostic Trouble Code
ECM	Engine Control Module
ECT Sensor	Engine Coolant Temperature Sensor.
ETC	Electronic Throttle Control
N.C	Normally Closed
N.O.	Normally Open
PCS	Pressure Control Solenoid (or Force Motor)
PIM	Powertrain Interface Module
PWM	Pulse Width Modulated
RWD	Rear Wheel Drive.
TCC	Torque Converter Clutch.
TCM	Transmission Control Module
TFP Switch	Transmission Fluid Pressure Manual Valve Position Switch
TFT	Transmission Fluid Temperature Sensor.
TP Sensor	Throttle Position Sensor.
VS Sensor	Vehicle Speed Sensor.

5 Service Notes

In the interests of safety to personnel, equipment and to the vehicle and its components, read and adhere to the following notes whenever servicing operations are to be carried out on the Hydra-matic 4L60E automatic transmission. In addition, some of this information also refers to sound workshop practices and, to achieve the design life of affected components.

Fasteners

- Always reinstall fasteners in the same locations as they were removed.
- If a fastener requires replacement, always use a part of the correct part number or of equal size and strength or stronger.

General Workshop Practice

- Keep work area and tools clean.
- To avoid unnecessary contamination, always clean the exterior of the transmission before removing any parts.
- Do not use wiping cloths or rags because of the risk of lint being trapped in the transmission.
- Do not use solvents on:
  - neoprene seals,
  - composition faced clutch plates, or
  - thrust washers.
- Always wear eye protection when using compressed air.
- Blow out all passages with compressed air. Only probe small passages with soft, thin wire.
- Handle parts with care to avoid nicks and scratches.
- Do not remove Teflon oil seal rings unless damaged or performing a complete overhaul.
- Expand internal snap rings and compress external snap rings to maximise retention and security.
- Lubricate all internal parts with transmission fluid (only use Dexron® III), as they are being installed.
- When installing cap screws into aluminium castings:
  - always use a torque wrench and
  - stripped or damaged threads in aluminium castings may be reconditioned by using commercially available thread inserts.
- Once removed, replace all gaskets, seals and O-rings with new parts.
- Always use seal protectors where indicated and do not use gasket cement or sealant on any joined face unless specified to do so.

6 Torque Specifications

Oil pan attaching bolt	12.0 Nm
Shift selector base plate attaching nut	7.0 Nm
Spring plate attaching screw	2.0 Nm
Selector lever knob attaching screw	2.0 Nm
Selector cable bracket attaching bolt	22.0 Nm
Heat shield front attaching screw	15.0 – 35.0 Nm
Heat shield rear attaching screw	9.0 Nm
Manual shaft linkage attaching nut	25.0 Nm
Neutral start and back-up lamp switch attaching screw	15.0 – 35.0 Nm
Vehicle speed sensor attaching bolt	11.0 - 14.0 Nm
Transmission mount attaching bolt	50.0 Nm
Transmission support attaching bolt and nut	50.0 – 65.0 Nm
Transmission mount attaching nut	52.0 Nm
Heat shield to transmission support attaching bolt	52.0 Nm
Extension housing attaching bolt	42.0 – 48.0 Nm
1 – 2 Accumulator cover attaching bolt	12.0 Nm
TCC solenoid attaching bolt	12.0 Nm
Control valve body attaching bolt	12.0 Nm
Transmission fluid pressure (TFP) manual valve position switch attaching bolt	12.0 Nm
Manual detent spring attaching bolt	23.0 Nm
Spacer plate support plate attaching bolt	12.0 Nm
Filler tube bracket attaching bolt	20.0 – 35.0 Nm
Vent pipe attaching bolt	6.0 Nm
Transmission cooler lines bracket attaching screw	23.0 Nm
Torque converter housing attaching bolt	52.0 – 66.0 Nm
Torque converter to flexplate attaching bolt	60.0 – 70.0 Nm
Torque converter cover attaching bolt	12.0 – 16.0 Nm
TCM bracket attaching nut	7.0 Nm
TCM attaching bolt and nut	7.0 Nm
Oil Pump Cover to Pump Body Attaching Bolt	25.0 Nm
Pressure Control Solenoid Retainer Attaching Bolt	12.0 Nm
Forward Accumulator Cover Attaching Bolt	12.0 Nm
Oil Pump to Transmission Case Attaching Bolt	30.0 Nm
Torque Converter Housing to Transmission Case Attaching Bolt	65.0 – 75.0 Nm

7 Transmission Specifications

7.1 General

Type

Hydra-matic 4L60E

Special Features

Electronically controlled shift pattern, feel and torque

Converter clutch operation

Overdrive 4th speed range

Selector Location .... Floor mounted console

Gear Ratios

Park (P) .... –

Reverse (R) 2.29

Neutral (N) .... –

Drive (D – 4) 0.7

Drive (D – 3) 1.0

Second (2) 1.63

First (1) 3.06

Shift Speeds

Refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis

Oil Pressure

Refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis

Torque Converter

Number of Elements .... 3 plus torque converter clutch

Torque Converter Diameter and End Play

HFV6 .... 258 mm

End Play .... 0.1 – 0.5 mm

Lubricant

Type recommended .... Dexron® III

Capacity .... Nominal only. Check when transmission is at operating temperature

Service Refill .... 4.8 litres

Total (Dry) .... 8.8 litres

Fluid Cooling .... Transmission fluid to engine coolant in one radiator tank

Clutches and Band

2 – 4 Band:

Type .... Composition lined, steel band

Operation: .... Servo

Adjustment: .... Selective Apply Pin

Pin Size and Identification.

65.82 – 66.12 mm .... 1 Groove

67.23 – 67.53 mm .... 2 Groove

68.64 – 68.94 mm .... No Groove

Reverse Input Clutch

Type .... Multiple wet disc

Backing plate .... (1) Selective

Clutch plate (numbers):

Steel 4

Composition 4

Belleville 1

Backing Plate .... 1 (Selective)

Backing plate, identification and thickness:

'2' .... 7.25 – 7.41 mm

'3' .... 6.52 – 6.68 mm

'4' .... 5.79 – 5.95 mm

Backing plate travel .... 1.02 – 1.94 mm

Forward Clutch

Type .... Multiple wet disc

Clutch plate, (number):

Flat steel plates .... (5)

Composition plates .... (5)

Waved steel plate .... (1)

Backing plate .... (1) Selective

Backing plate, identification and thickness:

'A' .... 6.97 – 7.07 mm

'B' .... 6.38 – 6.48 mm

'C' .... 5.79 – 5.89 mm

'D' .... 5.20 – 5.30 mm

'E' .... 4.61 – 4.71 mm

Backing plate travel .... 0.87 – 1.88 mm

Overrun Clutch

Type .... Multiple wet disc

Clutch plates, (number):

Flat steel .... (2)

Composition .... (2)

3 – 4 Clutch

Type .... Multiple wet disc

Clutch plates, (number):

Flat steel .... (5)

Composition .... (6)

Stepped apply plate .... (1)

Backing plate .... (1) Selective

Backing plate, identification and thickness:

'A' .... 5.88 – 5.68 mm

'B' .... 4.99 – 4.76 mm

'C' .... 4.10 – 3.90 mm

Backing plate travel .... 2.10 – 0.90 mm

Low and Reverse Clutch

Type .... Multiple wet disc

Clutch plates (number):

Flat steel .... (5)

Composition .... (5)

Waved flat steel .... (1)

Selective flat steel plate .... (1) Selective

Selective plate, (identification) and thickness,
measured dimension:

28.06 – 27.54 mm (identification NONE) .... 1.68 – 1.83 mm

28.59 – 28.07 mm (identification '0') .... 1.17 – 1.31 mm

27.54 – 27.03 mm (identification '1') .... 2.20 – 2.34 mm

Transmission End Play Check

Transmission end play check specification .... 0.13 – 0.92 mm

Identification and washer thickness:

67 .... 1.87 – 1.97 mm

68 .... 2.04 – 2.14 mm

69.. 2.21 – 2.31 mm
70.. 2.38 – 2.48 mm
71.. 2.55 – 2.65 mm
72.. 2.72 – 2.82 mm
73.. 2.89 – 2.99 mm
74.. 3.06 – 3.16 mm

3. INSTABILITY OF VEHICLE

Checkpoint		Problem	Countermeasure
Vehicle trim height	NG	Incorrect	Adjust
OK			
Rubber bushings for upper and lower links. (4 × 2 Except high ride suspension)	NG	Worn	Replace
OK			
Steering linkage and upper and lower links	NG	Worn or deformed	Replace
OK			
Wheel alignment	NG	Incorrect	Adjust
OK			
Tire pressure	NG	Incorrect	Adjust
OK			
Road wheel	NG	Deformed or unbalanced	Adjust

8 Special Tools

The following pages list and illustrate the special service tools required. The tools are classified into the following categories:

Mandatory: When required to perform routine maintenance operations and adjustments, or are required to carry out fault diagnosis procedures.

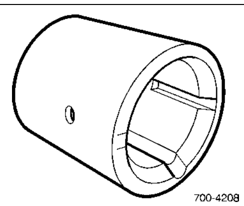
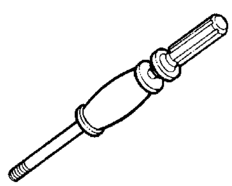
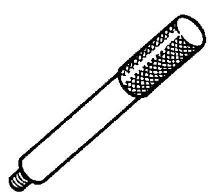
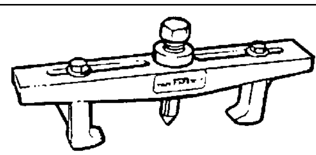
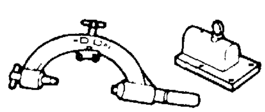
Desirable: These tools should be considered for purchase since their use will greatly facilitate performing designated tasks and permit achievement of standard times.

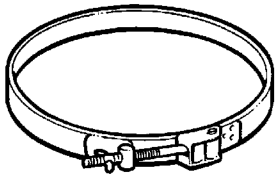
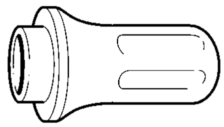
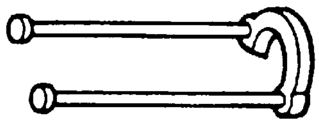
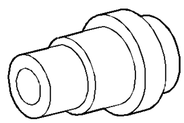
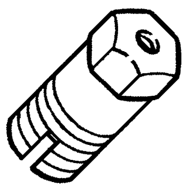
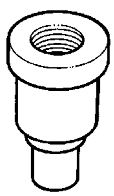
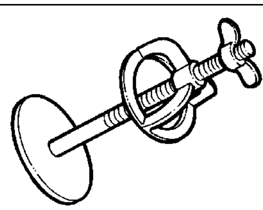
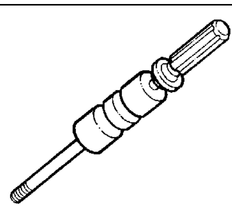
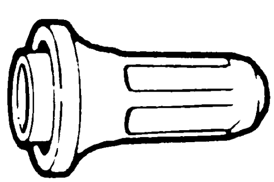
Unique: These tools are those that must be employed when overhauling major assemblies or performing relatively large tasks.

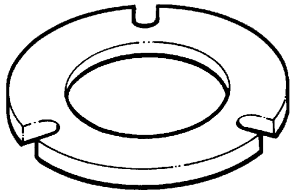
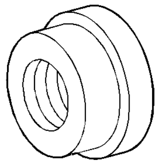
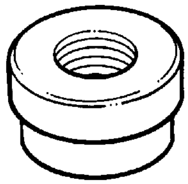
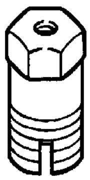
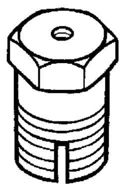
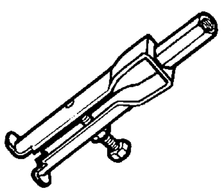
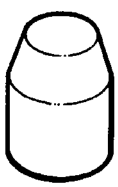
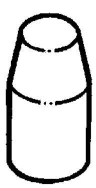
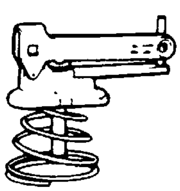
Available: Are those tools that are of a general nature for which commercially available equivalents exist, or tools which have had previous application.

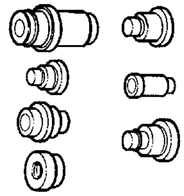
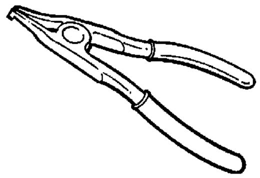
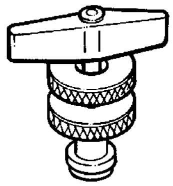
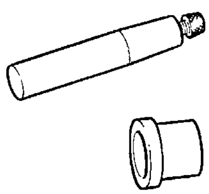
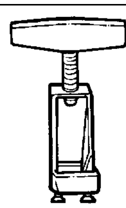
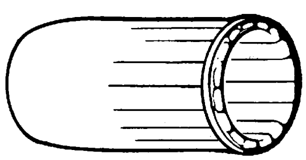
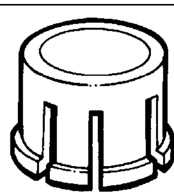
Unless otherwise specified, all tools are available from:

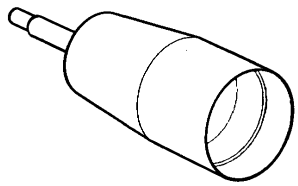
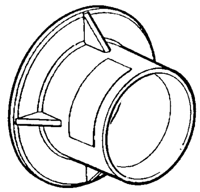
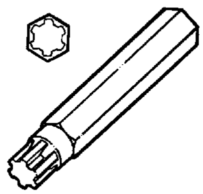
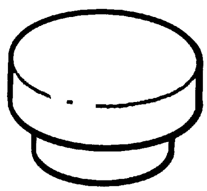
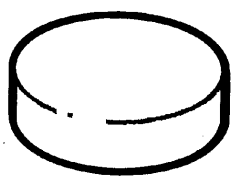
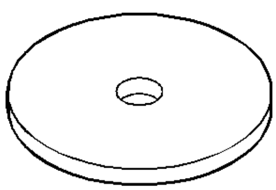
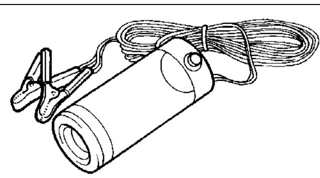
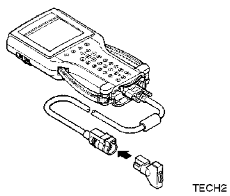
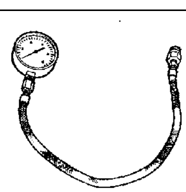
SPX Australia PTY. LTD.
Service Solutions
28 Clayton Road
Notting Hill, Victoria, 3168
Telephone: (03) 9544 6222
Facsimile: (03) 9544 5222

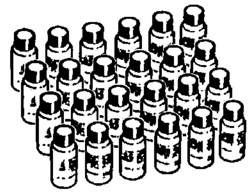
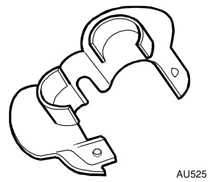
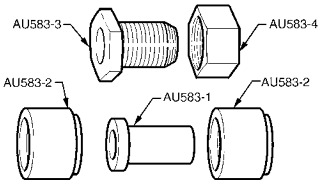
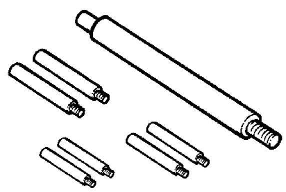
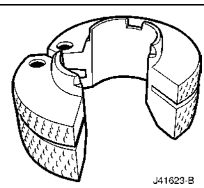
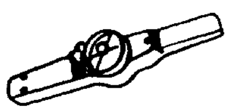
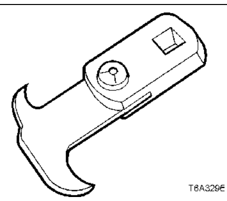
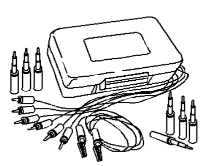
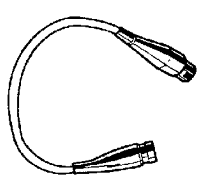
Tool Number	Illustration	Description	Tool Classification
700-4208		**Pass-Thru Connector Remover** Used to release the four locking tangs on the Pass-Thru connector from the transmission case. Previously released	Desirable
J6125-1B		**Slide Hammer** Used for a number of bush removal operations. Previously released	Unique
J8092		**Driver Handle** Used for a number of bush installation operations. Previously released	Unique
J8433		**Puller** Used with J21427-01 to remove the output speed sensor ring from the main shaft. Previously released	Unique
J8763-02		**Holding Fixture** Used in conjunction with holding fixture base J3289-20 to hold automatic transmission. Previously released.	Unique

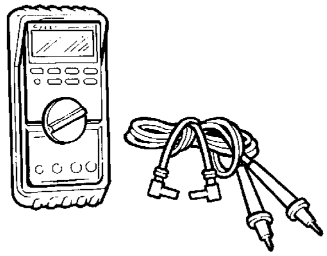
J21368		**Oil Pump Alignment Band** Used to align the two oil pump sections before tightening the securing bolts. Previously released	Unique
J21426		**Rear Seal Installer** Used to install the extension housing oil seal. Previously released	Unique
J21427-01		**Puller Adaptor** Used with J8433 to remove the output speed sensor ring from the main shaft. Previously released	Unique
J21465-2		**Installer** Used with driver J8092 to install the front stator shaft bush. Previously released	Unique
J21465-15		**Remover** Used in conjunction with slide hammer J6125-1B to remove the stator shaft front bushing. Previously released	Unique
J23062-14		**Bush Remover** Used in conjunction with driver handle J8092. Previously released	Unique
J23327-1		**Clutch Spring Compressor** Needed to compress the clutch, before dismantling. Plate J42628 is also required. Previously released	Unique
J23907		**Slide Hammer** Used with J29369-2 to remove the reaction carrier shaft bushes. Previously released	Unique
J25016		**Oil Pump Seal Installer** Used to install the oil pump oil seal. Previously released	Unique

J25018-A		**Clutch Spring Compressor Adaptor** Used with compressor J23327 to compress the reverse input clutch during disassembly. Previously released	Unique
J25019-4		**Bush Installer** Used in conjunction with J8092 Installer Handle. Previously Released	Unique
J25019-9		**Bush Installer** Used in conjunction with driver handle J8092. Previously released	Unique
J25019-14		**Bush Remover** Used with slide hammer J6125-1B. Previously released	Unique
J25019-16		**Bush Remover** Used with slide hammer J6125-1B. Previously released	Unique
J29369-2		**Universal Bush Remover** Used with slide hammer J23907. Previously released	Unique
J29882		**Inner Overrun Clutch Seal Protector** Used to protect the inner, overrun clutch piston seal from damage during installation. Previously released	Unique
J29883		**Inner Forward Clutch Seal Protector** Used to protect the inner, forward clutch piston seal from damage during installation. Previously released	Unique
J33037		**2 – 4 Band Apply Pin Tool** Used to check the selective apply pin length. Previously released	Unique

J34196-B		**Bush Remover/Installer Set** Used for various applications, described in the text. Previously released	Unique
J34627		**Snap Ring Pliers** Specific purpose is to assist in the removal/replacement of the output shaft snap ring. Previously released	Unique
J35138		**Torque Converter End Play** To be used in conjunction with commercially available magnetic stand and dial indicator. Previously released	Unique
J36352		**Speed Sensor Installer & Gauging Tool** Needed to correctly install the output speed sensor ring to the main shaft. Comprises sleeve, J36352-6 and C-washer J36352-4. Previously released	Unique
J36418-B		**Turbine Shaft Seal Installer & Resizer** Used to install and re-size the turbine shaft seal. Comprises J36418-1B installer and J36418-2A resizer. Previously released	Unique
J37789-A		**Oil Pump Remover** Used with J39119 to remove the oil pump assembly. Previously released	Unique
J38735-3		**Stator Shaft Sealing Ring Installer** Used with J39855-1 to install the stator shaft seal. Previously released	Unique
J39119		**Oil Pump Remover Adaptor** Used with J37789-A to remove the oil pump assembly. Previously released	Unique

J39855-1		**Stator Shaft Seal Expander** Used to expand the stator shaft seal prior to installation. Previously released	Unique
J39855-2		**Stator Shaft Seal Resizer** Used to re-size the stator shaft seal after installation. Previously released	Unique
J41510		**T50 Torx Plus® Bit** Used to loosen and tighten the torque converter housing to transmission case bolts. Also released as 6194. Previously released	Unique
J41778-1		**Oil Pump Bush Installer** Used with a bench press. Previously released	Unique
J41778-2		**Support Plate** Used to support the oil pump during bush installation. Previously released	Unique
J42628		**Plate** Used with clutch spring compressor, J23327-1. Previously released	Unique
16296		**12 Volt Black Light** Used with special, fluorescent dyes for tracing a variety of fluid leaks. Also previously released as J42220	Desirable
70000861		**Tech 2 Diagnostic Tool** Previously released	Mandatory
J21867		**Pressure Gauge And Hose Assembly** Previously released	Mandatory

J28431-B		**Fluorescent Oil Dye** Supplied in packs of 24, 1 oz bottles. Suitable for black light tracing of engine, transmission and power steering fluid leaks. Previously released	Desirable
AU525		**Quick-Connect Release Tool** This tool is used on all engines with automatic transmission. Previously released	Mandatory
AU583		**Selector Shaft Seal Remover/ Installer** Use to remove and install the manual shaft oil seal, with the transmission installed in the vehicle. Previously released	Unique
J25025-B		**Dial Indicator Stand and Guide Pin Set** Used for the guide pins for aligning the control valve body spacer plate. Previously released	Unique
J41623-B		**Cooler Line Disconnect Tool** Used to disconnect cooler lines at the transmission end, Quick-Connects. Previously released	Mandatory
7380 (J25765-A)		**Pre-load gauge (3/8" drive)** Used in several applications. In 7C5 it is used in conjunction with J33037 to measure selective apply pin length. (0-17 Nm.) Previously released	Mandatory
E308 (56750) (49V012001)		**Seal Remover** Used as a universal seal remover. Previously released	Available
J35616-C		**Electronic Kit** Used in conjunction with a multimeter for measuring voltages and resistances without damaging wiring harness connectors. Previously released	Desirable
J44152		**Jumper Harness** Used for checking automatic transmission during diagnostic checks. Previously released	Mandatory

J39200		**Digital Multimeter** Tool no. J39200 previously released, or use commercially available equivalent. Must have 10 meg ohm input impedance. Previously released	Available

7C2
Automatic Transmission – 4L60E – Electrical Diagnosis

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to 00 Warnings, Cautions and Notes for correct workshop practices with regard to safety and/or property damage.

4. STIFF STEERING WHEEL

Checkpoint		Problem	Countermeasure
Upper and ball joint	NG	Stiff or damaged or lack of grease	Replace
OK			
Wheel alignment	NG	Incorrect	Adjust
OK			
Steering gear	NG	Worn or damaged	Replace
OK			
Steering linkage	NG	Deformed	Replace
OK			
Steering gear box or steering linkage	NG	Insufficient lubricants or impurities present; or excessively worn	Replace the part
OK			
Steering column with turn signal switch	NG	Interference abrasion	Replace
OK			
Tire pressure	NG	Improper	Adjust

1 General Information

1.1 Introduction

This Section covers the electrical diagnostic for the 4L60E automatic transmission when mated to a V6 engine.

1.2 General Description

The 4L60E automatic transmission incorporates electronic controls that utilise a transmission control module (TCM) to control shift points through:

- the 1-2 and 2-3 shift solenoid valves,
- the 3-2 downshift solenoid valve,
- a torque converter clutch (TCC) solenoid valve,
- apply and release through the TCC pulse width modulated (PWM) solenoid valve, and
- line pressure through the pressure control (PC) solenoid valve.

Electrical signals from various sensors provide information to the TCM about the following:

- vehicle speed,
- throttle position,
- engine coolant temperature,
- transmission fluid temperature,
- gear range selector position,
- engine speed,
- converter turbine speed, and
- engine load braking and operating mode.

The TCM uses this information to determine the precise moment to upshift or downshift, apply or release the TCC and what fluid pressure is needed to apply the clutches. This type of control provides consistent and precise shift points and shift quality based on the operating conditions of the vehicle.

Figure 7C2 – 1 shows the location of the internal electronic components in the transmission.

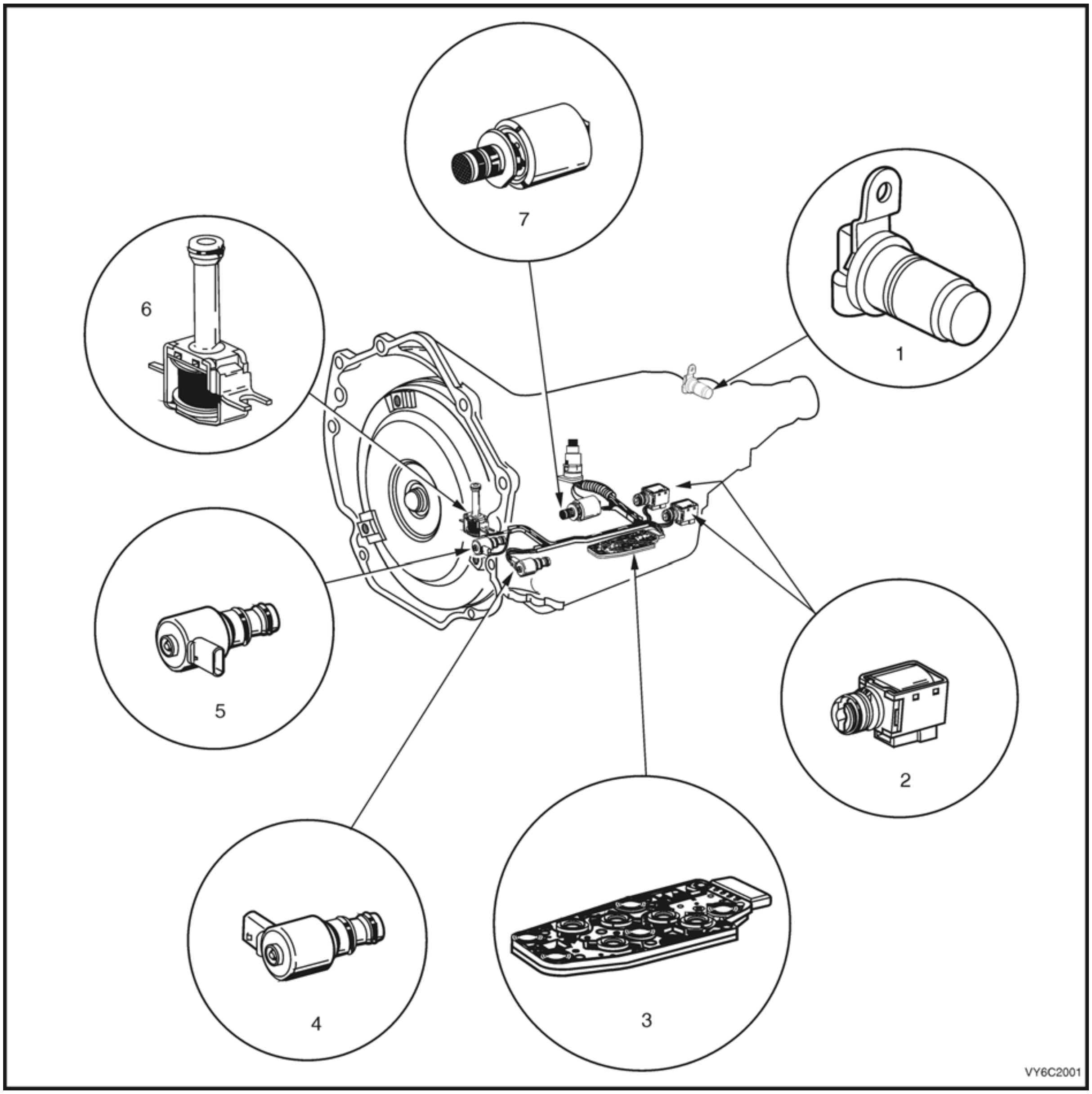


Figure 7C2 – 1

Legend

1	Vehicle Speed Sensor	5	Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve
2	1-2 Shift Solenoid (Solenoid A) and 2-3 Shift Solenoid (Solenoid B)	6	Torque Converter Clutch (TCC) Solenoid Valve
3	Automatic Transmission Fluid Pressure (TFP) Manual Valve Position	7	Pressure Control (PC) Solenoid Valve
4	3-2 Downshift Solenoid		

Transmission Adaptive Functions

The 4L60E automatic transmission uses a line pressure control system, which has the ability to adapt the system line pressure to compensate for normal wear within the transmission, such as the clutch pack fibre plates, seals, springs, etc. The adapt feature is similar in function to the long term/short term fuel trim feature of the engine management system.

The 4L60E automatic transmission uses the adapt function for garage shifts, upshifts and torque converter clutch (TCC) application. The TCM monitors the engine torque to determine if the shift is occurring too fast or too slow and adjusts the pressure control solenoid to maintain the correct shift feel.

Limp Home Mode Description

If a major electrical system failure occurs which could affect vehicle safety or damage the transmission during normal operation, the TCM enters a limp home mode. In the limp home mode, the transmission operates in the following manner:

- The pressure control solenoid is off and the line pressure is at maximum to minimise clutch slippage.
- The TCC solenoid is off, therefore the torque converter clutch is disabled.
- The two shift solenoids are turned off. The transmission will operate in fourth gear if the vehicle has successfully completed a 1-2 upshift in the current ignition cycle. If the vehicle has not completed a 1-2 upshift in the current ignition cycle, the transmission will operate in third gear. If the transmission is operating in fourth gear, third gear may be obtained if the engine is stopped briefly and re-started.

In limp home mode, the gear selector lever is ineffective at selecting forward gear ranges. In third or fourth gear, heat builds up in the transmission quickly, particularly in stop and go traffic. Excessive heat build-up may cause transmission failure if the vehicle is driven for extended distances in limp home mode.

1.3 Transmission Indicators and Messages

For information pertaining to the instrument cluster and the transmission information it displays, refer to the RA Rodeo Owner Handbook.

1.4 Electronic Component Description

For all other electrical components not covered in this section, refer to General Motors Powertrain Group Electronically Controlled Automatic Transmission Technician's Guide.

Transmission Control Module (TCM)

The Transmission Control Module (TCM) is located under the instrument panel, next to the brake pedal assembly and connects directly to the transmission wiring harness. A single 49-way connector is used to make the connection between the vehicle wiring harness and the TCM.

To access the connector for diagnosis:

1 Ensure the ignition switch is in the OFF position.

2 Disconnect the connector (1) from the transmission control module (TCM) (2) as follows, refer to Figure 7C2 – 2:

   a remove the securing pin (3),

   b press the locking tab and swing the lever (4) to free the connector,

   c remove the connector.

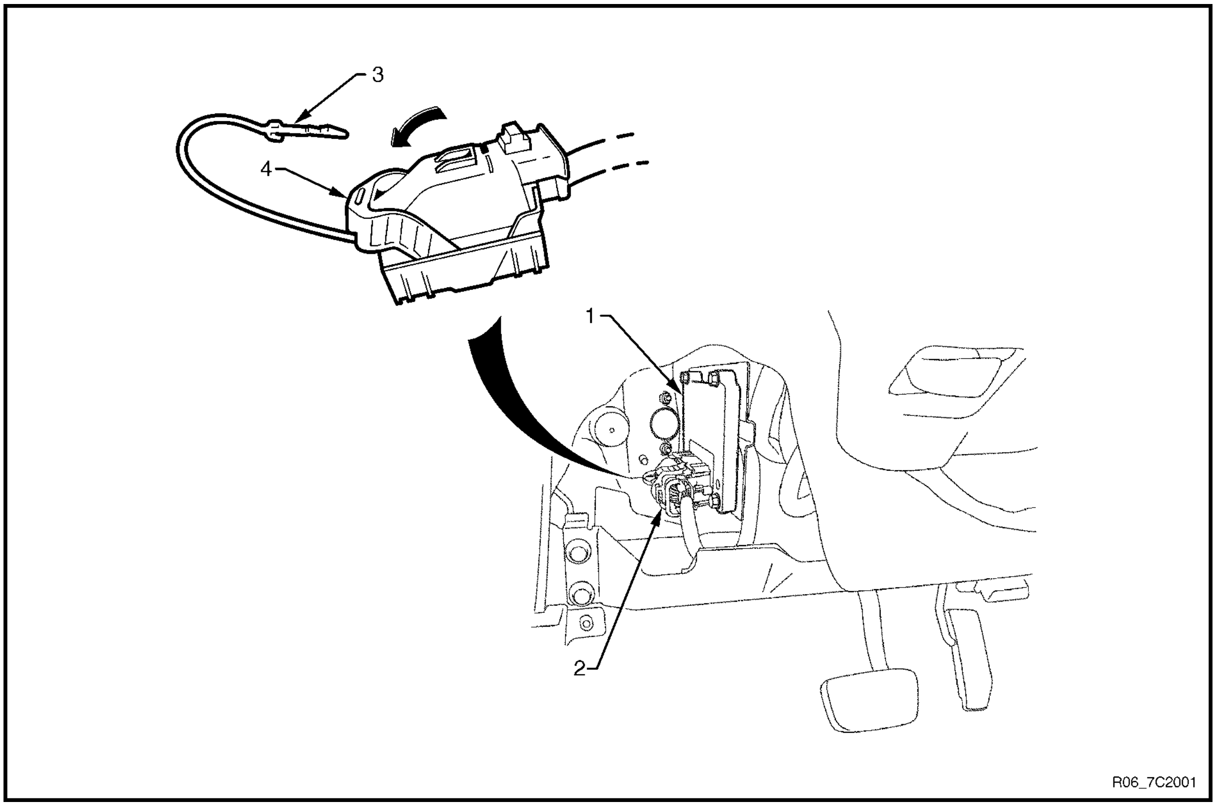


Figure 7C2 – 2

The TCM is an electronic control module receiving input or providing output to control the operation of the 4L60E automatic transmission.

The TCM receives the following inputs from the engine control module (ECM):

- engine speed and torque values,
- engine intake air temperature (IAT), accelerator pedal position (APP) information,
- engine coolant temperature (ECT),
- driver selected shift mode, and
- air-conditioning (A/C) status.

The ECM provides this data to the TCM through the databus.

Other TCM inputs are:

- battery and ignition voltage,
- brake switch status,
- transmission fluid temperature (TFT), and

vehicle speed sensor (VSS).

The TCM provides the following outputs to control the automatic transmission:

- shift solenoids to control transmission shifting,
- torque converter clutch (TCC) pulse width modulated (PWM) solenoid operation to control the apply and release of the torque converter clutch assembly, and
- pressure control (PC) solenoid to regulate the transmission line pressure.

Other TCM outputs provided to the ECM / PIM are:

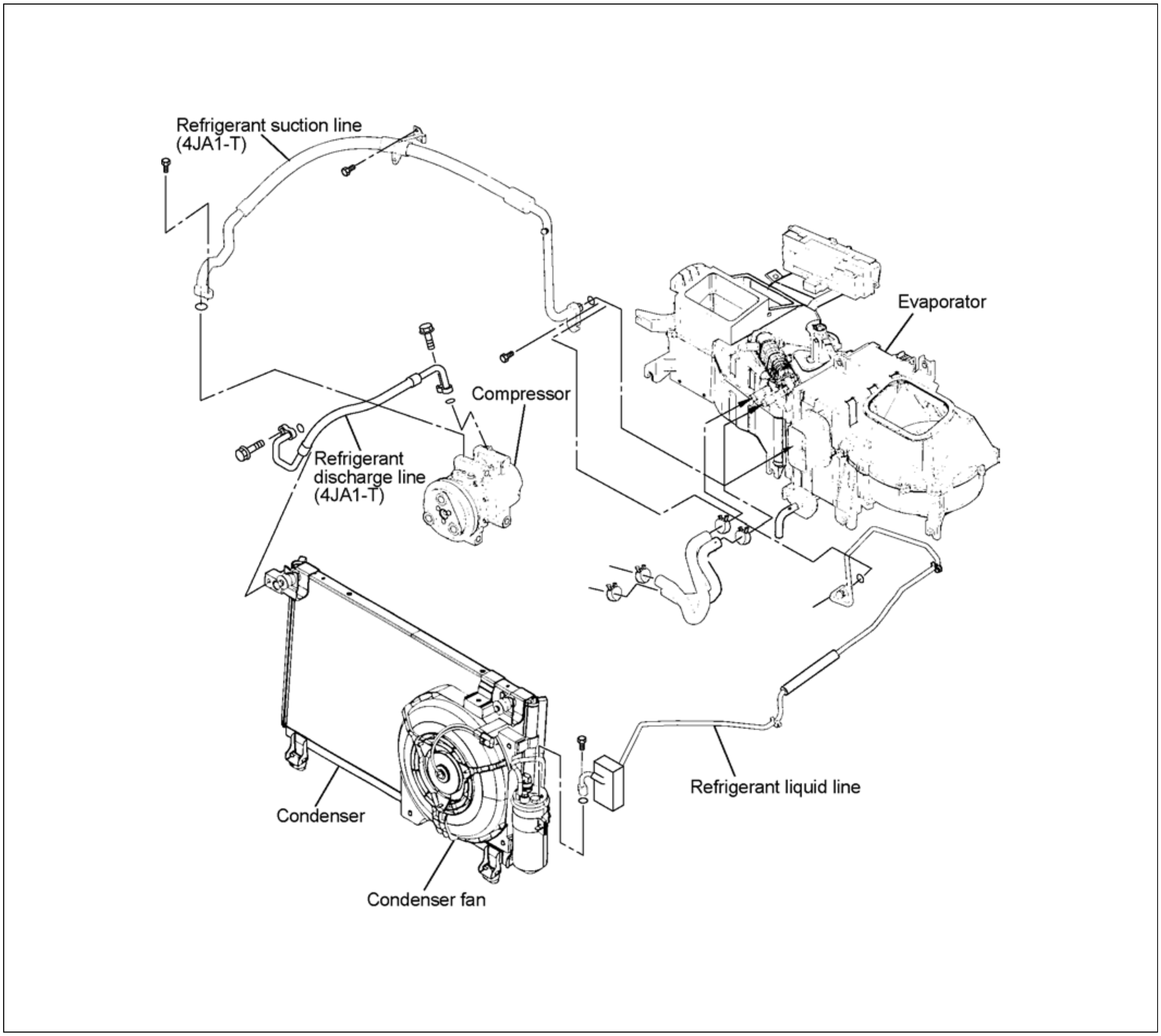
- MIL illumination request,
- vehicle speed,

- transmission fluid temperature,
- commanded gear status,
- TCC status, and
- torque reduction requests.

2 Wiring Diagrams and Connector Chart

For wiring diagrams and connector information, refer to 8A Electrica-Body and Chassis.

COMPONENTS (CHASSIS SIDE)
(4JA1-T RHD MODEL)



RTW710LF001901

5. NOISES

Checkpoint		Problem	Countermeasure
Upper and lower links bushings	NG	Worn	Replace
OK			
Shock absorber fixing nut and bolt	NG	Loose	Retighten
OK			
Stabilizer fixing nuts and bolts	NG	Loose	Retighten
OK			
Shock absorber	NG	Faulty	Replace
OK			
Lubricating oil and grease for upper and lower ball joint	NG	Insufficient	Replace
OK			
Upper and lower ball joint	NG	Damaged	Replace

Continued on the next page

3 Tech 2 Information

3.1 Tech 2 Diagnostics

Tech 2, with the appropriate software, cables and adapters, when connected to the serial data link connector (DLC) can read seat and exterior rear-view mirror serial data. The DLC is attached to the instrument panel trim retainer beneath the steering wheel.

1 DLC

2 DLC Adapter

3 DLC Cable

4 Tech 2

For additional general information on connecting and operating Tech 2, refer to 0C Tech 2.

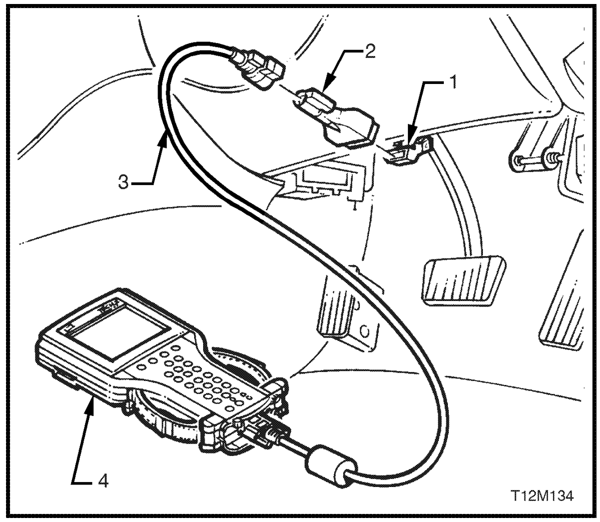


Figure 1A7 – 3

Test Modes

Tech 2 has six test modes for diagnosing the transmission. To get to these various test modes, on Tech 2 select:
Diagnostics / **Model Year** / **Model** / **Vehicle Type** / **Transmission** / **Automatic Transmission**
and follow Tech 2's prompts. This will then display the following menu operations.

Diagnostic Trouble Codes

If **Diagnostic Trouble Codes** is selected, a selection list is displayed which contains:

- **Read DTC Information** – Once selected, both current and history diagnostic trouble codes (DTCs) stored in the transmission control module will be displayed.
- **Clear Engine & Transmission DTC(s)** – Once selected, DTCs stored in the transmission control module (TCM) and engine control module (ECM) memory may be cleared.
- **Freeze Frame / Failure Records** – Shows Freeze Frame / Failure Records information. Freeze Frame / Failure Records are types of snapshots stored in the memory of the TCM and contain data parameters from the TCM at the time the DTC set.

NOTE

For a complete list of TCM DTCs, refer to 4.8 Diagnostic Trouble Code List. For further information on Tech 2 and it functions, refer to 0C Tech 2.

Data Display

If **Data Display** is selected, a selection list is displayed which contains:

- **Transmission Data** – Once is selected, a list of transmission components and the TCM inputs are displayed along with their status.
- **TCC Data** – Once selected, displays specific parameter information about the torque converter clutch controlling devices and their circuits.
- **1-2 Shift Data** – Once selected, displays specific parameter information about the 1-2 shift solenoid valve (shift solenoid A) and its circuits.

- **2-3 Shift Data** – Once this mode is selected, displays specific parameter information about the 2-3 shift solenoid valve (shift solenoid B) and its circuits.
- **3-4 Shift Data** – Once selected, displays information on 3-4 shift timing.
- **3-2 Downshift Data** – Once selected, displays information on 3-2 downshift timing.
- **Pressure Control Solenoid Data** – Once selected, displays specific parameter information about the PC solenoid and its circuits.
- **Transmission Adapts** – Once selected, it has further sub menus:
  - **1-2 Adapt Data** – In this mode Tech 2 continuously monitors and displays 1-2 TAP cell data parameters.
  - **2-3 Adapt Data** –In this mode Tech 2 continuously monitors and displays 2-3 TAP cell data parameters.
  - **3-4 Adapt Data** –In this mode Tech 2 continuously monitors and displays 3-4 TAP cell data parameters.
  - **Steady State Adapt Data** – In this mode Tech 2 continuously monitors and displays Steady State TAP data parameters.
- **System Identification:** In this mode, Tech 2 will display the transmission identification screen. The following items will be displayed; Identifier, Partnumber, Hardware Partnumber, Alpha Code, Software Version Number, Software Partnumber, VIN Digit 1-10, VIN Digit 11-17.

NOTE

Further information about the Data Display mode and the data parameter is contained in 3.2 Data Display.

Snapshot

In this test mode, Tech 2 captures TCM data before and after a forced manual trigger.

Additional Functions

If **Additional Functions** is selected, a selections list is displayed which contains:

- **System Identification**– In this mode, Tech 2 will display the transmission identification screen. The following items will be displayed; Identifier, Partnumber, Hardware Partnumber, Alpha Code, Software Version Number, Software Partnumber.

Miscellaneous Tests

If **Miscellaneous Functions** is selected, a selections list is displayed which contains:

- **TCC Solenoid** –Tech 2 can command the TCC solenoid on and off. Tech 2 will display whether the TCC solenoid is active or inactive.
- **TCC PWN Solenoid** – Tech 2 can command the TCC PWM solenoid on and off. Tech 2 will display whether the TCC PWM solenoid is active or inactive and torque percentage.
- **TCC Apply** – Tech 2 can command the TCC on when the vehicle is above 50 km/h.
- **Shift Solenoid A** – Tech 2 can command the shift solenoid A (1-2 shift solenoid) on and off.
- **Shift Solenoid B** – Tech 2 can command the shift solenoid B (2-3 shift solenoid) on and off.
- **3/2 Downshift Solenoid** – Tech 2 can command the 3/2 downshift solenoid (3-2 shift solenoid) on and off.
- **Gear Control** – Tech 2 can incrementally command shift solenoid states to correspond to relative gear states. The TCM will only allow single shift increments or decrements and does not allow a shift if it causes the engine RPM to exceed a calibrated limit.
- **Pressure Control Solenoid** – This function allows the user to control state of the pressure control solenoid in increments of 100 mA.

NOTE

For operating parameters of the Miscellaneous Test, refer to 3.4 Miscellaneous Tests.

Programming

If **Programming** is selected, a selection list is displayed which contains:

- **Reset TAP Cells** – This test allows the user to reset the Transmission Adapt (TAP) cells by pressing the **Reset** soft key.

NOTE

Upon resetting the TAP cells the TCM loses all learnt adaptive functions. When the vehicle is first driven after this, the shifts may be harsh. This harshness will ease as the TCM relearns the TAP cells.

3.2 Data Display

If **Data Display** is selected, a selection list is displayed which contains the following:

Transmission Data

Once this mode, a list of transmission components and the TCM inputs are displayed along with their status.

Transmission Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
Engine Torque	Nm	Varies
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies
Vehicle Speed	km/h	0
Commanded Gear	1,2,3,4	1
Shift Solenoid A	On / Off	Varies
Shift Solenoid B	On / Off	Varies
3-2 Downshift Solenoid	On/Off	On
Estimated Gear Ratio	Ratio	8.00:1
Speed Ratio	Ratio	8.00:1
Torque Converter Efficiency	Ratio	.00:1
TFP Switch A	Open 12 V / Closed 0 V	Varies
TFP Switch B	Open 12 V / Closed 0 V	Varies
TFP Switch C	Open 12 V / Closed 0 V	Varies
Engine Coolant Temperature	°C	Varies
Transmission Fluid Temp	°C	Varies
Transmission Hot Mode	On/Off	Off
PCS Actual Current	Amps	Varies (0.1 – 1.1 A)
PCS Desired Current	Amps	Varies (0.1 – 1.1 A)
PCS Duty Cycle	Percent	Varies

Tech 2 Parameter	Units Displayed	Typical Data Value
High Side Driver 1	N/A	N/A
TCC Solenoid	On / Off	Varies
TCC PWM Solenoid	Percent	0%
TCC Slip Speed	RPM	+/-50 RPM from Engine Speed
Transmission Range (TR)	Park/Neutral, Reverse, Drive4, Drive3, Drive2, Drive1 or Invalid	Park/Neutral
TR Switch A	Open 12 V / Closed 0 V	Varies
TR Switch B	Open 12 V / Closed 0 V	Varies
TR Switch C	Open 12 V / Closed 0 V	Varies
TR Switch P	Open 12 V / Closed 0 V	Varies
Latest Shift	Seconds	Varies
1-2 Shift Time	Seconds	Varies
2-3 Shift Time	Seconds	Varies
3-4 Shift Time	Seconds	Varies
Cruise Control	Active / Inactive	Varies
A/C Clutch	On / Off	Varies
Ignition Voltage	Volts	12-14 V
Shift Pattern	Normal / Power / Cruise	Varies
4 Wheel Drive Low	Active / Inactive	Inactive

TCC Data

Once this mode is selected, displays specific parameter information about the torque converter clutch controlling devices and their circuits.

TCC Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
TCC Solenoid	On / Off	Varies
TCC PWM Solenoid	Percent	0%
TCC Slip Speed	RPM	+/-50 RPM from Engine Speed
TCC Duty Cycle Circuit	Open or Shorted / Short to Battery / Okay	Okay
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies
Engine Torque	Nm	Varies
Vehicle Speed	km/h	0
Commanded Gear	1,2,3,4	1
Engine Coolant Temperature	°C	Varies

Tech 2 Parameter	Units Displayed	Typical Data Value
Transmission Fluid Temp	°C	Varies
Estimated Gear Ratio	Ratio	8.00:1
Transmission Hot Mode	On / Off	Off

1-2 Shift Data

Once this mode is selected, displays specific parameter information about the 1-2 shift solenoid valve and its circuits.

1-2 Shift Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
Shift Solenoid A	On / Off	Varies
Shift Solenoid B	On / Off	Varies
Commanded Gear	1,2,3,4	1
1-2 Shift Time	Seconds	Varies
1-2 Shift Error	Seconds	Varies
Shift Solenoid A Circuit	Open or Shorted / Short to Battery / Okay	Okay
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies
Vehicle Speed	km/h	0
Estimated Gear Ratio	Ratio	8.00:1

2-3 Shift Data

Once this mode is selected, displays specific parameter information about the 2-3 shift solenoid valve and its circuits.

2-3 Shift Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
Shift Solenoid A	On / Off	Varies
Shift Solenoid B	On / Off	Varies
Commanded Gear	1,2,3,4	1
2-3 Shift Time	Seconds	Varies
2-3 Shift Error	Seconds	Varies
Shift Solenoid B Circuit	Open or Shorted / Short to Battery / Okay	Okay
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies

Tech 2 Parameter	Units Displayed	Typical Data Value
Vehicle Speed	km/h	0
Estimated Gear Ratio	Ratio	8.00:1

3-4 Shift Data

Once this mode is selected, displays information on 3-4 shift timing.

3-4 Shift Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
Shift Solenoid A	On / Off	Varies
Shift Solenoid B	On / Off	Varies
Commanded Gear	1,2,3,4	1
3-4 Shift Time	Seconds	Varies
3-4 Shift Error	Seconds	Varies
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies
Vehicle Speed	km/h	0
Estimated Gear Ratio	Ratio	8.00:1

3-2 Downshift Data

Once this mode is selected, displays information on 3-2 downshift timing.

3-2 Downshift Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
3-2 Downshift Solenoid	On / Off	Varies
Commanded Gear	1,2,3,4	1
3-2 Downshift Solenoid Circuit	Open or Shorted / Short to Battery / Okay	Okay
Throttle Position	Percent	Varies
Engine Speed	RPM	Varies
AT Input Speed	N/A	N/A
AT Output Speed	RPM	Varies
Vehicle Speed	km/h	0
Estimated Gear Ratio	Ratio	8.00:1

Pressure Control Solenoid Data

Displays specific parameter information about the PC solenoid and its circuits.

Pressure Control Solenoid Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
PCS Actual Current	Amps	Varies (0.1 – 1.1 A)
PCS Desired Current	Amps	Varies (0.1 – 1.1 A)
PCS Duty Cycle	Percent	Varies
Engine Speed	RPM	Varies
Transmission Fluid Temp	°C	Varies
Throttle Position	Percent	Varies
Vehicle Speed	km/h	0
Commanded Gear	1,2,3,4	1

Transmission Adapts

Once this is selected, it has further sub menus.

1-2 Adapt Data

In this mode Tech 2 continuously monitors and displays 1-2 TAP cell data parameters.

1-2 Adapt Data Parameter

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
1-2 Shift Time	Seconds	Varies
1-2 Shift Error	Seconds	Varies
Current TAP Cell	4-16	Varies
Throttle Position	Percent	Varies
1-2 Tap Cell (1 – 17)	kPa	Varies

2-3 Adapt Data

In this mode Tech 2 continuously monitors and displays 2-3 TAP cell data parameters.

2-3 Adapt Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
2-3 Shift Time	Seconds	Varies
2-3 Shift Error	Seconds	Varies
Current TAP Cell	4-16	Varies
Throttle Position	Percent	Varies
2-3 Tap Cell (1 – 17)	kPa	Varies

3-4 Adapt Data

In this mode Tech 2 continuously monitors and displays 3-4 TAP cell data parameters.

3-4 Adapt Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
3-4 Shift Time	Seconds	Varies
3-4 Shift Error	Seconds	Varies
Current TAP Cell	4-16	Varies
Throttle Position	Percent	Varies
3-4 Tap Cell (1 – 17)	kPa	Varies

Steady State Adapt Data

In this mode TECH 2 continuously monitors and displays Steady State TAP data parameters.

Steady State Adapt Data Parameters

For definitions of the parameters in this table, refer to 3.3 Tech 2 Data Definitions.

Tech 2 Parameter	Units Displayed	Typical Data Value
Current TAP Cell	4-16	Varies
Throttle Position	Percent	Varies
Gear (1-4) TAP Cell	kPa	Varies
TCC (1-4) TAP Cell	kPa	Varies
Reverse Gear TAP Cell	kPA	Varies

3.3 Tech 2 Data Definitions

1-2 Shift Error: This parameter displays the difference between the desired 1-2 shift time and the actual 1-2 shift time. A positive number indicates a firm or fast shift and the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift and the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

1-2 Shift Time: This parameter displays the actual time of the last 1-2 shift. The shift time is based on the engine r.p.m. drop after the commanded 1-2 shift. This value is only accurate if the shift was adaptable.

1-2 TAP Cell (1-17): This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 Nm of engine torque increment per cell, added to or subtracted from shift pressure during a 1-2 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted to increase shift time.

2-3 Shift Error: This parameter displays the difference between the desired 2-3 shift time and the actual 2-3 shift time. A positive number indicates a firm or fast shift, the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift, the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

2-3 Shift Time: This parameter displays the actual time of the last 2-3 shift. The shift time is based on the engine r.p.m drop after the commanded 2-3 shift. This value is only accurate if the shift was adaptable.

2-3 TAP Cell (1-17): This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 Nm of engine torque increment per cell, added to or subtracted from shift pressure during a 2-3 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted to increase shift time.

3-4 Shift Error: This parameter displays the difference between the desired 3-4 shift time and the actual 3-4 shift time. A positive number indicates a firm or fast shift, the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift, the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

3-4 Shift Time: This parameter displays the actual time of the last 3-4 shift. The shift time is based on the engine r.p.m. drop after the commanded 3-4 shift. This value is only accurate if the shift was adaptable.

3-4 TAP Cell (1-17): This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 Nm of engine torque increment per cell, added to or subtracted from shift pressure during a 3-4 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted to increase shift time.

A/C Clutch: This parameter displays the condition of the sirconditioning compressor as either **On** or **Off**.

AT Output Speed: This parameter displays the rotational speed of the transmission output shaft. Tech 2 displays output shaft speed as revolutions per minute (RPM).

Commanded Gear: This parameter displays the current commanded state of the shift solenoid valves. Tech 2 displays **1**, **2**, **3** or **4**.

Current TAP Cell: This parameter displays the current transmission adaptive pressure (TAP) cell in use for transmission line pressure adaptation. The cells are based on 17 Nm of engine torque. The higher the engine torque, the higher the current TAP cell. The last cell used will remain displayed until the next adaptable upshift occurs.

Engine Coolant Temperature: This parameter displays the input signal from the engine coolant temperate (ECT) sensor. ECT is high at 151°C when the signal voltage is low, 0 V. ECT is low at -40°C when the signal voltage is high, 5 V.

Engine Speed: This parameter displays the rotational speed of the engine expressed as revolutions per minute.

Engine Torque: This parameter displays the calculated value based on engine load, throttle position, mass air flow, and other engine inputs. This parameter is accurate to within 20 Nm of actual measured engine torque.

Estimated Gear Ratio: This parameter displays the estimated turbine speed divided by the transmission output speed. Estimated turbine speed is calculated from engine speed and engine torque.

Ignition Voltage: This parameter displays the system voltage measured at the ignition feed.

Latest Shift: This parameter displays the actual time of the last upshift. This value is only accurate if the shift was adaptable.

PCS Actual Current: This parameter displays the current flow through the pressure control solenoid circuit, which is measured by the control module. High current flow results in low line pressure. Low current flow results in high line pressure.

PCS Duty Cycle: This parameter displays the commanded state of the pressure control solenoid, expressed as a percentage of energised on time. A reading of low percent indicates zero on time, non-energised, or no current flow. A high percent at idle indicates maximum on time, energised, or high current flow.

PCS Desired Current: This parameter displays the commanded current of the pressure control solenoid circuit. High current results in low line pressure. Low current results in high line pressure.

Shift Pattern: This parameter displays **Normal**, **Power** or **Cruise** depending on what mode the transmission is in.

Shift Solenoid A: This parameter displays the commanded state of the 1-2 shift solenoid valve. When the transmission is in 1^{st} and 4^{th} gear, the display should indicate **On**; current is flowing through the solenoid. When the transmission is in 2^{nd} and 3^{rd} gear, the display should indicate **Off**; current is not flowing through the solenoid.

Shift Solenoid A Circuit: This parameter displays whether an open or a short to ground, short to battery or the circuit is okay in the 1-2 shift solenoid valve feedback signal. The 1-2 shift solenoid valve must be commanded off and on.

Shift Solenoid B: This parameter displays the commanded state of the 2-3 shift solenoid valve. When the transmission is in 1^{st} and 4^{th} gear, the display should indicate **On**; current is flowing through the solenoid. When the transmission is in 2^{nd} and 3^{rd} gear, the display should indicate **Off**; current is not flowing through the solenoid.

Shift Solenoid B Circuit: This parameter displays whether an open or a short to ground, short to battery or the circuit is okay in the 2-3 shift solenoid valve feedback signal. The 2-3 shift solenoid valve must be commanded off and on.

Speed Ratio: This parameter displays the calculated speed ratio of the transmission.

TCC Duty Cycle Circuit: This parameter displays whether an open or a short to ground, short to battery or the circuit is okay in the TCC PWM solenoid valve feedback signal. The TCC PWM solenoid valve must be commanded off and on.

TCC Solenoid: This parameter displays the commanded sate of the TCC solenoid. **On** indicates a commanded energised state; current is flowing through the solenoid. **Off** indicates a commanded non-energised state; current is not flowing through the solenoid. This commanded state occurs at various vehicle speeds between applications.

TCC Slip Speed: This parameter displays the difference between transmission output speed and engine speed. A negative value indicates the engine speed is less than the output speed, deceleration. A positive value indicates the engine speed is greater than the output speed, acceleration. A value of zero indicates the engine speed is equal to the output speed, TCC applied.

TCC PWM Solenoid: This parameter displays the commanded percentage of on time for the TCC PWM solenoid. A high percentage represents an on, energised, commanded state.0 percent represents an off, non-energised, commanded state.

TFP Gear: This parameter displays **Park/Neutral**, **Reverse**, **Drive4**, **Drive3**, **Drive2**, **Drive1** or **Invalid**. This parameter is the decoded status of the three A/B/C inputs from the automatic transmission fluid pressure manual valve position switch. If a valid combination of inputs is not detected, invalid will be displayed.

TFP Swi A/B/C: This parameter displays **Open 12 V** / **Closed 0 V** for each switch. This parameter indicates the statues of the three inputs from the automatic transmission fluid pressure manual valve position switch assembly.

Throttle Position: This parameter displays a calculated value, which is determined by the accelerator pedal position and the actual throttle position, used to optimise transmission controls. It represents the driver's intended requested for torque or acceleration. The range is 0-100%, 0% represents an idle or coast request and 100% represents a request for wide open throttle (WOT).

Torque Converter Efficiency: This parameter displays a ratio of 0.00:1 to 2:1. The ratio is calculates by multiplying the speed ratio by a value related to the 'K factor' of the torque converter. The 'K factor' is the looseness or tightness of the torque converter for a given torque. The nearer the torque converter is to full coupling, i.e. 1:1, the closer the torque converter efficiency number will be to 1.

TR Switch A/B/C/P: This parameter displays the status of the four inputs from the transmission range switch. Tech 2 displays **Open 12V** / **Closed 0 V**. **Open 12 V** indicates an ignition voltage input to the control module. **Closed 0 V** indicates a zero voltage input to the control module.

Transmission Fluid Temperature: This parameter displays the input signal of the transmission fluid temperature sensor. Transmission fluid temperature is high, 151°C, when signal voltage is low, 0 V. Transmission fluid temperature is low, -40°C, when signal voltage is high, 5 V.

Transmission Hot Mode: This parameter displays the automatic transmission fluid temperature (TFT) and displays **On** or **Off**. **Off** indicates the TFT has not exceeded 130°C. **On** indicates the TFT has exceeded 130°C and has not cooled to 120°C for greater than 5 seconds. These numbers are approximate and differ with transmissions.

Vehicle Speed: This parameter displays the speed at which the vehicle is travelling. Tech 2 displays vehicle speed as kilometres per hour (km/h). The vehicle speed is calculates based on the input signal from the automatic transmission output shaft speed sensor.

3.4 Miscellaneous Tests

Tech 2 Miscellaneous Tests	Description

Shift Solenoid A	• The TCM commands the 1-2 shift solenoid valve on and off. Tech 2's Shift Solenoid A Parameter should match the commanded state. Tech 2's Commanded Gear parameter should correspond with the shift solenoid combination. Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.
	• When the ignition is on, and the engine is off, there no limits to this control. The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.
	• When the engine is running, the following control limits apply:
	  • Only sequential gear changes are allowed. For example, 1st to 3rd is not allowed. If a non-sequential gear change is attempted, the message **Non-sequential gear changes not allowed**. **Gear changes must be made in order** appears on Tech 2.
	  • The vehicle speed must be below a calibrated value. If the vehicle speed is too high, the message **Vehicle speed too high** appears on Tech 2.
	  • The engine speed must be below a calibrated value. If the engine speed is too high, the message **Engine speed too high** appears on Tech 2.
	  • Downshifts are allowed only when the vehicle speed is below a calibrated value. If the vehicle speed is too high, the message **Eng. is on and veh. speed to hi for 3-2 or 2-1 downshift** appears on Tech 2.
	  • The gear requested may not be greater than the current selected transmission range (PRNDL). For example, 3rd gear is not allowed if the transmission range is D2. If the gear requested is greater than the current selected transmission range, the message **Eng. running and gear request is greater than the current TR** appears on Tech 2.
	  • The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.

Continued from the previous page

Checkpoint		Problem	Countermeasure
Tire pressure	NG	Improper	Adjust
OK			
Steering linkage and steering gear	NG	Worn	Replace
OK			
Front wheel bearing	NG	Incorrect adjustment or abrasion	Adjust or replace
OK			
Steering unit fixing bolts and linkage	NG	Loose	Retighten
OK			
Lubricating oil and grease to steering linkage	NG	Insufficient	Replace

Shift Solenoid B	• The TCM commands the 2-3 shift solenoid valve on and off. Tech 2's Shift Solenoid B parameter should match the commanded state. Tech 2's Commanded Gear parameter should correspond with the shift solenoid combination. Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.
	• When the ignition is on, and the engine is off, there no limits to this control. The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.
	• When the engine is running, the following control limits apply:
	  • Only sequential gear changes are allowed. For example, 1st to 3rd is not allowed. If a non-sequential gear change is attempted, the message **Non-sequential gear changes not allowed. Gear changes must be made in order** appears on Tech 2.
	  • The vehicle speed must be below a calibrated value. If the vehicle speed is too high, the message **Vehicle speed too high** appears on Tech 2.
	  • The engine speed must be below a calibrated value. If the engine speed is too high, the message **Engine speed too high** appears on Tech 2.
	  • Downshifts are allowed only when the vehicle speed is below a calibrated value. If the vehicle speed is too high, the message **Eng. is on and veh. speed to hi for 3-2 or 2-1 downshift** appears on Tech 2.
	  • The gear requested may not be greater than the current selected transmission range (PRNDL). For example, third gear is not allowed if the transmission range is D2. If the gear requested is greater than the current selected transmission range, the message **Eng. running and gear request is greater than the current TR** appears on Tech 2.
	  • The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.

3-2 Downshift Solenoid	• The TCM commands the 3-2 shift solenoid valve on and off. Tech 2's 3-2 Downshift Sol. parameter should match the commanded state.
	• When the ignition is on, and the engine is off, there are no limits to this control. The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.
	• When the engine is running, the following control limits apply:
	  • The transmission range (PRNDL) must be Park or Neutral. If the transmission range is not in Park or Neutral, the message :**Engine running and transmission range is not Park/Neutral** appears on Tech 2.
	  • The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.

Clear TAPS (Transmission Adaptive Pressures)	• The TCM clears (or resets) the TAP cells to the original base value. • There are no limits to using this test. It may be performed with the engine running or when the ignition is on, and the engine is off.

<table>
<tr><td>PC Solenoid</td><td>

The TCM commands the current to the pressure control solenoid to control transmission line pressure. As the current increases, the line pressure decreases. As the current decreases, the line pressure increases. The current range is 0.00 – 1.10 A and may be commanded in one-tenth of an amp increments.
When the ignition is on, and the engine is off, the reference (commanded) amperage may be controlled within calibrated limits. Tech 2's parameter PCS Desired Current changes by the parameter PCS Actual Current does not change. The reference current remains until commanded otherwise.
When the engine is running, the following control limits apply:

When the transmission range is Park or Neutral, the reference (commanded) current may be controlled within calibrated limits. The engine speed must be less than 1,500 r.p.m. If the engine speed is great than 1,500 r.p.m, the message TR in park/neutral and engine speed over 1,500 RPM appears on Tech 2. Both Tech 2 parameters PCS Desired Current and PCS Actual Current parameters change. Both current readings remain until commanded otherwise.
When the transmission range is not in Park or Neutral, the reference current can only be controlled less than the current determined by the TCM. The TCM does not allow a value to be selected that may cause damage to the transmission. If the requested amperage is more than allowed by the TCM, the message Requested current for the PC Solenoid is too high appears on Tech 2.
Transmission range DTCs must not be active. If a transmission range DTC is active, the message Engine running with transmission DTC present appears on Tech 2.

</td></tr>
<tr><td>Gear Control</td><td>

The TCM commands upshifts and downshifts. Tech 2's Commanded Gear parameter should correspond with the shift solenoid combination. Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.
When the ignition is on, and the engine is off, there are no limits to this control. The Tech 2 shift solenoid states changes to match the Commanded Gear selected.
When the engine is running, the following control limits apply:

The TCM does not allow a shift if it causes the engine r.p.m. to exceed a calibrated limit. If a gear is requested and the engine speed is too high, the message Engine speed too high appears on Tech 2.
The TCM does not allow a 3-2 or 2-1 downshift if the vehicle speed exceeds a calibrated limit. If either downshift is requested and the vehicle speed is too high, the message Eng. is on and veh. Speed too hi for 3-2 or 2-1 downshift appears on Tech 2.
The TCM does not allow a 4-3 downshift if this vehicle speed exceeds a calibrated limit. If a 4-3 downshift is requested and the vehicle speed is too high, the message Vehicle speed to high appears on Tech 2.
The TCM does not allow an upshift if the vehicle speed exceeds a calibrated limit. If an upshift is requested and the vehicle speed is too high, the message Vehicle speed to high appears on Tech 2.
The TCM does not allow an upshift that is greater than the current selected transmission range (PRNDL). For example 3rd gear is not allowed if the transmission range is D2. If an upshift is requested that is greater than the current selected transmission range, the message Eng. running and gear request is greater than the current TR appears on Tech 2.

</td></tr>
</table>

TCC Control Solenoid	• The TCM commands the duty cycle of the TCC PWM solenoid. The duty cycle is represented by a percentage of on (energised) time. Approximately 90-100 percent duty cycle represents an on (energised) commanded state. Zero percent represents an off (non-energised) commanded state. Tech 2 TCC PWM Solenoid parameter should match the commanded state.
	• When the ignition is on, and the engine is off, there are no limits to this control. The solenoid remains on (90-100 percent duty cycle) until commanded off (zero percent duty cycle), and vice versa. When the test is exited, the solenoid duty cycle is determined by the TCM.
	• When the engine is running, the following control limits apply:
	  • If the transmission range is Park, and the transmission is in hot mode, the TCC control solenoid may not be commanded off. If the solenoid is requested off, the message **TCC OFF command disabled in Hot Mode** appears on Tech 2.
	  • The TCC control solenoid may not be commanded off for more than a calibrated amount of time. If the solenoid is commanded off for a certain amount of time, the message **TCC OFF time has been exceeded** appears on Tech 2.

TCC Apply	• The TCM commands the TCC enable solenoid valve on and off. Tech 2's TCC Solenoid parameter should match the commended state.
	• When the ignition is on, and the engine is off, there are no limits to this control. The solenoid remains on until commanded off, and vice versa. When the test is exited, the solenoid state is determined by the TCM.
	• When the engine is running, the following control limits apply:
	  • If the transmission range is Park or Neutral, the TCC enable solenoid may not be commanded off for more than a calibrated amount of time. If the solenoid is commanded off for a certain amount of time, the message **TCC OFF time has been exceeded** appears on Tech 2.
	  • If the transmission range is Park or Neutral and the TCC control solenoid duty cycle is less than maximum capacity, the TCC solenoid may not be commanded on. If the solenoid is requested on during these conditions, the message **TCC Control Solenoid is not set to maximum Pressure** appears on Tech 2.
	  • If the TCC control solenoid duty cycle is less than maximum capacity, the TCC solenoid may not be commanded on. If the solenoid is commanded on during these conditions the message **TCC Control Solenoid is not set to maximum Pressure** appears on Tech 2.
	  • If the transmission is in hot mode, the TCC solenoid may not be commanded off. If the solenoid is requested off the message **TCC OFF command disabled in Hot Mode** appears on the scan tool display.

4 Diagnostics

4.1 Introduction

The transmission diagnostic procedure is organised in a logical structure that begins with the diagnostic system check and as such must always be used as the starting point. The diagnostic system check directs the technician to the logical steps necessary to diagnose a transmission driveability fault condition.

4.2 Basic Knowledge Required

CAUTION

A lack of basic understanding regarding electronics, electrical wiring circuits and use of electrical circuit testing tools when performing any diagnostic procedure, could result in incorrect diagnostic results or damage to system components.

Understanding of the following is required to perform any of the diagnostic procedures detailed in this Service Information:

- Basic electronics,
- Electrical wiring circuits,
- Electrical circuits testing, and
- Correct use of basic system diagnostic tools.

4.3 Diagnostic Precautions

CAUTION

When tests are required on connector terminals, use the adapters in connector adaptor kit J35616-C to prevent damage to terminals.

The following precautions must be observed when performing all diagnostic procedures. Otherwise, incorrect diagnostic results or damage to system components will occur:

1 Disconnection of the battery affects certain vehicle electronic systems.

2 Disconnect the battery negative lead when performing the following procedures:

   - Disconnecting the electronic control module wiring harness connector/s or
   - Charging the battery.

3 Disconnect the battery terminal ground lead and the electronic control module wiring harness connector before attempting any electric arc welding on the vehicle.

4 Do not start the engine if the battery terminal is not properly secured to the battery.

5 Do not disconnect or reconnect any of the following while the ignition is switched on or when the engine is running:

   - Any electronic control module or system component electrical wiring connector, or
   - Battery terminal leads.

6 Ensure that the correct procedure for disconnecting and connecting system electrical wiring harness connectors is always followed. For information on the correct procedure for disconnecting and connecting specific wiring connectors, refer to 8A Electrical-Body and Chassis.

7 Ensure that all wiring harness connectors are fitted correctly and secure.

8 When steam or pressure cleaning vehicle components, such as engines, transmissions, etc., do not direct the cleaning nozzle at any system electrical wiring harness connectors or components.

9 Do not clear any DTCs unless instructed.

10 The fault must be present when using the Diagnostic Trouble Code (DTC) Diagnostic Tables. Otherwise, misdiagnosis or replacement of good parts may occur.

11 Do not touch any electronic control module connector pins or soldered components on the circuit board. This is required to avoid the possibility of electrostatic discharge damage.

12 Use only the test equipment specified in the diagnostic tables, as other test equipment may give incorrect results or damage good components.

13 Electronic control modules are designed to withstand normal current draws associated with vehicle operation. However, the following fault conditions or incorrect test procedure may overload internal control module circuits and irreparably damage the control module:

- A short to voltage fault condition in any of the control module low reference circuits may cause internal and/or sensor damage. Therefore, any short to voltage fault condition in the control module low reference circuits must be rectified before replacing a faulty component.
- A short to ground fault condition in any of the control module 5 volts reference circuits may cause internal control module and/or sensor damage. Therefore, any short to ground fault condition in the control module 5 volt reference circuits must be rectified before replacing a faulty component.
- When using a test light to test an electrical circuit, do not use any of the control module low reference circuits or 5 volts reference circuits as a reference point. Otherwise, excessive current draw from the test light may damage the control module.

14 Disregard DTCs that set while performing the following diagnostic Steps:

- Using the Tech 2 output control function, or
- Disconnecting a control module system sensor connector then switching the ignition ON.

15 After completing the required diagnostics and service operations, road test the vehicle to ensure correct system operation.

4.4 Preliminary Checks

The Preliminary Checks is a set of visual and physical checks or inspections that may quickly identify a control module system fault condition:

1 Refer to relevant Service Techlines for information regarding the fault condition.

2 Ensure that the battery is fully charged.

3 Inspect the battery connections for corrosion or a loose terminal.

4 Ensure that all relevant control module system related fuses are serviceable.

5 Inspect for incorrect aftermarket theft deterrent devices, lights or mobile phone installation.

6 Ensure that there is no speaker magnet positioned too close to any electronic module that contains relays.

7 Inspect the system wiring harness for proper connections, pinches or cuts.

8 Ensure that all control module related electrical wiring connectors are fitted correctly.

9 Inspect the control module ground connections for corrosion, loose terminal or incorrect position.

10 Ensure that the resistance between the control module housing and the battery ground cable is less than 0.5 ohms.

11 Check that the control module and its mounting bracket is secure.

12 Check all control module related components for correct installation.

13 Check the control module and related wiring harness routing to ensure that no rubbing or cutting of the wiring harness by sharp body components can occur.

4.5 Diagnostic Trouble Code Tables

The diagnostic system check and the DTC list, directs the technician to the appropriate diagnostic trouble code (DTC) tables if there is a DTC currently stored in the TCM.

The diagnostic tables locate a faulty circuit or component through a logic based on the process of elimination. These diagnostic tables are developed with the following assumptions:

- the vehicle functioned correctly at the time of assembly,
- there are no multiple faults, and
- the problem currently exists.

Understanding and the correct use of the diagnostic tables are essential to reduce diagnostic time and to prevent misdiagnosis.

Multiple DTCs Fault Condition

Some fault conditions trigger multiple component DTCs even if the fault condition exists only on a single component. If there are multiple DTCs stored in the TCM, the service technician must view and record all DTCs logged.

Relationship between the logged DTCs can then be analysed to determine the source of the fault condition. Always begin the diagnostic process with the DTC table of the fault condition that may trigger other DTCs to set.

The following fault conditions may trigger multiple DTCs:

- a fault in the serial data communication circuit,
- a system voltage that is too low may cause incorrect transmission tem operation or transmission component malfunction,
- a system voltage that is too high may damage the TCM and/or other components,
- fault condition in the TCM Read Only Memory (ROM) or Random Access Memory (RAM),
- fault condition in the TCM internal circuitry or programming, or
- improperly connected sensor or component wiring connector.

If there are no obvious faults to begin a multiple DTC fault condition diagnostic procedure, refer to the Conditions for Running the DTC in each diagnostic.

4.6 Diagnostic Trouble Code Definitions

The TCM constantly performs self-diagnostic tests on the transmission and it components. When the TCM detects a fault condition in the transmission operating parameters, the TCM sets a DTC to represents that fault condition. The following are the types of DTCs programmed in the TCM. In addition, DTCs are classified as either Current or History DTC.

- Type A – Emission Related DTCs,
- Type B – Emission Related DTCs, and
- Type C – Non-emission Related DTCs.

NOTE

Depending on the type of DTC set, the TCM may command the malfunction indiciator lamp (MIL) to display on the instrument cluster and warn the driver there is a fault in the transmission. Refer to the RA Rodeo Owner Manual for further information on the MIL.

Type A – Emission Related DTCs

The TCM takes the following action when a Type A DTC runs and fails:

- sets a current Type A DTC that represents the fault condition,
- illuminates the MIL, and

- records the operating condition at the time the diagnostic fails and stores this information in the Freeze Frame/ Failure Record.

Type B – Emission Related DTCs

The TCM takes the following actions when a Type B DTC runs and fails.

- On the first time a Type B DTC fails:
  - sets a current Type B DTC that represents the fault condition, and
  - records the operating conditions at the time the fault sets and stores this information in the Failure Records.
- On the second consecutive ignition cycle that a Type B DTC fails:
  - illuminates the MIL, and
  - records the operating condition at the time the diagnostic fails and stores this information in the Freeze Frame/ Failure Record.

Conditions for Clearing Type A or Type B DTCs

- The current DTC clears when there is no fault condition in the current TCM self-diagnostics.
- If there are no DTCs logged after six consecutive ignition cycles, the TCM deactivates the MIL.
- Type A or Type B History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.
- Use of Tech 2 to clear DTCs.

Type C – Non-emission Related DTCs

The TCM takes the following action when a Type C DTC runs and fails:

- sets a current Type C DTC that represents the fault condition,
- records the operating conditions at the time the DTC is logged and stores this information in the Failure Record, and

NOTE

The MIL does not illuminate when a Type C DTC sets.

Conditions for Clearing Type C DTCs

- The current DTC clears when there is no fault condition in the current TCM self-diagnostics.
- Type C History DTC clears when there is no fault condition after 40 consecutive warm-up cycles.
- Use of Tech 2 to clear DTCs.

Current DTCs

A DTC is a Current DTC if the fault condition that triggers the DTC is present during the last TCM self-diagnostics.

History DTCs

A DTC is a History DTC if the fault condition that triggers the DTC is not present during the last TCM self-diagnostics.

4.7 Diagnostic System Check

Description

This section procedure is organised in a logical structure that begins with the diagnostic system check. The diagnostic system check directs you in a logical direction to the appropriate Section or diagnostic procedure.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

1 Within this document there are a number of requirements that must be met before you can start diagnosis. Refer to 4.2 Basic Knowledge Required, 4.3 Diagnostic Precautions and 4.4 Preliminary Checks.

2 Checks if there is data communication between Tech 2 and the TCM.

3 Checks if the TCM has set any DTCs. If no DTCs have set, the functional test must be performed, which diagnoses the hydro-mechanical functions of the transmission.

Step	Action	Yes	No
1	Have you read the Basic Diagnostic Requirements, Diagnostic Precautions and Preliminary Checks?	Go to Step 3	Refer to Note 1
2	1 Connect Tech 2 to the DLC. 2 On Tech 2 select: **Transmission** / **Automatic Transmission** and follow the instruction on Tech 2. Does Tech 2 display the TCM specifications?	Go to Step 4	Refer to 6E1 Powertrain Interface Module
3	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information** Does Tech 2 display any DTCs?	Go to 4.8 Diagnostic Trouble Code List	Perform the Functional Test, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis

4.8 Diagnostic Trouble Code List

NOTE

If the DTC listed on Tech 2 is not contained in this list, refer to OD Vehicle Diagnostics.

DTC	Type	Description	Diagnostic Table
P0218	C	Transmission Fluid Overtemperature	4.9 DTC P0218 – Transmission Fluid Overtemperature
P0562	C	System Voltage Low	4.10 DTC P0562 – System Voltage Low
P0563	C	System Voltage High	4.11 DTC P0563 – System Voltage High
P0601	A	Transmission Control Module (TCM) Read Only Memory (ROM)	4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction
P0602	A	Transmission Control Module (TCM) Not Programmed	4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction
P0603	A	Transmission Control Module (TCM) Random Access Memory (RAM)	4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction
P0604	A	Transmission Control Module (TCM) Long Term Memory Performance	4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction
P0711	C	Transmission Fluid Temperature (TFT) Sensor Performance	4.13 DTC P0711 to P0713 – Transmission Fluid Temperature Sensor
P0712	C	Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage	4.13 DTC P0711 to P0713 – Transmission Fluid Temperature Sensor

DTC	Type	Description	Diagnostic Table
P0713	C	Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage	4.13 DTC P0711 to P0713 – Transmission Fluid Temperature Sensor
P0719	C	Brake Switch Circuit High Input (Stuck On)	4.14 DTC P0719 – Brake Switch Circuit High Input (Stuck On)
P0722	B	Vehicle Speed Sensor Circuit Low Voltage	4.15 DTC P0722 – Vehicle Speed Sensor Circuit Low Voltage
P0723	B	Vehicle Speed Sensor Circuit Intermittent	4.16 DTC P0723 – Vehicle Speed Sensor Circuit Intermittent
P0724	C	Brake Switch Circuit Low Input (Stuck Off)	4.17 DTC P0724 – Brake Switch Circuit Low Input (Stuck Off)
P0741	B	Torque Converter Clutch (TCC) System – Stuck Off	4.18 DTC P0741 – Torque Converter Clutch System – Stuck Off
P0742	B	Torque Converter Clutch (TCC) System – Stuck On	4.17 DTC P0724 – Brake Switch Circuit Low Input (Stuck Off)
P0751	B	1-2 Shift Solenoid (SS) Valve Performance – No First or Fourth Gear	4.20 DTC P0751 – 1-2 Shift Solenoid Valve Performance – No First or Fourth Gear
P0752	B	1-2 Shift Solenoid (SS) Valve Performance – No Second or Third Gear	4.21 DTC P0752 – 1-2 Shift Solenoid Valve Performance – No Second or Third Gear
P0756	A	2-3 Shift Solenoid (SS) Valve Performance – No First or Second Gear	4.22 DTC P0756 – 2-3 Shift Solenoid Valve Performance – No First or Second Gear
P0757	A	2-3 Shift Solenoid (SS) Valve Performance - No Third or Fourth Gear	4.23 DTC P0757 – 2-3 Shift Solenoid Valve Performance – No Third or Fourth Gear
P0787	A	3-2 Shift Solenoid (SS) Control Circuit Low Voltage	4.24 DTC P0787 – 3-2 Shift Solenoid Control Circuit Low Voltage
P0788	A	3-2 Shift Solenoid (SS) Control Circuit High Voltage	4.25 DTC P0788 – 3-2 Shift Solenoid Control Circuit High Voltage
P0894	B	Transmission Component Slipping	4.26 DTC P0894 – Transmission Component Slipping
P0961	C	Line Pressure Control (PC) Solenoid System Performance	4.27 DTC P0961 – Line Pressure Control Solenoid System Performance
P0973	B	1-2 Shift Solenoid (SS) Control Circuit Low Voltage	4.28 DTC P0973 – 1-2 Shift Solenoid Control Circuit Low Voltage
P0974	B	1-2 Shift Solenoid (SS) Control Circuit High Voltage	4.29 DTC P0974 – 1-2 Shift Solenoid Control Circuit High Voltage
P0976	A	2-3 Shift Solenoid (SS) Control Circuit Low Voltage	4.30 DTC P0976 – 2-3 Shift Solenoid Control Circuit Low Voltage
P0977	A	2-3 Shift Solenoid (SS) Control Circuit High Voltage	4.31 DTC P0977 – 2-3 Shift Solenoid Control Circuit High Voltage
P1621	A	Transmission Control Module (TCM) Long Term Memory Performance	4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction
P1810	B	Transmission Fluid Pressure (TFP) Position Switch Circuit	4.32 DTC P1810, P1815 and P1816 – Transmission Fluid Pressure Position Switch
P1815	B	Transmission Fluid Pressure (TFP) Valve Position Switch - Start in Wrong Range	4.32 DTC P1810, P1815 and P1816 – Transmission Fluid Pressure Position Switch

DTC	Type	Description	Diagnostic Table
P1816	B	Transmission Fluid Pressure (TFP) Valve Position Switch Indicates Park/Neutral (P/N) with Drive Ratio	4.32 DTC P1810, P1815 and P1816 – Transmission Fluid Pressure Position Switch
P2763	B	Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit High Voltage	4.33 DTC P2763 – Torque Converter Clutch Pressure Control Solenoid Control Circuit High Voltage
P2764	B	Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit Low Voltage	4.34 DTC P2764 – Torque Converter Clutch Pressure Control Solenoid Control Circuit Low Voltage
P2769	B	Torque Converter Clutch (TCC) Enable Solenoid Control Circuit Low Voltage	4.35 DTC P2769 – Torque Converter Clutch Enable Solenoid Control Circuit Low Voltage
P2770	B	Torque Converter Clutch (TCC) Enable Solenoid Control Circuit High Voltage	4.36 DTC P2770 – Torque Converter Clutch Enable Solenoid Control Circuit High Voltage
U0073	B	ECM CAN Bus Error	4.37 DTC U0073 and U0100 – CAN-Bus No Communication With ECM (Engine Control Module)
U0100	B	ECM CAN Bus Error	4.37 DTC U0073 and U0100 – CAN-Bus No Communication With ECM (Engine Control Module)

4.9 DTC P0218 – Transmission Fluid Overtemperature

DTC Description

This diagnostic procedure supports DTC P0218 Transmission Fluid Overtemperature.

Circuit Description

The flow of transmission fluid starts in the bottom pan and is drawn through the filter, control valve body assembly, transmission case and into the oil pump assembly. The oil pump assembly pressurises the fluid and directs it to the pressure regulator valve where it becomes the main supply of fluid to the various components and hydraulic circuits in the transmission. Hot fluid exiting the torque converter flows through the converter clutch apply valve and into the transmission cooler lines, to the oil cooler located in the vehicle radiator, and auxiliary cooler if equipped. From the cooler, fluid returns to cool and lubricate the front of the transmission. In forward drive ranges, D4 fluid from the manual valve is routed through an orificed cup plug in the rear of the transmission case to feed the rear lube fluid circuit.

When the transmission control module (TCM) detects a high transmission fluid temperature (TFT) for a long period of time, DTC P0218 sets. DTC P0218 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0711, P0712 or P0713.
- The ignition switch is on for 5 seconds.

Conditions for Setting the DTC

The TFT is greater than 130°C for 600 seconds (10 minutes).

Action Taken When the DTC Sets

- The TCM does not request the ECM to illuminate the MIL.
- The TCM freezes transmission adapt functions.

6. EXCESSIVE STEERING WHEEL PLAY

Checkpoint		Problem		Countermeasure
Upper, and lower links, bushing (4 × 2 Except high ride suspension)	NG	Worn		Replace
OK				
Steering linkage	NG	Worn		Replace
OK				
Front wheel bearing	NG	Incorrect adjustment or abrasion		Adjust or replace

- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as Failure Records.
- The TCM stores DTC P0218 in TCM history.

Conditions for Clearing the DTC

- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the fault no longer exists and the DTC passes.

Diagnostic Aids

- Tech 2's **Transmission Fluid Temp.** should rise steadily to a normal operating temperature, then stabilise.
- Ask about the customer's driving habits, trailer towing, etc. Trailer towing should occur in D3.
- Refer to Symptoms - Automatic Transmission in 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Low transmission fluid can cause the transmission to overheat.

3 This step inspects for airflow restrictions or damage, which may result in the transmission overheating.

4-5 Decreased line pressure will cause the transmission to overheat. The torque converter stator is the pump for the transmission fluid. If the torque converter is damaged, it may not be producing the required pressure.

DTC P0218 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Inspect for correct transmission fluid level, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you perform the fluid checking procedure?	Go to Step 3	Perform the transmission fluid checking procedure, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing

Step	Action	Yes	No
3	1 Inspect the engine cooling system and transmission cooling system for the following conditions: • Air flow restrictions • Air flow blockage • Debris 2 Inspect the transmission cooling system for damaged cooler lines. 3 Check the flow rate of the transmission fluid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you find and correct the condition?	Go to Step 6	Go to Step 4
4	Test for correct line pressure, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. Did you find and correct the condition?	Go to Step 6	Go to Step 5
5	Diagnose the torque converter stator, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. Did you find and correct the condition?	Go to Step 6	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
6	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Start and idle the engine until it reaches normal operating temperature. 4 On Tech 2 select: **Data Display** / **Transmission Data.** 5 Drive the vehicle for 10 minutes. 6 On Tech 2, monitor the **Transmission Fluid Temp.** and ensure it has stabilised and is less than 129°C. 7 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0218 set?	Go to Step 2	Go to Step 7
7	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.10 DTC P0562 – System Voltage Low

DTC Description

This diagnostic procedure supports DTC P0562 System Voltage Low.

Circuit Description

The transmission control module (TCM) continuously monitors the system voltage on the battery and ignition circuits. Lower than normal voltage may be inadequate to operate the transmission control solenoids properly. Improper solenoid operation may cause erratic transmission operation and tie-up conditions, which may result in internal damage.

When the TCM detects low voltage, DTC P0562 sets. DTC P0562 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

The engine speed is greater than 1,200 r.p.m.

Conditions for Setting the DTC

The TCM detects system voltage less than 11 V for 10 seconds.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM records this information as a Failure Record.
- The TCM stores DTC P0562 in TCM history.

Conditions for Clearing the DTC

- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- Tech 2 can clear the DTC.

Diagnostic Aids

- Observe the instrument cluster's multi-function display messaging that would indicate the electrical system requires service.
- Inspect for the following conditions:
  - Loose or damaged terminals at the generator, and
  - Loose or worn generator drive belt.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 The alternator warning indicator will illuminate if there is a problem with the charging system of the vehicle.

4 Checks the charging system voltage with a nominal load.

5 Checks if the ignition voltage measurement reported by the TCM is within acceptable parameters.

7 Checks if there is battery voltage supplied to the TCM.

8 Checks if there is battery voltage supplied through the ignition circuit to the TCM.

9 Checks the ground circuits of the TCM.

DTC P0562 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Using a multimeter set to measure voltage, probe across the battery terminals. Does the multimeter display greater than 11 V?	Go to Step 3	Check the serviceability of the battery, refer to 8A Electrical-Body and Chassis
3	1 Start the engine. 2 Allow the engine to warm up to normal operating temperature. Is the alternator fail warning indicator illuminated?	Refer to 6D1-1 Charging system – V6	Go to Step 4
4	1 Turn on the high beam headlamps. 2 Turn the HVAC fan control to the highest speed setting. 3 Turn on the rear window demister. 4 Increase the engine speed to 1,500 r.p.m. 5 Using a multimeter set to measure voltage, probe across the battery terminals. Does the multimeter display 12.5 – 14.5 V?	Go to Step 5	Refer to 6D1-1 Charging system – V6
5	1 Increase the engine speed to 1,500 r.p.m. 2 On Tech 2 select: **Data Display** / **Transmission Data** Does Tech 2 display the **Ignition Voltage** parameter within 12.5 – 14.5 V?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 6
6	Check the fuses EB-4 and C-8 for serviceability. Are the fuses serviceable?	Go to Step 7	Replace the affected fuse(s). If the fuse(s) blow again, check for a short to ground in the fuses circuit Go to Step 13
7	1 Turn off the ignition. 2 Disconnect the TCM connector C-96. 3 Using a multimeter set to measure voltage, probe between connector C-96 pin 32 and a known ground. Does the multimeter display battery voltage?	Go to Step 8	Check measured circuits for an open, high resistance or short to ground Repair or replace the affected circuit

Step	Action	Yes	No
8	1 Using a multimeter set to measure voltage, probe between connector C-96 pin 31 and a known ground. 2 Turn on the ignition, with the engine off. Does the multimeter display battery voltage?	Go to Step 9	Check measured circuits for an open, high resistance or short to ground Repair or replace the affected circuit
9	Using a multimeter set to measure resistance, probe between connector C-96 pin 49 and a known ground. Does the multimeter display continuity?	Got to Step 10	Check measured circuit for an open or high resistance Repair or replace affected circuit
10	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Is the action complete?	Go to Step 11	—
11	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Operate the vehicle under the following conditions: a Start the engine. b Allow the engine to warm up to normal operating temperature. c Raise the engine speed to at least 1,200 r.p.m. d TCM voltage must be greater than 11 V for 12 seconds. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0562 set?	Go to Step 2	Go to Step 12
12	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.11 DTC P0563 – System Voltage High

DTC Description

This diagnostic procedure supports DTC P0563 System Voltage High.

Circuit Description

The transmission control module (TCM) continuously monitors the system voltage on the battery and ignition circuits. Higher than normal voltage may cause the solenoids inside the transmission to operate improperly or damage solid-state components inside the TCM.

When the TCM detects high voltage, DTC P0563 sets. DTC P0563 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

The ignition is on.

Conditions for Setting the DTC

The TCM detects system voltage greater than 18 V for 10 seconds.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM records this information as a Failure Record.
- The TCM stores DTC P0563 in TCM history.

Conditions for Clearing the DTC

- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- Tech 2 can clear the DTC.

Diagnostic Aids

- Observe the instrument cluster's multi-function display for messaging that would indicate the electrical system requires service.
- Use Tech 2 to inspect all other modules for voltage related DTCs.
- Running the engine with a battery charger attached may cause DTC P0563 to set.
  - Inspect the charging circuit for high resistance.
  - Inspect the vehicle battery for open or sulphated cells.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 The alternator warning indicator will illuminate if there is a problem with the charging system of the vehicle.

4 Checks the charging system voltage with a minimal load.

5 Checks if there is a difference between the Tech 2 reading and the voltage measure in an earlier step.

DTC P0563 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0562 set?	Refer to 4.10 DTC P0562 – System Voltage Low	Go to Step 3
3	1 Start the engine. 2 Allow the engine to warm up to normal operating temperature. Is the alternator fail warning indicator illuminated?	Refer to 6D1-1 Charging system – V6	Go to Step 4
4	1 Turn off all electrical accessories. 2 Increase the engine speed to 2,000 r.p.m. 3 Using the multimeter set to measure voltage, probe across the battery terminals. Record the measurement for reference. Does the multimeter display 12.5 – 14.5 V?	Go to Step 5	Refer to 6D1-1 Charging system – V6
5	1 Leave the engine running. 2 On Tech 2 select: **Data Display** / **Transmission Data** and observe the **Ignition Voltage** on Tech 2. 3 Increase the engine speed to 2,000 r.p.m. Is the difference between the voltage displayed on Tech 2 and the voltage measurement in Step 4 greater than 1.0 V?	Go to Step 7	Go to Step 6
6	Did DTC P0563 reset?	Go to Step 7	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
7	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Is the action complete?	Go to Step 8	—

Step	Action	Yes	No
8	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **Transmission Data** 4 Operate the vehicle under the following conditions: a Start the engine. b Allow the engine to warm up to normal operating temperature. c Observe the **Ignition Voltage** on Tech 2. d **Ignition Voltage** must remain below 18 V for 12 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0563 set?	Go to Step 2	Go to Step 9
9	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.12 DTC P0601 to P0604 or P1621 – TCM Malfunction

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC P0601 Transmission Control Module (TCM) Read Only Memory (ROM),
- DTC P0602 Transmission Control Module (TCM) Not Programmed,
- DTC P0603 Transmission Control Module (TCM) Long Term Memory Reset,
- DTC P0604 Transmission Control Module (TCM) Random Access Memory (RAM), and
- DTC P1621 Transmission Control Module (TCM) Long Term Memory Performance.

Circuit Description

The internal fault detection is handled inside the transmission control module (TCM). No external circuits are involved. These DTCs are type A DTCs.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

The TCM runs the program to detect an internal fault when the engine is running. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The TCM has detected an internal malfunction.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL.
- The TCM allows the vehicle to operate in transmission protection mode.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- The ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the third consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 DTC P0602 indicates the TCM is not programmed.

DTC P0601 to P0604 or P1621 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0602 set?	Go to Step 3	Go to Step 4
3	1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Program the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0602 set?	Go to Step 4	Go to Step 5
4	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 5	—

Step	Action	Yes	No
5	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Start the engine. 4 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Have any of the DTCs in this procedure set?	Go to Step 2	Go to Step 6
6	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.13 DTC P0711 to P0713 – Transmission Fluid Temperature Sensor

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC P0711 – Transmission Fluid Temperature (TFT) Sensor Performance,
- DTC P0712 – Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage, and
- DTC P0713 – Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage.

Circuit Description

The automatic transmission fluid temperature (TFT) sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The automatic TFT sensor is a negative coefficient thermistor. The transmission control module (TCM) supplies a 5 volt reference signal to the sensor and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high and the TCM detects high signal voltage. As the fluid temperature increases, the resistance of the sensor decreases, which lowers the signal voltage. This diagnostic monitors the TFT circuit. The circuit may be functional, but not in the normal operating range. This diagnostic indicates stuck, erratic, intermittent, skewed, or inaccurate values, indicating poor system performance. The TFT range is -40 – 151°C.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

DTC P0711

- No DTC P0117, P0118, P0722 or P0723.
- DTC P0711 has not passed in the current ignition cycle.
- The engine run time is greater than 5 seconds.
- The transmission fluid temperature is -39 – 149°C.
- For conditions 1 and 2 in Conditions for Setting the DTC, the engine coolant temperature is greater than 70°C and has changed by at least 50°C since start-up.
- For conditions 1 and 2 in Conditions for Setting the DTC, the TCC slip speed is 120 r.p.m. or greater for 600 seconds (10 minutes) cumulatively.

DTC P0712

The engine run time is greater than 5 seconds.

7. GRATING TIRE NOISE

Checkpoint		Problem	Countermeasure
Wheel alignment	NG	Incorrect	Adjust
OK			
Knuckle spindle and steering linkage	NG	Deformed	Replace
OK			
Suspension fixing bolt	NG	Loose	Replace
OK			
Tire pressure	NG	Improper	Adjust

DTC P0713

- No DTCs P0722, P0723.
- The output shaft speed is greater than 200 r.p.m. for 200 seconds (3 minutes and 20 seconds) cumulative.
- The TCC slip speed is greater than 120 r.p.m. for 200 seconds (3 minutes and 20 seconds) cumulative.
- The engine run time is greater than 5 seconds.

Conditions for Setting the DTC

DTC P0711

One of the following conditions occurs:

Condition 1

- The transmission fluid temperature at start-up is -40 – 21°C.
- The vehicle speed is greater than 8 km/h for 900 seconds (15 minutes) cumulatively.
- The transmission fluid temperature has not changed by more than 2°C since start-up for 100 seconds (1 minute and 40 seconds).

Condition 2

- The transmission fluid temperature at start-up is 129 – 150°C.
- The vehicle speed is greater than 8 km/h for 600 seconds (10 minutes) cumulatively.
- The transmission fluid temperature has not changed by more than 2°C since start-up for 100 seconds (1 minute and 40 seconds).

Condition 3

The transmission fluid temperature has changed by 20°C or greater within 250 milliseconds and it has done this 14 times within 7 seconds.

DTC P0712

The TCM detects a transmission fluid temperature of 150°C or more for 2 seconds.

DTC P0713

The TCM detects a transmission fluid temperature of -39°C or less for 25 seconds.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.
- The TCM freezes transmission adaptive functions.
- The TCM calculates a default transmission fluid temperature based on engine coolant temperature, intake air temperature and engine run time.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- The TCM stores the DTC in TCM history.

Conditions for Clearing the DTC

- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the fault no longer exists and the DTC passes.

Diagnostic Aids

- Tech 2 displays the transmission fluid temperature in degrees. After the transmission is operating, the fluid temperature should rise steadily to a normal operating temperature, then stabilise.
- Verify the customer's driving habits, trailer towing, etc. Trailer towing should occur in D3.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Checks the hardware components that affect the transmission fluid temperature.

4 Checks there is power supplied to the TFT sensor.

5 Checks the TFT sensor high reference circuit for serviceability.

6 Check the TFT sensor for serviceability.

7 Checks the TFT sensor low reference circuit for serviceability.

DTC P0711 to P0713 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission / Automatic Transmission / Diagnostic Trouble Codes / Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Data Display / Transmission Data** 8 Drive the vehicle and observe Tech 2 for either of the following conditions: • The **Trans. Fluid Temp**. does not change more than 2.25°C in 409 seconds since start-up • The **Trans. Fluid Temp**. changes more than 20°C in 200 milliseconds 14 times within 7 seconds • The **Trans. Fluid Temp**. less than -39°C? Does Tech 2 display any of the above conditions?	Go to Step 4	Go to Step 3

Step	Action	Yes	No
3	Inspect the transmission and related components for the following: • transmission fluid level, • transmission fluid cooling system restrictions / blockages, • debris in the transmission fluid, • incorrect line pressure, • torque converter stator operation, and • transmission overload. Was a fault found and rectified?	Go to Step 10	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
4	1 Switch off the ignition. 2 Disconnect connector E-95 from the transmission. 3 Using a multimeter set to measure voltage, probe between harness connector E-95 pin 16 and a known ground. Does the multimeter display 4.8 – 5.2 V?	Go to Step 6	Go to Step 5
5	Test the TFT sensor signal circuit (between connectors E-95 pin 16 and C-96 pin 35) for a high resistance, open circuit, short to ground or short to voltage fault condition. Did you find and correct the condition?	Go to Step 10	Go to Step 9
6	1 Switch off the ignition. 2 Remove the TCM fuses C-8 and EB-4, refer to 8A Electrical-Body and Chassis. 3 Using a multimeter set to measure resistance, probe between connector E95 pin 15 and a known ground. Does the multimeter display less than 5 Ω?	Go to Step 8	Go to Step 7
7	Using a multimeter, test between E-95 pin 15 and C-96 pin 30 for high resistance, open circuit, short to ground or short to voltage fault condition. Was any fault found and rectified?	Go to Step 10	—
8	Replace the TFT sensor, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. **NOTE** Check for damaged wiring (short to ground, short to voltage, high resistance or open circuit) or poor connections inside the transmission assembly before replacing the TFT sensor. Was the repair complete?	Go to Step 10	—
9	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Was the repair completed?	Go to Step 10	—

Step	Action	Yes	No
10	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC or within the conditions in the Failure Records. 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Have any of the DTCs in this procedure set?	Go to Step 2	Go to Step 11
11	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.14 DTC P0719 – Brake Switch Circuit High Input (Stuck On)

DTC Description

This diagnostic procedure supports DTC P0719 Brake Switch Circuit High Voltage.

Circuit Description

The transmission control module (TCM) has a direct input from the stop lamp switch assembly. When the brake pedal is pressed, 12 V is supplied to the TCM through connector C-96 pin 42.

When the TCM detects a voltage on the stop lamp switch signal circuit during acceleration, then DTC P0719 sets. DTC P0719 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P0723 or P0724.
- The vehicle speed is 8 – 40 km/h for 6 seconds, then greater than 40 km/h for 7 seconds.

Conditions for Setting the DTC

The TCM detects voltage on the stop lamp switch signal circuit during acceleration.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM records this information as a Failure Record.
- The TCM stores DTC P0719 in TCM history.

Conditions for Clearing the DTC

- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- Tech 2 can clear the DTC.

Diagnostic Aids

CAUTION

- **Verify if the brake pedal position sensor is adjusted properly, refer to 8B Cruise Control.**
- **Test drive the vehicle if a switch or circuit condition cannot be located. An intermittent condition may be duplicated during a test drive.**
- **Application of the brake pedal while accelerating may cause this DTC to set.**

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks the stop lamp switch is serviceable.

4 Checks if there is a stop lamp switch signal to the TCM.

DTC P0719 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 On Tech 2 select: **Engine** / **V6 Engine** / **Data Display** / **Cruise** / **Traction Data.** 3 Turn on the ignition, with the engine off. **NOTE** Ensure the brake pedal is in the rest position. Does the **Stop Lamp Pedal Switch** parameter indicate **Inactive**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3
3	Test the stop lamp switch assembly, refer to 8B Cruise Control. Is the stop lamp switch assembly serviceable?	Go to Step 4	Replace the stop lamp switch assembly.
4	1 Disconnect connector C-96 from the TCM. 2 Using a multimeter set to measure voltage, probe between harness connector C-96 pin 42 and a known ground. **NOTE** Ensure the brake pedal is in the rest position. Does the multimeter display battery voltage?	Repair or replace affected circuit Go to Step 6	Go to Step 5
5	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 6	—

Step	Action	Yes	No
6	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Operate the vehicle under the following conditions: • Turn on the ignition, with the engine off for at least 2 seconds. • Start the vehicle and idle for 5 seconds. • Drive in D4 from 0 – 60 km/h 8 times in 1 ignition cycle. 4 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0719 set?	Go to Step 2	Go to Step 7
7	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.15 DTC P0722 – Vehicle Speed Sensor Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P0722 Vehicle Speed Sensor Circuit Low Voltage.

Circuit Description

The vehicle speed sensor (VSS) provides vehicle speed information to the transmission control module (TCM). The VSS is a permanent magnet generator. The sensor is mounted in the extension housing facing the rear internal gear which is splined to the output shaft assembly. As the output shaft and internal gear rotate, the toothed rotor of the internal gear produces AC voltage as the rotor teeth pass through the magnetic field of the sensor. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. The TCM converts the voltage to vehicle speed. The TCM uses the output shaft speed signal to determine shift timing and torque converter clutch (TCC) scheduling.

If the TCM detects no vehicle speed when there is engine speed in a drive gear range, then DTC P0722 sets. DTC P0722 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0723, P1810, P1815 or P1816.
- Ignition voltage is 8 – 18 V.
- TFT is -40°C – 150°C.
- The engine run time is greater than 5 seconds.
- The throttle position is greater than 12 percent.
- The engine torque is 108 – 882 Nm.

Conditions for Setting the DTC

The transmission output shaft speed is less than 50 r.p.m. for 3 seconds.

Action Taken When the DTC Sets

- The TCM illuminates the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM calculates vehicle speed from the automatic transmission engine r.p.m. and commanded gear.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0722 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the sixth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without an emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- Inspect the rear internal gear teeth for damage.
- Visually inspect the VSS for cracks or damage.
- Ensure the VSS is properly torqued to the extension housing.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Disable the traction control system when performing this step. When the ignition key is cycled off and then cycled back on, the traction control system defaults to on.

3 Checks the VSS for correct resistance.

4 Checks if the VSS and associated circuits are shorted to ground.

5 Checks the VSS produces an AC voltage when the output shaft is rotated.

6 Checks the integrity of the circuits between the TCM and the VSS.

DTC P0722 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Raise and support the rear axle assembly, refer to 0A General Information. 8 Start the engine. 9 Disable the traction control system. 10 Place the transmission in any drive range. 11 On Tech 2 select: **Data Display** / **Transmission Data.** With the drive wheels rotating, does the Tech 2 **AT Output Speed** parameter increase with the drive wheel speed?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3
3	1 Turn off the ignition. 2 Disconnect connector E-44 from the sensor. 3 Using a multimeter set to measure resistance, probe across the speed sensor pins 1 and 2. Does the multimeter display 976 – 2354 Ω?	Go to Step 4	Go to Step 6
4	1 Using a multimeter set to measure resistance, probe between connector E-44 pin 1 and a known ground. 2 Using a multimeter set to measure resistance, probe between connector E-44 pin 2 and a known ground. Does the multimeter display greater than 50 kΩ in both instances?	Go to Step 5	Go to Step 6
5	1 Place the transmission in neutral. 2 Using a multimeter set to measure AC voltage, probe across the speed sensor pins 1 and 2. 3 Rotate a rear wheel by hand. Does the multimeter display 0.3 V AC?	Go to Step 6	Go to Step 7

Step	Action	Yes	No
6	1 Disconnect connector C-96 from the TCM. 2 Test circuits speed sensor circuits (between C-96 pin 16 and E-44 pin 2; C-96 pin 41 and E-44 pin 1) for the following conditions: • Short to ground • Open circuit • Short together Did you find and correct the condition?	Go to Step 9	Go to Step 8
7	Replace the vehicle speed sensor, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
8	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
9	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Operate the vehicle so the transmission output speed is greater than 500 r.p.m. for 3 seconds. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0722 set?	Go to Step 2	Go to Step 9
10	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.16 DTC P0723 – Vehicle Speed Sensor Circuit Intermittent

DTC Description

This diagnostic procedure supports DTC P0723 Vehicle Speed Sensor Circuit Intermittent.

Circuit Description

The vehicle speed sensor (VSS) provides vehicle speed information to the transmission control module (TCM). The VSS is a permanent magnet generator. The sensor is mounted in the extension housing facing the rear internal gear which is splined to the output shaft assembly. As the output shaft and internal gear rotate, the toothed rotor of the internal gear produces AC voltage as the rotor teeth pass through the magnetic field of the sensor. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. The TCM converts the voltage to vehicle speed. The TCM uses the output shaft speed signal to determine shift timing and torque converter clutch (TCC) scheduling.

If the TCM detects an unrealistic drop in output shaft speed, DTC P0723 sets. DTC P0723 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P1810, P1815 or P1816.

- Ignition voltage is 8 – 18 V.
- TFT is -40°C and 150°C.
- The engine run time is greater than 5 seconds.
- The throttle position is greater than 12 percent.
- The engine torque is 108 – 882 Nm.

Conditions for Setting the DTC

The transmission output shaft speed drops greater than 1,000 r.p.m. for at least 3.4 seconds.

Action Taken When the DTC Sets

- The TCM illuminates the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM calculates vehicle speed from the automatic transmission input shaft speed sensor and commanded gear.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0723 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the sixth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without an emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- Inspect the rear internal gear teeth for damage.
- Visually inspect the VSS for cracks or damage.
- Ensure the VSS is properly torqued to the transmission housing.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Disable the traction control system when performing this step. When the ignition key is cycled off and then cycled back on, the traction control system defaults to on.

3 Checks the VSS for correct resistance.

4 Checks if the VSS and associated circuits are shorted to ground.

5 Checks the VSS produces an AC voltage when the output shaft is rotated.

6 Checks the integrity of the circuits between the TCM and the VSS.

8. EXCESSIVELY OR PARTIALLY WORN TIRE

Checkpoint		Problem	Countermeasure
Tire pressure	NG	Improper	Adjust
OK			
Wheel alignment	NG	Incorrect	Adjust
OK			
Front wheel bearing	NG	Faulty	Replace
OK			
Brake adjustment	NG	Incorrect	Adjust
OK			
Tire rotation	NG	Not rotated	Rotate tires at recomended intervals

DTC P0723 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Raise and support the rear axle assembly, refer to 0A General Information. 8 Start the engine. 9 Disable the traction control system. 10 Place the transmission in D3 range. 11 With the drive wheels rotating, slowly accelerate to 2,000 r.p.m. and hold. Road test the vehicle if necessary. 12 On Tech 2 select: **Data Display** / **Transmission Data.** With the drive wheels rotating, does the Tech 2 **AT Output Speed** parameter drop or fluctuate more than 1,300 r.p.m.?	Go to Step 3	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
3	1 Turn off the ignition. 2 Disconnect connector E-44 from the sensor. 3 Using a multimeter set to measure resistance, probe across the speed sensor pins 1 and 2. Does the multimeter display 976 – 2354 Ω?	Go to Step 4	Go to Step 7
4	1 Using a multimeter set to measure resistance, probe between connector E-44 pin 1 and a known ground. 2 Using a multimeter set to measure resistance, probe between connector E-44 pin 2 and a known ground. Does the multimeter display greater than 50 kΩ in both instances?	Go to Step 5	Go to Step 7
5	1 Place the transmission in neutral. 2 Using a multimeter set to measure AC voltage, probe across the speed sensor pins 1 and 2. 3 Rotate a rear wheel by hand. Does the multimeter display 0.3 V AC?	Go to Step 6	Go to Step 7

Step	Action	Yes	No
6	1 Disconnect connector C-96 from the TCM. 2 Test circuits speed sensor circuits (between C-96 pin 16 and E-44 pin 2; C-96 pin 41 and E-44 pin 1) for the following conditions: • Short to ground, • Short to battery, • Open circuit, and • Short together. Did you find and correct the condition?	Go to Step 9	Go to Step 8
7	Replace the vehicle speed sensor, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
8	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service. Did you complete the replacement?	Go to Step 9	—
9	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **Transmission Data.** 4 Operate the vehicle ensuring the transmission output speed drop is less than 500 r.p.m. for 2 seconds and output speed is greater than 500 r.p.m. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0723 set?	Go to Step 2	Go to Step 10
10	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.17 DTC P0724 – Brake Switch Circuit Low Input (Stuck Off)

DTC Description

This diagnostic procedure supports DTC P0724 Brake Switch Circuit Low Voltage.

Circuit Description

The transmission control module receives a direct input from the stop lamp switch assembly. When the brake pedal is pressed, 12 V is supplied to the TCM through connector C-96 pin 42.

When the TCM detects an open or short to ground on the stop lamp signal circuit during stopping then DTC P0724 sets. DTC P0724 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0719, P0722 or P0723.
- The vehicle speed is greater than 40 km/h for 7 seconds, then 8 – 40 km/h for 5 seconds, then less than 8 km/h.
- Continuously eight times once the previous criteria have been met.

Conditions for Setting the DTC

The TCM detects an open or short to ground on the stop lamp switch signal circuit when the circuit should be high, battery voltage.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.
- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM records this information as a Failure Record.
- The TCM stores DTC P0724 in TCM history.

Conditions for Clearing the DTC

- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- Tech 2 can clear the DTC.

Diagnostic Aids

CAUTION

- **Verify the brake pedal position sensor is adjusted properly, refer to 8B Cruise Control.**
- **Test drive the vehicle if a switch or circuit condition cannot be located. An intermittent condition may be duplicated during a test drive.**

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Checks if the stop lamp switch is serviceable.

4 Checks if there is a stop lamp switch signal to the TCM.

DTC P0724 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 On Tech 2 select: **Engine / V6 Engine / Data Display / Cruise / Traction Data.** 3 Turn on the ignition, with the engine off. 4 Press the brake pedal. Does the **Stop Lamp Pedal Switch** parameter indicate **Active**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3

Step	Action	Yes	No
3	Test the stop lamp switch assembly, refer to 8B Cruise Control. Is the stop lamp switch assembly serviceable?	Go to Step 4	Replace the stop lamp switch assembly
4	1 Disconnect connector C-96 from the TCM. 2 Using a multimeter set to measure voltage, probe between harness connector C-96 pin 42 and a known ground. 3 Press the brake pedal. Does the multimeter display battery voltage?	Go to Step 5	Repair or replace affected circuit Go to Step 6
5	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 6	—
6	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Operate the vehicle under the following conditions: • Turn on the ignition, with the engine off for at least 2 seconds. • Start the vehicle and idle for 5 seconds. • Drive in D4 from 0 – 60 km/h then brake, eight times in one ignition cycle. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0724 set?	Go to Step 2	Go to Step 7
7	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.18 DTC P0741 – Torque Converter Clutch System – Stuck Off

DTC Description

This diagnostic procedure supports DTC P0741 Torque Converter Clutch (TCC) System - Stuck Off.

Circuit Description

The torque converter clutch (TCC) solenoid valve is a normally-open exhaust valve that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve to control fluid acting on the converter clutch apply valve. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. When grounded by the transmission control module (TCM), the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and move the converter clutch apply valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port and converter feed fluid fills the apply fluid circuit. The converter feed fluid applies the TCC. When the TCM no longer provides a ground path, the TCC solenoid valve de-energizes and apply fluid exhausts, releasing the TCC.

When the TCM detects high torque converter slip when the TCC is commanded off, then DTC P0741 sets. DTC P0741 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P0723, P0742, P2763 or P2764.
- The IMS range is D2, D3 or D4.
- Ignition voltage is 8 – 18 V.
- The transmission fluid temperature is greater than 20°C.
- The engine torque is 108 – 881 Nm.
- The throttle position is greater than 10 percent.
- The gear ratio is within the following ranges:
    - 1.41:1 – 1.56:1 — 2nd gear,
    - 0.95:1 – 1.05:1 — 3rd gear.
- The TCC is commanded on 0.1 seconds.
- The TCC duty cycle is greater than 60 percent for more than 3 seconds.

Conditions for Setting the DTC

The TCM commands the TCC on, and the TCC slip is greater than 250 r.p.m. for 3 seconds.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive drive trip in which the conditions for setting the DTC are met.
- The TCM inhibits TCC.
- The TCM inhibits 4th gear if the transmission is in Hot Mode.
- The TCM commands elevated line pressure.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0741 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the sixth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- Inspect the transmission fluid lines to the radiator. The lines may be pinched, blocked or twisted.
- Contamination may cause the TCC apply valve to stick in the valve body.
- Internal damage to the torque converter may prevent TCC application.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the hydraulic state of the TCC. When the TCM commands the TCC solenoid valve off, the slip speed should increase.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0741 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Automatic Transmission** / **Data Display** / **Transmission Data.** 8 Drive the vehicle in the D4 drive range in second, third, or fourth gear under steady acceleration, with a TP angle at 20%. On Tech 2, while **TCC Solenoid** status is **On**, is the **TCC Slip Speed** within **-20 to +20 RPM**?	Refer to Diagnostic Aids within this Section	Go to Step 3
3	The TCC system is hydraulically stuck off. Inspect for the following conditions: • TCC PWM solenoid valve mechanically stuck in the off position or leaking. • TCC regulator apply valve stuck in the off position. • TCC solenoid valve stuck in the off position or leaking. • TCC enable valve stuck in the off position. • Incorrectly aligned, damaged or leaking valve body gasket. • Inspect the forward clutch input housing assembly for the input shaft fluid seal ring leaking or worn. Did you find and correct any of the above conditions?	Go to Step 4	—

Step	Action	Yes	No
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Automatic Transmission / Data Display / Transmission Data.** 4 Drive the vehicle in D4 with the TCC on and the throttle above 10%. Ensure Tech 2 displays **TCC Slip Speed** between **-25 to +25 RPM** for 3 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0741 set?	Go to Step 2	Go to Step 5
5	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.19 DTC P0742 – Torque Converter Clutch System – Stuck On

DTC Description

This diagnostic procedure supports DTC P0742 Torque Converter Clutch (TCC) System – Stuck On.

Circuit Description

The torque converter clutch (TCC) solenoid valve is a normally-open exhaust valve that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve to control fluid acting on the converter clutch apply valve. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. When grounded by the transmission control module (TCM), the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and move the converter clutch apply valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port and converter feed fluid fills the apply fluid circuit. The converter feed fluid applies the TCC. When the TCM no longer provides a ground path, the TCC solenoid valve de-energizes and apply fluid exhausts, releasing the TCC.

When the TCM detects low torque converter slip when the TCC is commanded off, then DTC P0742 sets. DTC P0742 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P0723, P0741 P02763, P02764, P02769 or P02770.
- Ignition voltage is 8 – 18 V.
- The engine run time is greater than 5 seconds.
- The IMS range is D4.
- The transmission fluid temperature is 10 – 130°C.
- The engine speed is 500 – 6,500 r.p.m. for 5 seconds, then 800 – 4,400 r.p.m.
- The engine torque is 156 – 881 Nm.
- The throttle position is greater than 10 percent.
- The transmission is not in 1st gear and the gear ratio is 0.95:1 – 1.56:1.

- The vehicle speed is greater than 15 km/h.
- TCC is commanded off.

Conditions for Setting the DTC

The following conditions occur four times in one ignition cycle:

- The TCM commands the TCC off.
- The TCC slip is -15 – +15 r.p.m. for greater than 3 seconds.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive drive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0742 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the sixth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

The TCC fluid hydraulically applies the TCC, possibly causing an engine stall, under the following conditions:

- The TCC is hydraulically stuck in the on position
- The parking brake is applied.
- Any gear range is selected.
- Contamination may cause the TCC apply valve to intermittently stick in the valve body.
- Internal damage in the torque converter may cause no TCC apply.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the hydraulic state of the TCC. When the TCM commands the TCC solenoid valve off, the slip speed should increase.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0742 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Automatic Transmission** / **Data Display** / **Transmission Data.** 8 Drive the vehicle in the D4 drive range in second, third, or fourth gear under steady acceleration, with a TP angle at 10%. On Tech 2, while **TCC Solenoid** status is **On**, is the **TCC Slip Speed** within **-20 to +20 RPM**?	Go to Step 3	Refer to Diagnostic Aids within this Section
3	The TCC is hydraulically stuck ON. Inspect for the following: • Blocked exhaust orifice in the TCC solenoid valve. • Converter clutch apply valve stuck in the apply position. • Incorrectly aligned or damaged valve body gasket. • Restricted release passage. • Restricted transmission cooler line. Did you find and correct the condition?	Go to Step 4	—
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Automatic Transmission** / **Data Display** / **Transmission Data.** 4 Drive the vehicle in D4 with the TCC ON and the throttle above 10%. Ensure Tech 2 displays **TCC Slip Speed** between **100 – 2,500 RPM** for 3 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0742 set?	Go to Step 2	Go to Step 5
5	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.20 DTC P0751 – 1-2 Shift Solenoid Valve Performance – No First or Fourth Gear

DTC Description

This diagnostic procedure supports DTC P0751 1-2 Shift Solenoid (SS) Valve Performance – No First or Fourth Gear.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The 1-2 SS valve is a normally-open exhaust valve that is used with the 2-3 SS valve, to allow four different shifting combinations.

If the transmission control module (TCM) detects a 2-2-3-3 shift pattern, then DTC P0751 sets. DTC P0751 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P0723, P0742, P0894, P0973, P0974, P0976, P0977 or P1815.
- Ignition voltage is 8 – 18 V.
- The engine r.p.m. is 500 – 6,500 r.p.m. for greater than 5 seconds.
- The transmission fluid temperature is 20 – 130°C.
- The throttle position is greater than 10 percent.
- The input shaft speed is 200 – 6,800 r.p.m.
- The output shaft speed is greater than 100 r.p.m.

Conditions for Setting the DTC

Both of the following conditions must occur twice during the same trip:

- Fail Case 1: The TCM commands 1st gear and the resulting gear ratio is 1.44:1 – 1.50:1 for 2 seconds.
- Fail Case 2: The TCM commands 4th gear and the resulting gear ratio is 0.98:1 – 1.03:1 for 4 seconds.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0751 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

SECTION 3D

REAR SUSPENSION

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Diagnostic Aids

- If you clear DTC P0751, and then cannot reset DTC P0751, the following conditions may exist:
  - Fluid contamination,
  - Blocked fluid circuits, or
  - Restricted fluid circuits.
- Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the TCM commanded all shifts, all shift solenoid valves responded correctly, and if all the shifts did not occur.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0751 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission / Automatic Transmission / Diagnostic Trouble Codes / Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Drive the vehicle in D4 range under the following conditions: • Accelerate the vehicle • Ensure the TCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 2-2-3-3 shift pattern?	Go to Step 3	Refer to Diagnostic Aids within this Section
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction. • Damaged seals on the shift solenoid valve. Perform the shift solenoid leak test, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. Did you find and correct the condition?	Go to Step 4	—

Step	Action	Yes	No
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Drive the vehicle in D4 range under the following conditions, only if traffic and road conditions permit: • Hold the throttle at 20%, and • Accelerate to 88 km/h. 4 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0751 set?	Go to Step 2	Go to Step 5
5	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.21 DTC P0752 – 1-2 Shift Solenoid Valve Performance – No Second or Third Gear

DTC Description

This diagnostic procedure supports DTC P0752 1-2 Shift Solenoid (SS) Valve Performance – No Second or Third Gear.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The 1-2 SS valve is a normally-open exhaust valve that is used with the 2-3 SS valve, to allow four different shifting combinations.

When the transmission control module (TCM) detects a 1-1-4-4 shift pattern, then DTC P0752 sets. DTC P0752 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0722, P0723, P0742, P0894, P0973, P0974, P0976, or P0977.
- Ignition voltage is 8 – 18 V.
- The engine run time is greater than 5 seconds.
- The transmission fluid temperature is 20 – 130°C.
- The throttle position is greater than 10 percent.
- The output shaft speed is greater than 150 r.p.m.
- The engine torque is 108 – 882 Nm.

Conditions for Setting the DTC

The TCM commands 2nd gear and the resulting gear ratio is 2.42:1 – 2.52:1, 1st gear ratio for 2 seconds twice during the same trip.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits 3-2 downshifts if the vehicle speed is greater than 40 km/h.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0752 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- If you clear DTC P0752, and then cannot reset DTC P0752, the following conditions may exist:
  - Fluid contamination,
  - Blocked fluid circuits, or
  - Restricted fluid circuits.
- Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the TCM commanded all shifts, all shift solenoid valves responded correctly, and if all the shifts did not occur.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0752 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Drive the vehicle in D4 range under the following conditions: • Accelerate the vehicle, and • Ensure the TCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 1-1-4-4 shift pattern?	Go to Step 3	Refer to Diagnostic Aids within this Section
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction. • Damaged seals on the shift solenoid valve. Perform the shift solenoid leak test, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. Did you find and correct the condition?	Go to Step 4	—
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Drive the vehicle in D4 range under the following conditions, only if traffic and road conditions permit: • Hold the throttle at 20%, and • Accelerate to 88 km/h. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0752 set?	Go to Step 2	Go to Step 5
5	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.22 DTC P0756 – 2-3 Shift Solenoid Valve Performance – No First or Second Gear

DTC Description

This diagnostic procedure supports DTC P0756 2-3 Shift Solenoid (SS) Valve Performance – No First or Second Gear.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The 2-3 SS valve is a normally-open exhaust valve that is used with the 1-2 SS valve, to allow four different shifting combinations.

When the transmission control module (TCM) detects a 4-3-3-4 shift pattern, then DTC P0756 sets. DTC P0756 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0120, P0722, P0723, P0742, P0973, P0974, P0976, P0977 or P1815.
- The engine torque is 108 – 882 Nm.
- The engine run time is greater than 5 seconds.
- The transmission fluid temperature is 20 – 130°C.
- The throttle position is greater than 10 percent.
- The output shaft speed is greater than 150 r.p.m.

Conditions for Setting the DTC

Both of the following conditions must occur twice during the same trip:

- Fail Case 1: The TCM commands 1st gear when the output shaft speed is 200 r.p.m. or greater, the engine torque is 40 – 350 Nm, and the resulting gear ratio is 0.73:1 – 0.77:1 for 2.8 seconds.
- Fail Case 2: The TCM commands 2nd gear when the engine torque is 36 – 350 Nm and the resulting gear ratio is 1.56:1 – 1.64:1 for 1 second.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM inhibits 1st gear.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0756 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.

- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- If you clear DTC P0756, and then cannot reset DTC P0756, the following conditions may exist:
  - Fluid contamination,
  - Blocked fluid circuits, or
  - Restricted fluid circuits.
- Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the TCM commanded all shifts, all shift solenoid valves responded correctly, and if all the shifts did not occur.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0756 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission / Automatic Transmission / Diagnostic Trouble Codes / Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Drive the vehicle in D4 range under the following conditions: • Accelerate the vehicle, and • Ensure the TCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 4-3-3-4 shift pattern?	Go to Step 3	Refer to Diagnostic Aids within this Section

Step	Action	Yes	No
3	1 Inspect the shift solenoid/hydraulic circuit for the following conditions: • Debris or chips in the AFL oil passage. • Debris or chips restricting oil flow in passage #29 of the case or through the spacer plate gasket into the valve body. • A cracked 2-3 shift solenoid. • A 2-3 shift valve which is stuck or hung up in the valve body bore. • A 2-3 shuttle valve which is stuck or hung up in its bore. • Damaged seals on the shift solenoid valves. Perform the shift solenoid leak test, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. 2 Clean and inspect the related valves, bores and the valve body for debris or contamination. Did you find and correct the condition?	Go to Step 4	—
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Drive the vehicle in D4 range under the following conditions, only if traffic and road conditions permit: • Hold the throttle at 40%, and • Accelerate to 64 km/h. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0756 set?	Go to Step 2	Go to Step 5
5	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.23 DTC P0757 – 2-3 Shift Solenoid Valve Performance – No Third or Fourth Gear

DTC Description

This diagnostic procedure supports DTC P0757 2-3 Shift Solenoid (SS) Valve Performance – No Third or Fourth Gear.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The 2-3 SS valve is a normally-open exhaust valve that is used with the 1-2 SS valve to allow four different shifting combinations.

When the transmission control module (TCM) detects a 1-2-2-1 shift pattern, then DTC P0757 sets. DTC P0757 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0120, P0722, P0723, P0742, P0973, P0974, P0976, P0977 or P1815.
- The engine torque is 108 – 882 Nm.
- The engine run time is greater than 5 seconds.
- The transmission fluid temperature is 20 – 130°C.
- The throttle position is greater than 10 percent.
- The output shaft speed is greater than 150 r.p.m.

Conditions for Setting the DTC

The TCM commands 3rd gear and the resulting gear ratio is a 1.44:1 – 1.52:1, 1st gear, for 2.25 seconds.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits 4th gear.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0757 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- If you clear DTC P0757, and then cannot reset DTC P0757, the following conditions may exist:
  - Fluid contamination,
  - Blocked fluid circuits, or
  - Restricted fluid circuits.
- Refer to 5.6 Shift Solenoid Valve State and Gear Ratio.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 This step tests the TCM commanded all shifts, all shift solenoid valves responded correctly, and if all the shifts did not occur.

3 Checks the mechanical components that cause the DTC and their state.

DTC P0757 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Drive the vehicle in D4 range under the following conditions: • Accelerate the vehicle, and • Ensure the TCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 1-2-2-1 shift pattern?	Go to Step 3	Refer to Diagnostic Aids within this Section
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction • Damaged seals on the shift solenoid valve. Perform the shift solenoid leak test, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis. Did you find and correct the condition?	Go to Step 4	—
4	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Drive the vehicle in D4 range under the following conditions, only if traffic and road conditions permit: • Hold the throttle at 15%, and • Accelerate to 80 km/h. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0757 set?	Go to Step 2	Go to Step 5

Step	Action	Yes	No
5	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.24 DTC P0787 – 3-2 Shift Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports the following DTC:

DTC P0787 3-2 Shift Solenoid (SS) Control Circuit Low Voltage.

Circuit Description

The 3-2 shift solenoid (SS) valve is a normally-closed, 3-port, on/off device that controls the 3-2 downshift. The solenoid attaches to the control valve body within the transmission. The solenoid receives ignition voltage through the ignition circuit. The transmission control module (TCM) controls the solenoid by providing a ground path on the 3-2 shift solenoid valve control circuit. During a 3-2 downshift, the 2-4 band applies as the 3-4 clutch releases. The TCM varies the timing between the 3-4 clutch release and the 2-4 band apply depending on the vehicle speed and the throttle position.

When the TCM detects a continuous open or short to ground in the 3-2 SS valve circuit, then DTC P0787 sets. DTC P0787 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 10 – 18 V.
- The engine speed is greater than 450 r.p.m. for 5 seconds.
- Vehicle speed is less than 200 km/h.

Conditions for Setting the DTC

The TCM commands the solenoid off and the voltage feedback remains low, 0 V.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM commands 3rd gear.
- The TCM inhibits TCC engagement.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0787 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.

MAIN DATA AND SPECIFICATIONS

General Specifications

Items \ Models	Standard Suspension, Soft ride Suspension		Heavy-duty Suspension
	4 × 2 (Except High Ride Suspension)	4 × 2 (High Ride Suspension) 4 × 4	4 × 2
Type	Leaf rigid		
Leaf spring			
No. of leaves	5		7
Spring eye type	Berlin eye type		Up turned eye type
Bushing outside dia mm(in)	Front; 40 (1.57), Rear; 30 (1.18)		
Length mm(in)	1,200 (47.24)		
Width mm(in)	60 (2.36)		
Rear shock absorbers			
Type	Gas-sealed, Twin tube		
Mean stroke mm(in)	198 (7.80)	199 (7.83)	198 (7.80)
Compressed length mm(in)	323 (12.7)	349 (13.7)	323 (12.7)
Extended length mm(in)	521 (20.5)	549 (21.6)	521 (20.5)

- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Checks the ability of the TCM to control the solenoid.

5 Checks for supply voltage to the 3-2 SS valve.

6 Checks the ability of the TCM and wiring to control the ground circuit.

8 Checks the resistance of the control valve body wiring harness and the 3-2 SS valve.

9 Checks if the 3-2 SS or control valve body wiring harness is shorted to the transmission housing.

13 Checks if the control valve body wiring harness is shorted to ground.

14 Checks if any of the other solenoids in the transmission are shorted to ground.

DTC P0787 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. Are any of the following DTCs also set? • P0961 • P0973 • P0976 • P2764 • P2769.	Go to Step 3	Go to Step 4
3	Inspect fuse C-8 and check if it is blown, refer to 8A Electrical-Body and Chassis. Is the fuse blown?	Replace the fuse Go to Step 12	Go to Step 5

Step	Action	Yes	No
4	1 On Tech 2 select: **Automatic Transmission** / **Miscellaneous Tests** / **3-2 Downshift Solenoid.** 2 With Tech 2 command the 3-2 shift solenoid **ON** and **OFF**. Does Tech 2 display the **3-2 Downshift Solenoid** as **Active** and **Inactive** respectively?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 5
5	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 10 and a known ground. Does the test lamp illuminate?	Go to Step 6	Test between E-95 pin 10 and C-107 pin 9 for an open circuit Repalce affected circuit Go to Step 18
6	1 Using a test lamp, probe connector E-95 pin 10 with the ground lead to connector E-95 pin 11. 2 On Tech 2 select: **Automatic Transmission** / **Miscellaneous Tests** / **3-2 Downshift Solenoid.** 3 With Tech 2 command the 3-2 shift solenoid **ON** and **OFF** three times. Does the test lamp turn on and off with each command?	Go to Step 8	Go to Step 7
7	Is the test lamp always illuminates?	Go to Step 15	Go to Step 16
8	1 Remove Tool No. J44152 from the harness connector E-95 and install on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 11. Does the multimeter display 20 – 32 Ω?	Go to Step 9	Go to Step 10
9	1 Using a multimeter set to measure resistance, probe between: • Transmission connector E-95 pin 10 and a known ground. • Transmission connector E-95 pin 11 and a known ground. Does the multimeter display greater than 250 kΩ in both instances?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 11
10	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 3-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 3-2 SS. 4 Using a multimeter set to measure resistance, probe across the 3-2 SS pins. Does the multimeter display 20 – 32 Ω?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 18	Replace the 3-2 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 18

Step	Action	Yes	No
11	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 3-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 3-2 SS. 4 Using a multimeter set to measure resistance, probe between each of the 3-2 SS pins and the transmission case. Does the multimeter display 250 kΩ in both instances?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 18	Replace the 3-2 shift solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 18
12	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for a short to ground. Did you find and correct the condition?	Go to Step 18	Go to Step 13
13	1 Gain access to the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Test for a short to ground in the control valve body wiring harness. Did you find a short to ground condition?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 18	Go to Step 14
14	1 Test each solenoid in the transmission for a short to ground, refer to 8A Electrical-Body and Chassis. 2 Replace the faulty solenoid as necessary. Did you complete the replacement?	Go to Step 18	—
15	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for a short to ground. Did you find and correct the condition?	Go to Step 18	Go to Step 17
16	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for an open circuit. Did you find and correct the condition?	Go to Step 18	Go to Step 17
17	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 18	—
18	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Automatic Transmission** / **Data Display** / **Transmission Data.** 4 Drive the vehicle in D3 or D4 and perform a 3-2 downshift. Ensure the **3-2 Downshift Solenoid** parameter displays **On** when the shift occurs. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0787 set?	Go to Step 2	Go to Step 19
19	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK

Step	Action	Yes	No
When all diagnosis and repairs are completed, check the system for correct operation.			

4.25 DTC P0788 – 3-2 Shift Solenoid Control Circuit High Voltage

DTC Description

This diagnostic procedure supports DTC P0788 3-2 Shift Solenoid (SS) Control Circuit High Voltage.

Circuit Description

The 3-2 shift solenoid (SS) valve is a normally-closed, 3-port, on/off device that controls the 3-2 downshift. The solenoid attaches to the control valve body within the transmission. The solenoid receives ignition voltage through the ignition 1 circuit. The transmission control module (TCM) controls the solenoid by providing a ground path on the 3-2 shift solenoid valve control circuit. During a 3-2 downshift, the 2-4 band applies as the 3-4 clutch releases. The TCM varies the timing between the 3-4 clutch release and the 2-4 band apply depending on the vehicle speed and the throttle position.

When the TCM detects a continuous short to voltage in the 3-2 shift solenoid valve control circuit, then DTC P0788 sets. DTC P0788 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 10 – 18 V.
- The engine speed is 450 r.p.m. for 5 seconds.
- The engine is not in fuel cut off.

Conditions for Setting the DTC

DTC P0788 sets if the TCM commands the solenoid on and the voltage feedback remains high, battery voltage.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM commands 3rd gear.
- The TCM inhibits TCC engagement.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0788 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks for a short to voltage in the 3-2 SS signal circuit.

3 Checks for the serviceability of the 3-2 SS.

DTC P0788 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Turn off the ignition. 8 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set 9 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 10 Turn on the ignition, with the engine off. 11 Using a test lamp and Tool No. J 35616-C, probe between connector E-95 pin 11 and a known ground. Does the test lamp illuminate?	Go to Step 5	Go to Step 3
3	1 Install Tool No. J 44152 to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 11. Does the multimeter display less than 20 Ω?	Go to Step 4	Go to Step 6

Step	Action	Yes	No
4	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 3-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 3-2 SS. 4 Using a multimeter set to measure resistance, probe across the 3-2 SS pins. Does the multimeter display less than 20 Ω?	Replace the 3-2 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 7	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 7
5	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for a short to voltage. Did you find and correct the condition?	Go to Step 7	Go to Step 6
6	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 7	—
7	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Automatic Transmission / Data Display / Transmission Data.** 4 Drive the vehicle in D3 or D4 and perform a 3-2 downshift. Ensure the **3-2 Downshift Solenoid** parameter displays **On** when the shift occurs and **Off** in all other instances 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0787 set?	Go to Step 2	Go to Step 8
8	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.26 DTC P0894 – Transmission Component Slipping

DTC Description

This diagnostic procedure supports DTC P0894 Transmission Component Slipping.

Circuit Description

The transmission control module (TCM) monitors the difference between engine speed and transmission output speed. In D3 drive range with the TCC engaged, the engine speed should closely match the transmission output speed. In D4 drive range, with the TCC engaged, the TCC slip speed should be -20 to +50 r.p.m.

When the TCM detects excessive TCC slip when the TCC should be engaged, then DTC P0894 sets. DTC P0894 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- No DTCs P0122, P0123, P0722, P0723, P0741, P0742, P0751, P0752, P0756, P0757, P0973, P0974, P1810, P1815, P1816, P2763 or P2764.
- The engine speed is greater than 450 r.p.m. for 5 seconds.
- The engine is not in fuel cut-off.
- The engine torque is 108 Nm – 882 Nm.
- The vehicle speed is 48 – 177 km/h.
- The engine speed is 1,200 – 3,750 r.p.m.
- The speed ratio is 0.70 – 2.25, speed ratio is engine speed divided by the transmission output speed.
- The gear range is D4.
- The commanded gear is not 1st gear.
- The TFT is 20 – 130°C.
- The shift solenoid performance diagnostic counters are zero.

Conditions for Setting the DTC

DTC P0894 sets if the following conditions occur for three TCC cycles.

- The TCC is commanded on for 5 seconds.
- The throttle position is greater than 10 percent.
- The TCC slip speed is 100 – 550 r.p.m. for 10 seconds.

NOTE

The following actions may occur before the DTC sets, if the:

- TCC is commanded on for 10 seconds, and
- the TCC is at 75 percent duty cycle for 5 seconds, and
- the TP angle is 10 – 99 percent, and
- the transmission slip counter has incremented to either 1 or 2, out of 3 to increment the fail counter for the current ignition cycle,

then the following slip conditions and actions may increment the fail counter for the current ignition cycle. These conditions must occur sequentially.

Condition 1

If the TCC slip speed is 100 – 550 r.p.m. for 10 seconds, then the TCM will command maximum line pressure and freeze shift adapts from being updated.

Condition 2

If Condition 1 is met and the TCC slip speed is 100 – 550 r.p.m. for 10 seconds, then the TCM will command the TCC off for 1.5 seconds.

Condition 3

If Condition 2 is met and the TCC slip speed is 100 – 550 r.p.m. for 10 seconds, then the fail counter on the current ignition cycle is incremented.

The above slip conditions and actions may be disregarded if the TCC is commanded off at any time, because of a driving manoeuvre, sudden acceleration or deceleration.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0894 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- Bronze material found in the transmission oil pan may indicate stator shaft bushing wear. If bushing wear is suspected, inspect the stator shaft and the input, turbine, shaft for damage.
- Perform the Torque Converter Diagnosis Procedure, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Checks the torque converter for slippage while in a commanded lock-up state.

4-12 Checks the mechanical components that cause the DTC and their state.

13 When the TAP cells are cleared the TCM needs to relearn the TAP cells for the transmission. As such, when the vehicle is first driven, the shifts may be harsh. The transmission shifts should become smoother the more the vehicle is driven until the TCM has relearned all TAP cells.

DTC P0894 Diagnostic Table

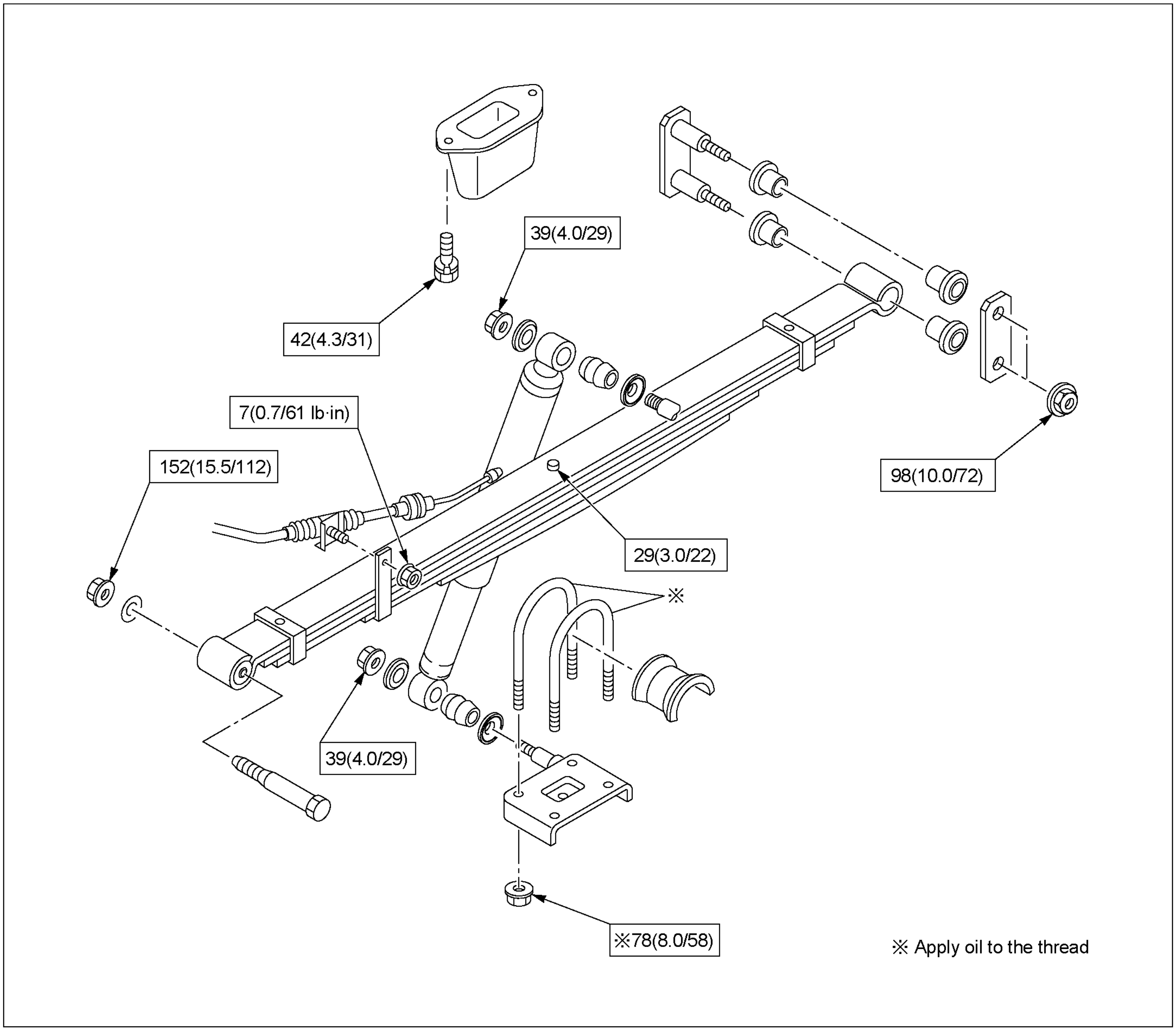
Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	Inspect for correct transmission fluid level, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you perform the fluid checking procedure?	Go to Step 3	Check the transmission fluid level, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing

Step	Action	Yes	No
3	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. **NOTE** It may be necessary to allow multiple TCC cycles to occur to verify a slipping condition. It may also be necessary to ensure the transmission is warm before performing this step. 7 On Tech 2 select: **Automatic Transmission** / **Data Display** / **Transmission Data.** 8 Drive the vehicle in 4th gear with the TCC commanded on. On Tech 2, while **TCC Solenoid** status is **On**, is the **TCC Slip Speed** within **130 – 800 RPM** for 7 seconds?	Go to Step 4	Refer to Diagnostic Aids within this Section
4	1 Inspect the torque converter clutch (TCC) solenoid valve for the following conditions: • internal malfunction, such as sediment or damage, and • damaged seals, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Inspect the torque converter clutch pulse width modulation (TCC PWM) solenoid valve for the following conditions: • internal malfunction, such as sediment or damage, and • damaged seals, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you find and correct the condition?	Go to Step 14	Go to Step 5

Step	Action	Yes	No
5	1 Inspect the 1-2 shift solenoid (SS) valve for the following conditions: • internal malfunction, such as sediment or damage, and • damaged seals, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Inspect the 2-3 shift solenoid (SS) valve for the following conditions: • internal malfunction, such as sediment or damage, and • damaged seals, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Inspect the 3-2 shift solenoid valve assembly for the following conditions: • internal malfunction, such as sediment or damage, and • damaged seals, 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you find and correct the condition?	Go to Step 14	Go to Step 6
6	Inspect the valve body assembly for the following conditions: • stuck regulator apply valve, and • scored regulator apply valve body, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 7
7	Inspect the torque converter assembly for the following conditions: • front stator shaft bushing for wear, • stator roller clutch not holding, and • external damage/leaks, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 8
8	Inspect the oil pump assembly for the following conditions: • a stuck converter clutch valve, • the converter clutch valve is assembled backwards, • a incorrectly position converter clutch valve retaining ring, • a cocked converter clutch outer valve spring, • a incorrectly positioned pump to case gasket, • restricted orifice cup plugs, • damaged orifice cup plugs, and • over-tightened, or unevenly tightened pump body to cover bolts, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 9

Torque Specifications

N·m(kgf·m/lb·ft)



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Step	Action	Yes	No
9	Inspect the input housing and shaft assembly for the following conditions: • cut turbine shaft O-ring seal, • damaged turbine shaft O-ring seal, • restricted turbine shaft retainer and ball assembly, and • damaged turbine shaft retainer and ball assembly, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 10
10	1 Inspect the 2-4 band assembly for the following conditions: • worn 2-4 band, • damaged 2-4 band, • incorrectly positioned 2-4 band, • incorrectly assembled 2-4 band, and • the band anchor pin is not engaged, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. 2 Inspect the 2-4 servo assembly for the following conditions: • restricted apply passages in the 2-4 servo assembly, • blocked apply passages in the 2-4 servo assembly, • nicks or burrs on the 2nd apply piston pin, • damaged 2nd apply piston pin, • incorrect 2nd apply piston pin, • nicks or burrs on the pin bore in the case, • damaged fourth servo piston, • incorrectly assembled fourth servo piston, • damaged servo bore in the case, • missing piston seals, • cut piston seals, • damaged piston seals, • porosity in the pistons, • porosity in the cover, • porosity in the case, • damaged piston seal grooves, • plugged orifice cup plug, and • missing orifice cup plug, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 11

Step	Action	Yes	No
11	Inspect the forward clutch assembly for the following conditions: • worn clutch plates, • porosity in the forward clutch piston, • damaged forward clutch piston, • missing forward clutch piston inner and outer seals, • cut forward clutch piston inner and outer seals, • damaged forward clutch piston inner and outer seals, • missing input housing to forward clutch housing O-ring seal, • cut input housing to forward clutch housing O-ring seal, • damaged input housing to forward clutch housing O-ring seal, • damaged forward clutch housing, • damaged forward clutch housing retainer and ball assembly, and • forward clutch housing retainer and ball assembly is not sealing, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Go to Step 12
12	Inspect the 3-4 clutch assembly for the following conditions: • worn clutch plates, • porosity in the 3-4 clutch piston, • damaged 3-4 clutch piston, • missing 3-4 clutch inner and outer seals, • cut 3-4 clutch inner and outer seals, • damaged 3-4 clutch inner and outer seals, • damaged 3-4 clutch spring assembly, • damaged 3-4 clutch apply ring, • damaged piston seal grooves, • blocked orifice cup plug, and • missing orifice cup plug, refer to 7C5 Automatic Transmission – 4L60E – Unit Repair. Did you find and correct the condition?	Go to Step 13	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
13	1 Change the transmission fluid and filter. 2 Inspect for correct transmission fluid level, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Add new fluid as necessary. **NOTE** The Clear TAPS function will clear all adapt cells. This may affect transmission performance. The TCM will update the transmission adapt cell values as the vehicle is driven. 4 On Tech 2 select: **Transmission** / **Programming** / **Reset TAP Cells** and follow Tech 2 instructions. Did you complete the above procedure?	Go to Step 14	—

Step	Action	Yes	No
14	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Automatic Transmission / Data Display / Transmission Data.** 4 Operate the vehicle under the following conditions: • Drive the vehicle in D4, with the TCC on, and a throttle position at 20%. • On Tech 2 ensure the **TCC Slip Speed** is **-20 to +50 RPM** for at least 7 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P0894 set?	Go to Step 2	Go to Step 15
15	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.27 DTC P0961 – Line Pressure Control Solenoid System Performance

DTC Description

This diagnostic procedure supports DTC P0961 Line Pressure Control (PC) Solenoid System Performance.

Circuit Description

The pressure control (PC) solenoid valve is an electronic device that regulates transmission line pressure based on the current flow through its coil winding. The magnetic field produced by the coil moves the solenoid's internal valve, which varies pressure to the pressure regulator valve. The transmission control module (TCM) controls the PC solenoid valve by applying a varying amount of current to the solenoid. The applied current can vary from 0.1 – 1.1 A. Low current, 0.1 A, indicates high line pressure. High current, 1.1 A, indicates low line pressure. The duty cycle of the PC solenoid valve is expressed as a percentage of energised on time. Zero percent indicates zero on time, non-energised, or no current flow. Approximately 60 percent at idle indicates maximum on time, energised, or high current flow. The TCM determines the appropriate line pressure for a given load by comparing the throttle position, the engine speed and other inputs.

When the TCM detects a continuous open or short to ground in the PC solenoid valve circuit, then DTC P0961 sets. DTC P0961 is a type C DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine is running.

Conditions for Setting the DTC

The PC solenoid valve duty cycle reaches its high limit, approximately 95 percent, or low limit, approximately 2 percent.

Action Taken When the DTC Sets

- The TCM does not request the engine control module (ECM) to illuminate the MIL.

- The TCM records the operating conditions when the conditions for setting the DTC are met. The TCM records this information as a Failure Record.
- The TCM freezes transmission adaptive functions.
- The TCM commands maximum line pressure.
- The TCM stores DTC P0961 in TCM history.

Conditions for Clearing the DTC

- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- Tech 2 can clear the DTC.

Diagnostic Aids

DTC P0961 may set under low voltage conditions caused by high electrical system demands.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks the ability of the TCM to control the solenoid.

3 Checks the resistance of the control valve body wiring harness and the PC solenoid.

5 Checks the serviceability of the PC solenoid circuits contained in the control valve body wiring harness.

6-8 Checks the serviceability the power and signal circuits between the TCM and the transmission.

DTC P0961 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Miscellaneous Tests** / **Pressure Control Solenoid.** 8 Using Tech 2, turn the pressure control solenoid on and off three times. Does Tech 2 display the PCS as **On** and **Off** when commanded by Tech 2?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3
3	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the transmission connector E-95. 4 Using the multimeter set to measure resistance, probe across transmission connector E-95 pins 1 and 2. Does the multimeter display 3 – 7 Ω?	Go to Step 4	Go to Step 5
4	Using the multimeter set to measure resistance, probe between connector E-95 pin 2 and the transmission case. Does the multimeter display greater than 250 kΩ?	Go to Step 6	Go to Step 5
5	Using a multimeter, test between E-95 pin 1 & E-95 pin 2 and the solenoid for the following: • open circuit, • short together, and • short to ground. Did you find any of the conditions tested?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 11	Replace the PC solenoid valve, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 11
6	1 Disconnect Tool No. J 44152 from connector E-95. 2 Connect E-95 to the transmission. 3 Disconnect connector E-95 from the TCM. 4 Using a multimeter set to measure resistance, probe between connector C-96 pins 17 and 40. Does the multimeter display 3 – 7 Ω?	Go to Step 7	Go to Step 8

Step	Action	Yes	No
7	Using a multimeter set to measure resistance, probe between connector C-96 pin 40 and a known ground. Does the multimeter display greater than 250 kΩ?	Go to Step 9	Go to Step 8
8	Using a multimeter, test between E-95 pin 2 & C-96 pin 40 and E-95 pin 1 & C-96 pin 17 for the following: • open circuit, • short together, and • short to ground. Did you find any of the conditions tested?	Repair or replace the affected circuit Go to Step 11	—
9	Using a multimeter, test between E-95 pin 1 & E-95 pin 2 and the solenoid for a short to voltage. Did you find and correct the condition?	Go to Step 11	Go to Step 10
10	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 11	—
11	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **Pressure Control Solenoid Data.** 4 Start the engine and ensure the difference on Tech 2 between the **PCS Actual Current** and the **PCS Desired Current** is less than 16 mA. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0961 set?	Go to Step 2	Go to Step 20
12	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
	When all diagnosis and repairs are completed, check the system for correct operation.		

4.28 DTC P0973 – 1-2 Shift Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P0973 1-2 Shift Solenoid (SS) Control Circuit Low Voltage.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The solenoid is a normally-open exhaust valve. With the 2-3 SS valve, the 1-2 SS valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. The 1-2 SS valve receives ignition voltage through the ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the 1-2 SS valve control circuit.

When the TCM detects a continuous open or short to ground in the 1-2 SS valve circuit, then DTC P0973 sets. DTC P0973 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The engine run time is greater than 5 seconds.
- The 1-2 SS is commanded on.

Conditions for Setting the DTC

DTC P0973 sets when either of the following conditions occurs for 4.3 seconds:

- The TCM detects an open in the 1-2 shift solenoid valve circuit when the 1-2 SS is commanded on.
- The TCM detects a short to ground in the 1-2 shift solenoid valve circuit when the 1-2 SS is commanded on.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive drive trip in which the conditions for setting the DTC are met.
- The TCC commands maximum line pressure.
- The TCM inhibits 3-2 shift if vehicle speed is less than 40 km/h.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0973 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without an emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Checks the ability of the TCM to control the solenoid.

5 Checks for supply voltage to the 1-2 SS valve.

6 Checks the ability of the TCM and wiring to control the ground circuit.

8 Checks the resistance of the control valve body wiring harness and the 1-2 SS valve.

9 Checks if the 1-2 SS or control valve body wiring harness is shorted to the transmission housing.

13 Checks if the control valve body wiring harness is shorted to ground.

14 Checks if any of the other solenoids in the transmission are shorted to ground.

DTC P0973 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. Are any of the following DTCs also set? • P0787 • P0976 • P2764 • P2769.	Go to Step 3	Go to Step 4
3	Inspect fuse C-8 and check if it is blown, refer to 8A Electrical-Body and Chassis. Is the fuse blown?	Replace the fuse Go to Step 12	Go to Step 5
4	1 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Miscellaneous Tests** / **Shift Solenoid A.** 2 With Tech 2 command the shift solenoid A **ON** and **OFF**. 3 On Tech 2 select: **Data Display** / **1-2 Shift Data.** Does Tech 2 display the **Shift Solenoid A Circuit** as **Okay**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 5
5	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 10 and a known ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 15

Step	Action	Yes	No
6	1 Using a test lamp, probe connector E-95 pin 10 with the ground lead to connector E-95 pin 4. 2 On Tech 2 select: **Automatic Transmission / Miscellaneous Tests / Shift Solenoid A.** 3 With Tech 2 command the shift solenoid A **On** and **Off** three times. Does the test lamp turn on and off with each command?	Go to Step 8	Go to Step 7
7	Is the test lamp always illuminated?	Go to Step 16	Go to Step 17
8	1 Remove Tool No. J44152 from the harness connector E-95 and install on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 4. Does the multimeter display 19 – 31 Ω?	Go to Step 9	Go to Step 10
9	Using a multimeter set to measure resistance, probe between: • Transmission connector E-95 pin 10 and a known ground. • Transmission connector E-95 pin 4 and a known ground. Does the multimeter display greater than 250 kΩ in both instances?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 11
10	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 1-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 1-2 SS. 4 Using a multimeter set to measure resistance, probe across the 1-2 SS pins. Does the multimeter display 19 – 31 Ω?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the 1-2 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 19
11	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 1-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Using a multimeter set to measure resistance, probe between each of the 1-2 SS pins and a known ground. Does the multimeter display 250 kΩ in both instances?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the 1-2 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 19
12	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for a short to ground. Did you find and correct the condition?	Go to Step 19	Go to Step 13
13	1 Gain access to the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Test for a short to ground in the control valve body wiring harness. Did you find a short to ground condition?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Go to Step 14

Step	Action	Yes	No
14	1 Test each solenoid for a short to ground. 2 Replace the faulty solenoid as necessary. Did you complete the replacement?	Go to Step 19	—
15	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for an open circuit. Did you find and correct the condition?	Go to Step 19	—
16	Using a multimeter, test between E-95 pin 4 and C-96 pin 2 for a short to ground. Did you find and correct the condition?	Go to Step 19	Go to Step 18
17	Using a multimeter, test between E-95 pin 4 and C-96 pin 2 for an open circuit. Did you find and correct the condition?	Go to Step 19	Go to Step 18
18	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 19	—
19	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **1-2 Shift Data.** 4 Drive the vehicle in D4 and ensure the following conditions are met:: • The TCM commands the **Shift Solenoid A On** and the **Shift Solenoid A Circuit** status parameter displays Okay. • The TCM commands the **Shift Solenoid A Off** and the **Shift Solenoid A Circuit** status parameter displays Okay. • All conditions are met for 5 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0973 set?	Go to Step 2	Go to Step 20
20	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.29 DTC P0974 – 1-2 Shift Solenoid Control Circuit High Voltage

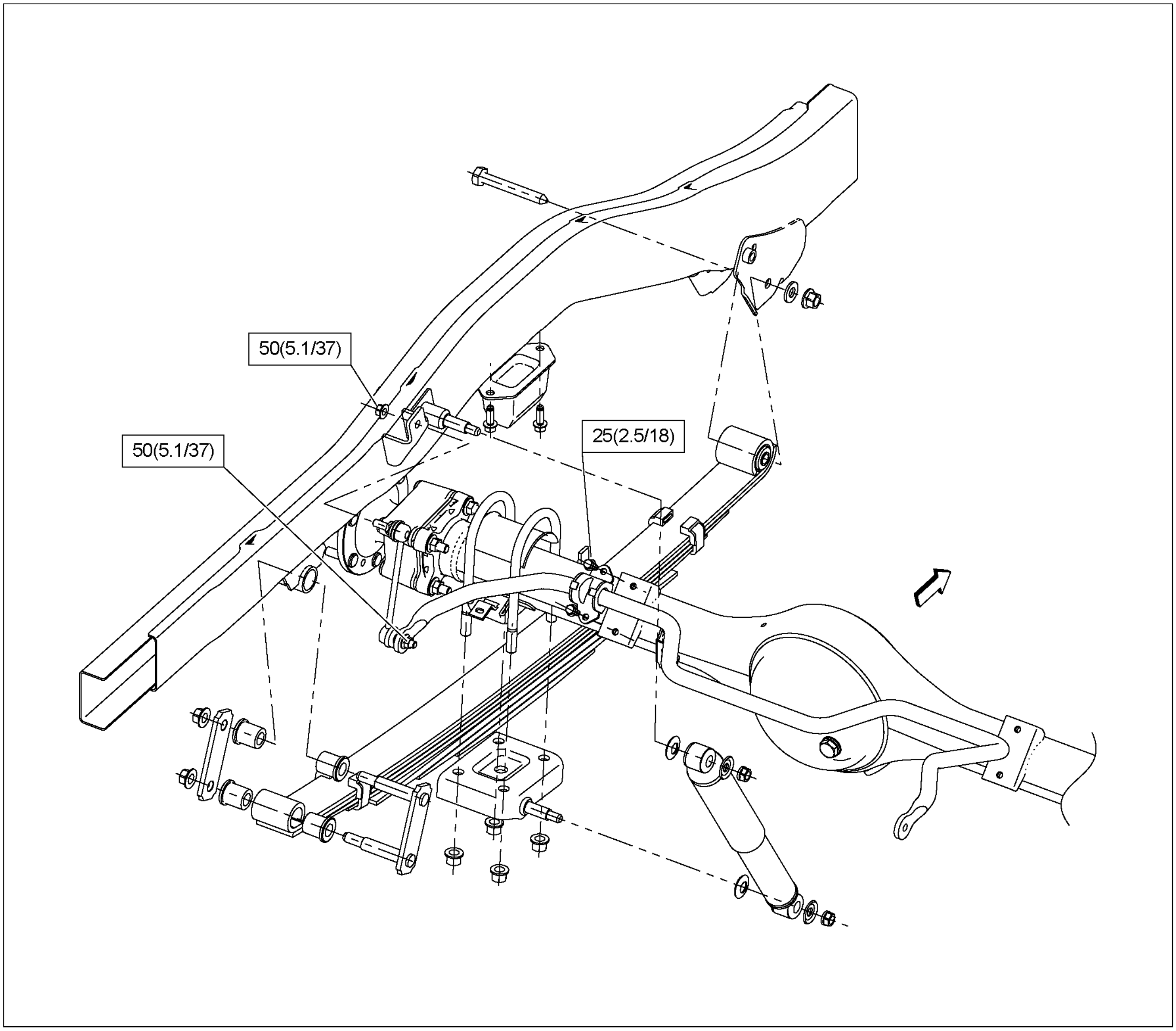
DTC Description

This diagnostic procedure supports DTC P0974 1-2 Shift Solenoid (SS) Control Circuit High Voltage.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The solenoid is a normally-open exhaust valve. With the 2-3 SS valve, the 1-2 SS valve allows four different shifting combinations. The solenoid

N·m(kgf·m/lb·ft)



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attaches to the control valve body within the transmission. The 1-2 SS valve receives ignition voltage through the ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the 1-2 SS valve control circuit.

When the TCM detects a continuous short to voltage in the 1-2 shift solenoid valve control circuit, then DTC P0974 sets. DTC P0974 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P0974 sets if the TCM commands the solenoid on and the voltage feedback remains high, battery voltage.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0974 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks the ability of the TCM to command the 1-2 SS valve.

3 Checks for a short to voltage in the 1-2 SS signal circuit.

4 Checks the serviceability of the 1-2 SS and the control valve body wiring harness.

DTC P0974 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td>2</td><td>1 Connect Tech 2 to the DLC.
2 Turn on the ignition, with the engine off.
NOTE
Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM.
3 On Tech 2 select:
Transmission / Automatic Transmission / Diagnostic Trouble Codes / Freeze Frame.
4 Select the relevant DTC and note the parameters at the time of the DTC setting.
5 On Tech 2 select:
Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.
6 Follow the instructions on Tech 2 and clear the DTCs.
7 On Tech 2 select:
Transmission / Automatic Transmission / Miscellaneous Tests / Shift Solenoid A.
8 With Tech 2 command the shift solenoid A ON and OFF.
9 On Tech 2 select:
Data Display / 1-2 Shift Data.
Does Tech 2 display the Shift Solenoid A Circuit as Okay?</td><td>Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis</td><td>Go to Step 3</td></tr>
<tr><td>3</td><td>1 Turn off the ignition.
2 Disconnect connector E-95 from the transmission.
NOTE
Additional DTCs may set
3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95.
4 Turn on the ignition, with the engine off.
5 Using a test lamp, probe between connector E-95 pin 4 and a known ground.
Does the test lamp illuminate?.</td><td>Go to Step 6</td><td>Go to Step 4</td></tr>
<tr><td>4</td><td>1 Install Tool No. J44152 on to the transmission connector E-95.
2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 4 and 10.
Does the multimeter display less than 20 Ω?</td><td>Go to Step 5</td><td>Go to Step 7</td></tr>
<tr><td>5</td><td>1 Remove Tool No. J44152 from the transmission.
2 Gain access to the 1-2 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.
3 Disconnect the internal connector from the 1-2 SS.
4 Using a multimeter set to measure resistance, probe across the 1-2 SS pins.
Does the multimeter display less than 20 Ω?</td><td>Replace the 1-2 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing.
Go to Step 8</td><td>Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing
Go to Step 8</td></tr>
</table>

Step	Action	Yes	No
6	Using a multimeter, test between E-95 pin 4 and C-96 pin 2 for a short to voltage. Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Did you complete the replacement?	Go to Step 8	—
8	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display / 1-2 Shift Data.** 4 Drive the vehicle in D4 and ensure the following conditions are met:: • The TCM commands the **Shift Solenoid A On** and the **Shift Solenoid A Circuit** status parameter displays Okay. • The TCM commands the **Shift Solenoid A Off** and the **Shift Solenoid A Circuit** status parameter displays Okay. • All conditions are met for 5 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0974 set?	Go to Step 2	Go to Step 9
9	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.30 DTC P0976 – 2-3 Shift Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P0976 2-3 Shift Solenoid (SS) Control Circuit Low Voltage.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The solenoid is a normally-open exhaust valve. With the 1-2 SS valve, the 2-3 SS valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. The 2-3 SS valve receives voltage through the ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the 2-3 SS valve control circuit.

When the TCM detects a continuous open or short to ground in the 2-3 SS valve control circuit, then DTC P0976 sets. DTC P0976 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The engine run time is greater than 5 seconds.
- The 2-3 SS is commanded on.

Conditions for Setting the DTC

DTC P0976 sets when either of the following conditions occurs for 4.3 seconds:

- The TCM detects an open in the 2-3 shift solenoid valve circuit when the 2-3 SS is commanded on.
- The TCM detects a short to ground in the 2-3 shift solenoid valve circuit when the 2-3 SS is commanded on.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL.
- The TCC commands maximum line pressure.
- The TCM inhibits 3-2 shift if vehicle speed is less than 40 km/h.
- The TCM freezes transmission adaptive functions.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0976 in TCM history.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without an emission related diagnostic fault occurring.
- The TCM cancels the default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Checks the ability of the TCM to control the solenoid.

5 Checks for supply voltage to the 2-3 SS valve.

6 Checks the ability of the TCM and wiring to control the ground circuit.

8 Checks the resistance of the control valve body wiring harness and the 2-3 SS valve.

9 Checks if the 2-3 SS or control valve body wiring harness is shorted to the transmission housing.

13 Checks if the control valve body wiring harness is shorted to ground.

14 Checks whether any of the other solenoids in the transmission are shorted to ground.

DTC P0976 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. Are any of the following DTCs also set? • P0787 • P0973 • P2764 • P2769.	Go to Step 3	Go to Step 4
3	Inspect fuse C-8 and check if it is blown, refer to 8A Electrical-Body and Chassis. Is the fuse blown?	Replace the fuse Go to Step 12	Go to Step 5
4	1 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Miscellaneous Tests** / **Shift Solenoid B.** 2 With Tech 2 command the shift solenoid B **ON** and **OFF** three times. 3 On Tech 2 select: **Data Display** / **2-3 Shift Data.** Does Tech 2 display the **Shift Solenoid B Circuit** as **Okay**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 5
5	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 10 and a known ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 15

Step	Action	Yes	No
6	1 Using a test lamp, probe between connector E-95 pin 10 with the ground lead to connector E-95 pin 3. 2 On Tech 2 select: **Automatic Transmission / Miscellaneous Tests / Shift Solenoid B.** 3 With Tech 2 command the shift solenoid B **On** and **Off** three times. Does the test lamp turn on and off with each command?	Go to Step 8	Go to Step 7
7	Is the test lamp always illuminated?	Go to Step 16	Go to Step 17
8	1 Remove Tool No. J44152 from the harness connector E-95 and install on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 3. Does the multimeter display 19 – 31 Ω?	Go to Step 9	Go to Step 10
9	Using a multimeter set to measure resistance, probe between: • Transmission connector E-95 pin 10 and a known ground. • Transmission connector E-95 pin 3 and a known ground. Does the multimeter display greater than 250 kΩ in both instances?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 11
10	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 2-3 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 2-3 SS. 4 Using a multimeter set to measure resistance, probe across the 2-3 SS pins. Does the multimeter display 19 – 31 Ω?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the 2-3 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19
11	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 2-3 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Using a multimeter set to measure resistance, probe between each of the 2-3 SS pins and a known ground. Does the multimeter display 250 kΩ in both instances?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the 2-3 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19
12	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for a short to ground Did you find and correct the condition?	Go to Step 19	Go to Step 13
13	1 Gain access to the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Test for a short to ground in the control valve body wiring harness. Did you find a short to ground condition?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Go to Step 14
14	1 Test each solenoid for a short to ground. 2 Replace the faulty solenoid as necessary. Did you complete the replacement?	Go to Step 19	—

Step	Action	Yes	No
15	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for an open circuit. Did you find and correct the condition?	Go to Step 19	—
16	Using a multimeter, test between E-95 pin 3 and C-96 pin 20 for a short to ground. Did you find and correct the condition?	Go to Step 19	Go to Step 20
17	Using a multimeter, test between E-95 pin 3 and C-96 pin 20 for an open circuit. Did you find and correct the condition?	Go to Step 19	Go to Step 20
18	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 19	—
19	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **2-3 Shift Data.** 4 Drive the vehicle in D4 and ensure the following conditions are met:: • The TCM commands the **Shift Solenoid B On** and the **Shift Solenoid A Circuit** status parameter displays **Okay**. • The TCM commands the **Shift Solenoid B Off** and the **Shift Solenoid A Circuit** status parameter displays **Okay**. • All conditions are met for 5 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0976 set?	Go to Step 2	Go to Step 20
20	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.31 DTC P0977 – 2-3 Shift Solenoid Control Circuit High Voltage

DTC Description

This diagnostic procedure supports DTC P0977 2-3 Shift Solenoid (SS) Control Circuit High Voltage.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The solenoid is a normally-open exhaust valve. With the 1-2 SS valve, the 2-3 SS valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. The 2-3 SS valve receives voltage through the ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the 2-3 SS valve control circuit.

When the TCM detects a continuous short to voltage in the 2-3 shift solenoid valve control circuit, then DTC P0977 sets. DTC P0977 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P0977 sets if the TCM commands the solenoid on and the voltage feedback remains high, battery voltage.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P0977 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Checks for a short to voltage in the 2-3 SS signal circuit.

4 Checks the serviceability of the 2-3 SS.

DTC P0977 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Miscellaneous Tests** / **Shift Solenoid B.** 8 With Tech 2 command the shift solenoid B **ON** and **OFF** three times. 9 On Tech 2 select: **Data Display** / **2-3 Shift Data.** Does Tech 2 display the **Shift Solenoid B Circuit** as **Okay**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3
3	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 3 and a known ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 4
4	1 Install Tool No. J44152 on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 3. Does the multimeter display less than 20 Ω?	Go to Step 5	Go to Step 7
5	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the 2-3 SS and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the 2-3 SS. 4 Using a multimeter set to measure resistance, probe across the 2-3 SS pins. Does the multimeter display less than 20 Ω?	Replace the 2-3 SS, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 8	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 8

Step	Action	Yes	No
6	Using a multimeter, test between E-95 pin 3 and C-96 pin 30 for a short to voltage. Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Did you complete the replacement?	Go to Step 8	—
8	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **2-3 Shift Data.** 4 Drive the vehicle in D4 and ensure the following conditions are met:: • The TCM commands the **Shift Solenoid B On** and the **Shift Solenoid B Circuit** status parameter displays **Okay**. • The TCM commands the **Shift Solenoid B Off** and the **Shift Solenoid B Circuit** status parameter displays **Okay**. • All conditions are met for 5 seconds. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P0977 set?	Go to Step 2	Go to Step 9
9	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.32 DTC P1810, P1815 and P1816 – Transmission Fluid Pressure Position Switch

DTC Description

This diagnostic procedure supports the following DTCs:

- DTC P1810 Transmission Fluid Pressure (TFP) Position Switch Circuit.
- DTC P1815 Transmission Fluid Pressure (TFP) Valve Position Switch – Start in Wrong Range.
- DTC P1816 Transmission Fluid Pressure (TFP) Valve Position Switch Indicates Park/Neutral (P/N) with Drive Ratio.

Circuit Description

The automatic transmission fluid pressure (TFP) manual valve position switch consists of five pressure switches (two normally-closed and three normally-open) and a transmission fluid temperature (TFT) sensor combined into one unit. The combined unit mounts on the valve body. The transmission control module (TCM) supplies ignition voltage for each range signal. By grounding one or more of these circuits through various combinations of the pressure switches, the TCM detects which manual valve position you select. The TCM compares the actual voltage combination of the switches to a TFP manual valve position switch combination chart stored in memory.

The TFP manual valve position switch cannot distinguish between park and neutral because the monitored valve body pressures are identical. With the engine off and the ignition switch on, the TFP manual valve position switch indicates

REAR SUSPENSION

GENERAL DESCRIPTION

Rear suspension absorbs vibration from the road surface thus preventing vehicle damage, as well as providing a comfortable ride.

Components parts

- Spring between the body and the axle case
- Spring shackle connecting the spring to the body
- Clamp and U-bolt fixing the axle case to the spring
- Shock absorber as a countermeasure for vibration

park/neutral. Disconnecting connector E-95 from the transmission removes the ground potential for the three range signals to the TCM. In this case, with the engine off, and the ignition switch on, D2 will be indicated.

When the TCM detects an invalid state of the TFP manual valve position switch circuit by deciphering the TFP manual valve position switch inputs, then either DTC P1810, P1815 or P1816 sets. All theses DTCs are a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

DTC P1810

- The system voltage is 8 – 18 V.
- The engine speed is greater than 500 r.p.m. for 5 seconds.

DTC P1815

- No DTCs P0722 or P0723.
- The system voltage is 8 – 18 V.
- The engine speed is less than 50 r.p.m., then 50 – 650 r.p.m. for 0.75 seconds, then greater than 650 r.p.m. for 5 seconds.
- Output shaft speed less than 250 r.p.m.

DTC P1816

- No DTCs P0722 or P0723.
- The system voltage is 8 – 18 V.
- The engine speed is less than 50 r.p.m., then 50 – 650 r.p.m. for 0.75 seconds, then greater than 650 r.p.m. for 5 seconds.
- Output shaft speed less than 250 r.p.m.

Conditions for Setting the DTC

DTC P1810

DTC P1810 sets when the TCM detects an invalid TFP manual valve position switch state for 60 seconds.

DTC P1815

DTC P1815 sets when the TCM detects D2 only, TFP manual valve position switch state after engine start for 7 seconds.

DTC P1816

DTC P1816 sets when the TCM detects one of the following conditions for 13 seconds:

- park/neutral indicated with a 1st gear ratio,
- park/neutral indicated with a 2nd gear ratio,
- park/neutral indicated with a 3rd gear ratio, or
- park/neutral indicated with a 4th gear ratio.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.

- The TCM commands 4th gear.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores the DTC in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Diagnostic Aids

- Refer to the 5.3 Transmission Fluid Pressure Manual Valve Position Switch Logic for the normal range signals and the invalid combinations. On the table, LOW is 0 V, HI is ignition voltage.
- Sediment in the valve body may cause improper operation of the TFP manual valve position switch. If the presence of sediment is suspected, clean the valve body and replace the TFP manual valve position switch.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

3 Checks the indicated range signal to the selected manual valve position.

4-5 Checks for correct voltage from the TCM to the transmission inline 20-way connector.

6 Checks if there is a short between any of the signal circuits.

DTC P1810, P1815 and P1816 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	Inspect for correct transmission fluid level, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you perform the fluid checking procedure?	Go to Step 3	Refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing

Step	Action	Yes	No
3	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Start the engine and idle at normal operating temperature. 8 Apply the brake pedal. 9 On Tech 2 select: **Data Display** / **Transmission Data.** 10 Select each transmission range: P, R, N, D4, D3, D2 and D1. Does each selected transmission range match the **TFP Gear** displayed on Tech 2?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 4
4	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Turn on the ignition, with the engine off. Does Tech 2 display **Open 12V** for any of the **TFP Switch. A**/**B**/**C** parameters?	Go to Step 5	Go to Step 7
5	1 Turn off the ignition. 2 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 3 Turn on the ignition, with the engine off. 4 Using a multimeter set to measure voltage, probe between the following pins and ground: • connector E-95 pin 5, • connector E-95 pin 13, and • connector E-95 pin 12. Did the multimeter display 10 – 12 V for all the tests?	Go to Step 6	Go to Step 8

Step	Action	Yes	No
6	1 Disconnect connector C-96 from the TCM. 2 Using a multimeter set to measure resistance, probe across the following pins: • connector E-95 pins 5 and 13, • connector E-95 pins 5 and 12, and • connector E-95 pins 12 and 13. Does the multimeter display continuity in any of the tests?	Go to Step 9	Go to Step 10
7	Test the circuit (A/B/C) that displayed **Closed** on Tech 2, for a short to ground between connector E-95 and C-96. Did you find and correct the condition?	Go to Step 12	Go to Step 11
8	Test the signal circuits of the TFP manual valve position switch that did not indicate battery voltage for an open circuit between connectors E-95 and C-96. Did you find and correct the condition?	Go to Step 12	Go to Step 11
9	Test the affected signal circuits of the TFP manual valve position switch for a shorted together condition between E-95 and C-96. Did you find and correct the condition?	Go to Step 12	Go to Step 11
10	Test the TFP circuits for an open circuit or shorted condition between connector E-95 and the TFP manual valve position switch. Did you find a condition?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 12	Replace the TFP manual valve position switch, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 12
11	Replace the TCM refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 12	—
12	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Operate the vehicle under the following conditions: • Turn on the ignition, with the engine off for at least 2 seconds. • Start the vehicle and idle for 5 seconds. • Drive in D4 until the TCC locks for 10 seconds. • Continue to run the engine for at least 60 seconds from start-up. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P1810 set?	Go to Step 2	Go to Step 13

Step	Action	Yes	No
13	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.33 DTC P2763 – Torque Converter Clutch Pressure Control Solenoid Control Circuit High Voltage

DTC Description

This diagnostic procedure supports DTC P2763 Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit High Voltage.

Circuit Description

The torque converter clutch pulse width modulation (TCC PWM) solenoid valve controls the fluid acting on the converter clutch valve. The converter clutch valve controls the TCC application and release. The solenoid attaches to the control valve body within the transmission. The solenoid receives voltage through ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing a ground path on the TCC PWM solenoid valve control circuit. Current flows through the solenoid coil according to the duty cycle, percentage of on and off time. The TCC PWM solenoid valve provides a smooth engagement of the TCC by operating during a duty cycle percent of on time.

When the TCM detects a continuous short to voltage in the TCC PWM solenoid valve control circuit, then DTC P2763 sets. DTC P2763 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P2763 sets if the TCM commands the solenoid on and the voltage feedback remains high, battery voltage.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P2763 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.

- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks for a short to voltage in the TCC PWM solenoid valve signal circuit.

3 Checks the serviceability of the TCC PWM solenoid valve.

DTC P2763 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Miscellaneous Tests** / **TCC PWM Solenoid.** 8 With Tech 2 command the TCC PWM solenoid **ON** and **OFF** three times. 9 On Tech 2 select: **Data Display** / **TCC Data.** Does Tech 2 display the **TCC Duty Cycle Circuit** as **Okay**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 3

Step	Action	Yes	No
3	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 11 and a known ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 4
4	1 Install Tool No. J44152 on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 11. Does the multimeter display less than 20 Ω?	Go to Step 5	Go to Step 7
5	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the TCC PWM solenoid and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the TCC PWM solenoid. 4 Using a multimeter set to measure resistance, probe across the TCC PWM solenoid pins. Does the multimeter display less than 20 Ω?	Replace the TCC PWM solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 8	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 8
6	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for a short to voltage. Did you find and correct the condition?	Go to Step 8	Go to Step 7
7	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 8	—
8	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display / TCC Data.** 4 Drive the vehicle in D4 and ensure the **TCC Duty Cycle Circuit** parameter displays **Okay** for 5 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P2763 set?	Go to Step 2	Go to Step 9
9	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.34 DTC P2764 – Torque Converter Clutch Pressure Control Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P2764 Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit Low Voltage.

Circuit Description

The torque converter clutch pulse width modulation (TCC PWM) solenoid valve controls the fluid acting on the converter clutch valve. The converter clutch valve controls the TCC application and release. The solenoid attaches to the control valve body within the transmission. The solenoid receives voltage through ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing a ground path on the TCC PWM solenoid valve control circuit. Current flows through the solenoid coil according to the duty cycle, percentage of on and off time. The TCC PWM solenoid valve provides a smooth engagement of the TCC by operating during a duty cycle percent of on time.

When the TCM detects a continuous open or short to ground in the TCC PWM solenoid valve control circuit, then DTC P2764 sets. DTC P2764 is a type A DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P2764 sets when either of the following conditions occurs for 5 seconds:

- The TCM detects an open in the TCC PWM shift solenoid valve circuit when the TCC PWM is commanded on.
- The TCM detects a short to ground in the TCC PWM shift solenoid valve circuit when the TCC PWM is commanded on.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P2764 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Checks the ability of the TCM to control the solenoid.

5 Checks for supply voltage to the TCC PWM solenoid valve.

6 Checks the ability of the TCM and wiring to control the ground circuit.

8 Checks the resistance of the control valve body wiring harness and the TCC PWM solenoid valve.

9 Checks if the TCC PWM solenoid valve or control valve body wiring harness is shorted to the transmission housing.

13 Checks if the control valve body wiring harness is shorted to ground.

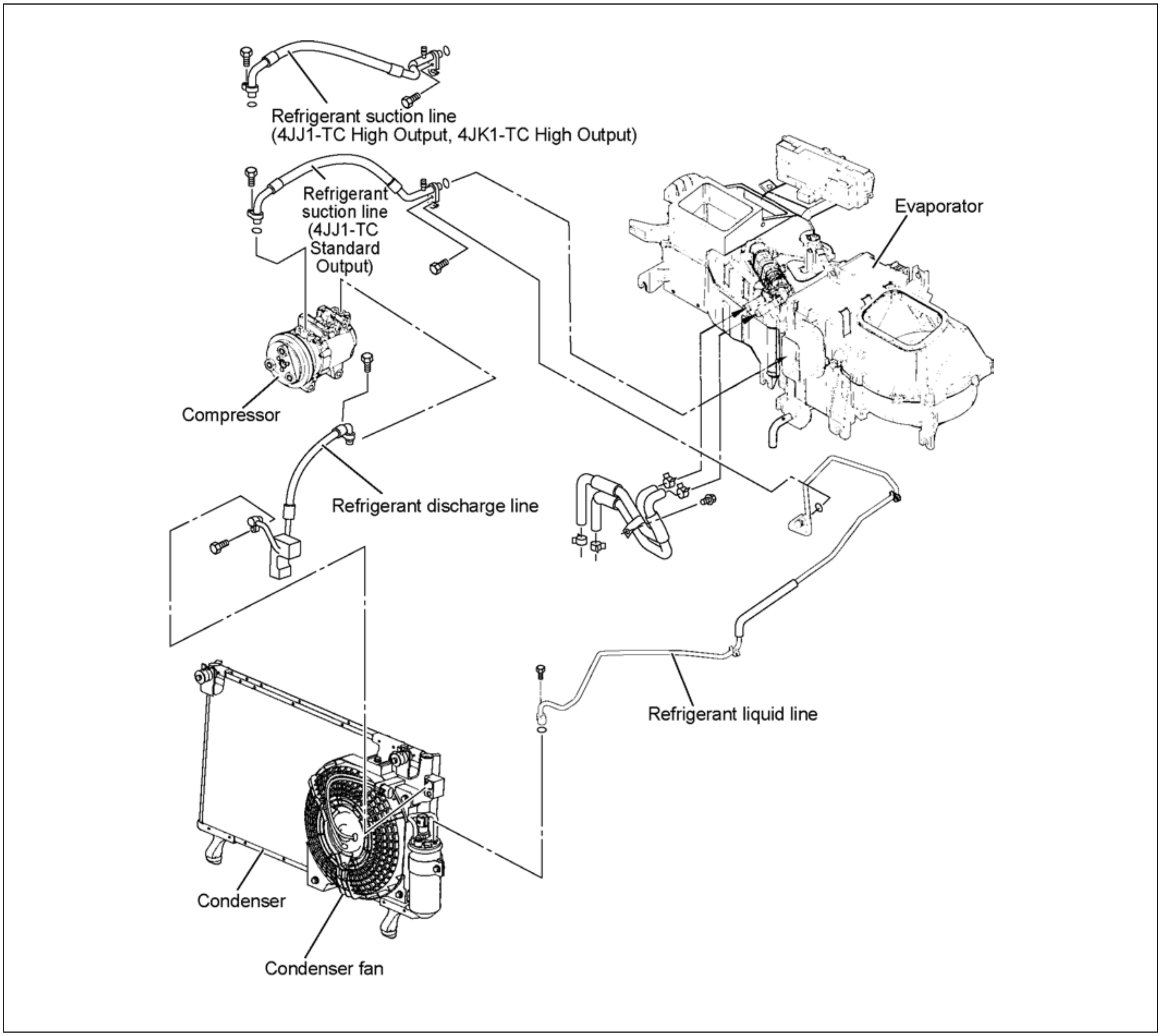
14 Checks if any of the other solenoids in the transmission are shorted to ground.

DTC P2764 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. Are any of the following DTCs also set? • P0787 • P0973 • P0976 • P2769.	Go to Step 3	Go to Step 4
3	Inspect fuse C-8 and check if it is blown, refer to 8A Electrical-Body and Chassis. Is the fuse blown?	Replace the fuse Go to Step 12	Go to Step 5

Step	Action	Yes	No
4	1 On Tech 2 select: **Transmission / Automatic Transmission / Miscellaneous Tests / TCC PWM solenoid.** 2 With Tech 2 command the TCC PWM solenoid **ON** and **OFF** three times. 3 On Tech 2 select: **Data Display / TCC Data.** Does Tech 2 display the **TCC Duty Cycle Circuit** as **Okay**?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 5
5	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 10 and a known ground. Does the test lamp illuminate?	Go to Step 6	Go to Step 15
6	1 Using a test lamp, probe connector E-95 pin 10 with the ground lead to connector E-95 pin 19. 2 On Tech 2 select: **Automatic Transmission / Miscellaneous Tests / TCC PWM Solenoid.** 3 With Tech 2 command the TCC PWM Solenoid **On** and **Off** three times. Does the test lamp turn on and off with each command?	Go to Step 8	Go to Step 7
7	Is the test lamp always illuminated?	Go to Step 16	Go to Step 17
8	1 Remove Tool No. J44152 from the harness connector E-95 and install on to the transmission connector E-95. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 19. Does the multimeter display 10 – 15 Ω?	Go to Step 9	Go to Step 10
9	Using a multimeter set to measure resistance, probe between: • Transmission connector E-95 pin 10 and a known ground. • Transmission connector E-95 pin 19 and a known ground. Does the multimeter display greater than 250 kΩ in both instances?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Go to Step 11
10	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the TCC PWM solenoid and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Disconnect the internal connector from the TCC PWM solenoid. 4 Using a multimeter set to measure resistance, probe across the TCC PWM solenoid pins. Does the multimeter display 10 – 15 Ω?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the TCC PWM solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 19

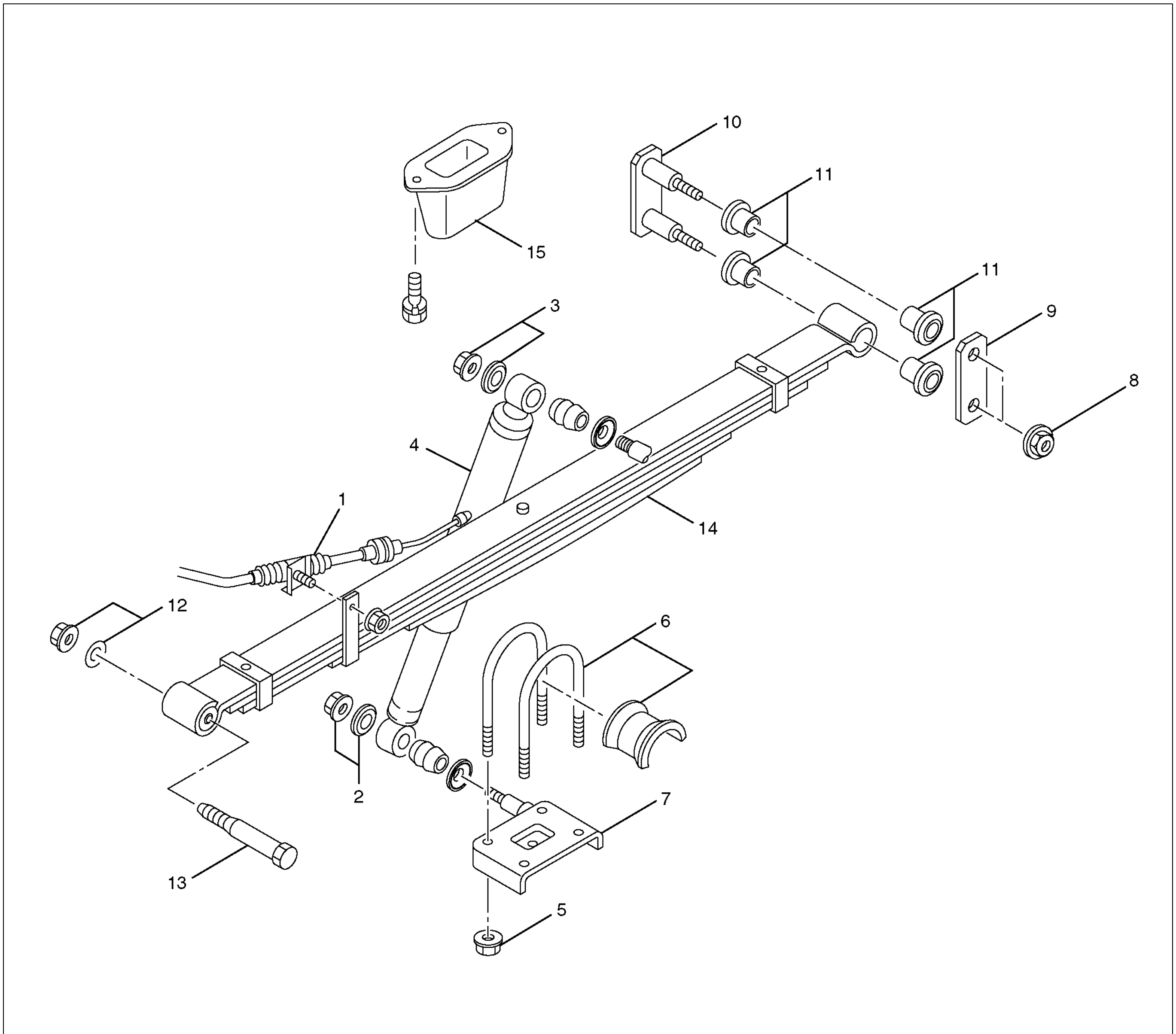
(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output RHD MODEL)



RTW710LF002001

LEAF SPRING AND SHOCK ABSORBER

LEAF SPRING AND ASSOCIATED PARTS



460R300001

Legend

1. Parking Brake Cable Bracket
2. Nut and Washer
3. Nut and Washer
4. Shock Absorber
5. Nut
6. U Bolt and Seat
7. Lower Clamp
8. Nut
9. Shackle Plate
10. Shackle Pin
11. Rubber Bushing
12. Nut and Plain Washer
13. Spring Pin
14. Leaf Spring
15. Bump Rubber

Step	Action	Yes	No
11	1 Remove Tool No. J44152 from the transmission. 2 Gain access to the TCC PWM solenoid and the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 3 Using a multimeter set to measure resistance, probe between each of the TCC PWM solenoid pins and a known ground. Does the multimeter display 250 kΩ in both instances?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Replace the TCC PWM solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 19
12	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for a short to ground. Did you find and correct the condition?	Go to Step 19	Go to Step 13
13	1 Gain access to the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Test for a short to ground in the control valve body wiring harness. Did you find a short to ground condition?	Replace the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 19	Go to Step 14
14	1 Test each solenoid for a short to ground. 2 Replace the faulty solenoid as necessary. Did you complete the replacement?	Go to Step 19	—
15	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for an open circuit. Did you find and correct the condition?	Go to Step 19	—
16	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for a short to ground. Did you find and correct the condition?	Go to Step 19	Go to Step 20
17	Using a multimeter, test between E-95 pin 11 and C-96 pin 14 for an open circuit. Did you find and correct the condition?	Go to Step 19	Go to Step 20
18	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 19	—
19	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Data Display** / **TCC Data.** 4 Drive the vehicle in D4 and ensure the **TCC Duty Cycle Circuit** parameter displays **Okay** for 5 seconds. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P2764 set?	Go to Step 2	Go to Step 20

Step	Action	Yes	No
20	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.35 DTC P2769 – Torque Converter Clutch Enable Solenoid Control Circuit Low Voltage

DTC Description

This diagnostic procedure supports DTC P2769 Torque Converter Clutch (TCC) Enable Solenoid Control Circuit Low Voltage.

Circuit Description

The torque converter clutch (TCC) solenoid valve is an electrical device that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve to control TCC apply and release. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. The TCC solenoid valve receives voltage through ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the TCC solenoid valve control circuit. The TCM monitors the throttle position (TP) voltage, the vehicle speed and other inputs to determine when to energize the TCC solenoid valve.

NOTE

The TCC solenoid valve is part of the control valve body wiring harness. To replace the solenoid valve, the control valve body harness must be replaced.

When the TCM detects a continuous open or short to ground in the TCC solenoid valve control circuit, then DTC P2769 sets. DTC P2769 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P2769 sets when either of the following conditions occurs for 5 seconds:

- The TCM detects an open in the TCC solenoid valve circuit when the TCC is commanded on.
- The TCM detects a short to ground in the TCC shift solenoid valve circuit when the TCC is commanded on.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.

- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P2769 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.

Diagnostic Aids

With the TCC engaged, the TCC slip speed should be -20 – +40 r.p.m.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4 Checks for supply voltage to the 3-2 SS valve.

5 Checks the ability of the TCM and wiring to control the ground circuit.

7 Checks the resistance of the control valve body wiring harness and the TCC solenoid valve.

8 Checks if the TCC solenoid valve or control valve body wiring harness is shorted to the transmission housing.

10 Checks if the control valve body wiring harness is shorted to ground.

11 Checks whether any of the other solenoids in the transmission are shorted to ground.

DTC P2769 Diagnostic Table

1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. Are any of the following DTCs also set? • P0787 • P0973 • P0976 • P2764.	Go to Step 3	Go to Step 4
3	Inspect fuse F8 and check if it is blown, refer to 8A Electrical-Body and Chassis. Is the fuse blown?	Replace the fuse Go to Step 9	Go to Step 5
4	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe between connector E-95 pin 10 and a known ground. Does the test lamp illuminate?	Go to Step 7	Go to Step 12
5	1 Using a test lamp, probe connector E-95 pin 10 with the ground lead to connector E-95 pin 20. 2 On Tech 2 select: **Automatic Transmission** / **Miscellaneous Tests** / **TCC Solenoid.** 3 With Tech 2 command the **TCC Solenoid On** and **Off** three times. Does the test lamp turn on and off with each command?	Go to Step 7	Go to Step 6
6	Is the test lamp always illuminated?	Go to Step 13	Go to Step 14

7	1 Remove Tool No. J44152 from the harness connector X121 – X1 and install on to the transmission connector X121 – X1. 2 Using a multimeter set to measure resistance, probe across transmission connector E-95 pins 10 and 20. Does the multimeter display 21 – 33 Ω?	Go to Step 8	Replace the control valve body wiring harness and TCC solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 16
8	Using a multimeter set to measure resistance, probe between: • Transmission connector E-95 pin 10 and a known ground. • Transmission connector E-95 pin 20 and a known ground. Does the multimeter display greater than 250 kΩ in both instances?	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis	Replace the control valve body wiring harness and TCC solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 16
9	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for a short to ground. Did you find and correct the condition?	Go to Step 16	Go to Step 10
10	1 Gain access to the control valve body wiring harness, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. 2 Test for a short to ground in the control valve body wiring harness. Did you find a short to ground condition?	Replace the control valve body wiring harness and TCC solenoid, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing Go to Step 16	Go to Step 11
11	1 Test each solenoid for a short to ground. 2 Replace the faulty solenoid as necessary. Did you complete the replacement?	Go to Step 16	—
12	Using a multimeter, test between E-95 pin 10 and C-107 pin 9 for an open circuit. Did you find and correct the condition?	Go to Step 16	—
13	Using a multimeter, test between E-95 pin 20 and C-96 pin 25 for a short to ground. Did you find and correct the condition?	Go to Step 16	Go to Step 15
14	Using a multimeter, test between E-95 pin 20 and C-96 pin 25 for an open circuit. Did you find and correct the condition?	Go to Step 16	Go to Step 15
15	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Did you complete the replacement?	Go to Step 16	—

16	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes / Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 On Tech 2 select: **Miscellaneous Tests / TCC Solenoid.** 4 Drive the vehicle in D4. With Tech 2 command the TCC solenoid valve **On** for 5 seconds and **Off** for 5 seconds 5 On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Has DTC P2769 set?	Go to Step 2	Go to Step 17
17	On Tech 2 select: **Diagnostic Trouble Codes / Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.36 DTC P2770 – Torque Converter Clutch Enable Solenoid Control Circuit High Voltage

DTC Description

This diagnostic procedure supports DTC P2770 Torque Converter Clutch (TCC) Enable Solenoid Control Circuit High Voltage.

Circuit Description

The torque converter clutch (TCC) solenoid valve is an electrical device that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve to control TCC apply and release. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. The TCC solenoid valve receives voltage through ignition voltage circuit. The transmission control module (TCM) controls the solenoid by providing the ground path on the TCC solenoid valve control circuit. The TCM monitors the throttle position (TP) voltage, the vehicle speed and other inputs to determine when to energize the TCC solenoid valve.

NOTE

The TCC solenoid valve is part of the control valve body wiring harness. To replace the solenoid valve, the control valve body harness must be replaced.

When the TCM detects a continuous short to voltage in the TCC solenoid valve control circuit, then DTC P2770 sets. DTC P2770 is a type B DTC.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

- The system voltage is 8 – 18 V.
- The engine speed is 500 r.p.m. for 5 seconds.

Conditions for Setting the DTC

DTC P2770 sets if the TCM commands the solenoid on and the voltage feedback remains high, battery voltage.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if in hot mode.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores DTC P2770 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

2 Checks for a short to voltage in the TCC solenoid valve signal circuit. Isolates whether the TCM or the TCC solenoid valve and control valve body wiring harness are at fault.

DTC P2770 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check
2	1 Turn off the ignition. 2 Disconnect connector E-95 from the transmission. **NOTE** Additional DTCs may set. 3 Install Tool No. J 44152 Jumper Harness (20 pins) on to the harness connector E-95. 4 Turn on the ignition, with the engine off. 5 Using a test lamp, probe connector E-95 pin 20 to ground. Does the test lamp illuminate?	Go to Step 3	Replace the internal wiring harness and TCC solenoid valve, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Go to Step 5
3	Using a multimeter, test between E-95 pin 20 and C-96 pin 25 for a short to voltage. Did you find and correct the condition?	Go to Step 5	Go to Step 4

Step	Action	Yes	No
4	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Service Did you complete the replacement?	Go to Step 5	—
5	Perform the following procedure to verify the repair: 1 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs** 2 Follow the instructions on Tech 2 and clear any DTCs. 3 Drive the vehicle in D4. 4 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has DTC P2770 set?	Go to Step 2	Go to Step 6
6	On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Does Tech 2 display any DTCs you have not diagnosed?	Refer to 4.8 Diagnostic Trouble Code List	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			

4.37 DTC U0073 and U0100 – CAN-Bus No Communication With ECM (Engine Control Module)

DTC Description

This diagnostic procedure supports:

DTC U0073 – CAN-Bus No Communication With ECM (Engine Control Module)

DTC U0100 – CAN-Bus No Communication With ECM (Engine Control Module)

Circuit Description

The Transmission Control Module (TCM) communicates directly with the control modules connected to the GM LAN serial data communication circuit through the GM LAN protocol. The first module that CAN-Bus is connected to is the Engine Control Module (ECM).

DTC U0073 or DTC U0100 will set if communications between the TCM and ECM are lost.

Refer to 2 Wiring Diagrams and Connector Chart to aid in diagnosis.

Conditions for Running the DTC

DTC U0073 and DTC U0101 runs continuously when the following conditions are met:

- The ignition is on for longer than 3 seconds.
- The ignition voltage is 10.0 – 16.0 V.

Conditions for Setting the DTC

DTC U0073

The TCM detects a short to ground between C-96 pin 7 and C-96 pin 49 within the specified time frame

DTC U0100

The TCM detects a short to ground between both C-96 pin 6 & 7 and C-96 pin 49 within the specifed time frame.

Action Taken When the DTC Sets

- The TCM requests the ECM to illuminate the MIL during the second consecutive trip in which the conditions for setting the DTC are met.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits TCC engagement.
- At the time of the first failure, the TCM records the operating conditions when the conditions for setting the DTC are met. The TCM stores this information as a Failure Record.
- At the time of the second failure, the ECM records the operating conditions when the conditions for setting the DTC are met. The ECM stores this information as a Freeze Frame.
- The TCM stores either DTC U0073 or DTC U0100 in TCM history during the second consecutive trip in which the conditions for setting the DTC are met.

Conditions for Clearing the DTC

- The ECM turns off the MIL after the fourth consecutive drive trip in which the TCM does not send a MIL illumination request.
- Tech 2 can clear the DTC.
- The TCM clears the DTC from TCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The TCM cancels the DTC default actions when the ignition is off long enough to power down the TCM.

Test Description

The following number refers to the step numbers in the diagnostic table:

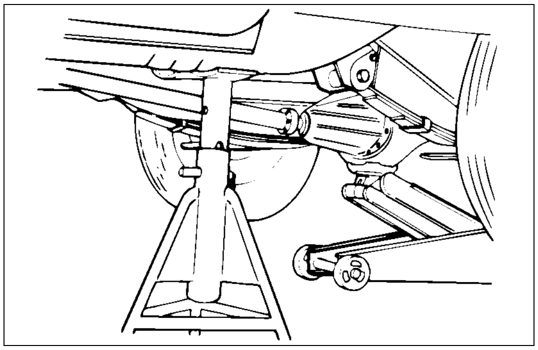
1 The following tests are included in the Diagnostic System Check.

  - Tests the integrity of the GM LAN serial data communication circuit.
  - Tests for fault conditions on the vehicle immobiliser system stored in the ICU.

DTC P0864 and U0101 Diagnostic Table

Step	Action	Yes	No
1	Has the Diagnostic System Check been performed?	Go to Step 2	Refer to 4.7 Diagnostic System Check

Step	Action	Yes	No
2	1 Connect Tech 2 to the DLC. 2 Turn on the ignition, with the engine off. **NOTE** Before clearing the DTC, use the Tech 2 Freeze Frame/Failure Record to record the transmission parameters at the time the DTC set. Using Tech 2 to clear the DTC(s) erases the Freeze Frame/Failure Record records from the TCM. 3 On Tech 2 select: **Transmission** / **Automatic Transmission** / **Diagnostic Trouble Codes** / **Freeze Frame.** 4 Select the relevant DTC and note the parameters at the time of the DTC setting. 5 On Tech 2 select: **Diagnostic Trouble Codes** / **Clear Engine & Transmission DTCs.** 6 Follow the instructions on Tech 2 and clear the DTCs. 7 Operate the vehicle within the conditions for running the DTC. 8 On Tech 2 select: **Diagnostic Trouble Codes** / **Read DTC Information.** Has either DTC PU0073 or DTC U0100 set?	Go to Step 3	Check for an intermittent fault in the circuit, refer to 8A Electrical-Body and Chassis
3	Using Tech 2, attempt to communicate with the PIM. Does the PIM failed to communicate?	Refer to the 6E1 Powertrain Interface Module – V6	Go to Step 4
4	Are DTCs also set in the PIM?	Refer to 6E1 Powertrain Interface Module – V6	Go to Step 5
5	Replace the TCM, refer to 7C4 Automatic Transmission – 4L60E – On-vehicle Servicing. Was the repair completed?	Go to Step 6	—
6	1 Using Tech 2, clear the DTCs. 2 Switch off the ignition for 30 seconds. 3 Start the engine. 4 Operate the vehicle within the conditions for running the DTC. Does any of the serial data communication circuit – TCM DTCs fail this ignition cycle?	Go to Step 2	Go to Step 78
7	Using Tech 2, select the DTC display function. Does Tech 2 display any DTCs?	Go to the appropriate DTC Table	System OK
When all diagnosis and repairs are completed, check the system for correct operation.			



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Removal

- Jack up the rear axle and place chassis stands under the frame near the front end of the rear spring brackets.

Note:

- **Be careful not to stretch the flexible brake hose or parking brake cable.**
- **Support the vehicle on the specified jack point.**

1. Remove the parking brake cable from the leaf spring.
2. Loosen the shock absorber fixing nut and remove the nut and special washer from the lower clamp.
3. Remove the shock absorber fixing nut and washer at frame side.
4. Lifting the rear axle using a jack, remove the shock absorber and lower the jack.
5. Remove the U bolt fixing nut.
6. Take out the U bolt, seat and lower clamp.
7. Support the leaf spring using a jack and remove the shackle pin fixing nuts.
8. Drive out the shackle pin, using a brass bar and hammer.
9. Remove the shackle plate and rubber bushings.
10. Remove the nut and drive out the shackle using a brass bar and hammer.
11. Remove the leaf spring.
12. Remove the bump rubber.

5 Electrical Specifications

5.1 Transmission Fluid Temperature (TFT) Sensor Specifications

Temperature	Minimum Resistance	Normal Resistance	Maximum Resistance	Signal
°C	Ω	Ω	Ω	Volts
-40	90636	100707	110778	5.00
-30	47416	52684	57952	4.78
-20	25809	28677	31545	4.34
-10	14558	16176	17794	3.89
0	8481	9423	10365	3.45
10	5104	5671	6238	3.01
20	3164	3515	3867	2.56
30	2013	2237	2461	1.80
40	1313	1459	1605	1.10
50	876	973	1070	3.25
60	600	667	734	2.88
70	420	467	514	2.56
80	299	332	365	2.24
90	217	241	265	1.70
100	159	177	195	1.42
110	119	132	145	1.15
120	89.9	99.9	109.9	0.87
130	69.1	76.8	84.5	0.60
140	53.8	59.8	65.8	0.32
150	42.5	47.2	51.9	0.00

5.2 Range Reference

Range	Park	Reverse	Neutral	4				3			2		1	
Gear				1st	2nd	3rd	4th	1st	2nd	3rd	1st **	2nd	1st	2nd ***
Shift Solenoid A (1-2 Shift Solenoid)	ON*	ON*	ON*	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	ON	OFF
Shift Solenoid B (2-3 Shift Solenoid)	ON*	ON*	ON*	ON	ON	OFF	OFF	ON	ON	OFF	ON	ON	ON	ON
2-4 Band	-	-	-	-	A	-	A	-	A	-	-	A	-	A
Reverse Input Clutch	-	A	-	-	-	-	-	-	-	-	-	-	-	-

Range	Park	Reverse	Neutral	4				3			2		1	
Overrun Clutch	-	-	-	-	A	A	-	-	A	A	A	A	A	A
Forward Clutch	-	-	-	A	A	A	A	A	A	A	A	A	A	A
Forward Sprag Clutch Assembly	-	-	-	H	H	H	-	H	H	H	H	H	H	H
3-4 Clutch	-	-	-	-	-	A	A	-	-	A	-	-	-	-
Lo/Roller Clutch	-	-	-	H	-	-	-	H	-	-	H	-	H	-
Lo/Rev Clutch	A	A	-	-	-	-	-	-	-	-	-	-	A	-

A = Applied

H = Holding

ON = Solenoid is energised

OFF = Solenoid is de-energised

* Shift solenoid state is a function of the vehicles speed and may change if the vehicle speed increases sufficiently

** Manual shift from second to first gear is electronically prevented under normal operating conditions

*** Manual shift from first to second gear is only available above approximately 48 – 56 km/h

5.3 Transmission Fluid Pressure Manual Valve Position Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C
Park/Neutral	Open 12 V	Closed 0 V	Open 12 V
Reverse	Closed 0 V	Closed 0 V	Open 12 V
Drive 4	Open 12 V	Closed 0 V	Closed 0 V
Drive 3	Open 12 V	Open 12 V	Closed 0 V
Drive 2	Open 12 V	Open 12 V	Open 12 V
Drive 1	Closed 0 V	Open 12 V	Open 12 V
Invalid	Closed 0 V	Open 12 V	Closed 0 V
	Closed 0 V	Closed 0 V	Closed 0 V

5.4 Transmission Range Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P
Park (P)	Closed 0 V	Open 12 V	Open 12 V	Closed 0 V
Reverse (R)	Closed 0 V	Closed 0 V	Open 12 V	Open 12 V
Neutral (N)	Open 12 V	Closed 0 V	Open 12 V	Closed 0 V
Drive 4 (OD)	Open 12 V	Closed 0 V	Closed 0 V	Open 12 V
Drive 3 (3)	Closed 0 V	Closed 0 V	Closed 0 V	Closed 0 V
Drive 2 (2)	Closed 0 V	Open 12 V	Closed 0 V	Open 12 V
Drive 1 (1)	Open 12 V	Open 12 V	Closed 0 V	Closed 0 V

5.5 Component Resistance

Component	Pass/Thru Pins	Resistance at 20°C	Resistance at 100°C	Resistance to Ground (Case)
Shift Solenoid A (1-2 Shift Solenoid Valve)	A, E	19 – 24 Ω	24 – 31 Ω	Greater than 250 kΩ
Shift Solenoid B (2-3 Shift Solenoid Valve)	B, E	19 – 24 Ω	24 – 31 Ω	Greater than 250 kΩ
TCC Solenoid Valve	T, E	21 – 26 Ω	26 – 33 Ω	Greater than 250 kΩ
TCC PWM Solenoid Valve	U, E	10 – 11 Ω	13 – 15 Ω	Greater than 250 kΩ
3-2 Shift Solenoid Valve	S, E	20 – 24 Ω	29 – 32 Ω	Greater than 250 kΩ
Pressure Control Solenoid Valve	C, D	3 – 5 Ω	4 – 7 Ω	Greater than 250 kΩ
*Transmission Fluid Temperature (TFT) Sensor	M, L	3088 – 3942 Ω	159.3 – 198.0 Ω	Greater than 10 MΩ
Vehicle Speed Sensor	A, B	1420Ω @ 25°C	2140 Ω @ 150°C	Greater than 10 MΩ

***:** The resistance of this device is necessarily temperature dependent and will therefore vary far more than any other device. Refer to 5.1 Transmission Fluid Temperature (TFT) Sensor Specifications.

5.6 Shift Solenoid Valve State and Gear Ratio

Gear	1-2 Shift Solenoid	2-3 Shift Solenoid	Gear Ratio
1	ON	ON	3.059:1
2	OFF	ON	1.625:1
3	OFF	OFF	1.000:1
4	ON	OFF	0.696:1

5.7 Line Pressure

Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (PSI)
0.00	198 – 227
0.10	197 – 226
0.20	189 – 221
0.30	181 – 216
0.40	168 – 205
0.50	154 – 193
0.60	137 – 175
0.70	114 – 156
0.80	90 – 132
0.90	64 – 105
1.00	53 – 85
1.10	53 – 68

6 Special Tools

For a complete listing of all the special tools used for servicing the 4L60E hydra-matic automatic transmission, refer to 7C1 Automatic transmission – 4L60E – General Information.

7C4
Automatic Transmission – 4L60E – On-vehicle Servicing

ATTENTION

Before performing any service operation or other procedure described in this Section, refer to General Information Warnings, Cautions and Notes for correct workshop practices with regard to safety and/or property damage.

1 General Information

This Section describes the removal and reinstallation procedures of the four speed 4L60E hydra-matic automatic transmission as well as the service operations which can be performed with the transmission still fitted to the vehicle.

1.1 General Service Information

Description

The shift selector mechanism is linked to the transmission manual shaft with a selector cable. A heat protector is fitted over the neutral start and back-up switch and manual shaft select lever.

For rear wheel drive (RWD) vehicles an extension housing is fitted to the rear of the transmission case.
Four wheel drive (4WD) vehicles have an adaptor housing and transfer case fitted to the rear of the transmission case, for description and service operation refer to 7D Transfer Case and Adaptor Housing.

The four speed 4L60E hydra-matic automatic transmission is fitted with a filler tube, a breather hose and a vent pipe for hot fluid overflow.

The transmission fluid is driven through a cooler within the radiator via the cooler line/hose assemblies to maintain normal operating temperature.

Service Information

WARNING

Throughout the service operations within this Section, when handling retaining clips, using compressed air or cleaning fluids, wear safety equipment to avoid personal injury.

Refer to 7C1 Automatic Transmission – 4L60E – General Information for the following:

- information relating to mechanical and electrical operations,
- abbreviations, transmission specifications, special tools and torque wrench specifications,
- servicing, cleaning and inspection procedure recommendations.

It is essential to read and understand the General Information, Warnings, Cautions and Service Notes contained in that same Section, before any service operation is performed on the four speed 4L60E hydra-matic automatic transmission or any associated components.
Failure to comply with the procedures and service notes can affect the reliable and efficient operation of this automatic transmission.

1.2 WARNINGS, CAUTIONS and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING Defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION Defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE Defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

2 Maintenance Operations

2.1 Transmission Fluid

When adding or changing the transmission fluid, use only the recommended automatic transmission fluid, refer to 0B Maintenance and Lubrication.

For the automatic transmission fluid diagnosis, refer to 7C3 Automatic Transmission – 4L60E – Hydraulic and Mechanical Diagnosis.

Transmission Fluid Colour

New transmission fluid is red in colour due to a dye that is added to the fluid so it can be distinguished from other oils and lubricants. The red dye is not permanent and as such, is not an indicator of the quality of the fluid.
As the vehicle is driven the transmission fluid will quickly look darker in colour and appear to be a light brown. A dark brown colour with a distinctively burnt odour may indicate fluid deterioration and the need for fluid replacement.

NOTE

A dark brown fluid colour observed, coupled with a reported delayed shift pattern may only indicate that fluid replacement is required. This is not a definite indication of a potential transmission failure.

Transmission Fluid Level

NOTE

Carry out this operation with the transmission at normal operating temperature (82 – 94°C), as the temperature greatly affects the fluid level.

1 Drive the vehicle for a distance of at least 25 km to bring the transmission up to normal operating temperature.

CAUTION

If the transmission is not at normal operating temperature and the correct procedure is not followed, the result could be a false reading of the fluid level on the transmission fluid indicator.

2 If the vehicle has been operated under any of the following conditions, switch the engine off and allow the transmission to cool for approximately thirty minutes:

- in high ambient temperatures above 32° C,
- at sustained high speeds,
- in heavy stop / start city traffic during hot weather, or
- towing.

3 Park the vehicle on level ground.

4 Move the gear selector to the Park position and apply the park brake.

5 Allow the engine to idle for 3 minutes with the accessories turned off.

6 Lift the locking lever (1) on the transmission fluid indicator, then remove the indicator from the filler tube (2) and check the fluid colour, condition and level.

CAUTION

Do not overfill the transmission. Overfilling can cause aeration resulting in fluid loss, shift complaints and possible damage to the transmission.

7 If the transmission fluid level is low, add only enough of the recommended fluid until its level shows onto the crosshatch hot area (3) of the fluid indicator.

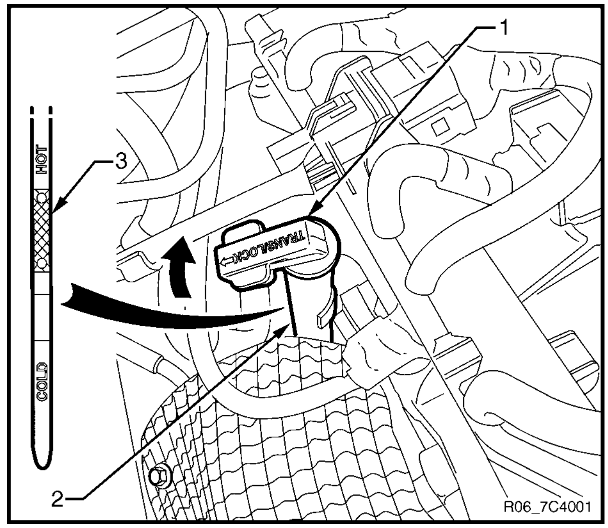


Figure 7C4 – 1

2.2 Reverse Flush and Flow Rate Test

It is essential to perform a reverse flush and oil cooler flow rate test after any of the following:

- the transmission is repaired or replaced,
- fluid contamination is suspected, or
- whenever the oil pump and/or torque converter is replaced.

NOTE

The reverse flush must be completed prior to conducting a flow rate test.

Reverse Flush

1 Disconnect both cooler hose/line assemblies at the transmission and at the radiator cooler, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

2 Check the cooler hose/line to radiator cooler fittings for damage, replace as required.

WARNING

To avoid personal injury, wear safety glasses when using compressed air.

3 Carefully check the radiator cooler lower fitting to see if any foreign material is evident at this point. If foreign material is found, remove it with a suitable tool and/or compressed air at a reduced pressure of approximately 345 kPa blown in the reverse direction through the cooler.

4 Using compressed air at a reduced pressure of approximately 345 kPa blown in a reverse direction, clean the cooler hose/line assemblies.

5 Reconnect the cooler outlet line to the transmission and both cooler hose/line assemblies to the radiator cooler fittings, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

NOTE

Do not reconnect the cooler inlet line at the transmission end. This line needs to be left disconnected to perform the flow rate test.

6 Perform the flow rate test, refer to Flow Rate Test in this Section.

INSPECTION AND REPAIR

Make correction or replace parts if wear, damage or abnormal conditions are found through inspection.

Visual Check

Inspect the following parts for wear, damage, nuts or other abnormal conditions.

- Leaf spring assembly
- Clip
- Center bolt
- U-bolt
- Spring pin
- Shackle pin
- Shock absorber
- Rubber bumper
- Rubber bushing
- Bump rubber seat

Shackle Pin

Shackle Pin diameter	mm (in)
17.93 - 18.00 (0.706 - 0.709)	

Spring Pin

Spring Pin Diameter	mm (in)
13.8 - 14.0 (0.543 - 0.551)	

Shock Absorber

Inspection operation of shock absorber

If no resistance is felt while expanding the shock absorber, it indicates that the absorber is faulty.

NOTE

This will also flush the cooler hose/line assemblies and cooler with transmission fluid.

7 If the flow rate is satisfactory, reconnect the cooler inlet line to the transmission, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

8 Lower the vehicle, check and top up the transmission fluid to the correct level as required, refer to 2.1 Transmission Fluid.

Flow Rate Test

CAUTION

Do not run the engine any longer than absolutely necessary, as a fluid level too low can cause aeration and foaming.

1 Ensure the transmission fluid is at the recommended level or slightly above, refer to 2.1 Transmission Fluid.

2 Disconnect the cooler inlet line at the transmission quick-connect fitting, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

3 Place a suitable size container underneath the disconnected cooler inlet line.

4 With the selector lever in the P position, start the engine and observe the fluid flow into the container after all the air bubbles have ceased and a steady flow is evident. Measure the flow rate over 20 seconds and ensure it is within the specification.

Transmission fluid flow rate specification per 20 Seconds:	
Temperature:	
Ambient	0.7 Litres
86° – 93° C	1.2 Litres

5 If the flow rate is less than the specification, the cause of the low flow rate must be located and rectified. Possible cause could include:

- restricted cooler within the radiator tank,
- kinked or damaged transmission cooler hose/line assemblies, or
- internal transmission fault such as a faulty pump.

6 Reinstall the cooler inlet line to the transmission quick-connect fitting, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

3 Service Operations

3.1 Fluid Change and Filter Replacement

WARNING

To avoid personal injury take note of the following:

- **Avoid accidental hot oil spillage by performing fluid change only when the transmission fluid is cold.**
- **Wear safety glasses and gloves when using compressed air and cleaning fluids.**

Remove

1 Raise the vehicle and support in a safe manner, refer to 0A General Information.

2 Clean all dirt from around the oil pan and the transmission case.

3 Place a suitable sized drain tray under the transmission.

4 Hold the oil pan (1) in place and remove the oil pan bolts (2) from the front and both sides.

NOTE

Leave the three rear oil pan bolts in place.

5 Loosen the three rear oil pan bolts by about 4 turns each. While still supporting the oil pan, lightly tap the sides with a rubber hammer to break the gasket (3) seal.

6 Lower the front of the oil pan and drain the fluid into a suitable container.

7 Remove the three remaining rear bolts and the oil pan from the transmission.

8 Remove the oil pan gasket and discard.

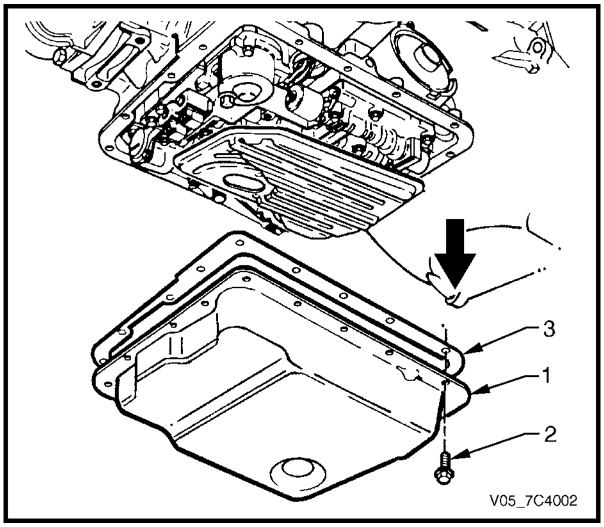


Figure 7C4 – 2

9 Remove the oil filter (1) by pulling down while twisting the filter and remove it from the transmission.

10 Open the filter by prising the metal crimping away from the top of the filter and pull it apart.

11 Inspect the filter material for particles that may indicate evidence of a potential transmission problem. Examples of the type of material are:

- clutch friction material,
- bronze slivers, indicating bush wear and
- steel particles.

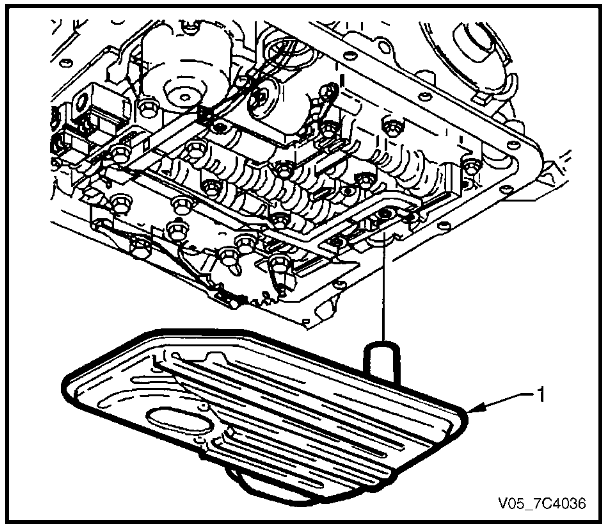


Figure 7C4 – 3

CAUTION

Take care not to scratch the oil pump bore, as fluid leakage could occur from this point or the pump may suck in air, causing the fluid to aerate.

12 Using suitable circlip pliers (1) or a two legged puller and slide hammer, remove the oil filter seal (2) taking care not to scratch the oil pump bore (3) during the process. Discard the seal.

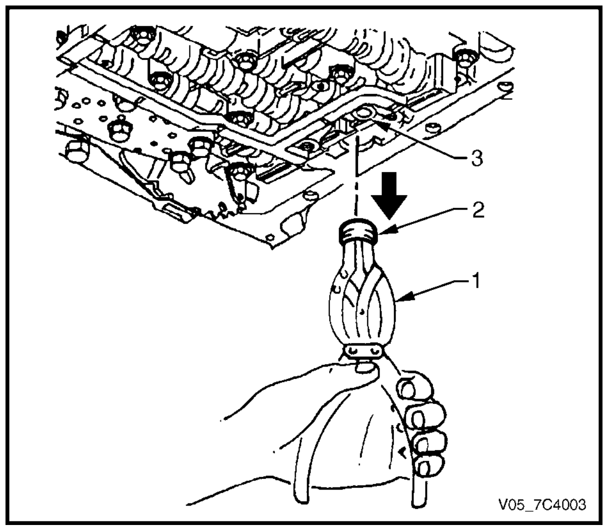


Figure 7C4 – 4

Reinstall

1 Clean the oil pan in a commercially available cleaning fluid and blow dry using compressed air.

NOTE

Ensure all traces of the old gasket are removed from the transmission and oil pan.

2 Wipe the transmission case gasket mating surface with a clean lint free cloth.

3 Lubricate a new oil filter seal (1) with clean transmission fluid and install into the oil pump bore (2) using a suitable sized socket or piece of tubing.

4 Install a new filter into the transmission case.

5 Check if the magnet is functional and located in the designated position in the oil pan. Install a new gasket and reinstall the oil pan.

6 Tighten the bolts attaching the oil pan to the correct torque specification.

Oil pan attaching bolt torque specification	12.0 Nm

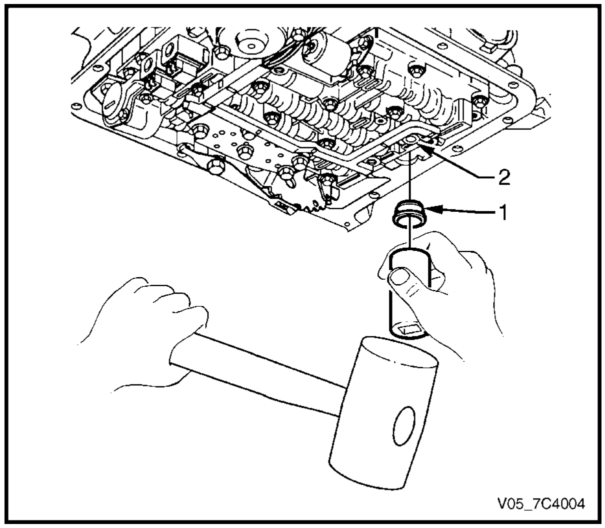


Figure 7C4 – 5

7 Lower vehicle and add approximately 4.8 litres of automatic transmission fluid.

8 Operate the vehicle for about 24 km or until normal transmission operating temperature is reached, refer to 2.1 Transmission Fluid.

9 Ensure there are no fluid leaks from the oil pan area, rectify as required.

10 Check and top up the transmission fluid to the correct level as required, refer 2.1 Transmission Fluid.

3.2 Shift Selector Assembly

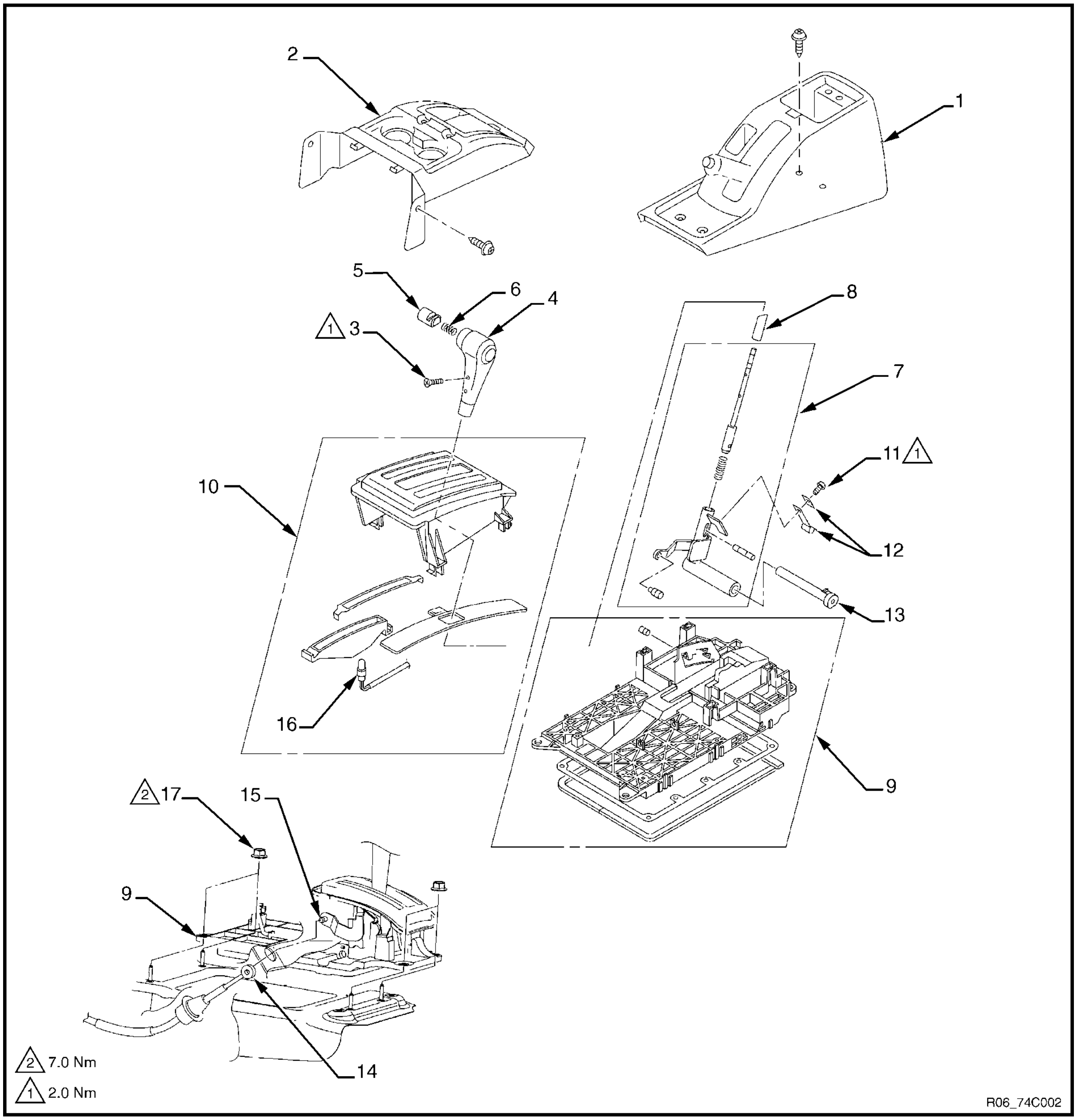


Figure 7C4 – 6

Legend

1	Rear Console	7	Selector Lever Assembly	13	Grooved Pin
2	Front Console	8	Sleeve	14	Selector Cable
3	Screw – Knob	9	Base Plate	15	Selector Lever Linkage
4	Knob	10	Upper Housing Assembly	16	Lamp
5	Button – Knob	11	Screw – Spring Plate	17	Nut – Base Plate
6	Spring – Knob	12	Spring Plate		

Remove

1 Remove the front and rear console, refer to 10 Cab.

2 Position the transmission selector lever to the N position.

3 Remove the screw (3), two places, attaching the selector lever knob (4), refer to Figure 7C4 – 6.

4 Remove the knob together with the button (5) and spring (6) from the selector lever assembly (7).

5 Turn the sleeve (8) counter clockwise to remove it, make note of the number of turns required to free it.

6 Remove the harness connectors from the base plate (9).

7 Remove the upper housing (10) which is held in place by four latched fasteners.

8 Remove the attaching screw (11) and spring plate (12).

9 Remove the grooved pin (13).

10 Using a small flat blade screwdriver, gently prise the upper end of the selector cable (14) from the pin on the selector lever linkage (15).

11 Remove the selector lever assembly by pressing the rod down (lever in the N position).

12 If required, remove the lamp (16) from its socket by aligning the groove in the socket and the protruding part of the lamp.

13 If required, remove the nut (17), four places, and the shift selector base plate.

Reinstall

1 Apply MULTEMP No 2 grease, or equivalent to the selector lever as indicated in Figure 7C4 – 7.

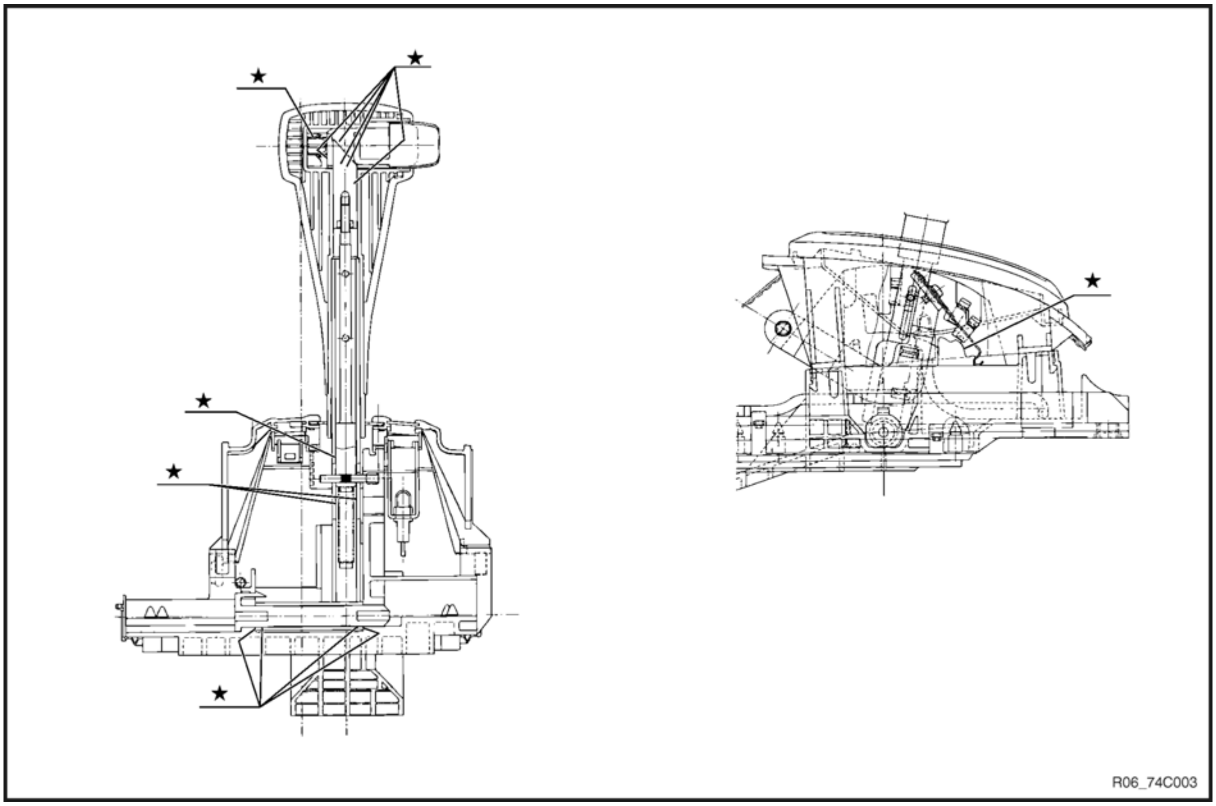


Figure 7C4 – 7

2 If required, install the shift selector base plate (9) and tighten the nut (17), four places, to the correct torque specification, refer to Figure 7C4 – 6.

Shift selector base plate attaching nut torque specification ....7.0 Nm

3 Install the selector lever assembly (7) to the base plate:

a insert and secure the rod,

b insert the paw led end of the selector lever linkage (15) into the base plate hole,

c attach the end of the selector cable to the pin on the selector lever linkage, d Install the grooved pin (13) in the selector lever.

4 Insert the grooved pin in the base plate détente groove until it touches the front wall. The selector lever is in the N position.

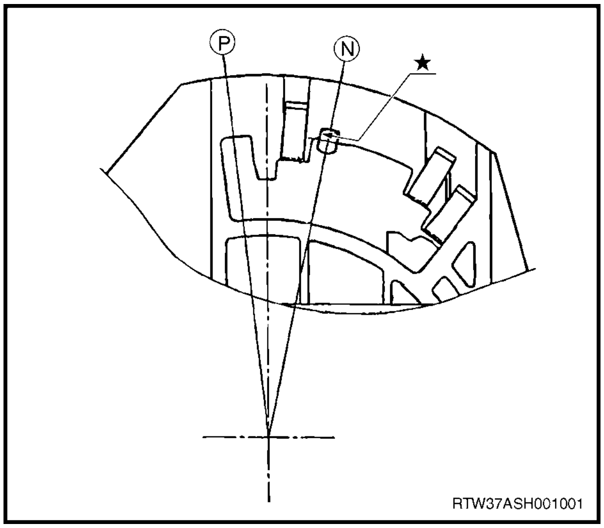


Figure 7C4 – 8

5 Install the spring plate (12) and tighten the screw (11) to the correct torque specification, refer to Figure 7C4 – 6.

Spring plate attaching screw torque specification ....2.0 Nm

6 With the selector lever knob temporarily installed, ensure the grooved pin of the selector lever moves smoothly in the base plate détente groove.

7 Temporarily install the sleeve (8).

8 If previously removed, install the lamp (16) by aligning the groove in the socket and the protruding part of the lamp and rotate the lamp 90 degrees clockwise.

9 Attach the harness connectors to the base plate.

10 Position the transmission selector lever to the P position.

11 Install the sleeve (8) by rotating it clockwise the same number of turns as noted on removal.

12 Fit the upper housing (10) over the selector lever assembly, do not secure at this stage.

13 Install the knob (4) together with the button (5) and spring (6) to the selector lever assembly.

14 Adjust the clearance (2) between the base plate détente groove and the grooved pin by moving the selector lever knob sleeve (1).

Base plate détente groove and grooved pin clearance............................... 0.2 – 1.0 mm

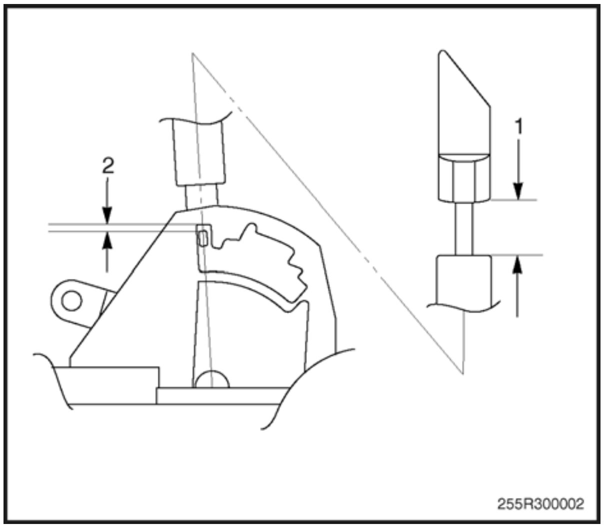


Figure 7C4 – 9

15 Install the screw (3), two places, attaching the knob and tighten to the correct torque specification, refer to Figure 7C4 – 6.

Selector lever knob attaching screw torque specification ....2.0 Nm

16 Secure the upper housing (10) to the base plate with the four latched fasteners.

17 Install the front and rear console, refer to 10 Cab.

3.3 Selector Cable Assembly

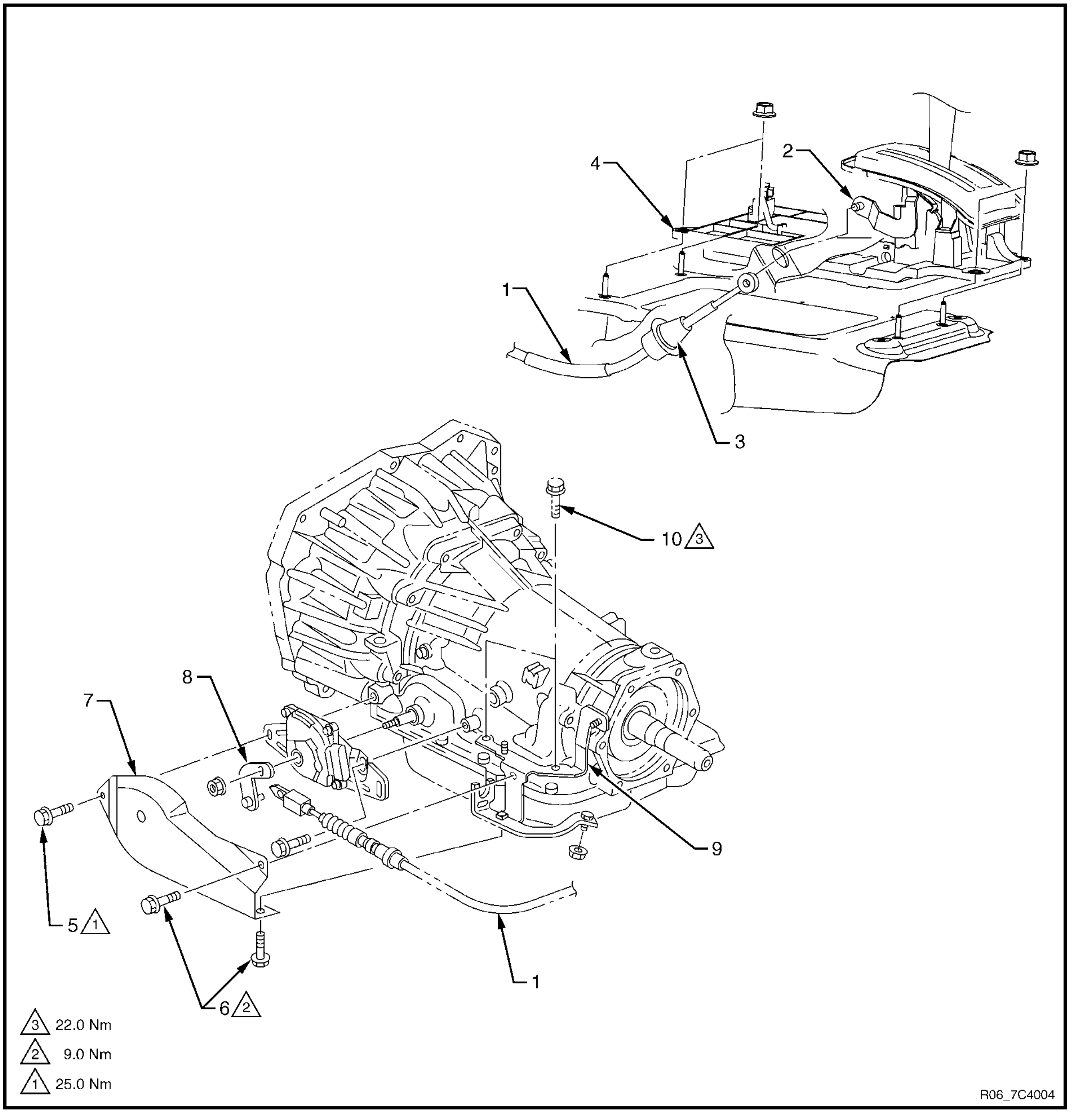


Figure 7C4 – 10

Legend

1	Selector Cable	6	Screw – Heat Shield
2	Selector Lever Linkage	7	Heat Shield
3	Retaining Pawl – Selector Cable	8	External Manual Shaft Linkage
4	Shift Selector Base Plate	9	Bracket
5	Screw – Heat Shield	10	Bolt – Bracket

Remove

1 Remove the front and rear console, refer to 10 Cab.

2 Position the transmission selector lever to the N position.

3 Using a small flat blade screwdriver, gently prise the upper end of the selector cable (1) from the pin on the selector lever linkage (2), refer to Figure 7C4 – 10.

4 Press on the selector cable retaining pawl (3) to remove the cable from the shift selector base plate (4).

5 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

6 Remove the three attaching screws (5 and 6) and the heat shield (7).

7 Using a small flat blade screwdriver, gently prise the transmission end of the selector cable from the transmission external manual shaft linkage (8).

8 Remove the clip and selector cable from the bracket (9).

9 Pull the selector cable free from the bottom of the vehicle.

10 If required, remove the two attaching bolts (10) and the selector cable bracket.

Reinstall

1 Install the selector cable (1) toward the inside of the cabin from under the vehicle, refer to Figure 7C4 – 10.

2 Push the end of the selector cable into the shift selector base plate (4).

3 Attach the end of the selector cable to the pin on the selector lever linkage (2).

4 If required, install the selector cable bracket (9), tighten the two attaching bolts (10) to the correct torque specification.

Selector cable bracket attaching bolt torque specification ....22.0 Nm

5 Fit the selector cable to the bracket and install the clip on the marking of the selector cable.

6 Ensure the selector lever is in the N position.

7 Ensure the transmission external manual shaft linkage (8) is in the N position.

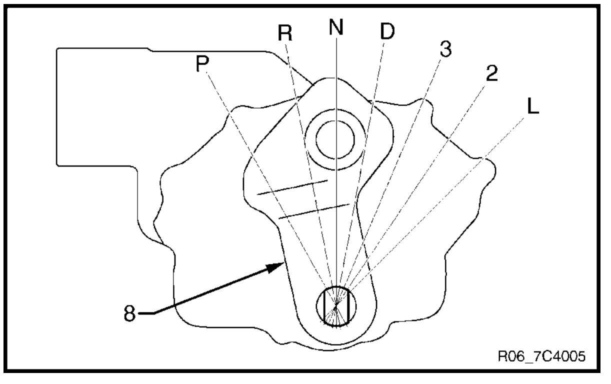


Figure 7C4 – 11

8 Slide the cover (3) in the direction shown by the arrow (1).

9 Using a small flat blade screwdriver, move the lock piece (4) from the position indicated by the arrow (2). Continue to move the lock piece until the adjuster (5) position begins to change.

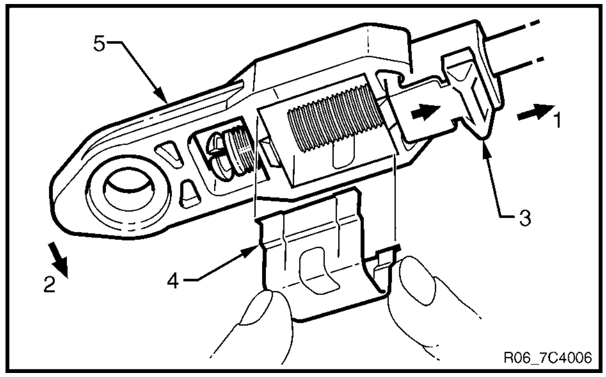


Figure 7C4 – 12

10 Connect the selector cable to the transmission external manual shaft linkage.

11 Insert the lock piece in the adjuster to engage with the serrated cable end (cable length adjustment).

12 Slide the cover (1) on the adjuster and secure the lock piece.

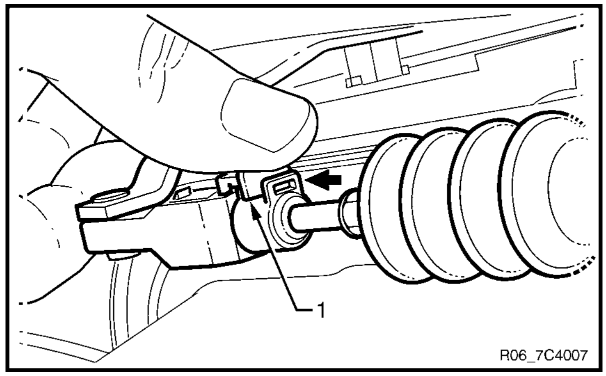


Figure 7C4 – 13

13 Install the heat shield (7) and tighten the attaching screws (1 and 6) to the correct torque specification, refer to Figure 7C4 – 10.

Heat shield front attaching screw torque specification	25.0 Nm
Heat shield rear attaching screw torque specification	9.0 Nm

14 Move the selector lever to the P position and press the selector lever knob button five times.

15 Ensure the selector lever moves smoothly to each of its positions.

16 Check if the shift position indicated by the selector lever and the actual shift position are the same, rectify if required.

17 Lower the vehicle to the ground. Ensure the engine can only be started with the transmission selector lever in Park or Neutral position and the back-up lamps work correctly. If required, adjust the neutral start and back-up lamp switch, refer to 3.4 Neutral Start and Back-up Lamp Switch.

18 Ensure the gear selection operates correctly.

19 Install the front and rear console, refer to 10 Cab.

3.4 Neutral Start and Back-up Lamp Switch

Remove

1 Position the transmission selector lever to the P position.

2 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

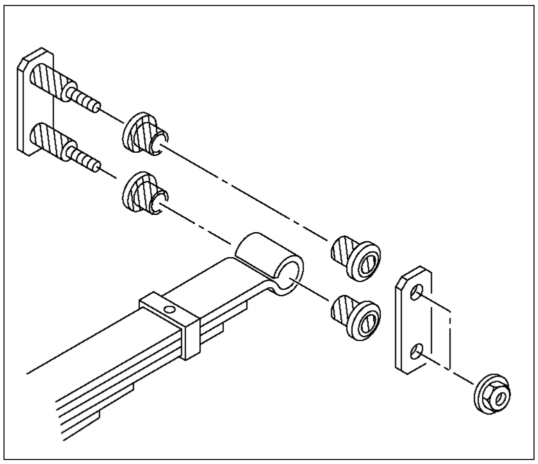
Installation

1. Install the bump rubber and bolt and tighten it to the specified torque.

Torque	N·m (kgf·m/lb·ft)
42 (4.3/31)	

2. Install the leaf spring.
   - The leaf spring assembly should be installed so that the built-in rubber bush is toward the front.
   - Align the holes of the spring eye and frame bracket.
   - Insert the spring pin toward vehicle inner side, through the frame bracket holes and the spring bush hole.
   - Tighten the nut a little and, after the vehicle is lowered, tighten it to the specified torque.

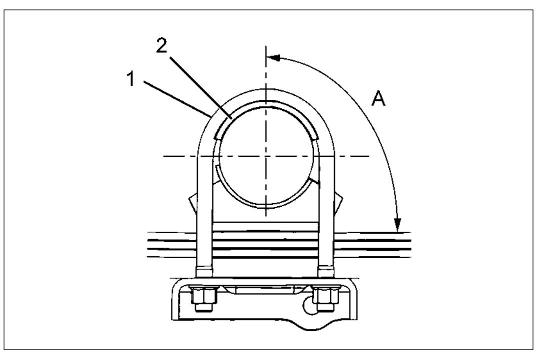
Torque	N·m (kgf·m/lb·ft)
152 (15.5/112)	


RTW340LF000101

   - Apply rubber grease to inside and outside of the rubber bushing.
   - Install the rubber bushings into the hole in the frame side bracket and the spring rear eye.
   - Install the shackle pin and shackle plate.
   - Tighten the nuts a little and, after vehicle is lowered, tighten it to the specified torque.

Torque	N·m (kgf·m/lb·ft)
98 (10.0/72)	

3. Support the lower clamp under the leaf spring.
4. Apply oil to the thread portion of U bolt.
   Install the U bolt (1) and seat (2) on the rear axle and insert the U bolt in the lower clamp holes.



RTW63DSH000101

Tolerance of assembling the seat

A
90° ±2°

5. Tighten the nut to the specified torque.
NOTE: Apply oil to the thread.

Torque	N·m (kgf·m/lb·ft)
78 (8.0/58)	

6. Install the shock absorber and inner washer on the lower clamp pin and frame side pin.
7. Install the washer and nut on the frame side pin and tighten the nut to the specified torque.

Torque	N·m (kgf·m/lb·ft)
39 (4.0/29)	

8. Install the washer and nut on the lower clamp pin and tighten the nut to the specified torque.

Torque	N·m (kgf·m/lb·ft)
39 (4.0/29)	

3 Remove the three attaching screws (1 and 2) and the heat shield (3).

4 Hold the transmission manual shaft linkage (4) with an adjustable wrench and remove the linkage attaching nut (5).

5 Carefully remove the manual shaft linkage and selector cable from the transmission manual shaft (6).

6 Prise the connector position assurance (CPA) securing pin (7) from the neutral start and back-up lamp switch (8) taking care not to break the pin in the process. Disconnect the connector (9) from the switch assembly by pulling down the release bar (10).

NOTE

The connector will automatically disconnect at the same time the release bar is withdrawn.

7 Remove the attaching screw (11) and slide the switch assembly over the transmission manual shaft to remove it.

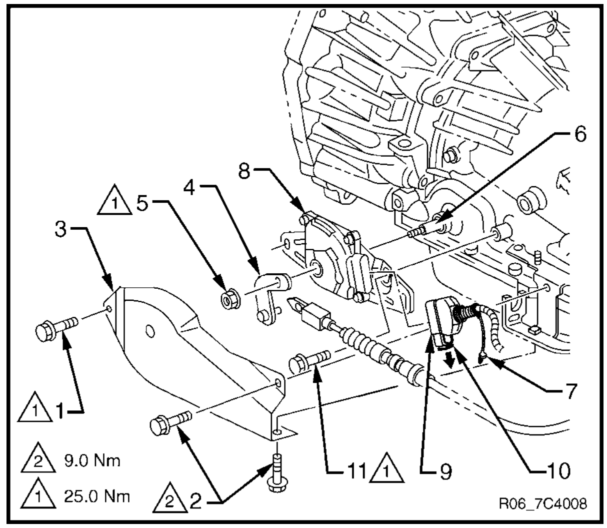


Figure 7C4 – 14

Reinstall

1 Slide the neutral start and back-up lamp switch (8) over the transmission manual shaft (6) and reinstall the two attaching screws (1 and 11), tighten them finger tight until the adjustment process has been completed, refer to Figure 7C4 – 14.

2 Install the manual shaft linkage (4) and the attaching nut (5). Hold the linkage with an adjustable wrench and tighten the nut to the correct torque specification.

Manual shaft linkage attaching nut torque specification ....25.0 Nm

3 Install the connector (9) but do not reinsert the CPA securing pin (7) at this stage.

4 Check the shift selector linkage operation and adjust as required, refer to 3.2 Shift Selector Assembly.

5 Check and adjust as required the neutral start and back-up lamp switch as described in this Section, refer to Adjust.

Adjust

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 If required, loosen the neutral start and back-up lamp switch (8) as follows, refer to Figure 7C4 – 14:

a Remove the three attaching screws (1 and 2) and the heat shield (3).

b Prise the connector position assurance (CPA) securing pin (7) from the neutral start and back-up lamp switch taking care not to break the pin in the process.

c Disconnect connector (9) from the switch assembly by pulling down the release bar (10).

NOTE

The connector will automatically disconnect at the same time the release bar is withdrawn.

d Loosen the screw (11) attaching the switch and refit the front screw (1) keep them finger tight.

e Reinstall the connector (9) but do not reinsert the CPA securing pin at this stage.

3 Rotate the neutral start and back-up lamp switch back and forth until a central position is attained and then lightly tighten the front screw (1) to prevent the switch from rotating.

WARNING

Ensure the four wheels are off the ground before performing the starting test.

4 With the ignition switched to the ON position, check if the engine can only be started in the Park and Neutral shift selector positions and ensure the back-up lamps illuminate when Reverse is selected. A further minor adjustment may be required to achieve this state.

NOTE

To gain access to the rear attaching screw (11) it will be necessary to remove the connector.

5 After the switch has been adjusted, tighten the rear attaching screw (11) to the correct torque specification.

Neutral start and back-up lamp switch attaching screw torque specification	25.0 Nm

6 Reinstall the connector and the CPA securing pin.

7 Remove the switch front attaching screw (1).

8 Install the heat shield (3) and tighten the attaching screws (1 and 2) to the correct torque specification.

Heat shield front attaching screw torque specification	25.0 Nm
Heat shield rear attaching screw torque specification	9.0 Nm

9 Lower the vehicle to the ground and re-check the operation of the neutral start and back-up lamp switch. The vehicle must start only with the shift selector in the Park or Neutral positions and the back-up lamps should only illuminate when Reverse is selected.

3.5 Vehicle Speed Sensor

NOTE

For the speed sensor fitted to four wheel drive vehicles (4WD), refer to 7D Transfer Case and Adaptor Housing.

Remove

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 Disconnect connector (1) from the vehicle speed sensor (2).

3 Remove the bolt (3) attaching the speed sensor to the transmission extension housing.

4 With a pulling and turning motion, remove the speed sensor and O-ring seal (4) from the transmission extension housing, discard the O-ring.

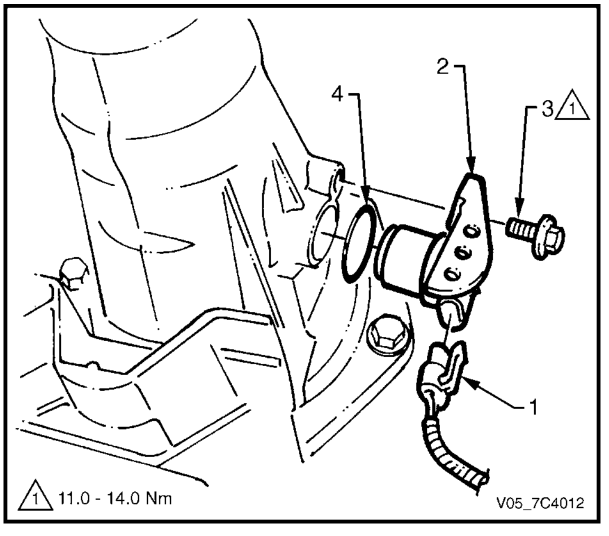


Figure 7C4 – 15

Reinstall

1 Lubricate a new O-ring seal with petroleum jelly and install it to the vehicle speed sensor.

2 Install the speed sensor to the transmission extension housing.

3 Install the attaching bolt and tighten to the correct torque specification.

Vehicle speed sensor attaching bolt torque specification .... 12.0 Nm

4 Connect the connector to the speed sensor.

5 Lower the vehicle to the ground.

3.6 Manual Shaft Oil Seal

Replace

NOTE

This procedure requires the use of special tool No. AU583.

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 Remove the neutral start and back-up lamp switch, refer to 3.4 Neutral Start and Back-up Lamp Switch.

3 Assemble the seal remover, Tool No. AU583-3 (1) by installing the remover nut, Tool No. AU583-4 (2) with its threaded inner diameter closest to the hexagonal head of the seal remover tool. Install the nut up to the hexagonal head.

4 Install the assembled seal remover tool over the manual shaft (3) engaging the tapered thread end (4) into the seal.

CAUTION

Do not over tighten the seal remover tool in the seal.

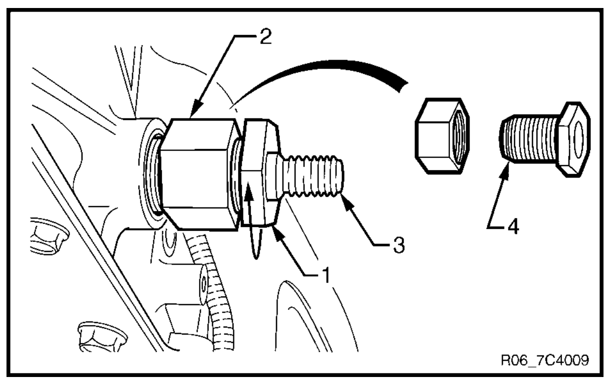


Figure 7C4 – 16

5 Rotate the hexagonal head of the seal remover tool clockwise, until the thread grips the steel shell of the seal.

6 While holding the hexagonal head of the seal remover tool (1) rotate the remover nut (2) clockwise, until it contacts the transmission case.

7 Continue rotating the remover nut until the seal is pulled into the remover nut cavity.

8 Remove and discard the seal.

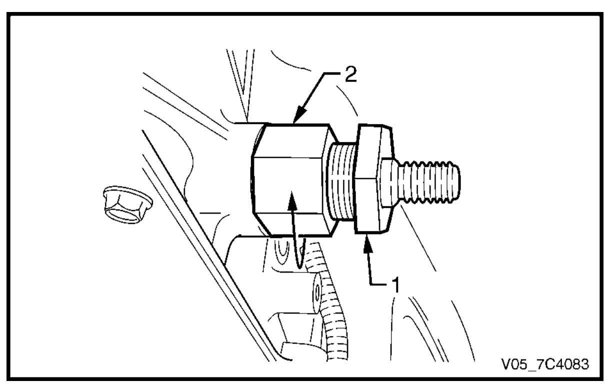


Figure 7C4 – 17

9 Install the seal protector, Tool No. AU583-1 (1) into one of the two plastic seal installers, Tool No. AU583-2 (2).

NOTE

Two plastic seal installers are required because of the restricted space between the end of the manual shaft and the floor pan.

10 Lubricate the lip of a new seal (3) with clean automatic transmission fluid and install it over the seal protector sleeve, with the steel casing facing the installer tool.

11 Install the seal protector with the new seal and installer tool over the manual shaft (4) and up to the transmission case.

CAUTION

If the seal protector sleeve jams on the manual shaft, the flats on the shaft locating the selector lever will be burred. Use a fine file to remove any burrs and then proceed.

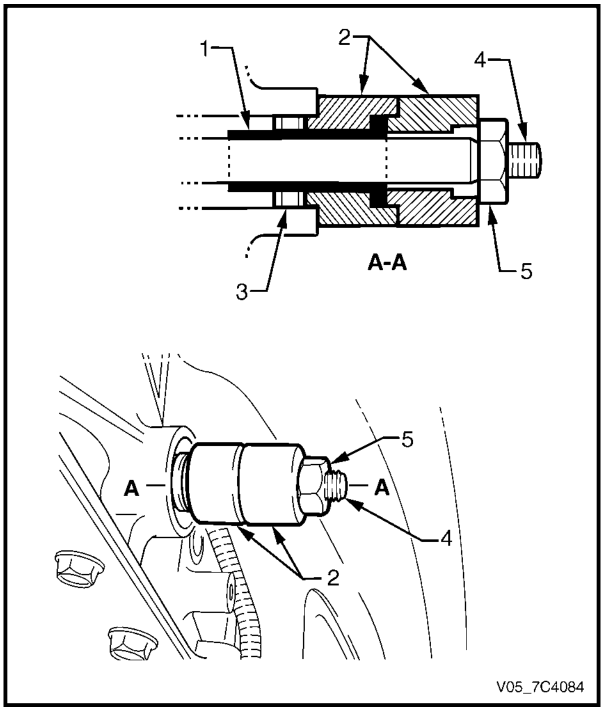


Figure 7C4 – 18

12 Fit the second plastic seal installer over the manual shaft until it seats against the first installer.

13 Install the manual shaft linkage attaching nut (5) and tighten it to drive the seal in position into the transmission case.

14 Remove the seal installer and protector tools from the manual shaft.

15 Reinstall the neutral start and back-up lamp switch, refer to 3.4 Neutral Start and Back-up Lamp Switch.

16 Lower the vehicle to the ground and as required, check and top up the automatic transmission fluid level, refer to 2.1 Transmission Fluid.

3.7 Transmission Support and Mount

Remove

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 Support the transmission with a Jack, do not place the support underneath the extension housing or the oil pan, refer to Figure 7C4 – 19.

3 Remove the clip (1) holding the fuel feed and fuel vapour lines on the transmission support (2).

4 Remove the bolt (3) attaching the heat shield (4) to the transmission support.

5 Remove the two nuts (5) attaching the transmission mount to the support.

6 Remove the four bolts and nuts (6) attaching the transmission support to the under body side rails and remove the support.

7 If required, remove the two bolts (7) attaching the transmission mount (8) to the extension housing and remove the mount.

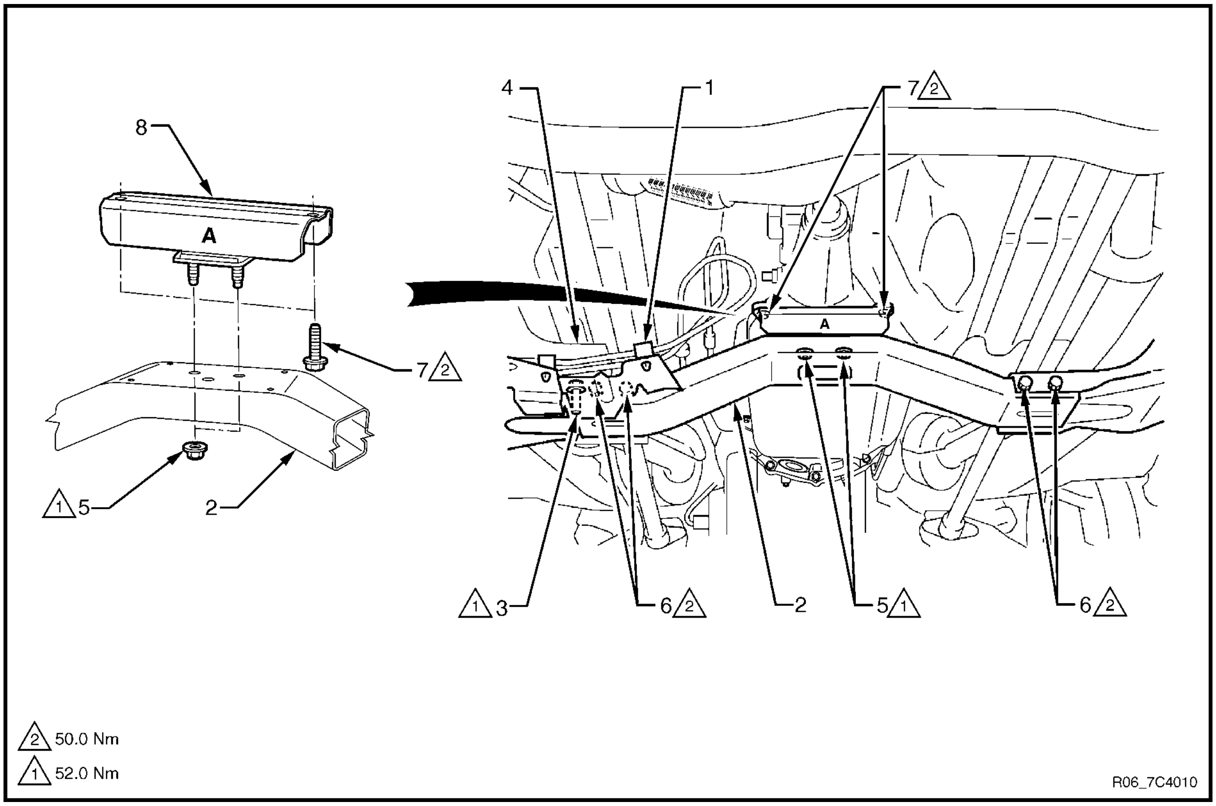


Figure 7C4 – 19

Legend

1	Fuel Feed and Vapour Lines Clip	5	Transmission Mount Nuts
2	Transmission Support	6	Transmission Support Bolts
3	Heat Shield Bolt	7	Transmission Mount Bolts
4	Heat Shield	8	Transmission Mount

Reinstall

1 If required, install the transmission mount (8) onto the extension housing, tighten the two attaching bolts (7) to the correct torque specification, refer to Figure 7C4 – 19.

Transmission mount attaching bolt torque specification ....50.0 Nm

2 Install the transmission support (2) to the under body side rails and tighten the four attaching bolts and nuts (6) to the correct torque specification.

Transmission support attaching bolt and nut torque specification ....50.0 Nm

3 Install and tighten the transmission mount two attaching nuts (5) to the correct torque specification.

Transmission mount attaching nut torque specification.....................................52.0 Nm

4 Install the bolt (3) attaching the heat shield (4) to the transmission support, tighten to the correct torque specification.

Heat shield to transmission support attaching bolt torque specification......................52.0 Nm

5 Reinstall the clip (1) holding the fuel feed and fuel vapour lines on the transmission support.

6 Lower the vehicle to the ground.

3.8 Extension Housing Oil Seal, RWD

Replace

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 Remove the rear propeller shaft, refer to 4A Propeller Shaft.

3 Place a suitable size drip tray underneath rear of transmission.

CAUTION

Take care not to scratch the machined seal recess in the extension housing as transmission fluid may weep past the outer diameter of the installed seal.

4 Using the seal remover, Tool No. E308 (1) or equivalent, prise the oil seal (2) from rear of the extension housing (3) and discard the seal.

5 Thoroughly clean around the seal bore in the extension housing and ensure there are no burrs.

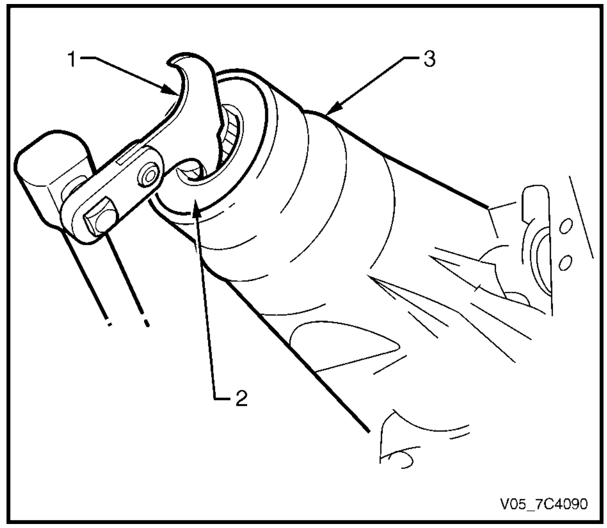


Figure 7C4 – 20

6 Use the seal installer, Tool No. J21426 (1) and a soft faced hammer to tap a new oil seal (2) into place in the extension housing (3).

7 Install the rear propeller shaft, refer to 4A Propeller Shaft.

8 Lower the vehicle to the ground and check the fluid level, refer to 2.1 Transmission Fluid.

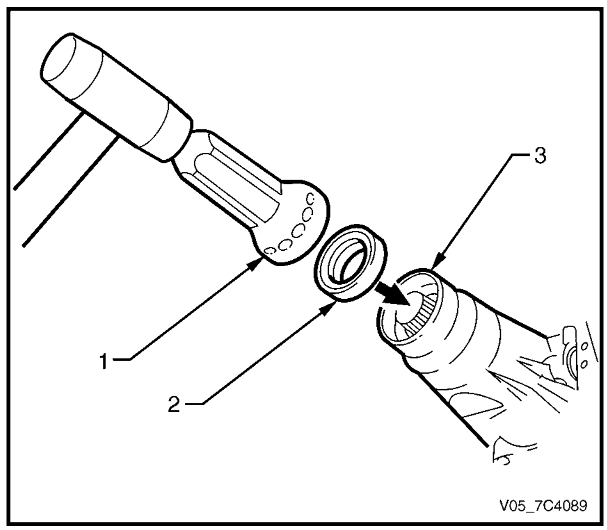


Figure 7C4 – 21

3.9 Extension Housing and Rear Bush, RWD

Remove

1 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

2 As required, remove the following components:

a Rear propeller shaft, refer to 4A Propeller Shaft.

b Transmission support and mount assembly, refer to 3.7 Transmission Support and Mount.

c Vehicle speed sensor, refer to 3.5 Vehicle Speed Sensor.

3 Remove the bolt (1), six places, attaching the extension housing (2) to the transmission case.

4 Remove the extension housing and seal (3) from the rear of the transmission case, discard the seal.

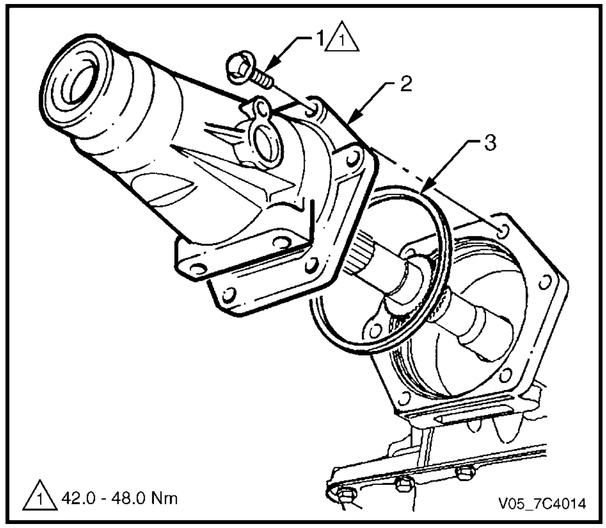


Figure 7C4 – 22

CAUTION

Take care not to scratch the machined seal recess in the extension housing as transmission fluid may weep past the outer diameter of the installed seal.

5 If the extension housing rear bush is to be replaced, remove the oil seal (1) from the extension housing (2), using a suitable removing tool such as Tool No. E308 and discard the seal.

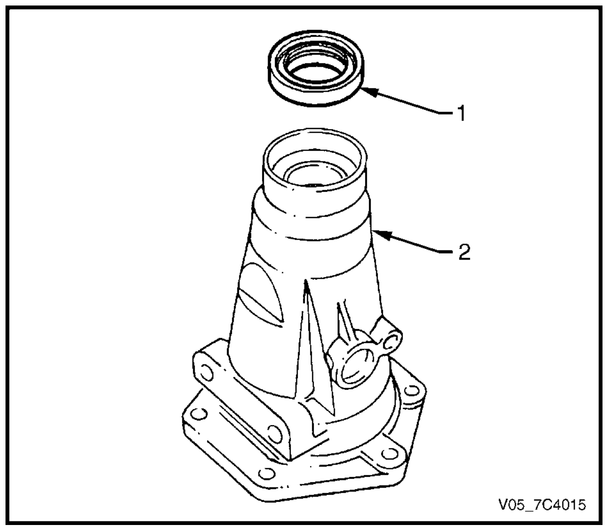


Figure 7C4 – 23

NOTE

Before removal, take note of the orientation of the split in the bush to assist in the replacement process.

6 If required, using the bush remover, Tool No. J23062-14 (1) and driver handle, Tool No. J8092 (2), press the bush (3) out of the extension housing (4) and discard.

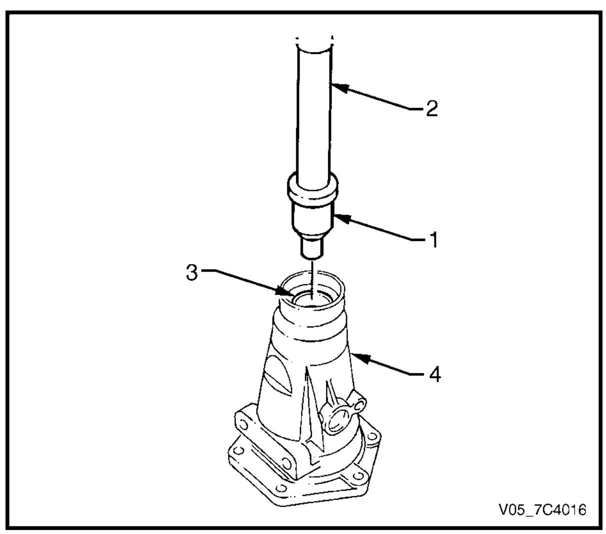


Figure 7C4 – 24

7 Lubricate the outside of a new bush with automatic transmission fluid to reduce the chance of material pick-up.

8 Ensure the split in the new bush (1) is in the same orientation as noted previously and Install it into the extension housing (2) using the installer tool, Tool No. J34196-4 (3) and driver handle, Tool No. J8092 (4).

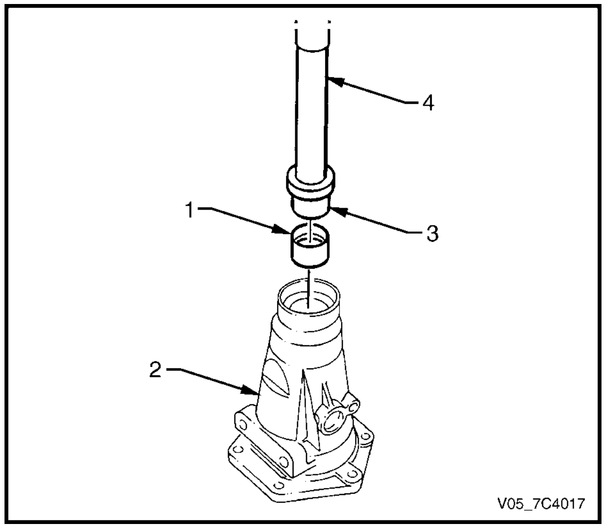


Figure 7C4 – 25

Reinstall

Installation of the extension housing is the reverse of the removal procedure, noting the following:

1 If required, install a new oil seal in the extension housing, refer to 3.8 Extension Housing Oil Seal.

2 Lubricate a new seal with clean automatic transmission fluid and fit to the extension housing mounting flange.

3 Tighten the six bolts attaching the extension housing to the correct torque specification.

Extension housing attaching bolt torque specification .... 42.0 – 48.0 Nm

3.10 Adaptor Housing, 4WD

Remove and Reinstall

For service operation of the transmission adaptor housing for 4WD vehicles, refer to 7D Transfer Case and Adaptor Housing.

3.11 Shift Solenoid Locations

Location and Identification

Legend

1. Transmission Fluid Pressure (TFP) Manual Valve Position Switch.
2. 1 – 2 Shift Valve Solenoid A.
3. 2 – 3 Shift Valve Solenoid B.
4. Pressure Control Solenoid (PCS).
5. Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid.
6. 3 – 2 Control Solenoid.

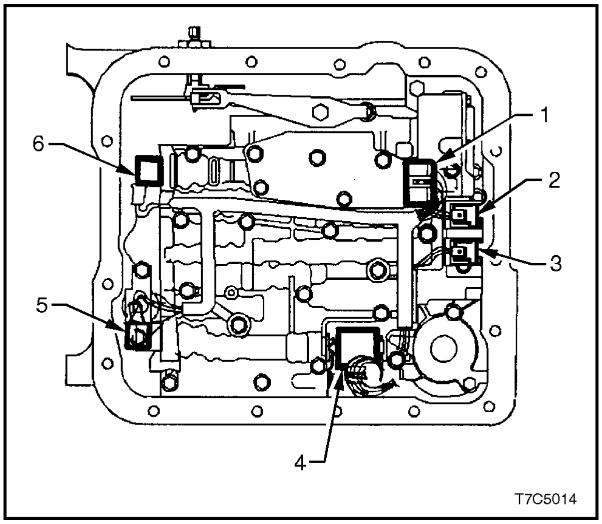


Figure 7C4 – 26

To service the TCC PWM solenoid, refer to 3.13 Control Valve Body Harness.

3.12 1 – 2 Accumulator Assembly

WARNING

Throughout this Section when using compressed air and cleaning fluids, wear safety glasses and gloves to avoid personal injury.

Remove

1. Remove the oil pan and filter, refer to 3.1 Fluid Change and Filter Replacement.
2. Remove the two short bolts (1) and one long bolt (2) attaching the accumulator cover (3) and remove the cover.
3. Using low pressure compressed air applied to the drilling in the cover, remove the 1 – 2 accumulator piston and seal assembly (4) and the two springs (5 and 6).
4. Remove the seal from the piston and discard the seal.

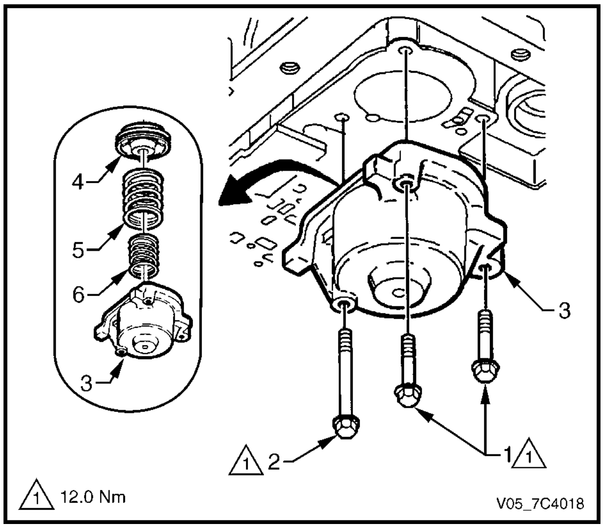


Figure 7C4 – 27

Clean and Inspect

1. Clean all components in a commercially available cleaning fluid and blow dry using compressed air.
2. Inspect the springs and ensure they are not distorted or broken, replace as required.
3. Inspect all machined surfaces for damage, wear or burrs.

Reinstall

Reinstallation of the 1 – 2 accumulator assembly is the reverse of the removal procedure, noting the following:

1. Lubricate a new seal with petroleum jelly and install it to the piston. Ensure the piston seal does not bind in the piston groove.
2. Tighten the three bolts attaching the accumulator cover to the correct torque specification.

1 – 2 Accumulator cover attaching bolt torque specification ....12.0 Nm

3.13 Control Valve Body Harness

Remove

1. Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.
2. As required, remove the oil pan and filter, refer to 3.1 Fluid Change and Filter Replacement.
3. Disconnect the control valve body harness connectors from all electrical components except the torque converter clutch (TCC) solenoid, which is hard wired. Connectors identification:
   - Transmission Fluid Pressure (TFP) Manual Valve Position Switch (1)
   - 1 – 2 Shift Valve Solenoid A (2)
   - 2 – 3 Shift Valve Solenoid B (3)
   - Pressure Control Solenoid (PCS) (4)
   - Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid (5)
   - 3 – 2 Control Solenoid (6).

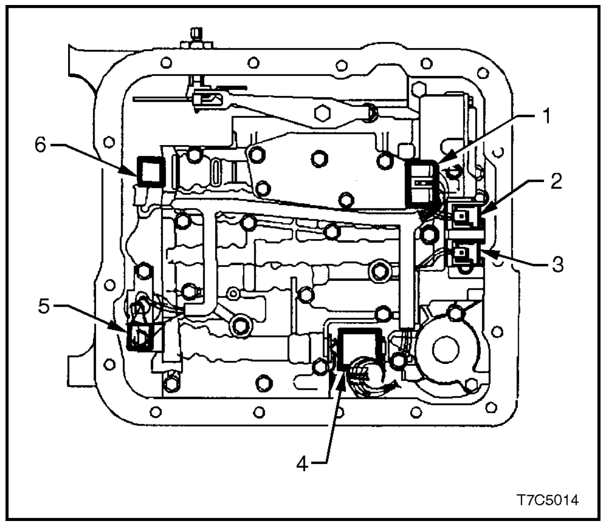


Figure 7C4 – 28

9. Install the parking brake cable on the leaf spring and tighten the nut at its bracket.

Torque	N·m (kgf·m/lb·in)
7 (0.7/61)	

CAUTION

To prevent personal injury, wear safety glasses when removing the clip.

NOTE

Note the following when removing the solenoid:

- If required, rotate the solenoid until the flat part of the clip becomes visible.
- The removal is only necessary to access the TCC solenoid attaching bolts.

4 Using a hooked piece of wire or a small flat blade screwdriver, remove the clip (1) retaining the TCC PWM solenoid (2).

5 With a twisting and pulling motion remove the TCC PWM solenoid from the control valve body, remove and discard the O-ring.

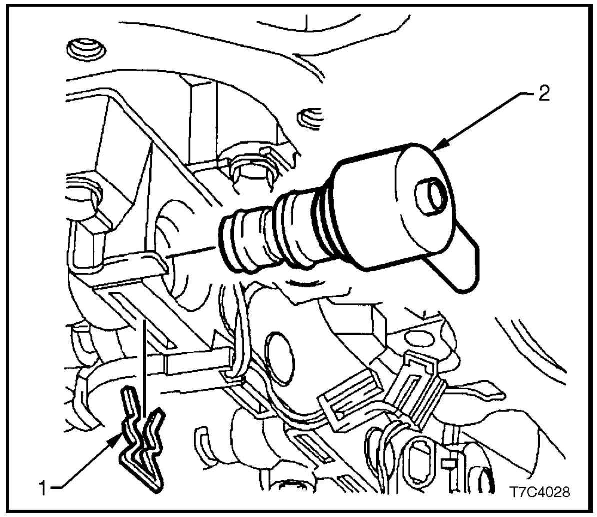


Figure 7C4 – 29

6 Remove the two bolts (1) attaching the TCC solenoid assembly (2) to the control valve body.

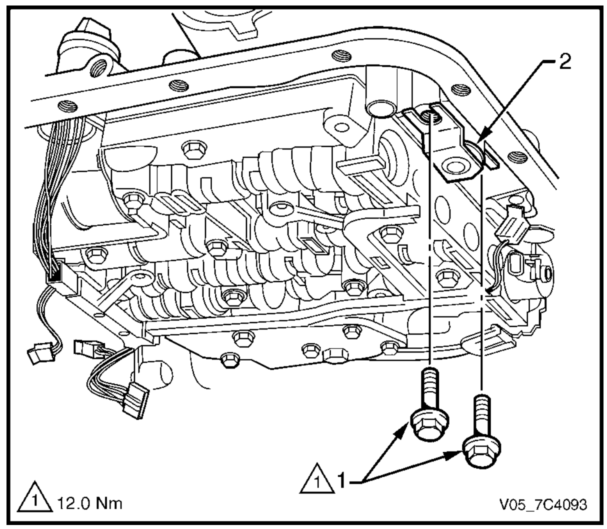


Figure 7C4 – 30

7 Withdraw the TCC solenoid assembly (1) from the control valve body (oil pump housing), remove and discard the O-ring.

8 Lower the harness (2) and TCC solenoid, allow it to hang from the pass-thru connector (3).

9 Remove the control valve body, refer to 3.14 Control Valve Body.

NOTE

This is necessary to provide clearance for the pass-thru connector to be removed.

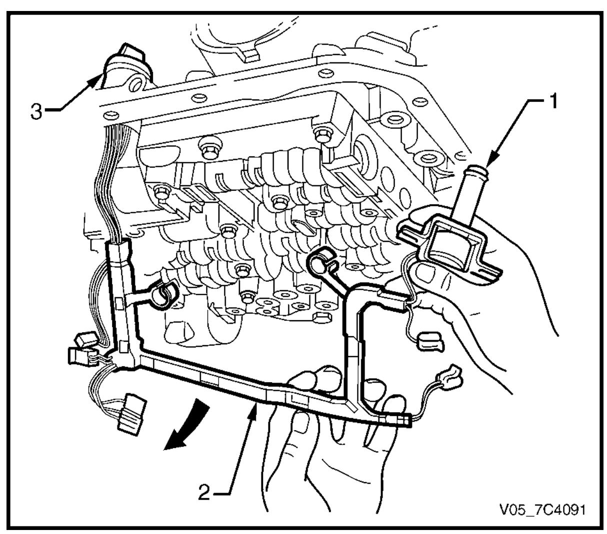


Figure 7C4 – 31

10 Lower the transmission to provide clearance between the floor pan and the pass-thru connector located at the right-hand rear of the transmission case.

11 Install the connector release, Tool No. 700-4208 (1) over the pass-thru connector and use hand force to push the tool down compressing the four retaining tangs on the connector.

12 Pull the pass-thru connector free from the transmission case and remove the control valve body harness and TCC solenoid assembly from the transmission.

13 Remove the O-ring from the pass-thru connector and discard.

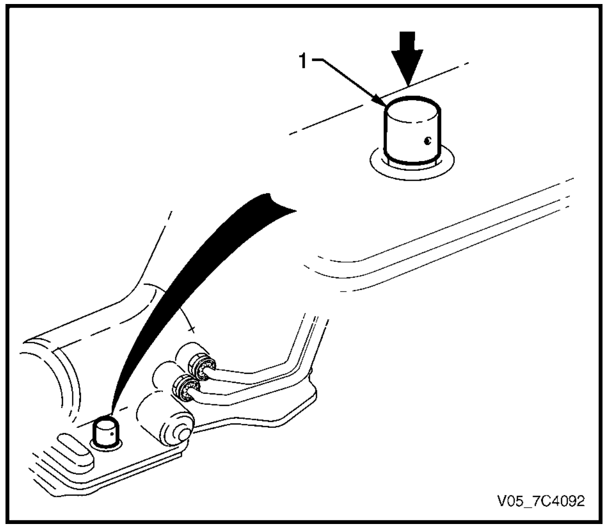


Figure 7C4 – 32

Reinstall

1 Lubricate a new O-ring with petroleum jelly and fit it to the pass-thru connector.

2 Reinstall the pass-thru connector up through the hole in the transmission case pushing it in until all four retaining tangs have emerged on the outside of the transmission case. Gently pull on the connector to check if engagement is secured.

3 Reinstall the control valve body, refer to 3.14 Control Valve Body.

4 Lubricate a new O-ring with petroleum jelly and fit it to the TCC solenoid (2).

5 Reinstall the TCC solenoid assembly in the control valve body , tighten the two attaching bolts (1) to the correct torque specification.

TCC solenoid attaching bolt torque specification	12.0 Nm

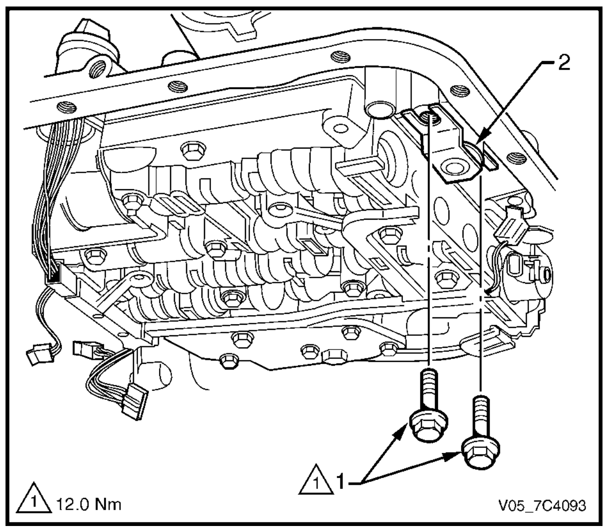


Figure 7C4 – 33

6 Lubricate a new O-ring with petroleum jelly and fit it to the TCC PWM solenoid (2).

7 Reinstall the TCC PWM solenoid in the control valve body and secure it with the retaining clip (1).

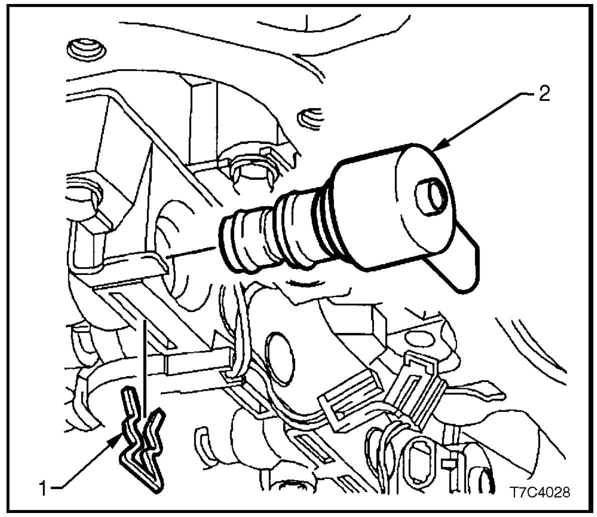


Figure 7C4 – 34

8 Reconnect the control valve body harness connectors. Connectors identification:

- Transmission Fluid Pressure (TFP) Manual Valve Position Switch (1)
- 1 – 2 Shift Valve Solenoid A (2)
- 2 – 3 Shift Valve Solenoid B (3)
- Pressure Control Solenoid (PCS) (4)
- Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid (5)
- 3 – 2 Control Solenoid (6).

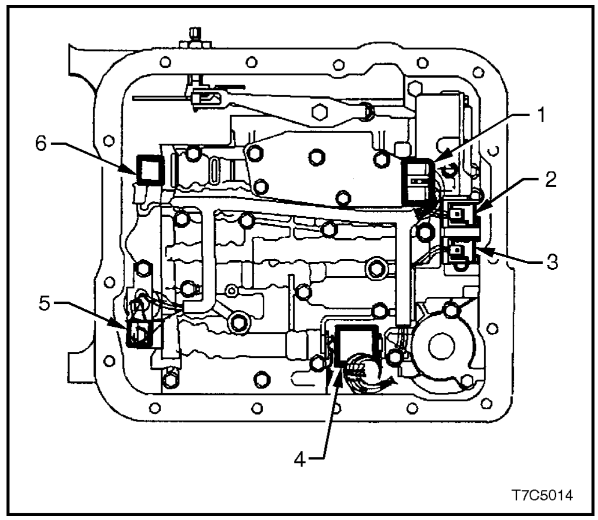


Figure 7C4 – 35

9 Secure the harness frame to the control valve body, place the tab between the valve body and pressure switch in location (1) and press the harness frame in position on bolt bosses (2 and 3).

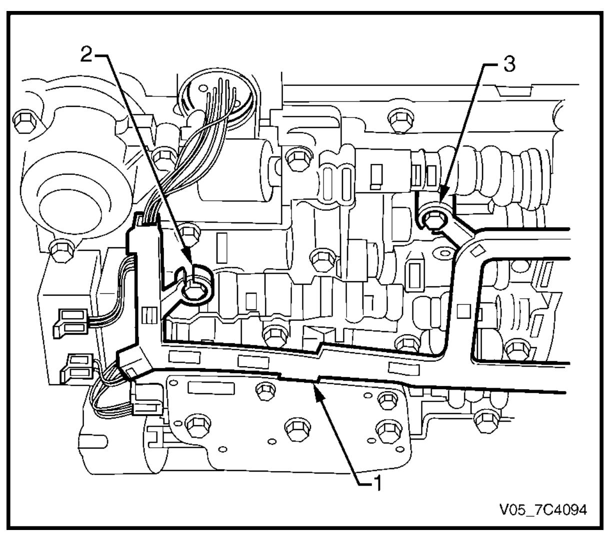


Figure 7C4 – 36

10 Reinstall the oil pan and filter and fill the transmission with the recommended automatic transmission fluid, refer to 3.1 Fluid Change and Filter Replacement.

11 Lower vehicle to the ground.

12 Road test until the transmission has reached operating temperature. Re-check the fluid level and for any fluid leaks from the oil pan area, refer to 2.1 Transmission Fluid.

3.14 Control Valve Body

Remove

1 Partially remove the control valve body harness until it hangs from the pass-thru connector, refer to 3.13 Control Valve Body Harness.

2 Remove the three long bolts (1) and the two short bolts (2) attaching the transmission fluid pressure (TFP) manual valve position switch assembly (3), remove the switch and discard the shield (4).

3 Remove the attaching bolt (5) and the manual detent spring (6).

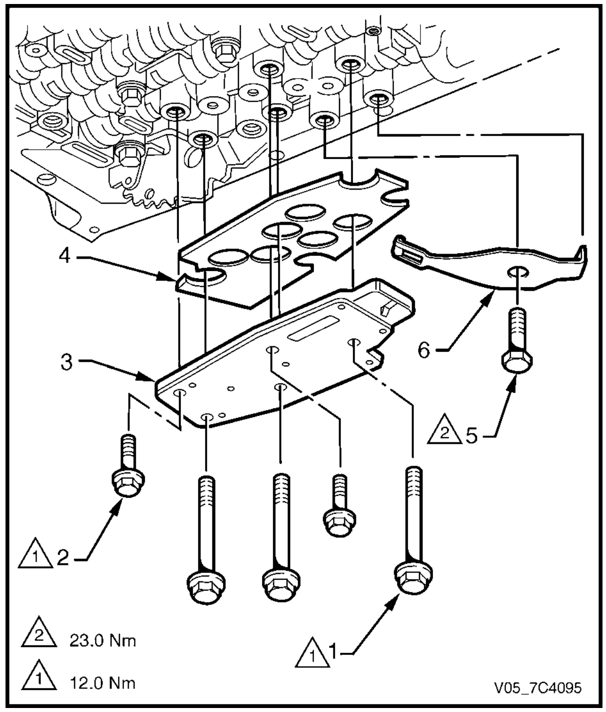


Figure 7C4 – 37

CAUTION

In the following procedure support the control valve body before removing the last bolt.

NOTE

The removal may be more manageable by removing the bolts in a spiral pattern starting from the outside, removing the centre bolt last.

4 Remove the fourteen remaining bolts (1) attaching the control valve body.

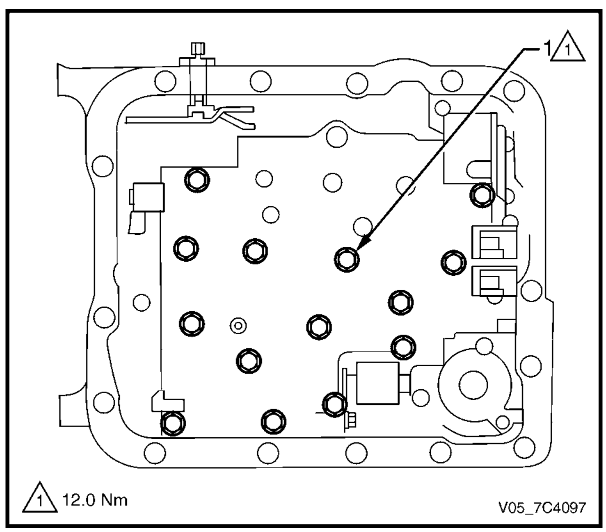


Figure 7C4 – 38

CAUTION

Keep the control valve body level when lowering it to prevent the loss of the checkballs located in the body passages.

5 Carefully lower the control valve body (1) from the transmission case. As the valve body is being lowered, rotate it slightly to disconnect the manual valve link (2) from the manual valve (3) and remove the control valve body.

6 Remove the manual valve link from the inner detent lever (4).

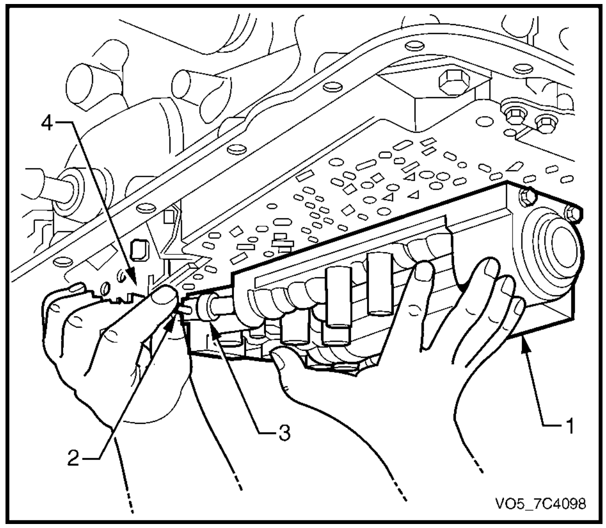


Figure 7C4 – 39

Reinstall

Different bolt sizes are used to attach the control valve body and components, Figure 7C4 – 40 shows the location of the attachment bolts with the letters referring to their dimensions.

NOTE

For clarity, the control valve body harness is not shown in the illustration.

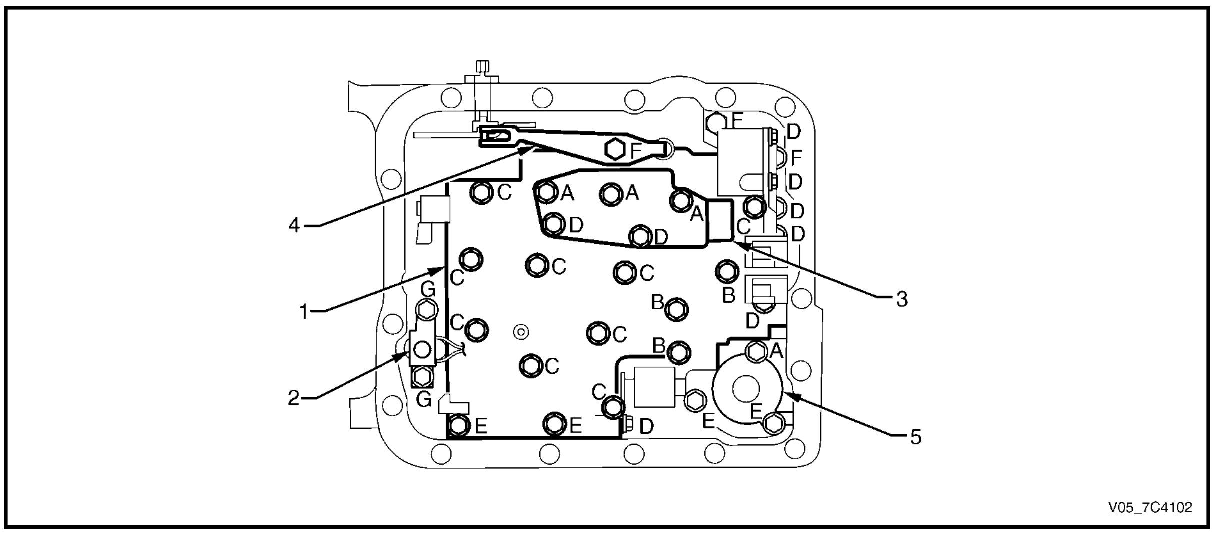


Figure 7C4 – 40

Legend

1	Control Valve Body	A	Bolt M6 x 1.00 x 65.0
2	Torque Converter Clutch (TCC) Solenoid	B	Bolt M6 x 1.00 x 54.4
3	Transmission Fluid Pressure (TFP) Manual Valve Position Switch	C	Bolt M6 x 1.00 x 47.5
		D	Bolt M6 x 1.00 x 18.0
4	Manual Detent Spring	E	Bolt M6 x 1.00 x 35.0
5	1 – 2 Accumulator Cover	F	Bolt M6 x 1.25 x 20.0
		G	Bolt M6 x 1.00 x 12.0

1 Ensure the spacer plate gasket is in a satisfactory condition, replace as required, refer to 3.15 Spacer Plate, Check Balls, Filter Screens and 3 – 4 Accumulator.

2 If required, reinstall the seven checkballs (1) in the control valve body securing them with petroleum jelly.

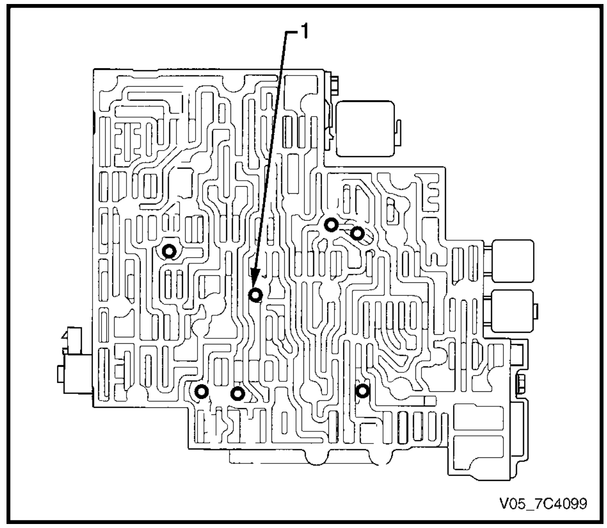


Figure 7C4 – 41

3 Reinstall the manual valve link (1) to the inner detent lever (2), refer to Figure 7C4 – 42.

4 While supporting the control valve body (3), rotate it slightly and connect the manual valve link with the manual valve (4).

CAUTION

Take care not to damage the two filter screens attached to the spacer plate during this operation.

5 Position the manual valve forward to retain the link connection and carefully raise the valve body into position.

6 Check if the manual valve link is correctly reinstalled in the detent lever and manual valve.

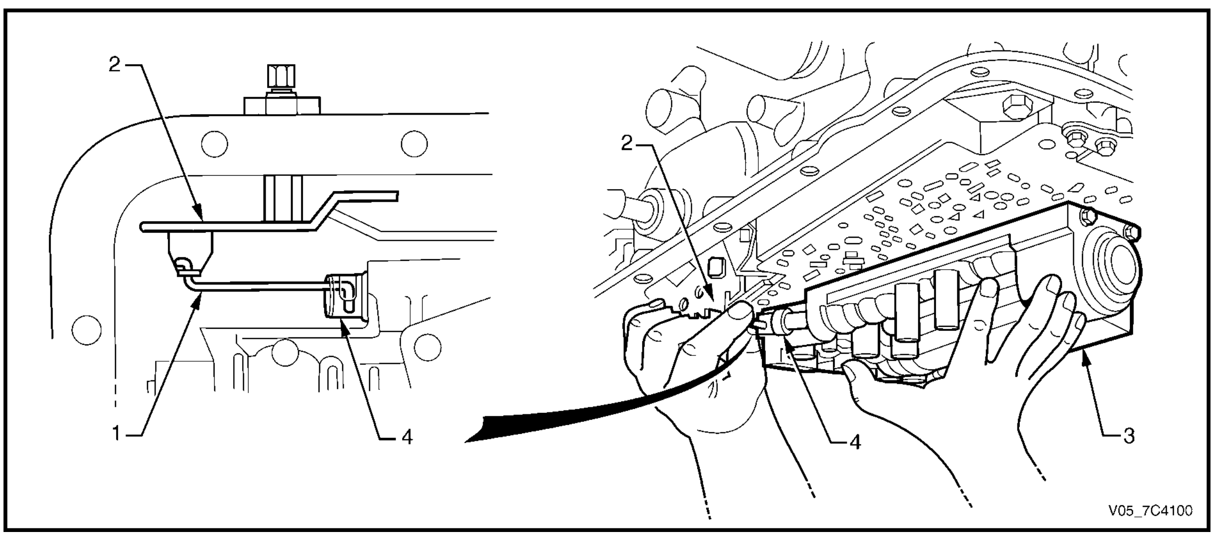


Figure 7C4 – 42

CAUTION

When reinstalling the bolts throughout this procedure, ensure to use the correct bolt dimension in each location.

7 Reinstall one bolt (1) (M6 X 1.0 X 47.5) hand tight in the centre of the control valve body to hold it in place, at location C as shown.

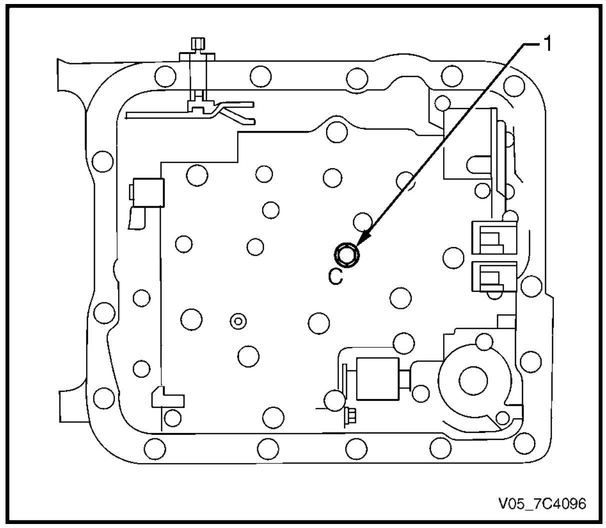


Figure 7C4 – 43

8 Reinstall hand tight only, the remainder of the fourteen bolts (1) attaching the control valve body directly.

NOTE

Refer to Figure 7C4 – 40 for each bolt dimension and corresponding location.

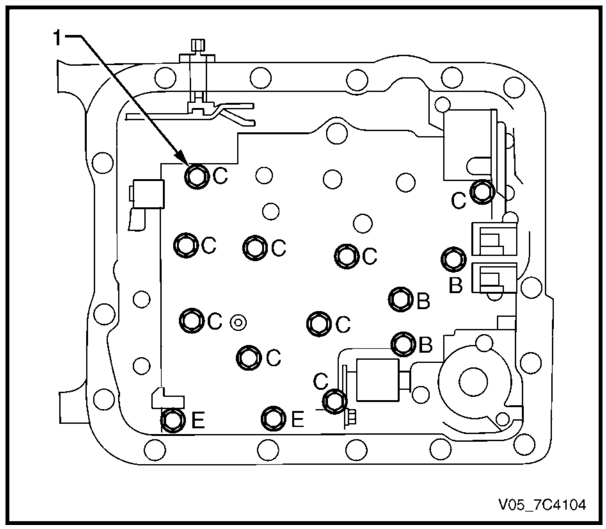


Figure 7C4 – 44

9 Fit a new shield (1) to the transmission fluid pressure (TFP) manual valve position switch (2) and reinstall to the control valve body.

NOTE

Refer to Figure 7C4 – 40 for bolt dimension and corresponding location.

10 Reinstall the three long bolts (3) and the two short bolts (4) hand tight only.

11 Reinstall the manual detent spring (5) and the attaching bolt (6) hand tight only.

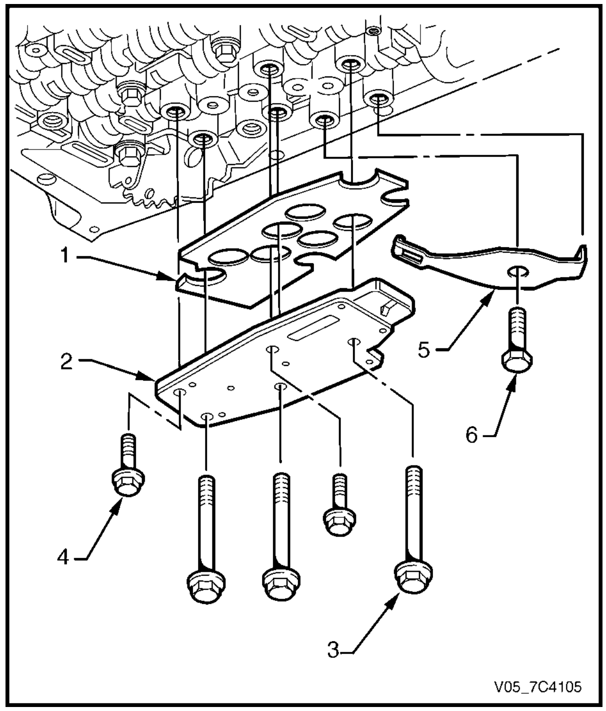


Figure 7C4 – 45

CAUTION

The control valve body bolts must be tightened in an outward spiral starting from the centre. Failure to follow this pattern may distort the valve body causing the valves to jam in their bores.

12 Follow the sequence starting from the centre as shown by the arrows to tighten the following bolts to the correct torque specification:

- fourteen bolts (1) attaching the control valve body,
- five bolts (2) attaching the transmission fluid pressure (TFP) manual valve position switch and
- one bolt (3) attaching the manual detent spring.

Control valve body attaching bolt torque specification	12.0 Nm
Transmission fluid pressure (TFP) manual valve position switch attaching bolt torque specification	12.0 Nm
Manual detent spring attaching bolt torque specification	23.0 Nm

13 Reinstall the control valve body harness , refer to 3.13 Control Valve Body Harness.

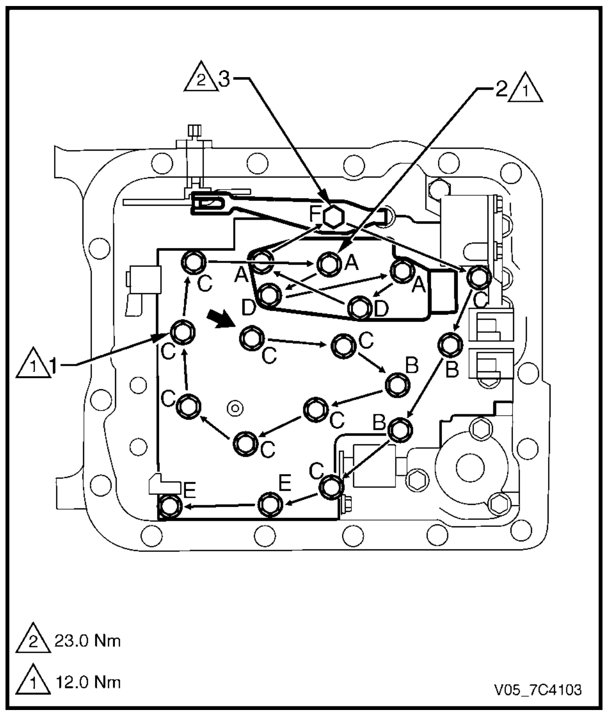


Figure 7C4 – 46

3.15 Spacer Plate, Check Balls, Filter Screens and 3 – 4 Accumulator

Remove

1 Remove the control valve body, refer to 3.14 Control Valve Body.

2 Remove the three attaching bolts (1) and the plate (2) supporting the spacer plate.

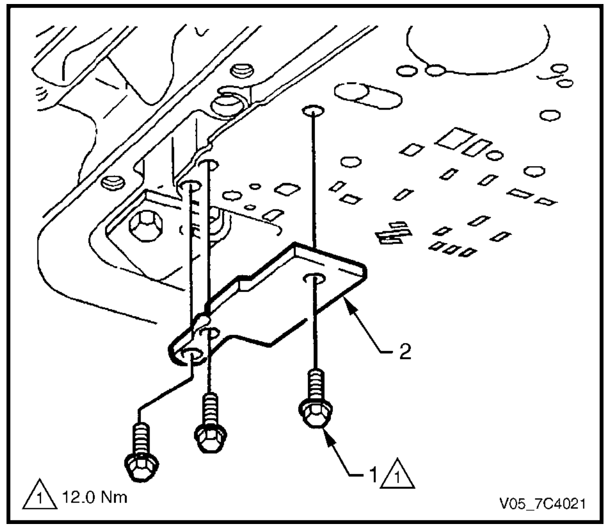


Figure 7C4 – 47

CAUTION

The 3 – 4 accumulator spring (1) may push the spacer plate away from transmission case when the 1 – 2 accumulator assembly is removed.

3 While supporting the spacer plate (2), carefully remove the 1 – 2 accumulator assembly (3), refer to 3.12 1 – 2 Accumulator Assembly.

CAUTION

As the spacer plate and gaskets are lowered from the transmission, a check ball and the 3 – 4 accumulator spring may drop. Do not lose the check ball and the spring.

4 Remove the two gaskets (4 and 5) and the spacer plate from the transmission case.

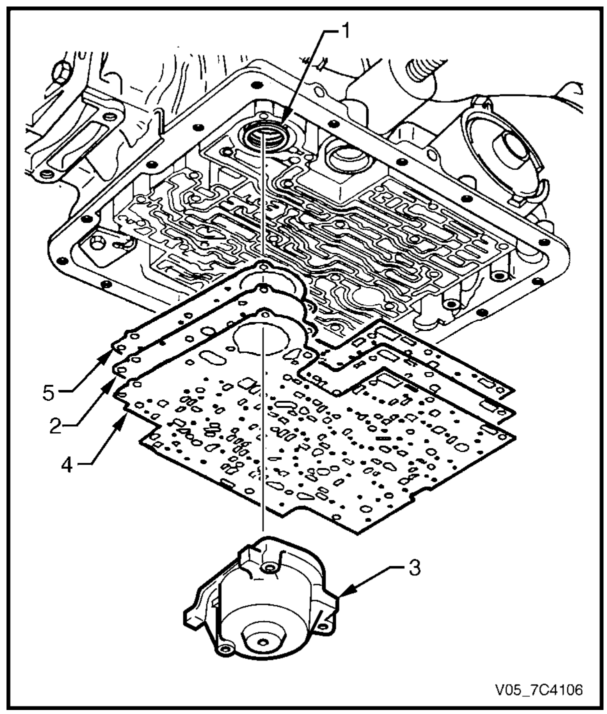


Figure 7C4 – 48

5 If not previously dropped, remove the spring (1).
If required, use snap ring pliers to rotate and pull the 3 – 4 accumulator piston (2) to remove it from the transmission case. Remove and discard the piston seal.

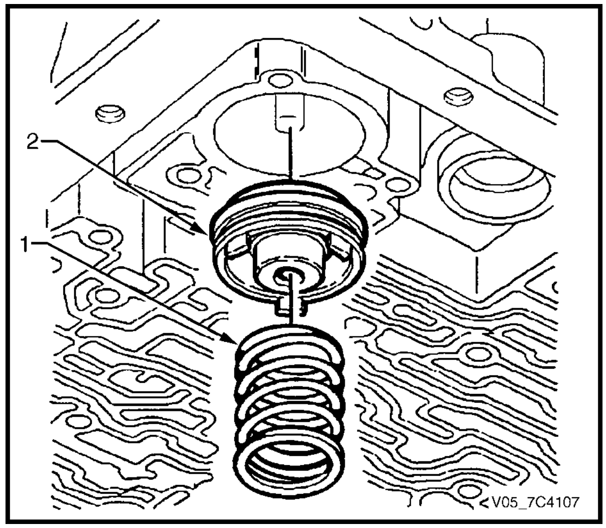


Figure 7C4 – 49

6 Remove the check-ball (1) if not previously dropped. Remove the 3rd accumulator check ball assembly (2), the orifice cup plug (3) and the guide pins (A) from the transmission case.

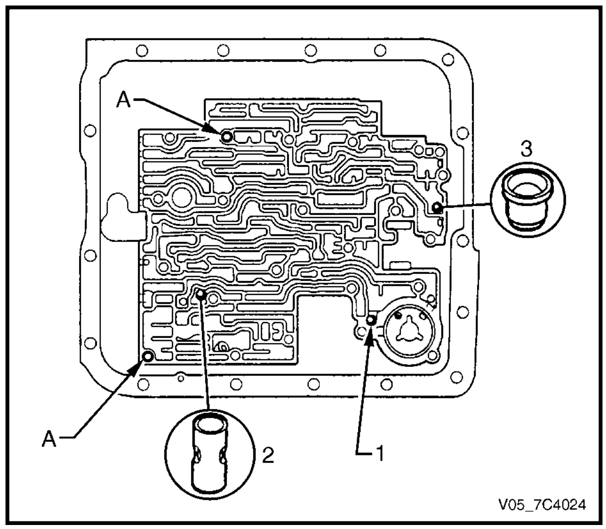


Figure 7C4 – 50

Clean and Inspect

WARNING

To avoid personal injury, wear safety glasses and gloves when using compressed air and cleaning fluids.

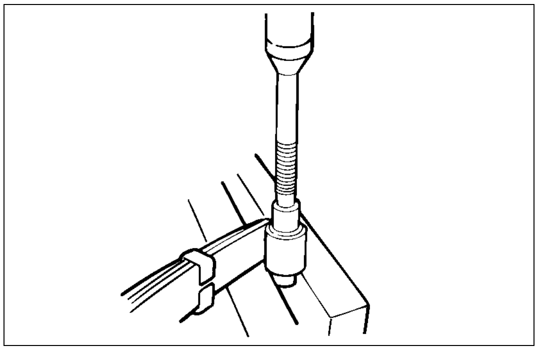
1 Wash all components in a commercially available cleaning fluid and blow dry using compressed air.

2 Inspect the components for the following:

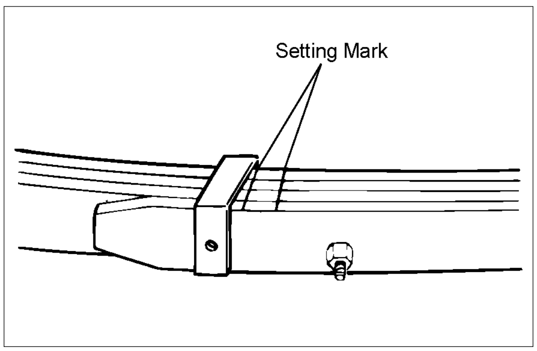
- piston for porosity,
- ring groove or pin hole damage,
- spring for distortion or damage,
- accumulator bore for wear or damage and
- spacer plate, filter screens and check balls for damage.

LEAF SPRING ASSEMBLY

Disassembly

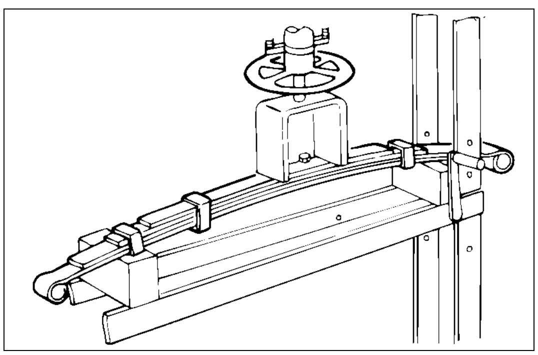

F03L100004

1. Remove the bushing using a bench press and a suitable metal fitting.

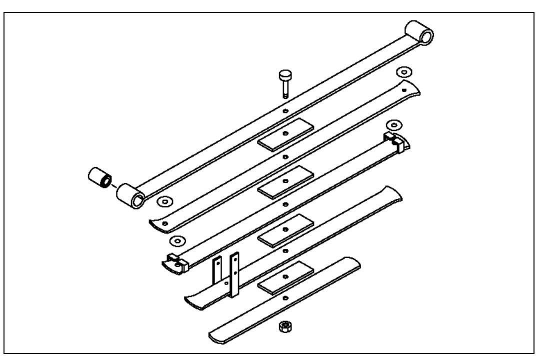


RTW430SH000101

2. Apply a setting mark across the springs before disassembling the leaf spring assembly.


F03L100006

3. Use a bench press and remove the center bolt.
   - Discard center bolt and install a new one.


465R300001

4. Disassemble the leaf spring assembly.

Inspection and Repair

Inspect leaf spring, bush, clips, liners and center spacer for wear, damage, rust or other abnormal conditions and repair or replace if necessary.

Reinstall

1 Lubricate a new seal (1) with petroleum jelly and install it to the 3 – 4 accumulator piston (2).

2 Reinstall the piston onto the pin (3). The piston side with the three lugs (4) must face out of the bore.

3 Reinstall the 3 – 4 accumulator spring, use a small amount of petroleum jelly to hold it in place, as needed.

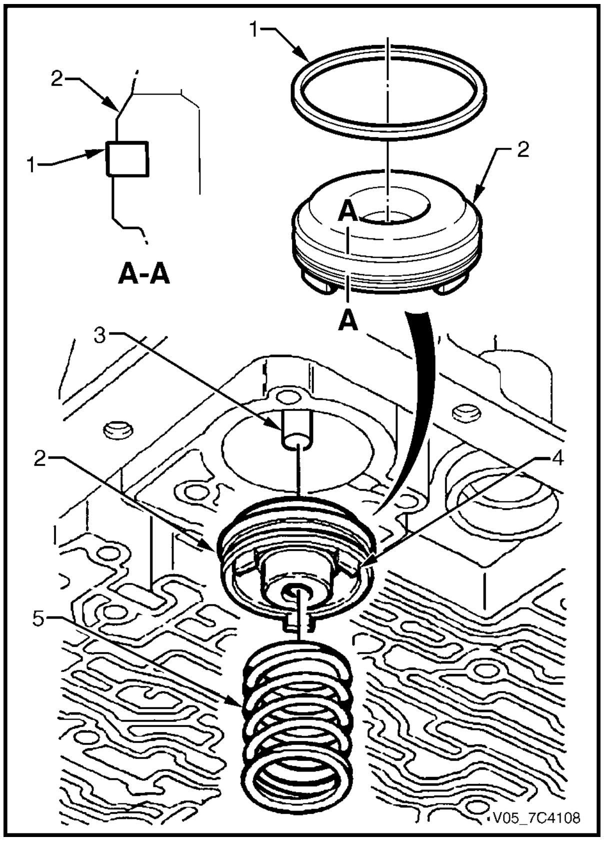


Figure 7C4 – 51

CAUTION

Ensure the guide pins are fully installed with no thread visible. Otherwise the spacer plate gasket could be caught in the thread during installation, resulting in incorrect alignment.

4 Reinstall the guide pins (A) at the correct locations in the transmission case.

5 Reinstall the check ball (1) in the transmission case using a small amount of petroleum jelly to hold it in place.

6 Reinstall the 3rd accumulator check ball assembly (2) and the orifice cup plug (3) in the transmission case.

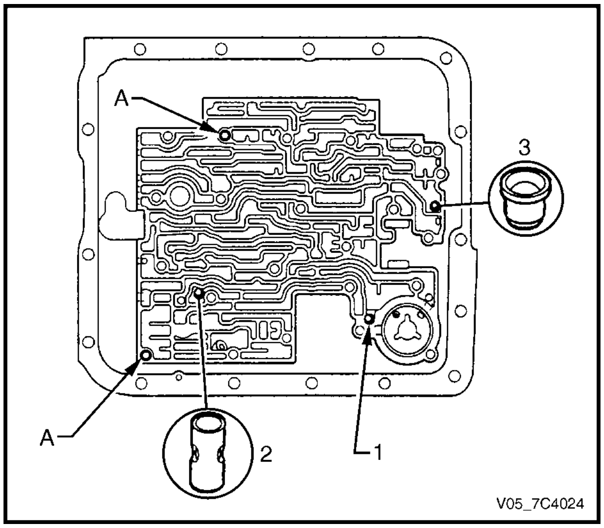


Figure 7C4 – 52

7 If a new spacer plate (1) is installed, it is necessary to fit two filter screens (2 and 3) to the spacer plate.

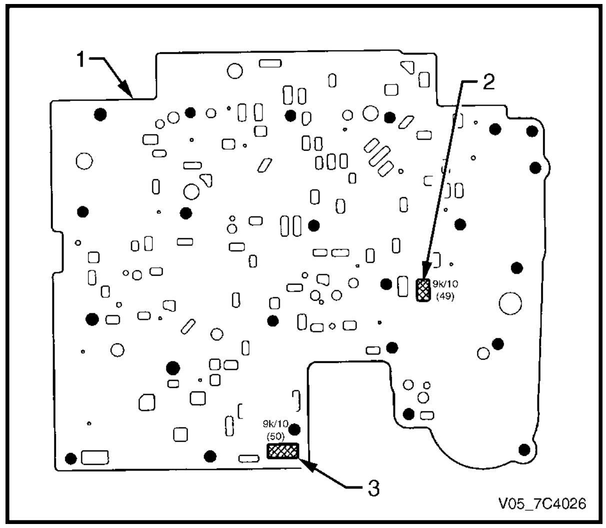


Figure 7C4 – 53

NOTE

When installing the spacer plate locate the gaskets as follows:

- The gasket (2) marked CA is fitted between the spacer plate and the transmission case.
- The gasket (3) marked VB is fitted between the spacer plate and the control valve body.

8 Reinstall the spacer plate (1) with the new gaskets (2 and 3) smeared with petroleum jelly. Hold the spacer plate in place until the 1 – 2 accumulator is reinstalled.

9 While supporting the spacer plate, carefully reinstall the 1 – 2 accumulator assembly (4), refer to 3.12 1 – 2 Accumulator Assembly.

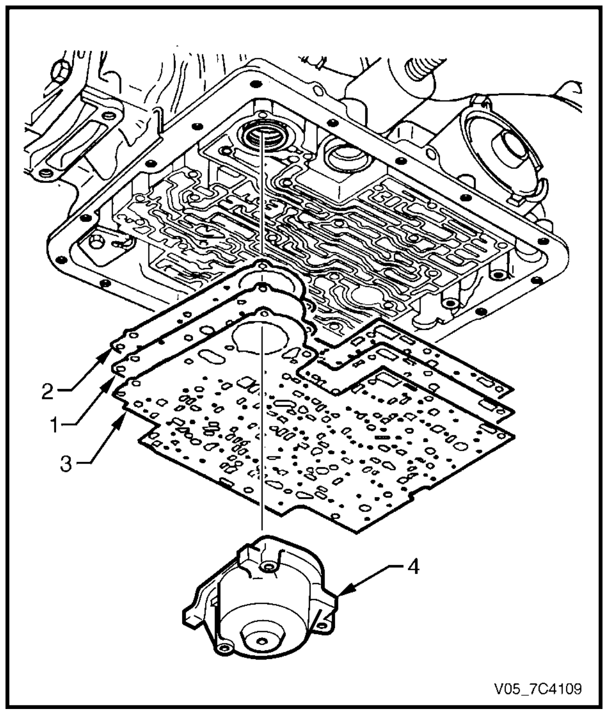


Figure 7C4 – 54

10 Reinstall the plate (2) supporting the spacer plate and tighten the three attaching bolts (1) to the correct torque specification.

Spacer plate support plate attaching bolt torque specification ....12.0 Nm

11 Reinstall the control valve body, refer to 3.14 Control Valve Body.

12 Reinstall the Oil pan and filter and fill the transmission with the recommended automatic transmission fluid, refer to 3.1 Fluid Change and Filter Replacement.

13 Lower vehicle to the ground.

14 Road test until the transmission has reached operating temperature. Re-check the fluid level and for any fluid leaks from the oil pan area, refer to 2.1 Transmission Fluid.

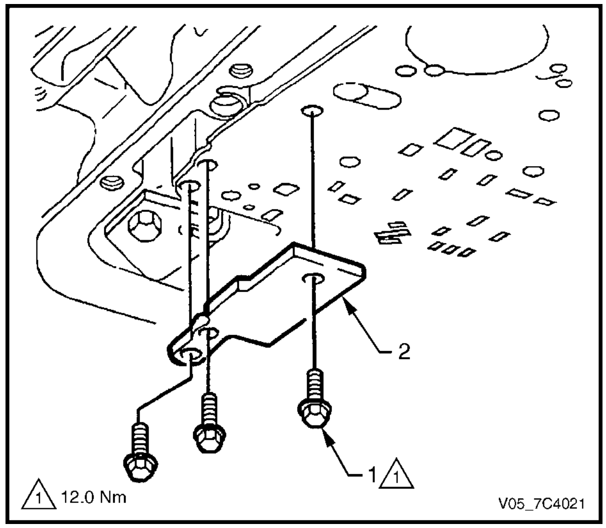


Figure 7C4 – 55

3.16 Filler Tube and Breather Hose

Remove

NOTE

The breather hose and/or vent pipe can be removed independently from the filler tube as described in step 7.

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 6D1-3 Battery, before disconnecting the battery.

1 Disconnect the battery ground lead.

2 Release the lock down lever (1) and remove the transmission fluid level indicator from the filler tube (2).

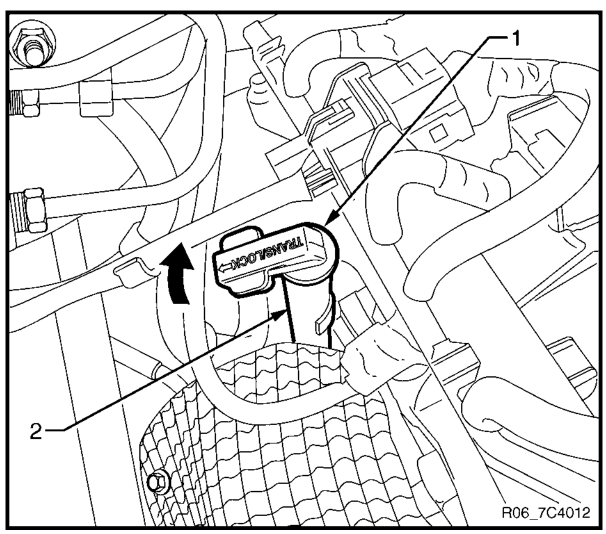


Figure 7C4 – 56

3 Remove the bolt (1) attaching the filler tube (2) to the side of the right-hand cylinder head, refer to Figure 7C4 – 57.

4 Using a twisting and pulling motion, remove the filler tube from the seal (3) in the transmission case.

5 Remove the filler tube from the engine compartment.

6 Remove the filler tube seal from the transmission case and discard.

7 If the breather hose needs to be replaced proceed as follows:

a unclip the breather hose (4) from the harness channel (5).

b Remove the transmission support and lower the rear of the transmission sufficiently to get access to the breather hose, refer to 3.7 Transmission Support and Mount.

c Disconnect the breather hose from the T-joint (6) and the top of the transmission case and remove.

d If required, remove the two bolts (7) attaching the brackets of the vent pipe (8) to the chassis, disconnect from the T-joint and remove the vent pipe.

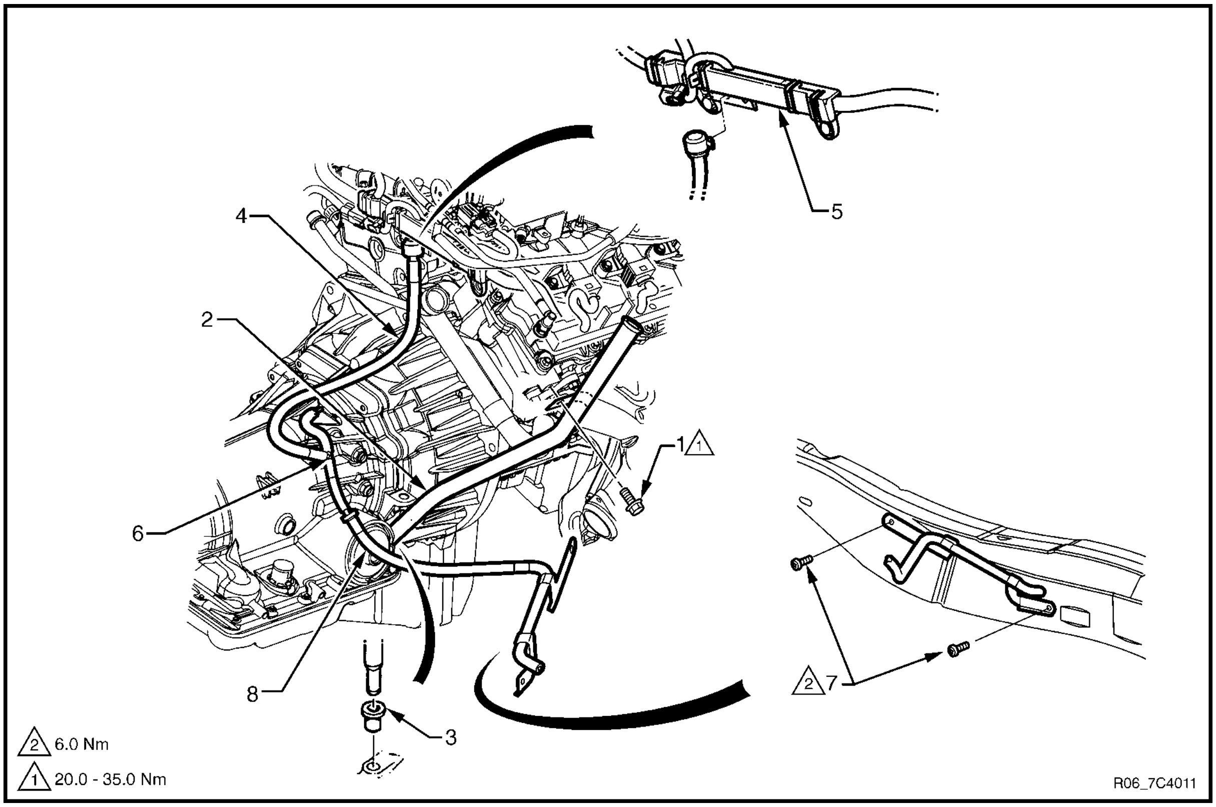


Figure 7C4 – 57

Reinstall

Reinstallation of the transmission filler tube and/or the breather hose is the reverse of the removal procedure, noting the following:

1 Smear a new filler tube seal with clean transmission fluid and fit it to the transmission case.

2 Ensure the transmission breather hose and the harness are secured to the filler tube lower bracket.

3 Tighten the bolt attaching the filler tube bracket to the correct torque specification.

Filler tube bracket attaching bolt torque specification .... 20.0 – 35.0 Nm

4 If required, tighten the two bolts attaching the vent pipe bracket to the chassis to the correct torque specification.

Vent pipe attaching bolt torque specification .... 6.0 Nm

3.17 Transmission Cooler Line/Hose Assemblies

Remove

1 Disconnect the transmission cooler hose/line assemblies from the radiator quick connect fittings as follows:

a Pull back the verifier disc (1) from the quick connect fitting (2) and slide it back along the line.

b Open the release tool, Tool No J-41623-B (3), slip it over the cooler line to be disconnected from the radiator, ahead of the verifier disc.

c Slide the release tool along the cooler line and engage it with the quick-connect fitting.

d While pushing inwards, rotate clockwise the release tool about one sixth of a turn to release the spring clip holding the cooler line.

e With the release tool held in this position, pull back on the cooler line to release it.

f Plug the openings to prevent fluid loss and/or contamination.

g Repeat the procedure to remove the remaining cooler line.

NOTE

If the spring clip and/or O-ring seal in the quick-connect fitting is damaged during the removal process, the complete fitting must be replaced.

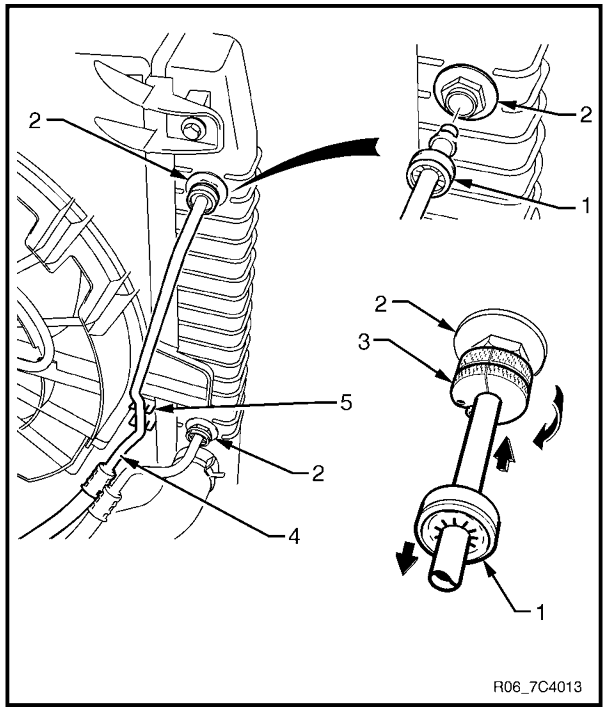


Figure 7C4 – 58

2 Unclip the outlet cooler line (4) from the radiator fan shroud (5).

3 Remove the screw (1) attaching the transmission cooler line bracket (2) to the right-hand side of the engine.

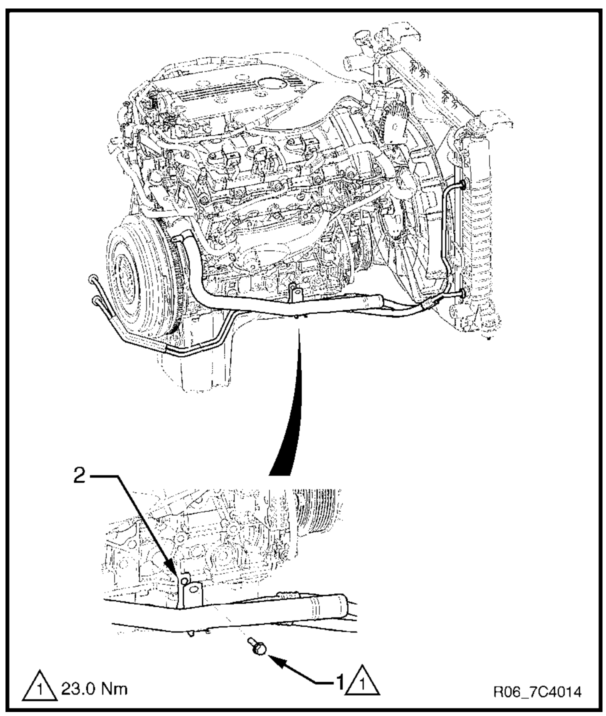


Figure 7C4 – 59

4 Remove the transmission support, refer to 3.7 Transmission Support and Mount.

5 Carefully lower the rear of the transmission sufficiently to get access to the cooler lines.

6 Place a suitable sized drip tray underneath the transmission.

7 With the rear of the transmission lowered, disconnect the cooler lines from the transmission, as follows:

  a Pull back the verifier disc (1) to release it and slide it back along the cooler line (2).

  b Open the release tool, Tool No J-41623-B (3), slip it over the cooler line to be disconnected from the transmission, ahead of the verifier disc.

  c Slide the release tool along the cooler line and engage it with the quick-connect fitting (4).

  d While pushing inwards, rotate clockwise the release tool about one sixth of a turn to release the spring clip holding the cooler line.

  e With the release tool held in this position, pull back on the cooler line to release it.

  f Plug all openings to prevent fluid loss and/or contamination.

  g Repeat this process with the remaining cooler line.

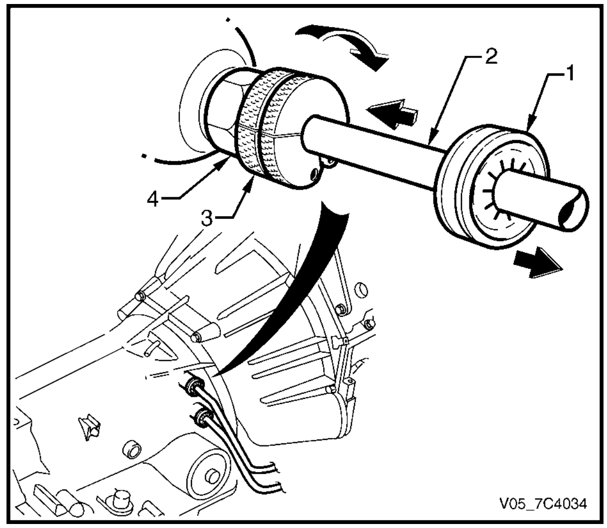


Figure 7C4 – 60

NOTE

If the spring clip and/or O-ring seal in the quick-connect fitting is damaged during the removal process, the complete fitting must be replaced.

8 Carefully remove the two cooler lines from the vehicle.

9 As required, separate the two cooler lines by removing the bracket and the two clips.

Reinstall

1 On the transmission end, ensure the spring clip and/or O-ring seal in each quick-connect fitting is not damaged, replace the complete fitting if required.

2 If required, fit the bracket and the two clips to attach the transmission two cooler lines together.

3 Position the cooler lines in place, attach the cooler line bracket (2) with the screw (1) hand tight to the right-hand side of the engine, refer to Figure 7C4 – 59.

4 Remove the plugs from the cooler lines and transmission fittings and wipe all exposed parts clean.

5 At the transmission end, smear the fluid lines rear fittings with clean automatic transmission fluid and push the quick-connect fittings together.

CAUTION

If the verifier disc does not clip into place, the quick-connect fitting is not engaged, rectify as required.

6 As a security check, push and clip each verification disc into place over the quick-connect fittings. If difficulty is experienced, repeat the installation process until the verification disc can be clipped into place over the transmission quick-connect fitting.

7 Reinstall the transmission support, refer to 3.7 Transmission Support and Mount.

8 Remove the plugs from the cooler lines and radiator fittings and wipe all exposed parts clean.

9 At the radiator end, smear the fluid lines fittings with clean automatic transmission fluid and push the quick-connect fittings together, refer to Figure 7C4 – 58.

CAUTION

If the verifier disc does not clip into place, the quick-connect fitting is not engaged, rectify as required.

10 As a security check, push and clip each verification disc into place over the quick-connect fittings. If difficulty is experienced, repeat the installation process until the verification disc can be clipped into place over the radiator quick-connect fitting.

11 Snap the outlet cooler line (4) in the clip (5) of the radiator fan shroud.

12 Ensure the routeing of the cooler lines is correct and there is no fouling of the lines.

13 Tighten the screw attaching the cooler lines bracket to the correct torque specifications.

Transmission cooler lines bracket attaching screw torque specification ....23.0 Nm

14 If required, top up the transmission fluid level (cold).

15 Start the engine and check for any fluid leak at the fittings. If a leak is found, stop the engine and rectify the leak.

16 Check and top up the transmission fluid to the correct level as required, refer to 2.1 Transmission Fluid.

3.18 Transmission Assembly

Remove

CAUTION

Disconnection of the battery affects certain vehicle electronic systems. Refer to 6D1-3 Battery, before disconnecting the battery.

1 Disconnect the battery ground lead.

2 Raise the vehicle and support in a safe manner, refer to 0A General Information for the location of support points.

3 Remove the heat shield from the neutral start and back-up lamp switch, gently prise the selector cable from the transmission external manual shaft linkage and remove the selector cable from the bracket, refer to 3.3 Selector Cable Assembly.

4 Disconnect the harness connectors from the following:

a Vehicle speed sensor, refer to 3.5 Vehicle Speed Sensor.

b Neutral start and back-up switch, refer to 3.4 Neutral Start and Back-up Lamp Switch.

c For the following on four wheel drive vehicles (4WD), refer to 7D Transfer Case and Adaptor Housing:

- neutral switch,
- 2WD – 4WD shift actuator switch,
- speed sensor.

NOTE

If the battery is connected, avoid turning the ignition switch to the ON position, as the transfer case control module (TTCM) must first be removed (memory to be cleared as Check 4WD Indicator will light).

5 Remove the following components:

a Front and centre exhaust assemblies, refer to 6F Exhaust System.

b Starter motor, refer to 6D1-2 Starting System.

b Rear propeller shaft and for 4WD front propeller shaft, refer to 4A Propeller Shaft.

6 On 4WD vehicle, disconnect the harness two clips from the upper side of the transfer case.

7 From within the starter motor access hole, remove the three bolts (2) attaching the torque converter to the flexplate and discard, refer to Figure 7C4 – 62.

8 Remove the transmission support, refer to 3.7 Transmission Support and Mount.

9 Disconnect the fuel and EVAP pipes three brackets and clips, refer to 6C Fuel System – V6.

CAUTION

Before lowering the transmission take care of the following:

- **Do not strain the harness and connector as the connector pins could be permanently damaged.**
- **Ensure the inlet manifold does not hit the firewall.**

10 Carefully lower the transmission to provide enough clearance to disconnect the harness connector (1).

CAUTION

Do not wiggle the connector from side to side during removal as the connector pins could be permanently damaged.

11 Disconnect the harness connector from the transmission as follows:

a Roll back the dust boot to access the connector.

b Squeeze the widest side of the connector (A) inward and pull it directly upward.

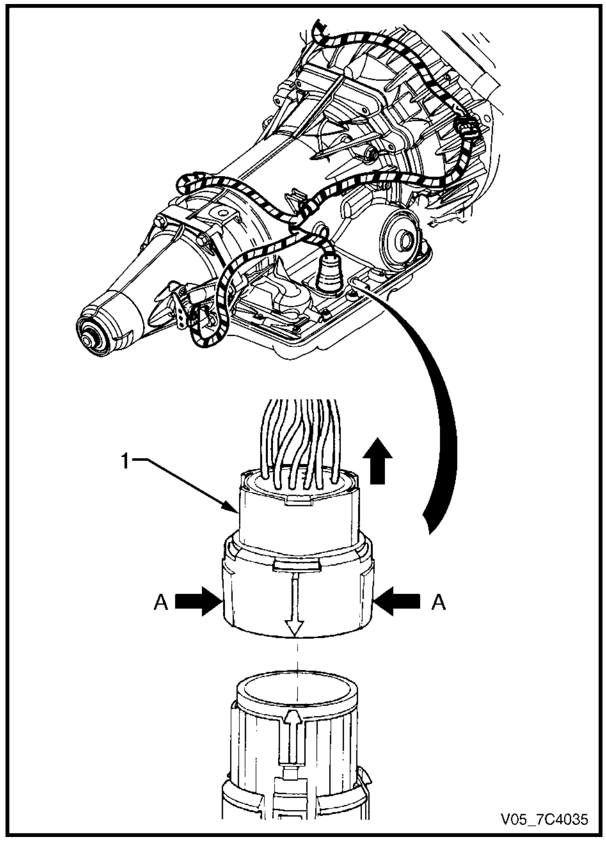


Figure 7C4 – 61

12 Remove the screws attaching the harness clips to the right-hand and left-hand sides of the transmission case, refer to 12O Fuses, Relays and Wiring Harnesses.

13 Place a suitable sized drip tray underneath the transmission.

14 Remove the transmission cooler lines, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

15 Disconnect the breather hose from the top of the transmission case.

CAUTION

Support the transmission when removing the attaching bolts to avoid damage to the torque converter and flexplate. Do not have the transmission hanging.

NOTE

The bolts attaching the torque converter housing are facing forward except for the bolt in position ℑ which is facing rearward.

16 With the transmission supported, using a long socket extension, universal joint and suitable size socket, remove the bolt (1), nine places, attaching the torque converter housing to the engine, in the reverse order of the torque sequence shown in B within Figure 7C4 – 62.

CAUTION

The transmission assembly must not be allowed to rest on its oil pan.

17 Support the transmission assembly on a suitable cradle and secure it. Place a suitable support under the engine oil pan rail to support the engine after the transmission has been removed.

18 Remove the transmission assembly, disengaging the filler tube attached to the engine.

19 Remove the bolt (3) and torque converter cover (4) on the transmission right-hand side, remove the bolt (5) and torque converter cover (6) on the transmission left-hand side.

20 Install a suitable holding tool to prevent the torque converter from becoming dislodged.

21 If required on 4WD vehicle, remove the transfer case, refer to 7D Transfer Case and Adaptor Housing.

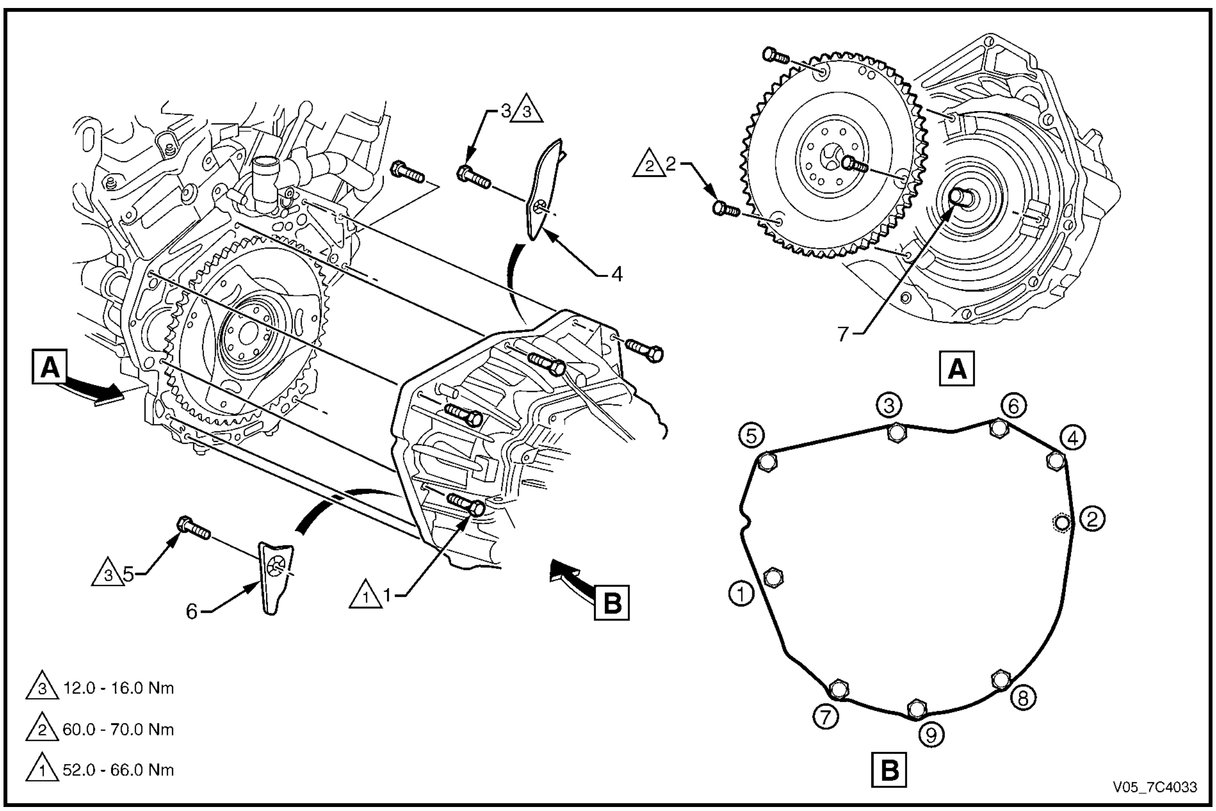


Figure 7C4 – 62

Reinstall

1 If required on 4WD vehicle, reinstall the transfer case, refer to 7D Transfer Case and Adaptor Housing.

2 Ensure the transmission and the engine mating surfaces are clean and free of burrs.

3 Lubricate the torque converter spigot (7) with a small amount of high temperature wheel bearing grease, refer to Figure 7C4 – 62.

4 Install a new filler tube seal into the transmission case.

CAUTION

Support the transmission while installing the attaching bolts to avoid damage to the torque converter and flexplate. Do not have the transmission hanging.

5 Bring the transmission up to the engine, inserting the filler tube and ensuring the locating dowels completely enter the torque converter housing.

6 Reconnect the breather hose to the top of the transmission case.

NOTE

The bolts attaching the torque converter housing are facing forward except for the bolt in position ℑ which is facing rearward.

7 With the transmission supported, install the bolt (1), nine places, attaching the torque converter housing to the engine and tighten to the correct torque specification following the sequence shown in $\boxed{B}$ within Figure 7C4 – 62.

Torque converter housing attaching bolt torque specification	52.0 – 66.0 Nm

8 Remove the access hole cover plate from the lower surface of the housing and push the torque converter forward to meet the flexplate, then hand start three new bolts (2) before tightening to the correct torque specification. Reinstall the access hole cover plate.

Torque converter to flexplate attaching bolt torque specification	60.0 – 70.0 Nm

9 Reinstall the bolt (3) and torque converter cover (4) on the transmission right-hand side and the bolt (5) and torque converter cover (6) on the transmission left-hand side, tighten the bolts to the correct torque specification.

Torque converter cover attaching bolt torque specification	12.0 – 16.0 Nm

10 Reinstall the transmission fluid lines, refer to 3.17 Transmission Cooler Line/Hose Assemblies.

CAUTION

Prior to connecting the harness connector to the transmission, check that all pins and seals are in sound condition and the dust boot is not torn or damaged.

11 Reconnect the transmission harness connector to the transmission as follows:

a Push straight down on the connector body until a click is heard.

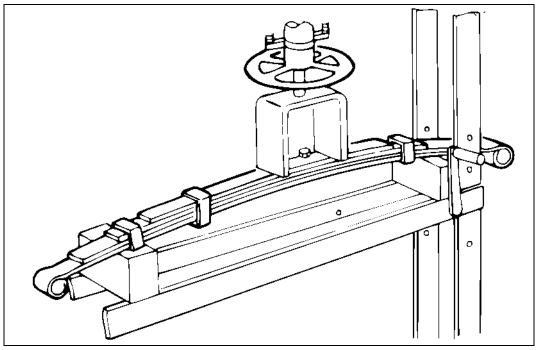
b Reinstall the dust boot ensuring it is correctly located.

12 Attach the harness clips to the right-hand and left-hand sides of the transmission case, refer to 12O Fuses, Relays and Wiring Harnesses.

13 On 4WD vehicle, connect the harness two clips from the upper side of the transfer case.

Reassembly

1. Apply grease to both faces of each leaf spring at reassembly.
2. Set the leaf springs, aligning them to the setting mark made before disassembly.



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3. Assemble the leaf springs using a bench press.
4. Apply grease to the outside of the bushing.
   Install a new center bolt and tighten it to the specified torque.

Torque	N·m (kgf·m/lb·ft)
29 (3.0/22)	

5. Install the bushing using a bench press and a suitable metal fitting.

14 Reconnect the fuel and EVAP pipes three brackets and clips, refer to 6C Fuel System – V6.

15 Reinstall the following components:

a Starter motor, refer to 6D1-2 Starting System.

b Transmission support, refer to 3.7Transmission Support and Mount.

c Front and centre exhaust assemblies, refer to 6F Exhaust System.

d Rear propeller shaft and for 4WD front propeller shaft, refer to 4A Propeller Shaft.

16 Reconnect the harness connectors to the following:

a Vehicle speed sensor, refer to 3.5Vehicle Speed Sensor.

b Neutral start and back-up switch, refer to 3.4 Neutral Start and Back-up Lamp Switch.

c For the following on 4WD vehicles, refer to 7D Transfer Case and Adaptor Housing:

- neutral switch,
- 2WD – 4WD shift actuator switch,
- speed sensor.

17 Reinstall the selector cable to the transmission external manual shaft linkage, secure the selector cable to the bracket and attach the heat shield to the neutral start and back-up lamp switch, refer to 3.3 Selector Cable Assembly.

18 Perform a reverse flush of the cooler lines and a flow rate test, refer to 2.2 Reverse Flush and Flow Rate, if either of the following applies:

- the transmission fluid is contaminated,
- the transmission has been replaced,
- the torque converter has been replaced, or
- the transmission oil pump has been replaced.

19 Lower the vehicle to the ground.

20 If required, top up the transmission fluid level (cold).

21 Reconnect the battery ground lead.

22 Start the engine and check for any fluid leaking at the fittings. If a leak is found, stop the engine and rectify the leak.

23 Road test until the transmission has reached operating temperature. Re-check the fluid level and for any fluid leaks, refer to 2.1 Transmission Fluid.

3.19 Transmission Control Module

Remove

1 Ensure the ignition switch is in the OFF position.

2 Disconnect the connector (1) from the transmission control module (TCM) (2) as follows, refer to Figure 7C4 – 63:

a remove the securing pin (3),

b press the locking tab and swing the lever (4) to free the connector,

c remove the connector.

3 Remove the four bolts (5) and nuts (6), then the TCM from the mounting bracket (7).

4 If required, remove the two nuts (8) and the mounting bracket from the firewall.

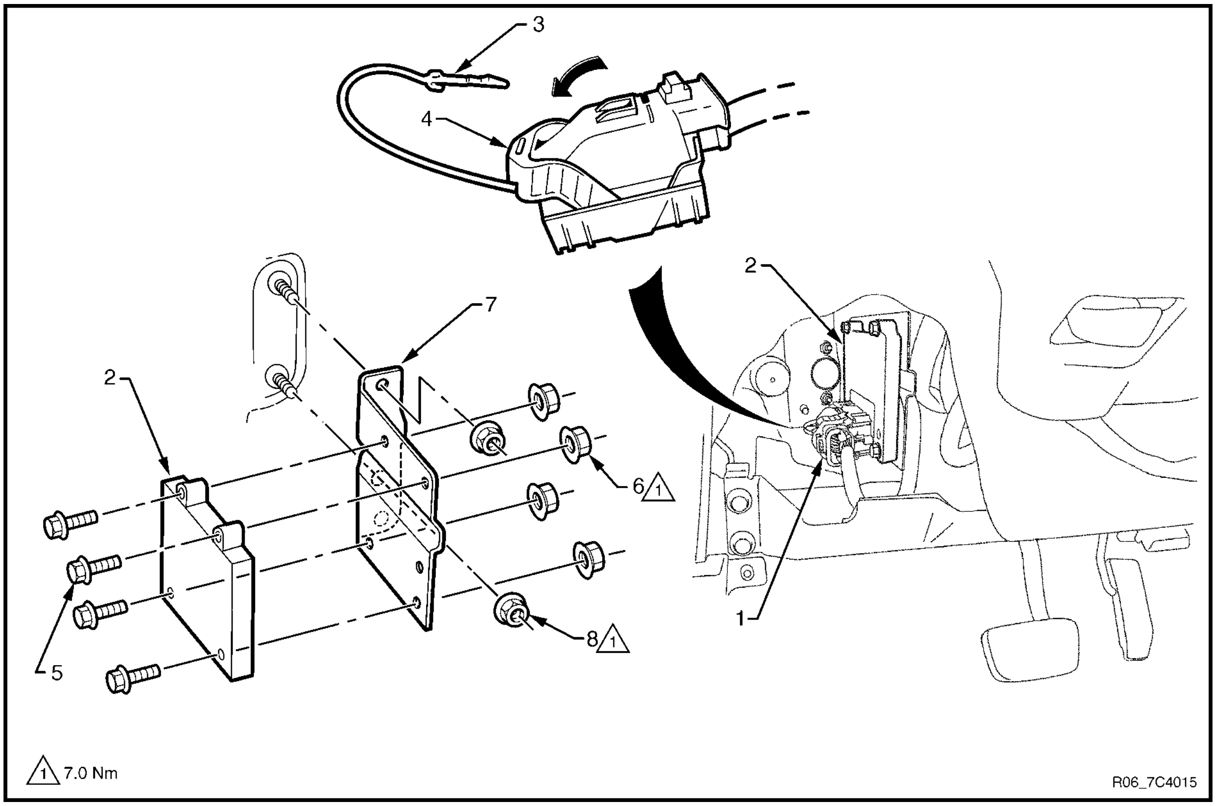

Figure 7C4 – 63

Reinstall

Reinstallation of the transmission control module (TCM) is the reverse of the removal procedure, noting the following:

1 If a new TCM is installed it must be programmed, refer to TCM Programming Procedure in this Section.

2 If required, install the mounting bracket to the firewall and tighten the nuts to the correct torque specification.

TCM bracket attaching nut torque specification ....7.0 Nm

3 Install the TCM onto the bracket and tighten the bolts and nuts to the correct torque specification.

TCM attaching bolt and nut torque specification ....7.0 Nm

4 Lock the connector securely to the TCM by with the locking lever and the securing pin.

5 Using Tech 2, clear any TCM diagnostic trouble code (DTC) that may have set during the removal procedure, refer to 0C Tech 2.

TCM Programming Procedure

1 The transmission control module (TCM) must be programmed with the correct software/calibration. Ensure the following conditions exist before starting the TCM programming procedure:

   a The battery is fully charged.

   b The Tech 2 cable connection at the data link connector (DLC) is secure.

   c The ignition switch is in the ON position.

2 Program the TCM using the latest software for the vehicle, refer to the following:

   a Current release of TIS for the latest software and

   b 0C Tech 2 for TCM service programming.

3 If the TCM fails to program, proceed as follows:

a Ensure the TCM connection is secured.

b Ensure Tech 2 is programmed with the latest software version.

c Attempt to re-program the TCM. Replace the TCM if it still cannot be programmed properly.

4 Specifications

For all 4L60E hydra-matic automatic transmission specifications, refer to 7C1 Automatic transmission – 4L60E – General Information.

5 Torque Wrench Specifications

For a complete listing of all torque wrench specifications for the 4L60E hydra-matic automatic transmission, refer to 7C1 Automatic transmission – 4L60E – General Information.

6 Special Tools

For a complete listing of all the special tools used for servicing the 4L60E hydra-matic automatic transmission, refer to 7C1 Automatic transmission – 4L60E – General Information.

SECTION 7

TRANSMISSION

AW30-40LE MODEL

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SECTION 7A2

TRANSMISSION CONTROL SYSTEM (AW30–40LE)

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Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

The AW30-40LE is a 4–speed fully electronically controlled automatic transmission. It uses a microcomputer as a control unit to judge driving conditions including throttle opening rate and vehicle speed, then it sets the shifting point in the optimum timing so that best driving performance can be achieved.

In addition, the built–in driving mode select function can select three driving modes according to the driver's preference:

- Normal mode –Normal shift pattern.
- 3rd Start mode –Starts in 3rd gear to reduce slippage on mud, ice or snow.
- Power mode –Delays upshift timing when more powerful acceleration is required.

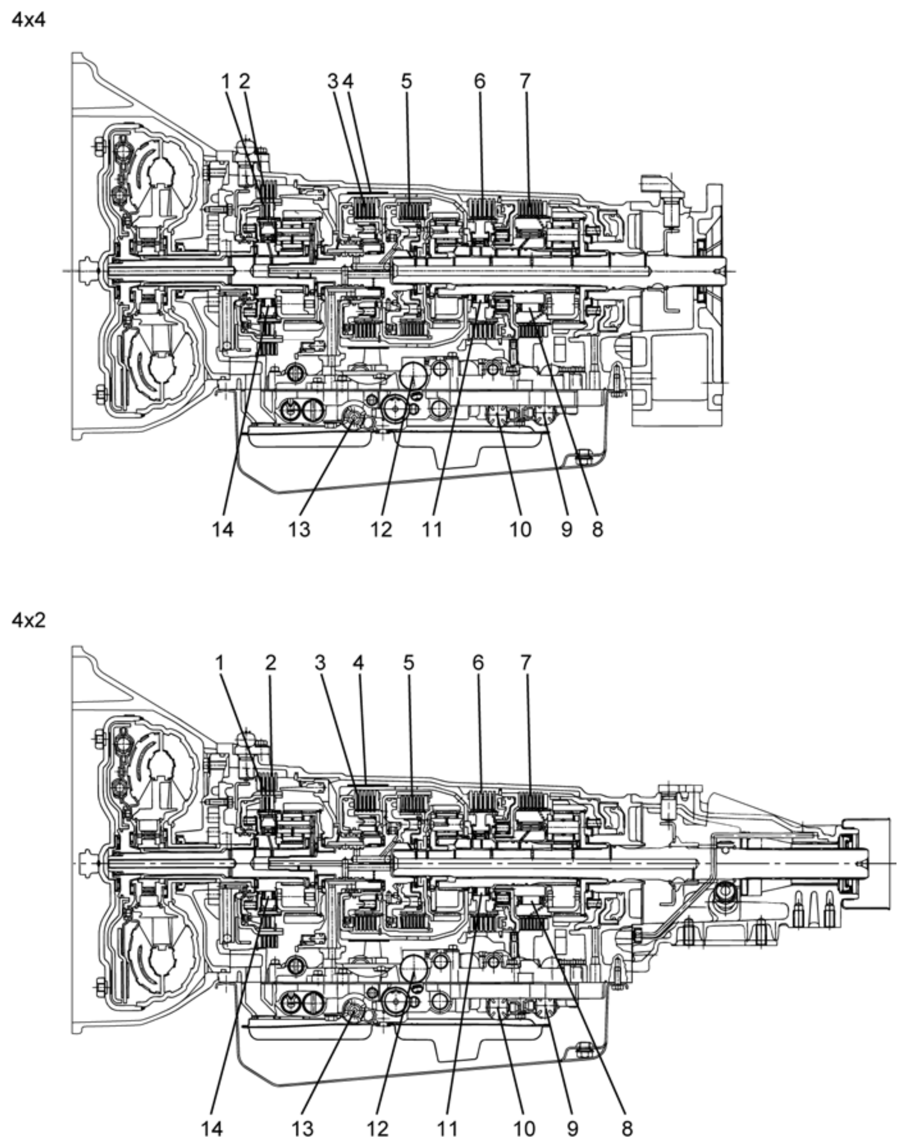
Also, the built–in fail–safe function (“emergency mode") assures driving performance even if the vehicle speed sensor, throttle signal or any solenoid fails.

Further, the self–diagnostic function conducts diagnosis in a short time when the control system fails, thus improving serviceability.

The major features of AW30-40LE are as follows:

- A compact structure consisting of 2 sets of planetary gears and flat torque converter.
- Electronic control selects the optimum driving mode according to the driving conditions.
- Electronic control maintains the optimum hydraulic pressure for clutch, band brake as well as transmission so that shift feeling is improved.
- Wide gear ratio and high torque rate of torque converter provide excellent starting performance.
- Optimum Lock-up control of each driving mode can have it both ways driving performance and fuel economy.
- Excellent shift quality can be achieved by the torque management control through the CAN communication with the engine.

Components Location



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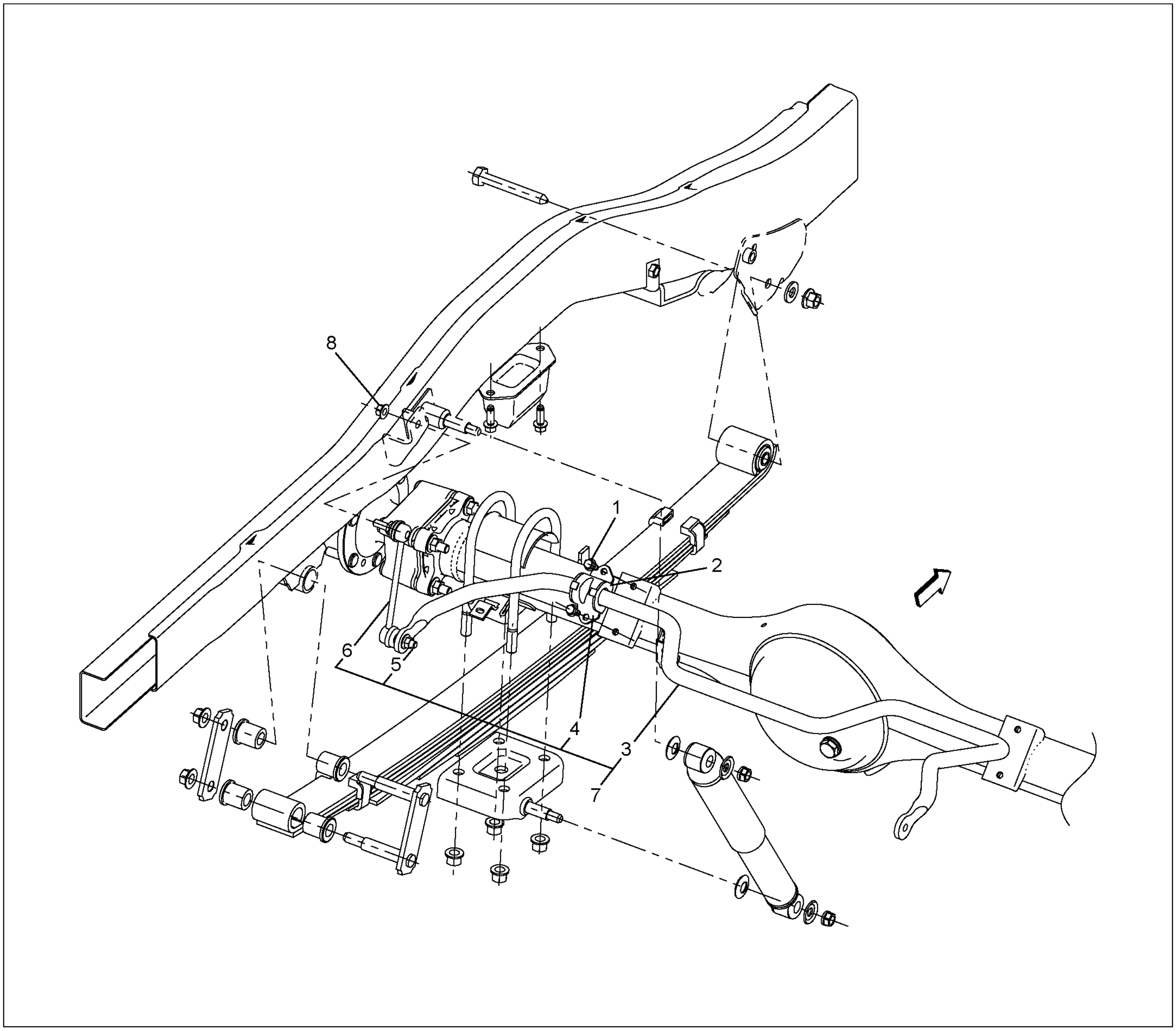
Legend

(1) Overdrive direct clutch (C-0)
(2) Overdrive brake (B-0)
(3) Direct clutch (C-2)
(4) Second coast brake (B-1)
(5) Forward clutch (C-1)
(6) Second brake (B-2)
(7) First and reverse brake (B-3)
(8) One-way clutch (No.2) (F-2)
(9) Shift solenoid (S-1)
(10) Shift solenoid (S-2)
(11) One-way clutch (No.1) (F-1)
(12) Pressure control solenoid (STH)
(13) Lock-up solenoid (SL)
(14) Overdrive one-way clutch (F-0)

REAR STABILIZER BAR

STABILIZER BAR AND ASSOCIATED PARTS



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Legend

1. Bolt
2. Bush
3. Stabilizer Bar
4. Cap
5. Nut
6. Link
7. Stabilizer Bar Assembly
8. Nut

Operating Condition

○: Operating ○×: Free at coast down ◎: Operating at Look-up

Select Lever Position	Gear Position	Gear Shift	C-0	C-1	C-2	B-0	B-1	B-2	B-3	F-0	F-1	F-2	S-1	S-2	SL
P	Parking		○										○		
R	Reverse		○		○				○	○			○		
N	Neutral		○										○		
D	1st		○	○						○		○×	○		
	2nd		○	○				○		○	○×		○	○	(2*)◎
	3rd		○	○	○			○		○				○	(3*)◎
	O/D			○	○	○		○							(4*)◎
3	1st		○	○						○		○×	○		
	2nd		○	○				○		○	○×		○	○	
	3rd		○	○	○			○		○				○	(4*)◎
	(1*)O/D			○	○	○		○							
2	1st		○	○						○		○×	○		
	2nd		○	○			○	○		○	○		○	○	(5*)◎
	(1*)3rd		○	○	○			○		○				○	
L	1st		○	○					○	○		○	○		
	(1*)2nd		○	○			○	○		○	○		○	○	
	(1*)3rd		○	○	○			○		○				○	

(1*) : Only downshift at select down
(2*) : Upslope, hot and cruise mode
(3*) : Except power, 4L and warm up mode
(4*) : Except 4L and warm up mode
(5*) : Only hot mode

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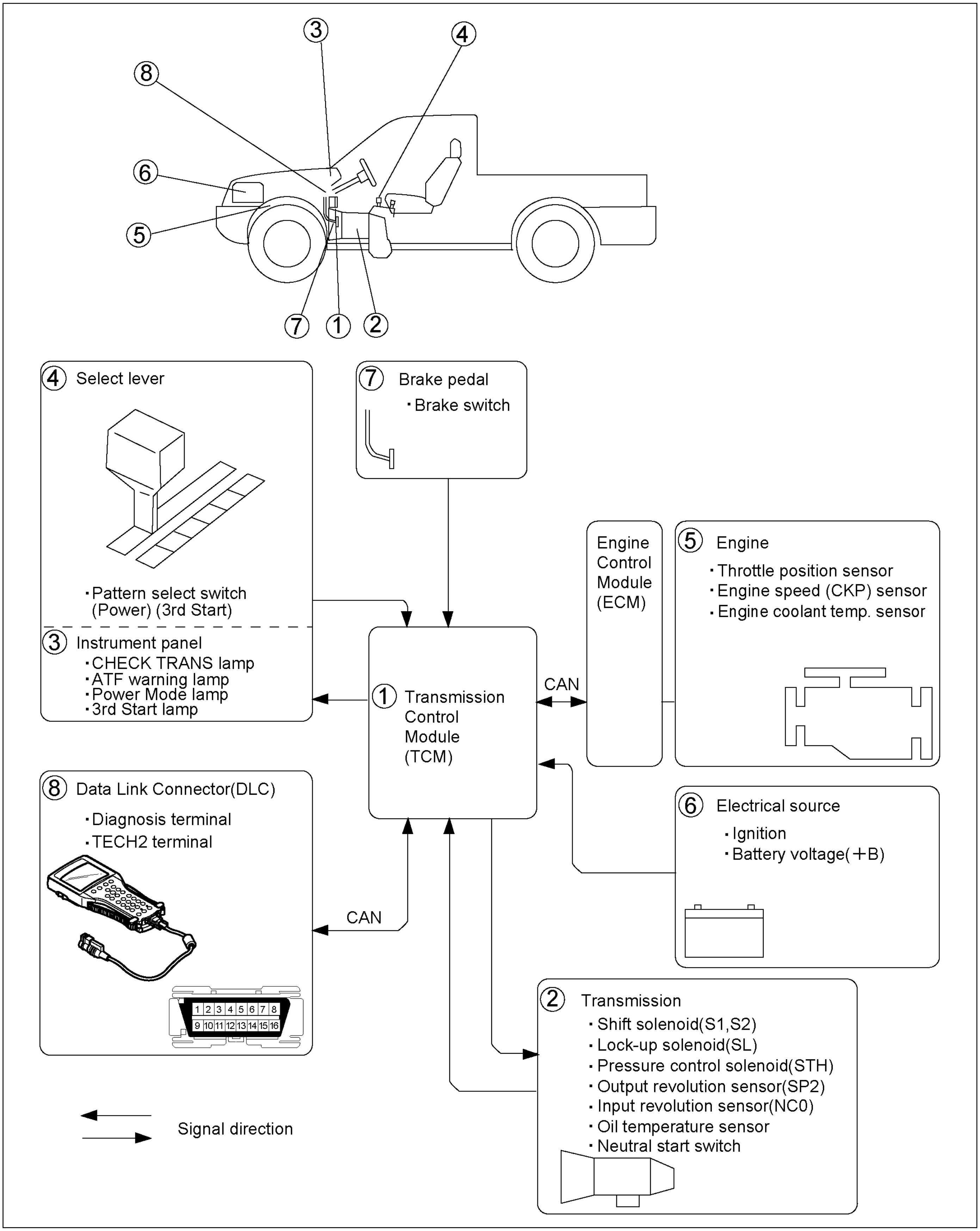
Electronic Control Diagram



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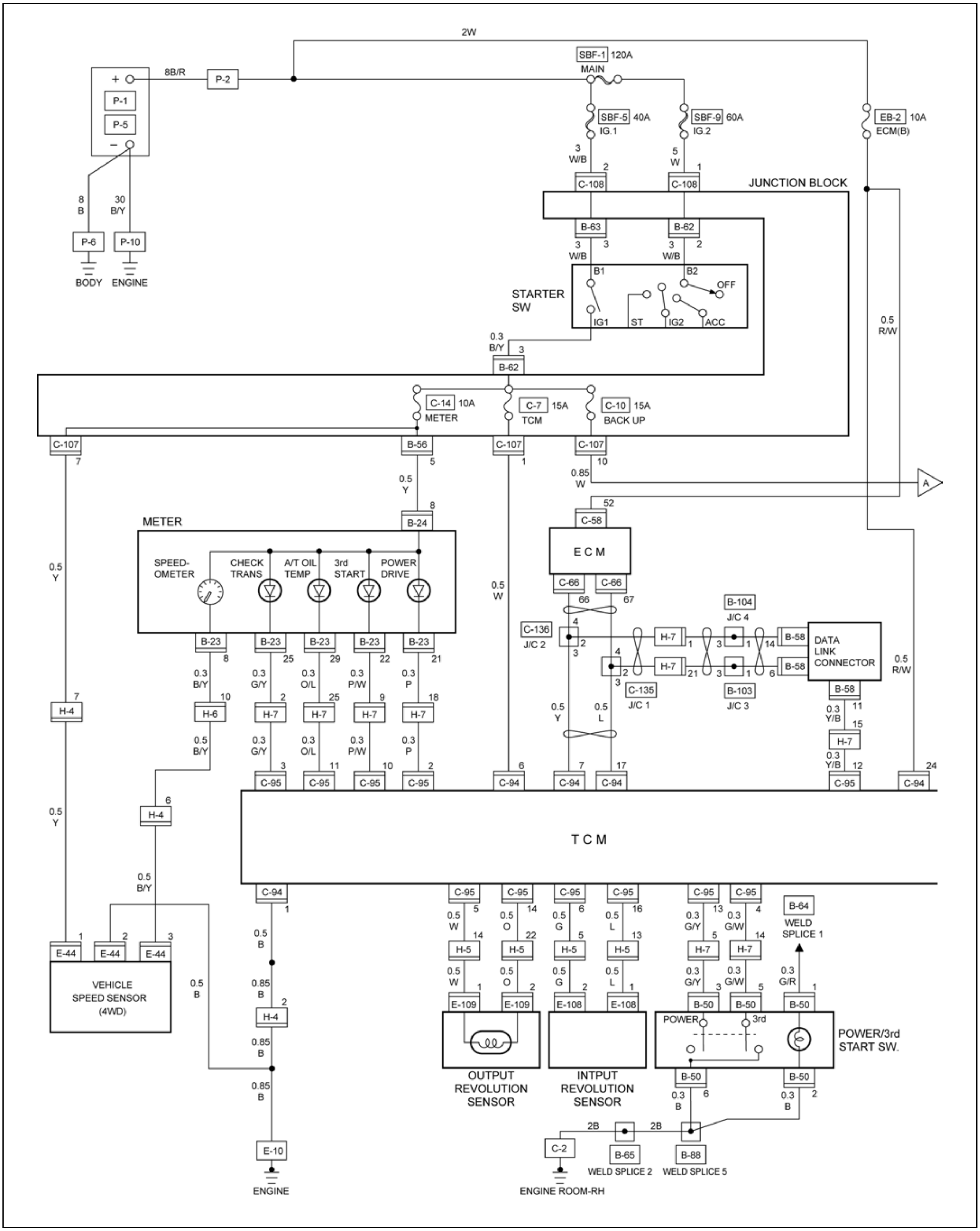
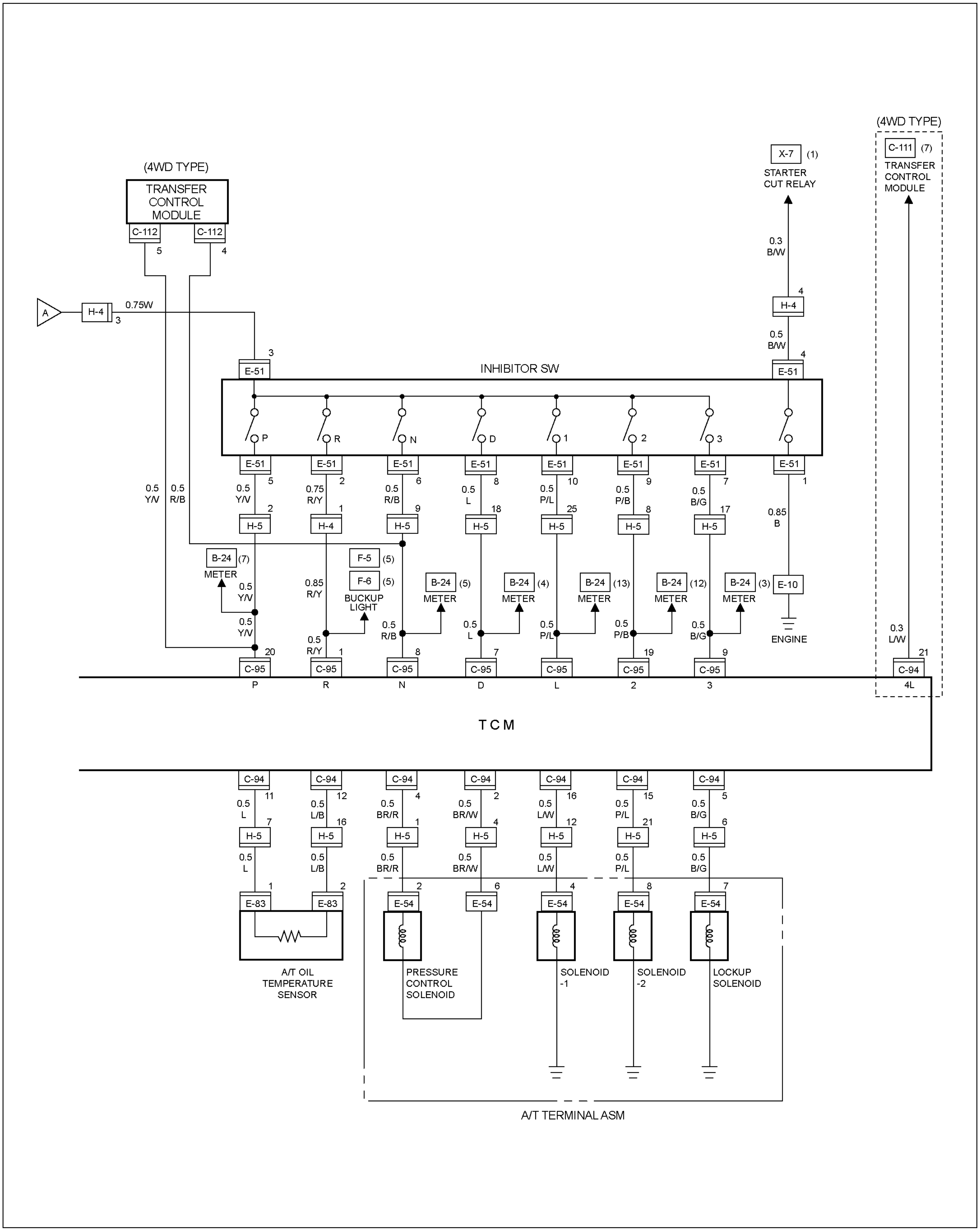
Transmission Control Module (TCM) (1/2)



Transmission Control Module (TCM) (2/2)



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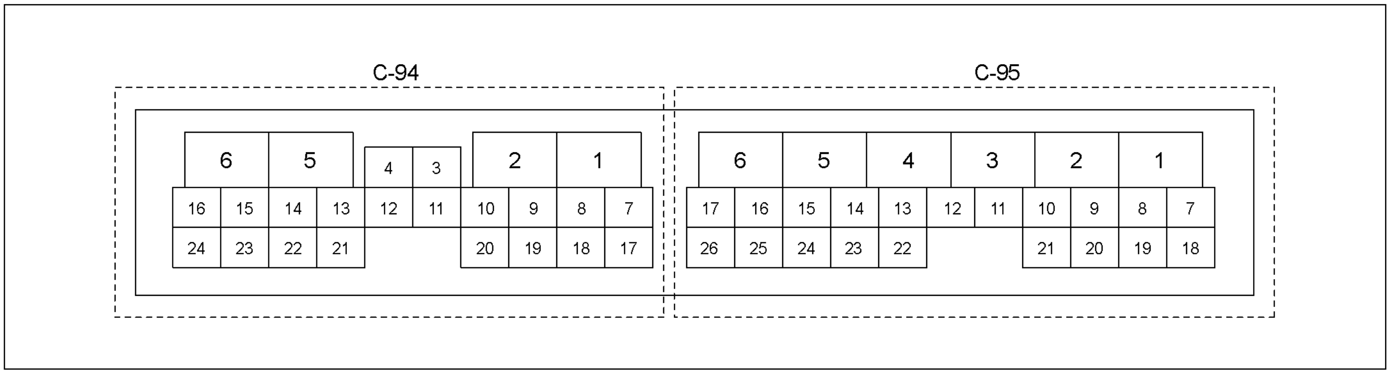
TCM Point Table



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C-94 Connector

PIN No.	SIGNAL NAME
A1	GND
A2	PRESSURE CONTROL SOLENOID GND
A3	—
A4	PRESSURE CONTROL SOLENOID
A5	L-up SOLENOID
A6	STARTER SW(IG1)
A7	CAN COMMUNICATION (-)
A8	—
A9	—
A10	—
A11	T/M OIL TEMPERATURE SENSOR
A12	T/M OIL TEMPERATURE SENSOR GND
A13	—
A14	—
A15	SHIFT SOLENOID (S2)
A16	SHIFT SOLENOID (S1)
A17	CAN COMMUNICATION (+)
A18	—
A19	—
A20	—
A21	—
A22	—
A23	GND
A24	BATTERY

C-95 Connector

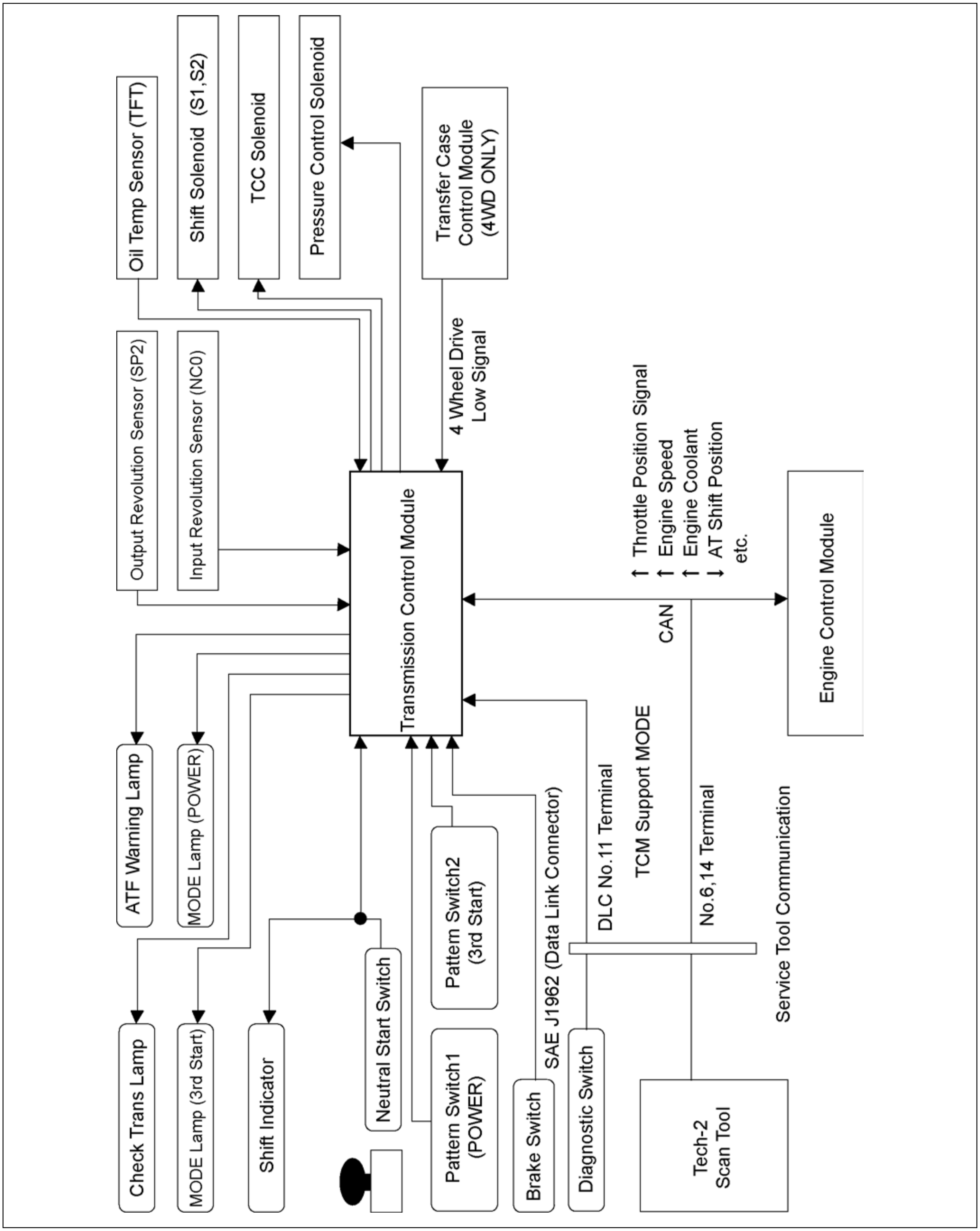
PIN No.	SIGNAL NAME
B1	NEUTRAL START SW (R)
B2	POWER LAMP
B3	CHECK TRANS LAMP
B4	PATTERN SELECT SW (3rd START)
B5	SPEED SENSOR (+)
B6	INPUT REVOLUTION SENSOR (+)
B7	NEUTRAL START SW (D)
B8	NEUTRAL START SW (N)
B9	NEUTRAL START SW (3)
B10	3rd START LAMP
B11	OIL TEMPERATURE WARNING LAMP
B12	DIAGNOSIS TERMINAL
B13	PATTERN SELECT SW (POWER)
B14	SPEED SENSOR (-)
B15	—
B16	INPUT REVOLUTION SENSOR (+)
B17	—
B18	NEUTRAL START SW (L)
B19	NEUTRAL START SW (2)
B20	NEUTRAL START SW (P)
B21	TRANSMISFER LOW 4 SW
B22	BRAKE LAMP SW
B23	DIAGNOSIS OUT PUT
B24	—
B25	—
B26	—

TCM Voltage & Resistance Check Sheet

CHECK ITEM	PIN No.	VALUE		NOTE
VIGN	C-94: 6–1	VIGN		Key “ON”
Backup Power Supply	C-94: 24–1	+B (Always)		Key “ON”
Neutral Start Switch P		“P” Position	VIGN	Key “ON”
		Except “P”	0V	
Neutral Start Switch R	C-95: 1–C-94: 1	“R” Position	VIGN	Key “ON”
		Except “R”	0V	
Neutral Start Switch N	C-95: 8–C-94: 1	“N” Position	VIGN	Key “ON”
		Except “N”	0V	
Neutral Start Switch D	C95: 7–C-94: 1	“D” Position	VIGN	Key “ON”
		Except “D”	0V	
Neutral Start Switch 2	C-95: 19–C-94: 1	“2” Position	VIGN	Key “ON”
		Except “2”	0V	
Neutral Start Switch 1	C-95: 18–C-94: 1	“1” Position	VIGN	Key “ON”
		Except “1”	0V	
Neutral Start Switch 3	C-95: 9–C-94: 1	“3” Position	VIGN	Key “ON”
		Except “3”	0V	
Power SW	C-95: 13–C-94: 1	“ON”	0V	Key “ON”
		“OFF”	VIGN	
3rd Start SW	C-95: 4–C-94: 1	“ON”	0V	Key “ON”
		“OFF”	VIGN	
Brake SW	C-95: 22–C-94: 1	“ON”	VIGN	Key “ON”
		“OFF”	0V	
AT Oil Temperature Sensor	C-94: 11–12	20°C/68°F	4.6V	Engine run.
		155°C/311°F	1.1V	
4L Signal	C-95: 21–C-94: 1	4L	0V	Key “ON”
		2H/4H	VIGN	
Diag SW	C-95: 12–C-94: 1	“ON”	VIGN	Key “ON”
		“OFF”	0V	
Shift Solenoid A (S1)	C-94: 16–1	P	VIGN	Engine run.
		R	VIGN	
		N	VIGN	
		D–1	VIGN	
		D–2	VIGN	
		D–3	0V	
		D–4	0V	

CHECK ITEM	PIN No.	VALUE		NOTE
Shift Solenoid B (S2)	C-94: 15–1	P	0V	Engine run.
		R	0V	Engine run. (Without the Reverse position lock out)
		N	0V	Engine run.
		D–1	0V	
		D–2	VIGN	
		D–3	VIGN	
		D–4	0V	
Lock-up Solenoid	C-94: 5–1	“ON”	VIGN	(ex.) It is “ON” when the vehicle speed is more than 65km/h.
		“OFF”	0V	
Check Trans Lamp	C-95: 3–C-94: 1	“ON”	0V	Key “ON” (The lamp is “ON” for 3 second after key “ON”)
		“OFF”	VIGN	
AT Oil Temperature Lamp	C-95: 11–C-94: 1	“ON”	0V	Key “ON” (The lamp is “ON” for 3 second after key “ON”)
		“OFF”	VIGN	
Power Lamp	C-95: 2–C-94: 1	“ON”	0V	Key “ON” (The lamp is “ON” when the Power switch is “ON”)
		“OFF”	VIGN	
3rd Start Lamp	C-95: 10–C-94: 1	“ON”	0V	Key “ON” (The lamp is “ON” when the 3rd Start switch is “ON”)
		“OFF”	VIGN	
AT Oil Temp Sensor Resistance	C-94: 11–C-94: 12	20°C/68°F	12kΩ	Key “OFF”
		50°C/122°F	1.5kΩ	
		155°C/311°F	293Ω	
Pressure Control Solenoid Resistance	C-94: 11–C-942	About 4–7Ω(20°C/68°F)		Key “OFF”
Speed Sensor Resistance	C-95: 5–C-95: 14	About 560Ω–120Ω(20°C/68°F)		Key “OFF”
Input Revolution Sensor Resistance	C-95: 6–C-95: 16	About 560Ω–120Ω(20°C/68°F)		Key “OFF”
Lock-up Solenoid Resistance	C-94: 5–C-94: 1	About 10Ω–15Ω(20°C/68°F)		Key “OFF”
Shift Solenoid A (S1) Resistance	C-94: 16–C-94: 1	About 10Ω–15Ω(20°C/68°F)		Key “OFF”
Shift Solenoid B (S2) Resistance	C-94: 15–C-94: 1	About 10Ω–15Ω(20°C/68°F)		Key “OFF”

Control System Diagram



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Control and Functions

Item	Description
Shift and lock-up control	Shift and lock-up points can be controlled in accordance with output of S1, S2, and SL solenoids based on "Shift-map" made up of vehicle speed and the opening.
Overdrive off cut control	When the select lever is operated from D to 3, if the vehicle speed is more than 142km/h (89mph), TCM enables to remain overdrive in order to prevent over rev.
Lock-up cut control	Lock-up is inhibited with following condition in order to improve the shift feeling. • 1st gear • Idling • Operating brake switch • L position • During shift change
Driveng mode select control	• The TCM selects a suitable driving mode from the ten kinds for the variety driving condition. 1) Normal mode 2) Power mode 3) 3rd start mode 4) HOT mode 5) L4 mode 6) Up slope1 mode 7) Up slope2 mode 8) Down slope mode 9) Auto cruise mode 10) Warm up mode • The priority of driving mode Normal < Power < Up slope1 < Up slope2 < Down slope < L4 < Warm up < Auto cruise < 3rd start < HOT
Oil temperature compensation control	If the ATF temperature exceeds 130°C (266°F), the TCM selects the HOT mode shift pattern for lock-up, thus preventing the oil temperature from rising. (The HOT mode is released, if the ATF temperature is less than 115°C /239°F.)
3rd start mode control	By selecting 3rd start mode, the vehicle starting can be controls smoothly on low frictional road like a snowy or muddy. 1. Enable condition a) The gear select position is "D" only. b) Vehicle speed is less than 11km/h (7mph). c) Transmission oil temperature is less than 120°C (248°F). d) Accelerator opening is less than 8%. e) Except 3rd start mode. 2. Disable condition a) Turning off the 3rd start mode switch b) Shifting select position to "3", "2", or "L"(3rd start mode is not canceled by selecting "N", "R", or "P") c) Ignition key is turned off. d) Vehicle speed is more than 35km/h (22mph).
L4 mode control	The TCM detects whether the transfer is engaged in high or low based on L4 switch signal, and selects the "Shift-map".

Item	Description
Reverse lock out control	If the select lever is moved to "R" position during forward driving, the TCM prohibits reverse driving by turn off the S1 and turn on the S2 for prevention of danger and protection of the automatic transmission. 1. Enable condition a) Vehicle speed is more than 11km/h (7mph). 2. Disable condition a) Vehicle speed is less than 9km/h (6mph). b) When except "R" position is detected.
Auto cruise mode control	If the auto cruise control can't keep the setting speed like a uphill driving, the TCM selects the auto cruise mode shift pattern for downshifting, thus keeping the vehicle speed.
Warm-up mode control	TCM selects the warm-up mode shift pattern in engine cold condition for improvement of drivability and facilitation of warm-up.
Squat control	When the TCM detects N→D garage shift, the TCM controls 1-3-1 shift by setting timer, in order to improve the shift feel at N→D.
Coast down control	The TCM switches to the coast down control at the coasting, in order to reduce the roughness of shifting.
Uphill control	When the TCM detected uphill, the TCM automatically switches to the uphill mode in two-stage in proportion to inclination pitch to prevent the busy shifting and to obtain an enough torque.
Downhill control	When the TCM detected downhill, the TCM automatically switches to the downhill mode, and shifts to the 3rd or keeps in the 3rd in order to prevent the vehicle acceleration. Then, the brake load is reduced by a moderate engine brake and fuel consumption is improved by the fuel cut.
Line pressure control	The TCM controls the impressed current of the pressure control solenoid based on the throttle opening, and regulates suitable throttle pressure.
Engine truque management control	The TCM controls engine torque for improvement of shift quality or durability under the following conditions. • Upshift and downshift • Garageshift
Indicate driving mode function	The TCM indicates the following driving mode on instrument panel. • Power mode • 3rd start mode
Indicate oil temperature warning function	If the transmission oil temperature sensor senses that transmission oil temperature is greater than 146°C (295°F), the TCM turns on ATF warning lamp. (The warning lamp is turned off, if oil temperature is less than 126°C/259°F.)
Fail-safe function	When trouble occurs to vehicle sensor and each solenoid, TCM automatically exerts fail-safe control not to spoil driveability. • This control is exerted when sensor or actuator is in trouble, while TCM works normally. • The "CHECK TRANS" light flashes to alert the driver, and the transmission must be manually shifted as follows. Select lever position / Gear position: D – 4 (Fourth); 3 – 4 (Fourth); 2 – 3 (Third); L – 3 (Third); R – Reverse Shift are firmer to prevent clutch slip and consequent wear. The fault should be corrected as soon as possible.

Removal

1. Remove the bolt and nut.
2. Take out the stabilizer bar assembly.
3. Remove the nut and take out the link from the stabilizer bar.
4. Take out the cap and bush from the stabilizer bar.

Installation

1. Set the bush and cap on the stabilizer bar.
2. Install the link on the stabilizer bar and tighten the nut to the specified torque.

Torque	N·m (kgf·m/lb·ft)
50 (5.1/37)	

3. Install the stabilizer bar assembly on the rear axle and tighten the bolt to the specified torque.

Torque	N·m (kgf·m/lb·ft)
25 (2.5/18)	

4. Set the stabilizer bar assembly to the frame bracket and tighten the nut to the specified torque.

Torque	N·m (kgf·m/lb·ft)
50 (5.1/37)	

Item	Description
Diagnosis function	• If there is an abnormality in vehicle sensors, each solenoid (S1, S2, SL, STH), or throttle position sensor, "CHECK TRANS" lamp is actuated to warn the drive. But when the abnormality items have been restored to normal, the light does not blink. • Faulty parts are memorized in TCM. If self-diagnosis start signal is inputted, "CHECK TRANS" lamp is blinked and results of diagnosis are indicated. A history of faults remains recorded even when IGN switch is off. If DG1 switch signal is inputted, or by using F1: Clear DTC Information for TECH 2, the records can be erased.
TECH 2	• Output of control data in the TCM • Actuator (Solenoid) operation check • Erasure of trouble code • Output of DTC code

Functions of Input / Output Components

Input/ Output Reflection Timinig — Input/ Output Correspondence Control

Basic control

			Input/ Output	Shift point control	Lock-up point control	Shift / Lock-up timing control	Squat control	Oil temperature revision control	Winter mode control	Auto cruise control	Line pressure control	O/D OFF prohibition control	Coast down control	Adaptive up slope shift control	Adaptive down slope shift control	"Torque management control at shift change"	"Torque management control at N-D or N-R"	Revese lock out control	Self Diagnosis	CAN DIAG	Service Programming System	Engine torque management control at stall
INPUT	OTHERS	TRANSMISSION	Output revolution	○	○	○	○	×	○	○	○	○	○	○	○	○	○	○	○	×	○	×
			Input revolution	×	×	○	×	×	×	×	○	×	×	○	○	○	×	×	○	×	×	○
			Neutral start switch	○	○	×	○	○	○	○	○	○	○	○	○	×	○	○	○	×	○	○
			Oil temperature sensor	×	×	○	○	○	○	×	○	×	○	○	○	×	×	×	○	×	×	×
	CAN	ENGINE	Engine speed	×	×	×	×	×	×	×	○	×	○	○	○	○	×	×	○	×	○	×
			ECM CAN	○	○	○	○	○	○	○	○	×	○	○	○	○	○	×	○	×	○	○
			Engine actual steady state torque	×	×	×	×	×	×	×	○	×	×	○	○	○	×	×	×	×	×	×
			Engine Non-Transmission regulated steady state torque	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×	×	×	×
			Engine actual steady state torque validity	×	×	×	×	×	×	×	○	×	×	○	○	○	×	×	○	×	×	○
			Engine coolant temperature	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	○
			Actual accelerator pedal position	○	○	○	○	×	○	×	○	×	○	○	○	○	○	×	○	×	×	○
			Accelerator effective position	×	×	×	×	×	×	○	×	×	×	×	×	×	×	×	○	×	×	×
			Air conditioning compressor operating status	×	×	×	×	×	×	×	×	×	○	×	×	×	×	×	×	×	×	×
	OTHERS	VEHICLE	Mode switch (3rd ST)	○	×	×	○	×	○	×	×	×	×	×	×	×	×	×	×	×	×	×
			Diag terminal	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
			Brake switch	×	○	×	○	×	×	×	×	×	○	×	○	×	×	×	×	×	×	×
	CAN		Cruise active	×	×	×	×	×	×	○	×	×	×	×	×	×	×	×	×	×	×	×
			Vehicle speed	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
		TOD	Transfer 4L switch	○	○	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
OUTPUT	OTHERS	TRANSMISSION	Shift solenoid S1	○	×	○	○	○	○	○	×	○	○	○	○	×	×	○	○	×	×	×
			Shift solenoid S2	○	×	○	○	○	○	○	×	○	○	○	○	×	×	○	○	×	×	×
			Lock-up solenoid SL	×	○	○	×	○	○	○	×	×	×	×	×	×	×	×	○	×	×	×
			Pressure control solenoid STH	×	×	×	×	×	×	×	○	×	×	×	×	×	×	×	○	×	×	×
	CAN	ENGINE	Torque reduction request	×	×	×	×	×	×	×	×	×	×	×	×	○	○	×	×	×	×	○
			Torque reduction request value	×	×	×	×	×	×	×	×	×	×	×	×	○	○	×	×	×	×	○
			Shift lever position	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
			Transmission gear ratio	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
			Lock-up state	×	○	○	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
			TCM valid signal	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
			Diag (MIL/ Freeze Frame)	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
	OTHERS	VEHICLE	Winter Mode lamp	×	×	×	×	×	○	×	×	×	×	×	×	×	×	×	×	×	×	×
			Oil temperature warning lamp	×	×	×	×	○	×	×	×	×	×	×	×	×	×	×	○	×	×	×
			Check Trans lamp	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	×	×	×
	CAN		Mode select switch	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
		VDC	Automatic Transmission commanded gear	○	×	○	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
			Transmission estimated gear	○	×	○	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
SERIAL	OTHERS	DIAG	CAN DIAG	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○	○	○	×

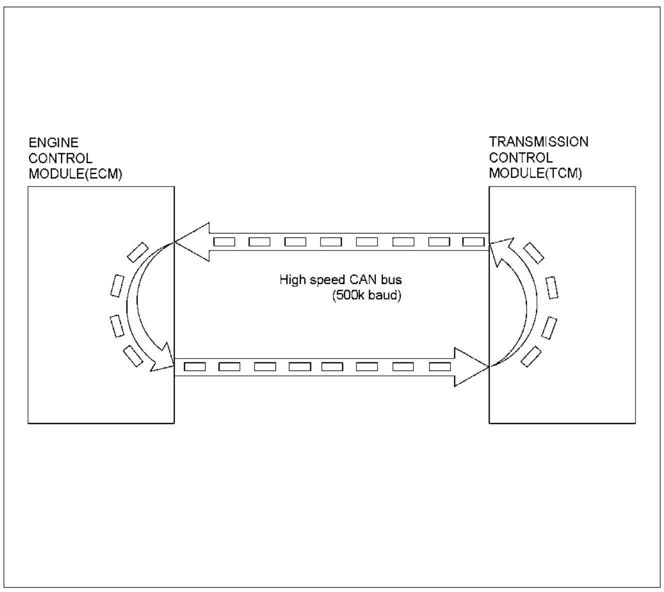
RTW77AXF000701

CAN bus systems in automatic transmission control (AW30-40LE)

The automatic transmission control system in AW30-40LE uses high speed CAN bus system .The individual CAN bus systems are connected via two interfaces and can exchange information and data. This allows control modules that are connected to different CAN bus systems to communicate.

High speed CAN bus

Transmission control module in the vehicle that require continuous, rapid communication are connected to the high speed CAN bus. For example, the automatic transmission is continuously notified of the current engine load status. Since the automatic transmission control module has to react immediately to load status changes, rapid communication is required between the engine control module and the automatic transmission control module. The high speed CAN bus in the AW30-40LE is designed as a two-wire CAN bus (twisted pair). The wires are shielded and twisted. The transfer rate is 500 K baud.



RUW37ASF000401

Diagnosis

Electronic Diagnosis

How To Diagnose The Problem

1. To avoid incorrect diagnostics, this book needs to be followed accurately. Unless stated, **do not jump directly to a section that could contain the solution. Some important information may be missed.**
2. The sections in CAPITALS and bold are the main sections that can be found in the contents.
3. The go to **"SECTION"** means to continue to check going to the "section".
4. The go through **"SECTION"** means to go through the "section" and then to go back to the place the go through was written.
5. BASIC ELECTRIC CIRCUITS:

   You should understand the basic theory of electricity. This includes the meaning of voltage, amps, ohms, and what happens in a circuit with an open or shorted wire. You should also be able to read and understand wiring diagrams.

Check Trans Indicator

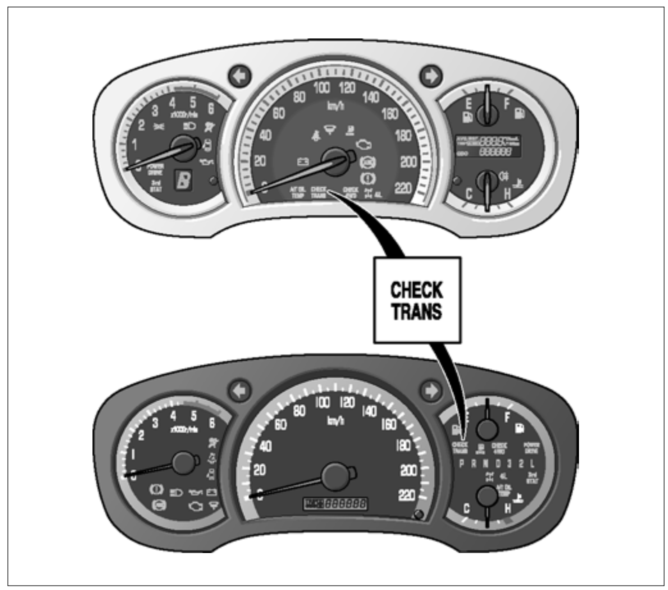
Find CHECK TRANS indicator and verify if it is

A. Flashing: Go to **On-Board Diagnostic (OBD) System Check.**

B. Staying on: Go through **"Check Trans" Check**.

C. Is never "ON" when the ignition key is turned on: Go through **"Check Trans" Check**

D. Is "ON" during 3 seconds at ignition but "OFF" after: Normal operation. No DTC or malfunction.



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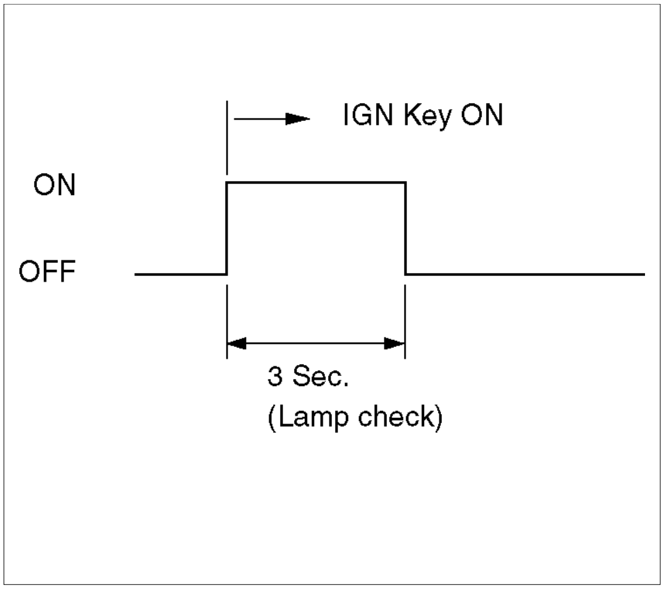
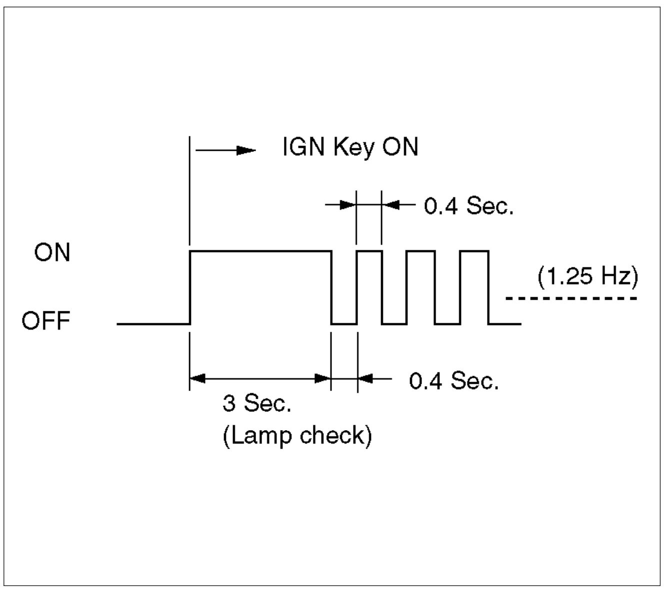
Normal



C07RY005-1

Abnormal



C07RY00042-1

On-Board Diagnostic (OBD) System Check

This test determines if the transmission or its input or output connections or sensors are failing.

1. Connect the Tech 2: Go through **Tech 2 Operating**.
2. Turn on the ignition but not the engine.
3. Push “F0” on Tech 2 to see the Diagnostic Trouble Code (DTC):
4. Do you have a DTC?

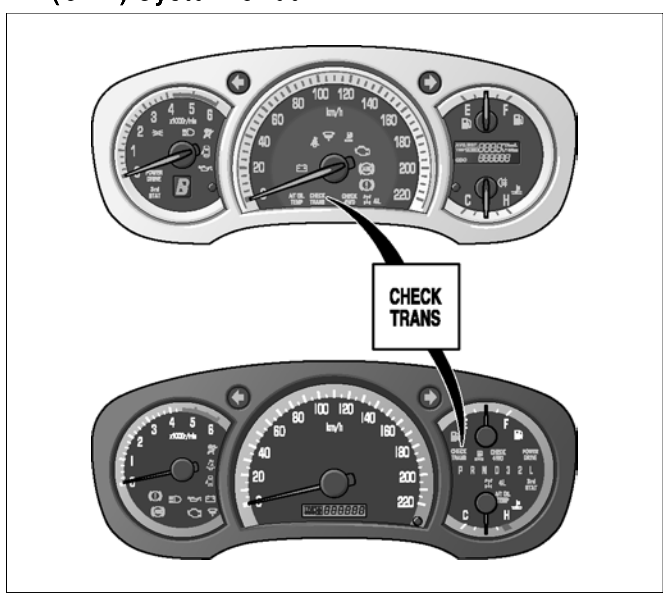
   YES: write down all code numbers and do the **DTC CHECK**

   NO: the DTC can not help you find the problem.

   1. Go through **“Check Trans” Check**
   2. If it is flashing and the flash is 0.4 seconds “ON” and 0.4 seconds “OFF”, this means that you should have a DTC stored. Please recheck go to **On-Board Diagnostic (OBD) System Check** and if you find the same problem, replace the Transmission Control Module (TCM).

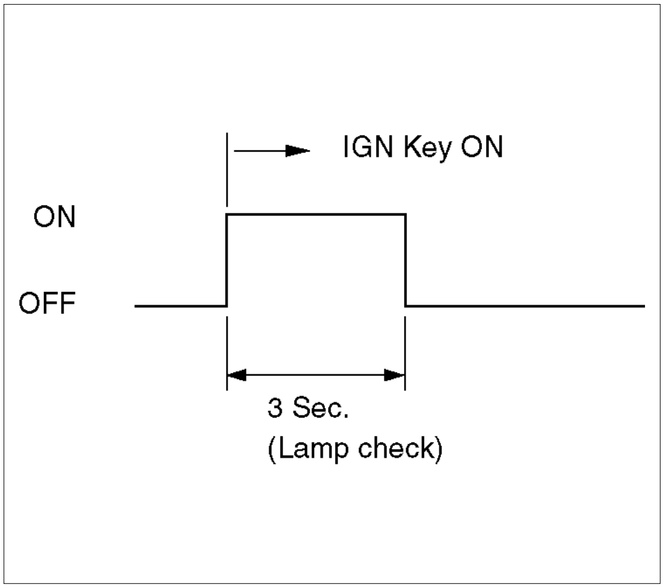
“Check Trans” Check

1. Indicator is “ON” during 3 seconds at ignition but it is “OFF” after the engine starts. The indicator is working normally go to **On-Board Diagnostic (OBD) System Check**.



RTW77ASH000101

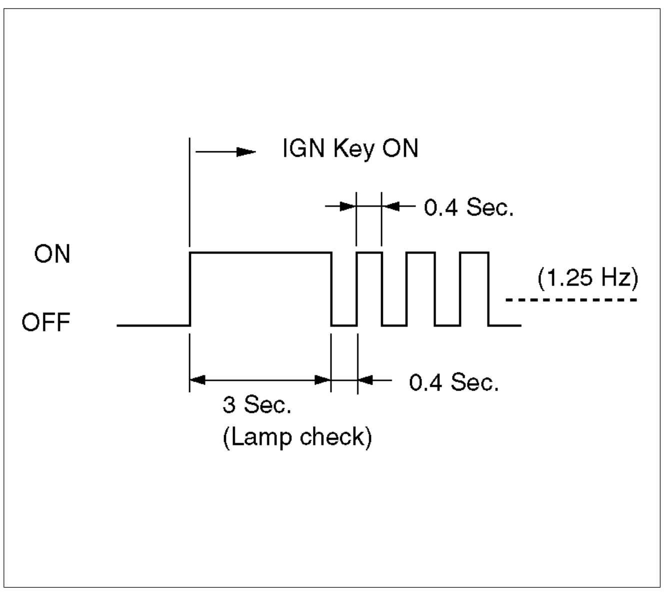
Normal



C07RY005-1

2. Indicator is flashing and the flash is 0.4 seconds "ON" and 0.4 seconds "OFF" always when ignition is on (engine cranked or not). This means that there is a malfunction. Go to **On-Board Diagnostic (OBD) System Check**.

Abnormal



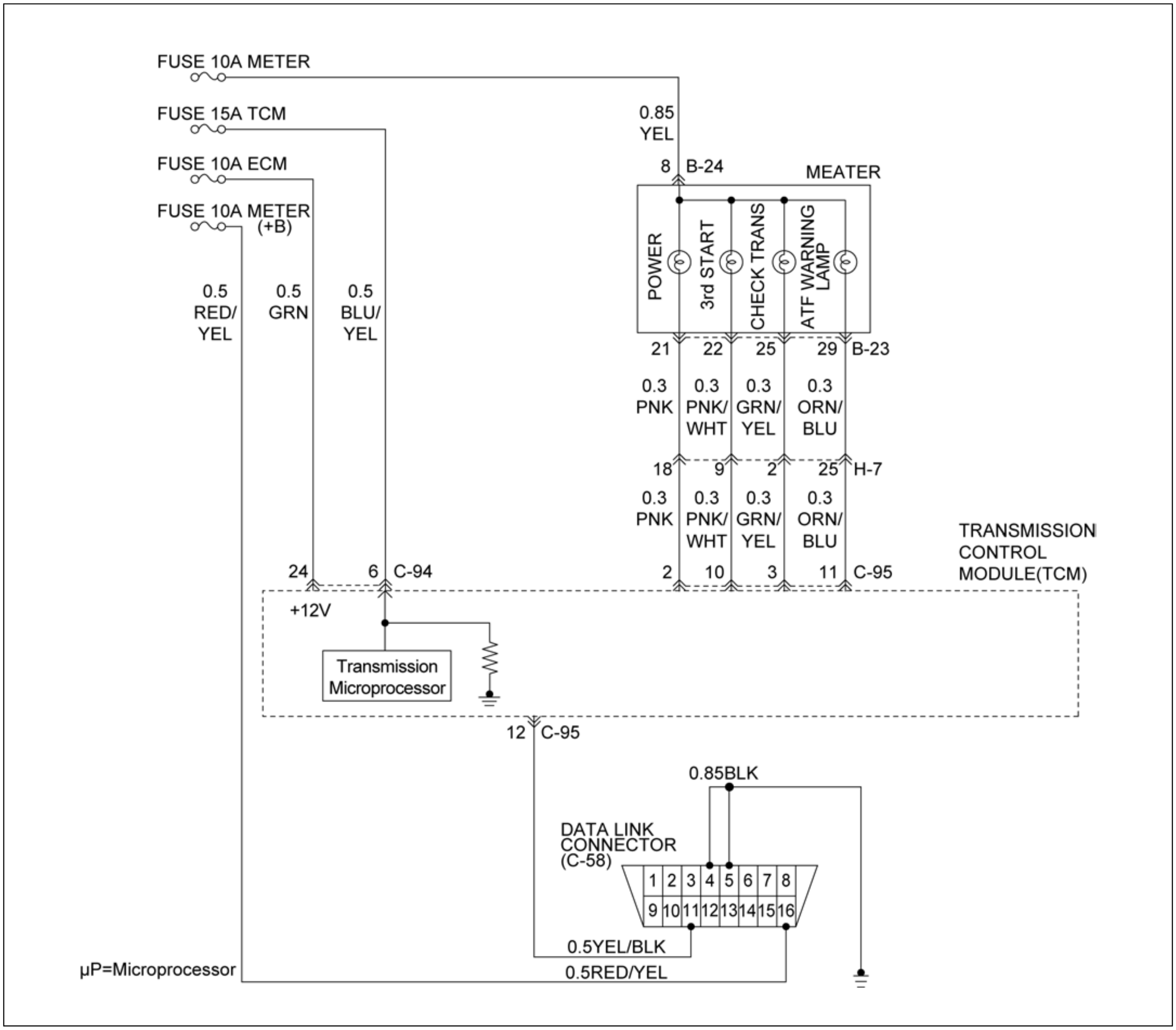
C07RY00042-1

3. Indicator is staying "ON" always when Ignition is "ON".
   1. This means that connection between the lamp and the indicator control unit is shorted to ground.
   2. Verify if instrument panel terminal 25 of connector B–23 is shorted to ground.
   3. Verify if the indicator control unit connector C–95 terminal 3 is shorted to ground.
   4. Verify that the instrument panel terminal 8 of connector B–24 is connected to battery.
   5. If a problem was solved: Go to **Check Trans Indicator**.

      NO: Replace Transmission Control Module (TCM).
4. Indicator is staying "OFF" with the ignition "ON" (engine "OFF").
   1. This means that connection between the lamp and the indicator control unit is shorted to battery or opened.
   2. Verify if instrument panel terminal 25 of connector B–23 is shorted to battery or open.
   3. Verify if the indicator control unit connector C–95 terminal 3 is shorted to battery or open.
   4. Verify that the instrument panel terminal 25 of connector B–23 is connected to battery. If not, check the meter fuse and the connections (terminal 2 of connector H–7) voltage.

5. If a problem was solved: Go to **Check Trans Indicator**.

   NO: Replace Transmission Control Module (TCM).



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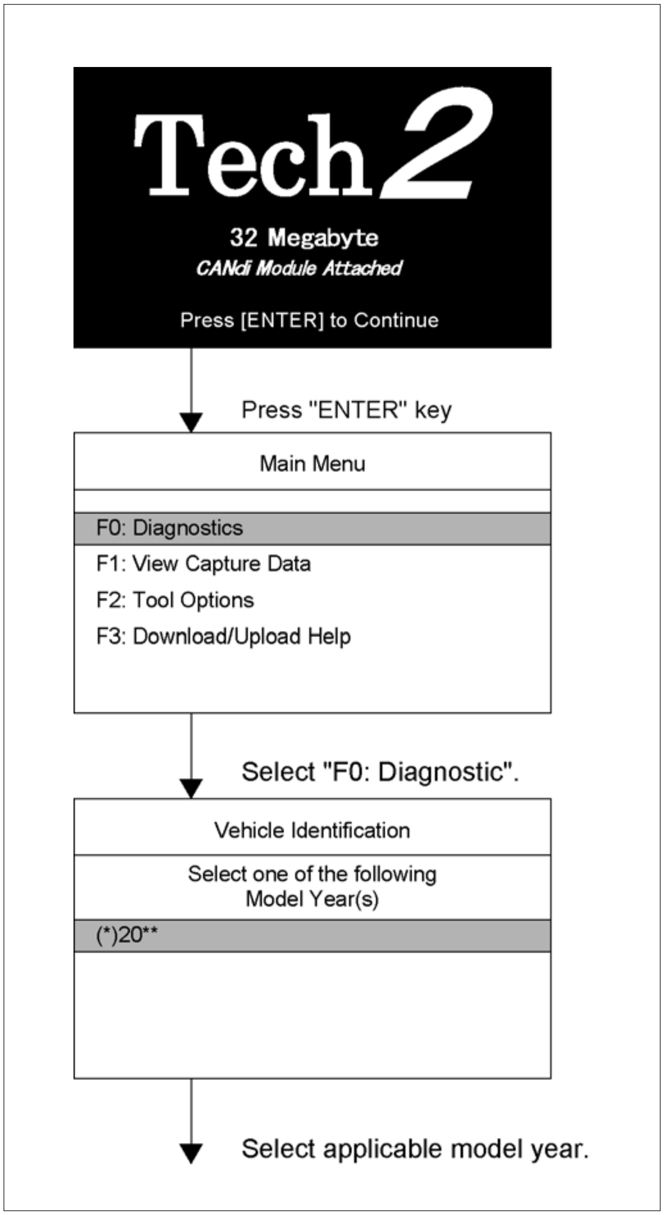
Tech 2 Operating



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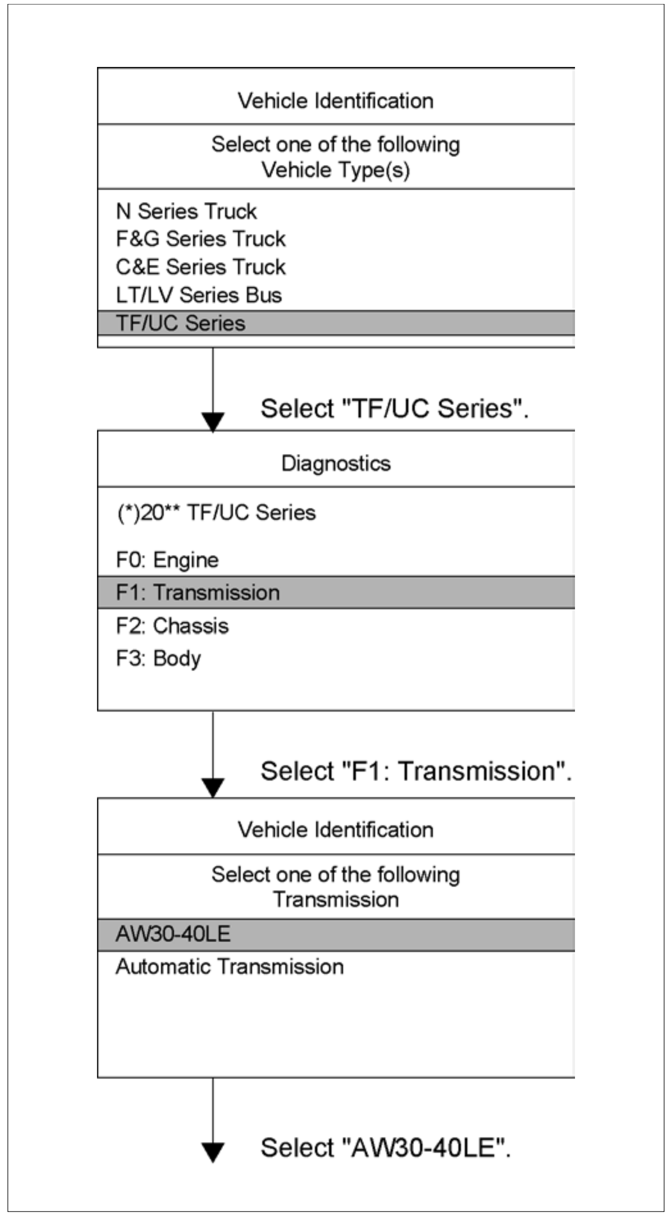

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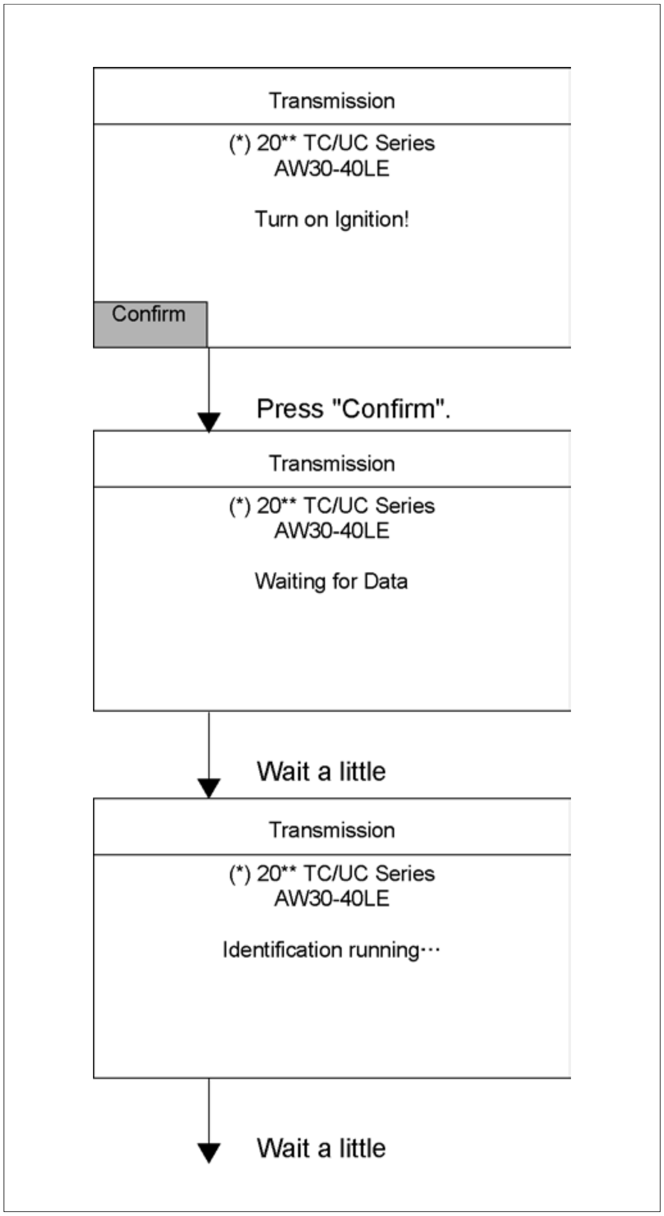

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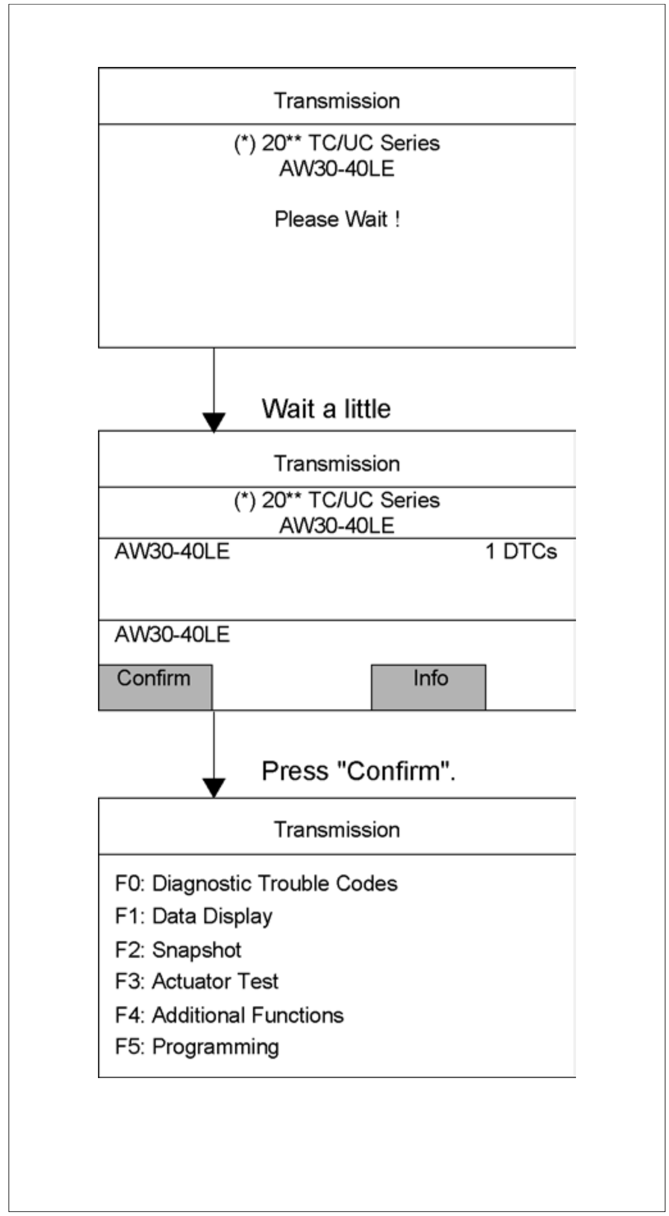


RTW77ALH000601

Once the test vehicle has been identified an "Application Menu" screen appears. Please select the appropriate application.

The following table shows, which functions are used for the available equipment versions.

- F0: Diagnostic Trouble Codes
  - F0: Read DTC Information
  - F1: Clear DTC Information
- F1: Data Display
- F2: Snapshot
- F3: Actuator Test
  - F0: Solenoid 2-3 Test
  - F1: Solenoid 1-2/3-4 Test
  - F2: Pressure Control Solenoid (PCS)
  - F3: TCC Solenoid Test
  - F4: 3rd Start Lamp Test
  - F5: Power Lamp Test
  - F6: AT Oil Temperature Lamp Test
  - F7: Check Light Test
- F4: Additional Functions
  - F0: Read ECU Identification
- F5: Programming
  - F0: Program Vehicle Identification No.

Diagnostic Trouble Codes

The purpose of the “Diagnostic Trouble Codes” mode is to display stored TCM trouble codes.

When “Diagnostic Trouble Codes” is selected an “Application Menu” screen appears.

Read DTC Information

When “Read DTC Information” is selected, an “Application Menu” appears with a list of DTC information function keys addressing DTC specifics and their origins.

Function key selections may vary for particular vehicle and/or system.

Requested emission-related DTCs

Clear DTC Information

The purpose of the “Clear DTC Information” mode is to command the clearing of stored TCM trouble codes.

When “Clear DTC Information” is selected, a “Clear DTC Information”, warning screen appears. This screen informs you that by cleaning DTC's, “all stored DTC information in controller will be erased”.

Do you want to clear DTC's (Yes/No).

Press either the Yes or No key when answering.

After clearing codes, confirm system operation by test-driving the vehicle.

Allow the vehicle to shift through all four forward gears in a manner which attempts to repeat the failure condition.

NOTE: When the trouble has not been repaired and the trouble code cannot be erased, check the vehicle again.

Data Display

The purpose of the “Data Display” mode is to continuously monitor data parameters.

The current actual values of all important sensors and signals in the system are displayed through F1 mode.

When “Data Display” is selected an “Application Menu” appears. “Transmission Data Display”.

See “Transmission Data” on next page.

Snapshot

When “Snapshot” is selected an “Application Menu” appears.

When “Transmission Snapshot” application is selected from the “Application Menu”, a “Snapshot Menu” appears, displaying several options. “Snapshot” options may vary from one system to another.

“Snapshot” allows a recording of all vehicle parameters. There parameters may then be replayed at a future point in time.

This action allows you to focus on making the condition occur, rather than trying to view all of the data in anticipation of the fault. The snapshot will collect parameter information around a trigger point that you select.

When a snapshot is taken, it is recorded onto the PCMCIA memory card. When the Tech 2 is powered down. Snapshots are not lost.

Actuator Test

The purpose of “Actuator Test” mode is to check for correct operation of electronic system actuators.

Solenoid 2-3 Test, Solenoid 1-2/3-4 and Test TCC Solenoid Test

You can operate the solenoids by pressing the “ON” and “OFF” buttons.

Preconditions: P–N position, no vehicle speed, no engine speed

Pressure Control Solenoid (PCS)

You can set desired PCS Current using the “ON” and “OFF” button. The PCS Data informs about PCS Current, Pressure and Duty Cycle.

Preconditions: P–N position, no engine speed, no vehicle speed

3rd Start Lamp Test, Power Lamp Test, AT Oil Temperature Lamp Test and Check Light Test

You can operate the lamps by pressing the “ON” and “OFF” buttons.

Preconditions: none

NOTE:

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emission-related fault is stored in memory and when the Check Trans Lamp is commanded on. These data can help to identity the cause of a fault. Refer to *Storing And Erasing Freeze Frame Data for more detailed information.*

TROUBLESHOOTING

1. BODY INCLINATION

Checkpoint	Problem	Countermeasure
Spring	Weak or broken	Replace
Shackle pins and bushings	Worn or disintegrated	Replace
	Poorly lubricated	Regrease
Spring brackets and U-bolts	Bolt loosened	Retighten
	Cracked	Replace
Shock absorbers	Bushings worn or disintegrated	Replace
Mounting brackets	Defective	Replace

TRANSMISSION DATA

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle
Operating Conditions: Engine idling/ Engine coolant temperature is between 75 to 85°C(167 to 185°F)/ Accelerator pedal is constant/ Neutral or Park/ Accessories OFF/ Vehicle located at sea level		
Engine Coolant temperature	°C/°F	75 to 85°C (167 to 185°F)
Engine Speed	RPM	700
Vehicle Speed	Km/h / MPH	0
Ignition Voltage	V	13.6
Accelerator Pedal Position Signal	%	0
Throttle Position	%	0
Accelerator Pedal Position Signal During Cruise Control	%	0
Cruise Control	Inactive / Active	Inactive
Cruise Control OD Cancel Request	ON / OFF	OFF
Engine Warm Up Cycle Achieved	FALSE / TRUE	FALSE
Transmission Shift in Progress	Inactive / Active	Inactive
Garage Shift Control	Inactive / Active	Inactive
MIL Request Command	ON / OFF	OFF
Transmission Check Light	ON / OFF	OFF
Transmission Oil Temperature Lamp	ON / OFF	OFF
Power Drive Lamp	ON / OFF	OFF
3rd Start Lamp	ON / OFF	OFF
Transmission Fluid Temperature	°C/°F	70 to 80°C (158 to 176°F)
AT Input Speed	RPM	625
AT Output Speed	RPM	0
Transmission Range	Park / Reverse / Neutral / Drive 4 / Drive 3 / Drive 2 / Drive 1	Park
TR Switch P	ON / OFF	ON
TR Switch R	ON / OFF	OFF
TR Switch N	ON / OFF	OFF
TR Switch D	ON / OFF	OFF
TR Switch 3	ON / OFF	OFF
TR Switch 2	ON / OFF	OFF
TR Switch L	ON / OFF	OFF
Diagnostic Switch	Open / Close	Open
Brake Pedal Switch	ON / OFF	OFF
Power Drive Switch	ON / OFF	OFF
3rd Start Switch	ON / OFF	OFF
4 Wheel Drive Low	ON / OFF	OFF
Shift Solenoid 1 Command	ON / OFF	ON
Shift Solenoid 2 Command	ON / OFF	OFF
TCC Solenoid	Engaged / Disengaged	Disengaged
Downhill Mode	Inactive / Active	Inactive
Active Shift Mode	Normal Mode / Power Mode / 3rd Gear Start / Transfer 4L MODE Hot 1 / Hot 2 / UPHILL MODE 1 / UPHILL MODE 2 / Cruise MODE / Warm Up MODE	Normal Mode
Estimated Gear Ratio	:1	7.97 : 1

Scan Tool Parameter	Units Displayed	Typical Data Value at Engine Idle
Desired PCS Pressure	kPa	32.0
Current Gear	Neutral / 1st / 2nd / 2nd L-Up / 3rd / 3rd L-Up / 4th / 4th L-Up	1st
Command Gear	Neutral / 1st / 2nd / 2nd L-Up / 3rd / 3rd L-Up / 4th / 4th L-Up	1st
PCS Desired Current	mA	976
PCS Actual Current	mA	976
Speed Ratio		0.89 : 1
TCC Slip Speed	rpm	75

Snapshot Display With TIS2000

Procedures for transferring and displaying Tech2 snapshot data by using TIS2000 [Snapshot Upload] function is described below.

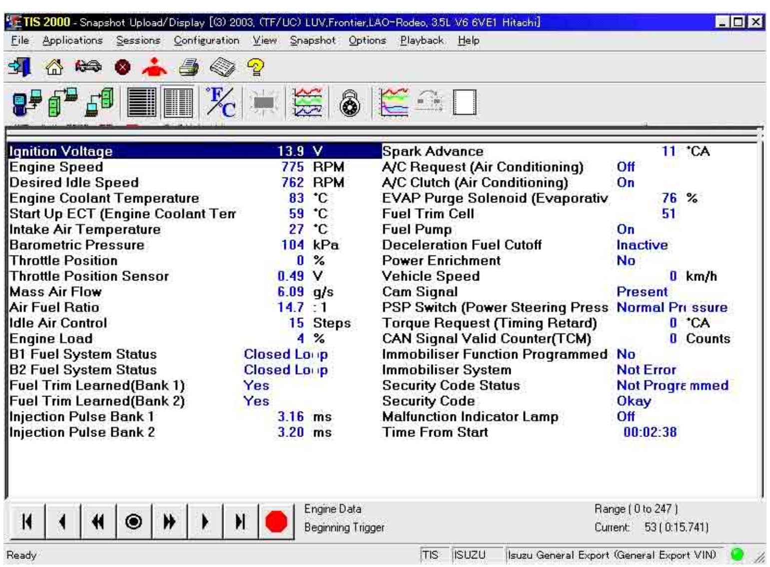
Snapshot data can be displayed with [Snapshot Upload] function included in TIS2000.

By analyzing these data in various methods, trouble conditions can be checked.

Snapshot data is displayed by executing the three steps below shown:

1. Record the snapshot data, in Tech2.

2. Transfer the snapshot data to PC.



After recording the snapshot in Tech2, transfer the data from Tech2 to PC by the below procedures.

1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Upload from trouble diagnosis tool (transfer from diagnosis tester)] or click the corresponding icon of the tool bar.
4. Select Tech2, and transfer the recorded snapshot information.
5. Select the transferred snapshot.
6. After ending transfer of the snapshot, data parameter list is displayed on the screen.

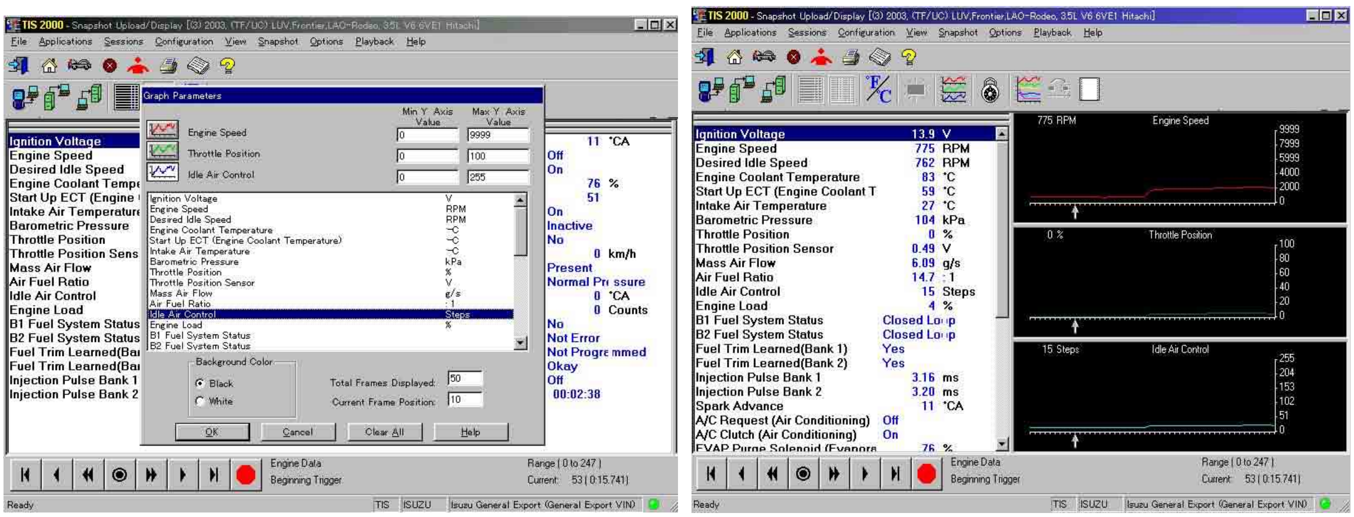
3. Snapshot data is displayed with TIS2000 [Snapshot Upload] function.

Snapshot is stored in the PC hard disk or floppy disk, and can be displayed any time.

Stored snapshot can be displayed by the following procedures.

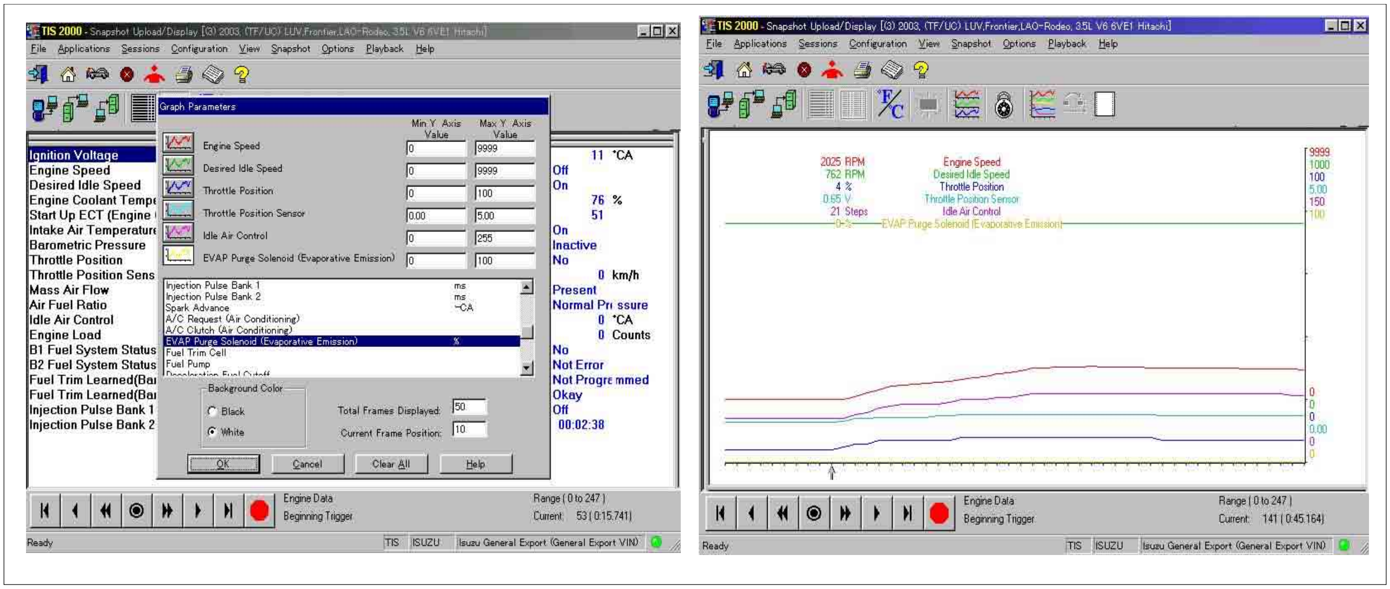
1. Start TIS2000.
2. Select [Snapshot Upload] on the TIS2000 start screen.
3. Select [Open the existing files] or click the corresponding icon of the tool bar.
4. Select the transferred snapshot.
5. Open the snapshot, to display the data parameter list on the screen.

Graph display Values and graphs (Max. 3 graphs):



1. Click the icon for graph display. [Graph Parameter] window opens.
2. Click the first graph icon of the window upper part, and select one parameter from the list of the window lower part. Selected parameter is displayed next to the graph icon. Graph division can be selected in the field on the parameter right side.
3. Repeat the same procedures with the 2nd and 3rd icons.
4. After selecting all parameters to be displayed (Max. 3 parameters), click [OK] button.
5. Parameter selected is displayed in graph form on the right of the data parameter on the screen.
6. Graph display can be moved with the navigation icon.
7. For displaying another parameter by graph, click the parameter of the list, drug the mouse to the display screen while pressing the mouse button and release the mouse button. New parameter is displayed at the position of the previous parameter. For displaying the graph display screen in full size, move the cursor upward on the screen. When the cursor is changed to the magnifying glass form, click the screen. Graph screen is displayed on the whole screen.

Display of graphs on one screen (Max. 6 graphs):



1. Click the 6 graph icon. [Graph Parameter] window opens.
2. Click the graph icon, select the parameter to be displayed from the list and change divisions according to necessity.
3. Repeat the same procedures with the graph icons, from the 2nd to 6th.
4. Click the [OK] button to display.
5. In this case, parameters are displayed only in graph form. All parameters are displayed in one graph.
6. The graph display screen can be moved with the navigation icon.

Service Programming System (SPS)

The procedure to program the control unit by using the Service Programming System (SPS) software contained in TIS2000 is explained below.

NOTE:

- Should Tech2 display "SPS Procedure was not successful", engine will not start, but no DTCs are present, low battery voltage or poor electrical connections should be the primary suspects. Perform the SPS procedure again after rectifying the fault/s.

IMPORTANT:

Perform the following checks before attempting to program the control unit:

- **The Tech2 PCMCIA card is programmed with the latest software release.**
- **The latest release of TIS2000 is loaded on the PC.**
- **The vehicle battery is fully charged.**
- **The control unit to be programmed is connected to the vehicle.**

1. Preparations of TIS 2000

1. Connect Tech 2 to P/C.
2. Check to see if Hardware Key is plugged into Port.
3. Activate TIS 2000 by P/C.
4. On the activating screen of TIS2000, choose "Service Programming System".

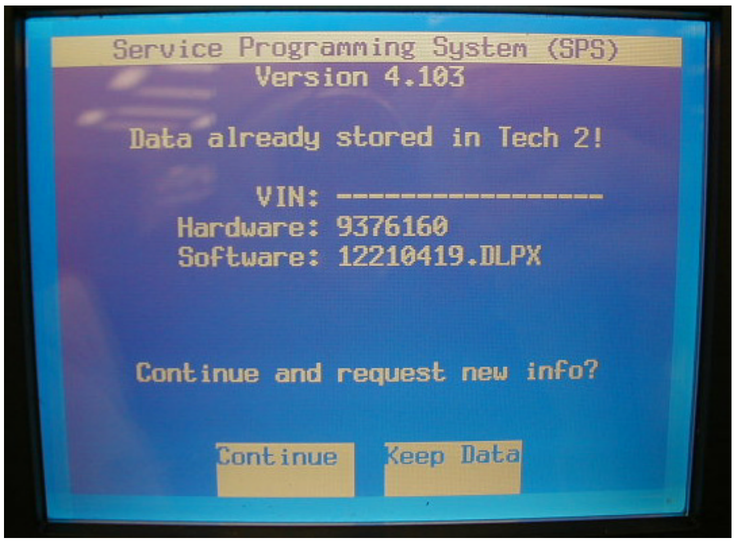
5. On the screen of "Diagnostic Tester and Processing Program Selection", choose the one that will comply with the following.

- Diagnostic tester in use
- New programming by the existing module or new programming by the replaced/new module.
- Fixing position of the control unit.

6. Upon completion of the selection, push the button of "Continue".

2.Demand of Data

1. Connect Tech 2 to the vehicle. When activated by turning on the power of Tech 2, push the "Enter" switch.
2. Turn on the ignition switch (without starting the engine)
3. In the main menu of Diagnostic Tester, push "F1: Service Programming System (SPS)".
4. Push “F0: Request Info” of Tech 2.
5. Where vehicle data has been already saved in Tech 2, the existing data come on display. In this instance, as Tech 2 starts asking whether to keep the data or to continue obtaining a new data from the control unit, choose either of them.



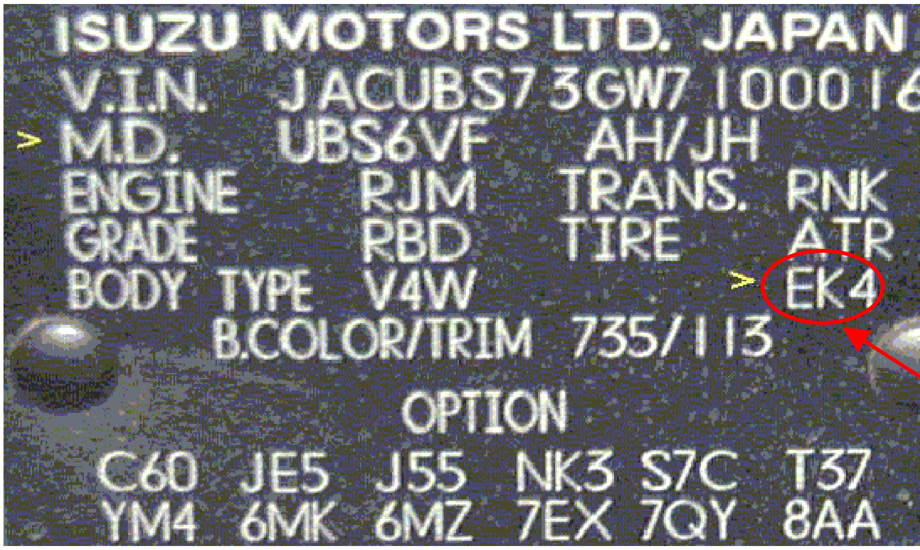
6. If you select “continue”, you have to select “Model Year”, “Vehicle Type”, “Controller Type (Engine)”.
7. After that. then push button and turn Ignition switch tuned on, off, on following Tech 2 display. Tech 2 will read information from controller after this procedure.
8. During obtaining information, Tech 2 is receiving information from the control unit chosen. In replacing the control unit, please be sure to undertake “Obtaining Information” from the new unit. With VIN not being programmed into the new control unit at the time of shipment, "obtaining information" is not complete (because the vehicle model, engine model and model year are specified from VIN). For the procedure get additional information on vehicles, instruction will be provided in dialog form, when TIS2000 is in operation.
9. Following instructions by Tech 2, push the “Exit” switch of Tech 2, turn off the ignition of the vehicle and turn off the power of Tech 2, thereby removing from the vehicle.

3.Data Exchange

1. Connect Tech 2 to P/C, turn on the power and click the “Next” button of P/C.
2. Check VIN of the vehicle and choose “Next”.
3. When a lack of data is asked from among the following menu, enter accordingly.
   Select following Menu
   - Model Year
   - Model
   - Engine type
   - Transmission type
   - Destination code (vehicles for general export)*1
   - Immobiliser

* 1: How to read the destination code

"Destination code can be read from ID Plate affixed on vehicles, while on VIN plate the destination code is described at the right-hand edge of Body Type line. In Fig.-3, the destination code can be read as “EK4” (Europe).



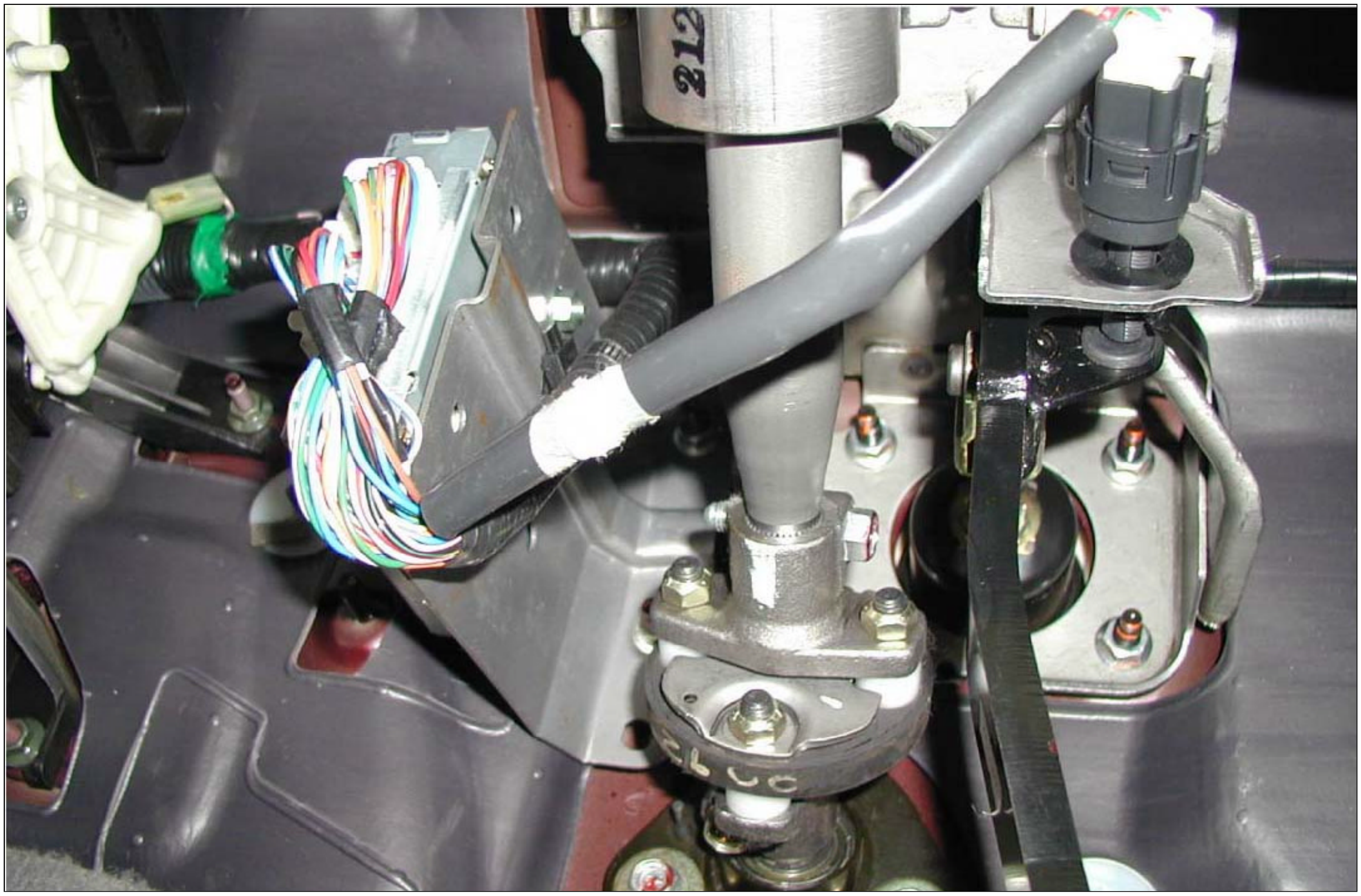
4. After choosing the data, click the “Next” button.
5. When all the necessary information is entered, the “details” of software within the database that match the entered data will appear for confirmation. Click the “Program” switch and then download the new software onto Tech 2.
6. “Data Transfer” comes on display. The progress of downloading will be displayed on the screen in the form of bar graph.
7. Upon finishing the data transfer, turn off the power of Tech-2, removing from P/C.
9. Following “Procedure 2: Demand of Data”, try over again "Information Obtaining" and check to confirm if the data has been correctly re-loaded.
10. Upon finishing confirmation, turn off the ignition of the vehicle and then turn off the power of Tech 2, removing from the vehicle.

4. Programming of TCM

1. Check to see if batteries are fully charged.
2. Connect Tech 2 to Vehicle Diagnostic Connectors.
3. Turn on the power of Tech 2 and the title screen comes on display.
4. Turn on the ignition (without allowing the engine to start)
5. On the title screen of Tech 2, push the "Enter" button.
6. Choose “F: Service Programming System” on the main screen and then choose “F1: Programming”.
7. While data is being transferred, “Downloading” will be displayed on the Tech 2 screen.
8. Upon finishing the data transfer, Tech 2 will display “Reprogramming Successful”. Push the “Exit” button to bring program to completion.

OBD Diagnostic Management System

Transmission Control Module (TCM) Location



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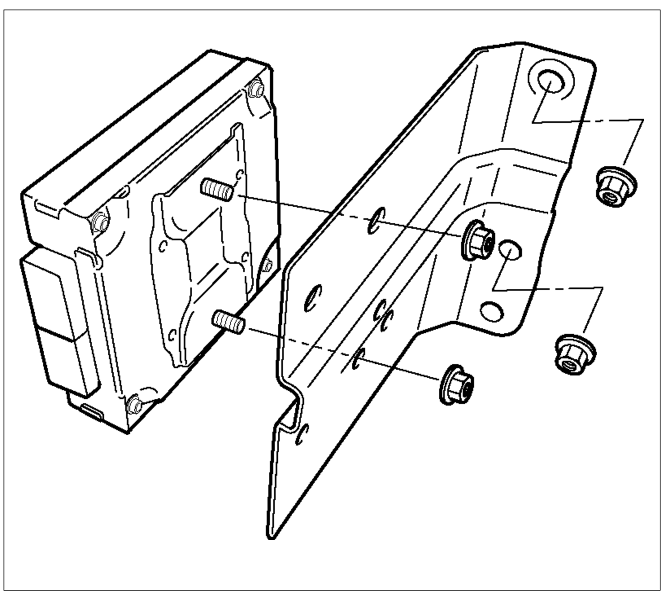
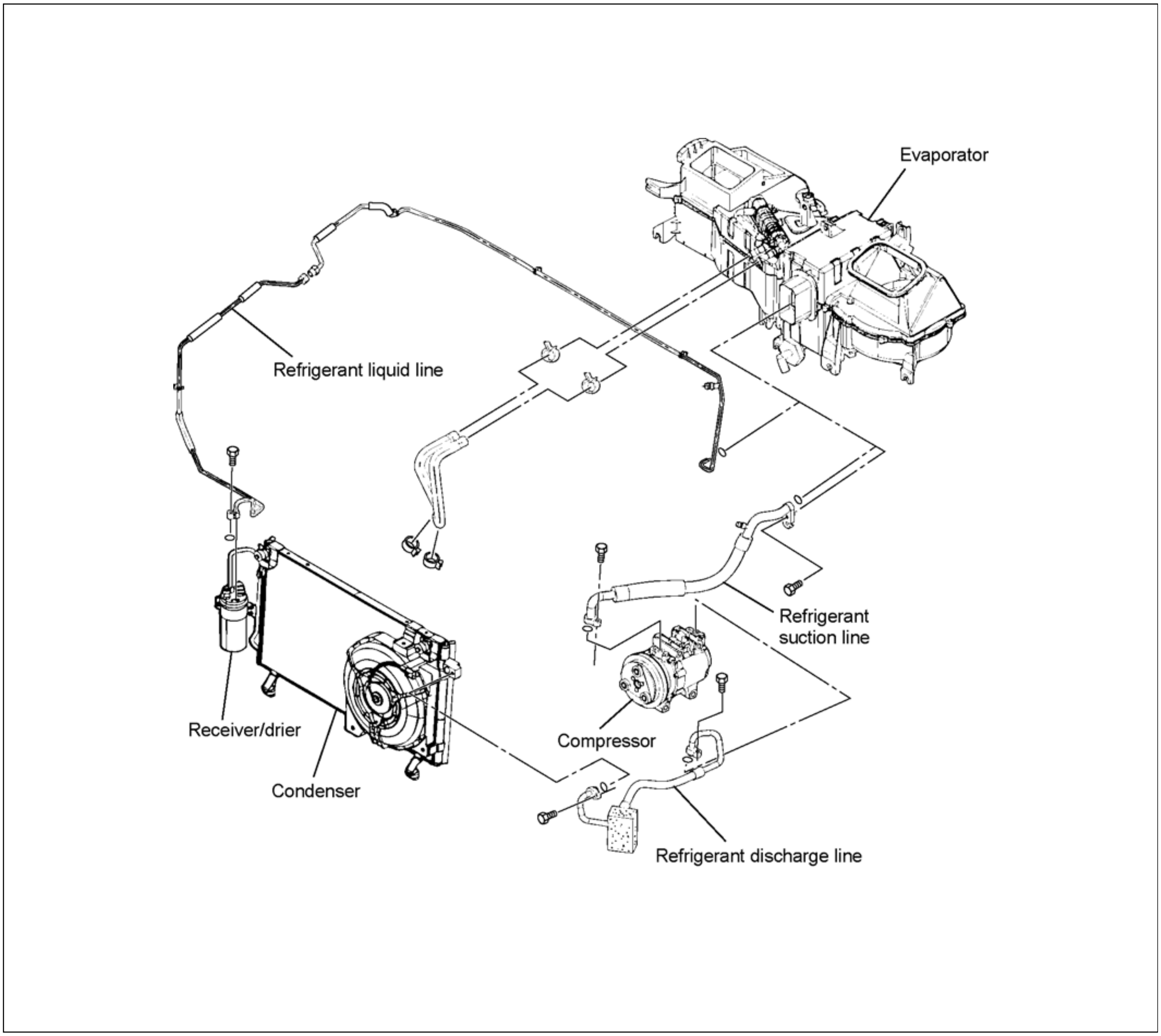


RTW37ASH000301

GENERAL REPAIR INSTRUCTIONS

1. Park the vehicle on level ground and chock the front or rear wheels before lifting the vehicle.
2. Raise the vehicle with a jack set against the axle or the frame.
3. Support the vehicle on chassis stands.
4. Use covers on the vehicle body, seats, and floor to prevent damage and/or contamination.
5. Disconnect the grounding cable from the battery before performing service operations.
   This will prevent cable damage or burning due to short circuiting.
6. Handle brake fluid and antifreeze solution with great care.
   Spilling these liquids on painted surfaces will damage the paint.
7. The use of the proper tool(s) and special tool(s) where specified is essential to efficient, reliable, and safe service operations.
8. Always use genuine ISUZU replacement parts.
9. Discard used cotter pins, gaskets, O-rings, oil seals, lock washers, and self-locking nuts at disassembly.
   Normal function of these parts cannot be guaranteed if they are reused.
10. Prepare new cotter pins, gaskets, O-rings, oil seals, lock washers, and self-locking nuts for installation.
11. Keep the disassembled parts neatly in groups.
    This will facilitate smooth and correct reassembly.
12. Keep fixing nuts and bolts separate.
    Fixing nuts and bolts vary in hardness and design according to installation position.
13. Clean all parts before inspection or reassembly.
14. Clean the oil ports and other openings with compressed air to make certain that they are free from dirt and obstructions.
15. Lubricate the rotating and sliding faces of all moving parts with oil or grease before installation.
16. Use the recommended liquid gasket to prevent leakage.
17. Carefully observe all nut and bolt torque specifications.
18. When removing or replacing parts that require refrigerant to the discharged from the air conditioning system, be sure to use the Vehicle Refrigerant Recovery and Recycling Equipment (VRRRE) to recover and recycle R134a, to promote the aim of the protection of the ozone layer covering the earth.
19. Check and recheck your work. No service operation is complete until you have done this.

(C24SE RHD MODEL)



RTW710LF002101

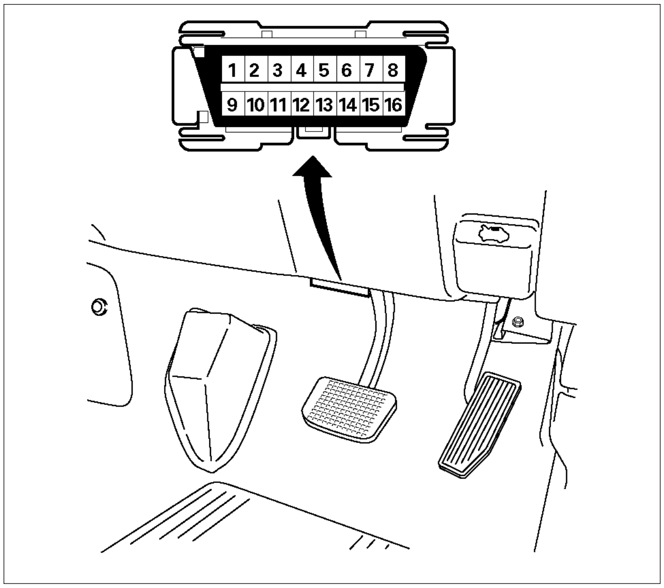
2. REDUCTION IN GROUND CLEARANCE

Checkpoint		Problem	Countermeasure
Condition of load	OK ↓		
Leaf springs	NG	Broken	Replace
↓ OK			
Springs clip bands	NG	Worn or broken	Replace
	NG	Loosened	Retighten
↓ OK			
Bushings	NG	Deteriorated or disintegrated	Replace
	NG	Poorly lubricated	Regrease
	NG	Over lubricated	Wipe off excess grease

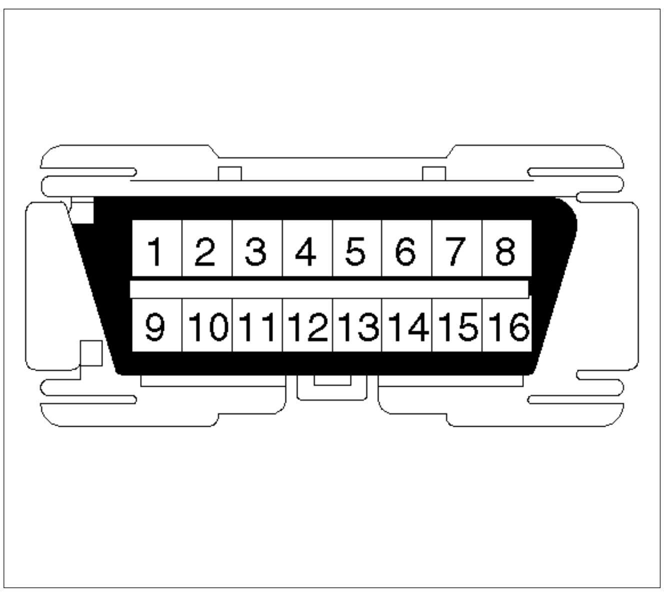
Continued on the next page

16 – Terminal Data Link Connector (DLC)

OBD standardizes Data Link Connector (DLC) configurations. The DLC, formerly referred to as the ALDL, will be a 16–terminal connector found on the lower right side of the driver's side instrument panel. All manufacturers must conform to this 16–terminal standard.



060R300015



810RT022

PIN 1 – Diagnostic request switch
PIN 2 – J1850 Class 2
PIN 3 – (Not used)
PIN 4 – Ground
PIN 5 – Ground
PIN 6 – CAN High
PIN 7 – Keyword 2000
PIN 8 – (Not used)
PIN 9 – (Not used)
PIN 10 – (Not used)
PIN 11 – TCM diagnostic
PIN 12 – ABS diagnostic request switch
PIN 13 – SIR diagnostic request switch
PIN 14 – CAN Low
PIN 15 – (Not used)
PIN 16 – Battery voltage

Clear DTC

NOTE: If you clear the DTC (Diagnostic Trouble Codes) you will not be able to read any codes recorded during the last occurrence.

NOTE: To use the DTC again to identify a problem, you will need to reproduce the fault or the problem. This may require a new test drive or just turning the ignition on (this depends on the nature of the fault).

1. IF you have a Tech 2:
    1. Connect the Tech 2 and perform the **Tech 2 Operating.**
    2. Push "F1: Clear DTC Information" in the Application Menu and answer "Yes" to the question "Do you want to clear DTC's?"
        a. When a malfunction still exists and the Tech 2 displays "AW30-40 CODES NOT CLEARED". This means that the problem is still there or that the recovery was not done. Please go to **DTC Check.**
        b. When a malfunction has been repaired and the recovery is done the Tech 2 displays "AW30-40LE CODES CLEARED".
2. When you have no Tech 2, the storaged trouble codes can be cleared by shorting the terminals No.11 and No.4 or 5 (ground) of data link connector with a lead wire for 1 ~ 6 seconds.

DTC Check

1. Diagnostic Trouble Codes (DTC) have been identified by Tech 2.
2. You have written the list of the DTCs. The order of the malfunctions has no meanings for this TCM. Usually only one or two malfunctions should be set for a given problem.
3. Check directly the DTCs you identified. The DTCs are sorted by number. Refer to Diagnostic Trouble Code (DTC) Identification in this section.

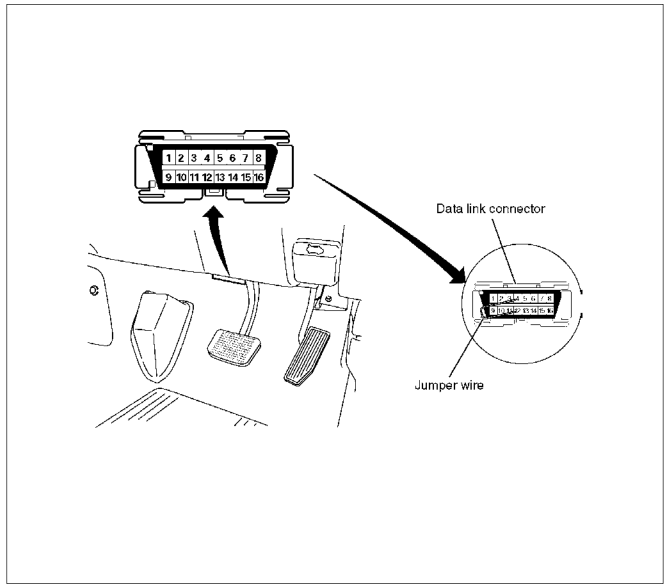
Self-diagnosis code (Flash code) display

- The stored trouble codes can be identified by shorting the terminal No. 11 and No. 4 or No. 5 (ground) data link connector with a lead wire.

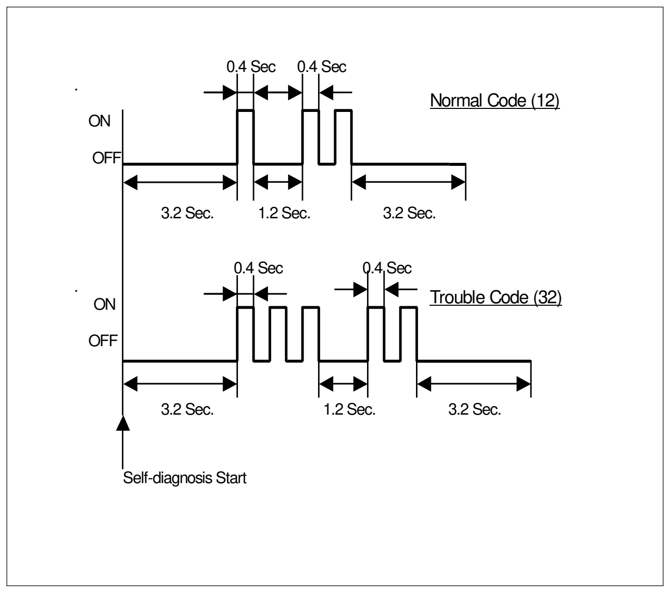
Indication Method:

1. Terminal No. 11 and No. 4 or No. 5 (ground) data link connector are short circuited.
2. Turn the key switch to the ON position.
3. If no trouble code exists, the normal code (12) is indicated repeatedly.

Data Link Connector Short Circuit



Flash Code Illumination Pattern



4. If several trouble codes have occurred at a time, each code is indicated three times in numerical order.

Trouble Code Clear Method:

If you have Tech 2:

Follow the procedure **"DIAGNOSIS WITH TECH 2"** in this manual.

If you have no Tech 2:

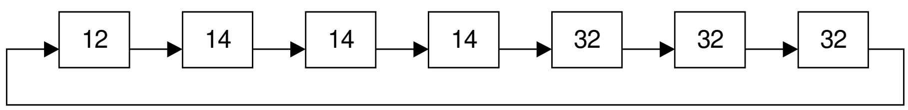
Remove ECM (B) fuse (10A) for at least 10 seconds with the ignition switched off.

NOTE:

If you clear the DTC you will not be able to read any codes recorded during the last occurrence.

To use the DTC again to identify a problem, you will need to reproduce the fault or the problem. This may require a new test drive or just turning the key switch on (this depends on the nature of the fault).

In case DTC 14 & 32 are stored:



TCM Precaution

The TCM can be damaged by:

1. The electrostatic discharge
2. The short circuit of some terminals to voltage or to ground.

Electrostatic Discharge Damage Description:

1. Electronic components used to control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to even feel the zap of a static discharge.
2. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction. An example of charging by friction is a person sliding across a car seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges for the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage, therefore, it is important to use care when handling and testing electronic components.

NOTE: To prevent possible electrostatic discharge damage:

1. Do not touch the TCM connector pins or soldered components on the TCM circuit board.
2. Be sure to follow the guidelines listed below if servicing any of these electronic components:
3. Do not open the replacement part package until it is time to install the part.
4. Avoid touching electrical terminals of the part.
5. Before removing the part from its package, ground the package to a known good ground on the vehicle.
6. Always touch a known good ground before handling the part. This step should be repeated before installing the part if the part has been handled while sliding across the seat, while sitting down from a standing position or while walking some distance.

Information On TCM

1. The Transmission Control Module (TCM) is located in the place of a clutch pedal and is the control center of the electronic transmission control system.

2. The TCM must be maintained at a temperature below 85°C (185°F) at all times. This is most essential if the vehicle is put through a paint baking process. The TCM will become inoperative if its temperature exceeds 85°C (185°F). Therefore, it is recommended that the TCM be removed or that temporary insulation be placed around the TCM during the time the vehicle is in a paint oven or other high temperature process.
3. The TCM is designed to process the various inputs and then respond by sending the appropriate electrical signals to control transmission upshift, downshift, shift feel and torque converter clutch engagement.
4. The TCM constantly interprets information from the various sensors, and controls the systems that affect transmission and vehicle performance. By analyzing operational problems, the TCM is able to perform a diagnostic function by displaying DTC(s) and aid the technician in making repairs.

TCM Diagnostic Trouble Codes

The following table lists the diagnostic trouble codes supported by this vehicle application. If any DTCs not listed here are displayed by a scan tool, the scan tool data may be faulty; notify the scan tool manufacture of any DTCs displayed that are not included in the following table.

DTC No.	Flash Code	DTC NAME	DTC Type	
			EURO 4	Except EURO 4
P0562	72	System Voltage Error (Low)	E	E
P0563	73	System Voltage Error (High)	E	E
P0602	63	Transmission Control Module (TCM) Programming Error	E	E
P0707	17	Transmission Range Sensor Circuit Open	B	D
P0708	17	Transmission Range Sensor Circuit Short	B	D
P0712	15	Transmission Oil Temperature Circuit Short	B	D
P0713	16	Transmission Oil Temperature Circuit Open	B	D
P0717	14	Input Speed Sensor Signal Error	B	D
P0722	11	Output Speed Sensor Signal Error	B	D
P0741	43	Torque Converter Clutch Stuck “OFF”	B	F
P0742	53	Torque Converter Clutch Stuck “ON”	B	F
P0746	45	Pressure Control Solenoid F/B Stuck	B	D
P0751	41	Shift Solenoid S1 Stuck “OFF”	B	D
P0752	51	Shift Solenoid S1 Stuck “ON”	B	F
P0756	42	Shift Solenoid S2 Stuck “OFF”	B	F
P0757	52	Shift Solenoid S2 Stuck “ON”	B	F
P0962	35	Pressure Control Solenoid Circuit Open or GND Short	B	F
P0963	35	Pressure Control Solenoid Circuit Ignition Short	B	D
P0973	31	Shift Solenoid S1 Circuit GND Short	B	D
P0974	31	Shift Solenoid S1 Circuit Open or Ignition Short	B	D
P0976	32	Shift Solenoid S2 Circuit GND Short	B	D
P0977	32	Shift Solenoid S2 Circuit Open or Ignition Short	B	D
P1790	61	Transmission Control Module (TCM) ROM Checksum Error	B	D
P1791	62	Transmission Control Module (TCM) RAM Error	B	D
P2769	33	Torque Converter Clutch Circuit GND Short	B	D
P2770	33	Torque Converter Clutch Circuit Open or Ignition Short	B	D
P2773	75	Transfer 4L Switch Circuit GND Short	B	D
P2774	75	Transfer 4L Switch Circuit Open or Ignition Short	B	D
U2104	65	CAN BUS OFF	A	C
U2105	67	Lost of Communication with ECM	A	C

Diagnostic Trouble Code (DTC) Type Definitions

Emission Related DTC

Action Taken When the DTC Sets - Type A

- The Engine Control Module (ECM) illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails. The ECM stores this information in the Freeze Frame/ Failure Records.

Action Taken When the DTC Sets - Type B

- The ECM illuminates the MIL on the second consecutive driving cycle when the diagnostic runs and fails.
- The ECM records the operating conditions at the time the diagnostic fails, the ECM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the ECM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/ DTC - Type A or Type B

- The ECM turns OFF the MIL after 3 consecutive driving cycles when the diagnostic runs and does not fail. (Euro 4 Specification)
- The ECM turns OFF the MIL after 1 driving cycle when the diagnostic runs and does not fail. (Except Euro 4 Specification)
- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the MIL and the DTC.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C or Type D

- The TCM illuminates the Check Trans lamp when the diagnostic runs and fails.
- The TCM records the operating conditions at the time the diagnostic fails. The TCM stores this information in the Failure Records.
- The TCM illuminates the Check Trans on the second consecutive driving cycle when the diagnostic runs and fails.
- The TCM records the operating conditions at the time the diagnostic fails, the TCM stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive driving cycle, the TCM records the operating conditions at the time of failure and stores this information in the Freeze Frame and updates the Failure Records.

Conditions for Clearing the Check Trans Lamp/ DTC - Type C or Type D

- The TCM turns OFF the Check Trans lamp after 1 driving cycle when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and passes after 3 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the Check Trans lamp and the DTC.

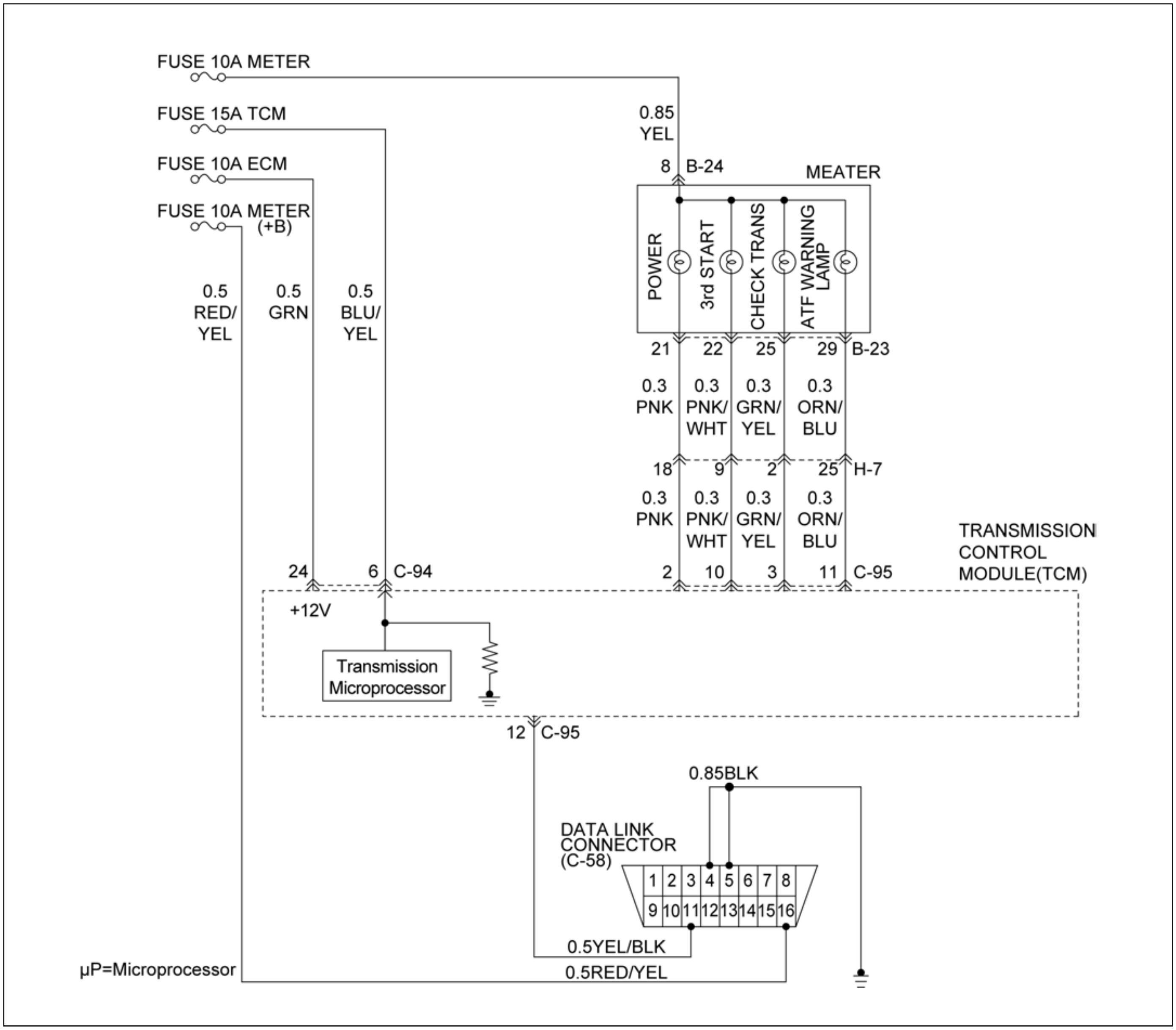
Action Taken When the DTC Sets - Type E or Type F

- The TCM will not illuminate the Check Trans lamp.
- The TCM records the operating conditions at the time the diagnostic fails. The TCM stores this information in the Failure Records.

Conditions for Clearing the DTC - Type E or Type F

- A current DTC clears when the diagnostic runs and passes after 1 driving cycle.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported.
- Use a scan tool to clear the DTC.

DTC P0562 or P0563 (Flash Code 72 or 73)



RTW77ALF001301

Circuit Description

The Transmission Control Module (TCM) monitors the system voltage on the ignition feed terminal to the TCM. A system voltage DTC will set whenever the voltage is below or above a calibrated value.

Condition For Running The DTC

Ignition "ON" and either (1) or (2) conditions are met.

(1) All of the following conditions are met.

- DTC U2104 is not detecting failure of not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 1000rpm.
- All of the following conditions are met.
  - Device Control is not operating
  - Disable Normal Communication is receiving enable
  - DTC Clear is not operating

(2) All of the following conditions are met.

- Input revolution sensor is not detecting failure or not deciding failure.
- Input revolution is more than 1000rpm.

- All of the following conditions are met.
  - Device Control is not operating
  - Disable Normal Communication Service is receiving enable
  - DTC Clear is not operating

Condition For Setting The DTC

When the TCM detects following conditions at 20 times continuously.

- Ignition voltage is less than 9 volts for 1 second or more continuously. (DTC P0562)
- Ignition voltage is more than 18 volts for 1 second or more continuously. (DTC P0563)

Action Taken When The DTC Sets

- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0562 or P0563

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Using the 5-8840-0285-0 DMM, measure the battery voltage at the battery. Is the battery voltage greater than the specified value?	11.5 V	Go to *Step 3*	Charge battery, then go to *Step 3*
3	1. Install a scan tool. 2. Select “Ignition Volts” on a scan tool. 3. Start the engine and raise the engine speed to the specified value. 4. Load the electrical system by turning on the headlights, high blower, etc. Is the ignition voltage approximately equal to the specified value?	More than 1000 rpm 9.0-18.0 V	Go to *Step 4*	Go to *Starting/ Charging*

Step	Action	Value(s)	YES	NO
4	1. Turn "OFF" the ignition. 2. Disconnect the TCM connector at the TCM. 3. Using the 5-8840-0285-0 DMM, measure the battery voltage between the TCM connector terminal C94 (Pin No.24) Is it approximately equal to battery voltage?	—	Check for excessive current with ignition "OFF" engine "OFF".	Go to *Step 5*
5	1. Check for faulty connections at the TCM harness terminals. 2. Repair as necessary. Was a repair necessary?	—	Go to *Step 8*	Go to *Step 6*
6	1. Check for an open battery feed circuit to the TCM. 2. Repair as necessary. Was a repair necessary?	—	Go to *Step 8*	Go to *Step 7*
7	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to SPS for procedure.) Was the action complete?	—	Go to *Step 8*	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0602 (Flash Code 63)

Circuit Description

The Service Programming System (SPS) updates the flash calibration files that are stored in a Transmission Control Module (TCM). The calibration file custom-tailors a module to a certain vehicle. The calibration file contains data for things such as spark curves and fuel control. When troubleshooting a driveability problem, diagnosis may call for reprogramming the controller with newer calibration information to correct a customer concern and Vehicle Identification Number (VIN).

Condition for setting the DTC

When a VIN No. is not written into the TCM.

Action Taken When The DTC Sets

- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

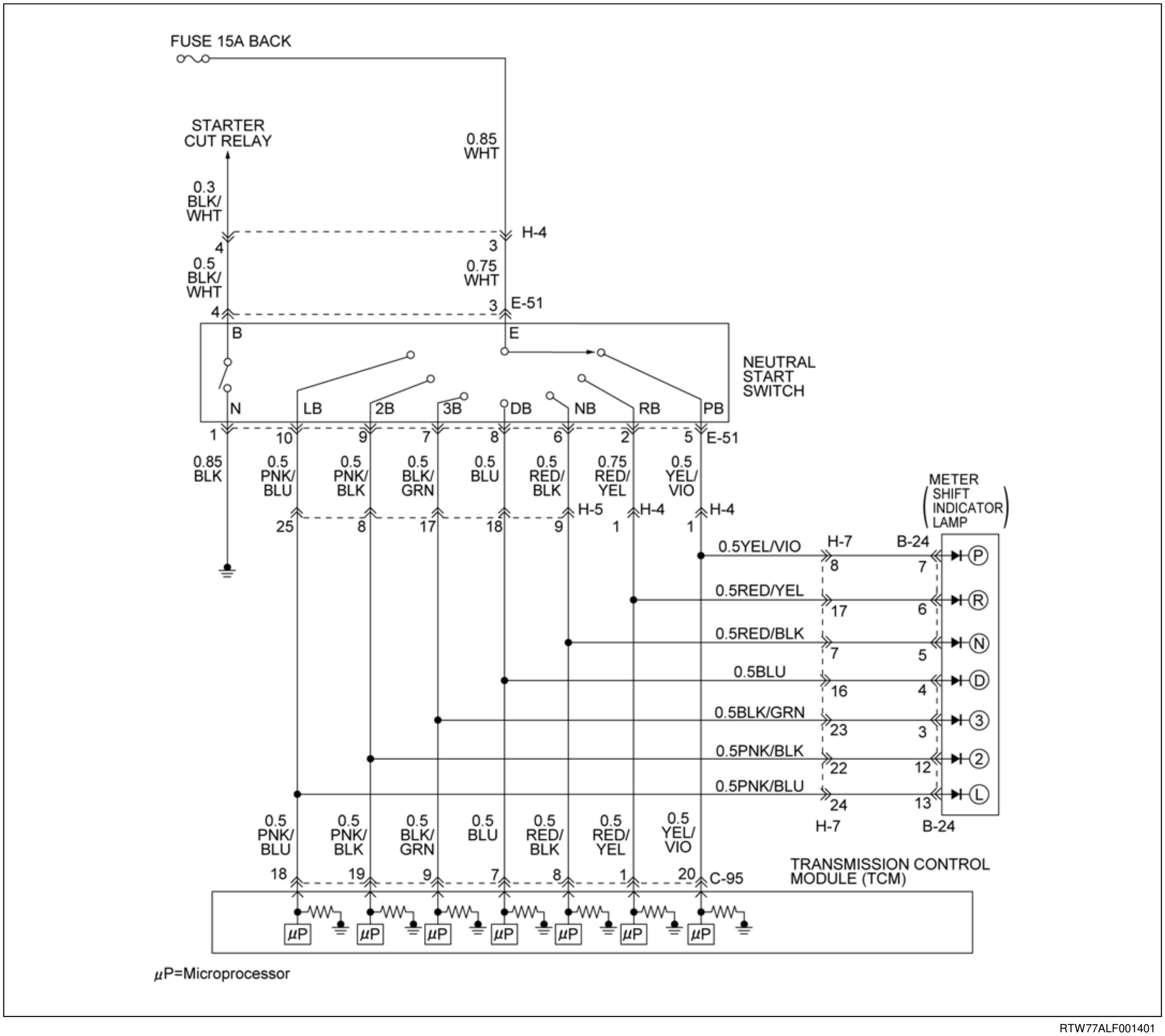
DTC P0602 is indicated when a VIN No. is not written into the TCM. A security lock is performed by SPS. And not replace the TCM when DTC P0602 can repair by SPS.

Checkpoint	Problem	Countermeasure
Continued from the previous page		
OK		
Parts for looseness	NG: Loose	Retighten
	NG: Cracked or damaged	Replace

Circuit/System Testing DTC P0602

Step	Action	Value(s)	YES	NO
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn "ON" the ignition. 3. Check the Vehicle Identification Number (VIN) by the scan tool. Is VIN on the scan tool same as VIN of vehicles?	—	Go to *Step 4*	Go to *Step 3*
3	Write a VIN by a scan tool. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 4*	—
4	Clear the DTC P0602 with a scan tool. Is the action complete?	—	Go to *Step 5*	—
5	Perform the SPS and perform security lock. (Refer to *SPS* for procedure) Is the action complete?	—	Go to *Step 6*	—
6	Recheck the DTC with a scan tool. 1. Turn "OFF" the ignition. 2. Wait a few seconds. 3. Turn "ON" the ignition. Does a scan tool indicate DTC P0602?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Was the action complete?	—	Go to *Step 8*	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0707 or P0708 (Flash Code 17)



Circuit Description

The neutral start switch gives the signals related to the selector lever position (PRND32L) to the Transmission Control Module (TCM). The neutral start switch turns on when the select lever is shifted to the P, R, N, D, 3, 2 or L position. The neutral start switch, which is connected to the starter switch circuit, is available only when the select lever is in the P or N position (Engine run).

The neutral start switch is connected to the transmission manual shaft and mounted on the transmission case.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

DTC P0707

All of the following conditions are met for 30 seconds or more continuously.

- All of the switches are “OFF”.
- Output revolution is more than 30 km/h (19 mph).
- Output revolution sensor is not detecting failure or not deciding failure.
- The engine revolution is more than 1500 rpm.

DTC P0708

The following condition is met at 10 seconds continuously.

- 2 switches or more are “ON” at the same time.

Action Taken When The DTC Sets

- No 3rd start mode.
- No slope control.
- No coast control.
- No output revolution sensor failure detection.
- No input revolution sensor failure detection.
- Keep oil temperature sensor OPEN failure detection accumulated timer.
- No T/F HI-Low SW failure detection.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- No engine torque reduction at stall.
- Regard as D position. (DTC P0707)
- There is a priority in order of D, 3, 2, L, R, N, and P. (DTC P0708)
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

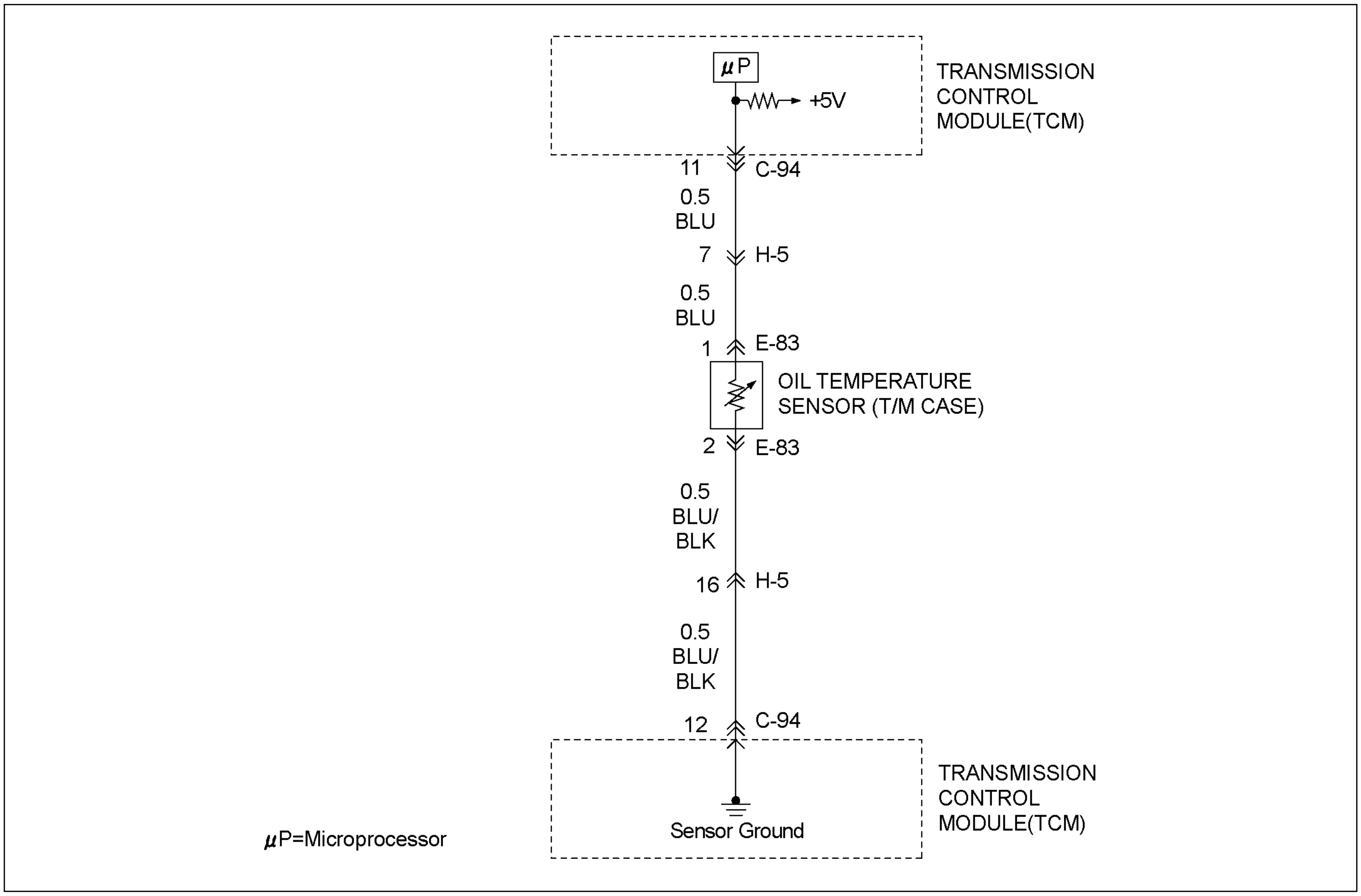
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Check neutral start switch for proper mounting and adjustment. (Refer to section 7A4 Components (1) neutral start switch)

Circuit/System Testing DTC P0707 or P0708

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostics (OBD) System check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition, with the engine “OFF”. 3. Select each lever position: D, 3, 2, L, N, R and P. Does each selected transmission position match the “Transmission Range” display on a scan tool?	—	Refer to *Diagnostic Aids*	Go to *Step 3*
3	Measure the voltage shifting the select lever every position, between TCM connector terminals and ground which performed selecting to every position. 1. Turn “OFF” the ignition. 2. Disconnect the TCM connector. 3. Turn “ON” the ignition. 4. Connect the 5-8840-0285-0 DMM to the TCM connector terminal and ground. Is the displayed voltage at every position normal?	7~16V	Go to *Step 8*	Go to *Step 4*
4	Measure the voltage between terminals the neutral start switch and ground. 1. Turn “OFF” the ignition. 2. Disconnect the inhibitor switch harness connector. 3. Turn “ON” the ignition. 4. Connect the 5-8840-0285-0 DMM to the each terminal of the neutral start switch harness connector E51-3 and ground. If a problem was found, repair as necessary. Was the problem found?	7~16V	Go to *Step 9*	Go to *Step 5*
5	Measure the resistance shifting the select lever to every position, between terminal neutral start switch connector E51-3 and E51 other terminal. 1. Turn “OFF” the ignition. 2. Disconnect the neutral start switch connector. 3. Connect the DMM to the each terminal of the neutral start switch connector E51-3 and E51-5 or E51-2 or E51-6, E51-8or E51-7or E51-9 or E51-10. If a problem was found repair as necessary. Was the problem found?	Less than 1Ω	Go to *Step 6*	Go to *Step 7*
6	Replace the neutral start switch. Is the action complete?	—	Go to *Step 9*	—

Step	Action	Value(s)	YES	NO
7	Measure he resistance between terminal neutral start switch harness connector E51 and TCM harness connector C-95. 1. Turn “OFF” the ignition. 2. Disconnect the neutral start switch and TCM connector. 3. Connect the jumper wire tot the neutral start switch harness connector E51-2, E51-5, E51-6, E51-7, E51-8, E51-9 and E51-10 and good ground. 4. Connect the 5-8840-0285-0 DMM to the each terminal of the TCM harness connector C95-1, C95-20, C95-8, C95-9, C95-7, C95-19 or C95-18. If the problem was found repair as necessary. Was the problem found?	Less than 1 Ω	Go to *Step 9*	Go to *Step 8*
8	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 9*	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0712 (Flash Code 15)



RTW77AMF000501

Circuit Description

The oil temperature sensor is a thermistor sensor that is installed in the transmission case and converts temperature changes into continuous electric signals, then outputs them to the Transmission Control Module (TCM). When the ATF temperature is low, the resistance of the sensor (thermistor) goes up, so that the voltage of the TCM signal becomes high.

As the ATF is gradually warmed, the resistance of the sensor goes down and the voltage becomes low. At the normal operating ATF temperature (80°C/176°F) of the transmission, the voltage of the TCM is about 3.7V.

Condition For Running the DTC

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Not Emergency mode

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

Condition for setting the DTC

- The TCM detects following condition for 5 minutes continuously.
- Oil temperature is less than 220°C (428°F).

Action Taken When The DTC Sets

- Control at A/T oil temperature 80°C (176°F).
- No squat control.
- No slope control.
- No 3rd start mode.
- No line pressure reduction at gear change.
- No coast control.
- No line pressure reduction control at garage.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

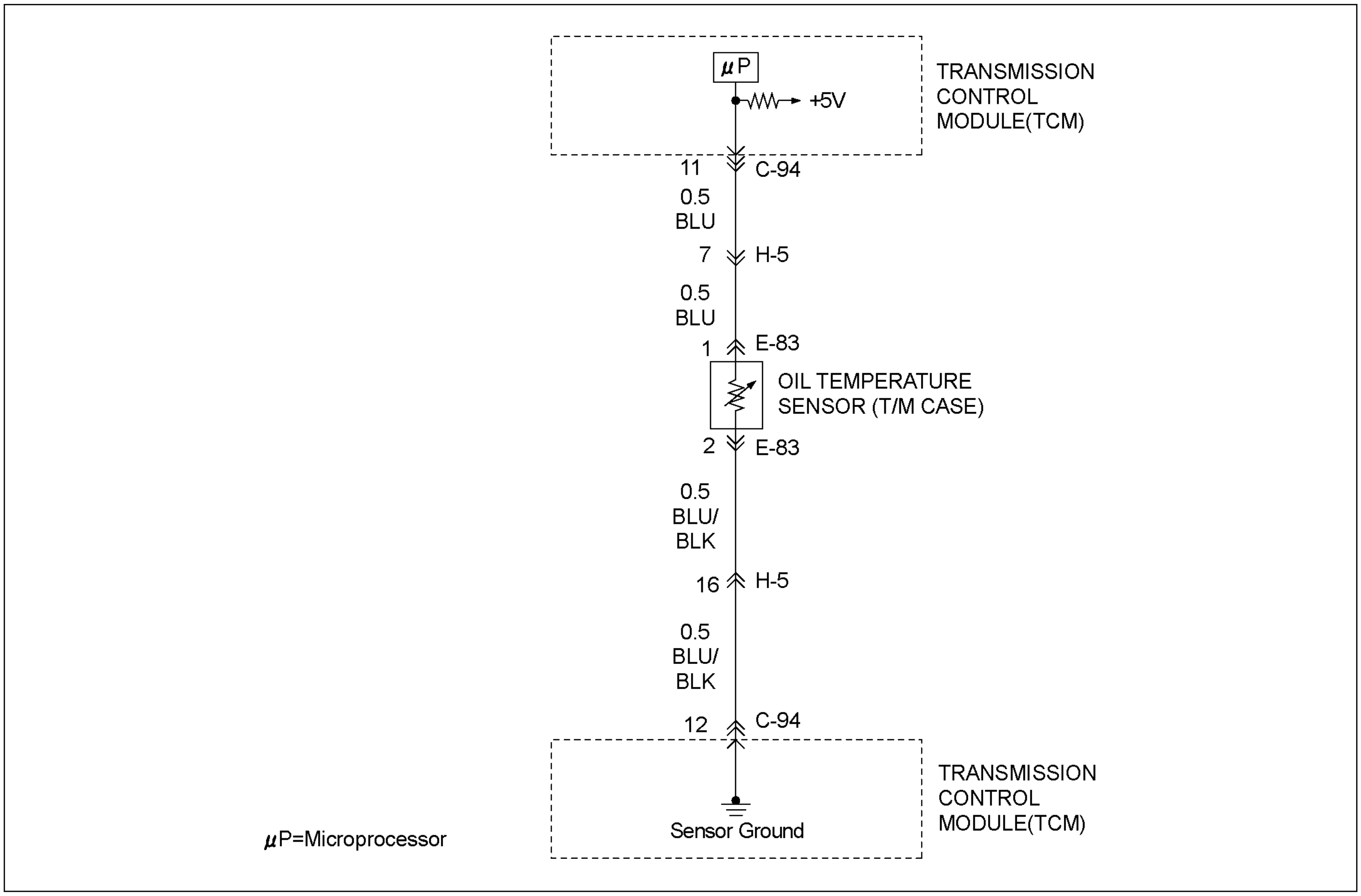
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Check oil temperature sensor for proper mounting and adjustment.

Circuit/System Testing DTC P0712

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. Was the fluid checking procedure performed?	—	Go to *Step 3*	Refer to Checking Transmission Fluid level and Condition in Automatic Transmission (AW30-40LE) section
3	1. Lift the driving wheels. 2. Start the engine and place the select lever in D position. 3. Wait for 5 minutes. Does a scan tool indicate DTC P0712?	—	Go to *Step 4*	Refer to *Diagnostic Aids*

Step	Action	Value(s)	YES	NO
4	Measure the voltage of the transmission fluid temperature sensor by the 5-8840-0285-0 DMM. 1. Turn “OFF” the ignition. 2. Disconnect the oil temperature sensor connector. 3. Turn “ON” the ignition., with the engine “OFF”. 4. Connect the 5-8840-0285-0 DMM to the each terminal of the oil temperature sensor harness connector E83-2 and E83-1. Does DMM indicate specified value?	About 5V	Go to *Step 5*	Go to *Step 6*
5	Replace the oil temperature sensor. Is the replacement complete?	—	Go to *Step 8*	—
6	Measure the resistance of the wire by the 5-8840-0285-0 DMM. 1. Turn “OFF” the ignition. 2. Disconnect the TCM connector. 3. Install a jumper wire from terminal E83-1 and E83-2 on the mission harness. 4. Connect the 5-8840-0285-0 DMM to the each terminal of the TCM connector C94-11 and C94-12. If a problem is found, repair as necessary. Was the problem found?	Less than 1Ω	Go to *Step 8*	Go to *Step 7*
7	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 8*	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0713 (Flash Code 16)



RTW77AMF000501

Circuit Description

The oil temperature sensor is a thermistor sensor that is installed in the transmission case and converts temperature changes into continuous electric signals, then outputs them to the Transmission Control Module (TCM). When the ATF temperature is low, the resistance of the sensor (thermistor) goes up, so that the voltage of the TCM signal becomes high.

As the ATF is gradually warmed, the resistance of the sensor goes down and the voltage becomes low. At the normal operating ATF temperature (80°C/176°F) of the transmission, the voltage of the TCM is about 3.7V.

Condition For Running The DTC

All of the following conditions are met.

(1) Detect the state which the all of the following conditions are met since ignition “ON” for accumulated 15 minutes or more.

- Except P or N position.
- Selector position switch is not detecting failure or not deciding failure.
- Output revolution is more than 600rpm.
- Output revolution sensor is not detecting failure or not deciding failure.

(2) Engine coolant temperature ≧ 50°C (122°F)

(3) Engine coolant temperature signal is not detecting failure or not deciding failure.

Condition For Setting The DTC

The TCM detects following condition for 12 times continuously.

- Oil temperature is more than –10°C (14°F).

Action Taken When The DTC Sets

- Control at A/T oil temperature 80°C (176°F).
- No squat control.
- No slope control.
- No 3rd start mode.
- No line pressure reduction at gear change.
- No coast control.
- No line pressure reduction control at garage.
- No shift solenoid functional failure detection.

- No L-up solenoid functional failure detection.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Check oil temperature sensor for proper mounting and adjustment.

Circuit/System Testing DTC P0713

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed ?	—	Go to *Step 2*	Go to *OBD System check*
2	Perform the transmission fluid checking procedure. Refer to Checking Transmission Fluid Level and condition Automatic Transmission 7A section. Was the fluid checking procedure performed?	—	Go to *Step 3*	Refer to checking Transmission Fluid Level and Condition Automatic Transmission (AW30-40LE) section
3	1. Lift the driving wheels. 2. Start the engine and place the select lever in D position. 3. Wait for 15 minutes. Does a scan tool indicate DTC P0713?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Observe the voltage of the oil temperature sensor on the Tech 2 data. 1. Turn “OFF” the ignition. 2. Disconnect the oil temperature sensor connector E-83 3. Install a fused jumper wire from terminal E83-2 to E83-1 on the transmission harness. 4. Turn “ON” the ignition. Does a scan tool indicate specified value?	About 0V	Go to *Step 5*	Go to *Step 6*
5	Replace the transmission fluid temperature sensor. If the action complete?	—	Go to *Step 9*	—

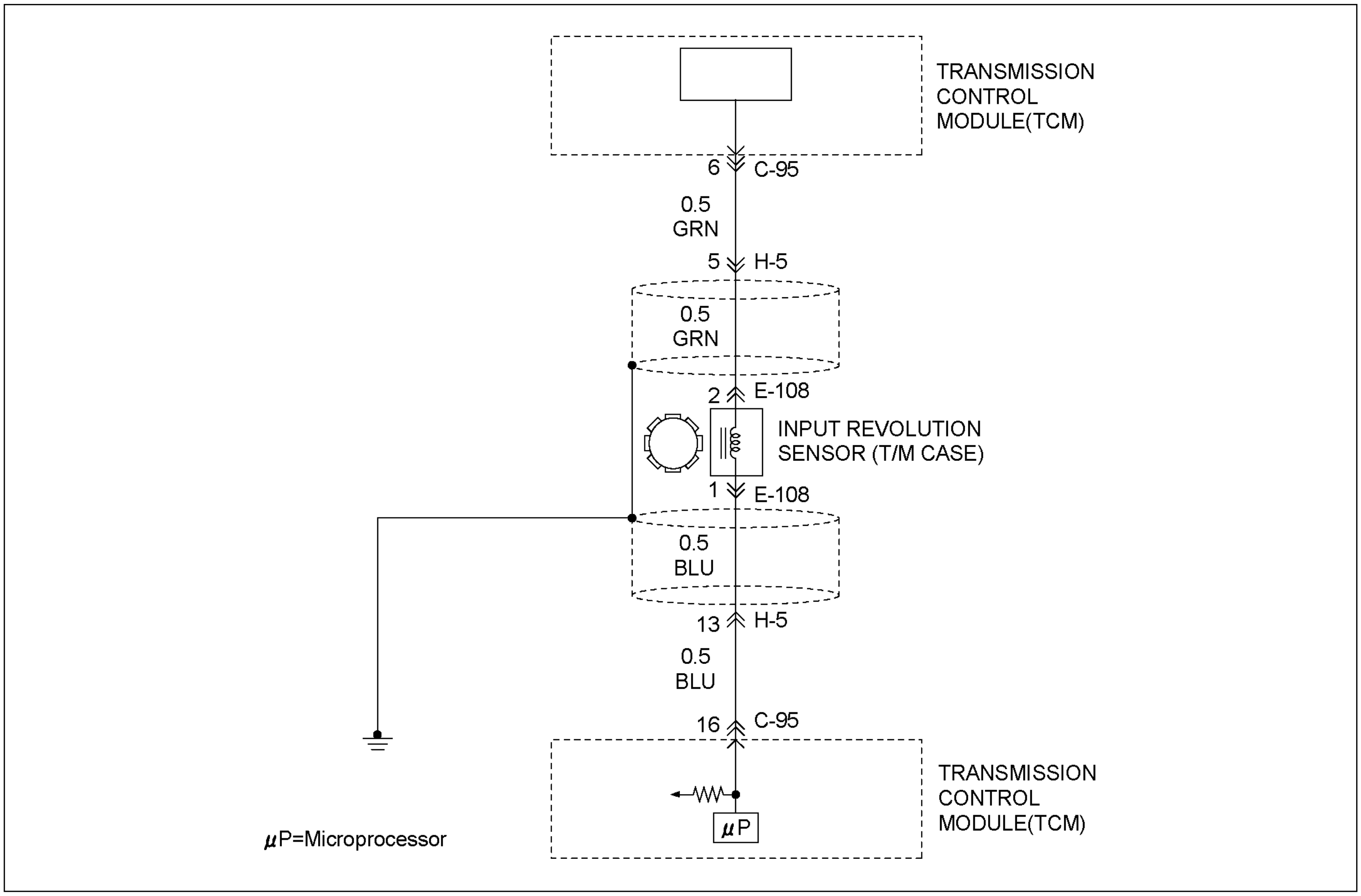
3. SPRING BREAKAGE

Checkpoint	Problem	Countermeasure
Condition of loading		
OK ↓		
Shackle pins and pivot pins	NG: Bolts and nuts for loosening	Retighten
	NG: Worn or damaged	Replace
OK ↓		
U-bolts	NG: Bolts and nuts for loosening	Retighten
	NG: Damaged	Replace
OK ↓		
Shock absorber	NG: Oil leakage	Replace
	NG: Bushing worn	Replace

Continued on the next page

Step	Action	Value(s)	YES	NO
6	Measure the resistance of wire by the 5-8840-0285-0 DMM. 1. Turn “OFF” the ignition. 2. Disconnect the TCM connector. 3. Install a fused jumper wire between terminals E83-1 and E83-2 on the transmission harness. Does DMM indicate specified value?	Less than 1Ω	Go to *Step 8*	Go to *Step 7*
7	An open circuit between TCM from oil temperature sensor. Repair the harness. Is the action complete ?	—	Go to *Step 9*	—
8	Replace the TCM **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 9*	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0717 (Flash Code 14)



RTW77AMF000601

Circuit Description

Input revolution information is provided to TCM by the input revolution sensor. This sensor is located in the transmission case.

The input revolution sensor is an electromagnetic pulse pickup type that generates a speed signal according to the revolution of the transmission OD direct clutch drum. As a result, the sensor sends a sine wave signal (AC) to the TCM, which converts this sine wave signal (pulse voltage) to a RPM signal.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution sensor is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

All of the following conditions are met.

(1) 25 seconds or more passed after changing to the except P/R/N from P/R/N.
If the following condition is met when 25 seconds or more passed after changing, it is considered that 25 seconds or more passed.

- The oil temperature sensor is not detecting failure or not deciding failure, and also oil temperature is more than 20°C (68°F).

(2) Select position switches is not detecting failure or not deciding failure.

(3) Output revolution sensor is not detecting failure or not deciding failure.

(4) Output revolution is more than 600rpm.

(5) If output signal pulse count is more than 9×500, any pulse is not detected from input revolution sensor.

(6) Any pulse is not detected at 2nd from input revolution sensor after condition (9) is met.

(7) Shift solenoid S1 and Shift solenoid S2 are not detecting electric failure or not deciding electric failure.

(8) Shift solenoid S1 and Shift solenoid S2 are not deciding functional failure.
If the following conditions are not met, keep the failure detection counter.

(9) 3.5 seconds or more passed after the gear change signal output.

(10) Not 4th gear.

Action Taken When The DTC Sets

- No L-up.
- No line pressure reduction control at gear shift.
- No torque reduction control.
- No slope control
- No output revolution sensor failure detection.
- Cancel input revolution condition of the “Condition For Running The DTC” of system voltage error detection.
- No shift solenoid failure detection.
- No L-up solenoid failure detection.
- DTC stored.
- Check Trans "ON".
- MIL request "ON". (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Check input speed sensor for proper mounting and adjustment.

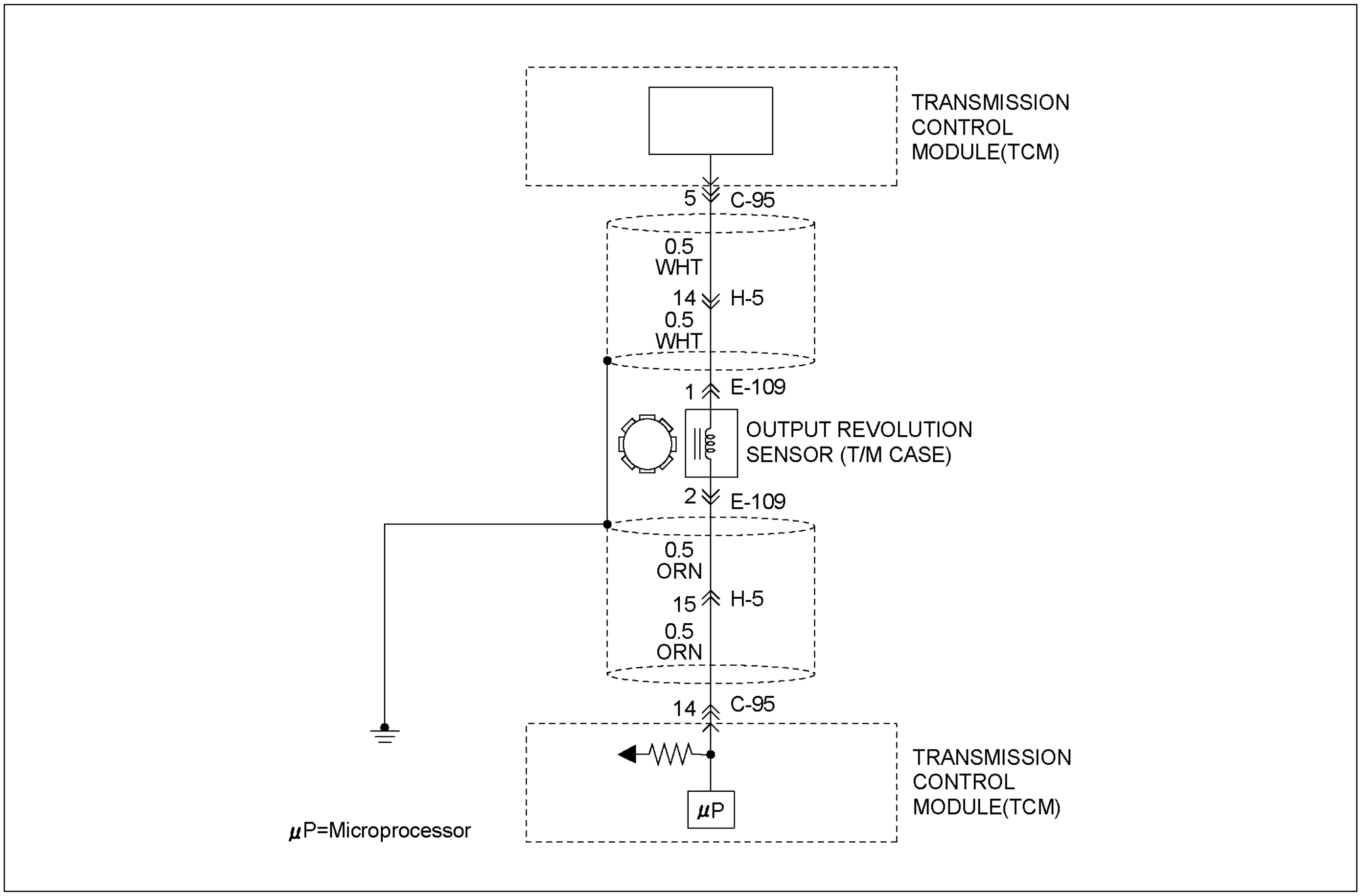
Circuit/System Testing DTC P0717

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System check performed?	—	Go to *Step 2*	Go to *OBD* system check
2	1. Install a scan tool. 2. Turn on the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0717?	—	Go to *Step 3*	Refer to *Diagnostic Aids*

Step	Action	Value(s)	YES	NO
3	Measure voltage of the input revolution sensor by the 5-8840-0285-0 DMM. 1. Turn "ON" the ignition. 2. Engine run. 3. Disconnect the input revolution sensor connector. 4. Measure the voltage between terminals to the input revolution sensor harness connector E108-1 and E108-2. Does DMM indicate specified value?	About 3V	Go to *Step 6*	Go to *Step 4*
4	Measure the resistance of wire by the 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the TCM connector. 3. Connect the input revolution sensor connector. 4. Measure the resistance between the TCM connector terminal C95-6 and C95-16. Does DMM indicate specified value?	560~680Ω (20°C/68°F)	Go to *Step 7*	Go to *Step 5*
5	Measure the resistance of input revolution sensor by the 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the input revolution sensor connector. 3. Measure the resistance between terminals of input revolution sensor side connector, E108-1 and E108-2. Does DMM indicate specified value?	560~680Ω (20°C/68°F)	Go to *Step 8*	Go to *Step 6*
6	Replace the input revolution sensor. Is the action complete?	—	Go to *Step 9*	—
7	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 9*	—
8	Check the wire between terminal C95-6 and E108-2 or C95-16 and E108-1. 1. Connect the 5-8840-0285-0 DMM to the each of the TCM connector and input revolution sensor. If the problem found repair as necessary. Was the problem found?	—	Go to *Step 9*	—

Step	Action	Value(s)	YES	NO
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0722 (Flash Code 11)



RTW77AMF000701

Circuit Description

Vehicle speed information is provided to the TCM by the output revolution sensor. This sensor is located in the transmission adapter or extension housing.

The output revolution sensor is an electromagnetic pulse pickup type that generates a speed signal according to the revolution of the transmission output shaft. As a result, the sensor sends a sine wave signal (AC) to the TCM, which converts this sine wave signal (pulse voltage) to a RPM signal.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds ore more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure
- Engine revolution sensor is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

All of the following conditions are met.

(1) 25 seconds or more passed after changing to the except P/R/N from P/R/N.
If the following condition is met when 25 seconds or more passed after changing, it is considered that 25 seconds or more passed.

- Oil temperature sensor is not detecting failure or not deciding failure, and also oil temperature is more than 20°C (68°F).

(2) Select position switches is not detecting failure or not deciding failure.

(3) Input revolution sensor is not detecting failure or not deciding failure.

(4) Output revolution calculated by input revolution is more than 300rpm.

(5) If input revolution signal pulse count is more than 13 $\times$500, any pulse is not detected from output revolution sensor.

Action Taken When The DTC Sets

- The TCM uses input speed sensor as a vehicle speed.
- No squat control.
- No torque reduction control.
- No line pressure control.
- No use 4th gear.
- No lock-up control.
- No reverse lock out control.
- No slope control.
- Control gear change by calculating vehicle speed from input revolution sensor.
- No coast control.
- No input revolution sensor failure detection.
- Keep oil temperature sensor open failure detection accumulated timer.
- No select position switch (OPEN) failure decision.
- No T/F Hi-Low SW failure detection.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- No lockup “OFF” control at fuel cut.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Check output revolution sensor for proper mounting and adjustment.

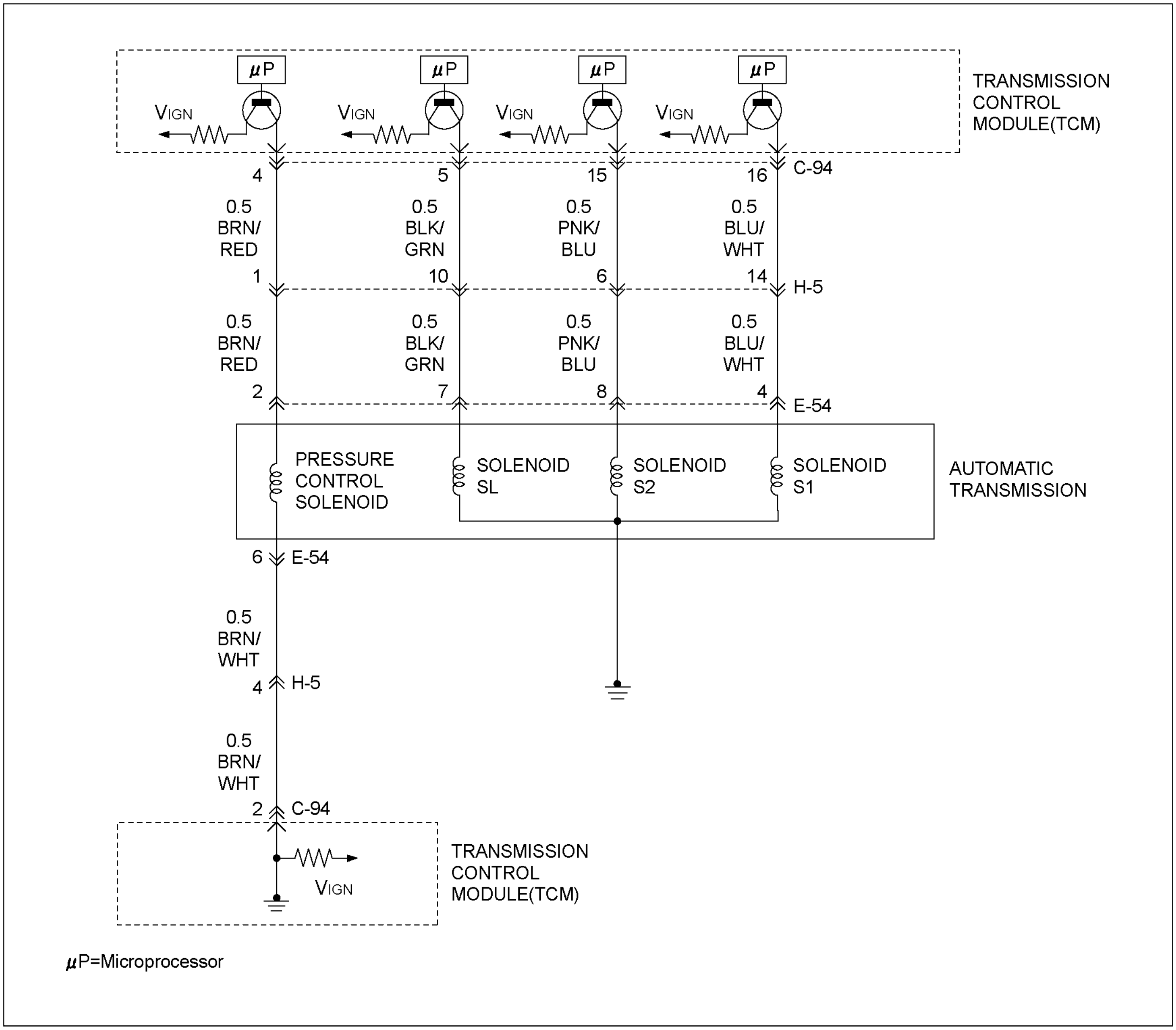
Circuit/System Testing DTC P0722

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System check performed ?	—	Go to *Step 2*	Go to *OBD system check*
2	1. Install a scan tool. 2. Turn on the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0722?	—	Go to *Step 3*	Refer to *Diagnostic Aids*

Step	Action	Value(s)	YES	NO
3	Measure the voltage of the output revolution sensor by the 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Lift the driving wheels. 3. Disconnect the output revolution sensor connector. 4. Turn "ON" the ignition with engine idling in gear. 5. Measure the voltage between the output revolution sensor connector terminal E109-1 and E109-2. Does the DMM indicate specified value?	About 3V	Go to *Step 6*	Go to *Step 4*
4	Measure the resistance of wire by the 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the TCM connector. 3. Connect the output revolution sensor connector. 4. Measure the resistance between the TCM connector terminal C95-5 and C95-14. Does the DMM indicate specified value?	560~680Ω (20°C/68°F)	Go to *Step 7*	Go to *Step 5*
5	Measure the resistance of output revolution sensor by the 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the output revolution sensor connector. 3. Measure the resistance between terminals at output revolution sensor side connector E109-1 and E109-2. Does the DMM indicate specified value?	560~680Ω (20°C/68°F)	Go to *Step 8*	Go to *Step 6*
6	Replace the output revolution sensor. Is the action complete?	—	Go to *Step 9*	—
7	Replace the TCM. **Important:** The replacement TCM must be programmed. (Refer to *SPS* for procedure.) Is the action complete?	—	Go to *Step 9*	—
8	Check the wire between terminal C95-5 and E109-1 or C95-14 and E109-2. 1. Connect the 5-8840-0285-0 DMM to the each the TCM connector and output revolution sensor. If the problem found repair as necessary. Was the problem found?	—	Go to *Step 9*	—

Step	Action	Value(s)	YES	NO
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0741 (Flash Code 43)



RTW77ALF001501

Circuit Description

The lock-up solenoid SL of the torque converter clutch (TCC) controls the lock-up clutch by a signal according to the lock-up position judgment of the Transmission Control Module (TCM) when the vehicle runs.

This function can improve the fuel consumption to almost the same extent as the manual transmission.

The lock-up solenoid SL is put into B+ by the TCM, so that the solenoid is actuated with the result of lock-up.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550 rpm.

Continued from the previous page

Checkpoint		Problem	Countermeasure
	NG	Brackets cracked	Replace
	NG	Defective	Replace
OK ↓			
Spring bushing	NG	Worn or disintegrated	Replace
OK ↓			
Center bolts	NG	Loosened	Retighten
	NG	Damaged	Replace

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) The engine revolution is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electronic failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electronic failure)

(13) L-up solenoid is not detecting failure or not deciding failure. (Electronic failure)

(14) Selector position switch is not detecting failure or not deciding failure.

(15) DTC U2104 is not detecting failure or not deciding failure.

(16) DTC U2105 is not detecting failure or not deciding failure.

(17) Input revolution sensor is not deciding failure.

(18) Throttle signal is not detecting failure or not deciding failure.

(19) Not emergency mode.

(20)Engine torque signal is not detecting failure or not deciding failure.

(21) Pressure control solenoid is not detecting failure not deciding failure.

(22) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The TCM detects following conditions are met for 4 seconds continuously.

- 2 seconds passed after gear change output and L-up “ON”/”OFF” output.
- T/C revolution difference more than 150 rpm for 4.5 seconds continuously.
- 4th gear lock-up “ON”.
- The throttle position is more than 20% and less than 100%.
- The vehicle speed is more than 5 km/h (3 mph) and less than 100 km/h (62 mph).

Action Taken When The DTC Sets

- Check Trans “ON”.
- DTC stored.
- MIL request “ON” (EURO 4 only).

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

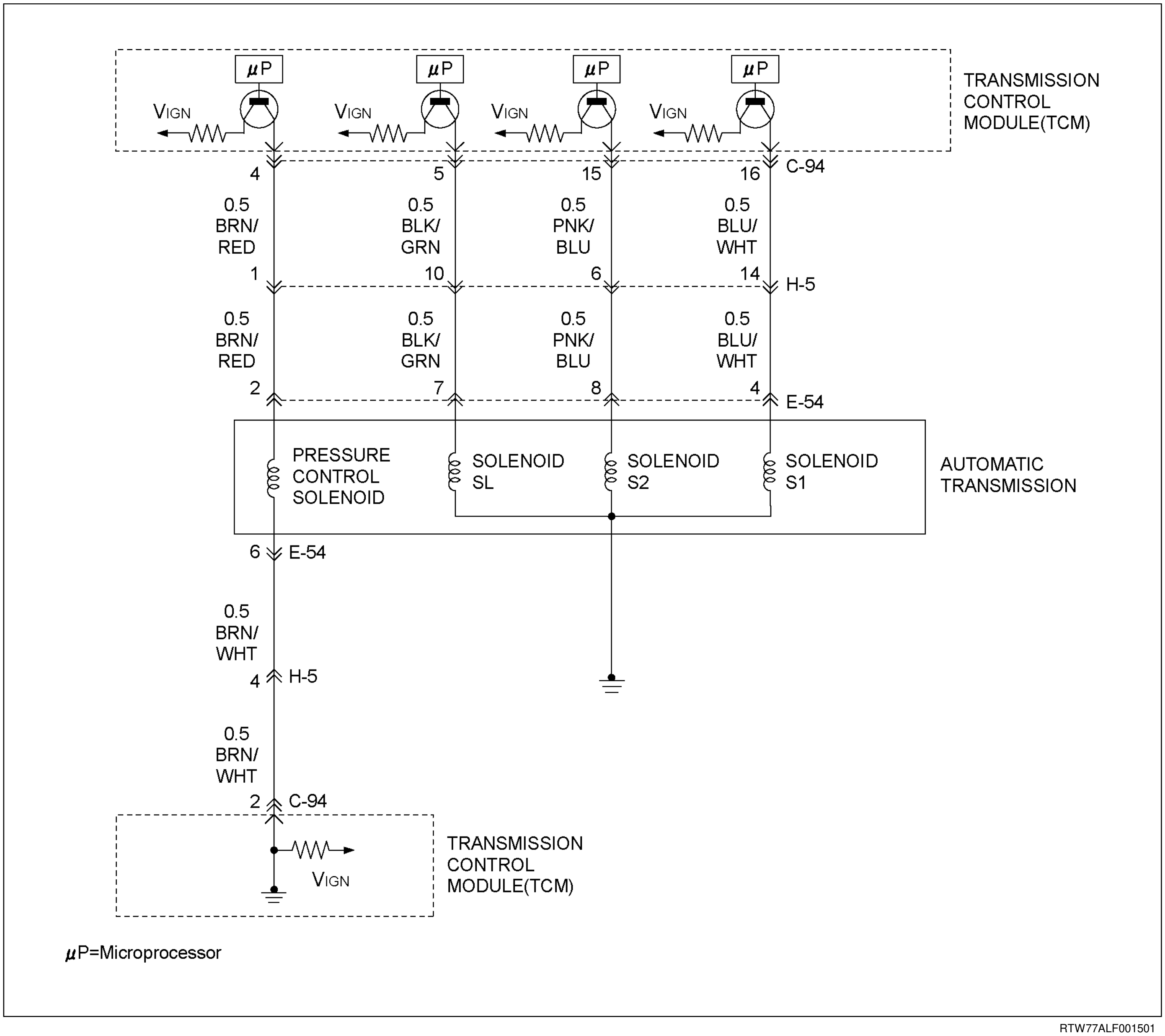
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0741

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0741?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replace necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the TCC slip speed data on a scan tool. 1. Turn “ON” the ignition with the engine “ON”. 2. Road testing the vehicle. 3. The throttle position is more than 20%. 4. The vehicle speed is more than 5 km/h (3 mph). 5. The TCC slip speed is less than 100 rpm at 4th gear L-up. Above conditions were indicated on a scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the L-up solenoid valve. (Refer to Section 7A3) • L-up solenoid valve stuck “OFF” the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces as necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the Torque converter (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—

Step	Action	Value(s)	YES	NO
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0742 (Flash Code 53)



Circuit Description

The lock-up solenoid SL of the torque converter clutch (TCC) controls the lock-up clutch by a signal according to the lock-up position judgment of the Transmission Control Module (TCM) when the vehicle runs.
This function can improve the fuel consumption to almost the same extent as the manual transmission.
The lock-up solenoid SL is put into B+ by the TCM, so that the solenoid is actuated with the result of lock-up.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) The engine revolution is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electronic failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electronic failure)

(13) L-up solenoid is not detecting failure or not deciding failure. (Electronic failure)

(14) Selector position switch is not detecting failure or not deciding failure.

(15) DTC U2104 is not detecting failure or not deciding failure.

(16) DTC U2105 is not detecting failure or not deciding failure.

(17) Input revolution sensor is not deciding failure.

(18) Throttle signal is not detecting failure or not deciding failure.

(19) Not emergency mode.

(20) Engine torque signal is not detecting failure or not deciding failure.

(21) Pressure control solenoid is not detecting failure not deciding failure.

(22) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The following conditions are detected two times or more between ignition “ON” and ignition “OFF”.

The TCM detects following conditions are met for 1 second continuously.

- 2 second passed after gear change output and L-up “ON”/”OFF” output.
- T/C revolution difference more than 100 rpm for 1 second continuously.
- 3rd gear lock-up “OFF”.

Action Taken When The DTC Sets

- No squat control. (For preventing engine stall)
- Fix 1st gear to prevent engine stall when vehicle speed is and below 10 km/h (6 mph). (Cancel at 15 km/h {9 mph})
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

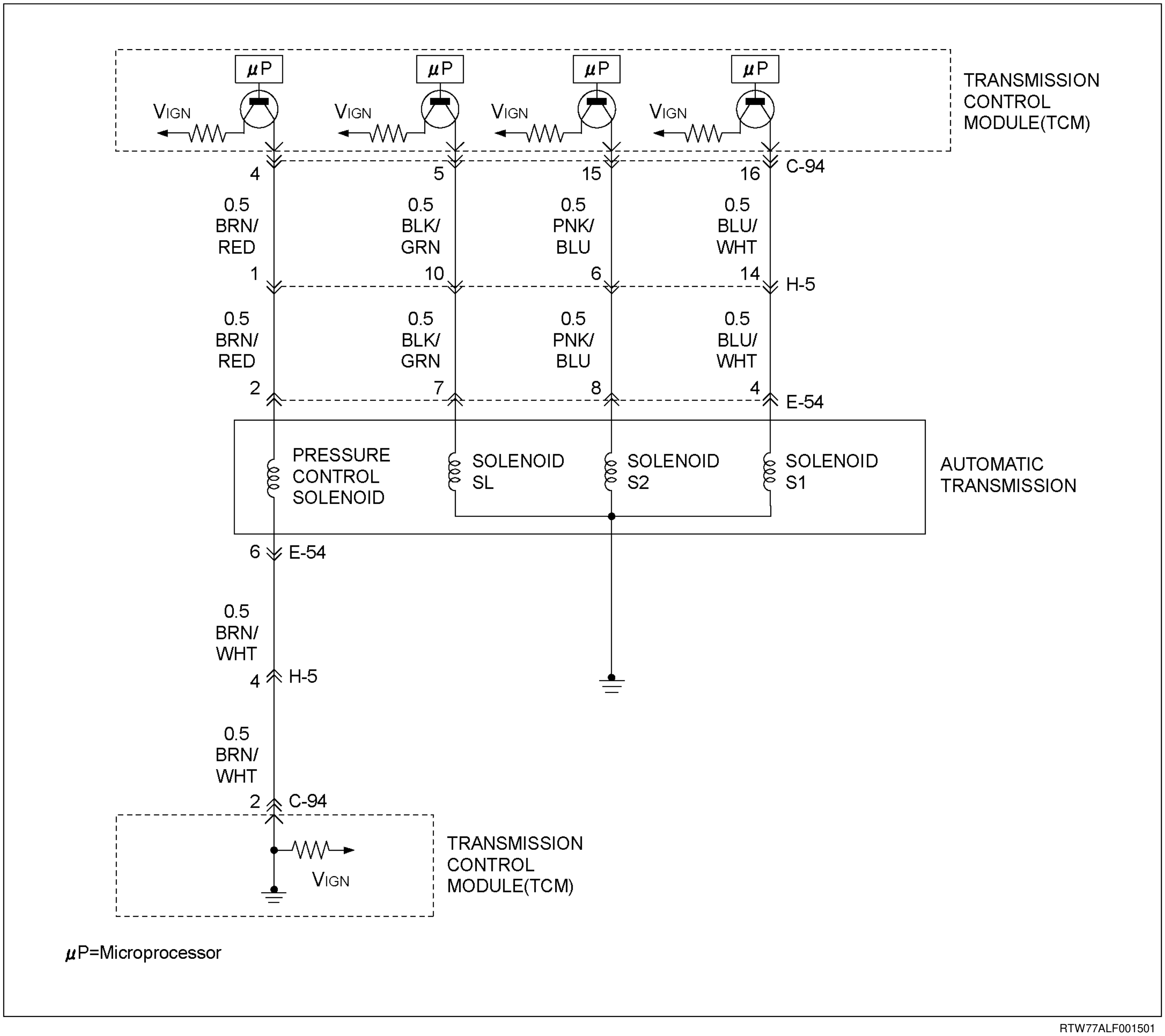
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0742

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed? 1. Install the scan tool.	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0742?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the TCC slip speed data on a scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Road testing the vehicle. 3. The throttle position is more than 20%. 4. The vehicle speed is between 5 km/h (3 mph) and 100 km/h (62 mph). 5. The TCC slip speed is more than 150 rpm at 2nd gear L-up “OFF”. 6. The throttle position is more than 25%. 7. The vehicle speed is between 5 km/h (3 mph) and 80 km/h (50 mph). 8. The T/C revolution difference is less than 100 rpm at 3rd L-up “OFF”. Above conditions were indicated on a scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the L-up solenoid valve. (Refer to Section 7A3) • L-up solenoid valve stuck “ON” the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces as necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*

Step	Action	Value(s)	YES	NO
7	Replace the Torque converter (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture Info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	Verify repair

DTC P0746 (Flash Code 45)



Circuit Description

The pressure control solenoid is a PWM duty control solenoid located in the valve body.

The pressure control solenoid is a Transmission Control Module (TCM)-controlled device used to regulate transmission throttle pressure by energizing current from the TCM.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

(4) Pressure control solenoid is not detecting failure or not deciding failure.

(5) Feedback AD value keeps less than 1000 for 0.5 seconds and also linear solenoid assured voltage keeps 10.5 volts for 0.5 seconds.

Condition For Setting The DTC

All of the following conditions are met.

- Accumulation of feedback error current value is more than 8A.
- Detect failure twice continuously.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned "ON", short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Action Taken When The DTC Sets

- No L-up control.
- No line pressure reduction control at gear change.
- No squat control.
- No slope control.
- No torque reduction control.
- No line pressure reduction control at garage.
- Line pressure FULL output.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- Become emergency mode.
- Check Trans "ON".
- DTC stored.
- MIL request "ON". (EURO 4 only)

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for change.

Circuit/System Testing DTC P0746

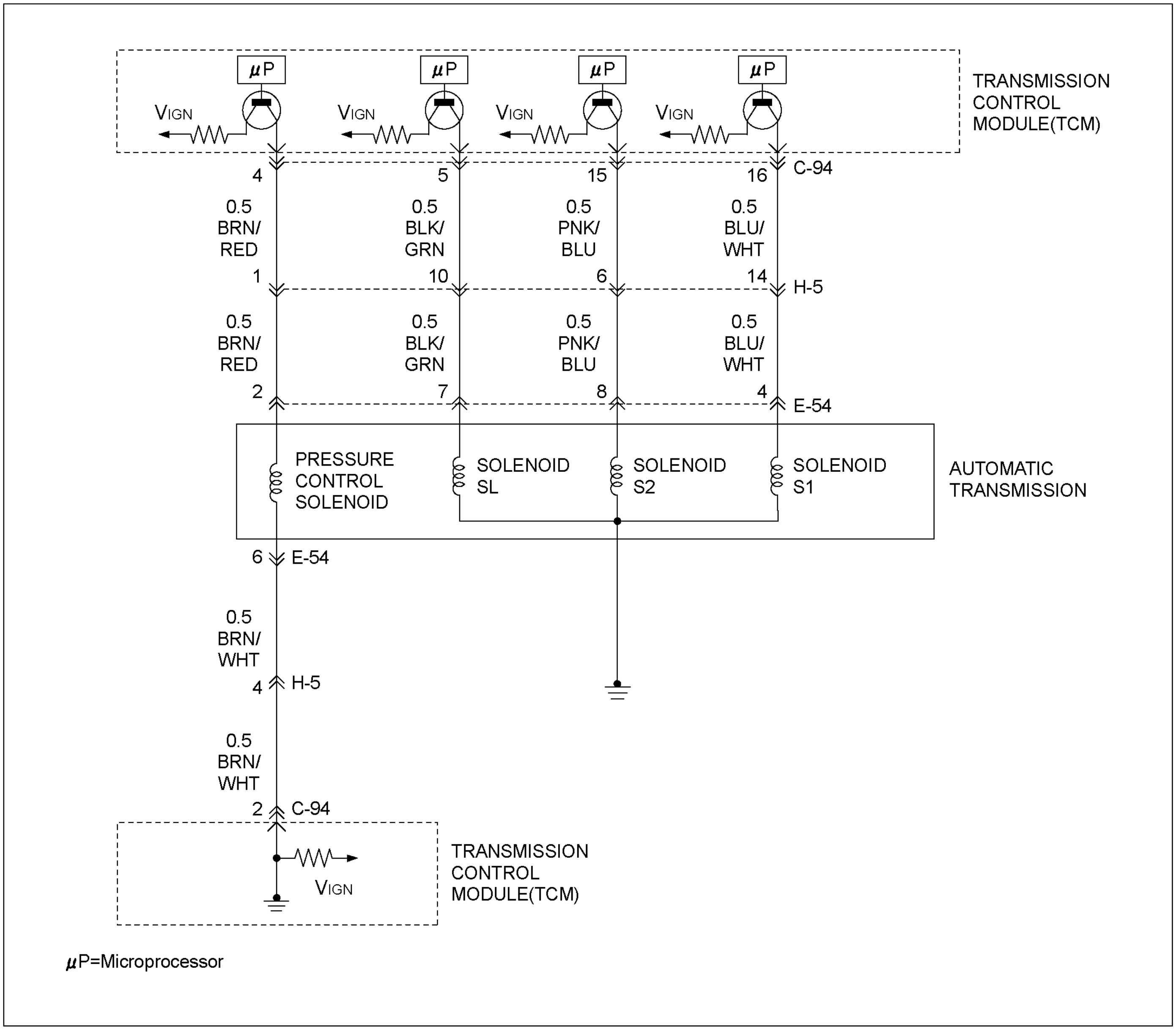
Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Record a scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0746?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replace necessary. Was the problem found?	—	Go to *Step 9*	Go to *Step 4*

Step	Action	Value(s)	YES	NO
4	Measure the resistance of pressure control solenoid. 1. Turn “OFF” the ignition. 2. Disconnect the automatic transmission connector and TCM connector. 3. Measure the resistance between automatic transmission terminal E54-2 and automatic transmission terminal E54-6. Is the resistance specified value?	5 to 5.6Ω at 20°C (68°F)	Go to *Step 5*	Go to *Step 7*
5	Measure the resistance of wire between terminal C94-2 and terminal C94-4. 1. Turn “OFF” the ignition. 2. Connect the automatic transmission connector. 3. Disconnect the TCM connector. 4. Measure the resistance between terminal C94-2 and terminal C94-4. Is the resistance specified value?	5 to 5.6Ω at 20°C (68°F)	Go to *Step 8*	Go to *Step 6*
6	Repair or Replace the wire between terminals C94-2, 4 and terminals E54-6, 2. Is the action complete?	—	Go to *Step 9*	—
7	Replace the pressure control solenoid. (valve body) Is the action complete?	—	Go to *Step 9*	—
8	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to SPS for procedure). Is the action complete?	—	Go to *Step 9*	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

4. HARSHNESS

Checkpoint		Problem	Countermeasure
Road test vehicle(Noise has a certain pattern)	NG	Noise does not have any specific pattern	Replace tires
OK ↓			
Tire inflation pressure	NG	Incorrect	Adjust
OK ↓			
Tires for out of balance	NG	Incorrect	Adjust or replace
OK ↓			
Bushings in suspension System	NG	Defective	Replace
	NG	Loosen or broken	Retighten or replace

DTC P0751 (Flash Code 41)



RTW77ALF001501

Circuit Description

The shift solenoid S1 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) Engine revolution rpm is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electric failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electric failure)

(13) Selector position switch is not detecting failure or not deciding failure.

(14) DTC U2104 is not detecting failure or not deciding failure.

(15) DTC U2105 is not detecting failure or not deciding failure.

(16) Input revolution sensor is not deciding.

(17) Throttle signal is not detecting failure or not deciding failure.

(18) Not emergency mode.

(19) Engine torque signal is not detecting failure or not deciding failure.

(20) Pressure control solenoid is not detecting failure or not deciding failure.

(21) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The following conditions are detected two times or more between ignition “ON” and ignition “OFF”.

2 second passed after gear change output.

- The TCM detects equivalent of 4th gear ratio for 1 second in case of 1st gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 7 km/h (4 mph).
- The TCM detects equivalent of 3rd gear ratio for 1 second in case of 2nd gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 5 km/h (3 mph) and less than 30 km/h (19 mph).

Action Taken When The DTC Sets

- No input revolution sensor failure detection.
- MIL request “ON”. (EURO 4 only)
- Check Trans “ON”.
- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

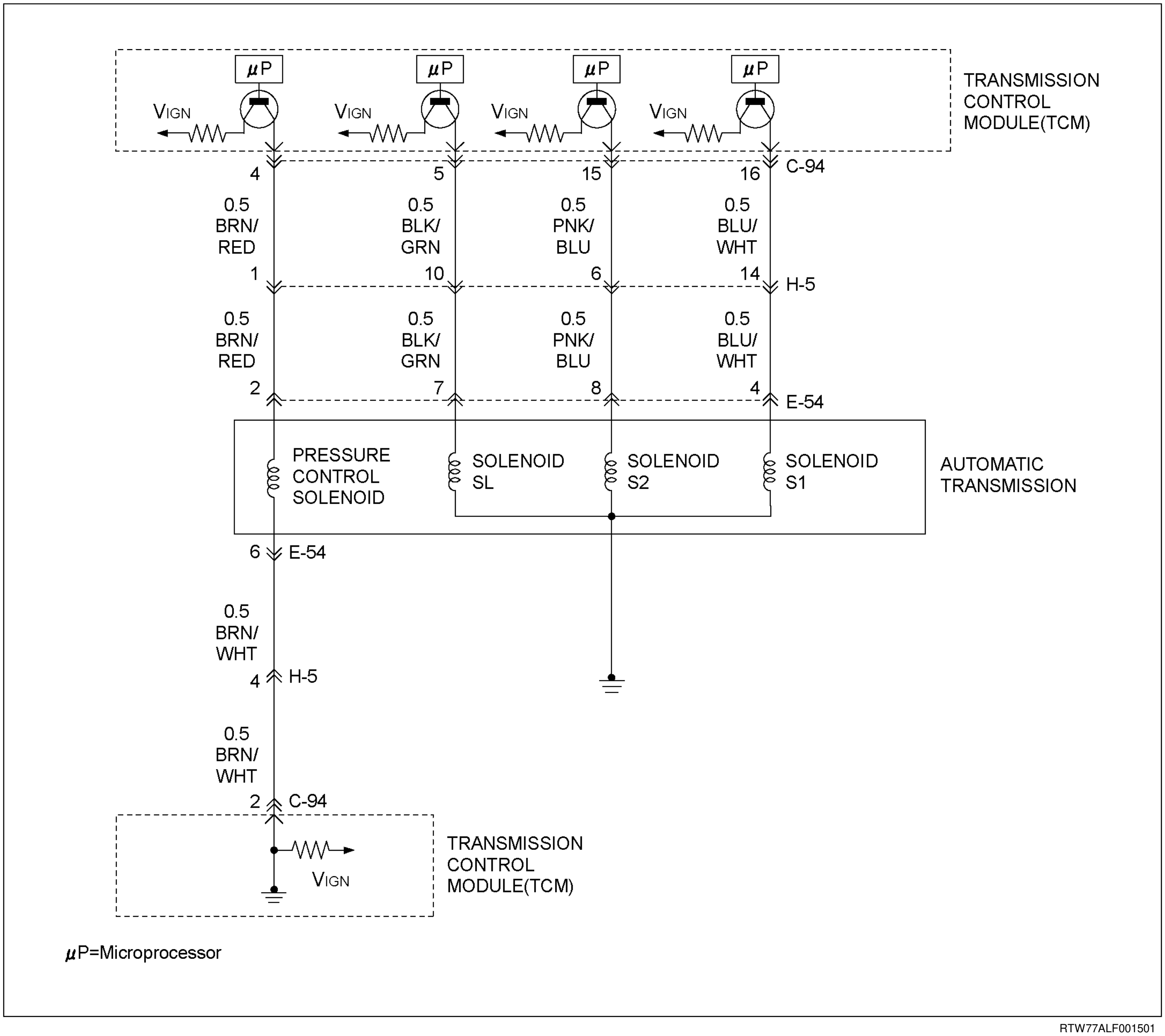
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0751

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0751?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the commanded gear and current gear on a scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Road testing the vehicle. 3. The throttle position is more than 8%. 4. The vehicle speed is more than 5 km/h (3 mph). Did the TCM detect 4th gear ratio in case of 1st gear target, and 3rd gear ratio in case of 2nd gear target? Above conditions were indicated on a scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the shift solenoid valve S1. (Refer to Section 7A3) • Shift solenoid valve S1 stuck “OFF” the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the valve body. (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—

Step	Action	Value(s)	YES	NO
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0752 (Flash Code 51)



Circuit Description

The shift solenoid S1 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550 rpm.

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) Engine revolution rpm is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electric failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electric failure)

(13) Selector position switch is not detecting failure or not deciding failure.

(14) DTC U2104 is not detecting failure or not deciding failure.

(15) DTC U2105 is not detecting failure or not deciding failure.

(16) Input revolution sensor is not deciding.

(17) Throttle signal is not detecting failure or not deciding failure.

(18) Not emergency mode.

(19) Engine torque signal is not detecting failure or not deciding failure.

(20) Pressure control solenoid is not detecting failure or not deciding failure.

(21) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The following conditions are detected two times or more between ignition “ON” and ignition “OFF”.

2 second passed after gear change output.

- The TCM detects equivalent of 2nd gear ratio for 1 second in case of 3rd gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 5 km/h (3 mph).

Action Taken When The DTC Sets

- No use 4th gear.
- No input revolution Sensor failure detection.
- MIL request “ON”. (EURO 4 only)
- Check Trans “ON”.
- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

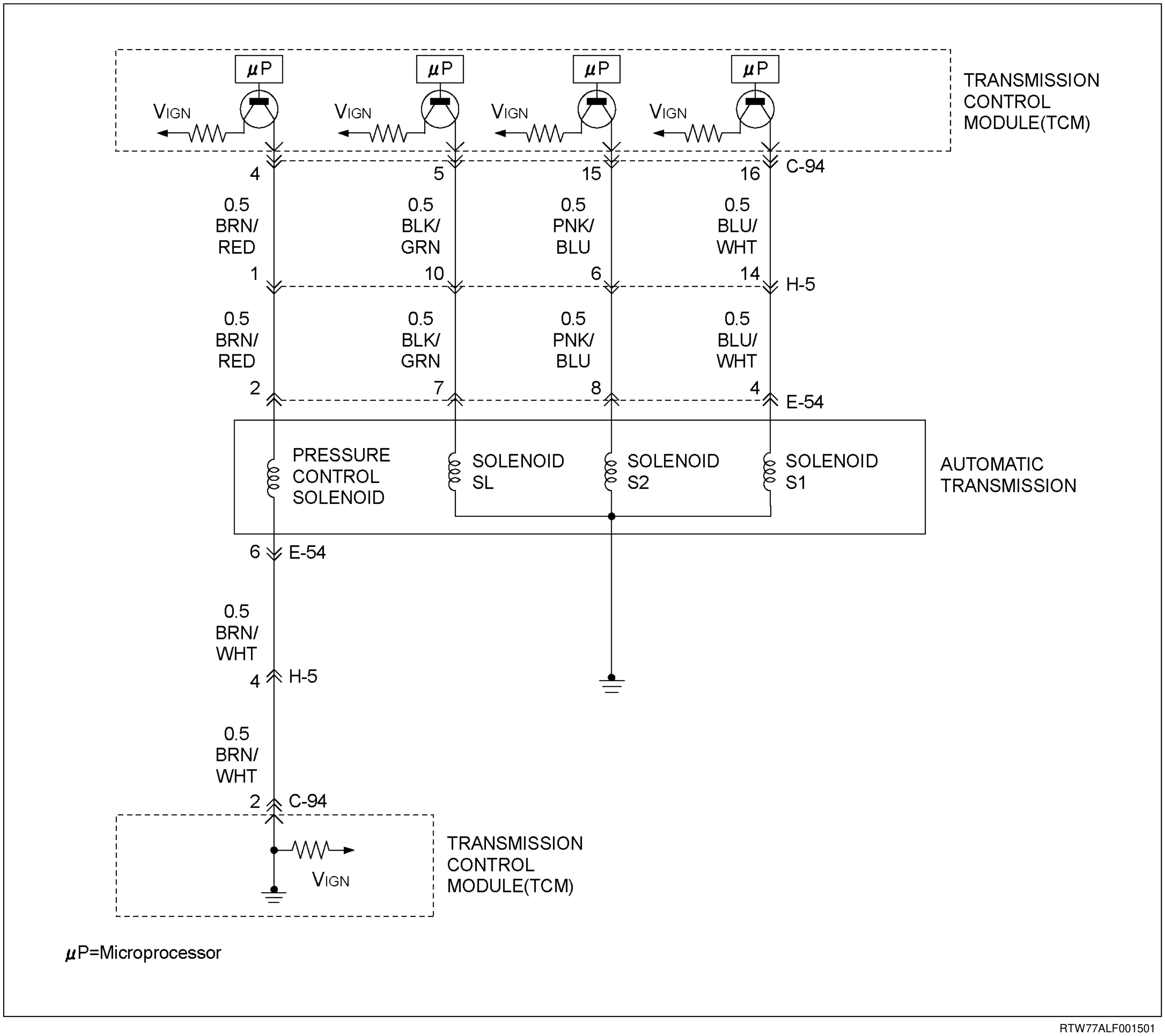
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0752

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn "ON" the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0752?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the commanded gear and current gear on the scan tool. 1. Turn "ON" the ignition with engine "ON". 2. Road testing the vehicle. 3. The throttle position is more than 8%. 4. The vehicle speed is more than 5 km/h (3 mph). Did the TCM detect 2nd gear ratio in case of 3rd gear target? Above conditions were indicated on the scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the shift solenoid valve S1. (Refer to Section 7A3) • Shift solenoid valve S1 stuck "ON" the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the valve body. (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—

Step	Action	Value(s)	YES	NO
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0756 (Flash Code 42)



Circuit Description

The shift solenoid S2 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550rpm.

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) Engine revolution rpm is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electric failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electric failure)

(13) Selector position switch is not detecting failure or not deciding failure.

(14) DTC U2104 is not detecting failure or not deciding failure.

(15) DTC U2105 is not detecting failure or not deciding failure.

(16) Input revolution sensor is not deciding.

(17) Throttle signal is not detecting failure or not deciding failure.

(18) Not emergency mode.

(19) Engine torque signal is not detecting failure or not deciding failure.

(20) Pressure control solenoid is not detecting failure or not deciding failure.

(21) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The following conditions are detected two times or more between ignition “ON” and ignition “OFF”.

2 second passed after gear change output.

- The TCM detects equivalent of 1st gear ratio for 1 second in case of 2nd gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 5 km/h (3 mph).
- The TCM detects equivalent of 4th gear ratio for 1 second in case of 3rd gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 20 km/h (12 mph).

Action Taken When The DTC Sets

- No input revolution Sensor failure detection.
- MIL request “ON”. (EURO 4 only)
- Check Trans “ON”.
- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

SECTION 3E

WHEELS AND TIRES

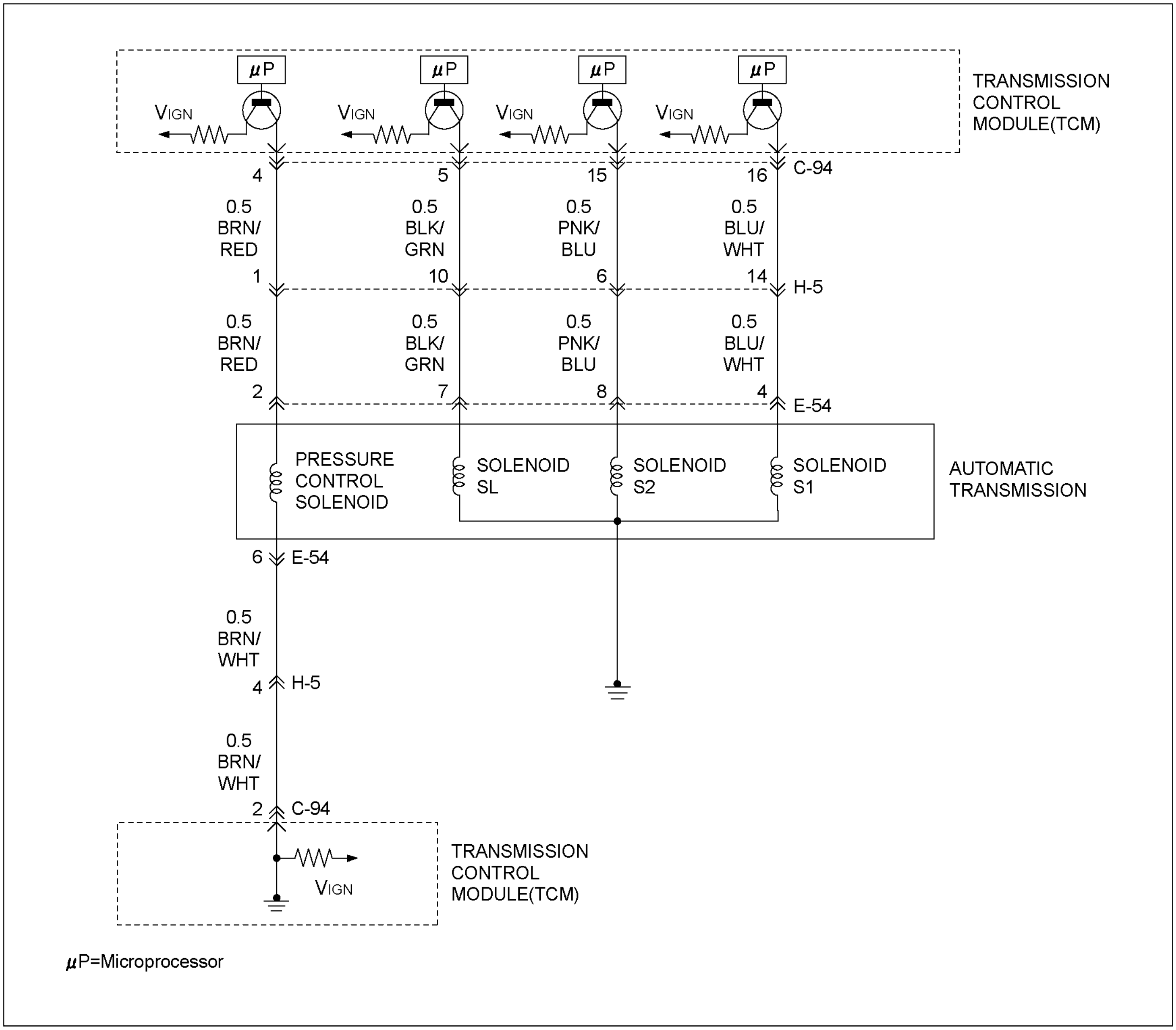
TABLE OF CONTENTS

Circuit/System Testing DTC P0756

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install the scan tool. 2. Turn "ON" the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0756?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replace necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the commanded gear and current gear on the scan tool. 1. Turn "ON" the ignition with engine "ON". 2. Road testing the vehicle. 3. The throttle position is more than 8%. 4. The vehicle speed is more than 5 km/h (3 mph). Did the TCM detect 1st gear ratio in case of 2nd gear target, and 4th gear ratio in case of 3rd gear target? Above conditions were indicated on a scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the shift solenoid valve S2. (Refer to Section 7A3) • Shift solenoid valve S2 stuck "OFF" the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the valve body. (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—

Step	Action	Value(s)	YES	NO
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0757 (Flash Code 52)



RTW77ALF001501

Circuit Description

The shift solenoid S2 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding failure.
- The engine revolution is more than 550 rpm.

(2) Oil temperature is more than 20°C (68°F), and water temperature signal is more than 70°C (158°F).

(3) 20 seconds or more passed after D position is detected.

(4) Oil temperature sensor is not deciding failure.

(5) Engine coolant temperature sensor is not detecting failure or not deciding failure.

(6) Engine revolution rpm is more than 600 rpm.

(7) Engine revolution sensor is not detecting failure or not deciding failure.

(8) T/F condition is high.

(9) T/F Hi-Low SW is not detecting failure or not deciding failure.

(10) Output revolution sensor is not detecting failure or not deciding failure.

(11) S1 solenoid is not detecting failure or not deciding failure. (Electric failure)

(12) S2 solenoid is not detecting failure or not deciding failure. (Electric failure)

(13) Selector position switch is not detecting failure or not deciding failure.

(14) DTC U2104 is not detecting failure or not deciding failure.

(15) DTC U2105 is not detecting failure or not deciding failure.

(16) Input revolution sensor is not deciding.

(17) Throttle signal is not detecting failure or not deciding failure.

(18) Not emergency mode.

(19) Engine torque signal is not detecting failure or not deciding failure.

(20) Pressure control solenoid is not detecting failure or not deciding failure.

(21) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The following conditions are detected two times or more between ignition “ON” and ignition “OFF”.

2 second passed after gear change output.

- The TCM detects equivalent of 2nd gear ratio for 1 second in case of 1st gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 5 km/h (3 mph).
- The TCM detects equivalent of 3rd gear ratio for 1 second in case of 4th gear output.
  - The throttle position is more than 8% and less than 100%.
  - The vehicle speed is more than 5 km/h (3 mph).

Action Taken When The DTC Sets

- No input revolution sensor failure detection.
- MIL request “ON”. (EURO 4 only)
- Check Trans “ON”.
- DTC stored.

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

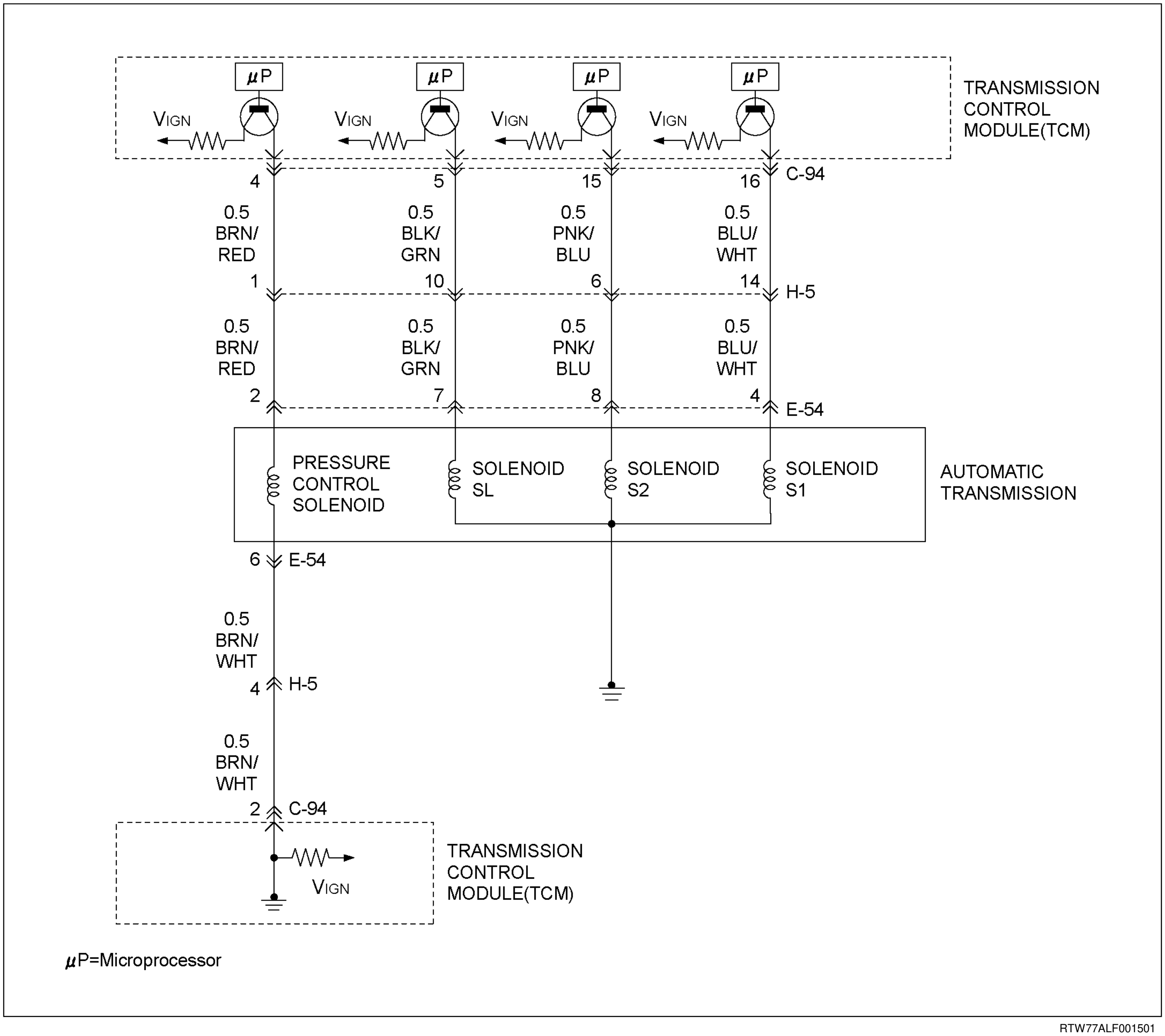
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0757

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0757?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the transmission fluid checking procedure. Refer to checking Transmission Fluid level and Condition in Automatic Transmission 7A section. If the problem found, repair or replace necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 4*
4	Observe the commanded gear and current gear on the scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Road testing the vehicle. 3. The throttle position is more than 8%. 4. The vehicle speed is more than 5 km/h (3 mph). Did the TCM detect 2nd gear ratio in case of 1st gear target, and 3rd gear ratio in case of 4th gear target? Above conditions were indicated on the scan tool display?	—	Refer to *Diagnostic Aids*	Go to *Step 5*
5	Check the following items. • Check the shift solenoid valve S2. (Refer to Section 7A3) • Shift solenoid valve S2 stuck “ON” the release position (Refer to Section 7A4) • Misaligned or damaged valve body gasket. • Restricted apply passage. If the problem found, replaces necessary. Was the problem found?	—	Go to *Step 8*	Go to *Step 6*
6	Check the DTC on a scan tool. Is DTC found on a scan tool?	—	Go to *Step 7*	Go to *Step 8*
7	Replace the valve body. (Refer to Section 7A4). Is the action complete?	—	Go to *Step 8*	—

Step	Action	Value(s)	YES	NO
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 9*
9	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0962 or P0963 (Flash Code 35)



Circuit Description

The pressure control solenoid is a PWM duty control solenoid located in the valve body.

The pressure control solenoid is a TCM-controled device used to regulate transmission throttle pressure by energizing current from the TCM.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) Not emergency mode.

(3) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication Service is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

(1) All of the following conditions are met for 12.5 seconds or more continuously. (DTC P0962)

- 1 second or more passed after ignition short failure detection condition is met or ignition short failure is never detected after ignition “ON”.

- Feedback current value is less than 92 mA

(2) All of the following conditions are met for 0.5 seconds or more continuously. (DTC P0963)

- 1 second or more passed after open failure detection condition is met or open failure is not detected after ignition "ON".
- Feedback current value is more than 1357 mA.

Action Taken When The DTC Sets

- No squat control.
- No line pressure reduction control at gear change.
- No lock-up control.
- No slope control.
- No torque reduction control.
- No line pressure reduction control at garage.
- Line pressure FULL output.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- No pressure control solenoid Feedback stuck failure detection.
- Check Trans "ON".
- DTC stored.
- MIL request "ON". (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned "ON", short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

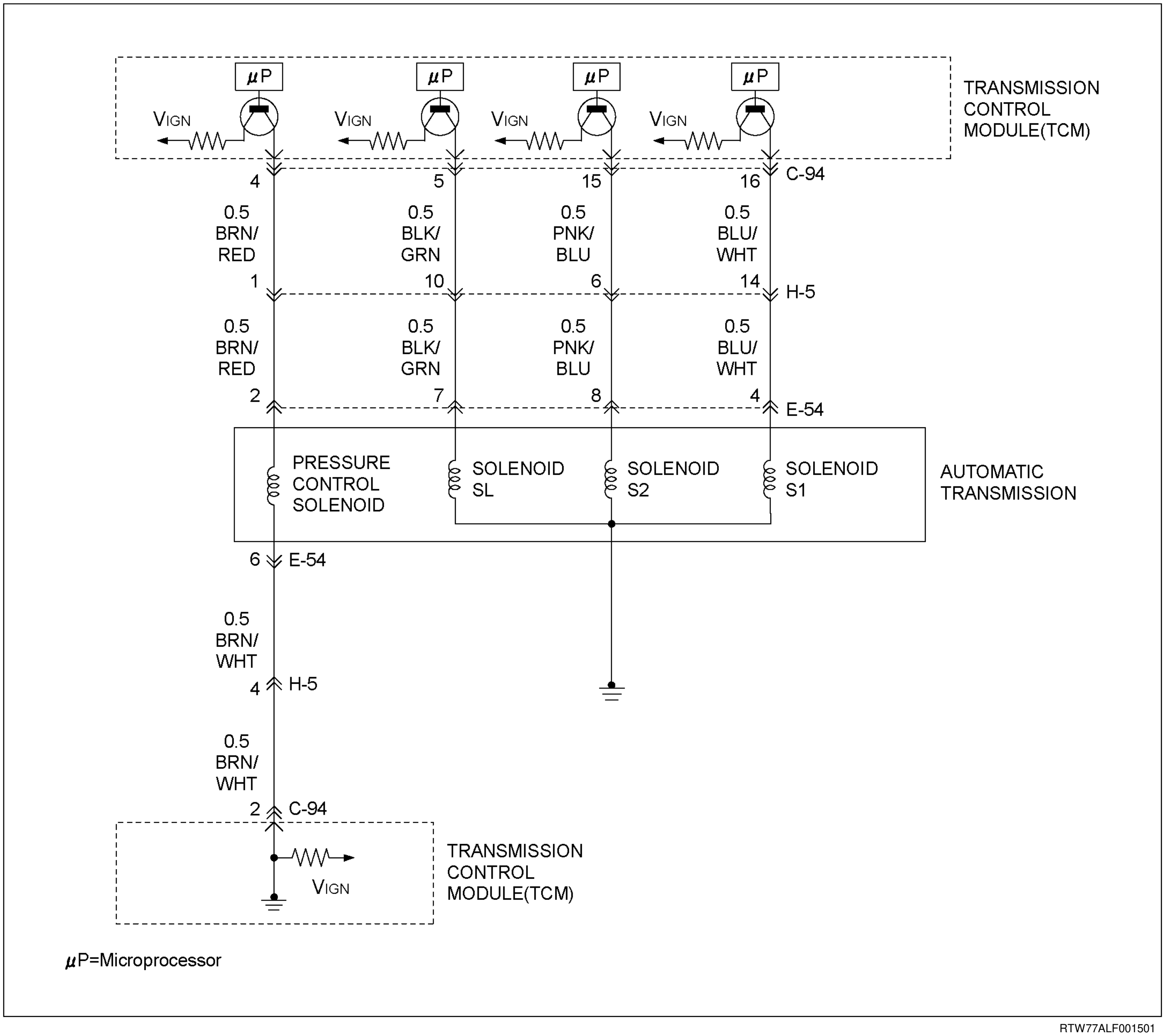
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0962 or P0963

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn "ON" the ignition. 3. Record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P0962 or P0963?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Measure the resistance of pressure control solenoid. 1. Turn "OFF" the ignition. 2. Disconnect the automatic transmission connector. 3. Measure the resistance between automatic transmission terminal E54-2 and automatic transmission terminal E54-6. Is the resistance specified value?	5 to 5.6Ω at 20°C (68°F)	Go to *Step 4*	Go to *Step 7*

Step	Action	Value(s)	YES	NO
4	Measure the resistance of wire between terminal C94-2 and terminal C94-4 1. Turn “OFF” the ignition. 2. Connect the automatic transmission connector. 3. Disconnect the TCM connector. 4. Measure the resistance between terminal C94-2 and terminal C94-4. Is the resistance specified value?	5 to 5.6Ω at 20°C (68°F)	Go to *Step 6*	Go to *Step 5*
5	Repair or Replace the wire between terminals C94-2, 4 and terminals E54-6, 2. Is the action complete?	—	Go to *Step 9*	—
6	Observe the PCS Actual Current data on a scan tool data. 1. Turn “ON” the ignition. Does the scan tool indicate is specified value?	About 1000mA	Go to *Step 9*	Go to *Step 8*
7	Replace the pressure control solenoid. Is the action complete?	—	Go to *Step 9*	—
8	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 9*	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0973 or P0974 (Flash Code 31)



Circuit Description

The shift solenoid S1 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the shift solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) Not emergency mode.

(3) 0.025 seconds or more passed after the state of power "ON" solenoid is changed.

(4) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

MAIN DATA AND SPECIFICATIONS

Tire Size and Pressure

Model	4×2 Except High Ride Suspension		4×2 High Ride Suspension, 4×4	
Tire Size	195R14C 8PR 106/104Q	215/70R15C 106/104S	225/75R15C 110/108S	245/70R16 111S
Wheel Size	14 x 5.5JJ	15 x 6.5JJ	15 x 6.5JJ	16 x 7JJ
Tire Pressure				
Front kPa (kgf/cm^2/psi)	245 (2.5/36)	221 (2.25/32)	221 (2.25/32)	200 (2.0/28)
Rear kPa (kgf/cm^2/psi)	441 (4.5/64)	368 (3.75/53)	319 (3.25/46)	270 (2.8/40)

Condition For Setting The DTC

The TCM detects following conditions for 0.5 seconds continuously at shifting.

- Voltage at connector pin is 0V when solenoid is “ON”. (DTC P0973)
- Voltage at connector pin is ignition voltage when solenoid is “OFF”. (DTC P0974)

Action Taken When The DTC Sets

- No L-up control.
- No line pressure reduction control at gear change.
- No torque reduction control.
- No squat control.
- No slope control.
- No line pressure reduction control at garage.
- No input revolution sensor failure detection.
- No shift solenoid failure detection.
- No L-up solenoid failure detection.
- Change to emergency mode.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

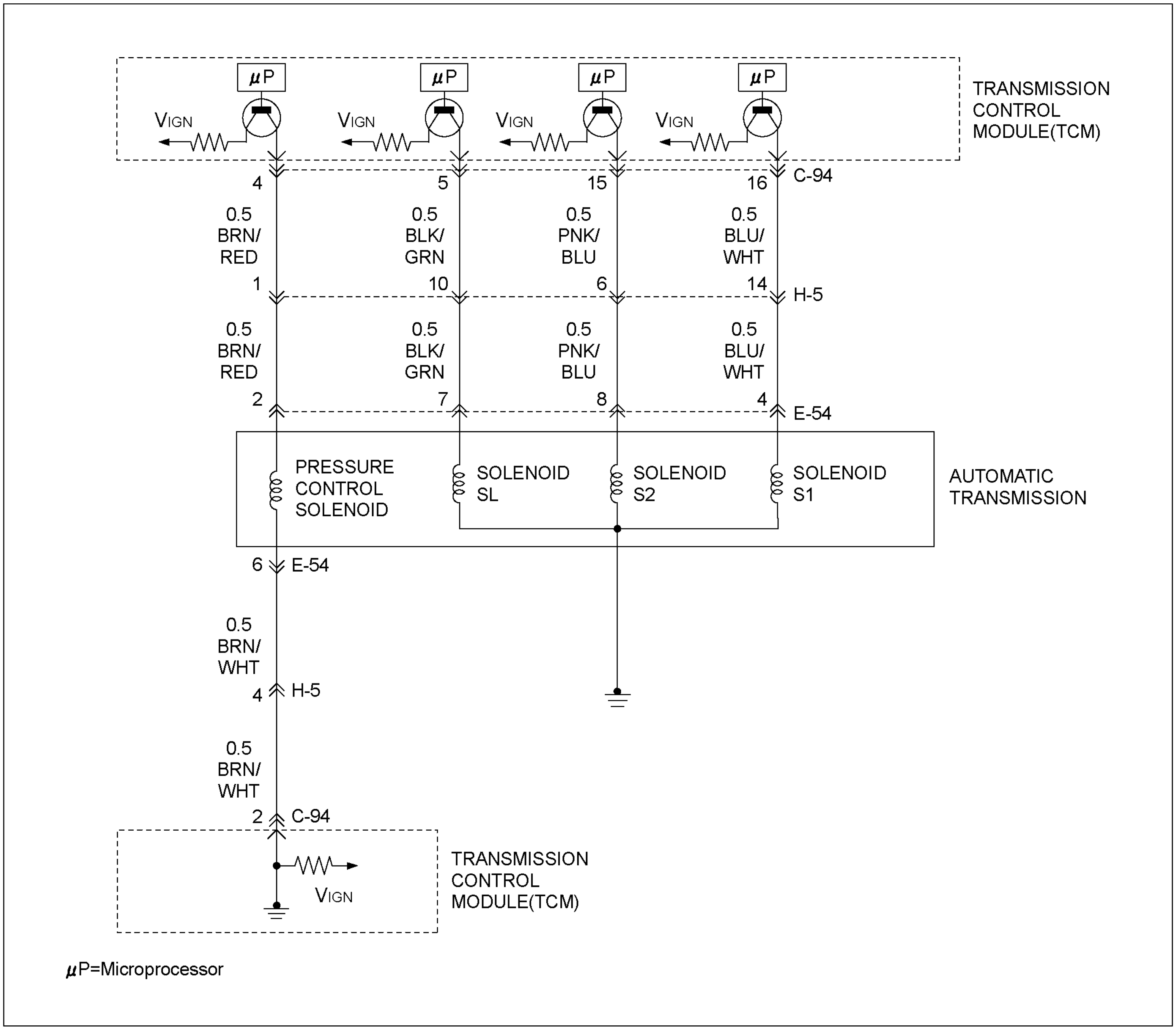
Circuit/System Testing DTC P0973 or P0974

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Start the engine. 3. Depress the brake pedal and place the select lever in D position. 4. Press the 3rd start switch. (Turn the 3rd start switch “ON”.) 5. Press the 3rd start switch again. (Turn the 3rd start switch “OFF”.) Does a scan tool indicate DTC P0973 or P0974?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Turn “ON” the ignition with the engine “ON”. 2. Place the selector lever in the “P” position. 3. Measure the voltage between terminal C94-16 and terminal C94-1 (GND) on the TCM pigtail connector by 5-8840-0285-0 DMM. Is the voltage specified value?	8~16V	Go to *Step 4*	Go to *Step 10*

Step	Action	Value(s)	YES	NO
4	1. Turn "OFF" the ignition. 2. Disconnect the TCM connector (C-94). 3. Turn "ON" the ignition. 4. Measure the voltage between terminal C94-16 and terminal C94-1 by 5-8840-0285-0 DMM. Is the voltage specified value?	0V	Go to *Step 5*	Go to *Step 7*
5	1. Turn "OFF" the ignition. 2. Measure the resistance between terminal C94-16 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 9*	Go to *Step 6*
6	1. Disconnect the automatic transmission connector (E-54). 2. Measure the resistance between terminal E54-4 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 7*	Go to *Step 8*
7	1. Check for open or short in the wire between terminal C94-16 and terminal E54-4. 2. Repair or replace the wire between terminal C94-16 and terminal E54-4. Is the action complete?	—	Go to *Step 11*	—
8	Replace the S1 solenoid. Is the action complete?	—	Go to *Step 11*	—
9	1. Clear the DTC. 2. Perform the test-driving. 3. Check the DTC. Was DTC P0973 or P0974 stored?	—	Go to *Step 10*	Refer to *Diagnostic Aids*
10	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 11*	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 12*

Step	Action	Value(s)	YES	NO
12	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P0976 or P0977 (Flash Code 32)



RTW77ALF001501

Circuit Description

The shift solenoid S2 changes the hydraulic route with the signals from the TCM according to the vehicle speed and the throttle opening to control shifting. When the shift solenoid S1 or S2 fails, the hydraulic circuit is mechanically operated as a backup.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) Not emergency mode.

(3) 0.025 seconds or more passed after the state of power “ON” solenoid is changed.

(4) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The TCM detects following conditions for 0.5 seconds continuously at shifting.

- Voltage at connector pin is 0V when solenoid is "ON". (DTC P0976)
- Voltage at connector pin is ignition voltage when solenoid is "OFF". (DTC P0977)

Action Taken When The DTC Sets

- No L-up control.
- No line pressure reduction control at gear change.
- No torque reduction control.
- No squat control.
- No slope control (keep mode).
- No line pressure reduction control at garage.
- No input revolution sensor failure detection.
- No shift solenoid failure detection.
- No L-up solenoid failure detection.
- Change to emergency mode.
- Check Trans "ON".
- DTC stored.
- MIL request "ON". (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned "ON", short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring.
  Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P0976 or P0977

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Start the engine. 3. Depress the brake pedal and place the select lever in D position. 4. Press the 3rd start switch. (Turn the 3rd start switch "ON".) 5. Press the 3rd start switch again. (Turn the 3rd start switch "OFF".) Does a scan tool indicate DTC P0976 or P0977?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Turn "ON" the ignition with the engine "ON". 2. Place the selector lever in the "P" position. 3. Measure the voltage between terminal C94-15 and terminal C94-1 on the TCM pigtail connector by 5-8840-0285-0 DMM. Is the voltage specified value?	8~16V	Go to *Step 4*	Go to *Step 5*

Step	Action	Value(s)	YES	NO
4	1. Turn “OFF” the ignition. 2. Disconnect the TCM connector (C-94). 3. Turn “ON” the ignition. 4. Measure the voltage between terminal C94-15 and terminal C94-1 by 5-8840-0285-0 DMM. Is the voltage specified value?	8~16V	Go to *Step 7*	Go to *Step 10*
5	1. Turn “OFF” the ignition. 2. Measure the resistance between terminal C94-15 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 9*	Go to *Step 6*
6	1. Disconnect the automatic transmission connector (E-54). 2. Measure the resistance between terminal E54-8 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 7*	Go to *Step 8*
7	1. Check for open or short in the wire between terminal C94-15 and terminal E54-8. 2. Repair or replace the wire between terminal C94-15 and terminal E54-8. Is the action complete?	—	Go to *Step 11*	—
8	Replace the S2 solenoid. Is the action complete?	—	Go to *Step 11*	—
9	1. Clear the DTC. 2. Perform the test-driving. 3. Check the DTC. Was DTC P0976 or P0977 stored?	—	Go to *Step 10*	Refer to *Diagnostic Aids*
10	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 11*	—

Step	Action	Value(s)	YES	NO
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 12*
12	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P1790 (Flash Code 61)

Description

The electrically erasable programable read only memory (EEPROM) is a permanent memory chip that is physically solenoid within the TCM. The EEPROM contans the program and the calibration information that the TCM needs to control powertrain operation.

Unlike the PROM used in past applications, the EEPROM is not replaceable. If the TCM is replaced, the new TCM will need to be programmed. Equipment containing the correct program and calibration for the vehicle is required to program the TCM.

Condition For Running The DTC

ROM check sum calculation is completed.

Condition For Setting The DTC

Following condition is met twice since ignition “ON”.

- ROM check sum calculation result/check sum value saved in ROM.

Action Taken When The DTC Sets

- Change to emergency mode.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.5 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P1790

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn "OFF" the ignition and keep the position for more than 30 seconds. 3. Turn "ON" the ignition. 4. Check the DTC on a scan tool. Does a scan tool indicate DTC P1791?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Perform the SPS for the TCM. Is the action complete?	—	Go to *Step 4*	—
4	Recheck the DTC on the scan tool. Does the scan tool indicate DTC P1790?	—	Go to *Step 5*	Go to *Step 6*
5	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 6*	—
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 7*
7	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P1791 (Flash Code 62)

Description

DTC P1791 is recorded by TCM when there is malfunction in the RAM.

Condition For Running The DTC

Execute only one time after ignition “ON”.

Condition For Setting The DTC

One of the following conditions are met two times continuously.

- Write Ox5a5a5a5a into RAM, and read value is not same as Ox5a5a5a5a.
- Write Oxa5a5a5a5 into RAM, and read value is not same as Oxa5a5a5a5.

Action Taken The DTC Sets

- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

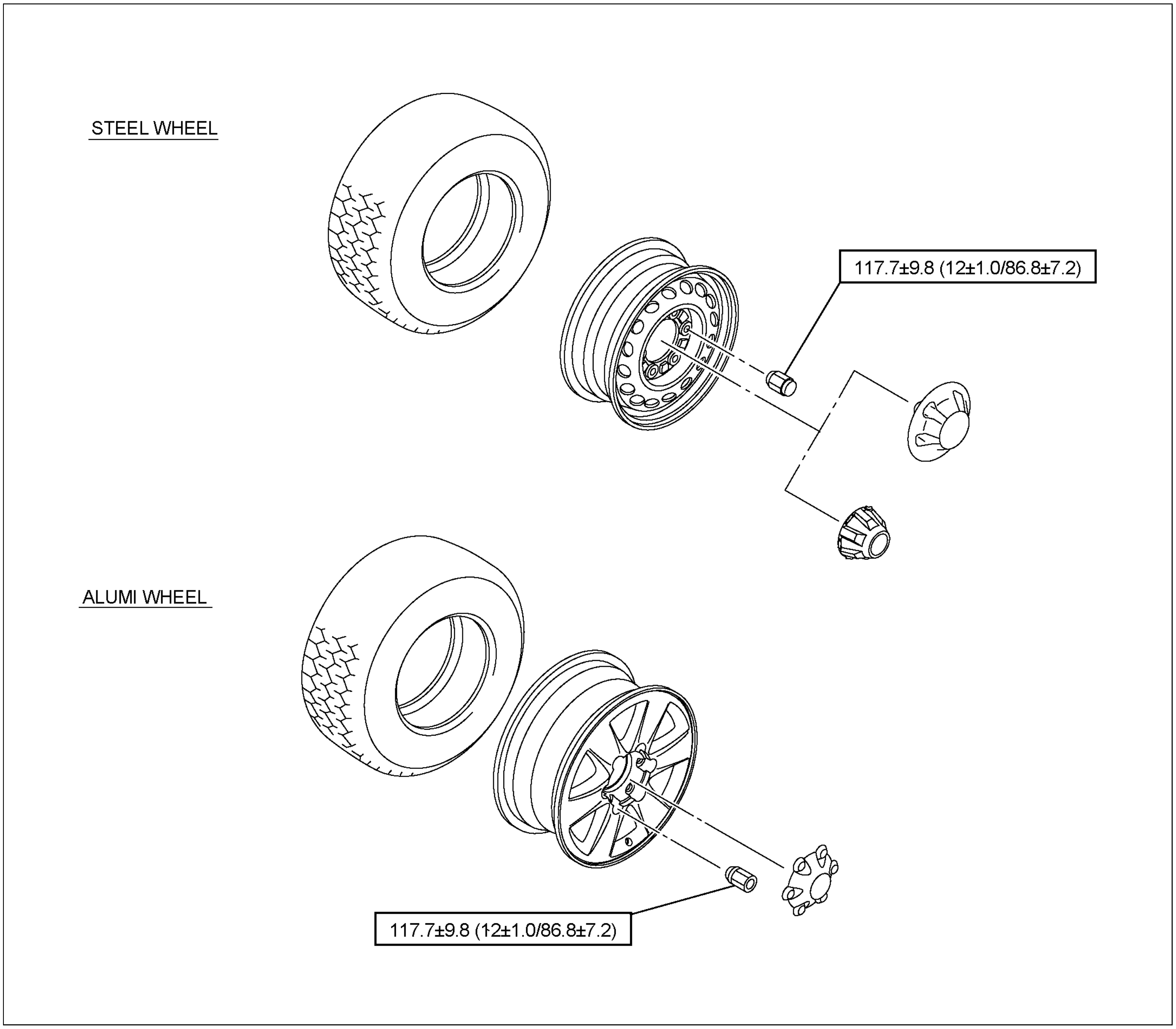
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

TORQUE SPECIFICATIONS

SPECIAL PARTS FIXING NUTS AND BOLTS

WHEELS AND TIRES

N·m (kgf·m/lb·ft)

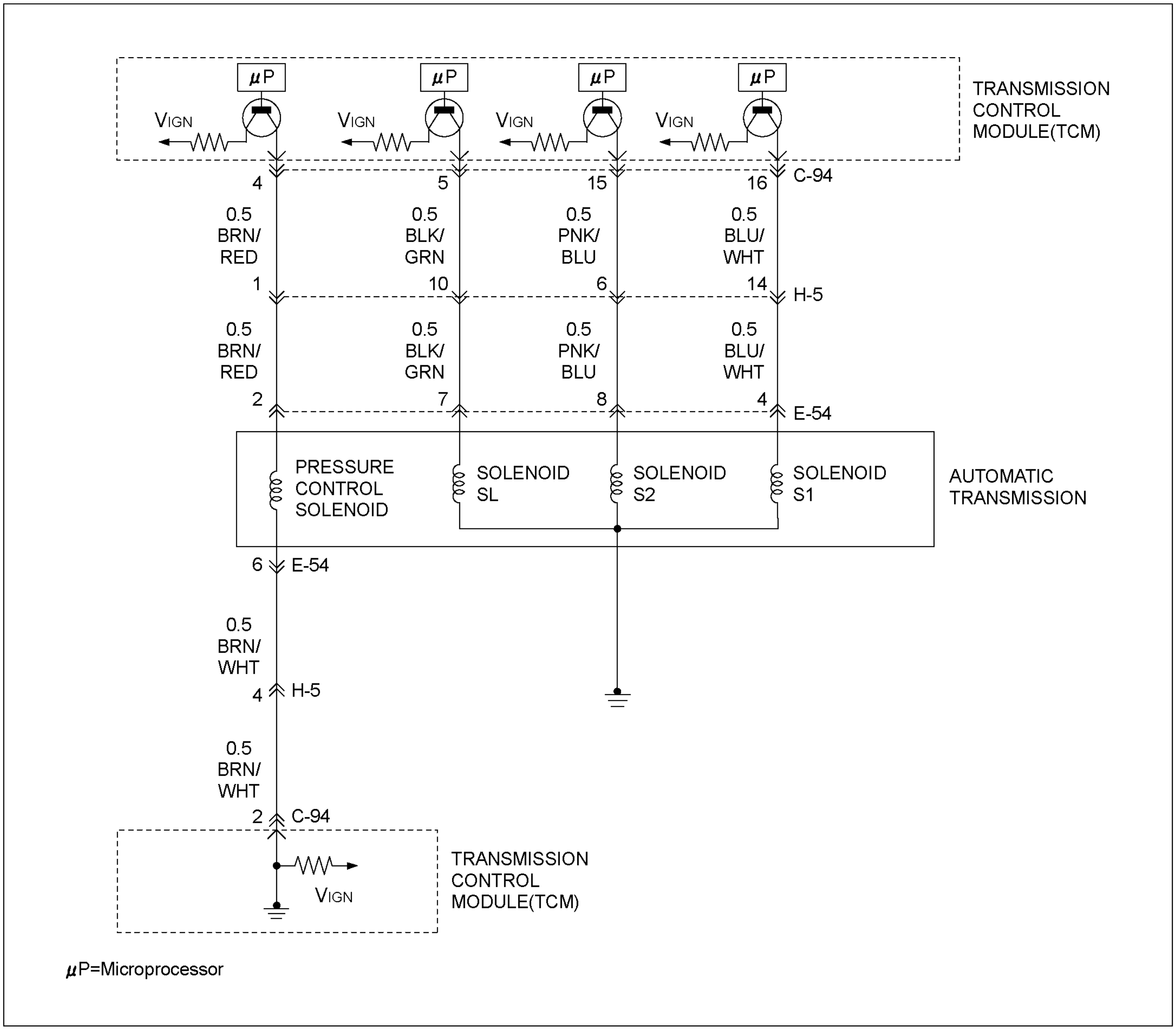


RTW73ELF000101

Circuit/System Testing DTC P1791

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “OFF” the ignition and keep the position for more than 30 seconds. 3. Turn “ON” the ignition. 4. Check the DTC on the scan tool. Does a scan tool indicate DTC P1791?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 4*	—
4	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 5*
5	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P2769 or P2770 (Flash Code 33)



RTW77ALF001501

Circuit Description

The lock-up solenoid SL of the torque converter clutch (TCC) controls the lock-up clutch by a signal according to the lock-up position judgment of the TCM when the vehicle runs.

This function can improve the fuel consumption to almost the same extent as the manual transmission. The lock-up solenoid SL is put into B+ by the TCM, so that the solenoid is actuated with the result of lock-up.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) Not emergency mode.

(3) 0.025 seconds or more passed after the state of energized solenoid is changed.

(4) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

The TCM detects following conditions for 0.5 seconds continuously at shifting.

- Voltage at connector pin is 0V when solenoid is “ON”. (DTC P2769)
- Voltage at connector pin is ignition voltage when solenoid is “OFF”. (DTC P2770)

Action Taken When The DTC Sets

- No L-up solenoid functional failure detection.
- No squat control. (DTC P2770)
- The TCM fixes to 1st gear when the vehicle speed is less than 10 km/h (6 mph).
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.5 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

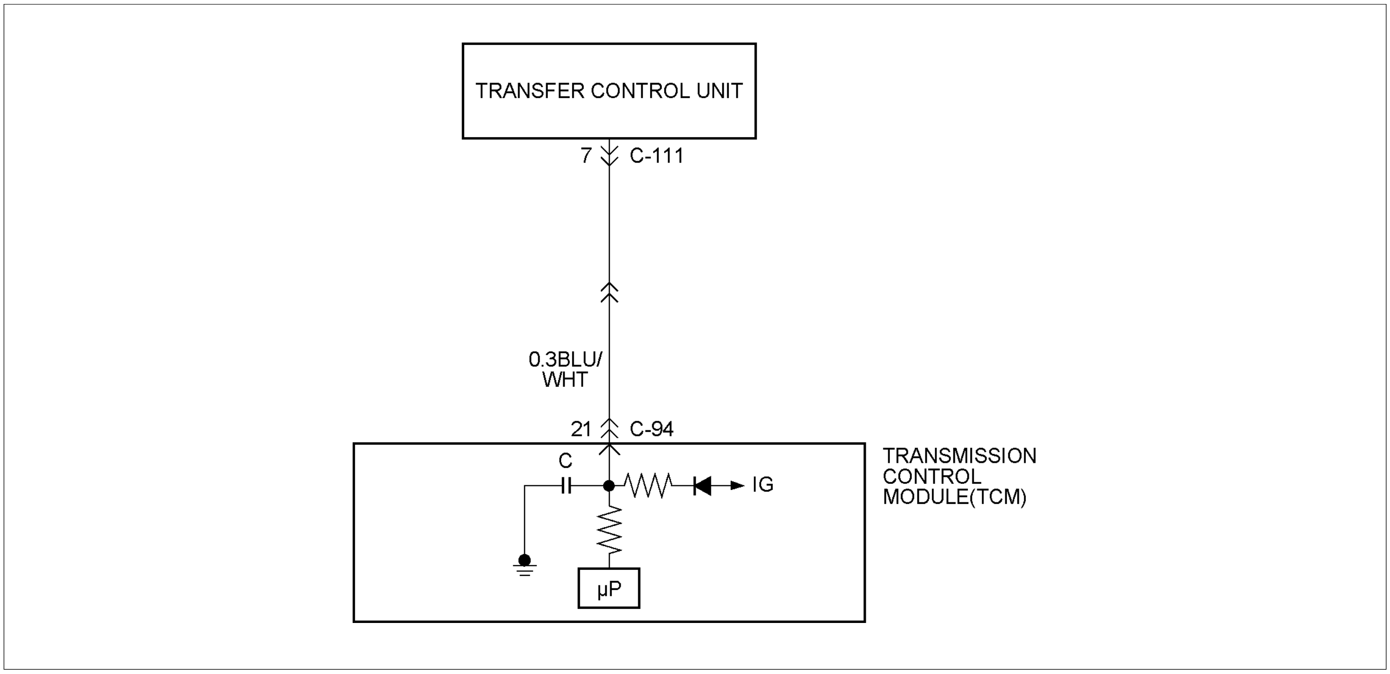
Circuit/System Testing DTC P2769 or P2770

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Start the engine. 3. Drive the vehicle in D position. 4. Accelerate the vehicle until the gear position becomes the 4th. 5. Release the accelerator pedal and accelerate the vehicle until the gear position becomes the 4th again. Does a scan tool indicate DTC P2769 or P2770?	—	Go to *Step 3*	Refer to *Diagnostic Aids*

Step	Action	Value(s)	YES	NO
3	1. Turn “ON” the ignition with the engine “ON”. 2. Place the selector lever in the “P” position. 3. Measure the voltage between terminal C94-5 and terminal C94-1 on the TCM pigtail connector by 5-8840-0285-0 DMM. Is the voltage specified value?	8~16V	Go to *Step 4*	Go to *Step 5*
4	1. Turn “OFF” the ignition. 2. Disconnect the TCM connector (C-94). 3. Turn “ON” the ignition. 4. Measure the voltage between terminal C94-5 and terminal C94-1 by 5-8840-0285-0 DMM. Is the voltage specified value?	8~16V	Go to *Step 7*	Go to *Step 10*
5	1. Turn “OFF” the ignition. 2. Measure the resistance between terminal C94-5 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 9*	Go to *Step 6*
6	1. Disconnect the automatic transmission connector (E-54). 2. Measure the resistance between terminal E54-7 and body ground by 5-8840-0285-0 DMM. Is the resistance specified value?	11~15Ω	Go to *Step 7*	Go to *Step 8*
7	1. Check for open or short in the wire between terminal C94-5 and terminal E54-7. 2. Repair or replace the wire between terminal C94-5 and terminal E54-7. Is the action complete?	—	Go to *Step 11*	—
8	Replace the SL solenoid. Is the action complete?	—	Go to *Step 11*	—
9	1. Clear the DTC. 2. Perform the test-driving. 3. Check the DTC. Was DTC P2769 or P2770 stored?	—	Go to *Step 10*	Refer to *Diagnostic Aids*
10	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 11*	—

Step	Action	Value(s)	YES	NO
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 12*
12	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC P2773 or 2774 (Flash Code 75)



RTW77AMF000901

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.
- DTC U2104 is not detecting failure or not deciding failure.
- DTC U2105 is not detecting failure or not deciding failure.
- Engine revolution signal is not detecting failure or not deciding.
- The engine revolution is more than 550 rpm.

(2) Not emergency mode.

(3) D, 3, 2, L position point is “ON”.

(4) Shift position signal is not detecting failure or not deciding failure.

(5) The vehicle speed is more than 29 km/h (18 mph) and less than 160 km/h (100 mph).

(6) Speed meter signal is detecting failure or not deciding failure.

(7) Output revolution rpm is more than 1500 rpm.

(8) Output revolution sensor is not detecting failure or not deciding failure.

(9) Throttle opening more than 2%.

(10) Throttle opening signal is not detecting failure or note deciding failure.

(11) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

Condition For Setting The DTC

All of the following conditions are met for 10 seconds continuously. (DTC P2773)

- Transfer 4L switch is “ON”.
- Transfer High judgment by transfer real gear ratio 0.9 < T/F Hi gear ratio < 1.1

All of the following conditions are met for 10 seconds continuously. (DTC P2774)

- Transfer 4L switch is “OFF”.
- Transfer Low judgment by transfer real gear ratio 2.23 < T/F Low gear ratio < 2.73

Action Taken When The DTC Sets

- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- MIL request “ON”.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

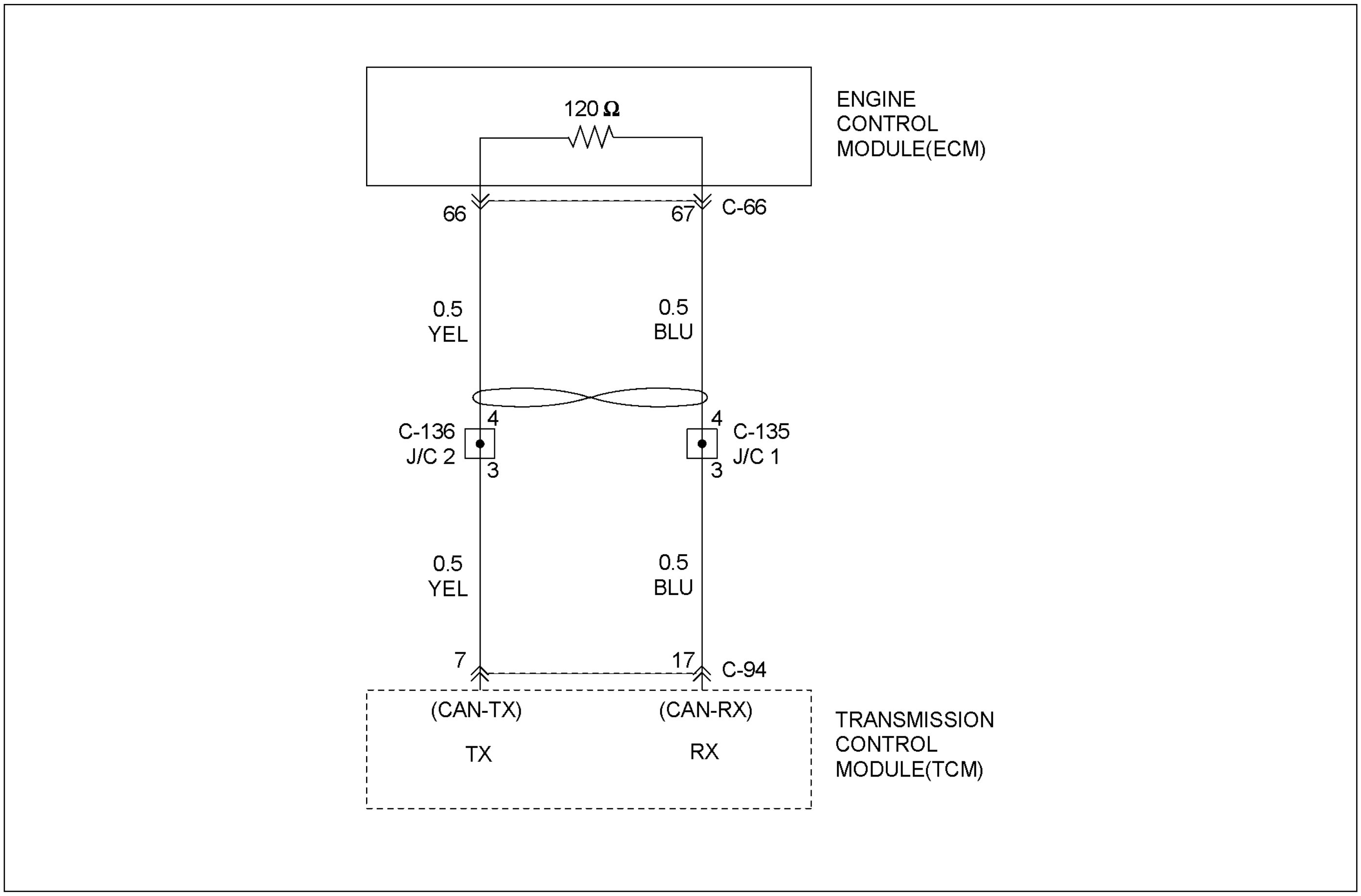
- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.

Circuit/System Testing DTC P2773 or P2774

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn “ON” the ignition. 3. Review and record scan tool data. 4. Operate the vehicle within scan tool data. Does a scan tool indicate DTC P2773 or P2774?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Observe the 4L signal data of the TCM on the scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Perform the road testing. 3. Check the 4L signal data on a scan tool. Was the problem found?	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Observe the 4L signal data of the TCM on a scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Perform the road testing. 3. Check the 4L signal data on a scan tool. Is the 4L signal fixed “ON”? (DTC P2773)	—	Go to *Step 6*	Go to *Step 5*
5	Observe the 4L signal data of the TCM on a scan tool. 1. Turn “ON” the ignition with engine “ON”. 2. Perform the road testing. 3. Check the 4L signal data on a scan tool. Is the 4L signal fixed “OFF”? (DTC P2774)	—	Go to *Step 6*	Go to *Step 8*
6	Replace or Repair the wire between the TCM terminal C94-21 and the T/F control unit terminal C111-7. Is the action complete?	—	Go to *Step 9*	—

Step	Action	Value(s)	YES	NO
7	Replace the T/F Control Unit.	—	Go to *Step 9*	—
8	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 9*	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn “OFF” the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC U2104 (Flash Code 65)



RTW77AMF000801

Circuit Description

The automatic transmission control system in AW30-40LE uses high speed CAN bus system. The individual CAN bus systems are connected via two interfaces and can exchange information and data. This allows control modules that are connected to different CAN bus systems to communicate. Transmission control module in the vehicle that requires continuous, rapid communication is connected to the high speed CAN bus. The automatic transmission is continuously notified of the current engine load status. Since the automatic transmission control module has to react immediately to load status changes, rapid communication is required between the engine control module and the automatic transmission control module. The high speed CAN bus in the AW30-40LE is designed as a two-wire CAN bus (twisted pair). The wires are shielded and twisted. The transmission rate is 500K band.

Condition For Running The DTC

All of the following conditions are met.

(1) All of the following conditions are met.

- The following condition is met for 2 seconds or more continuously.
  - The supply voltage is more than 10.2 volts and less than 15.5 volts.
- One of the following conditions is met once after ignition “ON”.
  - Output revolution sensor is not detecting failure or not deciding failure.
    Output revolution is more than 550rpm
  - Input revolution sensor is not detecting failure or not deciding failure.
    Input revolution is more than 550rpm
  - DTC U2104 is not detecting failure or not deciding failure.
    DTC U2105 is not detecting failure or not deciding failure.
    Engine revolution signal is not detecting failure or not deciding failure.
    The engine revolution is more than 550rpm.

(2) All of the following conditions are met.

- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

The following condition at ignition “OFF” form “ON” is detected seven times in total in 1 cycle.

- Receiving BUS “OFF” information from CAN controller.

Action Taken When The DTC Set

- Throttle judgment on torque reduction control, line pressure control at stationary status, line pressure reduction control at gear change and line pressure reduction control at garage. (Throttle opening 100%)
- Line pressure FULL output.
- Throttle judgment on gear change control. (Throttle opening 0%)
- No line pressure reduction control at gear change.
- No torque reduction control.
- No squat control.
- No slope control.
- No L-up control.
- Control Engine rpm at 7000rpm. (No inertia calculation)
- Control actual torque at MAX.
- Control driver torque at MAX.
- Control engine coolant temperature at 80°C (176°F).
- No coast control.
- No 3rd Start mode control.
- No line pressure reduction control at garage.
- No output revolution sensor failure detection.
- No input revolution sensor failure detection.
- No selector position switch failure detection.
- No oil temperature sensor failure detection.
- No T/F Hi-Low SW failure detection.
- No speed mater signal failure detection.
- No throttle signal failure detection.
- No Engine torque signal failure detection.
- No engine coolant temperature signal failure detection.
- No Engine revolution signal failure detection.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- No DTC U2105 failure detection.
- Cancel engine rpm condition of prerequisite of supply voltage failure detection.
- Control vehicle speed of speed meter at 0km/h.
- No torque reduction at stall.
- No cruise control.
- No warm up control.
- DTC stored.
- Check Trans “ON”.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Inspect the wiring for EMI (Electro-Magnetic Interference). Check that all wires are properly routed away from coil, and generator. Also check for improperly installed electrical options. When this test is performed, turn “OFF” on electronic auto parts switches to improperly for a noise preventing.

WHEELS AND TIRES

GENERAL DESCRIPTION

TIRE DESIGNATION

195 R 14 C 8PR

- 8PR: Ply Rating (Optional marking)
- C: Commercial Vehicle Tire
- 14: Rim Diameter (Inches)
- R: Radial Construction
- 195: Tire Section Width in millimeter nominal

215 / 70 R 15 C

- C: Commercial Vehicle Tire
- 15: Rim Diameter (Inches)
- R: Radial Construction
- 70: Normal Aspect Ratio (%)
- 215: Section Width in millimeter nominal

225 / 75 R 15 C

- C: Commercial Vehicle Tire
- 15: Rim Diameter (Inches)
- R: Radial Construction
- 75: Normal Aspect Ratio (%)
- 225: Section Width in millimeter nominal

245 / 70 R 16

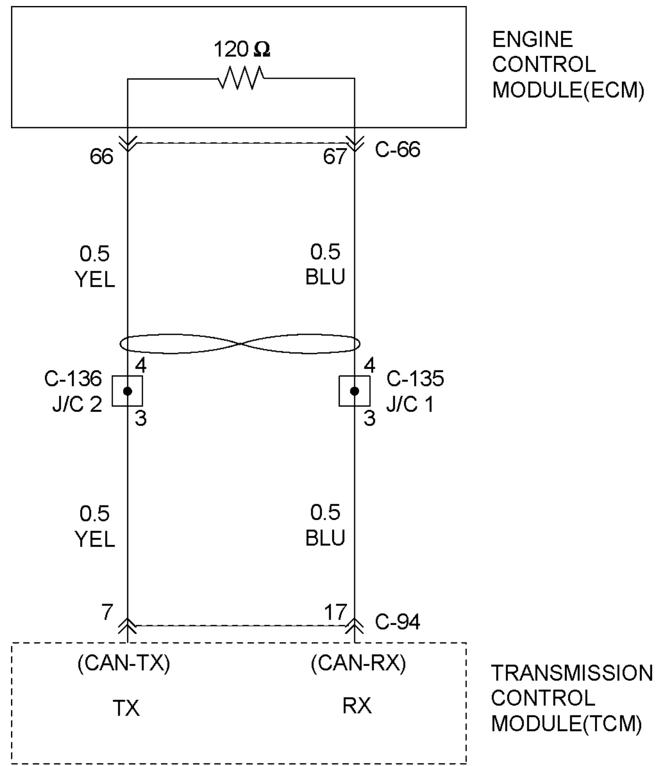
- 16: Rim Diameter (Inches)
- R: Radial Construction
- 70: Normal Aspect Ratio (%)
- 245: Section Width in millimeter nominal

Circuit/System Testing DTCU2104

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install a scan tool. 2. Turn "ON" the ignition. Does a scan tool indicate DTC U2104?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Observe the data from the ECM on the scan tool. Was the data from the ECM fixed or did not synchronized? (throttle opening, engine speed, etc)	—	Go to step 4	Refer to *Diagnostic Aids*
4	Check the wire between the TCM connector and the ECM connector by 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the TCM connector. 3. Measure the resistance between terminal C94-7 and terminal C94-17. Is the resistance specified value?	About 60Ω	Go to *Step 7*	Go to *Step 5*
5	Check the resistance of the ECM. 1. Turn "OFF" the ignition. 2. Disconnect the ECM connector. 3. Measure the resistance between the ECM terminal 70 and the ECM terminal 71. Is the resistance specified value?	About 120Ω	Go to step 6	Go to step 8
6	Replace or Repair the wire between the TCM connector C94-7, 17 and the ECM connector E60-70, 71. Is the action complete?	—	Go to step 9	—
7	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to step 9	—
8	Replace the ECM. **Important:** The replacement ECM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to step 9	—

Step	Action	Value(s)	YES	NO
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

DTC U2105 (Flash Code 67)



RTW77AMF000801

Circuit Description

The automatic transmission control system in AW30-40LE uses high speed CAN bus system. The individual CAN bus systems are connected via two interfaces and can exchange information and data. This allows control modules that are connected to different CAN bus systems to communicate. Transmission control modules in the vehicle that require continuous, rapid communication are connected to the high speed CAN bus. The automatic transmission is continuously notified of the current engine load status. Since the automatic transmission control module has to react immediately to load status changes, rapid communication is required between the engine control module and the automatic transmission control module. The high speed CAN bus in the AW30-40LE is designed as a two-wire CAN bus (twisted pair). The wires are shielded and twisted. The transmission rate is 500K band.

Condition For Running The DTC

All of the following conditions are met.

(1) The following condition is met for 2 seconds or more continuously.

- The supply voltage is more than 10.2 volts and less than 15.5 volts.

(2) One of the following conditions is met once after ignition “ON”.

- Output revolution sensor is not detecting failure or not deciding failure.
  Output revolution is more than 550rpm.
- Input revolution sensor is not detecting failure or not deciding failure.
  Input revolution is more than 550rpm.
- DTC U2104 is not detecting failure or not deciding failure U2105.
  DTC U2105 is not detecting failure or not deciding or not deciding failure.
  Engine revolution signal is not detecting failure or not deciding failure.
  The engine revolution is more than 550rpm.

(3) All of the following conditions are met.
- Device Control is not operating.
- Disable Normal Communication is receiving enable.
- DTC Clear is not operating.

(4) DTC U2104 is not detecting failure or not deciding failure.

Condition For Setting The DTC

Detection standard is met for 2.5 second continuously.

Detection standard:

If one or more ID sent from Engine Control Module (ECM) is not completed receiving for 2 basic cycles since last receiving completion.

Action Taken When The DTC Sets

- Throttle judgment on torque reduction control, line pressure control at stationary status, line pressure reduction control at gear change and line pressure reduction control at garage. (Throttle opening 100%)
- Line pressure FULL output.
- Throttle judgment on gear change control (Throttle opening 0%).
- No line pressure reduction control at gear change.
- No torque reduction control.
- No squat control.
- No slope control (keep mode).
- No L-up control.
- Control Engine rpm at 7000rpm (No inertia calculation).
- Control actual torque at MAX.
- Control driver torque at MAX.
- Control engine coolant temperature at 80°C (176°F).
- No coast control.
- No 3rd Start mode control.
- No line pressure reduction control at garage.
- No output revolution sensor failure detection.
- No C-0 rev sensor failure detection.
- No selector position switch failure detection.
- No oil temperature sensor failure detection.
- No T/F Hi-Low SW failure detection (Execute T/F judgment using only T/F-SW).
- No speed mater signal failure detection.
- No throttle signal failure detection.
- No Engine torque signal failure detection.
- No engine coolant temperature signal failure detection.
- No Engine revolution signal failure detection.
- No shift solenoid functional failure detection.
- No L-up solenoid functional failure detection.
- Cancel engine rpm condition of prerequisite of supply voltage failure detection.
- Control vehicle speed of speed meter at 0km/h.
- No torque reduction at stall.
- No cruise control.
- No warm up control.
- Check Trans “ON”.
- DTC stored.
- MIL request “ON”. (EURO 4 only)

Conditions For Clearing The DTC

- The DTC can be cleared from the TCM history by using a scan tool.
- The DTC will be cleared from history when the vehicle has achieved 40 warm-up cycles without a failure reported.
- After more than 1 second has elapsed after the ignition key has been turned “ON”, short between No.11 and No.4 (ground) of DLC (Data Link Connector). Then, after 1 second, but within 6 seconds, discontinue shorting.

Diagnostic Aids

- Inspect the wiring for poor electrical connection at the TCM. Look for possible bent, backed out, deformed or damaged terminals. Check for weak terminal tension as well. Also check for a chafed wire that could short to bare metal or other wiring. Inspect for a broken wire inside the insulation.
- When diagnosing for a possible intermittent short or open condition, move the wiring harness while observing test equipment for a change.
- Inspect the wiring for EMI (Electro-Magnetic Interference). Check that all wires are properly routed away from coil, and generator. Also check for improperly installed electrical options. When this test is performed, turn “OFF” on electronic auto parts switches to improperly for a noise preventing.

Circuit/System Testing DTC U2105

Step	Action	Value(s)	YES	NO
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to *Step 2*	Go to *OBD System Check*
2	1. Install the scan tool. 2. Turn "ON" the ignition. Does the scan tool indicate DTC U2105?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Observe the data from the ECM on a scan tool. Was the data from the ECM fixed or did not synchronized? (throttle opening, engine speed, etc)	—	Go to *Step 4*	Refer to *Diagnostic Aids*
4	Check the wire between the TCM connector and the ECM connector by 5-8840-0285-0 DMM. 1. Turn "OFF" the ignition. 2. Disconnect the TCM connector. 3. Measure the resistance between terminal C94-7 and terminal C94-17. Is the resistance specified value?	About 60Ω	Go to *Step 5*	Go to *Step 7*
5	Check the resistance of the ECM. 1. Turn "OFF" the ignition. 2. Disconnect the ECM connector. 3. Measure the resistance between the ECM terminal E66-66 and the ECM terminal E66-67. Is the resistance specified value?	About 120Ω	Go to *Step 6*	Go to *Step 8*
6	Replace or Repair the wire between the TCM connector C94-7, 17 and the ECM connector E66-66, 67. Is the action complete?	—	Go to *Step 9*	—
7	Replace the TCM. **Important:** The replacement TCM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 9*	—
8	Replace the ECM. **Important:** The replacement ECM must be programmed (Refer to *SPS* for procedure). Is the action complete?	—	Go to *Step 9*	—

Step	Action	Value(s)	YES	NO
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn "OFF" the ignition. 4. Start the engine. 5. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/ Failure Records. Did the DTC fail this ignition?	—	Go to *Step 2*	Go to *Step 10*
10	Observe the stored information, Capture info with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to *Diagnostic Trouble Code (DTC) List*	Verify repair

SECTION 7A3

ON-VEHICLE SERVICE (AW30–40LE)

TABLE OF CONTENTS

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

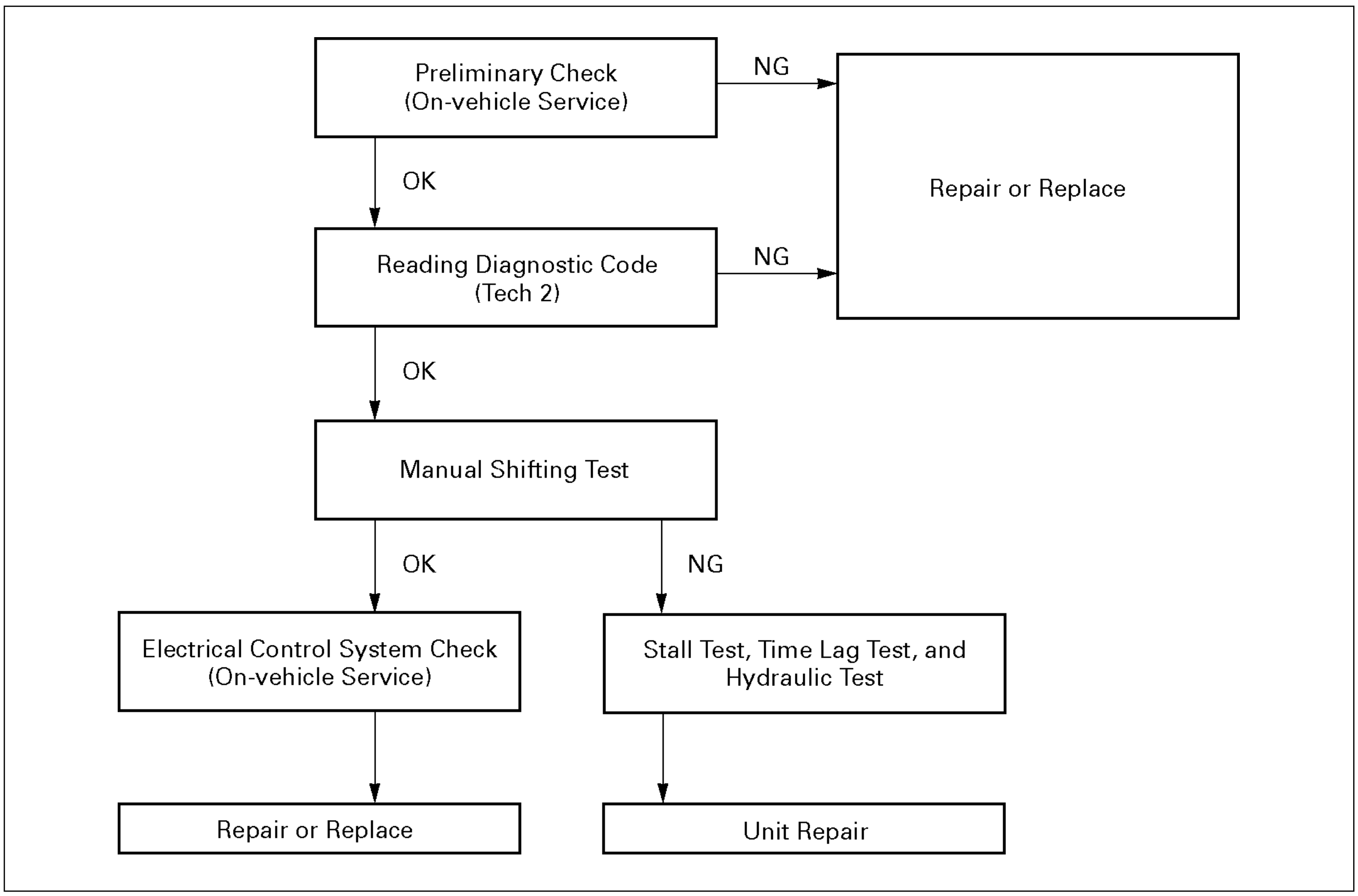
Diagnosis

Basic Troubleshooting

AW30–40LE transmission, with Transmission Control Module (TCM), differs from the Mechanical – Hydraulic control type transmissions. Accordingly, its troubleshooting procedure differs also.

Before troubleshooting an TCM, first determine whether the problem is electrical or mechanical. To do this, just refer to the basic troubleshooting flowchart provided below.

If the cause is already known, using the basic troubleshooting chart below along with the troubleshooting chart should speed the procedure.



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Troubleshooting Chart

Numbers are arranged in order of probability.

Perform inspections starting with number one and working up.

ON-VEHICLE TROUBLESHOOTING

A/T : Automatic Transmission

Inspection item		1 No vehicle movement: No forward movement	1 No vehicle movement: No reverse movement	2 Slippage: Slip to front	2 Slippage: Slip to rear	3 Long garage shift time lag: N→D	3 Long garage shift time lag: N→R	4 No engine start	5 Engine stop: N→D or N→R	5 Engine stop: Speed reduction	6 No shift: 1→2, 2→1	6 No shift: 2→3, 3→2	6 No shift: 3→4, 4→3	6 No shift: Lock-up does not operate	6 No shift: Poor engine braking in 2nd gear	6 No shift: Poor engine braking in 1st gear	6 No shift: No kick-down
A/T	A/T interior * Refer to unit troubleshooting	6	8	4	4	4	3		2	2	6	6	8	7	3	3	
	O-rings																
	Gaskets																
	Oil seals																
ATF	Water in fluid/Wrong fluid	2	2	2	2	2	2										
	Automatic transmission fluid level (Too much or too little)	1	1	1	1	1	1										
A/T (External)	Cooler pipe resonance																
	Cooler pipe installation																
	Cooler pipes (Bending and/or clogging)	4	6														
	Breather (Bending)																
	Select lever linkage (Operation and adjustment)	3	3					1							1	1	
Electrical system	TCM internal circuits										5	5	7	6			5
	Engine control unit			3	3						1	1	3	1			1
	Wire harness connectors																
	Brake switch circuit													5			
	4L switch circuit												1				
	Pattern select switch circuit																
	Oil temperature sensor circuit					3											
	Neutral start switch circuit (Operation and adjustment)							2			2	2	5	2	2	2	
	CO sensor circuit (Input speed sensor)												2				
	SP2 sensor circuit (Output speed sensor)		5								3	3	4	3			2
	Lock-up solenoid circuit													4			
	Shift solenoid S2 circuit		4								4		6				3
	Shift solenoid S1 circuit											4					4
	Pressure control solenoid STH circuit																
Chassis	Suspension looseness																
	Drive train and body interference																
ENG	Exhaust system resonance																
	Engine and automatic transmission mounting																
	Drive plate	5	7														
	Engine tuning								1	1							

TIRE PRESSURE LABEL (LOCATION: DRIVERS DOOR OR FRAME OF DRIVERS DOOR)

4×2 Except High Ride Suspension
SEE OWNERS AND
DRIVERS MANUAL FOR
ADDITIONAL INFORMATION

Tire Size	Wheel Size	Tire inflation pressure KPa (kgf/cm^2/psi)	
Front & Rear	**Front & Rear**	**Front**	**Rear**
195R14C 8PR	14X5.5JJ	245 (2.5/36)	441 (4.5/64)
215/70R15C	15X6.5JJ	221 (2.25/32)	368 (3.75/53)

4×2 High Ride Suspension, 4×4
SEE OWNERS AND
DRIVERS MANUAL FOR
ADDITIONAL INFORMATION

Tire Size	Wheel Size	Tire inflation pressure KPa (kgf/cm^2/psi)	
Front & Rear	**Front & Rear**	**Front**	**Rear**
225/75R15C	15X6.5JJ	221 (2.25/32)	319 (3.25/46)
245/70R16	16X7JJ	200 (2.0/28)	270 (2.8/40)

Note:

- **The air pressure of the tire should be maintained as indicated in the label instruction on the driver's door or frame of driver's door.**
  Lower pressure can cause burst and adverse vehicle handling.
  On the other hand, higher pressure can cause shock-burst and reduce gripping effect.

ON-VEHICLE TROUBLESHOOTING

A/T : Automatic Transmission

No	Symptom	Inspection item	ENG				Chassis		Electrical system														A/T (External)					ATF		A/T			
			Engine tuning	Drive plate	Engine and automatic transmission mounting	Exhaust system resonance	Drive train and body interference	Suspension looseness	Pressure control solenoid STH circuit	Shift solenoid S1 circuit	Shift solenoid S2 circuit	Lock-up solenoid circuit	SP2 sensor circuit (Output speed sensor)	CO sensor circuit (Input speed sensor)	Neutral start switch circuit (Operation and adjustment)	Oil temperature sensor circuit	Pattern select switch circuit	4L switch circuit	Brake switch circuit	Wire harness connectors	Engine control unit	TCM internal circuits	Select lever linkage (Operation and adjustment)	Breather (Bending)	Cooler pipes (Bending and/or clogging)	Cooler pipe installation	Cooler pipe resonance	Automatic transmission fluid level (Too much or too little)	Water in fluid/Wrong fluid	Oil seals	Gaskets	O-rings	A/T interior * Refer to unit troubleshooting
7	Shift point failure	Shift point too high											5	4	3	6	2				1	7											
		Shift point too low											5	4	3		2				1	6											
8	Shift lever too stiff or too loose																						1										2
9	Poor fuel economy											3				5	4	2											1				6
10	Pattern select switch not working															2	1					3											
11	Oil leakage	Breather																						3	4			1	2				5
		Engine and transmission housing mating surfaces		1																										2		3	4
		Transmission case and engine housing mating surfaces																													1		
		Oil pan																													1		2
		Manual shift oil seal																												1			
		O-rings (Union elbow and transmission wires																														1	
		Cooler pipe installation																							3	1	2						
12	Jolt when gears are changed	N→D			3											6					5	7	4					1	2				8
		N→R			3																5	6	4					1	2				7
		1→2	7		3								5								4	6						1	2				8
		2→3	7		3								5								4	6						1	2				8
		3→4	7		3								5								4	6						1	2				8
		Coast-down (Including vehicle stop)			2		3	4					6								5	7							1				8
		Kick-down			2			3					5								4	6							1				7
		Lock-up (ON/OFF)			2																3	4							1				5
		Accelerator ON/OFF (No gear change)	5		1							3									2	4											

ON-VEHICLE TROUBLESHOOTING

A/T : Automatic Transmission

No	Symptom	Inspection item	ENG				Chassis		Electrical system														A/T (External)					ATF		A/T			
			Engine tuning	Drive plate	Engine and automatic transmission mounting	Exhaust system resonance	Drive train and body interference	Suspension looseness	Pressure control solenoid STH circuit	Shift solenoid S1 circuit	Shift solenoid S2 circuit	Lock-up solenoid circuit	SP2 sensor circuit (Output speed sensor)	CO sensor circuit (Input speed sensor)	Neutral start switch circuit (Operation and adjustment)	Oil temperature sensor circuit	Pattern select switch circuit	4L switch circuit	Brake switch circuit	Wire harness connectors	Engine control unit	TCM internal circuits	Select lever linkage (Operation and adjustment)	Breather (Bending)	Cooler pipes (Bending and/or clogging)	Cooler pipe installation	Cooler pipe resonance	Automatic transmission fluid level (Too much or too little)	Water in fluid/Wrong fluid	Oil seals	Gaskets	O-rings	A/T interior * Refer to unit troubleshooting
13	Excessive vibration	Running	3	7	6	4	5																					1	2				8
14	Abnormal noise	Idling	3																								2	1					4
		Garage shift			1																												
		Running	2		1	1	1																				1						3
		Gear change	2		1	1	1																										3
		Accelerator ON/OFF (No gear change)	2		1	1	1																										
15	DTC	31(P0753)								1										1		2											
		32(P0758)									1									1		2											
		33(P0743)										1								1		2											
		35(P0748)							1											1		2											
		11(P0722)											1							1		2											
		25(P0560)																		1		2											
		14(P0717)												1						1													
		15(P0712)														1				1													
		16(P0713)														1				1													
		17(P0705)													1					1													
		61(P1790)																				1											
		62(P1791)																				1											
		65(U2104)																		1	1												
		67(P1767)																		1	1												

UNIT TROUBLESHOOTING

	Symptom	Inspection item	T/C: Internal problem	T/C: External problem	Oil pump	Oil strainer	Transmission case	Shift solenoid S1 (Stick)	Shift solenoid S2 (Stick)	Lock-up solenoid (Stick)	Valve body (Internal)	Accumulator (C0, C2, B0, and B2)	Clutch: Overdrive direct clutch (C0)	Clutch: Forward clutch (C1)	Clutch: Direct clutch (C2)	Brake: Overdrive brake (B0)	Brake: 2nd coast brake (B1)	Brake: 2nd brake (B2)	Brake: 1st and reverse brake (B3)	One-way clutch: Overdrive one-way clutch (F0)	One-way clutch: One-way clutch No. 1 (F1)	One-way clutch: One-way clutch No. 2 (F2)	Overdrive front and rear planetary gears	Bearing races	Detent spring
1	No vehicle movement	No forward movement	6		2	1					7			3								4	5		
		No reverse movement	5		2	1					6				3				4						
2	Slippage	Slip to front	6		2	1					7			3								4	5		
		Slip to rear	5		2	1					6				3				4						
3	Long garage shift time lag	N→D			1						4			2								3			
		N→R			1						4				2				3						
4	Engine stop	N→D or N→R	2							1	3														
		Speed reduction								1	2														
5	No shift	1→2							1		4							2			3				
		2→3						1			3				2										
		3→4							1		3					2									
		4→3							1		4		2			3				2					
		3→2						1			4				2						3				
		2→1							1		5							2			3	4			
		Lock-up does not operate	2							1	3														
		Poor engine braking in 2nd gear									2						1								
		Poor engine braking in 1st gear									2						1								
6	Shift lever too stiff or too loose																								1
7	Poor fuel economy		2							1	3														
8	Oil leakage	Breather									1														
		Engine and transmission housing mating surfaces		1	2																				
		Oil pan					1																		

UNIT TROUBLESHOOTING

Symptom \ Inspection item			T/C										Clutch			Brake				One-way clutch					
			Internal problem	External problem	Oil pump	Oil strainer	Transmission case	Shift solenoid S1 (Stick)	Shift solenoid S2 (Stick)	Lock-up solenoid (Stick)	Valve body (Internal)	Accumulator (C0, C2, B0, and B2)	Overdrive direct clutch (C0)	Forward clutch (C1)	Direct clutch (C2)	Overdrive brake (B0)	2nd coast brake (B1)	2nd brake (B2)	1st and reverse brake (B3)	Overdrive one-way clutch (F0)	One-way clutch No. 1 (F1)	One-way clutch No. 2 (F2)	Overdrive front and rear planetary gears	Bearing races	Detent spring
9	Jolt when gears are changed	N→D									2			1											
		N→R									3	1			2										
		1→2									3	1						2							
		2→3									3	1			2										
		3→4									3	1				2									
		Coast-down									2	1													
		Kick-down									2	1													
		Lock-up								1	2														
10	Excessive vibration	Running	2			1					3														
11	Abnormal noise	Idling	4		2	1																		3	
		Garage shift												2	1										
		Running	5		2	1					6												3	4	
		Gear change											1	5	3	2	4	6	7						

Manual Shifting Test

NOTE: With this test, it can be determined whether the trouble lies within the electrical circuit or is a mechanical problem in the transmission.

1. Disconnect TCM connector
2. Inspect manual driving operation

   Check that the relation of the position between select lever and gear corresponds to the following table.

   If any abnormality is found in the above test, do perform the stall, time lag or gear shift tests.

Select Lever Position	"D"	"3"	"2"
Gear	OD	OD	3rd

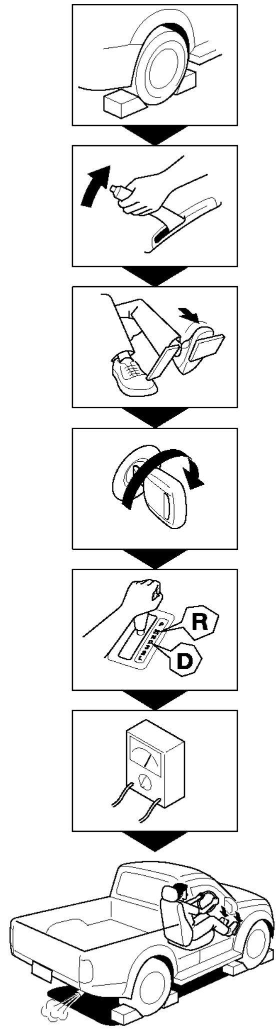
"L"	"R"	"P"
3rd	Reverse	Pawl Lock

RTW77ASH002901

3. Connect TCM connector

   With the engine off, connect the TCM connector.

Stall Test



RTW67ALH000101

The object of this test is to check the overall performance of the transmission and engine by measuring the maximum engine speeds at the "D" and "R" positions.

NOTE:

1. Perform the test at normal operating fluid temperature (50 – 80°C or 122 – 176°F).
2. Do not continuously run this test longer than 5 seconds.

Measure Stall Speed

1. Chock the four wheels.
2. Mount an engine tachometer.
3. Fully apply the parking brake.
4. Step down strongly on the brake pedal with your left foot. (Keep the state until the test is completed)
5. Start the engine.
6. Turn off the A/C.
7. Select into the “D" position. Step all the way down on the accelerator pedal with your right foot. Quickly record the highest speed as soon as the engine speed gets stabilized.
8. Select into the “N” position and maintain the engine idling condition more than 1 minute.

Stall speed: 2300±200 rpm *

* Ambient temperature to be between roughly 10°C (50°F) and 40°C (104°F).

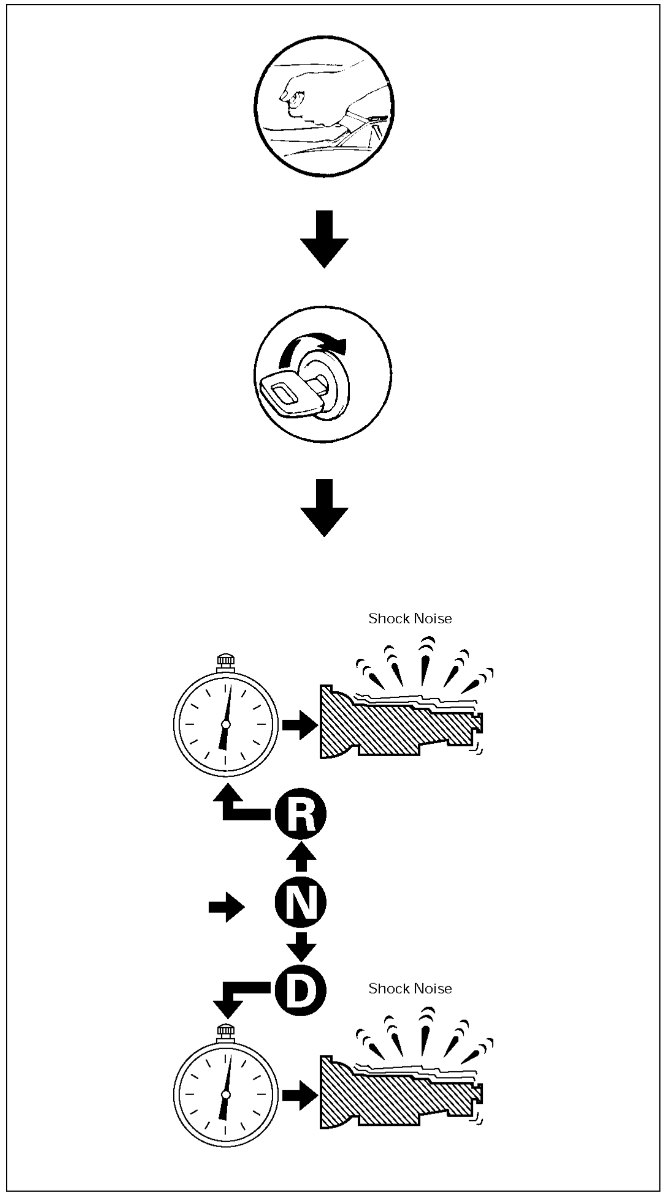
Evaluation

1. If the engine speed is the same for both positions but lower than the specified value:
   - Engine output is insufficient.
   - Stator one-way clutch is not operating properly.

NOTE: If more than 600 rpm below the specified value, the torque converter could be faulty.

2. If the stall speed in “D" position is higher than specified:
   - Line pressure too low
   - Forward clutch slipping
   - No.2 one-way clutch not operating properly
3. If the stall speed in “R" position is higher than specified:
   - Line pressure too low
   - Direct clutch slipping
   - No.3 brake slipping
4. If the stall speed in the “R" and “D" positions are higher than specified:
   - Line pressure too low
   - Improper fluid level

Time Lag Test



F07RY00003

If the shift lever is shifted while the engine is idling, there will be a certain time elapse or lag before the shock can be felt. This is used for checking the condition of the forward clutch, direct clutch, No.3 brake, and No.2 one-way clutch.

NOTE:

1. Perform the test at normal operating fluid temperature (50 – 80°C or 122 – 176°F)
2. Be sure to allow one minute interval between tests.
3. Make three measurements and take the average value.

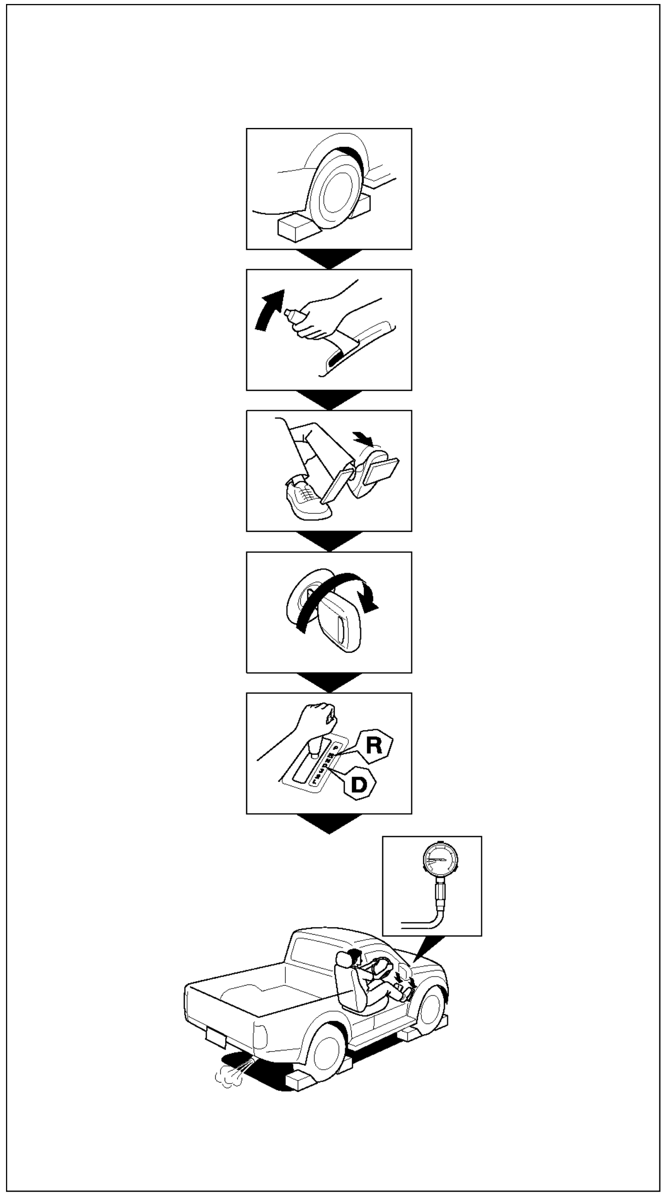
Measure Time Lag

1. Fully apply the parking brake.
2. Start the engine.
   Check idling speed (A/C OFF).
3. Operate the select lever from “N" to “D" position. Using a stopwatch, measure the time it takes from shifting the lever until the shock is felt.
   Time lag: Less than 0.7 seconds
4. In same manner, measure the time lag for “N" → “R".
   Time lag: Less than 1.2 seconds

Evaluation

1. If “N" → “D" time lag is longer than specified:
   - Line pressure too low
   - Forward clutch malfunction
   - No.2 one-way clutch not operating properly
2. If “N" → “R" time lag is longer than specified:
   - Line pressure too low
   - Direct clutch malfunction
   - First and Reverse brake malfunction
3. If both time lag is longer than specified:
   - Line pressure too low

Hydraulic Test



RTW67ALH000201

Preparation

1. Warm up the transmission fluid.
2. Remove the transmission case test plug and mount the hydraulic pressure gauge.

Oil pressure gauge: 5-8840-0093-0

NOTE: Perform the test at normal operating fluid temperature (50 – 80°C or 122 – 176°F).

Measure Line Pressure

1. Fully apply the parking brake and chock the four wheels.
2. Start the engine and check idling rpm.
3. Select into “D" position, step down strongly on the brake pedal with your left foot and while manipulating the accelerator pedal with the right foot, measure the line pressures at the engine speeds specified in the table.
4. In the same manner, perform the test in “R" position.

Engine speed	Line pressure kPa (kg/cm^2/psi)	
	“D" position	“R" position
Idling	349 – 408 (3.6 – 4.2 /51 – 59)	577 – 675 (5.9 – 6.9/84 – 98)
Stall	1,206 – 1,353 (12.3–13.8/175–196)	1,646 – 1,979 (16.8–20.2/239–287)

Evaluation

1. If the measured values at all positions are higher than specified:
   - Pressure control solenoid defective
   - Primary regulator valve defective
2. If the measured values at all positions are lower than specified:
   - Primary regulator valve defective
   - Oil pump defective
   - Pressure control solenoid defective
3. If pressure is low in “D" position only:
   - “D" position circuit fluid leakage
4. If pressure is low in “R" position only:
   - “R" position circuit fluid leakage

Road Test

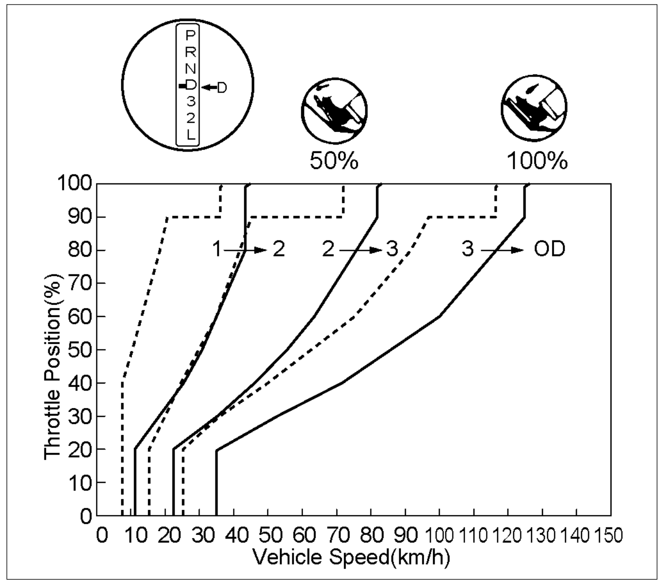
NOTE: Perform the test at normal operating fluid temperature (50 – 80°C or 122 – 176°F).

“D" Position Test in “NORMAL", and “POWER" Pattern

Select into the “D" position and hold the accelerator pedal constant at the 50% and 100% throttle valve opening positions.

Push in one of the pattern selector buttons and check the following:

1. 1–2, 2–3, 3–OD and lock-up, upshifts should take place, and shift points should conform to those shown in the automatic shift diagram.



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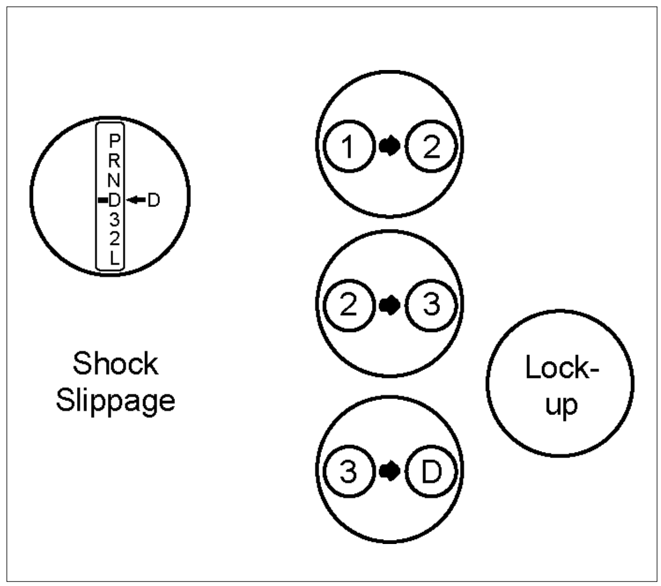

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Evaluation

i. If there is no 1→2 upshift:
- Solenoid S2 is stuck
- 1–2 shift valve is stuck

ii. If there is no 2→3 upshift:
- Solenoid S1 is stuck
- 2–3 shift valve is stuck

iii. If there is no 3→OD upshift (throttle valve opening 1/2):
- Solenoid S2 is stuck
- 3–OD shift valve is stuck

iv. If the shift point is defective:
Refer to TROUBLESHOOTING CHART in this section.

v. If the lock-up is defective:
Refer to TROUBLESHOOTING CHART in this section.

2. In the same manner, check the shock and slip at the 1→2, 2→3 and 3→OD upshifts.

NOTE: Drive the vehicle on level ground.

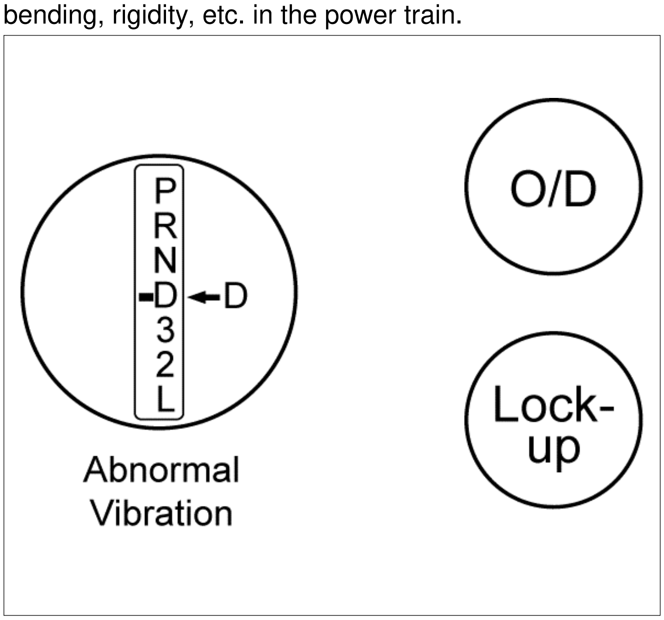
Evaluation

If the shock is excessive:

Refer to TROUBLESHOOTING CHART in this section.

3. Run at “D" position lock-up or OD gear and check for abnormal noise and vibration.

NOTE: The check for the cause of abnormal noise and vibration must be made with extreme care as it could also be due to loss of balance in the propeller shaft, differential, the torque converter, etc. or insufficient bending, rigidity, etc. in the power train.



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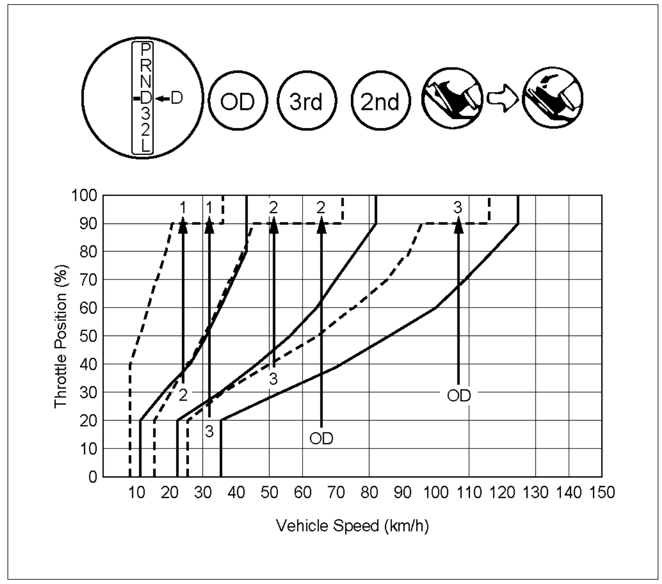
4. While running in “D" position, 2nd, 3rd gears and OD, check to see that the possible kick-down vehicle speed limits for 2→1, 3→1, 3→2, OD→3 and OD→2 kick-downs conform to those indicated on the automatic shift diagram.



RTW77ASH003101

5. Check for abnormal shock and slip at kick-down.
6. While running in “D" position, OD gear or “lock-up", shift to “2" and “L" positions and check the engine braking effect at each of these positions.

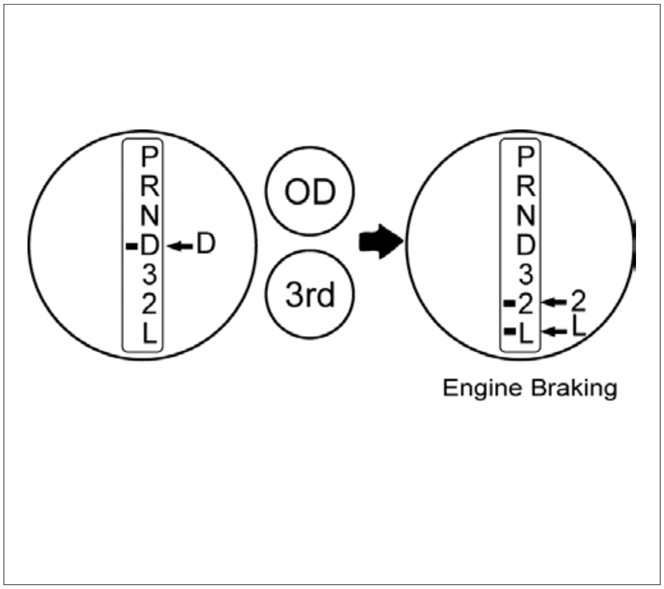
Evaluation

i. If there is no engine braking effect in the “2" position:

- Second coast (No.1) brake is defective.

ii. If there is no engine braking effect in the “L" position:

- First and reverse (No.3) brake is defective.



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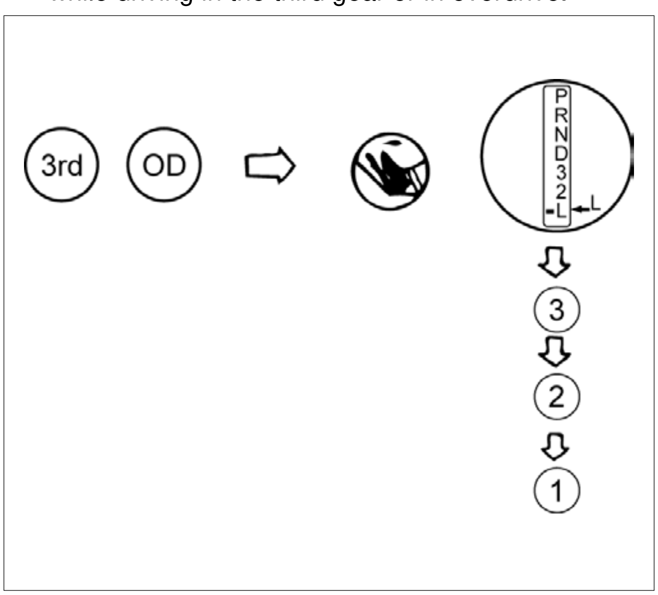
iii. Also check to see that downshift is made from 3 to 2 or from OD to 3 and then to 2 immediately and that 2→1 downshift point is within the limits shown in the diagram when tested by releasing the accelerator pedal and operaing into “L" position while driving in the third gear or in overdrive.



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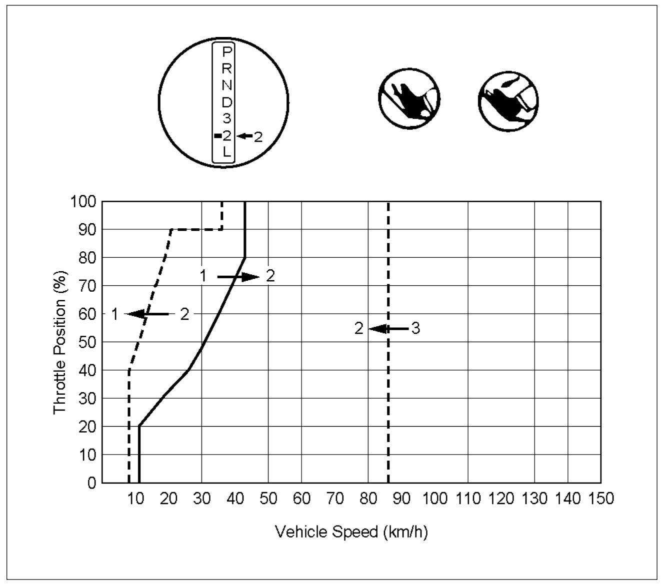
“2" Position Test

Select into “2" position and, while driving with the accelerator pedal held constantly at the specified point (throttle valve opening 50% and 100%), push in one of the pattern selectors and check on the following points.

1. At each of the above throttle openings, check to see that the 1→2 upshift takes place and that the shift points conform to those shown on the automatic shift diagram.

NOTE: There is no OD and no lock-up in the “2" position.



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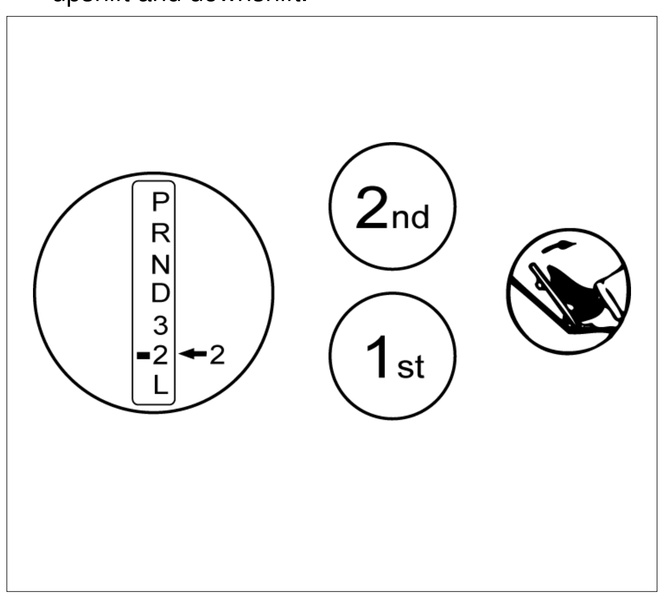
2. While running in the “2" position and 2nd gear, release the accelerator pedal and check the engine's braking effect.
3. Check for 2→1 downshift and abnormal noise at acceleration and deceleration, and for shock at upshift and downshift.



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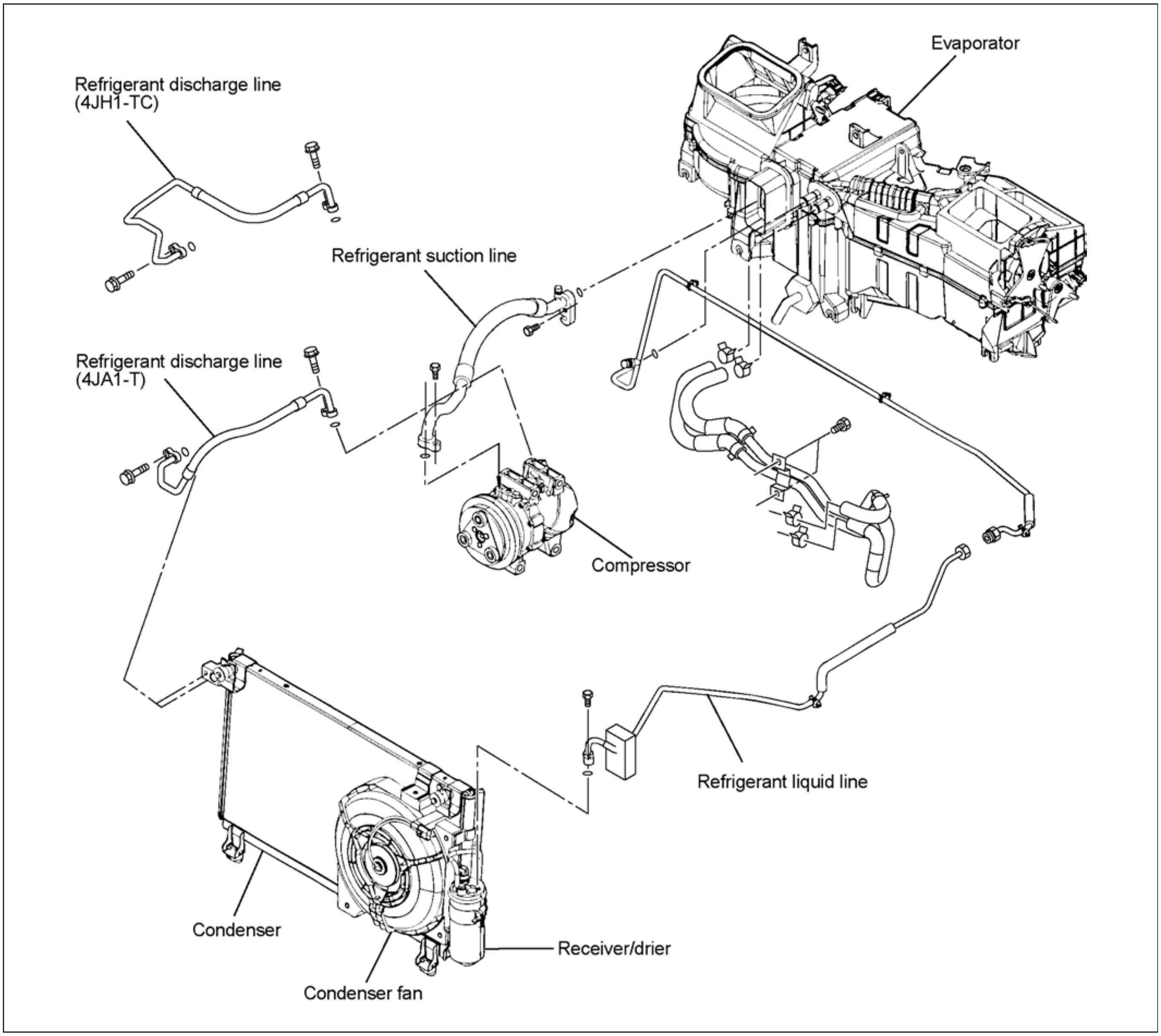
(4JA1-T, 4JH1-TC LHD MODEL)



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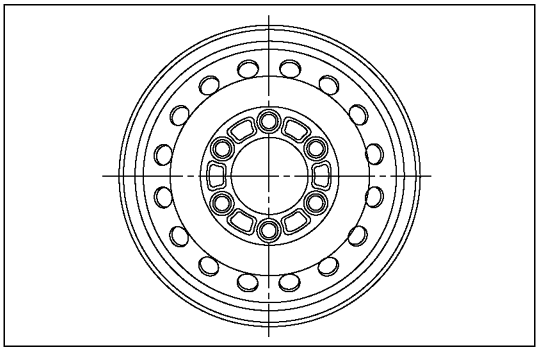
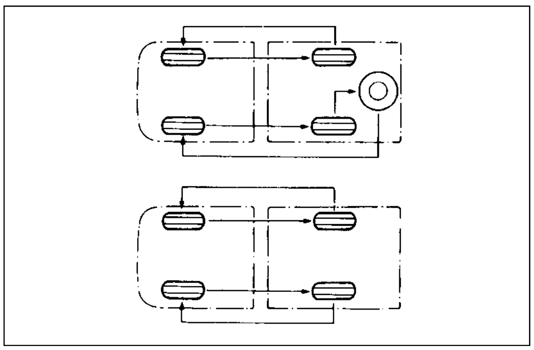
SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.



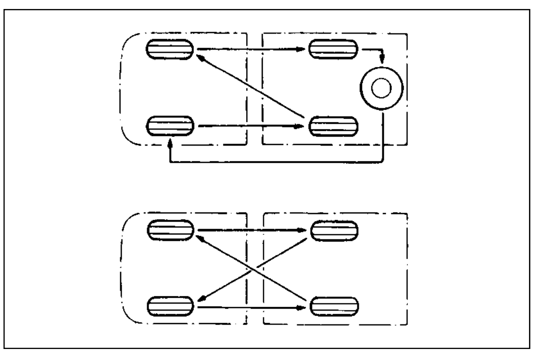
WHEEL NUT TORQUES

Wheel Nut Torque	N·m (kgf·m/lb·ft)
117.7 ± 9.8 (12 ± 1.0 / 86.8 ± 7.2)	



TIRE ROTATION

For of radial tires, interchange the front and the rear wheels on the same side as shown in the figure.

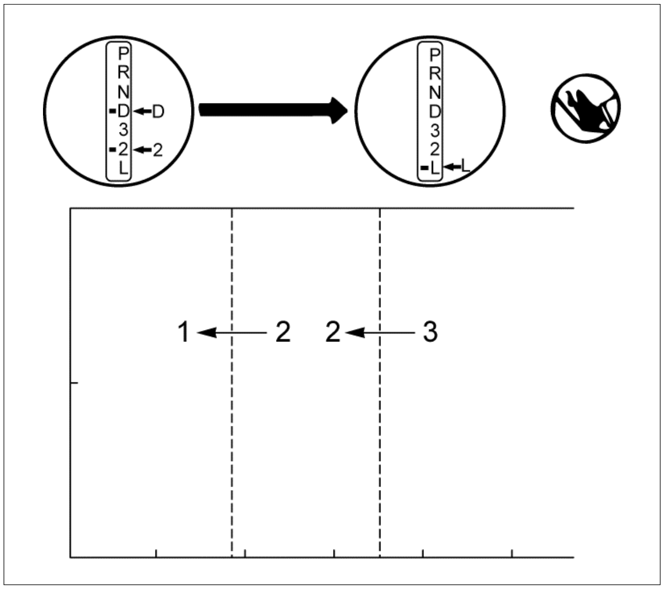


If one-sided tire wear appears on radial tires, rotate the wheels as shown in the figure.

Note:
After rotation, adjust the front and rear tire pressure and be sure to check wheel nut tightness.

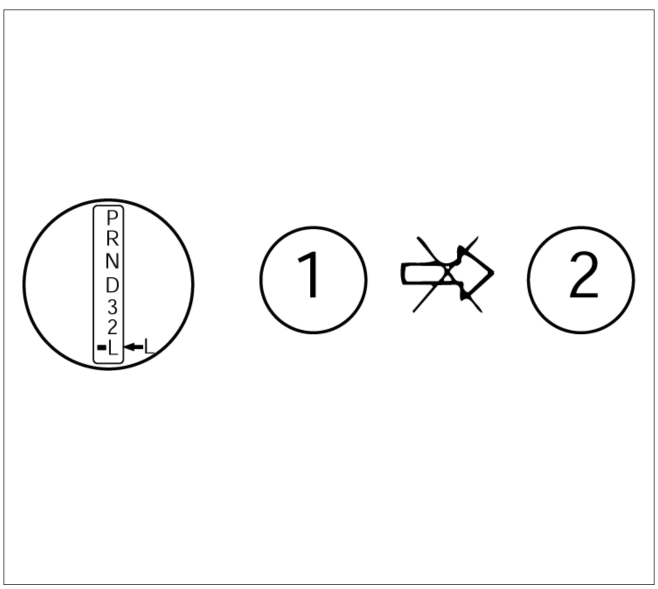
“L" Position Test

1. While running above 80 km/h (50 mph) in the “D" position, release your foot from the accelerator pedal and shift into the “L" position.
   Then check to see that the 2→1 downshift occurs at the specified point shown on the automatic shift diagram.



RUW37ASH000601

2. While running in the “L" position, check to see that there is no upshift to 2nd gear.
3. While running in the “L" position, release the accelerator pedal and check the engine braking effect.
4. Check for abnormal noise during acceleration and deceleration.



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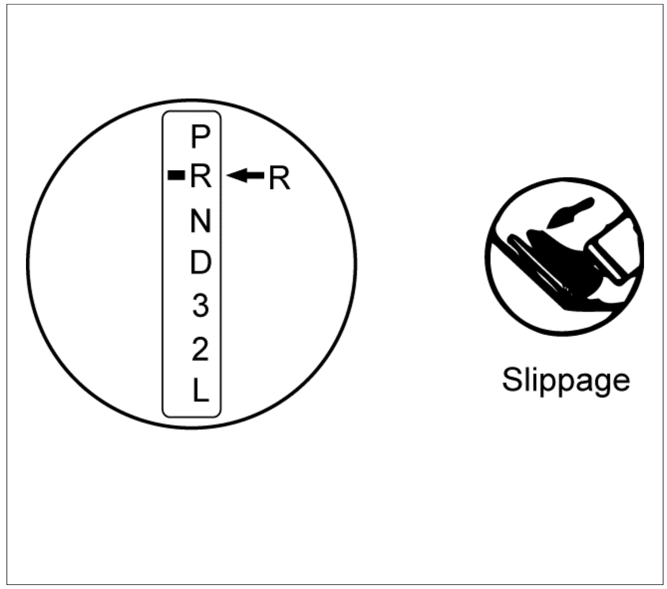
“R" Position Test

Select into the “R" position and, while starting at full throttle, check for slipping.



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“P" Position Test

Stop the vehicle on a grade (more than 9%) and after shifting into the “P" position, release the parking brake.

Then check to see that the parking lock pawl holds the vehicle in place.

Shift Point Chart and Lock-Up Point Chart

Shift Point Chart

(H2, H4)

(REAR AXLE RATIO: 4.100 / 3.909)

(RADIUS OF TIRE: 0.368 / 0.349m)

“NORMAL" mode

Upshift km/h (mph)

Position	Throttle Opening	1→2	2→3	3→4
D	Fully opened	40 - 46 (25 - 29)	79 - 85 (49 - 53)	122 - 128 (76 - 80)
	Half throttle	28 - 34 (17 - 21)	53 - 59 (33 - 37)	83 - 89 (52 - 55)
3	Fully opened	40 - 46 (25 - 29)	79 - 85 (49 - 53)	—
	Half throttle	28 - 34 (17 - 21)	53 - 59 (33 - 37)	—
2	Fully opened	40 - 46 (25 - 29)	—	—
	Half throttle	28 - 34 (17 - 21)	—	—

Downshift km/h (mph)

Position	Throttle Opening	1←2	2←3	3←4
D	Fully opened	33 - 39 (21 - 24)	69 - 75 (43 - 47)	113 - 119 (70 - 74)
	Half throttle	8 - 14 (5 - 9)	27 - 33 (17 - 21)	61 - 67 (38 - 42)
	Fully closed	5 - 11 (3 - 7)	12 - 18 (8 - 11)	22 - 28 (14 - 17)
3	Fully opened	33 - 39 (21 - 24)	69 - 75 (43 - 47)	—
	Half throttle	8 - 14 (5 - 9)	27 - 33 (17 - 21)	—
	Fully closed	5 - 11 (3 - 7)	12 - 18 (8 - 11)	—
2	Fully opened	33 - 39 (21 - 24)	83 - 89 (52 - 55)	—
	Half throttle	8 - 14 (5 - 9)	83 - 89 (52 - 55)	—
	Fully closed	5 - 11 (3 - 7)	83 - 89 (52 - 55)	—
L	Fully opened	42 - 48 (26 - 30)	—	—

“POWER" mode

Upshift km/h (mph)

Position	Throttle Opening	1→2	2→3	3→4
D	Fully opened	40 - 46 (25 - 29)	79 - 85 (49 - 53)	122 - 128 (76 - 80)
	Half throttle	28 - 34 (17 - 21)	63 - 69 (39 - 43)	100 - 106 (62 - 66)
3	Fully opened	40 - 46 (25 - 29)	79 - 85 (49 - 53)	—
	Half throttle	28 - 34 (17 - 21)	63 - 69 (39 - 43)	—
2	Fully opened	40 - 46 (25 - 29)	—	—
	Half throttle	28 - 34 (17 - 21)	—	—

Downshift km/h (mph)

Position	Throttle Opening	1←2	2←3	3←4
D	Fully opened	33 - 39 (21 - 24)	70 - 76 (43 - 47)	115 - 121 (71 - 75)
	Half throttle	11 - 17 (7 - 11)	36 - 42 (22 - 26)	66 - 72 (41 - 45)
	Fully closed	5 - 11 (3 - 7)	12 - 18 (8 - 11)	22 - 28 (14 - 17)
3	Fully opened	33 - 39 (21 - 24)	70 - 76 (43 - 47)	—
	Half throttle	11 - 17 (7 - 11)	36 - 42 (22 - 26)	—
	Fully closed	5 - 11 (3 - 7)	12 - 18 (8 - 11)	—
2	Fully opened	33 - 39 (21 - 24)	83 - 89 (52 - 55)	—
	Half throttle	11 - 17 (7 - 11)	83 - 89 (52 - 55)	—
	Fully closed	5 - 11 (3 - 7)	83 - 89 (52 - 55)	—
L	Fully opened	42 - 48 (26 - 30)	—	—

“3rd START" mode

km/h (mph)

D position, 3rd START mode ON→OFF	32 – 38 (20 – 24)

Lock-Up Point Chart

(H2, H4)

(REAR AXLE RATIO: 4.100 / 3.909)

(RADIUS OF TIRE: 0.368 / 0.349m)

km/h (mph)

Position	A/T Mode	Throttle Opening: 20 %			
		Lock-up ON		Lock-up OFF	
		3rd	4th	3rd	4th
D	NORMAL	64 - 70 (40 - 43)	64 - 70 (40 - 43)	41 - 47 (25 - 29)	59 -65 (37 - 40)
	POWER	—	71 - 77 (44 - 48)	—	59 - 65 (37 - 40)

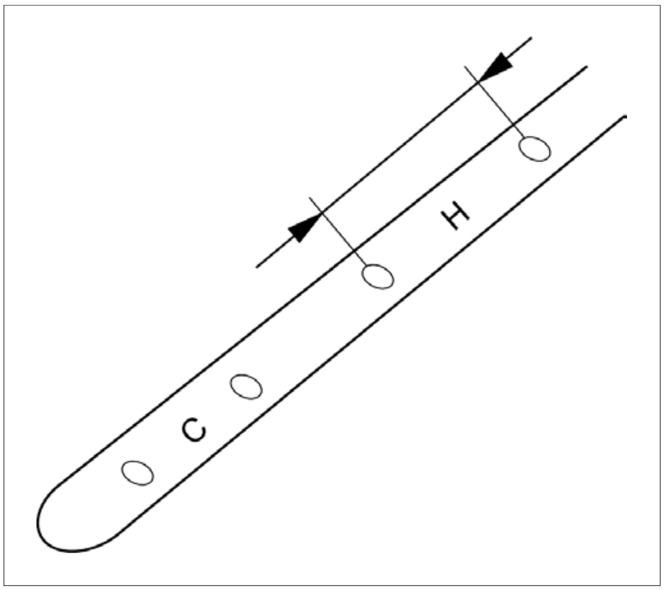
Transmission Fluid Level and Condition

Inspection

Park vehicle on level ground and set parking brake. With the engine idling, move the shift lever through all positions from “P" to “L", then return to position “P". Check to see if the level of fluid comes to “HOT" range of about 75°C (167°F) on the dipstick gauge.

If the level of fluid is too low, replenish to bring it to maximum level in “HOT" range.

Inspection of fluid condition. If the ATF is except normality (refer to the following table) or smells burnt, try to find these cause and replace it.



RUW37ASH002501

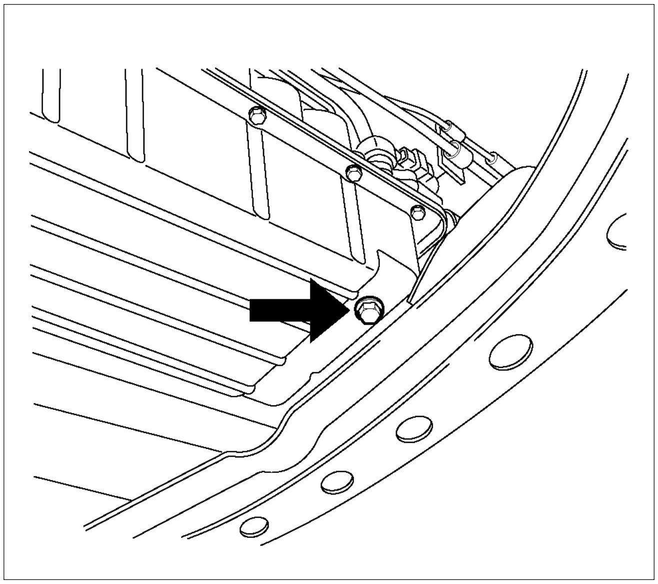
Color or ATF	Condiction
Clear red	Normality
Blackish discoloration	Defects of power train parts (clutches)
White turbidity	Include water
Discoloration of red brown	Deterioration of ATF

ATF Replacement

Inspection

NOTE: Do not overfill.

1. Remove the drain plug from oil pan and drain the fluid.



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2. Reinstall the drain plug securely.

Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

3. With the engine OFF, add new fluid through the filler tube.

Drain and refill	5.2 liter
Dry fill	8.7 liter
Fluid	Exxon Mobil ATF-3309

4. Start the engine and shift the selector into all position from “P" through “L", and then shift into “P".
5. With the engine idling, check the fluid level. Add fluid up to the “COLD" level on the dipstick.
6. The ATF level must be checked again for correct level with the “HOT" level.

NOTE: To prevent fluid leaks, the drain plug gasket must be replaced each time this plug is removed.

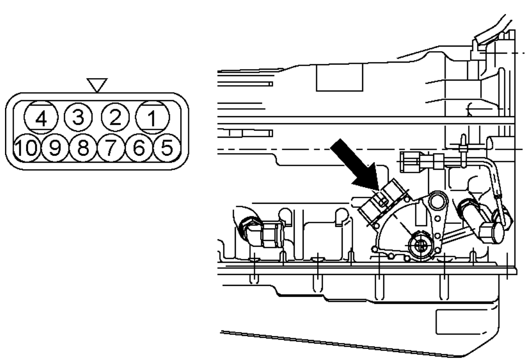
Neutral Start Switch (Mode Switch)

Inspection

With a circuit tester, make a continuity test on the neutral start switch with the moving piece set in each position.

Terminal / Position	1	4	3	5	2	6	8	7	9	10
P	○	○	○	○						
R			○		○					
N	○	○	○			○				
D			○				○			
3			○					○		
2			○						○	
L			○							○

○—○ Continuity



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Removal

Preparation:

Disconnect negative (–) battery cable.

1. Remove the rear side ATF cooler pipe from the transmission elbow.
2. Disconnect neutral start switch connector.
3. Unstake the lock washer, and then remove the shaft nut.
4. Remove the neutral start switch.

Installation

To install, follow the removal steps in the reverse order, noting the following points;

If a engine starts at any selector position except “N” or “P”, the neutral start switch (mode switch) should be adjusted.

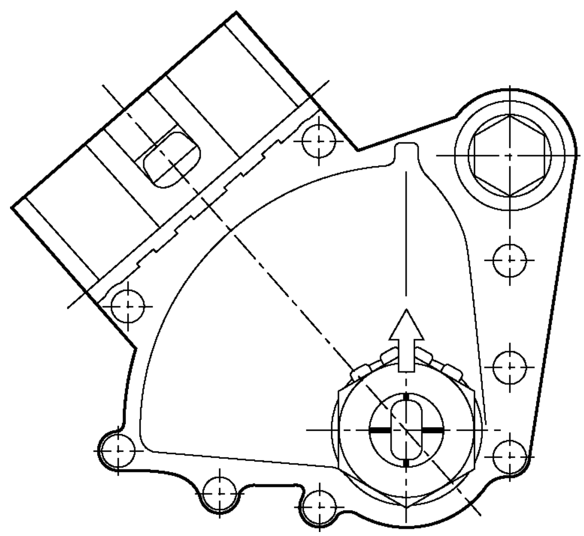
1. Loosen the neutral start switch bolt and set the shift selector to the “N" position.
2. Align the groove and neutral basic line.
3. Hold in position and tighten the bolt and nut.

Torque:

Nut – 7 N·m (0.7 kgf·m/61 lb·in)

Bolt – 13 N·m (1.3 kgf·m/113 lb·in)

4. Lock the nut with the lock washer tubs at two points.



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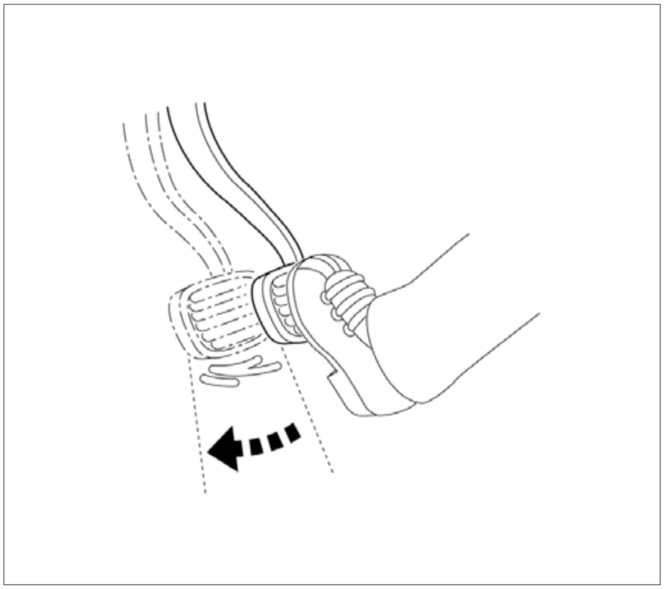
Brake Signal

Inspection

Check that the brake light comes on when the brake pedal is depressed.



310RW020

Input and Output Revolution Sensor

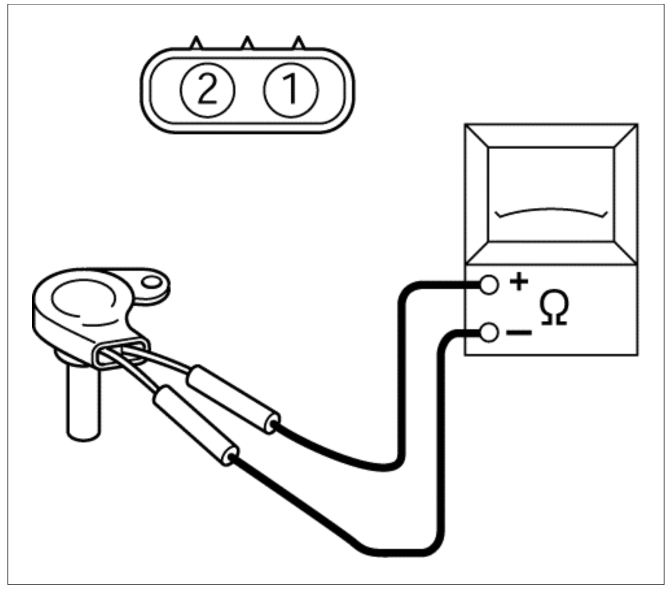
Inspection

1. Disconnect the input and output revolution sensor connector.
2. Use an ohmmeter to measure the resistance between terminals 1 and 2.

Standard resistance

Input revolution sensor: 560 – 680 Ω (at 20°C or 68°F)

Output revolution sensor: 560 – 680 Ω (at 20°C or 68°F)



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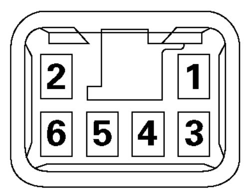
Power and 3rd Start Switch

Inspection

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Pry out the switch from the floor console.
4. Disconnect the harness connector.
5. Check continuity between terminals (5) and (6) at third (3rd) position.
6. Check continuity between terminals (3) and (6) at power (PWR) position.
7. Replace the power and 3rd start switch if the result of inspection is abnormal.
8. Connect the harness connector.
9. Connect the negative battery cable.
10. Remove the wheel blocks.



Switch Position	Terminal		
	3	6	5
PWR	○	○	
3rd		○	○

238R300003

Solenoid

Inspection

1. Resistance check

- Using an ohmmeter, check the resistance between each terminal (S1/S2/SL) and body.

Solenoid S1, S2 and lock-up solenoid SL resistance:

11 – 15 Ω (at 20°C or 68°F)

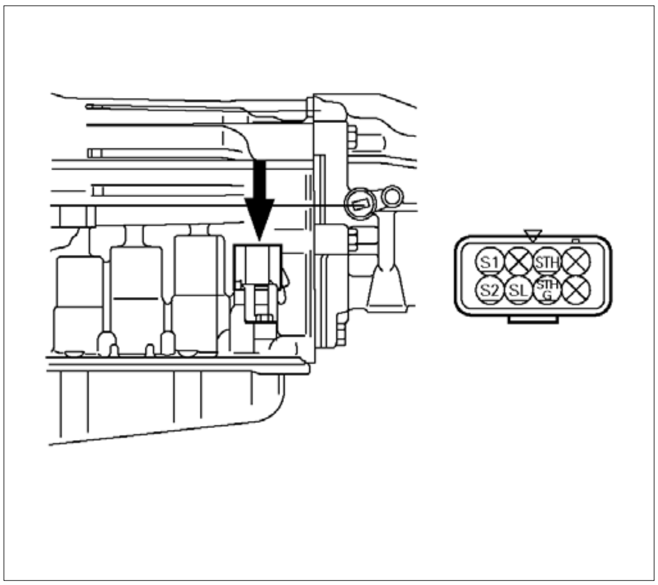
(Reference) 12 – 16 Ω (at 40°C or 104°F)

- Using an ohmmeter, check the resistance between each terminal (STH) and (STHG).

Pressure control solenoid resistance:

5 – 5.6Ω (at 20°C or 68°F)

(Reference) 5.4– 6.1Ω (at 40°C or 104°F)



220L100001

NOTE: If the pressure control solenoid resistance is not within specification, replace the valve body assembly.

2. Operation check

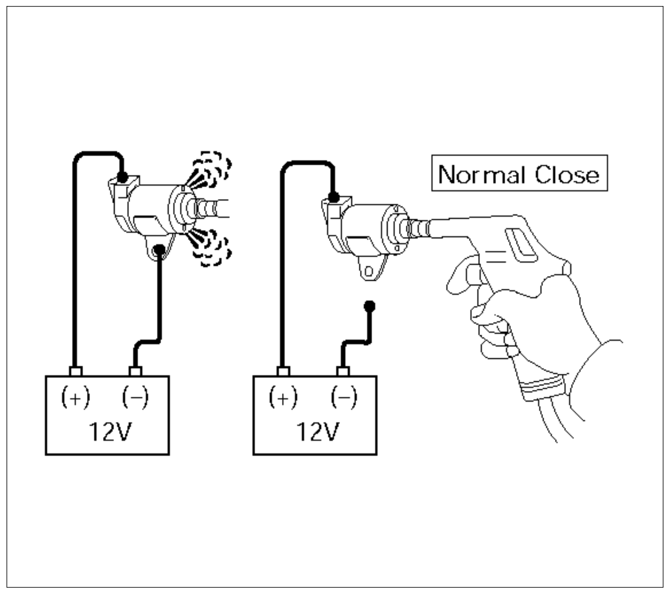
Check the solenoid operation by blowing into an oil hole as shown in the figure.

Solenoid S1 and S2 (Normal close type)

When battery terminal is disconnected	No air leaks
When battery terminal is connected	Air passes through

Lock-up solenoid SL (Normal open type)

When battery terminal is disconnected	Air passes through
When battery terminal is connected	No air leaks



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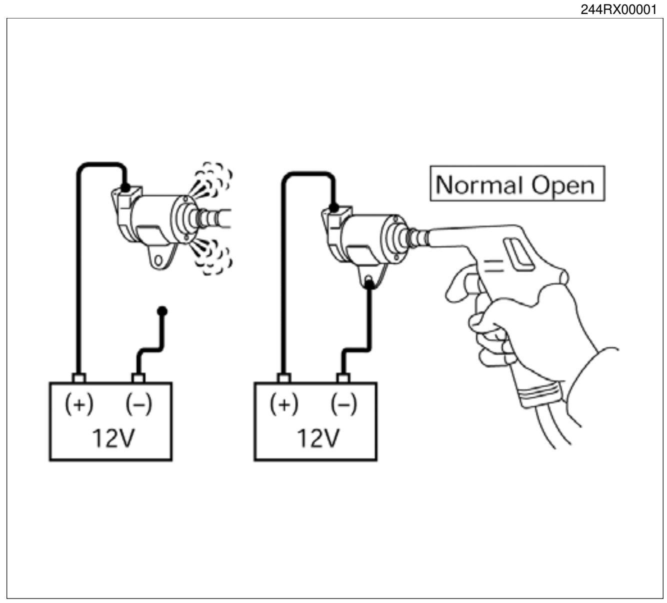
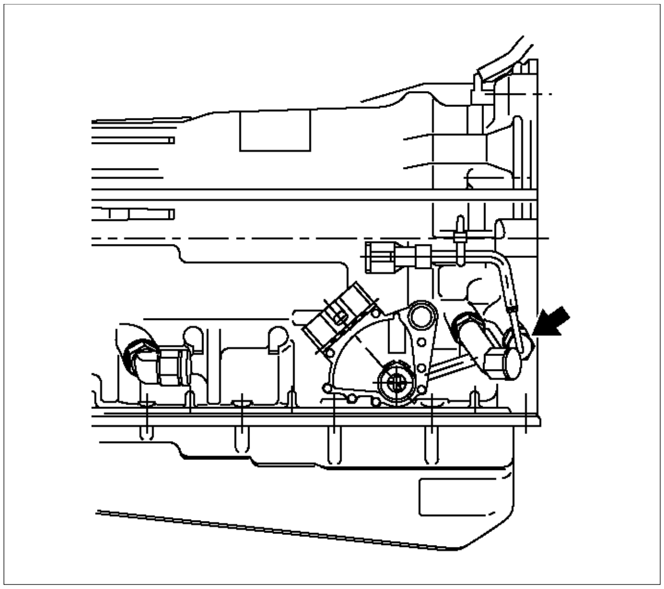


244RY00005

ATF Temperature Sensor

Inspection

1. Disconnect the front side ATF cooler pipe from the elbow and remove the elbow.
2. Remove the ATF temperature sensor from the transmission case.
3. Place the ATF temperature sensor in a container of ATF.



RTW77ASH003501

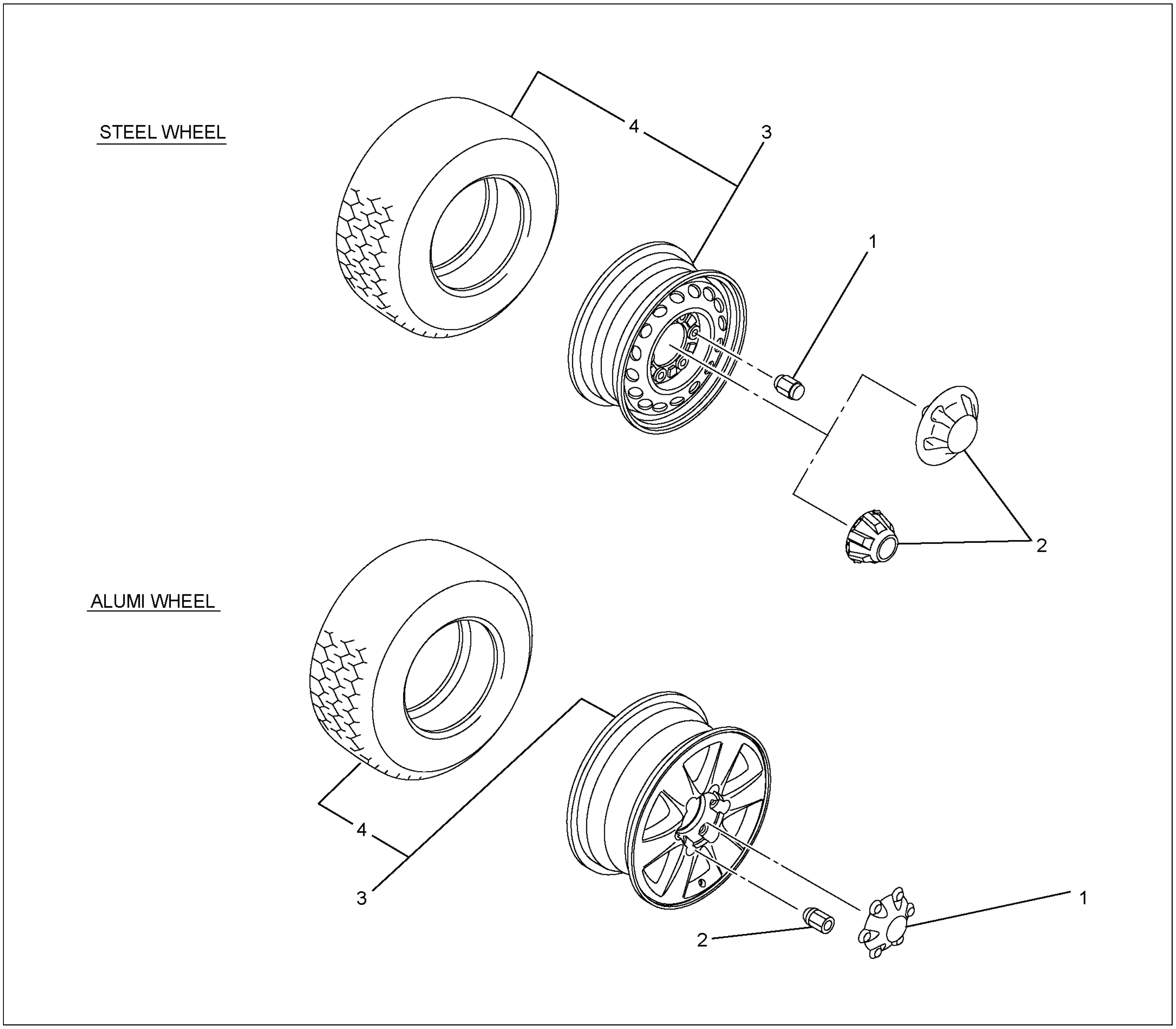
4. Measure the resistance between each terminal, while warming ATF.

Resistance: 0.5 – 30 kΩ (at 0°C – 120°C or 32°F – 248°F)

5. If either of the measured values exceeds the specified value, replace the ATF temperature sensor.

Torque: 15 N·m (1.5 kgf·m/11 lb·ft)

DISASSEMBLY AND REASSEMBLY



RTW73ELF000201

Disassembly Steps

(for Alumi models)

1. Wheel cap
2. Wheel nut
3. Wheel and tire assembly
4. Tire assembly

(for Steel models)

1. Wheel nut
2. Wheel cap
3. Wheel and tire assembly
4. Tire assembly

Reassembly Steps

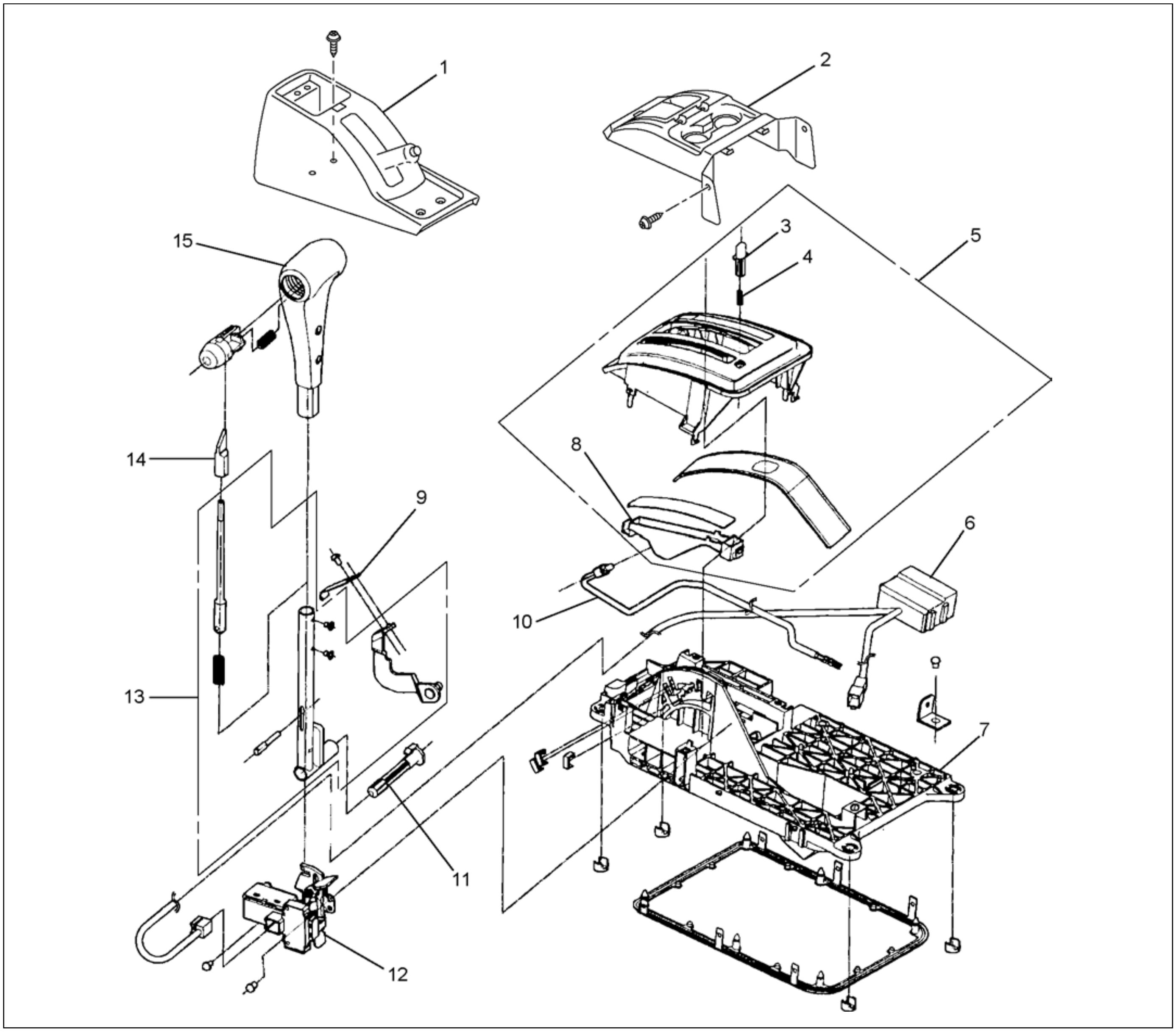
(for Alumi models)

4. Tire assembly
3. Wheel and tire assembly
2. Wheel nut
1. Wheel cap

(for Steel models)

4 Tire assembly
3. Wheel and tire assembly
2. Wheel cap
1. Wheel nut

Select Lever



RTW77ALF000201

Legend

1. Rear console
2. Front console
3. Shift lock release button
4. Shift lock button spring
5. Upper housing
6. Interlock controller
7. Base plate
8. Position indicator housing
9. Spring plate
10. Lamp assembly
11. Grooved pin
12. Shift lock unit
13. Lever assembly
14. Sleeve
15. Select lever knob

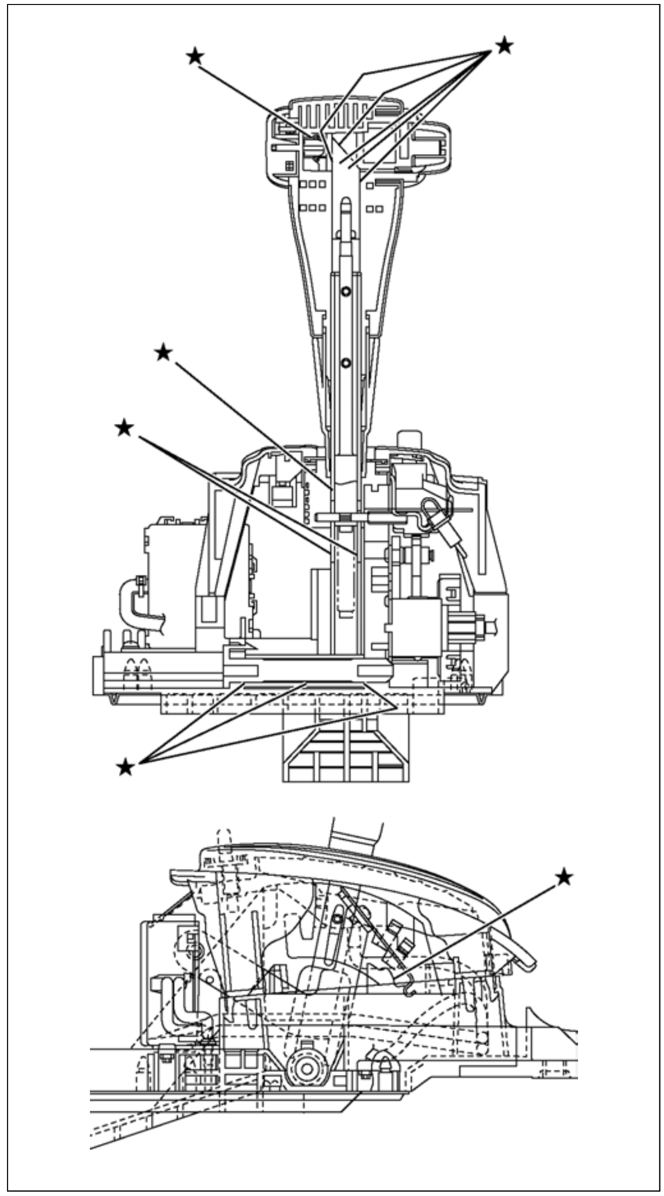
Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Remove the rear console and the front console.
4. Remove the 2 screws fixing the select lever knob.
5. Remove the knob together with the knob button and spring from the lever.
6. Turn the sleeve counterclockwise to remove it. Make a note of the number of turns required to free the sleeve.
7. Remove the harness connectors from the base plate.
8. Remove the upper housing (held in place by 4 latched fasteners).
9. Remove the lamp assembly by turning it counterclockwise.
10. Remove the spring plate.
11. Remove the grooved pin.
12. Disconnect the shift cable from the select lever.
13. Remove the lever assembly by pressing the rod down (lever in N position).
14. Remove the harness connectors from the shift lock unit, then remove the shift lock unit.
15. Remove the interlock controller.
16. If the replacement of shift lock release button or shift lock button spring is required, remove the position indicator housing, the shift lock button spring and shift lock release button can be removed.

Install or Connect

NOTE

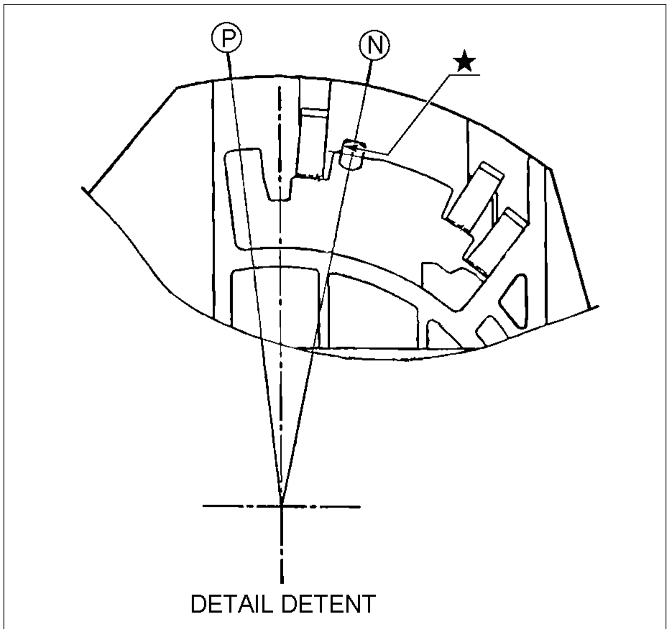
Apply MULTEMP No. 2 grease (or equivalent) to the select lever. Refer to the illustration.



RTW77ALH000201

1. Install the interlock controller.
2. Install the shift lock unit and connect the harness to the shift lock unit.
3. Install the lever assembly to the base plate.
   a. Insert and secure the shaft and connect the cable.
   b. Insert pawled end of the shaft into the base plate hole.
   c. Insert the detent pin of the shaft into detent aperture (lever assembly in N position).
   d. Install the grooved pin.

4. Install the spring plate.
   a. Insert the detent pin into the base plate detent groove until it touches the front wall (lever assembly in N position).



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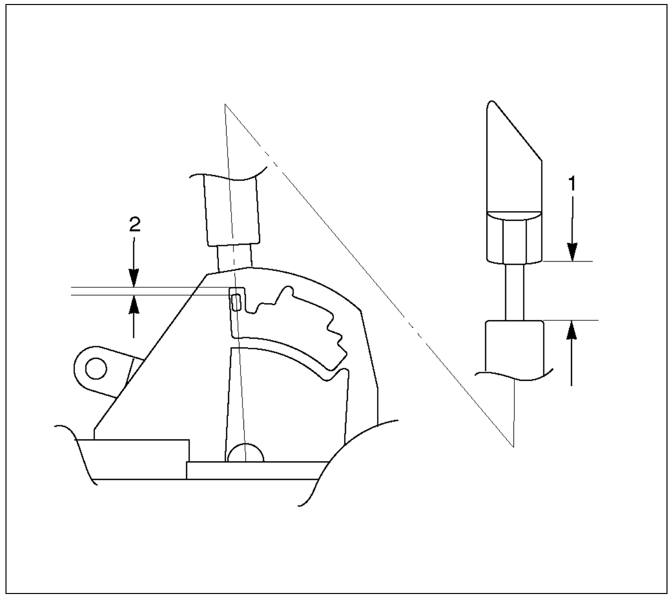
   b. Stack the short spring plate and tighten the screws to the specified torque.

Screw torque	2 N·m (0.2kgf·m/17 lb·in)

   c. Check that the detent pin moves smoothly in the detent groove (shift knob temporarily installed).
5. Temporarily install the sleeve.
6. Move the lever to the “P” position.
7. Adjust the clearance (2) between the detent plate and the pin by moving the select lever knob sleeve (1).

Detent plate and pin clearance	mm(in)
0.2 - 1.0 (0.01 - 0.04)	

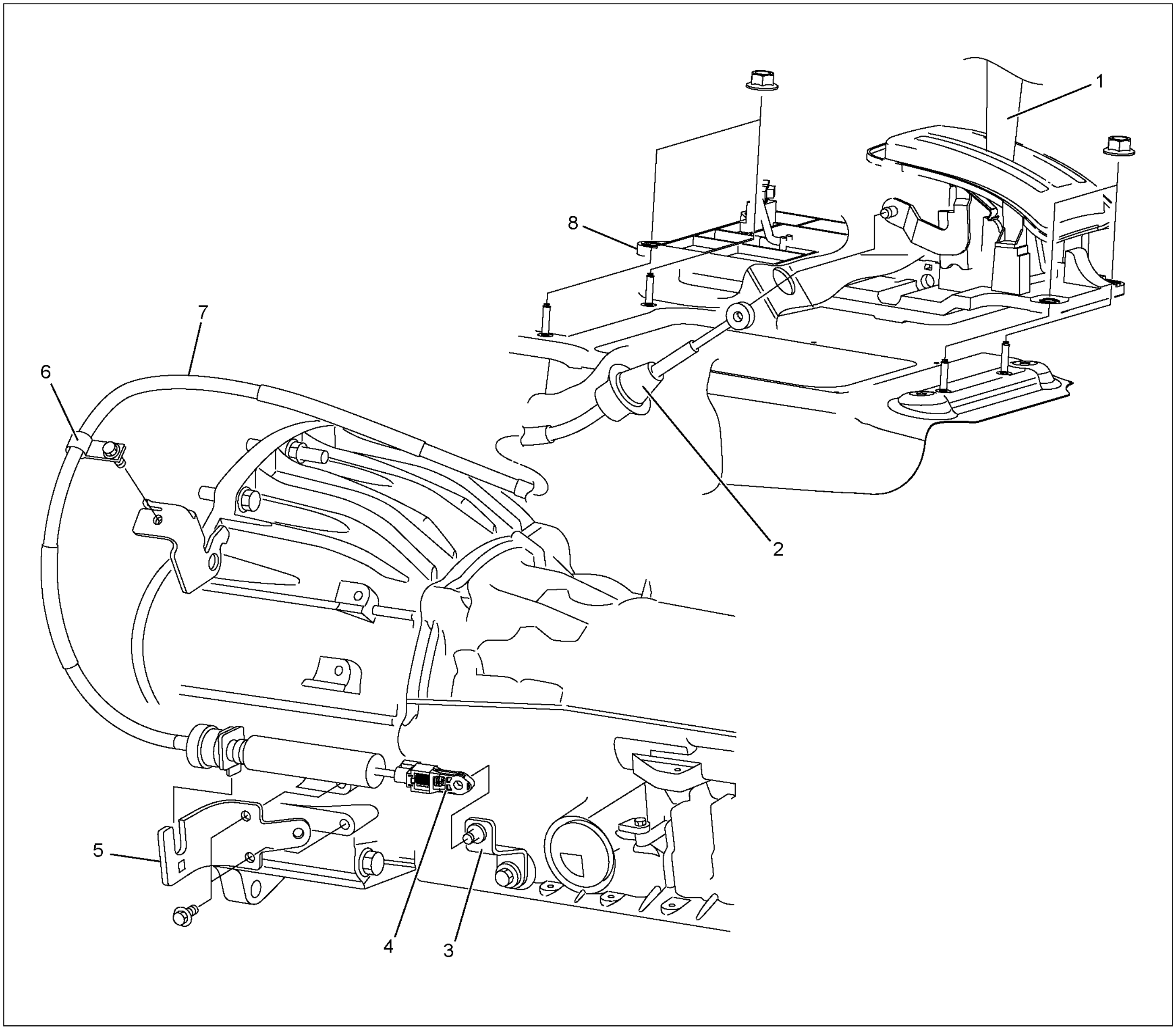


255R300002

8. Install the lamp assembly to the lamp socket.
   a. Align the recessed portion of the lamp socket with the protruding portion of the lamp assembly.
   b. Insert the lamp assembly into the lamp socket and rotate it 90 degrees clockwise.
9. Remove the sleeve and move the lever to the “N” position.
10. Install the upper housing. Make sure that the 4 latched fasteners are securely closed.
11. Attach the harness connectors to the base plate.
12. Install the sleeve (rotate the sleeve clockwise the same number of turns it was rotated counterclockwise at disassembly).
13. Install the knob, the knob button, and the knob spring.
14. Install the 2 screws securing the knob and tighten them to the specified torque.

Screw torque: 2 N·m (0.2kgf·m/17 lb·in)

Shift Cable



RTW77ALF001101

Legend

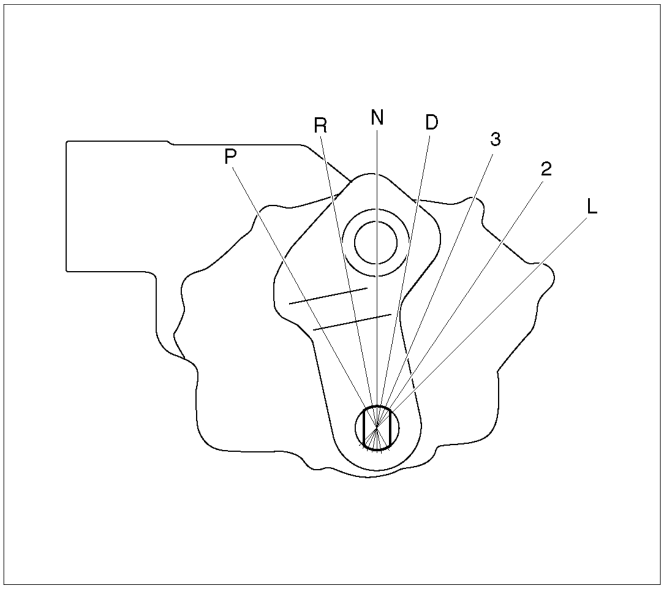
(1) Select lever
(2) Shift cable retaining pawl
(3) Manual shaft select lever
(4) Adjuster
(5) Bracket
(6) Clip
(7) Shift cable
(8) Select lever base

Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Move the select lever to the “N” position.
4. Remove the rear console and front console.
5. Disconnect the shift cable from the select lever.
6. Press on the shift cable retaining pawl to remove the cable from the select lever base.
7. Disconnect the shift cable from the transmission side.
8. Remove the shift cable from the bracket.
9. Pull the shift cable free from the bottom of the vehicle.

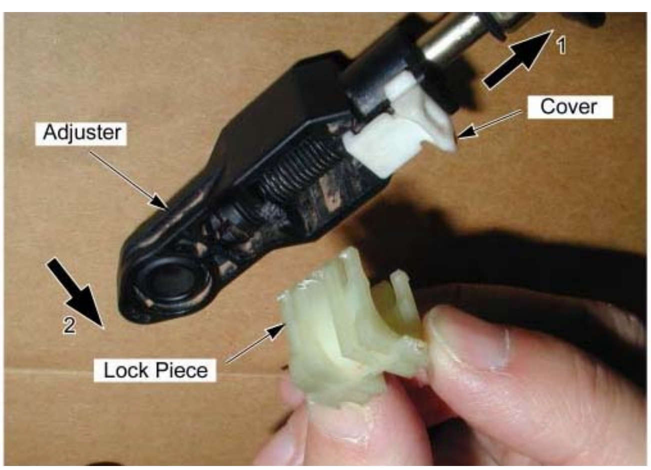
Install or Connect

1. Install the shift cable toward the inside of the cabin from the bottom of the vehicle.
2. Push the shift cable into the select lever base.
3. Connect the shift cable to the select lever.
4. Fix the shift cable to the bracket.
   Install the clip on the marking of shift cable.
5. Check that the select lever is in the “N” position.
6. Check that the transmission is in the “N” position.



249R300002

7. Slide the cover in the direction shown by the arrow (1).
8. Use an ordinary screwdriver to move the lock piece from the position indicated by the arrow (2). Continue to move the lock piece until the adjuster position begins to change.



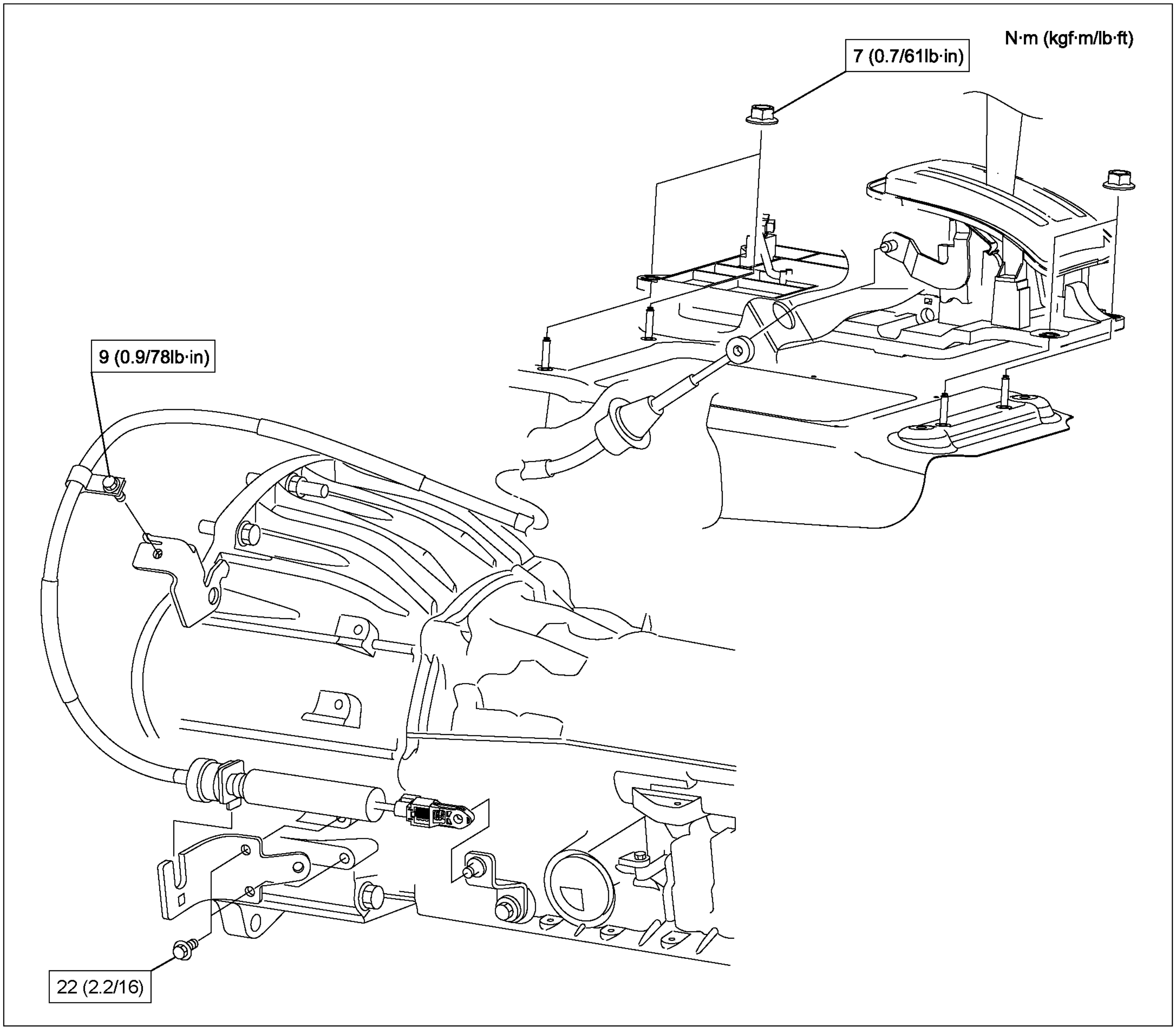
P1010012

9. Connect the shift cable to the manual shaft select lever at the transmission side.
10. Insert the lock piece to the adjuster (cable length adjustment).
11. Slide the cover on the adjuster and secure lock piece.

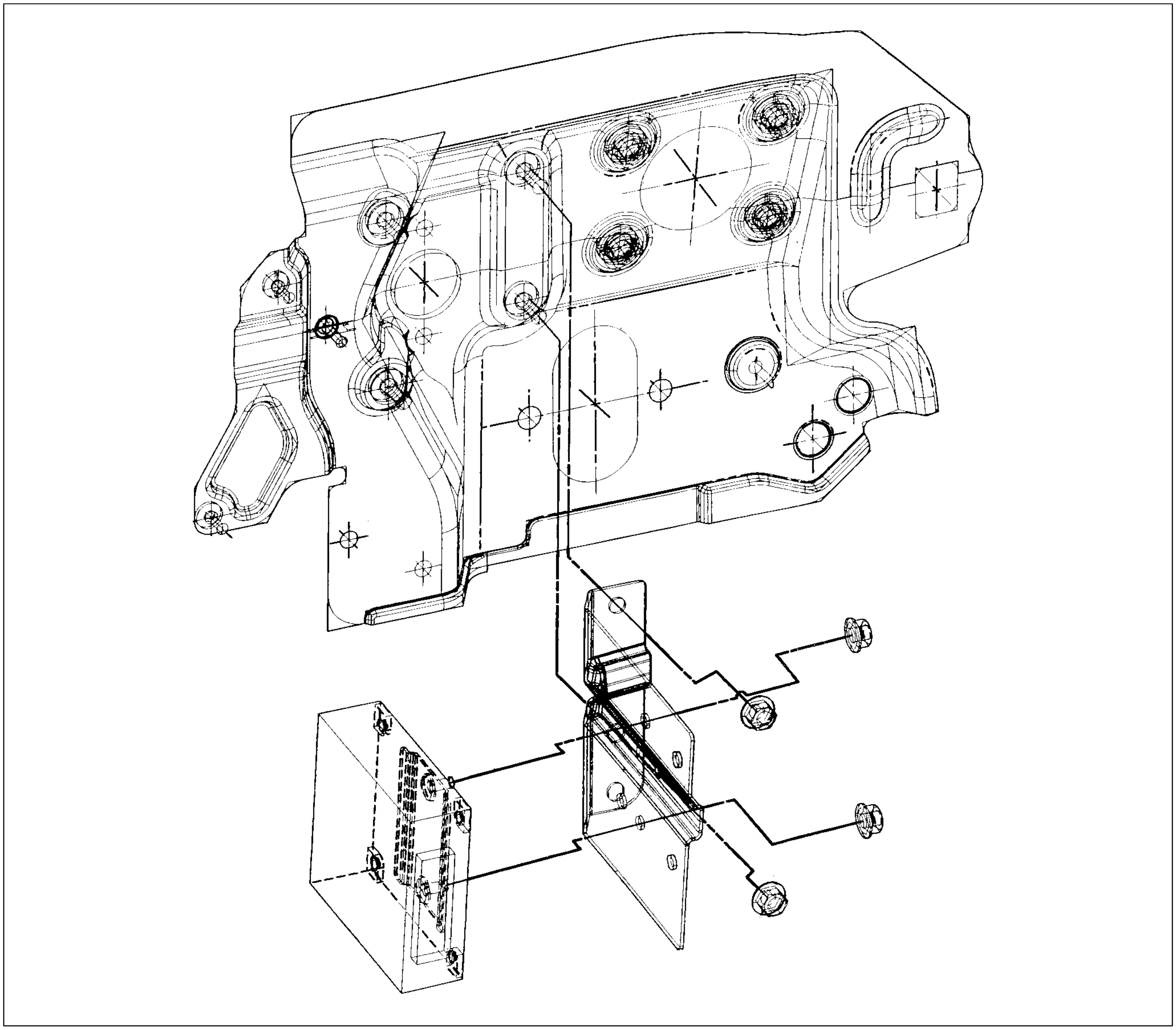
P1010016-2

11. Press the select lever knob button 5 times.
    Then check that the select lever moves smoothly to each of its positions.
13. Check that the shift position indicated by the select lever and the actual shift position are the same.
14. Install the front console and rear console.
15. Connect the negative battery cable.
16. Remove the wheel blocks.

Torque Specifications



Transmission Control Module (TCM)



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Removal

Preparation:

Disconnect negative (–) battery cable.

1. Disconnect the TCM harness connectors.
2. Remove fixing nuts (2 pieces) and TCM with bracket from the car.

NOTE: The TCM is fitted under instrument panel of the driver's compartment by means of two stud bolts.

3. Remove fixing nuts (2 pieces) and remove TCM from bracket.

Installation

To install, follow the removal steps in reverse order.

Shift Solenoid and Lock-Up Solenoid

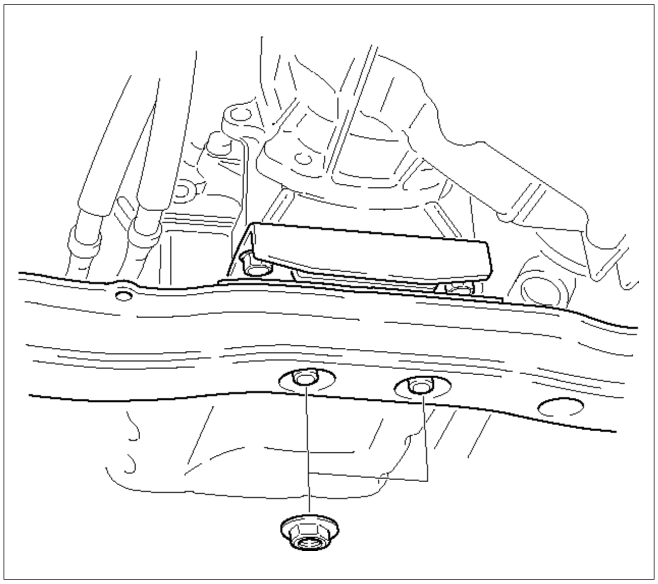
Removal

Preparation:

- Disconnect negative (–) battery cable.
- Drain the fluid.

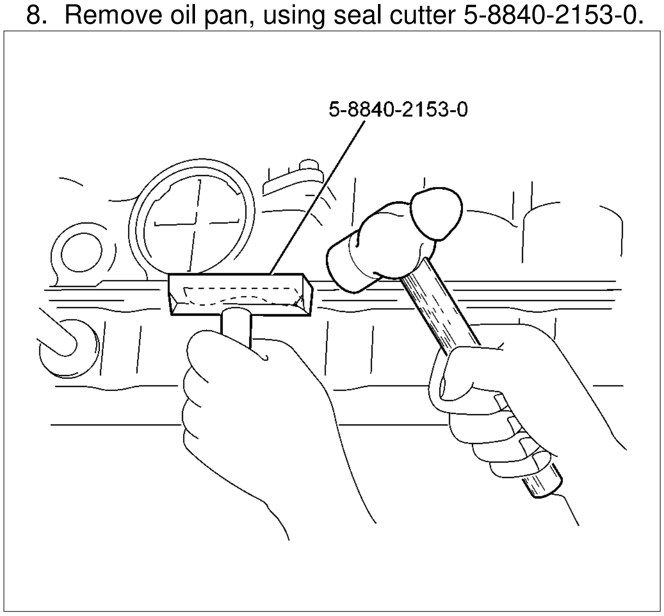
Refer to ATF REPLACEMENT in this section.

1. Remove oil lever gage and oil filler tube.
2. Support transfer case (4×4) or rear cover (4×2) with a transmission jack.
3. Remove engine rear mounting nuts.



F07RW008

4. Remove fule pipe heat protector on tansmission corssmenber.
5. Remove fuel pipe from the crossmenber.
6. Remove transmission crossmenber.
7. Remove the nineteen bolts.
8. Remove oil pan, using seal cutter 5-8840-2153-0.



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NOTE: Do not turn over the transmission as this will contaminate the valve body with foreign materials in the bottom of the oil pan.

Remove oil pan by lifting the transmission case.

Oil pan seal cutter: 5-8840-2153-0

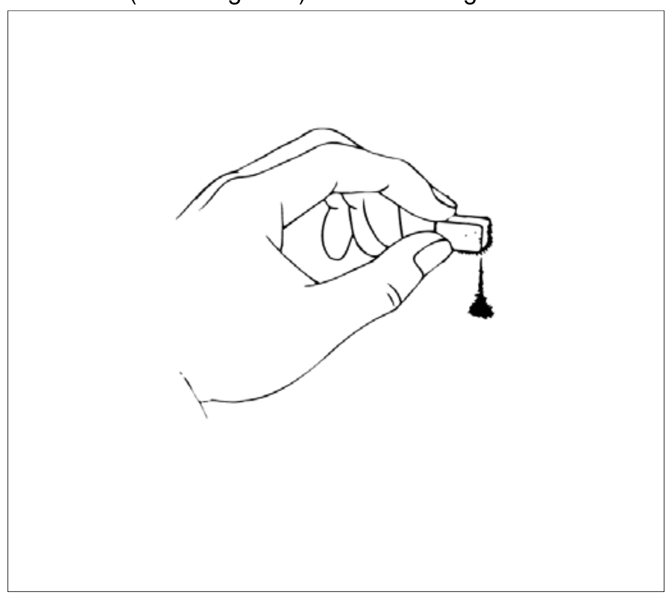
Examine particles in oil pan

Remove the magnet and use it to collect any steel chips.

Look carefully at the chips and particles in the oil pan and on the magnet to anticipate what type of wear you will find in the transmission:

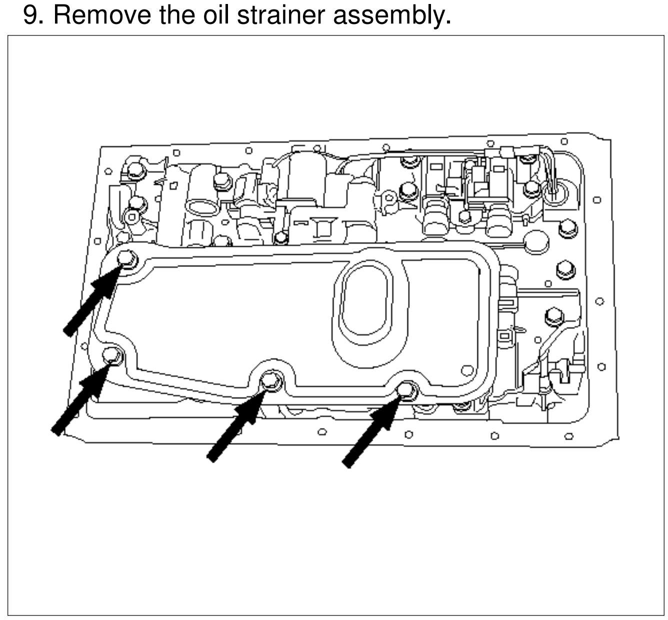
Steel (magnetic).................bearing, gear and clutch plate wear

Brass (non-magnetic)..........bushing wear



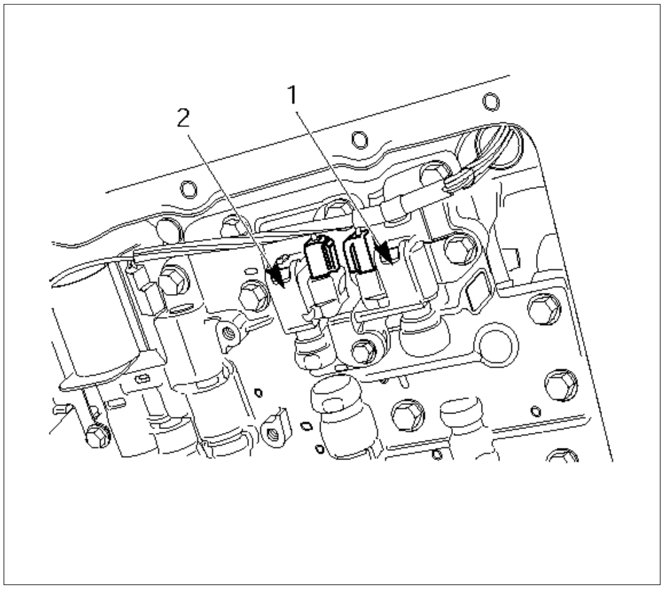
240RY00008

9. Remove the oil strainer assembly.



244RY00003

10. Disconnect the solenoid wiring connectors from the shift solenoid S1(1), S2(2), lock-up solenoid(3) and pressure control solenoid(4).



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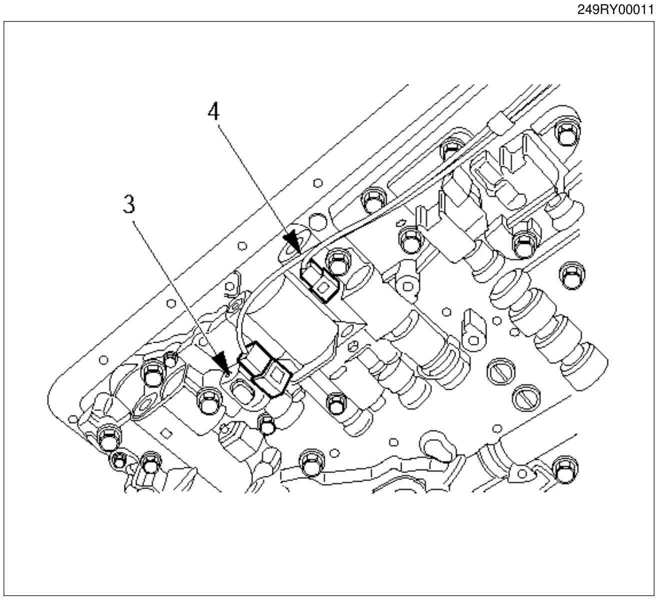


249RY00012

11. Remove each retaining bolts and solenoids. (Except pressure control solenoid:)

    Pressure control solenoid cannot be removed.

Installation

To install, follow the removal steps in reverse order noting the following point;

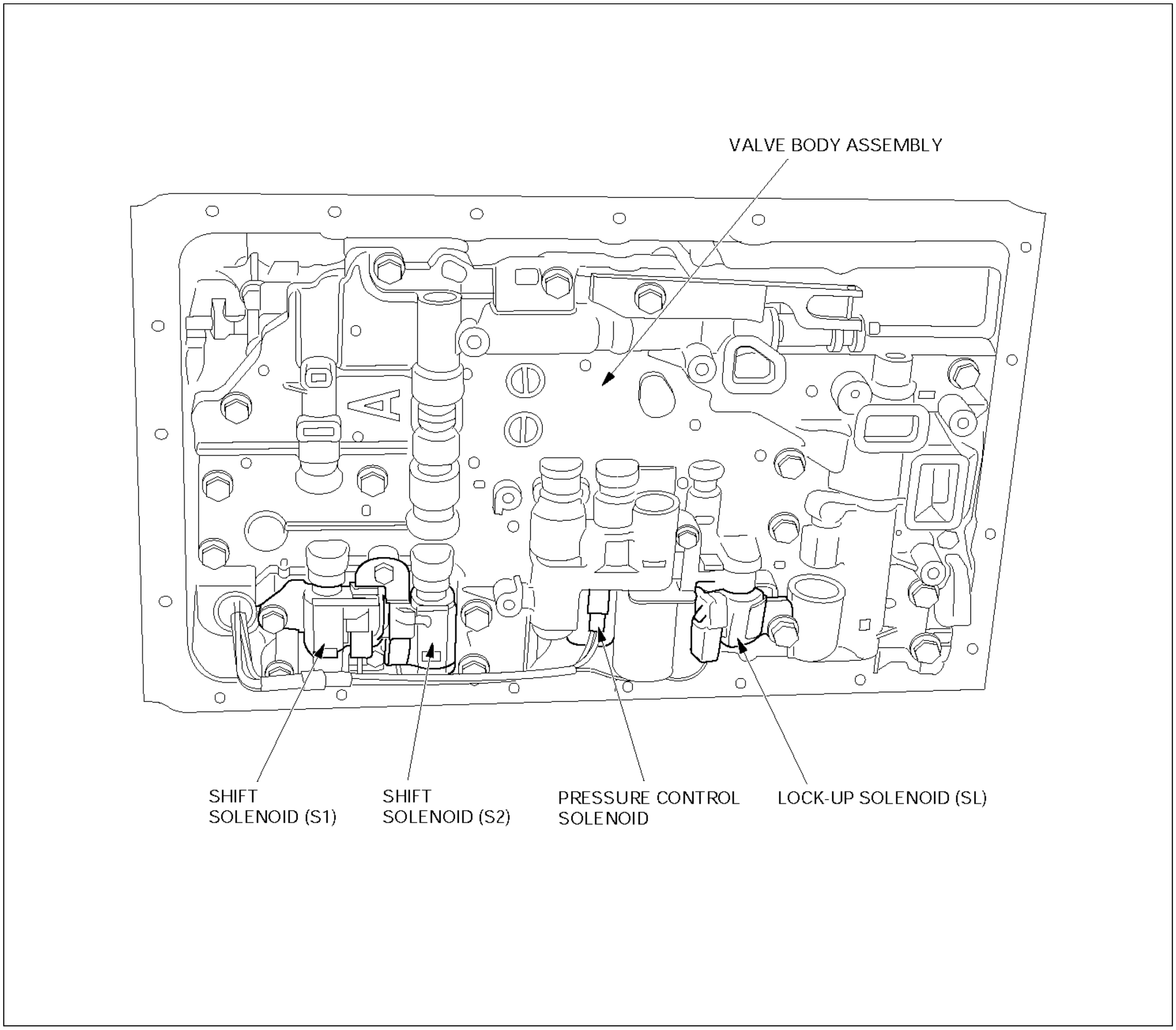
Refer to the section Reassembly of Major Components(2) and Transmission Removal and Installation.

Torque:

Solenoid S1, S2 bolt – 7 N·m (0.7 kgf·m/61 lb·in)

Lock-up solenoid bolt – 10 N·m (1.0 kgf·m/87 lb·in)

Valve Body Assembly and Pressure Control Solenoid



244RY00009

Removal

Preparation:

- Disconnect negative (–) battery cable.
- Drain the fluid.
  Refer to ATF REPLACEMENT in this section.

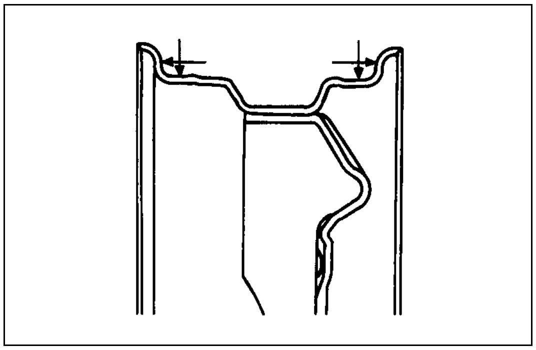
1. Remove the nineteen bolts and oil pan.

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Visual Check

Inspect all disassembled parts for wear, damage or other abnormal conditions.

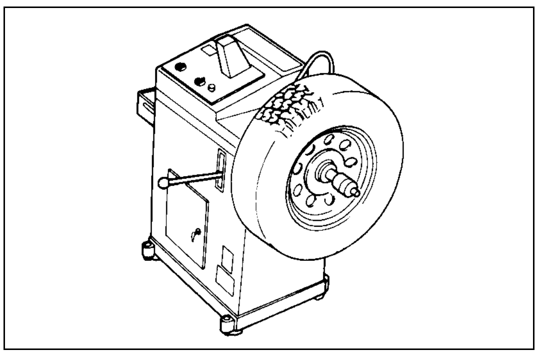


Measure Wheel Runout

mm (in)

Wheel Type	Radial	Lateral
14 inch Steel 15 inch Steel	Less than 1.0 (0.04)	Less than 1.0 (0.04)
15 inch Alumi 16 inch Alumi	Less than 0.4 (0.016)	Less than 0.55 (0.022)

If the measured value exceeds the specified limit, the wheel must be replaced.



Balancing Wheel and Tire

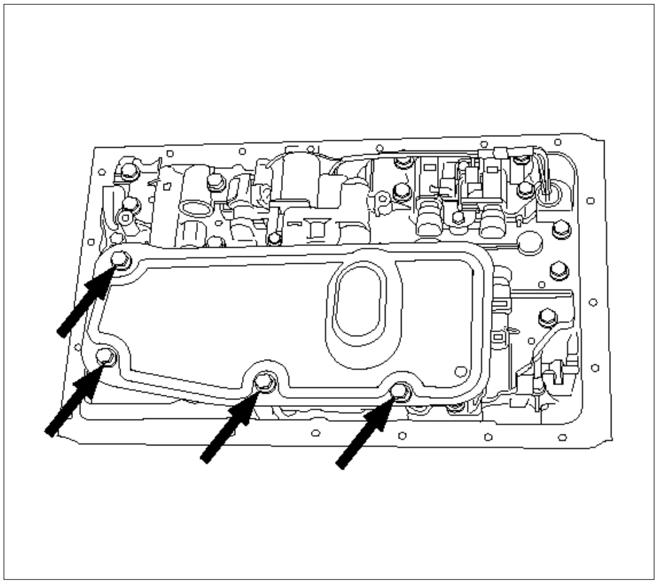
On-vehicle Balancing

On-Vehicle balancing methods very with equipment and tool manufacturers. Be sure to follow each manufacturer's instructions during the balancing operation.

Off- vehicle Balancing

Most electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers. They are easy to use and give a dynamic balance. Although they do not correct drum or disc imbalance (as the on-vehicle spin balancing does), they are very accurate.

2. Remove the oil strainer assembly.



244RY00003

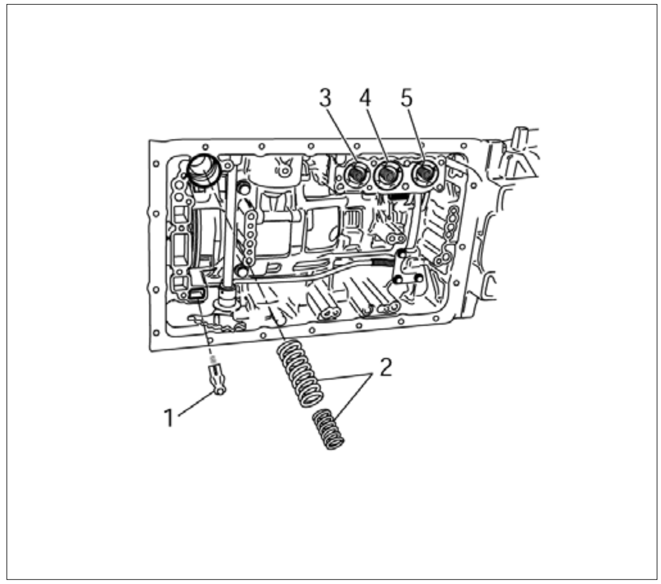
3. Disconnect the solenoid wiring connectors from the solenoids.
4. Remove the twenty bolts from the valve body.
5. Remove the valve body assembly and pressure control solenoid.
   - After removing valve body assembly from the transmission case, loosen the solenoid clamp bolt and remove the pressure control solenoid from the upper valve body assembly.

     Also disconnect the harness connector from the pressure control solenoid.

NOTE:

- Two or more persons are required for removal and installation of the valve body assembly and pressure control solenoid.
- The check valve assembly (1) and the C0 accumulator piston springs (2) will fall from the transmission case during removal of valve body assembly.

  Protect these parts from damage. The B0 (3), C2 (4), and B2 (5) accumulator piston and springs may also fall free and must be protected.



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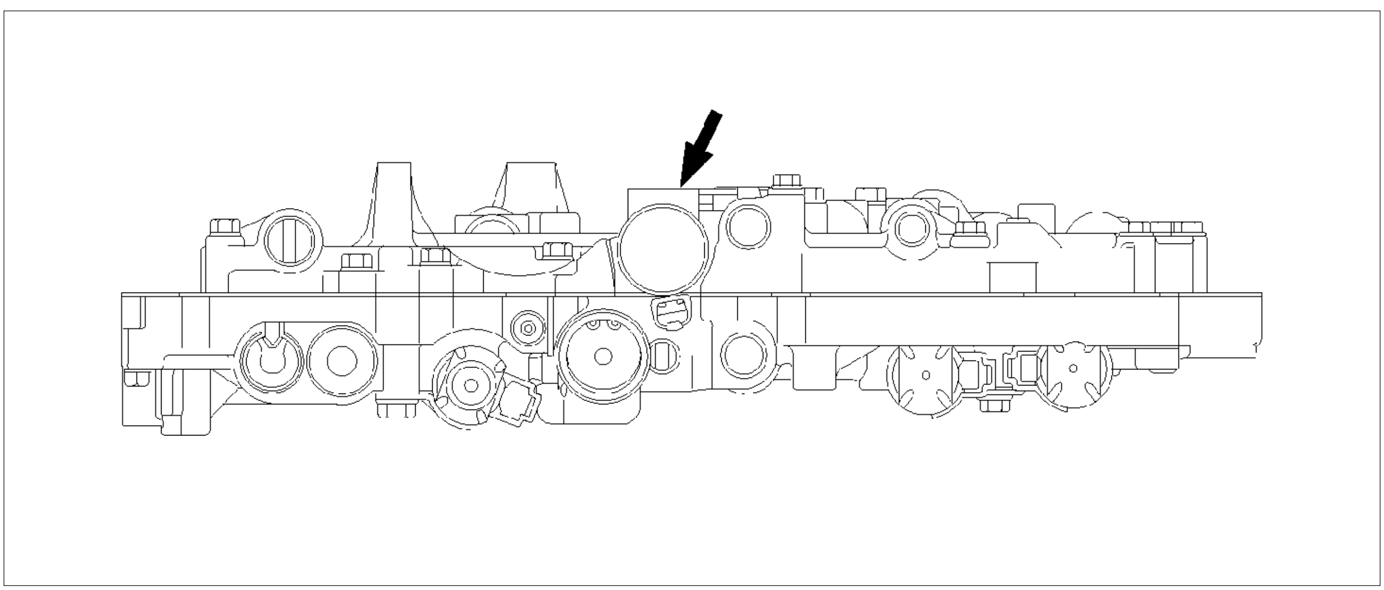


244RY00006

Installation

To install, follow the removal steps in reverse order noting the following point;

1. Reinstall the parts removed with the valve body assembly to their assigned positions in the transmission case (check valve assembly, C0 accumulator pistons, etc). Install the valve body assembly to the transmission case.

   Refer to REASSEMBLY OF MAJOR COMPONENTS (2).

2. Solenoid clamp bolt

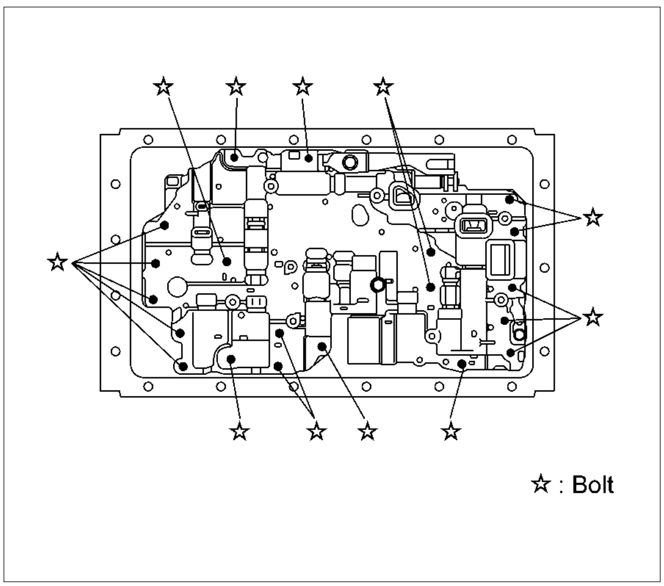
   Torque : 7 N·m (0.7 kgf·m/61 lb·in)

3. Valve body fixing bolts

   Each bolt location is indicated in the figure.

   Torque : 10 N·m (1.0 kgf·m/87 lb·in)

NOTE: Tighten the bolts toward outside equally.



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4. Oil strainer fixing bolts

   Torque : 10 N·m (1.0 kgf·m/87 lb·in)

5. Oil pan fixing bolts

   Torque : 7.4 N·m (0.75 kgf·m/65 lb·in)

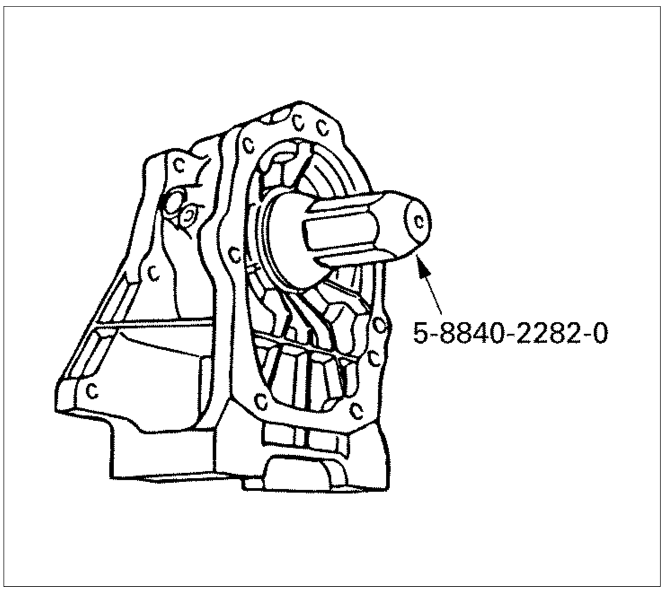
Rear Oil Seal (Adapter Housing, 4×4)

Removal

1. Remove the front and rear propeller shaft assembly from the transfer case.
2. Remove the transfer case assembly from the transmission case.
   Refer to Section 7D TRANSFER.
3. Using a screwdriver, remove the rear oil seal.

Installation

1. Apply ATF to a new rear oil seal lip.
2. Using oil seal installer, install the rear oil seal to the adapter housing.
   Oil seal installer : 5-8840-2282-0



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3. Install the transfer case assembly.
   Refer to section 7D TRANSFER.
4. Install the front and rear propeller shaft assembly.

Torque (Propeller shaft flange bolt) :
63 N·m (6.4 kgf·m/46 lb·ft)

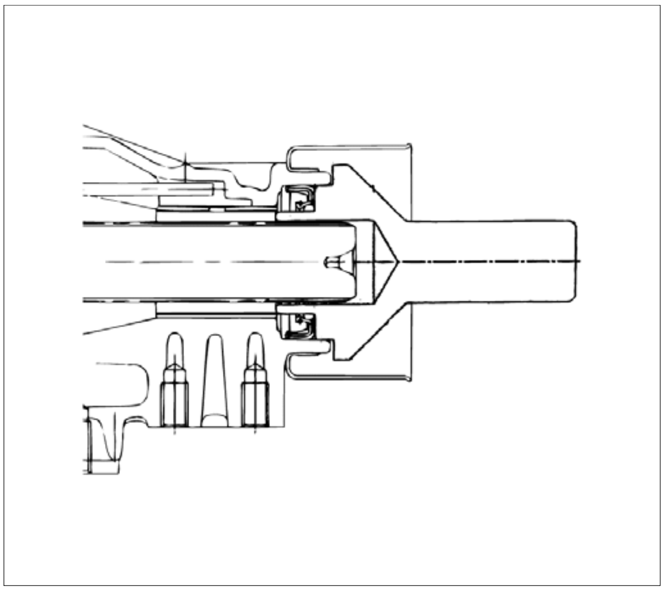
Rear Oil Seal (Extension Housing, 4×2)

Removal

1. Remove the rear propeller shaft assembly.
2. Using a screwdriver, remove the rear oil seal.

Installation

1. Apply ATF to a new rear oil seal lip.
2. Using oil seal installer, install the rear oil seal to the extension housing.
   Oil seal installer : 5-8840-2702-0



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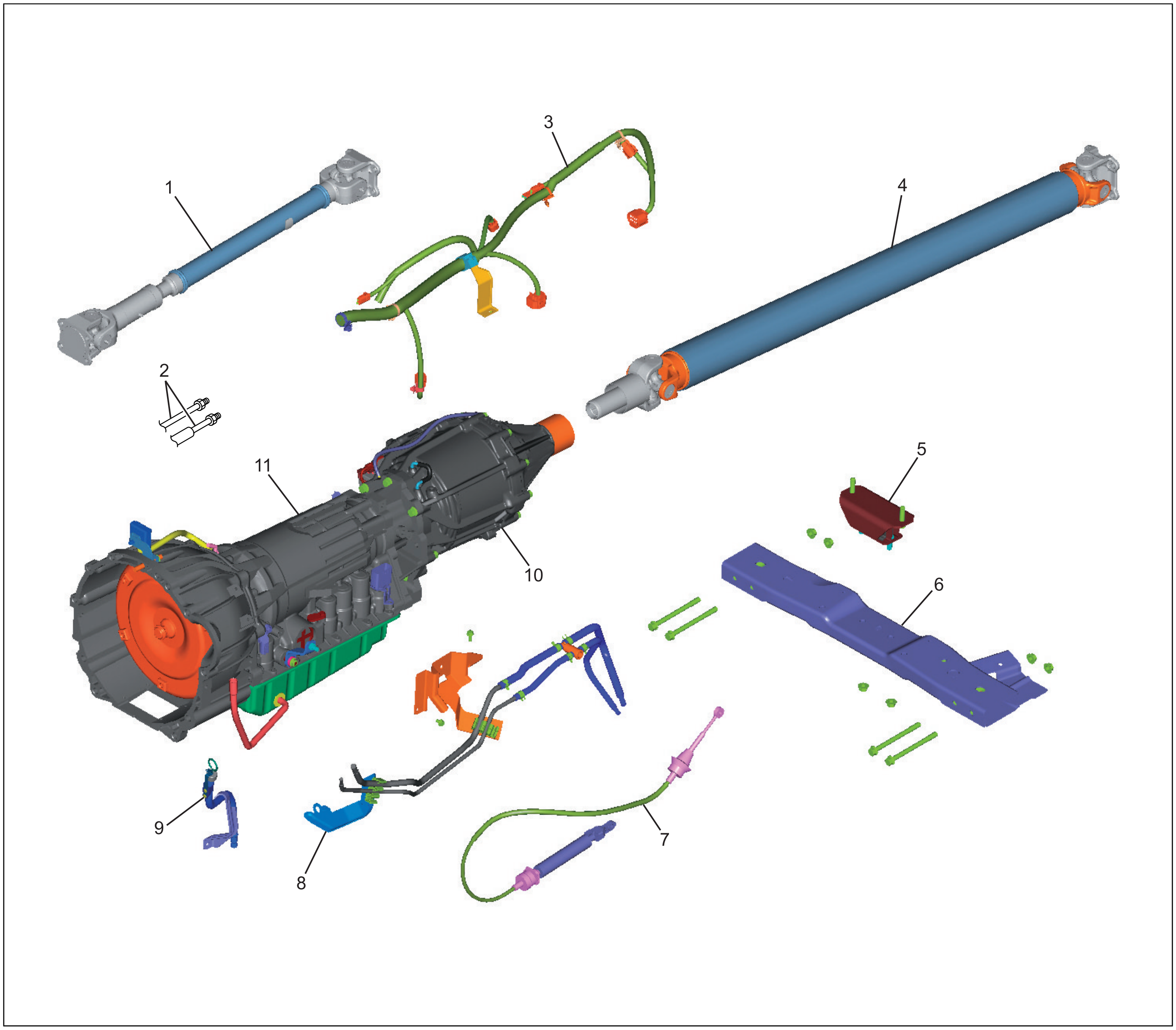
3. Install the rear propeller shaft.

   Torque (Flange bolt): 63 N·m (6.4 kgf·m/46 lb·ft)

Transmission Assembly

Transmission and Associated Parts



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Legend

(1) Front Propeller Shaft (4×4 only)
(2) ATF Pipe
(3) Transmission Harness
(4) Rear Propeller Shaft
(5) Transmission Mount
(6) Transmission Crossmember
(7) Shift Cable
(8) Fuel Pipe Bracket
(9) Oil Level Gauge And Upper Guide Tube
(10) Transfer Assembly (4×4 only)
(11) Transmission Assembly

Removal

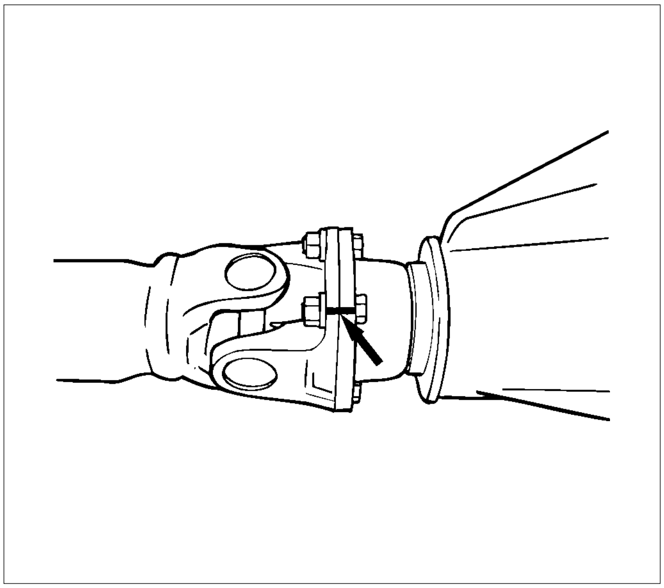
NOTE: Before removing transmission and transfer assembly from vehicle, change the transfer mode to 4×2 using the 4×4 push button switch on dash panel.

1. Disconnect battery ground cable.
2. Raise and support vehicle with suitable stands.
3. Remove the drain plug and drain the transmission oil.
4. Remove the front propeller shaft. (4×4 only)

NOTE: Apply alignment marks on the flange at both front and rear sides.

5. Remove the rear propeller shaft.

NOTE: Apply alignment marks on the differential side.



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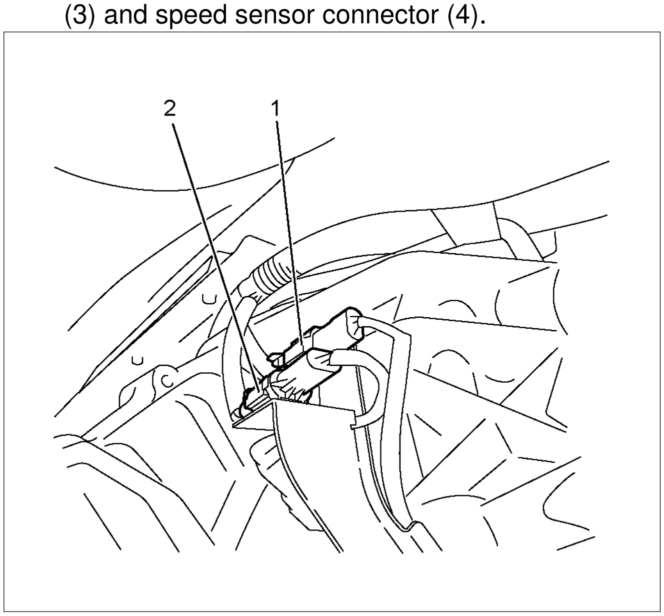
6. Disconnect the 2WD-4WD switch connector (1), neutral switch connector (2), actuator connector (3) and speed sensor connector (4).



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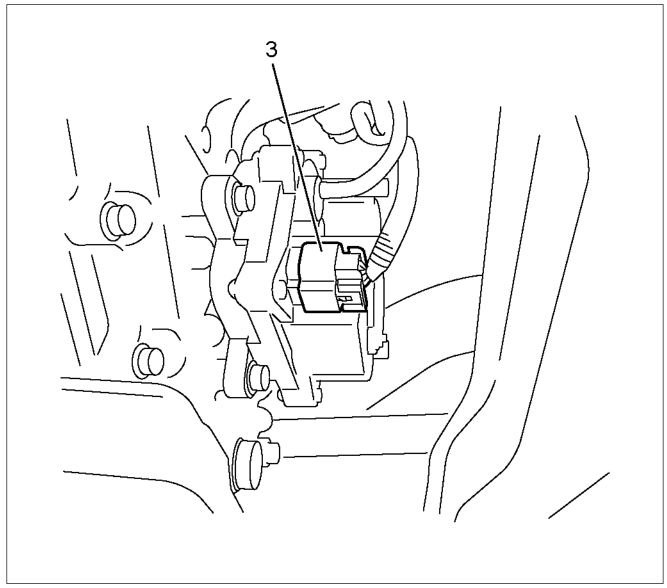

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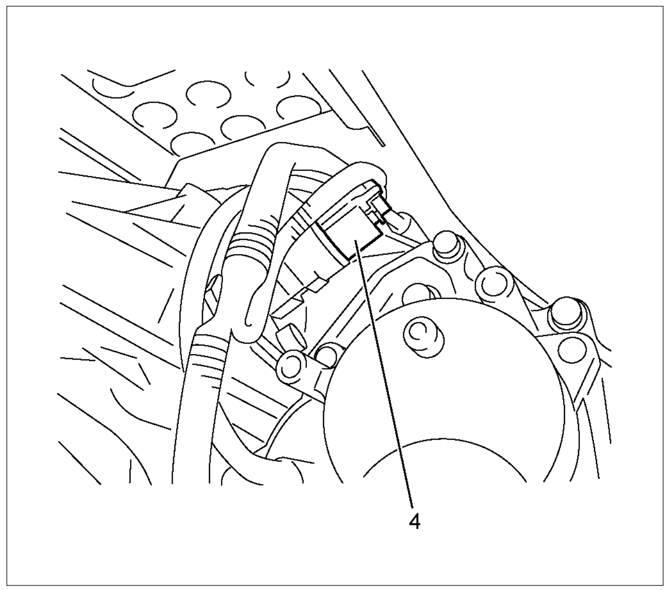

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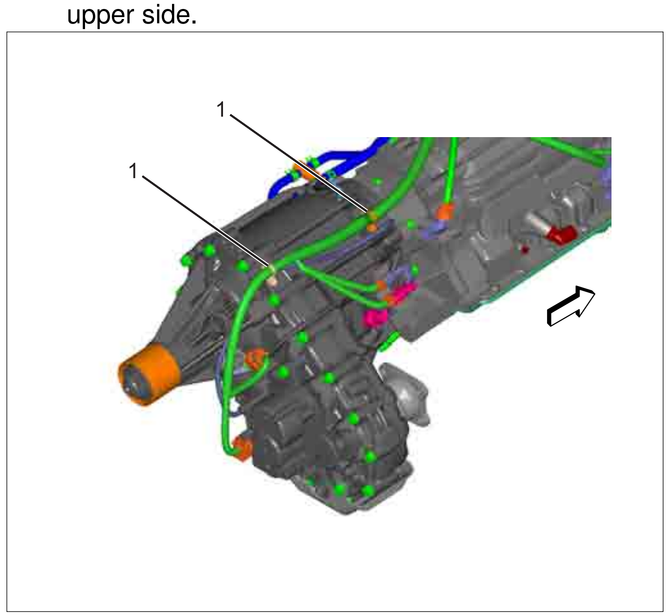
7. Disconnect two harness clips (1) of the transfer upper side.



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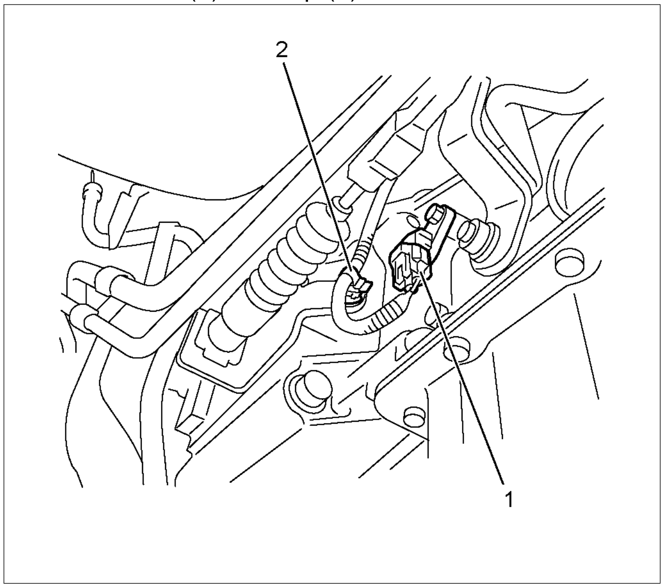
8. Remove the transfer assembly. (4×4 only)
9. Disconnect the input sensor connector (1), ATF temperature sensor connector (3), neutral start (mode) switch connector (4), output sensor connector (5) and clip (2).



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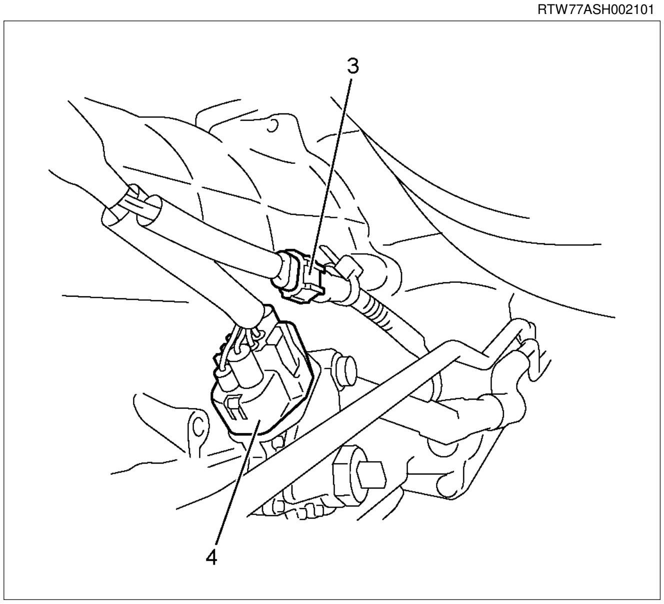

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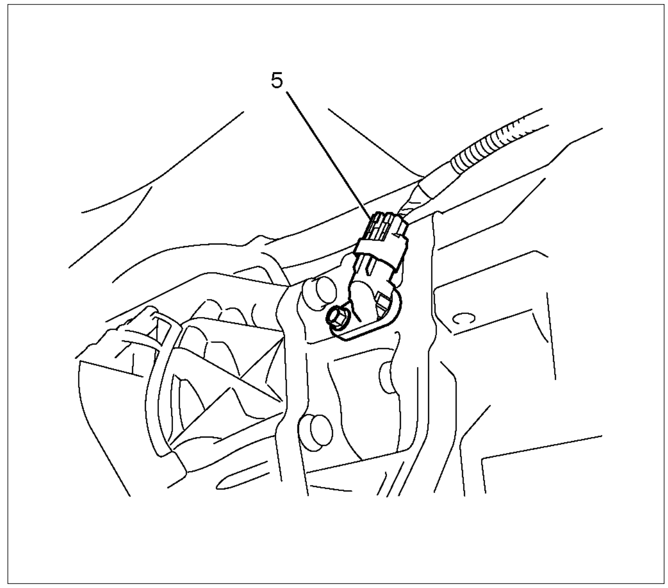

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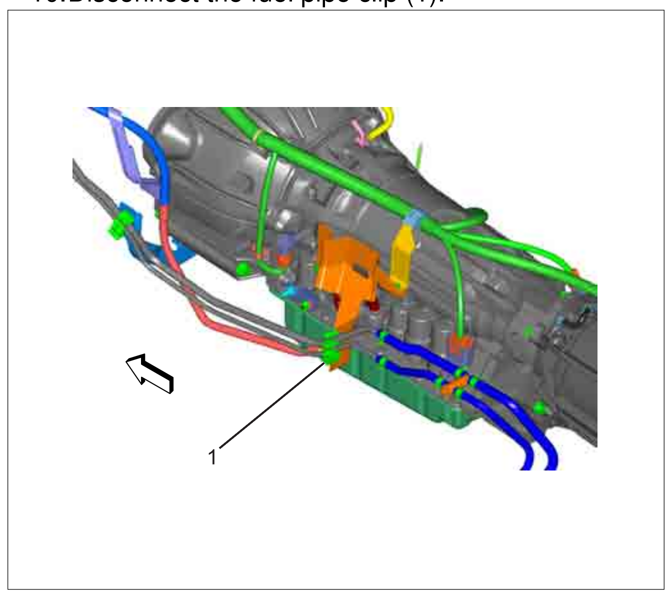
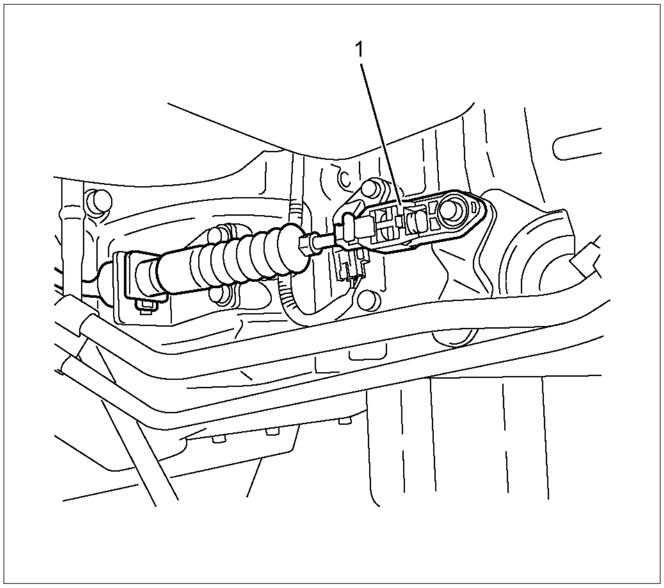
10. Disconnect the fuel pipe clip (1).



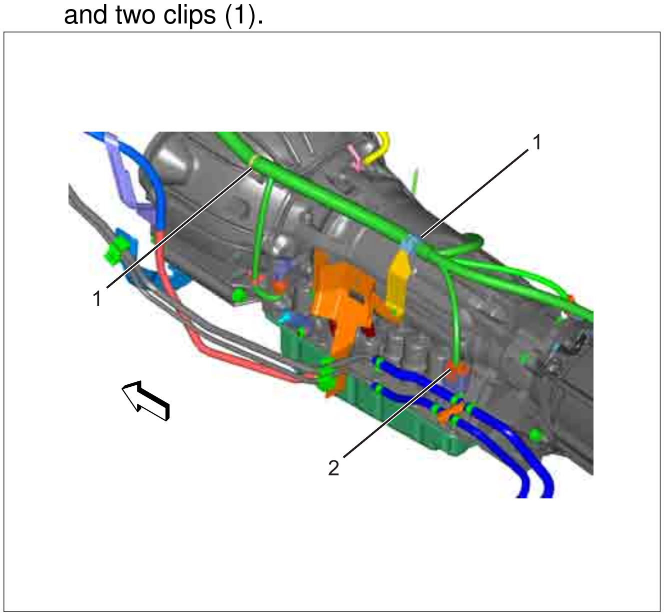
RTW77ASH001301

11.Disconnect the shift cable (1) from the transmission side.



RTW77ASH002801

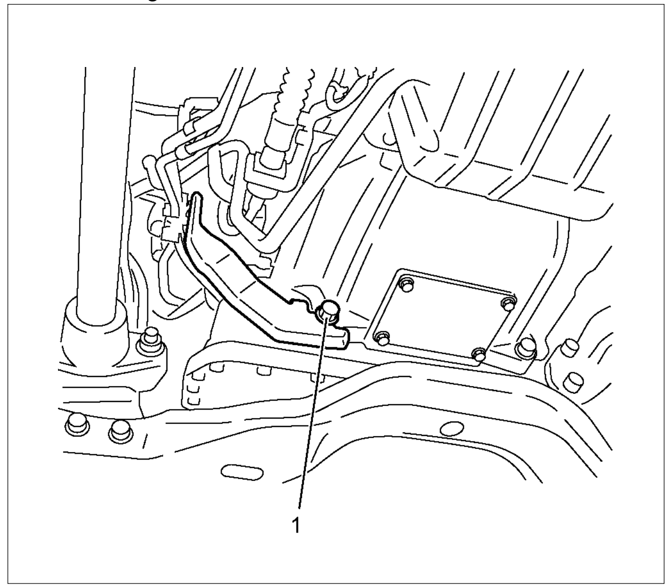
12.Disconnect the transmission harness connector (2) and two clips (1).



RTW77ASH001401

13.Remove the oil level gauge and upper guide tube.

14.Remove the fuel pipe bracket bolt (1) on clutch housing lower left side.

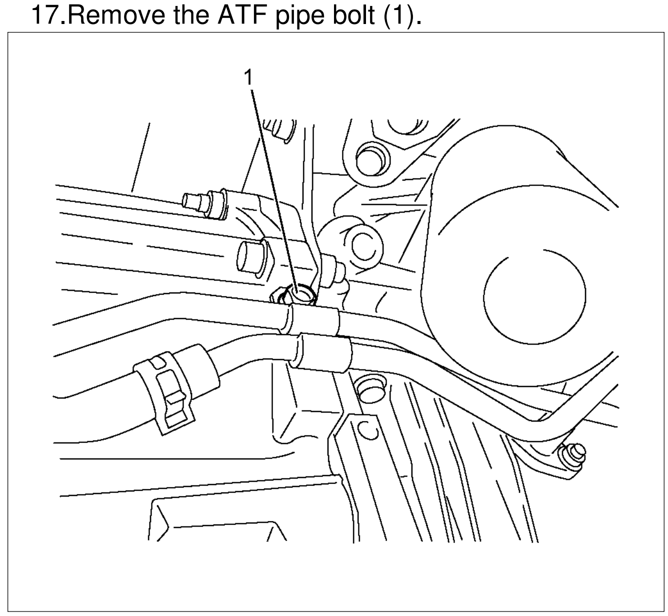


RTW77ASH002401

15.Disconnect the shift cable bracket on the transmission side.

16.Disconnect the starter assembly with shift cable bracket.

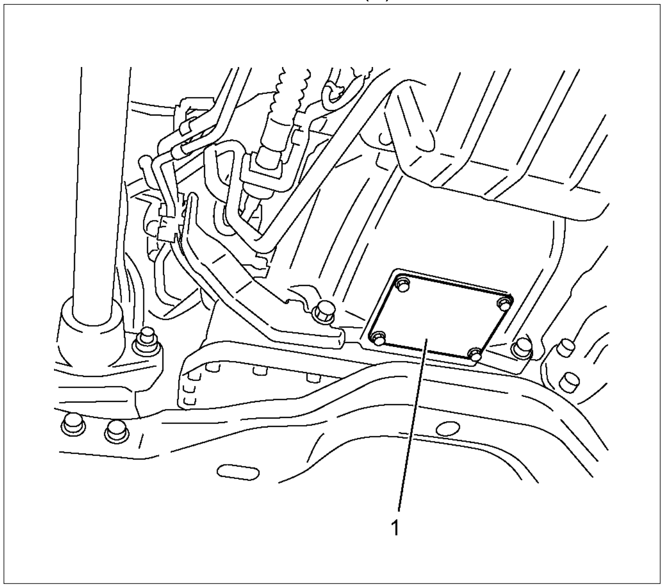
17.Remove the ATF pipe bolt (1).



RTW77ASH002501

18.Disconnect two ATF pipes.

19.Remove the under cover (1).

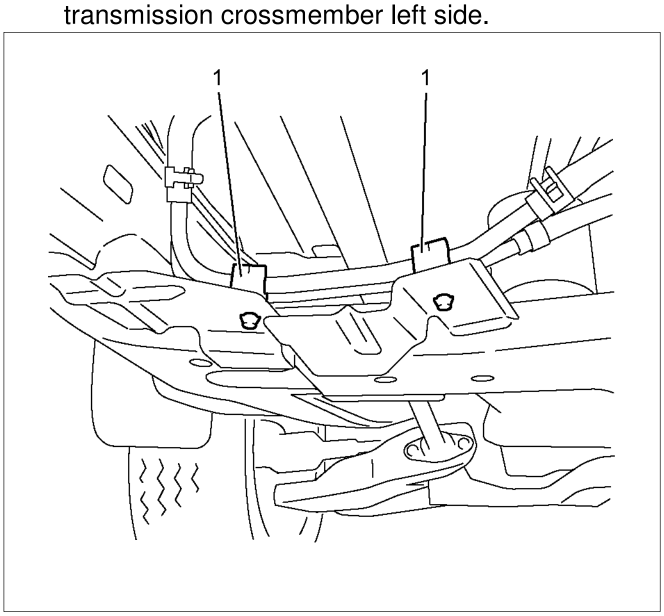


RTW77ASH002601

20.Remove the torque converter bolts by turning the crank shaft.

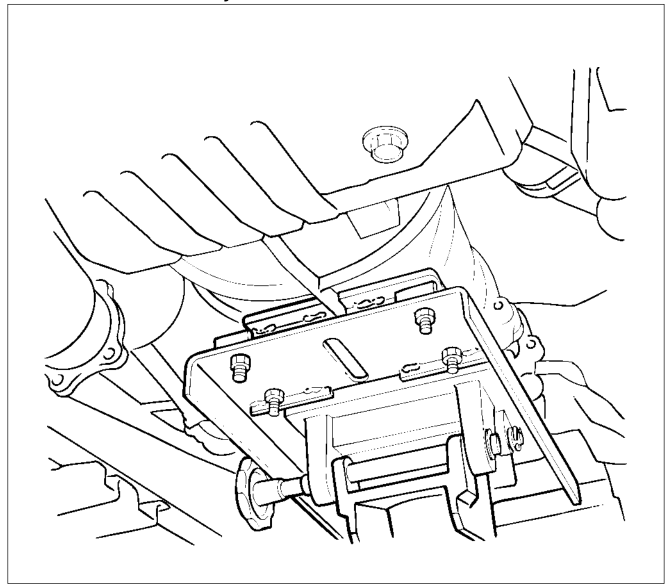
21.Remove the four transmission bolts.

22.Disconnect the two fuel pipe clips (1) on the transmission crossmember left side.



RTW77ASH002701

23.Support transmission assembly with a transmission jack.



RTW77BSH000401

24.Support engine assembly with a engine jack.

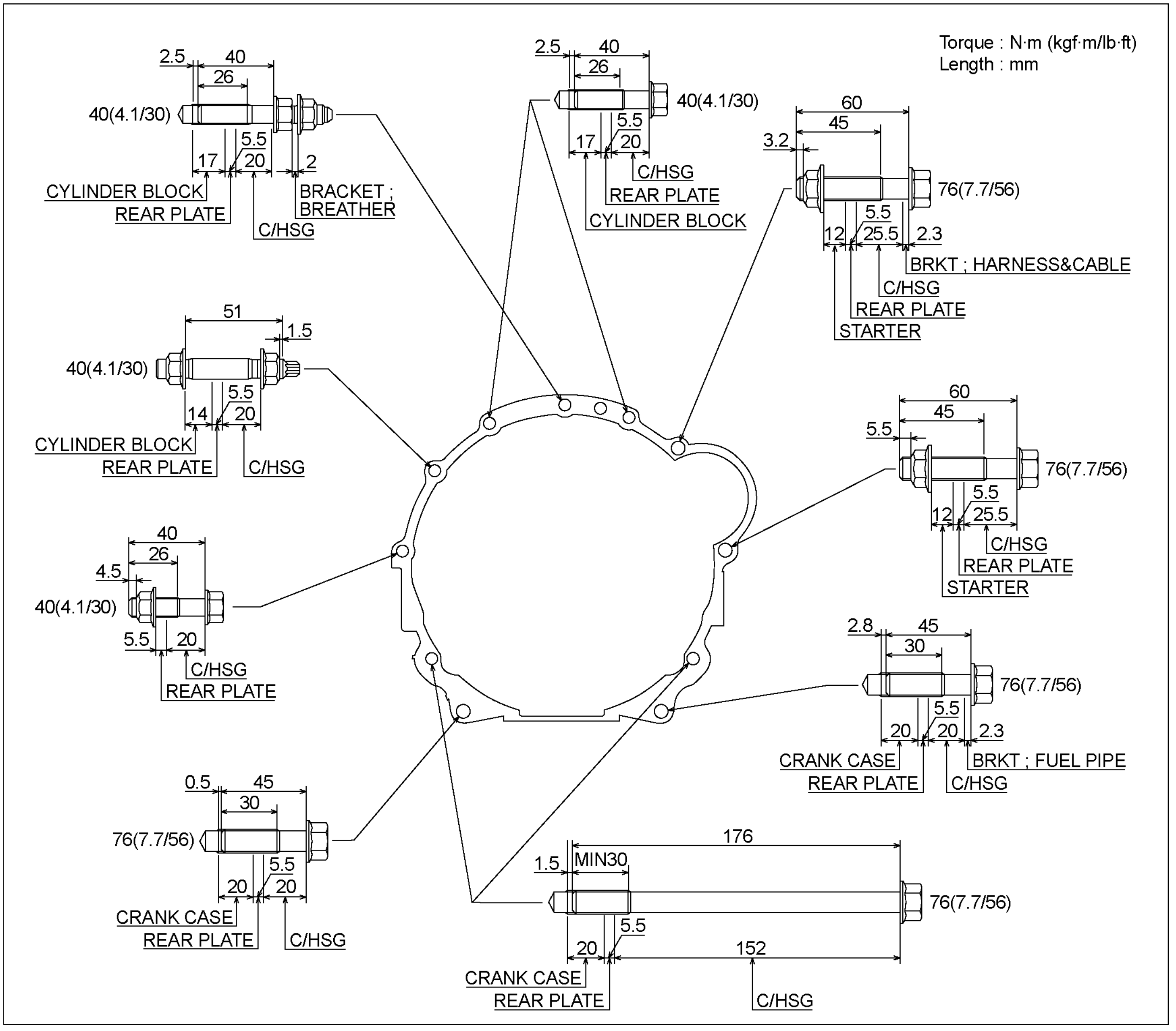
25.Remove the transmission crossmember.

- Remove the transmission mount nuts.
- Remove the transmission crossmember bolts and nuts.

26.Remove the transmission assembly from the vehicle.

Installation

1. Attach the transmission assembly to the engine.
   - Slowly raise transmission jack until front of the transmission assembly is aligned with rear of the engine.
   - Attach the transmission assembly to the engine.
   - Tighten engine transmission bolts as shown in the figure.



RTW77ALF000701

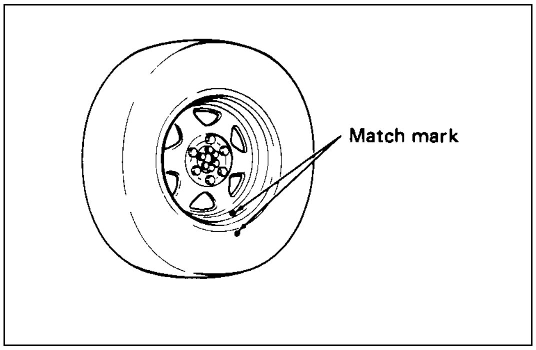
2. Install the transmission crossmember.
   - Install the transmission crossmember bolts and nuts.
   - Install the transmission mount nuts.

Torque: Crossmember ~ Frame

.... **76 N·m (7.8 kgf·m/56 lb·ft)**

Crossmember ~ Transmission mounting

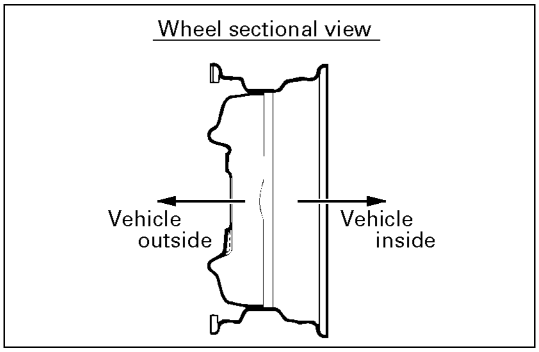
.... **52 N·m (5.3 kgf·m/38 lb·ft)**



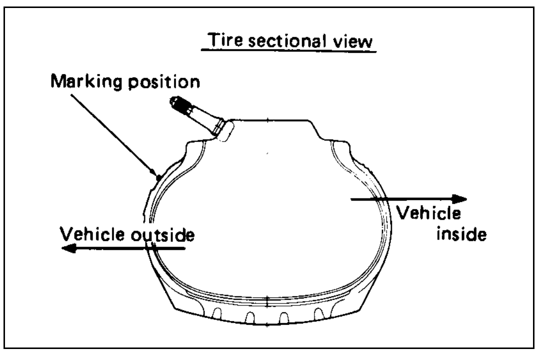
Important Operations

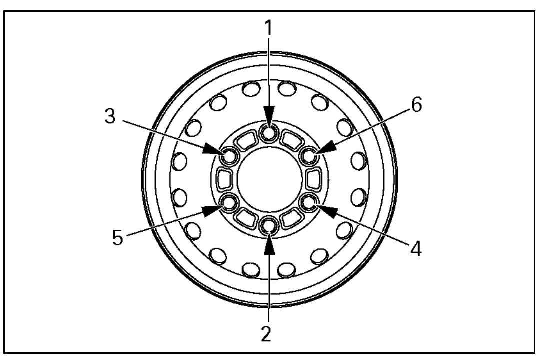
1. Tire Assembly

To assemble, align the match mark (approx. 10mm diameter paint mark) on the wheel with the match mark (approx. 8mm diameter red paint mark) on the tire. If the match mark on the wheel has disappeared, align with air valve instead.



2. Wheel and Tire Assembly



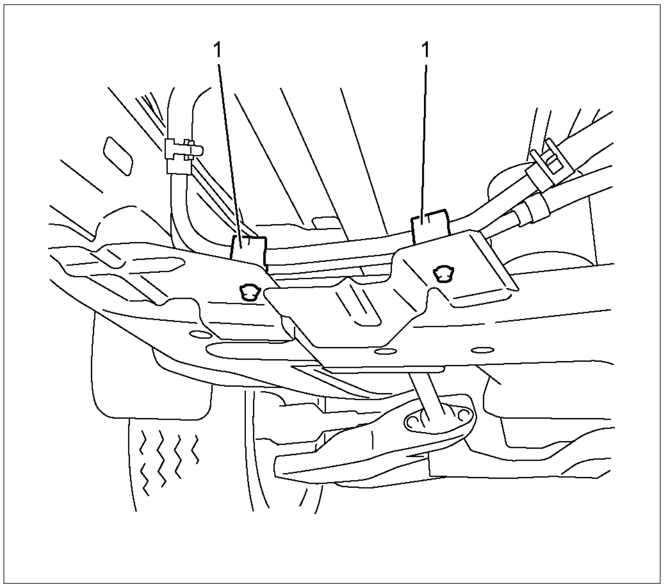


3. Wheel Nut

Tighten wheel nuts in numerical order.

Wheel Nut Torque	N·m (kgf·m/lb·ft)
117.7 ± 9.8 (12 ± 1.0 / 86.8 ± 7.2)	

3. Remove a engine jack.
4. Remove a transmission jack.
5. Connect the two fuel pipe clips (1) on the transmission crossmember left side.



RTW77ASH002701

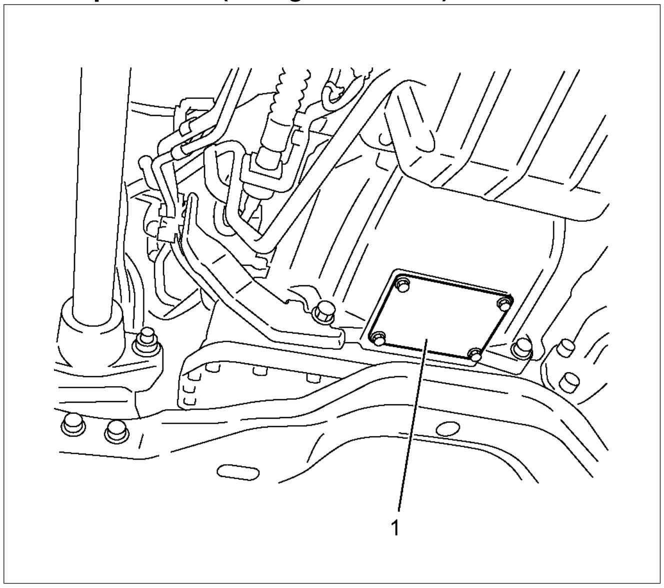
6. Install the torque converter bolts.

Torque: 29 N·m(3.0 kgf·m/22 lb·ft)

NOTE: Do not reuse the torque converter bolts.

7. Install the under cover(1).

Torque: 8 N·m(0.8 kgf·m/69 lb·in)

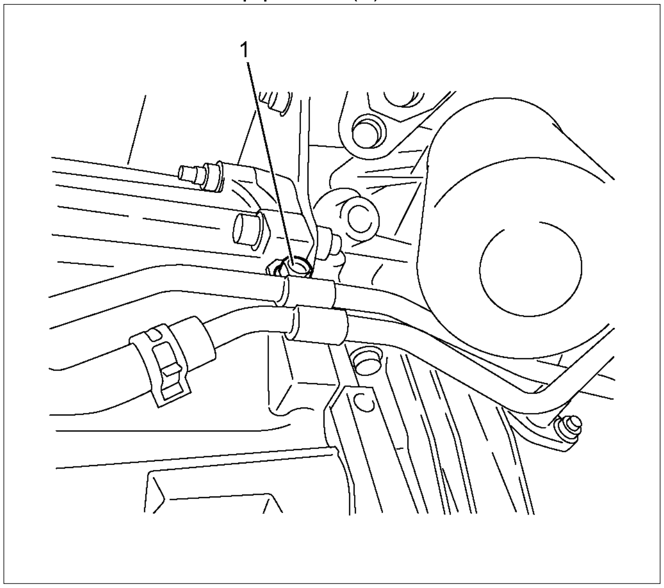


RTW77ASH002601

8. Connect two ATF pipes.

Torque: 44 N·m(4.5 kgf·m/33 lb·ft)

9. Install the ATF pipe bolt (1).



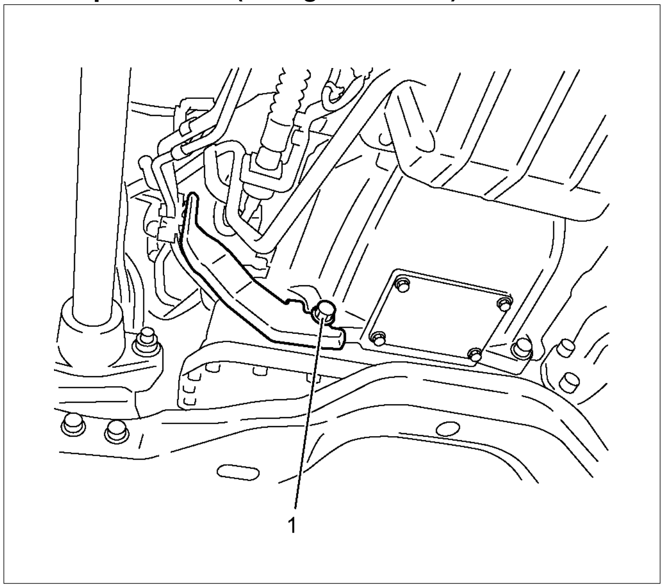
RTW77ASH002501

10. Connect the starter assembly with shift cable bracket.

Torque: 76 N·m(7.7 kgf·m/56 lb·ft)

11. Connect the shift cable bracket on the transmission side.
12. Install the fuel pipe bracket bolt (1) on clutch housing lower left side.

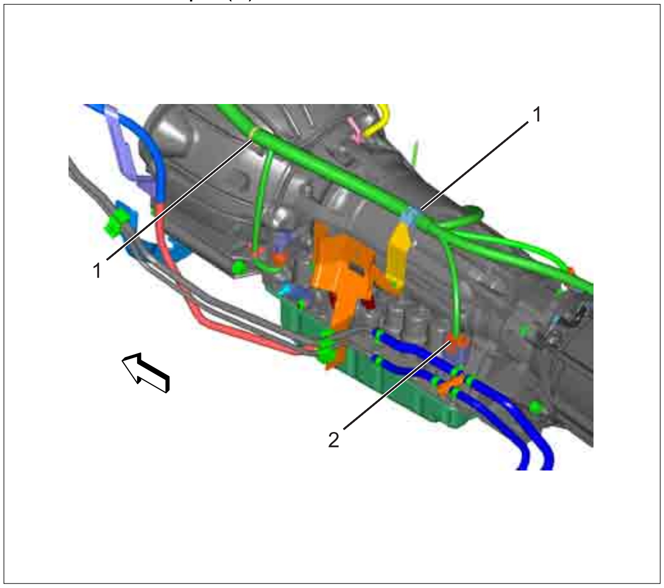
Torque: 76 N·m(7.7 kgf·m/56 lb·ft)



RTW77ASH002401

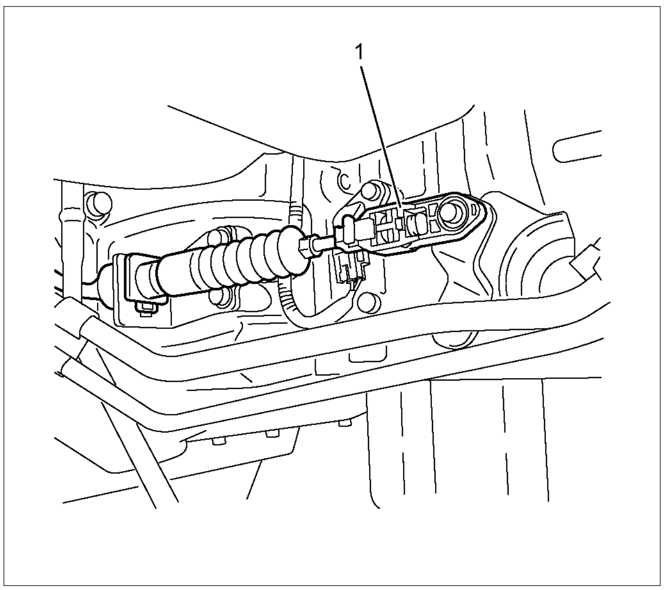
13. Install the oil level gauge and upper guide tube.

14. Connect the transmission harness connector (2) and two clips (1).



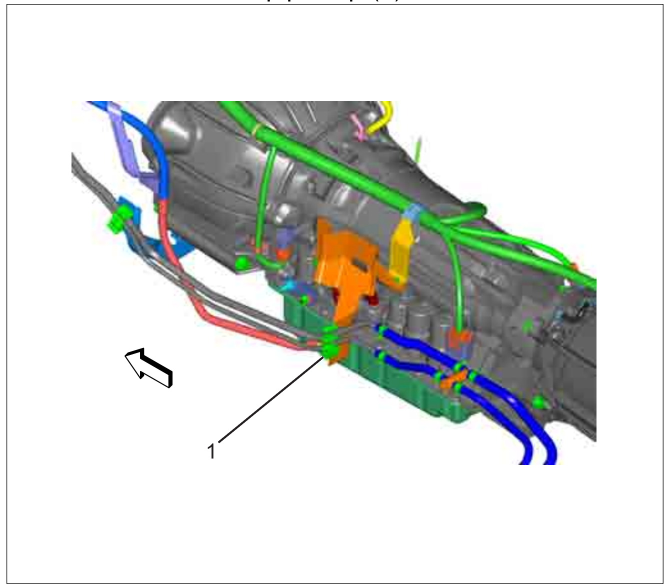
RTW77ASH001401

15. Connect the shift cable (1) to the transmission side.



RTW77ASH002801

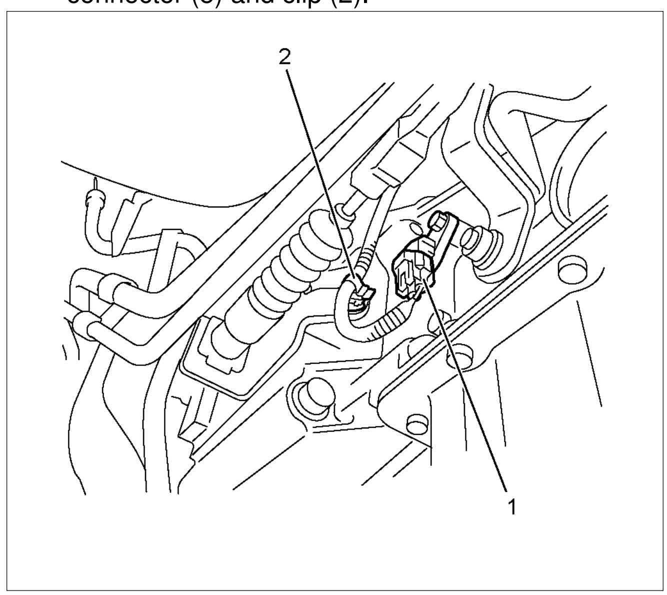
16. Connect the fuel pipe clip (1).



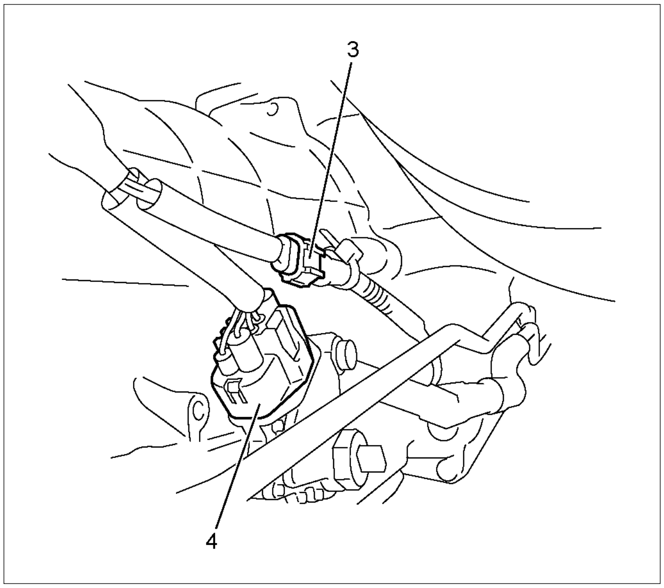
RTW77ASH001301

17. Connect the input sensor harness clip.

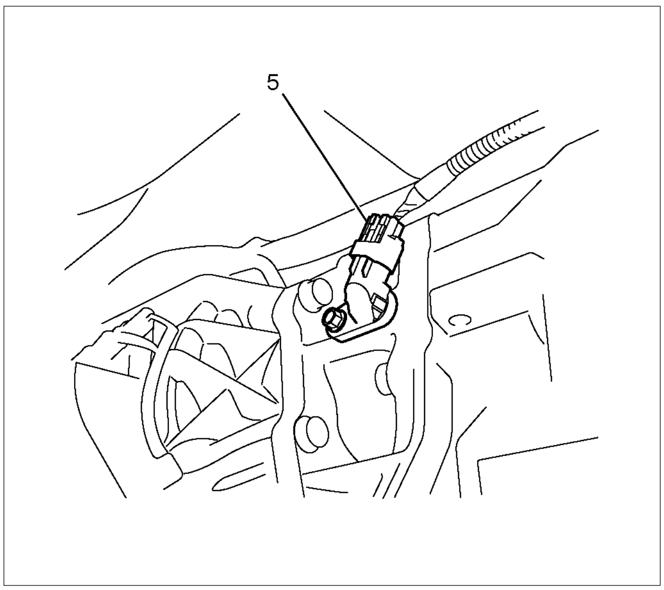
18. Connect the input sensor connector (1), ATF temperature sensor connector (3), neutral start (mode) switch connector (4), output sensor connector (5) and clip (2).



RTW77ASH002101



RTW77ASH002201

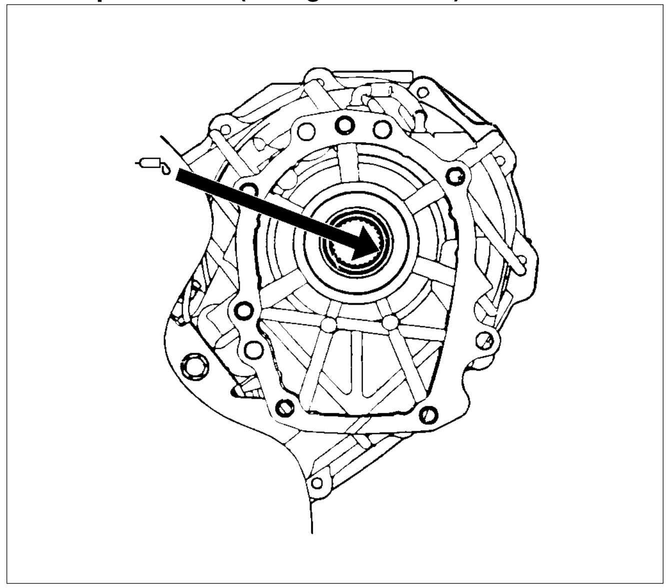


RTW77ASH002301

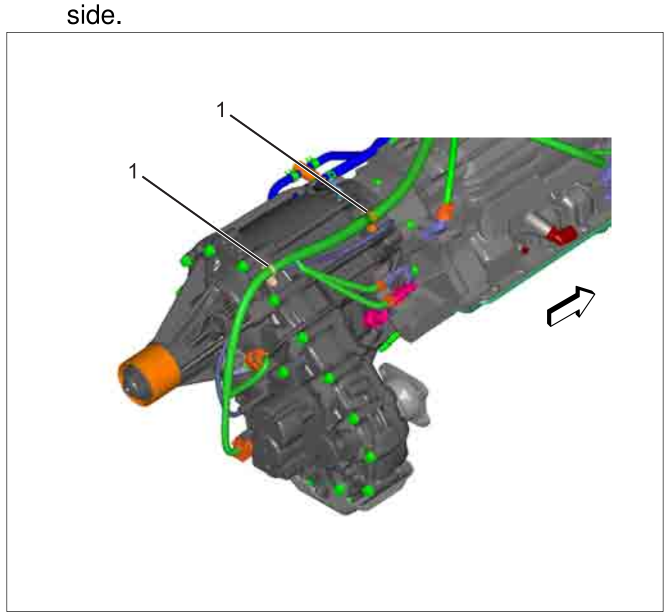
19.Install the transfer assembly.(4×4 only)

- Apply a thin coat of molybdenum disulfide grease to the input shaft spline.

Torque: 41 N·m(4.2 kgf·m/30 lb·ft)


RTW77ASH001701

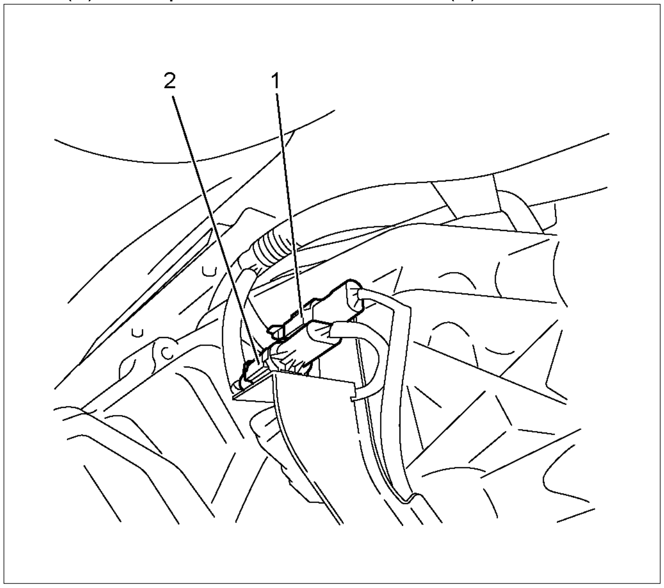
20.Connect two harness clips (1) of the tansfer upper side.



RTW77ASH001601

21.Connect the speed sensor connector.

22. Connect the 2WD-4WD switch connector (1), neutral switch connector (2), actuator connector (3) and speed sensor connector (4).



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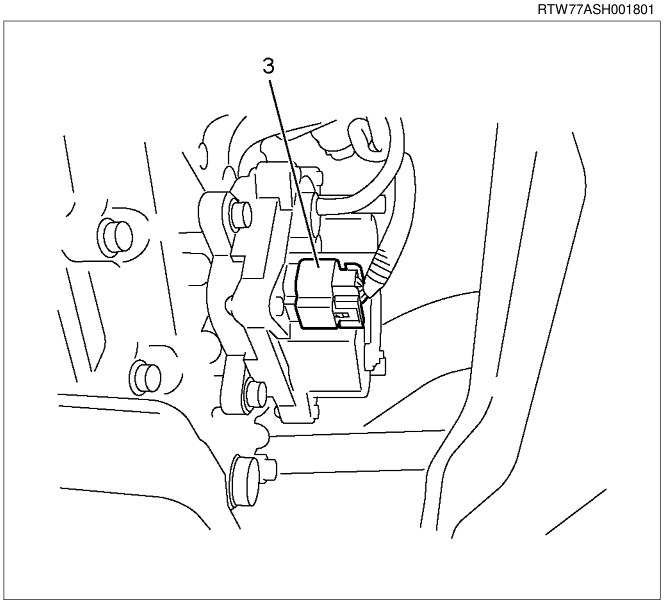

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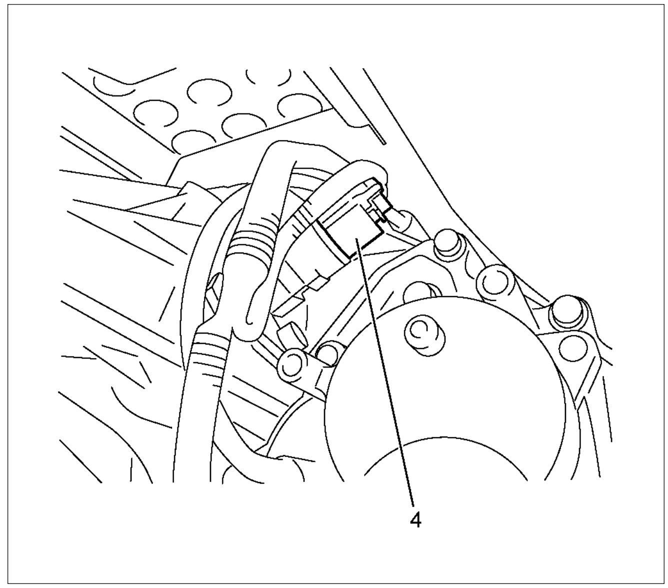
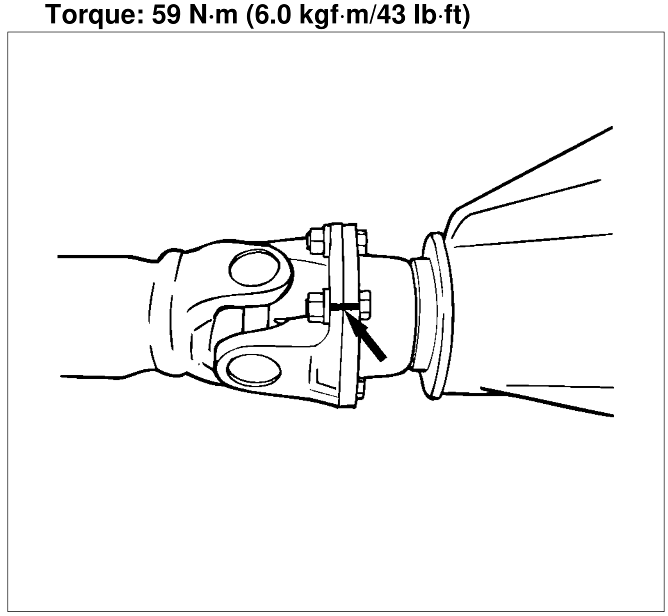


RTW77ASH002001

23. Install the rear propeller shaft.

NOTE: Align alignment marks on the flange.

Torque: 59 N·m (6.0 kgf·m/43 lb·ft)



RTW77BSH000201

24. Install the center bearing on the crossmember.

Torque: 69 N·m (7.0 kgf·m/51 lb·ft)

25. Install the front propeller shaft.(4×4 only)

NOTE: Align alignment marks on the flange.

Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

26. Remove the drain plug from oil pan and drain the fluid.

27. Install the drain plug.

Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

28. Pour the transmission oil.

29. Remove suitable stands.

30. Connect battery ground cable.

Major Components

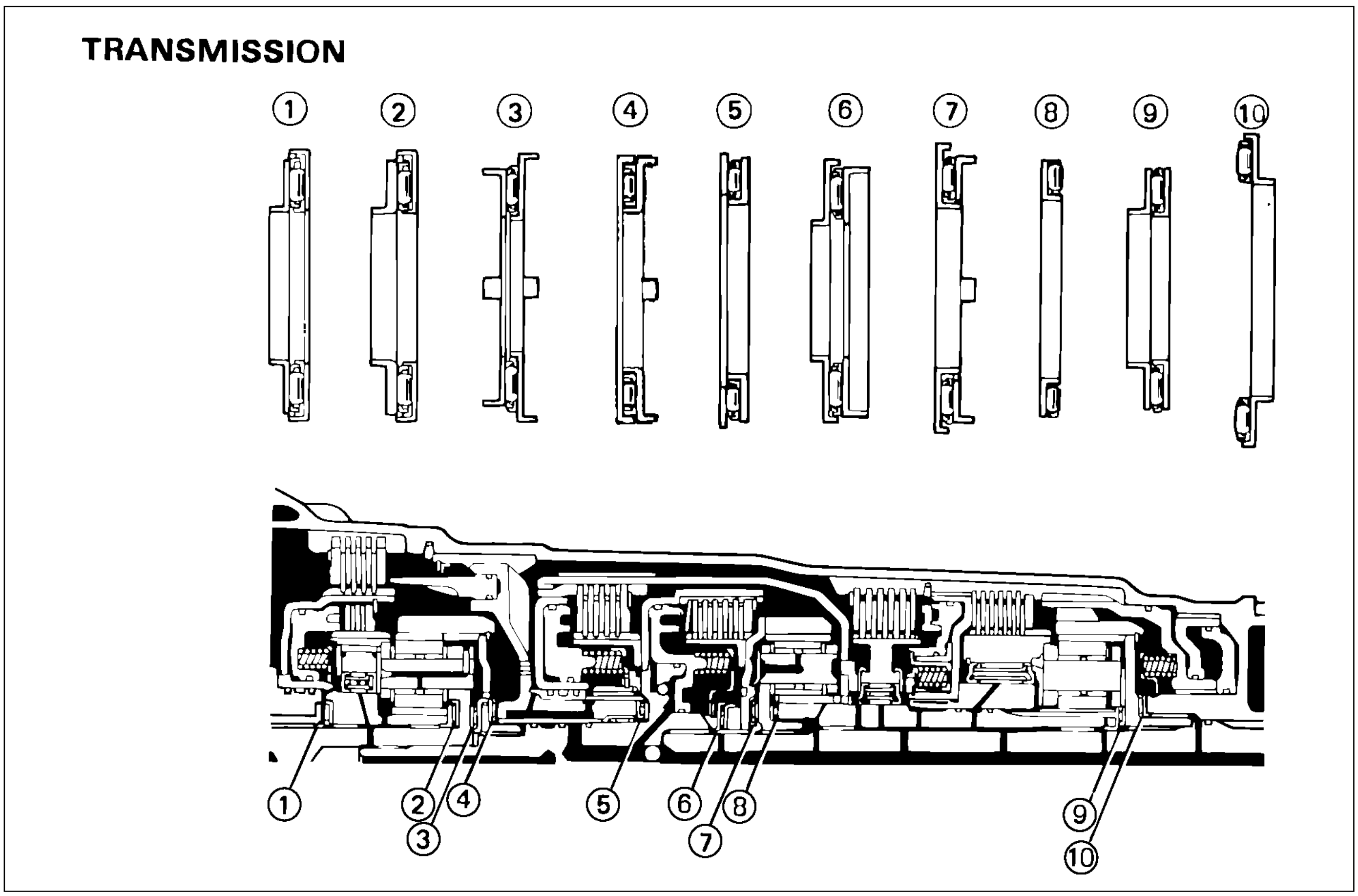
Disassembly, inspection and reassembly of each component group is indicated in the following chapter. Before reassembly, make sure, again, that all component groups are assembled correctly.

If something wrong is found in a certain component group during assembly, inspect and repair this group immediately.

General Assembly Notes:

1. The automatic transmission is composed of highly precision-finished parts, necessitating careful inspection before assembly because even a small nick could cause fluid leakage or affect performance.
2. Before assembling new clutch discs and brake bands, soak them in automatic transmission fluid for at least thirty minutes.
3. Apply automatic transmission fluid on the sliding or rotating surfaces of parts before assembly.
4. Use petroleum jelly to keep small parts in their palces.
5. Do not use adhesive cements on gaskets and similar parts.
6. When assembling the transmission, be sure to use new gaskets and O-rings.
7. Dry all parts with compressed air - never use shop rags.
8. Be sure to install the thrust bearings and races in the correct direction and position.

Bearing and Race



RUW36AMF000201

mm (in)

Mark	Front Race Diameter Inside/Outside	Thrust Bearing Diameter Inside/Outside	Rear Race Diameter Inside/Outside
1	28.6 (1.13) / 46.5 (1.83)	28.9 (1.14) / 50.2 (1.98)	—
2	28.45 (1.12) / 47.23 (1.86)	29.1 (1.15) / 50.2 (1.98)	—
3	24.7 (0.97) / 41.8 (1.65)	24.2 (0.95) / 47.8 (1.88)	—
4	37.2 (1.46) / 58.8 (2.31)	33.7 (1.33) / 50.1 (1.97)	—
5	36.7 (1.44) / 50.85 (2.00)	33.7 (1.33) / 47.8 (1.88)	—
6	26.0 (1.02) / 48.9 (1.93)	26.0 (1.02) / 46.7 (1.84)	26.8 (1.06) / 47.0 (1.85)
7	—	35.15 (1.38) / 53.65 (2.11)	34.3 (1.35) / 47.8 (1.88)
8	33.7 (1.33) / 47.6 (1.87)	35.6 (1.40) / 47.7 (1.88)	—
9	28.5 (1.12) / 44.2 (1.74)	27.7 (1.09) / 44.2 (1.74)	—
10	—	39.38 (1.55) / 58.15 (2.29)	—

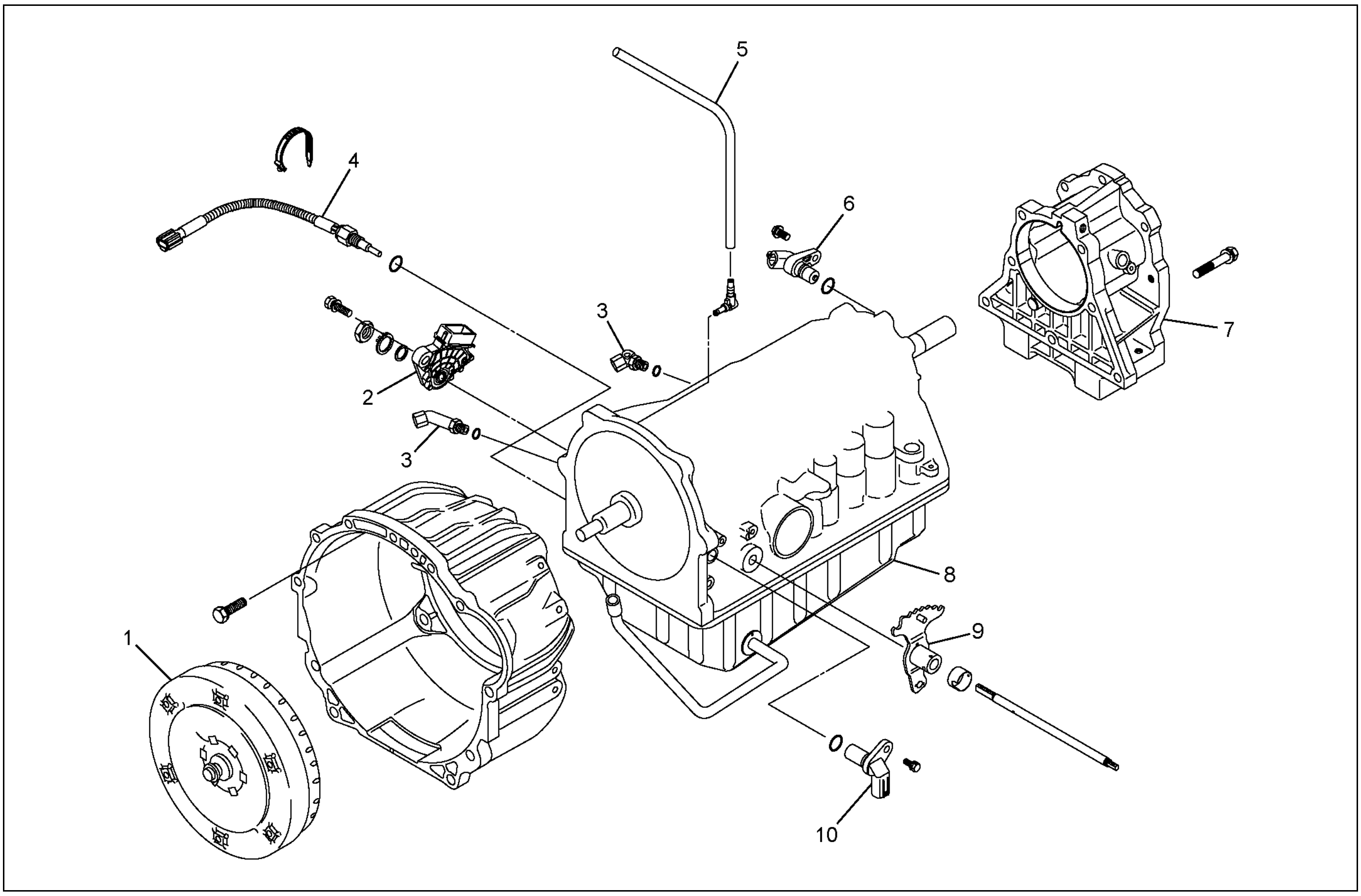
SECTION 7A4

UNIT REPAIR (AW30–40LE)

TABLE OF CONTENTS

Major Components (1)

Major Components (1) and Associated parts



RTW77AMF003801

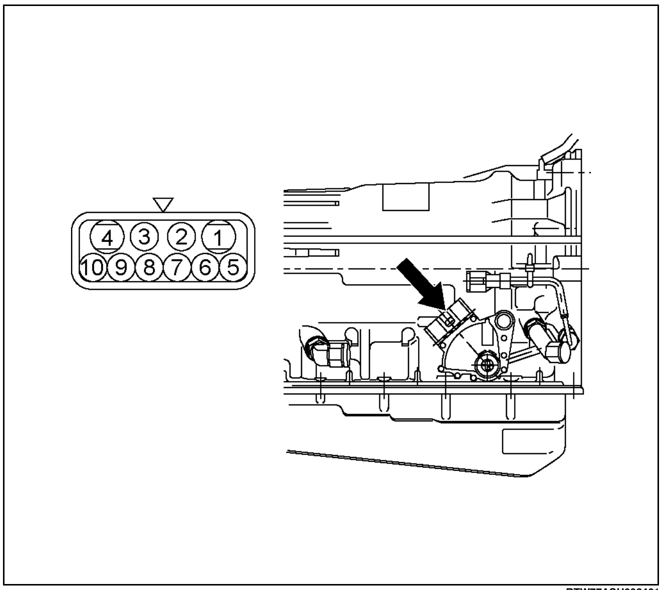
Legend

(1) Torque converter
(2) Neutral start switch
(3) Elbow
(4) Oil temperature sensor
(5) Breather hose
(6) Output revolution sensor
(7) Adapter housing
(8) Transmission assembly
(9) Select lever
(10) Input revolution sensor

Disassembly steps

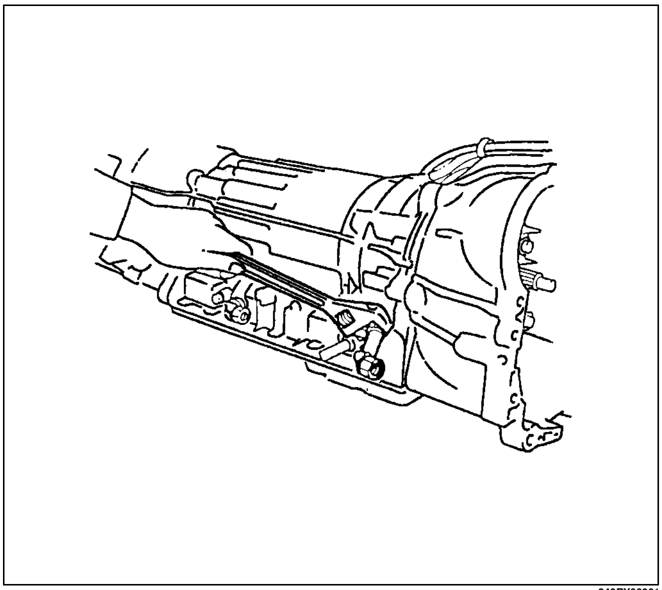
1. Remove the torque converter.
2. Remove the select lever.

3. Remove the neutral start switch (Mode switch).
   - Unstake the lock washer.
   - Remove the nut and bolt, and then remove the neutral start switch.
   - Remove the lock washer.



RTW77ASH003401

4. Remove the two elbows from transmission case.



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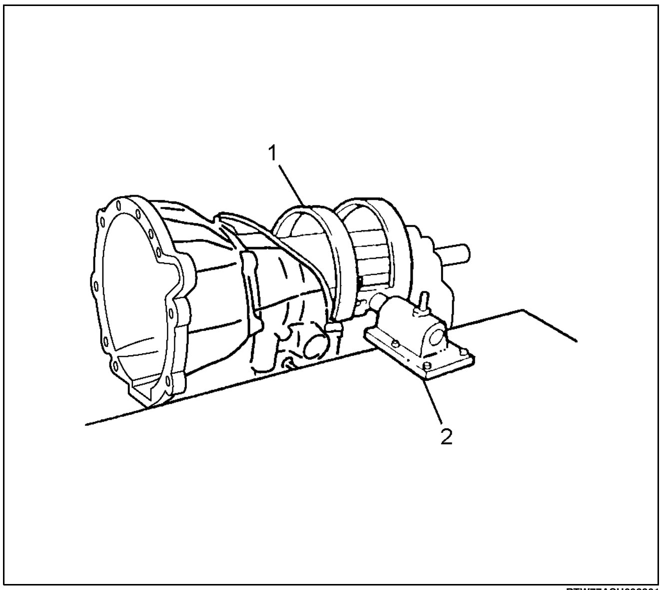
5. Remove the oil temperature sensor.
6. Remove the breather hose.
7. Remove the Input revolution sensor.
8. Remove the output revolution sensor (4×4).
9. Remove the output revolution sensor (4×2).
10. Remove the speedometer sensor, speedometer driven gear and plate (4×2).
11. Remove the extension housing (4×2).
12. Remove the adapter housing (4×4).
13. Remove the transmission assembly.
   - Install special tool to the transmission unit.
     Holding fixture: 5-8840-2152-0 (1)
     Holding fixture base: 5-8840-0003-0 (2)



RTW77ASH003301

Components (1)

Reassembly

1. Install a new gasket and the extension housing (4×2) to the transmission case.

Torque: 36 N·m (3.7 kgf·m/27 lb·ft)

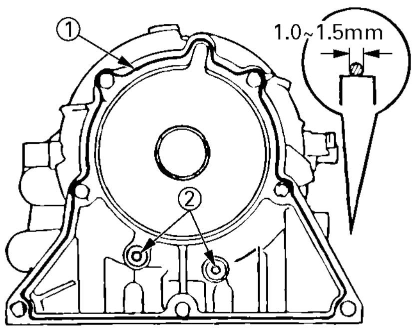
2. Install the speedometer driven gear, plate, and speedometer sensor (4×2).

Torque:

Plate bolt – 15 N·m (1.5 kgf·m/11 lb·ft)

Speedometer sensor – 25 N·m (2.5 kgf·m/18 lb·ft)

3. Install the adapter housing (4×4).
   - Remove any gasket material on the contacting surfaces of the adapter housing and transmission case.



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   - Apply liquid gasket (TB1281–B or its equivalent) (1) and install the apply gaskets (2) to the adapter housing as shown in the figure.
   - Install the adapter housing to the transmission case.

Torque: 36 N·m (3.7 kgf·m/27 lb·ft)

4. Install the neutral start switch.
   - Using the transmission select lever, fully turn the manual valve lever shaft back and return two notches.
     It is now in neutral.
   - Insert the neutral start switch onto the manual valve lever shaft and temporarily tighten the adjusting bolt.
   - Install the lock washer and nut.

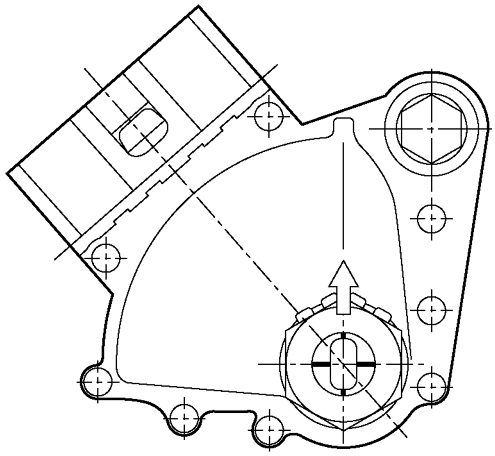
Torque: 7 N·m (0.7 kgf·m/61 lb·in)

   - Align the neutral standard line and the switch groove and tighten the adjusting bolt.

Torque: 13 N·m (1.3 kgf·m/113 lb·in)

   - Bend the tabs of the lock washer.

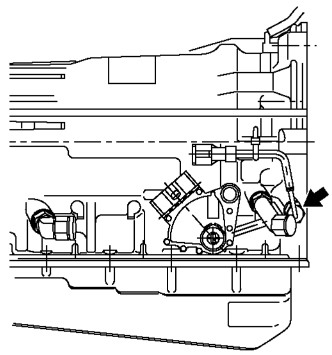
NOTE: Bend at least two of the lock washer tabs.



RUW17ASH013601

5. Install the oil temperature sensor to the transmission case.

Torque: 15 N·m (1.5 kgf·m/11 lb·ft)

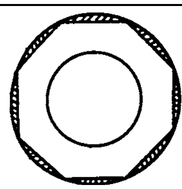


RTW77ASH003501

TROUBLESHOOTING

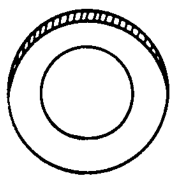
Typical examples of abnormal tire tread wear and major causes :

CAUTION:
Similar wear patterns can be caused by worn suspension parts, misalignment of wheels and tires, and other suspension related problems.



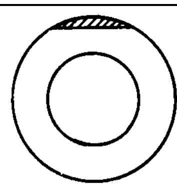
Spotty wear - wear localized on shoulder section. In extreme cases, the tire becomes polygonal in shape.

- Tire or wheel out of round or distorted.
- Hub or knuckle out of round or distorted.
- Play in hub bearings or ball joints.
- Rotating parts out of balance.



Tread wear one-sided.

- Rotating parts out of balance.
- Tire or wheel out of round.
- Hub or knuckle out of round or distorted.

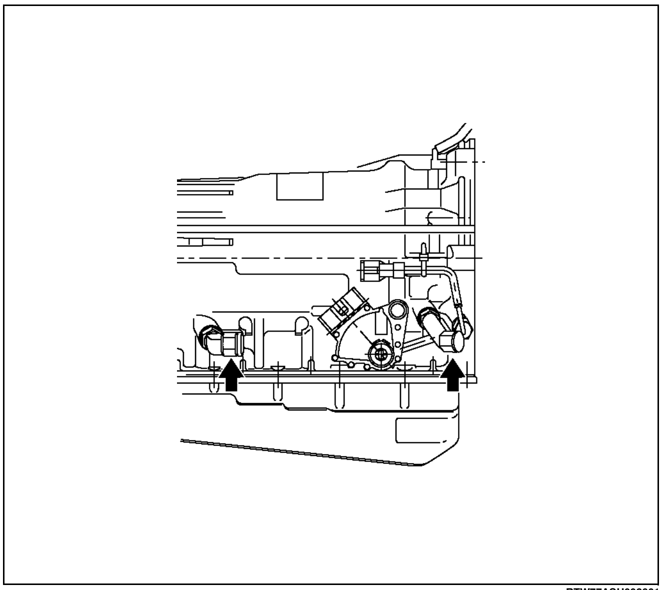


Localized tread wear.

- Once spotty wear develops in tread due to hard braking or abrupt starting, localized wear tends to be accelerated.

6. Install the elbow.
   - Coat new O-rings with ATF, install them to the two elbows.
   - Install the two elbows as shown in the figure.

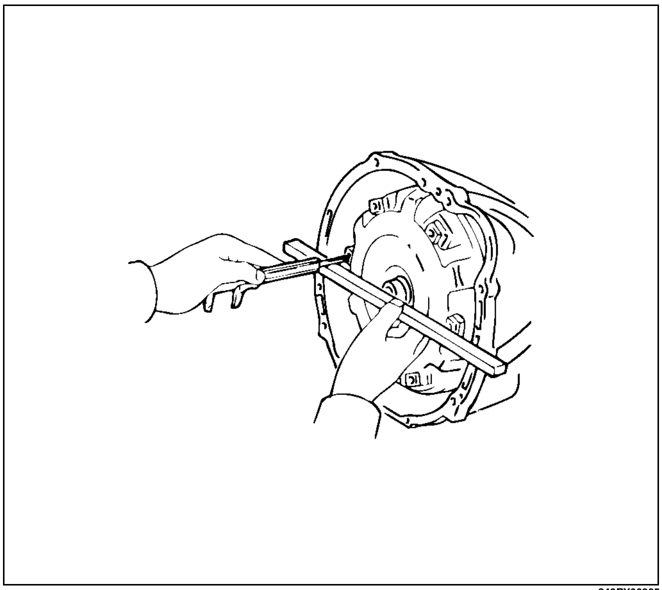
Torque: 29 N·m (3.0 kgf·m/22 lb·ft)



RTW77ASH003601

7. Install the select lever.
8. Install the output revolution sensor (4×2).
9. Install the output revolution sensor (4×4).
10. Install the input revolution sensor.
11. Install the breather hose.
12. Install the torque converter.
    Using calipers and a straightedge, measure the distance from the installed surface of the transmission housing to top of the torque converter nut.

Correct distance: 13.5 mm (0.53 in)



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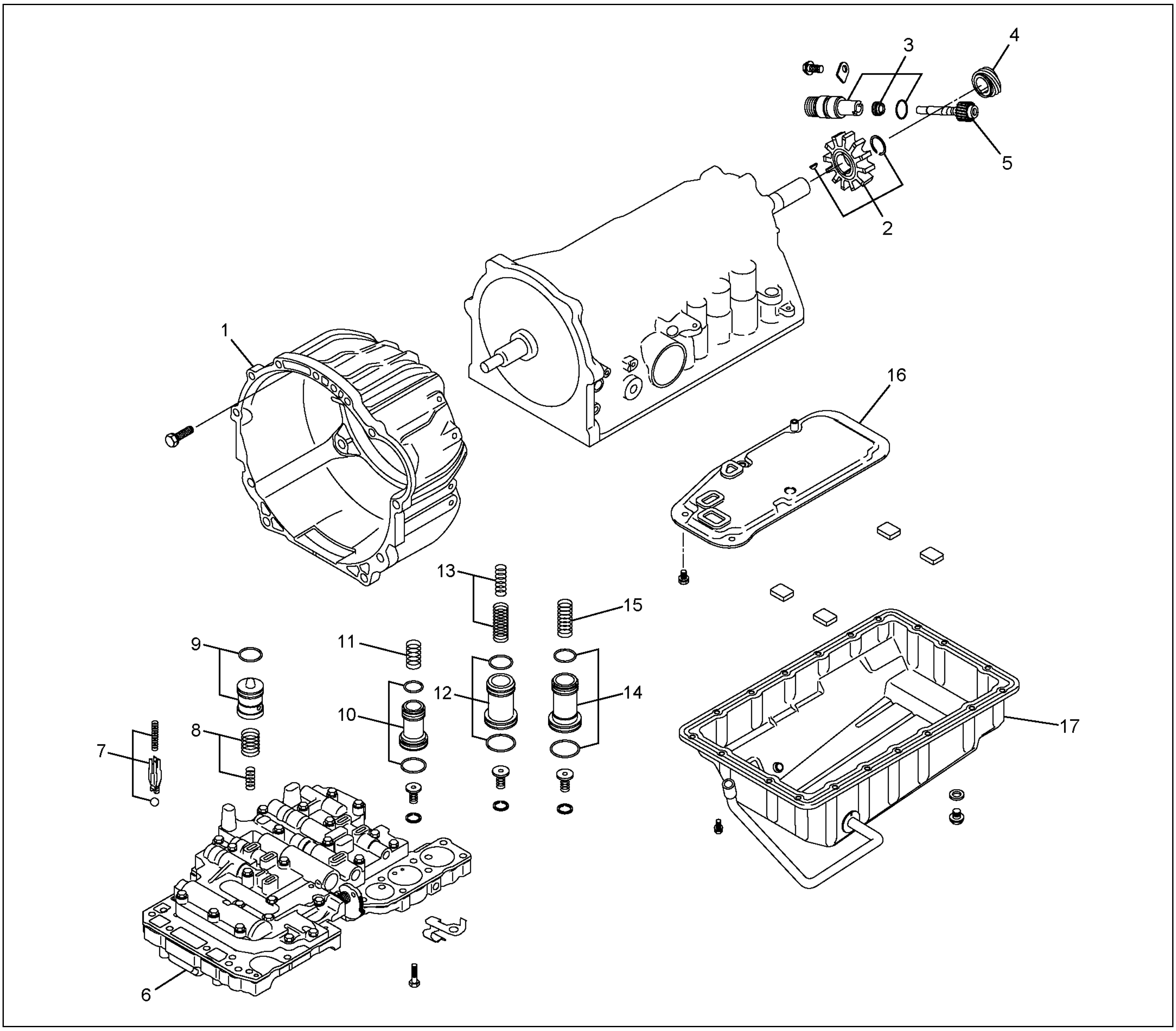
Major Components (2)

Major Componets (2) and Associated Parts

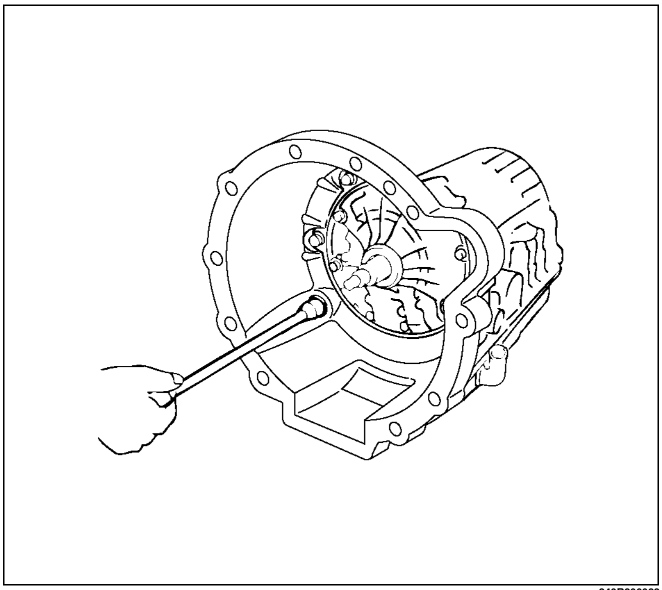


Legend

(1) Converter housing
(2) Snap ring, rotor, key
(3) Speedometer shaft sleeve
(4) Speedometer drive gear
(5) Speedometer driven gear
(6) Valve body
(7) Check valve, spring, ball
(8) Spring
(9) Accumulator piston (C–0), O-ring
(10) Accumulator piston (B–0), O-ring
(11) Spring
(12) Accumulator piston (C–2), O-ring
(13) Spring
(14) Accumulator piston (B–2), O-ring
(15) Spring
(16) Oil strainer assembly
(17) Oil pan

Disassembly

1. Remove the six bolts and remove the converter housing.



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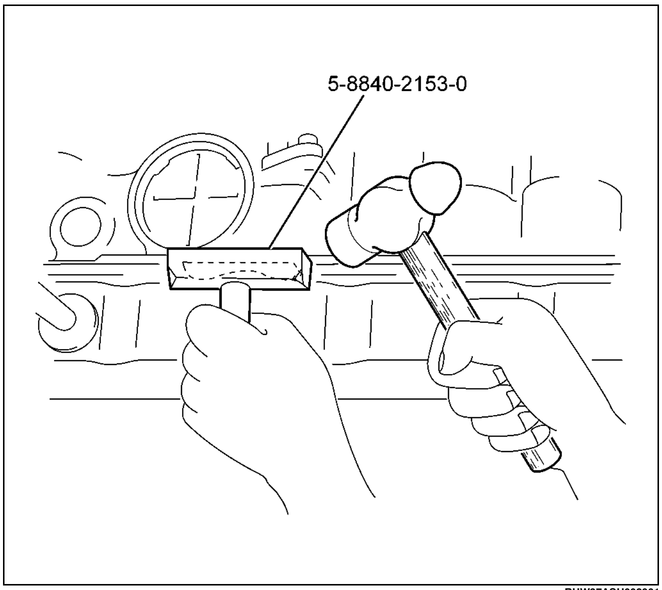
2. Remove the oil pan.

NOTE: Do not turn over the transmission as this will contaminate the valve body with foreign materials in the bottom of the oil pan.

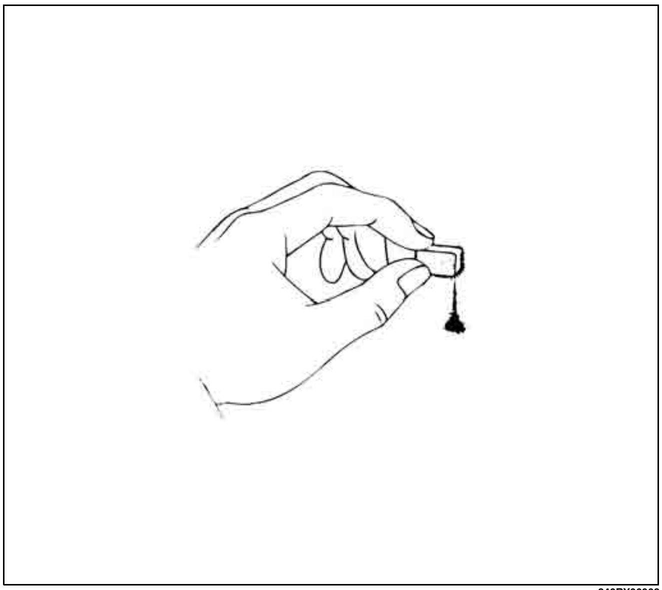
- Remove the nineteen bolts.
- Remove oil pan by lifting the transmission case. Oil pan seal cutter: 5-8840-2153-0



RUW37ASH002901

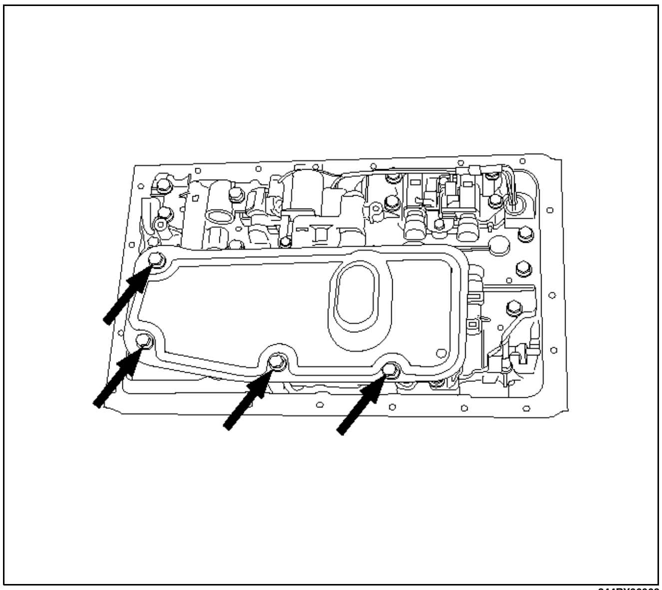
3. Examine particles in oil pan.

- Remove the magnet and use it to collect any steel chips.
- Look carefully at the chips and particles in the oil pan and on the magnet to anticipate what type of wear you will find in the transmission:
  Steel (magnetic) ...... bearing, gear and clutch plate wear
  Brass (non-magnetic)... bushing wear



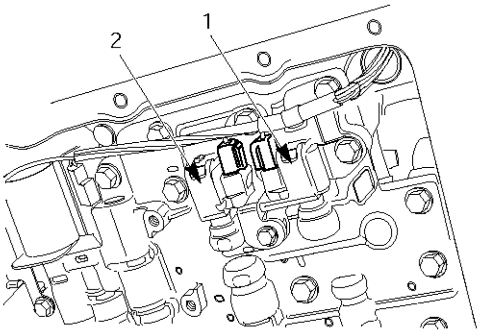
240RY00008

4. Remove the oil strainer assembly.
   Remove four bolts holding the oil strainer.

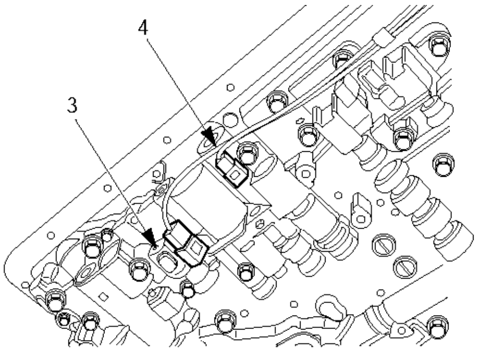


244RY00003

5. Remove the valve body.
   - Disconnect the connectors from the solenoid S1 (1), S2 (2), lock-up solenoid (3) and pressure control solenoid (4).

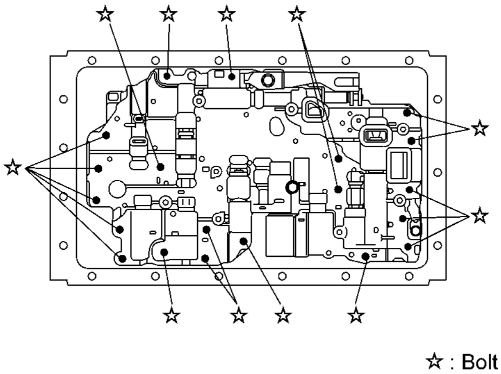


249RY00011



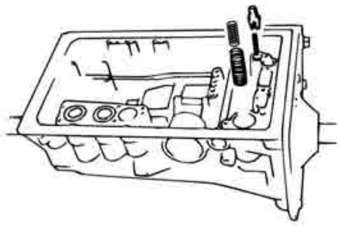
249RY00012

   - Remove the twenty bolts from valve body.



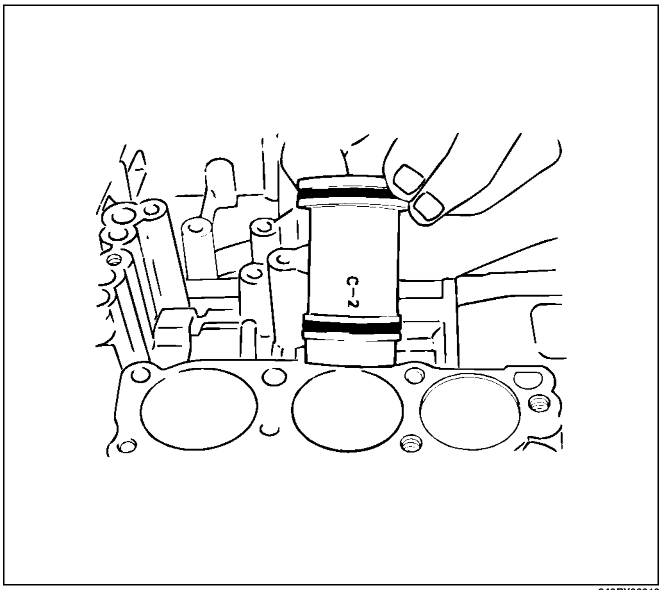
244R200078

6. Remove the check valve and spring.
7. Remove two springs from C–0 accumulator piston.



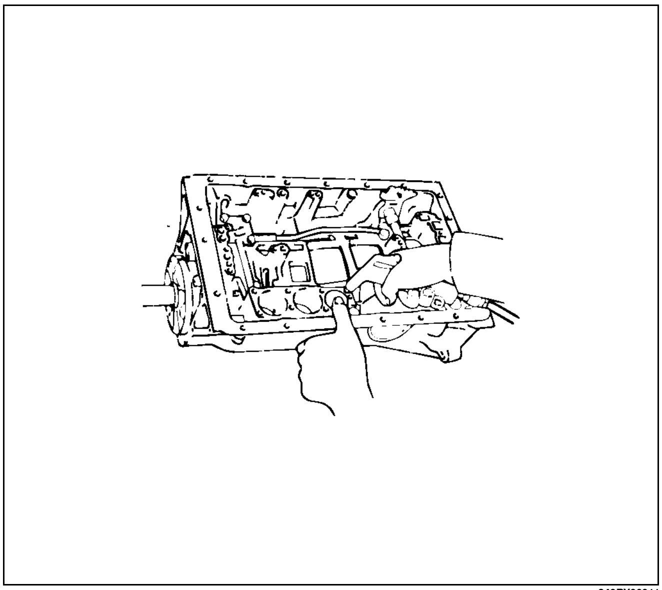
240RY00028

8. Remove the accumulator piston (B–2).
9. Remove the accumulator piston (C–2).
   - Remove accumulator pistons and springs from transmission case.



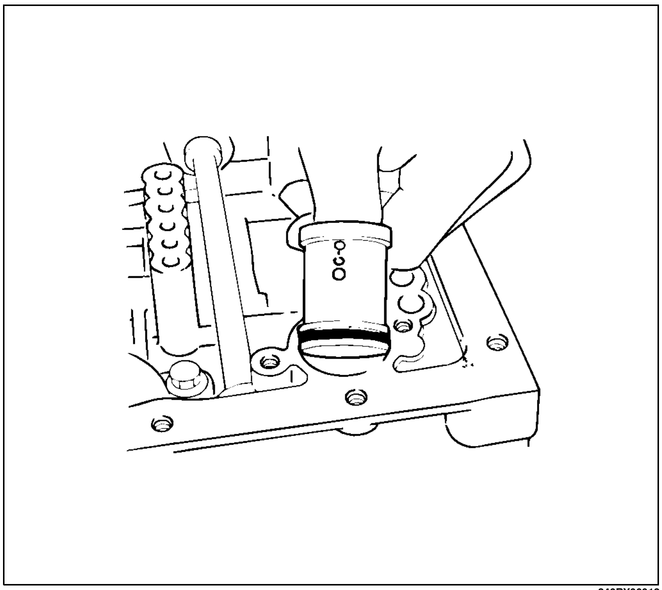
240RY00010

10. Applying compressed air to the oil hole, remove the B–0 accumulator piston and spring.



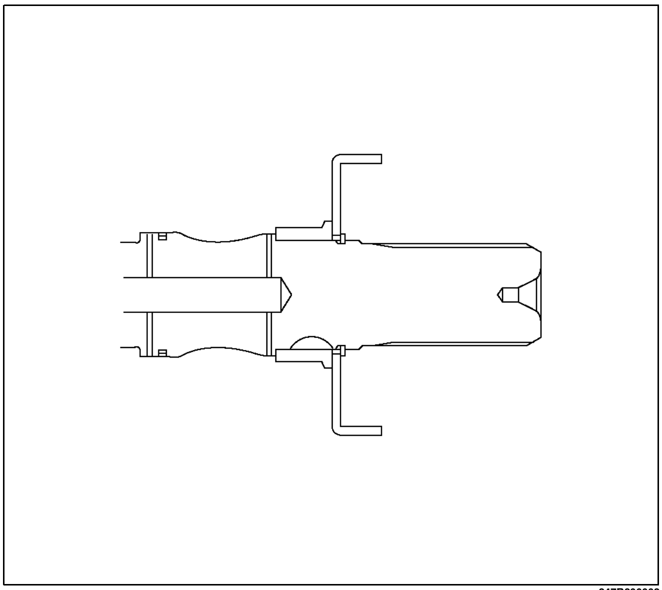
240RY00011

11. Remove the C–0 accumulator piston.



240RY00012

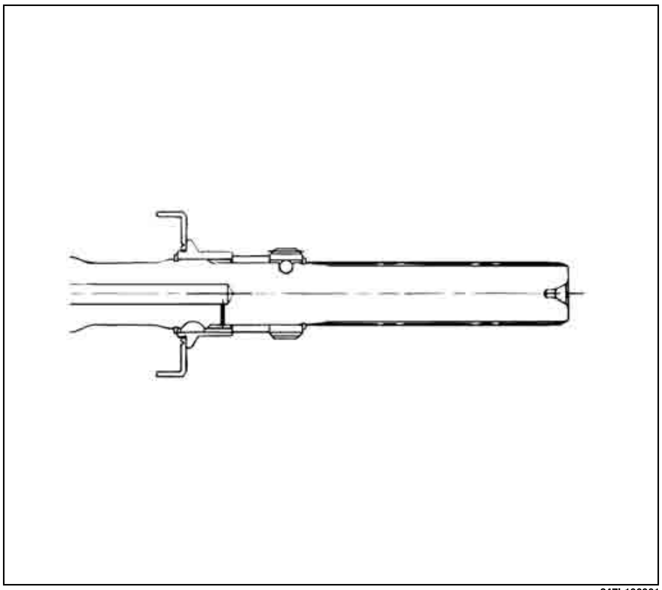
12. Remove the second brake drum gasket.
13. Remove the solenoid wiring.
    - Turn over transmission, remove the solenoid wiring stopper plate from the case.
    - Pull the wiring out of the transmission case.
14. Remove the snap ring, rotor and key (4×4).
    - Remove the snap ring from the output shaft.
    - Remove the rotor and key.



247R200002

15. Remove the snap ring, speedometer sensor drive gear and ball (4×2).
    - Remove the snap ring from the output shaft.
    - Remove the speedometer sensor drive gear, and ball.

16. Remove the spacer, rotor, key and snap ring (4×2).
    - Remove the spacer, rotor and key.
    - Remove the snap ring from the output shaft.



247L100001

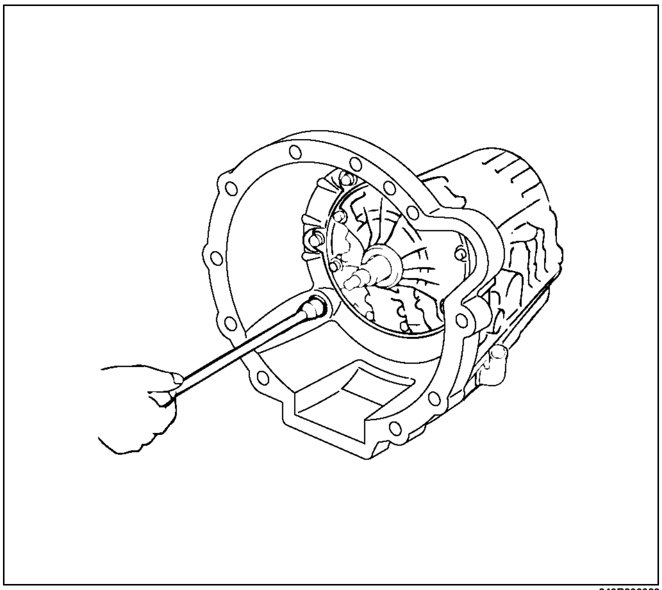
Reassembly

1. Install the converter housing.

Torque:

M10 – 34 N·m (3.5 kgf·m/25 lb·ft)

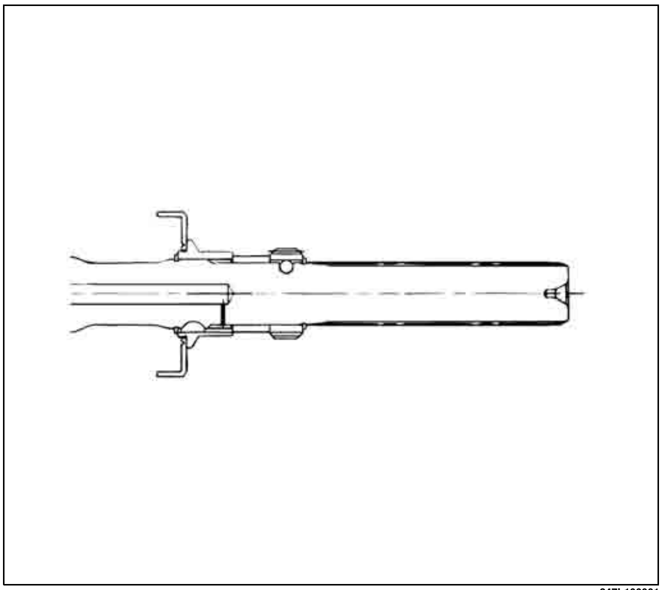
M12 – 57 N·m (5.8 kgf·m/42 lb·ft)



240R200022

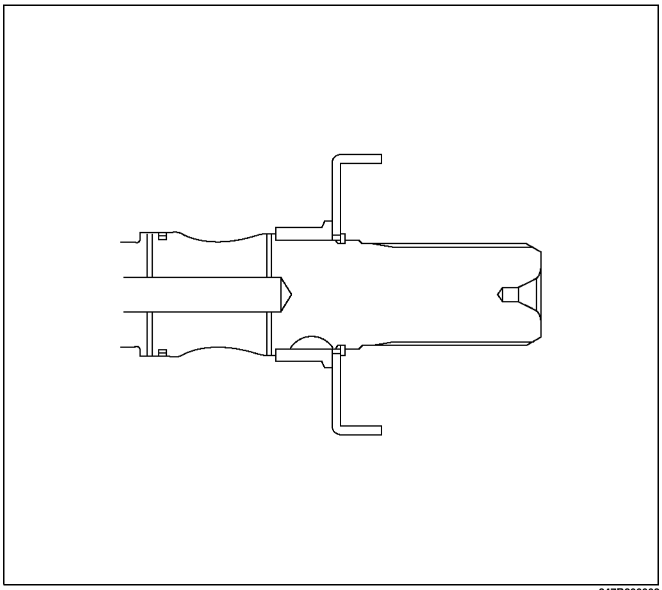
2. Install the snap ring, key and rotor (4×2).
    - Install the snap ring to the output shaft.
    - Install the key and rotor.

3. Install the spacer, ball, speedometer sensor drive gear and snap ring (4×2).
    - Install the spacer, ball and speedometer sensor drive gear.
    - Install the snap ring to the output shaft.



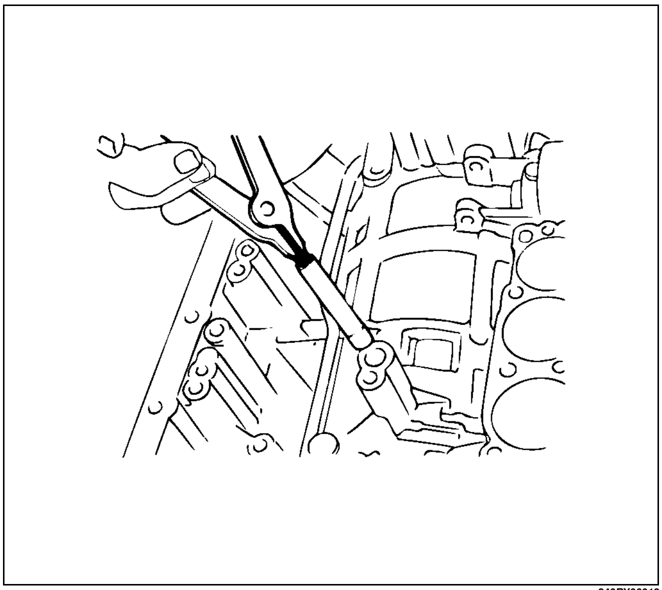
247L100001

4. Install the key, rotor and snap ring (4×4).
    - Install the key and rotor.
    - Install the snap ring to the output shaft.



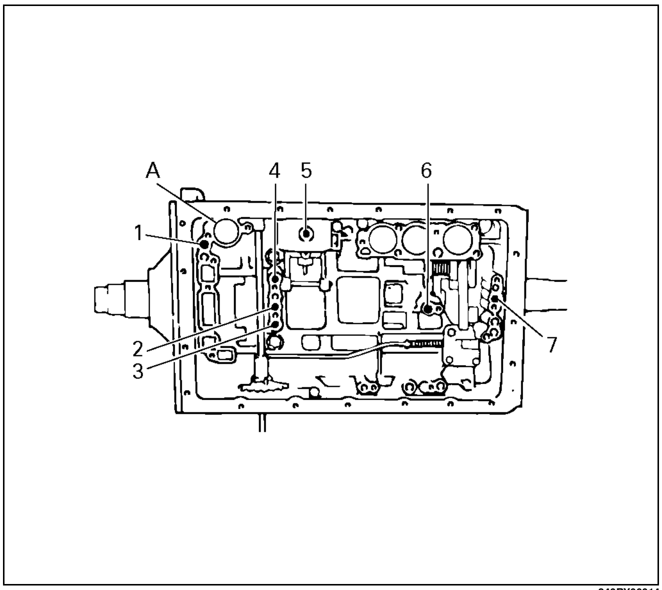
247R200002

5. Install the second brake drum gasket.
   - Install a new second brake drum gasket to the transmission case.



240RY00013

6. Individual piston operation inspection.
   Check for the sound of operation while injecting compressed air into the oil hole indicated in the figure.



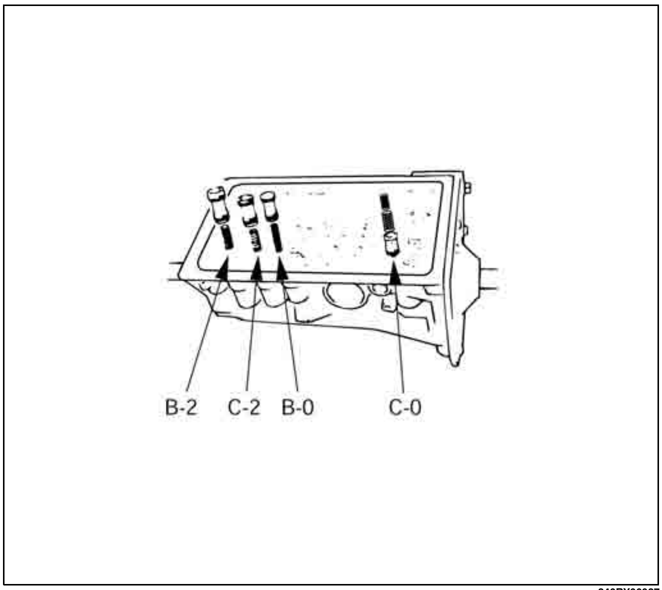
240RY00014

Legend

(1) OD direct clutch
(2) Direct clutch
(3) Forward clutch
(4) OD brake
(5) Second coast brake
(6) Second brake
(7) First and reverse brake
(A) C–0 Accumulator piston hole

NOTE: When inspecting the direct clutch, check with the C–0 accumulator piston hole closed. If there is no noise, disassemble and check the condition of the parts.

7. Install the accumulator pistons.
   - Coat the O–ring with ATF and install it to the piston.
     Install the three springs and four accumulator pistons to the bore as shown in th figure.

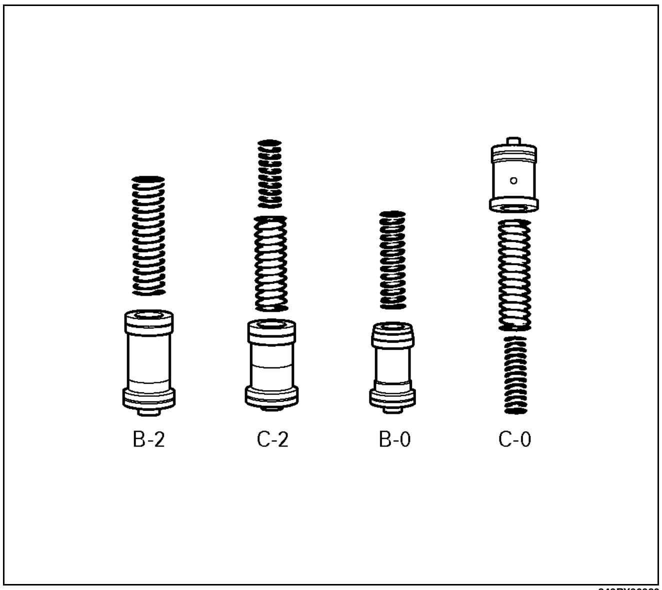


240RY00027

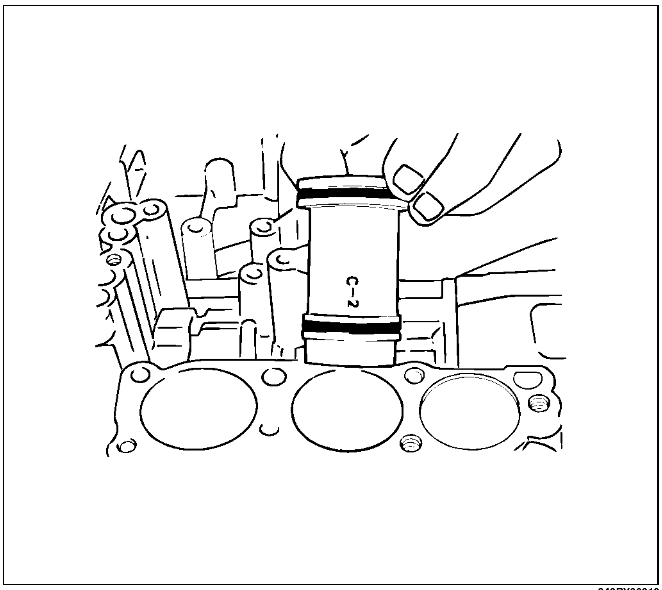
Piston	Outer diameter	Height
B–2	36.8 mm (1.449 in)	62.5 mm (2.461 in)
C–2	36.8 mm (1.449 in)	56.6 mm (2.228 in)
B–0	31.8 mm (1.252 in)	52.0 mm (2.047 in)
C–0	29.8 mm (1.173 in)	44.0 mm (1.732 in)

mm (in)

Spring	Free length	Outer diameter	Color
B–2	75.8 (2.984)	20.1 (0.791)	PURPLE
C–2 (Outer)	64.0 (2.520)	20.3 (0.799)	WHITE& PINK
C–2 (Inner)	42.1 (1.657)	14.7 (0.579)	PINK
B–0	62.0 (2.441)	16.0 (0.630)	GREEN
C–0 (Outer)	74.6 (2.937)	20.9 (0.823)	ORANGE
C–0 (Inner)	46.0 (1.811)	14.0 (0.551)	YELLOW

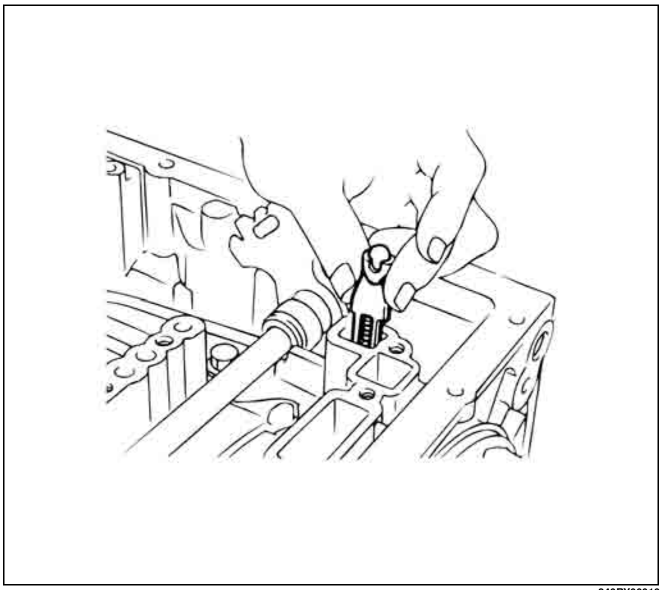


240RY00029



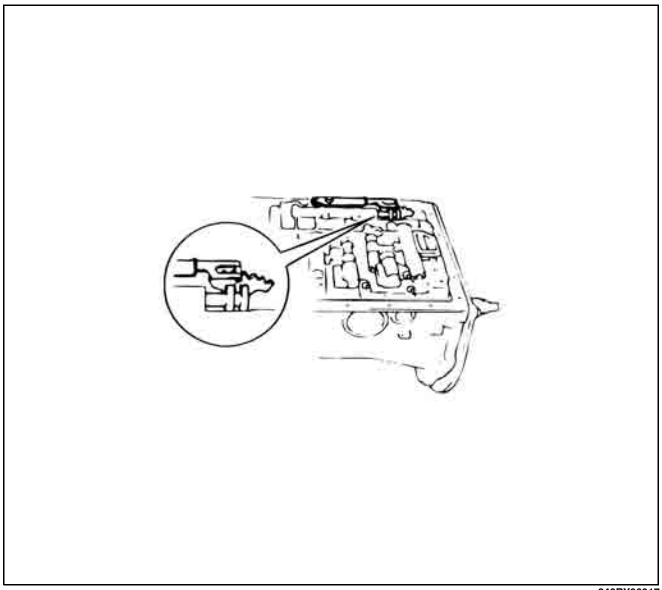
240RY00010

8. Install new check valve and spring.



240RY00016

9. Install the valve body.
   - Align the groove of the manual valve to the pin of the lever.

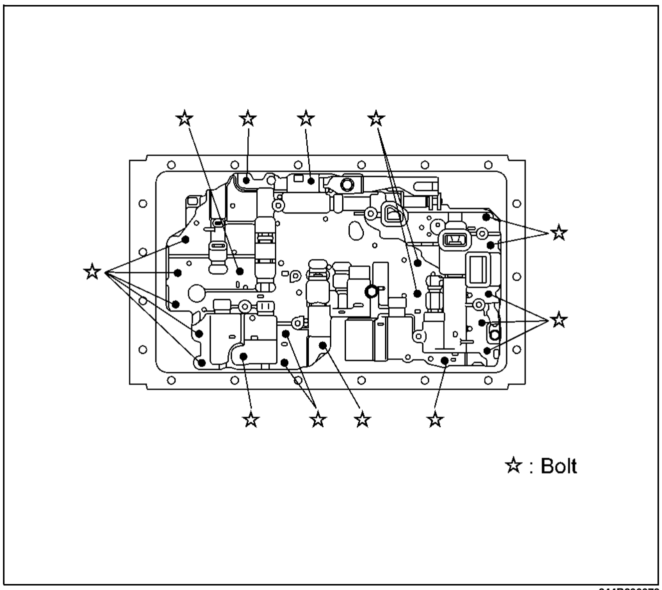


240RY00017

   - Install the twenty bolts.

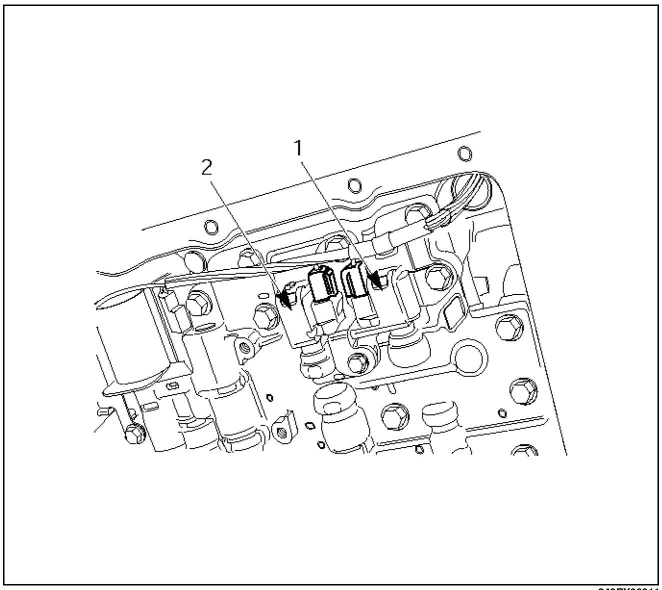
NOTE: Each bolt length (mm) is indicated in the figure.

Torque: 10 N·m (1.0 kgf·m/87 lb·in)

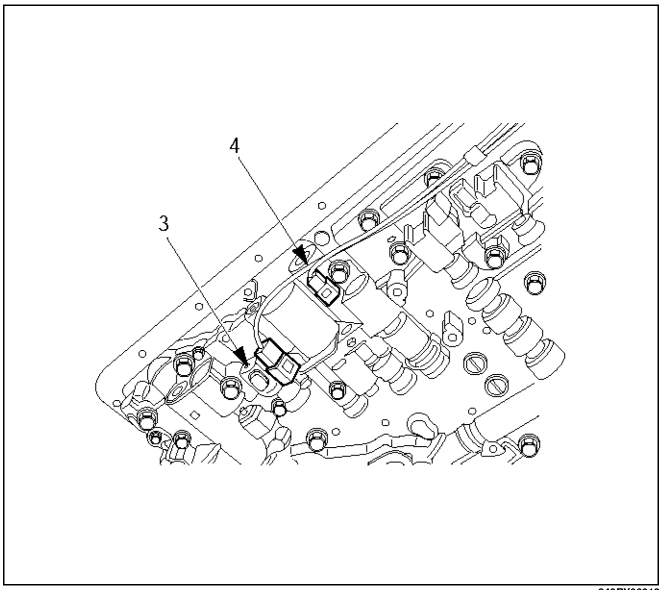


244R200078

10. Install the solenoid wiring.
    Coat a new O-ring with ATF, and install it to the solenoid wiring.
    Insert the solenoid wiring to the case and install the stopper plate.
    Connect the connectors to the solenoid S1 (1), S2 (2), lock-up solenoid (3), and pressure control solenoid (4).

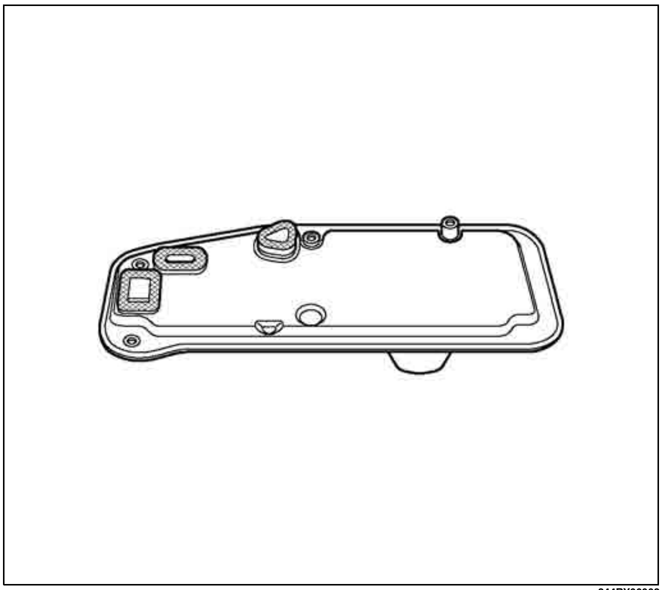


249RY00011



249RY00012

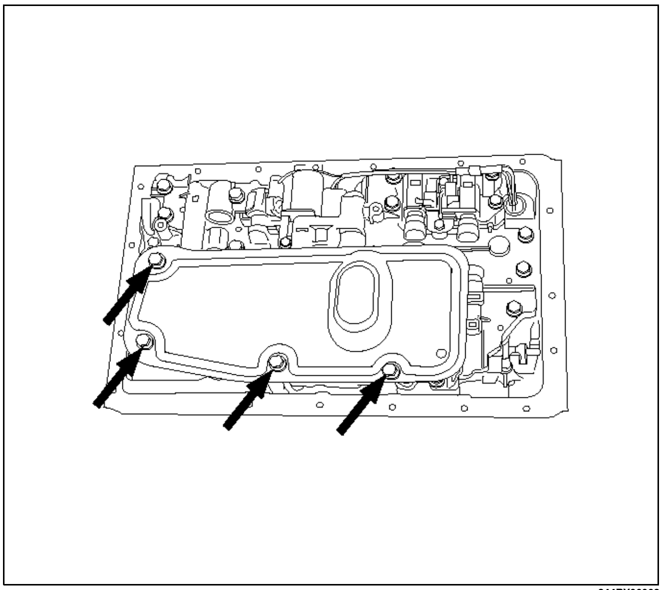
11. Install a new oil strainer assembly with gaskets.



244RY00002

- Install the oil strainer with the gaskets to the valve body. Tighten the four bolts.

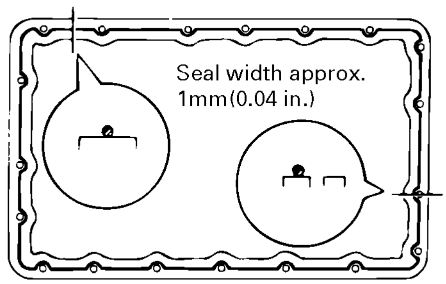
Torque: 10 N·m (1.0 kgf·m/87 lb·in)



244RY00003

12. Install the oil pan.
    Install two magnets in oil pan.
    Remove any gasket material and be careful not to drop oil on the contacting surfaces of the transmission case and oil pan.
    Apply liquid gasket (TB1281 or its equivalent) to the oil pan as shown in the figure.

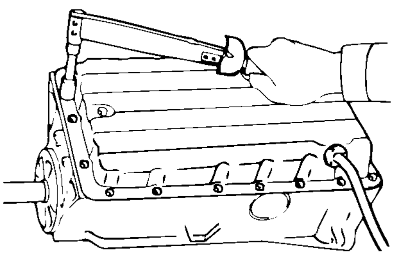
NOTE: Install the oil pan as soon as the seal gasket is applied.



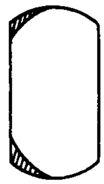
240RY00019

- Install and tighten the nineteen bolts.

Torque: 7.4 N·m (0.75 kgf·m/65 lb·in)



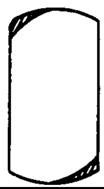
240RY00020



Shoulder wear (generally wear develops on outer shoulder).

Camber or toe-in incorrect.

Shoulder wear caused by repeated hard-cornering.



Wear on shoulders at points opposed to each other.

Tire or wheel out of round or distorted.

Play in bearings or ball joint.

Premature wear on shoulders.

Flexing of tire excessive due to under-inflation.

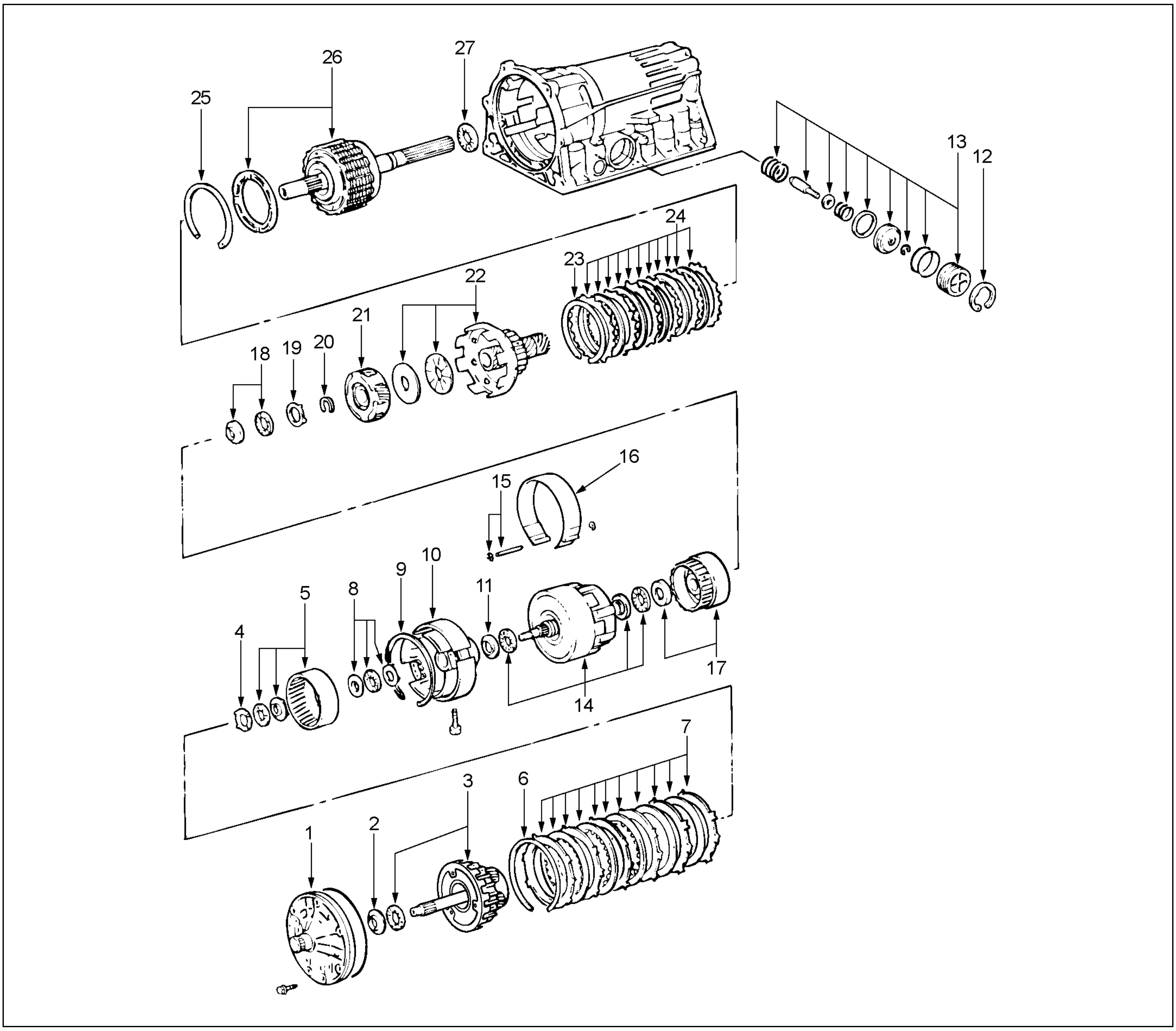
One-sided feather edging.

Wear caused by repeated hard-cornering.

Camber or toe-in incorrect.

Major Components (3)

Major Components (3) and Associated Parts

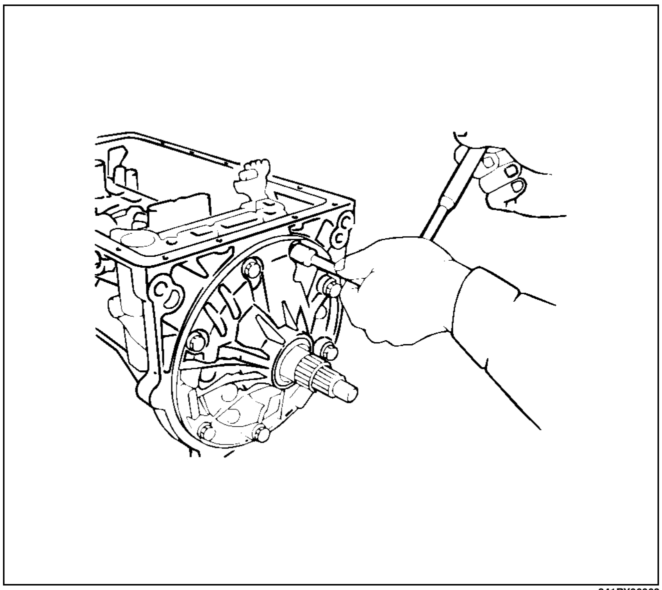


Legend

(1) Oil pump
(2) Race
(3) OD planetary gear and OD direct clutch
(4) Race
(5) OD planetary ring gear
(6) Snap ring
(7) Flange, plate and disc (B–0)
(8) Bearing and race
(9) Snap ring
(10) OD support
(11) Race
(12) Snap ring
(13) Second coast brake piston assembly
(14) Direct clutch and forward clutch
(15) E-ring and pin
(16) Second coast brake band
(17) Front planetary ring gear
(18) Bearing and race
(19) Race
(20) Snap ring
(21) Front planetary gear
(22) Drum and one-way clutch
(23) Snap ring
(24) Flange, plate and disc (B–2)
(25) Snap ring
(26) Rear planetary gear, second brake drum and output shaft
(27) Bearing

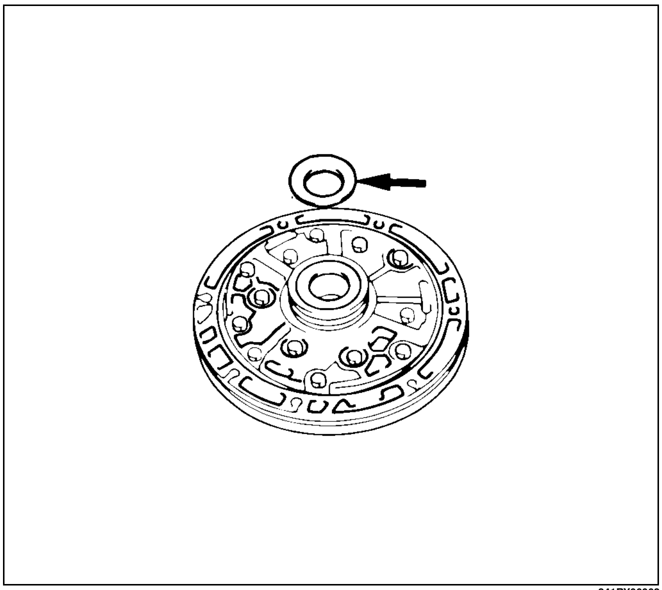
Disassembly

1. Remove seven bolts fixing the oil pump to the transmission case.
   Remove the oil pump.



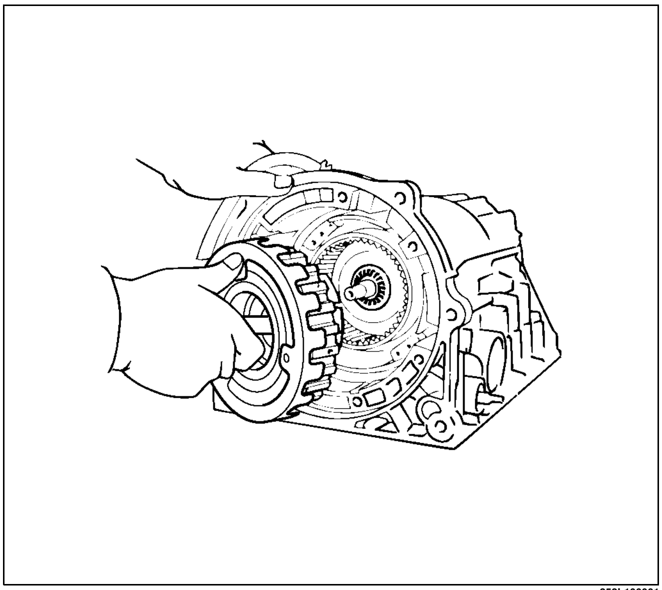
241RY00003

2. Remove race from oil pump.



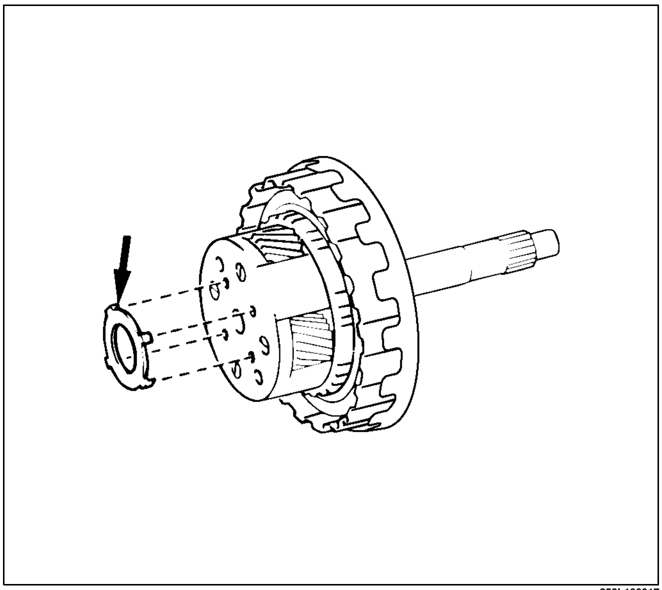
241RY00002

3. Remove the overdrive planetary gear and overdrive direct clutch with thrust needle bearing from the transmission case.



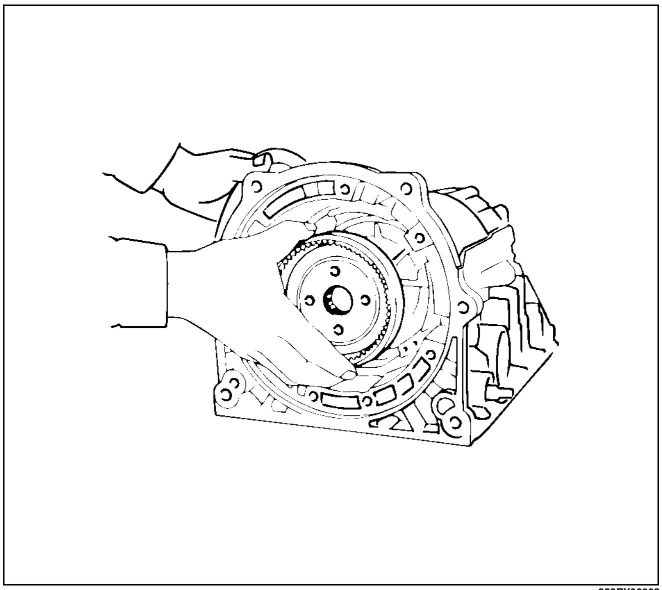
252L100001

4. Remove the race from OD planetary gear.



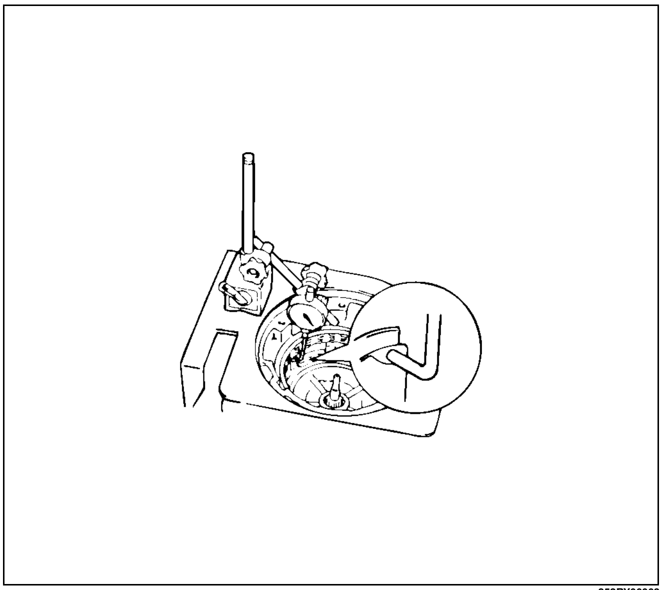
252L100017

5. Remove the overdrive planetary ring gear from the transmission case.



252RY00002

6. Check piston stroke of overdrive brake
   Place a dial indicator onto the overdrive brake piston as shown in the figure.



252RY00003

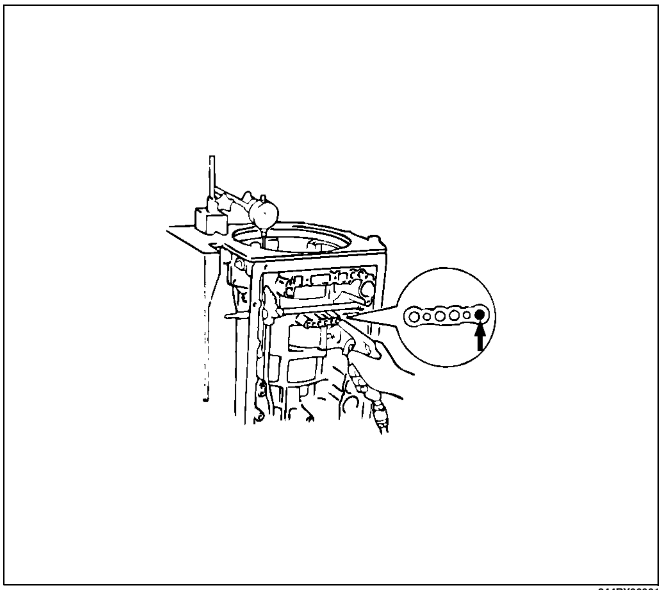
   Measure the stroke applying and releasing the compressed air (390 – 780 kPa or 57 – 114 psi) as shown in the figure.

Piston stroke: 1.75 – 2.05 mm (0.0689 – 0.0807 in)

   If the values are nonstandard, select another flange.

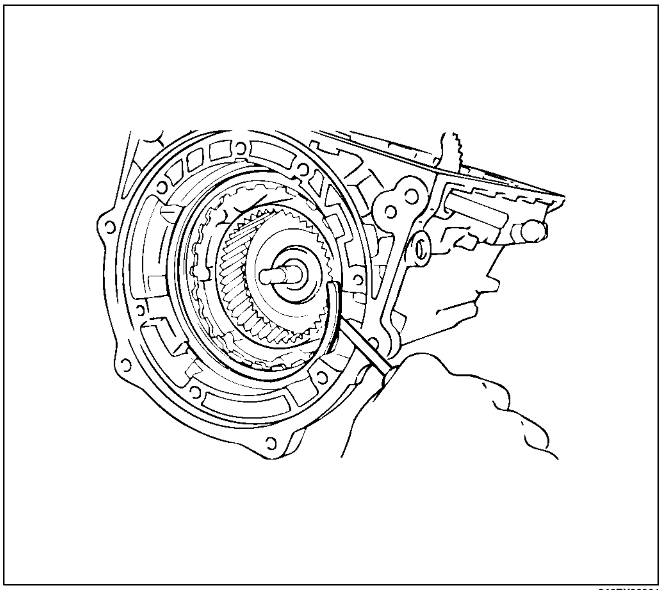
Available flange sizes

3.3 mm (0.130 in)	3.8 mm (0.150 in)
3.5 mm (0.138 in)	3.9 mm (0.154 in)
3.6 mm (0.142 in)	4.0 mm (0.158 in)
3.7 mm (0.146 in)	



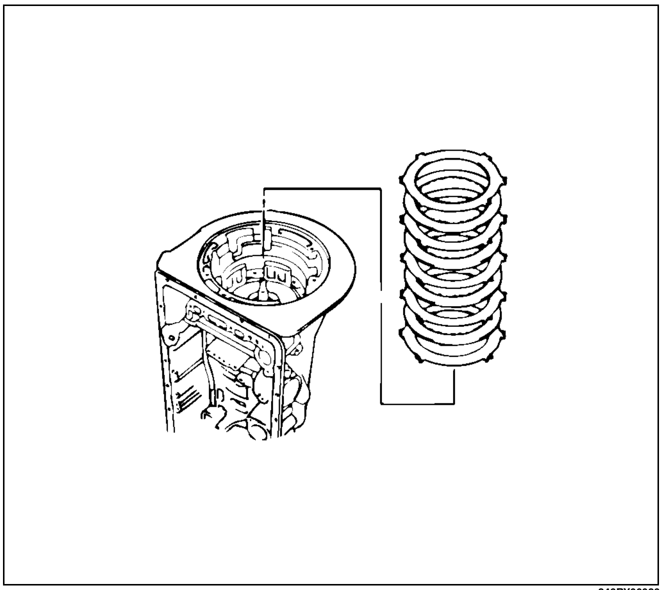
244RY00001

7. Remove the snap ring.



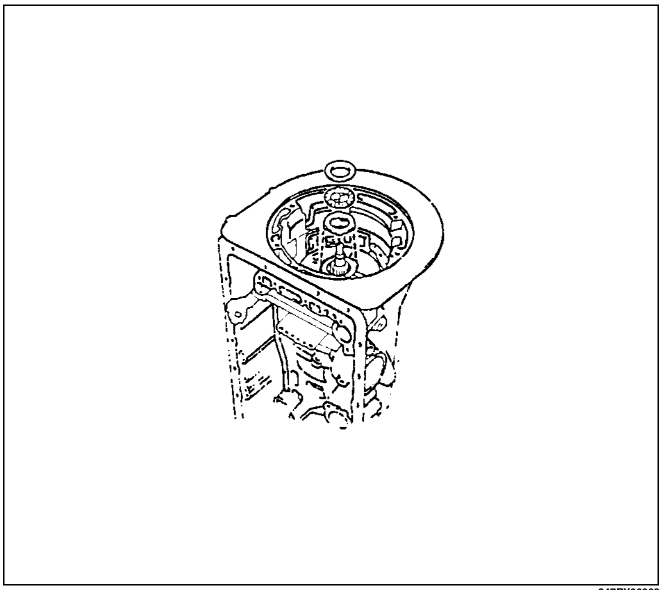
246RY00001

8. Remove one flange, four plates and four discs (B–0).



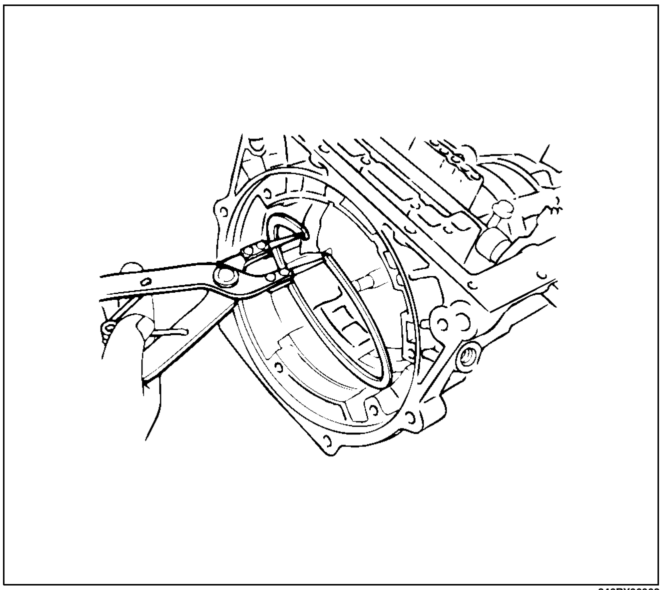
246RY00026

9. Remove the thrust bearing and two races.



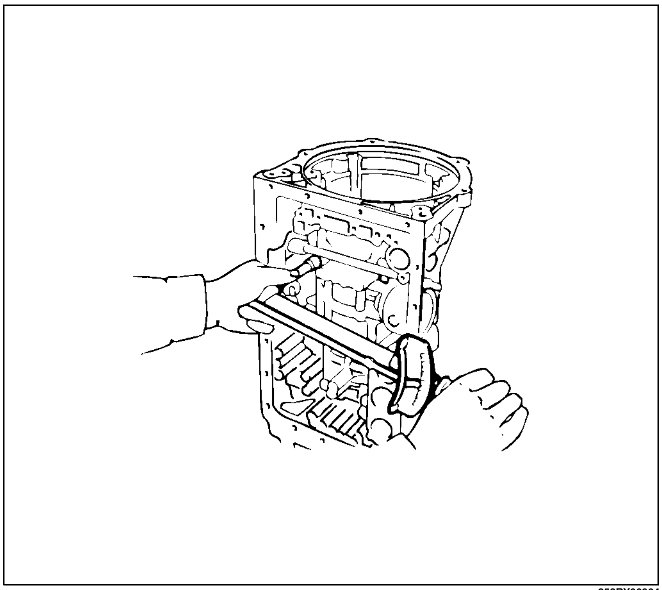
247RY00003

10. Using snap ring pliers, remove the snap ring.



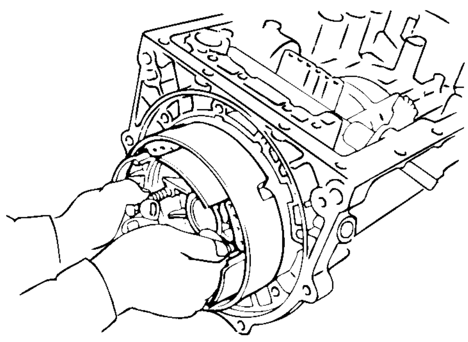
246RY00002

11. Remove the OD support.
    - Remove two bolts fixing the overdrive support assembly to the transmission case.



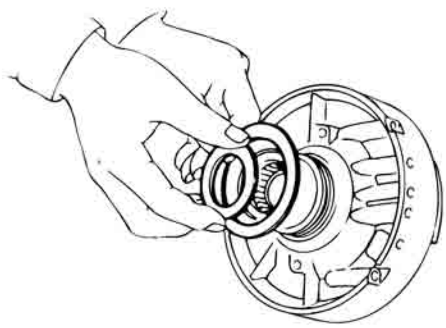
252RY00004

- Install two removed bolts to the OD support, and pull out the OD support assembly.



252RY00005

12. Remove the race from OD support.



252RY00006

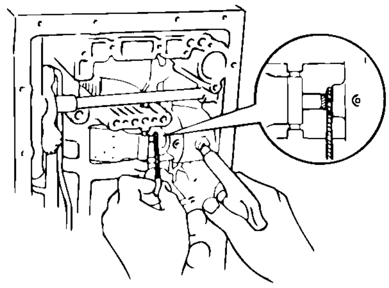
13. Check piston stroke of second coast brake (B–1)
 Place a mark on the second coast brake piston rod as shown in the figure.
 Using feeler gauge, measure the stroke applying the compressed air (390 – 780 kPa or 57 – 114 psi) as shown in the figure.

Piston stroke: 1.5 – 3.0 mm (0.059 – 0.118 in)

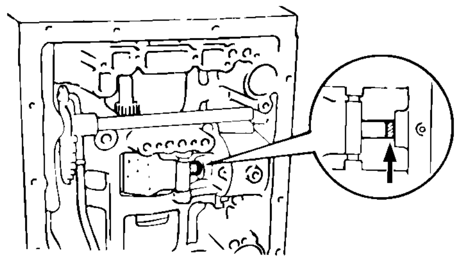
If the values are nonstandard, replace piston rod and recheck piston stroke.
If piston stroke is nonstandard, replace brake band.

There are two piston rods.

Rod length	78.4 mm (3.09 in) 79.9 mm (3.15 in)

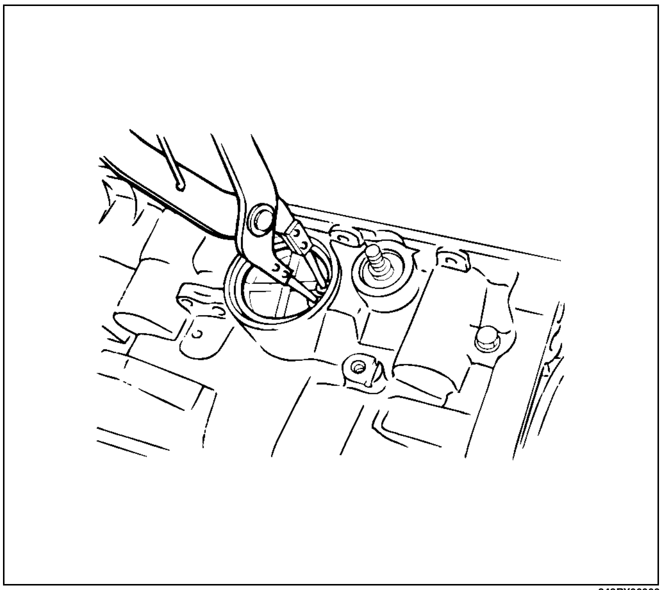


248RY00004



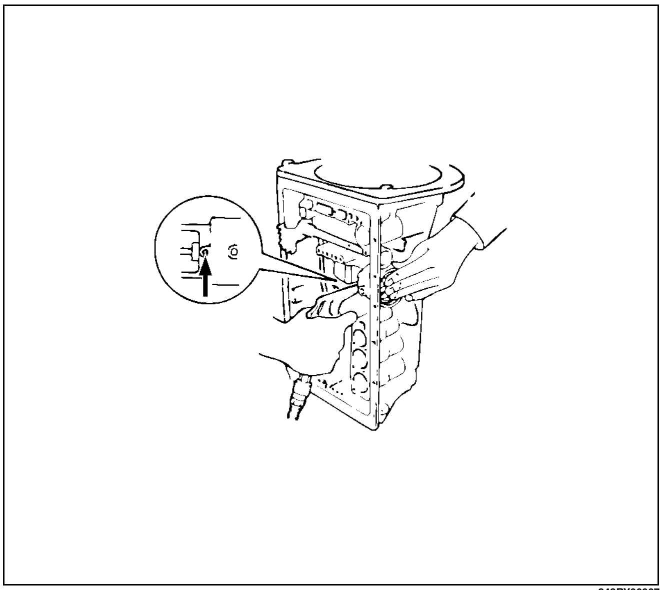
248RY00005

14. Using snap ring pliers, remove the snap ring.



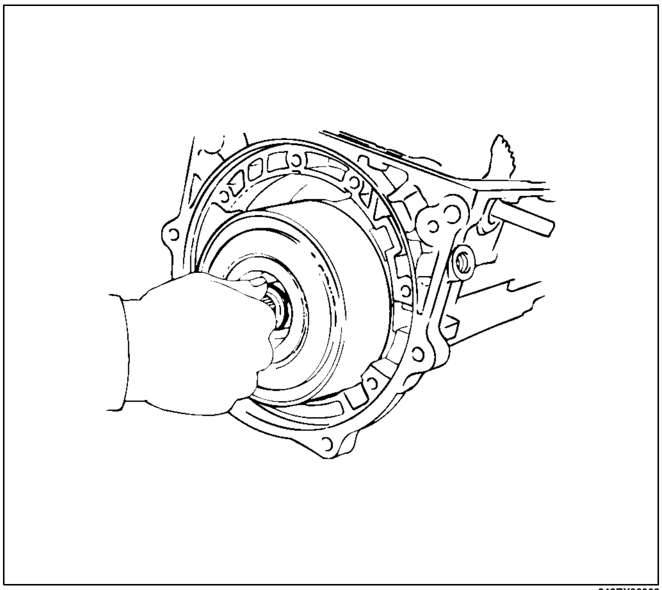
248RY00006

15. Applying compressed air to the oil hole, remove the second coast brake piston assembly.



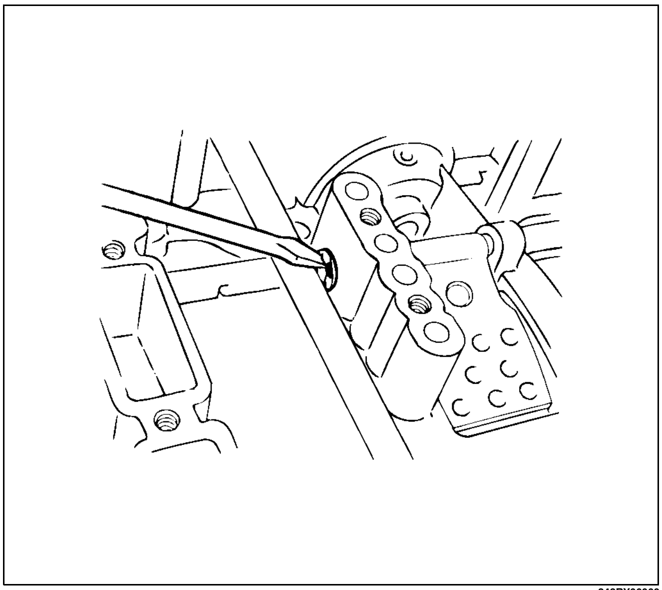
248RY00007

16. Remove the direct clutch and forward clutch from the transmission case.



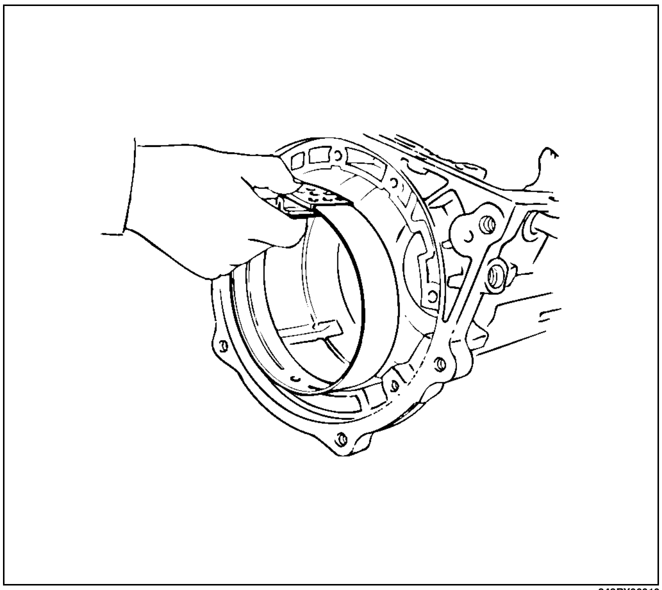
248RY00008

17. Remove the E-ring from the pin.
Remove the pin from the brake band.



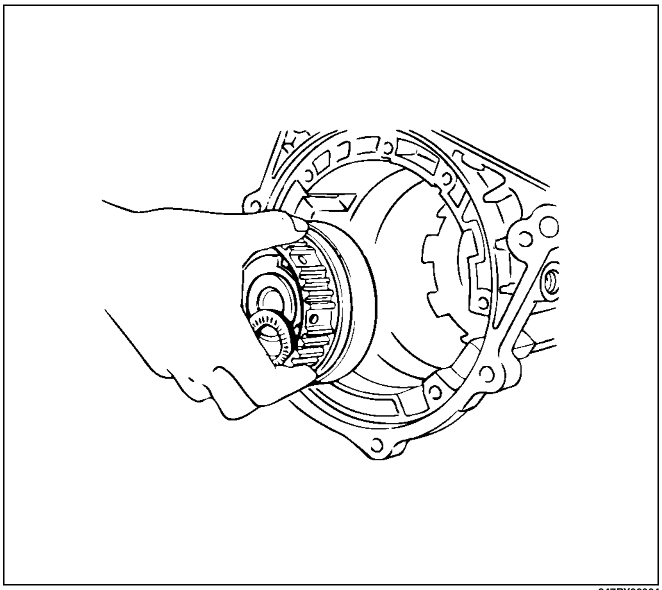
248RY00009

18. Remove the second coast brake band from the transmission case.



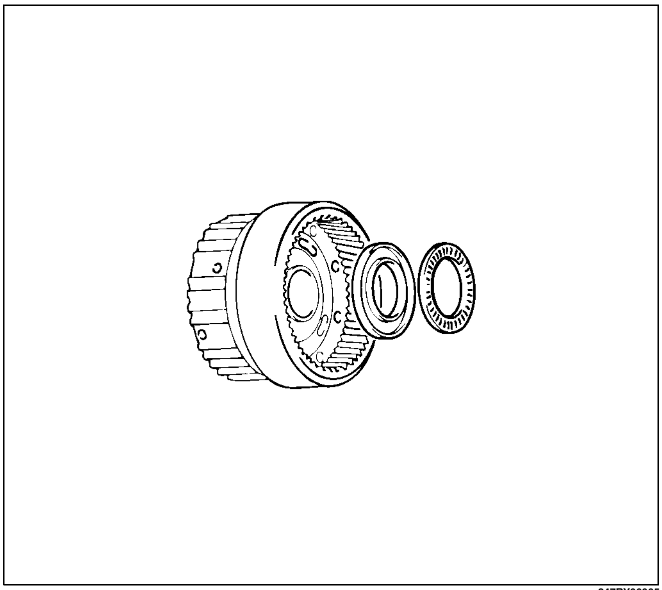
248RY00010

19. Remove the front planetary ring gear from the transmission case.



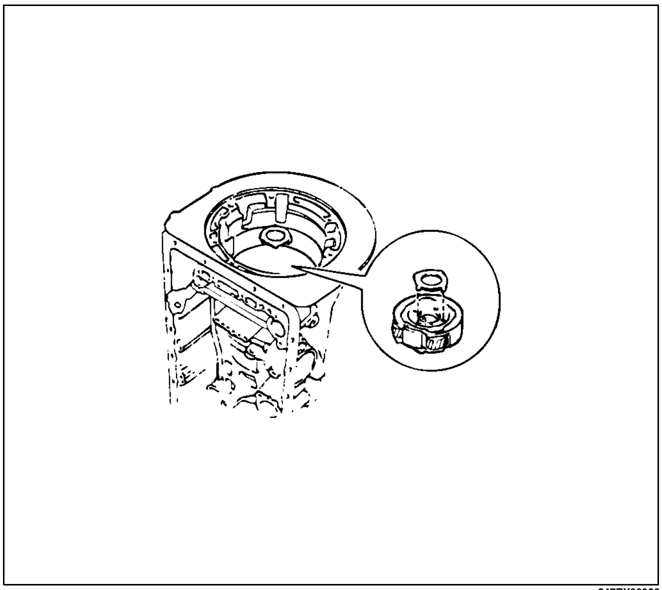
247RY00004

20. Remove the bearing and race.



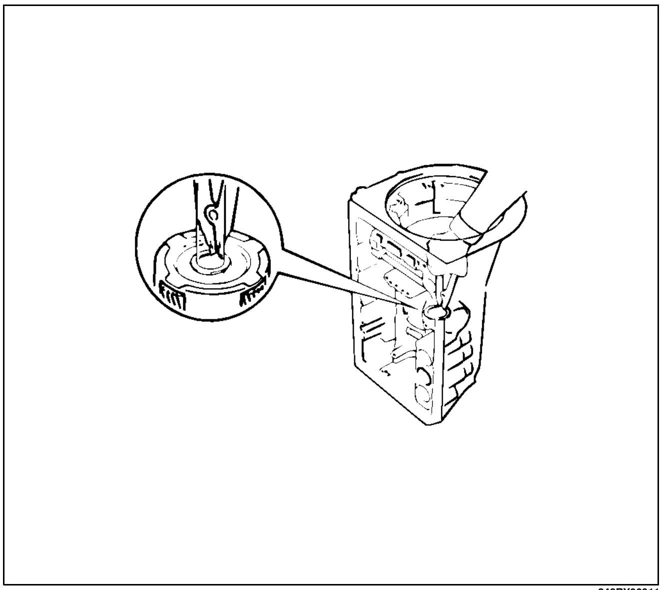
247RY00005

21. Remove the race.



247RY00006

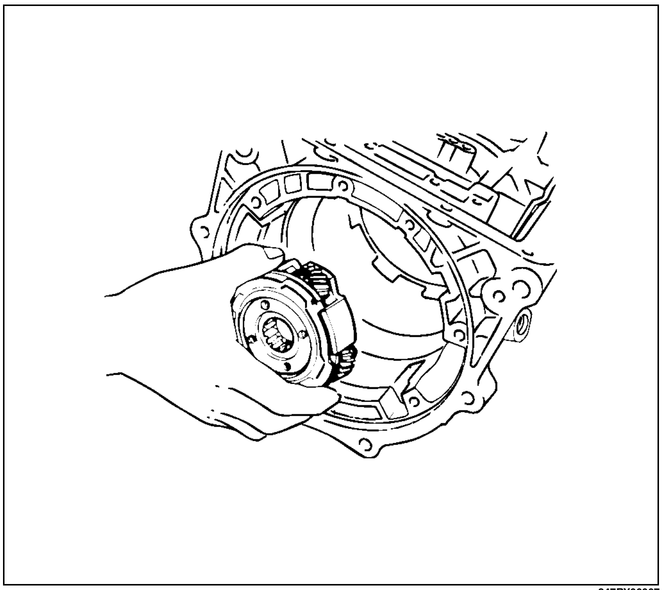
22. Using snap ring pliers, remove the snap ring.



248RY00011

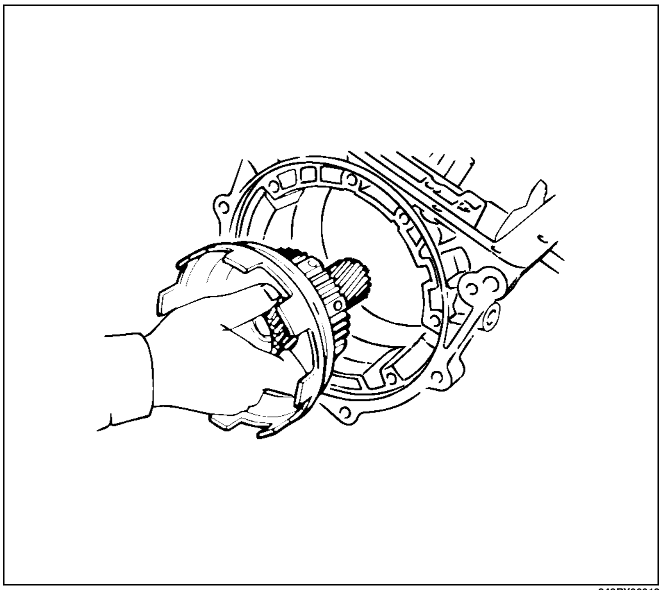
NOTE: Hold the output shaft to prevent it from falling. The output shaft falls when the snap ring is removed.

23. Remove the front planetary gear from the transmission case.



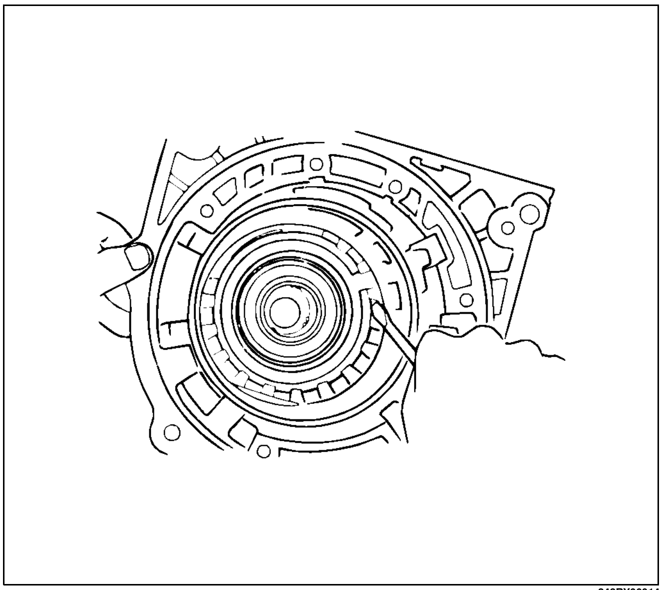
247RY00007

24. Remove sun gear input drum and one-way clutch.



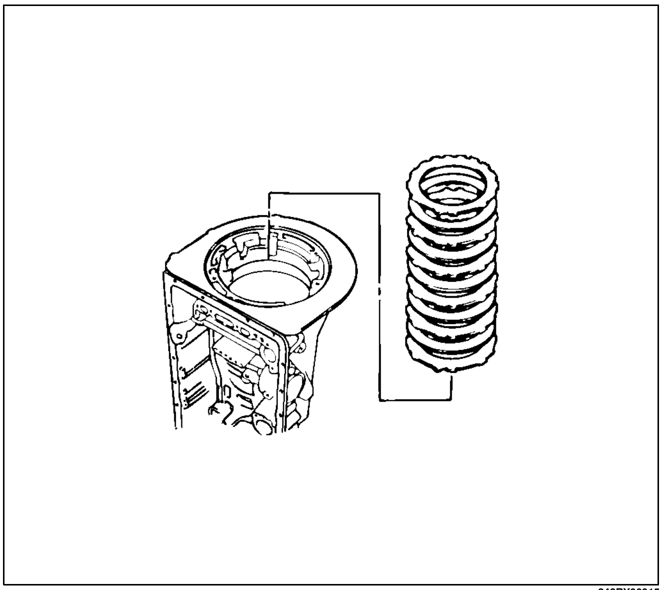
248RY00012

25. Using two screwdrivers, remove the snap ring.



248RY00014

26. Remove, five discs and six plates (B–2).

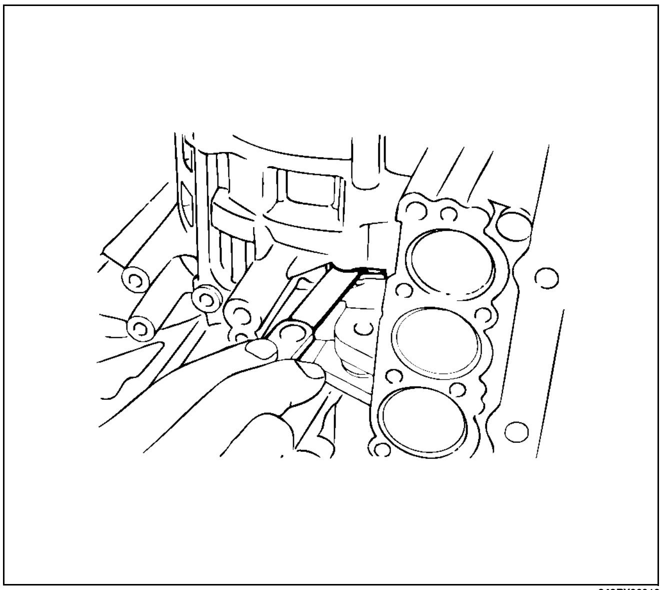


248RY00015

27. Check pack clearance of first and reverse brake (B–3)
Using a feeler gauge, measure the clearance between the plate and second brake drum as shown in the figure.

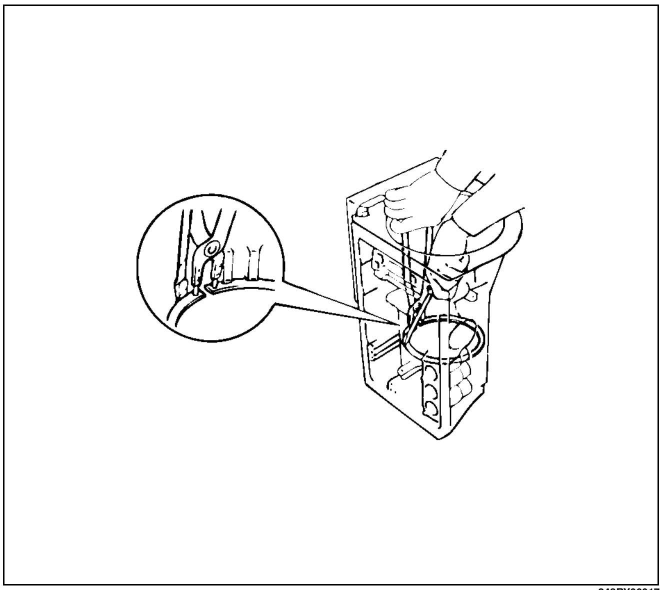
Clearance: 0.70 – 1.22 mm (0.0276 – 0.0480)

If the values are nonstandard, replace the discs.



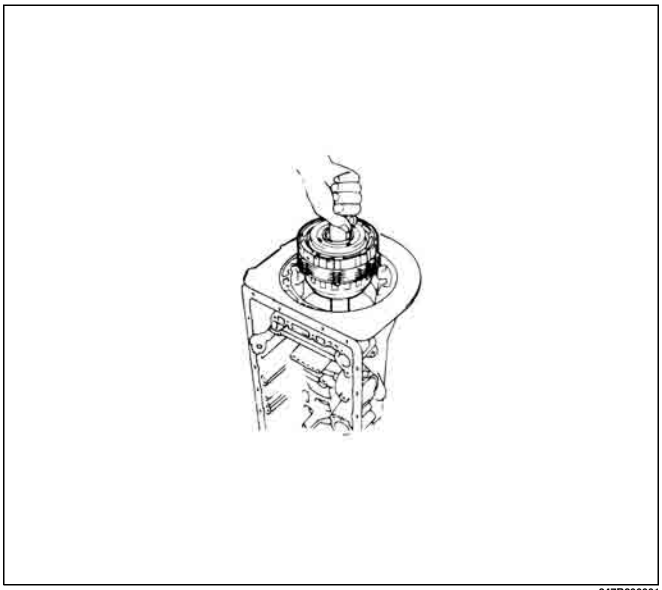
248RY00016

28. Using snap ring pliers, remove the snap ring.



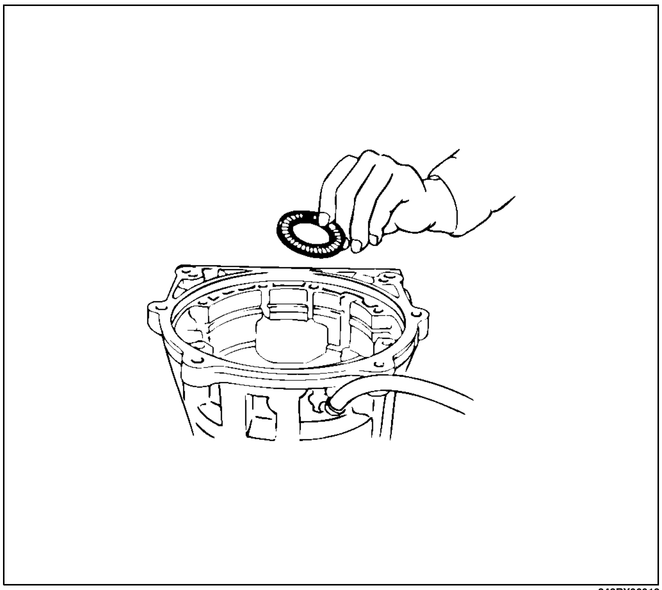
248RY00017

29. Remove the rear planetary gear, second brake drum and output shaft as an assembly.



247R200001

30. Remove the assembled thrust bearing and race from the transmission case.



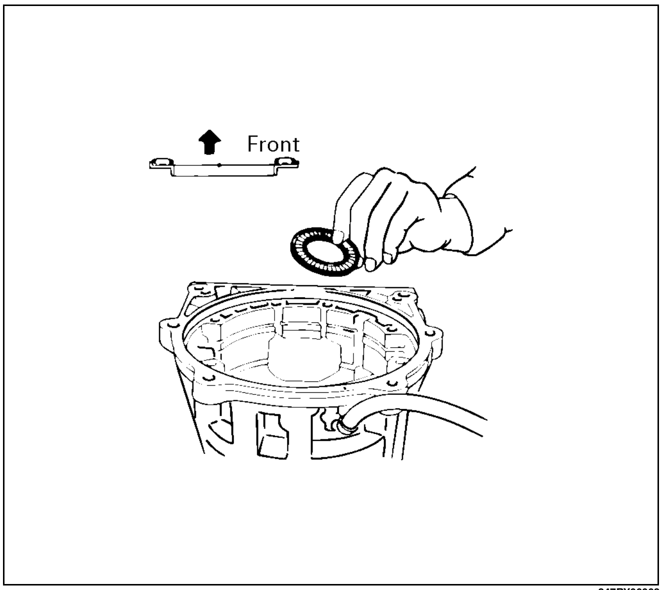
248RY00018

Reassembly

1. Coat the assembled bearing and race with petroleum jelly and install it onto the transmission case.

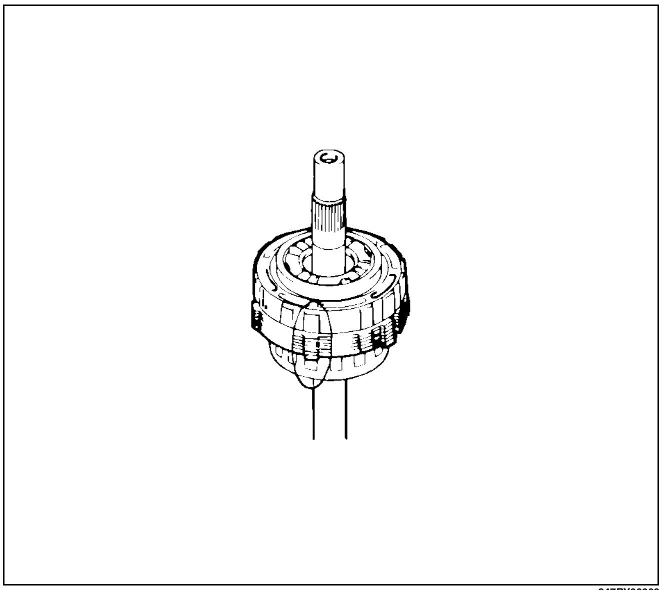
Assembled bearing and race (Reference)

Bearing and race	Diameter
Inside	39.38 mm (1.550 in)
Outside	58.15 mm (2.289 in)



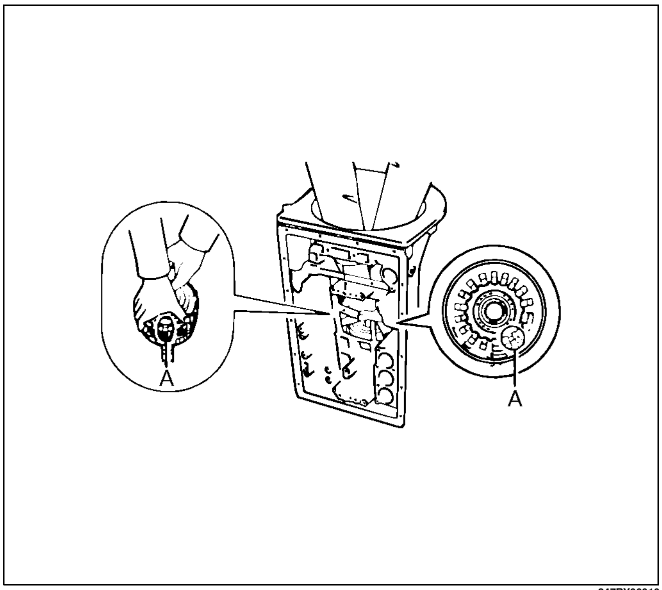
247RY00008

2. Install the rear planetary gear, second brake drum and output shaft.
   - Align the teeth of the second brake drum, flanges, discs and plates as shown in the figure.



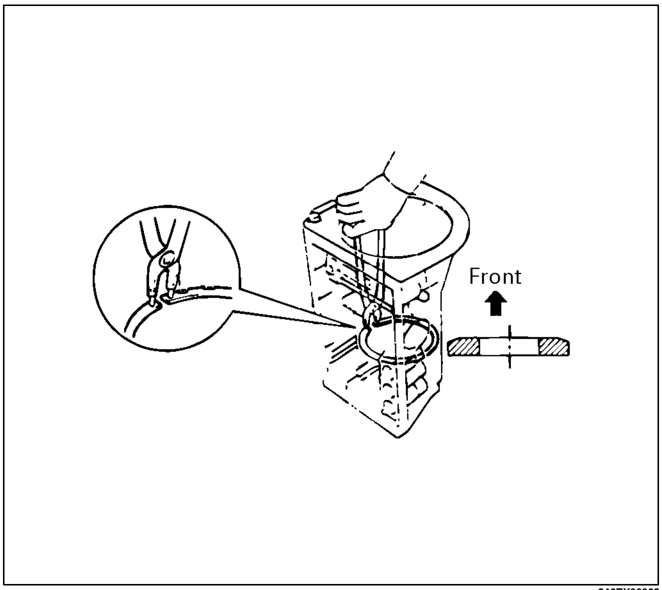
247RY00009

   - Align the splines of the transmission case and the assembled rear planetary gear, second brake drum and output shaft, indicated by A in the figure.



247RY00010

3. Using snap ring pliers, install the snap ring.



246RY00003

SECTION 4

AXLE

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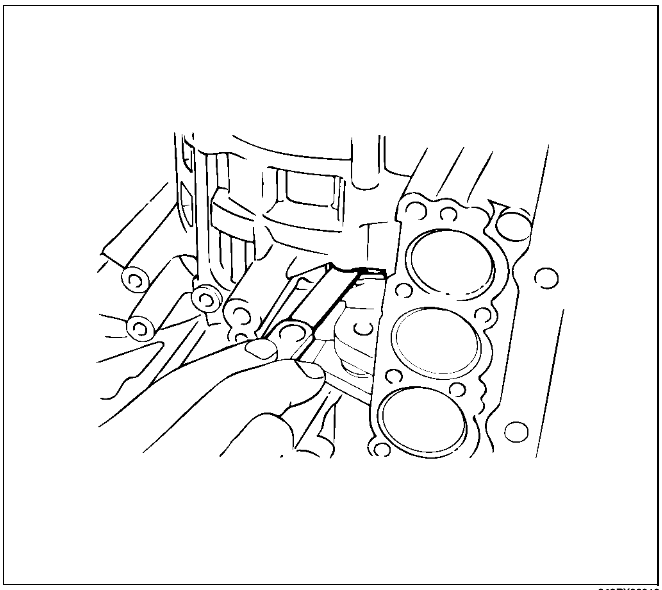
4. Check pack clearance of first and reverse brake.
   Using a thickness gauge, measure the clearance between the plate and second brake drum as shown in the figure.

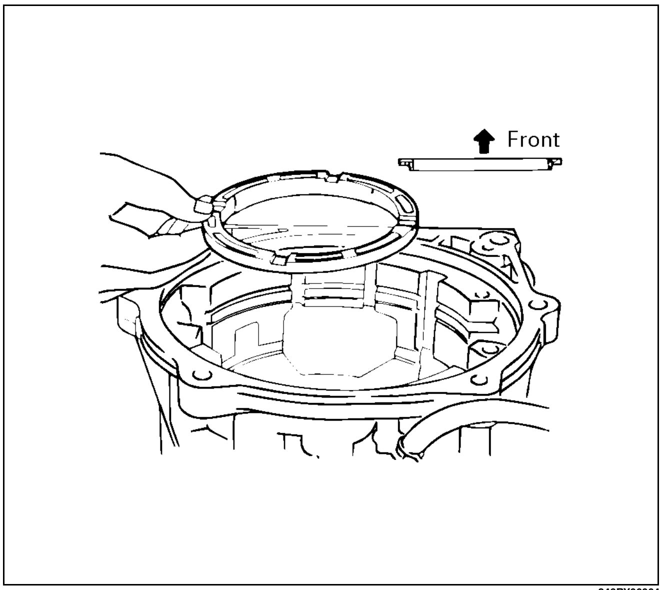
Clearance: 0.70 – 1.22 mm (0.0276 – 0.0480 in)

If the values are nonstandard, check for an improper installation.



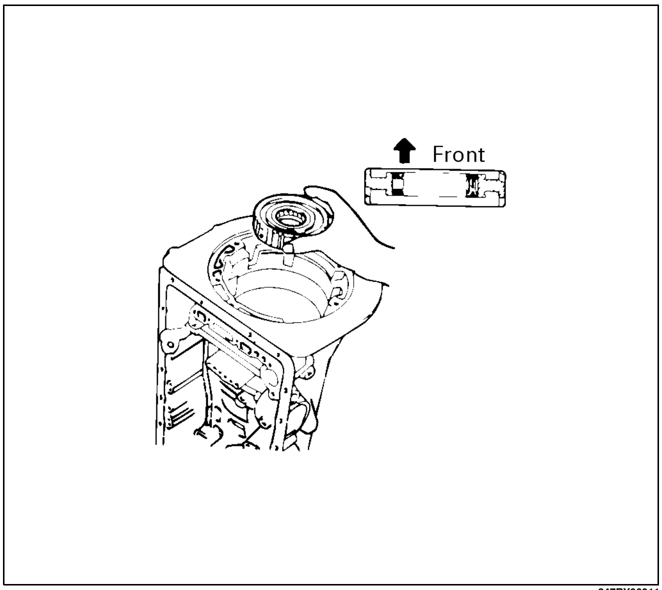
248RY00016

5. Install second brake piston sleeve.



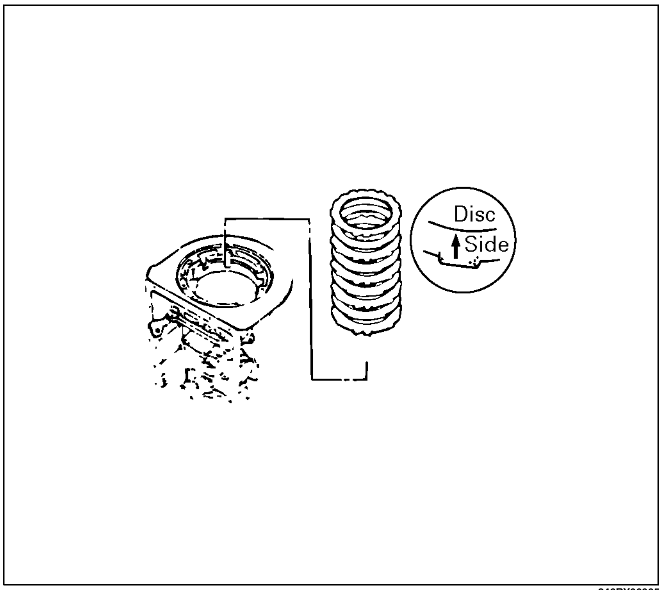
246RY00004

6. Install one-way clutch in the transmission case.



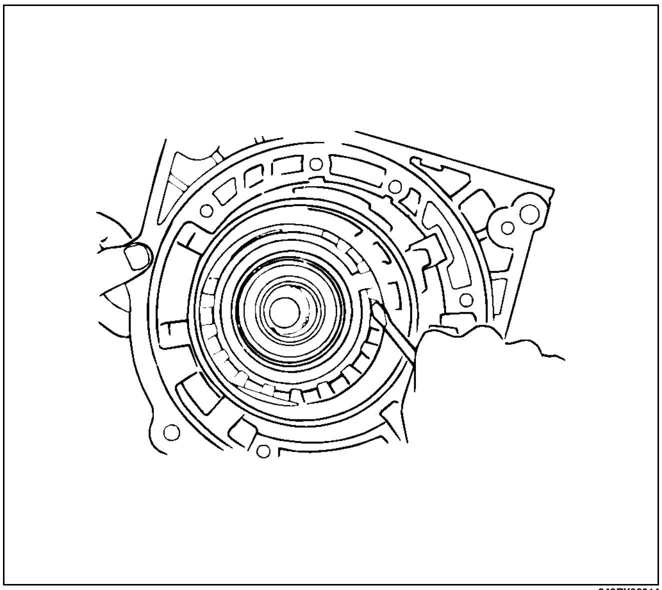
247RY00011

7. Install discs and plates (B–2).
   Instal the 2.5 mm (0.098 in) thick plate with the rounded edge side of the plate facing the disc.
   Alternately install five discs and six plates (Disc first)



246RY00005

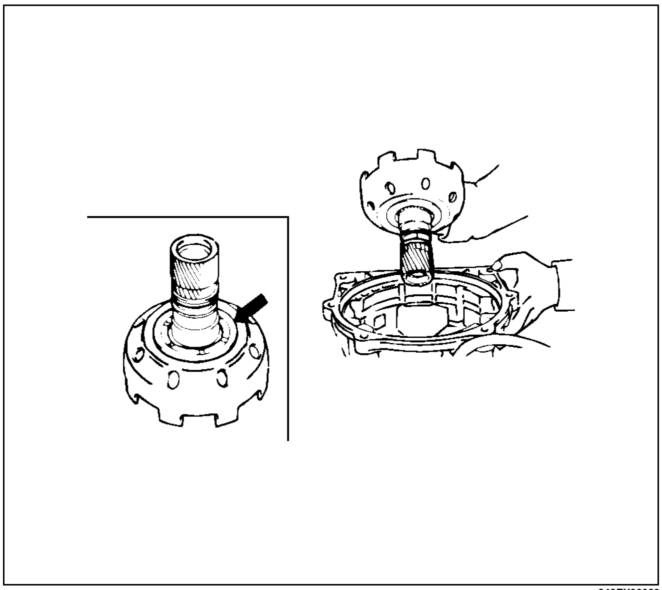
8. Install the snap ring.



248RY00014

9. While turning the sun gear input drum clockwise, install it into the one-way clutch

NOTE: Confirm the thrust washer is installed correctly.



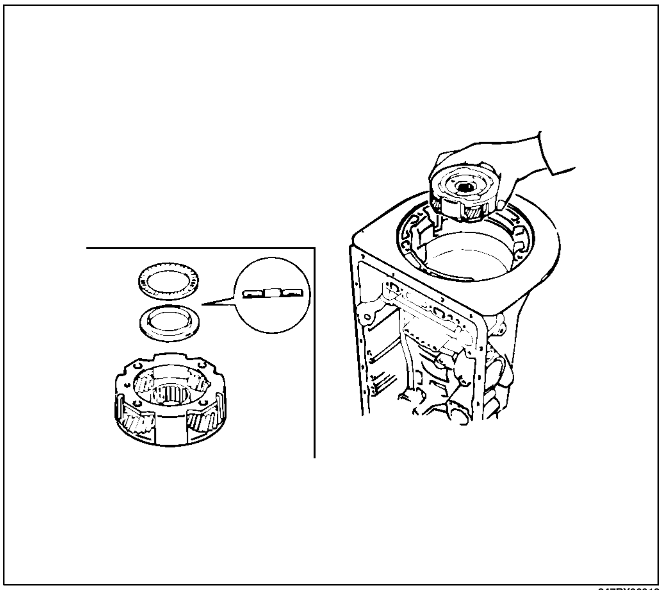
248RY00020

10. Install the front planetary gear and bearing to the sun gear.

NOTE: Confirm the bearing and race is installed correctly.

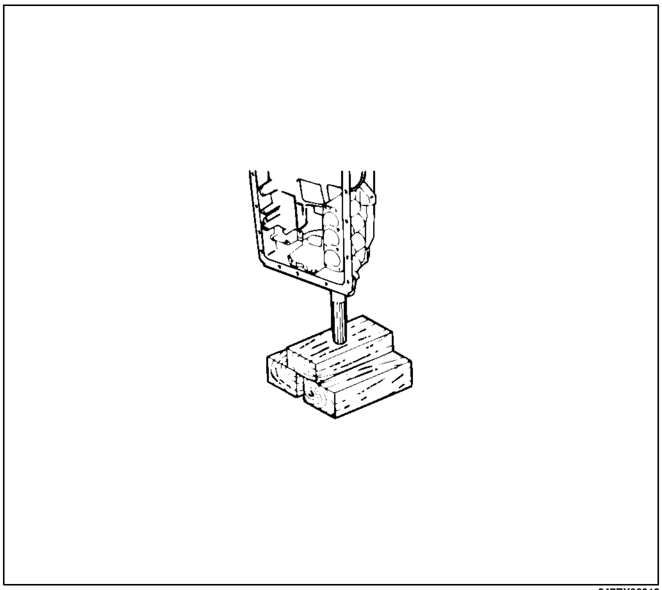
Bearing and race diameter (Reference)

	Inside	Outside
Bearing	35.6 mm (1.40 in)	47.7 mm (1.88 in)
Race	33.7 mm (1.33 in)	47.6 mm (1.87 in)



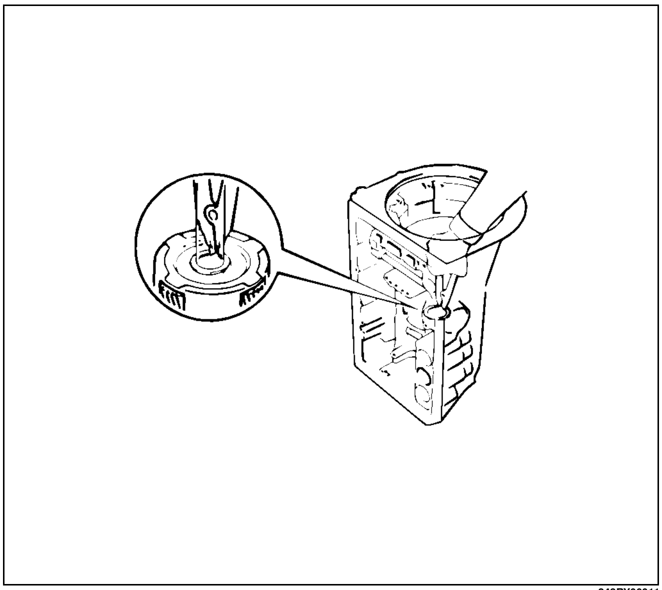
247RY00012

With wooden blocks under the output shaft, stand the transmission on the output shaft.



247RY00013

11. Using snap ring pliers, install the snap ring.

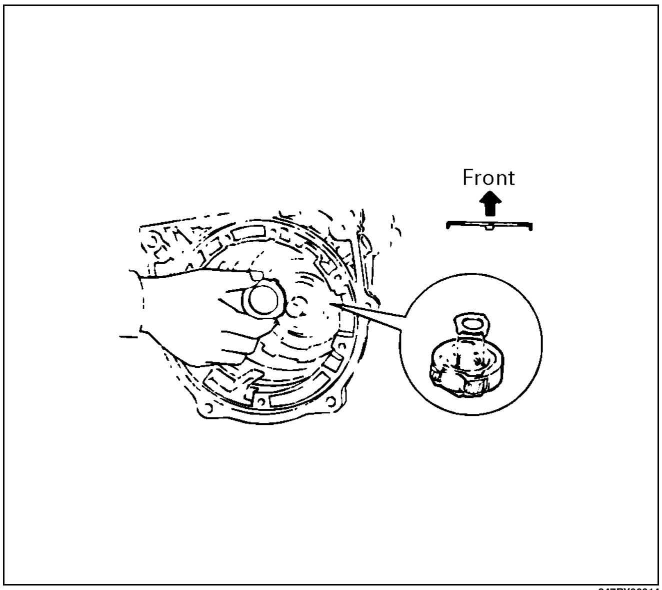


248RY00011

12. Coat the bearing race with petroleum jelly and install it onto the front planetary gear.

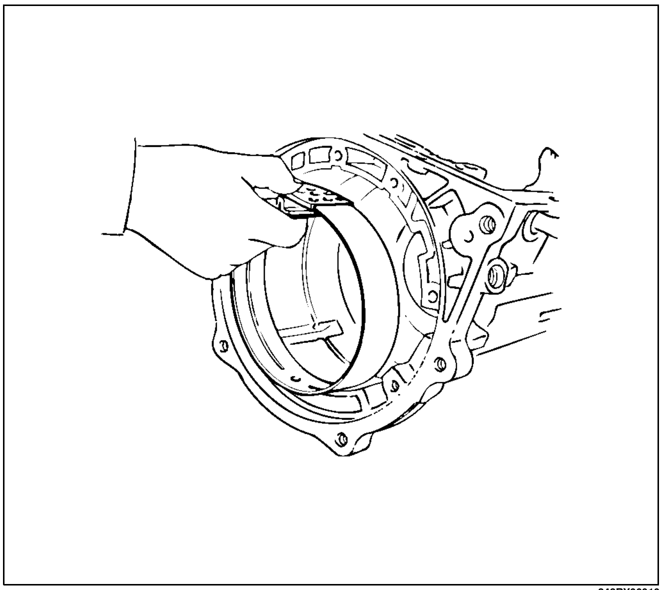
Bearing race diameter (Reference)

Bearing race	Diameter
Inside	34.3 mm (1.350 in)
Outside	47.8 mm (1.882 in)



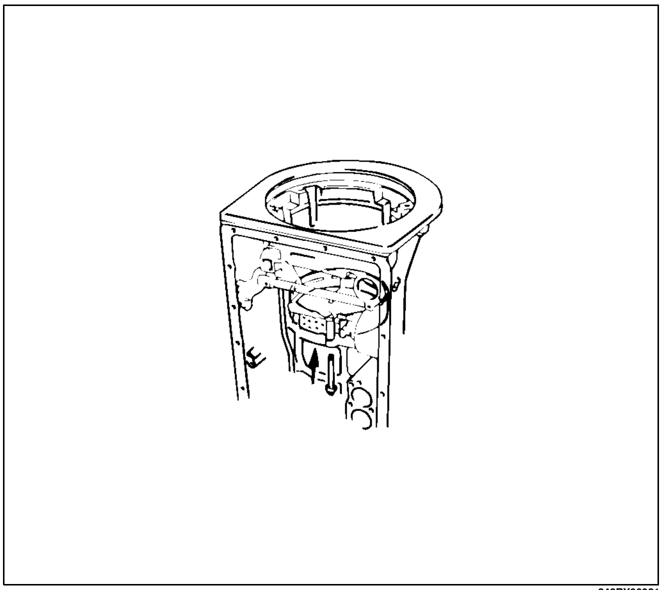
247RY00014

13. Insert the second coast brake band to the transmission case.



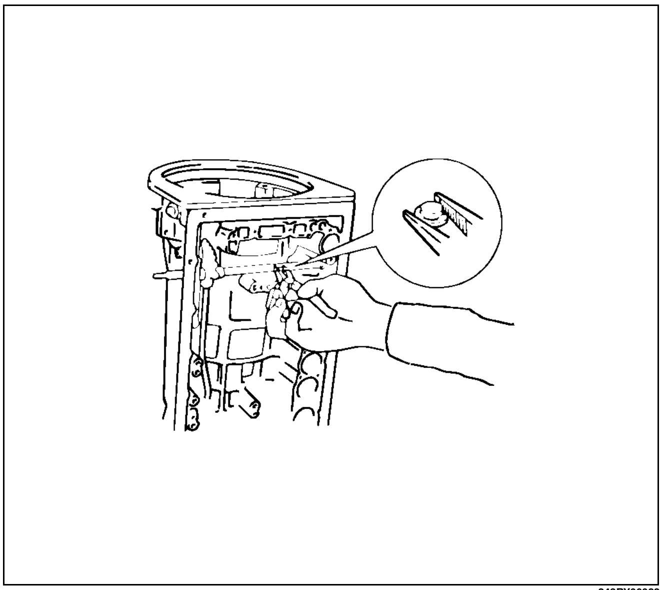
248RY00010

14. Install the E-ring and pin.
    - Install the pin through the brake band.



248RY00021

- Install the E-ring to the pin.

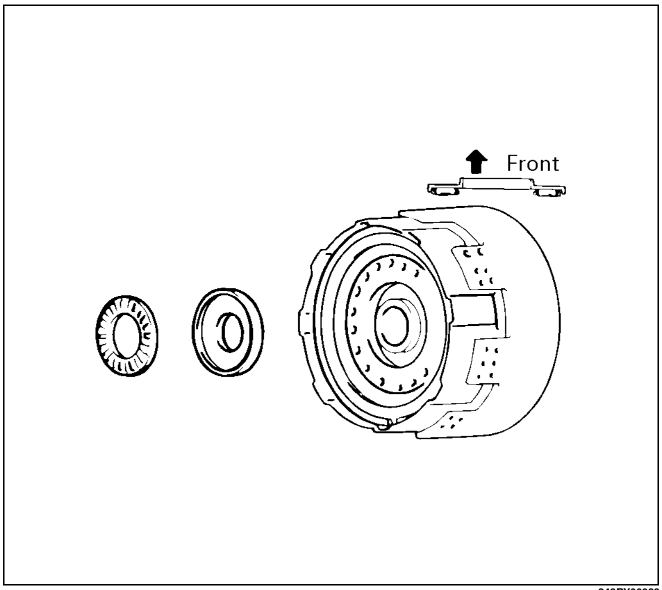


248RY00022

15. Coat the bearing and race with petroleum jelly and install them onto the forward clutch.

Bearing and race diameter (Reference)

	Inside	Outside
Bearing	26.0 mm (1.024 in)	46.7 mm (1.839 in)
Race	26.0 mm (1.024 in)	48.9 mm (1.925 in)

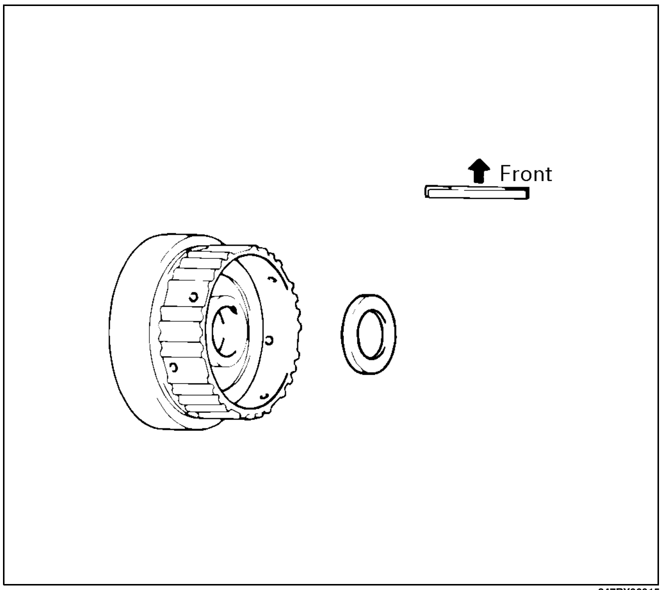


248RY00023

16. Coat the race with petroleum jelly and install it onto the front planetary ring gear.

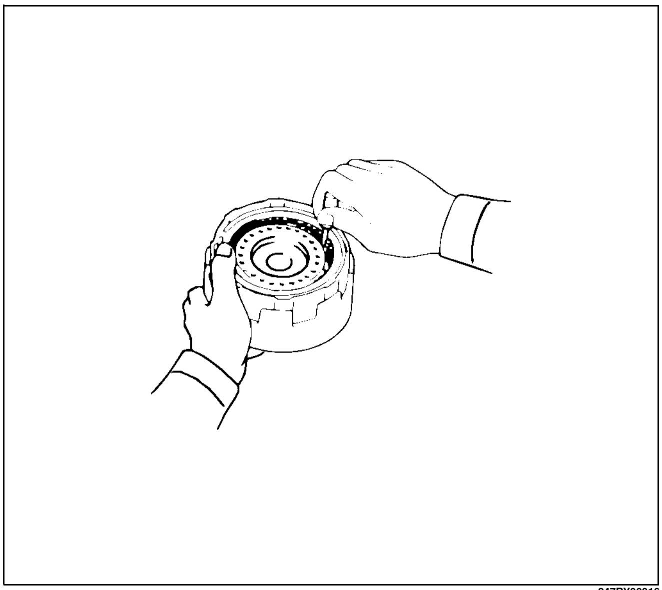
Race diameter (Reference)

	Inside	Outside
Race	26.8 mm (1.055 in)	47.0 mm (1.850 in)



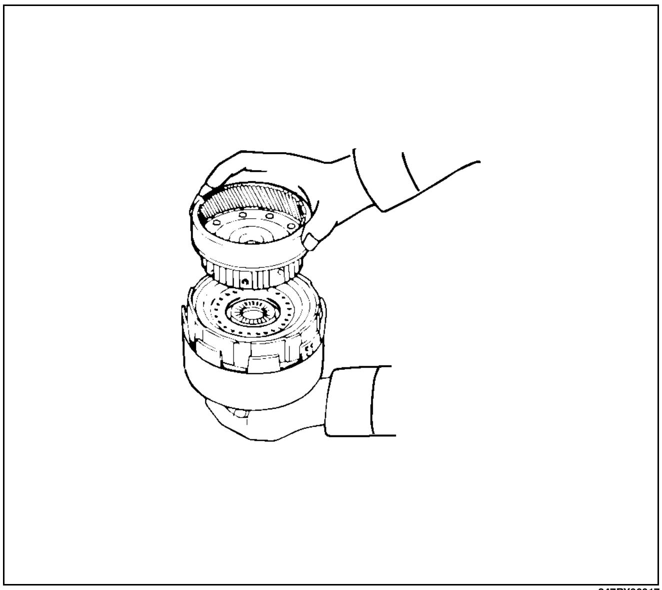
247RY00015

Align the flukes of the discs in the forward clutch.



247RY00016

17. Align the spline of the front planetary gear with the flukes of the discs and install the front planetary gear to the forward clutch.

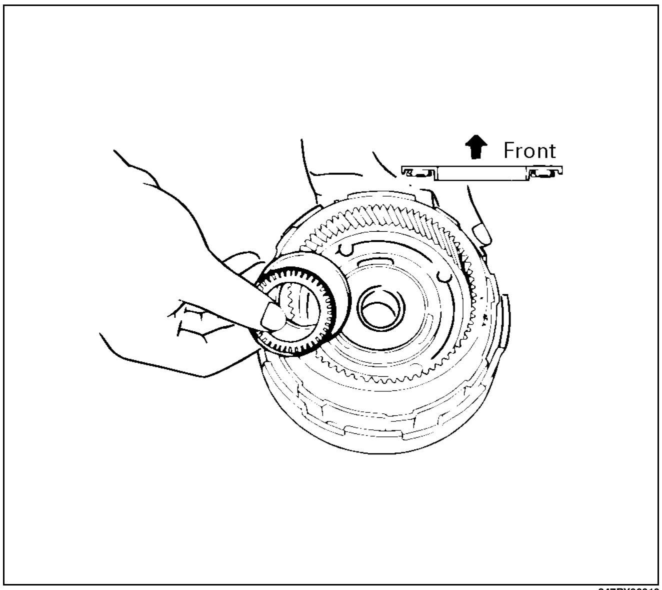


247RY00017

18. Coat the bearing and race with petroleum jelly and install them onto the ring gear.

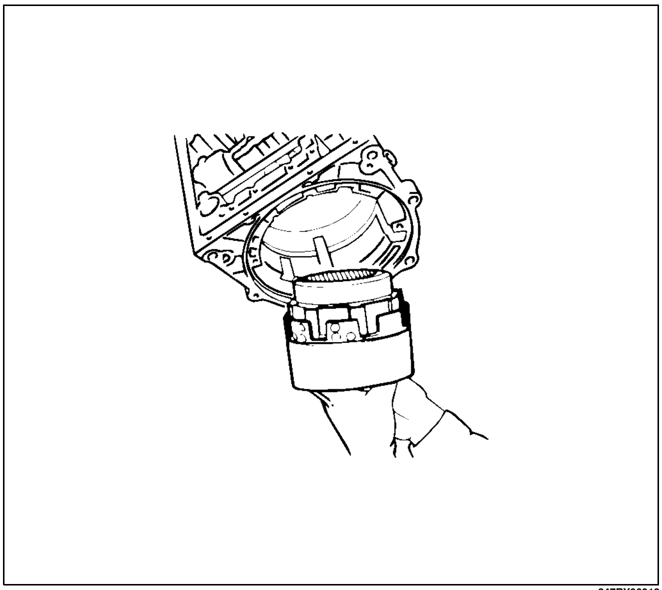
Bearing and race diameter (Reference)

	Inside	Outside
Bearing	35.15 mm (1.384 in)	53.65 mm (2.112 in)
Race	35.15 mm (1.384 in)	53.65 mm (2.112 in)



247RY00019

19. Install the assembled direct clutch, forward clutch and front planetary ring gear into the transmission case.

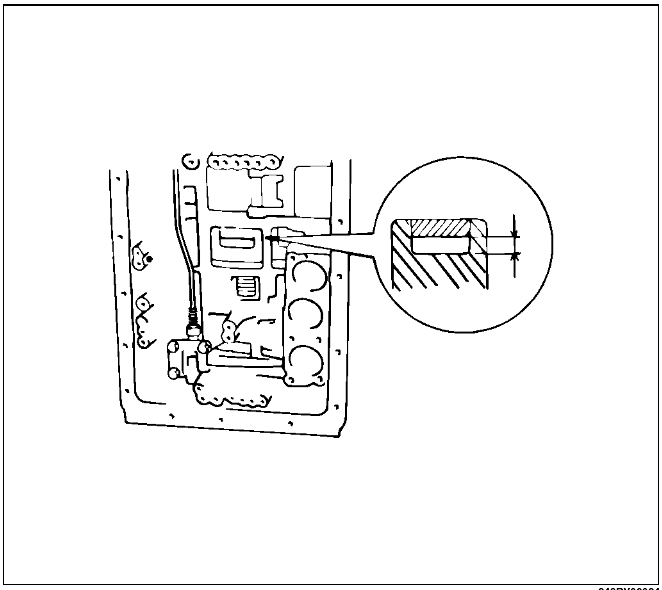


247RY00018

- Using vernier calipers, measure the distance between the sun gear input drum and direct clutch drum as shown in the figure.

Height: 2.5– 4.5 mm (0.098 – 0.177 in)

If the values are nonstandard, check for an improper installation.

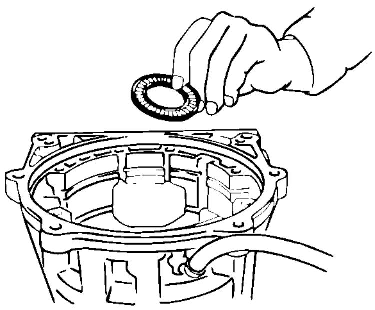


248RY00024

Coat the assembled bearing and race with petroleum jelly and install it onto the forward clutch.

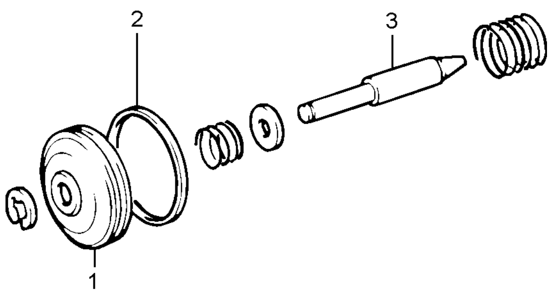
Assembled bearing and race diameter (Reference)

	Inside	Outside
Bearing and race	33.7 mm (1.33 in)	47.8 mm (1.88 in)



248RY00025

20. Assembly second coast brake piston assembly.
    Coat the oil seal ring with ATF and install it to the second coast brake piston.
    Install the washer, spring and piston to the piston rod. Install the E-ring.

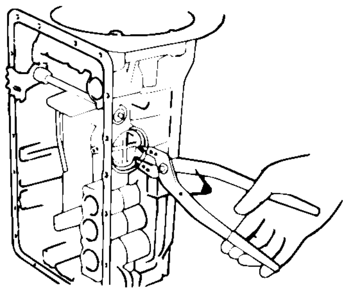


RUW37ASH004401

Legend

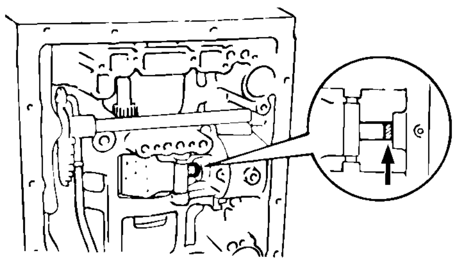
(1) Second coast brake piston
(2) Oil seal
(3) Piston rod

21. Coat two new oil seals with ATF and install them to the piston cover.
    Install the spring, second coast brake piston assembly and piston cover to the transmission case.
    Using snap ring pliers, install the snap ring.



248RY00027

22. Check piston stroke of second coast brake
    Place a mark on the second coast brake piston rod as shown in the figure.

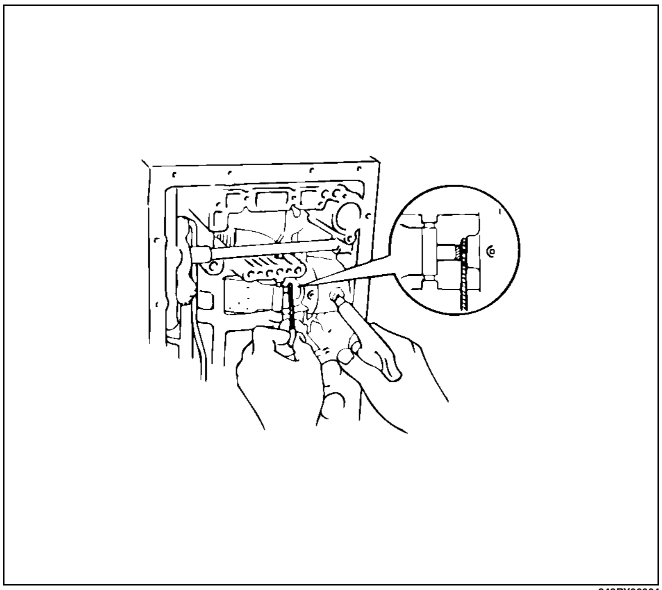


248RY00005

Using wire gauge, measure the stroke by applying the compressed air (390 – 780 kPa or 57 – 114 psi) as shown in the figure.

Piston stroke: 1.5 – 3.0mm (0.059 – 0.118in)

If the values are nonstandard, check for an improper installation.

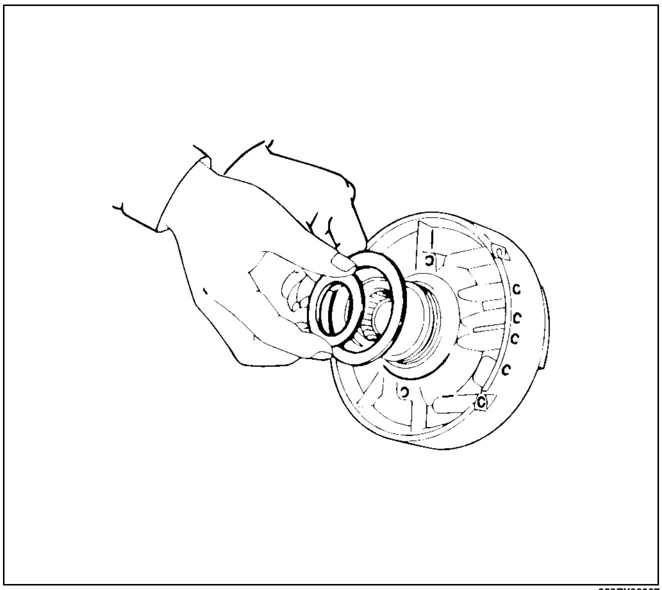


248RY00004

23. Coat the race with petroleum jelly and install it onto the overdrive support assembly.

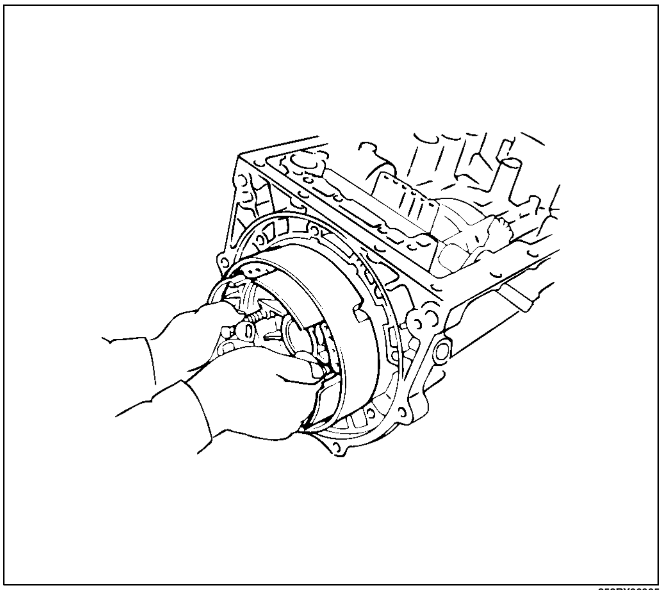
Race diameter (Reference)

	Inside	Outside
Race	36.7 mm (1.44 in)	50.8 mm (2.00 in)



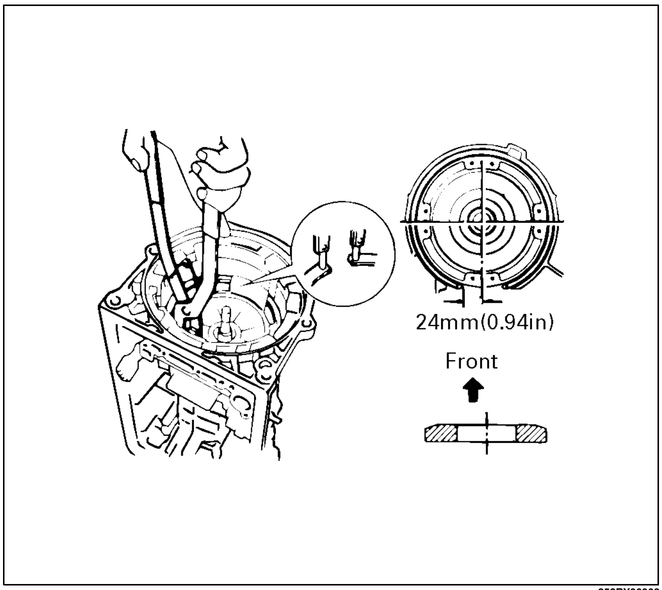
252RY00007

24. Aim the bolt and oil holes of the overdrive support toward the valve hole side, and align them with the bolt hole of the transmission case and insert the overdrive support.



252RY00005

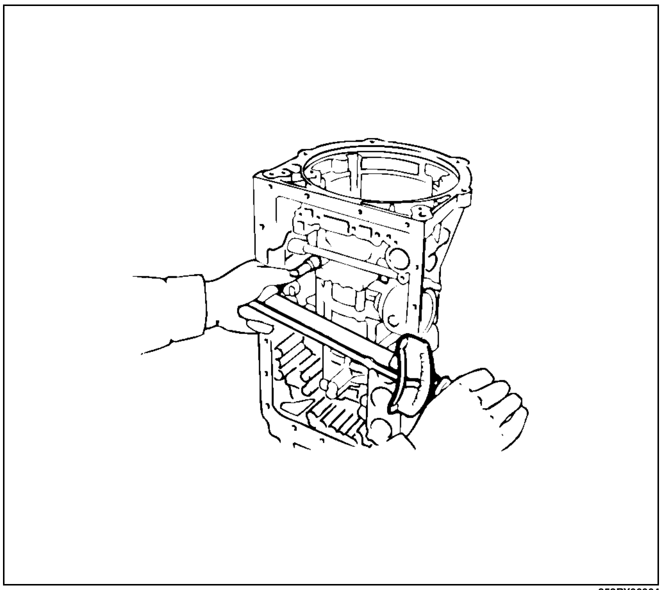
25. Using snap ring pliers, install the snap ring as shown in the figure.



252RY00008

- Install and tighten the two bolts.

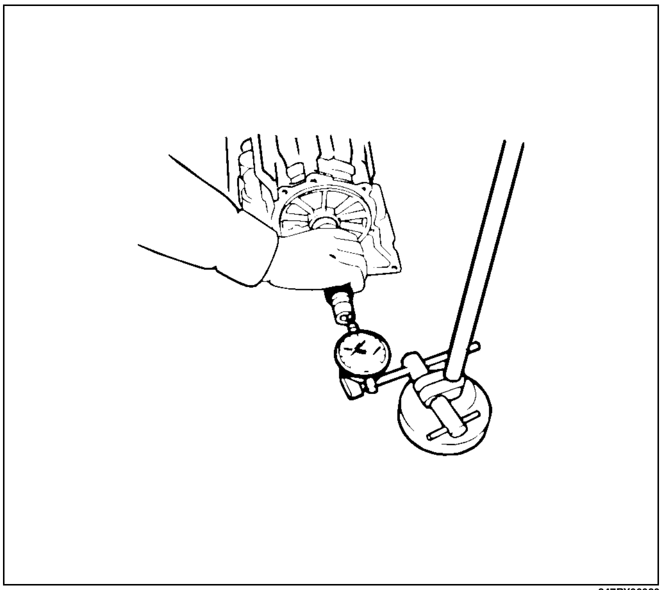
Torque: 25 N·m (2.5 kgf·m / 18 lb·ft)



252RY00004

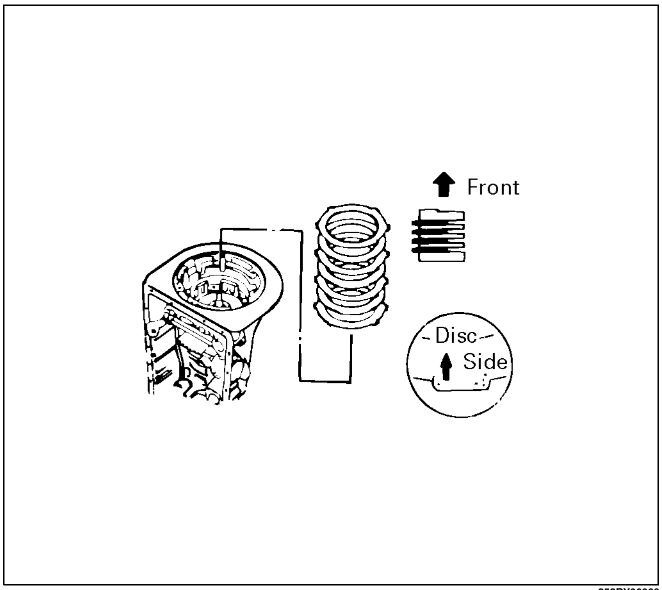
26. Check end of output shaft.
    Using a dial indicator, measure the end play of the output shaft by hand.

End play: 0.27 – 0.86 mm (0.0106 – 0.0339 in)



247RY00020

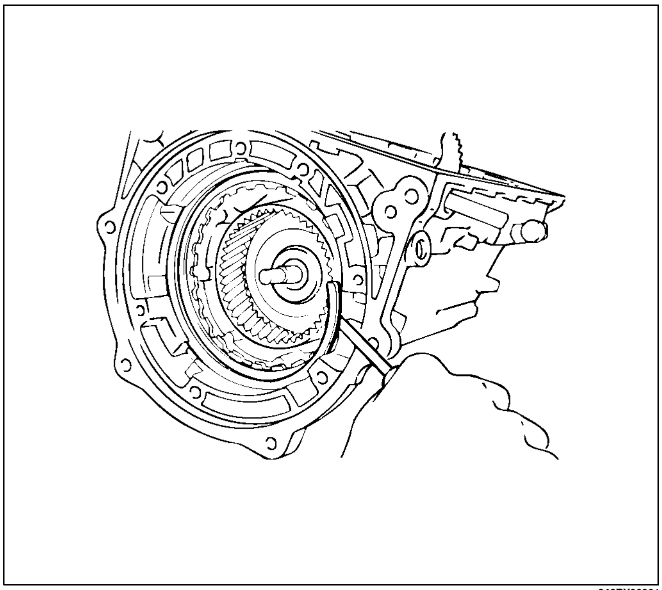
27. Install the (flat ring) 4.0 mm (0.157 in) thick flange with the rounded edge side of the flange facing the disc.
    Alternately install four discs and four plates. (Disc first)



252RY00009

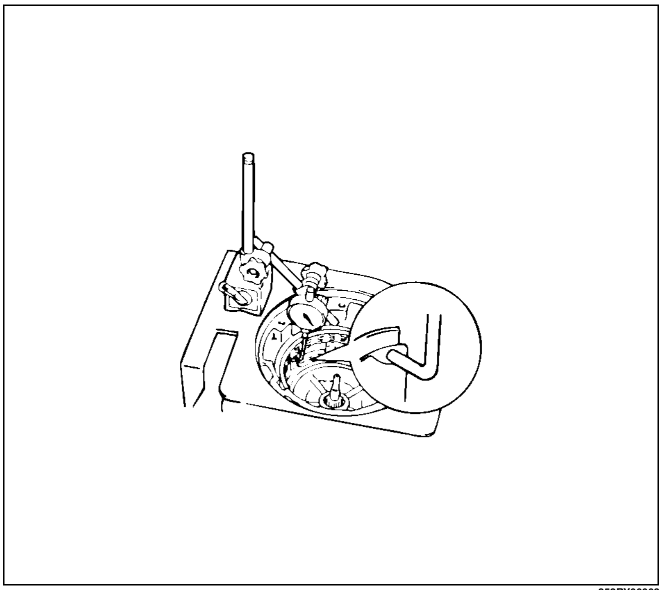
28. Install the (stepped ring) flange with the flat side of the flange facing the disc.
    Install the snap ring.
    Snap ring (Reference)

Inside diameter	167.9 mm (6.61 in)



246RY00001

29. Check piston stroke of overdrive brake.
    Place a dial indicator onto the overdrive brake piston as shown in the figure.



252RY00003

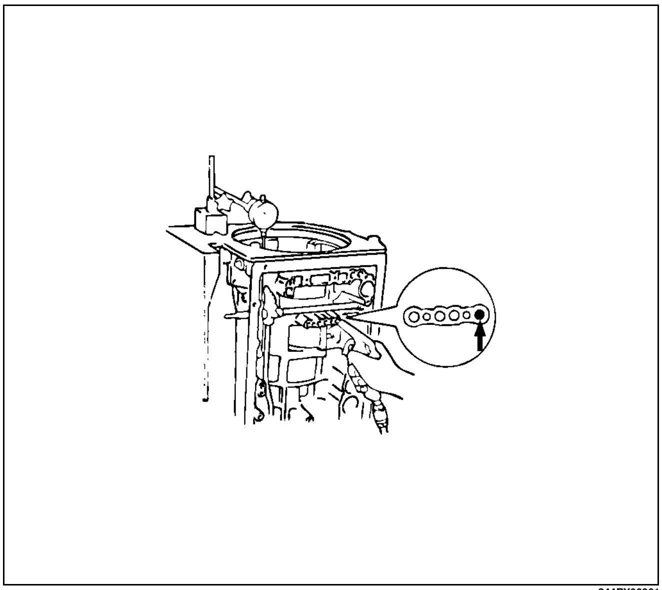
Measure the stroke by applying and releasing the compressed air (390 – 780 kPa or 57 – 114 psi) as shown in the figure.

Piston stroke: 1.75 – 2.05 mm (0.0689 – 0.0807 in)

If the values are nonstandard, check for an improper installation.

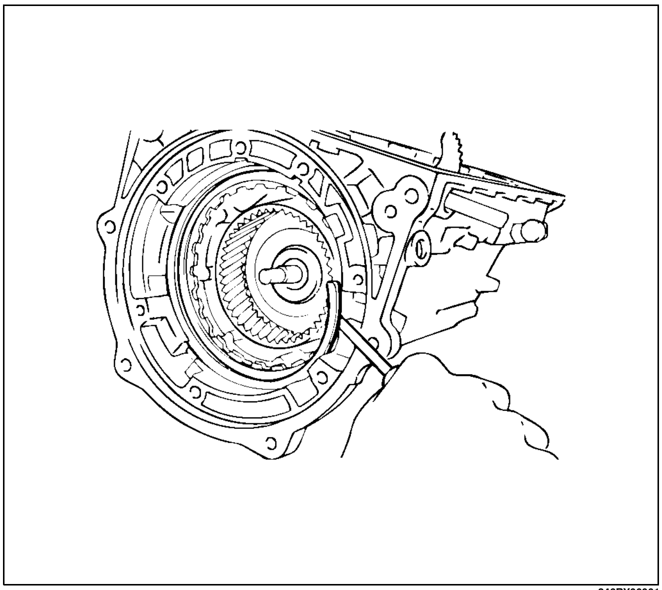
Available flange size

3.3 mm (0.130 in)	3.8 mm (0.150 in)
3.5 mm (0.138 in)	3.9 mm (0.154 in)
3.6 mm (0.142 in)	4.0 mm (0.158 in)
3.7 mm (0.146 in)	



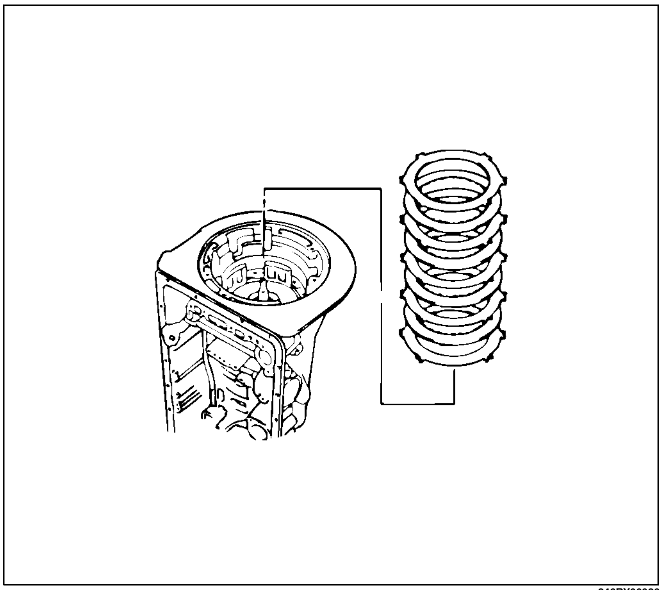
244RY00001

Remove the snap ring.



246RY00001

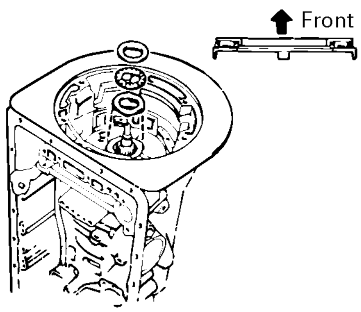
Remove one flange, four plates and four discs.



246RY00026

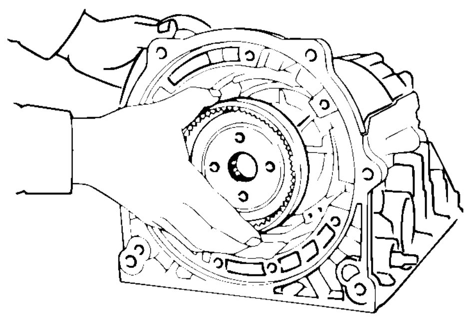
30. Coat the bearing and races with petroleum jelly and install them onto the overdrive support.
Bearing and races diameter (Reference)

	Inside	Outside
Race (Front)	37.2 mm (1.465 in)	58.8 mm (2.315 in)
Bearing and race (Rear)	33.7 mm (1.327 in)	50.1 mm (1.972 in)



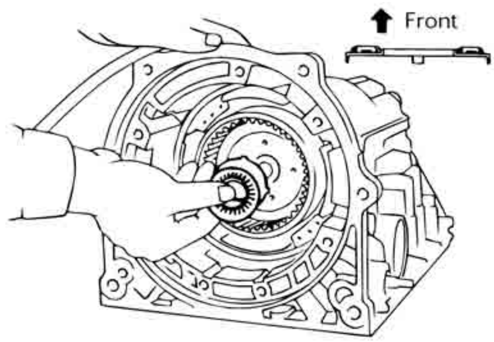
252RY00010

31. Install the overdrive planetary ring gear.


252RY00002

32. Coat the bearing and race with petroleum jelly and install them onto the planetary ring gear.
Bearing and race diameter (Reference)

	Inside	Outside
Bearing and race	24.2 mm (0.953 in)	47.8 mm (1.882 in)

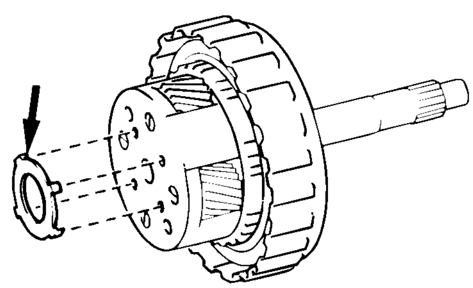


252RY00011

Install the (flat ring) 4.0 mm (0.157 in) thick flange with the rounded edge side of the flange facing the disc.
Alternately install four discs and three plates. (Disc first)
Install the (stepped ring) flange with the flat side of the flange facing the disc.
Install the snap ring.

33. Coat the race with petroleum jelly and install it onto the planetary gear.
Race diameter (Reference)

	Inside	Outside
Race	24.7 mm (0.972 in)	41.8 mm (1.646 in)

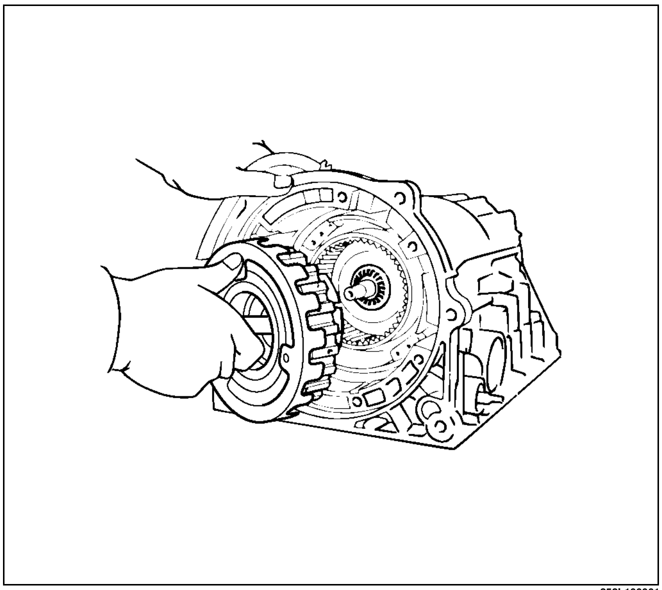

252RY00001

SECTION 4A

PROPELLER SHAFT

TABLE OF CONTENTS

34. Install the overdrive planetary gear and direct clutch.

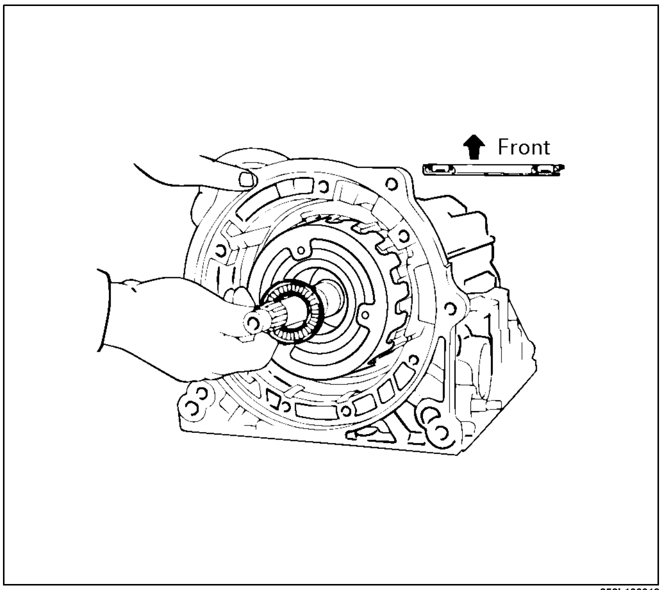


252L100001

35. Coat the assembled bearing and race with petroleum jelly and install it onto the direct clutch.

Bearing and race diameter (Reference)

	Inside	Outside
Bearing and race	28.9 mm (1.138 in)	50.2 mm (1.976 in)

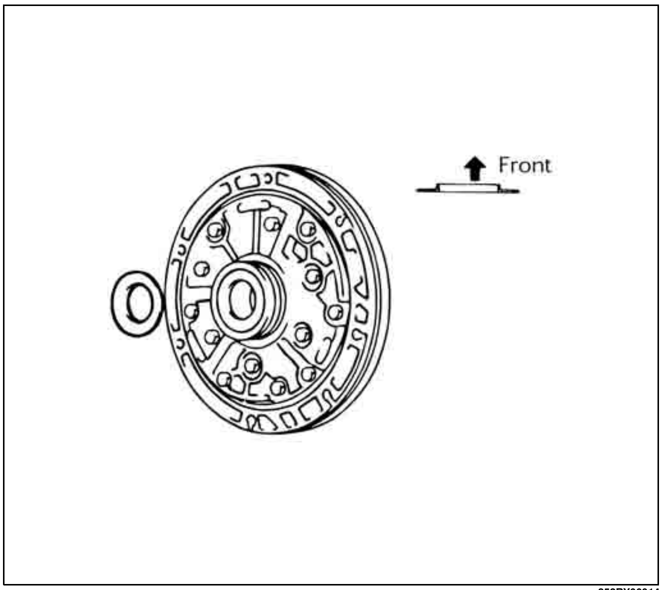


252L100018

36. Coat the race with petroleum jelly and install it onto the oil pump.

Race diameter (Reference)

	Inside	Outside
Race	28.6 mm (1.126 in)	46.5 mm (1.831 in)

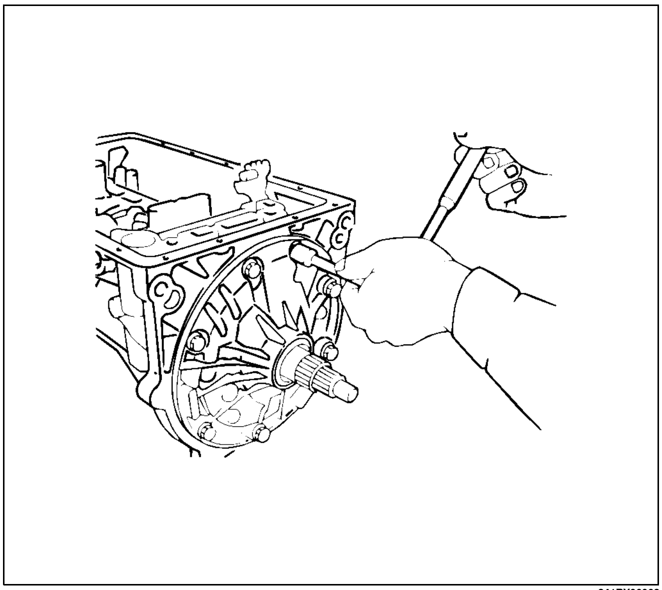


252RY00014

37. Coat the O-ring with ATF and install it around the pump body.
Place the oil pump through the input shaft, and align the bolt holes of the pump body with the transmission case.
Hold the input shaft, and lightly press the oil pump body to slide the oil seal rings on the stator shaft through the direct clutch drum.
CAUTION:
Do not push on the oil pump strongly or the oil seal ring will stick to the direct clutch drum.
Install the seven bolts.

Torque: 22 N·m (2.2 kgf·m/16 lb·ft)

38. Check input shaft rotation.
Make sure the input shaft rotates smoothly.



241RY00003

Diaassembly, Inspection and Reassembly of minor Components

NOTE: The instructions here are organized so that you work on only one component group at a time.
This will help avoid confusion from similar-looking parts of different subassemblies being on your workbench at the same time.
The component groups are inspected and repaired from the converter housing side.
As much as possible, complete the inspection, repair and reassembly before proceeding to the next component group. If a component group cannot be reassembled because parts are being ordered, be sure to keep all parts of that group in separate container while proceeding with disassembly, inspection, repair and reassembly of other component groups.
Recommended ATF type DEXRON III.

General Cleaning Notes:

1. All disassembled parts should be washed clean and any fluid passages and holes should be blown through with compressed air.
2. When using compressed air to dry parts, always aim away from yourself to prevent accidentally spraying automatic transmission fluid in your face.
3. The recommended automatic transmission fluid should be used for cleaning.

Parts Arrangement:

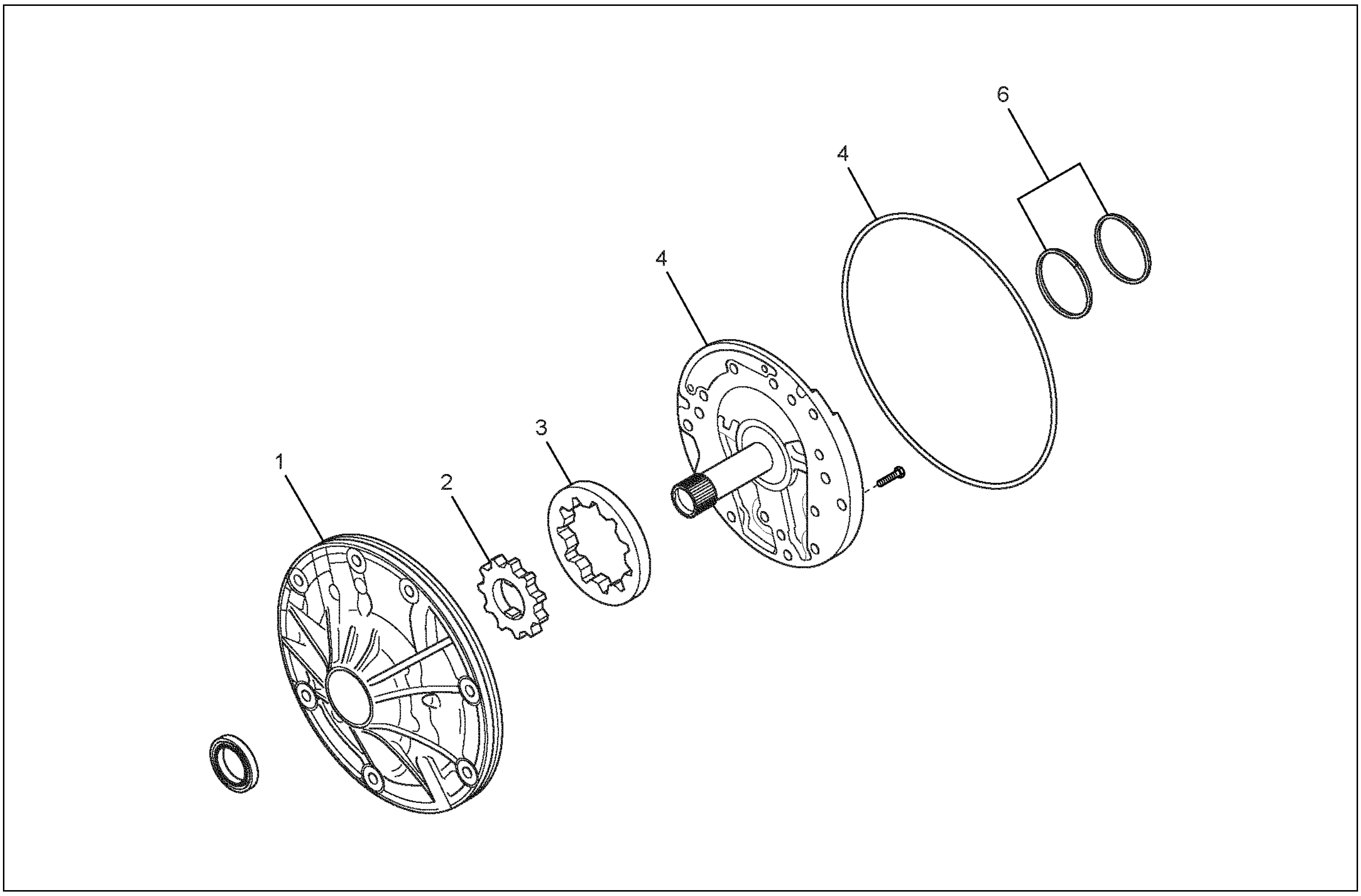
1. After cleaning, the parts should be arranged in proper order to allow performing inspection, repairs, and reassembly with efficiency.
2. When disassembling a valve body, be sure to keep each valve together with the corresponding spring.
3. New brakes and clutches that are to be used for replacement must be soaked in transmission fluid for at least thirty minutes before assembly.

General Assembly:

1. All oil seal rings, clutch discs, clutch plates, rotating parts, and sliding surfaces should be coated with transmission fluid prior to reassembly.
2. All gaskets and rubber O-ring should be replaced.
3. Make sure that the ends of a snap ring are not aligned with one of the cutouts and are installed in the groove correctly.
4. If a worn bushing is to be replaced, the subassembly containing that bushing must be replaced.
5. Check thrust bearings and races for wear or damage. Replace if necessary.
6. Use petroleum jelly or vaseline to keep parts in place.

Oil Pump

Disassembly View



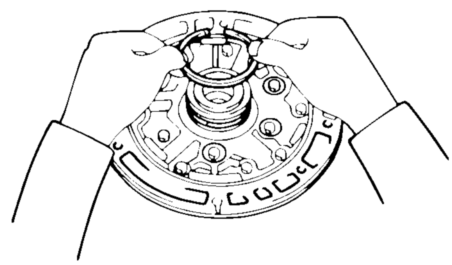
RTW77AMF000201

Legend

(1) Oil pump body
(2) Oil pump drive gear
(3) Oil pump driven gear
(4) Stator shaft
(5) O-ring
(6) Oil seal ring

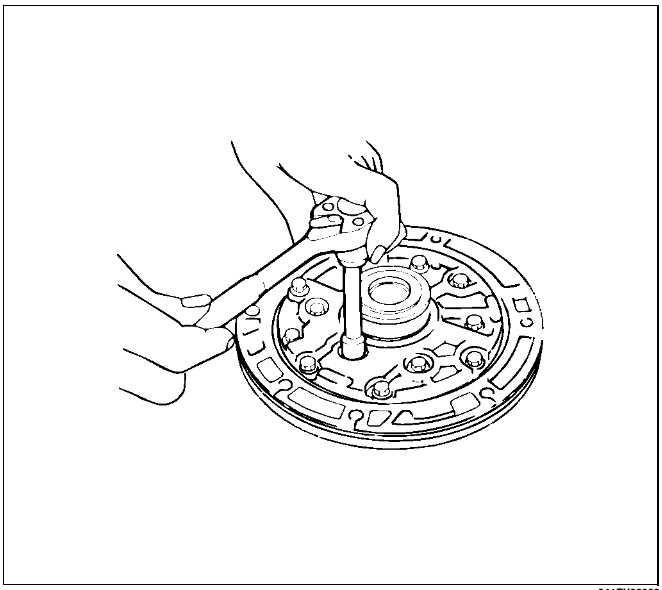
Disassembly

1. Use torque converter as work stand.
   Remove 2 oil seal rings from stator shaft.



241RY00005

2. Remove the O-ring.
3. Remove the stator shaft.
4. Remove the oil pump drive gear.
5. Remove the oil pump driven gear.
6. Remove the oil pump body.
   Remove 13 bolts, and then remove the stator shaft from oil pump body.
   Then remove drive and driven gear.



241RY00006

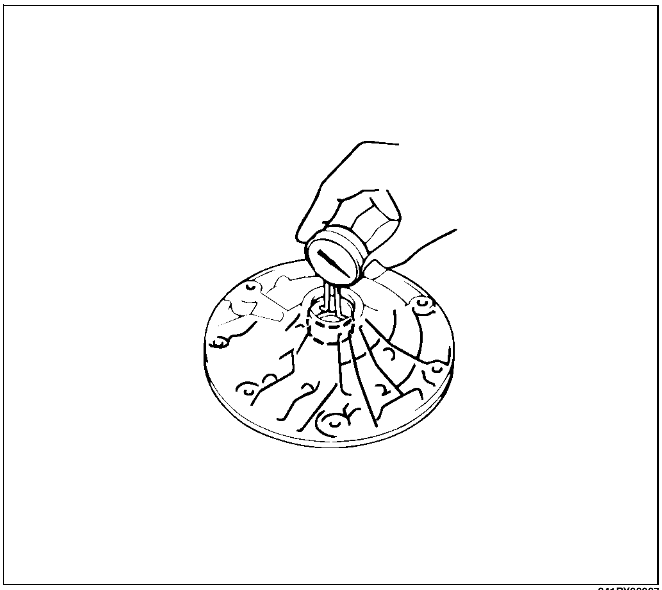
Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any abnormal conditions are found through inspection.

1. Check oil pump body bushing.
   Using a dial indicator, measure the inside diameter of the oil pump body bushing.

   Maximum inside diameter: 38.19mm (1.5035in)

   If the inside diameter is greater than the maximum, replace the oil pump body.



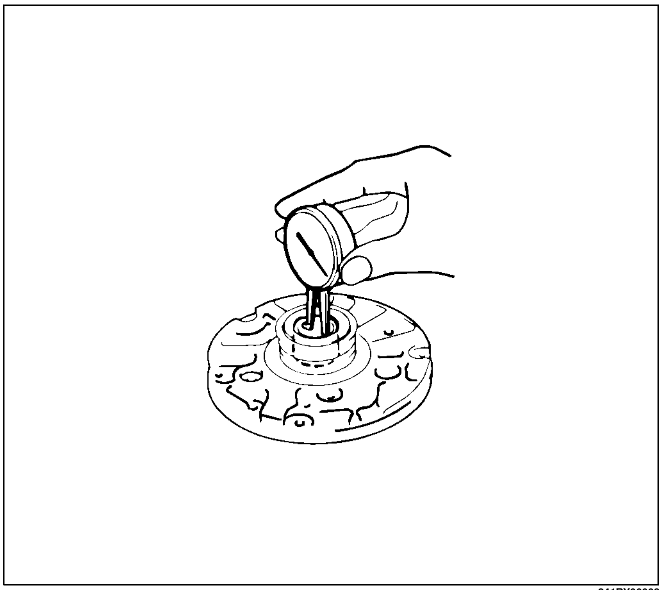
241RY00007

2. Check stator shaft bushing.
   Using a dial indicator, measure the inside diameter of the stator shaft bushing.

   Maximum inside diameter: Front side: 21.58mm (0.8496in)

   Maximum inside diameter: Rear side: 27.08mm (1.0661in)

   If the inside diameter is greater than the maximum, replace the stator shaft.



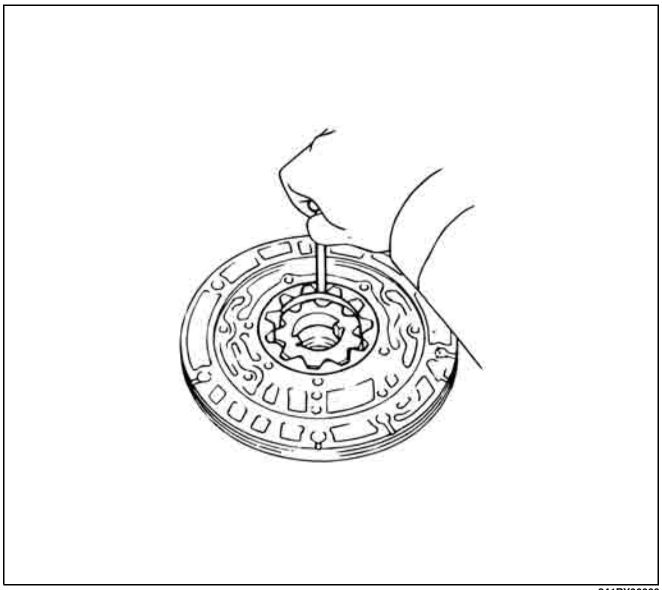
241RY00008

3. Check tip clearance of both gears.
   Measure between the gear teeth and the cresent-shaped part of the pump body.

   Standard tip clearance: 0.11 – 0.14mm (0.0043 – 0.0055in)

   Maximum tip clearance: 0.19mm (0.0075in)

   If the tip clearance is greater than the maximum, replace the drive gear, driven gear or pump body.



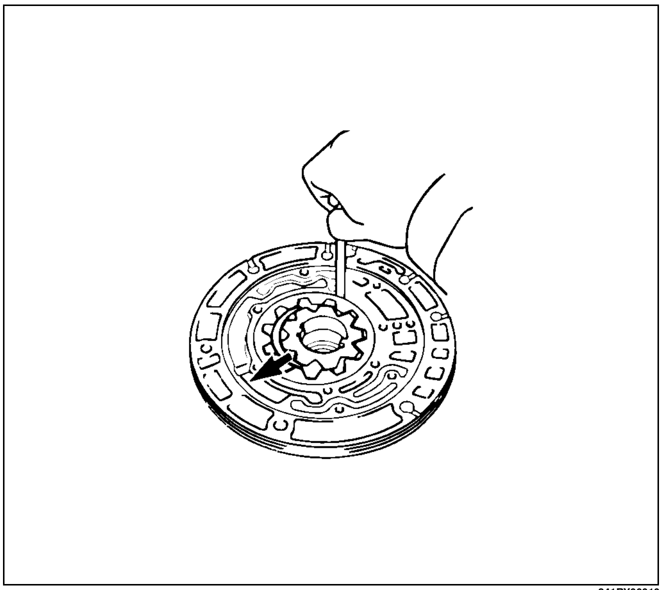
241RY00009

4. Check body clearance of driven gear.
   Push the driven gear to one side of the body.
   Use a feeler gauge, measure the clearance.

Standard body clearance: 0.07 – 0.15 mm (0.0028 – 0.0059 in)

Maximum body clearance: 0.2 mm (0.0079 in)

If the body clearance is greater than the maximum, replace the drive gear, driven gear or pump body.



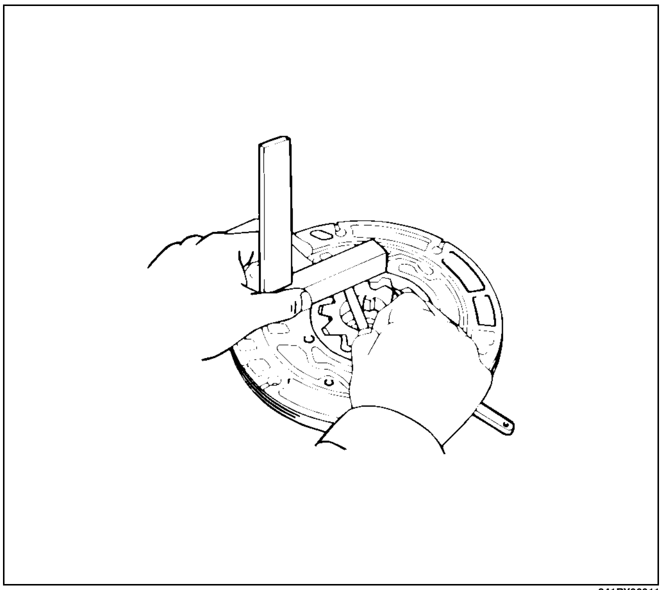
241RY00010

5. Check side clearance of both gears.
   Using a steel straightedge and a feeler gauge, measure the side clearance of both gears.

Standard side clearance: 0.02 – 0.05 mm (0.0008 – 0.0020 in)

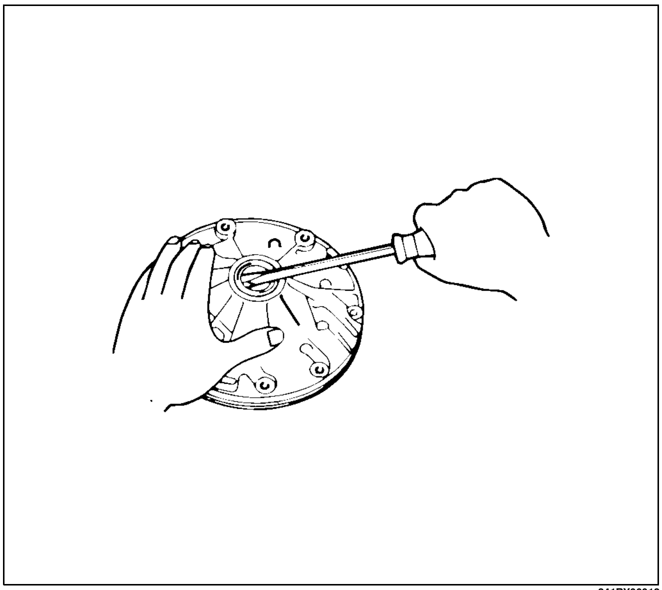
Maximum side clearance: 0.1 mm (0.004 in)

If the side clearance is greater than the maximum, replace the drive gear, driven gear or pump body.



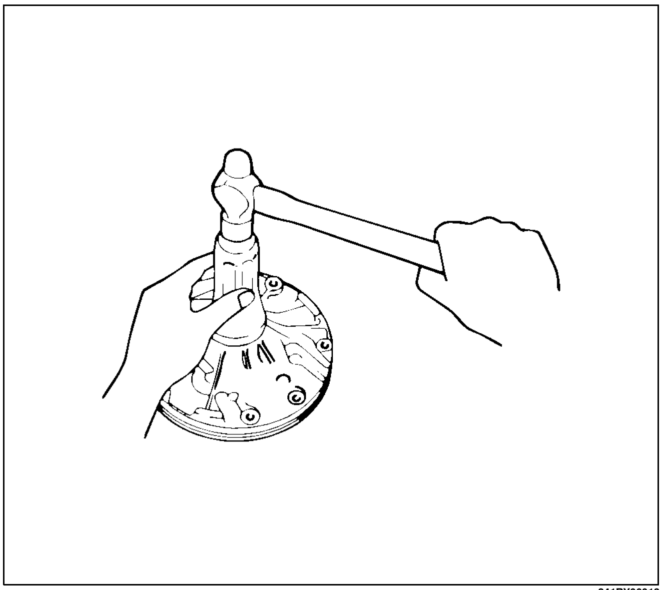
241RY00011

6. Check oil seal.
   Check for wear, damage or cracks.
   If necessary, replace oil seal.
   Pry off the oil seal with a screwdriver.



241RY00012

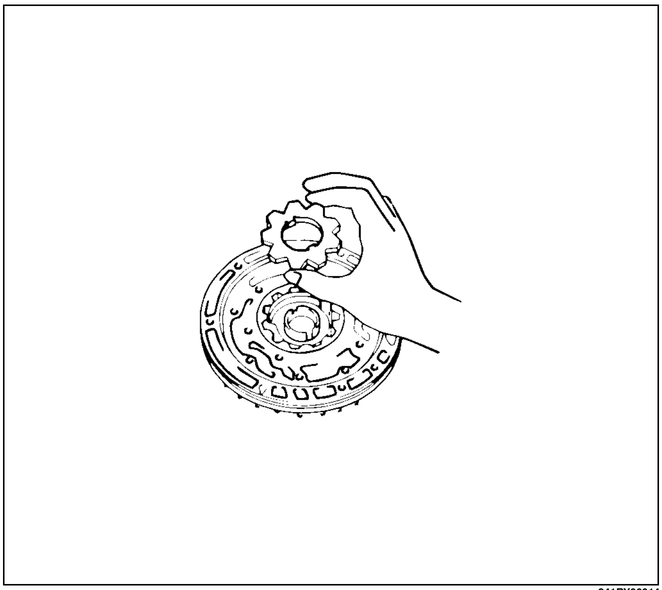
Using special tool, install a new oil seal.
The oil seal end should be flush with the outer edge of the pump body.
Oil seal installer : 5-8840-2256-0
Coat the oil seal lip with multipurpose grease.



241RY00013

Reassembly

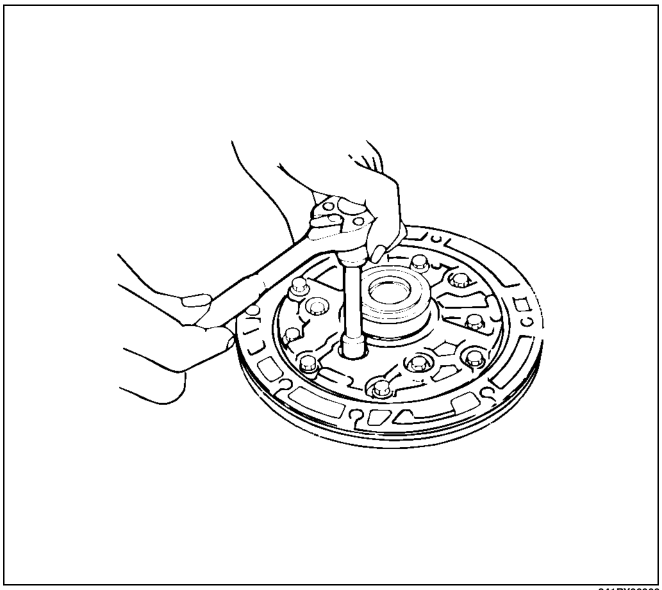
1. Place the oil pump body on the torque converter.
2. Coat the driven gear and drive gear with ATF.
3. Install the driven gear and drive gear.



241RY00014

4. Align the stator shaft with the bolt holes.
   Tighten the thirteen bolts.

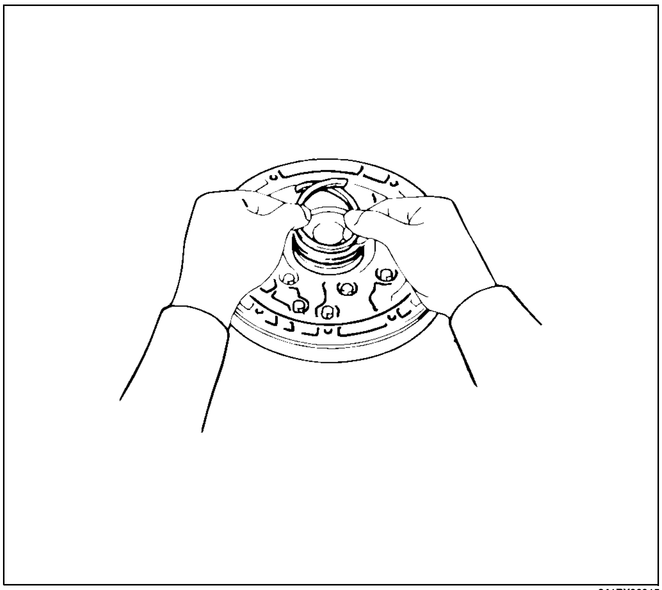
Torque: 10 N·m (1.0 kg·m/87 lb·in)



241RY00006

5. Install the oil seal ring.
   - Coat the oil seal rings with ATF.
   - Contract the oil seal rings as shown, and install them onto the stator shaft.

NOTE: Do not spread the ring ends too much.

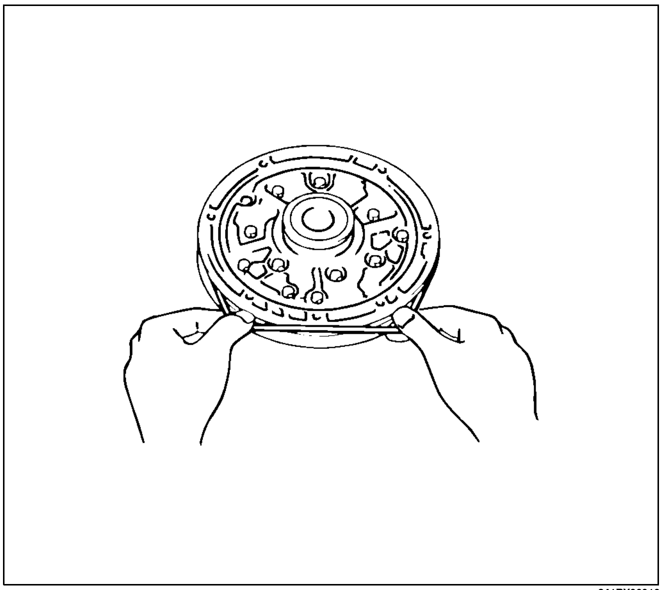


241RY00015

6. Coat a new O-ring with ATF and install it to the oil pump body.

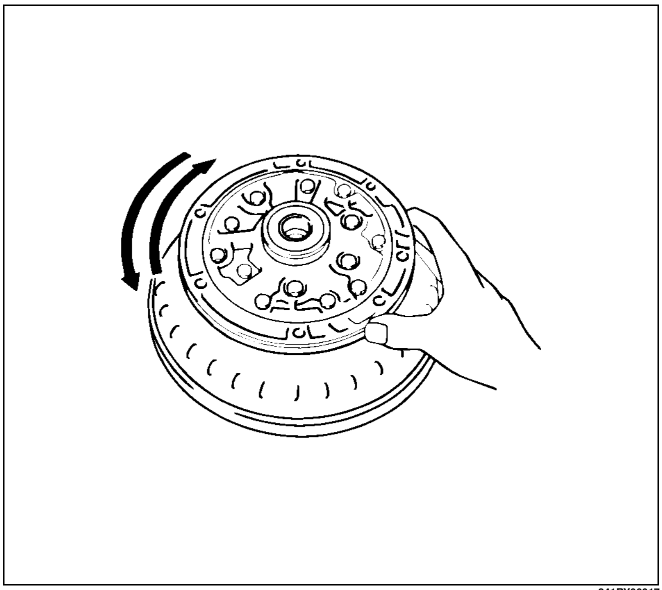
O-ring size (Reference)

Inside diameter	204.9 mm (8.067 in)
Thickness	3.5 mm (0.138 in)



241RY00016

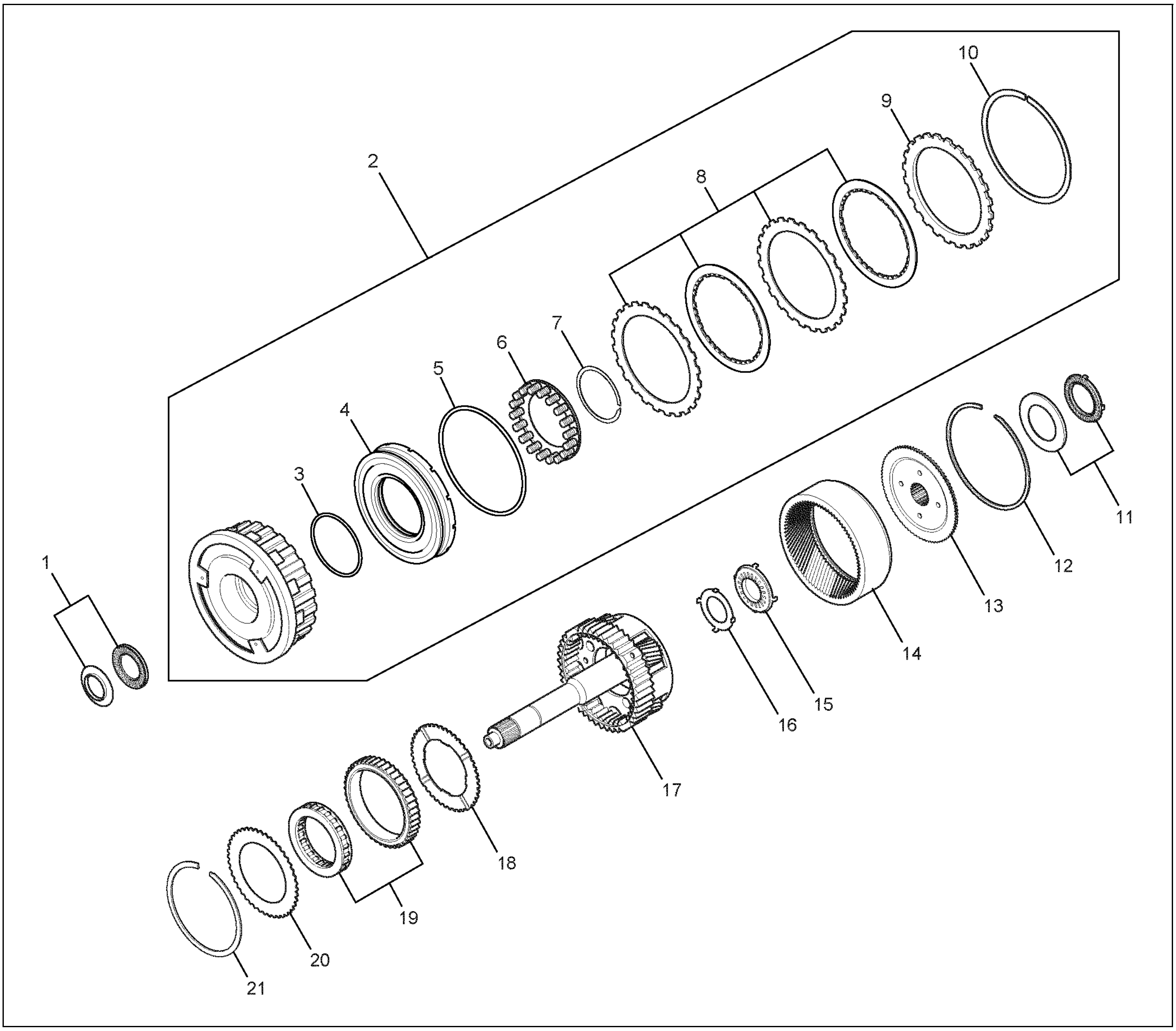
7. Check oil pump drive gear rotation.
   Make sure the drive gear rotates smoothly when installed to the torque converter.



241RY00017

OD Planetary Gear and OD Direct Clutch Assembly (C–0)

Disassembled View

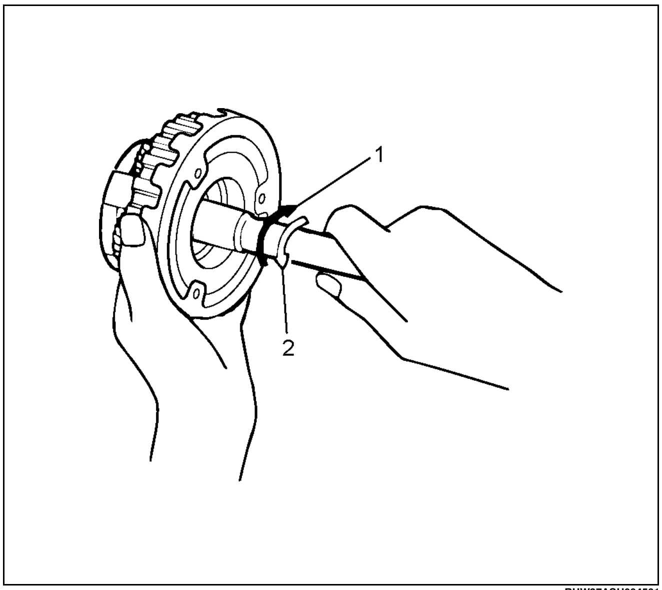


Legend

(1) Thrust bearing
(2) OD direct clutch assembly
(3) O-ring
(4) OD direct clutch piston
(5) O-ring
(6) Piston return spring
(7) Snap ring
(8) Clutch disc
(9) Flange
(10) Snap ring
(11) Thrust bearing
(12) Snap ring
(13) Ring gear flange
(14) OD planetary ring gear
(15) Thrust bearing
(16) Race
(17) OD planetary gear assembly
(18) Thrust washer
(19) OD one-way clutch
(20) Retaining plate
(21) Snap ring

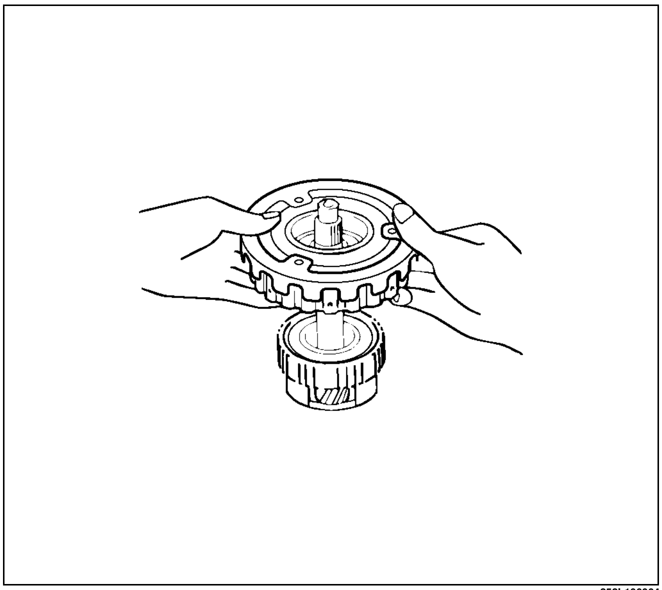
Disassembly

1. Check operation of one-way clutch.
   Hold the OD direct clutch drum and turn the input shaft.
   The input shaft should turn freely clockwise and should lock counterclockwise.



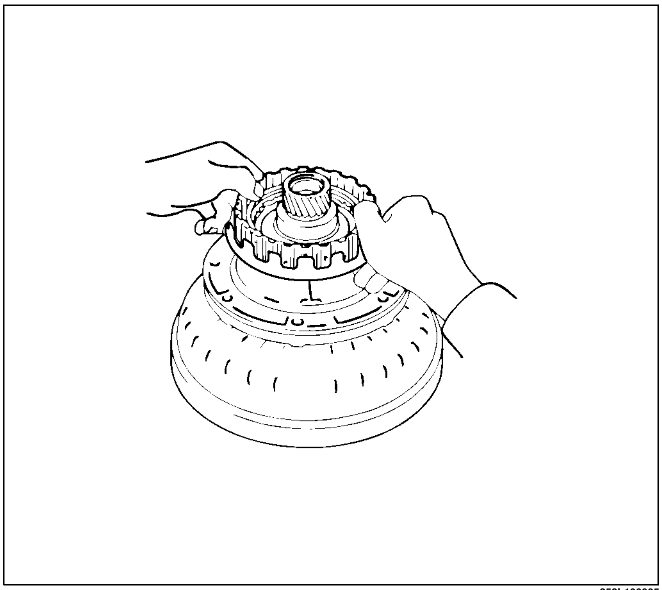
RUW37ASH004501

2. Remove OD direct clutch assembly from OD planetary gear assembly.


252L100004

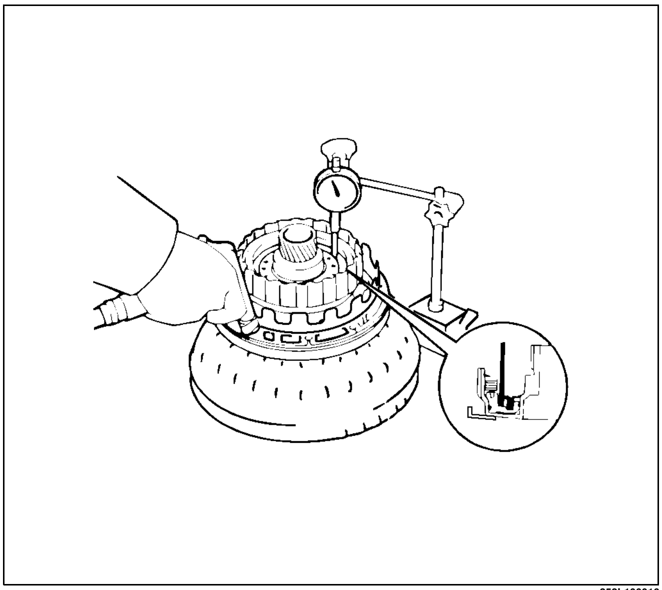
3. Then remove thrust bearing with the race from OD direct clutch drum.

4. Check piston stroke of OD direct clutch (C–0).
   Place the oil pump onto the torque converter, and then place the OD direct clutch assembly onto the oil pump.

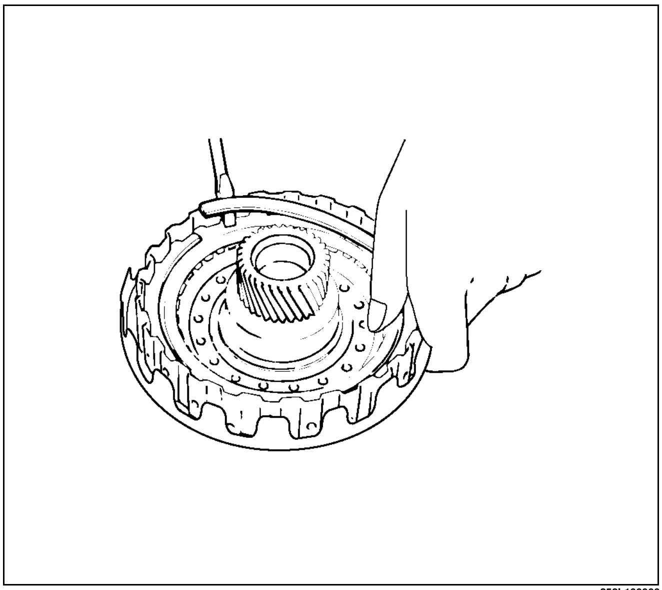

252L100005

Use a dial indicator, measure the OD direct clutch piston stroke applying and releasing the compressed air (390 – 780 kPa or 57 – 114 psi) as shown.

Piston stroke: 1.85 – 2.15 mm (0.0728 – 0.0846 in)

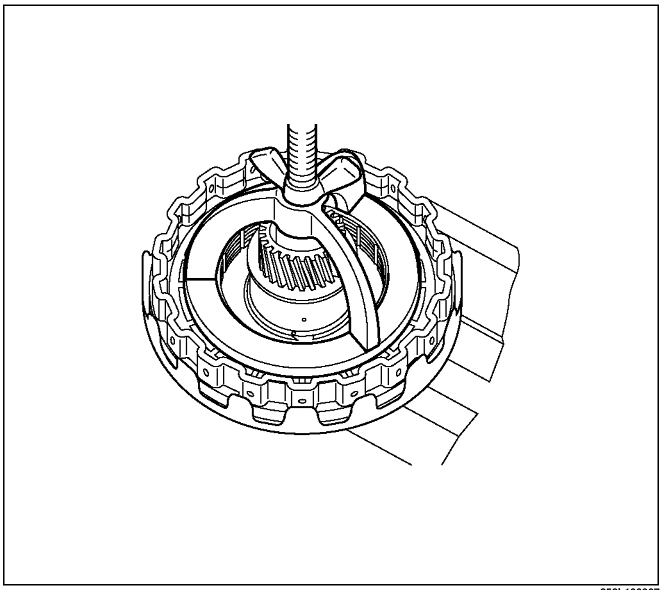

252L100016

5. Remove snap ring from clutch drum.



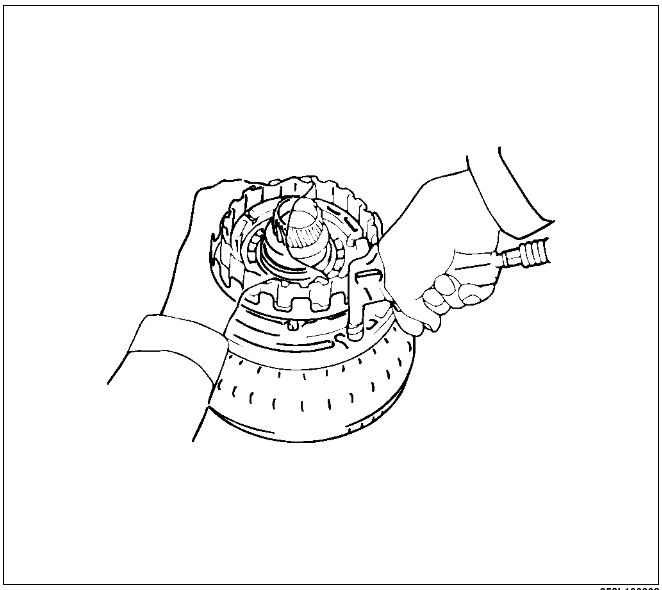
252L100006

6. Remove flange, two discs and two plates.
7. Place special tool on the spring retainer and compress the return spring.
   Using snap ring pliers, remove the snap ring.
   Spring compressor : 5-8840-0195-0



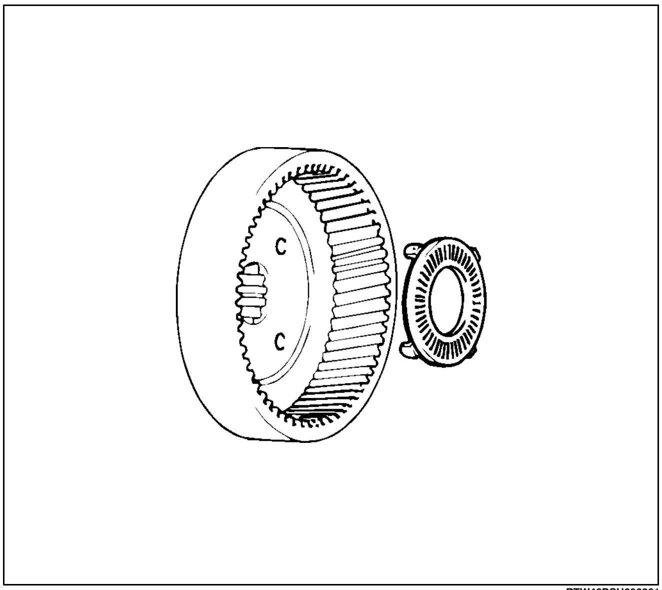
252L100007

8. Remove piston return spring
9. Remove the OD direct clutch piston with O-ring.
   - Place the oil pump onto the torque converter and then place the OD direct clutch onto the oil pump.
   - Holding the OD direct clutch piston by hand, apply compressed air to the oil pump to remove the OD direct clutch piston.
   - Remove the OD direct clutch piston.



252L100008

10. Remove two O–rings from piston.
11. Remove bearing and race from OD planetary ring gear.



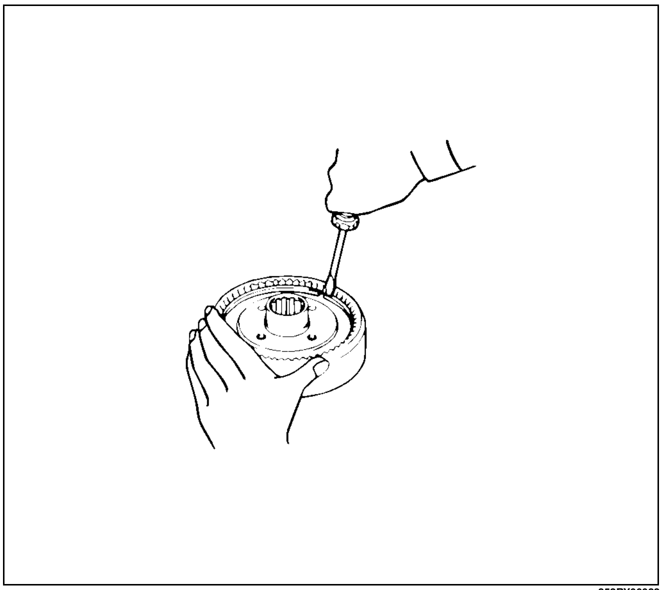
RTW46BSH000301

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNING COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

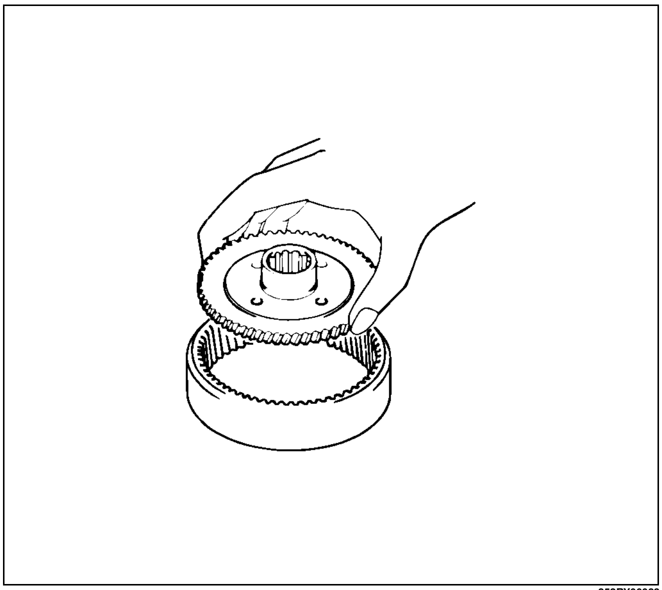
CAUTION : Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

12. Remove snap ring.



252RY00022

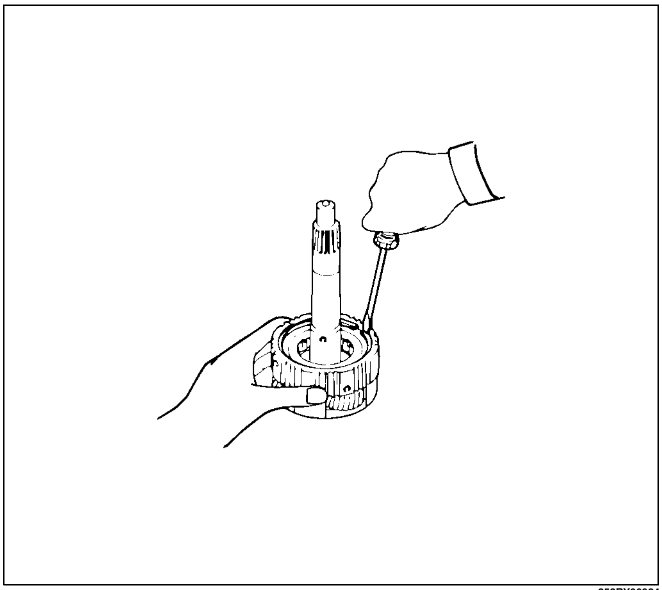
13. Remove ring gear flange from OD planetary ring gear.



252RY00023

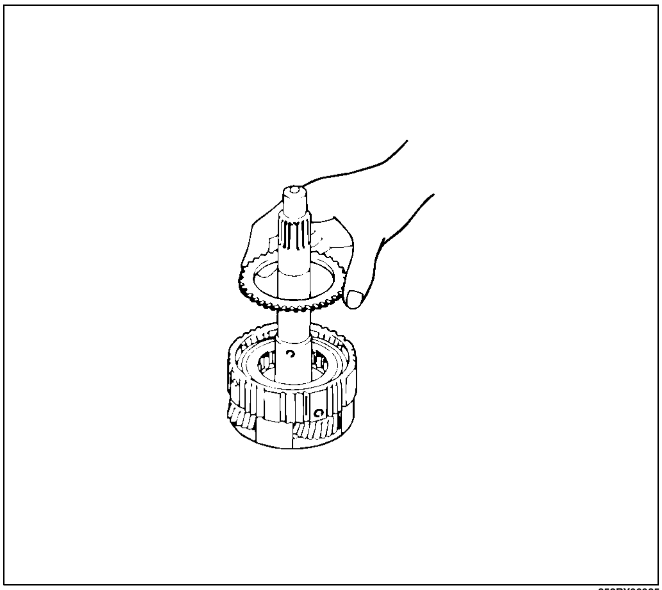
14. Remove the Race.

15. Remove snap ring, using screwdriver.



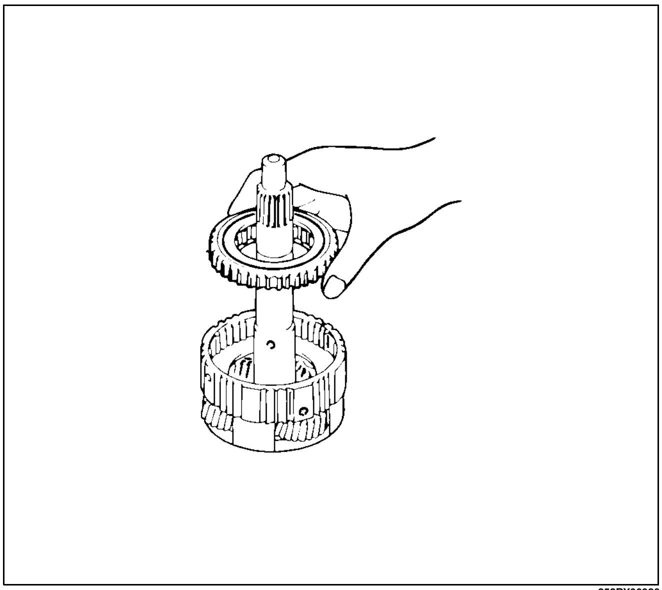
252RY00024

16. Remove retaining plate from OD planetary gear.



252RY00025

17. Remove OD one-way clutch with outer race.



252RY00026

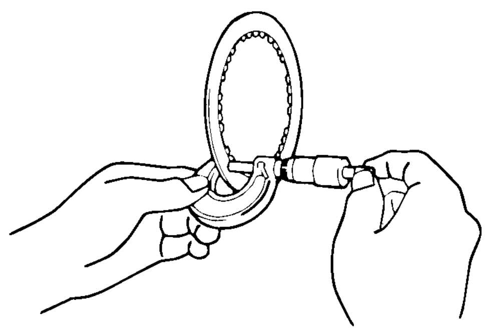
18. Remove the thrust washer.

Inspection and Repair

1. Check discs.
   Using a micrometer, measure the thickness of the discs.

   Minimum thickness: 2.04 mm (0.0803 in)

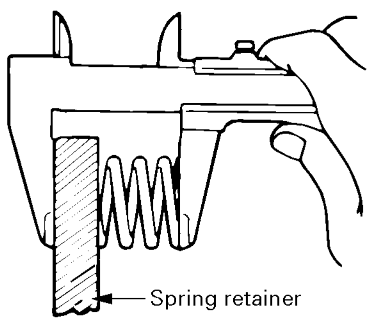
   If the thickness is less than the minimum, replace the disc.



252RY00027

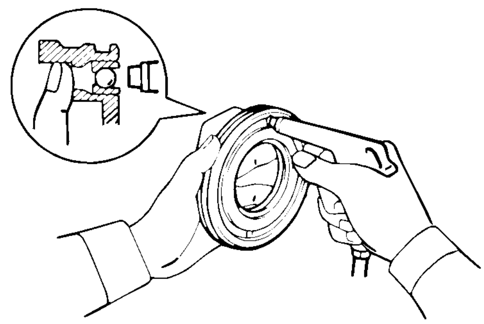
2. Check piston return spring
   Using calipers, measure the free length of the return spring.

   Standard length: 15.8 mm (0.622 in)



252RY00028

3. Check OD direct clutch piston.
   Check that the check ball is free by shaking the piston. Check that the valve does not leak by applying low-pressure compressed air.

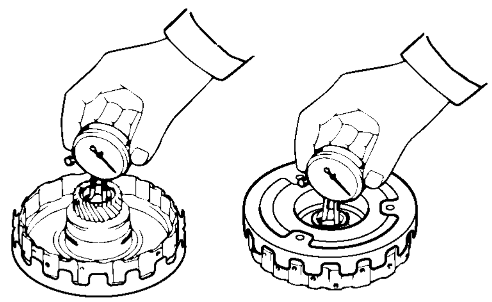


252RY00029

4. Check OD direct clutch drum bushings.
   Using a dial indicator, measure the inside diameter of the OD direct clutch drum bushings.

   Maximum inside diameter: 27.11 mm (1.0673 in)

   If the inside diameter is greater than the maximum, replace the OD direct clutch drum.

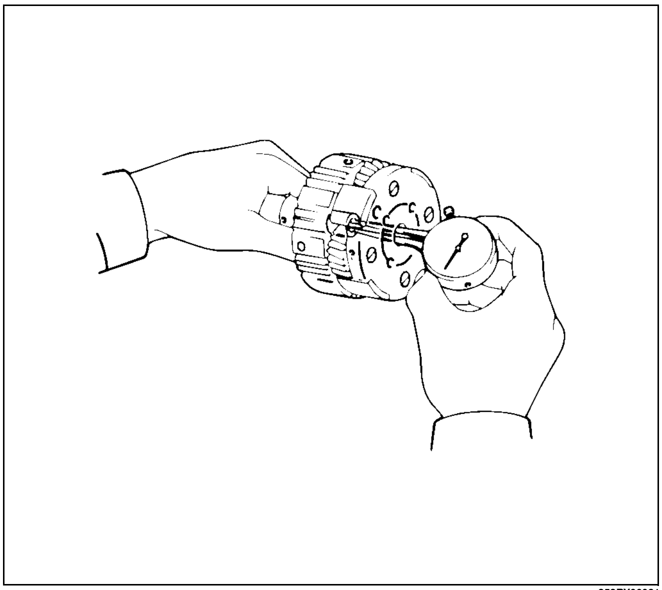


252L100009

5. Check OD planetary gear bushing.
   Using a dial indicator, measure the inside diameter of replace the OD planetary gear bushing.

Maximum inside diameter: 11.27 mm (0.4437 in)

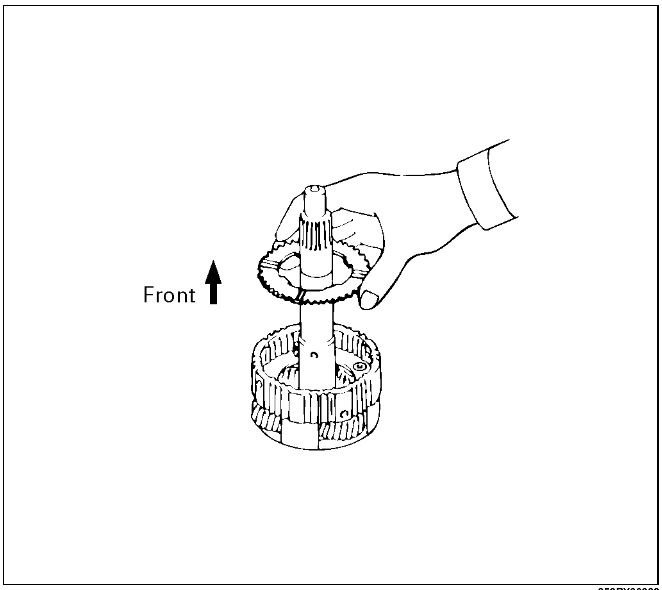
If the inside diameter is greater than the maximum, replace the OD planetary gear.



252RY00031

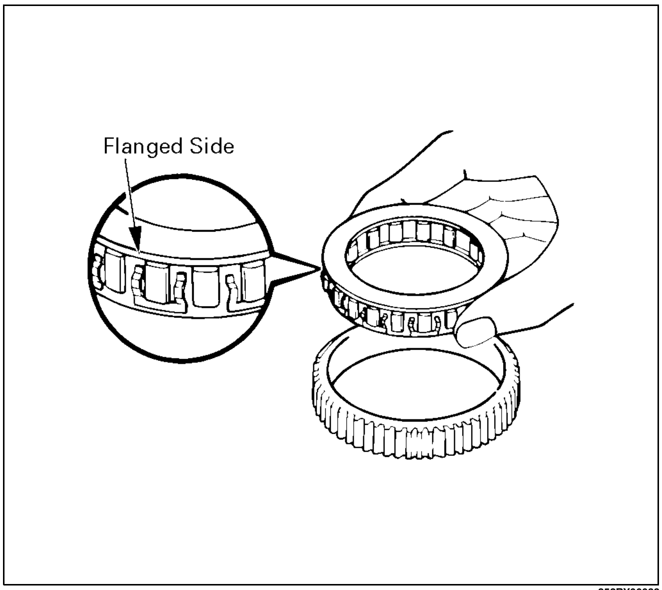
Reassembly

1. Install the thrust washer to the OD planetary gear, facing the grooved side upward.



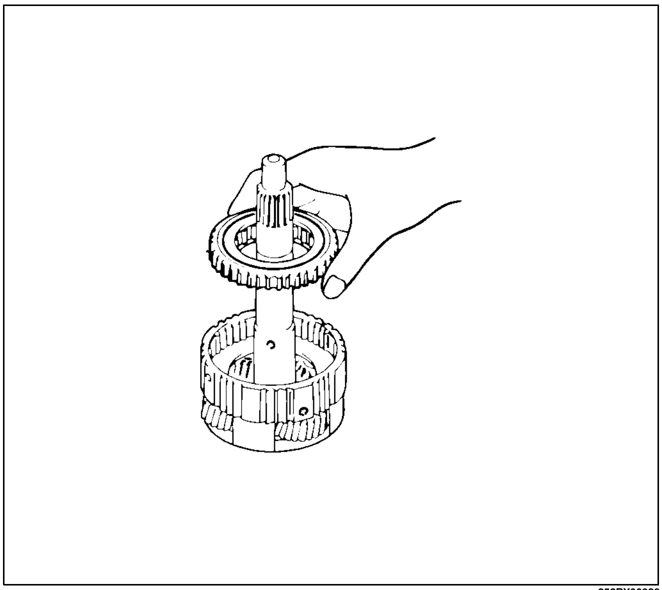
252RY00032

2. Install the one-way clutch into the outer race, with the flanged side of the one-way clutch facing upward.



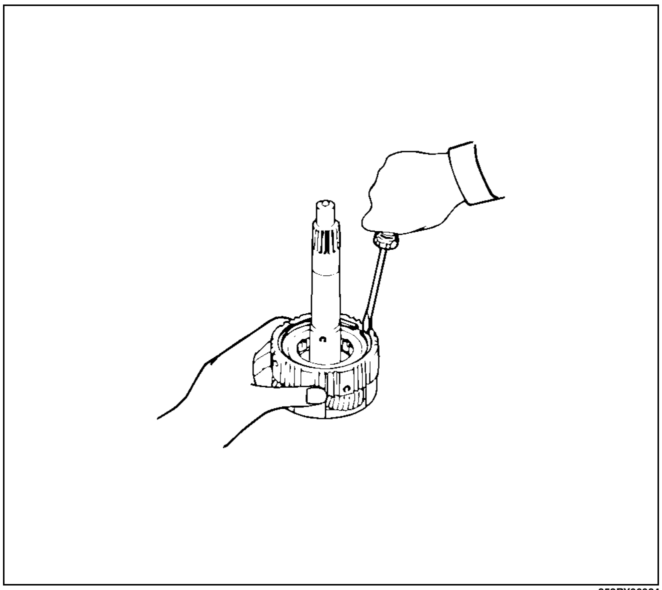
252RY00033

3. Install OD one-way clutch with outer race to overdrive planetary gear.



252RY00026

4. Install retaining plate, then install snap ring, using a screwdriver.

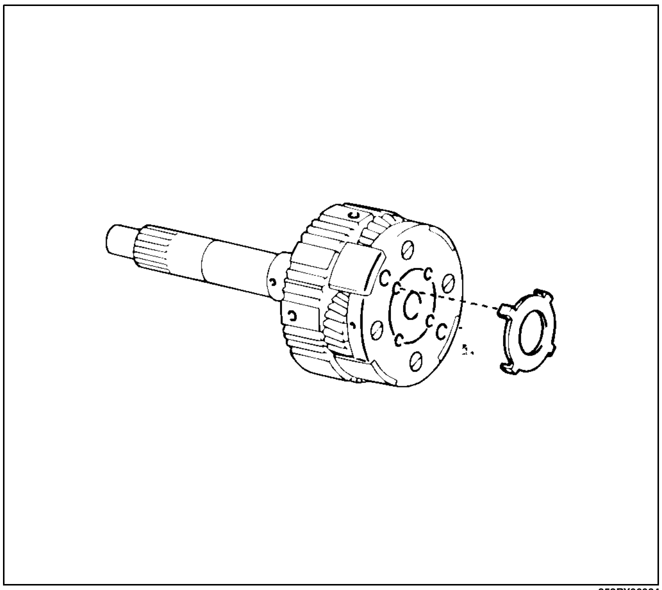


252RY00024

5. Coat the race with petroleum jelly and install it to the planetary gear.

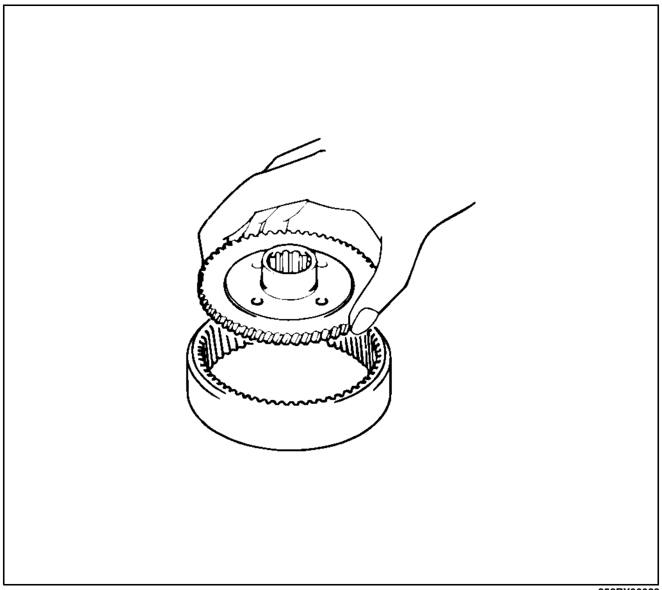
Race diameter (Reference)

Inside diameter	24.7 mm (0.972 in)
Outside diameter	41.8 mm (1.646 in)



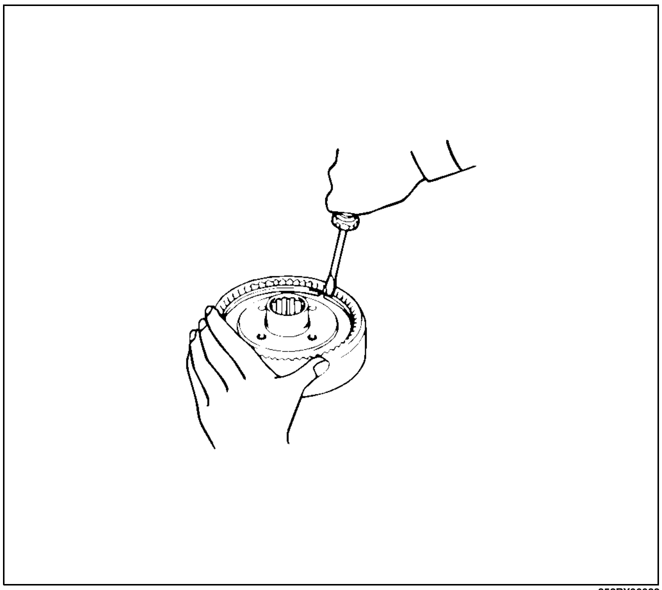
252RY00034

6. Install ring gear flange to OD planetary ring gear.



252RY00023

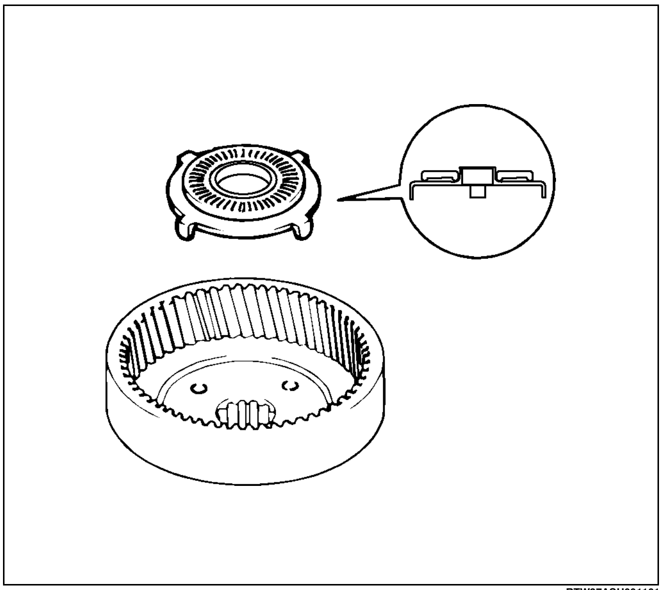
7. Install snap ring, using a screwdriver.



252RY00022

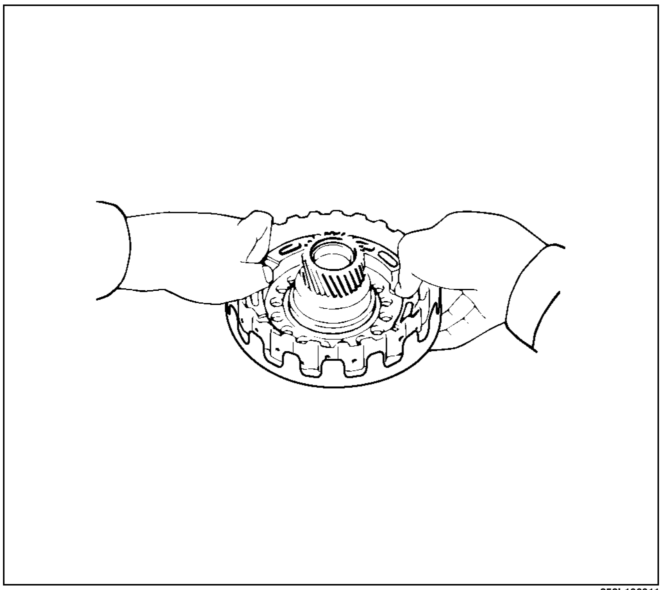
8. Install the race and bearing asm onto the OD planetary ring gear.
Race and bearing asm diameter (Reference)

	Inside	Outside
Bearing and race	24.2 mm (0.953 in)	47.8 mm (1.882 in)



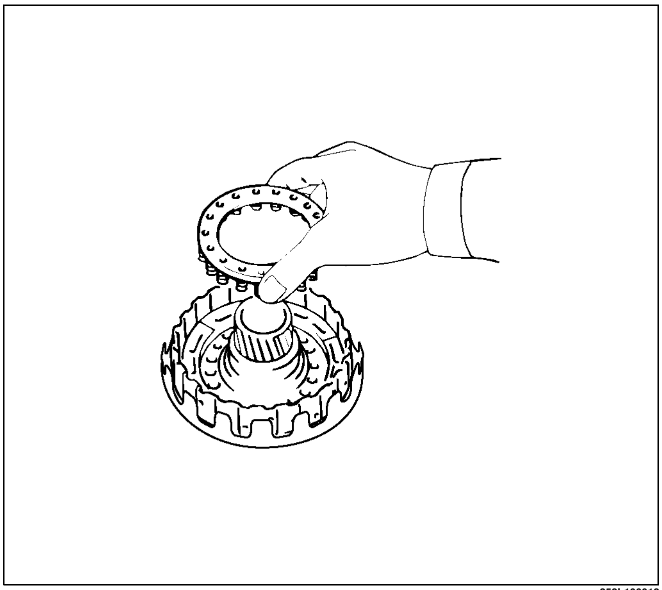
RTW37ASH001101

9. Coat new O-rings with ATF and install them on the OD direct clutch piston.
10. Being careful not to damage the O-rings, press in the OD direct clutch piston into the clutch drum, using both hands.



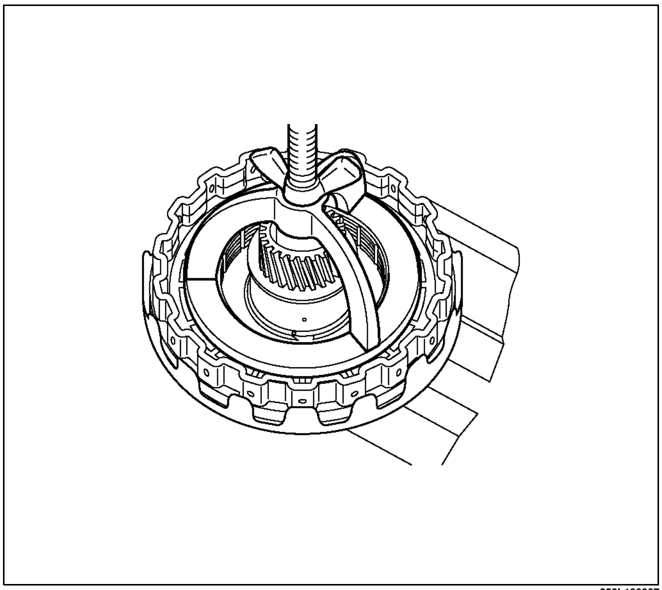
252L100011

11. Install piston return spring.



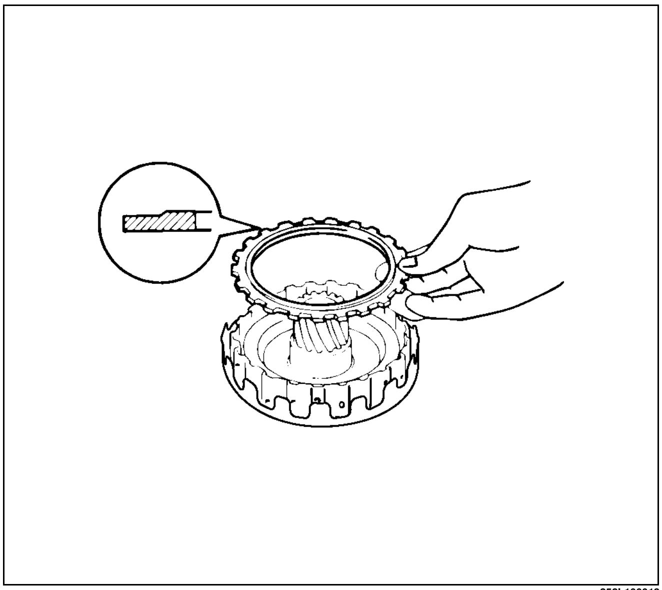
252L100012

12. Place special tool on the spring retainer, and compress the return spring.
Spring compressor : 5-8840-0195-0
Install the snap ring with snap ring pliers.
Be sure the end gap of the snap ring is not aligned with the spring retainer claw.



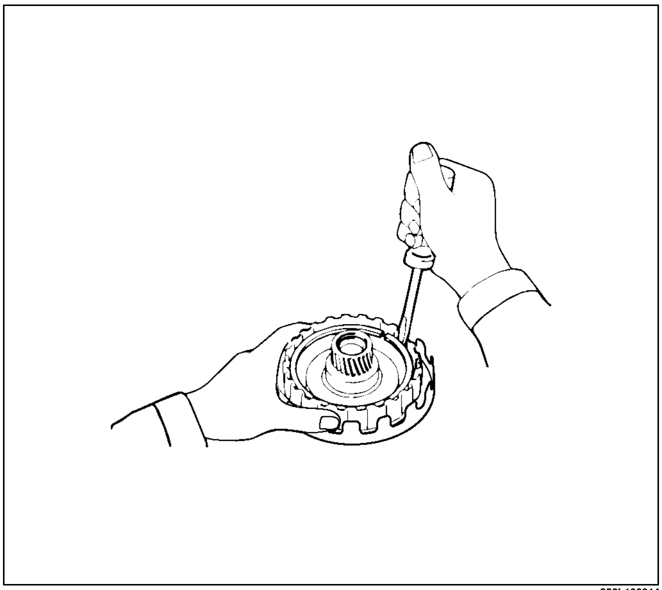
252L100007

13. Install two plates and two discs then install the flange, with the flat side facing downward.



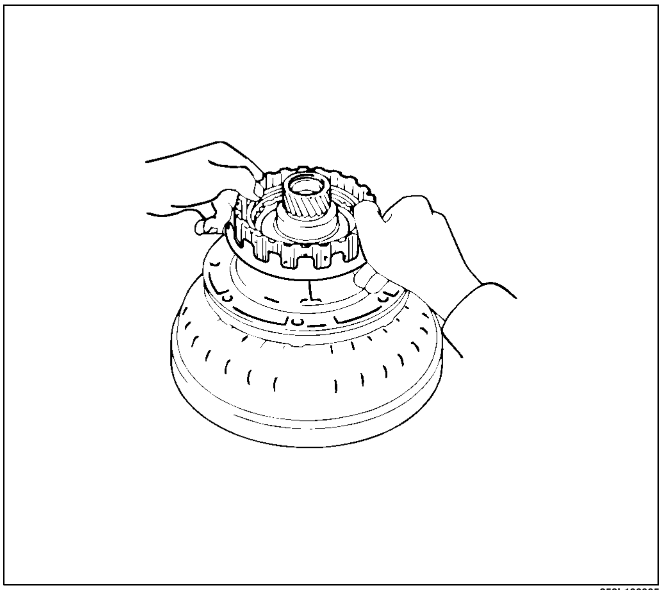
252L100013

14. Install snap ring.



252L100014

15. Check piston stroke of OD direct clutch (C–0)
Place the oil pump onto the torque converter, and then place the OD direct clutch assembly onto the oil pump.



252L100005

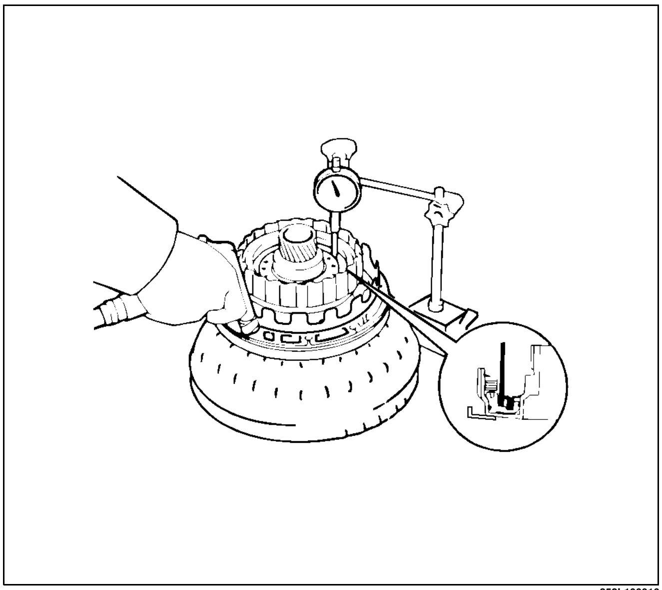
Using a dial indicator, measure the OD direct clutch piston stroke by applying and releasing the compressed air (390 – 780 kPa or 57 – 114 psi) as shown.

Piston stroke: 1.85 – 2.15 mm (0.0729 – 0.0847 in)

If the piston stroke is not within specification, replace the disc and recheck the piston stroke.
If the piston stroke is nonstandard, select another flange.

Flange sizes

Flange thickness	Flange thickness
3.8 mm (0.150 in)	3.4 mm (0.134 in)
3.7 mm (0.146 in)	3.3 mm (0.130 in)
3.6 mm (0.142 in)	3.2 mm (0.126 in)
3.5 mm (0.138 in)	3.1 mm (0.122 in)

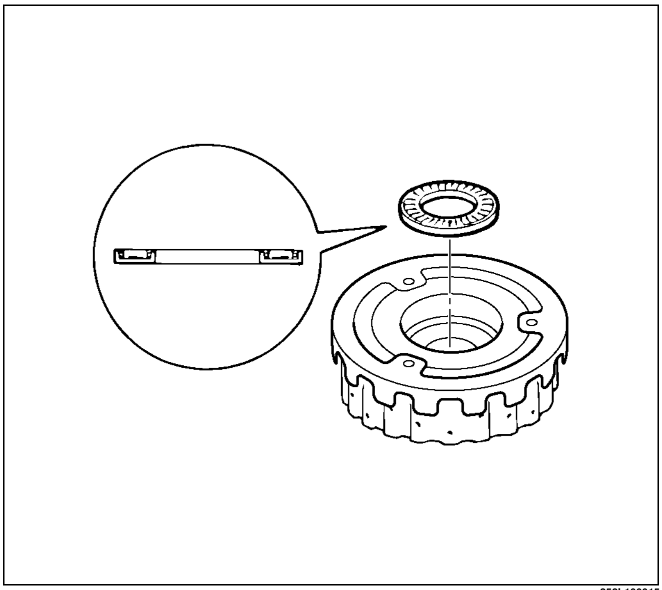


252L100016

16. Coat the assembled bearing and race with petroleum jelly and install it with the race side facing downward.

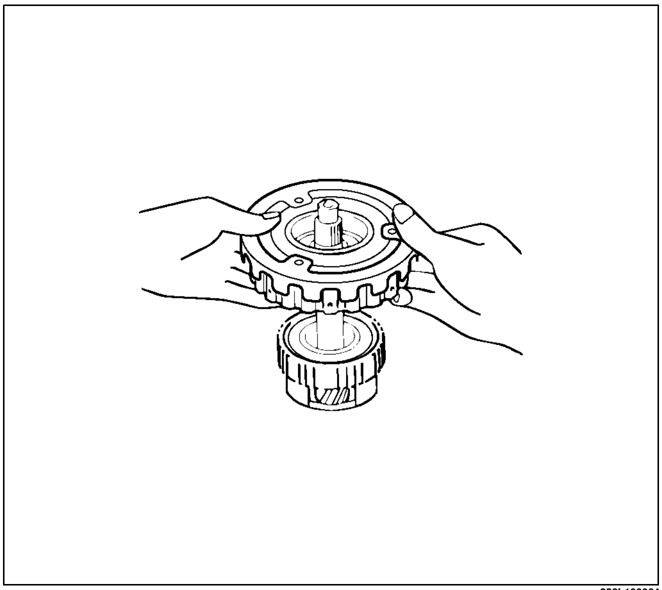
Bearing and race (Reference)

Inside diameter	28.9 mm (1.138 in)
Outside diameter	50.2 mm (1.976 in)



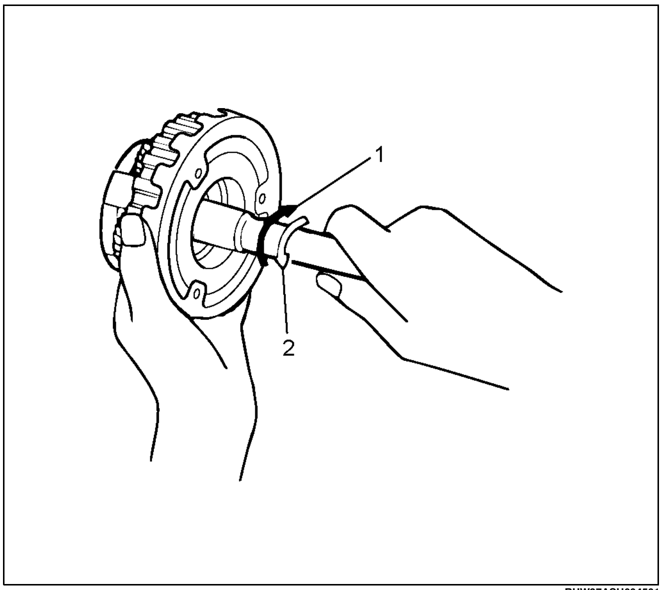
252L100015

17. Align the flukes of discs in the direct clutch.
Install the OD direct clutch assembly onto the OD planetary gear.



252L100004

18. Check operation of one-way clutch
Hold the OD direct clutch drum and turn the input shaft.
The input shaft should turn freely clockwise and should lock counterclockwise.



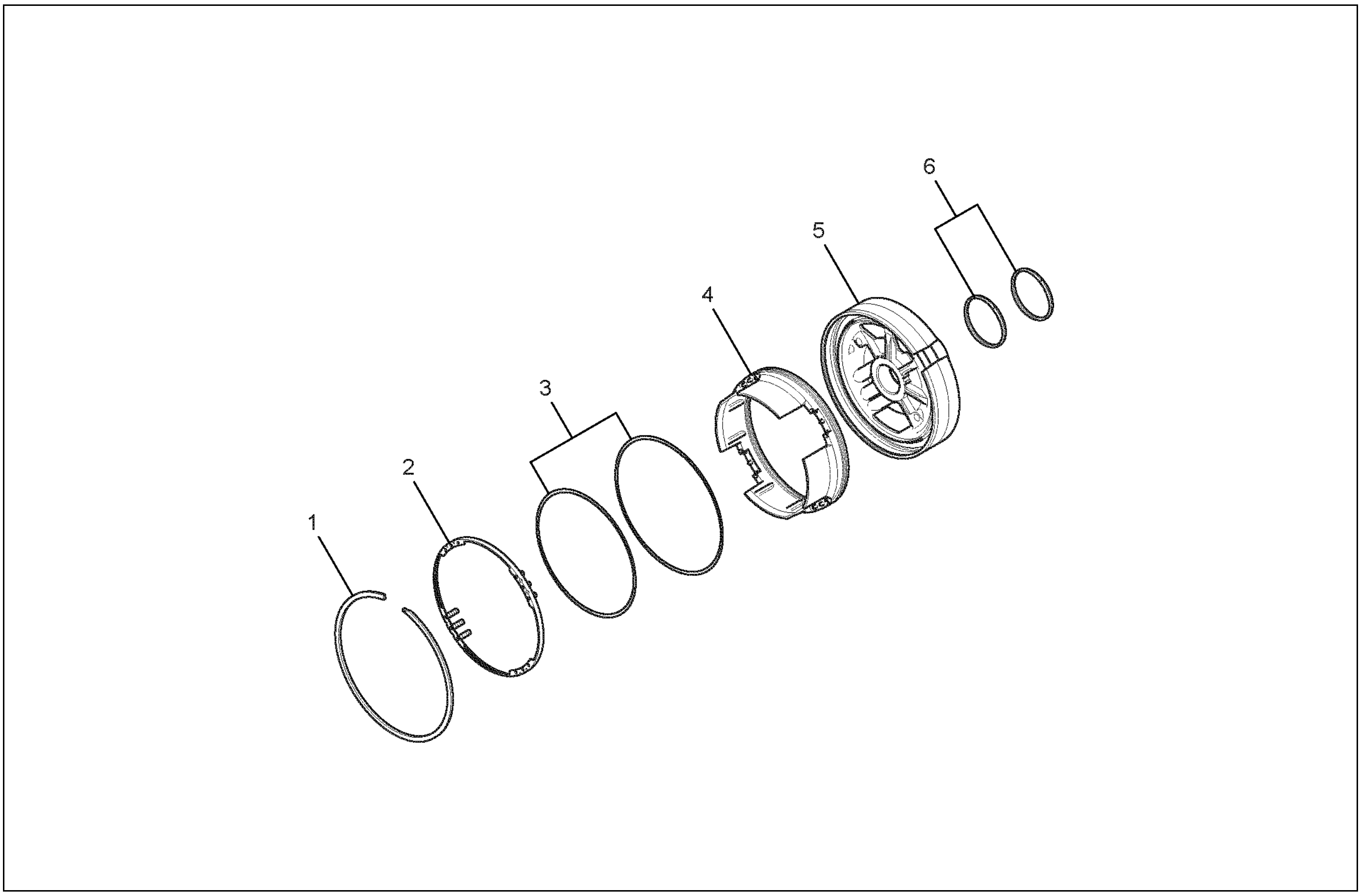
RUW37ASH004501

Legend

(1) Free
(2) Lock

OD Support Assembly

Disassembled View



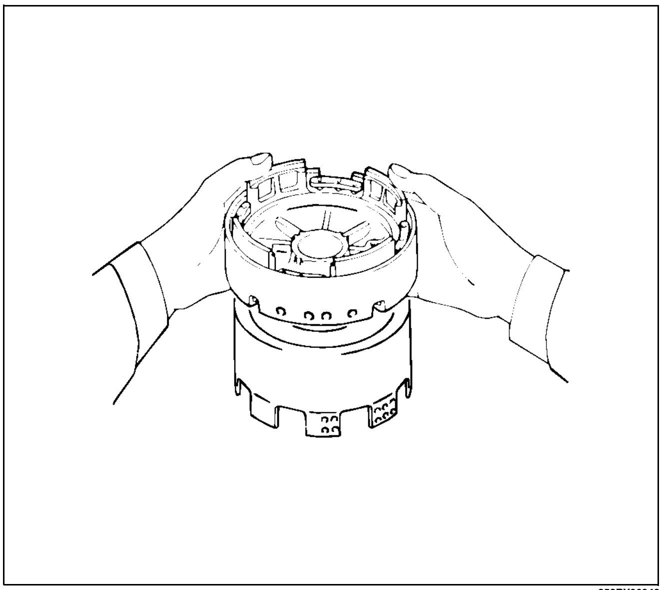
RTW77AMF000301

Legend

(1) Snap ring
(2) Piston return spring
(3) O-ring
(4) OD brake piston
(5) OD support
(6) Oil seal ring

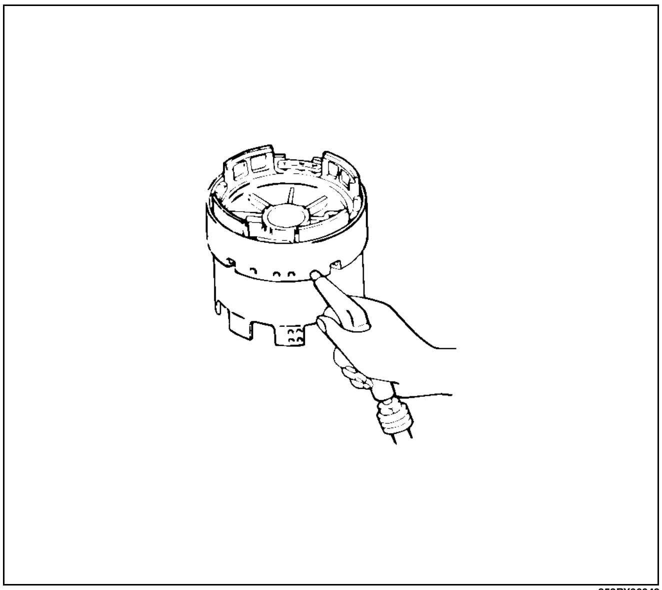
Disassembly

1. Check OD brake piston movement.
   Place the OD support assembly onto the direct clutch assembly.



252RY00042

Apply compressed air into the oil passage as shown, and be sure that the OD brake piston moves smoothly.

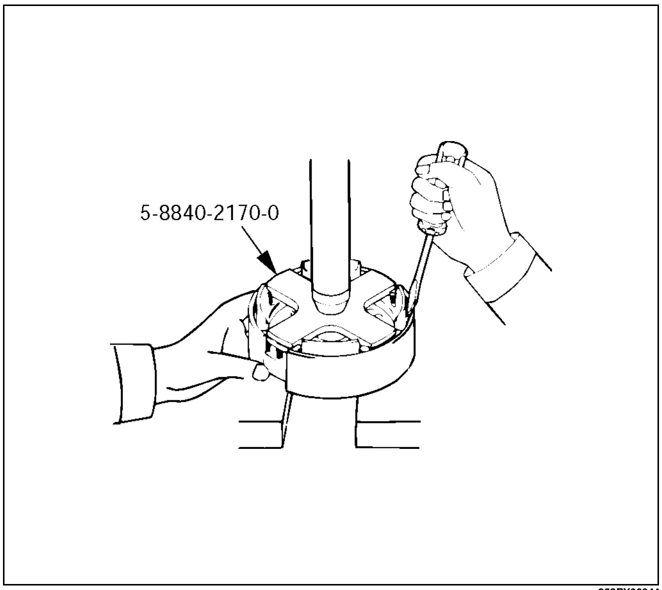


252RY00043

2. Remove the thrust bearing.
3. Remove the race.
4. Remove the thrust washer (plastic).
5. Place special tool on the spring retainer, and compress the return spring with a shop press.

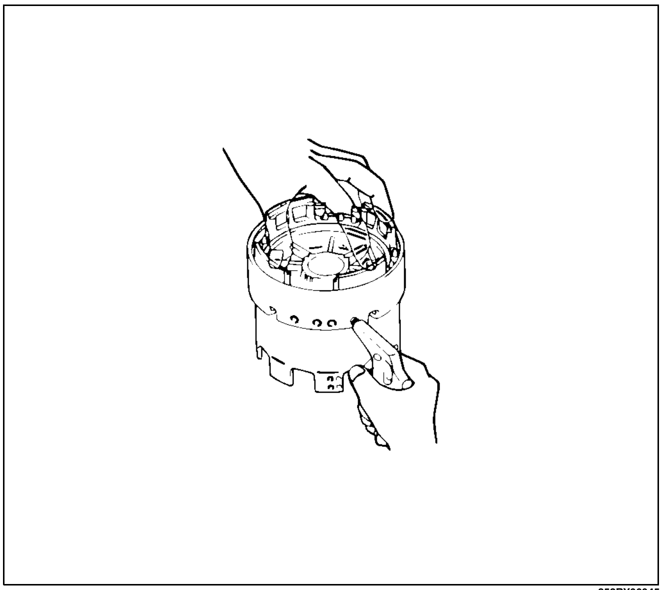
Spring compressor : 5-8840-2170-0

Remove the snap ring with a screwdriver.



252RY00044

6. Romove the piston return spring.
7. Place the OD support onto the direct clutch assembly.
   Hold the OD brake piston so it is not slanted and apply compressed air into the passage to remove the OD brake piston.
   Remove the OD brake piston.



252RY00045

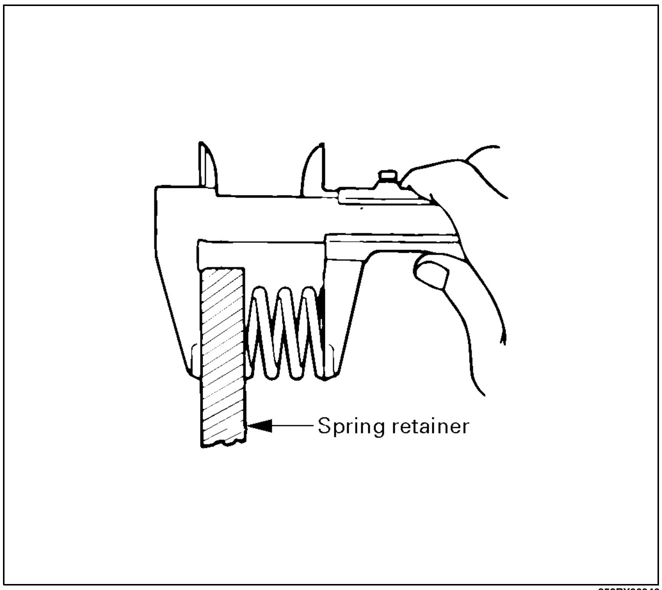
8. Remove the O-ring and oil seal rings from OD support.

Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any abnormal conditions are found through inspection.

1. Check piston return spring
   Using calipers, measure the free length of the return spring.

Standard length: 17.2mm (0.677in)

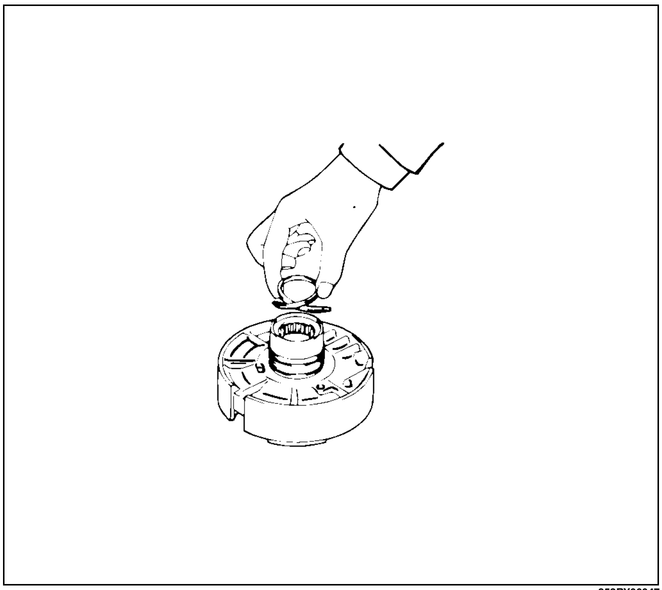


252RY00046

Reassembly

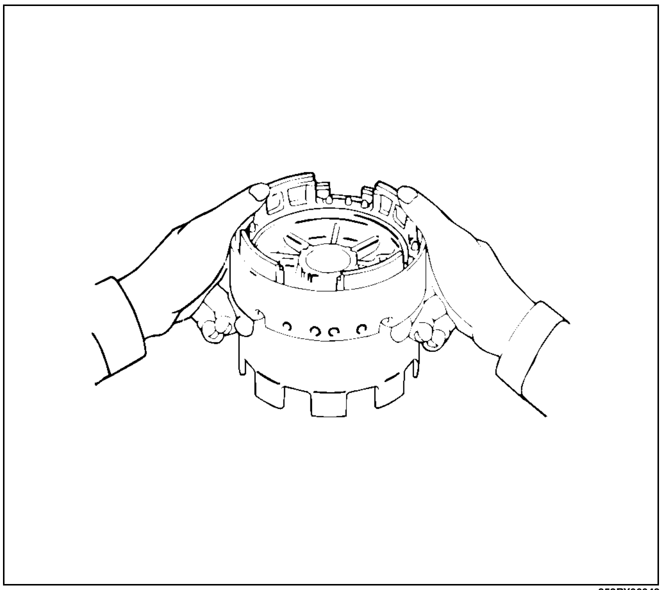
1. Coat the two oil seal rings with ATF.
   Contract the oil seals as shown, and install them onto the OD support.

NOTE: Do not spread the ring ends more than necessary.



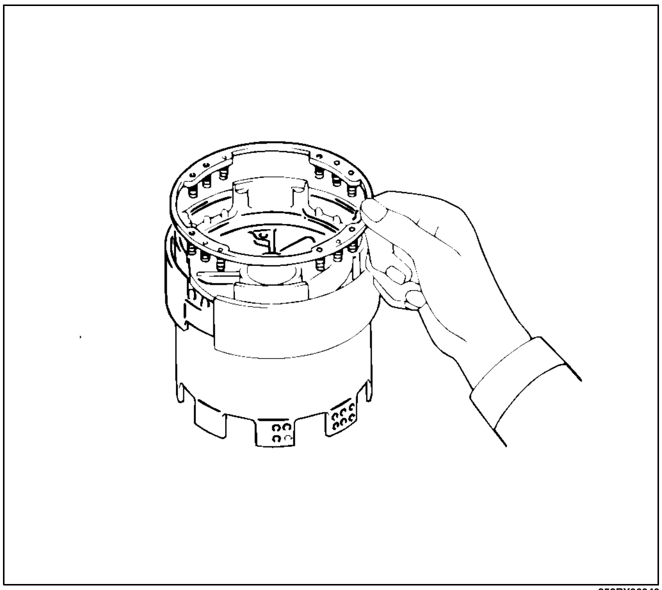
252RY00047

2. Coat two new O-rings with ATF and install them on the OD brake piston.
3. Being careful not to damage the O-rings, press the brake piston into the OD support, using both hands.



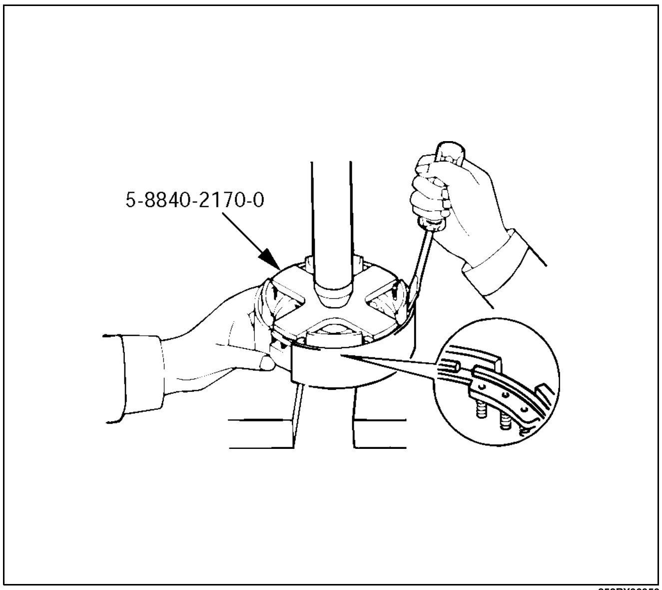
252RY00048

4. Install piston return spring.



252RY00049

5. Place special tool on the spring retainer, and compress the return spring with a shop press.
   Spring compressor : 5-8840-2170-0
   Install the snap ring with a screwdriver.
   Be sure the end gap of the snap ring is not aligned with cutout portion of the OD support.



252RY00050

MAIN DATA AND SPECIFICATIONS

REAR PROPELLER SHAFT

	4×2 Model				4×4 Model		
Engine Model	4JJ1 (Standard Output), 4JK1 (Standard Output)				4JJ1 (Standard Output)		4JK1 (Standard Output)
Transmission Type	5M/T (MUA)		A/T		5M/T (MUA)	A/T	5M/T (MUA)
Wheel Base	Long		←		←	←	←
Front Suspension	High Ride Suspension	Except High Ride Suspension	High Ride Suspension	Except High Ride Suspension	—	—	—
Rear Axle	φ220mm	←	←	←	←	←	←
Type	OBS	←	←	←	←	←	←
Outside Diameter mm	68.9	68.9	63.5	63.5	68.9	75	68.9
(in)	(2.71)	(2.71)	(2.50)	(2.50)	(2.71)	(2.95)	(2.71)
Inside Diameter mm	64.9	64.9	60.3	60.3	64.9	71.8	64.9
(in)	(2.56)	(2.56)	(2.37)	(2.37)	(2.56)	(2.83)	(2.56)
Length 1st(L1) mm	798.5	801.5	720.5	716.5	472.5	1204	472.5
(in)	(31.44)	(31.56)	(28.37)	(28.21)	(18.60)	(47.40)	(18.60)
2nd(L2) mm	801	796	801	796	801	—	801
(in)	(31.54)	(31.34)	(31.54)	(31.34)	(31.54)	—	(31.54)
Spline Major mm	29.89	29.89	29.89	29.89	29.89	29.89	29.89
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10	M10	M10	M10	M10	M10	M10

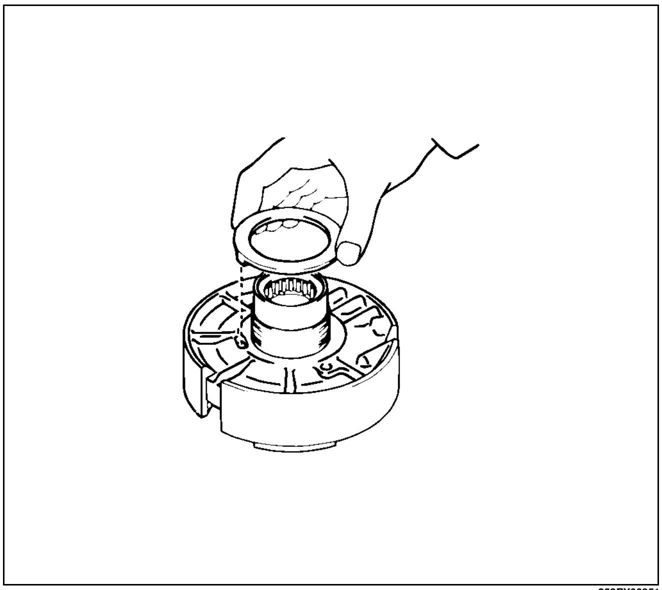
* OBS - Outboard Slip (Spline Engagement to T/M)

	4×2 Model				4×4 Model			
Engine Model	4JJ1 (High Output)							
Transmission Type	5M/T (MUX)			A/T	5M/T (MUX)			A/T
Wheel Base	Long	Long	Ext. Long	Long	Long	Long	Ext. Long	Long
Front Suspension	High Ride Suspension	Except High Ride Suspension	Except High Ride Suspension	High Ride Suspension	High Ride Suspension	High Ride 25up Suspension	High Ride Suspension	High Ride Suspension
Rear Axle	φ220mm	←	←	←	←	←	←	←
Type	OBS	←	←	←	←	←	←	←
Outside Diameter mm	68.9	68.9	68.9	75	68.9	68.9	68.9	75
(in)	(2.71)	(2.71)	(2.71)	(2.95)	(2.71)	(2.71)	(2.71)	(2.95)
Inside Diameter mm	64.9	64.9	64.9	71.8	64.9	64.9	64.9	71.8
(in)	(2.56)	(2.56)	(2.56)	(2.83)	(2.56)	(2.56)	(2.56)	(2.83)
Length 1st(L1) mm	777.5	777.5	925.5	706.5	434.5	438.5	584.5	1204
(in)	(30.61)	(30.61)	(36.44)	(27.81)	(17.11)	(17.26)	(23.01)	(47.40)
2nd(L2) mm	801	796	796	801	801	801	801	—
(in)	(31.54)	(31.34)	(31.34)	(31.54)	(31.54)	(31.54)	(31.54)	—
Spline Major mm	29.89	29.89	29.89	30.48	29.89	29.89	29.89	29.89
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.20)	(1.18)	(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10	M10	M10	M10	M10	M10	M10	M10

* OBS - Outboard Slip (Spline Engagement to T/M)

6. Coat the thrust washer (plastic) with petroleum jelly and install it onto the OD support.

NOTE: Make sure that the lug fits into the hole on the OD support.

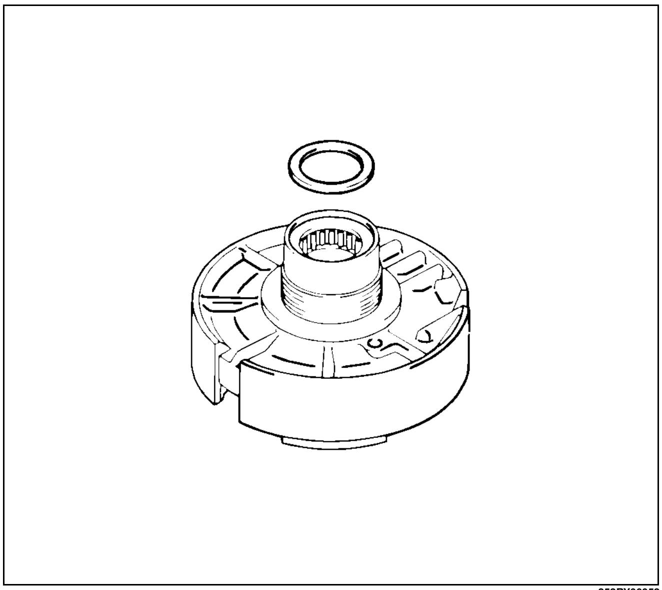


252RY00051

7. Coat the race with petroleum jelly, and install it onto the OD support.

Race diameter (Reference)

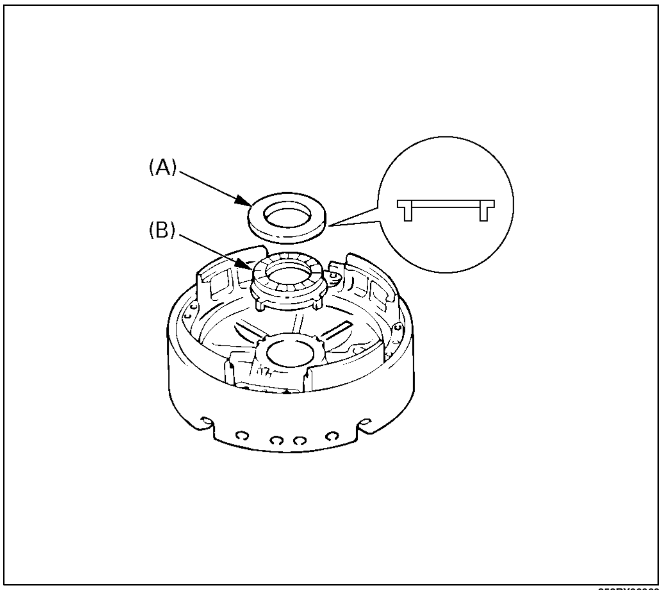
Inside diameter	36.7 mm (1.44 in)
Outside diameter	50.85 mm (2.00 in)



252RY00052

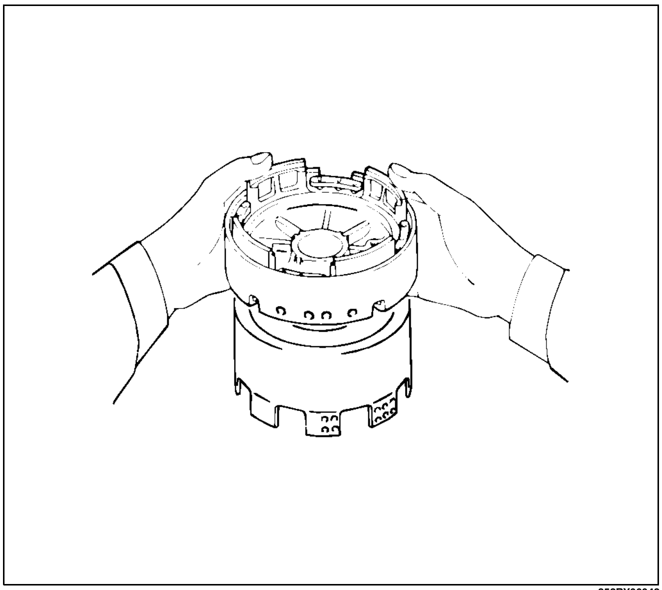
8. Turn over OD support.
   Coat the two races with petroleum jelly, and install them onto the OD support.
   Race and bearing diameter (Reference)

	Inside	Outside
Race (A)	37.2 mm (1.465 in)	58.8 mm (2.315 in)
Bearing and race (B)	33.7 mm (1.327 in)	50.1 mm (1.972 in)



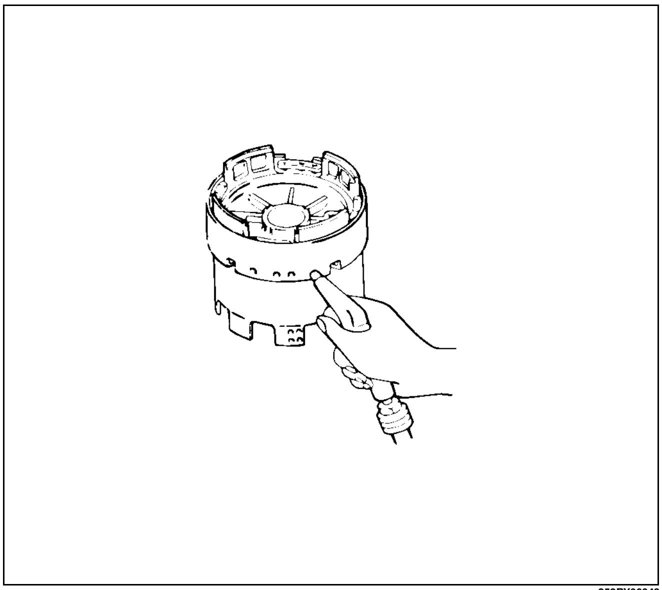
252RY00069

9. Check OD brake piston movement.
   Place the OD support assembly onto the direct clutch assembly.



252RY00042

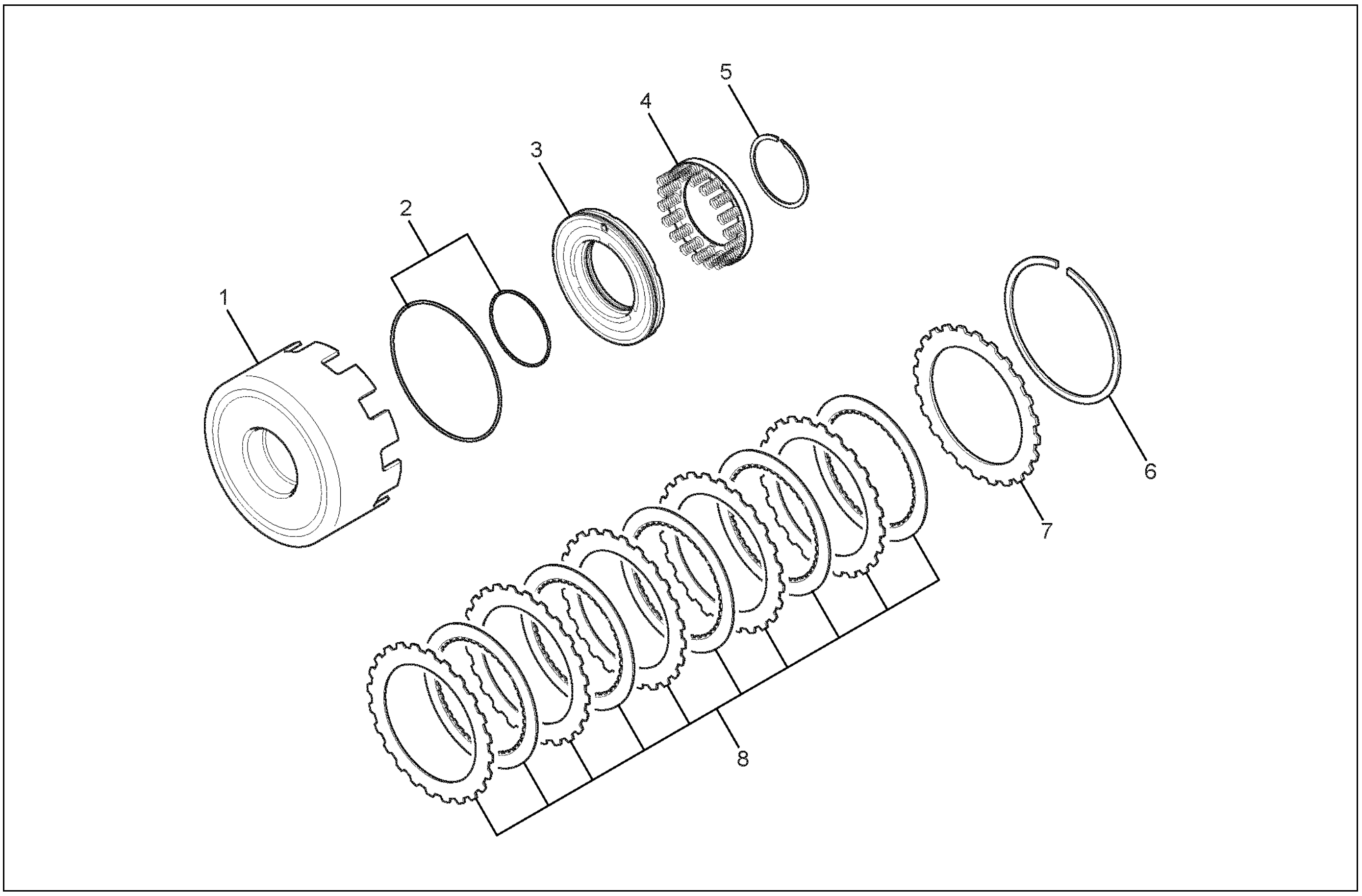
Apply compressed air into the oil passage as shown, and be sure that the OD brake piston moves smoothly.



252RY00043

Direct Clutch Assembly (C-2)

Disassembled View



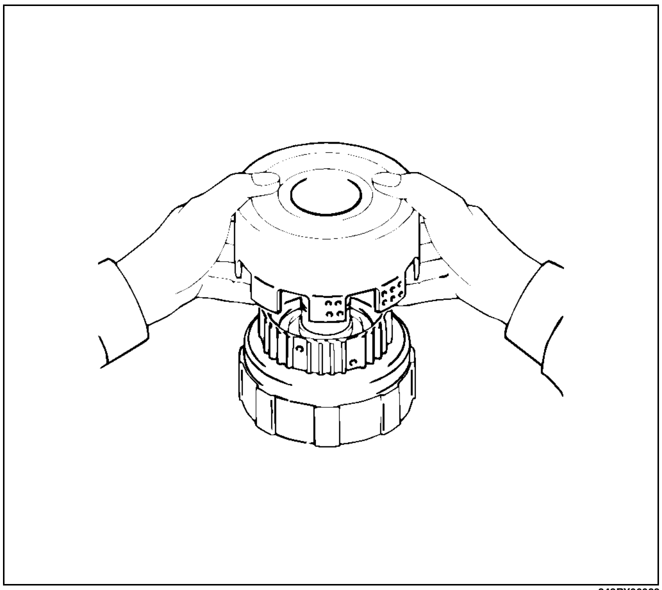
RTW77AMF000401

Legend

(1) Direct clutch drum
(2) O-ring
(3) Direct clutch piston
(4) Piston return spring
(5) Snap ring
(6) Snap ring
(7) Flange
(8) Plate and disc
Five plates and five discs

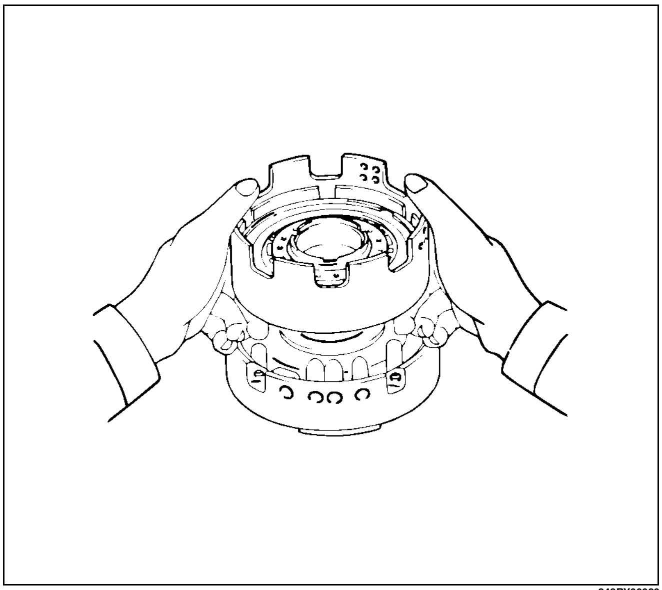
Disassembly

Remove direct clutch drum assembly from forward clutch assembly.



248RY00028

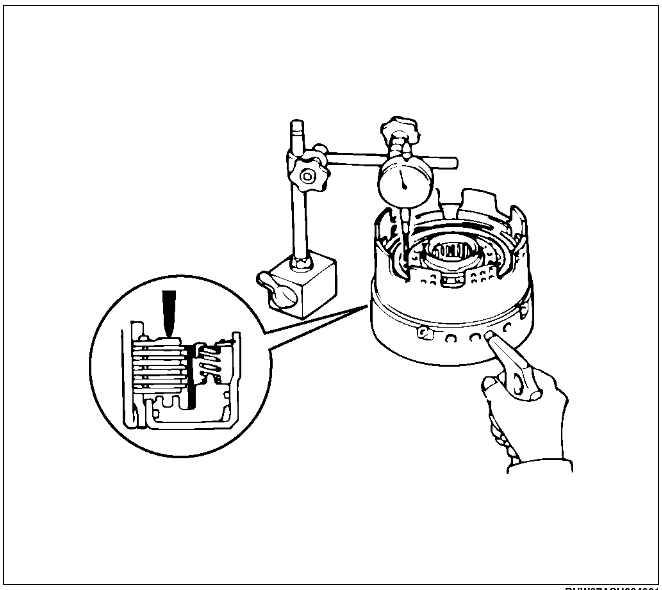
1. Check piston stroke of direct clutch (C–2).
   Place the direct clutch assembly onto the OD support assembly.



248RY00029

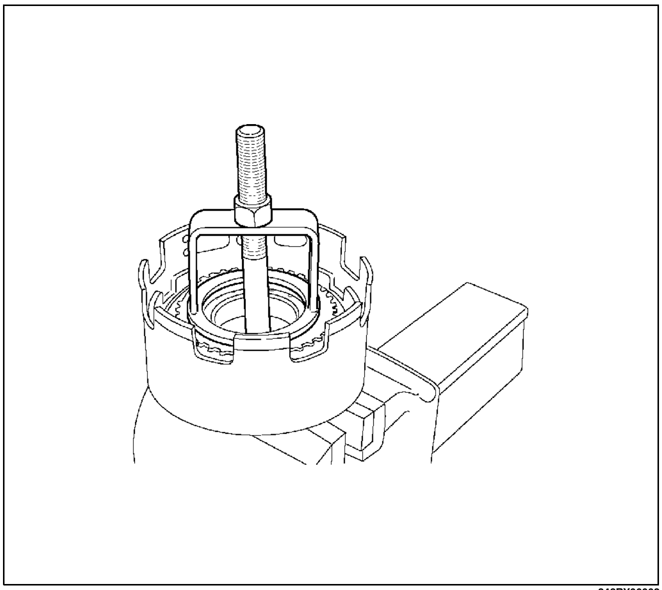
Using a dial indicator, measure the direct clutch piston stroke by applying and releasing compressed air (390 – 780 kPa or 57 – 114 psi) as shown.

Pack clearance: 0.5 – 0.8 mm (0.020 – 0.031 in)



RUW37ASH004901

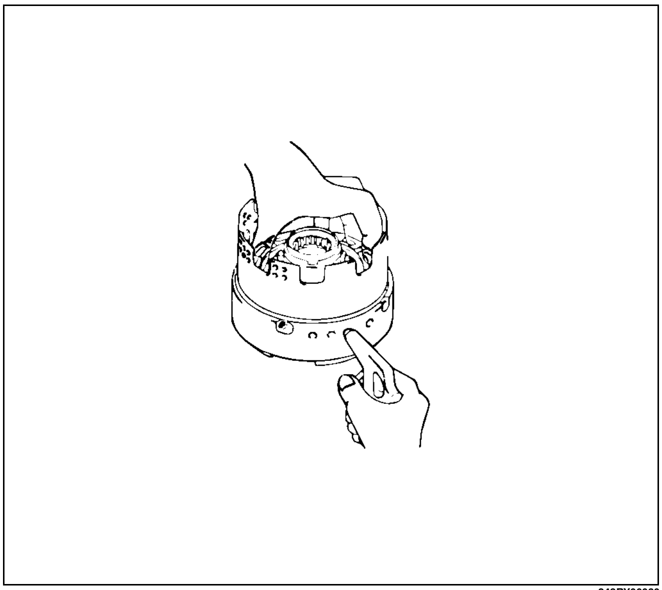
2. Remove the clutch drum thrust washer (Plastic) from the rear end of direct clutch.
3. Remove the snap ring from the direct clutch drum.
4. Remove the flange, plates and discs.
5. Place special tool on the spring retainer and compress the return spring.
   Using snap ring pliers, remove the snap ring.
   Spring compressor : 5-8840-0254-0



248RY00002

6. Remove the piston return spring.

7. Place the direct clutch drum onto the OD support.
   Holding the direct clutch piston by hand, apply compressed air to the OD support to remove the direct clutch piston.
   Remove the direct clutch piston from direct clutch drum.



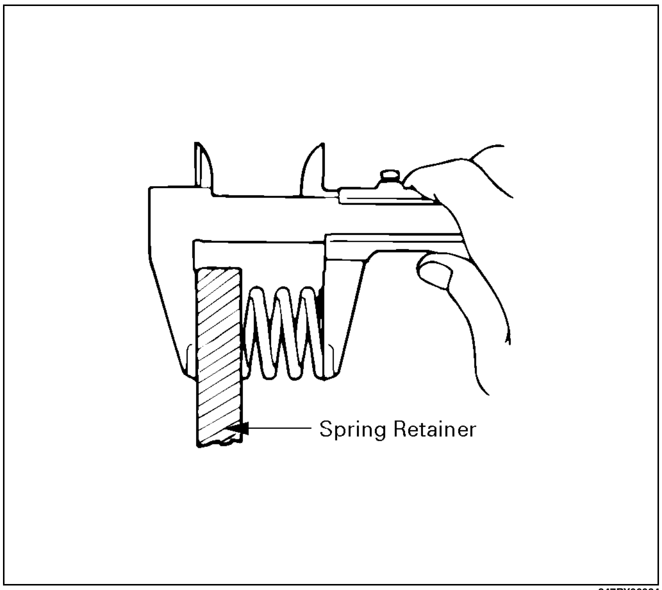
248RY00030

8. Remove two O-rings from piston.

Inspection and Repair

1. Check piston return spring.
   Using calipers, measure the free length of the return spring.

Standard length: 21.3 mm (0.839 in)

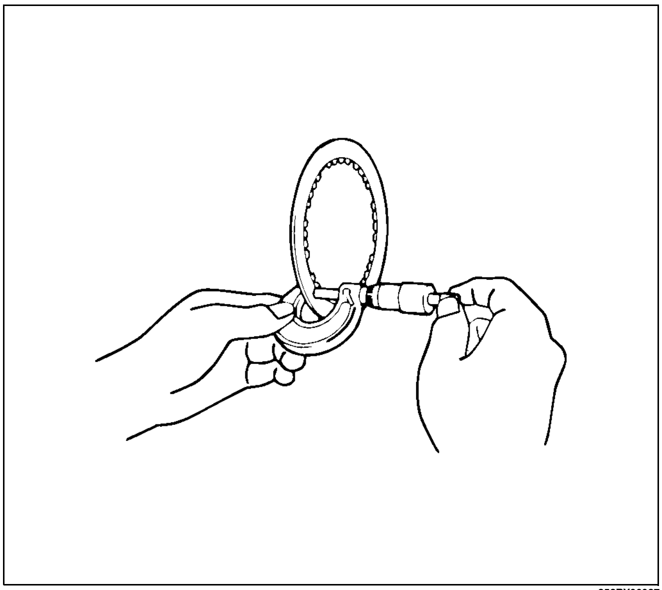


247RY00034

2. Check discs.
   Using micrometer, measure the thickness of the discs.

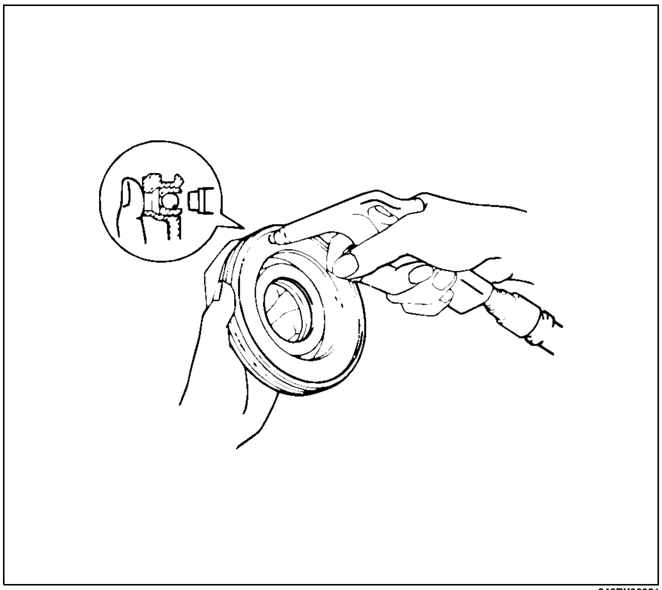
Minimum thickness: 2.04 mm (0.0803 in)

If the thickness is less than the minimum, replace the disc.



252RY00027

3. Check direct clutch piston.
   Check that check ball is free by shaking the piston.
   Check that the valve does not leak by applying low-pressure compressed air.

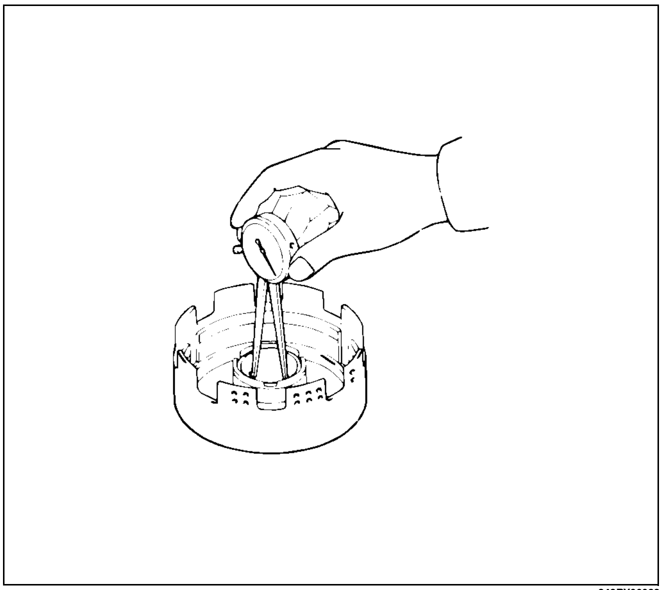


248RY00031

4. Check direct clutch drum bushing.
   Using a dial indicator, measure the inside diameter of the clutch drum bushing.

Maximum inside diameter: 53.99 mm (2.1256 in)

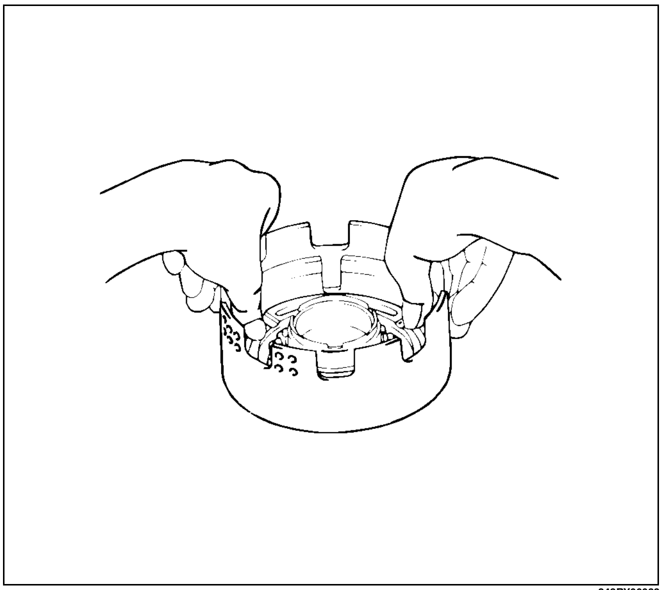
If the inside diamater is greater than the maximum, replace the clutch drum.



248RY00032

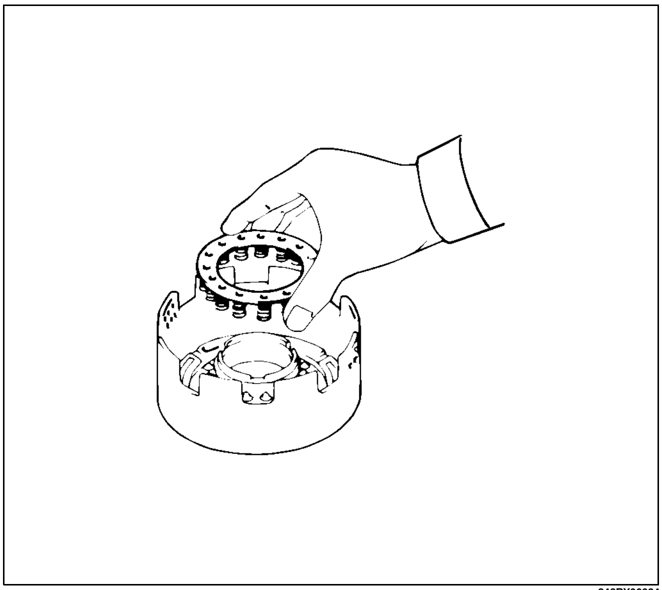
Reassembly

1. Coat new O-rings with ATF and install them on the direct clutch piston.
2. Install direct clutch piston to direct clutch drum.
   Being careful not to damage the O-rings, press in the direct clutch piston into the clutch drum, using both hands.



248RY00033

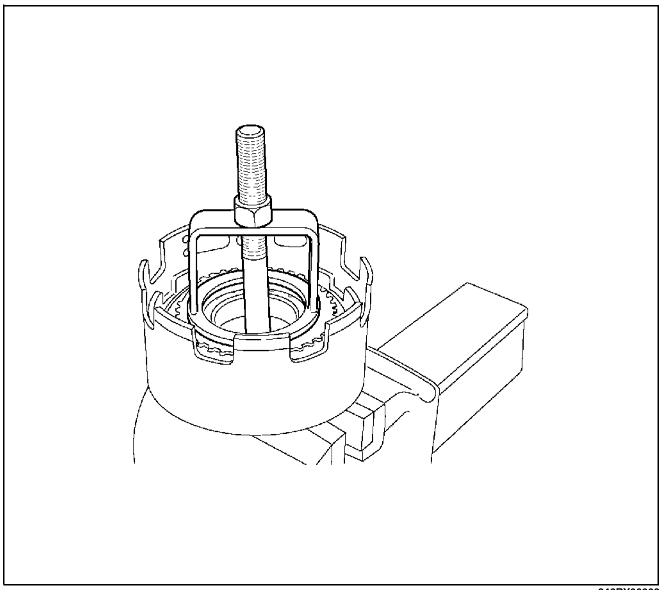
3. Install piston return spring.



248RY00034

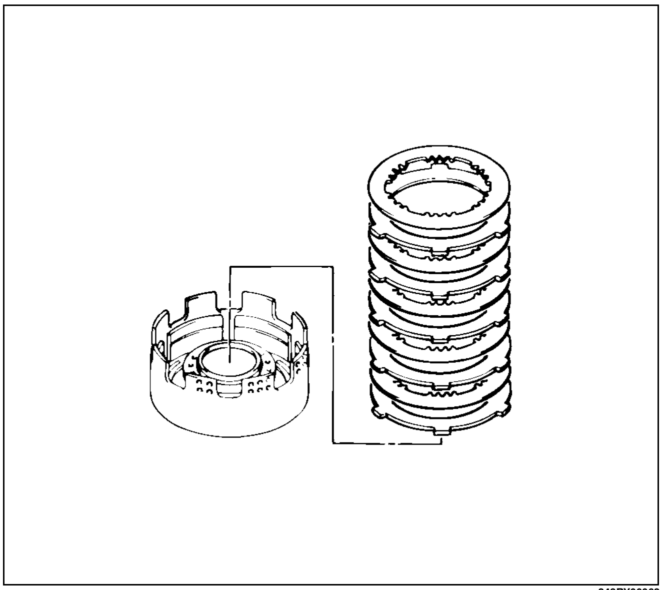
4. Compress piston return spring and install snap ring in groove.
   - Place special tool on the spring retainer, and compress the return spring.
   - Install the snap ring with snap ring pliers.
   - Be sure the end gap of the snap ring is not aligned with the spring retainer claw.

Spring compressor: 5-8840-0254-0



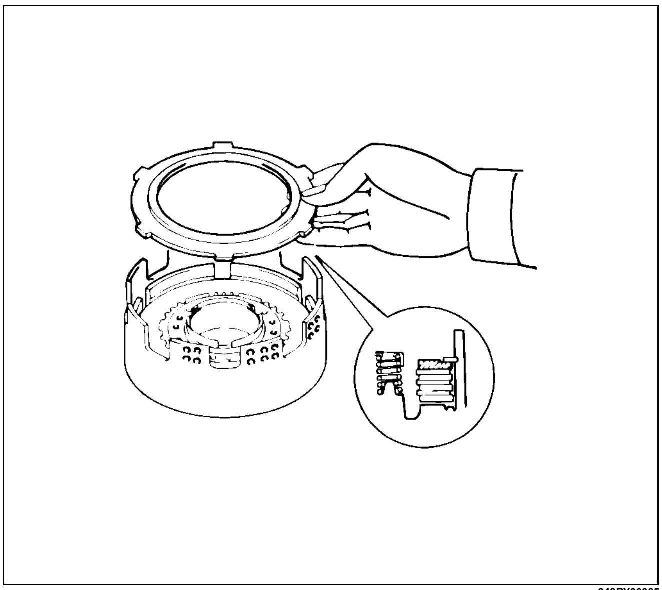
248RY00002

5. Install four plates and four discs.
   Install in order : P–D–P–D–P–D–P–D
   P : Plate, D : Disc



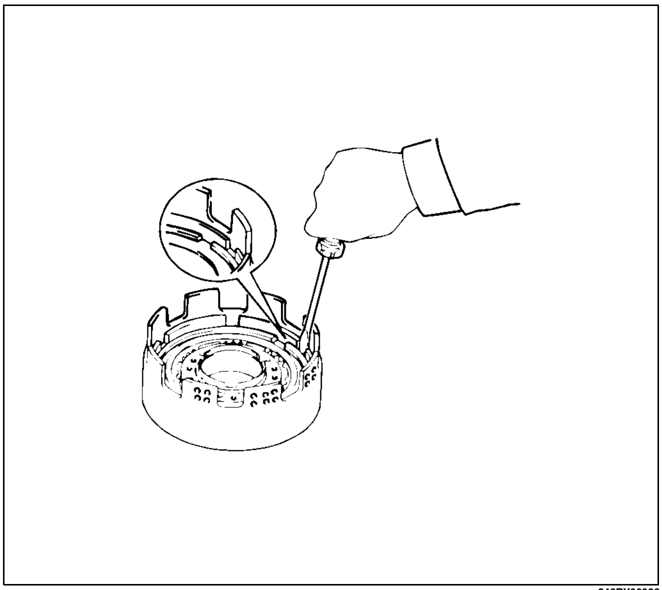
248RY00062

6. Install the flange, with the flat side facing downward.



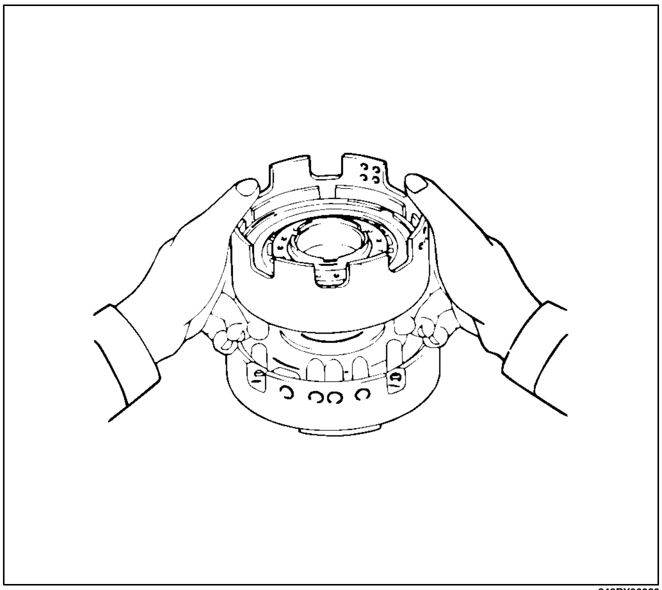
248RY00035

7. Install the snap ring with a screwdriver.
   Be sure the end gap of the snap ring is not aligned with the cutout portion of the direct clutch drum.



248RY00036

8. Check piston stroke of direct clutch (C–2).
   Place the direct clutch assembly onto the OD support assembly.



248RY00029

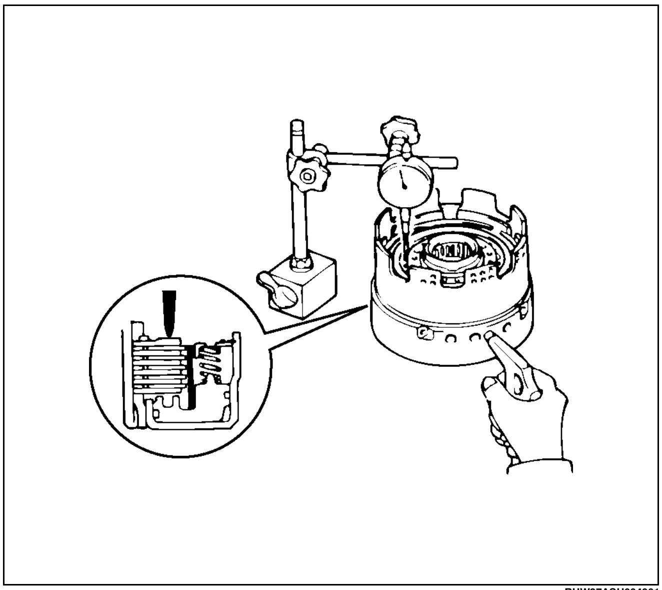
   Using a dial indicator, measure the direct clutch piston stroke by applying and releasing compressed air (390 – 780 kPa or 57 – 114 psi) as shown.

Pack clearance: 0.5 – 0.8 mm (0.020 – 0.031 in)

   If the piston stroke is not within specification, replace the discs and recheck the piston stroke.
   If the piston stroke is nonstandard, select another flange.

Flange sizes

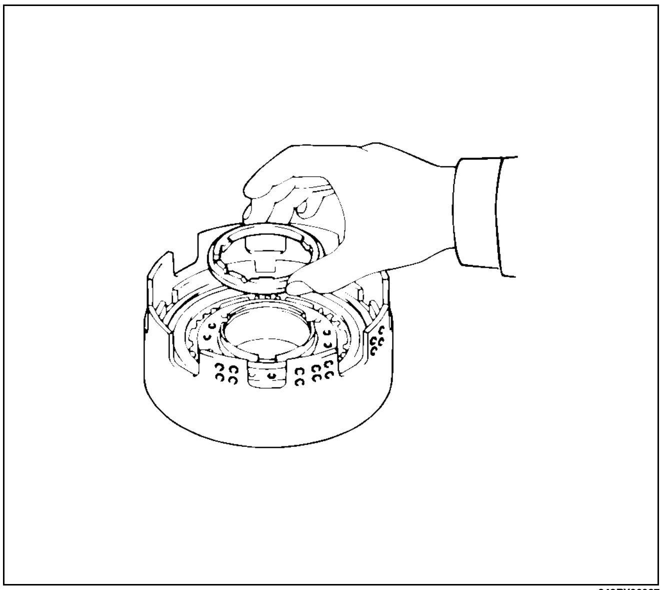
Flange thickness	Flange thickness
3.3mm (0.130in)	3.8mm (0.150in)
3.4mm (0.134in)	—
3.5mm (0.138in)	4.0mm (0.157in)
3.6mm (0.142in)	—
3.7mm (0.146in)	4.2mm (0.165in)



RUW37ASH004901

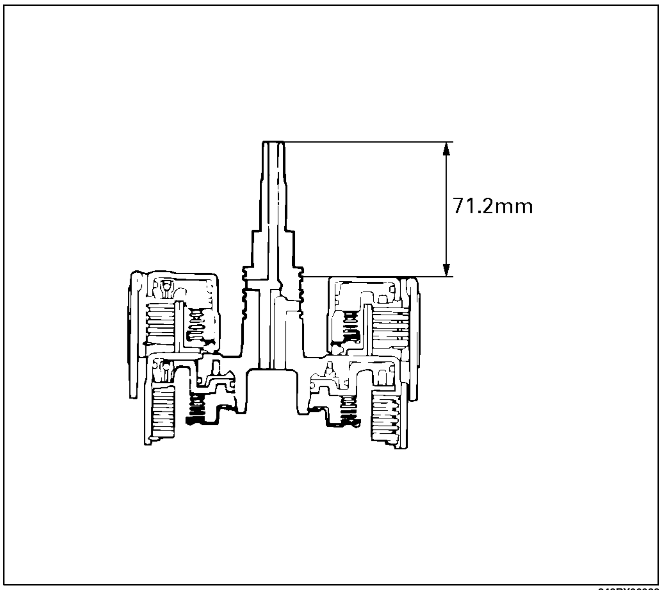
9. Coat the clutch drum thrust washer (plastic) with petroleum jelly and install it onto the direct clutch.

NOTE: Make sure that the lugs fit into the cutout portions on the direct clutch.



248RY00037

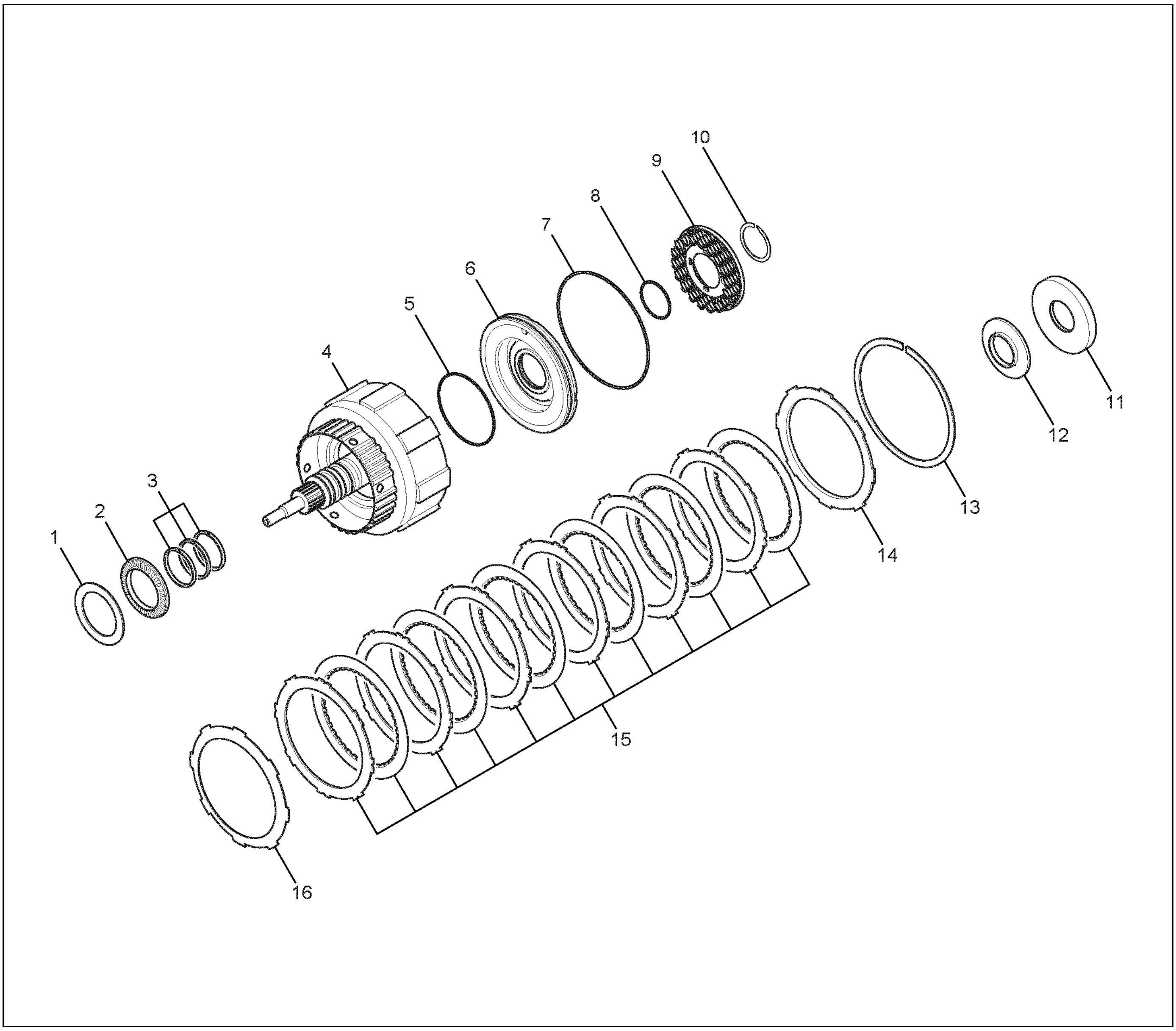
Align the flukes of discs in the direct clutch.
Install the direct clutch assembly onto the forward clutch assembly.
Check that the distance from the direct clutch end to the forward clutch end is 71.2mm (2.803in).



248RY00038

Forward Clutch Asseembly (C-1)

Disassembled View

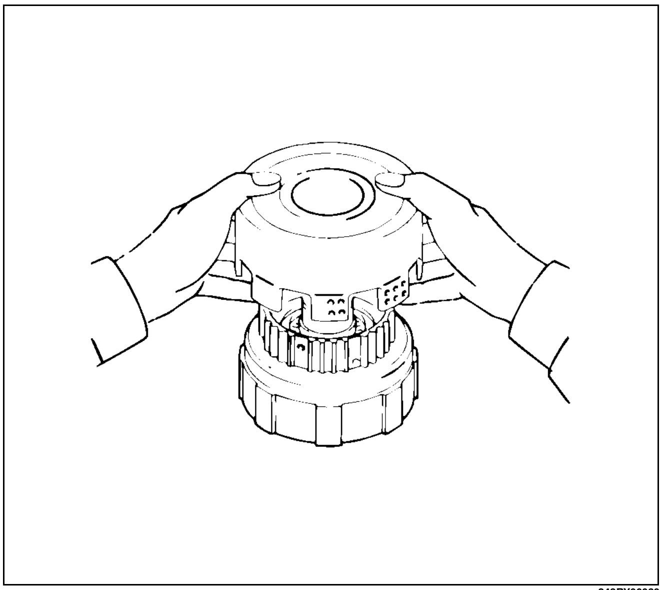


Legend

(1) Race
(2) Thrust bearing
(3) Oil seal ring
(4) Forward clutch drum
(5) O-ring
(6) Piston
(7) O-ring
(8) O-ring
(9) Piston return spring
(10) Snap ring
(11) Race
(12) Thrust bearing
(13) Snap ring
(14) Flange
(15) Plate and disc
Six plates and six discs
(16) Cushion plate

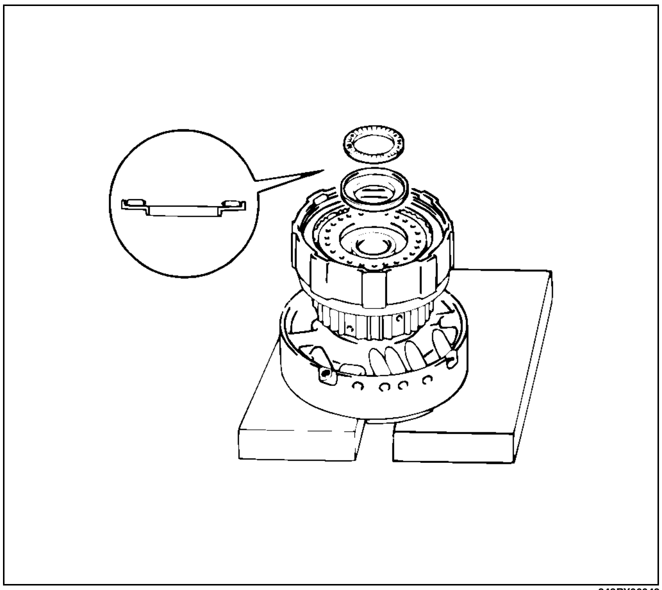
Disassembly

Remove forward clutch assembly from direct clutch assembly.



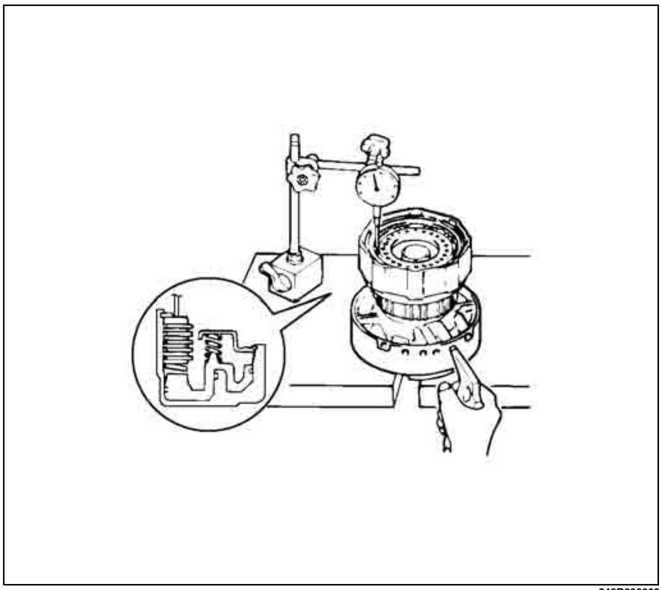
248RY00039

1. Place wooden blocks, etc. to prevent forward clutch shaft from touching the work stand, and place the OD support on them.
   Place the forward clutch onto the OD support and remove the bearing and race.



248RY00048

2. Check piston stroke of forward clutch (C–1).

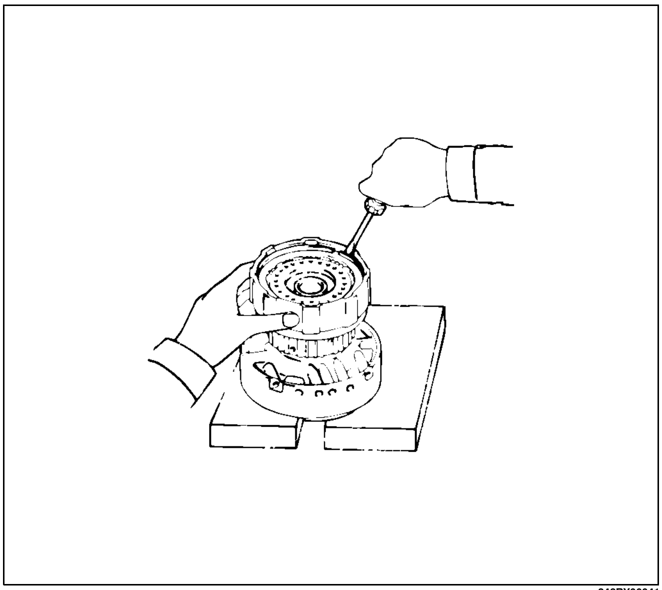


248R200008

   Using a dial indicator, measure the forward clutch piston stroke by applying and releasing compressed air (390 – 780 kPa or 57 – 114 psi) as shown.

Pack clearance: 0.6 – 1.0 mm (0.024 – 0.039 in)

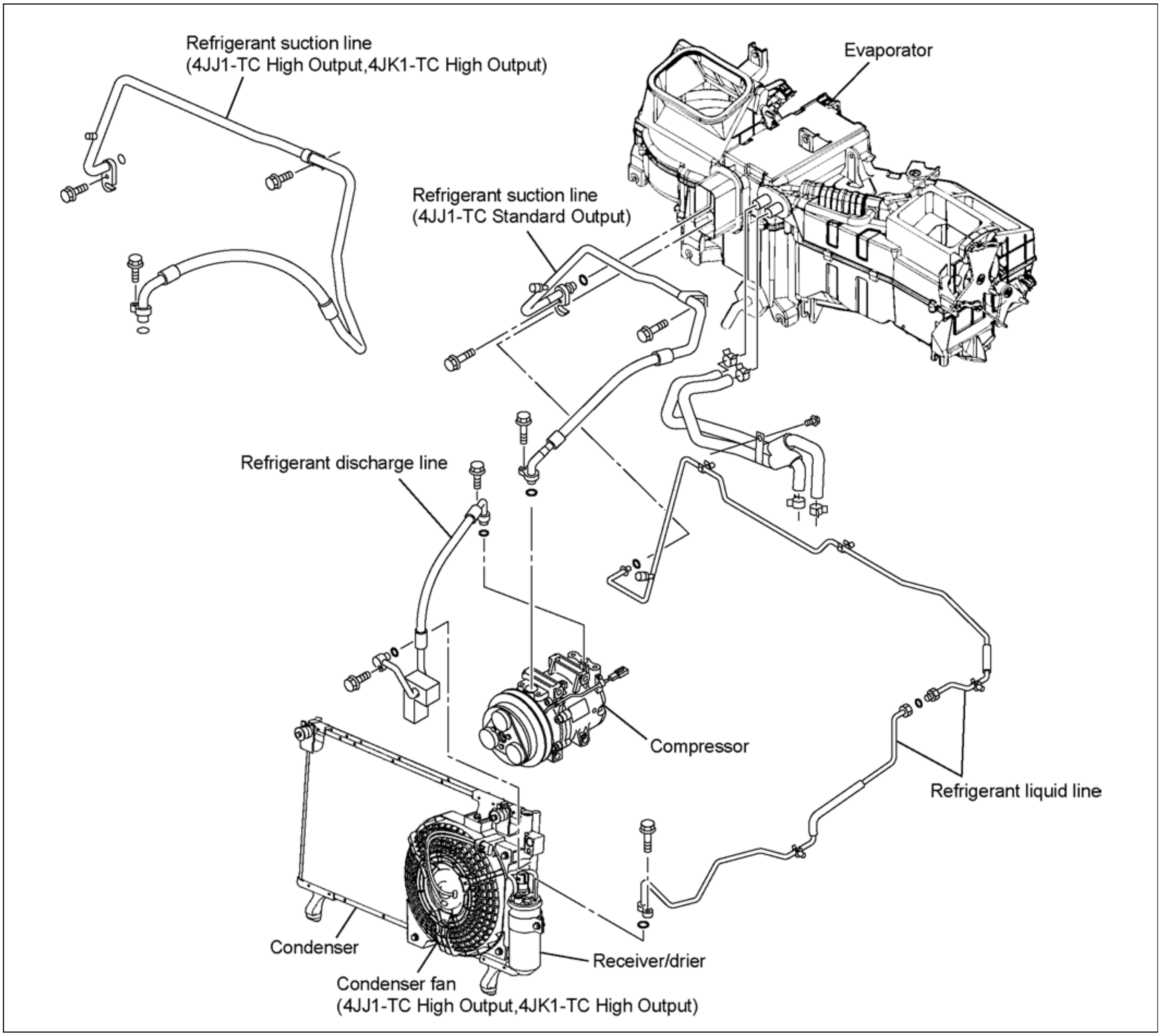
3. Remove snap ring from clutch drum.



248RY00041

4. Remove the flange, disc and plate, and cushion plate.

(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output LHD MODEL)



RTW710LF002301

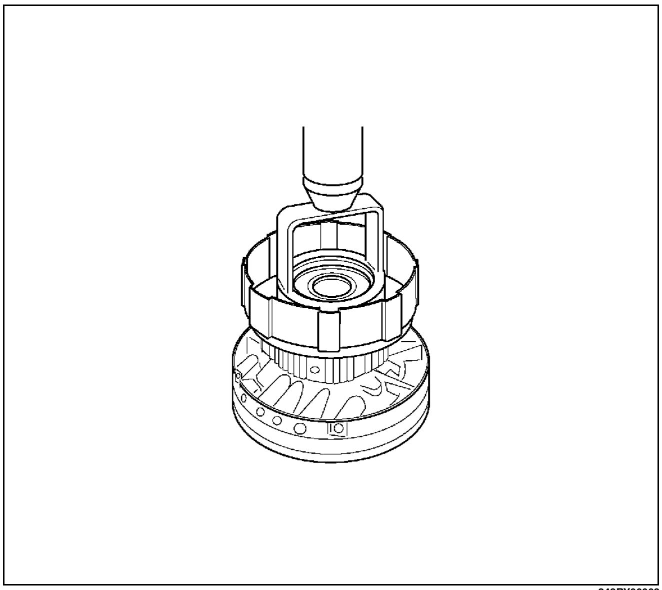
	4×2 Model						
Engine Model	4JA1-T(L)		4JA1-TC	4JA1-TC			
Transmission Type	5 M/T (MSG)	5 M/T (MSG/MUA)	5 M/T (MUA)	5M/T (MUA)			4A/T
Wheel Base	Long	Long	Long	Long		Extra Long	Long
Front Suspension	—	High Ride Suspension	—	High Ride Suspension	Except High Ride Suspension	—	—
Rear Axle	ϕ194mm	ϕ220mm	←	←	←	←	←
Type	OBS	←	←	←	←	←	←
Outside Diameter mm	63.5	75	75	68.9	68.9	68.9	63.5
(in)	(2.50)	(2.95)	(2.95)	(2.71)	(2.71)	(2.71)	(2.50)
Inside Diameter mm	60.3	71.8	71.8	64.9	64.9	64.9	60.3
(in)	(2.37)	(31.48)	(31.48)	(2.56)	(2.56)	(2.56)	(2.37)
Length 1st(L1) mm	798.5	799.5	782.5	798.5	801.5	946.5	720.5
(in)	(31.44)	(31.48)	(30.81)	(31.44)	(31.56)	(37.26)	(28.37)
2nd(L2) mm	819	801	796	801	796	801	801
(in)	(32.24)	(31.54)	(31.34)	(31.54)	(31.34)	(31.54)	(31.54)
Spline Major mm	29.89	29.89	29.89	29.89	29.89	29.89	29.89
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10	M10	M10	M10	M10	M10	M10

* OBS - Outboard Slip (Spline Engagement To T/M)

	4×2 Model						
Engine Model	C24SE			HFV6			
Transmission Type	5M/T (MUA)			5M/T (AR-5)		4A/T	
Wheel Base	Long		Extra Long	Long	Extra Long	Long	Extra Long
Front Suspension	High Ride Suspension	Except High Ride Suspension	—	High Ride Suspension	←	←	←
Rear Axle	ϕ220mm	←	←	←	←	←	←
Type	OBS	←	←	←	←	←	←
Outside Diameter mm	75	75	75	68.9	68.9	75	75
(in)	(2.95)	(2.95)	(2.95)	(2.71)	(2.71)	(2.95)	(2.95)
Inside Diameter mm	71.8	71.8	71.8	64.9	64.9	71.8	71.8
(in)	(2.83)	(2.83)	(2.83)	(2.56)	(2.56)	(2.83)	(2.83)
Length 1st(L1) mm	823.5	820.5	970.5	777.5	925.5	784.5	934.5
(in)	(32.42)	(32.30)	(38.21)	(30.61)	(36.43)	(30.89)	(36.79)
2nd(L2) mm	801	796	796	801	801	801	801
(in)	(31.54)	(31.34)	(31.34)	(31.54)	(31.54)	(31.54)	(31.54)
Spline Major mm	29.89	29.89	29.89	29.89	29.89	30.48	30.48
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.18)	(1.18)	(1.20)	(1.20)
Fix Bolt Size	M10	M10	M10	M10	M10	M10	M10

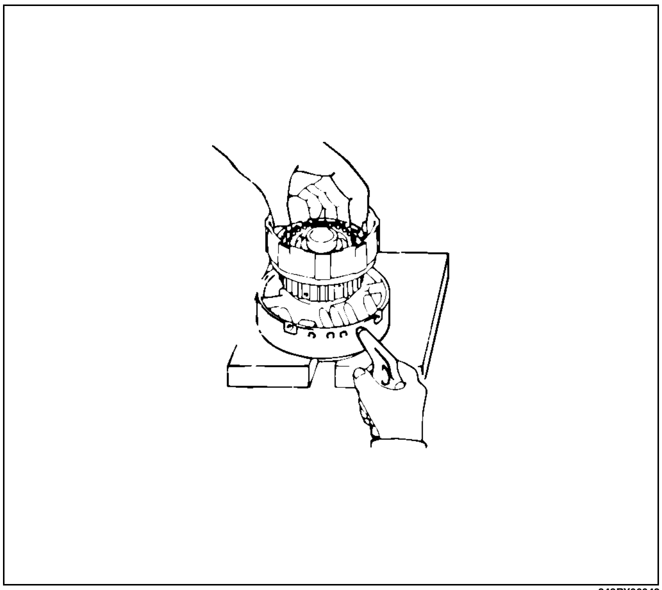
* OBS - Outboard Slip (Spline Engagement To T/M)

5. Place special tool on the spring retainer and compress the return spring.
   Using snap ring pliers, remove the snap ring.
   Spring compressor : 5-8840-0254-0



248RY00003

6. Remove the piston return spring.
7. Place the forward clutch drum onto the OD support.
   Holding the forward clutch piston by hand, apply compressed air to the OD support to remove the forward clutch piston.

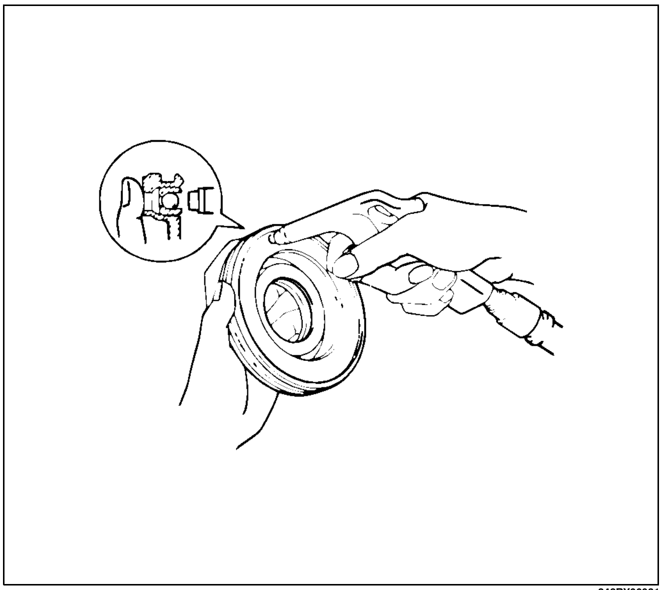


248RY00042

8. Remove the O-rings from piston.
9. Remove the O-ring from forward clutch drum.
10. Remove the oil seal rings and thrust bearing from forward clutch drum.

Inspection and Repair

1. Check forward clutch piston
   Check that check ball is free by shaking the piston.
   Check that the valve does not leak by applying low-pressure compressed air.

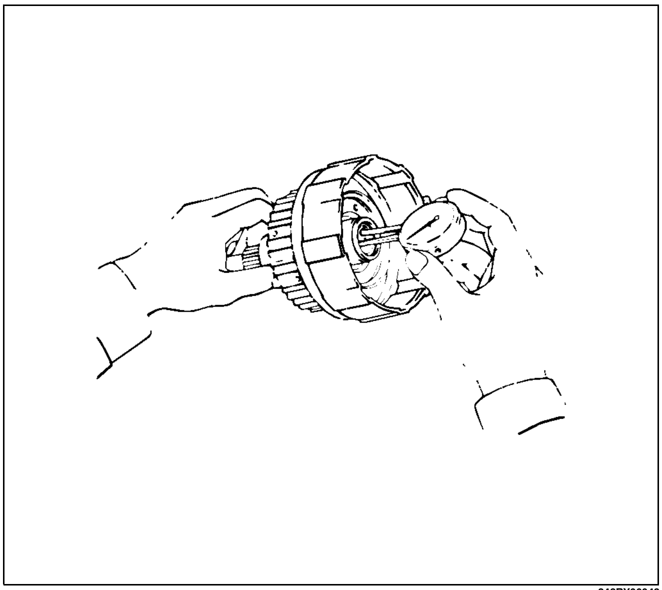


248RY00031

2. Check forward clutch drum bushing.
   Using a dial indicator, measure the inside diameter of the forward clutch drum bushing.

Maximum inside diameter: 24.08 mm (0.948 in)

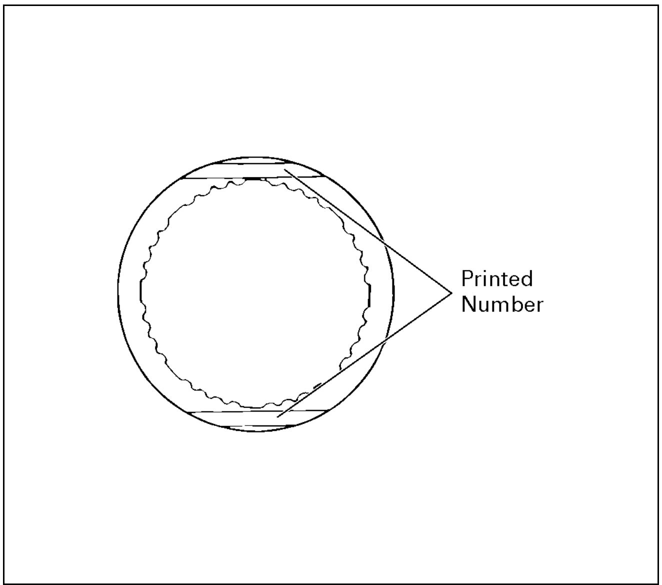
If the inside diameter is greater then the maximum, replace the forward clutch drum.



248RY00043

3. Check disc, plate and flange.
   Check to see if the sliding surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
   - If the lining of the disc is peeling off or discolored, or even if parts of the printed numbers are defaced, replace all discs.

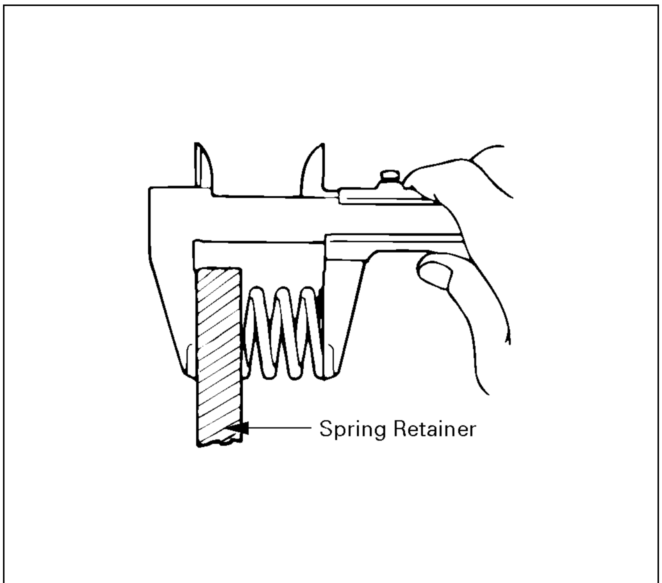
- Before assembling new discs, soak them in ATF for at least fifteen minutes.



248RY00045

4. Check piston return spring.
   Using calipers, measure the free length of the return spring.

Standard length: 19.47 mm (0.7665 in)

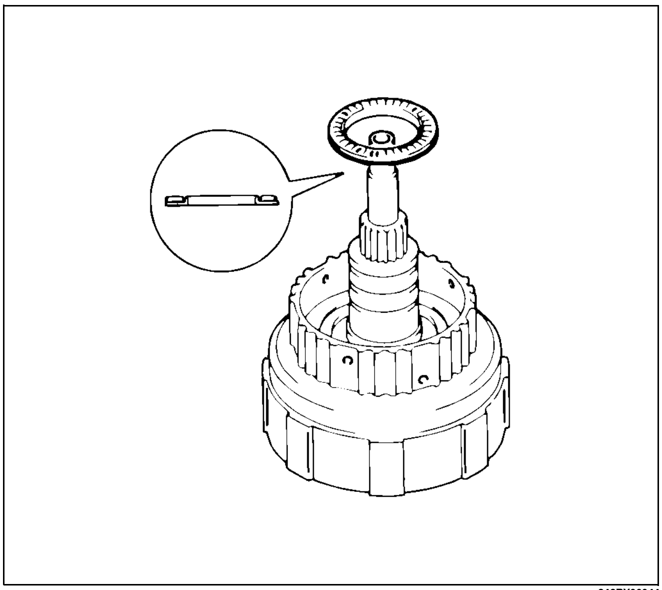


247RY00034

Reassembly

1. Coat the assembled thrust bearing and race with petroleum jelly and install it onto the forward clutch drum, with the race side facing downward.
   Bearing and race (Reference)

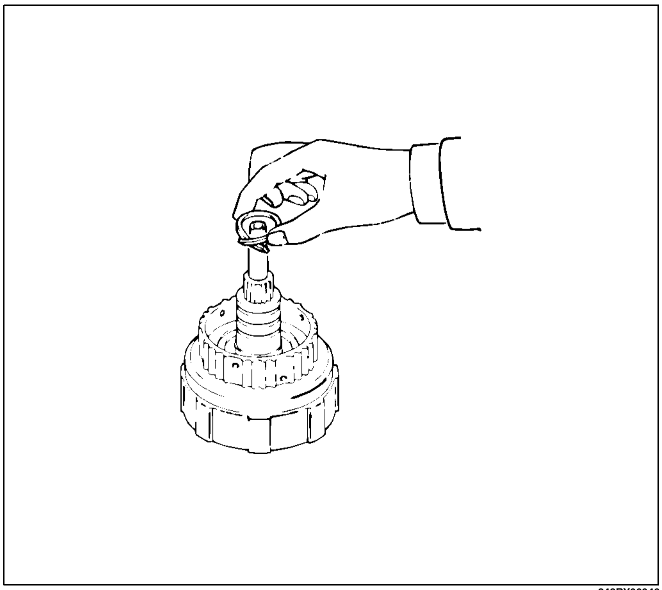
Inside diameter	33.7 mm (1.327 in)
Outside diameter	47.8 mm (1.882 in)



248RY00044

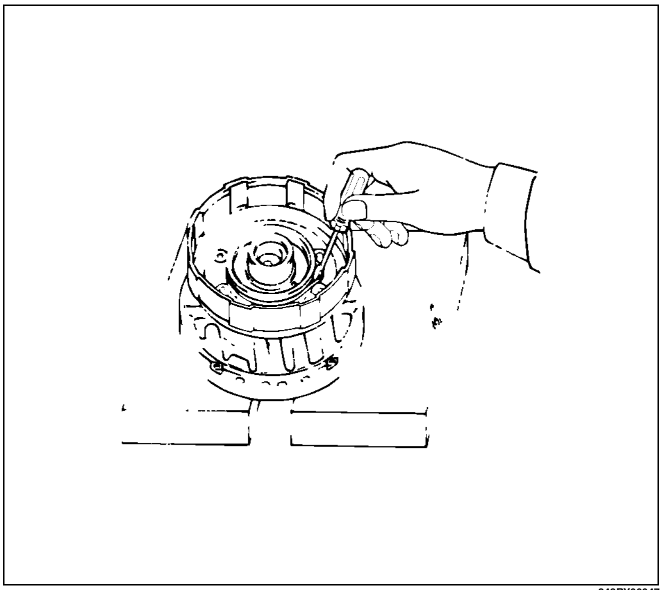
2. Coat the three oil rings with ATF.
   Contract the oil seal rings as shown, and install three oil seal rings onto the forward clutch drum.

NOTE: Do not spread the ring ends more than necessary.



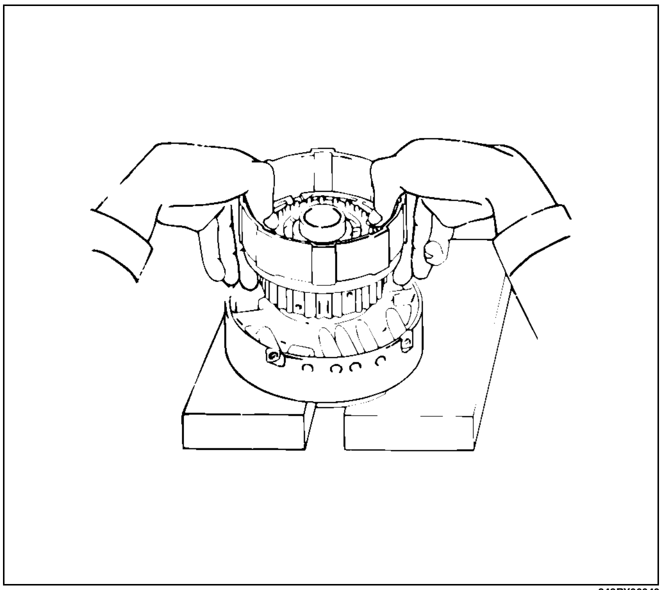
248RY00046

3. Coat a new O-ring with ATF and install O-ring on the forward clutch drum.



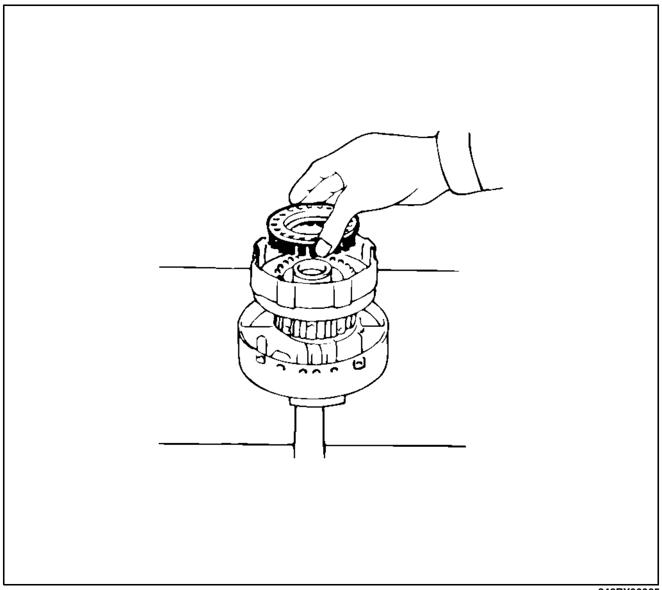
248RY00047

4. Coat new O-rings with ATF and install two O-rings on the forward clutch piston.
5. Being careful not to damage the O-rings, press the forward clutch piston into the forward clutch drum.



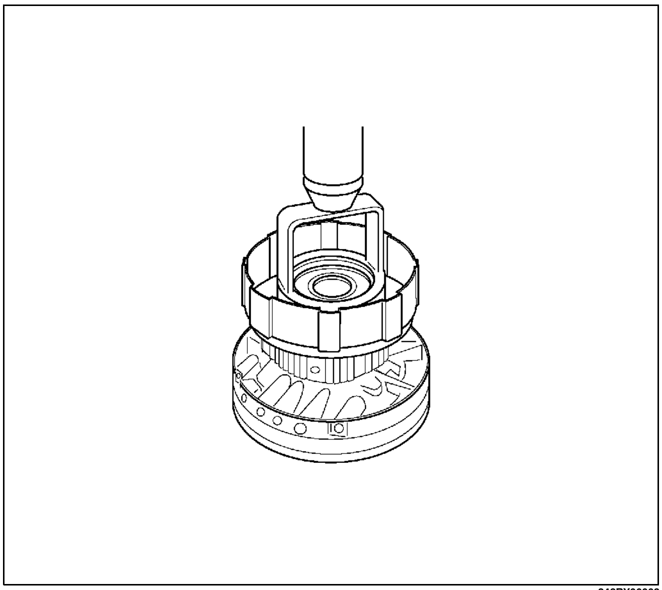
248RY00049

6. Install piston return spring.



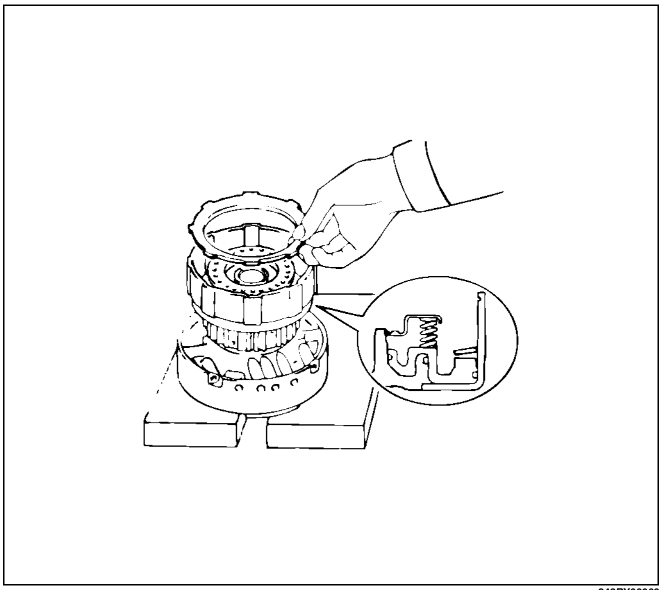
248RY00065

7. Place special tool on the spring retainer, and compress the return spring.
   Spring compressor: 5-8840-0254-0
   Install the snap ring with snap ring pliers.
   Be sure the end gap of the snap ring is not aligned with the spring retainer claw.



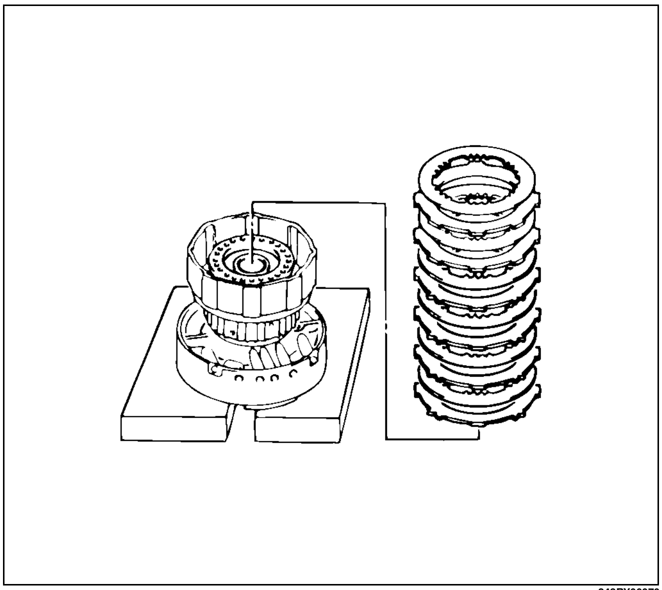
248RY00003

8. Install cushion plate rounded side down as shown.



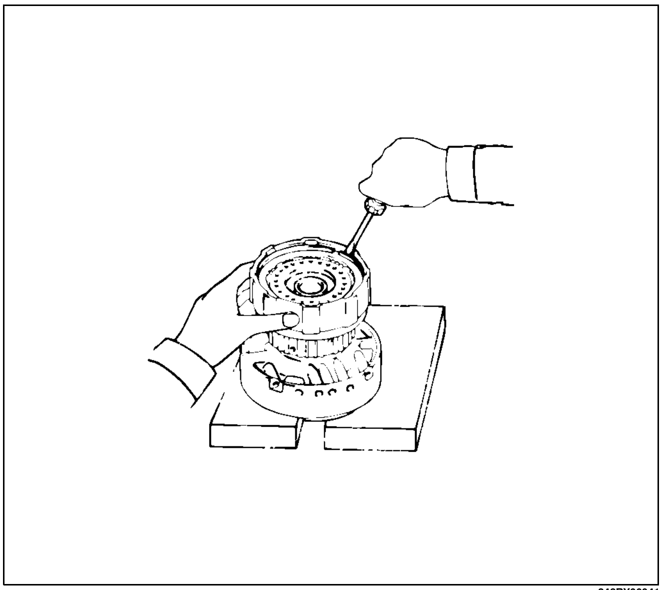
248RY00069

9. Install five discs and five plates.
   Install in order: P–D–P–D–P–D–P–D–P–D
10. And then install the flange, with the rounded edge facing downward.



248RY00070

11. Install the snap ring with a screwdriver.
    Be sure the end gap of the snap ring is not aligned with the cutout portion of the forward clutch drum.



248RY00041

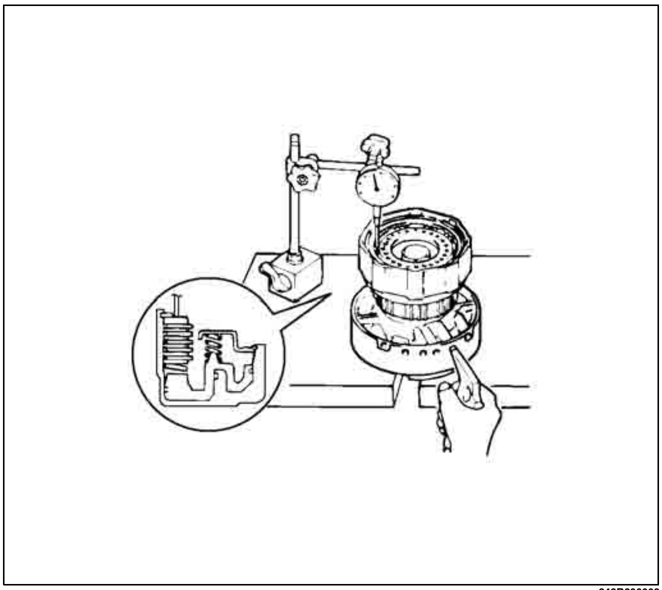
12. Check piston stroke of forward clutch (C–1).
    Using a dial indicator, measure the forward clutch piston stroke by applying and releasing the compressed air (380 – 780 kPa or 57 – 114 psi) as shown.

Pack clearance: 0.6 – 1.0 mm (0.024 – 0.039 in)

If the piston stroke is not within specification, replace the discs, and recheck the piston stroke.

Available flange sizes

3.0mm (0.118in)	3.4mm (0.134in)
4.2mm (0.165in)	3.6mm (0.142in)
4.4mm (0.173in)	3.8mm (0.150in)
3.2mm (0.126in)	4.0mm (0.158in)

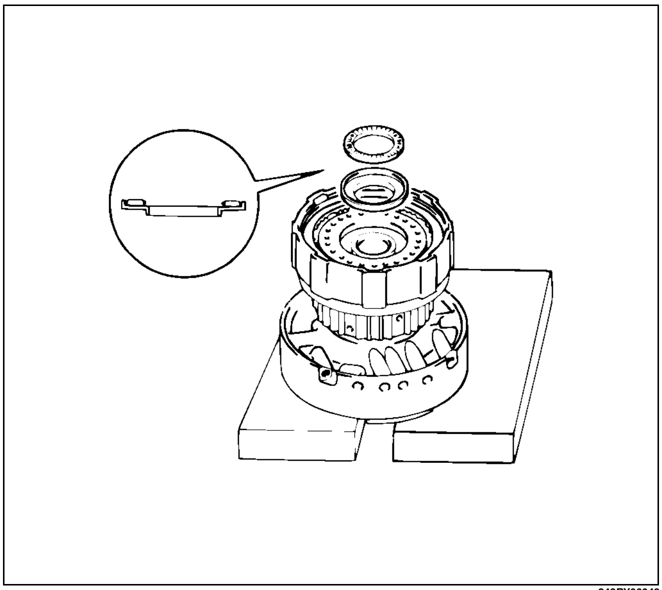


248R200008

13. Coat the race and thrust bearing with petroleum jelly, and install them onto the forward clutch drum.

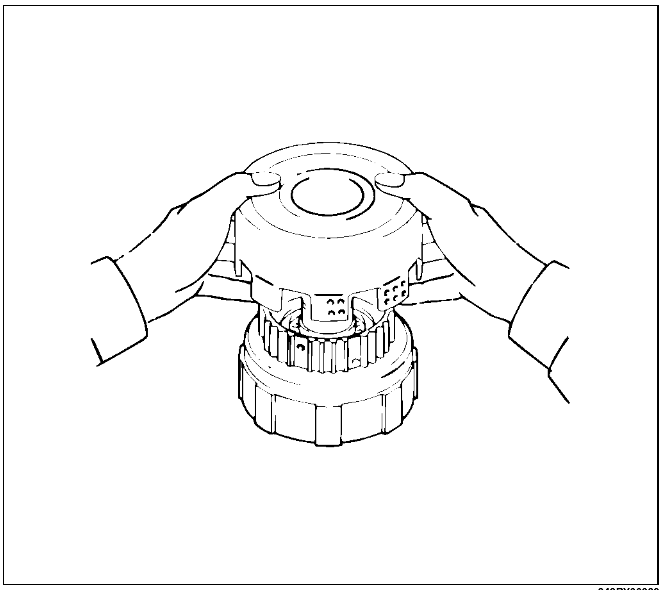
Race and bearing diameter (Reference)

	Inside	Outside
Race	26.0mm (1.024in)	48.9mm (1.925in)
Bearing	26.0mm (1.024in)	46.7mm (1.839in)



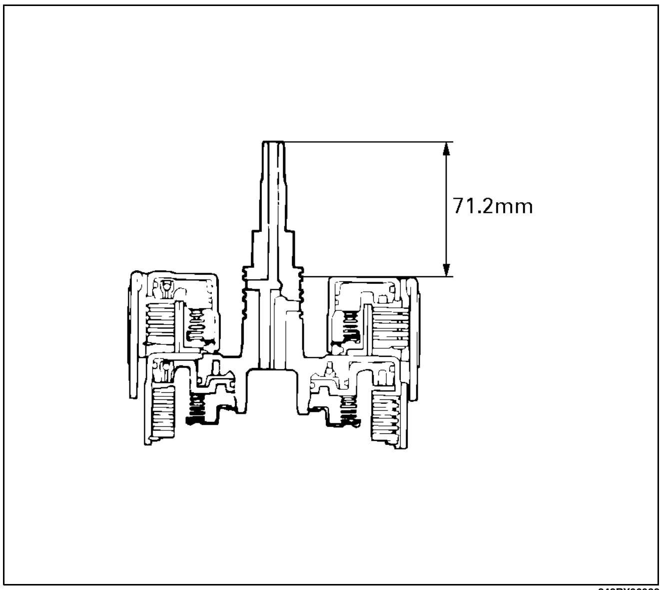
248RY00048

14. Align the flukes of discs in the direct clutch.
    Install the direct clutch assembly onto the forward clutch assembly.



248RY00039

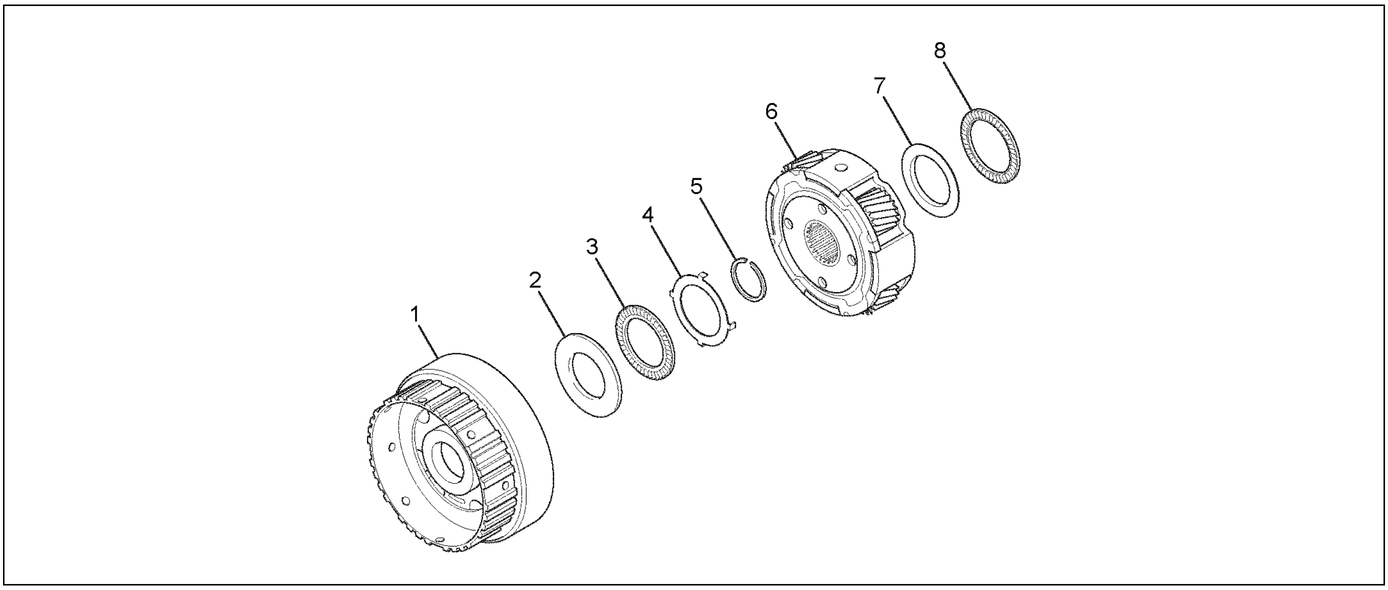
Check that the distance from the direct clutch end to the forward clutch end is 71.2mm (2.803in).



248RY00038

Front Planetary Gear

Disassembled View



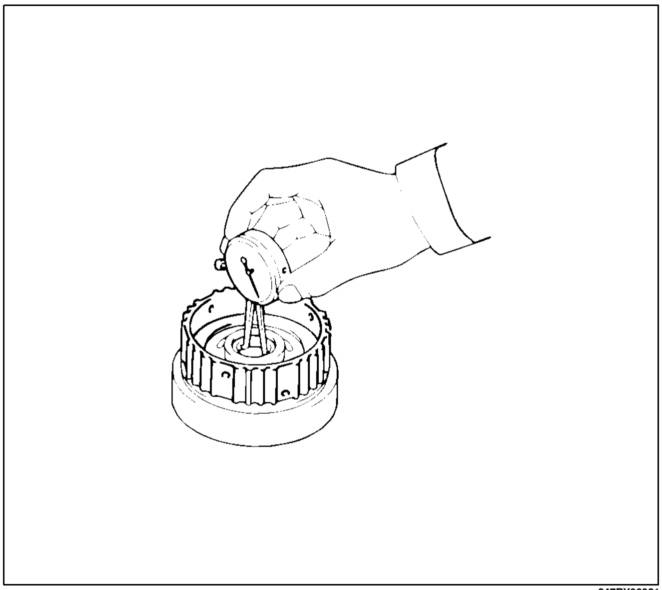
RTW77ASF000201

Legend

(1) Front planetary ring gear
(2) Race
(3) Thrust bearing
(4) Race
(5) Snap ring
(6) Front planetary gear
(7) Race
(8) Thrust bearing

Disassembly

1. Remove the race from front planetary ring gear.
2. Remove the thrust bearing and race from front planetary gear.
3. Remove the race (Metal), thrust bearing and race between front planetary ring gear and front planetary gear.



247RY00021

Inspection and Repair

1. Check front planetary ring gear bushing
   Using a dial indicator, measure the inside diameter of the front planetary ring gear bushing.

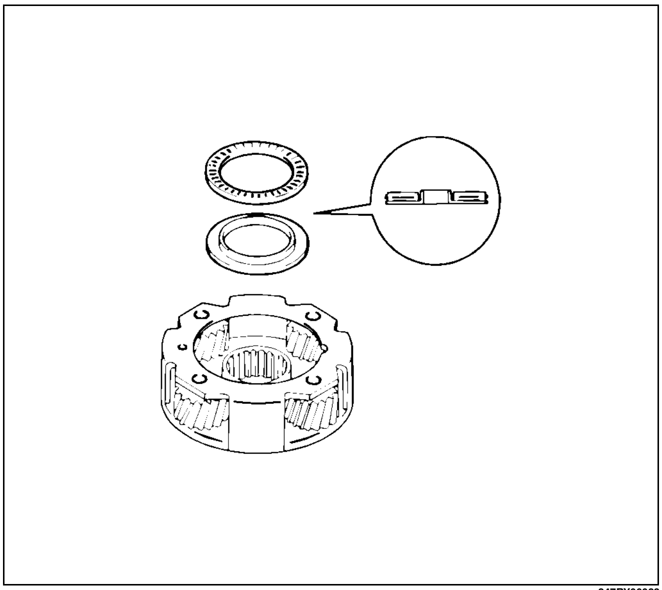
   Maximum inside diameter: 24.08 mm (0.9480 in)

   If the inside diameter is greater than the maximum, replace the front planetary ring gear.

Reassembly

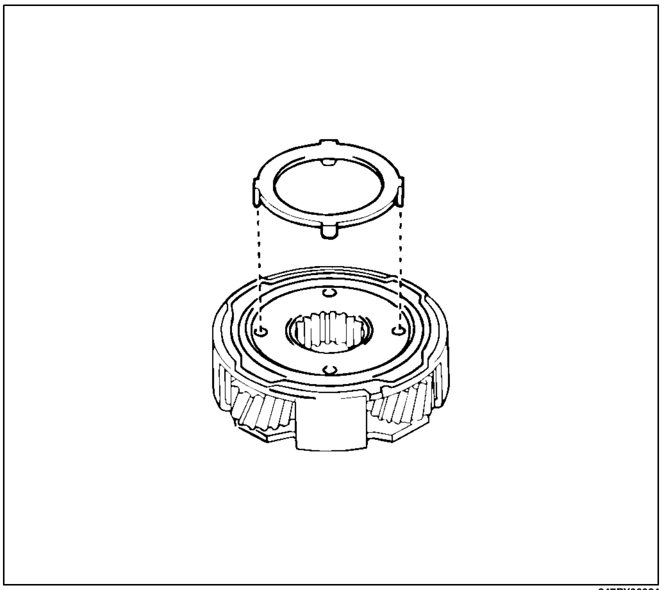
1. Coat the race and thrust bearing with petroleum jelly.
   Install the race and bearing to the rear side of the front planetary gear.
   Race and bearing diameter (Reference)

	Inside	Outside
Bearing	35.6mm (1.402in)	47.7mm (1.878in)
Race	33.7mm (1.327in)	47.6mm (1.874in)


247RY00023

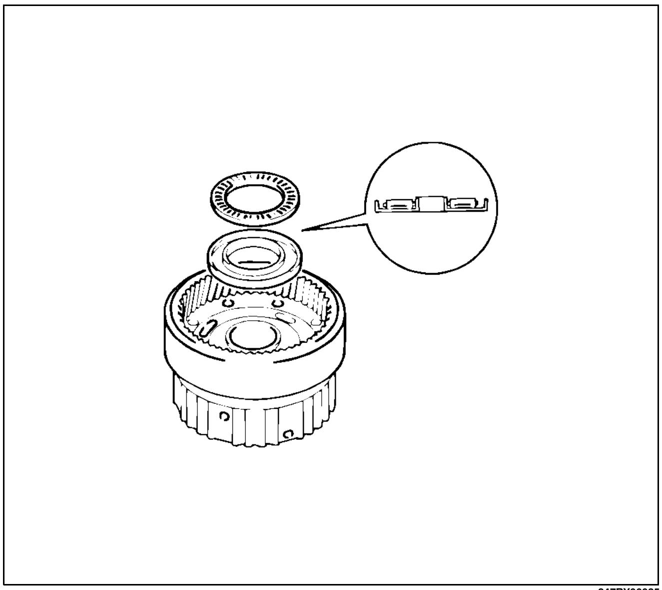
2. Turn over the planetary gear and install the race (metal).
   Make sure that the lugs fit into the holes on the front planetary gear.
   Race diameter (Reference)

	Inside	Outside
Race	34.3mm (1.350in)	47.8mm (1.882in)


247RY00024

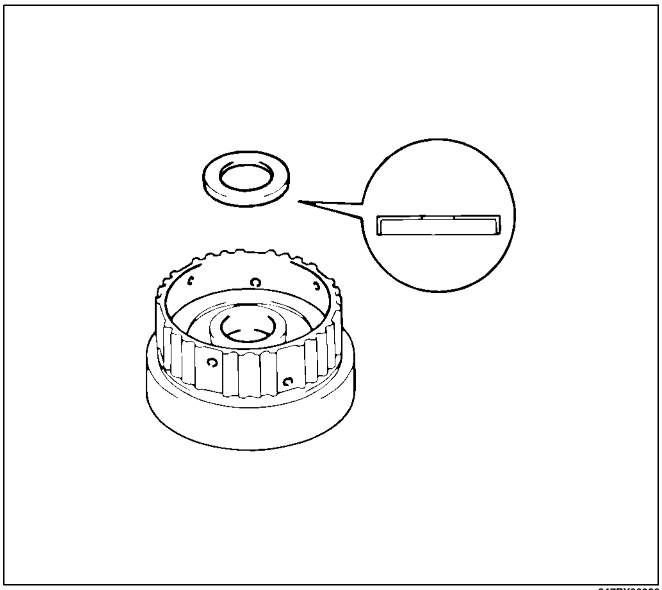
3. Coat the race and thrust bearing with petroleum jelly.
   Install the race and bearing onto the rear side of the front planetary ring gear.
   Race and bearing diameter (Reference)

	Inside	Outside
Race	35.15 mm (1.384 in)	53.65 mm (2.112 in)
Bearing	35.15 mm (1.384 in)	53.65 mm (2.112 in)


247RY00025

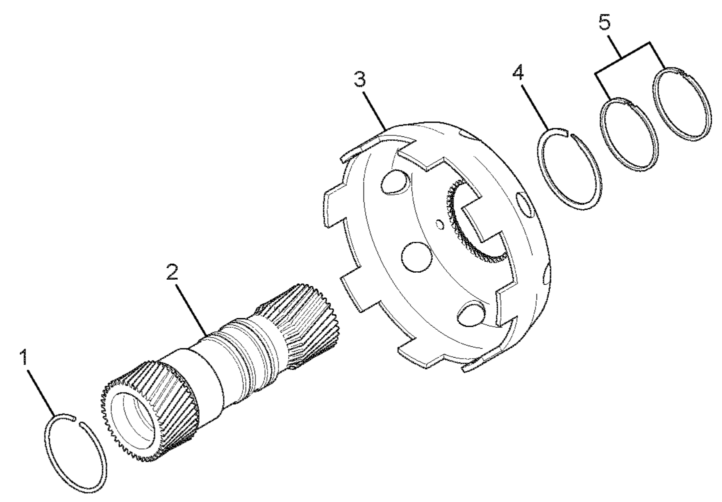
4. Turn over the planetary ring gear and install the race onto the front side of the front planetary ring gear.
   Race diameter (Reference)

	Inside	Outside
Race	26.8mm (1.055in)	47.0mm (1.850in)


247RY00026

Planetary Sun Gear and No.1 One-Way Clutch

Disassembled View



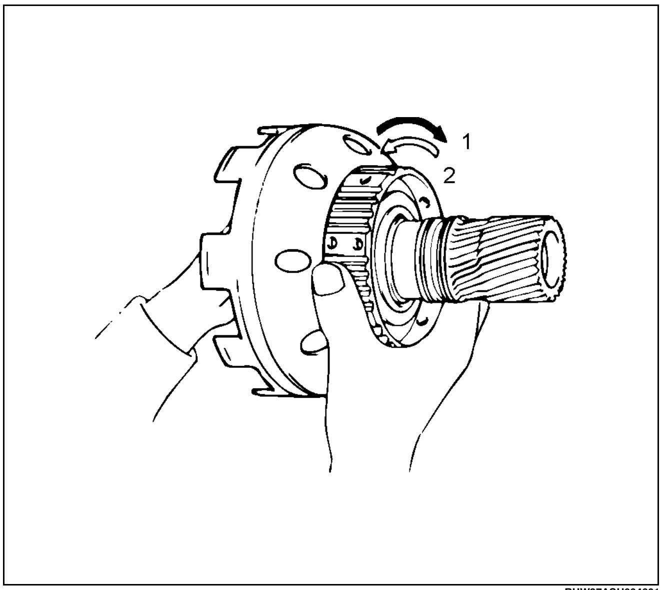
RTW77ASF000301

Legend

(1) Snap ring
(2) Planetary sun gear
(3) Sun gear input drum
(4) Snap ring
(5) Oil seal ring

Disassembly

1. Check operation of No.1 one-way clutch
   Hold the planetary sun gear and turn the second brake hub.
   The second brake hub should turn freely clockwise and should lock counterclockwise.

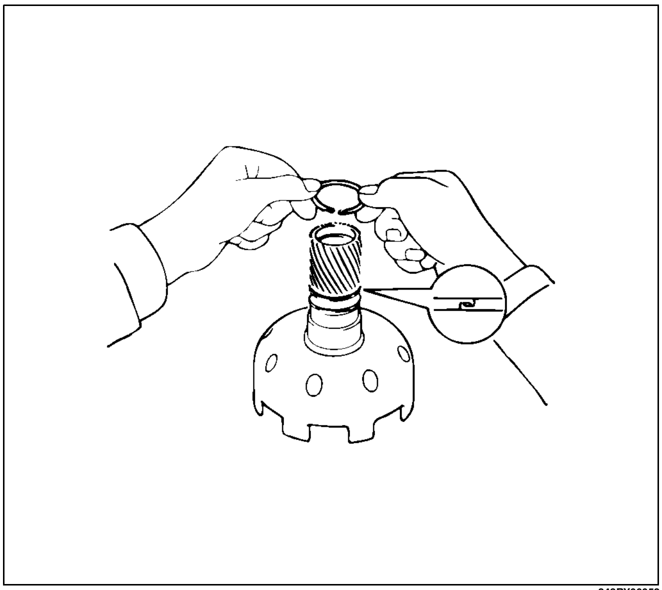


RUW37ASH004601

Legend

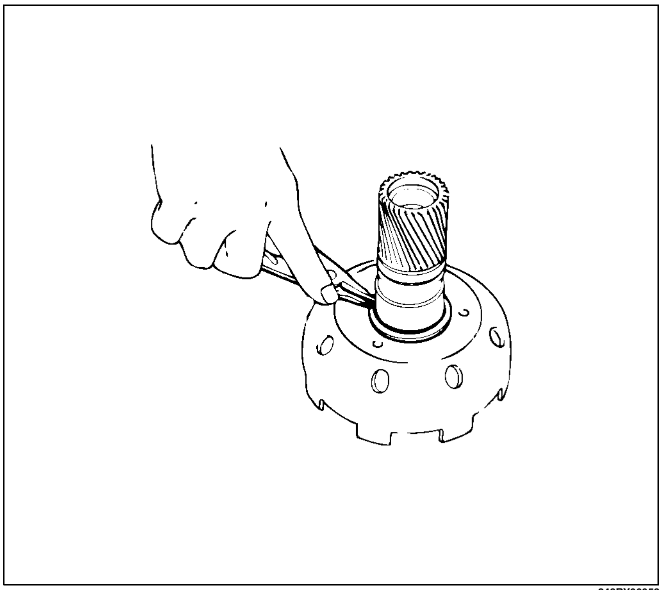
(1) Free
(2) Lock

2. Remove the one-way clutch and second brake hub.
3. Remove the trust washer (plastic).
4. Remove two oil seal rings (metal).



248RY00052

5. Remove the snap ring with snap ring pliers.



248RY00053

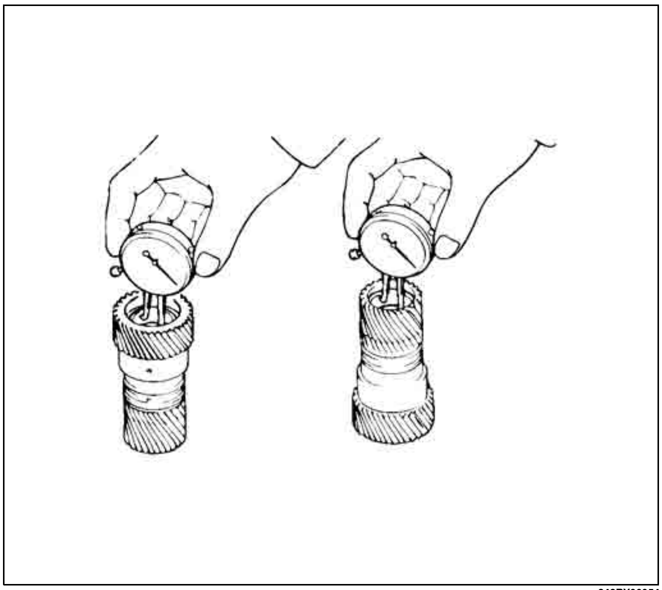
6. Remove the sun gear input drum.
7. Remove the snap ring from planetary sun gear.

Inspection and Repair

1. Check planetary sun gear bushing
   Using a dial indicator, measure the inside diameter of the planetary sun gear bushing.

Maximum inside diameter: 27.08 mm (1.066 in)

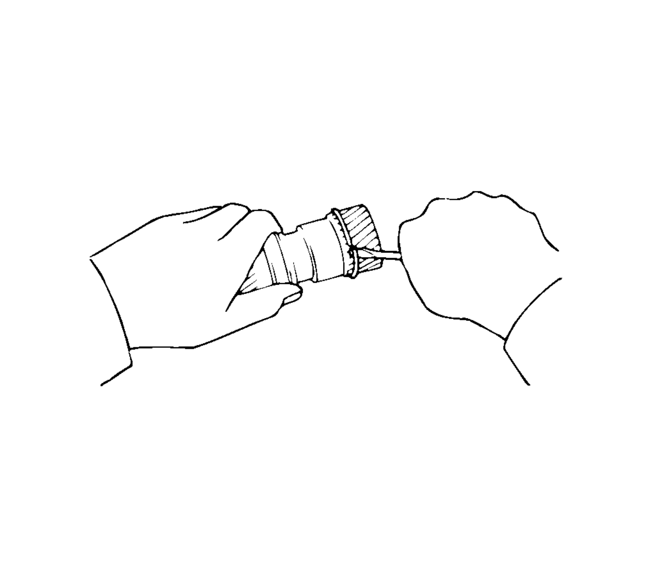
If the inside diameter is greater than the maximum, replace the planetary sun gear.



248RY00054

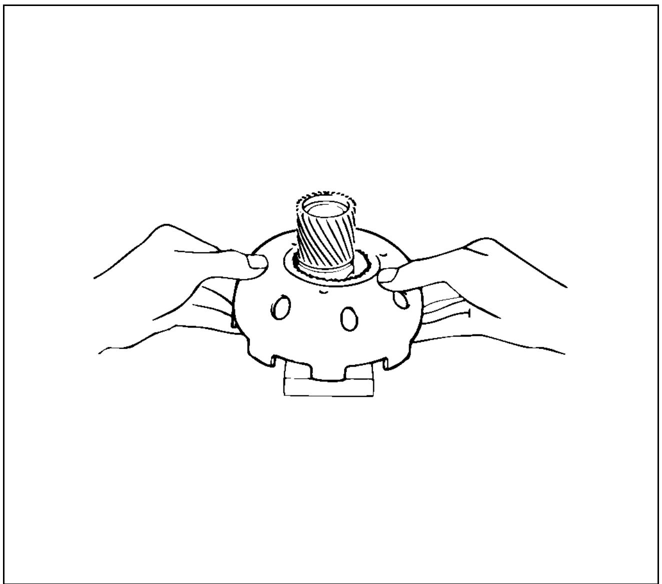
Reassembly

1. Install snap ring to planetary sun gear.



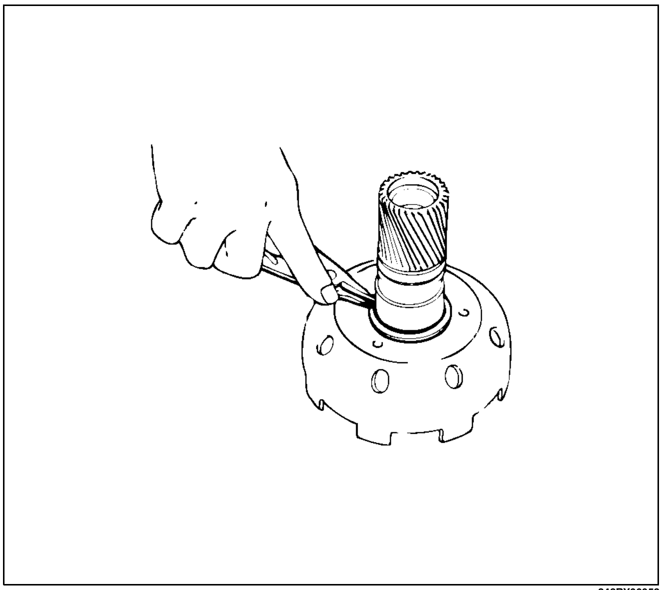
248RY00055

2. Place a wooden block, etc. as a work stand and place the planetary sun gear onto it.
   Install the sun gear input drum onto the planetary sun gear.



248RY00056

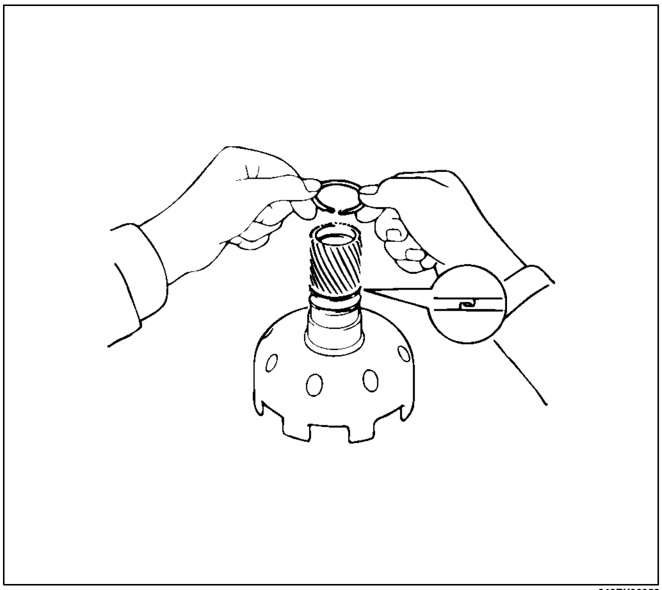
3. Install snap ring with snap ring pliers.



248RY00053

4. Coat the two oil seal rings (metal) with ATF.
   Install the two oil seal rings onto the planetary sun gear.

NOTE: Do not spread the ring ends too much.



248RY00052

	4×4 Model				
Engine Model	4JA1-T(L)	4JA1-TC	4JH1-TC		
Transmission Type	5M/T (MUA)		5M/T (MUA)		4A/T
Wheel Base	Long		Long	Extra Long	Long
Front Suspension	—		—	—	—
Rear Axle	ϕ220mm		←	←	←
Type	OBS		←	←	←
Outside Diameter mm	75		68.9	68.9	63.5
(in)	(2.95)		(2.71)	(2.71)	(2.50)
Inside Diameter mm	71.8		64.9	64.9	60.3
(in)	(2.83)		(2.56)	(2.56)	(2.37)
Length 1st(L1) mm	469.5		468.5	616.5	402.5
(in)	(18.48)		(18.44)	(24.27)	(15.85)
2nd(L2) mm	801		801	801	801
(in)	(31.54)		(31.54)	(31.54)	(31.54)
Spline Major mm	29.89		29.89	29.89	29.89
Diameter (in)	(1.18)		(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10		M10	M10	M10

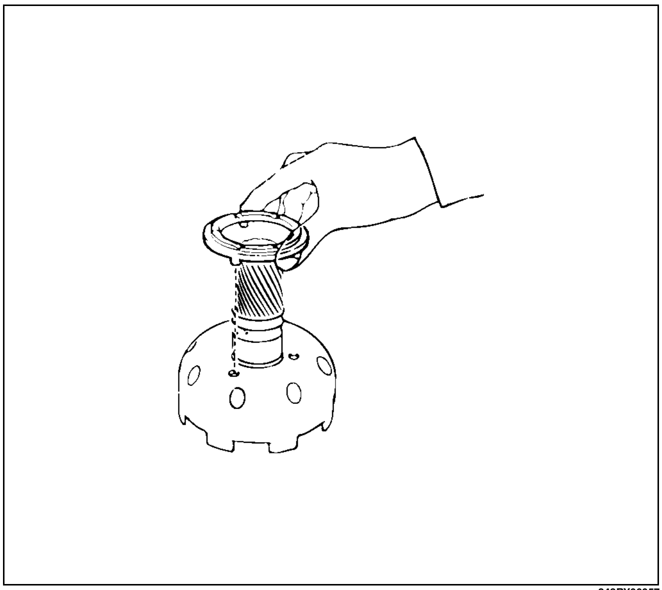
* OBS - Outboard Slip (Spline Engagement To T/M)

	4×4 Model			
Engine Model	C24SE	HFV6		
Transmission Type	5M/T (MUA)	5M/T (AR-5)		4A/T
Wheel Base	Long	Long	Extra Long	Long
Front Suspension	—	—	—	—
Rear Axle	ϕ220mm	←	←	←
Type	OBS	←	←	←
Outside Diameter mm	63.5	68.9	68.9	75
(in)	(2.50)	(2.71)	(2.71)	(2.95)
Inside Diameter mm	60.3	64.9	64.9	71.8
(in)	(2.37)	(2.56)	(2.56)	(2.83)
Length 1st(L1) mm	495.5	476.5	624.5	484.5
(in)	(19.51)	(18.75)	(24.59)	(19.07)
2nd(L2) mm	801	801	801	801
(in)	(31.54)	(31.54)	(31.54)	(31.54)
Spline Major mm	29.89	29.89	29.89	29.89
Diameter (in)	(1.18)	(1.18)	(1.18)	(1.18)
Fix Bolt Size	M10	M10	M10	M10

* OBS - Outboard Slip (Spline Engagement To T/M)

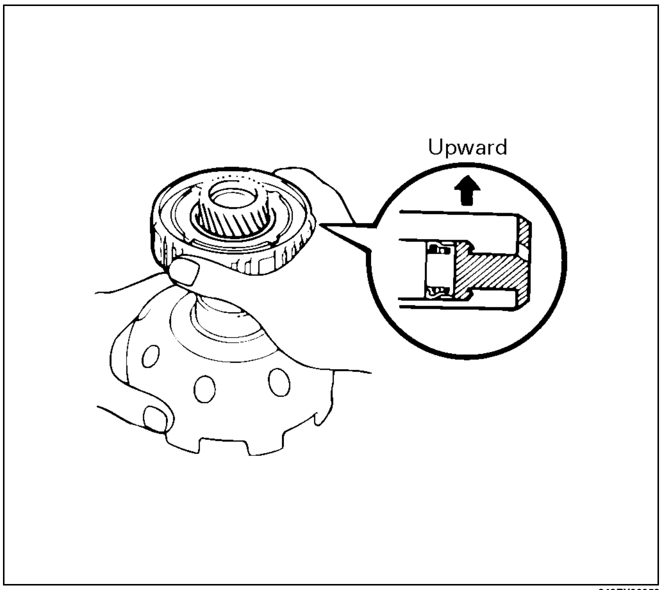
5. Install thrust washer (plastic).

NOTE: Make sure that the lugs fit into the holes on the sun gear input drum.



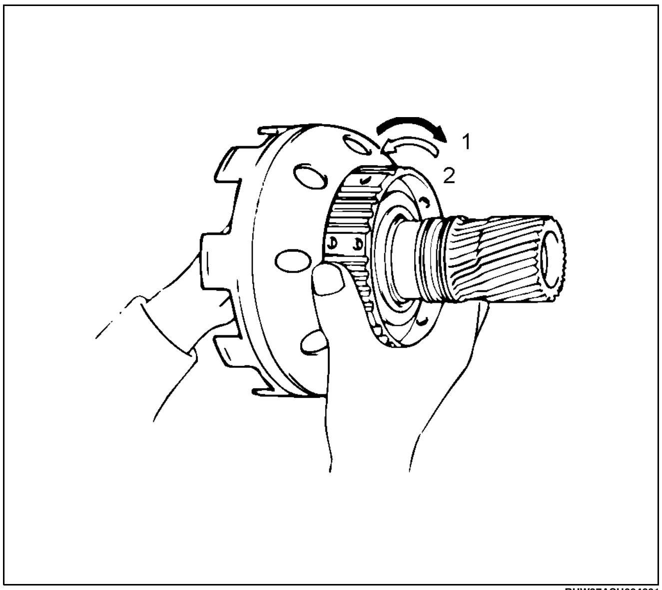
248RY00057

6. Install assembled No.1 one-way clutch and second brake hub onto planetary sun gear as shown.



248RY00058

7. Check operation of No.1 one-way clutch
Hold the planetary sun gear and turn the second brake hub.
The second brake hub should turn freely clockwise and should lock counterclockwise.



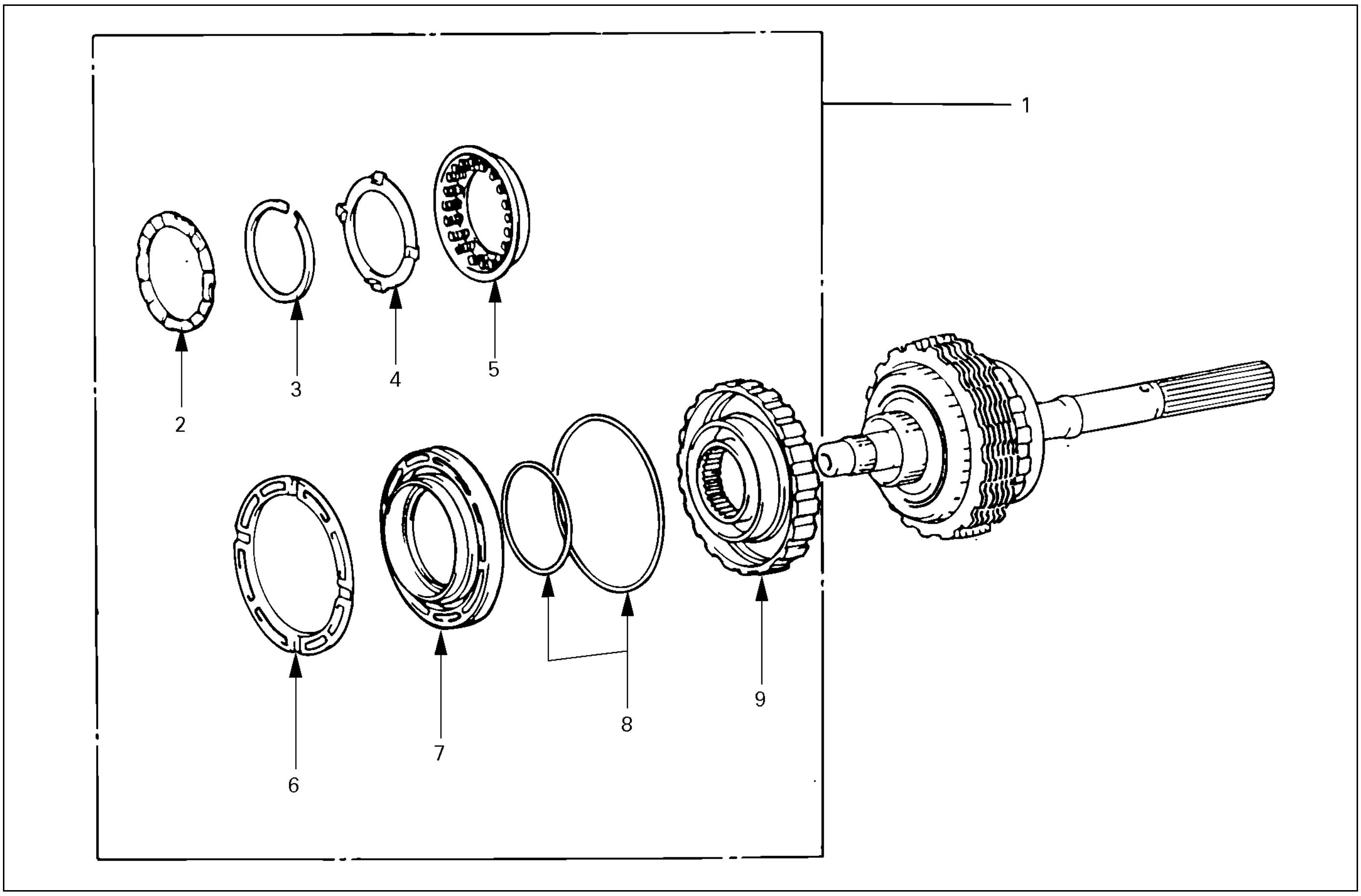
RUW37ASH004601

Legend

(1) Free
(2) Lock

Second Brake Assembly (B–2)

Disassembled View



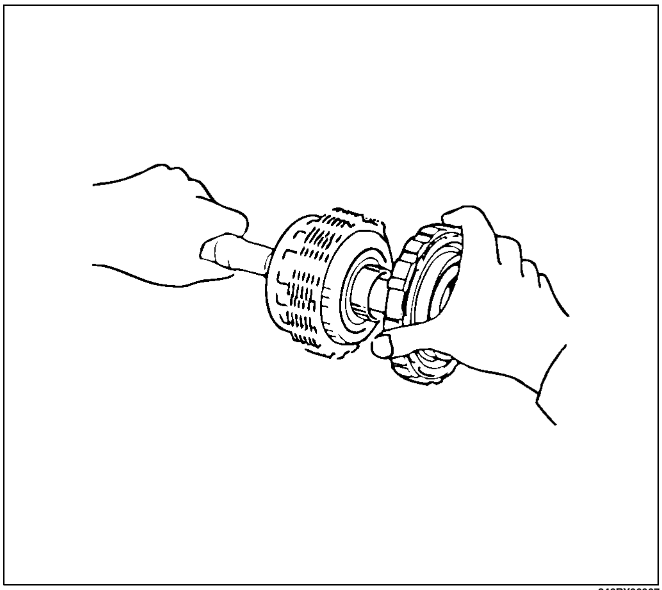
246R200001

Legend

(1) Second brake assembly
(2) Thrust washer (Plastic)
(3) Snap ring
(4) Spring retainer
(5) Piston return spring
(6) Piston sleeve
(7) Second brake piston
(8) O-ring
(9) Second brake drum

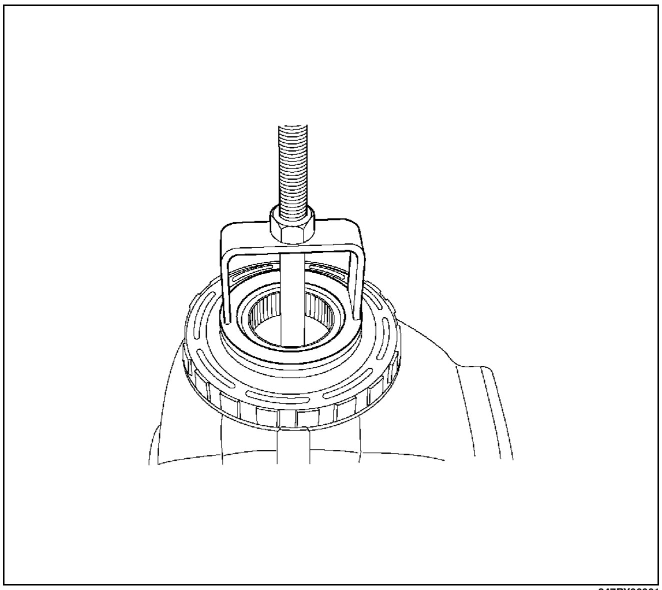
Disassembly

1. Remove second brake assembly from output shaft.



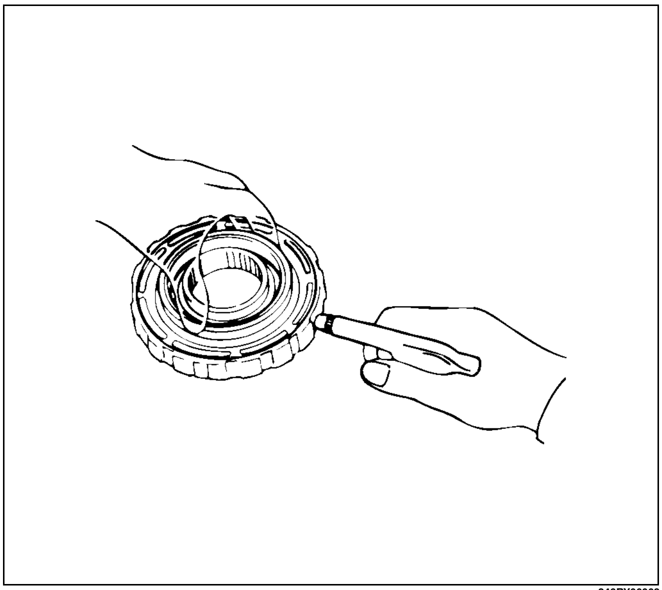
246RY00007

2. Remove the hrust washer (plastic).
3. Place special tool on the spring retainer, and compress the return spring.
   Spring compressor: 5-8840-0254-0
   Remove the snap ring with snap ring pliers.



247RY00001

4. Remove the spring retainer and piston return spring.
5. Romove piston sleeve.
6. Holding the second brake piston by hand, apply compressed air to the second brake drum to remove the second brake piston.
   Remove the second brake piston from the second brake drum.



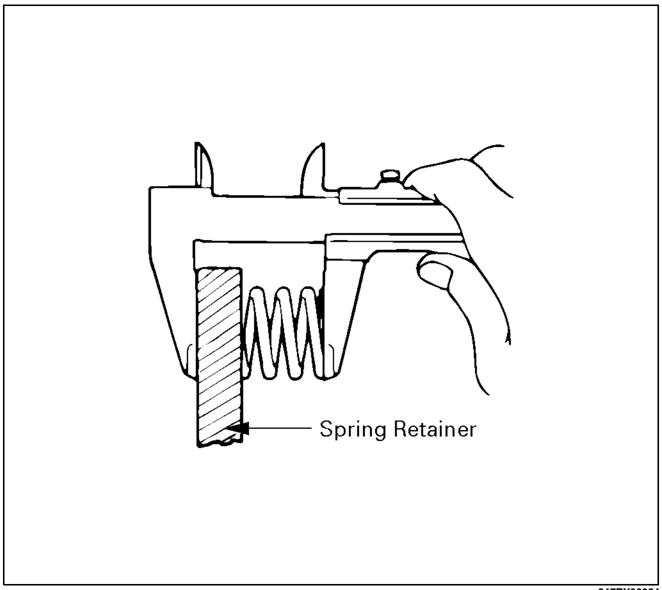
246RY00008

7. Remove the o-rings from the second brake piston.

Inspection and Repair

1. Check piston return spring.
   Using calipers, measure the free length of the return spring.

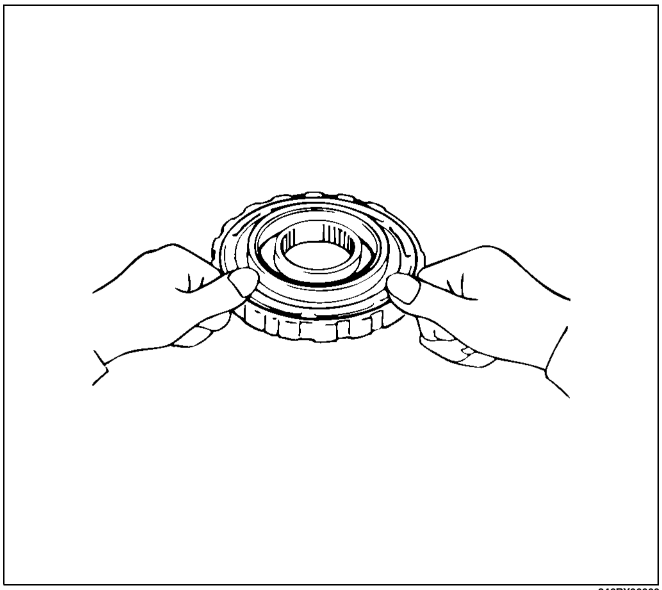
Standard length: 18.38 mm (0.724 in)



247RY00034

Reassembly

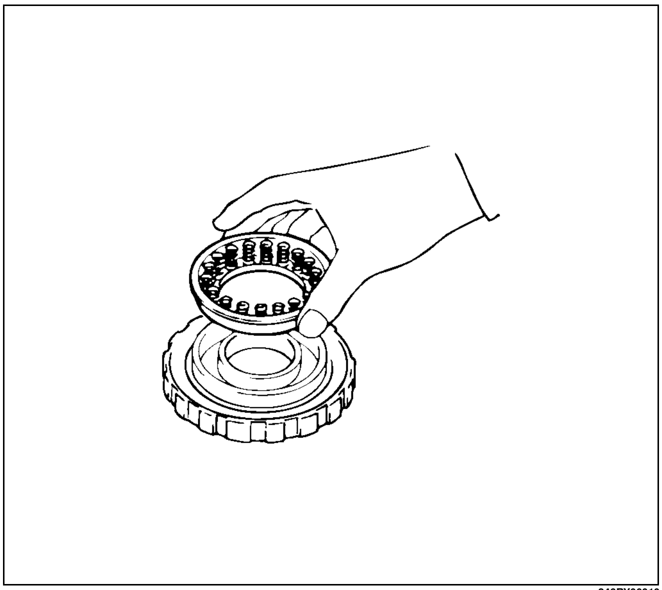
1. Coat new O-rings with ATF and install them on the second brake piston.



246RY00009

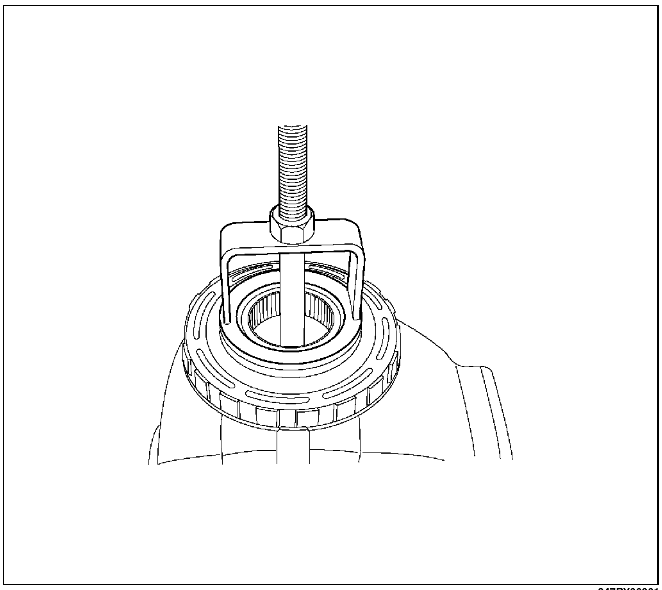
2. Being careful not to damage the O-rings, press in the second brake piston into the second brake drum.
3. Install piston sleeve.

4. Install piston return spring.



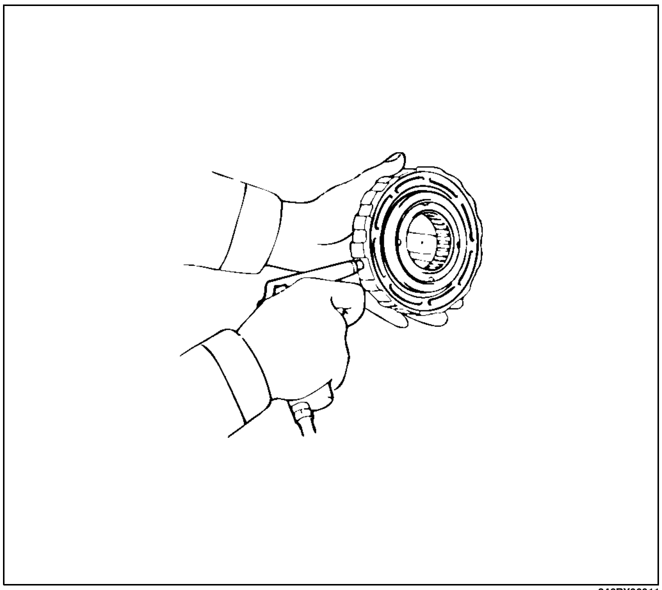
246RY00010

5. Install spring retainer.
6. Place special tool on the spring retainer, and compress the return spring.
   Spring compressor: 5-8840-0254-0
   Install the snap ring with snap ring pliers.
   Be sure the end gap of the snap ring is not aligned with the spring retainer claw.



247RY00001

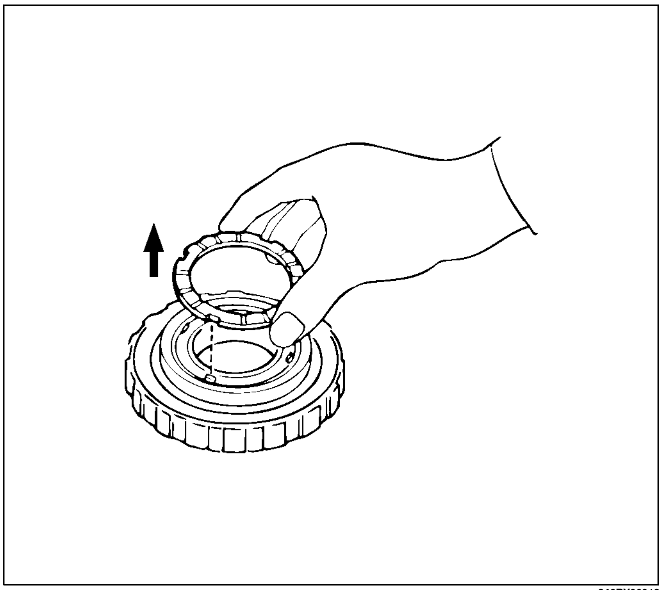
7. Check second brake piston movement.
   Make sure the second brake piston moves smoothly when applying and releasing the low compressed air to the second brake drum.



246RY00011

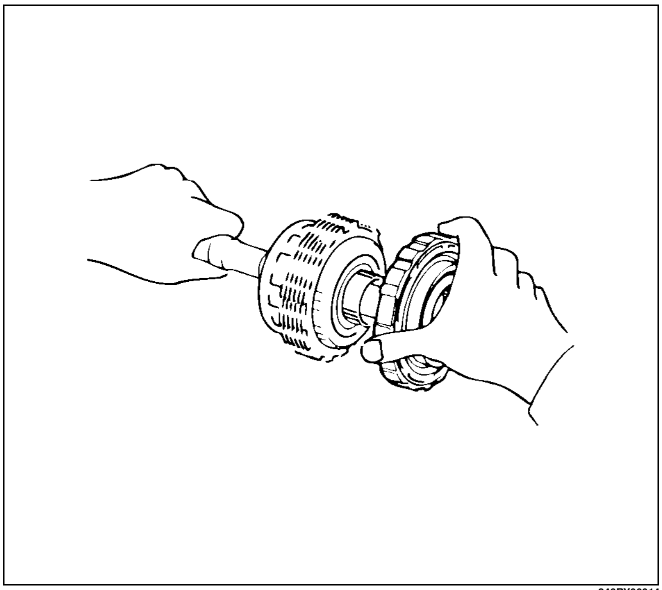
8. Coat the thrust washer (plastic) with petroleum jelly and install it to the second brake piston, with the grooved side facing upward.

NOTE: Make sure that the cutout portions of the thrust washer match the teeth of the spring retainer.



246RY00012

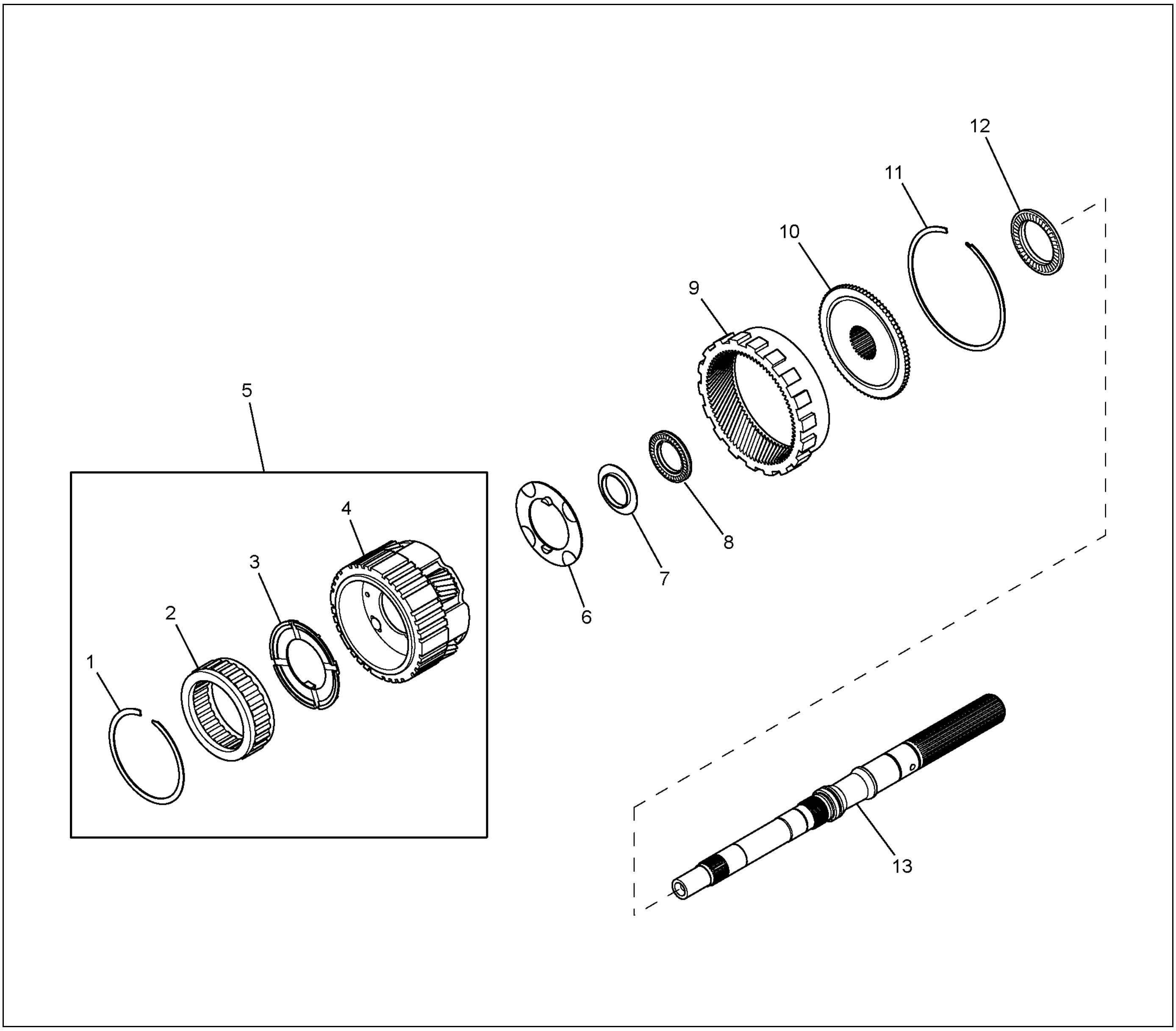
9. Install second brake assembly to output shaft.



246RY00014

Rear Planetary Gear Assembly and Output Shaft

Disassembled View

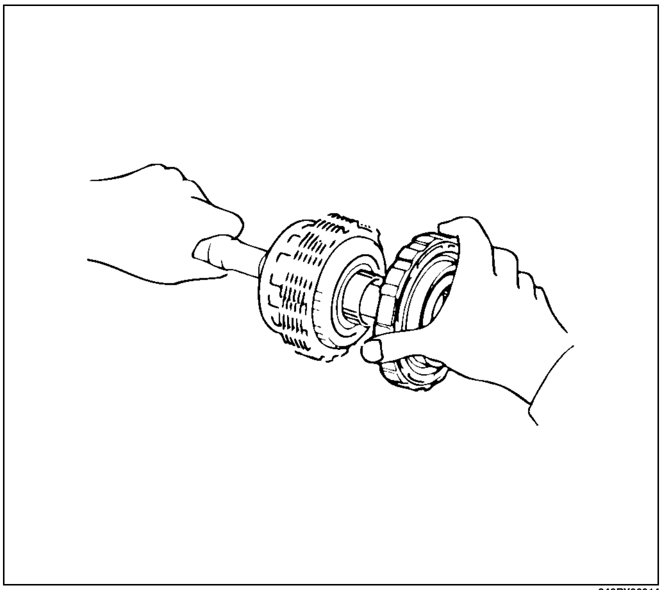


Legend

(1) Snap ring
(2) One-way clutch assembly
(3) Thrust washer
(4) Rear planetary gear
(5) Rear planetary gear assembly
(6) Thrust washer
(7) Thrust bearing race
(8) Thrust bearing with race
(9) Rear planetary ring gear
(10) Ring gear flange
(11) Snap ring
(12) Thrust needle roller bearing
(13) Output shaft

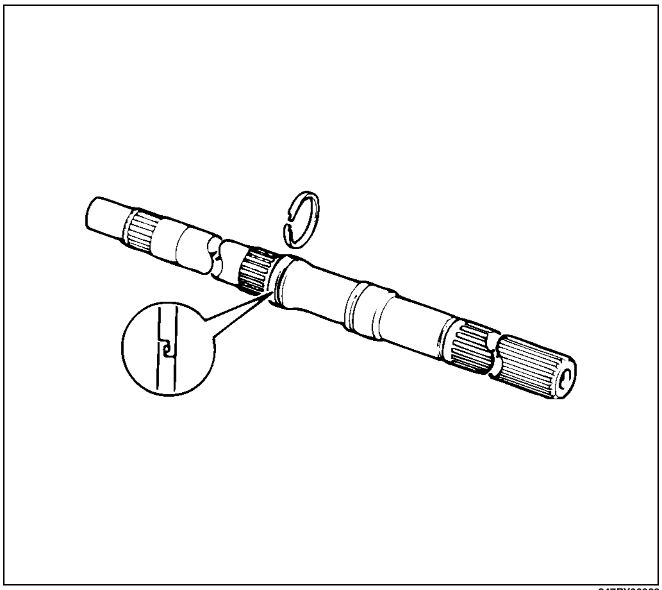
Disassembly

1. Remove second brake assembly from output shaft.



246RY00014

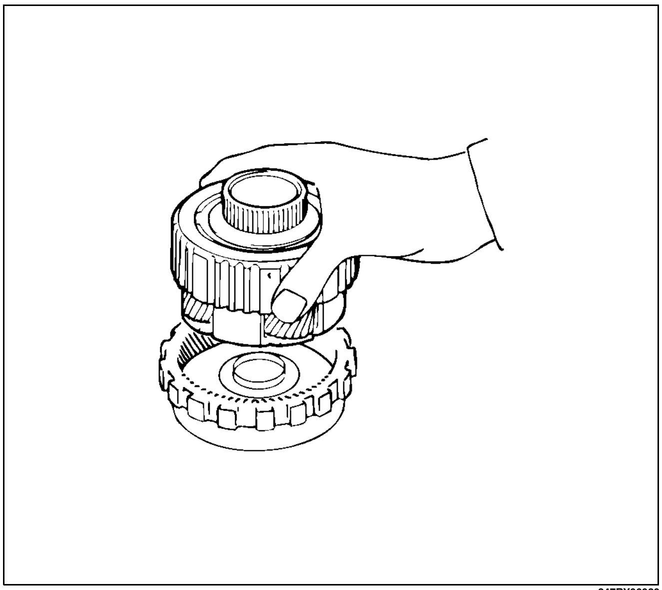
2. Remove oil seal ring from output shaft.



247RY00028

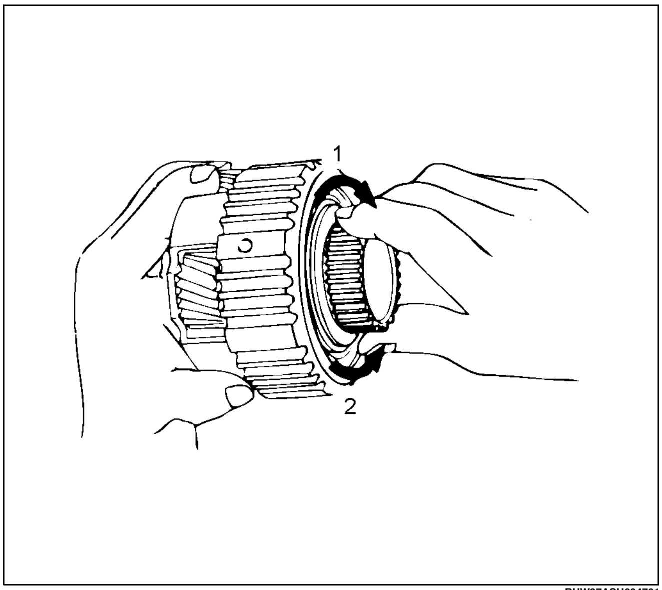
3. Remove the seven discs, seven plates and flange (B–3).

4. Remove rear planetary gear from rear planetary ring gear.



247RY00029

5. Check operation of No.2 one-way clutch.
   Hold the planetary gear and turn the one-way clutch inner race.
   The one-way clutch inner race should turn freely counterclockwise and should lock clockwise.

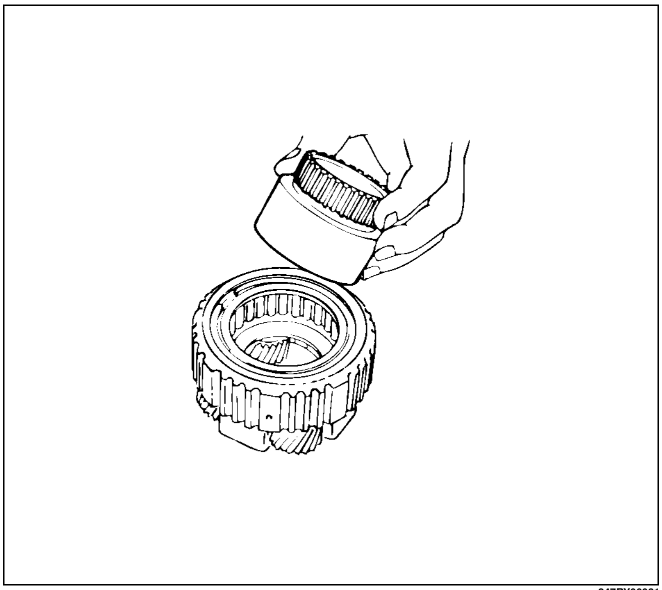


RUW37ASH004701

Legend

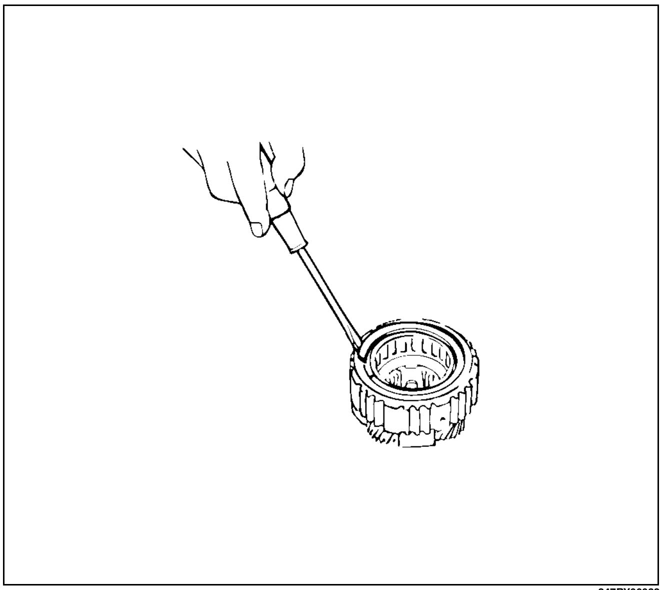
(1) Lock
(2) Free

6. Remove the one-way clutch inner race from the rear planetary gear.



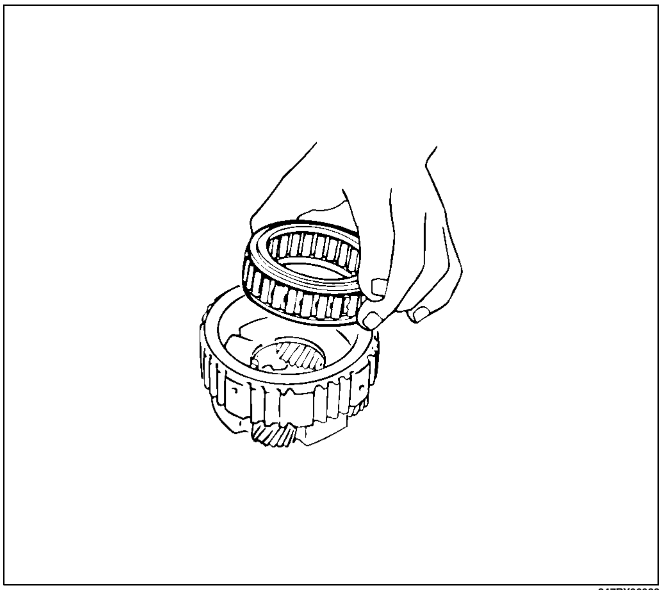
247RY00031

7. Remove the snap ring with a screwdriver.



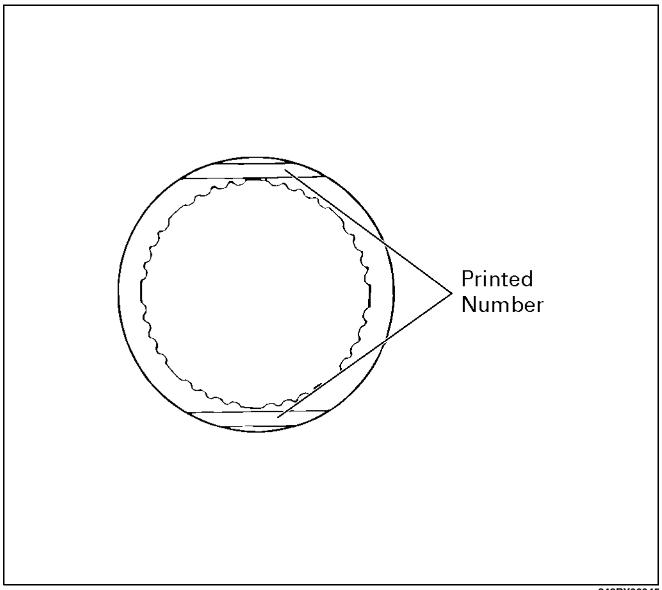
247RY00032

8. Remove the one-way clutch with retainers from the planetary gear.



247RY00033

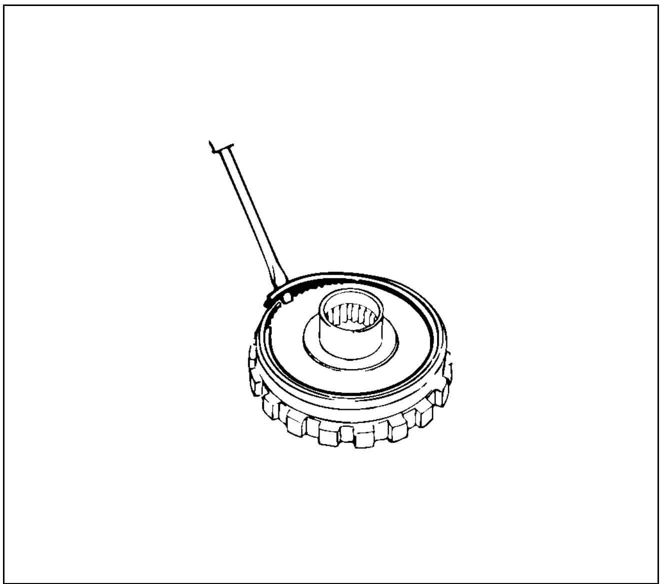
9. Remove the thrust washer (plastic) from front side of rear planetary gear.
10. Remove the thrust washer (plastic) from rear side of rear planetary gear.
11. Remove the thrust bearing and race from front side of ring gear flange.
12. Remove the snap ring from rear planetary ring gear.
13. Remove the ring gear flange from rear planetary ring gear.
14. Check disc, plate and flange.
    Check to see if the sliding surface of the disc, plate and flange are worn or burnt. If necessary, replace them.
    - If the lining of the disc is peeling off or discolored, or even if parts of the printed numbers are defaced, replace all discs.
    - Before assembling new discs, soak them in ATF for at least fifteen minutes.



248RY00045

Reassembly

1. Install ring gear flange to the rear planetary ring gear.
2. Install snap ring to the rear planetary ring gear.

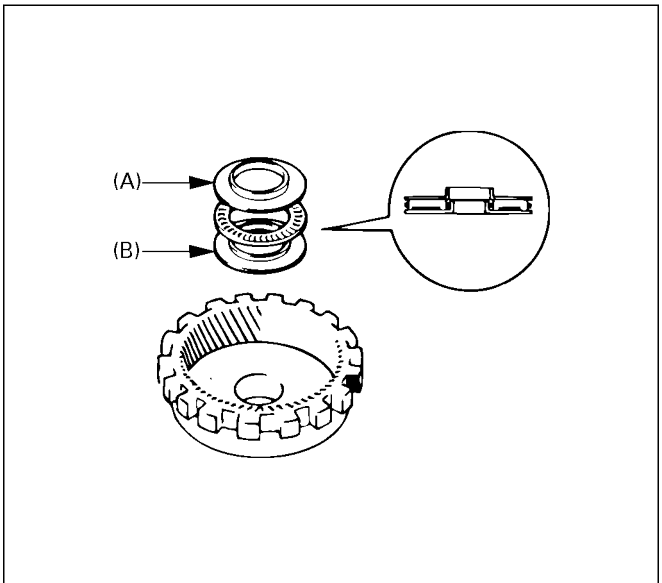


247RY00035

3. Coat the races and bearing with petroleum jelly, and install them onto the rear planetary ring gear.

Races and bearing diameter (Reference)

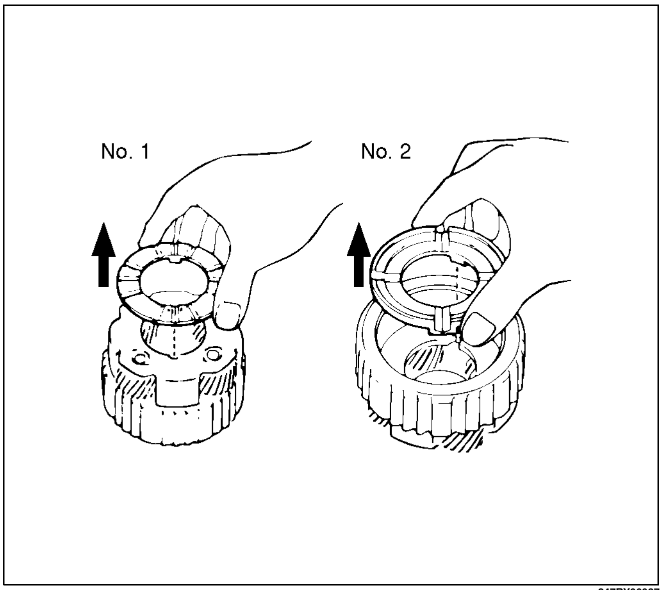
	Inside	Outside
Race (A)	28.5 mm (1.122 in)	44.2 mm (1.740 in)
Bearing and race (B)	27.7 mm (1.091 in)	44.2 mm (1.740 in)



247RY00036

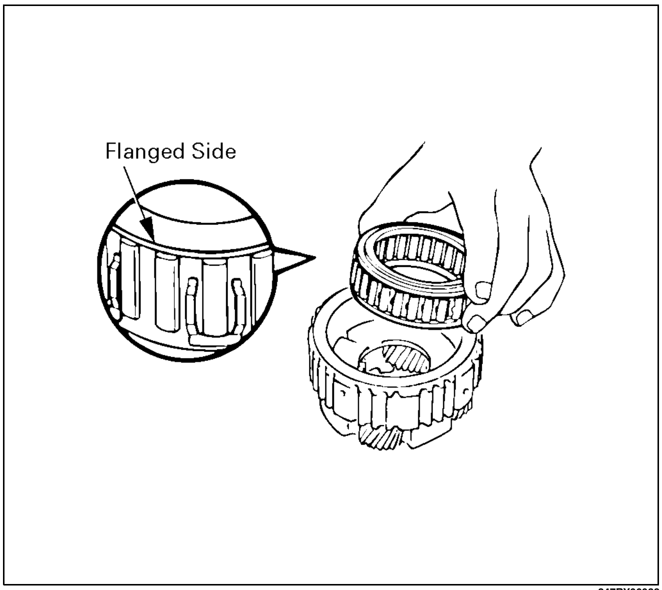
4. Coat the thrust washers (plastic) with petroleum jelly.
   Install the thrust washers onto both sides of the rear planetary gear, facing the grooved side upward.

NOTE: Make sure that the lugs fit into the cutout portions on the rear planetary gear.



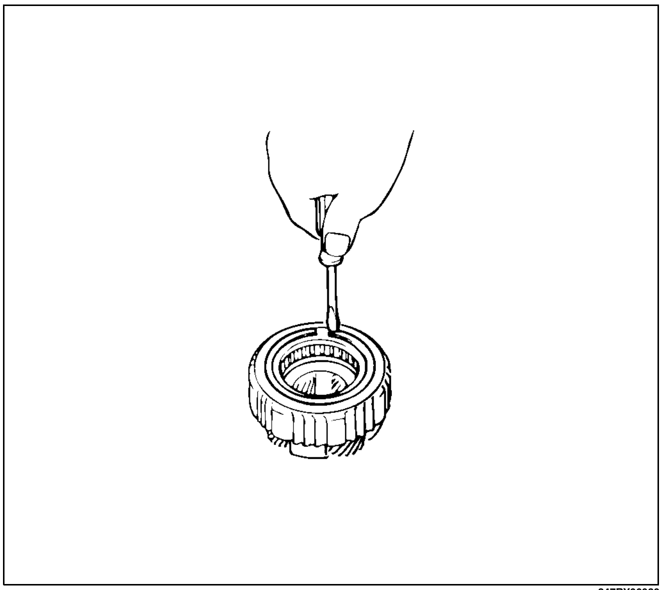
247RY00037

5. Install the one-way clutch with the flanged side facing upward onto the rear planetary gear.



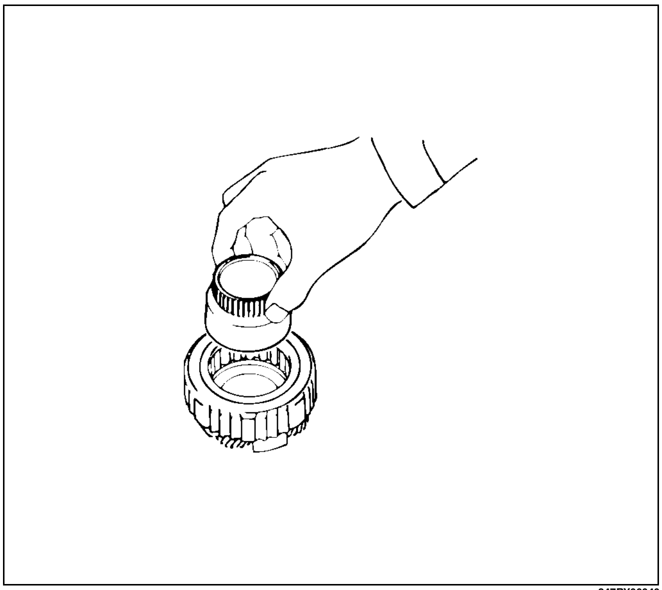
247RY00038

6. Install snap ring.



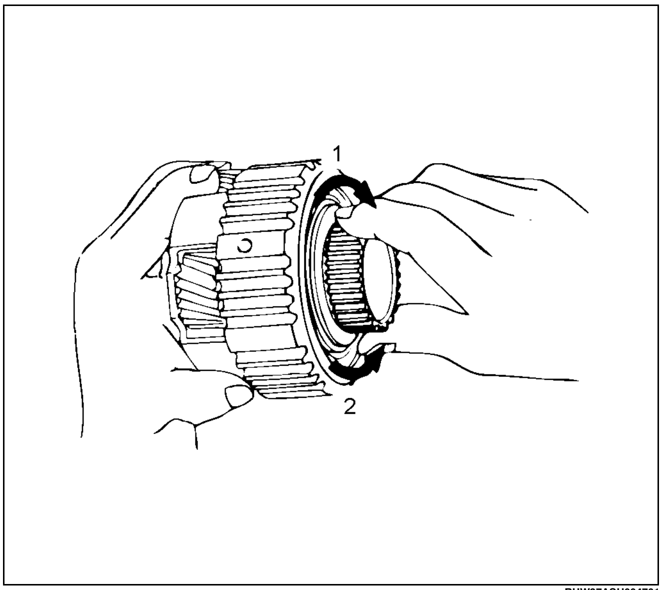
247RY00039

7. While turning counterclockwise, install one-way clutch inner race to rear planetary gear.



247RY00040

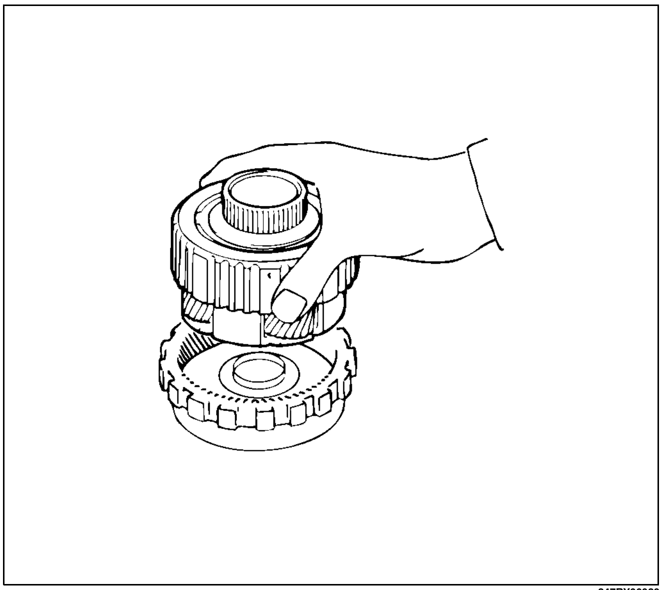
8. Check operation of one-way clutch.
   Hold the planetary gear and turn the one-way clutch inner race.
   The one-way clutch inner race should turn freely counterclockwise and should lock clockwise.



RUW37ASH004701

Legend
(1) Lock
(2) Free

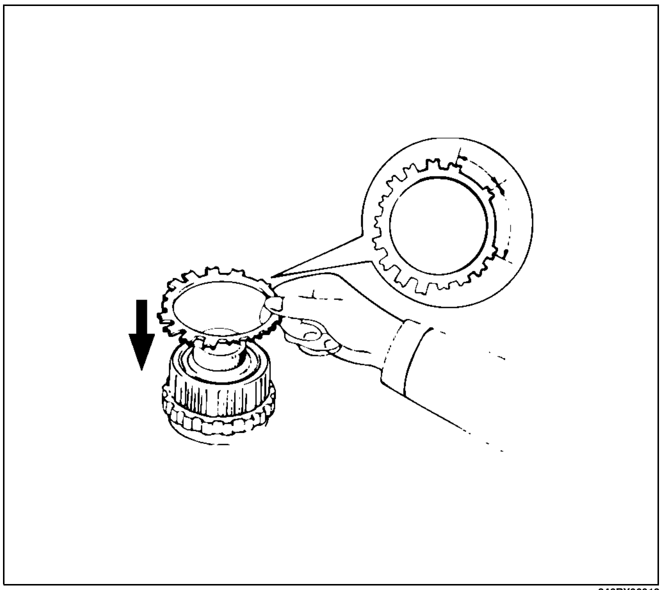
9. Install rear planetary gear onto rear planetary ring gear.



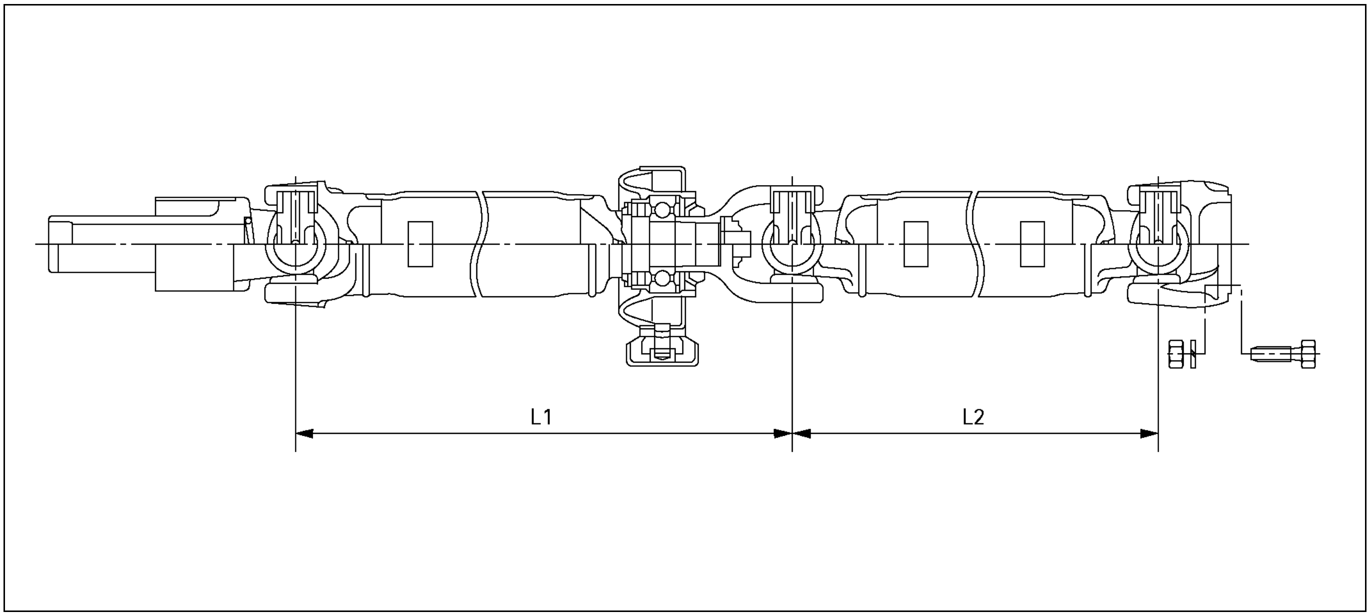
247RY00029

10. Install the disc, plate and flange (B–3).
    - Install a brake flange onto the rear planetary gear assembly.
    - Install a clutch disc onto the rear planetary gear assembly.

NOTE: The claw interval of the plate should be as shown in the figure when viewing the clutch plate from the arrow direction.



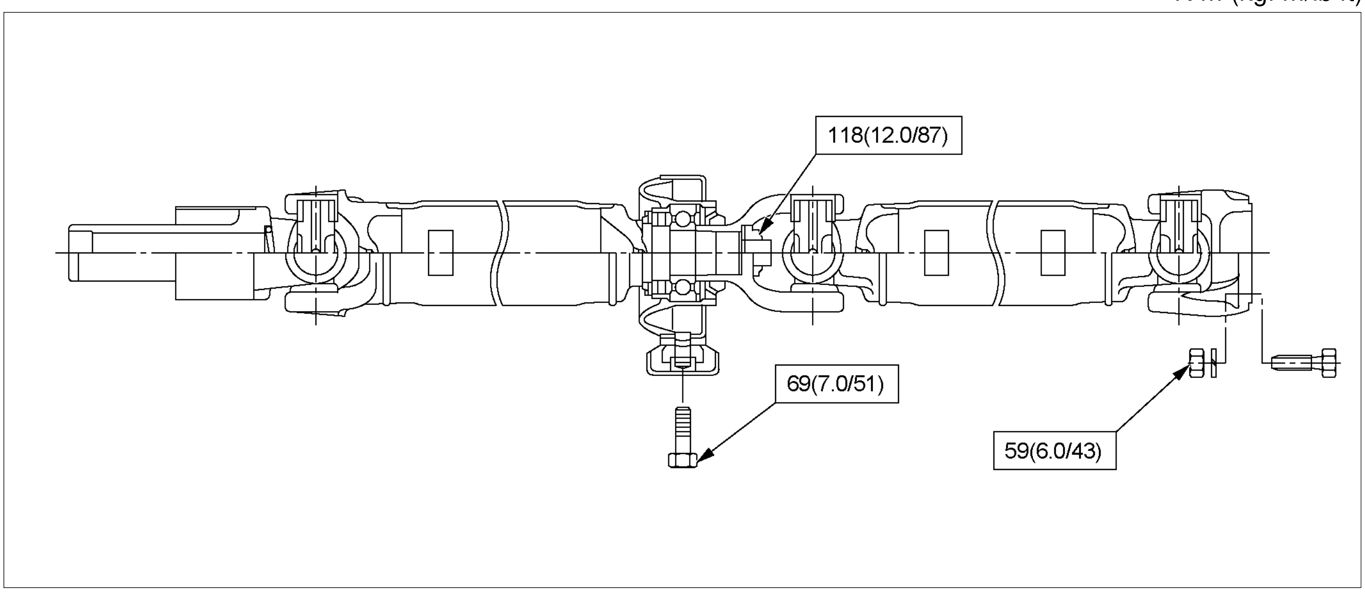
246RY00013



401R300006

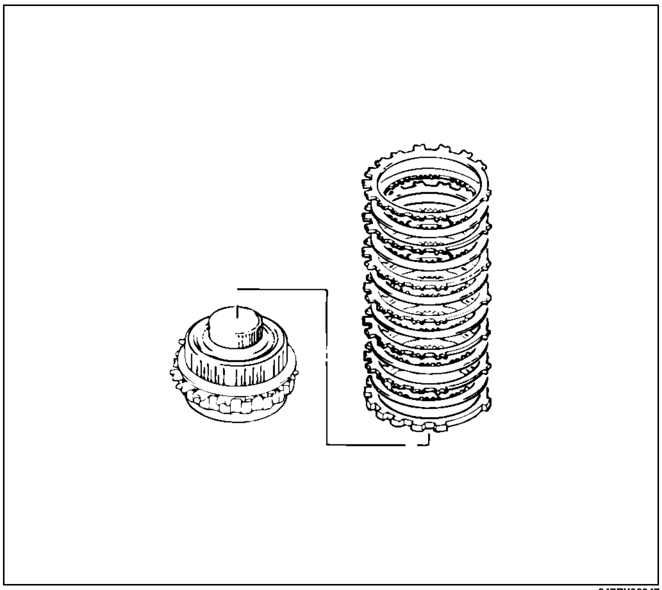
Torque Specifications

N·m (kgf·m/lb·ft)



RTW34ASF000301

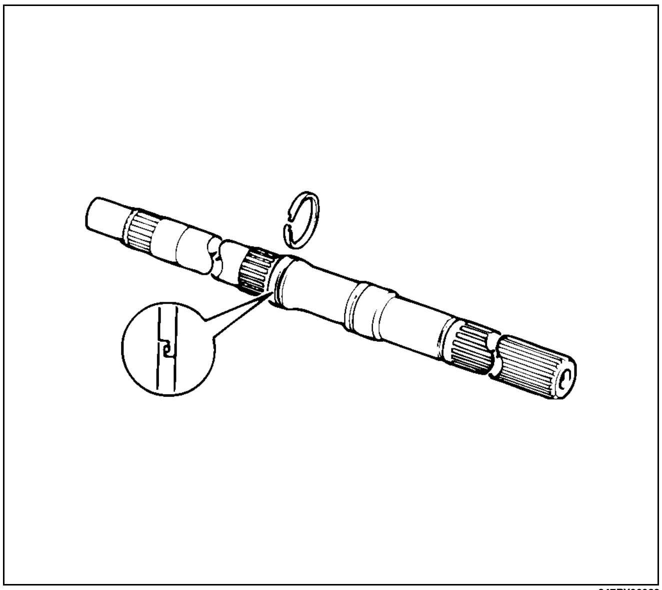
- Install six clutch discs and six brake plates alternately, starting with clutch disc, onto the rear planetary gear assembly.



247RY00047

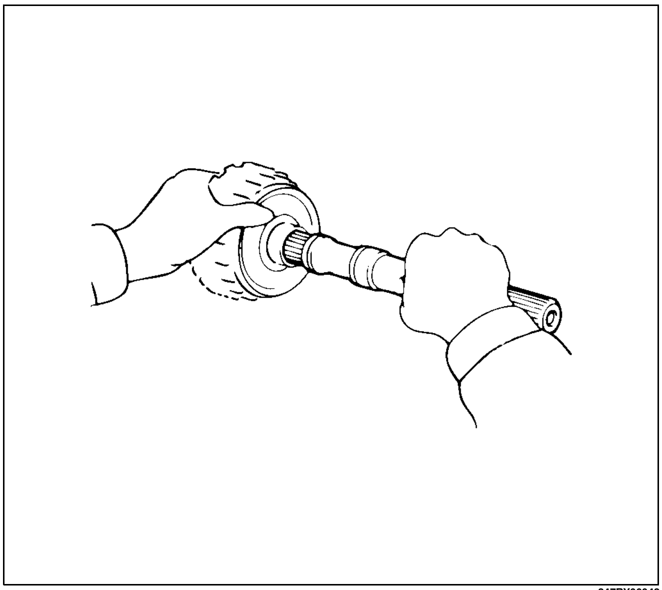
11. Coat the oil seal ring with ATF and install it to the output shaft.

NOTE: Do not spread the ring ends too much.



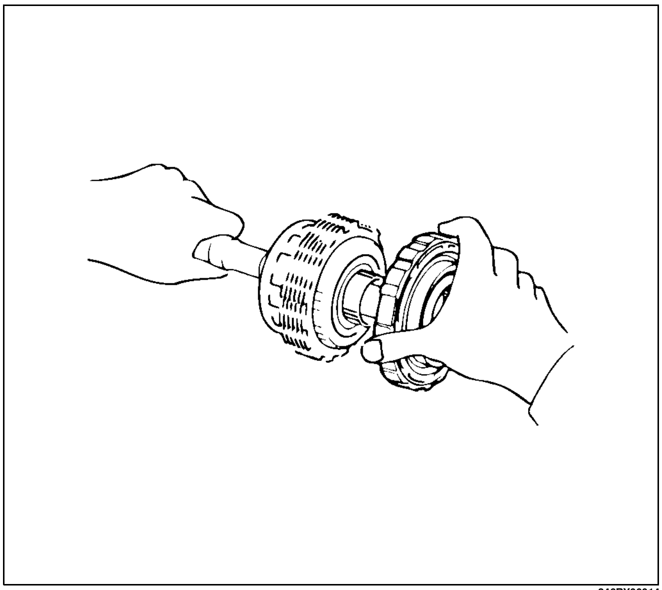
247RY00028

12. Install output shaft into rear planetary gear assembly.



247RY00042

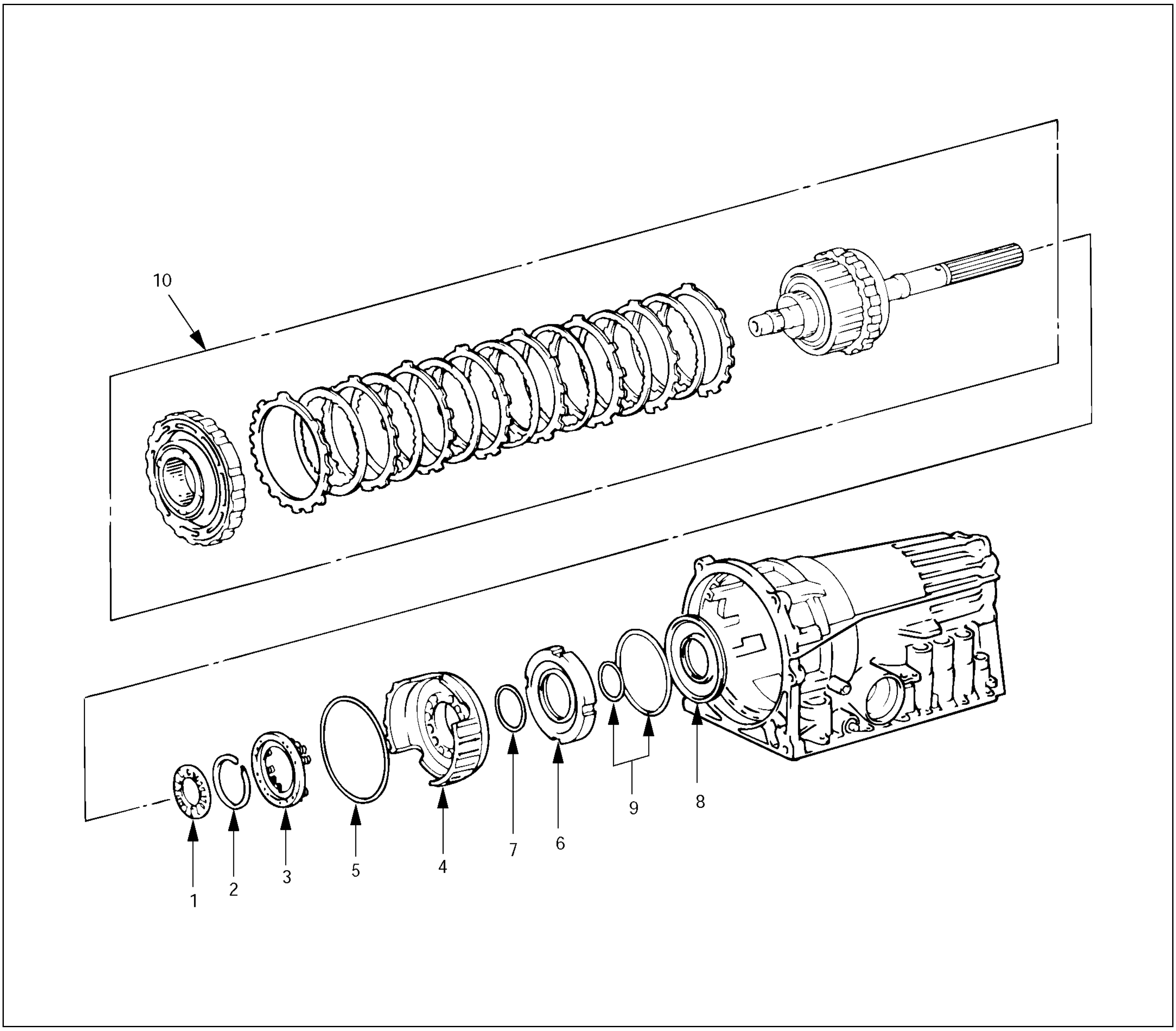
13. Install second brake assembly to output shaft.



246RY00014

First and Reverse Brake (B–3)

Disassembled View



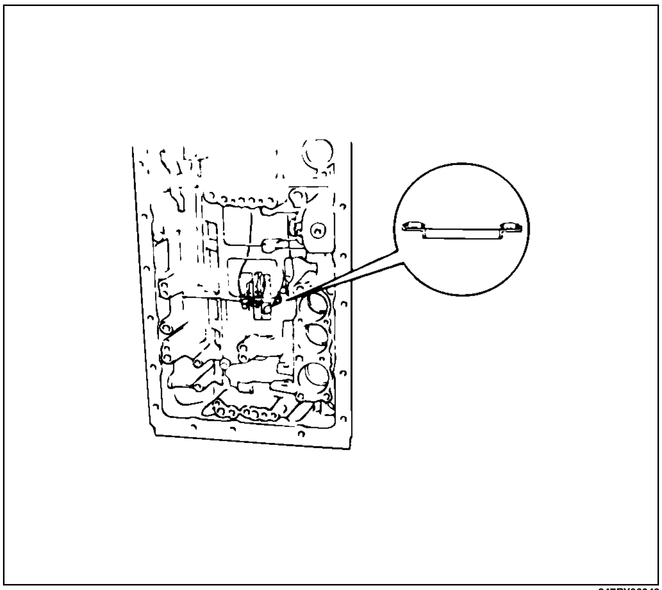
246RY00024-X

Legend

(1) Thrust bearing and race
(2) Snap ring
(3) Piston return spring
(4) First and reverse brake piston No.2
(5) O-ring
(6) Reaction sleeve
(7) O-ring
(8) First and reverse brake piston No.1
(9) O-ring
(10) Rear planetary gear assembly and output shaft

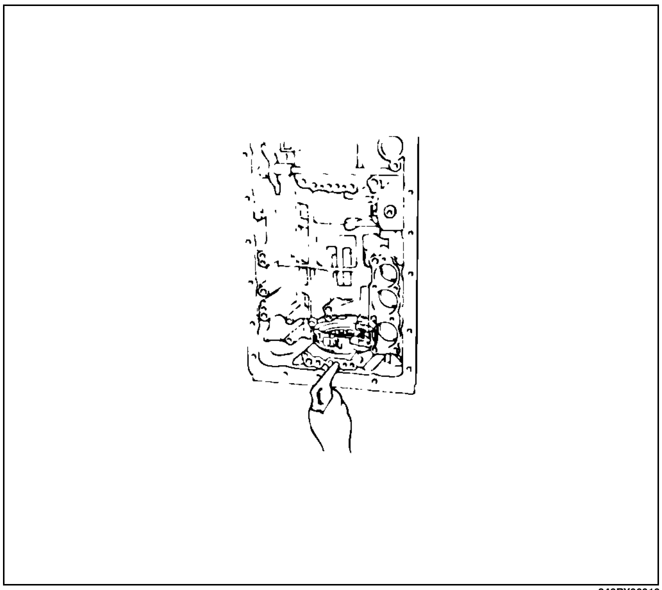
Disassembly

1. Remove assembled thrust bearing and race from transmission case.



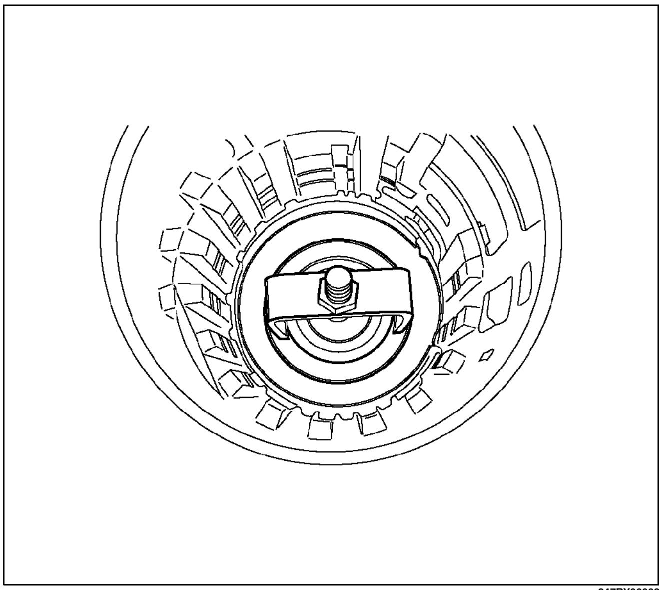
247RY00043

2. Check first and reverse brake piston movement. Make sure that first and reverse brake piston moves smoothly when applying and releasing the compressed air into the transmission case.



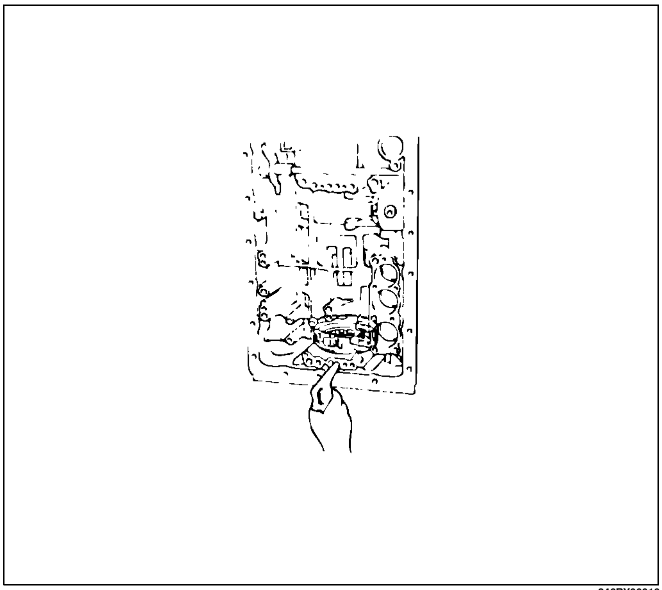
246RY00016

3. Set special tool on the spring retainer, and compress the return spring.
   Spring compressor: 5-8840-0254-0
   Remove the snap ring with snap ring pliers.



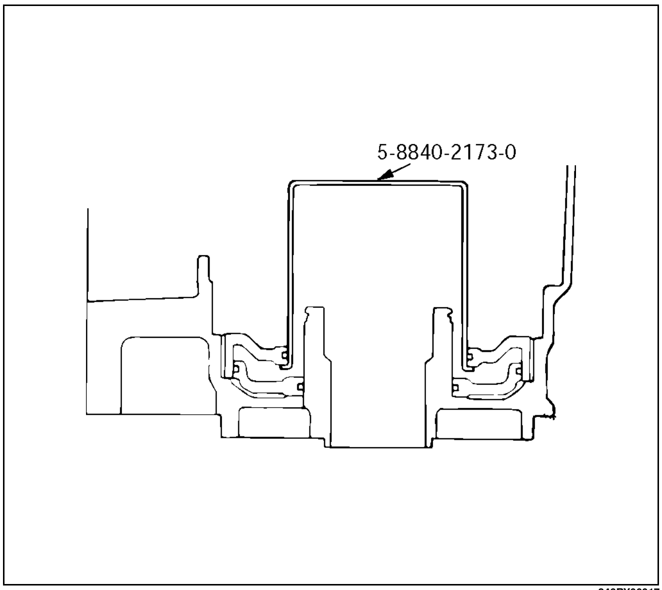
247RY00002

4. Remove the piston return spring.
5. Remove the first and reverse brake piston No.2.
   Holding the first and reverse brake piston No.2 by hand, apply compressed air to the transmission case to remove the first and reverse brake piston No.2.
   Remove the first and reverse brake piston No.2.
   If the piston does not pop out with compressed air, lift the piston out with needle-nose pliers.



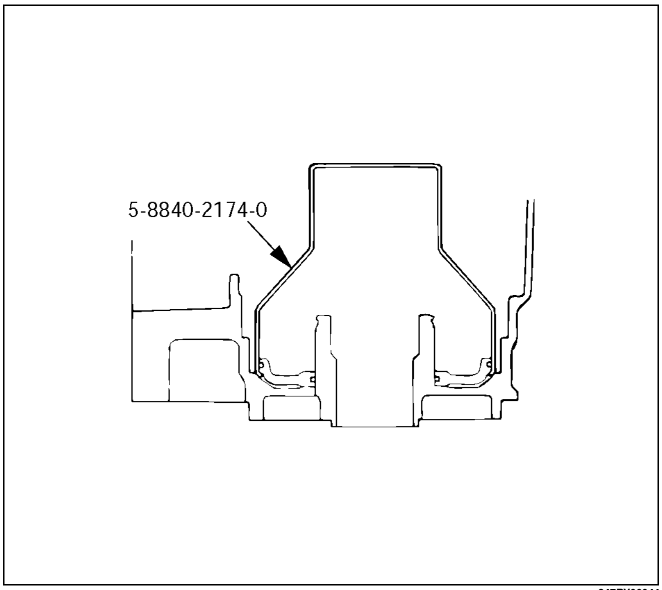
246RY00016

6. Remove the O-ring from first and reverse brake piston No.2.
7. Remove the reaction sleeve.
   Insert special tool behind the reaction sleeve and gradually lift it out of the transmission case.
   Reaction sleeve puller: 5-8840-2173-0



246RY00017

8. Remove the O-ring from reaction sleeve.
9. Remove the first and reverse brake piston No.1.
   Insert special tool behind the first and reverse brake piston No.1 and gradually lift it out of the transmission case.
   Piston puller: 5-8840-2174-0

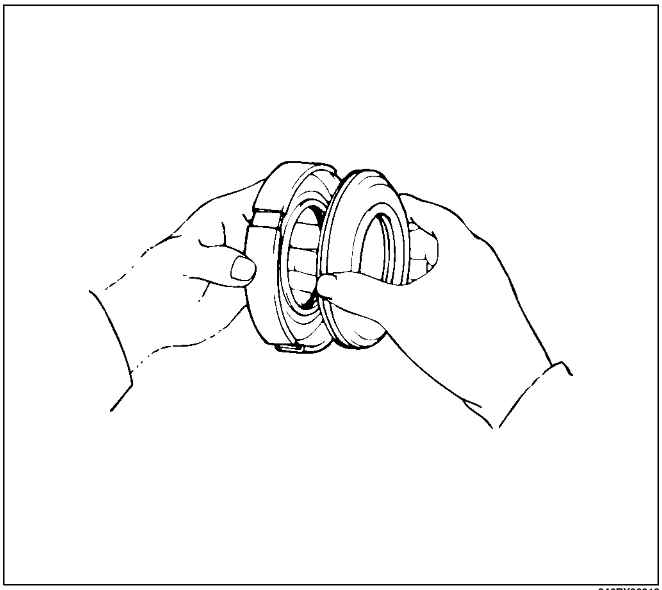


247RY00044

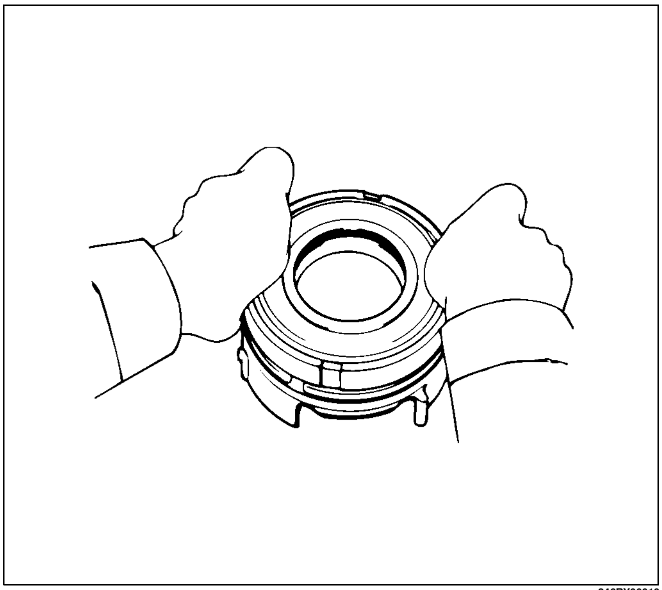
10. Remove the O-rings from first and reverse brake pistion No.1.

Reassembly

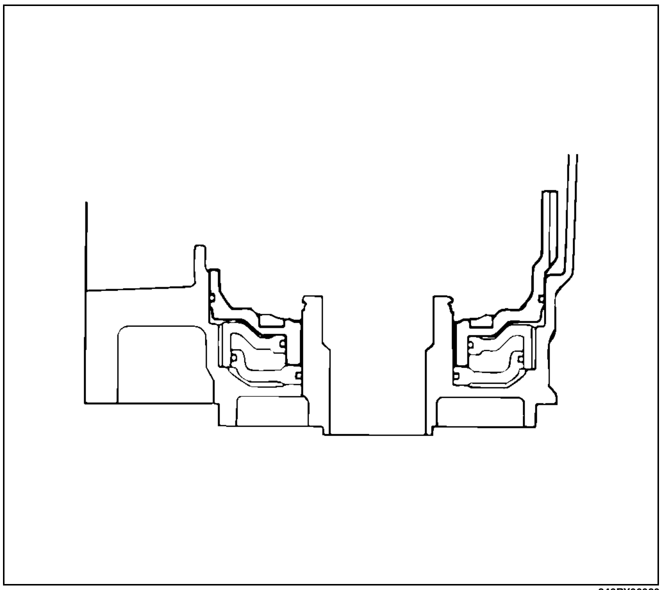
1. Coat three new O-rings with ATF.
   Install the two O-rings on the No.1 piston.
2. Install the O-ring on the reaction sleeve.
3. Install the first and reverse brake piston No.1 to the reaction sleeve.


246RY00018

4. Coat a new O-ring with ATF and install it on the first and reverse brake piston No.2.
5. Install the first and reverse brake piston No.1 with reaction sleeve onto the first and reverse brake piston No.2.

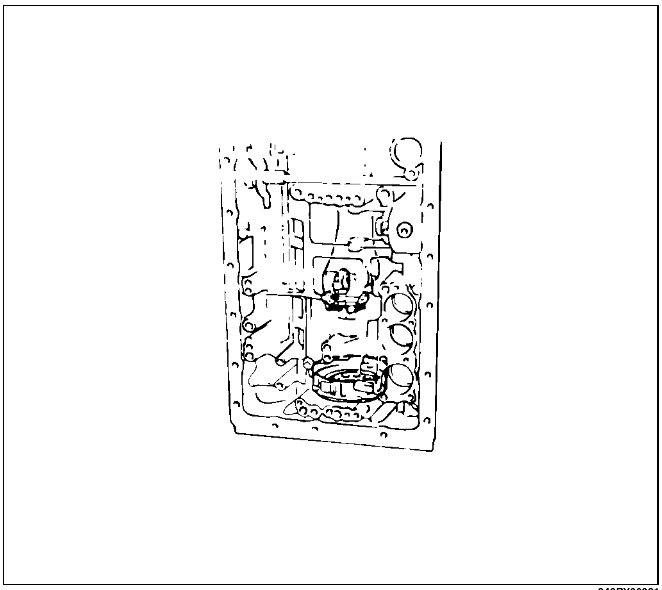

246RY00019

6. Align the teeth of the first and reverse brake piston No.2 into the proper grooves.
   Being careful not to damage the O-rings, press in the first and reverse brake piston No.2 with No.1 into the transmission case.



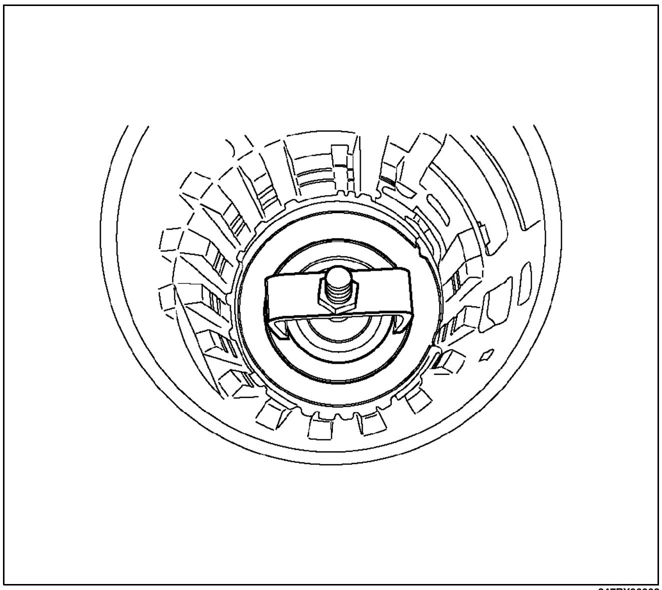
246RY00020

7. Place piston return spring onto first and reverse brake piston No.2.



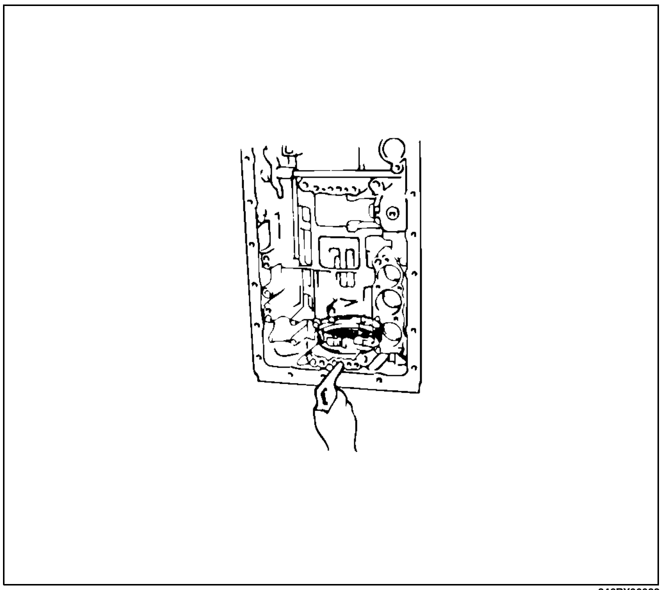
246RY00021

8. Set special tool as shown, and compress the return spring with special tool.
   Spring compressor: 5-8840-0254-0
   Install the snap ring with snap ring pliers.
   Be sure the end gap of the snap ring is not aligned with the spring retainer claw.



247RY00002

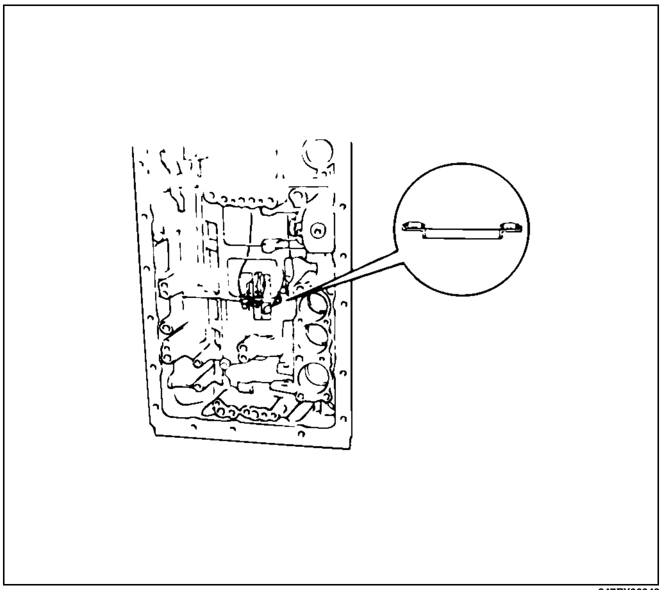
9. Check first and reverse brake piston movement.
   Make sure the first and reverse brake piston moves smoothly when applying and releasing the compressed air into the transmission case.



246RY00022

10. Coat the assembled bearing and race with petroleum jelly.
    Install the assembled bearing and race facing the bearing side upward.
    Bearing and race diameter (Reference)

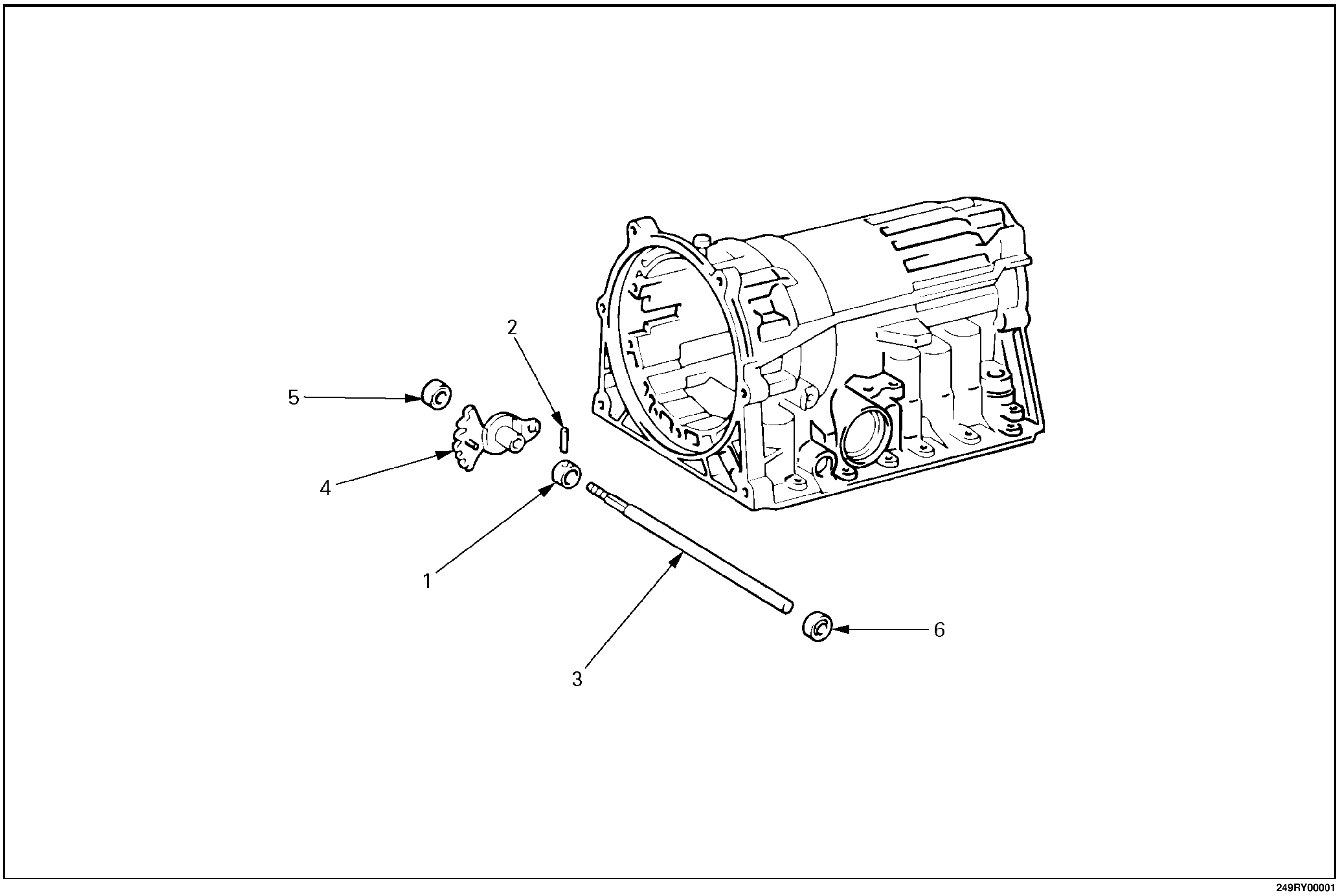
Inside diameter	39.38 mm (1.550 in)
Outside diameter	58.15 mm (2.289 in)



247RY00043

Transmission Case

Disassembled View

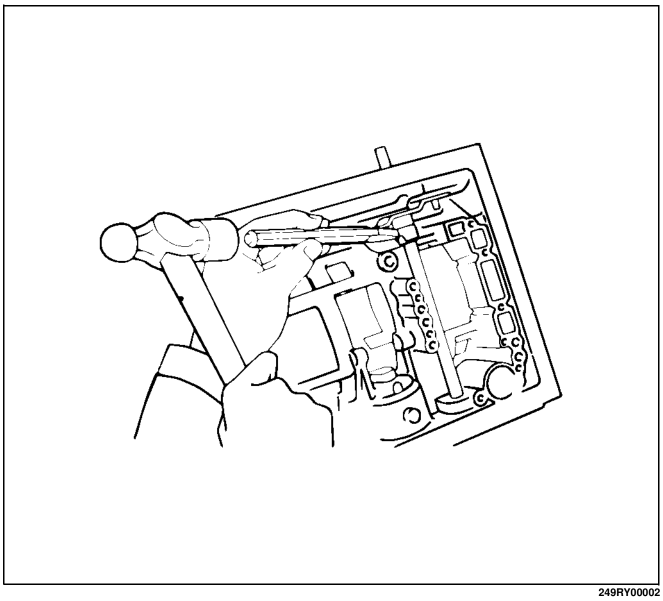


Legend

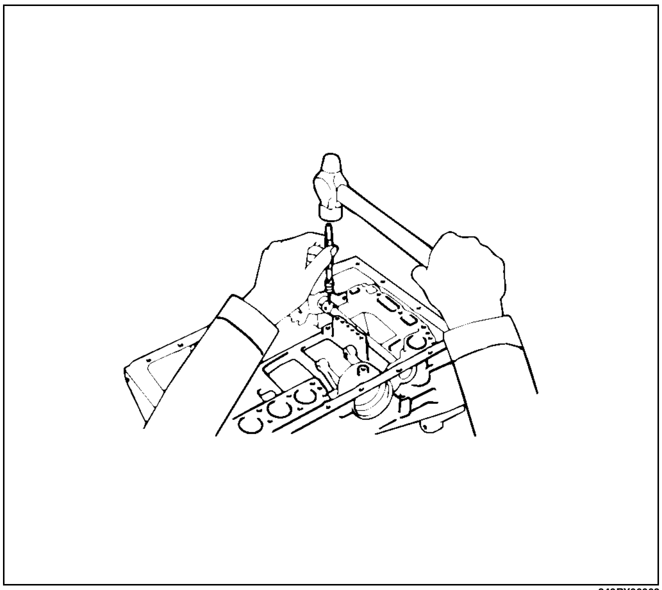
(1) Spacer
(2) Pin
(3) Manual valve lever shaft
(4) Manual valve lever
(5) Oil seal
(6) Oil seal

Disassembly

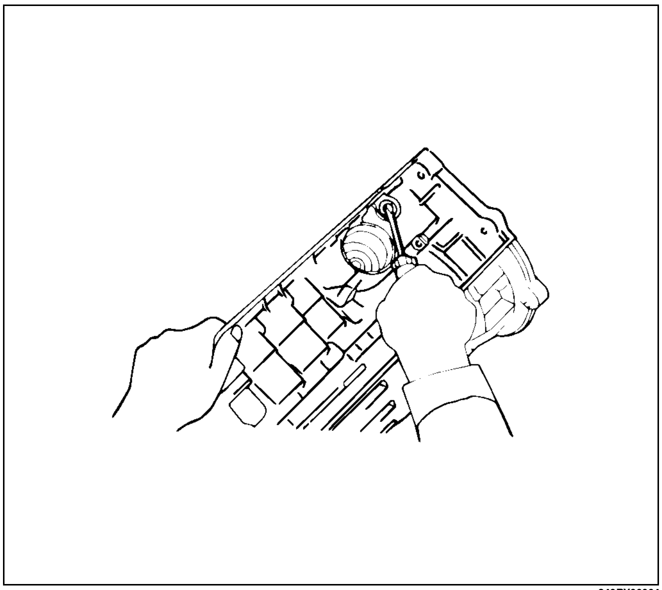
1. Using a chisel, cut off the spacer and remove it from the shaft.



2. Using a punch, drive out the pin.

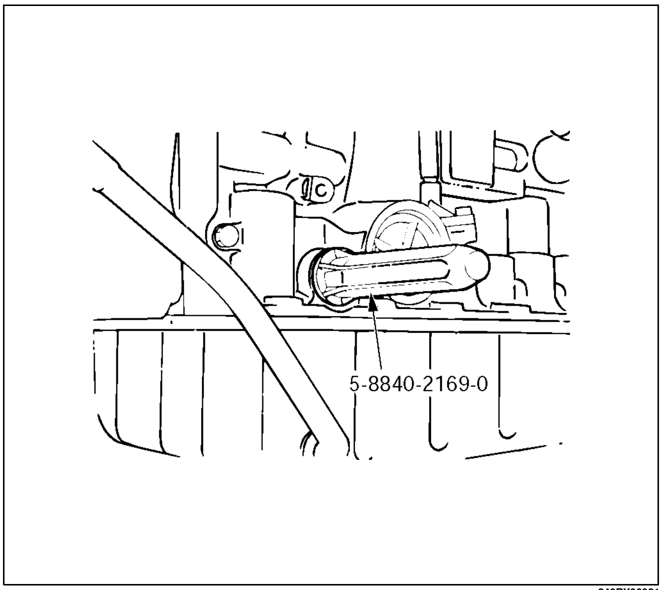

249RY00003

3. Pull the manual valve lever shaft out through the case by the threads.
4. Take out the manual valve lever.
5. Using a screwdriver, remove the oil seals.


249RY00004

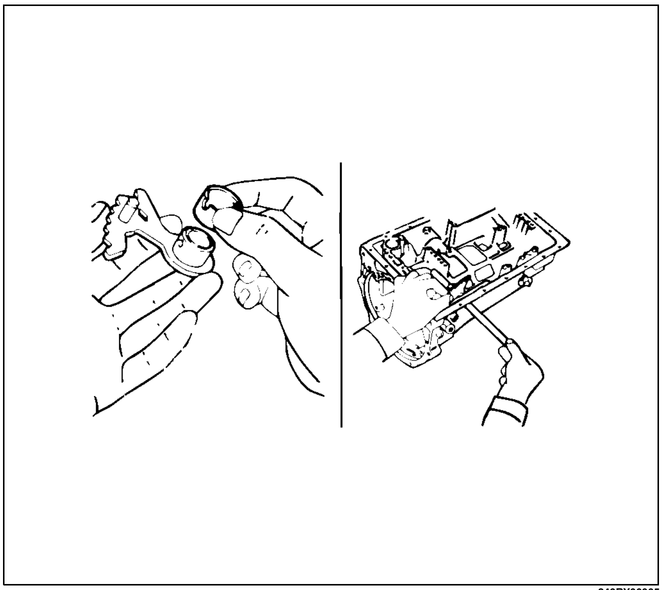
Reassembly

1. Coat a new oil seal lip with multi purpose grease. Using special tool, drive in the oil seal.
   Oil seal installer : 5-8840-2169-0

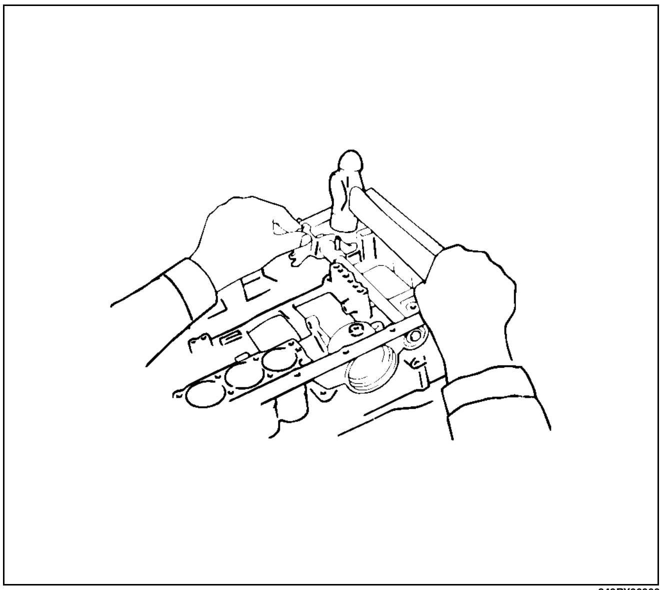


240RY00021

2. Assemble a new spacer to the manual valve lever.
3. Install the manual valve lever shaft to the transmission case through the manual valve lever by the threads.

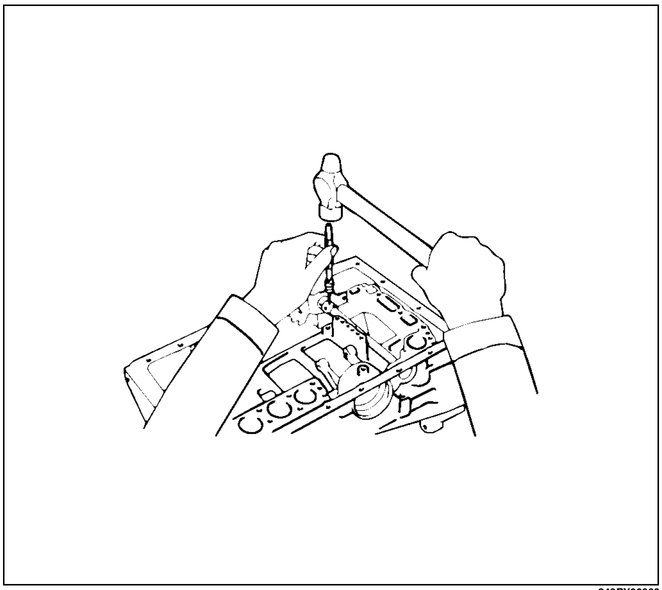

249RY00005

4. Drive in the pin with the slot at a right angle to the shaft.



249RY00006

5. Match the spacer hole to the lever staking hollow and stake the spacer to the lever.
   Make sure the manual valve lever shaft turns smoothly.

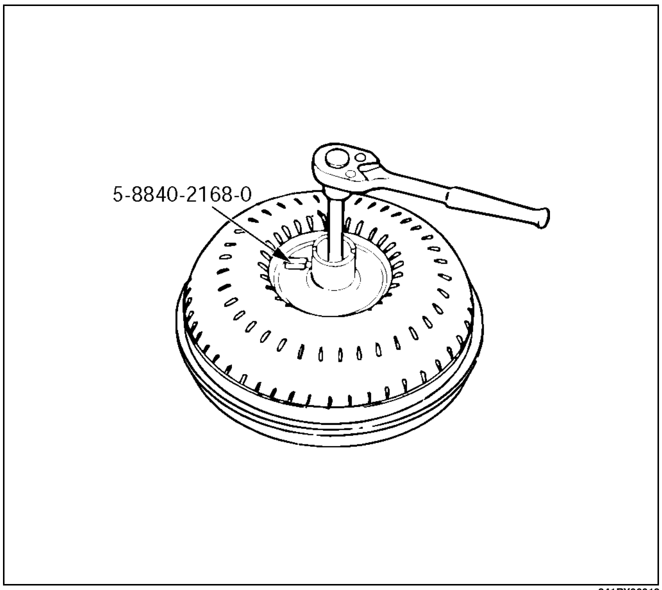


249RY00003

Torque Converter

Inspection and Repair

Insert special tool in end of torque converter.
Insert a turning tool into the inner race of the one-way clutch.
One-way clutch testing tool : 5-8840-2168-0
Insert the stopper so that it fits in the notch of the converter hub and outer race of the one-way clutch.



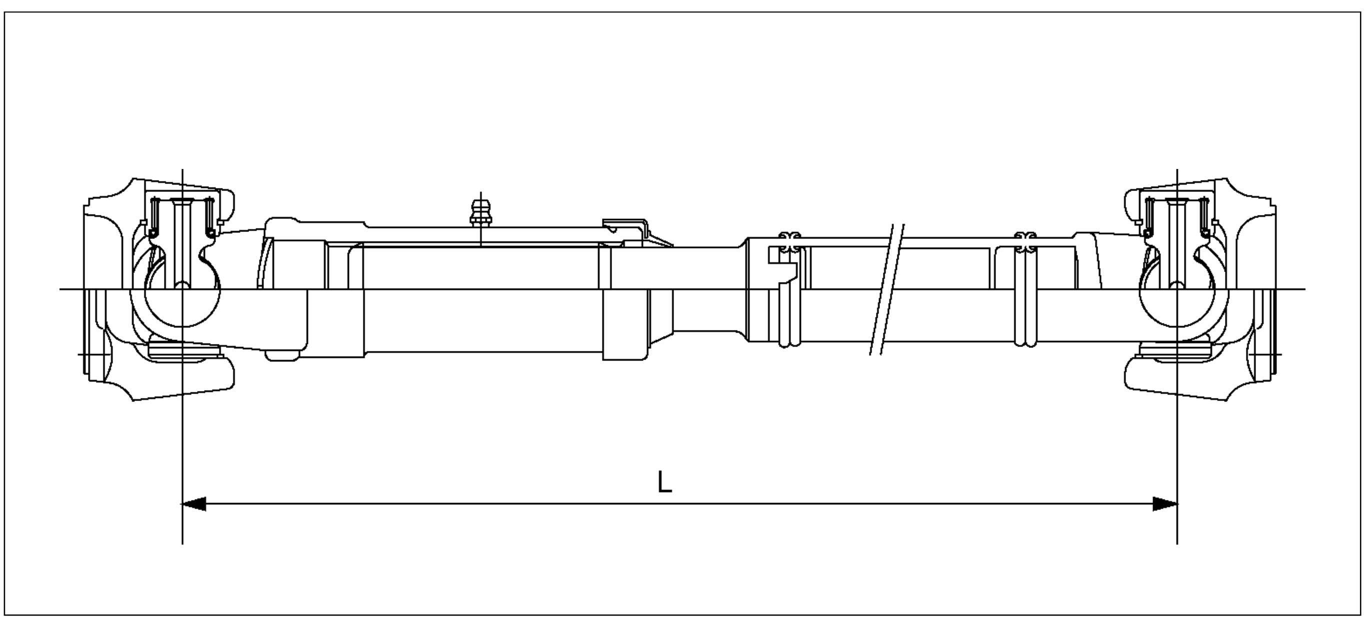
241RY00018

1. One-way clutch test.
   The clutch should lock when turned counterclockwise, and rotate freely and smoothly clockwise. Less than 2.5 N·m (0.25 kgf·m/22 lb·in) of torque should be required to rotate the clutch clockwise. If necessary, clean the converter and retest the clutch. Replace the converter if the clutch still fails the test.

Front Propeller Shaft

		4×4 Model		
Engine Model		4JK1 (Standard Output), 4JJ1 (Standard Output)	4JJ1 (High Output)	4JJ1 (Standard Output), 4JJ1 (High Output)
Transmission Type		5M/T (MUA)	5M/T (MUX)	4A/T
Wheel Base		Long	Long	Long
Outside Diameter	mm	40	40	40
	(in)	(1.57)	(1.57)	(1.57)
Inside Diameter	mm	32	32	32
	(in)	(1.26)	(1.26)	(1.26)
Length (L)	mm	579	618	649
	(in)	(22.80)	(24.33)	(25.55)
Spline Outside Diameter	mm	33	33	33
	(in)	(1.30)	(1.30)	(1.30)
Fix Bolt Size	T/F	M10	M10	M10
	Axle	M10	M10	M10

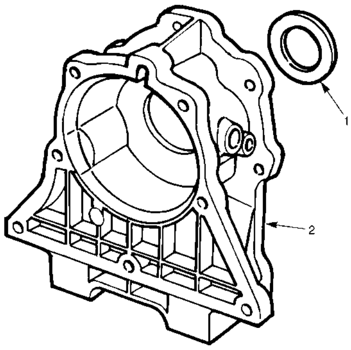
		4×4 Model					
Engine Model		4JA1-T(L)	4JA1-TC	4JH1-TC		C24SE	HFV6
Transmission Type		5M/T (MUA)		5M/T (MUA)	4A/T	5M/T (MUA)	5M/T (AR-5), 4A/T
Wheel Base		Long		Long	Long	Long	Long
Outside Diameter	mm	40		40	40	40	40
	(in)	(1.57)		(1.57)	(1.57)	(1.57)	(1.57)
Inside Diameter	mm	32		32	32	32	32
	(in)	(1.26)		(1.26)	(1.26)	(1.26)	(1.26)
Length (L)	mm	607		607	676	586	596
	(in)	(23.90)		(23.90)	(26.61)	(23.07)	(23.46)
Fix Bolt Size	T/F	M10		M10	M10	M10	M10
	Axle	M10		M10	M10	M10	M10



RUW54ASF000401

Adapter Housing (4 × 4)

Disassembled View



241R200005

Legend

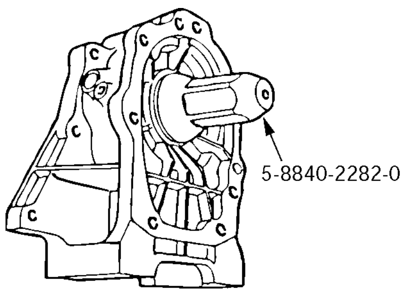
(1) Oil seal
(2) Adapter housing

Disassembly

1. Using a screwdriver, remove the oil seal.

Reassembly

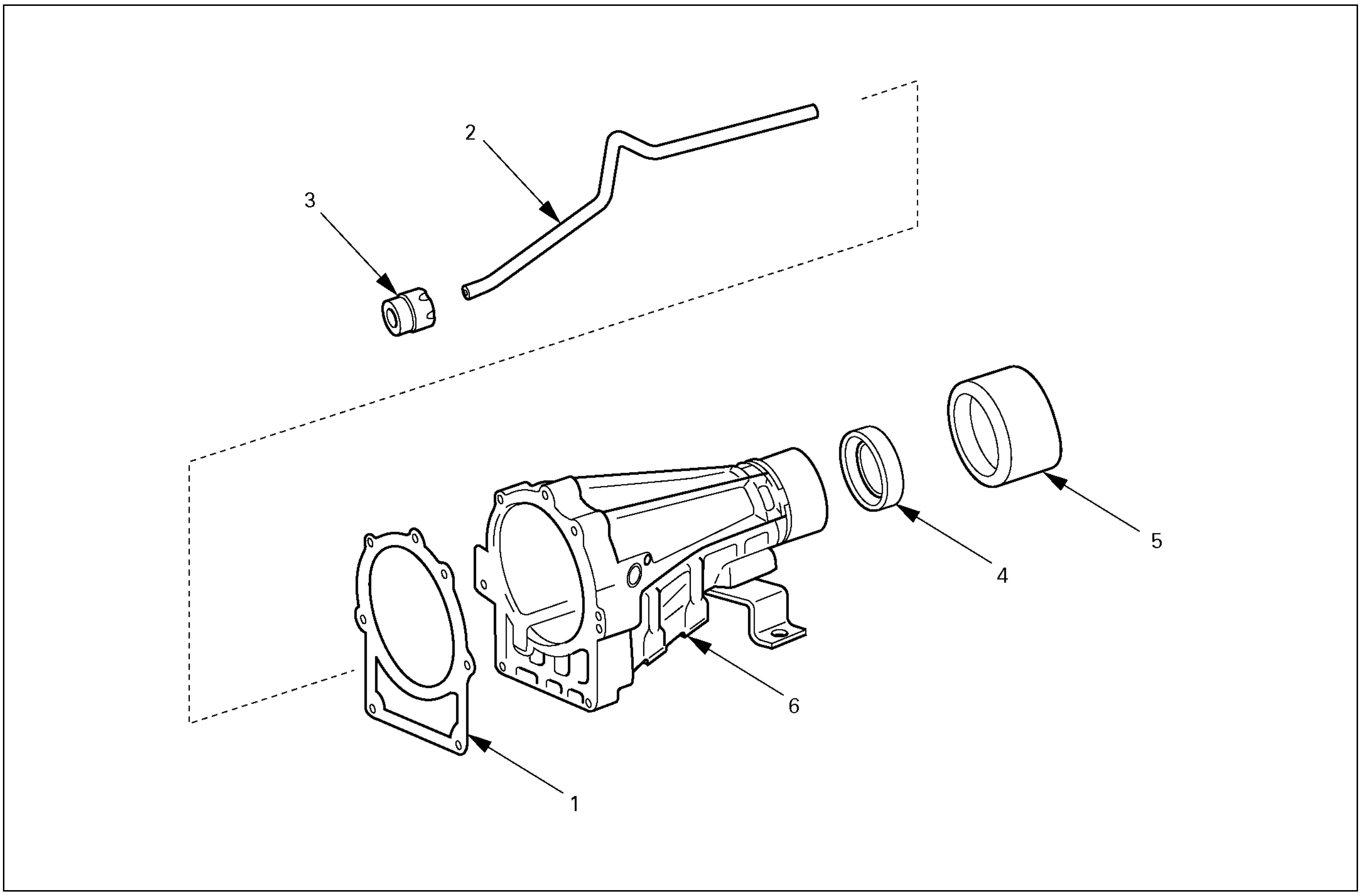
1. Using oil seal installer, install the new oil seal to the adapter housing.
   Oil seal installer : 5-8840-2282-0



240RY00003

Extension Housing (4 × 2)

Disassembled View



241R200007

Legend
- (1) Gasket
- (2) Tube
- (3) Tube packing
- (4) Oil seal
- (5) Dust deflector
- (6) Extension housing

Disassembly

1. Remove the gasket.
2. Remove the tube.
3. Remove the tube packing.
4. Using a screwdriver, remove the oil seal.

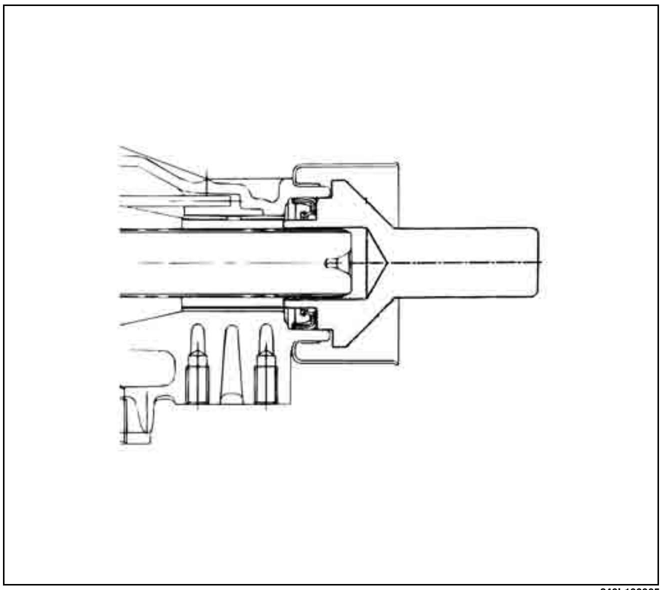
NOTE: The oil seal can be removed without removing the dust deflector.

5. Rrmove the dust deflector from extension housing.

Reassembly

1. Using oil seal installer, install the new oil seal to the extension housing.
   Oil seal installer : 5–8840–2702–0

NOTE: The oil seal can be installed without removing the dust deflector.



249L100005

2. Install the tube.
3. Install the tube packing.
4. Install the dust deflector.
5. Install the gasket.

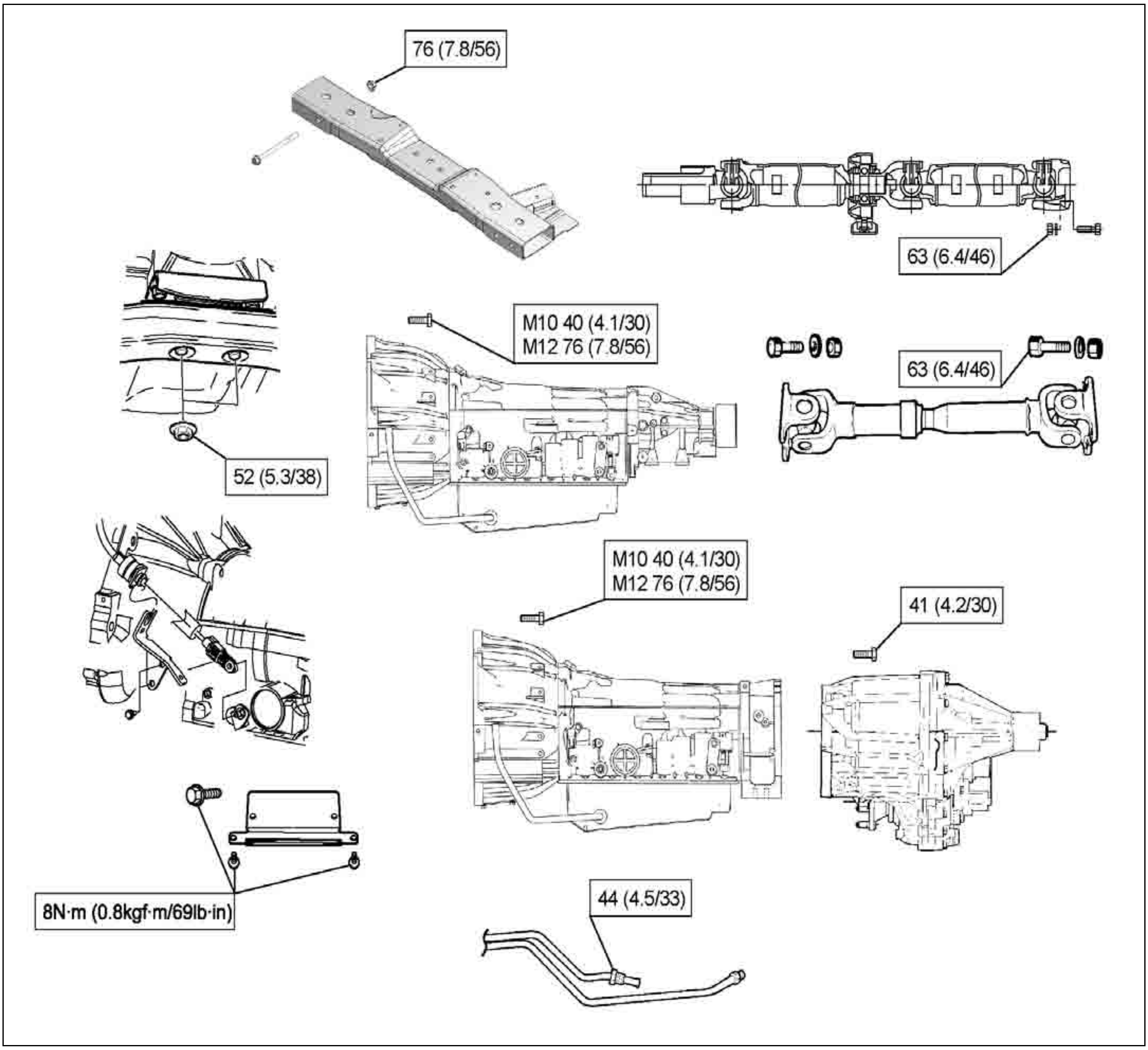
Main Data and Specifications

General Specifications

<table>
<tr><th colspan="4"></th><th></th><th>Remaks</th></tr>
<tr><td colspan="4">Model</td><td>AW30–40LE</td><td rowspan="12"></td></tr>
<tr><td colspan="4">Engine</td><td>4JJ1-TC High Output (3.0L)</td></tr>
<tr><td colspan="4" rowspan="2">Type</td><td>Electronic control planetary gear type</td></tr>
<tr><td>3–element 1–stage 2–phase type
(with lock-up mechanism)</td></tr>
<tr><td rowspan="5">Gear ratio</td><td colspan="3">1st</td><td>2.804</td></tr>
<tr><td colspan="3">2nd</td><td>1.532</td></tr>
<tr><td colspan="3">3rd</td><td>1.000</td></tr>
<tr><td colspan="3">4th (O/D)</td><td>0.705</td></tr>
<tr><td colspan="3">Reverse</td><td>2.394</td></tr>
<tr><td rowspan="2">Oil used</td><td colspan="3">Name</td><td>Exxon Mobil ATF-3309</td></tr>
<tr><td colspan="3">Q'ty (l)</td><td>8.7</td></tr>
<tr><td colspan="4">Torque converter</td><td>2300 ± 200</td><td>Stall speed (rpm)</td></tr>
<tr><td colspan="6">Friction element</td></tr>
<tr><td rowspan="7"></td><td colspan="2">Forward clutch</td><td>C–1</td><td>6</td><td rowspan="3">Number of discs</td></tr>
<tr><td colspan="2">Direct clutch</td><td>C–2</td><td>5</td></tr>
<tr><td colspan="2">OD direct clutch</td><td>C–0</td><td>3</td></tr>
<tr><td colspan="2">Second coast brake</td><td>B–1</td><td>40mm</td><td>Band width or Number of discs</td></tr>
<tr><td colspan="2">Second brake</td><td>B–2</td><td>5</td><td rowspan="3">Number of discs</td></tr>
<tr><td colspan="2">First and reverse brake</td><td>B–3</td><td>7</td></tr>
<tr><td colspan="2">Overdrive brake</td><td>B–0</td><td>5</td></tr>
<tr><td colspan="6">Clutch</td></tr>
<tr><td rowspan="3"></td><td colspan="2">One-way clutch No.1</td><td>F–1</td><td>22</td><td rowspan="3">Number of sprage</td></tr>
<tr><td colspan="2">One-way clutch No.2</td><td>F–2</td><td>28</td></tr>
<tr><td colspan="2">OD one-way clutch</td><td>F–0</td><td>24</td></tr>
<tr><td colspan="6">Planetary gear</td></tr>
<tr><td rowspan="9"></td><td rowspan="3">Front planetary</td><td colspan="2">Sun gear</td><td>42</td><td rowspan="9">Number of teeth</td></tr>
<tr><td colspan="2">Pinion gear</td><td>19</td></tr>
<tr><td colspan="2">Ring gear</td><td>79</td></tr>
<tr><td rowspan="3">Rear planetary</td><td colspan="2">Sun gear</td><td>33</td></tr>
<tr><td colspan="2">Pinion gear</td><td>23</td></tr>
<tr><td colspan="2">Ring gear</td><td>79</td></tr>
<tr><td rowspan="3">O/D planetary</td><td colspan="2">Sun gear</td><td>33</td></tr>
<tr><td colspan="2">Pinion gear</td><td>23</td></tr>
<tr><td colspan="2">Ring gear</td><td>79</td></tr>
</table>

Torque Specifications

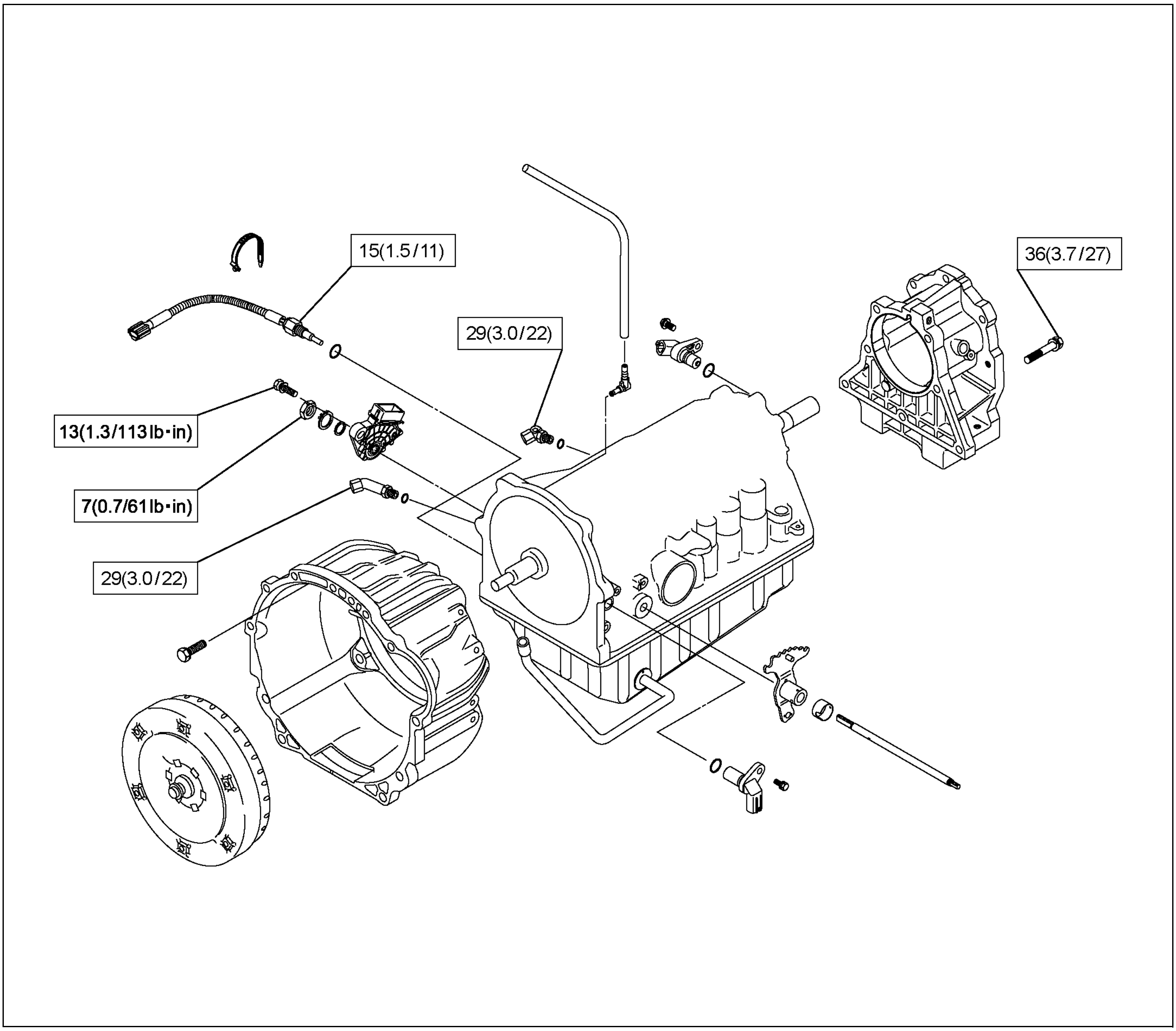
N·m (kgf·m/lb·ft)



RTW77ALF001901

Torque Specifications (Cont'd)

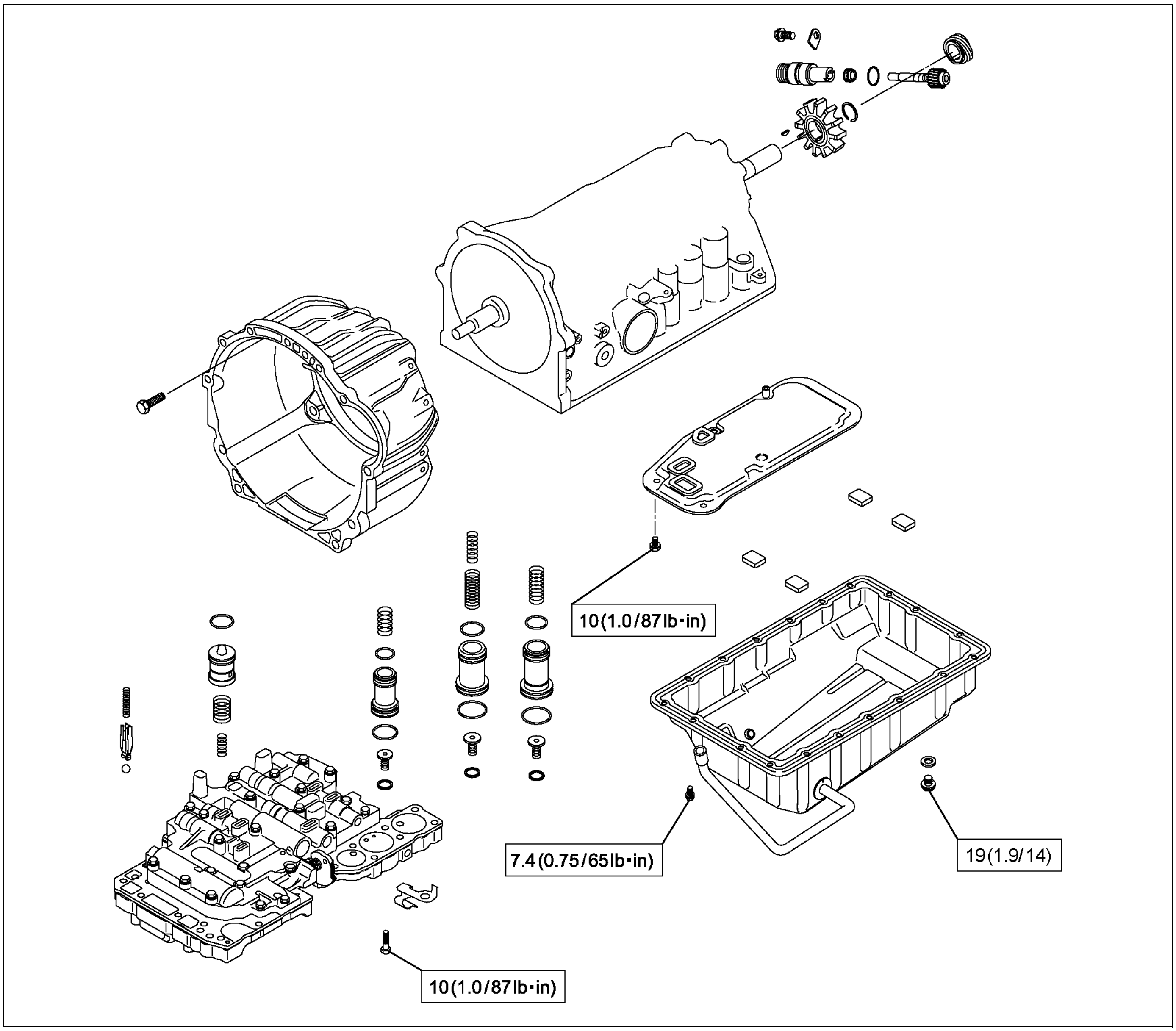
N·m (kgf·m/lb·ft)



RTW77ALF002201

Torque Specifications (Cont'd)

N·m (kgf·m/lb·ft)



Special Tools

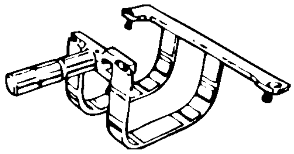
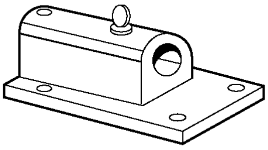
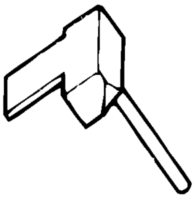
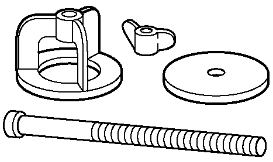
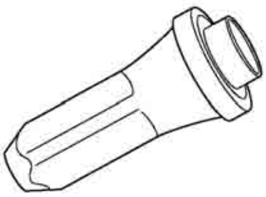
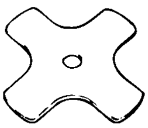
ILLUSTRATION	TOOL NO. TOOL NAME
	5-8840-2152-0 (J–37227) Holding fixture
	5-8840-0003-0 (J–3289–20) Holding fixture base
	5-8840-2153-0 (J–37228) Oil pan seal cutter
	5-8840-0195-0 (J–23327–1) Spring compressor
	5-8840-2256-0 (J–9617) Oil seal installer; oil pump
	5-8840-2170-0 (J–37233) Spring compressor; OD brake piston

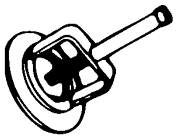
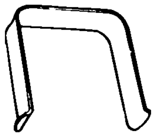
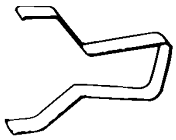
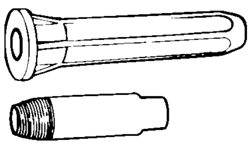
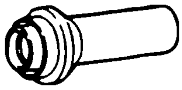
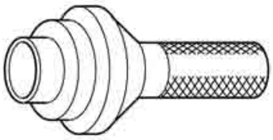
ILLUSTRATION	TOOL NO. TOOL NAME
	5-8840-0093-0 (J–29770–A) Oil pressure gauge
	5-8840-0254-0 (J–25048) Spring compressor
	5-8840-2173-0 (J–37236) Reaction sleeve puller; first and reverse brake
	5-8840-2174-0 (J–37237) Piston puller; first and reverse brake
	5-8840-2169-0 (J–37232–2) Oil seal installer; manual valve shaft seal installer & remover
	5-8840-2168-0 (J–35467) Onennway clutch testing tool; torque converter

ILLUSTRATION	TOOL NO. TOOL NAME
	5-8840-2282-0 (J–36797) Oil seal installer; adapter housing (4 × 4)
	5-8840-2702-0 (J–46197) Oil seal installer; extension housing (4 × 2)

SECTION 7

TRANSMISSION

JR405E MODEL

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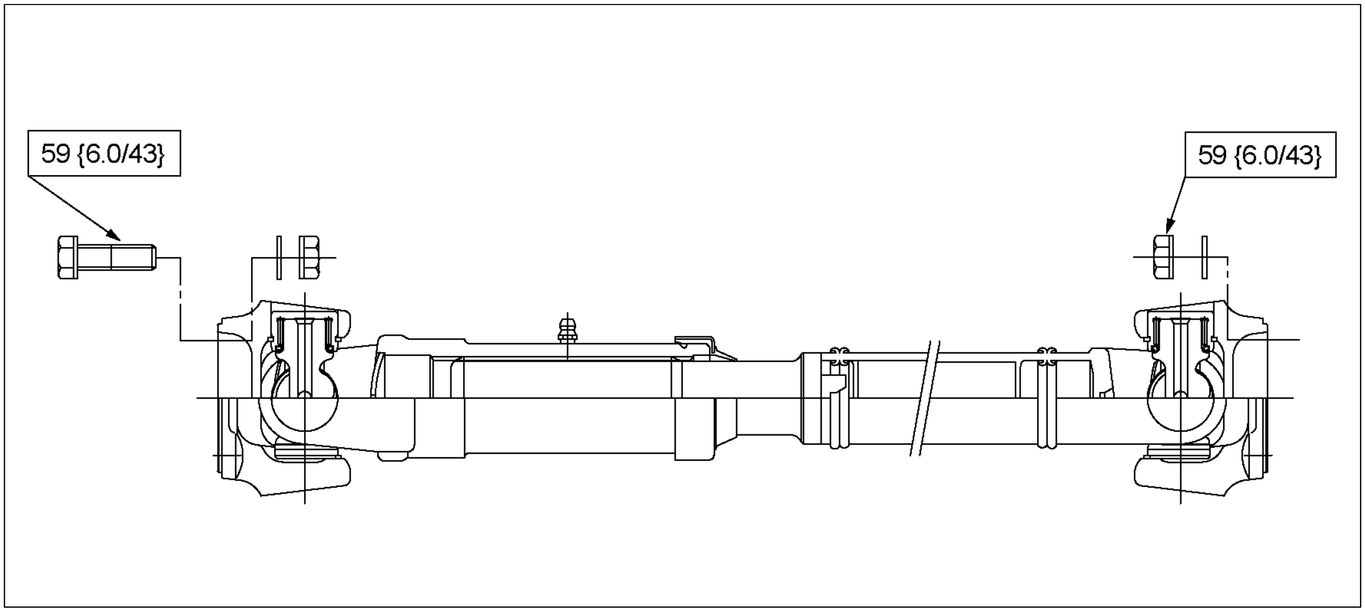
Torque Specifications

N·m (kgf·m/lb·ft)



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SECTION 7A1

CONSTRUCTION AND FUNCTION (JR405E)

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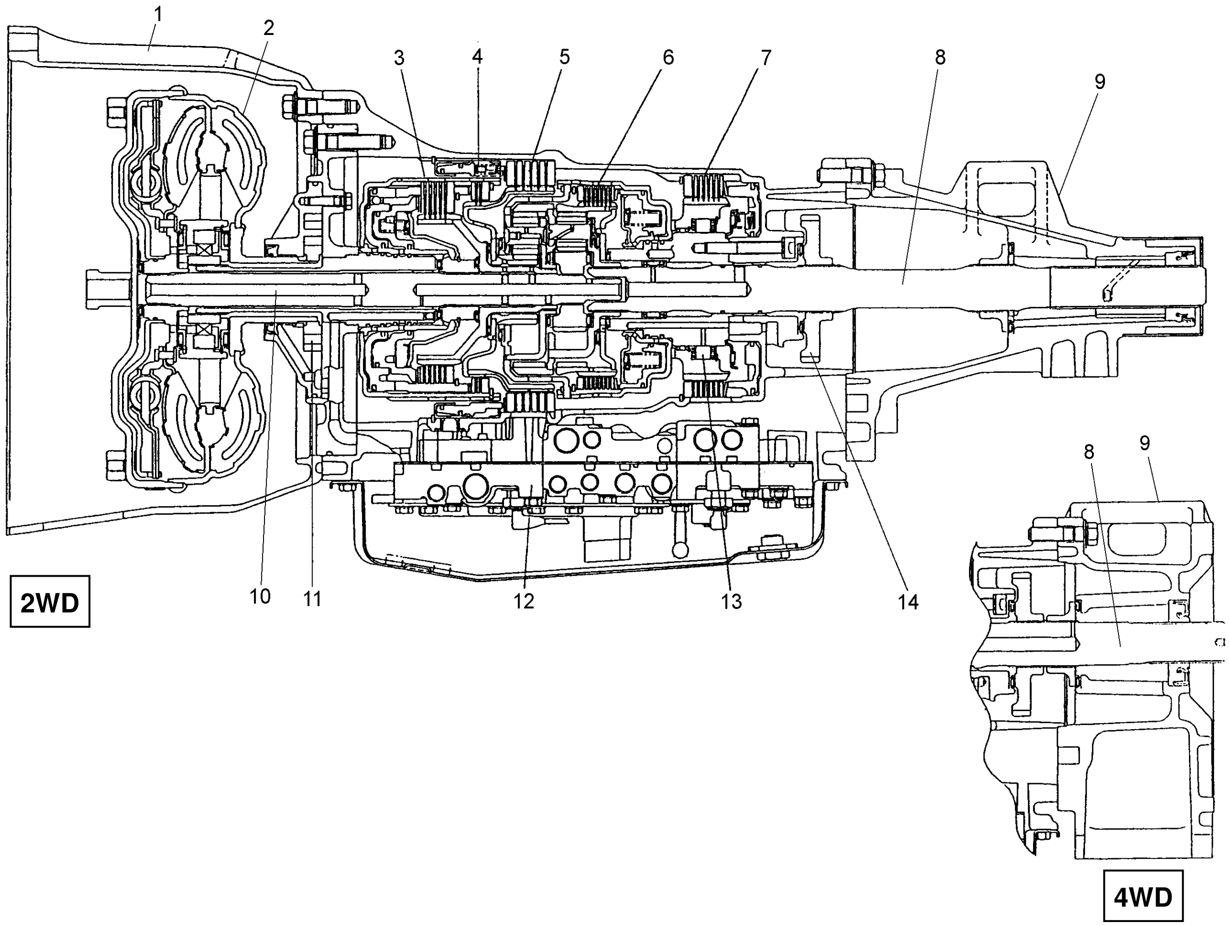
DESCRIPTION

CONSTRUCTION



1	Converter Housing	6	Low Clutch	11	Oil Pump
2	Torque Converter	7	Low & Reverse Brake	12	Control Valve
3	High Clutch	8	Output Shaft	13	Low One-way Clutch
4	Reverse Clutch	9	Extension Housing	14	Parking Gear
5	2-4 Brake	10	Input Shaft		

Figure 1. Construction of Automatic Transmission

The JR405E automatic transmission is electrically controlled by a microcomputer transmission control module (TCM). There are four forward speeds and one reverse speed.
This JR405E automatic transmission employs a clutch pressure direct control system (Direct Electronic Shift Control: DESC) using duty cycle type solenoids, which ensure high shift quality.
This transmission also has a learning function and constantly checks the time of each clutch and brake required for the shift in order to match this time with the target value for the optimum shift.

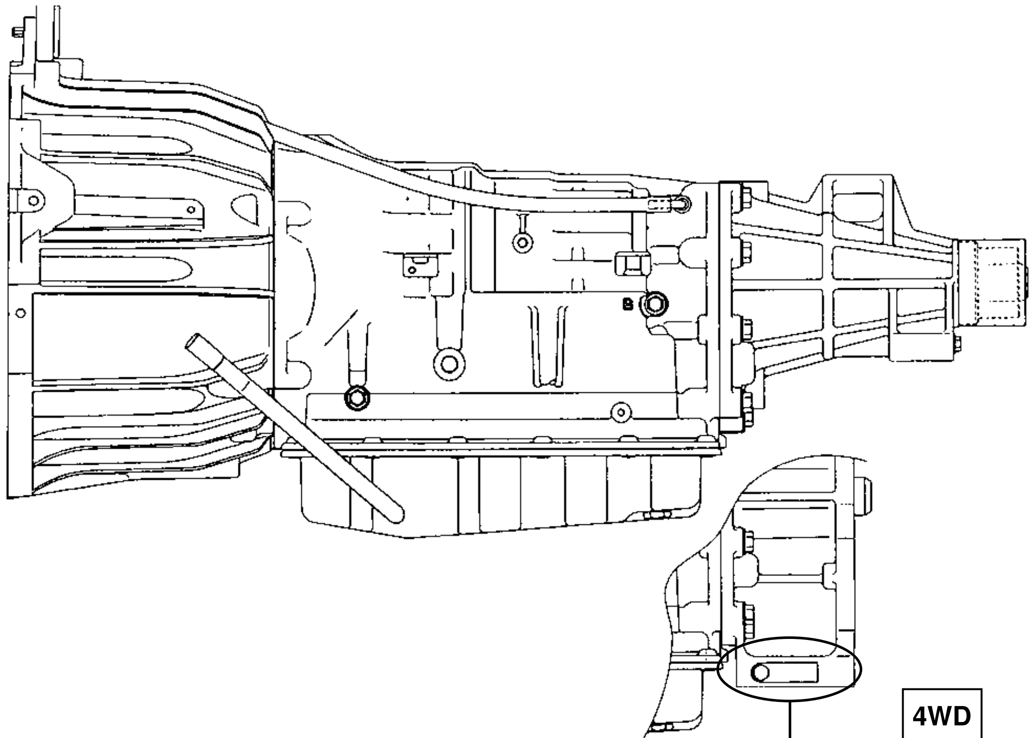
The TCM will automatically select the most appropriate shift points and lock-up points depending on the Accelerator pedal opening, the vehicle speed and the vehicle load.
If any trouble arises in the speed sensor, APP sensor, solenoid, etc., the fail-safe control function is activated to keep the running performance.
Problems with the sensors or the solenoids can quickly be detected with the self diagnosis procedure described in this manual.

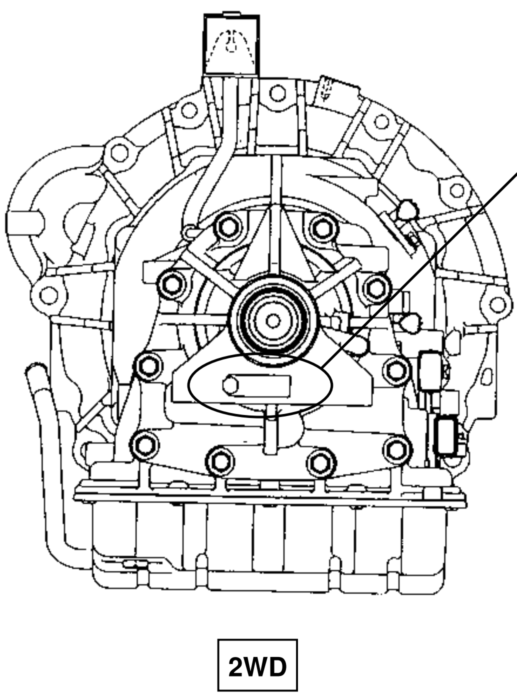
The JR405E automatic transmission consists of the torque converter, oil pump, input shaft, out put shaft, planetary gears and control valves.
The gear train consists of two planetary gear sets and three multiple plate clutches in combination with two multiple plate brakes and a one-way clutch.

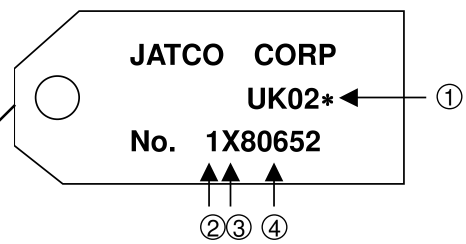
MAIN DATA AND SPECIFICATION

Model			JR405E	
Torque Converter Type			Three-Elements, One-Stage & Two-Phases Type With Lock-up Function	
Torque Converter Stall Torque Ratio			1.8	
ATF	Name		ATF DEXRON III	
	Quantity L (US gal/Imp gal)		9.2-9.6 (2.43-2.54/2.02-2.11)	
	Cooling System		Water Cooled Type (Radiator)	
Gear Ratio	1st		2.785	
	2nd		1.545	
	3rd		1.000	
	4th (Over Drive)		0.694	
	Reverse		2.272	
Clutch	Low Clutch	L/C	7	Number of Discs
	High Clutch	H/C	5	
	Reverse Clutch	R/C	2	
	Low One-way Clutch	L/O.C	1	Set
Brake	Low & Reverse Brake	L&R/B	6	Number of Discs
	2-4 Brake	2-4/B	5	
Planetary Gear Unit	Front Planetary	Sun Gear	33	Number of Teeth
		Pinion Gear	21	
		Ring Gear	75	
	Rear Planetary	Sun Gear	42	
		Pinion Gear	17	
		Ring Gear	75	

NUMBER PLATE LOCATION







①→UK000 UK020 = 2WD
UK021 = 4WD

②→1 Production Year
1=2001
2=2002
3=2003
4=2004
5=2005
6=2006
7=2007

③→X Product Month
1～9=January～September
X=October
Y=November
Z=December

④→80652 Production Sequence Number

Serial Number Location
2WD:Back of the transmission rear mounting
4WD:Left side of the transmission rear mounting

Figure 2. Number Plate Location

ELECTRONIC CONTROL COMPONENTS LOCATION

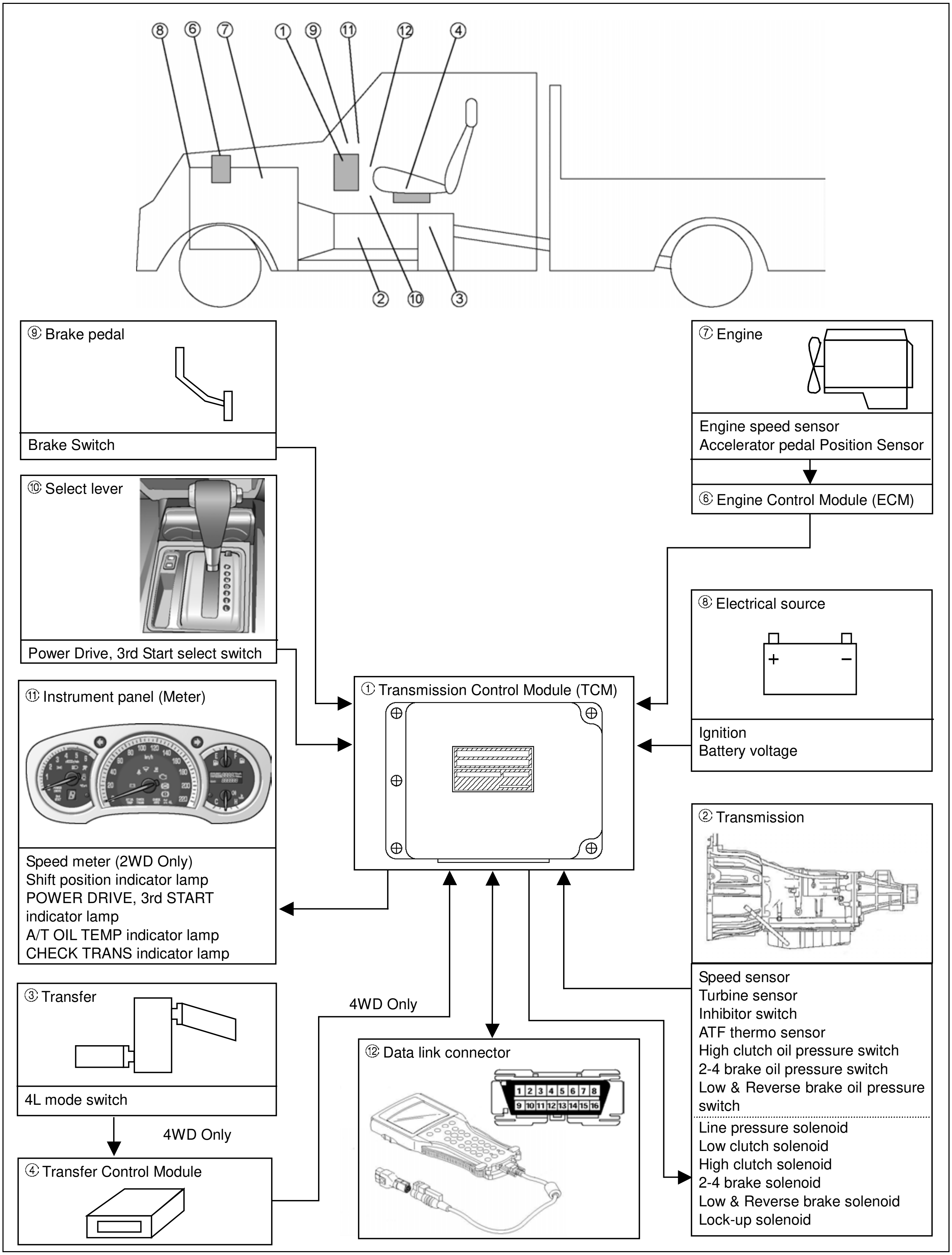


Figure 3. Electronic Control Components Location

TRANSMISSION CONTROL MODULE (TCM) PERIPHERAL CIRCUIT

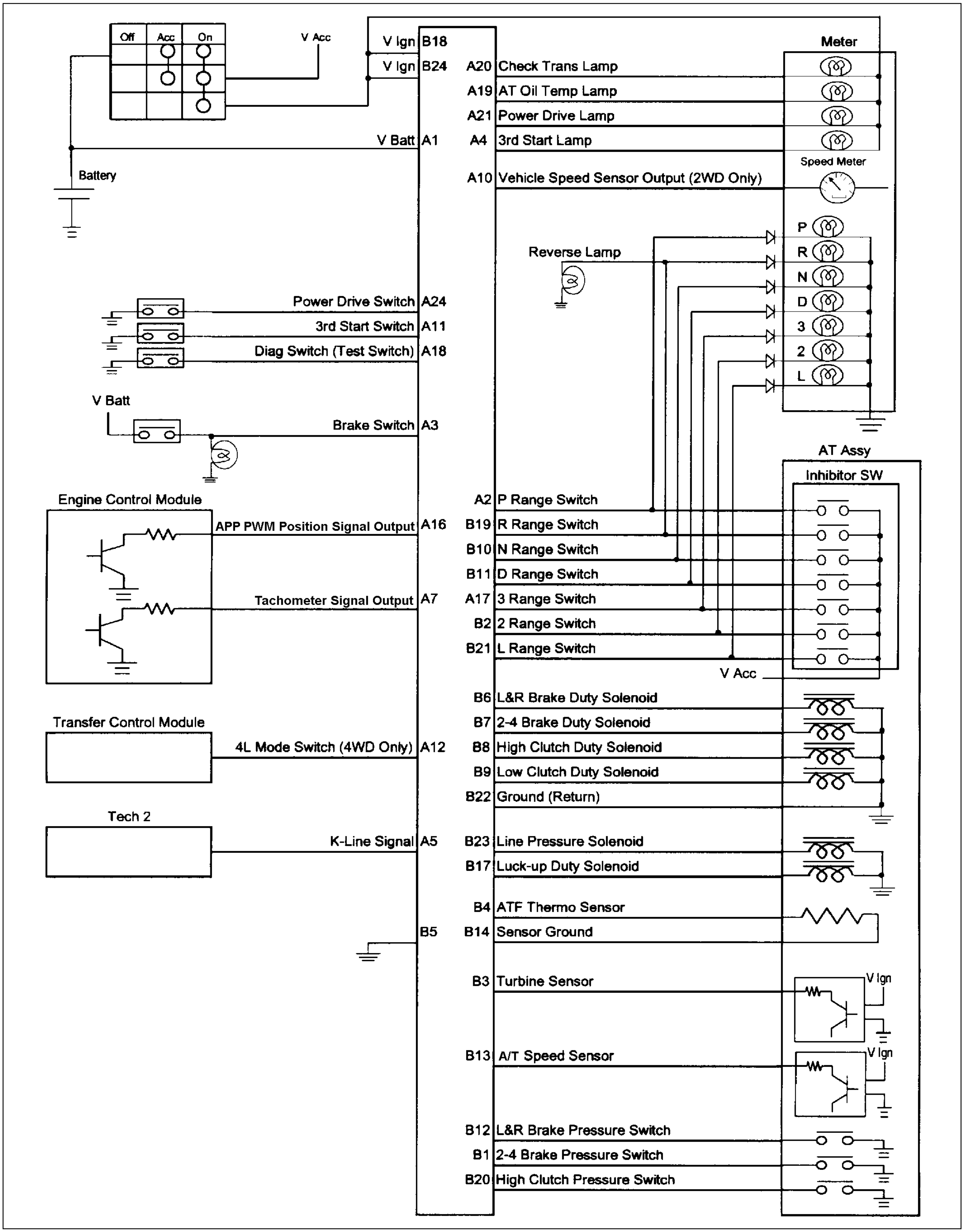
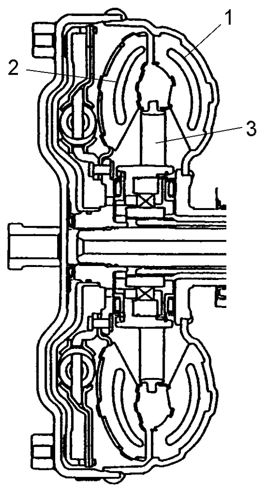


Figure 4. TCM Peripheral Circuit

STRUCTURE AND FUNCTION OF COMPONENT

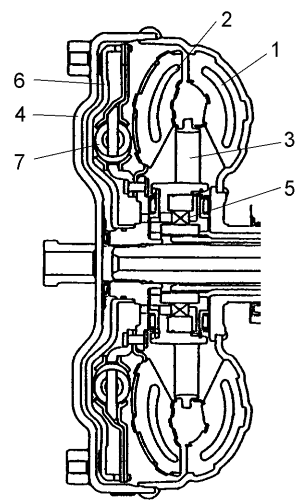
TORQUE CONVERTER (WITH LOCK-UP FUNCTION)

- The torque converter is a device for transmitting the engine torque to the transmission. It transmits power by means of oil when the lock-up clutch is disengaged, and by means of a lock-up clutch when it is engaged.
- The torque converter is of the symmetrical, three-element, single-stage, two-phase type.
- As shown in the drawing, the symmetrical three-elements refer to three elements (components) consisting of impeller (1), turbine (2) and stator (3) that are arranged symmetrically (figure 5).
- "Single-stage" means that there is only one turbine as an output element; "two-phase" means that the pump impeller acts as a torque converter when the turbine speed is comparatively low, and as a fluid coupling when the speed is high.



1. Pump Impeller
2. Turbine Runner
3. Stator

Figure 5. Torque Converter



1. Pump Impeller
2. Turbine Runner
3. Stator
4. Converter Cover
5. One-way Clutch
6. Lock-up Piston
7. Torsion Damper

Figure 6. Construction of Torque Converter

Lock-up mechanism

- "Lock-up" refers to a fixed state of the lock-up clutch inside the torque converter and thus connects the engine directly to the transmission.
- The hydraulic pressure for the lock-up control is supplied from two circuits.

When the lock-up clutch is disengaged (Figure 7)

- When the lock-up is disengaged, the torque converter operating pressure is supplied from the oil passage (A) to between the cover and the lock-up piston, and separates the lock-up piston clutch facing and converter cover.
- As a result, the engine drive power is transmitted from the converter cover to the pump impeller, to the ATF and to the turbine. The torque converter functions as a fluid connector in this condition.
- The torque converter operating pressure is supplied from oil passage (A), and passes through oil passage (B).

When the lock-up clutch is engaged (Figure 8)

- When the lock-up is engaged, the torque converter operating pressure is supplied from oil passage (B) to the oil pump impeller, the turbine, and then to the stator side. The oil between the lock-up piston and converter cover is drained.
- Since the force acting on the right side of the lock-up piston is greater than the force on the left side, it connects the lock-up piston clutch facing with the converter cover, thereby increasing the transmission efficiency.

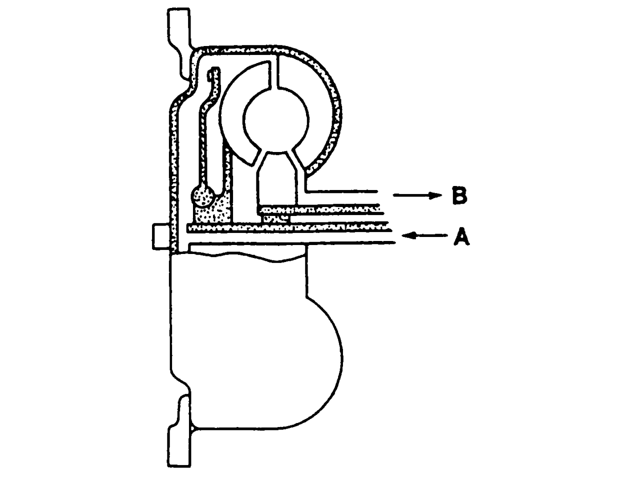


Figure 7. Lock-up Control (Disengaged)

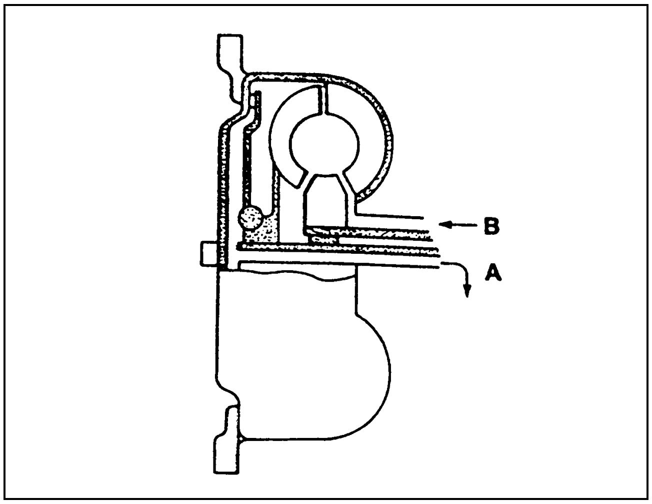


Figure 8. Lock-up Control (Engaged)

OIL PUMP

- The oil pump generating oil pressure is a small-size trochoid gear type oil pump. It feeds oil to the torque converter, lubricates the power train mechanism, and feeds the oil pressure to the oil pressure control unit under pressure.
- The oil pump is located behind the torque converter. Since the inner rotor in the oil pump is fitted with the drive sleeve of the torque converter, it works using power from the engine.

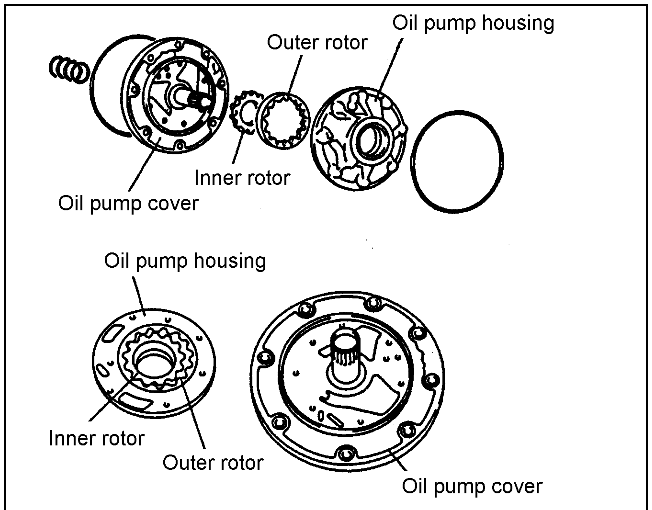


Figure 9. Construction of Oil Pump

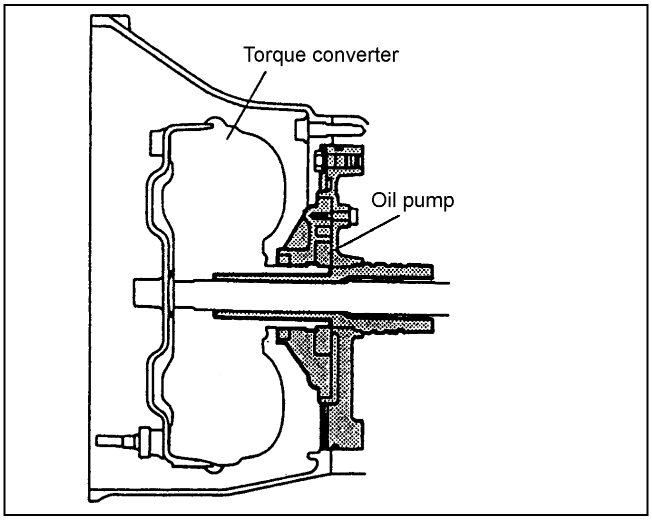


Figure 10. Location of Oil Pump

- When the inner rotor in the oil pump rotates, ATF is sucked in from the oil pan, passed between the inner rotor, outer rotor and crescent, and then discharged. This discharged pressure is sent to the pressure regulator valve in the control valve, and adjusted as required for operating the A/T. The flow rate under pressure increases or decreases in proportion to the number of rotations.

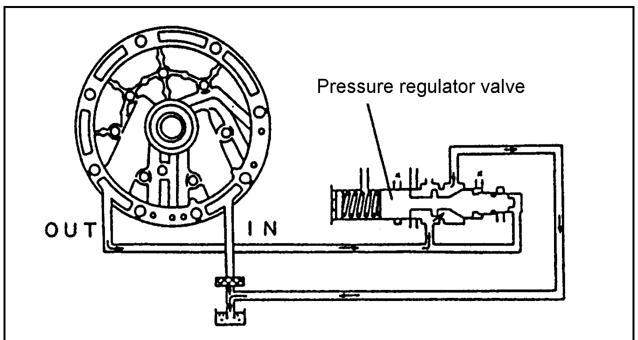


Figure 11. Operation of Oil Pump

INPUT SHAFT

- The input shaft has some oil holes, through which lubricating ATF is supplied to the torque converter, the bearings, etc.
- The input shaft is fitted to the turbine runner in the torque converter, the reverse & high clutch drum and the rear sun gear by means of the spline. Therefore, the engine driving force received by the torque converter is transmitted to the reverse & high clutch drum and rear sun gear.

OUTPUT SHAFT

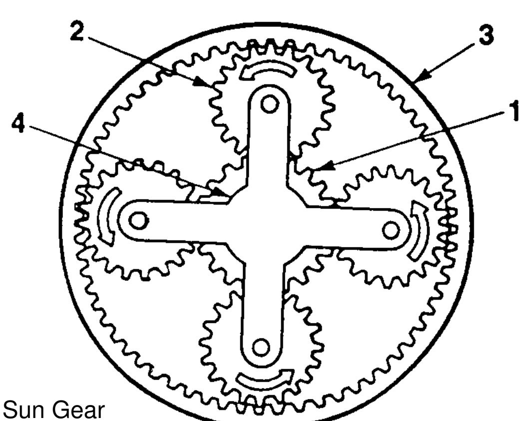
- The output shaft has some oil holes, through which the lubricating ATF is supplied to the bearings, the planetary gear unit, etc.
- The output shaft transmits the engine driving force from the planetary gear to the propeller shaft.
- The front internal gear is fitted with the rear carrier assembly by spline. The parking gear is also fitted by spline. By fixing this gear mechanically, the output shaft is fixed as required when parking the vehicle.

GEAR SHIFTING MECHANISM

- The JR405E consists of two sets of planetary gears, three multiple plate clutches, two multiple plate brakes and a one-way clutch. They are activated in different combinations in any of four forward and one reverse gear positions.

Principle of gear shifting (Figure 12)

- Planetary gears have the advantage of a compact configuration because of the way they are constructed with a single central shaft.
- Also, unlike the manual transmission gears that require changing of the gear mesh, the gear ratio of the planetary gears can be changed more easily by locking, releasing or rotating only some of their parts.
- A planetary gear is made up of a sun gear (1) at its center, and pinion gears (2) each of which rotates about its own center and around the sun gear, as shown. They are all contained within the internal gear (3).
- Also, since the pinion gears are further supported by the planetary carrier (4), they rotate as a unit in the same direction, and at the same rate.
- As shown below, each planetary gear is constructed of three elements; a sun gear, pinion gears, an internal gear and a planetary carrier. Gear shifting is achieved by conditioning two of the three elements, namely the sun gear, the internal gear and planetary carrier.
- The planetary gears are locked by the clutch, brake and one-way clutch according to the gear shifting.



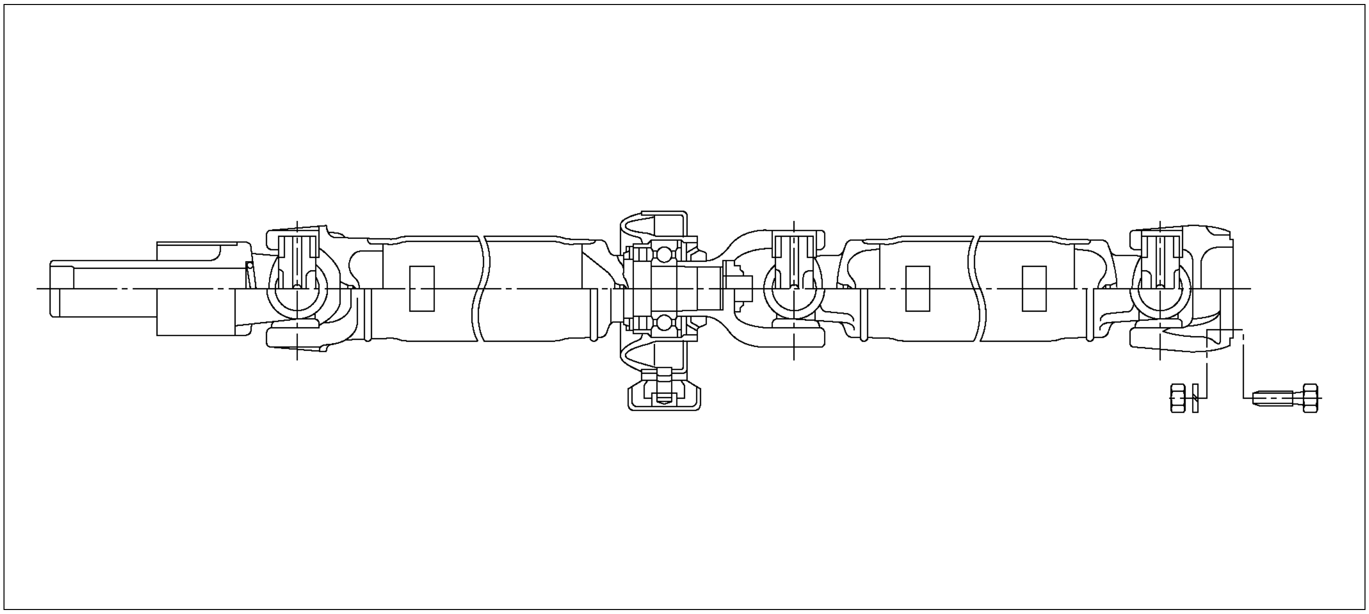
1. Sun Gear
2. Pinion Gear
3. Internal Gear
4. Planetary Carrier

Figure 12. Planetary Gear

Rear Propeller Shaft

General Description

4×2 (Except High Ride Suspension) Model



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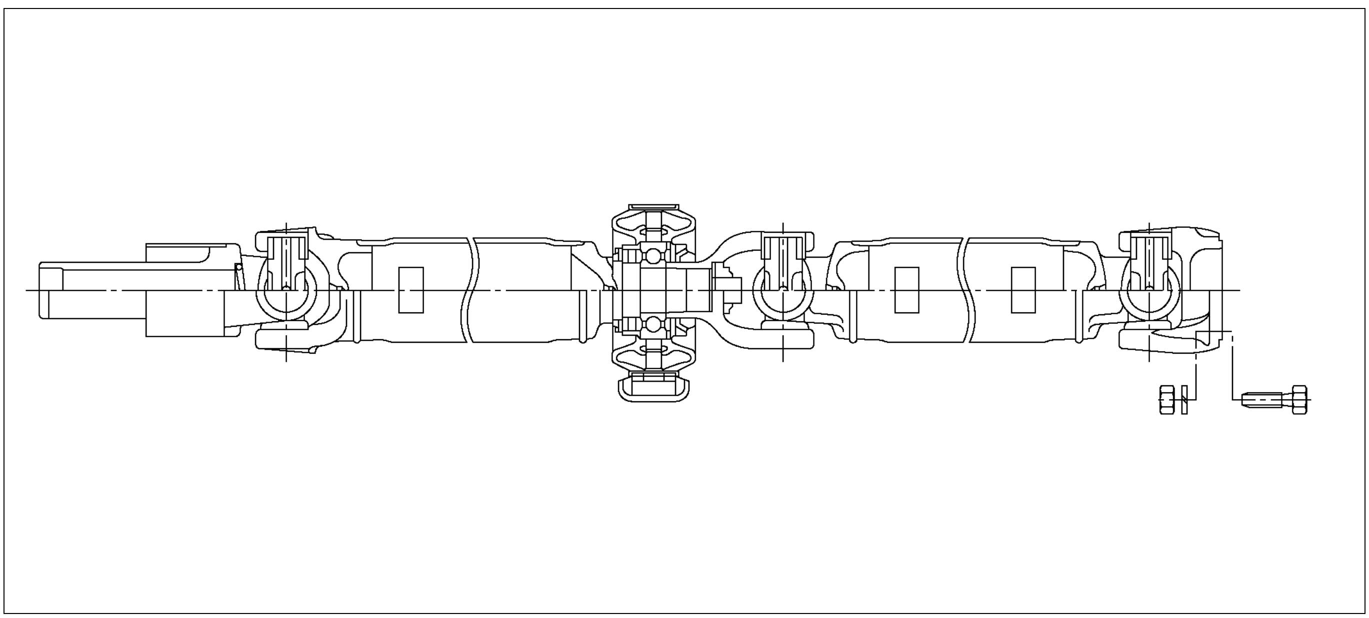
4×2 (High Ride Suspension), 4×4 Model



401R300007

- The JR405E consists of two sets of planetary gears, which are called front planetary gear and rear planetary gear.
- The sun gear of the front planetary gear is fixed to the drive plates of 2-4 brake and reverse clutch.
- The planetary carrier of the front planetary gear is fixed to the drum of the low clutch, the drive plates of the low & reverse brake, and the hub of the high clutch.
- The internal gear of the front planetary gear, and the planetary carrier of the rear planetary gear, are connected as one and fixed to the output shaft.
- The sun gear of the rear planetary gear is fixed to the input shaft.
- The internal gear of the rear planetary gear is fixed to the hub of the low clutch.

Clutch and Brake

- Basic structure of the clutch and brake is shown in the figures below.
- In the figure A, the clutch plates (drive plate and driven plate) are released so that they slip against each other, transmitting no power.
- Figure B shows the condition where the oil pressure is acting on the piston. The clutch plates are fitted to each other under pressure, transmitting the rotations of the clutch drum to the clutch hub.
- When the oil pressure is removed from the piston, the clutch returns to the condition in figure A via the return spring.

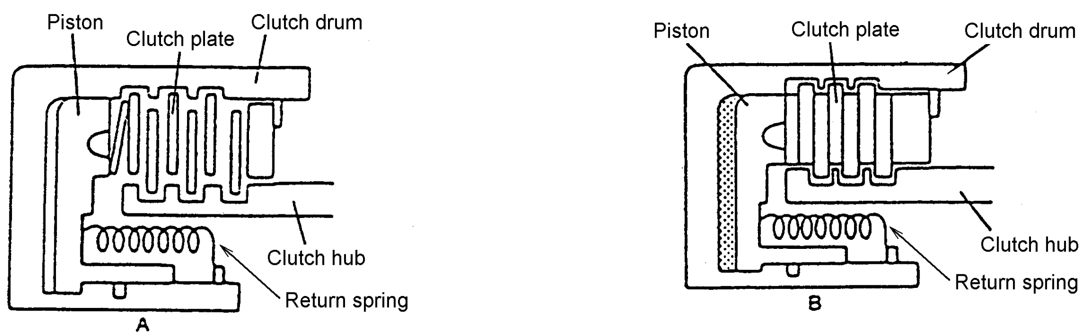


Figure 13. Basic Construction of Clutch and Brake

Low Clutch, High Clutch and Reverse Clutch (Multi-Plate Clutch)

- The multi-plate clutch is composed of drive plates and driven plates. By applying the oil pressure onto the end surface of the plates, the clutch is engaged. The oil pressure is adjusted with the control valve according to the signal from the TCM.
- All clutches use dish plates to prevent uncontrolled operation of the clutches when engaged, causing a shock.
- For the reverse clutch, a piston check ball is used to release the oil pressure. This prevents clutch drag caused by oil pressure generated by residual ATF due to the centrifugal force while the clutch is racing (under no oil pressure).
- For the low clutch and high clutch, a centrifugal balance chamber full of ATF is provided to offset the excessive oil pressure. This prevents clutch drag caused by oil pressure generated by residual ATF due to the centrifugal force while the clutch is racing (under no oil pressure).
- The solenoid in the control valve is driven based on the shift signal from TCM, it moves the shift valve, thereby engaging the drive plate and driven plate through the piston of each clutch.
- As a result, elements of the planetary gear unit are combined.
- When the oil pressure is removed, the piston returns to the original position via the force of the return spring.

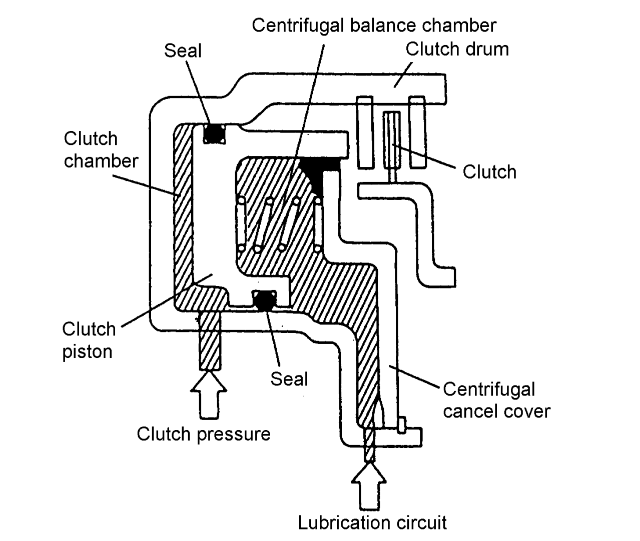


Figure 14. Basic Construction of Low Clutch and High Clutch

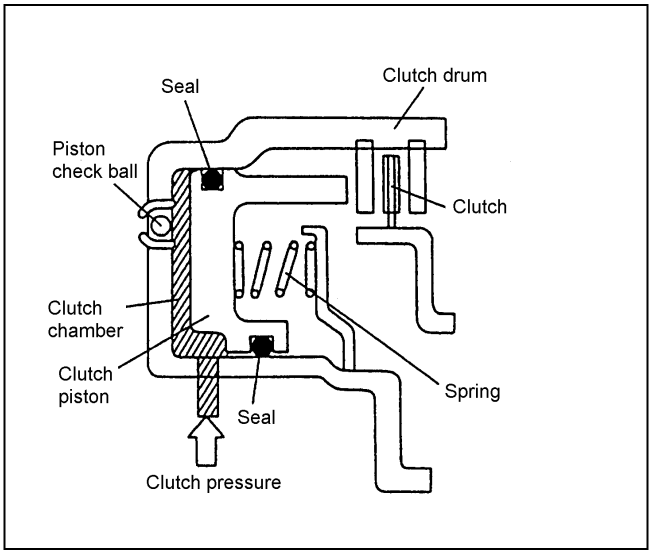


Figure 15. Basic Construction of Reverse Clutch

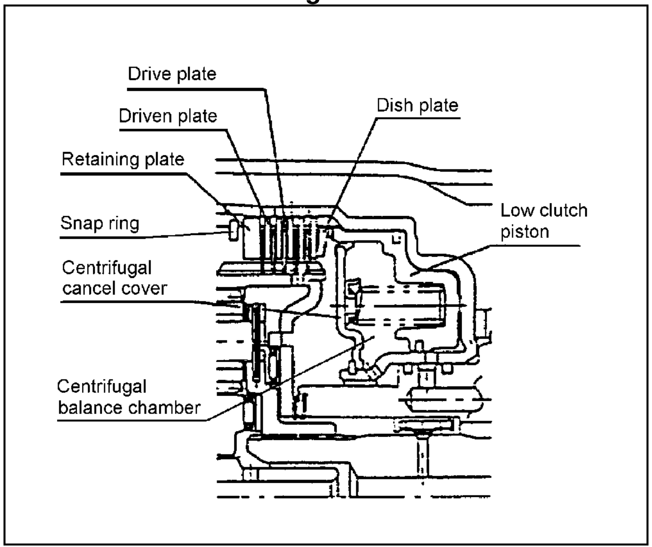


Figure 16. Construction of Low Clutch

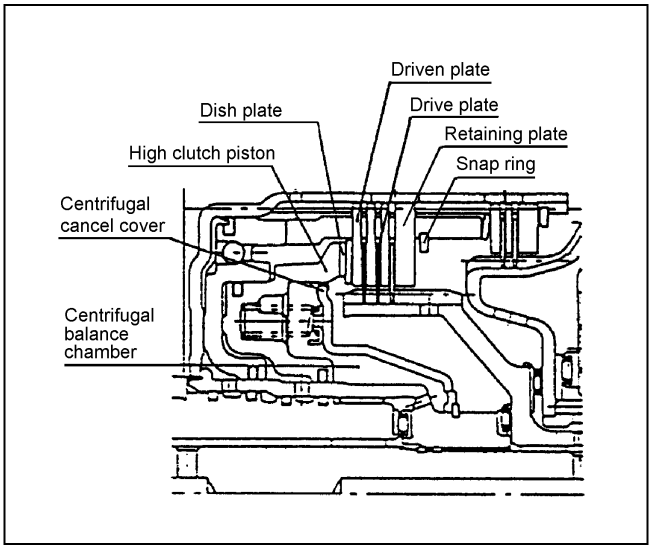


Figure 17. Construction of High Clutch

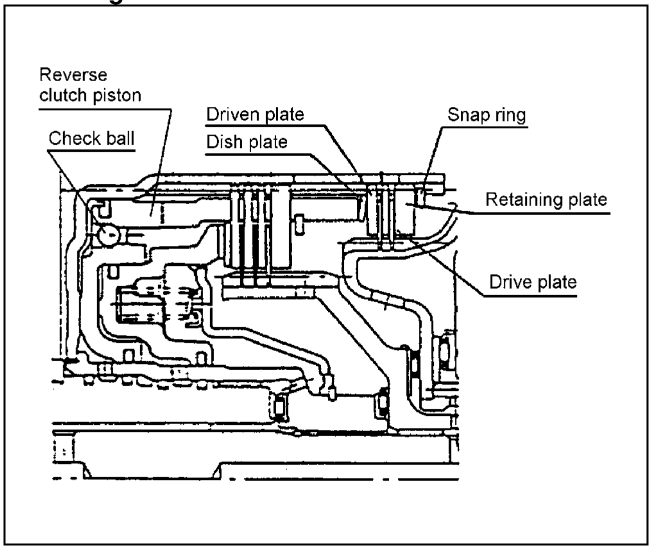


Figure 18. Construction of Reverse Clutch

2-4 Brake and Low & Reverse Brake (Multi-Plate Brake)

- The multi-plate brake is composed of drive plates and driven plates. By applying the oil pressure onto the end surface of the plates, the clutch is engaged. The oil pressure is adjusted with the control valve according to the signal from the TCM.
- All brakes use dish plates to prevent uncontrolled operation of the clutches when engaged, causing a shock.
- The solenoid in the control valve is driven based on the shift signal from TCM, it moves the shift valve, thereby engaging the drive plate and driven plate through the piston of each clutch.
- As a result, rotation of each element of the planetary gear unit is fixed.
- When the oil pressure is removed, the piston returns to the original position via the force of the return spring.

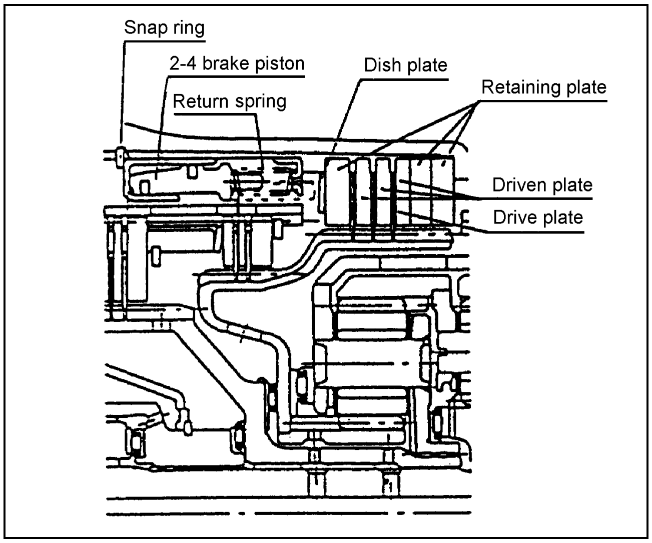


Figure 19. Construction of 2-4 Brake

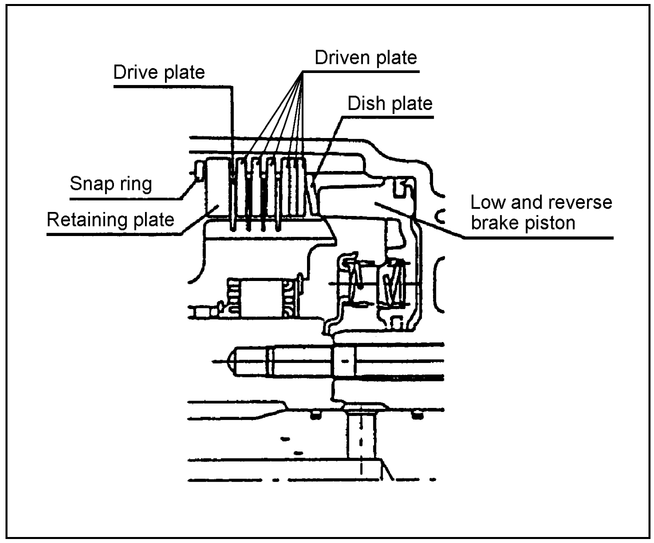


Figure 20. Construction of Low & Reverse Brake

Low One-way Clutch

- The low one-way clutch employs the sprag, which locks the counterclockwise rotation of the front planetary carrier and the rear internal gear.
- The one-way clutch outer race is fitted with the low clutch drum, and the inner race is fitted with the transmission case.
- The outer race rotates freely clockwise, but, when it attempts to rotate counterclockwise, the sprag locks the outer race.
- When the vehicle is traveling in 1st gear in the D, 3 or 2 position, the low one-way clutch locks the rear internal gear via the low clutch. It is left free in the 2nd, 3rd or 4th gear.

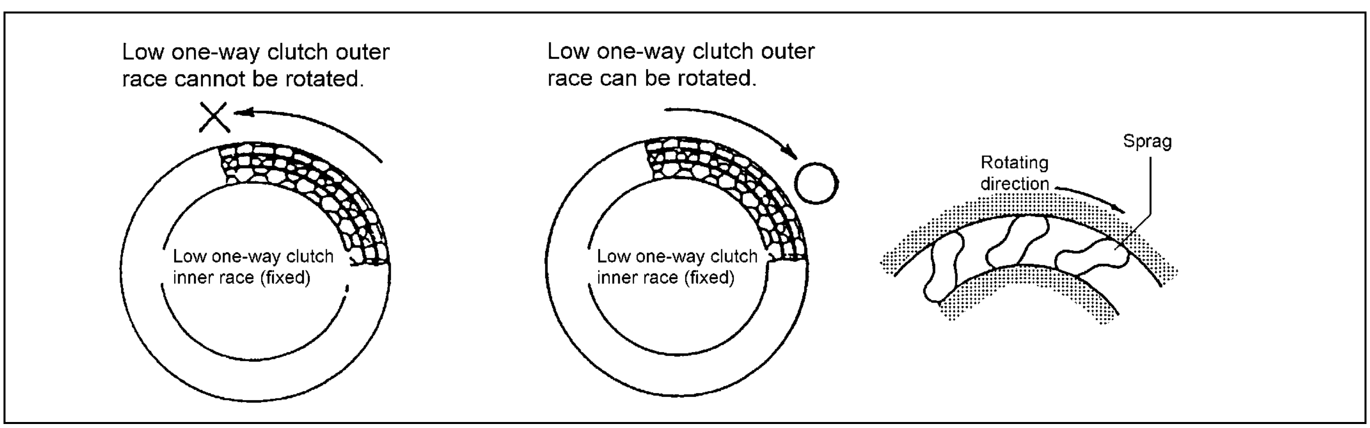


Figure 21. Construction of Low One-way Clutch

CONTROL VALVE

- Employing the direct electronic control (Direct Electronic Shift Control: DESC) for the clutch pressure has simplified the oil pressure circuit, reduced the number of functional components and made the control valve compact.
- The control valve body is divided into the upper body and the lower body. All solenoids, the oil pressure switch and the ATF thermo sensor are installed to the lower body.
- Three-way valve type solenoids providing high responsibility are employed. Some of the solenoids are switched between ON and OFF, and others repeat ON and OFF at 50Hz (duty cycle system). Functionally, some supply output pressure when power is not supplied, and others drain the output pressure.
- When the solenoid is driven based on the signal from the TCM, the oil pressure is changed.

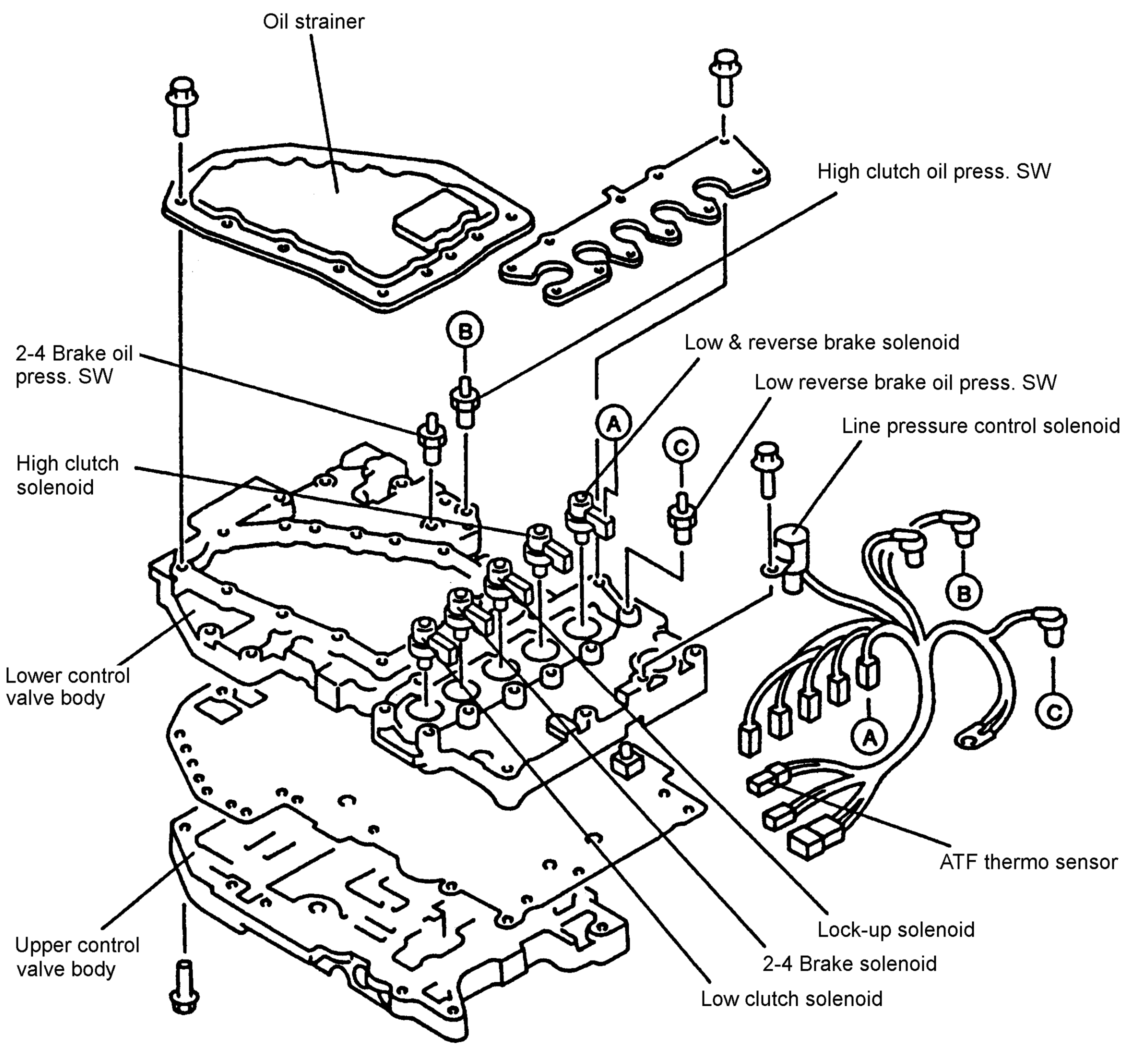


Figure 22. Construction of Valve Body

Line Pressure Solenoid

- The line pressure solenoid is turned ON or OFF according to the signal from the TCM. It switches the line pressure between high and low pressure.
- While no power is supplied, the solenoid supplies high pressure.

Shift Solenoid

- The shift solenoid is of the duty cycle type, which is turned ON or OFF at 50Hz. The ratio of the ON and OFF time can be freely controlled in the position of 0 - 100%.
- While no power is supplied, the solenoid supplies output pressure.
- The low clutch solenoid adjusts the low clutch pressure, the high clutch solenoid adjusts the high clutch pressure, the 2-4 brake solenoid adjusts the 2-4 brake pressure, and the low & reverse brake solenoid adjusts the low & reverse brake pressure respectively.

Lock-up Solenoid

- The lock-up solenoid is of the duty cycle type which is turned ON or OFF at 50Hz. The ratio of the ON and OFF time can be freely controlled in the position of 0 - 100%.
- While no power is supplied, the solenoid drains the output pressure.

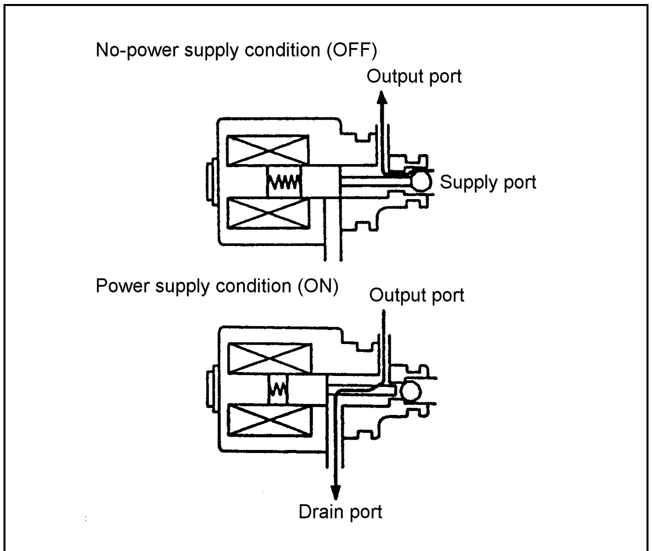


Figure 23. Shift Solenoid

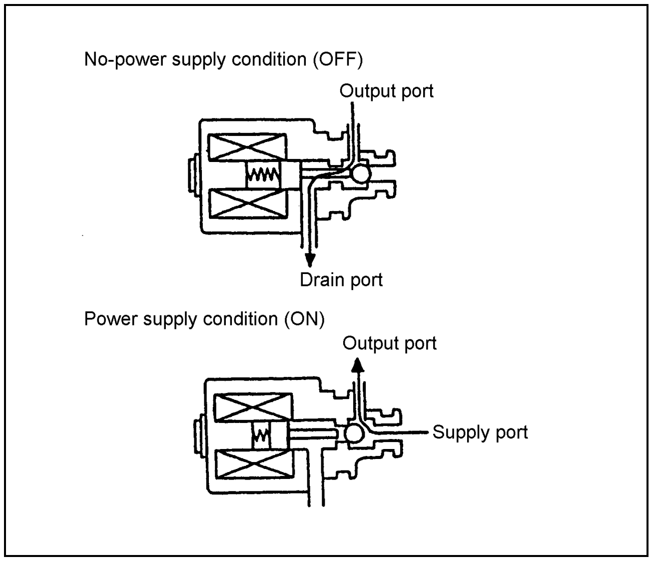


Figure 24. Lock-up Solenoid

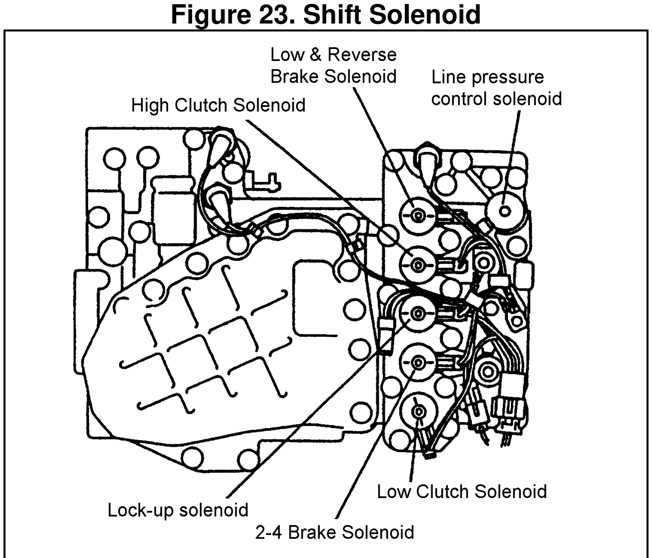


Figure 25. Location of Solenoid

Control Valve Fail-safe Function

- To prevent interlocking due to engagement of more than three clutches and brakes at the same time, the 2-4 brake fail-safe valve A and B, and the low & reverse brake fail-safe valve A and B are provided.
- When oil pressure is generated in the high clutch and the low clutch, the 2-4 brake solenoid is turned ON to drain the oil pressure applied to the 2-4 brake.
- When oil pressure is generated in the high clutch or 2-4 brake, the low & reverse brake solenoid is turned ON to drain the oil pressure applied to the low & reverse brake.

Oil Pressure Switch

- The oil pressure switch detects the condition of the oil pressure supply to the clutch and brake, and then sends the detection result to the TCM.
- The oil pressure switch is turned ON when the oil pressure reaches the switch working pressure, and turned OFF when the pressure decreases below the specified value.
- The high clutch oil pressure switch detects the high clutch oil pressure, the 2-4 brake oil pressure switch detects the 2-4 brake oil pressure, and the low & reverse brake oil pressure switch detects he low & reverse brake oil pressure respectively.

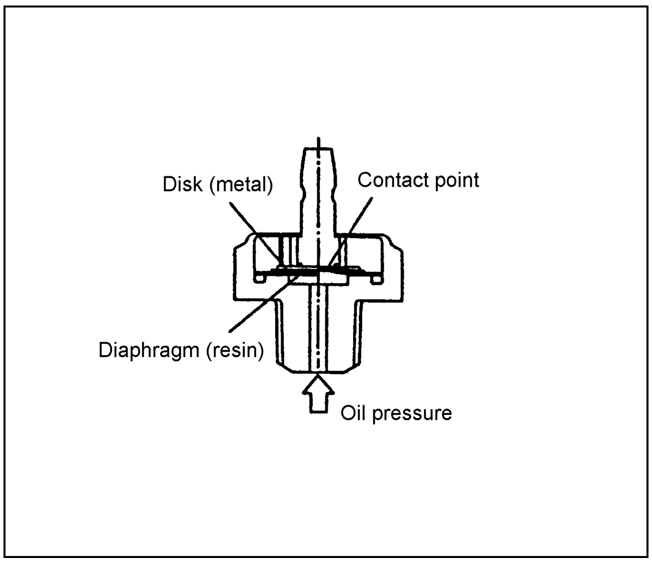


Figure 27. Oil Pressure Switch

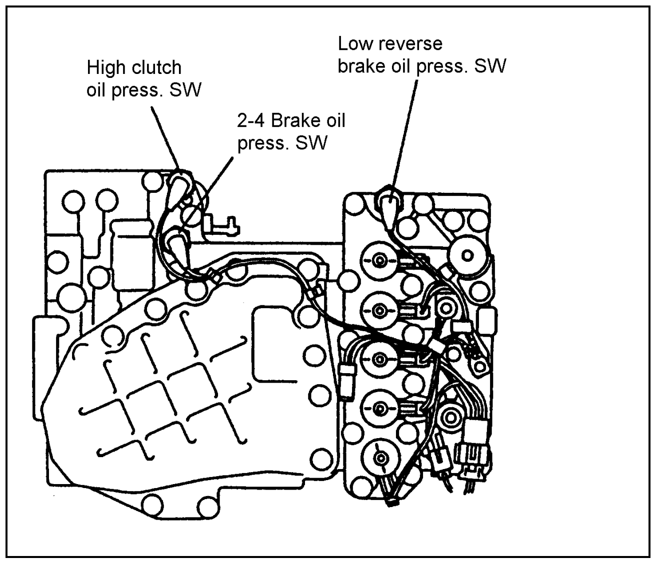


Figure 28. Location of Oil Pressure Switch

ATF Thermo Sensor

- The ATF thermo sensor detects the ATF temperature in the oil pan and sends a signal to the TCM.
- The ATF thermo sensor is of the thermister type and the resistance value changes according to the ATF oil temperature.
- When the ATF temperature is cold, the sensor resistance is high. When the ATF temperature increases, the sensor resistance decreases.
- When the ATF temperature increases to 135°C (275°F), the TCM lights up the ATF temperature warning lamp in the meter. When the ATF temperature decreases below 125°C (257°F), the ATF temperature warning lamp switches off.
- The ATF thermo sensor is installed to the lower control valve body and integrated with the harness assembly.

ATF Temperature (deg. C)	Resistance (Ohm) (Approximately)	ATF Temperature (deg. C)	Resistance (Ohm) (Approximately)
-30	29,614	100	190
-20	16,705	110	149
-10	9,842	120	118
0	6,028	128	98
20	2,500	130	94
40	1,160	135	84
50	819	140	76
60	591	145	68
80	324	150	62

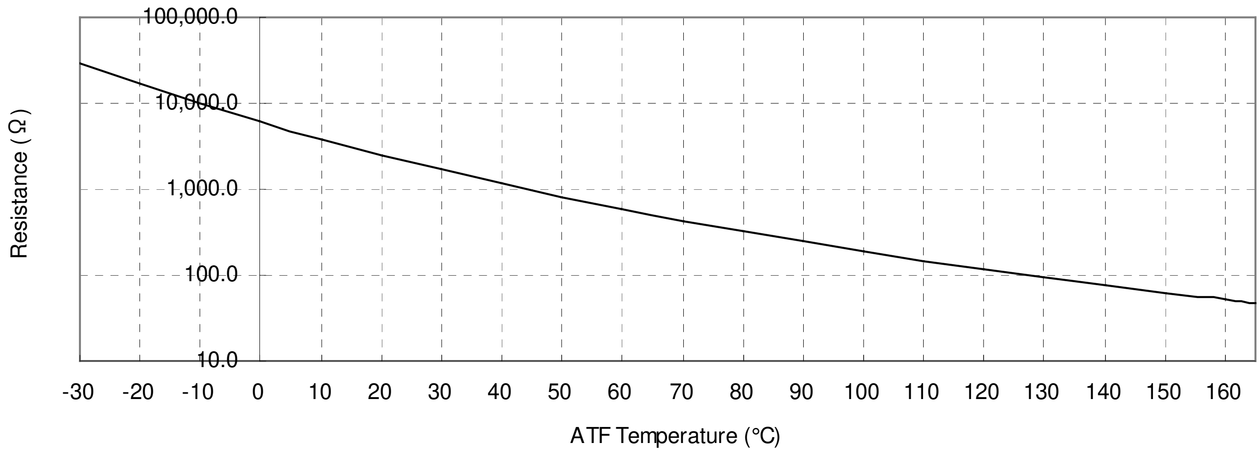


Figure 29. Characteristic of Thermo Sensor

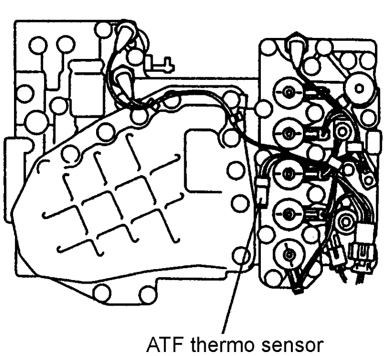


Figure 30. Location of Thermo Sensor

Terminal Assembly

Pin No.	Connected to	Connected TCMPin No.
6	Line Pressure Solenoid	B23
12	Low & Reverse Brake Oil Pressure Switch	B12
5	Low & Reverse Brake Duty Solenoid	B6
11	Ground Return	B22
4	Lock-up Duty Solenoid	B17
10	High Clutch Duty Solenoid	B8
3	Low Clutch Duty Solenoid	B9
9	2-4 Brake Duty Solenoid	B7
2	Oil Thermo Sensor	B4
8	Oil Thermo Sensor Ground	B14
1	High Clutch Oil Pressure Switch	B20
7	2-4 Brake Oil Pressure Switch	B1

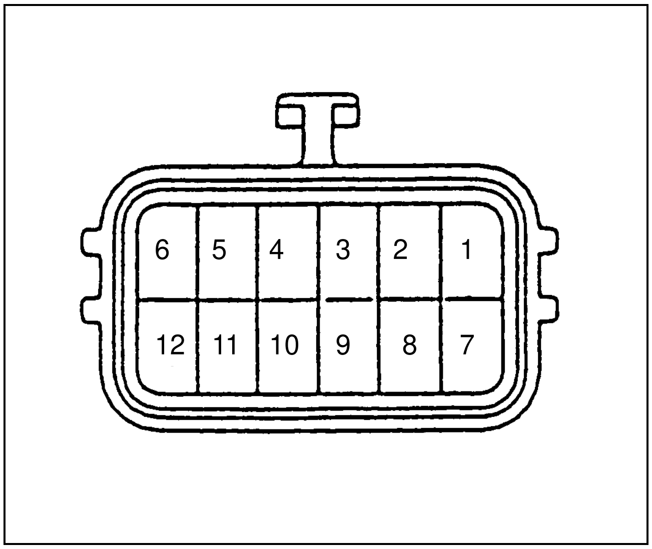


Figure 31. Pin Assignment

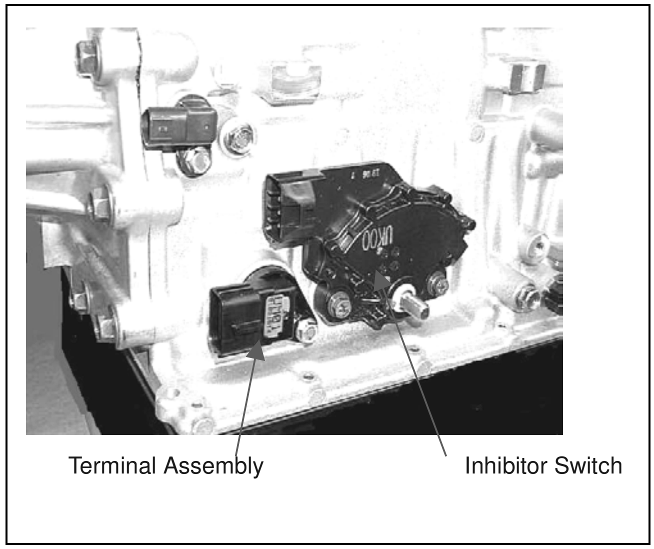


Figure 32. Location of Terminal Assembly

OIL PASSAGE

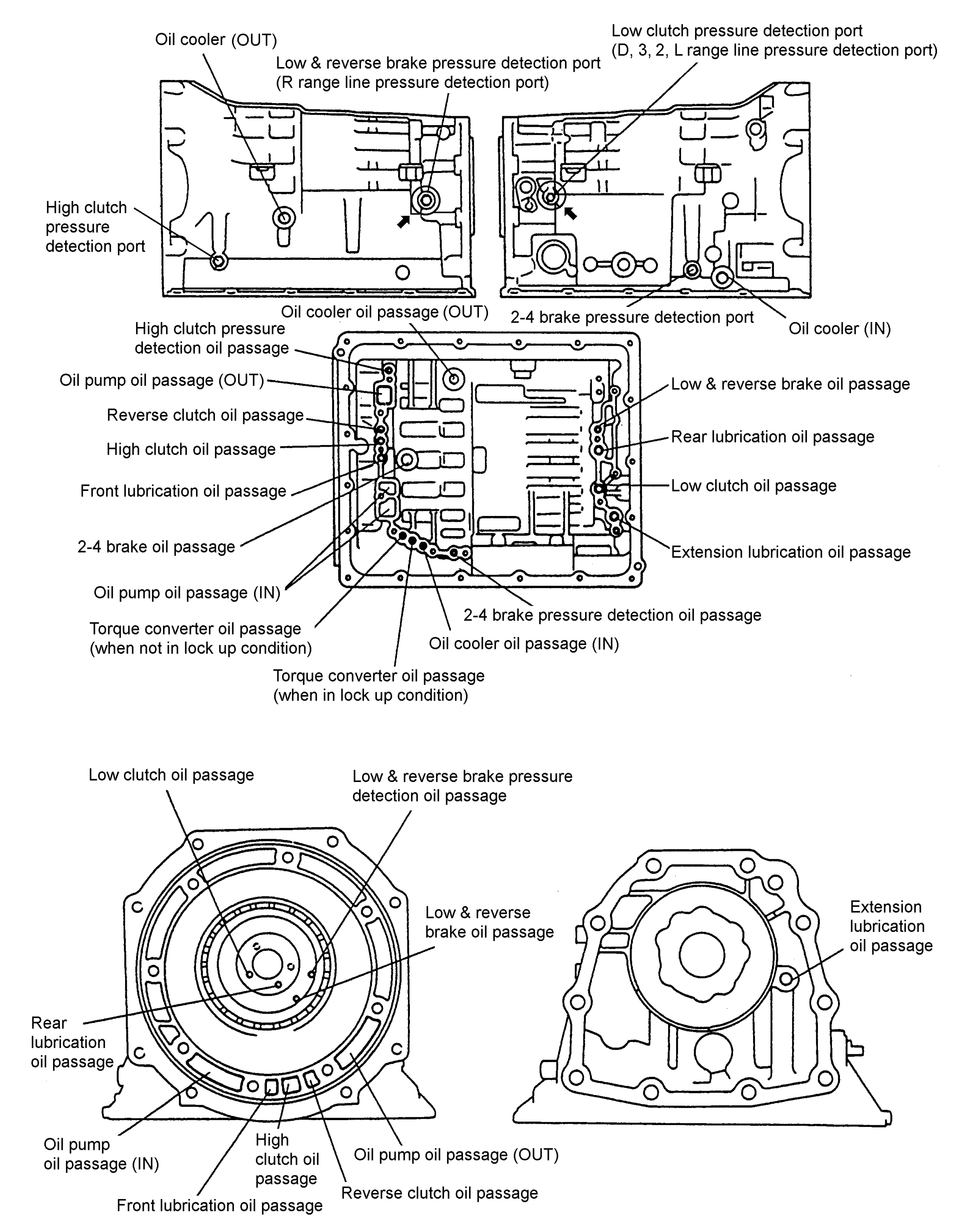


Figure 33. Oil Passage of Transmission Case

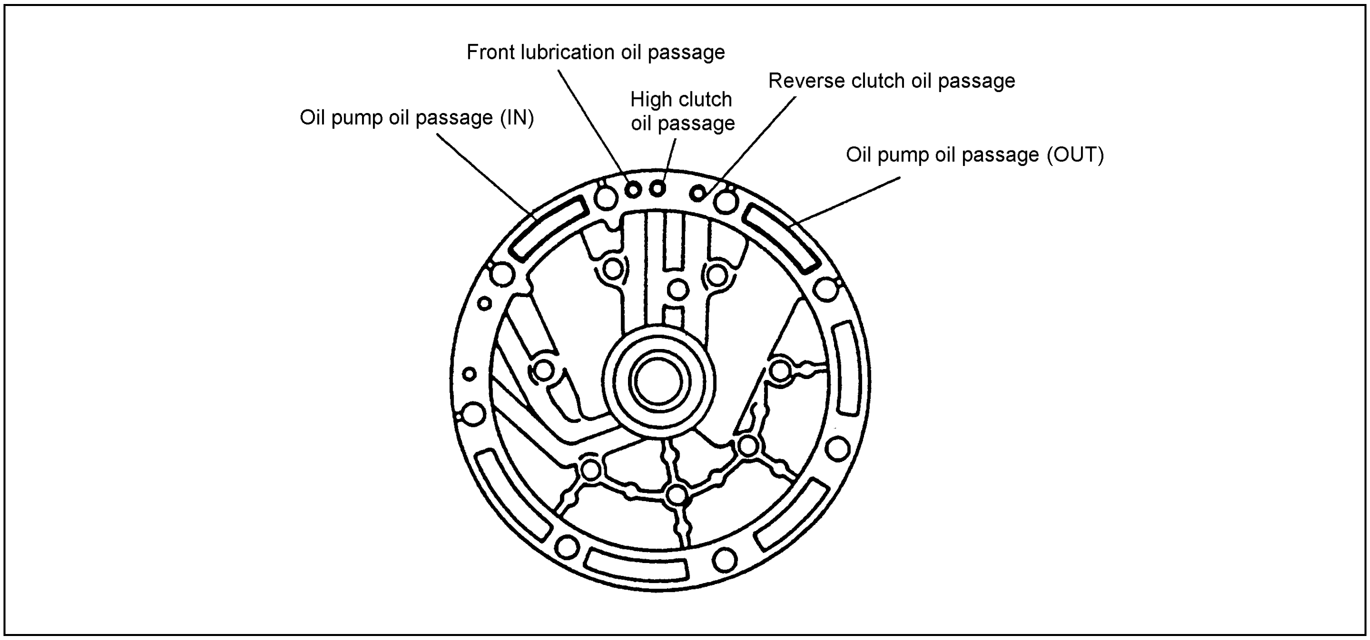


Figure 34. Oil Passage of Oil Pump

PARKING FUNCTION

- By setting the select lever to the P position, the parking pawl is engaged with the parking gear and fixes the output shaft.
- By moving the select lever, the manual shaft on the right side of the AT is moved. The manual plate and parking rod in the AT are interlocked with the manual shaft. When the manual shaft moves, the parking rod end pushes up the parking pawl.
- The parking pawl is engaged with the parking gear when pushed up, and fixes the output shaft.
- When the clutch is disengaged, it returns to the original position via the force of the return spring, fixed to the parking pawl.

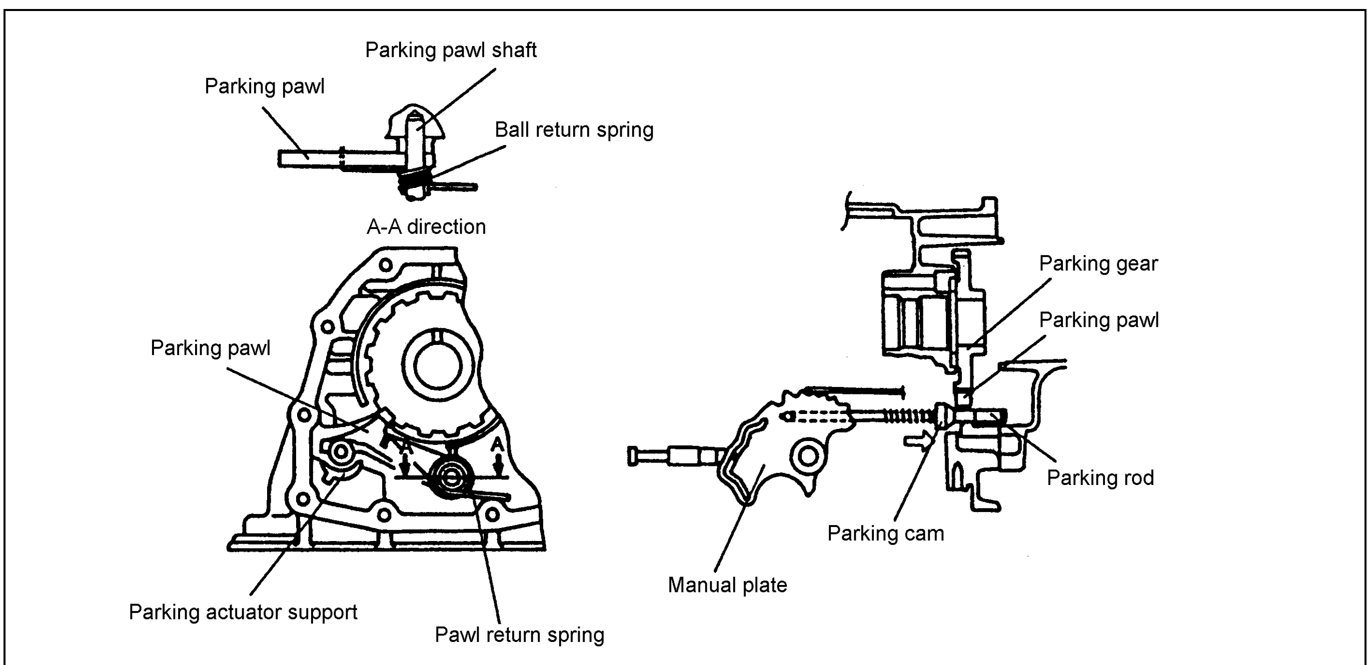
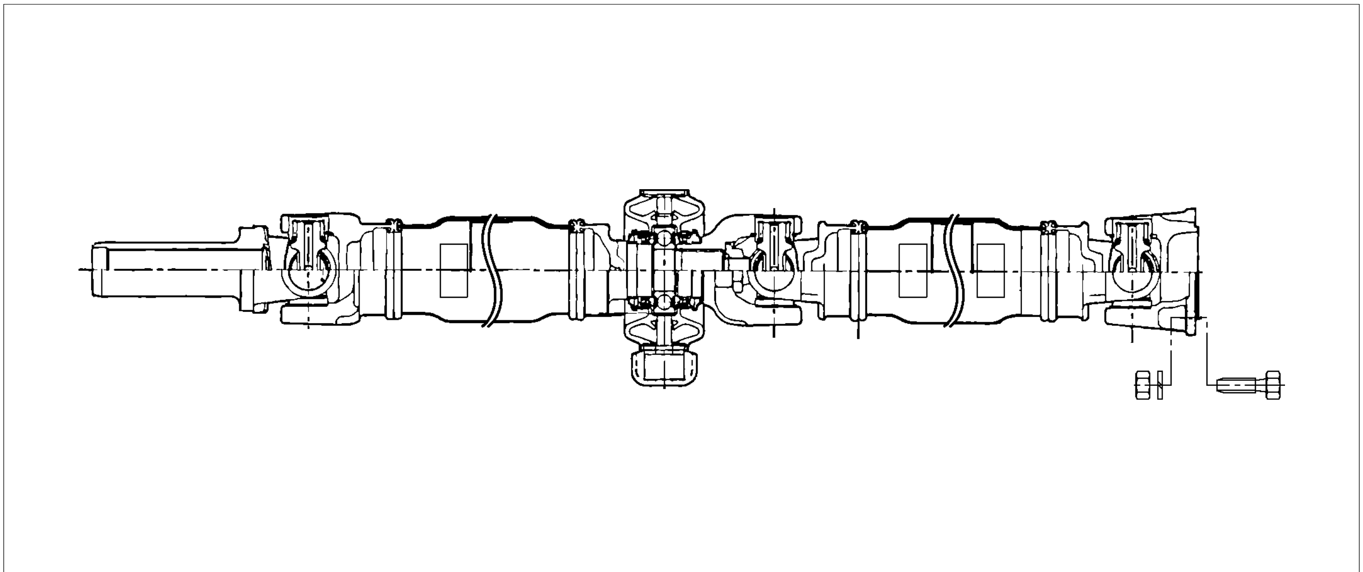


Figure 35. Parking Function

4×2 M/T AR-5, 4×2 A/T 4L60-E Model



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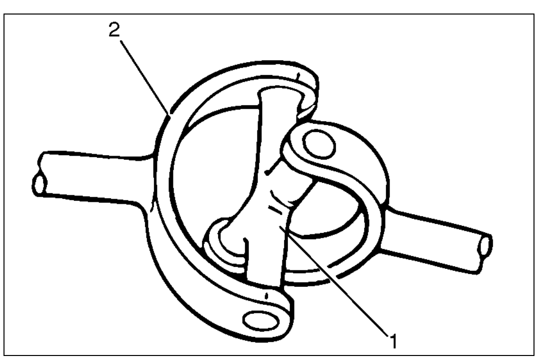
Torque is transmitted from the transmission to the axle through propeller shaft and universal joint assembles. All propeller shafts are the balanced tubular type. A splined slip joint is provided in some drivelines.

- Since the propeller shaft is total balanced carefully, welding or any other modification are not permitted.
- Alignment marks should be applied to each propeller shaft before removal.
- Be sure vehicle is stopped, engine is not running, brake is secured and vehicle is secured to prevent injury.
- Be careful not to grip the propeller shaft tube too tightly in the bise as this will be cause deformation.

Phasing

The propeller shaft is designer and built with the yoke lugs (ears) in line with each other. This design produces the smoothest running shaft possible, called phasing. Vibration can be caused by an out-of-phase propeller shaft. The propeller shaft down each time the universal joint goes around. This vibration would be the same as a person snapping rope and watching the “wave” reaction flow to the end. A propeller shaft working in phase would be similar to two persons snapping a rope at the same time, and watching the “waves” meet and cancel each other out. In comparison, this would be the same as the universal joints on a propeller shaft. A total cancellation of vibration produces a smooth flow of power in the driveline. It is very important to apply a reference mark to the propeller shaft before removal, to assure installation alignment.

Universal Joint



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A universal joint consists of two Y-shaped yokes (2) connected by a crossmember called a spider (1).
The spider is shaped like a cross. Universal joints are designed to handle the effects of various loadings and front or rear axle windup during acceleration. Within the designed angle variations, the universal joint will operate efficiently and safely. When the design angle is changed or exceeded the operational life of the joint may decrease.
The bearings used in universal joints are of the needle roller type. The needle rollers are held in place on the trunnions by round bearing cups. The bearing cups are held inside the yokes by snap rings.

INHIBITOR SWITCH

- The inhibitor switch is installed on the right side of the transmission main unit to detect the select lever position.
- The inhibitor switch is connected with the starter SW circuit. The engine cannot be started when the select lever is at any position other than the P and N position.
- By moving the select lever, the combination of the inhibitor switch pins is changed. The current position of TCM is detected based on the combination of the pins.

	10	7	3	2	4	8	5	1	9	6
P	○	○	○	○						
R			○	—	○					
N	○	○	○	—	—	○				
D			○	—	—	—	○			
3			○	—	—	—	—	○		
2			○	—	—	—	—	—	○	
L			○	—	—	—	—	—	—	○

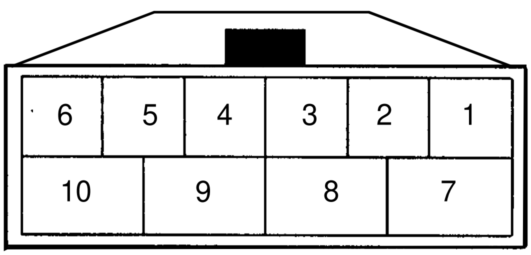

Figure 36. Pin Assignment

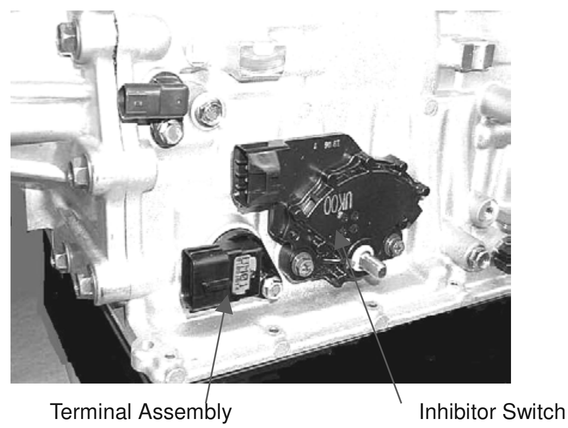

Figure 37. Location of Inhibitor Switch

TURBINE SENSOR

- The turbine sensor is a hall element. It is installed to the front of the transmission case. The turbine sensor converts the rotations of the reverse & high clutch drum fitted with the input shaft by spline to pulse signal and sends the signal to the TCM.
- One turn of the reverse & high clutch drum generates 32-pulse signals, which are sent to the TCM.

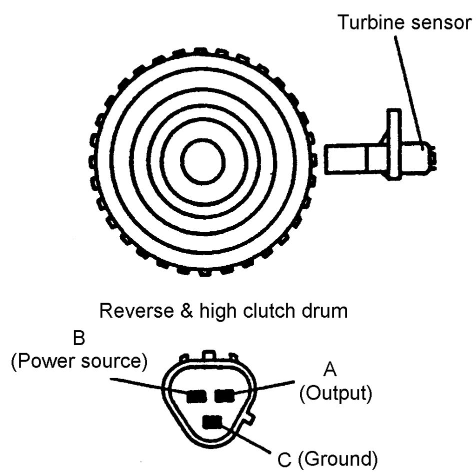

Figure 38. Turbine Sensor

SPEED SENSOR

- The speed sensor is a hall element. It is installed to the rear of the transmission case. The speed sensor converts the rotations of the parking gear, fitted with the output shaft by spline, to a pulse signal and sends the signal to the TCM.
- One turn of the parking gear generates 16-pulse signals, which are sent to the TCM.

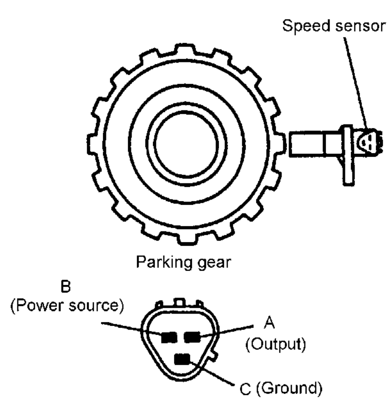

Figure 39. Speed Sensor

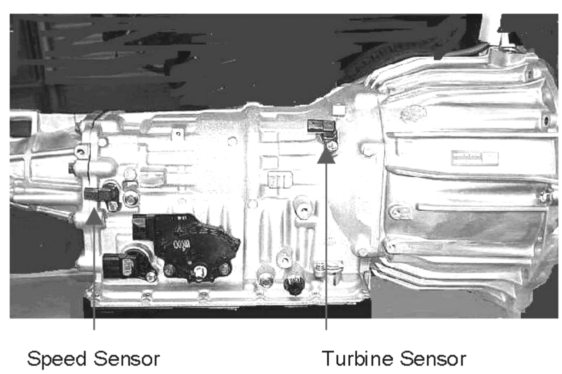

Figure 40. Location of Turbine & Speed Sensor

ACCELERATOR PEDAL POSITION SENSOR

- Opening of the accelerator pedal is converted to an electric signal which is transmitted from ECM to TCM.
- The accelerator pedal position sensor (1) is installed to the accelerator pedal.

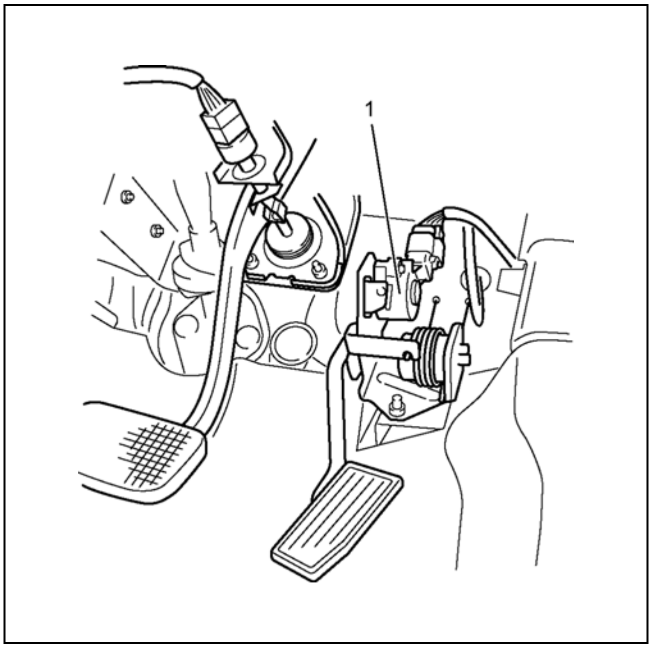

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Figure 41. Accelerator Pedal Position Sensor

Pin No.	Wire Color	Pin Function
1	BLU	APP Sensor 3 +5V Reference
2		Not Used
3	ORN/BLU	APP Sensor 2 Low Reference
4	BLK	APP Sensor 1 Low Reference
5	RED	APP Sensor 1 Signal
6	BLU/WHT	APP Sensor 3 Signal
7	BLU/RED	APP Sensor 3 Low Reference
8	ORN	APP Sensor 2 +5V Reference
9	BLU/GRN	APP Sensor 2 Signal
10	WHT	APP Sensor 1 +5V Reference

Figure 42. Pin Assignment

ENGINE SPEED SENSOR (=CKP SENSOR)

- The engine speed sensor converts the crankshaft from the Crankshaft Position (CKP) sensor rotation to a pulse signal which is transmitted from ECM to TCM.

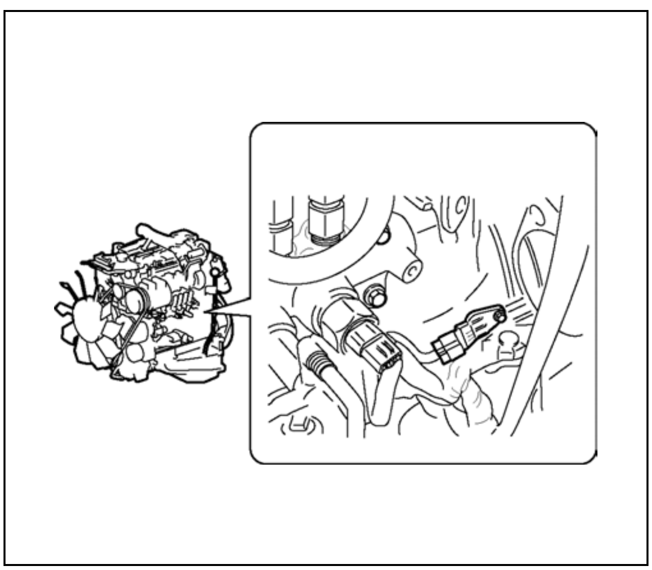

Figure 43. Crankshaft Position (CKP) Sensor

Pin No.	Wire Color	Pin Function
1	YEL	Sensor Signal
2	BLU	Sensor Low Reference
3	GRN	Sensor +5V Feed

Figure 44. Pin Assignment

BRAKE SWITCH

- The brake switch (1) is installed to the brake pedal (2). When the driver steps on the brake pedal, an electric signal is sent to the TCM.

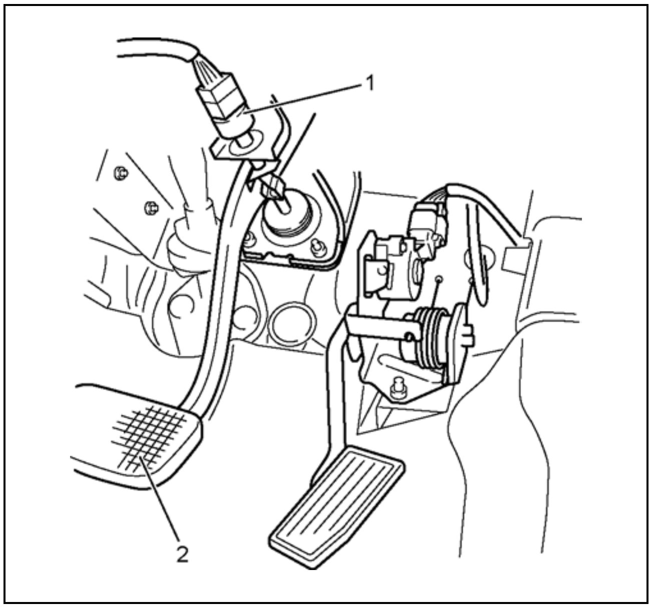

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Figure 45. Brake Switch

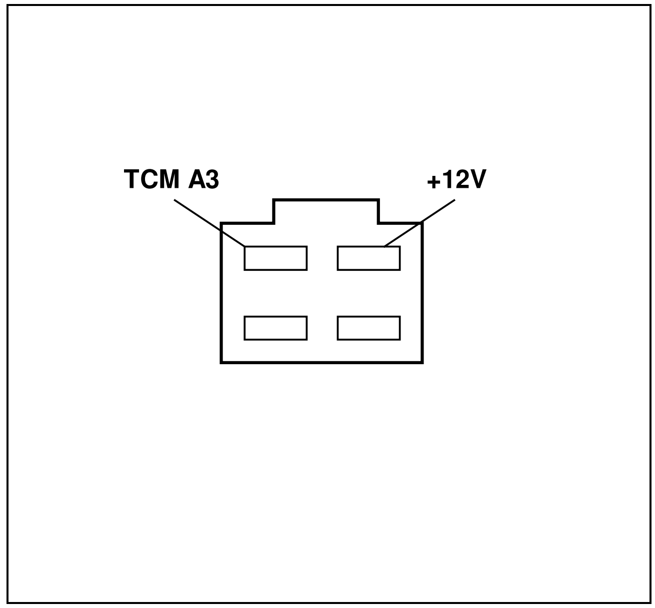

Figure 46. Pin Assignment

MODE SELECT SWITCH

- The mode select switch (2) is installed beside the select lever (1). When the driver selects the PWR or 3rd, an electric signal is sent. It turns ON the indicator lamp in the meter.
- The 3rd START mode can only be used in the D position.

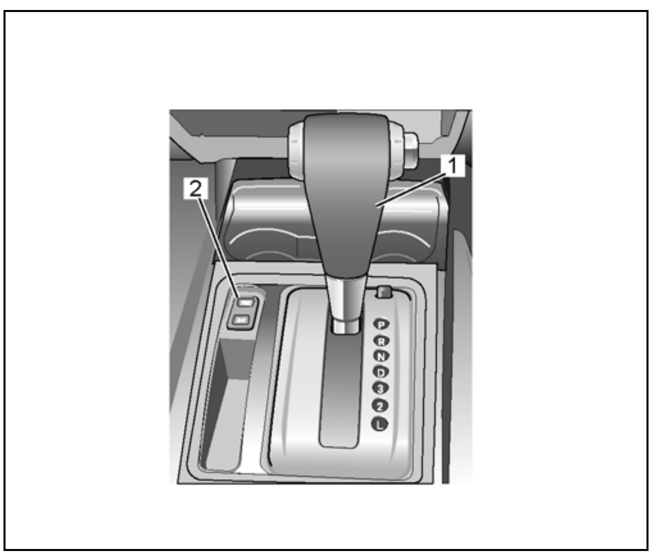

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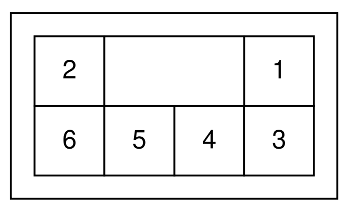
Figure 47. Mode Select Switch



	Power	3rd	Illumination Lamp
1 (Illumination)			○
2 (Ground)			○
3 (TCM A24)	○		
4 (No Connection)			
5 (TCM A11)		○	
6 (Ground)	○	○	

Figure 48. Pin Assignment

TRANSMISSION CONTROL MODULE (TCM)

- The TCM is fitted on the side of the brake pedal via two stud bolts.
- The TCM judges the line pressure, gear shifting point and lock-up operation based on electrical signals from switches and sensors, and sends the appropriate signals to solenoids.

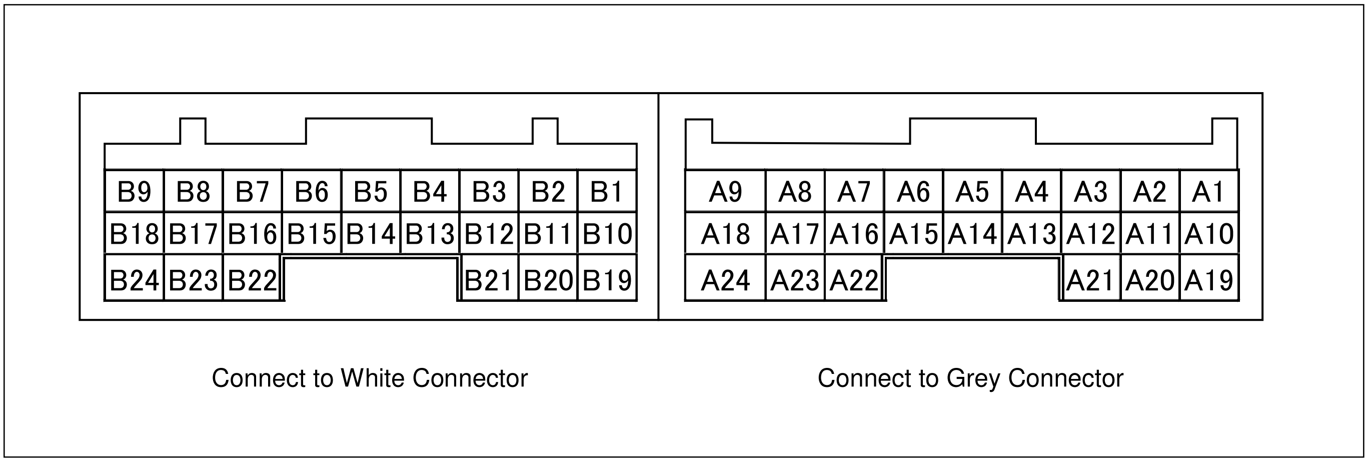


Figure 49. Pin Assignment

Pin No.	Pin Assignment	Pin No.	Pin Assignment
B1	2-4 Brake Oil Pressure Switch	A1	V BATT (Battery Back-up Power Supply)
B2	2 Position Switch	A2	P Position Switch
B3	Turbine Sensor	A3	Brake Switch
B4	ATF Thermo Sensor	A4	3rd Start Indicator Lamp
B5	Ground	A5	K-Line Signal (Tech 2 Serial Communication)
B6	Low & Reverse Brake Duty Solenoid	A6	No Connection
B7	2-4 Brake Duty Solenoid	A7	Engine Speed Sensor
B8	High Clutch Duty Solenoid	A8	No Connection
B9	Low Clutch Duty Solenoid	A9	No Connection
B10	N Position Switch	A10	Vehicle Speed Sensor Out (2WD Only)
B11	D Position Switch	A11	3rd START Select Switch
B12	Low & Reverse Brake Oil Pressure Switch	A12	4L Mode Switch (4WD Only)
B13	Vehicle Speed Sensor	A13	No Connection
B14	ATF Thermo Sensor Ground	A14	No Connection
B15	No Connection	A15	No Connection
B16	No Connection	A16	Accelerator Pedal Position Sensor
B17	Lock-up Duty Solenoid	A17	3 Position Switch
B18	Vign (Ignition Power Supply)	A18	DIAG Switch (Test Switch)
B19	R Position Switch	A19	A/T OIL TEMP Indicator Lamp
B20	High Clutch Oil Pressure Switch	A20	CHECK TRANS Indicator Lamp
B21	L Position Switch	A21	POWER DRIVE Indicator Lamp
B22	Ground (Shift Solenoid)	A22	No Connection
B23	Line Pressure Solenoid	A23	No Connection
B24	Vign (Ignition Power Supply)	A24	POWER DRIVE Select Switch

CONTROL MECHANISM

CONTENT OF FUNCTION AND CONTROL

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Line pressure control</td><td>TCM issues a signal according to vehicle travel, engine load and other conditions, which drives the ON/OFF type line pressure solenoid to switch the line pressure to high or low pressure.
The line pressure solenoid is switched to the low pressure side when the solenoid is turned ON (power supplied) and to the high pressure side when turned OFF (no power supplied).
In the forward travel position (D, 3, 2, L position), the line pressure decreases lower than that in the P, N, and R position through the oil pressure circuit.</td></tr>
<tr><td>Gear shift control</td><td>The TCM issues a shift solenoid drive signal based on the traveling mode switch, inhibitor switch, the vehicle speed, the APP opening and other input signals, to control the optimum gear position automatically.
Shift features have been set up to the TCM; the normal mode is suited to normal travel, and the power mode is used when the vehicle is loaded or the speed accelerated.
In addition, shift features used only for high oil temperature, hill climbing, and downward travel have been set up to the TCM. These are automatically switched depending on the travel conditions.
When the oil temperature is low (10°C or less), shifting up from the third speed to the fourth speed is prohibited by the gear shift control.</td></tr>
<tr><td>Shift pattern selection control</td><td>The TCM selects the following shift pattern according to a vehicle condition.
<table>
<tr><th>Selection Priority</th><th colspan="2">Shift Pattern</th><th>3rd Start Lamp</th><th>Power Drive Lamp</th></tr>
<tr><td rowspan="8">High
↑
Low</td><td colspan="2">High Temperature</td><td>OFF</td><td>OFF</td></tr>
<tr><td colspan="2">3rd Start</td><td>ON</td><td rowspan="3">OFF</td></tr>
<tr><td colspan="2">4L</td><td rowspan="6">OFF</td></tr>
<tr><td rowspan="2">Down Slope</td><td>Power SW Off</td></tr>
<tr><td>Power SW On</td><td rowspan="2">ON</td></tr>
<tr><td colspan="2">Power</td></tr>
<tr><td colspan="2">Up Slope</td><td rowspan="2">OFF</td></tr>
<tr><td colspan="2">Normal</td></tr>
</table>
- High temperature mode -
<u>High temperature mode setting condition</u>
ATF temperature: 122°C or more
Above condition is met for 10.16 seconds.
<u>High temperature mode cancel condition</u>
ATF temperature: 115°C or less
Above condition is met for 10.16 seconds.

-NOTE-
High temperature mode may be activated with driving conditions other than the setting conditions stated, in order to protect Automatic Transmission from thermal damage.

- 3rd start mode -
<u>3rd start mode setting condition</u>
3rd start switch: On → Off (Pushed)
Vehicle speed: 11km/h or less.
ATF temperature: 115°C or less.
APP position: 8% or less.
Select lever position: D position
Above conditions are all met at the same time.</td></tr>
</table>

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td></td><td><u>3rd start mode reset condition</u>
3rd start switch: On → Off again(Pushed again)
Vehicle speed: 34km/h or more
Select lever position: Other than D position
At least, one of above conditions is met.

- 4L mode -
<u>4L mode setting condition</u>
4L switch: On
Vehicle speed: 5km/h or more
Above conditions are all met at the same time.
<u>4L mode reset condition</u>
4L switch: Off
Vehicle speed: Less than 5km/h
Above conditions are all met at the same time.

- Down slope mode -
<u>Down slope mode setting condition</u>
Brake switch: On
Accelerator pedal condition: Released for 2 seconds or more.
Select lever position: D or 3 position
Vehicle speed: More than 60km/h
Increment of vehicle speed: More than 1km/h per second
Above conditions are all met at the same time.
<u>Down slope mode reset condition</u>
Accelerator pedal condition: Depressed
Select lever position: Other than D or 3 position
At least, one of above conditions is met.

- Power Mode -
When the power drive switch is On the shift pattern change is performed by 1 – 4 speed based on shift diagram set as power pattern.

- Up slope mode -
Up-slope reasoning value is calculated from the average APP angle and the average acceleration. Otherwise, up-slope reasoning value is calculated from the vehicle speed.
TCM chooses up-slope mode when the former is bigger than the latter.</td></tr>
<tr><td>Lock-up control</td><td>The lock-up solenoid adjusts the pressure to control the lock-up according to the signal from the TCM. This signal is based on the vehicle speed, APP opening and other input signals based on the pre-set lock-up point.
Smooth lock-up control engages and disengages the clutch smoothly at the time of lock-up.
When the oil temperature is low (20°C or less), lock-up is prohibited even when the vehicle is at a lock-up speed.
The lock-up is also disengaged when the APP is closed.</td></tr>
<tr><td>Direct electronic shift control (DESC)</td><td>The duty cycle type solenoid is used for each clutch and brake. The solenoid adjusts the clutch pressure to suit the engine load and vehicle traveling condition based on the signal from the TCM. The pressure switch provided in the control valve oil passage sends the oil pressure condition to the TCM, which controls the disengagement or engagement of the clutch and brake directly and finely.</td></tr>
</table>

Item	Description
Learning function	The learning function is provided to correct the oil pressure control timing to engage or disengage the clutch optimally in order to compensate changes of the engine performance and changes of the transmission with time. It is controlled to bring the shift time closer to the value pre-set to the TCM.
Fail-safe function	In the case of a malfunction of the vehicle speed sensor, APP sensor, all solenoids or the inhibitor switch, TCM automatically begins fail-safe control to minimize effects on driving. The gear is fixed in 3rd gear and the power supply to the solenoid is shut off so that the solenoid does not work. Lock up clutch is disengaged in this mode.
Self-diagnosis function	Parts required for controlling the automatic transmission are provided with a self-diagnosis function. When any trouble occurs, the check trans indicator lamp blinks to warn the driver. The trouble code is memorized in the TCM.

CONTROL ITEM, INPUT AND OUTPUT

	Item \ Control item	Line pressure control	Gear shift control	Shift pattern selection	Lock-up control	Direct electronic shift control (DECS)	Learning control	Fail-safe function	Self-diagnosis function
Input	Speed sensor	○	○	○	○	○	○	○	○
	Turbine sensor	○	○		○	○	○	○	○
	Engine speed sensor	○	○		○	○	○	○	○
	Brake switch		○	○					
	Inhibitor switch	○	○	○				○	○
	Mode select switch		○	○					
	4L switch (4WD Only)		○	○					
	ATF thermo sensor	○	○		○	○	○	○	○
	High clutch oil pressure switch					○	○	○	○
	2-4 brake oil pressure switch					○	○	○	○
	Low & Reverse brake oil pressure switch					○	○	○	○
	Accelerator Pedal position sensor	○	○	○	○	○	○	○	○
Output	Line pressure solenoid	○				○		○	○
	Low clutch solenoid		○			○	○	○	○
	High clutch solenoid		○			○	○	○	○
	2-4 brake solenoid		○			○	○	○	○
	Low & Reverse brake solenoid		○			○	○	○	○
	Lock-up solenoid				○			○	○
	Shift pattern indicator lamp		○					○	○
	ATF temperature indicator lamp							○	○
	Check trans indicator lamp							○	○

LINE PRESSURE CONTROL

- The TCM drives the ON/OFF type line pressure solenoid based on the APP opening, vehicle speed, turbine rotational speed, ATF temperature and shift position signal. The ON/OFF type line pressure solenoid is actuated, and switches the line pressure to a high or low pressure number appropriate to the situation.
- The line pressure generated by the oil pump acts on the point A of the pressure regulator valve. When the pressure control solenoid is turned ON by the signal from the TCM, the solenoid pressure does not act. The line pressure is adjusted to match the spring force acting on the right side of the pressure regulator valve.
- When the pressure control solenoid is turned OFF, the solenoid pressure acts so that the line pressure is adjusted to match the spring force acting on the right side of the pressure regulator valve.
- As a result, the line pressure is adjusted to be low when the pressure control solenoid is ON and to be high when the pressure control solenoid is OFF.
- In position D, 3, 2 and L, the line pressure through the oil pressure circuit acts onto the point B of the pressure regulator valve. The pressure regulator valve moves so as to increase the pressure to be drained, so that the line pressure is adjusted to be lower than the P, N, and R position by the difference of area at the point B.

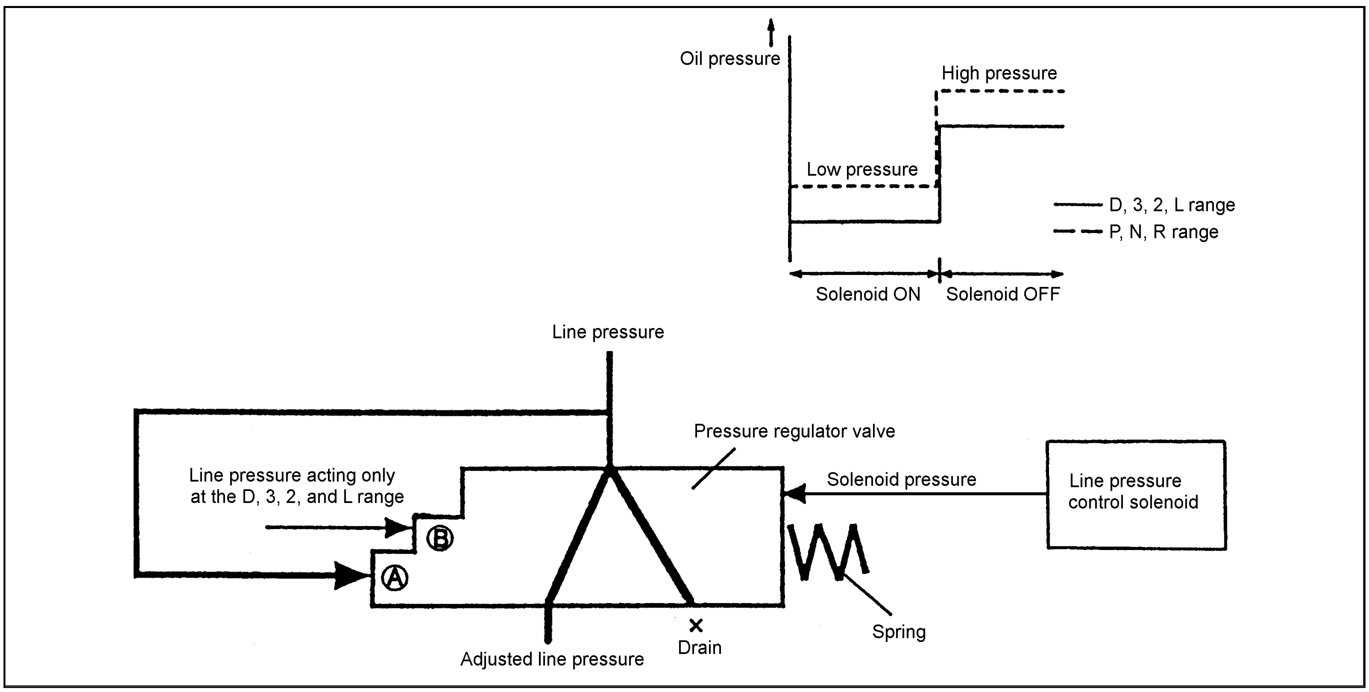


Figure 50. Line Pressure Control

LOCK-UP CONTROL

- The lock-up solenoid adjusts the pressure and controls the lock-up based on the pre-set lock-up point, according to the vehicle speed, APP opening, engine rotations, turbine rotations and ATF temperature input signal, based on the signal from the TCM.
- Smooth lock-up control is employed to engage or disengage the clutch smoothly at the time of lock-up on or off.
- When the oil temperature is low (20°C or less), lock-up is disengaged even though the vehicle is at the lock-up speed.
- The lock-up is disengaged also when the APP is closed.
- When the TCM determines the lock-up engagement, the DUTY ratio to supply power to the lock-up solenoid is gradually increased (5% to 95%) and the oil between the lock-up piston and converter cover is gradually drained.

Diagnosis of Propeller Shaft and Universal Joint

Condition	Possible cause	Correction
Leak at the Front Slip Yoke (An Occasional Drop of Lubricant Leaking from the Splined Yoke is Normal)	Rough surface on splined yoke; burred nicked or worn.	Replace the seal. Minor burrs can be Smoothed by careful use of crocus cloth or fine stone honing. Replace the yoke if badly burred.
	Defective transmission rear oil seal.	Replace the transmission rear oil seal and replenish the transmission oil.
Universal Joint Noise.	Worn universal joint bearings.	Replace.
	Improper lubrication.	Lubricate as directed.
	Loose flange bolts.	Tighten to specifications.
Ping, Snap, or Click in Drive Line (Usually Heard on Initial Load after the Transmission is in Forward or Reverse Gear)	Loose bushing bolts on the rear springs or upper and lower control arms.	Tighten the bolts to specified torque.
	Loose or out-of-phase end yoke.	Remove end yoke, turn 180 degrees from its original position, lubricate the splines and reinstall. Tighten the bolts and pinion nut to specified torque.
Squeak	Lack of lubricant.	Lubricate joints and splines. Also check for worn or brinelled parts.
Shudder on Acceleration (Low Speed)	Loose or missing bolts at the flanges.	Replace or tighten bolts to specified torque.
	Incorrectly set front joint angle.	Install shim under the transmission support mount to change the front joint angle.
	Worn universal joint.	Replace.
Vibration	Incorrect shaft runout.	Replace.
	Shaft out of balance.	Adjust.
	Transmission rear housing bushing, transfer case housing bushing worn.	Replace.
	Yoke spline jammed.	Replace.

As a result, the lock-up piston is fitted slowly to the converter cover under pressure securing smooth lock-up engagement.

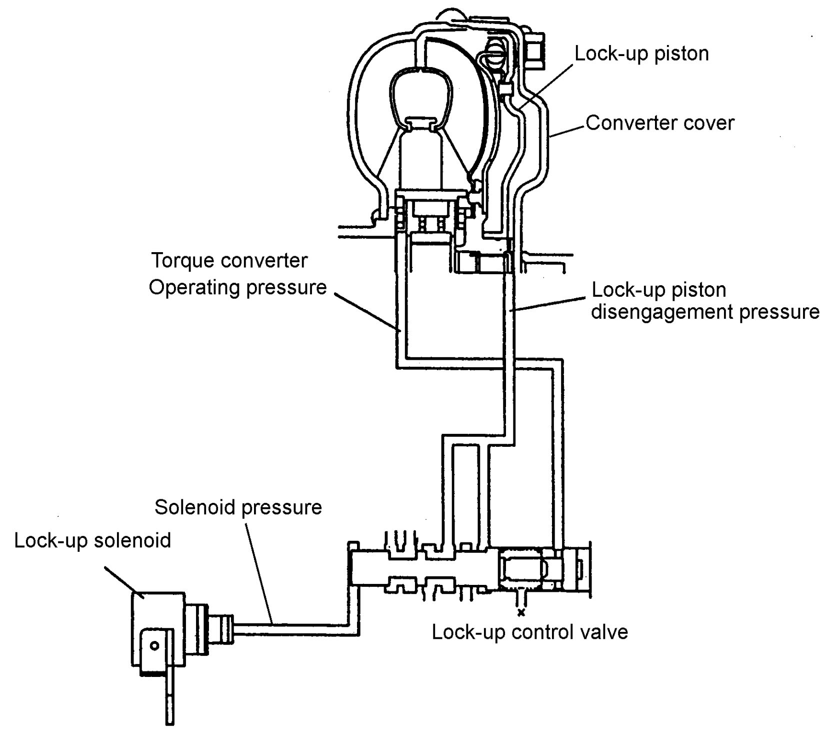


Figure 51. Lock-up Control

DIRECT ELECTRIC SHIFT CONTROL (DESC)

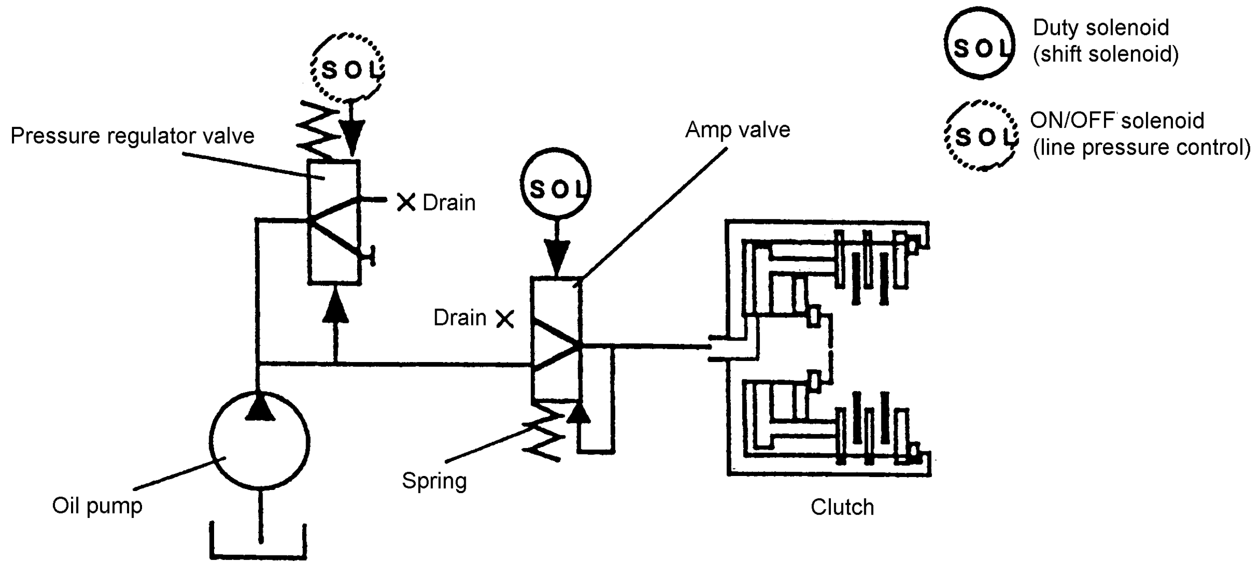
Feature

- Based on each switch signal (low & reverse brake pressure, 2-4 brake pressure & high clutch pressure) and each sensor signal (turbine sensor, speed sensor, engine speed signal & APP position signal), the duty cycle type solenoid adjusts the clutch pressure to match the engine load and vehicle travel conditions. Controlling the engagement and disengagement of the clutch and brake pressure is directly and accurately controlled via TCM, which is different to the previous accumulator type.

Operation

- Instead of the previous system (on/off type of shift solenoid and shift valve), the combination of the duty cycle type solenoid and the amplifier (Amp) valve are used to adjust the clutch pressure to match the engine load and vehicle travel conditions, based on the signal from the TCM. Also, the pressure switch provided in the oil passage of the control valve transmits the oil pressure condition (at that time) to TCM, enabling the engagement and disengagement control of the clutch and brake to be directly and finely carried out.
- When the gear is shifted from the 2nd to 3rd, 3rd to 4th (O/D), 4th (O/D) to 3rd and 3rd to 2nd, the clutch pressures on the engagement side and disengagement side are simultaneously controlled. As a result, engine racing or clutch drag is prevented which enables a smooth and quick shift response.

Direct Electric Shift Control



Previous Model

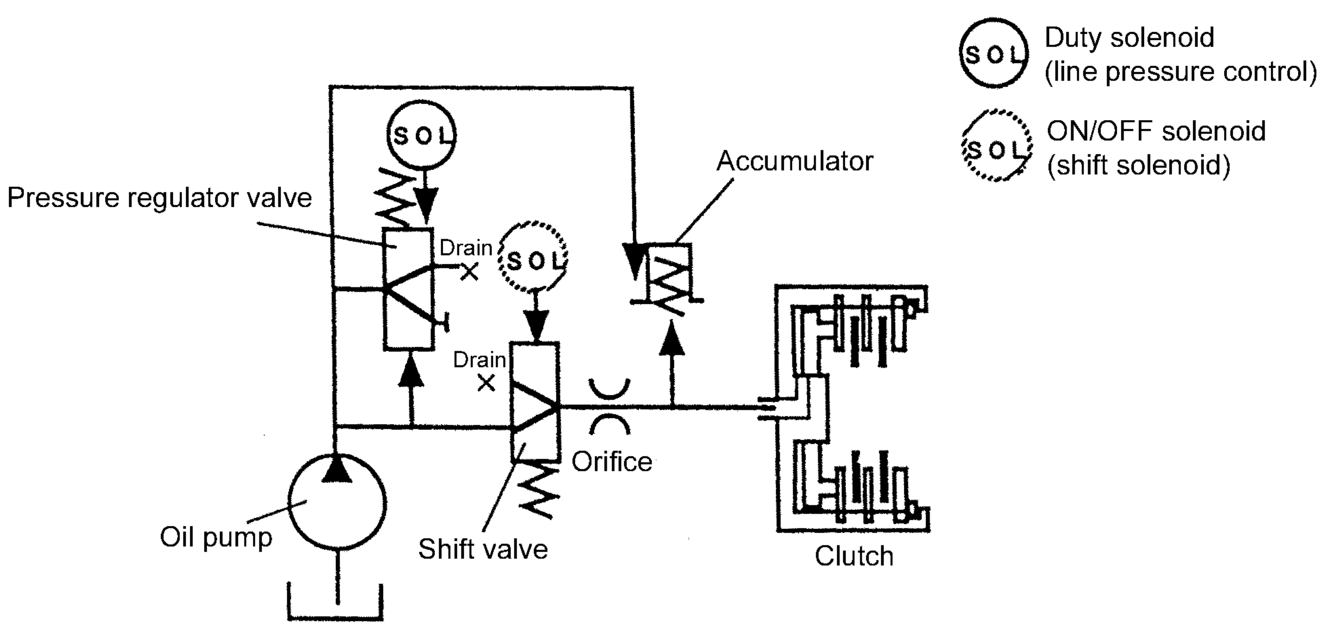


Figure 52. Direct Electric Shift Control (DESC)

LEARNING FUNCTION

- Oil pressure control timing is optimally corrected at the time of clutch engagement and disengagement. It is controlled to bring the shift time to the value preset to the TCM, and compensate for the changes in engine performance and transmission characteristics.
- When the gear is shifted, the clutch pressure ② is optimally corrected so that the shift time ① is as close to the target value preset to the TCM. The variation in the engine performance and changes to transmission characteristics which occur with time, can be compensated for based on the past shift results.
- When the clutch is operated to shift the gear, the time of the clutch oil pressure release ④ on the disengagement side is optimally corrected so that the change of the engine rpm ③ is optimum.

Note:

- When the battery terminal is disconnected, the contents of learning are cleared and as a result the shift shock may increase. After the vehicle has traveled, learning is repeated and the shock decreases gradually.

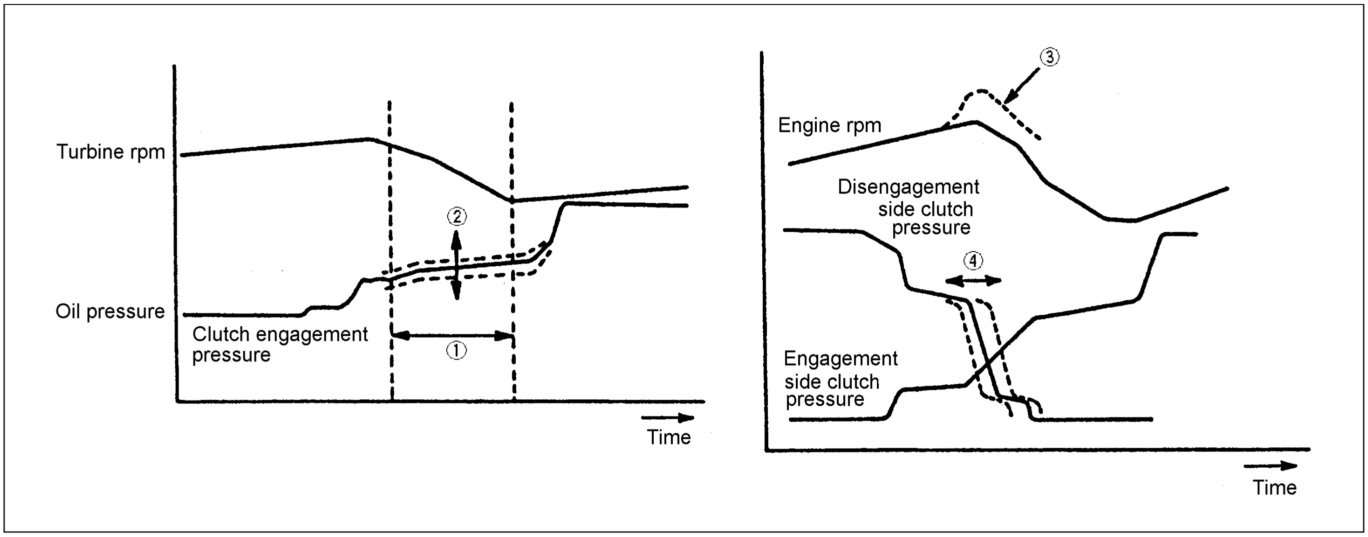


Figure 53. Learning Control

MAJOR INPUT/OUTPUT COMPONENT AND THEIR FUNCTIONS

Input	Speed sensor	Detects output shaft revolution and sends rpm signal to TCM.
	Turbine sensor	Detects input shaft revolution and sends rpm signal to TCM.
	Engine speed sensor	Inputs engine revolution from engine control computer.
	Brake switch	Detects brake pedal operation by the driver and sends signal to TCM.
	Inhibitor switch	Detects select lever position and sends signal to TCM.
	Mode select switch	Detects "Power Drive" or "3rd Start" selected by the driver and sends signal to TCM.
	4L switch (4WD Only)	Inputs 4L mode from transfer control computer.
	ATF thermo sensor	Detects ATF temperature and sends signal to TCM.
	High clutch oil pressure switch	Detects high clutch supply oil pressure and sends signal to TCM.
	2-4 brake oil pressure switch	Detects 2-4 brake supply oil pressure and sends signal to TCM.
	Low & Reverse brake oil pressure switch	Detects low & reverse brake supply oil pressure and sends signal to TCM.
	Accelerator Pedal position sensor	Inputs throttle opening angle from engine control computer.
	TCM	Judges necessary line pressure, gear shifting point and lock-up operation based on electrical signals from switches and sensors and sends appropriate signals to solenoids.
Output	Line pressure solenoid	Regulates oil pump delivery pressure to the appropriate line pressure for current driving conditions based on a signal from TCM.
	Low clutch solenoid	Selects appropriate gear shifting position for current driving conditions and regulates low clutch supply oil pressure based on a signal from TCM.
	High clutch solenoid	Selects appropriate gear shifting position for current driving conditions and regulates high clutch supply oil pressure based on a signal from TCM.
	2-4 brake solenoid	Selects appropriate gear shifting position for current driving conditions and regulates 2-4 brake supply oil pressure based on a signal from TCM.
	Low & Reverse brake solenoid	Selects appropriate gear shifting position for current driving conditions and regulates low & reverse brake supply oil pressure based on a signal from TCM.
	Lock-up solenoid	Regulates lock-up pressure to appropriate level for current driving conditions based on a signal from TCM.
	Mode indicator lamp	Indicates POWER DRIVE or 3rd START switch position.
	Speed meter signal (2WD Only)	Outputs vehicle speed to the speed meter.
	A/T OIL TEMP indicator lamp	Indicates A/T OIL TEMP indicator lamp in case of high temperature.
	CHECK TRANS indicator lamp	Indicates CHECK TRANS indicator lamp in case of malfunction.

CONTROL CIRCUIT BLOCK DIAGRAM

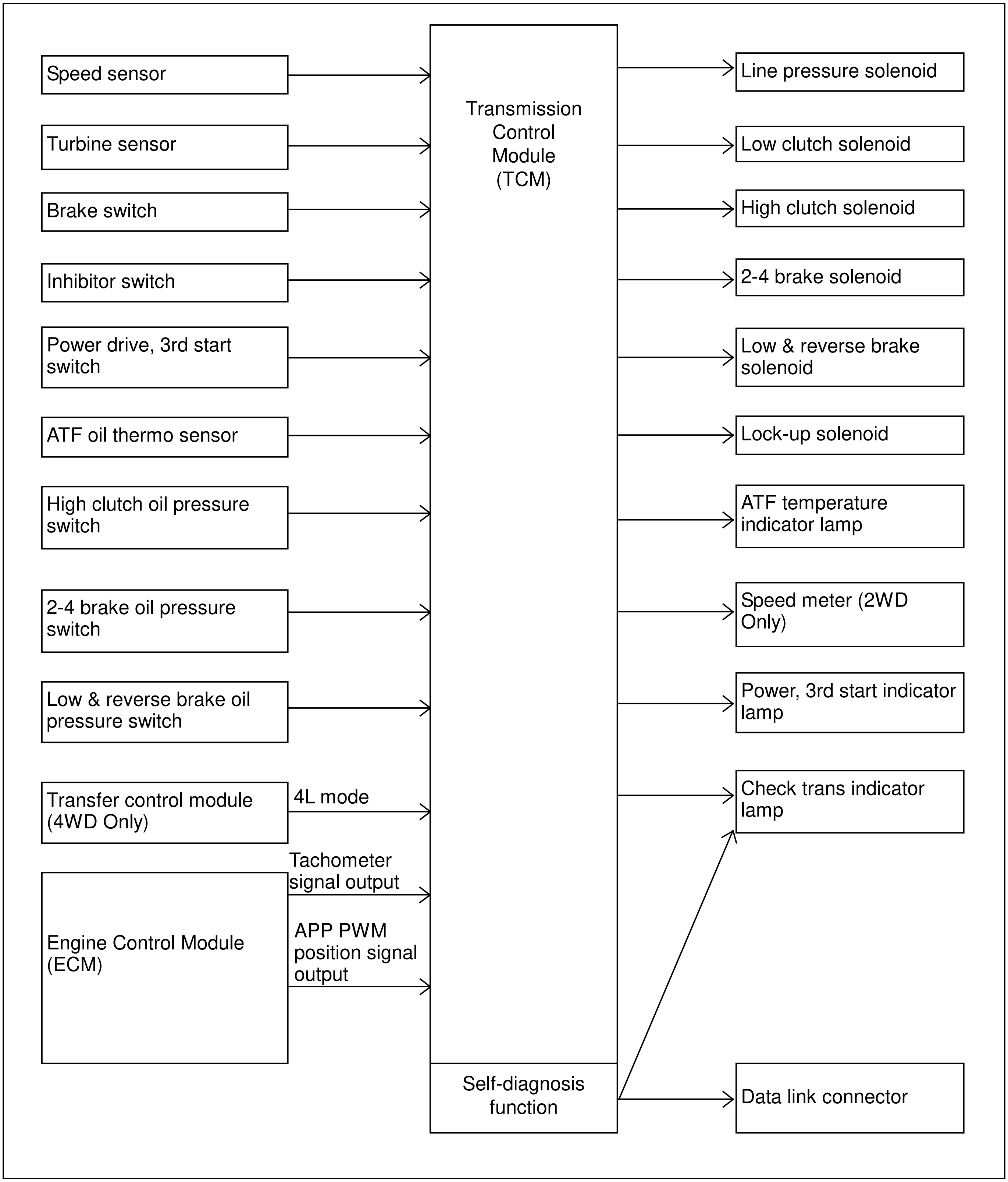
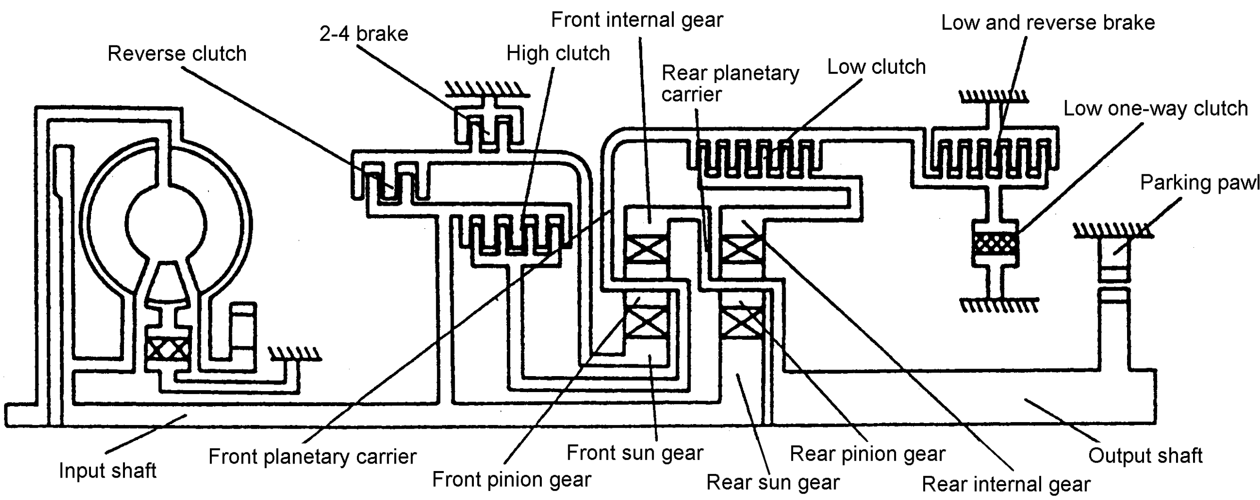


Figure 54. Control Circuit Block Diagram

GEAR TRAIN (TRANSMISSION MECHANISM) OPERATION AND HYDRAULIC CIRCUIT

CONSTRUCTION AND OPERATION

The JR405E consists of two sets of planetary gears, three multiple plate clutches, two multiple plate brakes and one one-way clutch.



COMPONENT NAME AND FUNCTION

Component Name	Symbol	Function
Low Clutch	L/C	Connects the front planetary carrier to the rear internal gear. Engaged at 1st, 2nd and 3rd gear.
High Clutch	H/C	Connects the input shaft to the front planetary carrier. Engaged at 3rd and 4th (O/D) gear.
Reverse Clutch	R/C	Connects the input shaft to the front sun gear. Engaged at Reverse gear.
Low & Reverse Brake	L&R/B	Locks the front planetary carrier. Engaged at L position and Reverse gear.
2-4 Brake	2-4/B	Locks the front sun gear. Engaged at 2nd and 4th (O/D) gear.
Low One-way Clutch	L/O.C	Allows the front planetary carrier to turn forward (clockwise) but locks to opposite direction (counterclockwise). Operative when accelerating.
Low Clutch Solenoid	L/C.S	Regulates low clutch pressure.
High Clutch Solenoid	H/C.S	Regulates high clutch pressure.
Low & Reverse Brake Solenoid	L&R/B.S	Regulates low & reverse brake pressure.
2-4 Brake Solenoid	2-4/B.S	Regulates 2-4 brake pressure.
Lock-up Solenoid	L/U.S	Regulates lock-up clutch pressure.
High Clutch Oil Pressure SW	H/C.P/SW	Detects high clutch supply oil pressure.
Low & Reverse Brake Oil Pressure SW	L&R/B.P/SW	Detects low & reverse brake supply oil pressure.
2-4 Brake Oil Pressure SW	2-4/B.P/SW	Detects 2-4 brake supply oil pressure.

COMPONENT AND THEIR OPERATING CONDITION

Select lever position	Gear position	Gear Shift	Lock-up	Clutch L/C	Clutch H/C	Clutch R/C	Clutch L/O.C	Brake L&R/B	Brake 2-4/B	Solenoid L/C.S	Solenoid H/C.S	Solenoid L&R/B.S	Solenoid 2-4/B.S	Solenoid L/U.S	Pressure Switch H/C.P/SW	Pressure Switch L&R/B.P/SW	Pressure Switch 2-4 B.P/SW
P	-	-									○	○	○				
R	Reverse	-				○		○			○		○			○	
N	-	-									○	○	○				
D	1st			○			△				○	○	○				
	2nd		○	○					○		○	○		○			○
	3rd		○	○	○							○	○	○	○		
	4th		○		○				○	○		○		○	○		○
3	1st			○			△				○	○	○				
	2nd		○	○					○		○	○		○			○
	3rd		○	○	○							○	○	○	○		
	4th(*1)				○				○	○		○			○		○
2	1st			○			△				○	○	○				
	2nd			○					○		○	○					○
	3rd(*1)			○	○							○	○		○		
	4th(*1)				○				○	○		○			○		○
L	1st			○			△	○			○		○			○	
	2nd(*1)			○					○		○	○					○
	3rd(*1)			○	○							○	○		○		
	4th(*1)				○				○	○		○			○		○

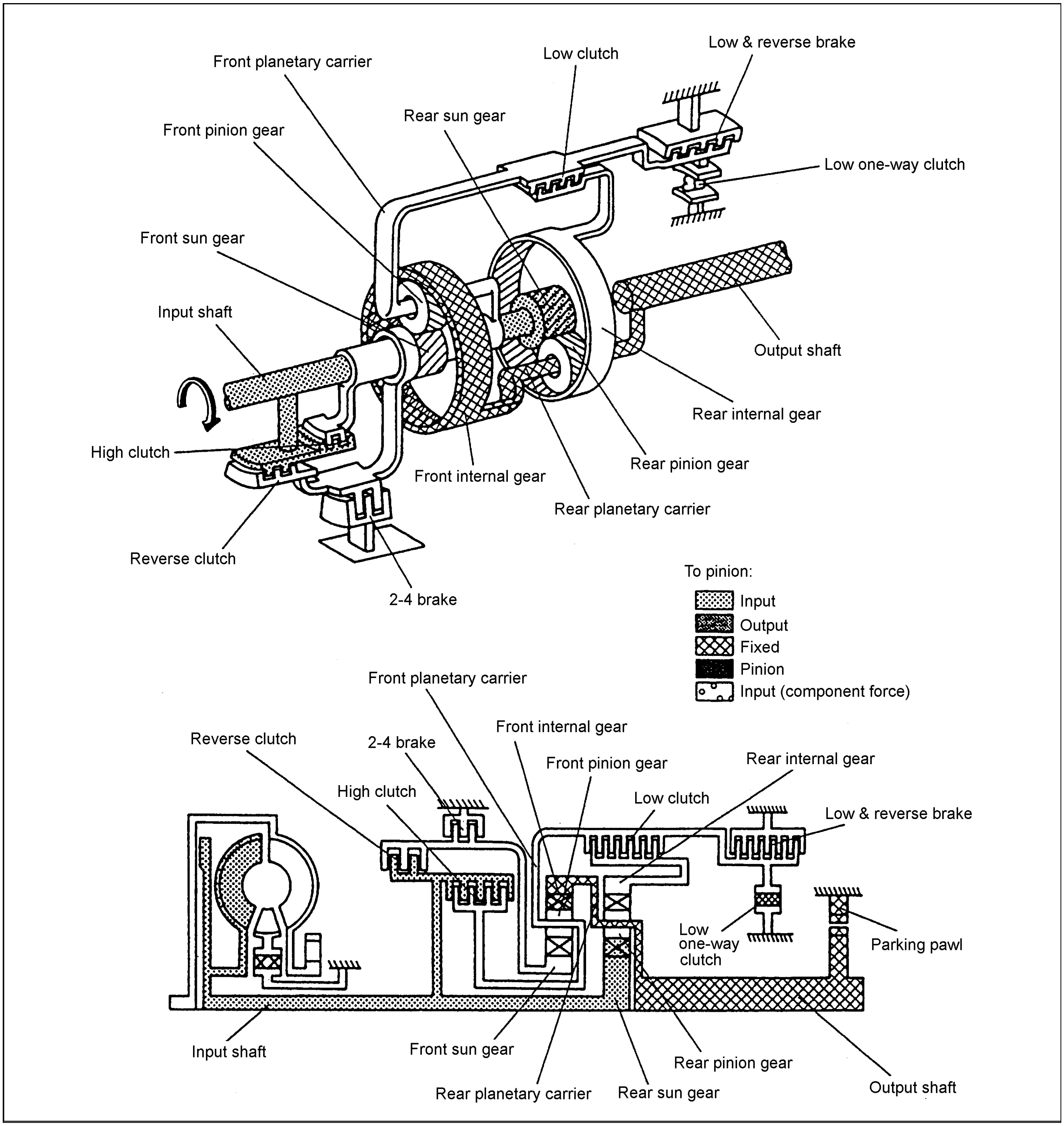
*1: Shifting the select lever to manual position at high speed, the transmission may hold the gear position until vehicle speed get down to certain speed to prevent engine overrun.

○ - Engaged or operated

△- Operative when accelerating

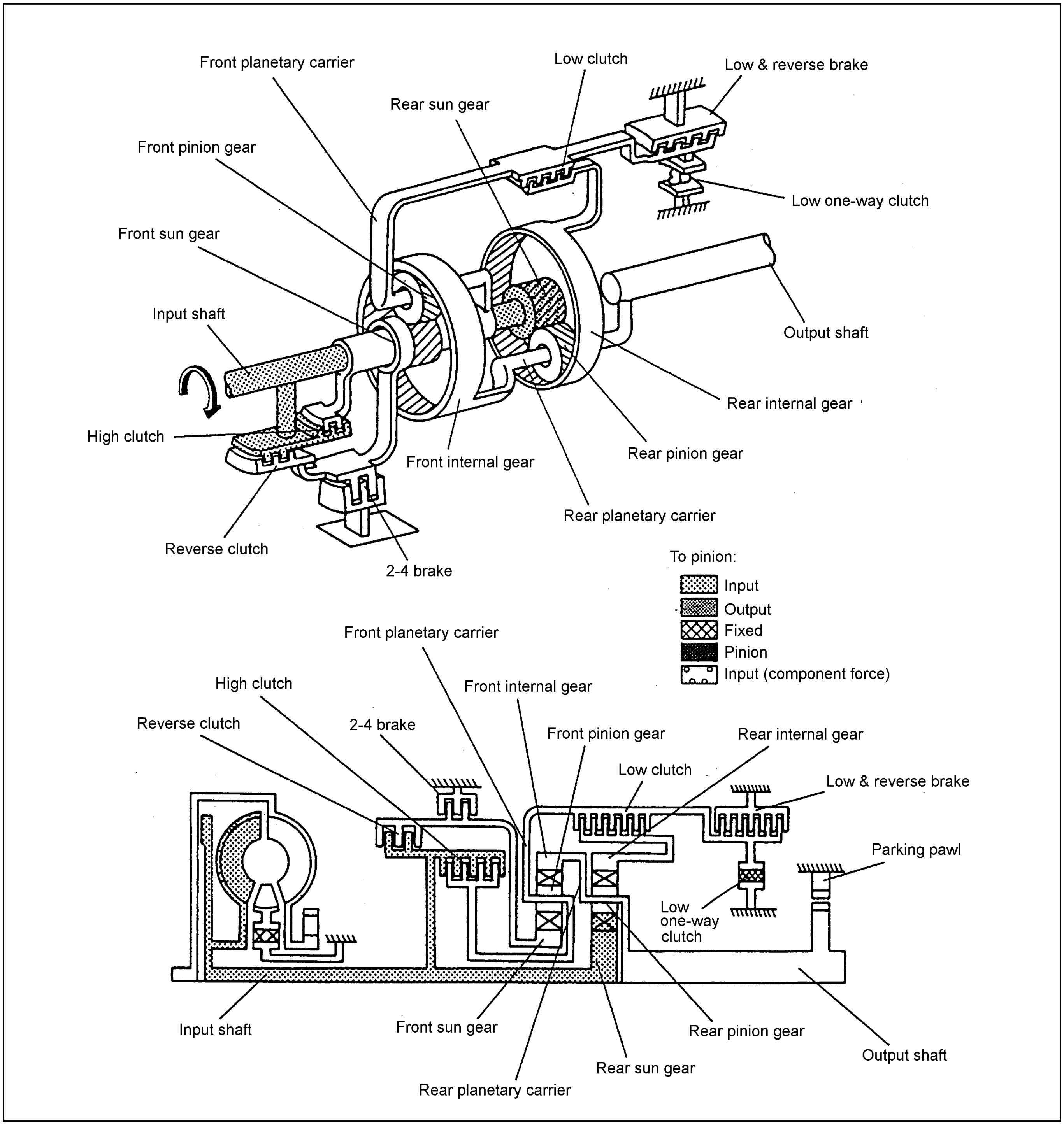
P Position

Although the driving force of the input shaft is transmitted to the rear sun gear and reverse & high clutch drum, the driving force is not transmitted to the output shaft since all of the clutches and brakes are not engaged. Therefore, the vehicle can move in this condition. However, since the output shaft is mechanically locked with the parking pawl, the rear planetary carrier and front internal gear are locked. For this reason, the vehicle does not move.



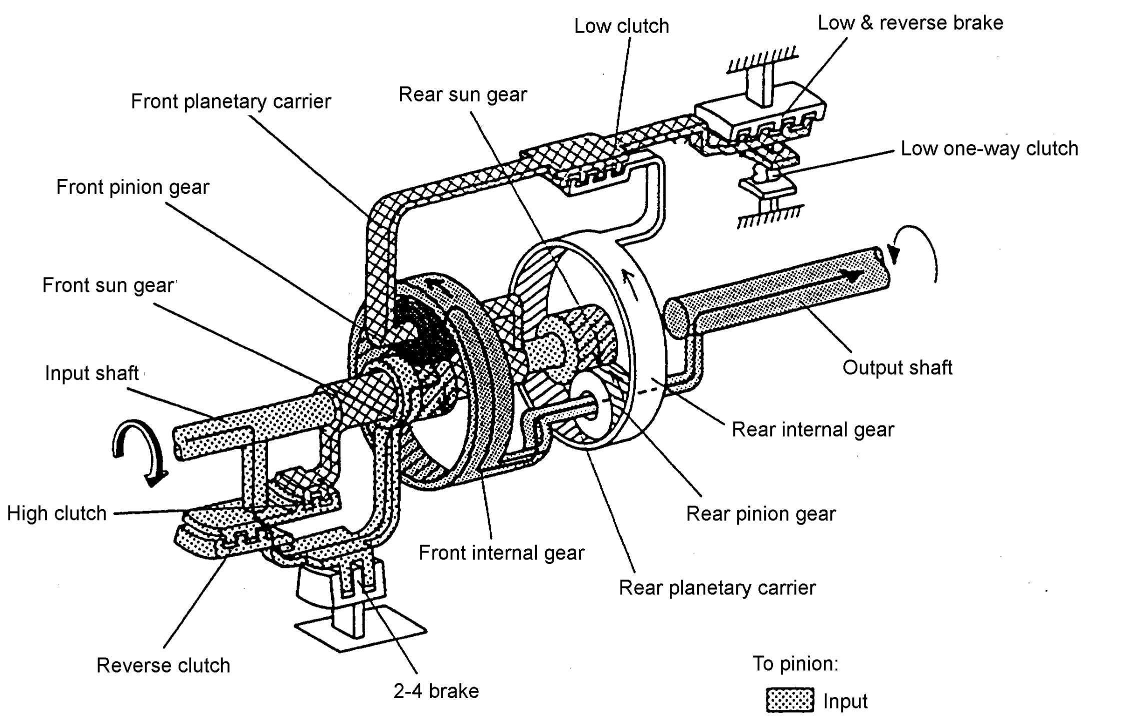
N Position

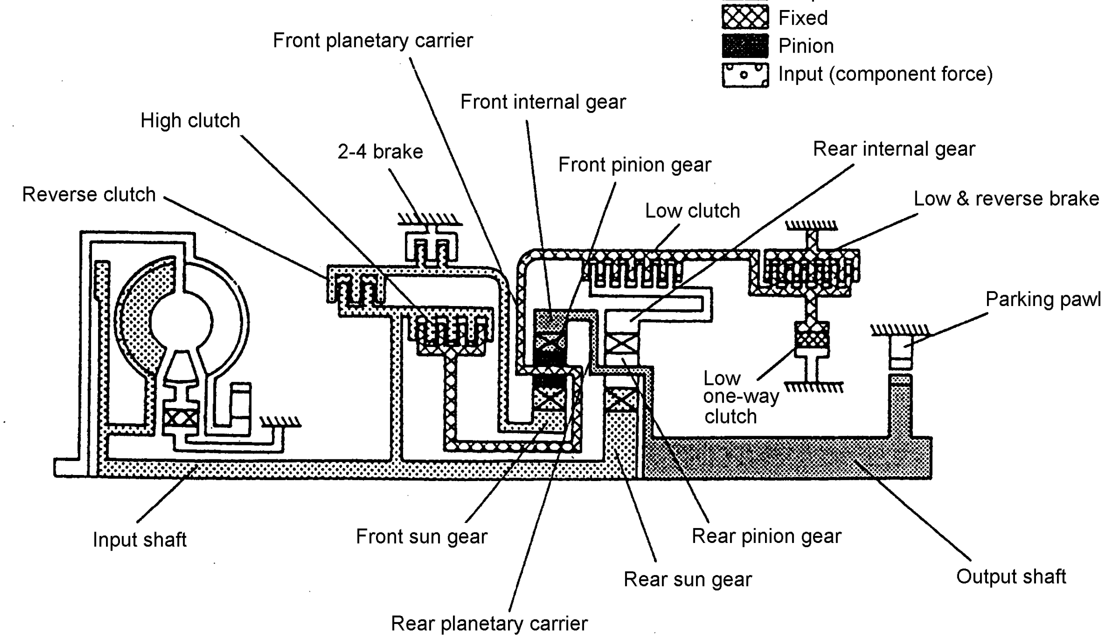
Although the driving force of the input shaft is transmitted to the rear sun gear and reverse & high clutch drum, the driving force is not transmitted to the output shaft, as all of the clutches and brakes are not engaged. Therefore, the vehicle can move at this condition.



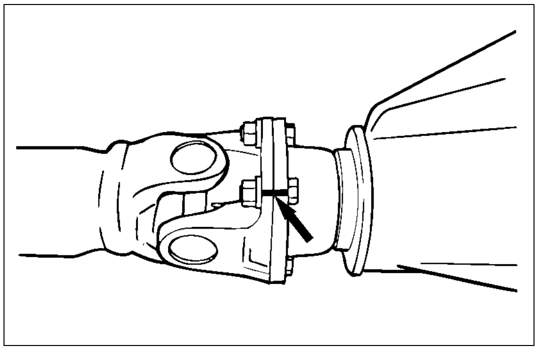
Reverse Gear in Position

The driving force from the input shaft is transmitted to the rear sun gear and reverse & high clutch drum. In the R position, the reverse clutch is engaged and the driving force is transmitted to the front sun gear and rotates it clockwise. The low & reverse brake is also engaged and the front planetary carrier is fixed so that the front pinion gear does not rotate clockwise, but can rotate counterclockwise. As a result, the output shaft rotates counterclockwise and the vehicle goes backwards.





Removal and Installation



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Removal

1. Raise the vehicle on a hoist.

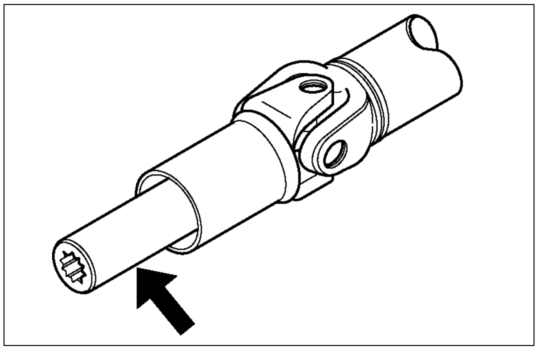
NOTE:

Apply alignment marks on the flange at the rear propeller shaft both front and rear side.

2. Remove center bearing fixing bolt.
3. Remove rear axle side bolt, nut and washer.
4. Remove rear propeller shaft.

NOTE:

Plug the hole of the transmission rear end to prevent oil leakage.



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Installation

NOTE:

Cover the slip yoke with cloth to avoid damage to the oil seal contact surface, when removing propeller shaft from transmission. Do not damage the oil seal contact surface of slip yoke with other parts at removal and installation.

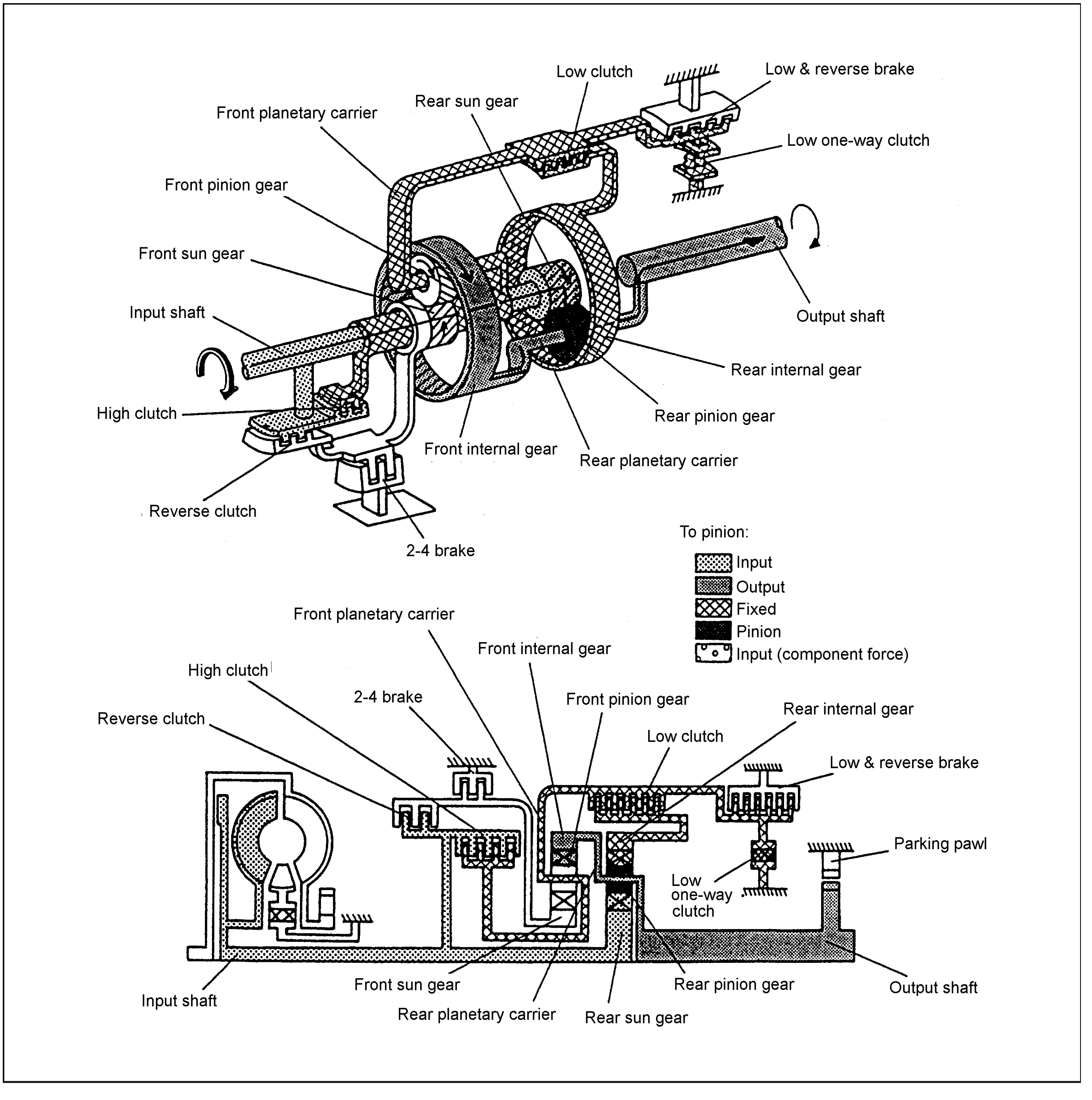
Completely remove the dust or foreign matter from the connecting surface of flange coupling on each end of the propeller shaft.

1. Align the mark which is applied at removal and insert the propeller shaft in the transmission.
2. Install rear propeller shaft and tighten the bolts to the specified torque.
   Torque: 59 N·m (6.0 kgf·m/43 lb·ft)
3. Install center bearing and tighten the bolts to the specified torque.
   Torque: 69 N·m (7.0 kgf·m/51 lb·ft)

1st Gear in D, 3, 2 Position

The driving force from the input shaft is transmitted to the rear sun gear and reverse & high clutch drum. As the low clutch is engaged, the movement of the rear internal gear is restricted. Since the low one-way clutch acts at the same time, counterclockwise rotations of the rear internal gear are locked. As a result, the driving force transmitted to the rear sun gear rotates the rear planetary carrier clockwise, then the rotation speed is decreased and multiple force is transmitted to the output shaft.

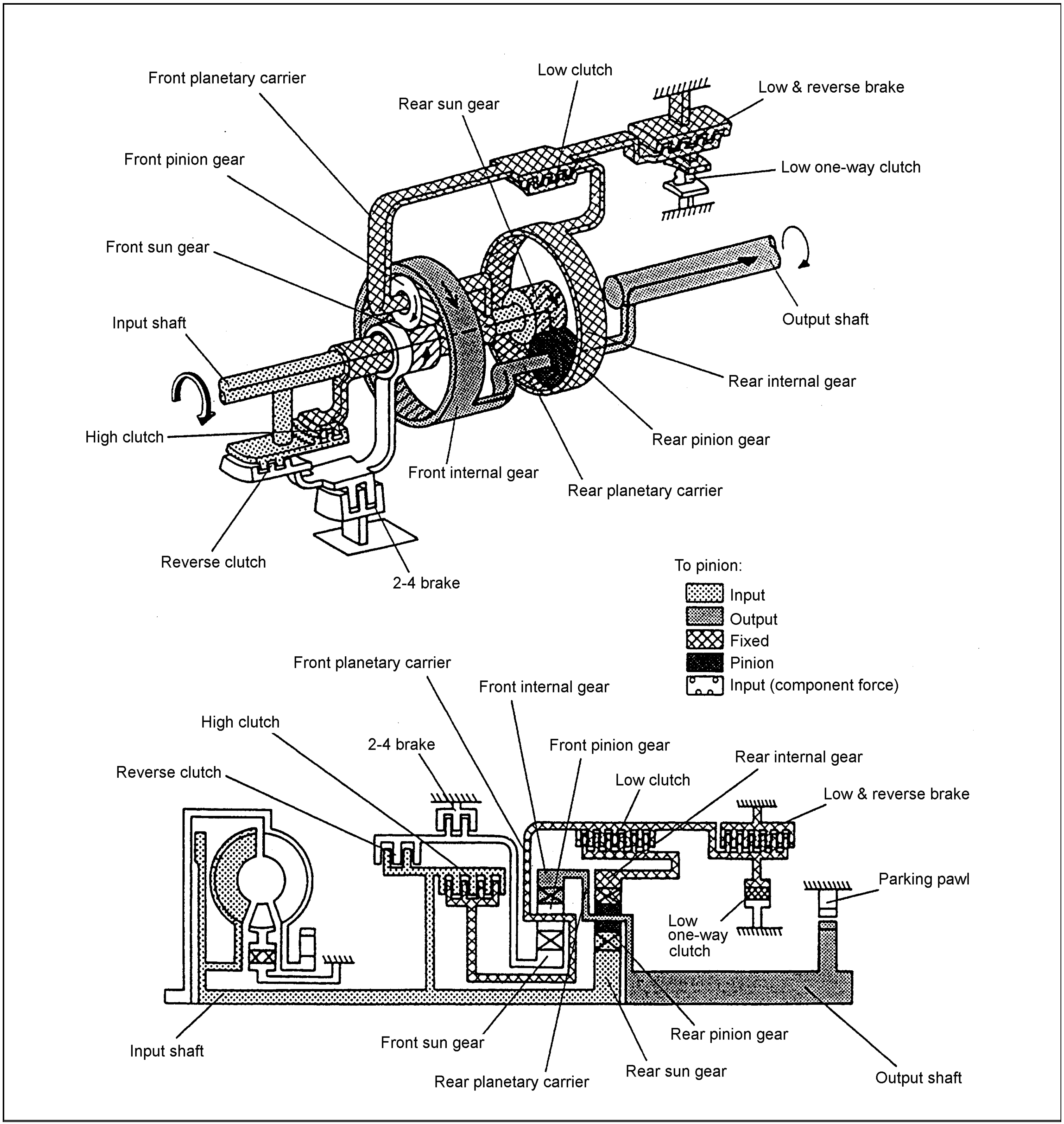
When decelerating, the rotating speed of the rear planetary carrier (rear pinion gear) is higher than that of the rear sun gear and the rear internal gear attempts to rotate clockwise. At this time, the low one-way clutch does not act but races, and therefore the rear internal gear rotates clockwise. The reverse torque from the driving shaft is not transmitted to the engine side and the engine brake does not act.



1st Gear in L Position

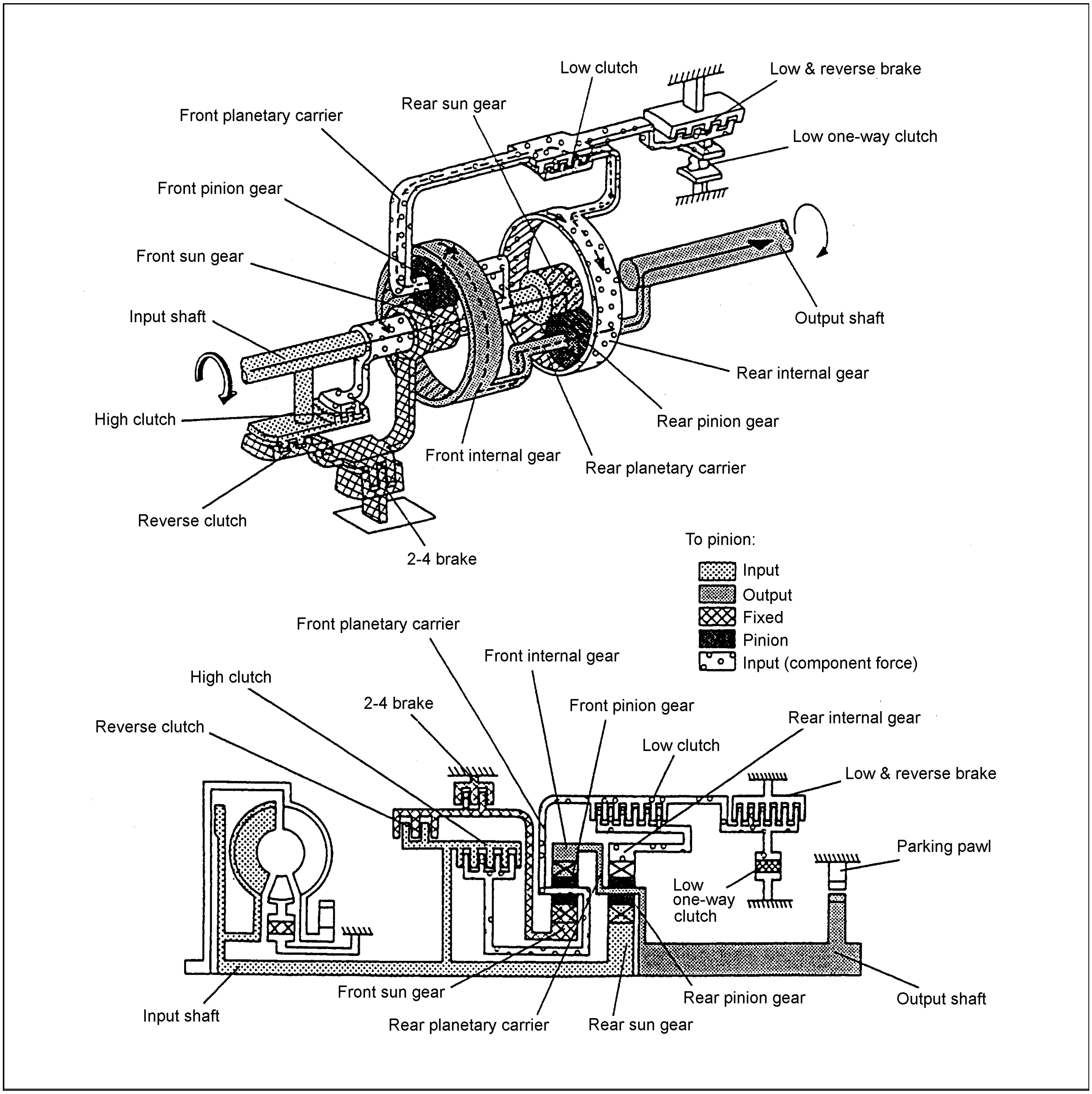
The basic mechanism is the same as in the D, 3, and 2 positions. To apply the engine brake, the low & reverse brake is engaged to restrict the movement of the low one-way clutch.

When decelerating, as the rear internal gear is fixed, reverse torque from the drive shaft is transmitted to the engine side so that the engine brake is applied.



2nd Gear in D, 3, 2 Position

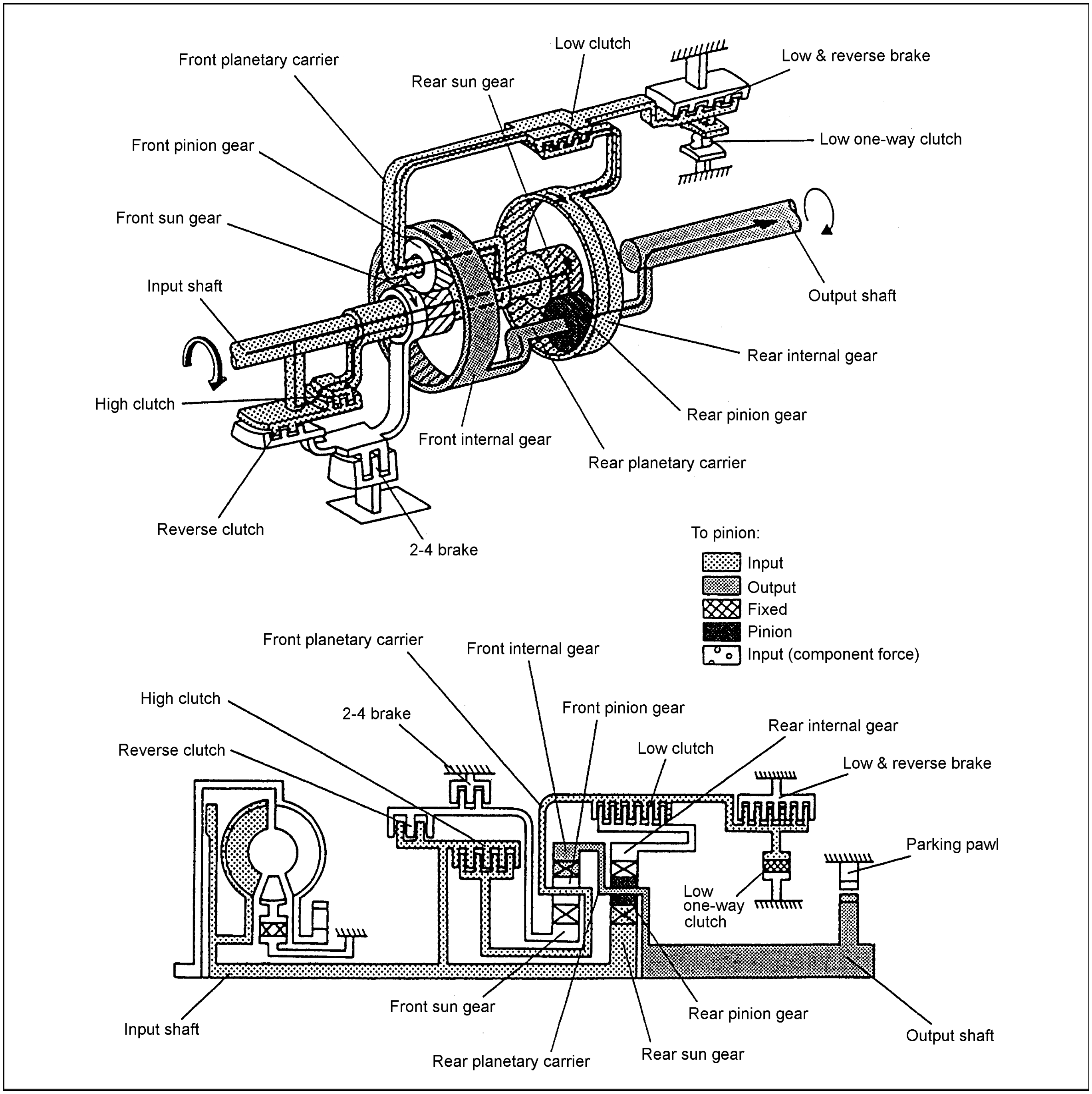
The driving force from the input shaft is transmitted to the rear sun gear and reverse & high clutch drum. As in the case of the 1st gear, the low clutch is engaged and the movement of the rear internal gear is restricted. Since the 2-4 brake is engaged, the front sun gear is fixed. As a result, movement of the rear internal gear is restricted, and the driving force transmitted to the rear sun gear rotates the rear planetary carrier clockwise. The rotating speed of the rear planetary carrier is higher than in 1st gear as the rear internal gear rotates. When decelerating, the engine brake is applied.



3rd Gear in D, 3 Position

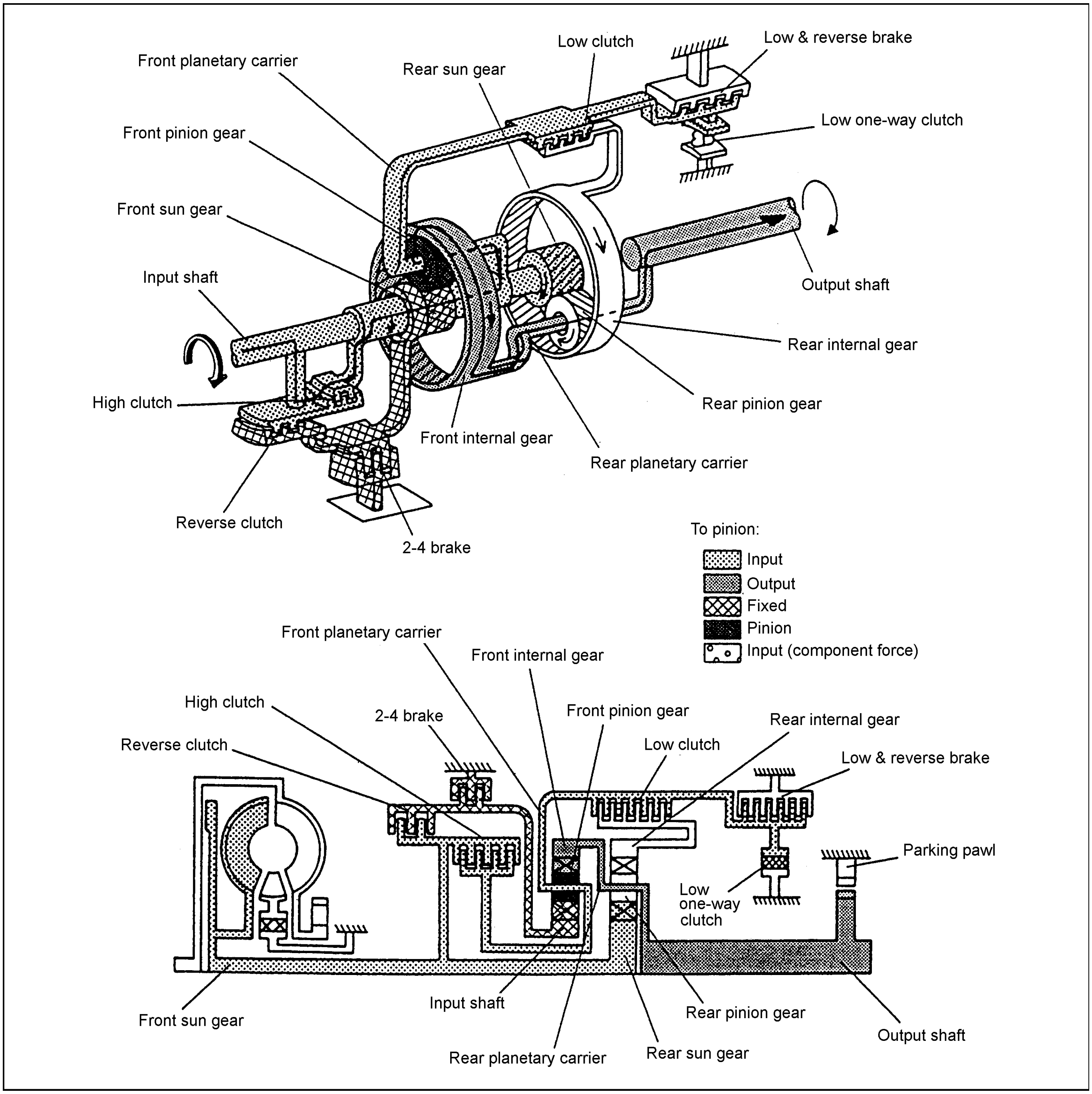
The driving force from the input shaft is transmitted to the rear sun gear and reverse & high clutch drum. As in the case of the 1st gear and 2nd gear, the low clutch is engaged and the movement of the rear internal gear is restricted. Since the high clutch is engaged, the driving force from the input shaft is directly transmitted to the rear internal gear. As a result, the rpm of the rear sun gear and the rear internal gear becomes the same as that of the input shaft, so that the rear pinion gear rotates not independently but together with the rear sun gear and rear internal gear.

When decelerating, the engine brake is applied.



4th Gear (O/D) in D Position

The driving force from the input shaft is transmitted to the rear sun gear and reverse & high clutch drum. Since the 2-4 brake is engaged, the front sun gear is fixed. In addition to this the high clutch is engaged. As a result, the front pinion gear rotates itself together with other gears clockwise. This rotation increases the speed of rotation of the front internal gear and is transmitted to the output shaft.



TRANSMISSION

TRANSMISSION CONTROL SYSTEM (JR405E)

This manual conforms when Scan Tool of ISO CAN Base Software is used.

TABLE OF CONTENTS

Specifications

Transmission General Specifications

Transmission model	JR405E	
Transmission type: J	Jatco	
Transmission type: R	Rear wheel drive	
Transmission type: 4	Four forward gears	
Transmission type: 05	Product series	
Transmission type: E	Electronic controls	
Torque converter type	Three elements, one stage & two phases type with torque converter clutch	
Torque converter stall torque ratio	1.8	
Transmission fluid	Name	DEXRON III
	Capacity (L)	9.2 - 9.6
	Cooling system	Water cooled type
Gear ratio	1st	2.785
	2nd	1.545
	3rd	1.000
	4th	0.694
	Reverse	2.272
Clutch	High clutch (Number of disc)	5
	Low clutch (Number of disc)	7
	Reverse clutch (Number of disc)	2
One-way clutch	Low one-way clutch (Number of set)	1
Brake	Low & reverse brake (Number of disc)	6
	2-4 brake (Number of disc)	5
Front planetary gear unit	Sun gear (Number of teeth)	33
	Pinion gear (Number of teeth)	21
	Ring gear (Number of teeth)	75
Rear planetary gear unit	Sun gear (Number of teeth)	42
	Pinion gear (Number of teeth)	17
	Ring gear (Number of teeth)	75

Transmission Fluid Temperature vs. Resistance

°C	°F	Ohms
Temperature vs. Resistance Value (Approximately)		
150	302	60
140	284	80
130	266	90
120	248	120
110	230	150
100	212	190
90	194	250
80	176	320
70	158	430
60	140	590
50	122	820
40	104	1160
30	86	1680
20	68	2500
10	50	3820
0	32	6030
-10	14	9840
-20	-4	16710
-30	-22	29610

Clutch, Brake, Solenoid and Pressure Switch Logic

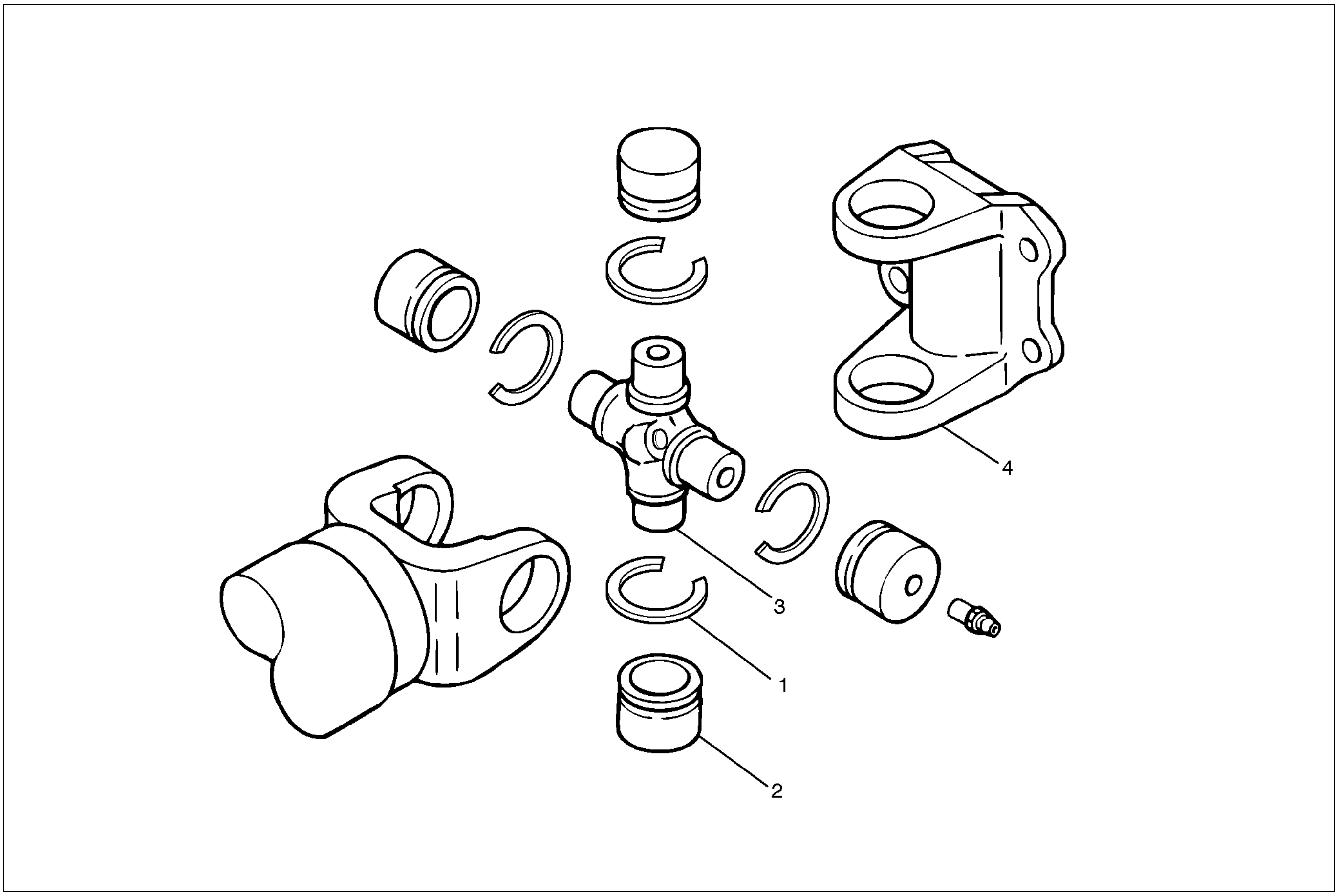
		Clutch status				Brake status	
Selector position	Selected gear position	High clutch	Low clutch	Reverse clutch	Low one-way clutch	Low & reverse brake	2-4 brake
P	-						
R	Reverse			○		○	
N	-						
D	1st		○		○ *1		
	2nd		○				○
	3rd	○	○				
	4th	○					○
3	1st		○		○ *1		
	2nd		○				○
	3rd	○	○				
2	1st		○		○ *1		
	2nd		○				○
L	1st		○		○ *1	○	
		○= Applied *1= Holding					

		Solenoid command				Transmission fluid pressure (TFP) switch		
Selector position	Selected gear position	Low & reverse brake	2-4 brake	High clutch	Low clutch	Low & reverse brake	2-4 brake	High clutch
P	-	○	○	○				
R	Reverse		○	○		○		
N	-	○	○	○				
D	1st	○	○	○				
	2nd	○		○			○	
	3rd	○	○					○
	4th	○			○		○	○
3	1st	○	○	○				
	2nd	○		○			○	
	3rd	○	○					○
2	1st	○	○	○				
	2nd	○		○			○	
L	1st		○	○		○		
		○= Command On				○= On (closed)		

Diagnostic Trouble Code (DTC) List

DTC	Flash Code	DTC Descriptor
P0560	16	System Voltage Malfunction
P0602	—	Control Module Programming Error
P0705	17	Inhibitor Switch Malfunction
P0710	15	Transmission Fluid Temperature Sensor Circuit Malfunction
P0717	14	Input/Turbine Speed Sensor “A” Circuit No Signal
P0722	11	Output Speed Sensor Circuit No Signal
P0727	13	Engine Speed Sensor Input Circuit No Signal
P0731	41	Gear 1 Incorrect Ratio
P0732	42	Gear 2 Incorrect Ratio
P0733	43	Gear 3 Incorrect Ratio
P0734	44	Gear 4 Incorrect Ratio
P0748	35	Line Pressure Solenoid Malfunction
P0753	31	Low & Reverse Brake Duty Solenoid Malfunction
P0758	32	2-4 Brake Duty Solenoid Malfunction
P0763	33	High Clutch Duty Solenoid Malfunction
P0768	34	Low Clutch Duty Solenoid Malfunction
P1120	22	Throttle Position Signal Malfunction
P1750	51	Low & Reverse Brake Fail Safe Valve Malfunction
P1755	52	2-4 Brake Fail Safe Valve Malfunction
P1853	26	Low & Reverse Brake Pressure Switch Malfunction
P1858	27	2-4 Brake Pressure Switch Malfunction
P1860	36	Lock Up Duty Solenoid Malfunction
P1863	28	High Clutch Pressure Switch Malfunction
P1875	25	Ground Return Malfunction

Universal Joint Disassembly



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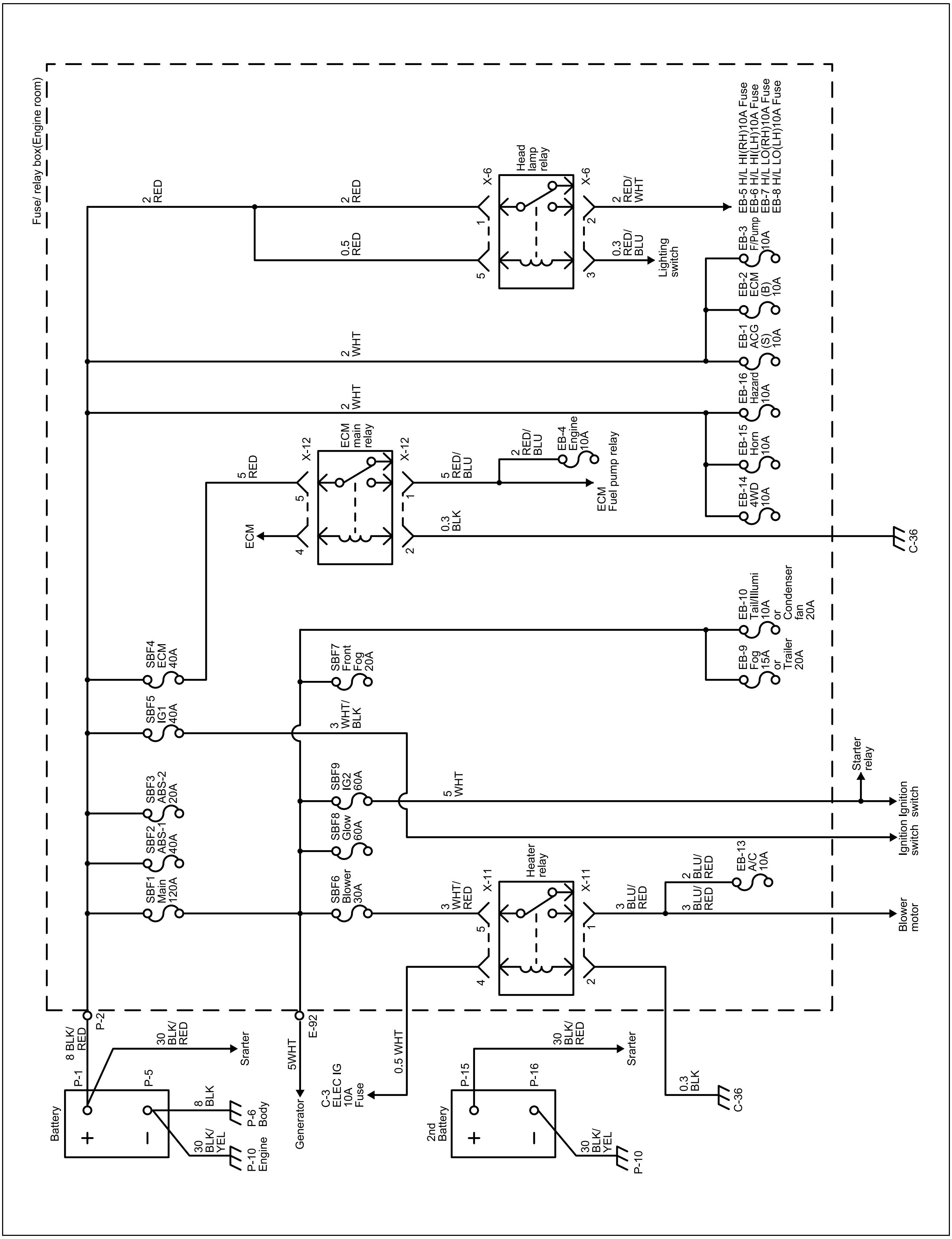
Legend

1. Snap Ring
2. Needle Roller Bearing
3. Spider
4. Yoke

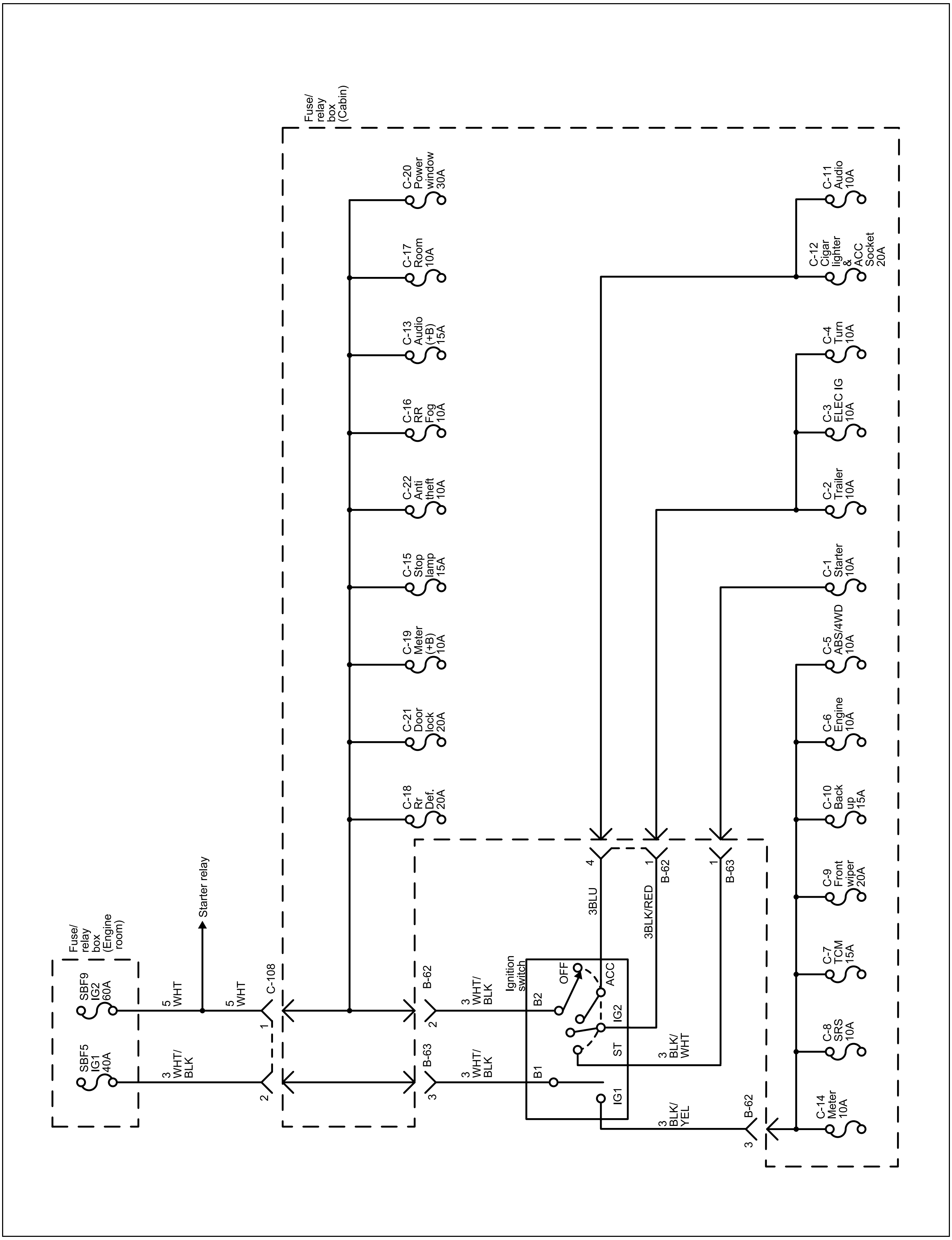
Schematic and Routing Diagrams

Transmission Controls Schematics

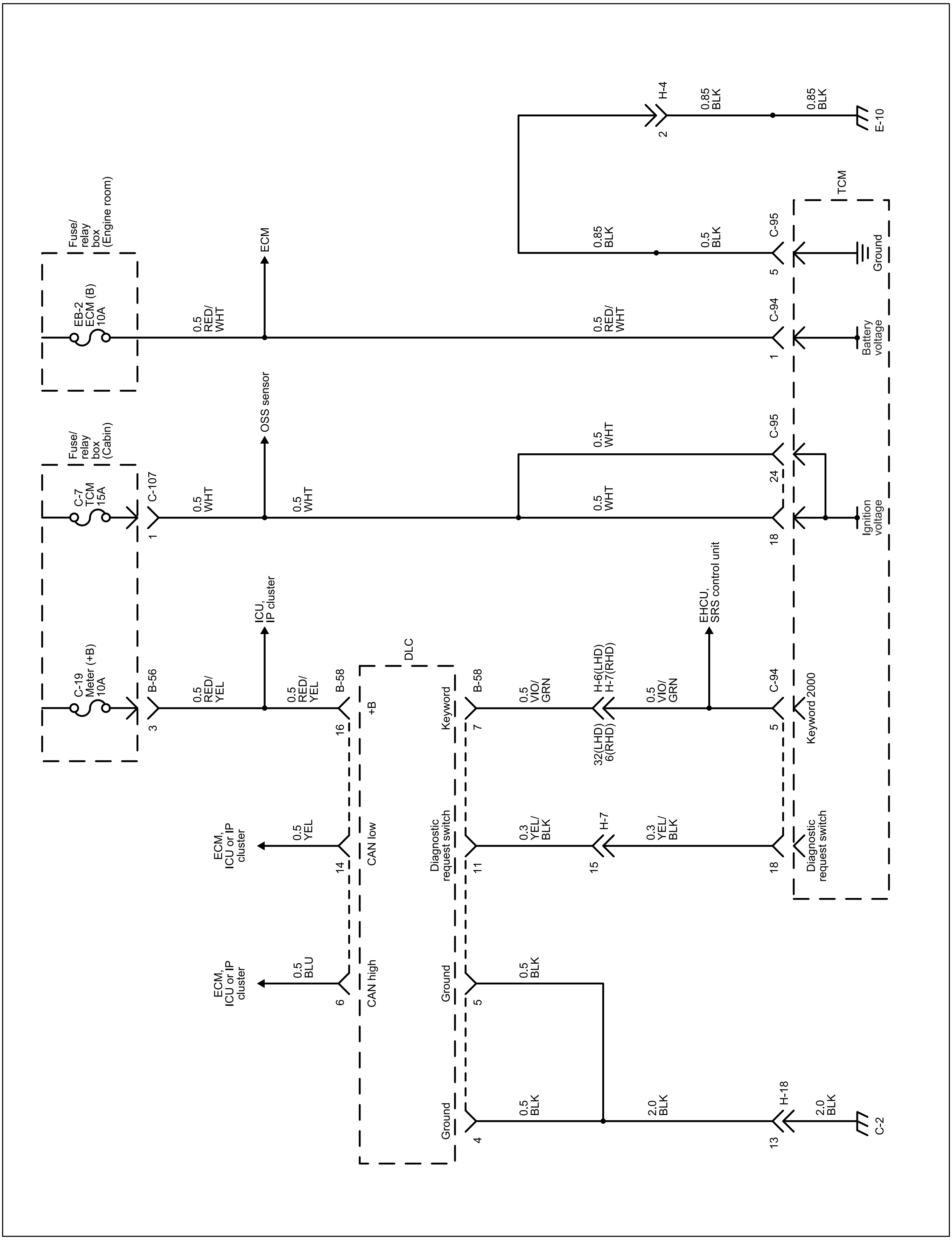
Power Distribution (1)



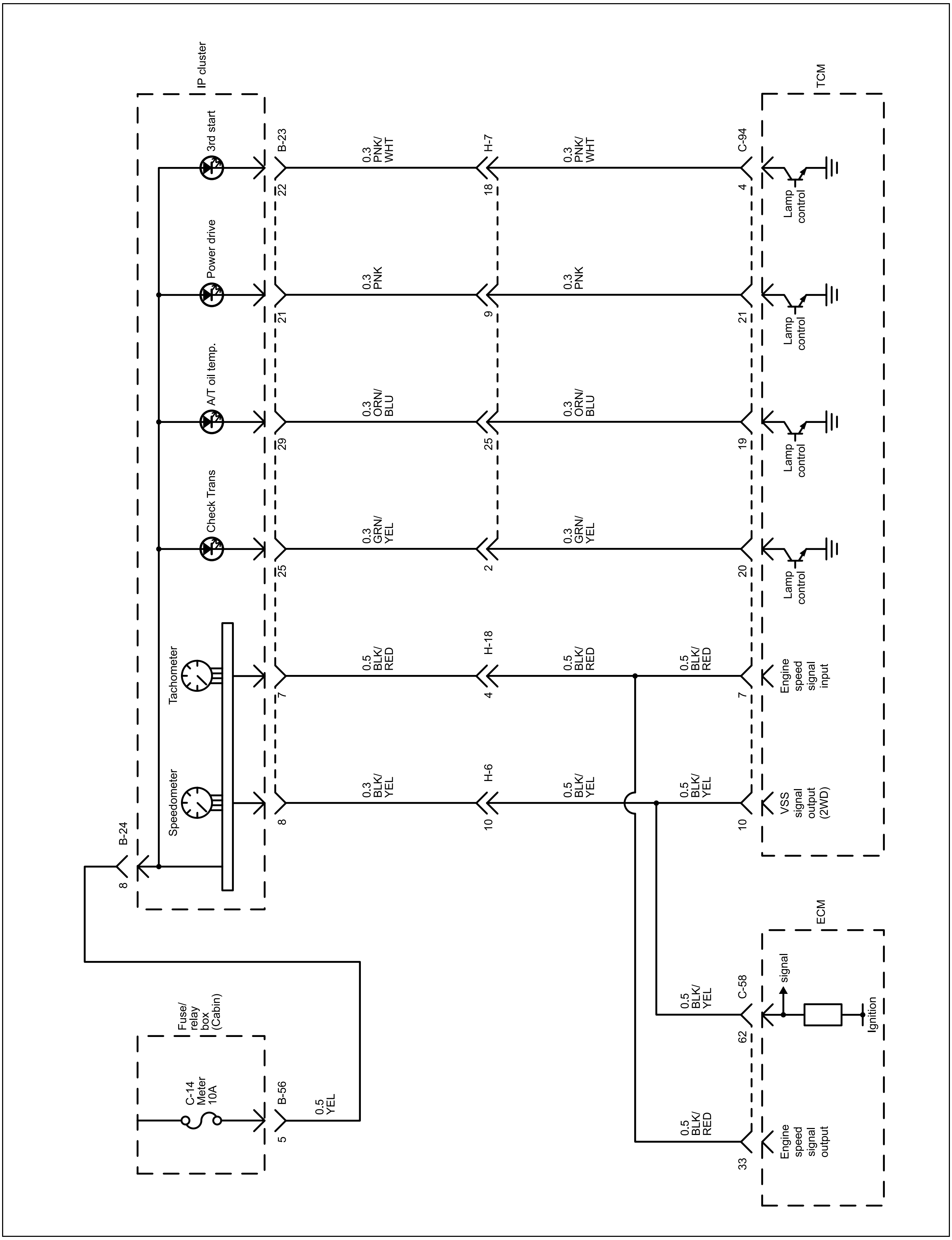
Power Distribution (2)



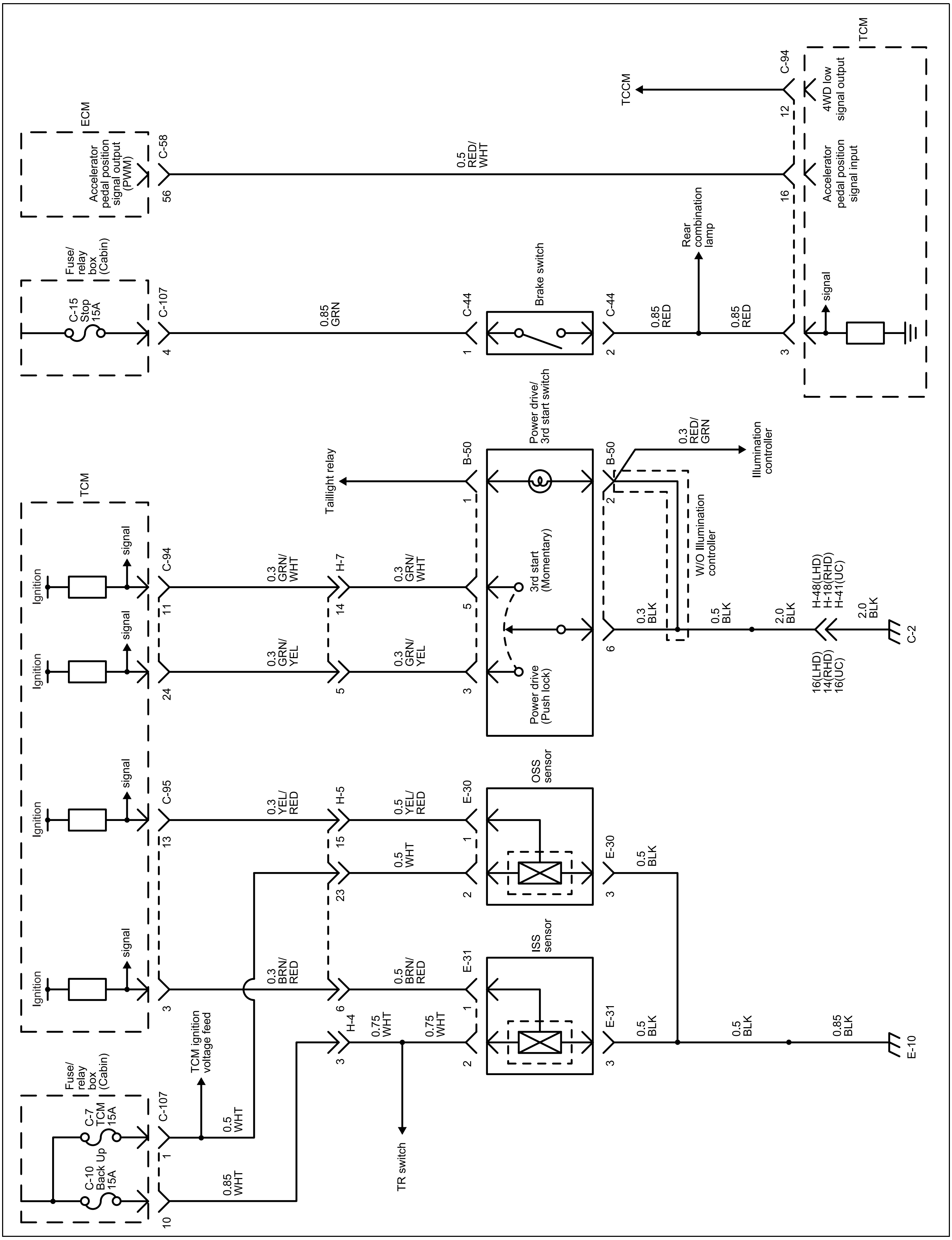
TCM Power, Ground and Serial Data Circuits



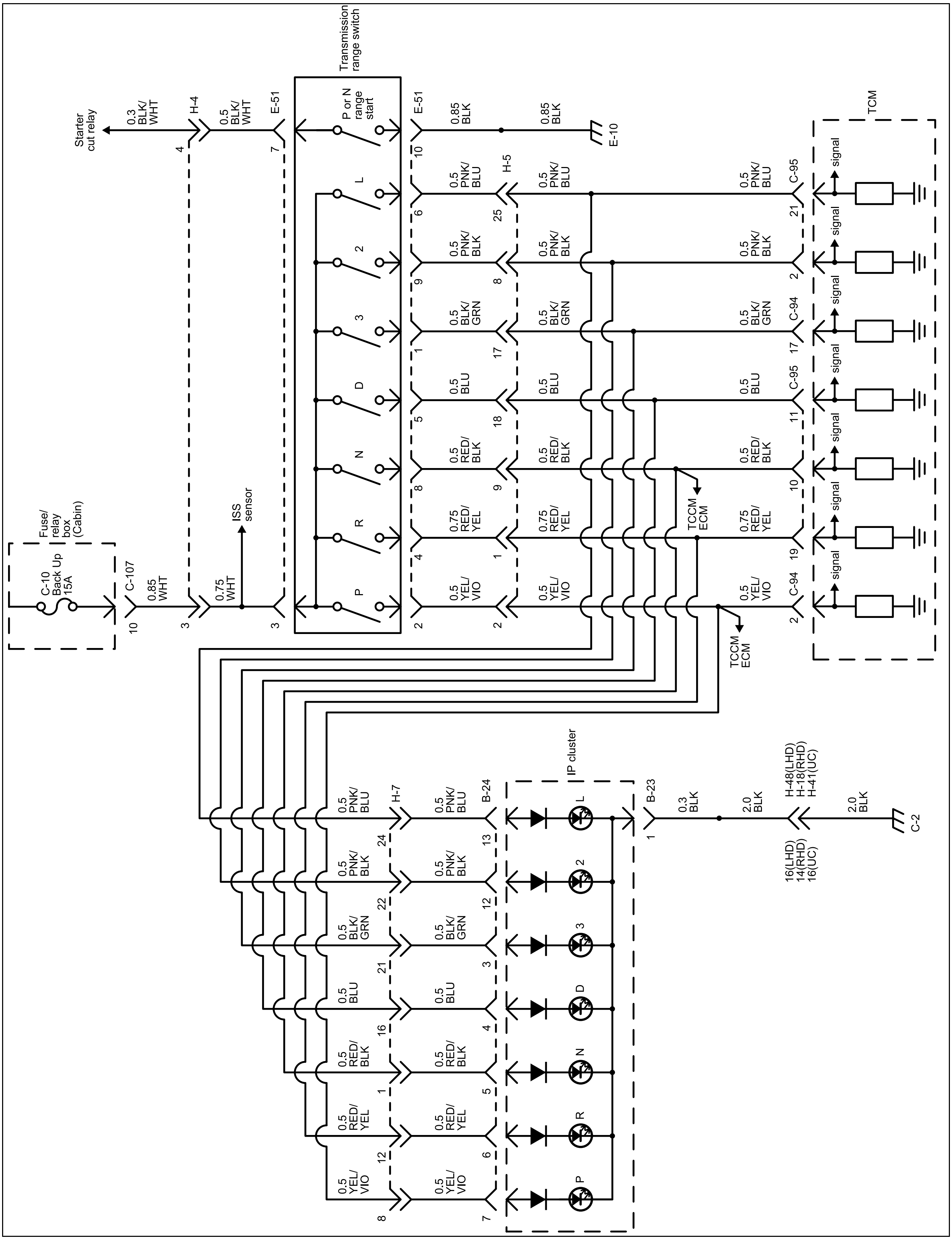
Meters and Warning Lamps



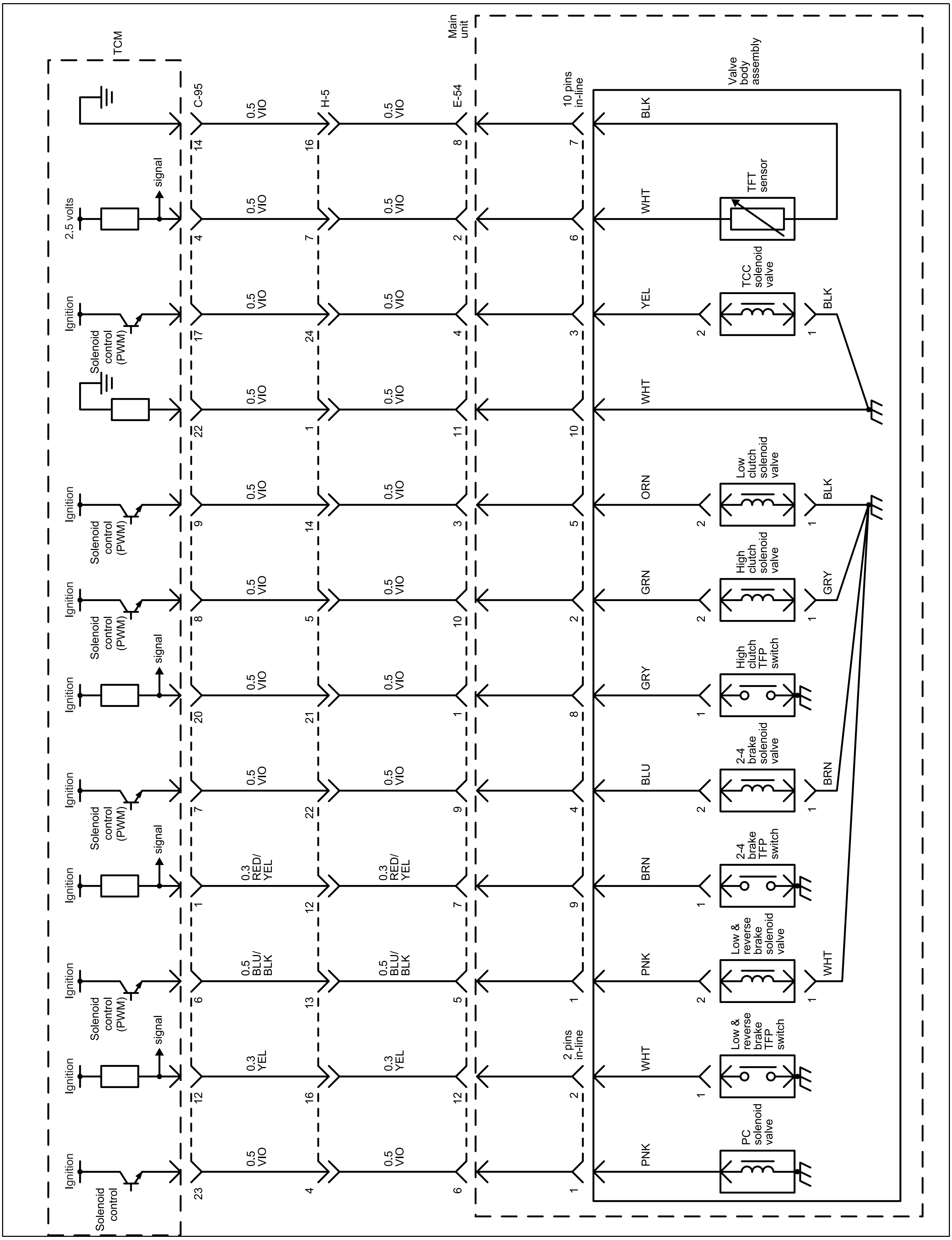
ISS & OSS Sensor, Driving Mode & Brake Switch and APP Signal



TR Switch and Indicator Lamps

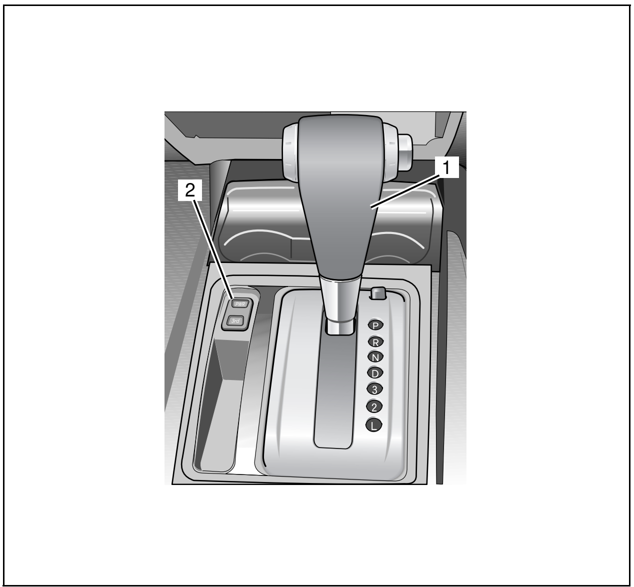


PC Solenoid, TCC Solenoid, Shift Solenoid, TFP Switch and TFT Sensor



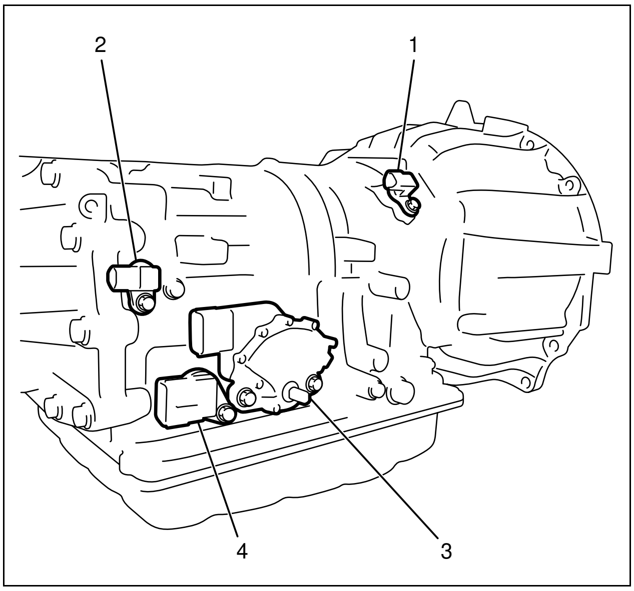
Component Locator

Transmission Controls Component Views



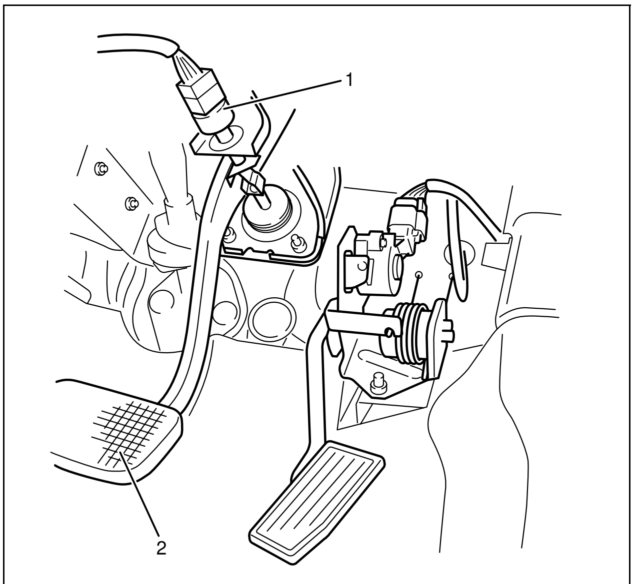
Legend

1. Selector lever
2. Power drive and 3rd start switch



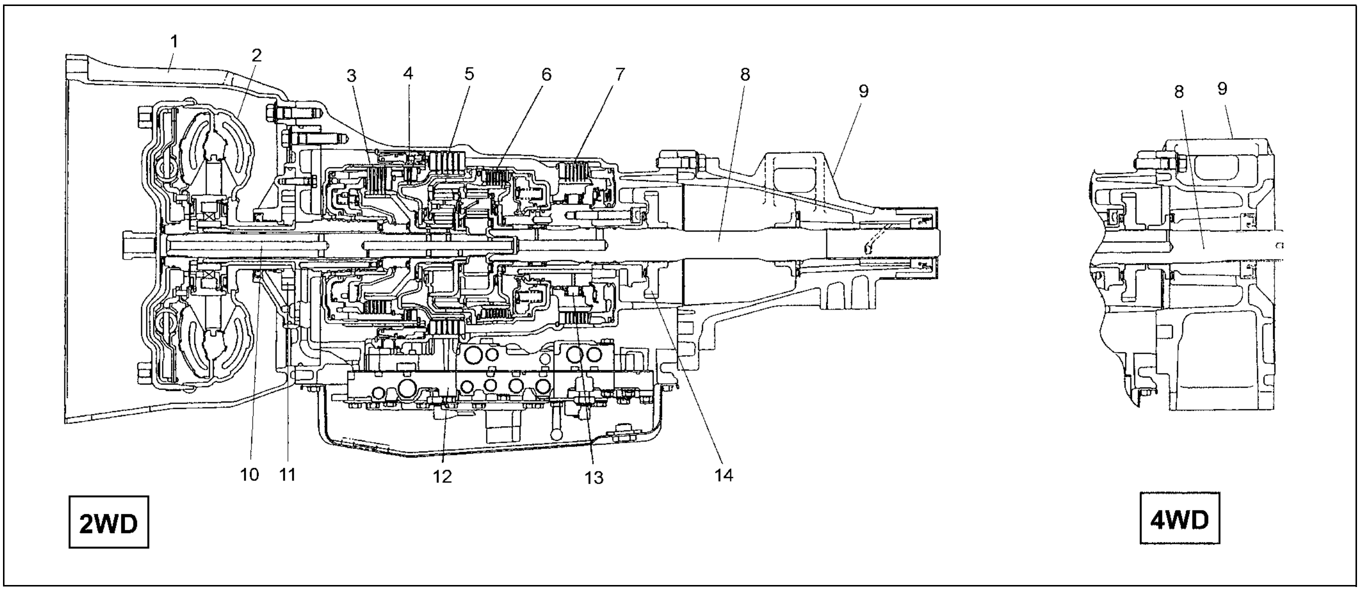
Legend

1. Input shaft speed (ISS) sensor
2. Output shaft speed (OSS) sensor
3. Transmission range (TR) switch
4. In-line harness connector



Legend

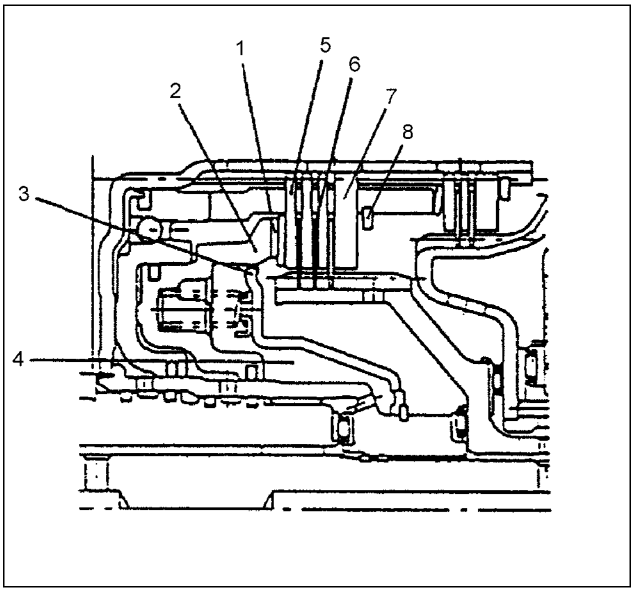
1. Brake pedal switch
2. Brake pedal



Legend

1. Torque converter housing
2. Torque converter
3. High clutch
4. Reverse clutch
5. 2-4 brake
6. Low clutch
7. Low & reverse brake
8. Output shaft
9. Extension housing
10. Input shaft
11. Oil pump
12. Valve body
13. Low one-way clutch
14. Parking gear

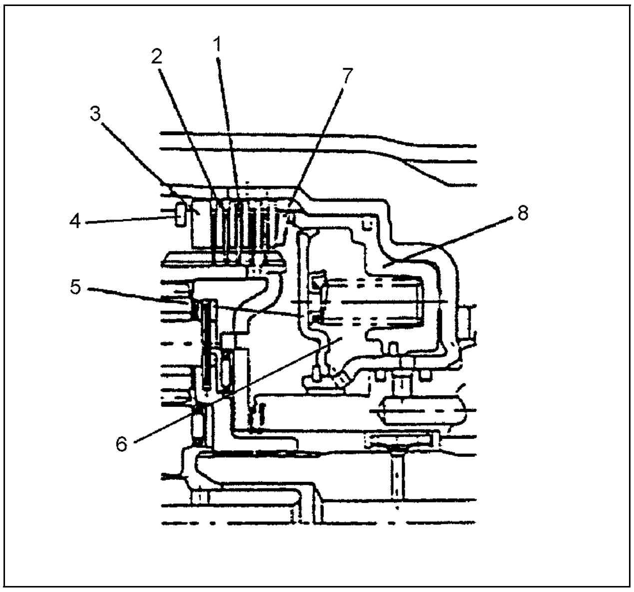
High Clutch



Legend

1. Dish plate
2. High clutch piston
3. Centrifugal cancel cover
4. Centrifugal balance chamber
5. Driven plate
6. Drive plate
7. Retaining plate
8. Snap ring

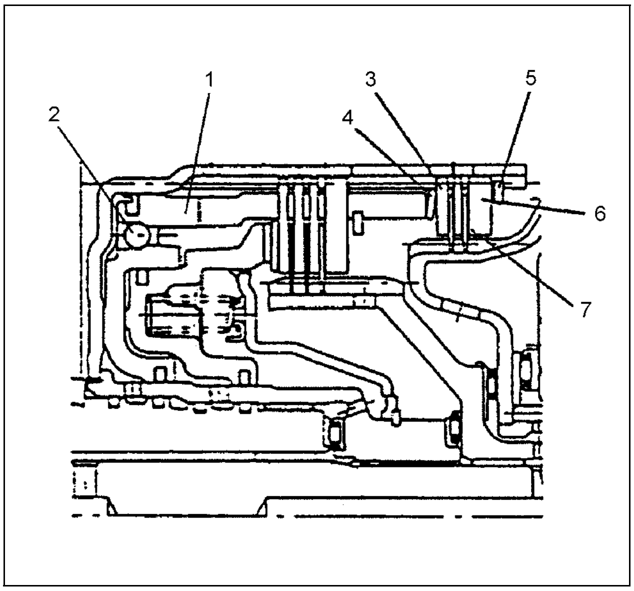
Low Clutch



Legend

1. Drive plate
2. Driven plate
3. Retaining plate
4. Snap ring
5. Centrifugal cancel cover
6. Centrifugal balance chamber
7. Dish plate
8. Low clutch piston

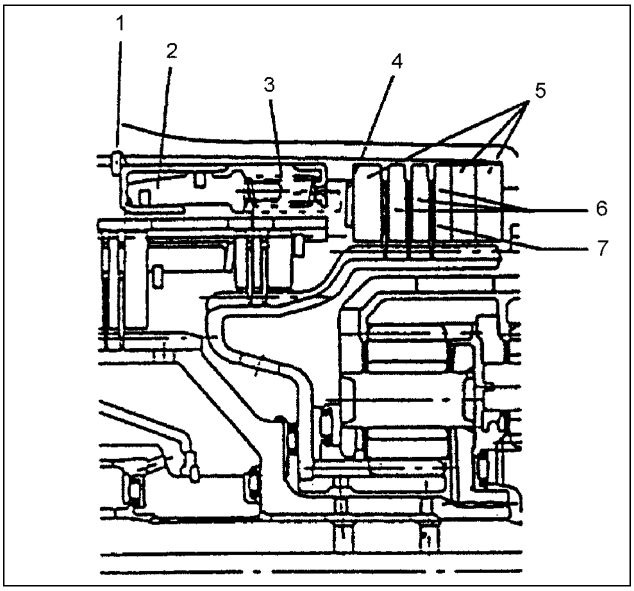
Reverse Clutch



Legend

1. Reverse clutch piston
2. Check ball
3. Driven plate
4. Dish plate
5. Snap ring
6. Retaining plate
7. Drive plate

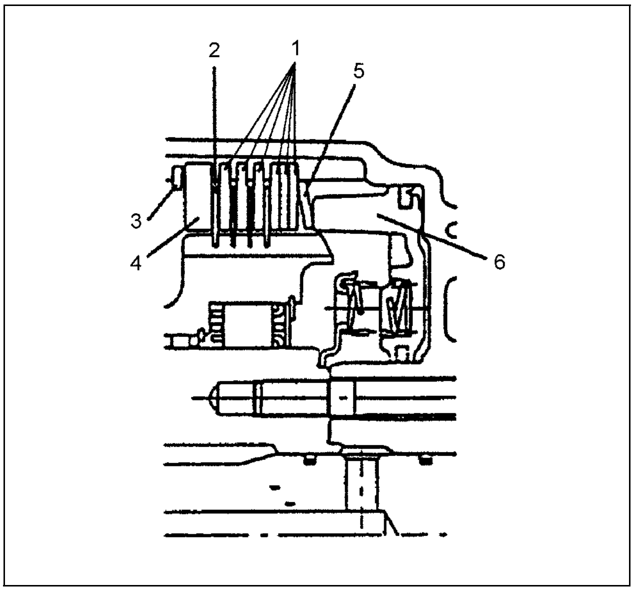
2-4 Brake



Legend

1. Snap ring
2. 2-4 brake piston
3. Return spring
4. Dish plate
5. Retaining plate
6. Driven plate
7. Drive plate

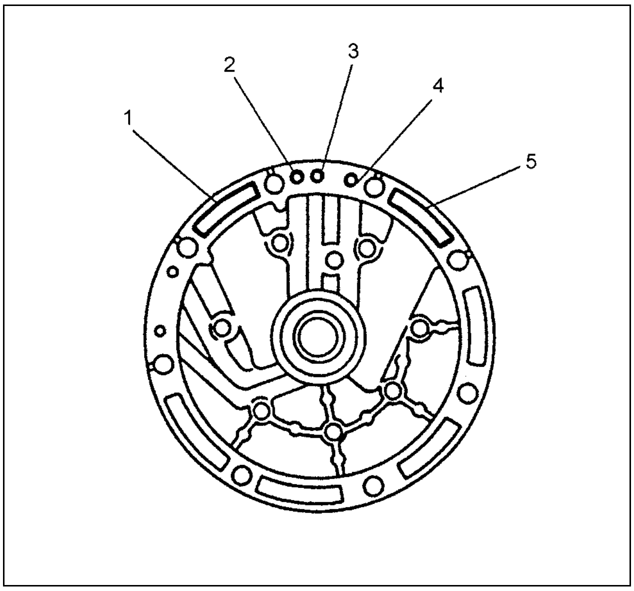
Low & Reverse Brake



Legend

1. Driven plate
2. Drive plate
3. Snap ring
4. Retaining plate
5. Dish plate
6. Low & reverse brake piston

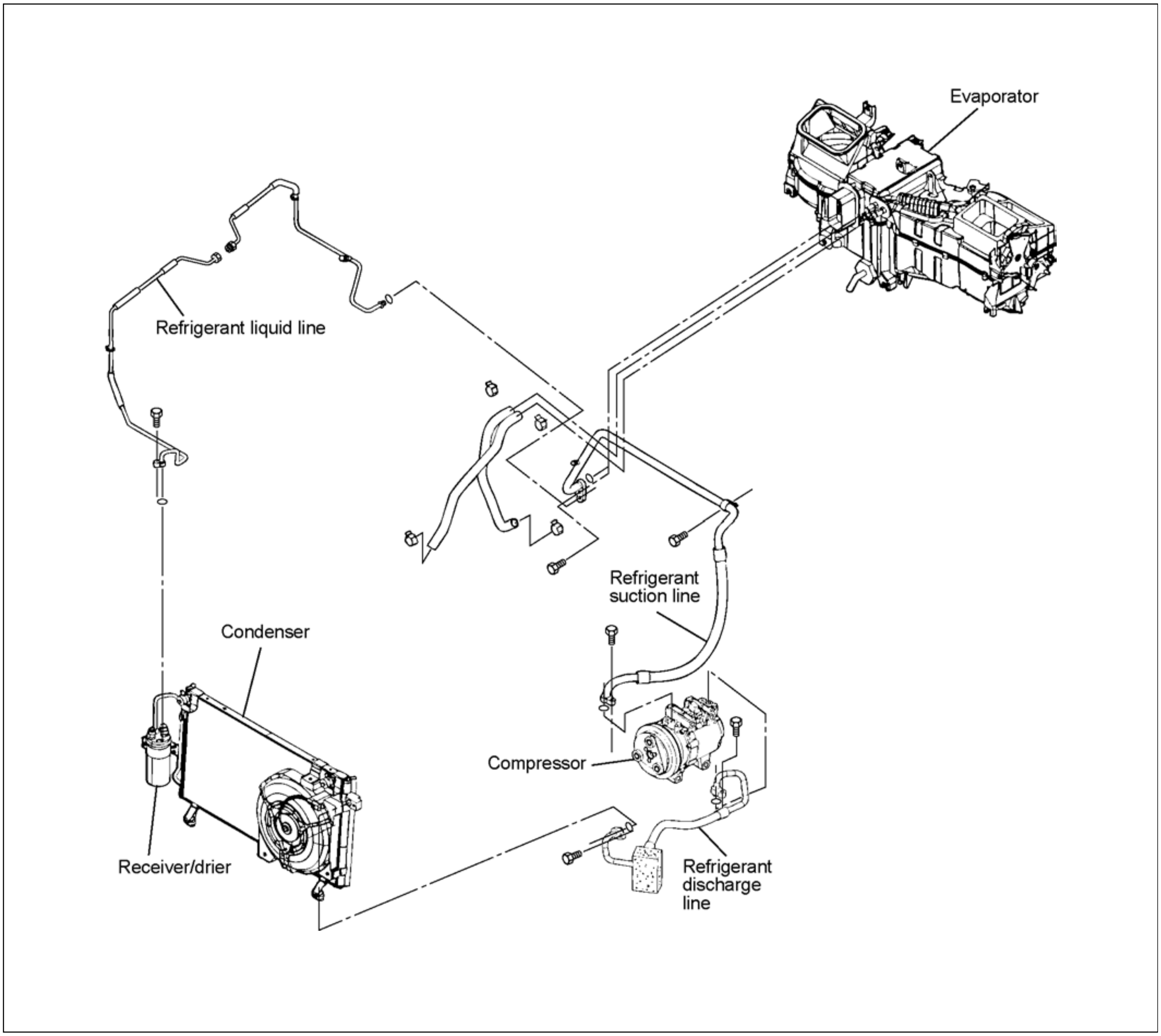
Transmission Fluid Passages (Oil Pump)



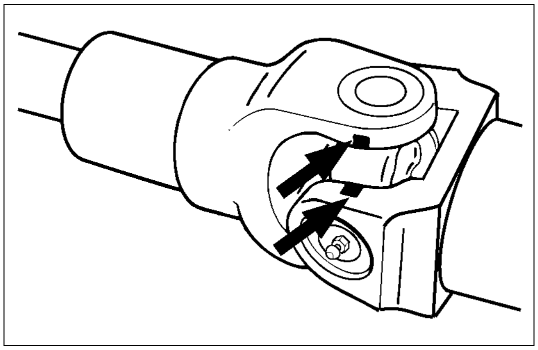
Legend

1. Oil pump passage (inlet)
2. Front lubrication passage
3. High clutch passage
4. Reverse clutch passage
5. Oil pump passage (outlet)

(C24SE LHD MODEL)

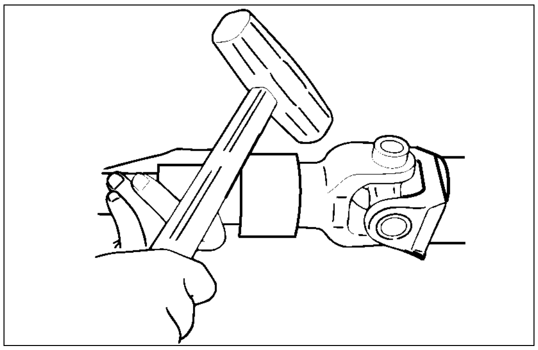


RTW710LF002401



401R300003

1. **Remove the snap rings.**
   - Apply alignment marks on the yokes of the universal joint.



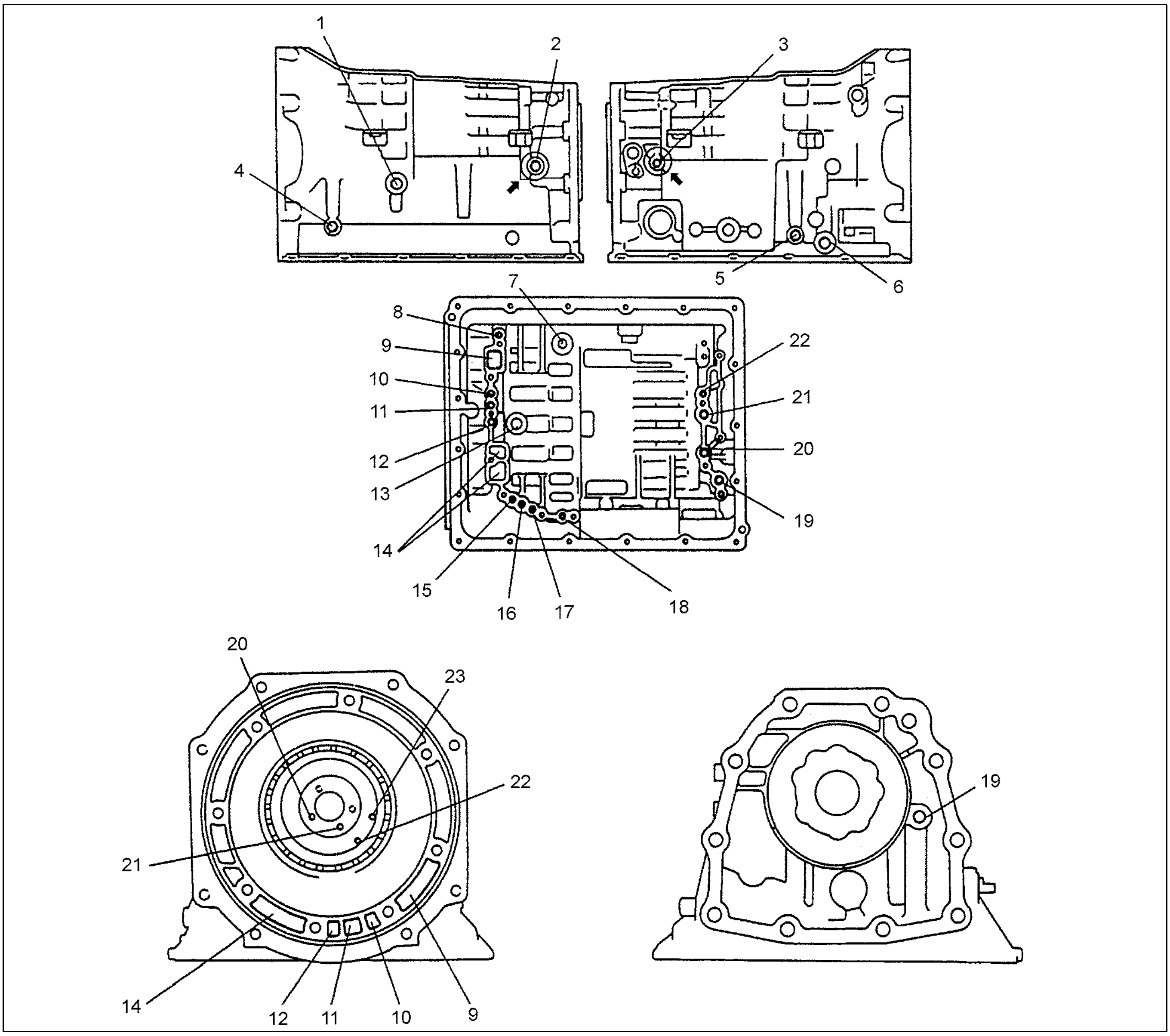
401R300004

2. **Remove the needle roller bearings.**
   - Tap out the bearing by gently striking the shoulder of the yoke, using a mallet or a copper hammer.

3. **Remove the spider.**
   - Make sure of proper position for reinstallation by applying setting marks.

4. **Remove the yoke.**

Transmission Fluid Passages (Main Unit)

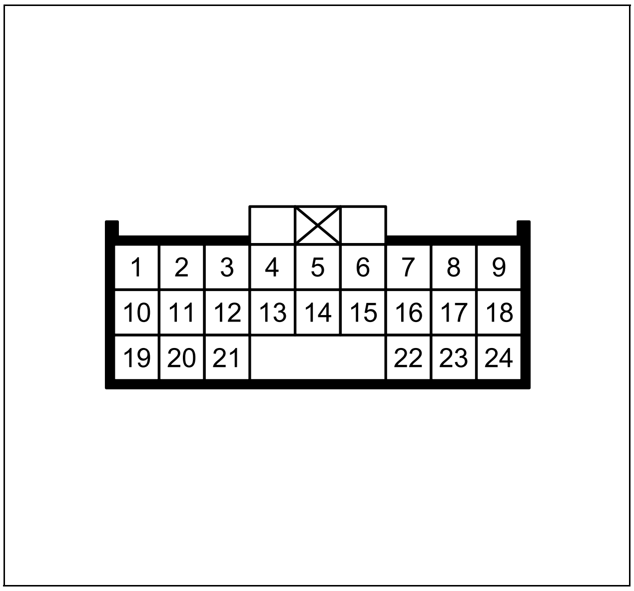


Legend

1. Oil cooler (outlet)
2. Low & reverse brake pressure detection port (R range line pressure detection port)
3. Low clutch pressure detection port (D, 3, 2, L range line pressure detection port)
4. High clutch pressure detection port
5. 2-4 brake pressure detection port
6. Oil cooler (inlet)
7. Oil cooler (outlet)
8. High clutch pressure detection passage
9. Oil pump passage (outlet)
10. Reverse clutch passage
11. High clutch passage
12. Front lubrication passage
13. 2-4 brake passage
14. Oil pump passage (inlet)
15. Torque converter passage (when not in lock up control)
16. Torque converter passage (when in lock up control)
17. Oil cooler passage (inlet)
18. 2-4 brake pressure detection passage
19. Extension lubrication passage
20. Low clutch passage
21. Rear lubrication passage
22. Low & reverse brake passage
23. Low & reverse brake pressure detection passage

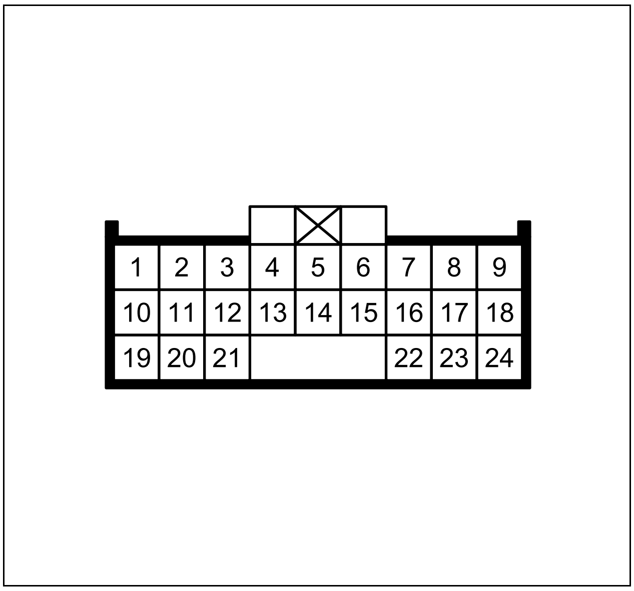
Transmission Control Module (TCM) Connector End Views

TCM (Gray connector)



Connector No.		C-94
Connector color		Gray
Test adapter No.		J-35616-64A
Pin No.	Wire color	Pin function
1	RED/ WHT	Battery voltage
2	YEL/ VIO	P range switch signal
3	RED	Brake pedal switch signal
4	PNK/ WHT	3rd start lamp control
5	VIO/ GRN	Keyword serial data communication
6	—	Not used
7	BLK/ RED	Engine speed signal input
8	—	Not used
9	—	Not used
10	BLK/ YEL	Vehicle speed signal output (2WD)
11	GRN/ WHT	3rd start switch signal
12	BLU/ WHT	4WD low signal output
13	—	Not used
14	—	Not used
15	—	Not used
16	RED/ WHT	Accelerator pedal position (APP) signal input
17	BLK/GRN	3 range switch signal
18	YEL/ BLK	Diagnostic request switch
19	ORN/ BLU	Transmission oil temperature lamp control
20	GRY/ YEL	Check trans lamp control
21	PNK	Power lamp control
22	—	Not used
23	—	Not used
24	GRN/ YEL	Power drive switch signal

TCM (White connector)

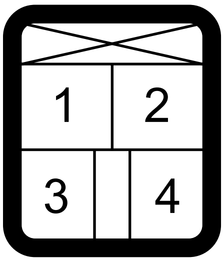


Connector No.		C-95
Connector color		White
Test adapter No.		J-35616-64A
Pin No.	Wire color	Pin function
1	RED/ YEL	2-4 brake TFP switch signal
2	PNK/ BLK	2 range switch signal
3	BRN/ RED	ISS sensor signal
4	BLU	TFT sensor signal
5	BLK	Ground
6	BLU/ BLK	Low & reverse brake solenoid control
7	BLK/ YEL	2 & 4 brake solenoid control
8	RED	High clutch solenoid control
9	WHT/ BLU	Low clutch solenoid control
10	RED/ BLK	N range switch signal
11	BLU	D range switch signal
12	YEL	Low & reverse brake TFP switch
13	YEL/ RED	OSS sensor signal
14	BLU/ BLK	TFT sensor low reference
15	—	Not used
16	—	Not used
17	BLK	TCC solenoid control
18	WHT	Ignition voltage

19	RED/ YEL	R range switch signal
20	WHT/ BLK	High clutch TFP switch signal
21	PNK/ BLU	L range switch signal
22	GRY/ RED	Ground return
23	VIO	PC solenoid control
24	WHT	Ignition voltage

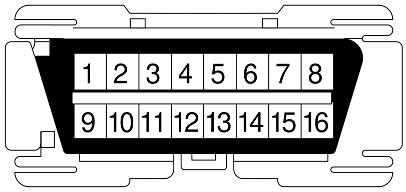
Transmission Control Connector End Views

Brake Switch



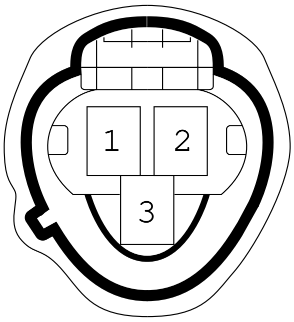
Connector No.	C-44	
Connector color	White	
Test adapter No.	J-35616-40	
Pin No.	Wire color	Pin function
1	GRN	Switch 1 (stop lamp switch) battery voltage feed
2	RED	Switch 1 (stop lamp switch) signal
3	—	Not used
4	—	Not used

Data Link Connector (DLC)



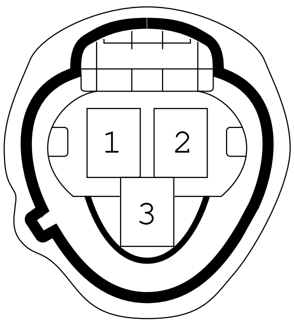
Connector No.	B-58	
Connector color	Black	
Test adapter No.	J-35616-2A	
Pin No.	Wire color	Pin function
1	BLK/ GRN	Diagnostic request switch (ECM)
2	—	Not used
3	—	Not used
4	BLK	Ground
5	BLK	Ground
6	BLU	CAN high
7	VIO/ GRN	Keyword serial data (TCM, EHCU [ABS module] and SRS control unit)
8	—	Not used
9	—	Not used
10	—	Not used
11	YEL/ BLK	Diagnostic request switch (TCM)
12	ORN/ WHT	Diagnostic request switch (EHCU [ABS module])
13	RED	Diagnostic request switch (SRS)
14	YEL	CAN low
15	—	Not used
16	RED/ YEL	Battery voltage

Input Shaft Speed (ISS) Sensor



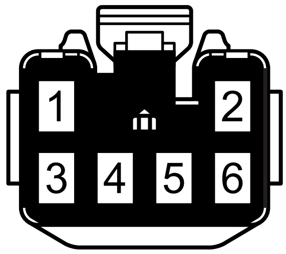
Connector No.		E-31
Connector color		Gray
Test adapter No.		J-35616-
Pin No.	Wire color	Pin function
1	BRN/ RED	Sensor signal
2	WHT	Sensor ignition voltage feed
3	BLK	Sensor low reference

Output Shaft Speed (OSS) Sensor



Connector No.		E-30
Connector color		Gray
Test adapter No.		J-35616-
Pin No.	Wire color	Pin function
1	YEL/ RED	Sensor signal
2	WHT	Sensor ignition voltage feed
3	BLK	Sensor low reference

Power Drive/ 3rd Start Switch



Connector No.		B-50
Connector color		White
Test adapter No.		J-35616-33
Pin No.	Wire color	Pin function
1	GRN/ RED	Illumination lamp voltage feed
2	RED/ GRN (TF) or BLK (UC)	Illumination lamp ground
3	GRN/ YEL	Power drive switch signal
4	—	Not used
5	GRN/ WHT	3rd start switch signal
6	BLK	Switch ground

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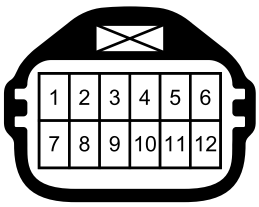
ISUZU KB P190 2007
TO MODEL INDEX

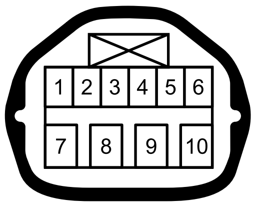
Transmission In-line Harness Connector



RTW77ASH004001

Connector No.		E-54
Connector color		Black
Test adapter No.		J-35616-64A
Pin No.	Wire color	Pin function
1	WHT/ BLK	High clutch TFP switch signal
2	BLU	TFT sensor signal
3	WHT/ BLU	Low clutch solenoid control (PWM)
4	BLK	TCC solenoid control (PWM)
5	BLU/ BLK	Low & reverse brake solenoid control (PWM)
6	VIO	PC solenoid control
7	RED/ YEL	2-4 brake TFP switch signal
8	BLU/ BLK	TFT sensor low reference
9	BLK/ YEL	2-4 brake solenoid control (PWM)
10	RED	High clutch solenoid control (PWM)
11	GRY/ RED	Ground return
12	YEL	Low & reverse brake TFP switch signal

Transmission Range (TR) Switch



RTW77ASH004101

Connector No.		E-51
Connector color		Black
Test adapter No.		J-35616-64A (pin 1 - 6) J35616-33 (pin 7 - 10)
Pin No.	Wire color	Pin function
1	BLK/GRN	3 range switch signal
2	YEL/ VIO	P range switch signal
3	WHT	Ignition voltage feed
4	RED/ YEL	R range switch signal
5	BLU	D range switch signal
6	PNK/ BLU	L range switch signal
7	BLK/ WHT	P or N range start switch signal
8	RED/ BLK	N range switch signal
9	PNK/ BLK	2 range switch signal
10	BLK	P or N range start switch ground

Diagnostic Information and Procedures

Diagnostic Starting Point - Transmission Controls

Begin the system diagnosis with Diagnostic System Check - Transmission Controls. The Diagnostic System Check - Transmission Controls will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

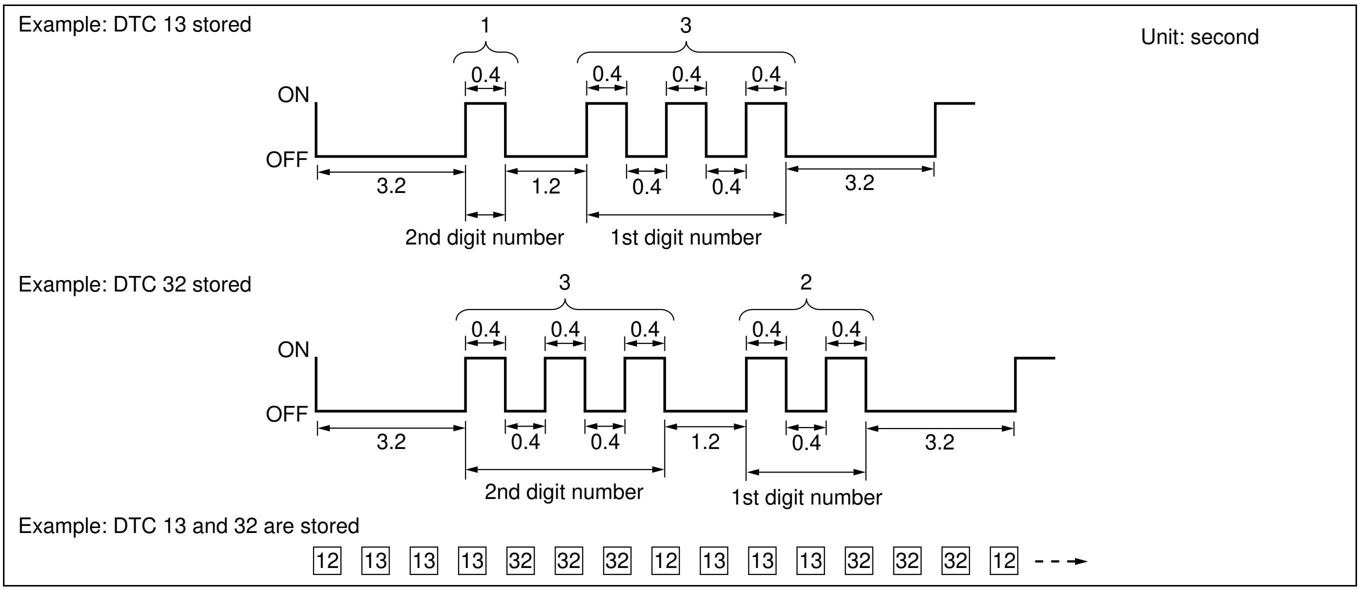
The use of the Diagnostic System Check - Transmission Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

Reading Flash Diagnostic Trouble Codes (DTC)

The provision for communicating with the TCM is the Data Link Connector (DLC). The DTC(s) stored in the TCM memory can be read either through a hand-held diagnostic scanner such as Tech 2 plugged into the DLC or by counting the number of flashes of the CHECK TRANS lamp when the diagnostic test terminal of the DLC is grounded. The DLC terminal “11” (diagnostic request) is pulled “Low” (grounded) by jumped to DLC terminal “4”, which is a ground wire. Once terminals “11” and “4” have been connected, turn the ignition switch ON, with the engine OFF. The CHECK TRANS lamp initially flashes 12. If more than one DTC has been stored in the TCM's memory, the DTCs will be output numerical order with each DTC being displayed three times. All the stored DTCs are flashed, then return 12 and continue to flash the DTC. If no DTC exists, the CHECK TRANS flashes 12 continuously. The flash DTC display will continue as long as the DLC is shorted.

Diagnostic Trouble Codes (DTC) Clear Method

If there is no scan tool, history DTCs can be cleared by removing the ECM (B) (10A) fuse for at least 10 seconds with the ignition switch OFF.



Diagnostic System Check - Transmission Controls

Description

The Diagnostic System Check - Transmission Controls is an organized approach to identifying a condition that is created by a malfunction in the electronic transmission control system. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

Test Description

The numbers below refer to the step numbers on the diagnostic table.
2. Lack of communication may be because of a partial or a total malfunction of the serial data circuit.
8. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order:

- Component level DTCs, such as sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs. Diagnose the multiple DTCs within this category in numerical order. Begin with the lowest numbered DTC, unless the diagnostic table directs you otherwise.

Diagnostic System Check Transmission Controls

Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the TCM grounds are clean, tight, and in the correct location.
- Ensure the TCM harness connectors are clean and correctly connected.
- Ensure the TCM terminals are clean and correctly mating.
- If there are gear ratio DTC's (P0731, P0732, P0733 or P0734), diagnose sensor DTCs and solenoid DTCs first.

Diagnostic System Check - Transmission Controls

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to Scan Tool Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. • TCM • Electronic hydraulic control unit (EHCU) [ABS module] (If so equipped) • Supplemental restraint system (SRS) control module (If so equipped) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with Keyword Device
3	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 4	Go to Engine Cranks but Does Not Run in engine control section
4	Select the DTC display function for the following control modules: • TCM • Engine control module (ECM) Does the scan tool display any DTCs?	—	Go to Step 5	Go to Step 9
5	Does the scan tool other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 6

Step	Action	Value(s)	Yes	No
6	Does the scan tool display TCM DTC P0602?	—	Go to Applicable DTC	Go to Step 7
7	Does the scan tool display TCM DTC P0560?	—	Go to Applicable DTC	Go to Step 8
8	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 9
9	Is the customer's concern with the engine system?	—	Go to Diagnostic System Check - Engine Controls	Go to Step 10
10	Drive vehicle and verify if any engine or transmission related driveability concern exist. Does an engine or transmission driveability concern exist?	—	Go to Symptoms - Engine Controls in engine control section or Symptoms Transmission Controls	System OK

Scan Tool Data List

The Transmission Scan Tool Data List contains all transmission related parameters that are available on the scan tool. Use the Transmission Scan Tool Data List only after the following is determined:

- The Transmission Controls - Diagnostic System Check is completed.
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the transmission you are diagnosing. The Transmission Scan Tool Data List represents values that would be seen on a normal running engine. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Scan Tool Parameter	Units Displayed	Typical Data
Operating Conditions: Engine idle/ Engine coolant temperature is between 75 to 85°C (167 to 185°F)/ Accelerator pedal is not pressed/ Park range/ Transfer case is 2H position/ Accessories OFF		
Accelerator Pedal Position	%	0%
Engine Speed	RPM	Nearly 700 RPM
AT Input Speed (Automatic Transmission)	RPM	600 to 700 RPM
TCC Slip Speed (Torque Converter Clutch)	RPM	Less than 100 RPM
AT Output Speed (Automatic Transmission)	RPM	0 RPM
Vehicle Speed	km/h/ MPH	0 km/h / MPH
Current Gear	1st/ 2nd/ 2nd L-Up/ 3rd/ 3rd L-Up/ 4th/ 4th L-Up	1st
Estimated Gear Ratio	: 1	32.77:1
Transmission Range (TR)	Park/ Neutral/ Reverse/ Drive/ Drive 3/ Drive 2/ Drive 1	Park
TR Switch P (Transmission Range)	On/ Off	On
TR Switch R (Transmission Range)	On/ Off	Off
TR Switch N (Transmission Range)	On/ Off	Off
TR Switch D (Transmission Range)	On/ Off	Off
TR Switch 3 (Transmission Range)	On/ Off	Off
TR Switch 2 (Transmission Range)	On/ Off	Off
TR Switch L (Transmission Range)	On/ Off	Off
PCS Command (Pressure Control Solenoid)	On/ Off	On
Low & Reverse Brake Solenoid Command	%	100%
Low & Reverse Brake Pressure Switch	On/ Off	Off
2-4 Brake Solenoid Command	%	100%
2-4 Brake Pressure Switch	On/ Off	Off
High Clutch Solenoid Command	%	100%
High Clutch Pressure Switch	On/ Off	Off
Low Clutch Solenoid Command	%	0%
TCC Solenoid (Torque Converter Clutch)	%	5%
Transmission Fluid Temperature	°C/ °F	Varies
Transmission Oil Temperature Lamp	On/ Off	Off
TCM Status Temp. (Temperature Transmission Control Module)	Low/ High	Low
4 Wheel Drive Low	On/ Off	Off
TCM Status Transfer (Transmission Control Module)	Low/ High	High
TCM Status Down Slope (Transmission Control Module)	On/ Off	Off

Scan Tool Parameter	Units Displayed	Typical Data
TCM Status Up Slope (Transmission Control Module)	On/ Off	Off
3rd Start Switch	On/ Off	Off
3rd Start Lamp	On/ Off	Off
Power Drive Switch	On/ Off	Off
Power Drive Lamp	On/ Off	Off
Brake Pedal Switch	On/ Off	Off
Diagnostic Switch	On/ Off	Off
Check Trans Lamp	On/ Off	Off

Scan Tool Data Definitions

This information will assist in driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnostic System Check - Transmission Controls first. The Diagnostic System Check will confirm proper system operation.

Accelerator Pedal Position

This parameter displays the angle of the accelerator pedal as calculated by the engine control module (ECM) using the signals from the accelerator pedal position (APP) sensors. This data is sent over the pulse wave modulation (PWM) signal from the ECM to the TCM. The scan tool will display linearly from 0 to 100% according to the pedal operation.

Engine Speed

This parameter displays the rotational speed of the crankshaft as calculated by the engine control module (ECM) based on inputs from the crankshaft position sensor or camshaft position sensor. This data is sent over the pulse signal from the ECM to the TCM.

AT Input Speed (Automatic Transmission)

This parameter displays the rotational speed of the reverse & high clutch drum as calculated by the TCM based on inputs from the input shaft speed (ISS) sensor.

TCC Slip Speed (Torque Converter Clutch)

This parameter displays the difference between transmission input shaft speed and the engine speed (engine speed - input shaft speed). A negative value indicates that the engine speed is less than the input shaft speed, deceleration. A positive value indicates that the engine speed is greater than the input shaft speed, acceleration. A value of zero indicates that the engine speed is equal to the input shaft speed, torque converter clutch (TCC) is applied.

AT Output Speed (Automatic Transmission)

This parameter displays the rotational speed of the parking gear that is connected to the output shaft as calculated by the TCM based on inputs from the output shaft speed (OSS) sensor.

Vehicle Speed

This parameter indicates the vehicle speed calculated by the TCM using the signal from the output shaft speed sensor. The scan tool will display a low value at lower vehicle speeds, and a high value at higher vehicle speeds.

Current Gear

This parameter displays the current gear position based on the command from the TCM.

Estimated Gear Ratio

This parameter displays the current gear ratio calculated by the TCM using the signal from the input shaft speed (ISS) sensor and the output speed sensor (OSS) sensor.

Transmission Range (TR)

This parameter displays the selector lever position based on the transmission range (TR) switch inputs.

TR Switch P, R, N, D, 3, 2, L (Transmission Range)

This parameter displays the input state of the transmission range (TR) switch to the TCM. When the selector lever is moved to each range, the scan tool displays On.

PCS Command (Pressure Control Solenoid)

This parameter displays the commanded state of the pressure control (PC) solenoid valve control circuit. On indicates the solenoid valve is being energized by the TCM, allowing line pressure to be low.

Low & Reverse Brake Solenoid Command

This parameter displays the low & reverse brake solenoid valve control duty ratio based on the command for the TCM. The scan tool will display a lower percentage when the low & reverse brake is controlled to engage (fluid pressure is applied to the low & reverse brake hydraulic circuits). The scan tool will display higher percentage when the low & reverse brake is controlled to disengage (fluid pressure is drained from the low & reverse brake hydraulic circuits).

Inspection and Repair

Make all necessary adjustment, repairs, and part replacements if wear, damage, or other problems are discovered during inspection.

Visual Check

Inspect following parts for wear, damage, or other abnormal conditions.

Spider

Needle roller bearing

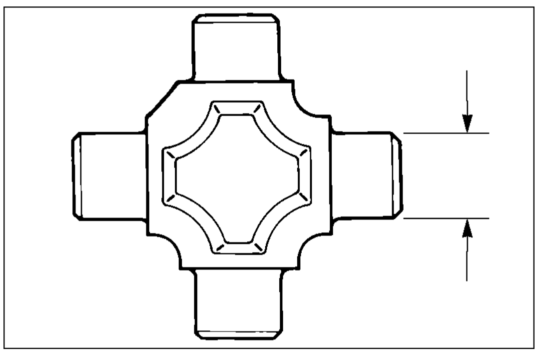
Yoke

Flange

Center bearing

Cushioning rubber

Bracket



401RS007

Outside Diameter of Spider Pins

mm(in)

Standard	Limit
17 (0.67)	16.99 (0.669)

Low & Reverse Brake Pressure Switch

This parameter displays the input state of the low & reverse brake transmission fluid pressure (TFP) switch to the TCM. When the low & reverse brake fluid pressure is generated, the scan tool displays On.

2-4 Brake Solenoid Command

This parameter displays the 2-4 brake solenoid valve control duty ratio based on the command from the TCM. The scan tool will display a lower percentage when the 2-4 brake is controlled to engage (fluid pressure is applied to the 2-4 brake hydraulic circuits). The scan tool will display higher percentage when the 2-4 brake is controlled to disengage (fluid pressure is drained from the 2-4 brake hydraulic circuits).

2-4 Brake Pressure Switch

This parameter displays the input state of the 2-4 brake transmission fluid pressure (TFP) switch to the TCM. When the 2-4 brake fluid pressure is generated, the scan tool displays On.

High Clutch Solenoid Command

This parameter displays the high clutch solenoid valve control duty ratio based on the command from the TCM. The scan tool will display a lower percentage when the high clutch is controlled to engage (fluid pressure is applied to the high clutch hydraulic circuits). The scan tool will display higher percentage when the high clutch is controlled to disengage (fluid pressure is drained from the high clutch hydraulic circuits).

High Clutch Pressure Switch

This parameter displays the input state of the high clutch transmission fluid pressure (TFP) switch to the TCM. When the high clutch fluid pressure is generated, the scan tool displays On.

Low Clutch Solenoid Command

This parameter displays the low clutch solenoid valve control duty ratio based on the command from the TCM. The scan tool will display a lower percentage when the low clutch is controlled to engage (fluid pressure is applied to the low clutch hydraulic circuits). The scan tool will display higher percentage when the low clutch is controlled to disengage (fluid pressure is drained from the low clutch hydraulic circuits).

TCC Solenoid (Torque Converter Clutch)

This parameter displays the torque converter clutch (TCC) control duty ratio based on the command from the TCM. The scan tool will display a lower percentage when the TCC is controlled to disengage (fluid pressure is drained from the TCC release hydraulic circuits). The scan tool will display higher percentage when the TCC is controlled to engage (fluid pressure is applied to the TCC apply hydraulic circuits).

Transmission Fluid Temperature

This parameter displays the temperature of the automatic transmission fluid (ATF) temperature as calculated by the TCM using the signal from the transmission fluid temperature (TFT) sensor. The scan tool will display a low temperature when the signal voltage is high, and a high temperature when the signal voltage is low.

Transmission Oil Temperature Lamp

This parameter displays the commanded state of the transmission oil temperature lamp control circuit. The lamp should be On when the scan tool indicates command On.

TCM Status Temp. (Temperature Transmission Control Module)

This parameter displays the commanded state of the high temperature mode shift map. On indicates the transmission fluid temperature is high and the high temperature mode is selected to prevent an overheating.

4 Wheel Drive Low

This parameter displays the input state of the 4WD low gear signal from the transfer case control module (TCCM). When the 4L mode is selected, the scan tool displays On.

TCM Status Transfer (Transmission Control Module)

This parameter displays the commanded state of the shift map that is based on the transfer case position. High indicates the high mode (2H or 4H) is inputted from the transfer case control module (TCCM). Low indicates the low mode (4L) is inputted from the TCCM.

TCM Status Down Slope (Transmission Control Module)

This parameter displays the commanded state of the down slope mode shift map. On indicates the down slope mode is selected under certain driving conditions.

TCM Status Up Slope (Transmission Control Module)

This parameter displays the commanded state of the up slope mode shift map. On indicates the up slope mode is selected under certin driving conditions.

3rd Start Switch

This parameter displays the input state of the 3rd start switch to the TCM. When the switch is pressed, the scan tool displays On.

3rd Start Lamp

This parameter displays the commanded state of the 3rd start lamp control circuit. The lamp should be On when the scan tool indicates command On.

Power Drive Switch

This parameter displays the input state of the power drive switch to the TCM. When the switch is pressed, the scan tool displays On.

Power Drive Lamp

This parameter displays the commanded state of the power drive lamp control circuit. The lamp should be On when the scan tool indicates command On.

Brake Pedal Switch

This parameter displays the input state of the brake pedal switch to the TCM. When the pedal is depressed, scan tool displays On.

Diagnostic Switch

This parameter displays the input state of the diagnostic request switch to the TCM. When the data link connector (DLC) terminal 11 is pulled low, the check trans lamp blinks to indicate flash code.

Check Trans Lamp

This parameter displays the commanded state of the check trans lamp control circuit. The lamp should be On when the scan tool indicates command On.

Scan Tool Output Controls

	Scan Tool Output Control	Descriptions
Lamp control	Power Lamp Test	The purpose of this test is for checking whether the power drive lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Lamp control	3rd Start Lamp Test	The purpose of this test is for checking whether the 3rd start lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Lamp control	AT Oil Temperature Lamp Test	The purpose of this test is for checking whether the AT oil temperature lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Lamp control	Check Light Test	The purpose of this test is for checking whether the check trans lamp is operating when commanded ON. Faulty circuit(s) or an open circuit could be considered when not operating when commanded ON.
Solenoid valve control	Low & Reverse Brake Solenoid	The purpose of this test is for checking whether the low & reverse brake solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.
Solenoid valve control	2-4 Brake Solenoid Test	The purpose of this test is for checking whether the 2-4 brake solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.
Solenoid valve control	High Clutch Solenoid Test	The purpose of this test is for checking whether the high clutch solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.
Solenoid valve control	Low Clutch Solenoid Test	The purpose of this test is for checking whether the low clutch solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.
Solenoid valve control	Pressure Control Solenoid (PCS)	The purpose of this test is for checking whether the pressure control (PC) solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.
Solenoid valve control	TCC Solenoid Test	The purpose of this test is for checking whether the torque converter clutch (TCC) solenoid valve is operating when commanded ON. Faulty circuit(s) or a faulty solenoid valve could be considered if not energizing when commanded ON.

Scan Tool Does Not Power Up

Circuit Description

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool power battery positive voltage at terminal 16
- Scan tool power ground at terminal 4
- Common signal ground at terminal 5

The scan tool will power up with the ignition OFF. Some modules however, will not communicate unless the ignition is ON.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing Scan Tool Does Not Power Up

Step	Action	Value(s)	Yes	No
1	**Important:** Make sure the scan tool works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the Meter (+B) (10A) fuse in the cabin fuse block. Is the Meter (+B) (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (+B) (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (+B) (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-58) for a backed out, spread or missing terminal. 2. Repair the terminal as necessary. Did you find and complete the repair?	—	Go to Step 7	Go to Step 4
4	Connect a test lamp between the +B circuit (pin 16 of B-58) at the DLC and a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the battery voltage circuit to the DLC. Did you complete the repair?	—	Go to Step 7	—
6	1. Test each ground circuit at the DLC (pins 4 and 5 of B-58) for an open circuit or high resistance. 2. Repair the circuit(s), clean or tighten ground as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the scan tool to the DLC. 2. Attempt to turn ON the scan tool. Does the scan tool ON?	—	System OK	Go to Step 1

Scan Tool Does Not Communicate with Keyword Device

Circuit Description

The TCM, electronic hydraulic control unit (EHCU) [ABS module] and supplemental restraint system (SRS) control module all communicate with the scan tool over the Keyword serial data link.

Diagnostic Aids

The following conditions will cause a loss of Keyword serial data communication between the scan tool and the TCM.

- A Keyword serial data circuit open
- A Keyword serial data circuit shorted to ground
- A Keyword serial data circuit shorted to voltage
- An internal condition within a module or connector on the Keyword serial data circuit, that causes a short to voltage or ground to the Keyword serial data circuit

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing Scan Tool Does Not Communicate with Keyward Device

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the listed control modules. • TCM • Electronic hydraulic control unit (EHCU) [ABS module] (If so equipped) • Supplemental restraint system (SRS) control module (If so equipped) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 7
3	Does the scan tool communicate with the TCM?	—	Go to Step 4	Go to Lost Communication with The Transmission Control Module (TCM)
4	**Notice:** If no ABS is installed, skip to Step 5. Does the scan tool communicate with the EHCU?	—	Go to Step 5	Go to Diagnostic System Check - Anti-lock Brake Controls
5	**Notice:** If no SRS is installed, skip to Step 6. Does the scan tool communicate with the SRS control module?	—	Go to Step 6	Go to Diagnostic System Check -SRS Controls
6	Test the Keyword serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the Keyword serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 15	System OK
7	1. Inspect for an intermittent, for a poor connection and for corrosion at the data link connector (DLC) (pin 7 of B-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Disconnect the TCM C-94 and C-95 harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the EHCU and SRS control module. Does the scan tool communicate with the EHCU and SRS control module?	—	Go to Step 12	Go to Step 9
9	**Notice:** If no ABS is installed, skip to Step 10. 1. Turn OFF the ignition. 2. Reconnect the TCM harness connectors. 3. Disconnect the EHCU harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the TCM and SRS control module. Does the scan tool communicate with the TCM and SRS control module?	—	Go to Step 13	Go to Step 10
10	**Notice:** If no SRS is installed, skip to Step 11. 1. Turn OFF the ignition. 2. Reconnect the TCM harness connectors if disconnected. 3. Reconnect the EHCU harness connector if disconnected. 4. Disconnect the SRS control module harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the TCM and EHCU. Does the scan tool communicate with the TCM and EHCU?	—	Go to Step 14	Go to Step 11
11	Repair the short to ground or short to voltage on the Keyword serial data circuit between the DLC and TCM, EHCU and SRS control module. Did you complete the repair?	—	Go to Step 15	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 15	—
13	Replace the EHCU. Refer to EHCU Replacement. Did you complete the replacement?	—	Go to Step 15	—
14	Replace the SRS control module. Refer to SRS Control Module Replacement. Did you complete the replacement?	—	Go to Step 15	—
15	Attempt to establish communication with the TCM, EHCU and SRS control module. Does the scan tool communicate with the TCM, EHCU and SRS control module?	—	System OK	Go to Step 2

Lost Communication with The Transmission Control Module (TCM)

Circuit Description

The TCM, electronic hydraulic control unit (EHCU) [ABS module] and supplemental restraint system (SRS) control module all communicate with the scan tool over the Keyword serial data link.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing Lost Communication with The Transmission Control Module (TCM)

Step	Action	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	Attempt to establish communication with the TCM. Does the scan tool communicate with the TCM?	—	Go to Intermittent Conditions	Go to Step 3
3	1. Inspect for an intermittent, for poor connections and for corrosion at the TCM C-94 and C-95 harness connectors. 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 4
4	1. Check the TCM (15A) in the cabin fuse block. Replace and retest if open. If any fuse continues to open, repair the short to ground on each circuit fed by that fuse. 2. Turn OFF the ignition. 3. Disconnect the TCM C-95 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the TCM (pins 18 and 24 of C-95). Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the ignition voltage circuit to the TCM. Did you complete the repair?	—	Go to Step 9	—
6	1. Turn OFF the ignition. 2. Disconnect the TCM C-94 harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the TCM (pin 5 of C-94). 4. Test the Keyword serial data circuit between the TCM (pin 5 of C-94) and the DLC (pin 7 of B-58) for an open circuit or high resistance. 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 7
7	1. Check TCM ground for corrosion and tightness. 2. Clean or tighten grounds as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8

Step	Action	Action	Yes	No
8	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse or harness connector(s). 3. Turn ON the ignition, with the engine OFF. 4. Attempt to establish communication with the TCM. Does the scan tool communicate with the TCM?	—	System OK	Go to Step 3

DTC P0560 (Flash Code 16)

Circuit Description

The TCM monitors the ignition voltage on the ignition feed terminal to make sure that the voltage stays within the proper range. If the TCM detects an excessively low ignition voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is more than 1000 RPM.

Condition for Setting the DTC

- The TCM detects that the ignition voltage feed circuit is less than 10 volts for 1 second.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- A charging system problem may set this DTC.
- The weakened battery may set this DTC.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0560

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine and let idle. 4. Load the electrical system by turning ON the headlights, A/C, etc. while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Test the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you find a charging system problem?	—	Go to Step 4	Go to Step 5
4	Repair the charging system. Refer to Diagnosis of The Charging System in the Charging System Section. Did you complete the repair?	—	Go to Step 6	—
5	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent, for poor connections and for corrosion at the harness connector of the TCM (pins 5, 18 and 24 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
6	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and let idle. 5. Load the electrical system by turning ON the headlights, A/C, etc. while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 7
7	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0602

Description

The TCM has the ability to set a diagnostic trouble code (DTC) if it detects that there is no vehicle identification number (VIN) stored. In order for the software to be locked, the mechanization counter used at time of production must be set to zero. If the counter is anything other than zero AND there is no VIN stored, this DTC will set.

Condition for Setting the DTC

- VIN in TCM is not programmed (blank) and TCM is unlocked.

Action Taken When the DTC Sets

- The TCM does not blink the Check Trans lamp.

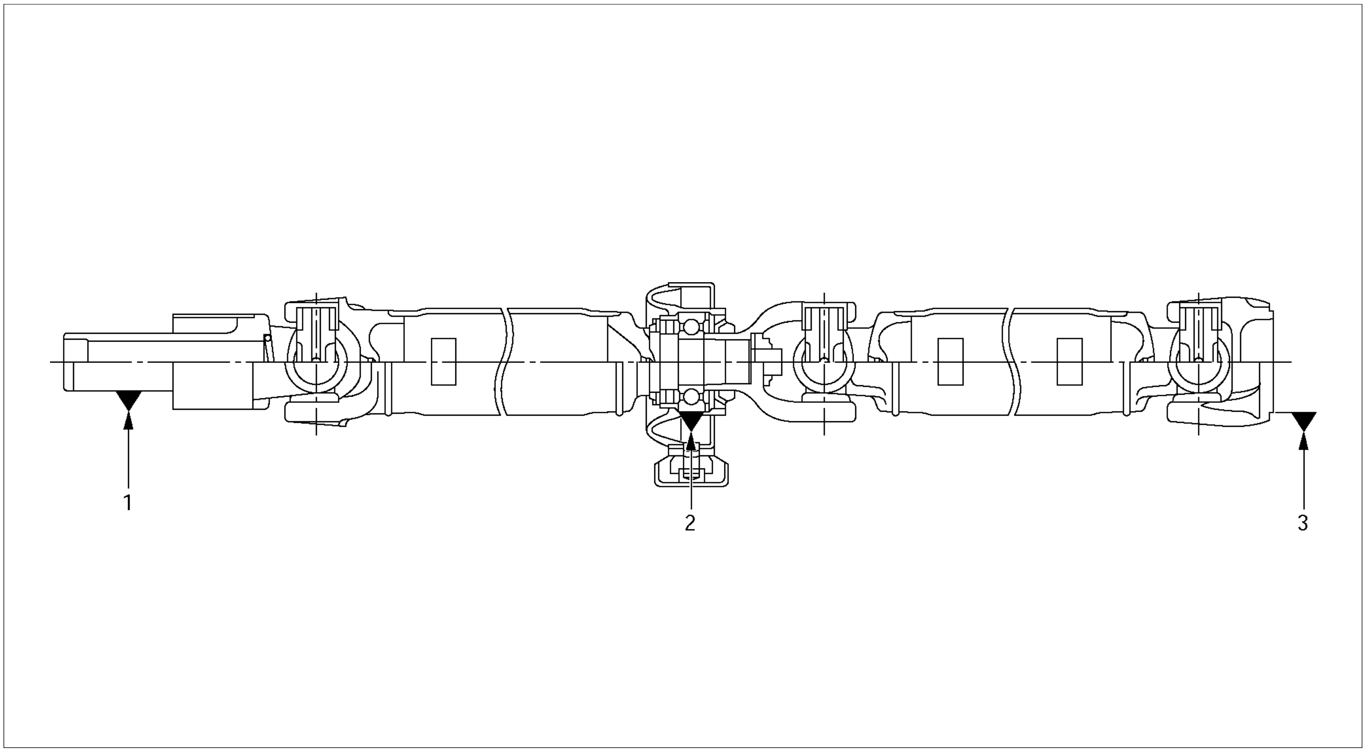
Notice:

- Clear the DTC with a scan tool after programming the VIN.

Circuit/ System Testing DTC P0602

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
3	1. Verify the correct VIN is entered into the TCM with a scan tool. Refer to TCM Replacement. If the VIN is correctly entered, clear the DTC with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 5
4	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 5	—
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Propeller Shaft Run-Out



401R300005

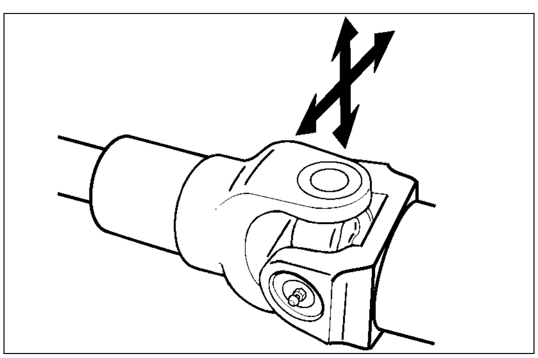
∗Grease fitting are installed to 4x4 vehicles only

Support 1 of splined yoke, 2 of center bearing and 3 of flange yoke and check for static run-out by holding the probe of a dial indicator in contact with the center part of the shaft and turning the propeller shaft.

If the amount of run-out is beyond the limit value, correct with a bench press or replace the shaft with a new one.

mm(in)

Limit	1.0 (0.04)


401R300008

Play in Spider Bearing

(1) Check the spider bearings for wear or damage.

(2) Check the amount of axial and radial play in spider bearing by moving the yoke back and forth on the spider axes and shaft axis.

mm(in)

Limit	0.1 (0.004)

If the limit is exceeded, replace the shaft assembly.

DTC P0705 (Flash Code 17)

Circuit Description

The transmission range (TR) switch is connected to the transmission manual shaft and installed externally to the transmission case. The TR switch relays a signal to the TCM indicating transmission range position by detecting ignition voltage through an internal switch. Only one of the seven internal switches will close for each P, R, N, D, 3, 2 and L position. Normally, the TCM expects to detect one high voltage input for each position. If the TCM detects more than one high voltage input at the same time or no input, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The TCM detects that the TR switch signals are all OFF for 2 seconds when the engine speed is more than 500 RPM.
- The TCM detects that multiple TR switch signals for 1 second.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0705

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Transmission Range (TR) Switch P, R, N, D, 3, 2 and L parameter with a scan tool while selecting each transmission range. Does the scan tool indicate ON when its position and OFF when other positions?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Check to ensure the TR switch is adjusted correctly. 2. Adjust the TR switch as necessary. Refer to repair instructions (On-Vehicle Service). Did you find and correct the condition?	—	Go to Step 16	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the TR switch harness connector. 3. Turn ON the ignition, with the engine OFF. Does the scan tool indicate all TR Switch parameters OFF?	—	Go to Step 5	Go to Step 11

Step	Action	Value(s)	Yes	No
5	Connect a test lamp between the ignition voltage feed circuit to the TR switch (pin 3 of E-51) and a known good ground. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 6
6	Repair the open circuit or high resistance between the Back Up (15A) fuse and the TR switch (pin 3 of E-51). Check the Back Up (15A) fuse first. Did you complete the repair?	—	Go to Step 16	—
7	Observe the ALL TR Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire across the TR switch harness connector. • P range: Between 3 and 2 of E-51 • R range: Between 3 and 4 of E-51 • N range: Between 3 and 8 of E-51 • D range: Between 3 and 5 of E-51 • 3 range: Between 3 and 1 of E-51 • 2 range: Between 3 and 9 of E-51 • L range: Between 3 and 6 of E-51 Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 8	Go to Step 9
8	Does the scan tool indicate multiple TR switch ON at Step 7?	—	Go to Step 10	Go to Step 12
9	1. Test the TR switch signal circuit (which ever parameter reading did not ON at Step 7) between the TCM and the TR switch for an open circuit or high resistance. • P range: Between 2 of C-94 and 2 of E-51 • R range: Between 19 of C-95 and 4 of E-51 • N range: Between 10 of C-95 and 8 of E-51 • D range: Between 11 of C-95 and 5 of E-51 • 3 range: Between 17 of C-94 and 1 of E-51 • 2 range: Between 2 of C-95 and 9 of E-51 • L range: Between 21 of C-95 and 6 of E-51 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13

Step	Action	Value(s)	Yes	No
10	Repair the short circuit each other between the TCM and the TR switch (which ever parameter reading multiple TR switch ON at Step 7). • P range: Between 2 of C-94 and 2 of E-51 • R range: Between 19 of C-95 and 4 of E-51 • N range: Between 10 of C-95 and 8 of E-51 • D range: Between 11 of C-95 and 5 of E-51 • 3 range: Between 17 of C-94 and 1 of E-51 • 2 range: Between 2 of C-95 and 9 of E-51 • L range: Between 21 of C-95 and 6 of E-51 Did you complete the repair?	—	Go to Step 16	—
11	1. Test the TR switch signal circuit (which ever parameter reading did not OFF at Step 4) between the TCM and the TR switch for a short to battery or ignition voltage. • P range: Between 2 of C-94 and 2 of E-51 • R range: Between 19 of C-95 and 4 of E-51 • N range: Between 10 of C-95 and 8 of E-51 • D range: Between 11 of C-95 and 5 of E-51 • 3 range: Between 17 of C-94 and 1 of E-51 • 2 range: Between 2 of C-95 and 9 of E-51 • L range: Between 21 of C-95 and 6 of E-51 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
12	1. Inspect for an intermittent and for poor connections at the harness connector of the TR switch (pins 1, 2, 3, 4, 5, 6, 8 and 9 of E-51). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the TCM (pins 2 and 17 of C-94 and pins 2, 10, 11, 19 and 21 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the TR switch. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
16	1. Reconnect all previously disconnected fuse, components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition, with the engine OFF. 5. Observe the TR Switch P, R, N, D, 3, 2 and L parameter with a scan tool while selecting each transmission range. Does the scan tool indicate ON when its position and OFF when other positions?	—	Go to Step 17	Go to Step 3
17	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0710 (Flash Code 15)

Circuit Description

The transmission fluid temperature (TFT) sensor is attached to the lower part of the valve body assembly. The TFT sensor is a variable resistor and it measures the temperature of the transmission fluid. The sensor has a signal circuit and a low reference circuit. The TCM supplies 2.5 volts to the signal circuit and a ground for the low reference circuit. When the TFT sensor is cold, the sensor resistance is high. When the transmission fluid temperature increases, the sensor resistance decreases. With high sensor resistance, the TCM detects a high voltage on the signal circuit. With lower sensor resistance, the TCM detects a lower voltage on the signal circuit. If the TCM detects an excessively low or high signal voltage, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

Either of following condition is met:

- The TCM detects that the TFT sensor signal voltage is less than 0.1 volts (more than 146°C [295°F]) when the selector lever is P or N range for longer than 5 minutes.
- The TCM detects that the TFT sensor signal voltage is more than 2.43 volts (less than -40°C [-40°F]) for 10 seconds when the vehicle speed is more than 20 km/h (12 MPH).

Action Taken When the DTC Sets

- The TCM does not blink the Check Trans lamp.
- The TCM inhibits 4th gear. (If the engine speed is more than 470 PRM for 10 minutes, shifting to 4th gear is allowed.)
- The TCM inhibits lock up control. (If the engine speed is more than 470 RPM for 10 minutes, lock up control is allowed.)
- The TCM uses a TFT substitution of 80°C (176°F) for transmission control.

Condition for Clearing the DTC

- current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the TFT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability (poor shift quality) concerns.

Test Description

The numbers below refer to the step number on the Circuit/ System Testing.

5. If the TFT sensor signal circuit is shorted to ground, A/T Oil Temp lamp turns ON and the TCM switches shift map to the high temperature mode until this DTC is set.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0710

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Transmission Fluid Temperature (TFT) parameter with a scan tool within 5 minutes from the ignition switch is ON. Is the TFT parameter more than the specified value?	146°C (295°F)	Go to Step 4	Go to Step 3
3	Is the TFT parameter less than the specified value at Step 2?	-40°C (-40°F)	Go to Step 7	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Turn ON the ignition, with the engine OFF. Is the TFT parameter less than the specified value?	-40°C (-40°F)	Go to Step 14	Go to Step 5
5	1. Test the signal circuit between the TCM (pin 4 of C-95) and the in-line harness connector (pin 2 of E-54) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect connections at the harness connector of the TCM (pins 4 and 14 of C-95) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
7	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a DMM between the signal circuit (pin 2 of E-54) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	2.8 volts	Go to Step 8	Go to Step 9
8	**Important:** The TFT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the TCM (pin 4 of C-95) and the in-line harness connector (pin 2 of E-54) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
9	Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit (pins 2 and 8 of E-54). Is the TFT parameter more than the specified value?	146°C (295°F)	Go to Step 13	Go to Step 10
10	Connect a 3-amp fused jumper wire between the signal circuit (pin 2 of E-54) and a known good ground. Is the TFT parameter more than the specified value?	146°C (295°F)	Go to Step 12	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Test the signal circuit between the TCM (pin 4 of C-95) and the in-line harness connector (pin 2 of E-54) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
12	1. Test the low reference circuit between the TCM (pin 14 of C-95) and the in-line harness connector (pin 8 of E-54) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 15
13	1. Inspect for an intermittent and for poor connections at the in-line harness connector (pins 2 and 8 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 14
14	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Test the signal circuit between the TFT sensor and the in-line harness connector (pin 2 of E-54) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • A short to the solenoid valve circuit • High resistance 3. Test the low reference circuit between the TFT sensor and the in-line harness connector (pin 8 of E-54) for an open circuit or high resistance. 4. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the TCM (pins 4 and 14 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 18	Go to Step 17
16	Replace the TFT sensor. Refer to repair instructions (On-Vehicle Service). (TFT sensor is part of the harness assembly) Did you complete the replacement?	—	Go to Step 18	—
17	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
18	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 19
19	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0717 (Flash Code 14)

Circuit Description

The input shaft speed (ISS) sensor is located on right-hand of the transmission case. The ISS sensor is a hall effect element type sensor, which generates a square wave signal pulse based on the reverse & high clutch drum rotational speed (32 pulses per a rotation of the reverse & high clutch drum). The sensor has the following circuits.

- Ignition voltage feed circuit
- Low reference circuit
- ISS sensor signal circuit

The TCM calculates the turbine speed by the ISS sensor signal, and uses it to calculate torque converter slip speed and gear ratio. If the TCM detects excessively low input shaft speed during the vehicle running, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The engine speed is more than 1500 RPM.
- The vehicle speed is more than 40 km/h (24 MPH).
- The selector lever is forward range.

Condition for Setting the DTC

- The TCM detects that the input shaft speed is less than 300 RPM for 2 seconds.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the ISS sensor circuits may set this DTC.
- An intermittent ISS sensor signal pulse may set this DTC.
- Ensure the ISS sensor is tight.

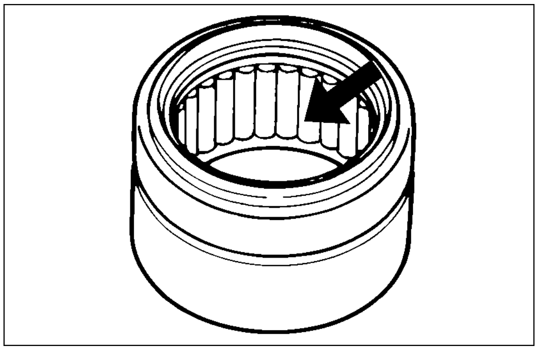
Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0717

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle. 4. Operate the vehicle within the Conditions for Running the DTC. 5. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the input shaft speed (ISS) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-31) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	Intermittently jump the signal circuit (pin 1 of E-31) with a test lamp that is connected to a known good ground while observing the AT Input Speed parameter with a scan tool. Does the scan tool indicate any AT input speed when the circuit is intermittently pulled to ground?	—	Go to Step 5	Go to Step 8
5	Connect a test lamp between the ignition voltage feed circuit and the low reference circuit (pins 2 and 3 of E-31). Does the test lamp illuminate?	—	Go to Step 9	Go to Step 7
6	Repair the open circuit or high resistance between the Back Up (15A) fuse and the ISS sensor (pin 2 of E-31). Check the Back Up (15A) fuse first. Did you complete the repair?	—	Go to Step 14	—
7	Repair the open circuit or high resistance on the low reference circuit between the ISS sensor (pin 3 of E-31) and the engine ground terminal (E-10). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 14	—
8	1. Test the signal circuit between the TCM (pin 3 of C-95) and the ISS sensor (pin 1 of E-31) for the following conditions • An open circuit • A short to ground • A short to the low reference • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
9	1. Inspect for an intermittent and for poor connections at the harness connector of the ISS sensor (pin 1, 2 and 3 of E-31). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 3 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13


401RS011

Universal Joint Reassembly

1. Set the propeller shafts.

- Be sure to set the propeller shaft yoke by aligning the setting marks made during disassembly.

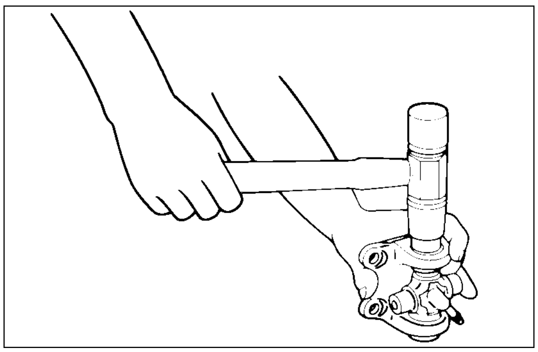
2. Spider

- Be sure to install the spider by aligning the setting marks made during disassembly.

3. Needle Roller Bearing

1) Apply a molybdenum-disulfide grease or a multi-purpose. type grease NLGI No.2 to inside of the bearing cap.

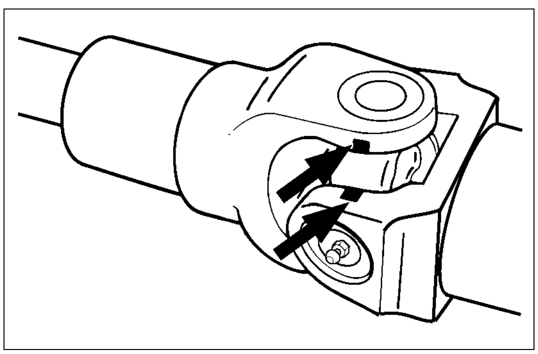
Grease Amount g(oz)
Approx. 1.2 (0.042)


401RS012

2) Using either a mallet (or copper hammer) or a press, install the needle roller bearing into the yoke so that snap ring can be installed in its groove.

CAUTION:

- **The needle roller bearing cannot be installed smoothly if it is set at an incorrect angle with the flange.**
- **Excessive hammering will damage the needle roller bearing.**


401R300003

3) Align setting marks and join the yokes.

NOTE:
Assemble the spider and spline yoke so that their grease fittings are arranged on the same side.(4×4)

4. Snap ring

NOTE:
Discard used snap rings and install new ones.

When the bearing cap is in position, select and attach a snap ring of suitable thickness so that the end play of the spider pin is held within 0.1mm (0.004in).

mm(in)

Snap ring thickness	Identification color
1.50 (0.059)	Light Blue
1.53 (0.060)	White
1.56 (0.061)	Pink
1.59 (0.063)	Yellow
1.62 (0.064)	Green
1.65 (0.065)	Brown
1.68 (0.066)	Not colored

NOTE:
Be sure to use snap rings of the same thickness on both sides.

Step	Action	Value(s)	Yes	No
11	1. Inspect the ISS sensor and the reverse & high clutch drum for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and reverse & high clutch drum • Physical damage of reverse & high clutch drum 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
12	Replace the ISS sensor. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected fuse, components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 15
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0722 (Flash Code 11)

Circuit Description

The output shaft speed (OSS) sensor is located on right-hand of the transmission case near the transmission range switch. The OSS sensor is a hall effect element type sensor, which generates a square wave signal pulse based on the parking gear rotational speed that is connected to output shaft (16 pulses per a rotation of the parking gear). The sensor has the following circuits.

- Ignition voltage feed circuit
- Low reference circuit
- OSS sensor signal circuit

The TCM calculates the vehicle speed by the OSS sensor signal, and uses it to determine appropriate shift points and calculate gear ratio. The 2WD vehicle outputs the vehicle speed signal from the TCM to the engine control module (ECM) and the vehicle speed meter via output signal line. If the TCM detects excessively low output shaft speed during the vehicle running, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The input shaft speed is more than 1000 RPM.
- The selector lever is forward range for longer than 25 seconds.

Condition for Setting the DTC

- The TCM detects that the vehicle speed is less than 5 km/h (3 MPH) for 5 seconds.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the OSS sensor circuits may set this DTC.
- An intermittent OSS sensor signal pulse may set this DTC.
- Ensure the OSS sensor is tight.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0722

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the output shaft speed (OSS) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition voltage feed circuit (pin 2 of E-30) and a known good ground. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	Intermittently jump the signal circuit (pin 1 of E-30) with a test lamp that is connected to a known good ground while observing the AT Output Speed or Vehicle Speed parameter with a scan tool. Does the scan tool indicate any AT output speed or vehicle speed when the circuit is intermittently pulled to ground?	—	Go to Step 5	Go to Step 8
5	Connect a test lamp between the ignition voltage feed circuit and the low reference circuit (pins 2 and 3 of E-30). Does the test lamp illuminate?	—	Go to Step 9	Go to Step 7
6	Repair the open circuit or high resistance between the TCM (15A) fuse and the OSS sensor (pin 2 of E-30). Did you complete the repair?	—	Go to Step 14	—
7	Repair the open circuit or high resistance on the low reference circuit between the OSS sensor (pin 3 of E-30) and the engine ground terminal (E-10). Clean or tighten ground as necessary. Did you complete the repair?	—	Go to Step 14	—
8	1. Test the signal circuit between the TCM (pin 13 of C-95) and the OSS sensor (pin 1 of E-30) for the following conditions: • An open circuit • A short to ground • A short to the low reference • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 10
9	1. Inspect for an intermittent and for poor connections at the harness connector of the OSS sensor (pin 1, 2 and 3 of E-30). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 13 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13

Step	Action	Value(s)	Yes	No
11	1. Inspect the OSS sensor and the parking gear for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between sensor and parking gear • Physical damage of parking gear 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
12	Replace the OSS sensor. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle while observing the Vehicle Speed parameter with a scan tool. Does the scan tool indicate correct vehicle speed?	—	Go to Step 15	Go to Step 3
15	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0727 (Flash Code 13)

Circuit Description

The engine speed signal to the TCM is sent from the engine control module (ECM) via a signal circuit based on inputs from the crankshaft position (CKP) sensor and camshaft position (CMP) sensor. If the TCM detects no engine speed signal from the ECM during the vehicle running, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The vehicle speed is more than 40 km/h (24 MPH).

Condition for Setting the DTC

- The TCM detects that the engine speed signal pulses from the ECM are not being received for 2 seconds.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.
- The TCM inhibits lock up control.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0727

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If the engine does not start, crank over the engine for 10 seconds. 4. Monitor the ENGINE DTC Information with a scan tool. Is DTC P0335, P0336, P0340 or P0341 set?	—	Go to Applicable DTC in engine control section	Go to Step 3
3	Observe the Engine Speed parameter in the transmission data display with a scan tool. Does the scan tool indicate correct engine speed?	—	Go to Diagnostic Aids	Go to Step 4
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Intermittently jump the signal circuit (pin 33 of C-58) with a test lamp that is connected to a known good ground while observing the Engine Speed parameter with a scan tool. Does the scan tool indicate any engine speed when the circuit is intermittently pulled to ground?	—	Go to Step 7	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Test the signal circuit between the ECM (33 of C-58) and the TCM (7 of C-94) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
6	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 7 of C-94). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
7	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the ECM (pin 33 of C-58). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
8	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 10	—
9	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the Engine Speed parameter with a scan tool. Does the scan tool indicate correct engine speed?	—	Go to Step 11	Go to Step 4
11	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0731, P0732, P0733 or P0734 (Flash Code 41, 42, 43 or 44)

Circuit Description

The TCM calculates the gear ratio based on the input shaft speed signal from the input shaft speed (ISS) sensor and the output speed signal from the output shaft speed (OSS) sensor. The TCM compares the known transmission gear ratio to the calculated ratio for the selected gear ranges. If the TCM detects an unknown transmission gear ratio two consecutive driving cycles, this DTC will set.

Condition for Running the DTC

- Other than DTCs P0731, P0732, P0733 and P0734 are not set.
- The ignition switch is ON.
- The transmission fluid temperature is more than 60°C (140°F).
- The input shaft speed is more than 1000 RPM.
- The vehicle speed is more than 10 km/h (6 MPH).
- The selector lever is forward range for longer than 2 seconds.
- The TCM is not under gearshift control.

Condition for Setting the DTC

- The TCM detects that the output shaft speed is more than 500 RPM over the calculated speed (based on the input shaft speed and the gear ratio) for 7 seconds after each gearshift has completed.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp on the second consecutive driving cycle when the diagnostic runs and fails.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electromagnetic interference in the ISS sensor or OSS sensor circuits may set this DTC.
- An intermittent ISS sensor or OSS sensor signal pulse may set this DTC.
- Ensure the ISS sensor and OSS sensor is tight.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A transmission mechanical problem will cause this DTC to set.
- Sticking or contamination of shift valves may cause intermittent incorrect gear ratios.
- If multiple incorrect gear ratio codes are set, problem in fluid pressure, low ATF level, plugged filter or oil pump problem may exist.

Notice:

- Each DTC agrees with the following gear positions.
  - P0731: 1st gear
  - P0732: 2nd gear
  - P0733: 3rd gear
  - P0734: 4th gear

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0731, P0732, P0733 or P0734

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	Perform the ATF level check. Refer to repair instructions (On-Vehicle Service). Did you perform the ATF level check?	—	Go to Step 3	Go to Transmission Fluid Checking Procedure
3	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Drive the vehicle while observing the DTC Information with a scan tool. Is there any DTCs set other than P0731, P0732, P0733 or P0734?	—	Refer to Applicable DTC	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Inspect all of the circuits going to the input shaft speed (ISS) sensor and the output shaft speed (OSS) sensor for the following conditions: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely to solenoids and relays 2. If you find incorrect routing, correct the harness routing. Did you find and correct the condition?	—	Go to Step 13	Go to Step 5
5	1. Disconnect the ISS sensor and the OSS sensor harness connector. 2. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ISS sensor (pins 1, 2 and 3 of E-31) and the OSS sensor (pins 1,2 and 3 of E-30). 3. Disconnect the TCM harness connector. 4. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the TCM (pins 3 and 13 of C-95). 5. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 6
6	1. Inspect the ISS sensor and the OSS sensor for the following conditions: • Physical damage of sensor • Loose or improper installation of sensor • Excessive air gap • Foreign material passing between ISS sensor and reverse & high clutch drum • Foreign material passing between OSS sensor and parking gear • Physical damage of reverse & high clutch drum or parking gear 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Place the selector lever in D range. 2. Observe the Low & Reverse Brake Pressure Switch, 2-4 Brake Pressure Switch and High Clutch Pressure Switch parameter with a scan tool. Refer to Clutch, Brake, Solenoid and Pressure Switch Logic table. Does the each transmission fluid pressure (TFP) switch display match each selected gear range?	—	Go to Step 8	Refer to DTC P1853, P1858 or P1863
8	Perform the line pressure test. Refer to Line Pressure Test. Is the line pressure within specifications for each selected gear range?	—	Go to Step 9	Refer to appropriate instructions in the Line Pressure Test

Step	Action	Value(s)	Yes	No
9	1. Remove the transmission oil pan. Refer to repair instruction (On-Vehicle Service). 2. Inspect the oil pan and the fluid for contamination. Was excessive contamination found?	—	Replace the transmission fluid and filter and Go to Step 10	Go to Step 11
10	Drive the vehicle while observing the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 11	Go to Step 13
11	1. Remove the all shift solenoid valve and all TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
12	Repair or replace the valve body assembly/ clutches or brakes (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0748 (Flash Code 35)

Circuit Description

The pressure control (PC) solenoid valve is installed to the lower part of the valve body assembly. It controls the transmission fluid supply to the pressure regulator spool valve in the valve body. The TCM controls the solenoid valve by ON/ OFF signal based on the vehicle running conditions. The TCM turns ON the solenoid valve when a lower line pressure is required and turns OFF when a higher line pressure is required. With the operation of this solenoid valve, the operation and shift of the hydraulic circuit in the transmission can be performed smoothly. The PC solenoid valve is controlled according to the range position, speed sensor signals, transmission fluid temperature signal and the accelerator pedal position signal. The TCM monitors the PC solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the PC solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Transmission Controls Schematics

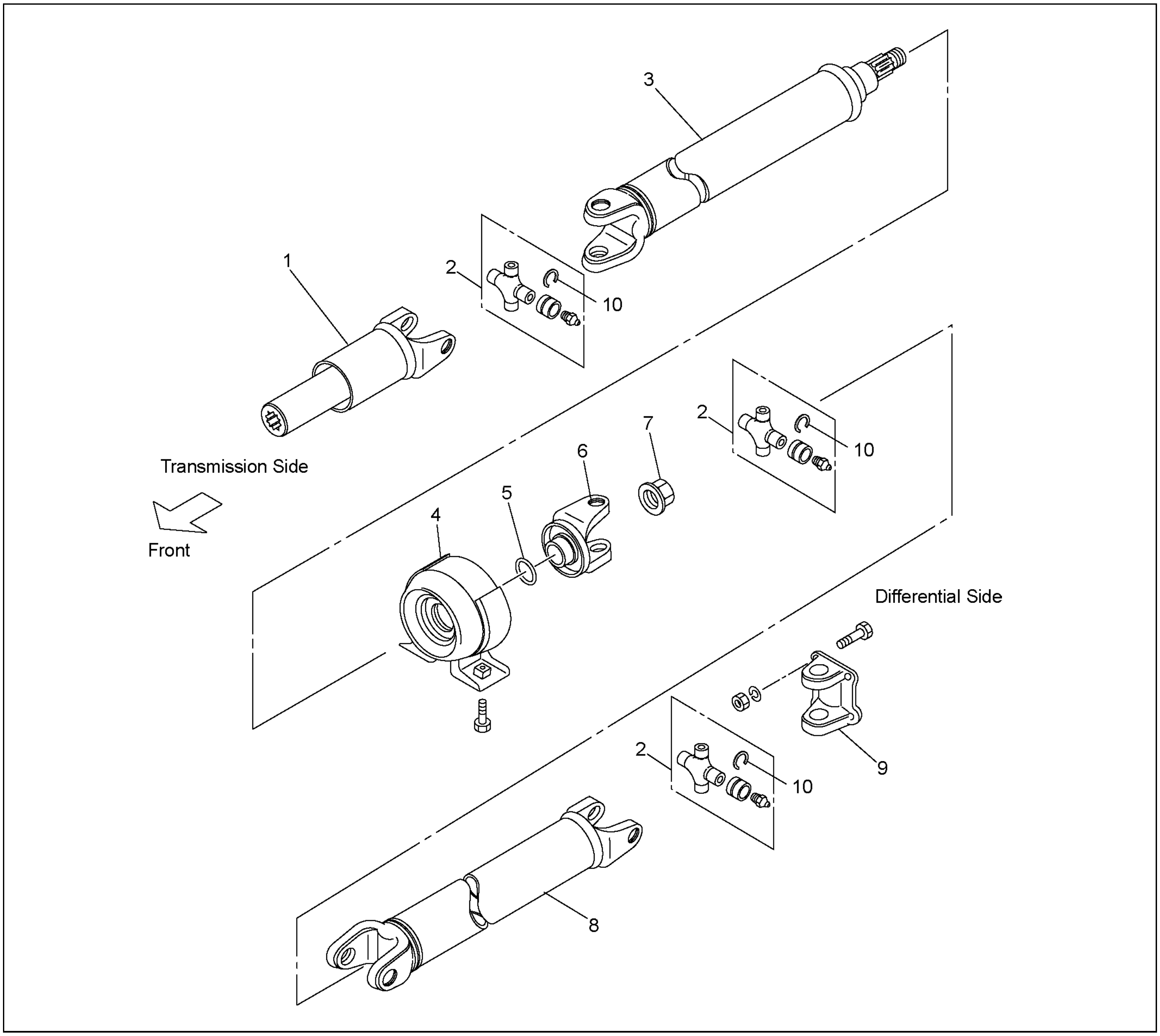
Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0748

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Perform the Pressure Control (PC) Solenoid control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the PC solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 6 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the PC Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 8	Go to Step 4
4	Does the test lamp remain illuminated with each command?	—	Go to Step 5	Go to Step 6

Rear Propeller Shaft Assembly

(4×2, 4×4)



Legend

1. Splined Yoke
2. Journal Assembly
3. 1st Tube Assembly
4. Center Bearing
5. Plain Washer
6. Center Yoke
7. Lock Nut
8. 2nd Tube Assembly
9. Flange Yoke
10. Snap Ring

Step	Action	Value(s)	Yes	No
5	1. Test the control circuit between the TCM (pin 23 of C-95) and the in-line harness connector (pin 6 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
6	1. Test the control circuit between the TCM (pin 23 of C-95) and the in-line harness connector (pin 6 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 23 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
8	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 6 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
9	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the PC solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the in-line harness connector. 4. Test the control circuit between the PC solenoid valve and the in-line harness connector (pin 6 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
10	Replace the PC solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
11	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0753 (Flash Code 31)

Circuit Description

The low & reverse brake solenoid valve controls fluid acting on spool valves in the low & reverse brake hydraulic circuits, which then controls low & reverse brake apply and release. The solenoid valve is installed to the lower part of the valve body assembly. The TCM controls the solenoid valve by a duty cycle (pulse width modulation [PWM]) signal based on the commanded gear position. The solenoid valve provides a smooth gearshift by operating on a duty cycle percentage of ON time. The TCM monitors the low & reverse brake solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the low & reverse brake solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM stops low & reverse brake solenoid valve.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0753

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P1875 also set?	—	Go to DTC P1875	Go to Step 3
3	1. Park the vehicle. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Low & Reverse Brake Solenoid control with a scan tool. 4. Command the solenoid valve ON and OFF. Does the low & reverse brake solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 5 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the Low & Reverse Brake Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the TCM (pin 6 of C-95) and the in-line harness connector (pin 5 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	1. Test the control circuit between the TCM (pin 6 of C-95) and the in-line harness connector (pin 5 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 6 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 5 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the low & reverse brake solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the harness connector of the low & reverse brake solenoid valve or in-line harness connector. 4. Inspect for an intermittent and for a poor connection of ground wire. 5. Test the control circuit between the low & reverse brake solenoid valve and the in-line harness connector (pin 5 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 6. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Replace the low & reverse brake solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 4	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0758 (Flash Code 32)

Circuit Description

The 2-4 brake solenoid valve controls fluid acting on spool valves in the 2-4 brake hydraulic circuits, which then controls 2-4 brake apply and release. The solenoid valve is installed to the lower part of the valve body assembly. The TCM controls the solenoid valve by a duty cycle (pulse width modulation [PWM]) signal based on the commanded gear position. The solenoid valve provides a smooth gearshift by operating on a duty cycle percentage of ON time. The TCM monitors the 2-4 brake solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the 2-4 brake solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM stops 2-4 brake solenoid valve.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0758

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P1875 also set?	—	Go to DTC P1875	Go to Step 3
3	1. Park the vehicle. 2. Turn ON the ignition, with the engine OFF. 3. Perform the 2-4 Brake Solenoid control with a scan tool. 4. Command the solenoid valve ON and OFF. Does the 2-4 brake solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 9 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the 2-4 Brake Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the TCM (pin 7 of C-95) and the in-line harness connector (pin 9 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	1. Test the control circuit between the TCM (pin 7 of C-95) and the in-line harness connector (pin 9 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 7 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 9 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the 2-4 brake solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the harness connector of the 2-4 brake solenoid valve or in-line harness connector. 4. Inspect for an intermittent and for a poor connection of ground wire. 5. Test the control circuit between the 2-4 brake solenoid valve and the in-line harness connector (pin 9 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 6. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Replace the 2-4 brake solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 4	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0763 (Flash Code 33)

Circuit Description

The high clutch solenoid valve controls fluid acting on spool valves in the high clutch hydraulic circuits, which then controls high clutch apply and release. The solenoid valve is installed to the lower part of the valve body assembly. The TCM controls the solenoid valve by a duty cycle (pulse width modulation [PWM]) signal based on the commanded gear position. The solenoid valve provides a smooth gearshift by operating on a duty cycle percentage of ON time. The TCM monitors the high clutch solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the high clutch solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM stops high clutch solenoid valve.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0763

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P1875 also set?	—	Go to DTC P1875	Go to Step 3
3	1. Park the vehicle. 2. Turn ON the ignition, with the engine OFF. 3. Perform the High Clutch Solenoid control with a scan tool. 4. Command the solenoid valve ON and OFF. Does the high clutch solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 10 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the High Clutch Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the TCM (pin 8 of C-95) and the in-line harness connector (pin 10 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	1. Test the control circuit between the TCM (pin 8 of C-95) and the in-line harness connector (pin 10 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 8 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 10 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Disassembly

1. Disassembly the three portions of the journal assemblies.
2. Remove the splined yoke, the 1st tube assembly with center bearing, the 2nd tube assembly and the flange yoke.
3. Remove the lock nut.
4. Remove the center yoke, the plain washer the center bearing and the 1st tube assembly.

Reassembly

1. Install the center bearing on the 1st tube assembly.

Clean the bearing fitting face.

Repack the grease.

Amount of grease required g(oz)	Approx. 12 (0.42)

2. Install the plain washer and the center yoke.
3. Install the lock nut and tighten it to the specified torque.
   Lock nut Torque : 118 N·m (12.0 kgf·m/87lb·ft)

(1) Discard the flange nut and install a new one.

(2) Stake the outer face of the flange nut against the slot in the shaft.

4. Install the splined yoke, the 1st tube assembly with center bearing, the 2nd tube assembly and the flange yoke by assembling the universal joint.

Step	Action	Value(s)	Yes	No
10	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the high clutch solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the harness connector of the high clutch solenoid valve or in-line harness connector. 4. Inspect for an intermittent and for a poor connection of ground wire. 5. Test the control circuit between the high clutch solenoid valve and the in-line harness connector (pin 10 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 6. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Replace the high clutch solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 4	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P0768 (Flash Code 34)

Circuit Description

The low clutch solenoid valve controls fluid acting on spool valves in the low clutch hydraulic circuits, which then controls low clutch apply and release. The solenoid valve is installed to the lower part of the valve body assembly. The TCM controls the solenoid valve by a duty cycle (pulse width modulation [PWM]) signal based on the commanded gear position. The solenoid valve provides a smooth gearshift by operating on a duty cycle percentage of ON time. The TCM monitors the low clutch solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the low clutch solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM stops low clutch solenoid valve.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P0768

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P1875 also set?	—	Go to DTC P1875	Go to Step 3
3	1. Park the vehicle. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Low Clutch Solenoid control with a scan tool. 4. Command the solenoid valve ON and OFF. Does the low clutch solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 3 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the Low Clutch Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 9	Go to Step 5
5	Does the test lamp remain illuminated with each command?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit between the TCM (pin 9 of C-95) and the in-line harness connector (pin 3 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
7	1. Test the control circuit between the TCM (pin 9 of C-95) and the in-line harness connector (pin 3 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 9 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 3 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the low clutch solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the harness connector of the low clutch solenoid valve or in-line harness connector. 4. Inspect for an intermittent and for a poor connection of ground wire. 5. Test the control circuit between the low clutch solenoid valve and the in-line harness connector (pin 3 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 6. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Replace the low clutch solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 4	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1120 (Flash Code 22)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The analogue APP signals are converted by the engine control module (ECM) into a pulse width modulation (PWM) signal. This converted signal is continually sent from the ECM to the TCM to determine appropriate shift points depending on the accelerator pedal pressing amount. If the TCM fails to receive a PWM signal from the ECM, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects that the APP PWM signal from the ECM is not being received.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Circuit/ System Testing DTC P1120

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the ENGINE DTC Information with a scan tool. Is DTC P2621 or P2622 set?	—	Go to Applicable DTC in engine control section	Go to Diagnostic Aids

DTC P1750 (Flash Code 51)

Circuit Description

The low & reverse brake transmission fluid pressure (TFP) switch is installed to the lower part of the valve body assembly and it feedbacks fluid pressure in the low & reverse brake hydraulic circuit. The low & reverse brake fail-safe spool valves are installed to the control valve body assembly and it uses to prevent interlocking of clutches and brakes. When the solenoid valve is energized, fluid pressure is drained to disengage the low & reverse brake and the TFP switch is OFF. When the solenoid valve is not energized, fluid pressure is applied to engage the low & reverse brake and the TFP switch is ON. The TCM monitors the low & reverse brake TFP switch ON/ OFF status through the signal circuit. If the TCM detects an improper status on the signal circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects that the low & reverse brake TFP switch signal repeats OFF/ ON twice when the selector lever in forward range with the 2nd, 3rd or 4th gear.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM fixes to the 3rd gear.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A sticking or intermittently sticking the low & reverse brake solenoid valve will cause this DTC to set.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1750

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P0753 or P1853 also set?	—	Go to Applicable DTC	Go to Step 3
3	Place the selector lever in forward range while observing the Low & Reverse Brake Pressure Switch parameter with a scan tool. Does the Low & Reverse Brake Pressure Switch parameter ever indicate ON when gear is shifted between 1st and 4th?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the low & reverse brake solenoid valve and transmission fluid pressure (TFP) switch for the following conditions: • Physical damage • Loose or improper installation 3. Test the signal circuit between the low & reverse brake TFP switch and the in-line harness connector (pin 12 of E-54 male side) for a short to ground. 4. Repair the circuit(s) or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the low & reverse brake solenoid valve and TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Repair or replace the valve body assembly. Refer to repair instructions (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1755 (Flash Code 52)

Circuit Description

The 2-4 brake transmission fluid pressure (TFP) switch is installed to the lower part of the valve body assembly and it feedbacks fluid pressure in the 2-4 brake hydraulic circuit. The low & reverse brake fail-safe spool valves are installed to the control valve body assembly and it uses to prevent interlocking of clutches and brakes. When the solenoid valve is energized, fluid pressure is drained to disengage the 2-4 brake and the TFP switch is OFF. When the solenoid valve is not energized, fluid pressure is applied to engage the 2-4 brake and the TFP switch is ON. The TCM monitors the 2-4 brake TFP switch ON/ OFF status through the signal circuit. If the TCM detects an improper status on the signal circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects that the 2-4 brake TFP switch signal repeats OFF/ ON twice when the selector lever in forward range with the 3rd gear.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

During the vehicle running;

- The TCM holds the last gear position when the diagnostic runs and fails.
- The TCM inhibits lock up control.

After the vehicle stopped;

- The TCM fixes to the 3rd gear.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A sticking or intermittently sticking the 2-4 brake solenoid valve will cause this DTC to set.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1755

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P0758or P1858 also set?	—	Go to Applicable DTC	Go to Step 3
3	Place the selector lever in forward range while observing the 2-4 Brake Pressure Switch parameter with a scan tool. Does the 2-4 Brake Pressure Switch parameter ever indicate ON when gear is positioned 1st and 3rd?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the 2-4 brake solenoid valve and transmission fluid pressure (TFP) switch for the following conditions: • Physical damage • Loose or improper installation 3. Test the signal circuit between the 2-4 brake TFP switch and the in-line harness connector (pin 7 of E-54 male side) for a short to ground 4. Repair the circuit(s) or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the 2-4 brake solenoid valve and TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Repair or replace the valve body assembly. Refer to repair instructions (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1853 (Flash Code 26)

Circuit Description

The low & reverse brake transmission fluid pressure (TFP) switch is installed to the lower part of the valve body assembly and it feedbacks fluid pressure in the low & reverse brake hydraulic circuit. When the solenoid valve is energized, fluid pressure is drained to disengage the low & reverse brake and the TFP switch is OFF. When the solenoid valve is not energized, fluid pressure is applied to engage the low & reverse brake and the TFP switch is ON. The TCM monitors the low & reverse brake TFP switch ON/ OFF status through the signal circuit. If the TCM detects an improper status on the signal circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0560, P0705, P0717, P0722, P0753, P0758, P0763, P0768, P1120, P1750, P1755 and P1875 are not set.

AND following conditions are met for longer than 2.5 seconds.

- The ignition switch is ON.
- The transmission fluid temperature is more than 60°C (140°F).
- The engine speed is more than 500 RPM.
- The TCM is not under gearshift control.

Condition for Setting the DTC

Either of following condition is met:

- The TCM detects that the low & reverse brake TFP switch signal is stuck at the ON for longer than 2 seconds when the selector lever in D range with 4th gear.
- The TCM detects that the low & reverse brake TFP switch signal is stuck at the OFF for longer than 2 second when the selector lever in R range.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A sticking or intermittently sticking the low & reverse brake solenoid valve will cause this DTC to set.

Schematic Reference: Transmission Controls Schematics

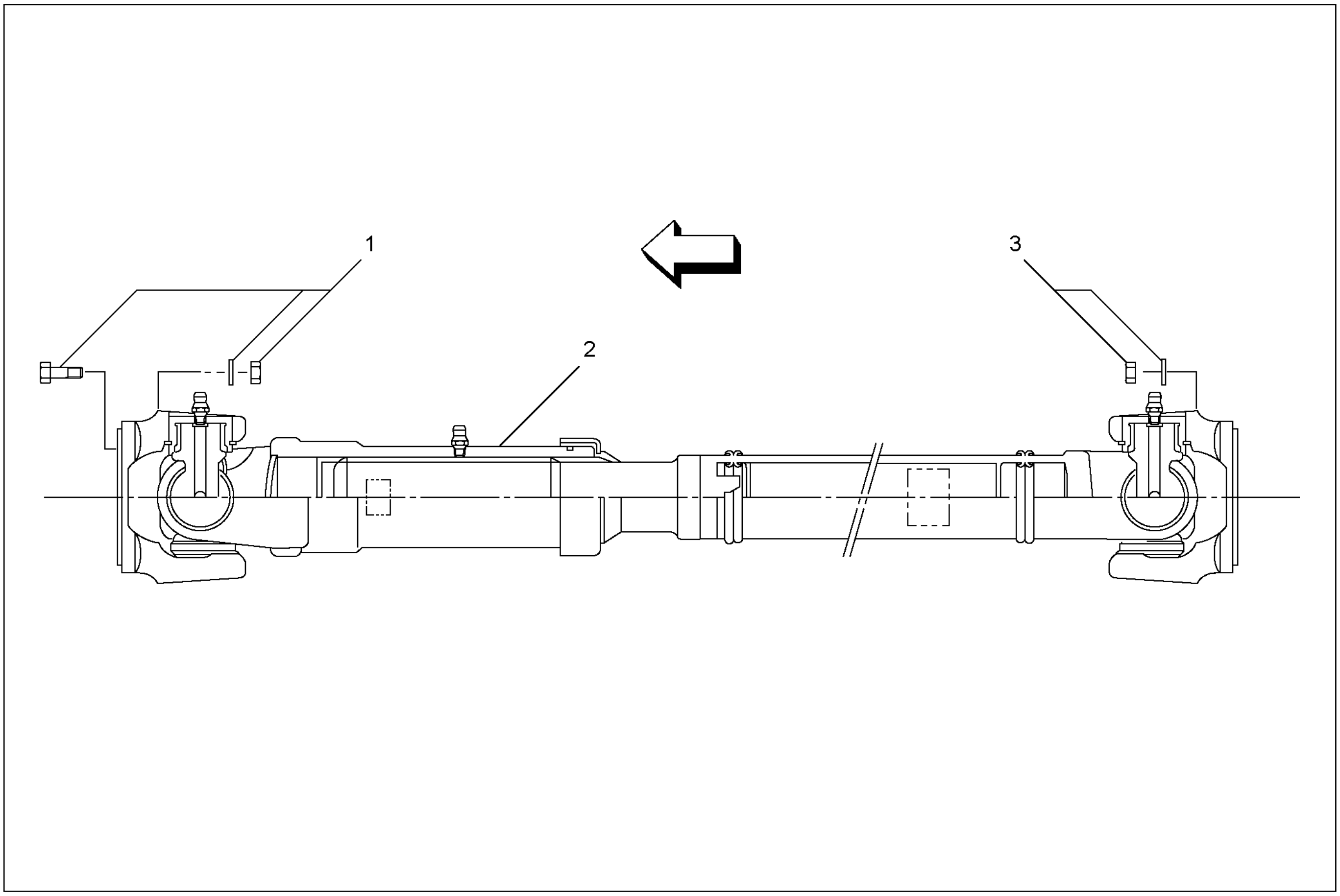
Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1853

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P0753 also set?	—	Go to DTC P0753	Go to Step 3
3	Place the selector lever in forward range while observing the Low & Reverse Brake Pressure Switch parameter with a scan tool. Does the Low & Reverse Brake Pressure Switch parameter ever indicate ON when gear is shifted between 1st and 4th?	—	Go to Step 5	Go to Step 4

Front Propeller Shaft

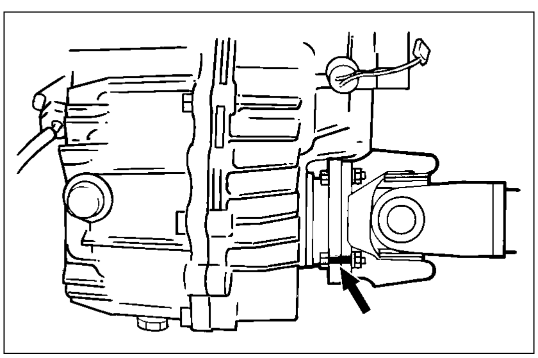
Removal and Installation



RUW54AMF000201

Legend

1. Bolt, Nut and Washer (Front Axle Side)
2. Front Propeller Shaft
3. Nut and Washer (Transfer Side)



401RS020

Removal

1. Jack up the vehicle and support it on the chassis stands.
2. Gear shift lever should be placed in neutral position and parking brake released.
3. Remove the exhaust and transfer protectors.

NOTE:
Apply alignment marks on the flange at the front propeller shaft both front and rear side.

4. Remove bolt, nut and washer (Front axle side).
5. Remove bolt, nut and washer (Transfer side).
6. Remove front propeller shaft.

Step	Action	Value(s)	Yes	No
4	Place the selector lever in R range while observing the Low & Reverse Brake Pressure Switch parameter with a scan tool. Does the Low & Reverse Brake Pressure Switch parameter indicate ON?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Low & Reverse Brake Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire between pin 12 of E-54 (female side) and a known good ground. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 8	Go to Step 6
6	1. Test the signal circuit between the TCM (pin 12 of C-95) and the in-line harness connector (pin 12 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 12 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 12 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the low & reverse brake solenoid valve and transmission fluid pressure (TFP) switch for the following conditions: • Physical damage • Loose or improper installation 3. Inspect for an intermittent and for a poor connection at the harness connector of the low & reverse brake TFP switch or in-line harness connector. 4. Test the signal circuit between the low & reverse brake TFP switch and the in-line harness connector (pin 12 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the solenoid valve circuit • High resistance 5. Repair the connection(s), circuit(s) or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
10	1. Remove the low & reverse brake solenoid valve and TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Repair or replace the valve body assembly. Refer to repair instructions (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1858 (Flash Code 27)

Circuit Description

The 2-4 brake transmission fluid pressure (TFP) switch is installed to the lower part of the valve body assembly and it feedbacks fluid pressure in the 2-4 brake hydraulic circuit. When the solenoid valve is energized, fluid pressure is drained to disengage the 2-4 brake and the TFP switch is OFF. When the solenoid valve is not energized, fluid pressure is applied to engage the 2-4 brake and the TFP switch is ON. The TCM monitors the 2-4 brake pressure switch ON/ OFF status through the signal circuit. If the TCM detects an improper status on the signal circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0560, P0705, P0717, P0722, P0753, P0758, P0763, P0768, P1120, P1750, P1755 and P1875 are not set.

AND following conditions are met for longer than 2.5 seconds.

- The ignition switch is ON.
- The transmission fluid temperature is more than 60°C (140°F).
- The engine speed is more than 500 RPM.
- The TCM is not under gearshift control.

Condition for Setting the DTC

Either of following condition is met:

- The TCM detects that the 2-4 brake TFP switch signal is stuck at the ON for longer than 2 seconds when the selector lever in P, R or N range.
- The TCM detects that the 2-4 brake TFP switch signal is stuck at the OFF for longer than 2 second when the selector lever in D range with 4th gear.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A sticking or intermittently sticking the 2-4 brake solenoid valve will cause this DTC to set.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1858

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P0758 also set?	—	Go to DTC P0758	Go to Step 3
3	Place the selector lever in forward range while observing the 2-4 Brake Pressure Switch parameter with a scan tool. Does the 2-4 Brake Pressure Switch parameter ever indicate OFF when gear is positioned 2nd and 4th?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Place the selector lever in P, R and N range while observing the 2-4 Brake Pressure Switch parameter with a scan tool. Does the 2-4 Brake Pressure Switch parameter indicate OFF?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Turn ON the ignition, with the engine OFF. 4. Observe the 2-4 Brake Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire between pin 7 of E-54 (female side) and a known good ground. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 8	Go to Step 6
6	1. Test the signal circuit between the TCM (pin 1 of C-95) and the in-line harness connector (pin 7 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 1 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 7 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9

Step	Action	Value(s)	Yes	No
9	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the 2-4 brake solenoid valve and transmission fluid pressure (TFP) switch for the following conditions: • Physical damage • Loose or improper installation 3. Inspect for an intermittent and for a poor connection at the harness connector of the 2-4 brake TFP switch or in-line harness connector. 4. Test the signal circuit between the 2-4 brake TFP switch and the in-line harness connector (pin 7 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the solenoid valve circuit • High resistance 5. Repair the connection(s), circuit(s) or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
10	1. Remove the 2-4 brake solenoid valve and TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Repair or replace the valve body assembly. Refer to repair instructions (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1860 (Flash Code 36)

Circuit Description

The torque converter clutch (TCC) solenoid valve controls fluid acting on the lock up control spool valve, which then controls lock up clutch apply and release. The solenoid valve is installed to the lower part of the valve body assembly. The TCM controls the solenoid valve by a duty cycle (pulse width modulation [PWM]) signal based on the vehicle running conditions. The solenoid valve provides a smooth engagement of the torque converter clutch by operating on a duty cycle percentage of ON time. The TCM monitors the TCC solenoid valve operating status through the feedback circuit. If the TCM detects an improper voltage level on the control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit or short circuit on the TCC solenoid valve control circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.
- The TCM inhibits lock up control.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1860

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Perform the Torque Converter Clutch (TCC) Solenoid control with a scan tool. 3. Command the solenoid valve ON and OFF. Does the TCC solenoid valve click with each command?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the control circuit (pin 4 of E-54 female side) and a known good ground. 4. Turn ON the ignition, with the engine OFF. 5. Perform the TCC Solenoid control with a scan tool. 6. Command the solenoid valve ON and OFF. Does the test lamp turn ON and OFF with each command?	—	Go to Step 8	Go to Step 4
4	Does the test lamp remain illuminated with each command?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the control circuit between the TCM (pin 17 of C-95) and the in-line harness connector (pin 4 of E-54 female side) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
6	1. Test the control circuit between the TCM (pin 17 of C-95) and the in-line harness connector (pin 4 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 17 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
8	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 4 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
9	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the TCC solenoid valve for the following conditions: • Physical damage of solenoid valve • Loose or improper installation of solenoid valve 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCC solenoid valve or in-line harness connector. 4. Inspect for an intermittent and for a poor connection of ground wire. 5. Test the control circuit between the TCC solenoid valve and the in-line harness connector (pin 4 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the other solenoid valve circuit • High resistance 6. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

Step	Action	Value(s)	Yes	No
10	Replace the TCC solenoid valve. Refer to repair instructions (On-Vehicle Service). Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1863 (Flash Code 28)

Circuit Description

The high clutch transmission fluid pressure (TFP) switch is installed to the lower part of the valve body assembly and it feedbacks fluid pressure in the high clutch hydraulic circuit. When the solenoid valve is energized, fluid pressure is drained to disengage the high clutch and the TFP switch is OFF. When the solenoid valve is not energized, fluid pressure is applied to engage the high clutch and the TFP switch is ON. The TCM monitors the high clutch TFP switch ON/ OFF status through the signal circuit. If the TCM detects an improper status on the signal circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0560, P0705, P0717, P0722, P0753, P0758, P0763, P0768, P1120, P1750, P1755 and P1875 are not set.

AND following conditions are met for longer than 3 seconds.

- The ignition switch is ON.
- The transmission fluid temperature is more than 60°C (140°F).
- The engine speed is more than 500 RPM.
- The TCM is not under gearshift control.

Condition for Setting the DTC

Either of following condition is met:

- The TCM detects that the high clutch TFP switch signal is stuck at the ON for longer than 2 seconds when the selector lever in P, R or N range.
- The TCM detects that the high clutch TFP switch signal is stuck at the OFF for longer than 2 second when the selector lever in D range with 4th gear.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Clutch, Brake, Solenoid and Pressure Switch Logic table to verify each component works properly within the selected gear range.
- A sticking or intermittently sticking the high clutch solenoid valve will cause this DTC to set.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1863

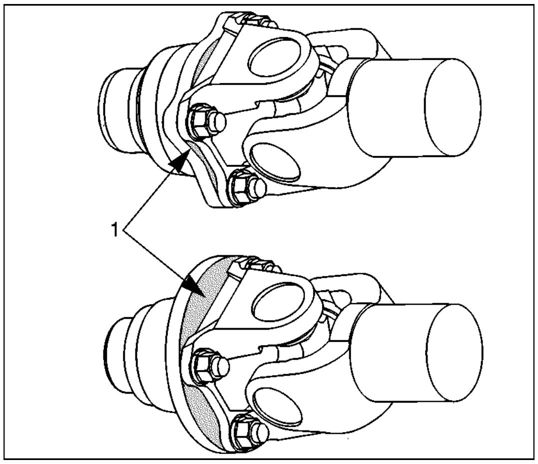
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Lift the driving wheels or drive the vehicle while observing the DTC Information with a scan tool. Is DTC P0763 also set?	—	Go to DTC P0763	Go to Step 3
3	Place the selector lever in forward range while observing the High Clutch Pressure Switch parameter with a scan tool. Does the High Clutch Pressure Switch parameter ever indicate OFF when gear is positioned 3rd and 4th?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Place the selector lever in P, R and N range while observing the High Clutch Pressure Switch parameter with a scan tool. Does the High Clutch Pressure Switch parameter indicate OFF?	—	Go to Diagnostic Aids	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Turn ON the ignition, with the engine OFF. 4. Observe the high clutch Switch parameter with a scan tool while momentarily jumping 3-amp fused jumper wire between pin 1 of E-54 (female side) and a known good ground. Does the scan tool indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 8	Go to Step 6
6	1. Test the signal circuit between the TCM (pin 20 of C-95) and the in-line harness connector (pin 1 of E-54 female side) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 20 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 1 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 9

Installation

NOTE:

Never install the shaft assembly backwards. Completely remove the black paint from the connecting surface of flange coupling on each end of propeller shaft. Clean so that no foreign matter will be caught in between.



401RS019

1. Align the mark, which was applied at removal. Install front propeller shaft and tighten the bolts and nuts to the specified torque.

   Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

2. Install the exhaust and transfer protectors.
3. After installing the propeller shaft, be sure to apply black paint (1) to exposed area (other than connecting surface) of the entire surface of flange coupling.

Step	Action	Value(s)	Yes	No
9	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect the high clutch solenoid valve and transmission fluid pressure (TFP) switch for the following conditions: • Physical damage • Loose or improper installation 3. Inspect for an intermittent and for a poor connection at the harness connector of the high clutch TFP switch or in-line harness connector. 4. Test the signal circuit between the high clutch TFP switch and the in-line harness connector (pin 1 of E-54 male side) for the following conditions: • An open circuit • A short to ground • A short to the solenoid valve circuit • High resistance 5. Repair the connection(s), circuit(s) or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
10	1. Remove the high clutch solenoid valve and TFP switch from the valve body assembly and perform function check. Refer to repair instructions (On-Vehicle Service). 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
11	Repair or replace the valve body assembly. Refer to repair instructions (On-Vehicle Service or Unit Repair). Did you complete the repair or replacement?	—	Go to Step 13	—
12	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Drive the vehicle while observing the DTC Information with a scan tool. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC P1875 (Flash Code 25)

Circuit Description

The all shift solenoid valves feed drive voltage from the TCM and low side circuit is connected to the TCM through the ground return circuit. The TCM monitors the ground return circuit through the feedback circuit. If the TCM detects an improper status on the ground return circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The TCM detects an open circuit on the ground return circuit.

Action Taken When the DTC Sets

- The TCM blinks the Check Trans lamp when the diagnostic runs and fails.
- The TCM stops all shift solenoid valves and fixes to the 3rd gear. If a fail-safe valve problem is detected, the shift solenoid valves are not stopped but gear is fixed to the 3rd gear.
- The TCM stops PC solenoid valve.
- The TCM inhibits lock up control.

Condition for Clearing the DTC

- The TCM turns OFF the Check Trans lamp when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail at next ignition cycle.

Diagnostic Aids

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing DTC P1875

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (E-54) near the transmission range switch. 3. Connect a test lamp between the ground return circuit (pin 11 of E-54 male side) and battery voltage. Does the test lamp illuminate?	—	Go to Step 4	Go to Step 7
4	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 11 of E-54). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5
5	1. Test the circuit between the TCM (pin 22 of C-95) and the in-line harness connector (pin 11 of E-54 female side) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the TCM harness connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 22 of C-95). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
7	1. Remove the transmission oil pan. Refer to repair instructions (On-Vehicle Service). 2. Inspect for an intermittent and for a poor connection at the ground terminal or in-line harness connector. Clean or tighten grounds as necessary. 3. Repair the open circuit or high between the ground terminal and the in-line harness connector (pin 11 of E-54 male side). Did you complete the repair?	—	Go to Step 9	—
8	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected components or harness connector(s). 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Check Trans Lamp Inoperative, Always On or Always Blinking

Circuit Description

The Check Trans Lamp is located on the instrument panel (IP) cluster. The Check Trans Lamp informs the driver that a transmission control system fault has occurred and that system requires service. The ignition voltage is supplied to the Check Trans Lamp via meter fuse. The TCM turns ON by grounding the lamp control circuit.

Check Trans Lamp Illumination

- The Check Trans Lamp illuminates for approximately 3 seconds when the ignition switch is turned ON, with the engine OFF.
- The Check Trans Lamp blinks if the TCM detects a fault.

Schematic Reference: Transmission Controls Schematics

Connector End View Reference: Transmission Controls Connector End Views or TCM Connector End Views

Circuit/ System Testing Check Trans Lamp Inoperative, Always On or Always Blinking

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Transmission Controls?	—	Go to Step 2	Go to Diagnostic System Check - Transmission Controls
2	1. Verify whether the instrument panel (IP) cluster is operational. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. Does the check trans lamp turn ON then turn OFF after 3 seconds passed?	—	Go to Intermittent Conditions	Go to Step 3
3	Does the check trans lamp blink?	—	Check for DTCs and if none exist Go to Step 4	Go to Step 6
4	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Diagnostic Switch parameter with a scan tool. Does the Diagnostic Switch parameter indicate ON?	—	Go to Step 5	Check for DTCs
5	Repair the short to ground between the TCM (pin 18 of C-94) and the data link connector (DLC) (pin 11 of B-58). Did you complete the repair?	—	Go to Step 21	—
6	1. Perform the Check Light control with a scan tool. 2. Command the lamp ON and OFF. Does the check trans lamp turn ON and OFF with each command?	—	Go to Intermittent Conditions	Go to Step 7
7	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the cabin fuse block. Is the Meter (10A) fuse open?	—	Go to Step 8	Go to Step 9

Step	Action	Value(s)	Yes	No
8	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 21	—
9	1. Turn OFF the ignition. 2. Disconnect the TCM C-94 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the check trans lamp OFF?	—	Go to Step 10	Go to Step 16
10	1. Remove the Meter (10A) fuse that supplies voltage to the Check Trans Lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the check trans lamp control circuit in the TCM harness connector (pin 20 of C-94) to a known good ground. Is the voltage less than the specified value?	1 volt	Go to Step 11	Go to Step 17
11	1. Turn OFF the ignition. 2. Reinstall the Meter (10A) fuse. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the TCM harness connector (pin 20 of C-94) and a known good ground. Is the check trans lamp illuminated?	—	Go to Step 15	Go to Step 12
12	1. Turn OFF the ignition. 2. Remove the IP cluster. 3. Connect a test lamp between the ignition voltage feed circuit of the IP cluster harness connector (pin 8 of B-24) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 18
13	1. Test the control circuit between the TCM (pin 20 of C-94) and the IP cluster (pin 25 of B-23) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 14
14	1. Inspect for an intermittent and for poor connections at the harness connector of the IP cluster (pin 25 of B-23 and pin 8 of B-24). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 19
15	1. Inspect for an intermittent and for a poor connection at the harness connector of the TCM (pin 20 of C-94). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 21	Go to Step 20
16	Repair the short to ground between the TCM (pin 20 of C-94) and the IP cluster (pin 25 of B-23). Did you complete the repair?	—	Go to Step 21	—

Step	Action	Value(s)	Yes	No
17	Repair the short to battery or ignition voltage between the TCM (pin 20 of C-94) and the IP cluster (pin 25 of B-23). Did you complete the repair?	—	Go to Step 21	—
18	Repair the open circuit or high resistance on ignition the voltage feed circuit between the Meter (10A) fuse and the IP cluster (pin 8 of B-24). Did you complete the repair?	—	Go to Step 21	—
19	Repair or replace the IP cluster. Did you complete the repair or replacement?	—	Go to Step 21	—
20	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 21	—
21	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Perform the Check Light control with a scan tool. 3. Command the lamp ON and OFF. Does the check trans lamp turn ON and OFF with each command?	—	System OK	Go to Step 7

Symptoms - Transmission Controls

Symptoms - Transmission Controls

Important Preliminary Inspections Before Starting

Perform Diagnostic System Check - Transmission Controls before using the symptom tables, and verify that all of the following are true:

- The TCM and check trans lamp is operating correctly.
- The scan tool data is within the normal operating range. Refer to Scan Tool Data List in this section.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

- The TCM grounds are clean, tight, and in their proper location.
- The transmission harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

Important: Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the serial data circuit.

Important: The problem may or may not turn ON the check trans lamp or store a DTC. Faulty electrical connections or wiring cause most intermittent problems.

Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
- Terminals that are not seated
- Terminals that are damaged or improperly formed

Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension.

Remove the terminal from the connector body in order to inspect for poor terminal wire connection.

Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored.

Use the scan tool in order to help detect intermittent conditions. Useful features of the Tech 2 includes the following:

- Trigger the Snapshot feature in order to capture and store transmission parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
- Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the scan tool Users Guide for more information.

Important: If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent check trans lamp with no stored DTC:

- The TCM grounds are loose or dirty. Refer to Transmission Controls Schematics.
- The check trans lamp circuit intermittently shorted to ground
- Electrical system interference caused by a malfunctioning relay, TCM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- There are any open diodes.

Important: The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to Transmission Controls Schematics for an application.

Use the following tables when diagnosing a symptom complaint:

- Intermittent Conditions
- Vehicle Does Not Run
- Trouble at Starting
- Faulty Gearshift
- Faulty Shift Pattern
- No or Error Gearshift
- Faulty Operation During Running
- Faulty Operation in Stopping
- Faulty Lock Up
- No Lock Up
- Transmission Fluid Leak
- Others

Intermittent Conditions

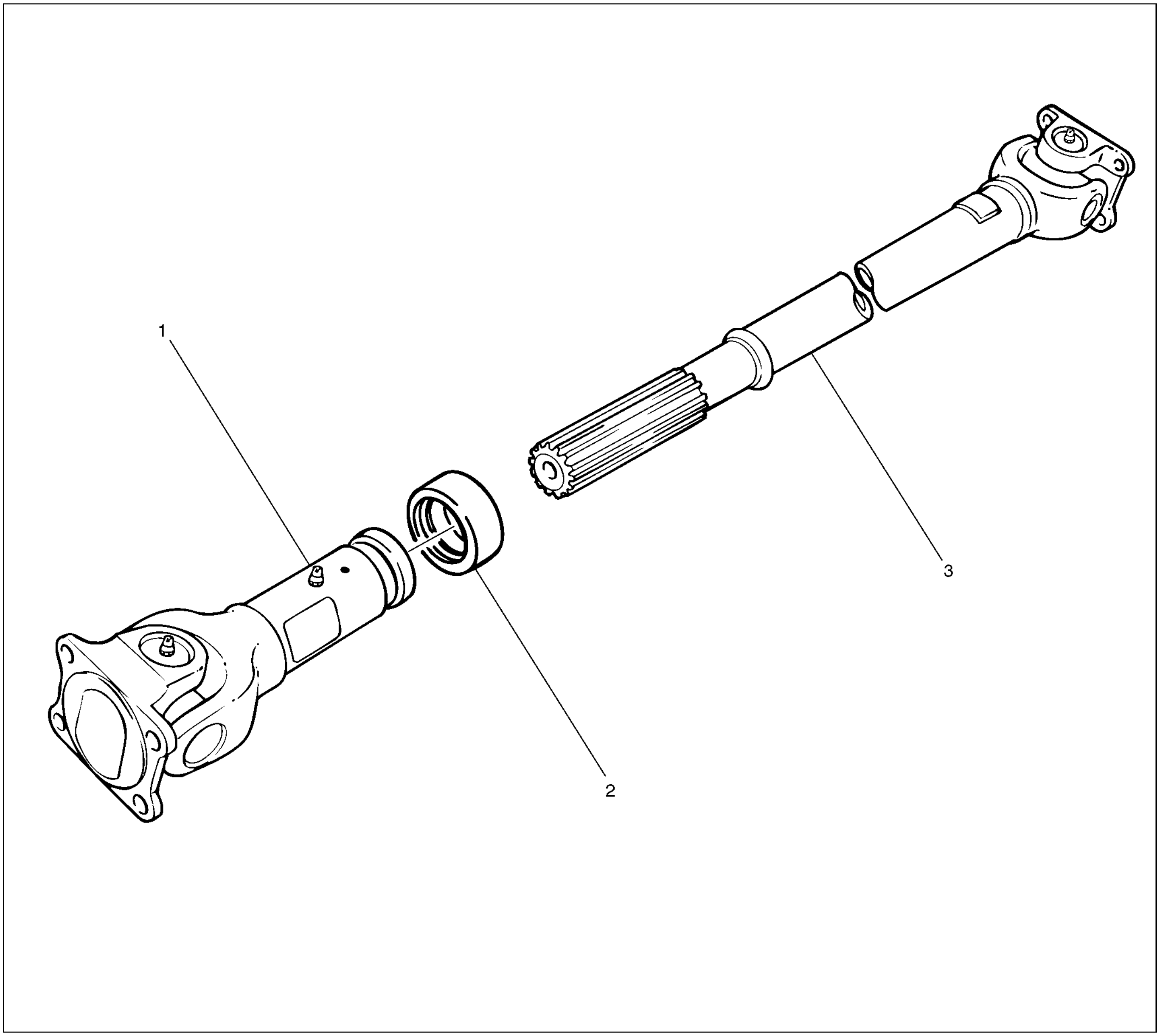
Checks	Action
Definition: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• Refer to Symptoms - Transmission Controls before starting.
Harness/ Connector	Many intermittent open or shorted circuits are affected by harness/ connector movement that is caused by vibration, engine torque, bumps/ rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/ system operation, or engine operation, inspect and repair the harness/ connections as necessary.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittent. To perform the following inspections: • Poor mating of the connector halves, or terminals improperly seated in the connector body. • Improperly formed or damaged terminals. Test for poor terminal tension. • Poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Corrosion/ water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Wires that are broken inside the insulation. • Harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/ component connectors, fuses, and any intermediate connections between the power source and the module/ component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component.

Checks	Action
Temperature Sensitivity	• An intermittent condition may occur when a component/ connection reaches normal operating temperature. The condition may occur only when the component/ connection is cold, or only when the component/ connection is hot. • If the intermittent is related to heat, review the data for a relationship with the following: - High ambient temperatures. - Underhood/ engine generated heat. - Circuit generated heat due to a poor connection, or high electrical load. - Higher than normal load conditions, towing, etc. • If the intermittent is related to cold, review the data for the following: - Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Test for water intrusion. - The condition only occurs on a cold start. - The condition goes away when the vehicle warms up. • Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
Electromagnetic Interference (EMI) and Electrical Noise	Some electrical components/ circuits are sensitive to EMI or other types of electrical noise. Inspect the following conditions: • A misrouted harness that is too close to high voltage/ high current devices such as injection components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation. • Electrical system interference caused by a malfunctioning relay, or the TCM driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating. • Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related failure while in use, but do not fail when the accessories are not in use. • Test for any open diodes. Some relays may contain a clamping diode. • Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system.
Incorrect TCM Programming	• There are only a few situations where reprogramming a TCM is appropriate: - An ECM from another vehicle is installed. - Revised software/ calibration files have been released for this vehicle. **Important:** DO NOT reprogram the TCM with the SAME software/ calibration files that are already present in the TCM. This is not an effective repair for any type of driveability problem. • Verify that the TCM contains the correct software/ calibration. If incorrect programming is found, reprogram the TCM with the most current software/ calibration.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/ or capture the failure conditions. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.
Scan Tool Snapshot	The scan tool can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the scan tool Users Guide for more information.

Vehicle Does Not Run
Trouble at Starting
Faulty Gearshift
Faulty Shift Pattern
No or Error Gearshift
Faulty Operation During Running
Faulty Operation in Stopping
Faulty Lock Up
No Lock Up
Transmission Fluid Leak
Others

Diagnostic Category		Category No.
This table consists of diagnostic categories that are located in the left column. Using this column, choose the appropriate category based on the operating conditions of the vehicle or transmission. After selecting a category, use the right column to locate the specific symptom diagnostic information.		
Vehicle Does Not Run	Vehicle does not run in D, 3, 2, L & L range	A1
	Vehicle does not run in R range	A2
	Vehicle does not run in D, 3, 2 and L range	A3
Trouble at Starting	Vehicle runs in N range	B1
	Poor acceleration at starting	B2
	Engine races up during starting (slip)	B3
	Large shock when selector lever is changed from N to D range or N to R range	B4
	Engine stalls when selector lever is changed from N to R, D, 3, 2 or L range	B5
	Engine does not crank in P or N range	B6
	Engine cranks in other than P or N range	B7
	Extended time lag when selector lever is changed from N to D	B8
	Extended time lag when selector lever is changed from N to R	B9
	Brake is applied in R range	B10
	Insufficient starting or shaking in D range	B11
	Noise or vibration occurs at starting	B12

Disassembly



401RW057

Legend

1. Sleeve Yoke
2. Seal
3. Tube Assembly

Diagnostic Category		Category No.
Faulty Gearshift	Engine race up (slipping) when gearshift is up from 1st to 2nd	C1
	Engine race up (slipping) when gearshift is up from 2nd to 3rd	C2
	Engine race up (slipping) when gearshift is up from 3rd to 4th	C3
	Engine race up (slipping) when gearshift is down from 4th to 3rd	C4
	Engine race up (slipping) when gearshift is down (or kick-down) from 4th to 2nd	C5
	Engine race up (slipping) when gearshift is down (or kick-down) from 3rd to 2nd	C6
	Engine race up (slipping) when gearshift is down (or kick-down) from 4th or 3rd to 2nd	C7
	Engine race up (slipping) others	C8
	Braking feel when gearshift is up from 1st to 2nd	C9
	Braking feel when gearshift is up from 2nd to 3rd	C10
	Braking feel when gearshift is up from 3rd to 4th	C11
	Large shock when gearshift from 1st to 2nd or 2nd to 1st	C12
	Large shock when gearshift from 2nd to 3rd or 3rd to 2nd	C13
	Large shock when gearshift from 3rd to 4th or 4th to 3rd	C14
	Large shock when kick-down	C15
	Large shock when accelerator pedal is stepped ON or OFF without gearshift	C16
	Large shock when gearshift from 2nd to 1st in L range	C17
	Large shock others	C18
	Large shock when vehicle speed is reduced by no accelerator pedal or vehicle is stopped	C19
	Large shock at lock up	C20
	Shift down or engine overrun when accelerator pedal is stepped ON in 4th gear	C21
Faulty Shift Pattern	Faulty gearshift schedule (different from shift speed chart)	D1
	Gearshift frequently	D2
	Gearshift point is low or high at all points	D3
	Gearshift point is low or high at limited area	D4
	No kick-down	D5
No or Error Gearshift	No gearshift	E1
	Only 4th gear is not selectable	E2
	Gear is changed from 2nd to 3rd in 2 range	E3
	Gear is changed from 1st to 2nd in L range	E4
	Gear is changed from 3rd to 4th in 3 range	E5
Faulty Operation During Running	Low maximum speed or poor acceleration	F1
	Only 4th gear is not selectable	F2
	Noise or vibration occurs during in R, D, 3, 2 or L range	F3
	Engine brake does not apply in L range	F4
	Engine stalls before vehicle stops from running	F5

Diagnostic Category		Category No.
Faulty Operation in Stopping	Vehicle moves in P range or parking is not disengaged in other than P range	G1
	Large creeping force	G2
	Small creeping force	G3
	Large noise during idle with vehicle stop	G4
Faulty Lock Up	Judder Occurs at Lock Up	H1
	Large Shock at Lock Up	H2
	Lock Up Point is High or Low	H3
No Lock Up	No Lock Up	I1
Transmission Fluid Leak	Transmission fluid leaks from breather	J1
	Transmission fluid leaks between engine and converter housing	J2
	Transmission fluid leaks between converter housing and transmission case	J3
	Transmission fluid leaks between transmission case and extension housing	J4
	Transmission fluid leaks from oil pan	J5
	Transmission fluid leaks from manual shaft oil seal	J6
	Transmission fluid leaks from oil cooler pipe joint	J7
Others	Transmission overheat	Z1
	Mode lamp (power drive or 3rd start) does not turn On	Z2
	Mode lamp (power drive or 3rd start) does not turn Off	Z3
	A/T oil temperature lamp turns On	Z4
	Selector lever feeling is faulty	Z5
	Poor fuel consumption	Z6
	Shift indicator is faulty	Z7
	Abnormal smell	Z8
	Transmission fluid quantity is low or high	Z9
	Transmission fluid quantity is low or high	Z10
	Abnormal transmission fluid pressure	Z11

Category	Possible causes		A1	A2	A3	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
	Diagnostic category		Vehicle does not run in D, 3, 2, L & L range	Vehicle does not run in R range	Vehicle does not run in D, 3, 2 and L range	Vehicle runs in N range	Poor acceleration at starting	Engine races up during starting (slip)	Large shock when selector lever is changed from N to D range or N to R range	Engine stalls when selector lever is changed from N to R, D, 3, 2 or L range	Engine does not crank in P or N range	Engine cranks in other than P or N range	Extended time lag when selector lever is changed from N to D	Extended time lag when selector lever is changed from N to R	Brake is applied in R range	Insufficient starting or shaking in D range	Noise or vibration occurs at starting
	Disordered selector lever cable		●			●			●		●	●	●	●	●		
	Disordered transmission range switch			●					●		●	●	●	●			
	Faulty line pressure		●				●	●	●							●	
	Faulty engine idle speed								●	●							
Electrical	Engine speed signal	Error, open or short circuit							●				●	●			
Electrical	Accelerator pedal position signal	Error, open or short circuit						●	●							●	
Electrical	Input shaft speed sensor	Error, open or short circuit						●	●								
Electrical	Output shaft speed sensor	Error, open or short circuit						●	●								
Electrical	Power drive or 3rd start switch	Open or short circuit					●	●									
Electrical	Transmission range switch	Open or short circuit		●					●		●	●	●	●	●	●	
Electrical	TCM power or ground	Open or short circuit						●	●							●	
Electrical	Transmission fluid temperature sensor	Error, open or short circuit							●								
Electrical	Pressure control solenoid	Open or short circuit						●	●				●	●		●	
Electrical	Torque converter clutch solenoid	Open or short circuit								●							
Electrical	Low & reverse brake solenoid	Open or short circuit		●					●					●		●	
Electrical	2-4 brake solenoid	Open or short circuit															
Electrical	High clutch solenoid	Open or short circuit															
Electrical	Low clutch solenoid	Open or short circuit			●			●	●				●			●	
Electrical	Ground return circuit	Open or short circuit						●	●								
Electrical	Low & reverse brake fluid pressure switch	Open or short circuit												●		●	
Electrical	2-4 brake fluid pressure switch	Open or short circuit															
Electrical	High clutch fluid pressure switch	Open or short circuit															
Hydraulic control	Transmission fluid quantity	Out of standard value	●				●	●					●	●	●	●	●
Hydraulic control	Control spool valve	Faulty operation	●			●	●	●	●	●			●	●		●	
Hydraulic control	High clutch solenoid accumulator	Faulty operation															
Hydraulic control	Low clutch solenoid accumulator	Faulty operation							●				●			●	
Hydraulic control	Low & reverse brake solenoid accumulator	Faulty operation							●					●		●	
Hydraulic control	2-4 brake solenoid accumulator	Faulty operation															
Hydraulic control	High clutch accumulator	Faulty operation															
Hydraulic control	2-4 brake accumulator	Faulty operation															
Hydraulic control	Pressure control solenoid hydraulic circuit	Clogged passage					●	●	●				●	●			
Hydraulic control	Torque converter clutch hydraulic circuit	Clogged passage								●							
Hydraulic control	High clutch solenoid hydraulic circuit	Clogged passage															
Hydraulic control	Low clutch solenoid hydraulic circuit	Clogged passage			●		●	●	●				●			●	
Hydraulic control	Low & reverse brake solenoid hydraulic circuit	Clogged passage						●	●					●			
Hydraulic control	2-4 brake solenoid hydraulic circuit	Clogged passage															
Hydraulic control	Oil cooler	Clogged passage								●							
Powertrain	Clutch (brake)	Slip	●	●	●			●	●				●	●	●	●	
Powertrain	Clutch (brake)	Seizure	●	●	●	●		●	●						●	●	
Powertrain	Torque converter	Faulty operation	●					●		●						●	
Powertrain	Torque converter clutch piston	Separation															
Powertrain	Torque converter clutch piston	Faulty operation								●						●	

Diagnostic category / Possible causes			C21 Shift down or engine overrun when accelerator pedal is stepped ON in 4th gear	C20 Large shock at lock up	C19 Large shock when vehicle speed is reduced by no accelerator pedal or vehicle is stopped	C18 Large shock others	C17 Large shock when gearshift from 2nd to 1st in L range	C16 Large shock when accelerator pedal is stepped ON or OFF without gearshift	C15 Large shock when kick-down	C14 Large shock when gearshift from 3rd to 4th or 4th to 3rd	C13 Large shock when gearshift from 2nd to 3rd or 3rd to 2nd	C12 Large shock when gearshift from 1st to 2nd or 2nd to 1st	C11 Braking feel when gearshift is up from 3rd to 4th	C10 Braking feel when gearshift is up from 2nd to 3rd	C9 Braking feel when gearshift is up from 1st to 2nd	C8 Engine race up (slipping) others	C7 Engine race up (slipping) when gearshift is down (or kick-down) from 4th or 3rd to 2nd	C6 Engine race up (slipping) when gearshift is down (or kick-down) from 3rd to 2nd	C5 Engine race up (slipping) when gearshift is down (or kick-down) from 4th to 2nd	C4 Engine race up (slipping) when gearshift is down from 4th to 3rd	C3 Engine race up (slipping) when gearshift is up from 3rd to 4th	C2 Engine race up (slipping) when gearshift is up from 2nd to 3rd	C1 Engine race up (slipping) when gearshift is up from 1st to 2nd
Disordered selector lever cable																							
Disordered transmission range switch																							
Faulty line pressure			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Faulty engine idle speed																							
Electrical	Engine speed signal	Error, open or short circuit																					
Electrical	Accelerator pedal position signal	Error, open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Input shaft speed sensor	Error, open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Output shaft speed sensor	Error, open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Power drive or 3rd start switch	Open or short circuit																					
Electrical	Transmission range switch	Open or short circuit				●	●																
Electrical	TCM power or ground	Open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Transmission fluid temperature sensor	Error, open or short circuit	●	●					●	●			●								●		●
Electrical	Pressure control solenoid	Open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Torque converter clutch solenoid	Open or short circuit		●			●																
Electrical	Low & reverse brake solenoid	Open or short circuit			●	●	●								●	●							●
Electrical	2-4 brake solenoid	Open or short circuit	●		●	●	●		●	●	●	●	●		●	●		●		●	●	●	●
Electrical	High clutch solenoid	Open or short circuit	●		●	●			●		●		●	●		●	●	●	●		●	●	
Electrical	Low clutch solenoid	Open or short circuit			●	●			●	●				●	●	●	●		●	●		●	●
Electrical	Ground return circuit	Open or short circuit	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Electrical	Low & reverse brake fluid pressure switch	Open or short circuit			●		●																
Electrical	2-4 brake fluid pressure switch	Open or short circuit	●		●	●	●		●	●	●	●	●		●	●		●		●	●		●
Electrical	High clutch fluid pressure switch	Open or short circuit	●		●	●			●		●		●	●		●	●	●	●		●	●	●
Hydraulic control	Transmission fluid quantity	Out of standard value	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hydraulic control	Control spool valve	Faulty operation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hydraulic control	High clutch solenoid accumulator	Faulty operation	●		●				●	●	●		●	●		●	●	●	●		●	●	
Hydraulic control	Low clutch solenoid accumulator	Faulty operation			●				●			●				●	●		●	●			
Hydraulic control	Low & reverse brake solenoid accumulator	Faulty operation			●		●									●							
Hydraulic control	2-4 brake solenoid accumulator	Faulty operation	●		●		●		●	●	●	●	●		●	●		●		●	●		●
Hydraulic control	High clutch accumulator	Faulty operation	●		●				●	●	●		●	●		●	●	●	●		●	●	
Hydraulic control	2-4 brake accumulator	Faulty operation	●		●		●		●	●	●	●	●		●	●		●		●	●		●
Hydraulic control	Pressure control solenoid hydraulic circuit	Clogged passage			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Hydraulic control	Torque converter clutch hydraulic circuit	Clogged passage		●	●																		
Hydraulic control	High clutch solenoid hydraulic circuit	Clogged passage	●		●				●	●	●		●	●		●	●	●	●		●	●	
Hydraulic control	Low clutch solenoid hydraulic circuit	Clogged passage			●				●			●		●	●	●	●		●	●		●	●
Hydraulic control	Low & reverse brake solenoid hydraulic circuit	Clogged passage			●		●									●							●
Hydraulic control	2-4 brake solenoid hydraulic circuit	Clogged passage	●		●		●		●	●	●	●	●		●	●		●		●	●		●
Hydraulic control	Oil cooler	Clogged passage																					
Powertrain	Clutch (brake)	Slip	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Powertrain	Clutch (brake)	Seizure	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Powertrain	Torque converter	Faulty operation																					
Powertrain	Torque converter clutch piston	Separation		●																			
Powertrain	Torque converter clutch piston	Faulty operation		●																			

Possible causes			I1 No Lock Up	H3 Lock Up Point is High or Low	H2 Large Shock at Lock Up	H1 Judder Occurs at Lock Up	G4 Large noise during idle with vehicle stop	G3 Small creeping force	G2 Large creeping force	G1 Vehicle moves in P range or parking is not disengaged in other than P range	F5 Engine stalls before vehicle stops from running	F4 Engine brake does not apply in L range	F3 Noise or vibration occurs during in R, D, 3, 2 or L range	F2 Only 4th gear is not selectable	F1 Low maximum speed or poor acceleration	E5 Gear is changed from 3rd to 4th in 3 range	E4 Gear is changed from 1st to 2nd in L range	E3 Gear is changed from 2nd to 3rd in 2 range	E2 Only 4th gear is not selectable	E1 No gearshift	D5 No kick-down	D4 Gearshift point is low or high at limited area	D3 Gearshift point is low or high at all points	D2 Gearshift frequently	D1 Faulty gearshift schedule (different from shift speed chart)
Disordered selector lever cable										●			●			●	●	●	●						●
Disordered transmission range switch			●												●	●	●	●	●	●					●
Faulty line pressure					●	●		●					●	●	●										
Faulty engine idle speed							●		●		●														
Electrical	Engine speed signal	Error, open or short circuit	●	●	●																				
Electrical	Accelerator pedal position signal	Error, open or short circuit		●	●	●	●							●	●					●	●	●	●	●	●
Electrical	Input shaft speed sensor	Error, open or short circuit				●	●							●	●					●	●	●	●	●	●
Electrical	Output shaft speed sensor	Error, open or short circuit				●								●	●					●					
Electrical	Power drive or 3rd start switch	Open or short circuit										●			●					●					●
Electrical	Transmission range switch	Open or short circuit													●	●	●	●	●	●					●
Electrical	TCM power or ground	Open or short circuit		●	●	●	●					●		●	●					●	●			●	●
Electrical	Transmission fluid temperature sensor	Error, open or short circuit	●	●	●	●								●	●				●						
Electrical	Pressure control solenoid	Open or short circuit		●	●	●	●							●	●										
Electrical	Torque converter clutch solenoid	Open or short circuit	●	●	●	●					●			●	●										●
Electrical	Low & reverse brake solenoid	Open or short circuit						●				●		●	●					●	●				●
Electrical	2-4 brake solenoid	Open or short circuit						●						●	●					●	●				●
Electrical	High clutch solenoid	Open or short circuit						●						●	●					●	●				●
Electrical	Low clutch solenoid	Open or short circuit						●						●	●					●	●				●
Electrical	Ground return circuit	Open or short circuit						●						●	●					●	●				●
Electrical	Low & reverse brake fluid pressure switch	Open or short circuit																		●					
Electrical	2-4 brake fluid pressure switch	Open or short circuit																		●					
Electrical	High clutch fluid pressure switch	Open or short circuit																		●					
Hydraulic control	Transmission fluid quantity	Out of standard value		●				●			●		●	●	●										
Hydraulic control	Control spool valve	Faulty operation	●	●	●	●	●	●			●	●	●	●	●	●	●	●	●	●	●	●	●		●
Hydraulic control	High clutch solenoid accumulator	Faulty operation																							
Hydraulic control	Low clutch solenoid accumulator	Faulty operation																							
Hydraulic control	Low & reverse brake solenoid accumulator	Faulty operation																							
Hydraulic control	2-4 brake solenoid accumulator	Faulty operation																							
Hydraulic control	High clutch accumulator	Faulty operation																							
Hydraulic control	2-4 brake accumulator	Faulty operation																							
Hydraulic control	Pressure control solenoid hydraulic circuit	Clogged passage				●	●							●											
Hydraulic control	Torque converter clutch hydraulic circuit	Clogged passage	●	●	●	●					●			●	●										
Hydraulic control	High clutch solenoid hydraulic circuit	Clogged passage						●						●	●					●	●				●
Hydraulic control	Low clutch solenoid hydraulic circuit	Clogged passage						●						●	●				●		●				●
Hydraulic control	Low & reverse brake solenoid hydraulic circuit	Clogged passage										●		●	●					●	●				●
Hydraulic control	2-4 brake solenoid hydraulic circuit	Clogged passage						●						●	●					●	●				●
Hydraulic control	Oil cooler	Clogged passage									●														
Powertrain	Clutch (brake)	Slip						●				●		●	●					●	●				●
Powertrain	Clutch (brake)	Seizure						●						●	●					●	●				●
Powertrain	Torque converter	Faulty operation	●		●	●		●			●		●		●										
Powertrain	Torque converter clutch piston	Separation	●		●	●														●					●
Powertrain	Torque converter clutch piston	Faulty operation	●	●		●					●				●										

Category	Possible causes		J1 Transmission fluid leaks from breather	J2 Transmission fluid leaks between engine and converter housing	J3 Transmission fluid leaks between converter housing and transmission case	J4 Transmission fluid leaks between transmission case and extension housing	J5 Transmission fluid leaks from oil pan	J6 Transmission fluid leaks from manual shaft oil seal	J7 Transmission fluid leaks from oil cooler pipe joint	Z1 Transmission overheat	Z2 Mode lamp (power drive or 3rd start) does not turn On	Z3 Mode lamp (power drive or 3rd start) does not turn Off	Z4 A/T oil temperature lamp turns On	Z5 Selector lever feeling is faulty	Z6 Poor fuel consumption	Z7 Shift indicator is faulty	Z8 Abnormal smell	Z9 Transmission fluid quantity is low or high	Z10 Transmission fluid quantity is low or high	Z11 Abnormal transmission fluid pressure
	Disordered selector lever cable													●		●				
	Disordered transmission range switch															●				
	Faulty line pressure														●					●
	Faulty engine idle speed														●					
Electrical	Engine speed signal	Error, open or short circuit													●					
Electrical	Accelerator pedal position signal	Error, open or short circuit													●					
Electrical	Input shaft speed sensor	Error, open or short circuit													●					
Electrical	Output shaft speed sensor	Error, open or short circuit													●					
Electrical	Power drive or 3rd start switch	Open or short circuit									●	●			●					
Electrical	Transmission range switch	Open or short circuit													●	●				
Electrical	TCM power or ground	Open or short circuit													●					
Electrical	Transmission fluid temperature sensor	Error, open or short circuit											●		●					
Electrical	Pressure control solenoid	Open or short circuit													●					●
Electrical	Torque converter clutch solenoid	Open or short circuit													●					
Electrical	Low & reverse brake solenoid	Open or short circuit													●					
Electrical	2-4 brake solenoid	Open or short circuit													●					
Electrical	High clutch solenoid	Open or short circuit													●					
Electrical	Low clutch solenoid	Open or short circuit													●					
Electrical	Ground return circuit	Open or short circuit													●					
Electrical	Low & reverse brake fluid pressure switch	Open or short circuit																		
Electrical	2-4 brake fluid pressure switch	Open or short circuit													●					
Electrical	High clutch fluid pressure switch	Open or short circuit													●					
Hydraulic control	Transmission fluid quantity	Out of standard value	●							●					●		●	●	●	●
Hydraulic control	Control spool valve	Faulty operation								●			●		●					●
Hydraulic control	High clutch solenoid accumulator	Faulty operation																		
Hydraulic control	Low clutch solenoid accumulator	Faulty operation																		
Hydraulic control	Low & reverse brake solenoid accumulator	Faulty operation																		
Hydraulic control	2-4 brake solenoid accumulator	Faulty operation																		
Hydraulic control	High clutch accumulator	Faulty operation																		
Hydraulic control	2-4 brake accumulator	Faulty operation																		
Hydraulic control	Pressure control solenoid hydraulic circuit	Clogged passage													●					●
Hydraulic control	Torque converter clutch hydraulic circuit	Clogged passage													●					
Hydraulic control	High clutch solenoid hydraulic circuit	Clogged passage													●					
Hydraulic control	Low clutch solenoid hydraulic circuit	Clogged passage													●					
Hydraulic control	Low & reverse brake solenoid hydraulic circuit	Clogged passage																		
Hydraulic control	2-4 brake solenoid hydraulic circuit	Clogged passage													●					
Hydraulic control	Oil cooler	Clogged passage							●	●			●				●	●	●	
Powertrain	Clutch (brake)	Slip								●			●		●		●	●		●
Powertrain	Clutch (brake)	Seizure								●			●		●		●	●		●
Powertrain	Torque converter	Faulty operation								●			●		●		●			
Powertrain	Torque converter clutch piston	Separation								●			●		●		●	●		●
Powertrain	Torque converter clutch piston	Faulty operation								●			●		●		●	●		●

Diagnostic category

A1: Vehicle Does Not Run in D, 3, 2 L and R Range

Checks	Action
Definition: Vehicle does not run even though the accelerator pedal is being stepped on.	
Diagnosis Hints	Trouble in transmission main unit is suspected. The trouble in the transmission main unit may originate from the input circuits or output circuits; these circuits should also be checked to prevent a reoccurrence of the trouble.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in all ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in all ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation or sticking.
Clutch and Brake Checks	Inspect the low clutch, reverse clutch, low one-way clutch and low & reverse brake for slipping.
Additional Checks	• Inspect the parking mechanism for faulty operation. • Inspect the engine for proper outputs.

A2: Vehicle Does Not Run in R Range

Checks	Action
Definition: Vehicle does not run in R range only. It runs correctly in forward range.	
Diagnosis Hints	Trouble in transmission main unit is suspected. The trouble in the transmission main unit may originate from the input circuits or output circuits; these circuits should also be checked to prevent a reoccurrence of the trouble.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in R range for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in R range. Refer to Stall Test in Test Instruction section.

Checks	Action
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation or sticking.
Clutch and Brake Checks	Inspect the reverse clutch and low & reverse brake for slipping.
Additional Checks	• Inspect the parking mechanism for faulty operation. • Inspect the engine for proper outputs.

A3: Vehicle Does Not Run in D, 3, 2 and L Range

Checks	Action
Definition: Vehicle does not run in D, 3, 2 and L range only. It runs correctly in R range.	
Diagnosis Hints	Trouble in transmission main unit is suspected. The trouble in the transmission main unit may originate from the input circuits or output circuits; these circuits should also be checked to prevent a reoccurrence of the trouble.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation or sticking.
Clutch and Brake Checks	Inspect the low clutch and low one-way clutch for slipping.
Additional Checks	• Inspect the parking mechanism for faulty operation. • Inspect the engine for proper outputs.

B1: Vehicle Runs in N Range

Checks	Action
Definition: Creeping force appears in N range. Vehicle moves unless the brake pedal is stepped on in N range.	
Diagnosis Hints	Trouble in transmission main unit is suspected. The trouble in the transmission main unit may originate from the input circuits or output circuits; these circuits should also be checked to prevent a reoccurrence of the trouble.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.

Checks	Action
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch, reverse clutch, low one-way clutch and low & reverse brake for seizing.

B2: Poor Acceleration at Starting

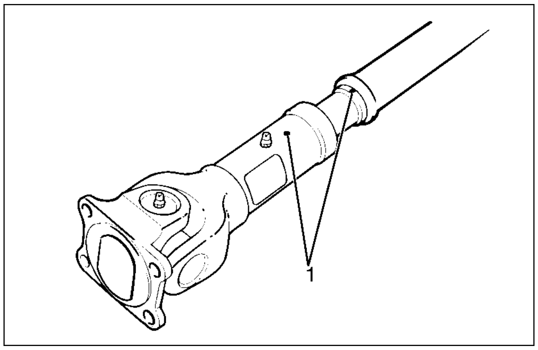
Checks	Action
Definition: Starting acceleration is poor.	
Diagnosis Hints	In addition to the low engine output, faulty gearshift of the transmission or fixing at the 3rd gear in the fail-safe operation may also be possible. Therefore, if “maximum speed is low, and acceleration is poor”, it should be cleared up whether the trouble originates from the engine system or transmission control system by a running test, inspection of stall speed, etc.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation.
Clutch and Brake Checks	Inspect the low clutch and high clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

B3: Engine Races Up During Starting (Slip)

Checks	Action
Definition: The engine speeds up but the vehicle speed does not increase when the accelerator pedal is stepped on at starting.	
Diagnosis Hints	Slipping of the clutch is suspected. Gear ratio error DTC might be set.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Faulty operation of transmission fluid pressure switch. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect any clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

B4: Large Shock When Selector Lever is Changed from N to D Range or N to R Range

Checks	Action
Definition: A large shock is felt when the selector lever is changed from N to D or N to R during idle.	
Diagnosis Hints	• Check the vehicle side such as exhaust mounting and engine mounting. • With the fail-safe operation, garage shock may grow worth. If there is no DTC, faulty operation of the control valve or seized clutch might be suspected.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Line Pressure Test	Inspect the line pressure in D range or R range for a possible high or low pressure. Refer to Line Pressure Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect any clutch for seizing.
Additional Checks	• Inspect the transmission input signals. • Inspect the engine for proper idle speed. • Inspect the suspension for play.



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1. Apply alignment marks (1) on the sleeve yoke and tube assembly then remove sleeve yoke.
2. Remove seal.
3. Remove tube assembly.

B5: Engine Stalls When Selector Lever is Changed from N to R, D, 3, 2 or L Range

Checks	Action
Definition: The engine stalls when selector lever is changed from N or P position to a run position during engine idling.	
Diagnosis Hints	• As the correct cause is attributable to the engine, faulty idle up, insufficient engine output, etc. are suspected. • As this is a cause of the transmission, faulty torque converter clutch (TCC) piston is suspected. • If the transmission fluid through resistance increases due to clogged oil cooler or some other reason, or if the transmission fluid level decreases, the TCC piston works causing the engine stall.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking lock up spool valve • Sticking TCC solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the engine for proper idle speed.

B6: Engine Does Not Crank in P or N Range

B7: Engine Cranks in other than P or N Range

Checks	Action
Definition: • The engine starter does not run even though the P or N range. • The engine starter runs even though the R, D, 3, 2 or L range.	
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.

B8: Extended Time Lag When Selector Lever is Changed from N to D

Checks	Action
Definition: The shift time lag is longer than the standard value when the selector lever is changed from N to D.	
Transmission Fluid Checks	Inspect the transmission fluid for low quantity.
Line Pressure Checks	Inspect the line pressure in D range for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.

Checks	Action
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch and low one-way clutch for slipping.
Solenoid Valve Checks	• Inspect the low clutch solenoid valve for faulty operation.

B9: Extended Time Lag When Selector Lever is Changed from N to R

Checks	Action
Definition: The shift time lag is longer than the standard value when the selector lever is changed from N to R.	
Transmission Fluid Checks	Inspect the transmission fluid for low quantity.
Line Pressure Checks	Inspect the line pressure in R range for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low & reverse brake for slipping.
Solenoid Valve Checks	• Inspect the low & reverse brake solenoid valve for faulty operation.

B10: Brake is Applied in R Range

Checks	Action
Definition: Brake is applied suddenly in R range.	
Diagnosis Hints	Trouble in transmission main unit is suspected. The trouble in the transmission main unit may originate from the input circuits or output circuits; these circuits should also be checked to prevent a reoccurrence of the trouble.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for low quantity.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch, high clutch or 2-4 brake for seizing.
Additional Checks	• Inspect the parking mechanism for faulty operation.

B11: Insufficient Starting or Shaking in D Range

Checks	Action
Definition: Insufficient starting or shaking in D range.	
Transmission Fluid Checks	Inspect the transmission fluid for low quantity.
Line Pressure Checks	Inspect the line pressure in D range for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.

Checks	Action
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch, reverse clutch, low one-way clutch or low & reverse brake for slipping.

B12: Noise or Vibration Occurs at Starting

Checks	Action
Definition: Noise or vibration occurs in the vicinity of the transmission at starting.	
Diagnosis Hints	Cause other than transmission is suspected. Reproduce the running condition using a lift up, chassis dynamo, etc. to investigate the origin of the noise and vibration.
Additional Checks	• Inspect the differential gear noise. • Inspect the propeller shaft noise. • Inspect the tires for unbalanced or poor uniformity.

C1: Engine Race Up (Slipping) When Gearshift is Up from 1st to 2nd
C2: Engine Race Up (Slipping) When Gearshift is Up from 2nd to 3rd
C3: Engine Race Up (Slipping) When Gearshift is Up from 3rd to 4th
C4: Engine Race Up (Slipping) When Gearshift is Down from 4th to 3rd
C5: Engine Race Up (Slipping) When Gearshift is Down (or Kick-down) from 4th to 2nd
C6: Engine Race Up (Slipping) When Gearshift is Down (or Kick-down) from 3rd to 2nd
C7: Engine Race Up (Slipping) When Gearshift is Down (or Kick-down) from 4th or 3rd to 2nd
C8: Engine Race Up (Slipping) Others

Checks	Action
Definition: • Engine speed-up occurs when the accelerator pedal is stepped on for acceleration, and the gear is shifted up. • Engine speed-up occurs when the accelerator pedal is stepped on for acceleration, and the gear is shifted down or for kick-down during steady run. • Engine speed-up occurs when the accelerator pedal is stepped on for acceleration, and the gear is shifted down or for kick-down during steady run.	
Diagnosis Hints	Slipping of the clutch is suspected. Gear ratio error DTC might be set.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.

Checks	Action
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Faulty operation of transmission fluid pressure switch. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect any clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

C9: Braking Feel When Gearshift is Up from 1st to 2nd

C10: Braking Feel When Gearshift is Up from 2nd to 3rd

C11: Braking Feel When Gearshift is Up from 3rd to 4th

Checks	Action
Definition: A braking feeling occurs when the accelerator pedal is stepped on for acceleration, and the gear is shifted up.	
Diagnosis Hints	Slipping of the clutch is suspected. Gear ratio error DTC might be set.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Faulty operation of transmission fluid pressure switch. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect any clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

C12: Large Shock When Gearshift from 1st to 2nd or 2nd to 1st
C13: Large Shock When Gearshift from 2nd to 3rd or 3rd to 2nd
C14: Large Shock When Gearshift from 3rd to 4th or 4th to 3rd
C15: Large Shock When Kick-down
C16: Large Shock When Accelerator Pedal is Stepped ON or OFF without Gearshift
C17: Large Shock When Gearshift from 2nd to 1st in L Range
C18: Large Shock Others
C19: Large Shock When Vehicle Speed is Reduced by No Accelerator Pedal or Vehicle is Stopped

Checks	Action
Definition: • A large shock is felt when the accelerator pedal is stepped on for acceleration and the gear is shifted up or down. • A large shock is felt when the accelerator pedal is stepped on for kick-down. • A large shock is felt when the accelerator pedal is not stepped on. • A large shock is felt when the selector lever is selected in L range.	
Diagnosis Hints	The same causes as in category No. “C1 - C8: Engine Race Up (Slipping)” are suspected.

C20: Large Shock at Lock Up

Checks	Action
Definition: A large shock is felt at lock up.	
Diagnosis Hints	Incorrect input signals or faulty operation of torque converter clutch is suspected. Refer to category No. “I1: No Lock Up.”

C21: Shift Down or Engine Overrun When Accelerator Pedal is Stepped ON in 4th Gear

Checks	Action
Definition: Shift down or engine overrun occurs above than kick-down area.	
Diagnosis Hints	The same causes as in category No. “C1 - C8: Engine Race Up (Slipping)” are suspected.

D1: Faulty Gearshift Schedule (Different from Shift Speed Chart)

Checks	Action
Definition: Faulty gearshift schedule, it is differ from the shift speed chart.	

Checks	Action
Diagnosis Hints	• When inspecting faulty gear shifting, it is important to distinguish between the fault of the electric system and transmission main unit. • Fault of electric system. - Monitor the output signal (each solenoid driving signal) using a scan tool. If a trouble signal is sent to the solenoid synchronously with the faulty gear shifting, the fault is originated in the electric system. - Monitor the input signal (signal from each sensor) using a scan tool and find an input signal which has an output signal (each solenoid driving signal) subjected to a fault. - Fault of the electric system may be derived from temperature or vibration. For instance, although the engine is normal while it is cold, fault may occur when the engine is warmed up or the vehicle is running. • Fault of mechanical system. - If the gear is incorrectly shifted, irrespective of the operating signal (On/Off) of each solenoid, the fault is originated from the transmission main unit. - If the clutch slips, or the transmission fluid smells burnt or is contaminated or black, or the stall speed increases. Gear ratio error DTC might be set.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Faulty operation of transmission fluid pressure switch. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit

D2: Gearshift Frequently

Checks	Action
Definition: Shift down or engine overrun occurs above than kick-down area.	
Diagnosis Hints	The same causes as in category No. “C1 - C8: Engine Race Up (Slipping)” are suspected.

D3: Gearshift Point is Low or High at All Points

D4: Gearshift Point is Low or High at Limited Area

Checks	Action
Definition: • Gearshift point is deviated from the shift speed chart. • Gear is not shifted up properly, even though the vehicle is accelerating. • Gear is not shifted immediately and enough acceleration cannot be obtained, even though the accelerator pedal is being stepped on.	
Diagnosis Hints	• Inspect the output shaft speed (OSS) sensor for faulty operation. • Incorrect accelerator pedal position signal is suspected. Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

D5: No Kick-down

Checks	Action
Definition: The engine speeds up but the vehicle speed does not increase when the accelerator pedal is being stepped on at starting.	
Diagnosis Hints	Incorrect accelerator pedal position signal is suspected. Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

E1: No Gearshift

Checks	Action
Definition: • Gear is fixed, such as no gearshift from 1st to 2nd, 2nd to 3rd, and 3rd to 4th. • Sometimes the gear is shifted, and sometimes it is not possible.	
Diagnosis Hints	• Fixing at same gear speed, a signal error from the accelerator pedal position (APP) sensor or trouble in the transmission main unit are suspected. • Slipping of the clutch is suspected. Gear ratio error DTC might be set.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch, high clutch or low & reverse brake for slipping.

Checks	Action
Sensor Checks	Inspect the input shaft speed (ISS) sensor and output shaft speed (OSS) sensor for faulty operation.
Additional Checks	• Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

E2: Only 4th Gear is Not Selectable

Checks	Action
Definition: Gearshift is not possible from 3rd to 4th even though the vehicle is accelerating.	
Diagnosis Hints	When the transmission fluid temperature is lower than 10°C (50°F), gearshift from the 3rd to the 4th is inhibited.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low clutch for seizing.
Sensor Checks	Inspect the transmission fluid temperature (TFT) sensor. Use the Temperature vs. Resistance table to test the TFT sensor at various temperature levels to evaluate the possibility of a skewed sensor.

E3: Gear is Changed from 2nd to 3rd in 2 Range

E4: Gear is Changed from 1st to 2nd in L Range

E5: Gear is Changed from 3rd to 4th in 3 Range

Checks	Action
Definition: • Gear is shifted from 2nd to 3rd in 2 range. • Gear is shifted from 1st to 2nd in L range. • Gear is shifted from 3rd to 4th in 3 range.	
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.

Checks	Action
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit

F1: Low Maximum Speed or Poor Acceleration

Checks	Action
Definition: • Starting acceleration is poor. • Acceleration is slow, even though the accelerator pedal is stepped on during the running.	
Diagnosis Hints	In addition to the low engine output, faulty gearshift of the transmission or fixing at the 3rd gear in the fail-safe operation may also be possible. Therefore, if “maximum speed is low, and acceleration is poor”, it should be cleared up whether the trouble originates from the engine system or transmission control system by a running test, inspection of stall speed, etc.
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation.
Clutch and Brake Checks	Inspect the low clutch and high clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Observe the Accelerator Pedal Position (APP). APP parameter should change linearly from 0 to 99 or 100% according to the accelerator pedal operation.

F2: Engine Race Up (Slipping) During Acceleration

Checks	Action
Definition: • Engine speed increases but the vehicle speed does not increase when the accelerator pedal is being stepped on.	

Checks	Action
Diagnosis Hints	The same causes as in category No. “C1 - C8: Engine Race Up (Slipping)” are suspected. When the condition of No. C1 - C8 grows worse, No. F2 results.

F3: Noise or Vibration Occurs During in R, D, 3, 2 or L Range

Checks	Action
Definition: Noise or vibration occurs in the vicinity of the transmission during running.	
Diagnosis Hints	Cause other than transmission is suspected. Reproduce the running condition using a lift up, chassis dynamo, etc. to investigate the origin of the noise and vibration.
Additional Checks	• Inspect the differential gear noise. • Inspect the propeller shaft noise. • Inspect the tires for unbalanced or poor uniformity.

F4: Engine Brake Does Not Apply in L Range

Checks	Action
Definition: The engine brake does not apply, allowing the vehicle to run freely when the accelerator pedal is released at low speed in L range.	
Diagnosis Hints	• Slipping of the clutch is suspected. Gear ratio error DTC might be set.
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Clutch and Brake Checks	Inspect the low & reverse brake for slipping.
Sensor Checks	Inspect the input shaft speed (ISS) sensor and output shaft speed (OSS) sensor for faulty operation.

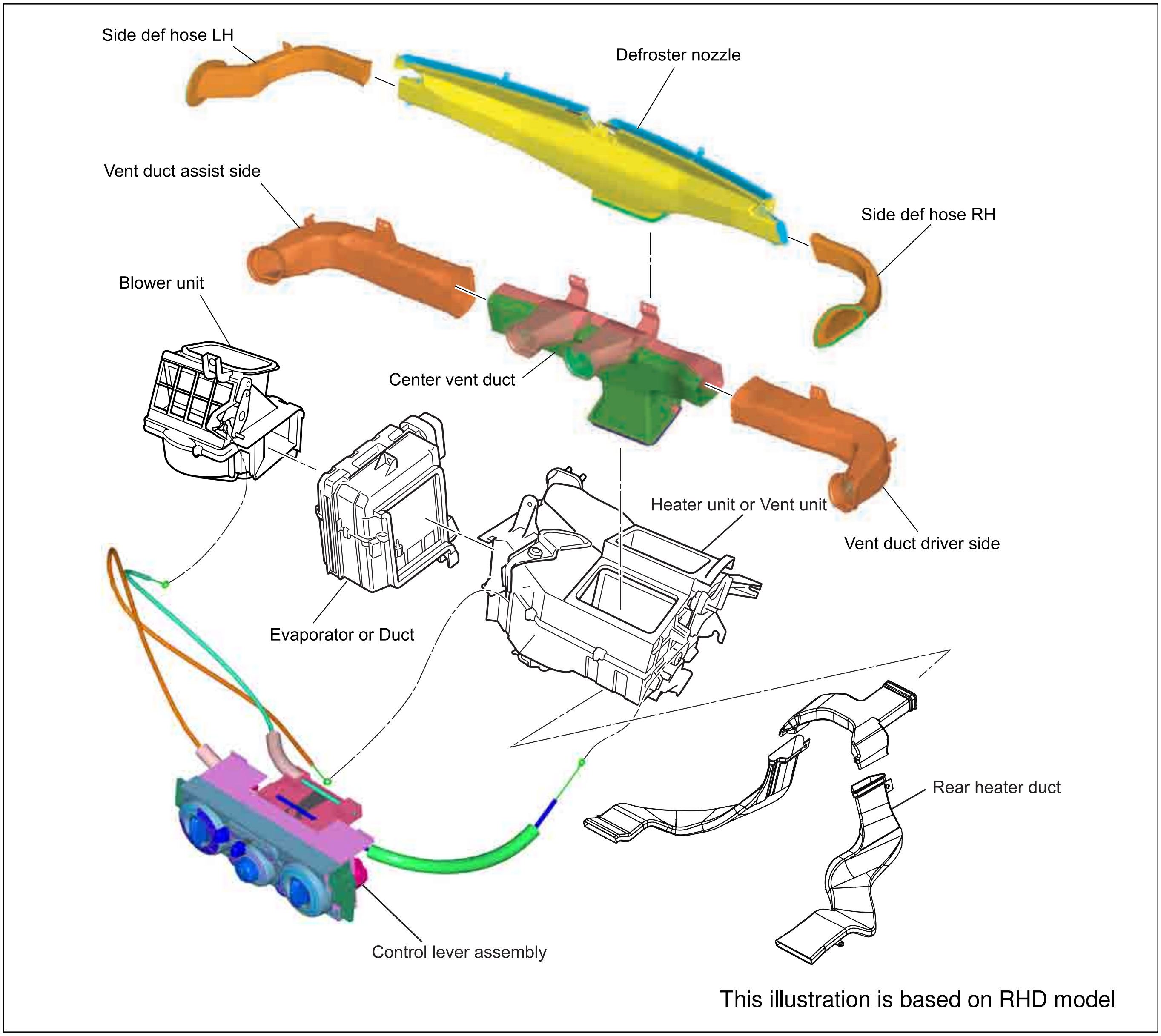
F5: Engine Stalls Before Vehicle Stops from Running

Checks	Action
Definition: The engine stalls simultaneously with the vehicle when the brake pedal is stepped on to stop the vehicle during running.	
Diagnosis Hints	The same causes as in category No. “B5: Engine Stalls When Selector Lever is Changed from N to R, D, 3, 2 or L Range” is suspected.

G1: Vehicle Moves in P Range or Parking is Not Disengaged in Other Than P Range

Checks	Action
Definition: Vehicle moves even though it stops on a slope and P range is selected. Vehicle does not move even though a position other than P range is selected, and the accelerator pedal is being stepped on.	
Diagnosis Hints	If the vehicle moves in N range, refer to category No. “B1: Vehicle Runs in N Range”.

COMPONENTS (INSIDE CAB)



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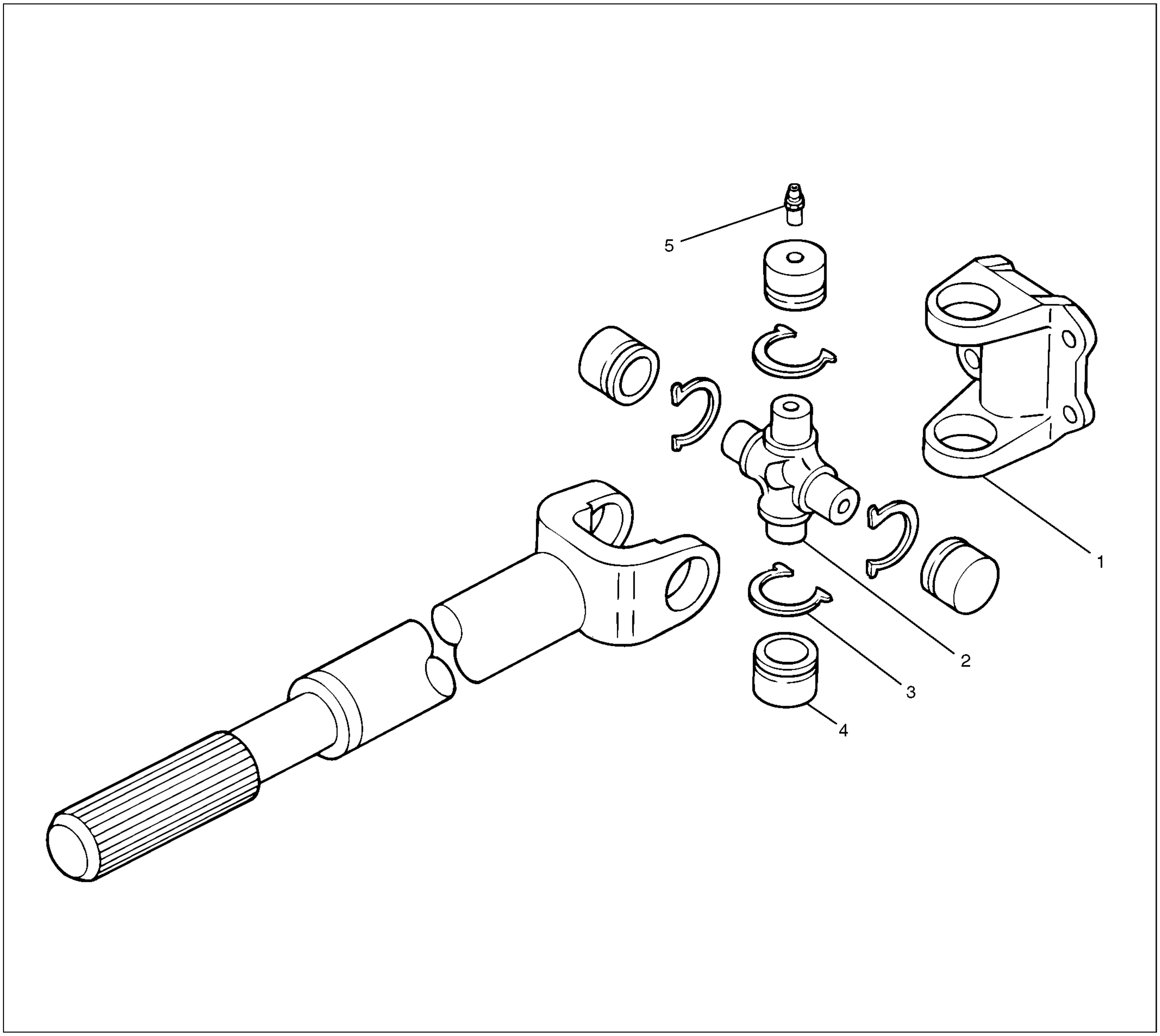
Universal Joint Disassembly and Reassembly



Legend

1. Flange Yoke
2. Spider
3. Snap Ring
4. Needle Roller Bearing
5. Grease Fitting

Checks	Action
Transmission Range Switch & Selector Lever Cable Checks	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.
Additional Checks	Inspect the parking mechanism for faulty operation.

G2: Large Creeping Force

Checks	Action
Definition: Vehicle accelerates in R, D, 3, 2 or L range, even though the accelerator pedal is not being stepped on.	
Diagnosis Hints	Too high idle speed is suspected. Inspect the engine for proper idle speed.

G3: Small Creeping Force

Checks	Action
Definition: Vehicle does not move, even though a run position is selected on a flat road during idling.	
Diagnosis Hints	When the creep force is small in all positions, low engine output is suspected. If the creep is normal only in the R position, operation of the fail-safe function due to trouble in the electrical system is suspected.
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Line Pressure Checks	Inspect the line pressure in forward ranges for a possible dropped pressure. Refer to Line Pressure Test in Test Instruction section.
Stall Speed Checks	Inspect the stall speed in forward ranges. Refer to Stall Test in Test Instruction section.
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking shift solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Torque Converter Checks	Inspect the torque converter for faulty operation.
Clutch and Brake Checks	Inspect the low clutch for slipping.
Additional Checks	• Inspect the engine for proper outputs. Refer to appropriate inspection chart in engine section. • Inspect the TCM grounds for being clean, tight, and in their proper locations. • Inspect the ground return circuit for being clean, tight, and in their proper locations.

G4: Large Noise During Idle with Vehicle Stop

Checks	Action
Definition: Transmission is noisy during idle in all range.	

Checks	Action
Diagnosis Hints	• Causes such as the solenoid operating sound or a faulty oil pump are suspected. • Distinguishing is possible by stopping the solenoid operation temporarily, checking the correlation for the former case and, changing the line pressure and confirming the correlation with noise. • As a matter of course, noise other than the transmission may be generated around the engine, and should be checked carefully. **Notice:** When the noise is generated only at the time of a gear shift, it may be the sound of transmission fluid flowing or gear noise. If the sound varies depending on the gear speed to be shifted, it may be the gear noise generated from the planetary gear and its components. If the sound varies depending on the vehicle speed, it may be the gear noise of the output system, or the gear noise of the input system or a faulty torque converter.

H1: Judder Occurs at Lock Up

Checks	Action
Definition: Judder occurs when lock up area.	
Diagnosis Hints	Slip due to burning of the torque converter clutch (TCC) facing or insufficient engagement due to dropped working pressure are suspected. Refer to category No. "I1: No Lock Up ". **Notice:** When the TCC facing has burnt, foreign material mixed in the oil cooler is suspected. In such a case, inspect the oil cooler circuit for clogging of the oil cooler.

H2: Large Shock at Lock Up
H3: Lock Up Point is High or Low

Checks	Action
Definition: • A large shock is felt at lock up. • Lock up point is excessively high or low.	
Diagnosis Hints	Incorrect input signals or faulty operation of torque converter clutch (TCC) is suspected. Refer to category No. "I1: No Lock Up".

I1: No Lock Up

Checks	Action
Definition: Lock up is not performed even though lock up control conditions being satisfied.	
Diagnosis Hints	• Monitor the signal to the torque converter clutch (TCC) solenoid valve while carrying out a running test. • When the transmission fluid temperature is lower than 20°C (68°F), lock up control is inhibited. • When the output signal to the TCC solenoid valve is sent correctly, causing no lock up, clogged hydraulic circuits or malfunction of the TCC piston may be suspected. • Even with the lock up area, the output signal to the TCC solenoid valve is not sent, a fault of the transmission fluid temperature (TFT) sensor controlling the lock up may be suspected. **Notice:** When the TCC facing has burnt, foreign material mixed in the oil cooler is suspected. In such a case, inspect the oil cooler circuit for clogging of the oil cooler.

Checks	Action
Transmission Fluid Checks	Inspect the transmission fluid for the following conditions. If the transmission fluid is extremely blacked, contaminated or smells burnt, slipping of clutch is suspected. • Low quantity • Contamination • Smell
Control Valve Body Checks	Inspect the valve body for the following conditions. • Faulty operation • Sticking spool valve • Sticking TCC solenoid valve. Perform function check. Refer to On-Vehicle Service section. • Clogged hydraulic circuit
Sensor Checks	Inspect the TFT sensor. Use the Temperature vs. Resistance table to test the TFT sensor at various temperature levels to evaluate the possibility of a skewed sensor.

J1: Transmission Fluid Leaks from Breather

Checks	Action
Definition: Transmission fluid leaks from breather.	
Diagnosis Hints	Transmission fluid quantity is excessively high.

J2: Transmission Fluid Leaks Between Engine and Converter Housing

J3: Transmission Fluid Leaks Between Converter Housing and Transmission Case

J4: Transmission Fluid Leaks Between Transmission Case and Extension Housing

J3: Transmission Fluid Leaks from Oil Pan

J3: Transmission Fluid Leaks from Manual Shaft Oil Seal

J3: Transmission Fluid Leaks from Oil Cooler Pipe Joint

Checks	Action
Definition: Transmission fluid leaks between engine and converter housing. Transmission fluid leaks between converter housing and transmission case. Transmission fluid leaks between transmission case and extension housing. Transmission fluid leaks from oil pan. Transmission fluid leaks from manual shaft oil seal. Transmission fluid leaks from oil cooler pipe joint.	
Diagnosis Hints	Faulty oil seal or contact surface is suspected.

Z1: Transmission Overheat

Checks	Action
Definition: Smells burnt or smoke from transmission.	
Diagnosis Hints	• Transmission fluid quantity is excessively high. • Slipping of the clutch is suspected. Gear ratio error DTC might be set. • Clogged oil cooler. • Faulty operation of oil pump. • Faulty torque converter clutch (TCC) piston.

Z2: Mode Lamp (Power Drive or 3rd Start) Does Not Turn On

Checks	Action
Definition: Mode lamp on the instrument panel (IP) cluster does not turn ON even though the switch is ON.	
Diagnosis Hints	• Faulty mode switch circuit. • Faulty mode switch. • Faulty lamp control circuit. • Faulty IP cluster.

Z3: Mode Lamp (Power Drive or 3rd Start) Does Not Turn Off

Checks	Action
Definition: Mode lamp on the instrument panel cluster does not turn OFF even though the switch is OFF.	
Diagnosis Hints	• Faulty mode switch circuit. • Faulty mode switch. • Faulty lamp control circuit. • Faulty IP cluster.

Z4: A/T Oil Temperature Lamp Turns On

Checks	Action
Definition: A/T oil temperature lamp turns On sometimes.	
Diagnosis Hints	• If the fluid temperature increases to 135°C (275°F), the TCM illuminates A/T Oil Temp lamp on the instrument panel cluster. When the fluid temperature deceases below 125°C (257°F), the lamp goes off. • When the vehicle is stuck in the mud or continues to accelerate under overload, transmission fluid temperature increases and lamp may be turned On. • If the lamp is On under usual conditions, following causes are suspected. - Transmission fluid level has increased for some fault. Refer to category No. “Z1: Transmission Overheat”. - Skewed transmission fluid temperature (TFT) sensor.

Z5: Selector Lever Feeling is Faulty

Checks	Action
Definition: Selector lever feeling is faulty.	
Diagnosis Hints	• Inspect the selector lever cable for misadjusting or disordering. • Faulty manual plate.

Z6: Poor Fuel Consumption

Checks	Action
Definition: Poor fuel consumption.	
Diagnosis Hints	The same causes as in category No. “C1 - C8: Engine Race Up (Slipping)” are suspected.

Z7: Shift Indicator is Faulty

Checks	Action
Definition: Shift indicator does not change even though the selector lever is moved.	
Diagnosis Hints	Inspect the transmission range switch and selector lever cable for misadjusting or disordering. Refer to On-Vehicle Service section.

Z8: Transmission Fluid is Splashed During Running

Checks	Action
Definition: Transmission Fluid is splashed during running.	
Diagnosis Hints	Transmission fluid quantity is excessively high.

Z9: Abnormal Smell

Checks	Action
Definition: Abnormal smell.	
Diagnosis Hints	A trouble in the transmission main unit.

Z10: Transmission Fluid Quantity is Low or High

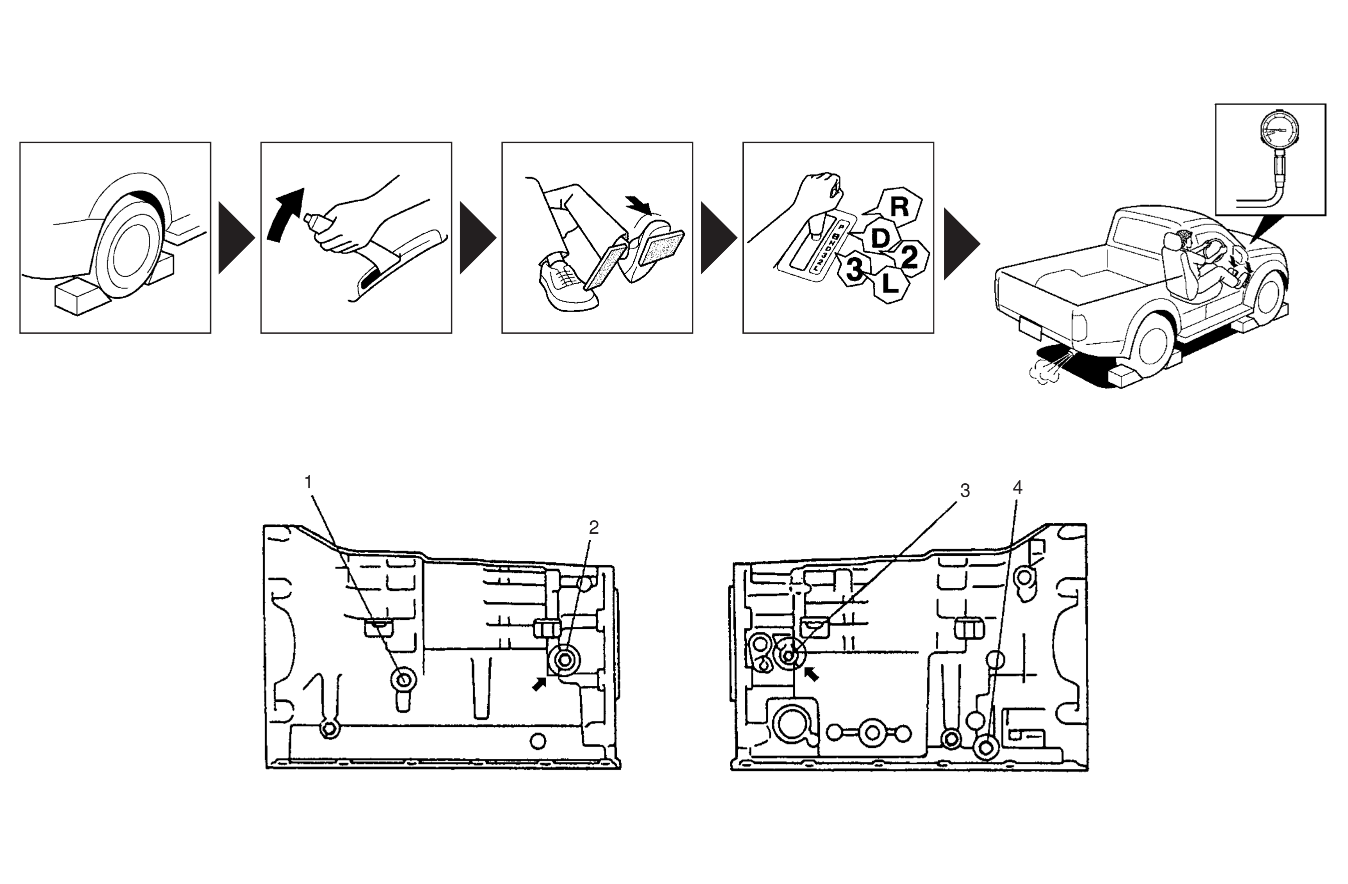
Checks	Action
Definition: Transmission fluid quantity is low or high.	
Diagnosis Hints	• If the fluid level is high, level check might be performed at low temperature. • If the fluid level is low, fluid leak is suspected.

Z11: Abnormal Transmission Fluid Pressure

Checks	Action
Definition: Transmission fluid pressure (TFP) is low or high.	
Diagnosis Hints	• Faulty pressure control (PC) solenoid valve or hydraulic circuits. • If pressure is low, faulty oil pump is suspected.

Test Instructions

Line Pressure Test



Legend
1. Oil cooler (outlet)
2. Low & reverse brake pressure detection port (R range line pressure detection port)
3. Low clutch pressure detection port (D, 3, 2, L range line pressure detection port)
4. Oil cooler (inlet)

Line Pressure Test Procedure

1. Fully apply the parking brake and chock all wheels.
2. Check the level of the engine oil, coolant and transmission fluid. Replenish as necessary.
3. Remove the plug from either of the line pressure detection port (low & reverse brake pressure detection port or low clutch pressure detection port).
4. Install a pressure gauge to the line pressure detection port.
5. Start the engine and warm up (allow engine coolant temperature to reach at least 70°C [158°F]).

Important: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

6. Let idle and record the line pressure when the selector lever is positioned R or D, 3, 2 and L range.

Important: Line pressure test at the stall speed must be finished within 5 seconds. Prolonged test time may break the transmission.

7. Fully depress the brake pedal with your left foot.
8. Move the selector lever to the R or D range and fully depress the accelerator pedal. Record the line pressure as soon as the stall speed.
9. Move the selector lever to the N range and let idle for at least 1 minute.
10. If the pressure gauge is connected to the low clutch pressure detection port, repeat the line pressure test (step 7 to 9) at the stall speed in 3, 2 and L range.
11. Turn OFF the ignition.
12. Disconnect a pressure gauge from the line pressure detection port.
13. Tighten the plug.

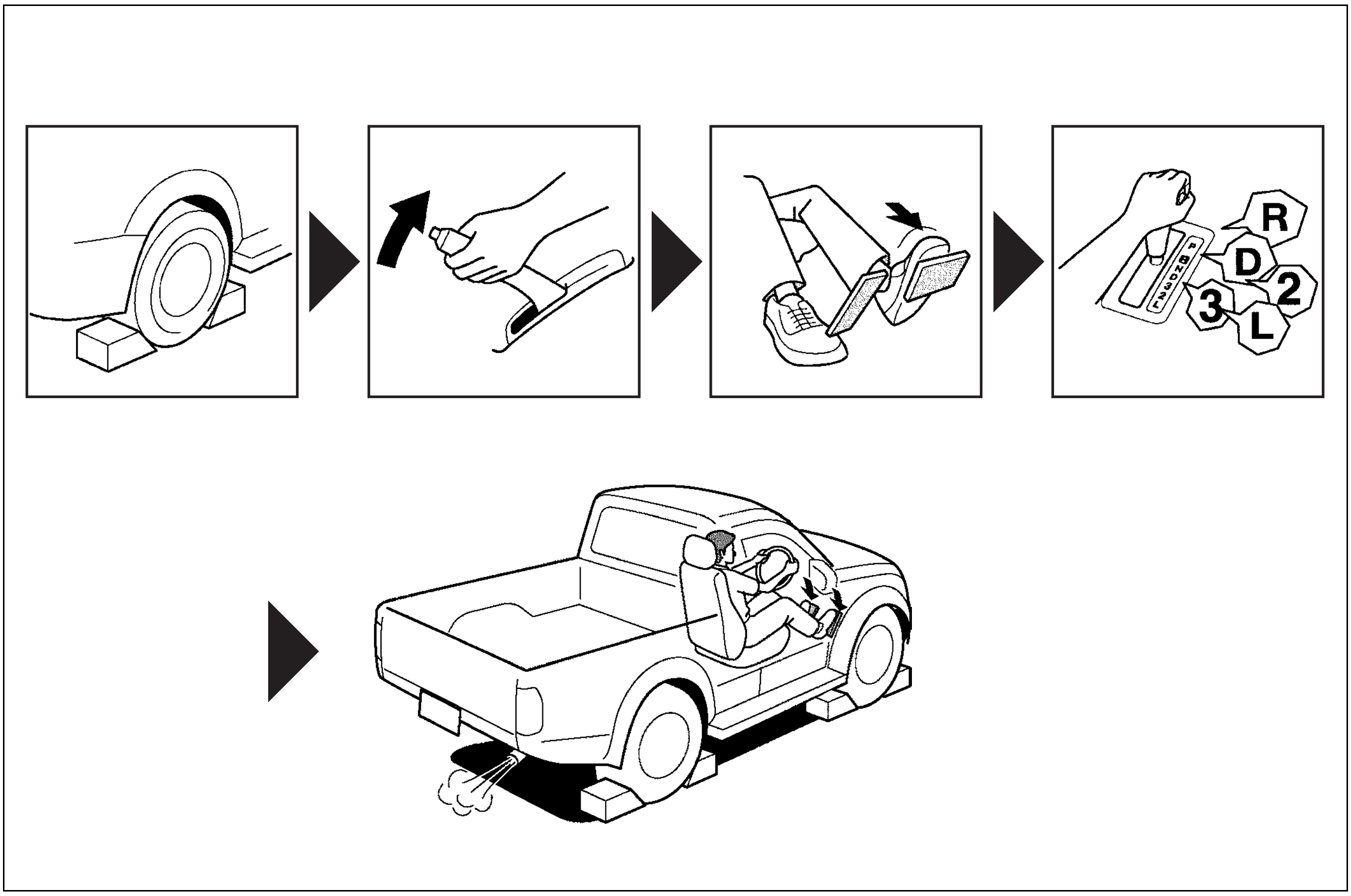
Standard Value

Selector lever position	Engine speed	Line pressure (kPa/ psi)
D, 3, 2 or D	Idle	350 - 480 / 51 - 70
	Stall	1050 - 1250 / 152 - 182
R	Idle	450 - 650 / 65 - 95
	Stall	1400 - 1630 / 203 - 237

Diagnosis

1. If the line pressure is lower than the standard value at idle in all ranges.
- Abraded oil pump.
- Faulty operation of each solenoid valve.
- Sticking of pressure regulator spool valve or pilot spool valve.
- Fatigued pressure regulator spool valve spring or pilot spool valve spring.
- Transmission fluid leaking from the oil strainer, oil pump, pressure regulator spool valve, torque converter relief spool valve or pressure relief valve.
2. If the line pressure is lower than the standard value at idle in D, 3, 2 and L range.
- Transmission fluid leaking from the low clutch hydraulic circuit.
3. If the line pressure is lower than the standard value at idle in R range.
- Transmission fluid leaking from the reverse clutch hydraulic circuit.
- Transmission fluid leaking from the low & reverse brake hydraulic circuit.
4. If the line pressure is lower that the standard value at idle in L or R range.
- Transmission fluid leaking from the low & reverse brake hydraulic circuit.
5. If the line pressure is higher than the standard value at idle in all ranges.
- Faulty accelerator pedal position signal.
- Faulty transmission fluid temperature (TFT) sensor.
- Faulty operation of low clutch solenoid valve.
- Sticking pilot spool valve.
- Sticking pressure regulator spool valve or plug.
6. If the line pressure is lower than the standard value at stall speed in all ranges.
- Faulty accelerator pedal position signal.
- Faulty operation of pressure control (PC) solenoid valve.
- Faulty operation of low clutch solenoid valve.
- Sticking pilot spool valve.
- Sticking pressure regulator spool valve or plug.

Stall Test



Stall Test Procedure

1. Fully apply the parking brake and chock all wheels.
2. Check the level of the engine oil, coolant and transmission fluid. Replenish as necessary.
3. Start the engine and warm up (allow engine coolant temperature to reach at least 70°C [158°F]).

Important: Stall test must be finished within 5 seconds. Prolonged test time may break the transmission.

4. Fully depress the brake pedal with your left foot.
5. Move the selector lever to the D range and fully depress the accelerator pedal. Record the engine speed as soon as the stall speed.
6. Move the selector lever to the N range and let idle for at least 1 minute.
7. Repeat the stall test (step 4 to 6) in R, 3, 2 and L range.

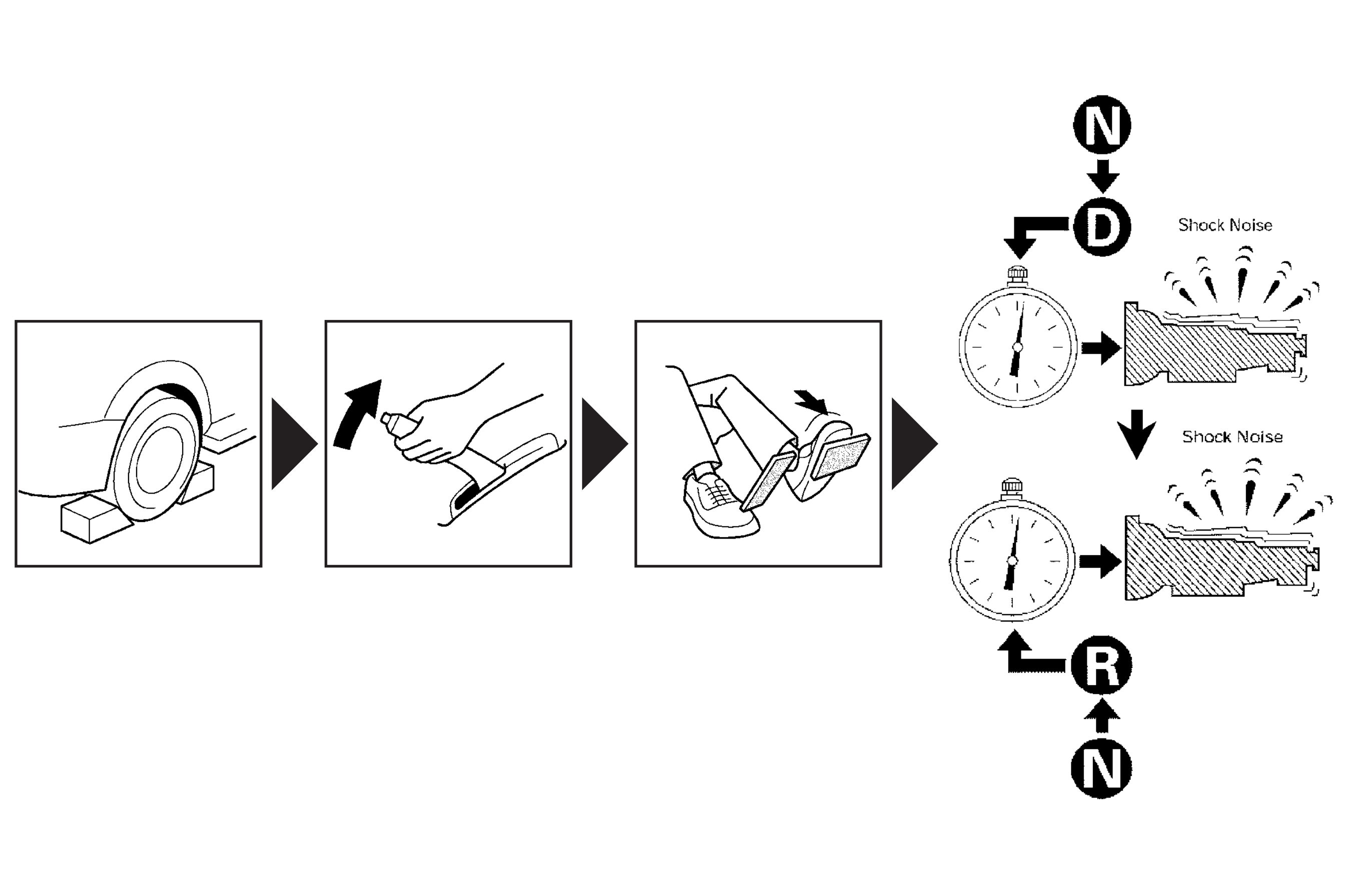
Standard Value

Stall speed	Pre condition
2050 ± 150 RPM	Ambient temperature between 10 and 40°C [50 and 104°F]

Diagnosis

1. If the stall speed is higher than the standard value in all ranges.
- Low line pressure.
- Abraded oil pump.
- Faulty operation of low clutch.
- Faulty transmission range switch.
- Transmission fluid leaking from the oil pump, valve body or transmission case.
- Sticking of pressure regulator spool valve or pilot spool valve.
2. If the stall speed is higher than the standard value in D, 3, 2 and L ranges.
- Slipping of low clutch
- Slipping of low one-way clutch
3. If the stall speed is higher than the standard value in R range.
- Slipping of low & reverse brake
- Slipping of reverse clutch
4. If the stall is lower than the standard value is all ranges.
- Slipping of torque converter one-way clutch
- Problem in engine

Time Lag Test



Time Lag Test Procedure

1. Fully apply the parking brake and chock all wheels.
2. Check the level of the engine oil, coolant and transmission fluid. Replenish as necessary.
3. Start the engine and warm up (allow engine coolant temperature to reach at least 70°C [158°F]).

Important: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

4. Let idle and record the time lag from when the selector lever is moved from N to D or N to R range until the shock has felt.

Standard Value

Selector lever position	Time lag
N to D range	Less than 0.7 seconds
N to R range	Less than 1.2 seconds

Diagnosis

1. If the time lag is out of the standard value when the selector lever is moved from N to D range.
   - Forward range line pressure is low.
   - Slipping of low clutch.
   - Slipping of low one-way clutch.
   - Problem in valve body (faulty operation, sticking or clogged hydraulic circuit).
   - Faulty operation of low clutch solenoid valve.
   - Shorter or faulty amount of transmission fluid.
2. If the time lag is out of the standard value when the selector lever is moved from N to R range.
   - Reverse range line pressure is low
   - Slipping of low & reverse brake
   - Slipping of reverse clutch
   - Problem in valve body (faulty operation, sticking or clogged hydraulic circuit).
   - Faulty operation of low & reverse brake solenoid valve.
   - Shorter or faulty amount of transmission fluid.

Road Test

Road Test Procedure

Selector lever position	Selected gear position	Gearshift
P	—	—
R	Reverse	—
N	—	—
D	1st	
	2nd	
	3rd	
	4th	
3	1st	
	2nd	
	3rd	
	4th(*1)	
2	1st	
	2nd	
	3rd(*1)	
	4th(*1)	
L	1st	
	2nd(*1)	
	3rd(*1)	
	4th(*1)	

*1: Shifting at high vehicle speed, the transmission may hold the gear position until vehicle speed gets down to prevent engine overruning.

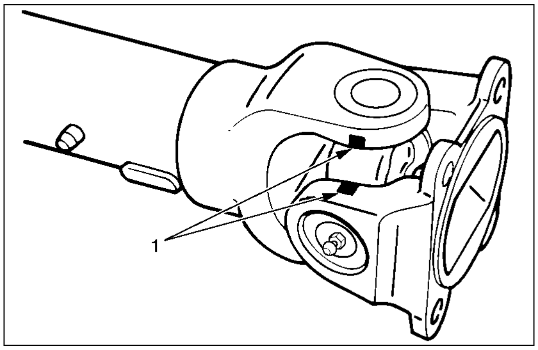
Notice: Perform this test at the normal transmission fluid temperature between 50 to 80°C (122 to 176°F). Drive the vehicle on level ground so as not to change to up slope mode and down slope mode.

1. D range road test in normal and power drive mode.
   - Select into the D range and hold the accelerator pedal constant at the 50% and 100% accelerator pedal position.
   - 1 to 2, 2 to 3, 3 to 4 upshift and lock up should take place, and shift points should match those shown in the shift speed chart.
   - Also check to see that downshift is made from 4 to 3, 3 to 2 and 2 to 1 point is within the limits shown in the shift speed chart.
2. 3 range road test in normal and power drive mode.
   - Select into the 3 range and hold the accelerator pedal constant at the 50% and 100% accelerator pedal position.
   - 1 to 2, 2 to 3 upshift and lock up should take place, and shift points should match those shown in the shift speed chart.
   - While running in the 3 range, does not upshift from 3 to 4.
3. 2 range road test in normal mode.
   - Select into the 2 range and hold the accelerator pedal constant at the 50% and 100% accelerator pedal position.
   - 1 to 2 upshift should take place, and shift points should match those shown in the shift speed chart.
   - While running in the 2 range, does not upshift from 2 to 3 or 3 to 4, and lock-up does not operate.
4. L range road test in normal mode.
   - While running in the L range, does not upshift from 1 to 2, 2 to 3 or 3 to 4, and lock-up does not operate.
5. R range road test.
   - Select into the R range and check for slipping.
6. P range road test.
   - Stop the vehicle on a grade and release the park brake after selecting into the P range. Then check to see that the parking lock pawl holds the vehicle in place.

Diagnosis

1. If there is no 1 to 2 upshift.
   - Faulty operation of 2-4 brake
   - Faulty operation of 2-4 brake hydraulic circuits
   - Sticking of 2-4 brake solenoid valve
   - Refer to symptom diagnosis No. D1: Faulty Gear Shifting or DTC P0731 - P0734 Incorrect Gear Ratio diagnosis.
2. If there is no 2 to 3 upshift.
   - Faulty operation of high clutch
   - Faulty operation of high clutch hydraulic circuits
   - Sticking of high clutch solenoid valve
   - Refer to symptom diagnosis No. D1: Faulty Gear Shifting or DTC P0731 - P0734 Incorrect Gear Ratio diagnosis.
3. If there is no 3 to 4 upshift.
   - Faulty operation of 2-4 brake
   - Faulty operation of 2-4 brake hydraulic circuits
   - Sticking of 2-4 brake solenoid valve
   - Refer to symptom diagnosis No. D1: Faulty Gear Shifting or DTC P0731 - P0734 Incorrect Gear Ratio diagnosis.
4. If there is no lock up in 2nd, 3rd and 4th.
   - Faulty operation of torque converter clutch (TCC) piston
   - Faulty operation of lock up hydraulic circuit
   - Sticking of TCC solenoid valve
   - Refer to symptom diagnosis No. I1: No Lock-up
5. If there is no reverse.
   - Faulty operation of reverse clutch
   - Faulty operation of reverse clutch hydraulic circuits
   - Faulty operation of low & reverse brake hydraulic circuits

Disassembly



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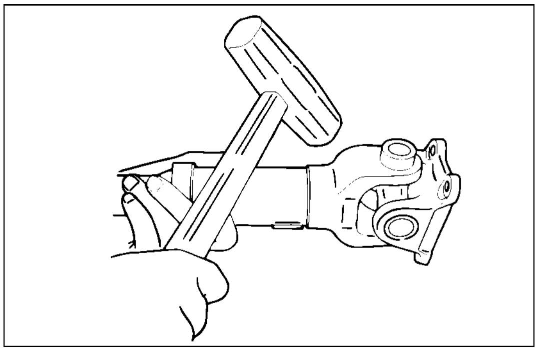
1. Apply alignment marks (1) on the yokes of the universal joint, then remove snap ring.


401RS006

2. Tap out the needle roller bearing by gently striking the shoulder of the yoke, using a mallet or a copper hammer.
3. Make sure of proper position for reinstallation by applying setting marks, then remove spider.

Inspection and Repair

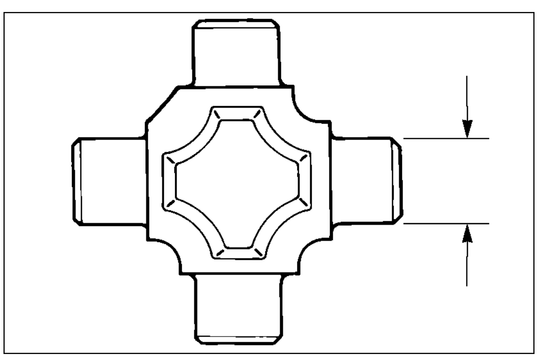
Make necessary correction or parts replacement if wear, damage, corrosion or any other abnormal condition is found through inspection.

NOTE:

When any part of the journal assembly (spider, needle roller bearing) requires replacement, be sure to replace the entire assembly.

Check the following parts for wear, damage, noise or any other abnormal conditions:

1. Spider
2. Needle roller bearing
3. Yoke
4. Flange
5. Constant velocity joint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Outside Diameter of Spider Pin

Standard: 17.00 mm (0.6693 in)

Limit: 16.99 mm (0.6689 in)

- Sticking of low & reverse brake solenoid valve
- Refer to symptom diagnosis No. A2: Vehicle Dose Not Run in R Range

6. If there is no parking.

- Faulty parking pawl
- Refer to symptom diagnosis No. G1: Vehicle Moves in P Range or Parking Gear in Not Disengaged other than P Range.

Notice: The check for the cause of abnormal noise and vibration must be made with extreme care as it could also be due to loss of balance in the propeller shaft, differential, the torque converter, etc. Or insufficient bending, rigidity, etc. in the powertrain.

Shift Speed Chart

1. All upshifts have a solid green line with:

- 1-2 has black filled diamond plot points
- 2-3 has black filled squre plot points
- 2-4 has back filled circular plot posints

2. All donwshift have a sloid blue line with:

- 2-1 has white filled diamonf plot points
- 3-2 has white filled squre plot points
- 4-3 has white filled circular plot points

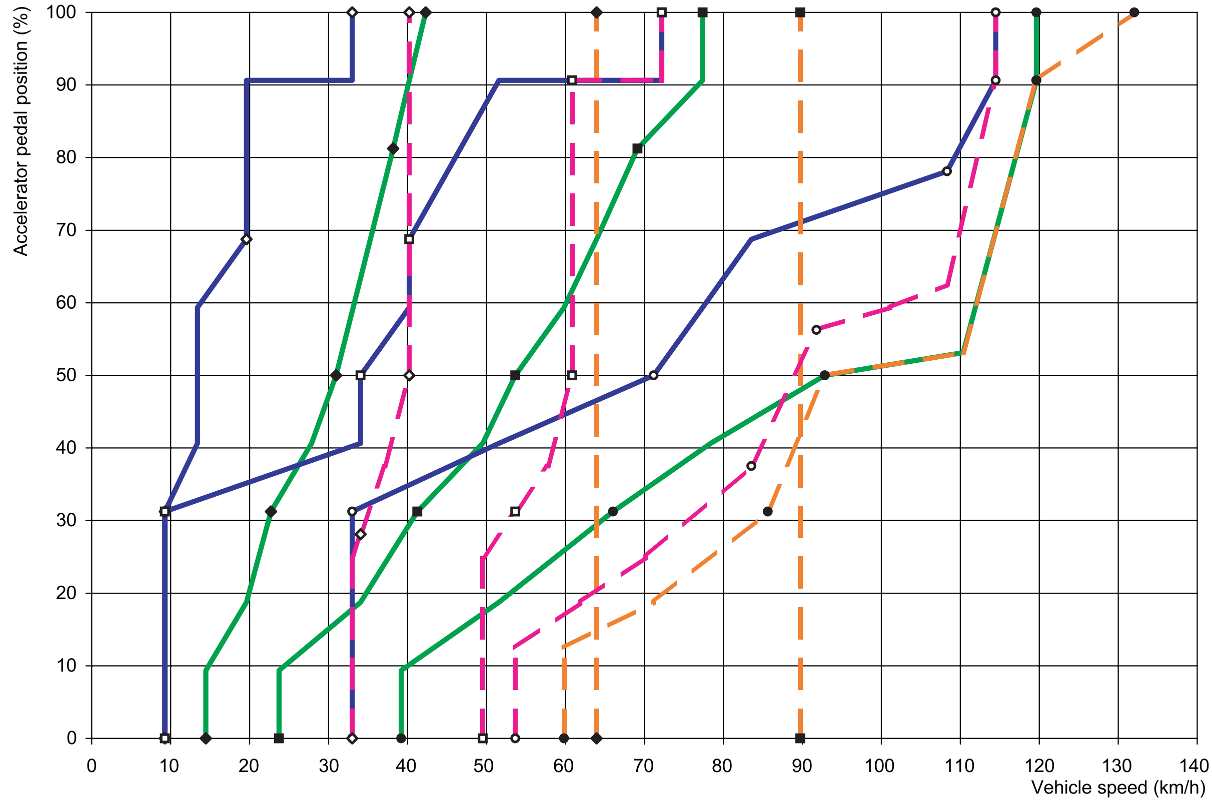
3. Torque converter clutch apply points have a dashed orange line with:

- 2nd apply has black filled diamond plot points
- 3rd apply has black filled squre plot points
- 4th apply has black filled circulat plot points

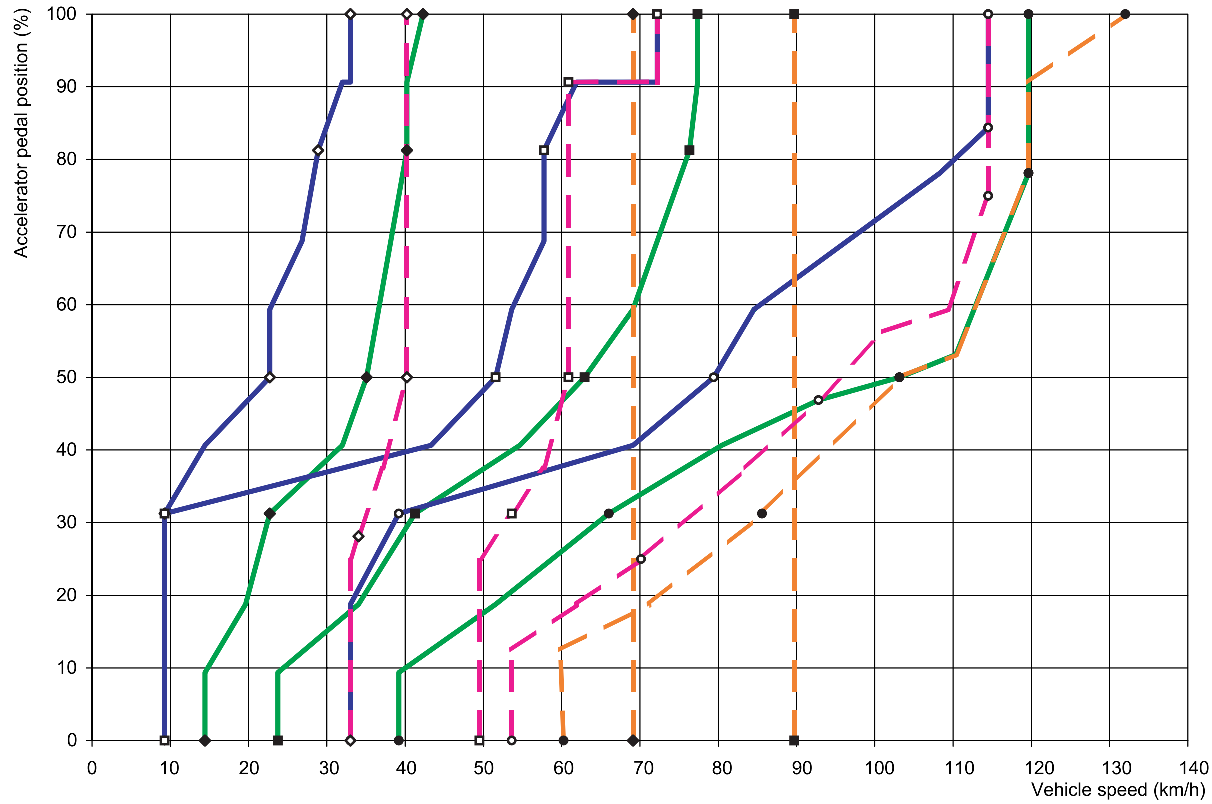
4. Torque converter clutch release points have a dashed pink line with:

- 2nd release has white filled diamond plot points
- 3rd release has white filled squre plot points
- 4th release has white filled circulat plot points

Normal mode/ Final gear ratio 41/11 (3.727)/ Tire size 215/70R15 (Euro 3 specification engine)



Power drive mode/ Final gear ratio 41/11(3.727)/ Tire size 215/70R15 (Euro 3 specification engine)



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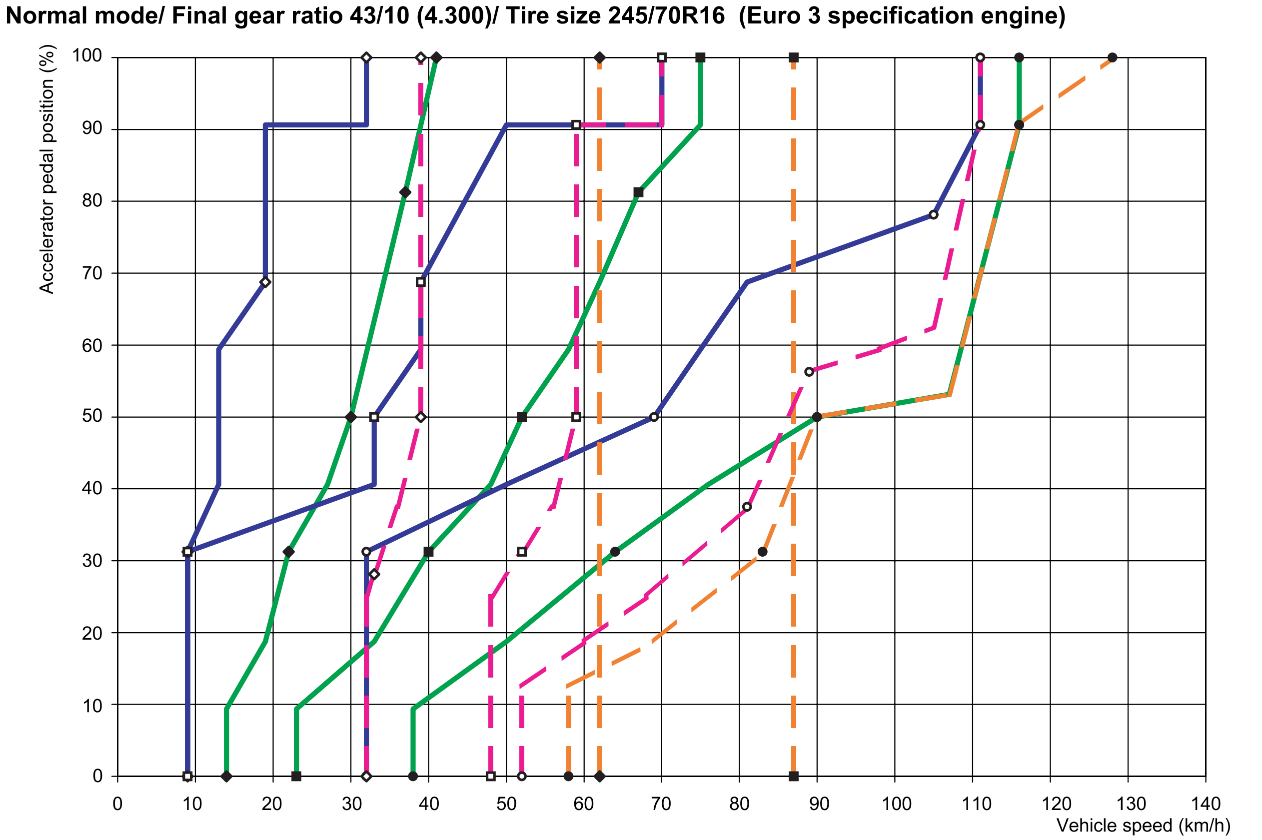
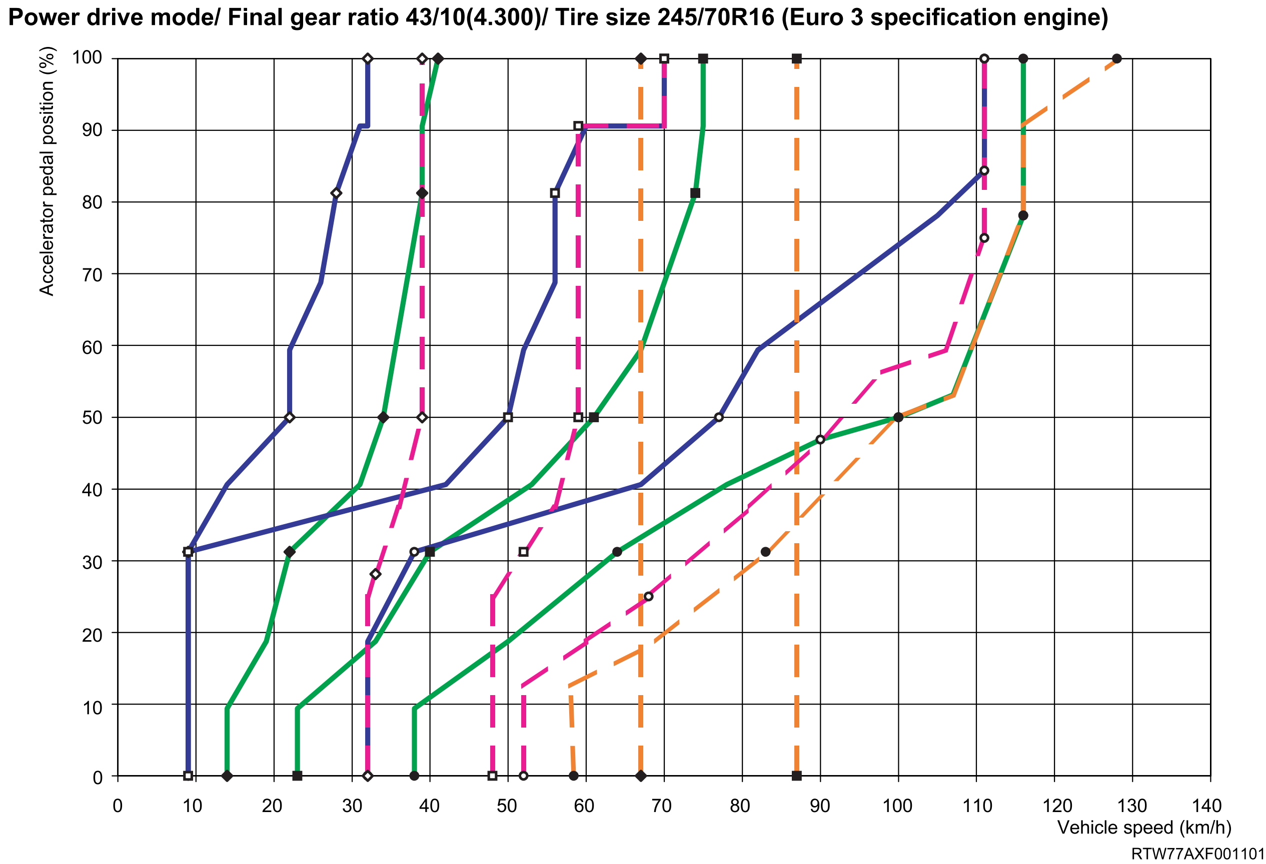

Normal mode/ Final gear ratio 43/10 (4.300)/ Tire size 245/70R16 (Euro 3 specification engine)
Accelerator pedal position (%)
Vehicle speed (km/h)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140


Power drive mode/ Final gear ratio 43/10(4.300)/ Tire size 245/70R16 (Euro 3 specification engine)
Accelerator pedal position (%)
Vehicle speed (km/h)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
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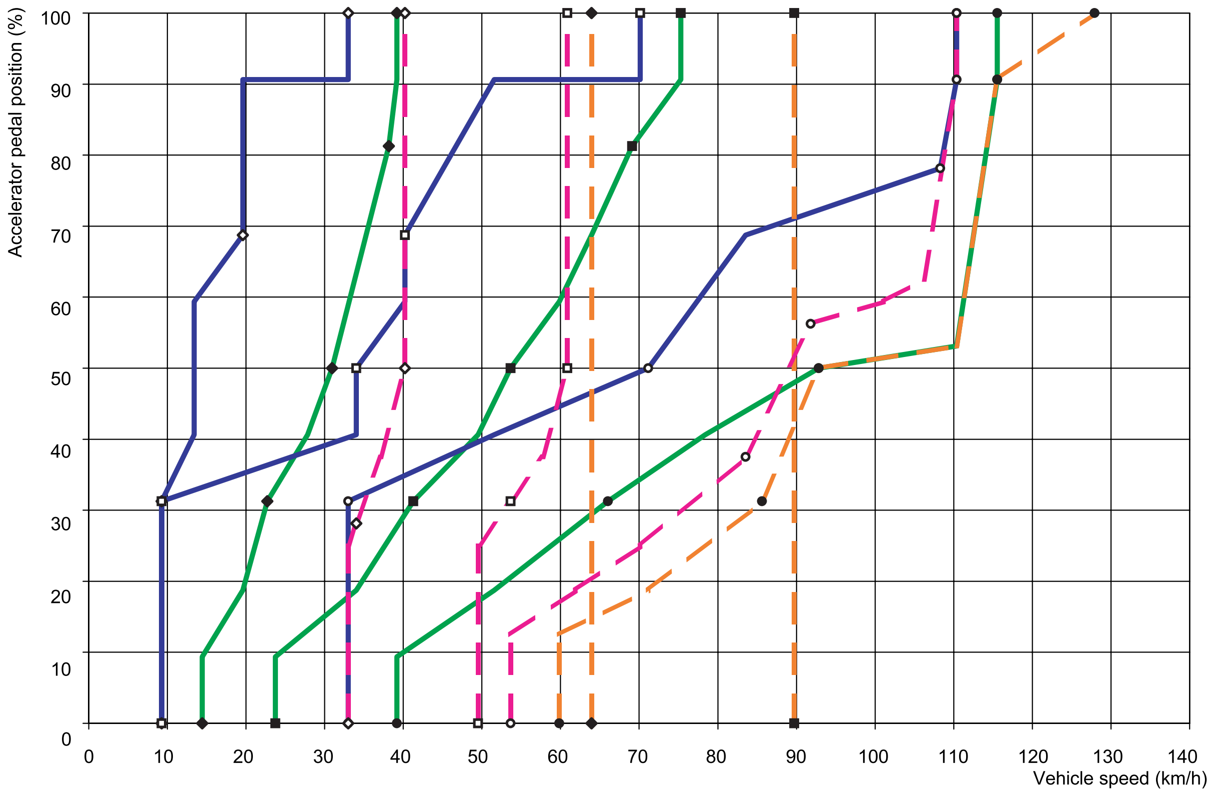
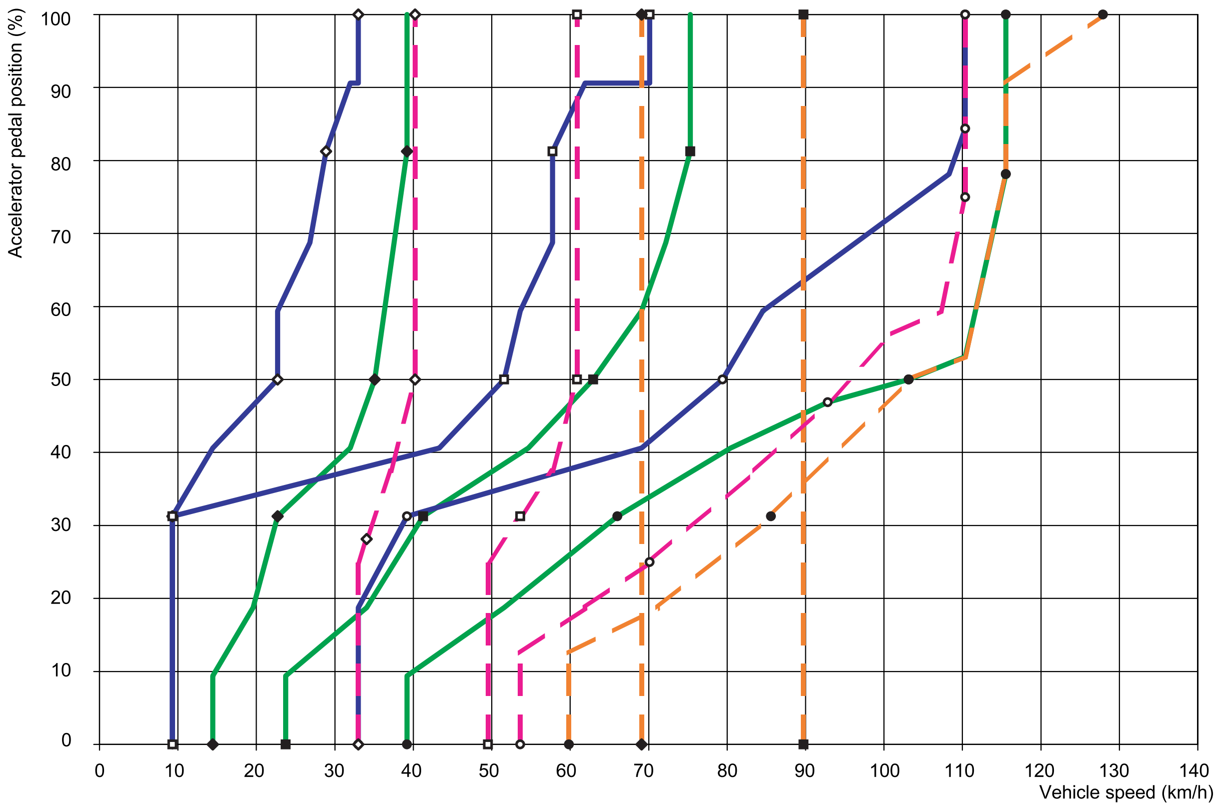
Normal mode/ Final gear ratio 41/11 (3.727)/ Tire size 215/70R15 (Except Euro 3 specification engine)



Power drive mode/ Final gear ratio 41/11 (3.727)/ Tire size 215/70R15 (Except Euro 3 specification engine)



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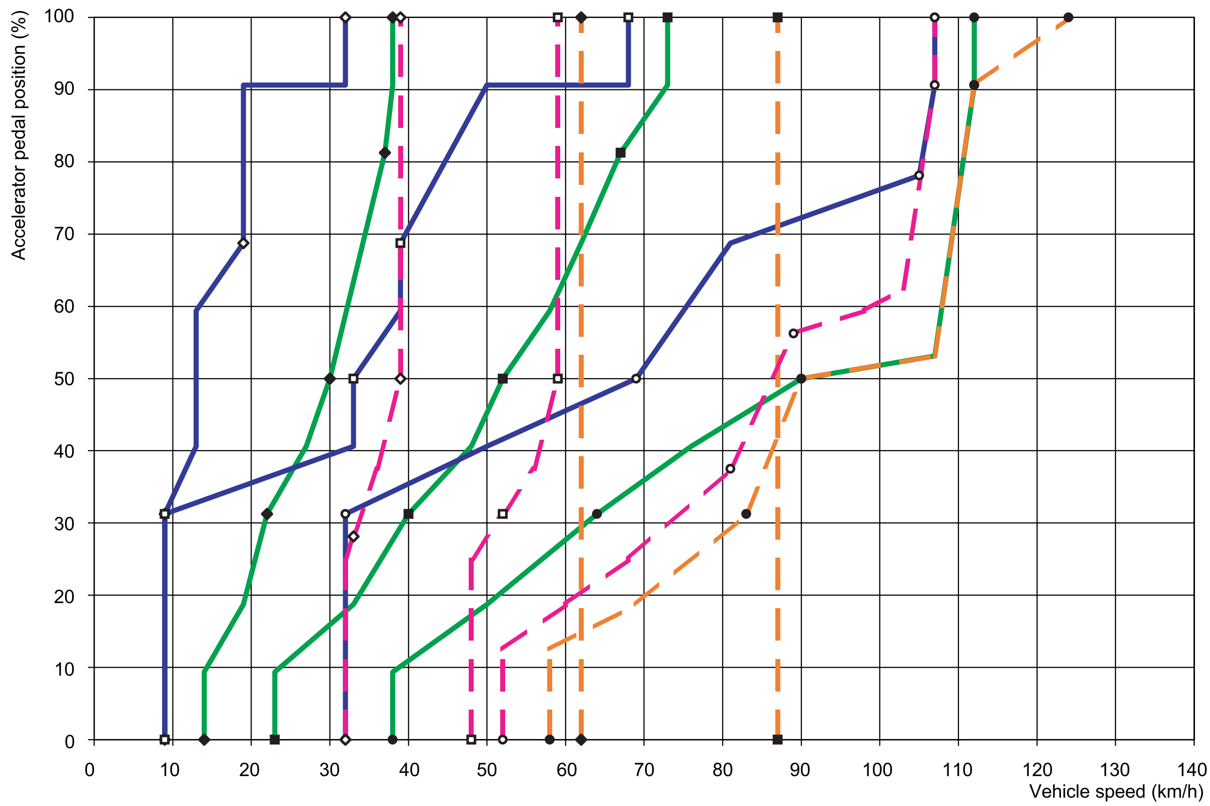
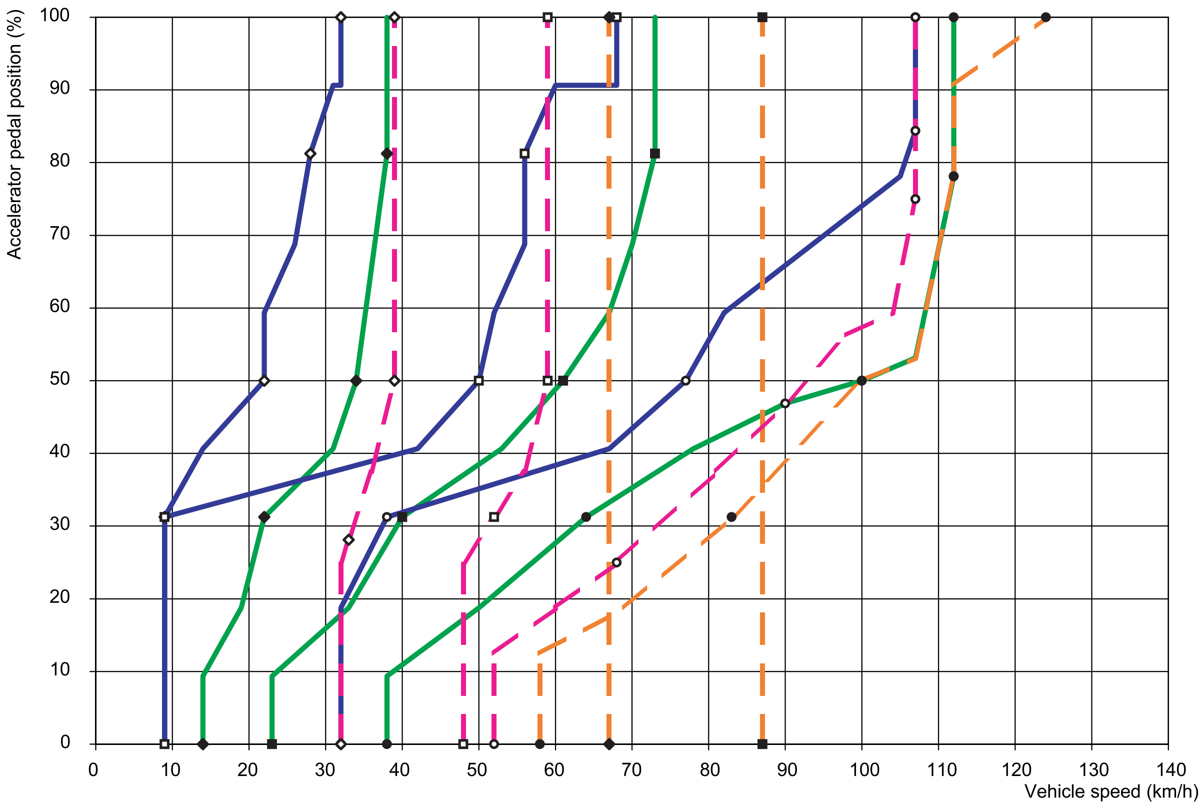
Normal mode/ Final gear ratio 43/10 (4.300)/ Tire size 245/70R16 (Except Euro 3 specification engine)



Power drive mode/ Final gear ratio 43/10(4.300)/ Tire size 245/70R16 (Except Euro 3 specification engine)



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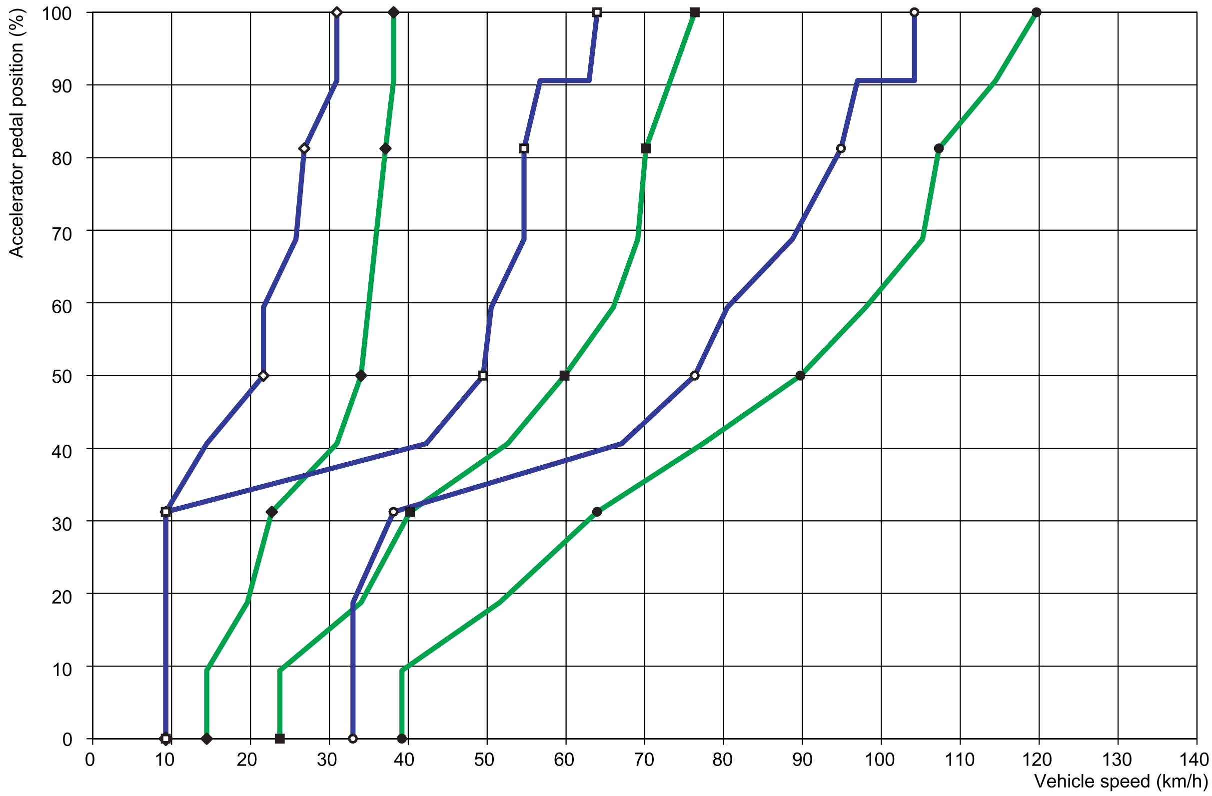
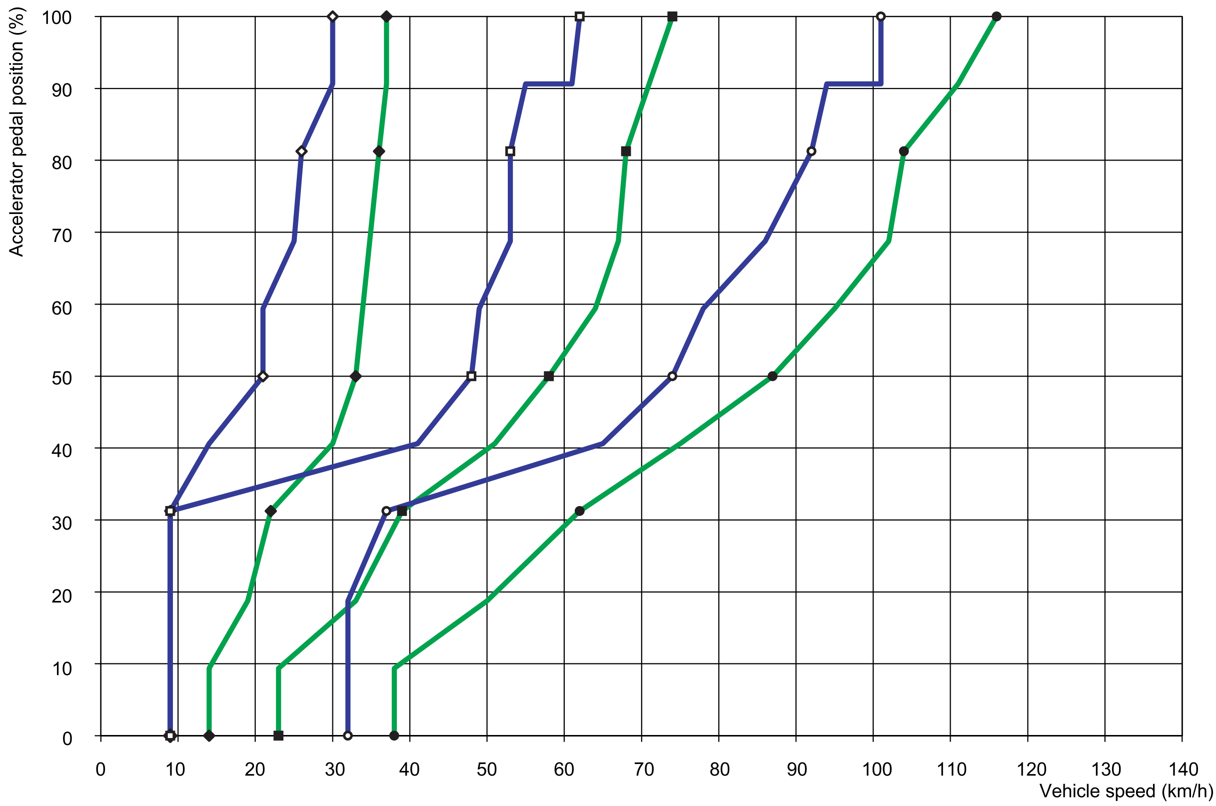
4L mode/ Final gear ratio 41/11 (3.727)/ Tire size 215/70R15



4L mode/ Final gear ratio 43/10 (4.300)/ Tire size 245/70R16



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Shift Speed Table

			Euro 3 specification engine								
Final gear ratio & tire size			41/11 (3.727) & 215/70R15								
			43/10 (4.300) & 245/70R16								
Gear		Accel. pedal position (%)	Normal mode			Power drive mode			4L mode		
			Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)	Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)	Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)
Upshift	1-2	50	27-34	16-20	930	31-38	19-23	1054	30-37	18-22	1023
		100	38-45	23-27	1271	38-45	23-27	1271	34-41	20-25	1147
	2-3	50	49-57	29-34	1612	58-66	35-40	1891	55-63	33-38	1798
		100	72-80	43-48	2325	72-80	43-48	2325	71-79	43-47	2294
	3-4	50	87-96	52-58	2790	97-106	58-64	3099	84-93	50-56	2697
		100	113-123	68-74	3595	113-123	68-74	3595	113-123	68-74	3595
Downshift	4-3	0	29-36	17-22	992	29-36	17-22	992	29-36	17-22	992
		50	66-74	40-44	2139	74-82	44-49	2387	71-79	43-47	2294
		100	108-117	65-70	3440	108-117	65-70	3440	98-107	59-64	3130
	3-2	0	6-12	4-7	279	6-12	4-7	279	6-12	4-7	279
		50	30-37	18-22	1023	47-55	28-33	1550	45-53	27-32	1488
		100	67-75	40-45	2170	67-75	40-45	2170	59-67	35-40	1922
	2-1	0	6-12	4-7	279	6-12	4-7	279	6-12	4-7	279
		50	10-16	6-10	403	19-26	11-16	682	18-25	11-15	651
		100	29-36	17-22	992	29-36	17-22	992	27-34	16-20	930

			Except Euro 3 specification engine								
Final gear ratio & tire size			41/11 (3.727) & 215/70R15 43/10 (4.300) & 245/70R16								
Gear		Accel. pedal position (%)	Normal mode			Power drive mode			4L mode		
			Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)	Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)	Vehicle speed (km/h)	Vehicle speed (MPH)	Output shaft speed (RPM)
Upshift	1-2	50	27-34	16-20	930	31-38	19-23	1054	30-37	18-22	1023
		100	35-42	21-25	1178	35-42	21-25	1178	34-41	20-25	1147
	2-3	50	49-57	29-34	1621	58-66	35-40	1891	55-63	33-38	1798
		100	70-78	42-47	2263	70-78	42-47	2263	71-79	43-47	2294
	3-4	50	87-96	52-58	2790	97-106	58-64	3099	84-93	50-56	2697
		100	109-119	65-71	3471	109-119	65-71	3471	113-123	68-74	3595
Downshift	4-3	0	39-36	23-22	992	29-36	17-22	992	29-36	17-22	992
		50	66-74	40-44	2139	74-82	44-49	2387	71-79	43-47	2294
		100	104-113	62-68	3316	104-113	62-68	3316	98-107	59-64	3130
	3-2	0	6-12	4-7	279	6-12	4-7	279	6-12	4-7	279
		50	30-37	18-22	1023	47-55	28-33	1550	45-53	27-32	1488
		100	65-73	39-44	2108	65-73	39-44	2108	59-67	35-40	1922
	2-1	0	6-12	4-7	279	6-12	4-7	279	6-12	4-7	279
		50	10-16	6-10	403	19-26	11-16	682	18-25	11-15	651
		100	29-36	17-22	992	29-36	17-22	992	27-34	16-20	930

TCM Signal Test

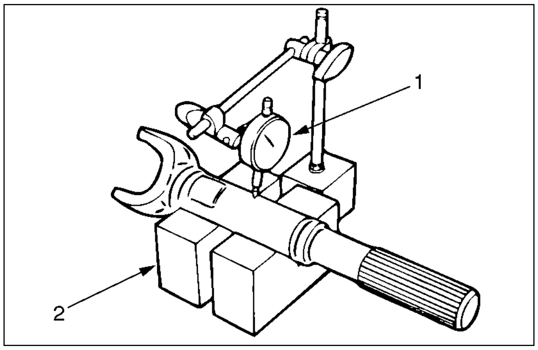
Inspection Tool

Use a DMM to measure voltage and circuit continuity. Also use an oscilloscope to measure waveform. Refer to the following table for the specified ranges or reference waveform.

Since the TCM terminals are extremely small, use appropriate test adapter from the test adapter kit. This will make measurement easier.

Pin No.	Wire color	Pin function	DMM (+)	DMM (-)	Test condition	Standard value
1 of C-94	RED/ WHT	Battery voltage	1 of C-94	Ground	Any time	Nearly 12 volts
2 of C-94	YEL/ VIO	P range switch signal	2 of C-94	Ground	P range	Nearly 12 volts
					Other than P range	Less than 2 volts
3 of C-94	RED	Brake pedal switch signal	3 of C-94	Ground	Pedal is released	Less than 2 volts
					Pedal is applied	Nearly 12 volts
4 of C-94	PNK/ WHT	3rd start lamp control	4 of C-94 (back probe)	Ground	Lamp OFF	Nearly 12 volts
					Lamp ON	Less than 2 volts
5 of C-94	VIO/ GRN	Keyword serial data communication	5 of C-94	7 of B-58	Ignition OFF	Continuity
6 of C-94	—	Not used	—	—	—	—
7 of C-94	BLK/ RED	Engine speed signal input	7 of C-94 (back probe)	5 of C-95 (back probe)	Engine run at 2000 RPM	Nearly 6.2 volts by AC range or waveform
8 of C-94	—	Not used	—	—	—	—
9 of C-94	—	Not used	—	—	—	—
10 of C-94	BLK/ YEL	Vehicle speed signal output (2WD)	10 of C-94 (back probe)	5 of C-95 (back probe)	Vehicle run at 20 km/h (12 MPH)	Nearly 6.5 volts by AC range or waveform
11 of C-94	GRN/ WHT	3rd start switch signal	11 of C-94 (back probe)	Ground	Switch is released	Nearly 12 volts
					Switch is pressed	Less than 2 volts
12 of C-94	BLU/ WHT	4WD low signal output	12 of C-94 (back probe)	Ground	4L mode	Less than 2 volts
					Other than 4L	Nearly 12 volts
13 of C-94	—	Not used	—	—	—	—
14 of C-94	—	Not used	—	—	—	—
15 of C-94	—	Not used	—	—	—	—
16 of C-94	RED/ WHT	Accelerator pedal position (APP) signal input	16 of C-94 (back probe)	5 of C-95	Pedal is released (0%)	Off duty ratio 10%
					Pedal is fully applied (100%)	Off duty ratio 90%
17 of C-94	BLK/GRN	3 range switch signal	17 of C-94	Ground	3 range	Nearly 12 volts
					Other than 3 range	Less than 2 volts
18 of C-94	YEL/ BLK	Diagnostic request switch	5 of C-94	11 of B-58	Ignition OFF	Continuity
19 of C-94	ORN/ BLU	Transmission oil temperature lamp control	19 of C-94 (back probe)	Ground	Lamp OFF	Nearly 12 volts
					Lamp ON	Less than 2 volts
20 of C-94	GRY/ YEL	Check trans lamp control	20 of C-94 (back probe)	Ground	Lamp OFF	Nearly 12 volts
					Lamp ON	Less than 2 volts
21 of C-94	PNK	Power drive lamp control	21 of C-94 (back probe)	Ground	Lamp OFF	Nearly 12 volts
					Lamp ON	Less than 2 volts

Pin No.	Wire color	Pin function	DMM (+)	DMM (-)	Test condition	Standard value
22 of C-94	—	Not used	—	—	—	—
23 of C-94	—	Not used	—	—	—	—
24 of C-94	GRN/ YEL	Power drive switch signal	24 of C-94 (back probe)	Ground	Switch is OFF	Nearly 12 volts
					Switch is ON	Less than 2 volts
1 of C-95	RED/ YEL	2-4 brake TFP switch signal	1 of C-95 (back probe)	Ground	2nd or 4th gear	Less than 2 volts
					Other than 2nd or 4th gear	Nearly 12 volts
2 of C-95	PNK/ BLK	2 range switch signal	2 of C-95	Ground	2 range	Nearly 12 volts
					Other than 2 range	Less than 2 volts
3 of C-95	BRN/ RED	ISS sensor signal	3 of C-95 (back probe)	5 of C-95 (back probe)	Vehicle run at 20 km/h (12 MPH) in L range with 1st gear	Nearly 6.5 volts by AC range or waveform
4 of C-95	BLU	TFT sensor signal	4 of C-95	14 of C-95	Ignition OFF	Refer to Temperature vs. Resistance table
5 of C-95	BLK	Ground	5 of C-95	Ground	Ignition OFF	Continuity
6 of C-95	BLU/ BLK	Low & reverse brake solenoid control	6 of C-95 (back probe)	22 of C-95 (back probe)	P or N range	Nearly 6.2 volts by AC range or waveform
7 of C-95	BLK/ YEL	2 & 4 brake solenoid control	7 of C-95 (back probe)	22 of C-95 (back probe)	P or N range	Nearly 6.2 volts by AC range or waveform
8 of C-95	RED	High clutch solenoid control	8 of C-95 (back probe)	22 of C-95 (back probe)	P or N range	Nearly 6.2 volts by AC range or waveform
9 of C-95	WHT/ BLU	Low clutch solenoid control	9 of C-95 (back probe)	22 of C-95 (back probe)	D range with 4th gear	Nearly 6.2 volts by AC range or waveform
10 of C-95	RED/ BLK	N range switch signal	10 of C-95	Ground	2 range	Nearly 12 volts
					Other than 2 range	Less than 2 volts
11 of C-95	BLU	D range switch signal	11 of C-95	Ground	D range	Nearly 12 volts
					Other than 2 range	Less than 2 volts
12 of C-95	YEL	Low & reverse brake TFP switch	12 of C-95 (back probe)	Ground	R range or L range	Less than 2 volts
					Other than R range or L range	Nearly 12 volts
13 of C-95	YEL/ RED	OSS sensor signal	13 of C-95 (back probe)	5 of C-95 (back probe)	Vehicle run at 20 km/h (12 MPH) in L range with 1st gear	Nearly 6.8 volts by AC range or waveform
14 of C-95	BLU/ BLK	TFT sensor low reference	4 of C-95	14 of C-95	Ignition OFF	Refer to Temperature vs. Resistance table
15 of C-95	—	Not used	—	—	—	—
16 of C-95	—	Not used	—	—	—	—
17 of C-95	BLK	TCC solenoid control	17 of C-95 (back probe)	5 of C-95 (back probe)	TCC is commanded OFF	Waveform
					TCC is commanded ON	Waveform
18 of C-95	WHT	Ignition voltage	18 of C-95	Ground	Ignition switch ON	Nearly 12 volts



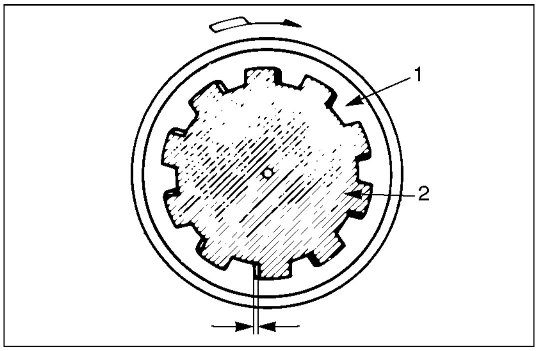
401RS027

Propeller Shaft Run-out

Support the ends of the propeller shaft on V-blocks (2) and check for run-out by holding the probe of a dial indicator (1) in contact with the center part of the shaft. If the amount of run-out is beyond the standard value for assembly, correct with a bench press or replace the shaft with a new propeller shaft assembly.

Standard: 0.3 mm (0.012 in)

Limit: 0.5 mm (0.02 in)



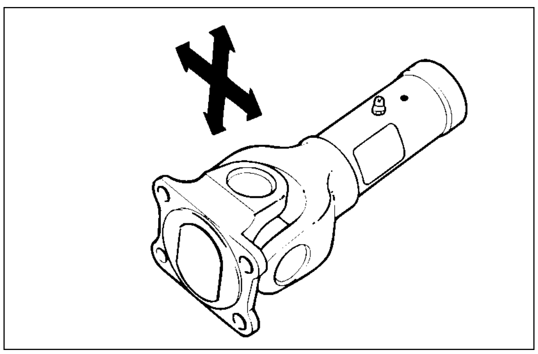
401RS009

Play in Splines in Normal Direction of Rotation

Check the amount of play between the sleeve yoke (1) and the propeller shaft spline (2) in the direction of rotation, using a pointed feeler gauge.

Standard: 0.073-0.156 mm (0.003-0.006 in)

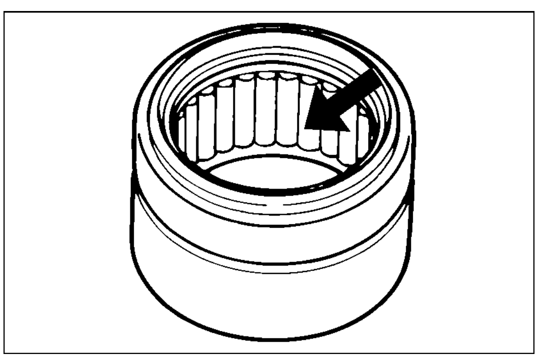
Limit: 0.3 mm (0.012 in)



401RS010

Play in Universal Joint

Limit: Less than 0.1 mm (0.004 in)



401RS011

Reassembly

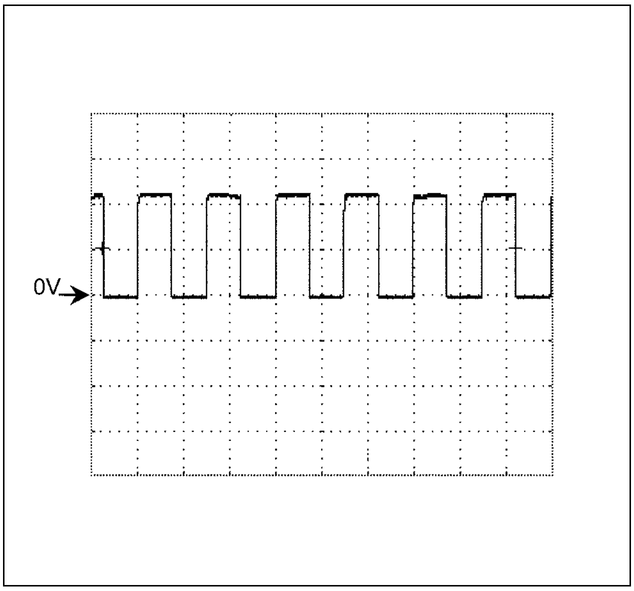
1. Install spider to flange yoke. Be sure to install the spider by aligning the setting marks made during disassembly.
2. Apply a molybdenum-disulfide grease or multi-purpose type grease NLGI No. 2 to inside of the bearing cap.

   Grease Amount: Approx. 1.2 g (0.042 oz)

Pin No.	Wire color	Pin function	DMM (+)	DMM (-)	Test condition	Standard value
19 of C-95	RED/ YEL	R range switch signal	19 of C-95	Ground	R range	Nearly 12 volts
					Other than R range	Less than 2 volts
20 of C-95	WHT/ BLK	High clutch TFP switch signal	20 of C-95 (back probe)	Ground	3rd or 4th gear	Less than 2 volts
					Other than 3rd to 4th gear	Nearly 12 volts
21 of C-95	PNK/ BLU	L range switch signal	21 of C-95	Ground	L range	Nearly 12 volts
					Other than L range	Less than 2 volts
22 of C-95	GRY/ RED	Ground return	22 of C-95	Ground	Ignition OFF	Continuity
23 of C-95	VIO	PC solenoid control	23 of C-95 (back probe)	5 of C-95 (back probe)	P or N rage	Nearly 12 volts
					D range	Less than 2 volts
24 of C-95	WHT	Ignition voltage	24 of C-95	Ground	Ignition switch ON	Nearly 12 volts

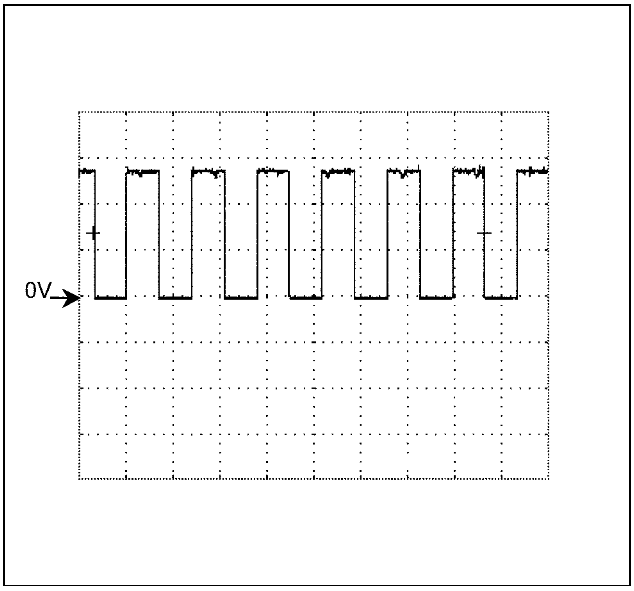
Reference Wave form

Engine speed signal



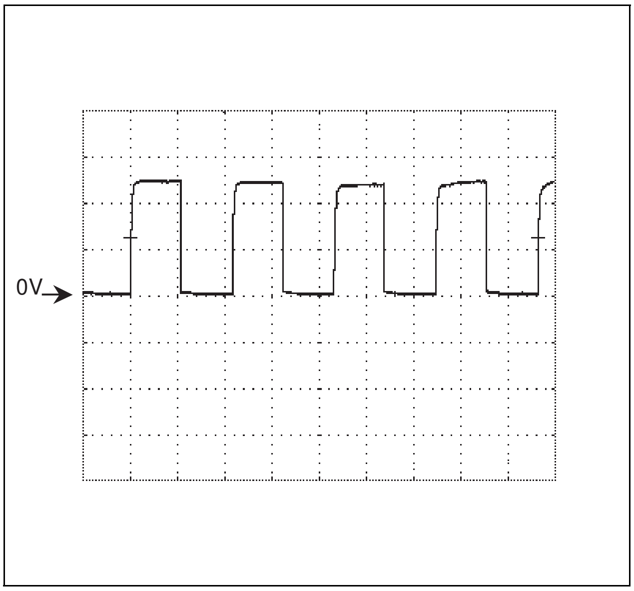
- Measurement terminal: 7 of C-94 (+) & 5 of C-95 (-)
- Measurement scale: 5 volts/div & 10 ms/div
- Measurement condition: Engine run at 2000 RPM

Vehicle speed signal



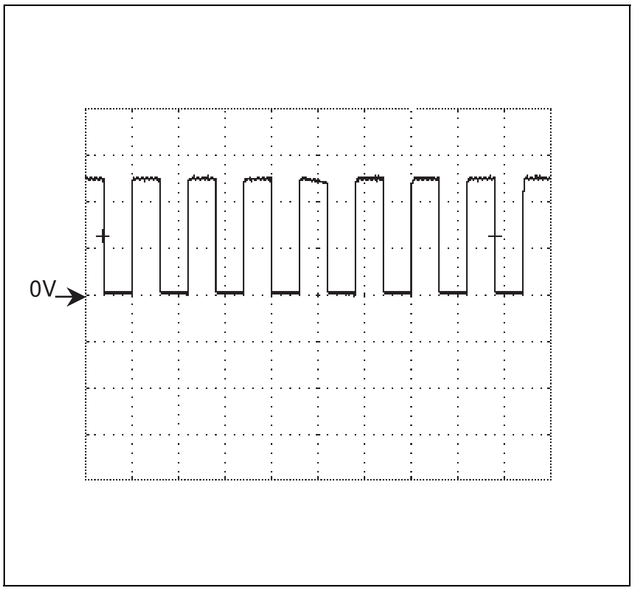
- Measurement terminal: 10 of C-94 (+) & 5 of C-95 (-)
- Measurement scale: 5 volts/div & 50 ms/div
- Measurement condition: Vehicle run at 20 km/h (12 MPH)

Input shaft speed (ISS) sensor signal



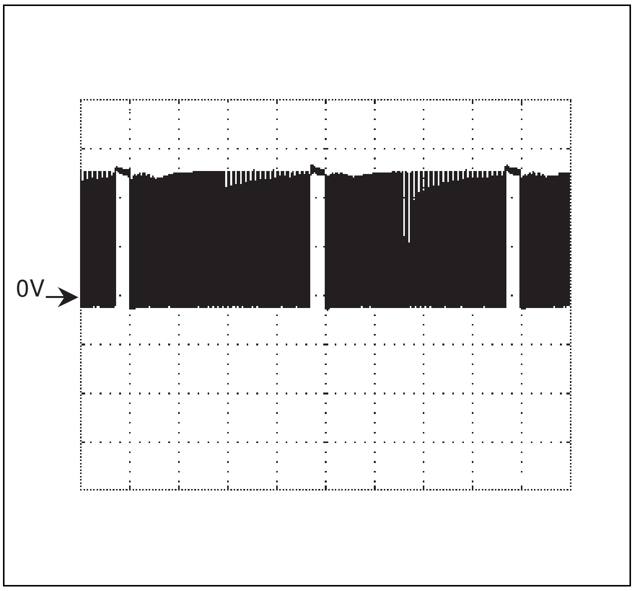
- Measurement terminal: 3 of C-95 (+) & 5 of C-95 (-)
- Measurement scale: 5 volts/div & 500 micro sec./div
- Measurement condition: Vehicle run at 20 km/h (12 MPH) in L range with 1st gear

Output shaft speed (OSS) sensor signal



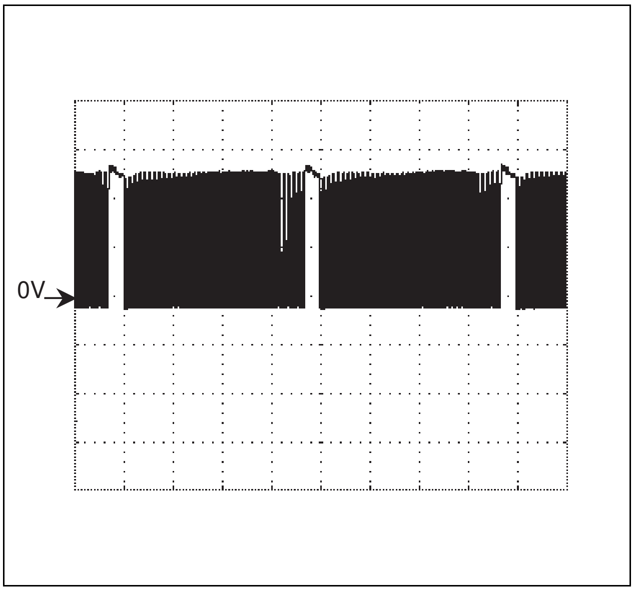
- Measurement terminal: 13 of C-95 (+) & 5 of C-95 (-)
- Measurement scale: 5 volts/div & 5 ms/div
- Measurement condition: Vehicle run at 20 km/h (12 MPH) in L range with 1st gear

Low & reverse brake solenoid valve control signal



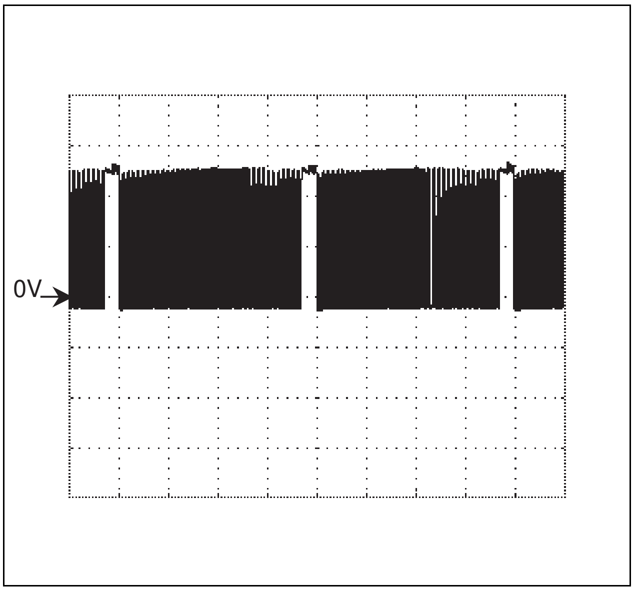
- Measurement terminal: 6 of C-95 (+) & 22 of C-95 (-)
- Measurement scale: 5 volts/div & 10 ms/div
- Measurement condition: P or N range

2-4 brake solenoid valve control signal



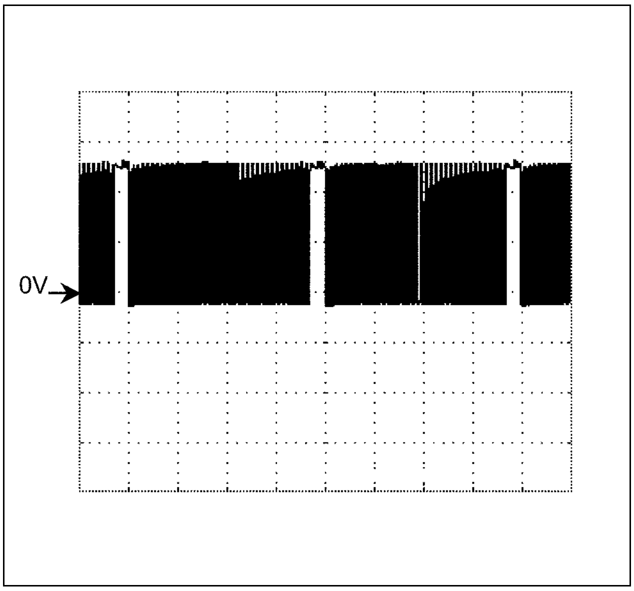
- Measurement terminal: 7 of C-95 (+) & 22 of C-95 (-)
- Measurement scale: 5 volts/div & 10 ms/div
- Measurement condition: P or N range

High clutch solenoid valve control signal



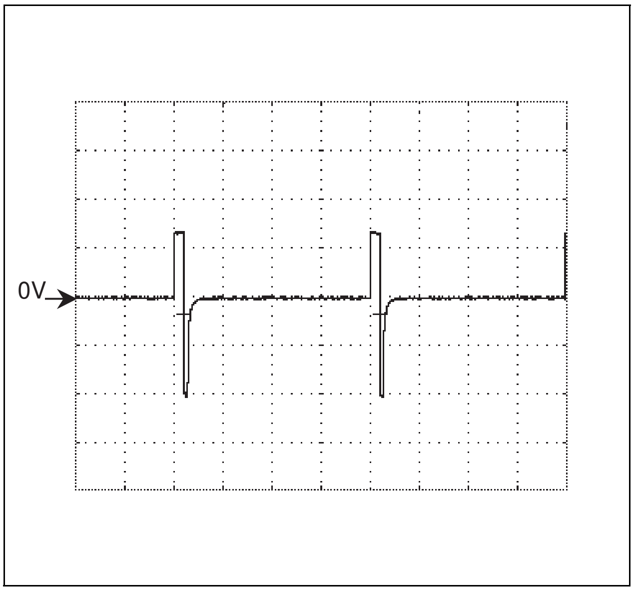
- Measurement terminal: 8 of C-95 (+) & 22 of C-95 (-)
- Measurement scale: 5 volts/div & 10 ms/div
- Measurement condition: P or N range

Low clutch solenoid valve control signal



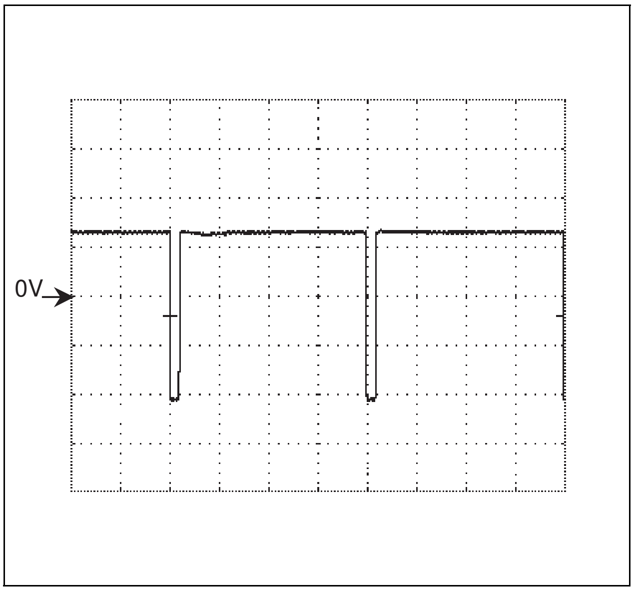
- Measurement terminal: 9 of C-95 (+) & 22 of C-95 (-)
- Measurement scale: 5 volts/div & 10 ms/div
- Measurement condition: D range with 4th gear

Torque converter clutch (TCC) solenoid valve control signal



- Measurement terminal: 17 of C-95 (+) & 5 of C-95 (-)
- Measurement scale: 10 volts/div & 5 ms/div
- Measurement condition: TCC is commanded OFF

Torque converter clutch (TCC) solenoid valve control signal



- Measurement terminal: 17 of C-95 (+) & 5 of C-95 (-)
- Measurement scale: 10 volts/div & 5 ms/div
- Measurement condition: TCC is commanded ON

Repair Instructions

Transmission Controls Module (TCM) Replacement

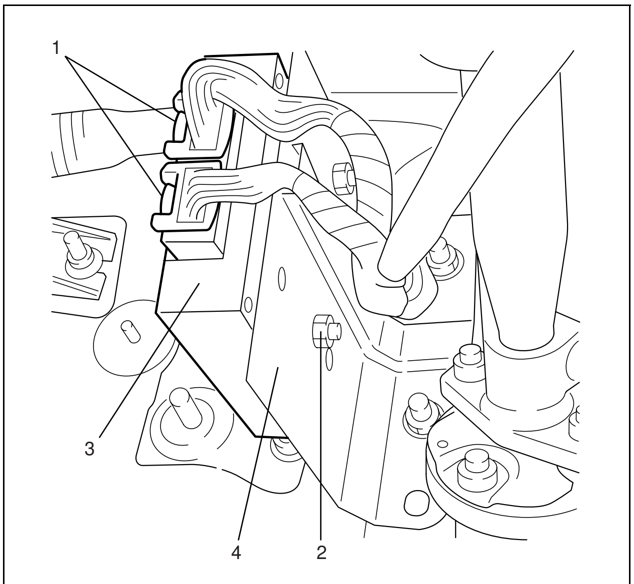
Description

The following A - C steps provide an overview procedure to replace and reprogram a TCM. Each A -C steps is explained further in this section.
A. Replace the old TCM with the new TCM.
B. Program the latest software and calibrations into the new TCM using the Service Programming System (SPS) if released. If not released, do not perform this and skip to Step C.
C. Program the vehicle identification number (VIN) into the TCM.

A. Removal and Installation

Removal Procedure

1. Disconnect the negative battery cable.
2. Disconnect the TCM harness connectors (1).
3. Loosen nuts (2) and remove the TCM (3) from the bracket (4).



Installation Procedure

Follow the removal steps in the reverse order. Be sure that the connectors are securely fastened.

B. Programming Software and Calibrations

Program the latest software/ calibrations if released. Refer to Service Programming System (SPS) Description and SPS (Remote Procedure) or SPS (Pass-Thru Procedure) in this section. If not released, do not perform this and skip to Step C.

C. Programming Vehicle Identification Number (VIN)

Notice: If you have performed SPS in the previous step, VIN has prgrommaned already. Programming VIN is not necessary in this step.

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > AT JR405E > Programming > Program VIN.
4. If you installed a new, skip to step 8. If you installed a reused TCM from another vehicle or incorrect VIN is programmed before, the TCM might be locked already. In order to get programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight the “Tech 2" on the Diagnostic Tool Selection screen and click “Next”.
   f. Click “Close” on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Install a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > appropriate vehicle identification > AT JR405E > Programming > Program VIN.
8. Input 17 digits of correct VIN.
9. After complete the programming, turn OFF/ ON the ignition.
10. Select Diagnostics > Lock ECU.
11. Follow the on-screen instructions and turn OFF/ ON the ignition.

Service Programming System (SPS) Description

The service programming system (SPS) allows a technician to program a control module through the data link connector (DLC). The information transfer circuit that is used at the DLC is the same serial data circuit used by the scan tool for retrieving DTCs, displaying data, clearing DTCs etc. This procedure offers the ability to install software/ calibrations matched to a particular vehicle.
Most control modules have two types of memory. The software/ calibrations reside in the flash memory. The two types of memory are listed below:

- Electrically Erasable Programmable Read Only Memory (EEPROM)
  This type of memory allows selected portions of memory to be programmed while other portions remain unchanged.
  Certain learned values reside in the EEPROM, such as:
  - The vehicle identification number (VIN)
  - The software/ calibrations identification numbers
  - The control module security information
- Flash Read Only Memory-Flash Memory

Flash memory has increased memory storage capacity. During programming, all information within this type of memory is erased, and then replaced with entirely new information.

Service Programming Methods

The two methods of programming a TCM are listed below:

- Remote Programming
- Pass Thru Programming

For information on programming a TCM using one of the methods listed above, refer to Service Programming System (SPS) (Remote Procedure) or Service Programming System (SPS) (Pass-Thru Procedure).

Before Programming a Control Module

Important: DO NOT program an existing TCM with the identical software/ calibration package. This procedure is not a short cut to correct the driveability condition. This is an ineffective repair. An TCM should only be programmed when the following occurs:

- When a service procedure instructs you to replace the TCM.
- An updated software/ calibrations is released.

Ensure that the following conditions are met before programming a TCM:

- The scan tool PCMCIA card is programmed with the latest software.
- The TIS 2000 is installed with the latest software.
- The hardware key is plugged into the computer port.
- Vehicle system voltage:
  - There are no charging system concerns. All charging system concerns must be repaired before programming the TCM.
  - The battery voltage is greater than 12 volts but less than 16 volts. The battery must be fully charged before programming the TCM.
  - A battery charger is NOT connected to the vehicles battery. Incorrect system voltage or voltage fluctuations from a battery charger may cause programming failure or TCM damage.
  - Turn OFF or disable any system that may put a load on the vehicles battery. Turn OFF or disable systems such as:
    - ◊ Heating, ventilation, and air conditioning (HVAC) systems
    - ◊ Headlights
    - ◊ Room lights
    - ◊ Accessory equipment
- The ignition switch is in the proper position. The scan tool prompts you to turn ON the ignition, with the engine OFF. DO NOT change the position of the ignition switch during the programming procedure unless instructed to do so.
- All tool connections are secure:
  - The RS-232 cable
  - The connection at the DLC
  - The voltage supply circuits
- DO NOT disturb the tool harnesses while programming. If an interruption occurs during the programming procedure, programming failure or TCM damage may occur.
- If you are performing the Pass-Thru programming procedure using a notebook computer without the power cord, ensure that the internal battery is fully charged.

Service Programming System (SPS) (Remote Procedure)

Notice: Some module will not accept SPS remote procedure using 10MB PCMCIA card. In such case, use 32MB PCMCIA card or SPS pass-thru procedure.

The Remote SPS method is a three-step process that involves the following procedures:

1. Connecting the scan tool to the vehicle and obtaining the information from the TCM.
2. Connecting the scan tool to the terminal and downloading a new calibration file from the terminal into the scan tool memory.
3. Reconnecting the scan tool to the vehicle and uploading the new calibration file into the TCM.

Performing the Remote Procedure

1. Connect a scan tool to the vehicle and obtain the TCM information using the following procedure:

Notice: Ensure the TCM is installed in the vehicle and the battery is fully charged before programming.

   a. Install a scan tool.
   b. Turn ON the ignition, with the engine OFF.
   c. Select Service Programming System (SPS) > Request Info.

d. If there is already stored in the scan tool, the existing data is displayed on the screen. The scan tool asks user to keep existing data "Keep Data" or "Continue" to request new vehicle information from the TCM. If there is no data in the scan tool, it will immediately start vehicle identification.
e. Select the vehicle description by following the on-screen instructions based on stamped VIN or affixed VIN plate on the vehicle.
f. During obtaining information, the scan tool is receiving information from all modules at the same time. But only ECM information is displayed on the screen.
g. Turn OFF all accessories and press "Okay".
h. Verify that the correct VIN is displayed on the scan tool. If the VIN is incorrect or no VIN, record the correct VIN.

2. Turn OFF the ignition.
3. Turn OFF the scan tool and disconnect from the vehicle.
4. Transfer the data from the terminal to the scan tool using the following procedure:

Notice: The TIS supports service programming with the Tech 2 scan tool only.

a. Connect the scan tool to the terminal.
b. Launch the TIS application.
c. Select the Service Programming System at the main screen.
d. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next".
   - Select Diagnostic Tool - Tech 2
   - Select Programming Process - Identify whether an existing TCM is being reprogrammed or a TCM is being replaced with a new one
   - Select ECU Location - Vehicle
e. Verify the connections on the Preparing for Communication screen, then click "Next".
f. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click "Next".

Notice: If the TCM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the TCM from another vehicle is installed, input correct VIN by same way.

g. Highlight Transmission on the Select System Type screen, then click "Next", if on-screen instruction displayed.
h. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until "Next" is highlighted, then click "Next".
   - Model
   - Model year
   - Engine type
   - Model designator
   - Destination code
   - Transmission type
i. Verify your selection on the Summary screen.

Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.

Notice: Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the TCM and reprogramming with the same download is not allowed.

j. Click "Reprog".
k. The Transfer Data screen will appear until the progress bar reaches 100%.

5. Close the application and return to the TIS application selection screen after the download is completed.
6. Turn OFF the scan tool and disconnect from the terminal.
7. Transfer the data from the scan tool to the TCM using the following procedure:

a. Install a scan tool.
b. Turn ON the ignition, with the engine OFF.
c. Select Service Programming System (SPS) > Program ECU.
d. Turn OFF all accessories and press "Continue".
e. Programming in Process will appear until the progress bar reaches 100%.

Notice: Some warning lamp may turn ON or blink while programming the TCM since communication between the TCM and other modules are interrupted. Clear DTC in any module after programming.

f. Press "Continue" and exit the program after the scan tool displays "Programming Was Successful".

8. Turn OFF the ignition.
9. Turn OFF the scan tool and disconnect from the vehicle.

Service Programming System (SPS) (Pass-Thru Procedure)

Pass-Thru programming allows the scan tool to remain connected to the terminal and to the vehicle throughout the programming process. The vehicle must be in close proximity to the terminal while using Pass-Thru.

1. Launch the TIS application.
2. Select the Service Programming System at the main screen.
3. Highlight the following information on the Select Diagnostic Tool and Programming Process screen, then click "Next":
   - Select Diagnostic Tool-Select Pass - Thru

- Select Programming Process - Identify whether as existing TCM is being reprogrammed or an TCM is being replaced with a new one.
- Select ECU Location - Vehicle

4. Complete all vehicle data on the Preparing for Communication/ Determine Vehicle screen until “Next” is highlighted, then click “Next”.
5. Follow the instruction on the Preparing for Communication screen, then click “Next”.

Notice: In order to reduce the potential for signal loss, the RS-232 cable should not be more than 25 feet long.

6. Verify the VIN on the Validate Vehicle Identification Number (VIN) screen, then click “Next”.

Notice: If the TCM is replaced to new one, VIN does not displayed. Input correct VIN reading from stamped VIN or affixed VIN plate on the vehicle. If the TCM from another vehicle is installed, input correct VIN by same way.

7. Highlight Transmission on the Select System Type screen, then click “Next”, if on-screen instruction displayed.
8. Complete the following information based on the service ID plate on the Validate Vehicle Data screen until “Next” is highlighted, then click “Next”.
   - Model
   - Model year
   - Engine type
   - Model designator
   - Destination code
   - Transmission type
9. Verify your selection on the Summary screen.

Notice: Refer to Service Bulletin and Description column before service programming is performed if the bulletins are listed along with the calibration files.

Notice: Select Cancel if you receive a message stating that the calibration selected is already the current calibration in the TCM and reprogramming with the same download is not allowed.

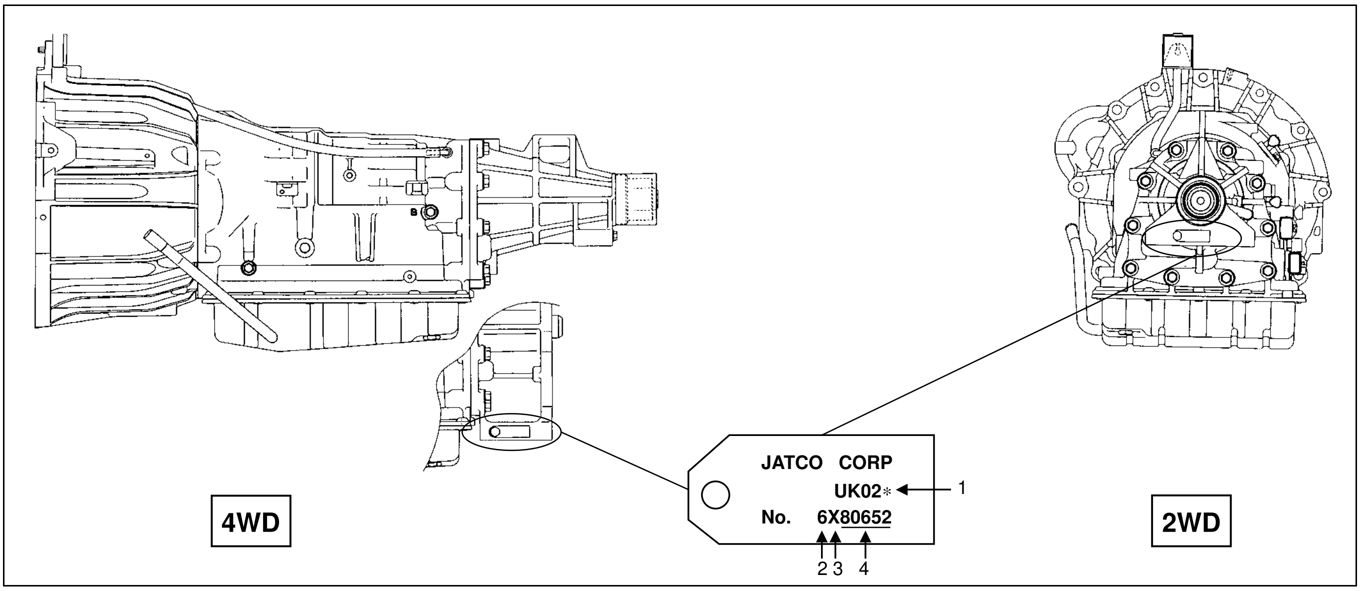
10. Click “Reprog”.
11. The Transfer Data screen will appear until the progress bar reaches 100%.

Notice: Some warning lamp may turn ON or blink while programming the TCM since communication between the TCM and other modules are interrupted. Clear DTC in any module after programming.

12. Close the application and return to the TIS application selection screen after the download is completed.
13. Turn OFF the ignition.
14. Turn OFF the scan tool and disconnect from the vehicle.

Description and Operation

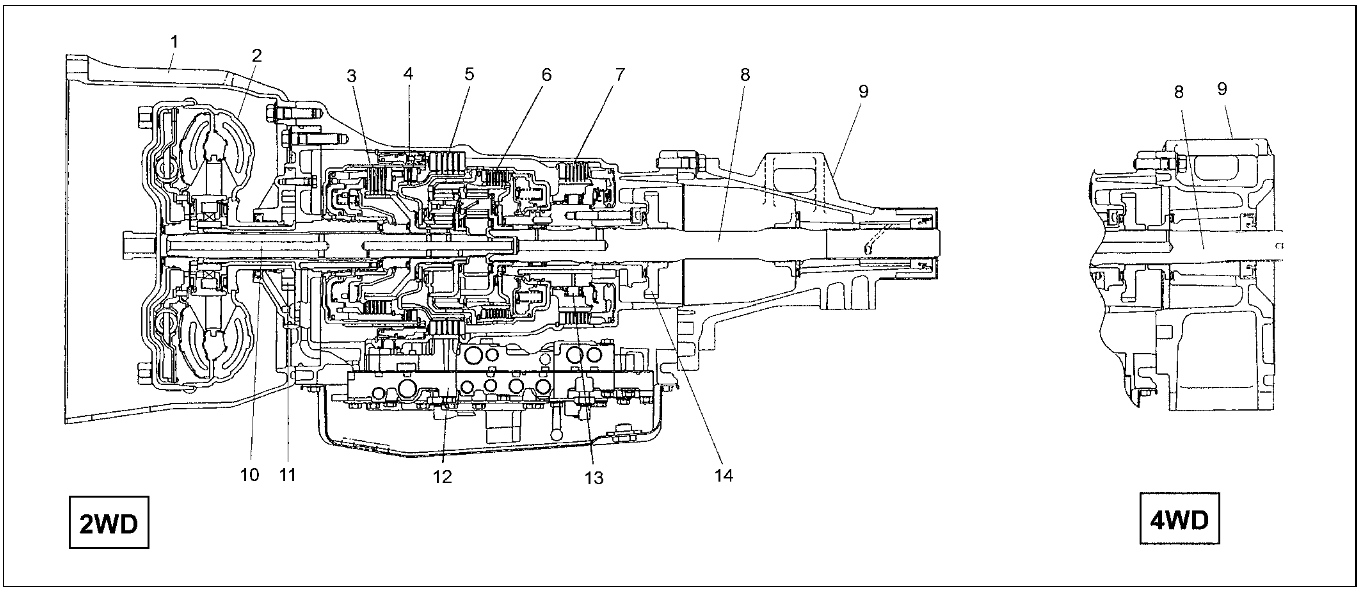
Transmission Identification Information



Legend

1. Drive train type (UK020= 2WD/ UK021= 4WD)
2. Production calendar year (6=2006/ 7= 2007/ 8= 2008)
3. Production month (1 - 9= January - September/ X= October/ Y= November/ Z= December)
4. Sequential number

Transmission General Description



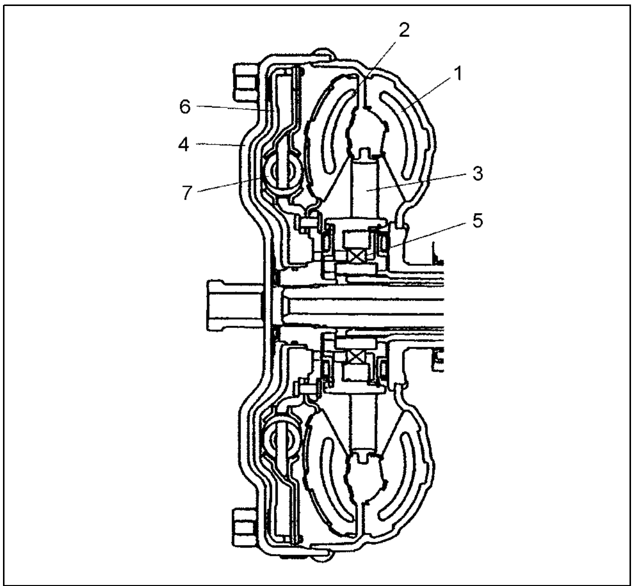
Legend

1. Torque converter housing
2. Torque converter
3. High clutch
4. Reverse clutch
5. 2-4 brake
6. Low clutch
7. Low & reverse brake
8. Output shaft
9. Extension housing
10. Input shaft
11. Oil pump
12. Valve body
13. Low one-way clutch
14. Parking gear

The JR405E automatic transmission is electrically controlled by a transmission control module (TCM). There are four forward speeds and one reverse speed. This JR405E automatic transmission employs a clutch pressure direct control system (Direct Electronic Shift Control: DESC) using duty cycle type solenoid valves, which ensure high shift quality. This transmission also has a learning function and constantly checks the time of each clutch and brake required for the shift in order to match this time with the target value for the optimum shift. The TCM will automatically select the most appropriate shift points and lock-up points depending on the accelerator pedal opening, the vehicle speed and the vehicle load. If any trouble arises in the speed sensor, solenoid valve, etc., the fail-safe control function is activated to keep the running performance.
The JR405E automatic transmission consists of the torque converter, oil pump, input shaft, out put shaft, planetary gears and valve body. The gear train consists of two planetary gear sets and three multiple plate clutches in combination with two multiple plate brakes and a one-way clutch.

Transmission Component Description

Torque Converter



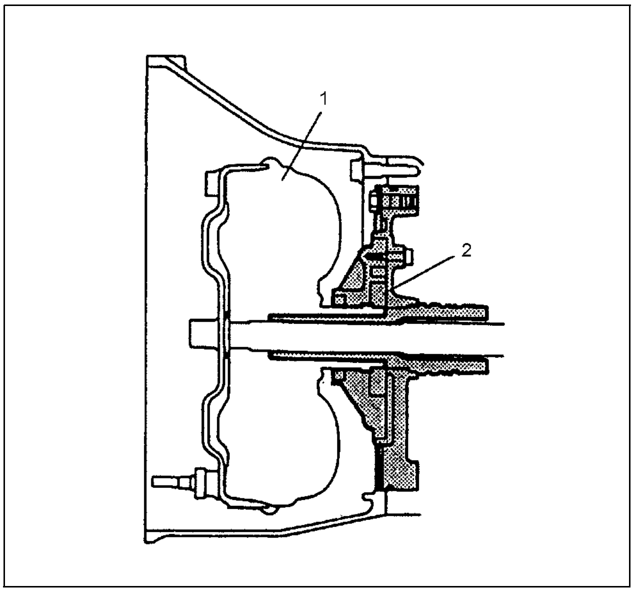
Legend

1. Pump impeller
2. Turbine runner
3. Stator
4. Converter front cover
5. One-way clutch
6. Torque converter clutch (TCC) piston
7. Torsion damper

The torque converter is a device for transmitting the engine torque to the transmission. It transmits power by means of oil when the lock up clutch is disengaged, and by means of a lock up clutch when it is engaged.

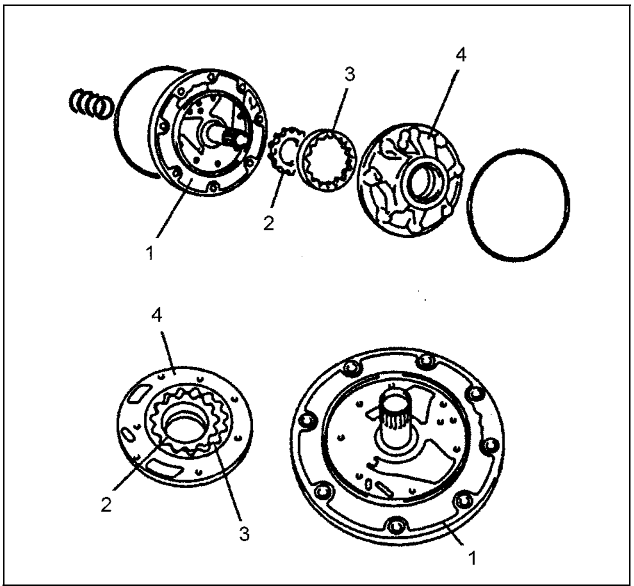
The torque converter is of the symmetrical, three-element, single-stage, two-phase type. As shown in the picture, the symmetrical three-elements refer to three elements (components) consisting of impeller (1), turbine (2) and stator (3) that are arranged symmetrically. Single-stage means that there is only one turbine as an output element; two-phase means that the pump impeller acts as a torque converter when the turbine speed is comparatively low, and as a fluid coupling when the speed is high. Lock up refers to a fixed state of the lock up clutch (=torque converter clutch (TCC) inside the torque converter and thus connects the engine directly to the transmission.

Oil Pump



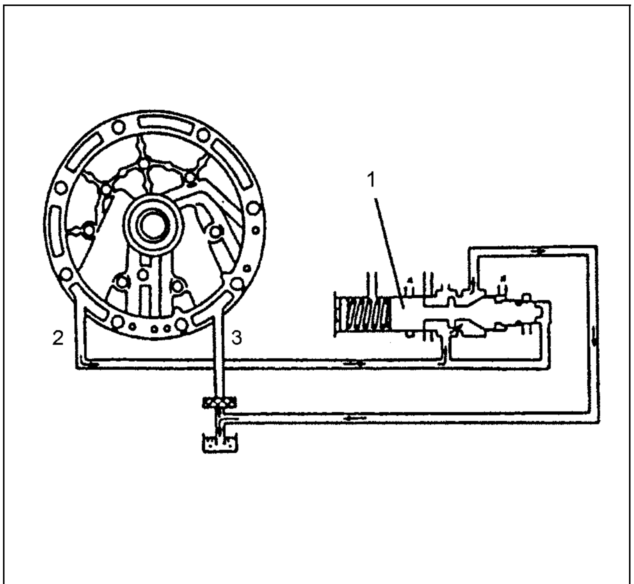
Legend

1. Torque converter
2. Oil pump



Legend
1. Oil pump cover
2. Inner rotor
3. Outer rotor
4. Oil pump housing

The oil pump generating oil pressure is a small sized trochoid gear type oil pump. It feeds oil to the torque converter, lubricates the power train mechanism, and feeds the oil pressure to the oil pressure control unit under pressure. The oil pump is located behind the torque converter. Since the inner rotor in the oil pump is fitted with the drive sleeve of the torque converter, it works using power from the engine.



Legend
1. Pressure regulator valve
2. Outlet
3. Inlet

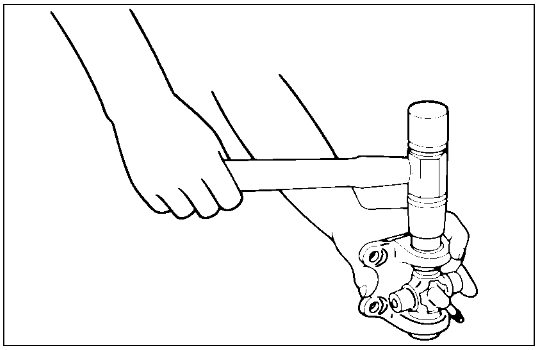
When the inner rotor in the oil pump rotates, transmission fluid is sucked in from the oil pan, passed between the inner rotor, outer rotor and crescent, and then discharged. This discharged pressure is sent to the pressure regulator valve in the valve body, and adjusted as required for operating the transmission. The flow rate under pressure increases or decreases in proportion to the number of rotations.

Input Shaft

The input shaft has some oil holes, through which lubricating transmission fluid is supplied to the torque converter, the bearings, etc. The input shaft is fitted to the turbine runner in the torque converter, the reverse & high clutch drum and the rear sun gear by means of the spline. Therefore, the engine driving force received by the torque converter is transmitted to the reverse & high clutch drum and rear sun gear.

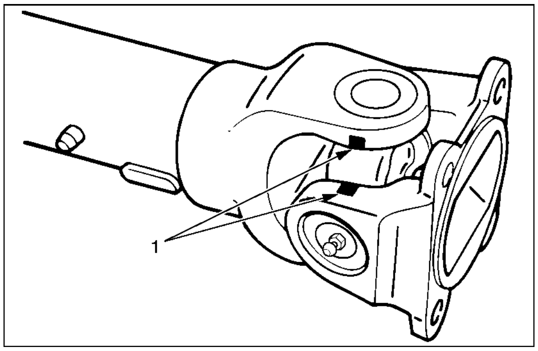
Output Shaft

The output shaft has some oil holes, through which the lubricating transmission fluid is supplied to the bearings, the planetary gear unit, etc. The output shaft transmits the engine driving force from the planetary gear to the propeller shaft. The front internal gear is fitted with the rear carrier assembly by spline. The parking gear is also fitted by spline. By fixing this gear mechanically, the output shaft is fixed as required when parking the vehicle.


401RS012

3. Using either a mallet (or copper hammer) or a press, install the needle roller bearing into the yoke so that the snap ring can be installed in its groove.

CAUTION:
The needle roller bearing cannot be installed smoothly if it is set at an incorrect angle with the flange and excessive hammering will damage the needle roller bearing.



401RS028

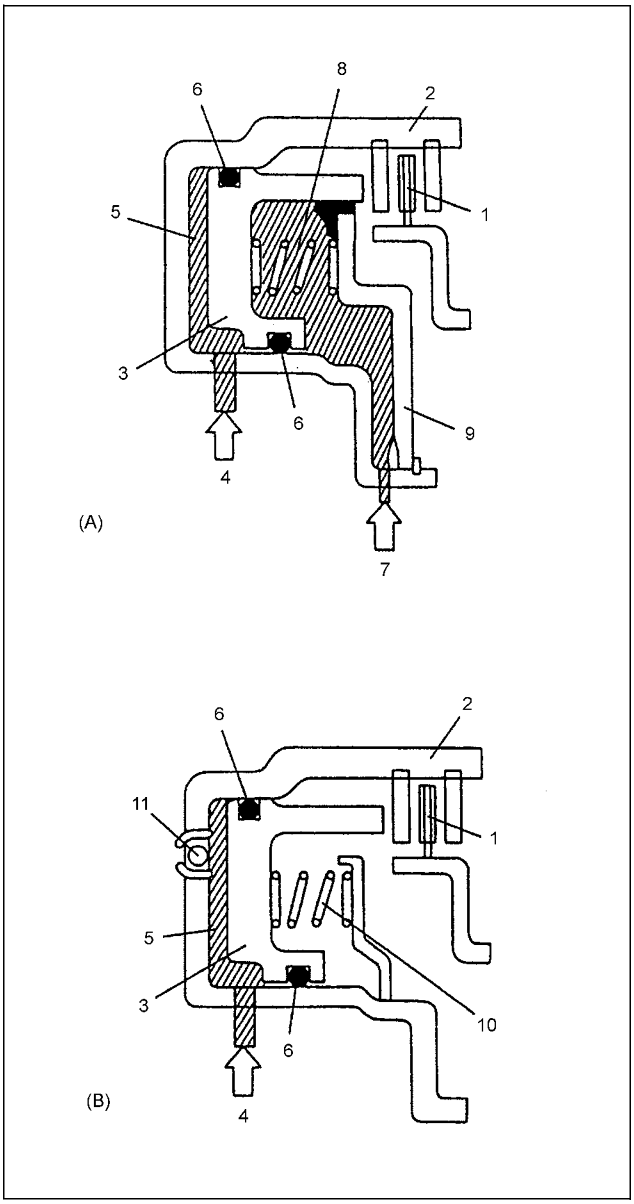
4. Align setting marks (1) and join the yokes.
5. Install snap ring.

NOTE:
Discard used snap rings and install new ones.
When the bearing cap is in position, select and attach a snap ring of suitable thickness so that the end play of the spider pin is held within 0.1 mm (0.004 in).

Snap ring thickness and Identification color
1.50 mm (0.059 in); Light Blue
1.53 mm (0.060 in); White
1.56 mm (0.061 in); Pink
1.59 mm (0.063 in); Yellow
1.62 mm (0.064 in); Green
1.65 mm (0.065 in); Brown
1.68 mm (0.066 in); Not colored

NOTE:
Be sure to use snap rings of the same thickness on both sides.

Low Clutch, High Clutch and Reverse Clutch



Legend

1. Clutch
2. Clutch drum
3. Clutch piston
4. Clutch fluid pressure
5. Clutch chamber
6. Oil seal
7. Lunrication circuit
8. Centrifugal balance chamber
9. Centrifugal cancel cover
10. Return spring
11. Piston check ball

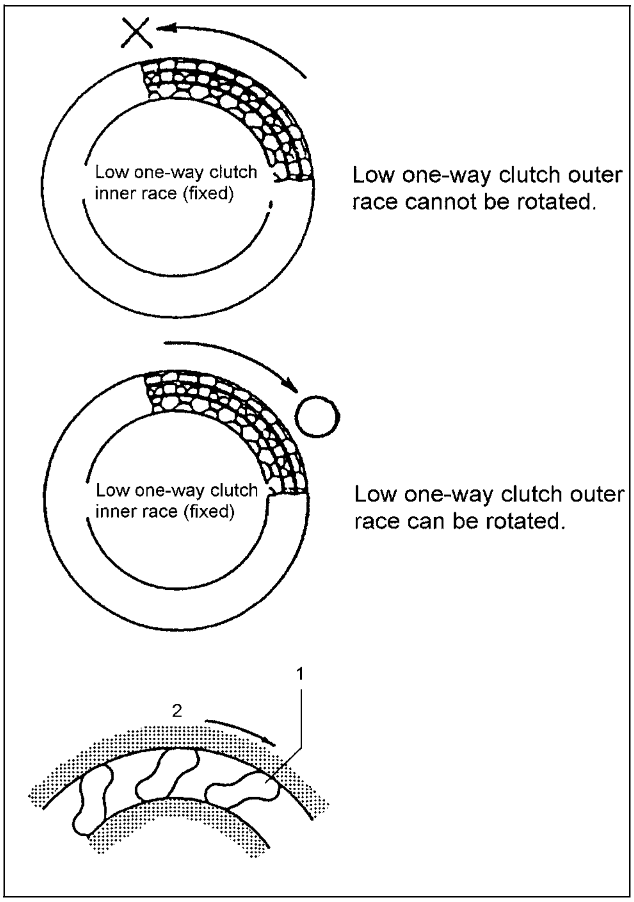
The multi-plate clutch is composed of drive plates and driven plates. By applying the oil pressure onto the end surface of the plates, the clutch is engaged. The oil pressure is adjusted with the spool valves according to the signal from the TCM. All clutches use dish plates to prevent uncontrolled operation of the clutches when engaged, causing a shock.

For the low clutch and high clutch (A), a centrifugal balance chamber full of transmission fluid is provided to offset the excessive oil pressure. This prevents clutch drag caused by oil pressure generated by residual transmission fluid due to the centrifugal force while the clutch is racing (under no oil pressure).
For the reverse clutch (B), a piston check ball is used to release the oil pressure. This prevents clutch drag caused by oil pressure generated by residual transmission fluid due to the centrifugal force while the clutch is racing (under no oil pressure).
The solenoid valve in the valve body is driven based on the shift signal from the TCM, it moves the shift valve, thereby engaging the drive plate and driven plate through the piston of each clutch. As a result, elements of the planetary gear unit are combined. When the oil pressure is removed, the piston returns to the original position via the force of the return spring.

2-4 Brake and Low & Reverse Brake

The multi-plate brake is composed of drive plates and driven plates. By applying the oil pressure onto the end surface of the plates, the brake is engaged. The oil pressure is adjusted with the spool valve according to the signal from the TCM. All brakes use dish plates to prevent uncontrolled operation of the clutches when engaged, causing a shock.
The solenoid valve in the valve body is driven based on the shift signal from the TCM, it moves the shift valve, thereby engaging the drive plate and driven plate through the piston of each brake. As a result, rotation of each element of the planetary gear unit is fixed. When the oil pressure is removed, the piston returns to the original position via the force of the return spring.

Low One-way Clutch

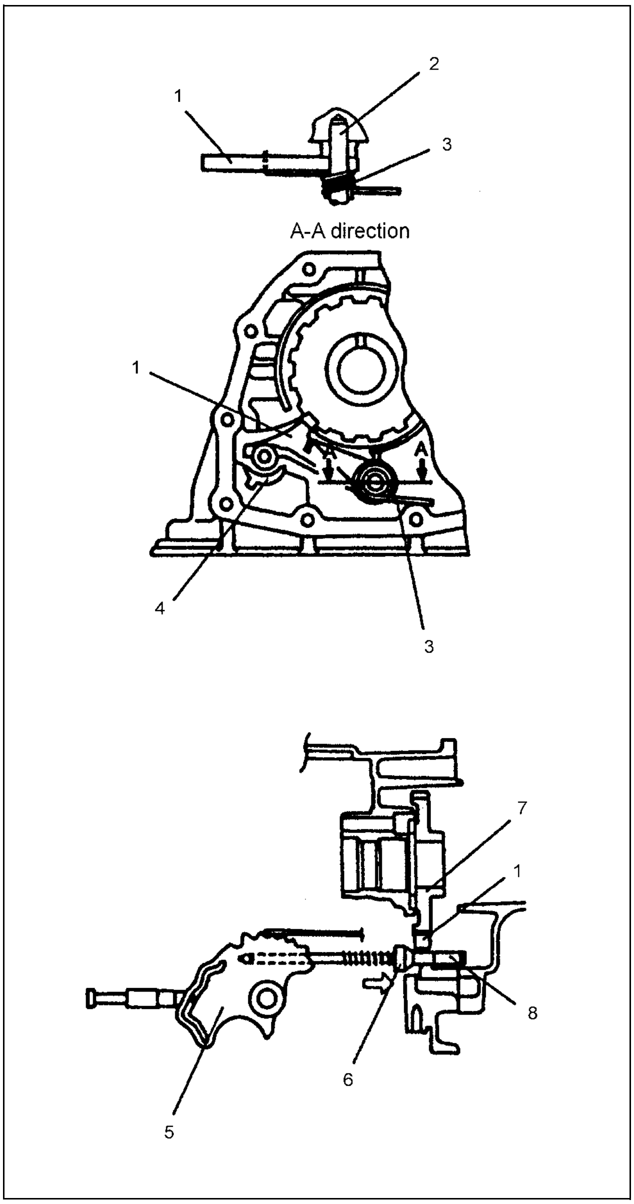


Legend

1. Sprag
2. Rotating direction

The low one-way clutch employs the sprag, which locks the counterclockwise rotation of the front planetary carrier and the rear internal gear. The one-way clutch outer race is fitted with the low clutch drum, and the inner race is fitted with the transmission case. The outer race rotates freely clockwise, but, when it attempts to rotate counterclockwise, the sprag locks the outer race. When the vehicle is traveling in 1st gear in the D, 3 or 2 position, the low one-way clutch locks the rear internal gear via the low clutch. It is left free in the 2nd, 3rd or 4th gear.

Parking Function

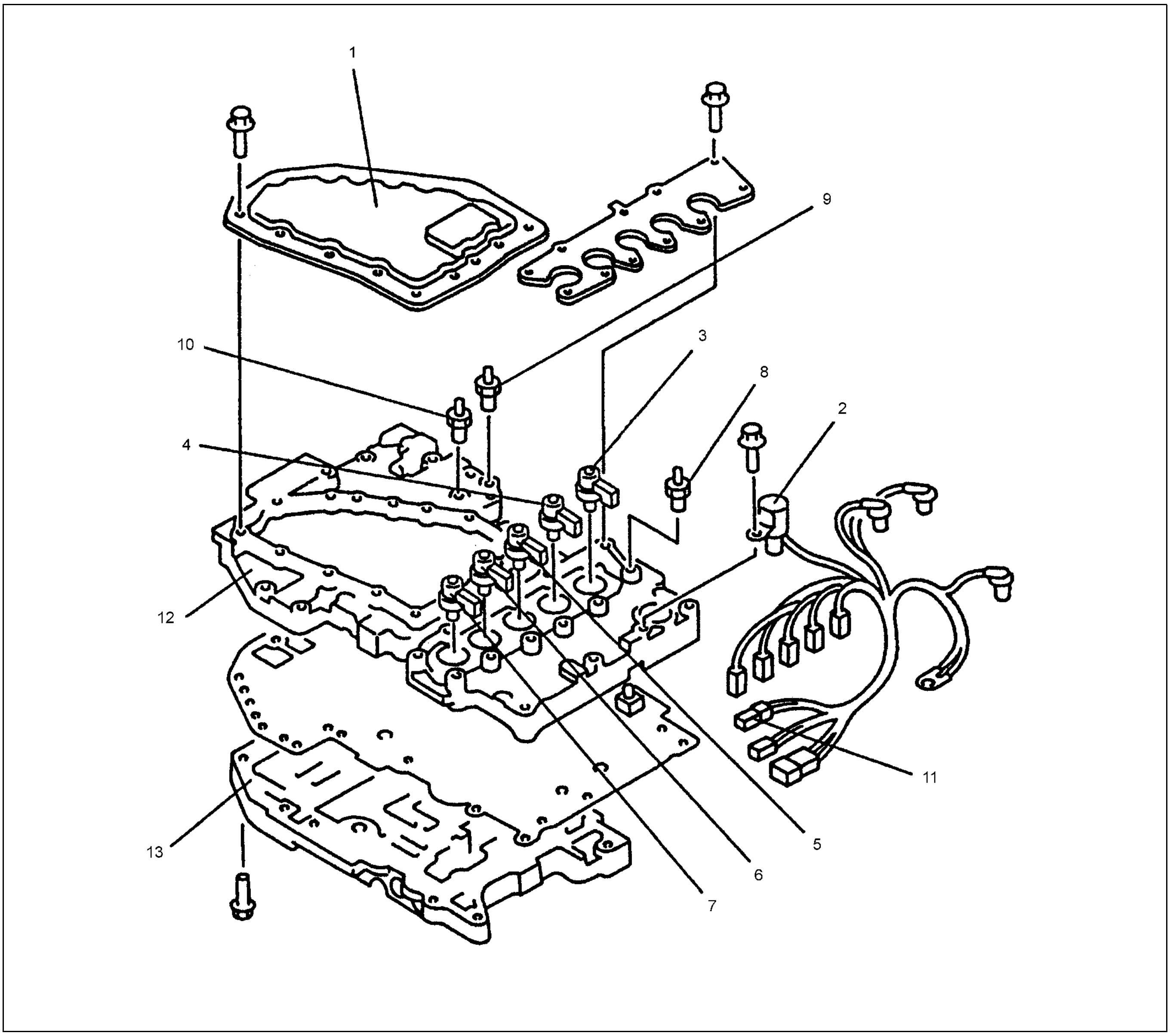


Legend

1. Parking pawl
2. Parking pawl shaft
3. Pawl return spring
4. Parking actuator support
5. Manual plate
6. Parking cam
7. Parking gear
8. Parking rod

By setting the selector lever to the P range, the parking pawl is engaged with the parking gear and fixes the output shaft. By moving the selector lever, the manual shaft on the right side of the transmission is moved. The manual plate and parking rod in the transmission is interlocked with the manual shaft. When the manual shaft moves, the parking rod end pushes up the parking pawl. The parking pawl is engaged with the parking gear when pushed up, and fixes the output shaft. When the parking is disengaged, it returns to the original position via the force of the return spring.

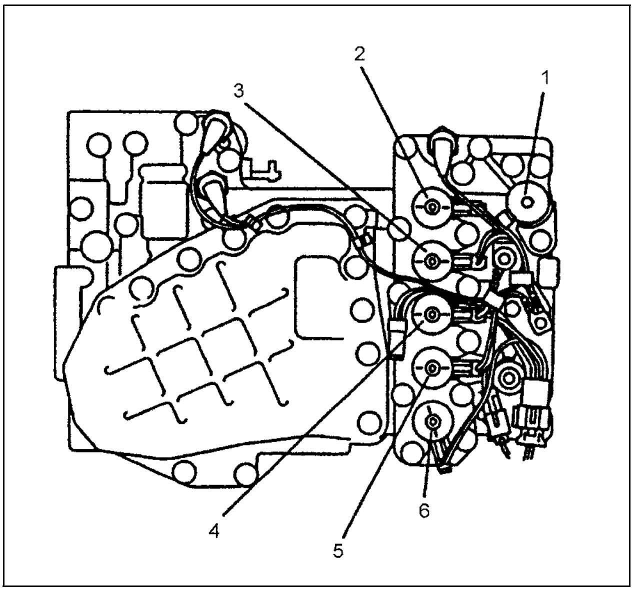
Valve Body Assembly



Legend

1. Oil filter
2. Pressure control (PC) solenoid valve
3. Low & reverse brake solenoid valve
4. High clutch solenoid valve
5. Torque converter clutch (TCC) solenoid valve
6. 2-4 brake solenoid valve
7. Low clutch solenoid valve
8. Low & reverse brake transmission fluid pressure (TFP) switch
9. High clutch TFP switch
10. 2-4 brake TFP switch
11. Transmission fluid temperature (TFT) sensor
12. Lower body
13. Upper body

Employing the direct electronic control (Direct Electronic Shift Control: DESC) for the clutch pressure has simplified the oil pressure circuit, reduced the number of functional components and made the control valve compact. The control valve body is divided into the upper body and the lower body. All solenoid valves, the transmission fluid pressure (TFP) switch and the transmission fluid temperature (TFT) sensor are installed to the lower body. Three-way valve type solenoid valves providing high responsibility are employed. The pressure control (PC) solenoid valve is switched between ON and OFF, and other solenoid valves repeat ON and OFF at 50Hz (duty cycle). When the solenoid valve is driven based on the signal from the TCM, the fluid pressure is changed.



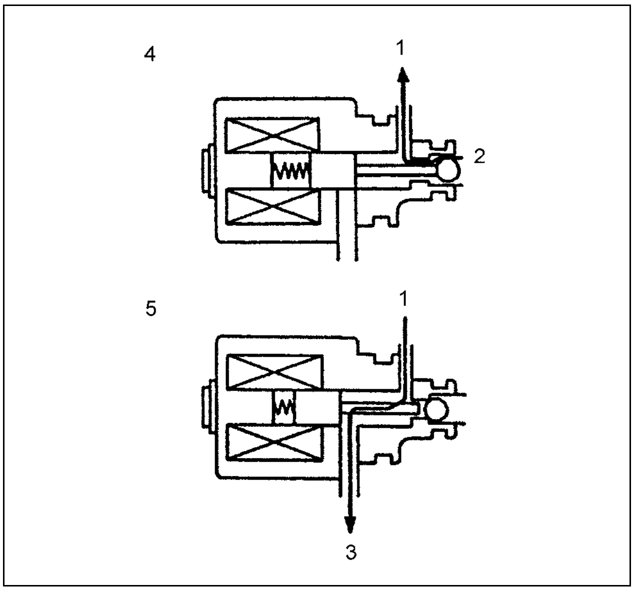
Legend

1. Pressure control (PC) solenoid valve
2. Low & reverse brake solenoid valve
3. High clutch solenoid valve
4. Torque converter clutch (TCC) solenoid valve
5. 2-4 brake solenoid valve
6. Low clutch solenoid valve

Pressure Control (PC) Solenoid Valve

The pressure control (PC) solenoid valve controls the transmission fluid supply to the pressure regulator spool valve in the valve body. The TCM controls the solenoid valve by ON/ OFF signal based on the vehicle running conditions. The TCM turns ON the solenoid valve when a lower line pressure is required and turns OFF when a higher line pressure is required. With the operation of this solenoid valve, the operation and shift of the hydraulic circuit in the transmission can be performed smoothly. The PC solenoid valve is controlled according to the range position, speed sensor signals, transmission fluid temperature signal and the accelerator pedal position signal.

Shift Solenoid Valve

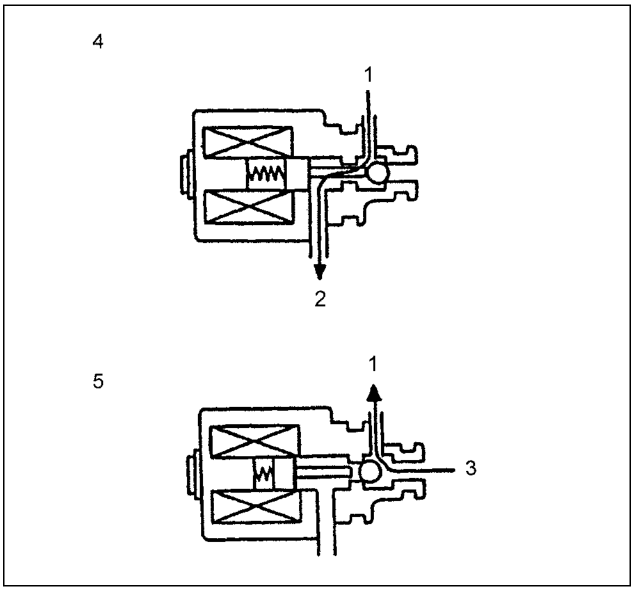


Legend

1. Output port
2. Supply port
3. Drain port
4. Deenergized (commanded OFF)
5. Energized (commanded ON)

All shift solenoid valve is a duty cycle type, which is turned ON and OFF at 50 Hz. The ration of ON and OFF time can be freely controlled within 0 to 100%. While no power is supplied, the solenoid valve supplies output pressure. The low clutch solenoid valve adjusts the low clutch pressure, the high clutch solenoid valve adjusts the high clutch pressure, the 2-4 brake solenoid valve adjusts the 2-4 brake pressure, and the low & reverse brake solenoid valve adjusts the low & reverse brake pressure respectively.

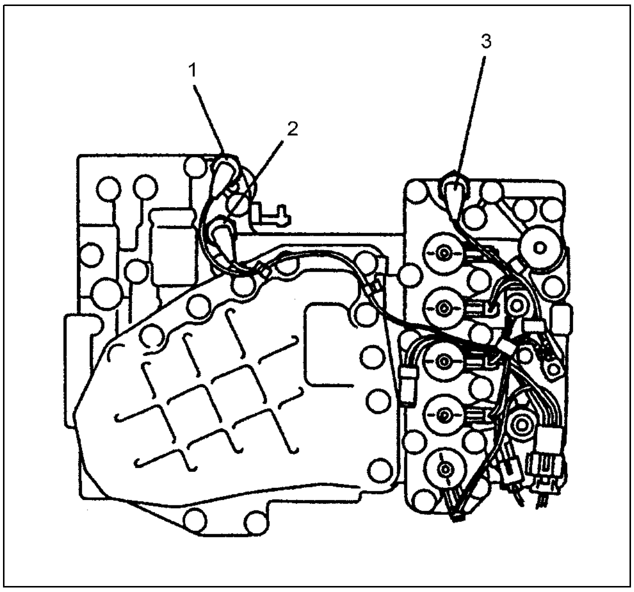
Torque Converter Clutch (TCC) Solenoid Valve



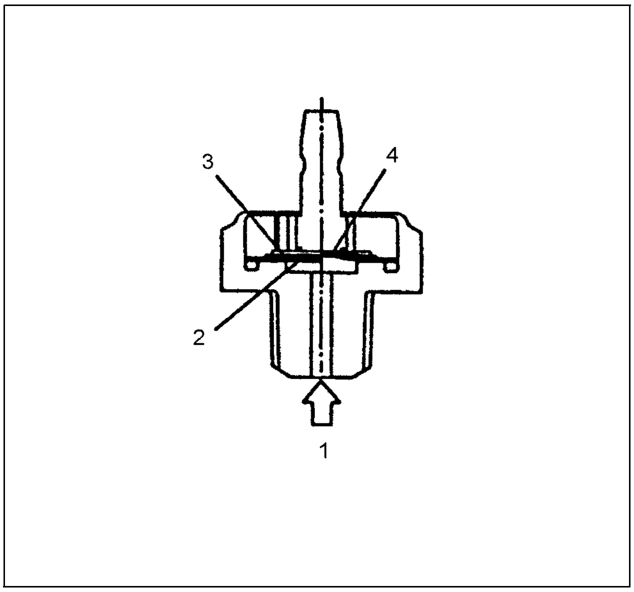
Legend
1. Output port
2. Drain port
3. Supply port
4. Deenergized (commanded OFF)
5. Energized (commanded ON)

The torque converter clutch (TCC) solenoid valve is a duty cycle type, which is turned ON and OFF at 50 Hz. The ration of ON and OFF time can be freely controlled within 5 to 95%. While no power is supplied, the solenoid valve drains the output pressure.

Transmission Fluid Pressure (TFP) Switch



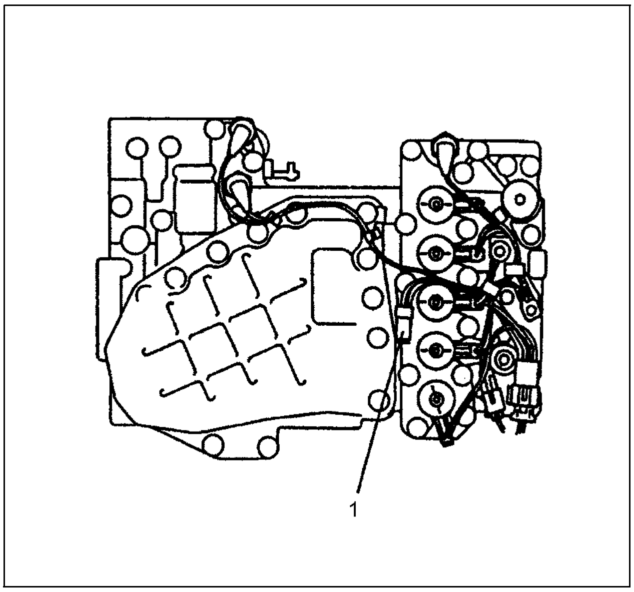
Legend
1. High clutch TFP switch
2. 2-4 brake TFP switch
3. Low & reverse brake TFP switch



Legend
1. Fluid pressure
2. Diaphram
3. Disc
4. Contact point

The transmission fluid pressure (TFP) switch detects the condition of the fluid pressure supply to the clutch and brake, and then sends the result to the TCM. The TFP switch is turned ON when the fluid pressure reaches the switch working pressure, and turned OFF when the fluid pressure decreases below the specified value. The high clutch TFP switch detects the high clutch fluid pressure, the 2-4 brake TFP switch detects the 2-4 brake fluid pressure, and the low & reverse brake TFP switch detects the low & reverse brake fluid pressure respectively.

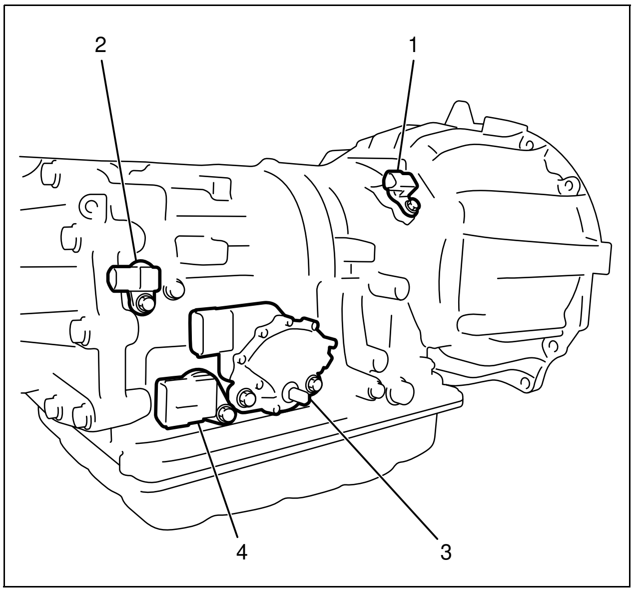
Transmission Fluid Temperature (TFT) Sensor



Legend
1. TFT sensor

The transmission fluid temperature (TFT) sensor is part of the harness assembly. The sensor is a variable resistor and it measures the temperature of the transmission fluid. When the TFT sensor is cold, the sensor resistance is high. When the transmission fluid temperature increases, the sensor resistance decreases. With high sensor resistance, the TCM detects a high voltage on the signal circuit. With lower sensor resistance, the TCM detects a lower voltage on the signal circuit.
If the fluid temperature increases to 135°C (275°F), the TCM illuminates A/T Oil Temp lamp on the instrument panel cluster. When the fluid temperature deceases below 125°C (257°F), the lamp goes off.

Transmission Range (TR) Switch



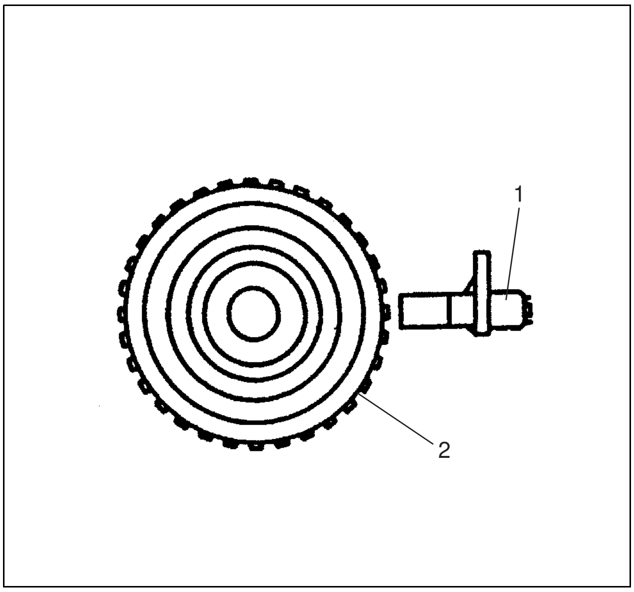
Legend

1. Input shaft speed (ISS) sensor
2. Output shaft speed (OSS) sensor
3. TR switch
4. In-line harness connector

	10	7	3	2	4	8	5	1	9	6
P	○	○	○	○						
R			○	—	○					
N	○	○	○	—	—	○				
D			○	—	—	—	○			
3			○	—	—	—	—	○		
2			○	—	—	—	—	—	○	
L			○	—	—	—	—	—	—	○

The transmission range (TR) switch is connected to the transmission manual shaft and installed externally to the transmission case. The selector lever moves the TR switch position via control cable. The TR switch relays a signal to the TCM indicating transmission range position by detecting ignition voltage through an internal switch. Only one of the seven internal switches will close for each P, R, N, D, 3, 2 and L position. Normally, the TCM expects to detect one high voltage input for each position.
The engine will not crank when the selector lever is at any position other than the P or N range.

Input Shaft Speed (ISS) Sensor

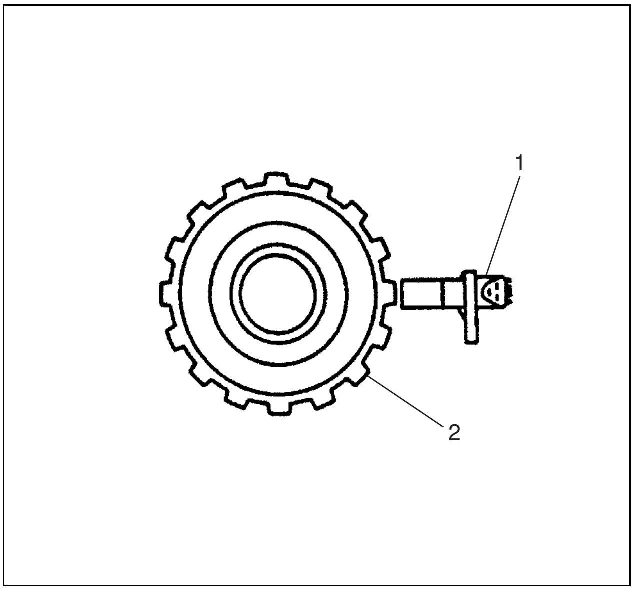


Legend

1. ISS sensor
2. Reverse & high clutch drum

The input shaft speed (ISS) sensor is located on right-hand of the transmission case. The ISS sensor is a hall effect element type sensor, which generates a square wave signal pulse based on the reverse & high clutch drum rotational speed (32 pulses per a rotation of the reverse & high clutch drum that is fitted with the input shaft by spline). The TCM calculates the turbine speed by the ISS sensor signal, and uses it to calculate torque converter slip speed and gear ratio.

Output Shaft Speed (OSS) Sensor



Legend

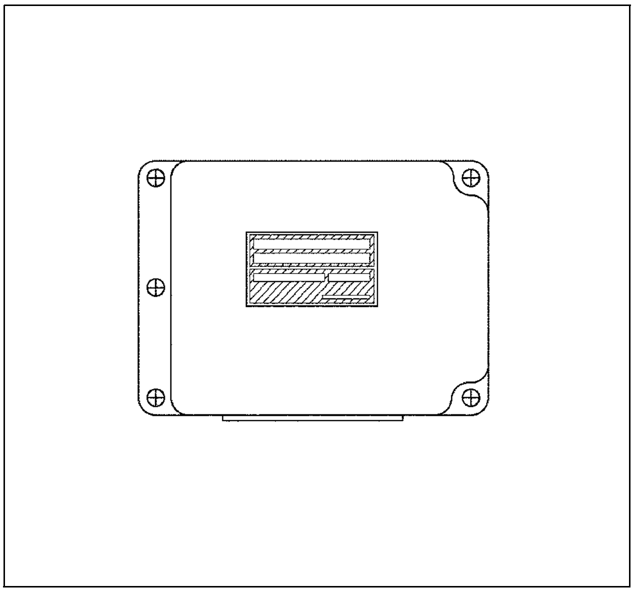
1. OSS sensor
2. Parking gear

The output shaft speed (OSS) sensor is located on right-hand of the transmission case near the transmission range switch. The OSS sensor is a hall effect element type sensor, which generates a square wave signal pulse based on the parking gear rotational speed that is connected to output shaft (16 pulses per a rotation of the parking gear that is fitted with the output shaft by spline). The TCM calculates the vehicle speed by the OSS sensor signal, and uses it to determine appropriate shift points and calculate gear ratio. The 2WD vehicle outputs the vehicle speed signal from the TCM to the engine control module (ECM) and the vehicle speed meter via output signal line.

Transmission Control System Description

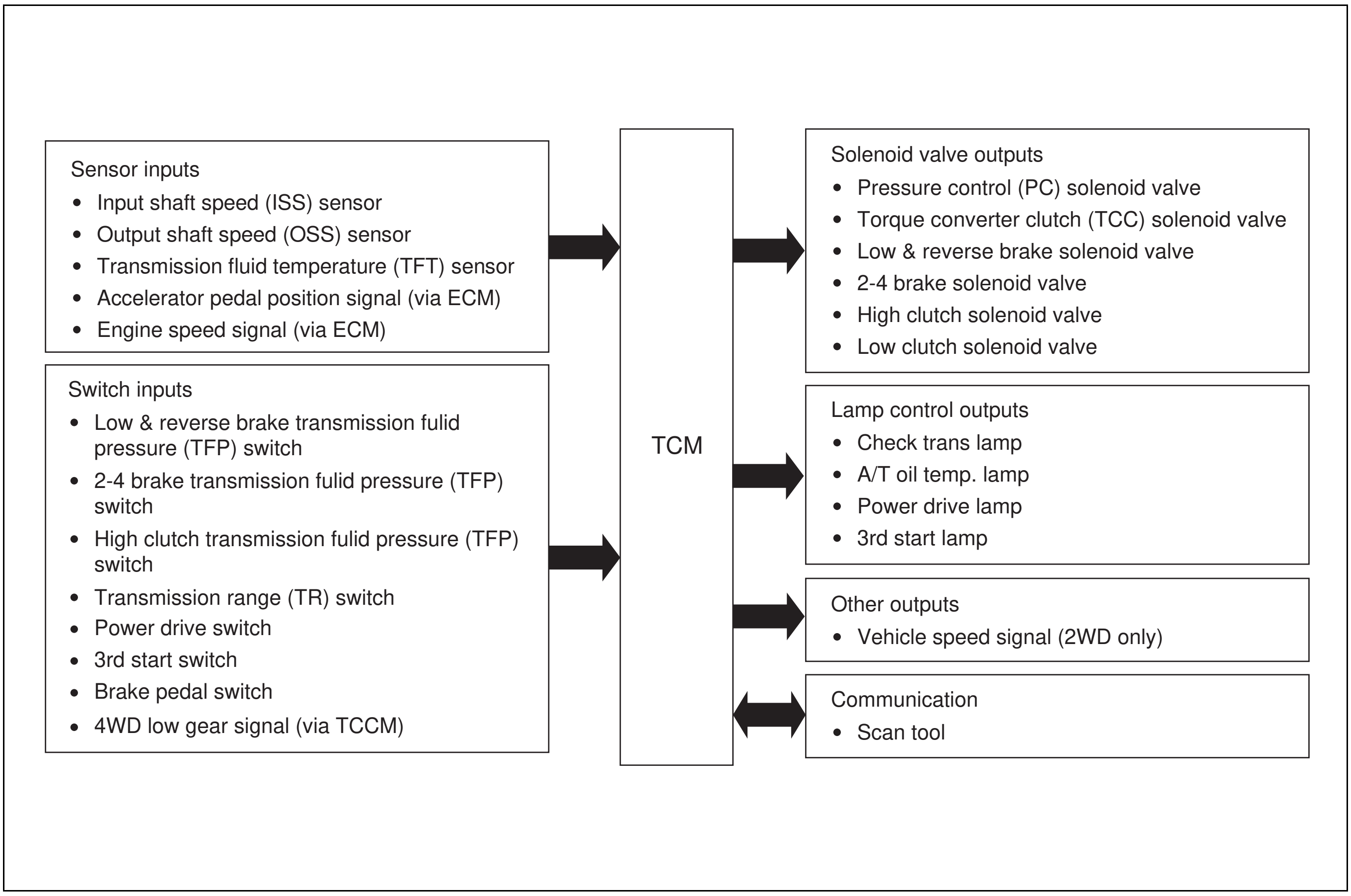
Transmission Control Module (TCM) Service Precautions

Important:
To avoid shock and possible serious injury, DO NOT touch the terminals. When disconnecting the harness connectors, always turn OFF the ignition switch or disconnect the battery cable.



The transmission control module (TCM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the TCM circuits unless instructed to do so. In some cases, these circuits should only be tested using a DMM. The TCM should remain connected to the TCM harness. The TCM is located next to brake pedal via mounting bracket. The TCM mainly controls the gearshift system control and on-board diagnostic for transmission control. The TCM constantly observes the information from various sensors. The TCM controls the systems that affect vehicle performance. The TCM performs the diagnostic function of the system. The TCM can recognize operational problems, alert the driver through the check trans lamp, and store diagnostic trouble codes (DTCs). DTCs identify the system faults to aid the technician in making repairs.

TCM Input & Output



TCM Voltage Description

The TCM supplies a buffered voltage to various switches and sensors. The TCM can do this because resistance in the TCM is so high in value that a test lamp may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megaohm input impedance DMM, to ensure accurate voltage readings. The input and/ or output devices in the TCM include analog-to-digital converters, signal buffers, counters, and special drivers. The TCM controls most components with electronic switches which complete a ground circuit when turned ON.

Electrostatic Discharge Damage

Electronic components used in the TCM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. By comparison, as much as 4,000 volts may be needed for a person to feel even the zap of a static discharge. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

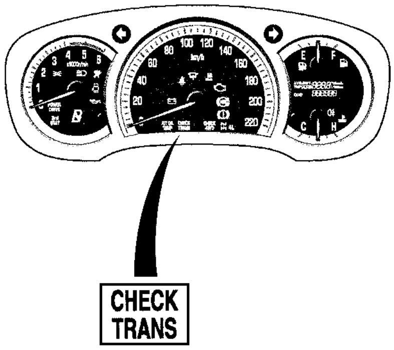
- An example of charging by friction is a person sliding across a vehicle seat.

Important: To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the TCM connector pins or soldered components on the TCM circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with opposite polarity.

Check Trans Lamp Operation

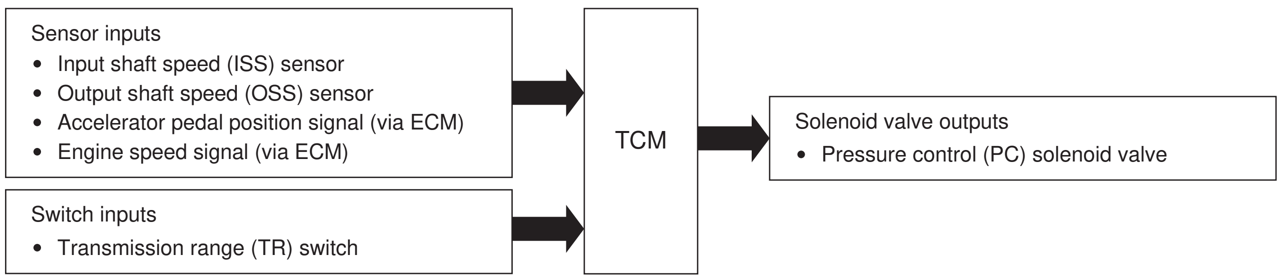
The check trans lamp is located in the instrument panel cluster.

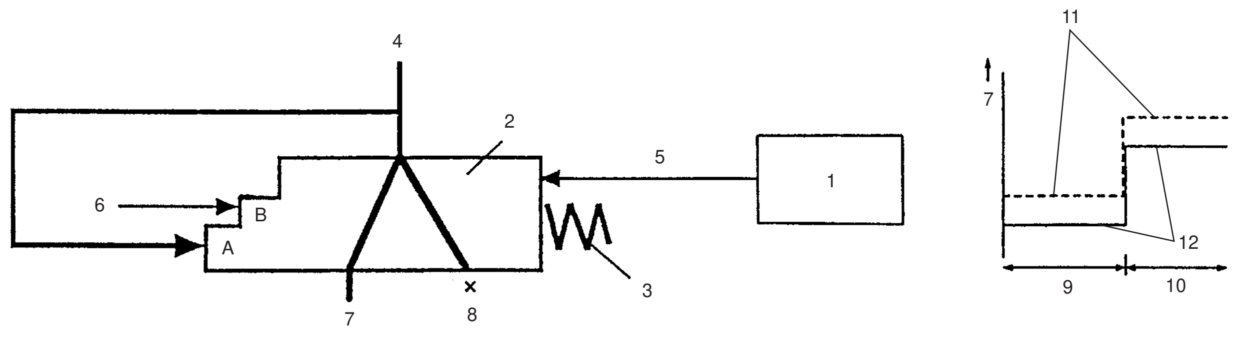


The check trans lamp indicates that a transmission related fault has occurred and vehicle service is required. The following is a list of the modes of operation for the check trans lamp:

- The check trans lamp illuminates for approximately 3 seconds when the ignition switch is turned ON, with the engine OFF. This is a bulb test to the check trans lamp is able to illuminate.
- The check trans lamp turns OFF after the engine is started if a diagnostic fault is not present.
- The check trans lamp remains blink after the engine is started if the TCM detects a fault. A DTC is stored any time the TCM blinks the check trans lamp due to a transmission related fault has occurred.

Line Pressure Control





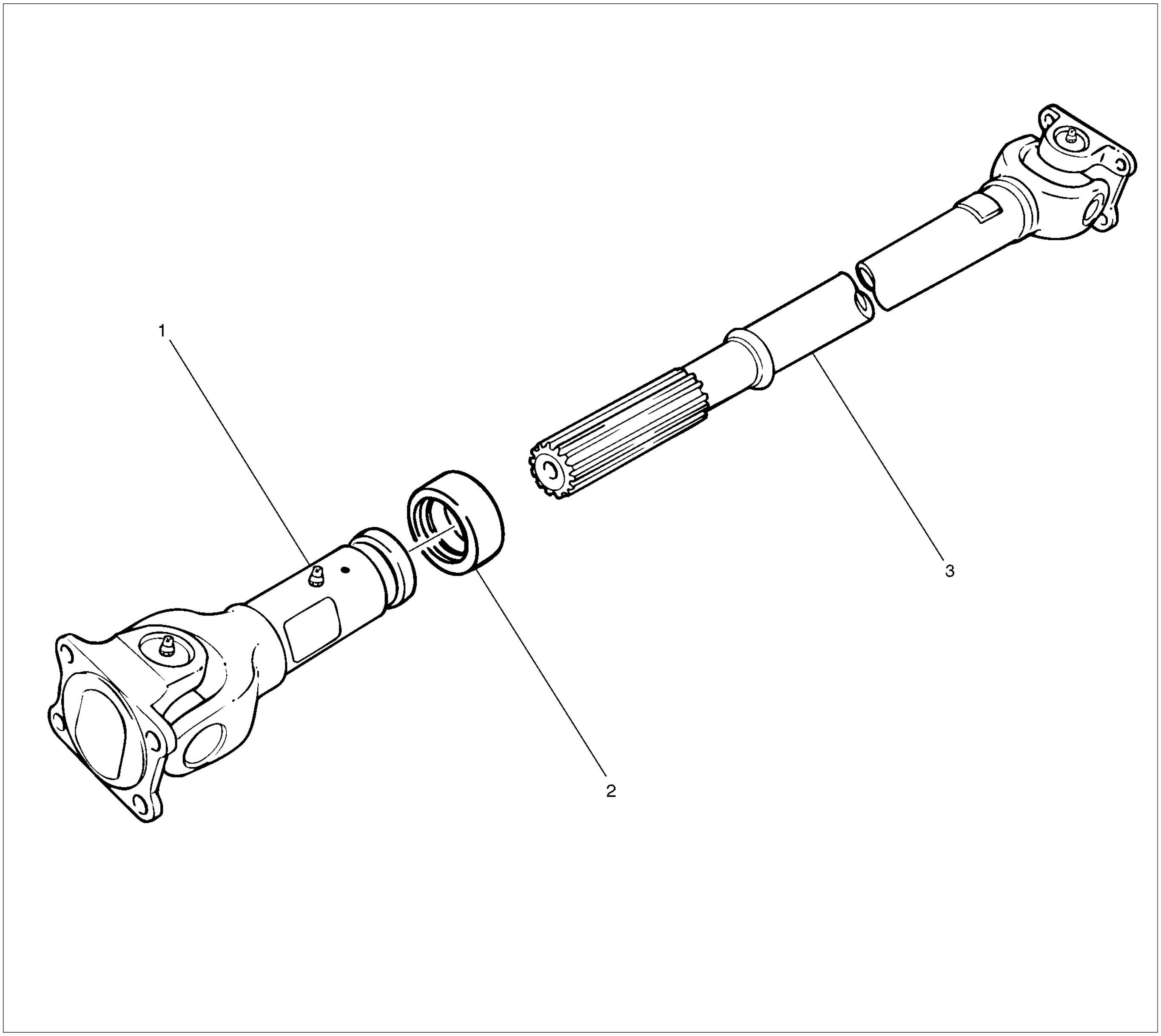
Legend

1. PC solenoid valve
2. Pressure regulator spool valve
3. Spring
4. Line pressure from oil pump
5. Solenoid fluid pressure
6. Line pressure in forward range
7. Adjusted line pressure
8. Drain
9. PC solenoid valve commanded ON
10. PC solenoid valve commanded OFF
11. Adjusted line pressure in P, N or R range
12. Adjusted line pressure in forward range

The TCM drives the ON/ OFF type pressure control (PC) solenoid valve based on the accelerator pedal angle, input shaft speed, output shaft speed, transmission fluid temperature and transmission range signal.

The line pressure generated by the oil pump acts on the point A of the pressure regulator spool valve. When the PC solenoid valve is turned ON by the signal from the TCM, the solenoid fluid pressure does not act. The line pressure is adjusted to match the spring force acting on the right side of the pressure regulator spool valve. When the PC solenoid valve is turned OFF, the solenoid fluid pressure acts so that the line pressure is adjusted to match the spring force acting on the right side of the pressure regulator spool valve. As a result, the line pressure is adjusted to be low when the PC solenoid valve is ON and to be high when the PC solenoid valve is OFF. In position D, 3, 2 and L, the line pressure through the oil pressure circuit acts onto the point B of the pressure regulator spool valve. The pressure regulator valve moves so as to increase the pressure to be drained, so that the line pressure is adjusted to be lower than the P, N, and R position by the difference of area at the point B.

Reassembly



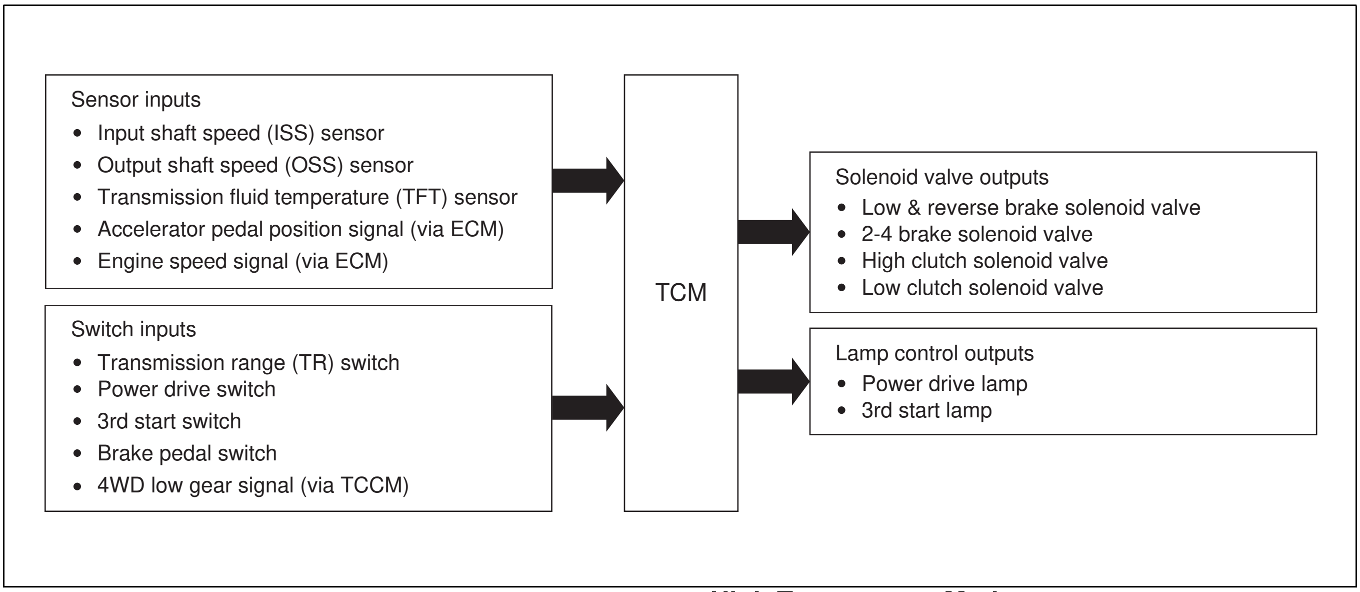
401RW057

Legend

1. Sleeve Yoke
2. Seal
3. Tube Assembly

1. Discard used seal and install new one.
2. Align the alignment marks and install tube assembly to sleeve yoke.

Gearshift Control & Shift Map Selection



The TCM commands each shift solenoid valve based on the traveling mode switch (power drive/ 3rd start), transmission range switch, the vehicle speed, the accelerator pedal angle and other input signals, to control the optimum gear position automatically. Shift features have been set up to the TCM as shift map; the normal mode is suited to normal travel, and the power mode is used when the vehicle is loaded or the speed accelerated. In addition, shift features used only for high transmission fluid temperature, hill climbing, and downward travel have been set up to the TCM. These are automatically switched depending on the driving conditions. When the transmission fluid temperature is lower than 10°C (50°F), gearshift from the 3rd to the 4th is inhibited.

Shift Map

The TCM selects either of the following shift map depending on the driving conditions.

Priority	Shift map	3rd start lamp	Power drive lamp
High	High temperature mode	OFF	OFF
	3rd start mode	ON	
	4L mode	OFF	
	Down slope mode when power drive SW Off		
	Down slope mode when power drive SW On		ON
	Power drive mode		
	Up slope mode		OFF
Low	Normal mode		

High Temperature Mode

Condition for setting the high temperature mode shift map;

- Transmission fluid temperature is more than 122°C (252°F) for 10 seconds.

Condition for canceling the high temperature mode shift map;

- Transmission fluid temperature is less than 115°C (239°F) for 10 seconds

Notice: High temperature mode may be set with driving conditions other than the setting condition met in order to protect from a thermal damage.

3rd Start Mode

Condition for setting the 3rd start mode shift map;
All of the following conditions are met:

- 3rd start switch is pressed
- Vehicle speed is less than 11 km/h (7 MPH)
- Transmission fluid is less than 115°C (239°F)
- Accelerator pedal position is less than 8%
- Selector lever is D range

Condition for canceling the 3rd start mode shift map;
Either of the following condition is met:

- 3rd start switch is pressed again
- Vehicle speed is more than 34 km/h (21 MPH)
- Selector lever is other than D range

4L Mode

Condition for setting the 4L mode shift map;
All of the following conditions are met:

- 4L switch is On
- Vehicle speed is more than 5 km/h (3 MPH)

Condition for canceling the 4L mode shift map;
Either of the following condition is met:

- 4L switch is On
- Vehicle speed is more than 5 km/h (3 MPH)

Down Slope Mode

Condition for setting the down slope mode shift map; All of the following conditions are met:

- Brake pedal switch is depressed
- Accelerator pedal is released
- Vehicle speed is more than 60 km/h (36 MPH)
- Increment of vehicle speed is more than 1 km/h (1 MPH) per second
- Selector lever is D or 3 range

Condition for canceling the down slope mode shift map; Either of the following condition is met:

- Accelerator pedal is depressed
- Selector lever is other than D or 3 range

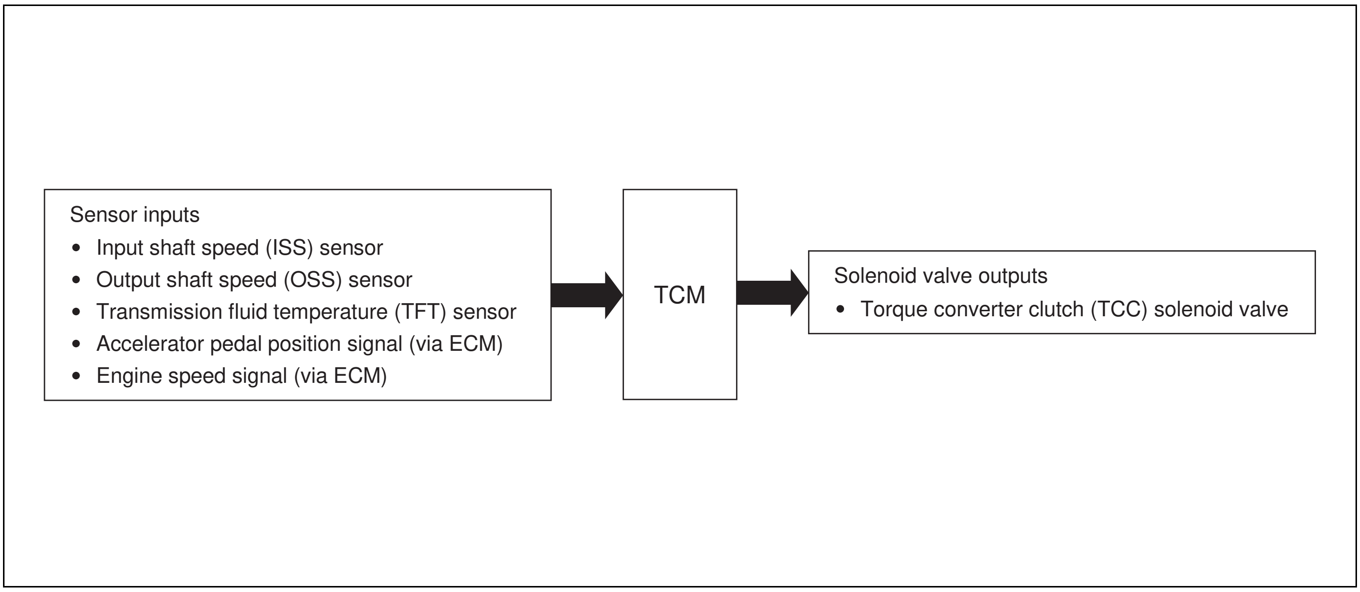
Power Drive Mode

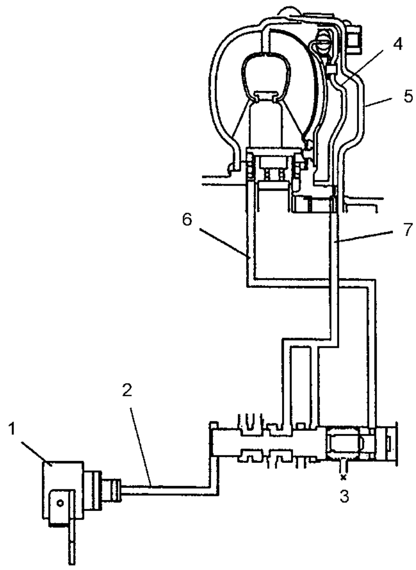
When the power drive switch is ON, the TCM switches shift map to the power drive mode map and performs gearshift control from 1st to 4th to gain more acceleration compared with normal mode.

Up Slope Mode

Up slope reasoning value is calculated from the averaged accelerator pedal angle and the averaged acceleration. Otherwise, up slope reasoning value is calculated from the vehicle speed. The TCM selects a up slope mode when the former is bigger than the latter.

Lock Up Control





Legend

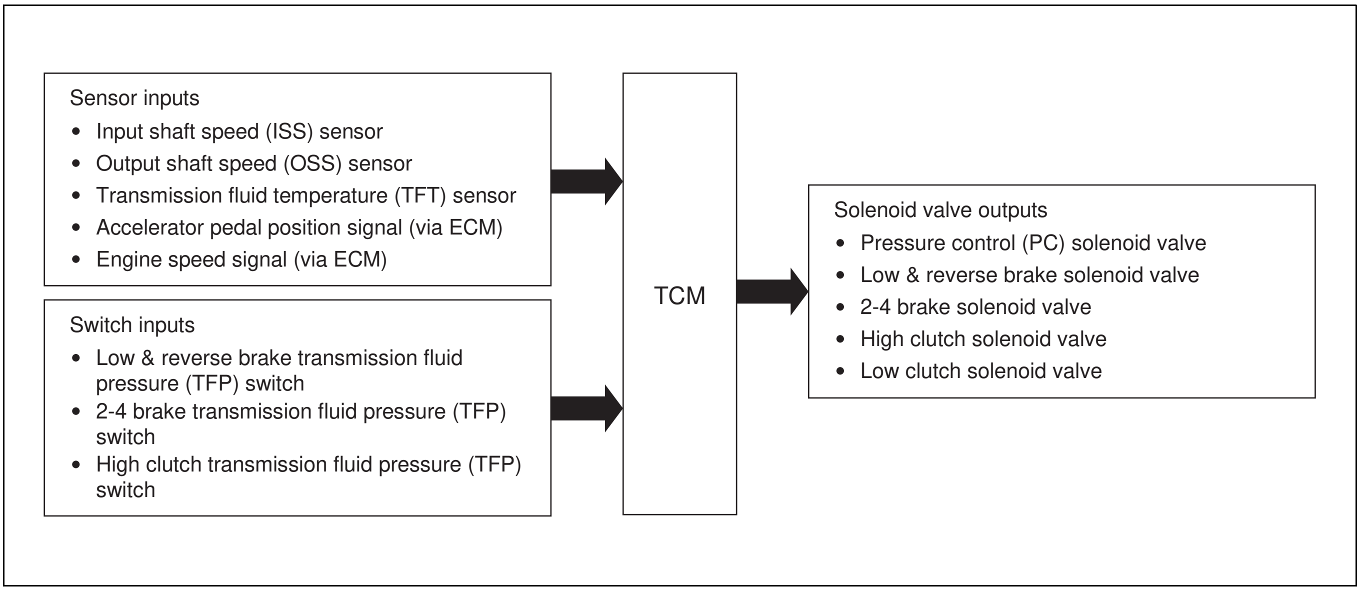
1. TCC solenoid valve
2. Solenoid fluid pressure
3. Lock up control spool valve
4. Torque converter clutch (TCC)
5. Torque converter front cover
6. TCC engagement fluid pressure
7. TCC disengagement fluid pressure

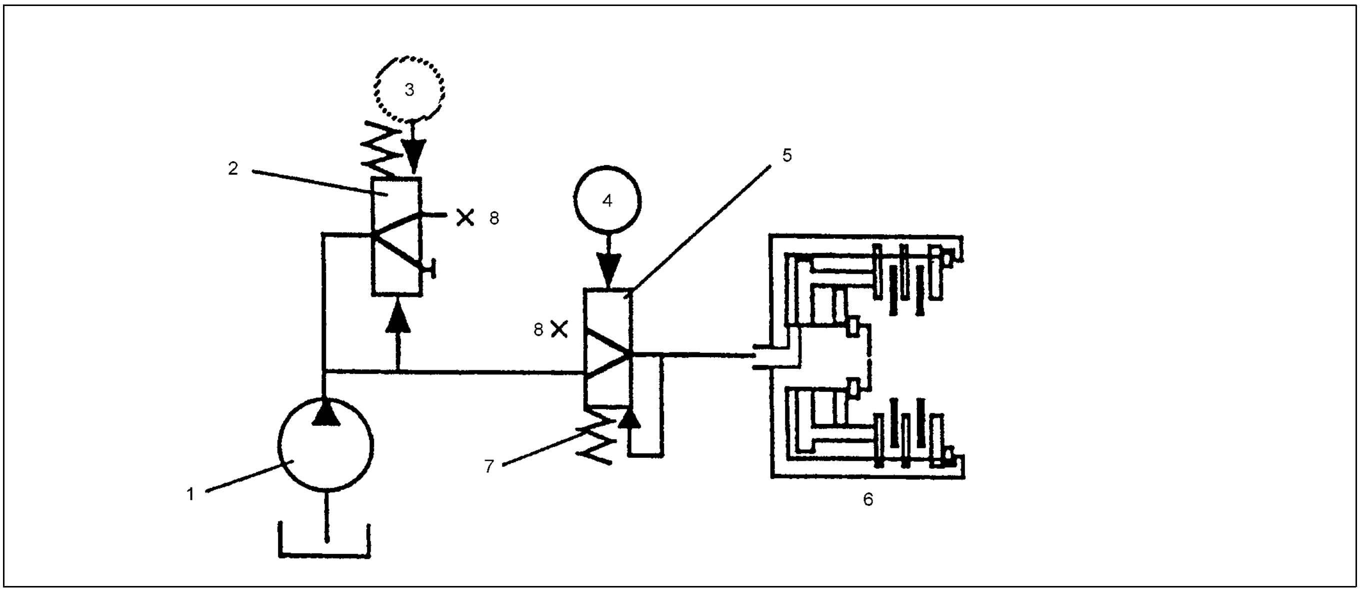
The TCM controls the torque converter clutch (TCC) solenoid valve based on the accelerator pedal angle, input shaft speed, output shaft speed and transmission fluid temperature.

Smooth lock up control is employed to engage or disengage the TCC smoothly at the time of lock up On or Off. When the TCM determines the TCC engagement, the solenoid valve control duty cycle (pulse width modulation [PWM]) signal is gradually increased (5% to 95%) and the transmission fluid between the TCC piston and torque converter front cover is gradually drained. As a result, the TCC piston is fitted slowly to the torque converter front cover under fluid pressure securing smooth lock up engagement.

The lock up control does not start when the transmission fluid temperature is less than 20°C (68°F) even though the vehicle is at the lock up control speed area. The lock up control disengages when the accelerator pedal angle is released.

Direct Electronic Shift Control (DECS)



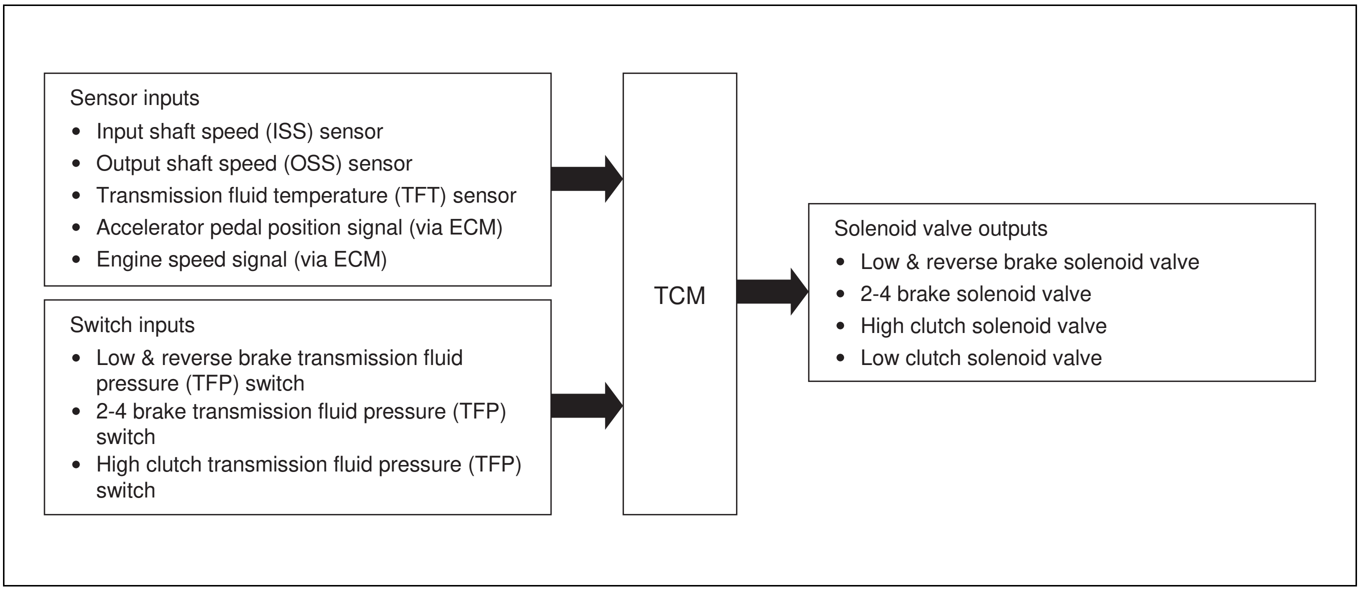


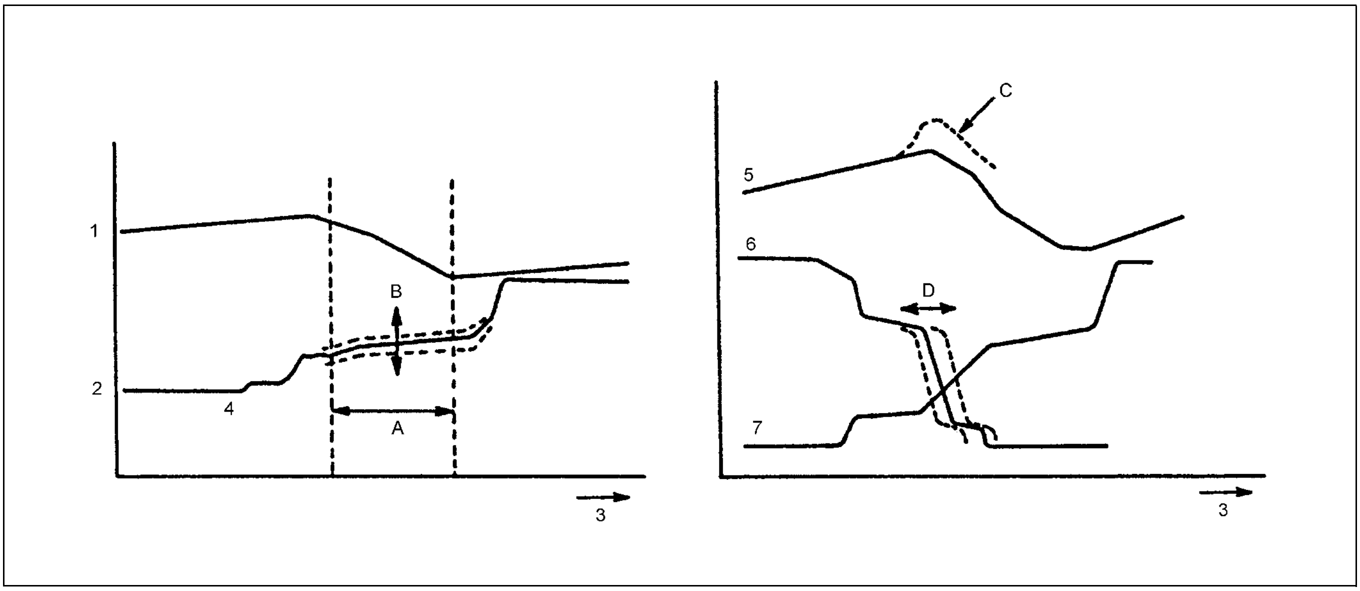
Legend

1. Oil pump
2. Pressure regulator spool valve
3. ON/ OFF type solenoid valve (pressure control [PC] solenoid valve
4. Duty cycle type solenoid valve (shift solenoid valve)
5. Amplifier (AMP) valve
6. Clutch

Based on each transmission fluid pressure (TFP) switch signal and each speed sensor signal and the accelerator pedal angle, the duty cycle type shift solenoid valve adjusts the clutch pressure to match the engine load and vehicle running conditions. Controlling the engagement and disengagement of the clutch and brake pressure is directly and accurately controlled via TCM, which is different to the conventional accumulator type. Instead of the conventional system (On/ Off type shift solenoid valve and shift valve), the combination of the duty cycle type solenoid valve and the amplifier (AMP) valve are used to adjust the clutch pressure to match the engine load and vehicle driving conditions, based on the signal from the TCM. Also, the TFP switch provided in the fluid passage of the control valve transmits to TCM, enabling the engagement and disengagement control of the clutch and brake to be directly and finely. When the gear is shifted from the 2nd to 3rd, 3rd to 4th, 4th to 3rd and 3rd to 2nd, the clutch pressures on the engagement side and disengagement side are simultaneously controlled. As a result, engine racing or clutch drag is prevented which enables a smooth and quick shift response.

Learning Control





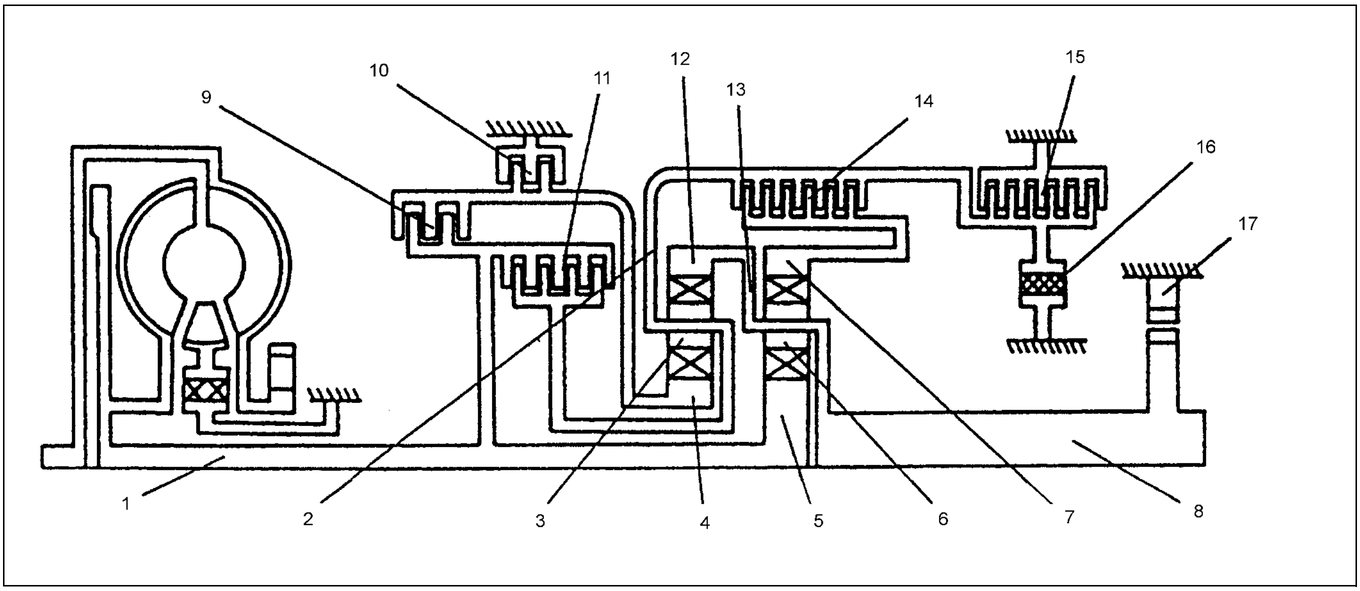
Legend

1. Input shaft speed
2. Transmission fluid pressure
3. Time
4. Clutch engagement fluid pressure
5. Engine speed
6. Disengagement side clutch fluid pressure
7. Engagement side clutch fluid pressure

Transmission fluid pressure control timing is optimally corrected at the time of clutch engagement and disengagement. It is controlled to bring the shift time to the value preset to the TCM, and compensate for the changes in engine performance and transmission characteristics. When the gear is shifted, the clutch pressure (B) is optimally corrected so that the shift time (A) is as close to the target value preset to the TCM. The variation in the engine performance and changes to transmission characteristics which occur with time, can be compensated for based on the past shift results. When the clutch is operated to shift the gear, the time of the clutch fluid pressure release (D) on the disengagement side is optimally corrected so that the change of the engine speed (C) is optimum.

Notice: When the battery terminal is disconnected, the contents of learning are cleared and as a result the shift shock may increase. After the vehicle has traveled, learning is repeated and the shock decreases gradually.

Transmission Power Flow Description



Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

Construction Parts

The JR405E consists of two sets of planetary gears, three multiple plate clutches, two multiple plate brakes and one one-way clutch.

High Clutch

High clutch (11) connects the input shaft (1) to the front planetary carrier (2). It is engaged at 3rd and 4th gear.

Low Clutch

Low clutch (14) connects the front planetary carrier (2) to the rear internal gear (7). It is engaged at 1st, 2nd and 3rd gear.

Reverse Clutch

Reverse clutch (9) connects the input shaft (1) to the front sun gear (4). It is engaged at reverse gear.

Low One-way Clutch

Low one-way clutch (16) allows the front planetary carrier (2) to turn forward (clockwise) but locks to opposite direction (counterclockwise). It is operative when accelerating.

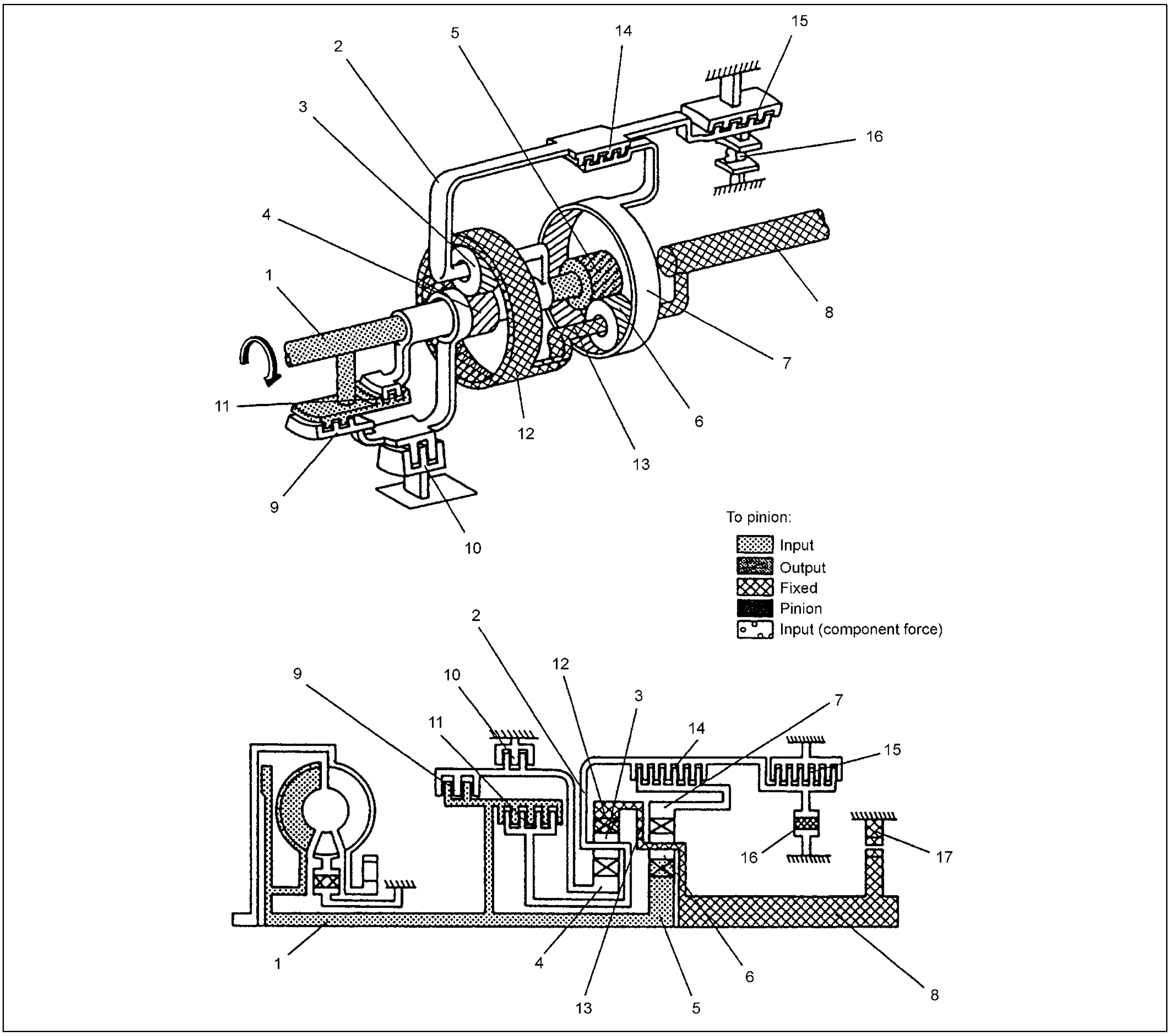
Low & Reverse Brake

Low & reverse brake (15) locks the front planetary carrier (2). It is engaged in L range and reverse gear.

2-4 Brake

2-4 brake (10) locks the front sun gear (4). It is engaged at 2nd and 4th (O/D) gear.

Parking

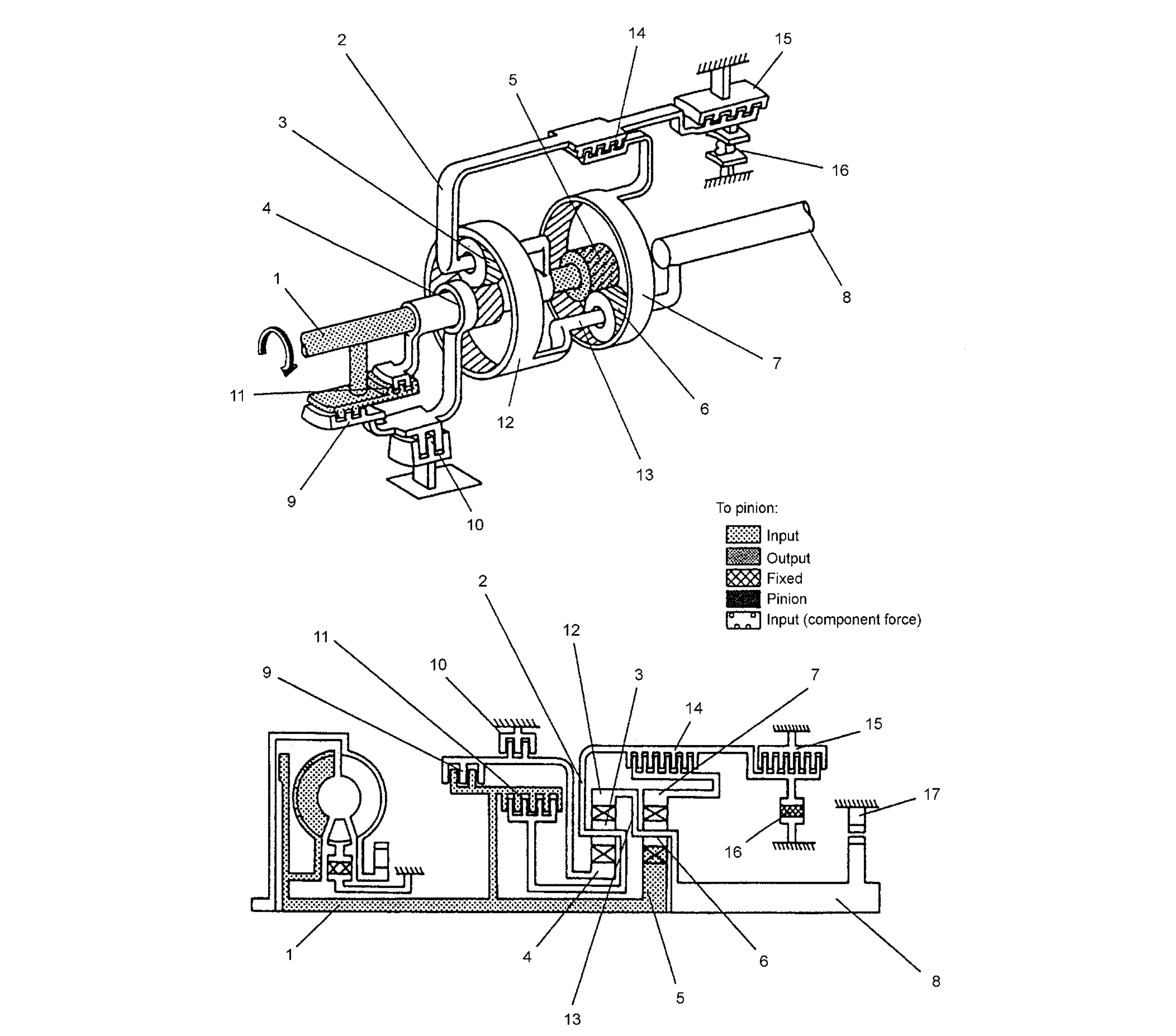


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

Although the driving force of the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum, the driving force is not transmitted to the output shaft (8) since all of the clutches and brakes are not engaged. Therefore, the vehicle can move in this condition. However, since the output shaft (8) is mechanically locked with the parking pawl (17), the rear planetary carrier (13) and front internal gear (12) are locked. For this reason, the vehicle does not move.

Neutral

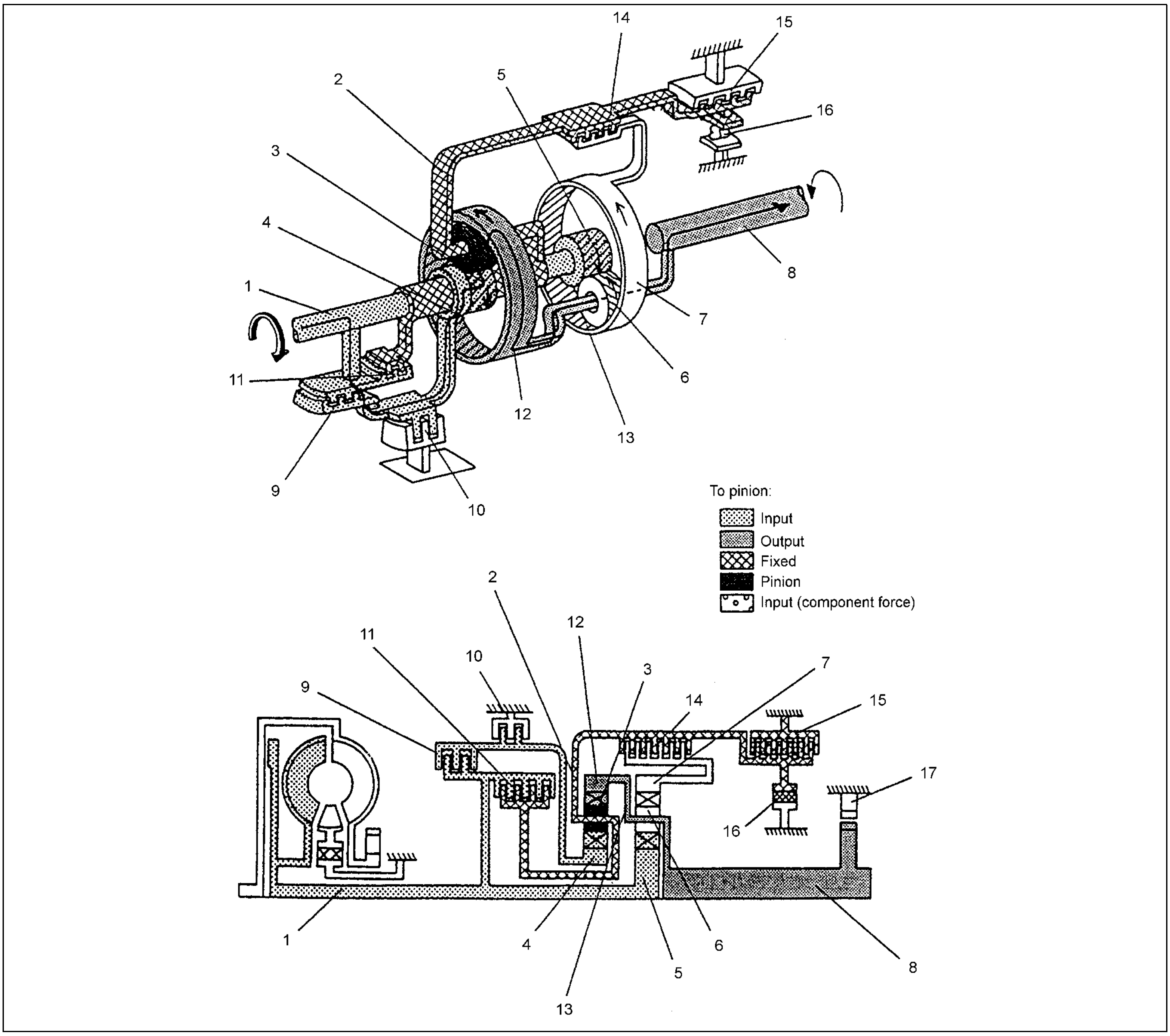


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

Although the driving force of the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum, the driving force is not transmitted to the output shaft (8) since all of the clutches and brakes are not engaged. Therefore, the vehicle can move in this condition.

Reverse Gear

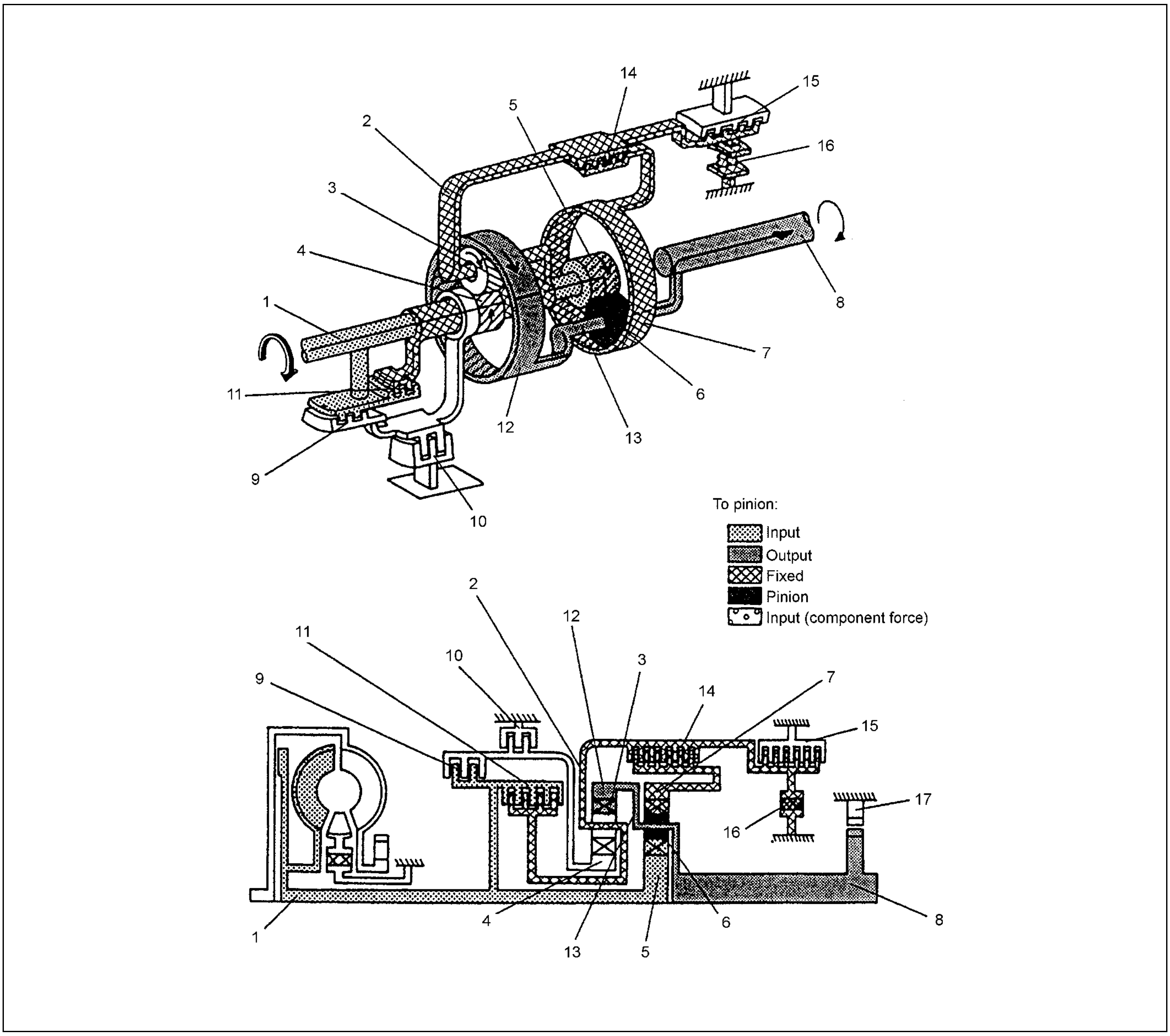


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The driving force from the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum. In the R range, the reverse clutch (9) is engaged and the driving force is transmitted to the front sun gear (4) and rotates it clockwise. The low & reverse brake (15) is also engaged and the front planetary carrier (2) is fixed so that the front pinion gear (3) does not rotate clockwise, but can rotate counterclockwise. As a result, the output shaft (8) rotates counterclockwise and the vehicle goes backwards.

First Gear In D, 3, 2 Range



Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The driving force from the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum. As the low clutch (14) is engaged, the movement of the rear internal gear (7) is restricted. Since the low one-way clutch (16) acts at the same time, counterclockwise rotations of the rear internal gear (7) are locked. As a result, the driving force transmitted to the rear sun gear (5) rotates the rear planetary carrier (13) clockwise, then the rotation speed is decreased and multiple forces is transmitted to the output shaft (8). When decelerating, the rotating speed of the rear planetary carrier (13) (rear pinion gear [6]) is higher than that of the rear sun gear (5) and the rear internal gear (7) attempts to rotate clockwise. At this time, the low one-way clutch (16) does not act but races, and therefore the rear internal gear (7) rotates clockwise. The reverse torque from the driving shaft is not transmitted to the engine side and the engine brake does not act.

SECTION 4B
REAR AXLE

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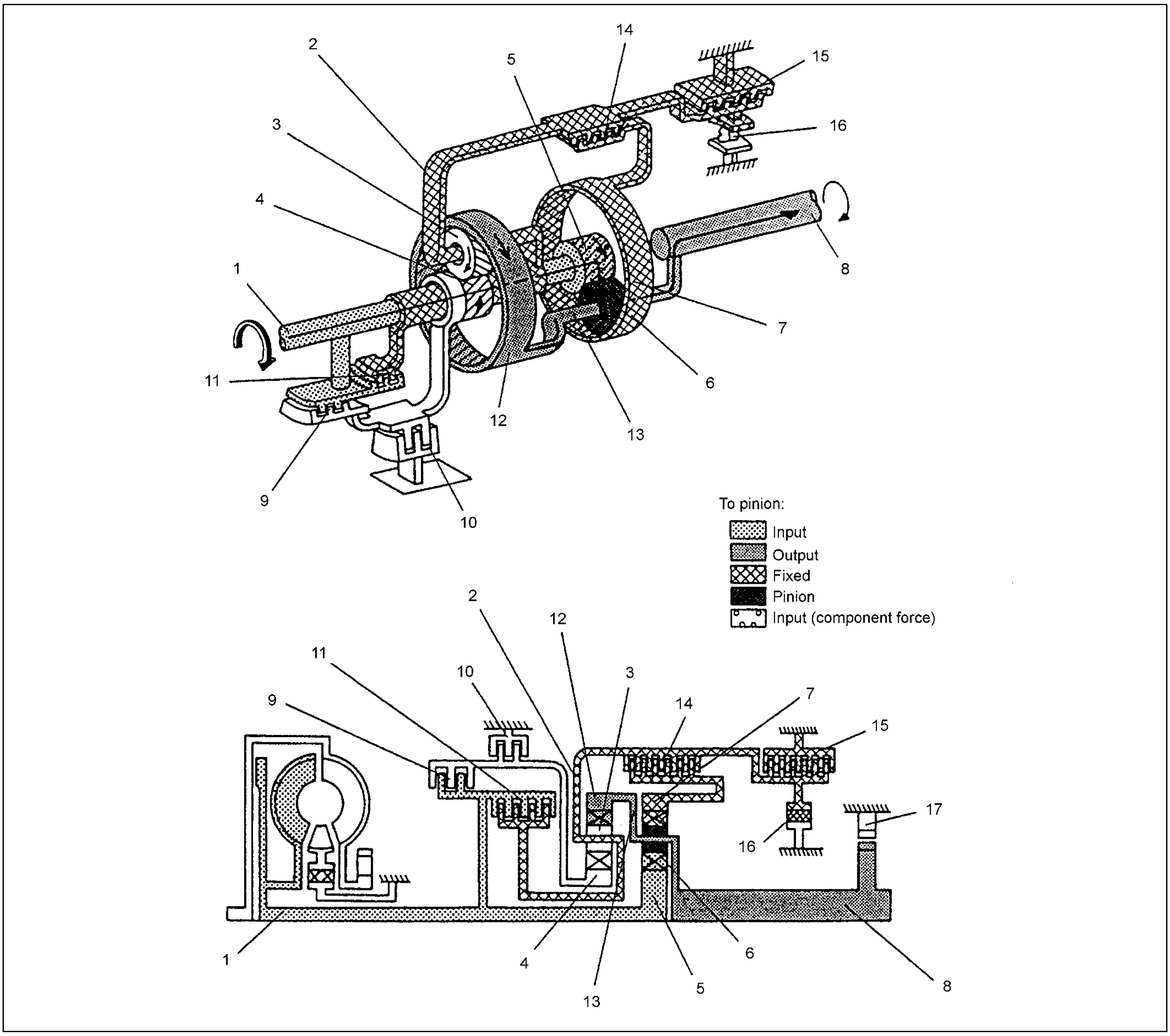
First Gear In L Range

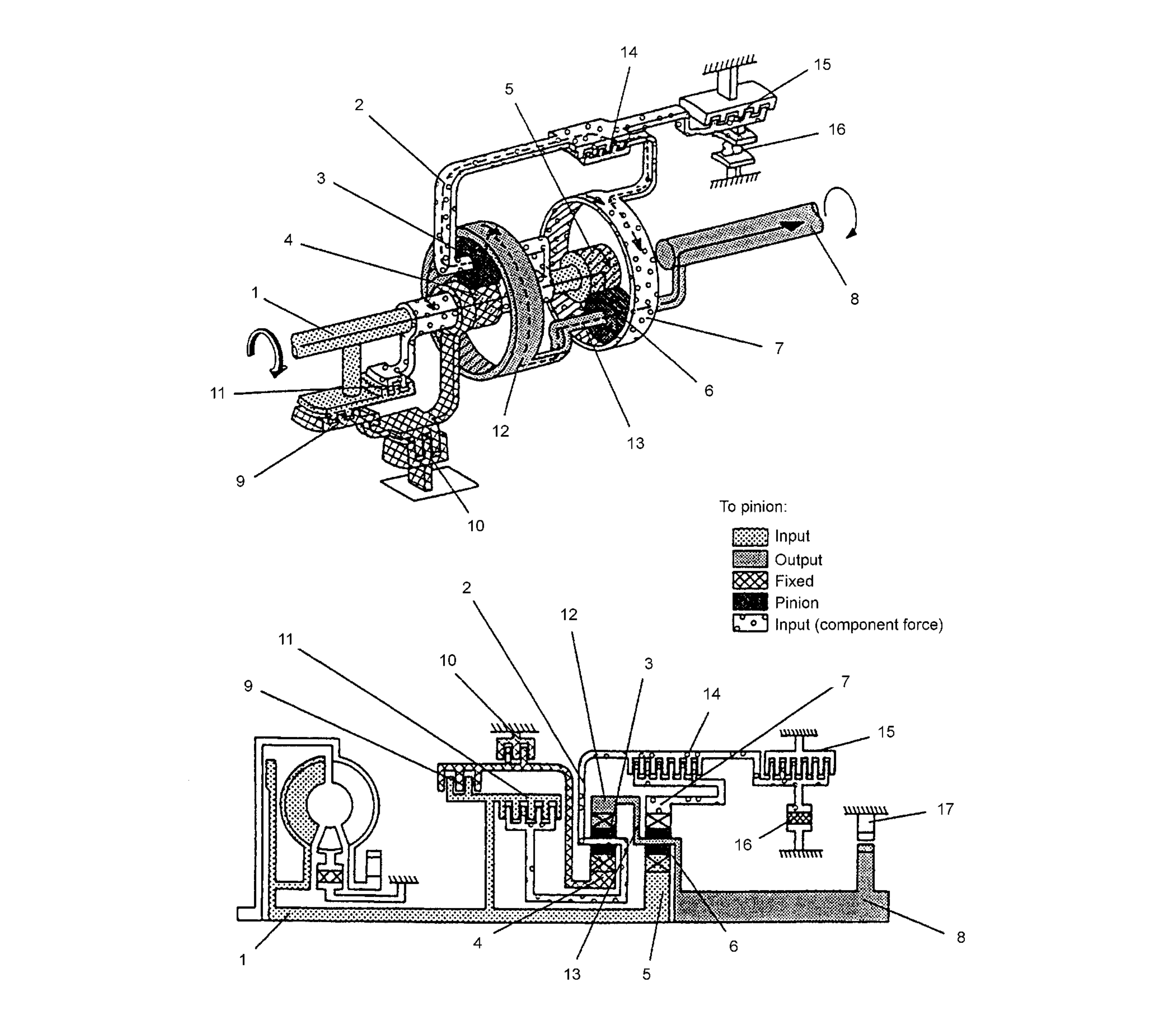


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The basic mechanism is the same as in the D, 3, and 2 ranges. To apply the engine brake, the low & reverse brake (15) is engaged to restrict the movement of the low one-way clutch (16).
When decelerating, as the rear internal gear (7) is fixed, reverse torque from the propeller shaft is transmitted to the engine side so that the engine brake is applied.

Second Gear

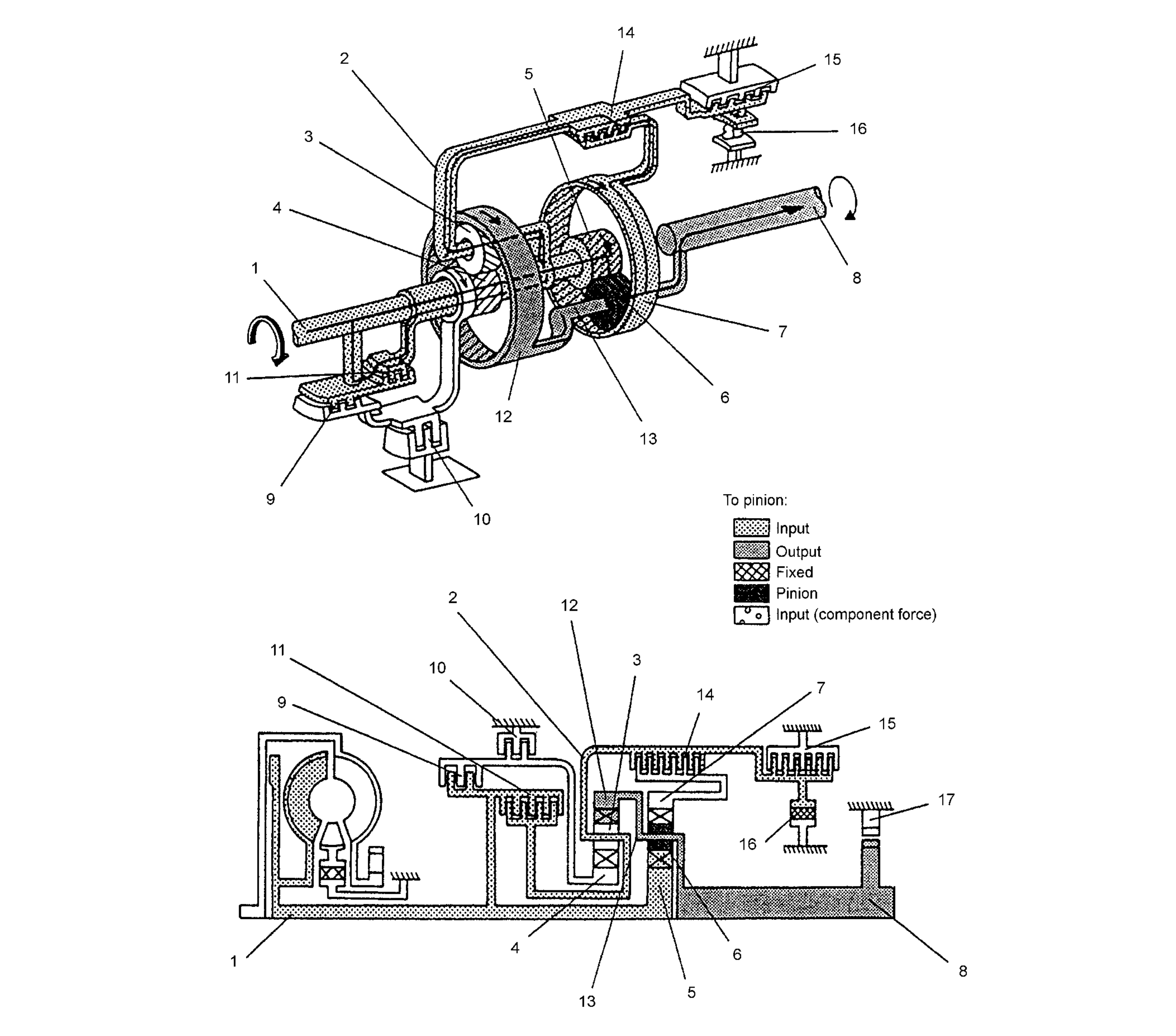


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The driving force from the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum. As in the case of the 1st gear, the low clutch (14) is engaged and the movement of the rear internal gear (7) is restricted. Since the 2-4 brake is engaged (10), the front sun gear (4) is fixed. As a result, movement of the rear internal gear (7) is restricted, and the driving force transmitted to the rear sun gear (5) rotates the rear planetary carrier (13) clockwise. The rotating speed of the rear planetary carrier (13) is higher than in 1st gear as the rear internal gear (7) rotates. When decelerating, the engine brake is applied.

Third Gear

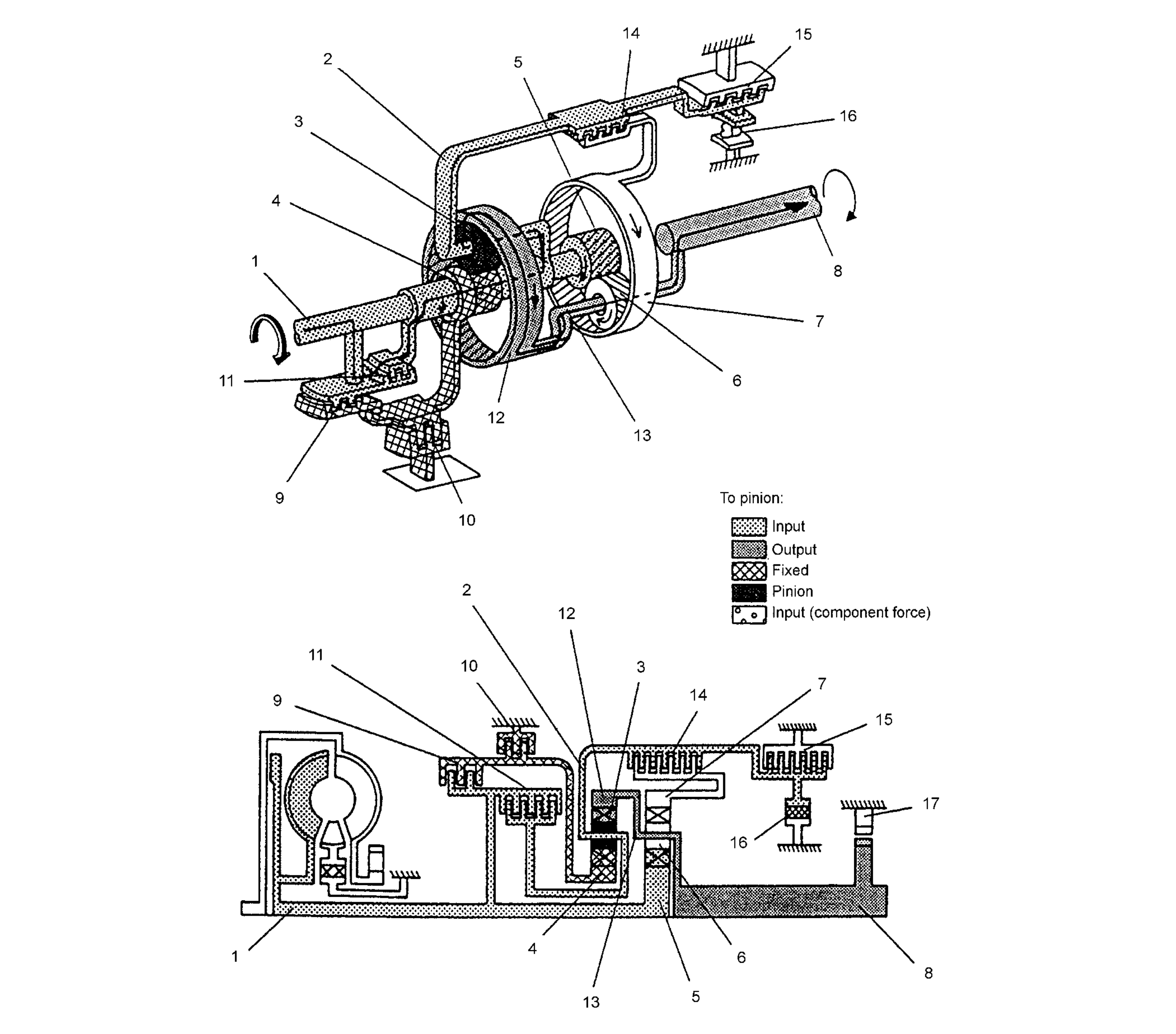


Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The driving force from the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum. As in the case of the 1st gear and 2nd gear, the low clutch (14) is engaged and the movement of the rear internal gear (7) is restricted. Since the high clutch (11) is engaged, the driving force from the input shaft (1) is directly transmitted to the rear internal gear (7). As a result, the speed of the rear sun gear (5) and the rear internal gear (7) becomes the same as that of the input shaft (1), so that the rear pinion gear rotates (6) not independently but together with the rear sun gear (5) and rear internal gear (7). When decelerating, the engine brake is applied.

Fourth Gear



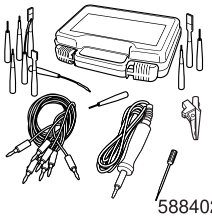
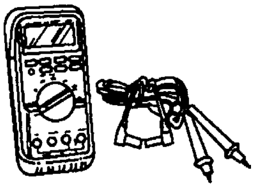
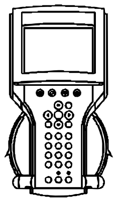
Legend

1. Input shaft
2. Front planetary carrier
3. Front pinion gear
4. Front sun gear
5. Rear sun gear
6. Rear pinion gear
7. Rear internal gear
8. Output shaft
9. Reverse clutch
10. 2-4 brake
11. High clutch
12. Front internal gear
13. Rear planetary carrier
14. Low clutch
15. Low & reverse brake
16. Low one-way clutch
17. Parking pawl

The driving force from the input shaft (1) is transmitted to the rear sun gear (5) and reverse & high clutch drum. Since the 2-4 brake (10) is engaged, the front sun gear (4) is fixed. In addition to this the high clutch (11) is engaged. As a result, the front pinion gear (6) rotates itself together with other gears clockwise. This rotation increases the speed of rotation of the front internal gear (12) and is transmitted to the output shaft (8).

Special Tools and Equipment

Special Tools and Equipment

Illustration	Tool Number / Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
	5-8840-0285-0 (J-39200) Digital Multimeter
	Tech 2 Kit

SECTION 7A3

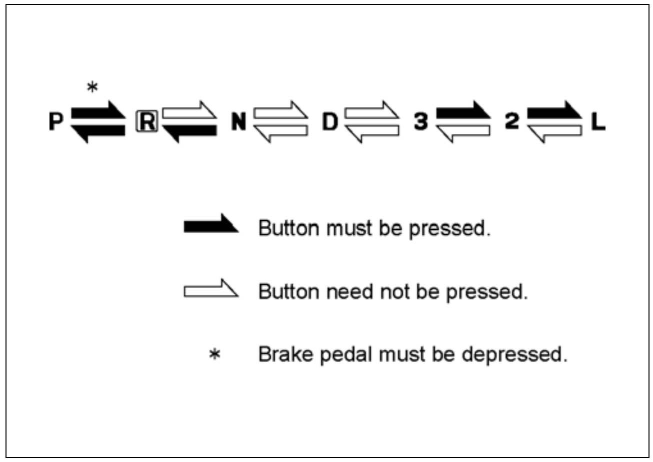
ON-VEHICLE SERVICE (JR405E)

TABLE OF CONTENTS

DESCRIPTION

Before performing on-vehicle service on the automatic transmission, check that the engine idling speed and general engine condition are normal.

For shift interlock function, if the ignition key is out of "LOCK" position, the shift lever select button can not be pushed. (shift lever can not be operated.)



RTW77ASH000901

AUTOMATIC TRANSMISSION FLUID (ATF)

Inspect

Remove the transmission dipstick to check the condition of the ATF.

Check the color and smell of the ATF.

If the ATF is abnormal color or smells burnt, replace it and investigate the cause of trouble.

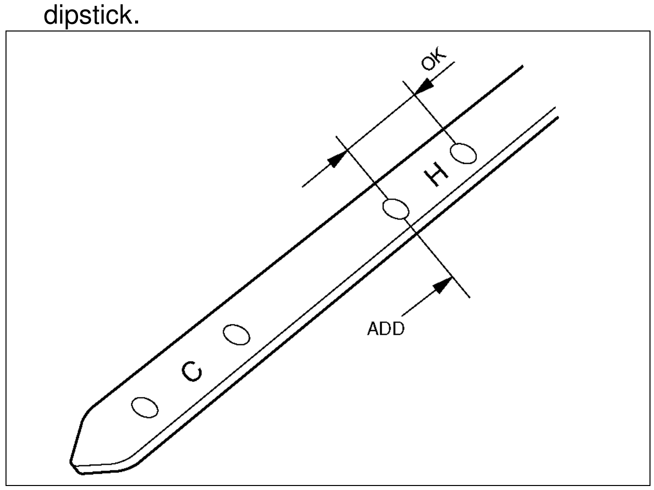
Coloor of ATF	Condition
Clear red	Normality
Blackish discoloration	Defects of power train parts (clutches)
White turbidity	Include water
Discoloration of red brown	Deterioration of ATF

ATF LEVEL

Inspect

Hot Level

1. Warm up the engine and the transmission by driving the vehicle on the road so that the temperature reaches around 80°C (176°F).
   Do not turn the engine off.
2. Park the vehicle on a level surface.
3. Apply the parking brake firmly.
4. Let the engine run at idle.
   Move the select lever slowly through all the gear positions.
   Stop in each gear position just long enough for the transmission to engage.
5. Return the select lever to either "P" or "N".
6. Remove the ATF level dipstick.
7. Wipe the dipstick clean with a paper towel.
8. Reinsert the dipstick and wait several seconds.
9. Remove the dipstick.
   The ATF level should be inside the "H" range on the dipstick.



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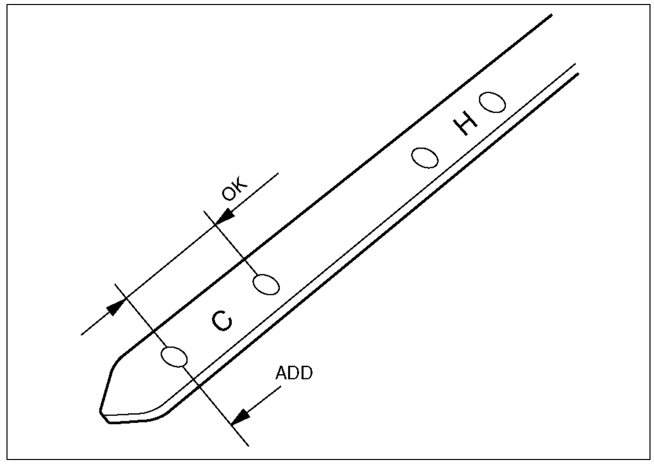
If the ATF level is below the "H" range, ATF must be added.

Cold Level

The vehicle must not have been driven so that the temperature reaches around 20°C (68°F) before the cold level check is made.

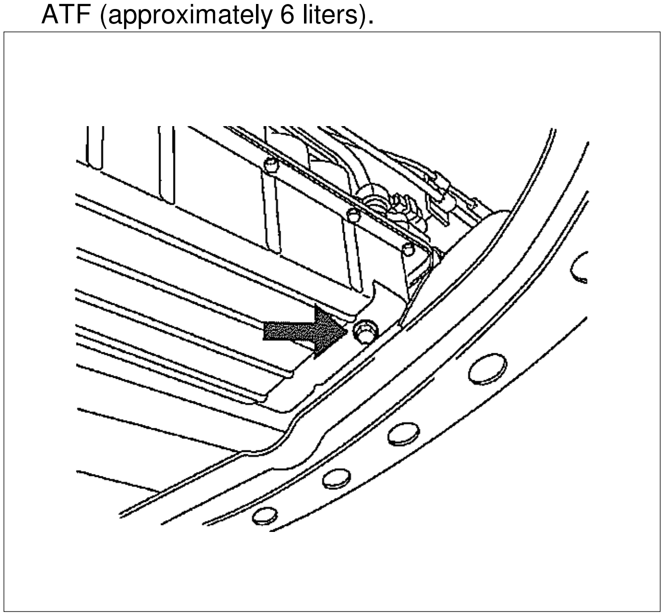
1. Park the vehicle on a level surface.
2. Apply the parking brake firmly.
3. Start the engine and allow it to warm up.
   The engine coolant temperature gauge needle should be midway between the "C" mark and "H" mark.
4. Let the engine run at idle.
   Move the select lever slowly through all the gear ranges.
   Stop in each range just long enough for the transmission to engage.
5. Return the select lever either "P" or "N".
6. Remove the ATF level dipstick.
7. Wipe the dipstick clean with a paper towel.
8. Reinsert the dipstick and wait several seconds.
9. Remove the dipstick.
   The ATF level should be inside the "C" range on the dipstick.
   If the ATF level is below the "C" range, ATF must be added.



242R300002

ATF CHANGE

1. Park the vehicle on level ground and block the rear wheels.
2. Start the engine and allow it to idle until the ATF reaches a temperature of 40-50°C (104-122°F).
3. Stop the engine.
4. Raise the front to the vehicle and support with suitable safety stands.
5. Remove the drain plug from the oil pan and drain the ATF (approximately 6 liters).



6. Remove the oil pan.
7. Inspect the oil pan (details written below).
8. Install the oil pan.

Note:

Use a new gasket. Clean the oil pan and magnet.

Oil pan bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)

9. Replace the gasket and install the drain plug.
   Drain plug torque : 35 N·m (3.6 kgf·m/26 lb·ft)

Note:

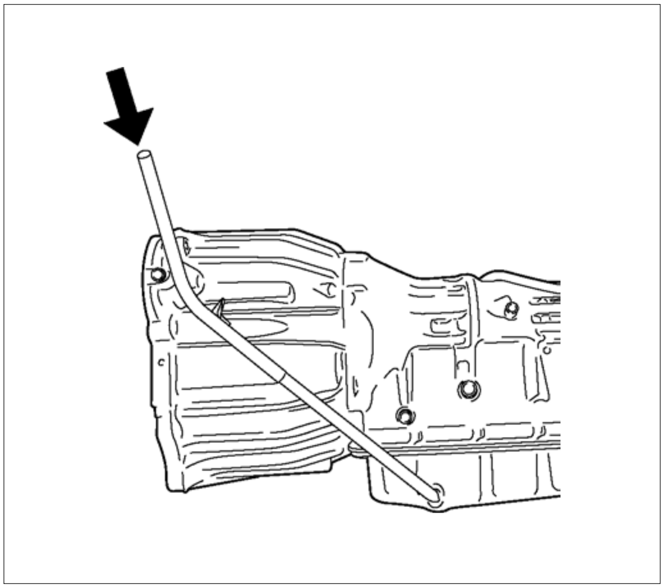
Do not reuse the old washer (gasket).

Clean the drain plug (especially the threaded section).

10. Remove the safety stands and wheel blocks.
11. Pour about 5 liters of new ATF.
12. Start the engine. With your foot on the brake, move the shift lever through each gear range, and shift to "P" range.
13. Check the ATF level. Add more ATF carefully as necessary using the dipstick. Refer to "ATF LEVEL" preciously in this section.

Note:

Keep the engine idle (do not stop it) during the ATF level adjustment.



RTW07ASH000101

Inspect

1. Check the drain plug tip for adhesion of foreign substances.
2. Check the drained ATF for color, smell and inclusion of foreign substances.
3. Check the oil pan bottom and magnet for adhesion of foreign substances.

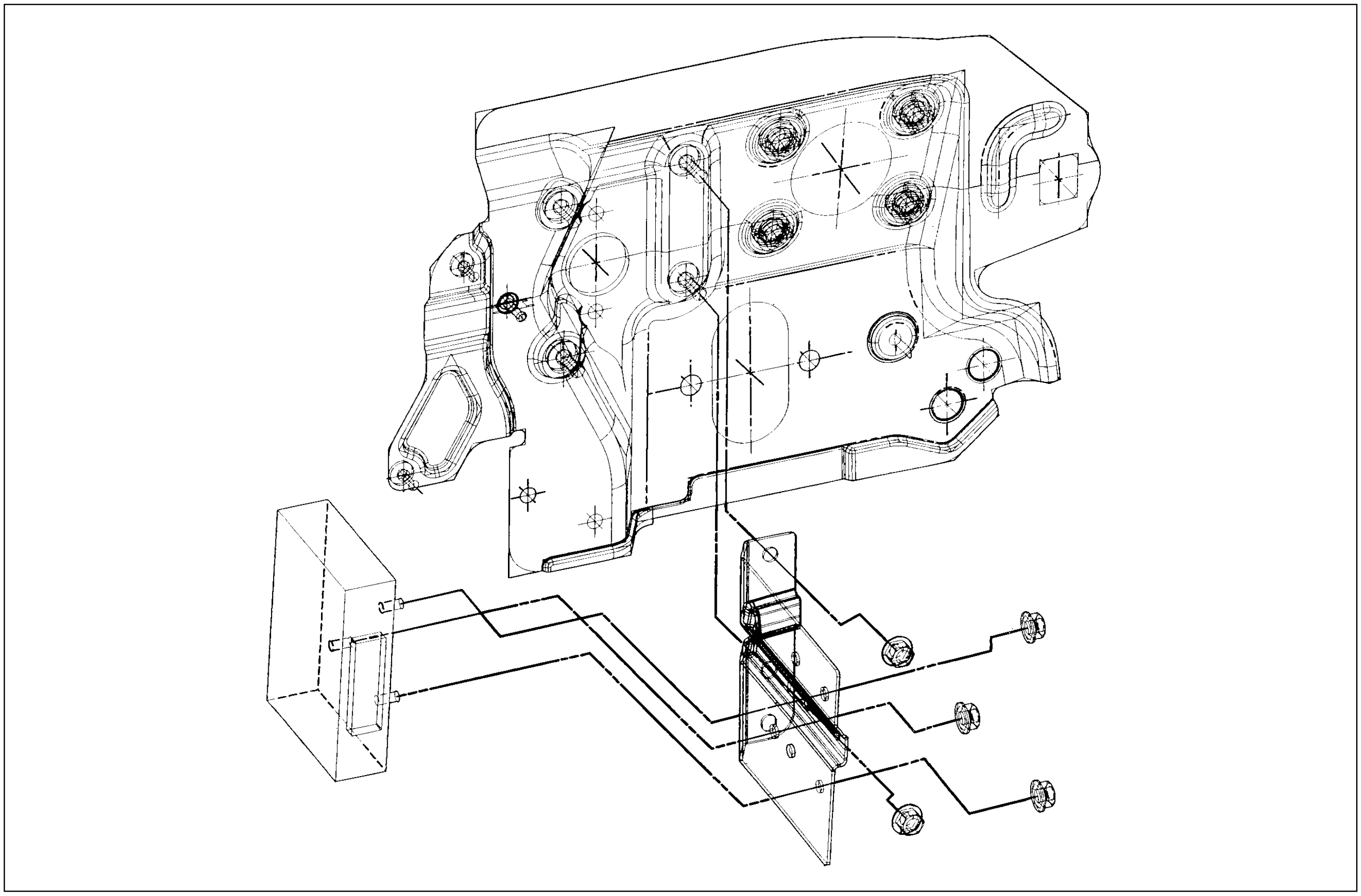
   If a problem is discovered during those checks, the Automatic transmission must be overhauled.

Note:

The torque converter and the oil strainer need replacing with new ones if the drained ATF contains large amounts of metallic or facing flakes.

In addition, flush the ATF cooler circuit.

TRANSMISSION CONTROL MODULE (TCM)



RTW37ALF001901

Remove and Disconnect

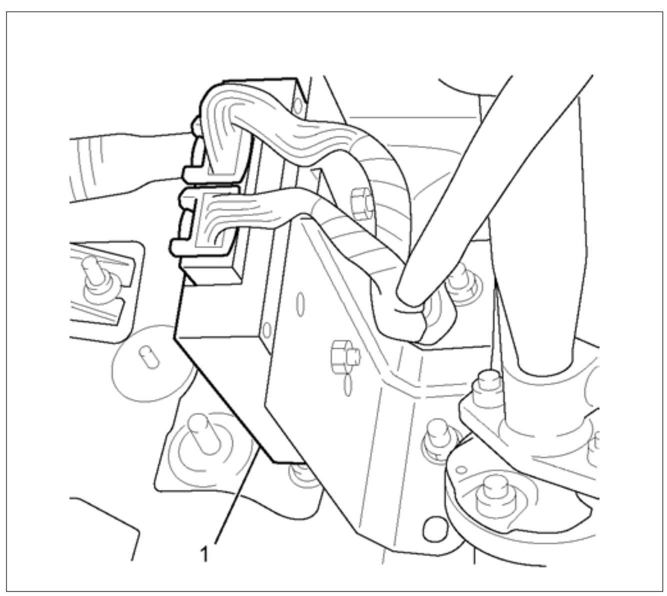
1. Disconnect the negative battery cable.
2. Remove the connectors.
3. Remove the fixing nuts and remove the TCM (1) from the bracket.

Note:

The TCM is fitted under the instrument panel of the driver's compartment via three stud bolts.

Install or Connect

Follow the removal steps in the reverse order. Be absolutely sure that the connectors are securely fastened.



RTW77ASH000801

Service Precaution

WARNING:
THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE REFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specification. Following these instructions can help you avoid damage to parts and systems.

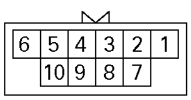
INHIBITOR SWITCH

The inhibitor switch is attached to the right side of the transmission.

Inspect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Disconnect the harness connectors.
4. Use an ohmmeter to check the inhibitor switch continuity between the following terminals as shown in the figure.
5. Place the select lever in the “N” position.

Terminal / Position	10	7	3	2	4	8	5	1	9	6
P	○	○	○	○						
R			○	—	○					
N	○	○	○	—	—	○				
D			○	—	—	—	○			
3			○	—	—	—	—	○		
2			○	—	—	—	—	—	○	
L			○	—	—	—	—	—	—	○



249R300001

6. Move the select lever to either side.
   Check the inhibitor switch continuity between the terminals shown in Step 4.
   The continuity readings should remain fairly steady as the select lever is moved.
   If there is no continuity or the continuity is intermittent, the inhibitor switch must be adjusted.

Adjust

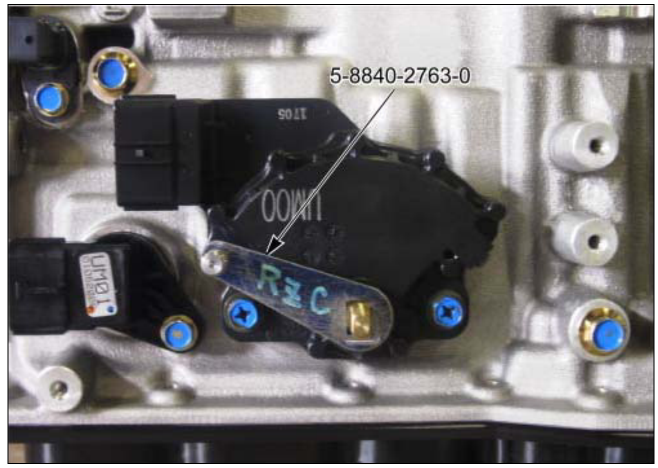
1. Disconnect the shift cable from the lever.
2. Loosen the inhibitor switch bolts.
3. Use the inhibitor switch set plate to align the neutral holes (manual shaft and inhibitor switch).
   Turn the inhibitor switch to adjust it.
   Inibitor switch set plate: 5-8840-2763-0

Note:

Inhibitor switch adjustment is very important.

If the inibitor switch is not correctly adjusted, the automatic transmission will not function normally.

4. Tighten the 2 inhibitor switch bolts to the specified touque.
   Torque: 6 N·m (0.6 kgf·m/52 lb·in)

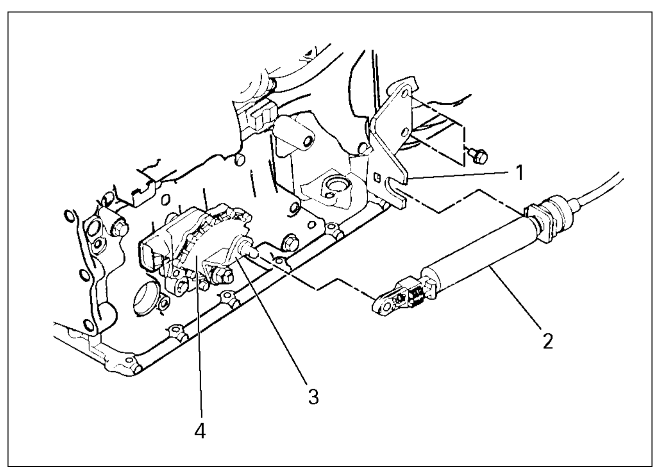


47INH-SW01

5. Remove the inhibitor switch set plate.
6. Connect the shift cable to the lever.
7. Connect the harness connector.

Remove or Disconnect

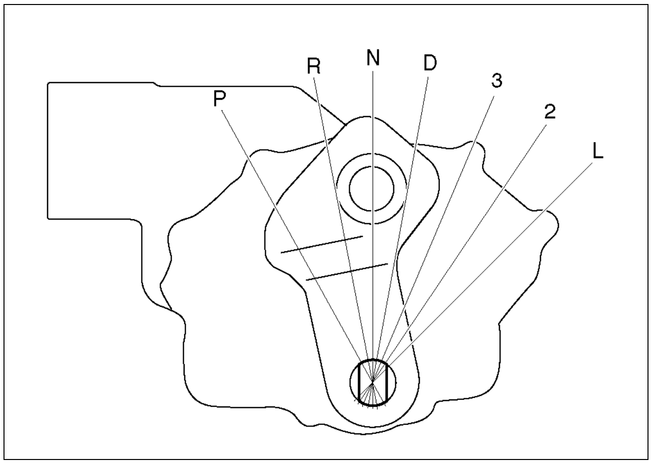
1. Remove the cable bracket (1) from the transmission.
2. Disconnect the shift cable (2) from the lever (3).
3. Disconnect the harness connectors.
4. Remove the inhibitor switch bolts.
5. Remove the inhibitor switch (4) from the transmission.



238R300001

Install or Connect

1. Install the inhibitor switch to the transmission.
   Temporarily tighten the inhibitor switch bolts.
2. Move the manual shaft select lever to the “N” position.



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3. Use the inhibitor switch set plate to align the neutral holes (manual shaft and inhibitor switch).
   Turn the inhibitor switch to adjust it.
   Inhibitor switch set plate: 5-8840-2763-0

Note:

Inhibitor switch adjustment is very important.

If the inhibitor switch is not correctly adjusted, the automatic transmission will not function normally.

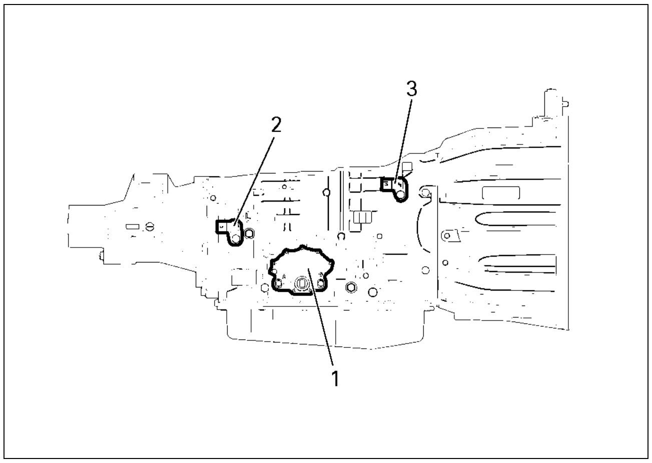
4. Tighten the 2 inhibitor switch bolts to the specified torque.
   Torque: 6 N·m (0.6 kgf·m/52 lb·in)

47INH-SW01

5. Remove the inhibitor switch set plate.
6. Install the cable bracket to the transmission.
7. Connect the shift cable to the lever.
8. Connect the harness connector.
9. Connect the negative battery cable.
10. Remove the wheel blocks.

SPEED SENSOR

The speed sensor is attached to the right side of the transmission.



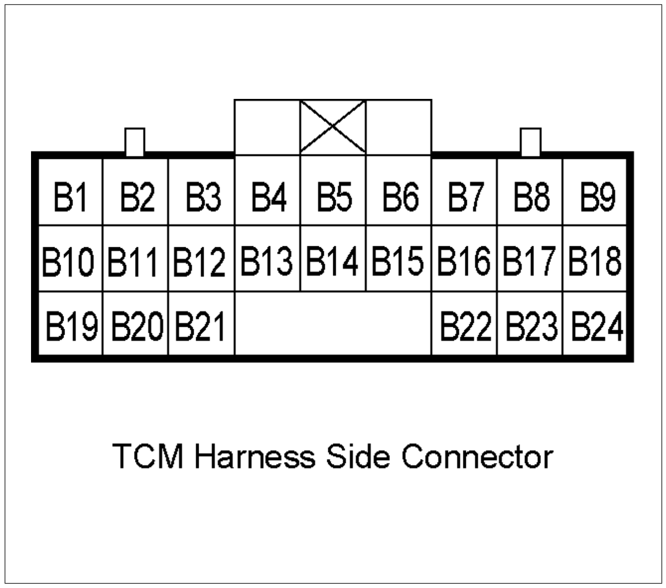
240L300001

Legend

1. Inhibitor switch
2. Speed sensor
3. Turbine sensor

Inspect

1. During driving at a speed of 20km/h (12mph) with “L” range in low gear, measure the voltage between the TCM connector terminals (B13) and (B5) with a digital voltmeter.
   Standard voltage : approx. 7V (AC range)



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2. If the voltage is outside of the standard value, check the speed sensor pole piece for the presence of foreign materials and the speeed sensor cable for a short or open circuit.
   If the result of the inspection is normal, replace the speed sensor.
   Torque: 6 N·m (0.6 kgf·m/52 lb·in)

TURBINE SENSOR

The turbine sensor is attached to the right side of the transmission.

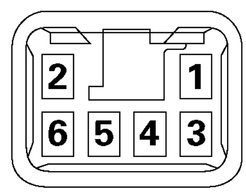
Inspect

1. During driving at a speed of 20km/h (12mph) with “L” range in low gear, measure the voltage between the TCM connector terminals (B3) and (B5) with a digital voltmeter.
   Standard voltage : approx. 7V (AC range)
2. If the voltage is outside of the standard value, check the turbine sensor pole piece for presence of foreign materials and the turbine sensor cable for a short or open circuit.
   If the result of the inspection is abnormal, replace the turbine sensor.
   Torque: 6 N·m (0.6 kgf·m/52 lb·in)

POWER AND 3RD START SWITCH

Inspect

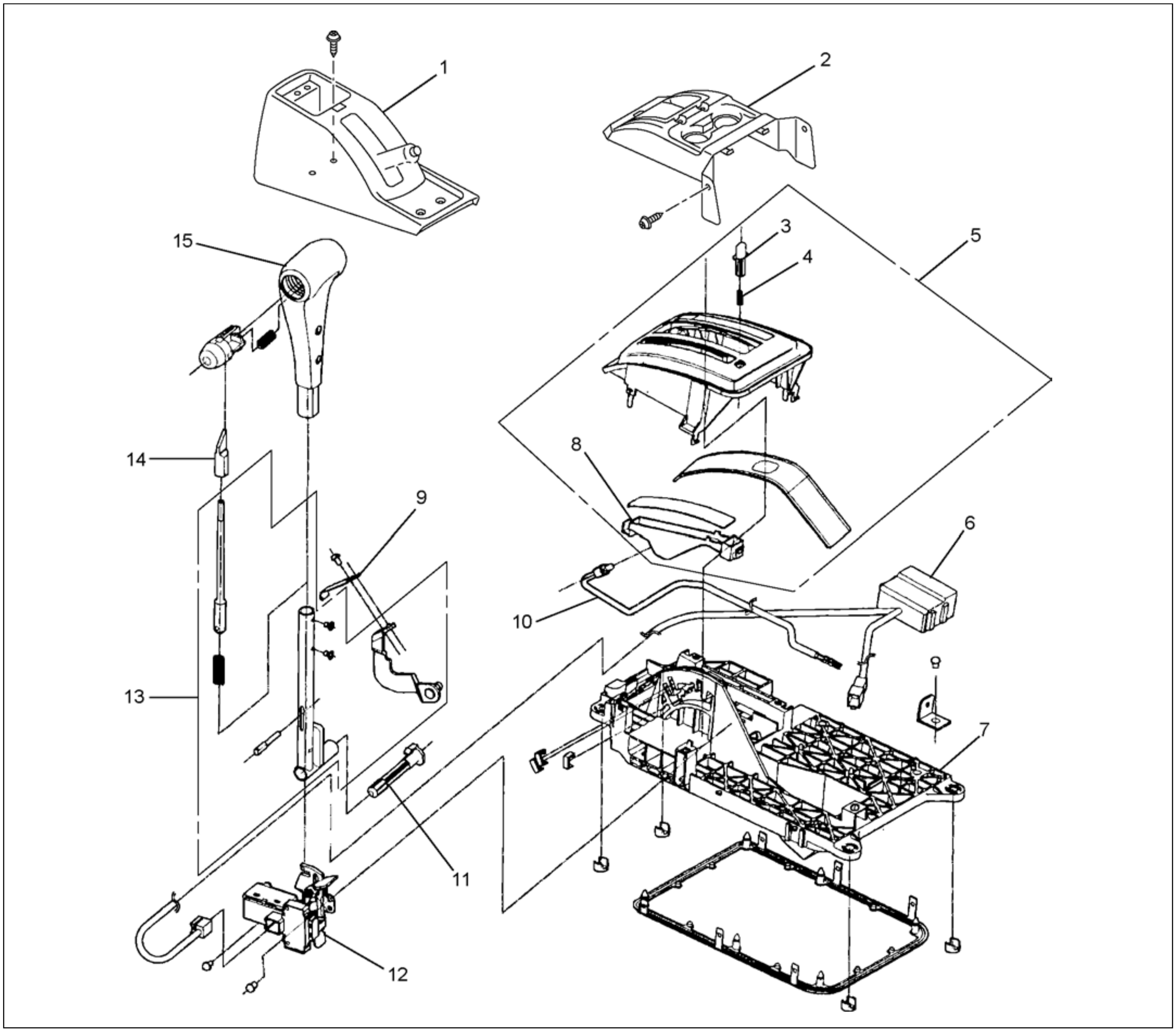
1. Block the wheels.
2. Disconnect the negative battery cable.
3. Pry out the switch from the floor console.
4. Disconnect the harness connector.
5. Check continuity between terminals (5) and (6) at third (3rd) position.
6. Check continuity between terminals (3) and (6) at power (PWR) position.
7. Replace the power and 3rd start switch if the result of inspection is abnormal.
8. Connect the harness connector.
9. Connect the negative battery cable.
10. Remove the wheel blocks.



Switch Position	Terminal		
	3	6	5
PWR	○	○	
3rd		○	○

238R300003

SELECT LEVER



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Legend

1. Rear console
2. Front console
3. Shift lock release button
4. Shift lock button spring
5. Upper housing
6. Interlock controller
7. Base plate
8. Position indicator housing
9. Spring plate
10. Lamp assembly
11. Grooved pin
12. Shift lock unit
13. Lever assembly
14. Sleeve
15. Select lever knob

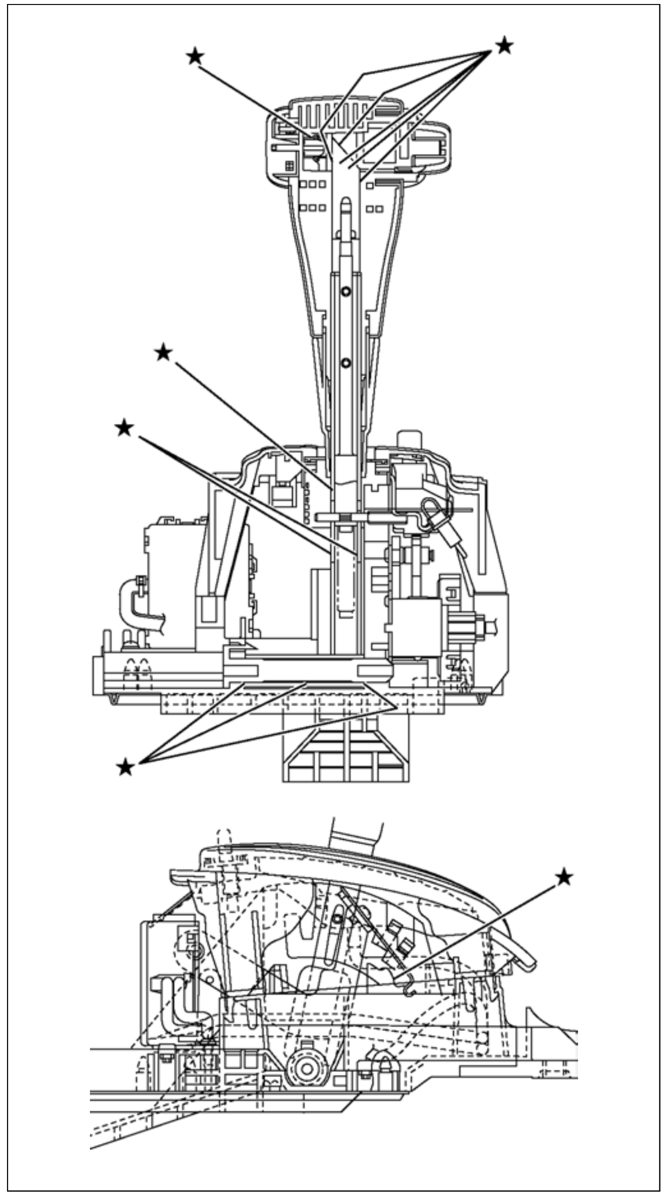
Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Remove the rear console and the front console.
4. Remove the 2 screws fixing the select lever knob.
5. Remove the knob together with the knob button and spring from the lever.
6. Turn the sleeve counterclockwise to remove it. Make a note of the number of turns required to free the sleeve.
7. Remove the harness connectors from the base plate.
8. Remove the upper housing (held in place by 4 latched fasteners).
9. Remove the lamp assembly by turning it counterclockwise.
10. Remove the spring plate.
11. Remove the grooved pin.
12. Disconnect the shift cable from the select lever.
13. Remove the lever assembly by pressing the rod down (lever in N position).
14. Remove the harness connectors from the shift lock unit, then remove the shift lock unit.
15. Remove the interlock controller.
16. If the replacement of shift lock release button or shift lock button spring is required, remove the position indicator housing, the shift lock button spring and shift lock release button can be removed.

Install or Connect

NOTE

Apply MULTEMP No. 2 grease (or equivalent) to the select lever. Refer to the illustration.



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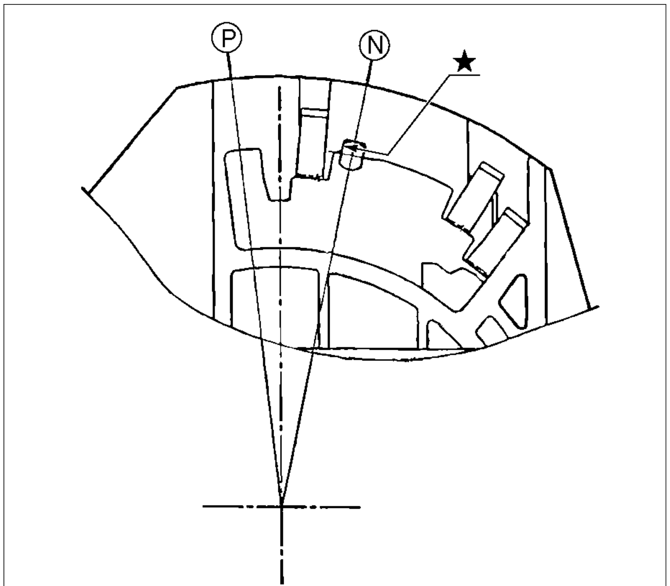
1. Install the interlock controller.
2. Install the shift lock unit and connect the harness to the shift lock unit.
3. Install the lever assembly to the base plate.
   a. Insert and secure the shaft and connect the cable.
   b. Insert pawled end of the shaft into the base plate hole.
   c. Insert the detent pin of the shaft into detent aperture (lever assembly in N position).
   d. Install the grooved pin.

4. Install the spring plate.
   a. Insert the detent pin into the base plate detent groove until it touches the front wall (lever assembly in N position).



DETAIL DETENT

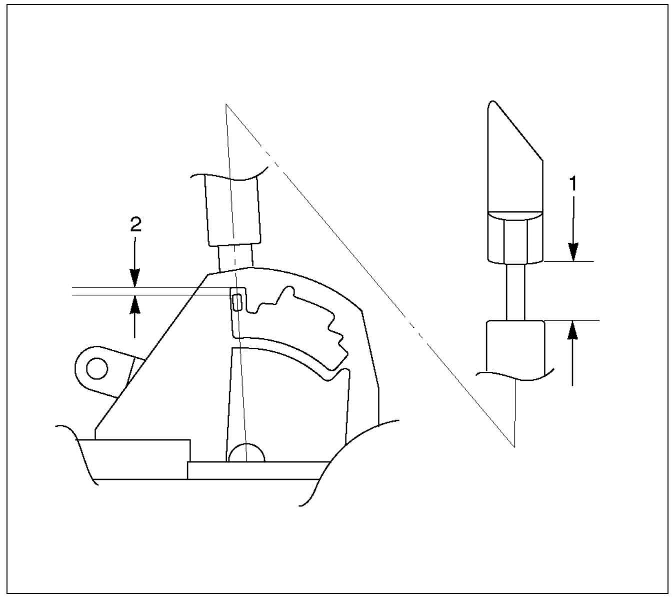
RTW37ASH001001

   b. Stack the short spring plate and tighten the screws to the specified torque.

Screw torque	2 N·m (0.2kgf·m/17 lb·in)

   c. Check that the detent pin moves smoothly in the detent groove (shift knob temporarily installed).
5. Temporarily install the sleeve.
6. Move the lever to the “P” position.
7. Adjust the clearance (2) between the detent plate and the pin by moving the select lever knob sleeve (1).

Detent plate and pin clearance	mm(in)
0.2 - 1.0 (0.01 - 0.04)	



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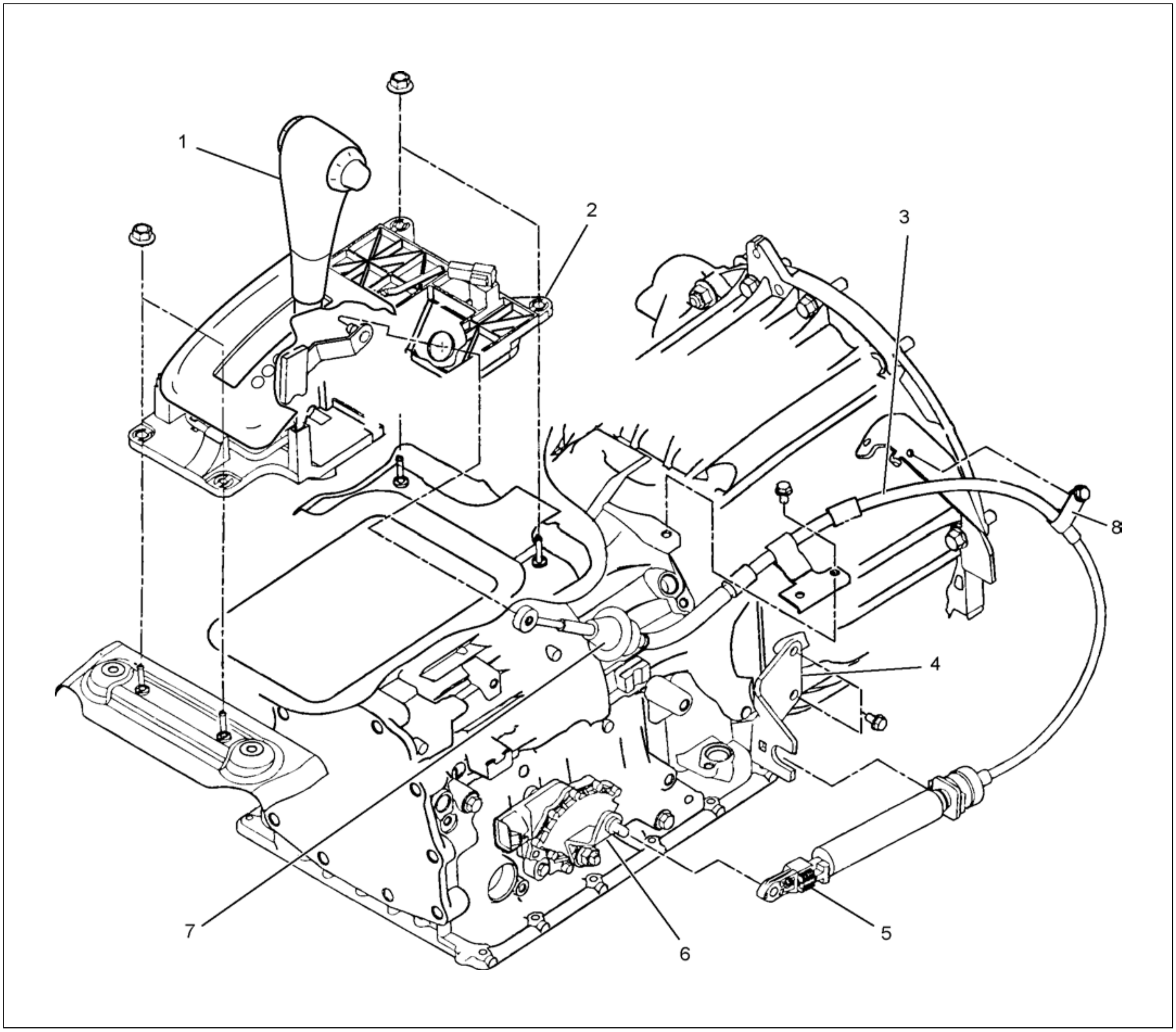
8. Install the lamp assembly to the lamp socket.
   a. Align the recessed portion of the lamp socket with the protruding portion of the lamp assembly.
   b. Insert the lamp assembly into the lamp socket and rotate it 90 degrees clockwise.
9. Remove the sleeve and move the lever to the “N” position.
10. Install the upper housing. Make sure that the 4 latched fasteners are securely closed.
11. Attach the harness connectors to the base plate.
12. Install the sleeve (rotate the sleeve clockwise the same number of turns it was rotated counterclockwise at disassembly).
13. Install the knob, the knob button, and the knob spring.
14. Install the 2 screws securing the knob and tighten them to the specified torque.

    Screw torque: 2 N·m (0.2kgf·m/17 lb·in)

SHIFT CABLE



Legend

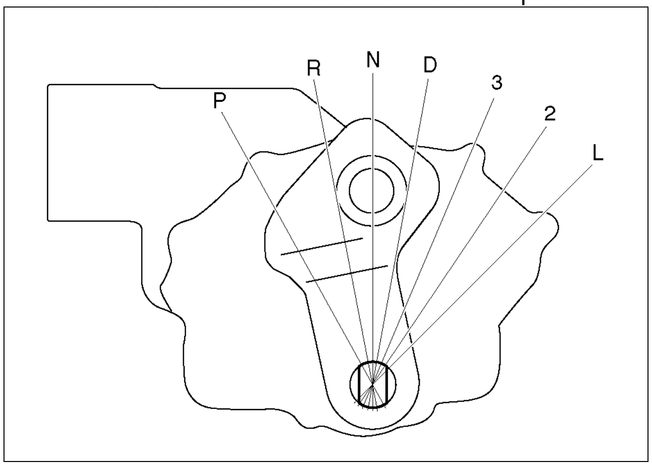
1. Select lever
2. Select lever base
3. Shift cable
4. Bracket
5. Adjuster
6. Manual shaft select lever
7. Shift cable retaining pawl
8. Clip

Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Move the select lever to the “N” position.
4. Remove the rear console and front console.
5. Disconnect the shift cable from the select lever.
6. Press on the shift cable retaining pawl to remove the cable from the select lever base.
7. Disconnect the shift cable from the transmission side.
8. Remove the shift cable from the bracket.
9. Pull the shift cable free from the bottom of the vehicle.

Install or Connect

1. Install the shift cable toward the inside of the cabin from the bottom of the vehicle.
2. Push the shift cable into the select lever base.
3. Connect the shift cable to the select lever.
4. Fix the shift cable to the bracket.
   Install the clip on the marking on the shift cable.
5. Check that the select lever is in the “N” position.
6. Check that the transmission is in the “N” position.



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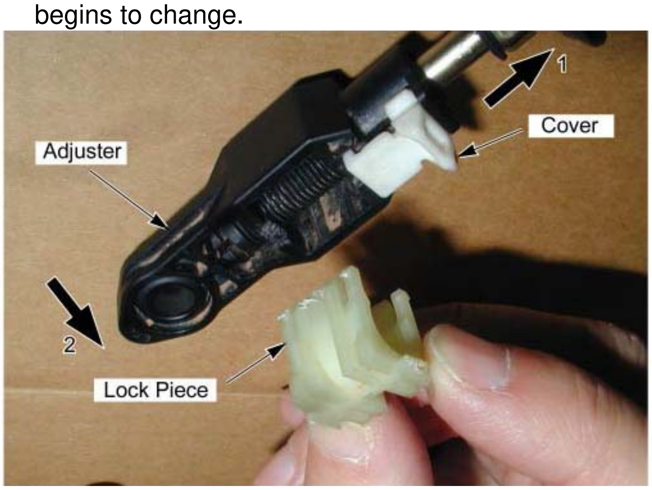
7. Slide the cover in the direction shown by the arrow (1).
8. Use an ordinary screwdriver to move the lock piece from the position indicated by the arrow (2). Continue to move the lock piece until the adjuster position begins to change.



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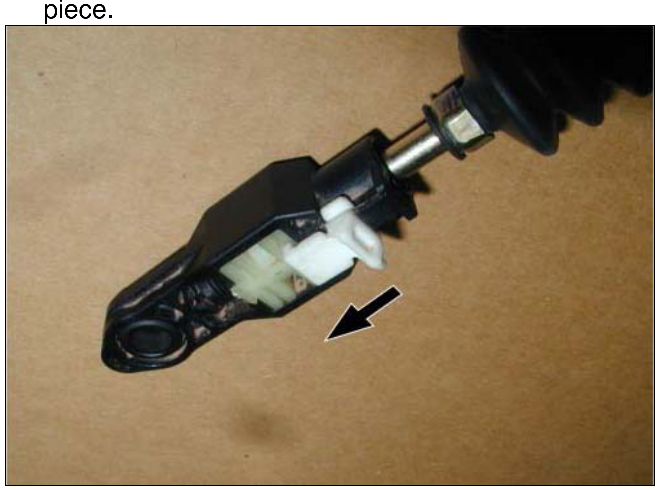
9. Connect the shift cable to the manual shaft select lever at the transmission side.
10. Insert the lock piece to the adjuster (cable length adjustment).
11. Slide the cover on the adjuster and secure the lock piece.



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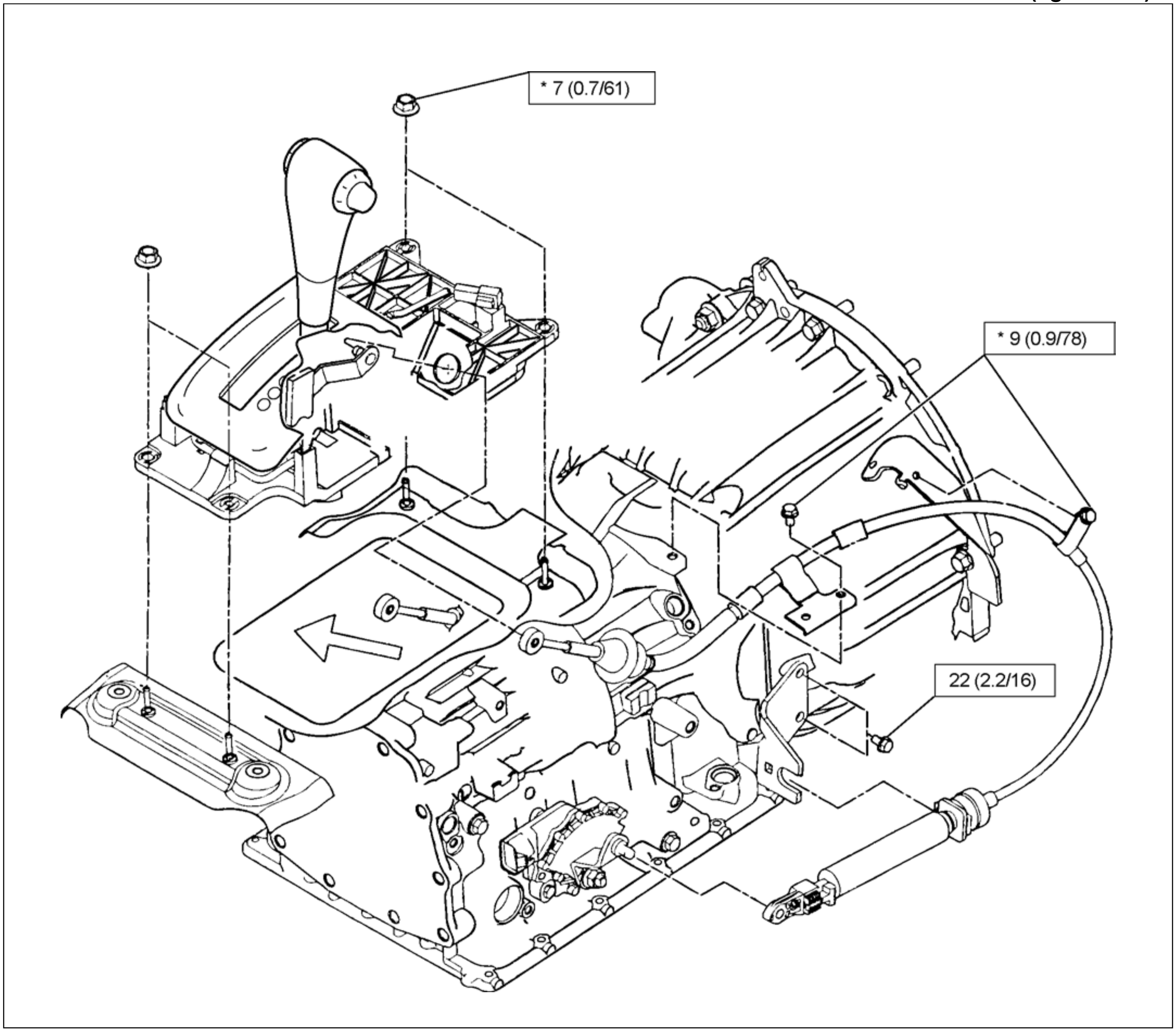
12. Press the select lever knob button 5 times at “P” position.
    Then check that the select lever moves smoothly to each of its positions.
13. Check that the shift position indicated by the select lever and the actual shift position are the same.
14. Install the front console and rear console.
15. Connect the negative battery cable.
16. Remove the wheel blocks.

Torque Specifications

∗N·m (kgf·m/lb·in)
N·m (kgf·m/lb·ft)



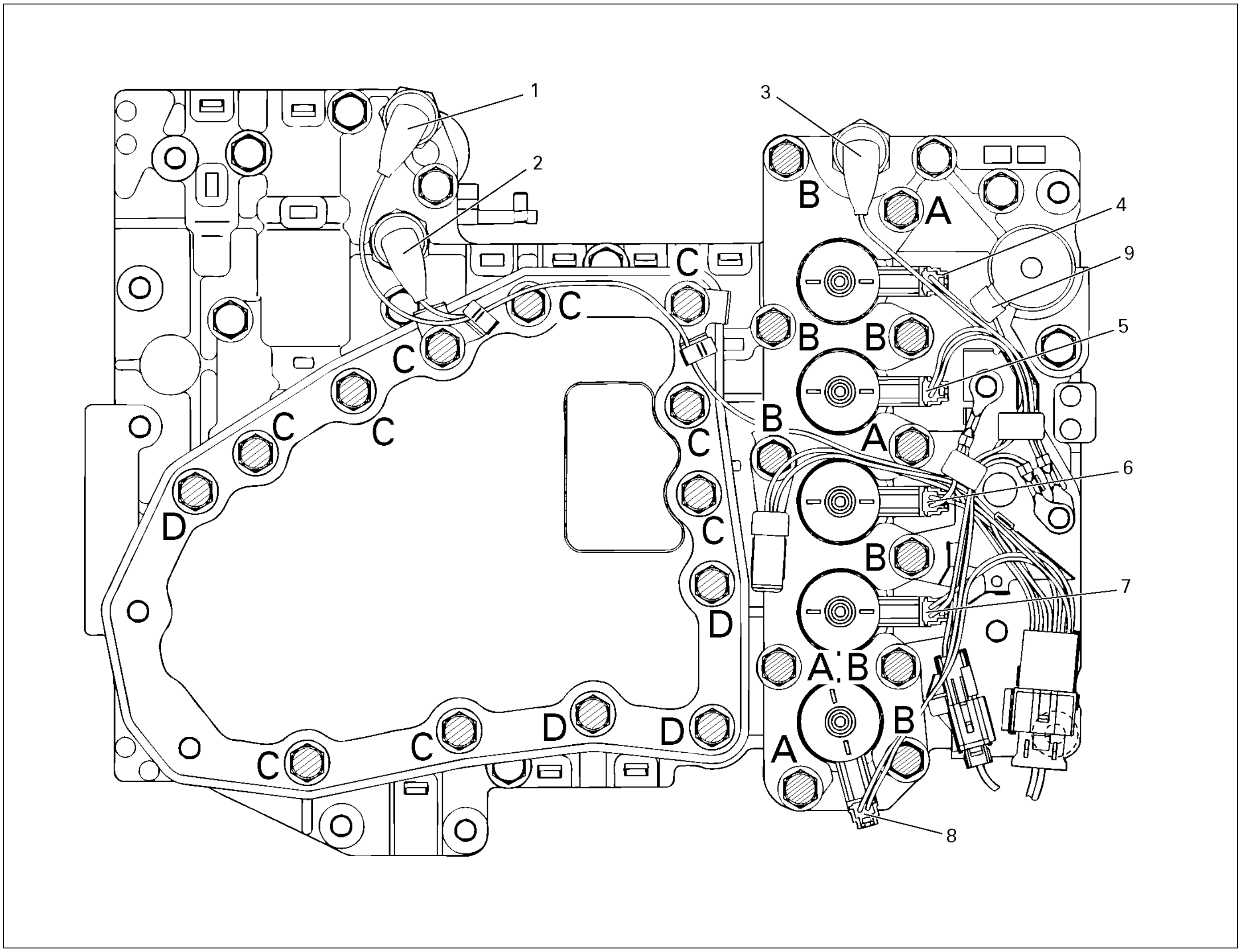
RTW77ALF000401

MAIN DATA AND SPECIFICATIONS

REAR AXLE

Ring gear size	mm (in)	ϕ194 (7.94)	ϕ220 (8.66)
Rear axle type		Banjo, semi-floating	
Rear axle capacity	N (kg/lb)	18140 (1850/4079)	
Rear axle case			
Axle tube section			
Outside diameter	mm (in)	80 (3.15)	
Thickness	mm (in)	4.5 (0.118)	
Final drive type		Single speed	
Final gear type		Hypoid	
Drive pinion bearing preload	N·m (kgf·cm/lb·in)		
Starting torque (At drive pinion flange nut)		0.6-1.1 (6.5-11.5/5.6-10.0)	0.7-1.3 (7.0-13.0/6.1-11.3)
Preload adjusting method		Collapsible	
Final gear backlash	mm (in)	0.13-0.18 (0.005-0.007)	0.15-0.20 (0.006-0.008)
Differential carrier assembly			
Weight (Dry)	kg/lb	22.0/48.5	29.0/63.9
Lubrication			
Specified gear oil (APL grade)		GL5	GL5 (STD), GL5LSD (LSD)
Oil capacity	liter (US/UK gal)	1.6 (0.42/0.35)	2.4 (0.63/0.53)

SOLENOIDS, OIL PRESSURE SWITCH AND OIL TEMPERATURE SENSOR



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Legend

1. High clutch oil pressure switch connector (wire color: Gray)
2. 2-4 brake oil pressure switch connector (wire color: Brown)
3. Low and reverse brake oil pressure switch connector (wire color: White)
4. Low and reverse brake duty solenoid connector (wire color: Pink and White)
5. High clutch duty solenoid connector (wire color: Green and Gray)
6. Lock-up duty solenoid connector (wire color: Yellow and Black)
7. 2-4 brake duty solenoid connector (wire color: Blue and Brown)
8. Low clutch duty solenoid connector (wire color: Orange and Black)
9. Line pressure solenoid connector (wire color: Pink)

Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Drain the fluid.
   Refer to “ATF CHANGE” in this section.
4. Remove the 19 bolts and oil pan.
5. Inspect the bottom of the oil pan and strainer netting for foreign material (clutch facing and metal shavings).
   If there is an excessive accumulation of foreign material, the oil strainer must be replaced.
   Further inspection is required to determine the source of the foreign material.
6. Remove the harness assembly (including the oil temperature sensor).
7. Remove the 11 bolts and the solenoid fixing plate.
8. Remove the 6 solenoids and 3 oil pressure switches.

Inspect

Oil pressure switch

Apply compressed air (390 kPa/4.0 kgf/cm^2/57 psi) to the oil pressure switch to check the oil pressure switch continuity between the connector and screw.

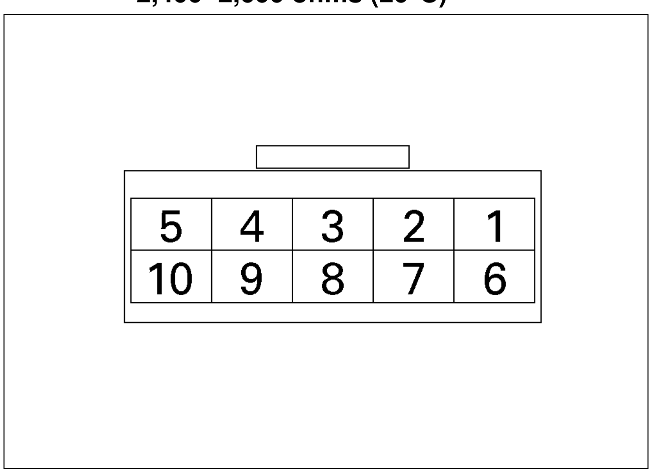
Replace the oil pressure switch if the result of inspection is abnormal.

Oil temperature sensor (harness assembly)

Check the oil temperature sensor resistance between harness terminals 7 and 6 (ground).

Oil temperature sensor resistance:

2,400~2,600 ohms (20°C)



244L300011

Solenoid

Measure the resistance of each solenoid.

Resistance:

Brown connector – 3.0~3.4 ohms (20°C)

Gray connector – 12.0~13.2 ohms (20°C)

White connector – 12.2~13.4 ohms (20°C)

Replace the solenoid if the result of inspection is abnormal.

Install or connect

1. Install the O-rings to each of the solenoids.
2. Install the 6 solenoids and 3 oil pressure switches.
   Line pressure solenoid bolt torque:
   8 N·m (0.8 kgf·m/69 lb·in)
   Oil pressure switch bolt torque:
   4 N·m (0.4 kgf·m/35 lb·in)
3. Install the solenoid fixing plate together with the harness brackets.

	Number	Length (Color)
Solenoid fixing plate bolt		
(A)	4	16 mm (0.63 in) (Gold)
(B)	7	45 mm (1.77 in) (Silver)

Bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)

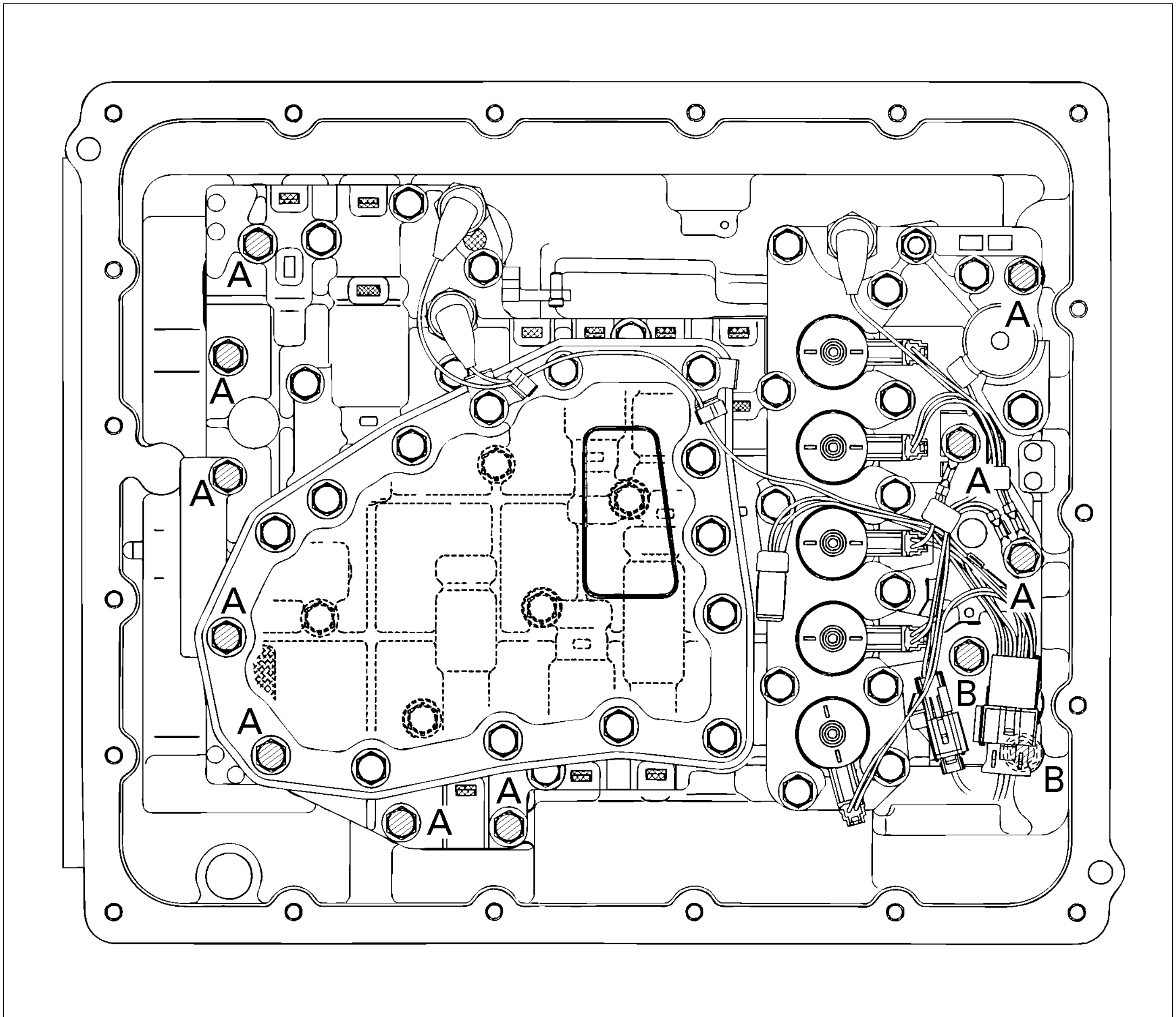
4. Install the harness assembly.
5. If removed, install the oil strainer.

	Number	Length (Color)
Oil strainer bolt		
(C)	9	13 mm (0.51 in) (Silver)
(D)	4	45 mm (1.77 in) (Silver)

Bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)

6. Install the new gasket and oil pan.
   Bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)
7. Fill the fluid.
   Refer to “ATF CHANGE” in this section.
8. Connect the negative battery cable.
9. Remove the wheel blocks.

CONTROL VALVE ASSEMBLY



244L300001

Remove or Disconnect

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Drain the fluid.
   Refer to “ATF CHANGE” in this section.
4. Remove the 19 bolts and oil pan.
5. Inspect the bottom of the oil pan and strainer netting for foreign material (clutch facing and metal shavings).
   If there is an excessive accumulation of foreign material, the oil strainer must be replaced.
   Further inspection is required to determine the source of the foreign material.
6. Disconnect the 2 harness connectors leading to the control valve.
7. Remove the 12 bolts and the control valve assembly.

Number of bolts	Length
10 (A) 2 (B)	40 mm (1.57 in) 30 mm (1.18 in)

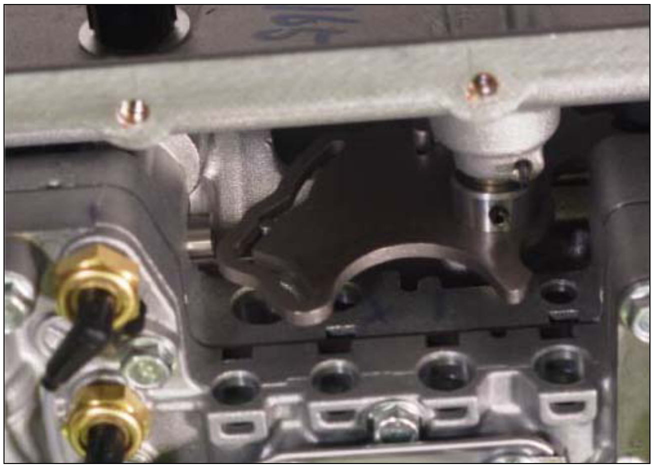
Note:

Take care not to disturb the manual valve (inside the control valve assembly).

Do not allow the pin to fall free (the pin prevents the valve from turning).

Install or Connect

1. Align the manual valve and the manual plate of the transmission case.



43ASSY119

2. Install the control valve assembly and tighten the 12 fixing bolts to the specified torque.

Number of bolts	Length	Color
10 (A)	40 mm (1.57 in)	Gold
2 (B)	30 mm (1.18 in)	Gold

Bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)

3. Connect the 2 harness connectors.
4. If removed, install the oil strainer.
   Refer to “Solenoids, Oil Pressure Switch and Oil Temperature Sensor” previously in this section.
5. Install the new gasket and oil pan.
   Bolt torque : 8 N·m (0.8 kgf·m/69 lb·in)
6. Fill with the fluid.
   Refer to “ATF CHANGE” in this section.
7. Connect the negative battery cable.
8. Remove the wheel blocks.

FLUSHING THE TRANSMISSION FLUID COOLER AND LINE

The fluid cooler and lines may be flushed under the following condition. This will help prevent more trouble after the transmission is repaired.

1. When an abnormal amount of debris is found.
2. When an abnormal wear or chips on gears and shafts is found while overhauling.
3. When there is abnormal clutch facing wear and oil contamination found.

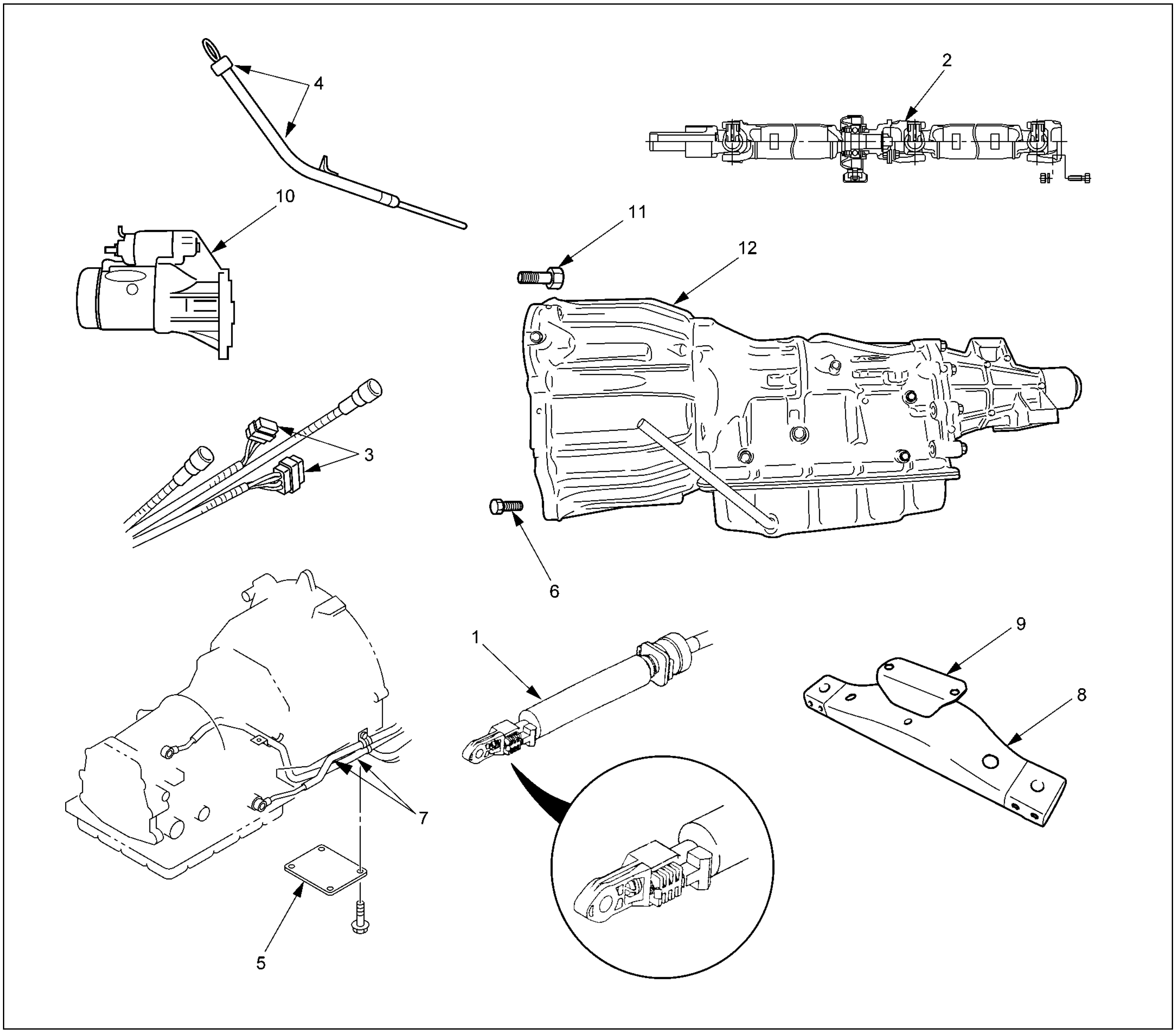
Procedures

1. Block the wheels.
2. Disconnect the negative battery cable.
3. Raise the vehicle and support it with suitable safety stands.
4. Disconnect the fluid cooler lines at the transmission case and fluid cooler.
5. Flush and back-flush the fluid cooler and lines using solvent and compressed air.

Note:
DO NOT exceed (200 kPa/2.0 kgf/cm^2/28 psi) air pressure, or damage may result to oil cooler.

6. Remove all remaining solvent from the system with compressed air.
7. Flush the cooling system again with Automatic Transmission Fluid (ATF).
   After the final flush, connect all lines.
   Cooler line joint connector torque :
   44 N·m (4.5 kgf·m/33 lb·ft)
8. Replenish the ATF.
9. Start the engine to test the system for the free flow of fluid. If the flow is restricted, the cooler assembly or lines must be replaced.
   Repeated cleaning and flushing may not remove all the debris from the fluid cooler circuit.
   Move the select lever through the various ranges and return to neutral.
   Check for fluid level.
   If the fluid level is below the specified range, ATF must be added.
10. Connect the negative battery cable.
11. Remove the safety stands.
12. Remove the wheel blocks.

TRANSMISSION ASSEMBLY



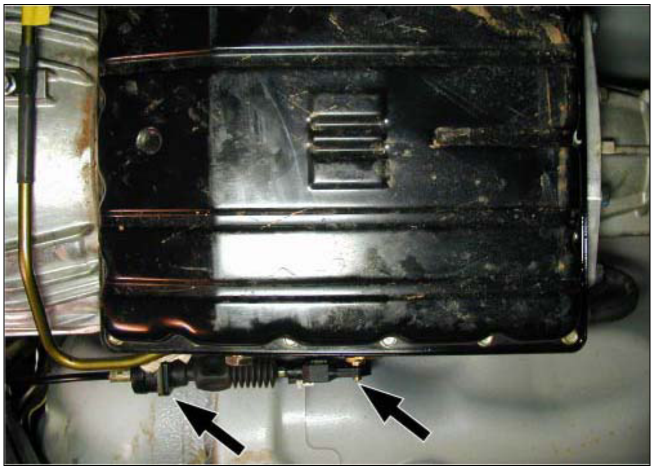
Legend

1. Shift Cable
2. Propeller Shaft
3. Engine Harness
4. ATF Level Dipstick & Filler Tube
5. Under Cover
6. Bolt
7. ATF Pipe
8. Crossmember
9. Transmission Mount
10. Starter Motor
11. Bolt
12. Automatic Transmission

Remove or Disconnect

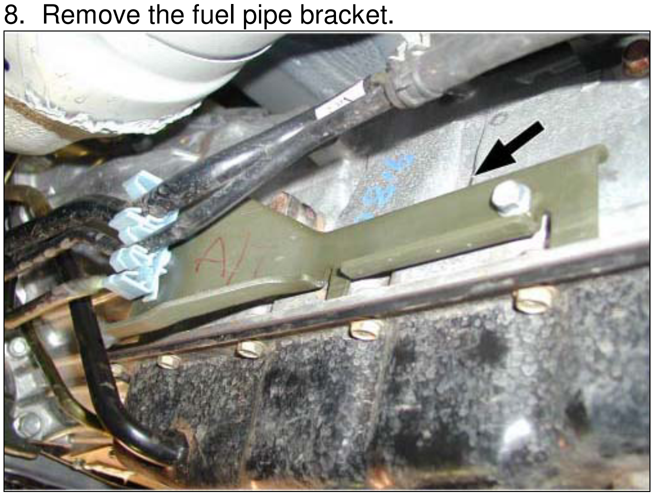
1. Block the wheels.
2. Disconnect the negative battery cable.
3. Raise the vehicle and support it with the suitable safety stands.

4. Remove the shift cable from the transmission.

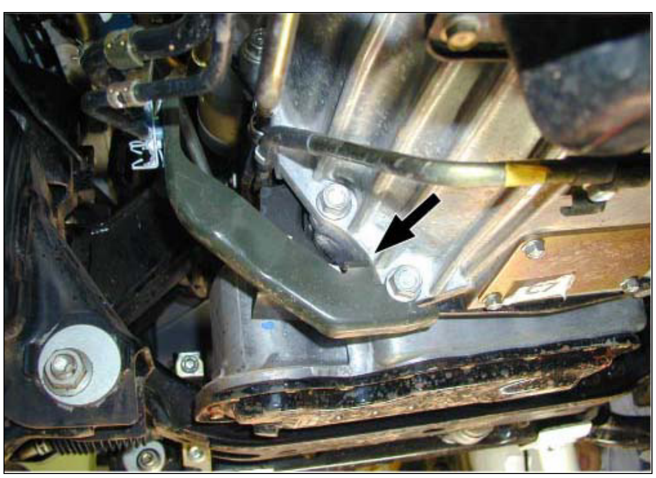


P1010068

5. Remove the rear propeller shaft assembly.
6. Loosen (do not remove) the nuts securing the exhaust manifold and the exhaust pipe.
7. Disconnect the harness connectors from the transmission.
8. Remove the fuel pipe bracket.



P1010013

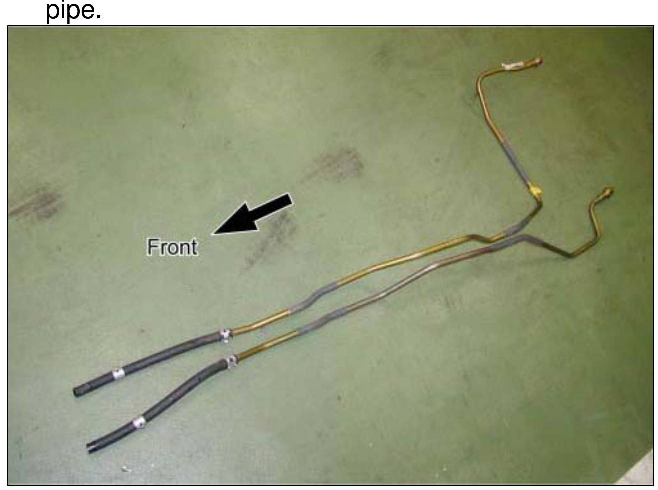


P1010014

9. Remove the ATF level dipstick and tube.
10. Remove the undercover.
11. Rotate the ring gear and remove the 6 torque converter bolts.

P1010016

12. Remove the automatic transmission fluid cooling pipe.



P1010060

13. Place a jack beneath the engine to support it.
14. Remove the 3rd crossmember.
15. Remove the transmission mount.
16. Lower the jack beneath the engine slightly to tilt the engine and transmission. Do not allow the radiator and air conditioner hoses to stretch.
17. Remove the bolts attaching the transmission to the engine.
18. Lower the transmission from beneath the vehicle. Take care not to damage the breathers.

Install or Connect

1. Install the transmission to the engine and tighten the bolts.

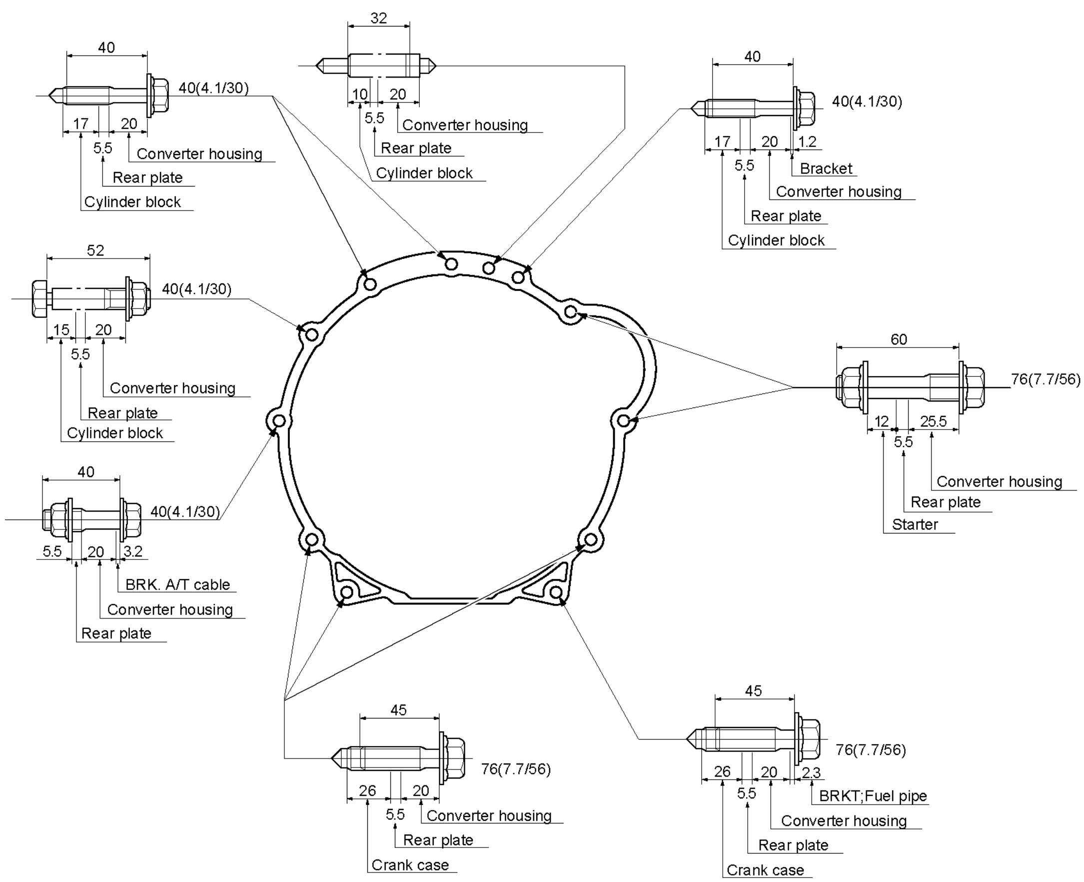
   Bolt torque : M10 40 N·m (4.1 kgf·m/30 lb·ft)
   M12 76 N·m (7.7 kgf·m/56 lb·ft)

2. Install the cable bracket to the transmission.
3. Connect the engine harness connectors.

4. Install the transmission mount.
   Bolt torque (rubber to transmission) :
   50N·m (5.1 kgf·m/37 lb·ft)
   Nut torque (rubber to crossmember) :
   52N·m (5.3 kgf·m/38 lb·ft)
5. Install the 3rd crossmember.
   Bolt and Nut torque : 67 N·m (6.8 kgf·m/49 lb·ft)
   Bolt torque : 50 N·m (5.1 kgf·m/37 lb·ft)
6. Install the automatic transmission fluid cooling pipe.
7. Install the torque converter bolts.
   Bolt torque : 29 N·m (3.0 kgf·m/22 lb·ft)
8. Install the undercover.
   Bolt torque : 9 N·m (0.9 kgf·m/78 lb·in)
9. Install the ATF level dipstick and tube.
10. Install the fuel hose bracket.
    Bolt torque : 10 N·m (1.0 kgf·m/87 lb·in)
11. Tighten the nuts securing the exhaust manifold and the exhaust pipe.
    Bolt torque : 43 N·m (4.4 kgf·m/32 lb·ft)
12. Install the rear propeller shaft assembly.
    Flange bolt torque : 59 N·m (6.0 kgf·m/43 lb·ft)
    Center bearing bracket bolt torque :
    69 N·m (7.0 kgf·m/51 lb·ft)
13. Install the shift cable.
14. Connect the negative battery cable.
15. Remove the safety stands.
16. Remove the wheels blocks.

Torque Specifications

N·m (kgf·m/lb·ft)
mm



RTW67ALF000301

SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	5-8840-2763-0	Inhibitor Switch Set Plate

SECTION 7A4

UNIT REPAIR (JR405E)

TABLE OF CONTENTS

AUTOMATIC TRANSMISSION DISASSEMBLY

Cleaning the automatic transmission

1. Use compressed steam and /or cleaning oil to thoroughly clean the outside of the transmission before disassembly.

CAUTION:
Steam under high pressure may cause dirt particles adhering to the transmission to fly through the air at great speed. These particles can cause serious eye injury. Wear protective goggles when steam-cleaning the outside of the transmission.

2. During disassembly, clean the removed parts with cleaning oil. Dry the parts with compressed air.
   Use Compressed air to clean the transmission oil holes and oil passages.

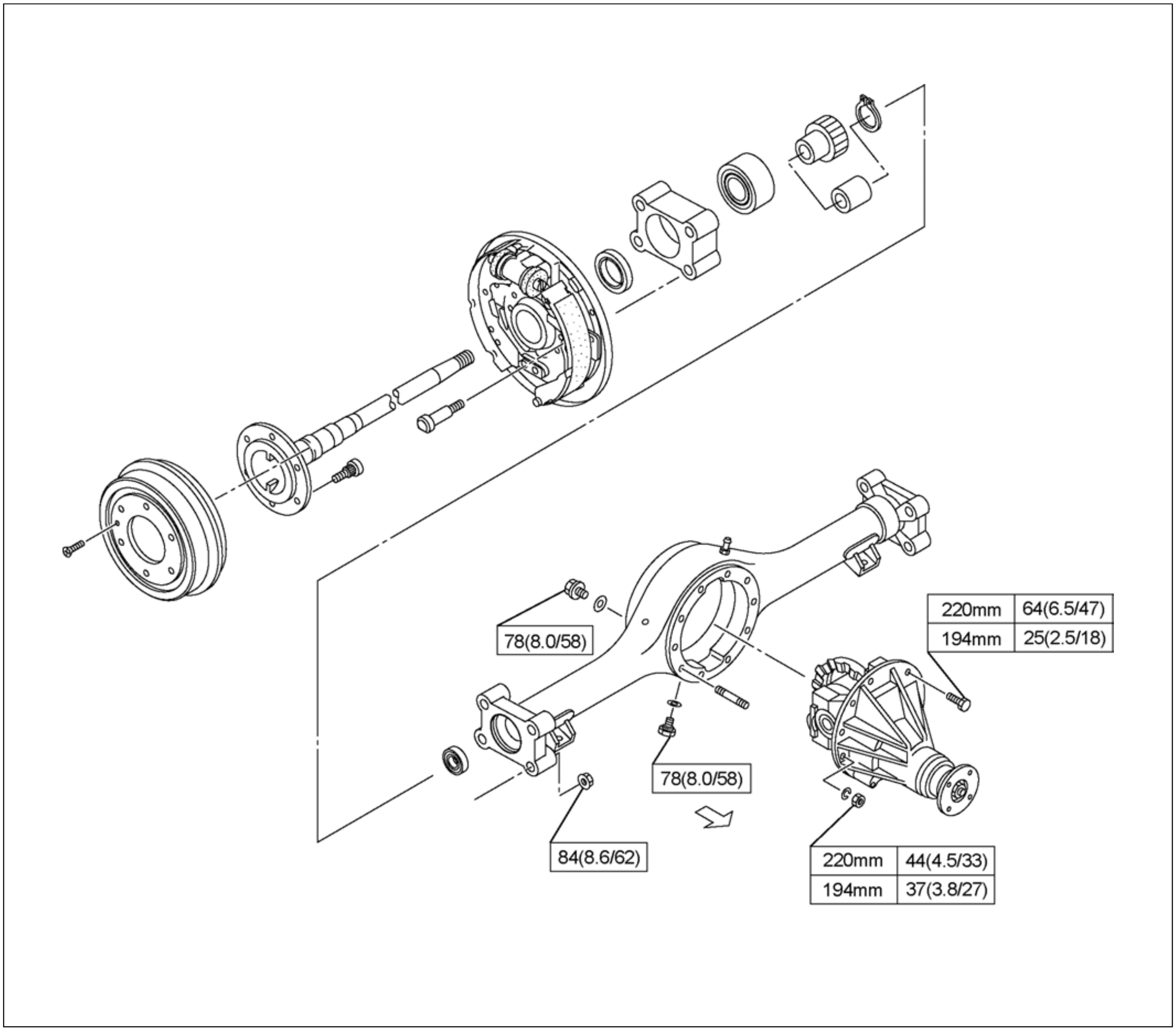
Automatic transmission disassembly cautions

- Perform the disassembly procedure in a dust-free environment to prevent the entry of foreign material into the transmission.
- Inspect each transmission part as you remove it.
- Carefully check the oil pan and the magnet for foreign material. This is a good way to estimate the transmission condition.
- Use your bare hands or vinyl gloves to disassemble the transmission. Do not use ordinary work gloves (loose threads from the gloves may fall into the transmission and cause problems).
- Use a plastic hammer to loosen the transmission case and other aluminum parts during disassembly. Strike around the parts lightly with the hammer. Do not pry aluminum parts away from each other with a screwdriver or similar object.
- Arrange the disassembled parts neatly in the order they were removed. Cover the parts with a plastic sheet or similar object to protect them from dust.

Torque Specifications

Rear Axle

N·m (kgf·m/lb·ft)



RTW74BLF000101

Disassembly steps

1. Torque converter

- Pull the torque converter free.

NOTE:
Place a pan beneath the torque converter to catch automatic transmission fluid (ATF) spillage.

- Drain the ATF from the torque converter.

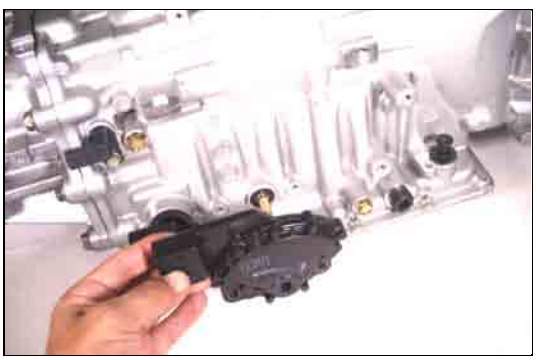

01ASSY101

2. Turbine sensor and speed sensor

- Remove the turbine sensor from the transmission case.

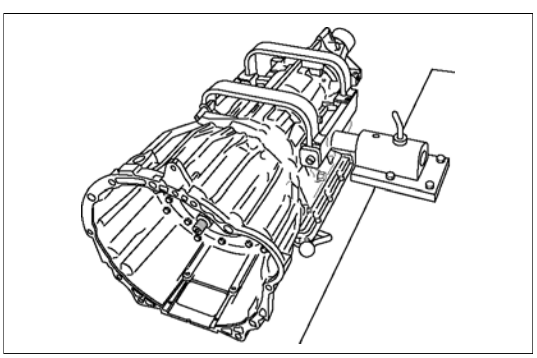

02ASSY103

- Remove the speed sensor from the transmission case.


03ASSY106

3. Inhibitor switch

Remove the 2 bolts and the inhibitor switch from the transmission case.


240L300002

4. Oil pan

- Lift and support the transmission with the holding fixture and holding fixture base.
  Holding fixture: 5-8841-0841-0
  Holding fixture base: 5-8840-0003-0
- Remove the drain plug from the oil pan and drain the ATF from the oil pan.
- Rotate the automatic transmission so that the converter housing is facing up and drain the ATF.
- Rotate the automatic transmission so that the oil pan is facing up.
- Remove the 19 bolts and the oil pan.

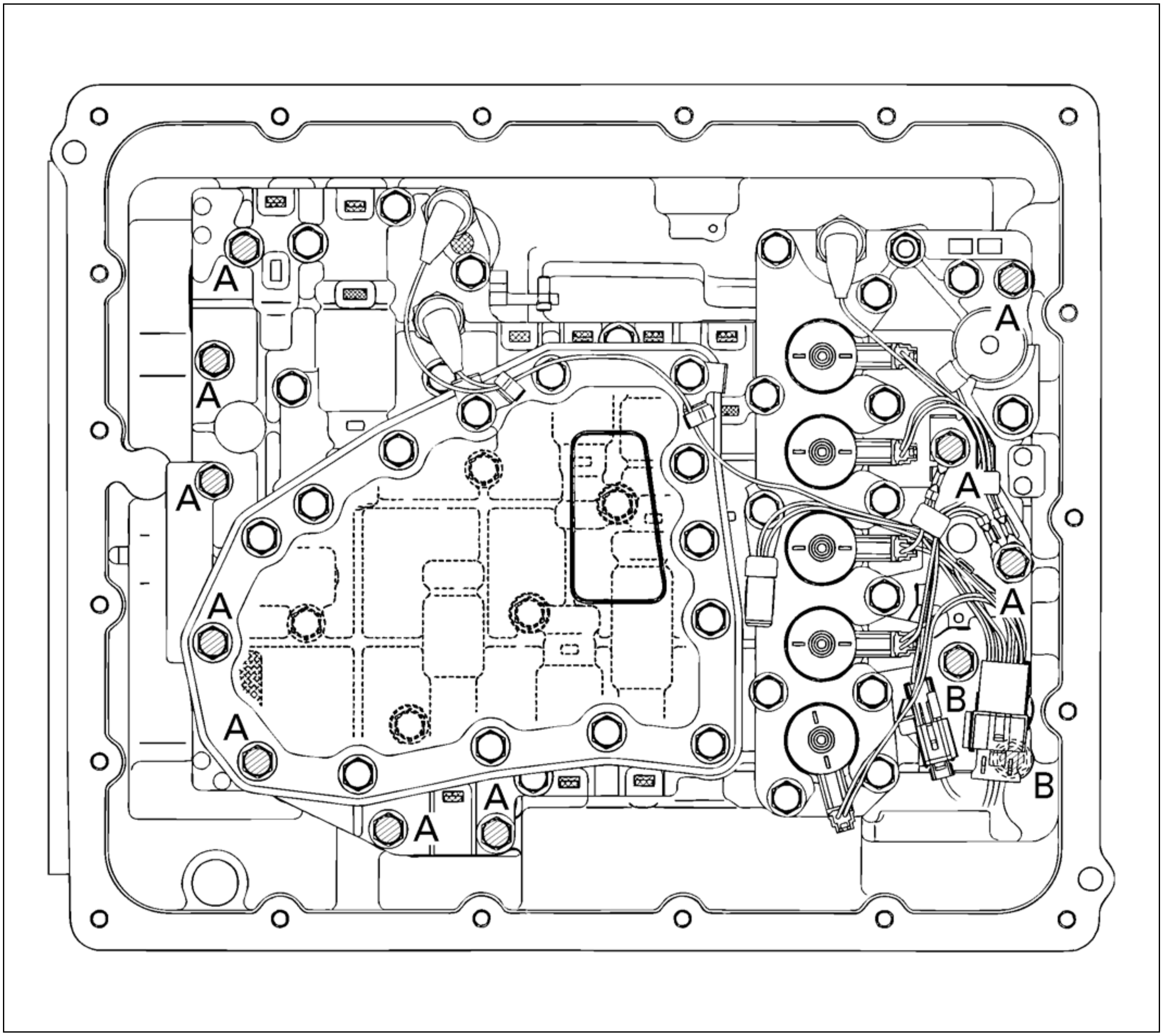
04CV37

- Inspect the bottom of the oil pan and strainer netting for foreign material (clutch facing and metal shavings).
  If there is an excessive accumulation of foreign material, the oil strainer must be replaced.
  Further inspection is required to determine the source of the foreign material.

45CV29

5. Control valve assembly

- Disconnect the 2 harness connectors leading to the control valve.



244L300001

- Remove the 12 bolts and the control valve assembly.

Number of bolts	Length
10 (A) 2 (B)	40 mm (1.57 in) 30 mm (1.18 in)


42ASSY118

NOTE:
Take care not to disturb the manual valve (inside the control valve assembly).
Do not allow the pin to fall free (the pin prevents the valve from turning).


10ASSY116

6. Converter housing

- Position the automatic transmission so that the converter housing is facing up.
- Remove the 8 bolts and the converter housing.


11ASSY068

7. O-ring

Remove the O-ring from the input shaft.


12ASSY067

8. Oil pump assembly and bearing race

- Remove the 8 bolts.
- Use a slide hammer to remove the oil pump assembly from the transmission case.

NOTE:
To prevent damage to the oil pump bolt hole threads, hand-tighten the slide hammer as far as possible.

- Remove the bearing race from the oil pump assembly.
- Inspect the bearing race surfaces for damage.


14ASSY057

9. Input shaft

Pull the input shaft free.


15ASSY049

10. Clutch pack (Reverse and high clutch assembly) and bearing

- Pull the clutch pack free.
- Remove the bearing from the clutch pack.


16ASSY047

11.High clutch hub, bearing, and bearing race
- Remove the clutch hub, bearing (with bearing race), and the bearing race.
- Remove the bearing (with bearing race) and the bearing race from the high clutch hub.
- Inspect the bearing race surfaces for damage.


17ASSY040

12.Front sun gear, bearing, and bearing race
- Remove the bearing, the front sun gear, and the bearing race.
- Remove the bearing and the bearing race from the front sun gear.
- Inspect the bearing race surfaces for damage.


19ASSY113

13.2-4 brake retainer
- Remove the brake seal ring and the sleeve.


23ASSY030

- Attach the spring compressor to the transmission case.
  Spring compressor: 5-8840-2764-0


24ASSY029

- Force out the 2-4 brake retainer and remove the snap ring.

NOTE:
Overturning the spring compressor will damage the 2-4 brake retainer.
- Remove the spring compressor.

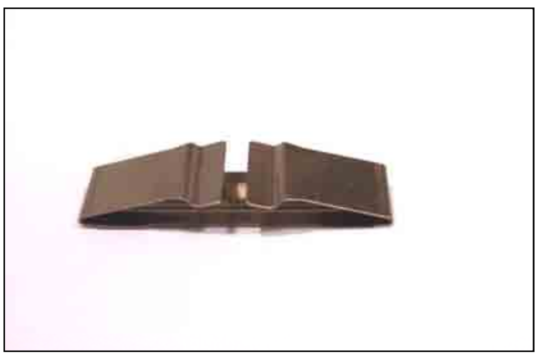
25ASSY019

- Remove the 2-4 brake retainer and return spring.

26ASSY026

14.Carrier assembly (Carrier and low clutch assembly), bearing, bearing race, and 2 – 4 brake assembly

- Pull the carrier assembly, the bearing, the bearing race and the 2-4 brake assembly (Dish plate, retaining plate, drive plate, and driven plate) from the transmission case at the same time.
- Remove the bearing, the bearing race, and the 2-4 brake assembly from the carrier assembly.



27U-SPG02

- Remove the 3 brake springs from the transmission case.

28L&R06

15.Low and reverse brake

- Remove the snap ring.
- Pull the low and reverse brake free.

16.Rear extension (2WD) or Adapter case (4WD)

- Rotate the transmission case so that the oil pan opening is facing up.
- Remove the 10 bolts and the rear extension (2WD) or the adapter case (4WD).

29ASSY091

17.Output shaft

- Pull the output shaft from the transmission case.

30ASSY089

- Remove the bearing (with bearing race) from the transmission case.

31ASSY124

18.Parking pawl, shaft, spring, and spacer

Remove the parking pawl, shaft, spring and spacer from the transmission case.

36ASSY075

19.Actuator support

Remove the actuator support from the transmission case.

37ASSY074

20.Low one-way clutch inner race and bearing

- Loosen the 7 bolts securing the low one-way clutch inner race.

NOTE:

Loosen the bolts a little at a time as uniformly as possible to prevent the inner race from tilting and becoming jammed.

- Remove the 6 bolts. Support the low one-way clutch inner race with your hand and remove the final bolt.


39ASSY006

- Remove the bearing and the low one-way clutch inner race from the transmission case.
- Remove the bearing from the low one-way clutch inner race.


40ASSY005

21.Low and reverse brake return spring

Remove the low and reverse brake return spring from the transmission case.


41L&R02

22.Low and reverse brake piston

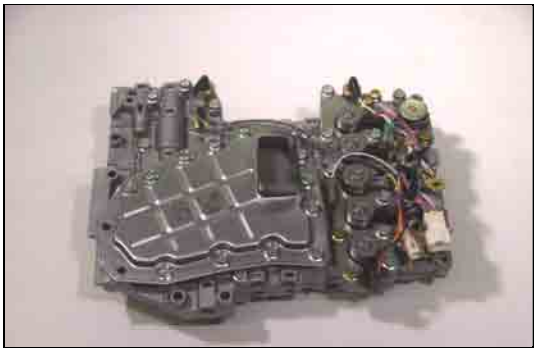
- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the transmission case oil passages.


42ASSY004

- Remove the low and reverse brake piston from the transmission case.

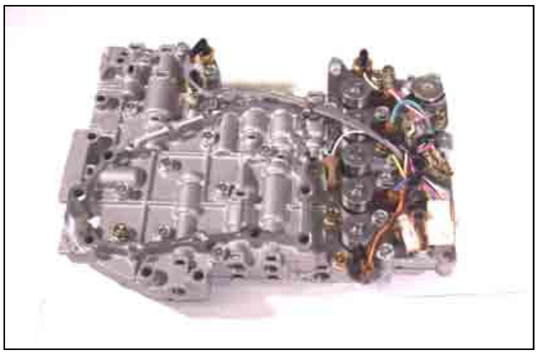
CONTROL VALVE ASSEMBLY

Disassembly steps


01CV40

1. **Oil strainer**

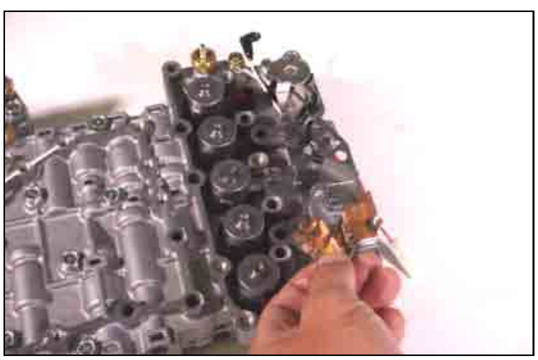
   Remove the 13 bolts and the oil strainer from the control valve assembly.


02CV26

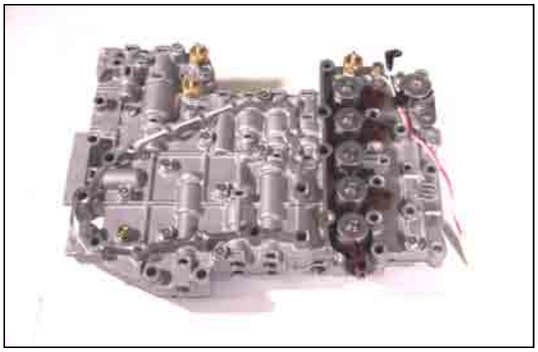
2. **Harness assembly**

   Remove the harness assembly.


04CV21


05CV20

3. **Solenoid fixing plate**
4. **Harness bracket**
   - Remove the 11 bolts and the solenoid fixing plate together with the harness bracket.

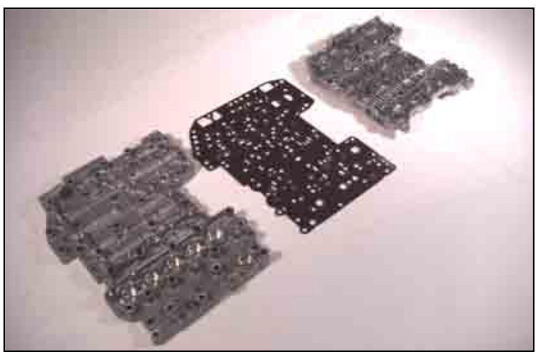

06CV19

5. **Solenoid**
6. **Oil pressure switch**

   Remove the 6 solenoids together and the 3 oil pressure switches.


07CV17

7. **Control valve upper body**
8. **Control valve lower body**
9. **Separation plate**
   - Remove the 17 bolts securing the control valve upper body, the control valve lower body, and the separation plate.


08CV16

- Separate the upper body, the lower body, and the separation plate.

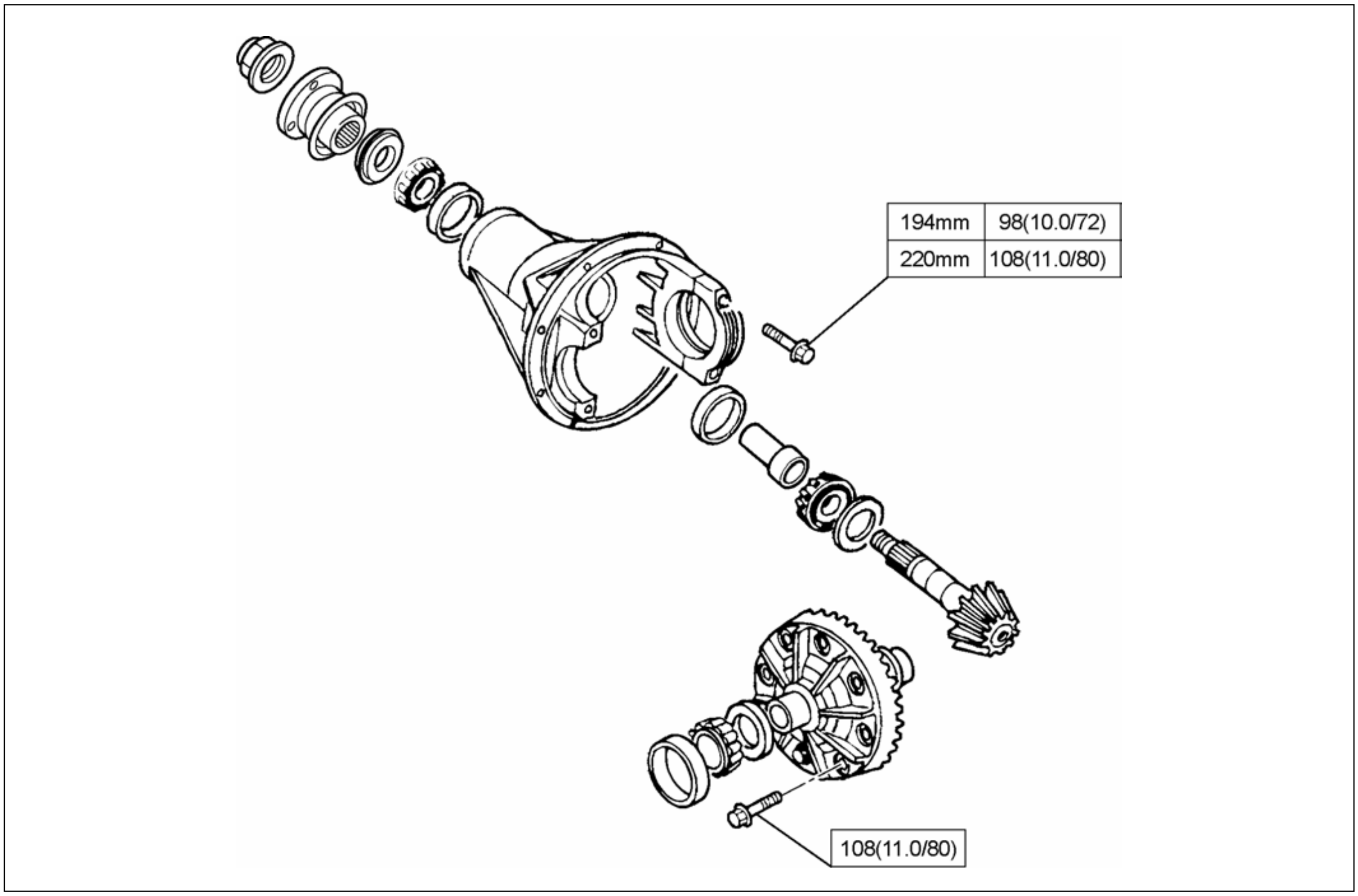
NOTE:
Take care not to drop or lose the parts at the inside of the control valve.

Inspection

- Inspect the separation plate for wear and other damage.

Differential

N·m (kgf·m/lb·ft)



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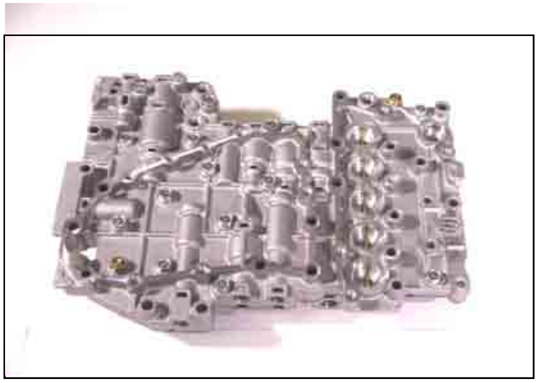


11CV18

Reassembly steps

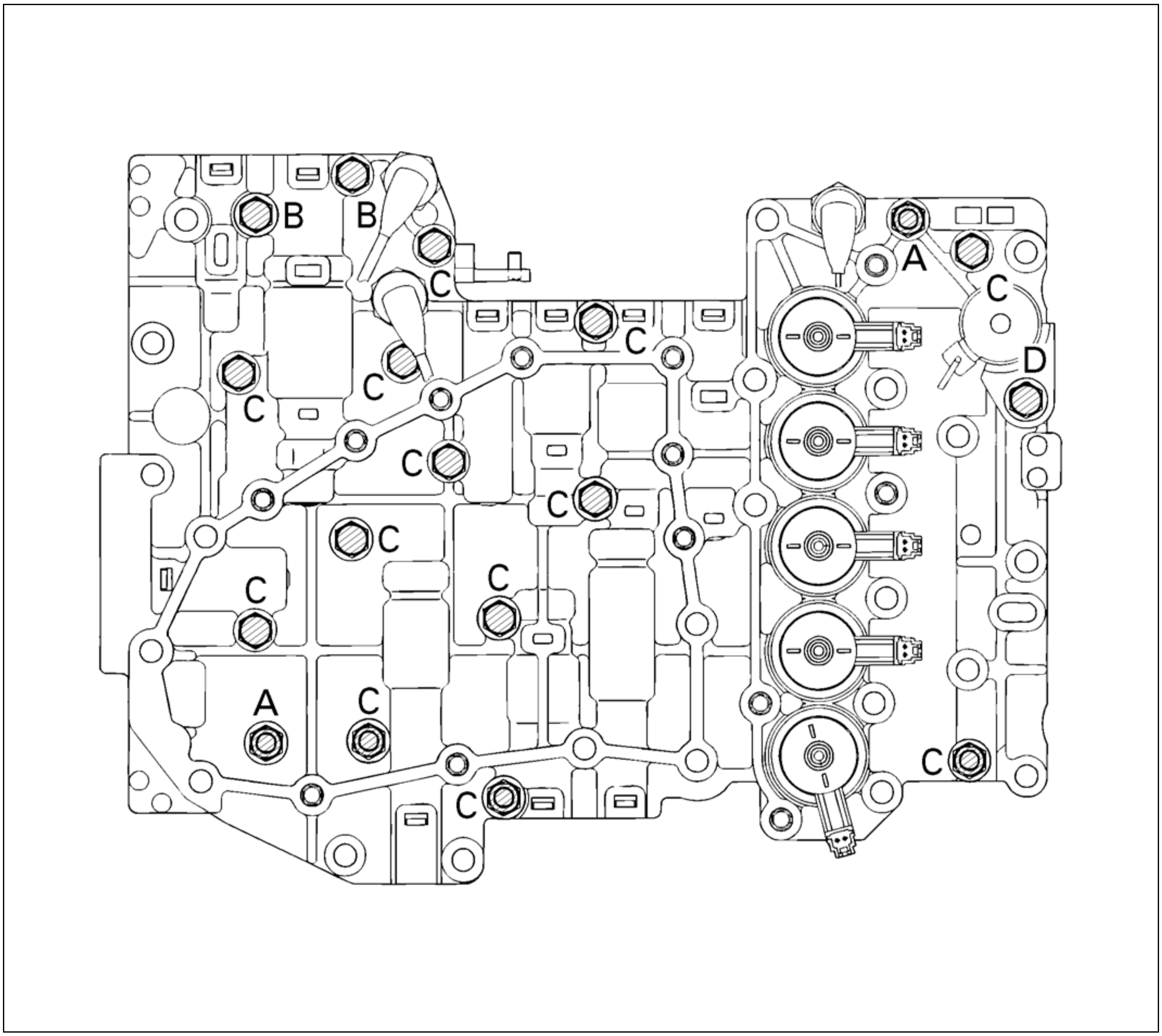
Coat the parts with ATF before installing them.

1. **Control valve upper body**
2. **Control valve lower body**
3. **Separation plate**

   Assemble the control valve upper body, the lower body, and the separation plate.

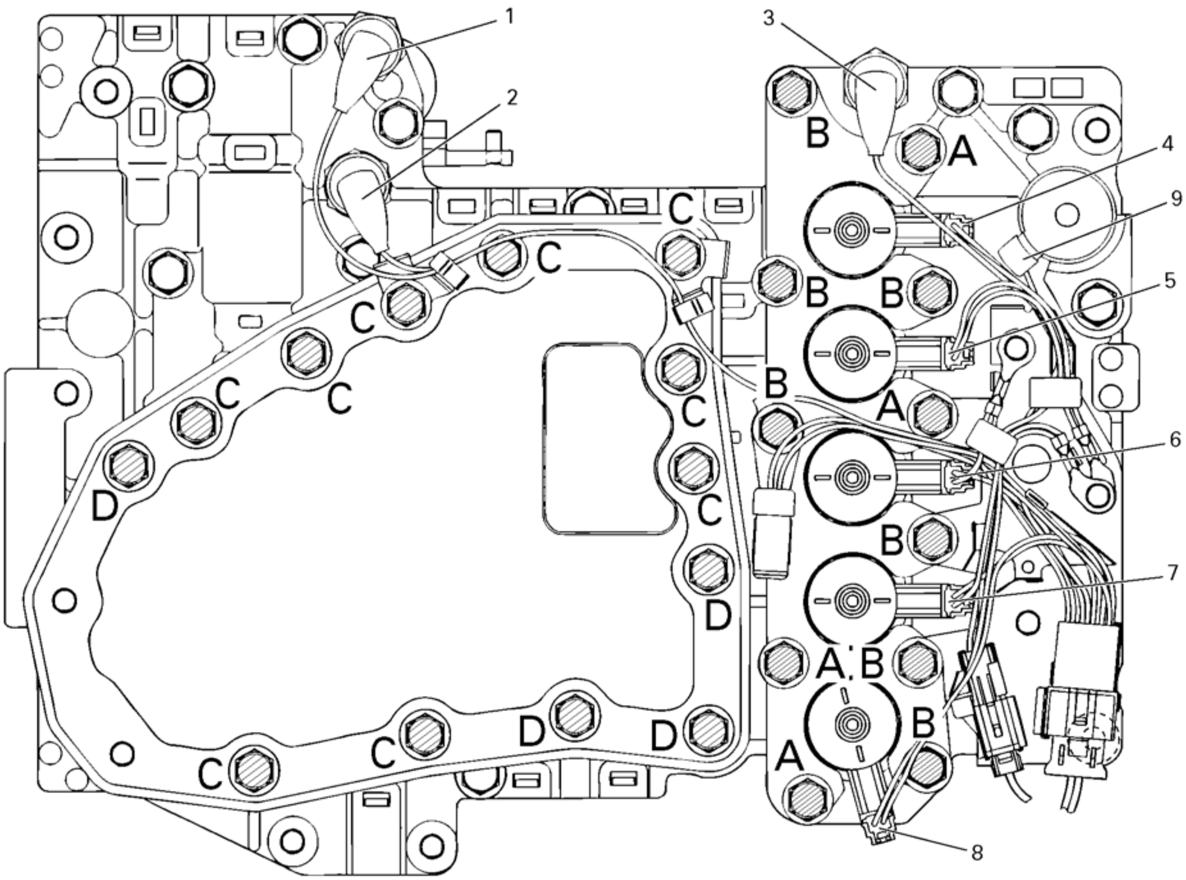
   Tighten the bolts to the specified torque.

Torque: 8 N·m (0.8 kgf·m/69 lb·in)



244L300002

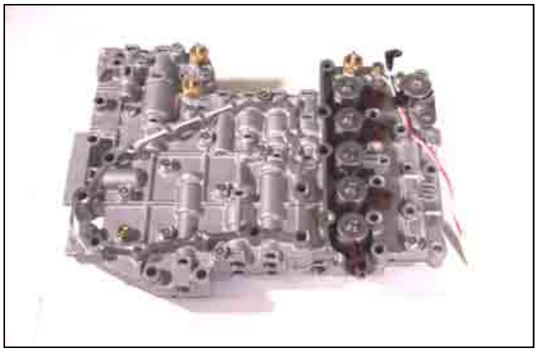
	Number	Length (Color)
Control valve rocket bolts and nuts (A)	2 (Plus 2 nuts)	50 mm (1.97 in) (Gold)
Upper body and lower body fixing bolts		
(B)	2	45 mm (1.77 in) (Silver)
(C)	13	35 mm (1.38 in) (Silver)
Line pressure solenoid fixing bolt (D)	1	16 mm (0.63 in) (Gold)



244L300003

Legend

1. High clutch oil pressure switch connector (wire color: Gray)
2. 2-4 brake oil pressure switch connector (wire color: Brown)
3. Low and reverse brake oil pressure switch connector (wire color: White)
4. Low and reverse brake duty solenoid connector (wire color: Pink and White)
5. High clutch duty solenoid connector (wire color: Green and Gray)
6. Lock-up duty solenoid connector (wire color: Yellow and Black)
7. 2-4 brake duty solenoid connector (wire color: Blue and Brown)
8. Low clutch duty solenoid connector (wire color: Orange and Black)
9. Line pressure solenoid connector (wire color: Pink)



12CV19

4. Solenoid

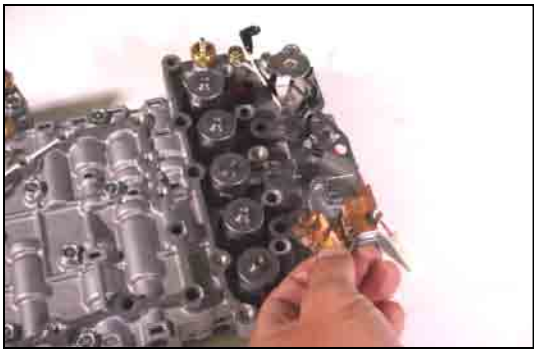
5. Oil pressure switch

- Install the O-rings to each of the solenoids.
- Install the 6 solenoids together and the 3 oil pressure switches.

NOTE:
Be sure the high clutch oil pressure switch is marked.

- Tighten the bolts to the specified torque.

Torque:
Oil pressure switch bolts – 4 N·m (0.4 kgf·m/35 lb·in)
Line pressure solenoid bolt (Single gold-colored bolt 16 mm) – 8 N·m (0.8 kgf·m/69 lb·in)



13CV20

6. Solenoid fixing plate

7. Harness bracket

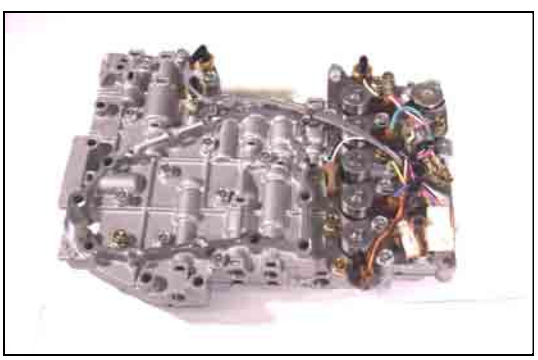
Install the solenoid fixing plate together with the harness bracket.

Tighten the bolts to the specified torque.

Torque: 8 N·m (0.8 kgf·m/69 lb·in)

	Number	Length (Color)
Solenoid fixing plate bolt		
(A)	4	16 mm (0.63 in) (Gold)
(B)	7	45 mm (1.77 in) (Silver)

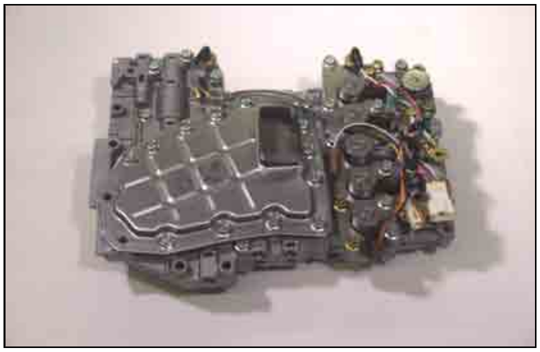
14CV21



15CV26

8. Harness assembly

Install the harness assembly.


16CV40

9. Oil strainer

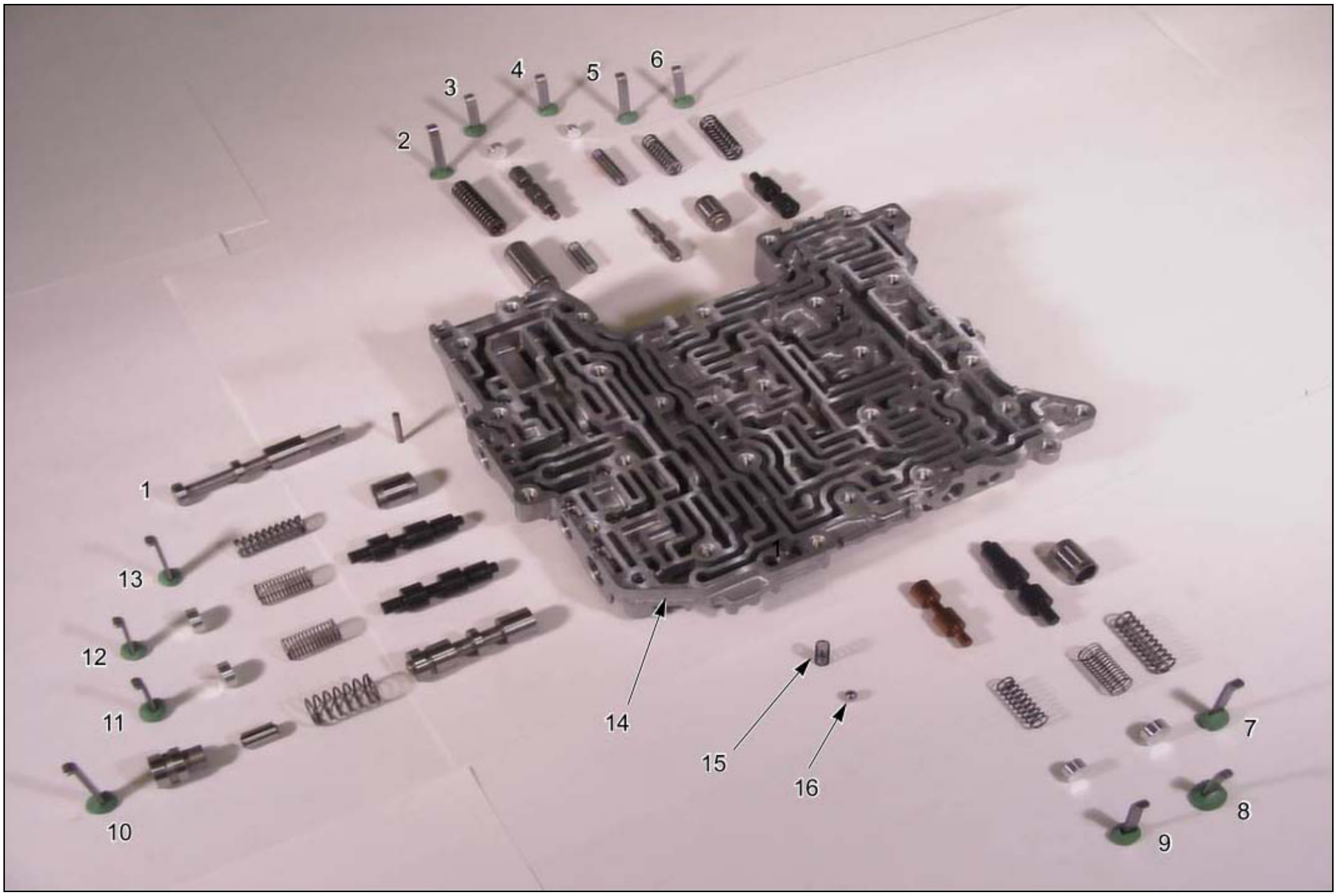
Install the oil strainer.

Tighten the bolts to the specified torque.

Torque: 8 N·m (0.8 kgf·m/69 lb·in)

	Number	Length (Color)
Oil strainer bolt		
(C)	9	13 mm (0.51 in) (Silver)
(D)	4	45 mm (1.77 in) (Silver)

CONTROL VALVE UPPER BODY



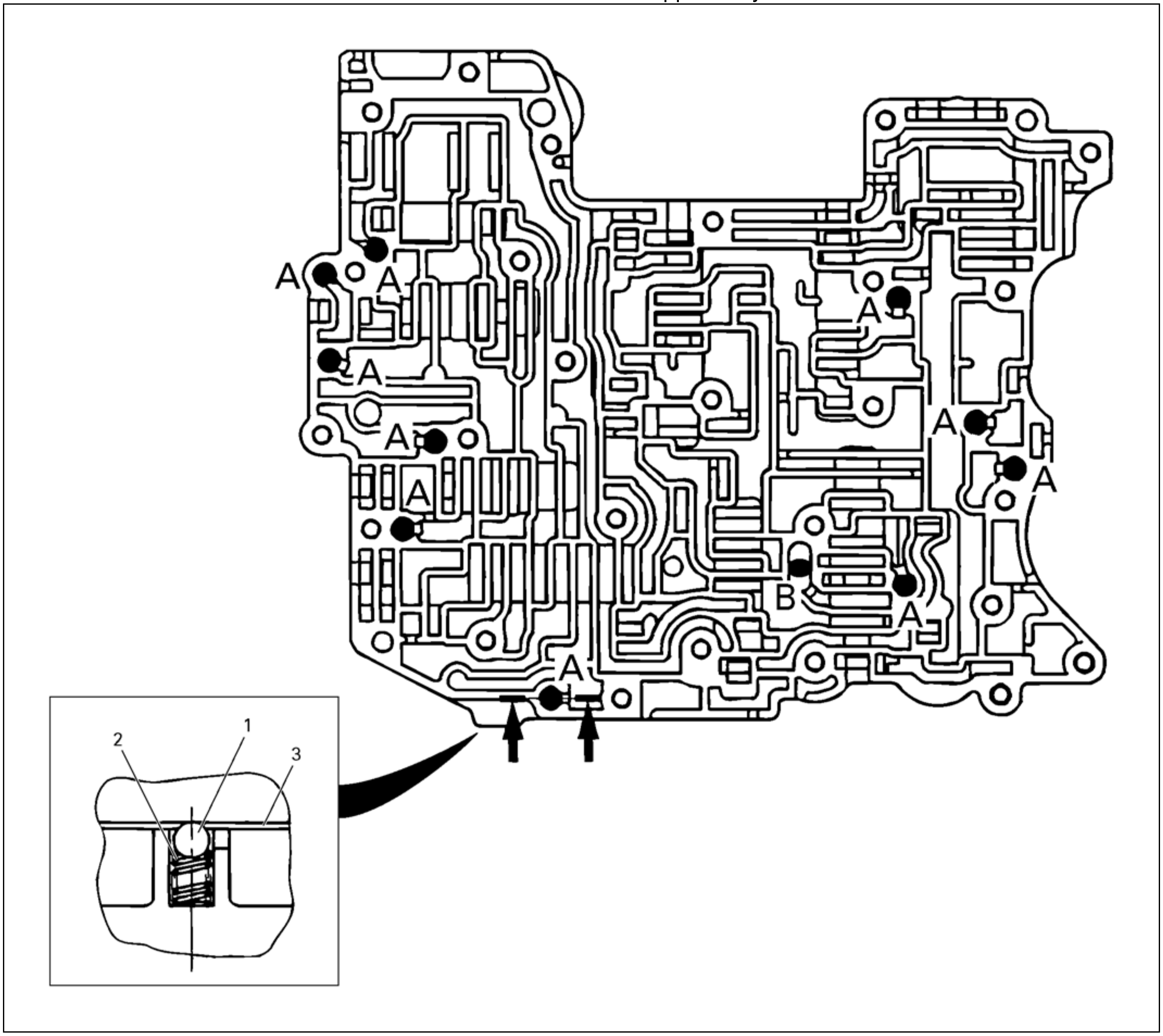
09CV02

Legend

1. Manual valve, and pin
2. Retainer plate, spring, and 2-4 brake accumulator
3. Retainer plate, plug, and low and reverse brake fail valve B
4. Retainer plate, plug, spring, and reverse stall valve
5. Retainer plate, spring, and low and reverse brake solenoid accumulator
6. Retainer plate, spring, and pilot valve
7. Retainer plate, spring, and low clutch solenoid accumulator
8. Retainer plate, plug, spring, and low clutch amp valve A
9. Retainer plate, plug, spring, and 2-4 brake fail valve B
10. Retainer plate, sleeve, plug, spring, and lock-up control valve
11. Retainer plate, plug, spring, and 2-4 brake amp valve
12. Retainer plate, plug, spring, and high clutch amp valve
13. Retainer plate, spring, and high clutch solenoid accumulator
14. Control valve upper body
15. Spring
16. Steel ball

Disassembly steps

- Remove the 11 steel balls and springs from the control valve upper body.



244L300005

Legend

1. Steel ball: A – 10 (Silver)
   B – 1 (Black)
2. Spring
3. Separation plate

- Remove the control valves from the control valve upper body.

NOTE:
Place the control valve where it will not get mixed up with the other parts.

Inspection

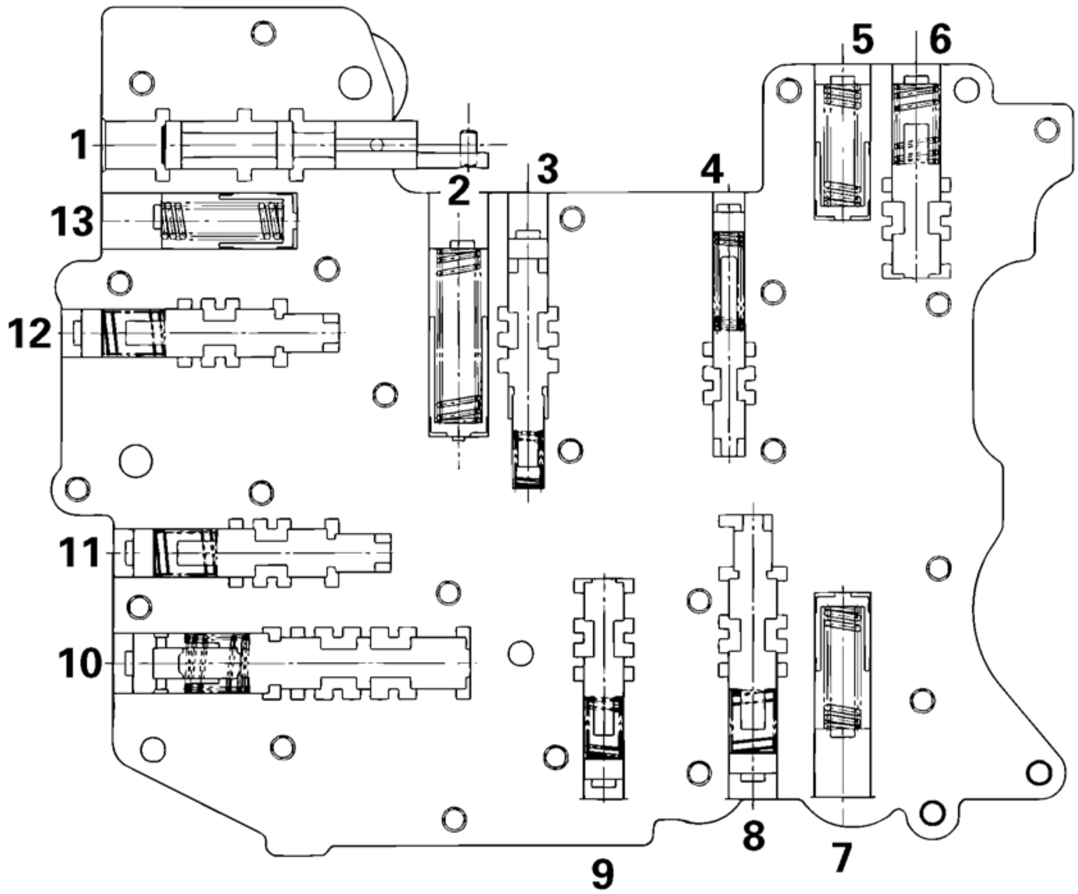
Valve

Inspect each of the valves for denting and other damage.

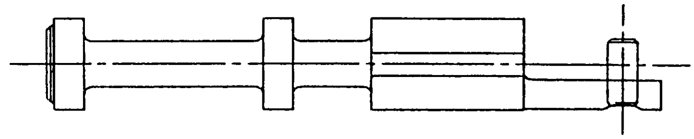
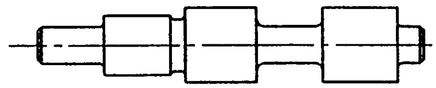
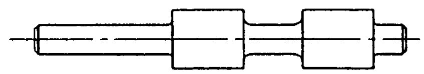
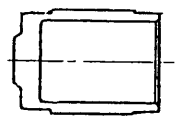
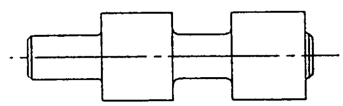
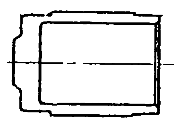
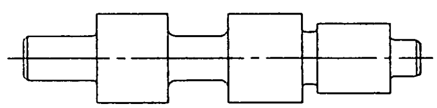
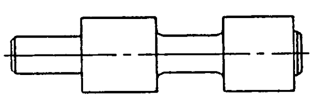
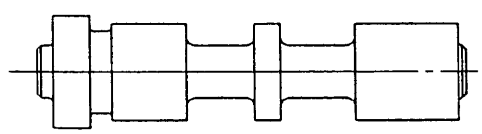
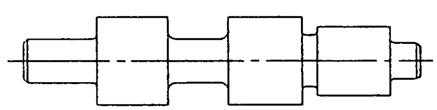
Spring

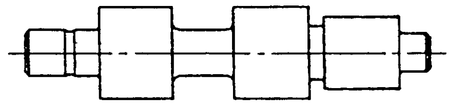
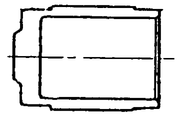
Inspect each of the springs for wear and fatigue.

Valve specifications



244L300006

No.	Valve nomenclature	Diameter (mm / in)	Length (mm / in)	Configuration
1	Manual	12.0 / 0.472	82.0 / 3.228	
2	2 – 4 brake accumulator	15.0 / 0.591	37.5 / 1.476	
3	Low and reverse brake fail (B)	10.0 / 0.394	52.0 / 2.047	
4	Reverse stall	8.0 / 0.315	50.0 / 1.969	
5	Low and reverse brake solenoid accumulator	14.0 / 0.551	19.5 / 0.768	
6	Pilot	12.0 / 0.472	38.5 / 1.516	
7	Low clutch solenoid accumulator	14.0 / 0.551	19.5 / 0.768	
8	Low clutch amp (A)	12.0 / 0.472	53.5 / 2.106	
9	2 – 4 brake fail (B)	10.0 / 0.394	39.0 / 1.535	
10	Lock-up control	12.9 / 0.508	57.5 / 2.264	
11	2 – 4 brake amp	12.0 / 0.472	53.5 / 2.106	

12	High clutch amp	12.0 / 0.472	53.5 / 2.106	
13	High clutch solenoid accumulator	14.0 / 0.551	19.5 / 0.768	

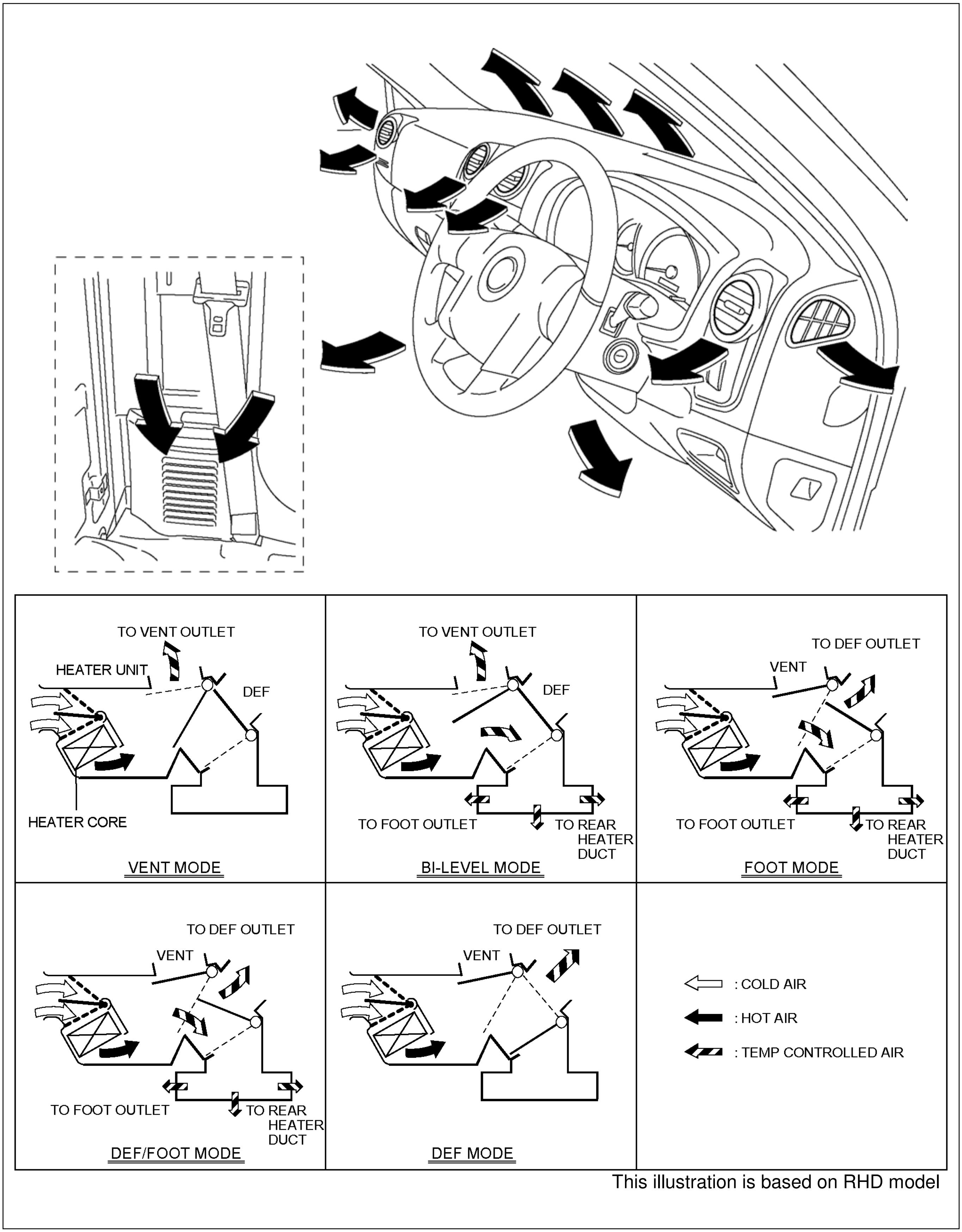
Spring specifications

No.	Valve nomenclature	Free length (mm / in)	Outside diameter (mm / in)	Linear diameter (mm / in)	Number of coils
1	Manual	----	----	----	----
2	2 – 4 brake accumulator	43.9 / 1.728	11.0 / 0.433	2.0 / 0.079	13.1
3	Low and reverse brake fail (B)	22.0 / 0.866	7.0 / 0.276	0.6 / 0.024	10.0
4	Reverse stall	31.5 / 1.240	7.0 / 0.276	1.0 / 0.039	12.8
5	Low and reverse solenoid brake accumulator	31.4 / 1.236	9.8 / 0.386	1.3 / 0.051	9.3
6	Pilot	32.0 / 1.260	11.0 / 0.433	1.3 / 0.051	9.2
7	Low clutch solenoid accumulator	31.4 / 1.236	9.8 / 0.386	1.3 / 0.051	9.3
8	Low clutch amp (A)	23.0 / 0.906	11.0 / 0.433	0.5 / 0.020	13.2
9	2 – 4 brake fail (B)	24.8 / 0.976	8.5 / 0.335	0.9 / 0.035	7.8
10	Lock-up control	27.0 / 1.063	14.0 / 0.551	1.1 / 0.043	5.7
11	2 – 4 brake amp	23.0 / 0.906	11.0 / 0.433	0.5 / 0.020	13.2
12	High clutch amp	23.0 / 0.906	11.0 / 0.433	0.5 / 0.020	13.2
13	High clutch solenoid accumulator	31.4 / 1.236	9.8 / 0.386	1.3 / 0.051	9.3

Reassembly steps

- Coat the parts with ATF before installing them.
- Install the control valve to the upper body.
- Install the 11 steel balls and springs to the upper body.

VENTILATION



RTW710MF000601 & RTW410MF000301

RECOMMENDED LIQUID GASKET

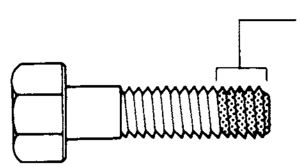
Type	Brand Name	Manufacture	Remarks
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215	Three Bond Three Bond Three Bond	For Engine Repairs For Axle Case Repairs, T/M
Water Base	ThreeBond 1141E	Three Bond	For Engine Repairs
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	Three bond Isuzu Isuzu Isuzu	For Engine Repairs
Anaerobic	LOCTITE 515 LOCTITE 518	Loctite Loctite	All

* RTV : Room Temperature Vulcanizer

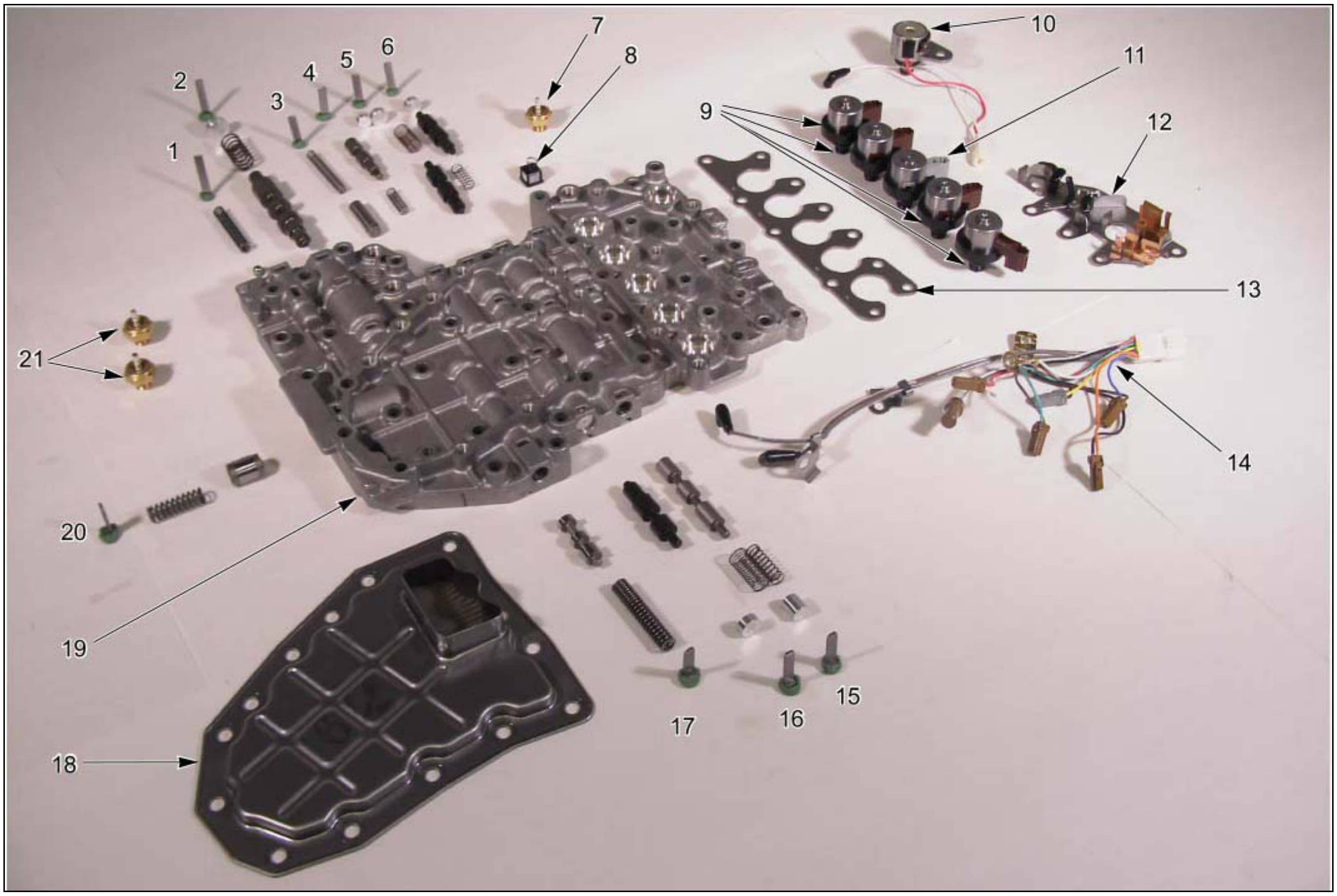
Note :

1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacture's instructions at all times.
3. **Be absolutely sure to remove all lubricants and moisture from the connecting surfaces before applying the liquid gasket.**
   The connecting surfaces must be perfectly dry.
4. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.01 in). Poor adhesion will result.

RECOMMENDED THREAD LOCKING AGENTS

LOCTITE Type	LOCTITE Color	Application Steps
LOCTITE 242	Blue	1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined. The surfaces must be perfectly dry.
LOCTITE 262	Red	2. Apply LOCTITE to the bolts. 
LOCTITE 270	Green	
LOCTITE 271	Red	3. Tighten the bolts to the specified torque. 4. Wait at least one hour before continuing the installation procedure.

CONTROL VALVE LOWER BODY

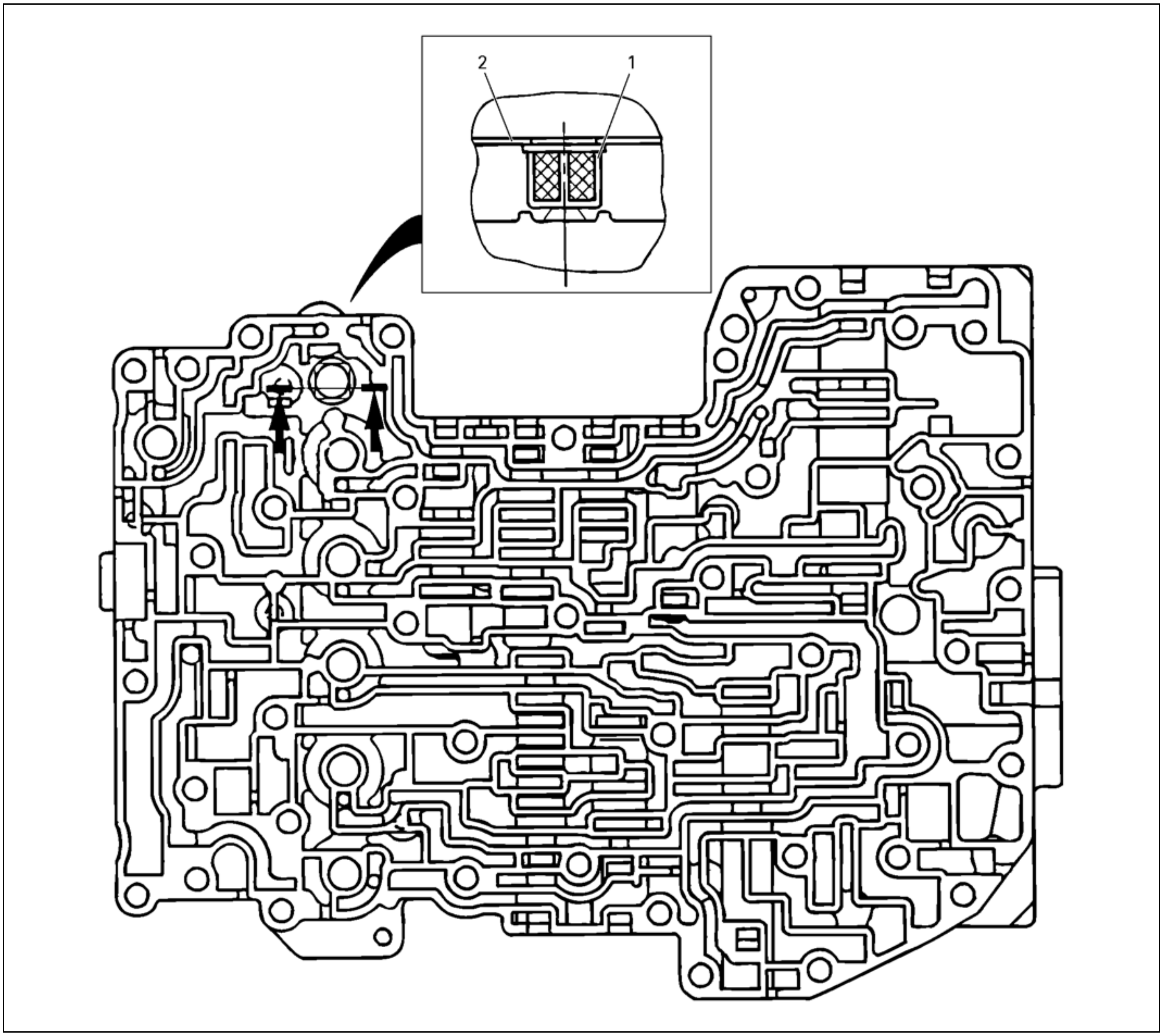


Legend

1. Retainer plate, spring, and steel ball
2. Retainer plate, plug, spring, and pressure regulator valve
3. Retainer plate, spring, and high clutch accumulator
4. Retainer plate, plug, low and reverse brake fail valve A, and spring
5. Retainer plate, plug, spring, and fail valve
6. Retainer plate, plug, low and reverse brake amp valve, and spring
7. Oil pressure switch
8. Oil filter
9. Solenoid
10. Line pressure solenoid
11. Lock-up solenoid
12. Harness bracket
13. Solenoid fixing plate
14. Harness assembly
15. Retainer plate, plug, spring, and 2-4 brake fail valve A
16. Retainer plate, plug, spring, and low clutch amp valve B
17. Retainer plate, spring, and torque converter relief valve
18. Oil strainer
19. Control valve lower body
20. Retainer plate, spring, and 2-4 brake solenoid accumulator
21. Oil pressure switch

Disassembly steps

- Remove the oil filter from the control valve lower body.



244L300009

Legend

1. Oil filter
2. Separation plate

- Remove the control valve from the control valve lower body.

NOTE:
Place the control valve where it will not get mixed up with the other parts.

Inspection

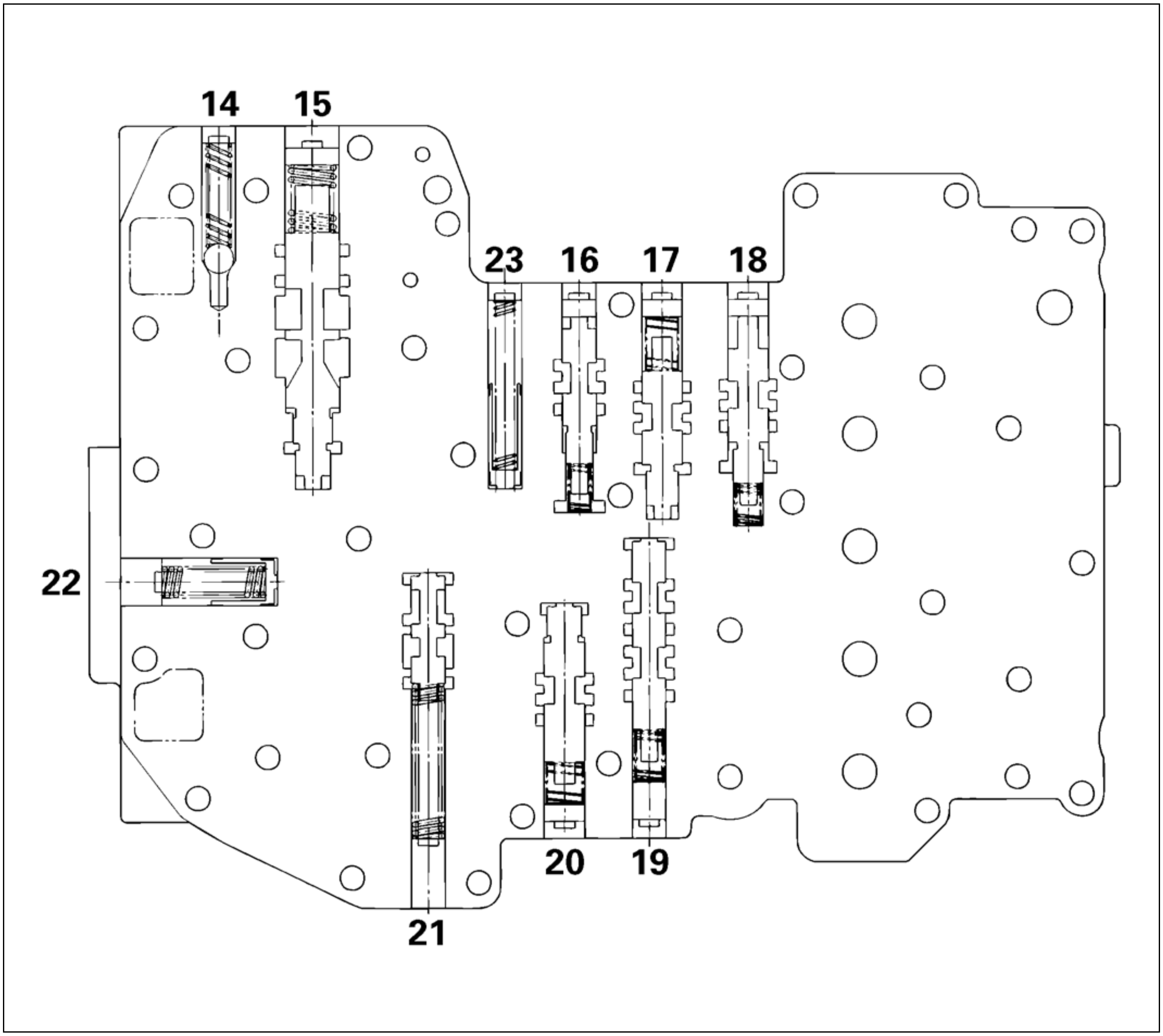
Valve

Inspect each of the valves for denting and other damage.

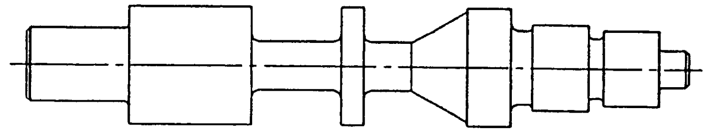
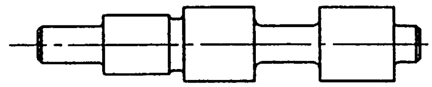
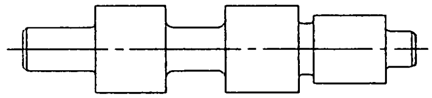
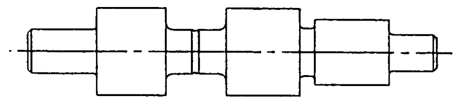
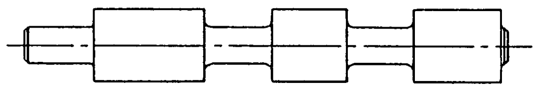
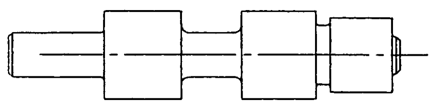
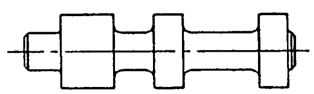
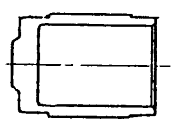
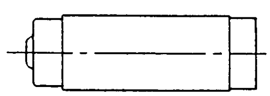
Spring

Inspect each of the springs for wear and fatigue.

Valve specifications



244L300008

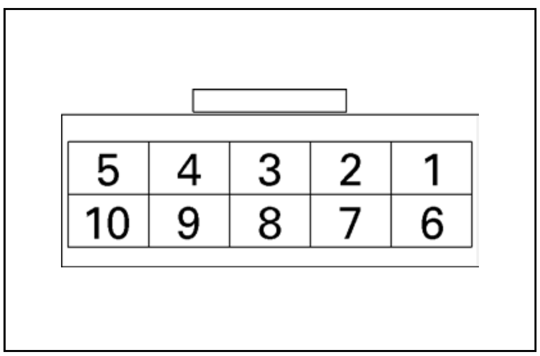
No.	Valve nomenclature	Diameter (mm / in)	Length (mm / in)	Configuration
14	Pressure relief	----	----	
15	Pressure regulator	16.0 / 0.630	89.5 / 3.524	
16	Low and reverse brake fail (A)	10.0 / 0.394	52.0 / 2.047	
17	Fail	12.0 / 0.472	53.5 / 2.106	
18	Low and reverse brake amp	12.0 / 0.472	55.5 / 2.185	
19	2 – 4 brake fail (A)	10.0 / 0.394	65.5 / 2.579	
20	Low clutch amp (B)	12.0 / 0.472	53.0 / 2.087	
21	Torque converter relief	10.0 / 0.394	37.4 / 1.472	
22	2 – 4 brake solenoid accumulator	14.0 / 0.551	19.5 / 0.768	
23	High clutch accumulator	10.0 / 0.394	31.0 / 1.220	

Spring specifications

No.	Valve nomenclature	Free length (mm / in)	Outside diameter (mm / in)	Linear diameter (mm / in)	Number of coils
14	Pressure relief	49.0 / 1.929	7.6 / 0.299	1.1 / 0.043	17.3
15	Pressure regulator	30.5 / 1.201	14.0 / 0.551	1.4 / 0.055	5.7
16	Low and reverse brake fail (A)	22.0 / 0.866	7.0 / 0.276	0.6 / 0.024	10.0
17	Fail	23.0 / 0.906	11.0 / 0.433	0.5 / 0.020	13.2
18	Low and reverse brake amp	19.5 / 0.768	7.9 / 0.311	0.5 / 0.020	6.9
19	2 – 4 brake fail (A)	24.8 / 0.976	8.5 / 0.335	0.9 / 0.035	7.8
20	Low clutch amp (B)	26.0 / 1.024	11.0 / 0.433	0.5 / 0.020	6.9
21	Torque converter relief	More than 47.2 / 1.858	9.2 / 0.362	1.6 / 0.063	20.2
22	2 – 4 brake solenoid accumulator	31.4 / 1.236	9.8 / 0.386	1.3 / 0.051	9.3
23	High clutch accumulator	51.0 / 2.008	6.5 / 0.256	0.8 / 0.031	23.5

Oil pressure switch

Apply compressed air (390 kPa/4.0 kgf/cm^2/57 psi) to the oil pressure switch to check the oil pressure switch continuity between the connector and screw.



244L300011

Oil temperature sensor (harness assembly)

Check the oil temperature sensor resistance between harness terminals 7 and 6 (ground).

Oil temperature sensor resistance: 2,400～2,600 ohms (20°C)

Solenoids

Measure the resistance of each solenoid.

Resistance:
Brown connector – 3.0~3.4 ohms (20°C)
Gray connector – 12.0~13.2 ohms (20°C)
White connector – 12.2~13.4 ohms (20°C)

Reassembly steps

- Coat the parts with ATF before installing them.
- Install the control valve to the control valve lower body.
- Install the oil filter to the control valve lower body.

OIL PUMP ASSEMBLY

01PUMP32

Legend

1. Oil seal
2. O-ring (small)
3. Oil pump housing
4. Inner rotor
5. Outer rotor
6. Oil pump cover
7. O-ring (large)
8. Seal ring (large)
9. Seal ring (small)
10. Bearing race

02PUMP07

Disassembly steps

1. **Oil pump cover**
2. **Oil pump housing**
   - Loosen the 8 bolts evenly a little at a time.


04PUMP10

- Separate the oil pump cover from the oil pump housing by tapping on each of the bolts with a plastic hammer.


06PUMP13

3. Inner rotor

Remove the inner rotor from the oil pump housing.


07PUMP14

4. Outer rotor

Remove the outer rotor from the oil pump housing.


15PUMP18

5. O-ring (small)

Remove the O-ring (small) from the oil pump housing.


08PUMP09

6. O-ring (large)

Remove the O-ring (large) from the oil pump cover.

09PUMP05

7. Seal ring

Remove the 4 seal rings from the oil pump cover.

11PUMP43

Inspection

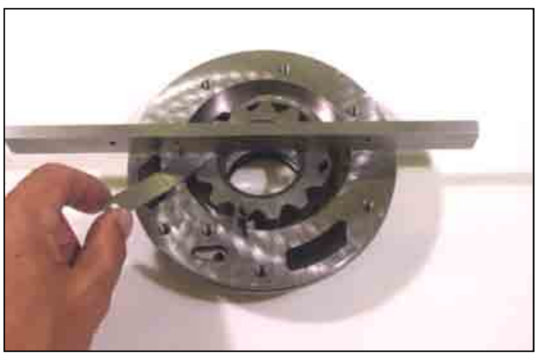
Oil pump cover

- Install new seal rings to the oil pump cover.

NOTE:

The seal ring with the large inside diameter fits into the primary mating surface of the cover.

- Measure the gap between the seal ring and the seal ring groove.
  If the measured gap is outside the specified range, the oil pump cover must be replaced.
  Seal ring and seal ring groove gap: 0.10~0.25 mm (0.0039~0.0098 in)



12PUMP45

Inner rotor

- Install the inner rotor to the oil pump housing.
- Use a straight edge to measure the side clearance between the oil pump housing and the inner rotor.
  If the measured clearance is outside the specified range, the inner rotor must be replaced.
  Oil pump housing and inner rotor side clearance: 0.02~0.04 mm (0.0008~0.0016 in)

13PUMP46

Outer rotor

- Install the outer rotor to the oil pump housing.
- Measure the gap between the outer rotor and the crescent.
  If the measured gap is outside the specified range, the outer rotor must be replaced.
  Outer rotor and crescent gap: 0.02~0.15 mm (0.0008~0.0059 in)

Reassembly steps

15PUMP18

1. **O-ring (small)**
   Install new O-ring (small) to the oil pump housing.

16PUMP29

2. **Outer rotor**
3. **Inner rotor**
   Install the outer rotor and the inner rotor to the oil pump housing.

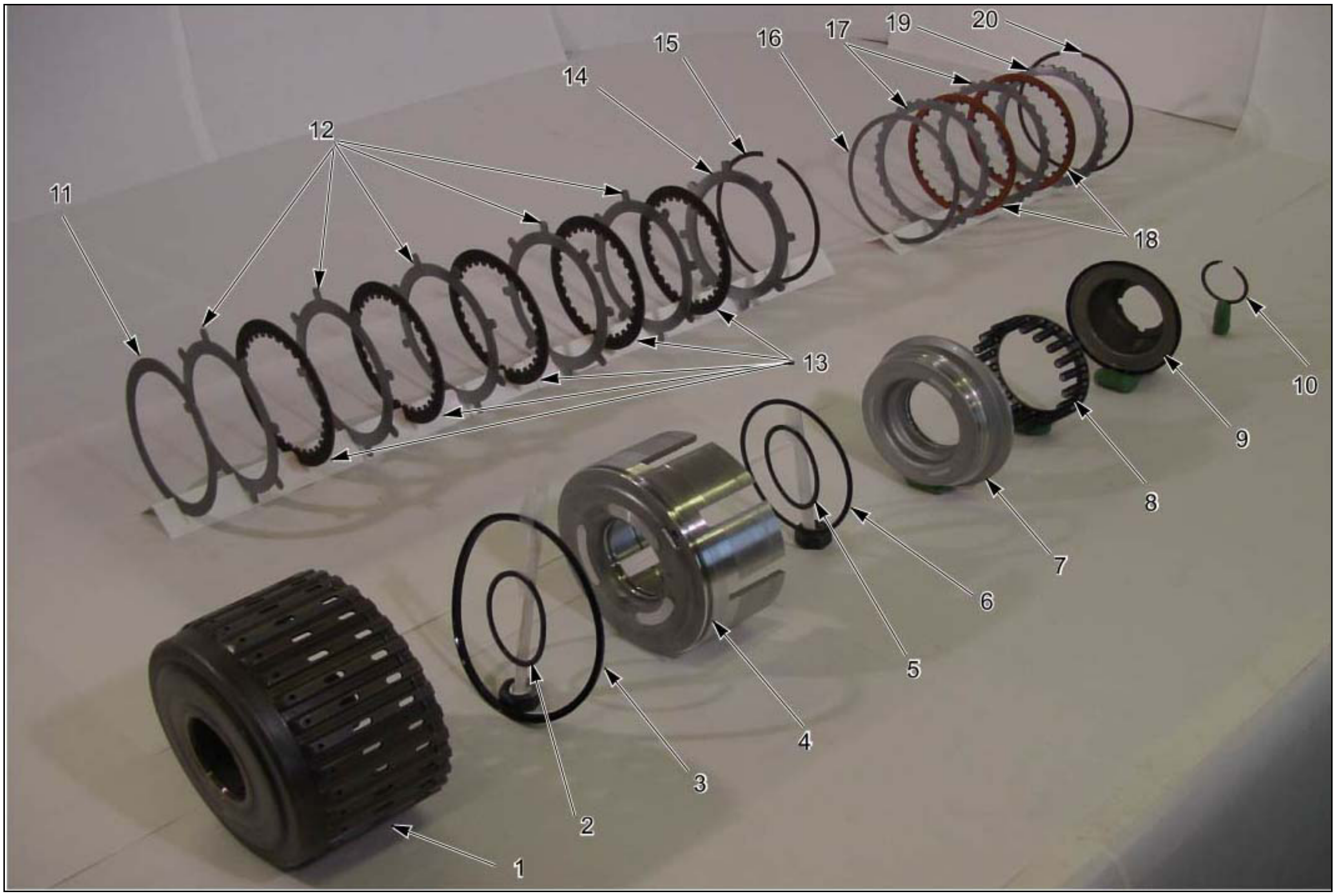
17PUMP42

NOTE:
The identification mark on the inner rotor must be facing the inside of the oil pump housing.

18PUMP07

4. **Oil pump cover**
5. **Oil pump housing**
   Install the oil pump cover to the oil pump housing.
   Tighten the 8 bolts to the specified torque.
   Torque: 9 N·m (0.9 kgf·m/78 lb·in)
6. **O-ring (large)**
   Install the O-ring (large) to the oil pump cover.
7. **Seal ring**
   Install the 4 seal rings to the oil pump cover.

CLUTCH PACK (REVERSE AND HIGH CLUTCH ASSEMBLY)



01R&H17

Legend

1. Reverse and high clutch drum
2. Seal ring (reverse clutch)
3. Lip seal (reverse clutch)
4. Reverse clutch piston
5. Seal ring (small, high clutch)
6. Seal ring (large, high clutch)
7. High clutch piston
8. Return spring
9. High clutch cover
10. Snap ring
11. Dish plate (high clutch)
12. Driven plate (5, high clutch)
13. Drive plate (5, high clutch)
14. Retaining plate (high clutch)
15. Snap ring (high clutch)
16. Dish plate (reverse clutch)
17. Driven plate (2, reverse clutch)
18. Drive plate (2, reverse clutch)
19. Retaining plate (reverse clutch)
20. Snap ring (reverse clutch)

02R&H18

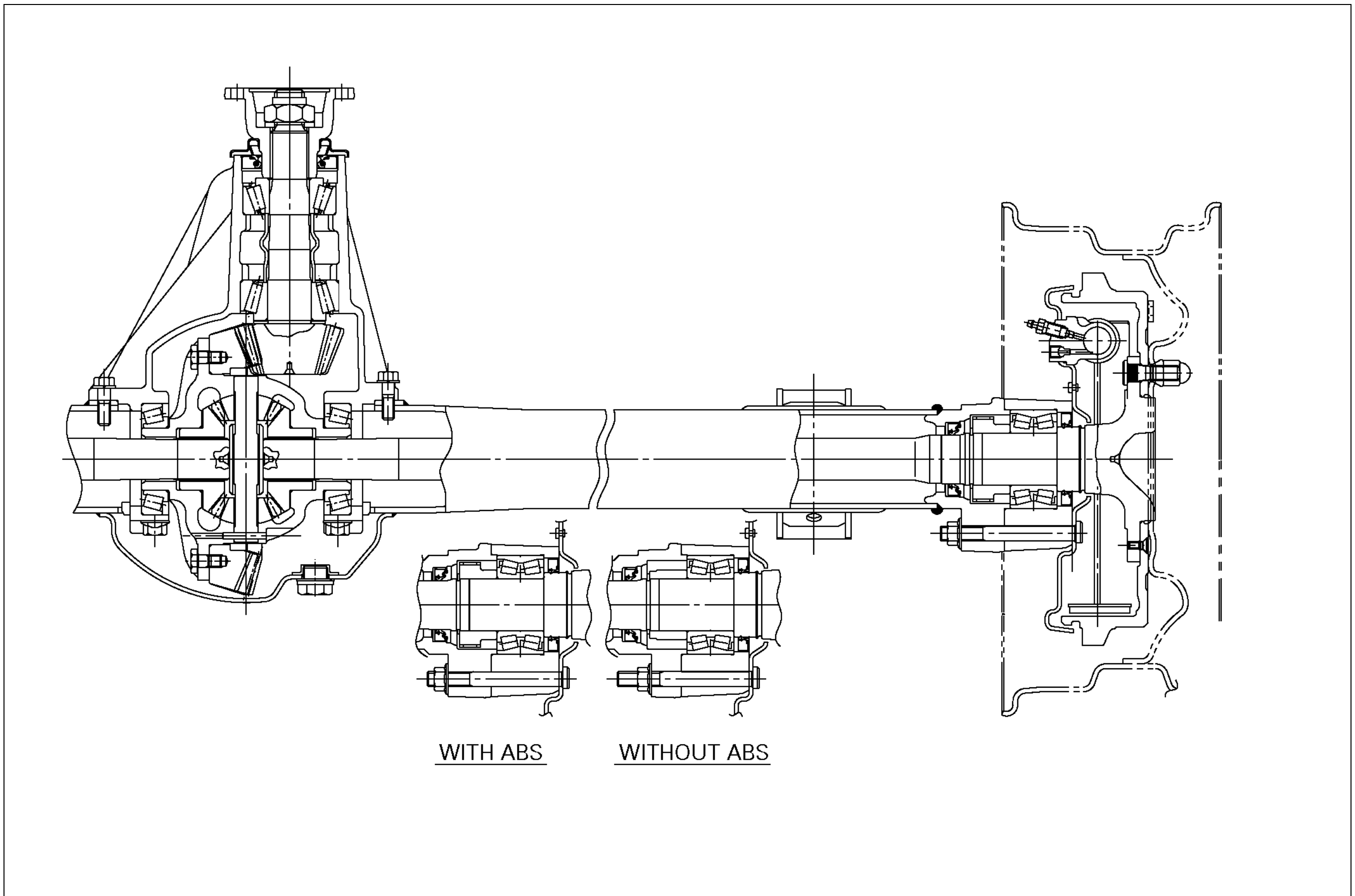
Disassembly steps

1. Snap ring

Remove the reverse clutch snap ring.

REAR AXLE ASSEMBLY

General Description



The rear axle assembly is of the semi–floating type in which the vehicle weight is carried on the axle housing .

The center line of the pinion gear is below the center line of the ring gear (hypoid drive).

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a banjo type axle housing.

The ϕ220 mm (8.6 in) or ϕ194mm (7.6 in) ring gear rear axle uses a conventional ring and pinion gear set to transmit the driving force of the engine to the rear wheels. This gear set transfers this driving force at a 90 degree angle from the propeller shaft to the drive shafts.

The axle shafts are supported at the wheel end of the shaft by a double tapered roller bearing.

The pinion gear is supported by two tapered roller bearings. The pinion depth is set by a shim pack located between the gear end of the pinion and the roller bearing that is pressed onto the pinion. The pinion bearing preload is set by crushing a collapsible spacer between the bearings in the axle housing.

The ring gear is bolted onto the differential cage with 12 bolts.

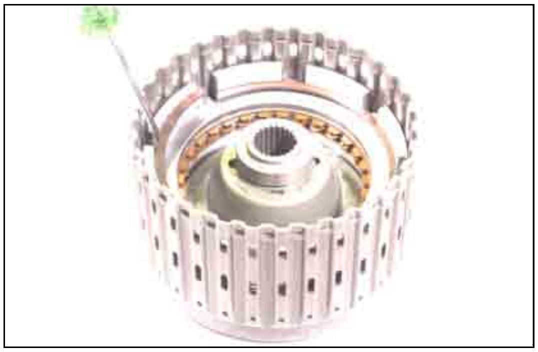
The differential cage is supported in the axle housing by two tapered roller bearings. The differential and ring gear are located in relationship to the pinion by using selective shims and spacers between the bearing and the differential cage. To move the ring gear, shims are deleted from one side and an equal amount are added to the other side. These shims are also used to preload the bearings, which are pressed onto the differential cage. Two bearing caps are used to hold the differential into the rear axle housing.

The differential is used to allow the wheels to turn at different rates of speed while the rear axle continues to transmit the driving force. This prevents tire scuffing when going around corners and prevents premature wear on internal axle parts.

The rear axle is sealed with a pinion seal, a seal at each axle shaft end, and by a liquid gasket between the differential carrier and the axle housing.


03R&H21

2. **Retaining plate, drive plates, driven plates and dish plate**
   Remove the reverse clutch retaining plate, the 2 drive plates, the 2 driven plates, and the dish plate.


04R&H22

3. **Snap ring**
   Remove the high clutch snap ring.


05R&H25

4. **Retaining plate, drive plates, driven plates and dish plate**
   Remove the high clutch retaining plate, the 5 drive plates, the 5 driven plates, and the dish plate.


07R&H28

5. **Snap ring**
6. **High clutch cover**
7. **Return spring**
   - Install the spring compressor to the reverse and high clutch drum.
     Spring compressor: 5-8840-2767-0
   - Carefully press the high clutch cover down.
     Take care not to damage the return spring.
   - Remove the snap ring.
   - Remove the high clutch cover and the return spring.


08R&H36

8. High clutch piston

9. Reverse clutch piston

- Install the reverse and high clutch drum to the oil pump.
- Force compressed air into the oil pump oil channels.
- Remove the high clutch piston and the reverse clutch piston.


09R&H37


12R&H39

10.Seal ring (high clutch)

Remove the 2 seal rings from the high clutch piston.


13R&H38

11.Seal ring (reverse clutch)

Remove the 2 seal rings from the reverse clutch piston.

Inspection

Drive plates

- Measure the drive plate facing thickness at 3 points.
- Calculate the average value.
  If the average value is less than the specified limit, the drive plate must be replaced.
  Drive plate facing thickness:
  Standard – 2.0 mm (0.079 in)
  Limit – 1.8 mm (0.071 in)

Return springs

- Check the number of effective return spring coils.
  If the number is less than the specified minimum, the return spring must be replaced.
  Effective return spring coils (standard): 10.2
- Measure the return spring outside diameter, free length, and linear diameter.
  If any of the measured values exceed the specified limit, the return spring must be replaced.
  Return spring measurements (standard):
  Outside diameter – 8.0 mm (0.315 in)
  Free length – 27.1 mm (1.067 in)
  Linear diameter – 1.1 mm (0.043 in)

10R&H40

Reverse clutch piston

- Apply compressed air (390 kPa/4.0 kgf/cm^2/57 psi) to the reverse clutch piston from the outside to the inside.
  The flow of air should be blocked.

11R&H44

- Apply compressed air (390 kPa/4.0 kgf/cm^2/57 psi) to the reverse clutch piston from inside to the outside.
  The flow of air should be unrestricted.

12R&H39

Reassembly steps

Coat the parts with ATF before installing them.

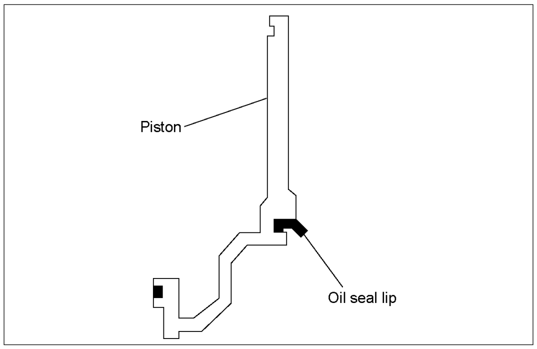
1. Seal ring (high clutch)

Install new seal rings to the high clutch piston.

13R&H38

2. Seal ring (reverse clutch)

Install new seal rings to the reverse clutch piston.



RTW47ASH000601

As shown in a figure, oil seal lip is attached.

14R&H32

3. Reverse clutch piston

Install the reverse clutch piston to the reverse and high clutch drum.

15R&H31

4. High clutch piston

Install the high clutch piston to the reverse clutch piston.

16R&H33

5. Return spring

Install the return spring to the high clutch piston.


17R&H30

6. **High clutch cover**
   - Carefully center the high clutch cover and install it.

NOTE:
If the clutch cover is not centered, the cover outside seal gum will be forced into the piston area where it will be damaged.


18R&H27

7. **Snap ring**
   - Install the spring compressor to the reverse and high clutch drum.
   - Use the spring compressor to carefully force the high clutch cover down.

   Spring compressor: 5-8840-2767-0

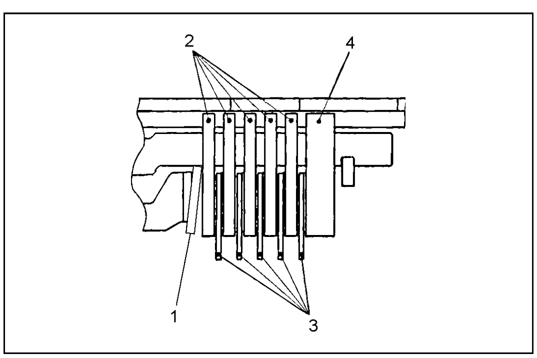
NOTE:
To avoid damage to the return springs, use only as much force as is required to press the high clutch cover into place.


19R&H28

   - Install the new snap ring to the reverse and high clutch drum.


20R&H25

8. **Dish plate, drive plates, driven plates, and retaining plate**
   Install the high clutch dish plate (1), the 5 driven plates (2), the 5 drive plates (3), and retaining plate (4).



RTW47ASH000501

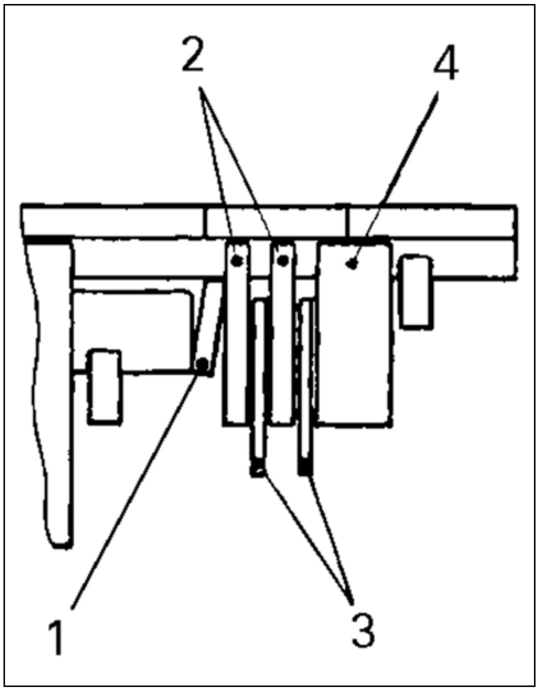
9. **Snap ring**
   Install the snap ring.

NOTE:
Ensure the attachment direction of dish plate (1) is correct.

21R&H21

10.Dish plate, drive plates, driven plates, and retaining plate

Install the reverse clutch dish plate (1) the 2 driven plates (2), the 2 drive plates (3), and retaining plate (4).

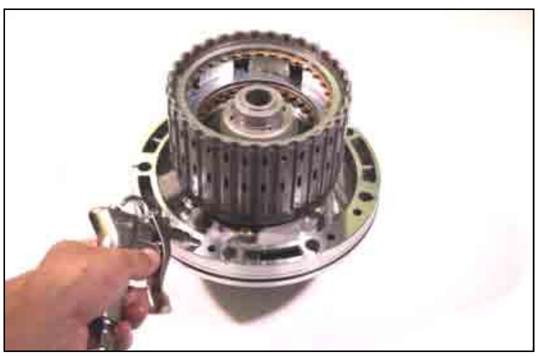


248L300003

11.Snap ring

Install the snap ring.

NOTE:
Ensure the attachment direction of dish plate (1) is correct.

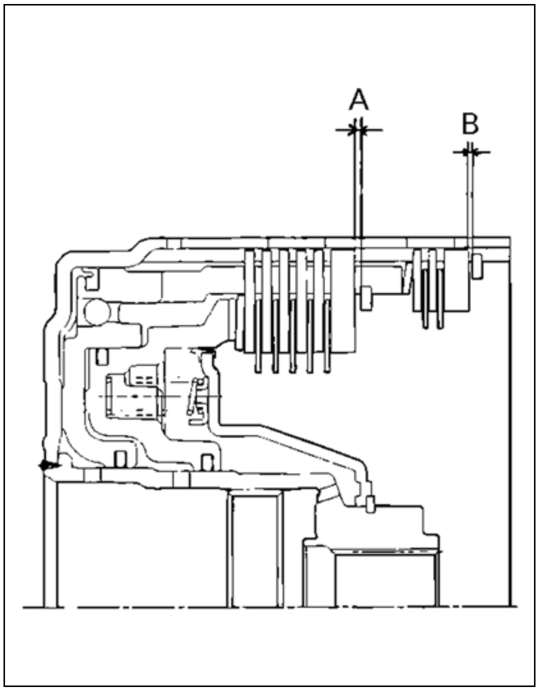


22R&H35

- Install the reverse and high clutch drum to the oil pump assembly.
- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the oil pump oil passages to check high clutch operation.
  If the clutch does not operate, the seal ring may be damaged or the parts may have been installed in the wrong order.

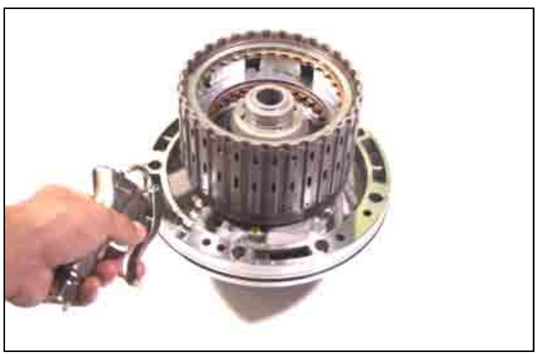
23CLEAR02

- Measure the clearance between the high clutch retaining plate and the snap ring.
  If the clearance is outside the specified range, replace the existing retaining plate with a new plate of the proper size (thickness).
  High clutch retaining plate and snap ring clearance (A): 1.2~1.6 mm (0.047~0.063 in)
  Available high clutch retaining plate thicknesses
  4.6 mm (0.181 in)
  4.8 mm (0.189 in)



248L300004

5.0 mm (0.197 in)
5.2 mm (0.205 in)
5.4 mm (0.213 in)


24R&H34

- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the oil pump oil passages to check reverse clutch operation.
  If the clutch does not operate, the seal ring may be damaged or the parts may have been installed in the wrong order.

25CLEAR04

- Measure the clearance between the reverse clutch retaining plate and the snap ring.
  If the clearance is outside the specified range, replace the existing retaining plate with a new plate of the proper size (thickness).
  Reverse clutch retaining plate and snap ring clearance (B):
  0.6~0.9 mm (0.024~0.035 in)
  Available reverse clutch retaining plate thicknesses
  4.8 mm (0.189 in)
  5.0 mm (0.197 in)
  5.2 mm (0.205 in)
  5.4 mm (0.213 in)

CARRIER AND LOW CLUTCH ASSEMBLY

01C&L12

Legend

1. Snap ring
2. Front carrier
3. Bearing (with bearing race)
4. Rear sun gear
5. Bearing
6. Rear carrier
7. Bearing race
8. Bearing
9. Rear internal gear
10. Bearing race
11. Snap ring
12. Retaining plate
13. Drive plate (7, low clutch)
14. Driven plate (6, low clutch)
15. Driven plate (1, 2 mm thick, low clutch)
16. Dish plate
17. Snap ring
18. Cancel cover
19. Return spring
20. Low clutch piston
21. Seal ring (small)
22. Seal ring (large)
23. Low clutch drum
24. Bearing
25. Snap ring
26. Low one-way clutch
27. Side plate
28. Snap ring

02C&L-SUB03

Disassembly steps

1. Snap ring

Remove the snap ring from the low clutch drum.

03C&L-SUB05

2. Front carrier

Remove the front carrier from the low clutch assembly.

04C&L-SUB06

3. Bearing (with bearing race)
4. Rear sun gear
5. Bearing
6. Rear carrier
7. Bearing race
8. Bearing
9. Rear internal gear
10. Bearing race

Remove the bearing (with bearing race), the rear sun gear, the bearing, the rear carrier, the bearing race, the bearing, and rear internal gear.

05C&L-SUB07

SERVICING

Rear Axle Oil Replacement

Oil Capacity liters (US/UK gal.)

ϕ220mm	2.4 (0.63/0.53)
ϕ194mm	1.6 (0.42/0.35)

Specified gear oil	GL5 (API grade)(STD) GL5LSD (LSD)

Filler Plug and Drain Plug Torque N·m (kgf·m/lb·ft)

78 (8.0/58)

Axle Shaft Roller Bearing Endplay Inspection

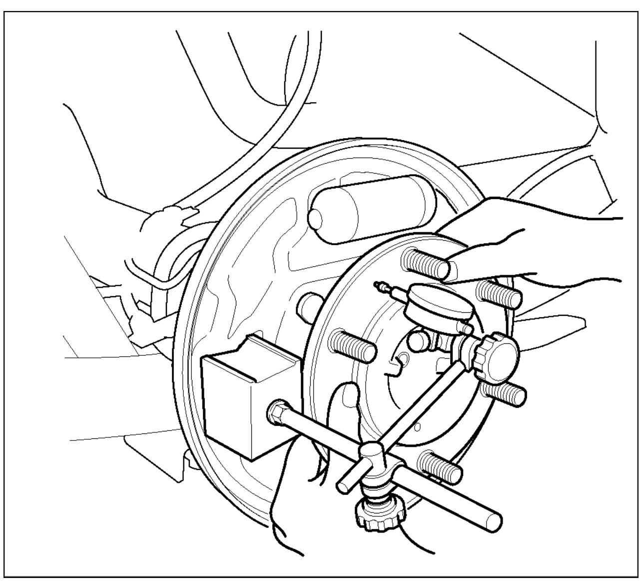
1. Raise and suitably support vehicle.
2. Remove the wheel and brake drum.
3. Inspect the axle shaft roller bearing endplay using dial gauge.

Endplay mm (in)

Standard	0 ~ 0.2 (0 ~ 0.008)

If the endplay exceeds 0.2mm (0.008 in), replace the axle shaft roller bearings.

Refer to Rear Axle Reassembly.



RTW34BSH000101


06C&L-SUB08


07C&L-SUB09


08C&L-SUB10


09C&L-SUB11


10C&L-SUB12

- Remove the bearing race from the rear internal gear.


11C&L-SUB13

11.Snap ring

Remove the low clutch snap ring.


12C&L-SUB15

12.Retaining plate, drive plates, driven plates, and dish plate

Remove the low clutch retaining plate, the 7 drive plates, the 7 driven plates, and the dish plate.


13C&L-SUB18

13.Snap ring

- Install the spring compressor to the low clutch drum.
  Spring compressor: 5-8840-2759-0
- Carefully press the cancel cover down.
  Take care not to damage the return spring.


14C&L-SUB19

- Remove the snap ring.


31C&L-SUB20

14.Cancel cover

Remove the cancel cover.


30C&L-SUB21

15.Return spring

Remove the return spring.


15C&L-SUB38

16.Low clutch piston

- Insert the low one-way clutch inner race to the low clutch drum.
- Force compressed air through the oil passages of the low one-way clutch inner race to remove the low clutch piston.


29C&L-SUB22


16C&L-SUB25

17.Snap ring

- Raise the low one-way clutch side.
- Remove the low one-way clutch snap ring.


17C&L-SUB27

18.Side plate

Remove the side plate.

18C&L-SUB28

19.Low one-way clutch

Remove the low one-way clutch.

19C&L-SUB29

20.Snap ring

Remove the snap ring from the low clutch drum.

20C&L-SUB31

21.Bearing

Remove the bearing.

Inspection

Drive plates

- Measure the drive plate facing thickness at 3 points.
- Calculate the average value.
  If the average value is less than the specified limit, the drive plate must be replaced.
  Drive plate facing thickness:
  Standard – 2.0 mm (0.079 in)
  Limit – 1.8 mm (0.071 in)

Return springs

- Check the number of effective return spring coils.
  If the number is less than the specified minimum, the return spring must be replaced.
  Effective return spring coils (standard): 9.9
- Measure the return spring outside diameter, free length, and linear diameter.
  If any of the measured values exceed the specified limit, the return spring must be replaced.
  Return spring measurements (standard):
  Outside diameter – 9.7 mm (0.382 in)

Free length – 36.4 mm (1.433 in)
Linear diameter – 1.2 mm (0.047 in)


21C&L-SUB31

Reassembly steps

Coat the parts with ATF before installing them.

1. **Bearing**
   Install the bearing into the low clutch drum.


22C&L-SUB30

2. **Snap ring**
   Install the snap ring to the low clutch drum.


23C&L-SUB28

3. **Low one-way clutch**
   Install the low one-way clutch to the low clutch drum.


24C&L-SUB33

NOTE:
The flanged side of the low one-way clutch must face the outside.


25C&L-SUB27

4. Side plate

Install the side plate.

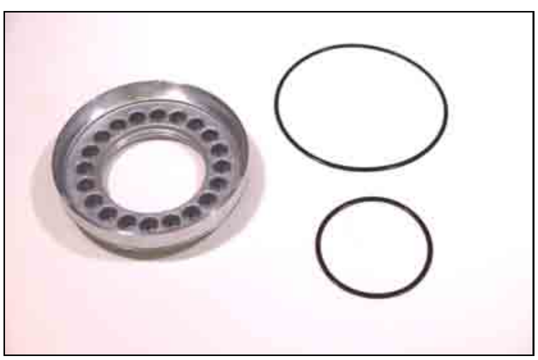

26C&L-SUB26

5. Snap ring

Install the snap ring to the low clutch drum.


27C&L-SUB58

- Attach the low one-way clutch inner race to the low clutch drum in the opposite direction of the normal position.
- Rotate the one-way clutch inner race clockwise. It should turn smoothly with little resistance.
- Rotate the low one-way clutch inner race counterclockwise.
  It should immediately lock (rotation is impossible).
  If it does not, check the low one-way clutch installation direction.
  Inspect and replace the low one-way clutch if required.
- Remove the low one-way clutch inner race.
- Reverse the low clutch drum.


28C&L-SUB32

6. Low clutch piston

- Install new seal rings to the low clutch piston.

29C&L-SUB22

- Install the low clutch piston to the low clutch drum.

30C&L-SUB21

7. **Return spring**

   Install the return spring to the low clutch piston.

31C&L-SUB20

8. **Cancel cover**

   - Carefully center the cancel cover and install it.

NOTE:

If the cancel cover is not centered, the cover outside seal ring gum will be forced into the low clutch piston area where it will be damaged.

32C&L-SUB18

- Install the spring compressor to the low clutch.

  Spring compressor: 5-8840-2759-0

33C&L-SUB19

9. **Snap ring**

   - Use the spring compressor to carefully force the cancel cover down.

NOTE:

To avoid damage to the return spring, use only as much force as is required to press the cancel cover into place.

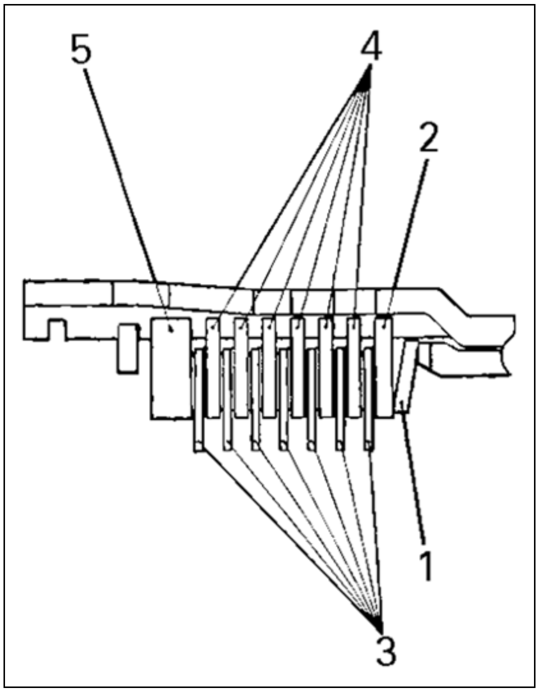
- Install new snap ring to the low clutch drum.


34C&L-SUB15

10.Dish plate, drive plates, driven plates, and retaining plate

Install the low clutch dish plate (1), the 2 mm thick driven plate (2), the 7 drive plates (3), the other 6 driven plates (4), and the retaining plate (5).

NOTE:
The dish plate side with the identification mark must face the driven plate.



248L300006

11.Snap ring

Install the snap ring to the low clutch drum.

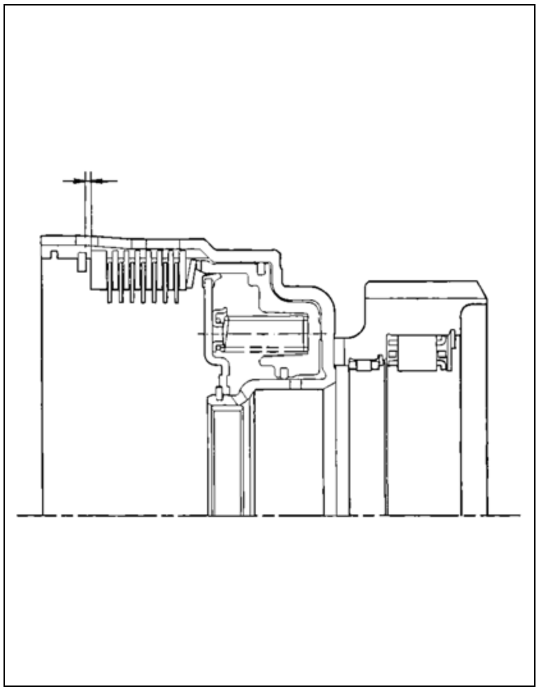
NOTE:
Ensure the attachment direction of dish plate is correct.

Inspection


35C&L-SUB38

- Insert the low one-way clutch inner race to the low clutch drum.
- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the oil passages of the low one-way clutch inner race to check low clutch operation.
  If the low clutch does not operate, the seal rings may be damaged or the parts may have been installed in the wrong order.
- Measure the clearance between the low clutch retaining plate and the snap ring.
  If the clearance is outside the specified range, replace the existing plate with a new plate of the proper size (thickness).
  Low clutch retaining plate and snap ring clearance:
  0.9~1.3 mm (0.035~0.051 in)
  Available low clutch retaining plate thicknesses
  3.8 mm (0.150 in)
  4.0 mm (0.157 in)


36CLEAR06


248L300007

4.2 mm (0.165 in)
4.4 mm (0.173 in)
4.6 mm (0.181 in)
4.8 mm (0.189 in)


37C&L-SUB40

12.Bearing race

13.Rear internal gear

14.Bearing

Install the bearing race and the bearing to the rear internal gear.

NOTE:

Apply Vaseline to the fitting surfaces of the rear internal gear to prevent the bearing race and the bearing from falling during the installation process.


38C&L-SUB43


39C&L-SUB60

- Install the rear internal gear to the low clutch drum.


40C&L-SUB46

15.Bearing race

16.Rear carrier

17.Bearing

Install the bearing race and the bearing to the rear carrier.

NOTE:

Apply Vaseline to the fitting surfaces of the rear carrier to prevent the bearing race and the bearing from falling during the installation process.


41C&L-SUB49


42C&L-SUB61

- Install the rear carrier to the low clutch drum.


43C&L-SUB07

18.Rear sun gear

Install the rear sun gear to the low clutch drum.


44C&L-SUB52

19.Bearing (with bearing race)

20.Front carrier

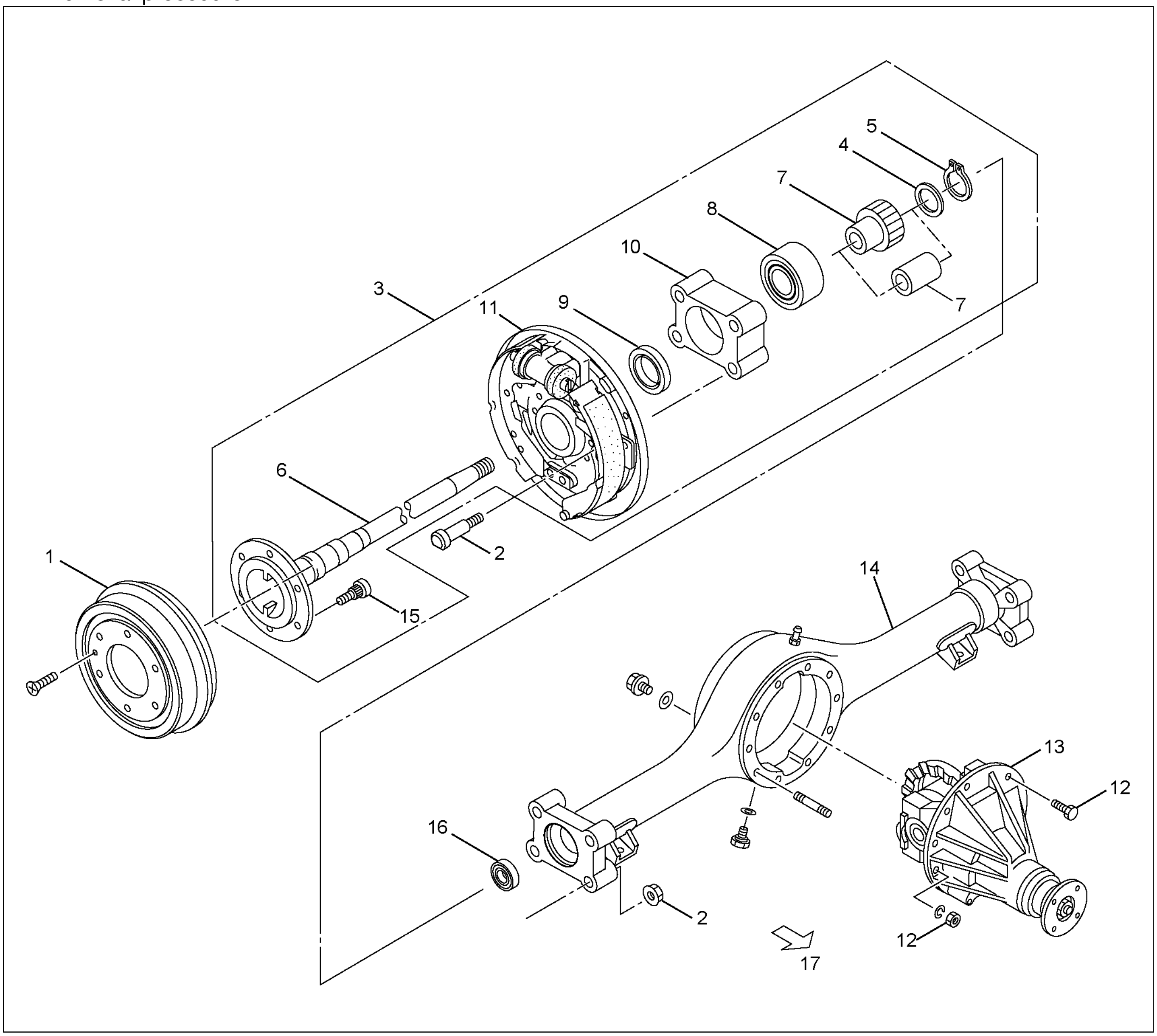
Install the bearing (with bearing race) to the front carrier.

NOTE:

Apply Vaseline to the fitting surfaces of the front carrier to prevent the bearing from falling during the installation process.

REAR AXLE

1. Refer to Section 3E “WHEELS and TIRES” for road wheel Disassembly procedure.
2. Refer to Section 5 “BRAKE” for rear brake removal procedure.



Legend

1. Brake Drum
2. Bolt and Nut
3. Axle Shaft Assembly with Brake
4. Shim
5. Snap Ring
6. Axle Shaft
7. Retainer (with ABS)
   Retainer (without ABS)
8. Double Taper Roller Bearing
9. Oil Seal
10. Bearing Holder
11. Rear Brake
12. Bolt and Nut
13. Differential Assembly
14. Rear Axle Case Assembly
15. Wheel Pin
16. Axle Case Oil Seal
17. Front


45C&L-SUB04

21.Snap ring

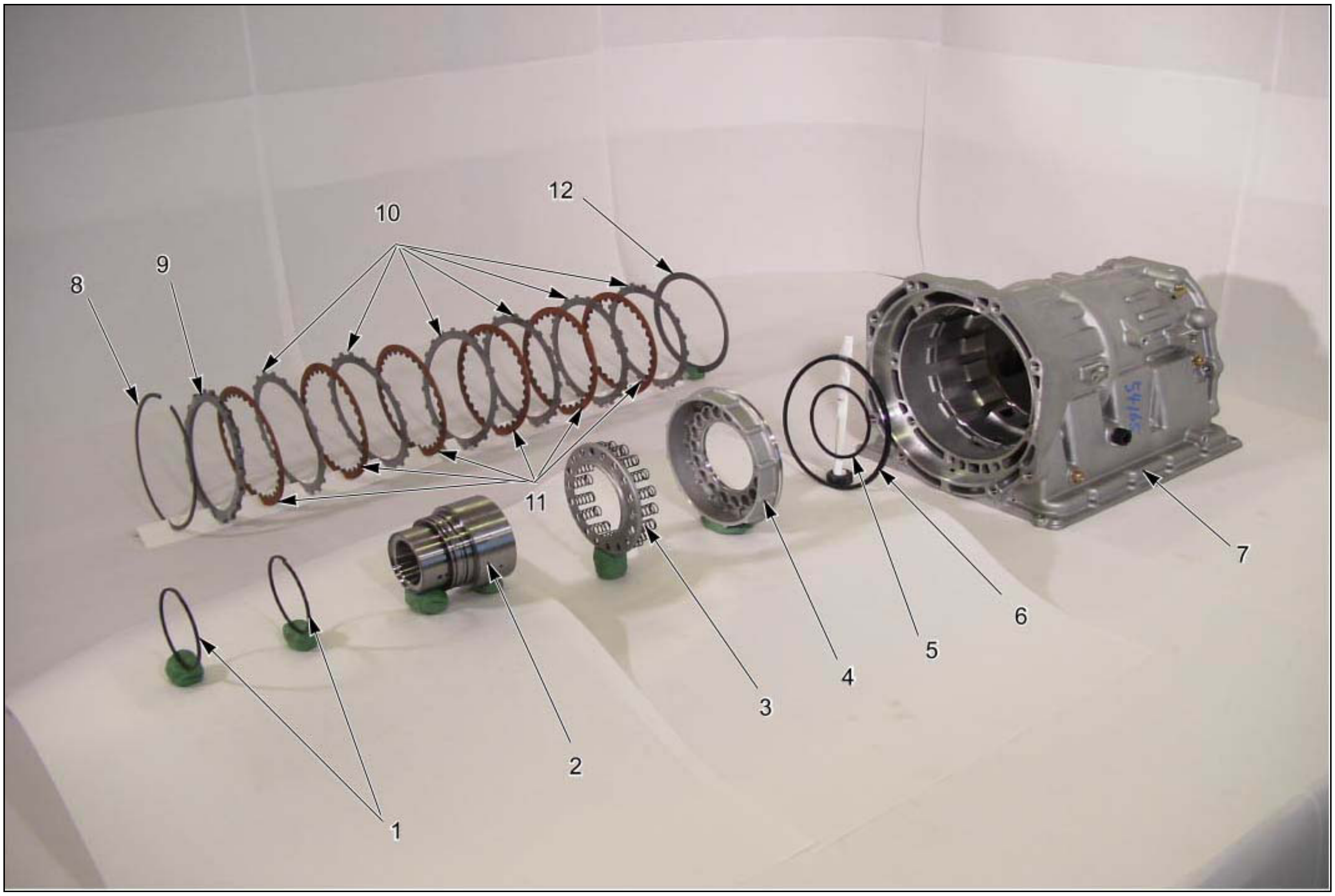
- Install the front carrier to the low clutch drum.
- Install the snap ring to the low clutch drum.

TRANSMISSION CASE

02CASE-BK06

Legend

1. Transmission case
2. Spring pin (slender)
3. Spring pin (fat)
4. Manual plate
5. Detent spring
6. Parking rod
7. Manual shaft
8. Oil seal
9. Inhibitor switch



01L&R-CS05

Legend

1. Seal ring
2. Low one-way clutch inner race
3. Return spring
4. Low and reverse brake piston
5. Seal ring
6. Lip seal
7. Transmission case
8. Snap ring
9. Retaining plate
10. Driven plate
11. Drive plate
12. Dish plate

04CASE-AY52

Disassembly steps

1. Harness assembly

Remove the fixing bolt and the harness assembly.

05CASE-AY30

2. Parking rod

- Use a pin punch to force out the parking rod spring pin.

06CASE-AY37

- Rotate the manual plate as you pull the parking rod free.

08CASE-AY45

3. Detent spring

Remove the fixing bolt and the detent spring.

09CASE-AY28

4. Manual shaft and manual plate

- Remove the manual shaft spring pin.

10CASE-AY21

- Remove the manual shaft together with the manual plate.


11CASE-AY01

5. **Oil seal**

   Using a screwdriver, remove the oil seal from the transmission case.

Inspection

2 – 4 brake drive plates

Measure the 2-4 brake drive plate facing thickness at 3 points and calculate the average value.

If the average value is less than the specified limit, the 2-4 brake drive plate must be replaced.

2 – 4 brake drive plate facing thickness:

Standard = 2.0 mm (0.079 in)

Limit = 1.8 mm (0.071 in)

Low and reverse brake drive plates

Measure the low and reverse brake drive plate facing thickness at 3 points and calculate the average value.

If the average value is less than the specified limit, the low and reverse drive plate must be replaced.

Low and reverse brake drive plate facing thickness:

Standard = 2.0 mm (0.079 in)

Limit = 1.8 mm (0.071 in)

2 – 4 brake return springs

- Check the number of effective 2-4 brake return spring coils.

  Effective return spring coils (Standard): 10.2
- Measure the 2-4 brake return spring outside diameter, free length, and linear diameter.

  If any of the measured values exceed the specified limit, the 2-4 brake return spring must be replaced.

  2 – 4 brake return spring measurements (Standard):

  Outside diameter = 6.9 mm (0.272 in)

  Free length = 22.5 mm (0.886 in)

  Linear diameter = 1.1 mm (0.043 in)

Low and reverse brake return springs

- Check the number of effective low and reverse brake return spring coils.

  Effective return spring coils (standard): 4.8
- Measure the low and reverse brake return spring outside diameter, free length, and linear diameter.

  If any of the measured values exceed the specified limit, the low and reverse return spring must be replaced.

  Low and reverse brake return spring measurements (Standard):

  Outside diameter = 11.2 mm (0.441 in)

Free length = 22.3 mm (0.878 in)
Linear diameter = 1.1 mm (0.043 in)

Reassembly steps

1. Oil seal, manual shaft, and manual plate

12CASE-AY06

- Use the oil seal installer to force the manual plate oil seal into place.
  Oil seal installer: 5-8840-2758-0

14CASE-AY21

- Install the manual shaft together with the manual plate.

15CASE-AY26

- Drive the spring pin into the transmission case.

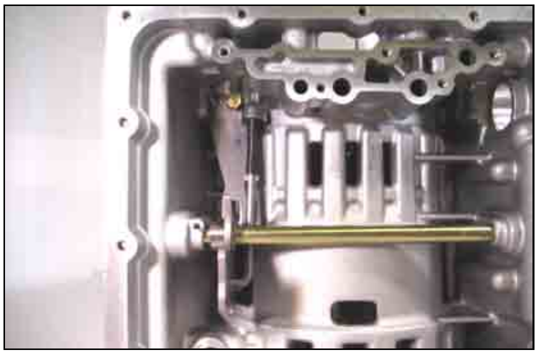
2. Parking rod

16CASE-AY37

- Rotate the manual plate while installing the parking rod.

18CASE-AY43

- Use a pin punch to drive the manual plate spring pin into place.



21CASE-AY48

3. **Detent spring**
   - Install the detent spring and tighten the fixing bolt to the specified torque.
     Torque: 7 N·m (0.7 kgf·m/61 lb·in)

23CASE-AY53

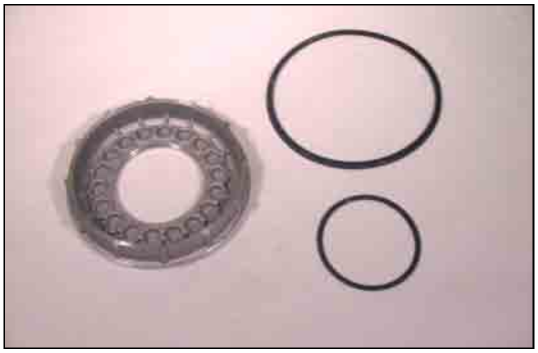
4. **Harness assembly**
   - Apply automatic transmission fluid to the new O-ring and install them to the harness assembly.
   - Install the harness assembly to the transmission case. Tighten the fixing bolt to the specified torque.
     Torque: 6 N·m (0.6 kgf·m/52 lb·in)

24ASSY003

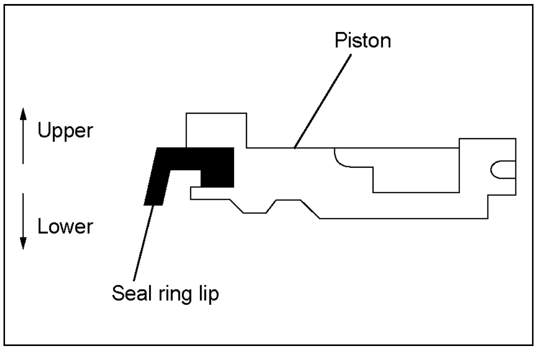
5. **Low one-way clutch inner race**
   - Install new seal rings to the low one-way clutch inner race.

25ASSY126

- Measure the gap between the seal ring and the ring groove.
  If the measured valve is outside the specified range the low one-way clutch inner race must be replaced.
  Sealing ring and ring groove gap:
  0.10~0.25 mm (0.0039~0.0098 in)


26L&R01

6. **Low and reverse brake piston**
   - Install new seal rings to the low and reverse piston.



RTW47ASH000701

As shown in a figure, a sealing lip is attached.


27ASSY004

   - Install the low and reverse brake piston to the transmission case.


28ASSY005

7. **Return spring**
   - Install the return spring to the low and reverse brake piston.


29ASSY006

8. **Low one-way clutch inner race**
   - Install the low one-way clutch inner race to the transmission case.
   - Temporarily tighten the 7 fixing bolts.


31ASSY074

- Tighten each of the bolts a little at a time to the specified torque.
  Be sure that the return spring and the low one-way clutch inner race installation position does not change as you tighten the bolts.
  Torque: 24 N·m (2.4 kgf·m/17 lb·ft)


32ASSY007

9. Dish plate, driven plates, drive plates, and retaining plate (low and reverse brake)

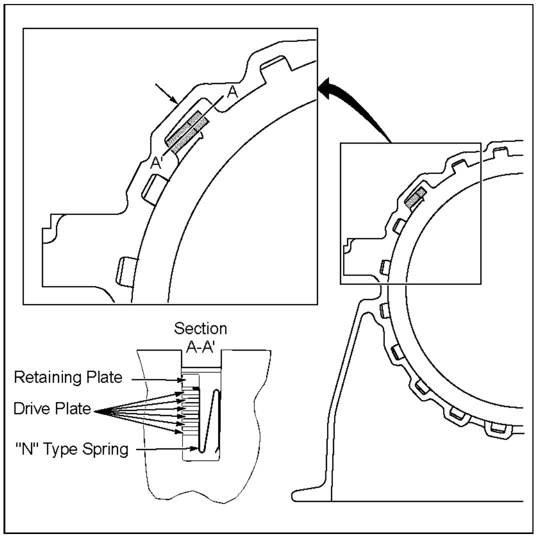
- Install the dish plate (1) followed by the 6 driven plates (2) and drive plates (3) sets.


33ASSY008


34ASSY009

- Install the N-type spring.


35N-SPG02



RTW37AMF0001-X


36ASSY10

- Install the retaining plate (4).


37ASSY011

- Install the snap ring.

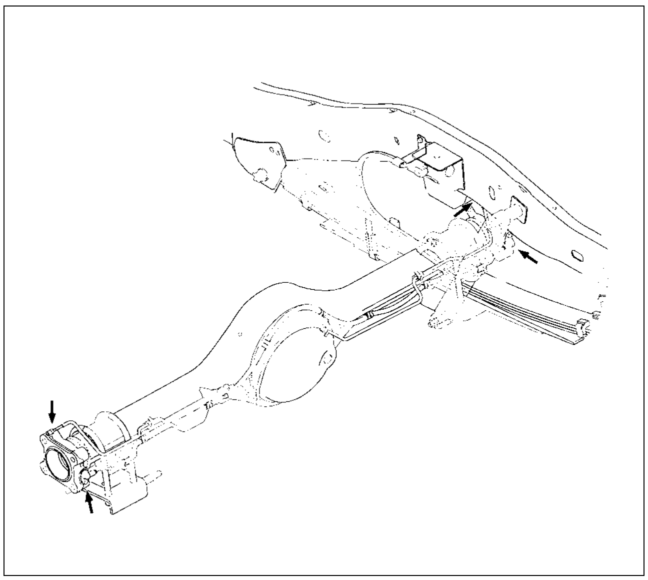

38L&R03

- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the oil passages of the transmission case to check low and reverse brake operation.
  If the low and reverse brake does not operate, check the seal rings for damage and replace if necessary. Also check that no parts have been installed out of place.

Disassembly

- Raise vehicle to the working level.
- Support the axle assembly with the proper jack and chassis stands.
- Remove wheel and tire.
- Drain differential oil.
- Remove propeller shaft. (Refer to the section “Rear Propeller Shaft”.)

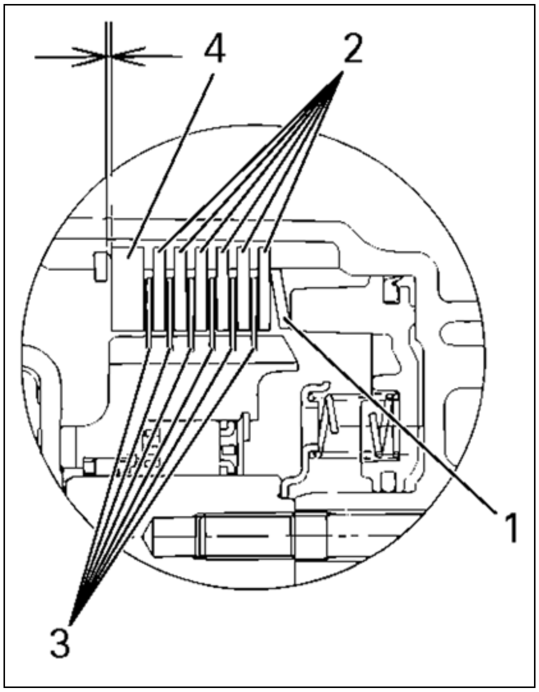
1. Remove brake drum.
2. Remove ABS sensor. (Refer to the section “ABS”.)
3. Remove brake pipe from wheel cylinder.



420R300003


39L&R04

- Measure the clearance between the low and reverse retaining plate and the snap ring.
  If the clearance is outside the specified range, replace the existing retaining plate with a new plate of the proper size (thickness).
  Low and reverse retaining and snap ring clearance:
  0.7~1.1 mm (0.028~0.043 in)
  Available low and reverse brake retaining plate thicknesses
  5.2 mm (0.205 in)
  5.4 mm (0.213 in)
  5.6 mm (0.220 in)
  5.8 mm (0.228 in)
  6.0 mm (0.236 in)



249L300003

10.Dish plate, drive plates, driven plates, and retaining plate. (2-4 brake)

NOTE:

Ensure the attachment direction of dish plate is correct.
If 2-4 brake clearance measurement is required, it must be done now.
Brake clearance cannot be measured after the carrier assembly has been installed.


402-4B08

- Install the 2-4 brake dish plate to the transmission case (plate contact surface).

412-4B09

- Install the drive plates, driven plates, and the retaining plate.

422-4B10

432-4B11

442-4B12

11.2 – 4 brake piston and 2 – 4 brake retainer

- Install new seal ring to the 2-4 brake piston.
- Install the 2-4 brake piston to the 2-4 brake retainer.

452-4B15

- Install the 2-4 brake piston and the 2-4 brake retainer to the transmission case.
  Pay close attention to the retainer projection from the case groove.


472-4B17

- Install the spring compressor to the transmission case.
  Spring compressor: 5-8840-2764-0

NOTE:
Be sure that the spring compressor is perfectly centered (an off-center special tool will damage the return spring).

- Use the spring compressor to force the 2-4 brake retainer.


482-4B18

NOTE:
To avoid damaging the return spring, apply as little force as possible to the 2-4 brake retainer.

- Install the snap ring.

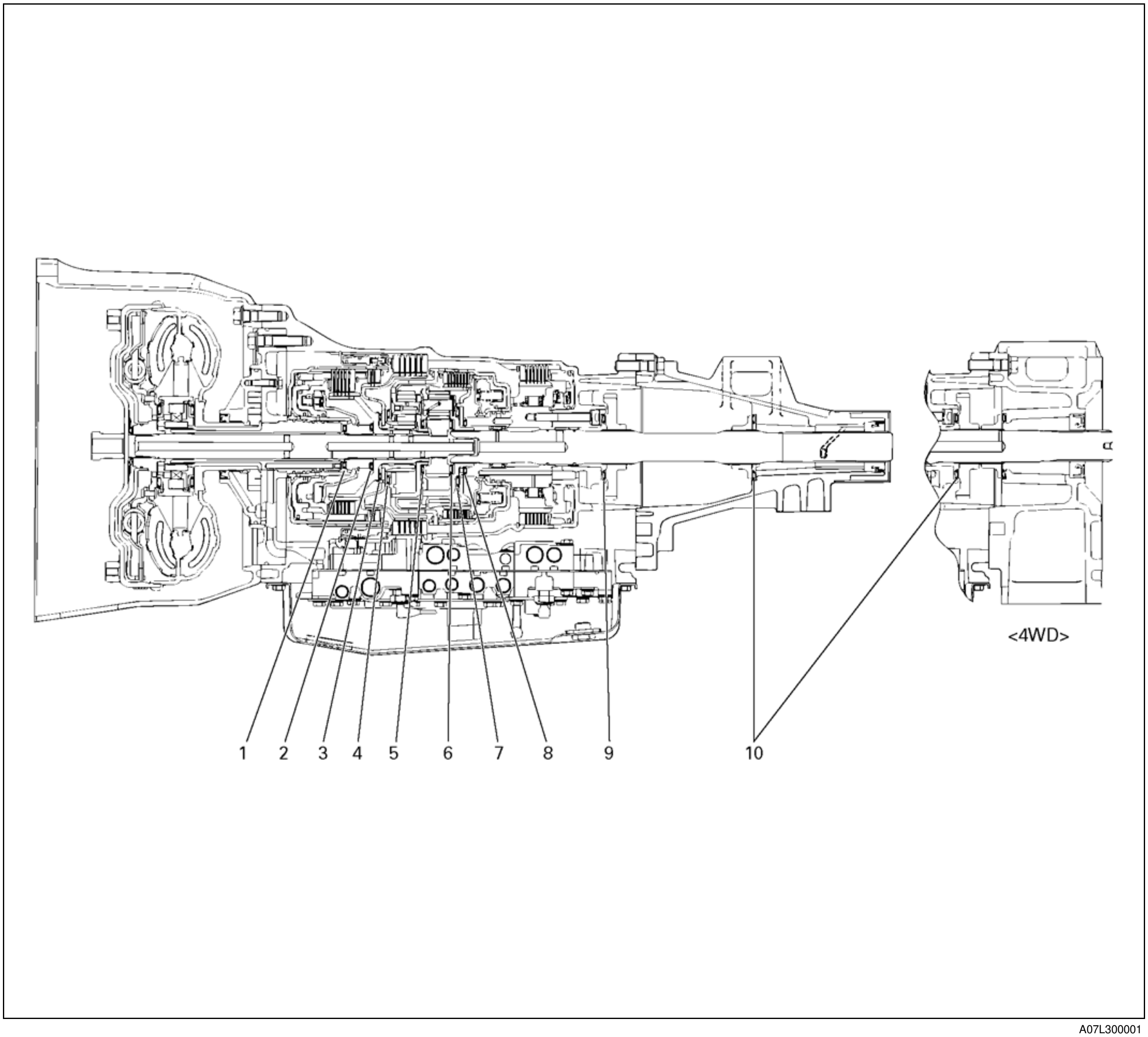

492-4B22

- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the oil passages of the transmission case to operate and break-in the 2-4 brake.


502-4B19

- Measure the clearance between the 2-4 brake retainer and the retaining plate.
  If the clearance is outside the specified range, replace the existing brake retainer with a new one of the proper size (thickness).
  2 – 4 brake retainer and retaining plate clearance:
  1.0~1.4 mm (0.039~0.055 in)
  Available 2-4 brake retaining plate thicknesses
  5.4 mm (0.213 in)
  5.6 mm (0.220 in)
  5.8 mm (0.228 in)
  6.0 mm (0.236 in)
  6.2 mm (0.244 in)
  6.4 mm (0.252 in)
- Use the spring compressor to release the 2-4 brake.

BEARING AND BEARING RACE INSTALLATION POSITION




01BRG16

1. **Bearing and bearing race**

		Outside diameter
Bearing	–	46 mm (1.811 in)
Bearing race	–	45 mm (1.772 in)


02BRG02

2. **Bearing (with bearing race)**

		Outside diameter
Bearing	–	46 mm (1.811 in)

Bearing race (black color) installation direction – Facing the front of the transmission.


03BRG04

3. **Bearing and bearing race**

		Outside diameter
Bearing	–	65 mm (2.559 in)
Bearing race	–	64 mm (2.520 in)


04BRG05

4. **Bearing and bearing race**

		Outside diameter
Bearing	–	73 mm (2.874 in)
Bearing race	–	72 mm (2.835 in)


05BRG06

5. **Bearing (with bearing race)**

		Outside diameter
Bearing	–	53 mm (2.087 in)

Bearing race (black color) installation direction – Facing the front of the transmission.

06BRG07

6. Bearing

		Outside diameter
Bearing	–	53 mm (2.087 in)

07BRG08

7. Bearing and bearing race

		Outside diameter
Bearing	–	78 mm (3.071 in)
Bearing race	–	76 mm (2.992 in)

08BRG09

8. Bearing and bearing race

		Outside diameter
Bearing	–	53.4 mm (2.102 in)
Bearing race	–	51 mm (2.008 in)

09BRG18

9. Bearing (with bearing race)

		Outside diameter
Bearing	–	64 mm (2.520 in)

Bearing race (black color) installation direction – Facing the rear of the transmission.

10BRG17

10. Bearing (with bearing race)

		Outside diameter
Bearing	–	64 mm (2.520 in)

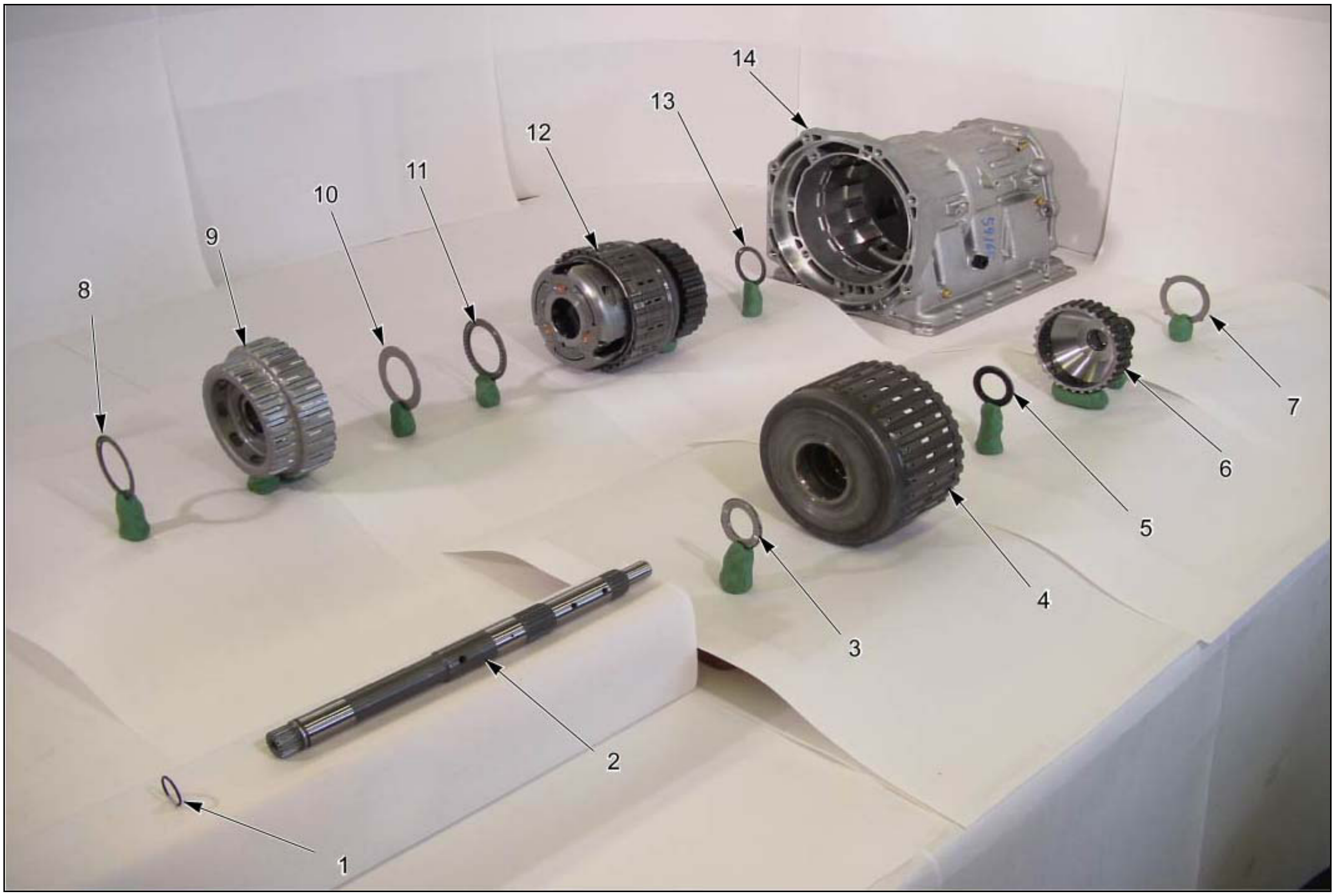
Bearing race (black color) installation direction – Facing the front of the transmission.

AUTOMATIC TRANSMISSION REASSEMBLY

Assembly cautions

- Use your bare hands or vinyl gloves to reassemble the transmission. Do not use ordinary work gloves (loosen threads from the gloves may fall into the transmission and cause problems).
- Before installing the drive plates, immerse them in the recommended automatic transmission fluid (BESCO ATF III). If the drive plate is new, it must be immersed for at least two hours to ensure oil penetration and saturation of the facing.
- Apply ATF to all sliding and contact surfaces before assembly. Also apply ATF to seal rings and O-rings. Assemble the parts carefully to avoid damaging them.
- Replace any snap ring that appears worn, bent out of shape, or damaged.
- If any part contacting the transmission case is damaged, it must be replaced with a new part.
- Be careful not to damage the plates during reassembly (oil leakage from the plate will result).
- If you are reusing a seal, remove the old adhesive agent and clean the surface with cleaning oil before applying the new adhesive agent.
- Wait at least two hours after installing the oil seals before installing the plates.
- Do not replace O-rings, snap rings, bearings, and/or bearing races with inferior substitutes.

Power train



01HUB-H04

Legend

1. O-ring
2. Input shaft
3. Bearing
4. Reverse and high clutch assembly
5. Bearing
6. High clutch hub
7. Bearing race
8. Bearing
9. Front sun gear
10. Bearing race
11. Bearing
12. Carrier and low clutch assembly
13. Bearing
14. Transmission case

Reassembly steps

1. Transmission case

Rotate the transmission case so that the converter housing installation surfaces are facing up.

02ASSY012

2. Bearing

Install the bearing to the low and one-way clutch inner race. Refer to the item “Transmission Case” for more detailed information.

NOTE:

Apply Vaseline to the bearing to prevent them from failing during the installation procedure.

03ASSY013

3. Carrier and low clutch assembly

Install the carrier and low clutch assembly to the transmission case.

NOTE:

Do not allow the low clutch drum end to protrude beyond the 2-4 brake plate contact surface (transmission case).

04ASSY014

4. Bearing

Install the bearing to the carrier and low clutch assembly.

05ASSY015

5. Driven plates, drive plates, retaining plate, and dish plate (2 – 4 brake)

Install the 2-4 brake 5 driven plates (1), 5 drive plates (2), retaining plate (3), and dish plate (4) in that order.

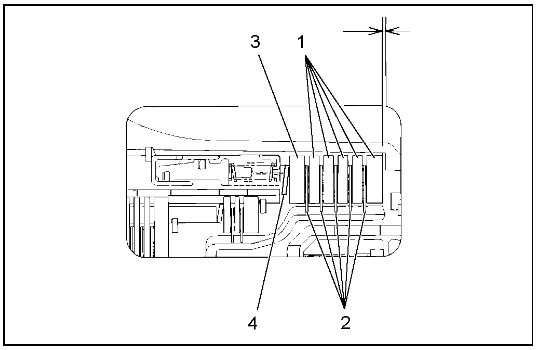
NOTE:

- **The thickest driven plate (5.6 mm) must be installed at the bottom (transmission case plate surface).**
- **The dish plate side with the identification mark must face the retaining plate.**

06ASSY016

07ASSY017

08ASSY018

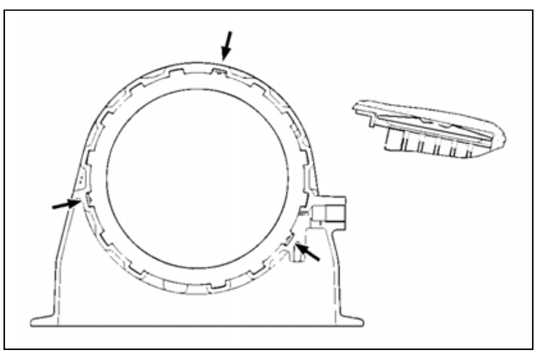


RTW47ASH000401

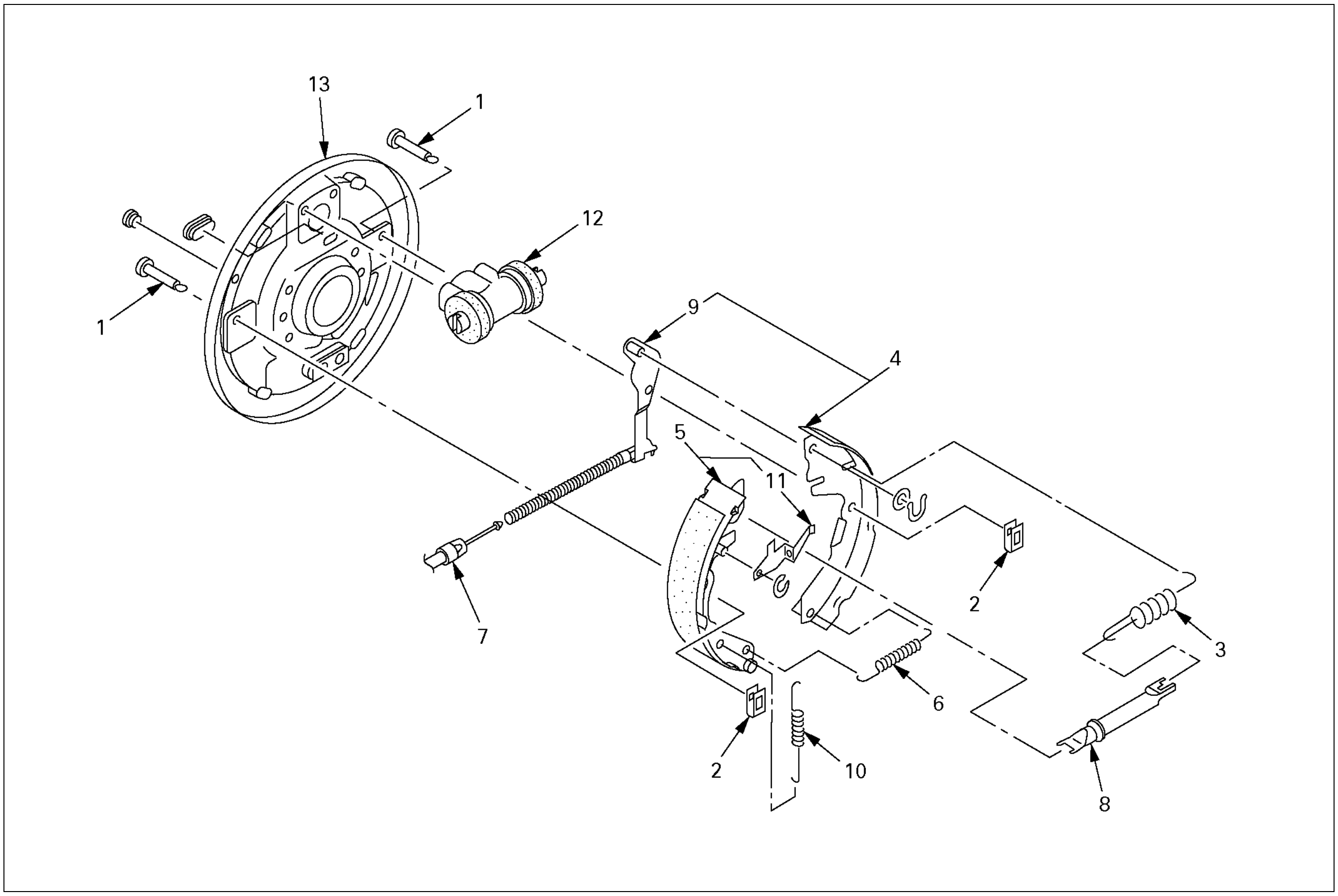
09U-SPG2

6. 2 – 4 brake spring

Install the three 2-4 brake springs to the transmission case.



248L300009



Legend

1. Tension Pin
2. Shoe Clamp Spring
3. Return Spring
4. Shoe Assembly with Parking Brake Lever
5. Shoe Assembly with Adjuster Lever
6. Spring
7. Parking Brake Cable
8. Adjuster
9. Parking Brake Lever
10. Adjuster Spring
11. Adjuster Lever
12. Wheel Cylinder
13. Back plate

4. Remove tension pin and shoe clamp spring.
5. Remove return spring.
6. Remove shoe assembly with parking brake lever.
7. Remove shoe assembly with adjuster lever and spring.
8. Remove parking brake inner cable from parking brake lever.

10ASSY019

7. Return spring and 2 – 4 brake retainer

- Align the transmission case groove and the 2-4 brake retainer projection.
- Install the return spring and the 2-4 brake retainer.

11ASSY028

12ASSY029

- Install the spring compressor to the transmission case.

  Spring compressor: 5-8840-2764-0

NOTE:
Carefully center the spring compressor to prevent damage to the return spring.

- Push the 2-4 brake retainer into place.

NOTE:
Do not push the brake retainer too far.
Damage to the return spring will result.

- Install the snap ring.

14ASSY031

17ASSY113

8. Sleeve and seal ring

- Install the new sleeve and seal ring to the transmission case.

192-4B22

- Force compressed air (390 kPa/4.0 kgf/cm^2/57 psi) through the transmission case oil passage to 2-4 brake operation.
  If the 2-4 brake does not operate, the seal ring may be damaged or the parts may have been installed in the wrong order.

20ASSY037

9. Bearing race, front sun gear, and bearing

- Install the bearing race to the front sun gear.

NOTE:

Apply Vaseline to the bearing race and bearing to prevent them from falling during the installation procedure.

21ASSY040

- Install the front sun gear to the transmission case.

22ASSY042

- Install the bearing to the front sun gear.

23ASSY045

10.High clutch hub and bearing race

Install the bearing race to the high clutch hub.

NOTE:

Apply Vaseline to the bearing race.


24ASSY047

- Install the high clutch hub and the bearing race to the transmission case.


25R&H42

11.Clutch pack (reverse and high clutch assembly)

- Install the bearing (with bearing race) to the clutch pack.

NOTE:

- **The black side (bearing race) of the bearing must contact the clutch pack.**
- **Apply Vaseline to the bearing.**


26ASSY049

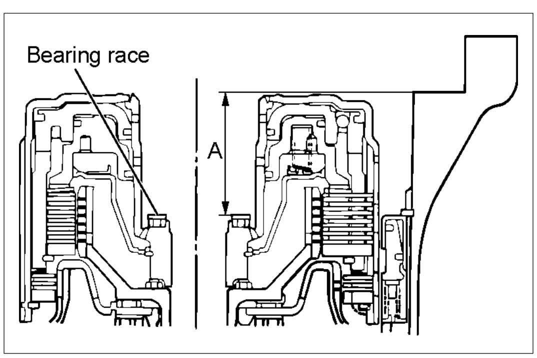
- Install the clutch pack and bearing to the transmission case.


27ASSY051

- Install the bearing to the clutch pack.

NOTE:

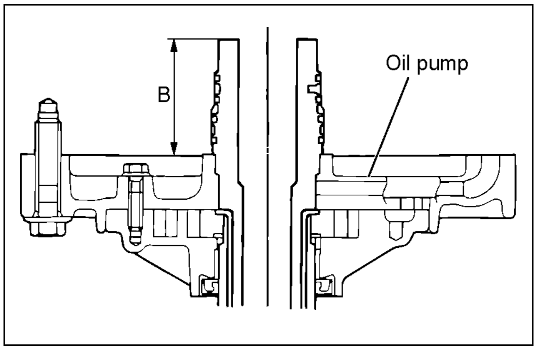
Apply Vaseline to the bearing.



RTW47ASH000101

Total end play measurement

- Install the bearing race (oil pump) to the clutch pack.
- Measure the distance (A) between the oil pump installation surface and the bearing race.



RTW47ASH000201

- Measure the distance (B) between the bearing race installation surface and the machined surface.
- Calculate the total end play using the following formula.

  Total end play = distance (A) – distance (B)

  If the measured and calculated end play is outside the specified range, replace the existing bearing race with a bearing race of the proper size (thickness).

  Total end play = 0.25~0.55 mm (0.0098~0.0217 in)

  Available oil pump bearing race thicknesses

  1.4 mm (0.055 in)

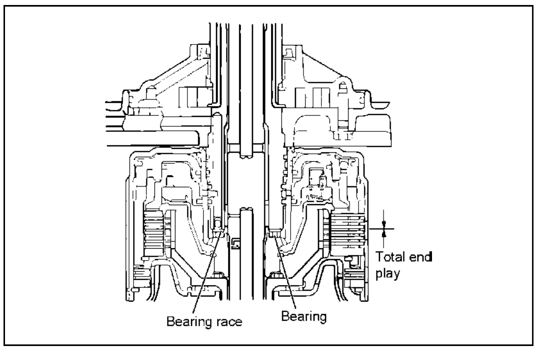
  1.6 mm (0.063 in)

  1.8 mm (0.071 in)

  2.0 mm (0.079 in)

  2.2 mm (0.087 in)

  2.4 mm (0.094 in)



RTW47ASH000201


28ASSY058

12.Input shaft

Install the input shaft.


29PUMP02

13.Oil pump assembly

- Install a new O-ring to the outside of the oil pump.
- Install the bearing race to the oil pump.

NOTE:

Apply Vaseline to the bearing race.

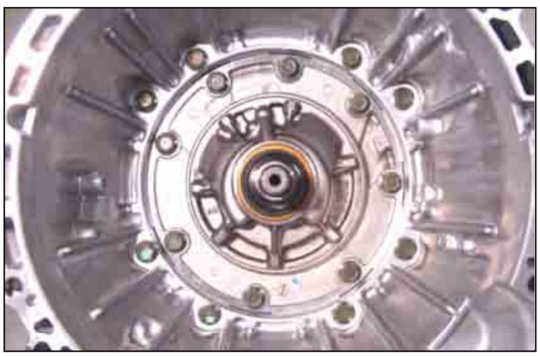
30ASSY067

- Apply ATF to the O-ring at the outside of the oil pump.
- Install the oil pump assembly to the transmission case.
- Apply sealing agent (TB1215) to the threaded surfaces of the 8 fixing bolts and tighten to the specified torque.
  Torque: 58 N·m (5.9 kgf·m/43 lb·ft)

31ASSY068

14.O-ring

Install a new O-ring to the input shaft.



32ASSY116

15.Converter housing

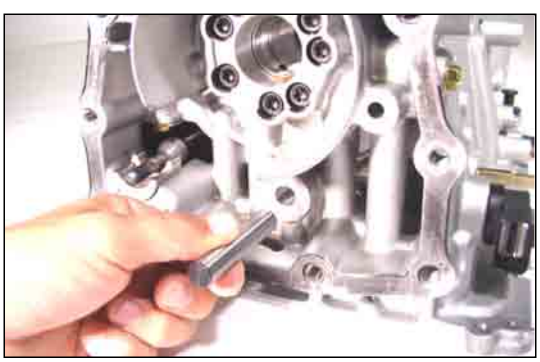
Install the converter housing and tighten the bolts to the specified torque.

Torque: 53 N·m (5.4 kgf·m/39 lb·ft)

33ASSY075

16.Actuator support

Install the actuator support.



34ASSY077

17.Parking pawl, shaft, spring, and spacer

Install the parking pawl, the shaft, the spring, and the spacer.

35ASSY082

36ASSY084

37ASSY086

38OUTPUT25

18.Output shaft

- Install a new seal ring to the output shaft assembly.
- Measure the gap between the seal ring and the ring groove.
  If the gap is outside the specified range, the output shaft must be replaced.
  Seal ring and ring groove gap:
  0.10~0.25 mm (0.0039~0.0098 in)
- Install the bearing to the case.

NOTE:

- **Apply Vaseline to the bearing (with bearing race).**
- **The black side (bearing race) of the bearing must be visible.**

29ASSY089


40ASSY091

- Push the output shaft into place.

19.Rear extension (2WD) or adapter case (4WD)

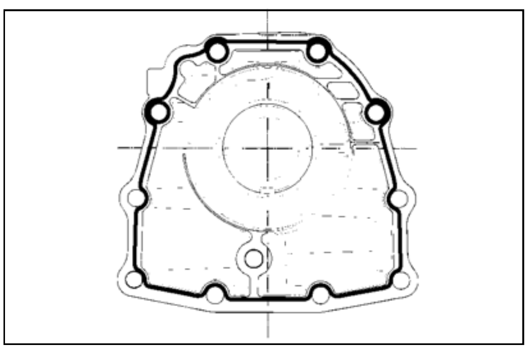
- Use the oil seal installer to install the oil seal to the rear extension (2WD) or adapter case (4WD).
  Oil seal installer:
  5-8840-2769-0 (2WD)
  5-8840-2770-0 (4WD)


41ASSY096

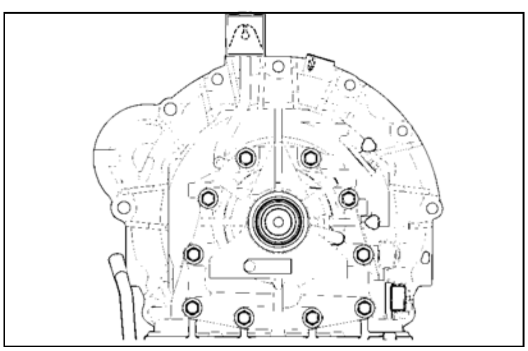
- Install the bearing (with bearing race) to the rear extension (2WD) or adapter case (4WD).

NOTE:

- **The black side (bearing race) of the bearing must be visible.**
- **Apply Vaseline to the bearing.**


249L300005

- Apply sealing agent (TB1216B) to the rear extension (2WD) or adapter case (4WD) contact surfaces.


249L300006

- Install the rear extension (2WD) or adapter case (4WD) to the transmission case and tighten the 10 bolts to the specified torque.
  Torque: 53 N·m (5.4 kgf·m/39 lb·ft)

43ASSY119

20.Control valve assembly

- Align the manual valve and the manual plate of the transmission case.

44ASSY121

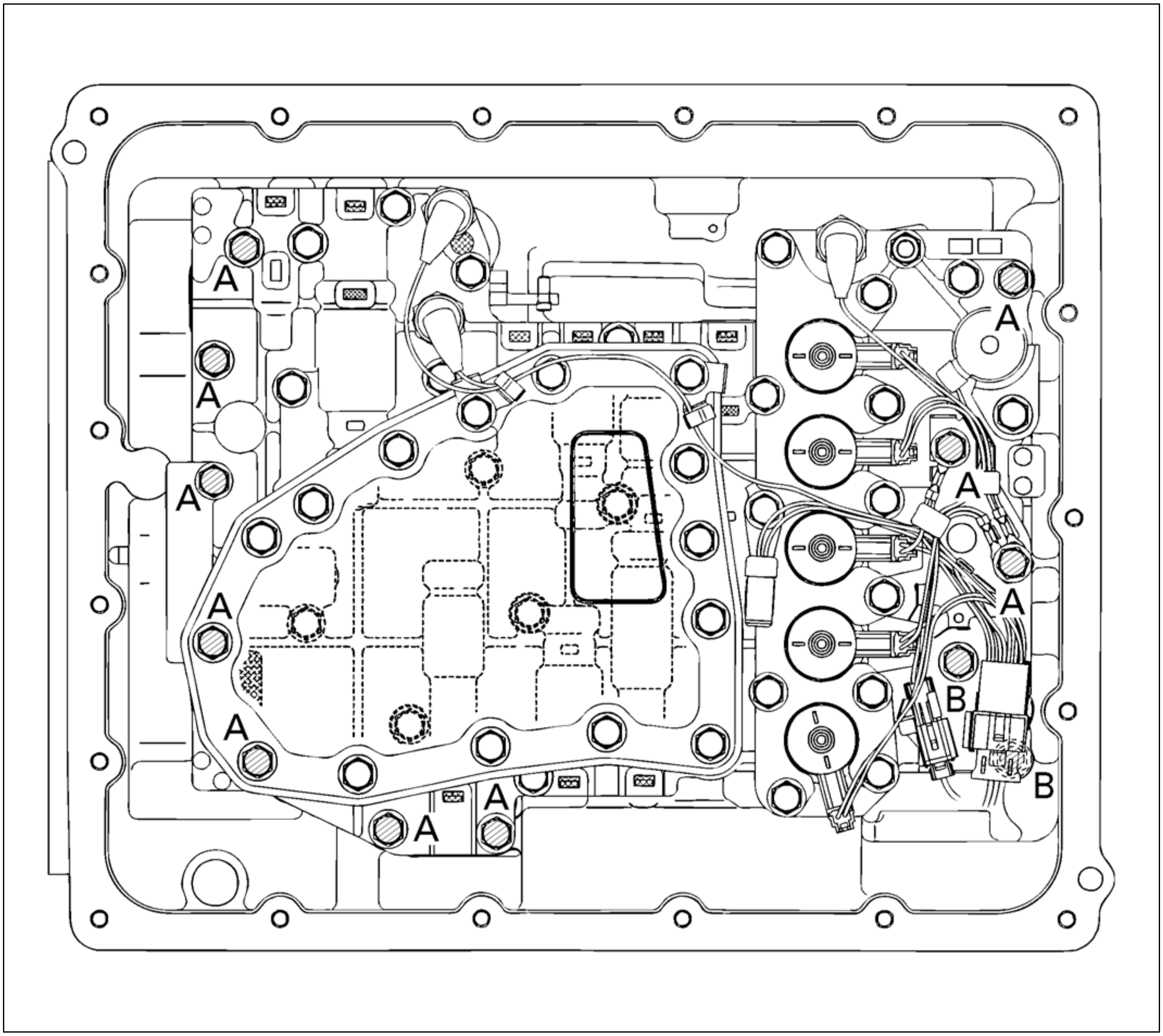
- Install the control valve assembly and tighten the 12 fixing bolts to the specified torque.

Number of bolts	Length	Color
10 (A)	40 mm (1.57 in)	Gold
2 (B)	30 mm (1.18 in)	Gold

Torque: 8 N·m (0.8 kgf·m/69 lb·in)

45CV29

- Connect the harness assembly and control valve assembly connectors.



244L300001

21.Oil pan

- Install a new gasket and the oil pan.
- Tighten the bolts to the specified torque.

  Torque: 8 N·m (0.8 kgf·m/69 lb·in)

22.Inhibitor switch


47INH-SW01

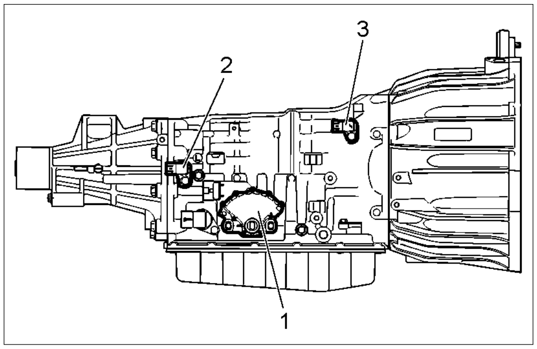
- Secure the inhibitor switch (1) by hand-tightening the 2 bolts.
- Use the inhibitor switch set plate to align the neutral holes (manual shaft and inhibitor switch).

  Turn the inhibitor switch to adjust it.

  Inhibitor switch set plate: 5-8840-2763-0

NOTE:
Inhibitor switch adjustment is very important.
If the inhibitor switch is not correctly adjusted, the automatic transmission will not function normally.

- Tighten the 2 inhibitor switch bolts to the specified torque.



RTW47ASH001001

Torque: 6 N·m (0.6 kgf·m/52 lb·in)

- Remove the holding fixture from the transmission case.

23.Speed sensor and turbine sensor

- Apply ATF to the new O-rings and install them in the speed sensor (2) and the turbine sensor (3).
- Install the speed sensor and the turbine sensor. Tighten the bolt to the specified torque.

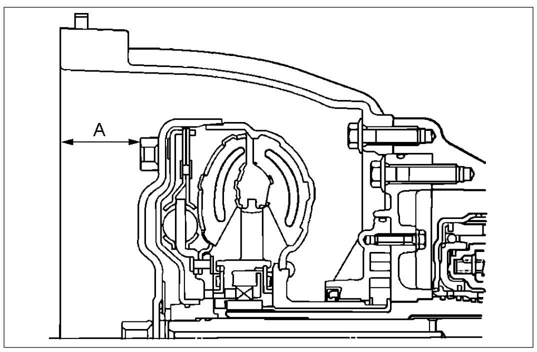
Torque: 6 N·m (0.6 kgf·m/52 lb·in)

24.Torque converter

- Pour the new ATF into the torque converter.
- Shake the torque converter to thoroughly clean the inside.
- Drain the ATF from the torque converter.
- Pour the new ATF into the torque converter.

NOTE:

If significant amounts of foreign material (clutch facing, metallic fragments, etc.) are found in the automatic transmission at time of disassembly, the existing torque converter must be replaced with a new one.



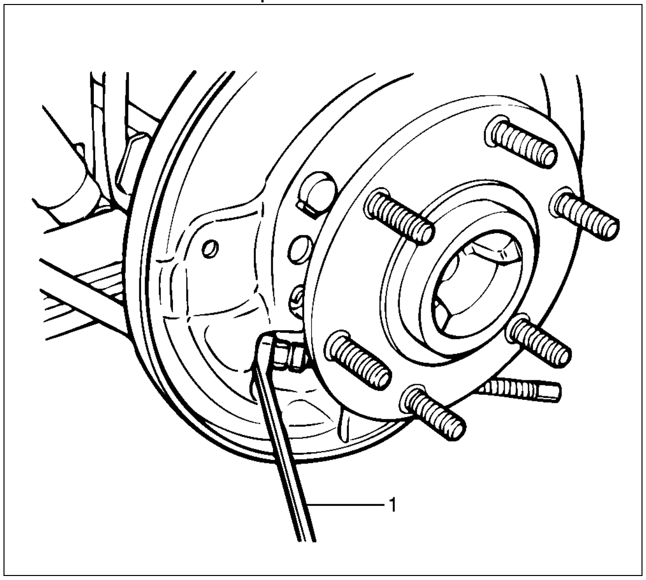
RTW47ASH000901

- Install the torque converter.
- Measure the torque converter end play (A).

If the measured value is greater than the specified minimum, the torque converter is correctly installed.

Torque converter end pay (Minimum): 67 mm (2.64 in)

9. Use offset box wrench to compress locking lugs on the cable, then remove parking brake outer cable from back plate.

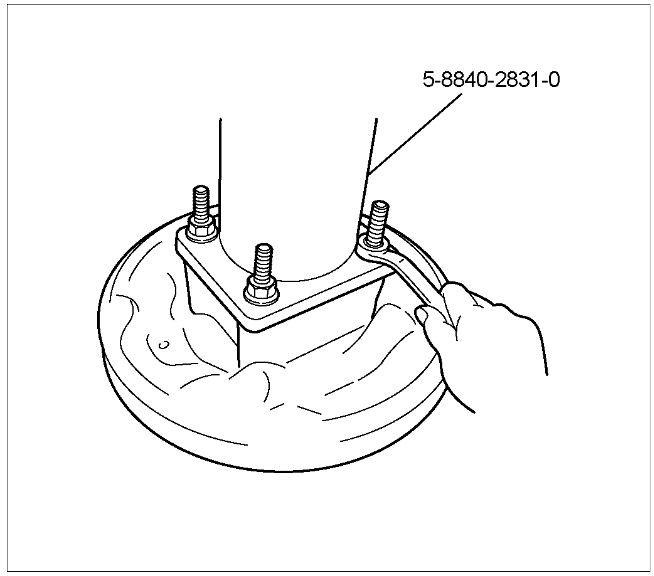


311RS012

Legend

1. Offset Box Wrench

10. Remove wheel cylinder.
11. Remove bearing holder fixing nuts.
12. Take out axle shaft assembly with back plate and set it on a bench press as following illustration. When axle shaft is extracted, since axle case oil seal is damaged, replace the axle case oil seal.
13. Remove snap ring. Use snap ring pliers to remove. Snap ring is prohibition of reuse.
14. Remove shim (If so equipped)
15. Grind the retainer surfaces using a grinder, then chisel them out with a chisel.
16. Position remover 5-8840-2831-0 on the bearing holder with 4 nuts.



RTW54BSH000801

SERVICE STANDARD

ATF	Name			BESCO ATF III	
	Quantity		L (US gal/Imp gal)	9.2 – 9.6	(2.43-2.54/2.02-2.11)
Oil pump	Seal ring clearance		mm (in)	0.10 – 0.25	(0.0039 – 0.0098)
	Housing and inner rotor side clearance		mm (in)	0.02 – 0.04	(0.0008 – 0.0016)
	Outer rotor and crescent clearance		mm (in)	0.02 – 0.15	(0.0008 – 0.0059)
Low clutch	Number of drive plates / driven plates			7/7	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and snap ring clearance		mm (in)	0.9 – 1.3	(0.035 – 0.051)
	Available low clutch retaining plate thickness		mm (in)	3.8	(0.150)
				4.0	(0.157)
				4.2	(0.165)
				4.4	(0.173)
				4.6	(0.181)
				4.8	(0.189)
	Return spring	Number of coils		9.9	
		Outside diameter	mm (in)	9.7	(0.382)
		Free length	mm (in)	36.4	(1.433)
		Linear diameter	mm (in)	1.2	(0.047)
High clutch	Number of drive plates / driven plates			5/5	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and snap ring clearance		mm (in)	1.2 – 1.6	(0.047 – 0.063)
	Available high clutch retaining plate thickness		mm (in)	4.6	(0.181)
				4.8	(0.189)
				5.0	(0.197)
				5.2	(0.205)
				5.4	(0.213)
	Return spring	Number of coils		10.2	
		Outside diameter	mm (in)	8.0	(0.315)
		Free length	mm (in)	27.1	(1.067)
		Linear diameter	mm (in)	1.1	(0.043)
Reverse clutch	Number of drive plates / driven plates			2/2	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and snap ring clearance		mm (in)	0.6 – 0.9	(0.024 – 0.035)
	Available reverse clutch retaining plate thickness		mm (in)	4.8	(0.189)
				5.0	(0.197)
				5.2	(0.205)
				5.4	(0.213)
Low one-way clutch	Seal ring clearance		mm (in)	0.10 – 0.25	(0.0039 – 0.0098)
Low & reverse brake	Number of drive plates / driven plates			6/6	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and snap ring clearance		mm (in)	0.7 – 1.1	(0.028 – 0.043)
	Available low & reverse brake retaining plate thickness		mm (in)	5.2	(0.205)
				5.4	(0.213)
				5.6	(0.220)
				5.8	(0.228)
				6.0	(0.236)

SERVICE STANDARD (Cont'd)

	Return spring	Number of coils		4.8	
		Outside diameter	mm (in)	11.2	(0.441)
		Free length	mm (in)	22.3	(0.878)
		Linear diameter	mm (in)	1.1	(0.043)
2-4 brake	Number of drives / driven plates			5/5	
	Drive plate facing thickness	Standard	mm (in)	2.0	(0.079)
		Limit	mm (in)	1.8	(0.071)
	Retaining plate and retaining plate clearance		mm (in)	1.0 – 1.4	(0.039 – 0.055)
	Available 2-4 brake retaining plate thickness		mm (in)	5.4	(0.213)
				5.6	(0.220)
				5.8	(0.228)
				6.0	(0.236)
				6.2	(0.244)
				6.4	(0.252)
	Return spring	Number of coils		10.2	
		Outside diameter	mm (in)	6.9	(0.272)
		Free length	mm (in)	22.5	(0.886)
		Linear diameter	mm (in)	1.1	(0.043)
Output shaft	Seal ring clearance		mm (in)	0.10 – 0.25	(0.0039 – 0.0098)
Total end play	Total end play		mm (in)	0.25 – 0.55	(0.0098 – 0.0217)
	Available oil pump bearing race thickness		mm (in)	1.4	(0.055)
				1.6	(0.063)
				1.8	(0.071)
				2.0	(0.079)
				2.2	(0.087)
				2.4	(0.094)
Torque converter end play			mm (in)	67.0	(2.638)

SPECIAL SERVICE TOOL

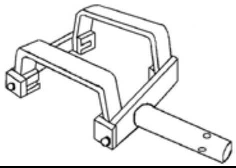
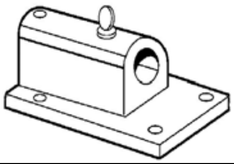
ILLUSTRATION	PART NO.	PART NAME
	5-8841-0841-0	Holding Fixture
	5-8840-0003-0	Holding Fixture Base
	5-8840-2764-0	2-4 Brake Spring Compressor
	5-8840-2767-0	High Clutch Spring Compressor
	5-8840-2759-0	Low Clutch Spring Compressor
	5-8840-2761-0	Oil Pump Oil Seal Installer
	5-8840-2769-0	Rear Extension Oil Seal Installer
	5-8840-2770-0	Rear Adapter Oil Seal Installer
	5-8840-2758-0	Manual Shaft Oil Seal Installer

ILLUSTRATION	PART NO.	PART NAME
	5-8840-2763-0	Inhibitor Switch Set Plate

SECTION 7

MANUAL TRANSMISSION

TABLE OF CONTENTS

SECTION 7B

MANUAL TRANSMISSION

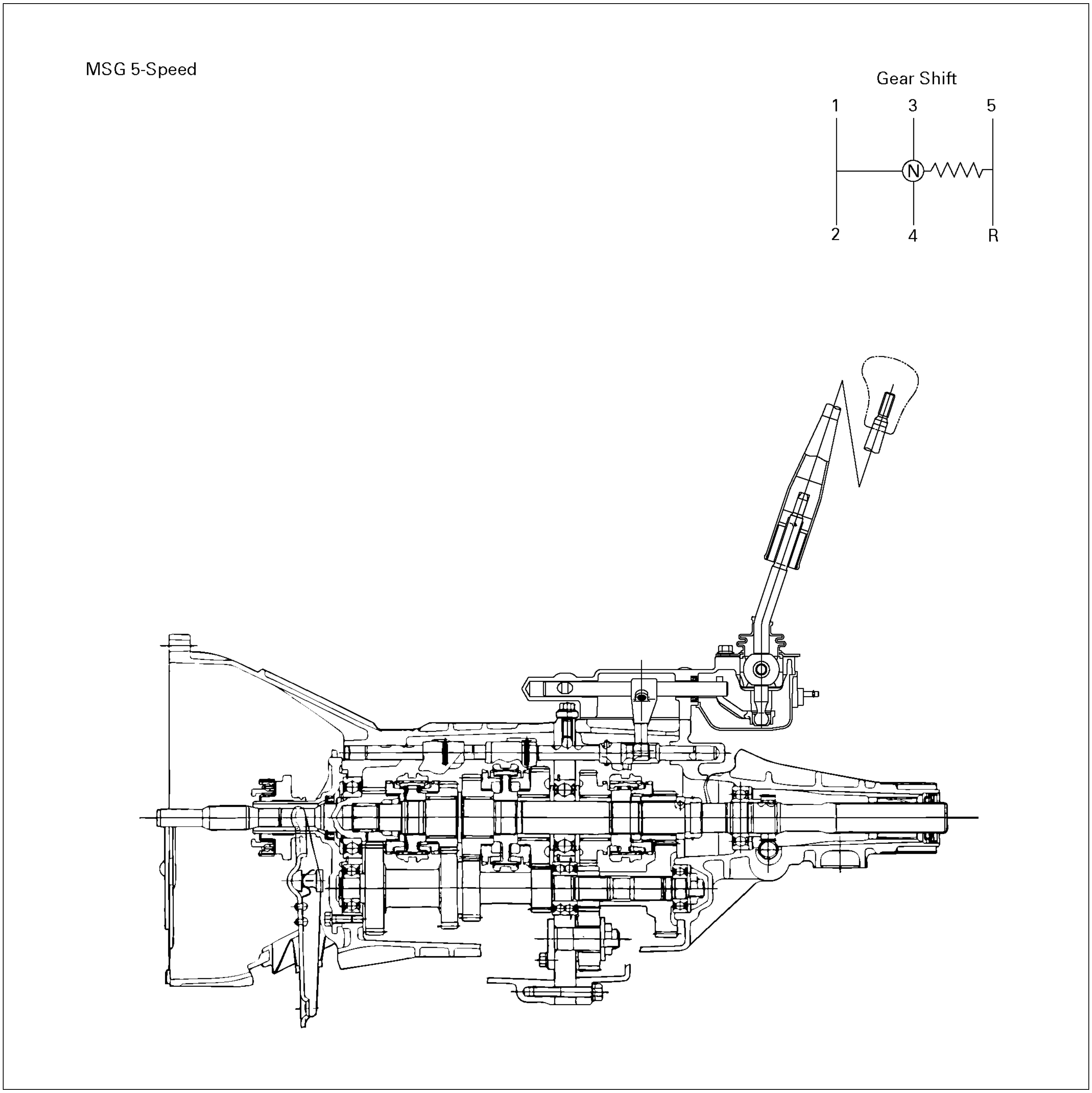
(MSG)

TABLE OF CONTENTS

MAIN DATA AND SPECIFICATIONS

Transmission type	Fully synchronized 5-forward gears with a constant mesh type reverse gear.
Transmission Control	Direct control with the gear shift lever on the floor.
Gear ratio	MSG5K
1st :	4.122
2nd :	2.493
3rd :	1.504
4th :	1.000
5th :	0.855
Rev :	3.720
Oil capacity lit. (US gal.)	1.55(0.41)
Weight ; approx. kg(lbs)	33.3(73.8)

GENERAL DESCRIPTION



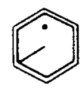
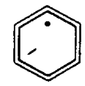
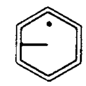
The MSG type transmission is fully synchronized 5-speed unit with blocking ring type synchronizers and a constant mesh type reverse gear.
The unit consists principally of a case with an integral clutch housing, intermediate plate, rear cover and gears.
The top of the rear cover is a quadrant box containing the transmission control mechanism.
The case and rear cover are cast aluminum alloy to reduce weight.

TORQUE SPECIFICATION

STANDDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

N·m (kgf·m/lb·ft)

Strength Class		4.8/4T	7T	8.8		9.8/9T
				Refined	Non-Refined	
Bolt Identification						
	Bolt Diameter× Pitch (mm)	 No mark	-			
Standard Hex. Head Bolt	M6 × 1.0	6 (0.6 / 52 lb.in)	7 (0.7 / 61 lb.in)	8 (0.8 / 69 lb.in)		-
	M8 × 1.25	13 (1.3 / 113 lb.in)	17 (1.7 / 12)	20 (2.0 / 14)		24 (2.4 / 17)
	M10 × 1.25	27 (2.8 / 20)	37 (3.8 / 27)	42 (4.3 / 31)		50 (5.1 / 37)
	M12 × 1.25	61 (6.3 / 45)	76 (7.8 / 56)	87 (8.9 / 64)		95 (9.7 / 70)
	M14 ×1.5	96 (9.8 / 71)	116 (11.8 / 85)	133 (13.6 / 98)		142 (14.5 / 105)
	M16 × 1.5	130 (13.3 / 96)	170 (17.3 / 125)	193 (19.7 / 143)		200 (20.4 / 148)
	M18 × 1.5	188 (19.2 / 139)	244 (24.9 / 180)	278 (28.3 / 205)		287 (29.3 / 212)
	M20 × 1.5	258 (26.3 / 190)	337 (34.4 / 249)	385 (39.3 / 284)		396 (40.4 / 292)
	M22 × 1.5	332 (33.9 / 245)	453 (46.3 / 335)	517 (52.7 / 381)		530 (54.1 / 391)
	M24 × 2.0	449 (45.8 / 331)	570 (58.2 / 421)	651 (66.3 / 480)		692 (70.6 / 511)
	*M10 × 1.5	26 (2.7 / 20)	36 (3.7 / 27)	41 (4.2 / 30)		48 (4.9 / 35)
	*M12 × 1.75	57 (5.8 / 42)	71 (7.2 / 52)	80 (8.2 / 59)		89 (9.1 / 66)
	*M14 × 2.0	89 (9.1 / 66)	110 (11.2 / 81)	125 (12.7 / 92)		133 (13.6 / 98)
	*M16 × 2.0	124 (12.7 / 92)	162 (16.5 / 119)	185 (18.9 / 137)		191 (19.5 / 141)
Flange Bolt	M6 × 1.0	7 (0.7 / 61 lb.in)	8 (0.8 / 69 lb.in)	9 (0.9 / 78 lb.in)		-
	M8 × 1.25	15 (1.5 / 11)	19 (1.9 / 14)	22 (2.2 / 16)		26 (2.7 / 20)
	M10 × 1.25	31 (3.2 / 23)	41 (4.2 / 30)	47 (4.8 / 35)		56 (5.7 / 41)
	M12 × 1.25	69 (7.0 / 51)	85 (8.7 / 63)	97 (9.9 / 72)		106 (10.8 / 78)
	M14 × 1.5	104 (10.6 / 77)	126 (12.8 / 93)	144 (14.6 / 106)		154 (15.7 / 114)
	M16 × 1.5	145 (14.8 / 127)	188 (19.2 / 139)	214 (21.8 / 158)		221 (22.5 / 163)
	M18 × 1.5	-	-	-		-
	M20 × 1.5	-	-	-		-
	M22 × 1.5	-	-	-		-
	M24 × 2.0	-	-	-		-
	*M10 × 1.5	30 (3.1 / 22)	40 (4.1 / 30)	46 (4.7 / 34)		54 (5.5 / 40)
	*M12 × 1.75	64 (6.5 / 47)	78 (8.0 / 58)	89 (9.1 / 66)		99 (10.1 / 73)
	*M14 × 2.0	97 (9.9 / 72)	119 (12.1 / 88)	135 (13.8 / 99.7)		144 (14.7 / 107)
	*M16 × 2.0	137 (14.0 / 101)	178 (18.2 / 132)	203 (20.7 / 132)		210 (21.5 / 155)

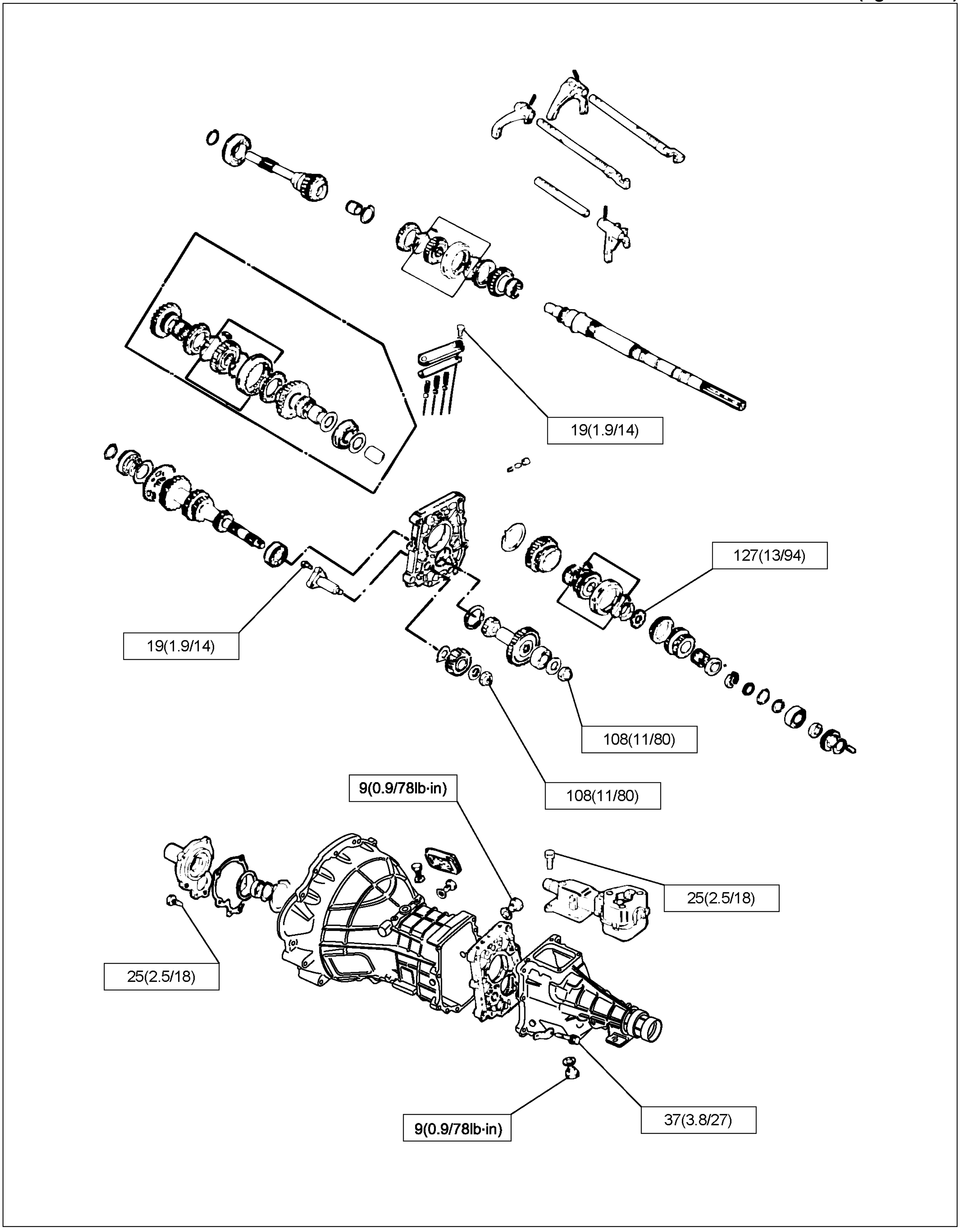
The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

FLARE NUTS

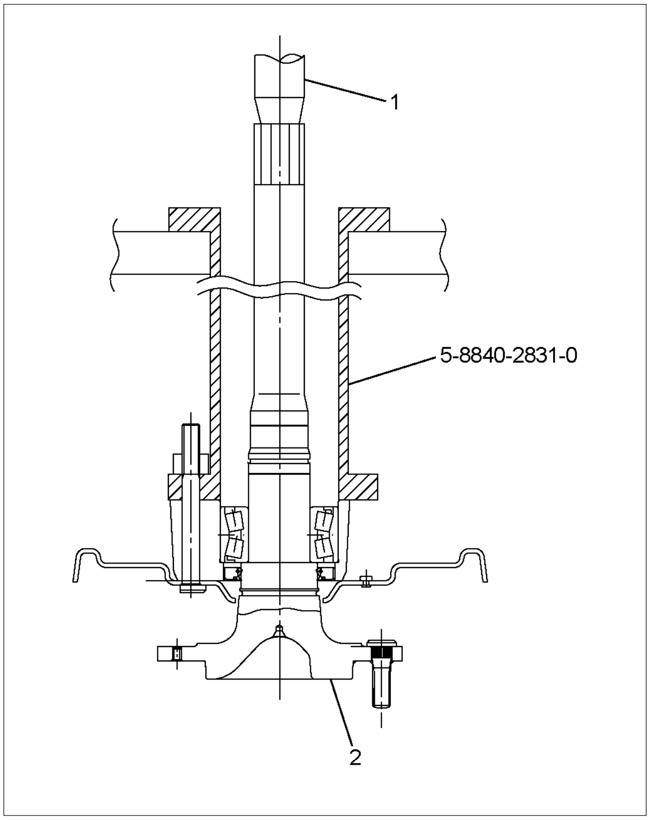
Pipe diameter mm (in)	Torque N·m (kgf·m/lb·ft)	Pipe diameter mm (in)	Torque N·m (kgf·m/lb·ft)
4.76 (0.187)	16 (1.6 / 12)	10.00 (0.394)	54 (5.5 / 40)
6.35 (0.250)	26 (2.7 / 20)	12.00 (0.472)	88 (9.0 / 65)
8.00 (0.315)	44 (4.5 / 33)	15.00 (0.591)	106 (10.8 / 78)

SPECIAL PARTS FIXING NUTS AND BOLTS

N·m (kgf·m/lb·ft)



17. Remove double taper roller bearing, oil seal, bearing holder, and back plate from axle shaft by means of a press.
    - Discard used oil seal, double taper roller bearing, snap ring, retainer.



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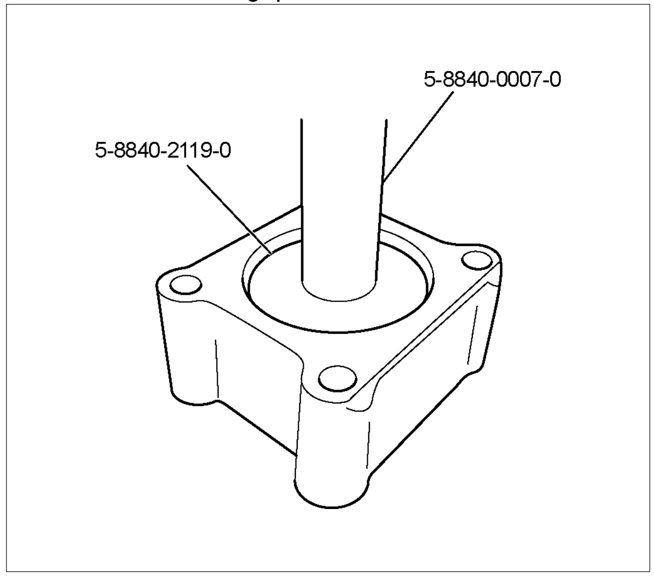
Legend

1. Bench Press Fitting
2. Axle Shaft

18. Oil seal is removed from bearing holder.

19. Bearing outer race is removed from bearing holder.
    - When it cannot remove by hand, bearing outer race is removed using installer 5-8840-2119-0 and grip 5-8840-0007-0.



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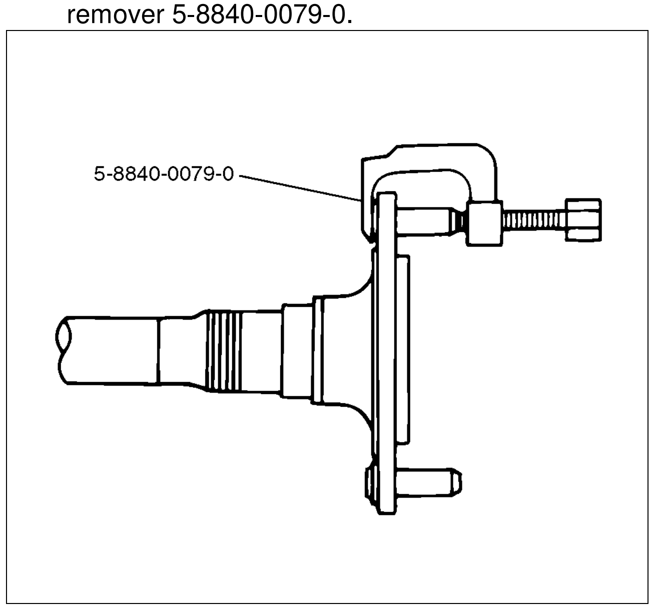
20. Remove differential assembly fixing bolts and nuts and take out differential assembly.
    - ϕ194mm differential assembly has three kinds of bolts.
      Note the installation holes.

21. Remove wheel pin from axle shaft, using the remover 5-8840-0079-0.



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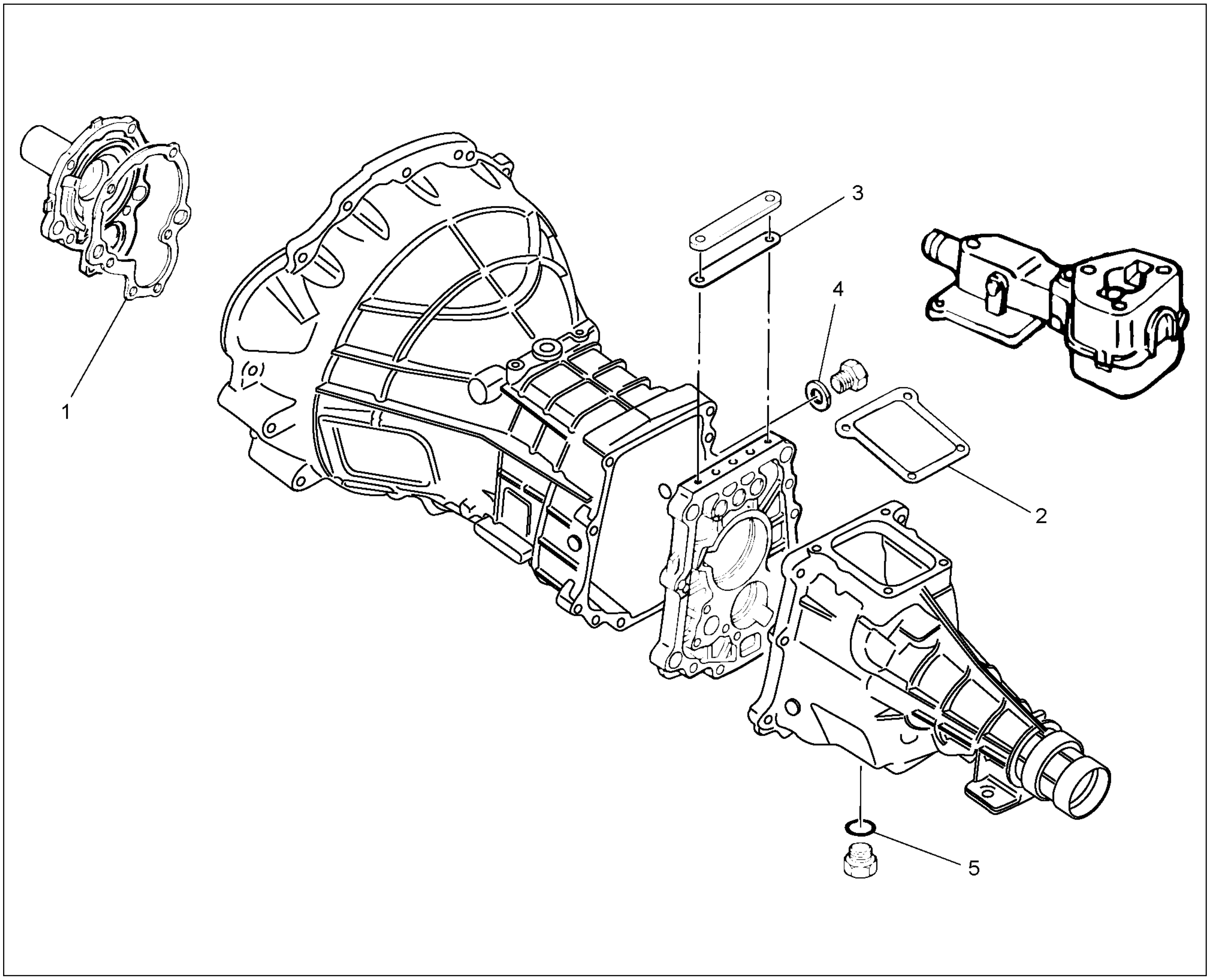
22. Remove axle case oil seal.
    - Discard used oil seal.

REPAIR KIT



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1. Case to front cover gasket
2. Control box gasket
3. Plate gasket
4. Filler plug O-ring
5. Drain plug O-ring

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Important Operations - Removal

Battery Cable

Disconnect the negative (-) cable from the battery terminal.

Engine Hood

Apply setting marks to the engine hood and the engine hood hinges before removing the engine hood.

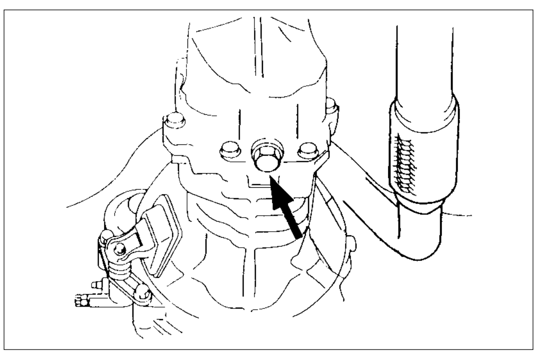
Gear Shift Lever

1. Place the gear shift lever in the neutral position.
2. Remove the gear shift lever knob.
3. Remove the front console assembly.
4. Remove the gear shift lever grommet and dust cover.
5. Remove the gear shift lever cover bolts.
6. Remove the gear shift lever.

Note:
Cover the shift lever hole to prevent the entry of foreign material into the transmission.

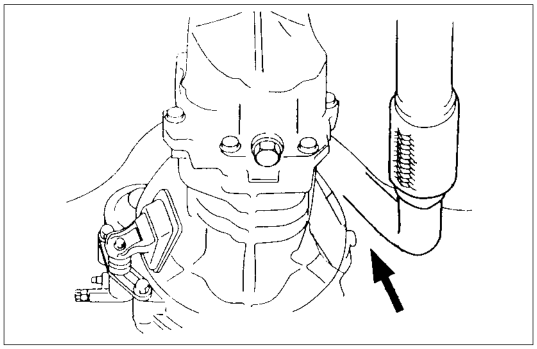
Lifting the Vehicle

1. Jack up the vehicle.
2. Place chassis stands at the front and the rear of the vehicle.



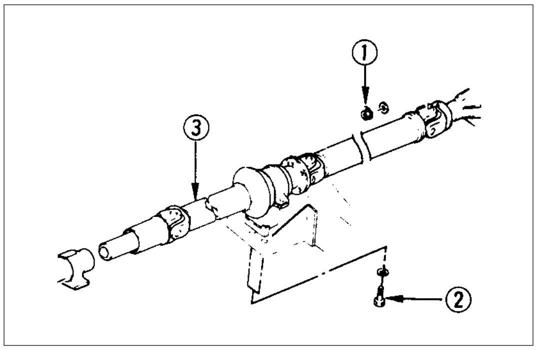
Transmission Oil Draining

1. Remove the transmission oil drain plug.
2. Replace the drain plug after draining the oil.



Exhaust Pipe

1. Remove the exhaust pipe bracket from the transmission case.
2. Remove the exhaust pipe.

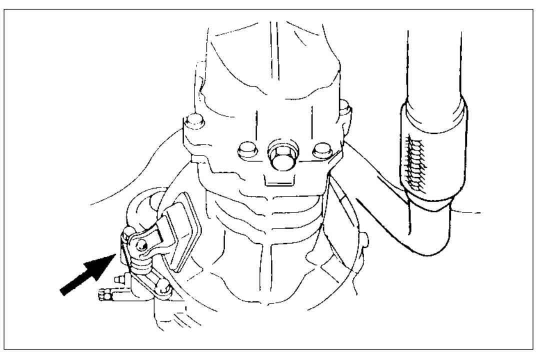


Rear Propeller Shaft (Dual Shaft Type)

1. Apply setting marks to the 2nd propeller shaft flange yoke.
   This will prevent mispositioning during the installation procedure.
2. Remove the 2nd propeller shaft flange yoke nuts at the drive pinion side ①.
3. Remove the center bearing retainer bolts ②.
4. Remove the 1st propeller shaft with the center bearing and the 2nd propeller shaft.
   Pull the 1st propeller shaft toward the rear of the vehicle until the spline yoke is free of the transmission main shaft.

Harness Connector

Disconnect the back up light switch connector and the speedometer sensor connector.

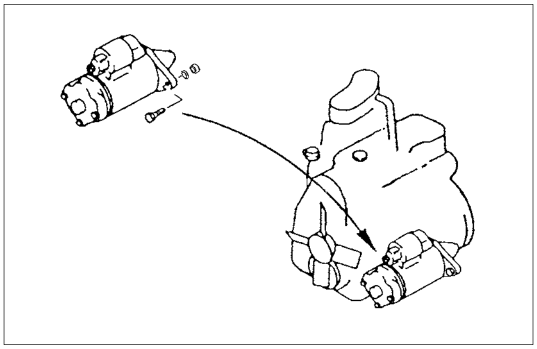


Slave Cylinder

Remove the slave cylinder from the transmission case.

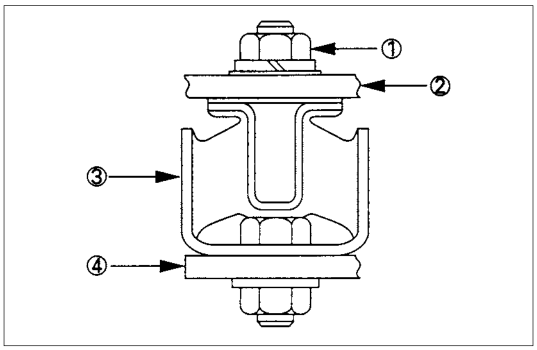
Engine Lifting Hanger

1. Attach the engine lifting hanger to the front portion of the engine.
2. Attach the lifting wire to both ends of the engine lifting hanger.



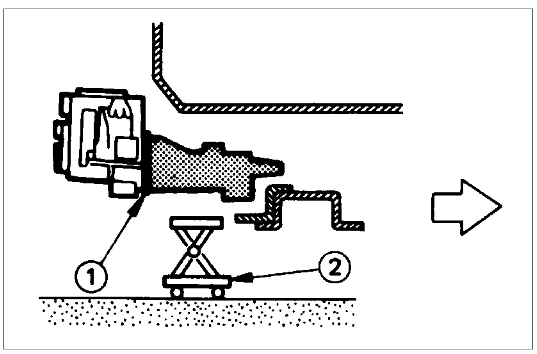
Starter Motor

Remove the starter motor from the engine rear plate.

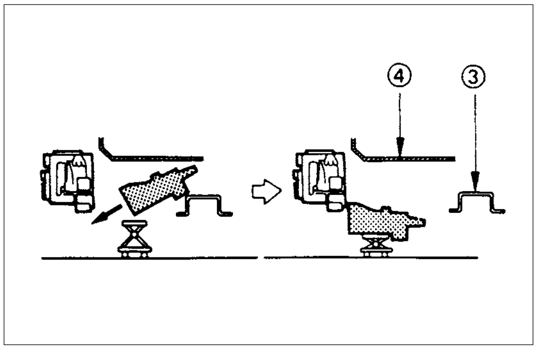


Transmission

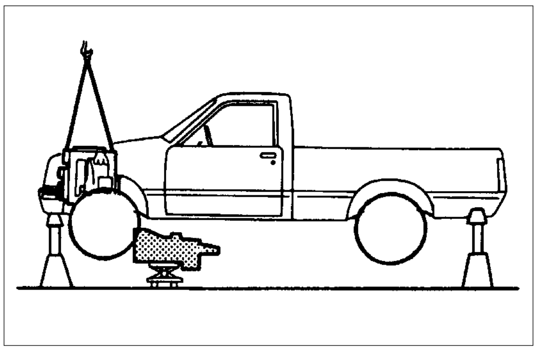
1. Support the transmission with a transmission jack.
2. Remove the engine rear mounting bracket bolts and nuts ① from the transmission ②.
3. Remove the bracket from No.3 crossmember.
4. Loosen the nuts for the rear mounting rubber.
5. Remove the rear mounting rubber ③ from the No.3 crossmember ④.
6. Remove the gear control box from the transmission.



7. Remove the transmission from the engine.
   The removal of the transmission will require the cooperative efforts of two mechanics.
   1) Remove the transmission nuts and bolts ① from the engine rear plate.
   2) Place a transmission jack ② beneath the transmission .
   Do not raise the transmission jack.



3) Manually move the transmission as far as possible toward the rear of the vehicle (into the space between the No.3 crossmember ③ and the floor panel ④.
4) Lower the clutch housing end of the transmission toward the transmission jack.
   The rear of the transmission is supported by the No.3 crossmember at this time.
5) Firmly grasp the transmission rear cover (1st mechanic).
   Raise the transmission jack toward the transmission (2nd mechanic).
   Carefully lower the transmission onto the transmission jack.
   The transmission must be centered on the transmission jack.

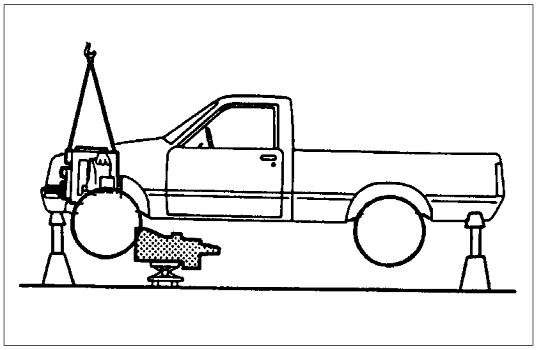


8. Carefully pull the transmission jack with the transmission from beneath the vehicle.

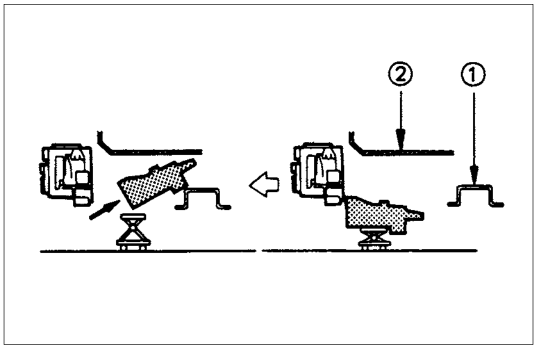
Important Operations - Installation

Follow the removal procedure in the reverse order to perform the installation procedure.
Pay careful attention to the important points during the installation procedure.

Transmission

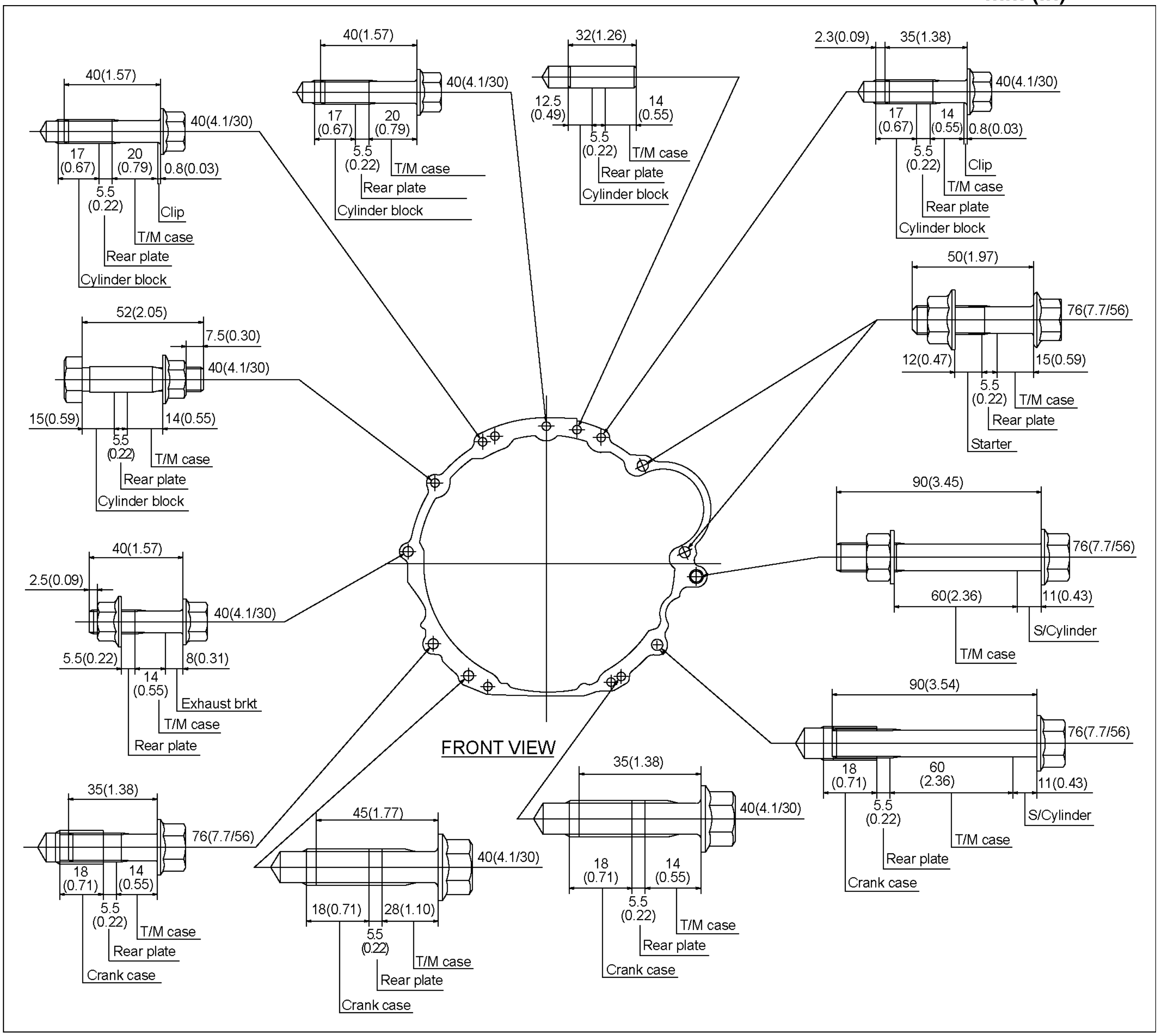


1. Apply a thin coat of molybdenum disulfide grease to the top gear shaft spline.
2. Place the transmission on a transmission jack.
3. Carefully move the transmission jack and transmission into position behind the engine.



4. Slowly operate the transmission jack to raise the transmission until the rear of the transmission is at the same level as the No.3 crossmember ①.
5. Manually support the transmission rear cover.
   Move the transmission into position between the No.3 crossmember and the floor panel ②.
6. Slowly raise the transmission jack until the front of the transmission is aligned with the rear of the engine.
   The slope of the engine and the transmission must be the same.
7. Install the gear control box the transmission.
8. Align the top gear shaft spline with the clutch drive plate spline.
9. Install the transmission to the engine.
   Tighten the transmission nuts and bolts as shown in the figure.

N·m (kgf·m/lb·ft)
mm (in)



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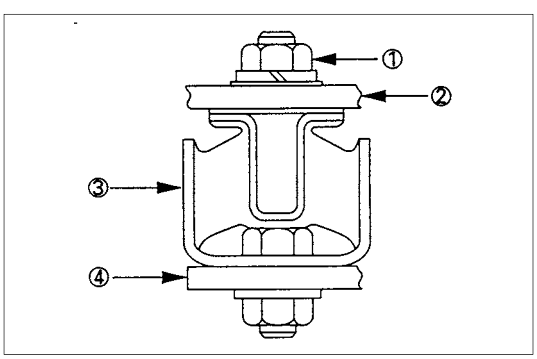
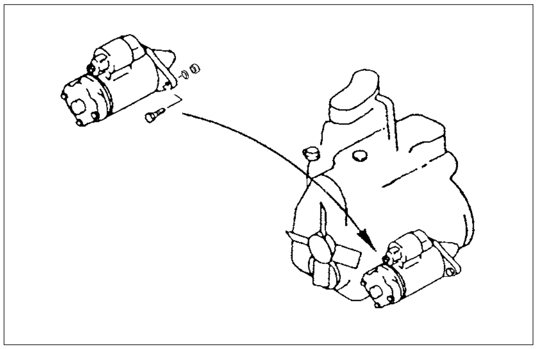


10. Install the rear mounting rubber ③ to the transmission ②. Install the rear mounting rubber ③ to the No.3 crossmember ④.
11. Tighten the rear mounting rubber nuts ① to the specified forque.

Rear Mounting Rubber Nut Torque	N·m (kgf·m/lb·ft)
41 (4.2 / 30)	

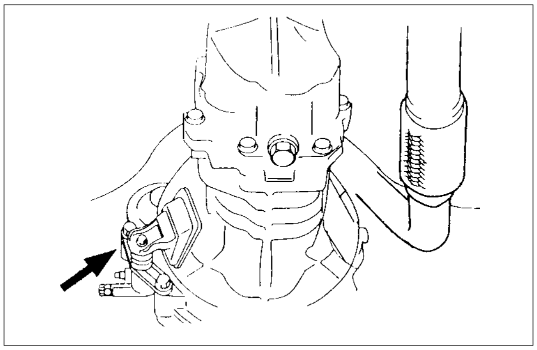
Mounting Bolt Torgue	N·m (kgf·m/lb·ft)
41 (4.2 / 30)	



Starter Motor

1. Install the starter motor to the engine rear plate.
2. Tighten the starter motor bolts to the specified torque.

Starter Motor Torque	N·m (kgf·m/lb·ft)
78 (8.0 / 58)	



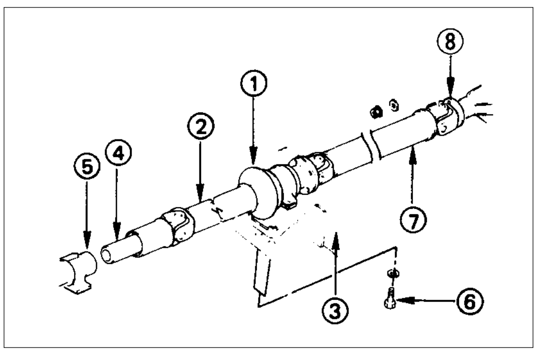
Slave Cylinder

Install the slave cylinder to the transmission case.

Slave Cylinder Bolt Torque	N·m (kgf·m/lb·ft)
78 (8.0 / 58)	

Harness Connector

Connect the back up light switch connector and speedometer sensor connector.



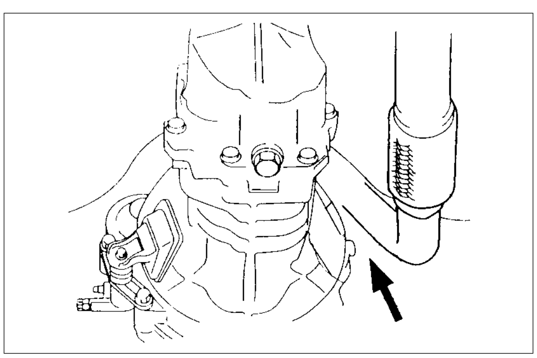
Rear Propeller Shaft (Dual Shaft Type)

1. Place the center bearing and retainer ① together with the 1st propeller shaft ② and 2nd propeller shaft ⑦ on the No.4 crossmember ③.
2. Insert the splined yoke ④ into the transmission main shaft spline ⑤.
3. Tighten the center bearing retainer bolts ⑥ to the specified torque.

Center Bearing Retainer Bolt Torque	N·m (kgf·m/lb·ft)
61 (6.2 / 45)	

4. Connect the 2nd propeller shaft ⑦ and drive pinion side ⑧. Be sure to align the setting marks applied at disassembly.
5. Tighten the coupling bolts to the specified torque.

Propeller Shaft Flange Yoke Bolt Torque	N·m (kgf·m/lb·ft)
M8 : 35 (3.6 / 26) M10 : 63 (6.4 / 46)	



Exhaust Pipe

1. Install the exhaust pipe to the exhaust manifold and the 2nd exhaust pipe.
2. Install the exhaust pipe bracket to the transmission case.

Gear Shift Lever

1. Replenish the transmission case with the specified engine oil.

Transmission Case Oil	lit(US gal.)
1.55 (0.41)	

2. Install the gear shift lever to the gear control box.
3. Tighten the gear shift lever cover bolts to the specified torque.

Shift Lever Cover Bolt Torque	N·m(kgf·m/lb·ft)
20 (2.0 / 14)	

4. Install the dust cover and the grommet.
5. Install the front console assembly.
6. Install the gear shift lever knob.

Lowering the Vehicle

1. Place a jack beneath the vehicle.
2. Raise the jack to remove the chassis stands.
3. Lower the vehicle to the ground.

Engine Hood

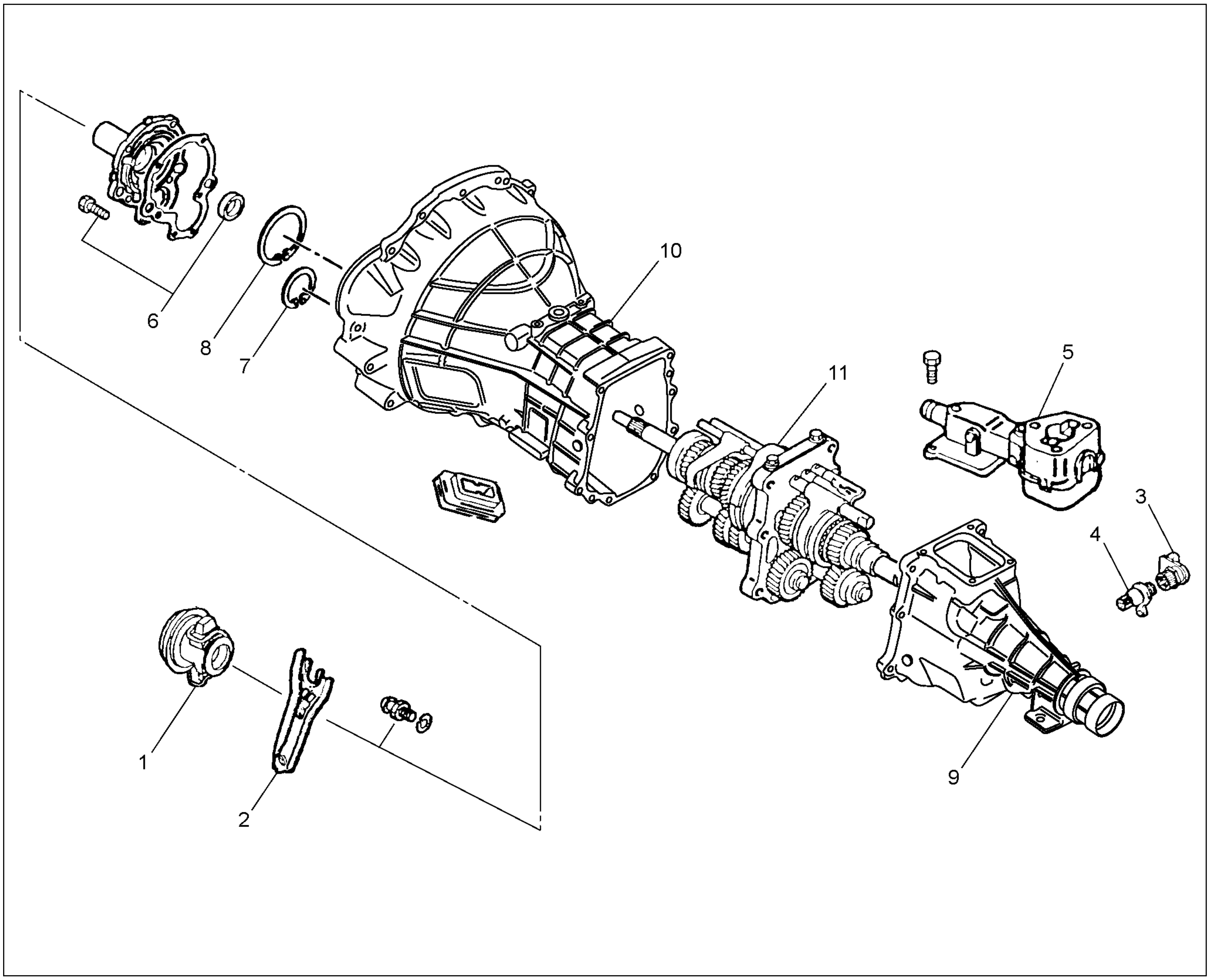
Align the setting marks(applied at removal)on the engine hood and the engine hood hinges to install the engine hood.

Battery Cable

Connect the negative (-) cable to the battery terminal.

DISASSEMBLY

MAJOR COMPONENTS



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Disassembly Steps

1. Clutch shift block and release bearing
2. Clutch shift fork
3. Speedometer sensor
4. Speedometer driven gear assembly
5. Gear control box assembly

▲ 6. Front cover with oil seal

▲ 7. Counter gear snap ring

▲ 8. Bearing snap ring

9. Rear cover with oil seal
10. Transmission case
11. Intermediate plate with gear assembly

Inspection and Repair

Make all necessary adjustments, repairs, and part replacements if wear, damage, or other problems are discovered during inspections.

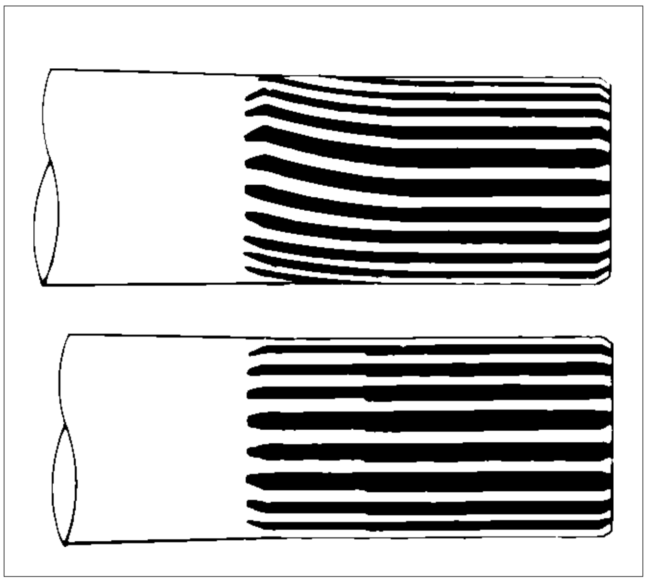
Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

- Axle Shaft

Axle Shaft

When checking the axle shaft, pay special attention to the splined portions and replace the shaft if distortion or step wear is noticeable. Correct slight step wear with a pencil grinder.



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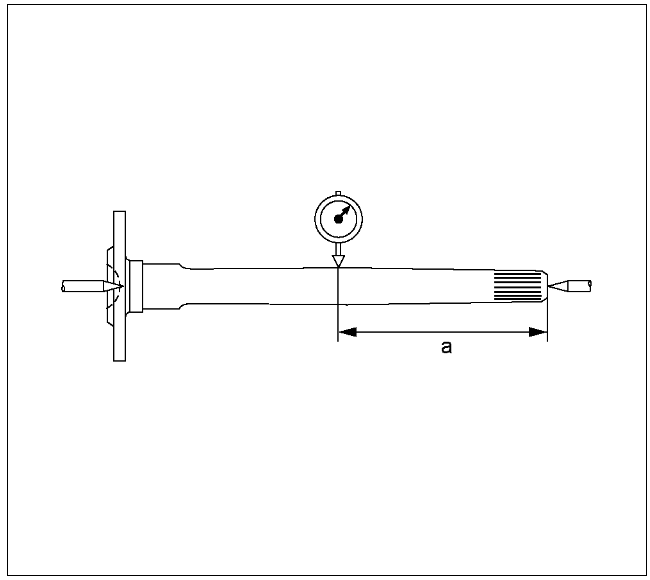
Axle Shaft Run-Out

Check the shafts for bending with the use of a dial indicator in contact with the shaft. Rotate the shaft slowly and observe the dial indicator.

Limit	mm (in)
1.0 (0.039)	

Note :
Never use heat to correct bending.



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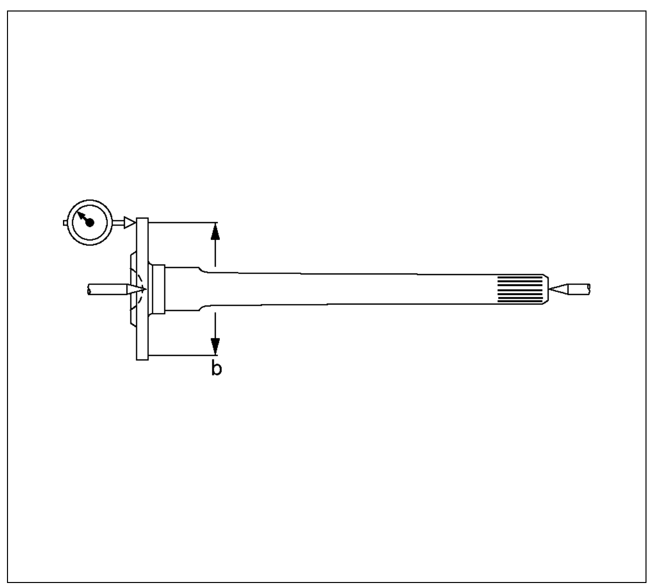
Legend

a. 350 mm (13.8 in)

Axle Shaft Flange Run-Out

Check the axle shaft flange for run-out. Hold the probe of a dial indicator in contact with the flange. Rotate the shaft slowly and observe the dial.

Limit	mm (in)
0.08 (0.003)	



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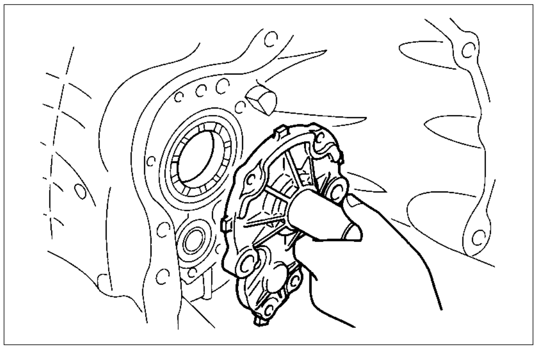
Legend

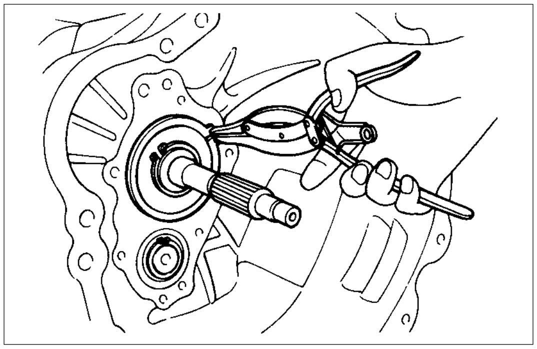
b. 160 mm (6.3 in)



Important Operations

6. Front Cover with Oil Seal

Remove the front cover with oil seal from the transmission case.



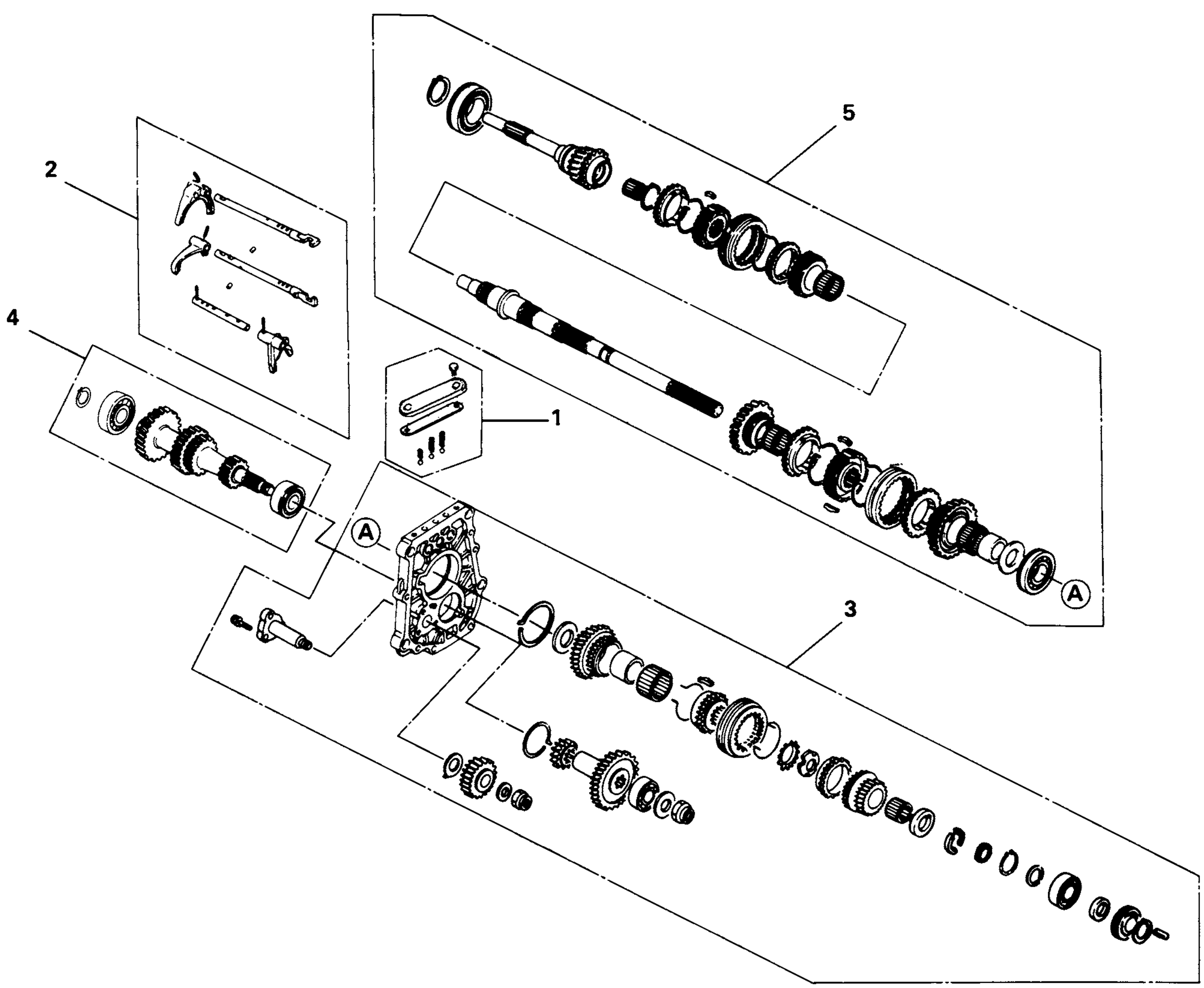
7. Counter Gear Snap Ring

8. Bearing Snap Ring

Use a pair of snap ring pliers to remove the snap ring.

MAJOR COMPONENT

INTERNAL PARTS

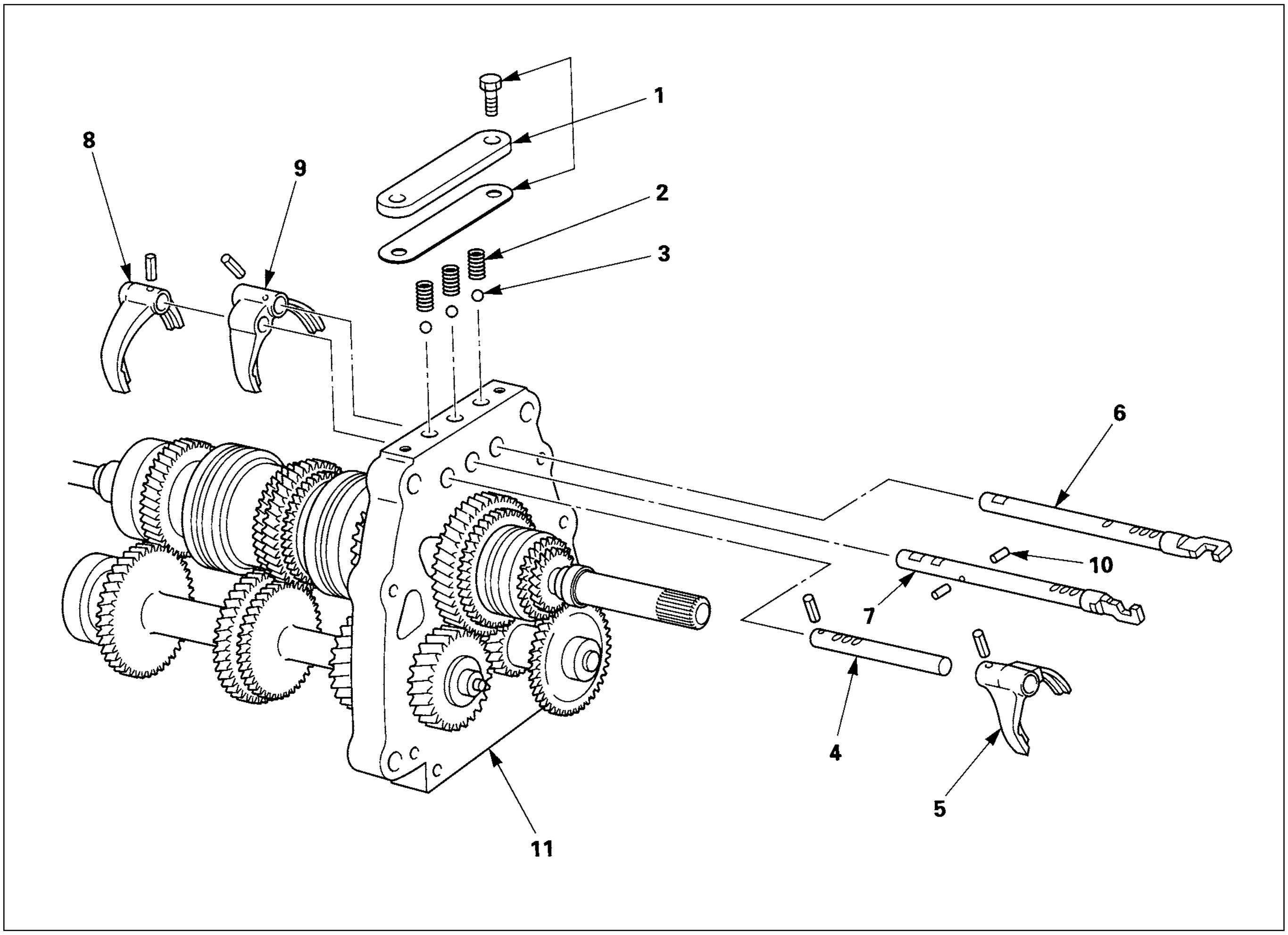


Disassembly steps

1. Detent assembly
2. Shift arm assembly & interlock pin
3. Rev. and 5th gear assembly
4. Counter gear shaft assembly
5. Top & main gear shaft assembly

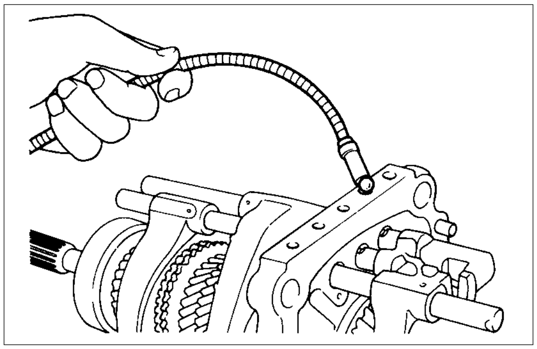
MINOR COMPONENTS

DETENT, SHIFT ARM ASSEMBLY AND INTERLOCK PIN



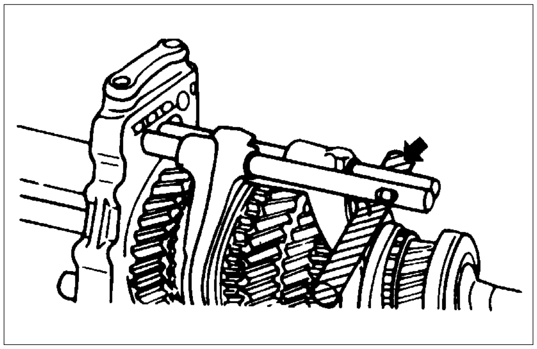
Disassembly Steps

1. Detent spring plate and gasket
2. Detent spring
▲ 3. Detent ball
4. Rev. - 5th shift rod
5. Rev. - 5th shift arm
6. 1st - 2nd shift rod
▲ 7. 3rd - 4th shift rod
▲ 8. 3rd - 4th shift arm
▲ 9. 1st - 2nd shift arm
10. Interlock pin
11. Intermediate plate and gear assembly



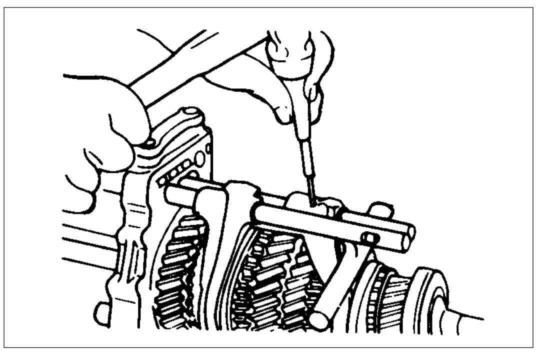
Important Operations

3. Detent Ball



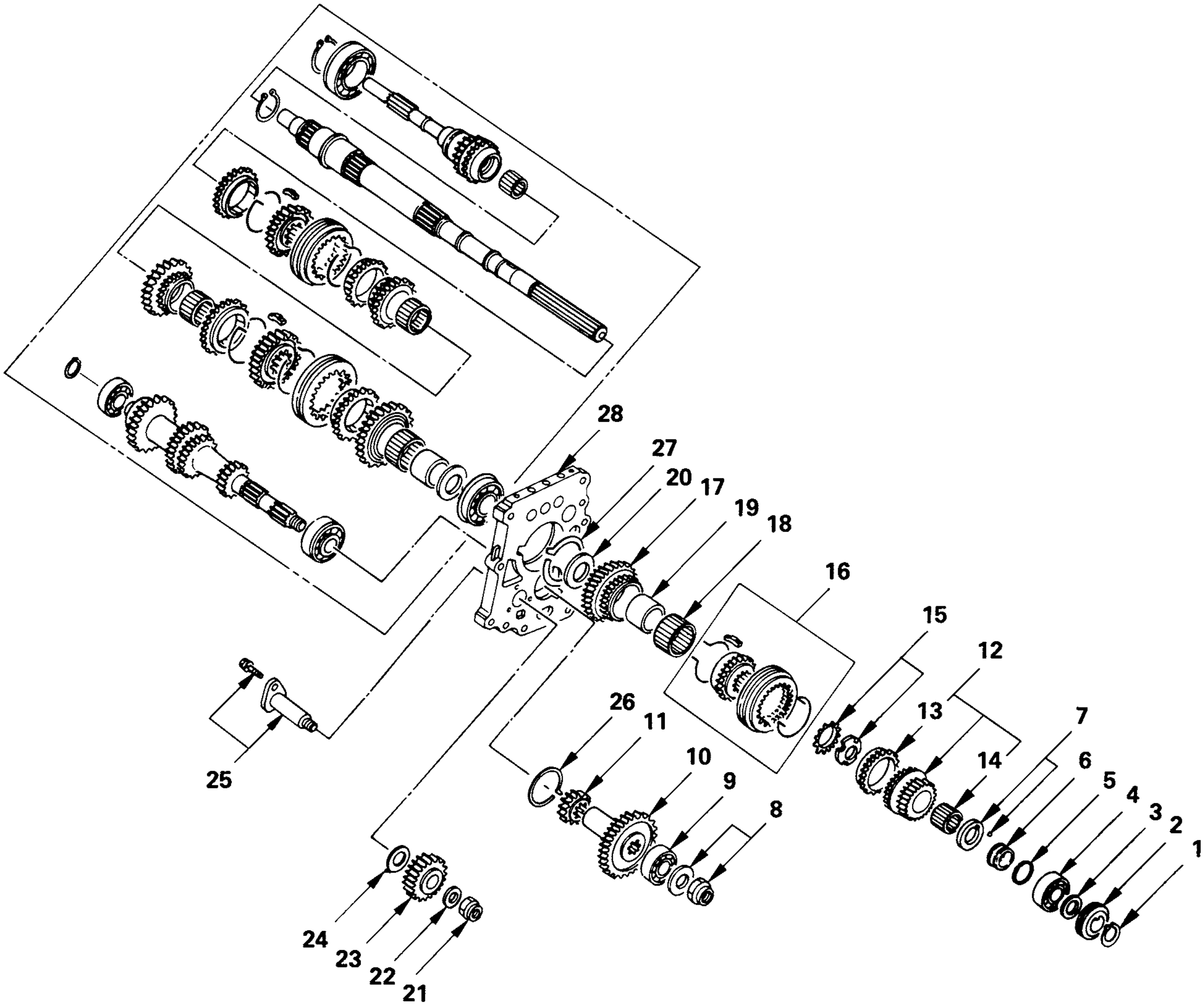
7. 3rd - 4th Shift Rod
8. 3rd - 4th Shift Arm
9. 1st - 2nd Shift Arm

1) Hold a round bar against the shift arm end.
   This will prevent damage to other components.



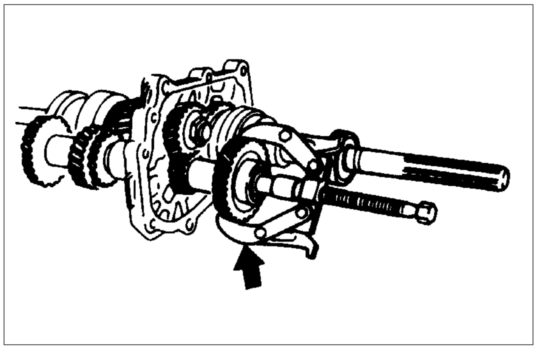
2) Use a spring pin remover to remove the shift arm spring pin from the shift arm and the shift rod.
   Spring Pin Remover : 9-8529-2201-0
   Discard the used spring pin.
3) Move the 3rd - 4th shift rod forward.
   Take care not to lose the interlock pins.

REVERSE GEAR AND 5TH GEAR



Disassembly Steps

1. Bearing snap ring
2. Speedometer drive gear and lock ball
3. Bearing spacer
4. Mainshaft end ball bearing
5. Thrust ring snap ring
6. Thrust washer thrust ring
7. Thrust washer and lock ball
8. Counter reverse gear nut and washer
▲ 9. Counter end ball bearing
▲10. Counter 5th gear
11. Counter reverse gear
12. 5th gear
13. 5th block ring
14. Needle bearing
▲15. Mainshaft lock nut and washer
▲16. Rev. - 5th synchronizer assembly
17. Reverse gear
18. Needle bearing
19. Needle bearing collar
20. Thrust washer
21. Counter reverse gear lock nut
22. Thrust washer
23. Reverse idler gear
24. Thrust washer
25. Reverse idler shaft
▲26. Bearing snap ring
▲27. Bearing snap ring
▲28. Intermediate plate

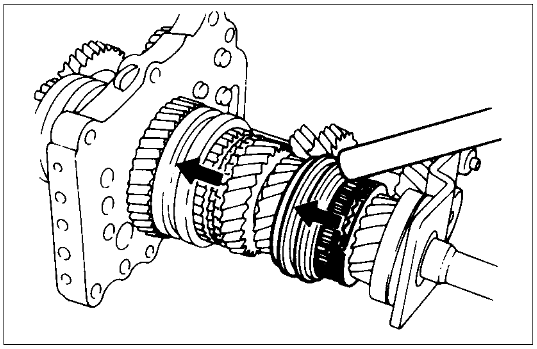


Important Operations

9.Counter End Ball Bearing

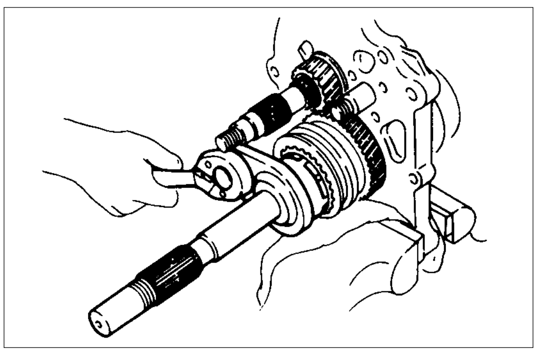
10.Counter 5th Gear

Use a gear remover to remove the counter 5th gear with the ball bearing.
Gear Remover : 5-8840-0013-0 (J-22888)

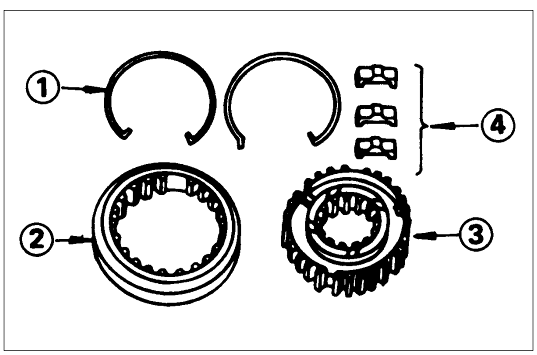


15. Mainshaft Lock Nut and Washer

1) Engage the 3rd - 4th synchronizer with the 3rd gear.
2) Engage the 1st - 2nd synchronizer with the 1st gear.
3) Attach a holding fixture to the mainshaft and the countergear.
   Holding Fixture : 5-8840-2001-0 (J-29768)

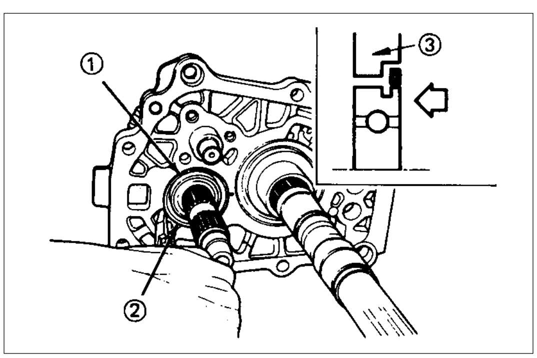


4) Use a lock nut wrench to remove the lock nut.
   Lock Nut Wrench: 5-8840-0353-0 (J-36629)



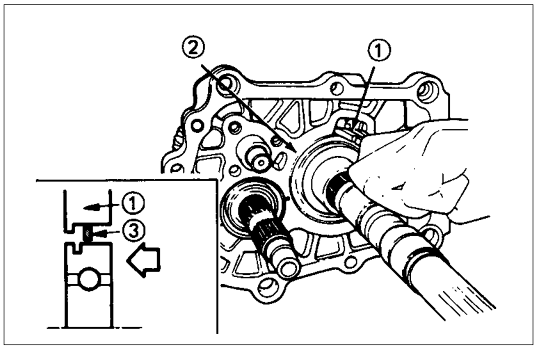
16.Rev. - 5th Synchronizer Assembly

1) Remove the synchronizer assembly as a set.
2) Disassemble the synchronizer assembly.
   ① Springs
   ② Sleeve
   ③ Clutch Hub
   ④ Inserts



26.Bearing Snap Ring

1) Insert the snap ring pliers ① into the counter gear bearing snap ring hole ②.
   The snap ring hole is in the intermediate plate ③.
2) Use the snap ring pliers to force open the counter gear bearing snap ring.
   Tap on the front of the intermediate plate.
   The ball bearing snap ring will come free.

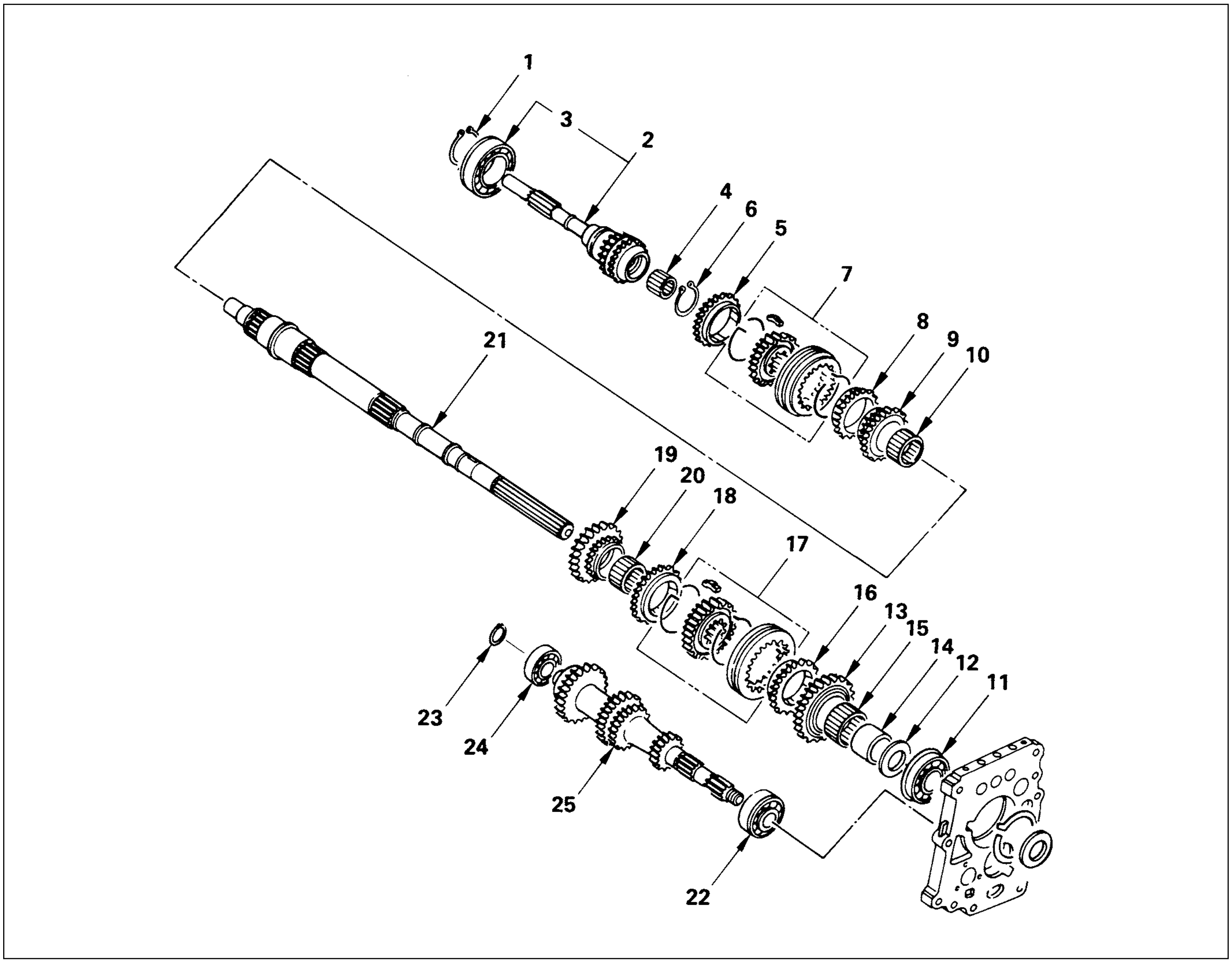


27.Bearing Snap Ring

28.Intermediate Plate

1) Insert the snap ring pliers into the mainshaft bearing snap ring hole.
   The snap ring hole is in the intermediate plate ②.
2) Use the snap ring pliers ① to force open the mainshaft bearing snap ring ③.
   Hold the snap ring open with the pliers.
3) Push the intermediate plate toward the rear of the transmission to remove it.
   The ball bearing snap ring will come free.

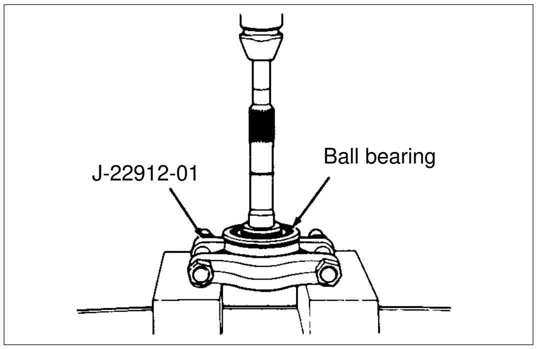
TOP GEAR SHAFT, MAINSHAFT GEAR AND COUNTER GEAR



Disassembly Steps

▲ 1. Top gear shaft snap ring
▲ 2. Top gear shaft
▲ 3. Ball bearing
4. Needle bearing
5. 4th block ring
6. Mainshaft snap ring
▲ 7. 3rd - 4th synchronizer assembly
8. 3rd block ring
9. 3rd gear
10. Needle bearing
▲11. Mainshaft ball bearing
12. 1st gear thrust washer
13. 1st gear
14. Needle bearing collar
15. Needle bearing
16. 1st block ring
▲17. 1st - 2nd synchronizer assembly
18. 2nd block ring
19. 2nd gear
20. Needle bearing
21. Mainshaft
▲22. Rear ball bearing
23. Bearing snap ring
▲24. Front ball bearing
25. Counter gear

Important Operations

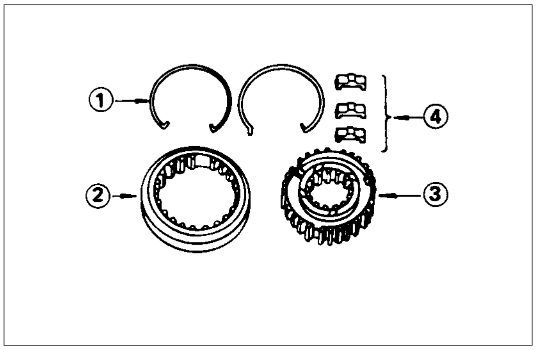


1. Top Gear Shaft Snap Ring

2. Top Gear Shaft

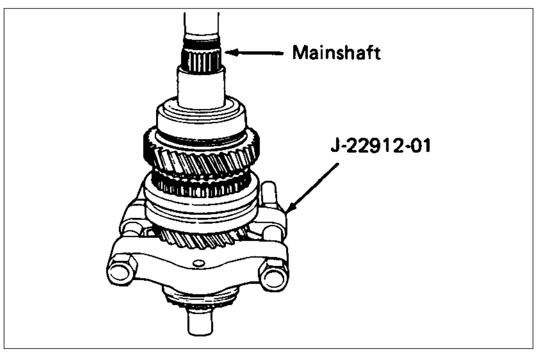
3. Ball Bearing

1) Use a pair of snap ring pliers to remove the snap ring.
2) Use a bench press and a bearing remover to remove the ball bearing.
Bearing Remover : 5-8840-0015-0 (J-22912-01)



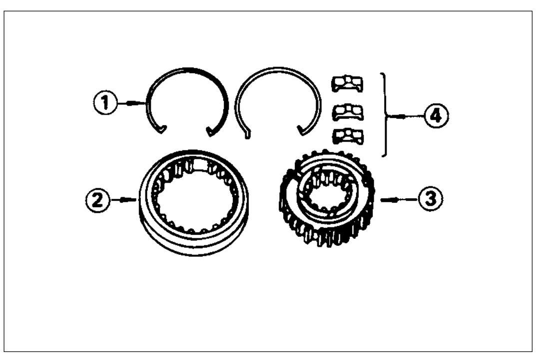
7. 3rd - 4th Synchronizer Assembly

1) Remove the synchronizer assembly as a set.
2) Disassemble the synchronizer assembly.
① Springs
② Sleeve
③ Clutch Hub
④ Inserts



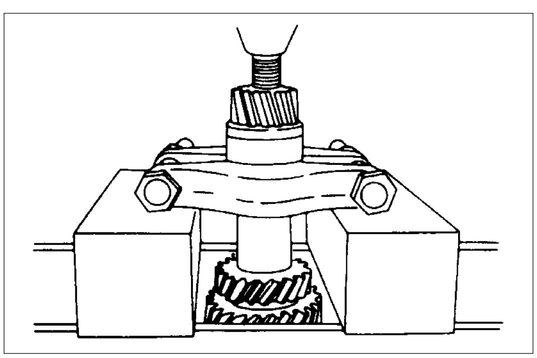
11.Mainshaft Ball Bearing

Use a bench press and a bearing remover to remove the ball bearing.
Bearing Remover : 5-8840-0015-0 (J-22912-01)



17.1st - 2nd Synchronizer Assembly

1) Remove the synchronizer assembly as a set.
2) Disassemble the synchronizer assembly.
① Springs
② Sleeve
③ Clutch Hub
④ Inserts



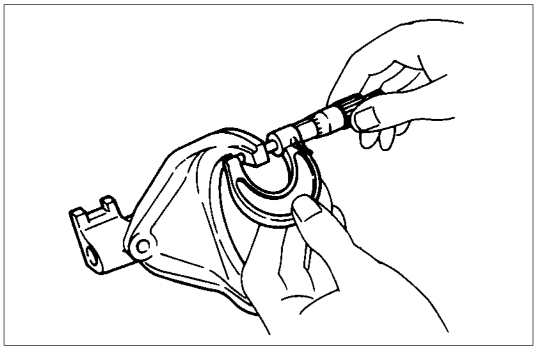
22.Rear Ball Bearing

24.Front Ball Bearing

Use a bench press and a bearing remover to remove the ball bearing.
Bearing Removar : 5-8840-0015-0 (J-22912-01)

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

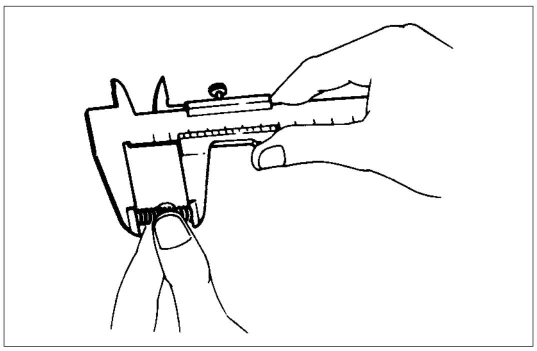


SHIFT ARM THICKNESS

Use a micrometer to measure the shift arm thickness.
If the measured value is less than the specified limit, the shift arm must be replaced.

Shift Arm Thickness mm(in)

	Standard	Limit
1st-2nd	9.6-9.8 (0.378-0.386)	9.0 (0.354)
3rd-4th	6.95-7.2 (0.274-0.283)	6.5 (0.256)
Rev.-5th	6.8-6.9 (0.268-0.272)	6.3 (0.248)

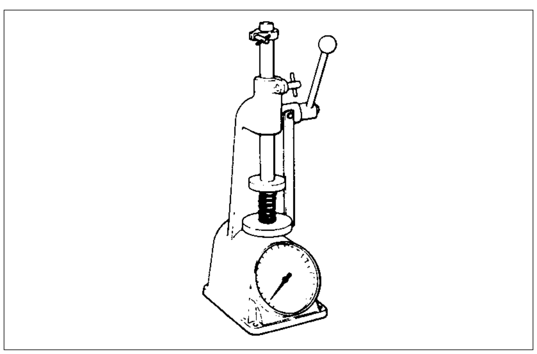


DETENT SPRING FREE LENGTH

Use a venier caliper to measure the detent spring free length.
If the measured value is less than the specified limit, the detent spring must be replaced.

Detent Spring Free Length mm(in)

Standard	Limit
25.6 (1.01)	23.6 (0.93)

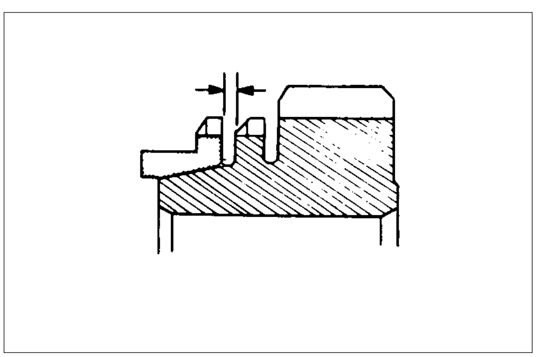


DETENT SPRING TENSION

Use a spring tester to measure the valve spring tension.
If the measured value is less than the specified limit, the valve spring must be replaced.

Valve Spring Tension N(kg/lb)

Compressed Height mm(in)	Standard	Limit
22.1 (0.870)	61.8-65.7 (6.3-6.7/13.9-14.8)	55.9 (5.7/12.6)



BLOCK RING AND DOG TEETH CLEARANCE

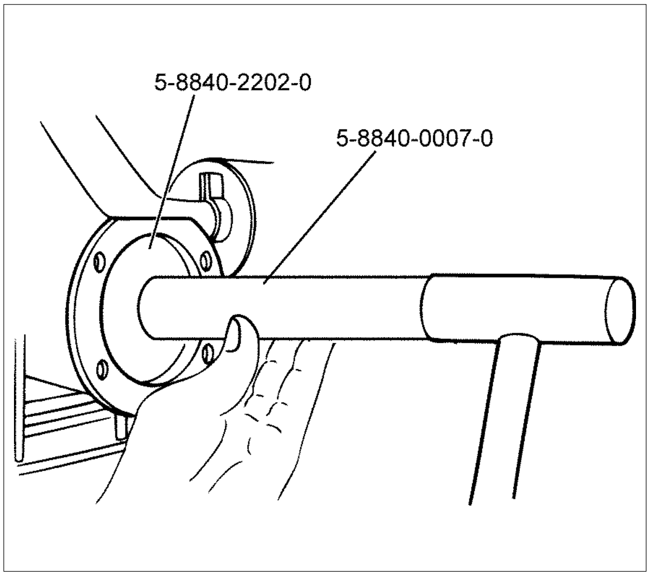
Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
If the measured value exceeds the specified limit, the block ring must be replaced.

Block Ring and Dog Teeth Clearance mm(in)

	Standard	Limit
1st,2nd	2.0 (0.079)	1.3 (0.051)
3rd, 4th, 5th	1.5 (0.059)	0.8 (0.031)

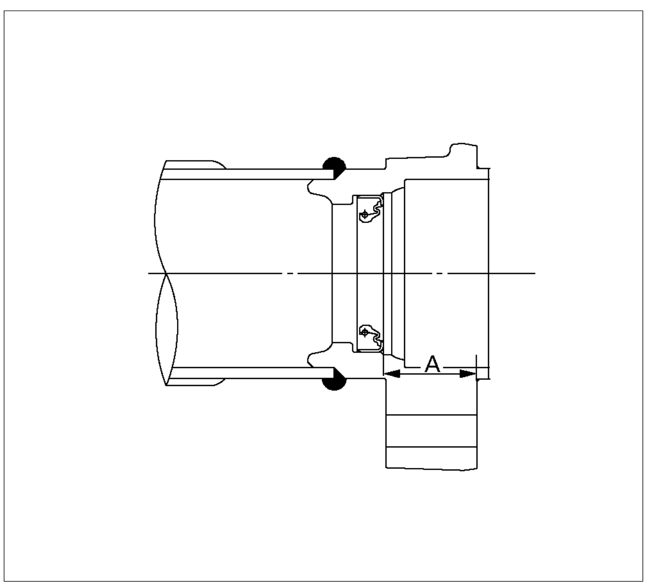
Reassembly

1. Using the oil seal installer 5-8840-2202-0 and grip 5-8840-0007-0, install new axle case oil seal.



RTW54BSH000301

Note :
Confirm that the dimension : A should be 34.5 – 36.1 mm (1.36 – 1.42 in)



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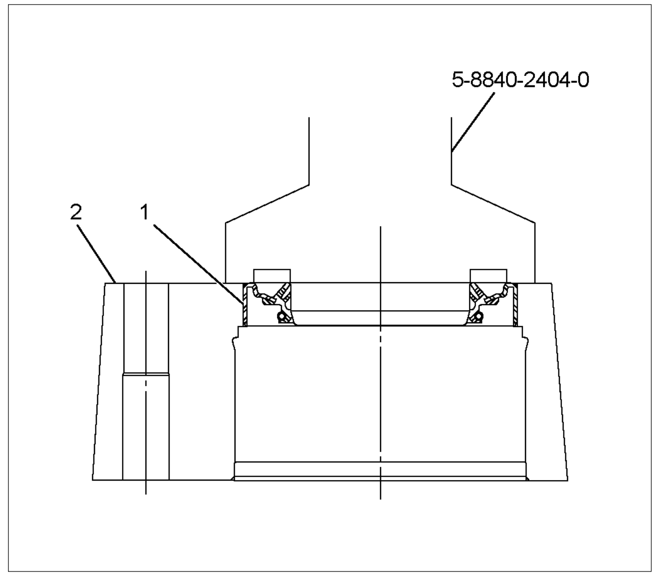
2. Install new oil seal in bearing holder, using the oil seal installer 5-8840-2404-0.

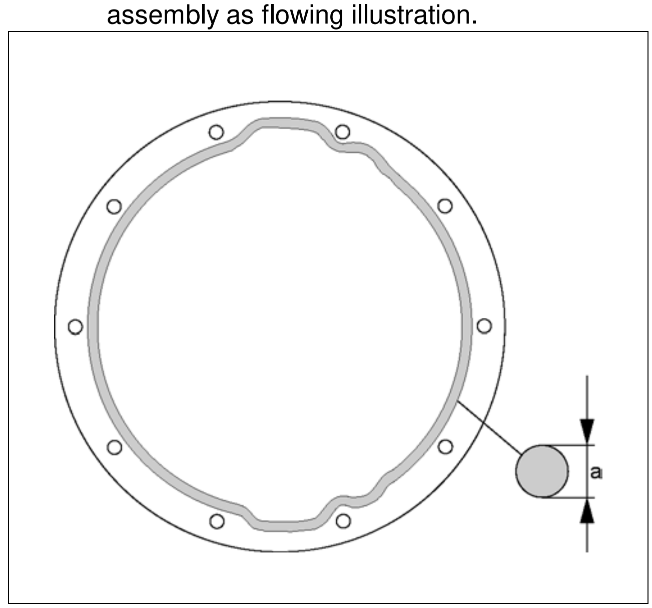


RTW54BSH000501

Legend

1. Oil Seal
2. Bearing Holder

3. Drive wheel pin into axle shaft flange, using a hammer.
4. Differential assembly
   a. Clean the mating surface of axle case and differential carrier.
   b. Apply Three Bond 1215 (TB1215) or equivalent on the surface of differential assembly as flowing illustration.

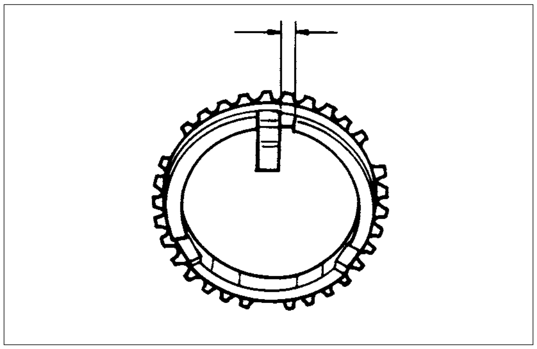


RTW74BSH000301

Legend

a. 3 mm (0.12 in)

   c. Tighten bolts and nuts to the specified torque.

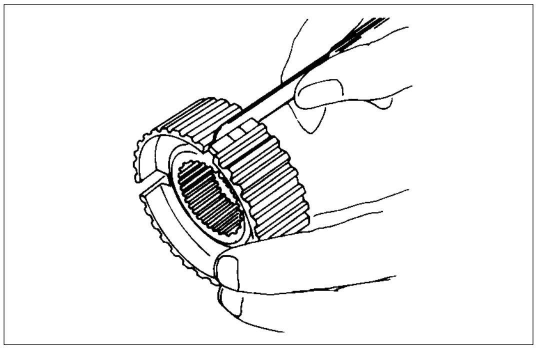


BLOCK RING AND INSERT CLEARANCE

Use a thickness gauge to measure the clearance between the block ring and the insert.
If the measured value exceeds the specified limit, the block ring and the insert must be replaced.

Block Ring and Insert Clearance mm(in)

	Standard	Limit
1st,2nd	3.46-3.74 (0.136-0.147)	4.0 (0.157)
3rd, 4th, 5th	3.51-3.79 (0.138-0.149)	

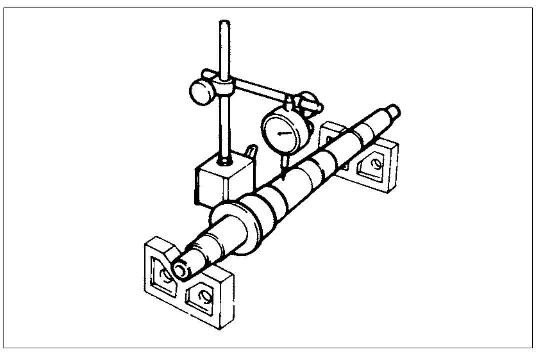


CLUTCH HUB AND INSERT CLEARANCE

Use a thickness gauge to measure the clearance between the clutch hub and the insert.
If the measured value exceeds the specified limit, the clutch hub and the insert must be replaced.

Clutch Hub and Insert Clearance mm(in)

Standard	Limit
0.01 - 0.19 (0.0004 - 0.0075)	0.3 (0.012)



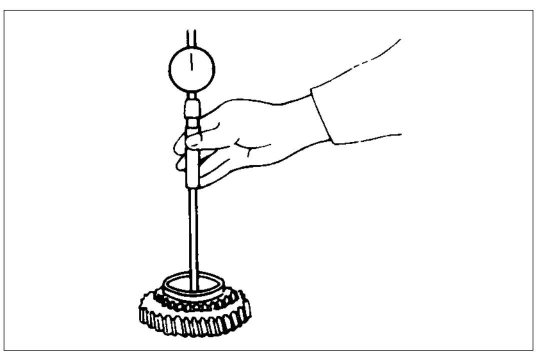
MAINSHAFT RUN - OUT

1. Install the mainshaft to a grinding machine.
2. Use a dial indicator to measure the mainshaft central portion run-out.

   If the measured mainshaft run-out exceeds the specified limit, the mainshaft must be replaced.

Mainshaft Run - Out mm(in)

Limit
Less than 0.03 (0.0012)

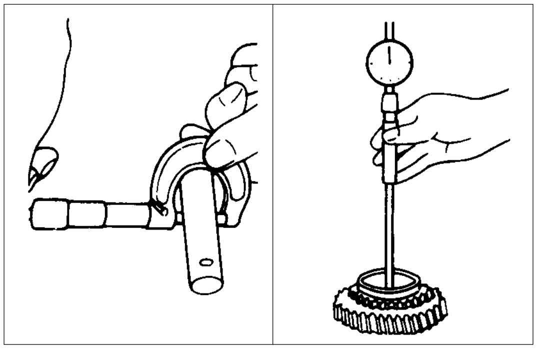


GEAR INSIDE DIAMETER

Use an inside dial indicator to measure the gear inside diameter.
If the measured value is less than the specified limit, the gear must be replaced.

Gear Inside Diameter mm(in)

	Standard	Limit
1st Rev.	45.00-45.01 (1.7717-1.7720)	45.10 (1.7756)
2nd 3rd	41.00-41.01 (1.6142-1.6146)	41.10 (1.6181)
5th	34.03-34.04 (1.3398-1.3402)	34.10 (1.3425)

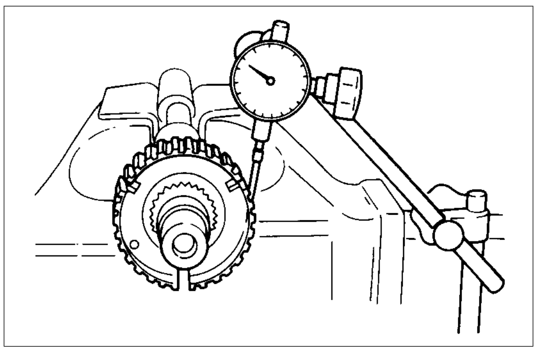


REVERSE IDLER GEAR AND IDLER GEAR SHAFT CLEARANCE

1. Use a micrometer to measure the idler gear shaft diameter.
2. Use an inside dial indicator to measure the idler gear inside diameter.
3. Calculate the idler gear and idler gear shaft clearance.
   Idler gear inside diameter - idler gear shaft diameter = idler gear and idler gear shaft clearance.
   If the measured value exceeds the specified limit, the idler gear and/or the idler gear shaft must be replaced.

Idler Gear and Idler Gear Shaft Clearance mm(in)

Standard	Limit
0.041 - 0.074 (0.0016 - 0.0029)	0.150 (0.0059)

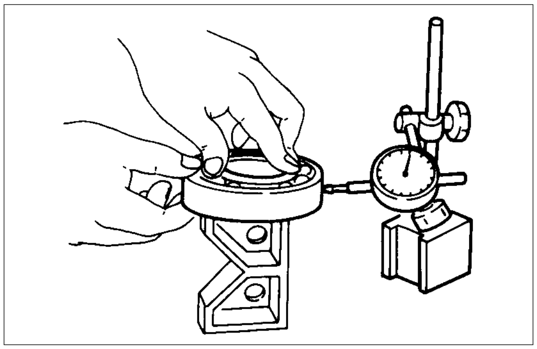


CLUTCH HUB SPLINE PLAY

1. Set a dial indicator to the clutch hub to be measured.
2. Move the clutch hub as far as possible to both the right and the left.
   Note the dial indicator reading.
   It the measured value exceeds the specified limit, the clutch hub must be replaced.

Clutch Hub Spline Play mm(in)

Standard	Limit
0 - 0.019 (0 - 0.0075)	0.20 (0.0079)



BALL BEARING PLAY

Use a dial indicator to measure the ball bearing play.

Ball Bearing Play mm(in)

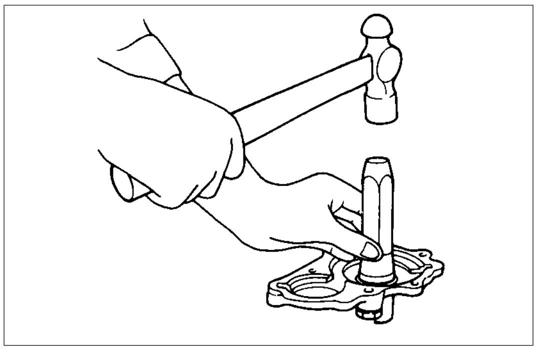
Limit
0.2 (0.0079)

FRONT COVER OIL SEAL

Oil Seal Replacement

Oil Seal Removal

Use a screwdriver to pry the oil seal from the front cover.



Oil Seal Installation

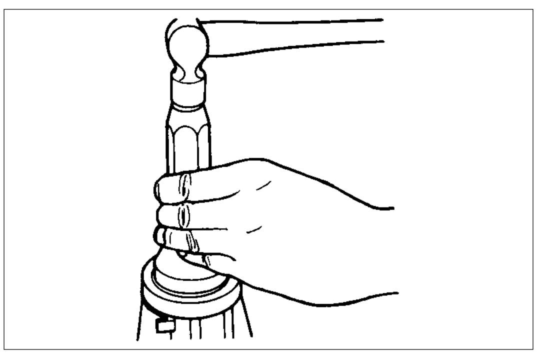
1. Use a oil seal installer to install the oil seal to the front cover.
   Oil Seal Installer : 5-8840-0026-0 (J-26540)
2. Apply engine oil to the oil seal lip.

REAR COVER OIL SEAL

Oil Seal Replacement

Oil Seal Removal

Use a screwdriver to pry the oil seal from the rear cover.



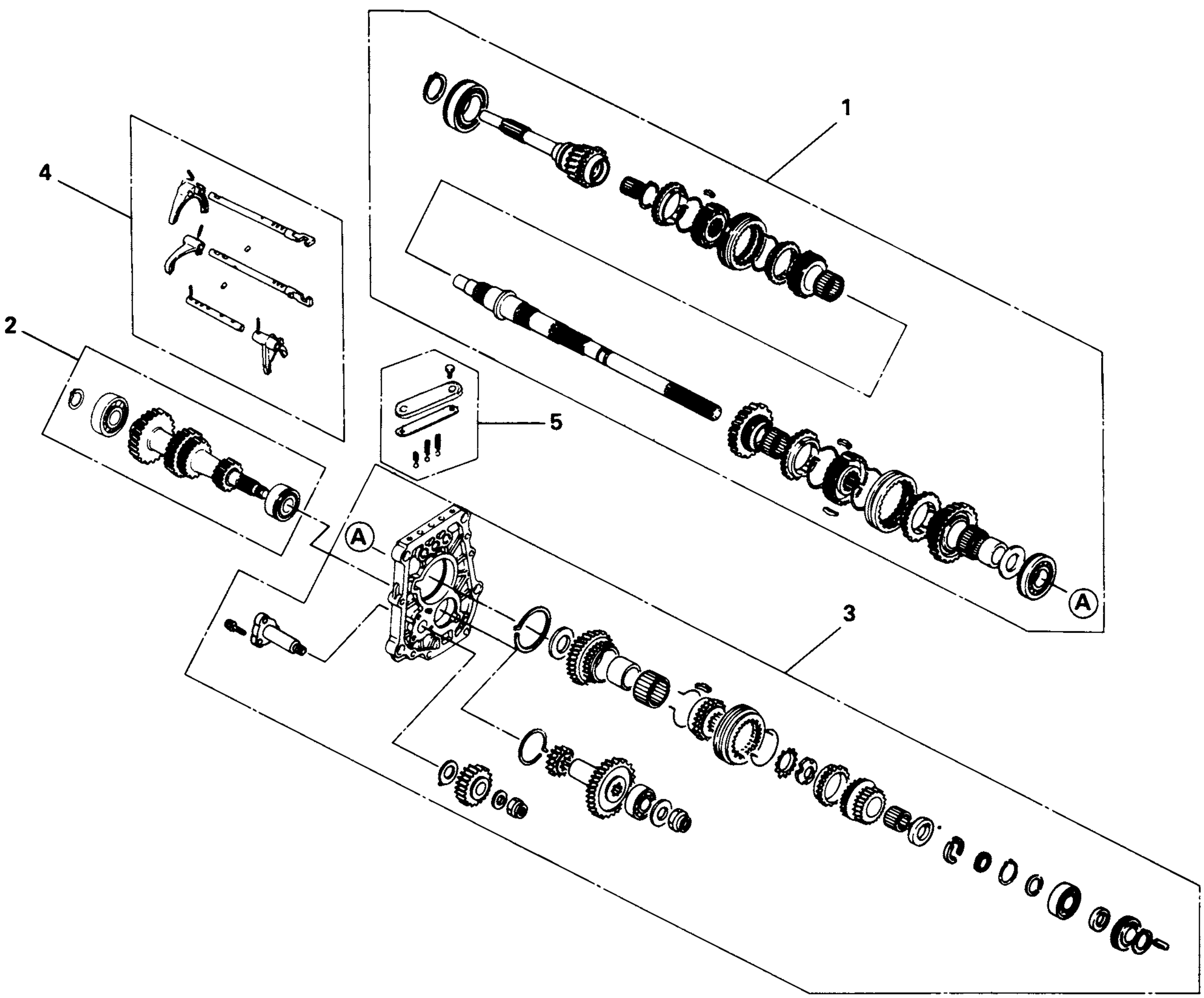
Oil Seal Installation

1. Use a oil seal installer to install the oil seal to the rear cover.
   Oil Seal Installer : 5-8522-0050-0 (J-29769)
2. Apply engine oil to the oil seal lip.

REASSEMBLY

MAJOR COMPONENT

INTERNAL PARTS

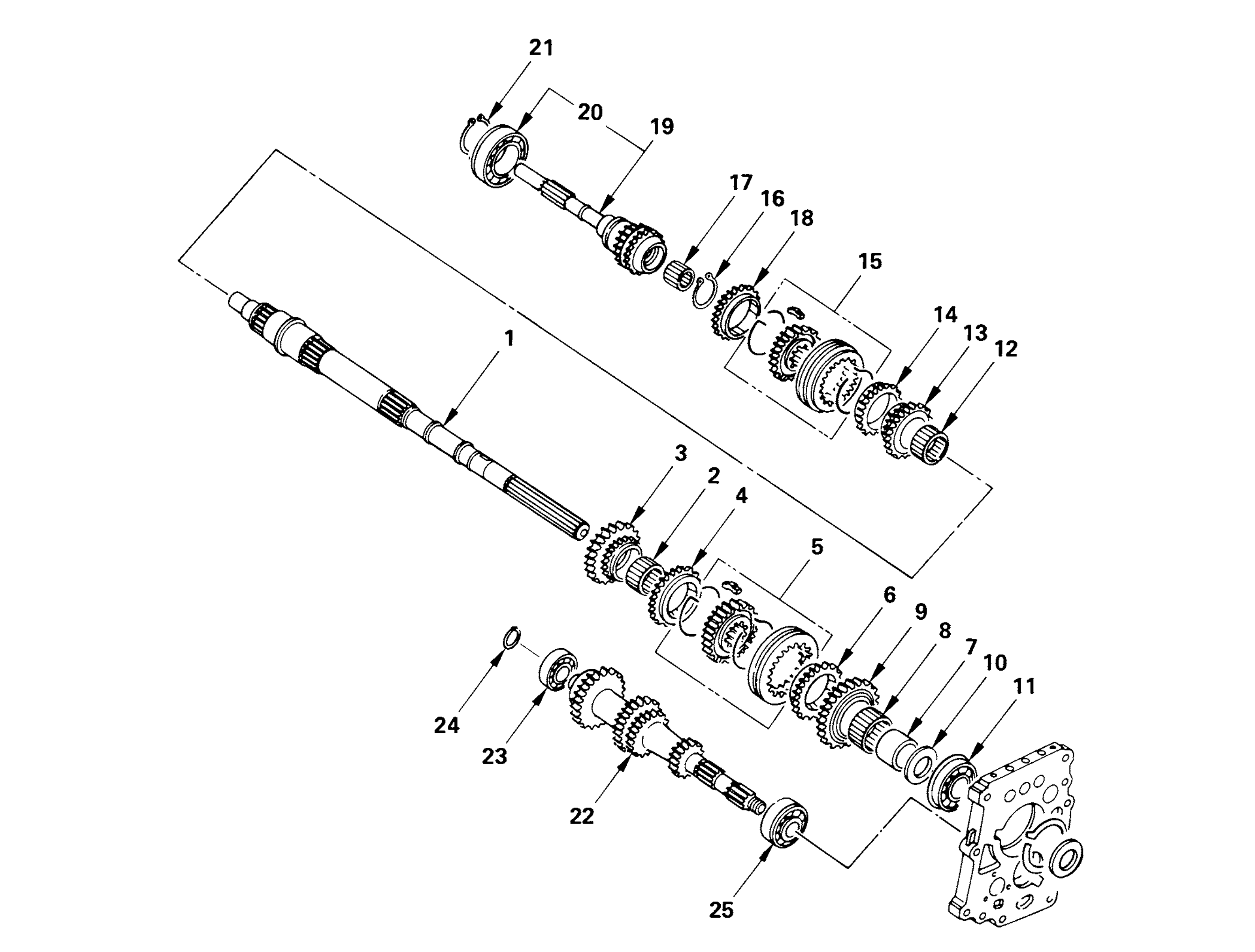


Reassembly steps

1. Top & main gear shaft assembly
2. Counter gear shaft assembly
3. Rev. and 5th gear assembly
4. Shift arm assembly & interlock pin
5. Detent assembly

MINOR COMPONENTS

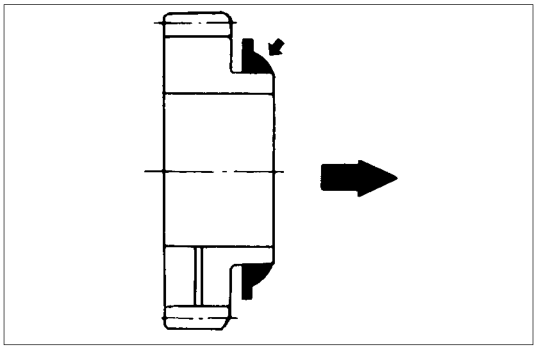
TOP GEAR SHAFT, MAINSHAFT GEAR AND COUNTER GEAR



Reassembly Steps

1. Mainshaft
▲ 2. Needle bearing
▲ 3. 2nd gear
4. 2nd block ring
▲ 5. 1st-2nd synchronizer assembly
6. 1st block ring
▲ 7. Needle bearing collar
▲ 8. Needle bearing
▲ 9. 1st gear
▲10. 1st gear thrust washer
▲11. Mainshaft ball bearing
▲12. Needle bearing
▲13. 3rd gear
14. 3rd block ring
▲15. 3rd-4th synchronizer assembly
▲16. Mainshaft snap ring
17. Needle bearing
18. 4th block ring
▲19. Top gear shaft
▲20. Ball bearing
21. Top gear shaft snap ring
22. Counter gear
23. Front ball bearing
24. Bearing snap ring
▲25. Rear ball bearing

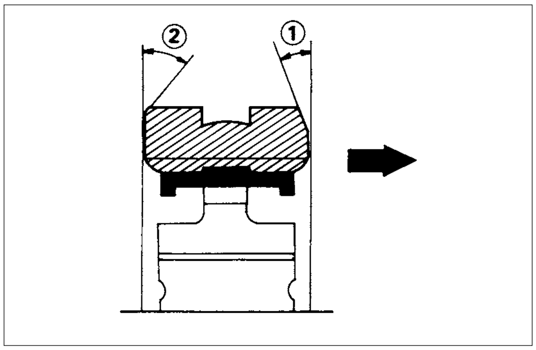
Important Operations



2. Needle Bearing

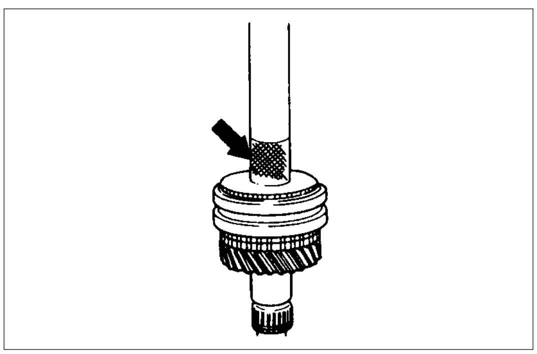
3. 2nd Gear

1) Apply the engine oil to the 2nd needle bearing and the 2nd gear.
2) Install the needle bearing and the 2nd gear to the mainshaft.
   The dog teeth of the 2nd gear must be facing the rear side of the transmission.



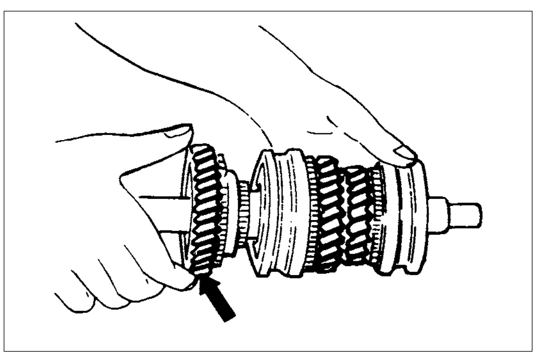
5. 1st-2nd Synchronizer Assembly

1) Apply the engine oil to the clutch hub spline.
2) Install the synchronizer assembly to the mainshaft.
   The outside sleeve heavy chamfering must be facing the rear of the transmission.
   ① Chamfer Angle = 30°
   ② Chamfer Angle = 45°



7. Needle Bearing Collar

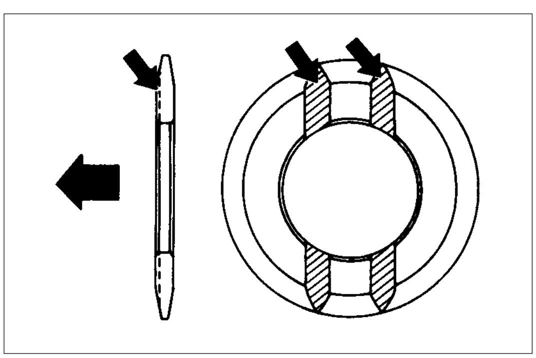
Use a bench press and a collar installer to install the needle bearing collar.
Collar Installer : 5-8840-0178-0 (J-33851)



8. Needle Bearing

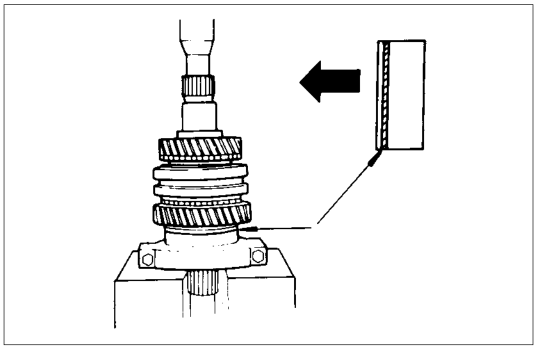
9. 1st Gear

1) Apply the engine oil to the 1st needle bearing and the 1st gear.
2) Install the needle bearing and the gear to the mainshaft.
   The dog teeth of the 1st gear must be facing the front side of the transmission.



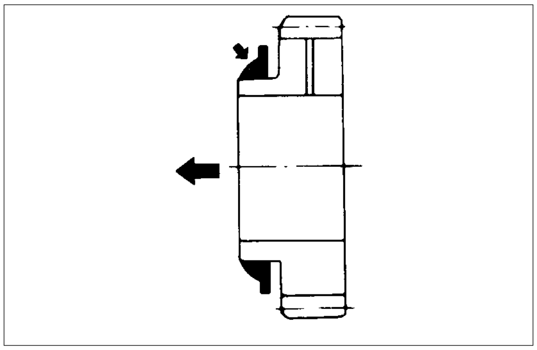
10.1st Gear Thrust Washer

Install the thrust washer to the mainshaft.
The thrust washer oil groove must be facing the 1st gear side.



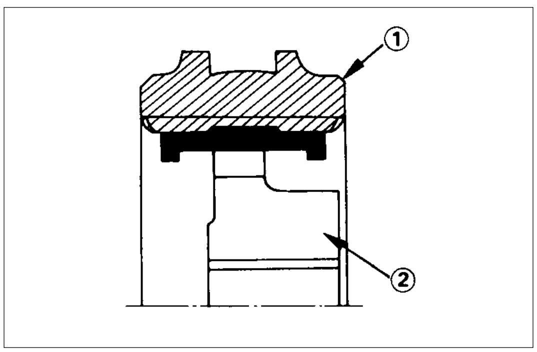
11.Mainshaft Ball Bearing

1) Apply the engine oil to the ball bearing inside circumference.
2) Use a bench press and a bearing installer to install the bearing.
   The bearing snap ring groove must be facing the front of the transmission.
   Bearing Installer : 5-8840-0015-0 (J-22912-01)



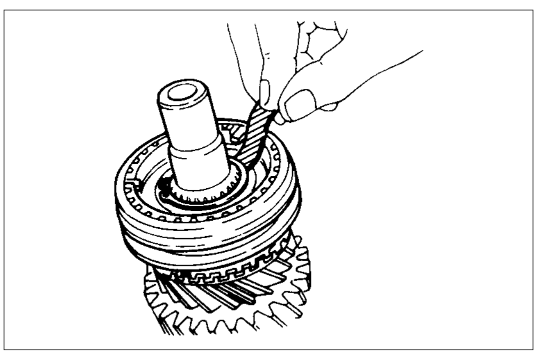
12.Needle Bearing
13.3rd Gear

1) Apply the engine oil to the 3rd needle bearing and the 3rd gear.
2) Install the needle bearing and the gear to the mainshaft.
   The dog teeth of the 3rd gear must be facing the front side of the transmission.



15.3rd-4th Synchronizer Assembly

1) Apply the recommended lubricating oil to the clutch hub spline.
2) Install the synchronizer assembly to the mainshaft.
   The sleeve light chamfering ① and the clutch hub heavy boss ② must be facing the rear of the transmission.

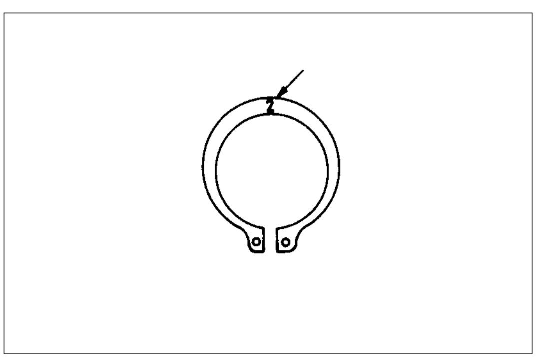


16.Mainshaft Snap Ring

1) Select the snap ring which will provide the minimum clearance between the mainshaft and the snap ring.
   There are four snap ring sizes available.
   The snap rings are numbered to indicate their thickness.

Mainshaft and Snap Ring Clearance mm(in)

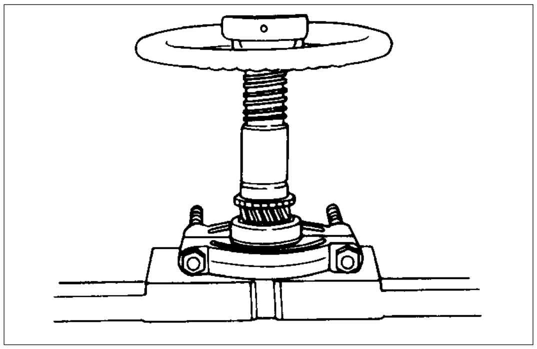
Standard
0 - 0.05 (0 - 0.002)



Snap Ring Availability mm(in)

Thickness	Identification Number
1.50 (0.059)	1
1.55 (0.061)	2
1.60 (0.063)	3
1.65 (0.065)	4

2) Use a pair of snap ring pliers to install the snap ring to the mainshaft.



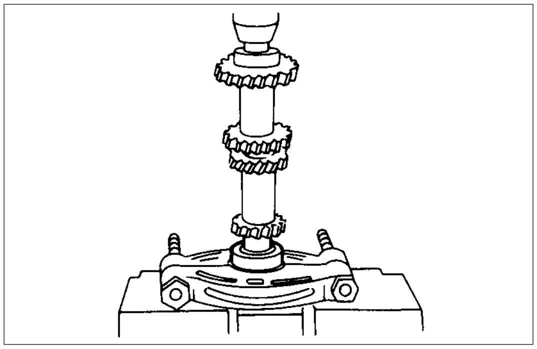
19.Top Gear Shaft

20.Ball Bearing

Use a bench press and a installer to install the ball bearing to the top gear shaft.

The snap ring groove must be facing the front of the transmission.

Bearing Installer : 5-8840-0015-0 (J-22912-01)

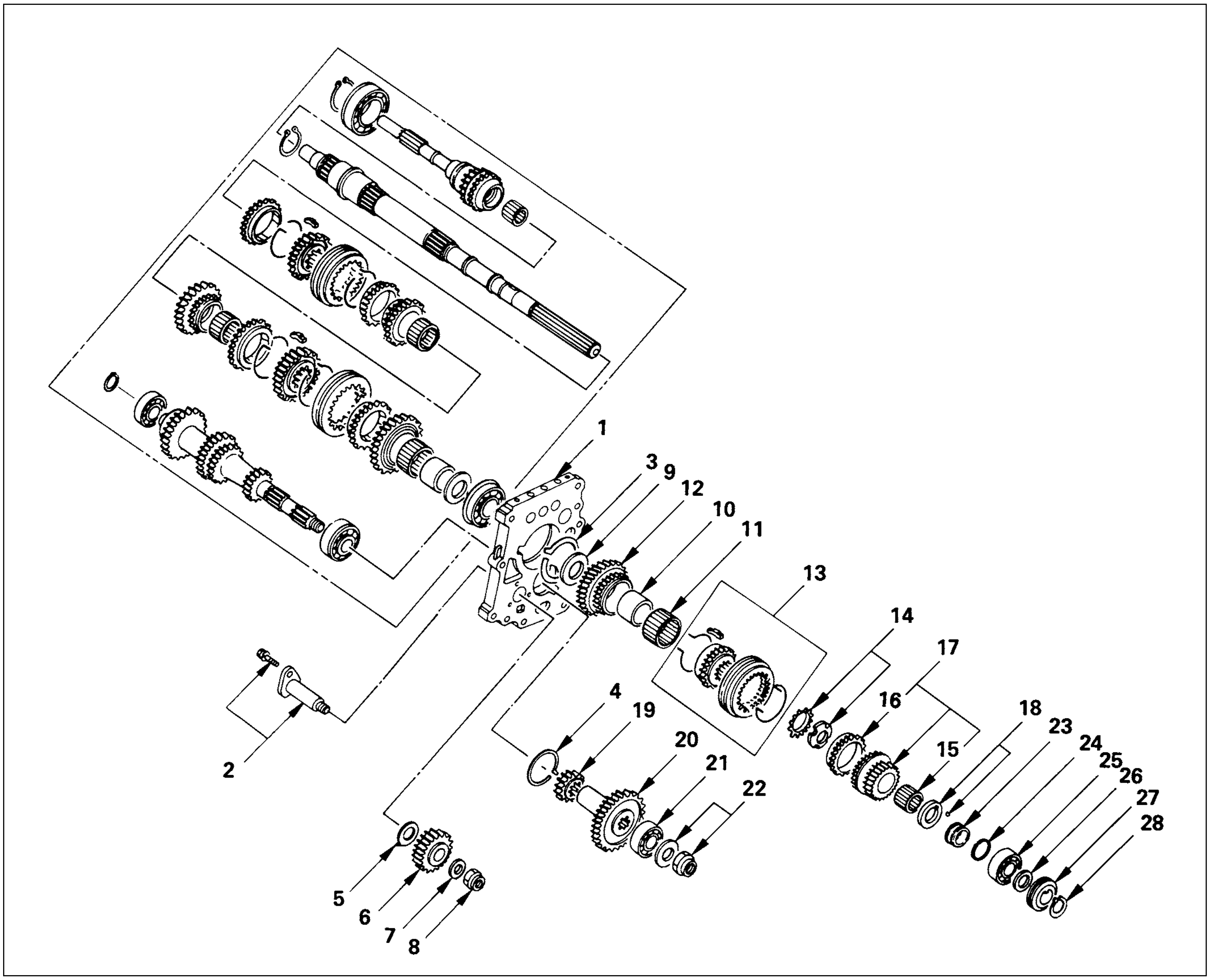


25.Rear Ball Bearing

Use a bench press and a bearing installer to install the bearing to the counter gear.

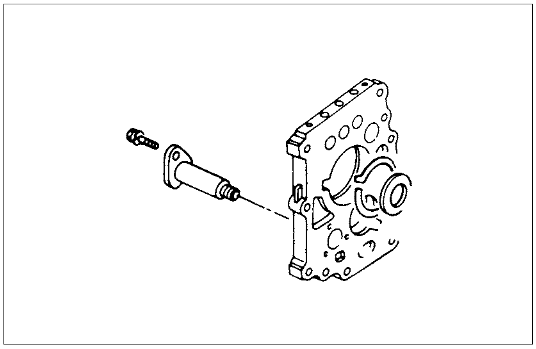
Bearing Installer : 5-8840-0015-0 (J-22912-01)

REVERSE GEAR AND 5TH GEAR



Reassembly Steps

▲ 1. Intermediate plate
▲ 2. Reverse idler shaft
3. Bearing snap ring
4. Bearing snap ring
5. Thrust washer
▲ 6. Reverse idler gear
7. Thrust washer
▲ 8. Counter reverse gear lock nut
▲ 9. Thrust washer
10. Needle bearing collar
11. Needle bearing
12. Reverse gear
▲13. Rev.-5th synchronizer assembly
▲14. Mainshaft lock nut and washer
15. Needle bearing
16. 5th block ring
17. 5th gear
▲18. Thrust washer and lock ball
19. Counter reverse gear
20. Counter 5th gear
21. Counter end ball bearing
▲22. Counter reverse gear nut and washer
▲23. Thrust washer thrust ring
▲24. Thrust ring snap ring
25. Mainshaft end ball bearing
26. Bearing spacer
27. Speedometer drive gear and lock ball
28. Bearing snap ring



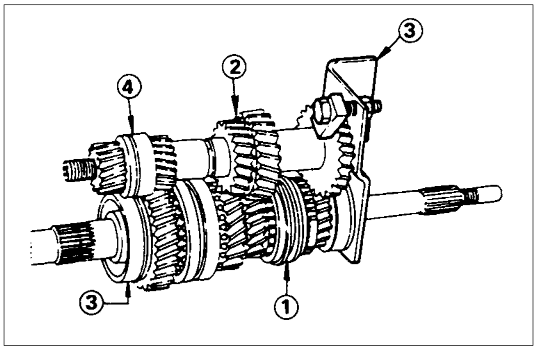
Important Operations

1. Intermediate Plate

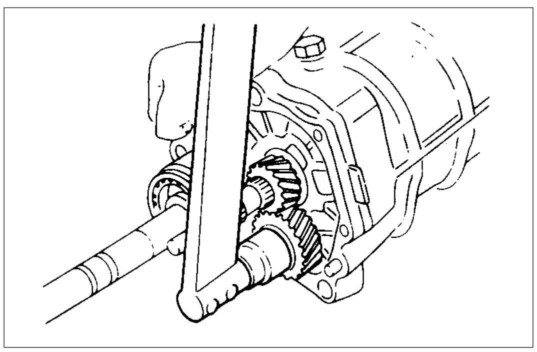
2. Reverse Idler Shaft

1) Install the reverse idler shaft to the intermediate plate.
2) Tighten the reverse idler shaft bolt to the specified torque.

Idler Shaft Bolt Torque	N·m(kgf·m/lb·ft)
19 (1.9 / 14)	



3) Set the mainshaft with gear assembly ① and the counter gear assembly ② to a holding fixture ③.
   Holding Fixture : 5-8840-2001-0 (J-29768)
4) Place the holding fixture (with the mainshaft and the counter shaft) in a vise.
5) Mesh the 3rd-4th synchronizer to the 3rd gear.
   Mesh the 1st-2nd synchronizer to the 1st gear.
6) Install the intermediate plate to the mainshaft and the counter gear ball bearings.

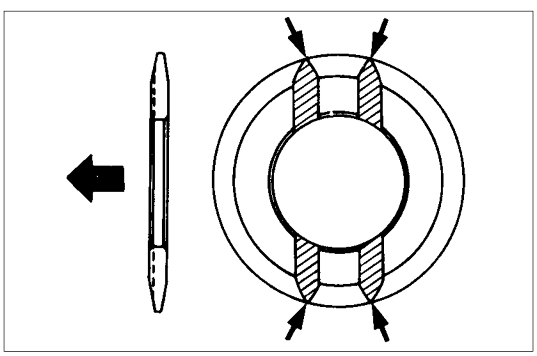


6. Reverse Idler Gear

8. Counter Reverse Gear Lock Nut

1) Apply the engine oil to the idler shaft and the reverse gear inside circumference.
2) Install the reverse gear to the idler shaft.
3) Install a new counter reverse gear lock nut.
   Never reinstall the old lock nut.
4) Tighten the reverse gear lock nut to the specified torque.

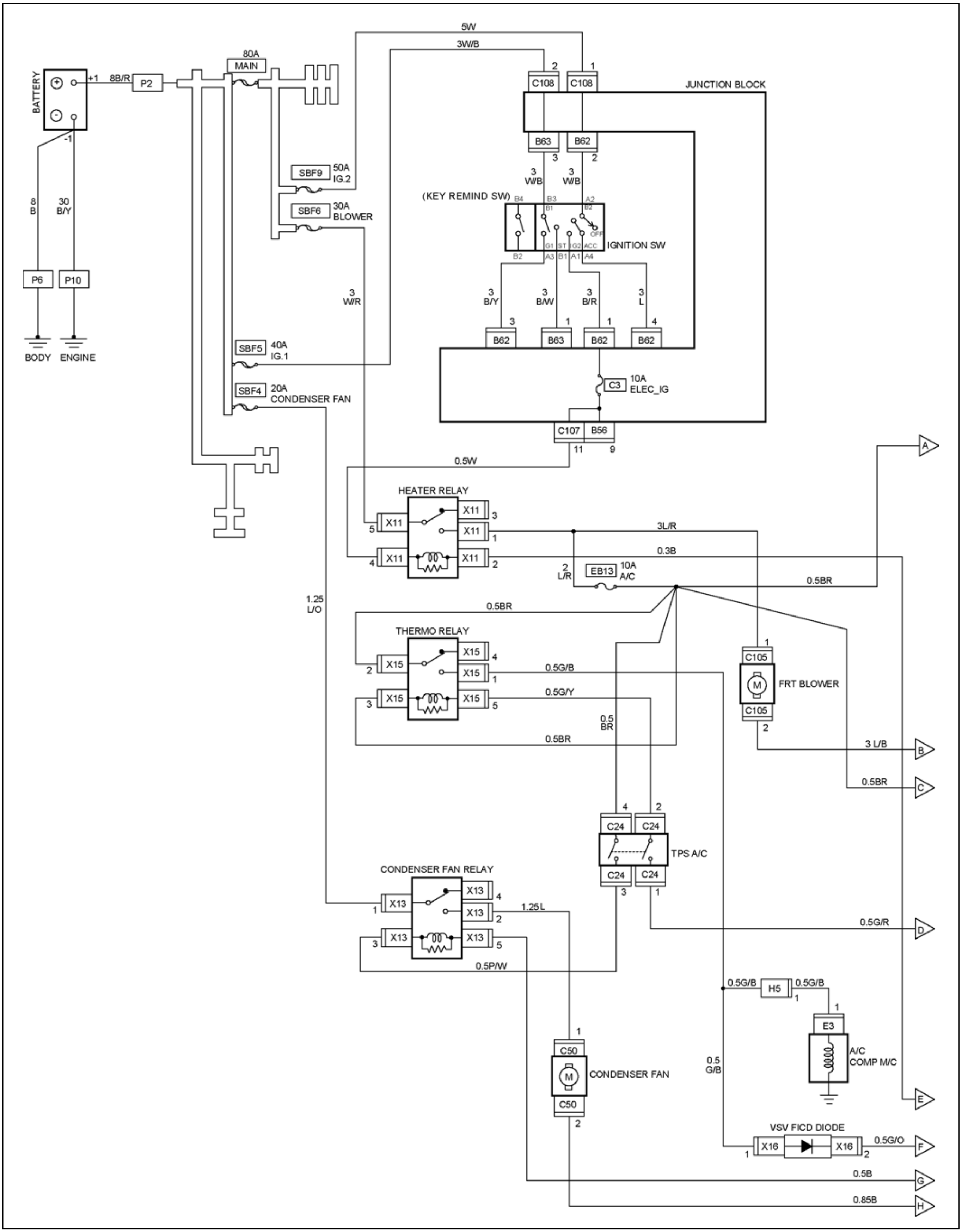
Lock Nut Torque	N·m (kgf·m/lb·ft)
108 (11 / 80)	



9. Thrust Washer

1) Apply the engine oil to both sides of the thrust washer.
2) Install the thrust washer to the mainshaft.
   The thrust washer oil groove must be facing the reverse gear side.

WIRING DIAGRAM (4JA1-T)



RTW78AXF008201

ϕ220mm

Torque : Bolt 64 N·m (6.5 kgf·m/47 lb·ft)

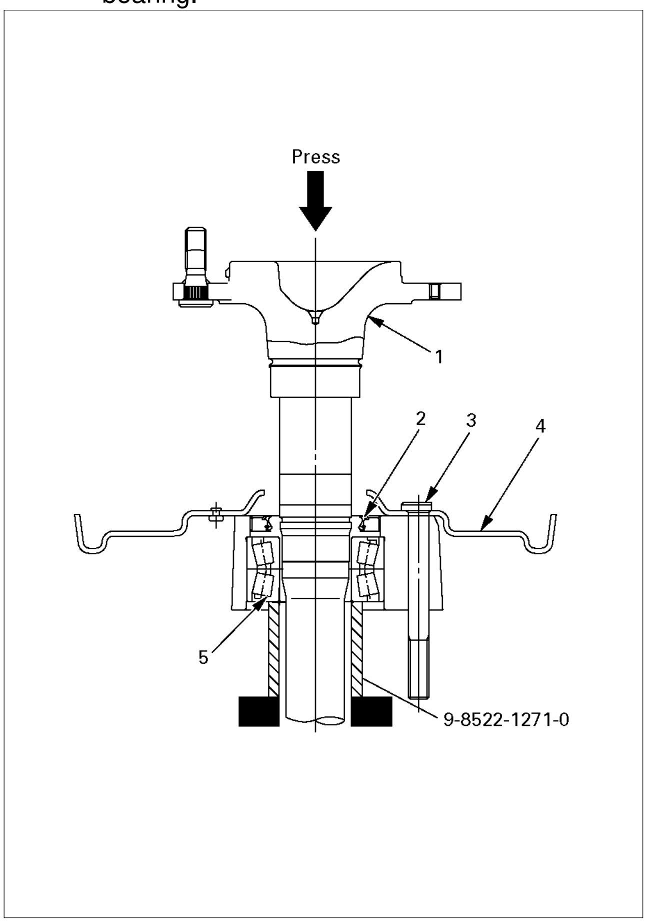
Nut 44 N·m (4.5 kgf·m/33 lb·ft)

ϕ194mm

Torque : Bolt 25 N·m (2.5 kgf·m/18 lb·ft)

Nut 37 N·m (3.8 kgf·m/27 lb·ft)

5. Axle Shaft Assembly
   a. Insert new double taper roller bearing in the bearing holder with oil seal.
   b. Set special tool (support stand : 9-8522-1271-0) on a bench press.
   c. Put bearing holder with bearing and oil seal and back plate on the support stand as following illustration.
   d. Insert bolts and axle shaft, aligning center of holes.
   e. Press fit axle shaft into double taper roller bearing.

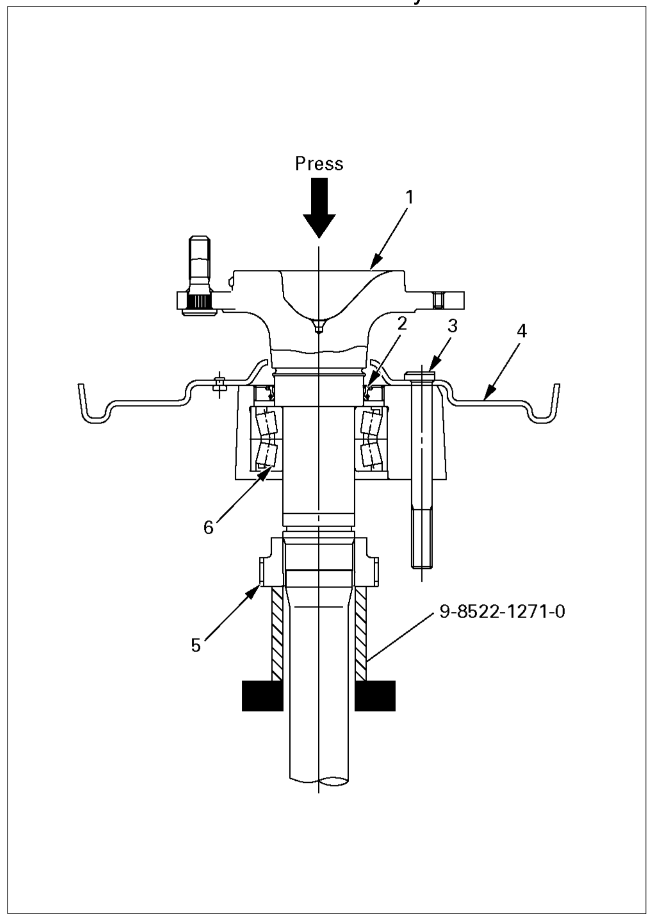


420R300010

Legend

1. Axle shaft
2. Oil Seal
3. Bolt
4. Back Plate
5. Double Taper Roller Bearing

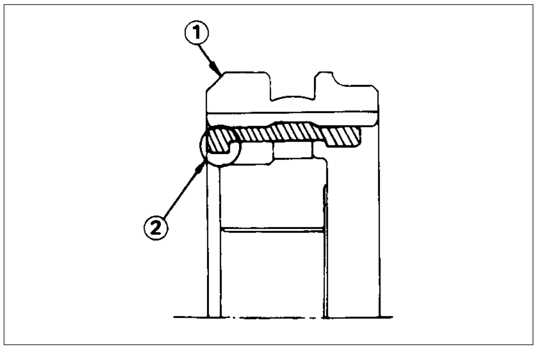
6. Put new retainer on the special tool 9-8522-1271-0.
7. Press fit axle shaft with the bearing into retainer and make axle shaft assembly.



420R300011

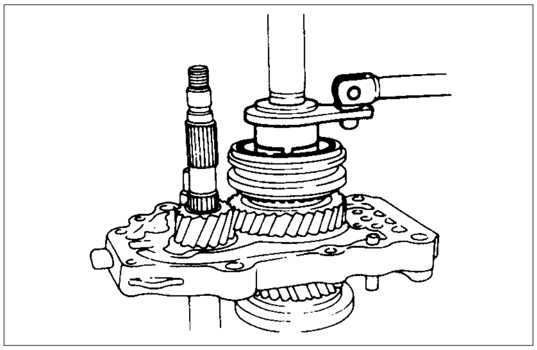
Legend

1. Axle shaft
2. Oil Seal
3. Bolt
4. Back Plate
5. Retainer
6. Double Taper Roller Bearing



13. Rev.-5th Synchronizer Assembly

1) Apply the engine oil to the clutch hub spline.
2) Install the synchronizer assembly to the mainshaft.
   The sleeve heavy chamfer ① and the insert short side ② must be facing to the rear side of the transmission.



14. Mainshaft Lock Nut and Washer

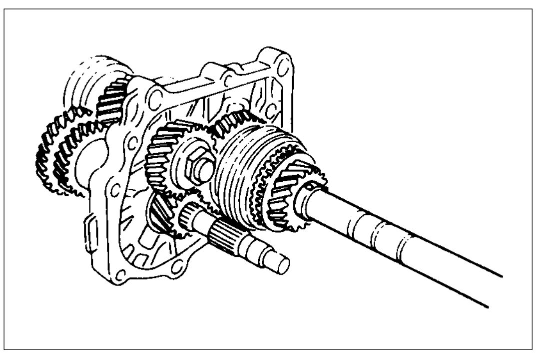
1) Install a new lock nut and washer to the mainshaft.
   Never reinstall the used lock nut and washer.
2) Use a lock nut wrench to tighten the lock nut to the specified torque.
   Lock Nut Wrench : 5-8840-0353-0 (J-36629)

Lock Nut Torque	N·m(kgf·m/lb·ft)
127 (11 / 94)	

22. Counter Reverse Gear Nut and Washer

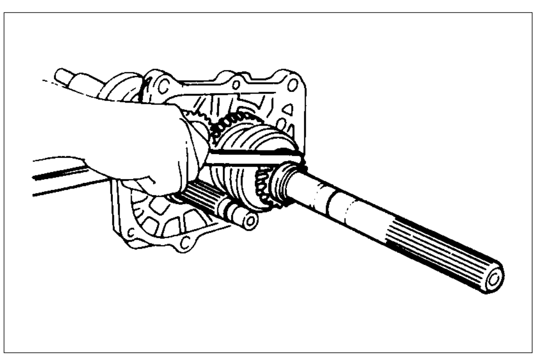
Tighten the counter gear lock nut to the specified torque.

Reverse Gear Nut Torque	N·m(kgf·m/lb·ft)
108 (11 / 80)	



18. Thrust Washer and Lock Ball
23. Thrust Washer Thrust Ring
24. Thrust Ring Snap ring

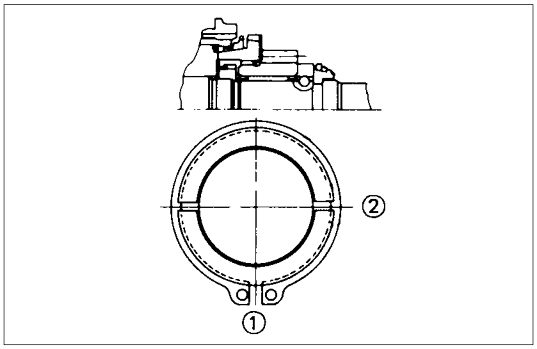
1) Install the thrust washer with lock ball together with the thrust ring to the mainshaft.
2) Use a pair of snap ring pliers to install the snap ring.



3) Use a thickness gauge to measure the clearance between the 5th gear and the thrust washer.

5th Gear and Thrust Washer Clearance	mm(in)
Standard	
0.1 - 0.3 (0.004 - 0.012)	

   If required, replace the existing thrust washer with a new thrust washer to bring the clearance to specification.



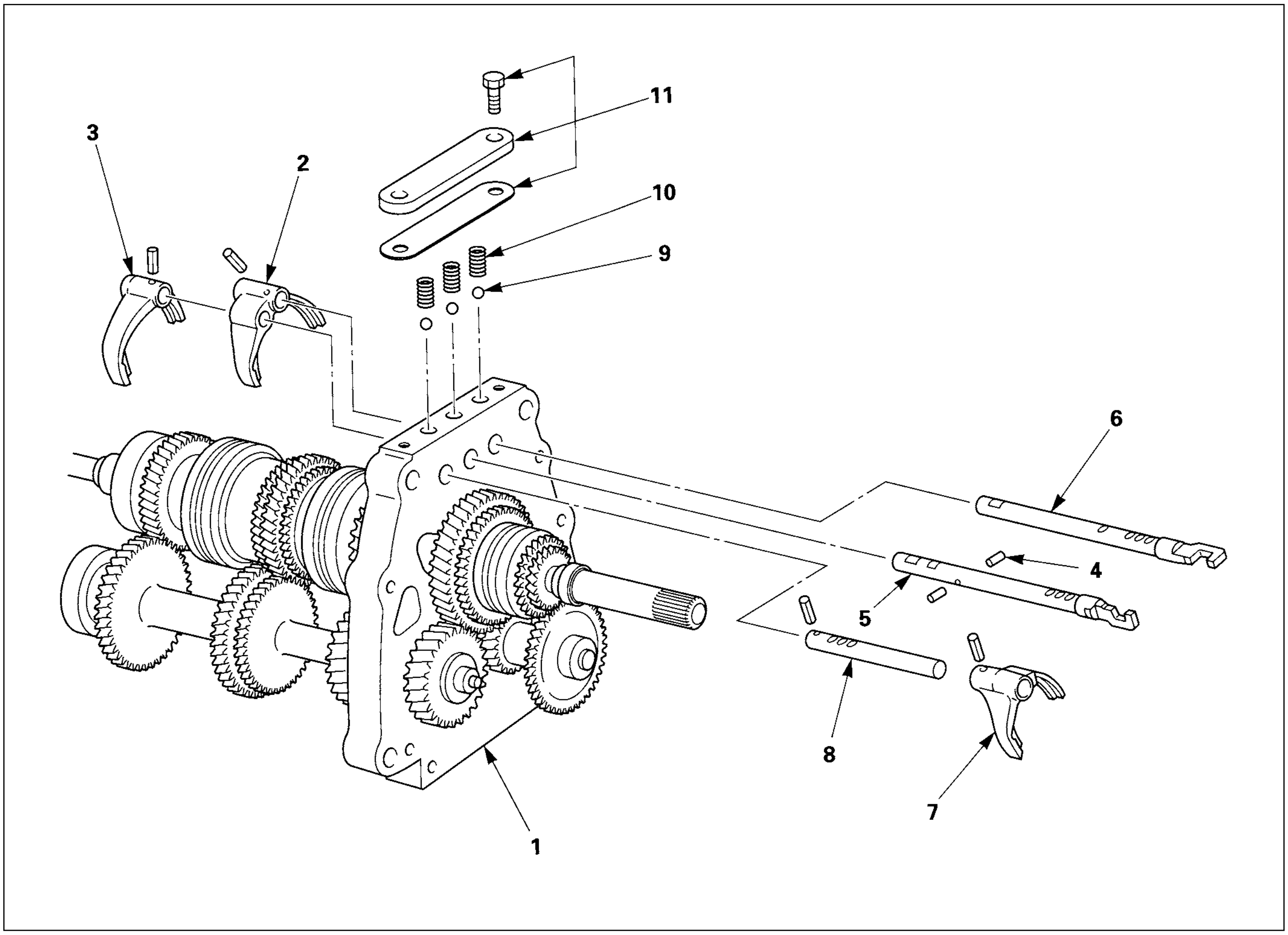
There are six thrust washer sizes available.

Thrust Washer Availability mm(in)

7.8 (0.307)	7.9 (0.311)	8.0 (0.315)
8.1 (0.319)	8.2 (0.323)	8.3 (0.327)

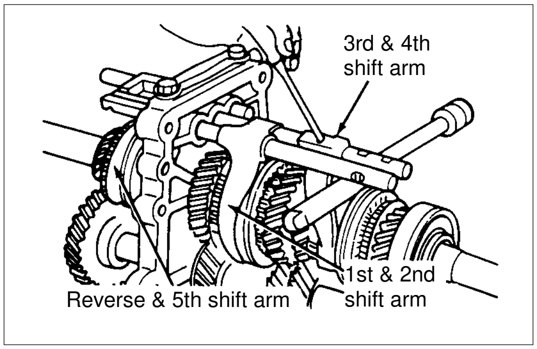
4) Position the thrust ring snap ring gap ① and the thrust ring gap ② so that they are separated at a 90° angle.

DETENT AND SHIFT ARM ASSEMBLY



Reassembly Steps

1. Intermediate plate and gear assembly
▲ 2. 1st-2nd shift arm
▲ 3. 3rd-4th shift arm
4. Interlock pin
5. 3rd-4th shift rod
6. 1st-2nd shift rod
▲ 7. Rev.-5th shift arm
8. Rev.-5th shift rod
9. Detent ball
10. Detent spring
▲11. Detent spring plate and gasket



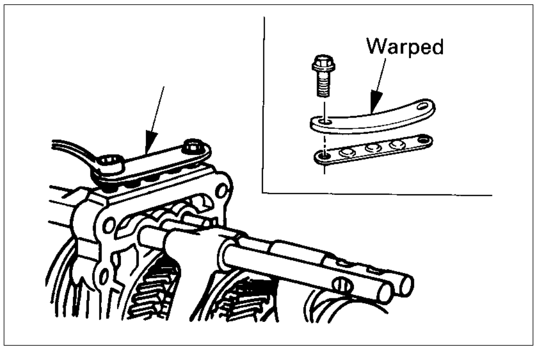
Important Operations

2. 1st-2nd Shift Arm

3. 3rd-4th Shift Arm

7. Rev.-5th Shift Arm

1) Hold a round bar against the shift rod end lower face to protect it against damage.
2) Use a spring pin installer to install the spring pin to the shift arm and the shift rod.
   Never reinstall the used spring pins.

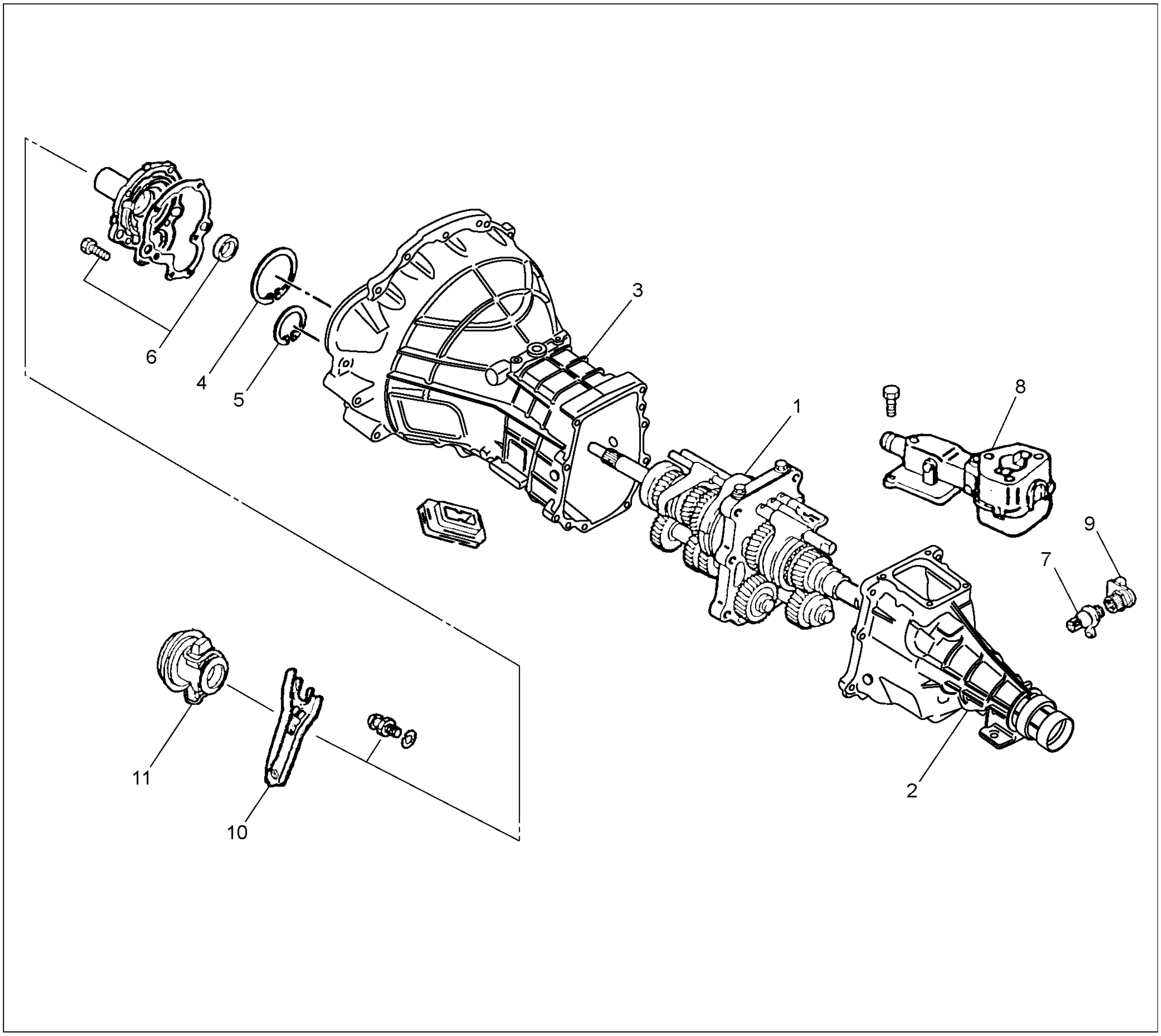


11. Detent spring Plate and Gasket.

1) Install the new detent plete and new gasket onto the transmission case into the correct direction.
2) Tighten the detent spring plate bolts to the specified torque.

Detent Spring Plate Bolt Torque	N·m(kgf·m/lb·ft)
19 (1.9 / 14)	

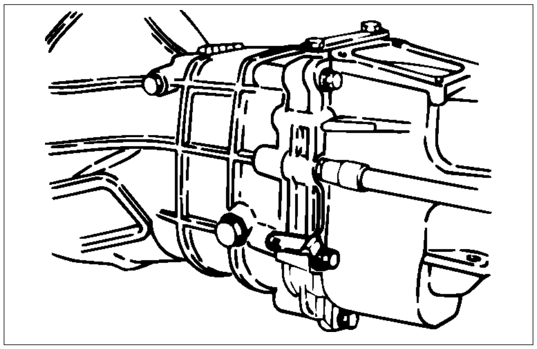
MAJOR COMPONENTS



RTW47BLF000401

Reassembly steps

1. Intermediate plate with gear assembly
▲ 2. Rear cover with oil seal
▲ 3. Transmission case
▲ 4. Bearing snap ring
5. Counter gear snap ring
▲ 6. Front cover with oil seal
7. Speedometer driven gear
8. Gear control box assembly
9. Speedometer sensor
10. Clutch shift fork
11. Clutch shift block and release bearing



RTW47BSH000201

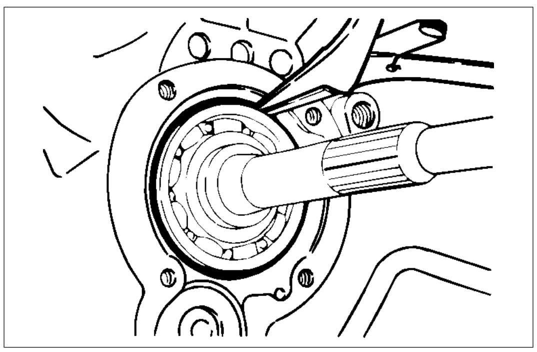
Important Operations

2. Rear Cover with Oil Seal

1) Align the pins at the lower side of the rear cover with the holes in the lower side of the intermediate plate.
2) Apply recommended liquid gasket (Three Bond TB1215) or its equivalent to the rear cover fitting surfaces.
3) Install the rear cover to the intermediate plate.
4) Tighten the rear cover bolts to the specified torque.

Rear Cover Bolt Torque	N·m(kgf·m/lb·ft)
37 (3.8 / 27)	

Note:
Take care not to twist or puncture the oil seal during the installation procedure.

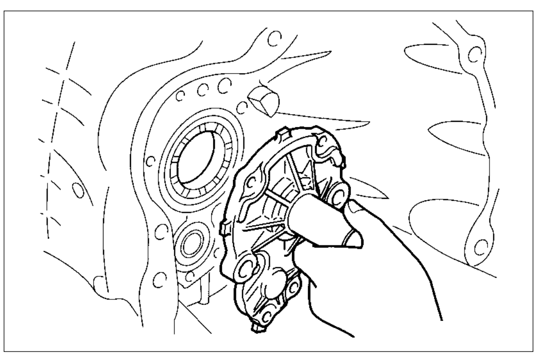


RTW47BSH000301

3. Transmission Case

4. Bearing Snap Ring

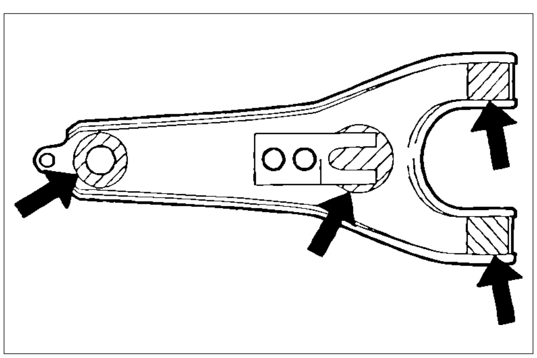
1) Apply the engine oil to the transmission case top gear shaft ball bearing fitting faces.
2) Apply recommended liquid gasket or its equivalent to the transmission case fitting surfaces.
3) Install the transmission case to the intermediate plate.
4) Pull the top gear shaft from the transmission case until the ball bearing snap ring grove protrudes from the transmission case front cover fitting faces.
5) Use a pair of snap ring pliers to install the snap ring to the ball bearing.



6. Front Cover with Oil Seal

1) Clean and apply recommended liquid gasket or its equivalent to the through bolt threads.
2) Install the new gasket and tighten the new cover bolt to the specified torque.

Front Cover Bolt Torque	N·m(kgf·m/lb·ft)
25 (2.5 / 18)	

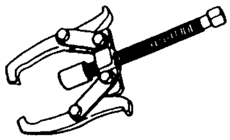
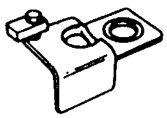
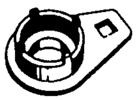
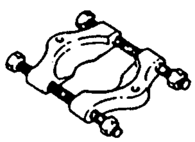
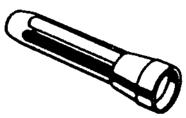
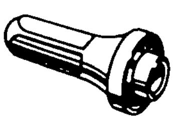


RTW47BSH000101

10.Shift Fork

Apply molybdenum disulfide type grease to the areas as shown in the figure and install shift fork (Diesel engine).

SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	9-8529-2201-0	Spring pin remover
	5-8840-0013-0 (J-22888)	Gear remover
	5-8840-2001-0 (J-29768)	Holding fixture
	5-8840-0353-0 (J-36629)	Lock nut wrench
	5-8840-0015-0 (J-22912-01)	Bearing remover/installer
	5-8840-0026-0 (J-26540)	Oil seal installer
	5-8522-0050-0 (J-29769)	Oil seal installer
	5-8840-0178-0 (J-33851)	Collar installer

SECTION 7B1

MANUAL TRANSMISSION (MUA)

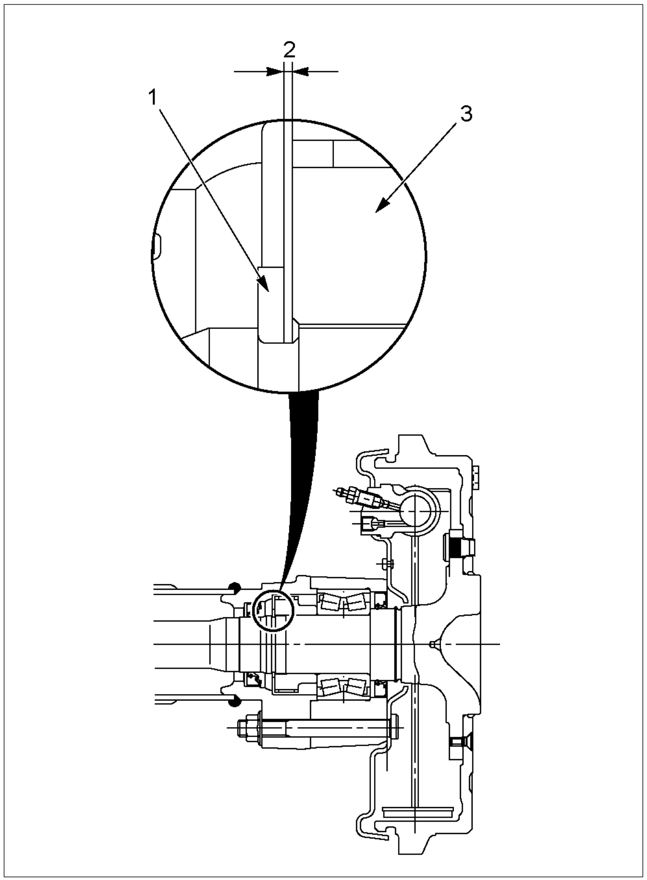
TABLE OF CONTENTS

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

8. Certainly install new snap ring, use snap ring pliers. When transform or damage, replace new one.



RTW34BMH000101

Legend

1. Snap ring
2. Crevice
3. Retainer (with ABS)
   Retainer (without ABS)

9. Insert a shim of sufficient thickness between snap ring and end of retainer.

   Standard 0 – 0.2 mm (0 – 0.008 in)

   Crevice is measured using thickness gauge, and when crevice exceeds 0.2 mm (0.008 in), it adjusts so that is may become 0.2 mm (0.008 in) or less using shim.

Shim Pats No.	Thickness
① 9-41519110-∗	0.18 mm (0.0071 in)
② 8-97130387-∗	0.50 mm (0.0197 in)

Crevice	No. of shim		Total
mm (in)	①	②	mm (in)
1.0(0.0394)	—	2	1.00(0.0394)
0.9(0.0354)	2	1	0.86(0.0339)
0.8(0.0315)	1	1	0.68(0.0268)
0.7(0.0276)	1	1	0.68(0.0268)
0.6(0.0236)	—	1	0.50(0.0197)
0.5(0.0197)	—	1	0.50(0.0197)
0.4(0.0157)	2	—	0.36(0.0142)
0.3(0.0118)	1	—	0.18(0.0071)
0.2(0.0079)	1	—	0.18(0.0071)

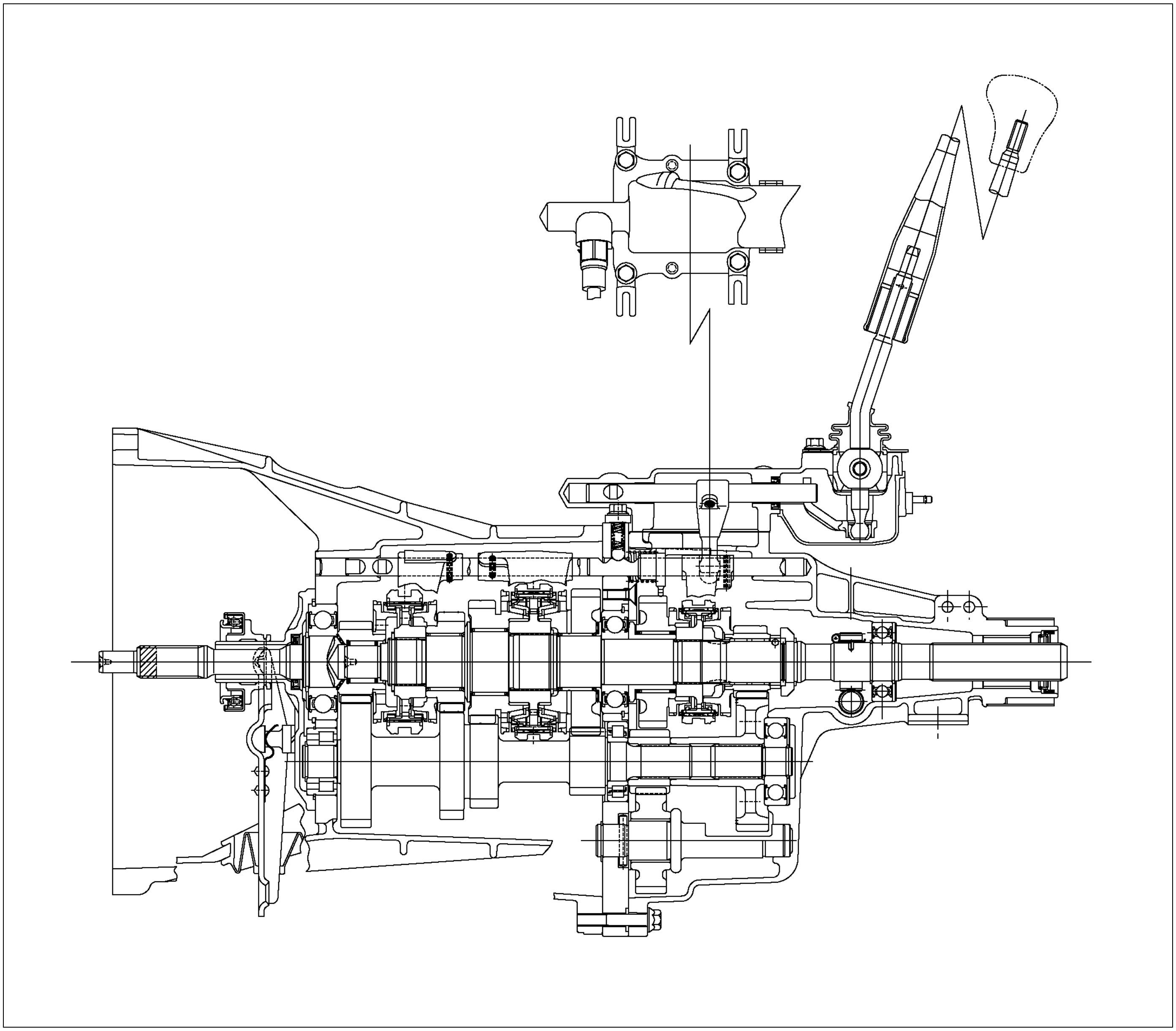
10. Install axle shaft assembly in rear axle case assembly.
    a. Clean the mating surface of axle case and bearing holder.
    b. Apply Three Bond 1215 (TB1215) or equivalent on the surface of axle case assembly.

Note:
When inserting an axle shaft, it inserts so that an oil seal may not be damaged.

11. Install and tighten bearing holder fixing nut to the specified torque.
    Torque : 84 N·m (8.6 kgf·m/62 lb·ft)
12. Install wheel cylinder and tighten the bolt to the specified torque.
    Torque : 9 N·m (0.9 kgf·m/78 lb·in)
13. Install parking brake outer cable in back plate and inner cable in parking brake lever.

General Description

MUA5G/5H/5S Transmission (4×2)



A07R300006

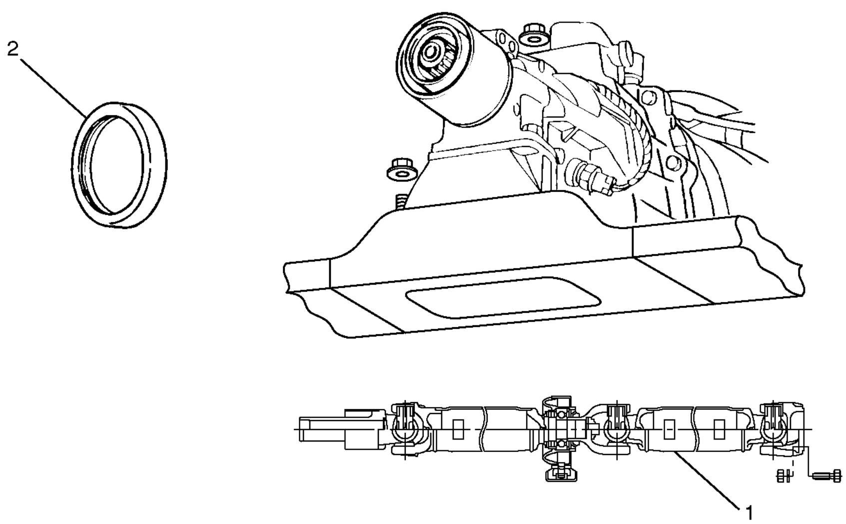
The MUA5G/5H/5S is a constant mesh transmission, synchronized in all speeds. The transmission has been designed to provide low shift effort and low gear noise.

Principle parts of the transmission are the integral clutch housing, the intermediate plate, the rear cover, and the gears.

The transmission control box is built into the transmission.

Rear Oil Seal

Disassembled View



220R300030

Legend

(1) Rear Propeller Shaft

(2) Rear Oil Seal

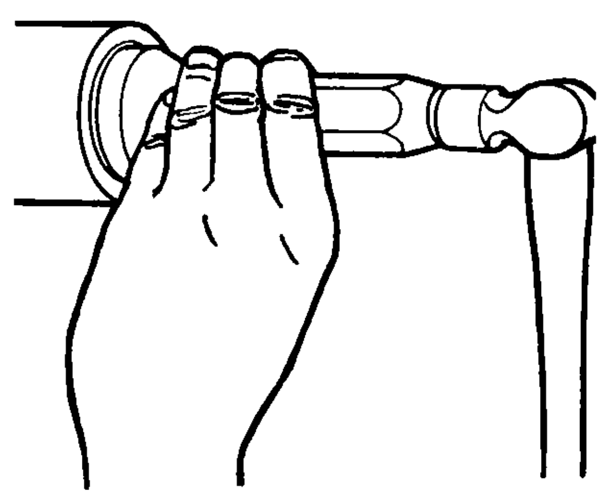
Removal

1. Raise and support the vehicle with suitable jack stands.
2. Remove the propeller shaft flange yoke bolts and nuts at the differential side.
3. Remove center bearing from the crossmember.
4. Remove prepeller shaft from the transmission main shaft spline.

   Refer to the section “Rear Propeller Shaft”.
5. Use a screwdriver to pry the rear oil seal from the rear cover.

Installation

1. Install a new oil seal using the installer 5-8522-0050-0.



220RS044

2. Insert the splined yoke into the transimission mainshaft spline.
3. Install the propeller shaft flange yoke to the drive pinion flange.

Torque : 63 N·m (6.4 kgf·m/46 lb·ft)

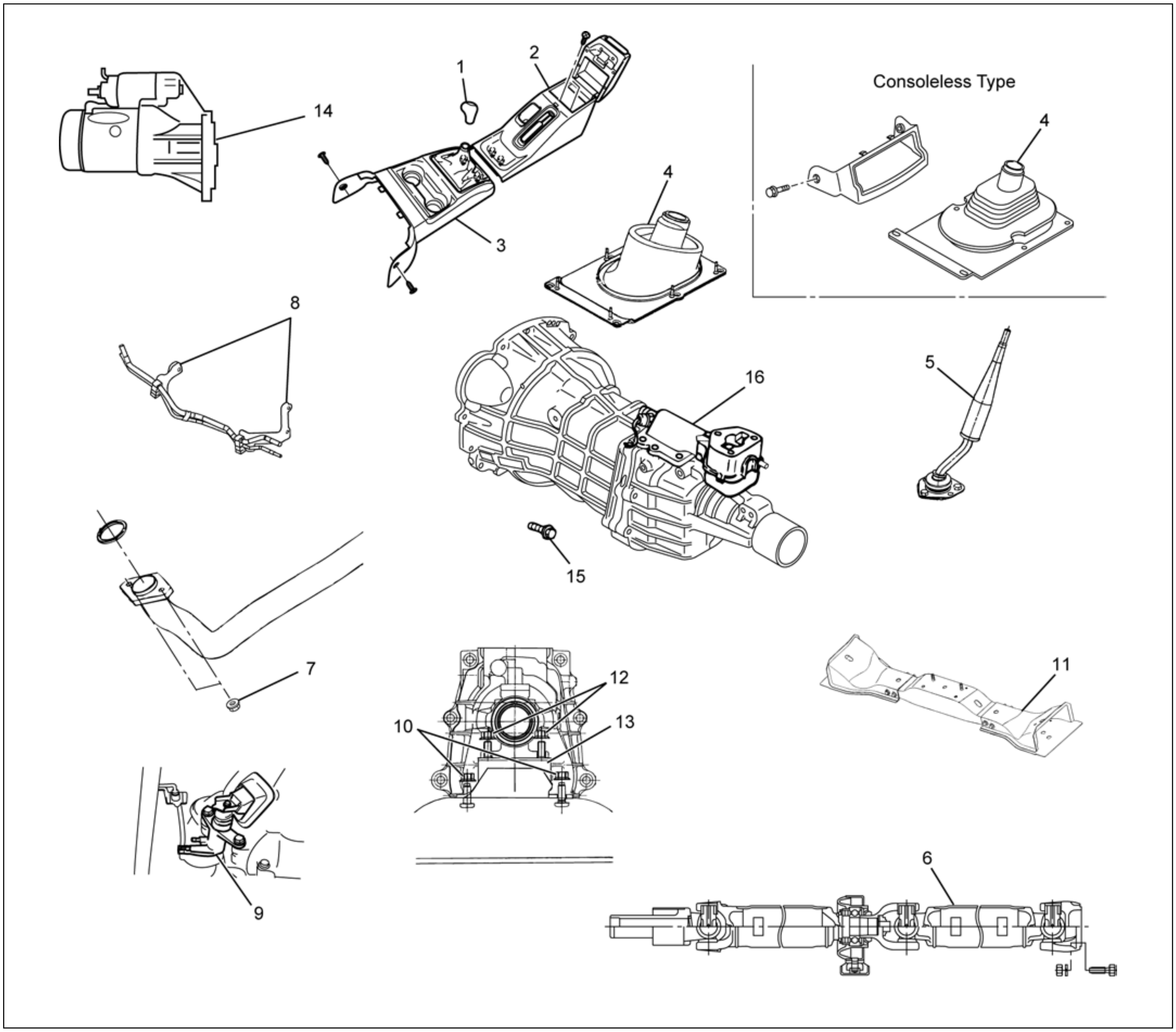
4. Install center bearing on crossmember.

Torque : 69 N·m (7.0 kgf·m/51 lb·ft)

5. Check transmission fluid level.
6. Lower the vehicle.

Transmission (4×2)

Disassembled View



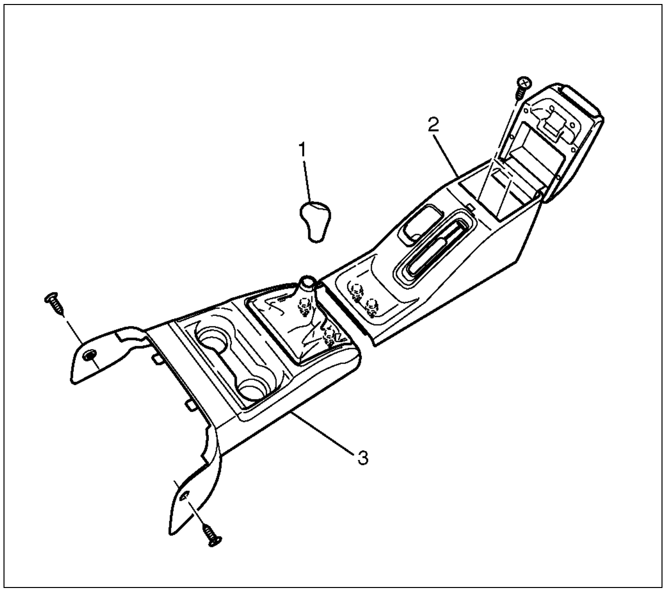
RTW77BLF003201

Legend

(1) Gear Control Lever Knob
(2) Rear Floor Console (bucket seat)
(3) Front Floor Console
(4) Grommet Assembly
(5) Gear Control Lever
(6) Rear Propeller Shaft
(7) Exhaust Pipe Nut (Diesel engine only)
(8) Fuel Pipe Bracket
(9) Slave Cylinder
(10) Nut: rear mount to Crossmember
(11) Transmission Crossmember
(12) Nut: rear mount to transmission
(13) Rear Mount Rubber
(14) Starter (Diesel engine only)
(15) Transmission Retaining Nut and Bolt
(16) Transmission Assembly

Removal

1. Disconnect the battery ground cable.
2. Remove the gear control lever knob.
3. Remove the rear floor console. (Bucket seat)
   Refer to the section “Floor Console”.
4. Remove the front floor console.
   Refer to the section “Floor Console”.

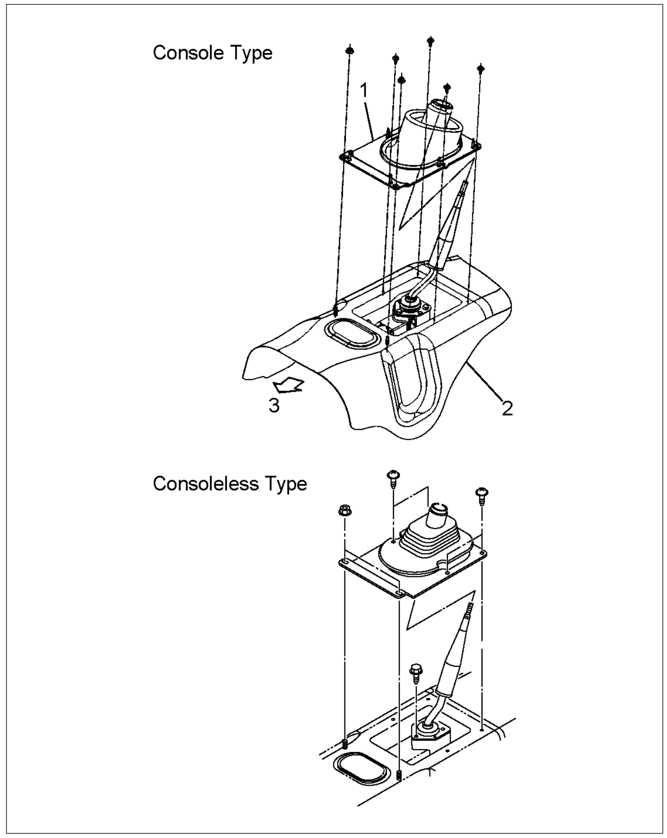


745R300006

Legend

(1) Knob
(2) Rear Floor Console
(3) Front Floor Console

5. Remove the grommet assembly.



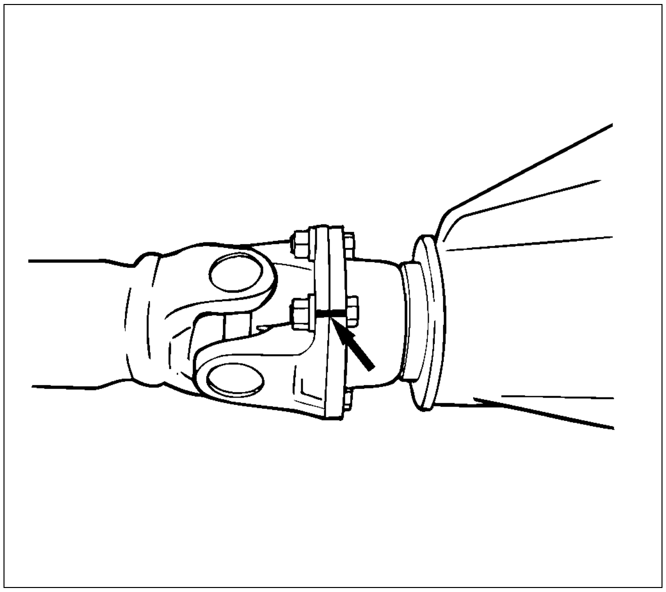
RTW47BMH000101

Legend

(1) Grommet Assembly
(2) Floor Panel
(3) Front

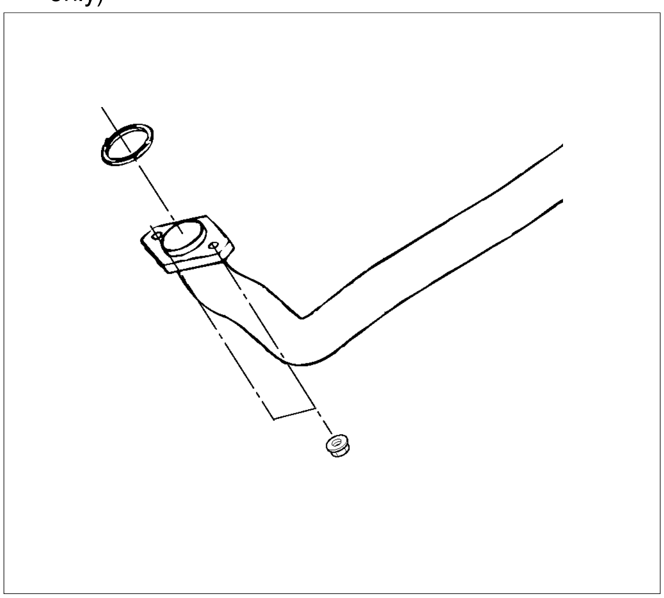
6. Remove the gear control lever.
7. Raise and support the vehicle with suitable stands.
8. Remove the rear propeller shaft.

NOTE: Apply alignment marks on the flange at the differential side.



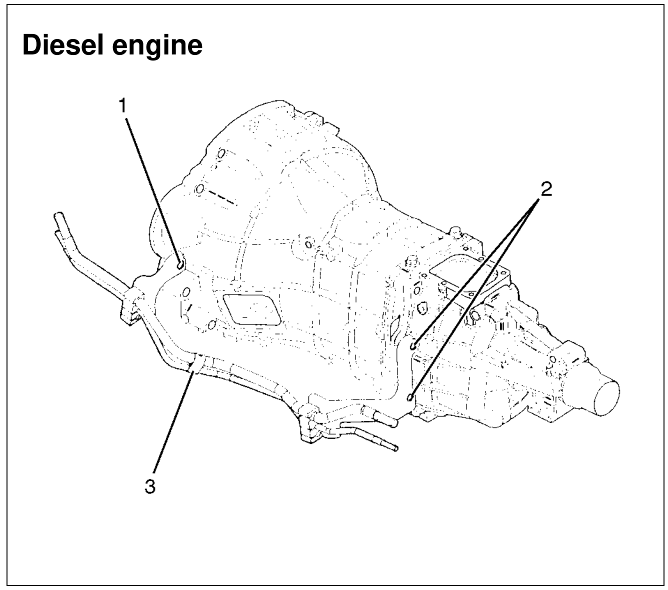
401RS023

9. Loosen the front exhaust pipe fixing nuts at the engine side but do not remove them. (Diesel engine only)



RTW67BSH000101

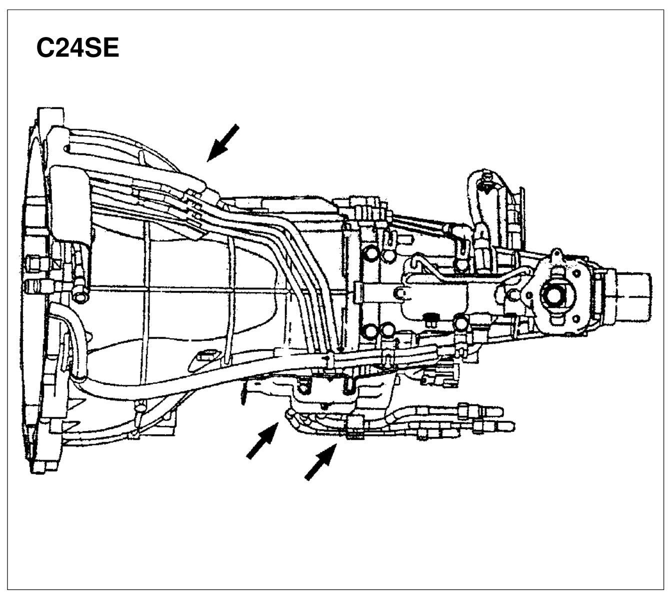
10. Disconnect the harness connectors and clips on the transmission.
    - Neutral Switch
    - Back up Switch
    - Car Speed Sensor
11. Remove the fuel pipe bracket with pipes from the transmission.



220R300012

Legend

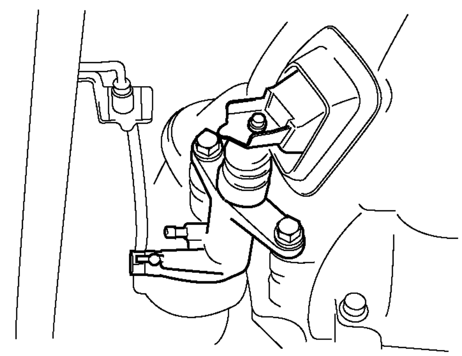
(1) Bolt
(2) Nut
(3) Fuel Pipe Assembly



Scan-1

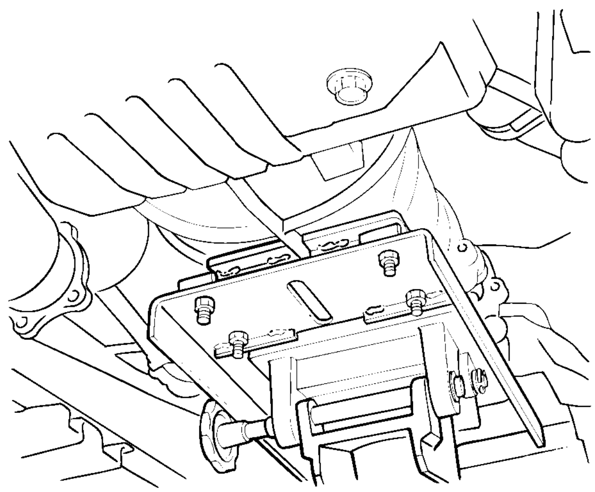
12. Remove slave cylinder and put it aside.

Diesel engine



220LV019

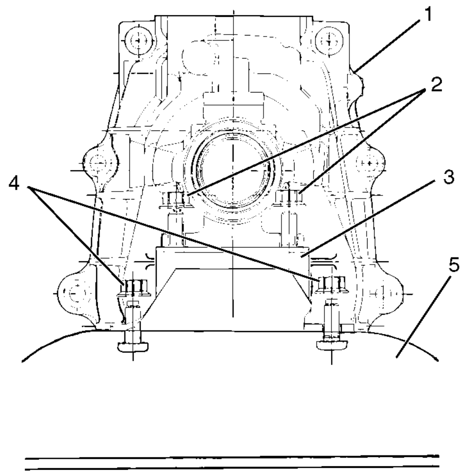
13. Support the transmission with a transmission jack.



220RS001

14. Remove engine rear mount nuts fixing on cross member, from the transmission crossmember.

15. Remove engine rear mount nuts fixing on the transmission.

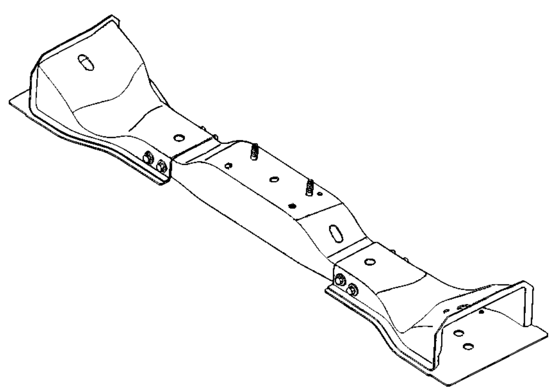


220R300029

Legend

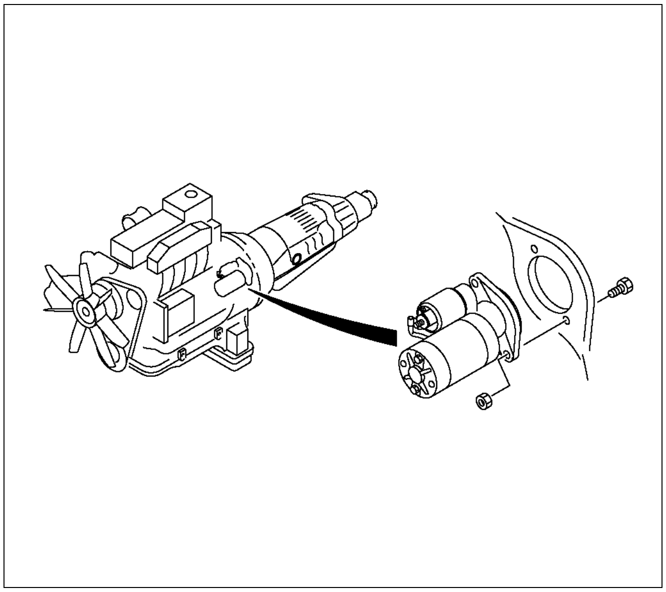
(1) Transmission
(2) Nut: rear mount to transmission
(3) Rear Mount Rubber
(4) Nut: rear mount to crossmember
(5) Transmission Crossmember

16. Remove the middle part of the transmission crossmember by removing four fixing bolts and nuts.



501R300008

17. Take out the rear mount rubber.
18. Remove the starter (Diesel engine only).



060L100070

19. Remove transmission retaining nuts and bolts.

    Remove the transmission assembly from the vehicle.

Installation

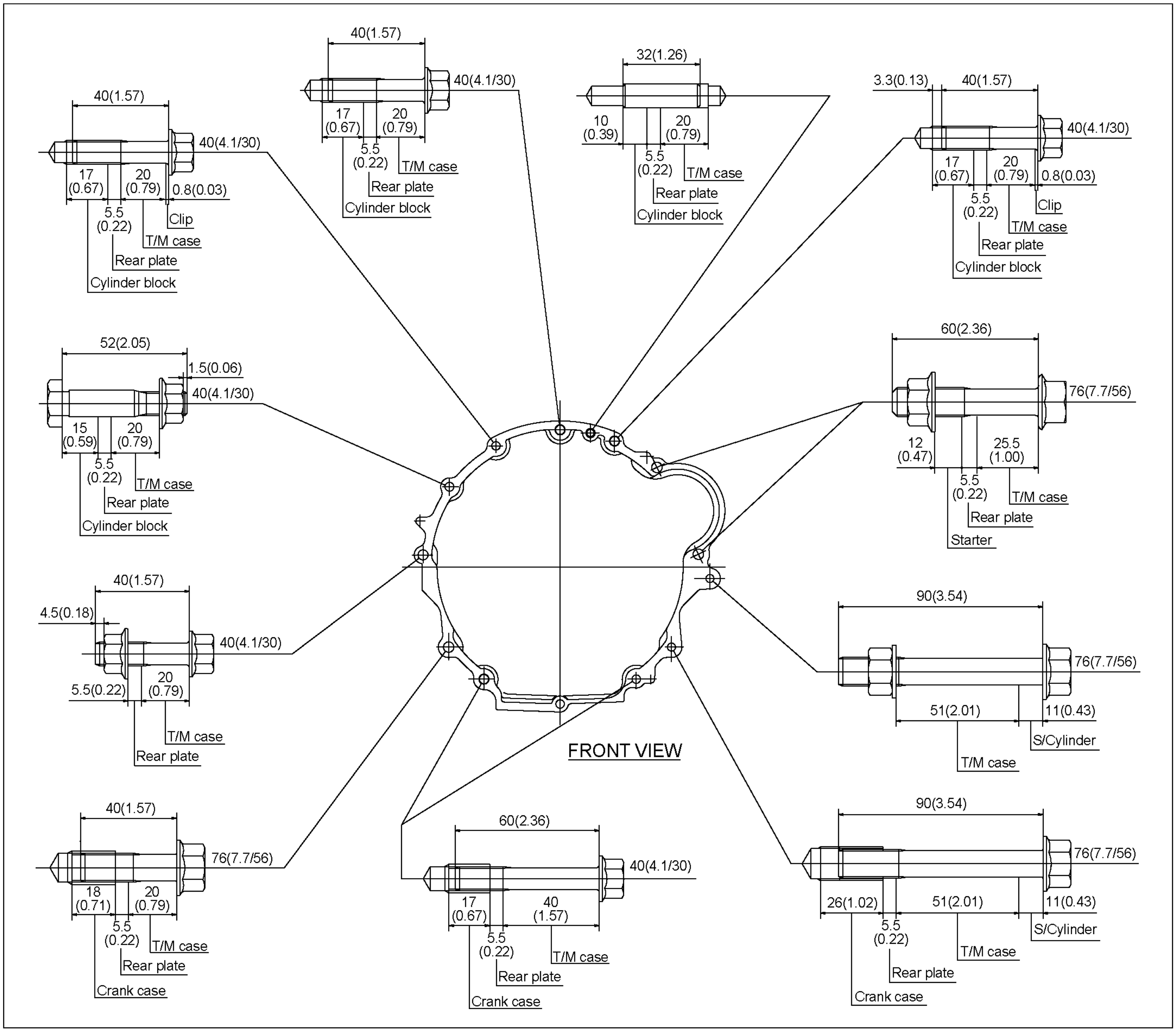
1. Apply a thin coat of molybdenum disulfide grease to the top gear shaft spline.
2. Slowly operate the transmission jack until the front of the transmission is aligned with the rear of the engine.

   The slope of the engine and the transmission must be the same.
3. Align the top gear shaft spline with the clutch driven plate spline.
4. Install the transmission assembly to the engine.

   Tighten the transmission nuts and bolts as shown in the figure.

Diesel engine

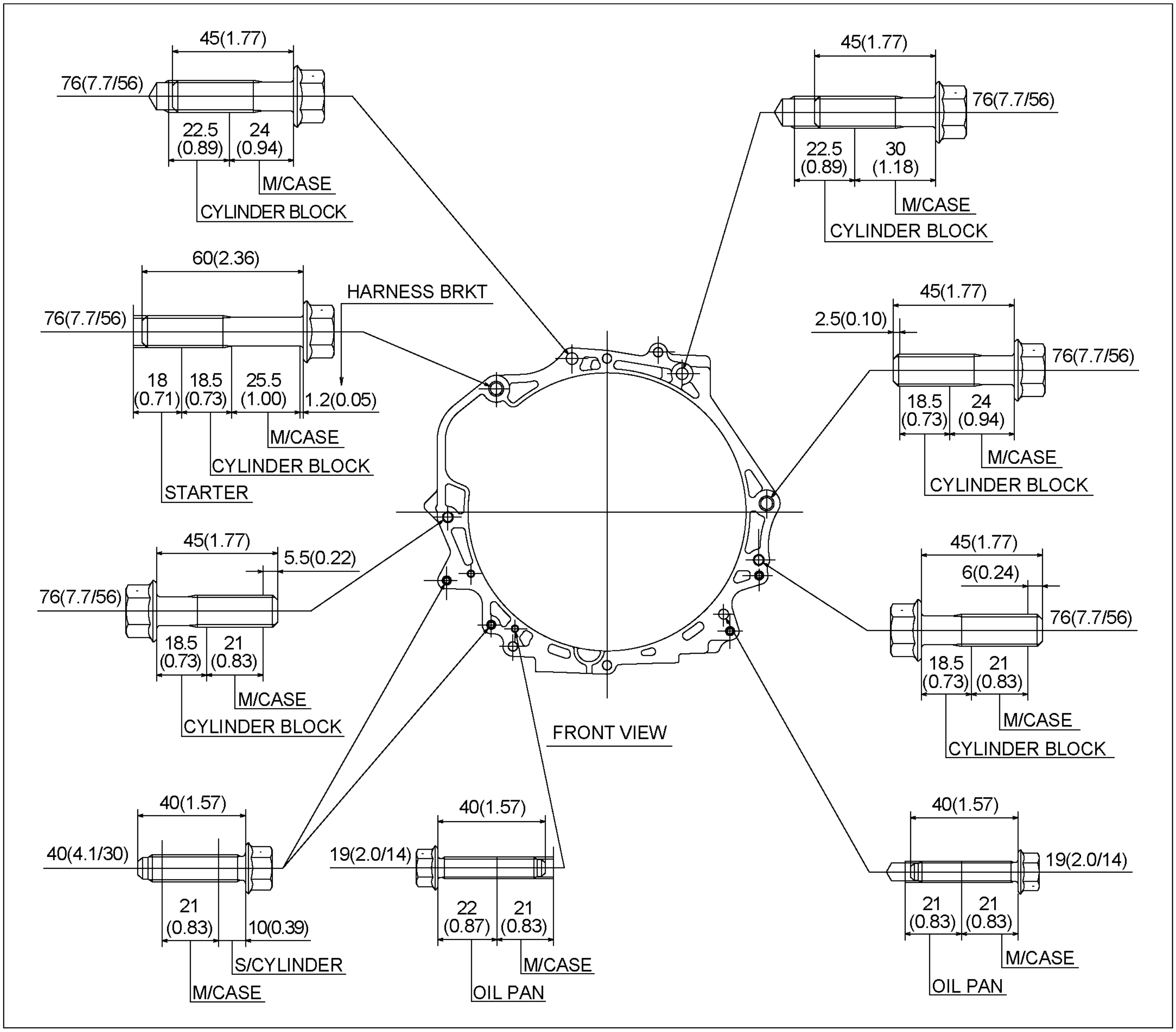
N·m (kgf·m/lb·ft)
mm (in)



RTW77BLF004001

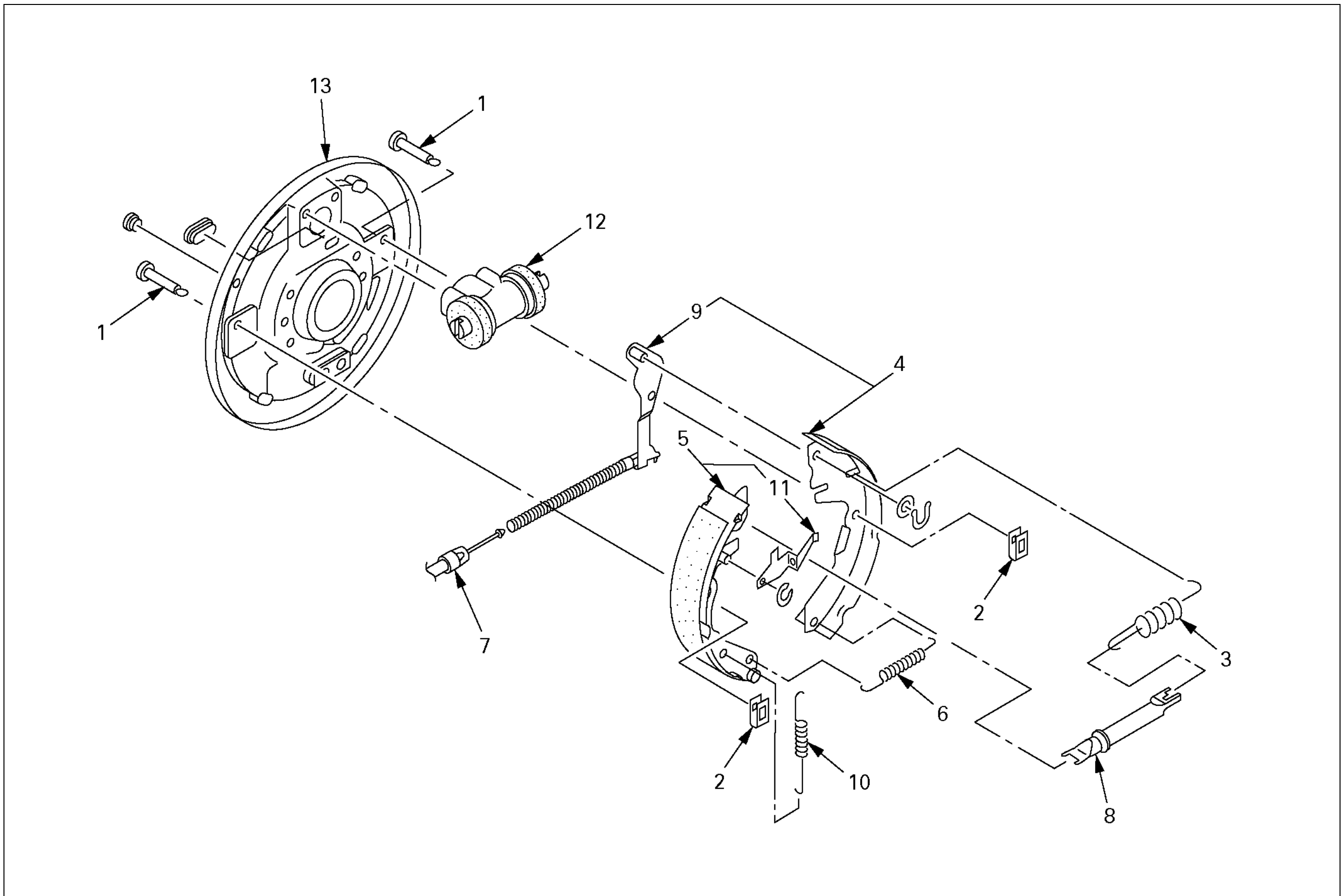
C24SE

N·m (kgf·m/lb·ft)
mm (in)



RTW77BLF004101

14. Install shoe assembly with adjuster lever, shoe assembly with parking brake lever and spring.
15. Install return spring.
16. Install shoe clamp spring and tension pin.



305R300001

Legend

1. Tension Pin
2. Shoe Clamp Spring
3. Return Spring
4. Shoe Assembly with Parking Brake Lever
5. Shoe Assembly with Adjuster Lever
6. Spring
7. Parking Brake Cable
8. Adjuster
9. Parking Brake Lever
10. Adjuster Spring
11. Adjuster Lever
12. Wheel Cylinder
13. Back plate

5. Install the starter. (Diesel engine only)

NOTE: Tighten the lower bolt temporarily.

After installing the fuel pipe assembly, tighten the bolt to the specified torque.

Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

6. Install the rear support rubber on the transmission and tighten the nuts to the specified torque.

Torque: 52 N·m (5.3 kgf·m/38 lb·ft)

7. Install the middle part of the transmission crossmember and the bolts.

Tighten the nuts to the specified torque.

Torque: 67 N·m (6.8 kgf·m/49 lb·ft)

8. Install the engine rear mount nuts fixing on the transmission crossmember.

Torque: 52 N·m (5.3 kgf·m/38 lb·ft)

Remove the transmission jack from transmission side.

9. Apply grease to the top hole portion of the shift fork.

Install the slave cylinder and tighten the bolts to the specified torque.

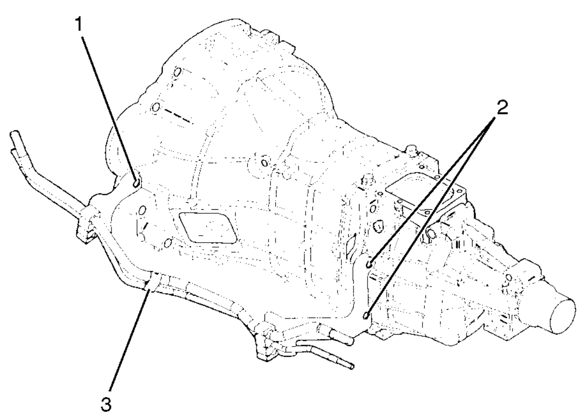
Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

10. Install the fuel pipe brackets on the transmission.

Install the fuel pipe assembly to the fuel brackets.

Torque:	**Bolt & Nut**	**76 N·m (7.7 kgf·m/56 lb·ft)**
	Nut	**37 N·m (3.8 kgf·m/27 lb·ft)**

Diesel engine

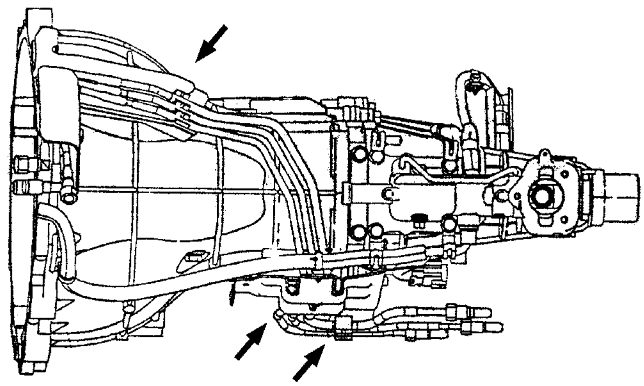


220R300012

Legend

(1) Bolt
(2) Nut
(3) Fuel Pipe Assembly

C24SE

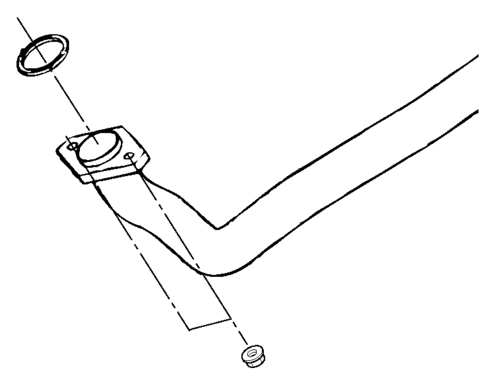


Scan-1

11. Connect the transmission harness connectors and clip. Connector: neutral switch, car speed sensor, and backup switch.

12. Tighten the exhaust pipe fixing nuts to the specified torque. (Diesel engine only)

Torque: 67 N·m (6.8 kgf·m/49 lb·ft)



RTW67BSH000101

13. Install the rear propeller shaft.

    Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

14. Install the center bearing on crossemember.

    Torque: 69 N·m (7.0 kgf·m/51 lb·ft)

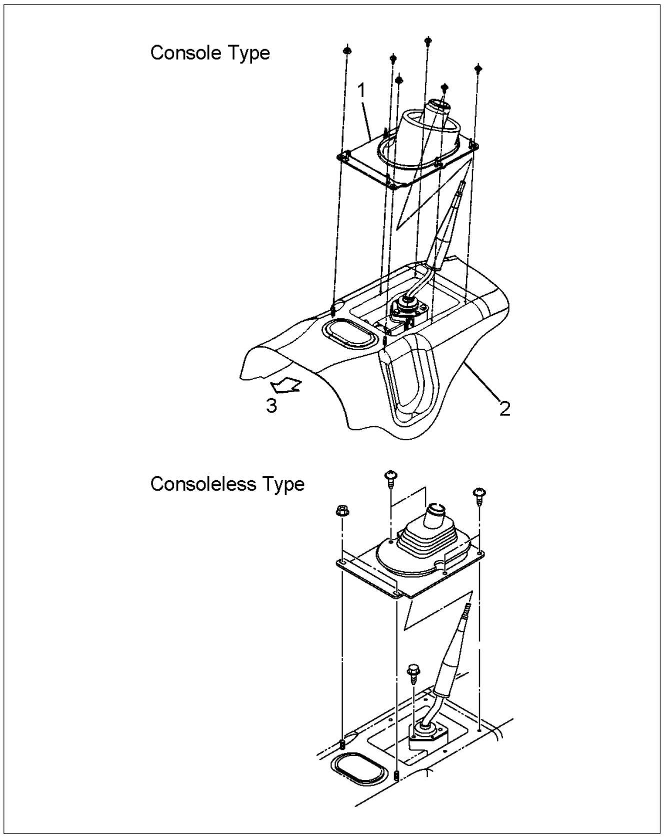
15. Install the gear control lever.

    Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

16. Install the grommet assembly.

    Torque: Screw 1.4 N·m (0.14 kgf·m/12 lb·in)

    Nut 7 N·m (0.7 kgf·m/61 lb·in)



RTW47BMH000101

Legend

(1) Grommet Assembly

(2) Floor Panel

(3) Front

17. Install the front floor console and the rear floor console.
18. Install the gear control lever knob.

    To the female thread portion, apply 3 - 4 drops of adhesive (TB1344 or LOCTITE 222 or equiv.) and tighten the transmission knob.

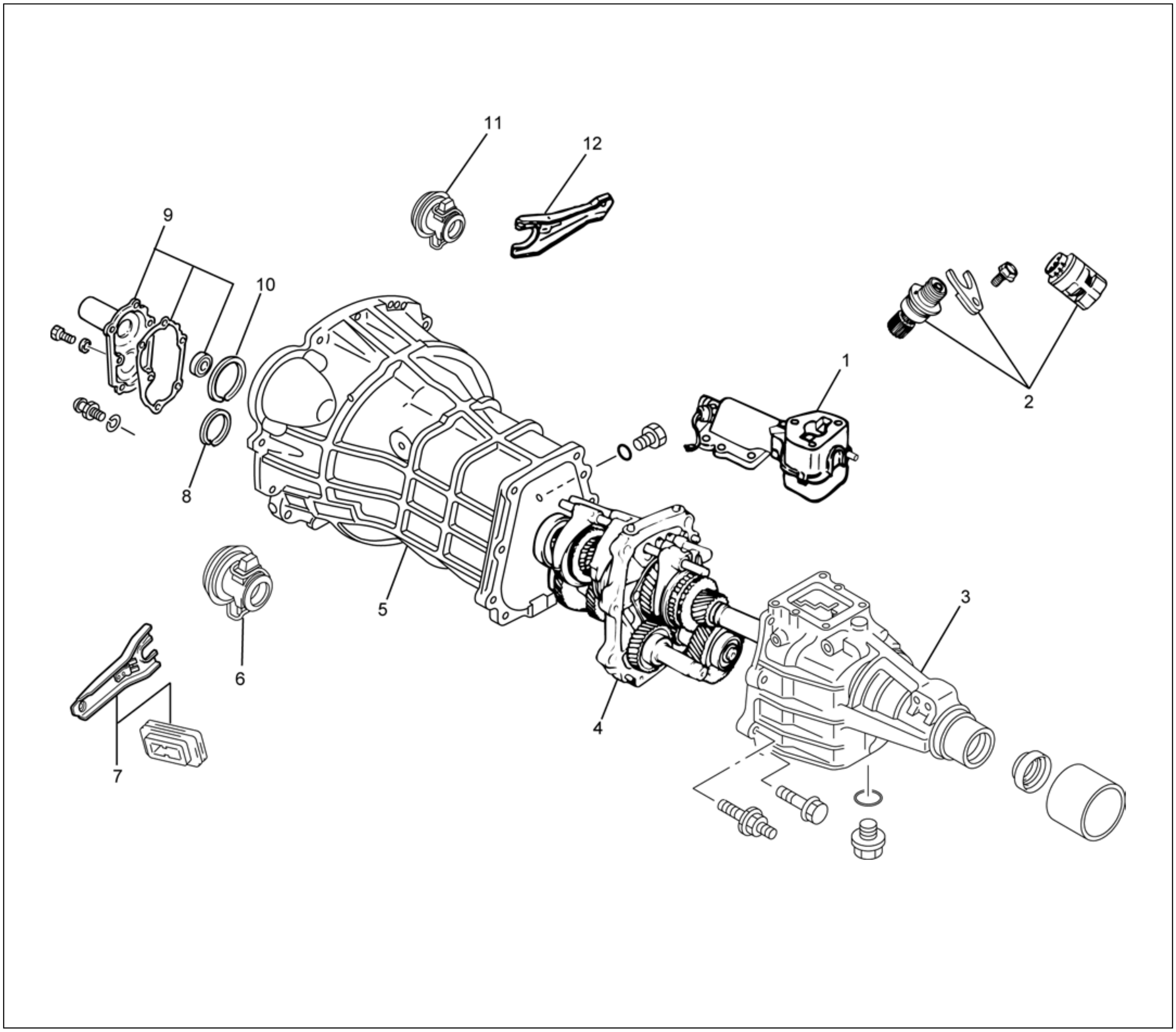
    Torque: 9 N·m (0.9 kgf·m/78 lb·in)

    After tightening to specified torque, rewrench the knob until the direction of the shift pattern is in the due positioned.

19. Connect the battery ground cable.

Transmission Case

Major Component



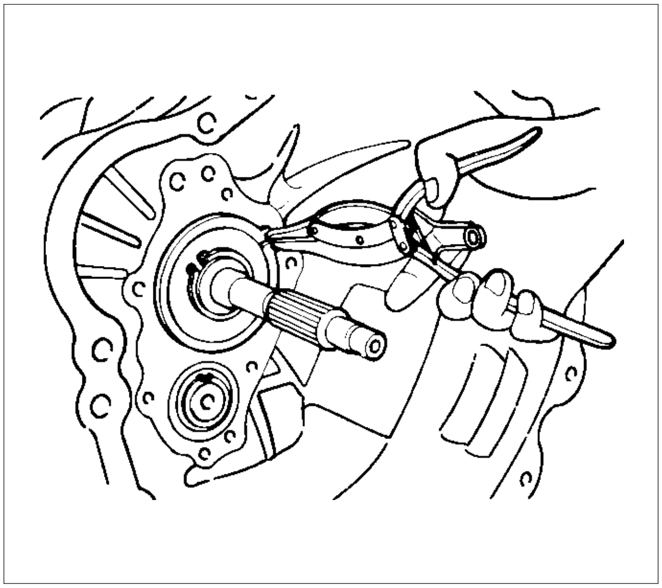
RTW77BLF003301

Legend

(1) Gear Control Box Assembly and Gasket
(2) Speedometer Sensor and Driven Gear
(3) Rear Cover Assembly
(4) Intermediate Plate with Gear Assembly
(5) Transmission Case
(6) Release Bearing (with Spring) : Diesel engine
(7) Shift Fork and Cover: Diesel engine
(8) Counter Front Bearing Snap Ring
(9) Front Cover (with Oil Seal)
(10) Top Gear Bearing Snap Ring
(11) Release Bearing: C24SE
(12) Shift Fork: C24SE

Disassembly

1. Clean the exterior of the unit with solvent.
2. Remove the drain plug from the transmission case and drain the lubricant.
3. Remove the clutch release bearing with spring from the transmission case.
4. Remove the shift fork, and boot.
5. Remove the front cover and gasket from the transmission case.
6. Remove the snap ring fixing counter front bearing.
7. Use a pair of snap ring pliers to remove the snap ring fixing top gear bearing.



226RS001

8. Remove the speedometer sensor.

   Remove the plate.

   Remove the driven gear bushing and driven gear.

NOTE: Apply a reference mark to the driven gear bushing before removal.

9. Remove the gear control box assembly.
10. Remove the rear cover assembly from the transmission case and intermediate plate.
11. Remove the intermediate plate with gear assembly from the transmission case.

Reassembly

1. Apply recommended liquid gasket (Three Bond TB1215) or its equivalent to the transmission case, intermediate plate and rear cover fitting surfaces.
2. Install the intermediate plate with the gear assembly to the transmission case.

   Pull out the top gear shaft until the ball bearing snap ring groove protrudes from the transmission case front cover fitting face.

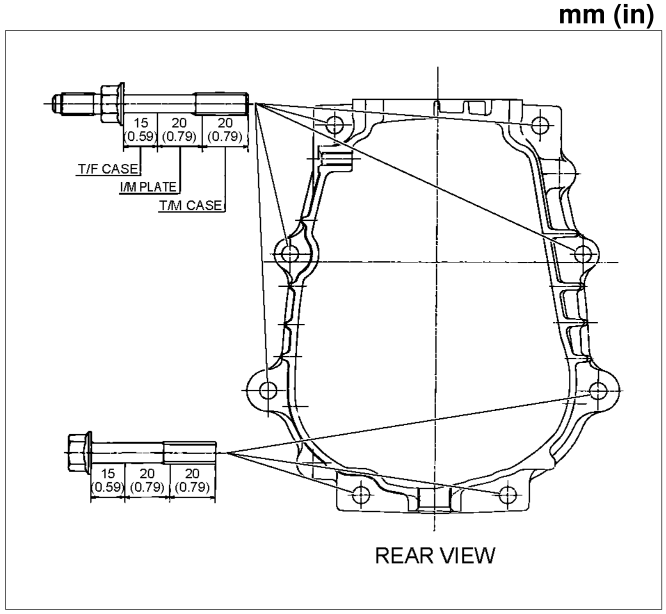
   Avoid subjecting the main shaft to sudden shock or stress.

3. Install the rear cover with an oil seal on the intermediate plate, with the gear, by performing the following steps.
   - Cover the shaft splines with adhesive tape.

     This will prevent damage to the oil seal lip.
   - Tighten the transmission rear case bolts and nuts to the specified torque.

   Torque: 37 N·m (3.8 kgf·m/27 lb·ft)

mm (in)



RTW77BSH008601

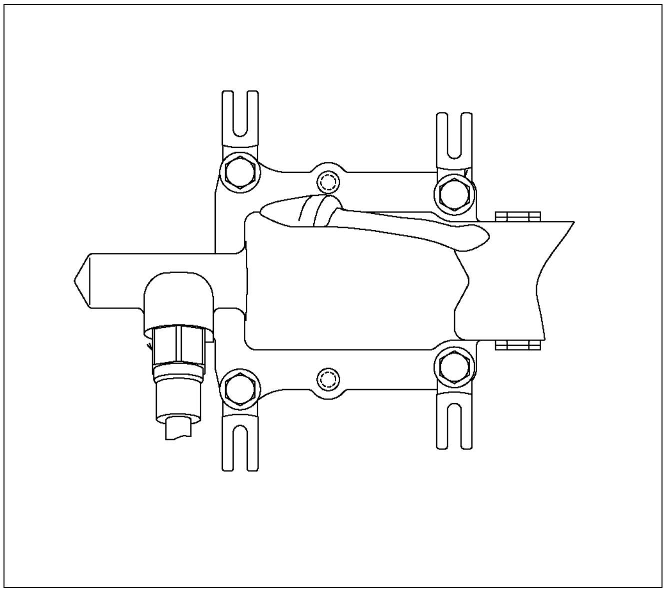
Notes When Tightening the Bolt:

- After cleaning the bolt hole, air dry it thoroughly.
- After cleaning the screw face of a removed or new bolt, dry it thoroughly. Apply recommended liquid gasket (LOCTITE 242) or its equivalent, before tightening.

4. Install a new gasket and gear control box assembly.

   Install the harness clips and brackets and then tighten four new gear control box bolts to the specified torque.

   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)



261R300004

5. Install the O-ring (3) to the speedometer driven gear bushing (2).

   Install the driven gear to the speedometer driven gear bushing (2).

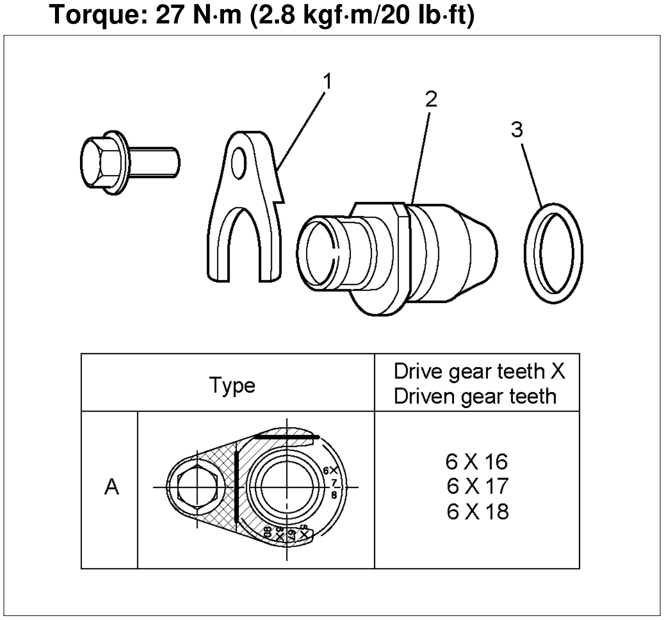
6. Install the speedometer driven gear assembly to the transmission rear cover.

   Install the plate (1) to the transmission rear cover.

   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)

7. Install the speedometer sensor.

   Torque: 27 N·m (2.8 kgf·m/20 lb·ft)

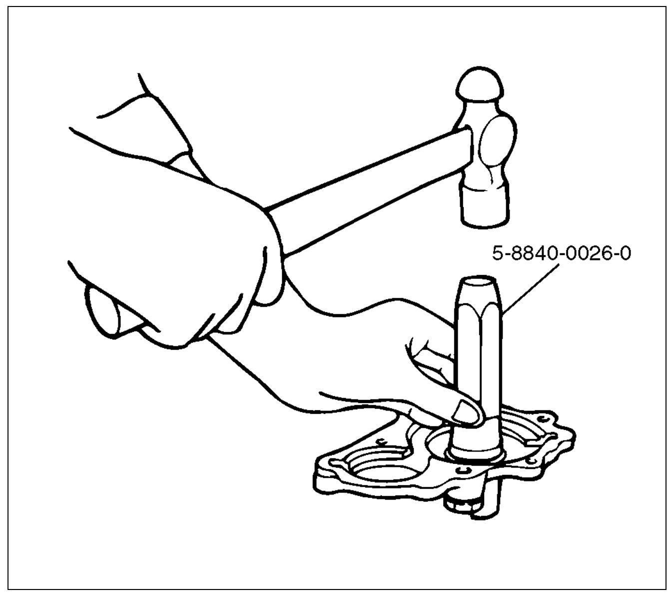


RTW77BSH008501

8. Install top gear bearing snap ring and counter front bearing snap ring.
   - Use a pair of snap ring pliers to install the snap rings to the mainshaft and countershaft.
   - The snap rings must be fully inserted into the bearing snap ring groove.

9. Front cover with oil seal.

   Front Cover Oil Seal Replacement
   - Remove the oil seal from the front cover.
   - Apply engine oil to a new oil seal, on the outer circumference.
   - Apply recommended grease to the oil seal lip.
   - Use the oil seal installer 5-8840-0026-0 to install the oil seal to the front cover.



220R3000020

10. Install a new gasket and front cover to the transmission case.

NOTE: Take care not to damage the oil seal.

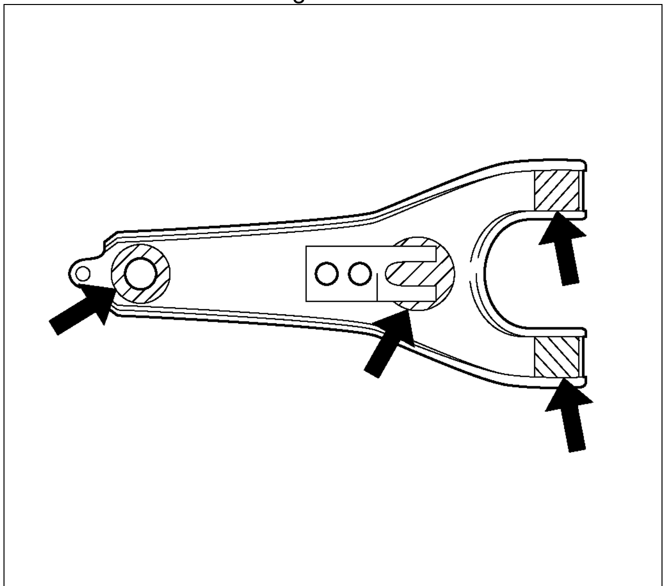
Notes When Tightening the Bolt:

- After cleaning the bolt hole, air dry it thoroughly.
- After cleaning the screw face of a removed or new bolt, dry it thoroughly. Apply recommended liquid gasket (LOCTITE 242) or its equivalent before tightening.

  Tighten the six front cover bolts to the specified torque.

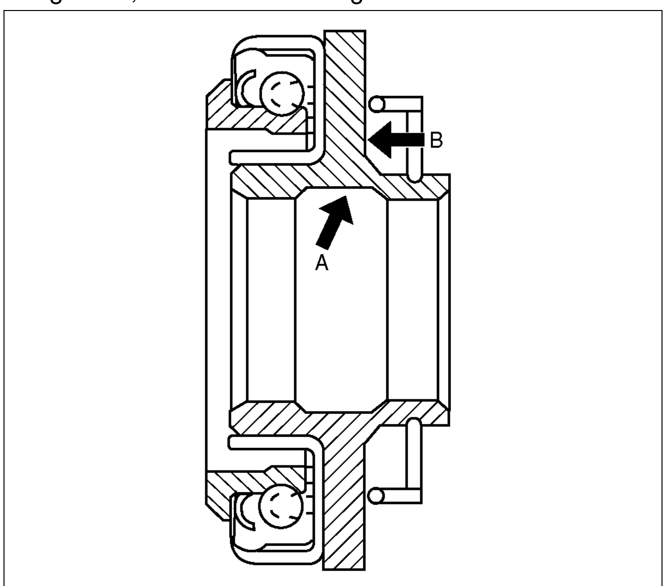
  Torque: 25 N·m (2.6 kgf·m/19 lb·ft)

11. Apply molybdenum disulfide type grease to the areas shown in the figure and install the shift fork.



F07L100026

12. Pack the inside recess (A) and coat the back (B) of the release bearing with molybdenum disulfide type grease, as shown in the figure.

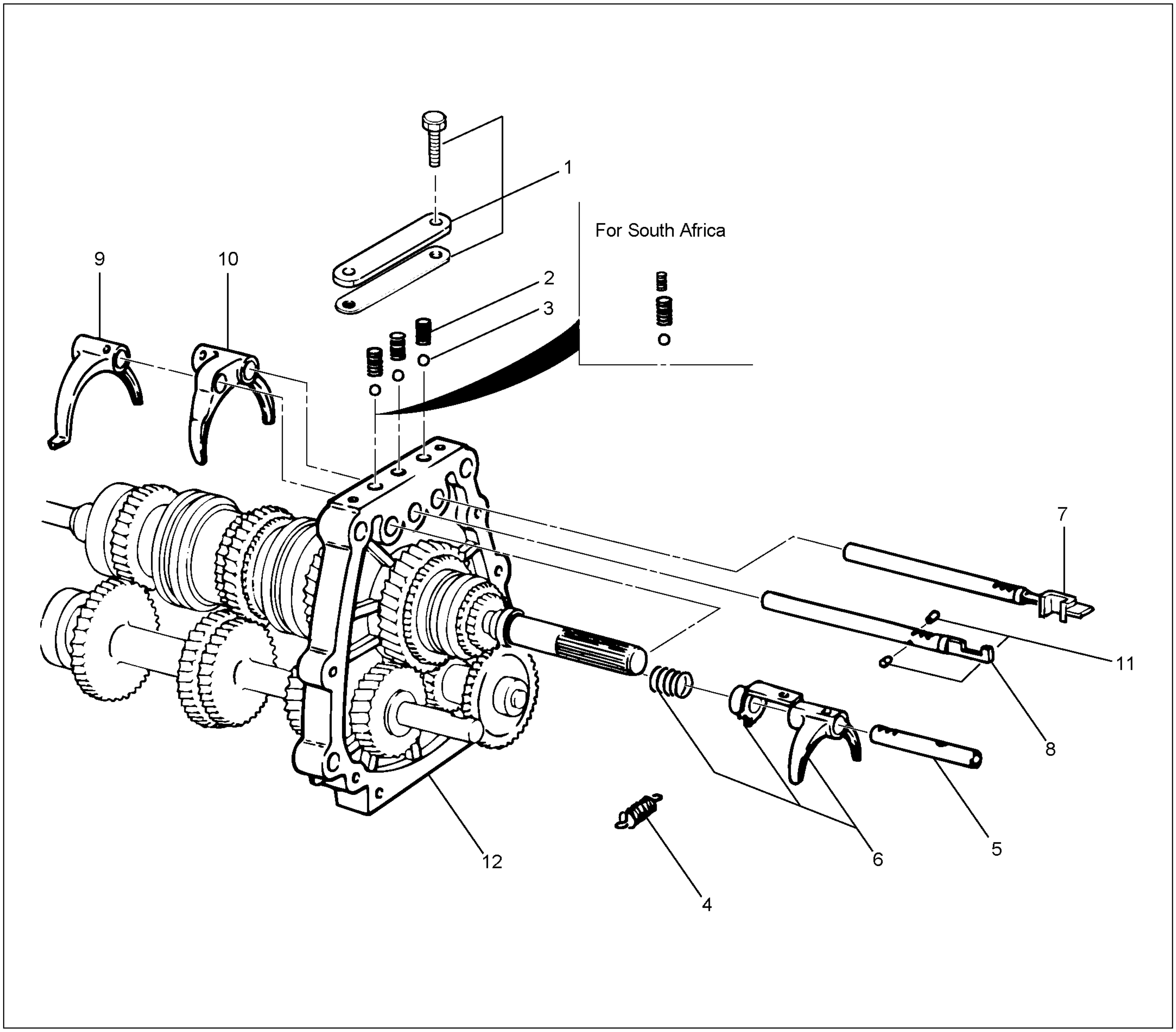


A07RW075

13. Install the release bearing on the front cover, joining it to the shift frok.

Intermediate Plate with Gear Assembly, Detent, Shift Arm, Shift Rod, and Interlock Pin

Disassembled View



RTW57BLF000201

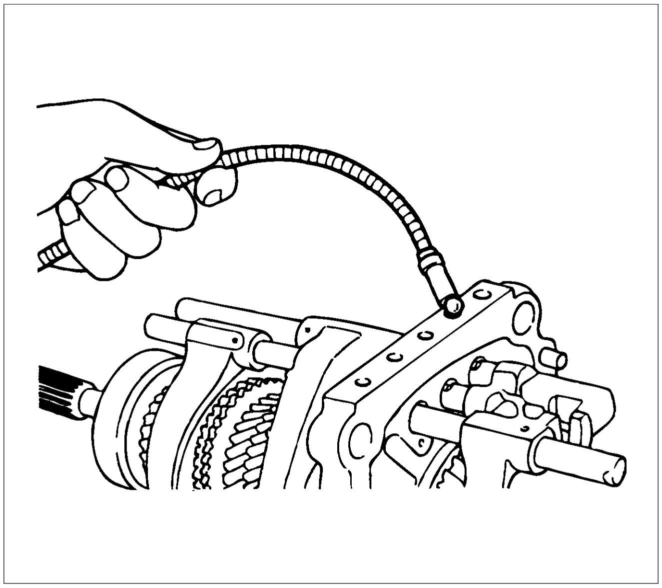
Legend

(1) Detent Spring Plate and Gasket
(2) Detent Spring
(3) Detent Ball
(4) Spring
(5) Rev-5th Shift Rod
(6) Rev-5th Shift Arm and Reverse Inhibitor
(7) 1st-2nd Shift Rod
(8) 3rd-4th Shift Rod
(9) 3rd-4th Shift Arm
(10) 1st-2nd Shift Arm
(11) Interlock Pin
(12) Intermediate Plate and Gear Assembly

Disassembly

1. Remove the detent spring plate and gasket, the detent spring and detent ball.

   Use a magnetic hand to remove the detent balls from the intermediate plate.

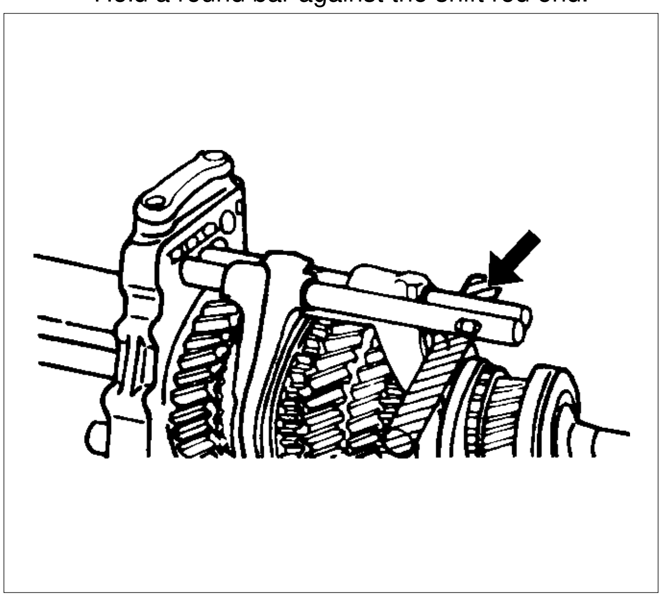


220RS011

2. Remove the spring.
3. Remove the rev-5th shift rod, and rev-5th shift arm and the reverse inhibitor.

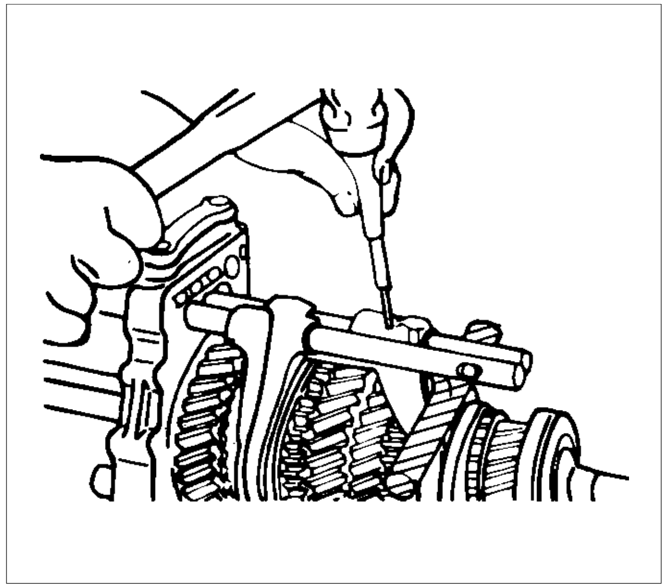
   Remove the 1st-2nd shift rod, 3rd-4th shift rod, 3rd-4th shift arm, and 1st-2nd shift arm.

   - Hold a round bar against the shift rod end.



230RS003

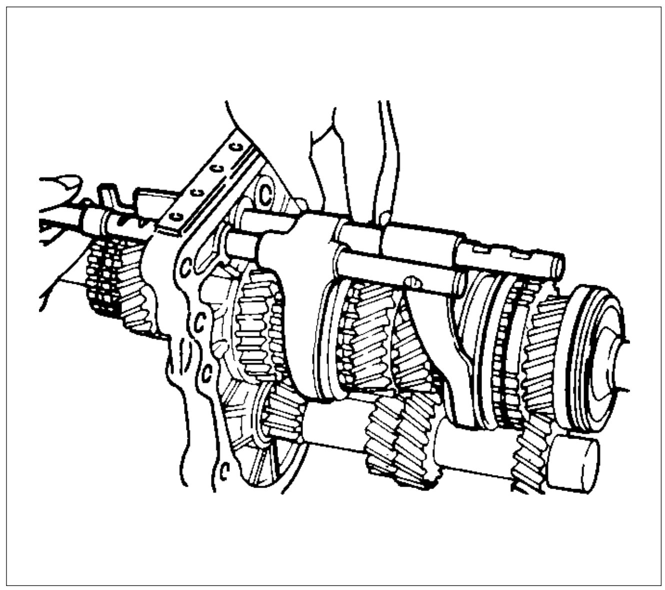
   - Use a spring pin remover to remove the shift arm spring pins from the shift arms, and the shift rods.



230RS0004

   - Be careful not to lose the interlock pins, when pulling out the shift rod rearward.

     The interlock pins are located between the shifter rods in the intermediate plate.



230RS0005

   - Remove the rev-5th, 1st-2nd and 3rd-4th shift rods carefully.

4. Remove the interlock pin from the intermediate plate and gear assembly.

Inspection and Repair

Make the necessary adjustments and part replacements if excessive wear or damage is discovered during inspection.

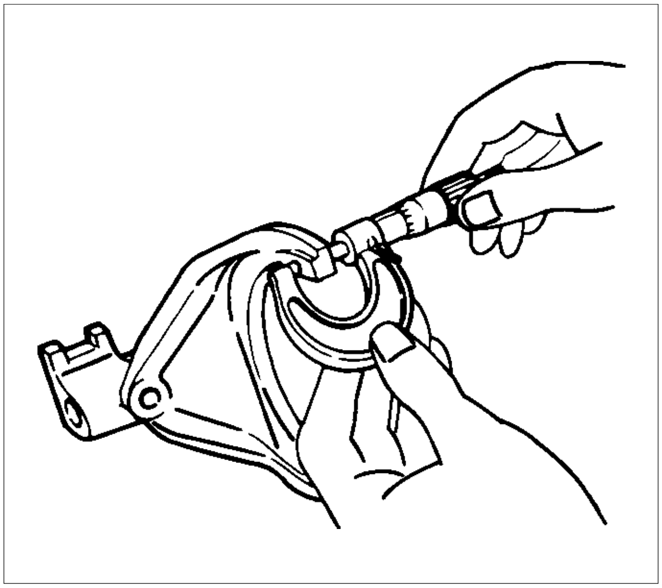
Shift Arm Thickness

- Use a micrometer to measure the shift arm thickness.

  If the measured value is less than the specified limit, the shift arm must be replaced.

Shift Arm Thickness

	Standard	Limit
1st-2nd	9.60 - 9.85 mm (0.378 - 0.388 in)	9.0 mm (0.354 in)
3rd-4th Rev.5th	9.60 - 9.80 mm (0.378 - 0.386 in)	



230RS006

Detent Spring Free Length

- Use a vernier caliper to measure the detent spring free length.

  If the measured value is less than the specified limit, the detent spring must be replaced.

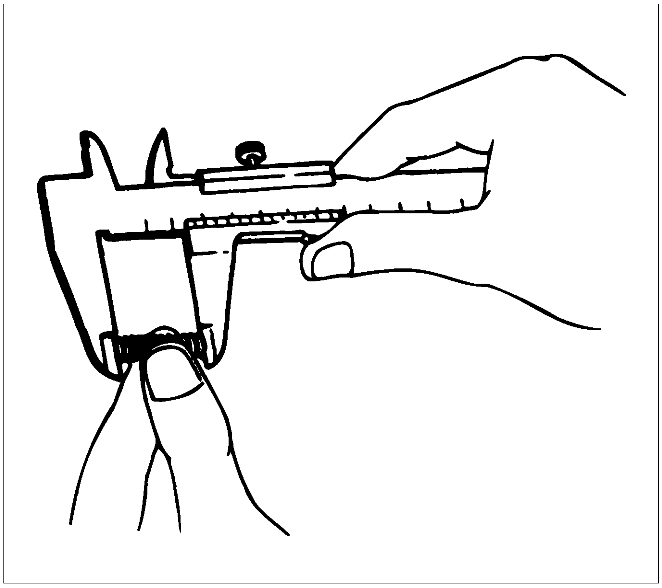
Detent Spring Free Length

Standard	Limit
26.8 mm (1.06 in)	26.2 mm (1.03 in)

SOUTH AFRICA 5th-Rev Only

Detent Spring Free Length

	Standard	Limit
Outer	27.6 mm (1.09 in)	27.0 mm (1.06 in)
Inner	26.6 mm (1.05 in)	26.0 mm (1.02 in)



220RS012

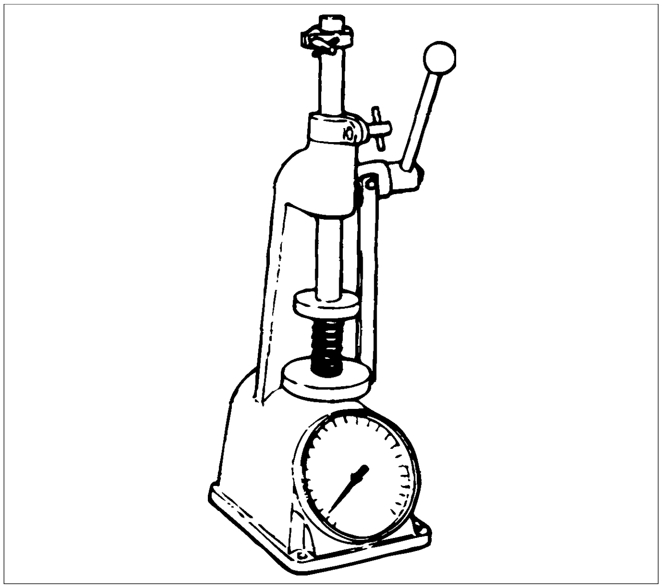
Detent Spring Tension

- Use a spring tester to measure the detent spring tension.

  If the measured value is less than the specified limit, the detent spring must be replaced.

Detent Spring Tension

Compressed height	Standard
20 mm (0.787 in)	87.2 - 97.1 N (19.6 - 21.8 lb)



220RS013

SOUTH AFRICA 5th-RV Only

Detent Spring Free Length

	Compressed	Standard
Outer	20 mm (0.787 in)	93.5 – 103.3 N (21.0 – 23.3 lb)
Inner	20 mm (0.787 in)	26.4 – 36.3 N (5.9 – 8.2 lb)

Reassembly

1. Install the rev-5th shift arm and reverse inhibitor and the rev-5th shift rod.
   - Apply oil to the reverse inhibitor inner surface.
   - Install the shift rod in the intermediate plate.
   - Hold a round bar against the shift rod end lower face to protect it against damage.
   - Install a new spring pin.

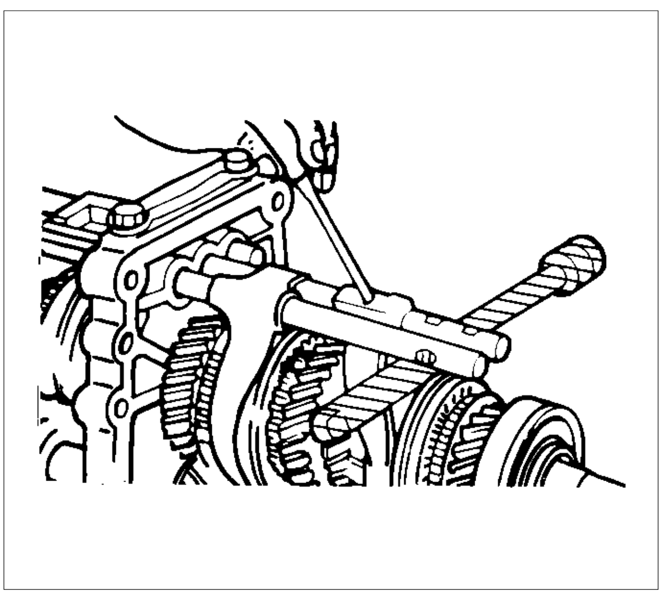
     Never reinstall the used spring pin.
   - Install the interlock pin in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
2. Install the 1st-2nd shift arm and 3rd-4th shift arm to the intermediate plate and gear assembly.
3. Install the 3rd-4th shift rod and 1st-2nd shift rod.
   - Install the interlock pin in the intermediate plate and gear assembly.
   - Install the 3rd-4th shift rod in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
   - Install the interlock pin and then 1st-2nd shift rod in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
   - Hold a round bar against the shift rod end lower face to protect it against damage.
   - Install a new spring pin.

     Never reinstall the used spring pin.



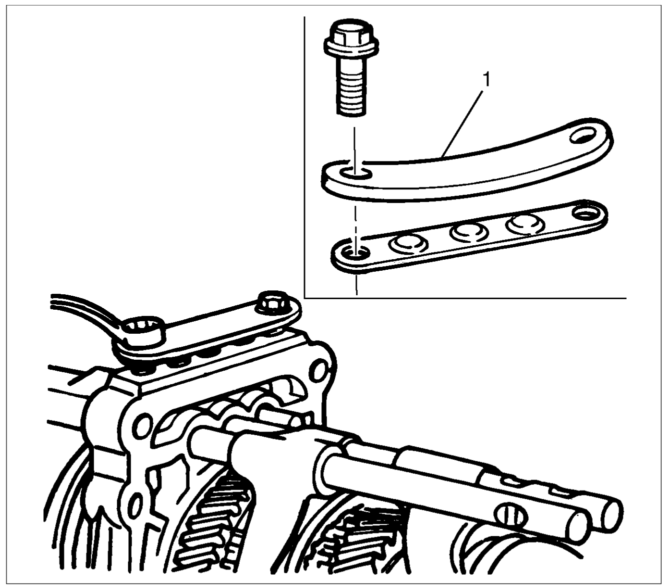
230RS007

4. Install the spring.
5. Put the detent balls in the intermediate plate holes.
   - Apply oil to the detent balls.
6. Install the detent springs and detent spring plate and gasket.

NOTE: For South Africa model, it has double detent spring for Rev-5th shift rod.

- Install a new gasket and the detent spring plate.
- Tighten the detent spring plate bolts to the specified torque.

Torque: 25 N·m (2.5 kgf·m/18 lb·ft)



220RS030

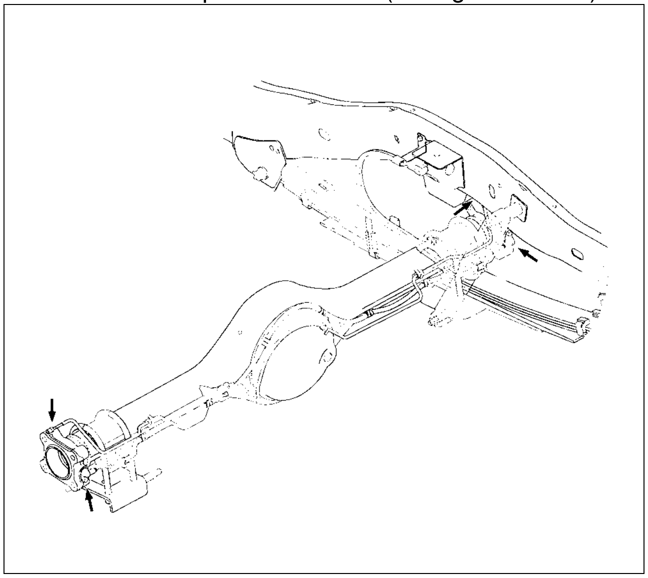
Legend

(1) Warped

17. Install brake pipe and ABS sensor and tighten it to the specified torque.

    Torque :

ABS Sensor	8 N·m (0.8 kgf·m/69 lb·in)
Brake Pipe	16 N·m (1.6 kgf·m/12 lb·ft)

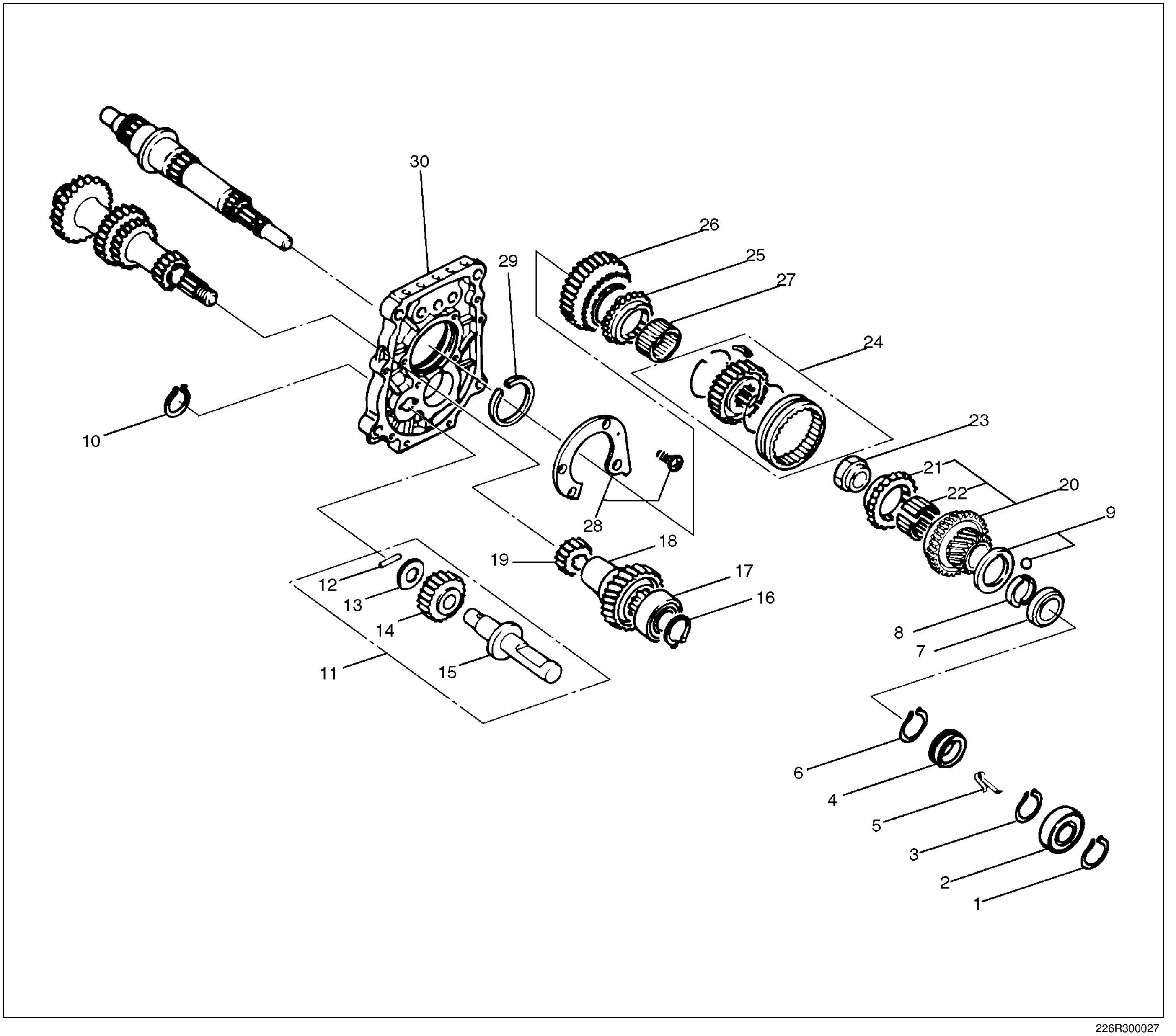


420R30003

18. Bleed brake pipe at the wheel cylinder. (Refer to the section “Power-assisted Brake System”)
19. Install brake drum.
    - Install propeller shaft. (Refer to Section “Rear Propeller Shaft”.)
    - Refill differential oil.
    - Install wheel and tire.
    - Lower vehicle.

Reverse Gear and 5th Gear

Disassembled View



226R300027

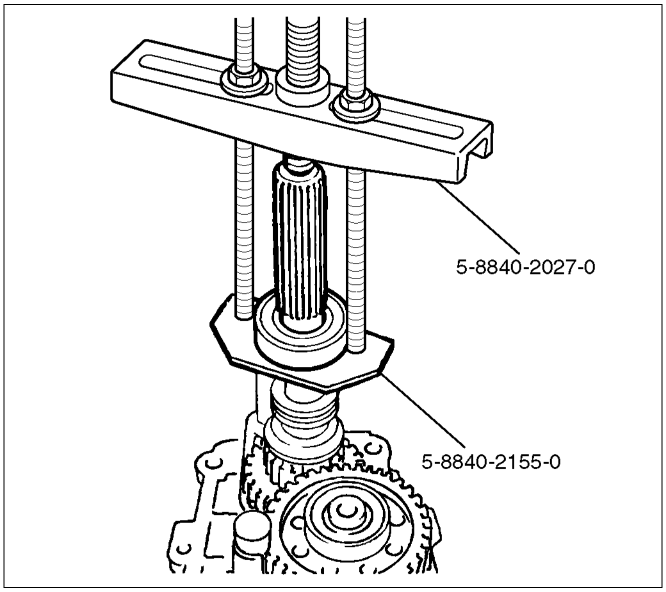
Legend

(1) Bearing Snap Ring
(2) Ball Bearing
(3) Bearing Snap Ring
(4) Speedometer Drive Gear
(5) Clip
(6) Retainer Snap Ring
(7) Retainer
(8) Thrust Plate
(9) Thrust Washer and Lock Ball
(10) Reverse Idler Gear Snap Ring
(11) Reverse Idler Gear Assembly
(12) Idle Shaft Pin
(13) Thrust Washer
(14) Reverse Idler Gear
(15) Reverse Idler Shaft
(16) Bearing Snap Ring
(17) Ball Bearing
(18) Counter 5th Gear
(19) Counter Reverse Gear
(20) 5th Gear

(21)	5th Block Ring	(26)	Reverse Gear
(22)	Needle Bearing	(27)	Needle Baring
(23)	Mainshaft Nut	(28)	Bearing Plate and Screw
(24)	Rev-5th Synchronizer Assembly	(29)	Bearing Snap Ring
(25)	Reverse Block Ring	(30)	Intermediate Plate

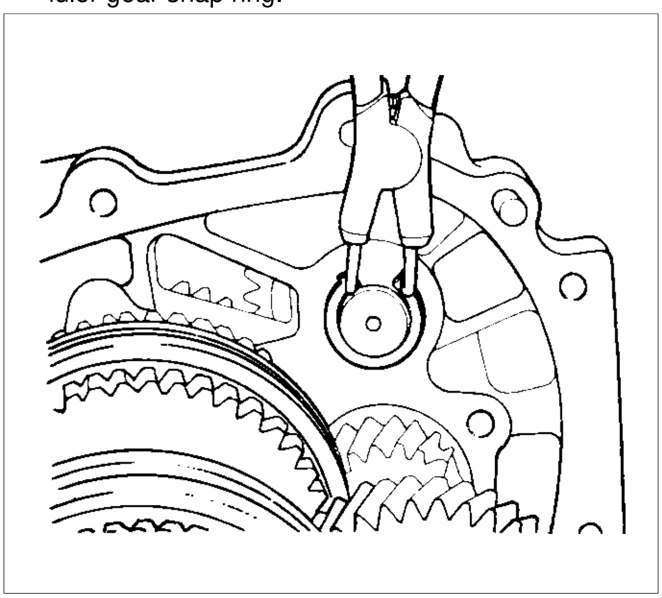
Disassembly

1. Use a pair of snap ring pliers to remove the bearing snap ring.
2. Set the bearing remover 5-8840-2155-0 and the puller 5-8840-2027-0 to the bearing and the mainshaft end, to remove the ball bearing.



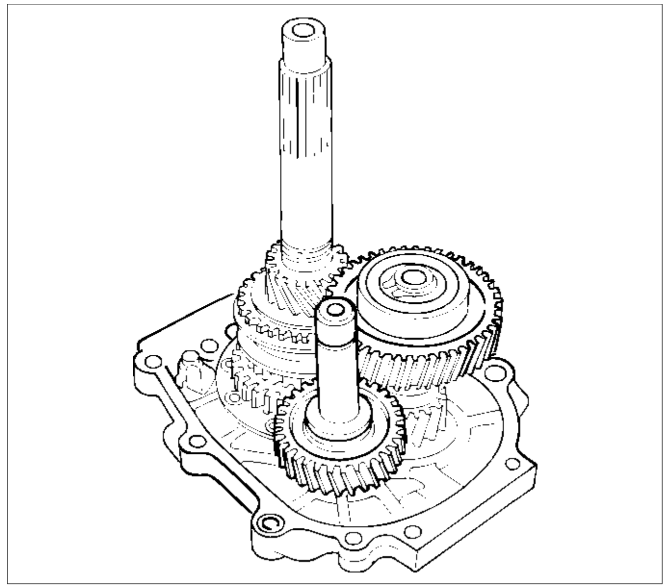
262L100001

3. Remove the bearing snap ring, clip, speedometer drive gear, retainer snap ring and the retainer.
4. Remove the thrust plate, thrust washer and lock ball.
5. Use a pair of snap ring pliers to remove the reverse idler gear snap ring.



226RS004

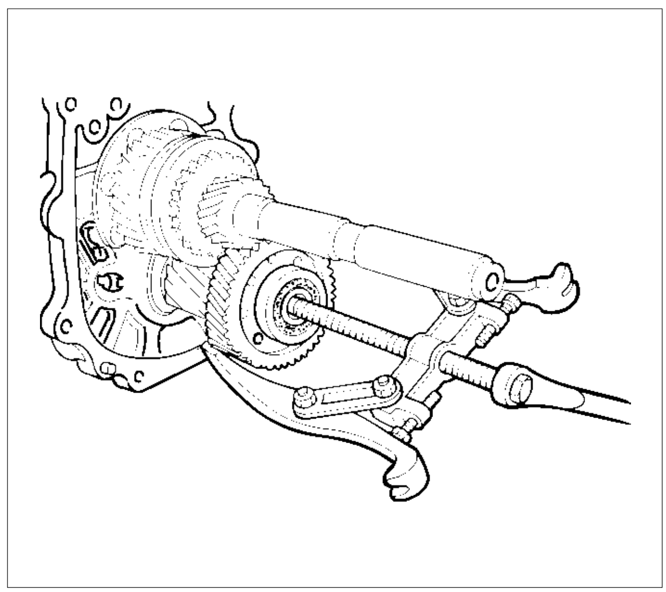
6. Remove the reverse idler gear assembly from the intermediate plate.



226RS005

7. Remove the idle shaft pin, thrust washer, reverse idler gear, and reverse idler shaft.
8. Use a pair of snap ring pliers to remove the snap ring.
9. Attach a universal puller to the counter gear shaft.

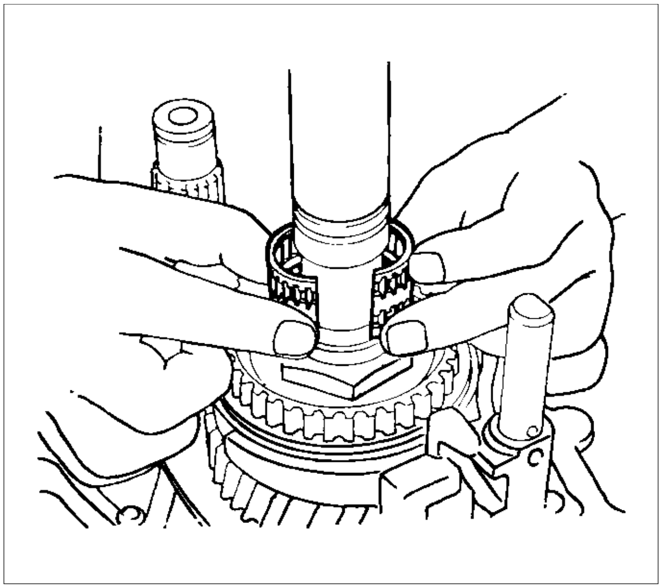
   Use a universal puller to remove the ball bearing and the counter 5th gear.



226RS006

10. Remove the counter reverse gear.

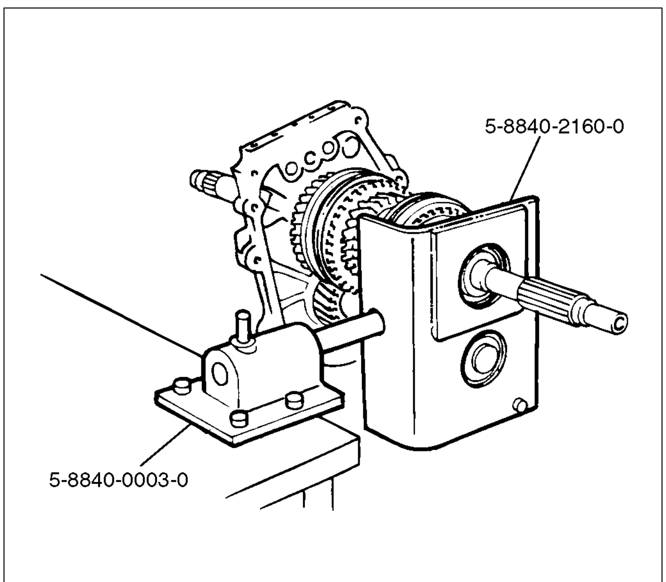
11. Remove the 5th gear, 5th block ring, and needle bearing (2 piece type).



226RS007

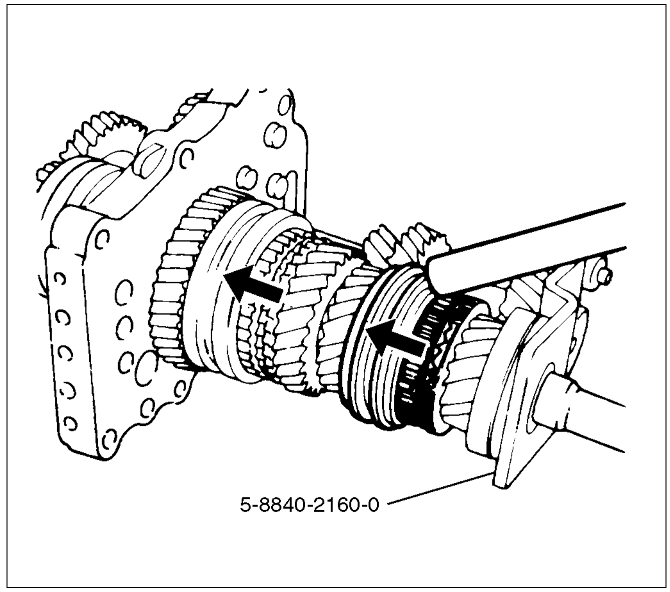
12. Remove the mainshaft nut according to following steps.

    Attach the holding fixture 5-8840-2160-0 and the base 5-8840-0003-0 to the mainshaft and the counter gear.



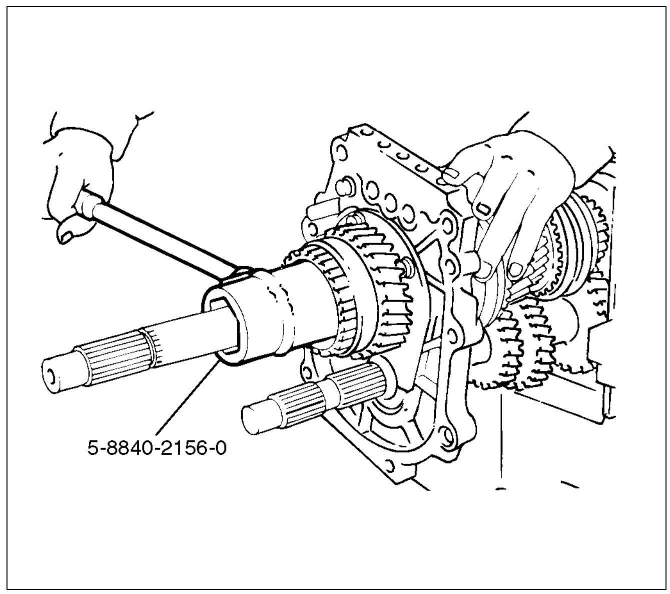
226RW212

- Engage the 3rd-4th synchronizer with the 3rd gear.
- Engage the 1st-2nd synchronizer with the 1st gear.



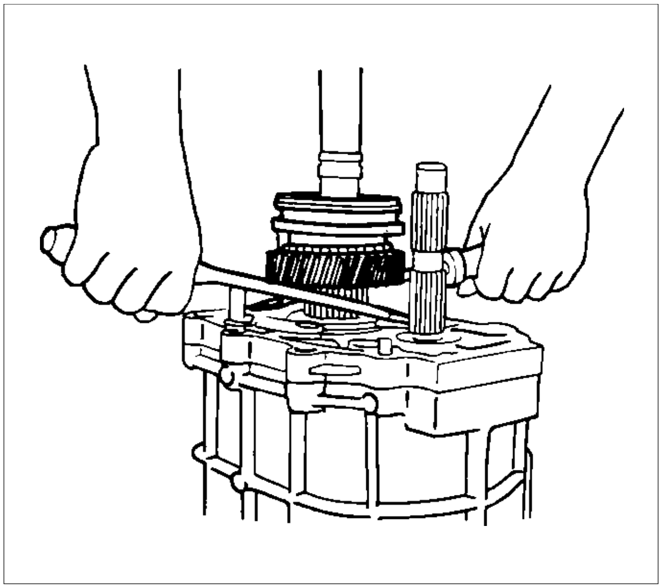
226RW210

- Use the mainshaft nut wrench 5-8840-2156-0 to remove the mainshaft nut.



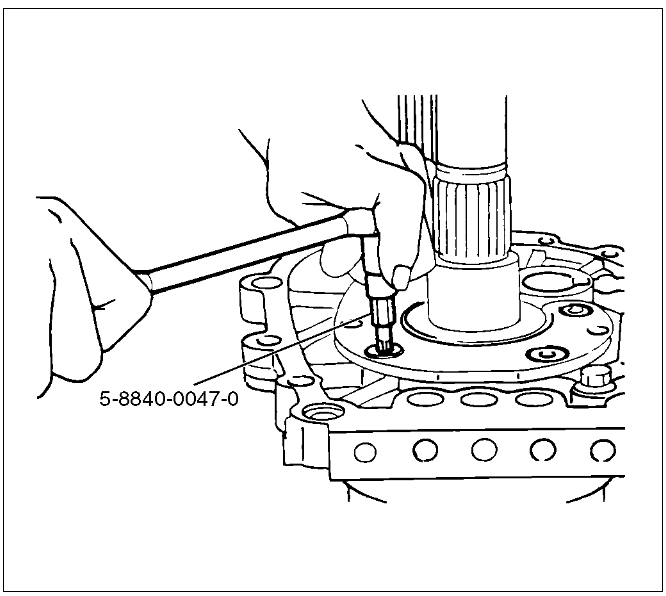
226RW211

13. Use screw drivers between the reverse gear and the bearing plate to remove the Rev-5th synchronizer assembly, together with the reverse block ring and reverse gear.



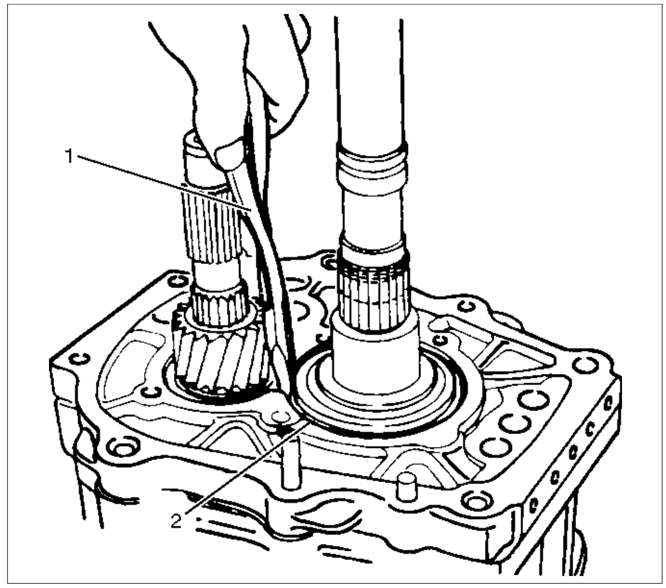
226RS010

14. Remove the needle bearing.
15. Use the torx bit wrench (T- 45) 5-8840-0047-0 to remove the bearing plate and screw from the intermediate plate.



220RW137

16. Use the snap ring pliers (1) to remove the mainshaft bearing snap ring (2).



226RS011

17. Hold the snap ring open with the pliers.

    Push the intermediate plate toward the rear of the transmission to remove it.

    The bearing snap ring will come free.

Inspection and Repair

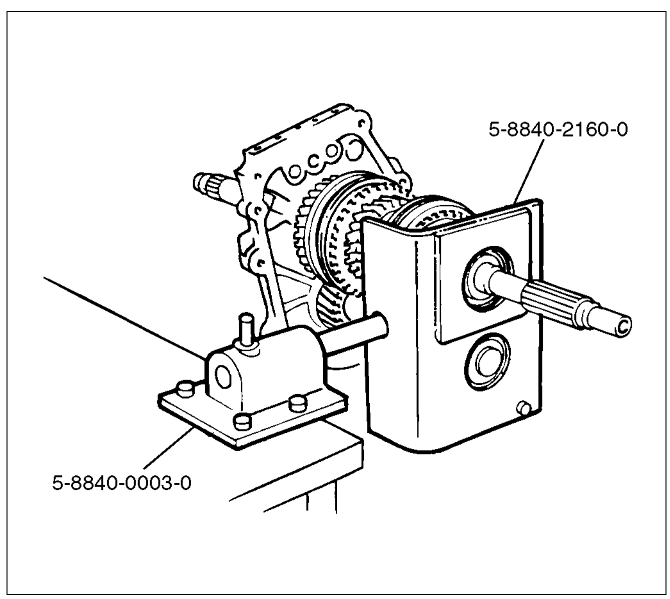
Refer to Top Gear Shaft, Main Gear Shaft, and Counter Gear in this section for inspection and repair.

Reassembly

1. Mesh the counter gear with the mainshaft assembly.

   Set the holding fixture 5-8840-2160-0 to the mainshaft and the counter gear, and then install it on the base 5-8840-0003-0.

   Install the intermediate plate on the gear assembly.



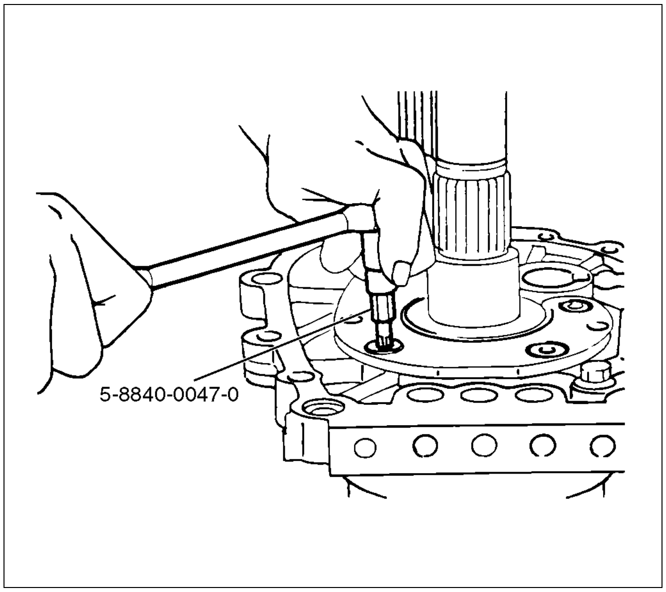
226RW212

2. Install the bearing snap ring.
3. Apply the recommended thread locking agents (LOCTITE 242) or its equivalent to each of the bearing plate screw threads.

   Install the bearing plate and screw.

   Tighten the screws to the specified torque by using torx bit wrench (T- 45) 5-8840-0047-0.

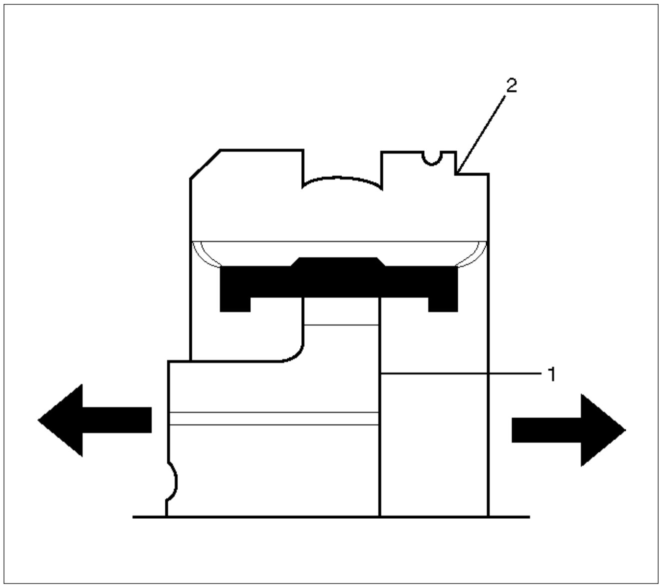
   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)



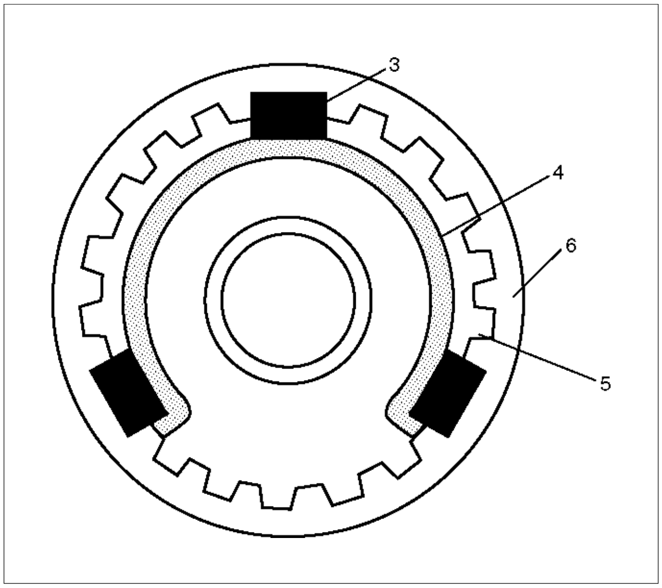
220RW137

4. Install the needle bearing, reverse gear, and reverse block ring.
5. Assemble rev-5th synchronizer assembly by performing the following steps.
   1. Turn the clutch hub face (1) toward the sleeve groove (2) (rear side) on the outer circumference.
   2. Check that the inserts (3) fit snugly into the clutch hub (5) ring insert grooves.
   3. Check that the inserts springs (4) are fitted to the inserts as shown in the illustration.
   4. Check that the clutch hub (5) and the sleeve (6) slide smoothly.
   5. Install the synchronizer assembly to the mainshaft.

   The clutch hub face with the heavy boss must be facing the reverse gear side.

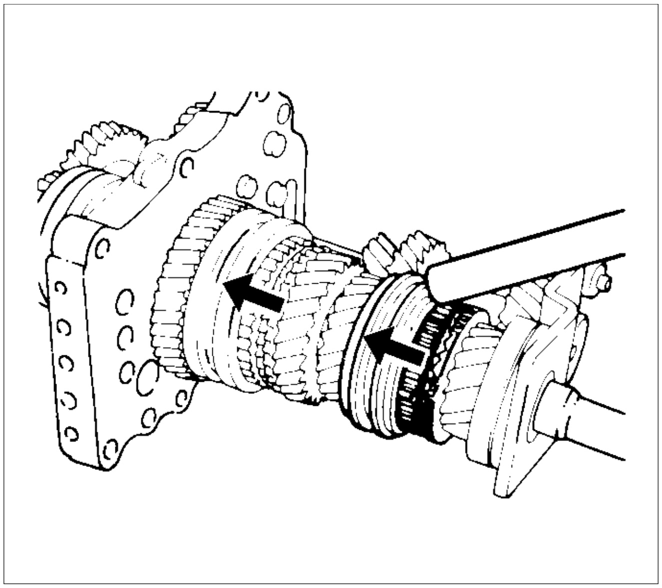


226RS013



226RS049

6. Mesh the 1st-2nd and 3rd-4th synchronizers with both the 1st and 3rd gears (double engagement).



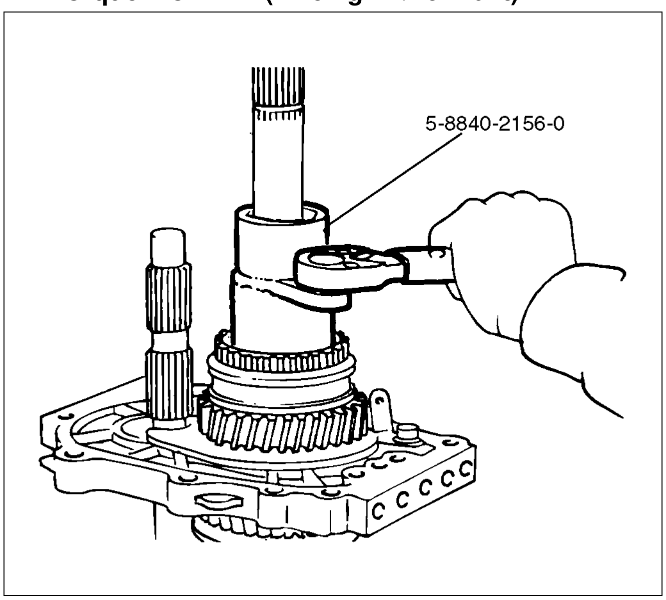
226RS015

This will prevent the mainshaft from turning.

7. Install the new mainshaft hub nut.

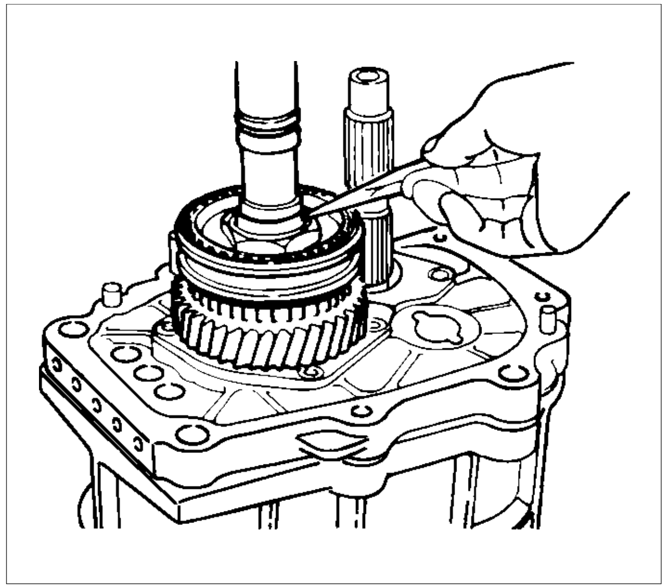
Use the mainshaft nut wrench 5-8840-2156-0 to tighten the mainshaft nut to the specified torque.

Torque: 137 N·m (14.0 kgf·m/101 lb·ft)



226RW214

8. Use a punch to stake the mainshaft nut.

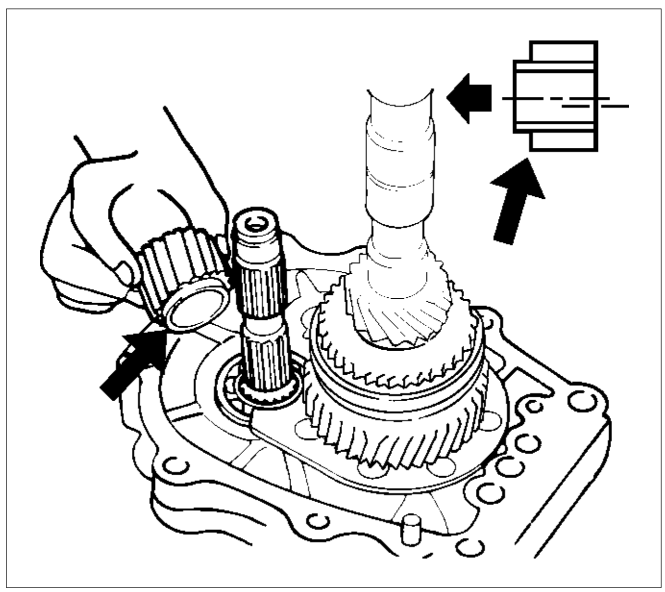


226RW153

9. Install the needle bearing, 5th block ring, and 5th gear.
10. Apply engine oil to the counter reverse gear and the reverse gear.

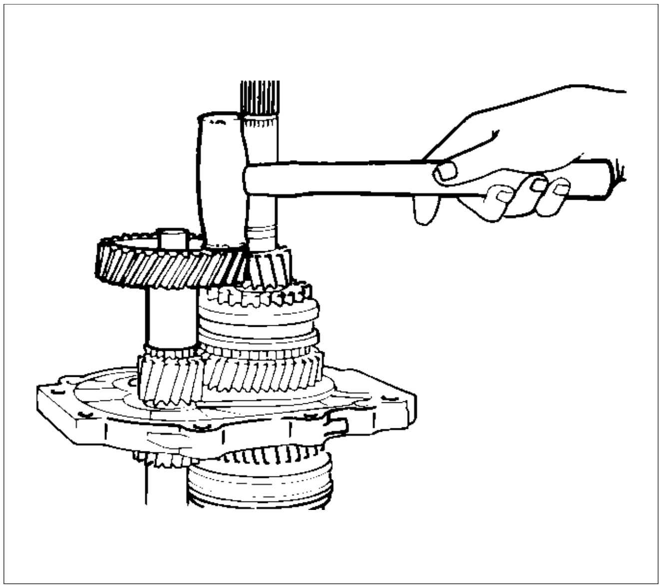
Install the counter reverse gear to the counter shaft.

The reverse gear projection must be facing the intermediate plate.



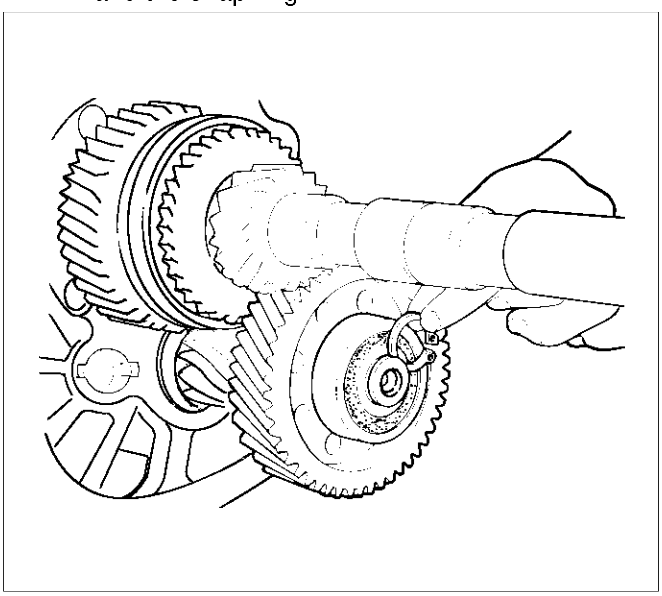
226RW151

11. Install the counter 5th gear to the counter shaft.



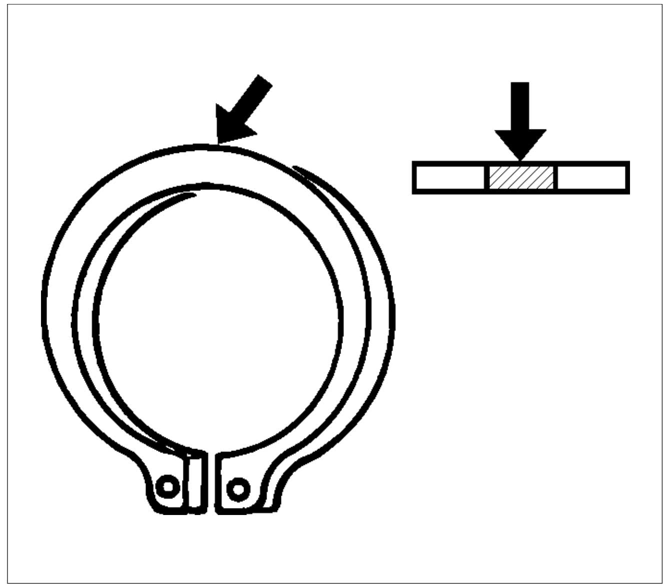
226RS019

12. Install the ball bearing and bearing snap ring by performing the following steps:
    - Select the snap ring which will provide the minimum clearance between the ball bearing and the snap ring.



226RS020

- There are six snap ring sizes available.
  The snap rings are color‐coded to indicate their thickness.



226RS021

Ball Bearing and Snap Ring Clearance

Standard: 0 - 0.15 mm (0 - 0.0059 in)

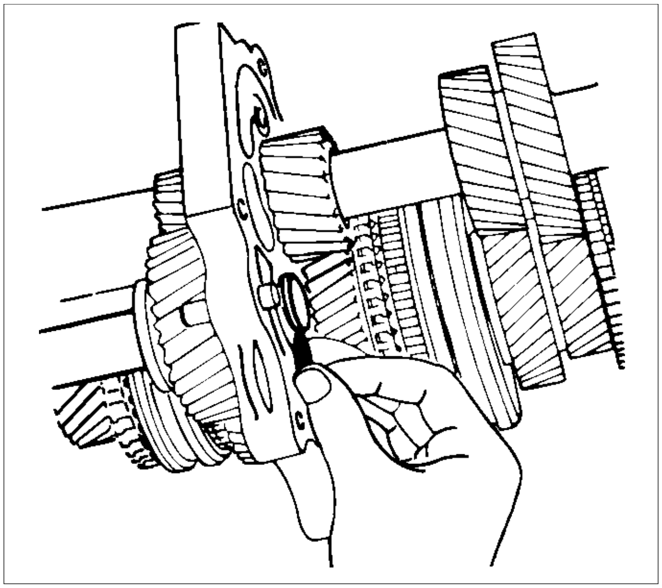
Snap Ring Availability

Thickness	Color Coding
1.1 mm (0.043 in)	White
1.2 mm (0.047 in)	Yellow
1.3 mm (0.051 in)	Blue
1.4 mm (0.055 in)	Pink
1.5 mm (0.059 in)	Green
1.6 mm (0.063 in)	Brown

- Use a pair of snap ring pliers to install the snap ring to the counter gear shaft.
  The snap ring must be fully inserted into the counter gear shaft snap ring groove.

13. Assemble the reverse idler shaft, reverse idler gear, thrust washer, and idle shaft pin into the reverse idler gear assembly.
    The thrust washer should be assembled with the oil groove faces to gear side.

14. Select the reverse idler gear snap ring which will provide the minimum clearance between the intermediate plate and the snap ring.



226RS022

- There are three snap ring sizes available.

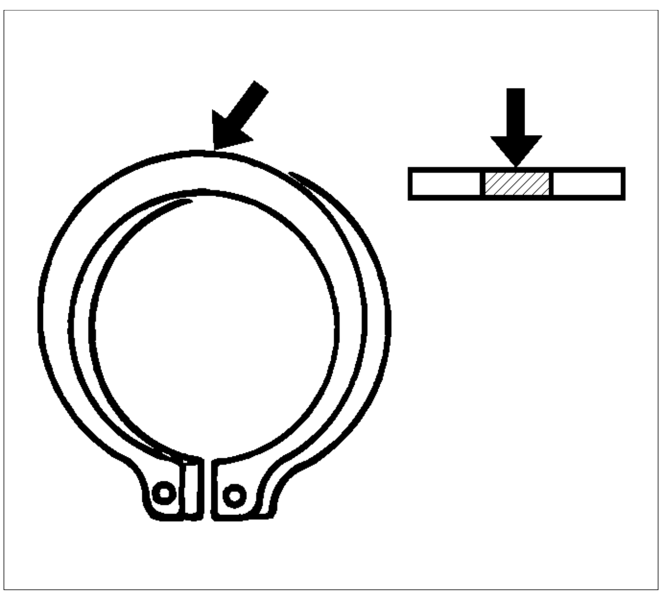
  The snap rings are color-coded to indicate their thickness.

Intermediate Plate and Snap Ring Clearance

Standard: 0 - 0.15 mm (0 - 0.0059 in)

Snap Ring Availability

Thickness	Color Coding
1.2 mm (0.047 in)	White
1.3 mm (0.051 in)	Yellow
1.4 mm (0.055 in)	Blue



226RS021

- Use a pair of snap ring pliers to install the snap ring to the reverse idler shaft.

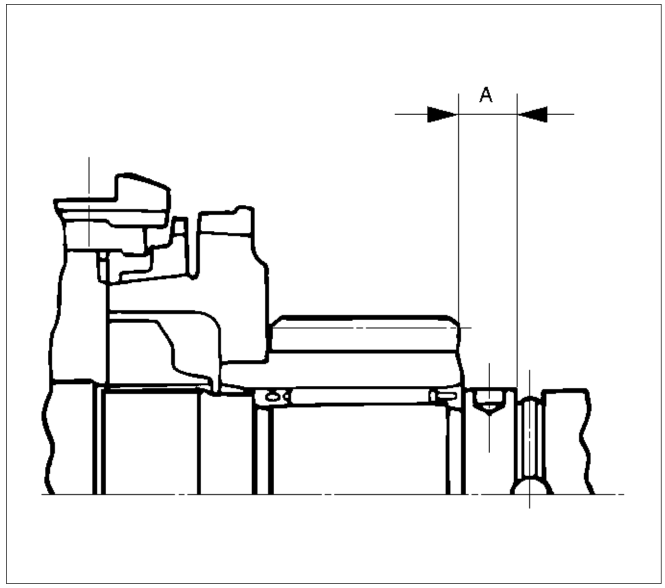
  The snap ring must be fully inserted into the reverse idler shaft snap ring groove.

15. Install the thrust washer and lock ball by performing the following steps:
    - Use a thickness gauge to measure the clearance between the 5th gear and the thrust washer.

5th Gear and Thrust Washer Clearance

Standard: 0.10 - 0.25 mm (0.004 - 0.010 in)

- Measure clearance "A" as shown in the figure.



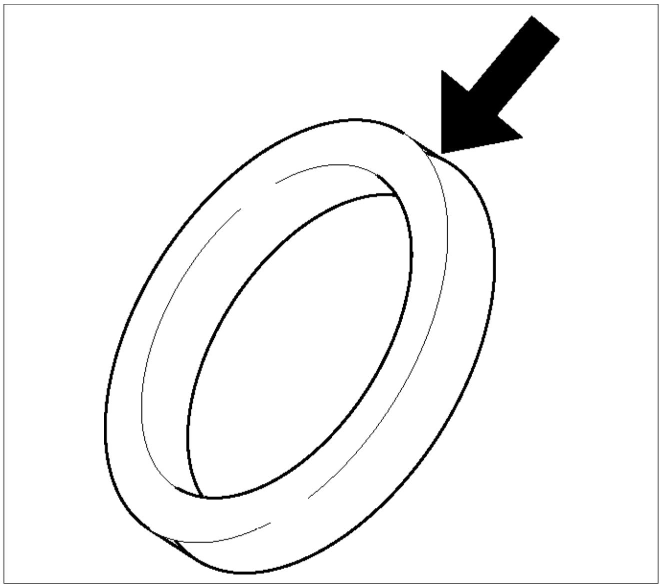
226RS023

- Select an appropriate thrust washer from the chart.
- There are four thrust washer sizes available.

Thrust Washer Availability

Thickness mm (in)	Color Coding	A mm (in)	Clearance mm (in)
7.9 (0.311)	White	8.05 - 8.1 (0.317-0.319)	0.15 - 0.25 (0.006-0.010)
8.0 (0.315)	Yellow	8.1 - 8.2 (0.319-0.323)	0.1 - 0.25 (0.004-0.010)
8.1 (0.319)	Green	8.2 - 8.3 (0.323-0.327)	0.1 - 0.25 (0.004-0.010)
8.2 (0.323)	Blue	8.3 - 8.36 (0.327-0.329)	0.1 - 0.21 (0.004-0.008)

- The thrust washers are color-coded to indicate their thickness, as shown in the figure.

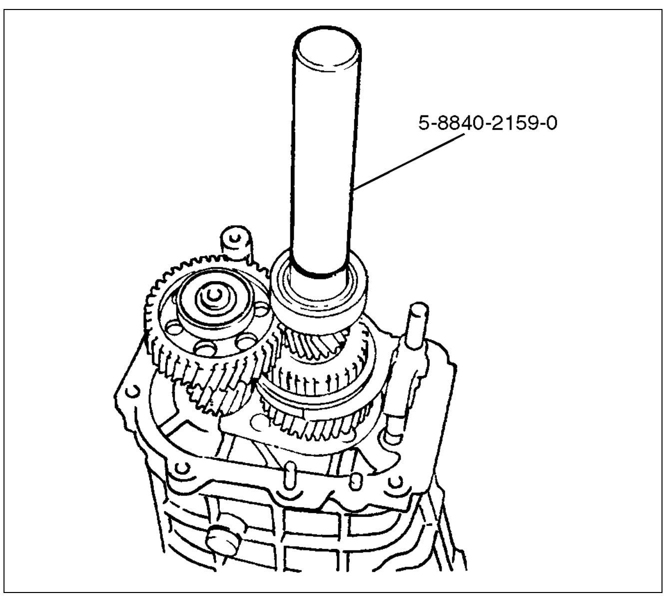


226RS024

- Apply grease to the thrust washer and the lock ball.
- Install the thrust washer and the lock ball.

16. Install the thrust plate and retainer.
17. Install the retainer snap ring, clip, speedometer drive gear and bearing snap ring.
18. Apply engine oil to the bearing inner and outer circumference.

    Use the installer 5-8840-2159-0 to install the ball bearing to the mainshaft.

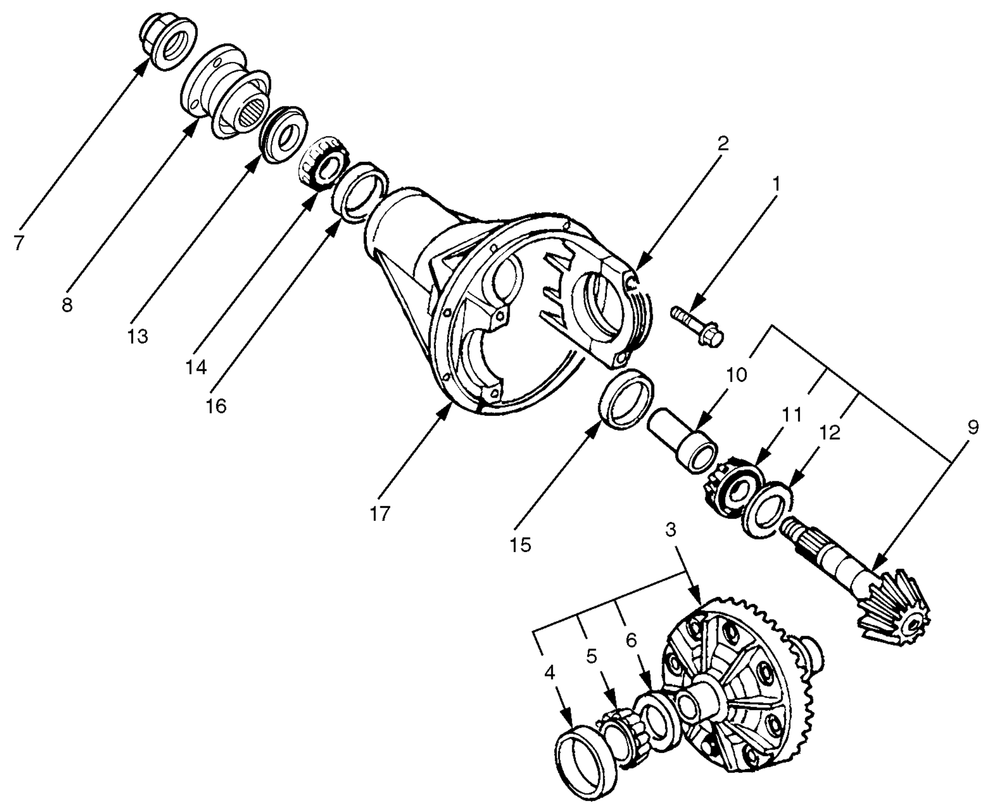


226L100002

19. Install the bearing snap ring.

DIFFERENTIAL ASSEMBLY

Disassemble View



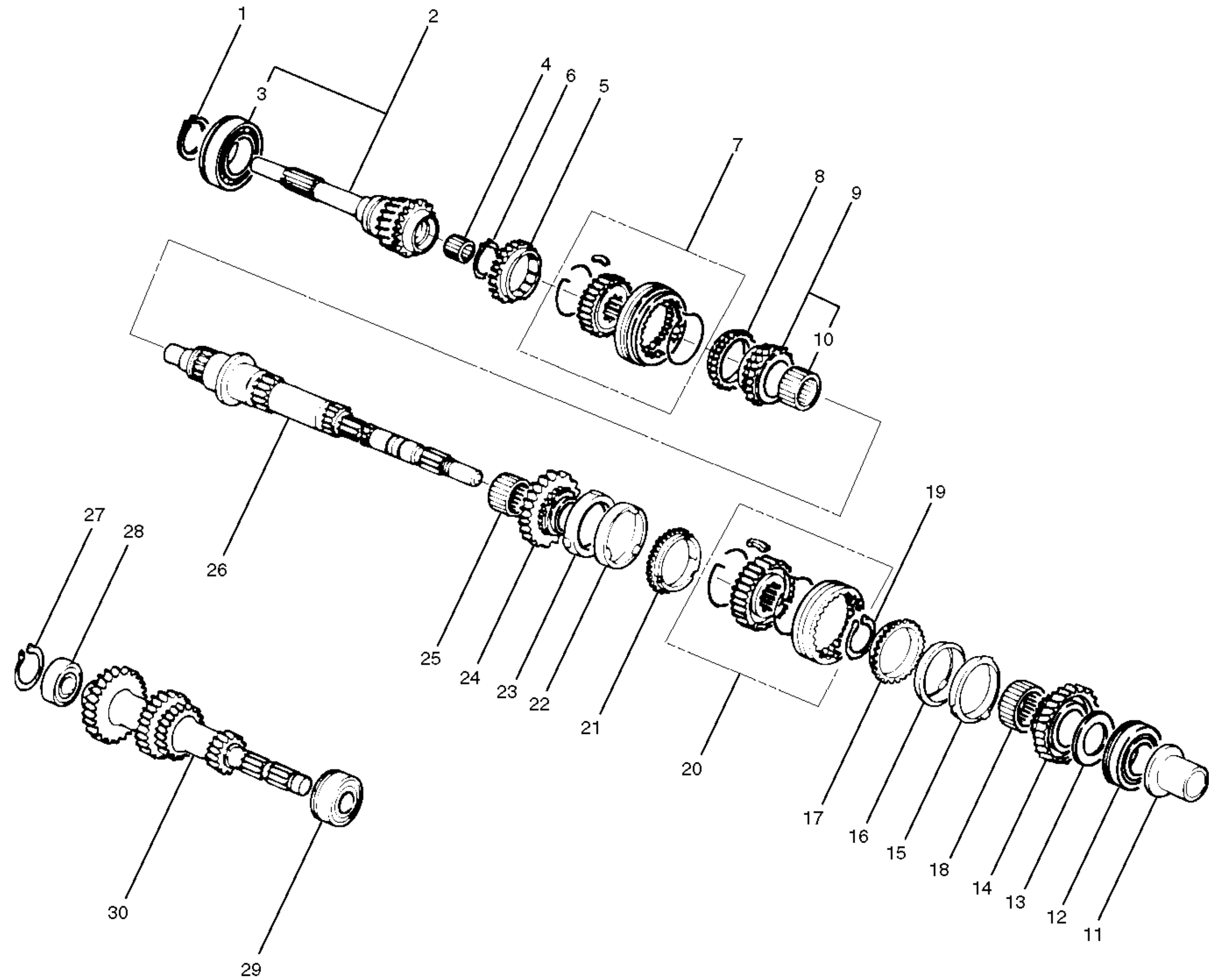
415RY00005

Legend

1. Bolt
2. Bearing Cap
3. Differential Cage Assembly
4. Side Bearing Outer Race
5. Side Bearing
6. Adjust Shim
7. Flange Nut
8. Flange Assembly
9. Drive Pinion Shaft Assembly
10. Collapsible Spacer
11. Inner Bearing
12. Adjust Shim
13. Oil Seal
14. Outer Bearing
15. Inner Bearing Outer Race
16. Outer Bearing Outer Race
17. Differential Carrier

Top Gear Shaft, Main Gear Shaft, and Counter Gear Shaft

Disassmebled View



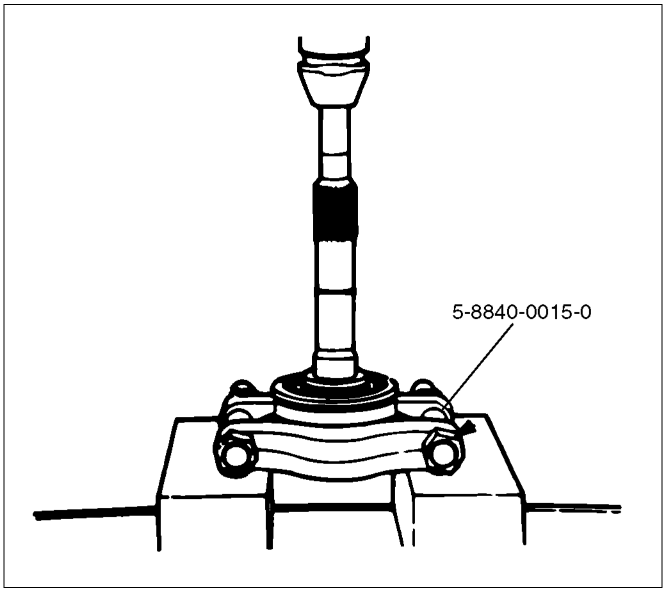
226RS026

Legend

(1) Top Gear Shaft Snap Ring
(2) Top Gear Shaft
(3) Ball Bearing
(4) Needle Bearing
(5) Top Block Ring
(6) Mainshaft Snap Ring
(7) 3rd-4th Synchronizer Assembly
(8) 3rd Block Ring
(9) 3rd Gear
(10) Needle Bearing
(11) Needle Bearing Collar
(12) Mainshaft Ball Bearing
(13) 1st Gear Thrust Bearing
(14) 1st Gear
(15) 1st Inside Ring
(16) 1st Outside Ring
(17) 1st Block Ring
(18) Needle Bearing
(19) Clutch Hub Snap Ring
(20) 1st-2nd Synchronizer Assembly
(21) 2nd Block Ring
(22) 2nd Outside Ring
(23) 2nd Inside Ring
(24) 2nd Gear
(25) Needle Bearing
(26) Mainshaft
(27) Bearing Snap Ring
(28) Front Roller Bearing
(29) Center Roller Bearing
(30) Counter Gear Shaft

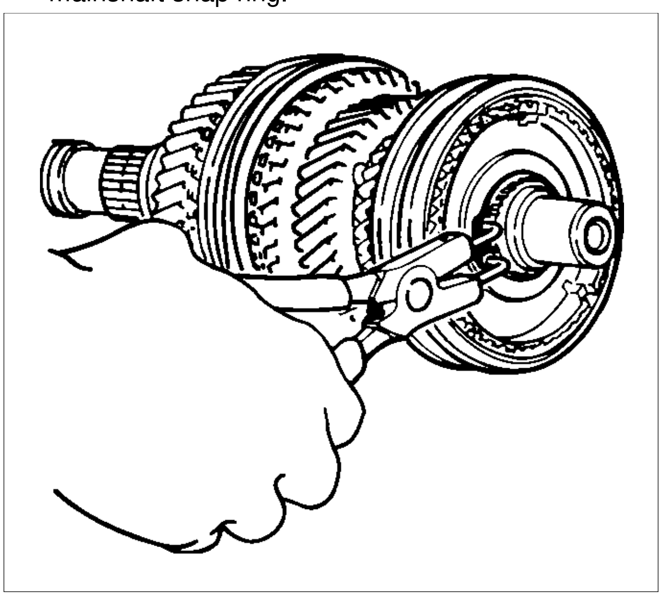
Disassembly

1. Use a pair of snap ring pliers to remove the top gear shaft snap ring.
2. Remove the top gear shaft with ball bearing.
3. Use a bench press and the bearing remover 5-8840-0015-0 to remove the ball bearing.



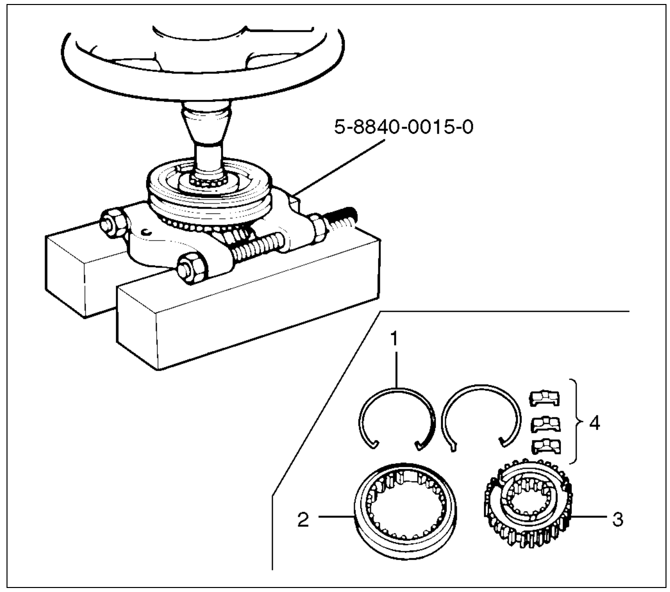
226RW216

4. Remove the needle bearing and top block ring, mainshaft snap ring.
5. Use a pair of snap ring pliers to remove the mainshaft snap ring.


226RS008

6. Use a bench press and the bearing remover 5-8840-0015-0 to remove the 3rd-4th synchronizer assembly as a set.

   Disassemble the synchronizer assembly.

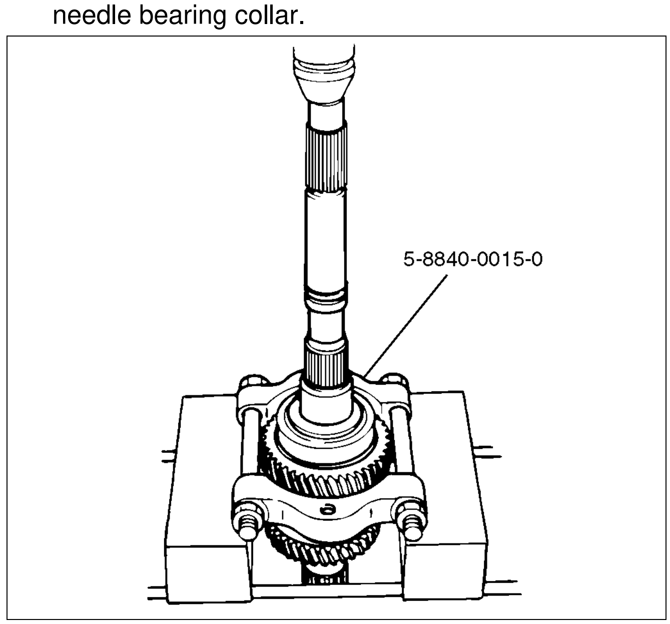


226RW217

Legend

(1) Springs
(2) Sleeve
(3) Clutch Hub
(4) Inserts

7. Remove the 3rd block ring, 3rd gear, and needle bearing.
8. Use a bench press and the bearing remover 5-8840-0015-0 to remove the 1st gear together with the mainshaft ball bearing, 1st gear thrust bearing, and needle bearing collar.

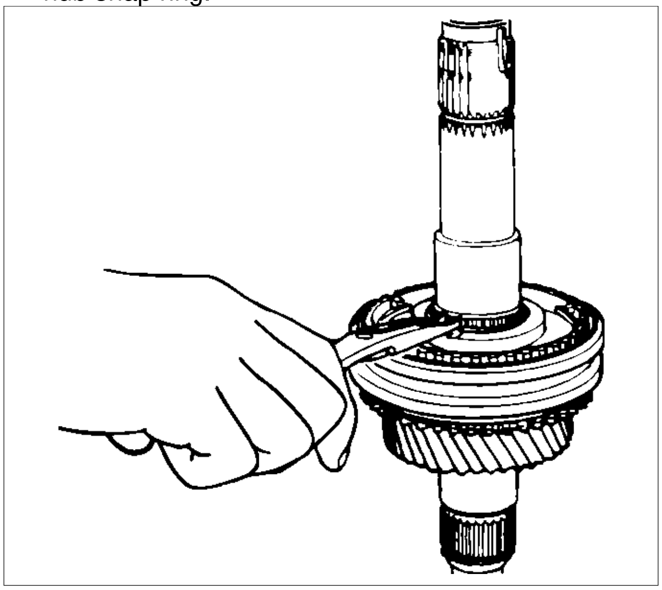


226RW218

9.Disassemble the 1st inside ring, 1st outside ring, and 1st block ring.

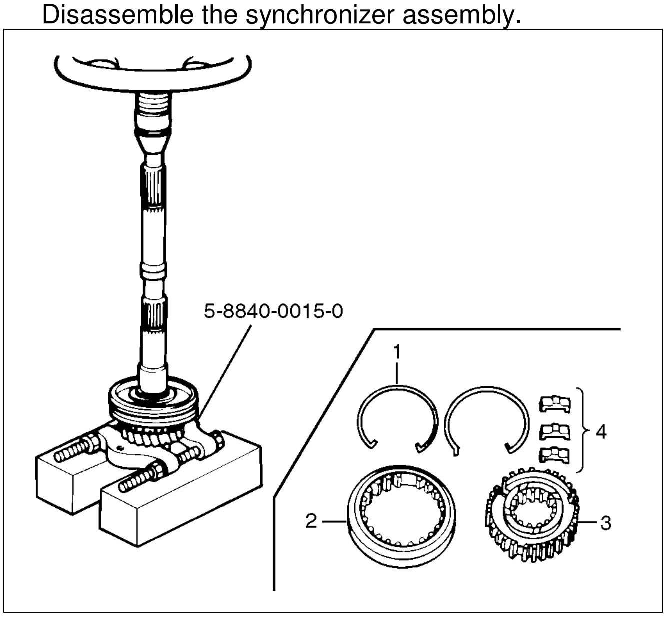
10.Remove the needle bearing.

11.Use a pair of snap ring pliers to remove the clutch hub snap ring.



226RS031

12.Use the bench press and the bearing remover 5-8840-0015-0 to remove the 2nd gear together with the 1st-2nd synchronizer assembly, 2nd block ring, 2nd outside ring, and the inside ring.
Disassemble the synchronizer assembly.

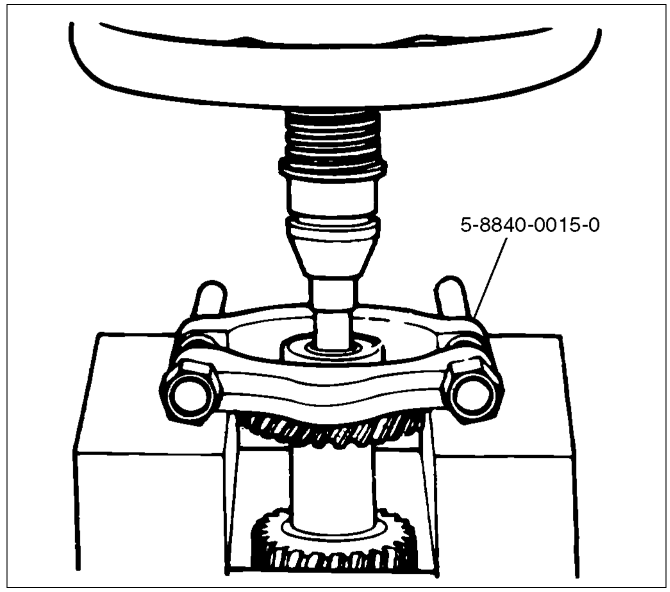


226RW220

Legend

(1) Springs
(2) Sleeve
(3) Clutch Hub
(4) Inserts

13. Remove the needle bearing from mainshaft.
14. Remove the bearing snap ring.
15. Remove the front roller bearing by performing the following steps.
    - Remove the ring, outer race and bearing assembly by using a bench press and remover 5-8840-0015-0.
    - Remove the inner race by using a bench press and remover 5-8840-0015-0.



226RW219

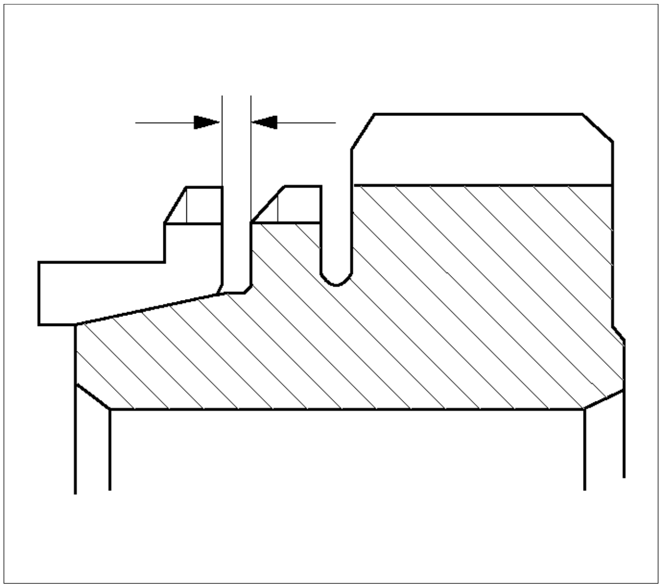
16. Remove the center roller bearing from the counter gear shaft.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Block Ring and Dog Teeth Clearance

- Use a thickness gauge to measure the clearance between the block ring and the dog teeth.



226RS035

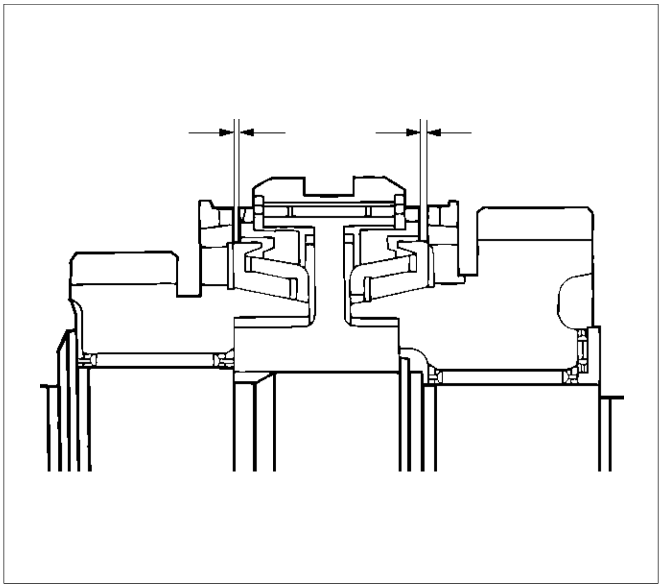
If the measured value exceeds the specified limit, the block ring must be replaced.

Block Ring and Dog Teeth Clearance

Standard	Limit
1.5 mm (0.059 in)	0.8 mm (0.031 in)

1st-2nd Synchronizer (3-CONE)

- Use a thickness gauge to measure the clearance between the block ring and the dog teeth.



226RS036

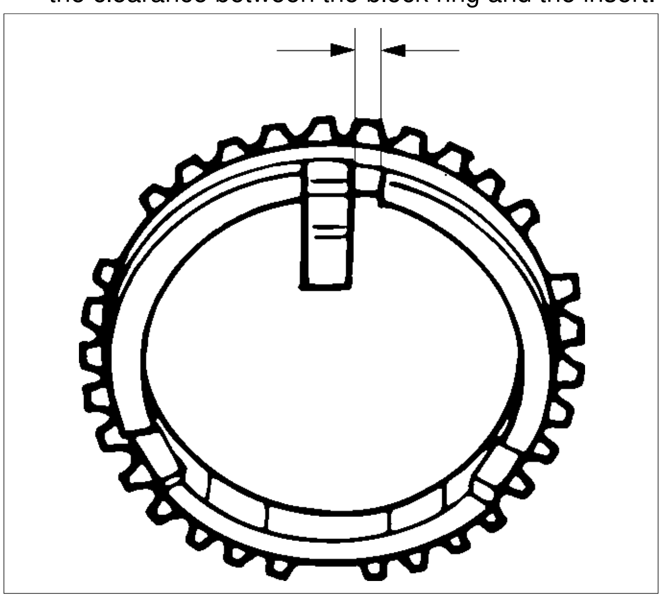
If the measured value exceeds the specified limit, the 1st-2nd synchronizer assembly must be replaced.

Block Ring and Dog Teeth Clearance

Standard	Limit
1.5 mm (0.059 in)	0.8 mm (0.031 in)

Block Ring and Insert Clearance

- Use a vernier caliper or thickness gauge to measure the clearance between the block ring and the insert.



226RS037

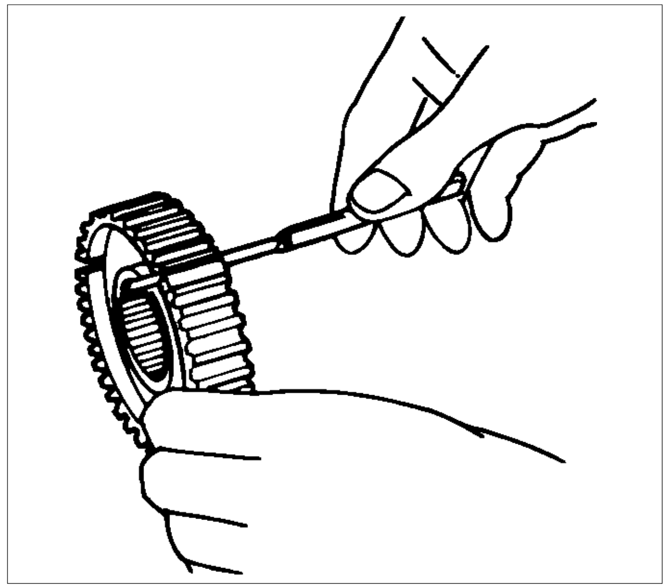
If the measured value exceeds the specified limit, the block ring and the insert must be replaced.

Block and Insert Clearance

	Standard	Limit
3rd-4th	3.46 - 3.76 mm (0.136 - 0.148 in)	4.0 mm (0.157 in)
1st-2nd	3.86 – 4.16 mm (0.152 - 0.164 in)	4.9 mm (0.193 in)
Rev.5th	3.59 - 3.91 mm (0.141 - 0.154 in)	4.1 mm (0.161 in)

Clutch Hub and Insert Clearance

- Use a thickness gauge to measure the clearance between the clutch hub and the insert.



226RS038

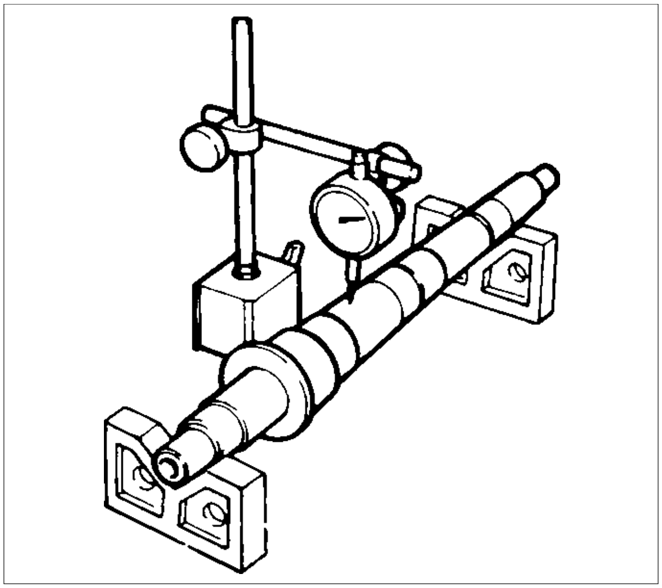
If the measured value exceeds the specified limit, the clutch hub and the insert must be replaced.

Clutch Hub and Insert Clearance

	Standard	Limit
1st-2nd 3rd-4th	0.01 – 0.21 mm (0.0004 - 0.0083 in)	0.3 mm (0.012 in)
Rev-5th	0.09 – 0.31 mm (0.0035 - 0.0122 in)	0.4 mm (0.016 in)

Mainshaft Run-out

- Install the mainshaft to V-blocks.
- Use a dial indicator to measure the mainshaft central portion run-out.



226RS039

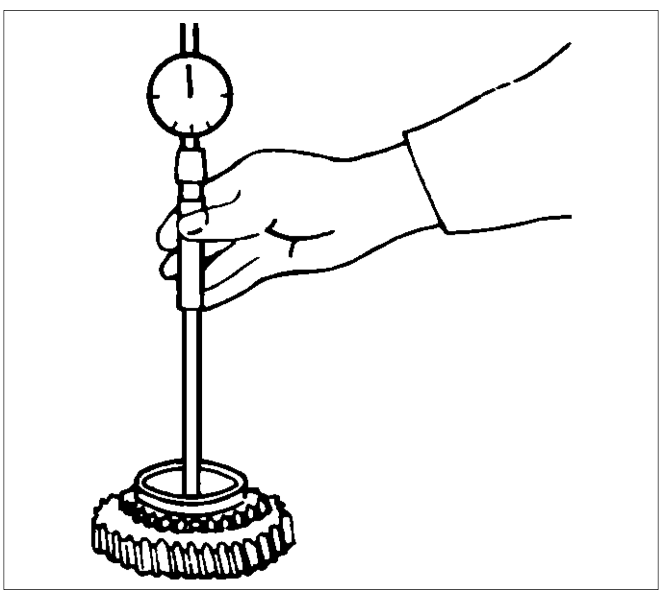
If the measured mainshaft run-out exceeds the specified limit, the mainshaft must be replaced.

Mainshaft Run-out

Limit: 0.05 mm (0.0020 in)

Gear Inside Diameter

- Use an inside dial indicator to measure the gear inside diameter.



226RS040

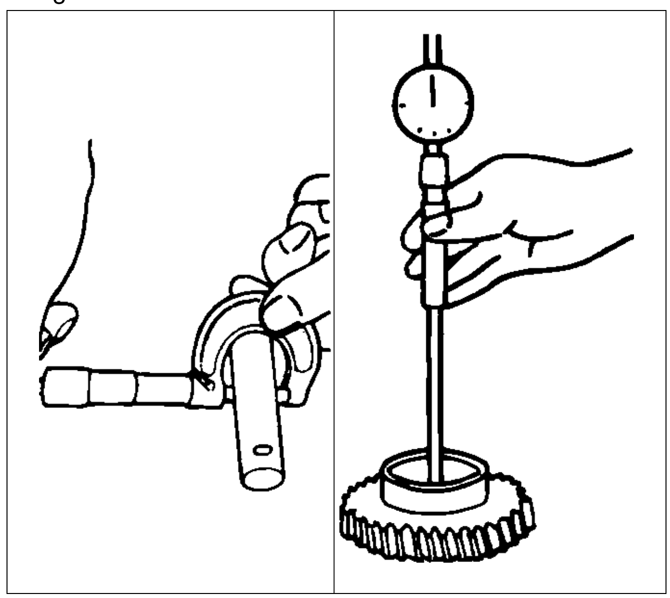
If the measured value is less than the specified limit, the gear must be replaced.

Gear Inside Diameter

	Standard	Limit
1st 3rd	45.000 - 45.013 mm (1.771 - 1.772 in)	45.100 mm (1.776 in)
2nd	52.000 - 52.013 mm (2.047 - 2.048 in)	52.100 mm (2.051 in)
Rev.	48.000 - 48.013 mm (1.889 - 1.890 in)	48.100 mm (1.894 in)
5th	32.000 - 32.013 mm (1.259 - 1.260 in)	32.100 mm (1.246 in)

Reverse Idler Gear and Idler Gear Shaft Clearance

- Use a micrometer to measure the idler gear shaft diameter.
- Use an inside dial indicator to measure the idler gear inside diameter.



226RS041

- Calculate the idler gear and idler gear shaft clearance.

  Idler gear inside diameter-idler gear shaft diameter = idle gear and idler gear shaft clearance.

  If the measured value exceeds the specified limit, the idle gear and/or the idler gear shaft must be replaced

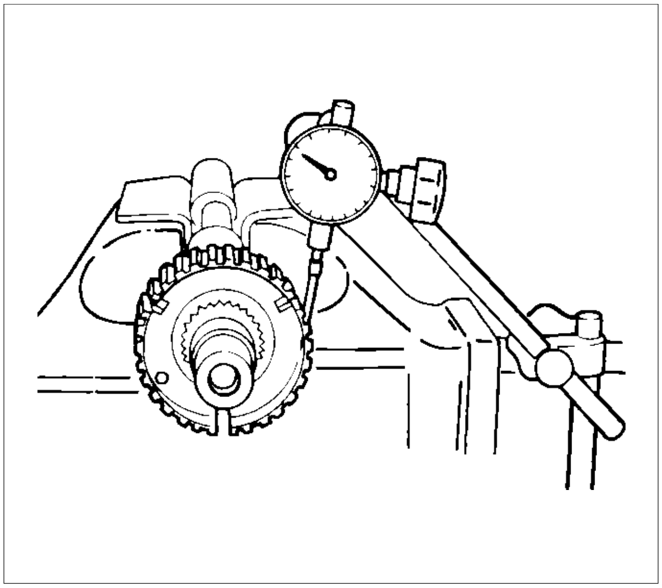
  Idler Gear and Idler Gear Shaft Clearance

  Standard: 0.041 - 0.074 mm (0.0016 -0.0029 in)

  Limit: 0.150 mm (0.0059 in)

Clutch Hub Spline Play

- Set a dial indicator to the clutch hub which requires measuring.



226RS042

- Move the clutch hub as far to the right and left as possible.

  Note the dial indicator reading.

  If the measured value exceeds the specified limit, the clutch hub must be replaced.

Clutch Hub Spline Play

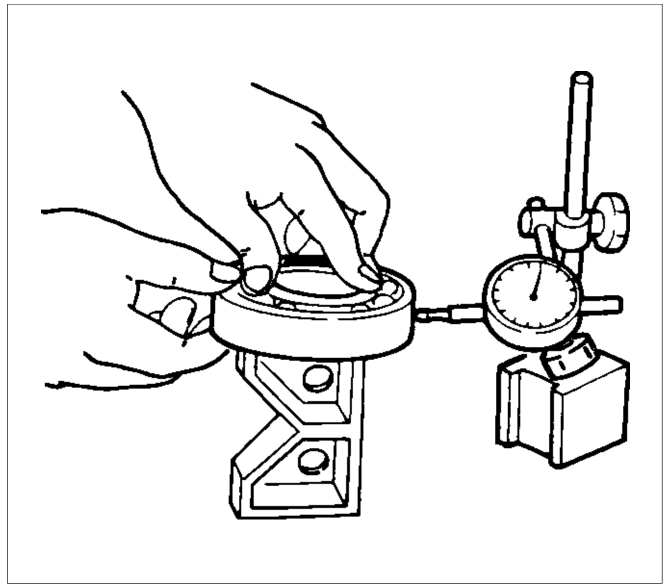
	Standard	Limit
1st-2nd 3rd-4th	0 - 0.1 mm (0 - 0.004 in)	0.2 mm (0.008 in)
Rev. 5th	0 - 0.2 mm (0 - 0.008 in)	0.3 mm (0.012 in)

Ball Bearing Play

- Use a dial indicator to measure the ball bearing play.

  Ball Bearing Play

  Limit: 0.2 mm (0.008 in)

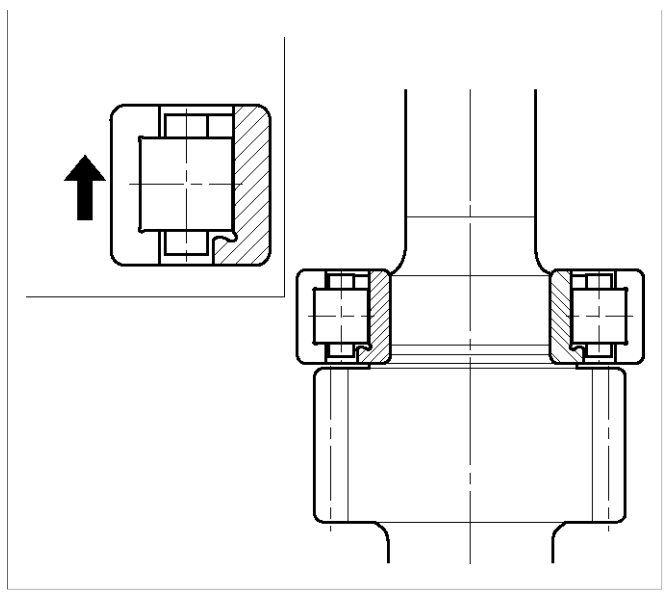


226RS043

Reassembly

1. Install the center roller bearing to counter gear shaft.
   - Apply engine oil to the bearing inner and outer circumferences.
   - Install the roller bearing in the proper direction.

NOTE: Check that the outer race moves only in the direction of the arrow.

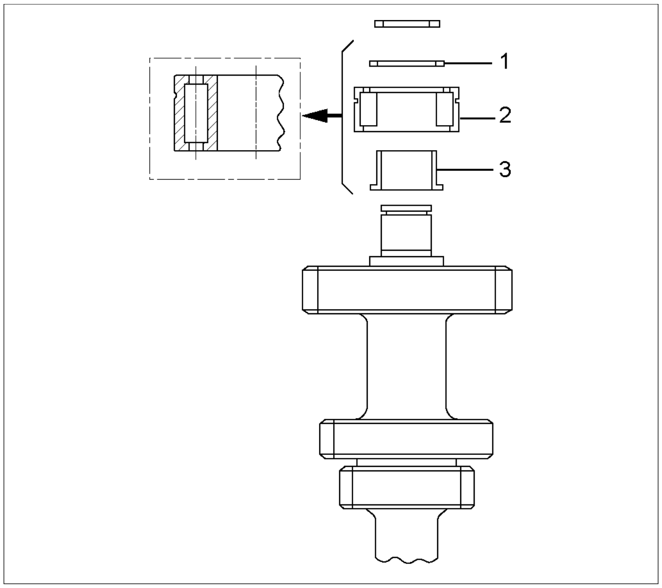


226RS044

2. Install the front roller bearing by performing the following steps.
   - Use bearing installer 5-8840-2194-0 to install the front roller bearing inner race to the counter gear shaft.
   - Install the outer race and roller assembly.

     The snap ring groove must be facing the transmission front side.

- Use bearing installer 5-8840-2194-0 to install the ring.



RTW57BSH000101

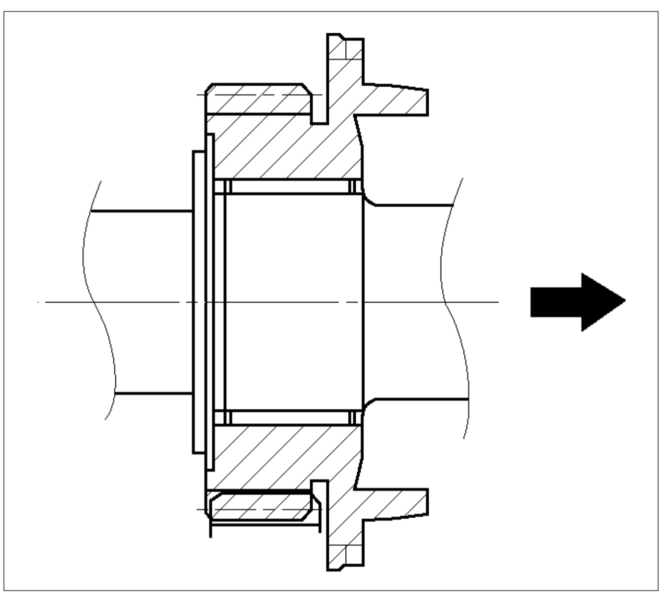
Legend

(1) Ring
(2) Outer Race and Roller Assembly
(3) Inner Race

3. Install the bearing snap ring to the counter gear shaft.
4. Apply engine oil to the needle bearing and the 2nd gear thrust surfaces.

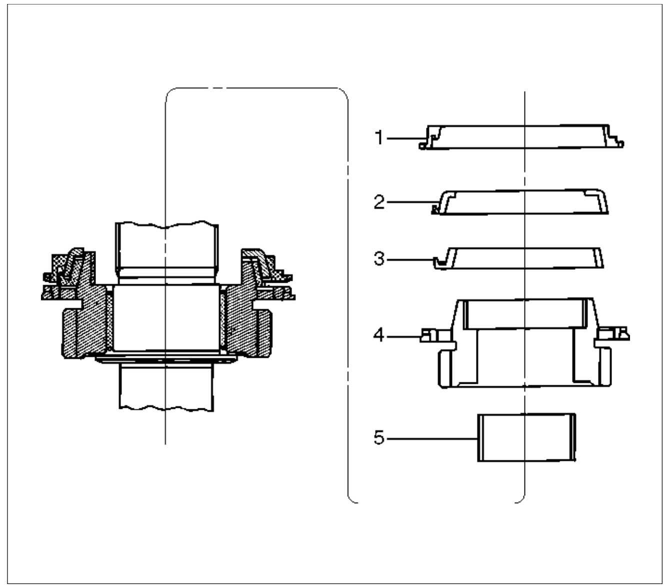
   Install the needle bearing and the 2nd gear to the mainshaft.

   The 2nd gear dog teeth must be facing the transmission rear side.



226RS046

5. Assemble the 2nd inside ring, 2nd outside ring, and 2nd block ring on the 2nd gear.
   - Apply engine oil to the synchronizer ring friction surfaces.

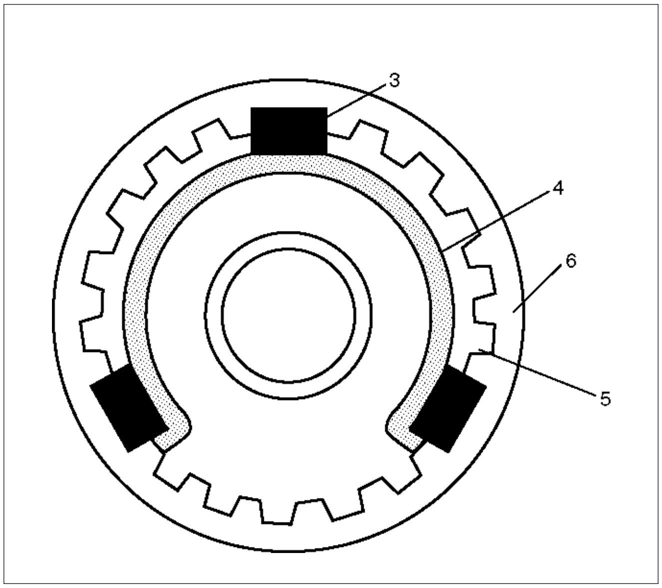


226RS047

Legend

(1) Block Ring
(2) Outside Ring
(3) Inside Ring
(4) 2nd Gear
(5) Needle Bearing

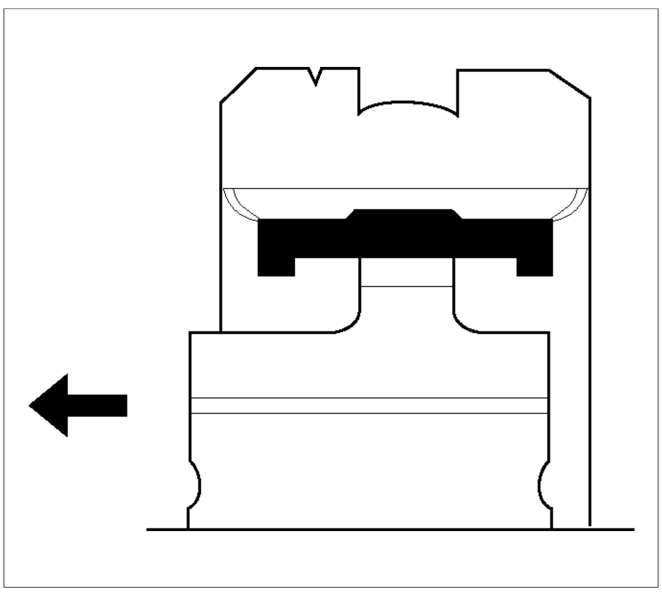
6. Assemble 1st-2nd synchronizer assembly by performing the following steps:
   1. Check that the inserts (3) fit snugly into the clutch hub (5) insert grooves.
   2. Check that the inserts springs (4) are fitted to the inserts as shown in the illustration.
   3. Check that the clutch hub (5) and the sleeve (6) slide smoothly.



266RS049

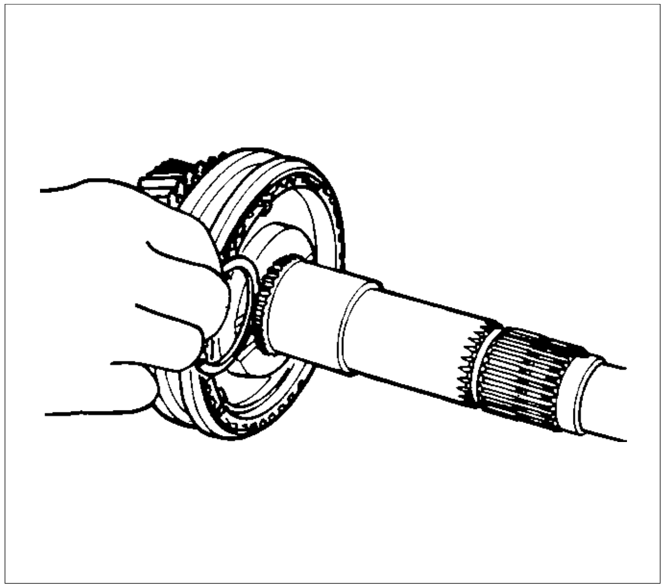
7. Install the synchronizer assembly to the mainshaft.

   The clutch hub face with the heavy boss must be facing the 2nd gear side.



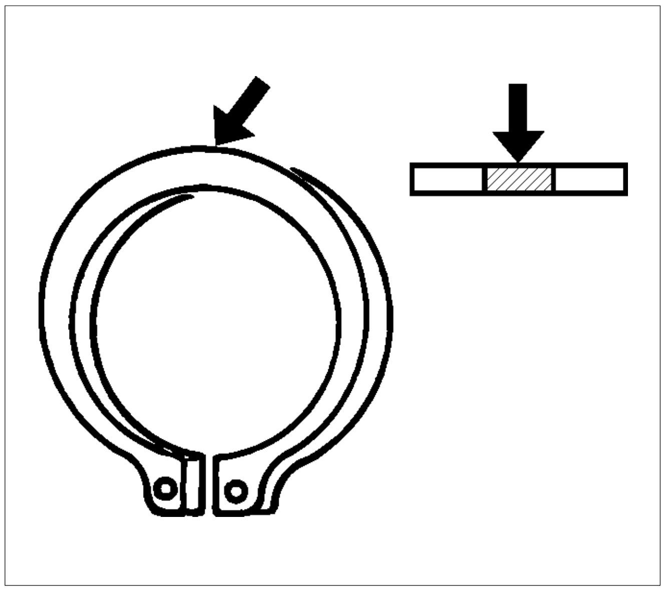
226RS048

8. Install the clutch hub snap ring by performing the following steps:
   - Select the snap ring which will provide the minimum clearance between the 1st-2nd clutch hub and the snap ring.



226RS050

- There are three snap ring sizes available.
- The snap rings are color-coded to indicate their thickness as shown in the figure.



226RS021

Clutch Hub and Snap Ring Clearance

Standard: 0 - 0.1 mm (0 - 0.004 in)

Snap Ring Availability

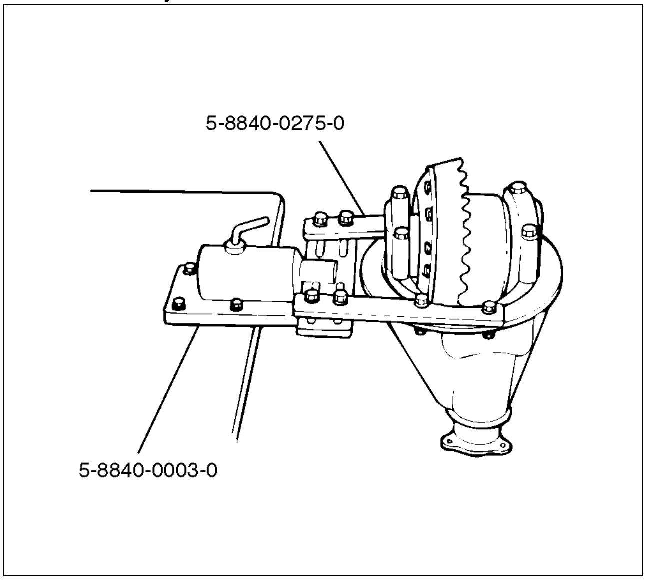
Thickness	Color Coding
1.80 mm (0.071 in)	White
1.85 mm (0.073 in)	Yellow
1.90 mm (0.075 in)	Blue

- Use a pair of snap ring pliers to install the snap ring to the mainshaft.

  The snap ring must be fully inserted into the mainshaft snap ring groove.

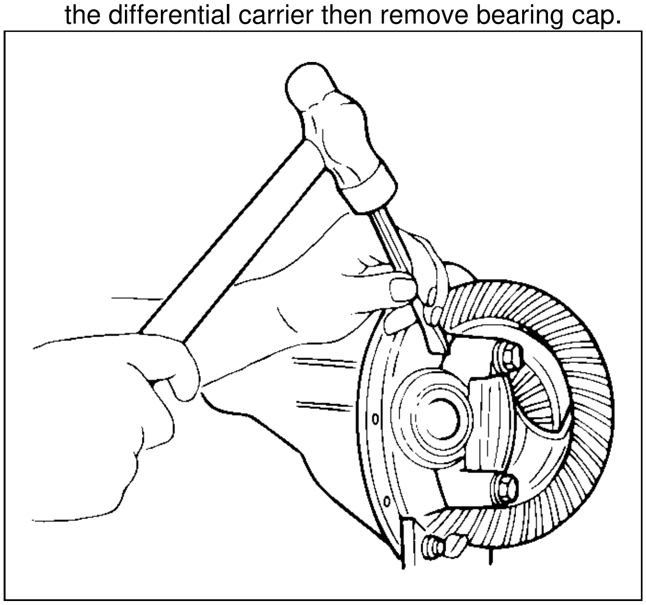
Disassembly

1. Using holding fixture 5-8840-0275-0 and holding fixture base 5-8840-0003-0, fix the differential assembly to the bench.



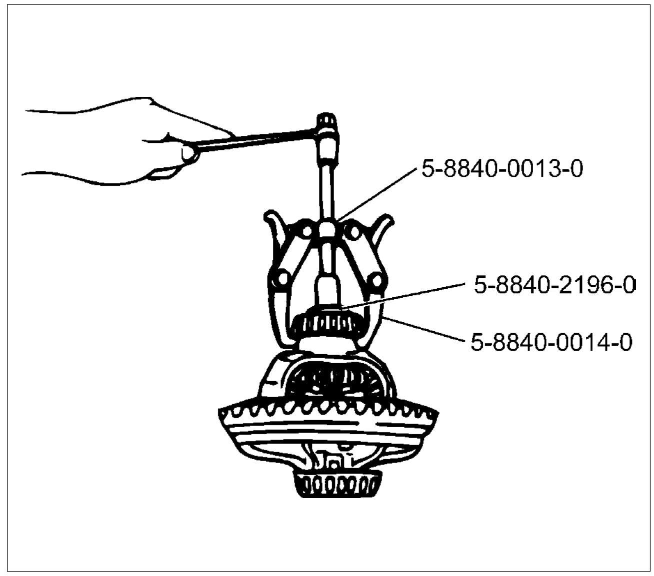
425L100007

2. Apply a setting mark to the side bearing cap and the differential carrier then remove bearing cap.


425RS009

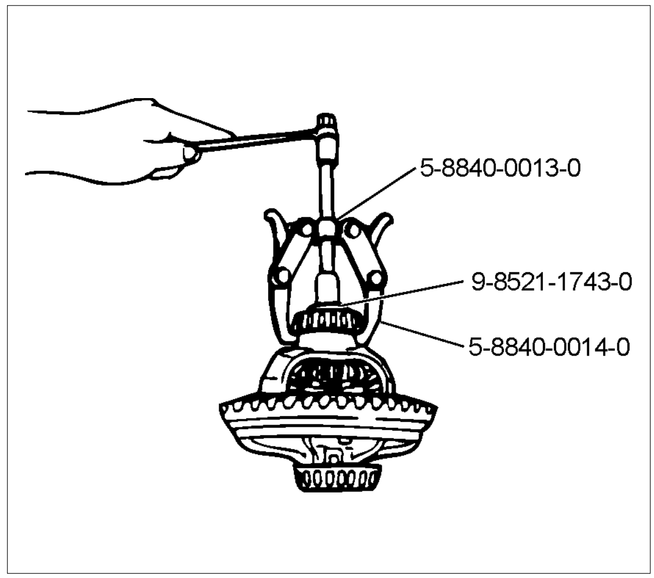
3. Remove differential cage assembly.
4. Remove side bearing outer race. After removal, keep the right and left hand side bearing assemblies separate to maintain inner and outer race combinations.
5. Remove side bearing by using remover 5-8840-0013-0, 5-8840-0014-0, adapter 5-8840-2196-0 (for ϕ220mm) and 9-8521-1743-0 (for ϕ194mm).

ϕ220mm



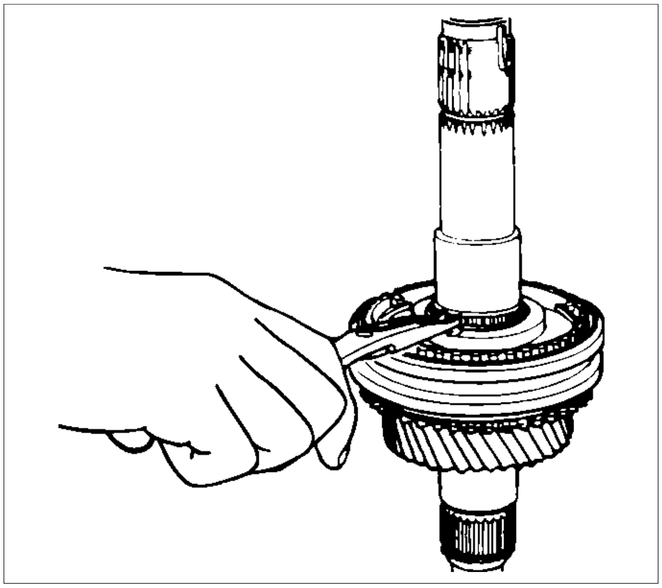
RTW54BSH000101

ϕ194mm



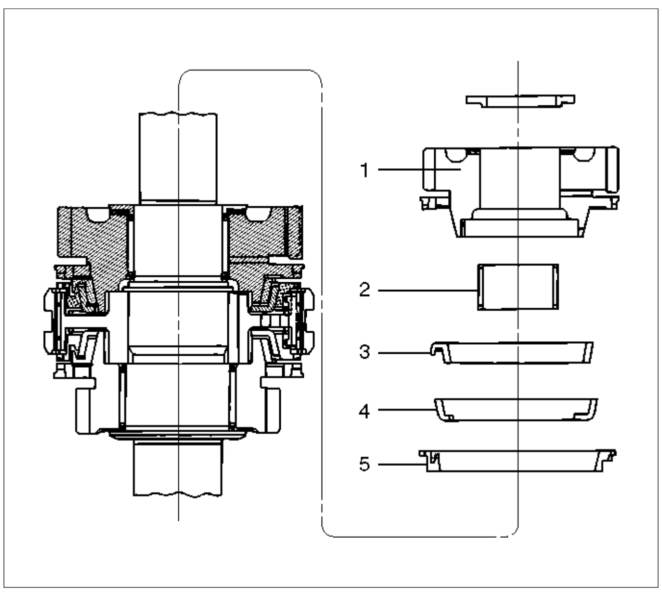
RTW54BSH000201

6. Note the thickness and position of the shims then remove adjust shim.
7. Remove the flange nut by using pinion flange holder 5-8840-0133-0 after raising up its staked parts completely.



226RS031

9. Install the needle bearing, 1st block ring, 1st outside ring , 1st inside ring, and 1st gear.
   - Apply engine oil to the needle bearing, 1st gear thrust surfaces and synchronizer ring friction surfaces.
   - The 1st gear dog teeth must be facing the transmission front side.



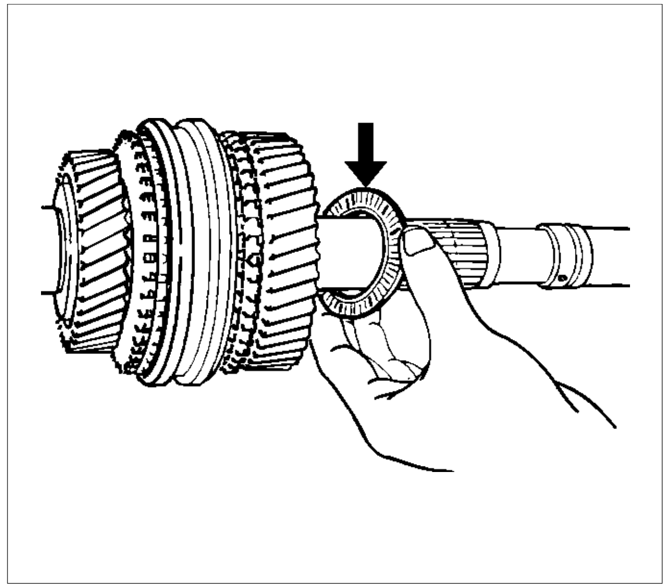
226RS053

Legend

(1) 1st Gear
(2) Needle Bearing
(3) Inside Ring
(4) Outside Ring
(5) Block Ring

10. Install the 1st gear thrust bearing and the race to the main shaft.

    The thrust bearing side must be facing the transmission front side.



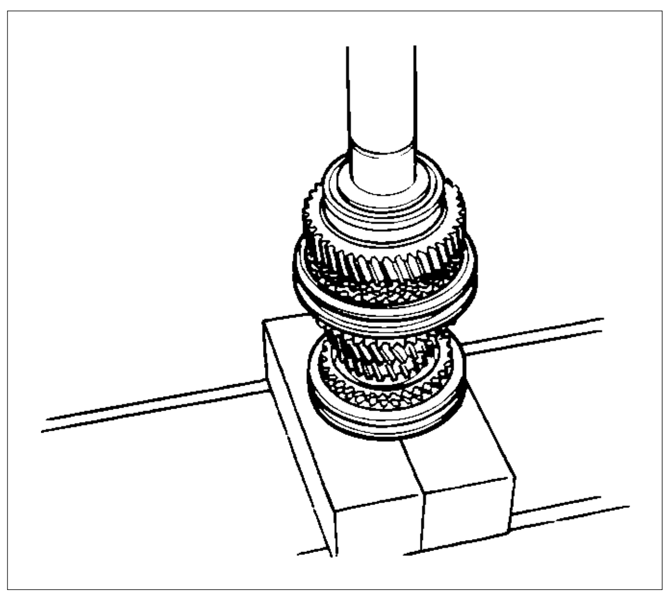
226RS054

11. Apply engine oil to the mainshaft ball bearing and the mainshaft.

    Install the ball bearing and needle bearing collar to the mainshaft.

    The ball bearing snap ring groove must be facing the transmission rear side.

    Use a bench press and installer 9-8522-1165-0 to slowly force the collar into place.

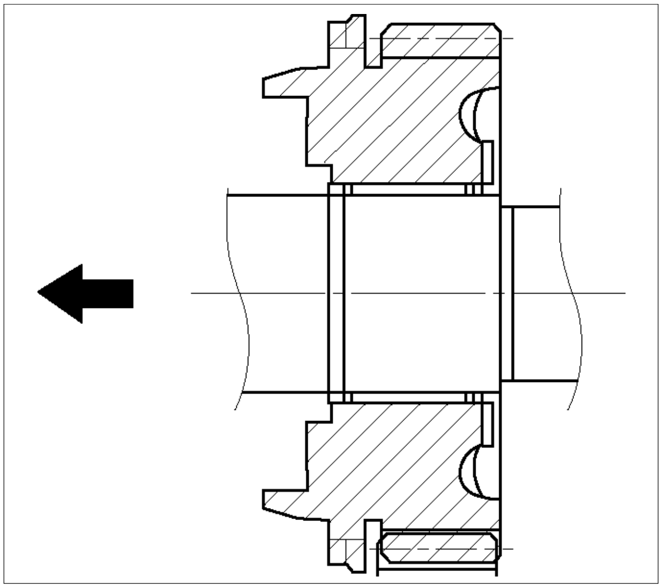


226RS055

12. Apply engine oil to the needle bearing and the 3rd gear thrust surfaces.

    Install the needle bearing and the 3rd gear to the mainshaft.

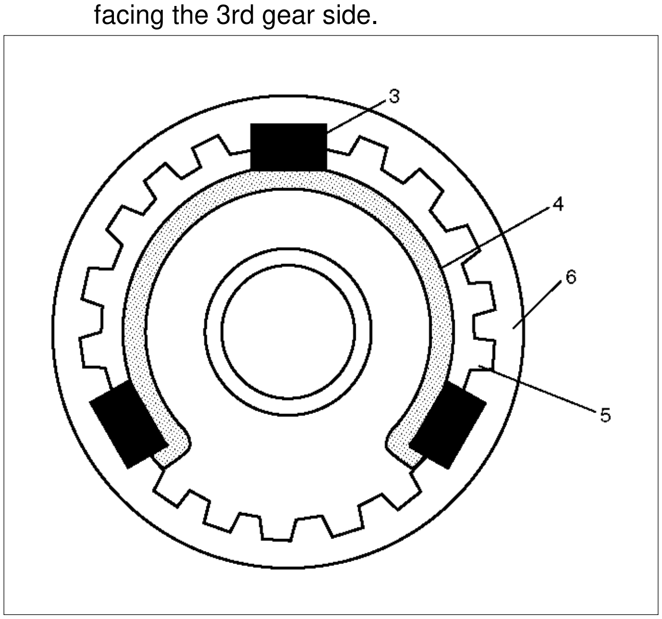
    The 3rd gear dog teeth must be facing the transmission front side.



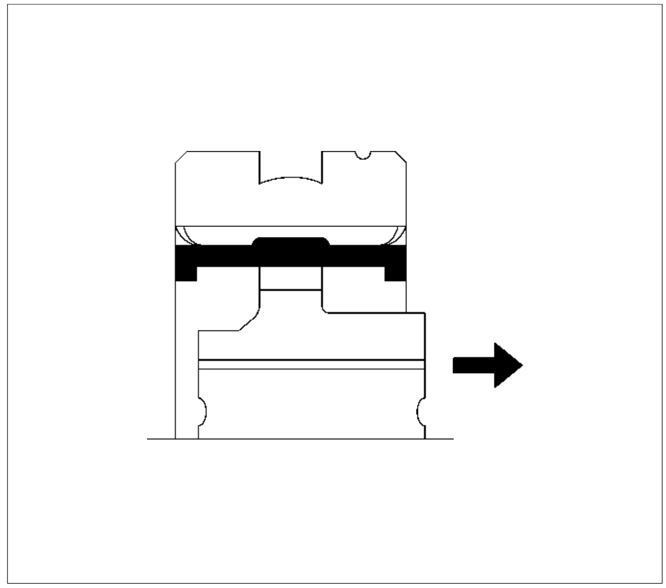
226RS056

13. Install the 3rd block ring.
14. Check and install the 3rd-4th synchronizer assembly using the following steps:
    1. Check that the inserts (3) fit snugly into the clutch hub insert grooves.
    2. Check that the insert springs (4) are fitted to the inserts, as shown in the illustration.
    3. Check that the clutch hub (5) and the sleeve (6) slide smoothly.
    4. Install the synchronizer assembly to the mainshaft.

    The clutch hub face with the heavy boss must be facing the 3rd gear side.



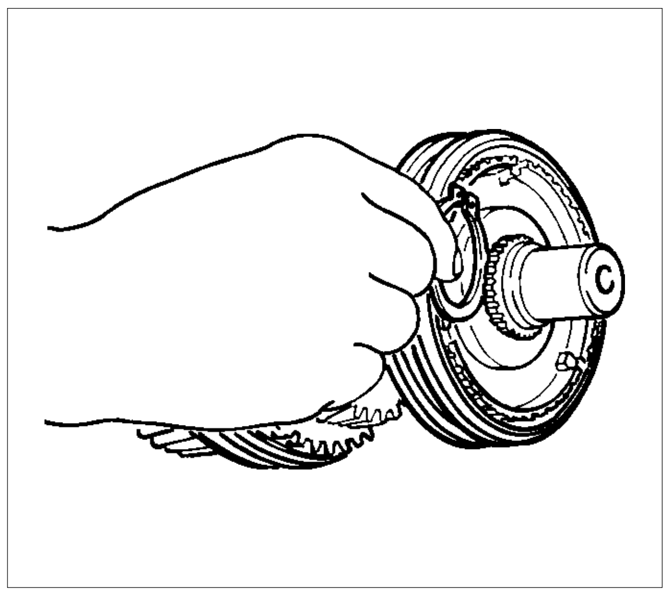
226RS049



226RW221

15. Select and install mainshaft snap ring using the following instructions:

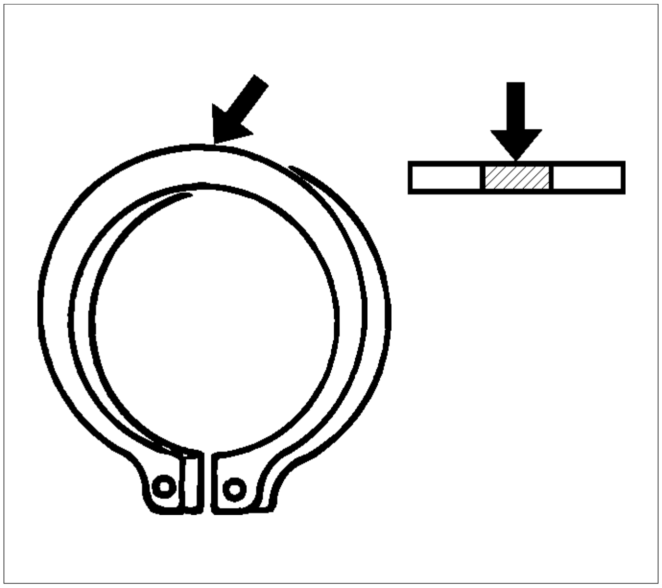
    Select the snap ring which will provide the minimum clearance between the 3rd-4th clutch hub and the snap ring.



226RS058

There are three snap ring sizes available.

The snap rings are color-coded to indicate their thickness as shown in the figure.



226RS021

Clutch Hub and Snap Ring Clearance

Standard: 0 - 0.1 mm (0 - 0.004 in)

Snap Ring Availability

Thickness	Color Coding
1.80 mm (0.071 in)	White
1.85 mm (0.073 in)	Yellow
1.90 mm (0.075 in)	Blue

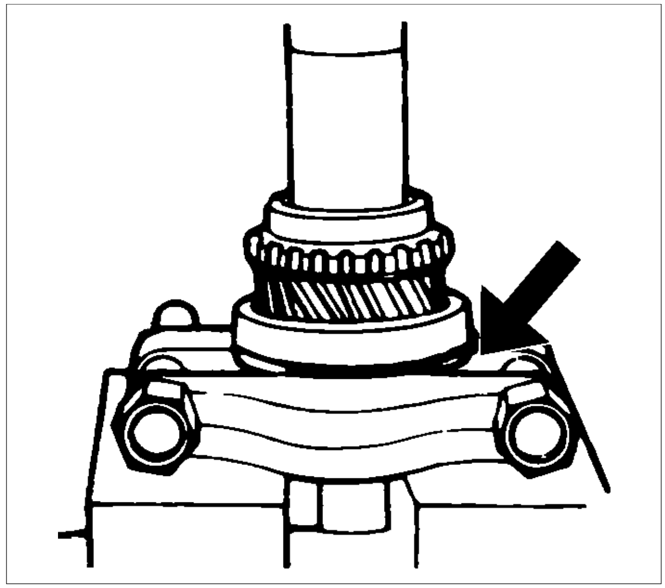
- Use a pair of snap ring pliers to install the snap ring to the mainshaft.

  The snap ring must be fully inserted into the mainshaft snap ring groove.

16. Install the top block ring.

    Apply grease to the needle bearing inner and outer circumferences and install the needle bearing in the top gear shaft.

17. Use a bench press to install the top gear shaft ball bearing to the top gear shaft.



226RS059

The snap ring groove of the ball bearing must be facing the transmission front side.

18. Use a pair of snap ring pliers to install the top gear shaft snap ring to the top gear shaft.

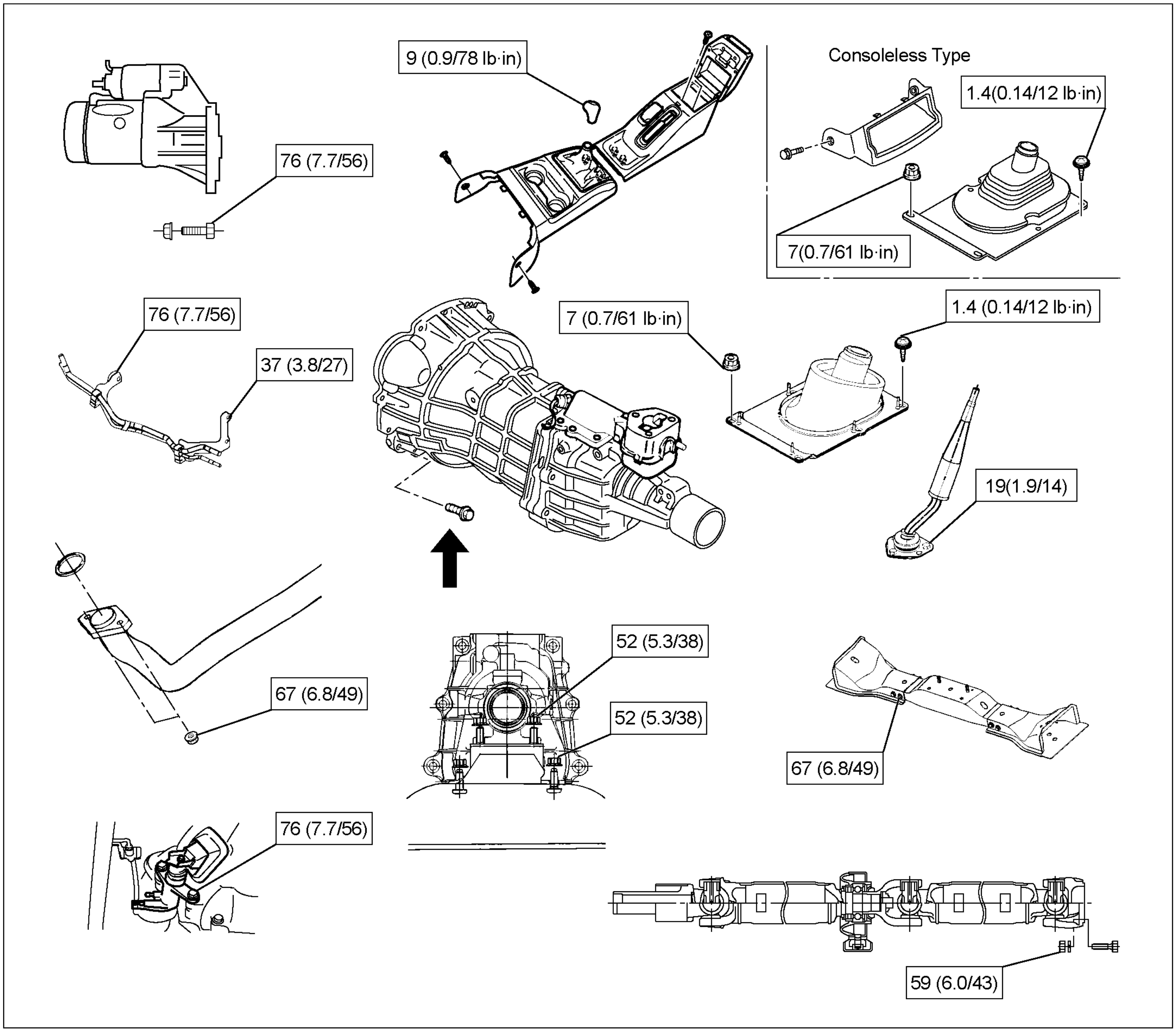
Main Data and Specifications

General Specifications

		MUA 5G	MUA 5H	MUA 5S
Transmission type		Fully synchronized forward and reverse gears		
Control method		Remote control with the gear shift lever on the floor.		
Gear ratio: Transmission	1st	4.008	4.008	4.357
	2nd	2.301	2.301	2.502
	3rd	1.427	1.427	1.501
	4th	1.000	1.000	1.000
	5th	0.828	0.744	0.809
	Rev.	3.651	3.651	3.970
Transmission oil capacity		2.95 lit. (3.12 US qt)		
Type of lubricant		Engine oil: Refer to the chart in "SECTION 0"		

Torque Specifications

N·m (kgf·m/lb·ft)

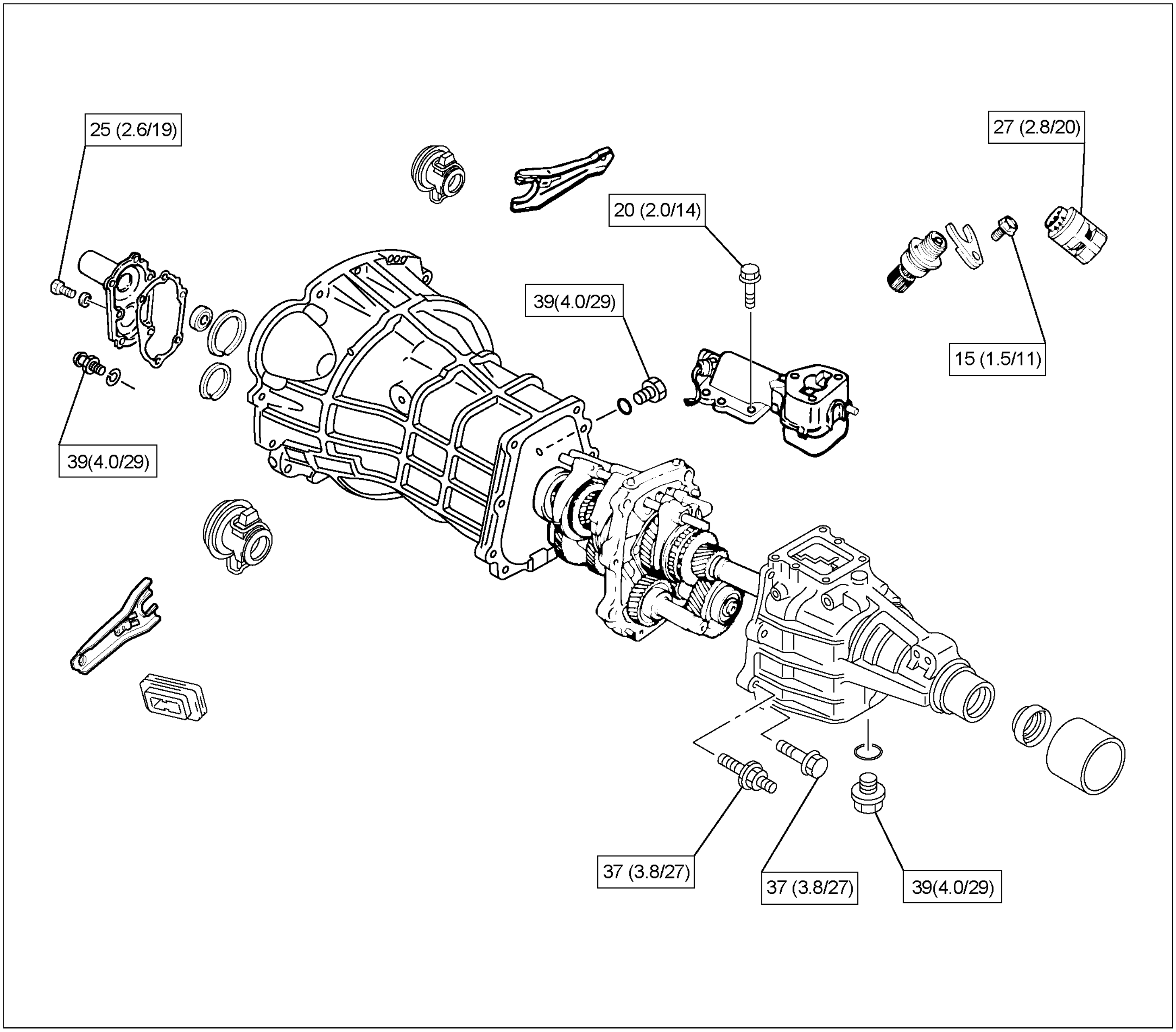


RTW77BLF003401

About arrow mark, refer to Transmission (MUA) Installation in this section.

Torque Specifications (Cont'd)

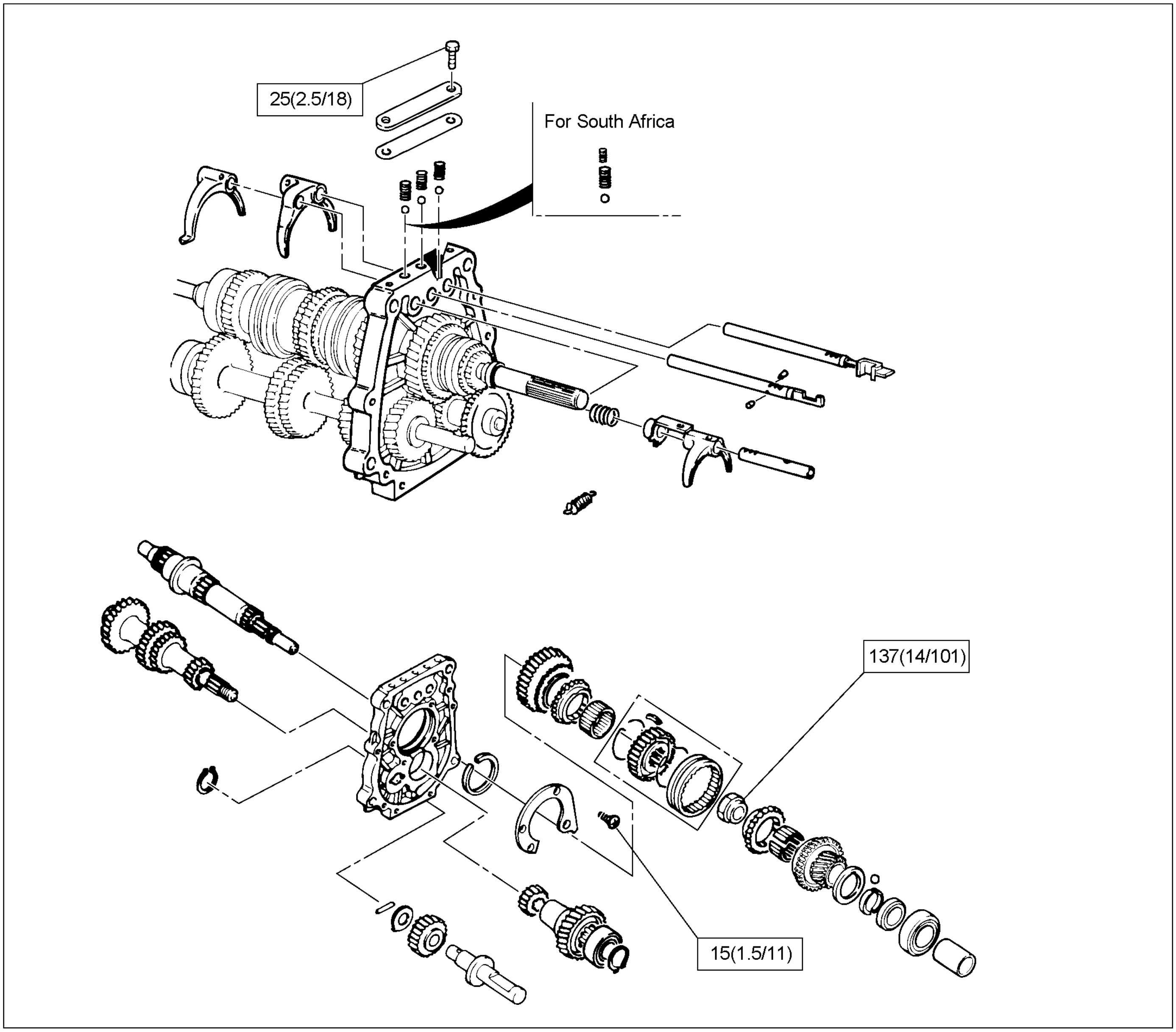
N·m (kgf·m/lb·ft)



RTW77BLF003501

Torque Specifications (Cont'd)

N·m (kgf·m/lb·ft)



RTW57BLF000301

TROUBLESHOOTING

1. ABNORMAL NOISE

1) NOISY IN NEUTRAL

Checkpoint		Trouble Cause	Countermeasure
Gear oil	NG	Insufficient or improper gear oil	Replenish or replace the gear oil
OK			
Flywheel pilot bearing	NG	Worn flywheel pilot bearing	Replace the flywheel pilot
OK			
Bearings (Mainshaft, countershaft, and transfer shaft)	NG	Worn or broken bearing(s)	Replace the bearing(s)
OK			
Gears (Mainshaft, countershaft, reverse idler gear and transfer gears)	NG	Worn or scuffed gear tooth contact surfaces	Replace the gear(s)
OK			
Mainshaft splines Synchronizer clutch hub splines	NG	Worn splines	Replace the main shaft and the synchronizer clutch hub
OK			
Transmission	NG	Transmission misalignment	Realign the transmission

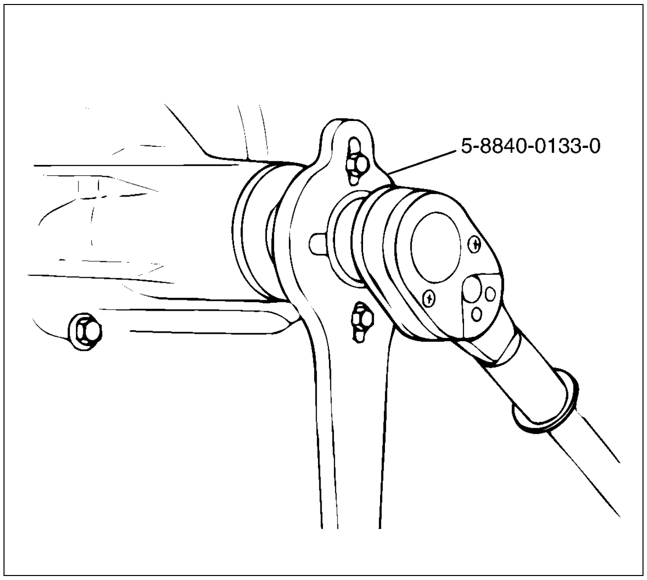
2) NOISY OPERATION

Checkpoint		Trouble Cause	Countermeasure
Gear oil (Metallic rattling)	NG	Insufficient or improper engine oil	Replenish or replace the gear oil
OK			
Bearings (Hissing, thumping or bumping)	NG	Worn or broken bearing(s)	Replace the bearing(s)
OK			
Gears (Growling, humming, or grinding)	NG	Worn, chipped, or cracked gear(s)	Replace the gear(s)
OK			
Gears (Squealing at high speeds)	NG	Free running gears seizing on the thrust face or the inner face	Replace the gear(s)
OK			
Gears (Gear whining)	NG	Lack of backlash between meshing gears	Replace the gear(s)

2. HARD SHIFTING

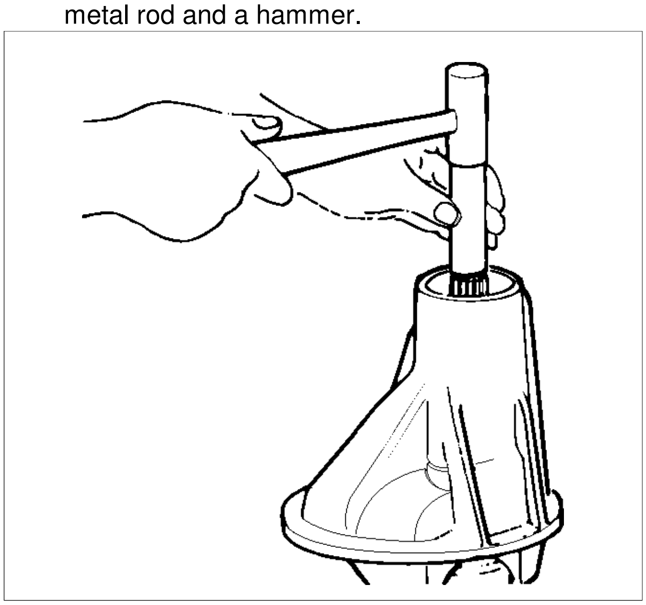
Checkpoint		Trouble Cause	Countermeasure
Gear oil	NG	Insufficient or improper gear oil	Replenish or replace the engine oil
OK			
Clutch pedal free play	NG	Improper clutch pedal free play	Readjust the clutch pedal free play
OK			
Change lever operation	NG	Hard operating change lever caused insufficient grease	Repair or regrease the change lever assembly
OK			
Change lever play	NG	Worn change lever sliding portions	Repair or replace the applicable parts and regrease
OK			
Shift block sleeve movement	NG	Sleeve movement failure	Repair or replace the sleeve
OK			
Shift rod and quadrant box sliding faces, and other parts	NG	Worn shift rod and/or sliding faces	Replace the shidt rod and/or the quadrant box

Continued on the next page



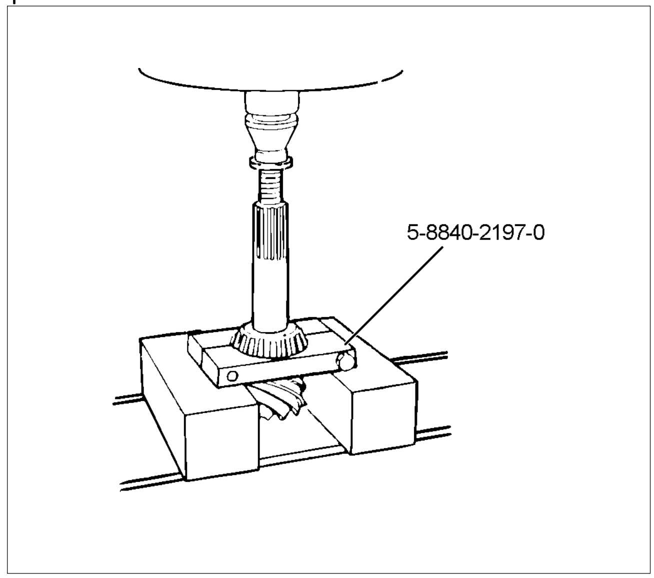
415RW040

8. Removed flange assembly.
9. Remove the drive pinion assembly using a soft metal rod and a hammer.


425RY005

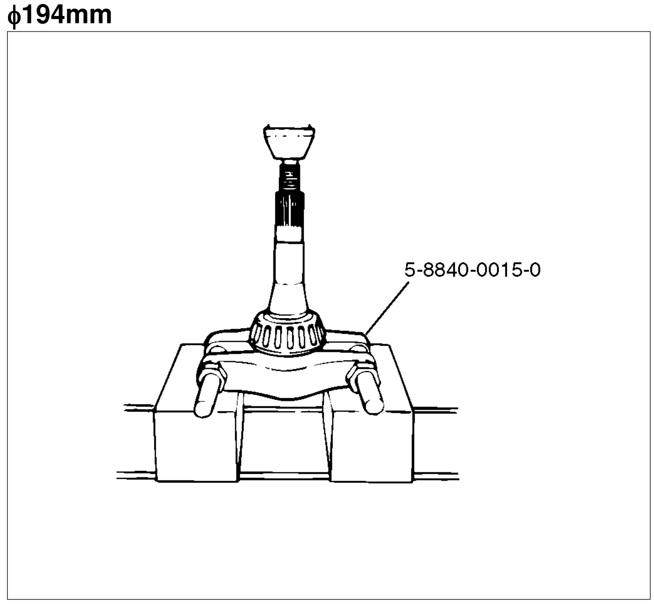
10. Remove collapsible spacer.
11. Remove the inner bearing by using separator 5-8840-2197-0 (ϕ220mm) and 5-8840-0015-0 (ϕ194mm) .

ϕ220mm



RTW54BSH000601

ϕ194mm



415R300001

12. Remove adjust shim.
13. Remove oil seal.
14. Remove outer bearing.

Checkpoint		Trouble Cause	Countermeasure
Continued from the previous			
OK			
Shift arm and synchronizer sleeve	NG	Worn shift arm and/or synchronizer sleeve groove	Replace the worn parts
OK			
Mainshaft and countershaft thrust play	NG	Worn thrust washer, collar, and/or gear thrust faces	Replace the worn parts
OK			
Synchronizer assembly	NG	Worn synchronizer parts	Replace the worn parts

3. WALKING OR JUMPING OUT OF GEAR

Checkpoint		Trouble Cause	Countermeasure
Change lever play	NG	Insufficient stroke caused by sliding position wear and excessive play	Replace the worn parts
OK			
Detent ball	NG	Worn detent ball	Replace the detent ball
OK			
Detent spring	NG	Detent spring weak or broken	Repair or replace the detent spring
OK			
Shift rod and quadrant box sliding faces	NG	Worn shift rod and/or sliding faces	Replace the shift rod and/or the quadrant box
OK			
Shift arm and synchronizer sleeve	NG	Worn shift arm and/or synchronizer sleeve groove	Replace the worn parts
OK			
Mainshaft and countershaft thrust play	NG	Worn thrust washer, collar, and/or gear thrust faces	Replace the worn parts

Continued on the next page

Checkpoint	Trouble Cause	Countermeasure

Continued from the previous page

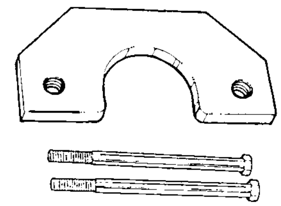
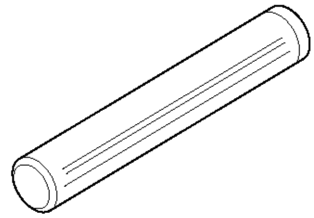
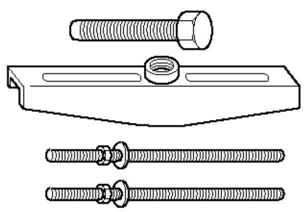
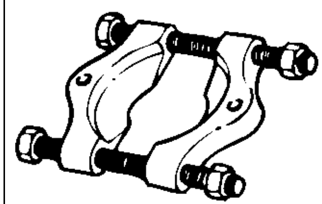
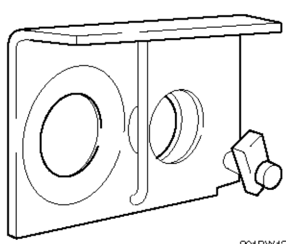
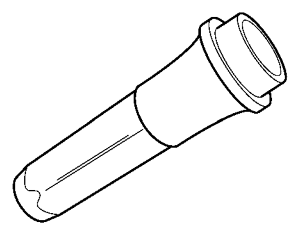
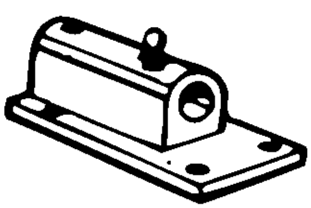
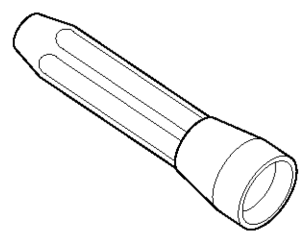
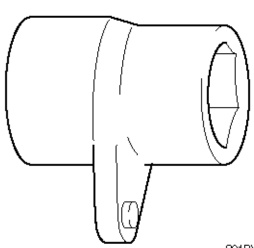
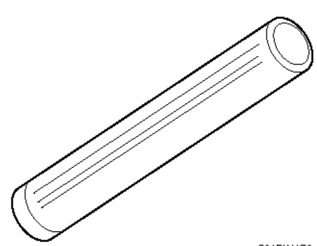
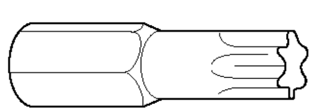
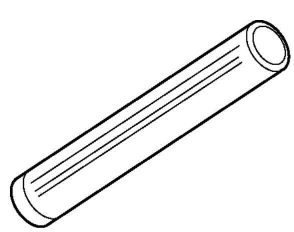
OK

Checkpoint		Trouble Cause	Countermeasure
Bearings (Mainshaft, countershaft, and individual gears)	NG	Worn or broken bearings(s)	Replace the bearing(s)
OK			
Mainshaft splines Synchronizer clutch hub splines	NG	Worn splines	Replace the main shaft and the synchronizer clutch hub
OK			
Synchronizer assembly	NG	Weak or broken spring	Replace the spring

4. OIL LEAKAGE

Checkpoint		Trouble Cause	Countermeasure
Oil level	NG	Oil level too high	Drain the oil to the correct level
OK			
Gear oil	NG	Improper gear oil	Replace the gear oil
OK			
Drain plug and/or filler plug	NG	Loose plug(s)	Tighten the plug(s) and replenish the oil
OK			
Gaskets	NG	Defective or improperly installed gasket(s)	Replace the gasket(s)
OK			
Air breather	NG	Air breather not installed Air breather clogged	Install the air breather Replace the air breather
OK			
Front cover oil seal	NG	Worn or scratched oil seal	Replace the oil seal
OK			
Rear cover oil seal	NG	Worn or scratched oil seal	Replace the oil seal

Special Tools (4×2)

ILLUSTRATION	TOOL NO. TOOL NAME	ILLUSTRATION	TOOL NO. TOOL NAME
	**5-8840-2155-0** **(J-37217)** Bearing remover		**5-8840-2159-0** **(J-37223)** Mainshaft end bearing installer
	**5-8840-2027-0** Puller		**5-8840-0015-0** **(J-22912-01)** Bearing remover/installer
	**5-8840-2160-0** **(J-37224)** Holding fixture		**5-8522-0050-0** **(J-29769)** Rear case oil seal installer
	**5-8840-0003-0** **(J-3289-20)** Holding fixture base		**5-8840-0026-0** **(J-26540)** Front cover oil seal installer
	**5-8840-2156-0** **(J-37219)** Mainshaft nut wrench		**9-8522-1165-0** **(J-6133-01)** Mainshaft collar remover
	**5-8840-0047-0** **(J-37225)** Tork bit wrench (T– 45)		**5-8840-2194-0** **(J-35283)** Bearing installer

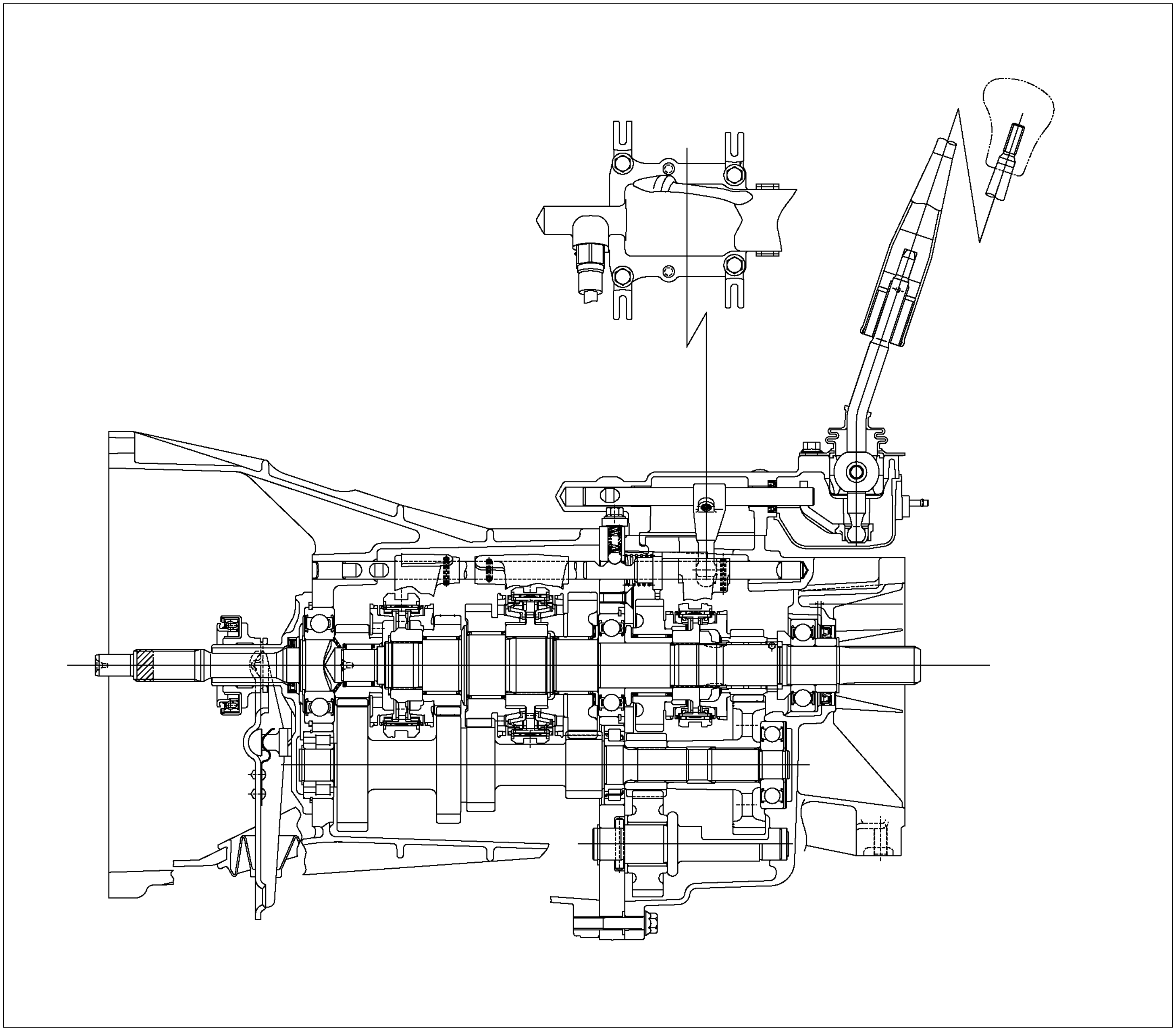
Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLE MENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

MUA5G/5H/5S Transmission (4×4)



A07R300003

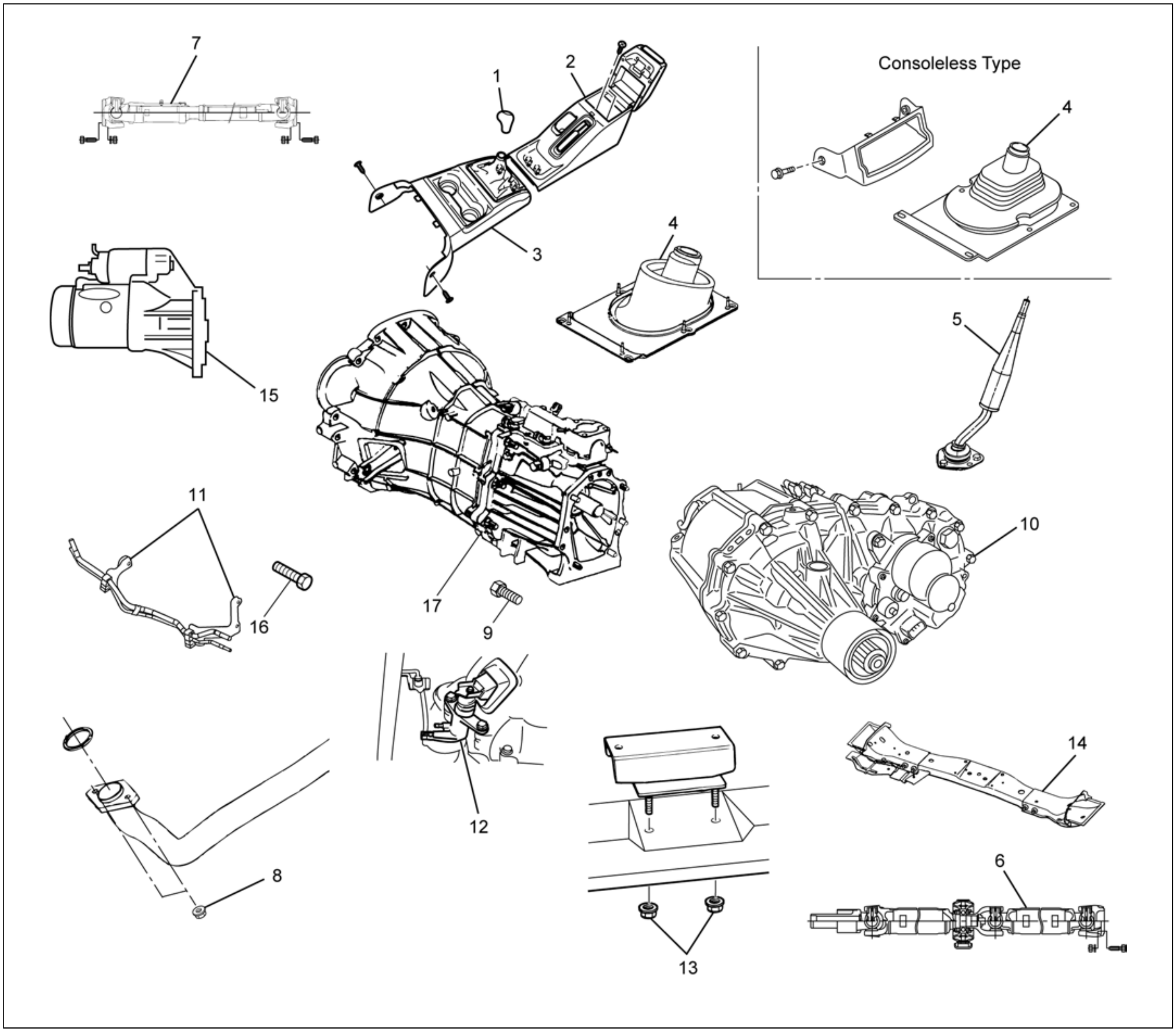
The MUA5G/5H/5S is a constant mesh transmission, synchronized in all speeds. The transmission is designed for a great reduction of the shift effort and the quietest possible operation.

Principle parts of the transmission are the integral clutch housing, the intermediate plate, the rear case, and the gears.

The transmission control box is built into the transmission.

Transmission (4×4)

Disassembled View

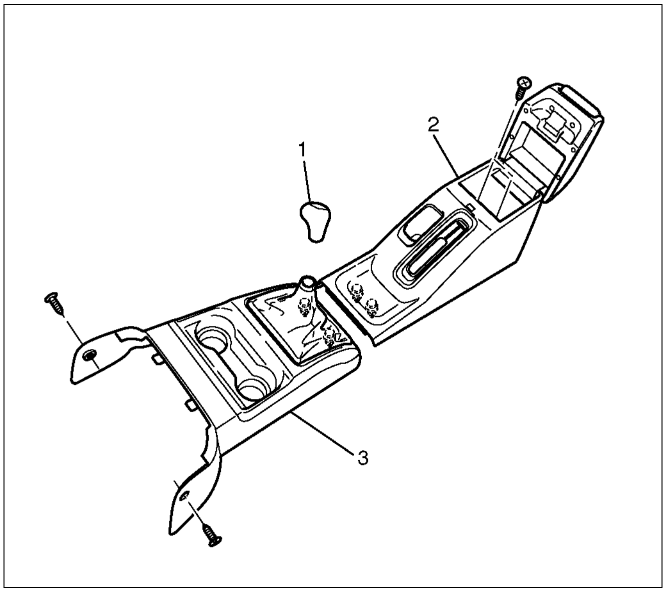


Legend

- (1) Gear Control Lever Knob
- (2) Rear Floor Console (bucket)
- (3) Front Floor Console
- (4) Grommet Assembly
- (5) Gear Control Lever
- (6) Rear Propeller Shaft
- (7) Front Propeller Shaft
- (8) Exhaust Pipe Nut (Diesel engine)
- (9) Transmission-Transfer Fixing Bolt
- (10) Transfer Assembly
- (11) Fuel Pipe Bracket
- (12) Slave Cylinder
- (13) Rear Mount Nut
- (14) Transmission Crossmember
- (15) Starter (Diesel engine only)
- (16) Transmission Retaining Nut and Bolt
- (17) Transmission Assembly

Removal

1. Disconnect the battery ground cable.
2. Remove the gear control lever knob.
3. Remove the rear floor console. (Bucket seat)
   Refer to the section "Floor Console".
4. Remove the front floor console.
   Refer to the section "Floor Console".

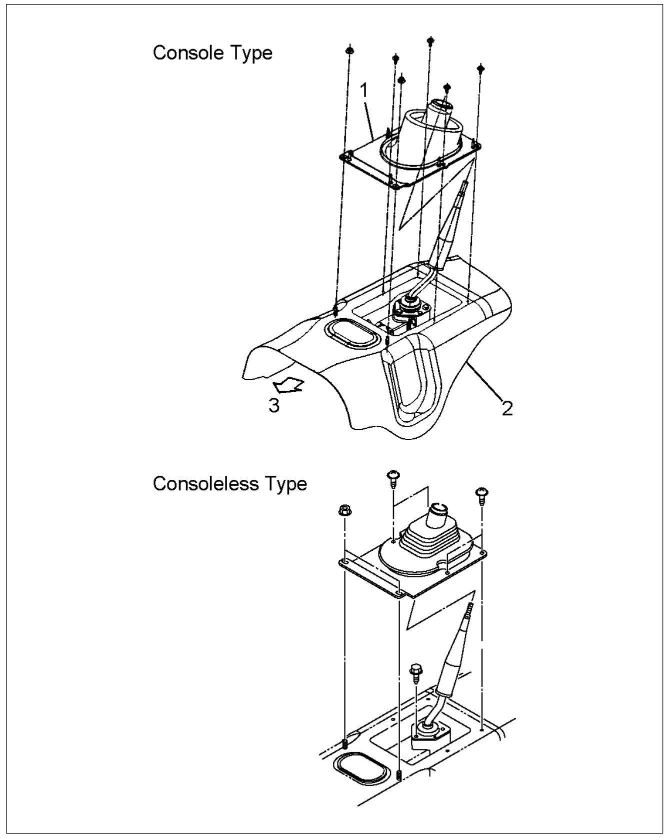


745R300006

Legend

(1) Knob
(2) Rear Floor Console
(3) Front Floor Console

5. Remove the grommet assembly.



RTW47BMH000101

Legend

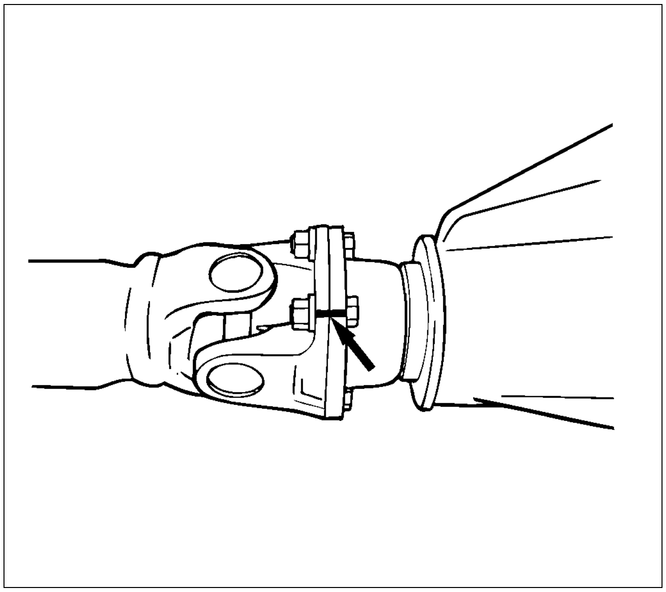
(1) Grommet Assembly
(2) Floor Panel
(3) Front

6. Remove the gear control lever.
7. Raise and support the vehicle with suitable stands.
8. Remove the rear propeller shaft.

NOTE: Apply alignment marks on the flange at the differential side.

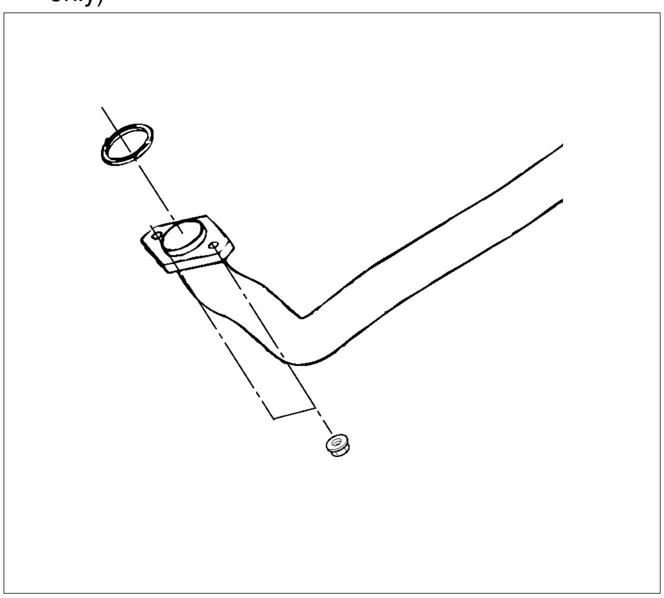
9. Remove the front propeller shaft.

NOTE: Apply alignment marks on the flange at both front and rear sides.



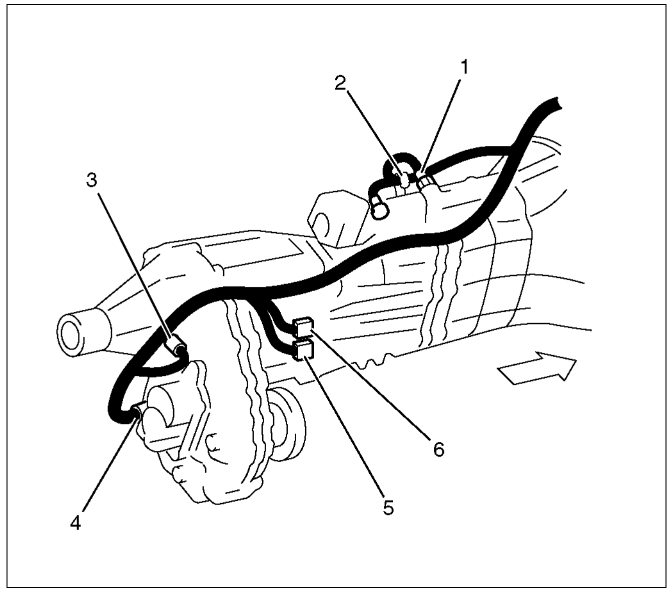
401RS023

10. Loosen the front exhaust pipe fixing nuts at the engine side but do not remove them. (Diesel engine only)



RTW67BSH000101

11. Disconnect the harness connectors and clips on the transmission and transfer.
    - Neutral Switch: Transmission
    - Back up Switch
    - Actuator
    - 2WD-4WD Switch
    - Neutral Switch: Transfer
    - Car Speed Sensor

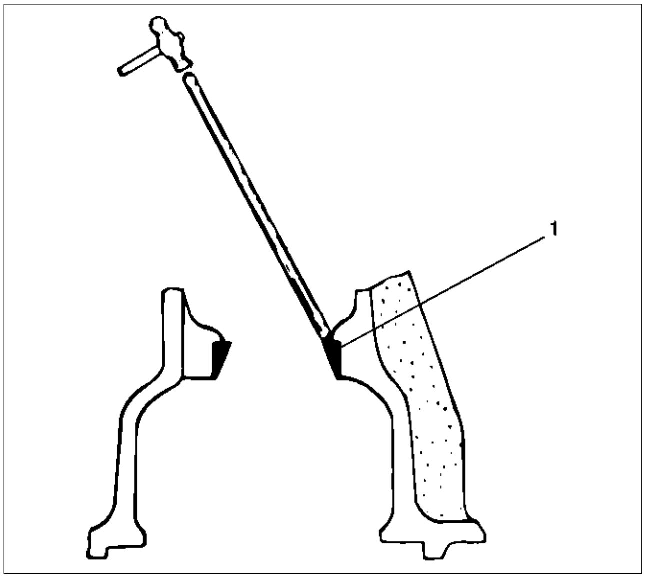


810R300069

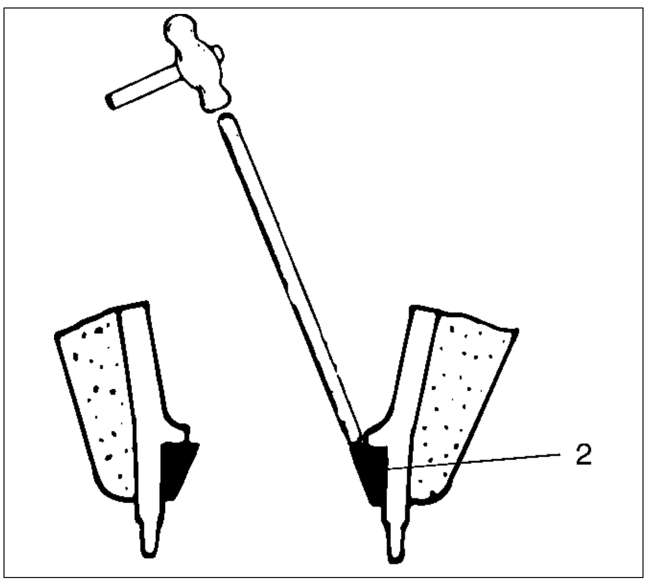
Legend

(1) Neutral Switch Connector: Transmission
(2) Back up Switch Connector
(3) Speed Sensor Connector
(4) Actuator Connector
(5) 2WD - 4WD Switch Connector
(6) Neutral Switch Connector: Transfer

15. Remove the inner bearing outer race (1) and the outer bearing outer race (2) by using a brass bar and a hammer.



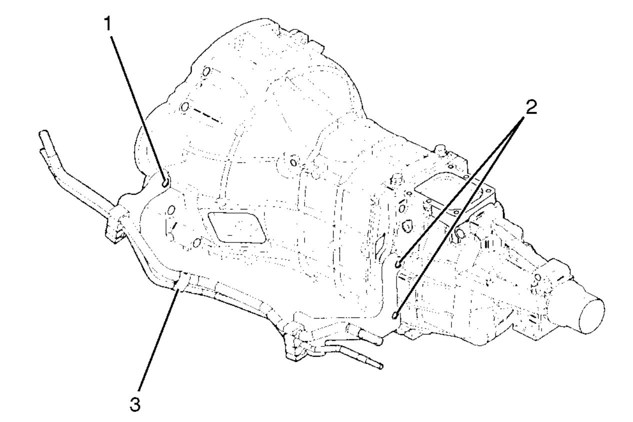
425RS014



425RS015

12. Remove the fuel pipe brackets with pipes from the transmission.

Diesel engine

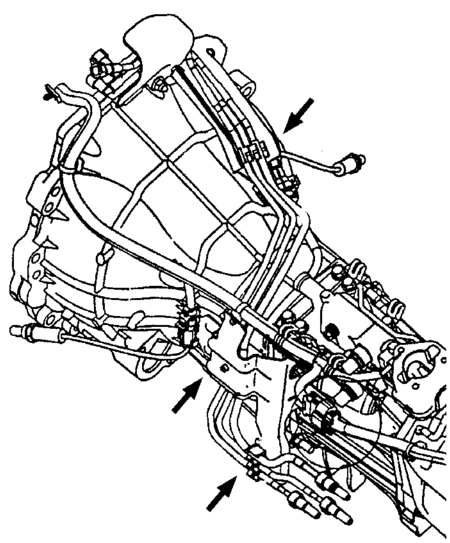


220R300012

Legend

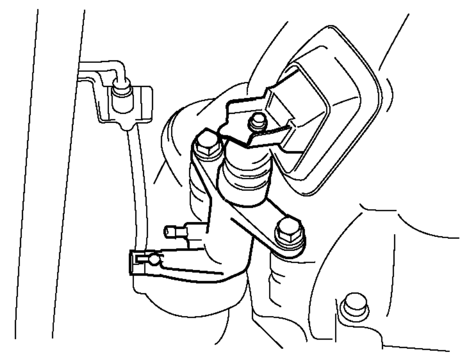
(1) Bolt
(2) Nut
(3) Fuel Pipe Assembly

C24SE



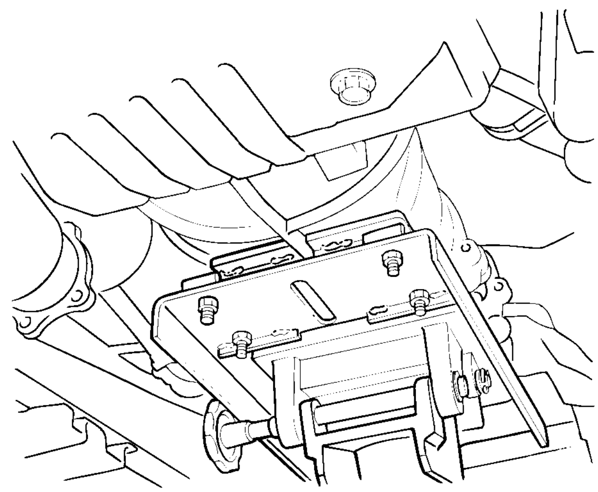
Scan-2

13. Remove the slave cylinder and put it aside.



220LV019

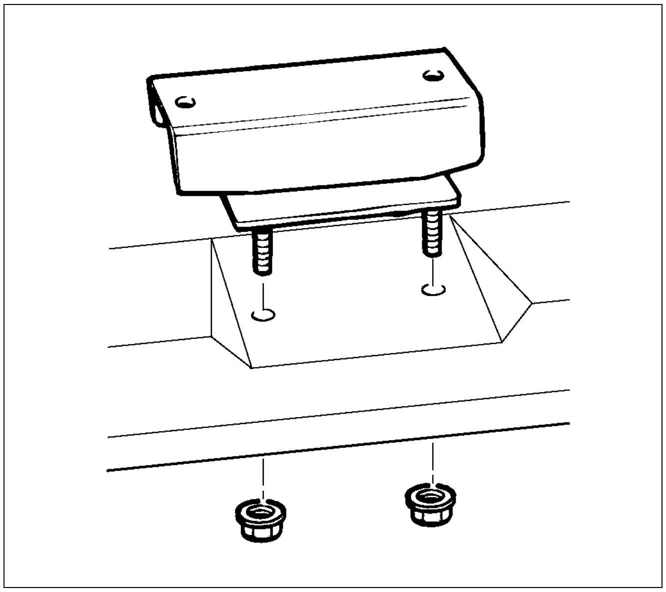
14. Support the transmission with a transmission jack.



220RS0001

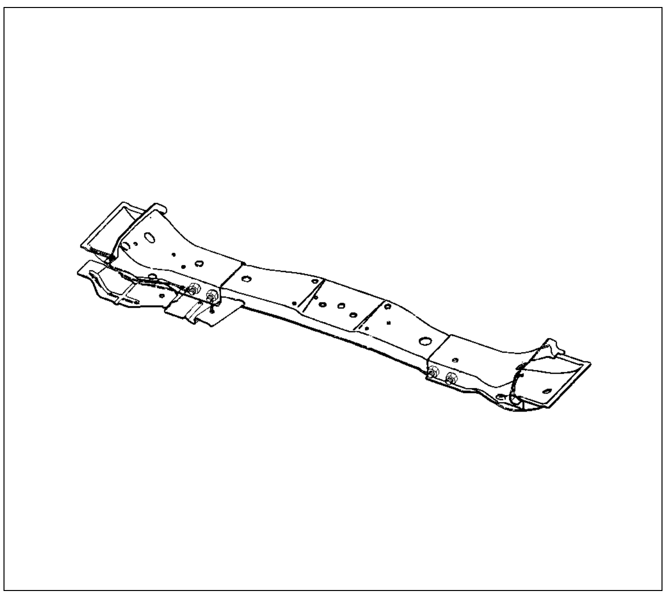
15. Remove the engine rear mount nuts from the transmission crossmember.

16. Remove the engine rear mount bolts fixing transmission.



220R300009

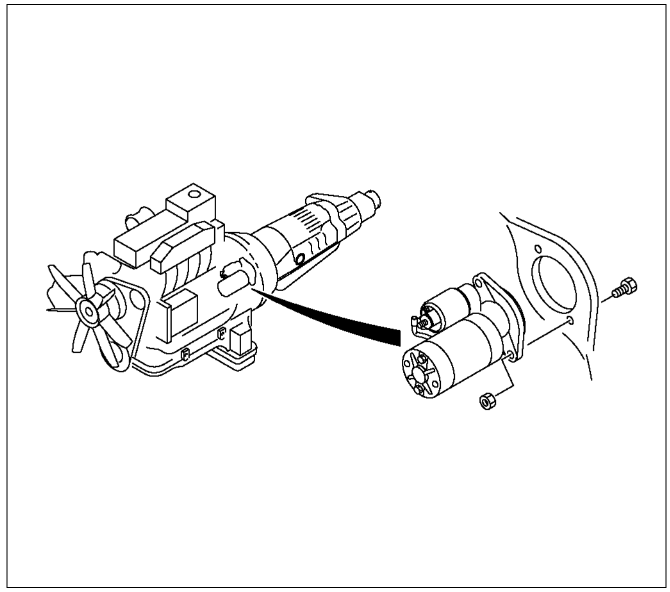
17. Remove the middle part of the transmission crossmember by removing the four fixing bolts and nuts.



501R30007

18. Take out the rear support rubber.

19. Remove the starter. (Diesel engine only)



060L100070

20. Remove the transmission retaining nuts and bolts.

    Remove the transmission assembly from the vehicle.

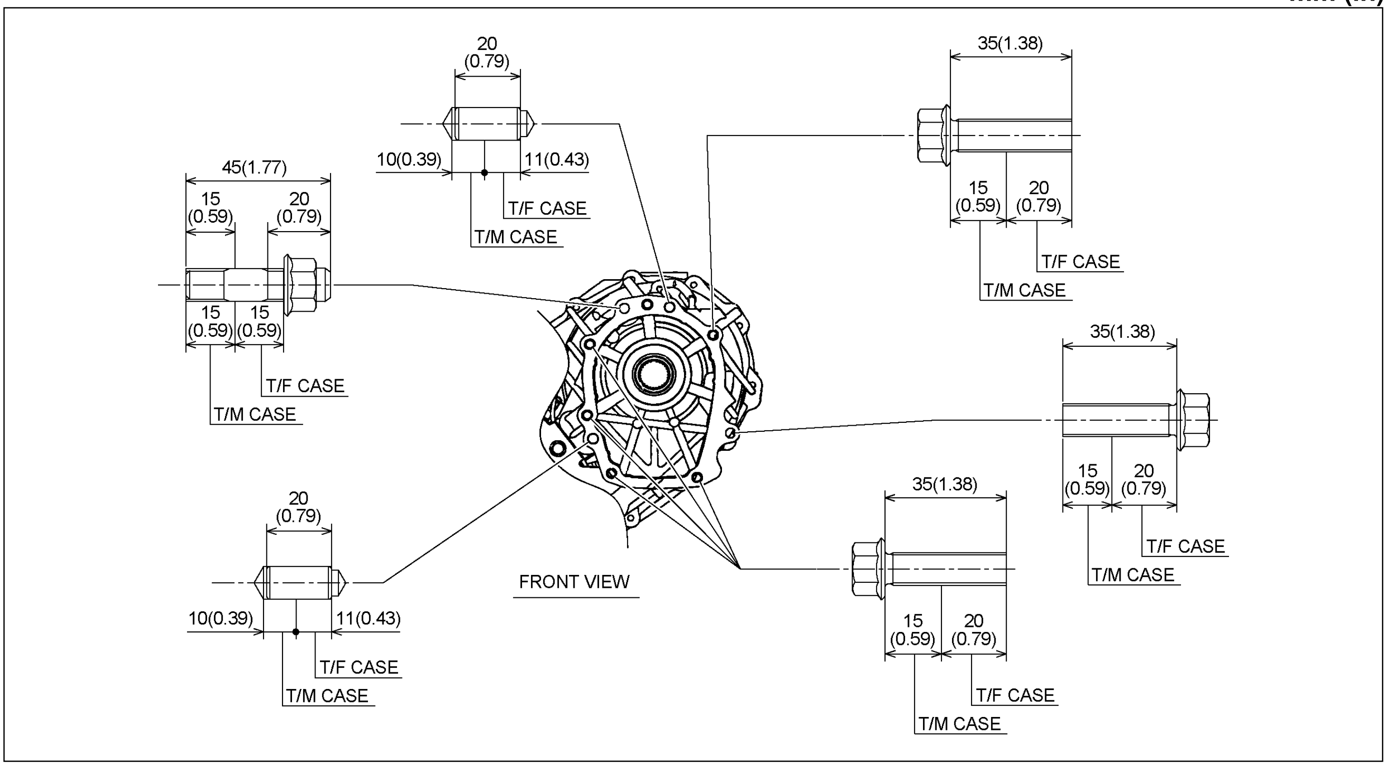
21. Remove the transmission–transfer fixing bolts and nut, and disassemble the transfer from the transmission.

Installation

1. Apply grease (BESCO L2 or equivalent) on the splined portion of the output shaft.
2. Connect the transfer to the transmission.
3. Install the transmission-transfer bolts and nut and tighten them to the specified torque.

   Torque: 41 N·m (4.2 kgf·m/30 lb·ft)

mm (in)



RTW77BMF001501

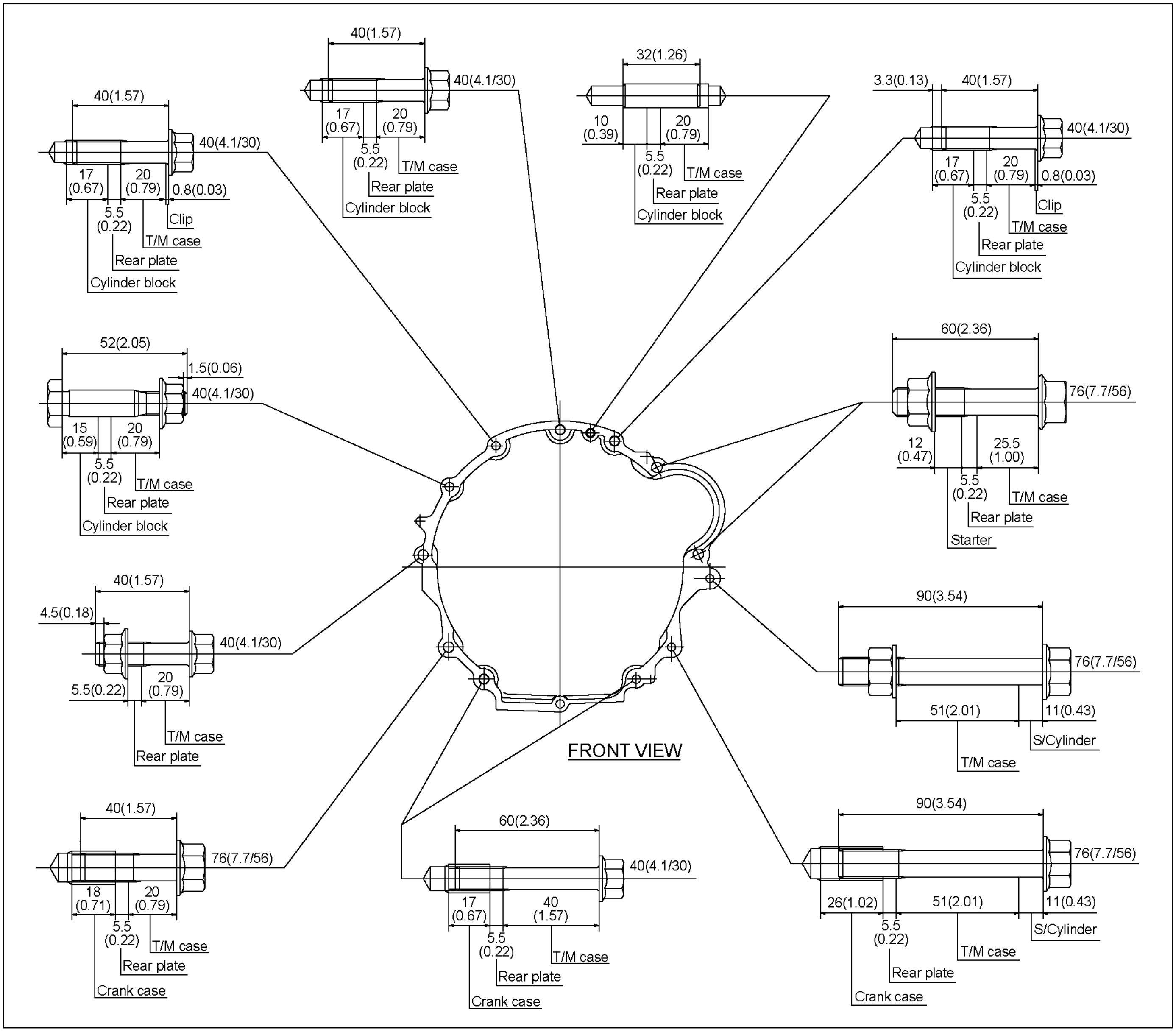
4. Apply a thin coat of molybdenum disulfide grease to the top gear shaft spline.
5. Slowly operate the transmission jack until the front of the transmission is aligned with the rear of the engine.

   The slope of the engine and the transmission must be the same.
6. Align the top gear shaft with the clutch driven plate spline.
7. Install the transmission assembly to the engine.

   Tighten the transmission nuts and bolts, as shown in the figure.

Diesel engine

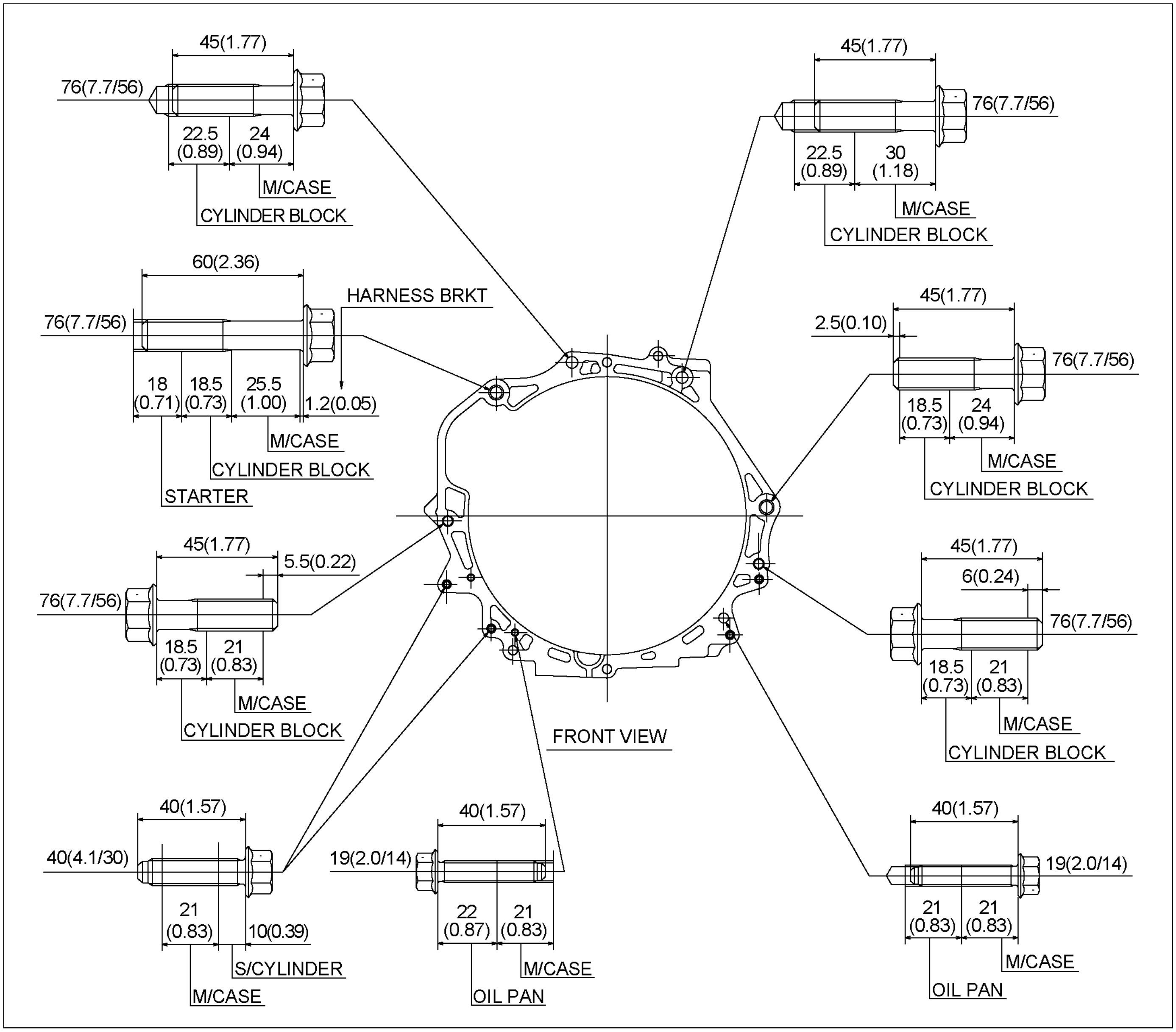
N·m (kgf·m/lb·ft)
mm (in)



RTW77BLF004001

C24SE

N·m (kgf·m/lb·ft)
mm (in)



8. Install the starter. (Diesel engine)

NOTE: Tighten the lower bolt temporarily.

After installing the fuel pipe assembly, tighten the bolt to the specified torque.

Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

9. Install the rear support rubber on the transmission and tighten the bolts to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

10. Install the middle part of transmission crossmember and bolts.

Tighten the nuts to the specified torque.

Torque: 67 N·m (6.8 kgf·m/49 lb·ft)

11. Install the engine rear mount nuts.

Torque: 52 N·m (5.3 kgf·m/38 lb·ft)

Remove the transmission jack from the transmission side.

12. Apply grease to top hole portion of the shift fork.

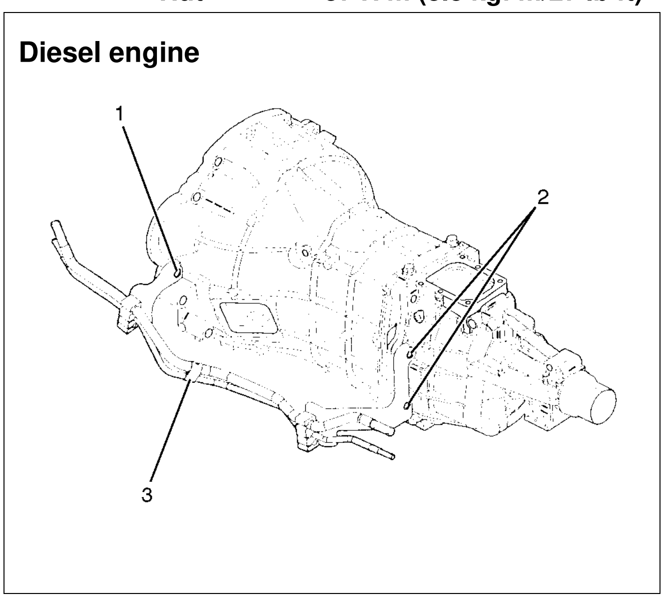
Install the slave cylinder and tighten the bolts to the specified torque.

Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

13. Install the fuel pipe brackets on the transmission.

Install the fuel pipe assembly to the fuel pipe brackets

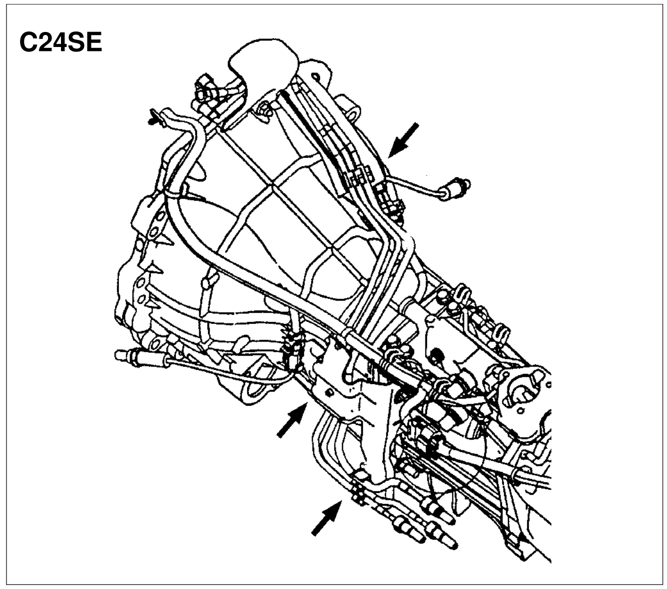
Torque: Bolt & Nut	**76 N·m (7.7 kgf·m/56 lb·ft)**
Nut	**37 N·m (3.8 kgf·m/27 lb·ft)**



220R300012

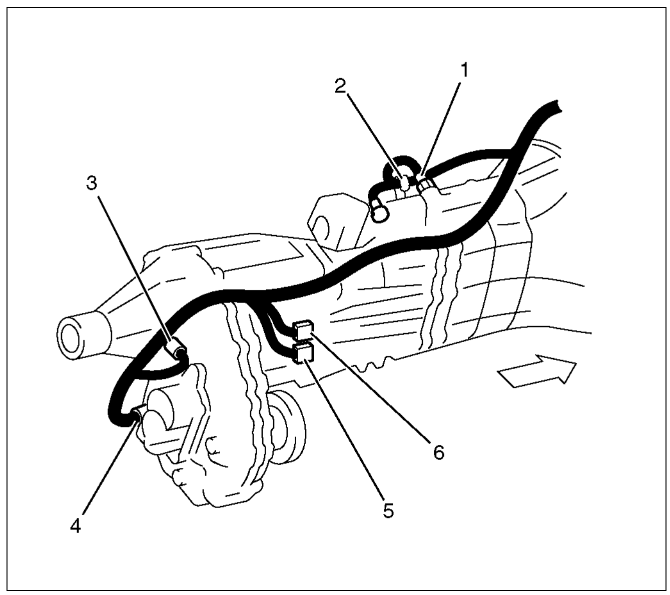
Legend

(1) Bolt
(2) Nut
(3) Fuel Pipe Assembly



Scan-2

14. Connect the transmission harness connectors and clips. Connector: transfer neutral switch, 2WD - 4WD switch, actuator, car speed sensor, backup switch, transmission neutral switch.



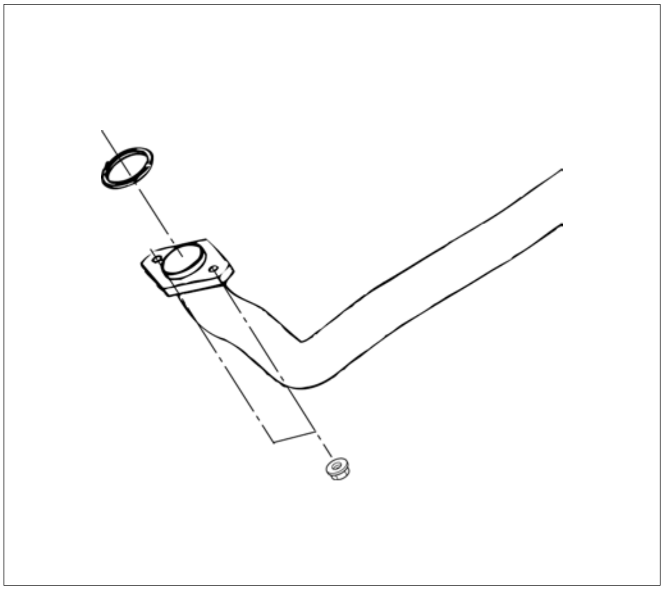
810R300069

Legend

(1) Neutral Switch Connector: Transmission
(2) Backup Switch Connector
(3) Speed Sensor Connector
(4) Actuator Connector
(5) 2WD - 4WD Switch connector
(6) Neutral Switch Connector: Transfer

15. Tighten the exhaust pipe fixing nuts to the specified torque. (Diesel engine only)

    Torque: 67 N·m (6.8 kgf·m/49 lb·ft)



RTW67BSH000101

16. Install the front propeller shaft.

    Refer to the section “Front Propeller Shaft”.

17. Install the rear propeller shaft.

    Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

18. Install the center bearing on crossmember.

    Torque: 69 N·m (7.0 kgf·m/51 lb·ft)

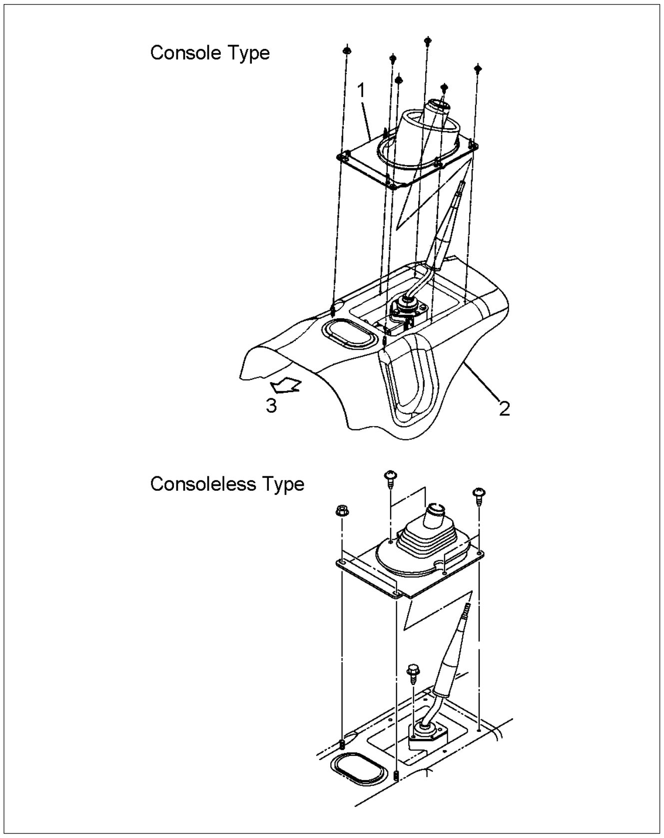
19. Install the gear control lever.

    Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

20. Install the grommet assembly.

    Torque: Screw 1.4 N·m (0.14 kgf·m/12 lb·in)

    Nut 7 N·m (0.7 kgf·m/61 lb·in)



RTW47BMH000101

Legend

(1) Grommet Assembly

(2) Floor Panel

(3) Front

21. Install the front floor console and rear floor console.
22. Install the gear control lever knob.

    To the female thread portion, apply 3 - 4 drops of adhesive (TB1344 or LOCTITE 222 or equiv.) and tighten the transmission knob.

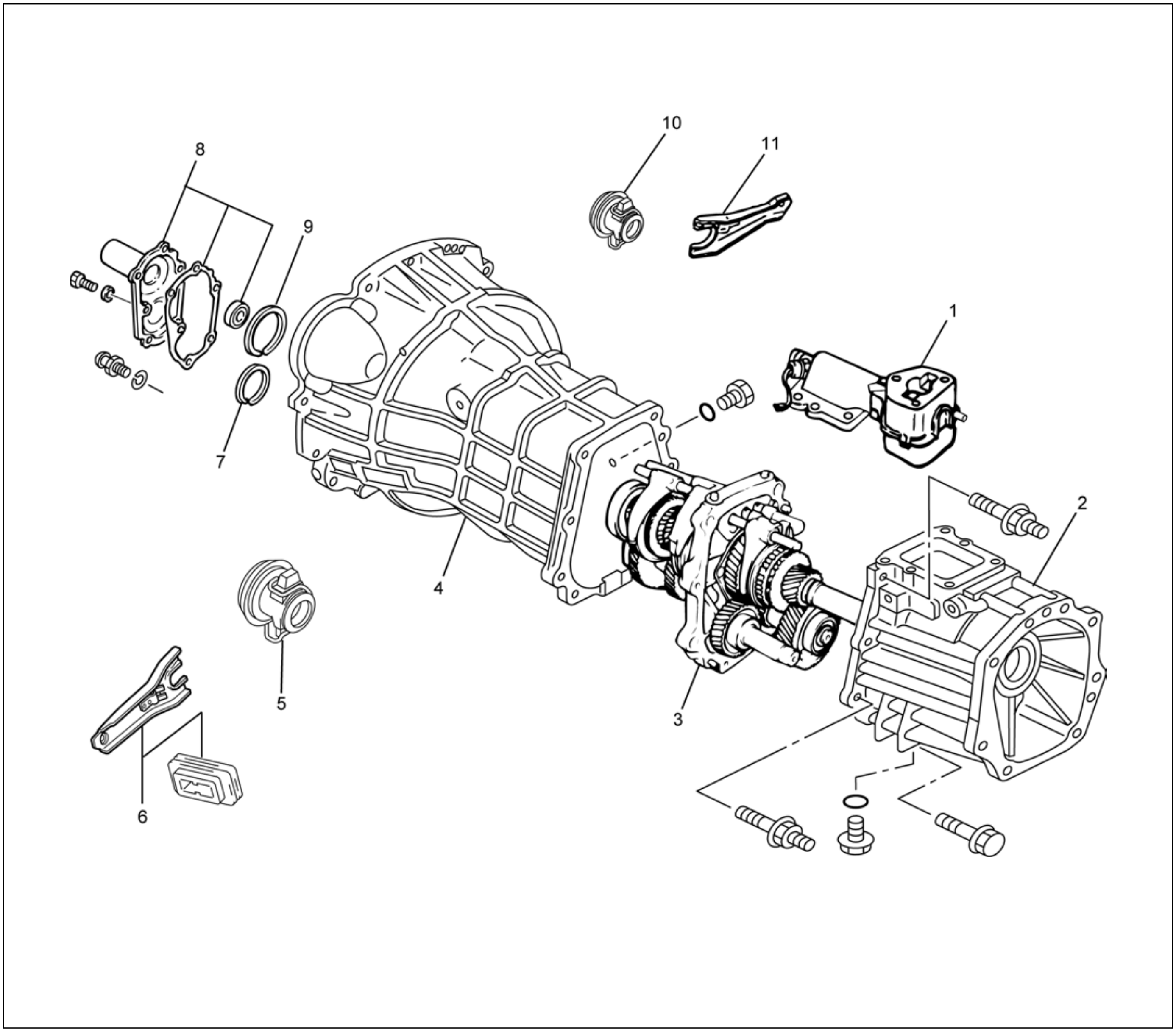
    Torque: 9 N·m (0.9 kgf·m/78 lb·in)

    After tightening to specified torque, rewrench the knob until the direction of the shift pattern is in the due position.

23. Connect the battery ground cable.

Transmission Case

Major Component



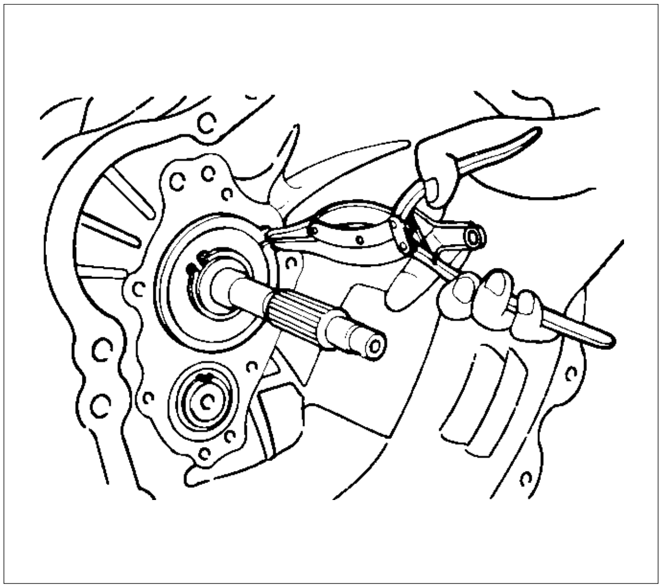
RTW77BLF003701

Legend

(1) Gear Control Box Assembly and Gasket
(2) Rear Case Assembly
(3) Intermediate Plate with Gear Assembly
(4) Transmission Case
(5) Release Bearing (with Spring): Diesel engine
(6) Shift Fork and Cover: Diesel engine
(7) Counter Front Bearing Snap Ring
(8) Front Cover (with Oil Seal)
(9) Top Gear Bearing Snap Ring
(10) Release Bearing: C24SE
(11) Shift Fork: C24SE

Disassembly

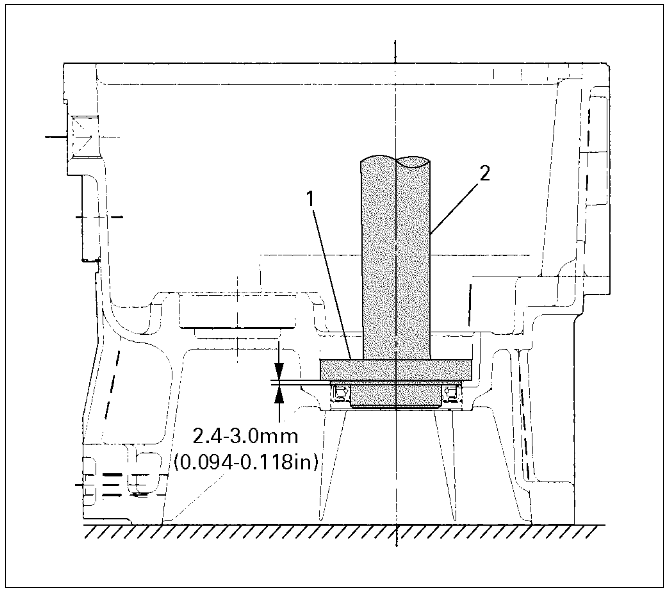
1. Clean the exterior of the unit with solvent.
2. Remove the drain plug from the transmission case and drain the lubricant.
3. Remove the clutch release bearing with spring from the transmission case.
4. Remove the shift fork, and boot.
5. Remove the front cover and gasket from the transmission case.
6. Remove the snap ring fixing counter front bearing.
7. Use a pair of snap ring pliers to remove the snap ring fixing top gear bearing.



226RS001

8. Remove the gear control box assembly.
9. Remove the rear case assembly from the transmission case and intermediate plate.
10. Remove the intermediate plate with gear assembly from the transmission case.

Rear Oil Seal Replacement



220R300025

Legend

(1) Installer 5-8840-2797-0

(2) Grip 5-8840-0007-0

1. Remove the oil seal from the rear case and discard the used oil seal.
2. Apply engine oil to the new oil seal outer surfaces.
3. Apply recommended grease (BESCO L2) or equivalent to the oil seal lip.
4. Use the oil seal installer 5-8840-2797-0 and grip 5-8840-0007-0 to install the oil seal to the rear case.

Reassembly

1. Apply recommended liquid gasket (Three Bond TB1215) or its equivalent to the transmission case, intermediate plate and rear case fitting surfaces.
2. Install the intermediate plate with gear assembly to the transmission case.

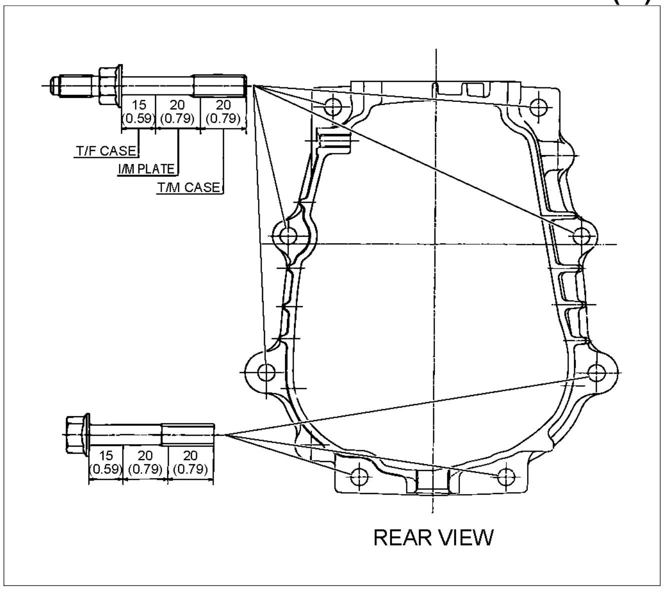
   Pull out the top gear shaft until the ball bearing snap ring groove protrudes from the transmission case front cover fitting face.

   Avoid subjecting the mainshaft to sudden shock or stress.
3. Install the rear case with oil seal on the intermediate plate, with gear, by performing the following steps.
   - Cover the shaft splines with adhesive tape.

     This will prevent damage to the oil seal lip.
   - Tighten the transmission rear case bolts and nuts to the specified torque.

   Torque: 37 N·m (3.8 kgf·m/27 lb·ft)

mm (in)



RTW77BSH008601

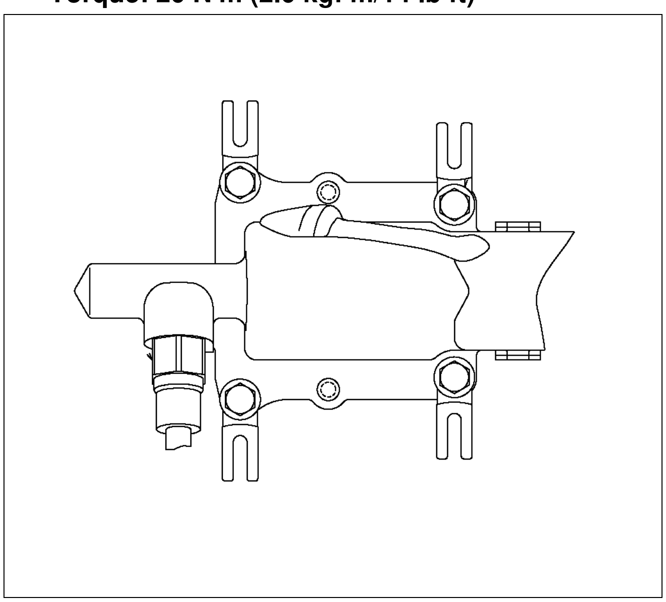
Notes When Tightening the Bolt:

- After cleaning the bolt hole, air dry it thoroughly.
- After cleaning the screw face of a removed or new bolt, dry it thoroughly. Apply recommended liquid gasket (LOCTITE 242) or its equivalent before tightening.

4. Install a new gasket and gear control box assembly.

   Install the harness clips and brackets and then tighten the four new gear control box bolts to the specified torque.

   Torque: 20 N·m (2.0 kgf·m/14 lb·ft)

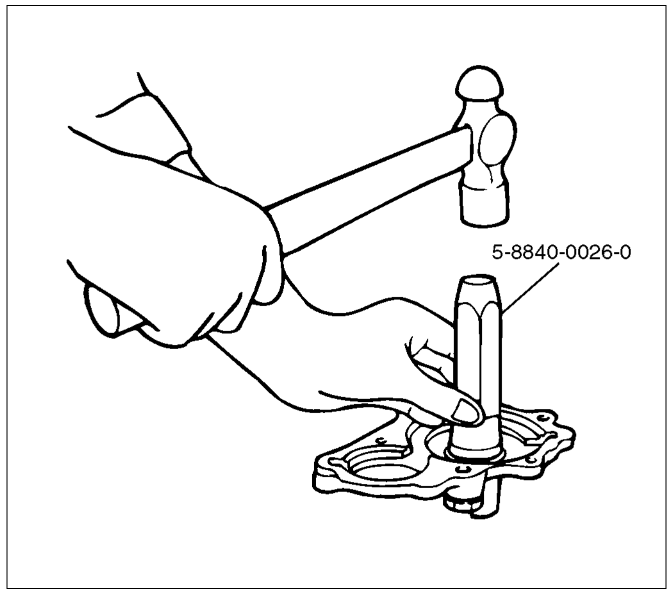


261R300004

5. Install the top gear bearing snap ring and counter front bearing snap ring.
   - Use a pair of snap ring pliers to install the snap rings to the mainshaft and countershaft.
   - The snap rings must be fully inserted into the bearing snap ring groove.
6. Front cover with oil seal.

Front Cover Oil Seal Replacement

- Remove the oil seal from the front cover.
- Apply engine oil to the outer circumference of new oil seal.
- Apply recommended grease to the oil seal lip.
- Use the oil seal installer 5-8840-0026-0 to install the oil seal to the front cover.



220R300002

7. Install a new gasket and front cover to the transmission case.

NOTE: Take care not to damage the oil seal.

Notes When Tightening the Bolt:

- After cleaning the bolt hole, air dry it thoroughly.
- After cleaning the screw face of a removed or new bolt, dry it thoroughly. Apply recommended liquid gasket (LOCTITE 242) or its equivalent before tightening.

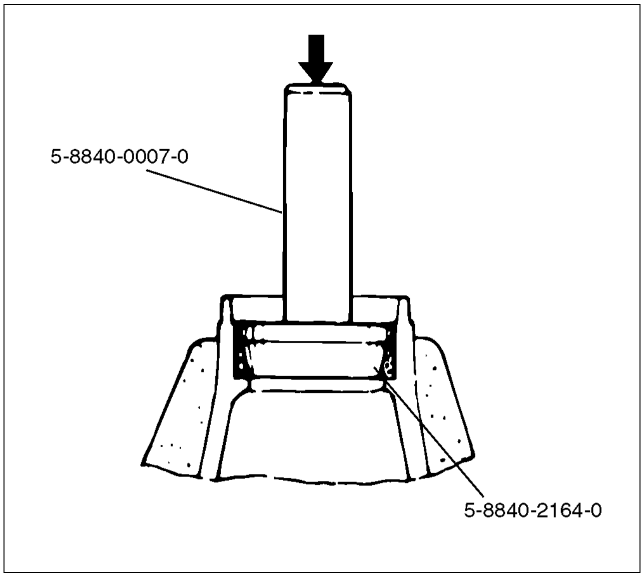
  Tighten the six front cover bolts to the specified torque.

  Torque: 25 N·m (2.6 kgf·m/19 lb·ft)

Reassembly

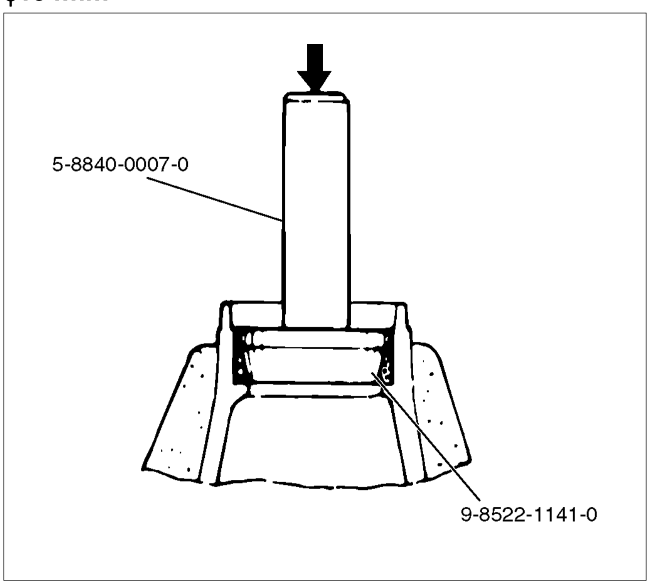
1. Install outer bearing outer race by using installer 5-8840-2164-0 (ϕ220mm), 9-8522-1141-0 (ϕ194 mm) and grip 5-8840-0007-0.

ϕ220mm



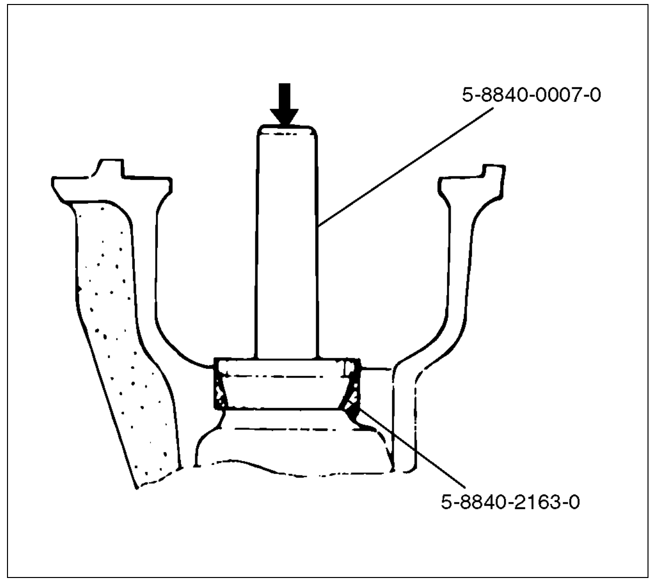
425L100002

ϕ194mm



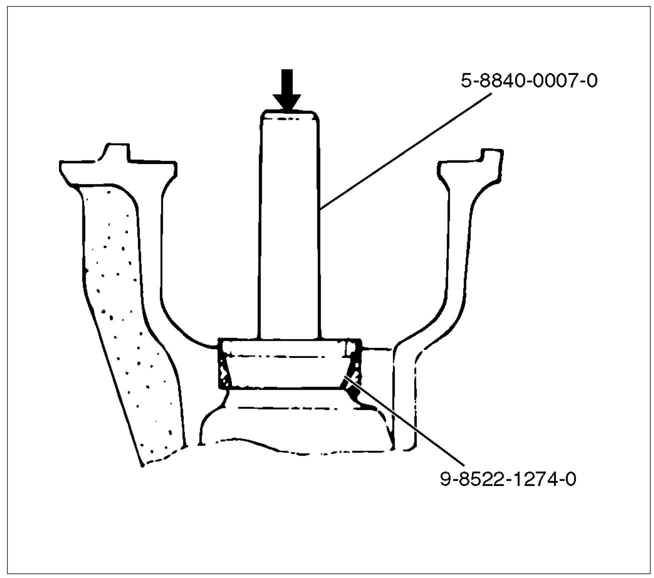
425R300001

2. Install inner bearing outer race by using installer 5-8840-2163-0 (ϕ220mm), 9-8522-1274-0 (ϕ194 mm) and grip 5-8840-0007-0.



425L100003

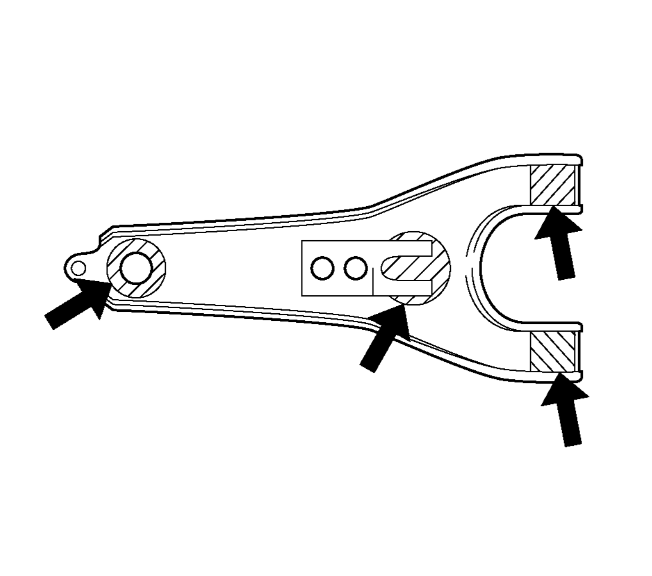
ϕ194mm



425R300002

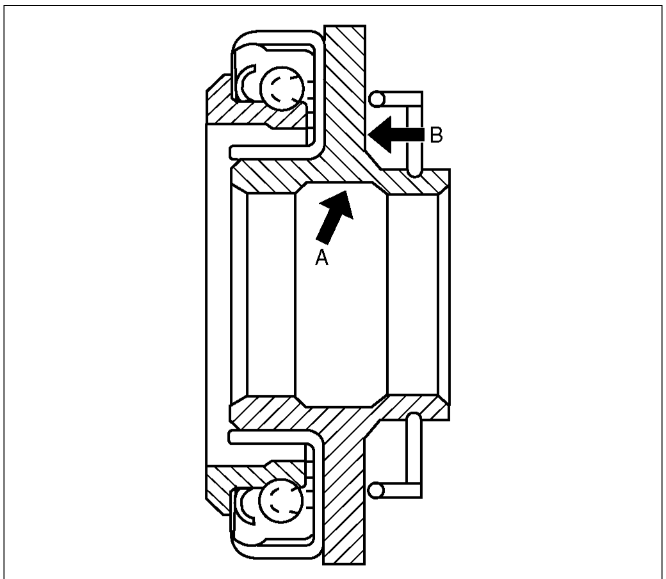
3. Adjust the drive pinion mounting distance as follows:
   a. Apply gear oil to the inner and outer drive pinion bearing. Clean the pinion setting gauge set. Then install the gauge set together with the inner and outer bearings.
      Install gauge plate 5-8840-2166-0 (ϕ220mm) and 5-8840-2087-0 (ϕ194mm) (3), inner pilot 5-8840-0129-0 (ϕ220mm) (2), stud and nut 5-8840-0127-0 (ϕ220mm) and 5-8840-2089-0 (ϕ194mm) (4) and outer pilot 5-8840-2085-0 (ϕ220mm and ϕ194mm) (1) through inner and outer bearings.

8. Apply molybdenum disulfide type grease to the areas shown in the figure and install the shift fork.



F07L100026

9. Pack the inside recess (A) and coat the back (B) of the release bearing with molybdenum disulfide type grease, as shown in the figure.

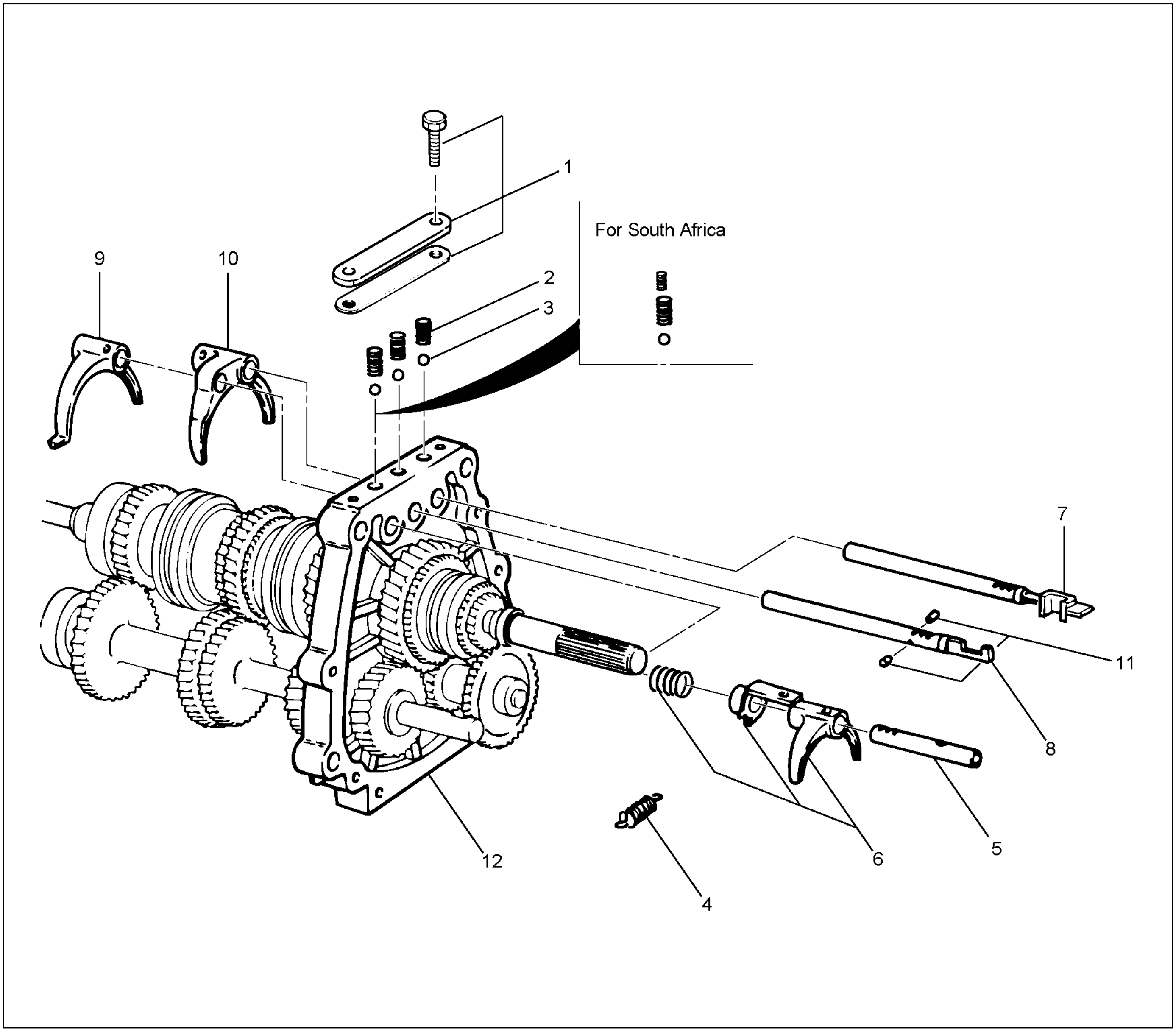


A07RW075

10. Install the release bearing on the front cover, joining it to the shift fork.

Intermediate Plate with Gear Assembly, Detent, Shift Arm, Shift Rod, and Interlock Pin

Disassembled View



RTW57BLF000201

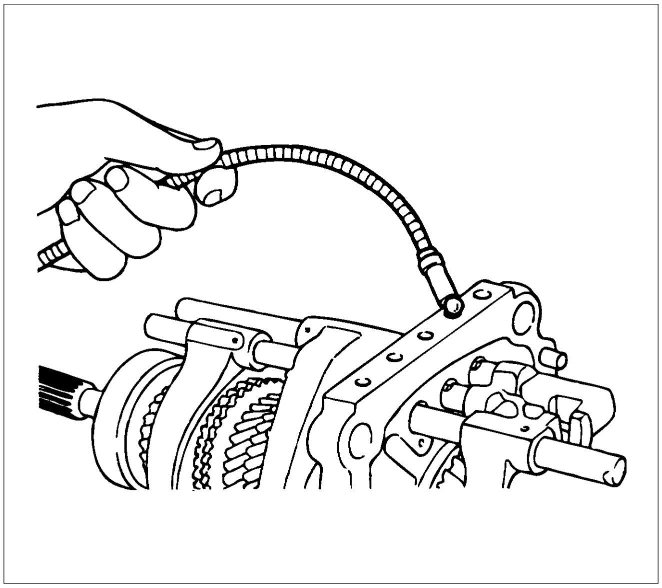
Legend

(1) Detent Spring Plate and Gasket	(7) 1st-2nd Shift Rod
(2) Detent Spring	(8) 3rd-4th Shift Rod
(3) Detent Ball	(9) 3rd-4th Shift Arm
(4) Spring	(10) 1st-2nd Shift Arm
(5) Rev-5th Shift Rod	(11) Interlock Pin
(6) Rev-5th Shift Arm and Reverse Inhibitor	(12) Intermediate Plate and Gear Assembly

Disassembly

1. Remove the detent spring plate and gasket, detent spring and detent ball.

   Use a magnetic hand to remove the detent balls from the intermediate plate.

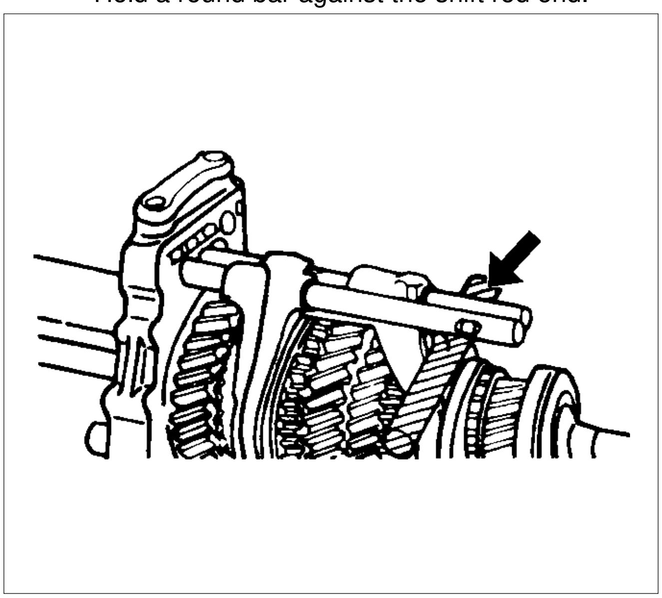


220RS011

2. Remove the spring.
3. Remove the rev-5th shift rod, and rev-5th shift arm and the reverse inhibitor.

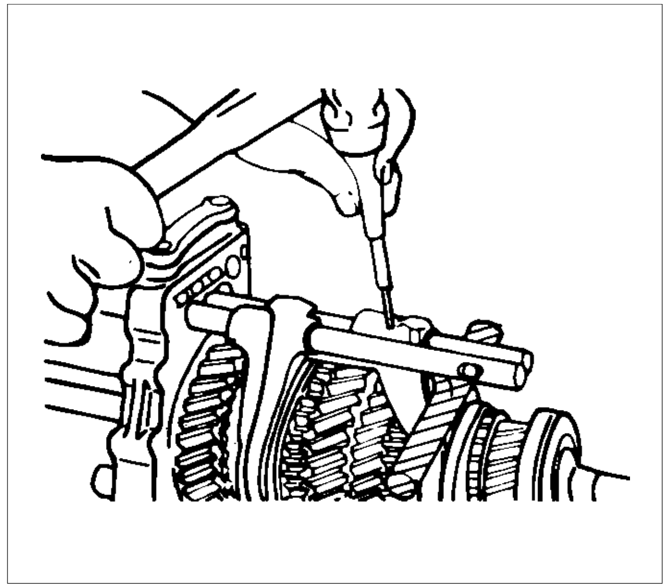
   Remove the 1st-2nd shift rod, 3rd-4th shift rod, 3rd-4th shift arm, and 1st-2nd shift arm.

   - Hold a round bar against the shift rod end.



230RS003

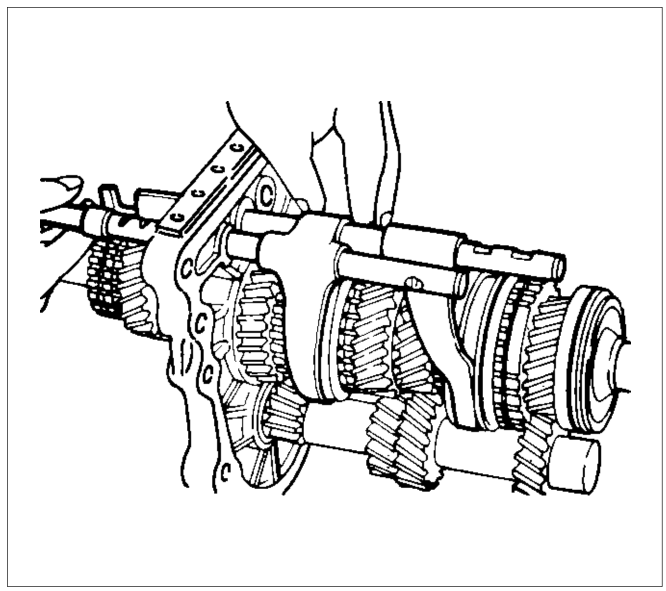
   - Use a spring pin remover to remove the shift arm spring pins from the shift arms and the shift rods.



230RS0004

   - Be careful not to lose the interlock pins, when pulling out the shift rod rearward.

     The interlock pins are located between the shifter rods in the intermediate plate.



230RS0005

   - Remove the rev-5th, 1st-2nd and 3rd-4th shift rods carefully.

4. Remove the interlock pin from intermediate plate and gear assembly.

Inspection and Repair

Make the necessary adjustments and part replacements if excessive wear or damage is discovered during inspection.

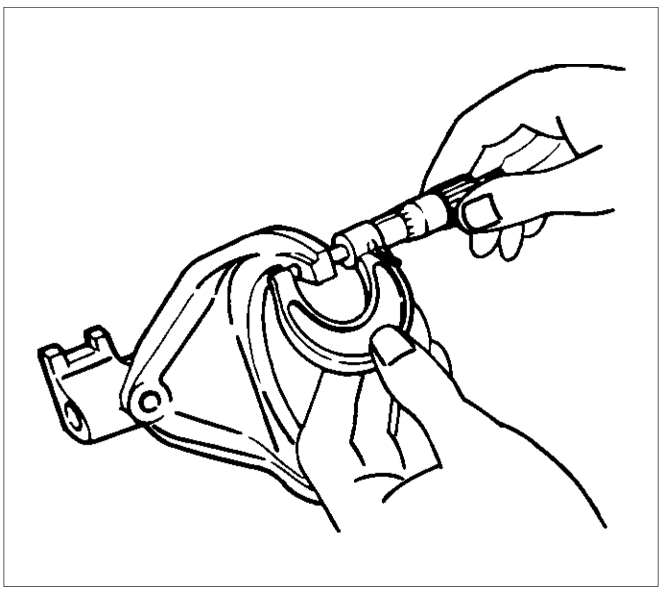
Shift Arm Thickness

- Use a micrometer to measure the shift arm thickness.

  If the measured value is less than the specified limit, the shift arm must be replaced.

Shift Arm Thickness

	Standard	Limit
1st-2nd	9.60 - 9.85 mm (0.378 - 0.388 in)	9.0 mm (0.354 in)
3rd-4th Rev.5th	9.60 - 9.80 mm (0.378 - 0.386 in)	



230RS006

Detent Spring Free Length

- Use a vernier caliper to measure the detent spring free length.

  If the measured value is less than the specified limit, the detent spring must be replaced.

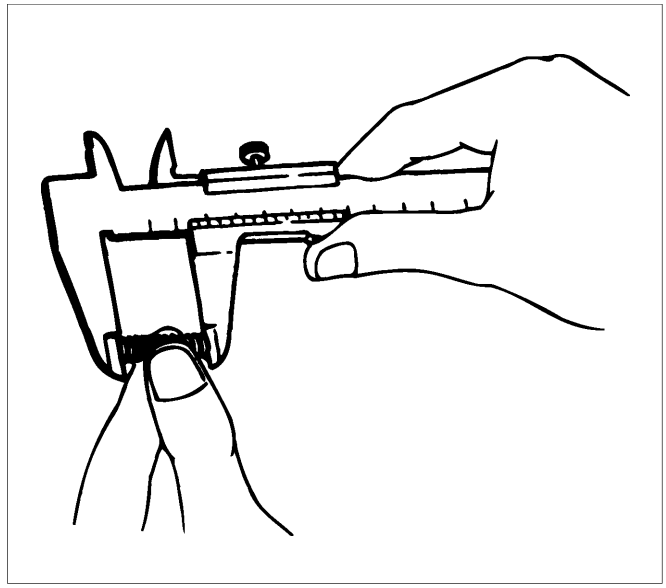
Detent Spring Free Length

Standard	Limit
26.8 mm (1.06 in)	26.2 mm (1.03 in)

SOUTH AFRICA 5th-Rev Only

Detent Spring Free Length

	Standard	Limit
Outer	27.6 mm (1.09 in)	27.0 mm (1.06 in)
Inner	26.6 mm (1.05 in)	26.0 mm (1.02 in)



220RS012

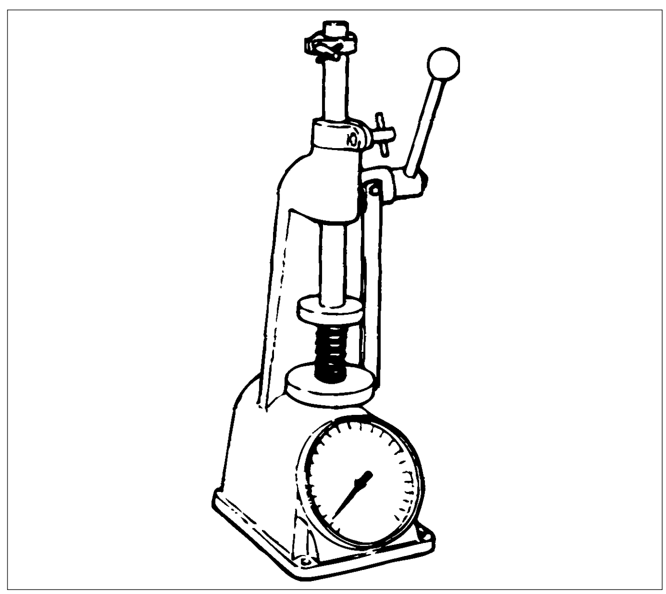
Detent Spring Tension

- Use a spring tester to measure the detent spring tension.

  If the measured value is less than the specified limit, the detent spring must be replaced.

Detent Spring Tension

Compressed height	Standard
20 mm (0.787 in)	87.2 - 97.1 N (19.6 - 21.8 lb)



220RS013

SOUTH AFRICA 5th-RV Only

Detent Spring Free Length

	Compressed	Standard
Outer	20 mm (0.787 in)	93.5 – 103.3 N (21.0 – 23.3 lb)
Inner	20 mm (0.787 in)	26.4 – 36.3 N (5.9 – 8.2 lb)

Reassembly

1. Install the rev-5th shift arm and reverse inhibitor and rev-5th shift rod.
   - Apply oil to the reverse inhibitor inner surface.
   - Install the shift rod in the intermediate plate.
   - Hold a round bar against the shift rod end lower face to protect it against damage.
   - Install a new spring pin.

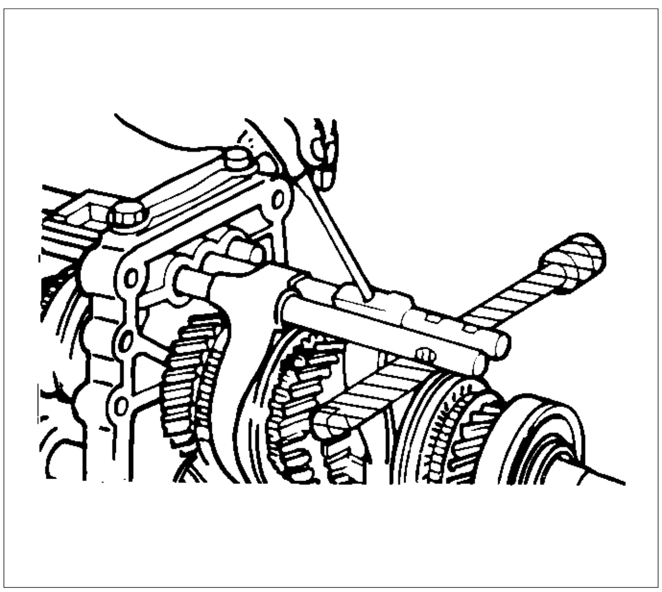
     Never reinstall the used spring pin.
   - Install the interlock pin in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
2. Install the 1st-2nd shift arm and 3rd-4th shift arm to the intermediate plate and gear assembly.
3. Install the 3rd-4th shift rod and the 1st-2nd shift rod.
   - Install the interlock pin in the intermediate plate and gear assembly.
   - Install the 3rd-4th shift rod in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
   - Install the interlock pin and then the 1st-2nd shift rod in the intermediate plate.

     Do not allow the interlock pin to fall from the intermediate plate.
   - Hold a round bar against the shift rod end lower face to protect it against damage.
   - Install a new spring pin.

     Never reinstall the used spring pin.



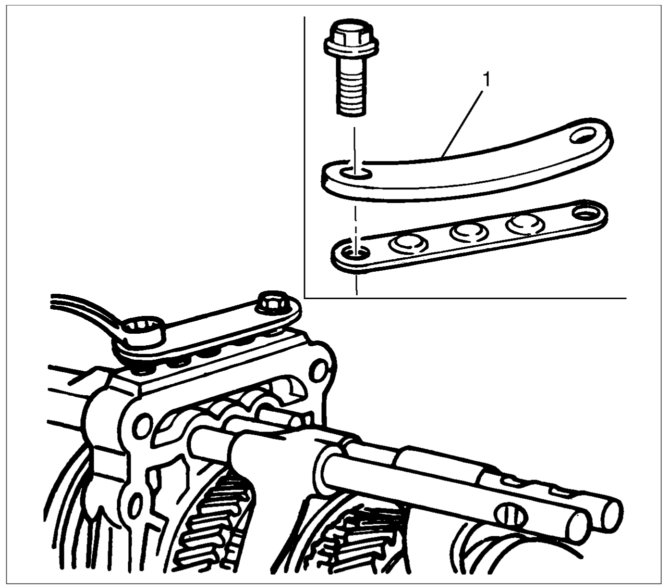
230RS007

4. Install the spring.
5. Put the detent balls in the intermediate plate holes.
   - Apply oil to the detent balls.
6. Install the detent springs and detent spring plate and gasket.

NOTE: For South Africa model, it has double detent spring for Rev-5th shift rod.

- Install a new gasket and the detent spring plate.
- Tighten the detent spring plate bolts to the specified torque.

Torque: 25 N·m (2.5 kgf·m/18 lb·ft)



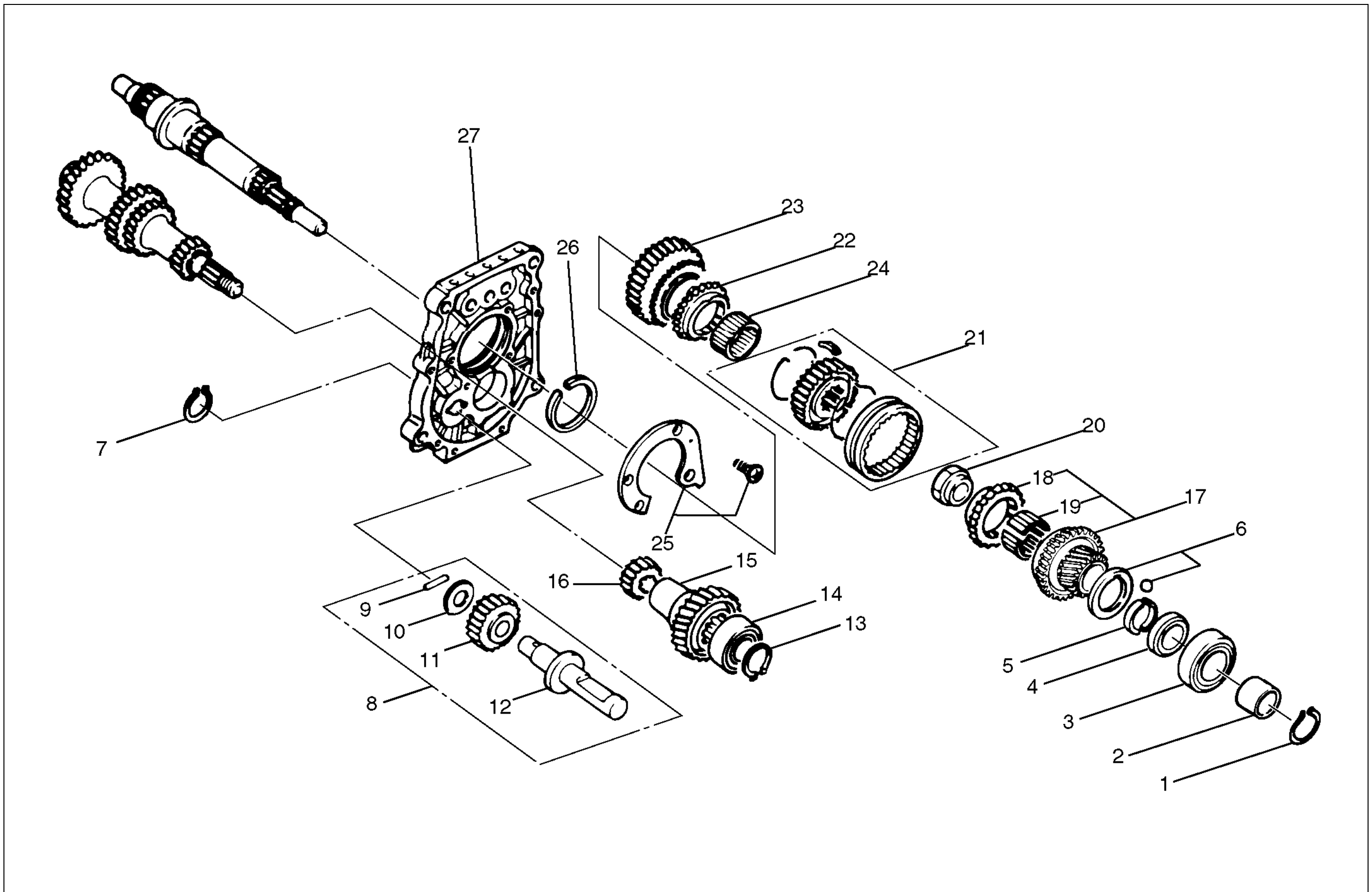
220RS030

Legend

(1) Warped

Reverse Gear and 5th Gear

Disassembled View



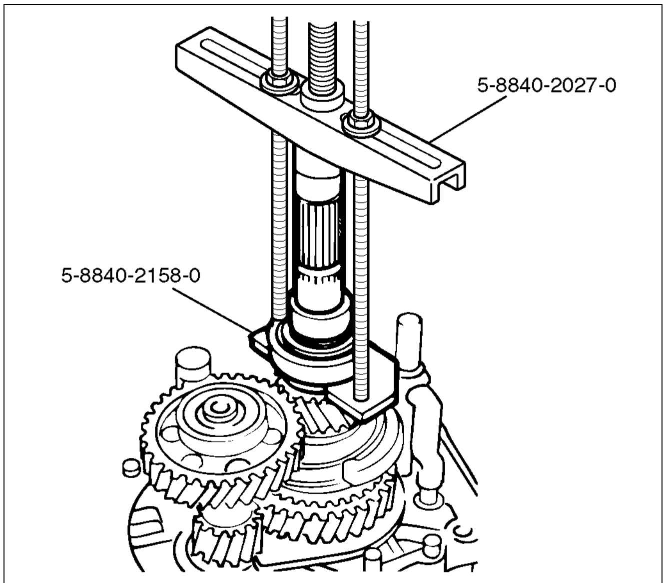
226R300024

Legend

- (1) Collar Snap Ring
- (2) Oil Seal Collar
- (3) Ball Bearing
- (4) Retainer
- (5) Thrust Plate
- (6) Thrust Washer and Lock Ball
- (7) Reverse Idler Gear Snap Ring
- (8) Reverse Idler Gear Assembly
- (9) Idle Shaft Pin
- (10) Thrust Washer
- (11) Reverse Idler Gear
- (12) Reverse Idler Shaft
- (13) Bearing Snap Ring
- (14) Ball Bearing
- (15) Counter 5th Gear
- (16) Counter Reverse Gear
- (17) 5th Gear
- (18) 5th Block Ring
- (19) Needle Bearing
- (20) Mainshaft Nut
- (21) Rev-5th Synchronizer Assembly
- (22) Reverse Block Ring
- (23) Reverse Gear
- (24) Needle Baring
- (25) Bearing Plate and Screw
- (26) Bearing Snap Ring
- (27) Intermediate Plate

Disassembly

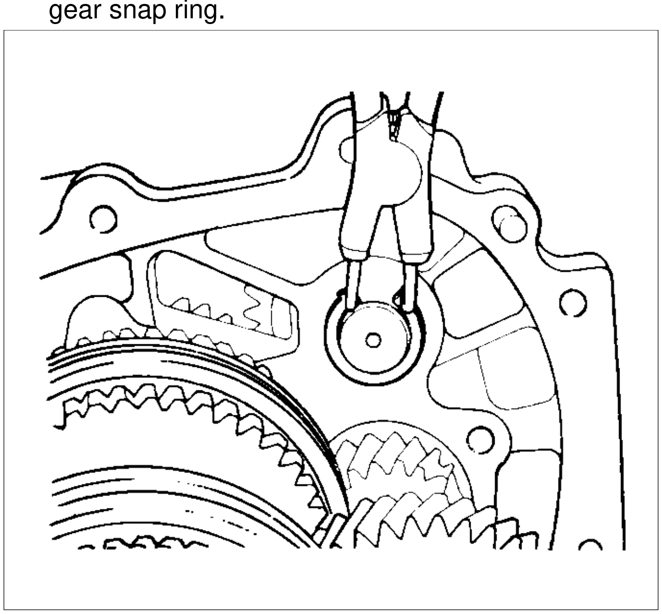
1. Use a pair of snap ring pliers to remove the collar snap ring.
2. Set the mainshaft retainer remover 5-8840-2158-0 and puller 5-8840-2027-0 to the retainer and the mainshaft end.



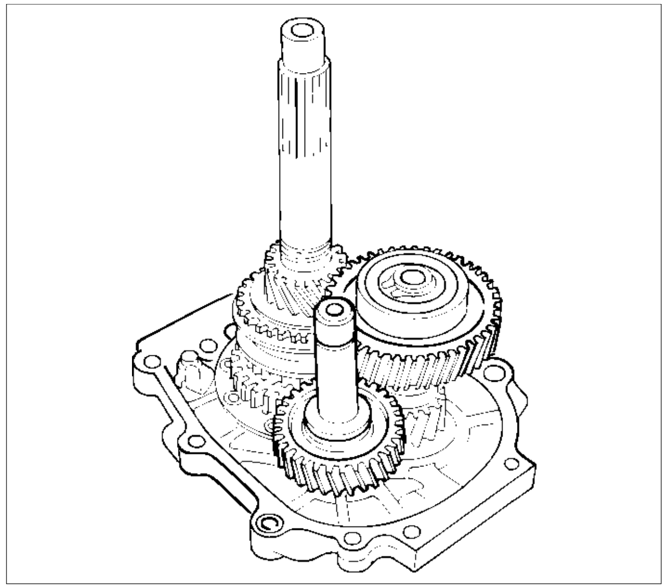
262RW079

3. Remove the retainer together with the bearing and the oil seal collar.

   The universal puller may be used in place of the retaining ring remover.
4. Remove the thrust plate, thrust washer and lock ball.
5. Use a pair of snap ring pliers to remove reverse idler gear snap ring.

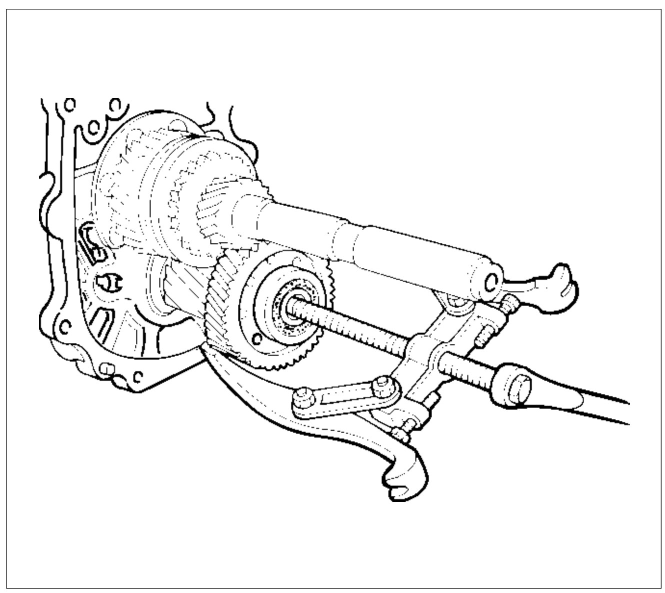

226RS004

6. Remove the reverse idler gear assembly from the intermediate plate.


226RS005

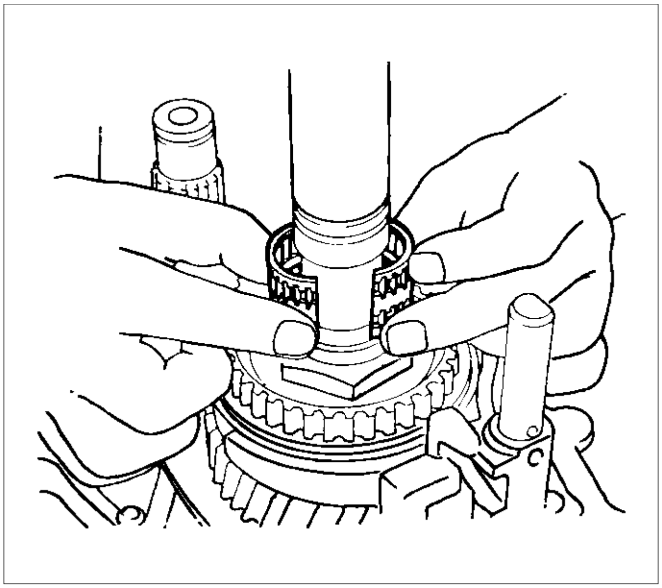
7. Remove the idle shaft pin, thrust washer, reverse idler gear, and reverse idler shaft.
8. Use a pair of snap ring pliers to remove the snap ring.
9. Attach a universal puller to the counter gear shaft.

   Use a universal puller to remove the ball bearing and the counter 5th gear.


226RS006

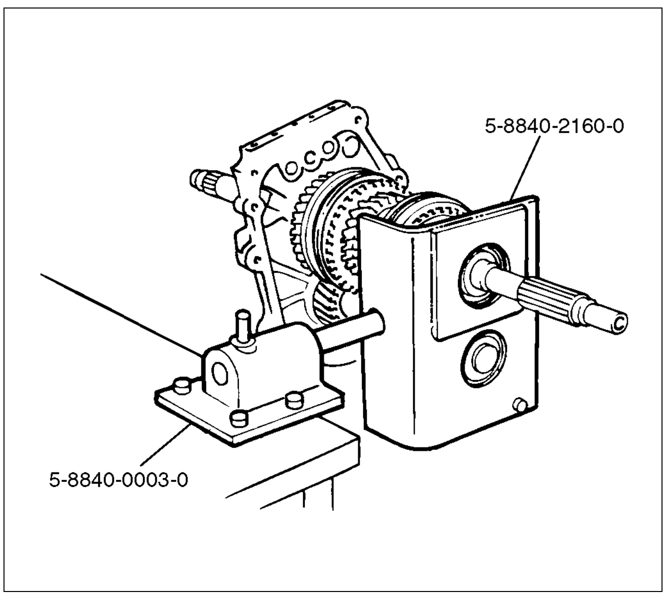
10. Remove the counter reverse gear.

11. Remove the 5th gear, 5th block ring, and needle bearing (2 piece type).


226RS007

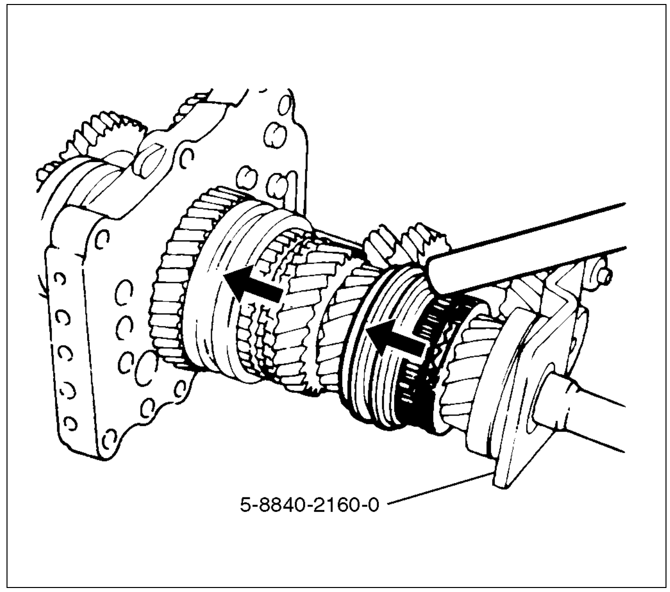
12. Remove the mainshaft nut according to following steps.

Attach the holding fixture 5-8840-2160-0 and base 5-8840-0003-0 to the mainshaft and the counter gear.



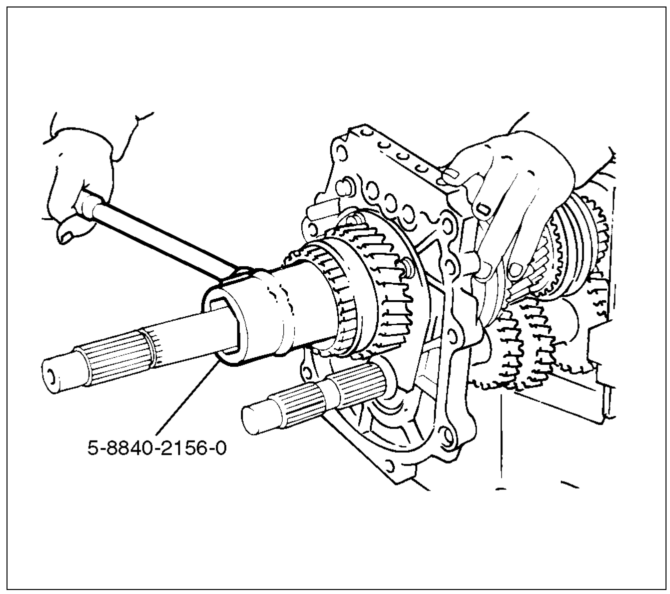
226RW212

- Engage the 3rd-4th synchronizer with the 3rd gear.
- Engage the 1st-2nd synchronizer with the 1st gear.



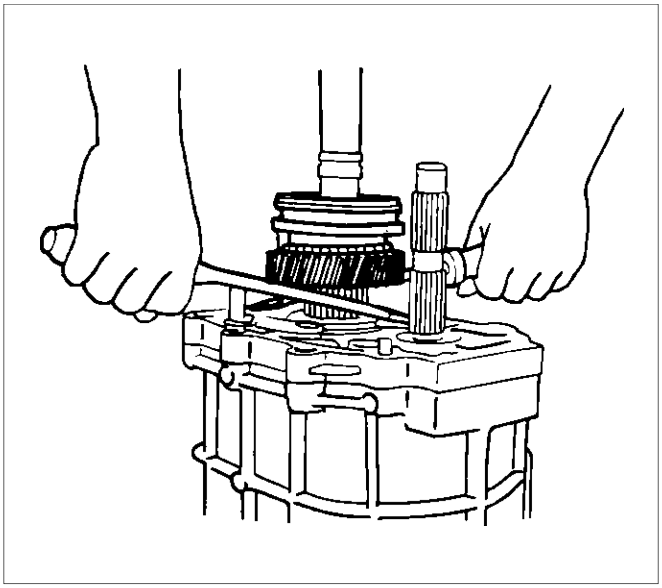
226RW210

- Use the mainshaft nut wrench 5-8840-2156-0 to remove the mainshaft nut.



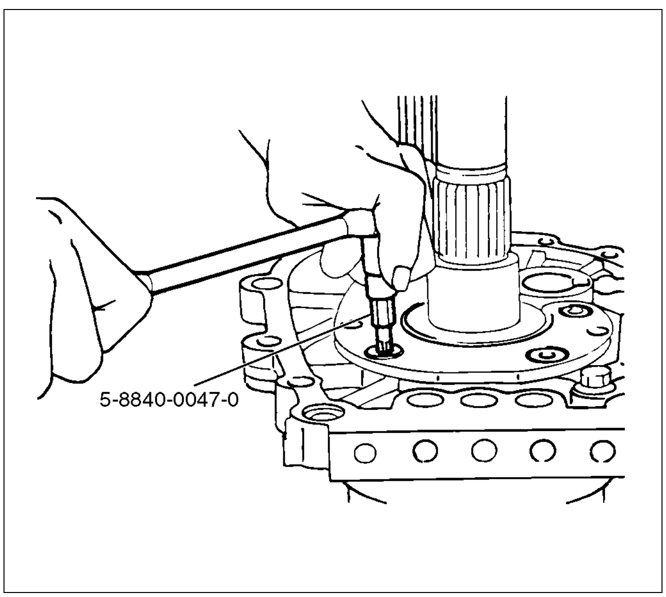
226RW211

13. Use screw drivers between the reverse gear and the bearing plate to remove the Rev-5th synchronizer assembly together with the reverse block ring and reverse gear.



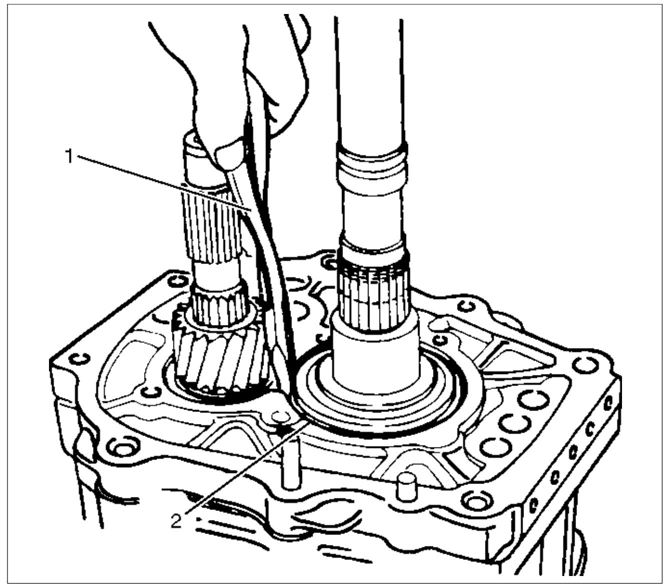
226RS010

14. Remove the needle bearing.
15. Use the torx bit wrench (T- 45) 5-8840-0047-0 to remove the bearing plate and screw from the intermediate plate.



220RW137

16. Use the snap ring pliers (1) to remove the mainshaft bearing snap ring (2).



226RS011

17. Hold the snap ring open with the pliers.

    Push the intermediate plate toward the rear of the transmission to remove it.

    The bearing snap ring will come free.

Inspection and Repair

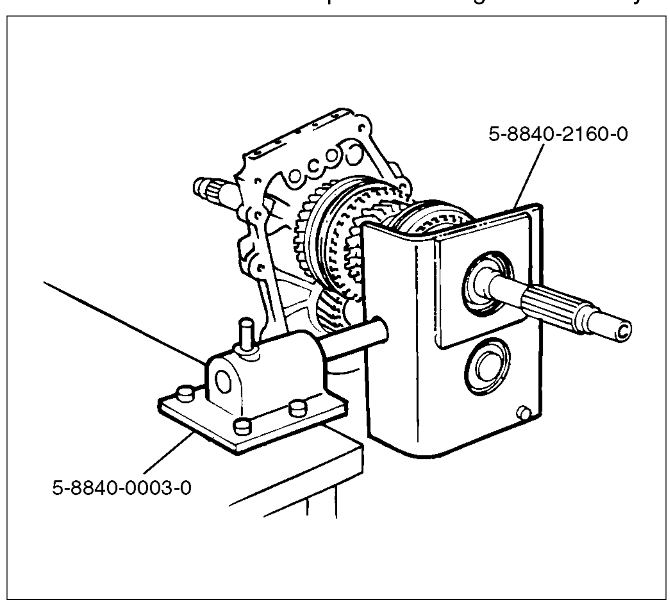
Refer to Top Gear Shaft, Main Gear Shaft, and Counter Gear in this section for inspection and repair.

Reassembly

1. Mesh the counter gear with the mainshaft assembly.

   Set the holding fixture 5-8840-2160-0 to the mainshaft and the counter gear and then install it on the base 5-8840-0003-0.

   Install the intermediate plate on the gear assembly.



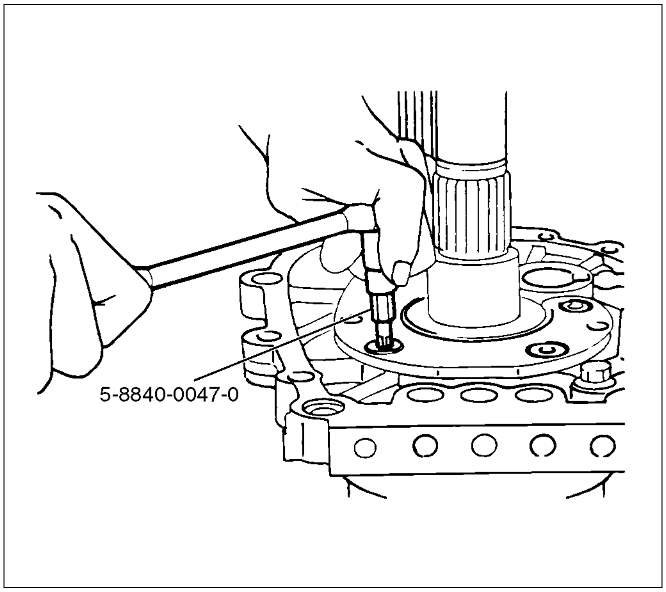
226RW212

2. Install the bearing snap ring.
3. Apply recommended thread locking agents (LOCTITE 242) or equivalent to each of the bearing plate screw threads.

   Install the bearing plate and screw.

   Tighten the screws to the specified torque by using torx bit wrench (T- 45) 5-8840-0047-0.

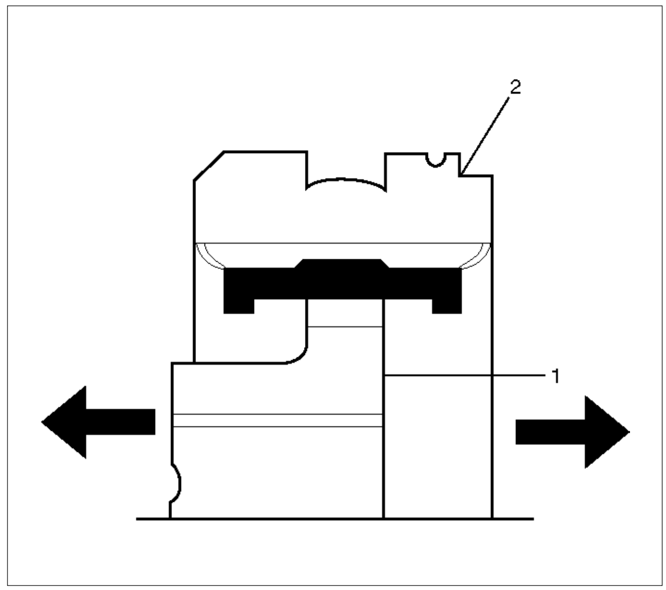
   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)



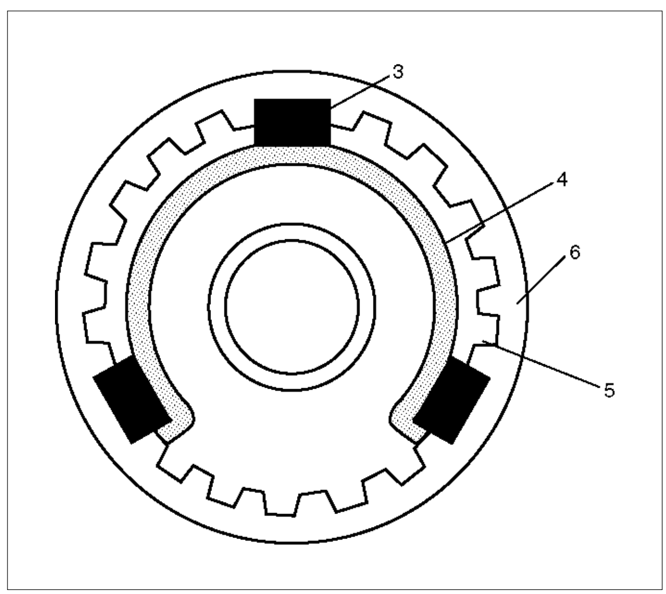
220RW137

4. Install the needle bearing, reverse gear and reverse block ring.
5. Assemble the rev-5th synchronizer assembly by performing the following steps.
   1. Turn the clutch hub face (1) toward the sleeve groove (2) (rear side) on the outer circumference.
   2. Check that the inserts (3) fit snugly into the clutch hub (5) ring insert grooves.
   3. Check that the inserts springs (4) are fitted to the inserts as shown in the illustration.
   4. Check that the clutch hub (5) and the sleeve (6) slide smoothly.
   5. Install the synchronizer assembly to the mainshaft.

   The clutch hub face with the heavy boss must be facing the reverse gear side.

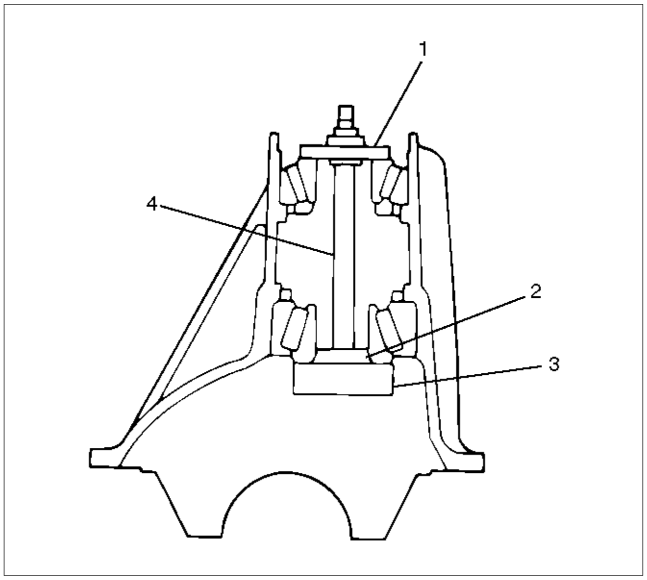


226RS013



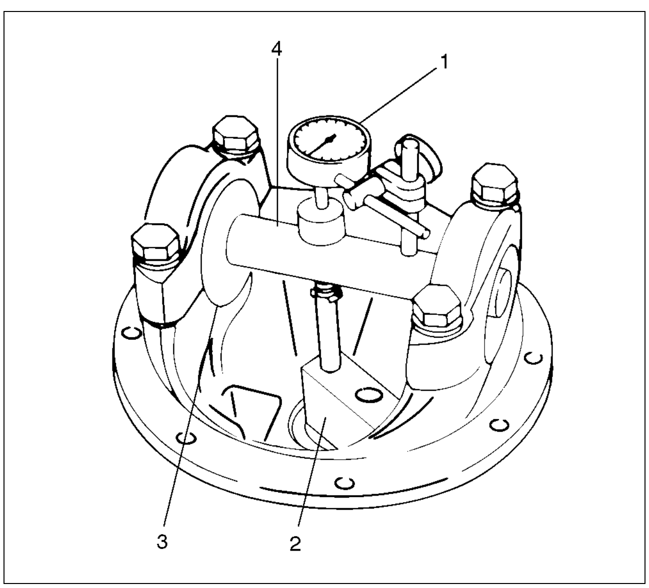
226RS049

b. Tighten the nut to the specified torque.
Torque:
ϕ220mm : 2.7 N·m (0.28 kgf·m/24 lb·in)
ϕ194mm : 2.3 N·m (0.23 kgf·m/20 lb·in)



425RW030

c. Clean the side bearing bores. Place discs and dial indicator on to arbor, and place tool into position in side bearing bores. Install and tighten the bearing caps to the specified torque.
Torque : ϕ220mm : 108N·m (11 kgf·m/80 lb·ft)
ϕ194mm : 94N·m (10 kgf·m/72 lb·ft)



425RW031

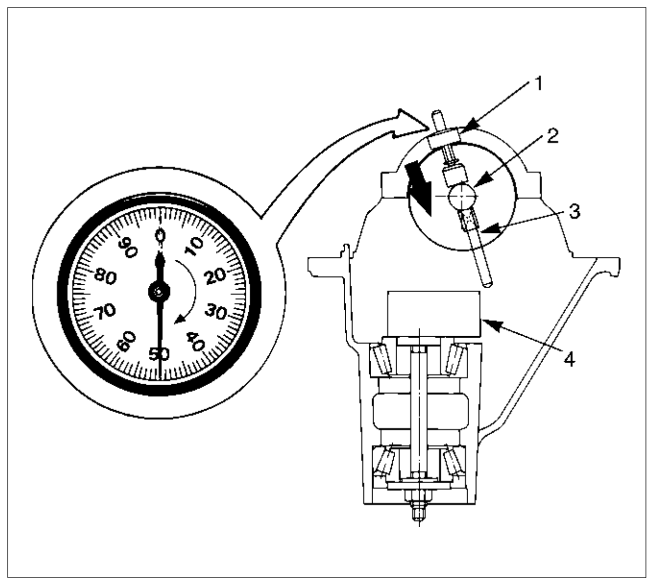
Legend

ϕ220mm
1. Dial Indicator : 5-8840-0126-0
2. Gauge Plate : 5-8840-2166-0
3. Disc (2 pcs.) : 5-8840-2167-0
4. Arbor : 5-8840-0128-0

ϕ194mm
1. Dial Indicator : 5-8840-0126-0
2. Gauge Plate : 5-8840-2087-0
3. Disc (2 pcs.) : 5-8840-2088-0
4. Arbor : 5-8840-0128-0

Note :
The scale on the dial indicator (5-8840-0126-0) is inch unit.

d. Set the dial indicator 5-8840-0126-0 to “0”. Place it on the mounting post of the gauging arbor with the contact button touching the indicator pad. Force the dial indicator downward until the needle has made a half turn clockwise. Tighten down the dial indicator in this position.



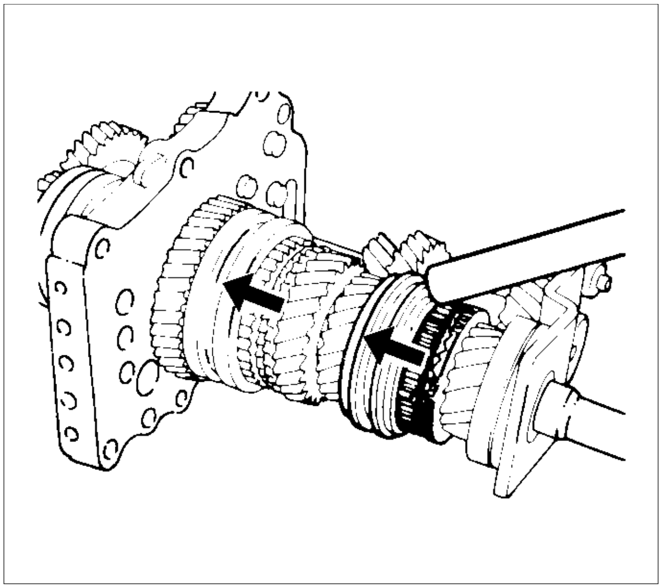
425RS020

Legend

1. Dial Indicator
2. Gauging Arbor
3. Plunger
4. Gauge Plate

e. Position the plunger on the gauge plate. Move the gauging arbor slowly back and forth and locate the position at which the dial indicator shows the greatest deflection. At this point, once again set the dial indicator to “0”.
Repeat the procedure to verify the “0” setting.

6. Mesh the 1st-2nd and 3rd-4th synchronizers with both the 1st and 3rd gears (double engagement).



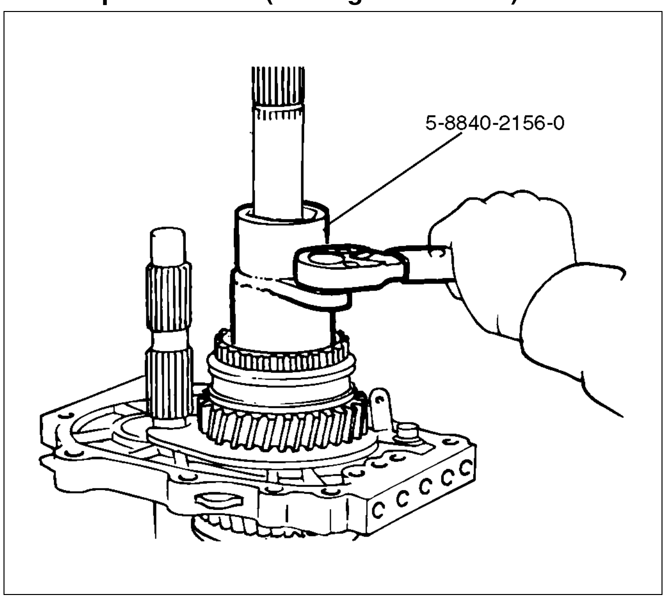
226RS015

This will prevent the mainshaft from turning.

7. Install the new mainshaft hub nut.

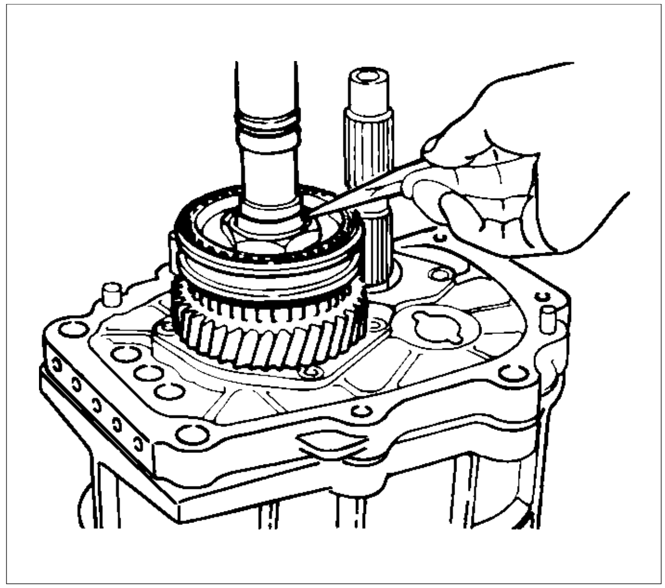
Use the mainshaft nut wrench 5-8840-2156-0 to tighten the mainshaft nut to the specified torque.

Torque: 137 N·m (14.0 kgf·m/101 lb·ft)



226RW214

8. Use a punch to stake the mainshaft nut.

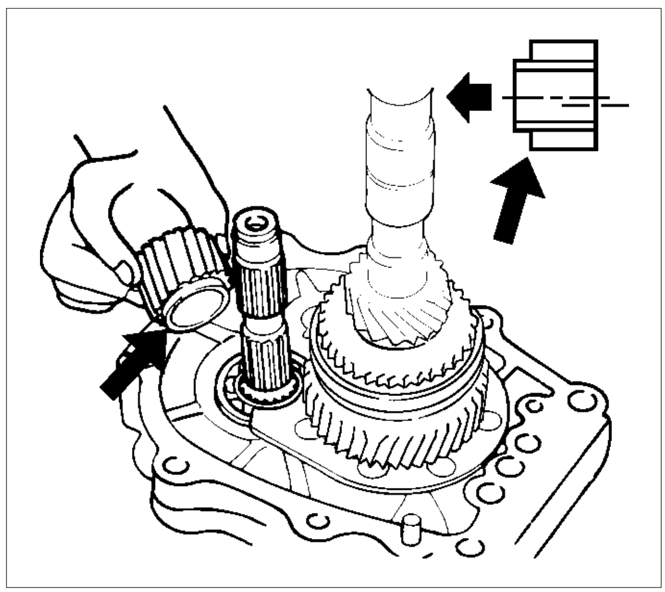


226RW153

9. Install the needle bearing, 5th block ring, and 5th gear.
10. Apply engine oil to the counter reverse gear and the reverse gear.

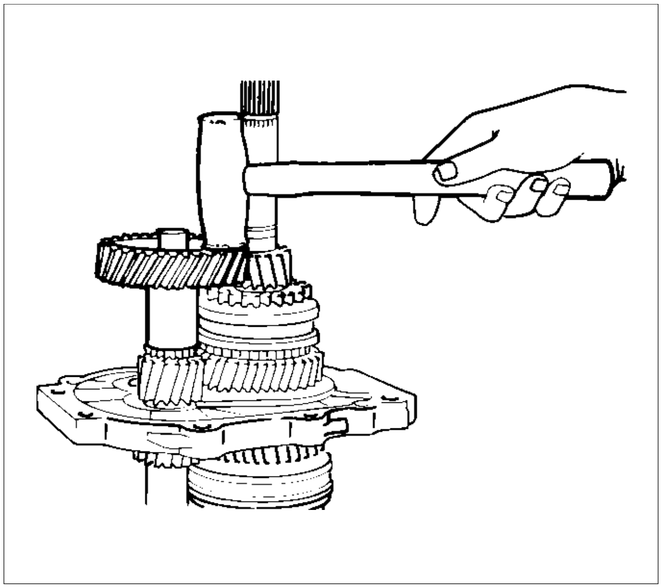
Install the counter reverse gear to the counter shaft.

The reverse gear projection must be facing the intermediate plate.



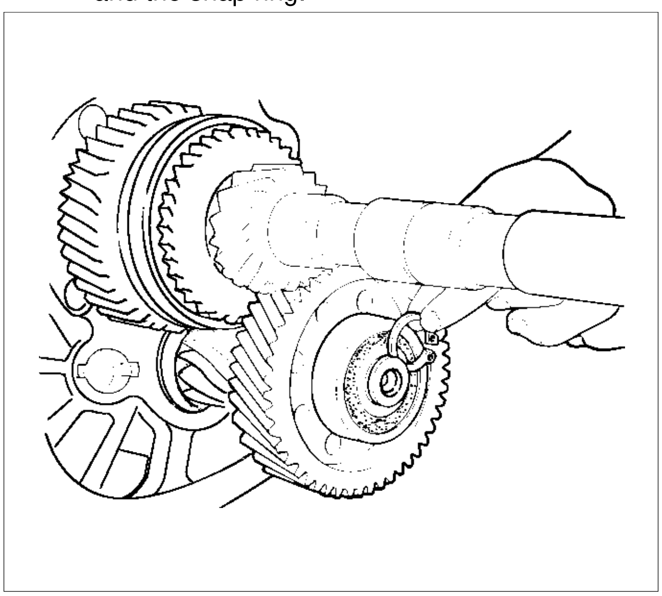
226RW151

11. Install the counter 5th gear to the counter shaft.



226RS019

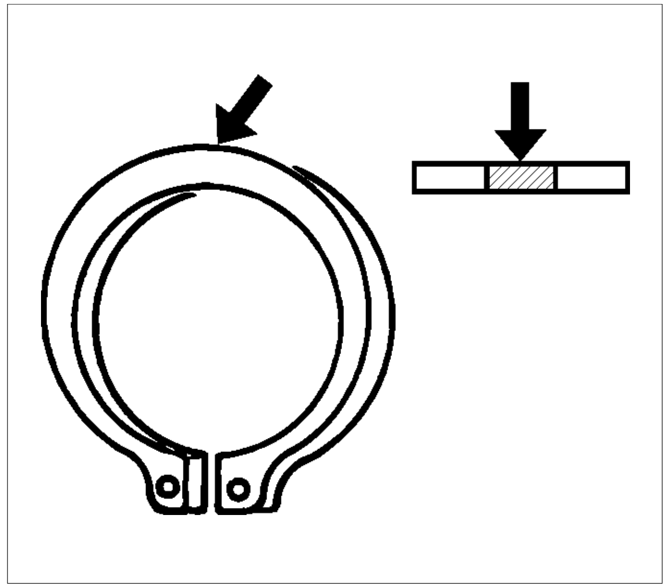
12. Install the ball bearing and bearing snap ring by performing the following steps:
    - Select the snap ring which will provide the minimum clearance between the ball bearing and the snap ring.



226RS020

- There are six snap ring sizes available.

  The snap rings are color‐ coded to indicate their thickness.



226RS021

Ball Bearing and Snap Ring Clearance

Standard: 0 - 0.15 mm (0 - 0.0059 in)

Snap Ring Availability

Thickness	Color Coding
1.1 mm (0.043 in)	White
1.2 mm (0.047 in)	Yellow
1.3 mm (0.051 in)	Blue
1.4 mm (0.055 in)	Pink
1.5 mm (0.059 in)	Green
1.6 mm (0.063 in)	Brown

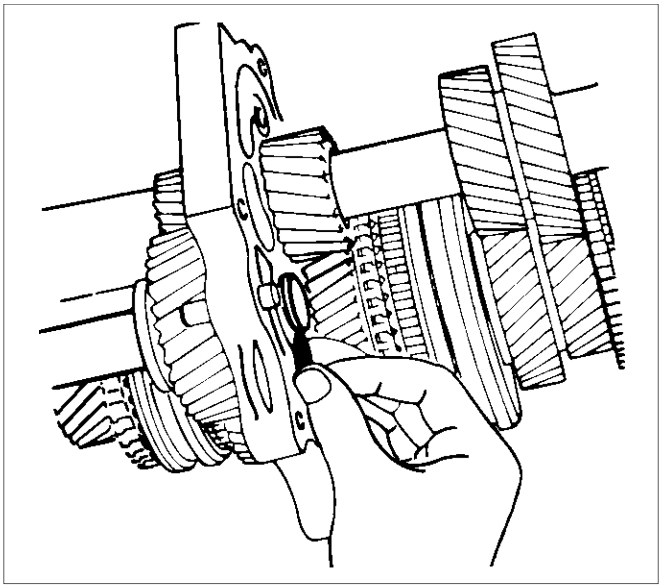
- Use a pair of snap ring pliers to install the snap ring to the counter gear shaft.

  The snap ring must be fully inserted into the counter gear shaft snap ring groove.

13. Assemble the reverse idler shaft, reverse idler gear, thrust washer, and idle shaft pin into the reverse idler gear assembly.

    The thrust washer should be assembled with the oil groove faces to gear side.

14. Select the reverse idler gear snap ring which will provide the minimum clearance between the intermediate plate and the snap ring.



226RS022

- There are three snap ring sizes available.

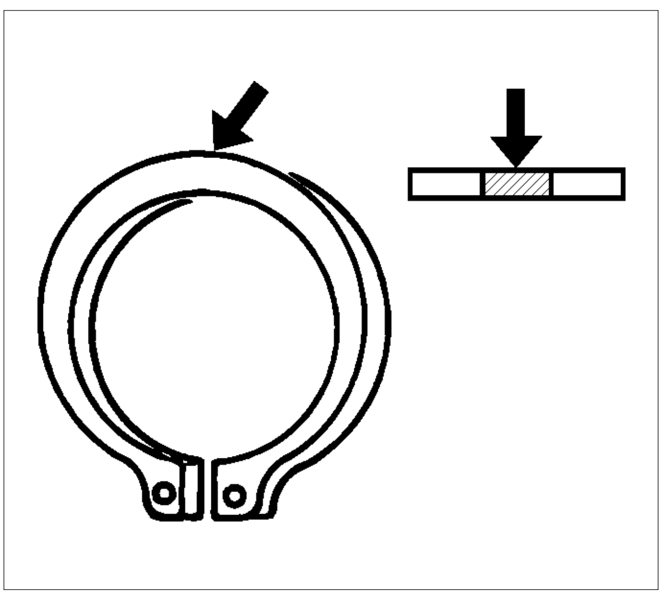
  The snap rings are color-coded to indicate their thickness.

Intermediate Plate and Snap Ring Clearance

Standard: 0 - 0.15 mm (0 - 0.0059 in)

Snap Ring Availability

Thickness	Color Coding
1.2 mm (0.047 in)	White
1.3 mm (0.051 in)	Yellow
1.4 mm (0.055 in)	Blue



226RS021

- Use a pair of snap ring pliers to install the snap ring to the reverse idler shaft.

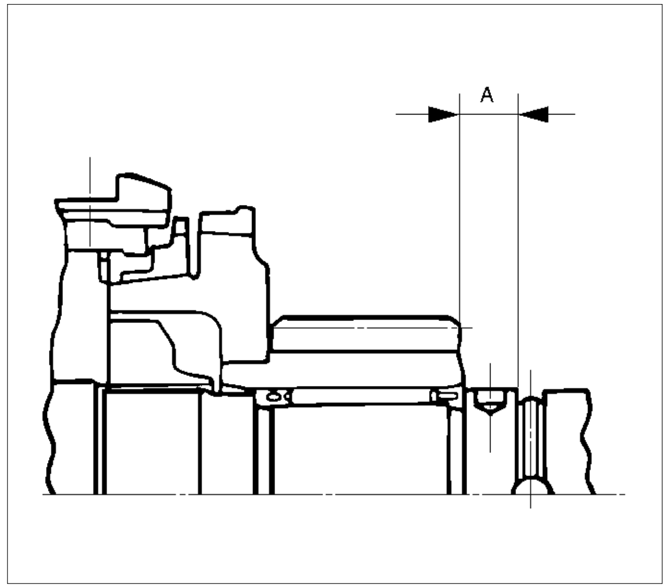
  The snap ring must be fully inserted into the reverse idler shaft snap ring groove.

15. Install the thrust washer and lock ball by performing the following steps:
    - Use a thickness gauge to measure the clearance between the 5th gear and the thrust washer.

5th Gear and Thrust Washer Clearance

Standard: 0.10 - 0.25 mm (0.004 - 0.010 in)

- Measure clearance "A" as shown in the figure.



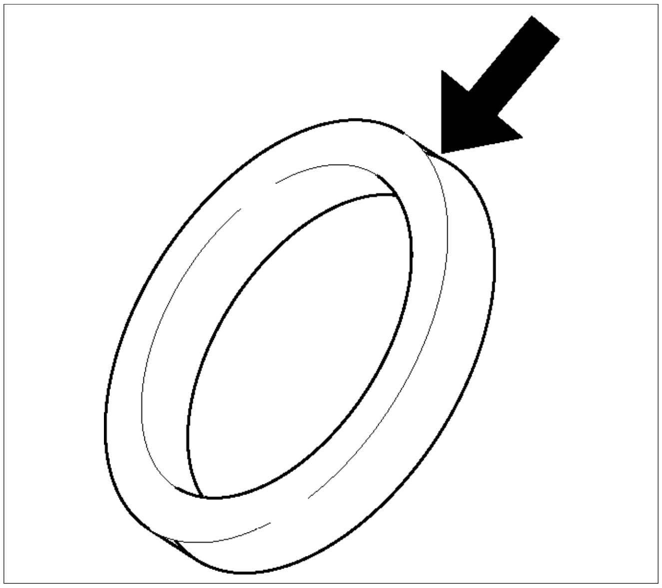
226RS023

- Select an appropriate thrust washer from the chart.
- There are four thrust washer sizes available.

Thrust Washer Availability

Thickness mm (in)	Color Coding	A mm (in)	Clearance mm (in)
7.9 (0.311)	White	8.05 - 8.1 (0.317-0.319)	0.15 - 0.25 (0.006-0.010)
8.0 (0.315)	Yellow	8.1 - 8.2 (0.319-0.323)	0.1 - 0.25 (0.004-0.010)
8.1 (0.319)	Green	8.2 - 8.3 (0.323-0.327)	0.1 - 0.25 (0.004-0.010)
8.2 (0.323)	Blue	8.3 - 8.36 (0.327-0.329)	0.1 - 0.21 (0.004-0.008)

- The thrust washers are color coded to indicate their thickness as shown in the figure.

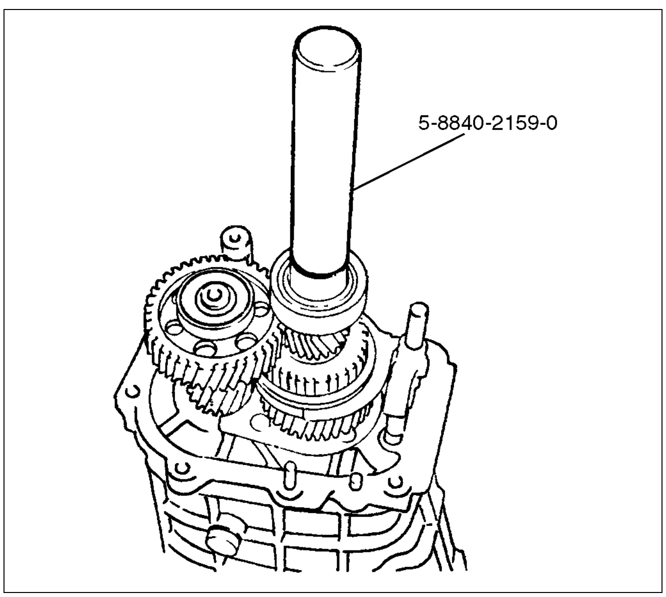


226RS024

- Apply grease to the thrust washer and the lock ball.
- Install the thrust washer and the lock ball.

16. Install the thrust plate and retainer.
17. Apply engine oil to the bearing inner and outer circumference.

    Use the installer 5-8840-2159-0 to install the ball bearing to the mainshaft.



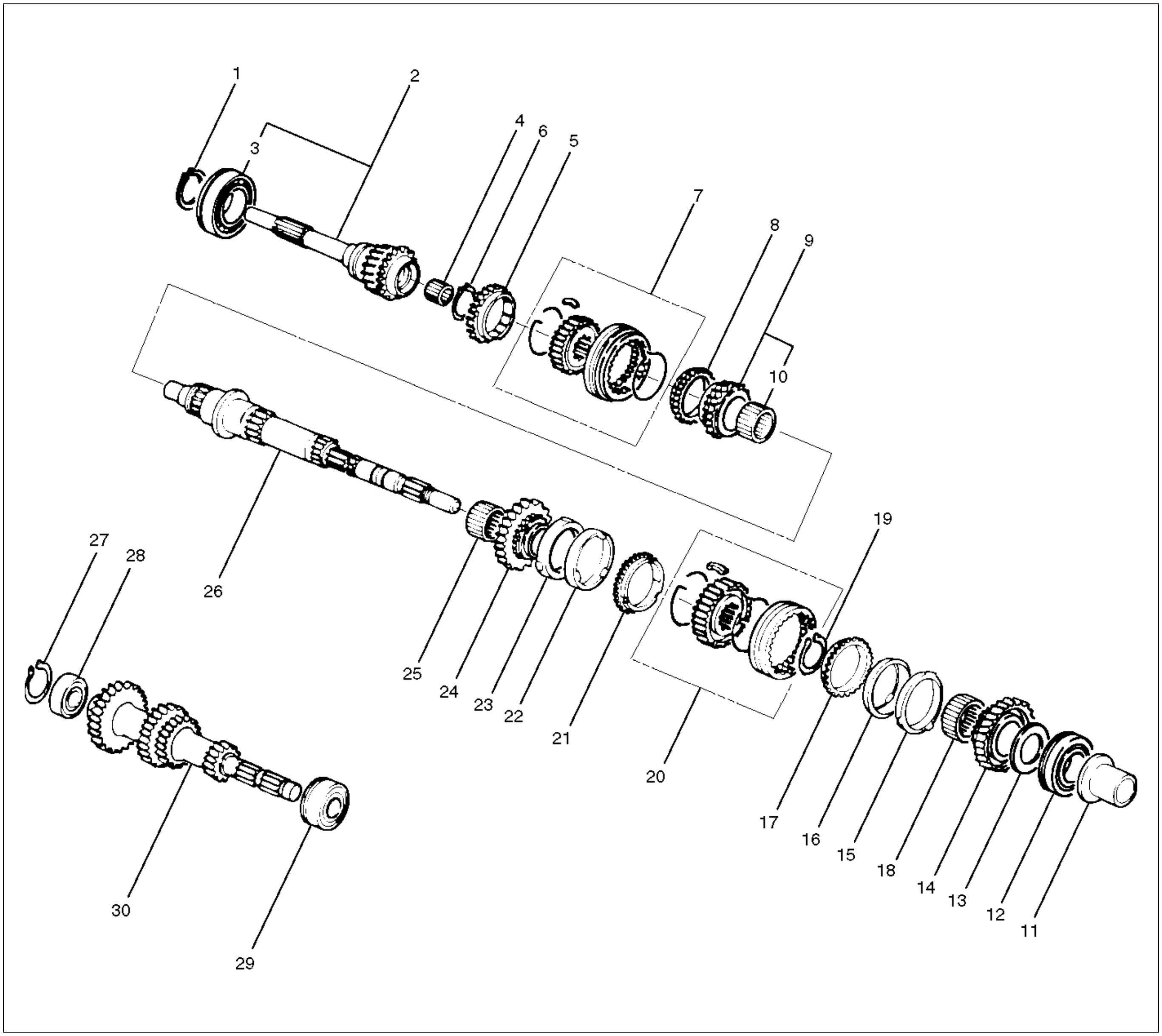
226L100002

18. Apply engine oil to the oil seal collar inner circumference.

    Install the oil seal collar to the mainshaft by using the installer 5-8840-2159-0.
19. Install the oil seal collar snap ring.

Top Gear Shaft, Main Gear Shaft, and Counter Gear Shaft

Disassembled View

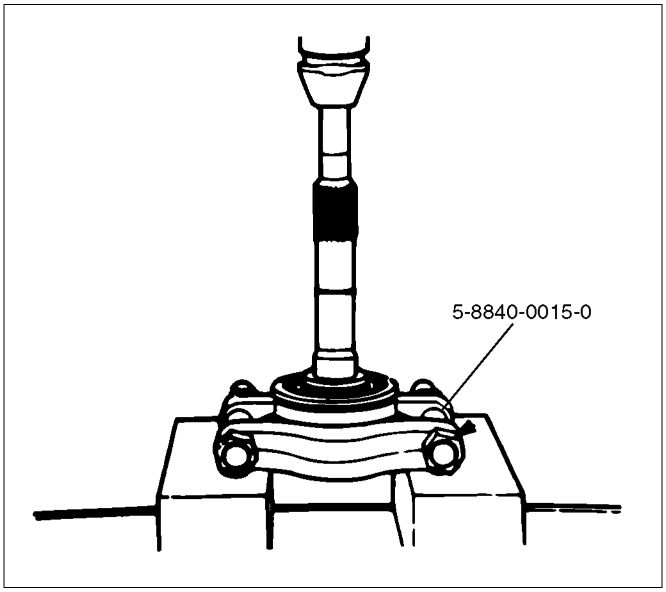


Legend

(1)	Top Gear Shaft Snap Ring	(16)	1st Outside Ring
(2)	Top Gear Shaft	(17)	1st Block Ring
(3)	Ball Bearing	(18)	Needle Bearing
(4)	Needle Bearing	(19)	Clutch Hub Snap Ring
(5)	Top Block Ring	(20)	1st-2nd Synchronizer Assembly
(6)	Mainshaft Snap Ring	(21)	2nd Block Ring
(7)	3rd-4th Synchronizer Assembly	(22)	2nd Outside Ring
(8)	3rd Block Ring	(23)	2nd Inside Ring
(9)	3rd Gear	(24)	2nd Gear
(10)	Needle Bearing	(25)	Needle Bearing
(11)	Needle Bearing Collar	(26)	Mainshaft
(12)	Mainshaft Ball Bearing	(27)	Bearing Snap Ring
(13)	1st Gear Thrust Bearing	(28)	Front Roller Bearing
(14)	1st Gear	(29)	Center Roller Bearing
(15)	1st Inside Ring	(30)	Counter Gear Shaft

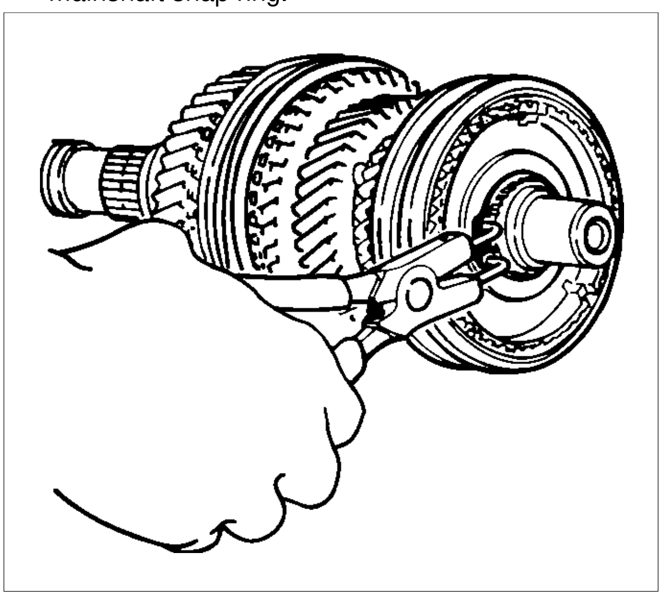
Disassembly

1. Use a pair of snap ring pliers to remove the top gear shaft snap ring.
2. Remove the top gear shaft with ball bearing.
3. Use a bench press and the bearing remover 5-8840-0015-0 to remove the ball bearing.



226RW216

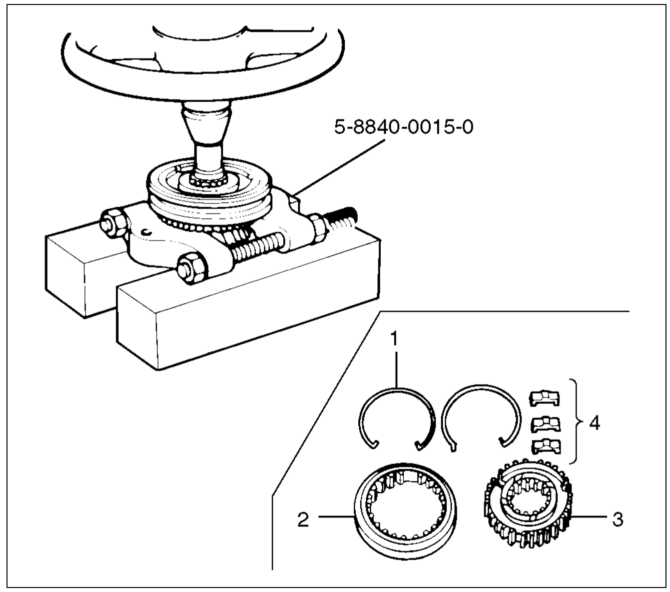
4. Remove the needle bearing and top block ring, mainshaft snap ring.
5. Use a pair of snap ring pliers to remove the mainshaft snap ring.



226RS008

6. Use a bench press and the bearing remover 5-8840-0015-0 to remove the 3rd-4th synchronizer assembly as a set.

   Disassemble the synchronizer assembly.

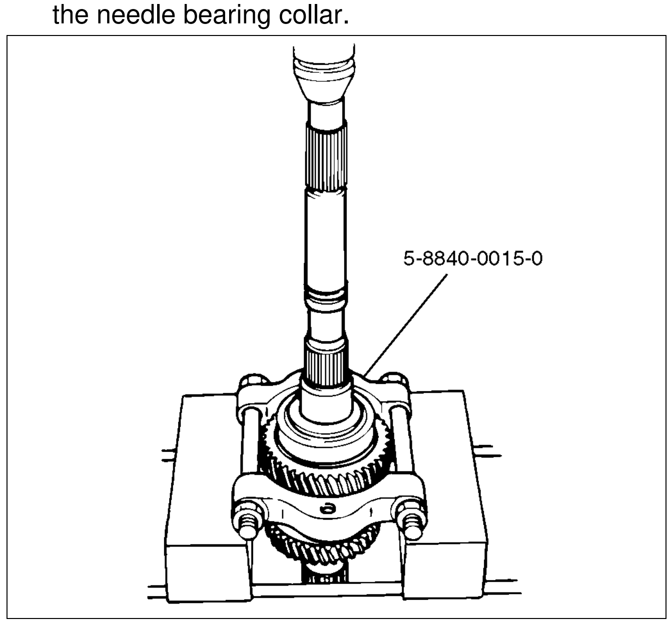


226RW217

Legend

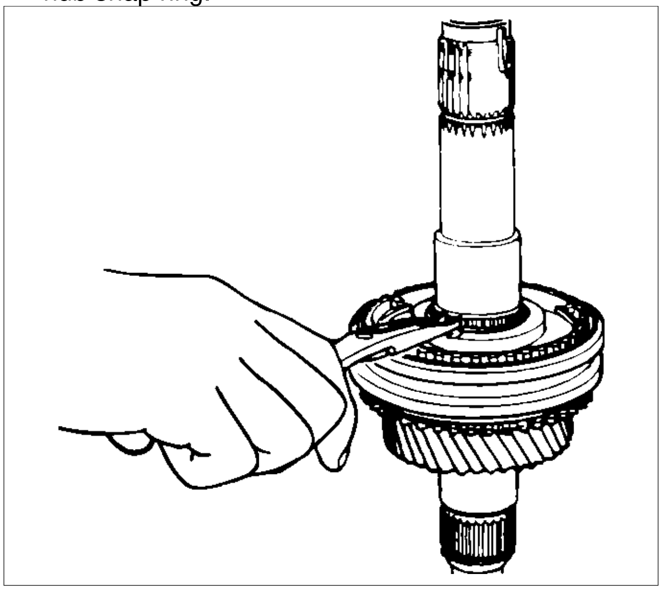
(1) Springs
(2) Sleeve
(3) Clutch Hub
(4) Inserts

7. Remove the 3rd block ring, 3rd gear, and needle bearing.
8. Use a bench press and the bearing remover 5-8840-0015-0 to remove the 1st gear together with the mainshaft ball bearing, 1st gear thrust bearing, and the needle bearing collar.



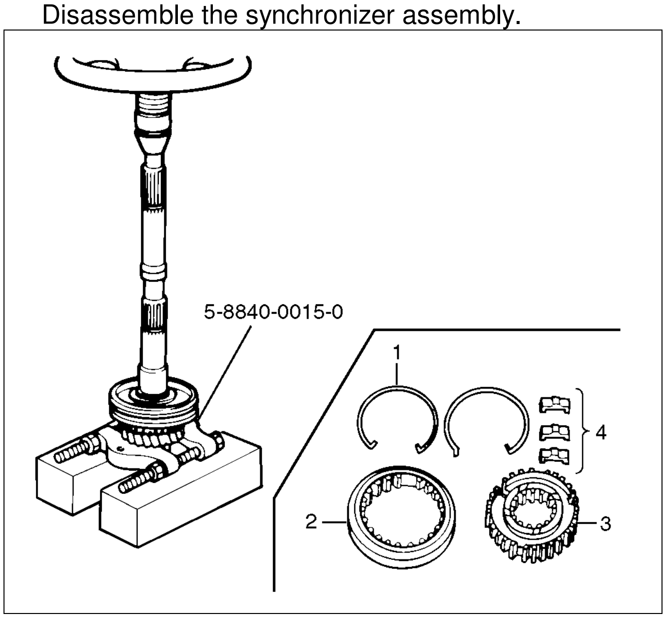
226RW218

9.Disassemble the 1st inside ring, 1st outside ring, and 1st block ring.
10.Remove the needle bearing.
11.Use a pair of snap ring pliers to remove the clutch hub snap ring.



226RS031

12.Use a bench press and the bearing remover 5-8840-0015-0 to remove the 2nd gear together with 1st-2nd synchronizer assembly, 2nd block ring, 2nd outside ring, and inside ring.
Disassemble the synchronizer assembly.

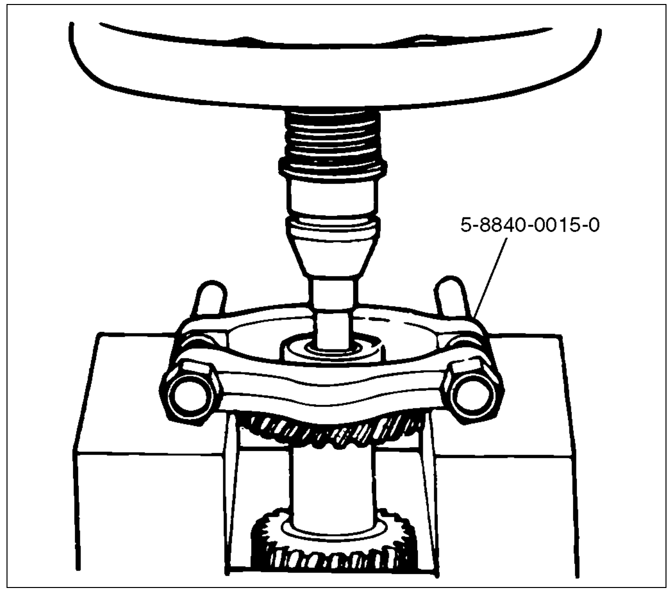


226RW220

Legend

(1) Springs
(2) Sleeve
(3) Clutch Hub
(4) Inserts

13. Remove the needle bearing from the mainshaft.
14. Remove the bearing snap ring.
15. Remove the front roller bearing by performing the following steps.
    - Remove the ring, outer race and bearing assembly by using a bench press and remover 5-8840-0015-0.
    - Remove the inner race by using a bench press and remover 5-8840-0015-0.



226RW219

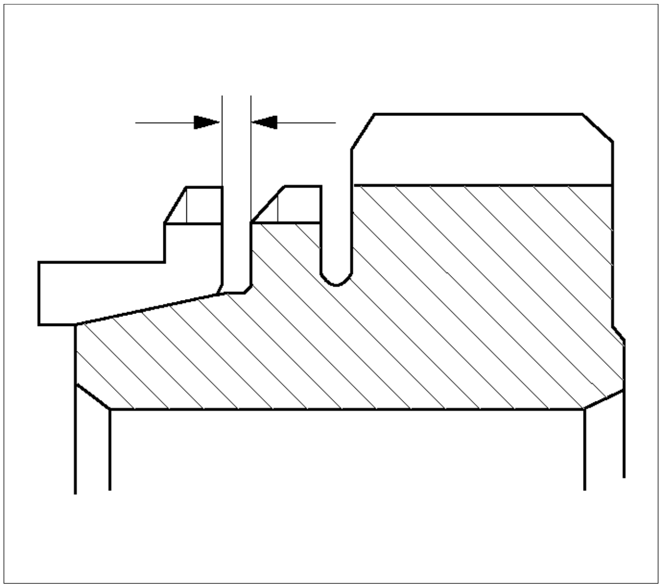
16. Remove the center roller bearing from the counter gear shaft.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Block Ring and Dog Teeth Clearance

- Use a thickness gauge to measure the clearance between the block ring and the dog teeth.



226RS035

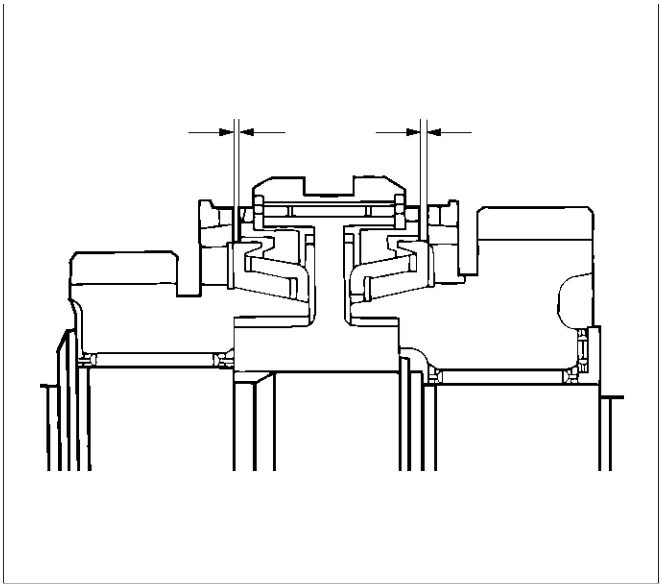
If the measured value exceeds the specified limit, the block ring must be replaced.

Block Ring and Dog Teeth Clearance

Standard	Limit
1.5 mm (0.059 in)	0.8 mm (0.031 in)

1st-2nd Synchronizer (3-CONE)

- Use a thickness gauge to measure the clearance between the block ring and the dog teeth.



226RS036

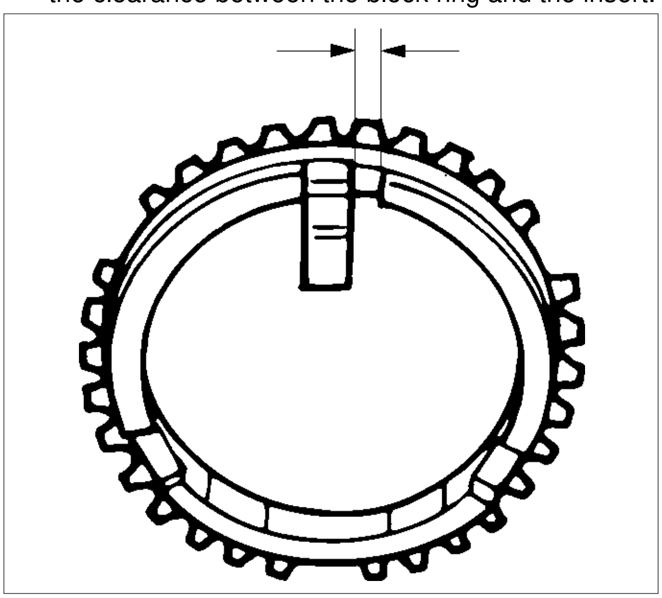
If the measured value exceeds the specified limit, the 1st-2nd synchronizer assembly must be replaced.

Block Ring and Dog Teeth Clearance

Standard	Limit
1.5 mm (0.059 in)	0.8 mm (0.031 in)

Block Ring and Insert Clearance

- Use a vernier caliper or thickness gauge to measure the clearance between the block ring and the insert.



226RS037

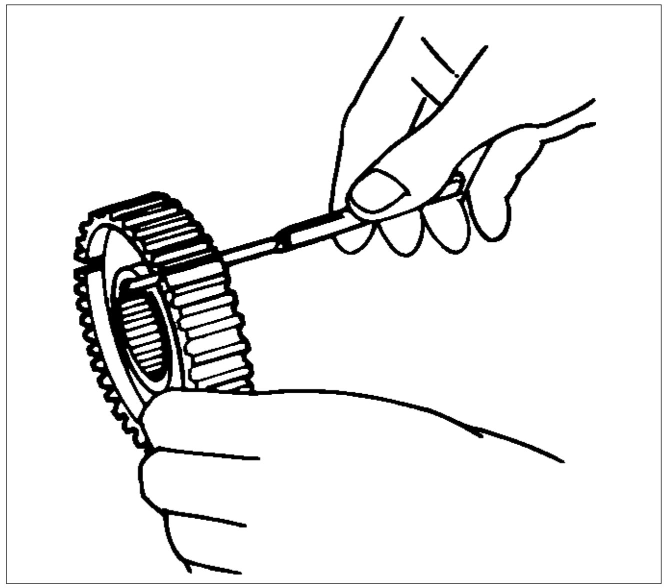
If the measured value exceeds the specified limit, the block ring and the insert must be replaced.

Block and Insert Clearance

	Standard	Limit
3rd-4th	3.46 - 3.76 mm (0.136 - 0.148 in)	4.0 mm (0.157 in)
1st-2nd	3.86 – 4.16 mm (0.152 - 0.164 in)	4.9 mm (0.193 in)
Rev.5th	3.59 - 3.91 mm (0.141 - 0.154 in)	4.1 mm (0.161 in)

Clutch Hub and Insert Clearance

- Use a thickness gauge to measure the clearance between the clutch hub and the insert.

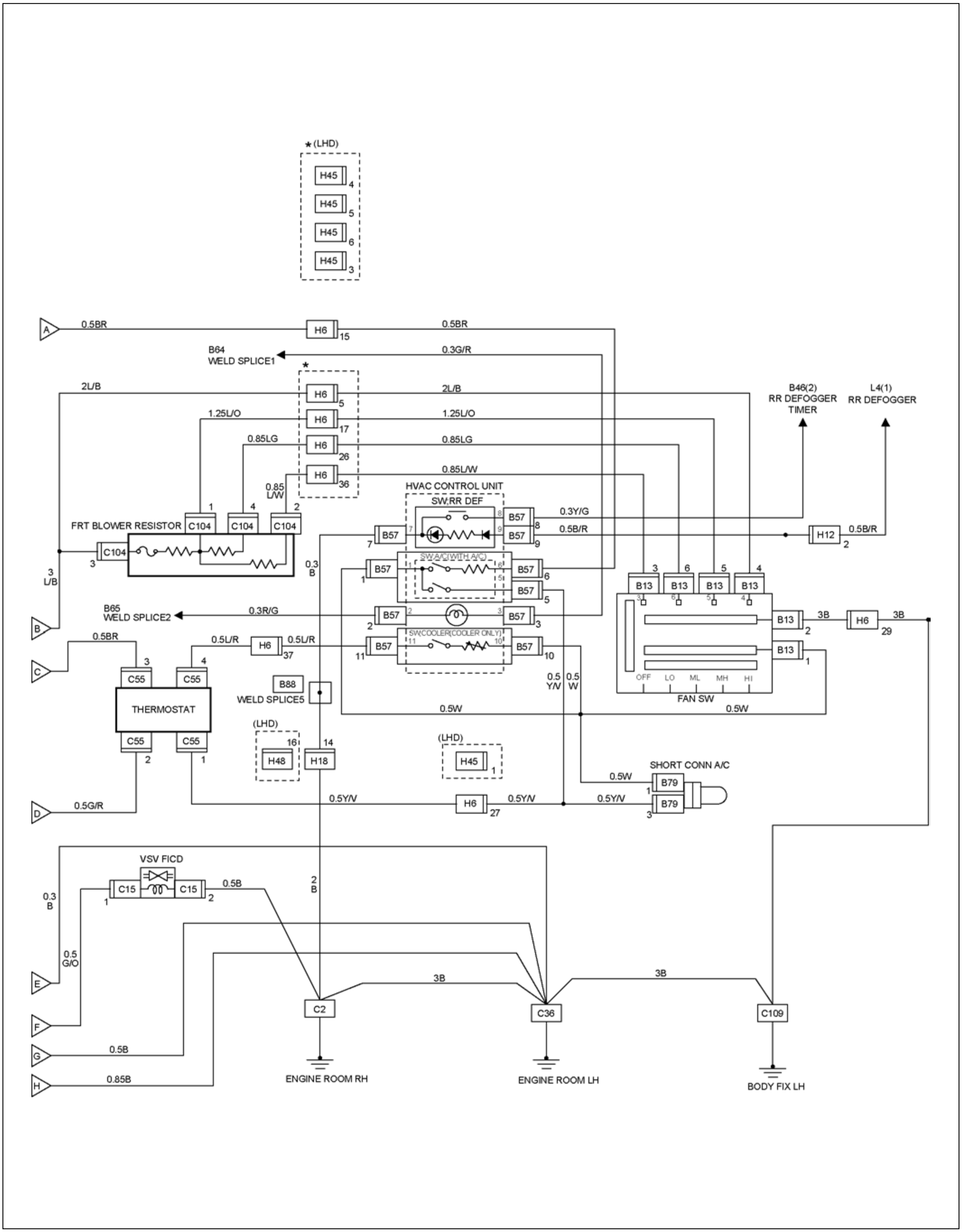


226RS038

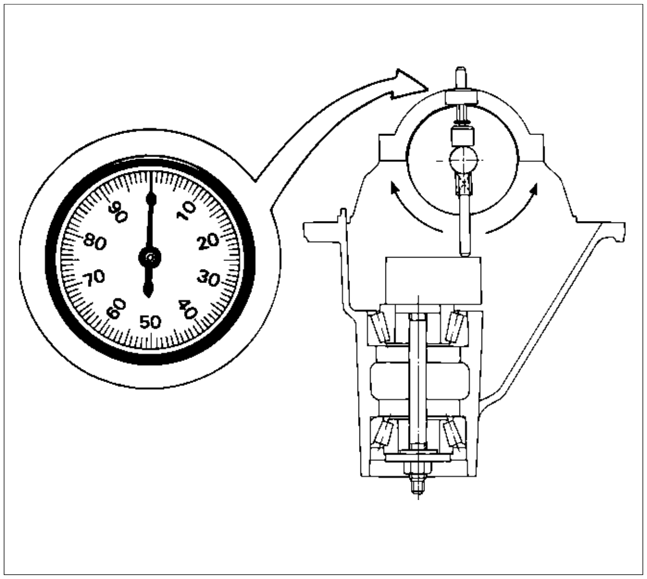
If the measured value exceeds the specified limit, the clutch hub and the insert must be replaced.

Clutch Hub and Insert Clearance

	Standard	Limit
1st-2nd 3rd-4th	0.01 – 0.21 mm (0.0004 - 0.0083 in)	0.3 mm (0.012 in)
Rev-5th	0.09 – 0.31 mm (0.0035 - 0.0122 in)	0.4 mm (0.016 in)

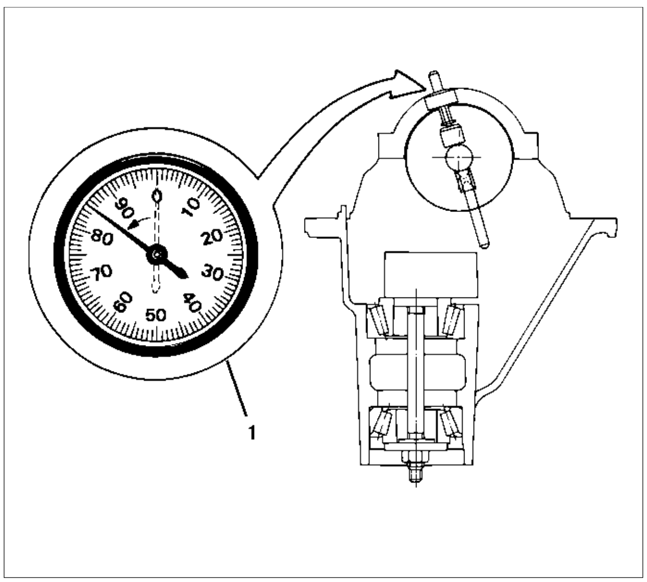


RTW78AXF008301



425RS02

f. After the ZERO setting is obtained, rotate the gauging arbor until the dial indicator rod does not touch the gauging plate. Record the number the dial indicator needle points.

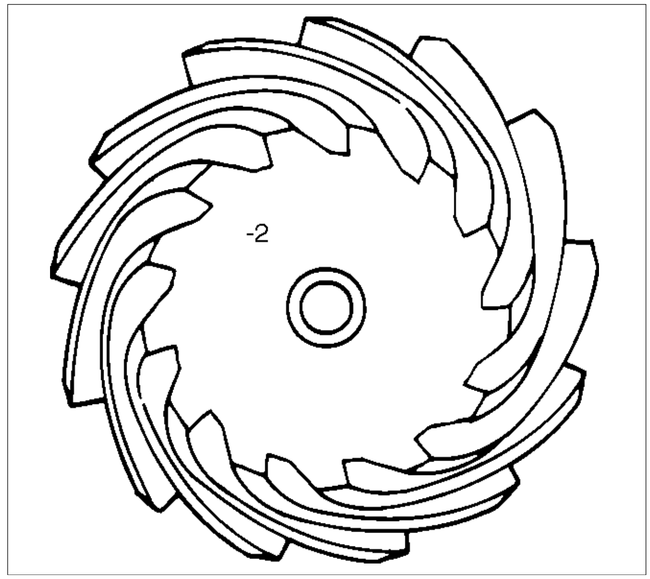


425RS022

Legend

1. Example=Dial indicator reading on 0.085

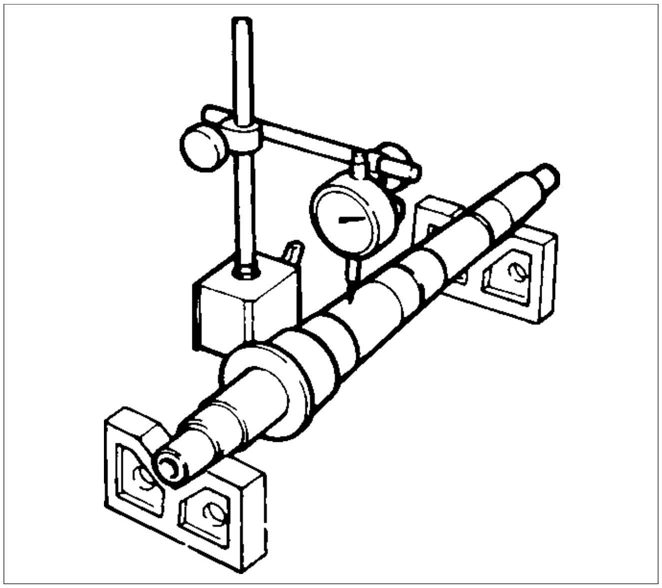
g. Record the pinion depth code on the head of the drive pinion. The number indicates a necessary change in the pinion mounting distance. A plus number indicates the need for a greater mounting distance (which can be achieved by decreasing the shim thickness). A minus number indicates the need for a smaller mounting distance (which can be achieved by increasing the shim thickness). If examination reveals pinion depth code “0”, the pinion is “nominal”.



425RS023

Mainshaft Run-out

- Install the mainshaft to V-blocks.
- Use a dial indicator to measure the mainshaft central portion run-out.



226RS039

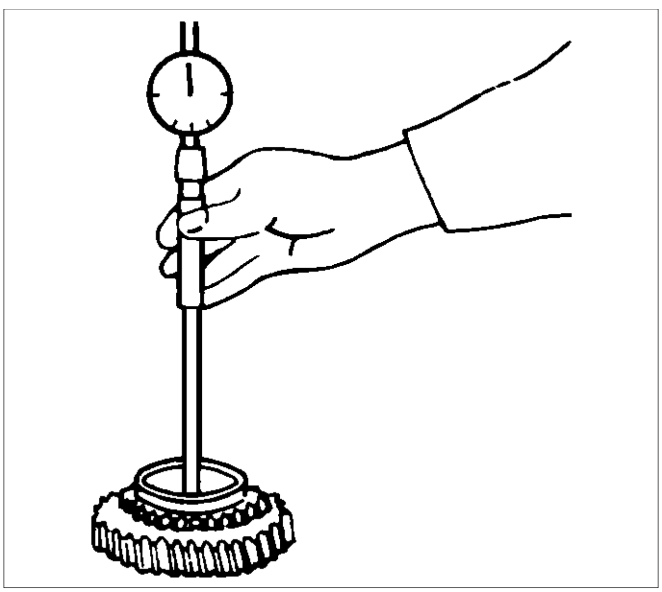
If the measured mainshaft run-out exceeds the specified limit, the mainshaft must be replaced.

Mainshaft Run-out

Limit: 0.05 mm (0.0020 in)

Gear Inside Diameter

- Use an inside dial indicator to measure the gear inside diameter.



226RS040

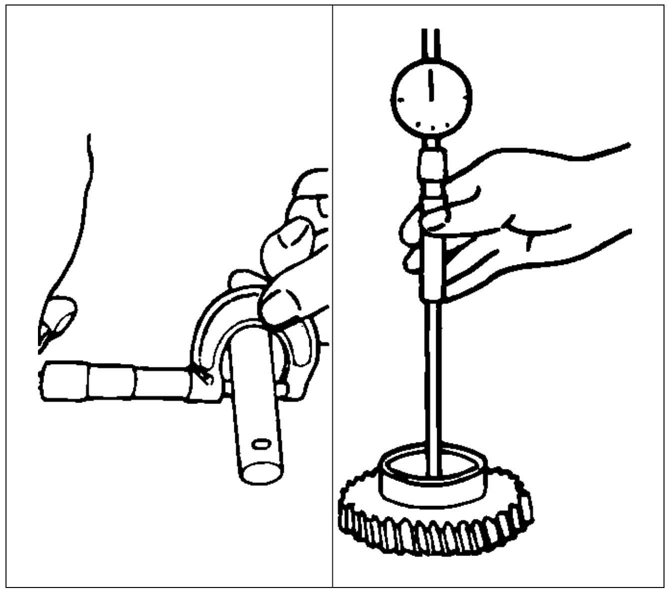
If the measured value is less than the specified limit, the gear must be replaced.

Gear Inside Diameter

	Standard	Limit
1st 3rd	45.000 - 45.013 mm (1.771 - 1.772 in)	45.100 mm (1.776 in)
2nd	52.000 - 52.013 mm (2.047 - 2.048 in)	52.100 mm (2.051 in)
Rev.	48.000 - 48.013 mm (1.889 - 1.890 in)	48.100 mm (1.894 in)
5th	32.000 - 32.013 mm (1.259 - 1.260 in)	32.100 mm (1.246 in)

Reverse Idler Gear and Idler Gear Shaft Clearance

- Use a micrometer to measure the idler gear shaft diameter.
- Use an inside dial indicator to measure the idler gear inside diameter.



226RS041

- Calculate the idler gear and idler gear shaft clearance.

  Idler gear inside diameter-idler gear shaft diameter = idle gear and idler gear shaft clearance.

  If the measured value exceeds the specified limit, the idle gear and/or the idler gear shaft must be replaced

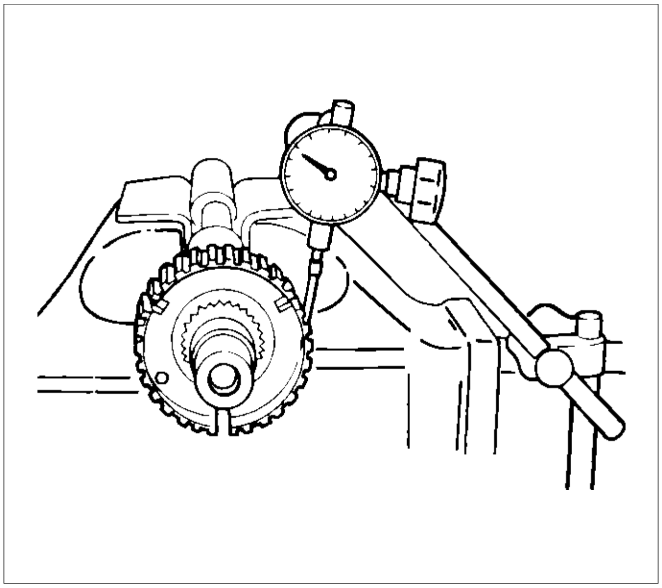
  Idler Gear and Idler Gear Shaft Clearance

  Standard: 0.041 - 0.074 mm (0.0016 -0.0029 in)

  Limit: 0.150 mm (0.0059 in)

Clutch Hub Spline Play

- Set a dial indicator to the clutch hub which requires measuring.



226RS042

- Move the clutch hub as far as possible to the right and left.

  Note the dial indicator reading.

  If the measured value exceeds the specified limit, the clutch hub must be replaced.

Clutch Hub Spline Play

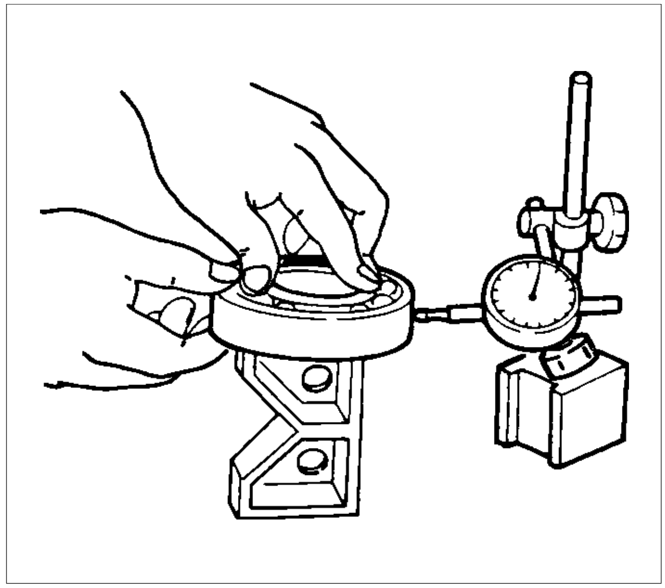
	Standard	Limit
1st-2nd 3rd-4th	0 - 0.1 mm (0 - 0.004 in)	0.2 mm (0.008 in)
Rev. 5th	0 - 0.2 mm (0 - 0.008 in)	0.3 mm (0.012 in)

Ball Bearing Play

- Use a dial indicator to measure the ball bearing play.

  Ball Bearing Play

  Limit: 0.2 mm (0.008 in)

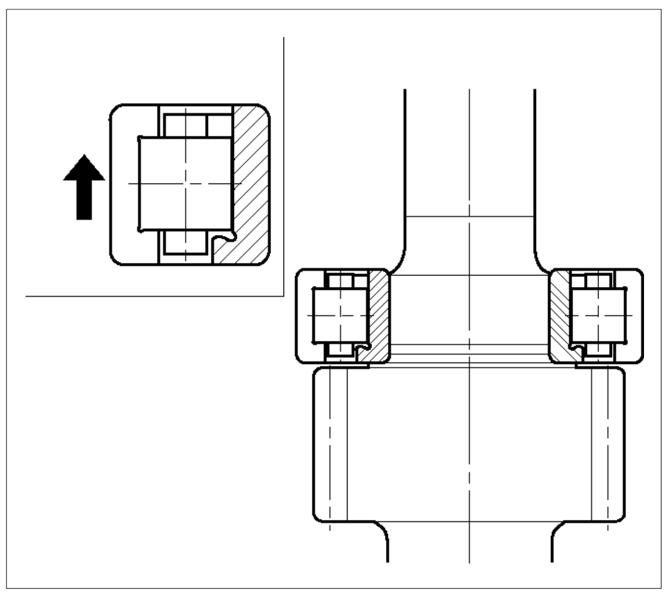


226RS043

Reassembly

1. Install the center roller bearing to the counter gear shaft.
   - Apply engine oil to the bearing inner and outer circumferences.
   - Install the roller bearing in the proper direction.

NOTE: Check that the outer race moves only in the direction of the arrow.

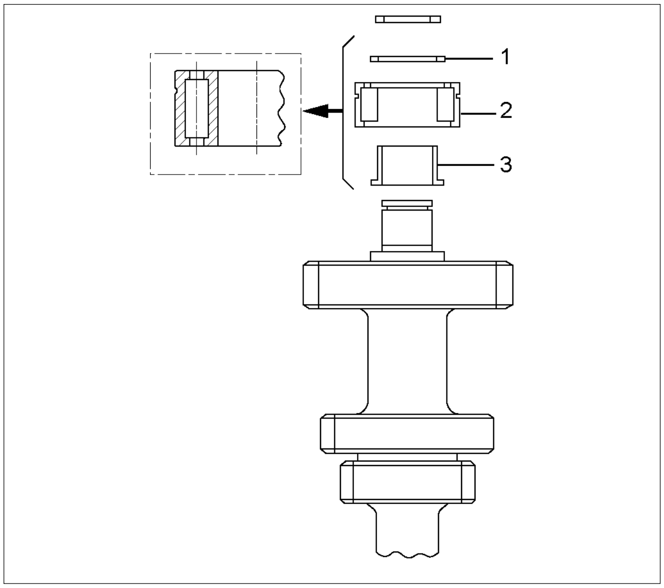


226RS044

2. Install the front roller bearing by performing the following steps.
   - Use the bearing installer 5-8840-2194-0 to install the front roller bearing inner race to the counter gear shaft.
   - Install the outer race and roller assembly.

     The snap ring groove must be facing the transmission front side.

- Use the bearing installer 5-8840-2194-0 to install the ring.



RTW57BSH000101

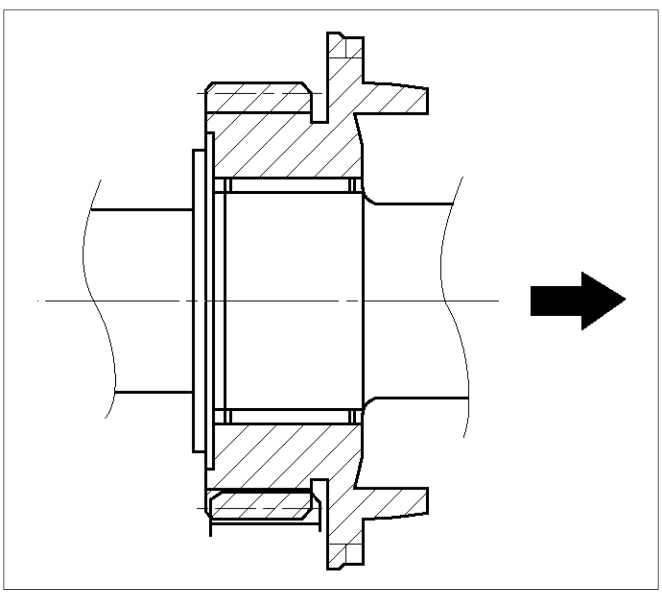
Legend

(1) Ring
(2) Outer Race and Roller Assembly
(3) Inner Race

3. Install the bearing snap ring to the counter gear shaft.
4. Apply engine oil to the needle bearing and the 2nd gear thrust surfaces.

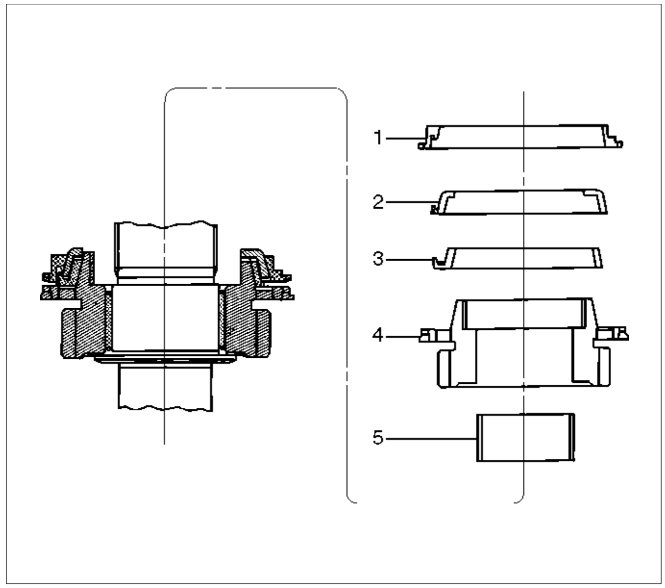
   Install the needle bearing and the 2nd gear to the mainshaft.

   The 2nd gear dog teeth must be facing the transmission rear side.



226RS046

5. Assemble the 2nd inside ring, 2nd outside ring, and the 2nd block ring.
   - Apply engine oil to the synchronizer ring friction surfaces.

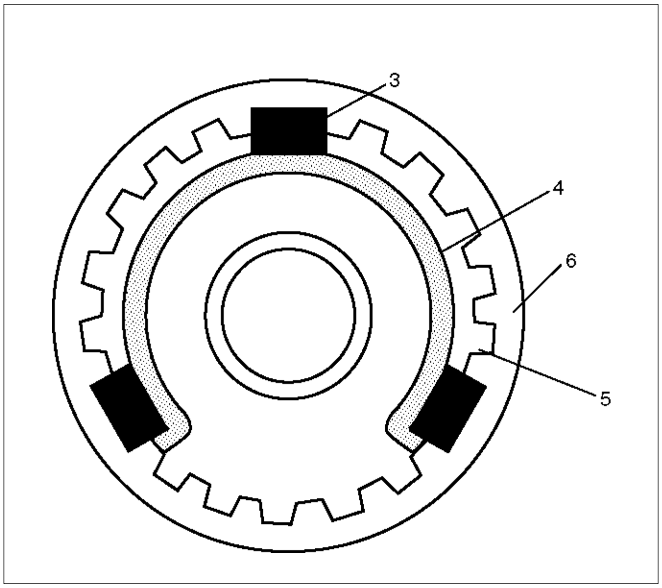


226RS047

Legend

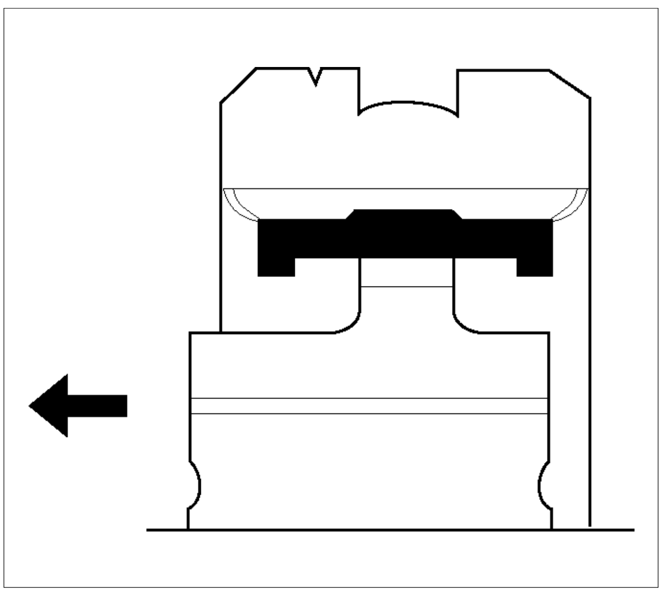
(1) Block Ring
(2) Outside Ring
(3) Inside Ring
(4) 2nd Gear
(5) Needle Bearing

6. Assemble the 1st-2nd synchronizer assembly by performing the following steps:
   1. Check that the inserts (3) fit snugly into the clutch hub (5) insert grooves.
   2. Check that the inserts springs (4) are fitted to the inserts as shown in the illustration.
   3. Check that the clutch hub (5) and the sleeve (6) slide smoothly.

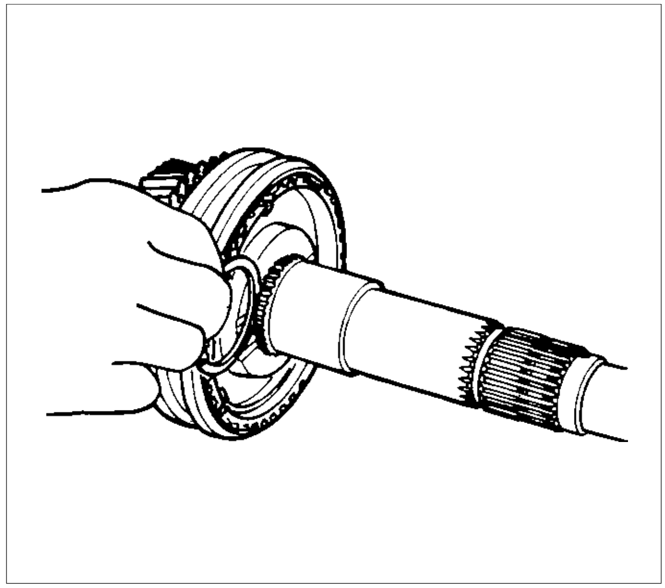


266RS049

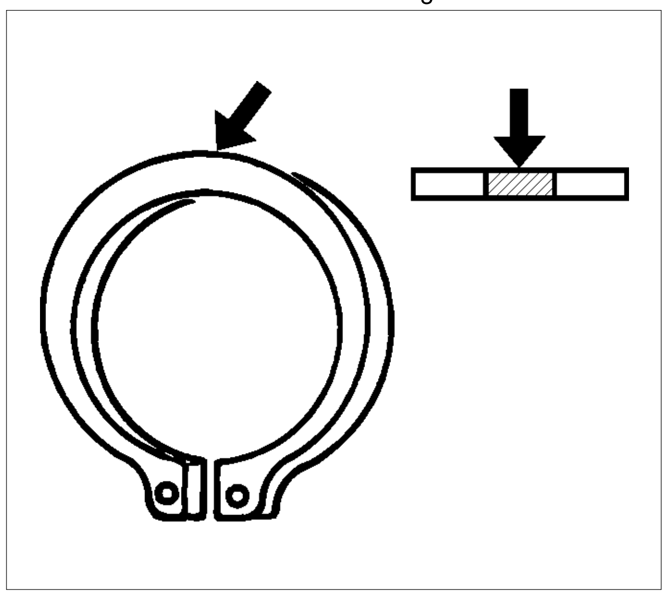
7. Install the synchronizer assembly to the mainshaft.
   The clutch hub face (with the heavy boss) must be facing the 2nd gear side.


226RS048

8. Install the clutch hub snap ring by performing the following steps:
   - Select the snap ring which will provide the minimum clearance between the 1st-2nd clutch hub and the snap ring.


226RS050

- There are three snap ring sizes available.
- The snap rings are color coded to indicate their thickness as shown in the figure.


226RS021

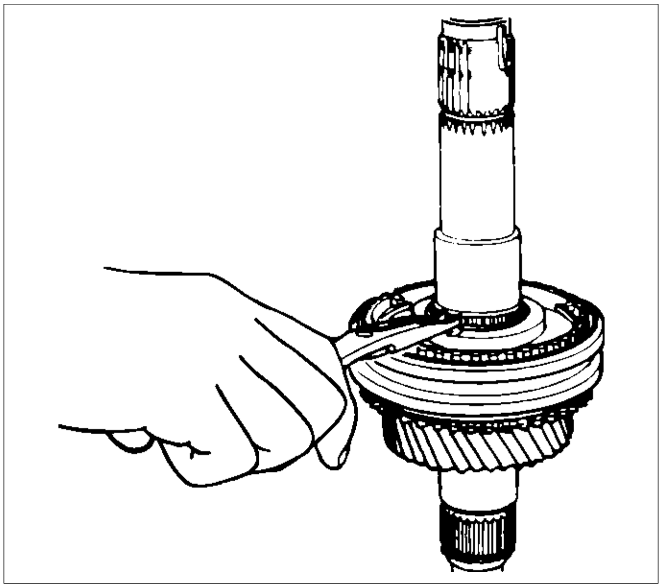
Clutch Hub and Snap Ring Clearance

Standard: 0 - 0.1 mm (0 - 0.004 in)

Snap Ring Availability

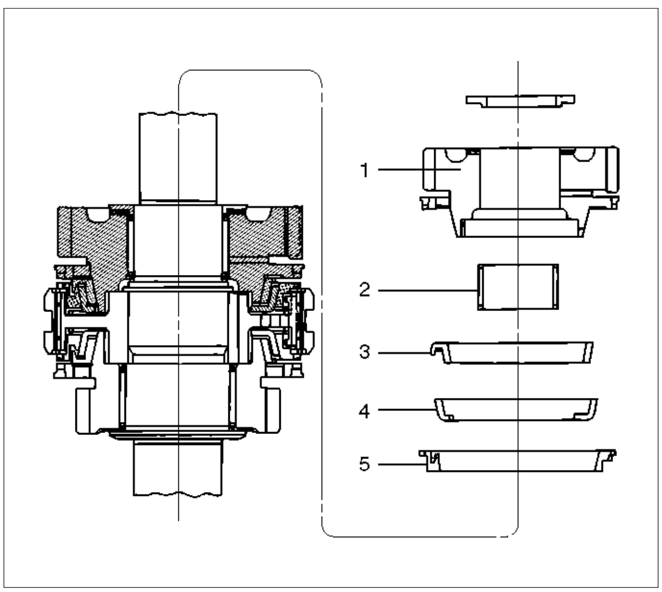
Thickness	Color Coding
1.80 mm (0.071 in)	White
1.85 mm (0.073 in)	Yellow
1.90 mm (0.075 in)	Blue

- Use a pair of snap ring pliers to install the snap ring to the mainshaft.
  The snap ring must be fully inserted into the mainshaft snap ring groove.



226RS031

9. Install the needle bearing, 1st block ring, 1st outside ring, 1st inside ring, and 1st gear.
   - Apply engine oil to the needle bearing, 1st gear thrust surfaces and synchronizer ring friction surfaces.
   - The 1st gear dog teeth must be facing the transmission front side.



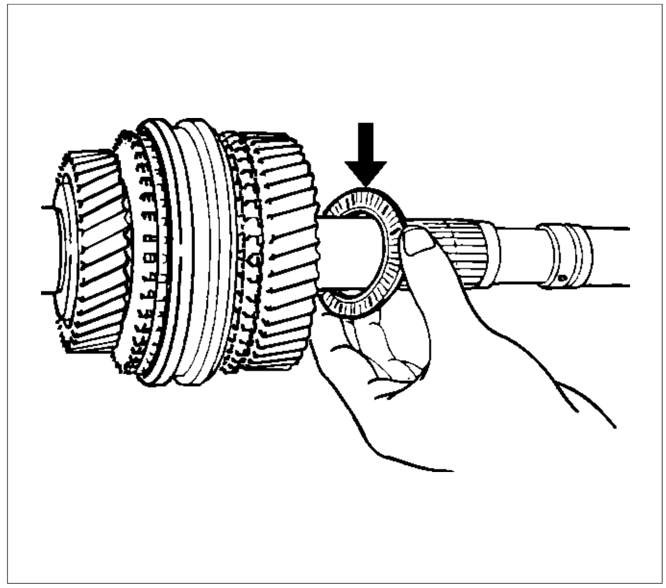
226RS053

Legend

(1) 1st Gear
(2) Needle Bearing
(3) Inside Ring
(4) Outside Ring
(5) Block Ring

10. Install the 1st gear thrust bearing and the race to the main shaft.

    The thrust bearing side must be facing the transmission front side.



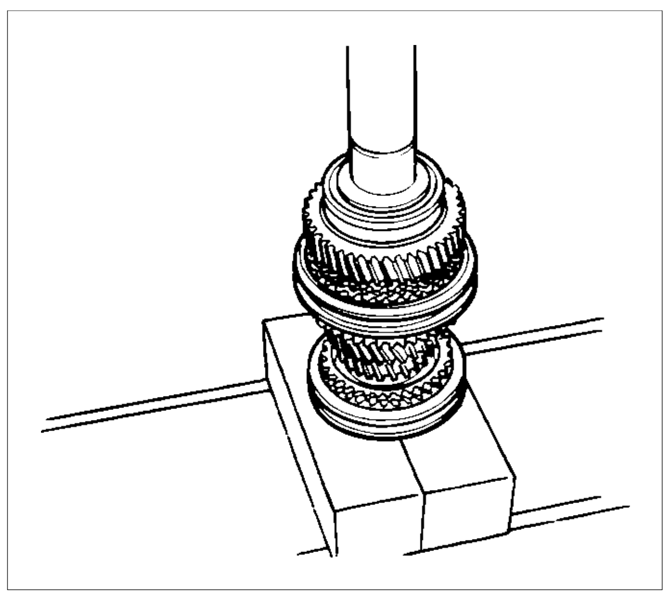
226RS054

11. Apply engine oil to the mainshaft ball bearing and the mainshaft.

    Install the ball bearing and needle bearing collar to the mainshaft.

    The ball bearing snap ring groove must be facing the transmission rear side.

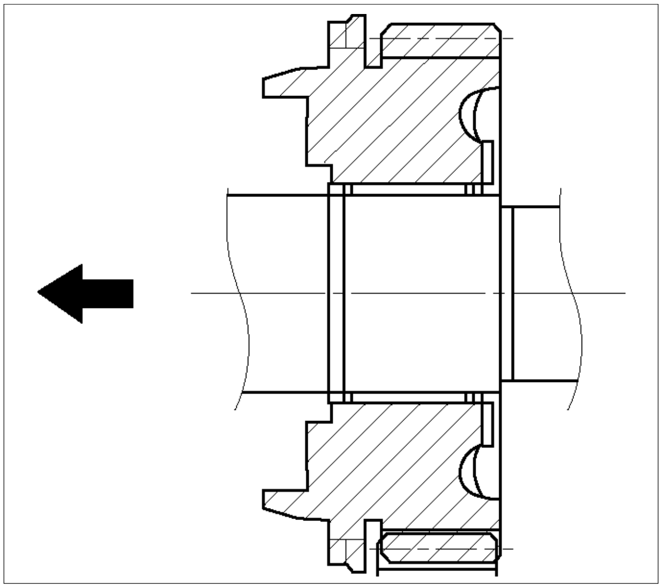
    Use a bench press and installer 9-8522-1165-0 to slowly force the collar into place.



12. Apply engine oil to the needle bearing and the 3rd gear thrust surfaces.

    Install the needle bearing and the 3rd gear to the mainshaft.

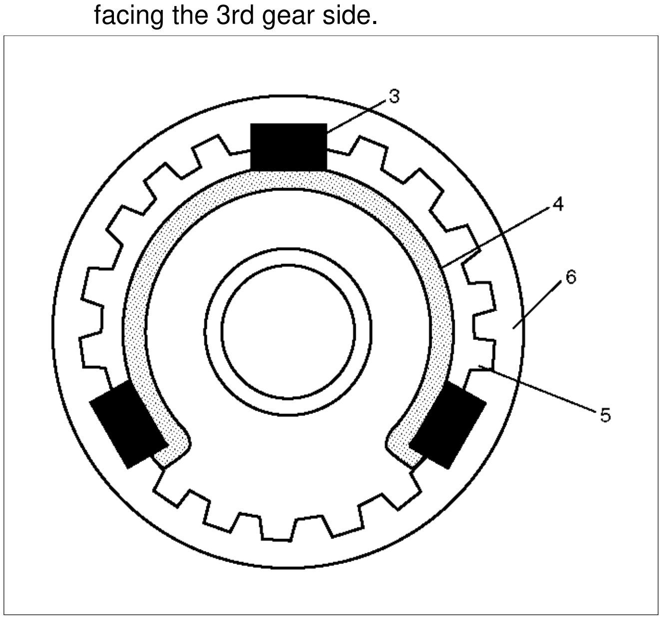
    The 3rd gear dog teeth must be facing the transmission front side.



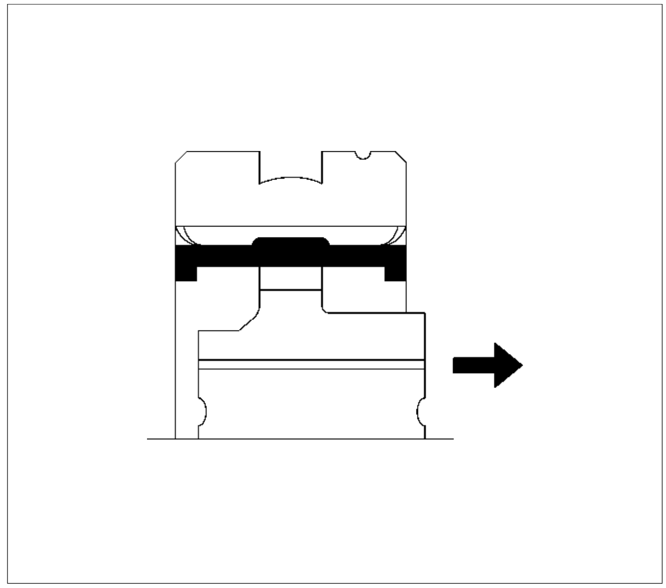
226RS056

13. Install the 3rd block ring.
14. Check and install the 3rd-4th synchronizer assembly by using the following steps:
    1. Check that the inserts (3) fit snugly into the clutch hub insert grooves.
    2. Check that the insert springs (4) are fitted to the inserts as shown in the illustration.
    3. Check that the clutch hub (5) and the sleeve (6) slide smoothly.
    4. Install the synchronizer assembly to the mainshaft.

    The clutch hub face with the heavy boss must be facing the 3rd gear side.



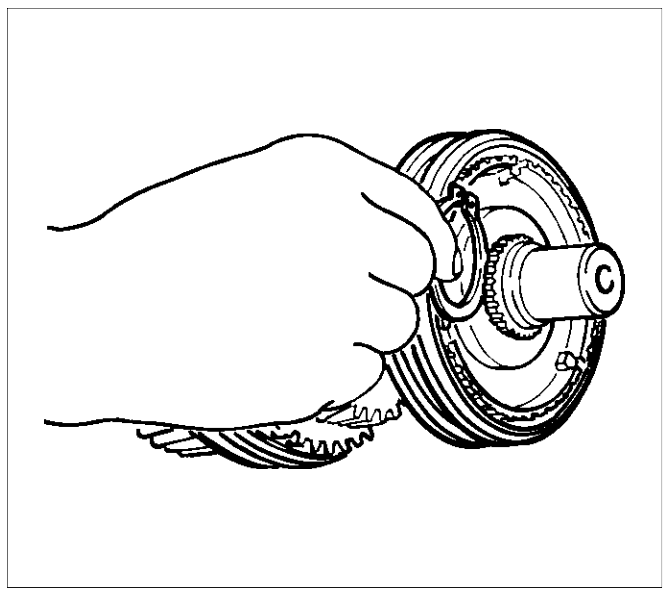
226RS049



226RW221

15. Select and install mainshaft snap ring using the following instructions:

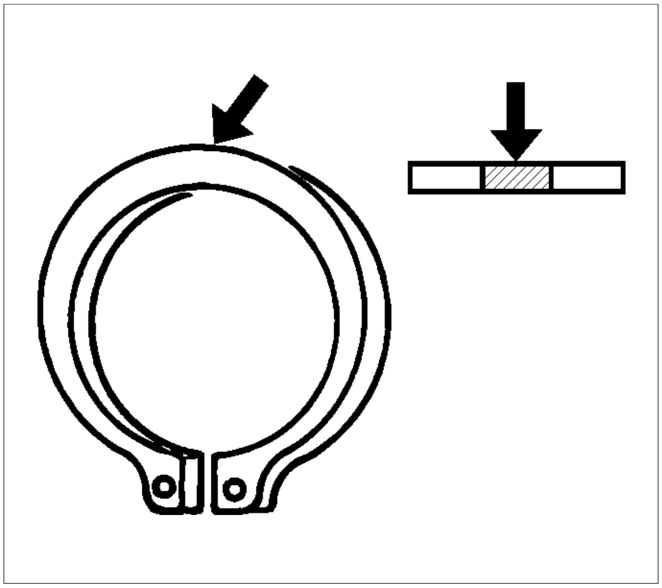
    Select the snap ring which will provide the minimum clearance between the 3rd-4th clutch hub and the snap ring.



226RS058

There are three snap ring sizes available.

The snap rings are color-coded to indicate their thickness, as shown in the figure.



226RS021

Clutch Hub and Snap Ring Clearance

Standard: 0 - 0.1 mm (0 - 0.004 in)

Snap Ring Availability

Thickness	Color Coding
1.80 mm (0.071 in)	White
1.85 mm (0.073 in)	Yellow
1.90 mm (0.075 in)	Blue

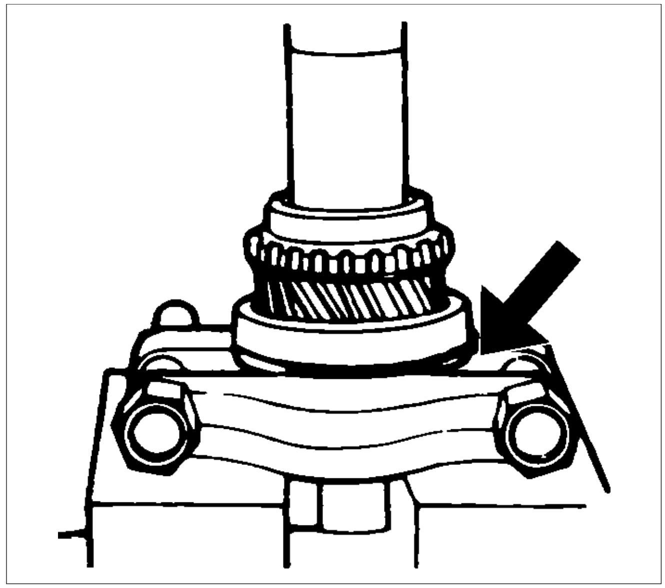
- Use a pair of snap ring pliers to install the snap ring to the mainshaft.

  The snap ring must be fully inserted into the mainshaft snap ring groove.

16. Install the top block ring.

    Apply grease to the needle bearing inner and outer circumferences and install the needle bearing in the top gear shaft.

17. Use a bench press to install the top gear shaft ball bearing to the top gear shaft.



226RS059

The snap ring groove of the ball bearing must be facing the transmission front side.

18. Use a pair of snap ring pliers to install the top gear shaft snap ring to the top gear shaft.

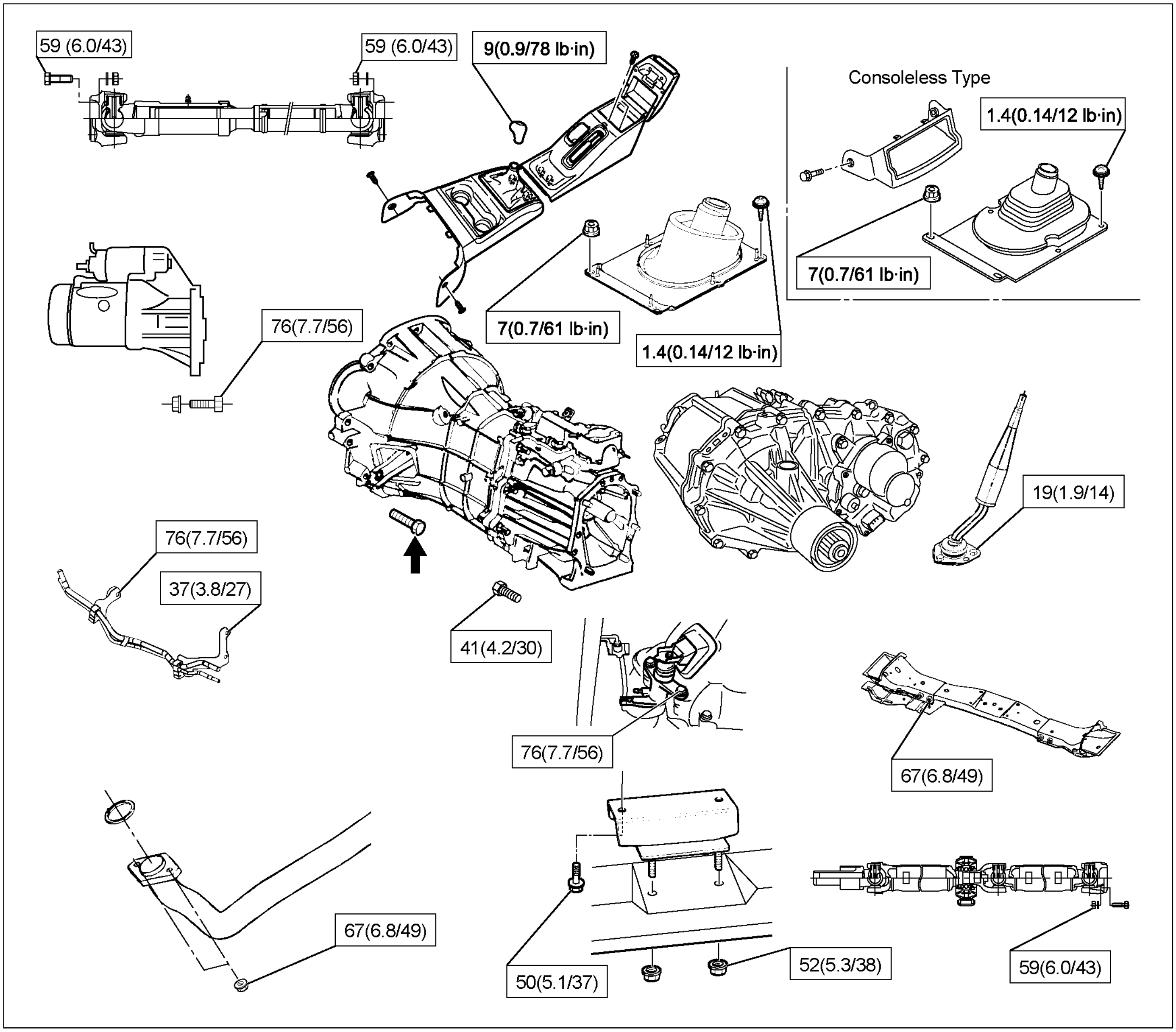
Main Data and Specifications

General Specifications

		MUA5G	MUA5H	MUA5S
Transmission type		Fully synchronized forward and reverse gears		
Control method		Remote control with the gear shift lever on the floor.		
Gear ratio: Transmission	1st	4.008	4.008	4.357
	2nd	2.301	2.301	2.502
	3rd	1.427	1.427	1.501
	4th	1.000	1.000	1.000
	5th	0.828	0.744	0.809
	Rev.	3.651	3.651	3.970
Transmission oil capacity		2.95 lit. (3.12 US qt)		
Type of lubricant		Engine oil: Refer to the chart in "SECTION 0"		

Torque Specifications

N·m (kgf·m/lb·ft)

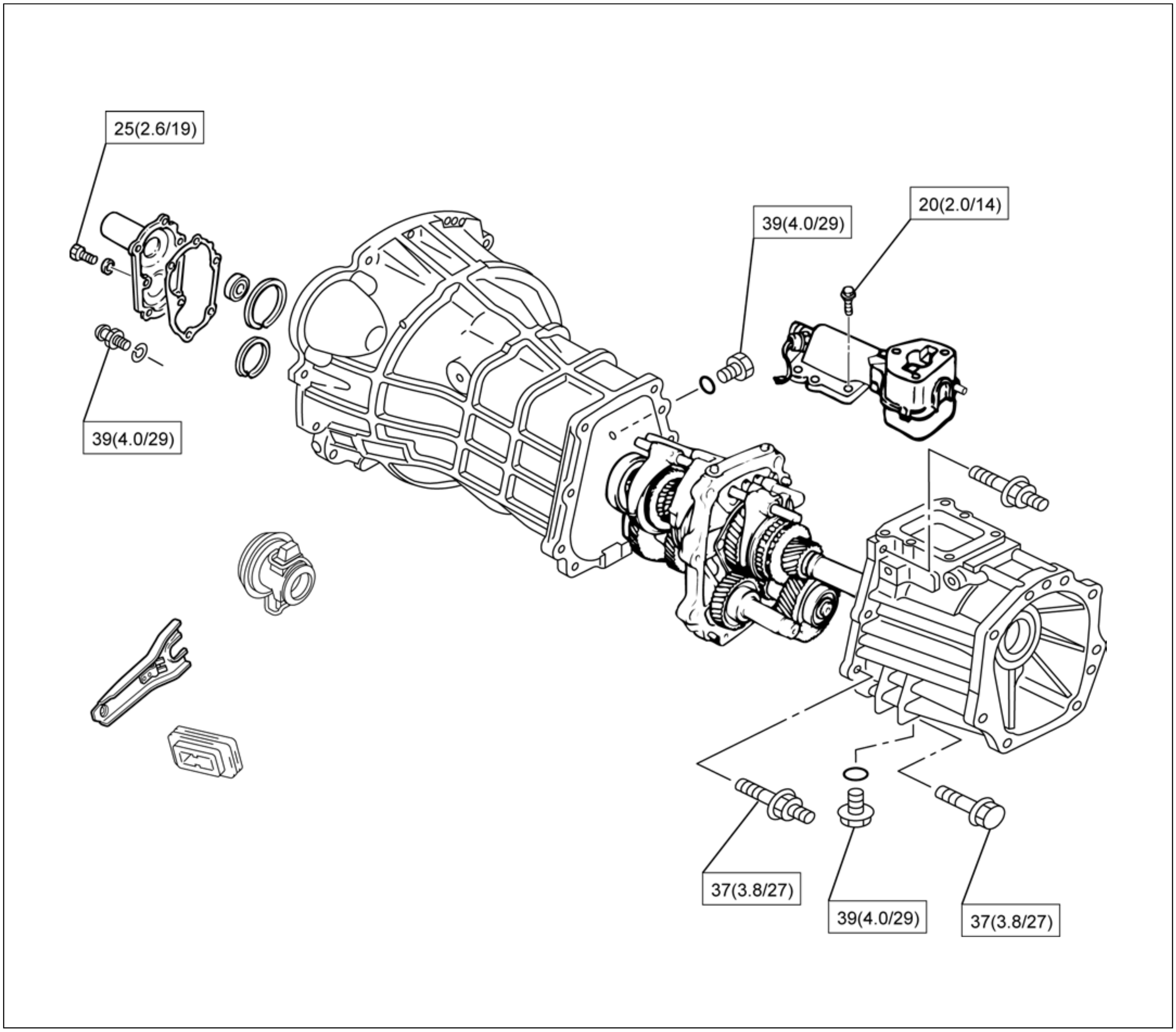


RTW77BLF003801

About arrow mark, refer to Transmission (MUA) Installation in this section.

Torque Specifications (Cont'd)

N·m (kgf·m/lb·ft)



RTW77BLF003901

h. Select the shim using table below.

[ϕ220 mm]

mm (in)

Pinion marking / Dial indicator reading (inches)	+10	+8	+6	+4	+2	0	-2	-4	-6	-8	-10
0.073										1.94 (0.0764)	1.96 (0.0772)
0.074									1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)
0.075								1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)
0.076						1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)
0.077						1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)
0.078				1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)
0.079			1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)
0.080	1.94 (0.0764)	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)
0.081	1.96 (0.0772)	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)
0.082	1.98 (0.0780)	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)
0.083	2.00 (0.0787)	2.02 (0.0795)	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)
0.084	2.04 (0.0803)	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)
0.085	2.06 (0.0811)	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)
0.086	2.08 (0.0819)	2.10 (0.0827)	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)
0.087	2.12 (0.0835)	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)
0.088	2.14 (0.0843)	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)
0.089	2.16 (0.0850)	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)
0.090	2.18 (0.0858)	2.20 (0.0866)	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	
0.091	2.22 (0.0874)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)			
0.092	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)				
0.093	2.26 (0.0890)	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)					
0.094	2.28 (0.0898)	2.30 (0.0906)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)						
0.095	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)								
0.096	2.34 (0.0921)	2.36 (0.0929)									
0.097	2.36 (0.0929)										

[ϕ194 mm]

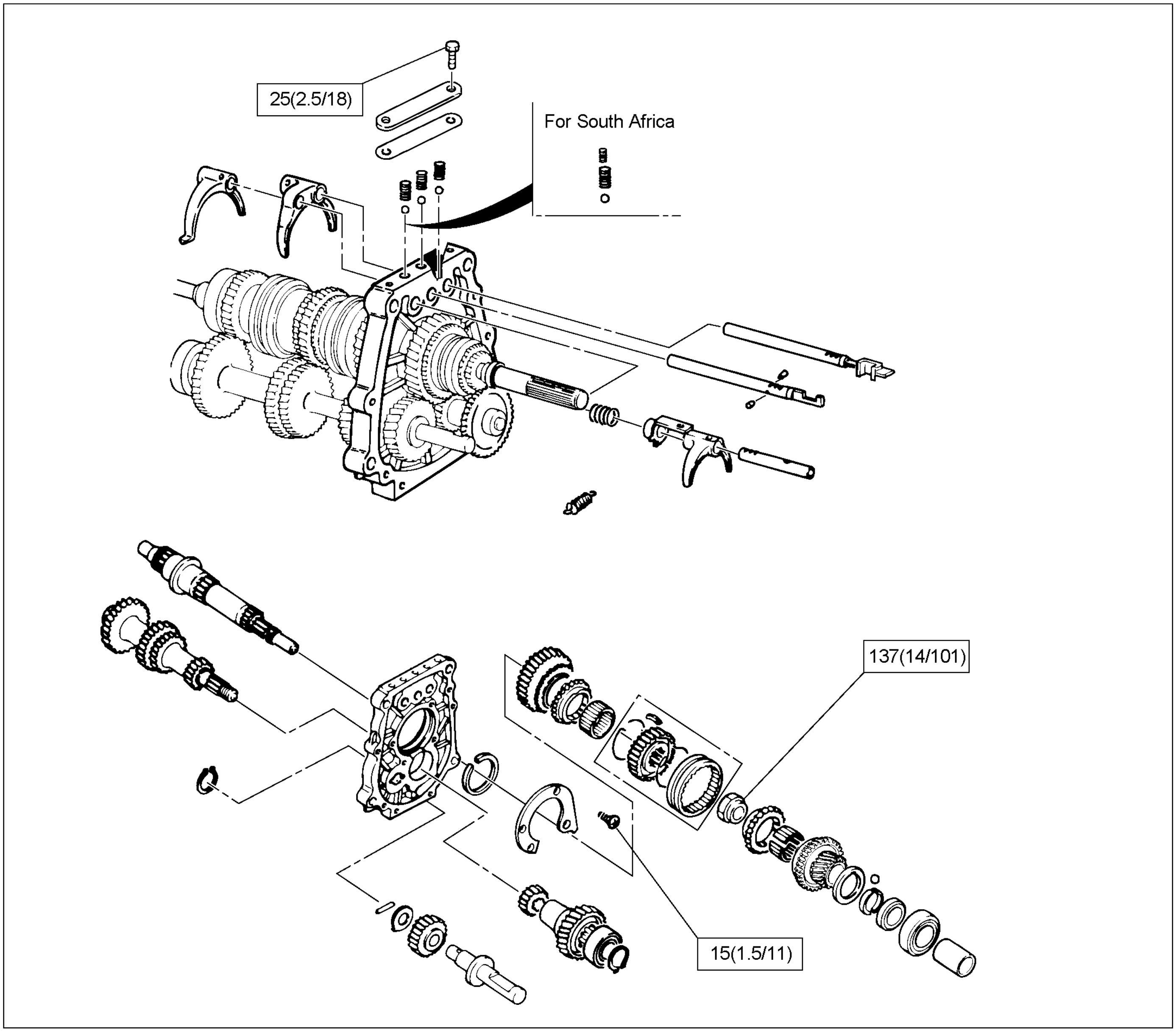
mm (in)

Pinion marking / Dial indicator reading (inches)	+10	+8	+6	+4	+2	0	-2	-4	-6	-8	-10
0.081											2.18 (0.0858)
0.082										2.18 (0.0858)	2.20 (0.0866)
0.083									2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)
0.084								2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)
0.085							2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)
0.086						2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)
0.087					2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)
0.088				2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)
0.089			2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)
0.090		2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)
0.091	2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)
0.092	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)
0.093	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)
0.094	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)
0.095	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)
0.096	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)
0.097	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)	
0.098	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)		
0.099	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)			
0.000	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)				
0.001	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)					
0.002	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)						
0.003	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)							
0.004	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)								
0.005	2.54 (0.1000)	2.56 (0.1008)									
0.006	2.56 (0.1008)										

Note :
When ordering shims, find the part number in the Parts Catalog by using the thickness of the shims listed in the above table.

Torque Specifications (Cont'd)

N·m (kgf·m/lb·ft)



RTW57BLF000301

TROUBLESHOOTING

1. ABNORMAL NOISE

1) NOISY IN NEUTRAL

Checkpoint		Trouble Cause	Countermeasure
Gear oil	NG	Insufficient or improper gear oil	Replenish or replace the gear oil
OK			
Flywheel pilot bearing	NG	Worn flywheel pilot bearing	Replace the flywheel pilot
OK			
Bearings (Mainshaft, countershaft, and transfer shaft)	NG	Worn or broken bearing(s)	Replace the bearing(s)
OK			
Gears (Mainshaft, countershaft, reverse idler gear and transfer gears)	NG	Worn or scuffed gear tooth contact surfaces	Replace the gear(s)
OK			
Mainshaft splines Synchronizer clutch hub splines	NG	Worn splines	Replace the main shaft and the synchronizer clutch hub
OK			
Transmission	NG	Transmission misalignment	Realign the transmission

2) NOISY OPERATION

Checkpoint		Trouble Cause	Countermeasure
Gear oil (Metallic rattling)	NG	Insufficient or improper engine oil	Replenish or replace the gear oil
OK			
Bearings (Hissing, thumping or bumping)	NG	Worn or broken bearing(s)	Replace the bearing(s)
OK			
Gears (Growling, humming, or grinding)	NG	Worn, chipped, or cracked gear(s)	Replace the gear(s)
OK			
Gears (Squealing at high speeds)	NG	Free running gears seizing on the thrust face or the inner face	Replace the gear(s)
OK			
Gears (Gear whining)	NG	Lack of backlash between meshing gears	Replace the gear(s)

2. HARD SHIFTING

Checkpoint		Trouble Cause	Countermeasure
Gear oil	NG	Insufficient or improper gear oil	Replenish or replace the engine oil
OK			
Clutch pedal free play	NG	Improper clutch pedal free play	Readjust the clutch pedal free play
OK			
Change lever operation	NG	Hard operating change lever caused insufficient grease	Repair or regrease the change lever assembly
OK			
Change lever play	NG	Worn change lever sliding portions	Repair or replace the applicable parts and regrease
OK			
Shift block sleeve movement	NG	Sleeve movement failure	Repair or replace the sleeve
OK			
Shift rod and quadrant box sliding faces, and other parts	NG	Worn shift rod and/or sliding faces	Replace the shidt rod and/or the quadrant box

Continued on the next page

Checkpoint		Trouble Cause	Countermeasure
Continued from the previous			
OK			
Shift arm and synchronizer sleeve	NG	Worn shift arm and/or synchronizer sleeve groove	Replace the worn parts
OK			
Mainshaft and countershaft thrust play	NG	Worn thrust washer, collar, and/or gear thrust faces	Replace the worn parts
OK			
Synchronizer assembly	NG	Worn synchronizer parts	Replace the worn parts

3. WALKING OR JUMPING OUT OF GEAR

Checkpoint		Trouble Cause	Countermeasure
Change lever play	NG	Insufficient stroke caused by sliding position wear and excessive play	Replace the worn parts
OK			
Detent ball	NG	Worn detent ball	Replace the detent ball
OK			
Detent spring	NG	Detent spring weak or broken	Repair or replace the detent spring
OK			
Shift rod and quadrant box sliding faces	NG	Worn shift rod and/or sliding faces	Replace the shift rod and/or the quadrant box
OK			
Shift arm and synchronizer sleeve	NG	Worn shift arm and/or synchronizer sleeve groove	Replace the worn parts
OK			
Mainshaft and countershaft thrust play	NG	Worn thrust washer, collar, and/or gear thrust faces	Replace the worn parts

Continued on the next page

Continued from the previous page

OK

Checkpoint		Trouble Cause	Countermeasure
Bearings (Mainshaft, countershaft, and individual gears)	NG	Worn or broken bearings(s)	Replace the bearing(s)
OK			
Mainshaft splines Synchronizer clutch hub splines	NG	Worn splines	Replace the main shaft and the synchronizer clutch hub
OK			
Synchronizer assembly	NG	Weak or broken spring	Replace the spring

4. OIL LEAKAGE

Checkpoint		Trouble Cause	Countermeasure
Oil level	NG	Oil level too high	Drain the oil to the correct level
OK			
Gear oil	NG	Improper gear oil	Replace the gear oil
OK			
Drain plug and/or filler plug	NG	Loose plug(s)	Tighten the plug(s) and replenish the oil
OK			
Gaskets	NG	Defective or improperly installed gasket(s)	Replace the gasket(s)
OK			
Air breather	NG	Air breather not installed Air breather clogged	Install the air breather Replace the air breather
OK			
Front cover oil seal	NG	Worn or scratched oil seal	Replace the oil seal
OK			
Rear cover oil seal	NG	Worn or scratched oil seal	Replace the oil seal

Special Tools (4×4)

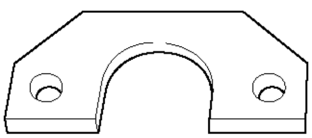
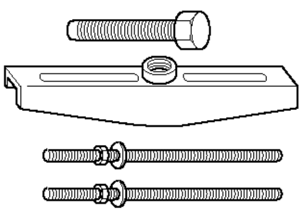
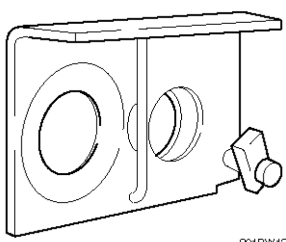
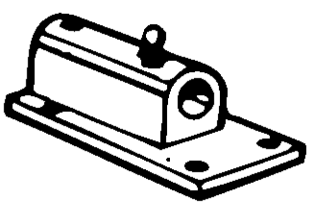
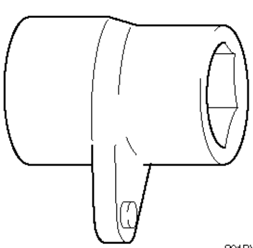
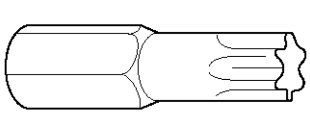
ILLUSTRATION	TOOL NO. TOOL NAME
	**5-8840-2158-0** **(J-37222)** Mainshaft retainer remover
	**5-8840-2027-0** Puller
	**5-8840-2160-0** **(J-37224)** Holding fixture
	**5-8840-0003-0** **(J-3289-20)** Holding fixture base
	**5-8840-2156-0** **(J-37219)** Mainshaft nut wrench
	**5-8840-0047-0** **(J-37225)** Tork bit wrench (T– 45)

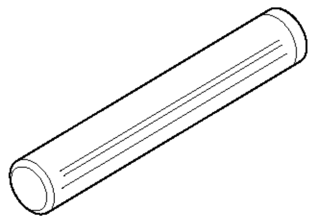
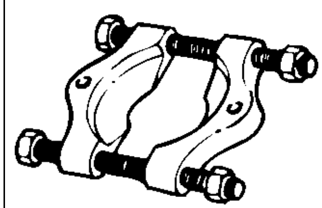
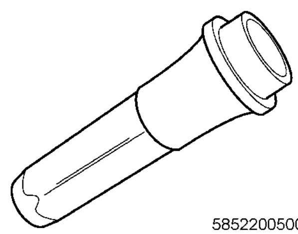
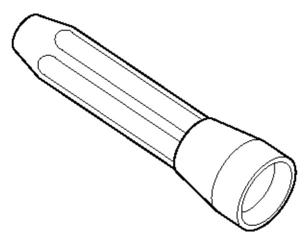
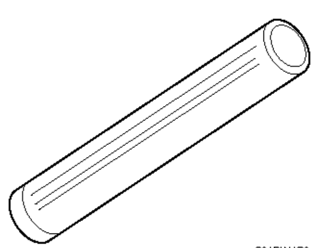
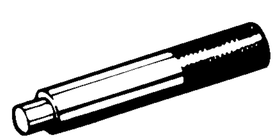
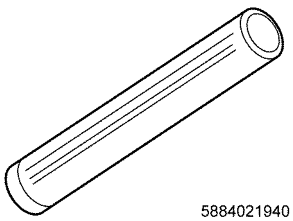
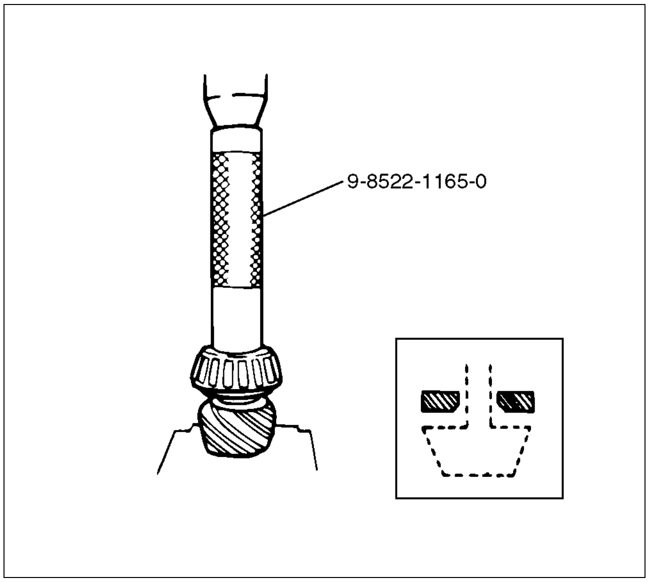
ILLUSTRATION	TOOL NO. TOOL NAME
	**5-8840-2159-0** **(J-37223)** Mainshaft end bearing installer
	**5-8840-0015-0** **(J-22912-01)** Bearing remover/installer
	**5-8522-0050-0** **(J-29769)** Rear case oil seal installer
	**5-8840-0026-0** **(J-26540)** Front cover oil seal installer
	**9-8522-1165-0** **(J-6133-01)** Mainshaft collar remover
	**5-8840-0007-0** **(J-8092)** Grip

ILLUSTRATION	TOOL NO. TOOL NAME
 	**5-8840-2194-0** Bearing installer

4. Place the shim on the drive pinion, then install the inner bearing onto the pinion by using installer 9-8522-1165-0 and a press.

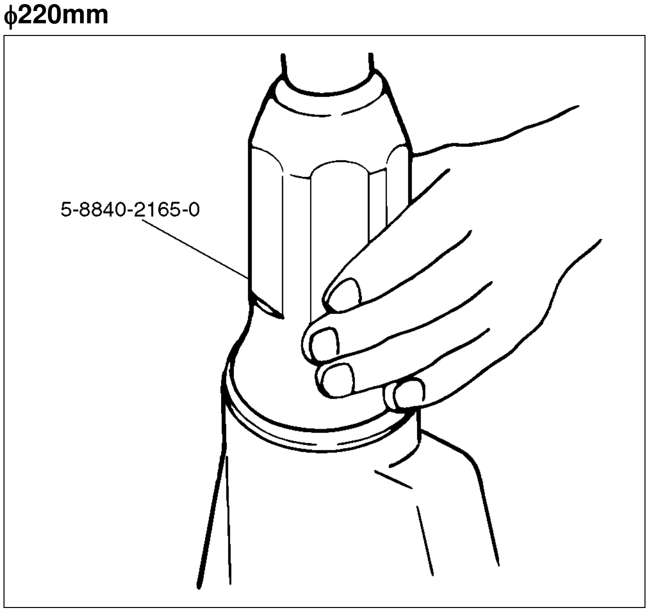
Note:
Do not apply pressure to the roller cage. Apply NOTE: pressure only to the inner race.



425L100008

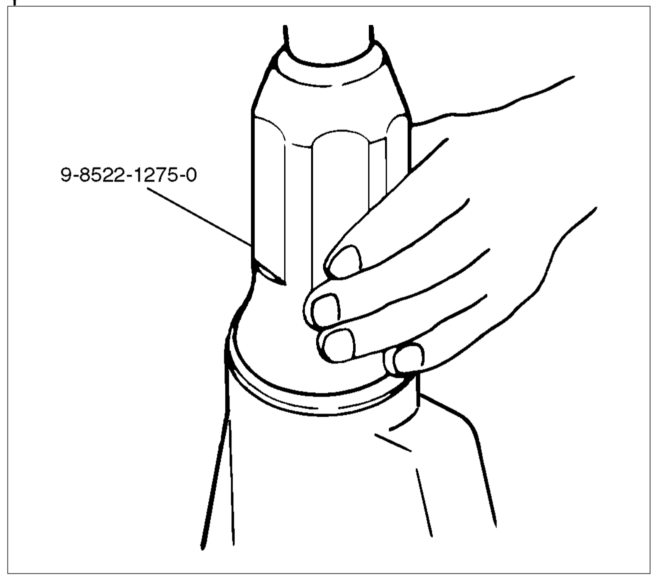
5. Install collapsible spacer. Discard the used collapsible spacer and install a new one.
6. Install drive pinion shaft assembly.
7. Install outer bearing and oil seal.
8. Use oil seal installer 5-8840-2165-0 (ϕ220mm) and 9-8522-1275-0 (ϕ194mm) to install a new oil seal that has grease on seal lip.

ϕ220mm



415RW029

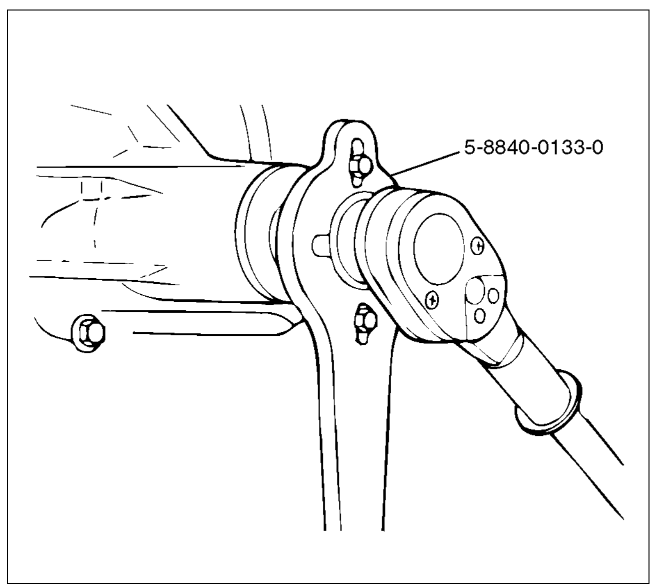
ϕ194mm



415RW024

9. Install flange assembly.
10. Install flange nut.
    a. Apply lubricant to the pinion threads.
    b. Using the pinion flange holder 5-8840-0133-0, tighten the nut only enough to remove the shaft end play.

Note :
Discard used flange nut and install new one.



415RW040

    c. Adjust pinion bearing preload.
    - Measure the bearing preload by using a torque meter and note the scale reading required to rotate the flange.
    - Continue tightening flange nut until the specified starting torque is obtained.

TRANSMISSION/TRANSAXLE

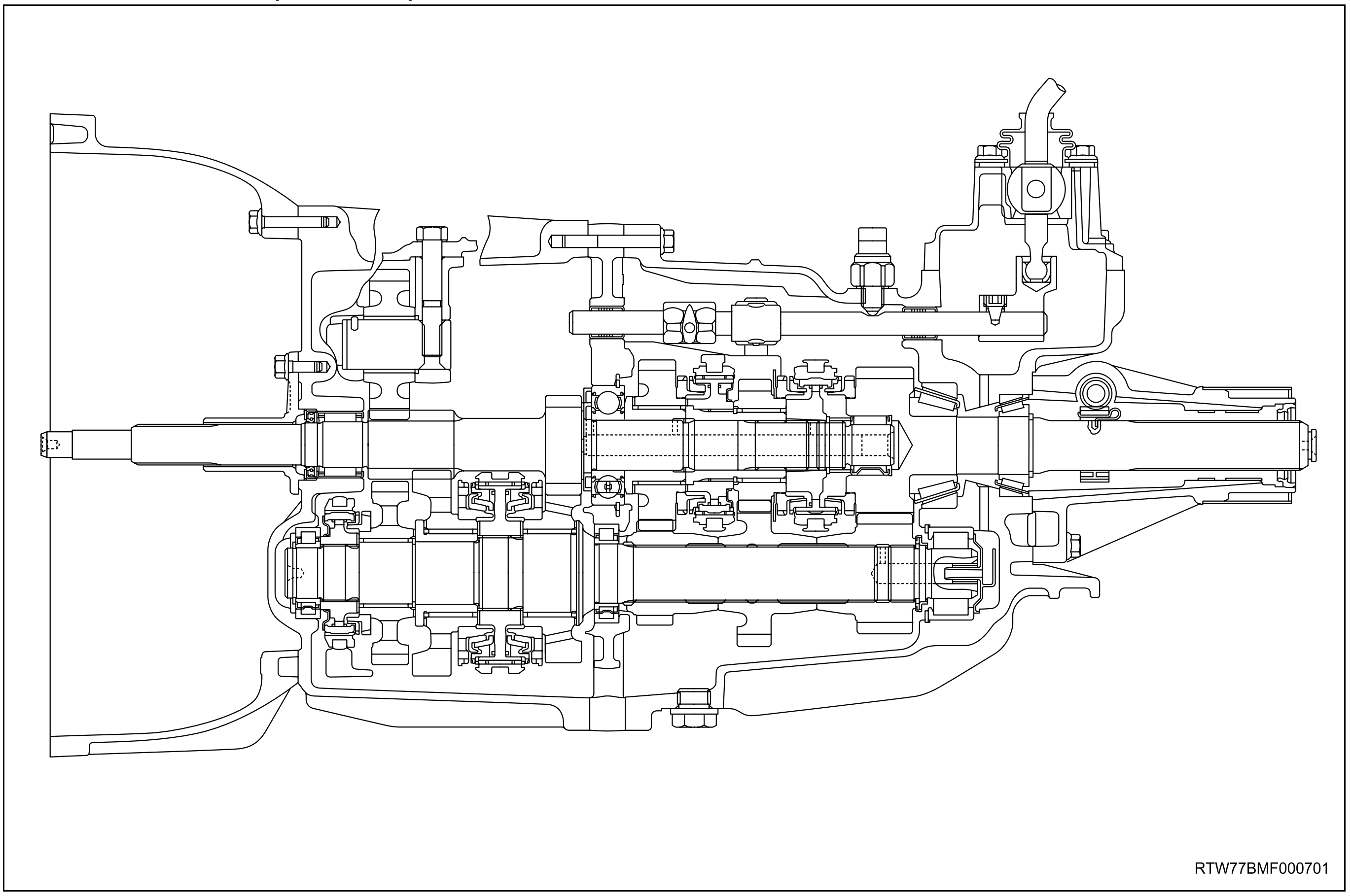
Manual Transmission (MUX)

TABLE OF CONTENTS

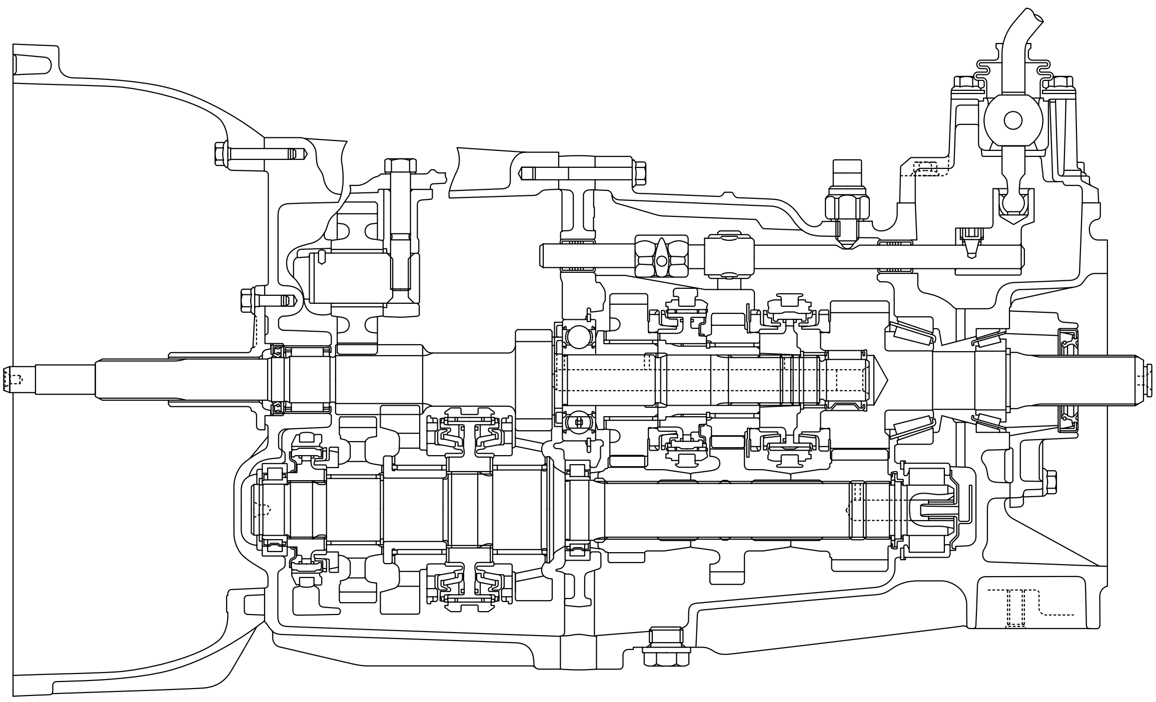
General Description

General Description

MUX5S Transmission(4x2 model)



MUX5S Transmission(4x4 model)



The MUX5S is a constant mesh transmission, synchronized in all speeds.
The transmission is designed for a reduction of the shift effort and the quietest possible operation.
Principle parts of the transmission are the clutch housing, the front case, the intermediate plate, the rear case, the end cover, and the gears.
The transmission control box is built into the transmission.

Troubleshooting

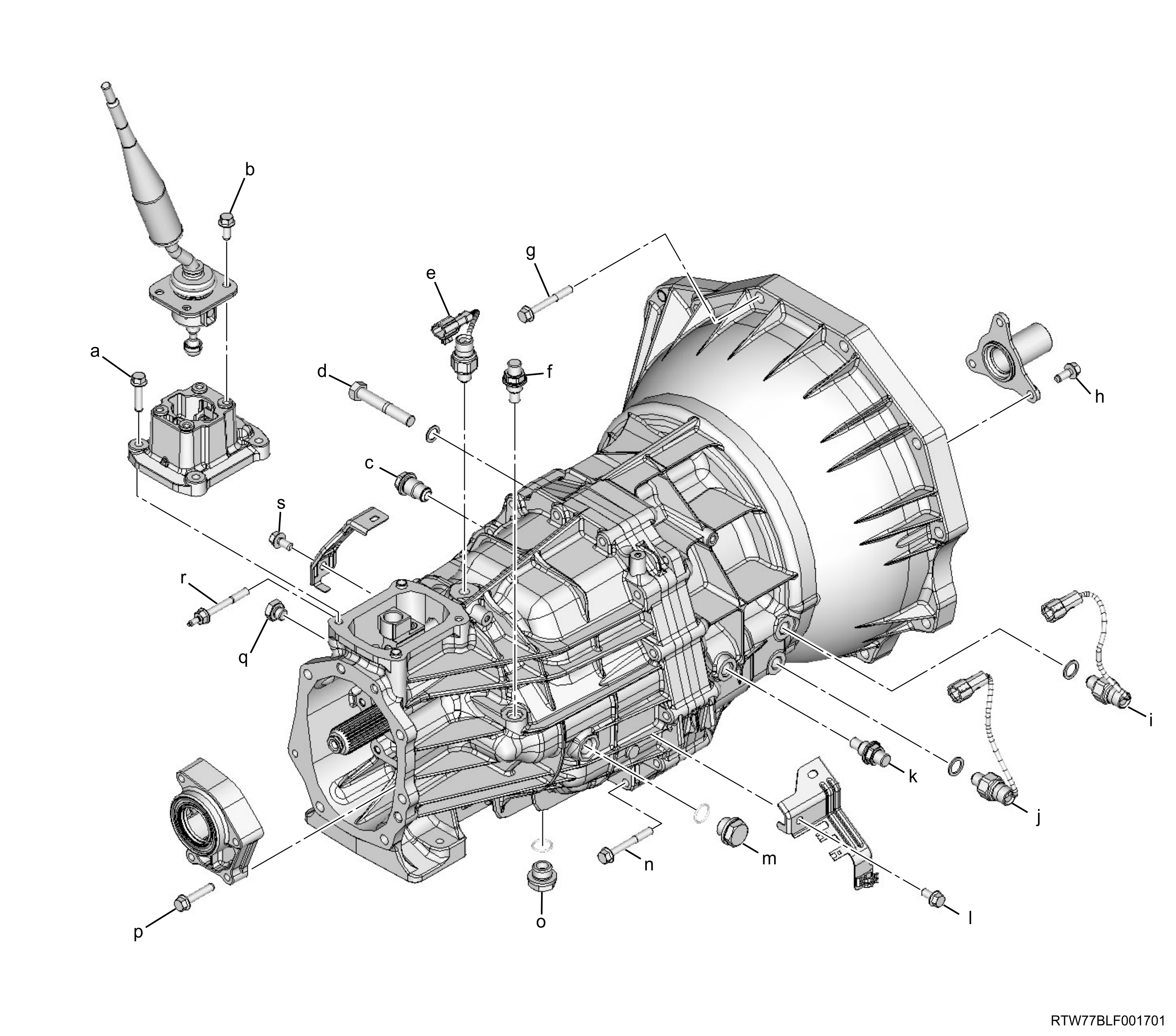
Condition	Possible Cause	Correction
Abnormal Noise (Noisy in Neutral)	Insufficient or improper lubricant	Replenish or replace lubricant
	Flywheel pilot bearing worn or broken	Replace flywheel pilot bearing
	Bearing(s) worn or broken (Input shaft, counter shaft, and output shaft)	Replace bearing(s)
	Gear tooth contact surfaces worn or scuffed (Input shaft, counter shaft, output shaft, and reverse idler gear)	Replace gear(s)
	Spline worn (Input shaft, output shaft, counter shaft, and synchronizer clutch hub)	Replace worn parts
	Transmission misalignment	Realign transmission
Abnormal Noise (Noisy Operation)	Insufficient or improper lubricant (Metallic rattling)	Replenish or replace lubricant
	Bearing(s) worn or broken (Hissing, thumping, or bumping)	Replace bearing(s)
	Gear(s) worn, chipped, or cracked (Growling, humming, or grinding)	Replace gear(s)
	Gears seizing on thrust face or inner face free running (Squealing at high speeds)	Replace gear(s)
	Gears lack of backlash between meshing (Gear whining)	Replace gear(s)
Hard Shifting	Insufficient or improper lubricant	Replenish or replace lubricant
	Improper clutch pedal free play	Readjust clutch pedal free play
	Hard operating of change lever caused insufficient grease	Repair or regrease change lever assembly
	Change lever sliding portions worn	Repair or replace applicable parts and regrease
	Shift block sleeve movement failure	Repair or replace sleeve
	Shift rod and/or quadrant box sliding face worn	Replace worn parts
	Shift arm and/or synchronizer sleeve groove worn	Replace worn parts
	Collar, and/or gear thrust faces worn (Input shaft and counter shaft thrust play)	Replace worn parts
	Synchronizer parts worn	Replace worn parts

Condition	Possible Cause	Correction
Walking or Jumping Out of Gear	Change lever sliding portion worn and excessive play	Replace worn parts
	Shift rod and/or quadrant box sliding faces worn	Replace worn parts
	Shift arm and synchronizer sleeve groove worn	Replace worn parts
	Collar and/or gear thrust faces worn (Input shaft and counter shaft thrust play)	Replace worn parts
	Bearing worn or broken (Input shaft, counter shaft, and individual gears)	Replace bearing(s)
	Input shaft spline, output shaft spline, and synchronizer clutch hub splines worn	Replace input shaft, output shaft, and synchronizer clutch hub
	Synchronizer parts worn or broken	Replace worn or broken parts
	Taper bolt slack	Replace taper bolt
Oil Leakage	Oil level too high	Drain oil to correct level
	Improper lubricant	Replace lubricant
	Drain plug and/or filler plug loose	Tighten plug and replenish lubricant
	Defective or improperly installed gasket (s)	Replace gasket(s)
	Front oil seal worn or scratched	Replace oil seal
	Rear oil seal worn or scratched	Replace oil seal

Main Specifications

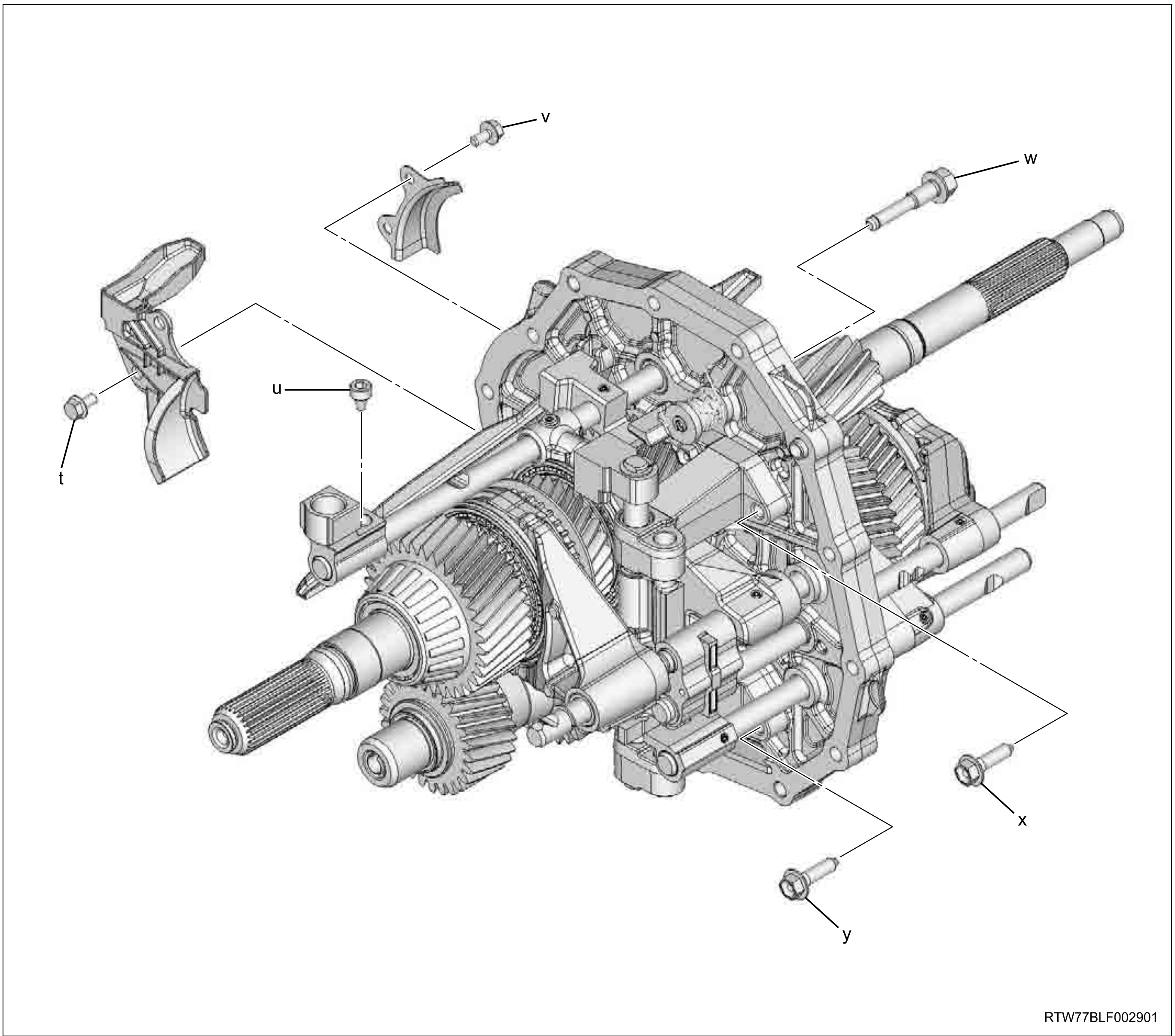
Model		MUX5S
Transmission Type		Fully synchronized forward and reverse gears
Control method		Remote control with the gear shift lever on the floor
Gear ratio	1st	4.326
	2nd	2.557
	3rd	1.490
	4th	1.000
	5th	0.790
	Revese	3.942
Transmission oil capacity		3.0 lit. (3.17 US qt)
Type of lubricant		BESCO TRANS AXLE OIL (5W-30 SF)

Fixing Torque



Legend

- (a) 23 N·m (2.3 kgf·m/17 lb·ft)
- (b) 19 N·m (1.9 kgf·m/14 lb·ft)
- (c) 30 N·m (3.1 kgf·m/22 lb·ft)
- (d) 83 N·m (8.5 kgf·m/61 lb·ft)
- (e) 39 N·m (4.0 kgf·m/29 lb·ft)
- (f) 30 N·m (3.1 kgf·m/22 lb·ft)
- (g) 76 N·m (7.7 kgf·m/56 lb·ft)
- (h) 23 N·m (2.3 kgf·m/17 lb·ft)
- (i) 39 N·m (4.0 kgf·m/29 lb·ft)
- (j) 39 N·m (4.0 kgf·m/29 lb·ft)
- (k) 30 N·m (3.1 kgf·m/22 lb·ft)
- (l) 23 N·m (2.3 kgf·m/17 lb·ft)
- (m) 39 N·m (4.0 kgf·m/29 lb·ft)
- (n) 23 N·m (2.3 kgf·m/17 lb·ft)
- (o) 39 N·m (4.0 kgf·m/29 lb·ft)
- (p) 23 N·m (2.3 kgf·m/17 lb·ft)
- (q) 34 N·m (3.5 kgf·m/25 lb·ft)
- (r) 23 N·m (2.3 kgf·m/17 lb·ft)
- (s) 23 N·m (2.3 kgf·m/17 lb·ft)



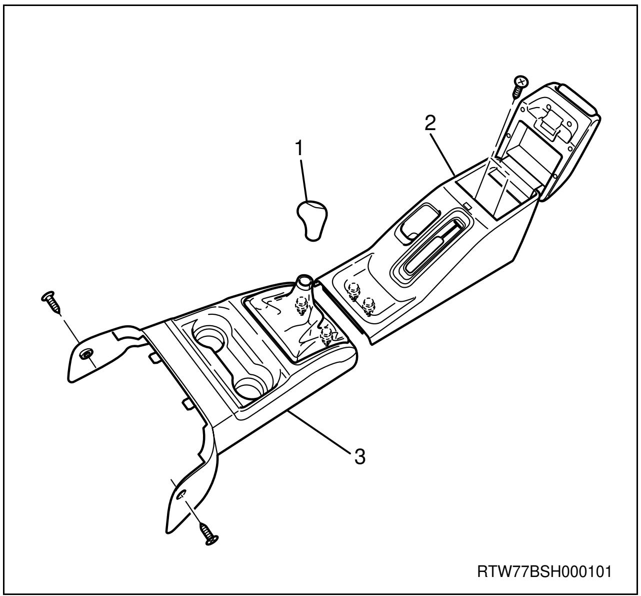
Legend

(t) 9 N·m (0.9 kgf·m/78 lb·in)
(u) 47 N·m (4.8 kgf·m/35 lb·ft)
(v) 9 N·m (0.9 kgf·m/78 lb·in)
(w) 36 N·m (3.7 kgf·m/27 lb·ft)
(x) 25 N·m (2.5 kgf·m/18 lb·ft)
(y) 25 N·m (2.5 kgf·m/18 lb·ft)

Transmission Assembly

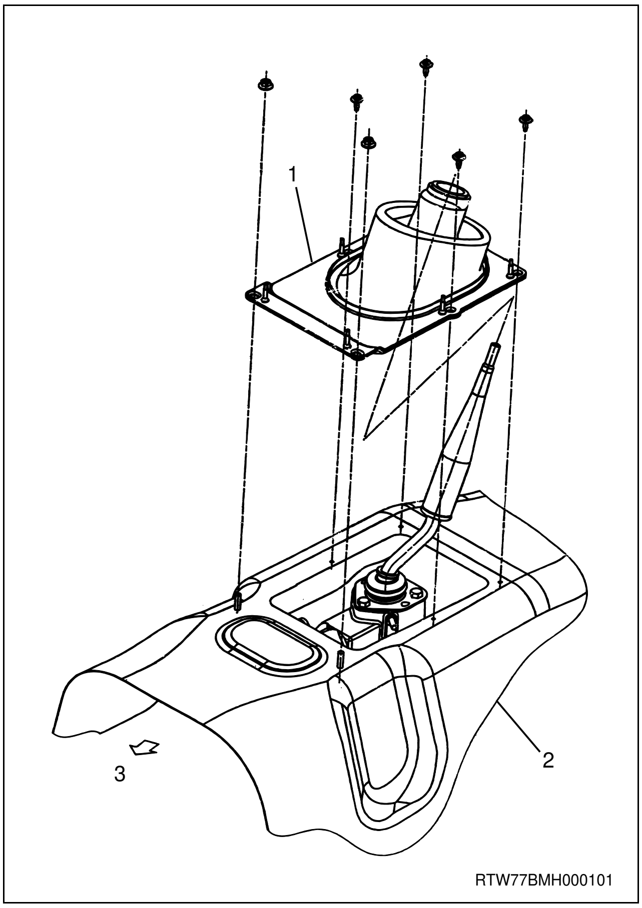
Removal

1. Disconnect battery ground cable.
2. Remove the gear control knob.
3. Remove the rear floor console. (Bucket seat)
   Refer to the section "Floor Console".
4. Remove the front floor console.
   Refer to the section "Floor Console".



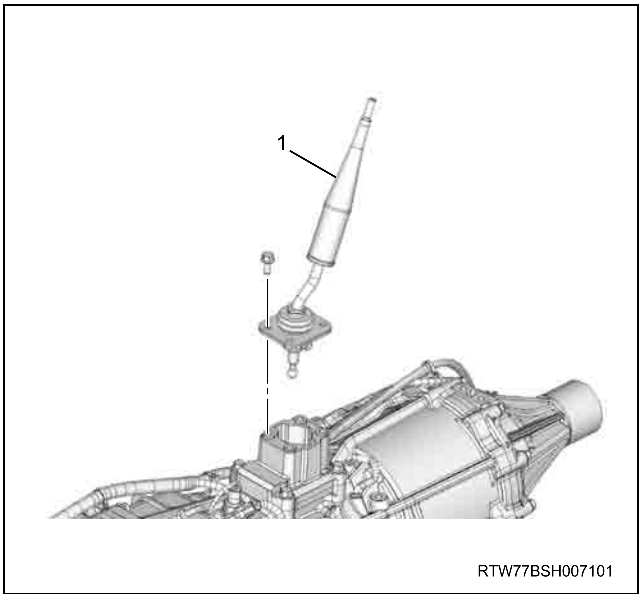
Legend
1. Gear control knob
2. Rear floor console
3. Front floor console

5. Remove the grommet assembly.



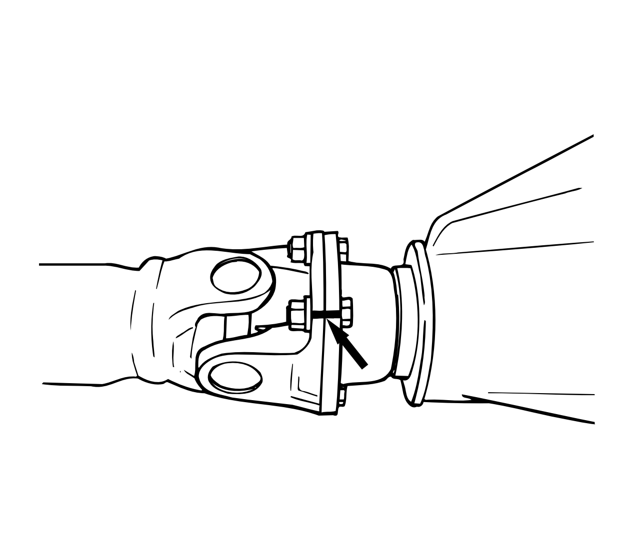
Legend
1. Grommet assembly
2. Floor panel
3. Front

6. Remove the gear control lever (1).



7. Raise and support vehicle with suitable stands.
8. Remove the rear propeller shaft.

- Apply alignment marks on the flange at the differential side.



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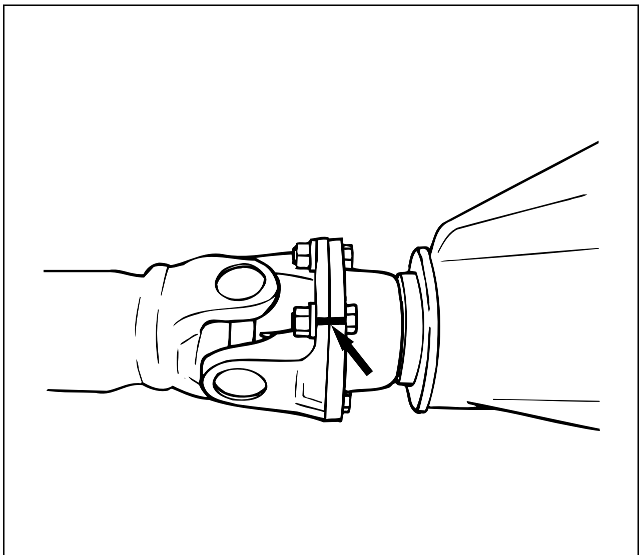
9. Remove the front propeller shaft. (4x4 model)
   - Apply alignment marks on the flange at both front and rear side.



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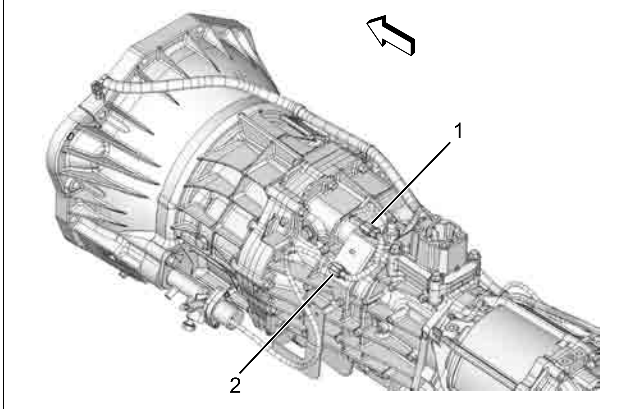
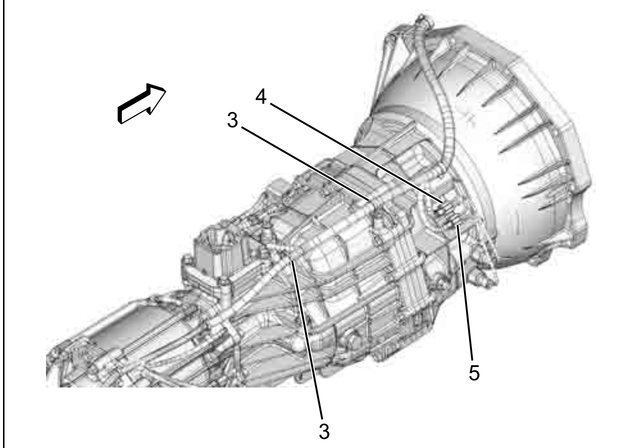
10. Disconnect the harness connectors and clips on the transmission.



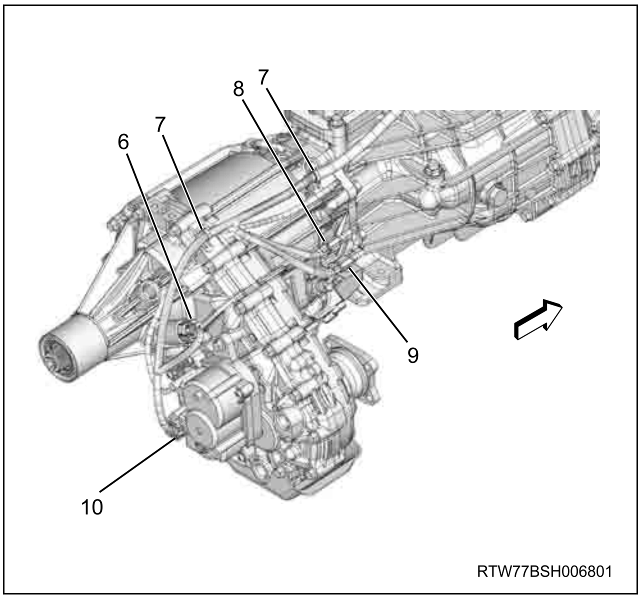
RTW77BSH006601

Legend
1. Neutral switch connector
2. Clutch damper valve connector



RTW77BSH006701

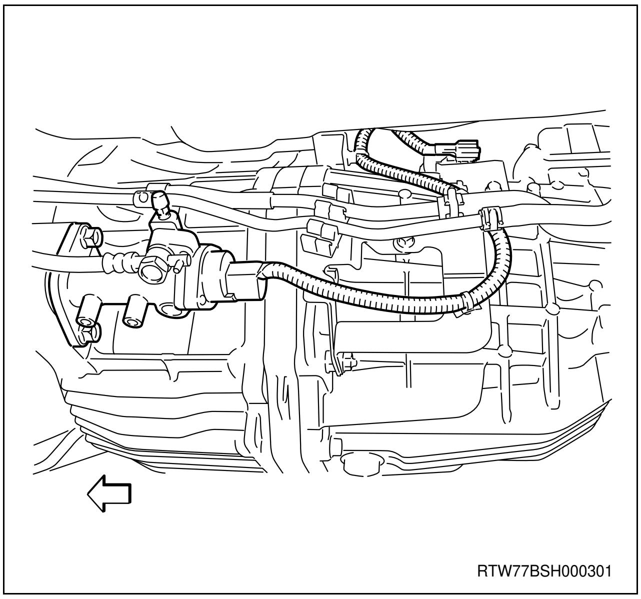
Legend
3. Clip
4. Reverse switch connector
5. 1st switch connector



Legend

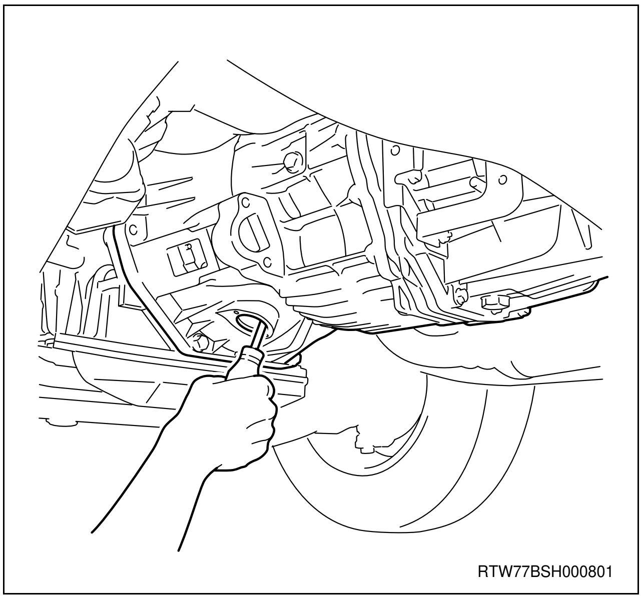
6. Car speed sensor conector
7. Clip
8. 2-4 switch connector (4x4 model)
9. Neutral switch connector (4x4 model)
10. Transfer actuator connector (4x4 model)

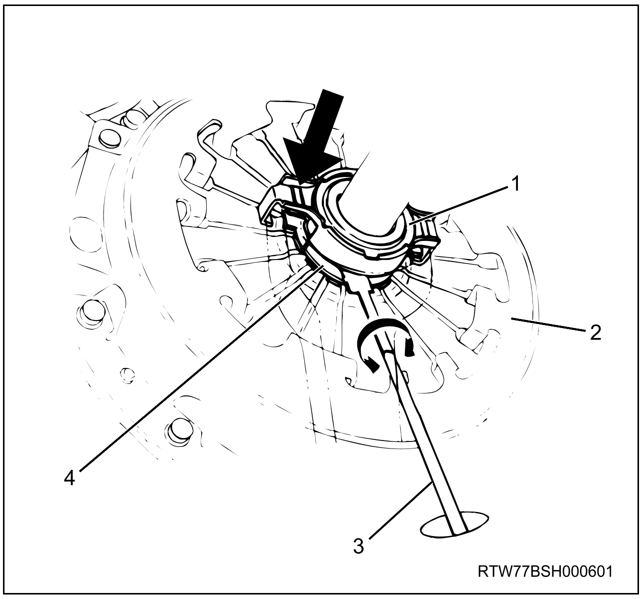
11. Remove the harness bracket fixing bolt on the transmission left side.
12. Remove the slave cylinder fixing bolts.



13. Remove the fuel pipe bracket fixing bolt and disconnect fuel pipe clip.
14. Remove the clutch housing cover and clutch bearing dust cover.
15. Use the remover 5-8840-2291-0 to disconnect the clutch release bearing from the clutch pressure plate.
    a. Pull the shift fork toward the transmission to press the clutch release bearing against the clutch.
    b. Insert the remover between the wedge collar and the release bearing.
    c. Turn the remover to separate the release bearing.

Notice:
Be sure not to insert the remover between the wedge collar and the clutch.





Legend

1. Release bearing
2. Pressure plate assembly
3. Bearing remover : 5-8840-2291-0
4. Wedge collar

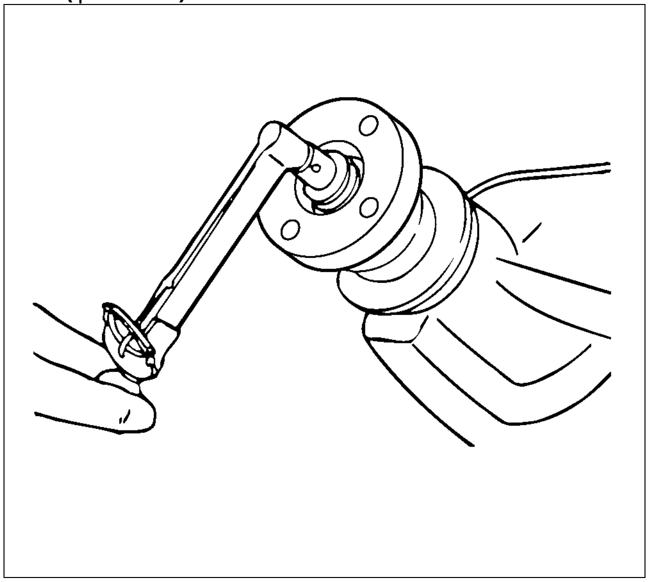
Starting torque :

ϕ220mm : 0.7-1.3 N·m
(0.07-0.13 kgf·m/6-11 lb·in)

ϕ194mm : 0.7-1.1 N·m
(0.07-0.11 kgf·m/6-10 lb·in)

Note :

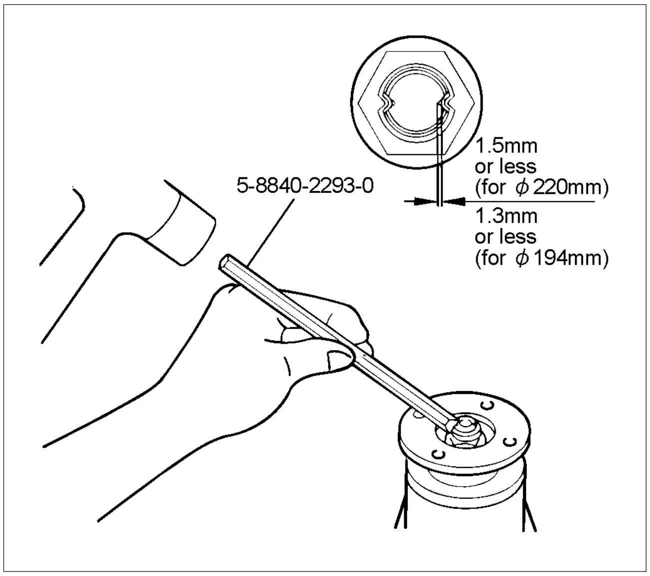
- **Do not overtighten or loosen and then retighten the nut.**
- **Pinion nut torque will be in the range of 245-294 N·m (25-30 kgf·m/181-217 lb·ft) (ϕ220mm) and 177-275 N·m (18-28 kgf·m/130-203 lb·ft) (ϕ194mm).**



425RW018

d. Using punch 5-8840-2293-0, stake the flange nut at two points.

Note :
When staking, be sure to turn the nut to ensure that there is no change in bearing preload. Make sure NOTE: of preload again as instructed in c.



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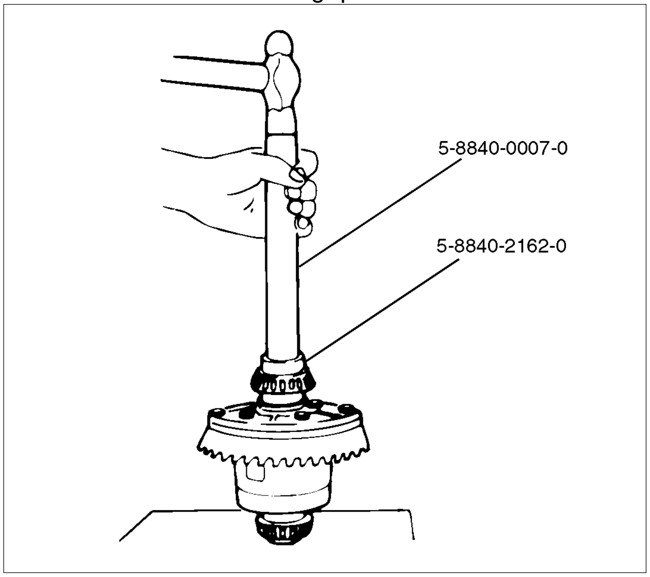
11. Adjust ring gear backlash.

a. Attach the side bearing to the differential assembly without shims by using installer 5-8840-2162-0 and grip 5-8840-0007-0.



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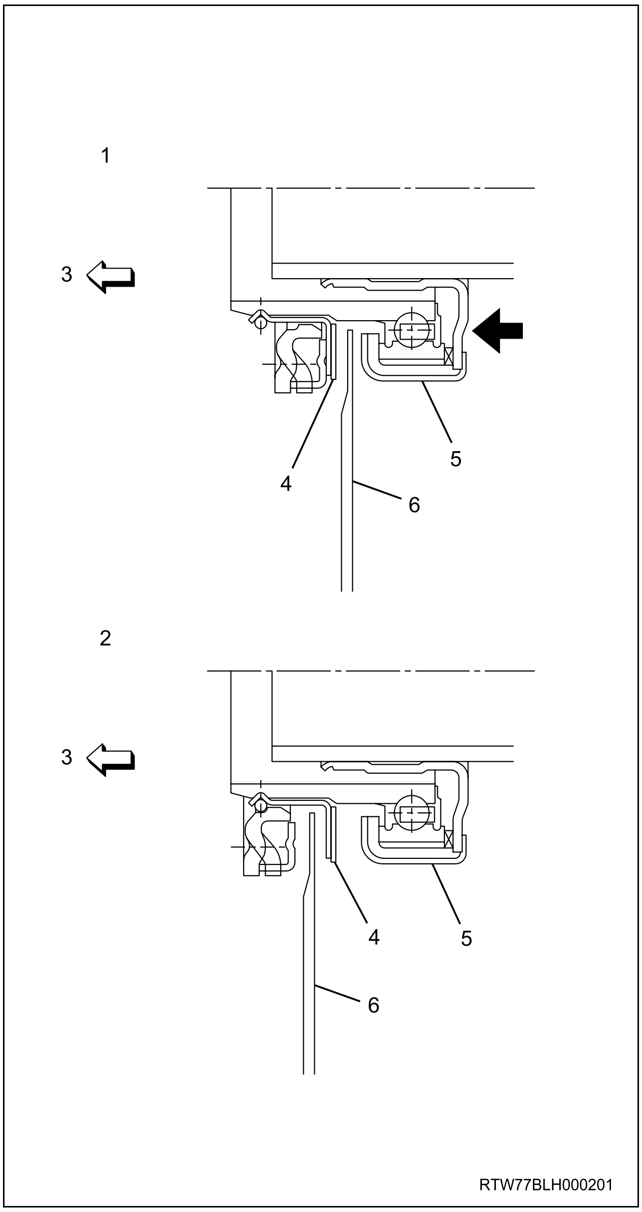
b. Insert the differential cage assembly with bearing outer races into the side bearing bores of the carrier.

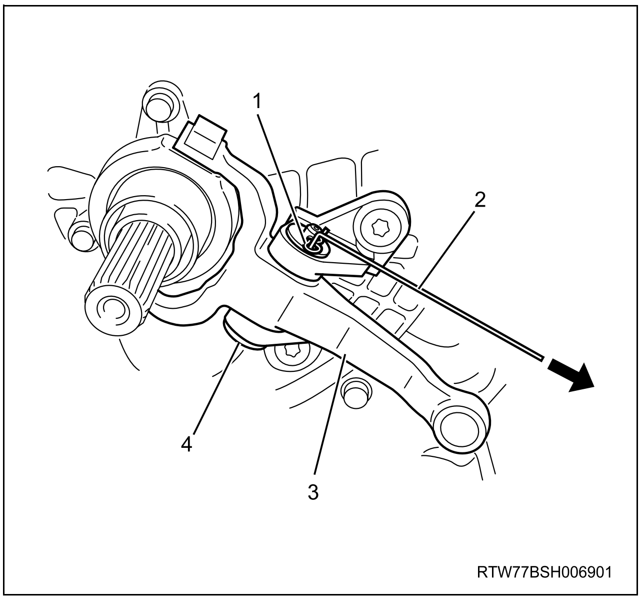


Legend

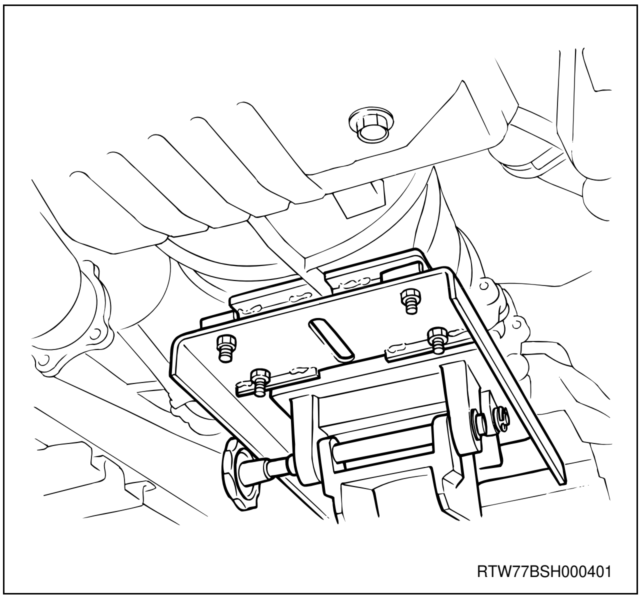
1. Correct procedure
2. Wrong procedure
3. Front
4. Wedge collar
5. Clutch release bearing
6. Bearing remover : 5-8840-2291-0

- When clutch release bearing cannot be removed (For instance, transformation of wedge collar, and other reasons), remove the shift fork in order of the following with a tool of L-type (2) as shown in figure.
  1) Remove the snap pin (1).
  2) Remove the shift fork pin (4).
  3) Remove the shift fork (3).

Notice:
Do not remove by this method usually.
The clutch release bearing or wedge collar might be damaged with the input shaft of transmission at removed the transmission because the clutch release bearing is adhered to clutch.



16. Support transmission assembly (4x2 model) or transmission & transfer assembly (4x4 model) with a transmission jack.



17. Remove the transmission rear mount nuts fixing on crossmember from the transmission crossmember.
18. Remove the transmission crossmember by removing four fixing bolts and nuts.
19. Remove the transmission rear mount.
20. Remove the starter assembly.
21. Disconnect harness clips on the transmission left side.

22. Remove the transmission retaining nuts and bolts. Remove the transmission assembly (4x2 model) or the transmission & transfer assembly (4x4 model) from the vehicle.
23. Remove the transmission-transfer fixing bolts and nut, and disassemble the transfer from the transmission. (4x4 model)

Installation

1. Apply grease (BESCO L-2 or equivalent) on the splined portion of the output shaft.
2. Connect the transfer to the transmission. (4x4 model)
3. Install the transmission-transfer fixing bolts and nut, and tighten them to the specified torque. (4x4 model)

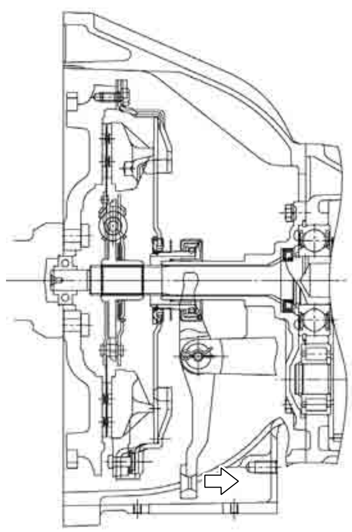
Torque: 41 N·m (4.2 kgf·m/30 lb·ft)

4. Apply a thin coat of molybdenum disulfide grease on the splined portion of the input shaft spline.
5. Slowly operate the transmission jack until the front of transmission is aligned with the rear of the engine.
6. Align the input shaft spline with the clutch driven plate spline.
7. Install the transmission assembly (4x2 model) or the transmission & transfer assembly (4x4 model) to the engine.
   - Tighten the transmission bolts to the specified torque.

Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

8. Apply a force 69 N·m (7 kgf·m/51 lb·ft) to the tip of the shift fork in the direction of the transmission to engine the clutch pressure plate and release bearing.

Notice:
A click sound is heard when the release bearing and the tip of the diaphragm spring engage each other.
Check to see if they are securely engaged by pushing the tip of the shift fork toward the engine side while applying a force of about 25 N·m (2.6 kgf·m/19 lb·ft). If the shift fork will not move, then they are securely engaged.



9. Connect harness clips on the transmission left side.
10. Install the starter assembly.
    - Tighten the starter bolts to the specified torque.

Torque: 94 N·m (9.6 kgf·m/69 lb·ft)

11. Install the transmission rear mount to the transmission.
    - Tighten the transmission rear mount bolts to the specified torque.

Torque: 50 N·m (5.1 kgf·m/37 lb·ft)

12. Install the transmission crossmember by removing four bolts and nuts.
    - Tighten the transmission crossmember bolts to the specified torque.

Torque: 67 N·m (6.8 kgf·m/49 lb·ft)

13. Install the transmission rear mount nuts fixing on crossmember from transmission crossmember.
    - Tighten the transmission rear mount nuts to the specified torque.

Torque: 52 N·m (5.3 kgf·m/38 lb·ft)

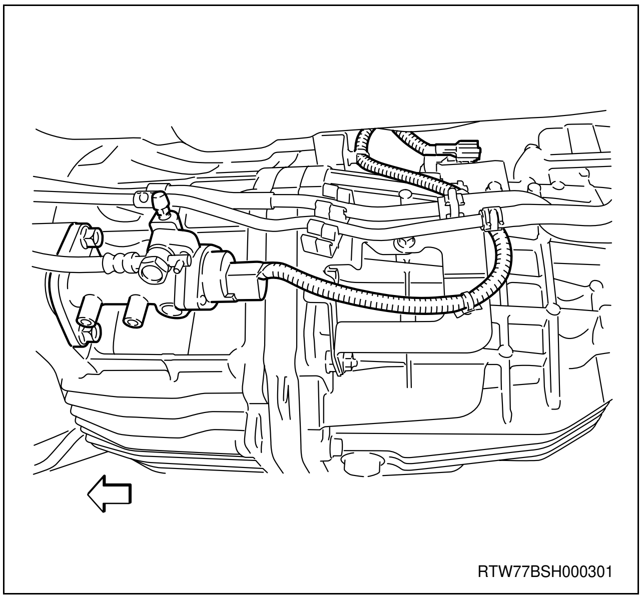
Remove the transmission jack from transmission side.

14. Install the fuel pipe bracket bolt and connect fuel pipe clip.
    - Tighten the fuel pipe bracket bolt to the specified torque.

Torque: 76 N·m (7.7 kgf·m/56 lb·ft)

15. Install the slave cylinder fixing bolts.
    - Tighten the slave cylinder bolts to the specified torque.

Torque: 43 N·m (4.4 kgf·m/32 lb·ft)



16. Install the front propeller shaft. (4x4 model)
    - Tighten the front propeller shaft bolts to the specified torque.

Torque: 59 N·m (6.0 kgf·m/43 lb·ft)

17. Install the rear propeller shaft.
    - Tighten the rear propeller shaft bolts to the specified torque.

Torque

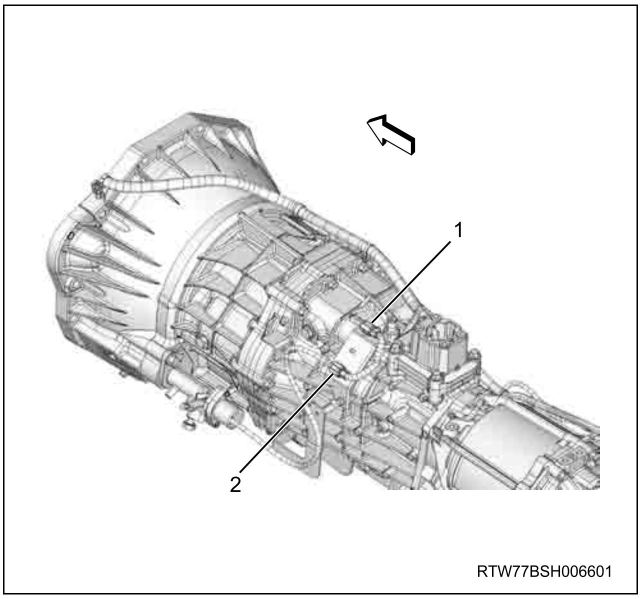
Rear flange: 59 N·m (6.0 kgf·m/43 lb·ft)

Center bearing: 69 N·m (7.0 kgf·m/51 lb·ft)

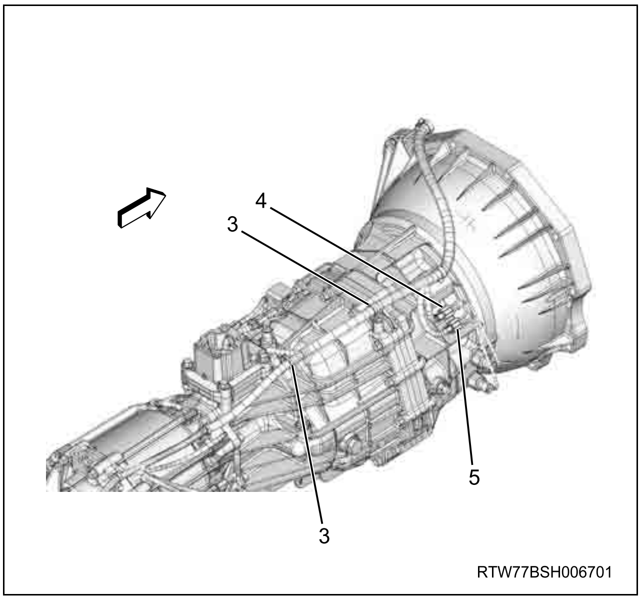
18. Connect harness clip on the transmission left side bracket.
    Install the harness bracket bolt.
    - Tighten the harness bracket bolt to the specified torque.

Torque: 23 N·m (2.3 kgf·m/17 lb·ft)

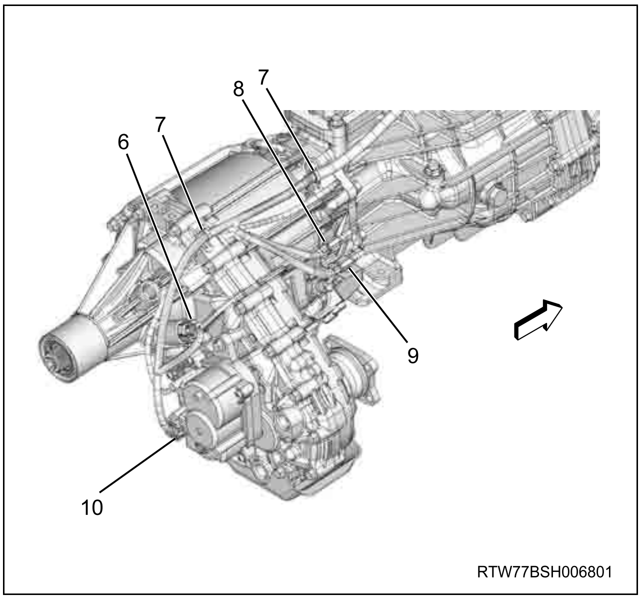
19. Connect the harness connectors and clips on the transmission.



Legend
1. Neutral switch connector
2. Clutch damper valve connector



Legend
3. Clip
4. Reverse switch connector
5. 1st switch connector



Legend

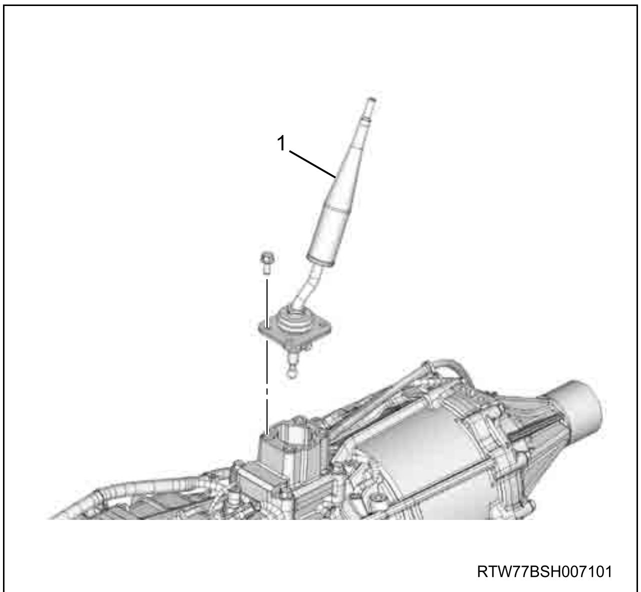
6. Car speed sensor conector
7. Clip
8. 2-4 switch connector (4x4 model)
9. Neutral switch connector (4x4 model)
10. Transfer actuator connector (4x4 model)

20. Install the clutch housing cover and clutch bearing dust cover.
    - Tighten the clutch housing cover bolts and clutch bearing dust cover bolts to the specified torque.

Torque: 8 N·m (0.8 kgf·m/69 lb·in)

21. Install the gear control lever (1).
    - Tighten the gear control lever bolts to the specified torque.

Torque: 19 N·m (1.9 kgf·m/14 lb·ft)

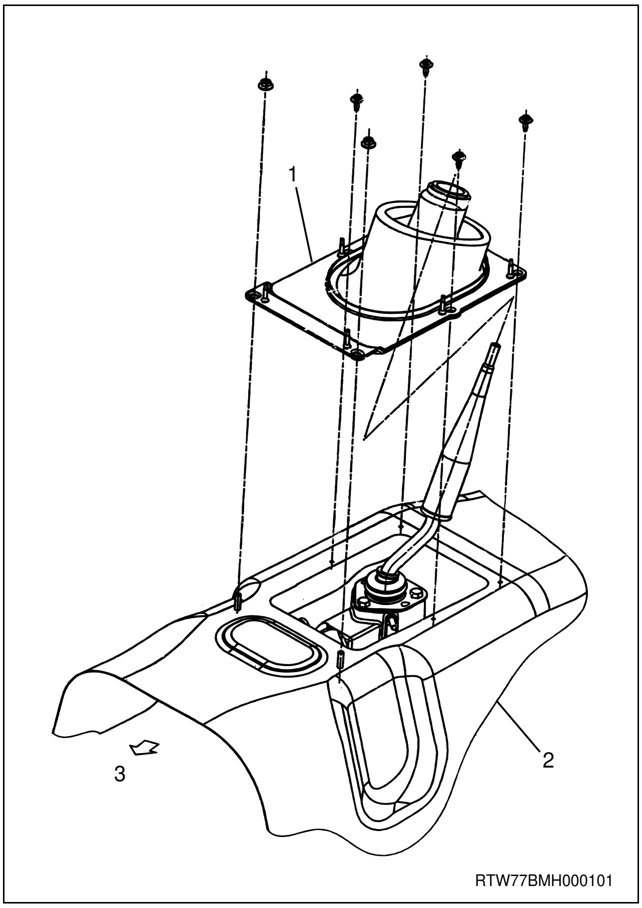


22. Install the grommet assembly.
    - Tighten the grommet bolts to the specified torque.

Torque

Screw: 1.4 N·m (0.14 kgf·m/12 lb·in)

Nut: 7 N·m (0.7 kgf·m/61 lb·in)

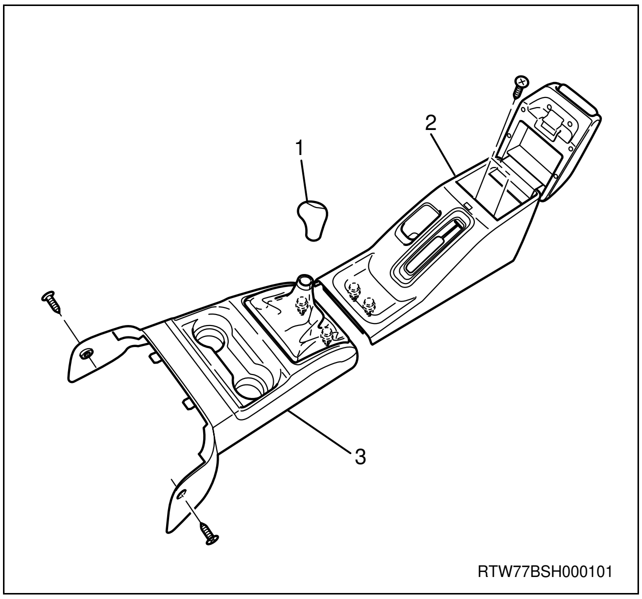


Legend

1. Grommet Assembly
2. Floor Panel
3. Front

23. Install the front floor console.
    Refer to the section "Floor Console".
24. Install the rear floor console. (Bucket seat)
    Refer to the section "Floor Console".

25. Install the gear control knob.



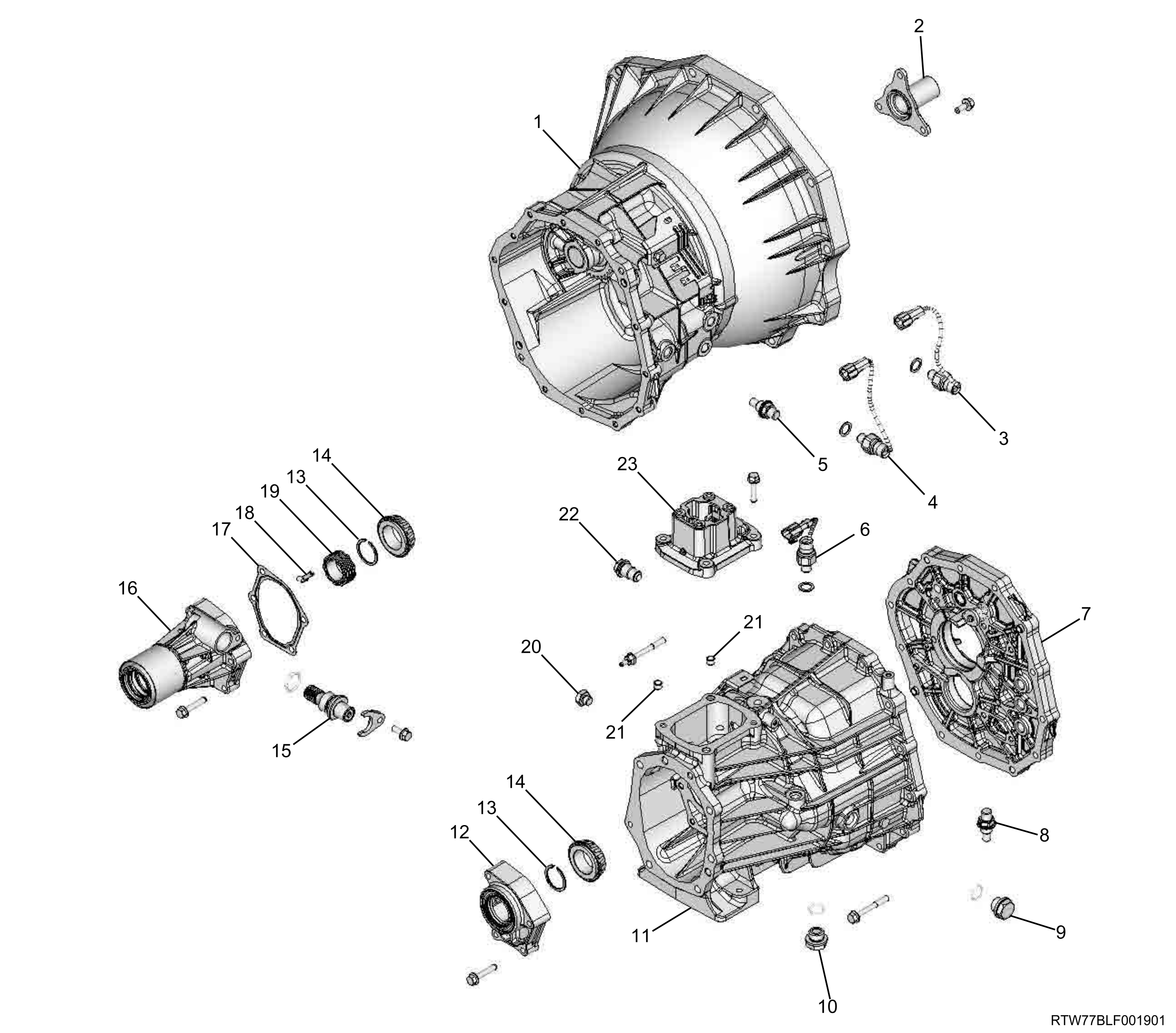
Legend

1. Knob
2. Rear Floor Console
3. Front Floor Console

26. Connect battery ground cable.

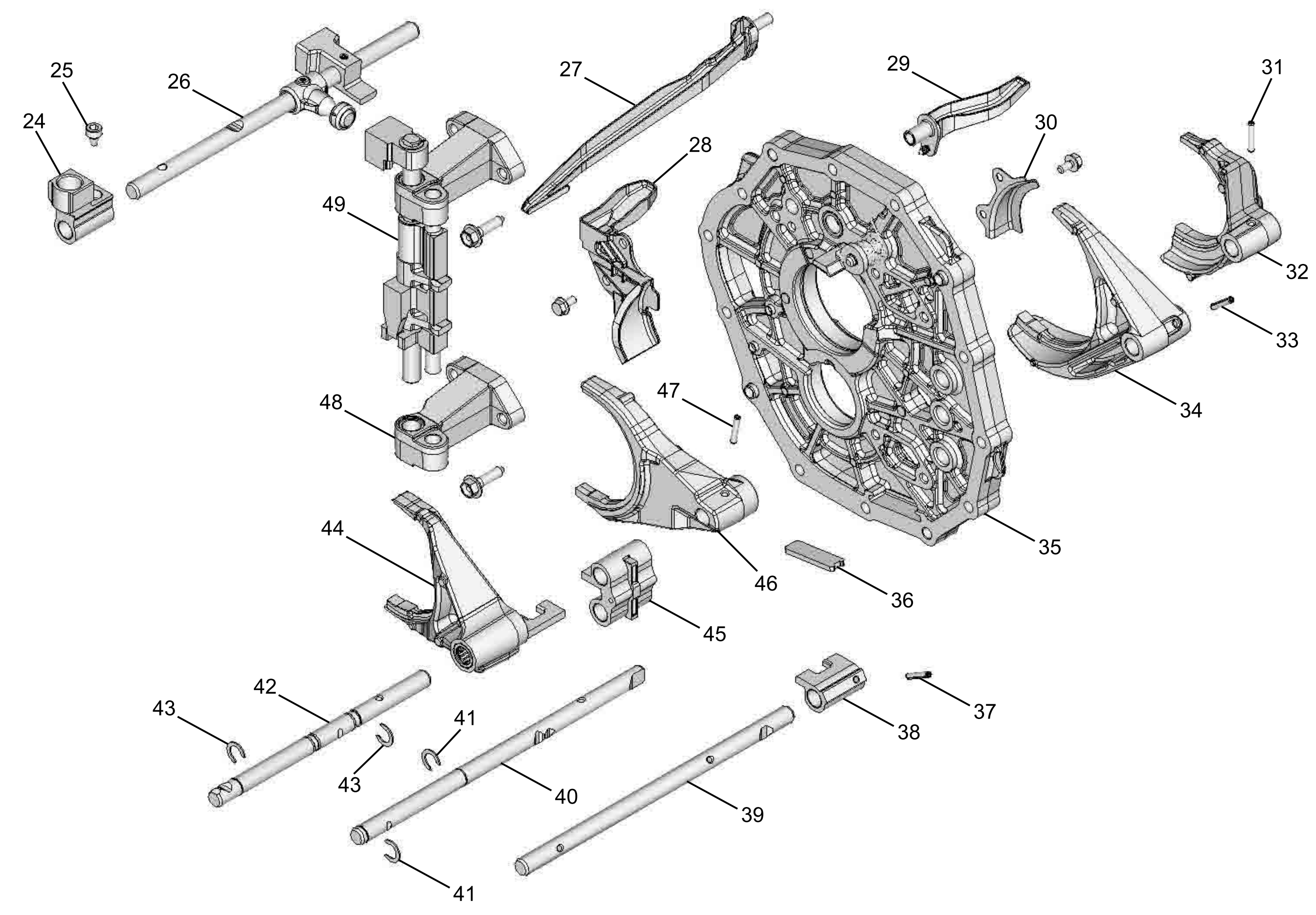
Transmission

Component



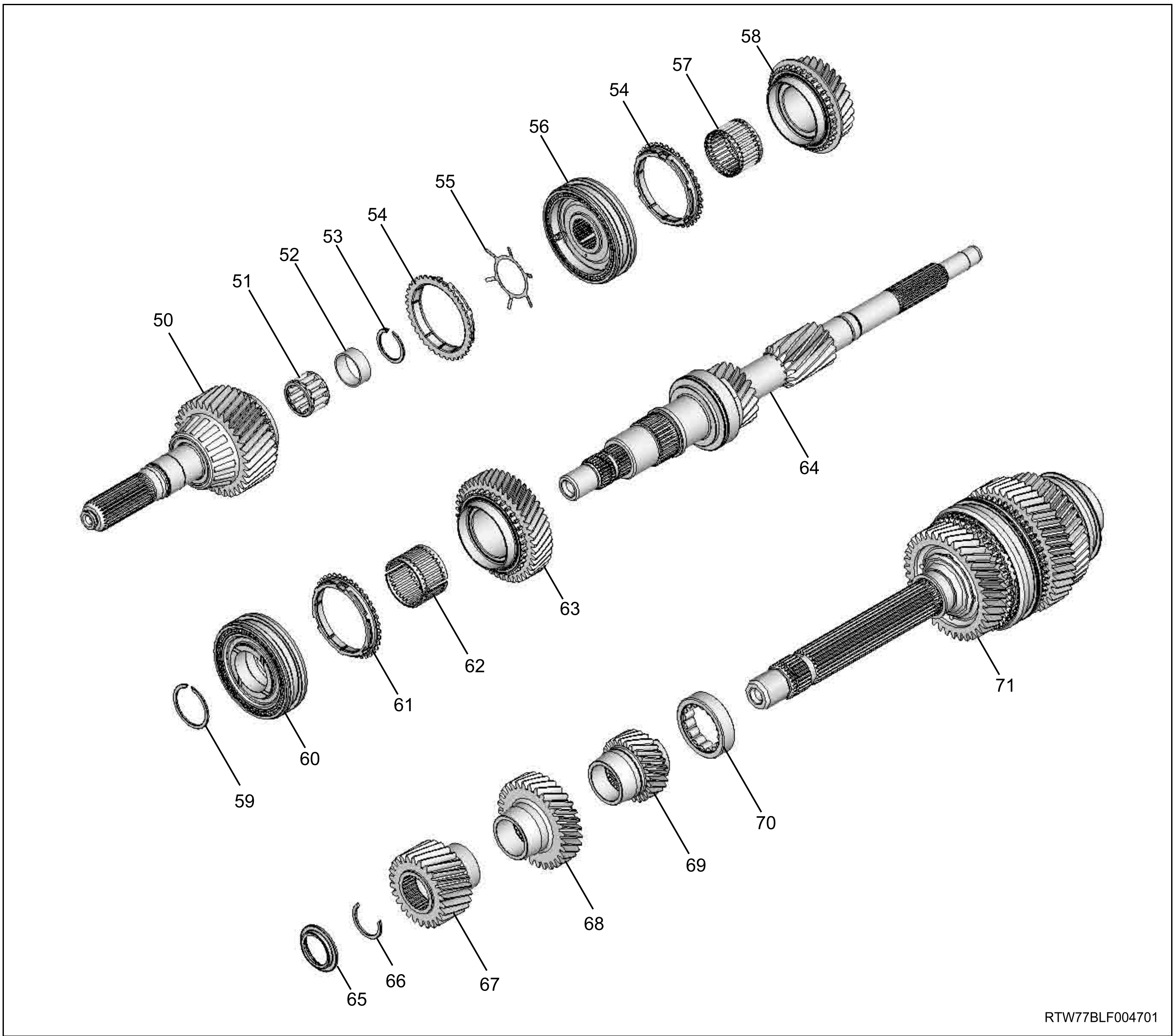
Legend

1. Front case assembly with clutch housing
2. Front cover
3. Reverse switch
4. 1st switch
5. Reverse detent assembly
6. Neutral switch
7. Intermediate plate assembly
8. 5th detent assembly
9. Filler plug
10. Drain plug
11. Rear case assembly
12. End cover assembly (4x4 model)
13. Output shaft snap ring
14. Output rear bearing inner race
15. Speedometer driven gear
16. End cover assembly (4x2 model)
17. End cover gasket
18. Gear set clip
19. Speedometer drive gear
20. Straight plug
21. Dowel
22. Control rod detent assembly
23. Quadrant box



Legend

24. Control unit block
25. Taper bolt
26. Control rod assembly
27. Rear gutter
28. Counter 5th gutter
29. Front gutter
30. Counter 2nd gutter
31. Reverse shift arm apring pin
32. Reverse shift arm
33. 1st-2nd shift arm spring pin
34. 1st-2nd shift arm
35. Intermediate plate assembly
36. Magnet
37. 1st-2nd shift block spring pin
38. 1st-2nd shift block
39. 1st-2nd shift rod
40. Reverse shift rod
41. Reverse shift rod snap ring
42. 3rd-4th-5th shift rod
43. 3rd-4th-5th shift rod snap ring
44. 3rd-4th shift arm assembly
45. 5th-Reverse shift block assembly
46. 5th shift arm
47. 5th shift arm spring pin
48. Shift rod bracket
49. Shift & select rod assembly



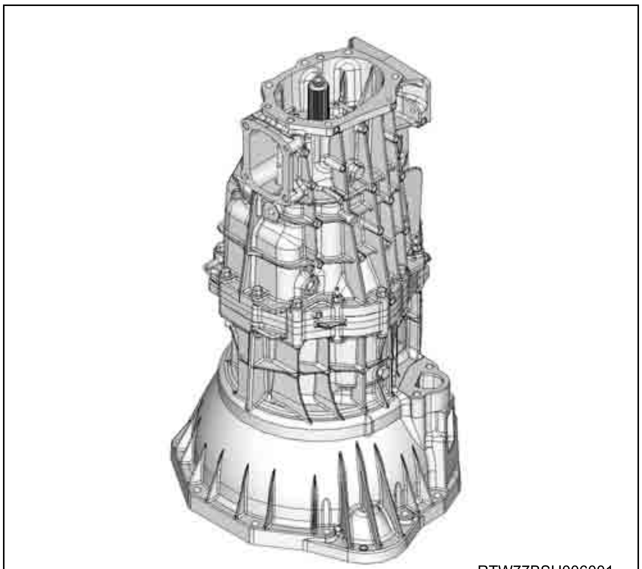
Legend

50. Output shaft assembly
51. Pilot bearing
52. Pilot bearing spacer
53. 3rd-4th hub snap ring
54. 3rd-4th block ring
55. Plate spring
56. 3rd-4th synchronizer assembly
57. 3rd input gear needle bearing
58. 3rd input gear assembly
59. 5th hub snap ring
60. 5th synchronizer assembly
61. 5th block ring
62. 5th input gear needle bearing (2 piece type)
63. 5th input gear assembly
64. Input shaft assembly
65. Rubber seal
66. Counter end snap ring
67. Output counter gear
68. 3rd counter gear
69. 5th counter gear
70. Counter middle roller bearing outer race
71. Counter shaft assembly

Removal

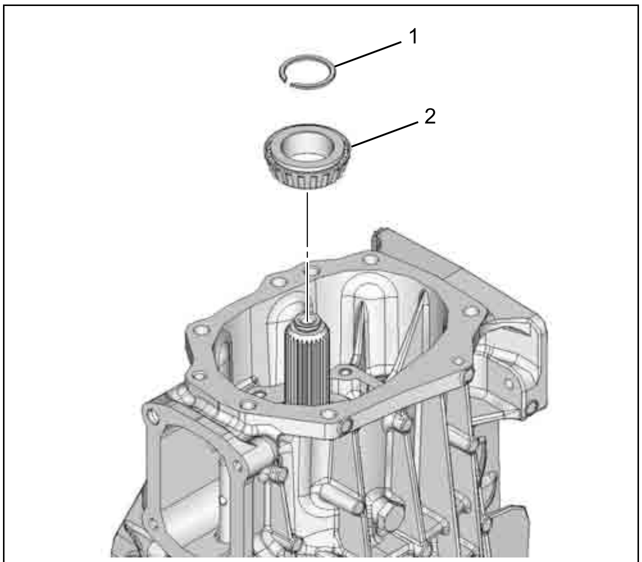
1. Clean the exterior of the unit with solvent.
2. Remove the drain plug with gasket and drain the lubricant.
3. Remove the front cover.
4. In order to protect the front oil seal lip, wrap a tape around the spline portion of the input shaft.
5. Remove the quadrant box and two dowels.
6. Remove the control unit block by performing the following steps.
   a. Push the control unit block ahead.

b. Remove the taper bolt, and discard the used taper bolt.
c. Remove the control unit block.
7. Remove the reverse switch (Connector color Brown), 1st switch (Connector color Gray) and neutral switch (Connector color Brown) with gasket.
Remove the three detent assemblies, and discard the used 5th & reverse detent assemblies.
8. Remove the two harness brackets.
9. Remove the speedometer driven gear and plate. (4x2 model)
10. Remove the end cover assembly.
11. Remove the gear set clip. (4x2 model)
12. Remove the speedometer drive gear. (4x2 model)
13. Stand the transmission assembly.



RTW77BSH006001

14. Remove the output shaft snap ring (1).
15. Remove the output rear bearing inner race (2).



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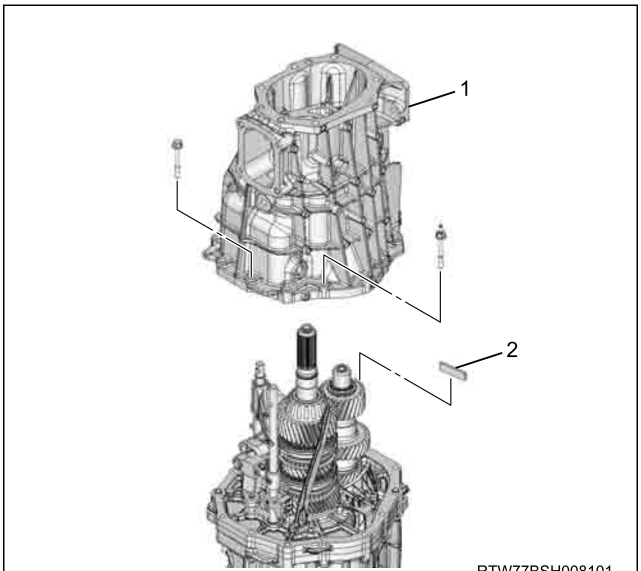
16. Remove the rear case assembly (1).
17. Remove the magnet (2).



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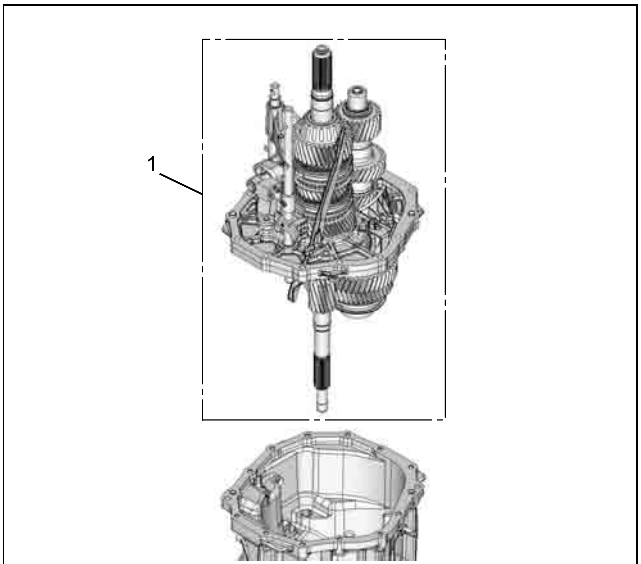
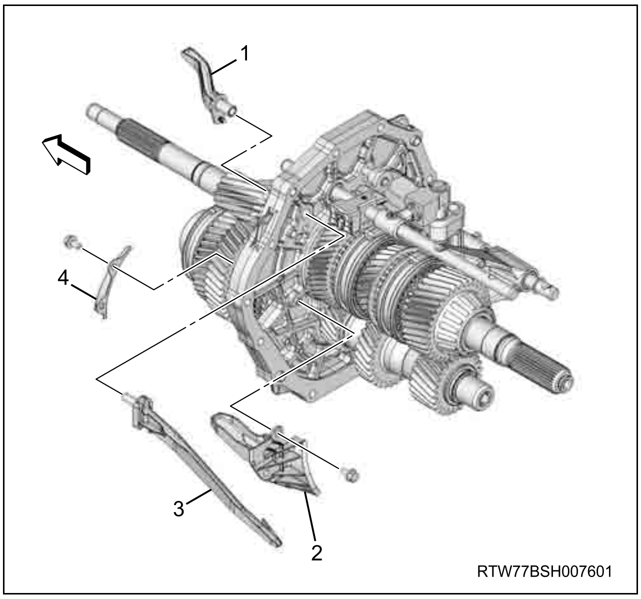
18. Remove the intermediate plate assembly with gear (1) from the front case.



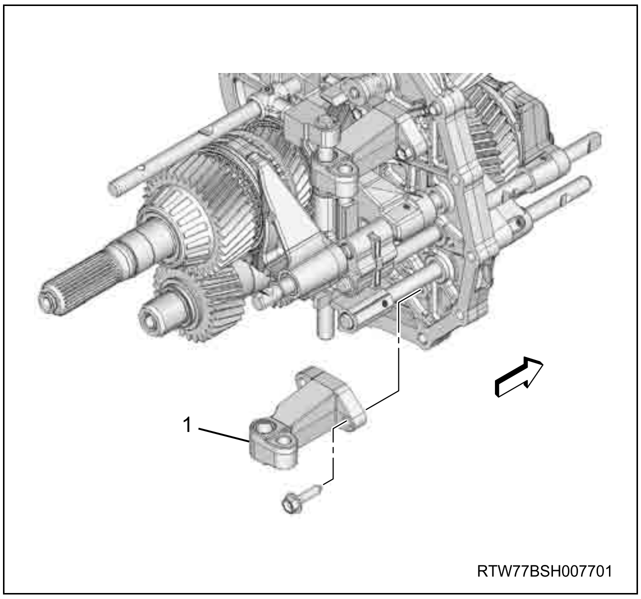
RTW77BSH007501

19. Remove the tape from the spline portion of the input shaft.
20. Remove the front gutter (1) and rear gutter (3), and discard the used gutters.

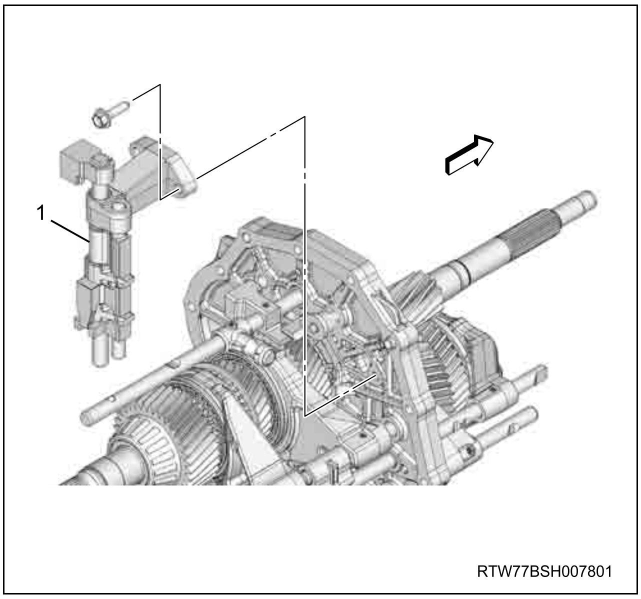
21. Remove the counter 2nd gutter (4) and counter 5th gutter (2).



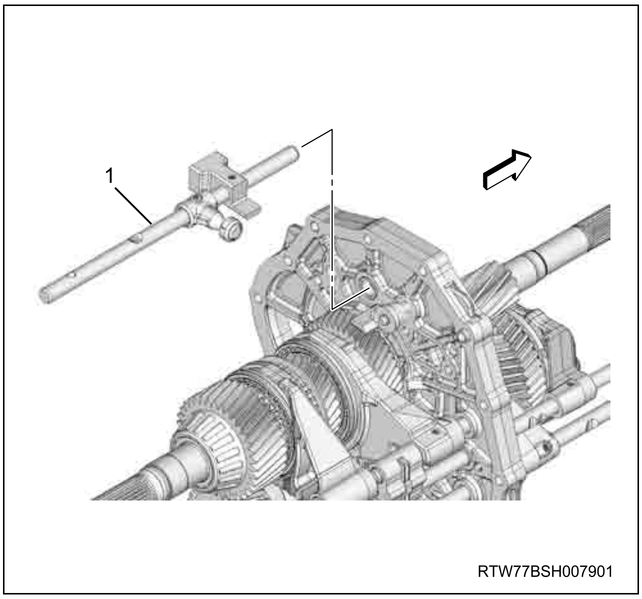
22. Remove the shift rod bracket (1).



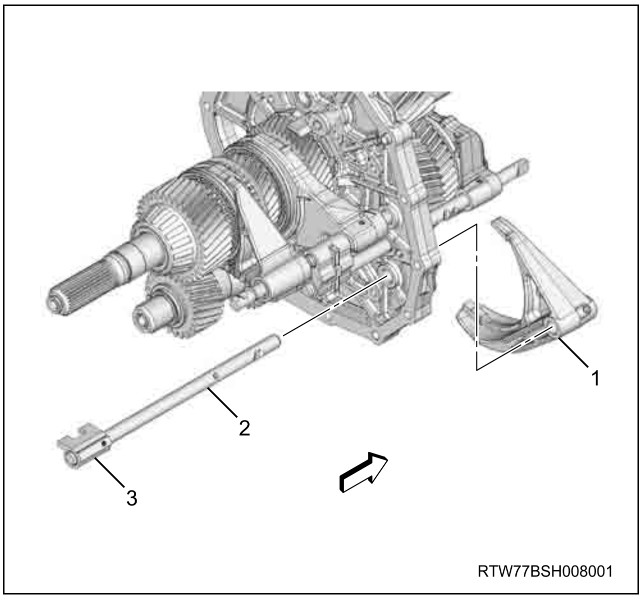
23. Remove the shift & select rod assembly (1).



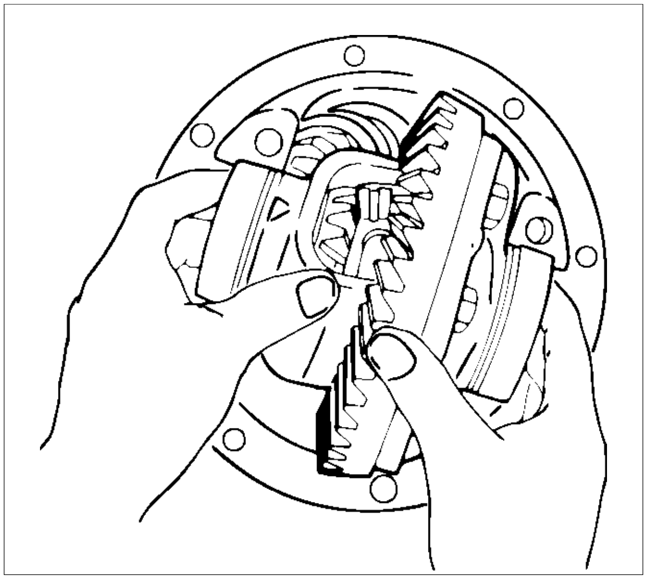
24. Remove the control rod assembly (1).

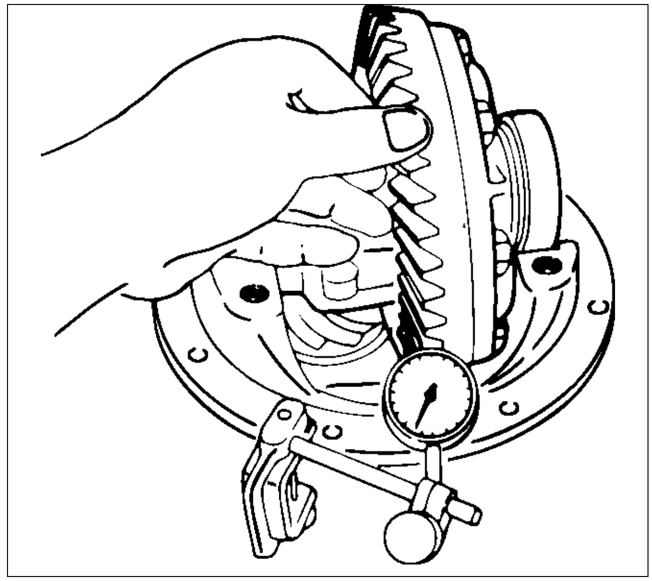


25. Use a spring pin remover to remove the 1st-2nd shift arm spring pin.
26. Remove the shift rod (2) with the 1st-2nd shft block (3).
27. Remove the 1st-2nd shift arm (1).



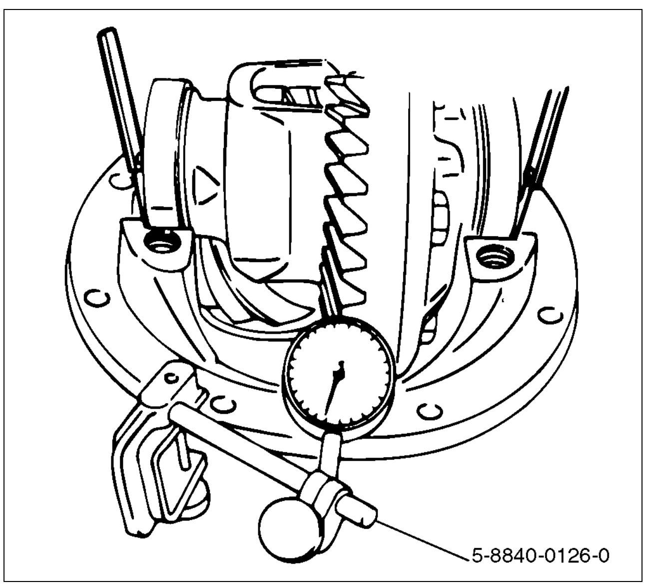
28. Use a spring pin remover to remove the reverse shift arm spring pin.


425RS030


425RS032

c. Using two sets of feeler gauges, insert a feeler stock of sufficient thickness between each bearing outer race and the carrier to remove all end play. Make certain the feeler stock is pushed to the bottom of the bearing bores.

   Mount the dial indicator 5-8840-0126-0 on the carrier so that the indicator stem is at right angles to a tooth on the ring gear.



425RW049

d. Adjust feeler gauge thickness from side to side until ring gear backlash is in the specified range.

   Backlash :

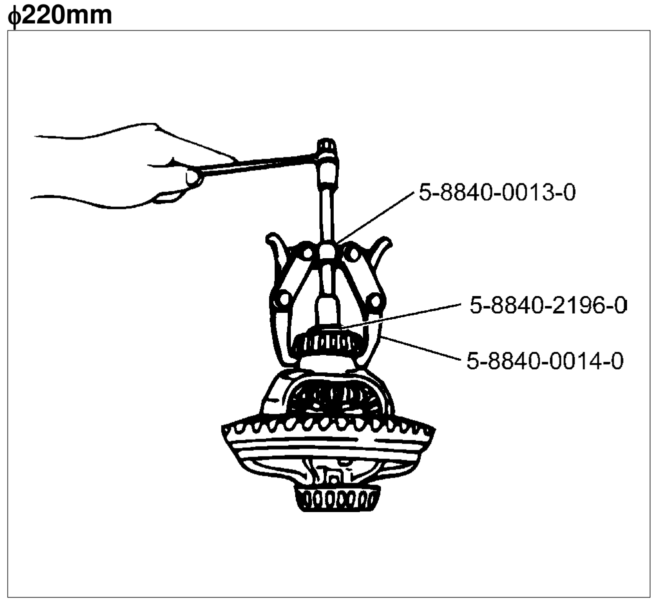
   ϕ220mm : 0.15-0.20 mm (0.006-0.008 in)

   ϕ194mm : 0.13-0.18 mm (0.005-0.007 in)

   With zero end play and correct backlash established, remove the feeler gauge packs, determine the thickness of the shims required and add 0.05 mm (0.002 in) to each shim pack to provide side bearing preload. Always use new shims.

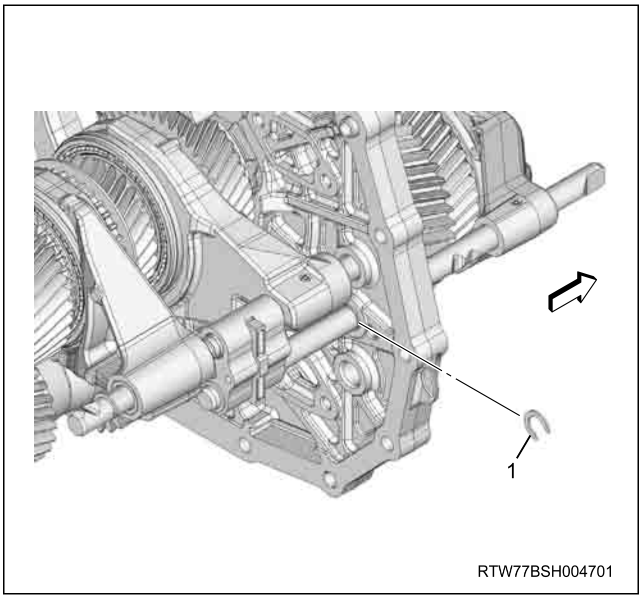
e. Remove side bearing by using remover 5-8840-0013-0 and 5-8840-0014-0 and adapter 5-8840-2196-0 (ϕ220mm) and 9-8521-1743-0 (ϕ194mm).

ϕ220mm

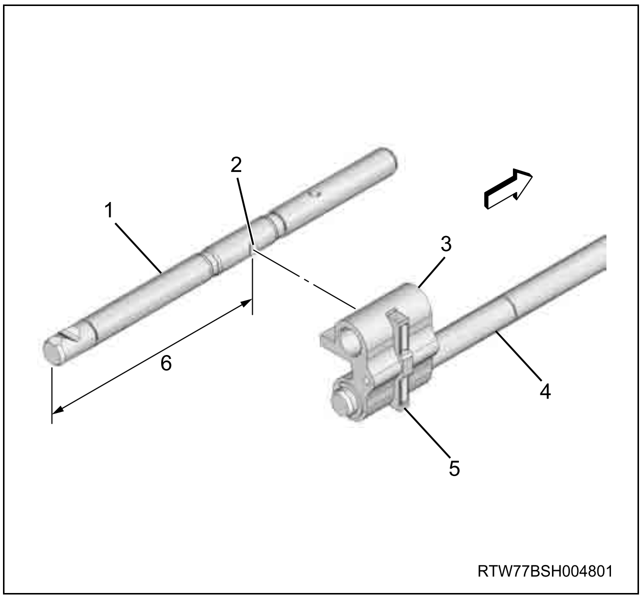


RTW54BSH000101

29. Remove the reverse shift rod snap ring (1).



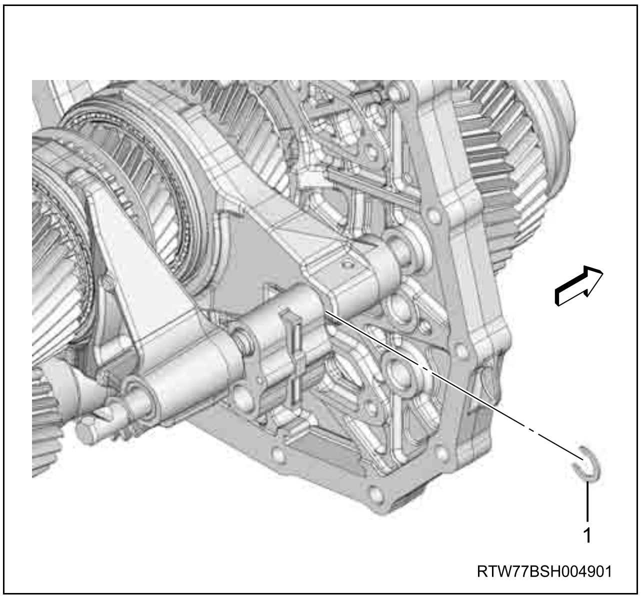
30. The shift block lever is put into the dent of the 3rd-4th-5th shift rod.



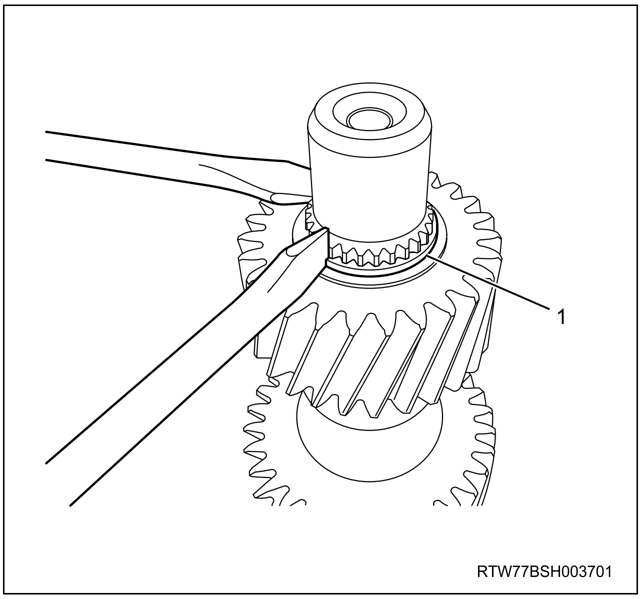
Legend

1. 3rd-4th-5th shift rod
2. Dent of 3rd-4th-5th shift rod
3. 5th-reverse shift block
4. Reverse shift rod
5. Shift block lever
6. 123.5 mm (4.86 in)

31. Remove the reverse shift rod.
32. Remove the reverse shift arm.
33. Use a spring pin remover to remove the 5th shift arm spring pin.
34. Remove the 3rd-4th-5th shift rod snap ring (1).

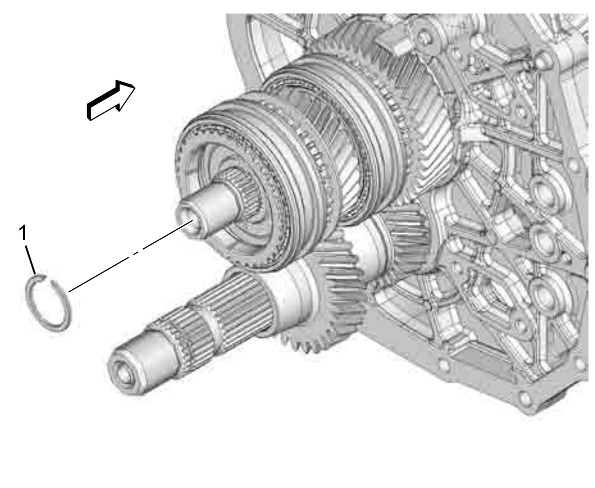


35. Remove the 3rd-4th-5th shift rod.
36. Remove the 5th shift arm.
37. Remove the 5th-reverse shift block assembly.
38. Remove the 3rd-4th shift arm assembly.
39. Remove the output shaft assembly.
40. Remove the rubber seal, and discard the used rubber seal.
41. Remove the counter end snap ring (1).



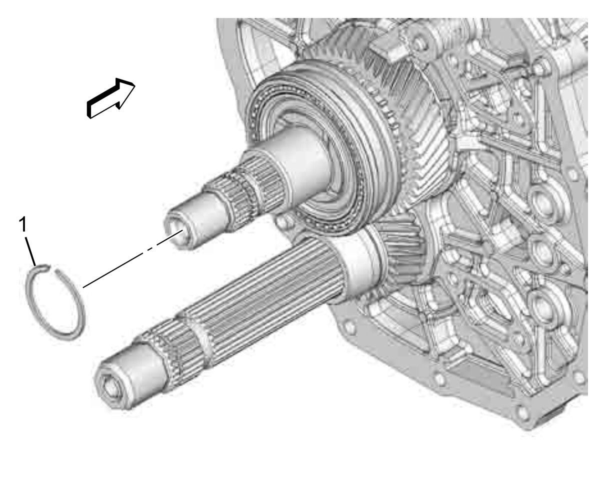
42. Remove the output counter gear.
43. Remove the pilot bearing.
44. Remove the pilot bearing spacer.
45. Remove the 3rd-4th block ring of the output shaft side.
46. Remove the plate spring.

47. Remove the 3rd-4th hub snap ring (1).



RTW77BSH005001

48. Remove the 3rd-4th synchronizer assembly, 3rd-4th block ring of 3rd input gear side, and 3rd input gear assembly.
49. Remove the 3rd input gear needle bearing.
50. Remove the 3rd counter gear.
51. Remove the counter shaft assembly and 5th counter gear from the intermediate plate.
52. Remove the counter middle roller bearing outer race.
53. Remove the 5th hub snap ring (1).



RTW77BSH005101

54. Remove the 5th synchronizer assembly, 5th block ring and 5th input gear assembly.
55. Remove the 5th input gear needle bearing. (2 piece type)
56. Use a pair of snap ring pliers to hold the input middle bearing snap ring open .
Push the input shaft assembly toward the front of the transmission to remove it.
The input middle bearing snap ring will come free.

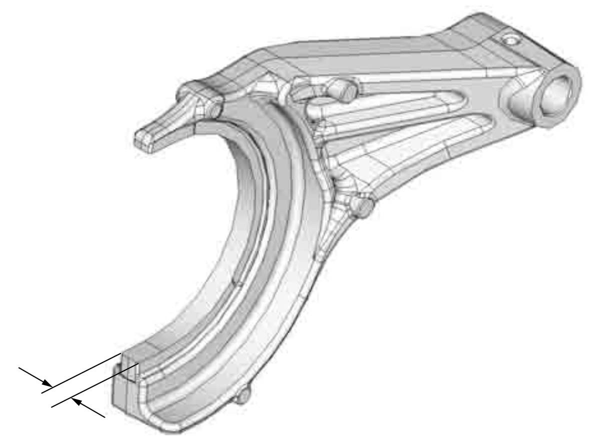
Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Shift Arm Thickness

Use a micrometer to measure the shift arm thickness.
If the measured value exceeds the specified limit, the shift arm must be replaced.

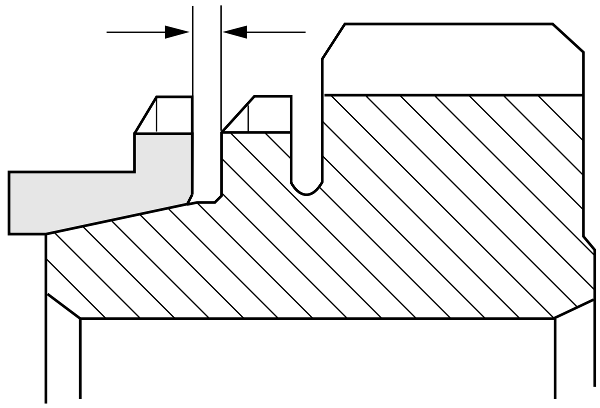
	Standard	Limit
1st - 2nd 3rd - 4th	9.60 - 9.85 mm (0.378 - 0.388 in)	8.85 mm (0.348 in)
5th	9.60 - 9.85 mm (0.378 - 0.388 in)	9.35 mm (0.368 in)
Reverse	7.85 - 8.10 mm (0.309 - 0.319 in)	7.60 mm (0.299 in)


RTW77BSH006401

Block Ring and Dog Teeth Clearance

Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
If the measured value exceeds the specified limit, the block ring must be replaced.

	Standard	Limit
3rd - 4th 5th	1.50 mm (0.059 in)	0.80 mm (0.031 in)

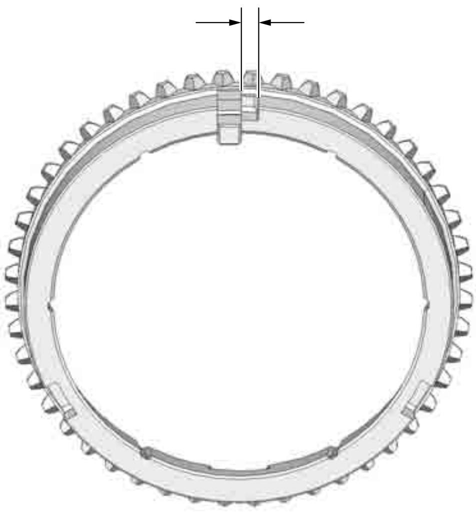


LNW25CSH028401

Block Ring and Insert Clearance

Use a vernier caliper or thickness gauge to measure the clearance between the block ring and insert.
If the measured value exceeds the specified limit, the block ring and insert must be replaced.

	Standard	Limit
3rd - 4th 5th	3.59 - 3.91 mm (0.141 - 0.154 in)	4.10 mm (0.161 in)

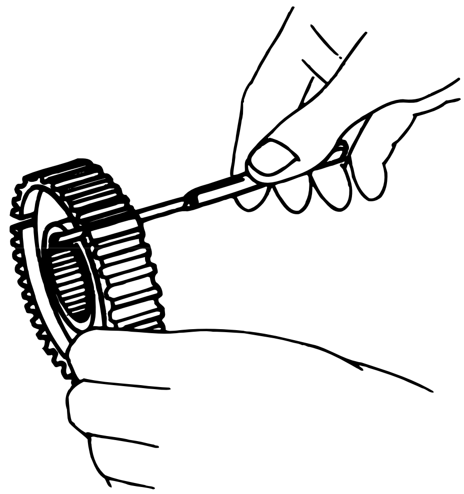


RTW77BSH006501

Clutch Hub and Insert Clearance

Use a thickness gauge to measure the clearance between the clutch hub and insert.
If the measured value exceeds the specified limit, the clutch hub and insert must be replaced.

	Standard	Limit
3rd - 4th 5th	0.09 - 0.31 mm (0.004 - 0.012 in)	0.40 mm (0.016 in)

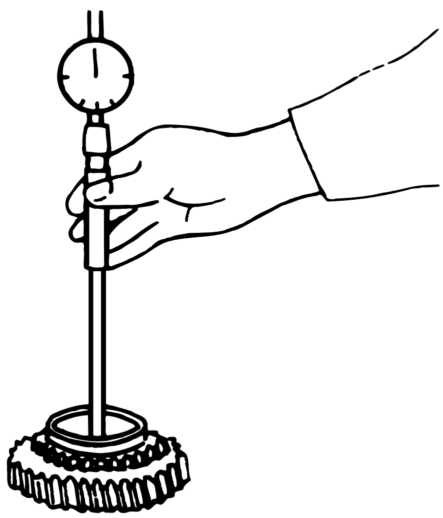


LNW25CSH028701

Gear Inside Diameter

Use an inside dial indicator to measure the gear inside diameter.
If the measured value is less than the specified limit, the gear must be replaced.

	Standard	Limit
3rd	45.000 - 45.016 mm (1.7717 - 1.7723 in)	45.056 mm (1.7739 in)
5th	48.000 - 48.016 mm (1.8898 - 1.8904 in)	48.056 mm (1.8920 in)



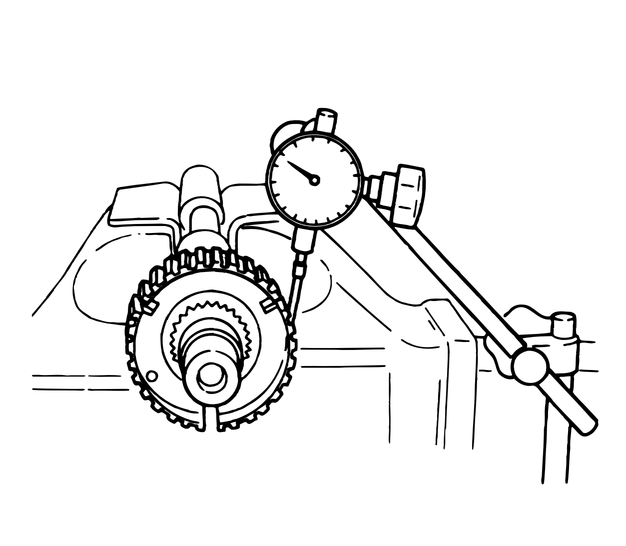
LNW25CSH028901

Clutch Hub Spline Play

- Set a dial indicator to the clutch hub to be measured.
- Move the clutch hub as far as possible to both the right and the left.

Note the dial indicator reading.
If the measured value exceeds the specified limit, the clutch hub must be replaced.

	Standard	Limit
3rd - 4th	0.010 - 0.102 mm (0.0004 - 0.0040 in)	0.15 mm (0.0059 in)
5th	0.009 - 0.104 mm (0.0004 - 0.0041 in)	0.15 mm (0.0059 in)

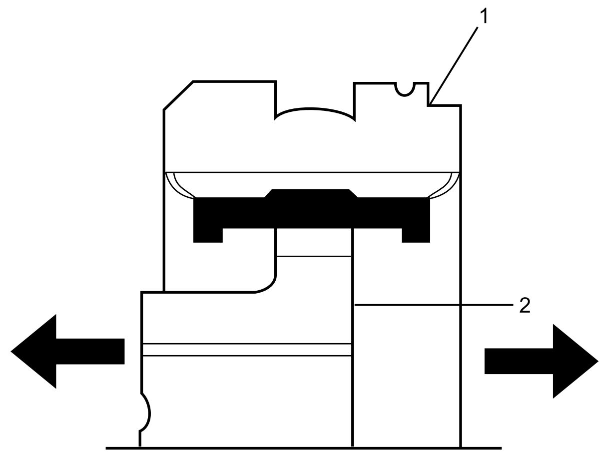

LNW25CSH029101

Counter Gear Spline Play

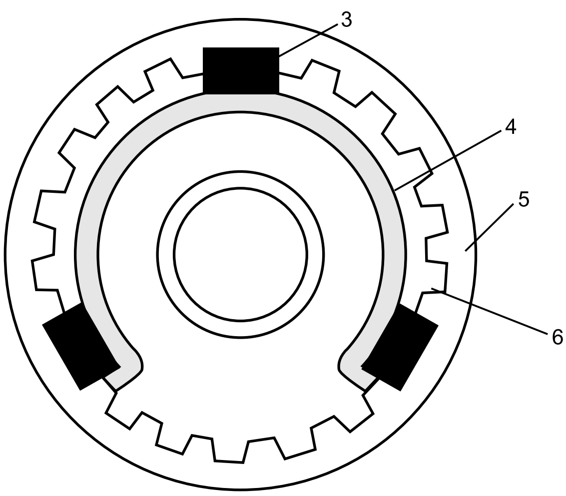
Refer to Counter Shaft Assembly in this section.

Installation

1. Use a pair of snap ring pliers to hold the new input middle bearing snap ring open .
   Install the input shaft assembly to the intermediate plate.
   - Never reinstall the used snap ring.
2. Install the input middle bearing snap ring.
3. Install the 5th input gear needle bearing. (2 piece type)
4. Install the 5th input gear assembly.
   - Apply engine oil to the gear internal surface.
5. Assemble the 5th synchronizer assembly by performing the following steps.
   - Turn the clutch hub face (2) toward the sleeve groove (1) (rear side) on the outer circumference.
   - Check that the inserts (3) fit snugly into the clutch hub (6) ring insert grooves.
   - Check that the inserts springs (4) are fitted to the inserts as shown in the figure.
   - Check that the clutch hub (6) and the sleeve (5) slide smoothly.
   - The insert springs (4) must be set in such a way that the opening of spring faces different direction.



LNW25CSH025601

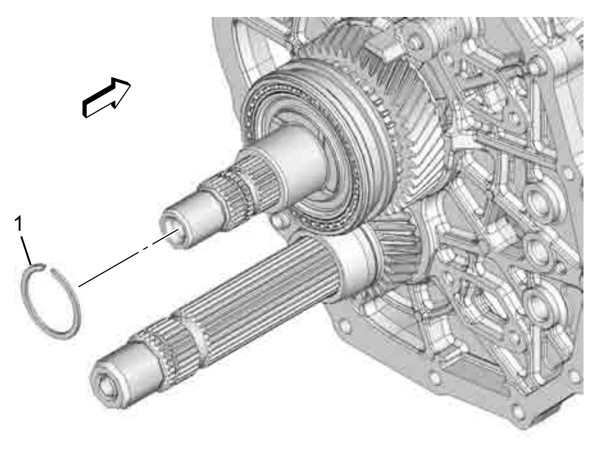


LNW25CSH025701

6. Install the 5th block ring and 5th synchronizer assembly.
7. Install the new 5th hub snap ring (1).
   - Never reinstall the used snap ring.
   - Choose the thickest snap ring among ones which can be assembled.

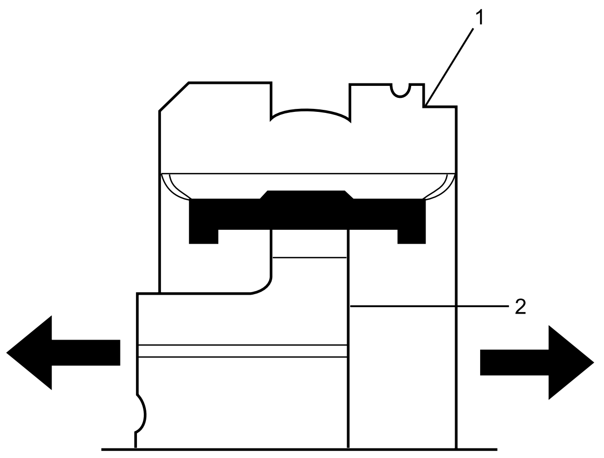
Snap Ring Availability

Thickness	Identification color
1.95 mm(0.077 in)	No color
2.10 mm(0.083 in)	Yellow

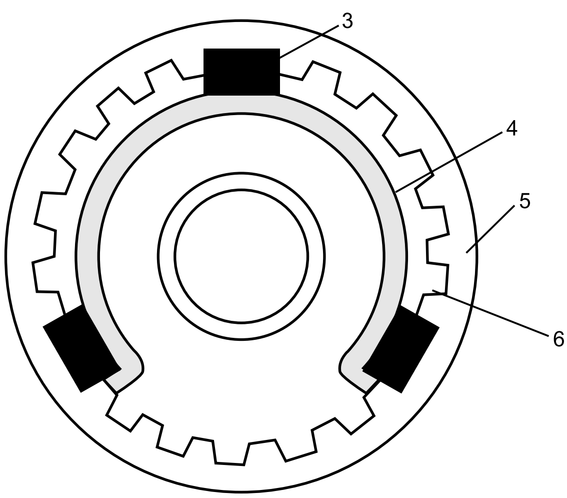


RTW77BSH005101

8. Install the counter middle roller bearing outer race, counter shaft assembly and 5th counter gear to the intermediate plate.
   - Apply engine oil to the gear internal surface.
9. Install the 3rd counter gear.
   - Apply engine oil to the gear internal surface.
10. Iinstall the 3rd input gear needle bearing.
11. Assemble the 3rd-4th synchronizer assembly by performing the following steps.
   - Turn the clutch hub face (2) toward the sleeve groove (1) (rear side) on the outer circumference.
   - Check that the inserts (3) fit snugly into the clutch hub (6) ring insert grooves.
   - Check that the inserts springs (4) are fitted to the inserts as shown in the figure.
   - Check that the clutch hub (6) and the sleeve (5) slide smoothly.
   - The insert springs (4) must be set in such a way that the opening of spring faces different direction.



LNW25CSH025601

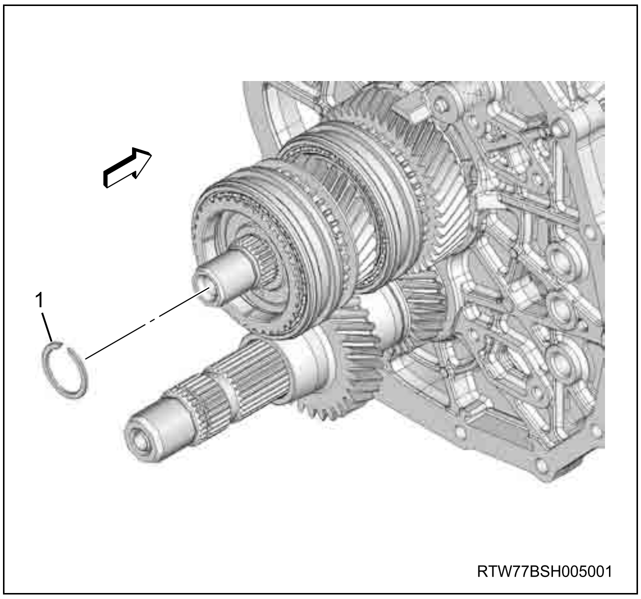


LNW25CSH025701

12. Install the 3rd input gear assembly, 3rd-4th block ring of 3rd input gear side, and 3rd-4th synchronizer assembly.
   - Apply engine oil to the gear internal surface.
13. Install the new 3rd-4th hub snap ring (1).
   - Never reinstall the used snap ring.
   - Choose the thickest snap ring among ones which can be assembled.

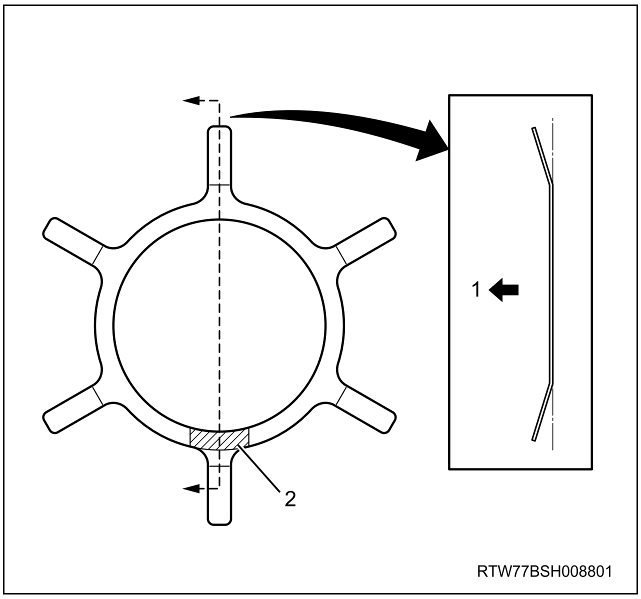
Snap Ring Availability

Thickness	Identification color
1.9 mm(0.075 in)	No color
2.1 mm(0.083 in)	Yellow
2.3 mm(0.091 in)	Pink



14. Install the plate spring.

Notice:
Painted identification color (Blue) side to be Transmission rear side.



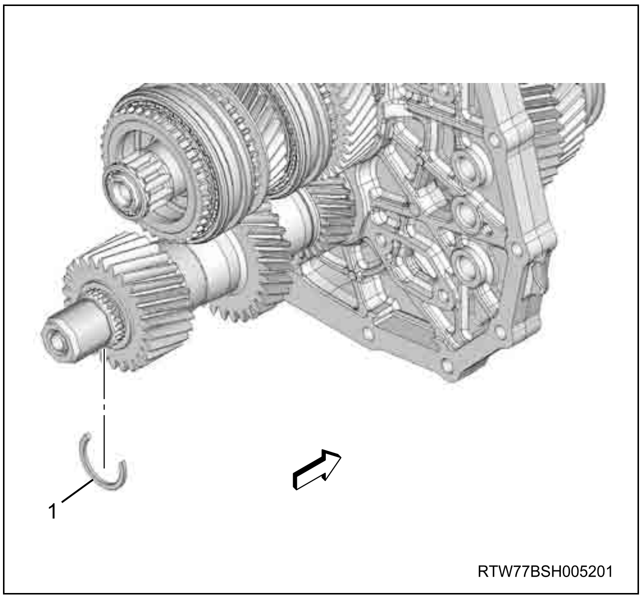
Legend

1. Transmission rear side
2. Painted area of identification color (Blue)

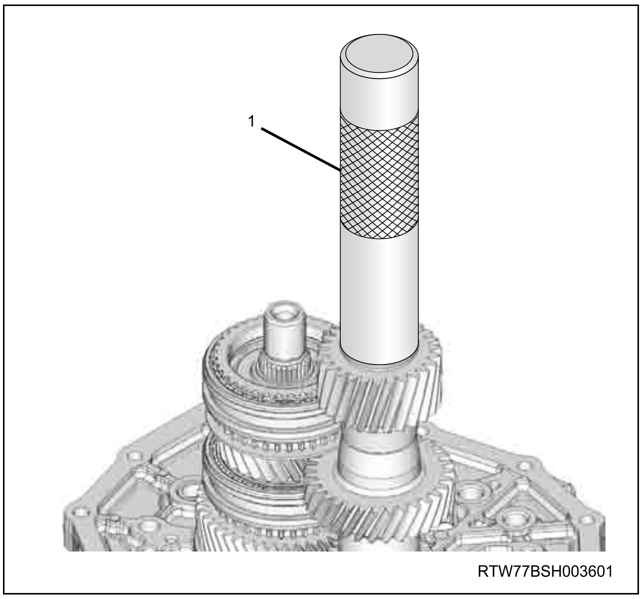
15. Install the 3rd-4th block ring of output shaft side.
16. Install the output counter gear.
    - Apply engine oil to the gear internal surface.
17. Install the new counter end snap ring (1).
    - Never reinstall the used snap ring.
    - Choose the thickest snap ring among ones which can be assembled.

Snap Ring Availability

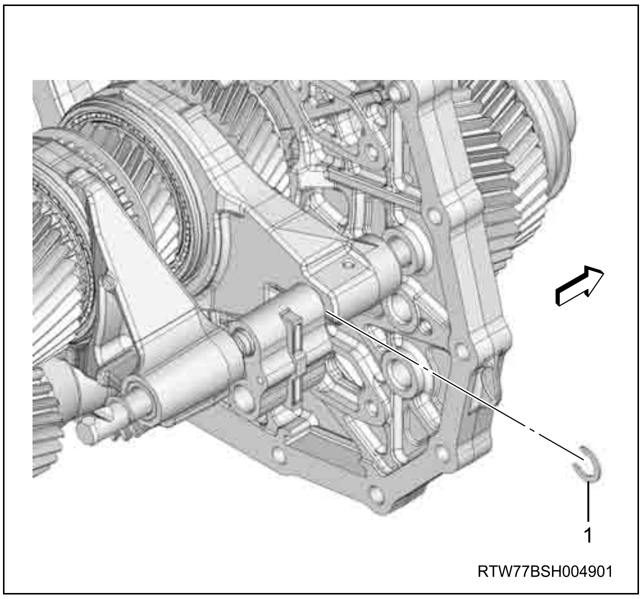
Thickness	Identification color
2.3 mm(0.091 in)	Pink
2.5 mm(0.098 in)	White
2.7 mm(0.106 in)	Green



18. Use the installer 5-8840-2346-0 (1) to install the new rubber seal.
    - Never reinstall the used rubber seal.
    - When seal press fitted, clearance not exists between lip and end surface of gear.



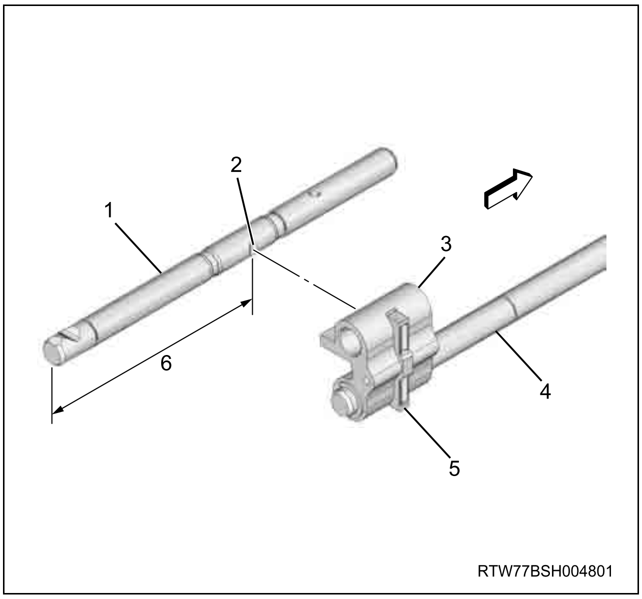
19. Install the pilot bearing spacer.
20. Install the pilot bearing.
    - Apply grease (BESCO L-2 or equivalent) to the bearing roller.
21. Install the output shaft assembly.
22. Install the 3rd-4th shift arm assembly.
23. Install the 5th-reverse shift block assembly.
24. Install the 5th shift arm.
25. Install the 3rd-4th-5th shift rod.
26. Install the new 3rd-4th-5th shift rod snap ring (1).
    - Never reinstall the used snap ring.



27. Install the 5th shift arm new spring pin.
    - Never reinstall the used spring pin.

Notice:
The spring pin must be drive in to this hole end surface surfly.

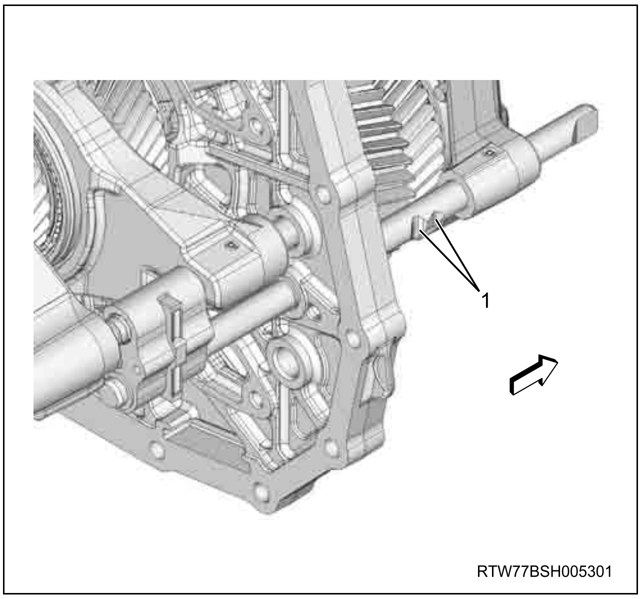
28. Install the reverse shift arm.
29. The shift block lever is put into the dent of the 3rd-4th-5th shift rod.



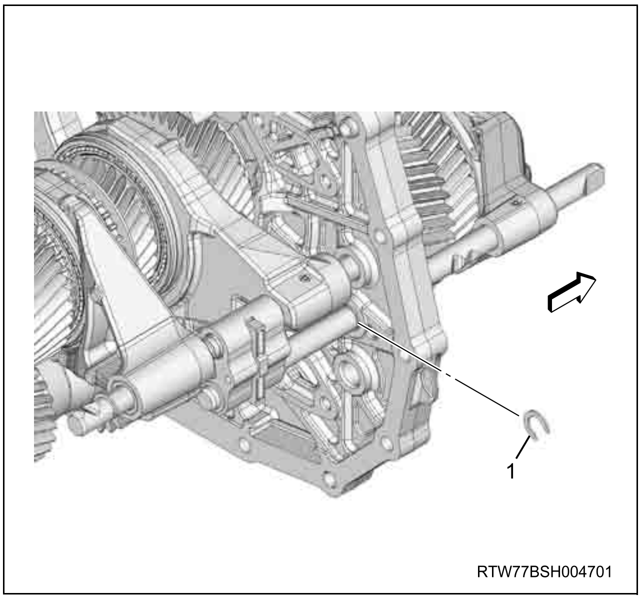
Legend
1. 3rd-4th-5th shift rod
2. Dent of 3rd-4th-5th shift rod
3. 5th-reverse shift block
4. Reverse shift rod
5. Shift block lever
6. 123.5 mm (4.86 in)

30. Install the reverse shift rod.

Notice:
The dents (1) of the shift rod should face outside of the transmission so that the detent of the front case fits them when reassembled.



31. Install the new reverse shift rod snap ring (1).
    - Never reinstall the used snap ring.

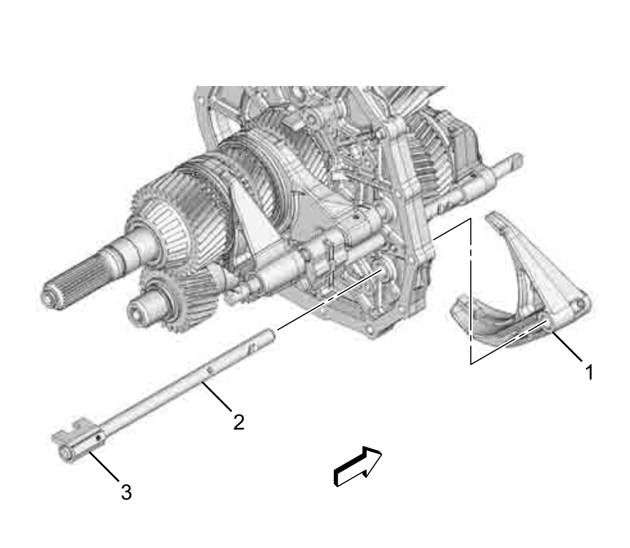


32. Install the reverse shift arm new spring pin.
    - Never reinstall the used spring pin.

Notice:
The spring pin must be drive in to this hole end surface surfly.

33. Install the 1st-2nd shift arm (1).

34. Install the shift rod (2) with the 1st-2nd shft block (3).

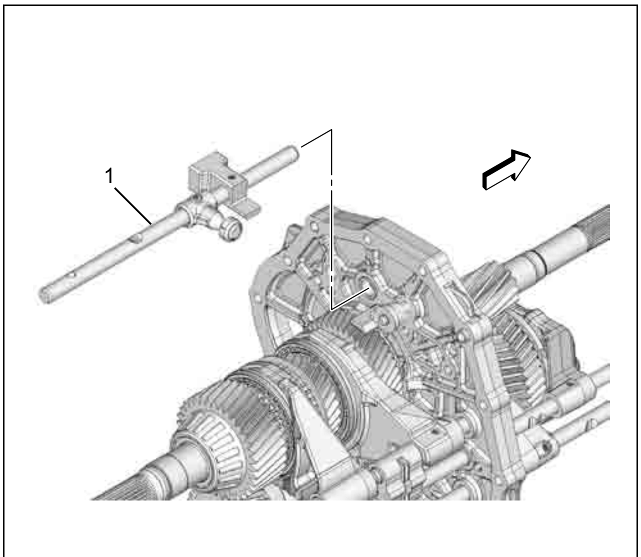


RTW77BSH008001

35. Install the 1st-2nd shift arm new spring pin.
   - Never reinstall the used spring pin.

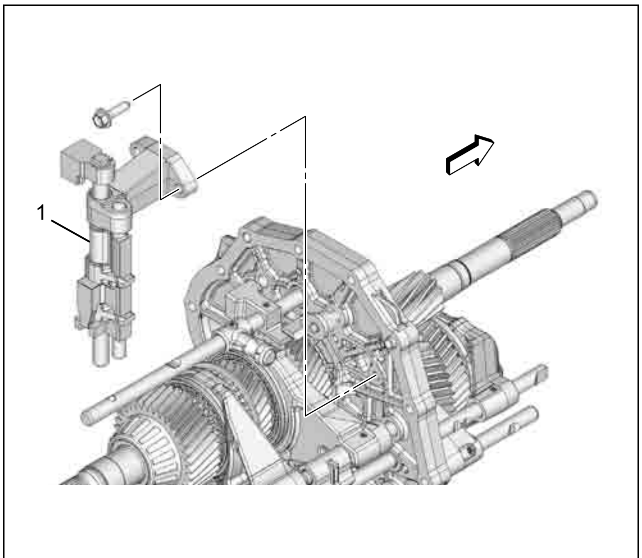
Notice:
The spring pin must be drive in to this hole end surface surfly.

36. Install the control rod assembly (1).



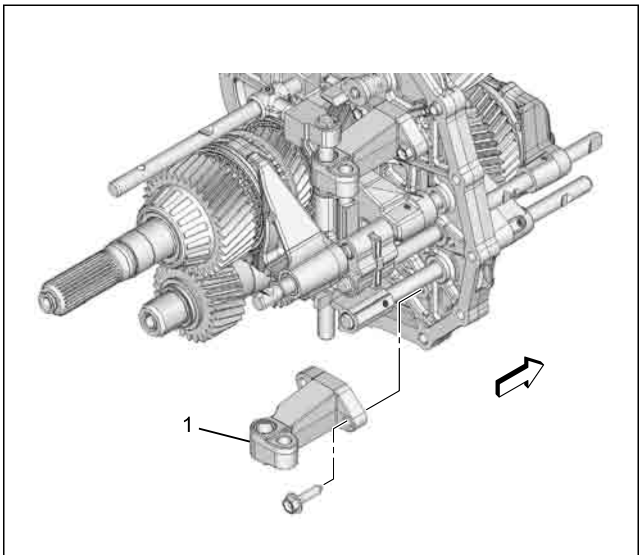
RTW77BSH007901

37. Install the shift & select rod assembly (1) and bolts temporarily.



RTW77BSH007801

38. Install the shift rod bracket (1) and bolts temporarily.



RTW77BSH007701

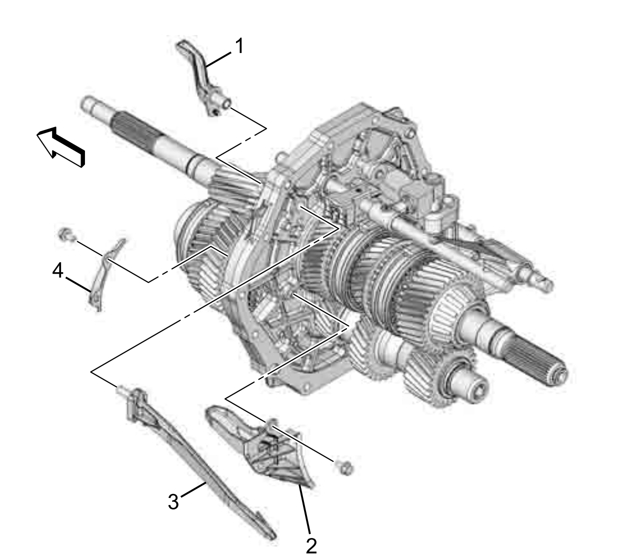
39. Install the bolts to the shift & select rod assembly and shift rod bracket.
   - Tighten the shift & select rod bolts and the shift rod bracket bolts to the specified torque.

Torque: 25 N·m (2.5 kgf·m/18 lb·ft)

40. Install the counter 2nd gutter (4) and counter 5th gutter (2).
   - Tighten the gutter bolts to the specified torque.

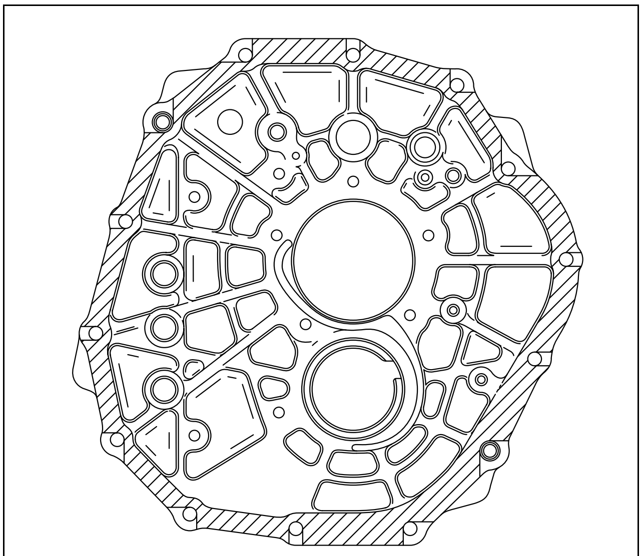
Torque: 9 N·m (0.9 kgf·m/78 lb·in)

41. Install the new front gutter (1) and new rear gutter (3).
   - Never reinstall the used gutters.



RTW77BSH007601

42. In order to protect the front oil seal lip, wrap a tape around the spline portion of the input shaft.
43. Install the intermediate plate assembly with gear (1) to the front case.
    - Apply recommended liquid gasket (LOCTITE FMD-127 or equivalent) with the width of 3 to 5 mm to the area marked in the figure below.



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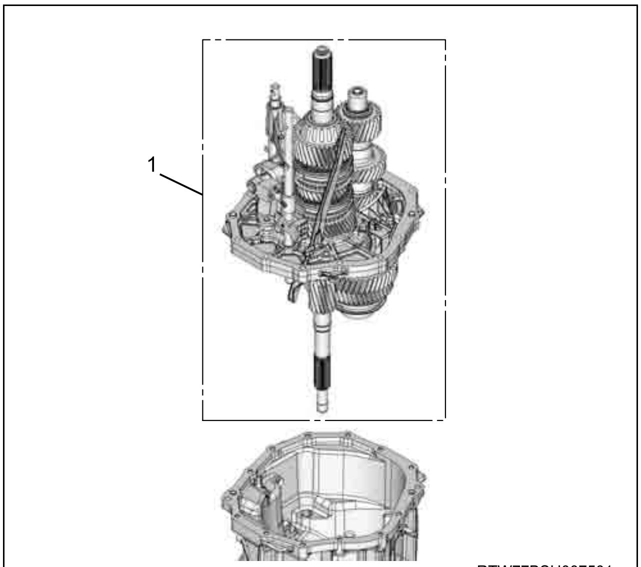
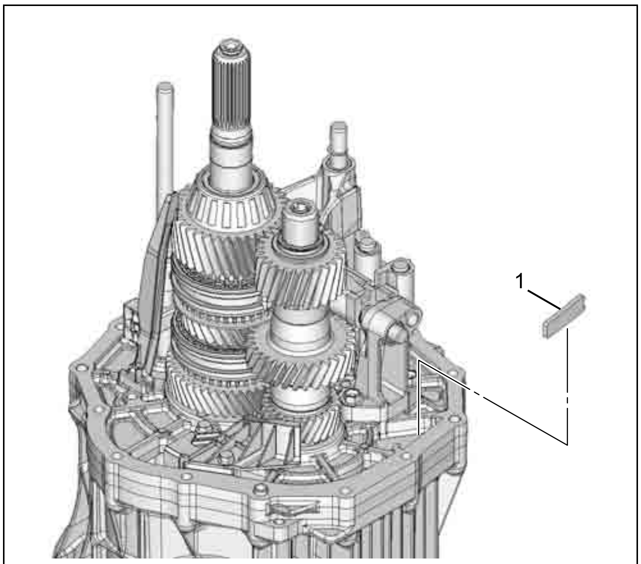


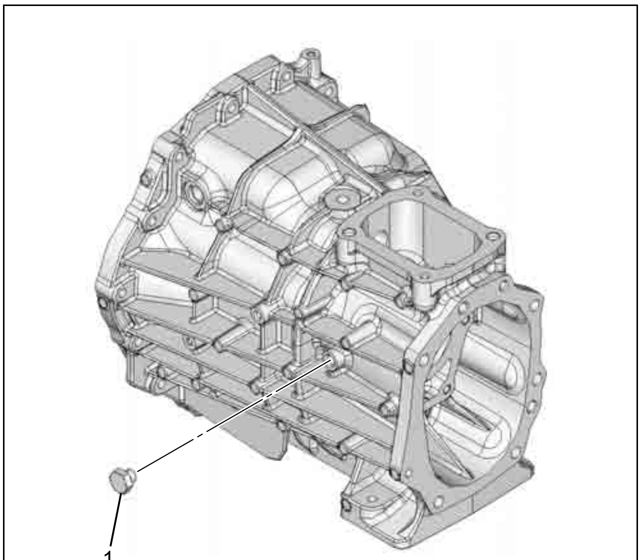
RTW77BSH007501

44. Install the magnet (1).



RTW77BSH008201

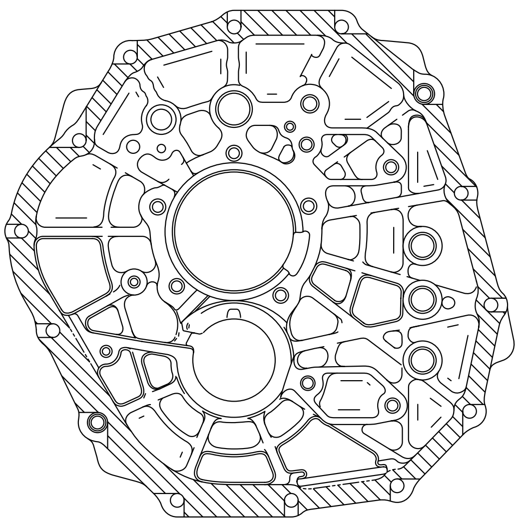
45. Remove the straight plug (1) from the rear case.



RTW77BSH006301

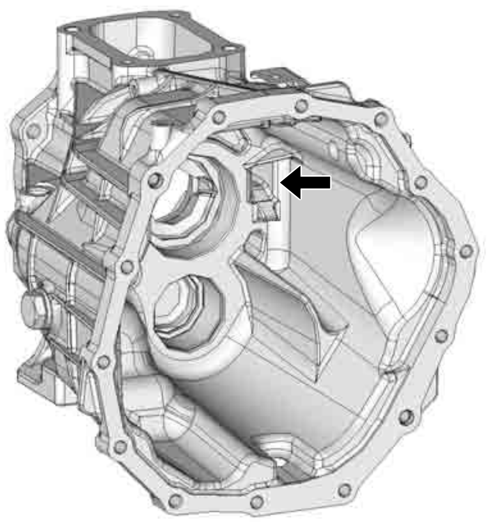
46. Install the rear case assembly.

- Apply recommended liquid gasket (LOCTITE FMD-127 or equivalent) with the width of 3 to 5 mm to the area marked in the figure below.



RTW77BSH005901

Notice:
Be careful of the insertion position of the rear gutter.

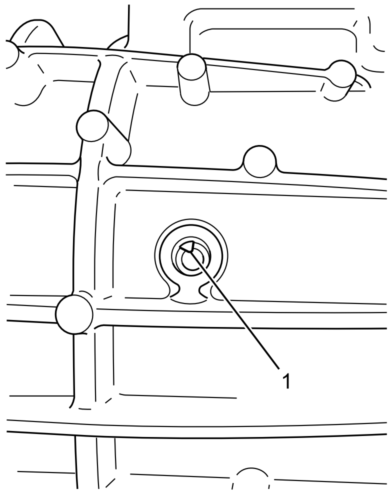


RTW77BSH008301

47. Check whether the rear gutter (1) appears from the straight plug hole.
    Install the new straight plug.
    - Never reinstall the used straight plug.
    - Tighten the straight plug to the specified torque.

Torque: 34 N·m (3.5 kgf·m/25 lb·ft)

Notice:
- If the rear gutter does not appear from the straight plug hole, the rear gutter is not in the right position. Remove and reinstall the rear case.
- When there is no rear gutter in the right position, it becomes lubriciously poor.



RTW77BSH003401

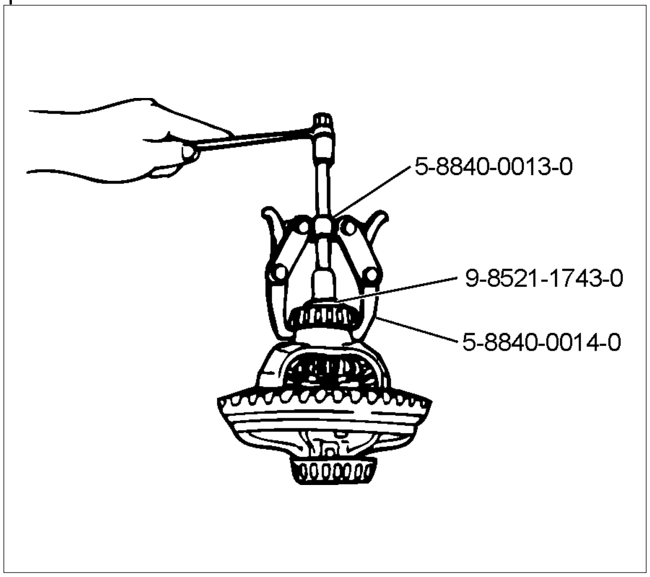
48. Install the rear case bolts.
    - Tighten the rear case bolts to the specified torque.

Torque: 23 N·m (2.3 kgf·m/17 lb·ft)

49. Install the output rear bearing inner race.
50. Use the snap ring selector 5-8840-2849-0 to select the new output shaft snap ring.
    - Never reinstall the used snap ring.

    a. Place the snap ring selector on the output rear bearing.
    b. Join the bolt (2) to the output shaft (4).
    c. Adjust the end of both grips (3) with a bottom of spline and tighten both grips evenly.

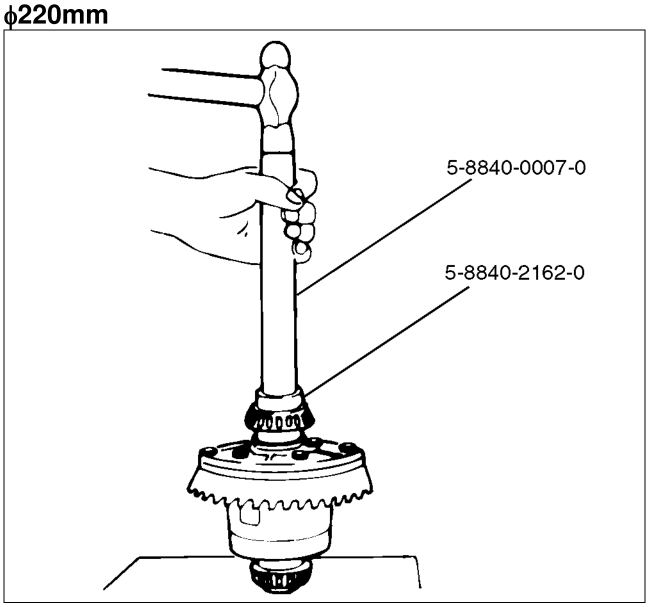
ϕ194mm



RTW54BSH000201

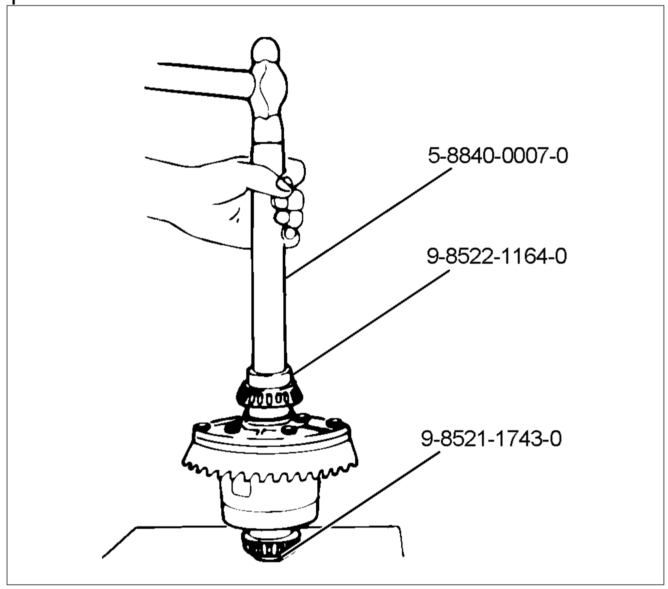
12. Install the side bearings together with the selected shims by using installer 5-8840-2162-0 (ϕ220mm) and 9-8522-1164-0 (ϕ194mm), drive handle 5-8840-0007-0 and pilot 9-8521-1743-0 (ϕ194mm).

ϕ220mm



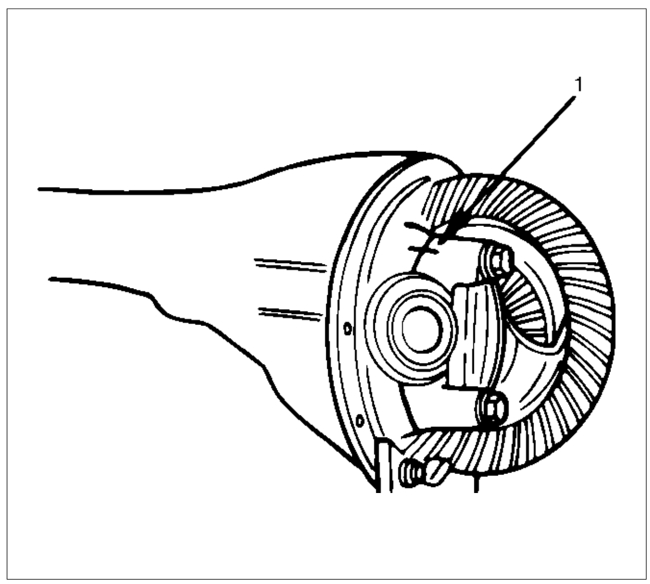
425L100010

ϕ194mm



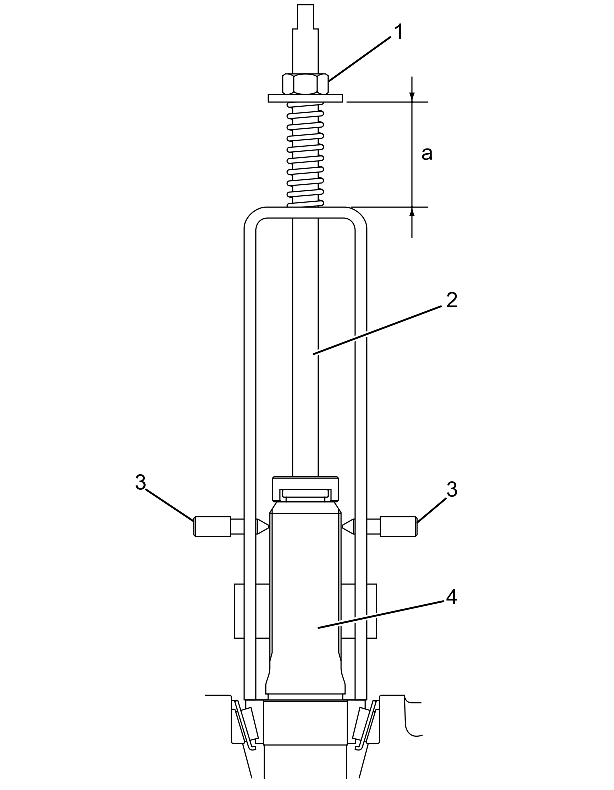
425R300004

13. Install side bearing outer race.
14. Install differential cage assembly.
15. Align the setting marks (1) applied at disassembly then install the bearing cap.



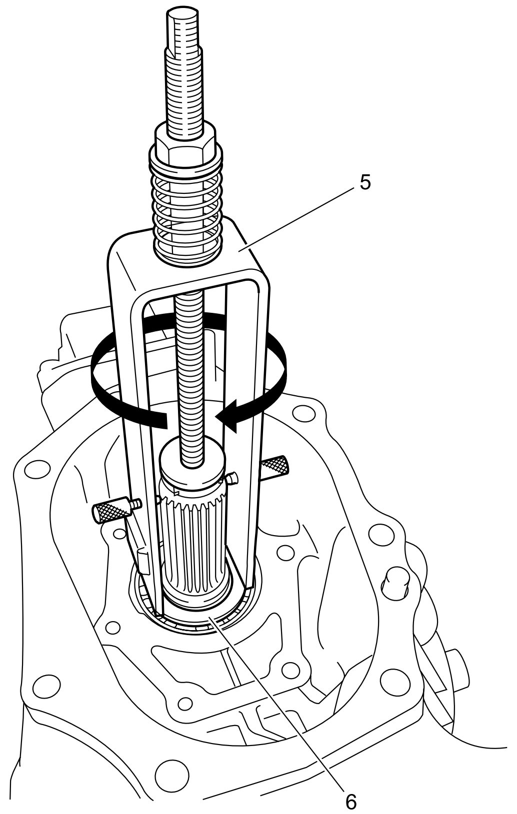
425RS035

d. Tighten the nut (1) till the height of spring reaches 29 mm (1.142 in) (a).



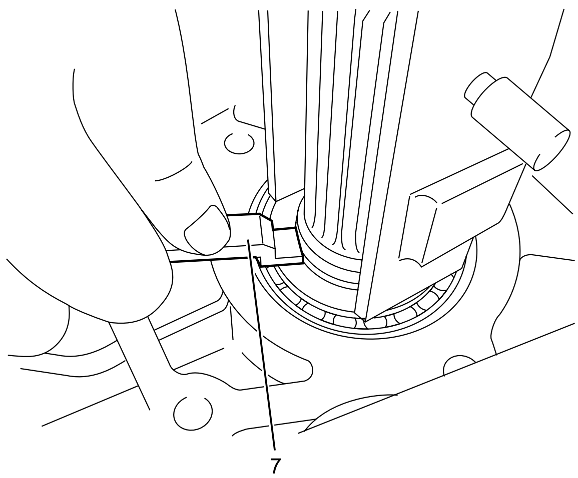
RTW77BMH000201

e. Turn the output shaft rear bearing inner race (6) and the snap ring selector (5) together 16 times or more in order to make the output shaft rear bearing inner and outer race fit well.



RTW77BMH000301

f. Try to insert gauges (7) of six different thickness in turn to the snap ring groove of output shaft.
Select the thickest gauge that could be inserted.



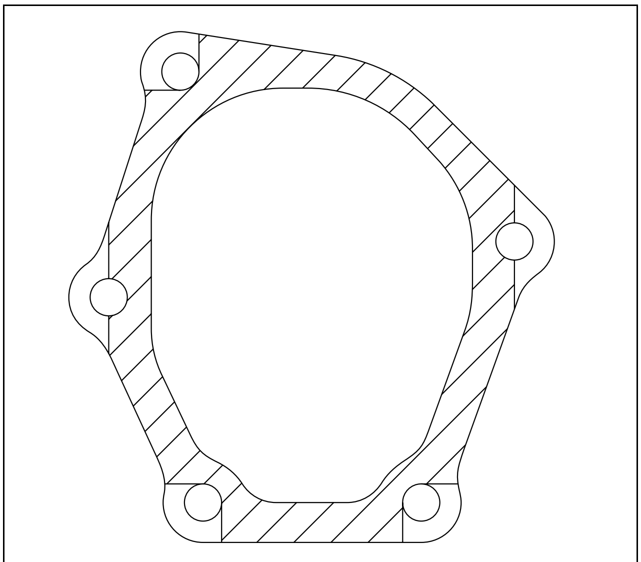
RTW77BSH008401

g. The thickness of the selected gauge shows the thickness of the snap ring to be installed.

Snap Ring Availability

Thickness	Identification color
2.1 mm(0.083 in)	White
2.2 mm(0.087 in)	Blue
2.3 mm(0.091 in)	Green
2.4 mm(0.094 in)	Yellow
2.5 mm(0.098 in)	Orange
2.6 mm(0.102 in)	Black

51. Install the new snap ring to the output shaft.
    - Never reinstall the used snap ring.
52. Install the speedometer drive gear. (4x2 model)
53. Install the gear set clip. (4x2 model)
54. Install the end cover assembly.
    - The gasket must be assembled. (4x2 model)
    - Apply recommended liquid gasket (LOCTITE FMD-127 or equivalent) with the width of 3 to 5 mm to the area marked in the figure below. (4x4 model)


RTW77BSH005601

    - Tighten the end cover bolts to the specified torque.

Torque: 23 N·m (2.3 kgf·m/17 lb·ft)

55. Install the speedometer driven gear and plate. (4x2 model)
56. Install the control rod detent assembly.
    - Tighten the three detent assemblies to the specified torque.

Torque: 30 N·m (3.1 kgf·m/22 lb·ft)

57. Install the new 5th detent assembly and new reverse detent assembly.
    - Never reinstall the used detent assembly.
    - Tighten the three detent assemblies to the specified torque.

Torque: 30 N·m (3.1 kgf·m/22 lb·ft)

58. Install the two harness brackets.

Torque: 8N·m (0.8 kgf·m/69 lb·in)

59. Install the reverse switch (Connector color Brown), 1st switch (Connector color Gray) and neutral switch (Connector color Brown) with gasket.
    - Tighten the three switches to the specified torque.

Torque: 39 N·m (4.0 kgf·m/29 lb·ft)

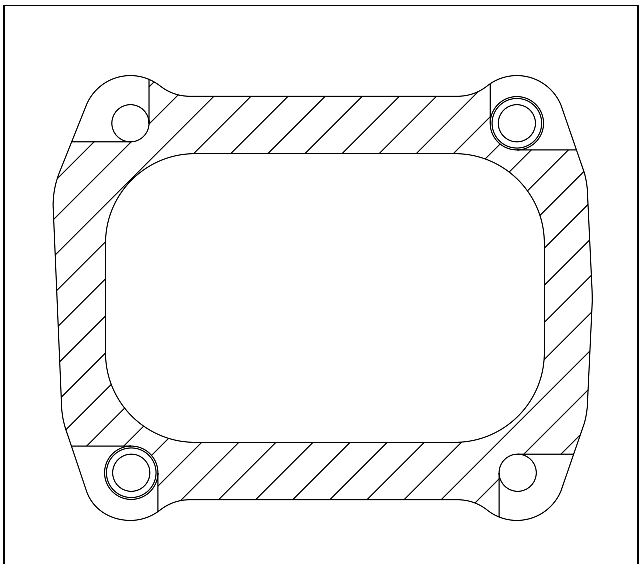
60. Install the control unit block by performing the following steps.
    a. Push the control unit block ahead.
    b. Install the control unit block.
    c. Install the new taper bolt.
        - Never reinstall the used taper bolt.
        - Tighten the taper bolt to the specified torque.

Torque: 47 N·m (4.8 kgf·m/35 lb·ft)

Important:

- Must be checked no flaw to taper bolt.
- Must be checked no jam of foreign body before assembled.
- Must be checked same position upper surface of the taper bolt and the control unit block after assembled.

61. Install the two dowels and quadrant box.
    - Apply recommended liquid gasket (LOCTITE FMD-127 or equivalent) with the width of 3 to 5 mm to the area marked in the figure below.


RTW77BSH005701

    - Tighten the quadrant box bolts to the specified torque.

Torque: 23 N·m (2.3 kgf·m/17 lb·ft)

62. Remove the tape from the spline portion of the input shaft.

63. Install the front cover.
    - Tighten the front cover bolts to the specified torque.

Torque: 23 N·m (2.3 kgf·m/17 lb·ft)

64. After reassembling the transmission, refill the case with the new specified transmission oil.
    a. Install the drain plug with new gasket.
       - Never reinstall the used gasket.
       - Apply engine oil to the new gasket surface.
       - Tighten the drain plug to the specified torque.

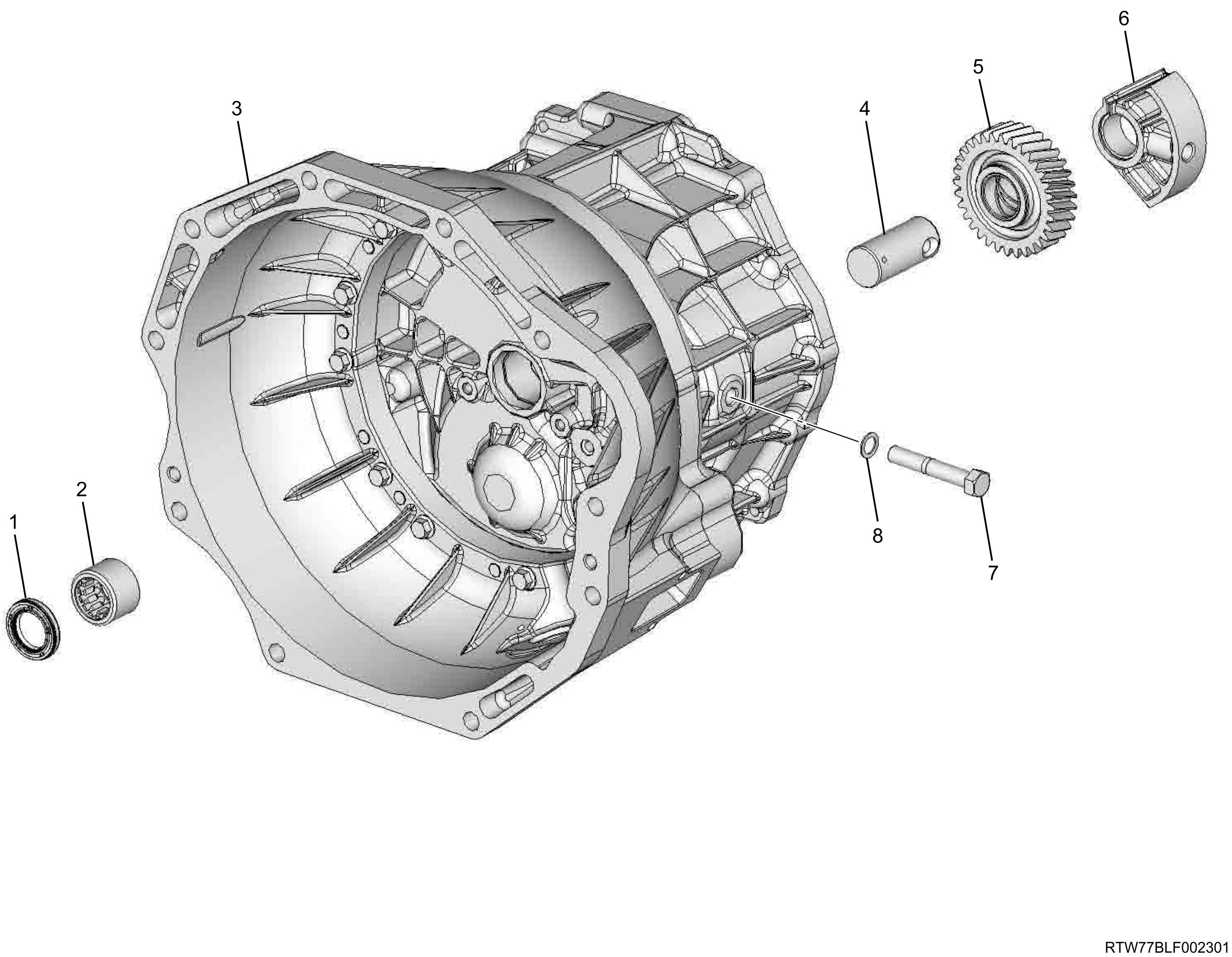
Torque: 39 N·m (4.0 kgf·m/29 lb·ft)

    b. Remove the filler plug with gasket.
    c. Refill the case with the new specified transmission oil (BESCO Trans Axle Oil 5W-30 SF) amount 3.0 liters.
    d. Install the filler plug with new gasket.
       - Never reinstall the used gasket.
       - Apply engine oil to the new gasket surface.
       - Tighten the filler plug to the specified torque.

Torque: 39 N·m (4.0 kgf·m/29 lb·ft)

Front Case Assembly

Component



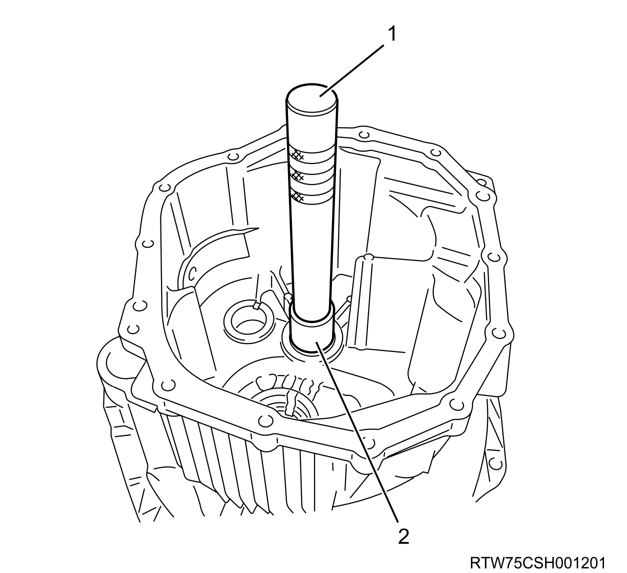
Legend

1. Front oil seal
2. Input shaft needle bearing
3. Front case with clutch housing
4. Reverse idler shaft
5. Reverse idler gear assembly
6. Reverse shaft bracket
7. Reverse idler bolt
8. Gasket

Removal

1. Remove the reverse idler bolt with gasket.
2. Remove the reverse shaft bracket and reverse idler gear assembly.
3. Remove the reverse idler shaft with straight pin.

4. Use the installer 5-8840-0125-0 (2) and grip 5-8840-0007-0 (1) to remove the front oil seal and input shaft needle bearing from the front case, and discard the used oil seal.

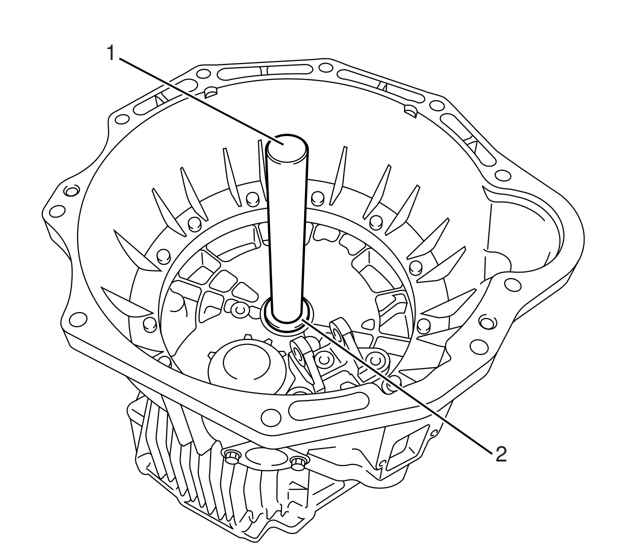


RTW75CSH001201

Installation

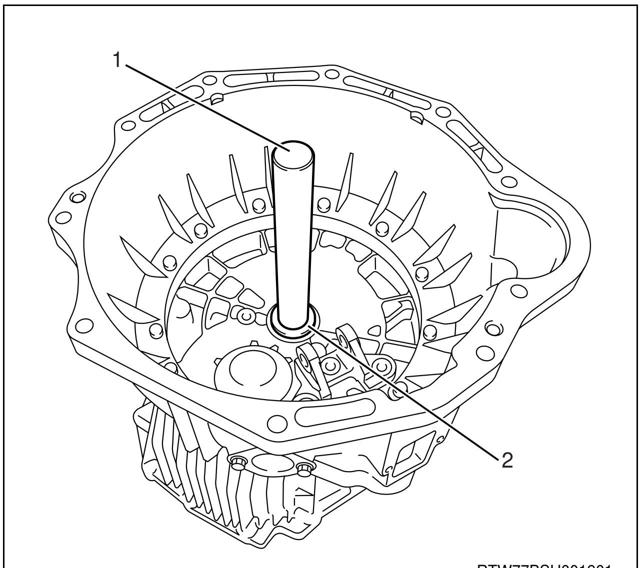
1. Use the installer 5-8840-2846-0 (2) and grip 5-8840-0007-0 (1) to install the input shaft needle bearing to the front case.

Notice:
Please install by making a stamp side into rear.



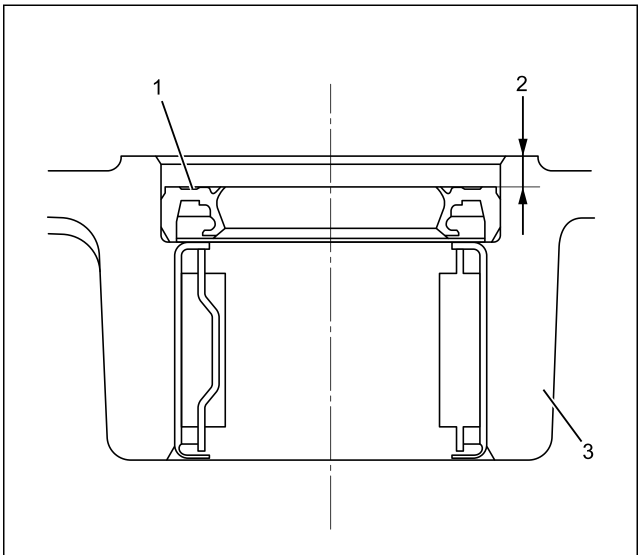
RTW77BSH001901

2. Install the front oil seal.
   a. Use the installer 5-8840-2846-0 (2) and grip 5-8840-0007-0 (1) to install the new front oil seal to the front case.
      - Never reinstall the used oil seal.
      - Apply engine oil to new front oil seal outer surfaces, and apply grease (BESCO L-2 or equivalent) to the oil seal lip.
      - At press fitting the oil seal, to be careful not to inflict lip of it.



RTW77BSH001901

   b. The oil seal must be pressed fit as shown in the figure.



RTW77BSH002001

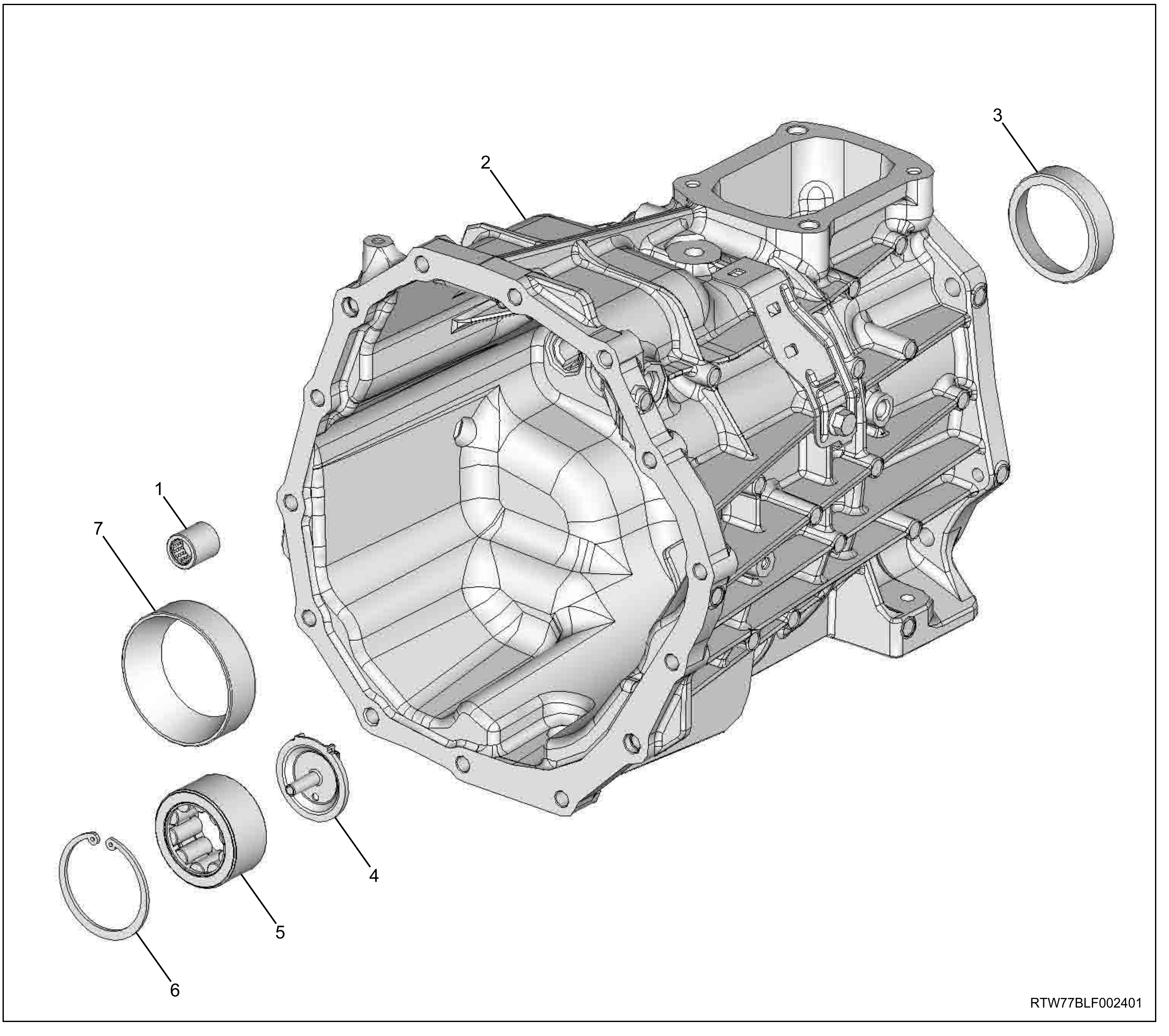
Legend
1. Front oil seal
2. 4 mm (0.157 in)
3. Front case

3. Install the reverse idler shaft with straight pin.
4. Install the reverse idler gear assembly and reverse shaft bracket.
   - Apply engine oil to gear internal surface.
5. Install the reverse idler bolt with gasket.
   - Tighten the reverse idler bolt to the specified torque.

Torque: 83 N·m (8.5 kgf·m/61 lb·ft)

Rear Case Assembly

Component



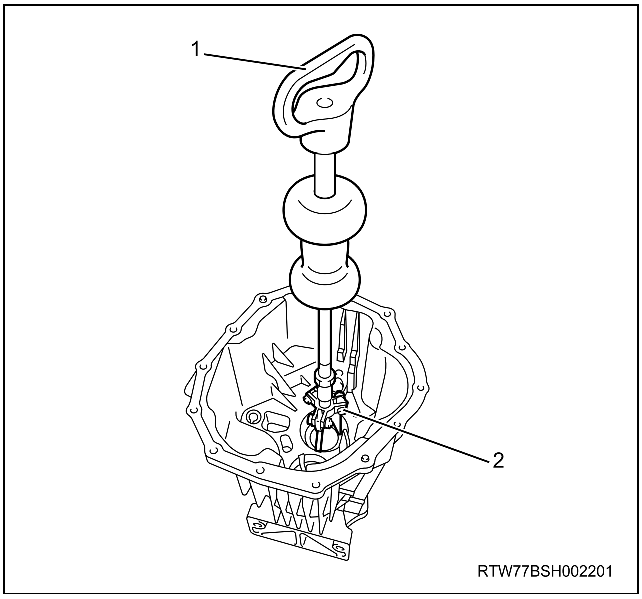
Legend

1. Linear ball bearing
2. Rear case
3. Output rear bearing outer race
4. Oil nozzle
5. Counter end roller bearing
6. Snap ring
7. Output front bearing outer race

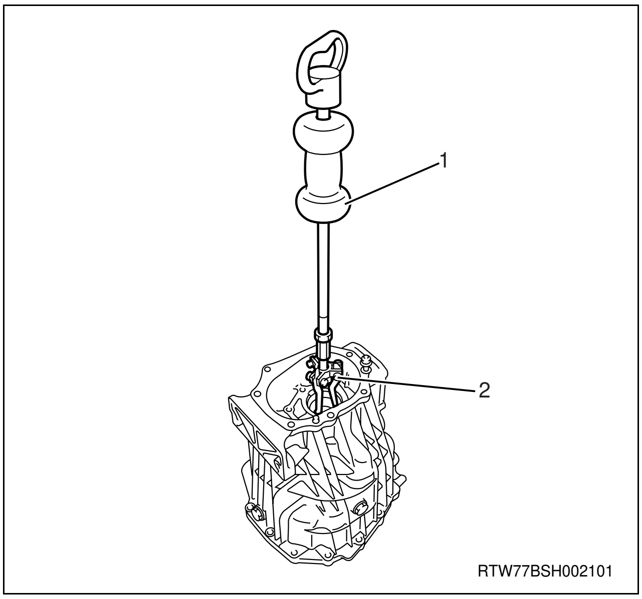
Removal

1. Remove the linear ball bearing from the rear case.
2. Use a pair of snap ring pliers to remove the snap ring from the rear case.
3. Remove the counter end roller bearing from the rear case.
4. Remove the oil nozzle from the rear case.

5. Use the remover 5-8840-2757-0 (2) and sliding hammer 5-8840-0084-0 (1) to remove the output front bearing outer race from the rear case.

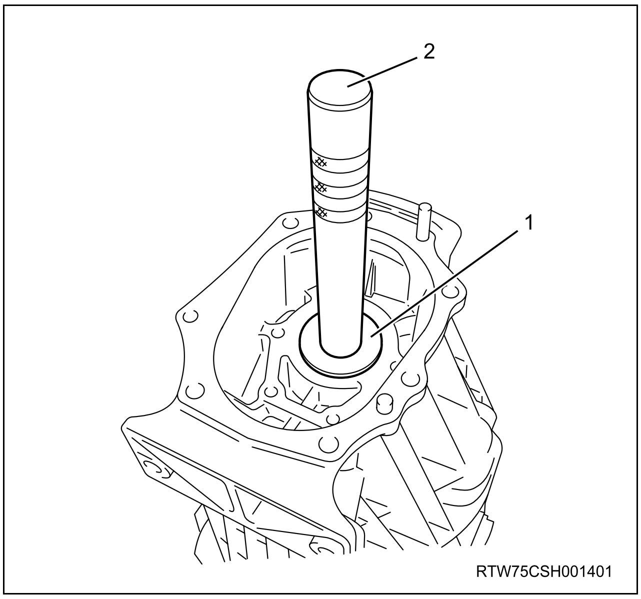


6. Use the remover 5-8840-2757-0 (2) and sliding hammer 5-8840-0084-0 (1) to remove the output rear bearing outer race from the rear case.

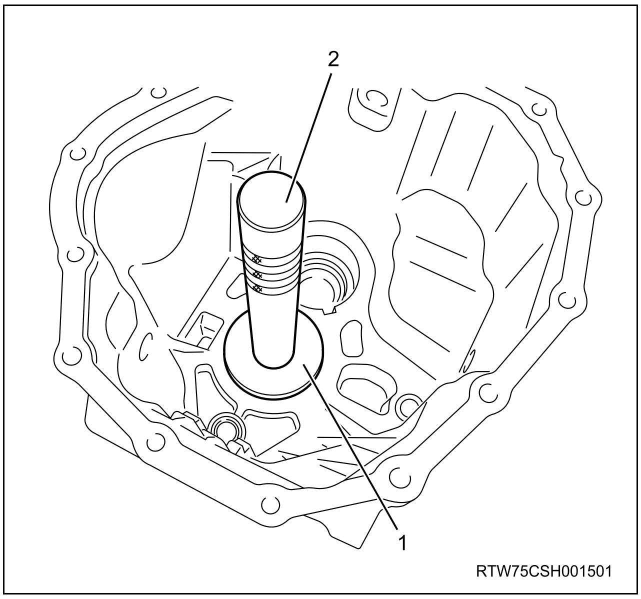


Installation

1. Use the installer 5-8522-0053-0 (1) and grip 5-8840-0007-0 (2) to install the output rear bearing outer race to the rear case.



2. Use the installer 5-8840-2850-0 (1) and grip 5-8840-0007-0 (2) to install the output front bearing outer race to the rear case.



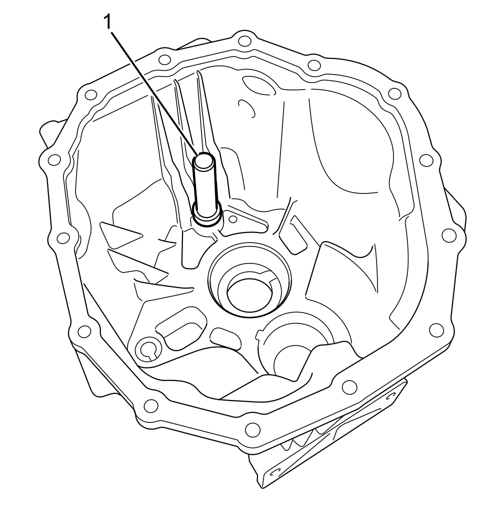
3. Install the oil nozzle to the rear case.

Important:
Convex of oil nozzle must be assembled in guide part of rear case.

4. Install the counter shaft end roller bearing to the rear case.
5. Install the new snap ring to the rear case.
   - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove of rear case surely.

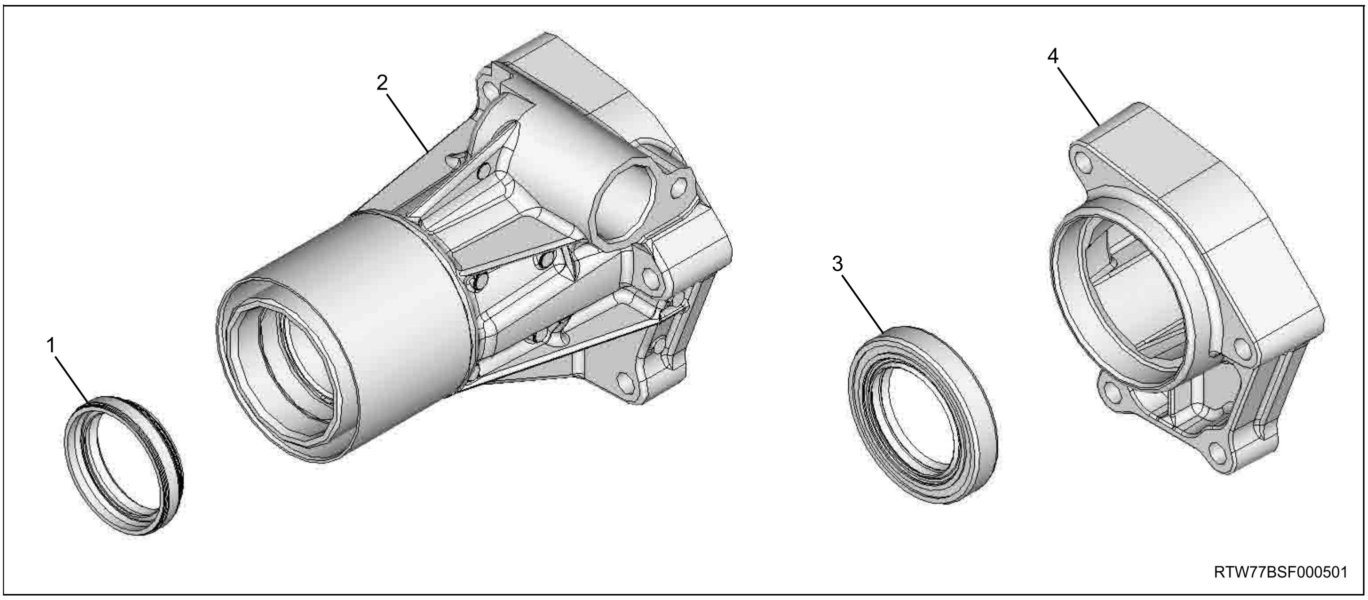
6. Use the installer 5-8840-2848-0 (1) to install the linear ball bearing to the rear case.
   - The linear ball bearing to be pressed fit to front boss side.
   - The linear ball bearing must be pressed at marked side.



RTW77BSH003101

End Cover Assembly

Component



Legend

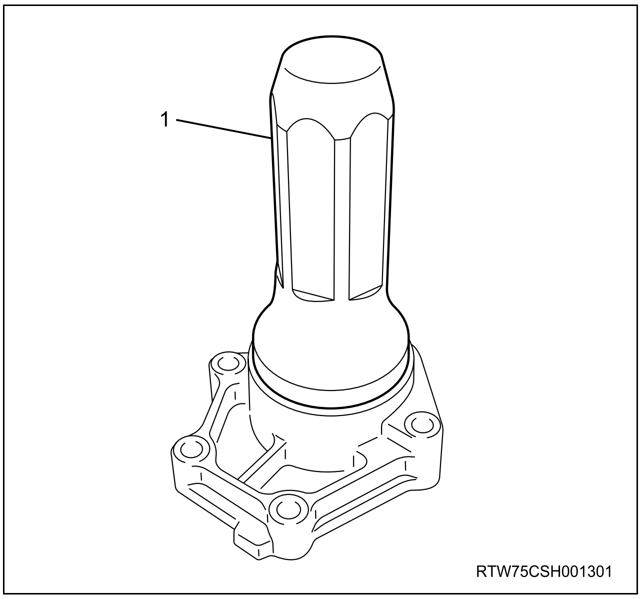
1. Rear oil seal (4x2 model)
2. End cover (4x2 model)
3. Rear oil seal (4x4 model)
4. End cover (4x4 modeel)

Removal

1. Remove the rear oil seal from the end cover, and discard the used oil seal.

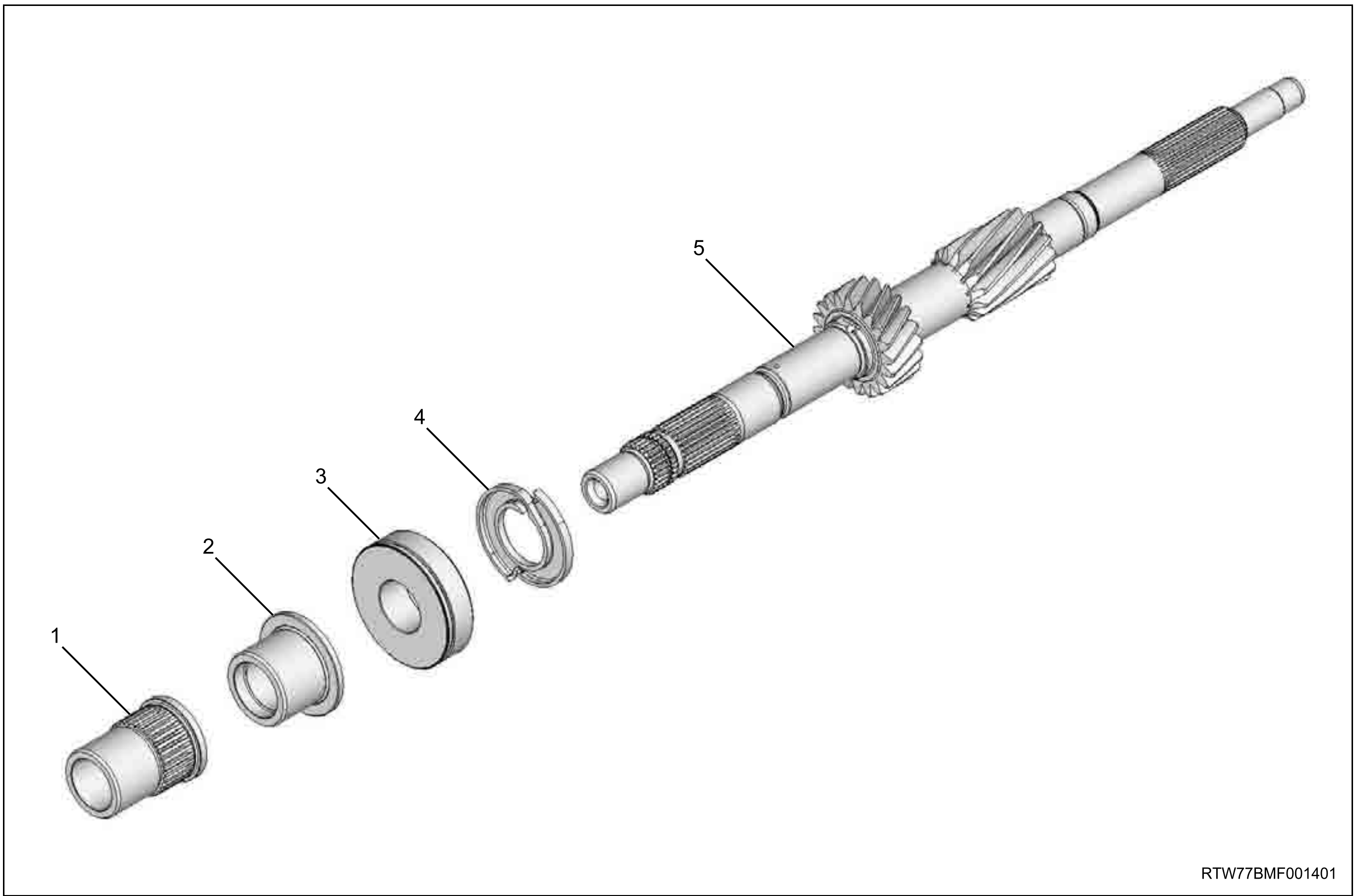
Installation

1. Use the installer 5-8840-2786-0 to install the new rear oil seal to the end cover. (4x2 model)
   Use the installer 5-8840-2282-0 (1) to install the new rear oil seal to the end cover. (4x4 model)
   - Never reinstall the used oil seal.
   - Apply engine oil to new rear oil seal outer surfaces, and apply grease (BESCO L-2 or equivalent) to the oil seal lip.
   - At press fitting the oil seal, to be careful not to inflict lip of it.



Input Shaft Assembly

Component

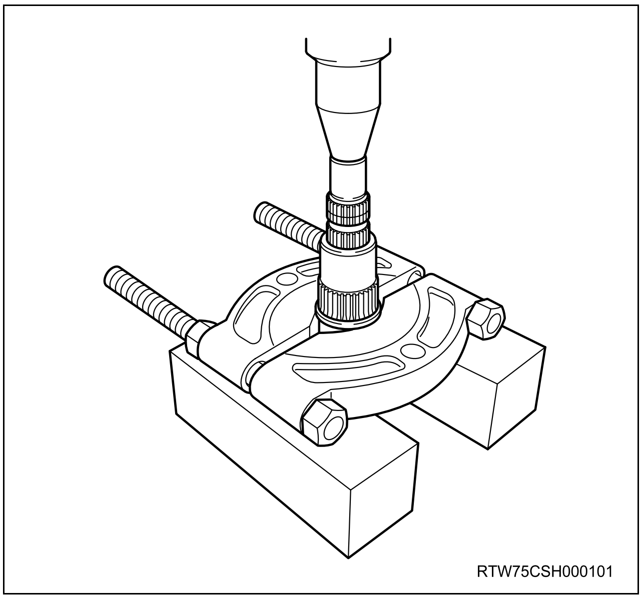


Legend

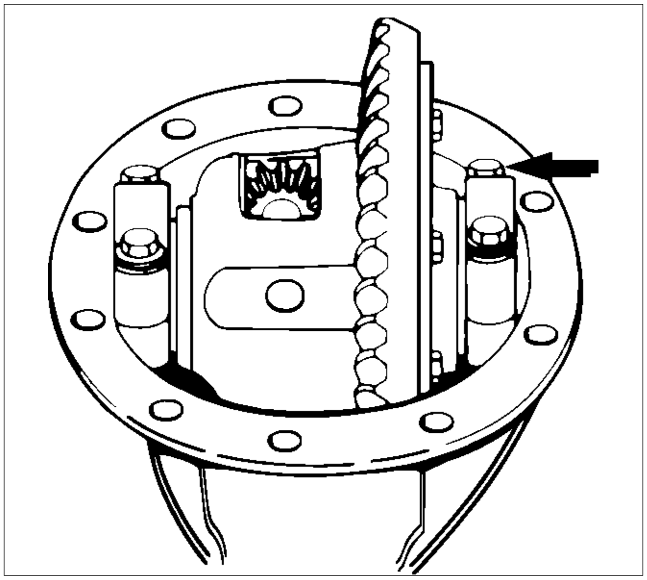
1. 3rd input collar
2. 5th input collar
3. Input middle bearing
4. Oil catch impeller
5. Input shaft

Removal

1. Use a bench press to remove the 3rd input collar from the input shaft.



16. Tighten the bolt to the specified torque.
    Torque :
    ϕ220mm : 108 N·m (11 kgf·m/80 lb·ft)
    ϕ194mm : 98 N·m (10 kgf·m/72 lb·ft)

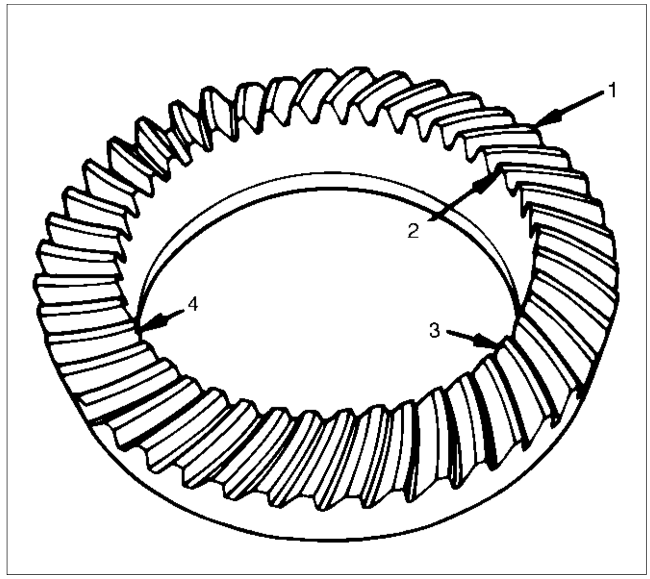


425RS036

- Measure the amount of run-out of the ring gear at its rear face. It should be 0.05 mm (0.002 in) or less

Gear Tooth Contact Pattern Check and Adjustment

1. Apply a thin coat of Prussian blue or equivalent to the faces of the 7–8 teeth of the ring gear. Check the impression of contact on the ring gear teeth and make necessary adjustment as described in illustration if the contact is abnormal.

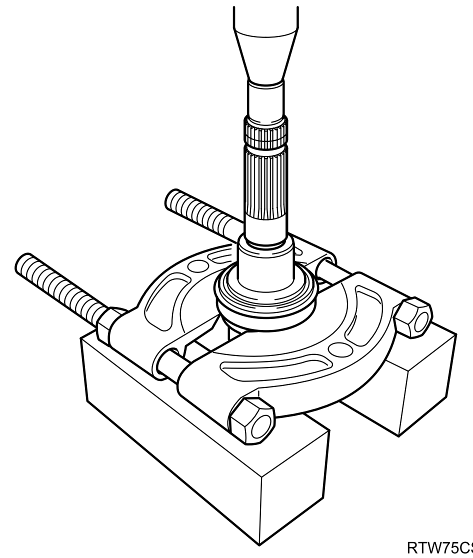


425RS038

Legend

1. Heel
2. Toe
3. Concave Side(Coast)
4. Convex Side(Drive)

2. Use a bench press to remove the 5th input collar and input middle bearing from the input shaft.



RTW75CSH000201

3. Remove the oil catch impeller from the input shaft.

Inspection and Repair

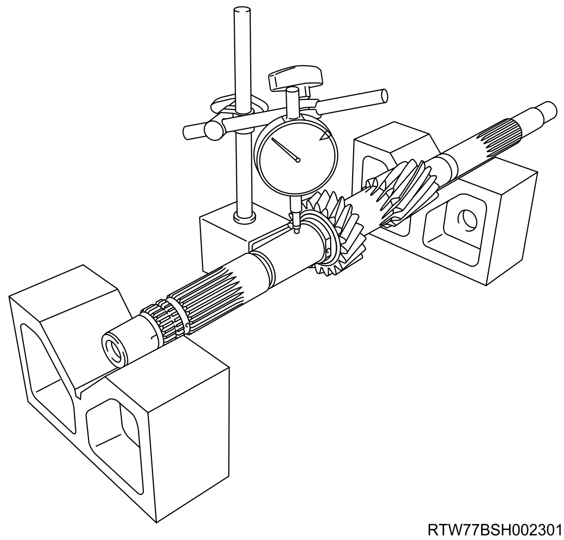
Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Input Shaft Run-out

- Install the input shaft to V-blocks.
- Use a dial indicator to measure the input shaft central portion run-out.

If the measured input shaft run-out exceeds the specified limit, the input shaft must be replaced.

Limit
0.05 mm (0.002 in)

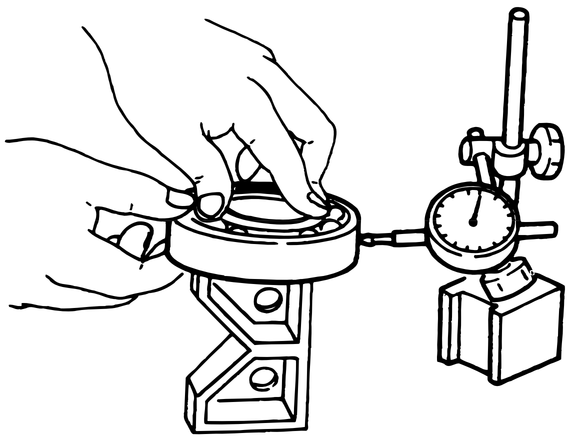


RTW77BSH002301

Ball Bearing Play

Use a dial indicator to measure the ball bearing play.
If the measured value exceeds the specified limit, the ball bearing must be replaced.

Standard	Limit
0 - 0.066 mm (0 - 0.0026 in)	0.1 mm (0.004 in)

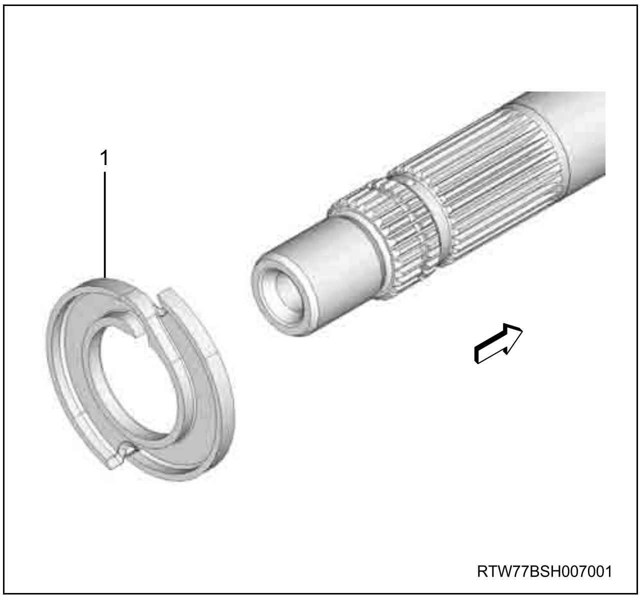


LNW25CSH029201

Installation

1. Install the oil catch impeller (1) to the input shaft.

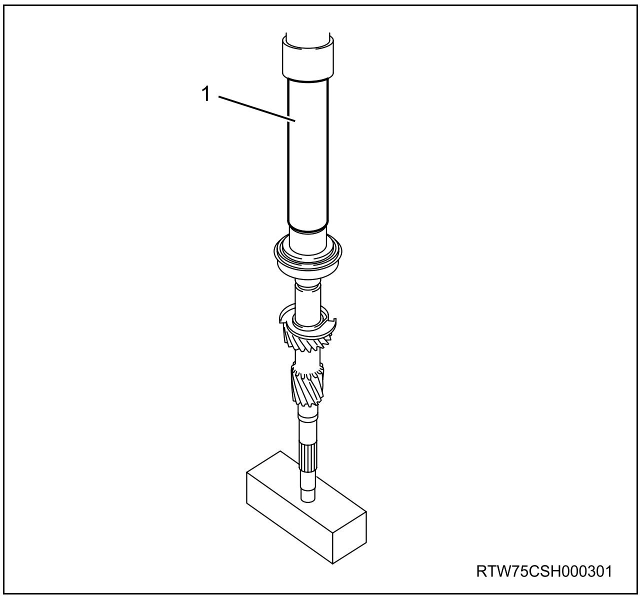
Notice:
Direction of assembling exists. (Groove opening area to be bearing side.)



2. Use a bench press and installer 5-8840-2346-0 (1) to install the 5th input collar and input middle bearing to the input shaft.

Notice:

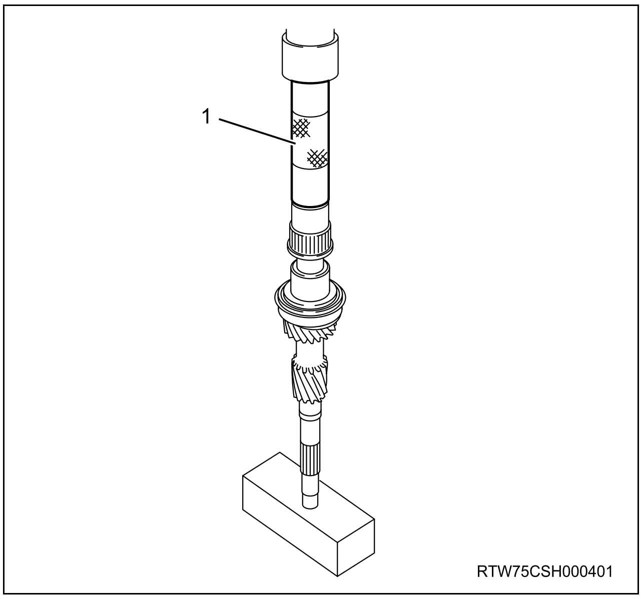
- Direction of assembling exists. (Groove of outside periphery to be collar side.)
- The bearing must be press fitted with end surface of shaft.
- The collar must be press fitted with end surface of bearing.
- The outer race must not be punch. (Inner race to be push.)



3. Use a bench press and installer 5-8840-2346-0 (1) to install the 3rd input collar to the input shaft.

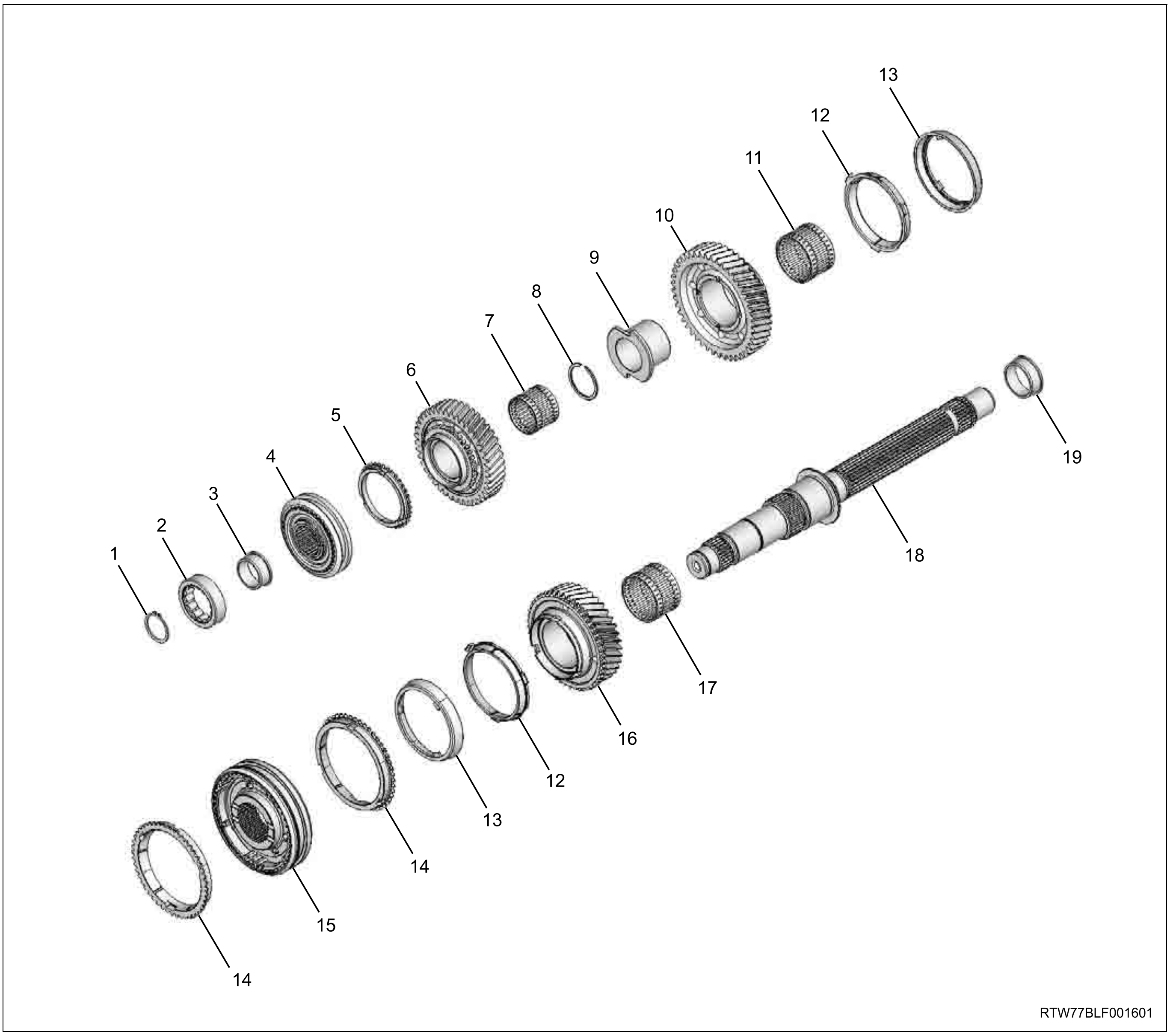
Notice:

The collar must be press fitted with end surface of the 5th collar.



Counter Shaft Assembly

Component



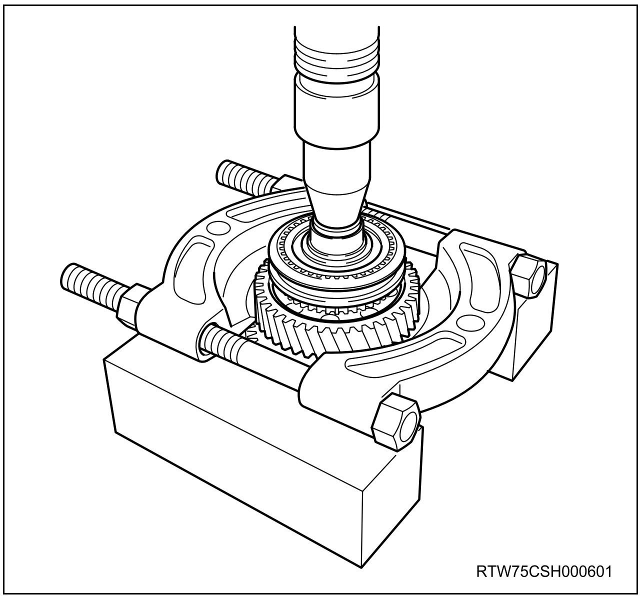
Legend

1. Reverse counter snap ring
2. Counter front roller bearing outer race
3. Counter front roller bearing inner race
4. Reverse synchronizer assembly
5. Reverse block ring
6. Reverse counter gear assembly
7. Reverse counter gear needle bearing
8. 1st counter snap ring
9. 1st counter collar
10. 1st counter gear assembly
11. 1st counter gear needle bearing
12. 1st-2nd inside ring
13. 1st-2nd outside ring
14. 1st-2nd block ring
15. 1st-2nd synchronizer assembly
16. 2nd counter gear assembly
17. 2nd counter gear needle bearing
18. Counter shaft
19. Counter middle roller bearing inner race

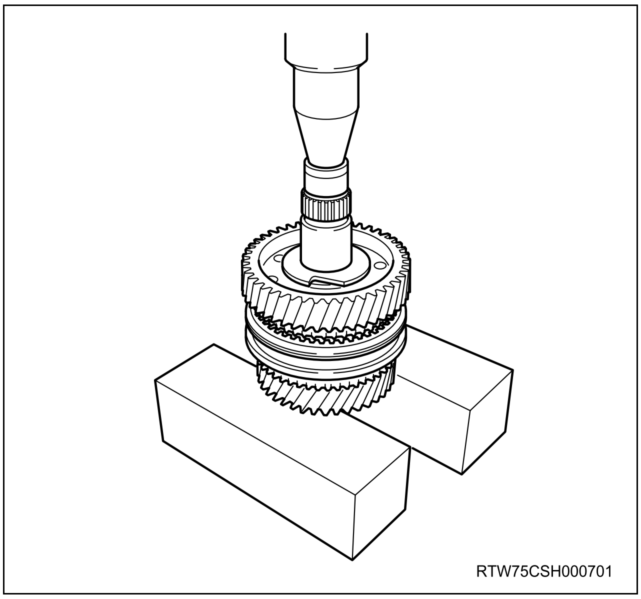
Removal

1. Use a pair of snap ring pliers to remove the reverse counter snap ring.
2. Remove the counter front roller bearing outer race.

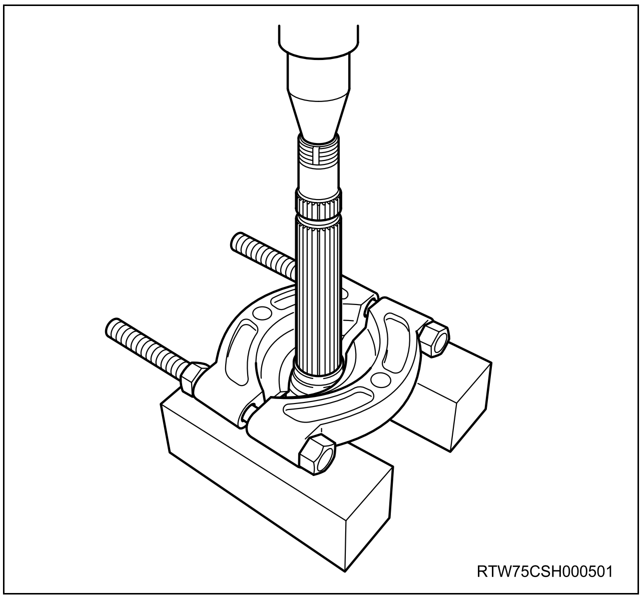
3. Use a bench press to remove the reverse counter gear assembly together with reverse block ring, reverse synchronizer assembly, and counter front roller bearing inner race.



4. Remove the reverse counter gear needle bearing.
5. Remove the 1st counter snap ring.
6. Use a bench press to remove the 2nd counter gear assembly together with 1st-2nd synchronizer assembly, inside ring, outside ring, block ring, 1st counter gear assembly, and 1st counter collar.



7. Use a bench press to remove the counter middle roller bearing inner race.



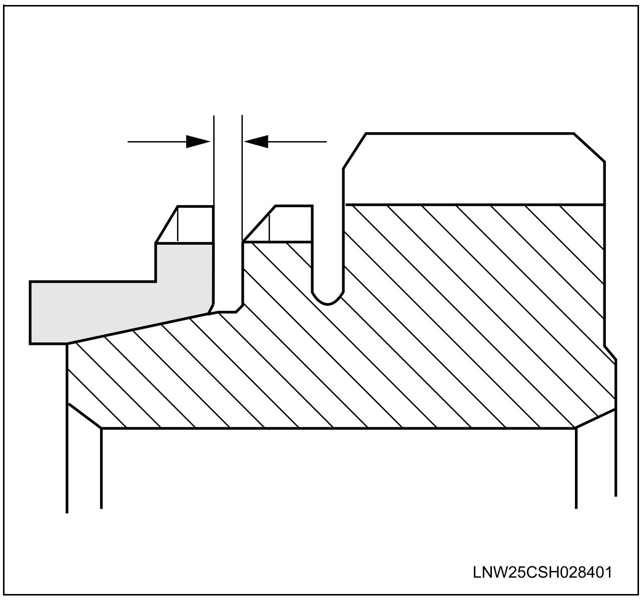
Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

Block Ring and Dog Teeth Clearance

Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
If the measured value exceeds the specified limit, the block ring must be replaced.

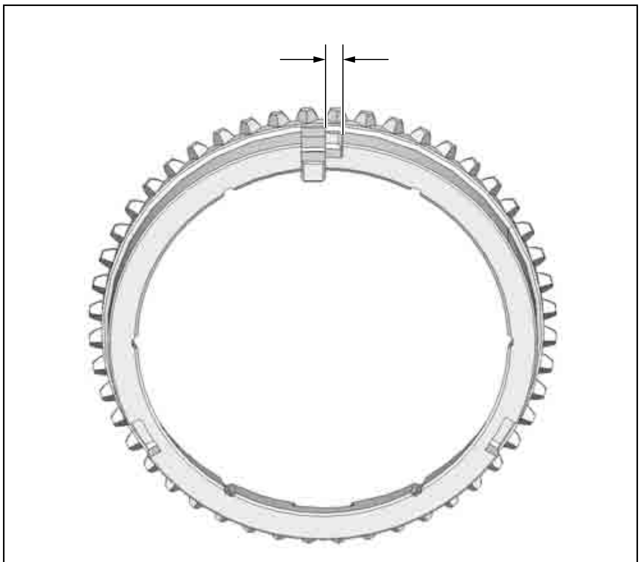
	Standard	Limit
Reverse	1.5 mm (0.059 in)	0.8 mm (0.031 in)



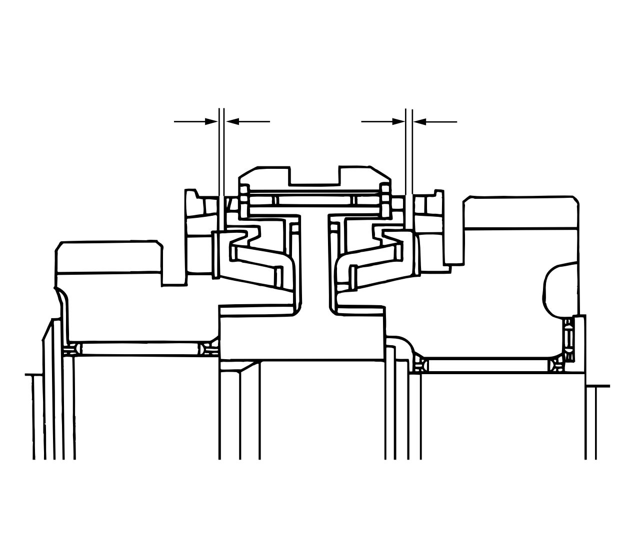
1st-2nd Synchronizer (3-CONE)

Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
If the measured value exceeds the specified limit, the 1st-2nd synchronizer assembly must be replaced.

Standard	Limit
1.5 mm (0.059 in)	0.8 mm (0.031 in)



RTW77BSH006501



LNW25CSH028501

Clutch Hub and Insert Clearance

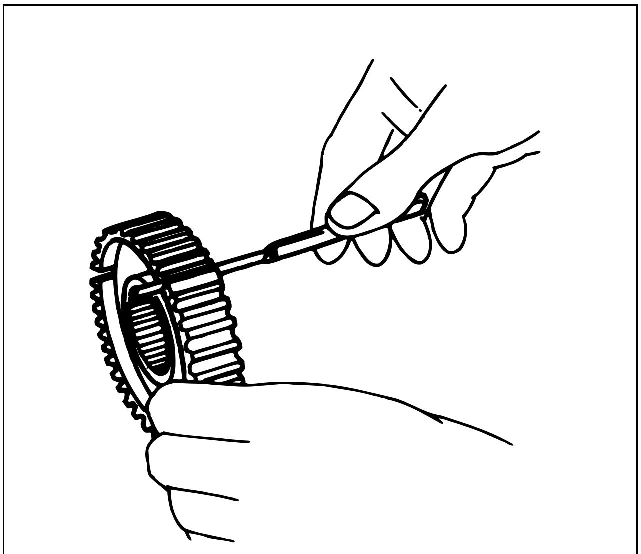
Use a thickness gauge to measure the clearance between the clutch hub and insert.
If the measured value exceeds the specified limit, the clutch hub and insert must be replaced.

	Standard	Limit
1st - 2nd Reverse	0.01 - 0.21 mm (0.0004 - 0.0083 in)	0.3 mm (0.0118 in)

Block Ring and Insert Clearance

Use a vernier caliper or thickness gauge to measure the clearance between the block ring and insert.
If the measured value exceeds the specified limit, the block ring and insert must be replaced.

	Standard	Limit
1st - 2nd	3.86 - 4.16 mm (0.152 - 0.164 in)	4.4 mm (0.173 in)
Reverse	2.16 - 2.46 mm (0.085 - 0.097 in)	2.7 mm (0.106 in)



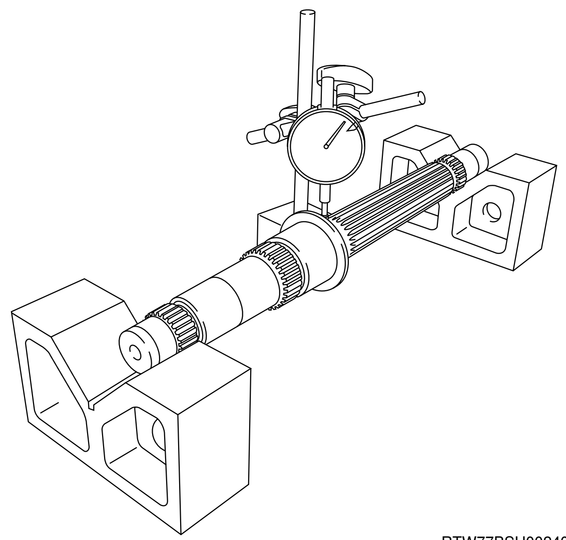
LNW25CSH028701

Counter Shaft Run-out

- Install the counter shaft to V-blocks.
- Use a dial indicator to measure the counter shaft central portion run-out.

If the measured counter shaft run-out exceeds the specified limit, the counter shaft must be replaced.

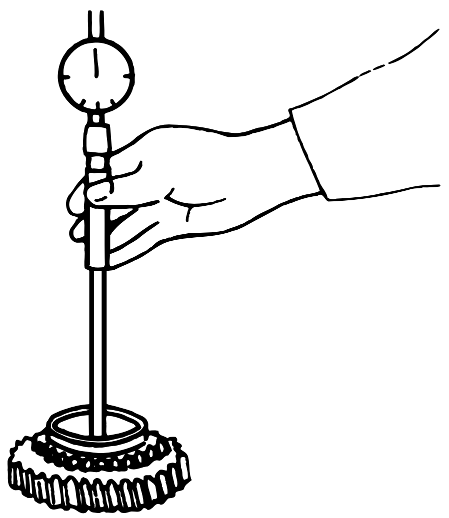
Limit
0.05 mm (0.002 in)


RTW77BSH002401

Gear Inside Diameter

Use an inside dial indicator to measure the gear inside diameter.
If the measured value is less than the specified limit, the gear must be replaced.

	Standard	Limit
1st 2nd	53.000 - 53.019 mm (2.0866 - 2.0874 in)	53.059 mm (2.0889 in)
Reverse	42.000 - 42.019 mm (1.6535 - 1.6543 in)	42.059 mm (1.6559 in)

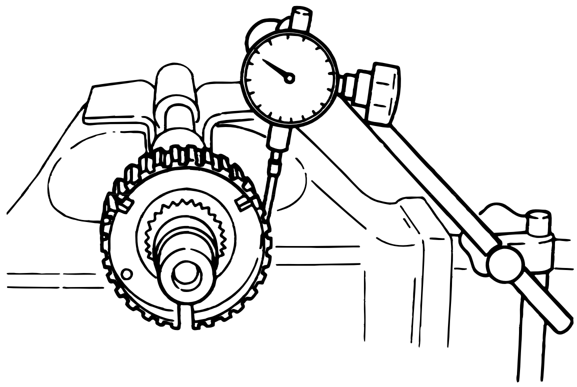

LNW25CSH028901

Clutch Hub Spline Play

- Set a dial indicator to the clutch hub to be measured.
- Move the clutch hub as far as possible to both the right and the left.

Note the dial indicator reading.
If the measured value exceeds the specified limit, the clutch hub must be replaced.

	Standard	Limit
1st - 2nd	0 - 0.04 mm (0 - 0.0016 in)	0.10 mm (0.0039 in)
Reverse	0 - 0.107 mm (0 - 0.0042 in)	0.15 mm (0.0059 in)


LNW25CSH029101

Counter Gear Spline Play

- Set a dial indicator to the gear to be measured.
- Move the gear as far as possible to both the right and the left.

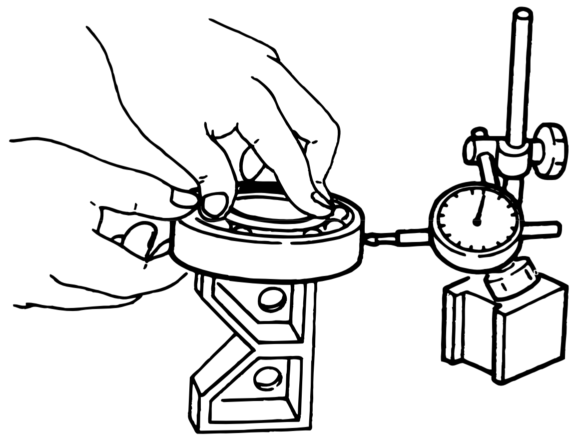
Note the dial indicator reading.
If the measured value exceeds the specified limit, the gear must be replaced.

	Standard	Limit
3rd 5th Output	0.013 - 0.121 mm (0.0005 - 0.0048 in)	0.15 mm (0.0059 in)

Ball Bearing Play

Use a dial indicator to measure the ball bearing play.
If the measured value exceeds the specified limit, the ball bearing must be replaced.

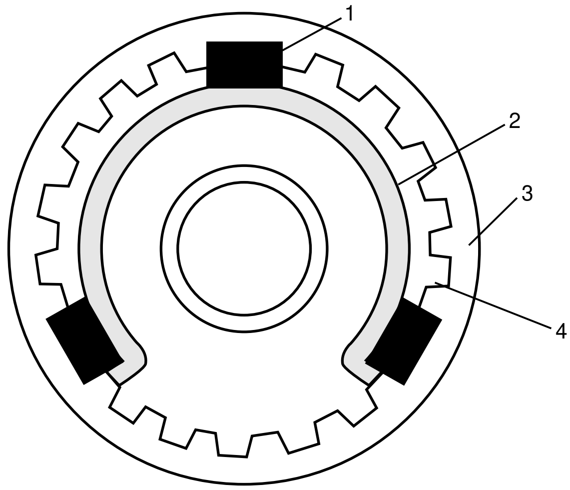
	Standard	Limit
Front	0 - 0.098 mm (0 - 0.0039 in)	0.15 mm (0.0059 in)



LNW25CSH029201

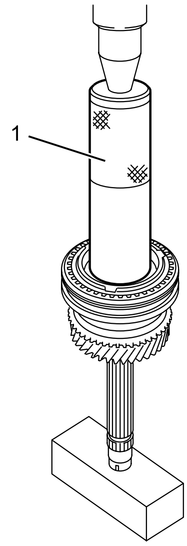
Installation

1. Install the needle bearing, 2nd counter gear assembly, 2nd inside ring, 2nd outside ring, and 2nd block ring.
   - Apply engine oil to the needle bearing and gear internal surface.
2. Assemble the 1st-2nd synchronizer assembly by performing the following steps.
   - Check that the inserts (1) fit snugly into the clutch hub (4) insert grooves.
   - Check that the inserts springs (2) are fitted to the inserts as shown in the figure.
   - Check that the clutch hub (4) and sleeve (3) slide smoothly.
   - The insert springs (2) must be set in such a way that the opening of each spring faces different direction.



LNW45CSH002301

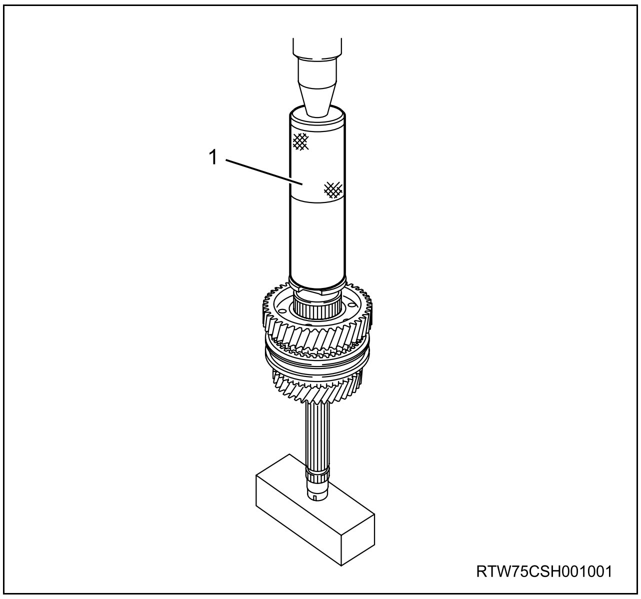
3. Use a bench press and installer 9-8522-1182-0 (1) to install the 1st-2nd synchronizer assembly, 1st block ring, 1st outside ring and 1st inside ring.
   - Apply engine oil to the block ring internal surface.



RTW75CSH000901

4. Install the needle bearing and 1st counter gear assembly.
   - Apply engine oil to the needle bearing and gear internal surface.
5. Use a bench press and installer 9-8522-1182-0 (1) to install the 1st counter collar.

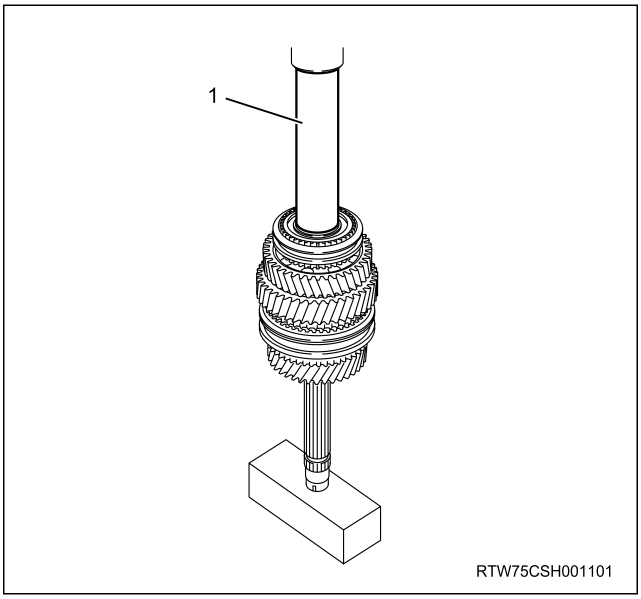
Notice:
The collar must be press fitted with end surface of sleeve & hub.



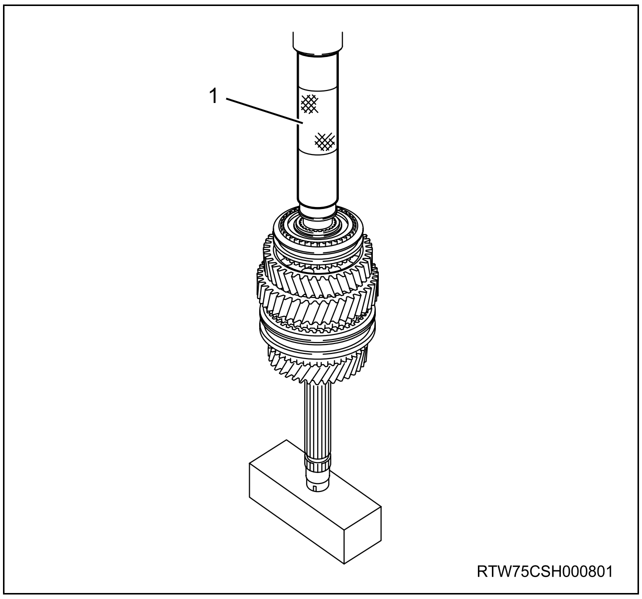
6. Install the new 1st counter snap ring.
   - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove surely.

7. Install the needle bearing, reverse block ring, and reverse counter gear assembly.
   - Apply engine oil to the needle bearing and gear internal surface.
8. Use a bench press and installer 5-8840-2244-0 (1) to install the reverse synchronizer assembly.
   - Apply engine oil to the block ring internal surface.



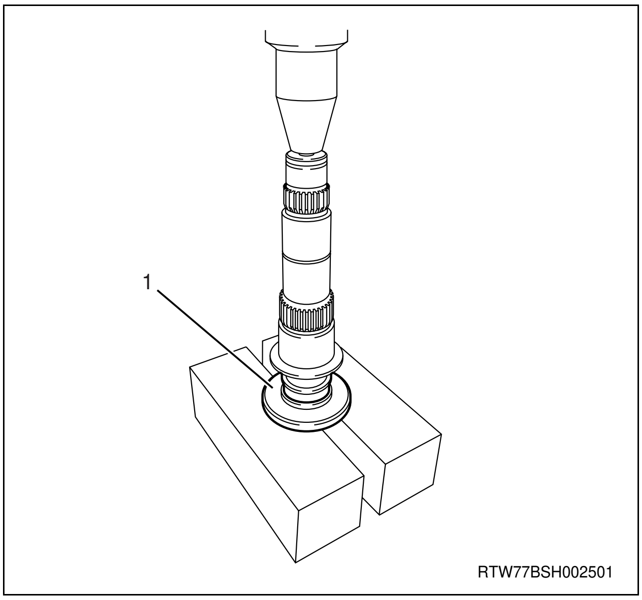
9. Use a bench press and installer 5-8840-2346-0 (1) to install the counter front roller bearing inner race.



10. Install the counter front roller bearing outer race.
11. Use a pair of snap ring pliers to install the new reverse counter snap ring.
    - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove surely.

12. Install the counter middle roller bearing by performing the following steps.
    a. Use a bench press and installer 5-8840-2847-0 (1) to install the counter middle roller bearing inner race.



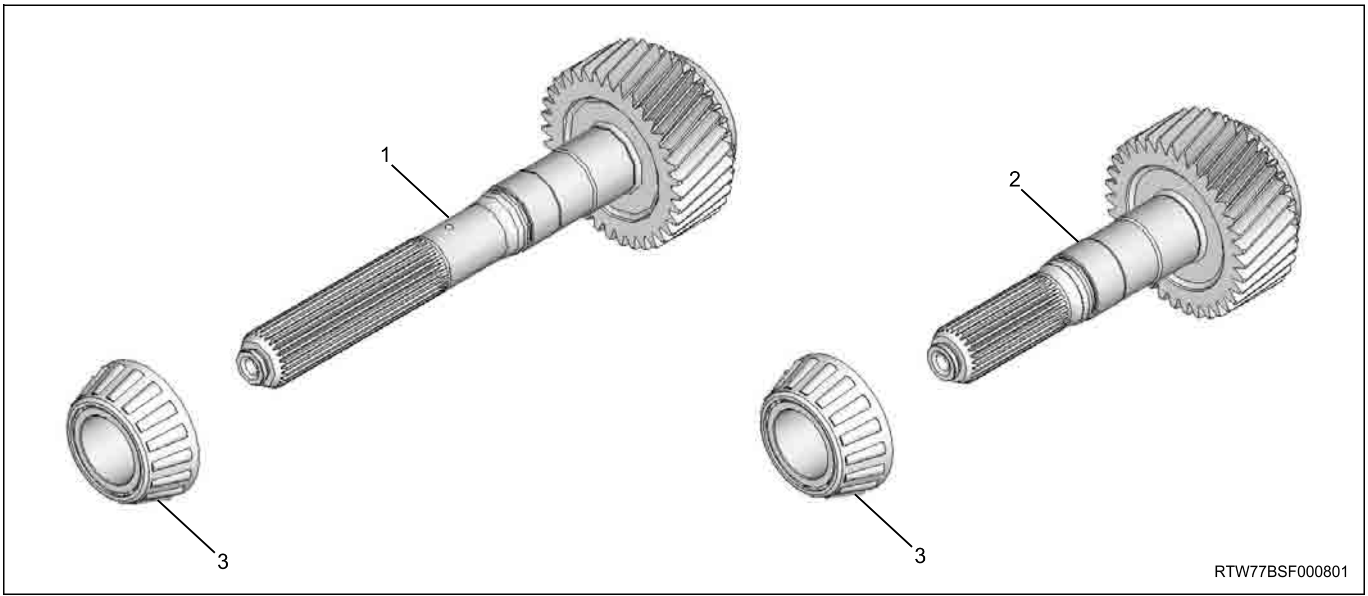
    b. Install the counter middle roller bearing outer race.

Notice:
- Direction of assembling exists. (Flange of inner race to be shaft side.)

- The bearing must be press fitted with end surface of shaft.
- The outer race must not be punch. (Inner race to be punch.)

Output Shaft Assembly

Component

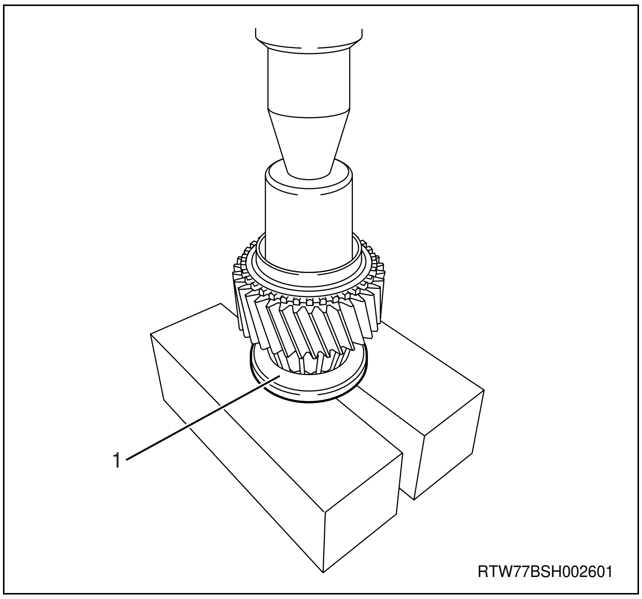


Legend

1. Output shaft (4x2 model)
2. Output shaft (4x4 model)
3. Output front bearing inner race

Removal

1. Break the output front bearing cage with hammer and chisel.
   Remove the output front bearing inner race, and discard the used inner race.

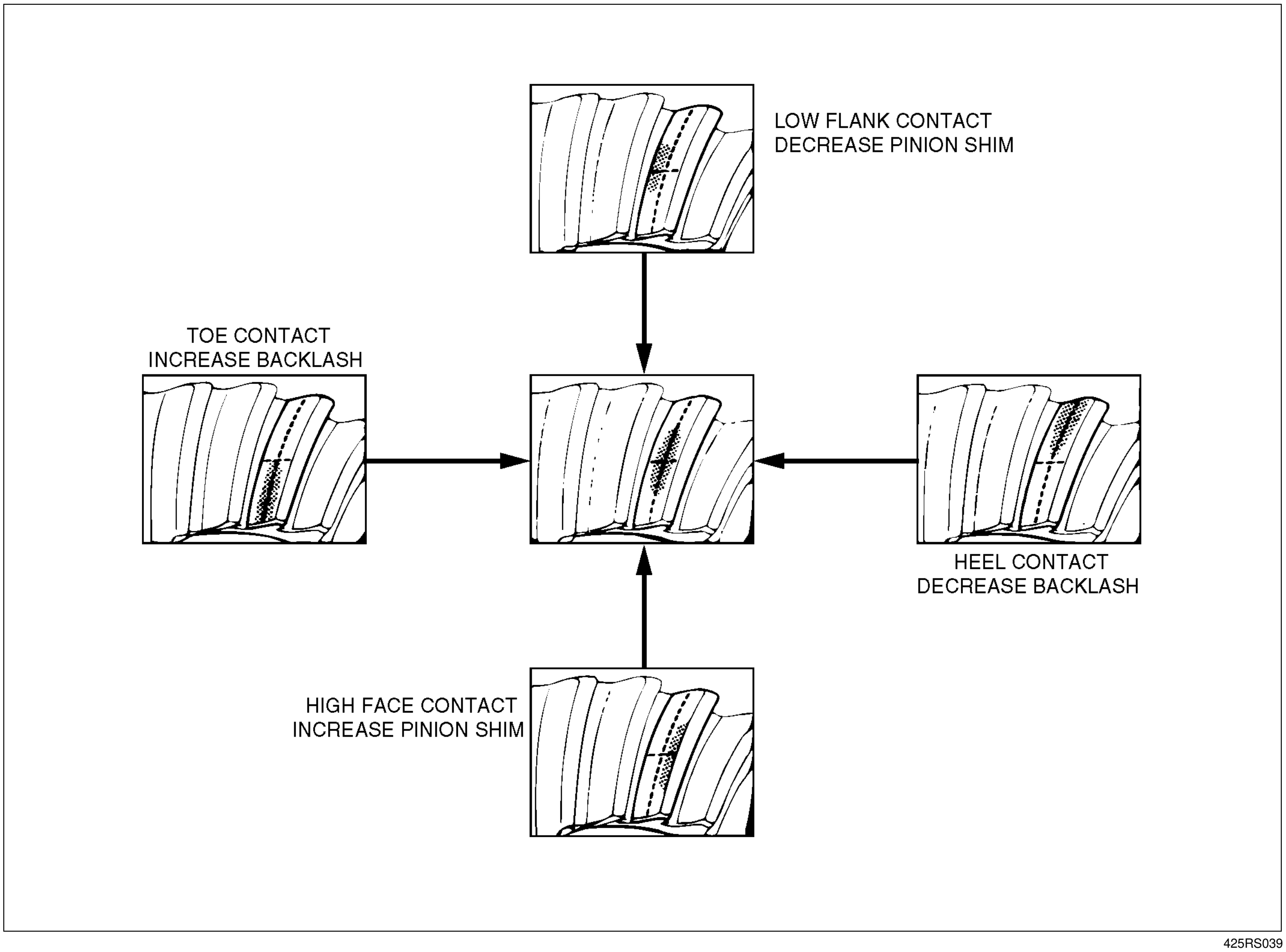


Installation

1. Use a bench press and installer 5-8840-2847-0 (1) to install the output front bearing inner race to the output shaft.
   - Never reinstall the used output front bearing inner race.
   - Apply grease (BESCO L-2 or equivalent) to the bearing roller.

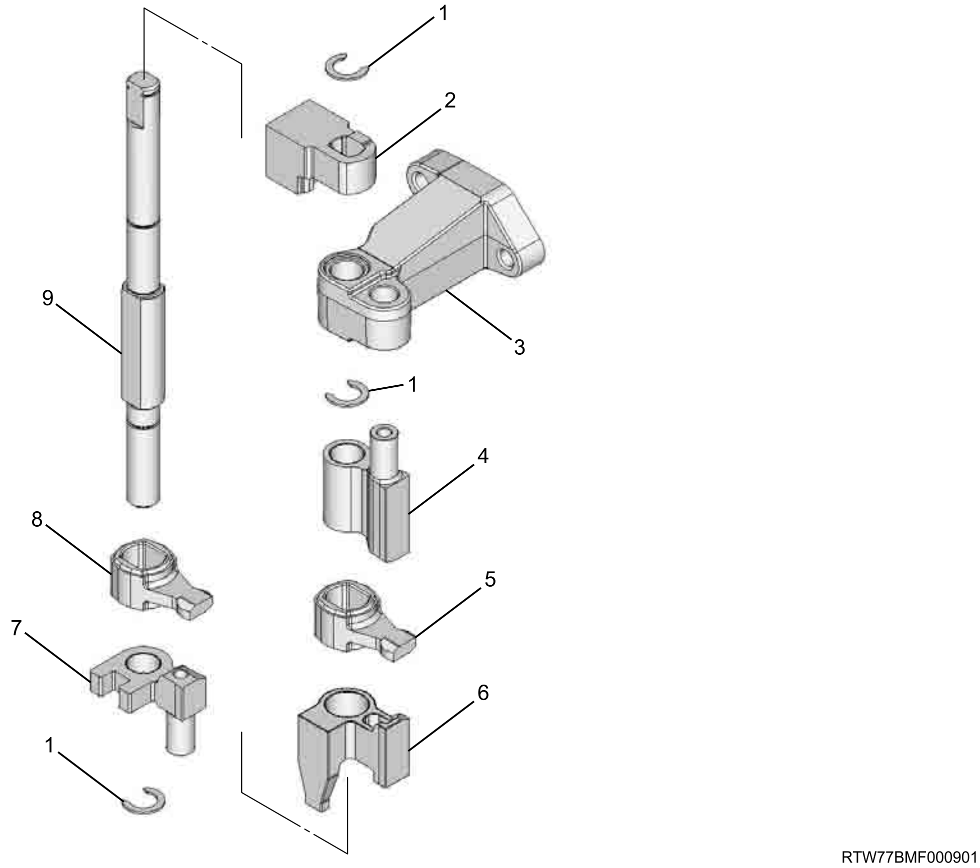
Notice:

- The bearing innner race must be press fitted to end surface of gear.
- The cage must not be push.


LOW FLANK CONTACT
DECREASE PINION SHIM
TOE CONTACT
INCREASE BACKLASH
HEEL CONTACT
DECREASE BACKLASH
HIGH FACE CONTACT
INCREASE PINION SHIM
425RS039

Shift & Select Rod Assembly

Component



Legend

1. Snap ring
2. Shift & select block
3. Shift rod bracket
4. Interlock upper block
5. Internal common upper lever
6. Interlock middle block
7. Interlock lower block
8. Internal common lower lever
9. Shift & select rod

Removal

1. Remove the snap ring from the interlock lower block lower side.
2. Remove the interlock lower block.
3. Remove the internal common lower lever.
4. Remove the interlock middle block.
5. Remove the internal common upper lever.
6. Remove the snap ring from the shift & select block upper side.
7. Removel the shift & select block.
8. Removel the shift rod bracket.
9. Remove the snap ring from the interlock upper block upper side.
10. Remove the interlock upper block.

Installation

1. Install the interlock upper block.
2. Install the new snap ring to the interlock upper block upper side.
   - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove of rod surely.

3. Install the shift rod bracket.
4. Install the shift & select block.
5. Install the new snap ring to the shift & select block upper side.
   - Never reinstall the used snap ring.

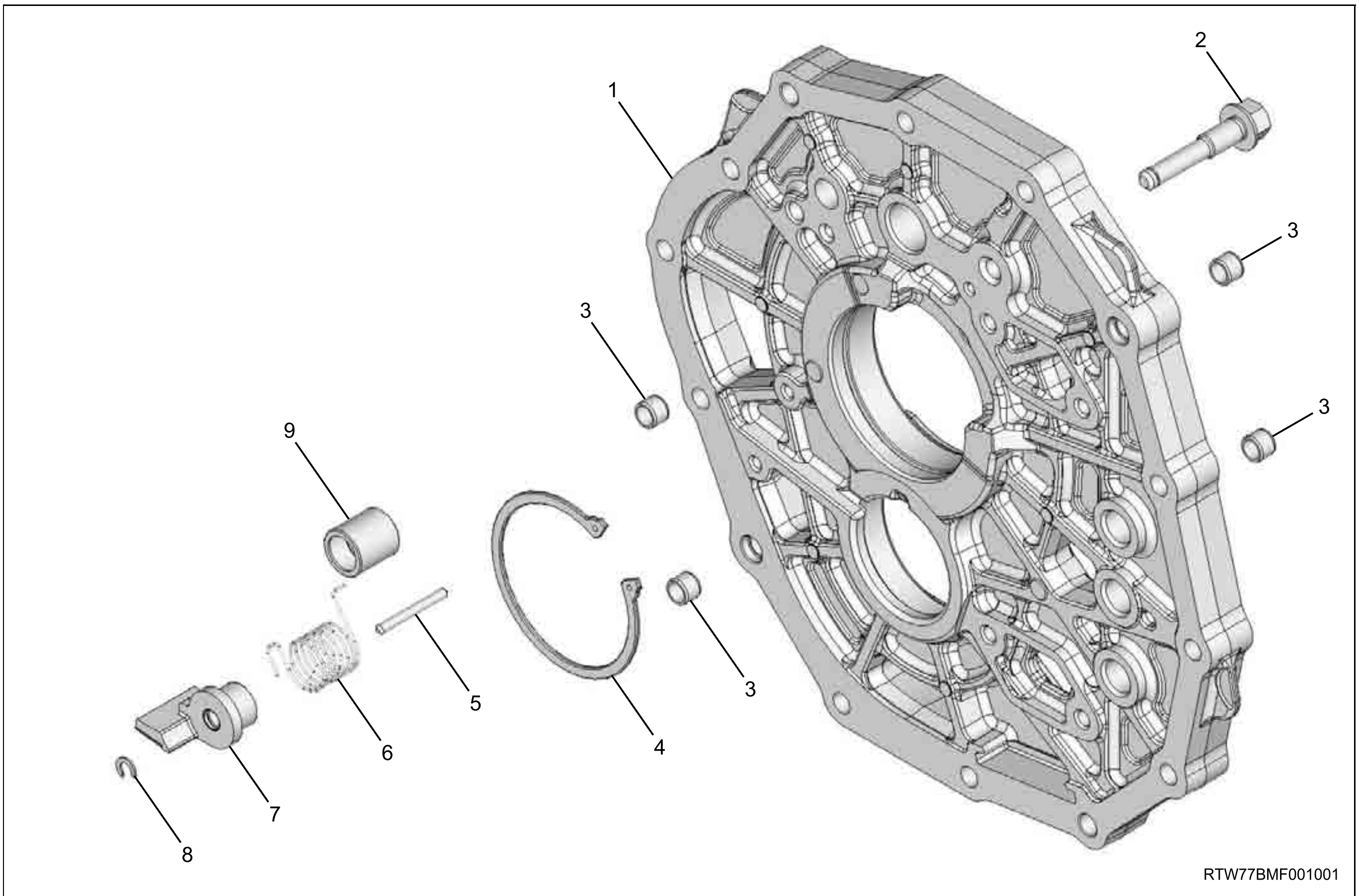
Notice:
The snap ring must be assembled in groove of rod surely.

6. Install the internal common upper lever.
7. Install the interlock middle block.
8. Install the internal common lower lever.
9. Install the interlock lower block.
10. Install the new snap ring to the interlock lower block lower side.
    - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove of rod surely.

Intermediate Plate Assembly

Component



Legend

1. Intermediate plate
2. Reverse inhibitor bolt
3. Dowel
4. Input middle bearing snap ring
5. Straight pin
6. Reverse inhibitor spring
7. Reverse inhibitor
8. Reverse inhibitor snap ring
9. Linear ball bearing

Removal

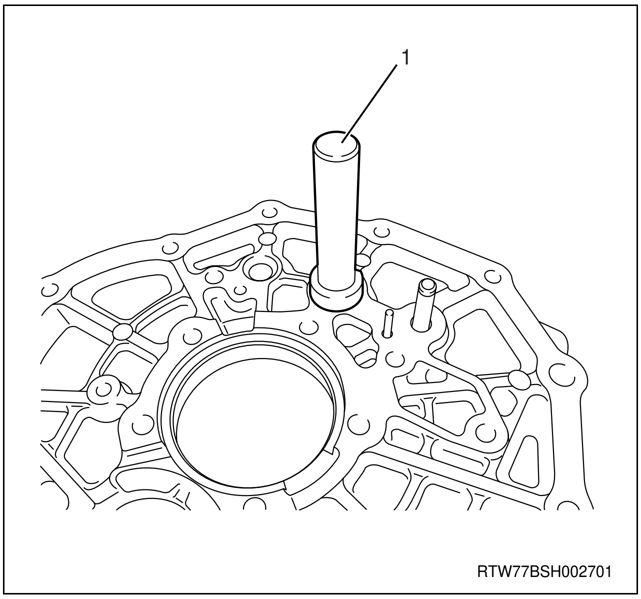
1. Remove the reverse inhibitor snap ring.
2. Remove the reverse inhibitor and spring.
3. Remove the reverse inhibitor bolt.
4. Remove the straight pin.
5. Remove the linear ball bearing.
6. Remove the four dowels.
7. Use a pair of snap ring pliers to remove the input middle bearing snap ring.

Installation

1. Use a pair of snap ring pliers to install the new input middle bearing snap ring.
   - Never reinstall the used snap ring.
2. Install the four dowels.
3. Use the installer 5-8840-2848-0 (1) to install the linear ball bearing.

Notice:

- The bearing to be pressed fit to boss face.
- The bearing must be pressed at marked side.



4. Install the straight pin.
5. Install the reverse inhibitor bolt.
   - Tighten the reverse inhibitor bolt to the specified torque.

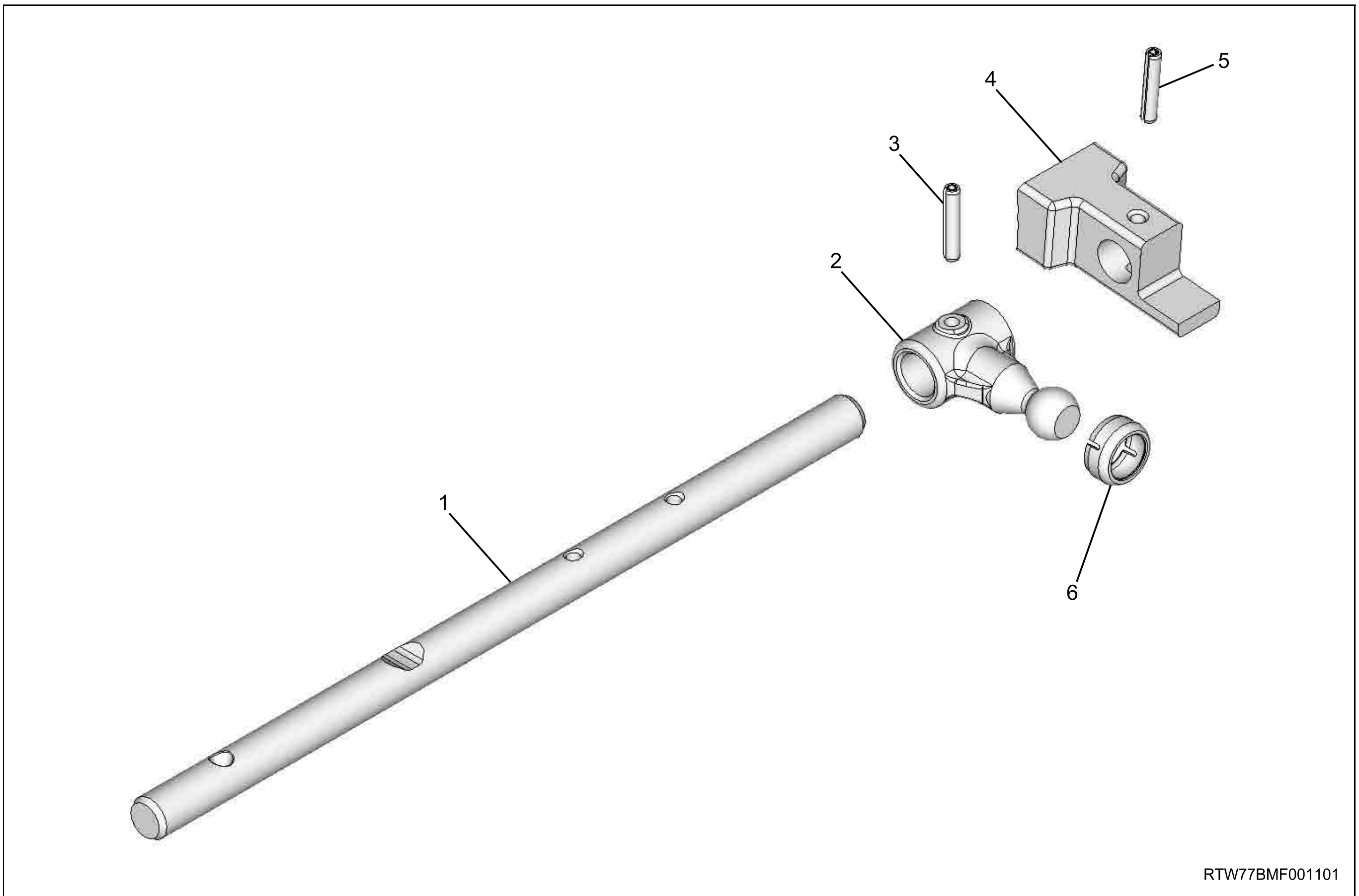
Torque: 36 N·m (3.7 kgf·m/27 lb·ft)

6. Install the reverse inhibitor and spring.
7. Install the new reverse inhibitor snap ring.
   - Never reinstall the used snap ring.

Notice:
The snap ring must be assembled in groove of bolt surely.

Control Rod Assembly

Component



Legend

1. Control rod
2. Control unit lever
3. Control unit lever spring pin
4. Detent shift block
5. Detent shift block spring pin
6. Shift control seat

Removal

1. Remove the shift control seat.
2. Use a spring pin remover to remove the spring pin and the control unit lever.
3. Use a spring pin remover to remove the spring pin and the detent shift block.

Installation

1. Install the detent shift block and the new spring pin.
   - Never reinstall the used spring pin.

Notice:

- When assembled, vertical direction of block exists.
- The spring pin must be drive in to hole of end surface of block surely.

2. Install the control unit lever and the new spring pin.
   - Never reinstall the used spring pin.

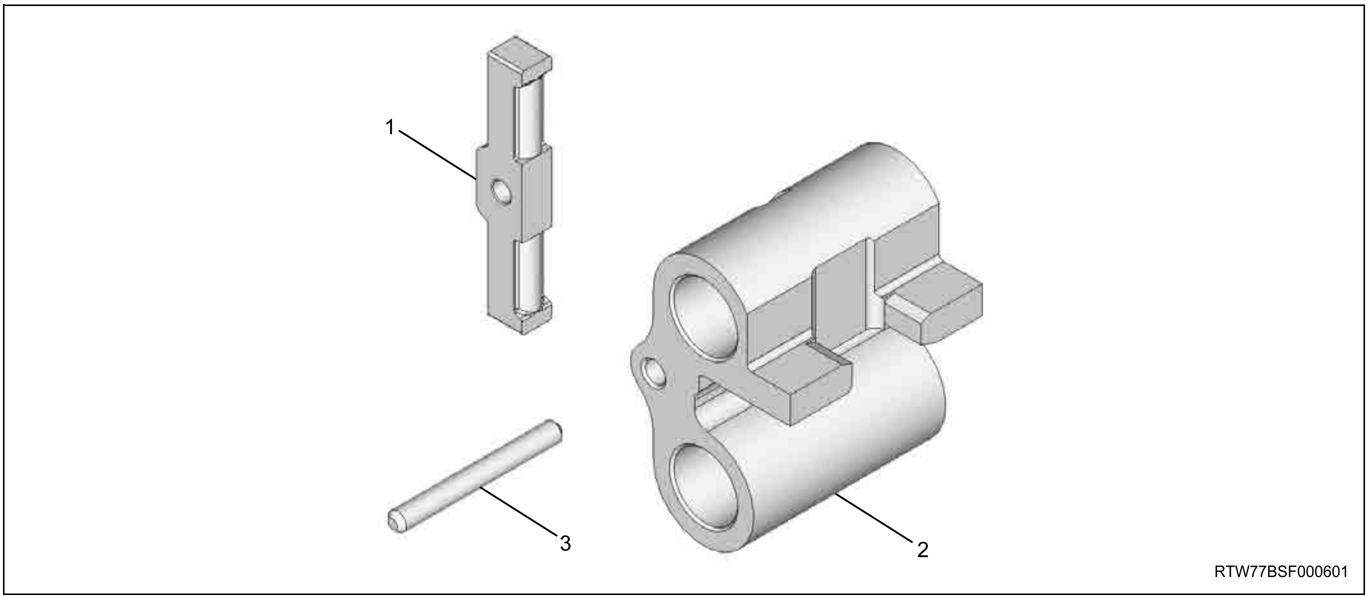
Notice:

The spring pin must be drive in to hole of end surface of lever surely.

3. Install the shift control seat.
   - Apply grease to tip of sphere of lever and seat.

5th-Reverse Shift Block Assembly

Component



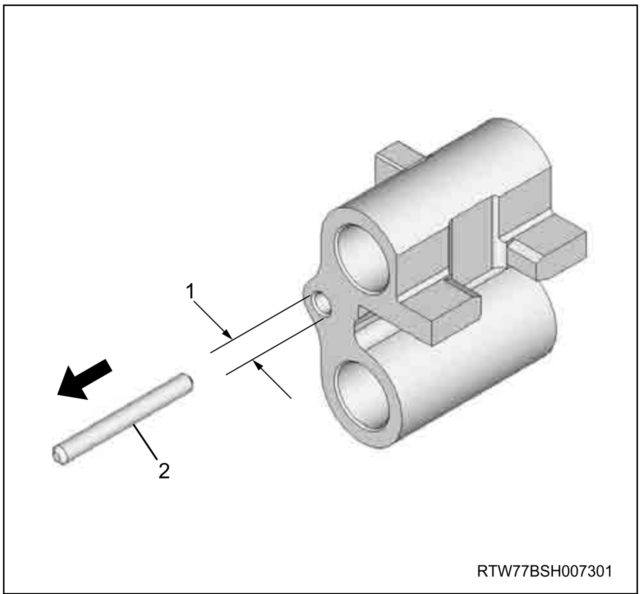
Legend

1. 5th-reverse shift lever
2. 5th-reverse shift block
3. Straight pin

Removal

1. Remove the straight pin and the 5th-reverse shift lever.

Notice:
Make sure to remove the straight pin (2) in the direction of 4.5 mm (0.177 in) diameter bore (1) side.

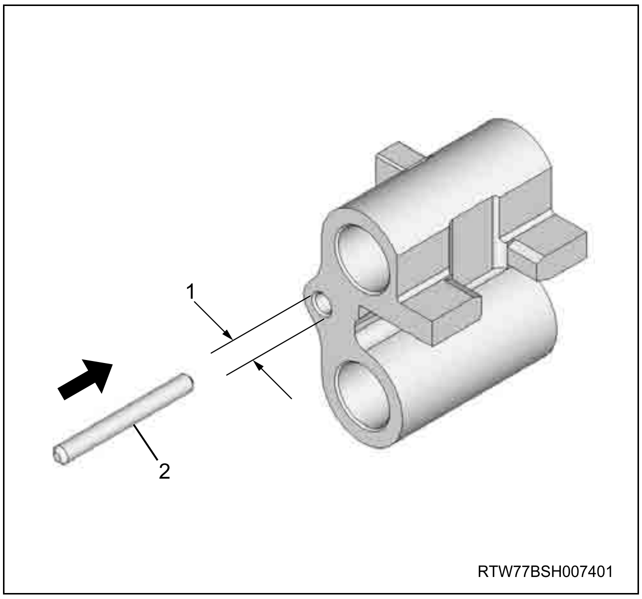


Installation

1. Install the 5th-reverse shift lever and the straight pin.

Notice:

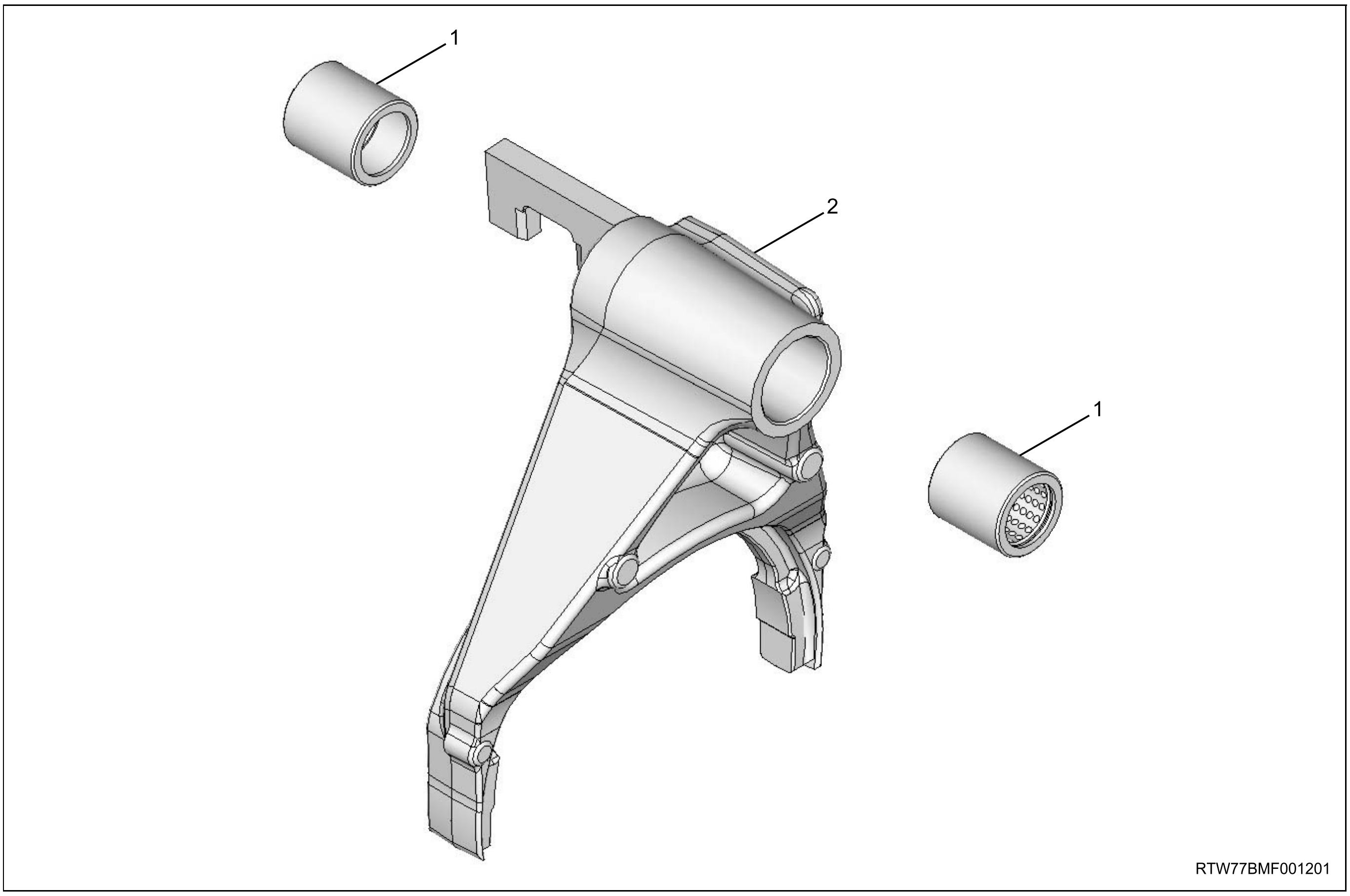
- Install the straight pin (2) from 4.5 mm (0.177 in) diameter bore (1) side, and adjust the setting position to make the end of straight pin flush with the end of the shift block.



- Installation direction of the lever to be not misassembled.

3rd-4th Shift Arm Assembly

Component

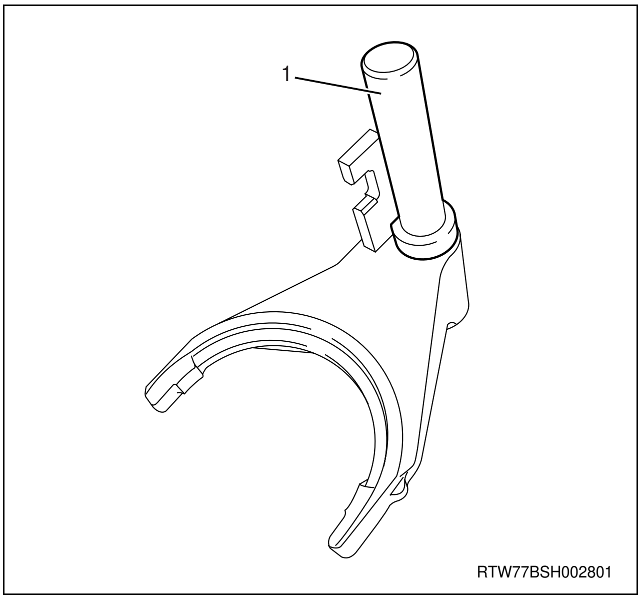


Legend

1. Linear ball bearing
2. 3rd-4th shift arm

Removal

1. Remove the two linear ball bearings.



Installation

1. Use the installer 5-8840-2848-0 (1) to install the two linear ball bearings.

Notice:

- The bearing to be pressed fit to both boss faces.
- The bearing must be pressed at marked side.

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Special Tools

Special Tools

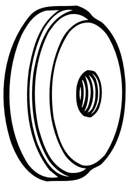
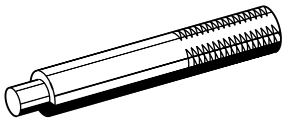
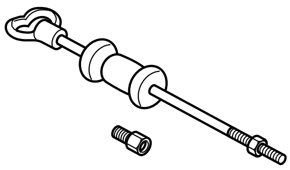
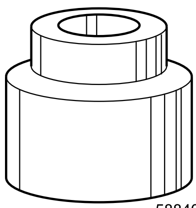
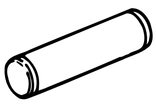
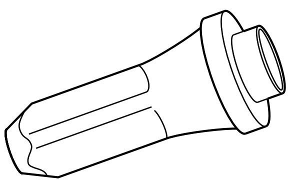
Illustration	Tool Number/ Description
 5852200530	5-8522-0053-0 (J-29016) Bearing Installer
 5884000070	5-8840-0007-0 (J-8092) Grip
 5884000840	5-8840-0084-0 (J-2619-01) Sliding Hammer
 5884001250	5-8840-0125-0 (J-26516) Pilot Bearing Installer
 5884022440	5-8840-2244-0 (J-5590) Bearing Installer
 5884022820	5-8840-2282-0 (J-36797) Oil Seal Installer

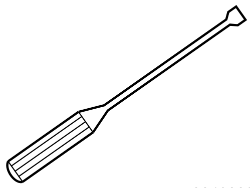
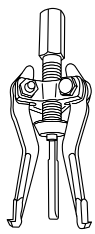
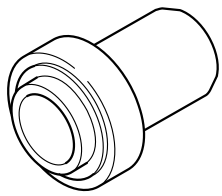
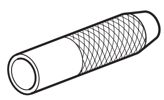
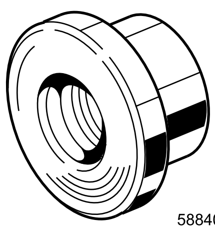
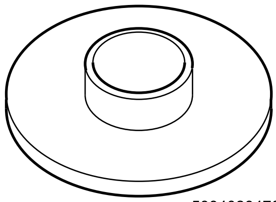
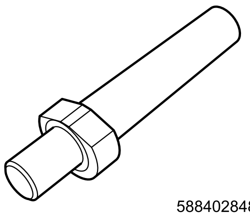
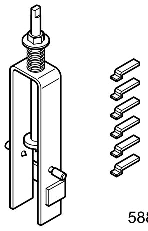
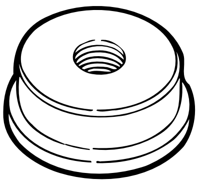
Illustration	Tool Number/ Description
 5884022910	5-8840-2291-0 (J-39207) Bearing Remover
 5884023460	5-8840-2346-0 Installer
 5884027570	5-8840-2757-0 (J-45887) Bearing Remover
 5884027860	5-8840-2786-0 (J-46202) Oil Seal Installer
 9852211820	9-8522-1182-0 (J-35835) Bearing Installer
 5884028460	5-8840-2846-0 Oil Seal & Bearing Installer

Illustration	Tool Number/ Description
 5884028470	5-8840-2847-0 Bearing Installer
 5884028480	5-8840-2848-0 Linear Ball Bearing Installer
 5884028490	5-8840-2849-0 Snap Ring Selector
 5884028500	5-8840-2850-0 (J-6197-A) Bearing Installer

SECTION 7C

CLUTCH

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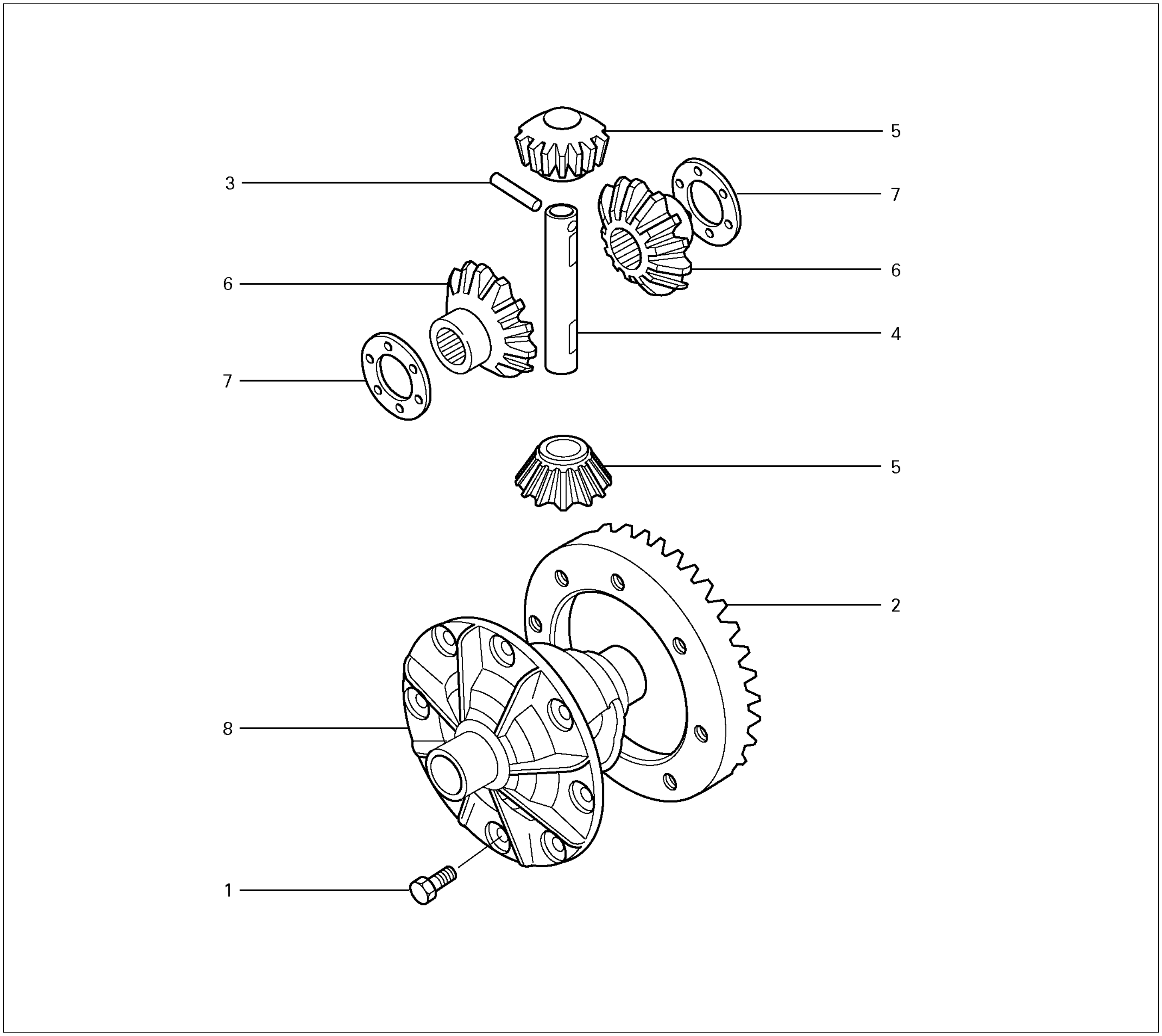
Differential Cage Assembly

Disassembled View



425R300005

Legend

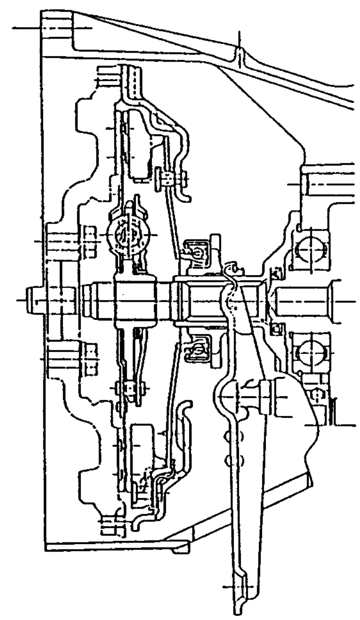
1. Bolt
2. Ring Gear
3. Lock Pin
4. Cross Pin
5. Pinion Gear
6. Side Gear
7. Thrust Washer (for Side Gear)
8. Differential Cage

MAIN DATA AND SPECIFICATIONS

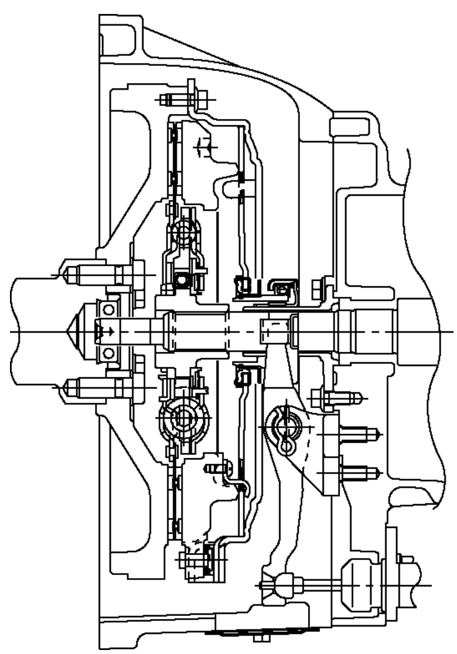
ENGINE		4JJ1 (High Output)	4JA1-T	4JK1-TC 4JJ1 (Standard Output) 4JH1-TC	C24SE
TRANSMISSION		**MUX**	**MSG**	**MUA**	**MUA**
Clutch type		Dry single plate with diaphragm			
Size	mm (in)	275 (10.83)	225 (8.86)	250 (9.84)	240 (9.45)
Clamping force	kg(lb)	700 (1544)	517 (1140)	640 (1411)	560 (1235)
	(N)	(6860)	(5070)	(6300)	(5500)
Pressure plate					
Outside diameter	mm(in)	275 (10.83)	225 (8.86)	250 (9.84)	240 (9.45)
Inside diameter	mm(in)	180 (7.087)	150 (5.906)	160 (6.299)	160 (6.299)
Driven plate					
Thickness	mm(in)				
at free		8.8 (0.346)	8.4 (0.331)	8.3 (0.327)	8.7 (0.342)
at compressed		8.3 (0.327)	7.8 (0.307)	7.8 (0.307)	8.0 (0.315)
Clutch Cont. type		Hydraulic			
Pedal free play	mm(in)	5.0-15.0 (0.2-0.6)			
Master cylinder					
Bore×Stroke	mm(in)	15.87 × 35 (0.625 × 1.38)			
Slave cylinder					
Bore × Stroke	mm(in)	22.22 × 18.9 (0.875 × 0.744)	19.05 × 23 (0.749 × 0.906)	20.64 × 23 (0.813 × 0.906)	19.05 × 23 (0.749 × 0.906)

GENERAL DESCRIPTION

PUSH TYPE CLUTCH (MSG and MUA)



PULL TYPE CLUTCH (MUX)

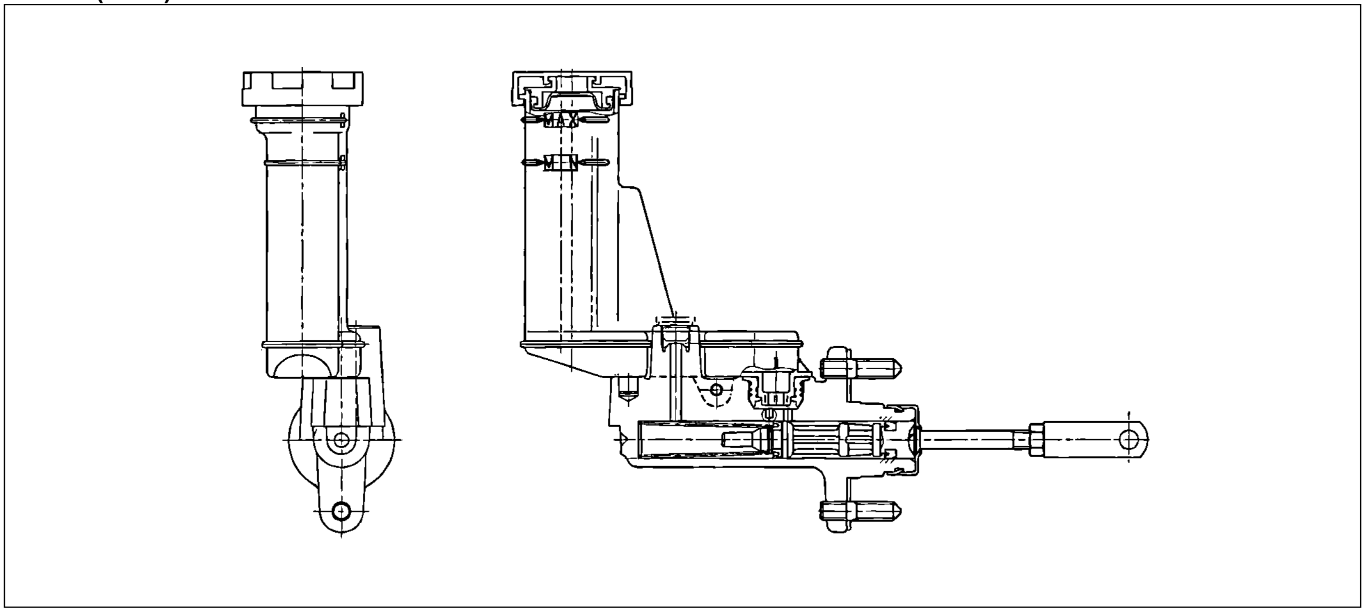


RTW77CSF000601

The clutch assembly consists of the pressure plate, the clutch cover, the diaphragm spring pivot pin and the driven plate assembly.
The clutch pedal is connected to the release bearing through the shift fork.
The driven plate assembly is installed between the flywheel and the pressure plate.
For models with MSG transmission and MUA transmission, the push-type clutch is used.
Diaphragm spring pressure holds the driven plate against flywheel and the pressure plate to provide the friction necessary to engage the clutch.
Depressing the clutch pedal moves the shift fork against the release bearing.
The release bearing forces the diaphragm to overcome the force of the diaphragm spring and separate the driven plate from the flywheel and pressure plate to disengage the clutch.
For model with MUX transmission, the pull-type clutch is used. The pull-type clutch is disengaged by pulling the release lever (release bearing) to disengage the pressure plate.

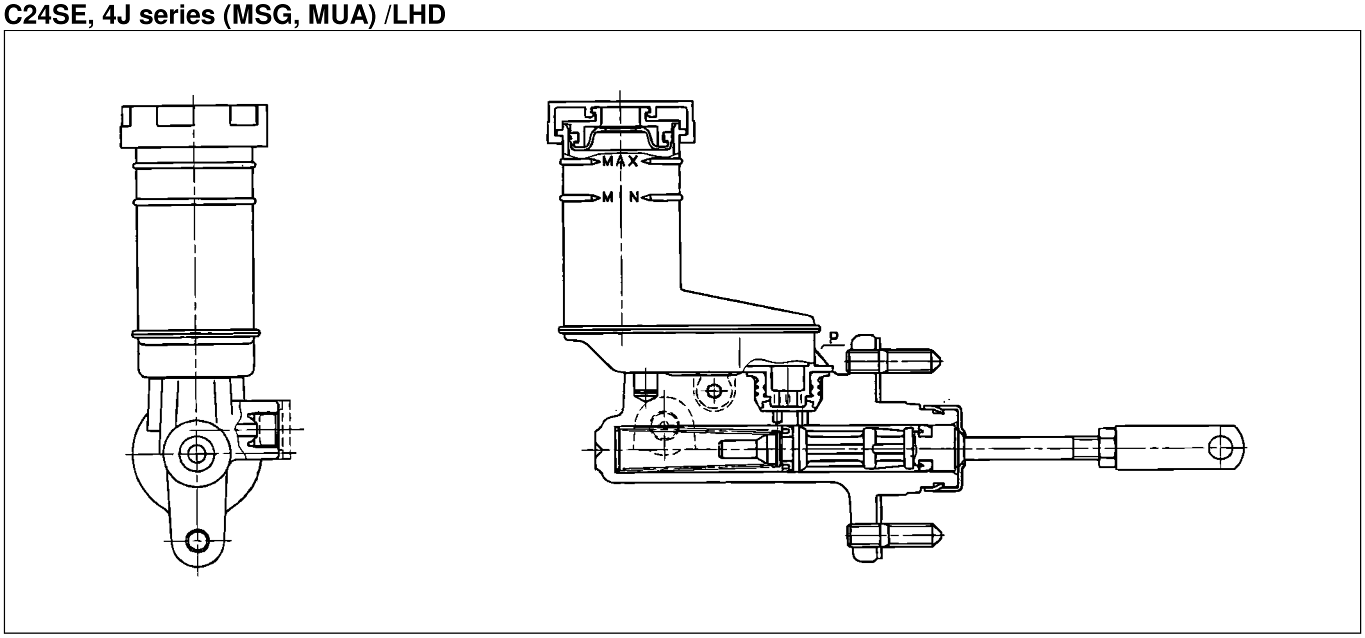
MASTER CYLINDER

C24SE (MUA) /RHD



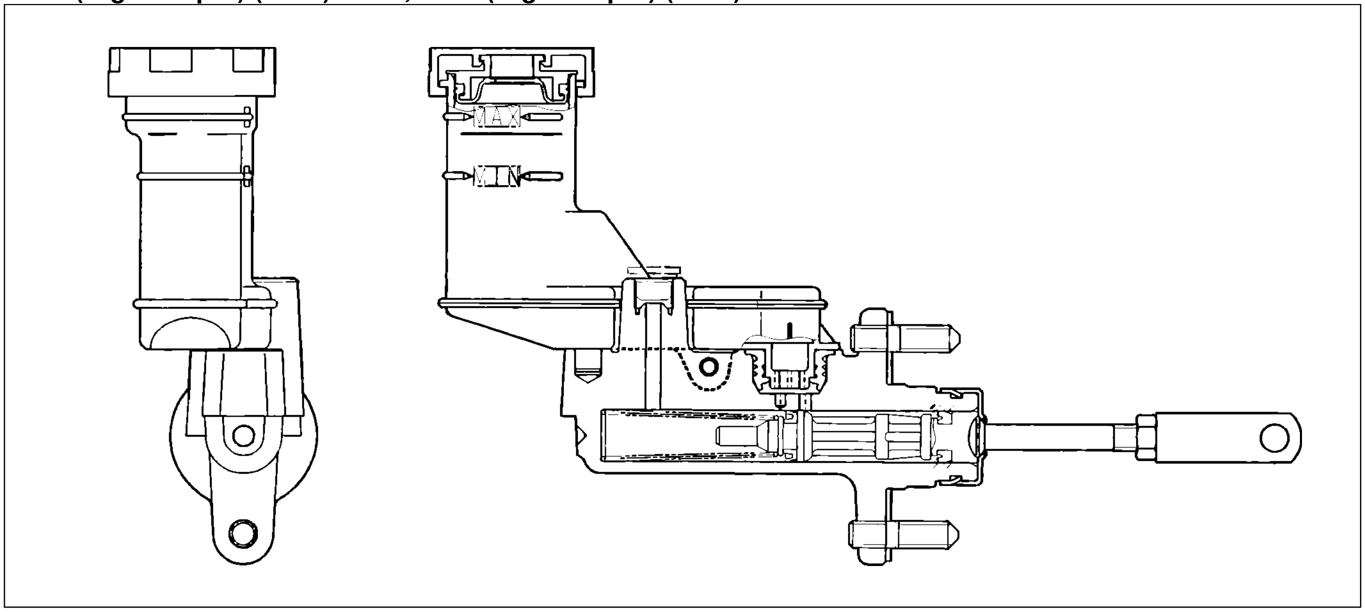
RTW47CSF000501

C24SE, 4J series (MSG, MUA) /LHD



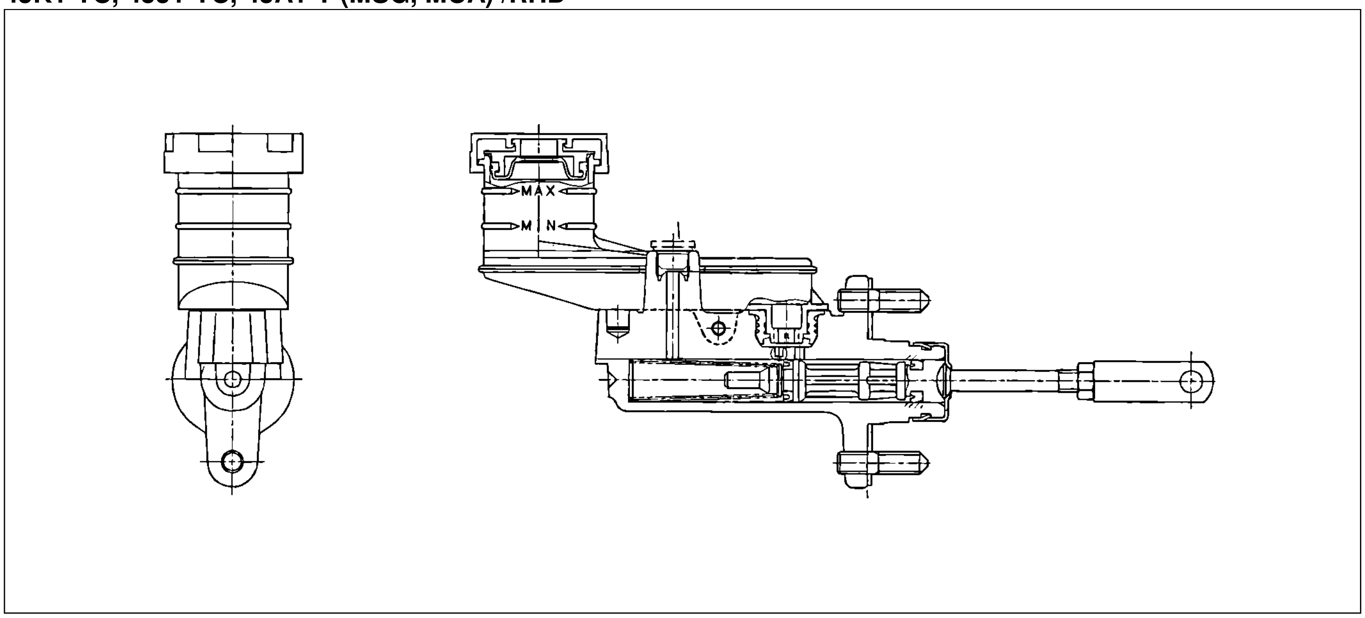
RTW47CSF000201

4JK1 (High Output) (MUA) /RHD, 4JJ1 (High Output) (MUX)



RTW77CSF000101

4JK1-TC, 4JJ1-TC, 4JA1-T (MSG, MUA) /RHD

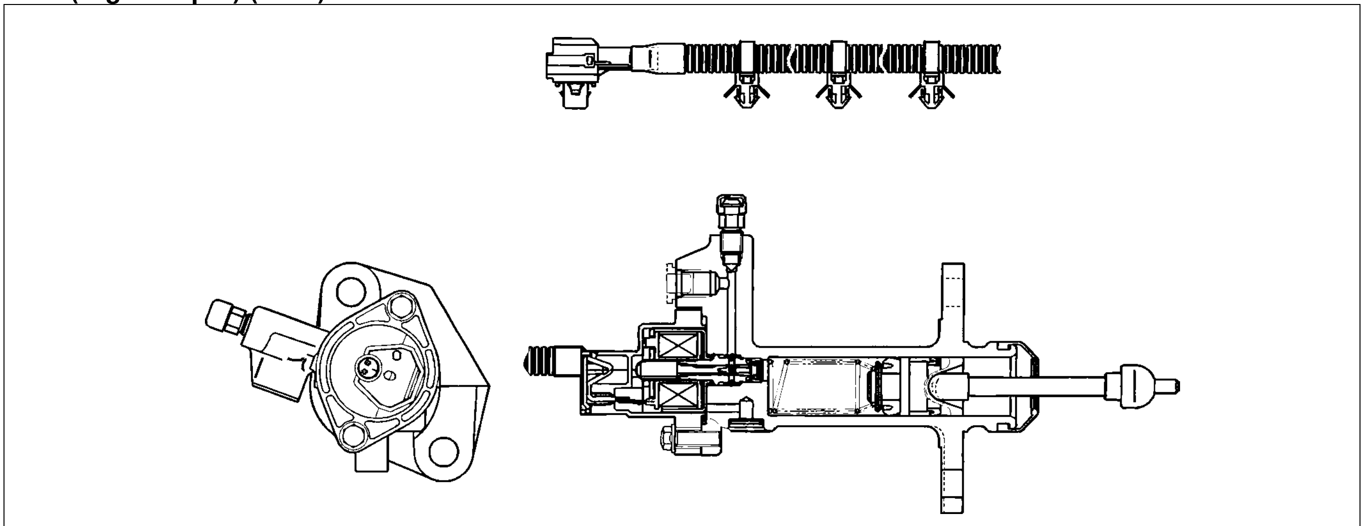


RTW47CSF000401

The master cylinder converts mechanical energy into hydraulic energy.
Depressing the clutch pedal causes the push rod to move against the piston to close the return port.
Clutch fluid is forced out of the master cylinder.
Releasing the clutch pedal causes the return spring to force the piston back to its original position.
The return port is opened and the clutch fluid flows back into the fluid reservoir.
Quickly releasing the clutch pedal will cause the fluid pressure at the return spring side to be lower than the fluid pressure at the push rod side.
This allows the fluid at the push rod side to quickly flow to the return spring side through a port in the piston head.
This equalizes the pressure at both sides of the piston.

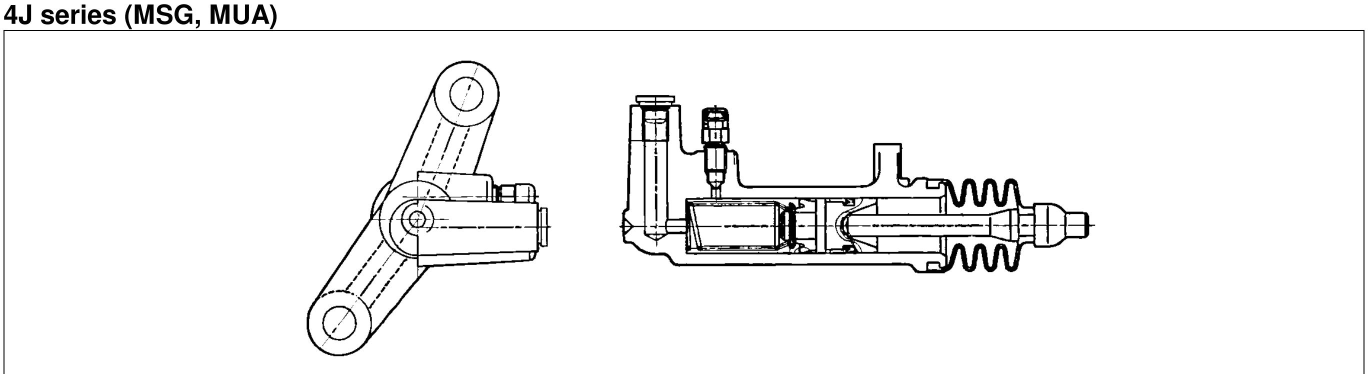
SLAVE CYLINDER

4JJ1 (High Output) (MUX)

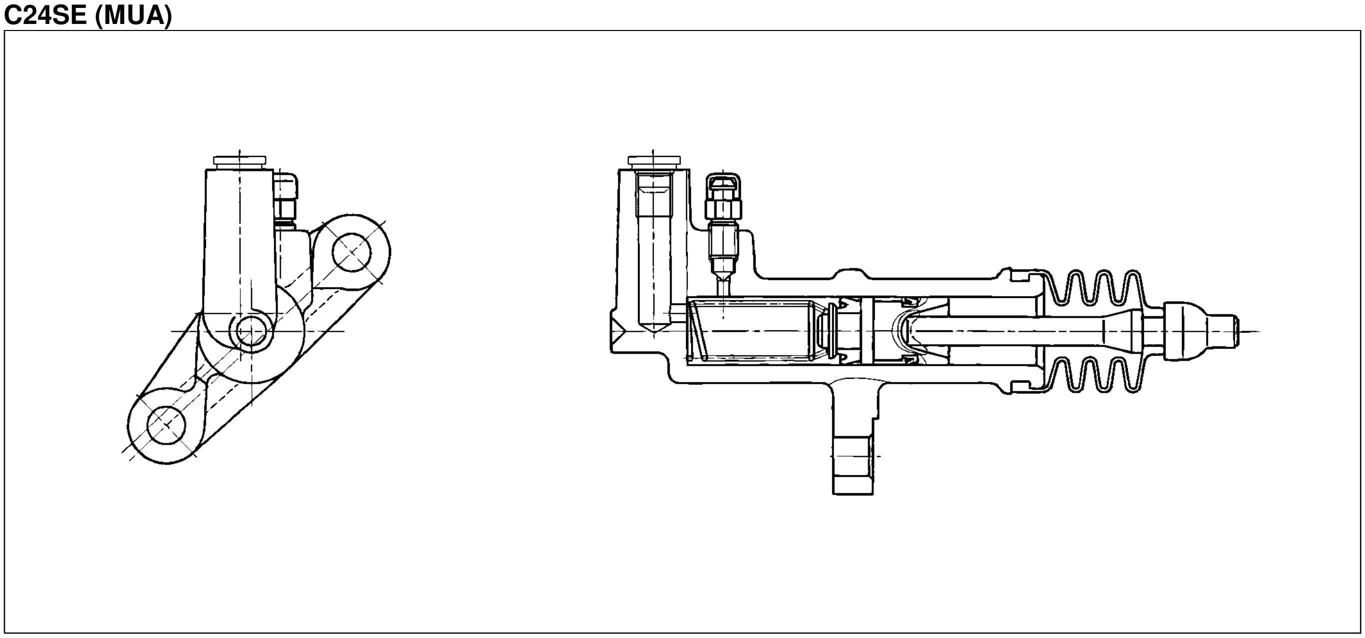


RTW77CSF000701

4J series (MSG, MUA)



C24SE (MUA)

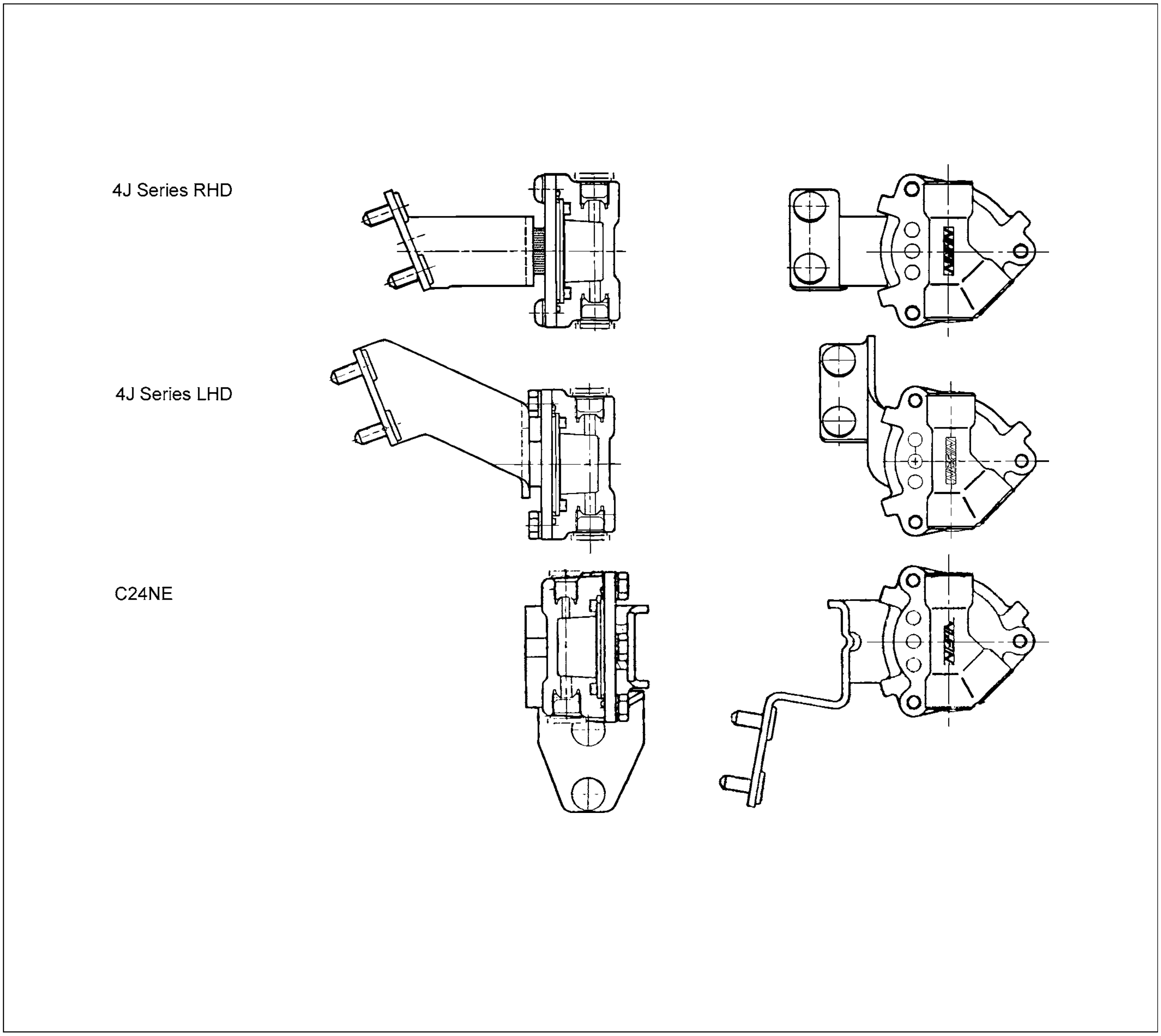


RTW47CSF000301

The slave cylinder converts hydraulic energy into mechanical energy.
Hydraulic fluid supplied by the master cylinder moves the slave cylinder piston to actuate the shift fork.
The mechanical energy produced by the slave cylinder is directly proportional to the diameters of the master cylinder and the slave cylinder.
A bleeder screw is provided to bleed the slave cylinder.

The Clutch Damper Valve is installed in the slave cylinder for MUX.
The Clutch Damper Valve delays return speed of clutch fluid when clutch is being engaged quickly at Low or Reverse, and decreases a shock torque transmitted to drive train.

HYDRAULIC DAMPER CYLINDER

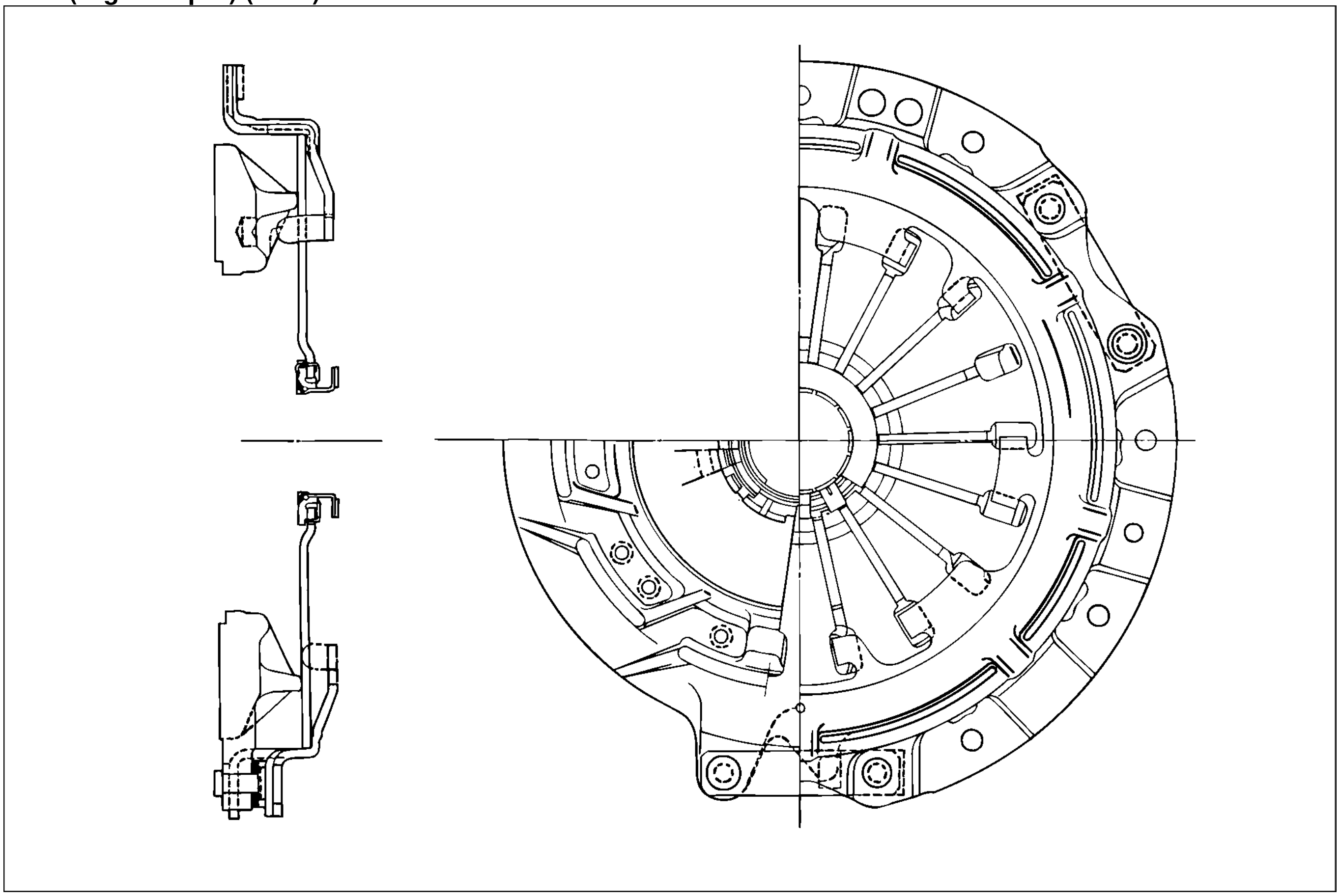


RTW77CMF000401

The hydraulic damper cylinder is installed between the master cylinder and the slave cylinder to smooth out variations in clutch pedal feel.

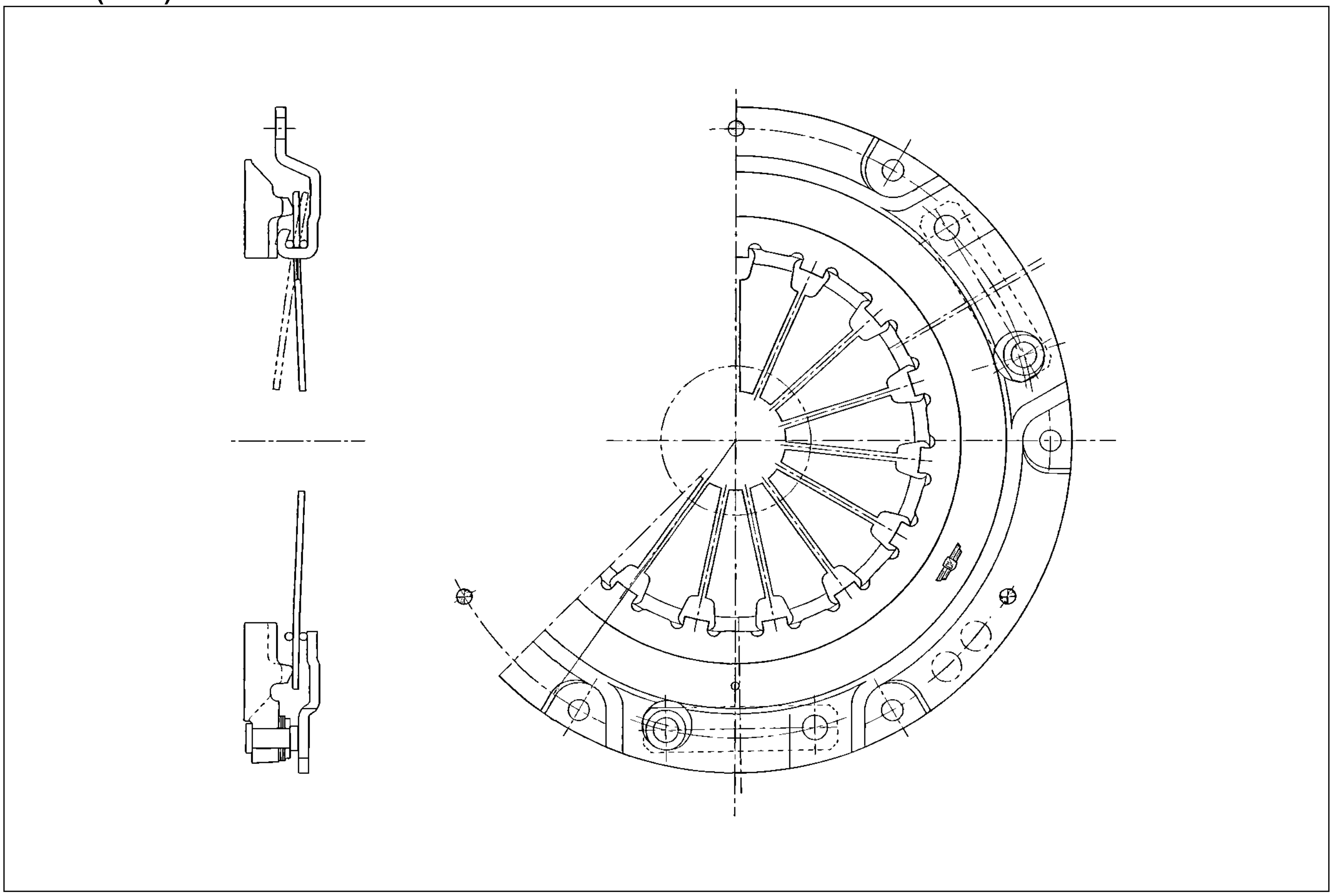
PRESSURE PLATE ASSEMBLY

4JJ1 (High Output) (MUX)



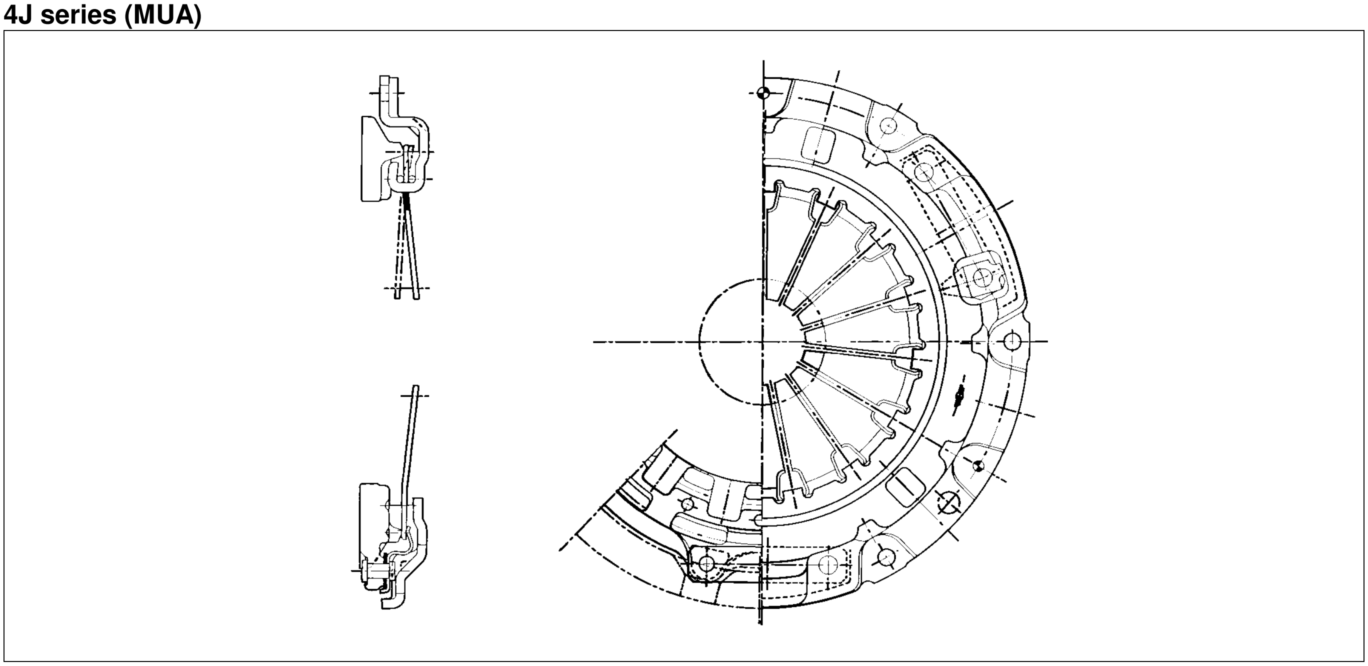
A07RS006

4JA1-T (MSG)



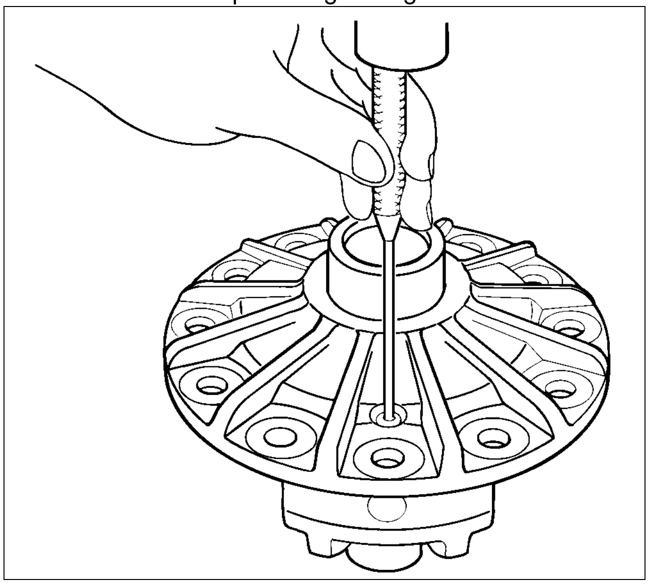
RTW47CMF000101

4J series (MUA)



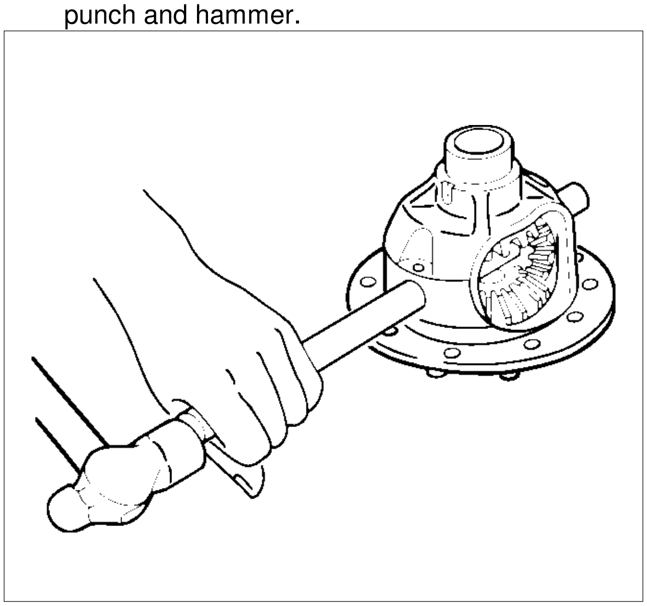
Disassembly

1. Remove bolt.
2. Remove ring gear.
3. Drive out lock pin using a long drift Punch.



425RS042

4. Check the amount of backlash between pinion gear on side gear before removal of cross pin.
   Backlash :
   ϕ220mm : 0.13-0.18 mm (0.005-0.007 in)
   ϕ194mm : 0.10-0.20 mm (0.004-0.008 in)
5. Remove the cross pin by using a brass drift punch and hammer.



425RS043

6. Take out pinion gear, side gear and thrust washer.

Inspection and Repair

Make necessary correction or parts replacement if wear, damage, corrosion or any other abnormal conditions are found through inspection.

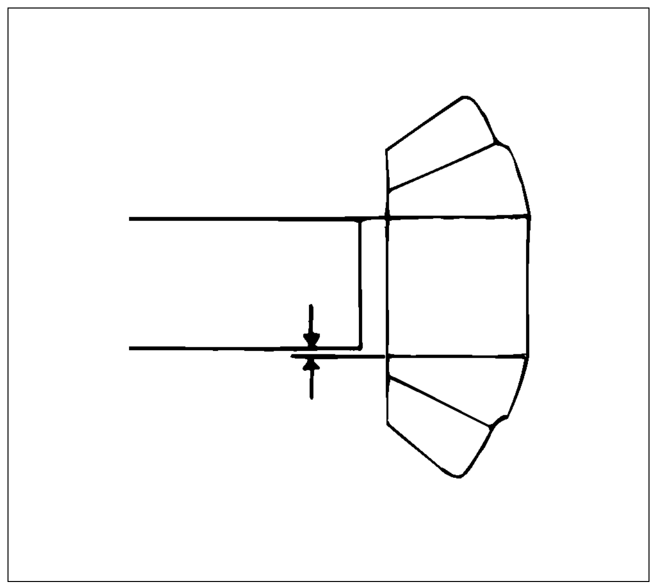
Check the following parts:

- Ring gear, pinion gear
- Bearing
- Side gear, pinion gear, cross pin
- Differential cage, carrier
- Thrust washer
- Oil seal

Clearance between pinion gear and cross pin:

mm (in)

Standard	Limit
0.06 - 0.12 (0.002 - 0.005)	0.2 (0.008)



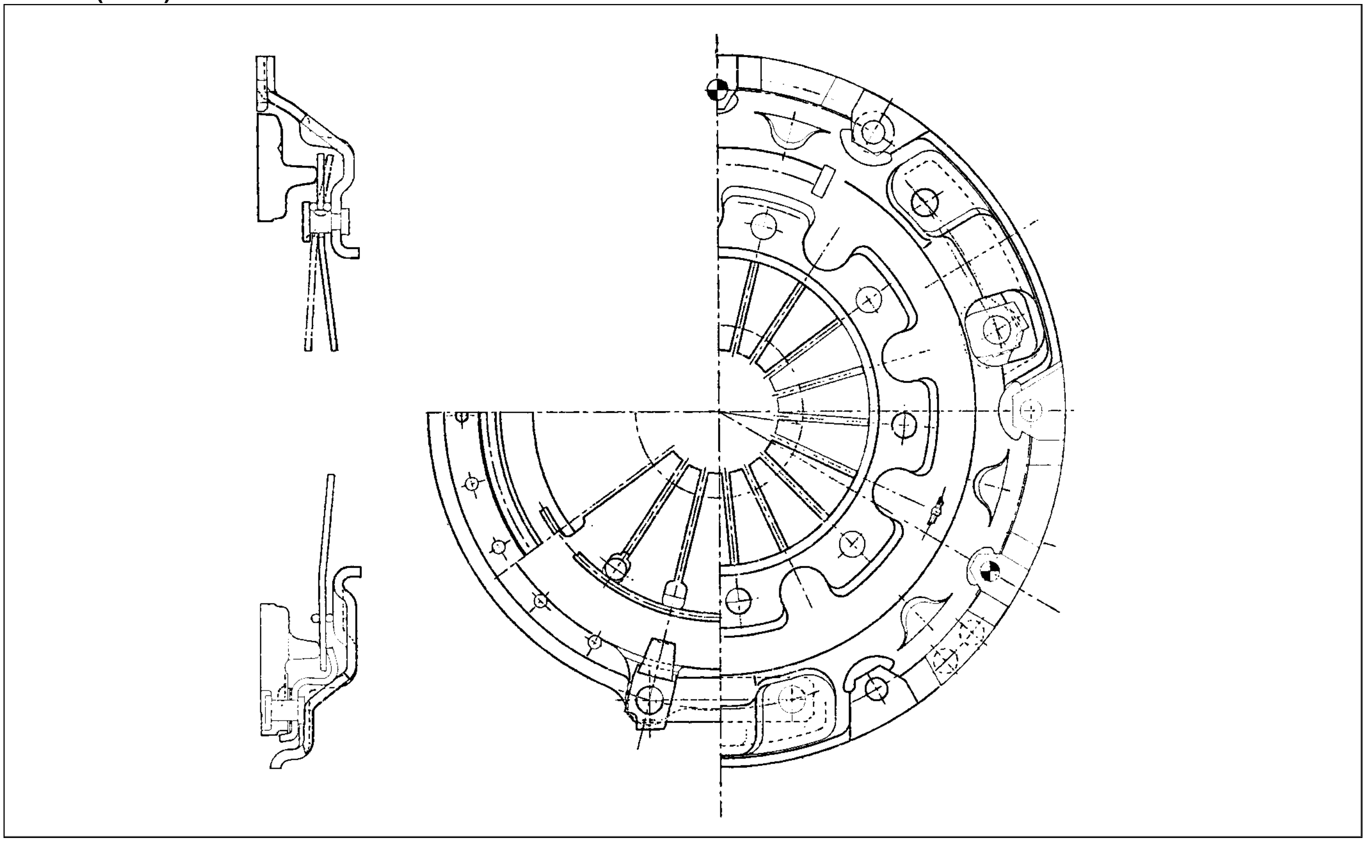
425L100012

Clearance between side gear and differential cage.

mm (in)

	Standard	Limit
ϕ220mm	0.05 - 0.11 (0.002 - 0.004)	0.15 (0.006)
ϕ194mm	0.03 - 0.10 (0.001 - 0.004)	0.15 (0.006)

C24SE (MUA)

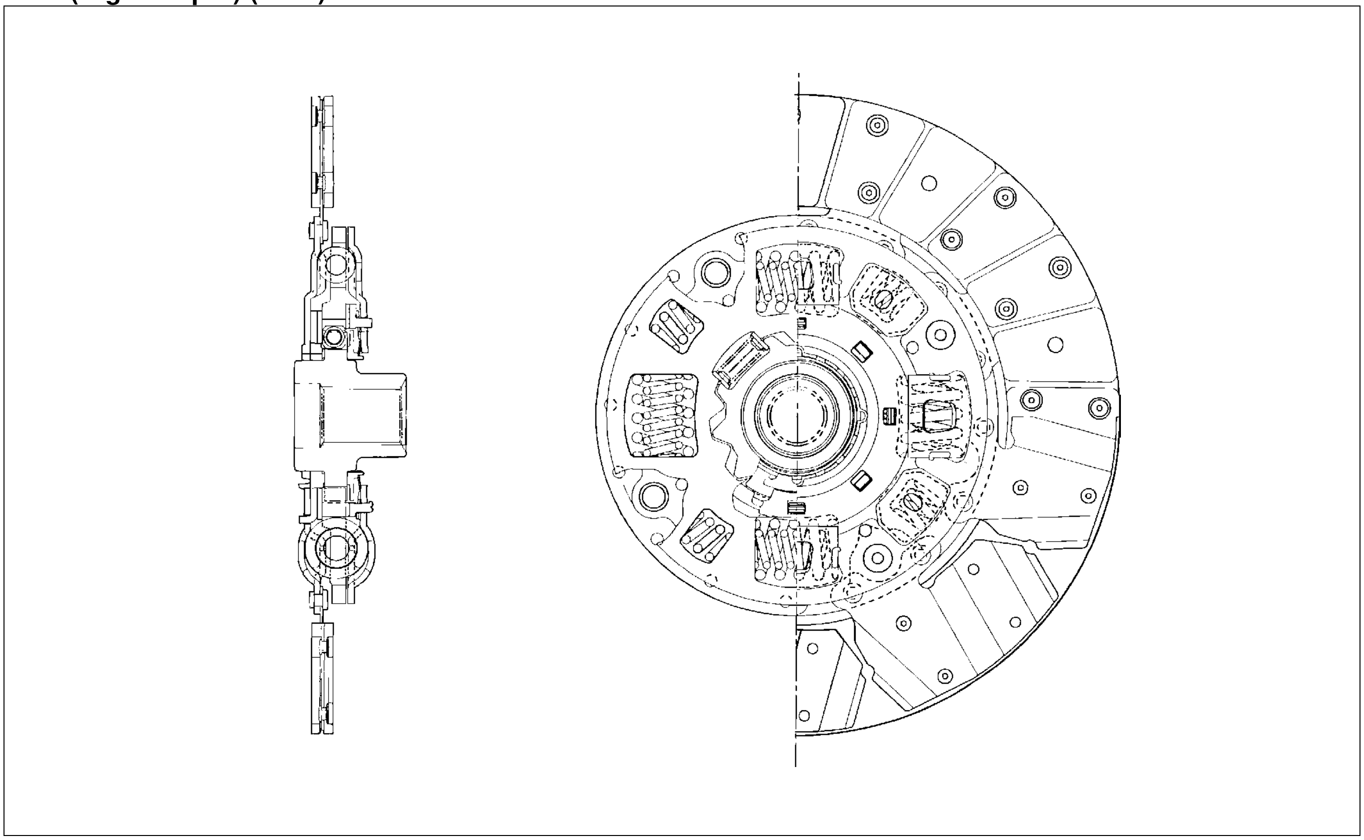


RTW37CMF000101

The pressure plate assembly consists of the clutch cover, the pressure plate with diaphragm spring.
Operating the clutch pedal causes the pressure plate to move in an axial direction to engage and disengage the clutch.

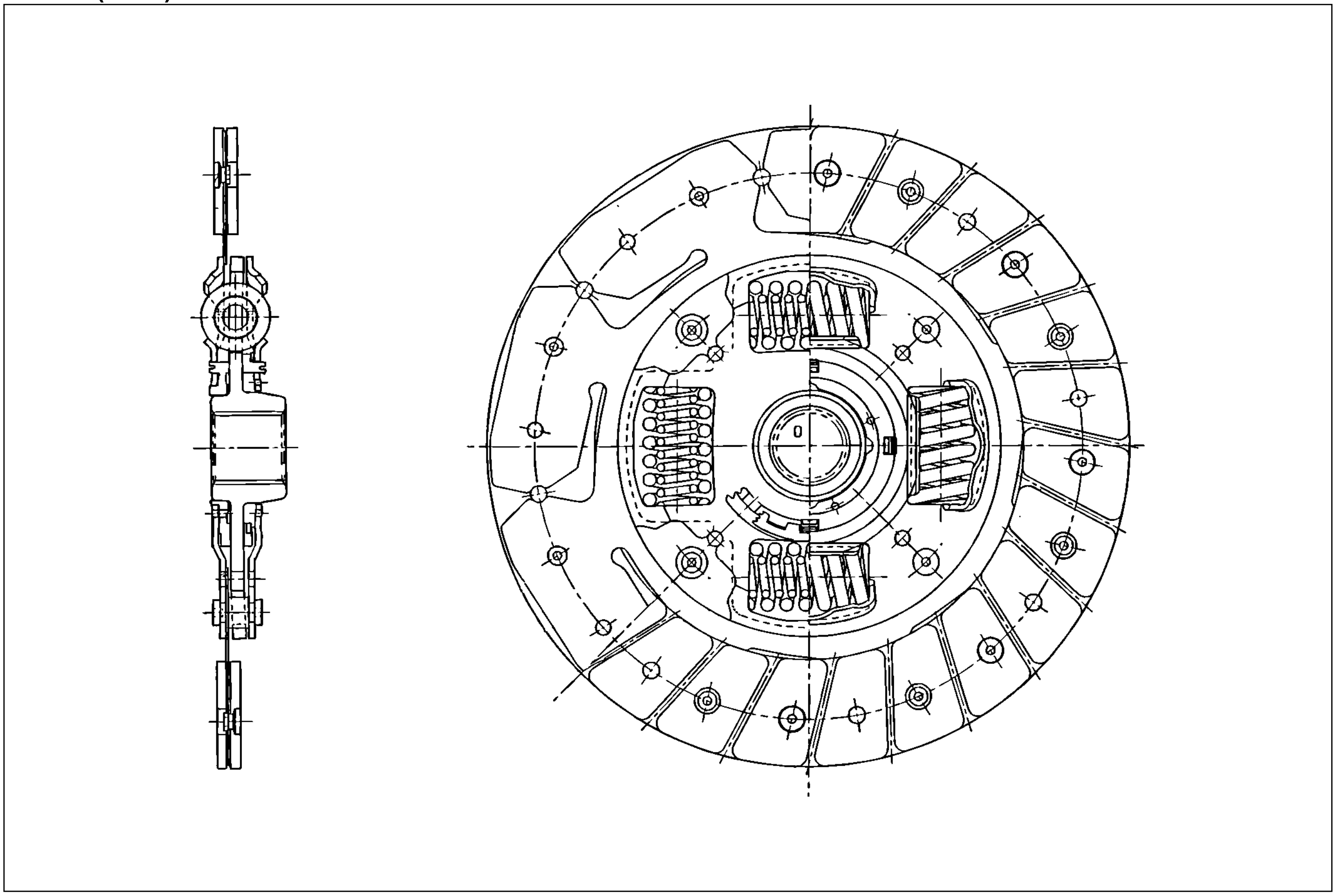
DRIVEN PLATE ASSEMBLY

4JJ1 (High Output) (MUX)



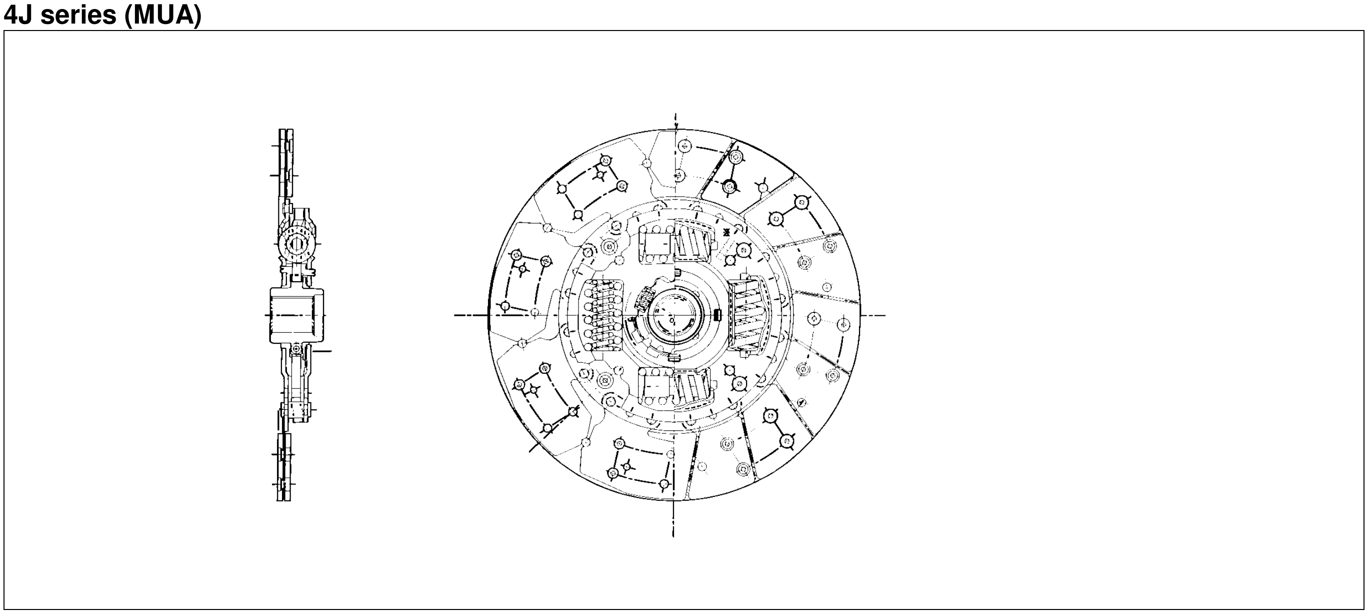
RTW77CMF000501

4JA1-T (MSG)

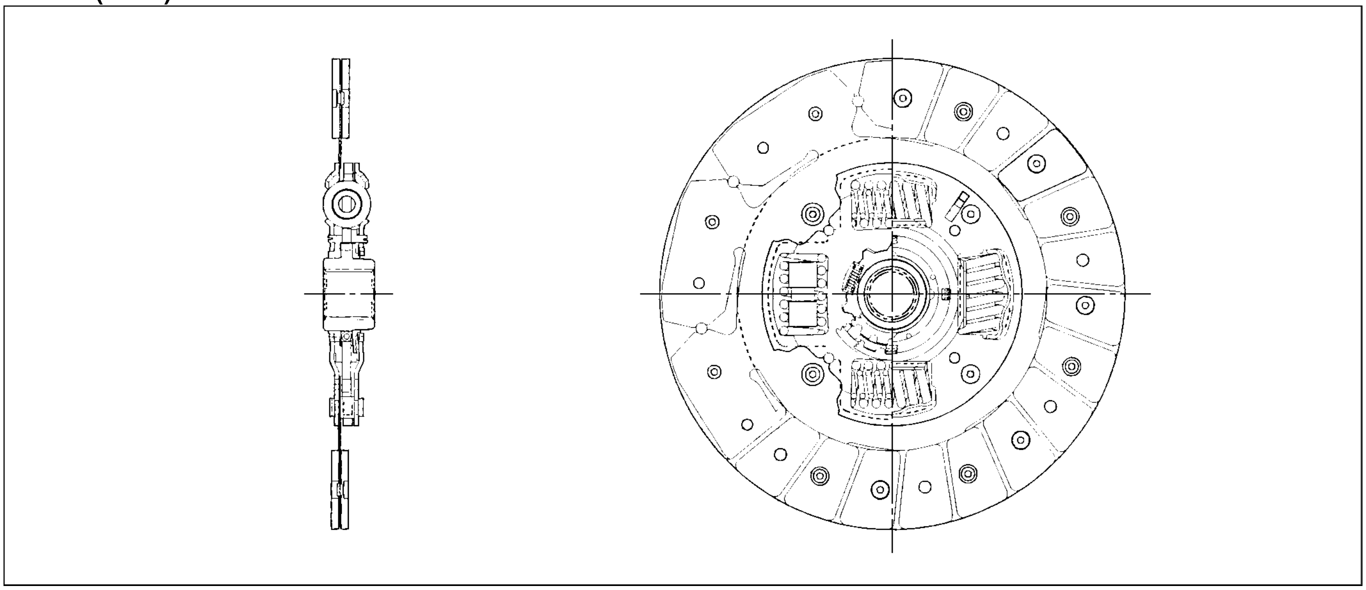


RTW47CMF000401

4J series (MUA)



C24SE (MUA)



RTW37CSF0003

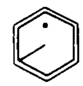
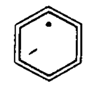
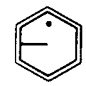
The driven plate assembly consists of the plate and the facing.
The plate consists of the clutch center, the cushioning plate and the torsion springs.
The facing is riveted to both sides of the cushioning plate.
The cushioning plate provides a longer service life by minimizing wear and vibration at the clutch contact surfaces.

TORQUE SPECIFICATION

STANDARD BOLTS

The torque values given in the following table should be applied where a particular torque is not specified.

N·m (kgf·m/lb·ft)

Strength Class		4.8/4T	7T	8.8		9.8/9T
				Refined	Non-Refined	
Bolt Identification		4	7	8	.8	9
Bolt Diameter× Pitch (mm)		 No mark	-			
Standard Hex. Head Bolt	M6 × 1.0	6 (0.6 / 52 lb.in)	7 (0.7 / 61 lb.in)	8 (0.8 / 69 lb.in)		-
	M8 × 1.25	13 (1.3 / 113 lb.in)	17 (1.7 / 12)	20 (2.0 / 14)		24 (2.4 / 17)
	M10 × 1.25	27 (2.8 / 20)	37 (3.8 / 27)	42 (4.3 / 31)		50 (5.1 / 37)
	M12 × 1.25	61 (6.3 / 45)	76 (7.8 / 56)	87 (8.9 / 64)		95 (9.7 / 70)
	M14 ×1.5	96 (9.8 / 71)	116 (11.8 / 85)	133 (13.6 / 98)		142 (14.5 / 105)
	M16 × 1.5	130 (13.3 / 96)	170 (17.3 / 125)	193 (19.7 / 143)		200 (20.4 / 148)
	M18 × 1.5	188 (19.2 / 139)	244 (24.9 / 180)	278 (28.3 / 205)		287 (29.3 / 212)
	M20 × 1.5	258 (26.3 / 190)	337 (34.4 / 249)	385 (39.3 / 284)		396 (40.4 / 292)
	M22 × 1.5	332 (33.9 / 245)	453 (46.3 / 335)	517 (52.7 / 381)		530 (54.1 / 391)
	M24 × 2.0	449 (45.8 / 331)	570 (58.2 / 421)	651 (66.3 / 480)		692 (70.6 / 511)
	*M10 × 1.5	26 (2.7 / 20)	36 (3.7 / 27)	41 (4.2 / 30)		48 (4.9 / 35)
	*M12 × 1.75	57 (5.8 / 42)	71 (7.2 / 52)	80 (8.2 / 59)		89 (9.1 / 66)
	*M14 × 2.0	89 (9.1 / 66)	110 (11.2 / 81)	125 (12.7 / 92)		133 (13.6 / 98)
	*M16 × 2.0	124 (12.7 / 92)	162 (16.5 / 119)	185 (18.9 / 137)		191 (19.5 / 141)
Flange Bolt	M6 × 1.0	7 (0.7 / 61 lb.in)	8 (0.8 / 69 lb.in)	9 (0.9 / 78 lb.in)		-
	M8 × 1.25	15 (1.5 / 11)	19 (1.9 / 14)	22 (2.2 / 16)		26 (2.7 / 20)
	M10 × 1.25	31 (3.2 / 23)	41 (4.2 / 30)	47 (4.8 / 35)		56 (5.7 / 41)
	M12 × 1.25	69 (7.0 / 51)	85 (8.7 / 63)	97 (9.9 / 72)		106 (10.8 / 78)
	M14 × 1.5	104 (10.6 / 77)	126 (12.8 / 93)	144 (14.6 / 106)		154 (15.7 / 114)
	M16 × 1.5	145 (14.8 / 127)	188 (19.2 / 139)	214 (21.8 / 158)		221 (22.5 / 163)
	M18 × 1.5	-	-	-		-
	M20 × 1.5	-	-	-		-
	M22 × 1.5	-	-	-		-
	M24 × 2.0	-	-	-		-
	*M10 × 1.5	30 (3.1 / 22)	40 (4.1 / 30)	46 (4.7 / 34)		54 (5.5 / 40)
	*M12 × 1.75	64 (6.5 / 47)	78 (8.0 / 58)	89 (9.1 / 66)		99 (10.1 / 73)
	*M14 × 2.0	97 (9.9 / 72)	119 (12.1 / 88)	135 (13.8 / 99.7)		144 (14.7 / 107)
	*M16 × 2.0	137 (14.0 / 101)	178 (18.2 / 132)	203 (20.7 / 132)		210 (21.5 / 155)

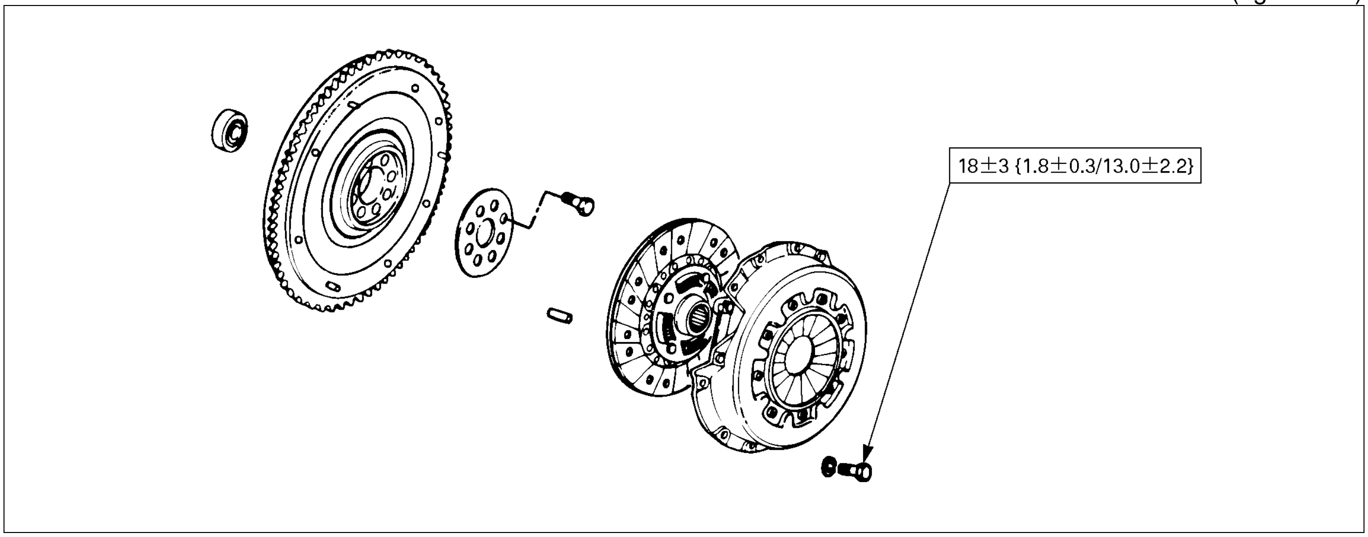
The asterisk * indicates that the bolts are used for female-threaded parts that are made of soft materials such as casting, etc.

FLARE NUTS

Pipe diameter mm (in)	Torque N·m (kgf·m / lb·ft)	Pipe diameter mm (in)	Torque N·m (kgf·m / lb·ft)
4.76 (0.187)	16 (1.6 / 12)	10.00 (0.394)	54 (5.5 / 40)
6.35 (0.250)	26 (2.7 / 20)	12.00 (0.472)	88 (9.0 / 65)
8.00 (0.315)	44 (4.5 / 33)	15.00 (0.591)	106 (10.8 / 78)

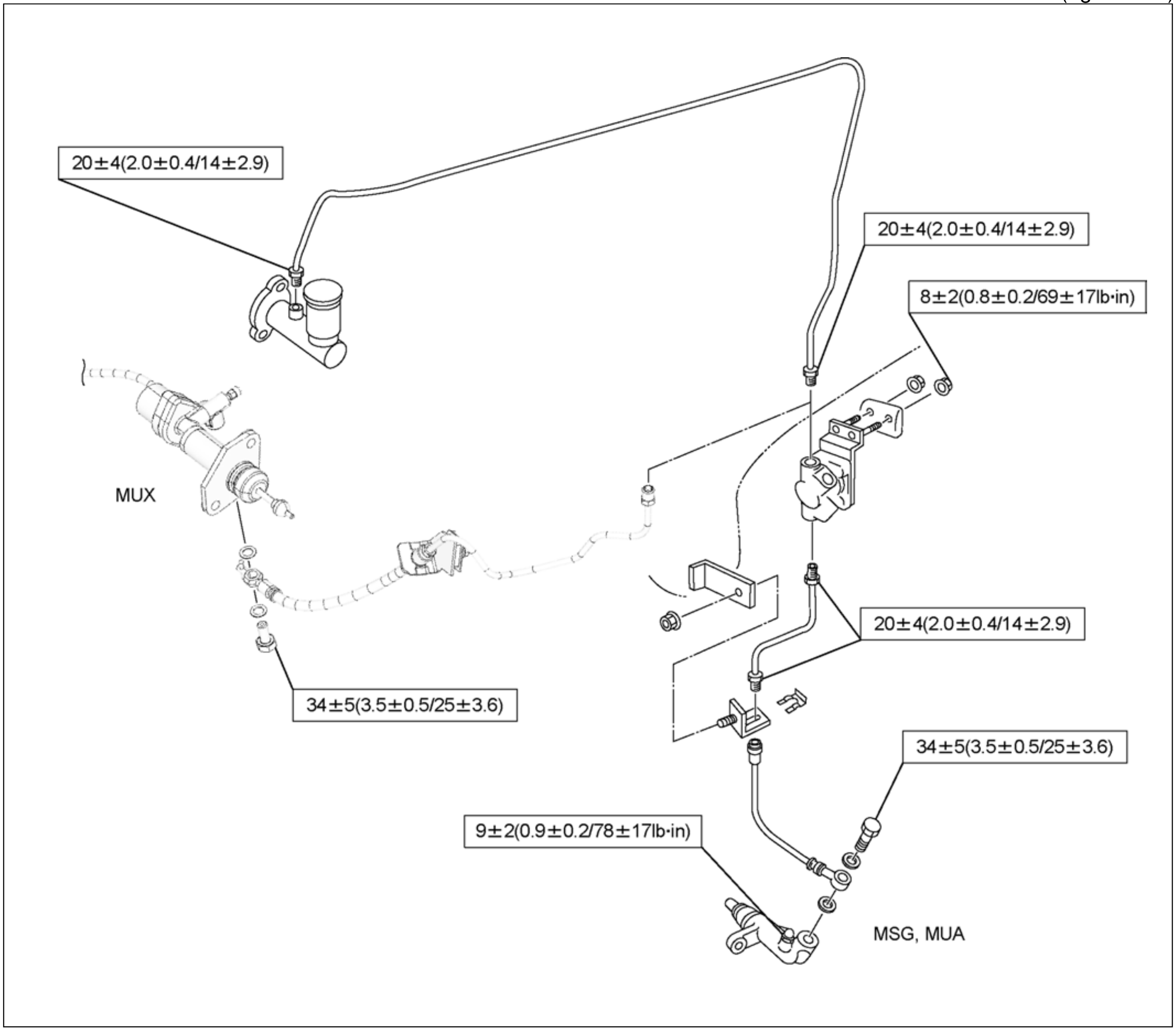
TORQUE SPECIFICATIONS

N·m (kgf·m/lb·ft)



4J series

N·m (kgf·m/lb·ft)



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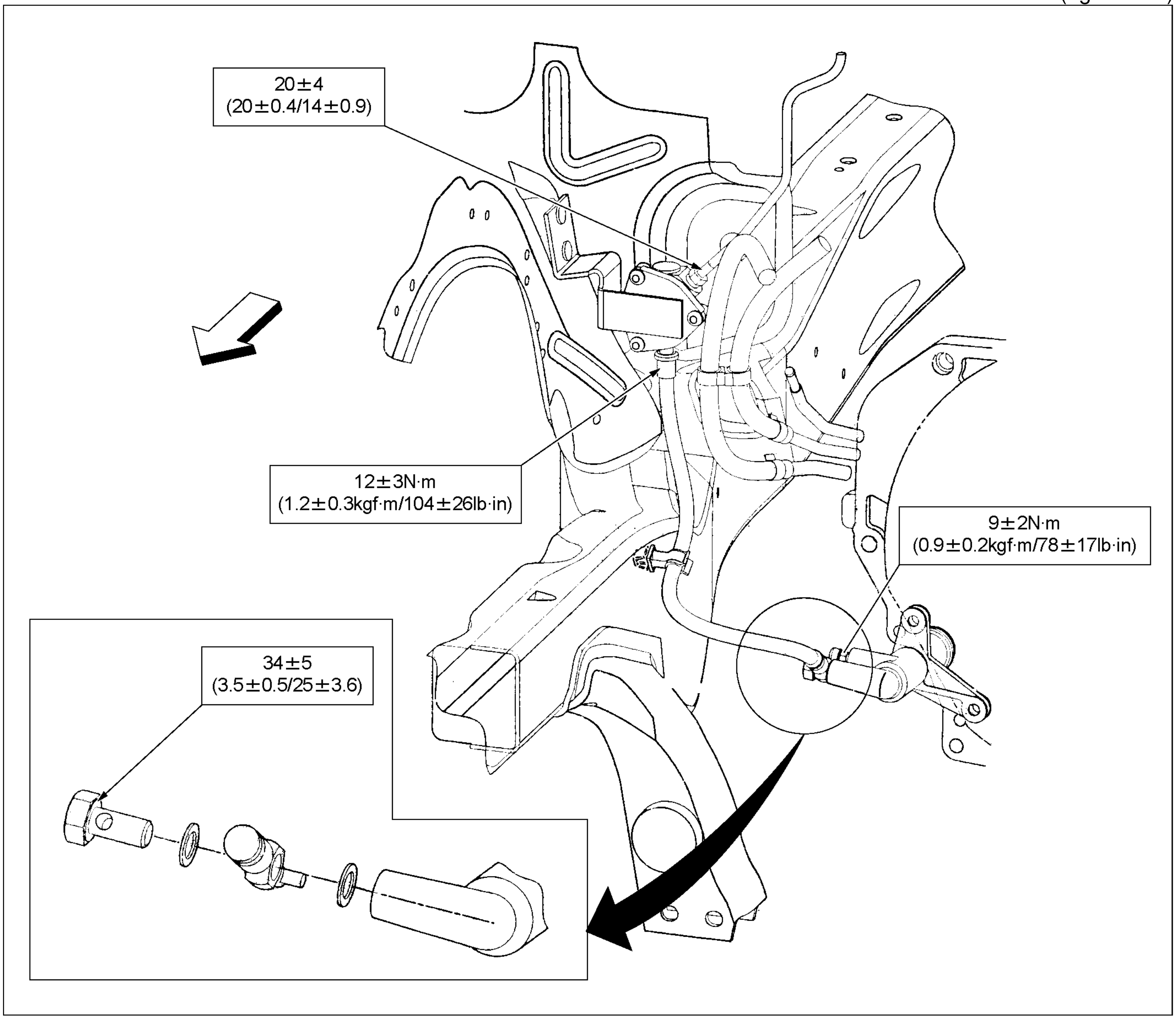
C24SE

N·m (kgf·m/lb·ft)



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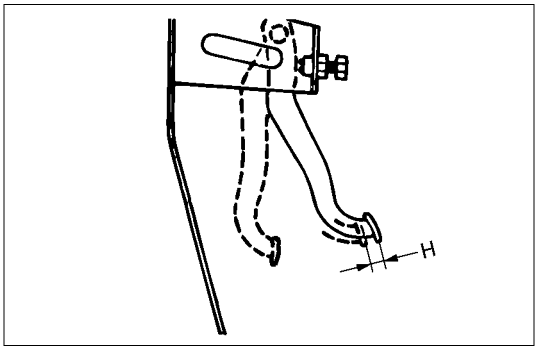
SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.



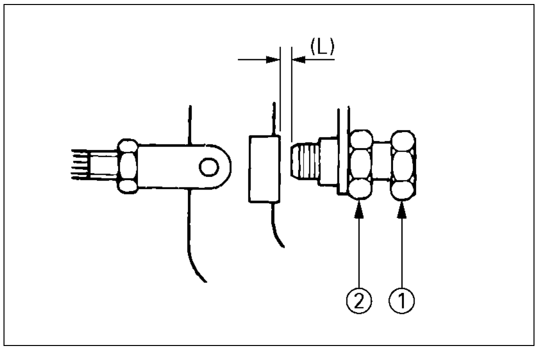
CLUTCH PEDAL PLAY

Inspection

Depress the clutch pedal lightly by hand, and measure to determine if the free play is within the standard value.

Pedal Free Play mm(in)

H	5.0-15.0 (0.2-0.6)



Adjustment of the clutch switch (or stopper bolt)

Turn the clutch switch or stopper bolt ① until the switch bolt or stopper bolt just touches the clutch pedal arm.

Adjust clutch switch or stopper bolt by backing it out half a turn, and measure the clearance (L) between the clutch pedal arm and the clutch switch bolt end or stopper bolt.

Lock the lock nut ②.

Connect clutch switch connector.

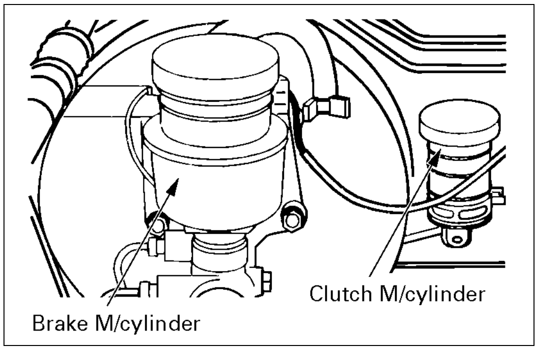
Clutch switch and clutch pedal

Clearance mm(in)

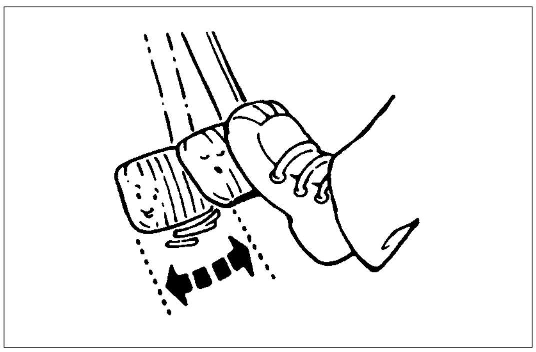
(L)	0.5-1.5 (0.020-0.059)

AIR BLEEDING

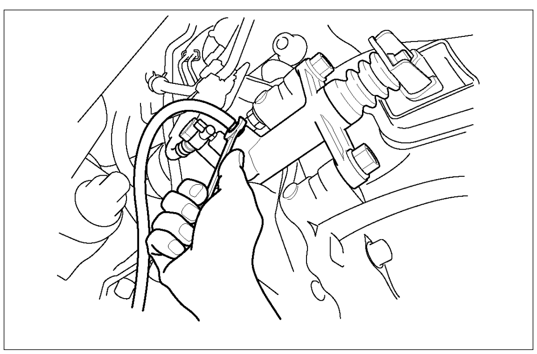
Bleed air from clutch operating cylinder according to the following procedure.
Carefully monitor fluid level at master cylinder during bleeding operation.



1. Set the parking brake.
2. Top up reservoir with recommended brake fluid.



3. Connect a transparent vinyl tube to air bleeder valve.
4. Fully depress clutch pedal several times.



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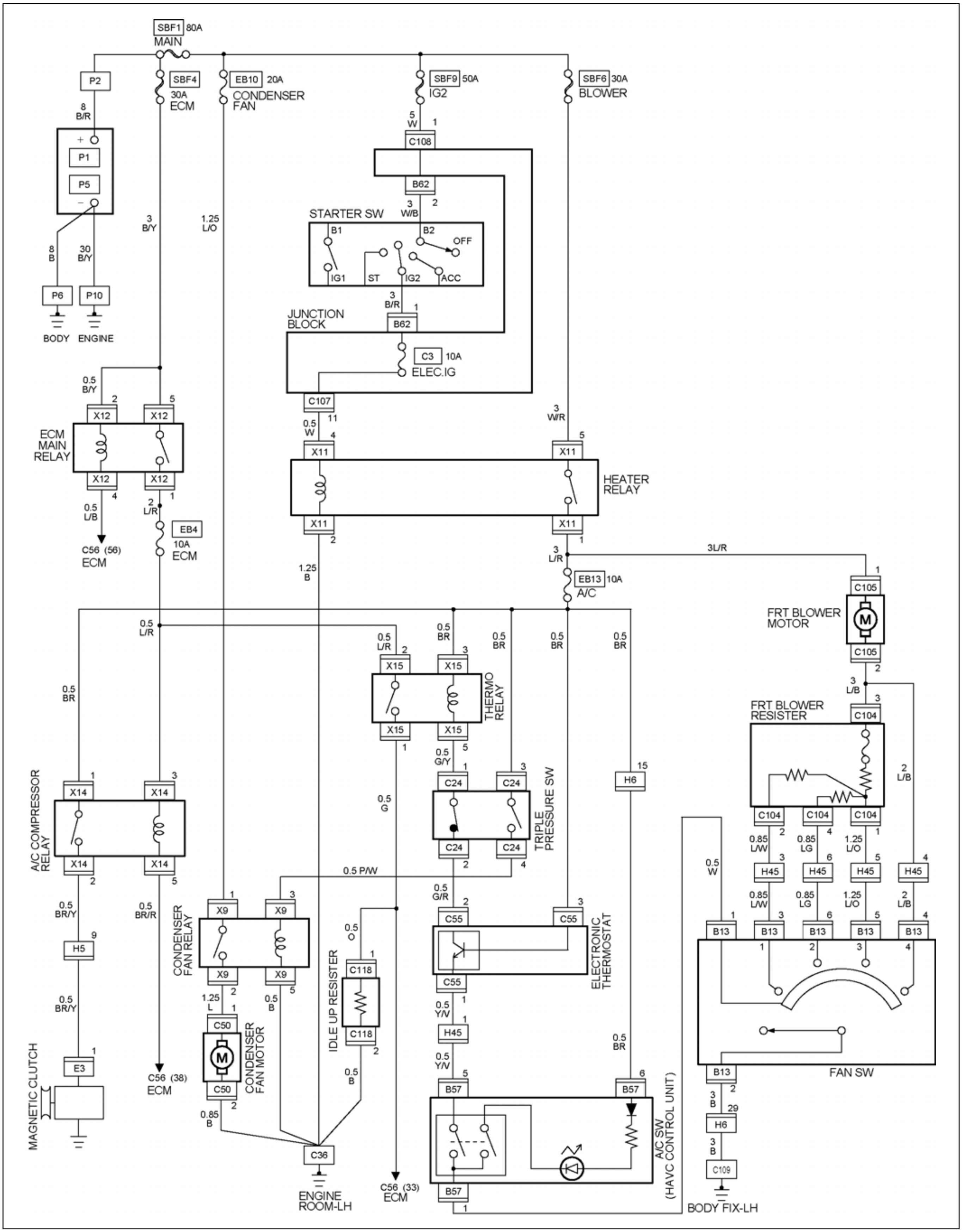
5. With clutch pedal depressed, open bleeder valve to release air.
6. Close bleeder valve.
7. Repeat steps 5 through 6 above until brake fluid flows from air bleeder valve without air bubbles.
8. Bleed air from clutch damper according to the above procedure.
9. Repeat the above bleeding procedure until the air completely removed.

(4JH1-TC)



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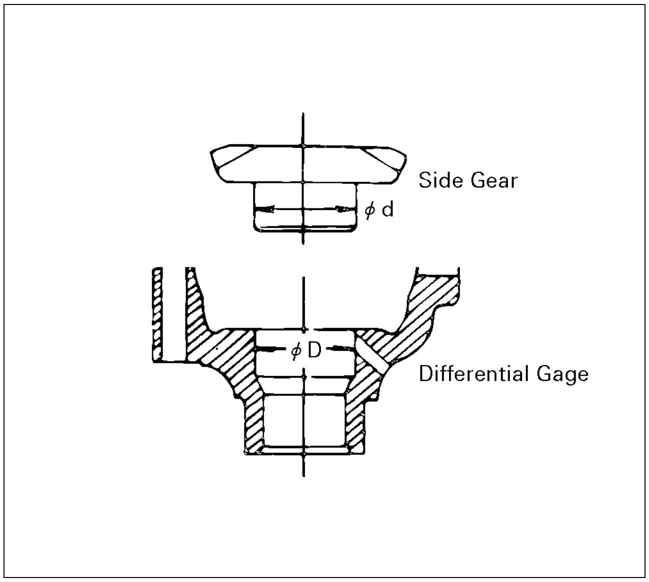
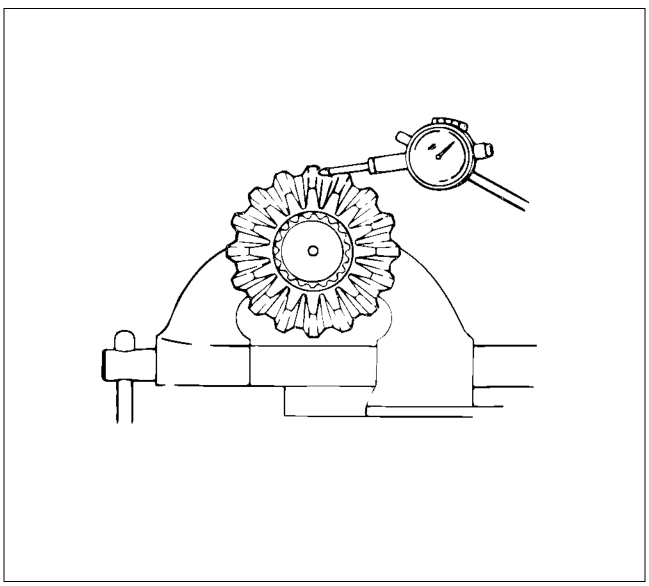


425R300010

Play in splines between the side gear and axle shafts.

mm(in)

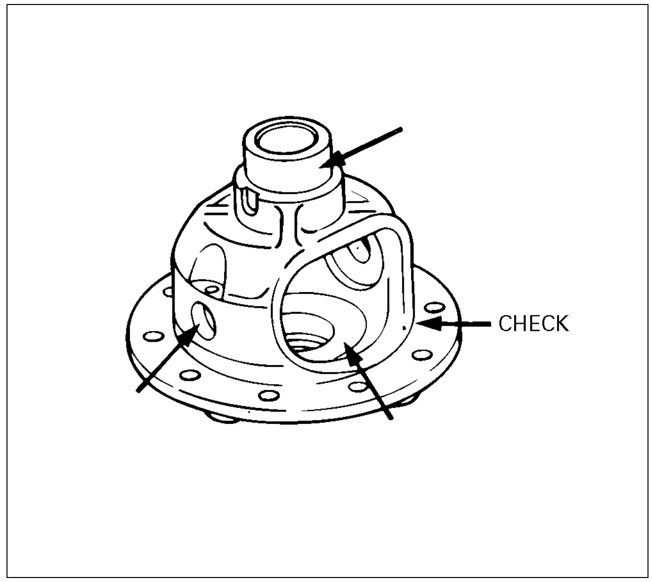
	Standard	Limit
ϕ220mm	0.08 - 0.38 (0.003 - 0.015)	0.5 (0.02)
ϕ194mm	0.08 - 0.36 (0.003 - 0.014)	0.5 (0.02)



425L100014

Differential cage

Check the ring gear the side gear fitting faces and the cross pin hole for scores or roughness. Correct as necessary. Slight scores or roughness may be corrected with an oil stone or fine sand paper.

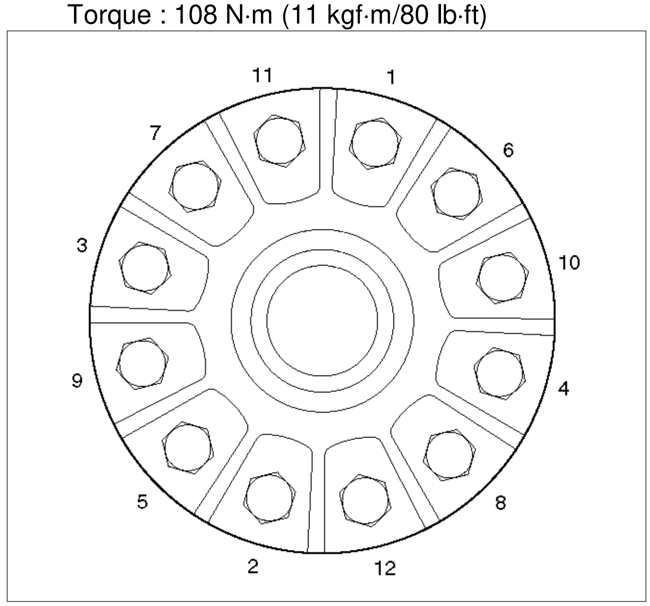


425R300006

Ring gear replacement:

1. The ring gear should always be replaced with the drive pinion as a set.
2. Discard use bolts and install new ones.
3. Apply LOCTITE 271 on bolt from the end of thread to the middle of straight portion.
4. Tighten the fixing bolts in a diagonal sequence as illustrated.

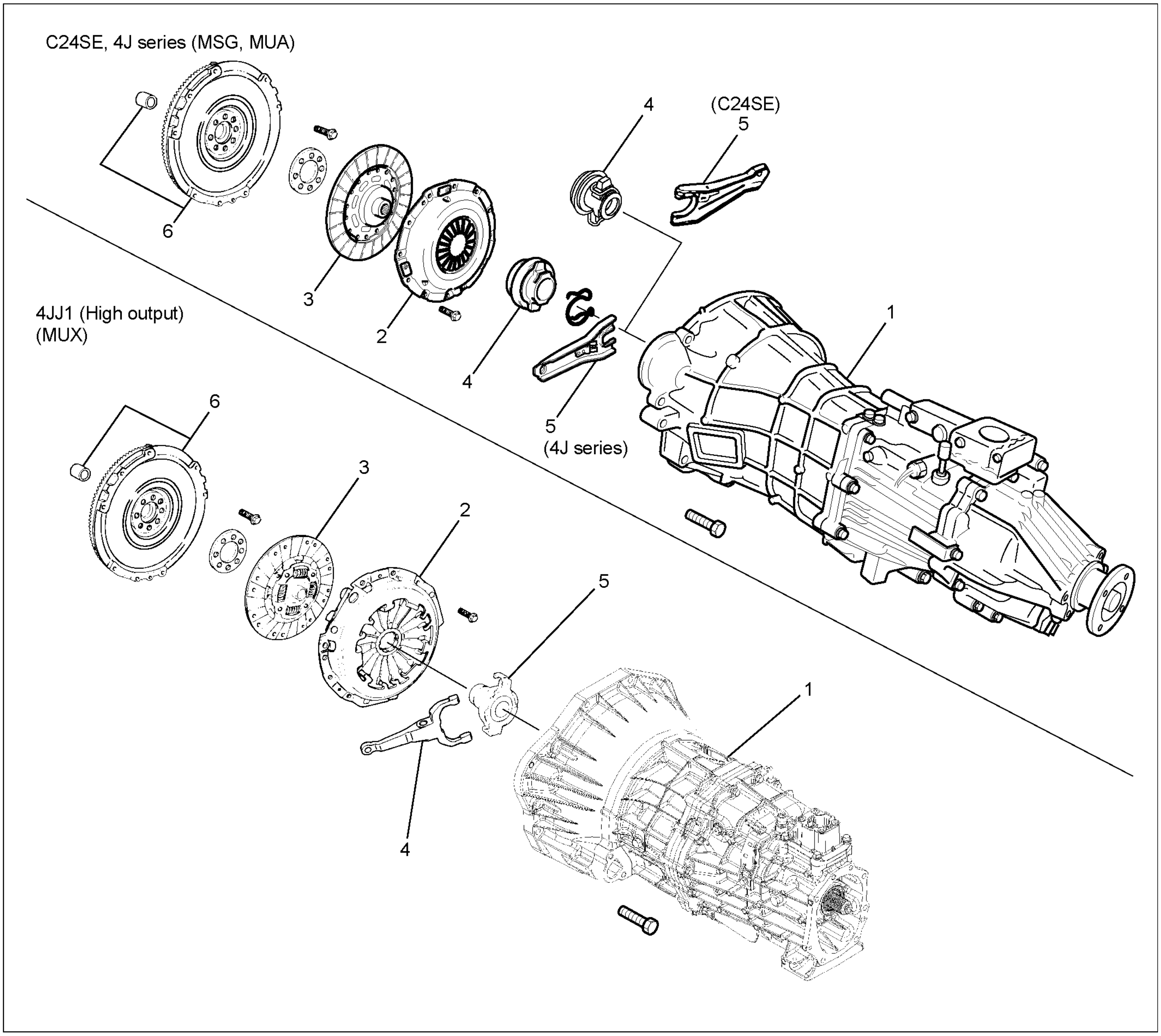
   Torque : 108 N·m (11 kgf·m/80 lb·ft)



425RW033

CLUTCH

REMOVAL AND INSTALLATION



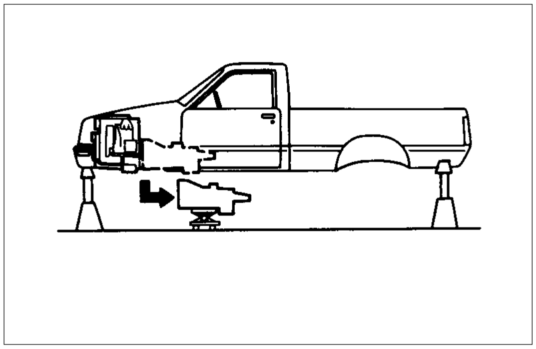
RTW77CLF000501

Removal Steps

▲ 1. Transmission assembly
▲ 2. Pressure Plate assembly
▲ 3. Driven plate assembly
4. Release bearing (MSG, MUA)
▲ 4. Shift fork (MUX)
5. Shift fork (MSG, MUA)
▲ 5. Release bearing (MUX)
6. Flywheel assembly and crank bearing

Installation Steps

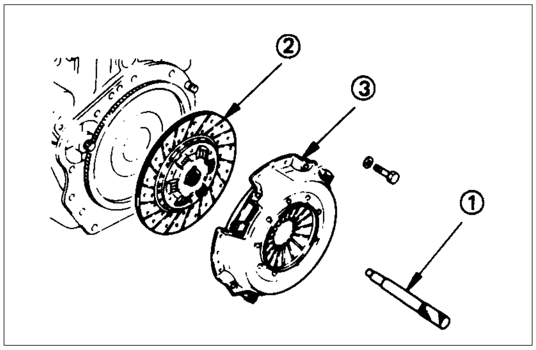
6. Flywheel assembly and crank bearing
5. Shift fork (MSG, MUA)
▲ 5. Release bearing (MUX)
4. Release bearing (MSG, MUA)
▲ 4. Shift fork (MUX)
▲ 3. Driven plate assembly
▲ 2. Pressure Plate assembly
1. Transmission assembly.



Important Operations - Removal

1. Transmission Assembly

Refer to “MANUAL TRANSMISSION” of section 7B and 7B1 for “REMOVAL AND INSTALLATION” procedure.



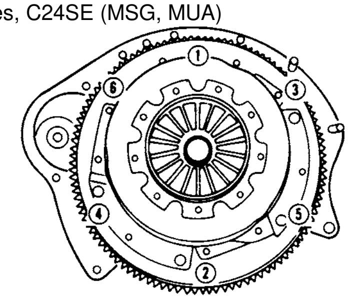
2. Pressure Plate Assembly

3. Driven Plate Assembly

(1) Use the clutch pilot aligner ① to prevent the driven plate assembly ② from falling free.

Clutch Pilot Aligner : 5-8525-3001-0(J-24547)

4J series, C24SE (MSG, MUA)

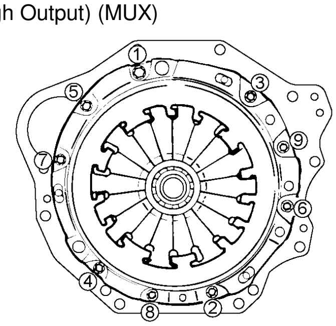


(2) Loosen the clutch cover bolts in the numerical order shown in the illustration.

(3) Remove the pressure plate assembly ③ from the flywheel.

(4) Remove the driven plate from the flywheel.

4JJ1 (High Output) (MUX)



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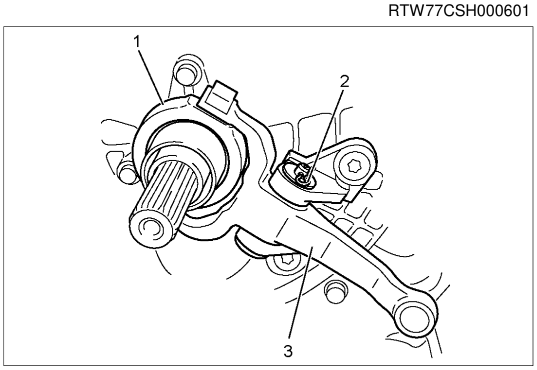

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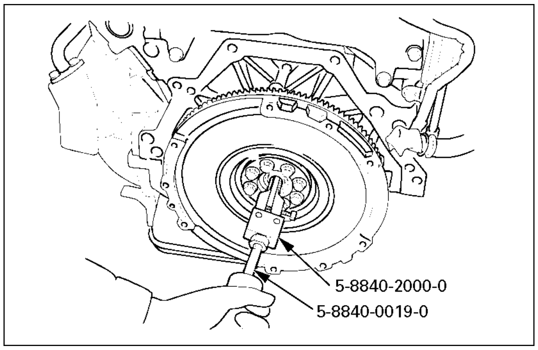
4. Shift Fork (MUX)

5. Release Bearing (MUX)

(1) Remove the shift fork snap pin (2).

(2) Remove the shift fork pin and shift fork (3) from the fulcrum bridge.

(3) Remove the release bearing (1) from the transmission case.



015RW053

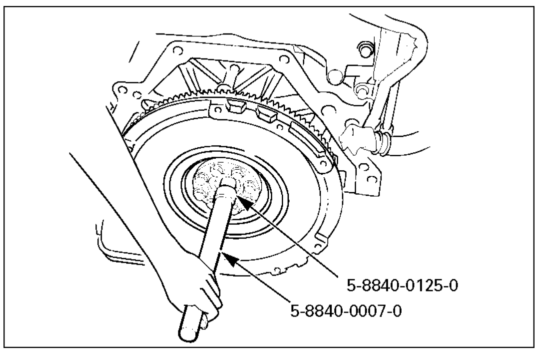
6. Flywheel Assembly and Crank Bearing (MUX)

(1) Remove flywheel assembly and crankshaft bearing. Do not remove except for replacement.

(2) Use the remover 5-8840-2000-0 (J-5822) and sliding hammer 5-8840-0019-0 (J-23907) to remove the crankshaft bearing

Important Operations - Installation

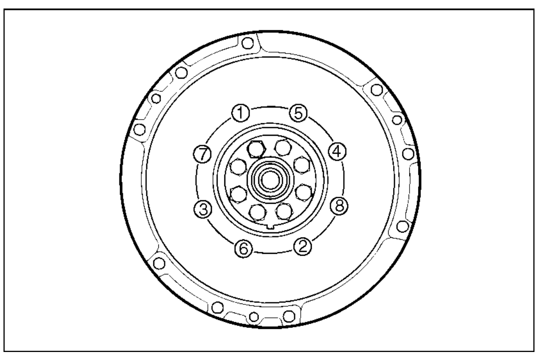
Follow the removal procedure in reverse order to perform the installation procedure.
Pay careful attention to the important points during the installation procedure.



015RW054

6. Flywheel Assembly and Crank Bearing (MUX)

(1) Install flywheel assembly and crankshaft bearing. Use the installer 5-8840-0125-0 (J-26516-A) and driver handle 5-8840-0007-0 (J-8092) to install the crankshaft bearing then clean and lubricate with grease.



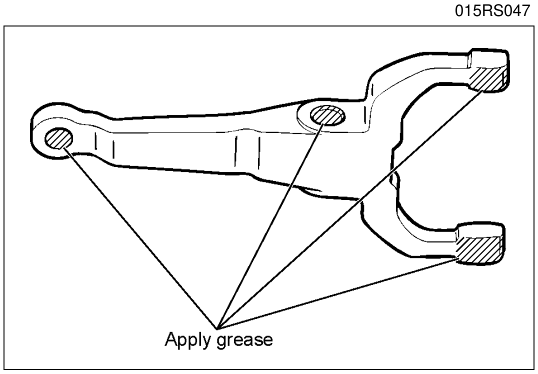
015RS047

(2) Install new flywheel fixing bolts in the order illustrated and tighten them to the specified torque.

N·m (kg·m/lb·ft)

MUX	54 (5.5/40)

NOTE: Do not reuse the bolt and do not apply oil or thread lock to the bolt.



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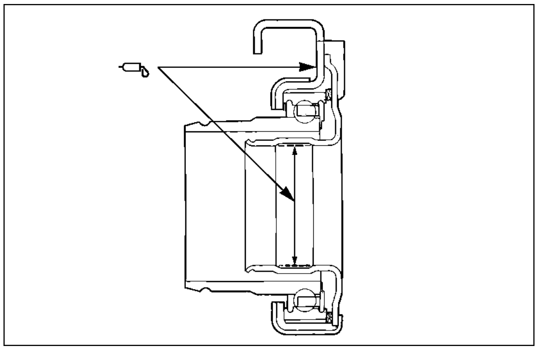
5. Release Bearing (MUX)

4. Shift Fork (MUX)

(1) Apply molybdenum disulfide type grease to the pin hole inner circumferences and thrust surfaces.



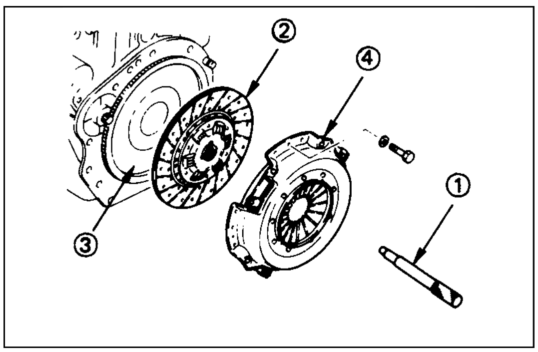
201RW012

(2) Apply molybdenum disulfide type grease to the areas shown in illustration.

(3) Install the release bearing to the transmission front cover.

(4) Install the shift fork to the fulcrum bridge and insert the pin from bottom of the fulcrum bridge.

(5) Install the washer and snap pin.



3. Driven plate Assembly

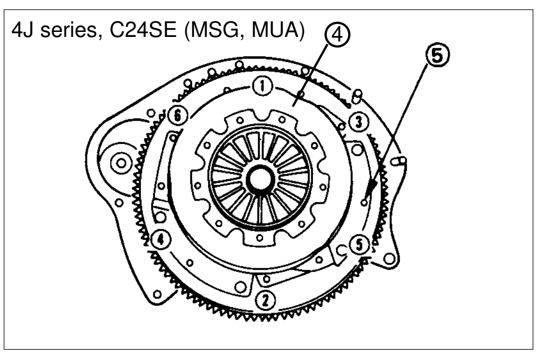
2. Pressure Plate Assembly

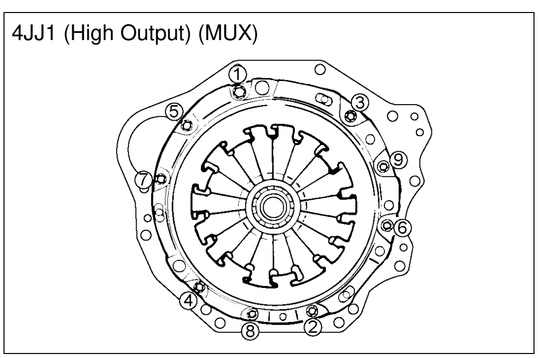
(1) Clean the flywheel surface.

(2) Clean the facing surface.

(3) Use the clutch pilot aligner ① to install the driven plate assembly ② to the flywheel ③.

Clutch Pilot Aligner : 5-8525-3001-0(J-24547)





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(4) Clean the pressure plate surfaces.

(5) Align the pressure plate assembly ④ with the flywheel knock pin ⑤.

(6) Install the pressure plate assembly to the flywheel.

(7) Tighten the clutch cover bolts a little at a time in the numerical order shown in the illustration.

Clutch Cover Bolt Torque	N·m (kgf·m/lb·ft)
18 ± 3 (1.8 ± 0.3 / 13.0 ± 2.2)	

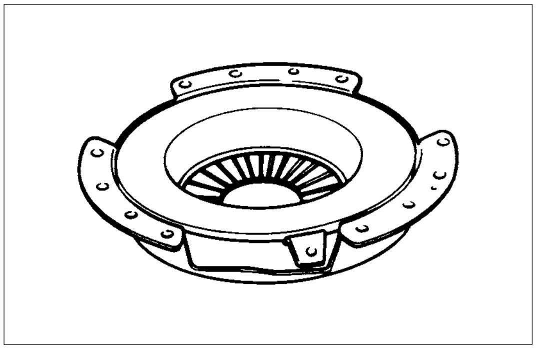
(8) Remove the clutch pilot aligner.

Note:

Do not strike the clutch pilot aligner with a hammer to remove it.

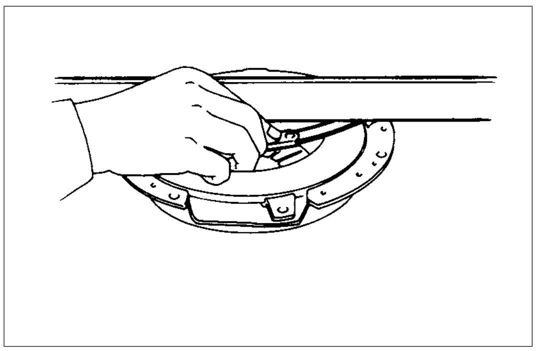
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



PRESSURE PLATE ASSEMBLY

Visually inspect the pressure plate friction surface for excessive wear and heat cracks.
If excessive wear or deep heat cracks are present, the pressure plate must be replaced.

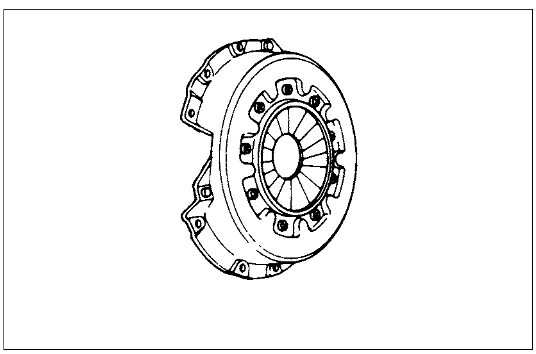


Pressure Plate Warpage

Use a straight edge and a feeler gauge to measure the pressure plate friction surface flatness in four directions.
If any of the measured values exceed the specified limit, the pressure plate must be replaced.

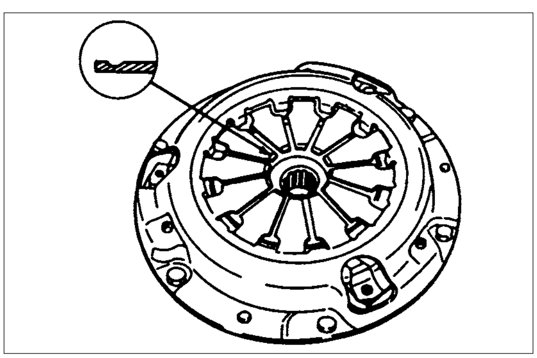
Pressure Plate Warpage mm(in)

Limit
0.3 (0.012)



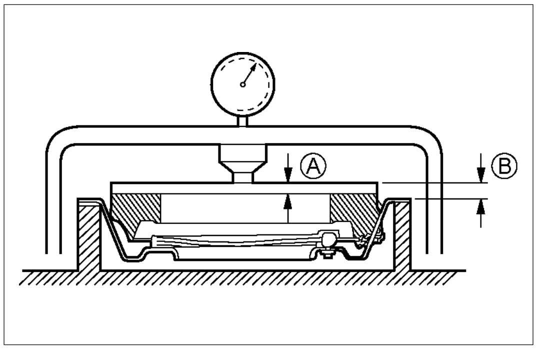
Clutch Cover

Visually inspect the entire clutch cover for excessive wear, cracking , and other damage.
The clutch cover must be replaced if any of these conditions are present.



1. Abrasion, scratches, cracks and deflection of friction face to the disc, loose rivet and wear of ring

- Grind small scratches, or replace the assembly if extreme scratches are found.



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Clutch Set Force

1. Invert the pressure plate assembly.
2. Place a metal sheet “A” on the pressure plate.
3. Compress the pressure plate assembly until the distance “B” becomes specified.

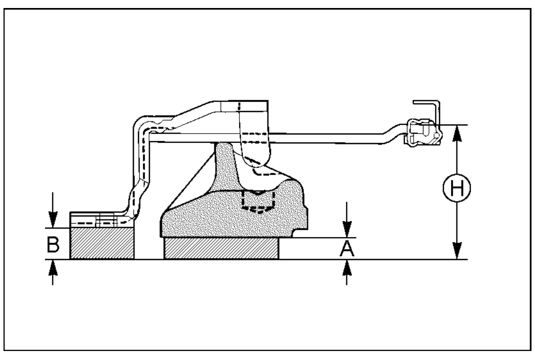
Thickness and Distance mm(in)

	A	B
4JJ1 (High Output) (MUX)	8.3 (0.327)	12 (0.472)
4JA1-T (MSG)	7.8 (0.307)	20 (0.787)
4J series (MUA)	7.8 (0.307)	18 (0.709)
C24SE (MUA)	8.0 (0.315)	7.9 (0.311)

4. Note the pressure plate gauge reading.

Driven Plate Clamping Load N (kg/lb)

	Standard
4JJ1 (High Output) (MUX)	6860 (700/1544)
4JA1-T (MSG)	5070 (517/1140)
4J series (MUA)	6300 (642/1415)
C24SE (MUA)	5500 (561/1237)



RTW37CSH000101

Diaphragm Spring Finger Height

1. Place a new driven plate or the appropriate spacer beneath the pressure plate.
2. Fully compress the pressure plate and diaphragm spring. There are two ways to do this.

- Use a bench press to press down on the assembly from the top.
- Tighten the fixing bolts.

NOTE: Preload on diaphragm spring finger must be 49 - 98 N (11 - 22 lb) in direction of release, when clutch cover assembly is bolted to the flywheel.

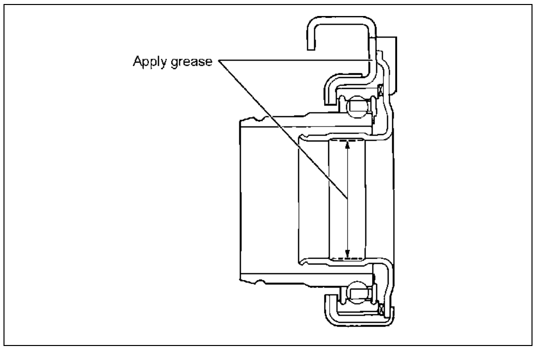
3. Measure the spring height from base to spring tip "H". If the measured value exceeds the specified limit, the pressure plate assembly must be replaced.

Spacer Thickness mm(in)

	A	B
4JJ1 (High Output) (MUX)	8.3 (0.327)	12 (0.472)
4JA1-T (MSG)	7.8 (0.307)	20 (0.787)
4J series (MUA)	7.8 (0.307)	18 (0.709)
C24SE (MUA)	8.0 (0.315)	7.9 (0.311)

Finger Height: Ⓗ

4JJ1 (High Output) (MUX)	49.9-51.9 (1.96-2.04)
4JA1-T (MSG)	31-33 (1.22-1.30)
4J series (MUA)	39-41 (1.54-1.61)
C24SE (MUA)	39-41 (1.54-1.61)



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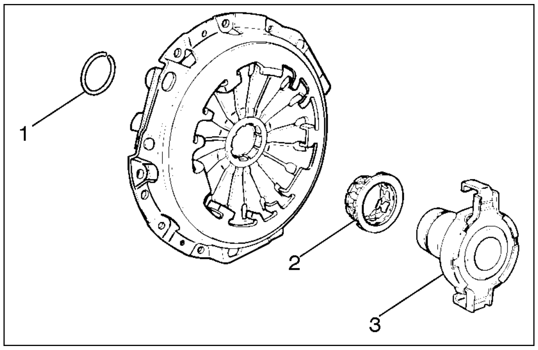
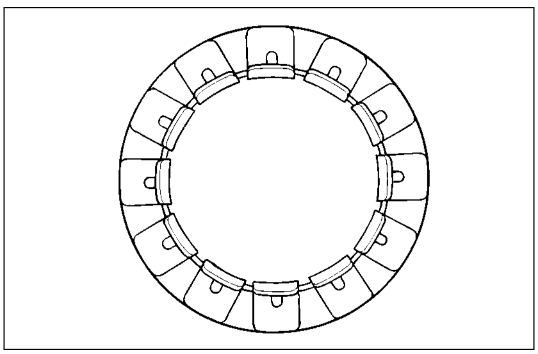
Release Bearing (MUX)

1. Visually check the release bearing for excessive play, noise and breakage.
2. If any of these conditions are discovered, the release bearing must be replaced.
3. Apply molybdenum disulfide grease to the areas shown in illustration.



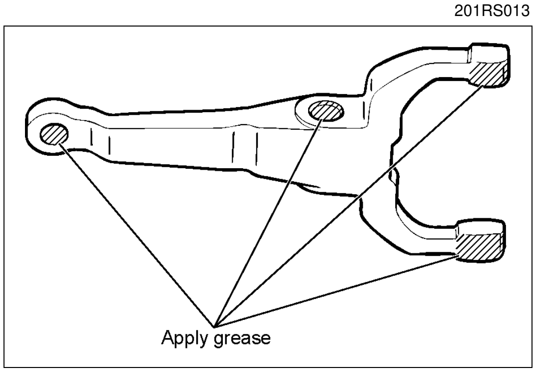
201RW010-X

4. When replacing the release bearing (3), replace both the wedge collar (2) and wire ring (1) at the same time.


201RS013

Wedge Collar

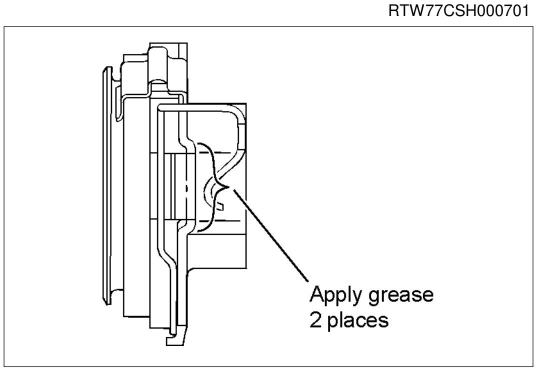
1. Visually check the surfaces of the wedge collar making contact with the release bearing for excessive wear and damage.
2. Replace any exhibiting excessive wear or damage.



RTW77CSH000701

Shift Fork

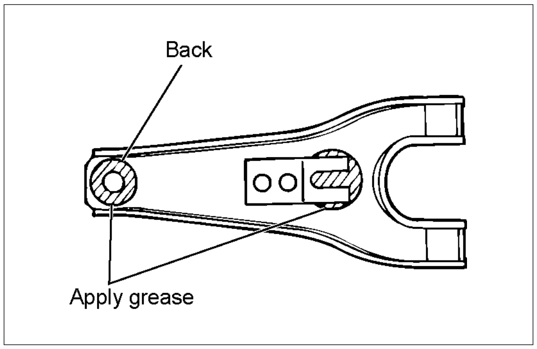
1. Visually check the surfaces of the shift fork making contact with the release bearing for excessive wear and damage.
2. Remove any minor stepping or abrasion from shift fork with an oil stone.
3. Replace any exhibiting excessive wear or damage.
4. Apply molybdenum disulfide grease to the pin hole inner circumferences and thrust surfaces.



RTW57CSH000401

Release Bearing (MSG, MUA)

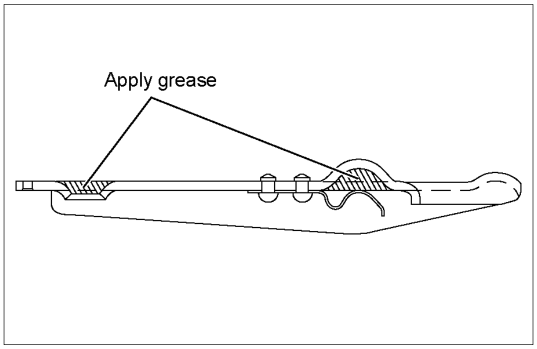
1. Visually inspect the surfaces of the release bearing making contact with the shift fork for excessive wear and damage. Replace any exhibiting excessive wear or damage.
2. Apply multi-purpose type grease (NLGI No.2 or No.3) to contact surface between the release bearing and the shift fork. (Do not apply grease to the sleeve inner face.)



RTW57CSH000201

Shift Fork

1. Visually inspect the surfaces of the shift fork making contact with the release bearing for excessive wear and damage.
2. Remove any minor stepping or abrasion from the release bearing with an oil stone.
   Replace any exhibiting excessive wear or damage.
3. Apply multi-purpose type grease (NLGI No.2 or No.3) to area.



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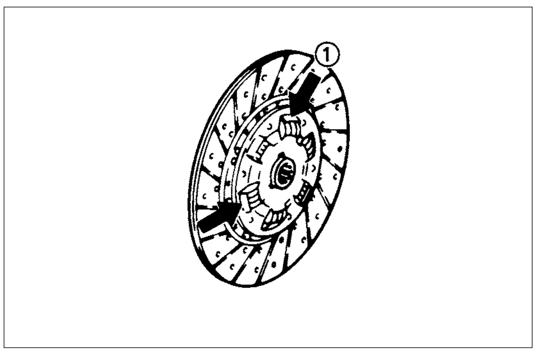
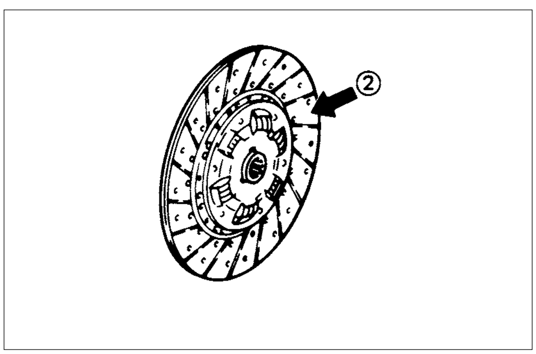
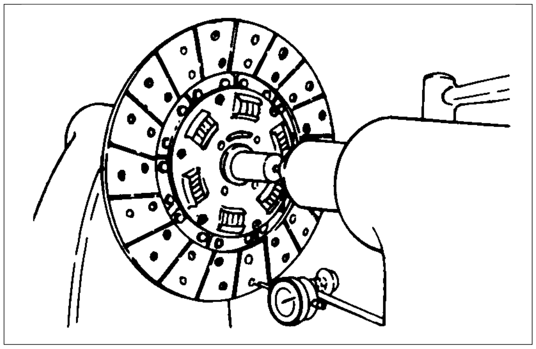


DRIVEN PLATE ASSEMBLY

1. Visually inspect the torsion spring ① for looseness, breakage, and weakening.
   If any of these conditions are discovered, the driven plate assembly must be replaced.



2. Visually inspect the facing surfaces ② for cracking and excessive scorching.
   Visually inspect the facing surfaces for the presence of oil or grease.
   If any of these conditions are discovered, the facing must be cleaned or replaced.
3. Check that the driven plate moves smoothly on the transmission top gear shaft spline.
   Minor ridges on the top gear shaft spline may be removed with an oil stone.

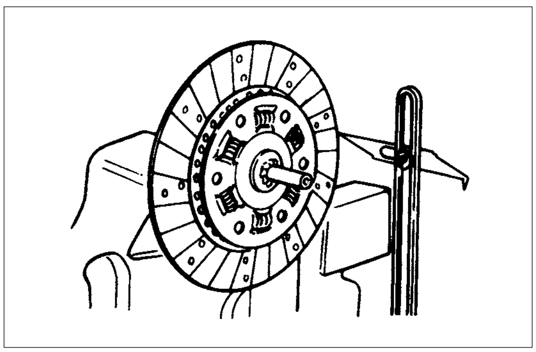


Driven Plate Warpage

1. Insert the clutch pilot aligner into the driven plate splined hub.
   The clutch pilot aligner must be held perfectly horizontal.
   Clutch Pilot Aligner : 5-8525-3001-0
2. Set a dial indicator to the driven plate outside circumference.
3. Slowly turn the driven plate.
   Read the dial indicator as you turn the driven plate.
   If the measured value exceeds the specified limit, the driven plate assembly and/or the facing must be replaced.

Driven Plate Warpage mm(in)

Standard	Limit
0.7 (0.028)	1.0 (0.039)

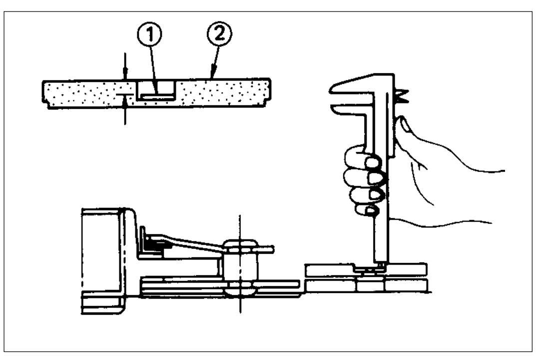


Driven Plate Splined Hub Spline Wear

1. Clean the driven plate splined hub.
2. Install the driven plate to the transmission top gear shaft spline.
3. Set a surface gauge to the driven plate outside circumference.
4. Slowly turn the driven plate counterclockwise.
   Measure the spline rotation play as you turn the driven plate.
   If the measured value exceeds the specified limit, the driven plate assembly must be replaced.

Driven Plate Splined Hub Spline Wear mm(in)

Standard	Limit
0.5 (0.020)	1.0 (0.039)



Rivet Head Depression

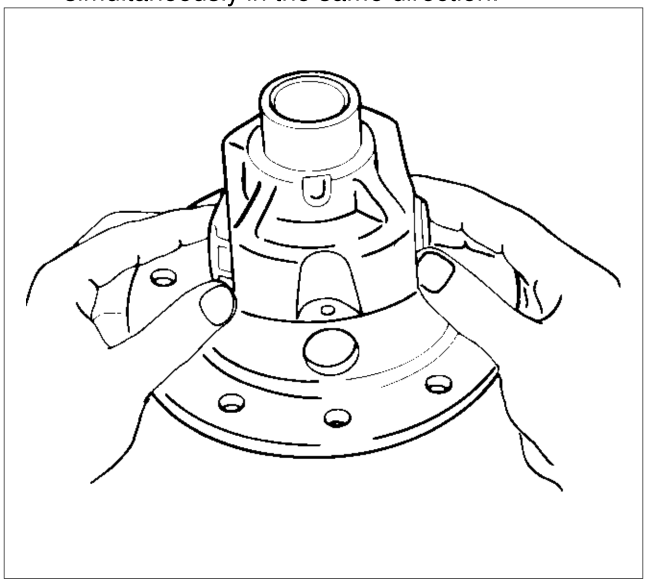
Use a depth gauge or a straight edge with steel rule to measure the rivet head depression ① from the facing surface ②.
Be sure to measure the rivet head depression on both sides of the driven plate.
If the measured value is less than the specified limit, the facing must be replaced.

Rivet Head Depression mm(in)

	Standard		Limit
	Fly wheel side	P/Plate side	
4J series	1.35-1.95 (0.053-0.077)	1.65-2.25 (0.065-0.089)	0.2 (0.008)
C24SE	1.65-2.25 (0.065-0.089)	1.65-2.25 (0.065-0.089)	0.2 (0.008)
4JJ1 (High Output)	1.40-2.00 (0.055-0.079)	1.70-2.30 (0.067-0.091)	0.2 (0.008)

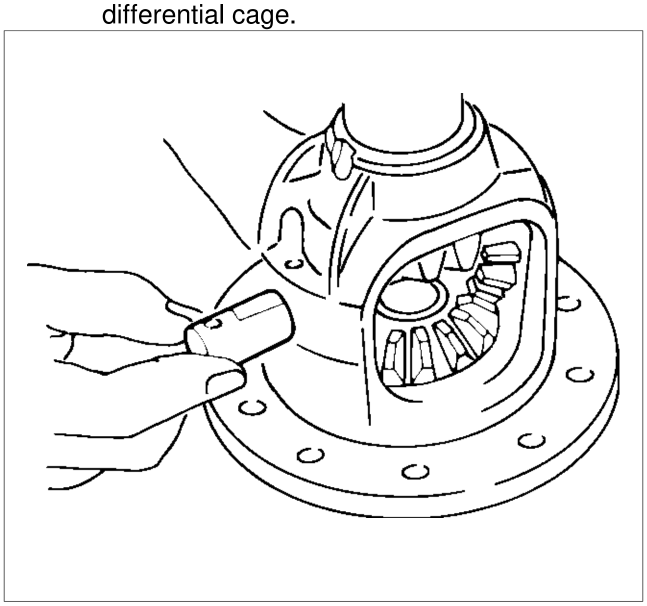
Reassembly

1. Install side gear with thrust washer in differential cage.
2. Install the pinion gear by engaging it with the side gears while turning both pinion gears simultaneously in the same direction.



425RS048

3. Install cross pin.
   - Be sure to install the cross pin so that it is in alignment with the lock pin hole in the differential cage.



425RS049

4. Check the amount of backlash.
   Backlash between the side gear and the pinion gear.

mm (in)

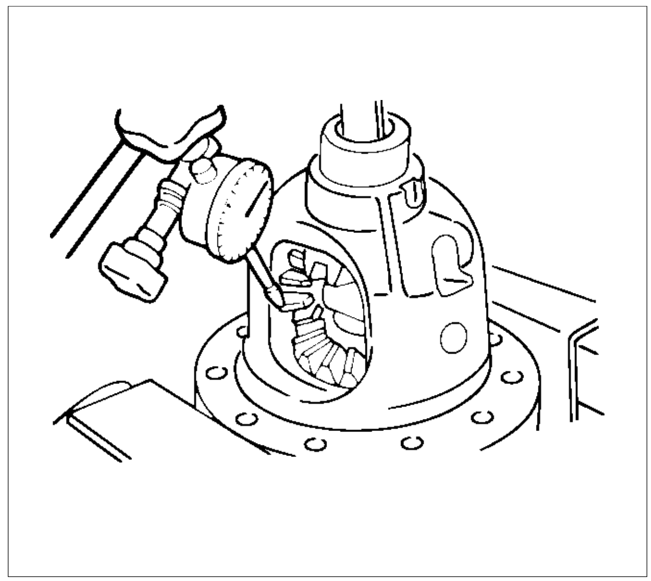
ϕ220mm	0.13-0.18 (0.005-0.007)
ϕ194mm	0.10-0.20 (0.004-0.008)

If the backlash is beyond the limits, adjust with a thrust washer of selected thickness.

Thicknesses of thrust washers available.

Backlash mm (in)

ϕ220 mm	0.80 (0.031)	0.90 (0.035)	1.00 (0.039)	1.10 (0.043)	1.20 (0.047)	1.30 (0.051)
ϕ194 mm	1.00 (0.039)	1.05 (0.041)	1.10 (0.043)			

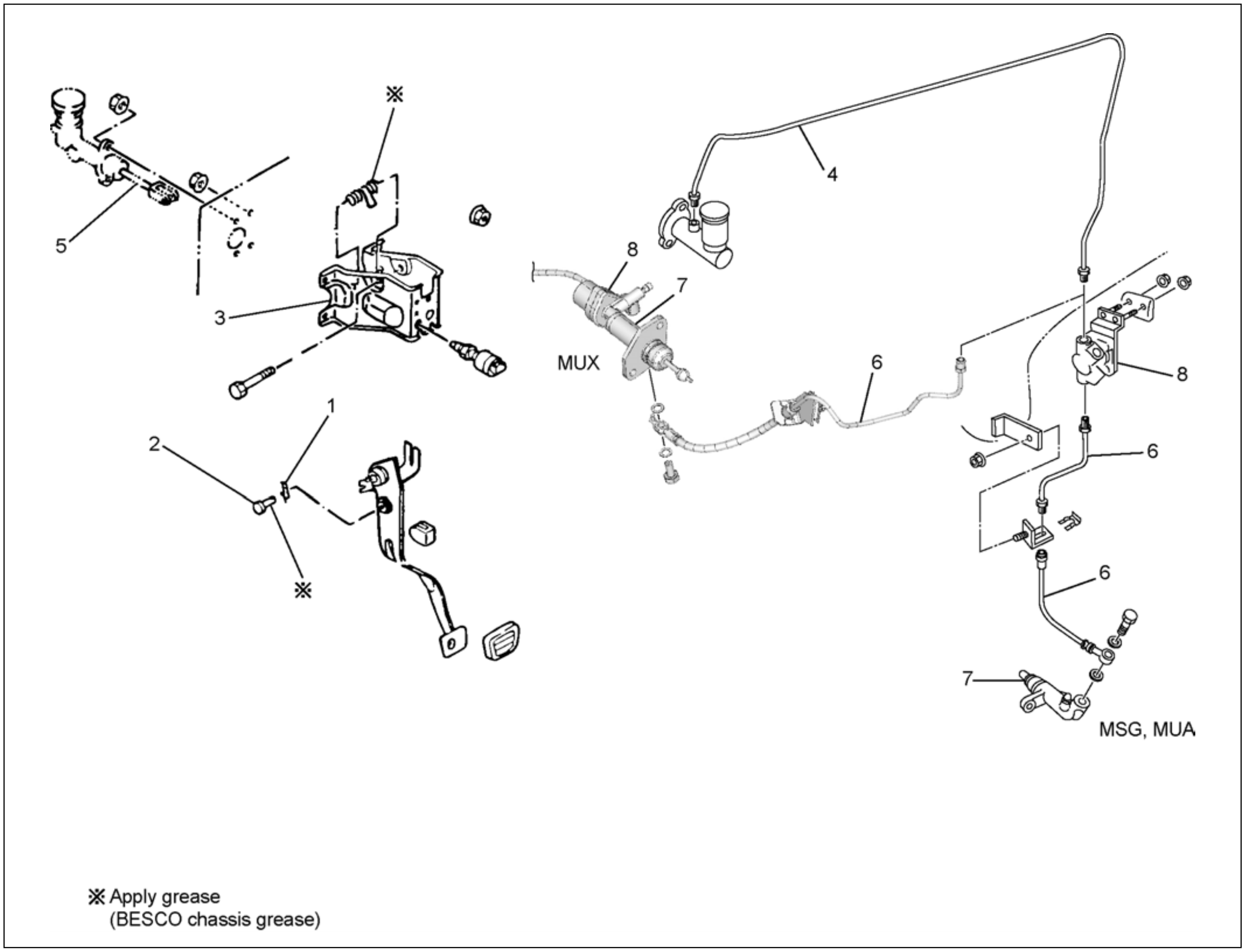


425RY00008

5. Install lock pin.
   After lock pin installation, stake the case to secure the lock pin.
6. Install ring gear.
   Refer to “Ring gear replacement” on this section.

CLUTCH CONTROL

REMOVAL AND INSTALLATION



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Removal Steps

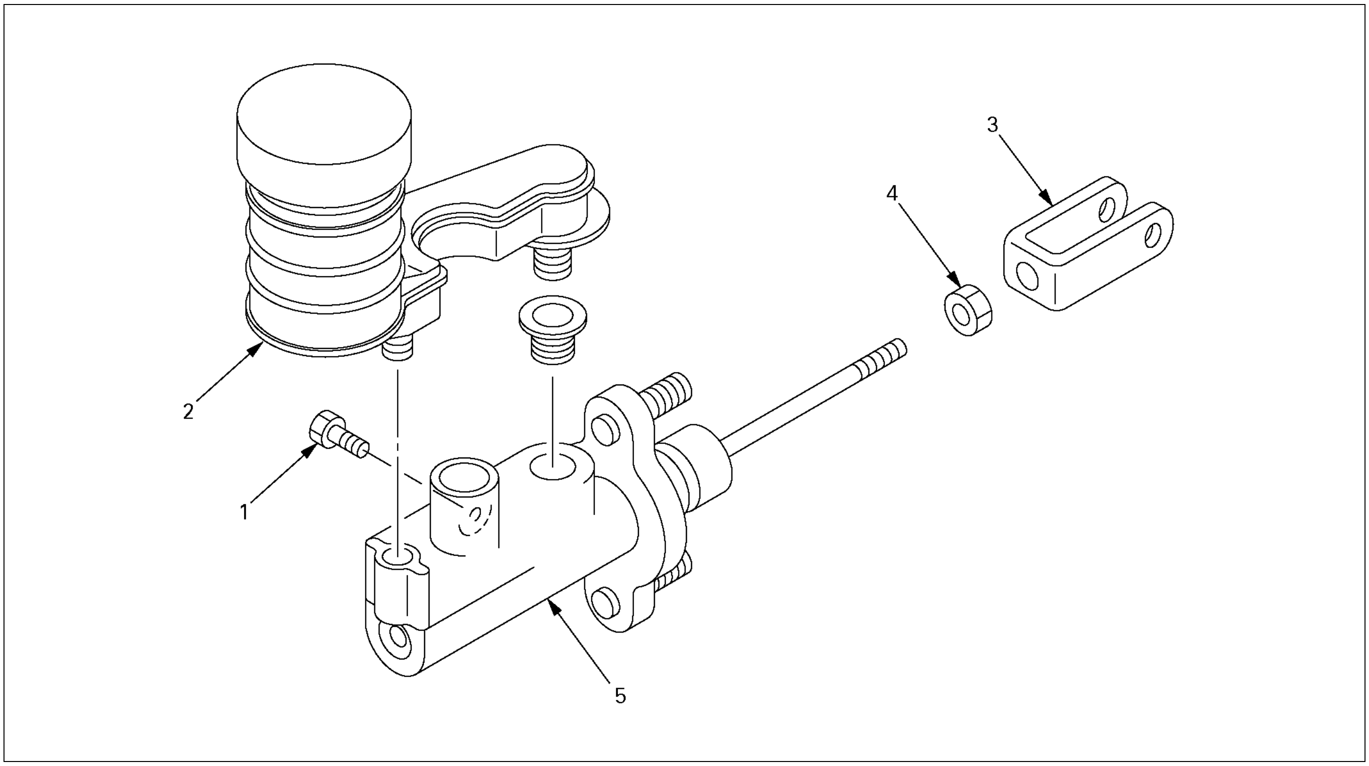
1. Pin
2. Jaw joint pin
3. Pedal assembly
4. Oil line
5. Master cylinder assembly
6. Oil line
7. Slave cylinder assembly
8. Damper cylinder assembly

Installation Steps

8. Damper cylinder assembly
7. Slave cylinder assembly
6. Oil line
5. Master cylinder assembly
4. Oil line
3. Pedal assembly
2. Jaw joint pin
1. Pin

MASTER CYLINDER

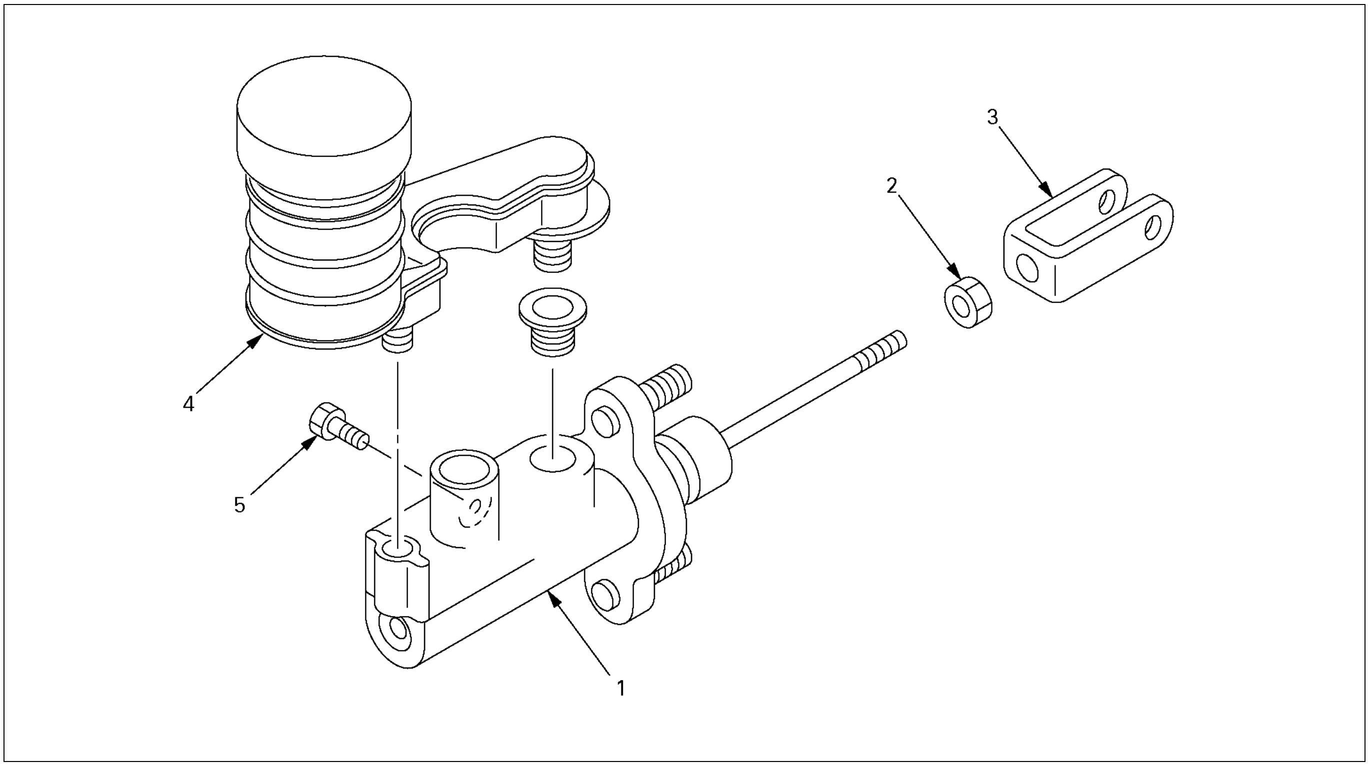
DISASSEMBLY



Disassembly Steps

1. Bolt : reservoir tank
2. Reservoir tank
3. Yoke
4. Lock nut
5. Body sub assembly

REASSEMBLY

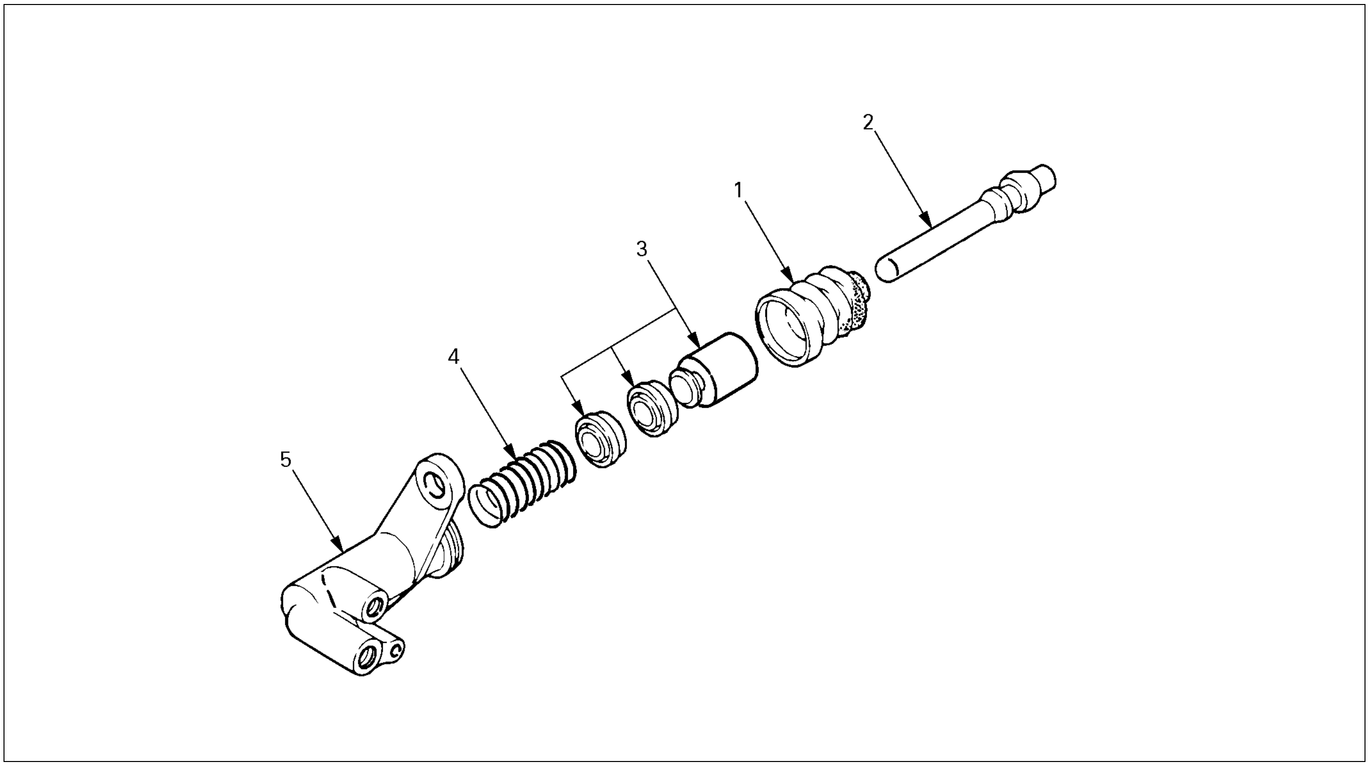


Reassembly Steps

1. Body sub assembly
2. Lock nut
3. Yoke
4. Reservoir tank
5. Bolt : Reservoir Tank

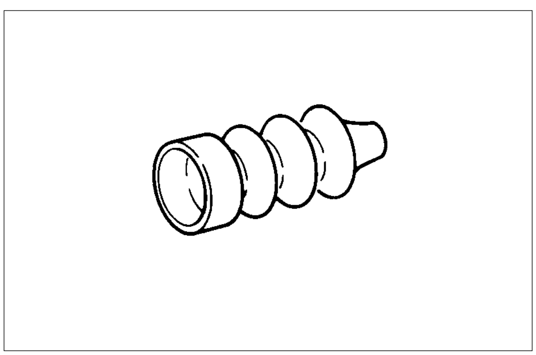
SLAVE CYLINDER (MSG, MUA)

DISASSEMBLY



Disassembly Steps

▲ 1. Boot
2. Push rod
3. Piston and piston cup
4. Spring
5. Cylinder body



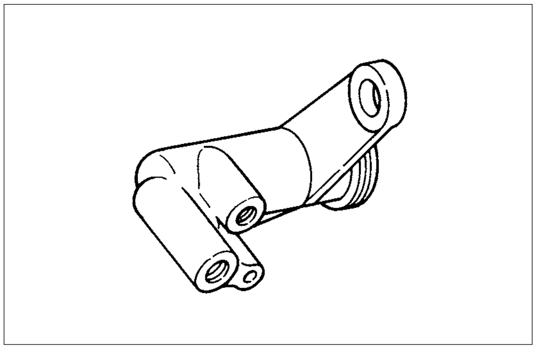
Important Operations

1. Boot

Brake fluid spilled on painted or plastic surfaces will cause serious damage.
Take care not to spill brake fluid.

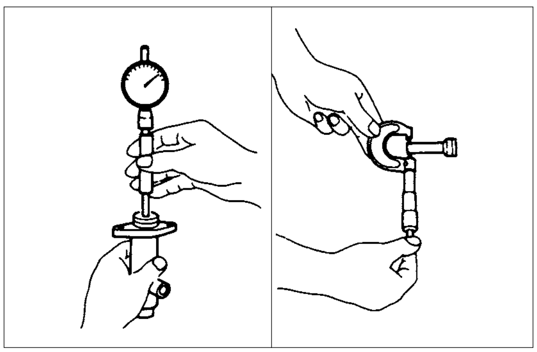
INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Cylinder Body

1. Clean the cylinder body.
2. Check the fluid return port for restrictions and clean it if necessary.

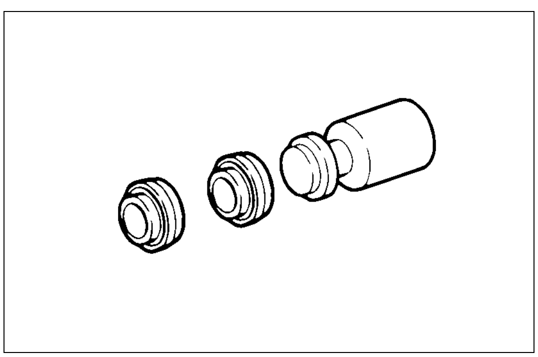


Cylinder Bore and piston Clearance

1. Clean the cylinder body and the piston.
2. Use an inside dial indicator to measure the cylinder bore.
3. Use a micrometer to measure the piston diameter.
4. Calculate the clearance between the cylinder bore and the piston diameter.
   If the clearance exceeds the limit, the entire slave cylinder assembly must be replaced.

Cylinder Bore and Piston Clearance mm(in)

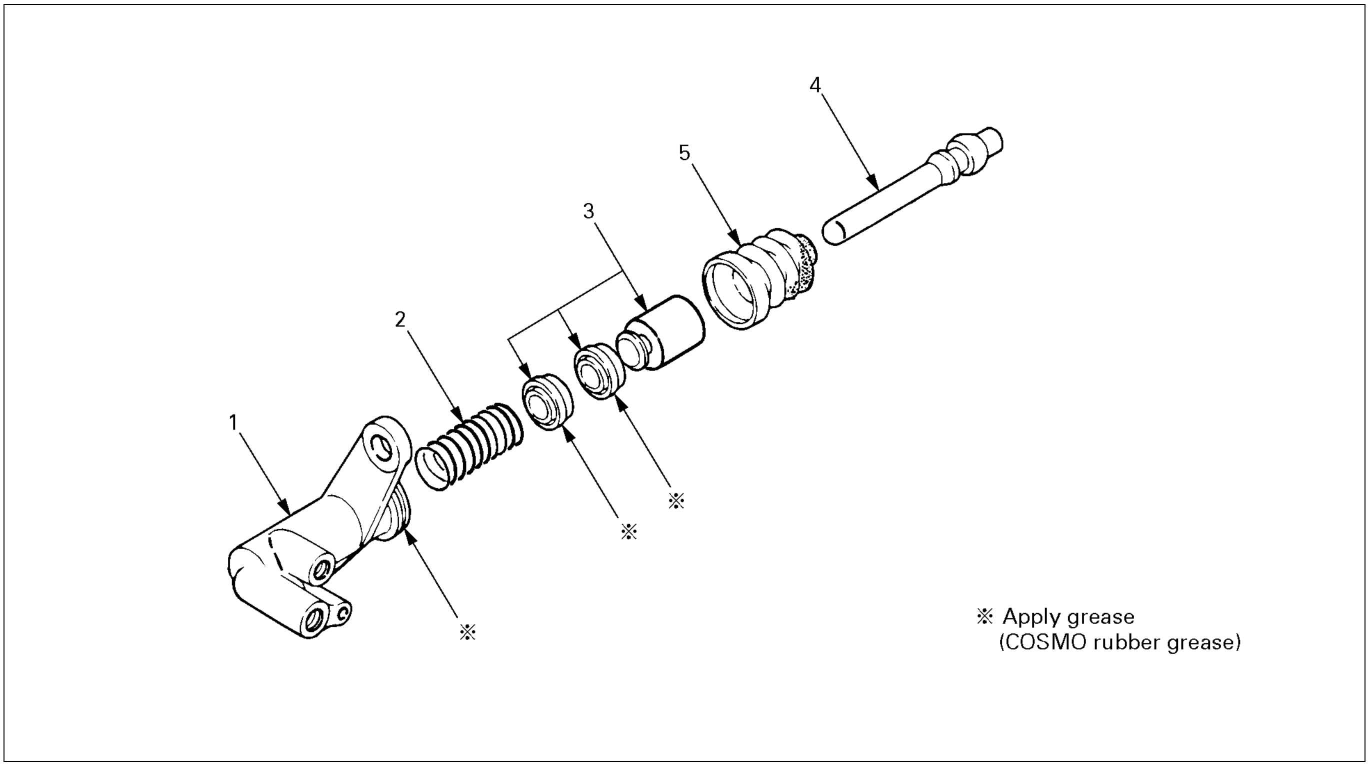
Standard	Limit
0.07 (0.0028)	0.15 (0.006)



Piston and Piston Cup

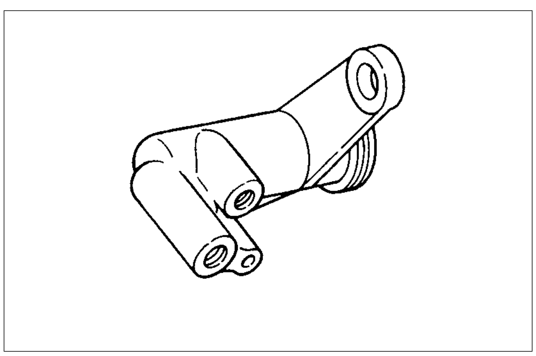
Visually inspect the disassembled piston and piston cup for excessive wear and damage.
Replace the inner parts with new parts (Repair kit A) shown in the illustration.

REASSEMBLY



Reassembly Steps

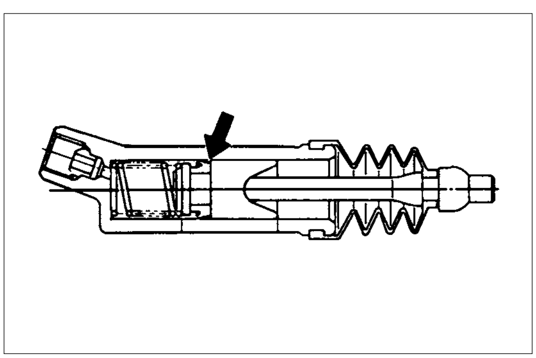
▲ 1. Cylinder body
2. Spring
▲ 3. Piston and piston cup
4. Push rod
5. Boot



Important Operations

1. Cylinder Body

1) Clean the cylinder body.
2) Apply brake fluid to the cylinder bore.

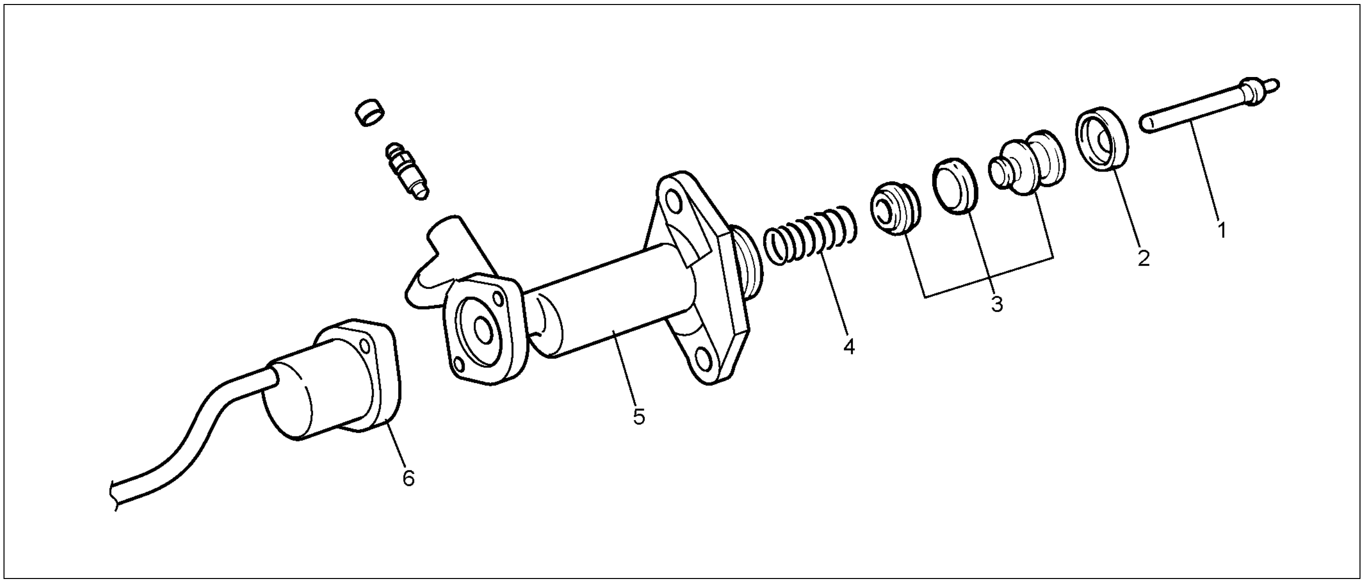


3. Piston and piston Cup

1) Apply brake fluid to the piston and piston cup.
2) Install the cups to the piston.
Note the installation direction of the piston cups in the illustration.
3) Install the piston and piston cup to the cylinder body.

SLAVE CYLINDER (MUX)

DISASSEMBLY



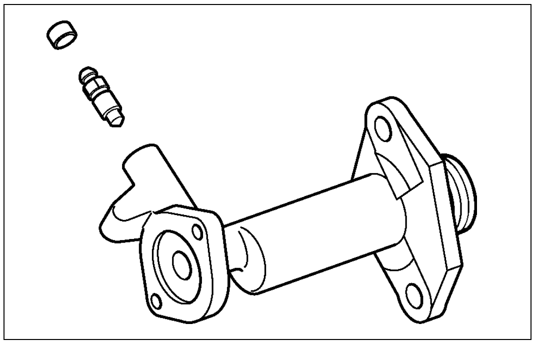
RTW77CSF000501

Disassembly Steps

1. Push rod
2. Boot
3. Piston and piston cup
4. Spring
5. Cylinder body
6. Clutch damper valve

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



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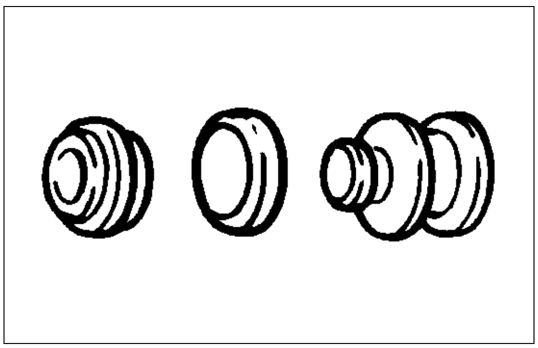
Cylinder Body

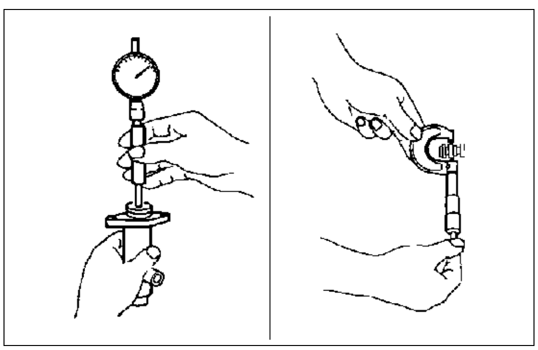
1. Clean the cylinder body.
2. Check the fluid return port for restrictions and clean it if necessary.



206RS004

Piston and Piston Cup

1. Visually inspect the disassembled piston and piston cup for excessive wear and damage.
2. Replace the inner parts with new parts shown in the illustration.



206RS005

3. Measure the clearance between slave cylinder wall and piston.
4. If the measured value exceeds the specified limit, the slave cylinder assembly must be replaced.

mm(in)

Standard	Limit
0.07 (0.0028)	0.15 (0.006)

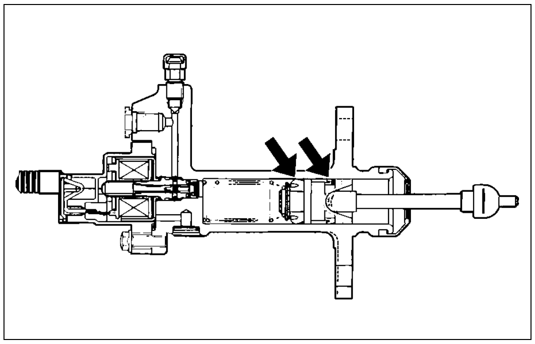
Clutch Damper Valve

1. Visually inspect the entire clutch damper valve housing or connector for cracking and other damage.
   The slave cylinder assembly must be replaced if any of these conditions are present.
2. Measure resistance between terminals.
   Replace slave cylinder assembly if less than standard value.

Standard: 14.3 Ω

REASSEMBLY

To reassemble, follow the disassembly steps in the reverse order, noting the following points: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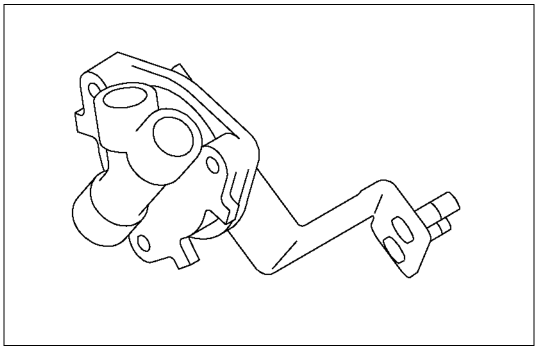
1. Before installing the parts, apply a thin coat of rubber grease.
2. Install cup in groove in piston with the lip turned to the front of cylinder. Use care so as not to scratch the cylinder.

HYDRAULIC DAMPER CYLINDER

INSPECTION AND REPAIR

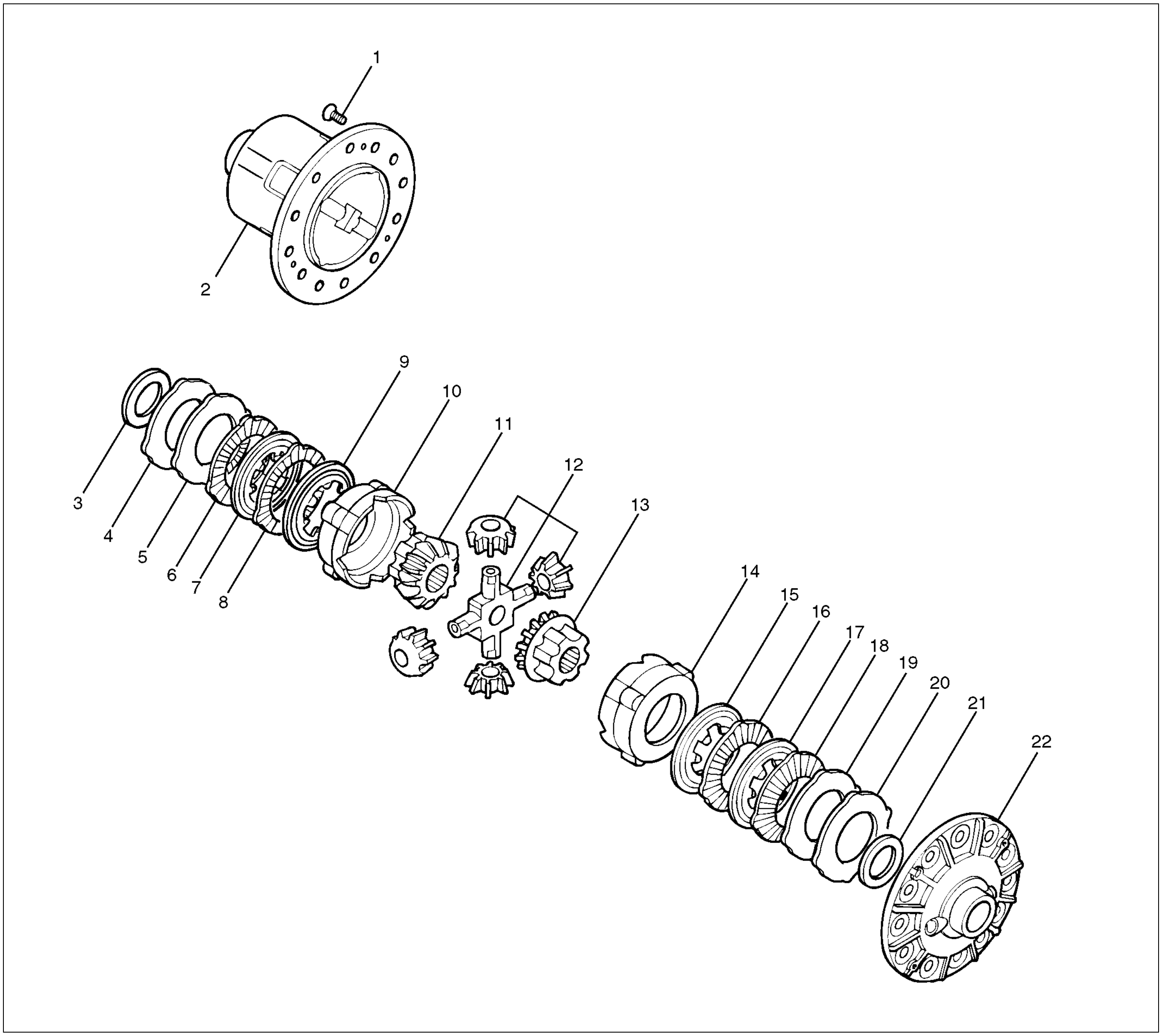
Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



Visually check for oil leakage and other damage.
If oil leakage or other damage is discovered during the inspection; the damper cylinder assembly must be replaced as a unit.

LIMITED SLIP DIFFERENTIAL (LSD)

Disassembled View



Legend

1. Screw
2. Differential Cage B
3. Thrust Washer
4. Spring Plate
5. Spring Plate
6. Friction plate
7. Friction disc
8. Friction plate
9. Friction disc
10. Pressure Ring
11. Side Gear
12. Pinion and Pinion Shaft
13. Side Gear
14. Pressure Ring
15. Friction Disc
16. Friction Plate
17. Friction Disc
18. Friction Plate
19. Spring Plate
20. Spring Plate
21. Thrust Washer
22. Differential Cage A

TROUBLESHOOTING

Refer to this Section to quickly diagnose and repair clutch problems.
Each troubleshooting chart has three headings arranged from left to right.
(1) Checkpoint (2) Trouble Cause (3) Countermeasure
This Section is divided into five sub-sections:

1. Clutch Slippage
2. Clutch Does Not Release Properly
3. Clutch Shudder
4. Clutch Noise
   1) Clutch pedal Depressed (Clutch Disengaged)
   2) Clutch pedal Not Depressed (Clutch Engaged)
5. Oil Leakage

1. CLUTCH SLIPPAGE

Checkpoint	Result	Problem	Countermeasure
Clutch pedal free play	NG	No push rod play in the master cylinder	Adjust the push rod play
	OK		
Release bearing	NG	Transmission front cover unevenly worn	Repair or replace the transmission front cover
	OK		
Grease or oil adhering to the facing	NG	Too much grease	Clean the related parts and/or replace the facing
	NG	Defective transmission front cover oil seal	Clean the related parts and/or replace the facing Replace the transmission front cover oil seal
	OK		

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OK

Checkpoint		Problem	Countermeasure
Grease or oil adhering to the facing	NG	Defective crankshaft rear oil seal	Clean the related parts and/or replace the facing Replace the crankshaft rear oil seal
	NG	Release bearing broken	Replace the release bearing
OK			
Facing	NG	Worn facing	Replace the driven plate assembly
OK			
Clutch diaphragm spring	NG	Weak or broken clutch diaphragm spring	Replace the clutch pressure plate assembly

2. CLUTCH DOES NOT RELEASE PROPERLY

Checkpoint	Problem	Countermeasure
Clutch pedal free play	NG: Too much push rod play in the master cylinder	Adjust the push rod play
OK ↓		
Hydraulic circuit	NG: Air in the hydraulic circuit	Bleed the hydraulic circuit
OK ↓		
Driven plate	NG: Driven plate warped or unevenly worn	Replace the driven plate
	NG: Insufficient grease on the spline contact surface of the splined hub	Clean and grease the splined contact surface
	NG: Corrosion or step wear on the top gear shaft spline	Clean or repair the top gear shaft spline Replace the top gear shaft
OK ↓		
Pressure plate	NG: Pressure plate unevenly worn	Replace the pressure plate assembly
OK ↓		

Continued on the next page

Checkpoint		Problem	Countermeasure
Continued from the previous page			
OK			
Flywheel	NG	Flywheel unevenly worn	Repair or replace the flywheel
OK			
Crankshaft pilot bearing	NG	Top gear shaft wobble is causing pilot bearing wear	Replace the pilot bearing

3. CLUTCH SHUDDER

Checkpoint		Problem	Countermeasure
Power train	NG	Poorly connected components causing looseness and abrasion	Tighten the connections Repair or replace the applicable parts
OK			
Pressure plate	NG	Pressure plate unevenly worn	Replace the pressure plate assembly
OK			
Grease or oil adhering to the facing	NG	Too much grease	Clean the related parts and/or replace the facing
	NG	Defective transmission front cover oil seal	Clean the related parts and/or replace the facing Replace the transmission front cover oil seal
	NG	Defective crankshaft rear oil seal	Clean the related parts and/or replace the facing Replace the crankshaft rear oil seal
OK			
Driven plate	NG	Insufficient grease on the spline contact surface of the splined hub	Clean and grease the spline contact surface
	NG	Corrosion or step wear on the top gear shaft spline	Clean or repair the top gear shaft spline Replace the top gear shaft
OK			

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Continued from the previous page

OK

Checkpoint		Problem	Countermeasure
Driven plate	NG	Loose facing rivets	Replace the driven plate assembly
	NG	Warpage and/or uneven wear	Replace the driven plate assembly
OK			
Flywheel	NG	Flywheel uneven wear	Repair or replace the flywheel

4. CLUTCH NOISE

1) Clutch Pedal Depressed (Clutch Disengaged)

Checkpoint		Problem	Countermeasure
Pedal shaft and sleeve	NG	Insufficient grease at the pedal shaft and sleeve	Clean and grease the pedal shaft and sleeve
	NG	Worn pedal shaft and/or sleeve	Replace the pedal shaft with the sleeve
OK			
Master cylinder piston and push rod contact faces	NG	Insufficient grease at the maser cylinder piston and push rod contact faces	Clean and grease the master cylinder piston and push rod contact faces
OK			
Driven plate	NG	Loose or broken damper spring	Replace the driven plate assembly
OK			
Crankshaft pilot bearing	NG	Insufficient grease at the crankshaft pilot bearing (pilot bearing worn)	Replace the crankshaft pilot bearing

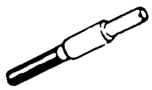
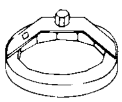
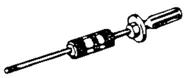
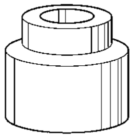
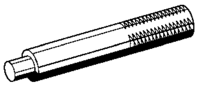
2) Clutch Pedal Not Depressed (Clutch Engaged)

Checkpoint		Problem	Countermeasure
Driven plate damper spring	NG	Weak or broken damper spring	Replace the driven plate
OK			
Crankshaft pilot bearing	NG	Insufficient grease at the crankshaft pilot bearing (pilot bearing worn)	Replace the crankshaft pilot bearing

5. OIL LEAKAGE

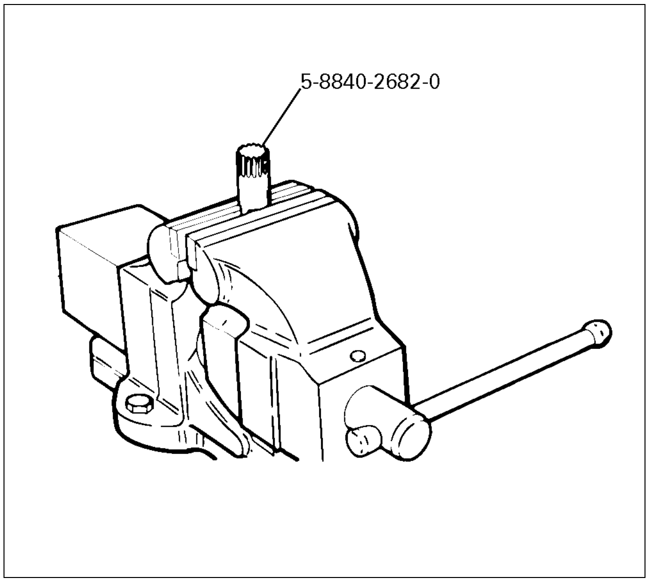
Checkpoint		Problem	Countermeasure
Master cylinder	NG	Weak or damaged piston cup	Replace the body sub assembly
OK			
Master cylinder fluid pipe and hose	NG	Loosely connected fluid pipe and/or hose	Tighten the fluid pipe and/or hose connections
OK			
Slave cylinder	NG	Weak or damaged piston cup	Replace the piston cup
OK			
Slave cylinder oil pipe	NG	Loosely connected oil pipe	Tighten the oil pipe connection
OK			
Fluid reservoir	NG	Loosely connected oil pipe	Tighten the oil pipe

SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	5-8525-3001-0 (J-24547)	Clutch pilot aligner
	5-8840-2000-0 (J-5822)	Pilot bearing remover
	5-8840-0019-0 (J-23907)	Sliding hammer
	5-8840-0125-0 (J-26516-A)	Pilot bearing installer
	5-8840-0007-0 (J-8092)	Drive handle

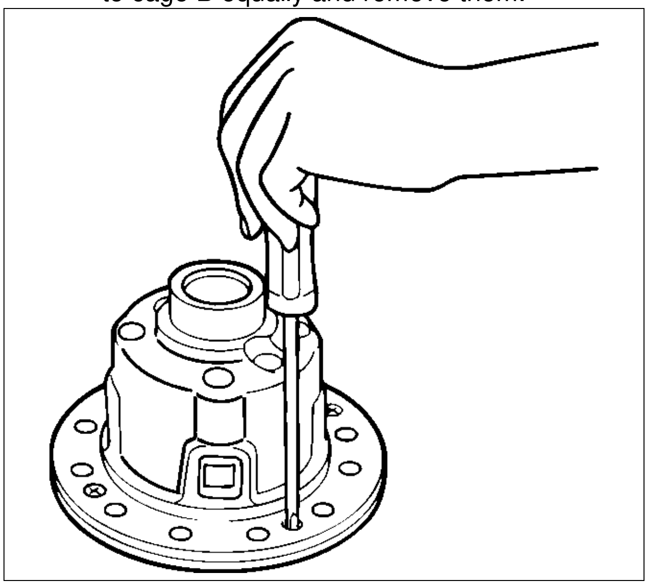
Disassembly

- Prepare a side gear holder : 5-8840-2682-0 as shown in the left figure, clamp it with a stock vice, and set a differential.



425R300008

1. Screw
   - Apply a setting mark to the differential cage A and differential cage B remove the bolt using the press.
   - Loosen four screws fixing differential cage A to cage B equally and remove them.



425RS055

2. Remove differential cage A and B.
3. Remove thrust washer and two spring plates.
4. Remove friction plate and friction disc.
5. Remove friction plate and friction disc.
6. Remove pressure ring and side gear.
7. Remove pinion and pinion shaft.
8. Remove side gear and pressure ring.
9. Remove friction disc and friction plate.
10. Remove friction disc and friction plate.
11. Remove two spring plates and thrust washer.

SECTION 7

TRANSFER CASE

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SECTION 7D

TRANSFER CASE

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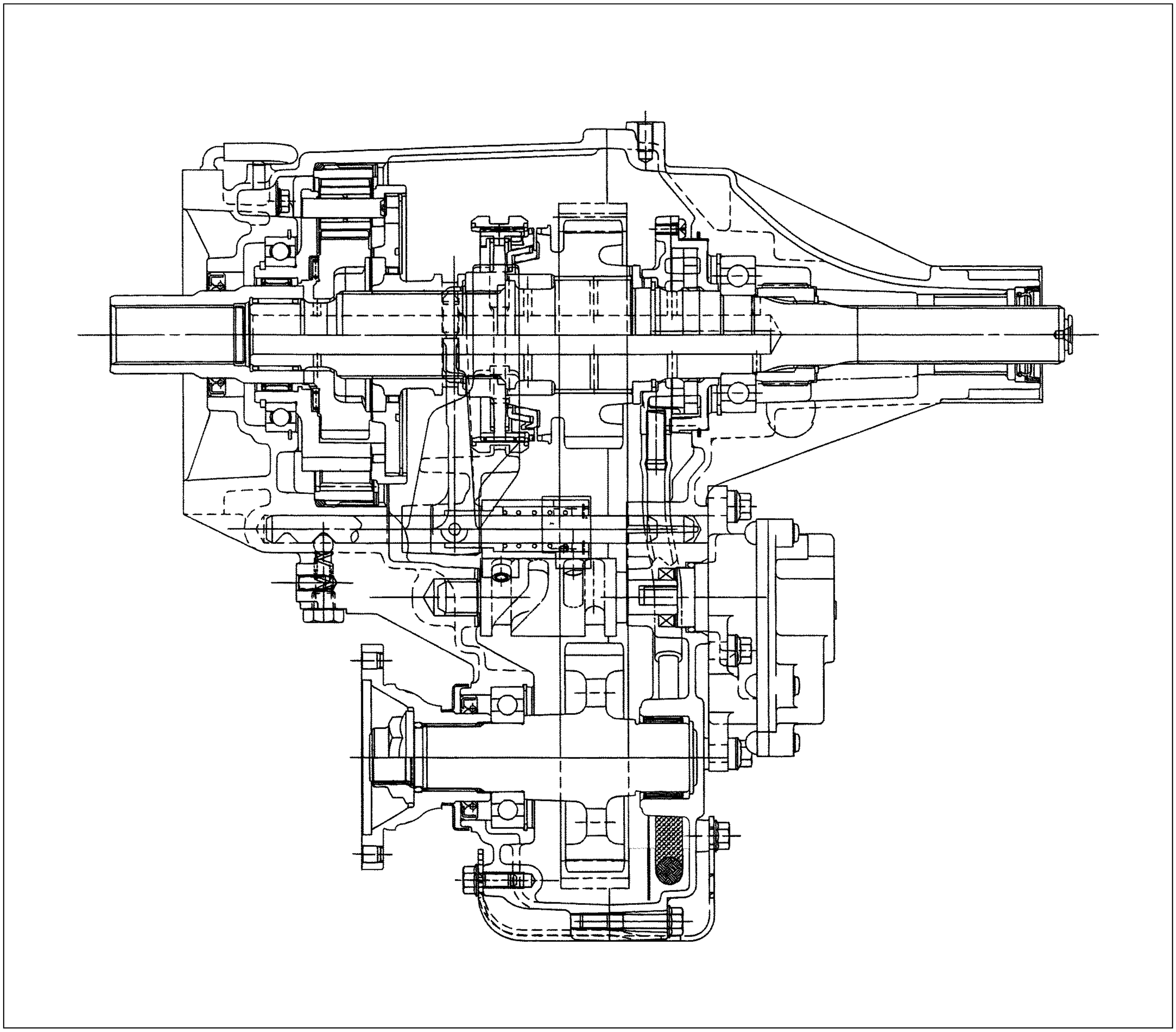
Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description



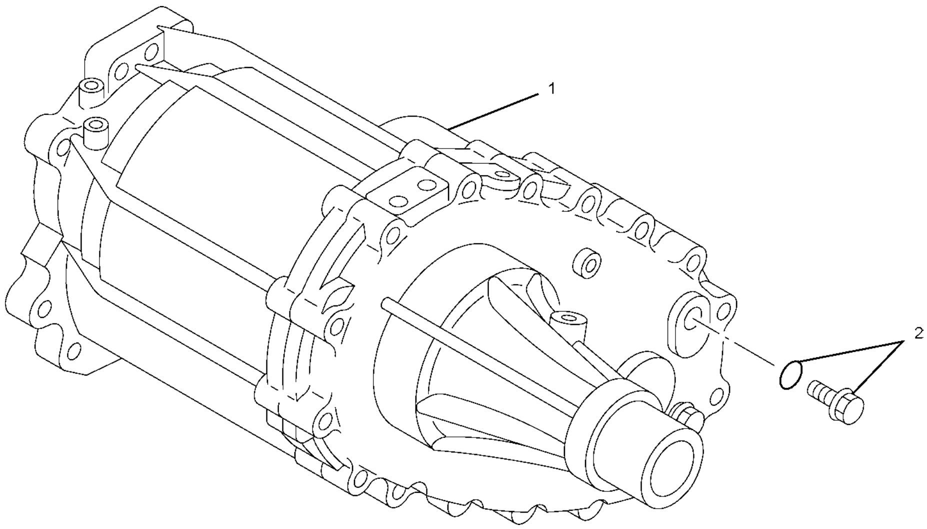
RTW57ALF000301

The transfer case is used to provide a means of providing power flow to the front axle. The transfer case also provides a means of disconnecting the front axle, providing better fuel economy and quieter operation when the vehicle is driven on improved roads where four wheel drive is not required. In addition, the transfer case provides an additional gear reduction when placed in low range, which is useful when difficult off-road conditions are encountered.

Use the 4WD switch on the center cluster panel to select the drive range. The 4WD indicator lamp will be lit when 4WD is selected.

On-Vehicle Service

Transfer Case Oil Level



RTW67DMF000101

Legend

(1) Transfer Case
(2) Filler Plug and O-ring

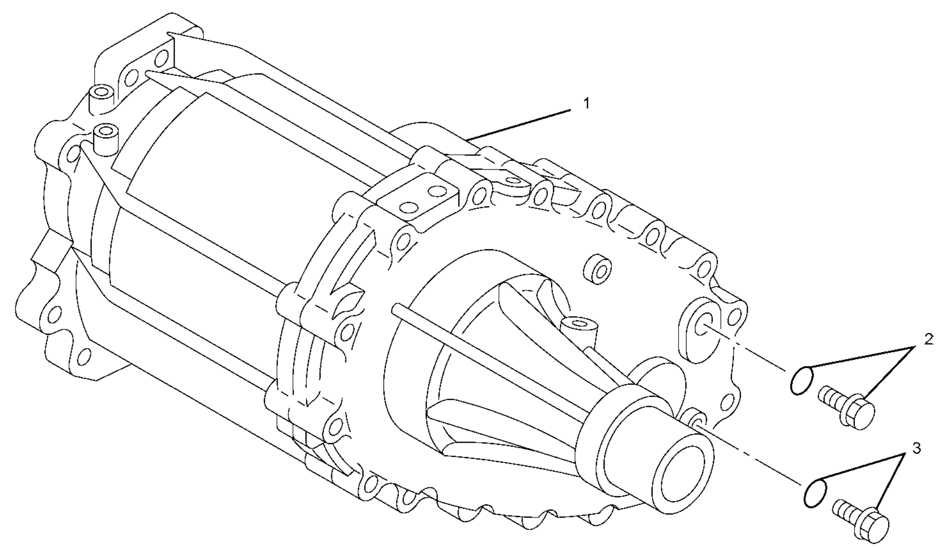
Removal

1. Disconnect the battery ground cable.
2. Rise and support the vehicle with suitable stands.
3. Remove the filler plug and O-ring.
4. Check the oil level reaches the filler hole.
5. If the oil level is low, fill the transfer oil (5W-30) or equivalent to the transfer through the filler hole.

Installation

1. Replace the filler plug and O-ring tighten it to the specified torque.
   Filler plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)
2. Lower the vehicle to the ground.
3. Connect the battery ground cable.

Transfer Case Oil Change



RTW67DMF000201

Legend

(1) Transfer Case
(2) Drain Plug and O-ring
(3) Filler Plug and O-ring

Removal

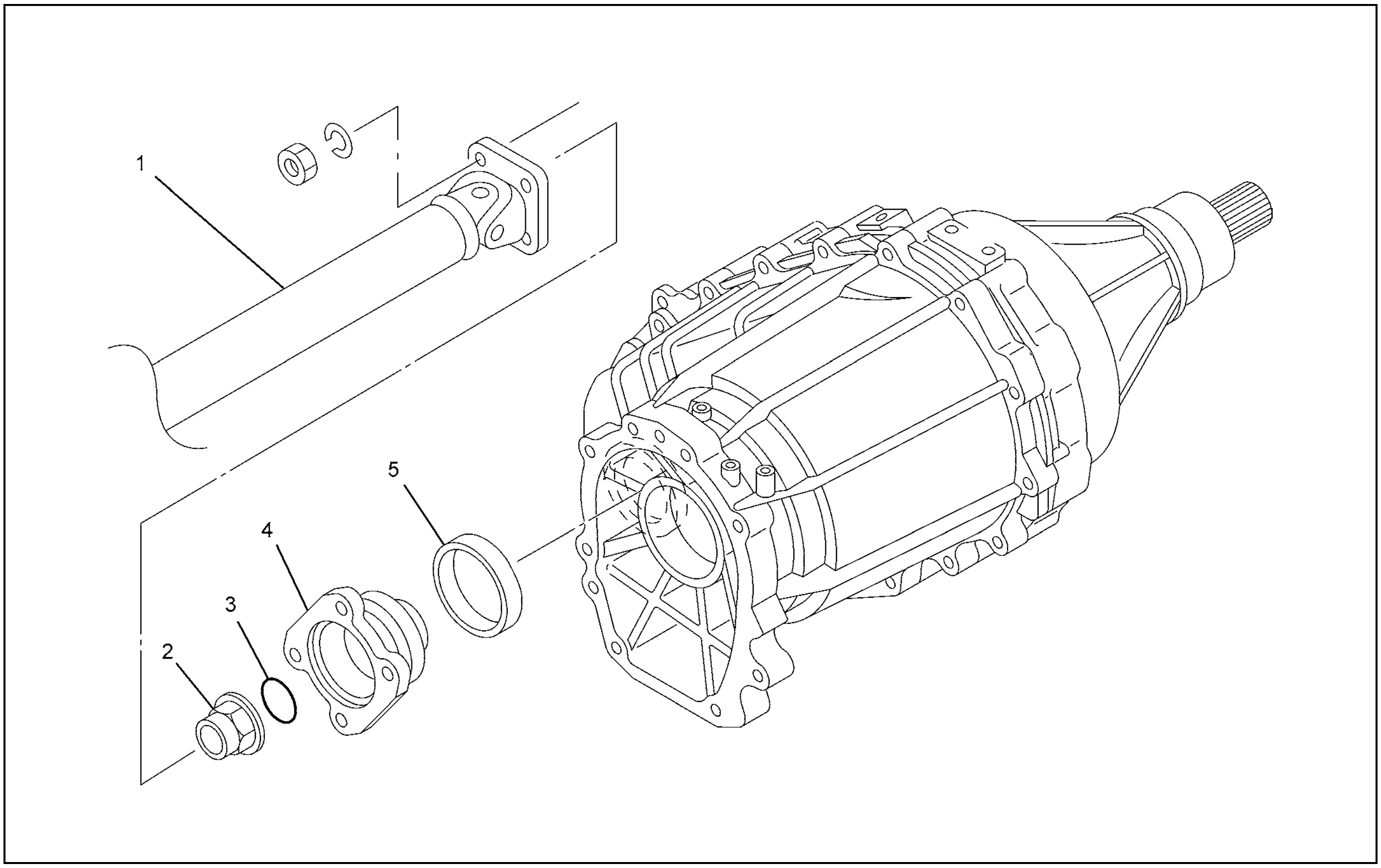
1. Disconnect the battery ground cable.
2. Rise and support the vehicle with suitable stands.
3. Place a suitable sized drain tray under the transfer case.
4. Remove the drain plug and O-ring drain the transfer case oil.
5. Remove the filler plug.

Installation

1. Replace the drain plug and O-ring to the transfer case and tighten it to the specified torque.
   Drain plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)
2. Fill the specified volume of the transfer oil (5W-30) or equivalent to the transfer case through the filler hole.
   Transfer oil volume: 1.3 lit. (1.37 US qt)
3. Replace the filler plug and O-ring tighten it to the specified torque.
   Filler plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)
4. Lower the vehicle to the ground.
5. Connect the battery ground cable.

Transfer Case Front Oil Seal

Transfer Front Oil Seal and Associated Parts



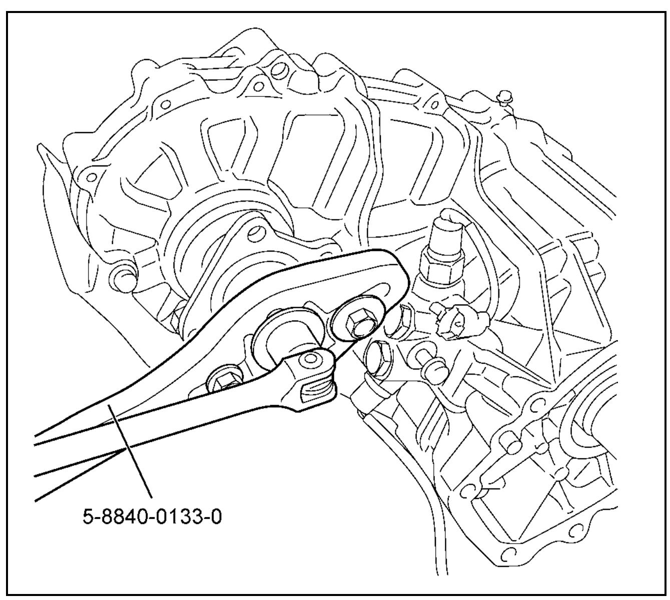
RTW67DMF000301

Legend

(1) Front Propeller Shaft
(2) End Nut
(3) O-ring
(4) Output Flange
(5) Front Oil Seal

Removal

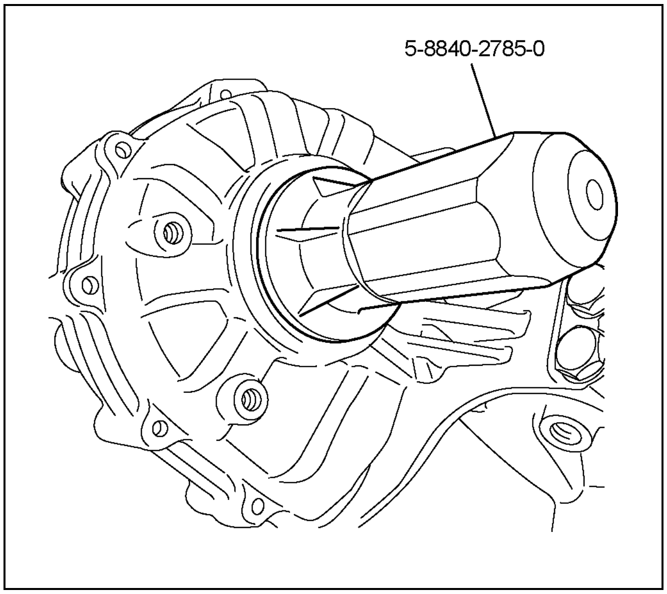
1. Disconnect the battery ground cable.
2. Raise and support the vehicle with suitable stands.
3. Place a suitable sized drain tray under the transfer case.
4. Remove the drain plug and drain the transfer case oil.
5. Remove the filler plug.
6. Remove the front propeller shaft.
7. Use a flange holder (5-8840-0133-0) to remove the end nut from the front output shaft then remove the O-ring and the output flange.
8. Remove the front oil seal from the front cover.



RTW77DSH000201

Installation

1. Thoroughly clean around the oil seal bore in the case and ensure there are no burrs.
2. Apply the engine oil to the new oil seal outer surfaces and apply the recommended grease (BESCO L2) or equivalent to the oil seal lip.
3. Tap the oil seal in to place, use an oil seal installer (5-8840-2785-0) and a soft hammer.

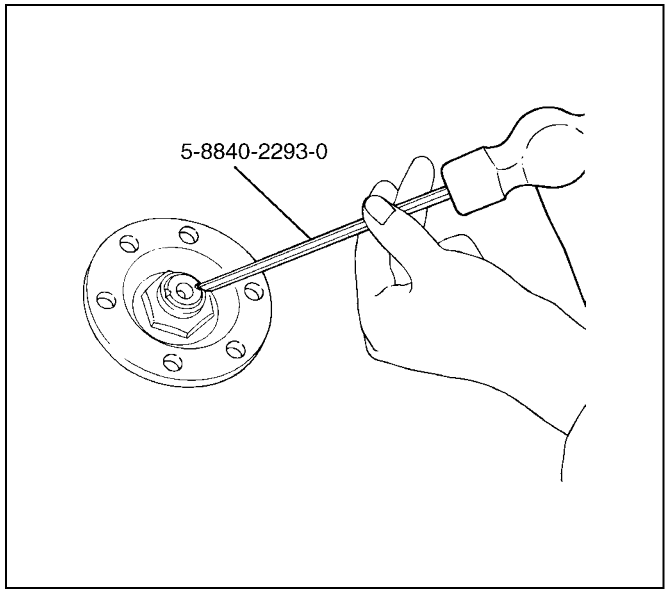


RTW77DSH000301

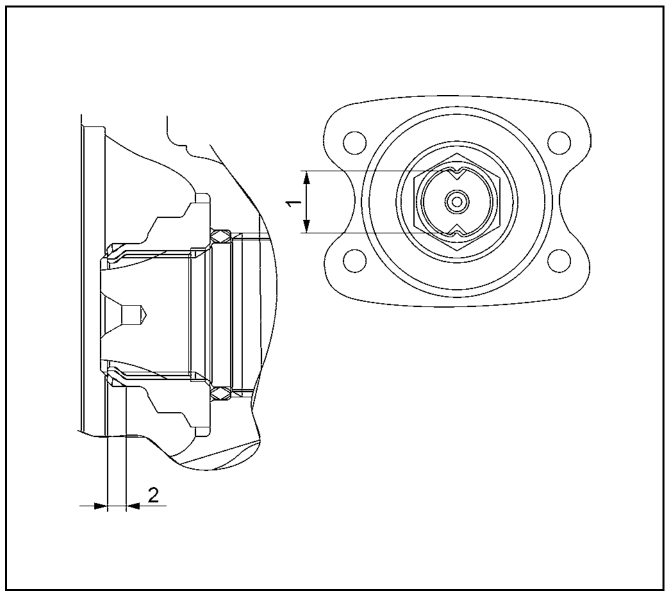
4. Install the output flange to the front output shaft.
5. Apply the engine oil to the new O-ring and install it to the front output shaft.
6. Secure the output flange with a flange holder (5-8840-0133-0).
7. Install the new end nut and tighten them to specified torque.

   Front coupling driver fixing nut torque:
   137 N·m (14.0 kgf·m/101 lb·ft)

8. Use a punch (5-8840-2293-0) to caulk the end nut.



226R300012



RUW34DSH000301

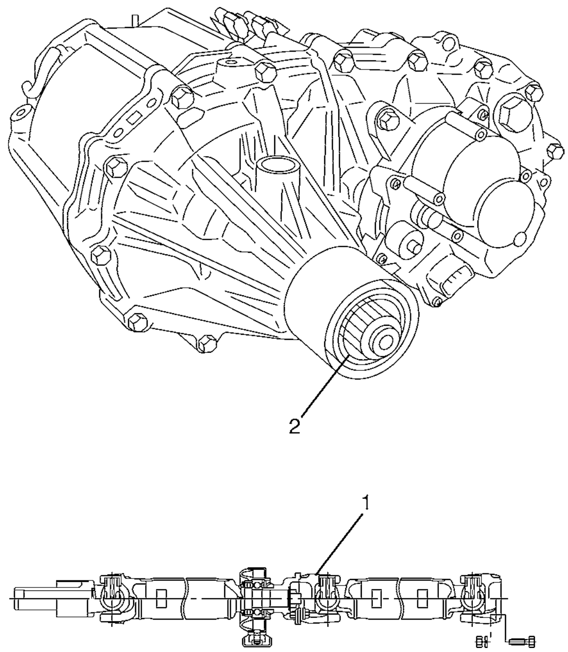
Legend

(1) MAX 26mm (1.02in)
(2) MIN 4mm (0.16in)

9. Install the drain plug to the transfer case and tighten it to the specified torque.
   Drain plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)
   Transfer oil volume: 1.3 lit. (1.37 US qt)
10. Install the filler plug and tighten it to the specified torque:
    Filler plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)
11. Install the front propeller shaft.
    Propeller shaft bolts torque:
    59 N·m (6.0 kgf·m/43 lb·ft)
12. Lower the vehicle to the ground.
13. Connect the battery ground cable.

Transfer Case Rear Oil Seal

Transfer Rear Oil Seal and Associated Parts



220R300018

Legend

(1) Rear Propeller Shaft
(2) Rear Oil Seal

Removal

1. Disconnect the battery ground cable.
2. Raise and support the vehicle with suitable stands.
3. Remove the rear propeller shaft.
4. Remove the oil seal from the transfer case.

Installation

1. Thoroughly clean around the oil seal bore in the transfer case and ensure there are no burrs.
2. Apply the engine oil to the new oil seal outer surfaces and apply the recommended grease (BESCO L2) or equivalent to the oil seal lip.

Inspection and Repair

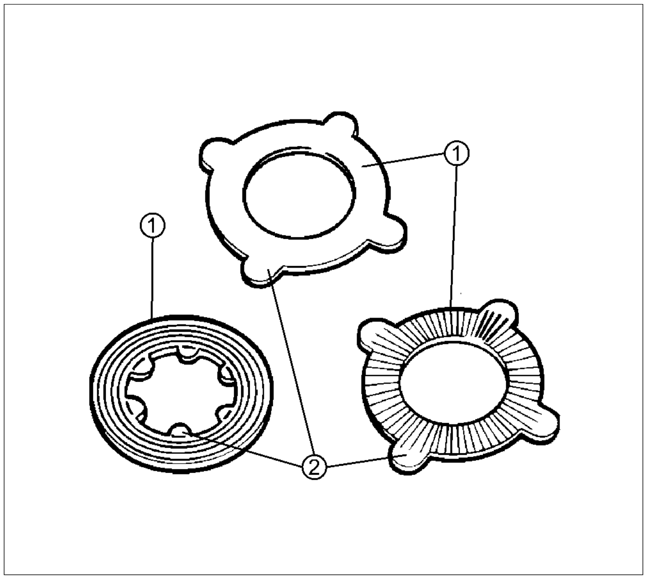
Make all necessary adjustments, repairs, and part replacements if wear, damage, rust or other problems are discovered during inspection.

Visual Check

Inspect the following parts for wear, damage or other abnormal conditions.

- Friction disc
- Friction plate
- Spring plate

① Sliding surface
② Protrusion

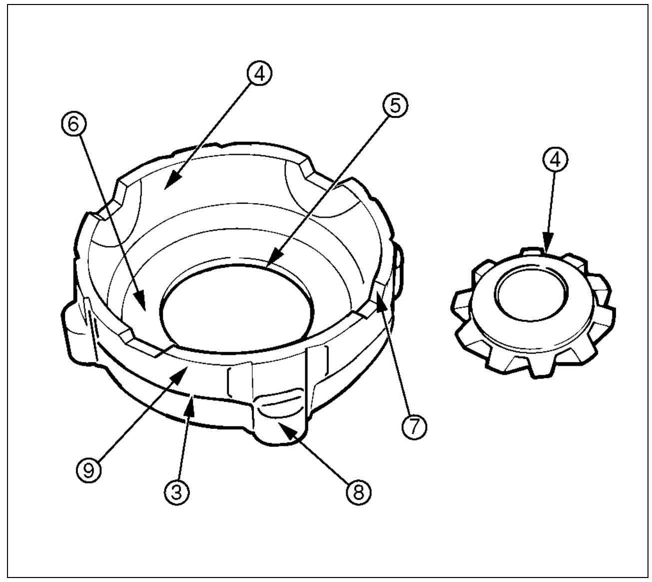


425RS056

Pressure ring

Check the parts for damage or other abnormal conditions.

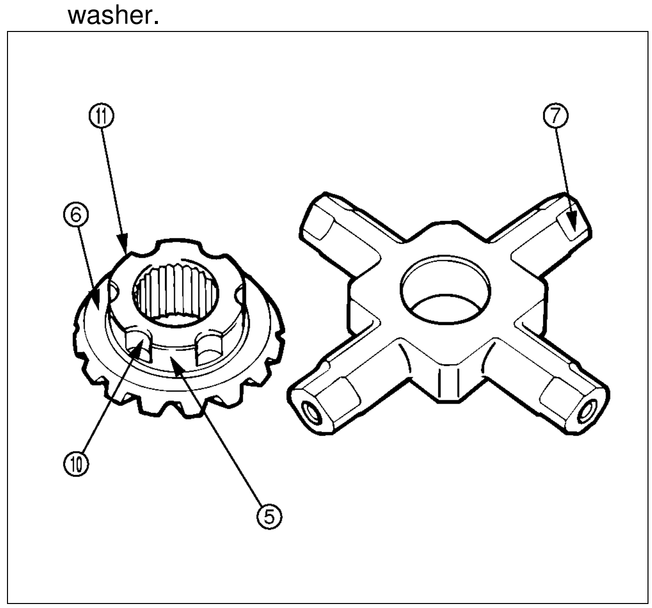
③ Sliding surface for friction disc
If dents or damages are discovered, grind them with oil stone, and repair them with compound on surface plate.
④ Sliding surface of pressure ring inner surface and pinion gear.
⑤ Sliding surface of pressure ring bore and side gear.
⑥ sliding surface of pressure ring and side gear.
⑦ Sliding surface of pressure ring and pinion shaft.
⑧ Mating surface to differential cage A.
⑨ Burrs or dents on sliding surface of pressure ring and rear differential cage should be repaired, using oil stone.



425RY00022

- Thrust Washer

⑩ Groove on side gear circumference small burrs of dens should be repaired, using oil stone.
⑪ Sliding surface between side gear and thrust washer.

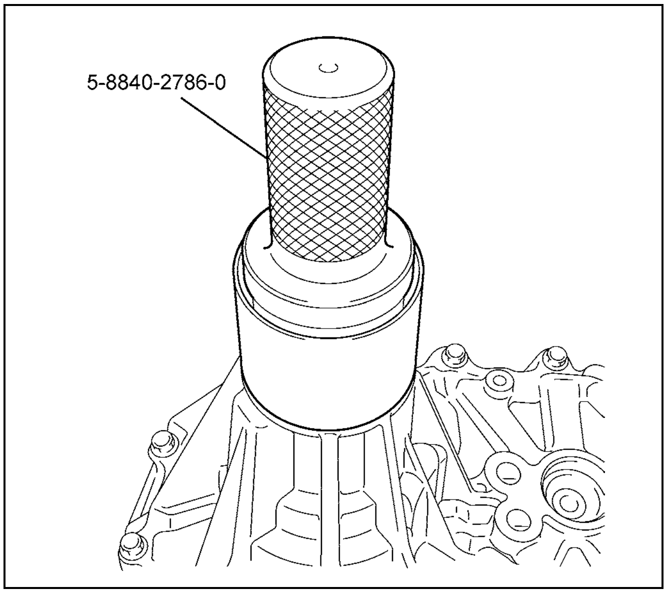


425RY00024

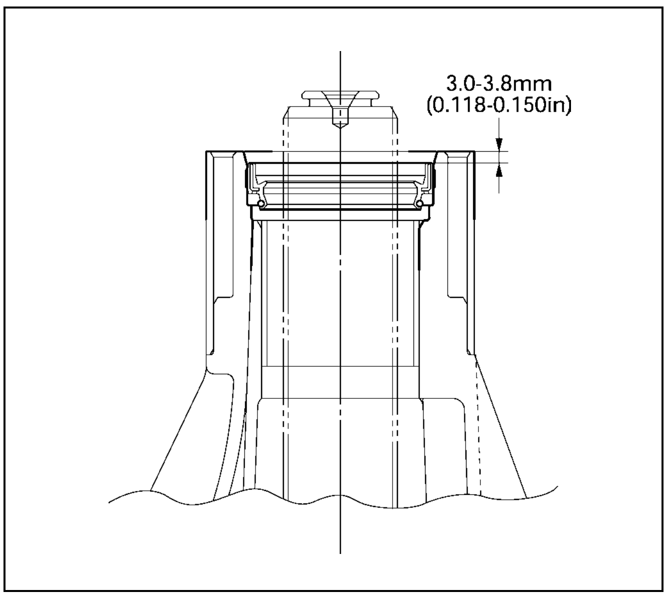
- Differential cage A and B

⑫ Contact surface to spring plate
⑬ Differential cage A and B contact surfaces to thrust washers Small burrs or dents should be repair, using oil stone.

3. Tap an oil seal in to place, use an oil seal installer 5-8840-2786-0 and a soft hammer.



RTW77DSH000401

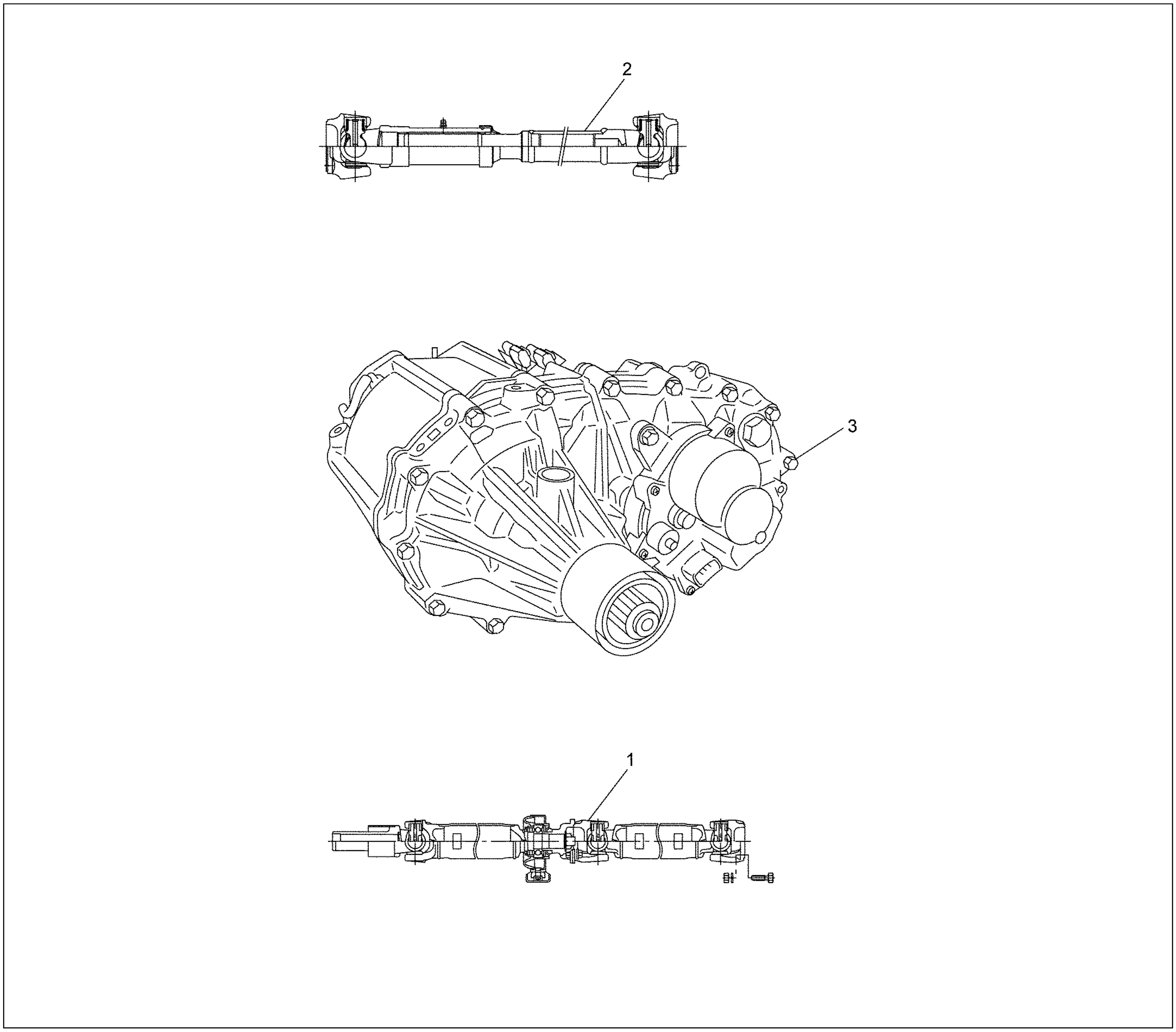


220R300021

4. Install the rear propeller shaft.
   Propeller shaft bolts torque:
   59 N·m (6.0 kgf·m/43 lb·ft)
5. Lower the vehicle to the ground.
6. Connect the battery ground cable.

Transfer Case Assembly

Transfer Case Assembly and Associated Parts



RTW57ALF000201

Legend

(1) Rear Propeller Shaft
(2) Front Propeller Shaft
(3) Transfer Case Assembly

Removal

NOTE: Before removing transmission and transfer assembly from vehicle, change the transfer mode to 2WD using the 4WD push button switch on dash panel.

1. Disconnect battery ground cable.
2. Raise and support vehicle with suitable stands. Drain transfer case fluid.
3. Remove rear propeller shaft and front propeller shaft.

NOTE: Apply alignment marks on the flange at both front and rear sides.

4. Disconnect harness connectors and clip.
   Connector: transfer switch, 2WD-4WD actuator, speed sensor.

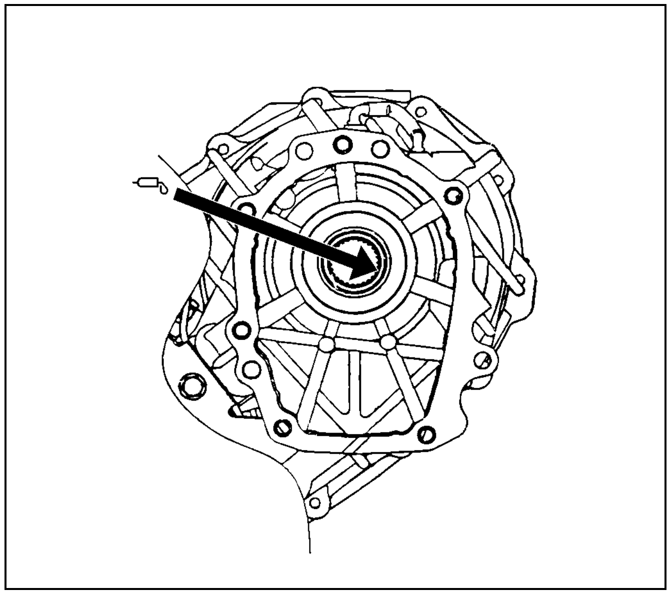
NOTE: Avoid turning the vehicle ignition switch to the ON position when the 2WD-4WD connector is removed (battery connected).

If the ignition switch must be turned to the ON position, the controller must first be removed (memory must be cleared because the CHECK 4WD INDICATOR will light).

5. Remove transfer case assembly from the vehicle.

Installation

1. Apply a thin coat of molybdenum disulfide grease to the input shaft spline as shown in the figure.

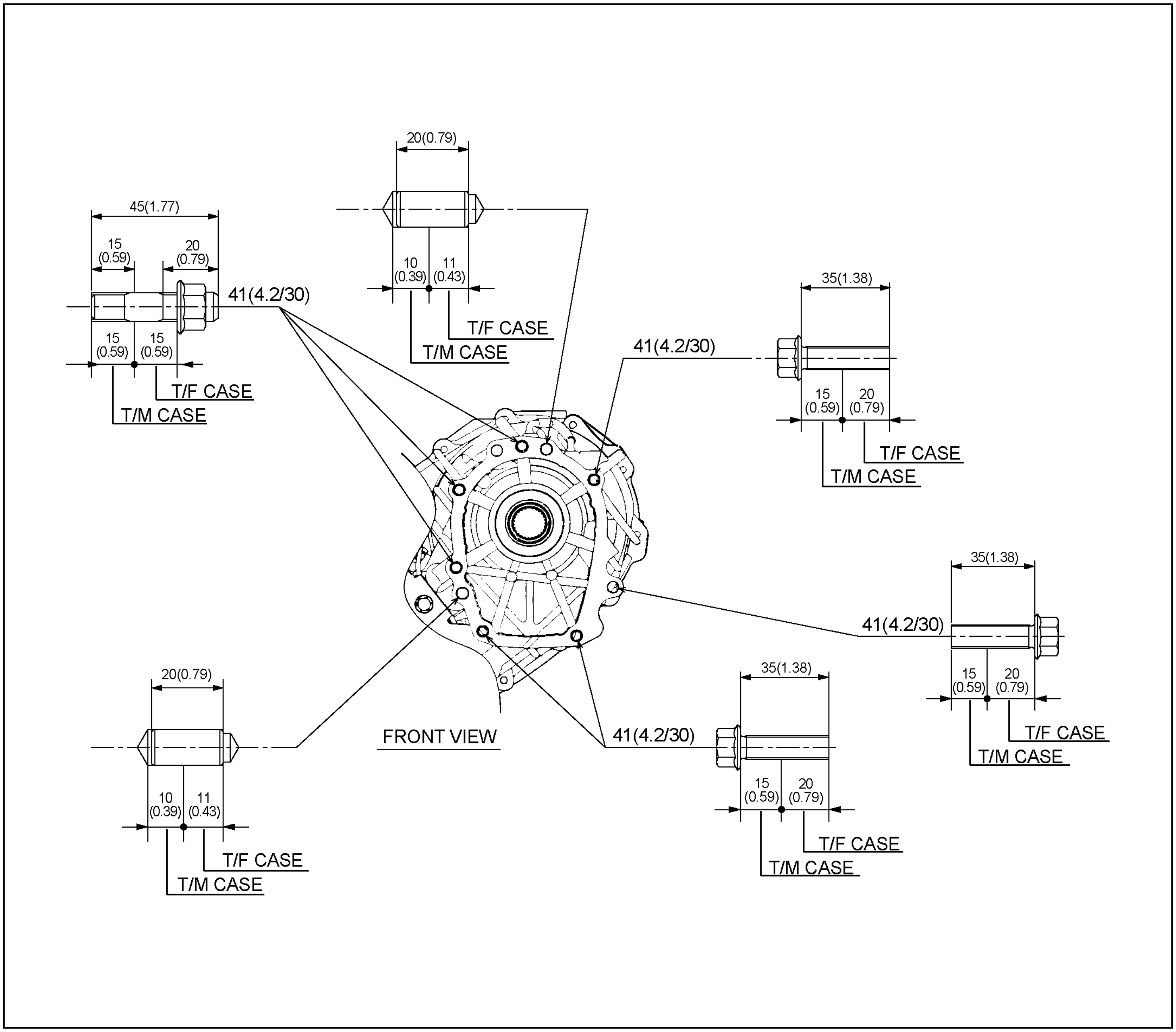


260R300001

2. Install transfer case assembly to the transmission.
   Tighten transfer bolts as shown in the figure.

For M/T (MUA, MUX)

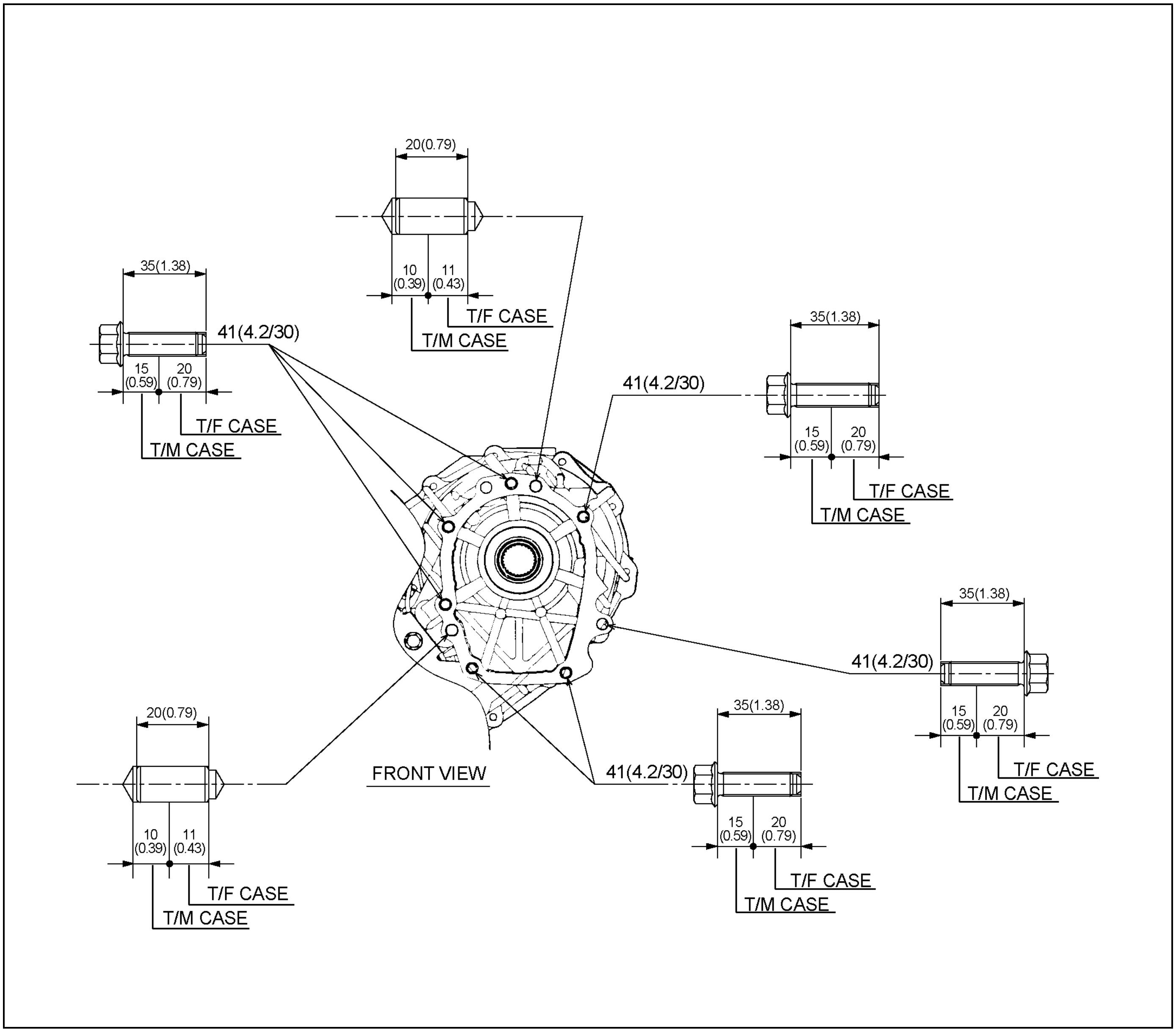
N·m (kgf·m/lb·ft)
mm (in)



RTW77DLF000201

For A/T (JR405E, AW30-40LE)

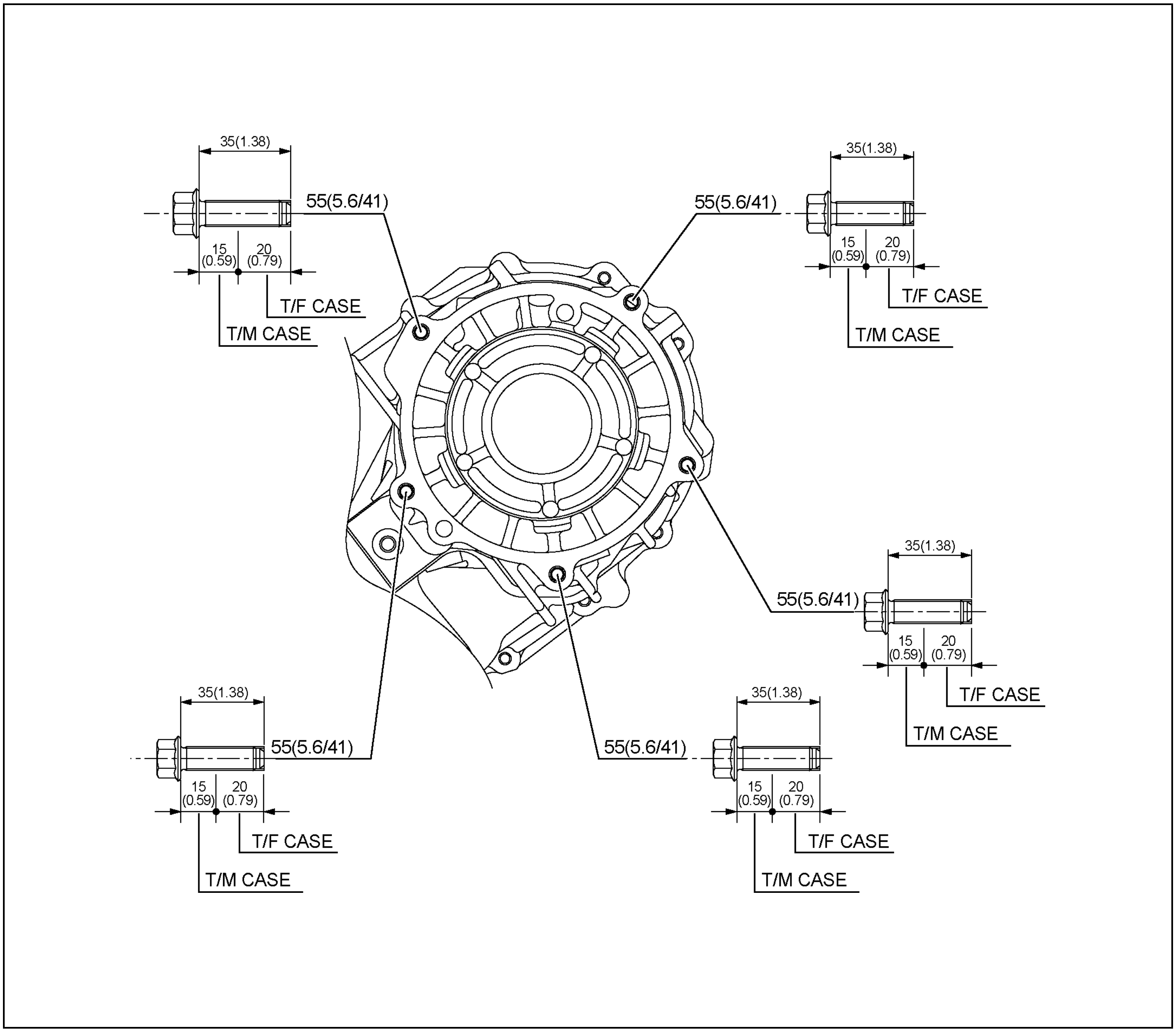
N·m (kgf·m/lb·ft)
mm (in)



RTW77DLF000301

For M/T (AR-5), A/T (4L60-E)

N·m (kgf·m/lb·ft)
mm (in)

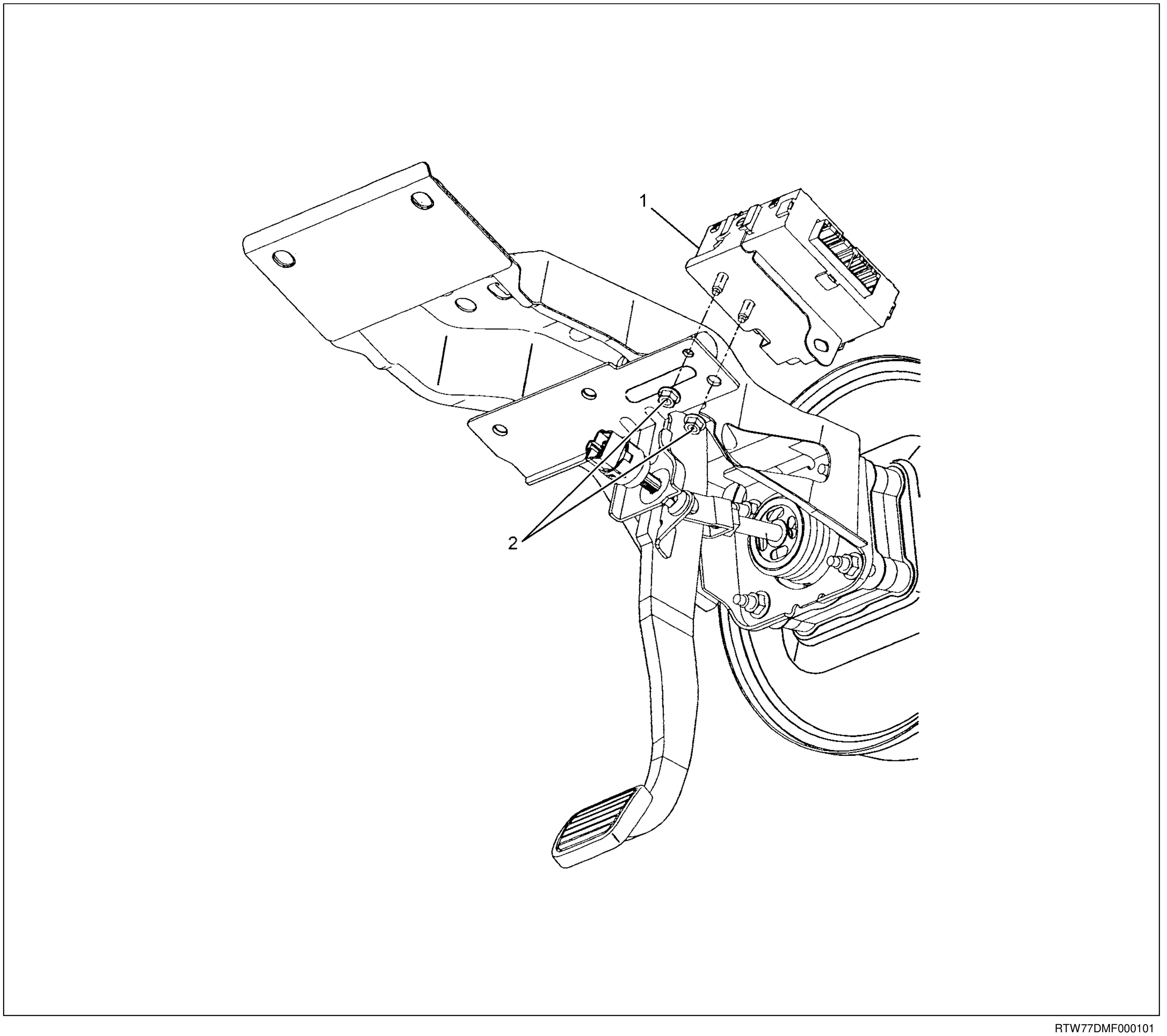


RTW77DLF000401

3. Connect harness connectors and clip.
   Connector: transfer switch, 2WD-4WD actuator, speed sensor.
4. Install rear propeller shaft and front propeller shaft.
   Propeller shaft torque: 59 N·m (6.0 kgf·m/43 lb·ft)

Transfer Control Unit

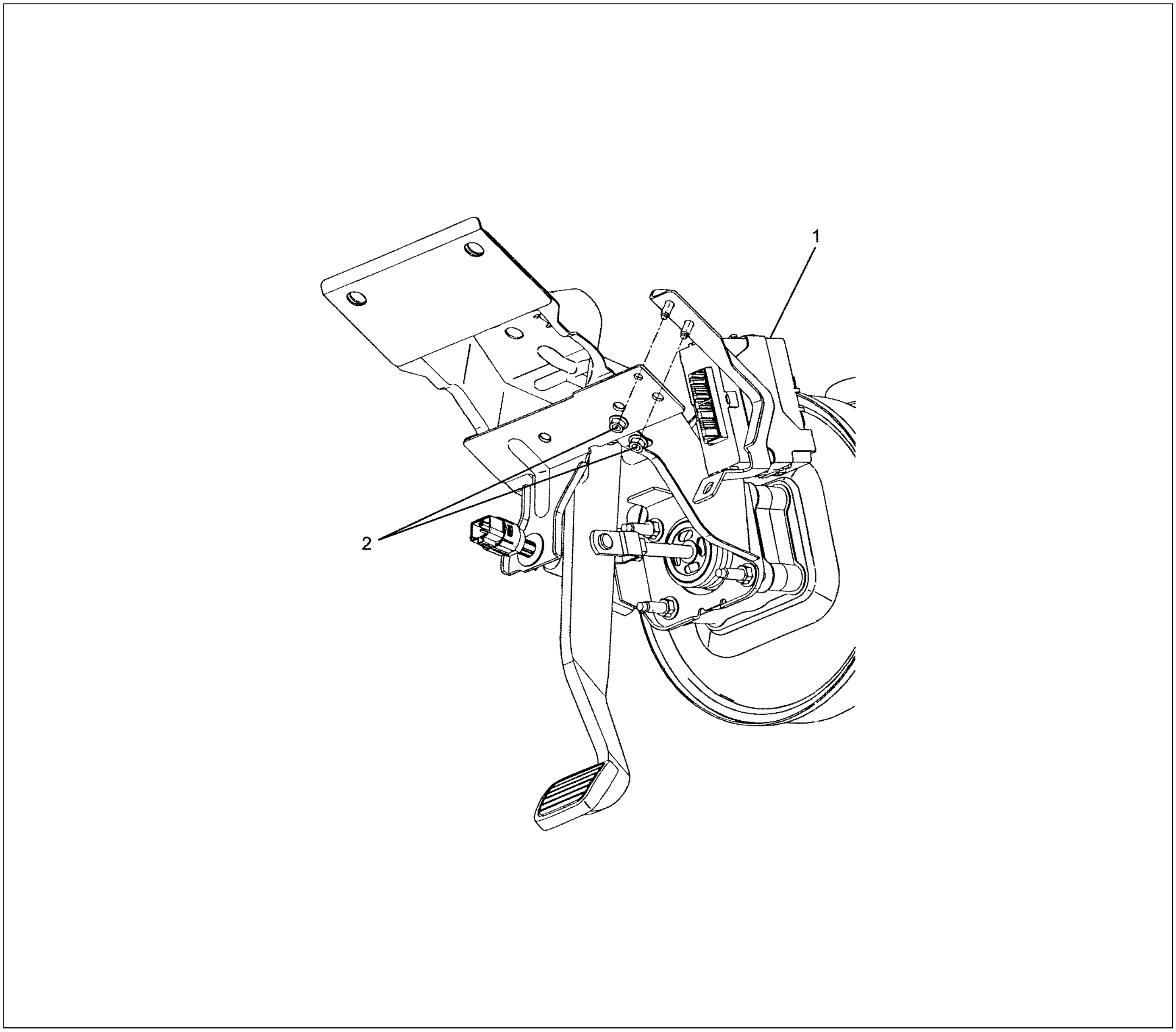
RHD



Legend

(1) Transfer Control Unit
(2) Nut

LHD



RTW77DMF000101

Legend

(1) Transfer Control Unit
(2) Nut

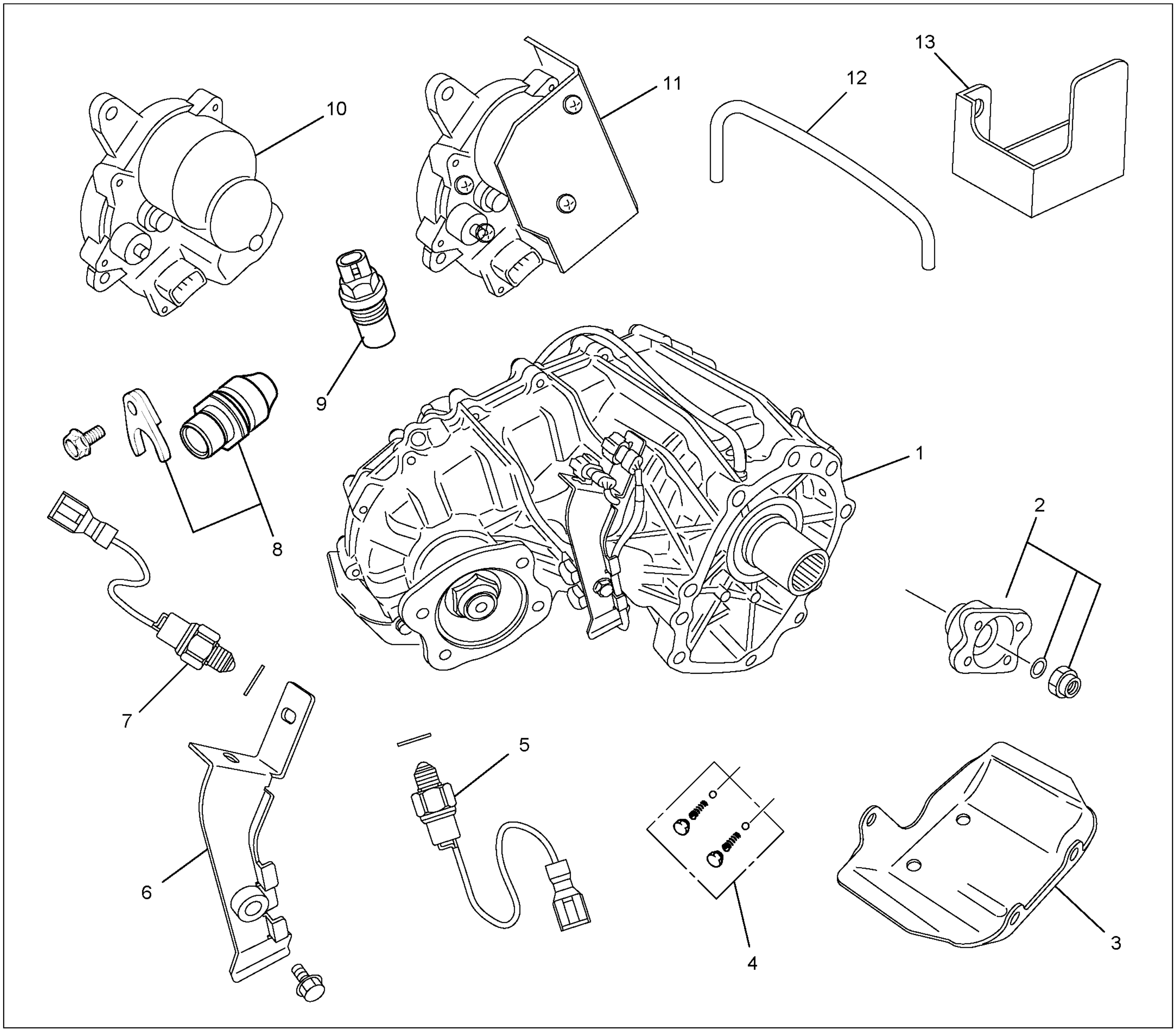
Removal

1. Disconnect the battery ground cable.
2. Disconnect the harness connector from the Transfer control unit.
3. Remove the Transfer control unit.

Installation

1. Install the Transfer control unit.
   Transfer control unit torque:
   7 N·m (0.7 kgf·m/61 lb·in)
2. Connect the harness connector to the Transfer control unit.
3. Connect the battery ground cable.

Transfer Disassembly



RTW67DLF000101

Legend

(1) Transfer Case
(2) Companion Flange, O-ring and Nut
(3) Stoneguard
(4) Detent Plug, Spring and Detent Ball
(5) 2-4 Switch ASM
(6) Switch Bracket
(7) Neutral Switch ASM
(8) Speedometer Bushing, Plate and Driven Gear (M/T: MUA, MUX, A/T: JR405E, AW30-40LE)
(9) Speed sensor (M/T: AR-5, A/T: 4L60-E)
(10) Transfer Actuator (Diesel Engine)
(11) Transfer Actuator (Gasoline Engine)
(12) Breather Hose
(13) Heat Protector (Gasoline Engine)

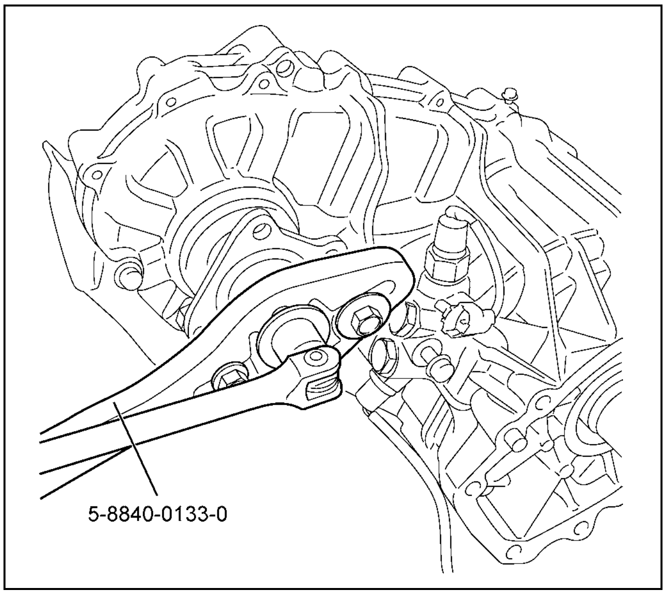
Removal

1. Remove the stoneguard.
2. Remove the drain plug from the transfer case to drain the oil.
3. Remove the parts listed below.

- Speedometer bushing, plate, and speedometer driven gear (M/T: MUA, MUX, A/T: JR405E, AW30-40LE)
- Speed sensor (M/T: AR-5, A/T: 4L60-E)

- Breather hose (Between the transfer case and the transfer actuator assembly)
- Transfer actuator assembly
- Switch bracket
- 2-4 switch assembly (Gray harness cover)
- Neutral switch assembly (Black harness cover)
- Detent plugs, detent springs, and detent balls (2 parts each)

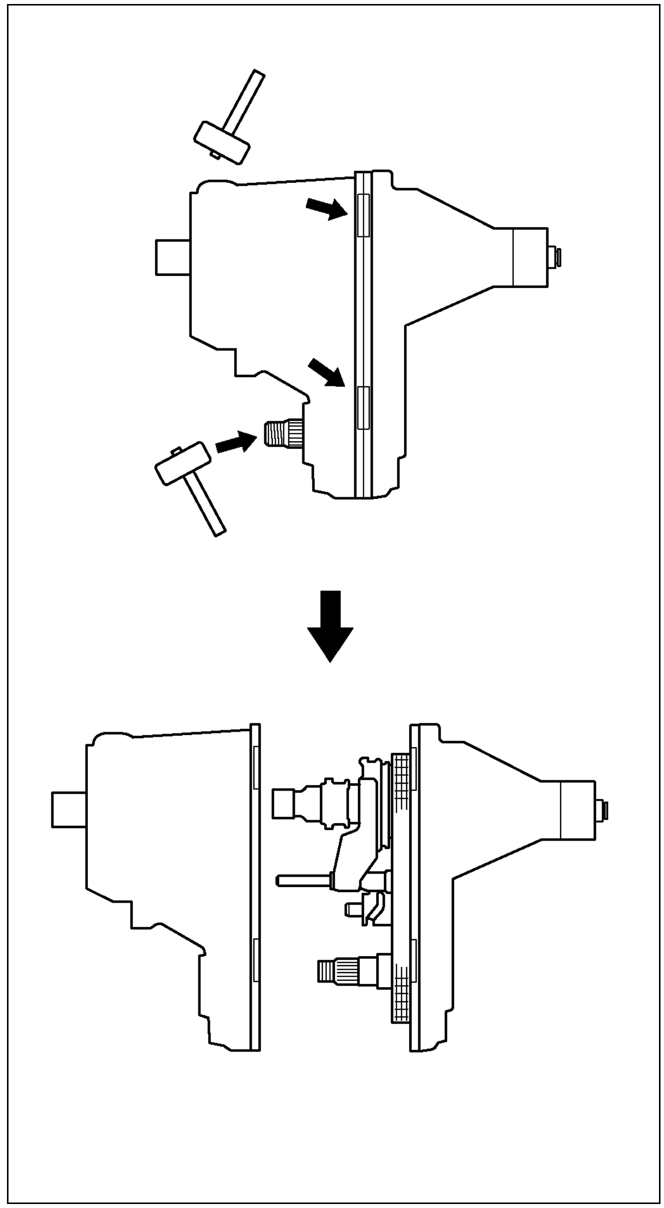
4. Use a flange holder (5-8840-0133-0) to remove the end nut from the front companion flange.



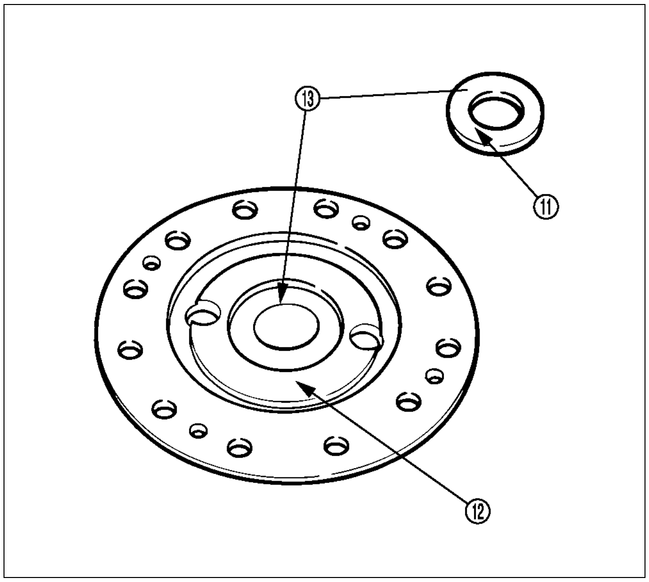
RTW77DSH000201

5. Remove the bolts attaching the rear cover to the transfer case.

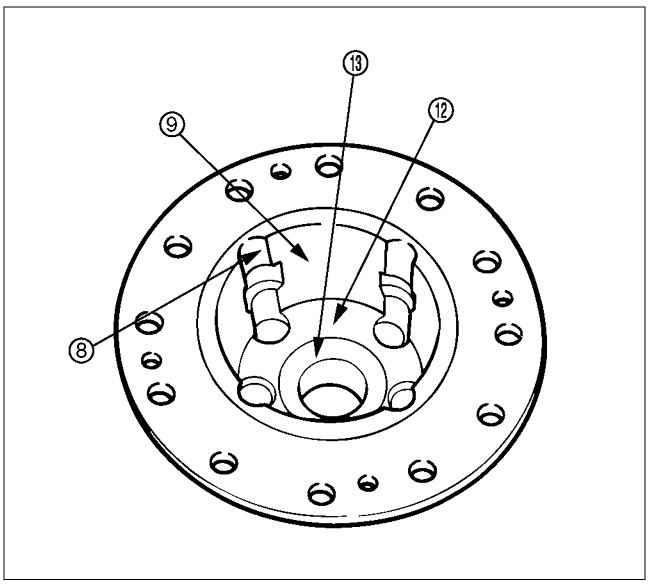
6. Strike the area around the front output shaft head and the rear cover bolt holes with a plastic hammer to remove the rear cover.



220R300022



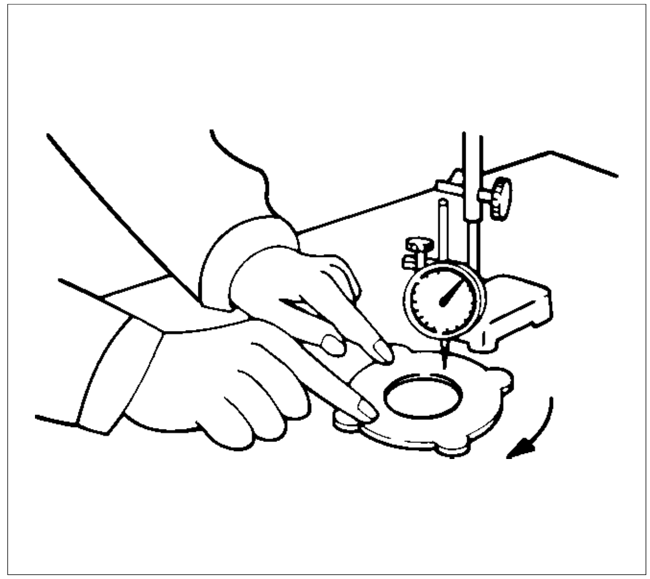
425RY00025



425RY00023

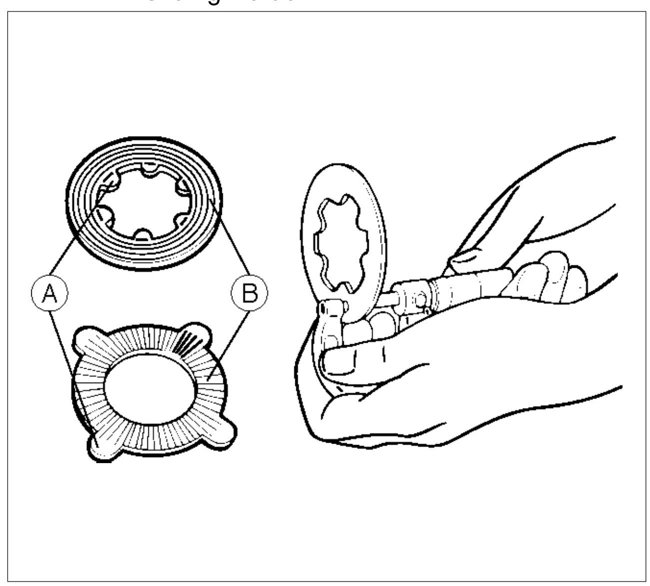
Friction Disc and Friction Plate

- Check friction disc and friction plate for distortion.
  Limit : 0.08 mm



425RS061

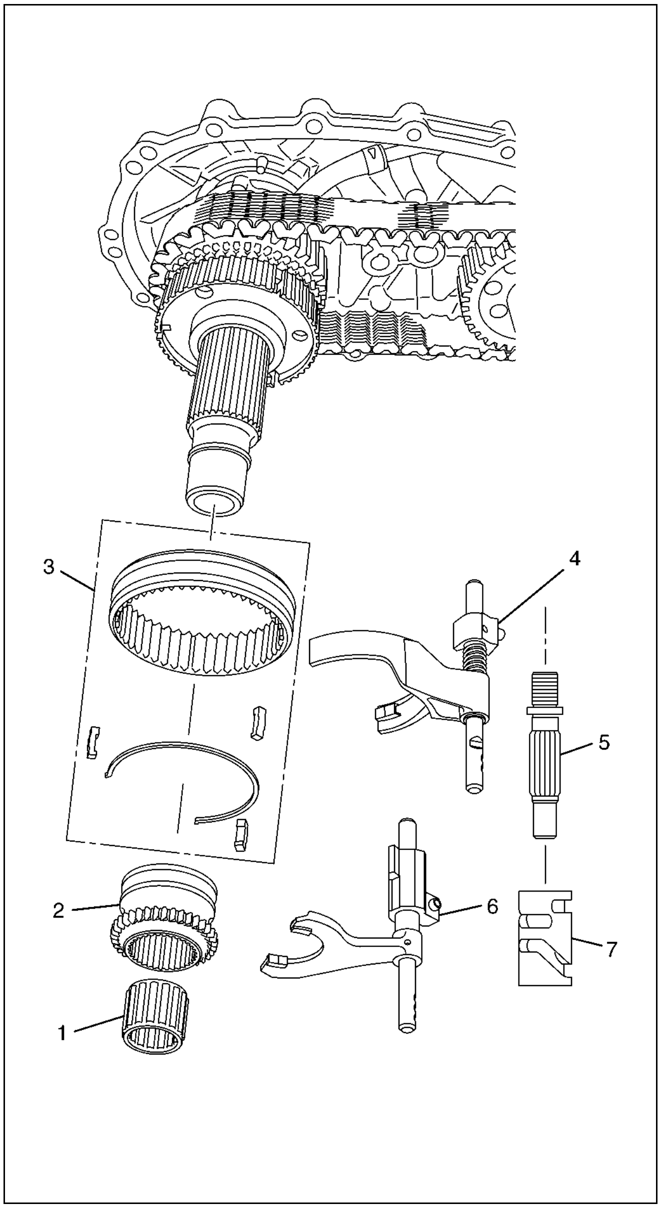
- Check friction plate and friction disc for wear.
  Limit : (A-B) 0.1 mm
  A : Protrusion Portion
  B : Sliding Portion



425RS062

- Check thrust washer for wear.
  Limit : 1.3 mm

7. Remove the parts listed below from the rear cover.
   - H-L sleeve
   - H-L shift assembly
   - 2-4 sleeve, synchronizer key, and front synchronizer spring (do not remove the rear spring)
   - 2-4 shift assembly
   - Shift drum and shift shaft
   - Sun gear needle bearing

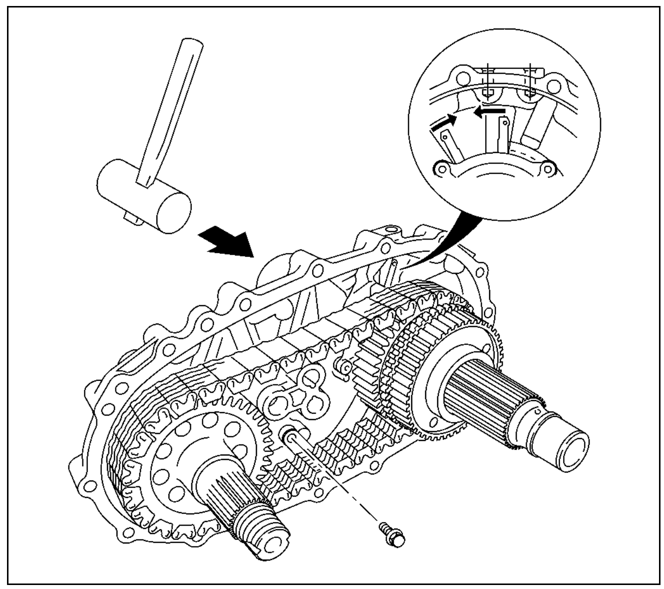


260R300001

Legend

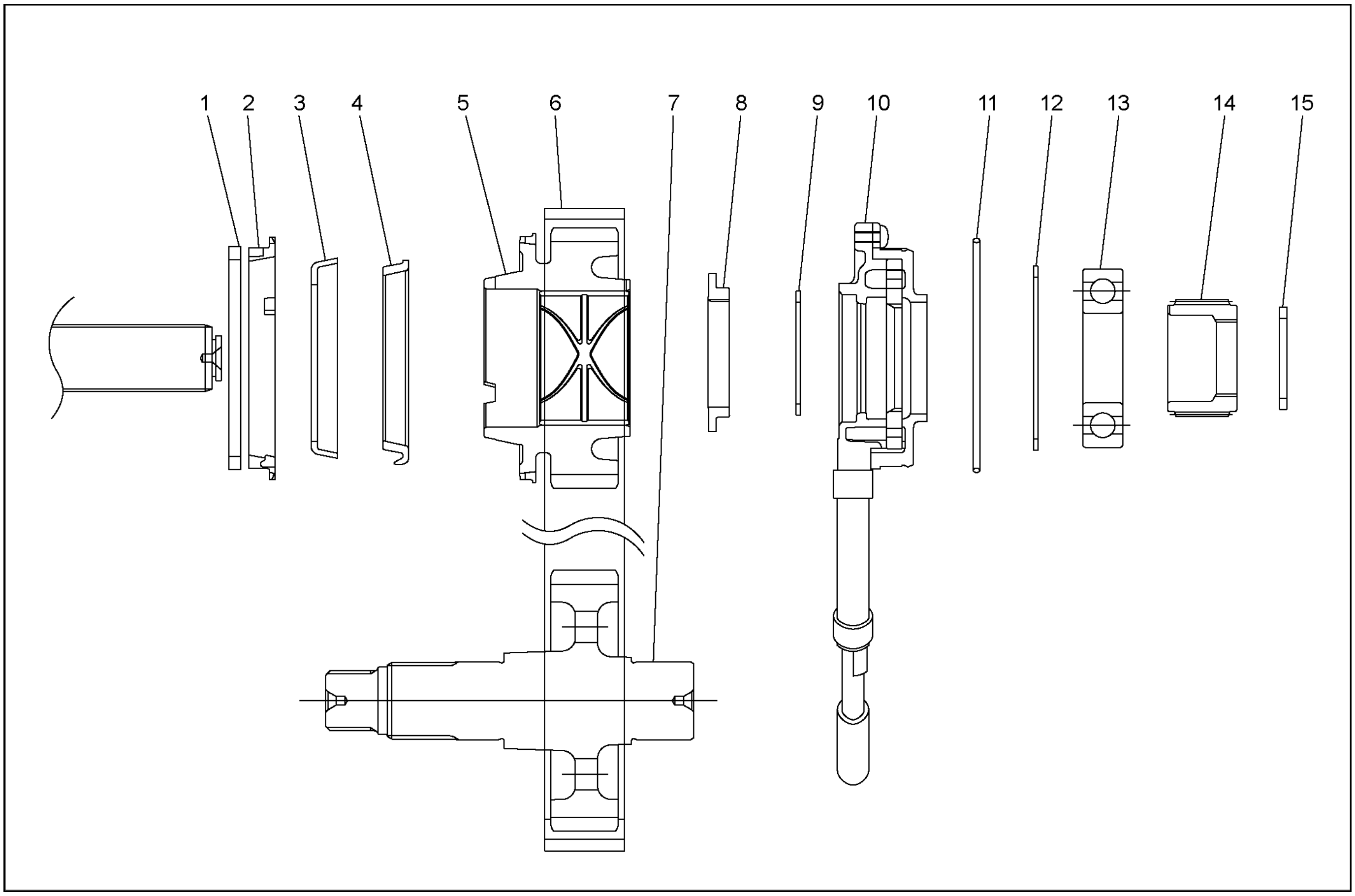
(1) Sun Gear Needle Bearing
(2) H-L Sleeve
(3) 2-4sleeve, synchronizer key, and front synchronizer spring
(4) 2-4 Shift ASM
(5) Shift Shaft
(6) H-L Shift ASM
(7) Shift Drum

8. Remove the oil pump strainer fixing bolts from the rear cover.
9. Compress the retaining ring at the rear of the chain. Strike the rear end of the main shaft with a plastic hammer to remove the main shaft, transfer chain, and front output shaft assembly from the rear cover. Be careful not to damage the oil pump strainer.



226R30001

10. Remove the transfer chain and the front output shaft from the main shaft.
11. Remove the main shaft snap ring.
12. Remove the speedometer drive gear, the ball bearings, the retaining ring, and the oil pump assembly.
13. Remove the sprocket snap ring.
14. Remove the thrust washer, the drive sprocket, the inside ring, the outside ring, the block ring, and the rear synchronizer spring.

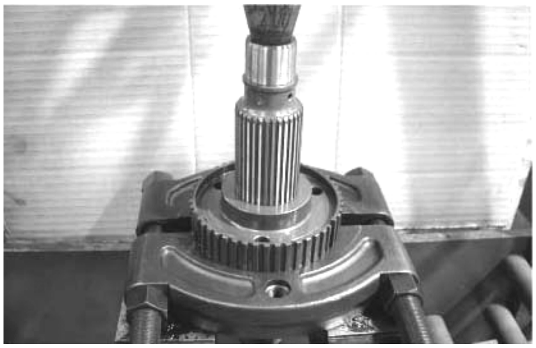


RTW37DMF000101

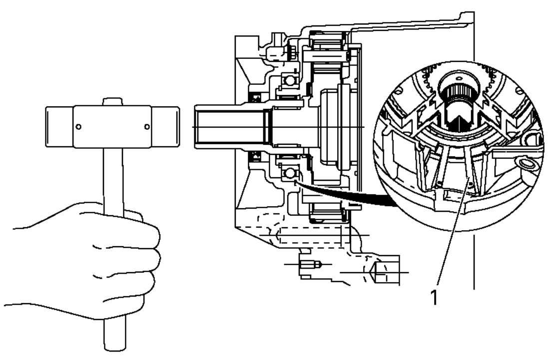
Legend

(1) Rear synchronizer spring
(2) Block Ring
(3) Outside Ring
(4) Inside Ring
(5) Drive Sprocket
(6) Transfer Chain
(7) Front Output shaft
(8) Thrust Washer
(9) Sprocket Snap Ring
(10) Oil Pump ASM
(11) Oil Pump Retaining Ring
(12) Retaining Ring
(13) Ball Bearing
(14) Speedometer Drive Gear
(15) Main Shaft Snap Ring

15. Remove the snap ring from the main shaft.
16. Use a press to remove the 2-4 hub from the main shaft.

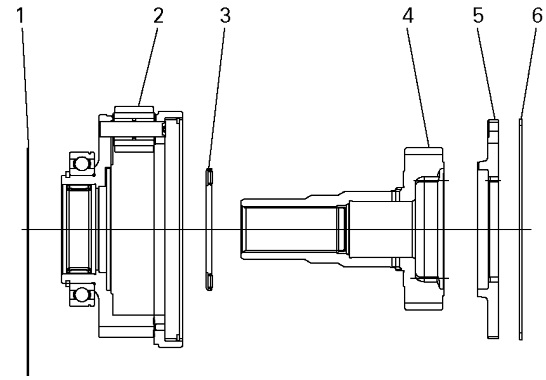


17. Spread the edges of the retaining ring (1) while lightly tapping on the sun gear input shaft end. Remove the carrier and gear assembly from the transfer case.



226R300020

18. Remove the dog teeth snap ring from the carrier and gear assembly.
19. Remove the planetary dog teeth and the sun gear input shaft together with the thrust needle bearing.

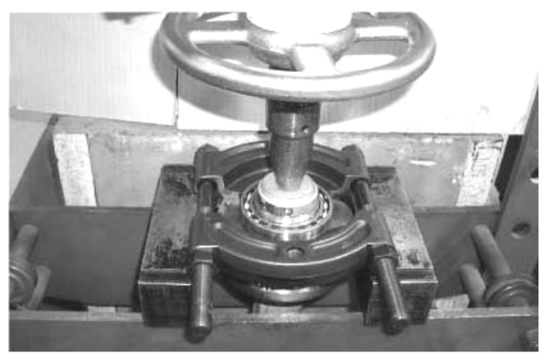


2260R300021

Legend

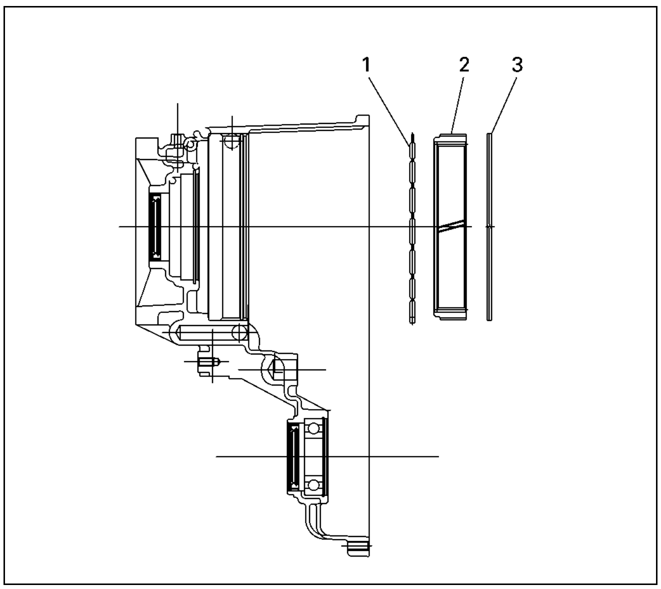
(1) Outer Retaining Ring
(2) Carrier and Gear ASM
(3) Thrust needle Bearing
(4) Sungear Input Shaft
(5) Planetary DogTeeth
(6) Dog Teeth Snap Ring

20. Remove the carrier snap ring.
21. Use a press to remove the ball bearings.



22. Use a sliding hammer (5-8840-0084-0) and a needle bearing replacer (5-8840-0027-0) to remove the needle bearing from the center of the carrier and gear assembly.

23. Remove the retaining ring (spiral type) together with the internal gear and the damper ring.

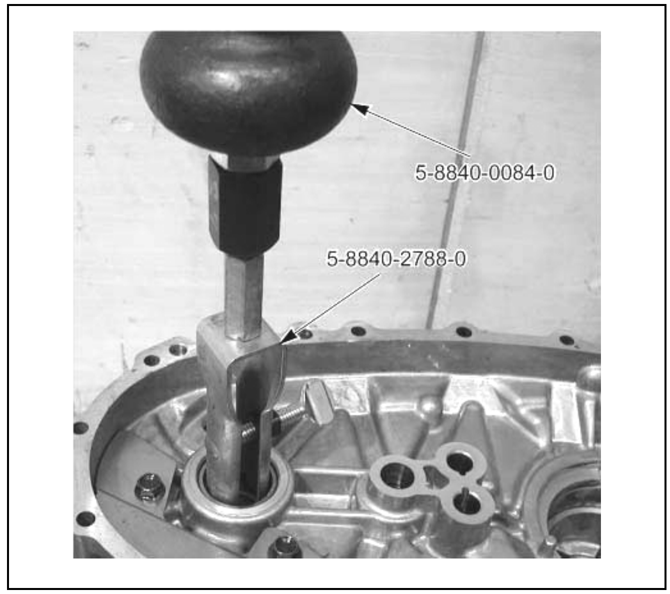


226R300004

Legend

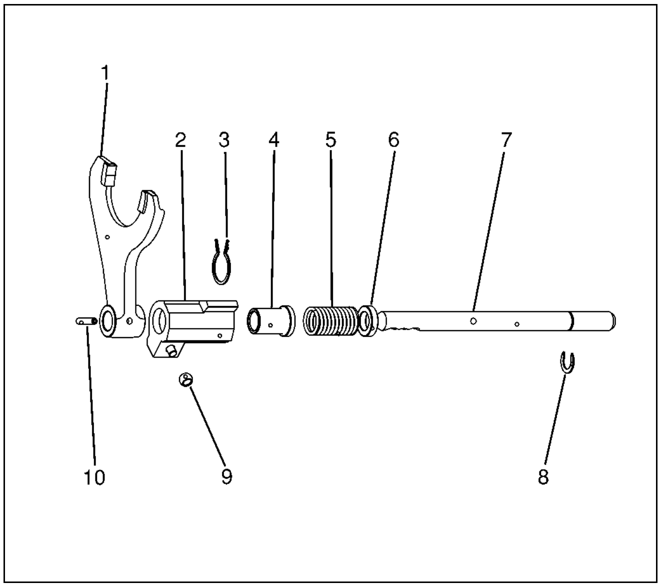
(1) Dumper Ring
(2) Internal Gear
(3) Retaining Ring

24. Remove the snap ring.
25. Use a press to remove the front output shaft ball bearings.
26. Remove the oil pump wire snap ring from the rear cover.
27. Use a sliding hammer (5-8840-0084-0) and a needle bearing replacer (5-8840-2788-0) to remove the needle bearing from the front output shaft.



P1010023

Internal Component Disassembly and Reassembly



226R300017

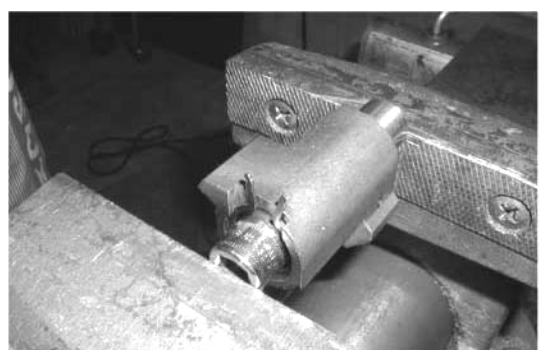
Legend

(1) Shift Arm
(2) Shift Block Assembly
(3) Inner Retaining Ring
(4) Collar (Front)
(5) Shift Block Spring
(6) Collar (Rear)
(7) Shift Rod
(8) Outer Snap Ring
(9) Guide Roller
(10) Spring Pin

H-L Shift Disassembly

1. Remove the guide roller.
2. Use a vise to compress the H-L shift spring (inside the assembly)

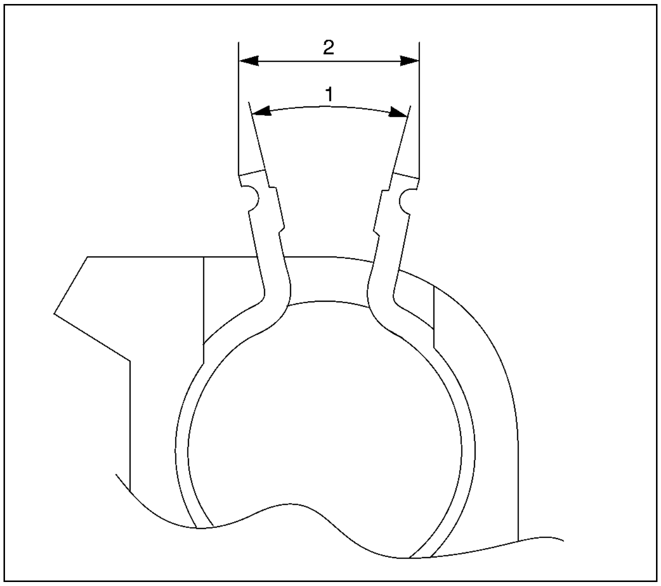
3. Remove the outer snap ring.
4. Remove the shift block assembly from the shift rod.



5. Use a socket and a vise to compress the shift block spring (inside the assembly)
6. Remove the inner retaining ring.
7. Remove the collar (rear)
8. Remove the shift block spring.
9. Remove the collar (front)
10. Remove the shift block assembly
11. Remove the spring pin.
12. Remove the shift arm.

H-L shift reassembly

1. Install the shift arm to the shift rod.
2. Install the spring pin. The top of the pin must be flush with the surrounding surface (no projection).
3. Install the front collar, the spring, and the rear collar to the shift block in that order.
4. Use a socket and a vise to compress the shift block spring.
5. Install the inner retaining ring. Be sure that the arm aperture width is within the specified limit.



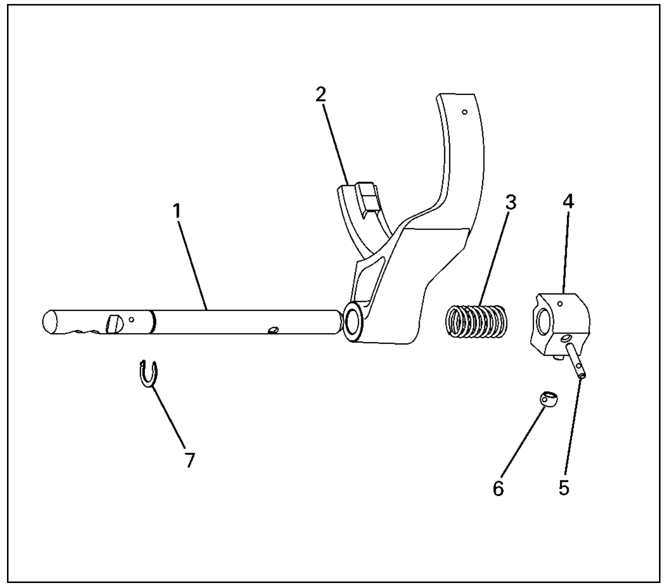
226R300014

Legend

(1) 25.62°
(2) 14.1mm

6. Install the shift lock assembly to the shift rod.
7. Use a socket and a vise to compress the H-L shift spring.
8. Install the outer snap ring.
9. Install the guide roller.

2-4 shift ASM



226R300016

Legend

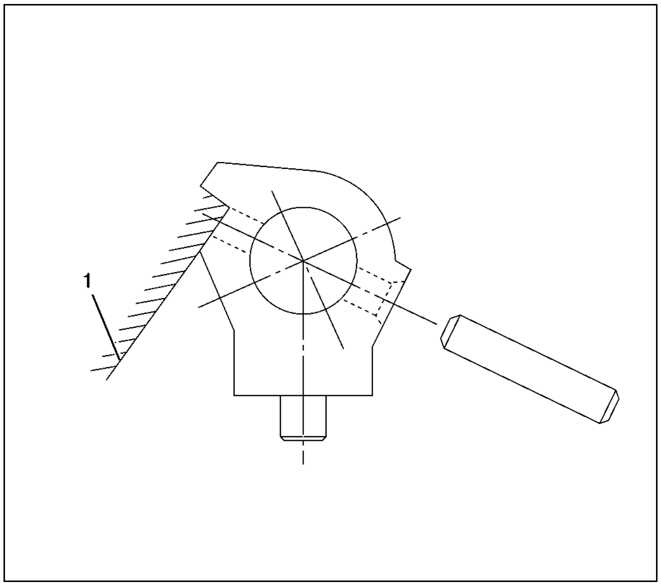
(1) Shift Rod
(2) Shift Arm
(3) Spring
(4) Shift Block Assembly
(5) Spring Pin
(6) Guide Roller
(7) Snap Ring

2-4 shift disassembly

1. Remove the guide roller.
2. Compress the spring and remove the snap ring.
3. Remove the shift arm.
4. Remove the spring.
5. Remove the spring pin.
6. Remove the shift block assembly.
7. Remove the shift rod.

2-4 shift reassembly

1. Install the shift block assembly to the shift rod.
2. Install the spring pin. The head of the pin must not project beyond the surface (1) of the shift block.



226R300015

3. Install the spring.
4. Install the shift arm.
5. Compress the spring and install the snap ring.
6. Install the guide roller.

Oil pump disassembly

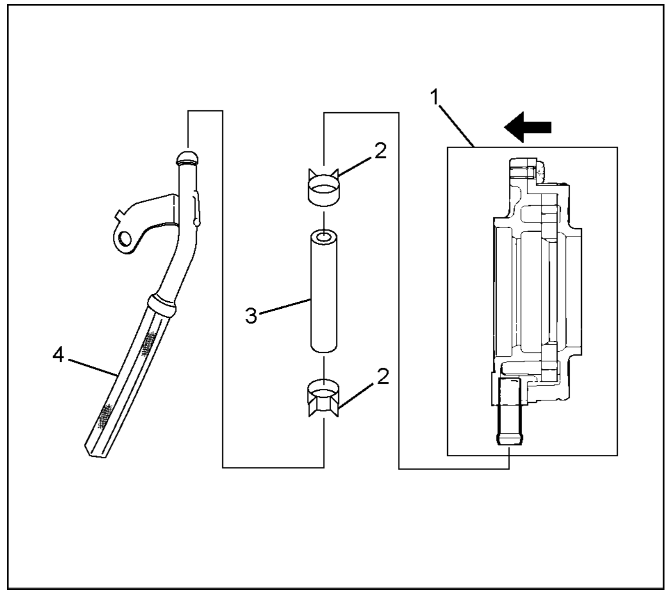
1. Remove the clamps securing the screen.
2. Remove the screen.
3. Remove the clamps securing the hose.
4. Remove the hose.

NOTE: To maintain and protect oil pump function, the pump is constructed so that it cannot be disassembled.

Under no conditions attempt to disassemble the pump.

Oil pump reassembly

1. Tighten the clamps to secure the hose.
2. Tighten the clamps to secure the screen.
   NOTE: Be careful in the direction of clamps.



RTW37DSH000101

Legend

(1) Oil Pump Assembly
(2) Clamp
(3) Hose
(4) Screen Assembly

Inspection and Repair

1. Make the necessary repair or parts replacement if wear, damage or any other abnormal conditions are found during inspection.
2. Wash all parts thoroughly in clean solvent. Be sure all old lubricant, metallic particles, dirt, or foreign material are removed from the surfaces of every part. Apply compressed air to each oil feed port and channel in each case half to remove any obstructions or cleaning solvent residue.

Inspection and Repair (Transfer Case Assembly)

When wear, damage, or any other defects are observed during the inspection, the part or parts must be repaired or replaced. Wash all the parts with clean detergent, and check that old oil, metallic particles, dirt, or foreign materials are completely removed. Blow the air into oil holes and grooves to remove foreign materials or residual detergent.

Chain

- Check whether the face that contacts the sprocket is free from excessive wear or damage. If defects are observed, replace the part.
- If the chain interference mark is found on the inside wall of the transfer cover or the chain is so slack that a skipped engagement occurs between the chain and sprocket, replace the chain.

Sprocket

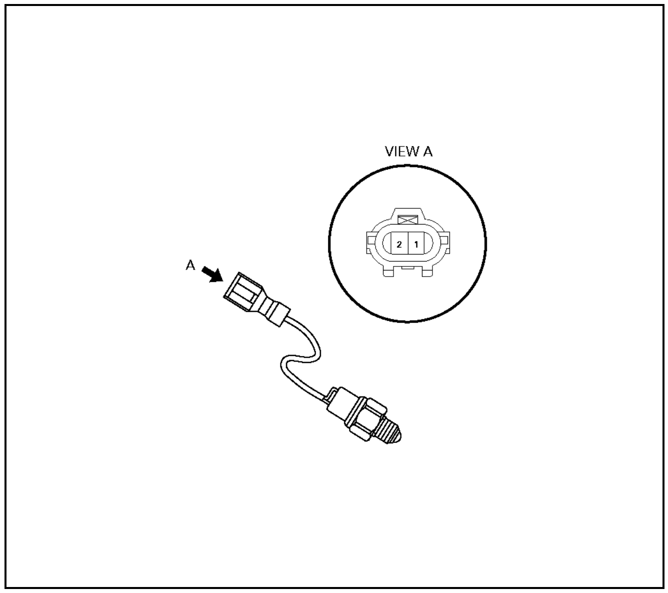
- Check whether the sprocket tooth surface is excessively worn or damaged, and there is evidence of burrs, chipping, wear, or damage on the gear spline. Remove minor flaws or scratches with oil stone. If excessive wear or damage is observed, replace the part.
- If excessive wear or damage is observed on the sprocket inside sliding surface, replace the part.

Gear

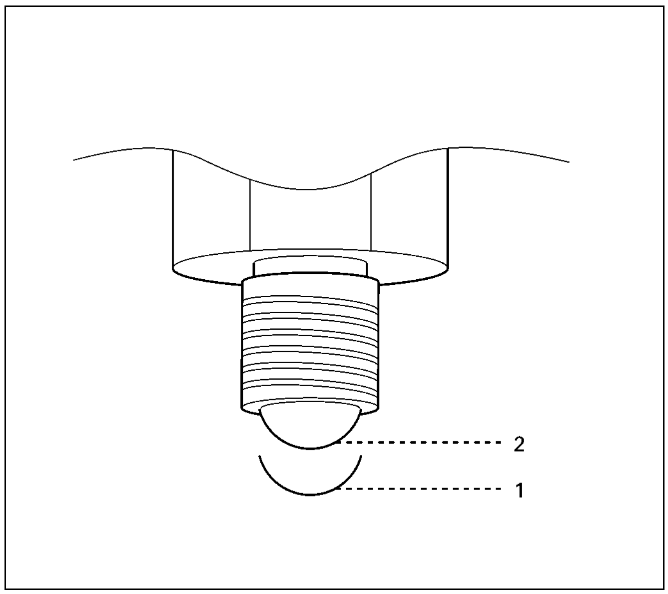
- Check whether the gear tooth surface is excessively worn or damaged, and there is evidence of burrs, chipping, wear, or damage on the gear spline.
- Remove minor flaws or scratches with oil stone. If excessive wear or damage is observed, replace the part.

2-4 and Neutral Switch

- Check the continuity of 2-4 and Neutral switch.
  If defects are observed, replace the 4H and 4L switch.



221R300001



261R300003

Switch Stroke	2-4 Switch Signal	Neutral Switch Signal
	Terminal 1 to 2	Terminal 1 to2
1	Open	Close
2	Close	Open

Oil Pump

- Remove foreign materials from the strainer. If the strainer is damaged, replace it.

If the area into which the shaft is inserted is excessively worn or damaged, replace the oil pump assembly.

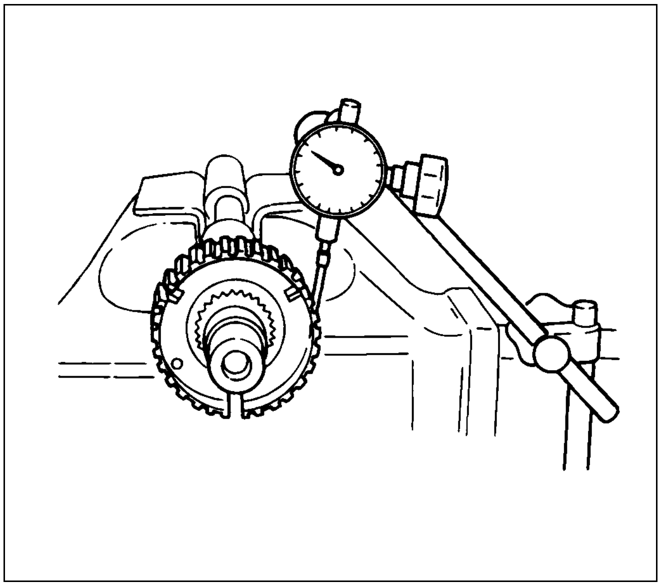
Clutch Hub Spline Play

- Set a dial indicator to the clutch hub to be measured.
- Move the clutch hub as far as possible to both the right and the left.
  Note the dial indicator reading.
- If the measured value exceeds the specified limit, the clutch hub must be replaced.

Clutch hub spline play

Standard: 0-0.1 mm (0-0.004 in)

Limit: 0.2 mm (0.008 in)



226RS042

Bearings

1. Inspect the condition of all the needles and ball bearings. Wash bearings thoroughly in a cleaning solvent. Apply compressed air to the bearings.

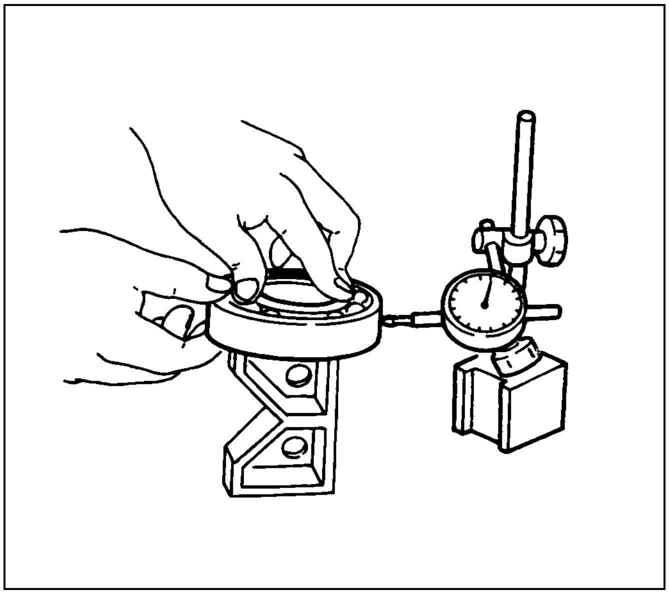
NOTE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the rollers.

2. Lubricate the bearings with a light oil and check them for roughness by slowly turning the race by hand.

Ball Bearing Play

1. Use a dial indicator to measure the ball bearing play.
2. If the measured value exceeds the specified limit, the ball bearing must be replaced.

Limit: 0.2 mm (0.008 in)



226R3043

Synchronizers

The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled.

Clean synchronizer components with clean solvent and air dry.

Inspect the components for the following:

- Teeth for wear, scuffs, nicks, burrs or breaks.
- Keys and springs for wear, cracks or distortion, replace if these conditions are present.
- If scuffed, nicked or burred conditions cannot be corrected with a soft stone or crocus cloth, replace the component.

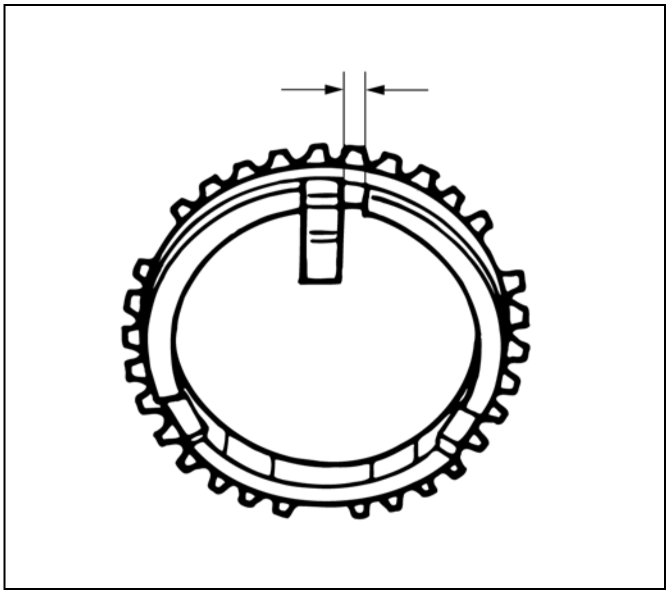
Block Ring and Insert Clearance

1. Use a vernier caliper to measure the clearance between the block ring and the insert.
2. If the measured value exceeds the specified limit, the block ring and the insert must be replaced.

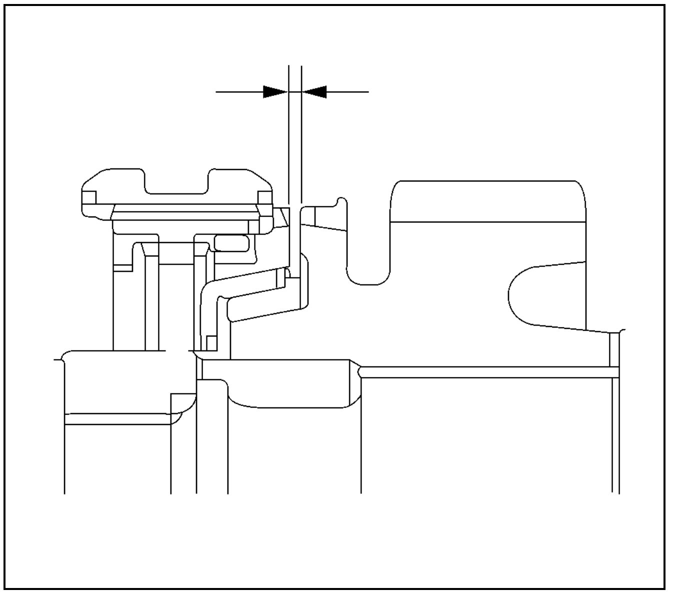
Block ring and insert clearance

Standard: 2.46-2.74 mm (0.097-0.108 in)

Limit: 3.0 mm (0.118 in)



226RS037



226R300019

2WD-4WD Synchronizer (3-Cone)

1. Use a thickness gauge to measure the clearance between the block ring and the dog teeth.
2. If the measured value exceeds the specified limit, the 2WD-4WD synchronizer assembly must be replaced.

Block ring and dog teeth clearance

Standard: 1.5 mm (0.059 in)

Limit: 0.8 mm (0.031 in)

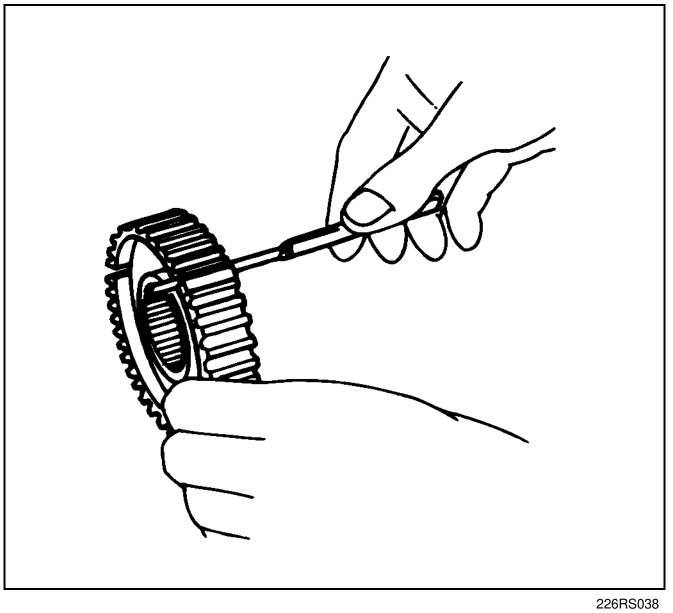
Clutch Hub and Insert Clearance

1. Clutch Hub and Insert Clearance
2. Use a thickness gauge to measure the clearance between the clutch hub and the insert.
3. If the measured value exceeds the specified limit, the clutch hub and the insert must be replaced.

Clutch hub and insert clearance

Standard: 0.01-0.19 mm (0.0004-0.0075 in)

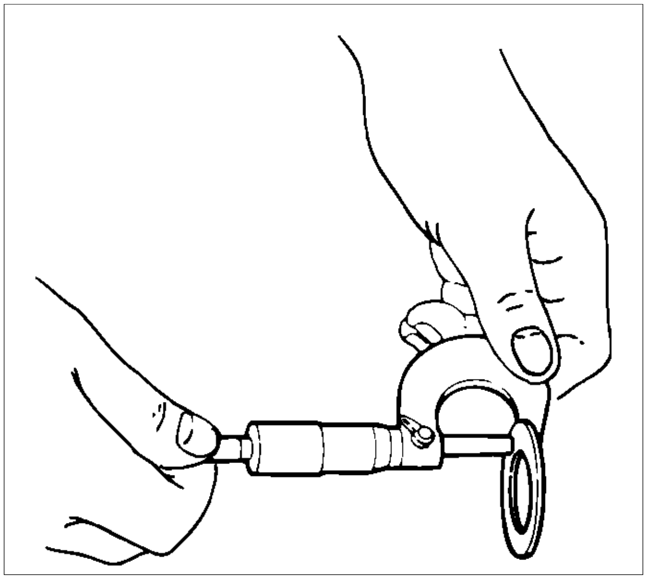
Limit: 0.3 mm (0.012 in)

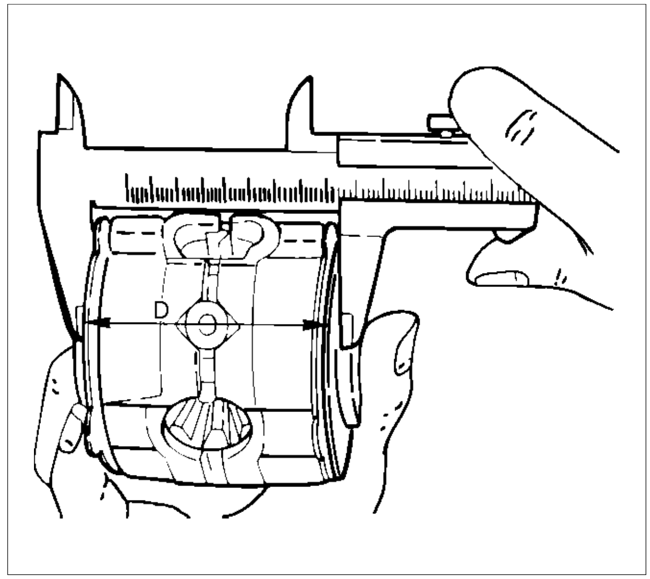


226RS038

Detent Springs

1. Inspect the springs for distortion, cracks or wear. Replace if these conditions are present.


425RS063



425RS065

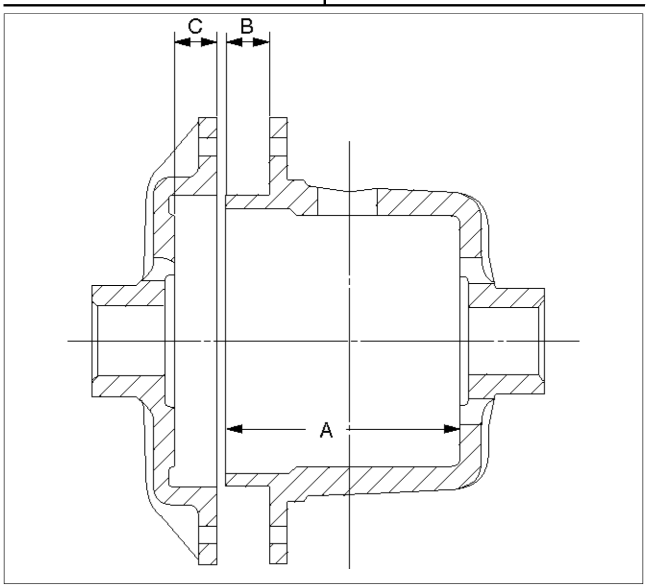
Reassembly

Adjustment of Clearance between Friction Disc and Plate

1. Measuring depth of differential case

mm(in)

Standard (A-B)	80.58 (3.17)
(C)	10.58 (0.42)



425RS064

2. Measuring overall length of pressure ring, friction disc and plate assembly
   - Assemble pinion shaft with pressure ring, then friction disc and plate.
   - Measure length between plates at both ends over V-shape groove. (D)
3. After A, B, C and D dimensions are measured, perform adjustment with the following procedure.
   - Measure spring plate :
     1.75 mm (0.069 in) × 4 pcs (E)
   - Measure thickness of plate spring
     Standard dimension :
     1.75 mm (0.069 in) × 2 pcs (F)
4. Select a friction disc or plate so that ((A-B+C) - (D+E) = 0.06 to 0.20 mm (0.002 to 0.008 in.) and also the difference in total dimension of friction disc and plate and spring plate (left/right side) does not exceed 0.05 mm (0.002 in.).
   Thickness : 1.65, 1.75, 1.85 mm (0.065, 0.069, 0.073 in)

Adjusting Backlash of Side Gear in Axial Direction

1. Measuring depth of differential case

mm(in)

Standard (F-B)	82.03 (3.23)
(G)	12.03 (0.47)

Detent Spring Free Length

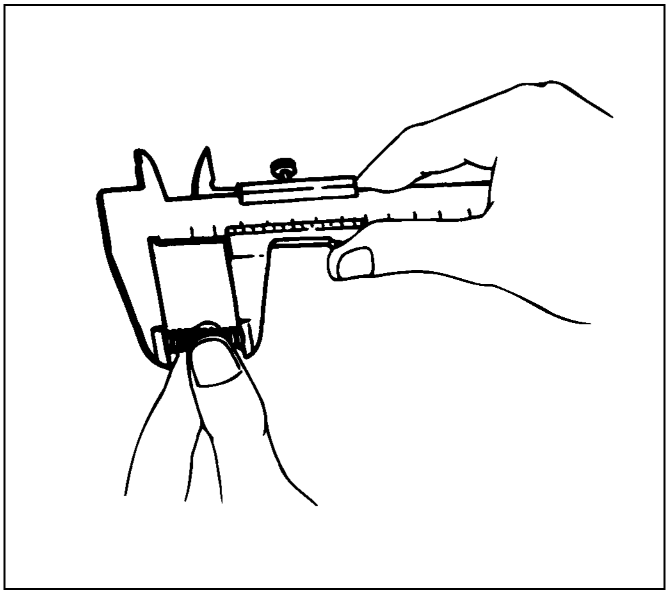
1. Use a vernier caliper to measure the detent spring free length.
2. If the measured value is less than the specified limit, the detent spring must be replaced.

Detent spring free length

Detent ball

Standard: 23.4 mm (0.92 in)

Limit: 22.8 mm (0.90 in)



220RW035

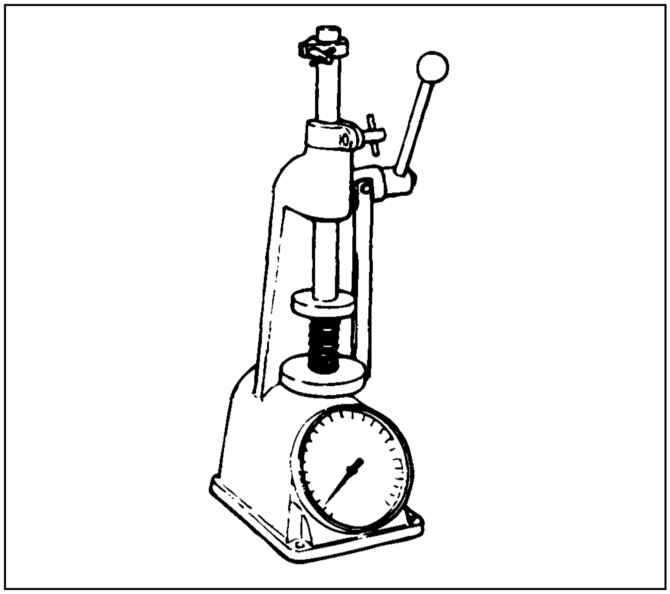
Detent Spring Tension

1. Use a spring tester to measure the detent spring tension.
2. If the measured value is less than the specified limit, the detent spring must be replaced.

Detent ball

Compressed height: 18.7 mm (0.736 in)

Standard: 68.6-88.2 N (7.0-9.0 kg/ 15.4-19.8 lb)



220RS013

Shift Arm

1. Inspect the shift arms for wear, distortion or scoring. Replace if these conditions are present.

Shift Arm Thickness

1. Use a micrometer to measure the shift arm thickness.
2. If the measured value is less than the specified limit, the shift arm must be replaced.

H-L Shift arm thickness

Standard: 7.6-7.85 mm (0.299-0.309 in)

Limit: 7.0 mm (0.276 in)

2-4 Shift arm thickness

Standard: 9.6-9.85 mm (0.378-0.388 in)

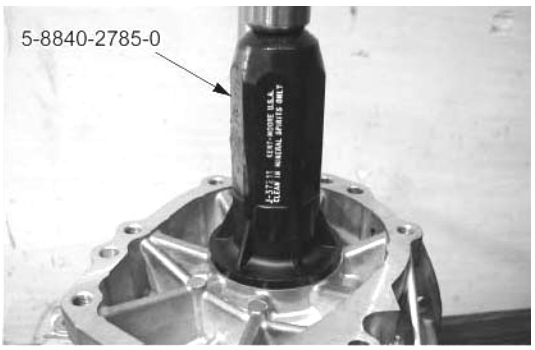
Limit: 9.0 mm (0.354 in)

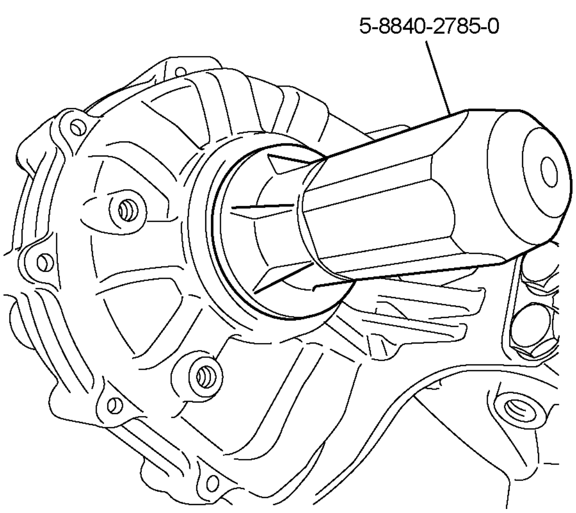
Reassembly

Transfer Reassembly

The rear cover oil seals and the rear output shaft ball bearings cannot be reused. They must be replaced with new ones when the transfer is reassembled.

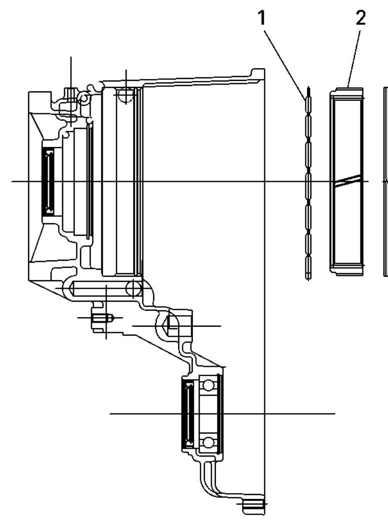
1. Use an oil seal installer (5-8840-2785-0) to press the new input shaft and/or front output shaft oil seals into place (If replacement is required).





RTW77DSH000301

2. Use a press to install the ball bearings to the front output shaft. Be sure that the bearings are fully inserted and then install the snap ring.
3. Install the damper ring and the internal gear to the transfer case. Be sure that the damper ring is between the internal gear and the case.

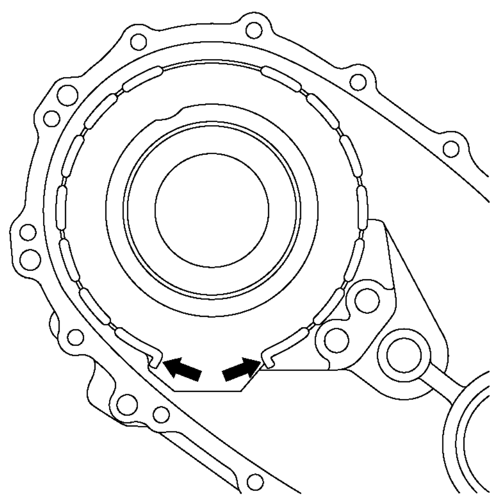


226R300004

Legend

(1) Dumper Ring
(2) Internal Gear
(3) Retaining Ring

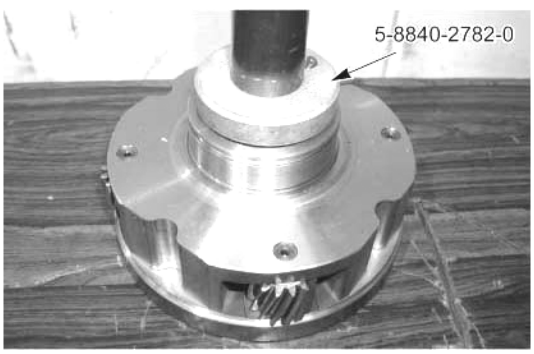
Note the direction of the dumper ring installation as figure.



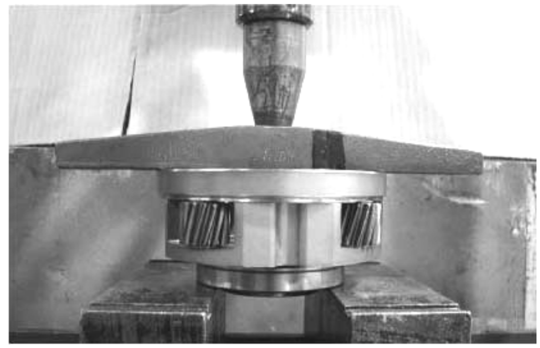
226R300025

4. Use a press and an installer (5-8840-2784-0) to hold the internal gear against the damper ring. Install the retaining ring (spiral type).

5. Use a press and an installer (5-8840-2782-0) to force the needle bearing fully into the carrier and gear assembly.

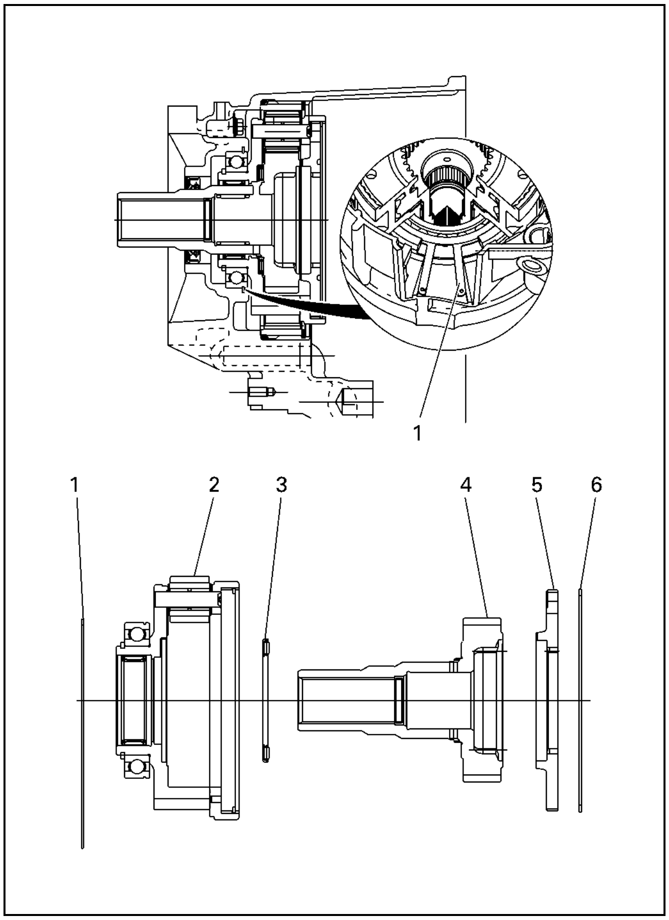


6. Use a press and an appropriate special tool to force the ball bearings fully into the carrier and gear assembly.



7. Install the carrier snap ring.
8. Install the thrust needle bearing, the sun gear input shaft, the needle bearing, the planetary dog teeth, and the dog teeth snap ring to the carrier and gear assembly in that order.
9. Install the outer retaining ring to the transfer case
10. Use a pair of snap ring pliers to install the carrier and gear assembly.

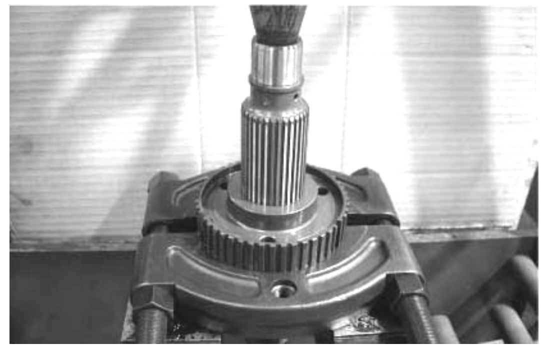
NOTE: Be sure that the outer retaining ring fits snugly in its groove.



Legend

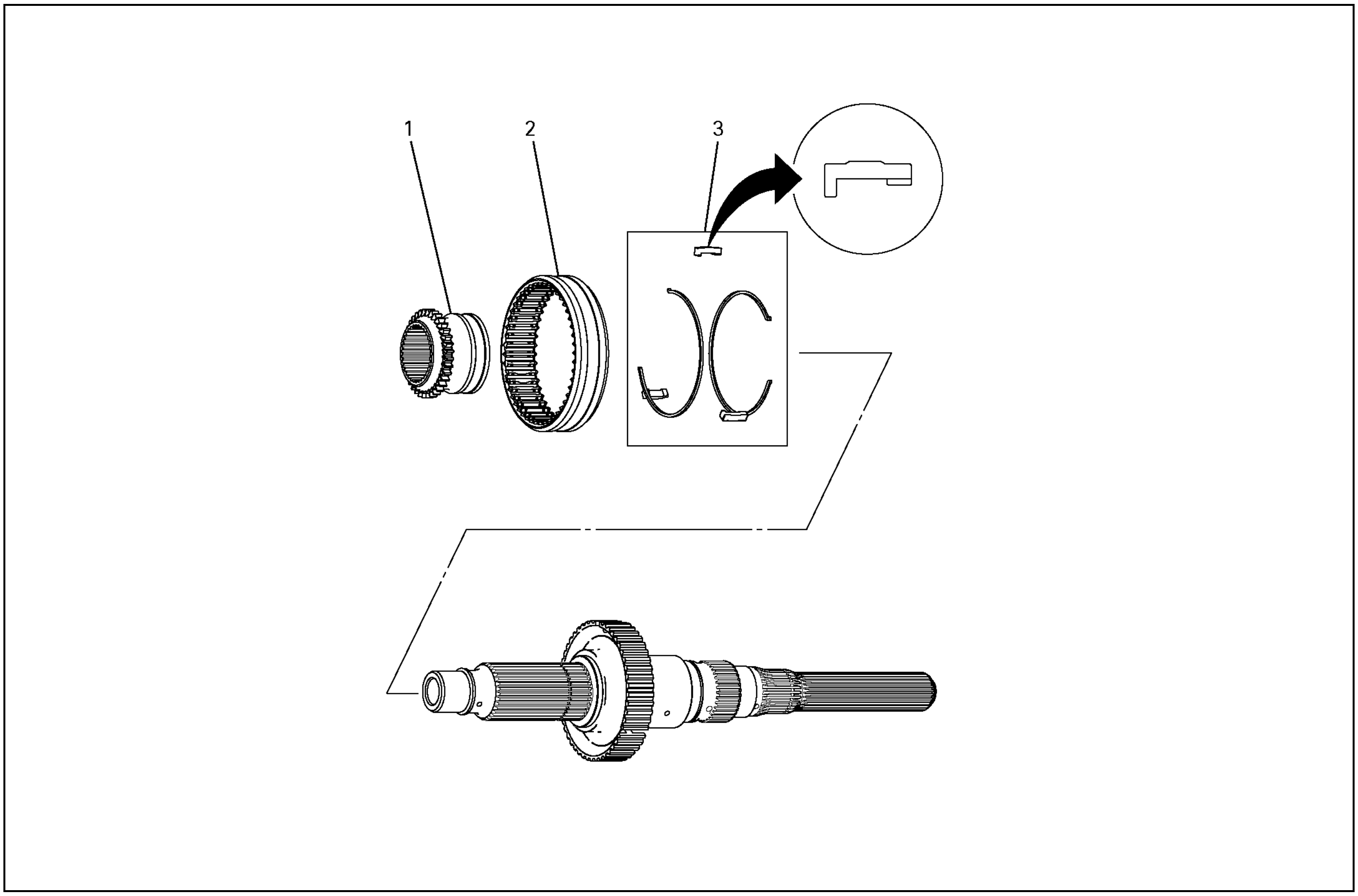
(1) Retaining Ring
(2) Carrier and Gear ASM
(3) Thrust Needle Bearing
(4) Sungear Input Shaft
(5) Planetary Dog Teeth
(6) Dog Teeth Snap Ring

11. Use a press to install the 2-4 hub.



12. Install the hub snap ring.
13. Install the synchronizer key springs, the synchronizer key, and the 2-4 sleeve to the 2-4 hub. The key and the open end of the springs must be facing in the opposite direction.

14.Insert the H-L sleeve into the main shaft.



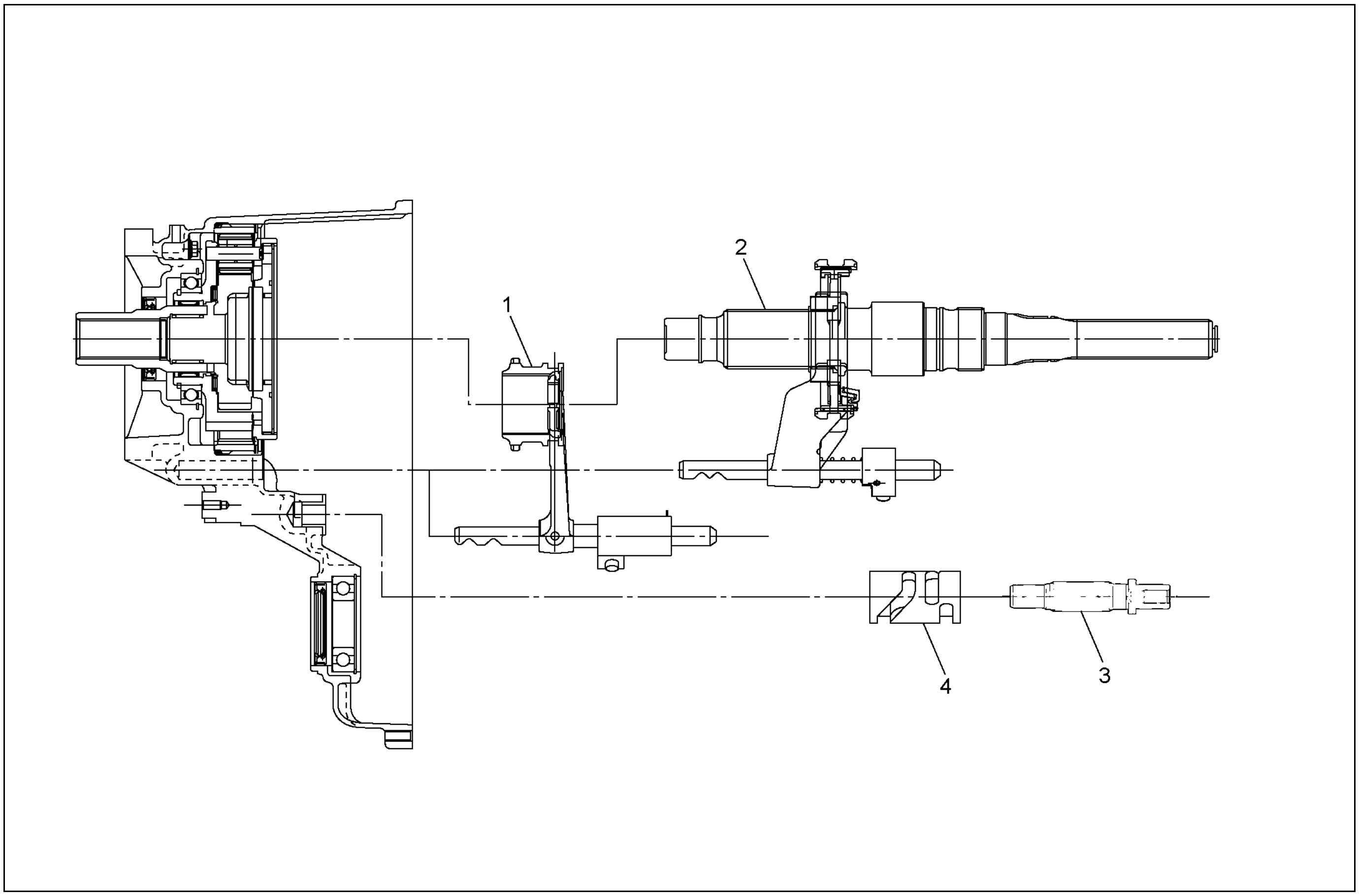
226R300023

Legend

(1) H-L Sleeve
(2) 2-4 Sleeve
(3) Synchronizer Key and Key Spring

15.Install the sleeve to the H-L shift assembly.
16.Install the sleeve to the 2-4 shift assembly.
17.Coat the area around each of the shift assembly insertion holes (transfer case) with transfer oil.
18.Install the main shaft together with the H-L shift assembly and the 2-4 shift assembly to the shift drum.

19.Align the shift shaft splines with the shift drum and install the shafts to the drum.

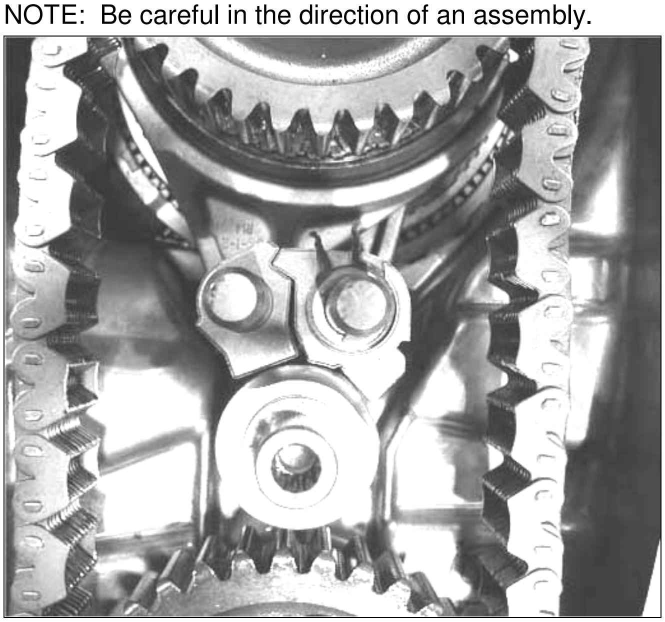


RTW320MF000201

Legend

(1) H-L Sleeve and Shift ASM
(2) 2-4 Sleeve ASM with Main Shaft and Shift ASM
(3) Shift Shaft
(4) Shift Drum

NOTE: Be careful in the direction of an assembly.



P1010041/020124

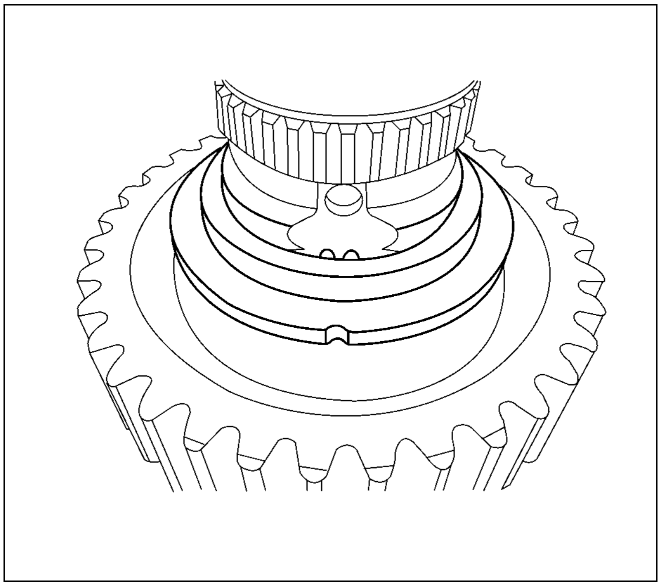
20.Coat the main shaft with oil.

21.Align the block ring, the outside ring, and the inside ring with the 2-4 hub assembly and install them.

22.Assemble the sprocket, transfer chain, and front output shaft.

23.Install the sprocket, transfer chain, and front output shaft to the main shaft and the transfer case.

24. Align the sprocket thrust washer with the main shaft groove and install it.

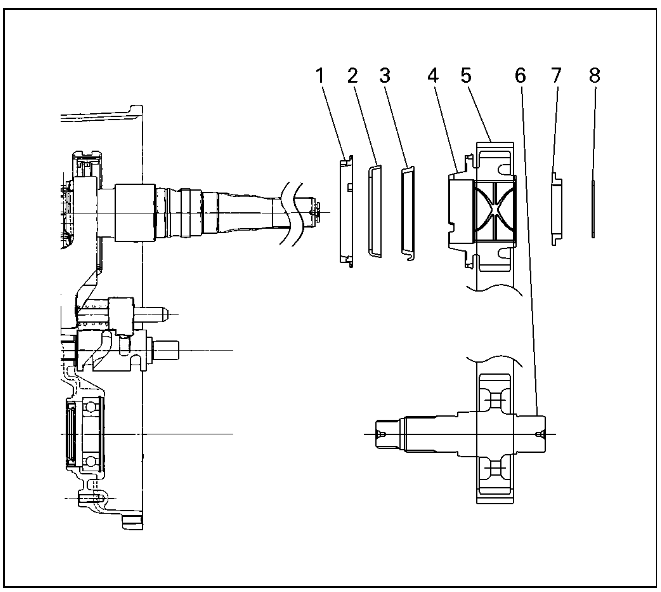


226R300009

25. Select a snap ring that will allow minimum axial play. Insert it to the main shaft installation groove.

mm (in)

Snap ring thickness	Identification color
2.15 (0.085)	Red
2.10 (0.083)	Not colored
2.05 (0.081)	Blue
2.00 (0.079)	White



226R300008

Legend

(1) Block Ring
(2) Outside Ring
(3) Inside Ring
(4) Sprocket
(5) Transfer Chain
(6) Front Output Shaft
(7) Thrust Washer
(8) Snap Ring

26. Measure the snap ring external diameter. If the measured diameter is outside the specified range, a larger or smaller snap ring must be used.

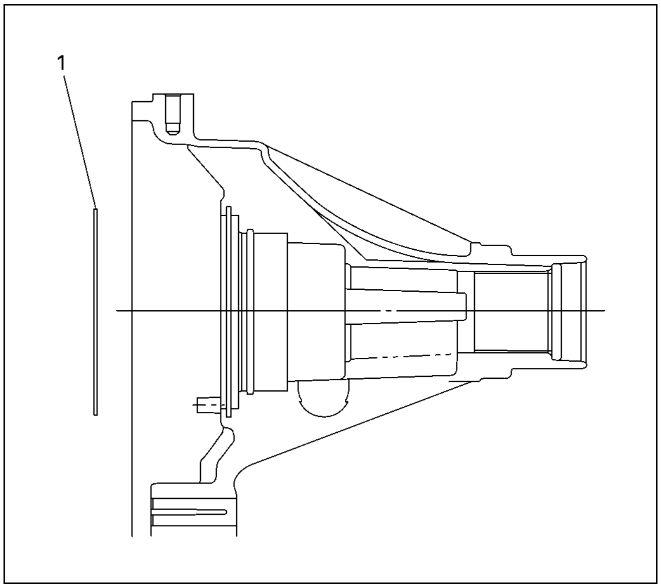
Snap ring outside diameter (Standard):

53.0 ± 0.5 mm (2.09 ± 0.02 in)

27. Position the rear cover so that its mating surfaces are facing up.

28. Use a press and an installer (5-8840-2783-0) to install the front output shaft needle bearing. The installer must be aligned with the bearing manufacturer's name (stamped into the bearing).

29. Install the oil pump wire snap ring to the rear cover.



Legend

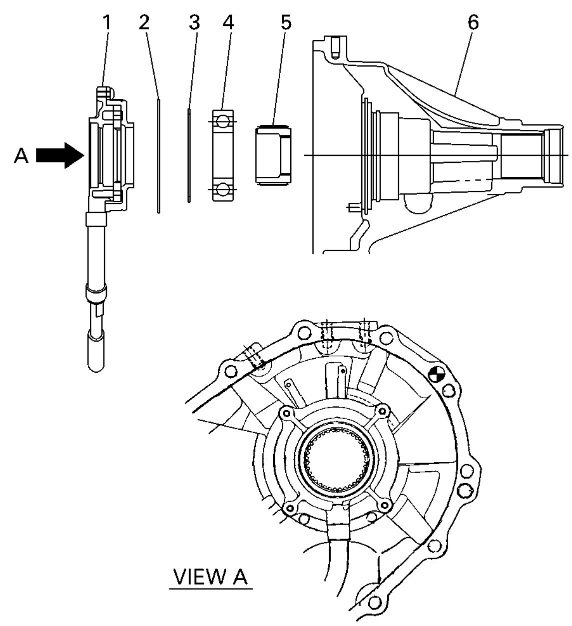
(1) Wire Snap Ring

30. Temporarily install the speedometer drive gear to the inside of the rear cover. Pay close attention to installation direction.
31. Use a press and an installer (9-8522-1268-0) to install the rear output shaft ball bearings. Do not drive the ball bearings into place with a hammer.

32. Install the rear output shaft retaining ring.
33. Place the oil pump in its specified position.
34. Secure the oil pump strainer to the rear cover and tighten the bolts to the specified torque.

Oil pump and rear cover bolt torque:

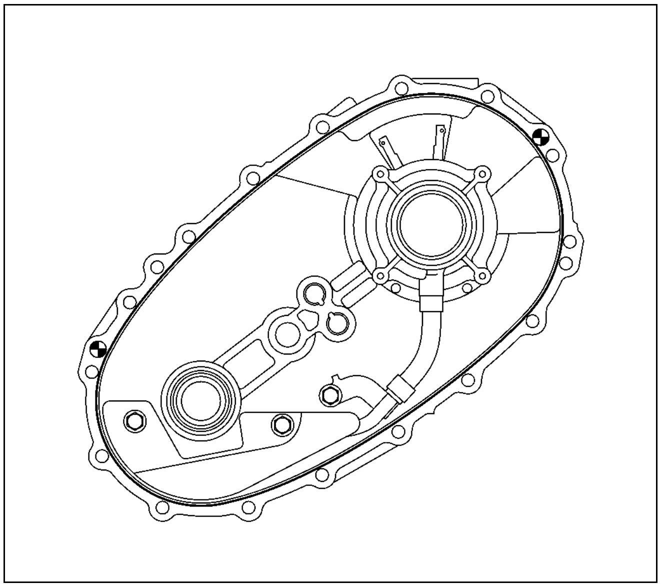
15 N·m (1.5 kgf·m/11 lb·ft)



Legend

(1) Oil Pump Assembly
(2) Wire Snap Ring
(3) Retaining Ring
(4) Ball Bearing
(5) Speedometer Gear Drive Gear
(6) Rear Cover

35. Apply Loctite FMD 127 to the mating surfaces of the rear cover and the transfer case. Be sure that the Loctite is evenly applied to the inside surfaces of the bolt holes with no gaps.



226R300011

36. Install the rear cover to the transfer case and tighten the bolts to the specified torque.

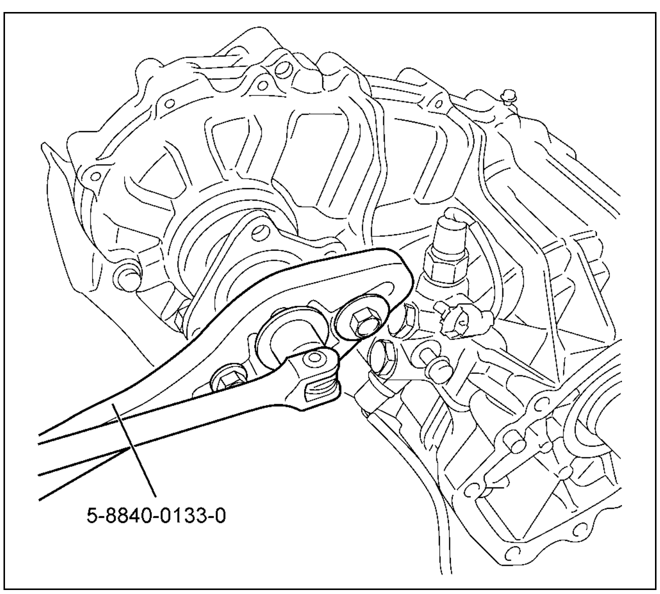
Rear cover and transfer case bolt torque:

22 N·m (2.2 kgf·m/16 lb·ft)

37. Apply engine oil to the companion flange O-ring.
38. Install the O-ring to the front output shaft.
39. Secure the front companion flange with a flange holder (5-8840-0133-0).
40. Install the end nuts and tighten them to the specified torque.

Front companion flange end nut torque:

137 N·m (14.0 kgf·m/101 lb·ft)



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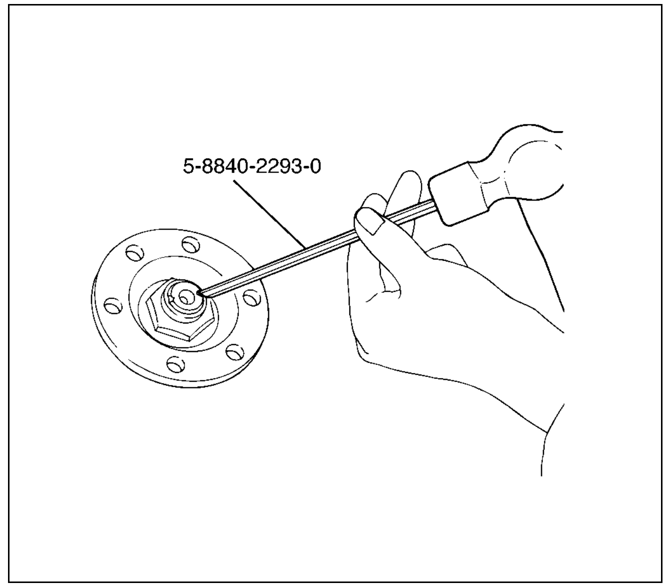
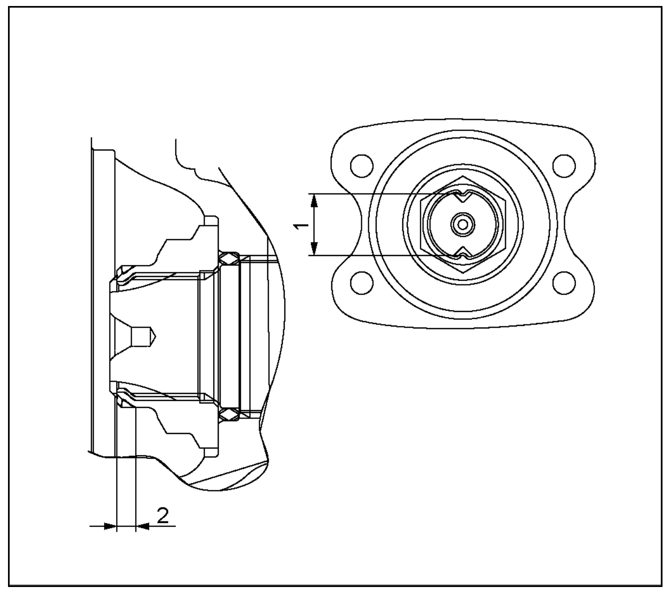
41. Use a punch (5-8840-2293-0) to caulk the front companion flange end nut.



226R300012



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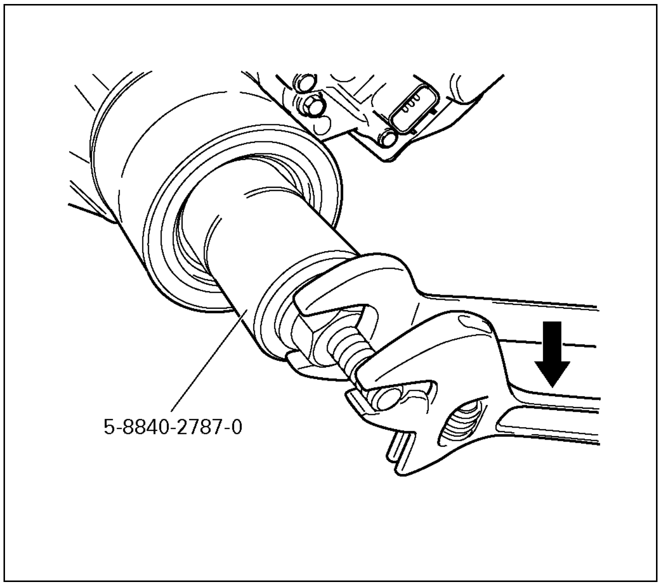
Legend

(1) MAX 26mm (1.02 in)
(2) MIN 4mm (0.16 in)

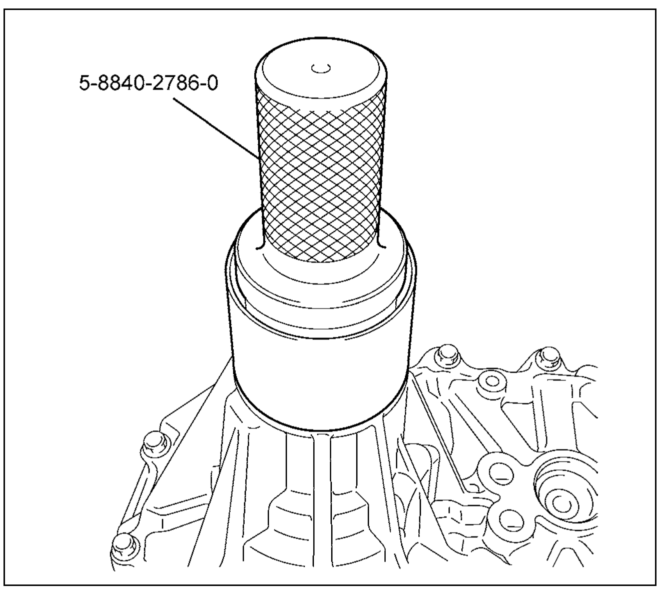
42. Apply Loctite 575 to the threaded portion of the detente plugs.

43.Use an installer (5-8840-2787-0) to install the main shaft end snap ring to the rear output shaft (from the back end of the shaft). Be absolutely sure that the snap ring is seated in the groove.



226R300022

44.Use an installer (5-8840-2786-0) to install the rear output oil seal to the rear case.



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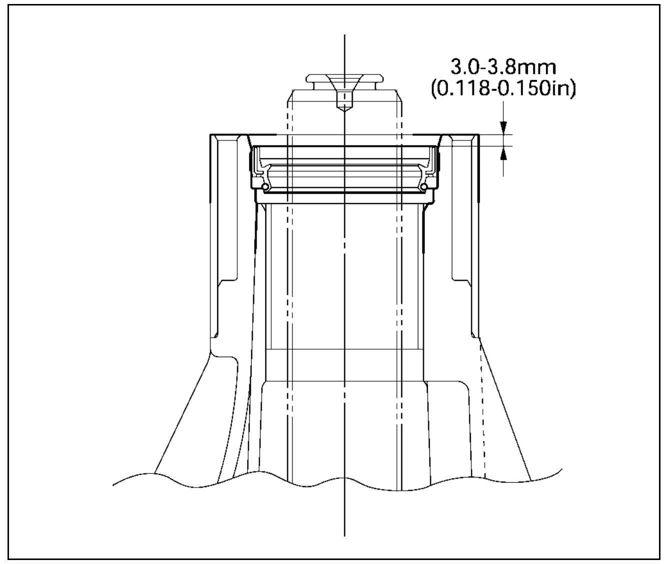


220R300021

45.Install the detent balls, the detent springs, and the detent plugs (2 parts each) to the transfer case. Tighten the plugs to the specified torque.

Detent plug torque: 19 N·m (1.9 kgf·m/14 lb·ft)

46.Install the neutral switch (black harness cover) to the transfer case and tighten the bolts to the specified torque.

Neutral switch bolt torque:

39 N·m (4.0 kgf·m/29 lb·ft)

47.Install the 2-4 switch (gray harness cover) to the transfer case and tighten the bolts to the specified torque.

2-4 switch bolt torque: 39 N·m (4.0 kgf·m/29 lb·ft)

48.Install the switch bracket to the transfer case and tighten the bolts to the specified torque.

Switch bracket bolt torque:

15 N·m (1.5 kgf·m/11 lb·ft)

49.Install the transfer actuator assembly to the transfer case and tighten the bolts to the specified torque. The actuator must be installed in the same direction as the shaft.

Transfer actuator assembly bolt torque:

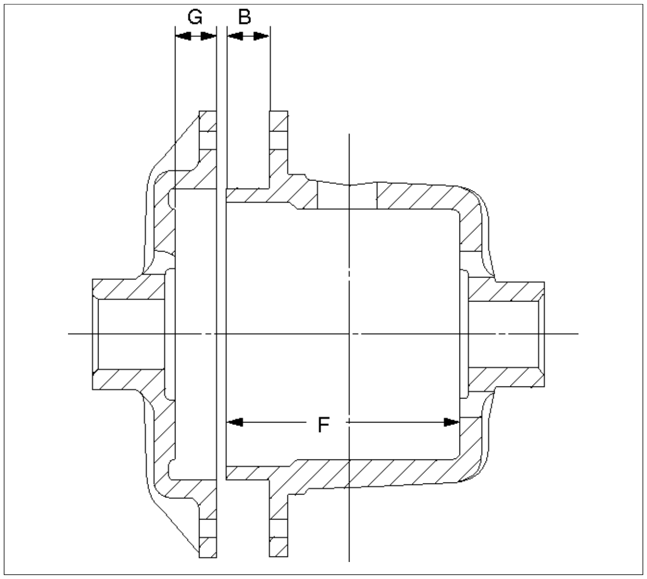
22 N·m (2.2 kgf·m/16 lb·ft)

50.Install the breather hose between the transfer actuator and the transfer case.

51.Install the speedometer driven gear, the speedometer bushing, and the speedometer stay to the transfer case. Tighten the bolts to the specified torque. (M/T: MUA, MUX, A/T: JR405E, AW30-40LE)

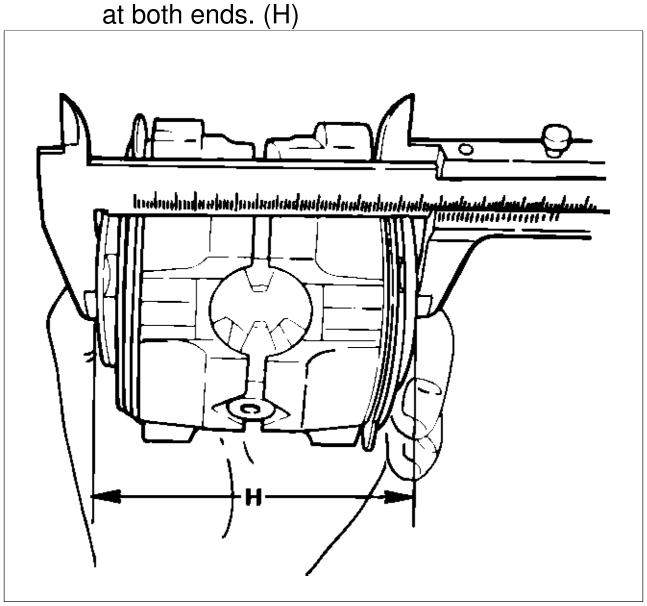
Speedometer bolt torque:

15 N·m (1.5 kgf·m/11 lb·ft)



425RS066

2. Measuring dimension between thrust washers at both ends.
   Assemble side gear, pinion, pinion shaft pressure ring and thrust washer.
   - Eliminate clearance by pushing pressure ring against the pinion shaft in axial direction.
   - Eliminate backlash by connecting side gear to the pinion.
   - Measure dimension between thrust washers at both ends. (H)

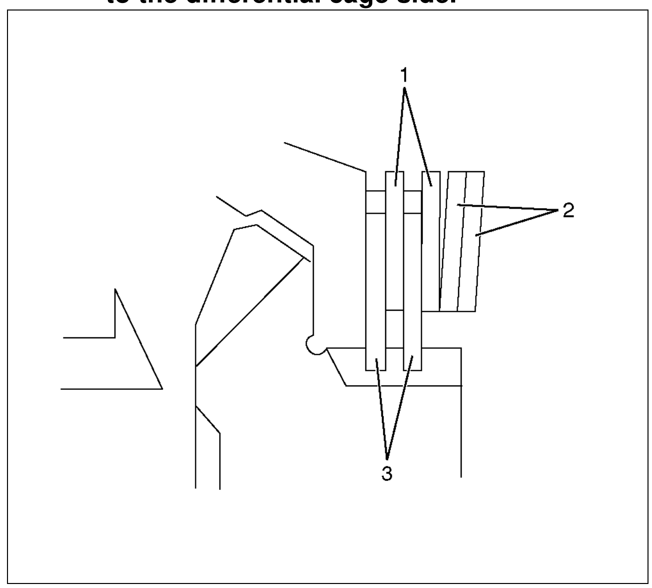


425RS067

3. After each dimension is measured, perform adjustment with the following procedure.
   Adjust so that ((F-B) + G-H) = 0.05 to 0.2 mm (0.002 to 0.008 in). Also, select a proper thrust washer so that the dimension difference from back face of the pressure ring to thrust washer (left/right side) does not exceed 0.05 mm (0.002 in).
   Thickness : 1.5, 1.6, 1.7 mm (0.059, 0.063, 0.067 in)

Note :
When reassembling, sufficiently apply gear oil on every part, especially on sliding surface.

1. **Install thrust washer in differential cage A and B.**
2. **Assemble spring plate, friction plate and friction disc as following illustration.**
   - **Install spring plate with dished side turned to the differential cage side.**



425R300009

Legend

1. Friction Plate
2. Spring Plate
3. Friction Disc

4. Install pressure ring and side gear.
   - Fit two side gears in two pressure rings, one from under a ring and the other from above a ring.
   - Fit two pairs of a friction disc and a friction plate under it on and under these two pressure rings.
5. Set pinion and pinion shaft on differential cage A assembly.
6. Assemble differential cage A and B.
7. Align the setting marks on differential cage A and B and tighten screws in diagonal order evenly.

52. Install the speed sensor to the transfer case and tighten the specified torque. (M/T: AR-5, A/T: 4L60-E)

    Speed sensor torque: 17 N·m (1.7 kgf·m/12 lb·ft)

53. Install the drain plug to the transfer case and tighten it to the specified torque.

    Drain plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)

54. Loosen and remove the filler plug. Add the specified volume of transfer oil (5W-30) or the equivalent to the transfer through the filler hole.

    Transfer oil volume: 1.3 lit. (1.37 US qt)

55. Replace the filler plug and tighten it to the specified torque.

    Filler plug torque: 39 N·m (4.0 kgf·m/29 lb·ft)

56. Install the underguard and tighten the bolts to the specified torque.

    Underguard bolt torque:
    39 N·m (4.0 kgf·m/29 lb·ft)

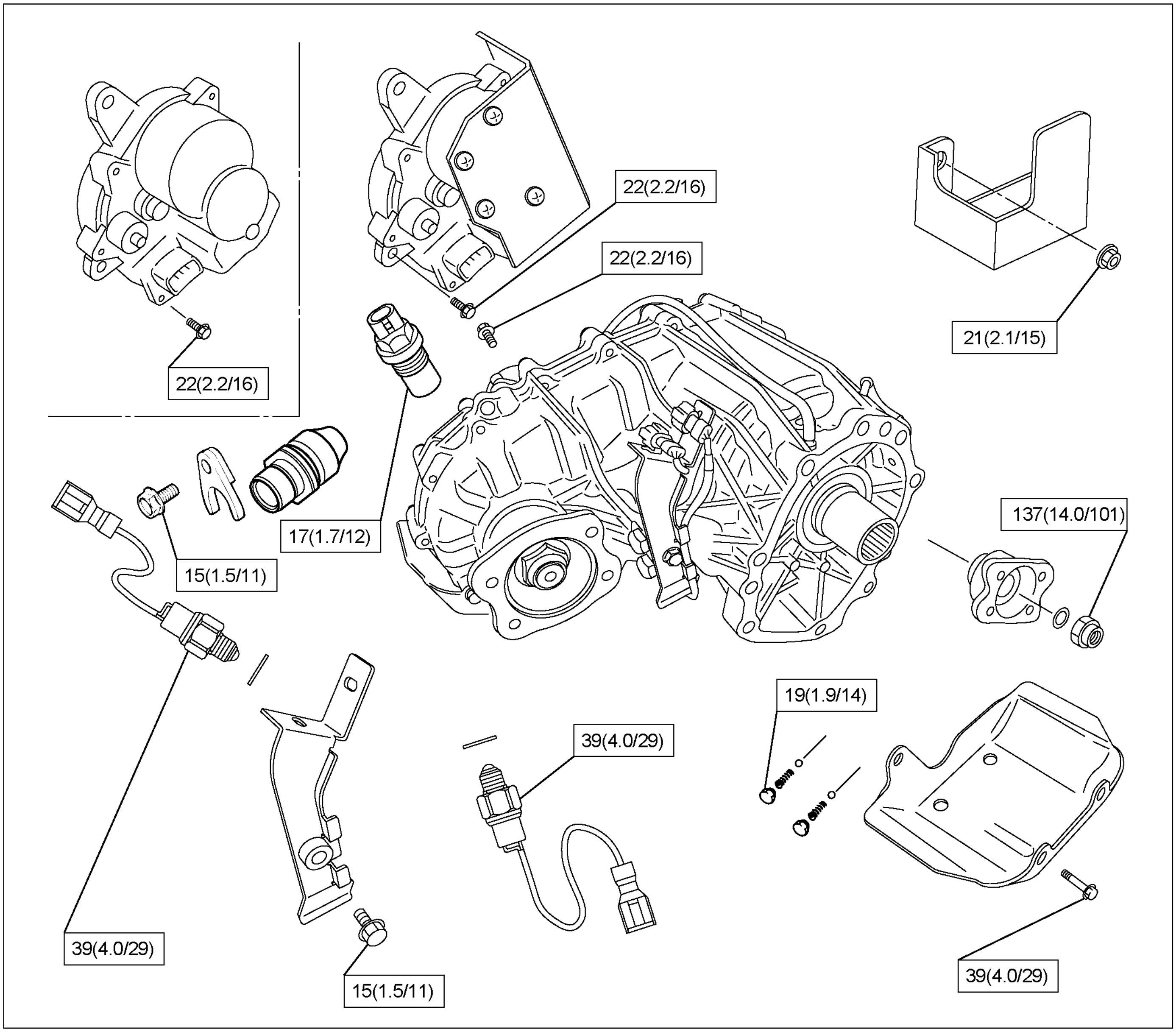
Main Data and Specifications

General Specifications

Type	Synchronized type gears shifting between the 2 and 4 wheel drive mode. Planetary type gears shifting between "low" and "high".
Control method	Remote control with the button switch on the instrument panel for gears shifting among "2H", "4H" and "4L".
Gear ratio	High; 1.000 Low; 2.482
Oil capacity	1.3 lit. (1.37 US qt)
Type of lubricant	BESCO GEAR OIL TRANSAXLE (5W-30) Refer to Section 0B

Torque Specifications

N·m (kgf·m/lb·ft)



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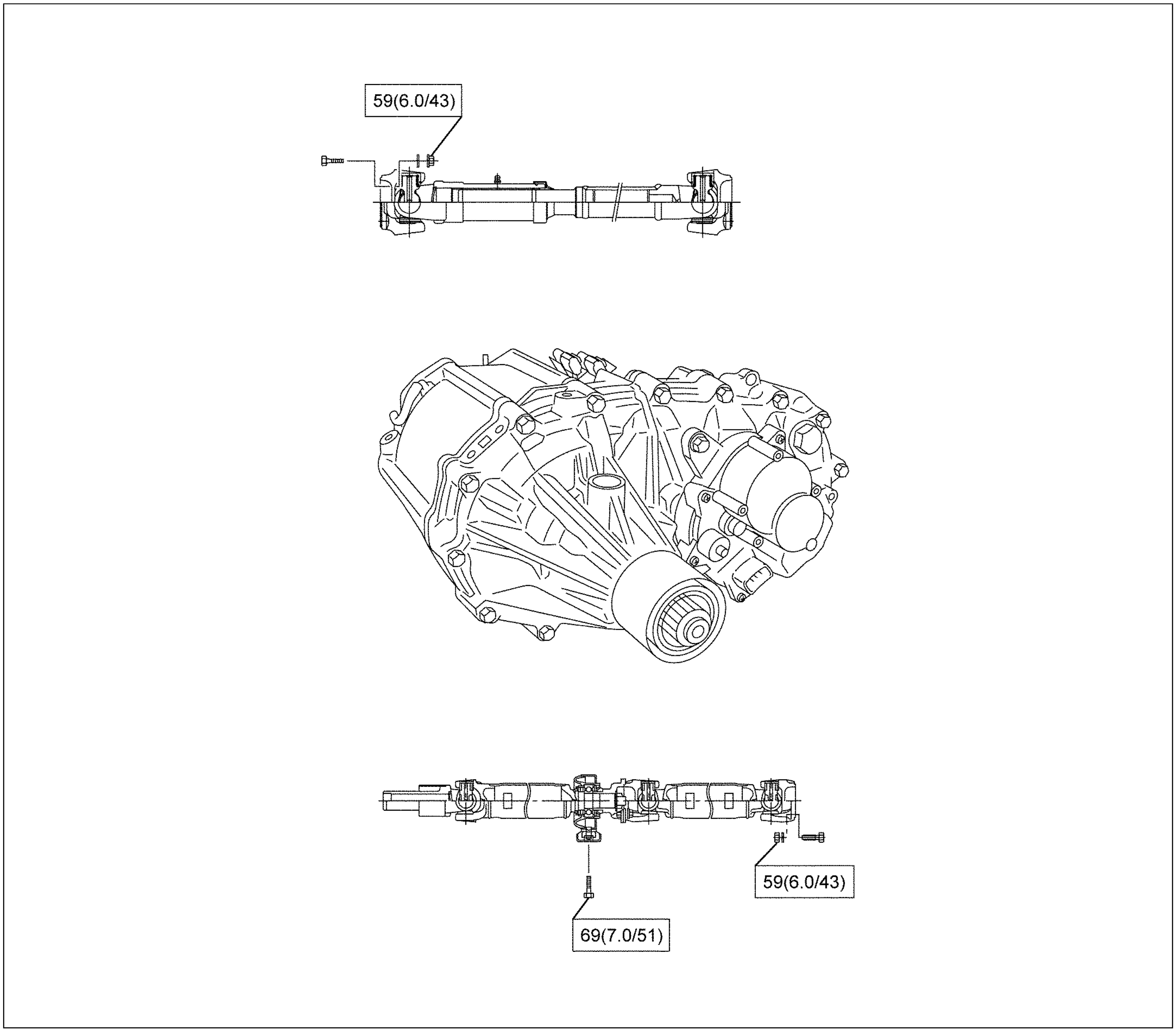
N·m (kgf·m/lb·ft)



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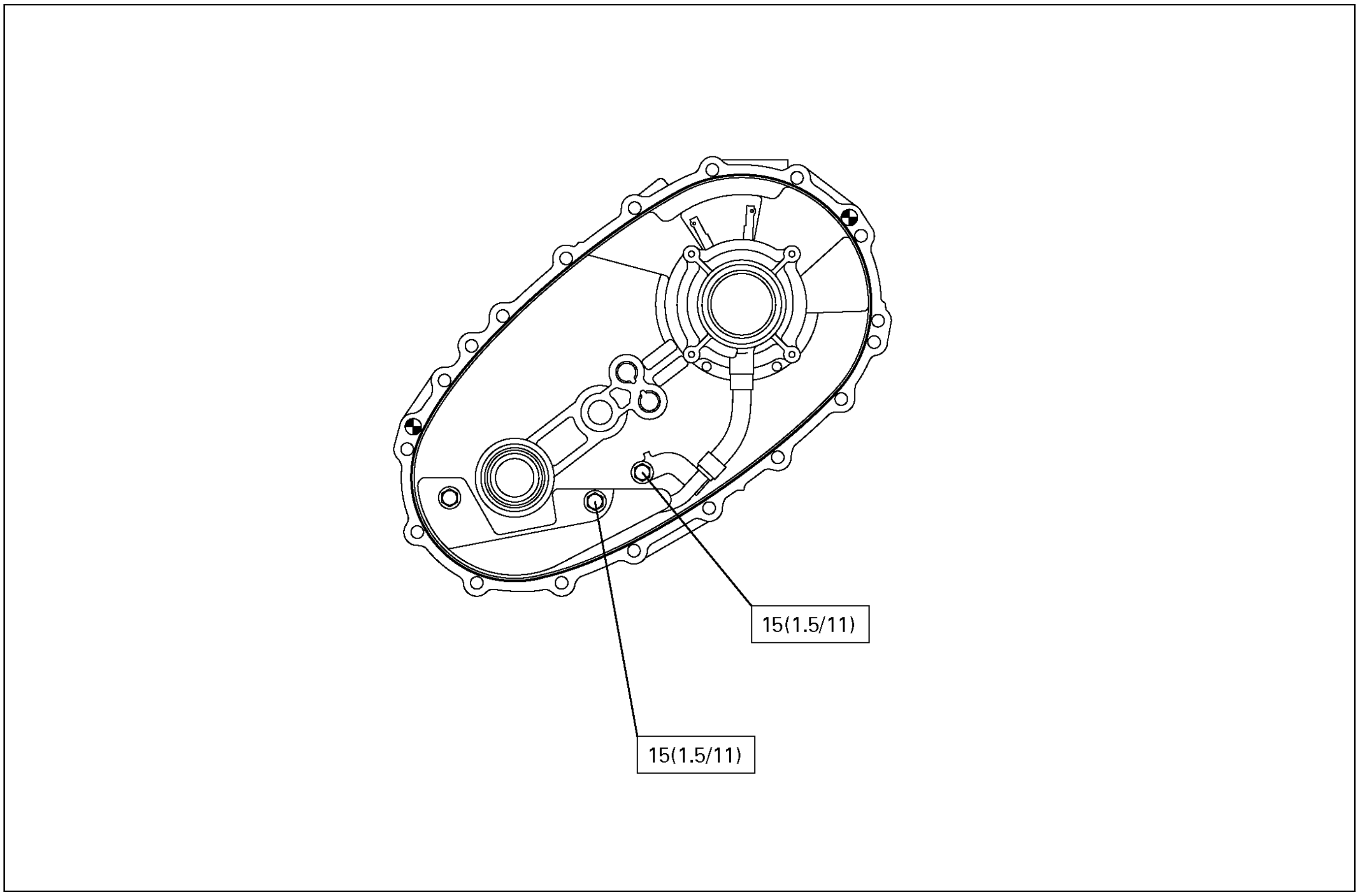
N·m (kgf·m/lb·ft)



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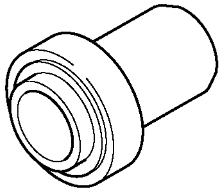
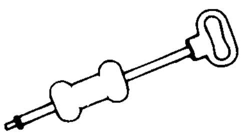
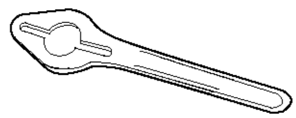
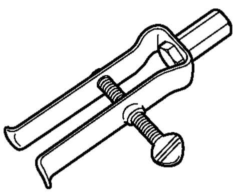
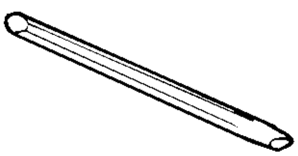
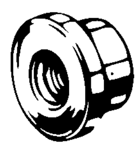
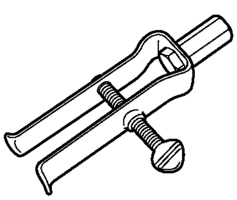
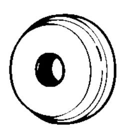
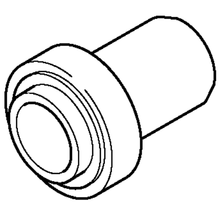
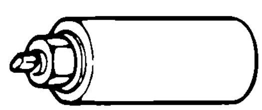
Special Tools

ILLUSTRATION	PART NO. PART NAME	ILLUSTRATION	PART NO. PART NAME
	**5-8840-2786-0** **(J-46202)** Transfer case oil seal installer		**5-8840-2784-0** **(J-46200)** Ring gear installer
	**5-8840-0084-0** **(J-2619-01)** Sliding hammer	 901RW071	**5-8840-0133-0** **(J-8614-01)** Flange holder
	**5-8840-0027-0** **(J-26941)** Rear output shaft needle bearing replacer		**5-8840-2782-0** **(J-46198)** Needle bearing installer
 901RS263	**5-8840-2293-0** **(J-39209)** Punch; end nut		**5-8840-2783-0** **(J-46199)** Needle bearing installer
	**5-8840-2788-0** Front output shaft needle bearing replacer		**9-8522-1268-0** Rear output shaft ball bearing installer
	**5-8840-2785-0** **(J-46201)** Input shaft and/or front output shaft oil seal installer		**5-8840-2787-0** **(J-46203)** Snap ring installer

SECTION 7D1

TRANSFER CONTROL SYSTEM

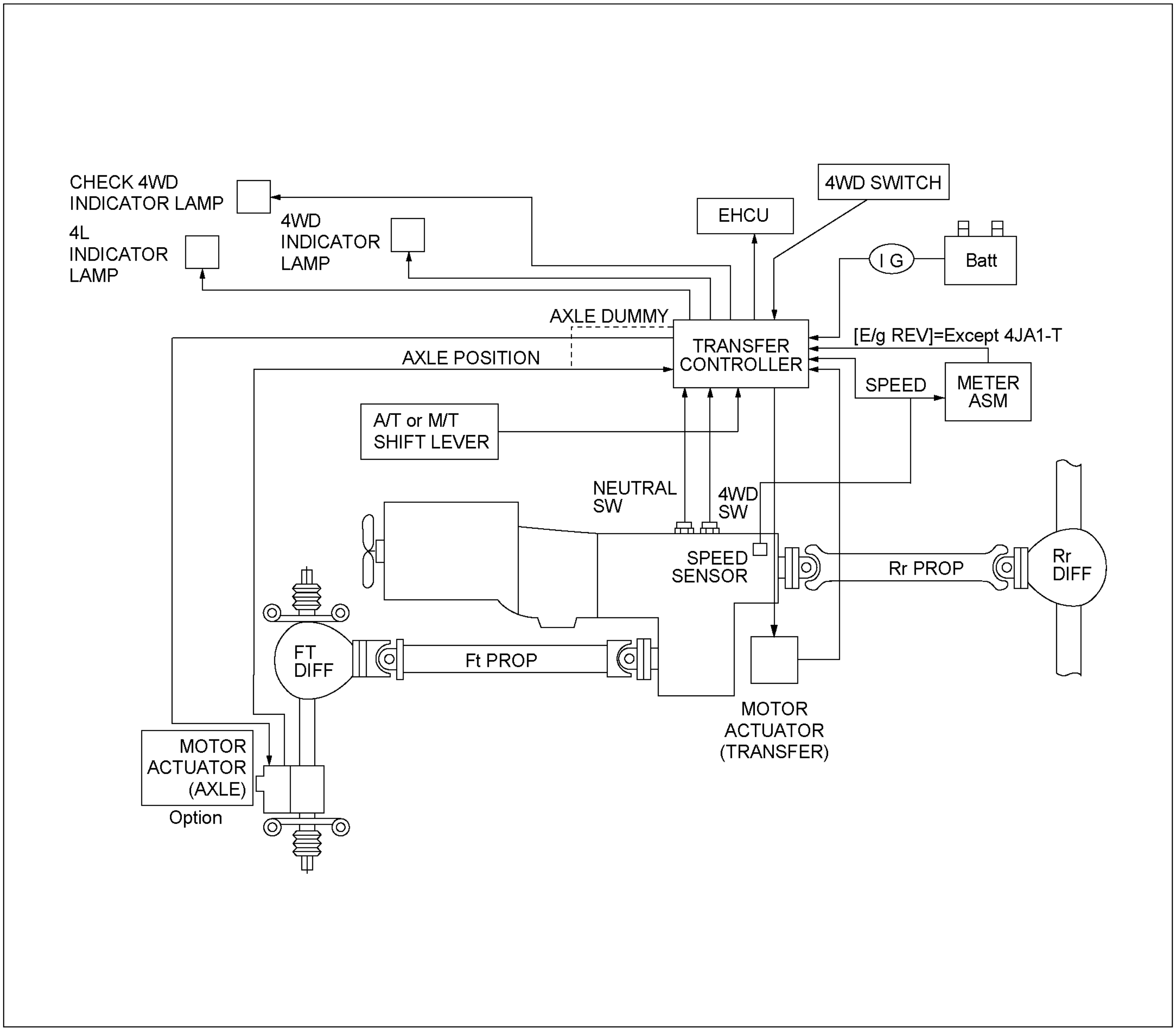
TABLE OF CONTENTS

Service Precaution

WARNING:
THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION:
Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description



RTW77DLF000501

Transfer Position and Drive Mode

Three drive modes can be selected through operation of 4WD switch.

Transfer Position	4WD SWITCH	Mode	Drive mode
HIGH	2H	RWD	Rear wheel drive
	4H	4WD (HIGH)	High-speed mechanical lock-up four wheel drive
LOW	4L	4WD (LOW)	Low-speed mechanical lock-up four wheel drive
NEUTRAL	2H & 4L (10 Sec)	NEUTRAL	Towed by other vehicle

Summary of transfer control system

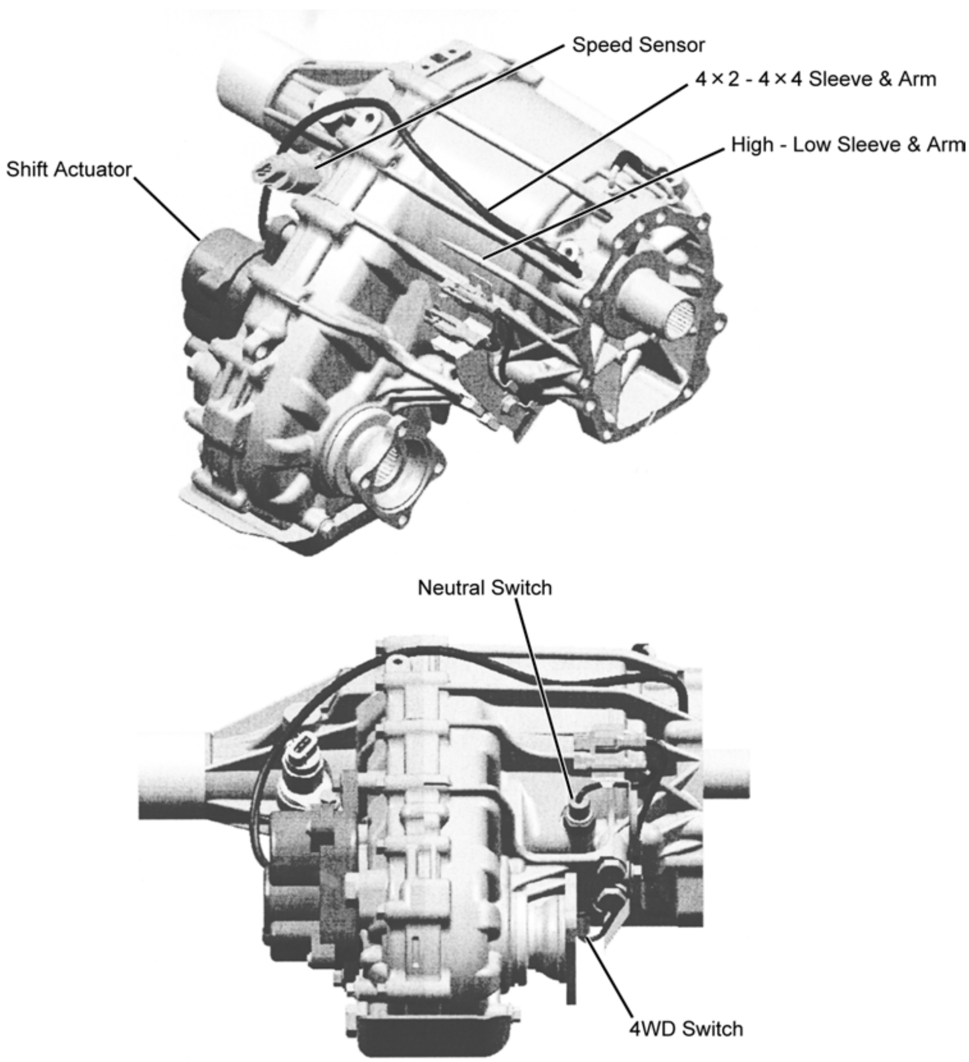
The transfer control system switches between the 2-wheel drive (2H), 4-wheel drive high-speed (4H), 4-wheel drive low-speed (4L), and neutral positions electrically when the driver operates the switches.

This system has following functions.

1. Connection or disconnection of drive force distribution to the front wheel front shaft (axle shaft). (The drive force distribution to the front propeller is connected or disconnected with the motor actuator.)
2. Try to repeat the connection or disconnection of the front wheel drive function as described above.
3. Option: Shift on the fly type only.
   Instruction of connection or disconnection of the drive force transmission between the front wheel axle (axle shaft) and front wheel. (The motor actuator connects or disconnects the left front wheel and front wheel axle (axle shaft).)
4. Shifting of auxiliary transmission gears, connection or disconnection of wheel and engine drive force (4H, 4L, neutral).
5. Operation of the indicator on the instrument panel.
6. Transmission of the position signal to other controllers.

System Components

Parts Location



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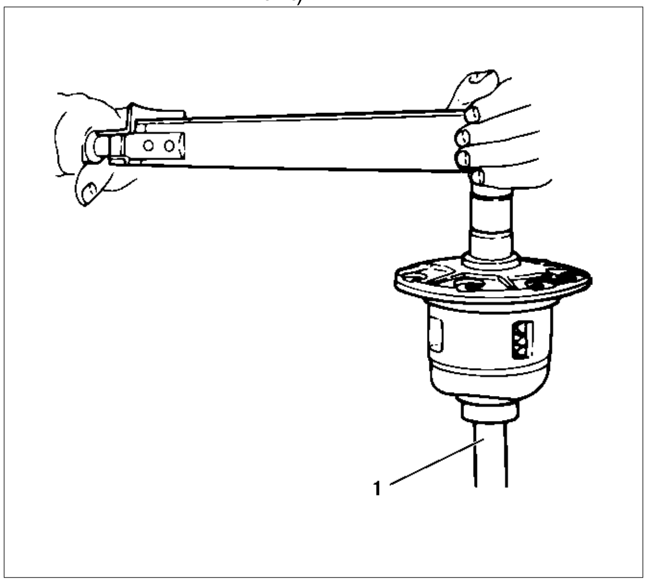
Speed sensor
Revolutions of the rear output shaft are decreased and taken out by the speed/drive/driven gears installed in the transfer case. The number of revolutions is detected with a speed sensor.
About 4/3 pulses per revolution of the shaft are output.

4WD switch
The 4WD switch detects the movement of the shift rod driving the 4×2 - 4×4 sleeve.
PUSH open is achieved with the PUSH open switch when the shift rod is at the 4×2 position.

4×2 - 4×4 sleeve & Arm
The 4×2 - 4×4 sleeve moves directly in the 4×4 direction with

Confirmation of Operation

- Using the side gear holder : 5-8840-2682-0, measure the starting torque of the side gear.
  Starting torque :29-45 N·m (3.0-4.6 kgf·m/22-33 lb·ft)



425RW065

Legend

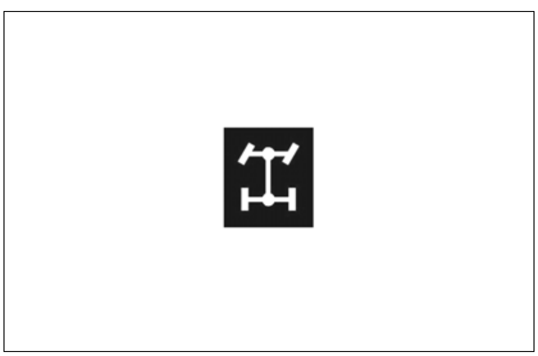
1. Side Gear Holder : 5-8840-2682-0

the 4×2 - 4×4 shift rod. When moving in 4×2 direction, a spring standby mechanism is provided between the rod and sleeve so that the rod is positioned at the 4×2 position, while the sleeve is at the 4×4 position.
This mechanism is provided to protect the shift mechanism from the force and to prevent movement of the sleeve (torsional torque etc. of the drive system). By releasing the preventive force, the sleeve can move to the 4×2 state by the spring force.

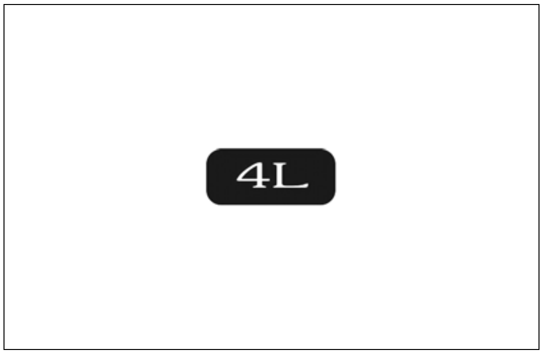
Neutral switch
The neutral switch detects the movement of the shift rod driving the high-low sleeve.
PUSH close is achieved with the PUSH close switch when the shift rod is positioned between the High and the Low, at the neutral state.

High-Low Sleeve & Arm
The spring standby mechanism is provided for the high-low sleeve in both directions of the high-low shift rod. Therefore, the rod position and the actual sleeve position may be offset in some cases.
This system is provided to protect the shift mechanism from a collision due to coincidence of the high and low phases of the engaged splines. By giving rotational force to the preventing phase coincidence, the splines are moved to the proper engagement position by the spring force.

Shift actuator
The output shaft is rotated by the built-in motor and the transfer position is switched.
Detection (limit) switches to detect the rotating angle of the output shaft that is provided to the actuator at 4 positions.
These are connected to the transfer controller through the vehicle harness to constantly transmit the actuator operating angle and changes in its transfer status.

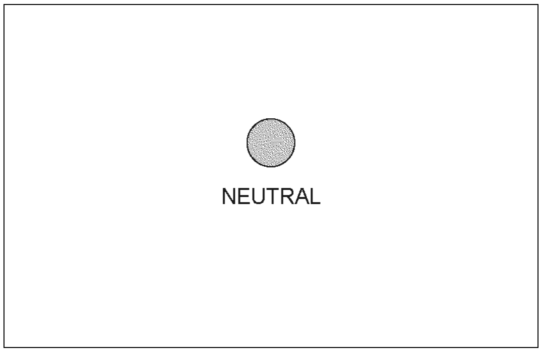

7B4-PDF2

4WD indicator (in meter panel)
This lamp indicates the following items:
Valve check
Drive condition (2WD-4WD)
Operating condition (2Hz: Actuator in operation, mechanism standby)
Restrictions on operation (4Hz, including indication of interrupted operation due
to excessive load)



7B4-PDF3

4L indicator (in meter panel)
This lamp indicates following items:
Valve check
Driving status (High-Low)
Operating status (2Hz: Actuator in operation, mechanism standby)
Restrictions on operation (4Hz)

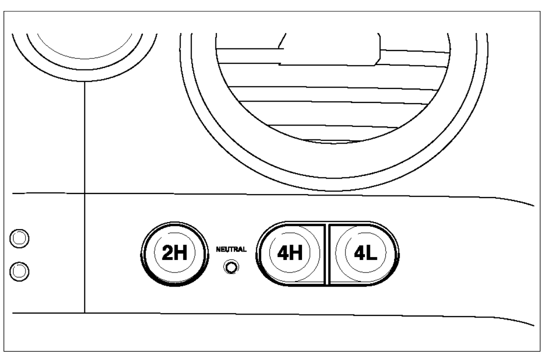


RTW77DSH000601

Neutral indicator (in operation switch panel)
This LED indicates following items:
LED check
Driving status (Neutral)
Operating status (2Hz: Actuator in operation, mechanism standby)
Restrictions on operation (4Hz)

7B4-PDF5

Check 4WD warning light (in meter panel)
This light indicates following items:
Valve check
Faulty actuator limit SW, and circuit related faults with the limit switch

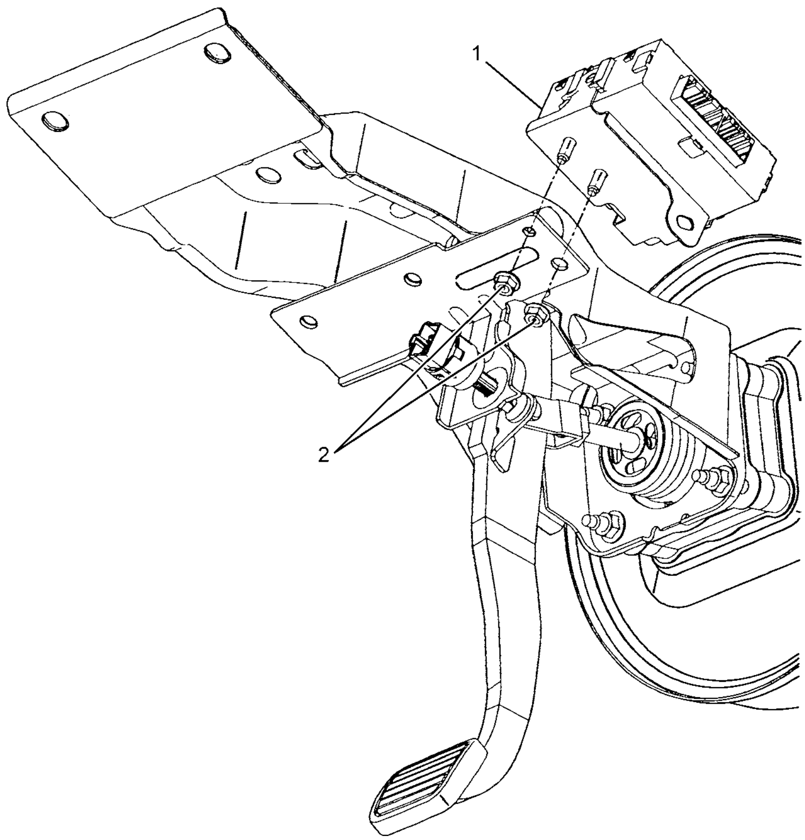


RTW77DSH000501

4WD switch
Switch to transmit a switching command to the 2H, 4H, Neutral, or 4L position.
It comprises 3 PUSH momentary switches. By pushing the 2H and 4L switches for 10 seconds,
operation is changed to the neutral position.
To shift from the neutral to another position, push another switch for 10 seconds.

Transfer controller

RHD



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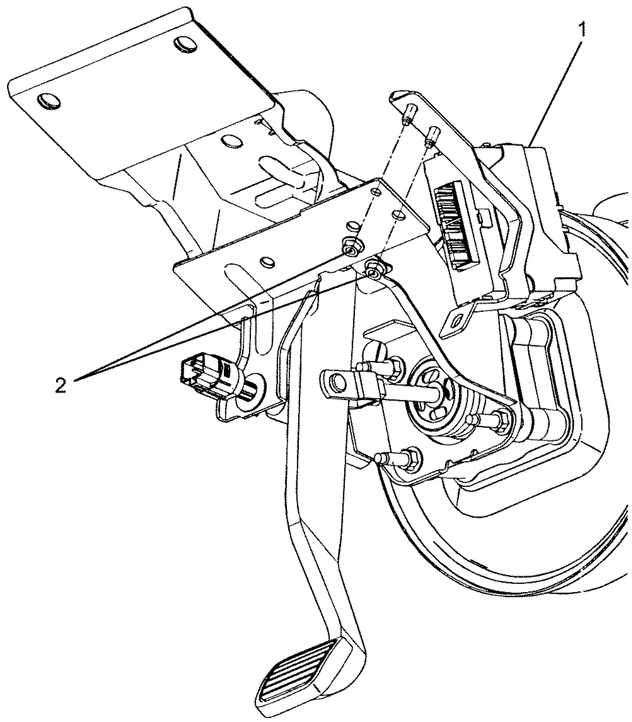
Legend

(1) Transfer Controller

(2) Nut

LHD



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Legend

(1) Transfer Control Unit

(2) Nut

Transfer Actuator

Method of confirming the actuator position detection (limit) switch

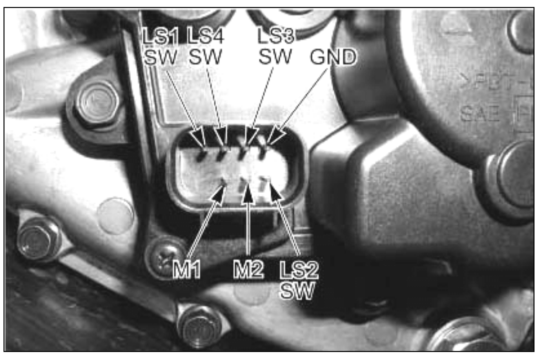
The actuator indicates the continuity condition of combinations, as shown in the list below between the 4 detection (limit) switch pins and the GND pin along the direction of the notch of the output shaft spline. Check that these combinations are as specified.

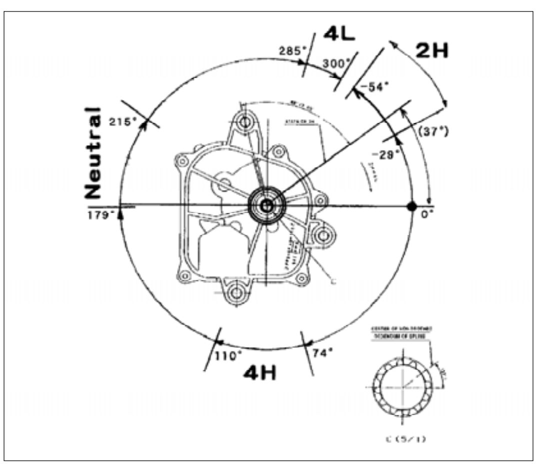
The middle condition between these positions (4 patterns in the case of 2H-4H) is either of the combinations shown below, depending upon manufacturing variations of the switch plate.

	2H	2H-4H				4H	4H-N		N	N-L	4L
Direction of output shaft notch (outline)	-54° to -29°	-29° to 74°				74° to 110°	110° to 179°		179° to 215°	215° to 285°	285° to 300°
LS1	Close	Close	Open	Open	Open	Open	Open	Open	Open	Close	Close
LS2	Open	Close	Open	Close	Close	Open	Open	Close	Close	Close	Close
LS3	Close	Close	Close	Close	Close	Close	Open	Open	Open	Open	Open
LS4	Open	Open	Open	Open	Close	Close	Close	Close	Open	Open	Close

Continuity between each pin and GND pin. (Continuity also exists between CLOSE pins.)

Transfer Actuator Connector





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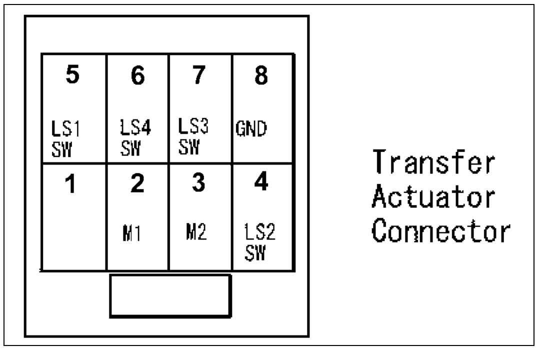
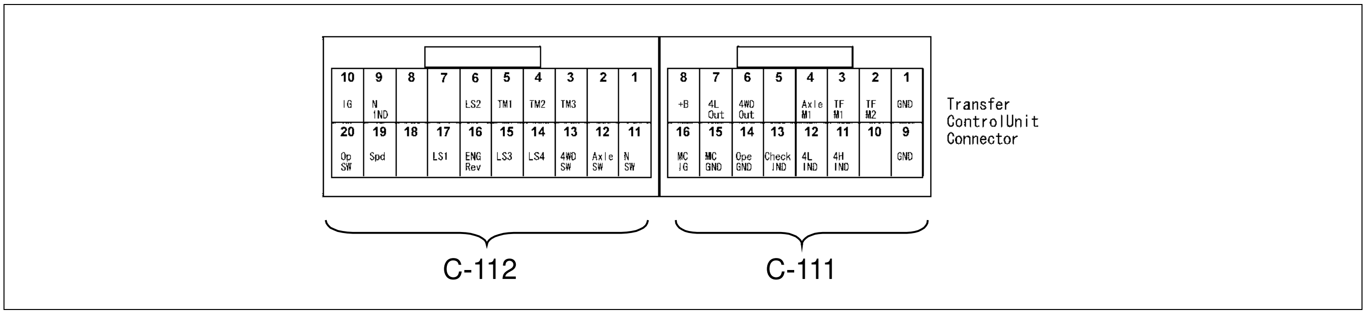


Method of checking the position detection switch harness

Disconnect the vehicle harness connector on the transfer controller side, and the vehicle harness connector on the transfer actuator side as shown in the wiring diagram. Check the continuity between the following connector pins, ensure there is no continuity between those pins and GND or power source.

Check that there is continuity between the GND pin and the vehicle GND on the transfer actuator, and there is no continuity between the GND pin and another power source.



Vehicle harness connector pin No. (connector of mating parts of the harness is shown in this figure)

Name of pin	T/F controller side	T/F actuator side	Remarks
LS1	C-112, 17	5	
LS2	C-112, 6	4	
LS3	C-112, 15	7	
LS4	C-112, 14	6	
GND	C-111, 1, 9	8	

Functions of Switch and indicator Lamp

Transfer-related indicator lamp and switch function

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----
4H start of operation	Off	Off	Off	Off	4H position for 0.1 second	1,0,1,0	Open	Open	Open	Switch operation sensor
Start of operation	Blinking (2HZ)	Off	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H while driving
During operation (Synchro)	Blinking (2HZ)	Off	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H using synchro and retrial
During operation (Axle drive)	Blinking (2HZ)	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Open	Axle drive
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Open	Axle drive
4H	On	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Closed	-----
4L start of operation	On	Off	Off	Off	4L position for 0.1 second	0,0,1,1	Closed	Open	Closed	Switch operation sensor
Start of operation	On	Blinking (2HZ)	Off	Off	No operation	0,0,0,1 0,1,0,1	Closed	Open	Closed	4H to 4L while driving
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	0,0,0,1 0,1,0,1	Closed	Closed	Closed	4H to 4L through neutral
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,0	Closed	Closed	Closed	4H to 4L through neutral
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Closed	4H to 4L through neutral
4L waiting	On	Blinking (2HZ)	Off	Off	No operation	1,1,0,1	Closed	Closed	Closed	4H to 4L while waiting
4L	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----
4H start of operation	On	Off	Off	Off	4H position for 0.1 second	1,1,0,1	Closed	Open	Closed	Switch operation sensor

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
During operation	On	Blinking (2HZ)	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	4L to 4H while driving
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Closed	4L to 4H through neutral
During operation	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,1 0,0,0,1	Closed	Closed	Closed	4L to 4H while driving
4H waiting	Off	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Closed	Closed	4L to 4H while waiting
4H	On	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Closed	-----
2H start of operation	On	Off	Off	Off	2H position for 0.1 second	0,0,1,1	Closed	Open	Closed	Switch operation sensor
Start of operation	Blinking (2HZ)	Off	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Closed	Open	Closed	2H to 4H while driving
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Open	Open	Closed	Axle drive
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	1,0,1,0	Open	Open	Closed	Axle waiting
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----

2H to 4H retrial

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----
4H start of operation	Off	Off	Off	Off	4H position for 0.1 second	1,0,1,0	Open	Open	Open	-----
Start of operation	Blinking (2HZ)	Off	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H while driving
During operation (Synchro) (Go to 4H if synchro complete)	Blinking (2HZ)	Off	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H using synchro and retrial X 2
Abandon ed operation (2H)	Blinking (4HZ)	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	Return to 2H
2H indication after 10second s	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----

- Completion of transfer case H-L area and axle shift timing may cause some variation in the 2Hz blinking pattern.

Operational limits (4H→4L) (Vehicle speed, engine speed, and transmission position not specified)

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
4H	On	Off	Off	Off	Open	0,0,1,1	Closed	Open	Closed	-----
4H start of operation	On	Off	Off	Off	4L position for 0.1 second	0,0,1,1	Closed	Open	Closed	-----
10 second display during limitation	On	Blinking (4HZ)	Off	Off	Open	0,0,1,1	Closed	Open	Closed	No operation during limitation
Go to 4H after 10 seconds	On	Off	Off	Off	Open	0,0,1,1	Closed	Open	Closed	-----

Operational limits (4L→4H) (Vehicle speed, engine speed, and transmission position not specified)

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
4L	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----
4L start of operation	On	On	Off	Off	4H position for 0.1 second	1,1,0,1	Closed	Open	Closed	-----
10 second display during limitation	On	Blinking (4HZ)	Off	Off	Open	1,1,0,1	Closed	Open	Closed	No operation during limitation
Go to 4L after 10 seconds	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----

- Under some conditions, a secondary operational indication may be received when the 4Hz operational indication is present.

TROUBLESHOOTING

Refer to this Section to quickly diagnose and repair rear axle problems.

Each troubleshooting chart has three headings arranged from left to right.

(1) Checkpoint

(2) Trouble Cause

(3) Countermeasure

This Section is divided into five sub-sections:

1. Abnormal Rear Axle Noise
   1) Noise when the engine is driving the vehicle
   2) Noise when the vehicle is coasting
   3) Intermittent noise
   4) Noise when the vehicle is turning
   5) Constant noise
2. Vibration
3. Oil Leakage
   1) Differential carrier leakage
   2) Axle case leakage
   3) Axle case to inside hub leakage
   4) Axle case to inside brake drum leakage
4. Power Not Being Transmitted to the Wheels (Propeller Shaft Operation is Normal)

Transfer-related indicator lamp and switch function

Skip operation

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----
4L start of operation	Off	Off	Off	Off	4L position for 0.1 second	1,0,1,0	Open	Open	Open	Switch operation sensor
Start of operation	Blinking (2HZ)	Blinking (2HZ)	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H while driving
During operation (Synchro)	Blinking (2HZ)	Blinking (2HZ)	Off	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H using synchro and retrial
During operation (Passing through 4H)	Off	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Open	Open	-----
During operation (Passing through 4H)	Off	Blinking (2HZ)	Off	Off	No operation	0,0,1,1 0,1,0,1	Closed	Open	Open	-----
During operation (N)	On	Blinking (2HZ)	Off	Off	No operation	0,0,1,1 0,1,0,1	Closed	Open	Closed	-----
During operation (N)	On	Blinking (2HZ)	Off	Off	No operation	0,1,0,0	Closed	Open	Closed	Switch operation sensor
During operation (N)	On	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Open	Closed	4H to 4L while driving
During operation (Axle drive)	Blinking (2HZ)	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Open	Open	-----
Axle waiting	Blinking (2HZ)	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Open	Open	-----
4L waiting	On	Blinking (2HZ)	Off	Off	No operation	1,1,0,1	Closed	Closed	Closed	4H to 4L while waiting
4L	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD lamp	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2H start of operation	On	On	Off	Off	2H position for 0.1 second	1,1,0,1	Closed	Open	Closed	Switch operation sensor
During operation	Blinking (2HZ)	Blinking (2HZ)	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	4L to 4H while driving
During operation (Passing through N)	On	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Closed	4L to 4H through neutral
During operation (Passing through N)	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,0	Closed	Closed	Closed	4L to 4H through neutral
During operation (4H waiting)	Off	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Closed	Closed	4L to 4H while waiting
During operation (Axle)	Off while waiting for start of H shift	Blinking (2HZ) while waiting for start of H shift	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Closed	Open	Closed	2H to 4H while driving
During operation (Axle)	Blinking (2HZ) at end of H shift	Off at end of H shift	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Closed	Open	Closed	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	1,0,1,0	Open	Open	Closed	-----
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----

- Completion of transfer case H-L area and axle shift timing may cause some variation in the 2Hz blinking pattern.

Skip operation limitations (4L→2H) (Vehicle speed, engine speed, and transmission position not specified)

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
4L	Off	On	Off	Off	Open	1,1,0,1	Closed	Open	Closed	-----
4L start of operation	Off	On	Off	Off	2H position for 0.1 second	1,1,0,1	Closed	Open	Closed	-----
10 second display during limitation	Blinking (4HZ)	Off	Off	Off	Open	1,1,0,1	Closed	Open	Closed	No operation during limitation
Go to 4L after 10 seconds	Off	ON	Off	Off	Open	1,1,0,1	Closed	Open	Closed	-----

Skip operation limitations (2H→4L) (Vehicle speed, engine speed, and transmission position not specified)

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2HL	Off	Off	Off	Off	Open	1,0,1,0	Open	Open	Open	-----
4L start of operation	Off	Off	Off	Off	2H position for 0.1 second	1,0,1,0	Open	Open	Open	-----
10 second display during limitation	Blinking (4HZ)	Blinking (4HZ)	Off	Off	Open	1,0,1,0	Open	Open	Open	No operation during limitation
Go to 2H after 10 seconds	Off	Off	Off	Off	Open	1,0,1,0	Open	Open	Open	-----

- Under some conditions, a secondary operational indication may be received when the 4Hz operational indication is present.

Transfer-related indicator lamp and switch function

2H→Neutral→2H

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----
Neutral start of operation	Off	Off	Off	Off	Neutral position for 10 seconds	1,0,1,0	Open	Open	Open	Switch operation sensor
Start of operation	Off	Off	Blinking (2HZ)	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H while driving
During operation (Synchro)	Off	Off	Blinking (2HZ)	Off	No operation	1,1,1,0 0,0,1,0 0,1,1,0 0,1,1,1	Open	Open	Open	2H to 4H using synchro and retrial
During operation (Passing through 4H)	Off	Off	Blinking (2HZ)	Off	No operation	0,0,1,1	Closed	Open	Closed	-----
During operation (Passing through 4H)	Off	Off	Blinking (2HZ)	Off	No operation	0,0,0,1 0,1,0,1	Closed	Open	Closed	4H to 4L while driving
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	0,0,0,1 0,1,0,1	Closed	Closed	Closed	4H to 4L through neutral
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	0,1,0,0	Closed	Closed	Closed	Switch operation sensor
Neutral	Off	Off	On	Off	No operation	0,1,0,0	Closed	Closed	Open	-----
2H start of operation	Off	Off	On	Off	2H position for 10 seconds	0,1,0,0	Closed	Open	Closed	Switch operation sensor
During operation (Passing through N)	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,0	Closed	Closed	Closed	4L to 4H through neutral
During operation	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,1 0,0,0,1	Closed	Closed	Closed	4L to 4H while driving

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
During operation (4H waiting)	Off	Blinking (2HZ)	Off	Off	No operation	0,0,1,1	Closed	Closed	Closed	4L to 4H while waiting
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Closed	Open	Closed	2H to 4H while driving
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Open	Open	Closed	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	1,0,1,0	Open	Open	Closed	-----
2H	Off	Off	Off	Off	No operation	1,0,1,0	Open	Open	Open	-----

- Operational restrictions (vehicle speed, engine speed, and transmission position) are applicable to transfer shifts in both directions (H←→Neutral←→L).

4H→Neutral→4H

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
4H	On	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Closed	-----
Neutral start of operation	On	On	Off	Off	Neutral position for 10 seconds	1,1,0,1	Closed	Open	Closed	-----
Start of operation	Off	Off	Blinking (2HZ)	Off	No operation	1,1,0,0	Closed	Open	Closed	4L to N while driving
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	1,1,0,0	Closed	Closed	Closed	4L to N with axle driving
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	0,1,0,0	Closed	Closed	Closed	4L to 4N with axle removed
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,1,1,1 0,1,1,0 0,0,1,0 1,1,1,0	Open	Open	Closed	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	1,0,1,0	Open	Open	Closed	-----
Neutral	Off	Off	On	Off	No operation	0,1,0,0	Closed	Closed	Open	-----
4H start of operation	Off	Off	Off	Off	2H position for 10 seconds	0,1,0,0	Open	Open	Open	Switch operation sensor
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Open	4L to 4H through neutral
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,0	Closed	Closed	Open	4L to 4H through neutral
During operation	Off	Blinking (2HZ)	Off	Off	No operation	0,1,0,1 0,0,0,1	Closed	Closed	Open	4L to 4H while driving
4H waiting	Blinking (2HZ)	Off)	Off	Off	No operation	0,0,1,1	Closed	Closed	Open	4L to 4H while waiting
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Open	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Open	-----
4H	On	Off	Off	Off	No operation	0,0,1,1	Closed	Open	Closed	-----

- Operational restrictions (vehicle speed, engine speed, and transmission position) are applicable to transfer shifts in both directions (H←→Neutral←→L).

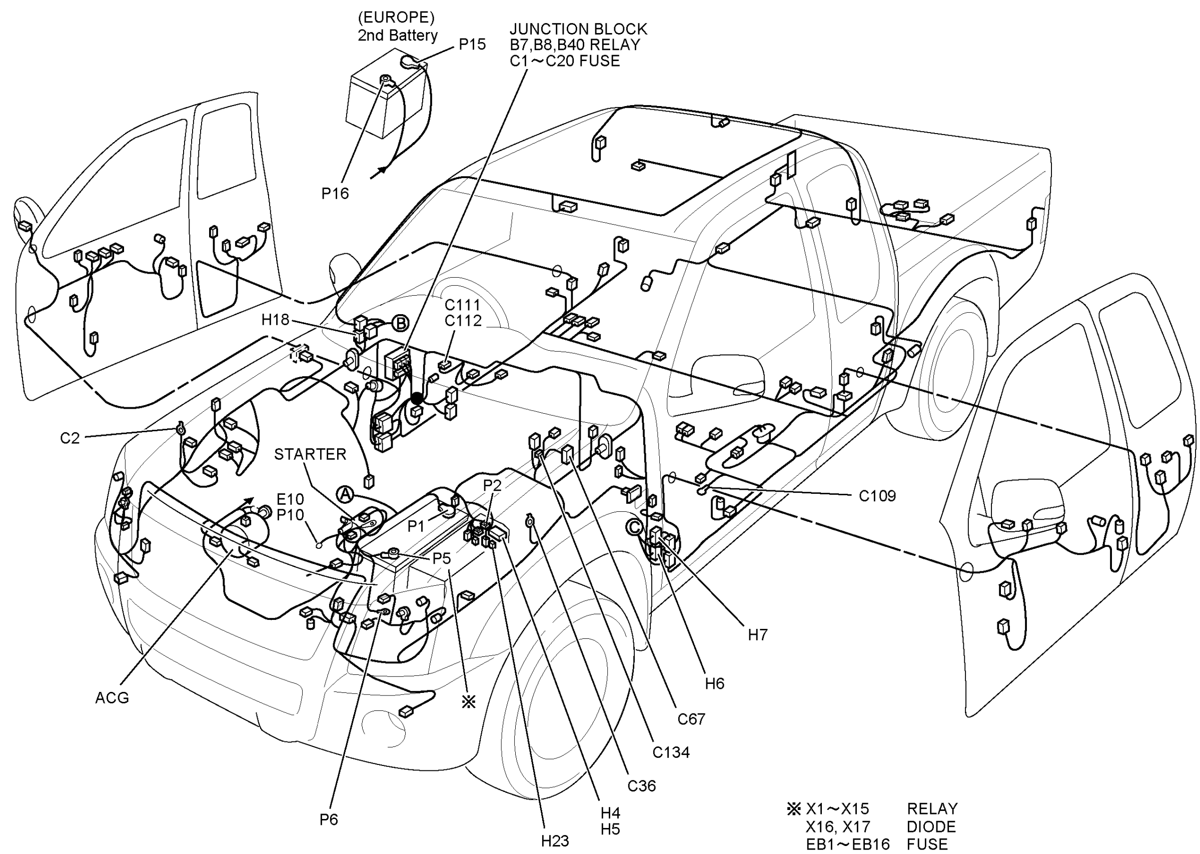
4L→Neutral→4L

Item	4WD lamp	4L lamp	Neutral lamp	Check 4WD warning light	4WD switch	Actuator detection (limit) switches LS1, LS2, LS3. and LS4 1 = on 2 = off	Transfer 4WD switch	Transfer neutral switch	SOF actuator switch Or Axle dummy	Remarks
4L	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----
Neutral start of operation	On	On	Off	Off	Neutral position for 10 seconds	1,1,0,1	Closed	Open	Closed	-----
Start of operation	Off	Off	Blinking (2HZ)	Off	No operation	1,1,0,0	Closed	Open	Closed	4L to N while driving
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	1,1,0,0	Closed	Closed	Closed	4L to N with axle driving
During operation (N)	Off	Off	Blinking (2HZ)	Off	No operation	0,1,0,0	Closed	Closed	Closed	4L to 4N with axle removed
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	0,1,0,0	Closed	Closed	Closed	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	0,1,0,0	Closed	Closed	Closed	-----
Neutral	Off	Off	On	Off	No operation	0,1,0,0	Closed	Closed	Open	-----
4L start of operation	Off	Off	On	Off	4L position for 10 seconds	0,1,0,0	Open	Open	Open	Switch operation sensor
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Open	4H to 4L through neutral
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Open	4H to 4L through neutral
During operation (N)	Off	Blinking (2HZ)	Off	Off	No operation	1,1,0,0	Closed	Closed	Open	4H to 4L through neutral
4H waiting	On	Blinking (2HZ)	Off	Off	No operation	1,1,0,1	Closed	Closed	Open	4L while waiting
During operation (Axle)	Blinking (2HZ)	Off	Off	Off	No operation	1,1,0,1	Closed	Open	Open	Axle driving
Axle waiting	Blinking (2HZ)	Off	Off	Off	No operation	1,1,0,1	Closed	Open	Open	-----
4H	On	On	Off	Off	No operation	1,1,0,1	Closed	Open	Closed	-----

- Operational restrictions (vehicle speed, engine speed, and transmission position) are applicable to transfer shifts in both directions (H←→Neutral←→L).

Parts Location

RHD



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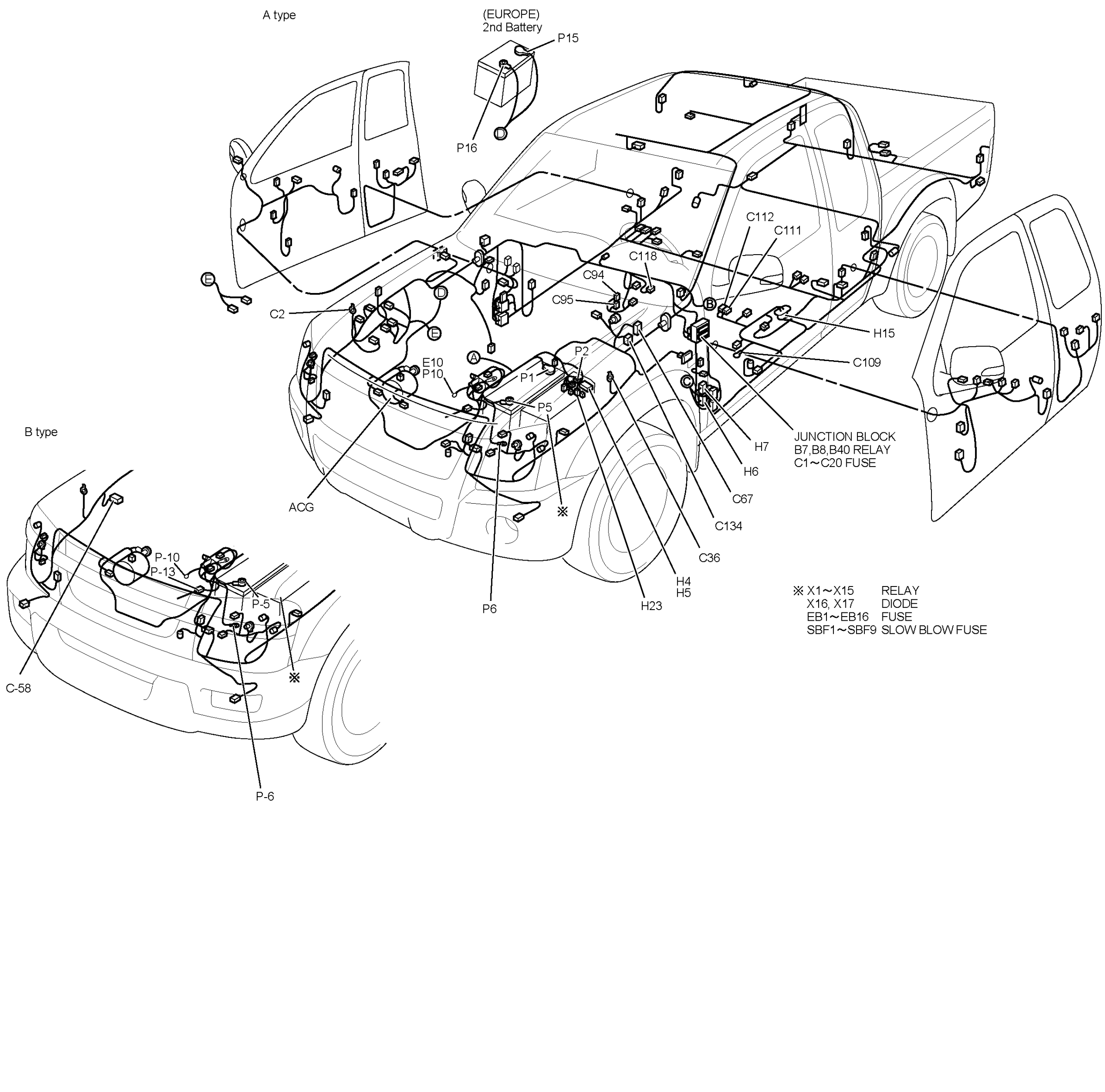
LHD



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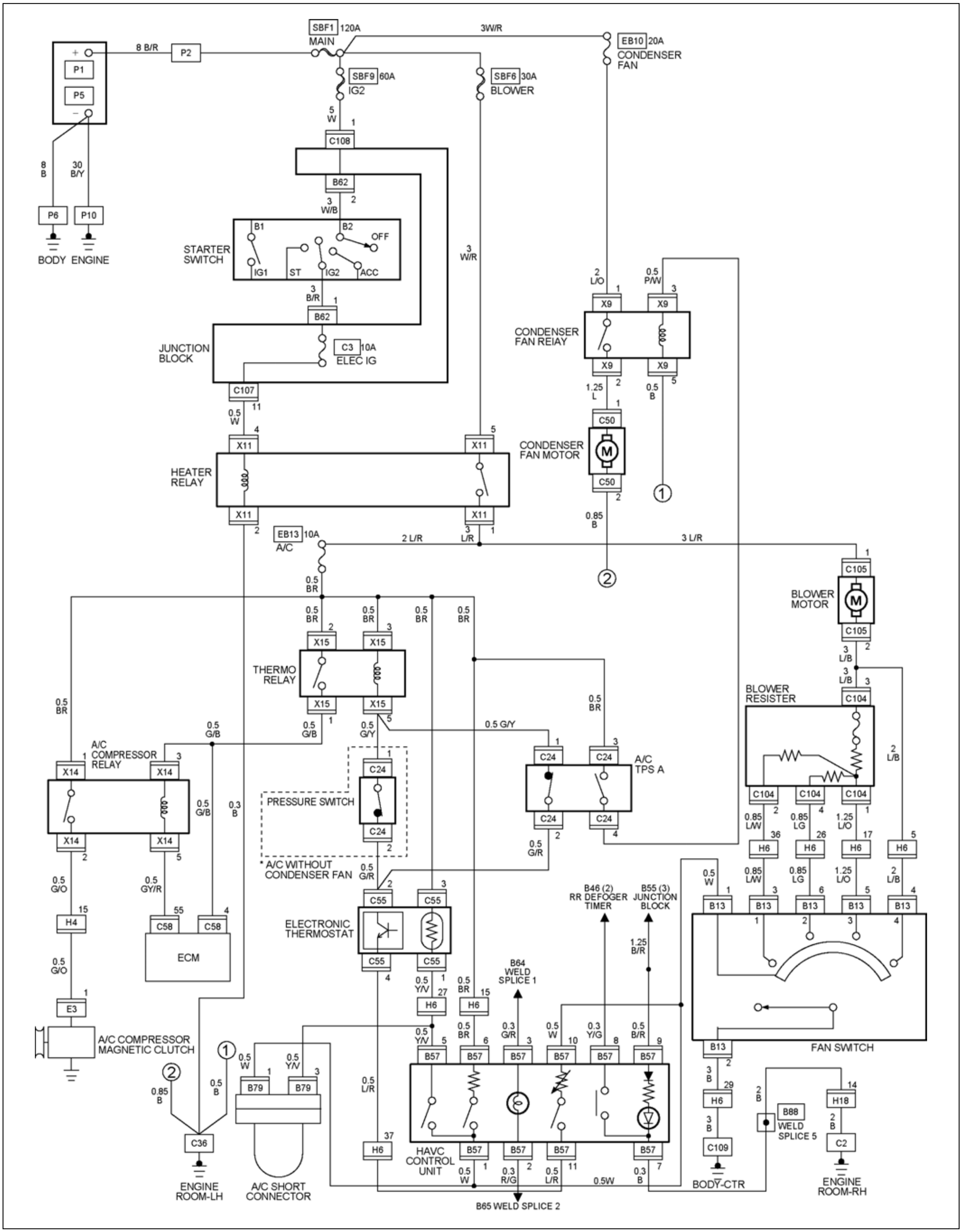
(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output RHD MODEL)



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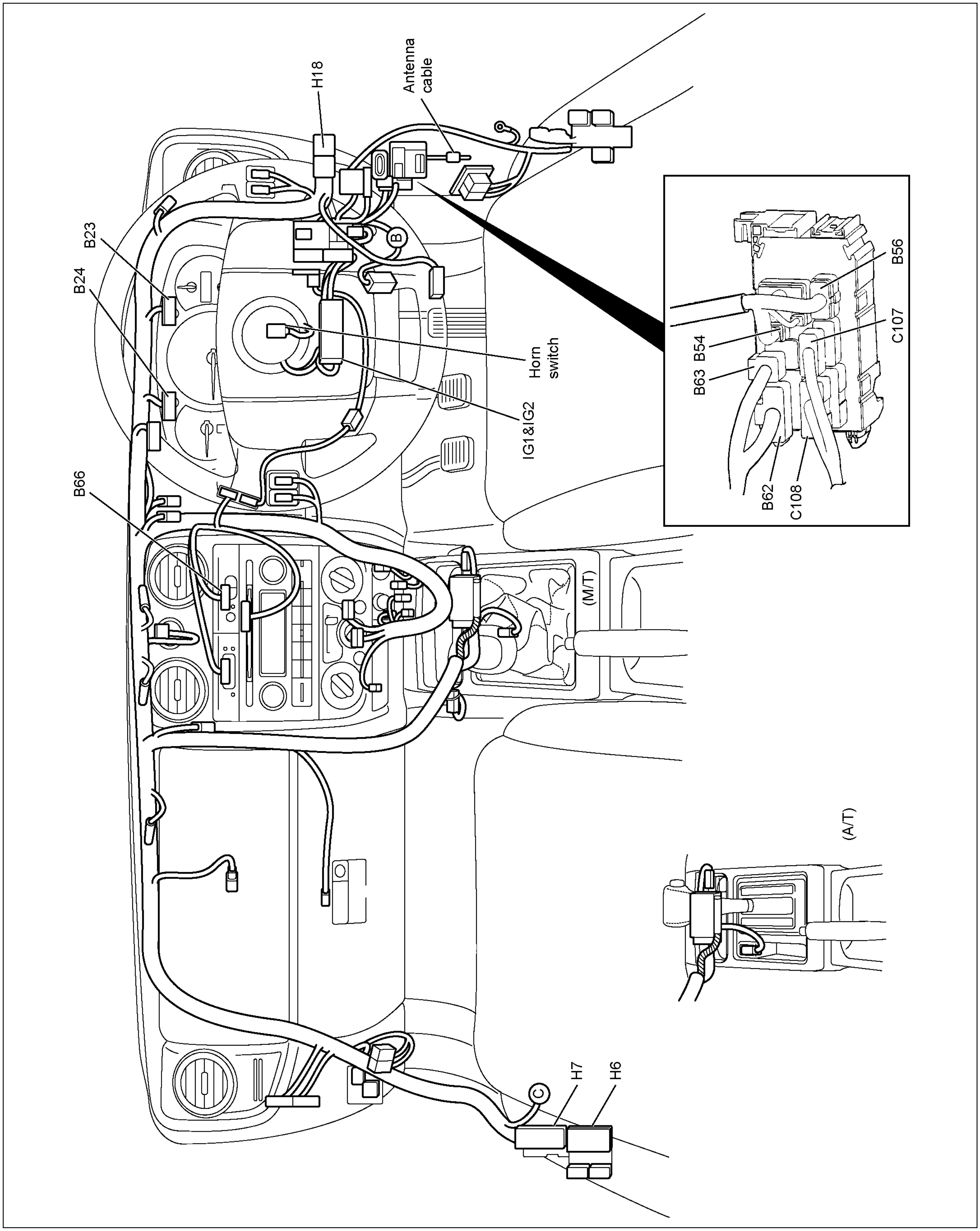
1. ABNORMAL REAR AXLE NOISE

1) Noise when the Engine is Driving the Vehicle

Checkpoint	Trouble Cause	Countermeasure
Rear axle gear oil (NG)	Insufficient gear oil	Replenish the gear oil
(NG)	Wrong or poor grade gear oil	Replace the gear oil
OK ↓ Drive pinion to ring gear backlash (NG)	Too much or too little backlash	Adjust the backlash
OK ↓ Drive pinion end play (NG)	Loose drive pinion bearings	Adjust the drive pinion bearing preload
(NG)	Worn drive pinion bearings	Replace the drive pinion bearings
OK ↓ Differential side bearing (NG)	Loose differential side bearings	Adjust the differential side bearing preload
(NG)	Worn differential side bearings	Replace the differential side bearings
OK ↓		

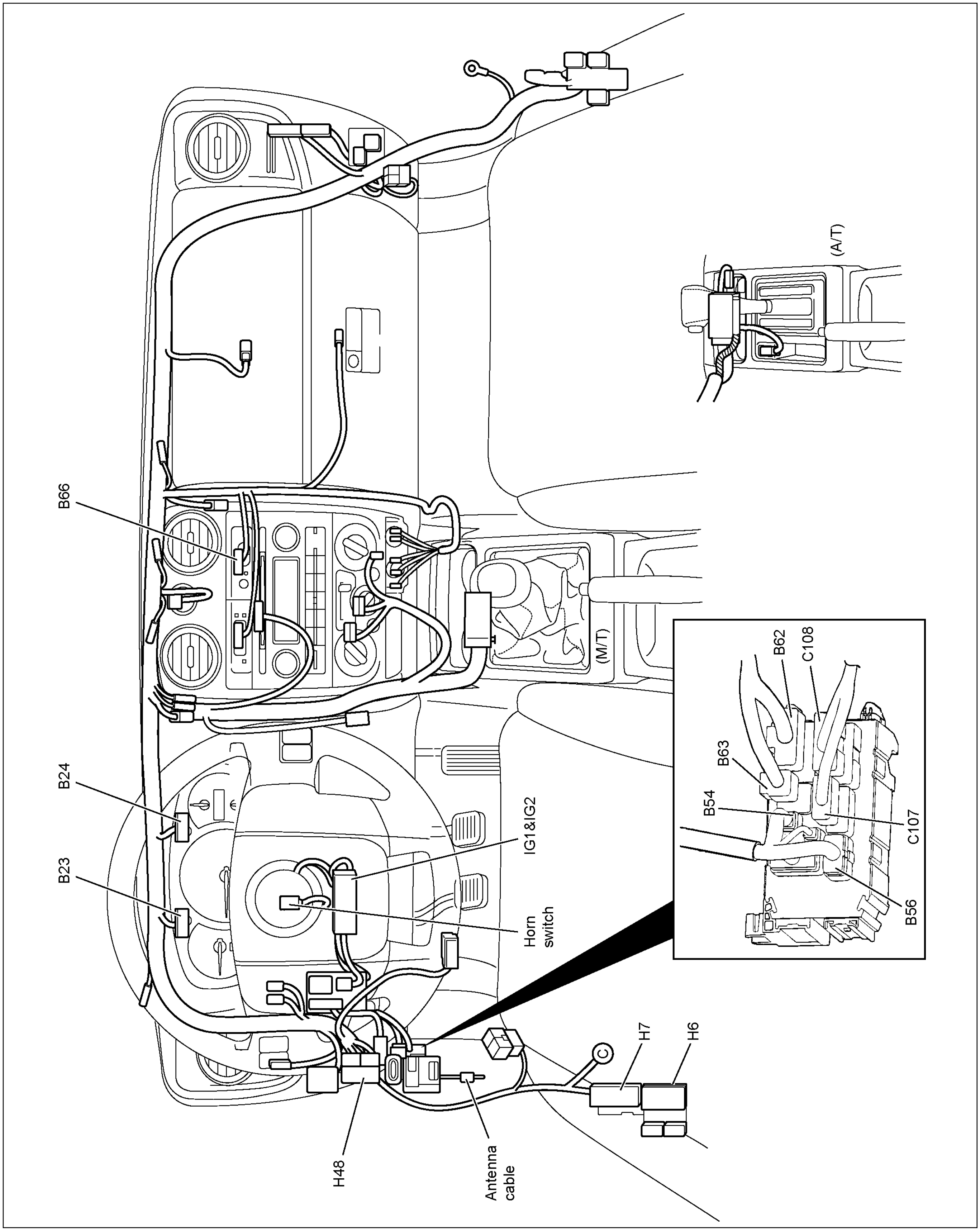
Continued on the next page

RHD



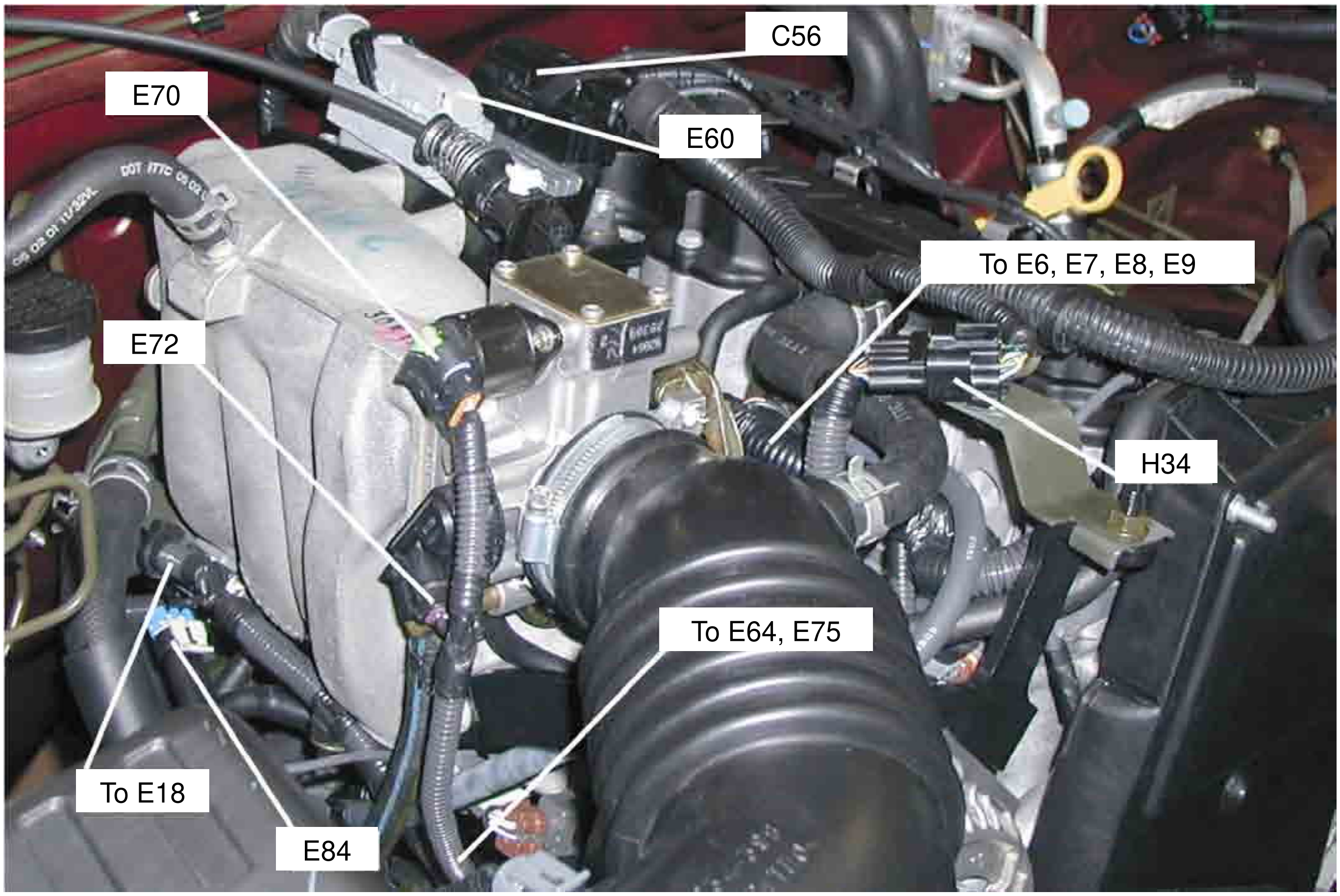
RTW78AXF046701

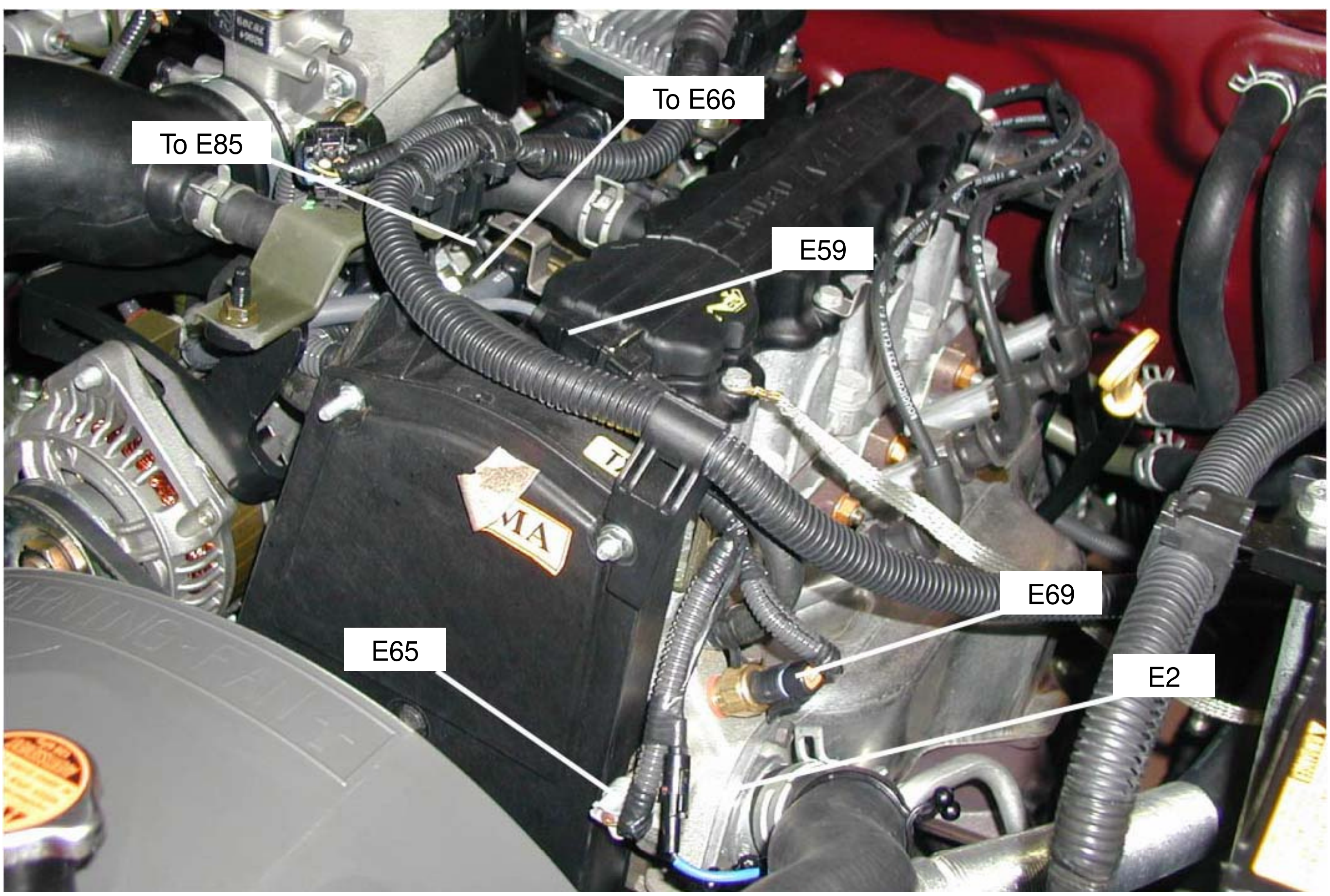
LHD



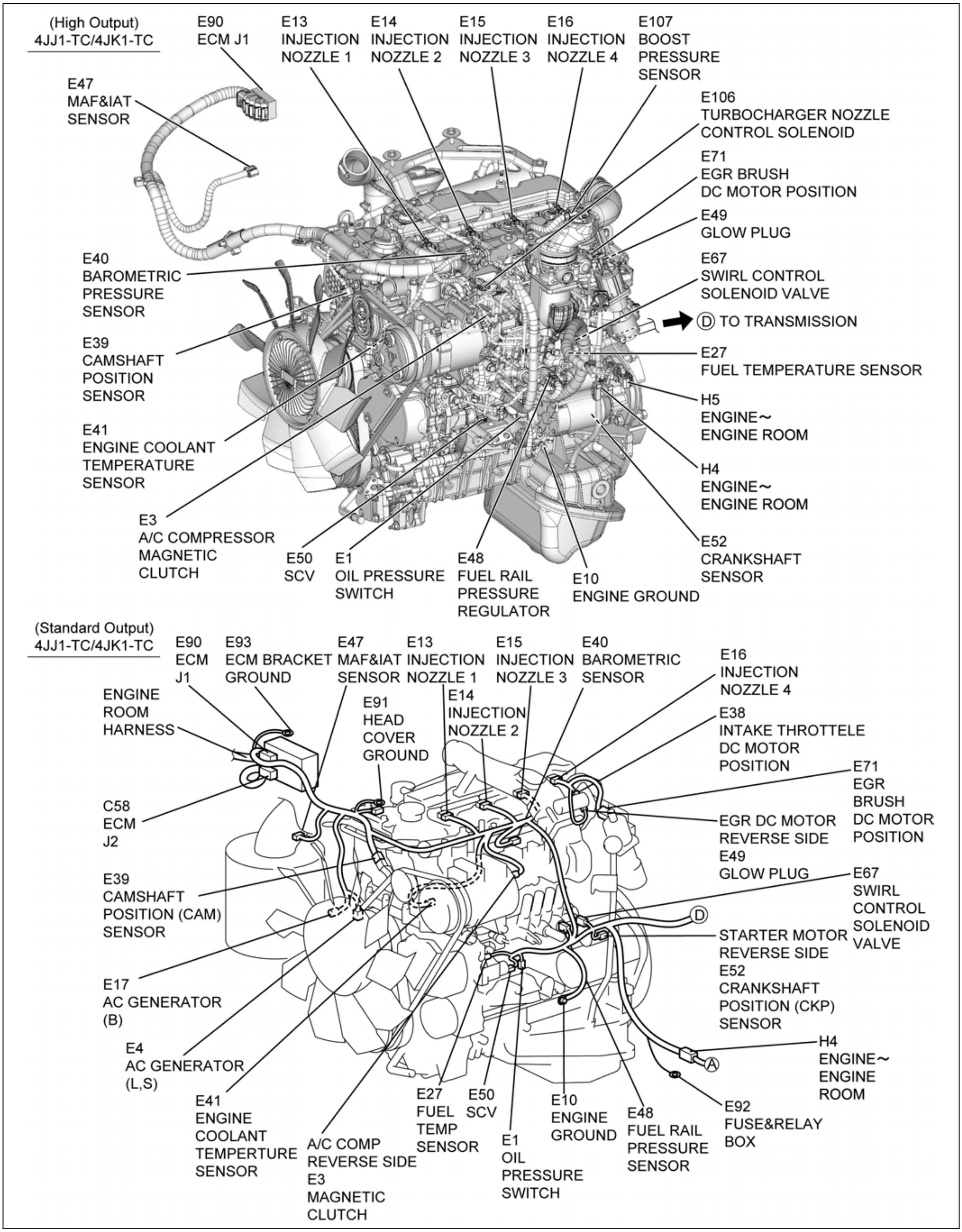
RTW78AXF046801

C24SE


C56
E70
E60
To E6, E7, E8, E9
E72
H34
To E64, E75
To E18
E84

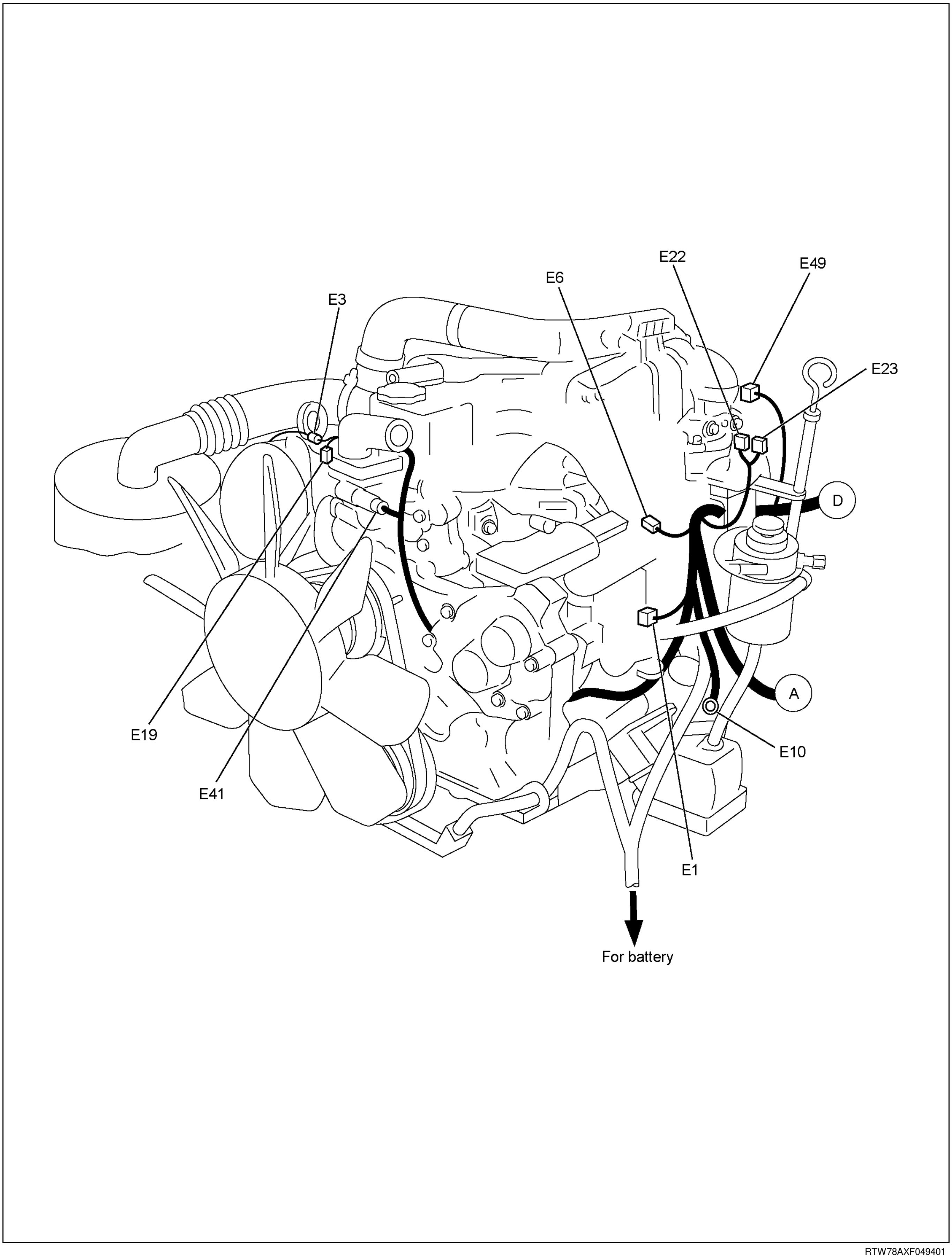

To E66
To E85
E59
E69
E65
E2

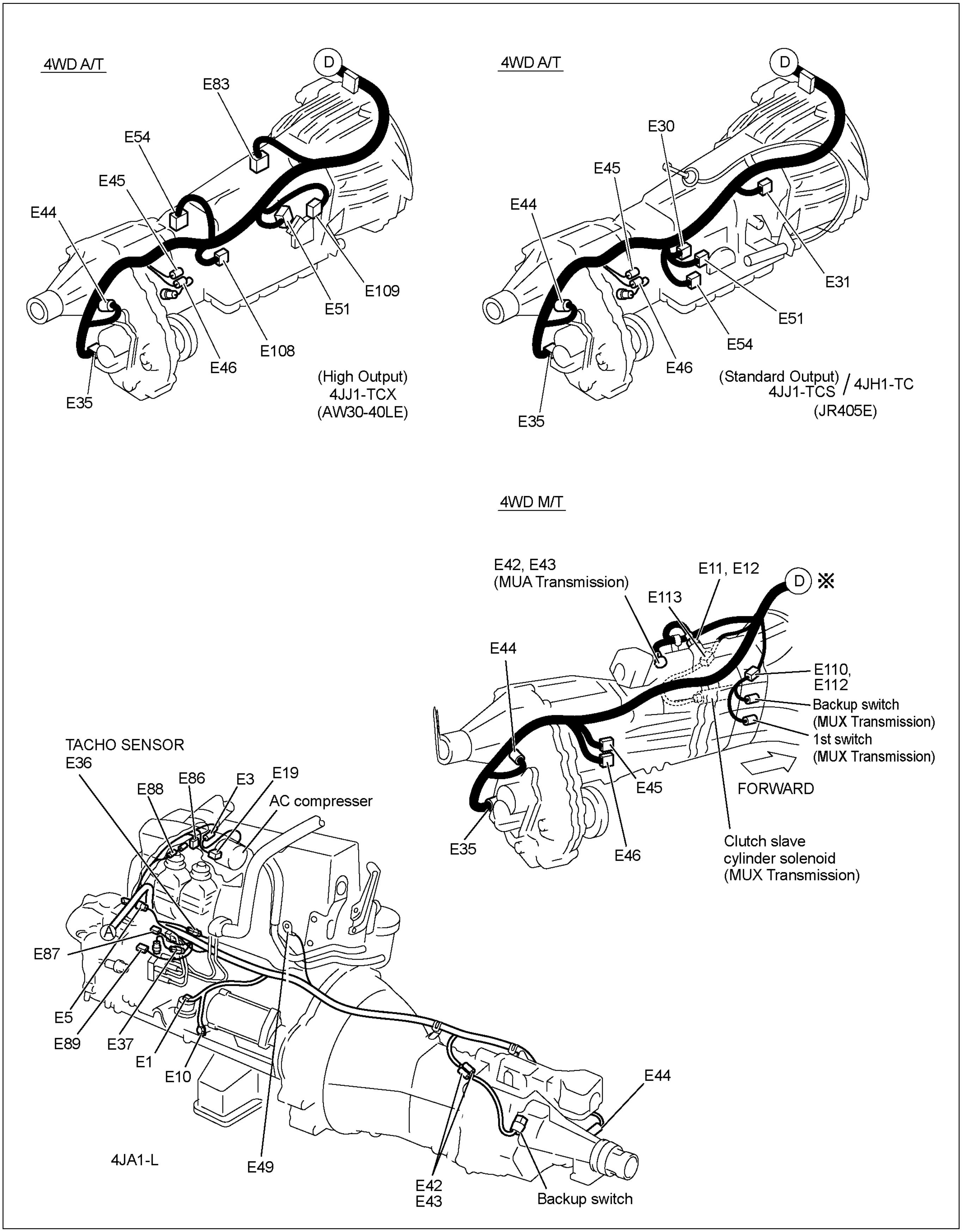
4JJ1-TC / 4JK1-TC



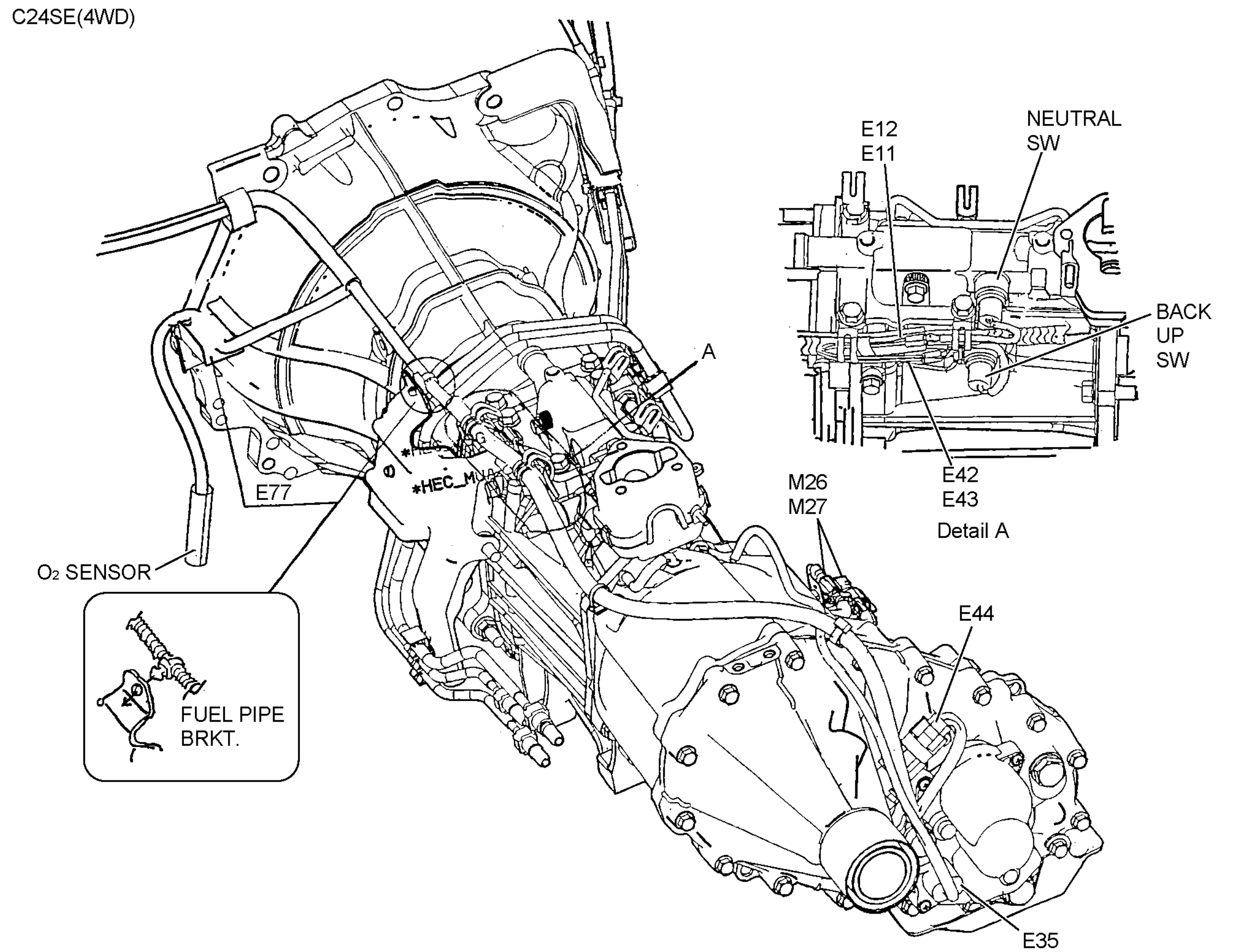
RTW78AXF048601

4JH1-TC


E22
E49
E6
E3
E23
D
A
E19
E10
E41
E1
For battery
RTW78AXF049401



RTW78AXF035901



RTW78AXF036001

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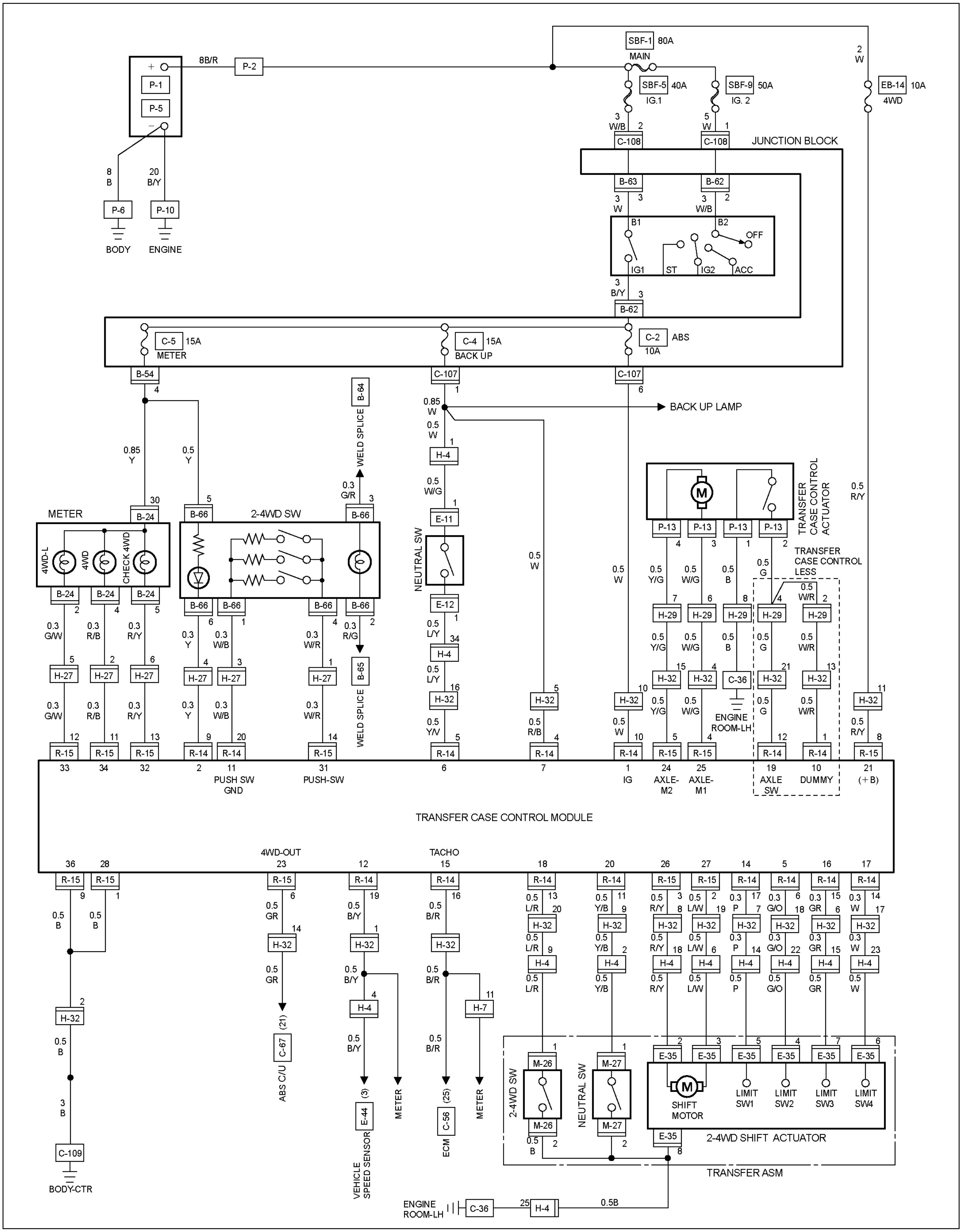
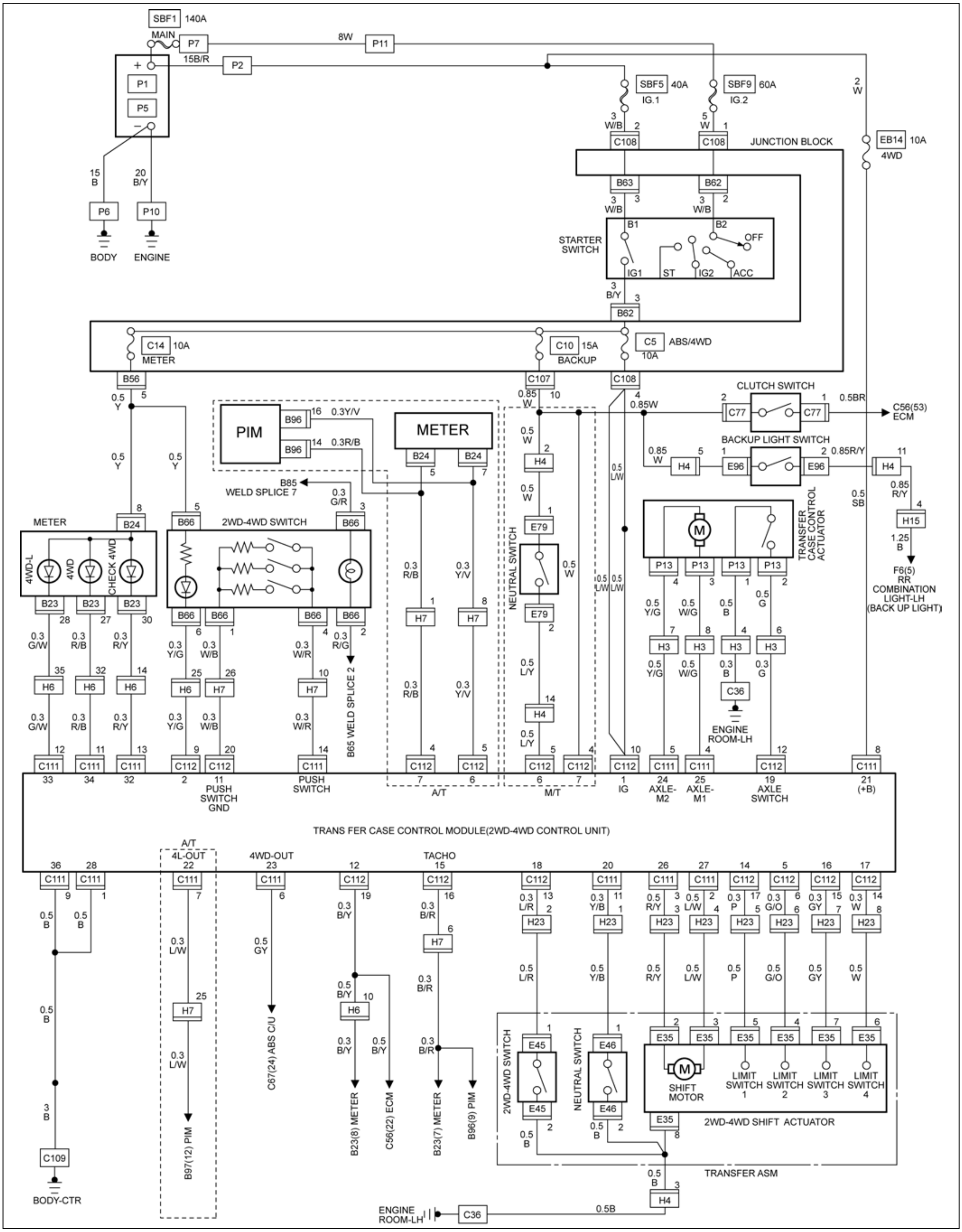
CIRCUIT DIAGRAM

C24SE



RTW680XF014201

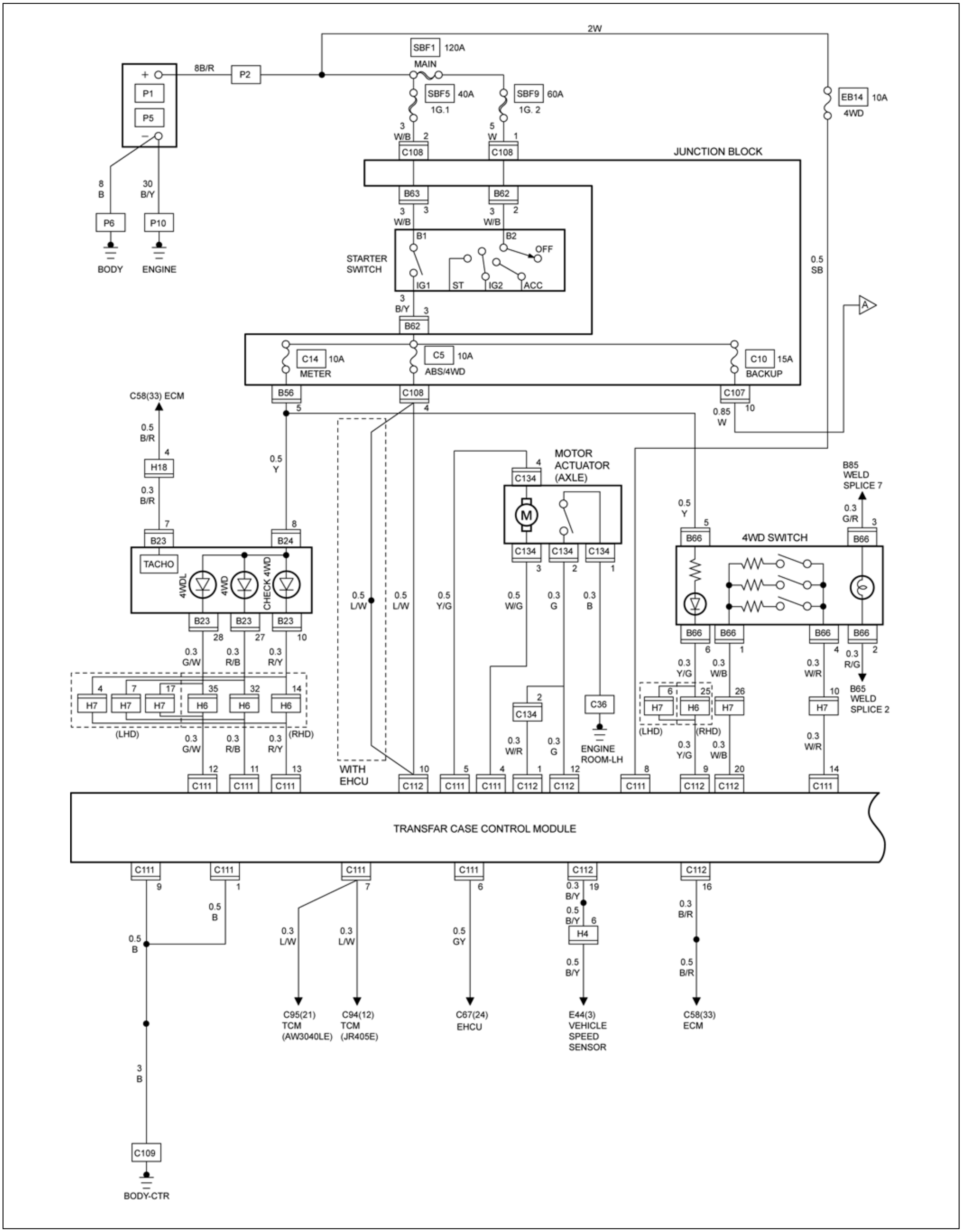
HFV6 (RHD)



RTW78AXF023801

4JJ1-TC / 4JK1-TC

Sheet 1/2



RTW78AXF025801

Continued from the previous page

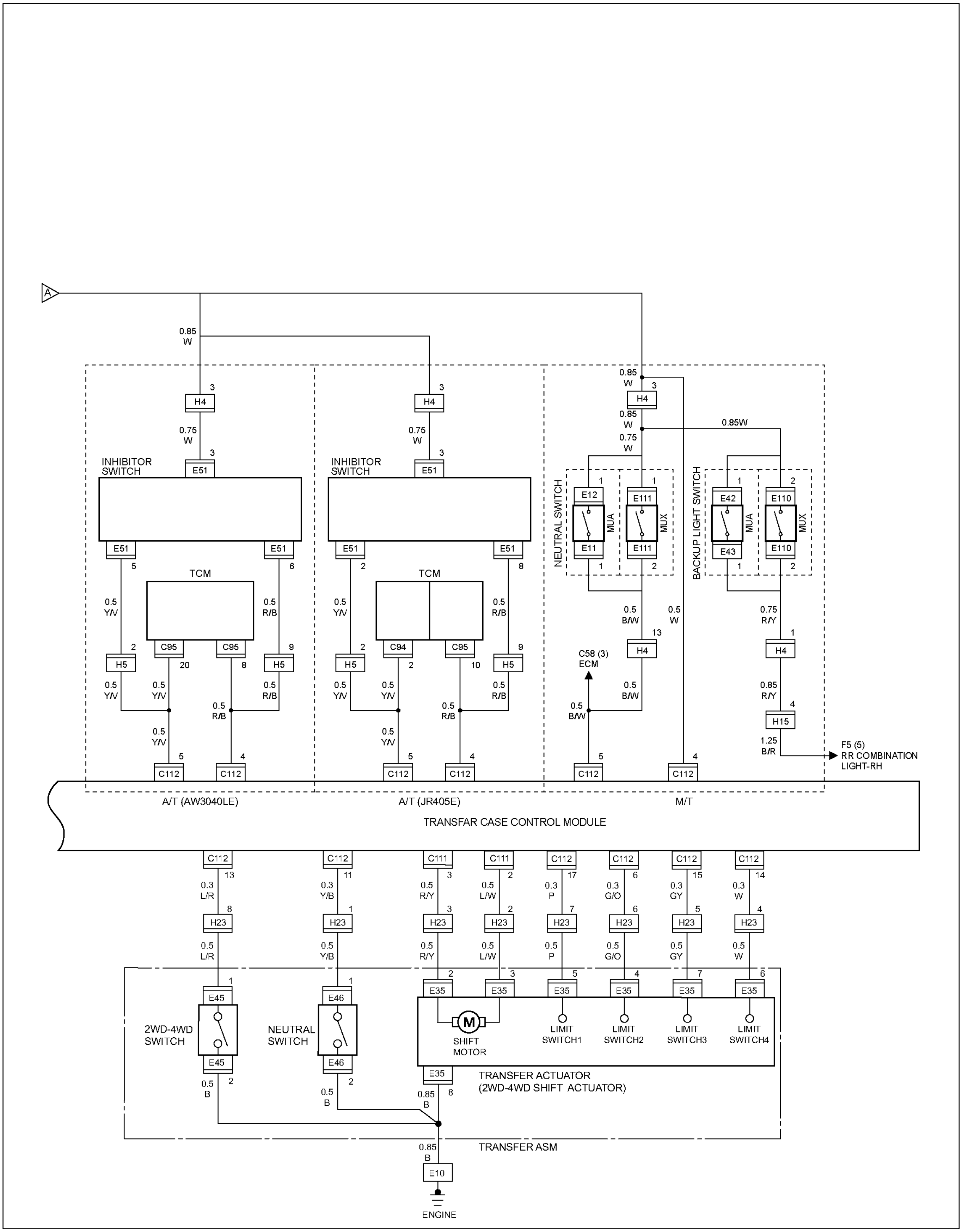
Checkpoint		Trouble Cause	Countermeasure
Drive pinion and ring gear	NG	Drive pinion and/or ring gear damage	Replace the drive pinion and the ring gear as a set
	NG	Excessive ring gear run-out	Replace the drive pinion and the ring gear as a set
	NG	Worn drive pinion and ring gear	Replace the drive pinion and the ring gear as a set

2) Noise when the Vehicle is Coasting

Checkpoint		Trouble Cause	Countermeasure
Drive pinion and ring gear backlash	NG	Insufficient backlash	Adjust the backlash
OK ↓			
Ring gear	NG	Ring gear damaged	Replace the ring gear and the pinion as a set

4JJ1-TC / 4JK1-TC

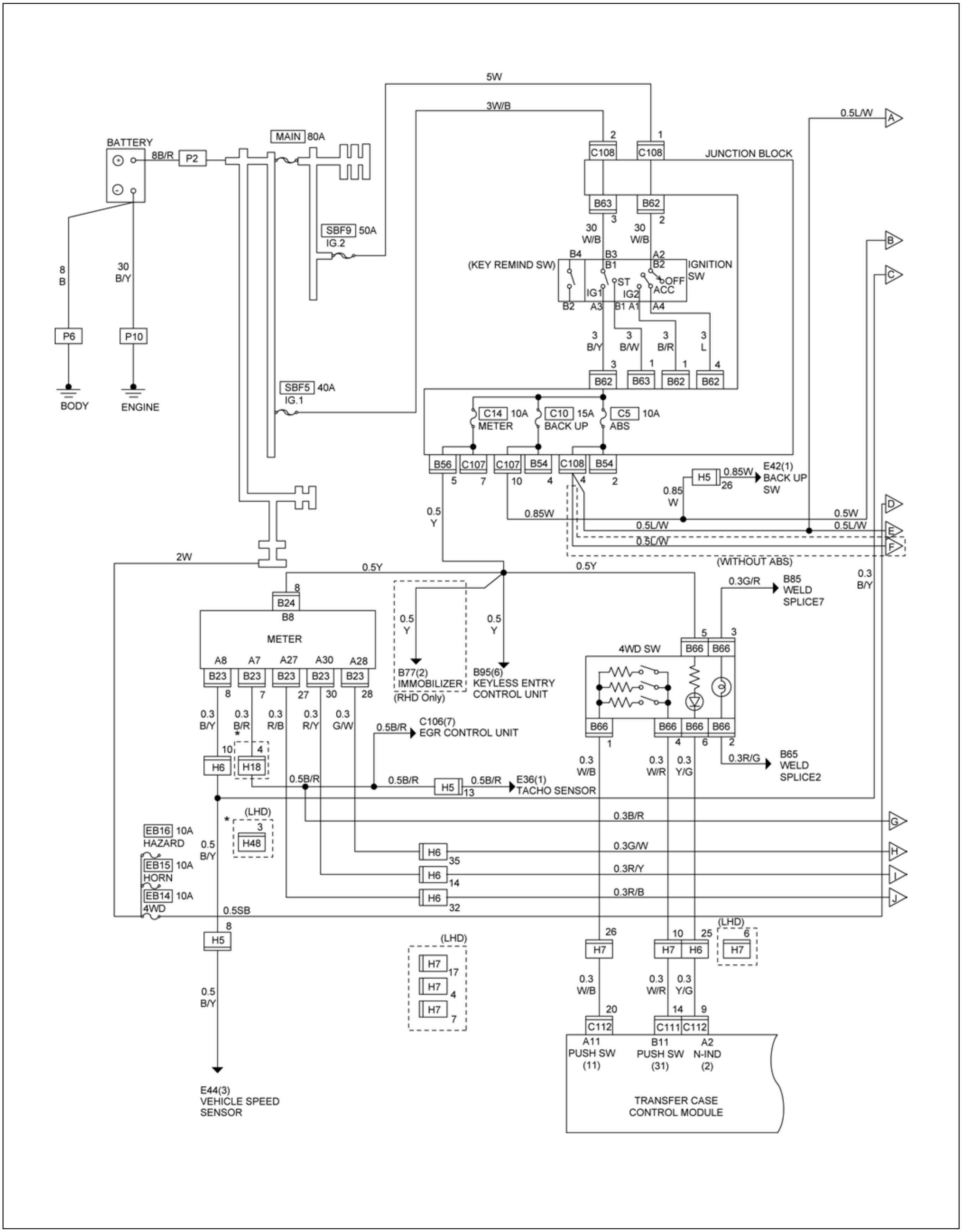
Sheet 2/2



RTW78AXF022501

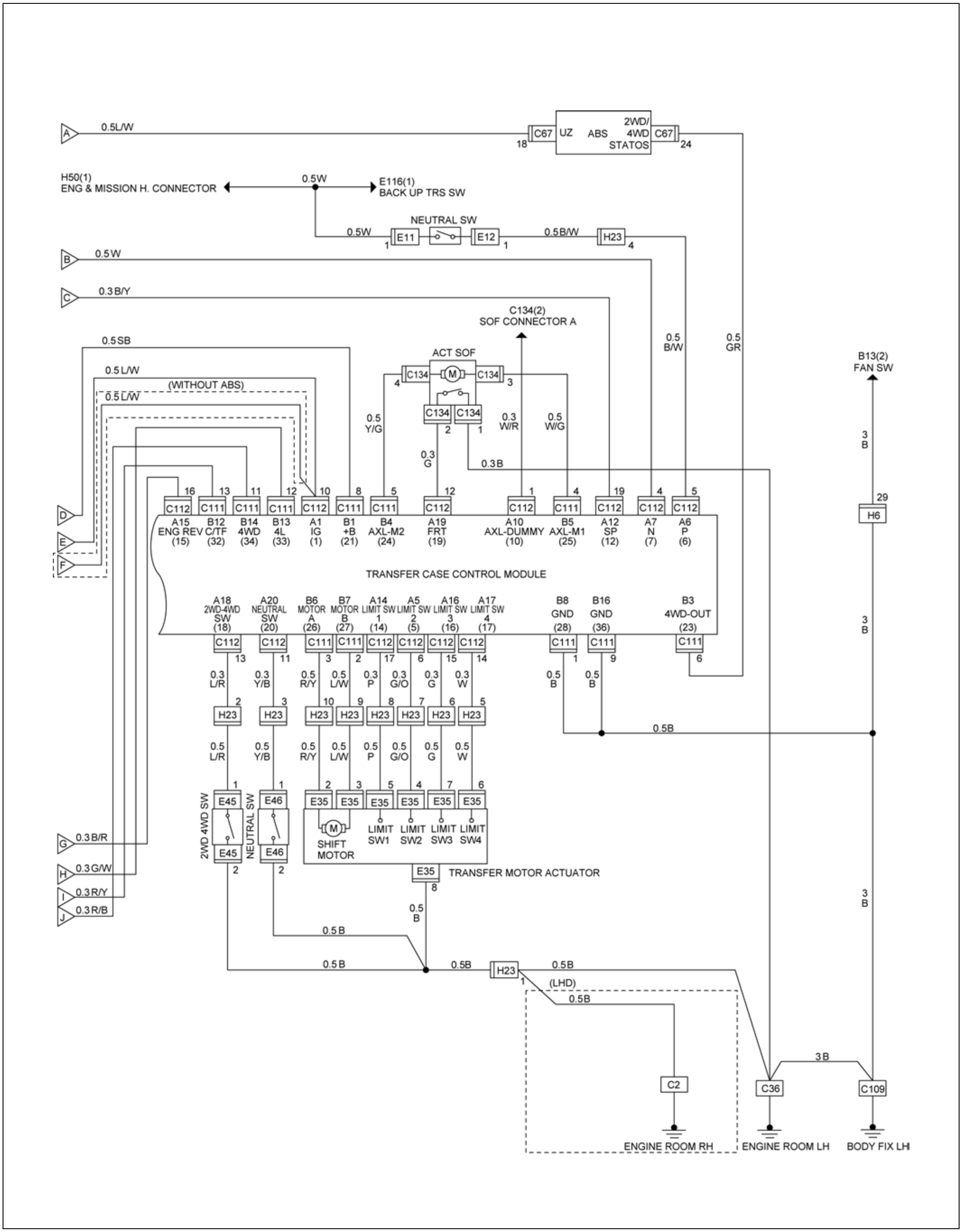
4JA1-T

Sheet 1/2



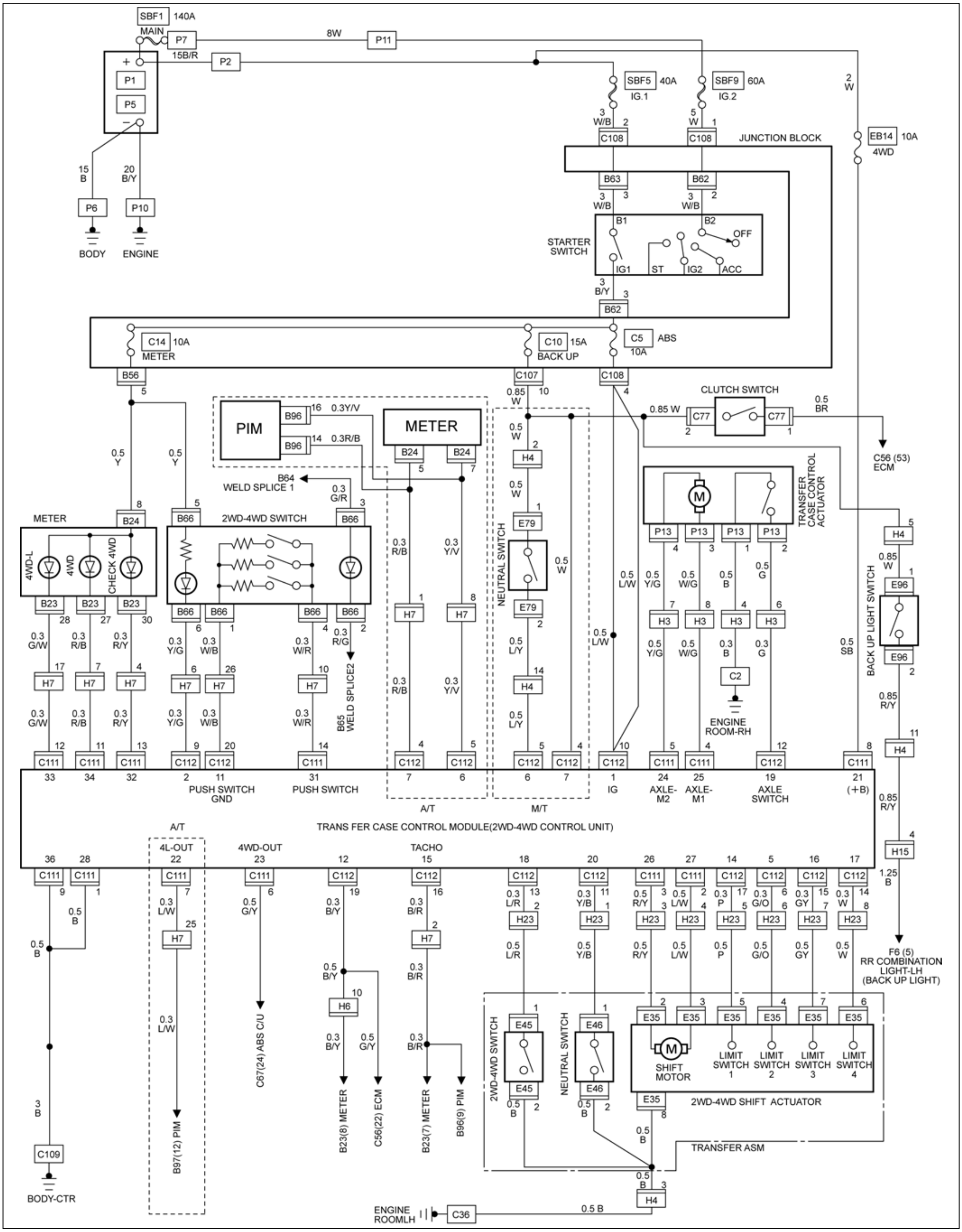
RTW78AXF008901

4JA1-T Sheet 2/2



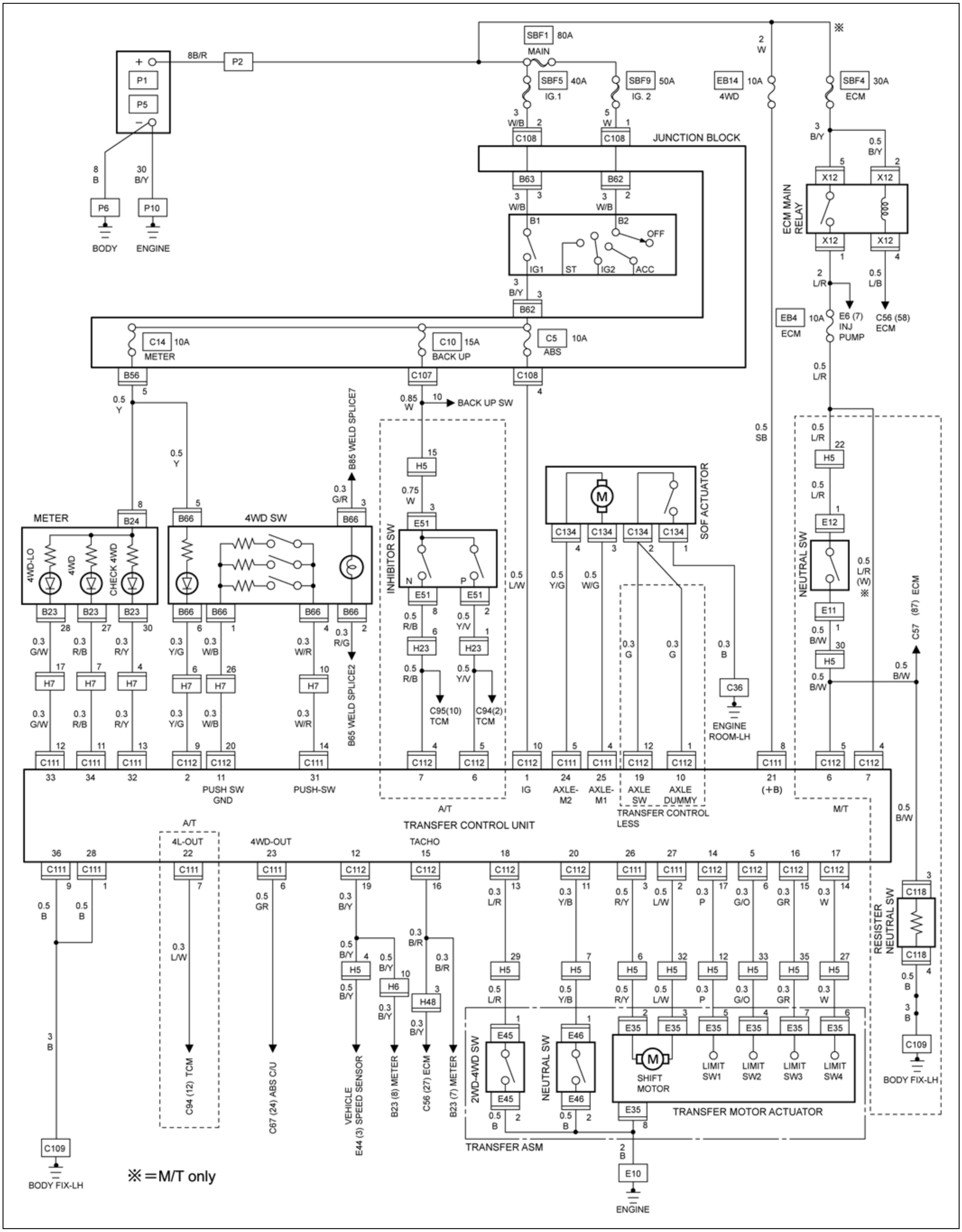
RTW78AXF009001

HFV6 (LHD)



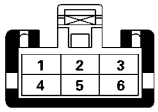
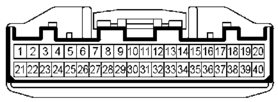
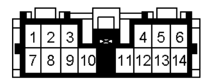
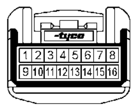
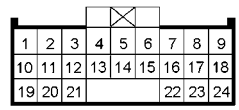
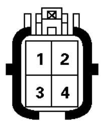
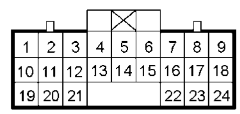
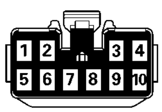
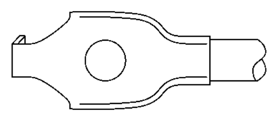
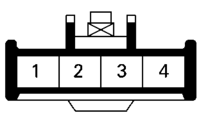
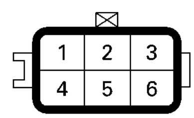
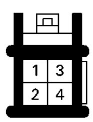
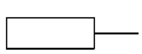
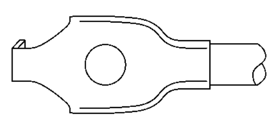
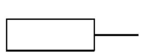
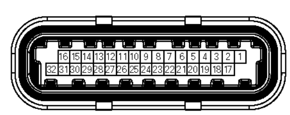
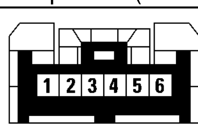
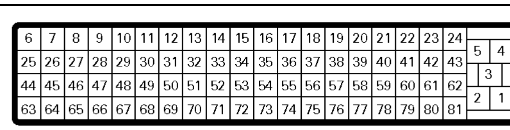
RTW78AXF012701

4JH1-TC



RTW78AXF006901

CONNECTOR LIST

No.	Connector face	No.	Connector face
B13 White	 Fan switch	B85	 Weld splice 7 (Ground)
B23 White	 Meter-A	B95 White	 Keyless entry control unit
B24 White	 Meter-B	B96 Gray	 PIM1
B54 White	 J/B I2	B97 White	 PIM2
B56 White	 J/B I4	C2 Silver	 Engine room-RH ground
B62 White	 Ignition switch (IGSUB: G1)	C4 Sky blue	 Front wiper motor
B63 White	 Ignition switch (IGSUB: G2)	C5 ~ C14	**NOT USED**
B64	 Weld splice 1 (Illumination)	C36 Silver	 Engine room-LH; ground
B65	 Weld splice 2 (Ground)	C56 (C24SE)	 ECM
B66 White	 4×4 switch	C56 (4JH1-TC) Black	 ECM-A

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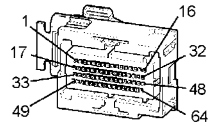
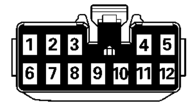
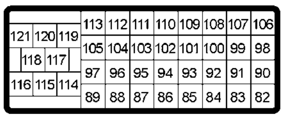
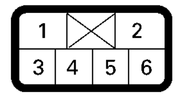
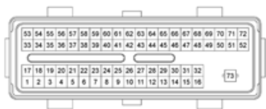
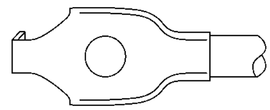
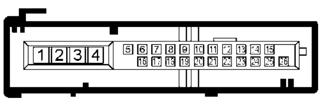
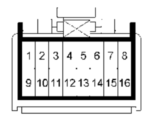
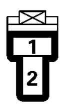
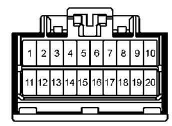
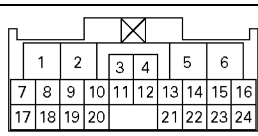
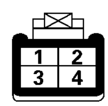
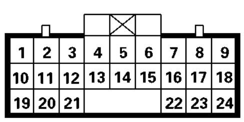
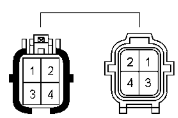
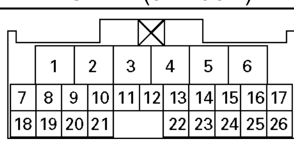
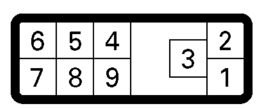
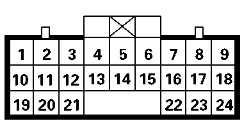
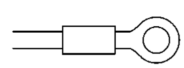
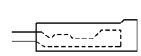
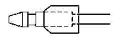
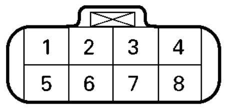
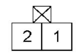
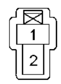
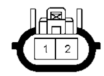
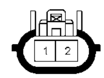
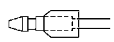
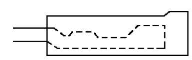
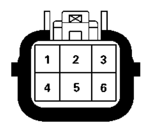
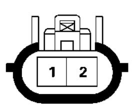
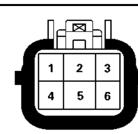
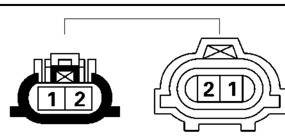
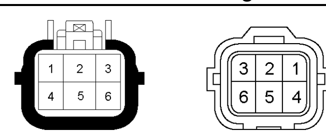
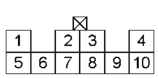
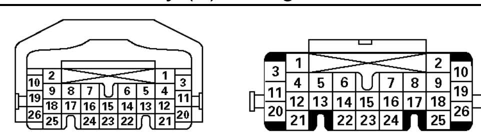
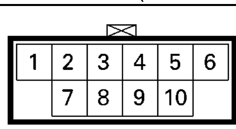
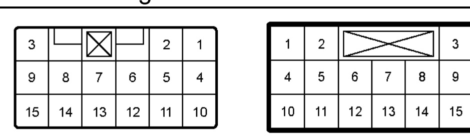
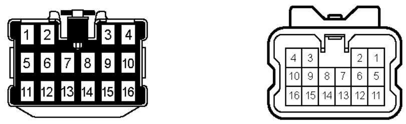
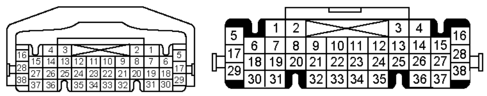
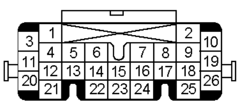
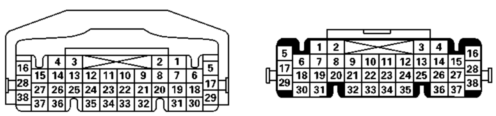
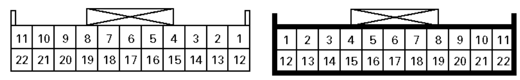
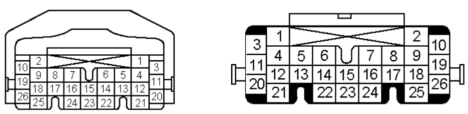
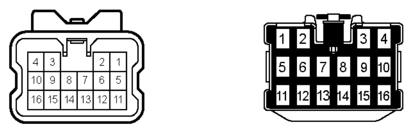
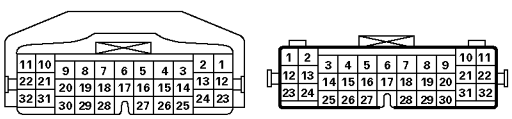
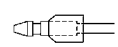
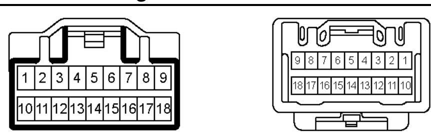
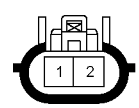
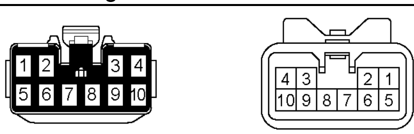
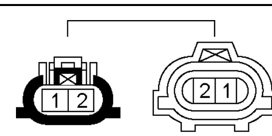
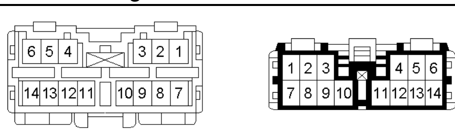
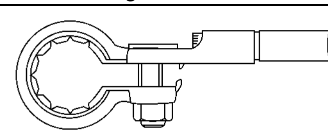
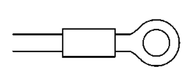
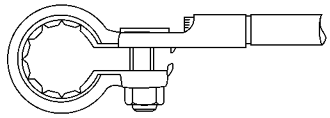
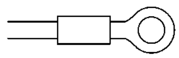
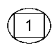
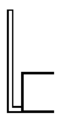
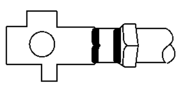
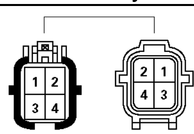
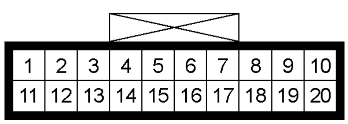
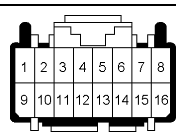
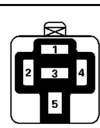
No.	Connector face	No.	Connector face
C56 (HFV6) Black	 ECM-A	C107 White	 J/B E2
C57 Black	 ECM-B	C108 White	 J/B E1
C58 Black	 ECM J2	C109 Silver	 Body-CTR; ground
C67 Black	 EHCU	C111 Black	 Transfer case control module
C77 White	 Clutch switch	C112 Black	 Transfer case control module
C94 White	 TCM-A (AW30-40LE)	C118	 A/C Resister & Neutral switch
C94 Gray	 TCM-A (JR405E)	C134 Gray	 Sof actuator
C95 White	 TCM-B (AW30-40LE)	E6	 Injector pump
C95 White	 TCM-B (JR405E)	E10 Silver	 Engine ground
C106	**NOT USED**	E11 Natural green	 Neutral switch

No.	Connector face	No.	Connector face
E12 Natural green	 Neutral switch	E78 ~ E80	**NOT USED**
E35 Black	 Motor actuator	E96 Black	 Reverse switch
E36	 TACHO sensor	E110 Brown	 Backup light switch
E42 Natural green	 Backup light switch	E111 Brown	 Neutral switch
E43 Natural green	 Backup light switch	E116	 Backup light switch
E44 Black	 Vehicle speed sensor	F5 Gray	 Rear combination light-RH
E45 Gray	 2WD-4WD switch	F6 Black	 Rear combination light-LH
E46 Brown	 H-L neutral switch	H3 (HFV6 4JH1-TC) Gray	 Battery (+) ~ Engine room
E51 Gray	 Inhibiter switch (AW30-40LE)	H4 (HFV6) (C24SE) White	 Engine room ~ Mission
E51 Black	 Inhibitor switch (JR405E)	H4 (4JH1-TC) White	 Engine ~ Engine room

No.	Connector face	No.	Connector face
H4 (4JJ1-TC) White	 Engine ~ Engine room	H23 (4JA1-L) White	 Engine room B ~ T/misson
H5 (HFV6 4JH1-TC) White	 Engine room ~ Mission	H27	NOT USED
H5 (4JJ1-TC 4JA1-L) White	 Engine ~ Engine room	H29 (C24SE)	 Battery (+) ~ Engine room
H6 White	 Engine room ~ INST	H32 (C24SE)	 Engine room ~ Rear body
H7 White	 Engine room ~ INST	H48 White	 Engine room ~ INST
H7 (4JJ1-TC) White	 Engine room ~ INST	H50	 Engine & Mission ~
H15 (HFV6 4JH1-TC) Black	 Engine room ~ Chassis	M26 (C24SE) Brown	 2WD-4WD switch
H15 (4JJ1-TC, 4JA1-L) Black	 Engine room ~ Chassis	M27 (C24SE) Brown	 Head leveling neutral switch
H18 White	 Engine room ~ INST	P1 Silver	 Battery (+)
H23 White	 Engine ~ Engine room B	P2 Silver	 Relay & Fuse box

No.	Connector face	No.	Connector face
P5 Silver	 Battery (-)		
P6 Silver	 Body earth (Ground)		
P7	 Battery (ALT)		
P10 Silver	 Engine ground		
P11 Silver	 Fuse & relay box		
P13 Gray	 Shift on the fly actuator		
R14 Black	 2WD-4WD control unit		
R15 Black	 2WD-4WD control unit		
X12 Black	 ECM main relay		

3) Intermittent Noise

Checkpoint		Trouble Cause	Countermeasure
Axle shaft	NG	Too much spline play	Replace the shaft
OK			
Ring gear	NG	Warped ring gear	Replace the drive pinion and the ring gear as a set
OK			
Differential cage	NG	Loose differential cage bolts	Tighten the differential cage bolts
OK			
Axle case inside	NG	Foreign material in the axle case	Remove the foreign material

Diagnosis

Before determining a trouble (Non-trouble mode)

1. *When shifting from 2H to 4H:*

1-1-1 When the flashing frequency of the 4WD indicator is changed from 2Hz to 4Hz (Shift on the fly)

If the load is too large to shift the gears synchronously, the operation is repeated up to 3 times. If the shifting is not effected after being repeated 3 times, the indicator frequency is changed from 2Hz to 4Hz. At the same time, the actuator condition is changed to 2H, indicator flashes at 4Hz for 10 seconds, and then goes out.
Cause of excessive synchronous shifting load

- Extremely low temperature (the oil viscosity of the front differential increases requiring a large load for synchronization).
- High speed (since the difference of relative revolutions of gears to be shifted synchronously is too large, required work load per unit time becomes larger).

Step 1-1-1:

Stop the vehicle or decrease the speed and operate as required again.

1-1-2 When the flashing frequency of the 4WD indicator is changed from 2Hz to 4Hz (Rigid and free wheel Hub) / Block out of meshing spline in transfer case.

Step 1-1-2:

Run the vehicle forward and backward several meters and operate as required again.

1-2 When the flashing of 4WD indicator at 2Hz continues more than 11.5 seconds (repetition of 3 times of above No.1 is counted) (Shift on the fly)

If there is difference of revolutions and phases between the front wheel and the axle, connecting the front wheel and axle is difficult.
Until shifting in the transfer and connection of the front wheel and axle are completed*, the indicator flashes at a frequency of 2Hz. In the above case, the indicator continues flashing at a frequency of 2Hz until the connection of the front axle is completed. (If the shifting in the transfer is not completed, the flashing frequency is changed to 4Hz (above No.1).)
By correcting the difference of relative revolutions and deviation of phases, the shifting can be completed.

Step 1-2:

While the vehicle is running, check it is safe around the vehicle and then accelerate or decelerate the vehicle while going straight.
When the vehicle is at a stop, run the vehicle forward and backward several meters.

2. *When shifting from 4H to 2H*

2-1 When 4WD indicator continues flashing at 2Hz

When shifting from 4H to 2H, the 4WD indicator continues flashing at 2Hz until separation in the transfer and the separation of the front wheel axle are completed*. When torsional torque is accumulated in the drive system, separation in the transfer and separation of the front axle* is difficult. In such a case, they can be separated by removing the torsional torque of the drive system.

Step 2-1:

While the vehicle is running, check it is safe around the vehicle and then accelerate or decelerate the vehicle while going straight.
When the vehicle is in stop, run the vehicle several meters forward and backward.

∗: Shift on the fly only.

3. *Shifting from 4H to 4L*

3-1 When the 4L indicator flashes at 2Hz

When shifting from 4H to 4L, the 4L indicator continues flashing at 2Hz until shifting in the transfer case is completed. The phases of the engaged splines may sometimes deviate preventing completion of shifting. By correcting the deviation of phases, shifting is completed.

Step 3-1:
(In case of AT): **Set the select bar of the transmission to the D position.**
(In case of MT): **Set the lever of the transmission to a position allowing running and engage the clutch gently.**
At this time, some rotating force acts on the engaged splines, phase is corrected and the engagement is completed.

3-2 When the 4L indicator flashes at 2Hz for 10 seconds and then keeps ON again (AT vehicle)

This condition occurs when torsional torque has been generated between the transmission and road surface and the transfer standby mechanism cannot absorb it completely.

Step 3-2:
Set the select lever of the transmission to the N position. (Stepping on the brake pedal is effective at this time.)

3-3 When the 4L indicator flashes at a frequency of 4Hz

Shifting from 4H to 4L is restricted.
When the vehicle is running, the transmission lever is at the running range and the engine speed is high (L4: 3000rpm or more V6: 2000rpm), the transfer cannot be shifted from 4H to 4L (restriction on operation).

Restriction on operation (Except 4JA1-T)

The 4H, neutral and 4L shifting mechanism has no synchronization function. Therefore, if relative rotations in the mechanism become excessive, shifting exerts adverse influence on the internal mechanism of the transfer. To avoid such a trouble, vehicle condition is detected to restrict the operation (vehicle speed, engine speed and TM position).

Requirement to restrict the speed: Vehicle should be in stop.

Due to the detection logic, time to wait for start of operation may be required.

A/T: If the vehicle is in stop for a long time at the TM running range (D, 1, 2) before operating the AT, waiting time becomes longer (from 1 second to 3 minutes at the maximum).

M/T: If the vehicle is at stop with the clutch stepped on at the T/M running position (1 – R), the time to wait becomes longer.

Waiting time means the time commencing from when other requirements (engine speed and T/M position) are met to permission of the speed restriction. Operation during the waiting time is not permissible.

The waiting time is 1 second at the minimum and increases up to 5 seconds if the above condition continues for 3 minutes. After that, the waiting time increases up to 3 minutes in 2 minute intervals.

When it is clear that the above condition has continued and reduction of waiting time is required, turn on or off the ignition or start and stop the vehicle several meters.

Requirements for permission of restriction on engine speed: Engine speed should be decreased.

The engine speed of 3000rpm (V6: 2000rpm) or below is advisable.

Requirements for permission of restriction on T/M position restriction:

(AT) N range is recommended

(MT) should be at the neutral.

These requirements for permission should all be met before the switch is operated. If the requirements are met after operation, operation is not automatically effected but re-operation is required after permission is given.

Restriction on operation (4JA1-T)

The 4H, neutral and 4L shifting mechanism has no synchronization function. Therefore, if relative rotations in the mechanism become excessive, shifting exerts adverse influence on the internal mechanism of the transfer. To avoid such a trouble, vehicle condition is detected to restrict the operation (vehicle speed, and TM position).

Requirement to restrict the speed: Vehicle should be in stop.

Requirements for permission of restriction on engine speed: Engine speed should be decreased.
The engine speed of 3000rpm or below is advisable.
Requirements for permission of restriction on T/M position restriction:
should be at the neutral.

These requirements for permission should be all met before the switch is operated. If the requirements are met after operation, operation is not automatically effected but re-operation is required after permission is given.

Note: Don't' accelerate engine speed a the time of this operation.

Step 3-3:
Stop the vehicle. (Close the accelerator and decrease the engine speed to below L4: 3000rpm, V6: 2000rpm.)
(In case of AT): Set the transmission select lever to the N position.
(In case of MT): Set the transmission lever to the neutral position. (Stepping on the clutch is recommended.) Push the 4L button.
If shifting operation is not completed (the lamp flashes at 2Hz), perform step 3-1.

4. Shifting from 4L to 4H

4-1 When 4L indicator continues flashing at 2Hz

When shifting from 4L to 4H, the 4L indicator continues flashing at 2Hz until the shifting in the transfer case is completed. Phases of engaged splines may deviate and the operation may not be completed in some cases. Shifting is completed by correcting the deviation of the splines.

Step 4-1: (same as step 3-1)
(In case of AT): Set the transmission select lever to the D position.
(In case of MT): Shift the transmission lever to a position allowing running and engage the clutch gently.

4-2 When the indicator continues flashing at 2Hz for 10 seconds and then keeps on at 4L again (AT vehicle)

This condition occurs when torsional torque has been generated between the transmission and the road surface (use of the parking position on a slope). Resistance against the separation of the driving force cannot be completed by the waiting mechanism of the transfer.
Shifting is also possible by using the brake at the neutral position of the transmission

Step 4-2: (Same procedure as the step 3-2)
Set the transmission select lever to the N position.
(Leaving the brake lever and stepping on it again is recommended.)

4-3 When the 4L indicator flashes at 4Hz

Shifting from 4L to 4H is restricted.
When the vehicle is running, the transmission lever is at the running range, and the engine speed is high, the transfer 4L cannot be shifted to 4H.

Step 4-3: (Same procedure as the step 3-3)

Stop the vehicle (close the accelerator and decrease the engine speed to L4: 3000rpm V6: 2000rpm or below).

(In case of AT): **Set the transmission select lever to the N position.**

(In case of MT): **Set the transmission lever to the neutral position (stepping on the clutch lever is recommended).**

Push the 4H button.

If shifting is not complete (indicator flashes at 2Hz), go to step 4-1.

5. When shifting from 4H or 4L to neutral

(Same procedure is required when shifting from 2H but in such a case, requirements for shifting from 2H to 4H are also applied.)

5-1 Neutral indicator continues flashing at 2Hz

The neutral indicator continues flashing at 2Hz until 4H (4L) is completely separated in the transfer. If torsional torque has accumulated between the transmission and road surface, separation may be difficult.

Step 5-1:

If the operation is not complete, execute step 7 for confirmation.

(In case of AT): **Set the transmission select lever to the D position.
After confirming that the gears are at the neutral position, return the lever to the N position.**

(In case of MT): **Set the transmission lever to a vehicle running position and engage the clutch gently.
After confirming that the gears are at the neutral position, return the lever to the neutral position**

5-2 When the neutral indicator flashes at 4Hz

As in the case of shifting from 4L to 4H, restriction is imposed to the operation from 4L or 4H (including 2H). If the transmission lever is at a running range and engine speed is high (L4: 3000rpm, V6: 2000rpm or more) while the vehicle is running, operation from the 4L or 4H (including 2H) of the transfer to the neutral is impossible (restriction on operation).

Step 5-2:

Stop the vehicle.

(In case of AT): **Set the transmission select lever to the N (or P) position.**

(In case of MT): **Set the transmission lever to the neutral position (at this time, stepping on the clutch is recommended).**

Keep pushing the 2H and 4L button for 10 seconds.

Follow the start procedure for confirmation. (Confirmation of drive force is not transferred; same as in step 5-1)

After the confirmation, set the transmission to the neutral position in the case of MT or to the neutral position in the case of AT.

6. *When shifting from neutral to 2H, 4H or 4L*

6-1 When the 4L indicator or 4WD indicator flashes at 2Hz

Indicator flashing at 2Hz indicates that the engagement of the splines has not completed because of deviation of the spline phases. By eliminating such a deviation, shifting is complete (same as in step 3-1 and 4-1).

6-2 When the 4L indicator or 4WD indicator flashes at 4Hz

As in the case of shifting from 4L to 4H, restriction is imposed to the operation to 4L or 4H (including 2H). If the transmission lever is at a running range and engine speed is high (3000rpm or more) while the vehicle is running, operation from neutral of the transfer to the 4L or 4H (including 2H) is impossible (restriction on operation).

Step 6-2:

Stop the vehicle.

(In case of AT): **Set the transmission select lever to the N (or P) position.**

(In case of MT): **Set the transmission lever to the neutral position (at this time, stepping on the clutch is recommended).**

Keep pushing the 4H or 4L or 2H button for 10 seconds.

Trouble diagnosis based on the operation switch, transfer indicator lamp and operating sound “Check 4WD” indicator ON (operation guard based on the transfer actuator position detection error)

This condition indicates a faulty circuit related with the detection (limit) switches of the system actuator.

Detection (limit) switches detect the actuator operating angle based on their combinations.

The controller monitors transition of the actuator based on the combination of the detection (limit) switch output.

If the transition based on the combinations indicates some trouble, it is memorized, and shifting operation is stopped when the trouble is counted 5 times, and the “Check 4WD” indicator lights up. At this time, the system permits operation to 2H only.

When such a condition occurs, inspection of the transfer shift actuator, checking of the harness related with the detection (limit) switch, and erasure of the memory of the controller is required.

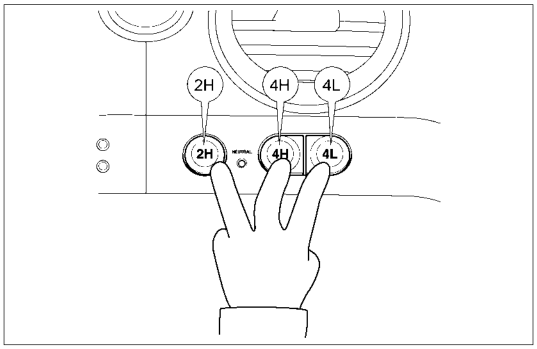
(Refer to the memory erasure procedure for the erasure of the memory.)

At this time, the position indicator may flash at 4Hz. It means that a detection (limit) switch trouble wad detected in the operation process shown by that position indicator (example: 4WD indicator when shifting from 2H to 4H).

Caution:
During trouble diagnosis and correction, do not turn ON the ignition with the harness connector of the transfer actuator disconnected. (Do not disconnect the harness connector of the transfer actuator when the ignition is ON.)
If the controller is connected during this condition, a limit SW trouble is judged and the above-described “Check 4WD” condition occurs.
This can be reset by clearing the memory.
When disconnecting the harness connector of the actuator and turning the ignition ON is required, remove the controller at the same time or remove the IG power fuse of the transfer controller.

Memory erasing procedure

1-1 Memory erasing with operation button



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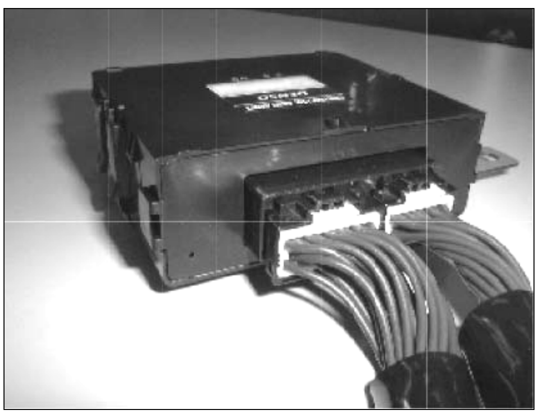
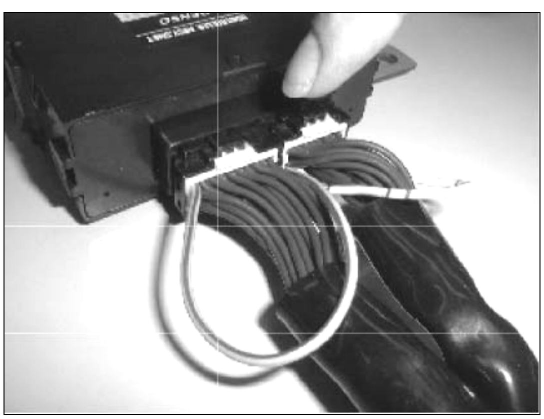
1. Turn on the ignition.
2. Shift to the “N” position with the vehicle stopped.
3. Simultaneously push the 3 buttons (2H/4H/4L) for 20 seconds.
4. Confirm the “Check 4WD” indicator on the meter panel is OFF.
5. Before erasing the memory, check that the circuit of the T/F actuator position detection harness is normal.

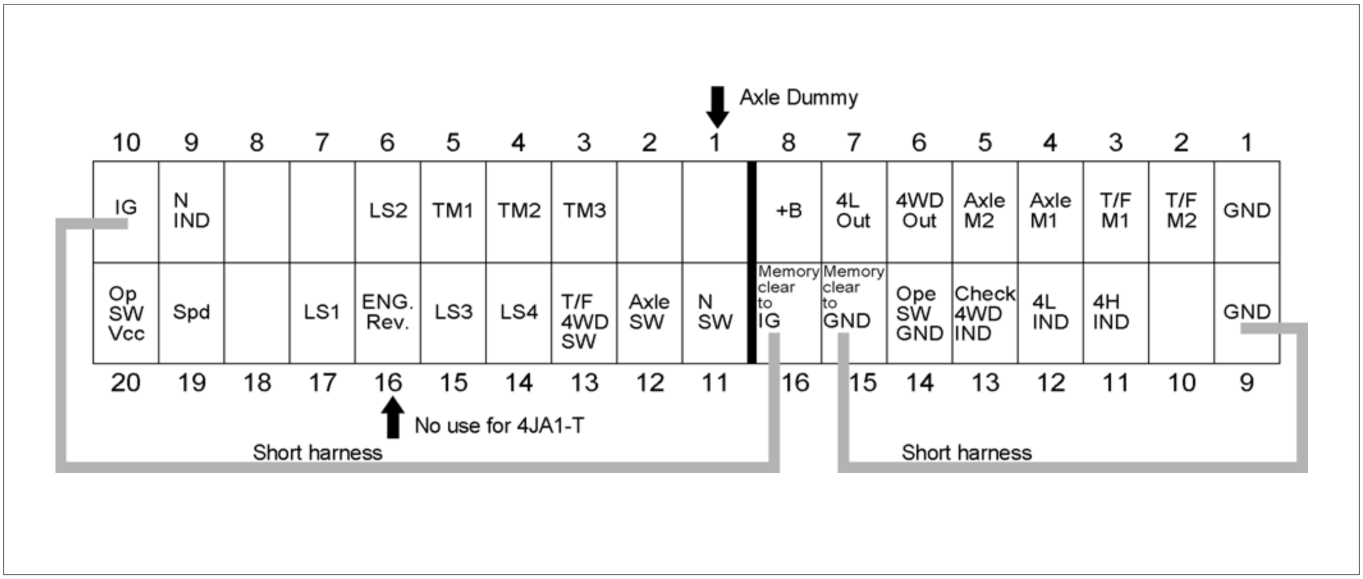
1-2 Memory erasing with short harness (Other procedure)





1. Prepare two pieces of short harness with the end sharpened like a needle (about 20 cm(7.9 in) long).
2. Turn OFF the ignition.
3. Keeping the connector of the transfer controller connected, set the short harness from the back of the connector as illustrated.
4. Turn ON the ignition, wait for 2 seconds, and then turn OFF the ignition after confirming the relay sound.
5. Disconnect the short harness, turn ON the ignition again, and confirm the “Check 4WD” lamp on the meter panel is OFF.
6. Before erasing the memory, check that the circuit of the T/F actuator position detection harness is normal.

Transfer Controller Pin Assignment



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Diagnosis from symptom

Check4WD lighting up

Step	Action	Yes	No
1	Check what was done before the trouble occurred. Was the harness between the transfer controller and actuator disconnected with the ignition kept ON for the purpose of servicing the vehicle? Or, was the ignition turned ON (power supplied to the transfer controller) with the harness of the actuator removed?	If the power is supplied with the actuator not connected, a faulty position detection switch is considered. Clear the memory and trace this chart from the beginning.	Go to step 2.
2	Is the ignition switch ON?	Go to step 3.	Turn the ignition switch ON and trace this chart from the beginning.
3	Does the transfer-related indicators (4WD, 4Lo, Check 4WD, neutral) light up for 2 seconds when the ignition switch is turned ON?	Go to step 4.	Indicator lamp burnt out. Disconnected harness wire. After repairing, trace this chart from the beginning.
4	Has the harness between the Check4WD indicator and transfer controller GND shorted?	GND (body) short of the indicator harness. After repairing, trace this chart from the beginning.	Go to step 5.
5	Check the continuity of harness between the transfer controller and transfer actuator. Check the power short and GND short. Check the GND harness of the transfer actuator. Is a trouble noticed?	Repair the harness, clear the memory and trace this chart from the beginning.	Go to step 6.
6	Check the limit switch of the actuator. Is a trouble noticed?	Failed actuator. Replace the actuator, clear the memory and trace this chart from the beginning.	Clear the memory and trace this chart from the beginning. Failed controller. Replace the controller, clear the memory and trace this chart from the beginning.

To check the operation after completing the repair and clearing the memory, shift between 2H and 4L at least 5 times.

To judge the condition more quickly, ask the customer what happens when the Check4WD lamp lights up.

When the position indicator blinks at a frequency of 4Hz immediately after trouble occurs, the position of failure which the indicator shows may be limited.

(Since it indicates the situation immediately before detection of failure, whether the vehicle is running or at a standstill, the possibility of failure around that point is high.)

Status of the transfer when the Check4WD lights up is not always the same. Immediately after failure occurs, 2H can be operated.

Cannot shift from 2WD to 4H or 4L.

When shifting from 2H to other position, the indicator (4WD, 4Lo, Check4WD, neutral) does not respond.

Step	Action	Yes	No
1	Is the ignition switch ON?	Go to step 2.	Turn the ignition switch ON and trace this chart from the beginning.
2	Does the transfer-related indicators (4WD, 4Lo, Check 4WD, neutral) light up for 2 seconds when the ignition switch is turned ON?	Failed operation switch. Or, Failed controller.	Indicator lamp burnt out. Disconnected harness wire. After repairing, trace this chart from the beginning.

Even after correction step 1-1(*), 4WD indicator blinks at 4Hz and changes to 2H after 10 seconds.

Step	Action	Yes	No
1	Is the ignition switch ON?	Go to step 2.	Turn the ignition switch ON and trace this chart from the beginning.
2	Does the transfer-related indicators (4WD, 4Lo, Check 4WD, neutral) light up for 2 seconds when the ignition switch is turned ON?	Go to step 3.	Indicator lamp burnt out. Disconnected harness wire. After repairing, trace this chart from the beginning.
3	After 2 seconds, check that the Check4WD lamp is ON or OFF. Is the Check4WD lamp OFF?	Go to step 4.	Failed actuator position detection switch (LS1, LS2, LS3, LS4, GND). Short or disconnection of harness of this detection switch. After repairing, trace this chart from the beginning.
4	Press the 4H button. Is sound of relay heard from the transfer control?	Go to step 5.	Failed controller. Replace the controller and trace this chart from the beginning.
5	Is the sound of a running motor heard?	Failed control system of the transfer mechanism. Check and repair and trace this chart from the beginning.	Failed actuator motor. Disconnected controller motor drive output circuit, GND short circuit. +B fuse blown out. Disconnection of that harness. After repairing, trace this chart from the beginning.

*Before determining a trouble (Non-trouble mode)

4) Noise when the Vehicle is Turning

Checkpoint		Trouble Cause	Countermeasure
Rear axle shaft	NG	Worn rear axle shaft splines	Replace the rear axle shaft
OK			
Side gear	NG	Worn side gear	Replace the side gear
OK			
Differential pinion	NG	Worn differential pinion	Replace the differential pinion
OK			
Differential cross pin	NG	Worn differential cross pin	Replace the differential cross pin

Even after the correction step 1-2(*), the 4WD indicator still blinks at 2Hz when shifting from 2H to 4H.

Step	Action	Yes	No
1	Check the air pressure and wear of all the tires. Is any trouble noticed?	After adjusting the air pressure and repairing the worn tires, try the correction step 1-2(*).	Go to step 2.
2	Check the 4WD detection switch on the transfer case, neutral detection switch and each harness. Is a trouble noticed?	4WD detection switch is open or the harness failed. The neutral detection switch is closed or the harness GND is shorted. Replace or repair and then trace this chart from the beginning.	Go to step 3.
3	Is there continuity in the harness between the transfer controller and front axle actuator? Has a body short or disconnection been detected?	Go to step 4.	Body short or disconnection of the harness between the transfer controller and front axle actuator. After repairing, trace this chart from the beginning.
4	Is trouble detected in the axle detection harness between the axle actuator and transfer controller?	Disconnected harness. After repairing trace this chart from the beginning.	Malfunction of axle actuator. Refer to the paragraph of the axle disconnect. After repairing, trace this chart from the beginning.

*Before determining a trouble (Non-trouble mode)

Note:

Vehicles with manual hub and rigid hub don't have axle actuator.

When the above-mentioned procedure is followed, check the harness between the axle dummy output terminal and the axle switch input terminal of the transfer controller, instead of axle actuator.

After operation, indicator of target position blinks for 1.5 sec. at 2Hz, return to 2H condition (4WD indicator going out)

Step	Action	Yes	No
1	Keep pressing the 4H button (about 10 seconds). Does the 4WD indicator blink at 2Hz for 15 seconds and then blink at 4Hz?	Failed actuator motor. Disconnection of controller motor drive output circuit, or GND short. +B fuse blown out. Disconnection of that harness. After repairing, trace this chart from the beginning.	Go to step 2.
2	Press the 4H button. Is the sound of relay heard from the transfer controller?	Go to step 3.	Failed controller. Replace the controller and trace this chart from the beginning.
3	Is the sound of running motor heard?	Failed control system of the transfer mechanism. Check and repair and trace this chart from the beginning.	Failed actuator motor. Disconnection or GND short of controller motor drive output circuit. After repairing, trace this chart from the beginning.

Transfer cannot shift to another position (Except "Check 4WD" failure).

When shifting to another position, indicator (4WD, 4Lo, Check4WD, neutral) does not respond (Current condition keeping).

Step	Action	Yes	No
1	Is the ignition switch ON?	Go to step 2.	Failed indicator and harness (When lighting). After repairing, trace this chart from the beginning.
2	Does the transfer-related indicators (4WD, 4Lo, Check 4WD, neutral) light up for 2 seconds when the ignition switch is turned ON?	Go to step 3.	All indicators are burnt out (Check for GND short circuit between the indicator and transfer controller). Disconnected harness wire. After repairing, trace this chart from the beginning.
3	Press the other positions button. Is the sound of relay heard from under the seat, and the sound of a running motor heard?	Failed controller. After replacing the controller, trace this chart from the beginning.	*Failed operation switch. Or harness for the operation switch has disconnected or shorted.

* The operation switch is an analog type switch which reads the internal composite resistance value at the time of operation. If an abnormal value is detected, it is kept at the home position (The position before operating it).

Even after the correction step 2-1(*), the 4WD indicator still blinks at 2Hz when shifting from 4H to 2H.

Step	Action	Yes	No
1	Check all the tires for air pressure and wear. Is any trouble detected?	After adjusting the air pressure and repairing the worn tires, try the correction step 2-1(*).	Go to step 2.
2	Check the 4WD detection switch on the transfer case and neutral detection switch and each harness. Is a trouble detected?	4WD detection switch is closed or the GND short of harness. The neutral detection switch is closed or the harness GND has shorted. Replace or repair and then trace this chart from the beginning.	Go to step 3.
3	Is there continuity in the harness between the transfer controller and axle actuator? Has a short or disconnection been detected? Is the connection incorrect?	Go to step 4.	Body short, disconnection or incorrect connection of the harness between the transfer controller and actuator. After repairing, trace this chart from the beginning.
4	Is trouble detected in the axle detection harness between the axle actuator and transfer controller?	GND short of harness	Malfunction of axle actuator. Refer to the paragraph of axle disconnect. After repairing, trace this chart from the beginning.

*Before determining a trouble (Non-trouble mode)

Note:
Vehicle with manual hub and rigid hub don’t have axle actuator.
When the above-mentioned procedure is followed, check the harness between the axle dummy output terminal and the axle switch input terminal of the transfer controller, instead of axle actuator.

Though the indicator responds when shifting from 4H to 2H(or other position), it returns to 4H.

Step	Action	Yes	No
1	Is the ignition switch ON?	Go to step 2.	Turn the ignition switch ON and trace this chart from the beginning.
2	Does the transfer-related indicators (4WD, 4Lo, Check 4WD, neutral) light up for 2 seconds when the ignition switch is turned ON?	Go to step 3.	Indicator lamp burnt out. Disconnected harness wire. After repairing, trace this chart from the beginning.
3	After 2 seconds, check if the Check4WD lamp lights up. Is the Check4WD lamp OFF?	Go to step 4.	Failed actuator position detection (limit) switch (LS1, LS2, LS3, LS4, GND). Short or disconnection of harness of this detection switch. Refer to paragraph of Check4WD. After repairing, trace this chart from the beginning.
4	Press the 2H button. Is the sound of relay heard from the transfer controller?	Go to step 5.	Failed controller. Replace the controller and trace this chart from the beginning.
5	Is the sound of a running motor heart?	Failed control system of the transfer mechanism. Check and repair and trace this chart from the beginning.	Failed actuator motor. Disconnection of controller motor drive output circuit or GND short. After repairing, trace this chart from the beginning.

If the motor does not or cannot run at all (stuck transfer mechanism, disconnected motor, failed drive circuit), the lamp blinks at 4Hz when the position is shifted to other position by pressing the button for more 10 seconds (20 seconds in case of neutral position).

From 4H to 4L; Even after the correction step 3-3(*), 4Lo indicator blinks at 4Hz

Step	Action	Yes	No
1	Is the ignition switch ON?	Turn it OFF once.	Go to step 2.
2	Turn ON the ignition switch and check the valve. Do not start the engine. Has the valve check for 2 seconds been completed normally?	Go to step 3.	Refer to the paragraph about the indicator when it does not react when shifted from 2H to 4H. After taking the remedy, trace this chart from the beginning.
3	Shift to 2H. Can be shifted to 2H and then to 4H?	Go to step 4.	Refer to the paragraph about shifting from 2H to 4H. In particular, check if not at the Check4WD condition, return to this chart and trace it from the beginning.
4	Set to N position in case of AT and set to the neutral position in case of MT and check if the lamp blinks at 4Hz after operation.	Failed T/M position switch and harness (failure of TM1 and TM2 harness and their related switches shown in the figure). Incorrect wiring. Repair as required and trace this chart from the beginning.	Shift back to 4H and go to step 5.
5	Start the engine and use the vehicle. Does the speedometer run at this time?	Go to step 6.	Failure of speed sensor or disconnection or short of harness (for the meter). After repairing, trace this chart from the beginning.
6	Check the harness between the transfer controller and speed sensor. (Check the engine rotation detection harness at the same time.) Is any trouble detected?	Failed harness between the transfer controller and speed sensor. After repairing, trace this chart from the beginning. (Repair the engine rotation detection unit, if required.)	Go to step 7.
7	Run the vehicle for several meters, stop it, meet the permission requirements for operation limits. Did you wait for several seconds after the requirements were met?	Failed controller. Replace the controller and trace this chart from the beginning.	You did not wait for enough time. Optimum waiting time is 1 second or maximum 3 minutes, depending on the previous conditions. Refer to the paragraph about operation without failure.

*Before determining a trouble (Non-trouble mode)

From 4L to 4H: After the correction step 4-3(*), 4Lo indicator blinks at 4H.

Step	Action	Yes	No
1	Is the ignition switch ON?	Turn it OFF once.	Go to step 2.
2	Turn ON the ignition switch and check the valve. Do not start the engine. Has the valve check for 2 seconds been completed normally?	Go to step 3.	Refer to the paragraph about the indicator when it does not react when shifted from 2H to 4H. After taking the remedy, trace this chart from the beginning.
3	Can be shifted to 2H and then to 4L?	Go to step 4. (Impossible usually.) Failed controller	In case of Check 4WD, shifting to 2H is possible. Returning to 4L is impossible. Refer to the paragraph about Check4WD.
4	Set to N position in case of AT and set to the neutral position in case of MT and check if the lamp blinks at 4Hz after operation.	Failed T/M position switch and harness (failure of TM1 and TM2 harness and their related switches shown in the figure). Incorrect wiring. Repair as required and trace this chart from the beginning.	Press the operation switch of 4L and go to step 5.
5	Start the engine and use the vehicle. Does the speedometer run at this time?	Go to step 6.	Failure of speed sensor or disconnection or short of harness (for the meter). After repairing, trace this chart from the beginning.
6	Check the harness between the transfer controller and speed sensor. (Check the engine rotation detection harness at the same time.) Is any trouble detected?	Failed harness between the transfer controller and speed sensor. After repairing, trace this chart from the beginning. (Repair the engine rotation detection unit, if required.)	Go to step 7.
7	Run the vehicle for several meters, stop it, meet the permission requirements for operation limits. Did you wait for several seconds after the requirements were met?	Failed transfer controller. Replace the controller and trace this chart from the beginning.	You did not wait for enough time. Optimum waiting time is 1 second or maximum 3 minutes, depending on the previous conditions. Refer to the paragraph about operation without failure.

*Before determining a trouble (Non-trouble mode)

To neutral: After the correction step 5-2(*), neutral indicator blinks at 4Hz.

Check the function between H and L according to the chart for 4L to 4H instead of check for the requirements of neutral.

Step	Action	Yes	No
1	Is the ignition switch ON?	Turn it OFF once.	Go to step 2.
2	Turn ON the ignition switch and check the valve. Do not start the engine. Has the valve check for 2 seconds been completed normally?	Go to step 3.	Refer to the paragraph about the indicator when it does not react when shifted from 2H to 4H (7D1-37). After taking the remedy, trace this chart from the beginning.
3	Can be shifted to 2H and then to 4L?	Go to step 4. (Impossible usually.) Failed controller	Refer to the paragraph about shifting from 2H to 4H. In particular, check if not at the Check4WD condition, return to this chart and trace it from the beginning. In case of Check4WD, shifting to 2H is possible. Returning to 4H is impossible. Refer to the paragraph about Check4WD.
4	Set to N position in case of AT and set to the neutral position in case of MT and check if the lamp blinks at 4Hz after operation.	Failed T/M position switch and harness (failure of TM1 and TM2 harness and their related switches shown in the figure). Incorrect wiring. Repair as required and trace this chart from the beginning.	Shift back to 4H and go to step 5.
5	Start the engine and use the vehicle. Does the speedometer run at this time?	Go to step 6.	Failure of speed sensor or disconnection or short of harness (for the meter). After repairing, trace this chart from the beginning.
6	Check the harness between the transfer controller and speed sensor. (Check the engine rotation detection harness at the same time.) Is any trouble noticed?	Failed harness between the transfer controller and speed sensor. After repairing, trace this chart from the beginning. (Repair the engine rotation detection unit, if required.)	Go to step 7.
7	Run the vehicle for several meters, stop it, meet the permission requirements for operation limits. Did you wait for several seconds after the requirements were met?	Failed controller. Replace the controller and trace this chart from the beginning.	You did not wait for enough time. Optimum waiting time is 1 second or maximum 3 minutes, depending on the previous conditions. Refer to the paragraph about operation without failure.

*Before determining a trouble (Non-trouble mode)

For shifting to neutral, 2H and 4L switches should be pressed at the same time for 10 seconds.
For shifting from neutral to other position, 2H, 4H or 4L switch should be pressed for 10 seconds.
When shifting from neutral to other position, the lamp blinking at 2Hz indicates active condition.
When the lamp keeps blinking at 2Hz, follow the step for the case when the lamp keeps blinking at 2Hz when shifting between positions.

SECTION 8

ELECTRICAL- BODY AND CHASSIS

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SECTION 8A

ELECTRICAL-BODY AND CHASSIS

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5) Constant Noise

Checkpoint	Trouble Cause	Countermeasure
Rear axle shaft	NG: Bent rear axle shaft	Replace the rear axle shaft
OK ↓ Drive pinion	NG: Flat spot on the drive pinion gear teeth	Replace the drive pinion and the ring gear as a set
	NG: Worn pinion splines oil seal	Replace the drive pinion and the ring gear as a set
OK ↓ Ring gear	NG: Flat spot on the gear teeth pilot bearing wear	Replace the drive pinion and the ring gear as a set
OK ↓ Bearing	NG: Flat spot on the drive pinion	Replace the drive pinion bearing
	NG: Flat spot on the side bearing oil seal	Replace the side bearing

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GENERAL INFORMATION

The body and chassis electrical system operates on a twelve volt power supply with negative ground polarity.
The main harness consists of the engine harness, the instrument harness, the body harness, and the chassis harness.
The harnesses use a split corrugated tube to protect the wires from the elements.
Wire size is determined by current flow, circuit length, and voltage drop.
All wires have color-coded insulation.
Wire color-codes are shown in the circuit diagrams.
This makes it easier to trace circuits and to make the proper connections.

Each circuit consists of the following:

5. Power source – The battery and the alternator
5. Wires – To carry electrical current through the circuit
5. Fuses – To protect the circuit against current overload
5. Relays – To protect voltage drop between the battery and the circuit parts and to protect the switch points against burning
5. Switches – To open and close the circuit
5. Load – Any device, such as a light or motor, which converts the electrical current into useful work
5. Ground – To allow the current to flow back to the power source

NOTES FOR WORKING ON ELECTRICAL ITEMS


Battery

BATTERY CABLE

Disconnecting the Battery Cable

5. All switches should be “OFF” position.
5. Disconnect the battery ground cable.
5. Disconnect the battery positive cable.

CAUTION:

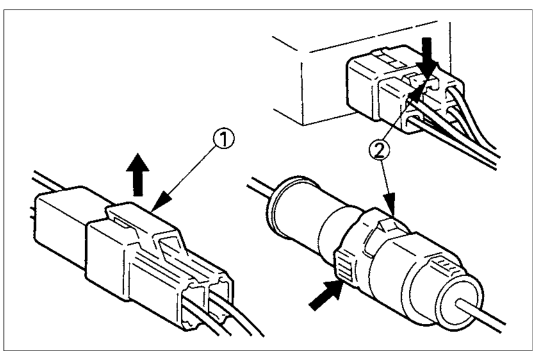
It is important that the battery ground cable be disconnected first.
Disconnecting the battery positive cable first can result in a short circuit.

Connecting the Battery Cable

Follow the disconnecting procedure in the reverse order to connect the battery cables.

CAUTION:

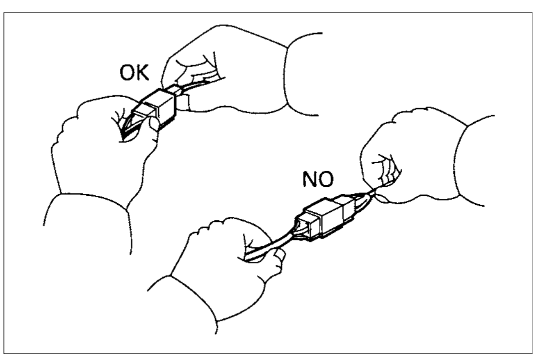
Clean the battery terminal and apply light coat of grease to prevent terminal corrosion.



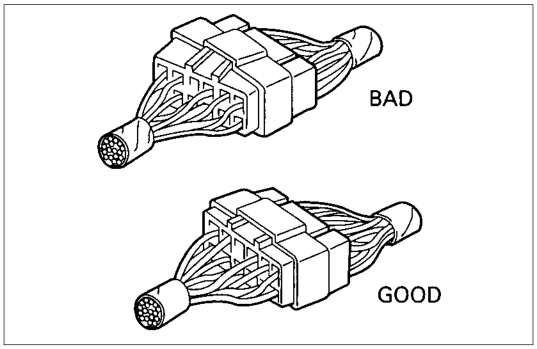
CONNECTOR HANDLING

Disconnecting the Connectors

Some connectors have a tang lock to hold the connectors together during vehicle operation.
Some tang locks are released by pulling them towards you ①.
Other tang locks are released by pressing them forward ②.
Determine which type of tang lock is on the connector being handled.

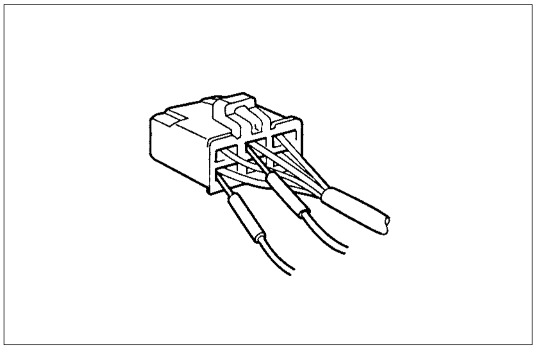


Firmly grasp both sides (male and female) of the connector.
Release the tang lock and carefully pull the two halves of the connector apart.
Never pull on the wires to separate the connectors.
This will result in wire breakage.



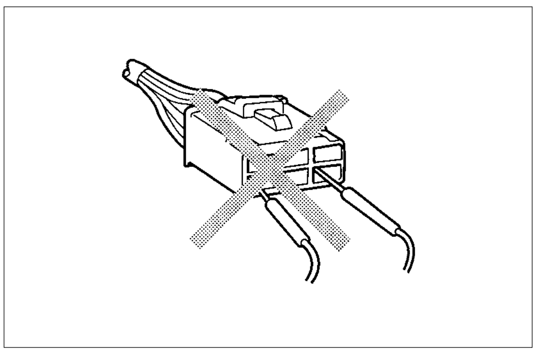
Connecting the Connectors

Firmly grasp both sides (male and female) of the connector.
Be sure that the connector pins and pin holes match.
Be sure that both sides of the connector are aligned with each other.
Firmly but carefully push the two sides of the connector together until a distinct click is heard.

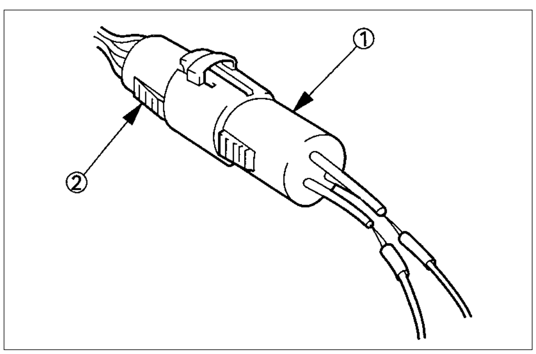


Connector Inspection

Use a circuit tester to check the connector for continuity.
Insert the test probes from the connector wire side.

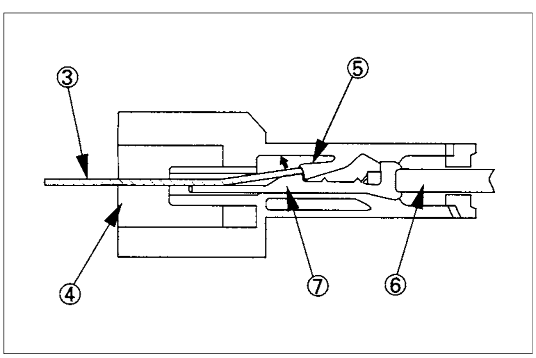


CAUTION
Never insert the circuit tester test probes into the connector open side to test the continuity.
Broken or open connector terminals will result.



Waterproof Connector Inspection

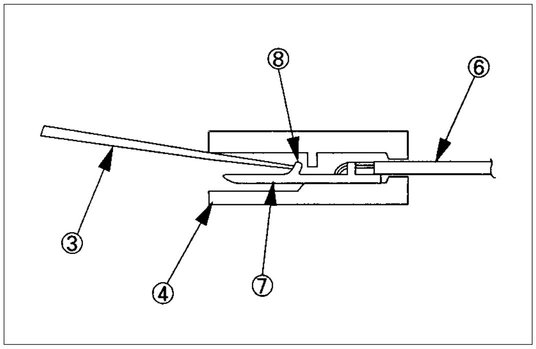
It is not possible to insert the test probes into the connector wire side of a waterproof connector.
Use one side of a connector ① with its wires cut to make the test.
Connect the test connector to the connector ② to be tested.
Connect the test probes to the cut wires to check the connector continuity.



Connector Pin Removal
Connector Housing Tang Lock Type

5. Insert a slender shaft ③ into the connector housing open end ④.
5. Push the tang lock ⑤ up (in the direction of the arrow in the illustration).

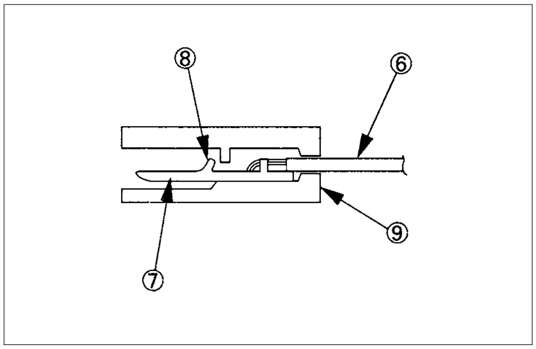
   Pull the wire ⑥ with pin ⑦ free from the wire side of the connector.



Pin Tang Lock Type

5. Insert a slender shaft ③ into the connector housing open end ④.
5. Push the tang lock ⑧ flat (toward the wire side of the connector).

   Pull the wire ⑥ with pin ⑦ free from the wire side of the connector.



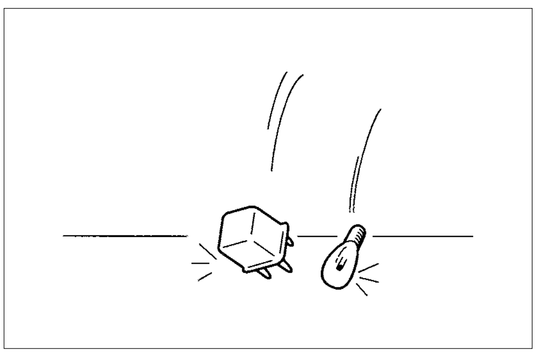
Connector Pin Insertion

5. Check that the tang lock ⑧ is fully up.
5. Insert the pin ⑦ from the connector wire side ⑨.

   Push the pin in until the tang lock closes firmly.
5. Gently pull on the wires ⑥ to make sure that connector pin is firmly set in place.

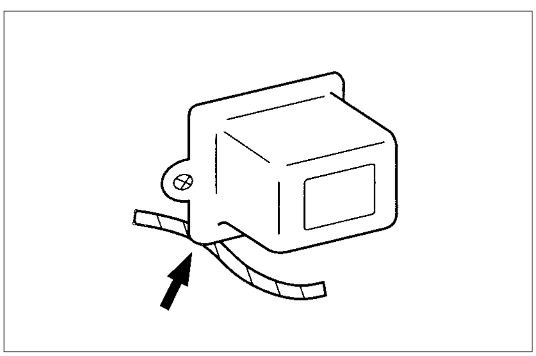
Fuse Replacement

The replacement fuse must have the same amperage specification as the original fuse.
Never replace a burn out fuse with a fuse of a different amperage specification.
Doing so can result in an electrical fire or other serious circuit damage.



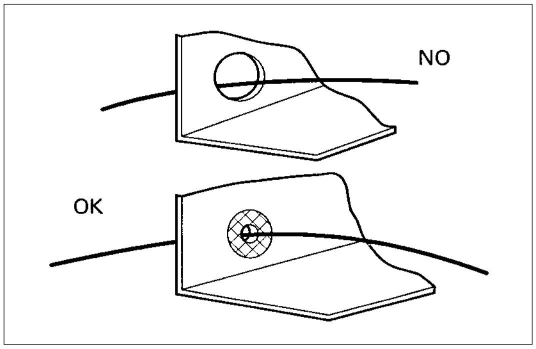
Parts Handling

Be careful for parts handling and any part should not be dropped or thrown, otherwise short circuit or disorder may result.

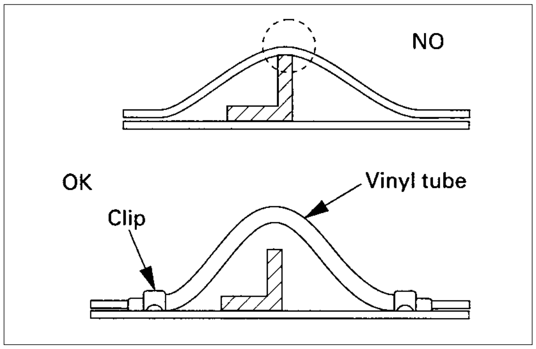


Wiring Harness

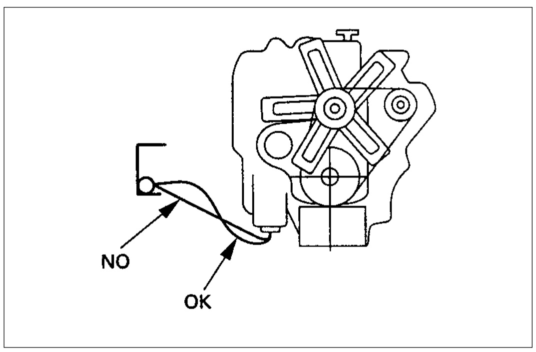
5. When assembling the parts, be careful not to bite or wedge the wiring harness.
5. All electrical connections must be kept clean and tight.



5. Use a grommet or guard tube to protect the wiring harness from contacting a sharp edge or surface.



5. Position the wiring harness with enough clearance from the other parts and guard the wiring harness with a vinyl tube to avoid direct contact.



5. The wiring harness between engine and chassis should be long enough to prevent chafing or damage due to various vibrations.

SPLICING WIRE

Open the Harness

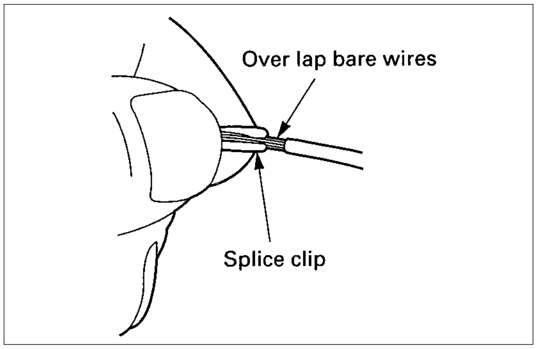
If the harness is taped, remove the tape.
To avoid wire insulation damage, use a sewing “seam ripper” (available from sewing supply stores) to cut open the harness.
If the harness has a black plastic conduit, simply pull out the desired wire.

Cut the wire

Begin by cutting as little wire off the harness as possible.
You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice.
You may have to adjust splice locations to make certain that each splice is at least 1-1/2” (40 mm) away from other splices, harness branches, or connectors.

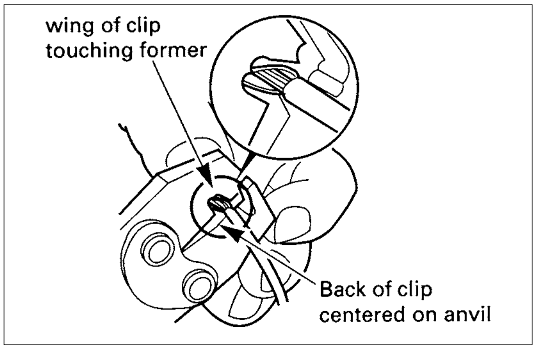
Strip the insulation

When replacing a wire, use a wire of the same size as the original wire.
Check the stripped wire for nicks or cut strands.
If the wire is damaged, repeat the procedure on a new section of wire.
The two stripped wire ends should be equal in length.

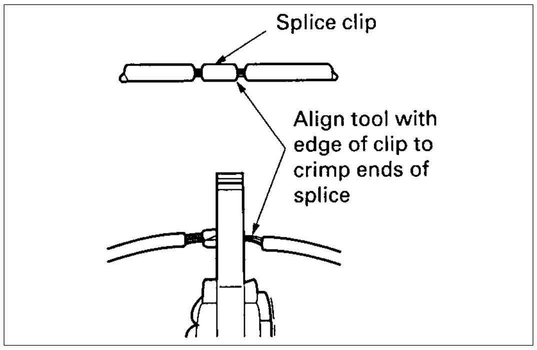


Crimp the Wires

Select the proper clip to secure the splice.
To determine the proper clip size for the wire being spliced, follow the directions included with your clips.
Select the correct anvil on the crimper.
(On most crimpers your choice is limited to either a small or large anvil.)
Overlap the two stripped wire ends and hold them between your thumb and forefinger.
Then, enter the splice clip under the stripped wires and hold it in place.

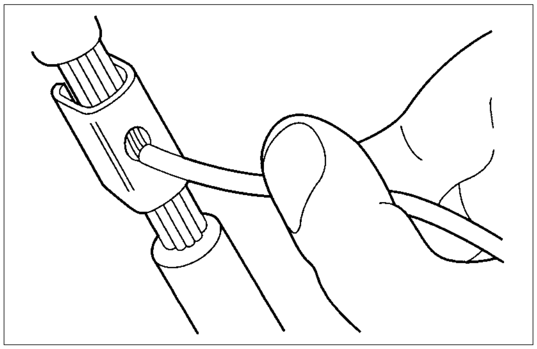


- Open the crimping tool to its full width and rest one handle on a firm flat surface.
- Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the back of the splice clip touches the wings of the clip.
- Make sure that the clip and wires are still in the correct position. Then, apply pressure until the crimping tool closes.



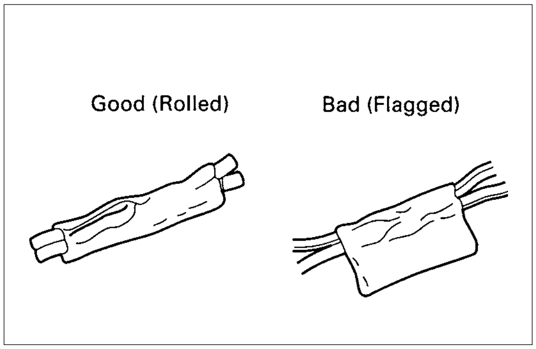
Before crimping the ends of the clip, be sure that:
- The wires extend beyond the clip in each direction.
- No strands of wire are cut loose.
- No insulation is caught under the clip.

Crimp the splice again, once on each end.
Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires.



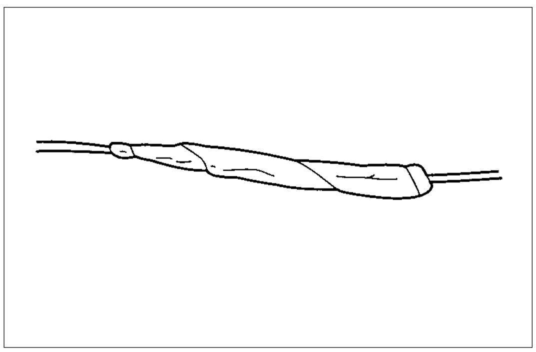
Solder

Apply 60/40 rosin core solder to the opening in the back of the clip.
Follow the manufacturer's instructions for the solder equipment you are using.



Tape the Splice

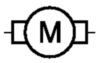
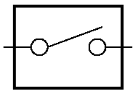
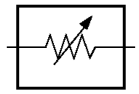
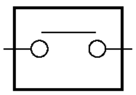
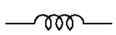
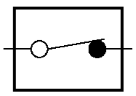
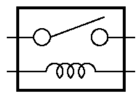
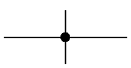
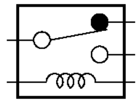
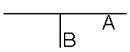
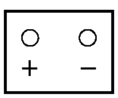
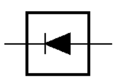
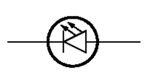
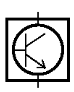
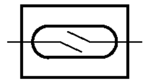
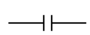
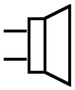
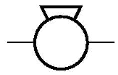
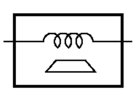
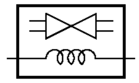
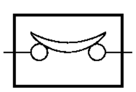
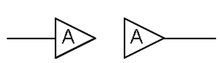
Center and roll the splicing tape.
The tape should cover the entire splice.
Roll on enough tape to duplicate the thickness of the insulation on the existing wires.
Do not flag the tape.
Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness.



If the wire does not belong in a conduit or other harness covering, tape the wire again.
Use a winding motion to cover the first piece of tape.

SYMBOLS AND ABBREVIATIONS

SYMBOLS

Symbol	Meaning of Symbol	Symbol	Meaning of Symbol
	Fuse		Bulb
	Slow blow fuse		Double filament bulb
	Fusible link wire		Motor
	Switch (Normal open type)		Variable register Rheostat
	Switch		Coil (inductor), solenoid, magnetic valve
	Switch (Normal close type)		Relay (Normal open type)
	Contact wiring		Relay (Normal close type)
	Selection of harness. It displays selecting shared.		
	Battery		Connector
	Diode		Light emitting diode
	Electronic Parts		Reed switch
	Resistor		Condenser
	Speaker		Horn
	Buzzer		Vacuum switching valve
	Circuit breaker		Arrow shows circuit continues to the deferent page
			Arrow shows circuit continues in the same page

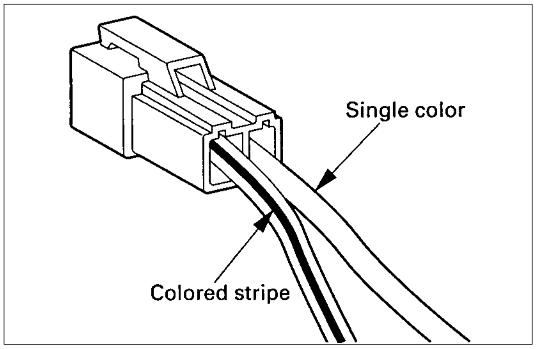
2. VIBRATION

Checkpoint		Trouble Cause	Countermeasure
Rear hub bearing	NG	Worn rear hub bearing	Replace the rear hub bearing
OK ↓			
Rear axle shaft	NG	Bent rear axle shaft	Replace the rear axle shaft

ABBREVIATIONS

Abbreviation	Meaning of abbreviation	Abbreviation	Meaning of abbreviation
A	Ampere (S)	kW	Kilowatt
ABS	Anti-lock brake system	LH	Left hand
ASM	Assembly	LWB	Long wheel base
AC	Alternating current	MPI	Multipart fuel injection
A/C	Air conditioner	M/T	Manual transmission
ACC	Accessories	PA	Passenger
CARB	Carburetor	PIM	Power train interface module
C/B	Circuit breaker	PJT	Projector
CKP	Crankshaft position	QOS	Quick On Start system
CSD	Cold start device	RH	Right hand
DIS	Direct ignition system	RR	Rear
DR	Driver	RWAL	Rear wheel anti-lock brake system
DRM	Data Recording Module	SCV	Suction control valve
EHCU	Electronic Hydraulic control Unit	SRS	Supplemental restraint system
ECGI	Electronic control gasoline injection	ST	Start
ECM	Engine control module	STD	Standard
ECU	Electronic control unit	SW	Switch
EFE	Early fuel evaporation	SWB	Short wheel base
EGR	Exhaust gas recirculation	TCM	Transmission control module
2WD	Two-wheel drive	TCCM	Transfer case control module
4WD	Four-wheel drive	V	Volt
FL	Fusible link	VSV	Vacuum switching valve
FRT	Front	W	Watt (S)
H/L	Headlight	WOT	Wide open throttle
HVAC	Heater, Ventilation, and Air Conditioning	W/	With
		W/O	Without
IC	Integrated circuit	W/S	Weld Splice
IG	Ignition		

PARTS FOR ELECTRICAL CIRCUIT



WIRING

Wire Color

All wires have color-coded insulation.
Wires belonging to system's main harness will have a single color.
Wires belonging to a system's sub-circuits will have a colored stripe.
Striped wires use the following code to show wire size and colors.

Example: 0.5 G / R

- R — Red (Stripe color)
- G — Green (Base color)
- 0.5 — Wire size ($0.5mm^2$)

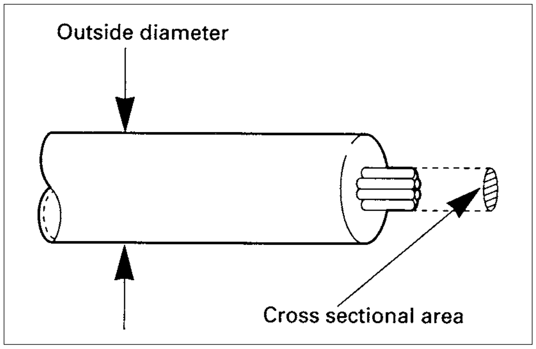
Abbreviations are used to indicate wire color within a circuit diagram.
Refer to the following table.

Wire Color-Coding

Color-Coding	Meaning	Color-Coding	Meaning
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Gray
G	Green	P	Pink
Y	Yellow	SB	Sky blue
L	Blue	V	Violet
O	Orange		

Distinction of Circuit by Wire Base Color

Base color	Circuits	Base color	Circuits
B	Starter circuit and grounding circuit	Y	Instrument circuit
W	Charging circuit	L, O, BR, LG, GR, P, LB, V	Other circuits
R	Lighting circuit		
G	Signal circuit		

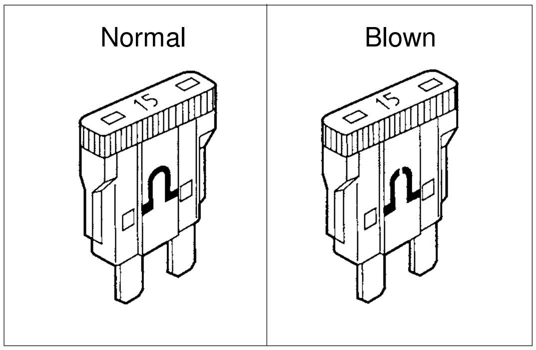


Wire Size

Wire size is specified with the metric gauge system.
The metric gauge system gives the wire size in cross sectional area measured in square millimeters.

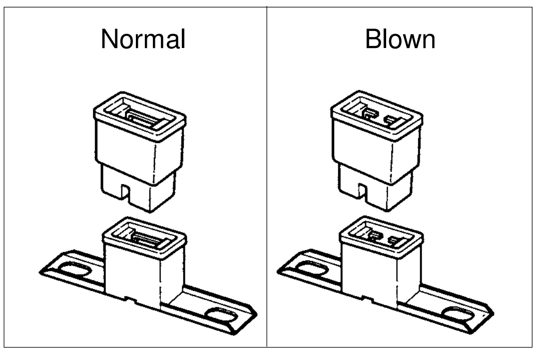
Wire Size Specifications

Nominal size	Cross sectional area (mm^2)	Outside diameter (mm)	Allowable current (A)
0.3	0.372	1.8	9
0.5	0.563	2.0	12
0.85	0.885	2.2	16
1.25	1.287	2.5	21
2	2.091	2.9	28
3	3.296	3.6	37.5
5	5.227	4.4	53
8	7.952	5.5	67
15	13.36	7.0	75
20	20.61	8.2	97



FUSE

Fuses are the most common form of circuit protection used in vehicle wiring.
A fuse is a thin piece of wire or strip of metal encased in a glass or plastic housing.
It is wired in series with the circuit it protects.
When there is an overload of current in a circuit, such as a short of a ground, the wire or metal strip is designed to burn out and interrupt the flow of current.
This prevents a surge of high current from reaching and damaging other components in the circuit.
Determine the cause of the overloaded before replacing the fuse.
Never replace a blown fuse with a fuse of a different amperage specification.
Doing so can result in an electrical fire or other serious circuit damage.
A blown fuse is easily identified.

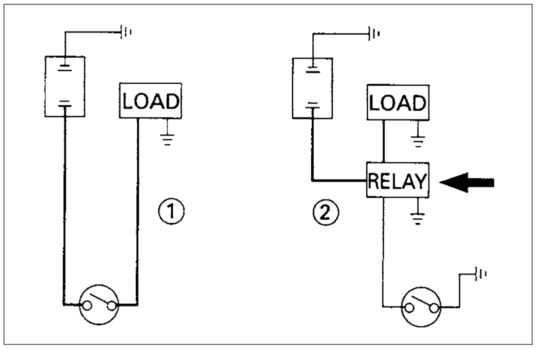


FUSIBLE LINK

The fusible link is primarily used to protect circuits where high amounts of current flow and where is would not be practical to use a fuse.
For example, the starter circuit.
When a current overload occurs, the fusible link melts open and interrupts the flow of current so as to prevent the rest of the wiring harness from burning.
Determine the cause of the overload before replacing the fusible link.
The replacement fusible link must have the same amperage specification as the original fusible link.
Never replace a blown fusible link with fusible link of a different amperage specification.
Doing so can result in an electrical fire or other serious circuit damage.
A blown fusible link is easily identified.

Fusible Link Specifications

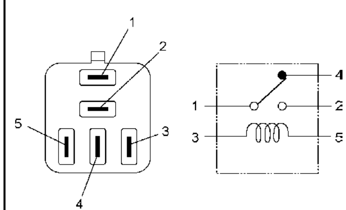
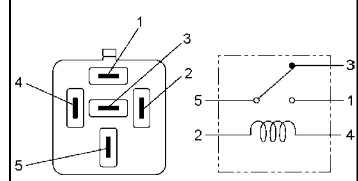
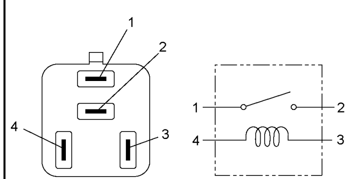
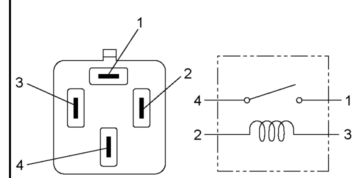
Type	Rating	Case Color	Maximum Circuit Current (A)
Connector	30A	Pink	15
Connector	40A	Green	20
Bolted	50A	Red	25
Bolted	60A	Yellow	30
Bolted	80A	Black	40



RELAY

Battery and load location may require that a switch be placed some distance from either component.
This means a longer wire and a higher voltage drop ①. The installation of a relay between the battery and the load reduces the voltage drop ②.
Because the switch controls the relay, amperage through the switch can be reduced.

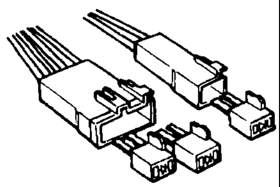
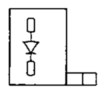
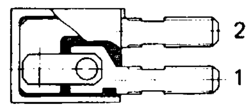
Relay Specifications and Configurations

Name/ Color	Rated voltage/ Coil resistance	Internal circuit	Name/ color	Rated Voltage/Coil resistance	Internal circuit
1T (MICRO ISO) /Black	12V Approx. 92Ω Minimum operating voltage: 7V at 20°C (77°F)		1M (MINI ISO) /Black	12V Approx. 94Ω Minimum operating voltage: 7V at 20°C (77°F)	
1M (MICRO ISO) /Black	12V Approx. 132-3 Ω Minimum operating voltage: 7V at 20°C (77°F)		1M (power)/ Black	12V Approx. 94Ω Minimum operating voltage: 7V at 20°C (77°F)	

* Relay contact shown in the wiring diagram indicates condition before actuation.

DIODE

Diode Specifications and Configurations

<table>
<tr><th>SHAPE</th><th>MARK/
COLOR</th><th>CONSTRUCTION</th><th>CHECKING (THERE SHOULD BE CONTINUITY IN EITHER A OR B WHEN A CIRCUIT TESTER IS CONNECTED WITH DIODE TERMINAL)</th></tr>
<tr><td></td><td>
BLACK</td><td>
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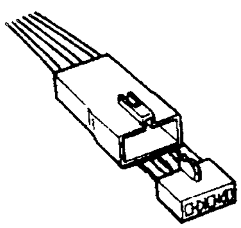
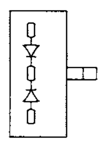
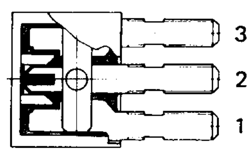
<tr><td rowspan="3"></td><td>
BLACK</td><td rowspan="2">
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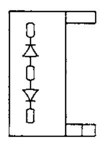
<tr><td>
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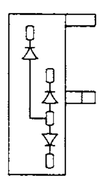
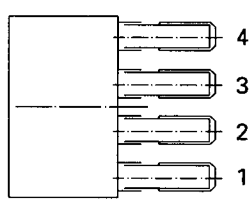
<tr><td>
BLACK</td><td>
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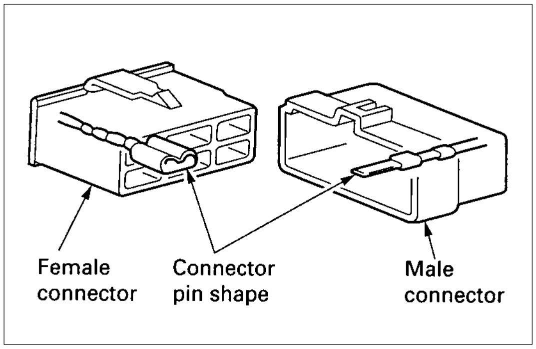
<tr><td>⊕</td><td></td><td>⊖</td><td></td></tr>
</table>
</td></tr>
</table>

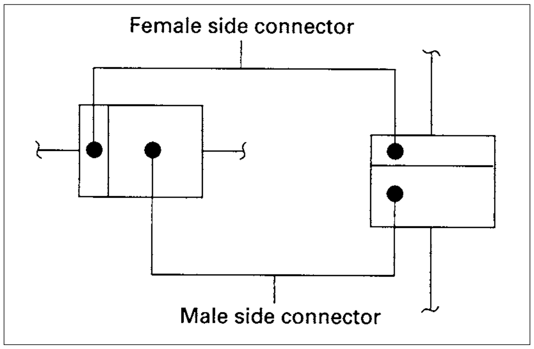
Maximum Rating (Temp.=25°C)

Items	Rating	Remarks
Peak reverse voltage	400V	
Transient peak reverse voltage	500V	
Average output current	1.5A	Temp.=40°C
Working ambient temperature	-30°C~80°C	
Storage temperature	-40°C~100ßC	

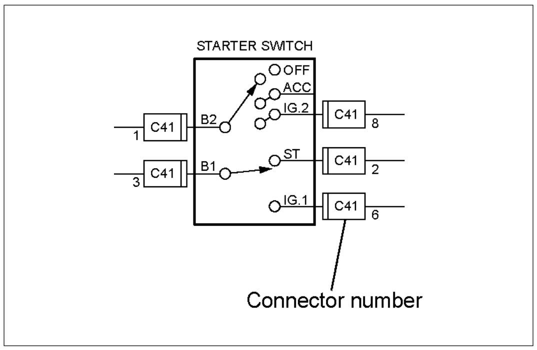
CONNECTOR



The connector pin shape determines whether the connector is male or female.
The connector housing configuration does not determine whether a connector is male or female.

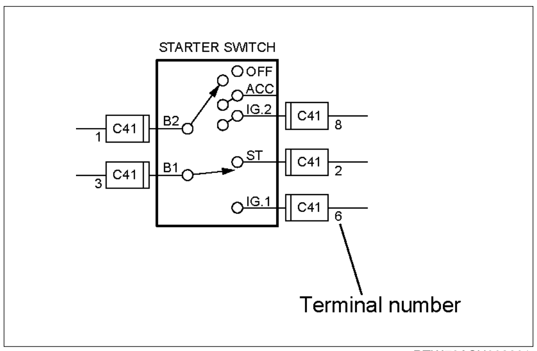


The symbol illustrated in the figure is used as connector in the circuit this section.



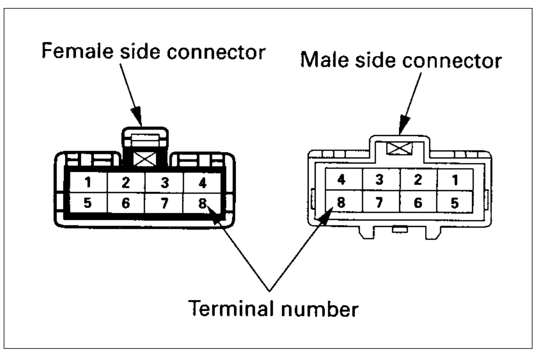
RTW78ASH003101

Connector is identified with a number.



RTW78ASH003201

The applicable terminal number is shown for each connector.



Connector terminal numbers are clearly shown.
Male side connector terminal numbers are in sequence from upper right to lower left.
Female side connector terminal numbers are in sequence from upper left to lower right.

NOTE:

For those connectors on which specific terminal numbers on symbols are shown, the terminal numbers or symbols are used in the circuit diagram, irrespective of the above rule.

Battery-1

BATTERY

Inspection

1. Check the battery terminals ① for corrosion.
2. Check the battery cables ② for looseness.
3. Check the battery case ③ for cracks and other damage.
4. Check the battery electrolyte level.

Battery-2

Battery Replacement

1. Disconnect the battery ground cable ①.
2. Disconnect the battery positive cable ②.
3. Remove the battery clamp ③.
4. Remove the battery

Caution:
It is important that the battery ground cable be removed first.
Removing the battery positive cable first can result in a short circuit.

Jump Starting the Engine with a Booster Battery

The following description assumes that you are using a booster battery mounted on a second vehicle.
The listed steps (with some minor modifications) are also applicable if you are using a naked booster battery or special battery charging equipment.

Caution:
Never push or tow the vehicle in an attempt to start it.
Extensive damage to the emission system and other vehicle parts will result.
(Only catalytic converter vehicle)
Treat both the discharged battery and the booster battery with great care when using jumper cables.
Carefully follow the procedure outlined below.
Always be aware of the dangers of sparking.
Failure to follow the following procedure can result in:

a. Serious personal injury, specially to your eyes.

b. Extensive property damage from a battery explosion, battery acid discharge, or electrical file.

c. Extensive damage to the electronic components of both vehicles.

Do not use a 24 volt booster battery.
Serious damage to the vehicle's electrical system and electronic components will result.

Jump Starting Procedure

1. Set the parking brake on both vehicles.
2. If one or both vehicles is equipped with a manual transmission, place the gear shift in the "NEUTRAL" position.
3. Turn off the ignition on both vehicles.
4. Turn off all vehicle lights and accessories.
5 Be sure that the two vehicles are not touching.
  Attach the end of one jumper cable to the booster battery positive terminal.
6 Attach the other end of the same cable to the discharged battery positive terminal.
7. Once again, check that the booster battery has a 12 volt rating.
8. Attach one end of the remaining booster cable to the booster battery negative terminal.
9. Attach the other end of the booster cable to a solid ground (such as the air conditioner compressor mounting bracket or the alternator mounting bracket) in the engine room of the vehicle with the discharged battery.
10. Be sure that the ground connection is at least 500 mm (20 in) from the discharged battery.

Caution:
Do not attach the booster cable to the discharged battery negative terminal.

11. Start the engine of the vehicle with the booster battery. Check that all unnecessary electrical accessories are off.
12. Start the engine of the vehicle with the discharged battery.
13. Remove the jumper cables in the reverse order to which they were attached.

Caution:
Be absolutely sure to remove the negative jumper cable from the vehicle with the discharged battery first.

3. OIL LEAKAGE

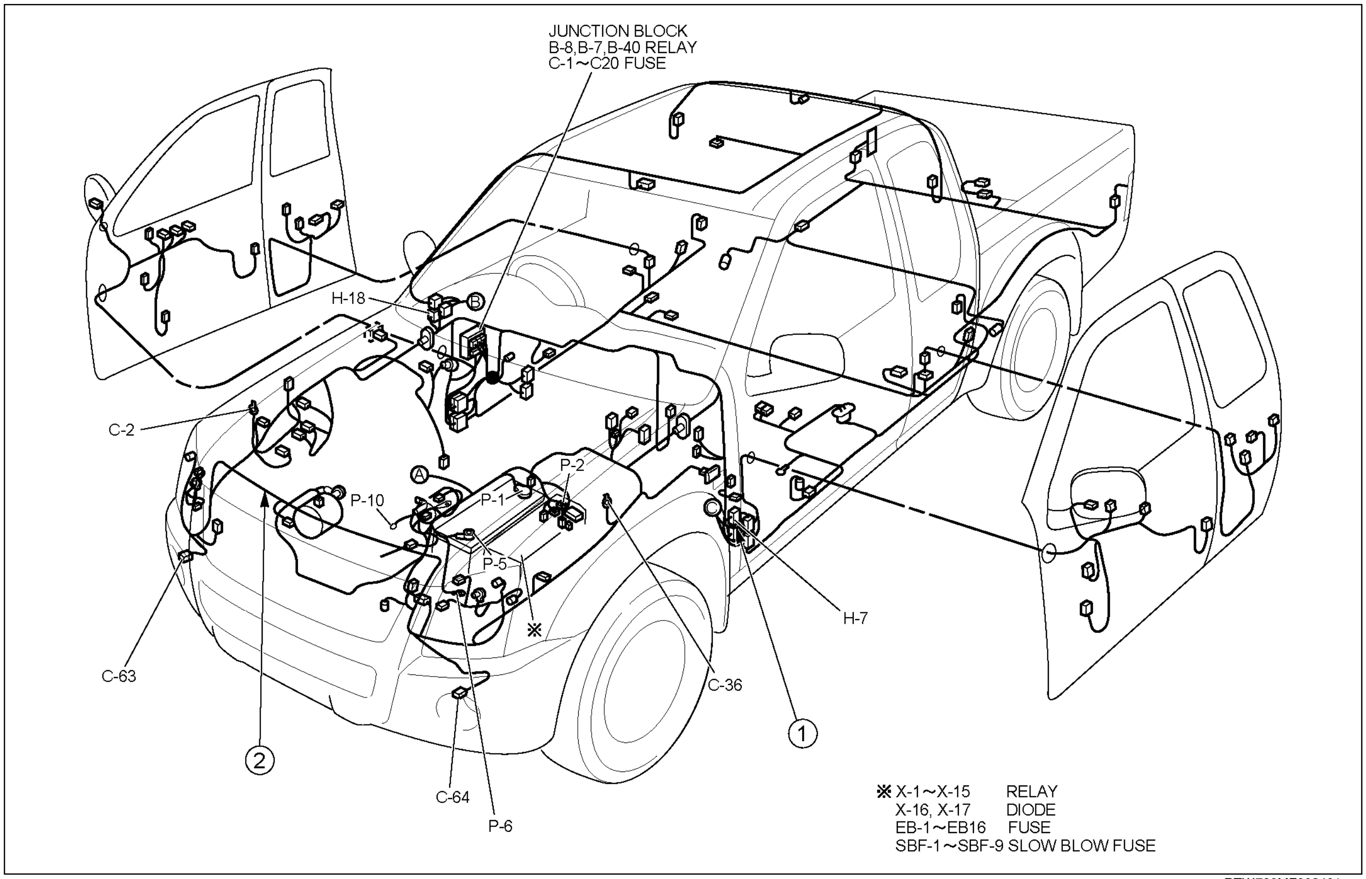
1) Differential Carrier Leakage

Checkpoint	Trouble Cause	Countermeasure
Gear oil level	Too much gear oil	Correct the oil level
Oil seal	Worn or defective oil seal	Replace the oil seal
Air breather	Clogged air breather	Clean the air breather
Differential carrier	Loose bolts	Tighten the bolts to the specified torque
	Liquid gasket seal bed	Reapply the liquid gasket
Ring gear thrust bolt	Loose lock nut and/or liquid	Reapply the liquid gasket and/or tighten the lock nut to the specified torque

READING THE CIRCUIT DIAGRAM

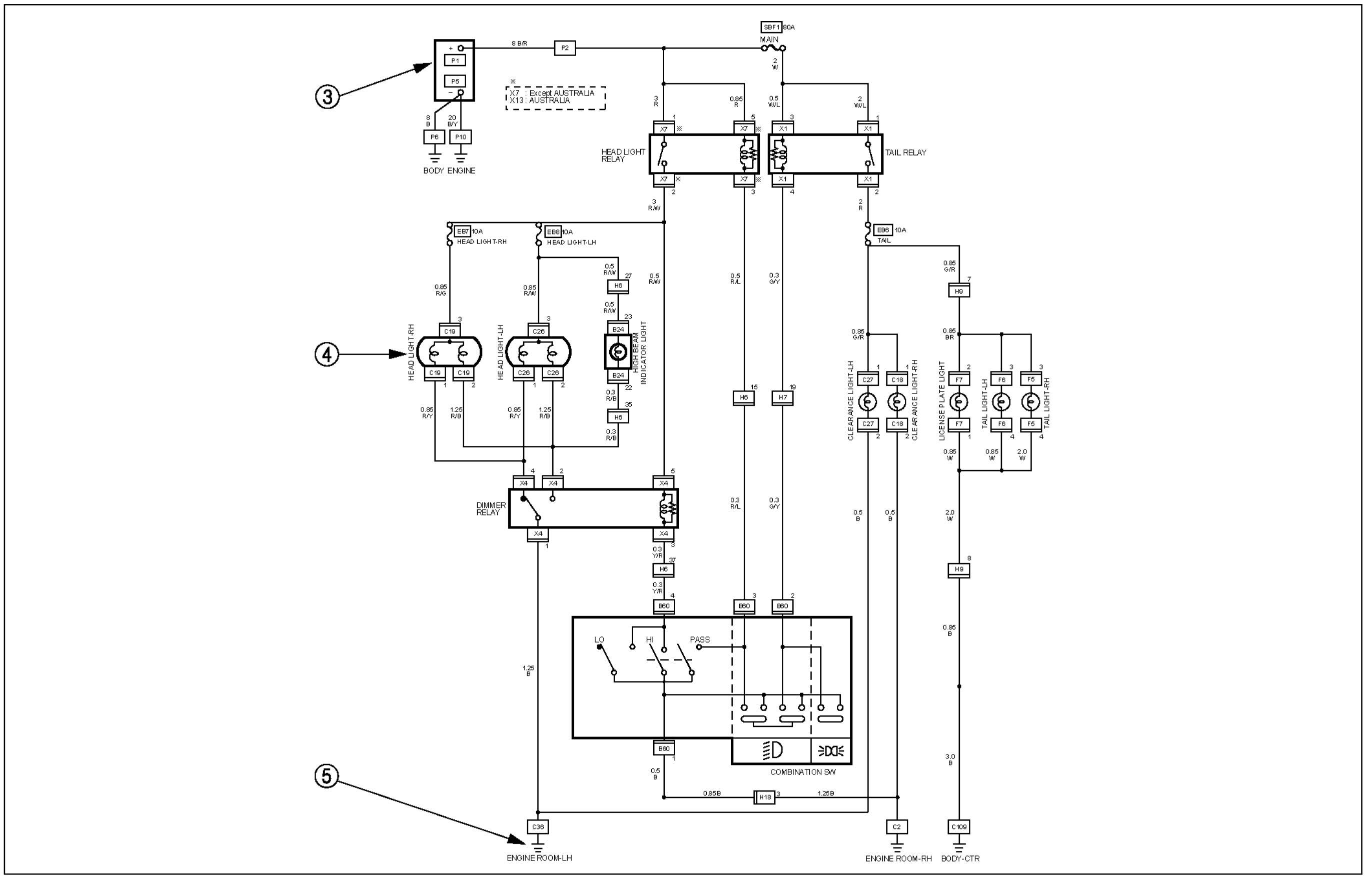
In this manual, each system has its own parts location illustration and circuit diagram.
And connector configurations used in the circuit diagram are shown at the end of this manual.
PARTS LOCATION: The parts location shows the location of the connectors ① and the harnesses ② used in the each system.
CIRCUIT DIAGRAM: The circuit diagram shows the power supply ③, the load or loads ④ and the grounding point(s) ⑤.
CONNECTOR LIST: The connector configuration shows each connector's number ⑥, configuration ⑦ and the pin numbers ⑧, parts name ⑨, connector color ⑩.

PARTS LOCATION



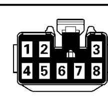
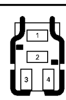
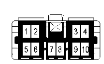
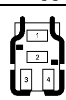
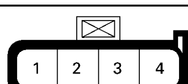
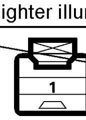
RTW780MF002401

CIRCUIT DIAGRAM



CONNECTOR LIST

CONNECTOR LIST

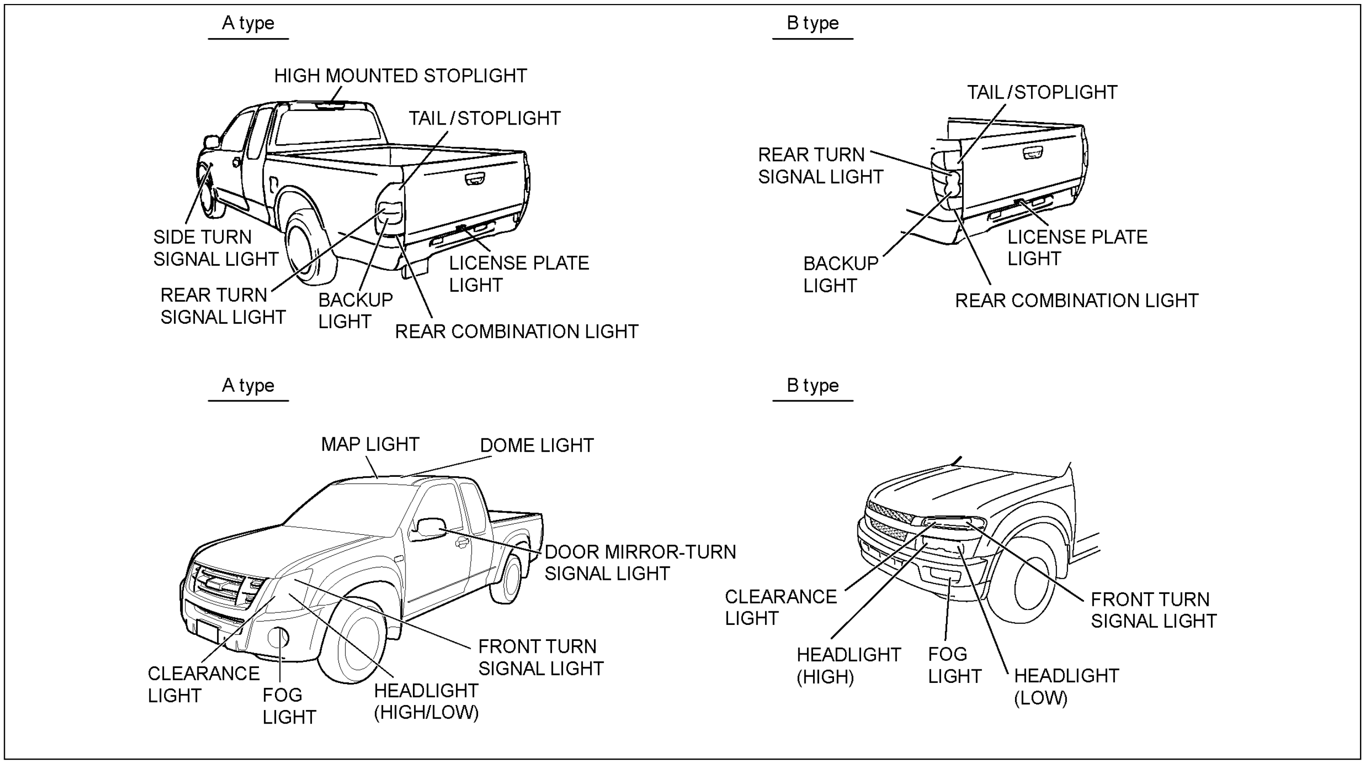
No.	Connector face	No.	Connector face
B1 ~ B6	NOT USED	B16 (HFV6 4JH1-TC) White	 Hazard switch
B7 Black	 Rear defogger relay	B16 (4JJ1-TC 4JA1T-(L)) Gray	 Hazard switch
B8 Black	 Power window relay	B17 ~ B19	NOT USED
B9	NOT USED	B20 White	 Cigar lighter illumination
B10	 Clock	B21	 lighter-1

⑥ ⑦ ⑧ ⑨ ⑩

MAIN DATA AND SPECIFICATIONS

BULB SPECIFICATIONS

This illustration based on LHD



RTW78AMF000801

Light Name	Bulb No.	Rated Power V-W	Number of Bulbs	Lens Color	Remarks	
Headlight	H4	12-60/55	2	White	A type, Halogen	
	HB3	12-65	2	White	A type, Halogen projector type	
	H7	12-55	2	White		
	HB3	12-60	2	White	B type	High Bean
	HB4	12-51	2	White		Low Bean
High mounted stoplight	W5W	12-5	4	RED		
Fog light	H3	12-55	2	White		
Front turn signal light	PY21W	12-21	2	White	Bulb Lens color Amber	
Clearance light	W5W	12-5	2	White		
Door mirror-turn signal light (out side mirror type)	-	-	2	White	LED (Illuminated color Amber)	
Side turn signal light	W5W	12-5	2	White with amber inner lens		
Rear turn signal light	PY21W	12-21	2	White	Bulb Lens color Amber	
Rear fog light	P21W	12-21	1	Red		
Tail and stoplight	P21/5W	12-21/5	2	Red		

Light Name	Bulb No.	Rated Power V-W	Number of Bulbs	Lens Color	Remarks
Backup light	P16W	12-21	2	White	Regular cab
	P21W	12-16	2	White	Extend cab, Crew cab
License plate light	W5W	12-5	2	White	
A/C-Heater control light	-	12-0.7	1	-	
Dome light	-	12-10	1	White	
Spotlight/ Map light	-	12-5	2	White	

<table>
<tr><th colspan="3">Light Name</th><th>Rated Power V-W</th><th>Luminous Color</th><th>Remarks</th></tr>
<tr><td rowspan="28">Meter
(Illumination light, Indicator light, Warning light)</td><td colspan="2">ILLUMINATION LIGHT</td><td>LED</td><td>White</td><td></td></tr>
<tr><td colspan="2">MULTI FUNCTION DISPLAY</td><td>LCD</td><td>Light blue</td><td></td></tr>
<tr><td colspan="2">TURN SIGNAL</td><td>LED</td><td>Green</td><td></td></tr>
<tr><td colspan="2">HIGH BEAM</td><td>LED</td><td>Blue</td><td></td></tr>
<tr><td colspan="2">LOW FUEL</td><td>LED</td><td>Amber</td><td></td></tr>
<tr><td colspan="2">A/T OIL TEMP</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">BRAKE</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">4WD</td><td>LED</td><td>Green</td><td></td></tr>
<tr><td colspan="2">SEAT BELT</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">CHECK ENGINE</td><td>LED</td><td>Amber</td><td></td></tr>
<tr><td colspan="2">OIL</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">FUEL FILTER</td><td>LED</td><td>Green</td><td></td></tr>
<tr><td colspan="2">ABS</td><td>LED</td><td>Amber</td><td></td></tr>
<tr><td colspan="2">SEDIMENTER</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">SRS</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">CHARGE</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">CHECK TRANS</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">CHECK 4WD</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td colspan="2">POWER DRIVE</td><td>LED</td><td>Amber</td><td></td></tr>
<tr><td colspan="2">3RD START</td><td>LED</td><td>Green</td><td></td></tr>
<tr><td colspan="2">4WD-LOW</td><td>LED</td><td>Green</td><td></td></tr>
<tr><td colspan="2">DOOR AJAR</td><td>LED</td><td>Red</td><td></td></tr>
<tr><td rowspan="7">A/T shift indicator</td><td>P</td><td>LED/LCD</td><td>Green</td><td rowspan="7">LED: Indicated on the gauge panel
LCD: Indicated on the tachometer panel</td></tr>
<tr><td>R</td><td>LED/LCD</td><td>Green</td></tr>
<tr><td>N</td><td>LED/LCD</td><td>Green</td></tr>
<tr><td>D</td><td>LED/LCD</td><td>Green</td></tr>
<tr><td>3</td><td>LED/LCD</td><td>Green</td></tr>
<tr><td>2</td><td>LED/LCD</td><td>Green</td></tr>
<tr><td>L</td><td>LED/LCD</td><td>Green</td></tr>
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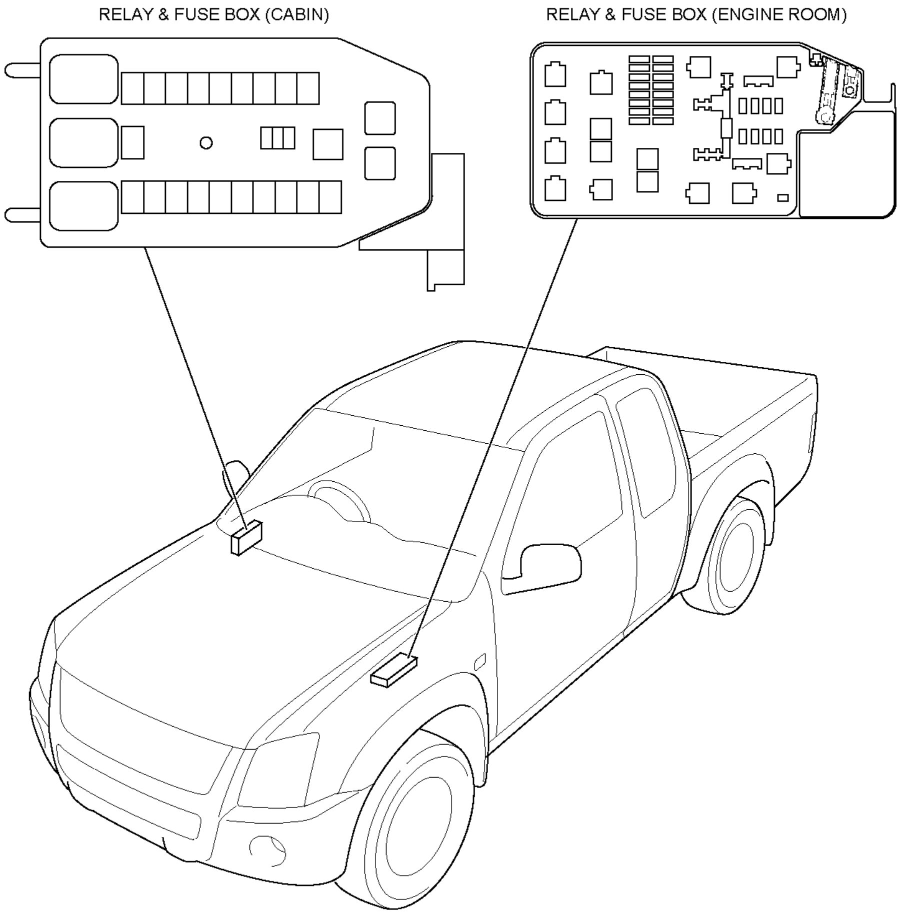
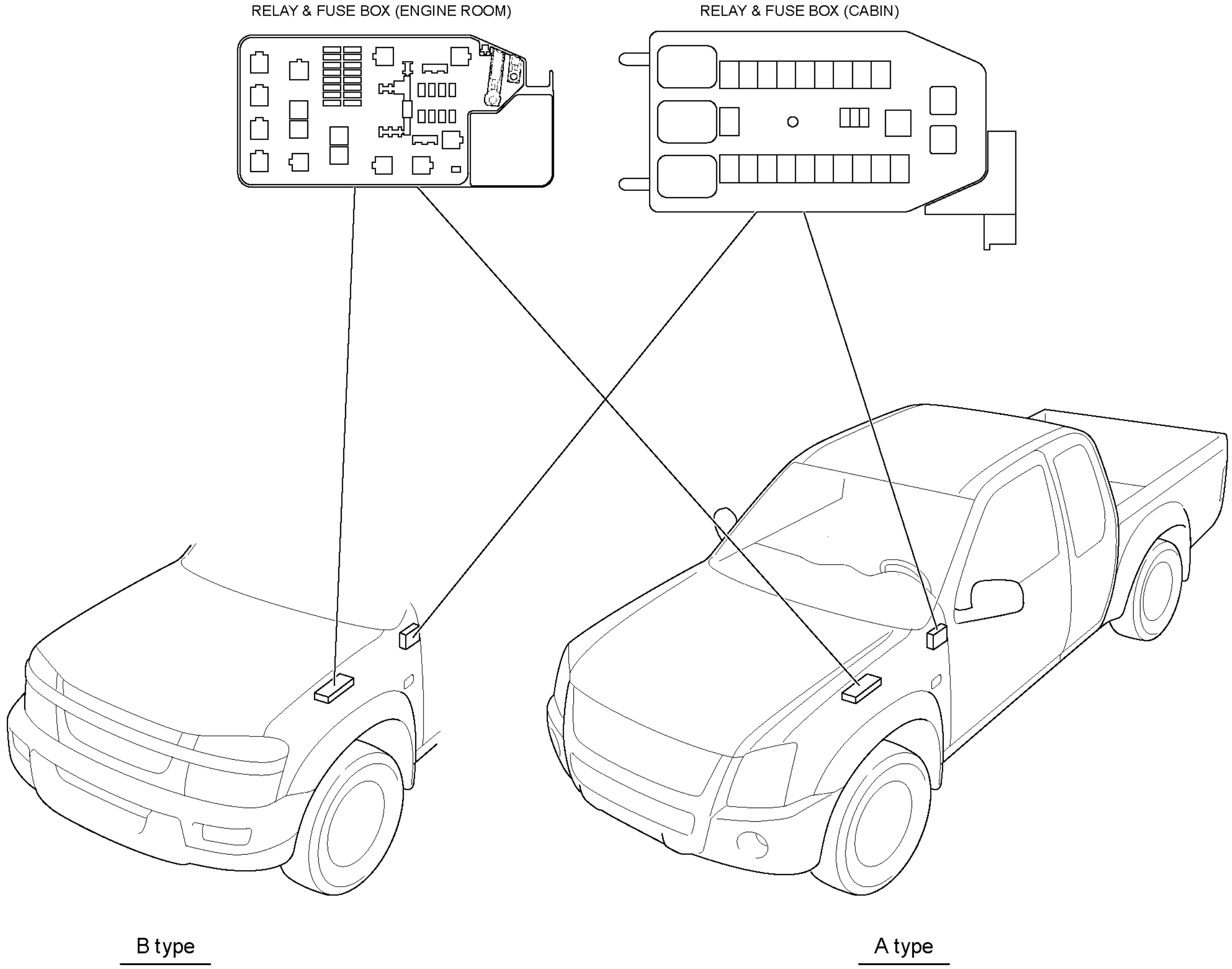
RELAY AND FUSE

RELAY AND FUSE BOX LOCATION (RHD)



RTW780MF002301

RELAY AND FUSE BOX LOCATION (LHD)

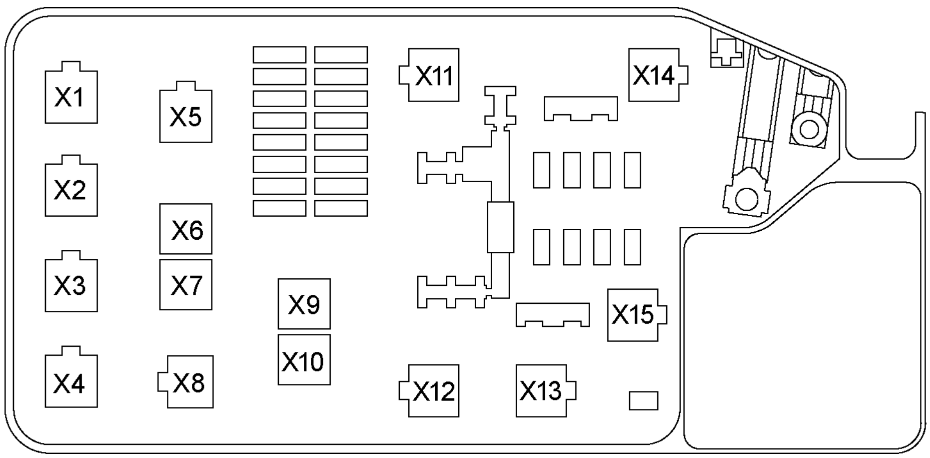


RTW78ALF000201

RELAY LOCATION

RELAY & FUSE BOX (ENGINE ROOM)

RHD

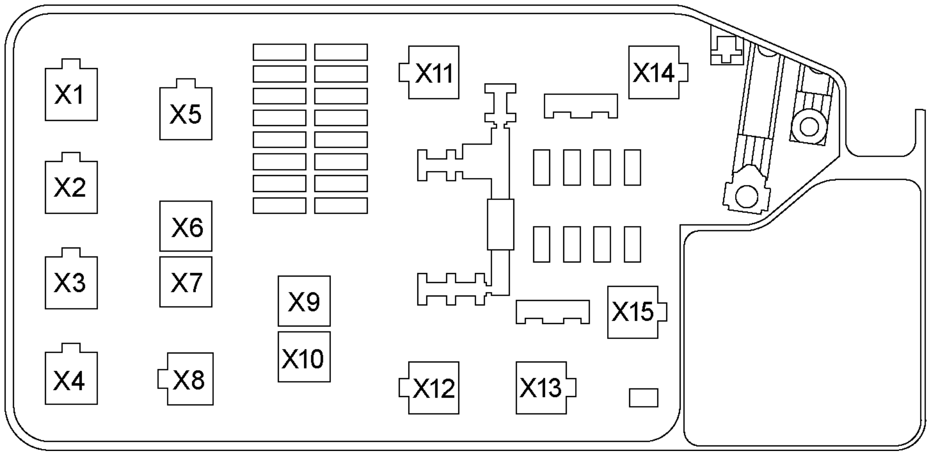


NO.	RELEY (C24SE)	RELAY (HFV6)	RELAY (4JA1T(L))	RELAY (4JJ1-TC/4JK1-TC)
X1	RELAY; TAIL LIGHT	RELAY; FOG LIGHT	←	←
X2	RELAY; FUEL PUMP	RELAY; TAIL LIGHT	←	←
X3	RELAY; HORN	←	←	←
X4	RELAY; DIMMER	←	←	←
X5	—	—	RELAY; GLOW	←
X6	RELAY; STARTER	RELAY; H/LIGHT	←	←
X7	RELAY; H/LIGHT (Except AUSTRALIA) RELAY; COND FAN (AUSTRALIA)	RELAY; H/ LIGHT	RELAY; CSD	RELAY; STARTER CUT
X8	—	—	RELAY; STARTER	←
X9	RELAY; FRT FOG LAMP	—	—	RELAY; COND FAN
X10	RELAY; COND FAN	—	—	RELAY; TRANSMISSION
X11	RELAY; HEATER	←	←	←
X12	RELAY; STARTER CUT (AUSTRALIA)	RELAY; ECM MAIN	—	RELAY; ECM MAIN
X13	RELAY; STARTER CUT (Except AUSTRALIA) RELAY; H/LIGHT (AUSTRALIA)	RELAY; F/PUMP	RELAY; COND FAN	RELAY; F/PUMP
X14	RELAY; A/C COMP	←	RELAY; STARTER CUT	RELAY; A/C COMP
X15	RELAY; THERMO	RELAY; STARTER	RELAY; THERMO	←

RELAY LOCATION

RELAY & FUSE BOX (ENGINE ROOM)

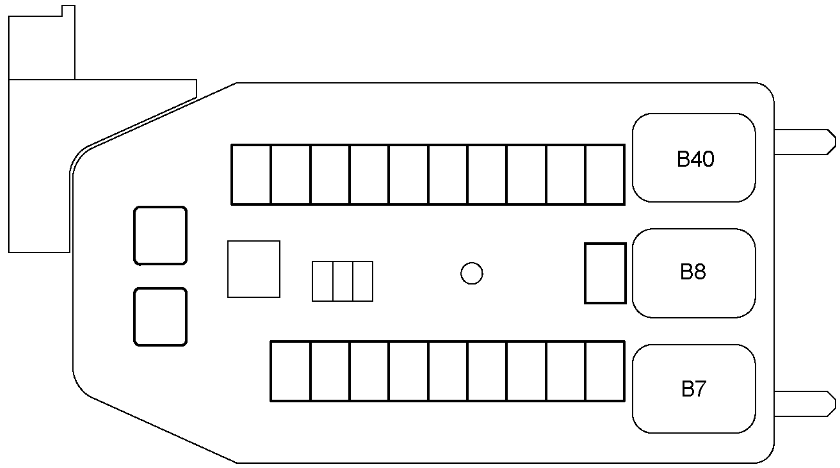
LHD



NO.	RELEY (C24SE)	RELAY (HFV6)	RELAY (4JH1-TC)	RELAY (4JA1T(L))	RELAY (4JJ1-TC/4JK1-TC)
X1	RELAY; TAIL LIGHT	RELAY; FOG LIGHT	←	←	←
X2	RELAY; FUEL LIGHT	RELAY; TAIL LIGHT	←	←	←
X3	RELAY; HORN	←	←	←	←
X4	RELAY; DIMMER	←	←	←	←
X5	—	—	RELAY; GLOW	←	←
X6	RELAY; STARTER	RELAY; H/LIGHT	←	←	←
X7	RELAY; H/LIGHT	—	RELAY; STARTER CUT	RELAY; CSD	RELAY; STARTER CUT
X8	—	—	RELAY; STARTER	←	←
X9	RELAY; FRT FOG LIGHT	—	RELAY; COND FAN	—	←
X10	RELAY; COND FAN	—	—	—	RELAY; TRANSMISSION
X11	RELAY; HEATER	←	←	←	←
X12	—	RELAY; ECM MAIN	RELAY; ECM MAIN	—	←
X13	RELAY; STARTER CUT	RELAY; F/PUMP	—	RELAY; COND FAN	RELAY; F/PUMP
X14	RELAY; A/C COMP	←	←	RELAY; STARTER CUT	RELAY; A/C COMP
X15	RELAY; THERMO	RELAY; STARTER	RELAY; THERMO	RELAY; THERMO	←

RELAY LOCATION

RELAY & FUSE BOX (CABIN)



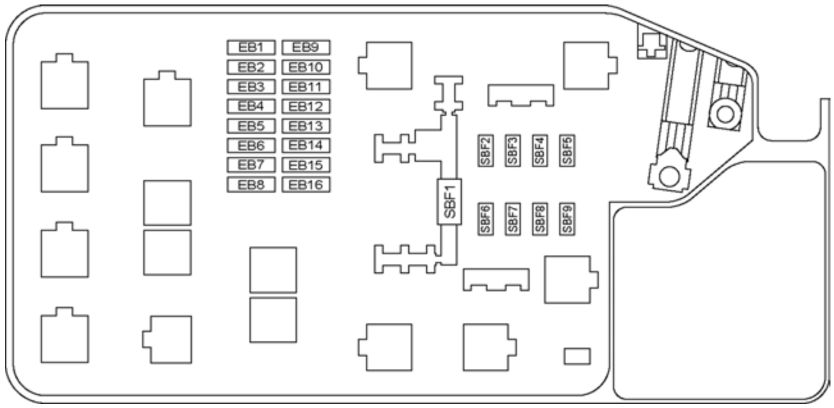
RELAY

Connector No.	B7	B8	B40
Relay name	REAR DEFOGGER	POWER WINDOW	(NO RELAY)

FUSE AND SLOW BLOW FUSE LOCATION

RELAY & FUSE BOX (ENGINE ROOM)

RHD



FUSE

∗1 AUSTRALIA

	ENGINE MODEL			
FUSE NO.	C24SE	HFV6	4JA1T (L)	4JJ1-TC/ 4JK1-TC
EB1	15A ECM	←	10A ACG (S)	←
EB2	—	15A 02 SENS PRE	—	10A ECM (B)
EB3	15A FRT FOG 20A TRAILER ∗1	10A ECM (B)	—	10A F/PUMP
EB4	10A ACG (S)	10A TCM PIM B	—	10A ENGINE
EB5	10A ILLUMI 10A H/L (RH) HI ∗1	10A H/L (RH) HI	←	←
EB6	10A H/L (LH) HI	←	←	←
EB7	10A H/L (RH) LOW	←	←	←
EB8	10A H/L (LH) LOW	←	←	←
EB9	20A F/PUMP	20A TRAILER	—	20A TRAIKER
EB10	10A SENSOR	—	—	20A COND, FAN
EB11	10A TAIL (RH)	←	←	←
EB12	10A ILLUMI & TAIL-LH	←	←	←
EB13	10A A/C	←	←	←
EB14	10A 4WD	←	←	←
EB15	10A HORN	←	←	←
EB16	10A HAZARD	←	←	←

SLOW BLOW FUSE

	ENGINE MODEL			
FUSE NO.	C24SE	HFV6	4JA1T (L)	4JJ1-TC / 4JK1-TC
SBF1	100A MAIN	←	80A MAIN	120A MAIN
SBF2	—	20A FRT FOG	40A ABS1	←
SBF3	—	60A RAD. FAN	20A ABS2	←
SBF4	20A COND, FAN	20A F/PUMP	20A COND, FAN	40A ECM
SBF5	40A IG 1	←	←	←
SBF6	—	30A BLOWER	←	←
SBF7	20A FRT FOG	40A ABS1	20A FRT FOG	←
SBF8	30A BLOWER	20A ABS2	50A GLOW	60A GLOW
SBF9	50A IG 2	60A IG 2	50A IG 2	60A IG 2

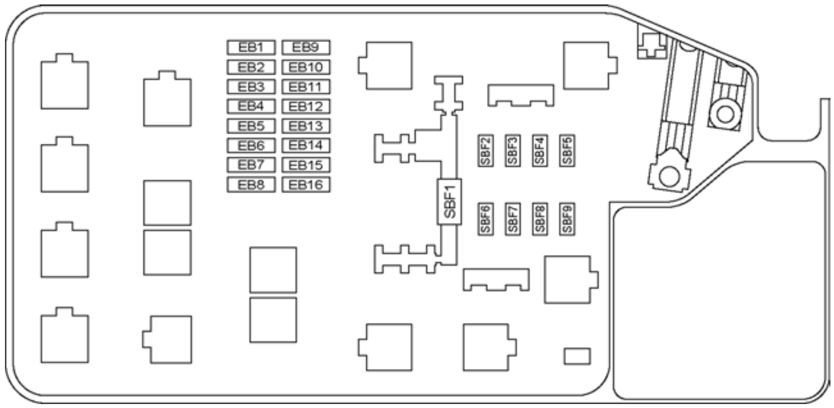
2) Axle Case Leakage

Checkpoint		Trouble Cause	Countermeasure
Oil filler and drain plug	NG	Loose drain plug and/or defective gasket(s)	Tighten the drain plug and/or replace the gasket(s)
OK			
Air breather	NG	Clogged air breather	Clean the air breather
OK			
Axle case	NG	Cracked axle case	Replace the axle case
OK			
Differential carrier	NG	Loose bolts	Tighten the bolts to the specified torque
	NG	Liquid gasket seal bad	Reapply the liquid gasket

FUSE AND SLOW BLOW FUSE LOCATION

RELAY & FUSE BOX (ENGINE ROOM)

LHD



FUSE

∗2 WITH HEADLIGHTS LEVELING

	ENGINE MODEL				
FUSE NO.	C24SE	HFV6	4JH1-TC	4JA1T (L)	4JJ1-TC / 4JK1-TC
EB1	15A ECM	15A ECM	10A ACG (S)	←	←
EB2	—	15A 02 SENS PRE	—	—	10A ECM (B)
EB3	—	10A ECM (B)	—	—	10A F/PUMP
EB4	10A ACG (S)	10A TCM PIM B	10A ECM	—	10A ENGINE
EB5	10A H/L (RH) HI ∗2	10A H/L (RH) HI	10A H/L (RH) HI ∗2	10A H/L (RH) HI	←
EB6	10A H/L (LH) HI ∗2	10A H/L (LH) HI	10A H/L (LH) HI ∗2	10A H/L (LH) HI	←
EB7	10A H/L (RH) 10A H/L (RH) LOW ∗2	10A H/L (RH) LOW	10A H/L (RH) 10A H/L (RH) LOW ∗2	10A H/L (RH) LOW	←
EB8	10A H/L (LH) 10A H/L (LH) LOW ∗2	10A H/L (LH) LOW	10A H/L (LH) 10A H/L (LH) LOW ∗2	10A H/L (LH) LOW	←
EB9	20A F/PUMP	—	—	—	20A TRAILER
EB10	10A SENSOR	—	20A COND FAN	—	20A COND FAN
EB11	10A TAIL (RH)	←	←	←	←
EB12	10A ILLUMI & TAIL LH	←	←	←	←
EB13	10A A/C	←	←	←	←
EB14	10A 4WD	←	←	←	←
EB15	10A HORN	←	←	←	←
EB16	10A HAZARD	←	←	←	←

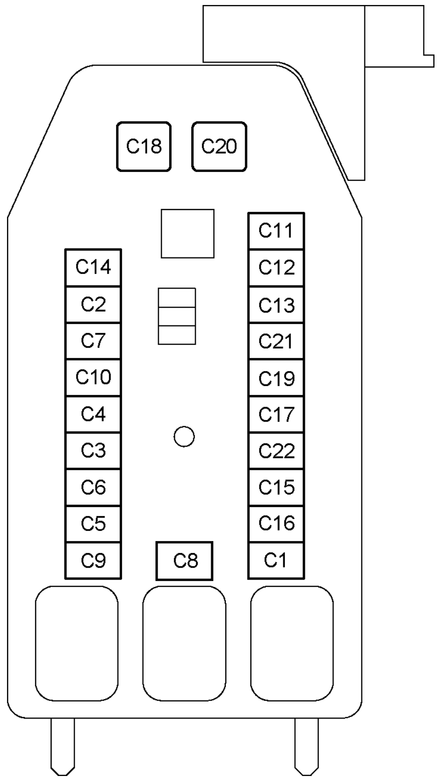
SLOW BLOW FUSE

	ENGINE MODEL				
FUSE NO.	C24SE	HFV6	4JH1-TC	4JA1T (L)	4JJ1-TC / 4JK1-TC
SBF1	100A MAIN	←	80A MAIN	←	120A MAIN
SBF2	—	20A FRT FOG	40A ABS1	—	40A ABS1
SBF3	—	60A RAD. FAN	30A ABS2	20A ABS2	←
SBF4	20A COND, FAN	20A F/PUMP	30A ECM	20A CON FAN	40A ECM
SBF5	40A IG 1	←	←	←	←
SBF6	—	30A BLOWER	←	←	←
SBF7	20A FRT FOG	40A ABS1	20A FRT FOG	←	←
SBF8	30A BLOWER	20A ABS2	60A GLOW	50A GLOW	60A GLOW
SBF9	50A IG 2	60A IG 2	50A IG 2	←	60A IG 2

FUSE LOCATION

FUSE BOX

RHD/LHD



FUSE

NO.	Capacity	Indication on label	NO.	Capacity	Indication on label
C1	10A	STARTER	C11	10A	AUDIO
C2	—	—	C12	20A	CIGAR/ACC SOCKET
	10A	TRAILER *3	C13	15A	AUDIO (+B)
C3	10A	ELEC IG	C14	10A	METER
C4	10A	TURN	C15	15A	STOP
C5	10A	ABS/4WD	C16	—	—
C6	10A	ENGINE	C17	10A	ROOM
	10A	ECU *4	C19	10A	METER (+B)
C7	15A	TCM/IG COIL/	C21	20A	DOOR LOCK
	10A	GLOW ENGINE *4	C22	—	—
C8	10A	SRS		10A	ANTI THEFT *5
C9	20A	FRT WIPER			
C10	15A	BACKUP			

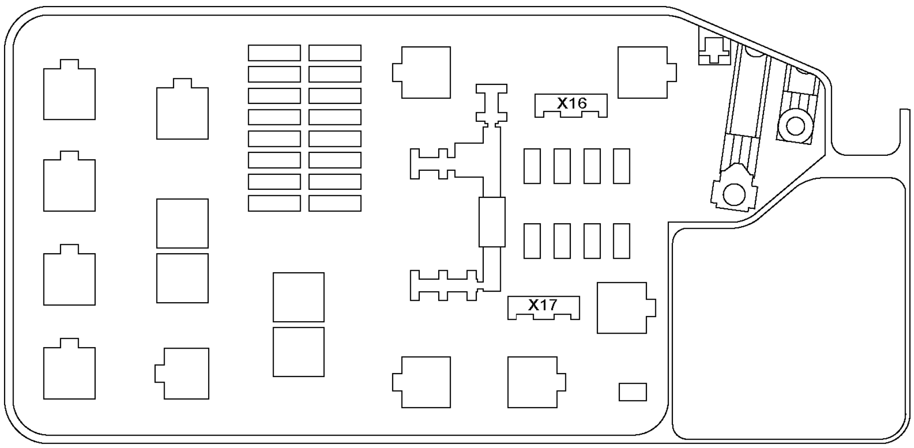
SLOW BLOW FUSE

NO.	Capacity	Indication on label
C18	20A	RR DEF
C20	30A	POWER WINDOW

*3… HFV6 (AUSTRALIA)
*4… HFV6
*5… 4JJ1-TC (EUROPE)

DIODE LOCATION

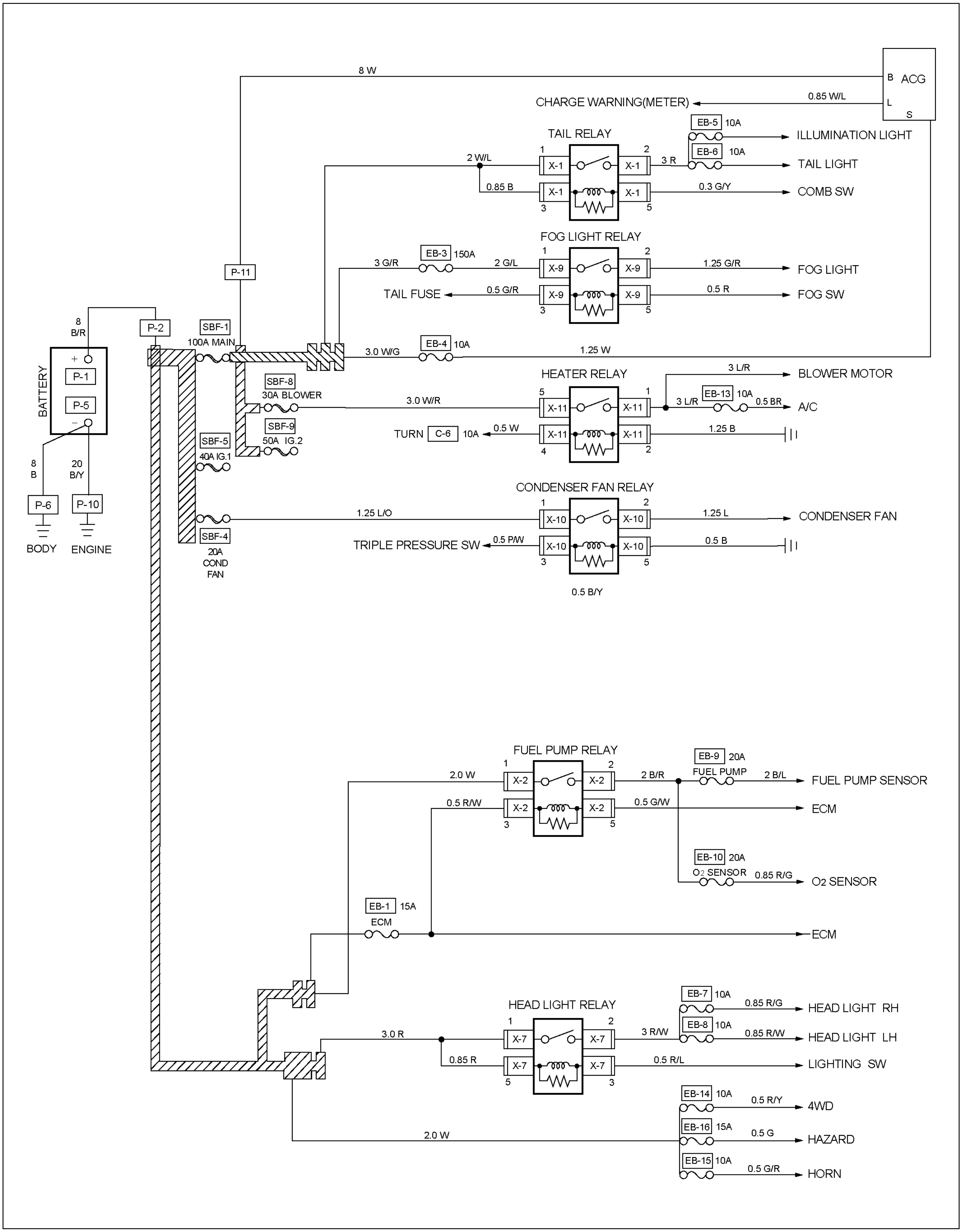
RELAY & FUSE BOX



No.	DIODE								
	C24SE		HFV6		4JH1-TC	4JA1T (L)		4JJ1-TC/4JK1-TC	
	RHD	LHD	RHD	LHD	LHD	RHD	LHD	RHD	LHD
X16	—		—		DIODE	VSV FICD		DIODE	
X17	—		—		—	—		DIODE	

FUSE BLOCK CIRCUIT C24SE

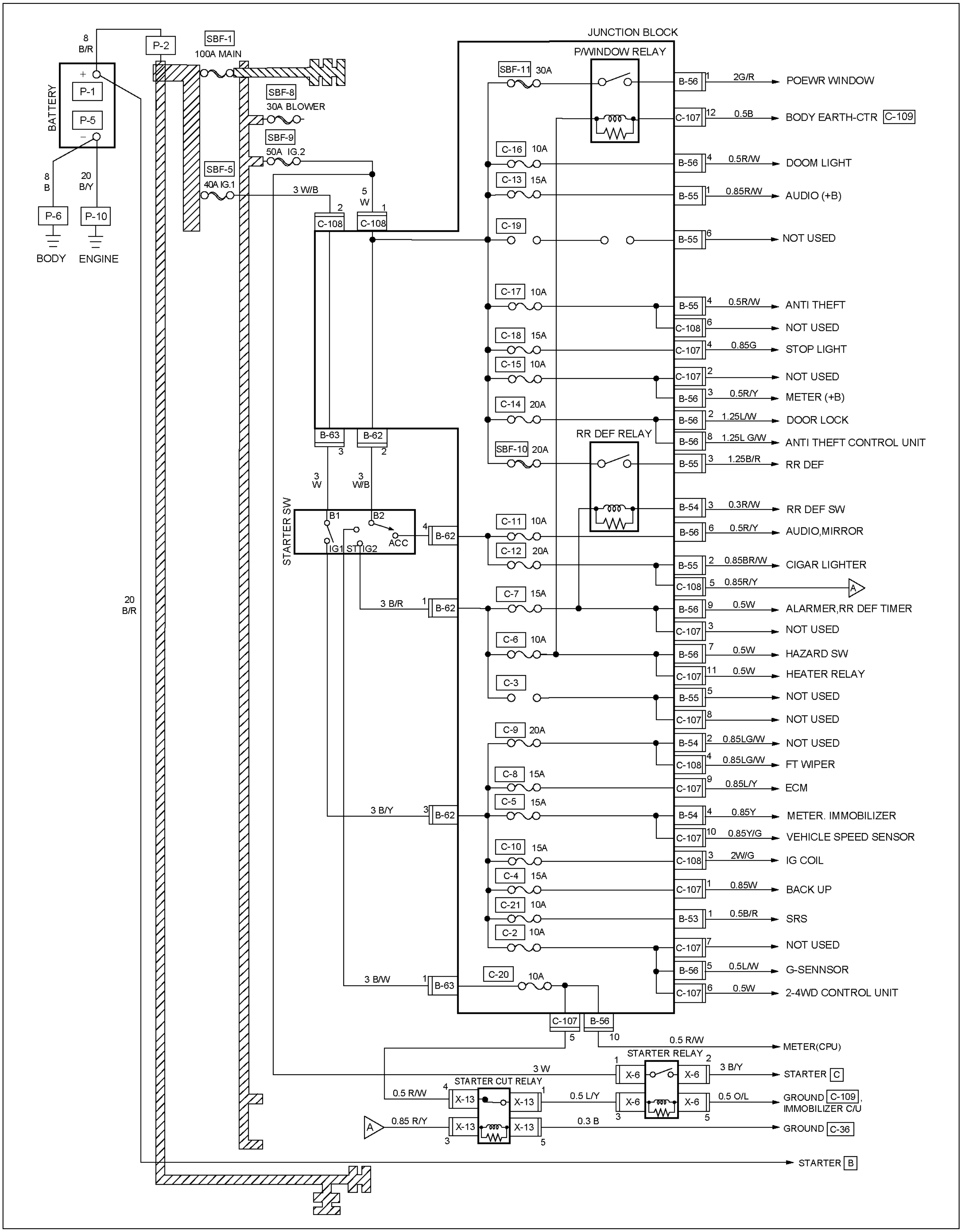
Sheet 1/2



RTW68AXF005801

FUSE BLOCK CIRCUIT C24SE

Sheet 2/2



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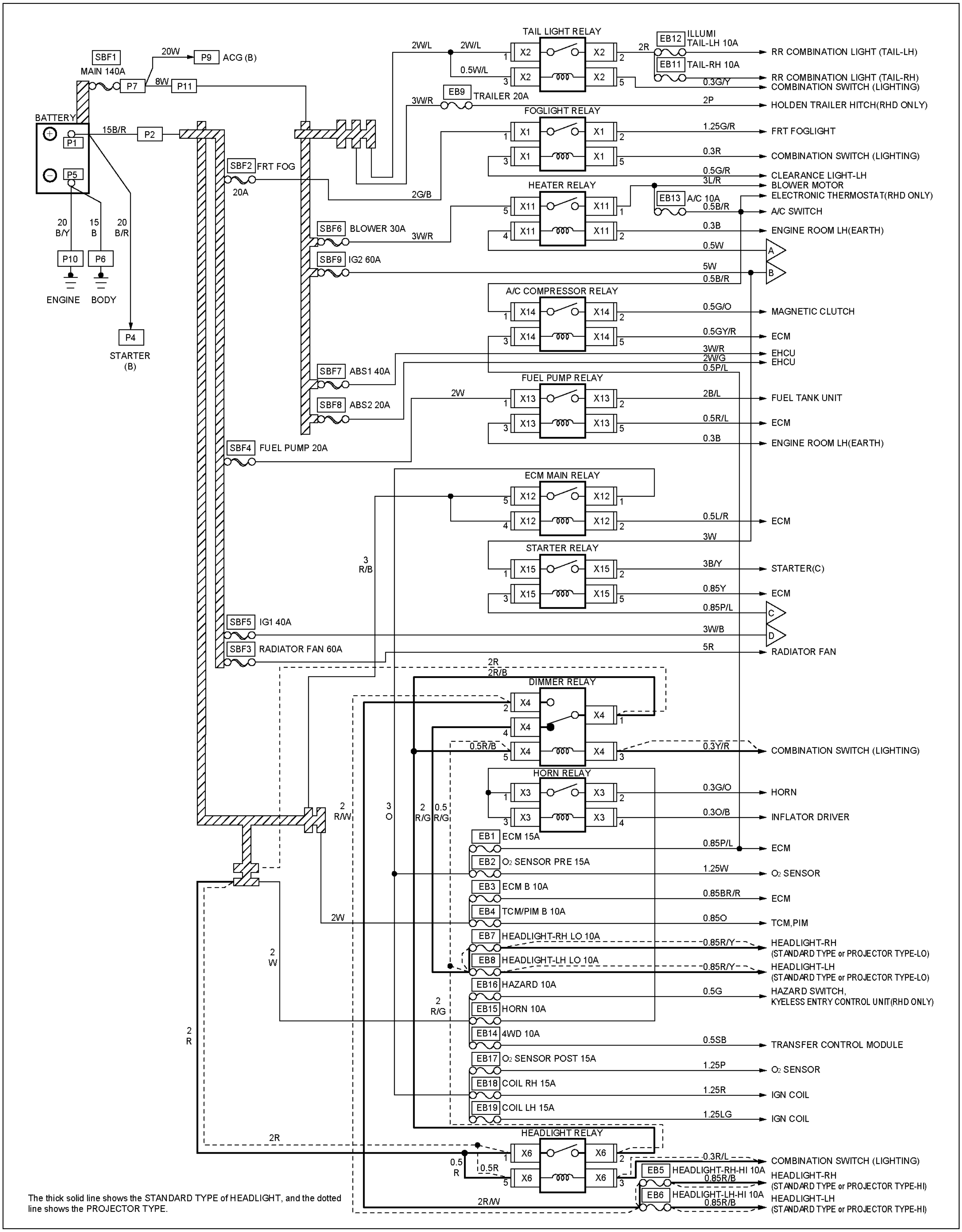
FUSE BLOCK CIRCUIT HFV6

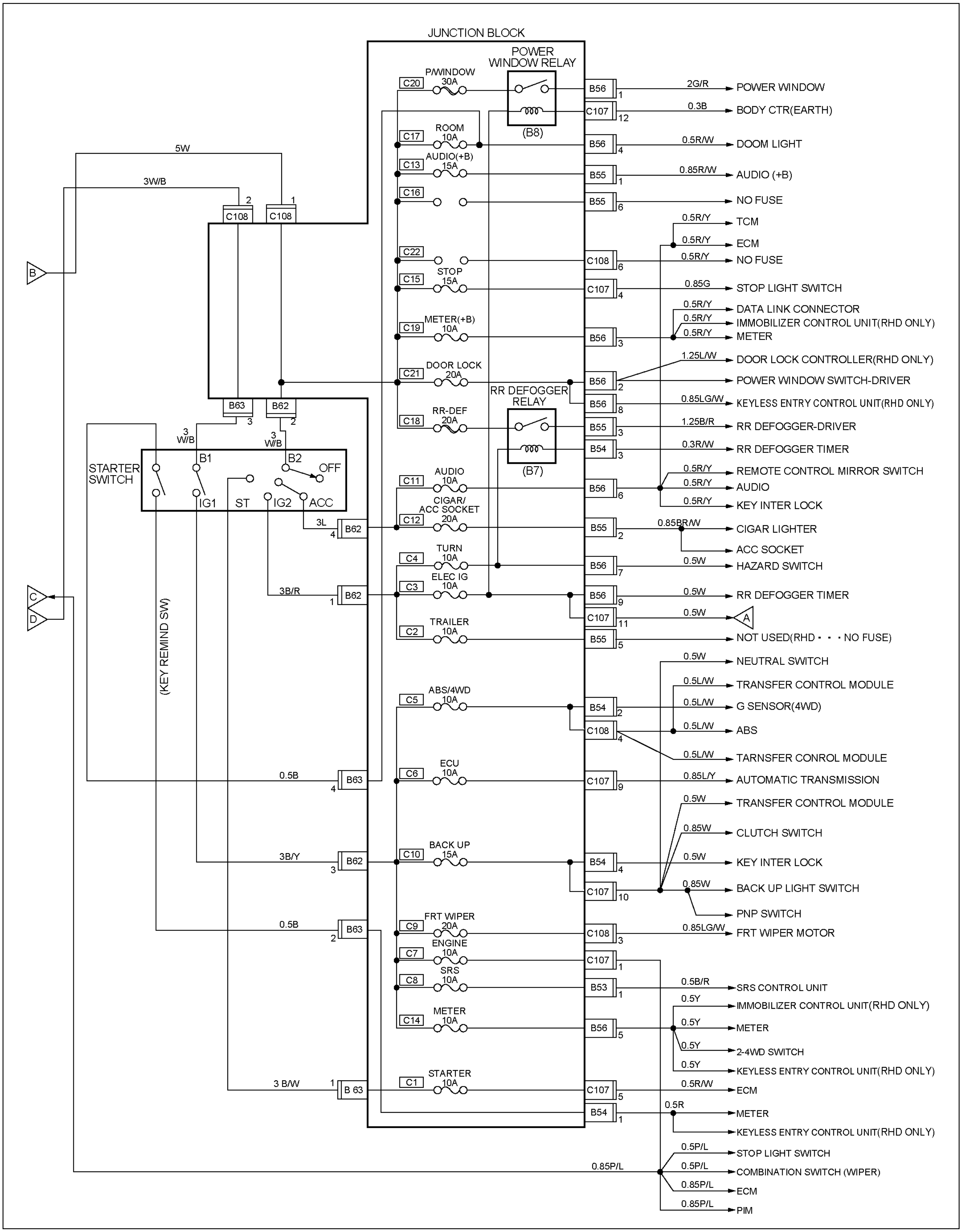
Sheet 1/2



RTW78AXF003001

FUSE BLOCK CIRCUIT HFV6

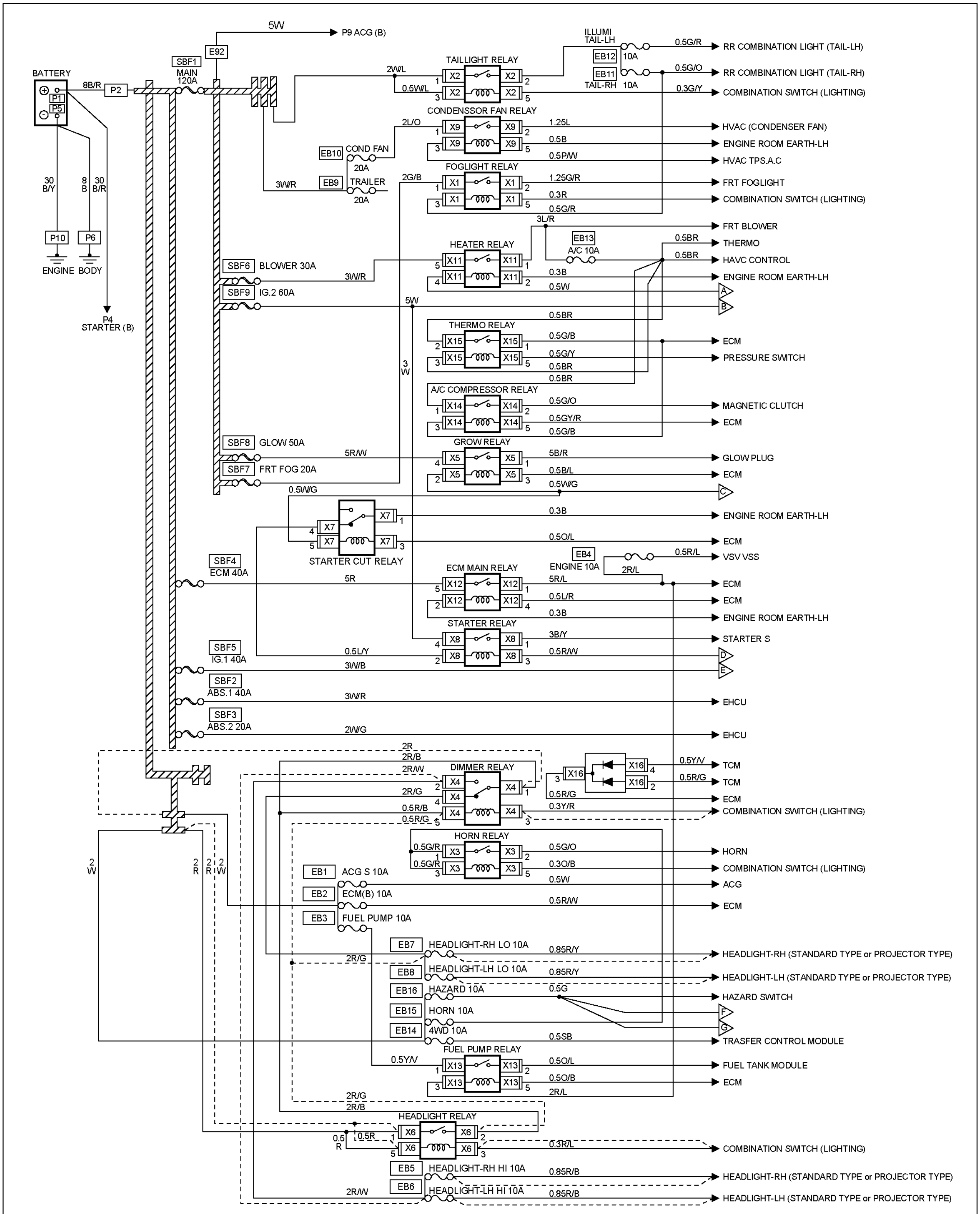
Sheet 2/2



RTW78AXF003101

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 1/2

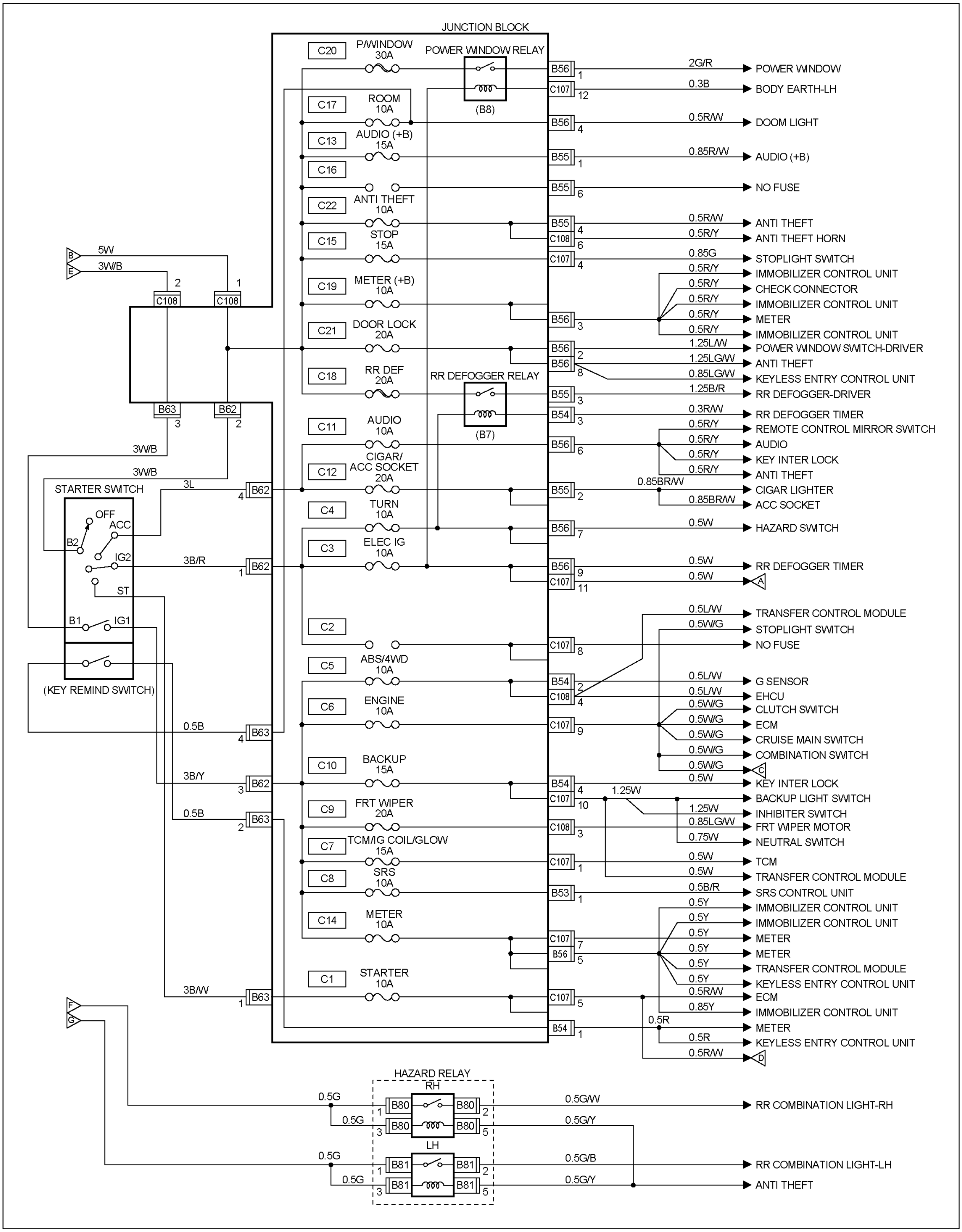


The thick solid line shows the STANDARD TYPE of HEADLIGHT, and the dotted line shows the PROJECTOR TYPE.

RTW78AXF020201

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

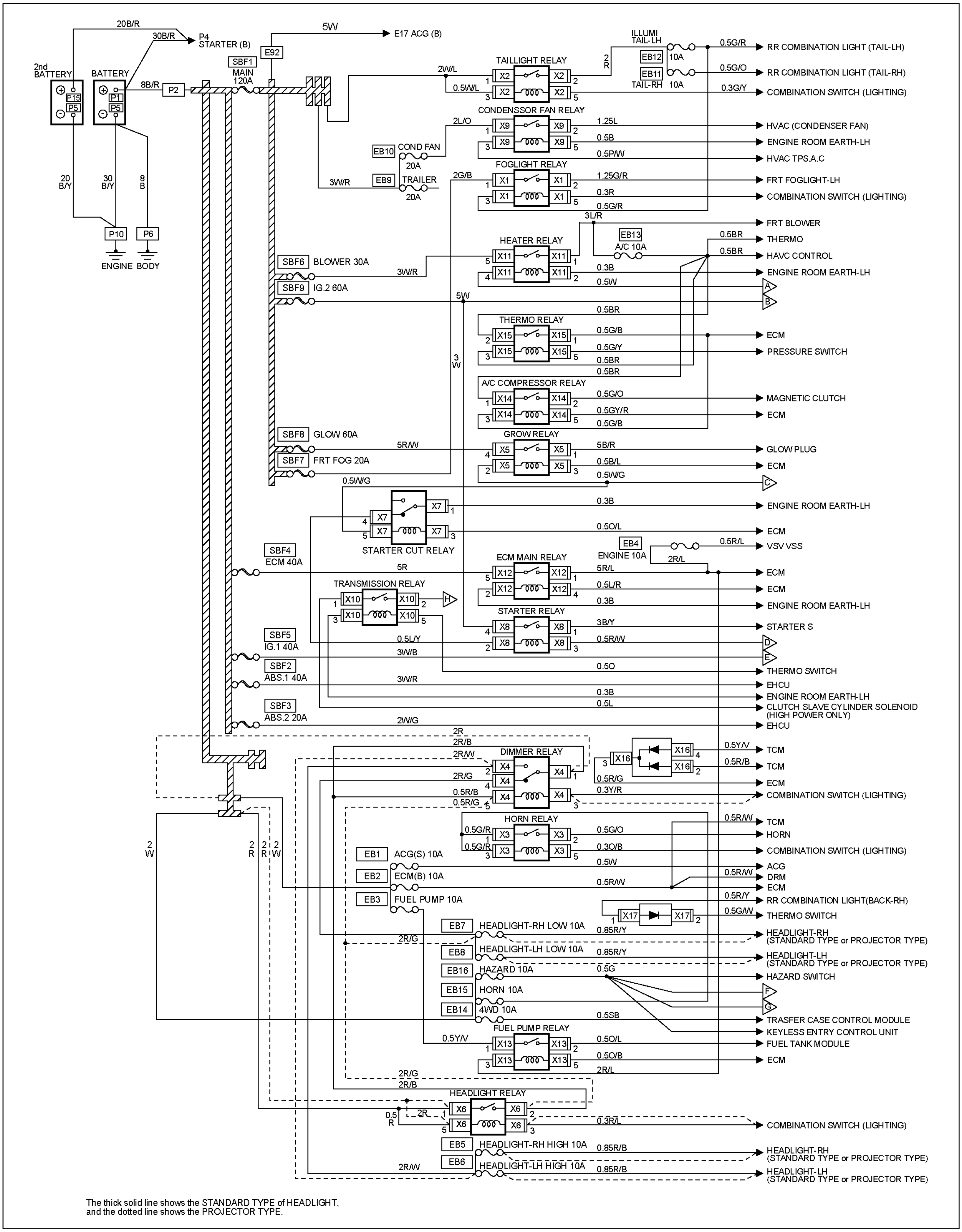
Sheet 2/2



RTW78AXF020301

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 1/2



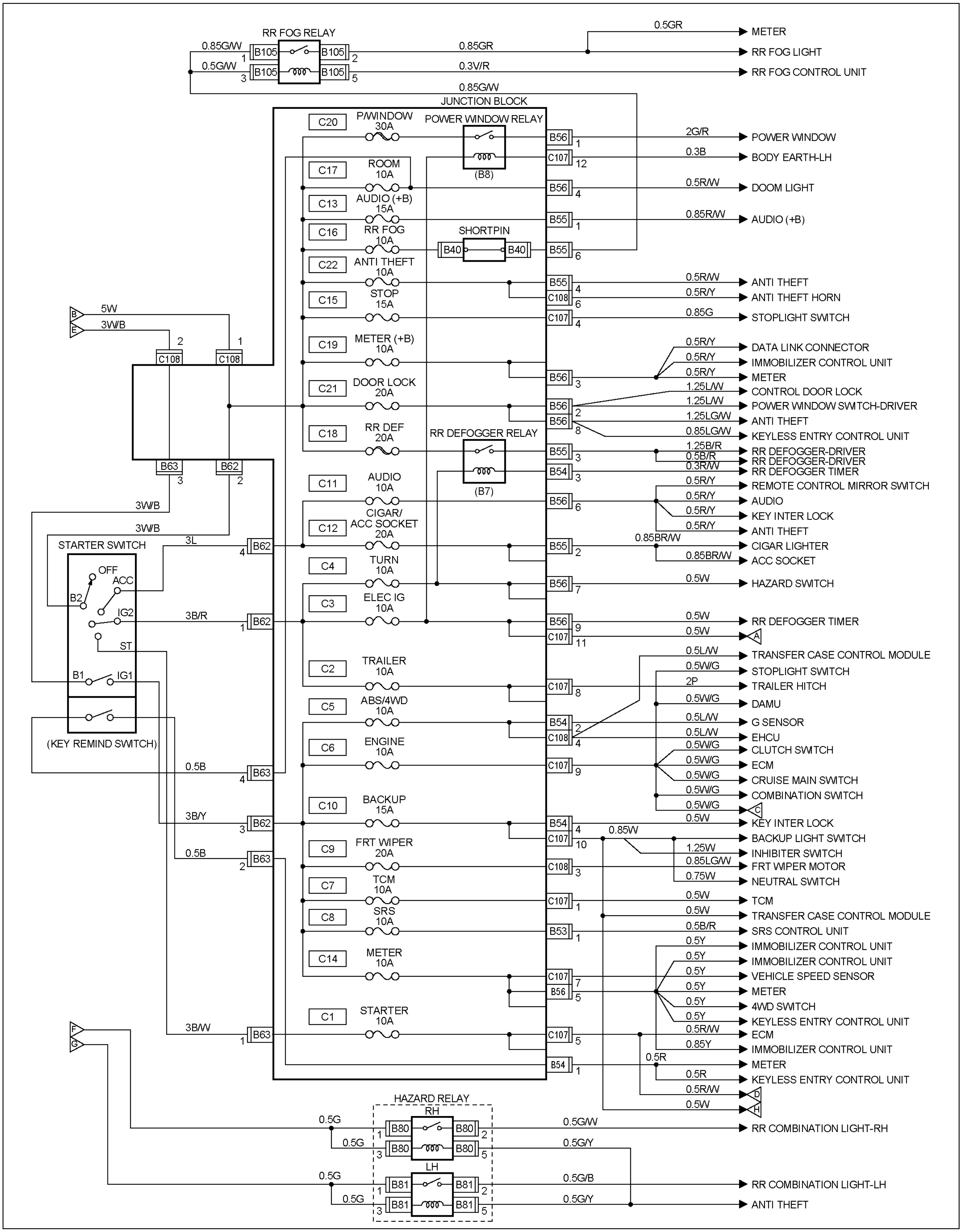
RTW78AXF035001

3) Axle Case to Inside Brake Drum Leakage

Checkpoint		Trouble Cause	Countermeasure
Oil seal	NG	Worn or defective oil seal	Replace the oil seal

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

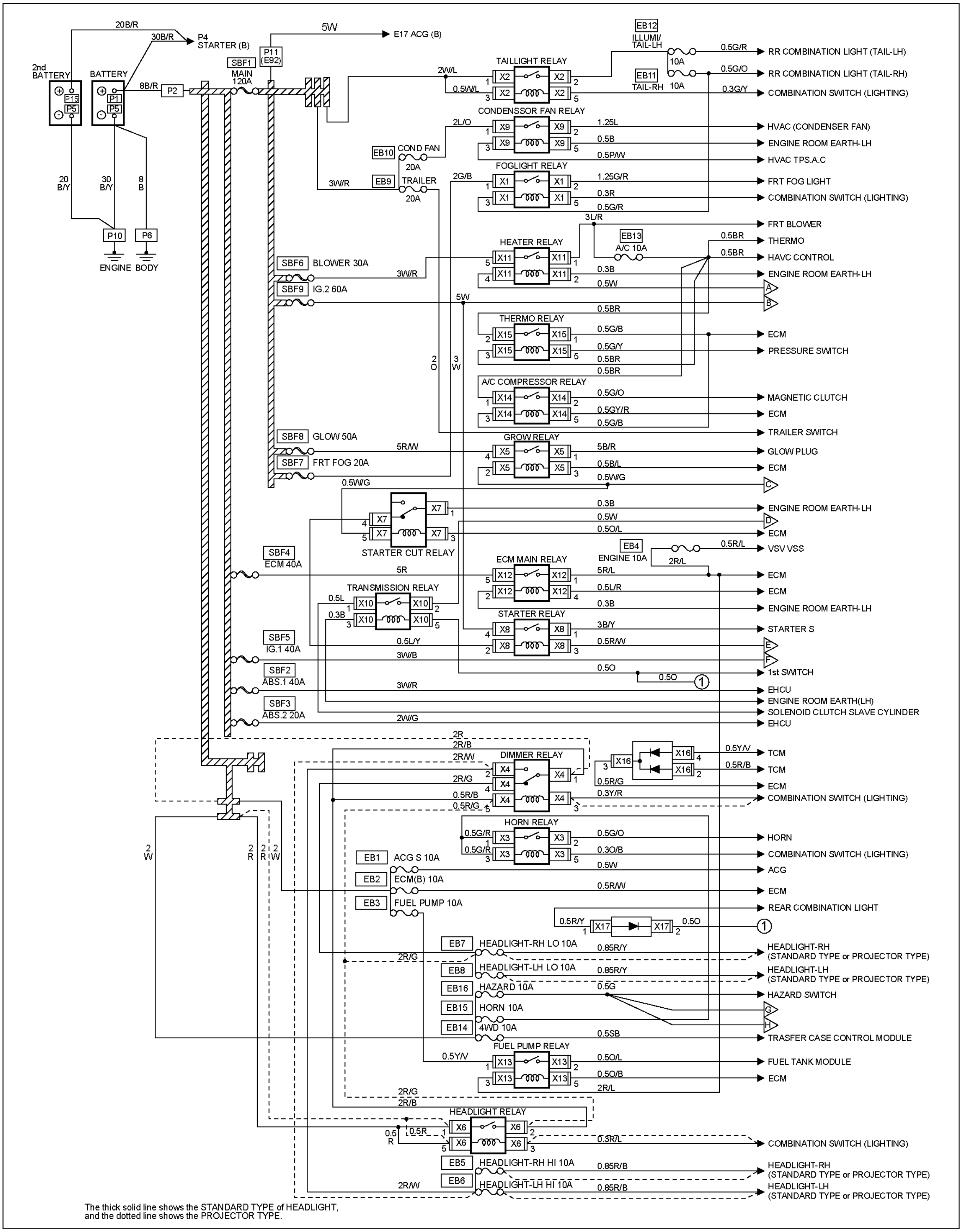
Sheet 2/2



RTW78AXF034901

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (LHD) G.EXP

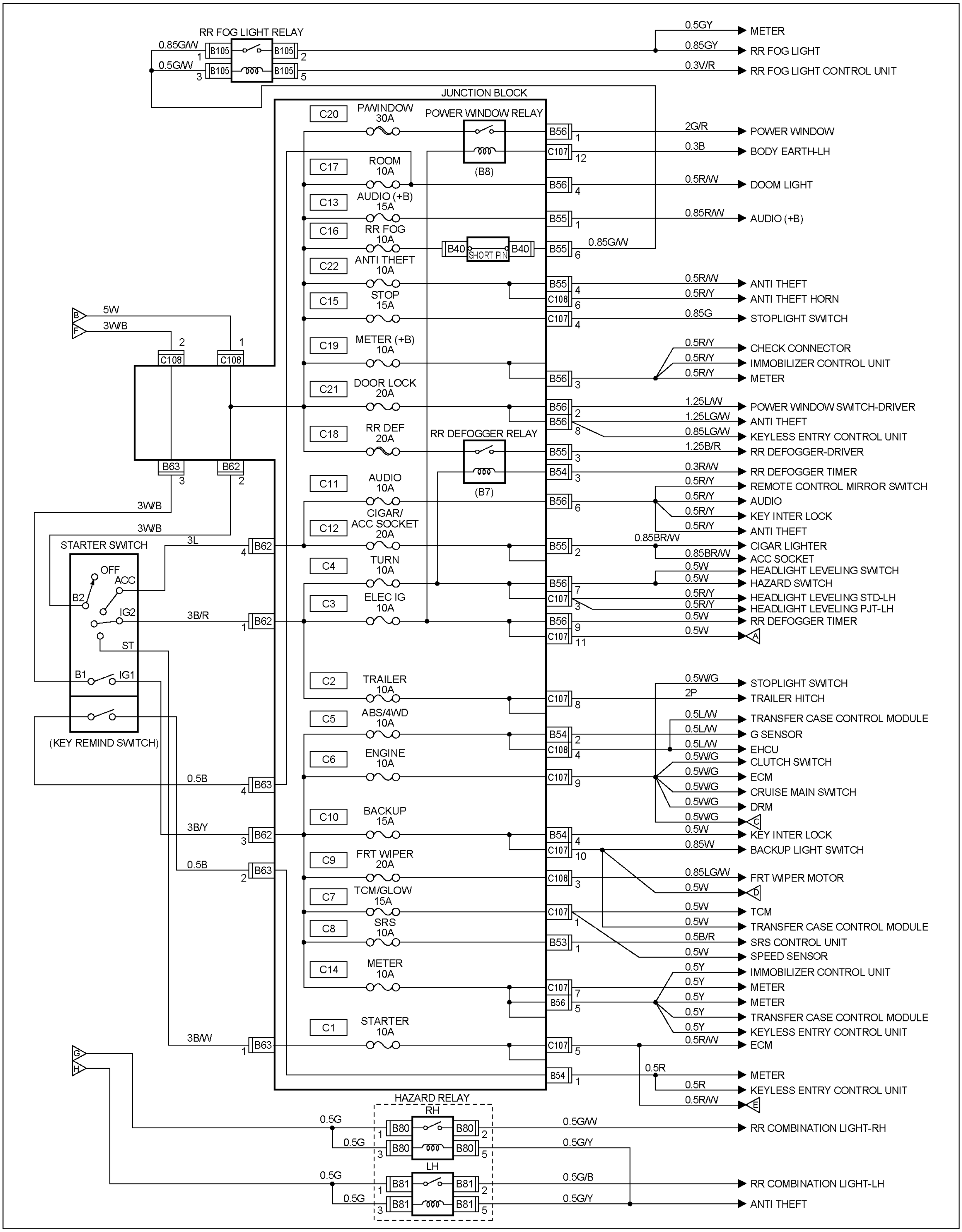
Sheet 1/2



RTW78AXF029901

FUSE BLOCK CIRCUIT 4JJ1-TC/4JK1-TC (LHD) G.EXP

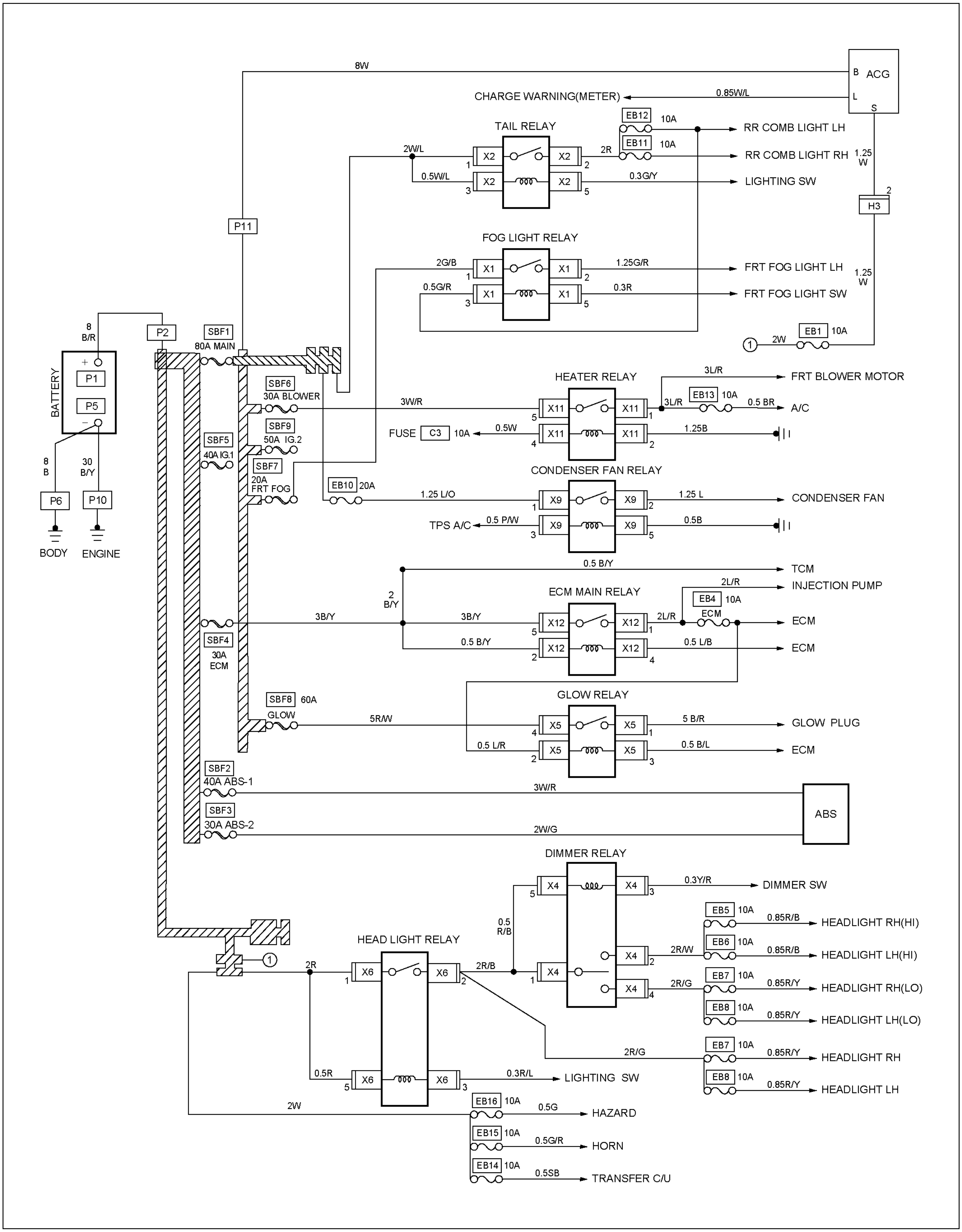
Sheet 2/2



RTW78AXF030001

FUSE BLOCK CIRCUIT 4JH1-TC (LHD)

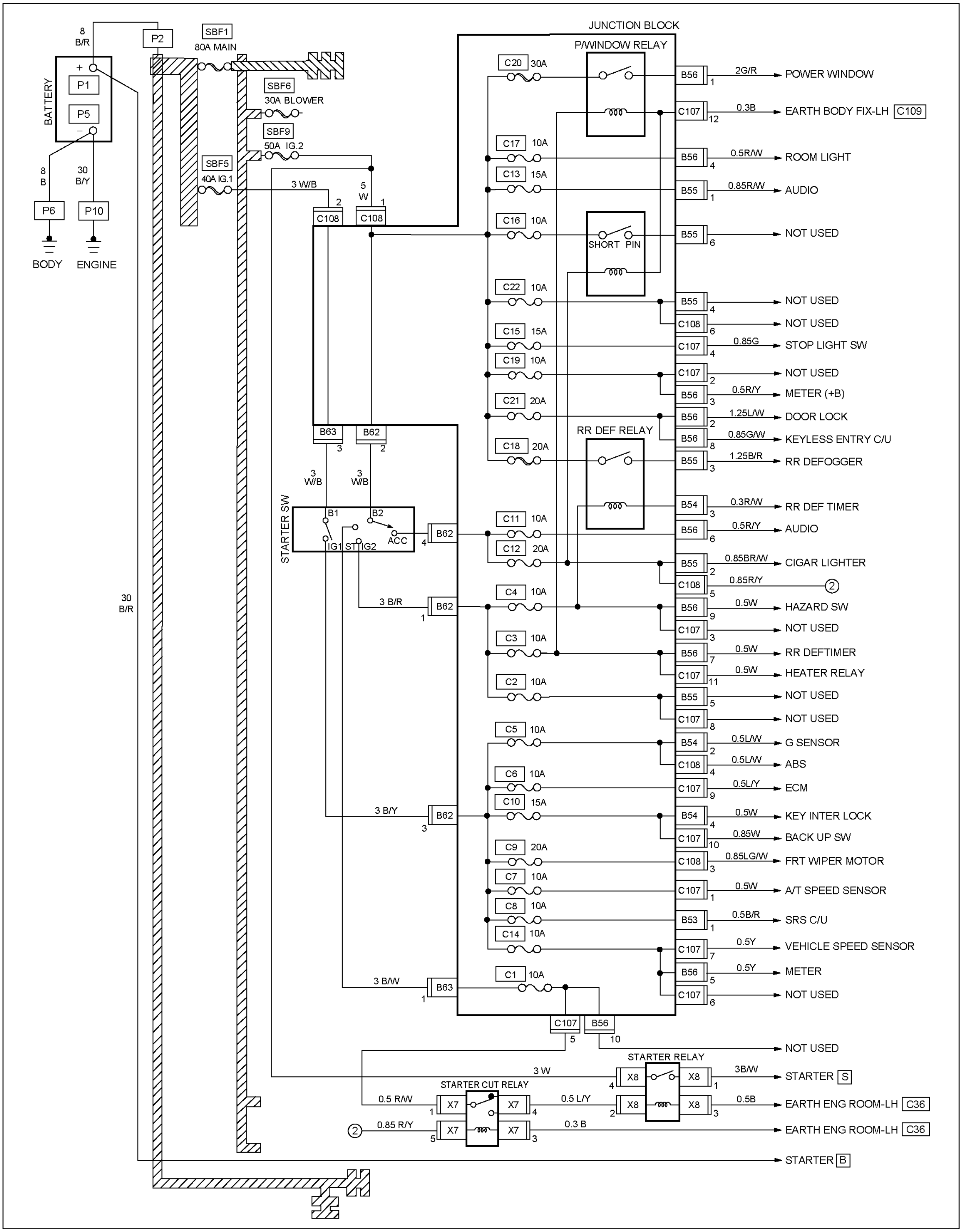
Sheet 1/2



RTW78AXF005201

FUSE BLOCK CIRCUIT 4JH1-TC (LHD)

Sheet 2/2



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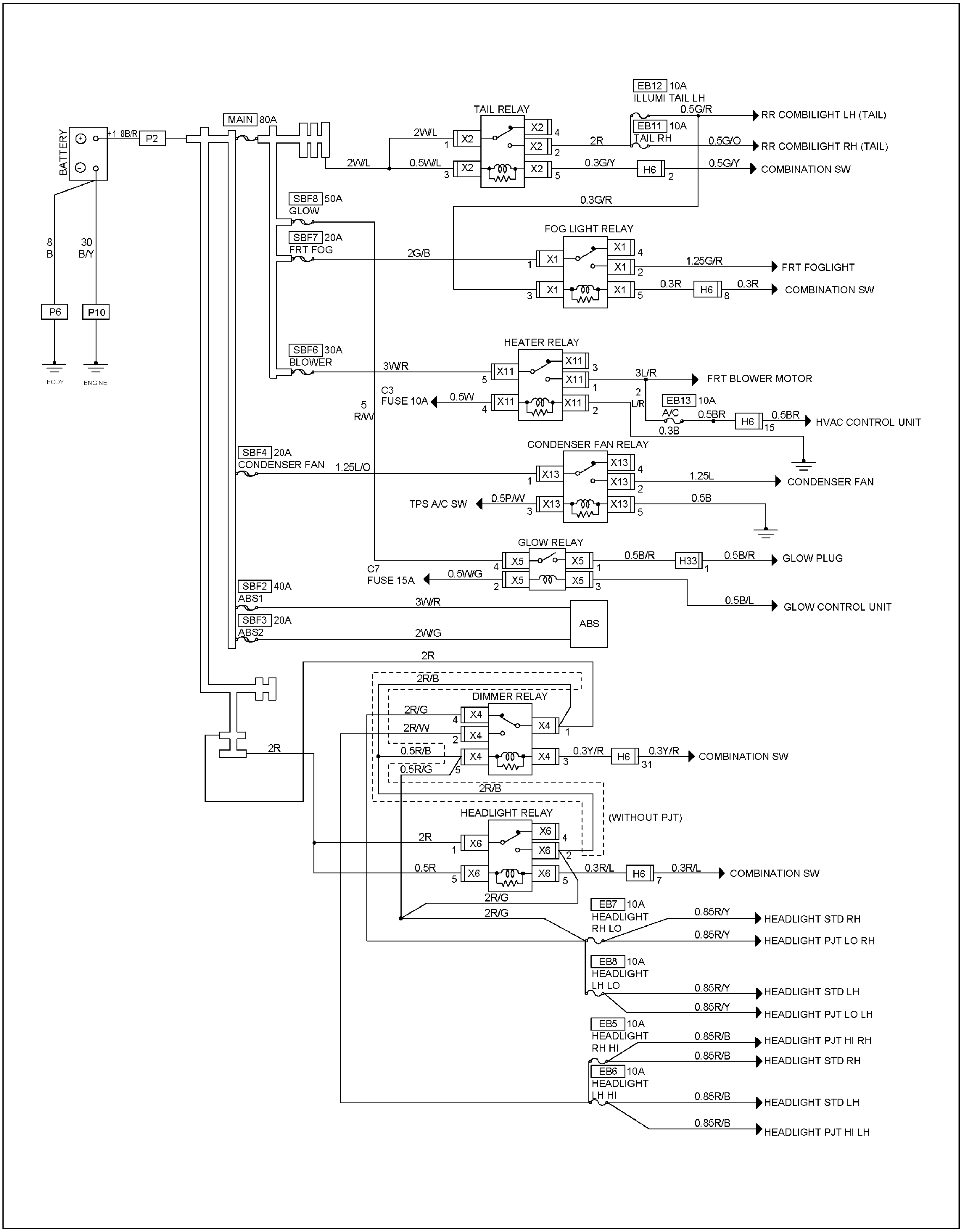
FUSE BLOCK CIRCUIT 4JA1T (L)

Sheet 1/2



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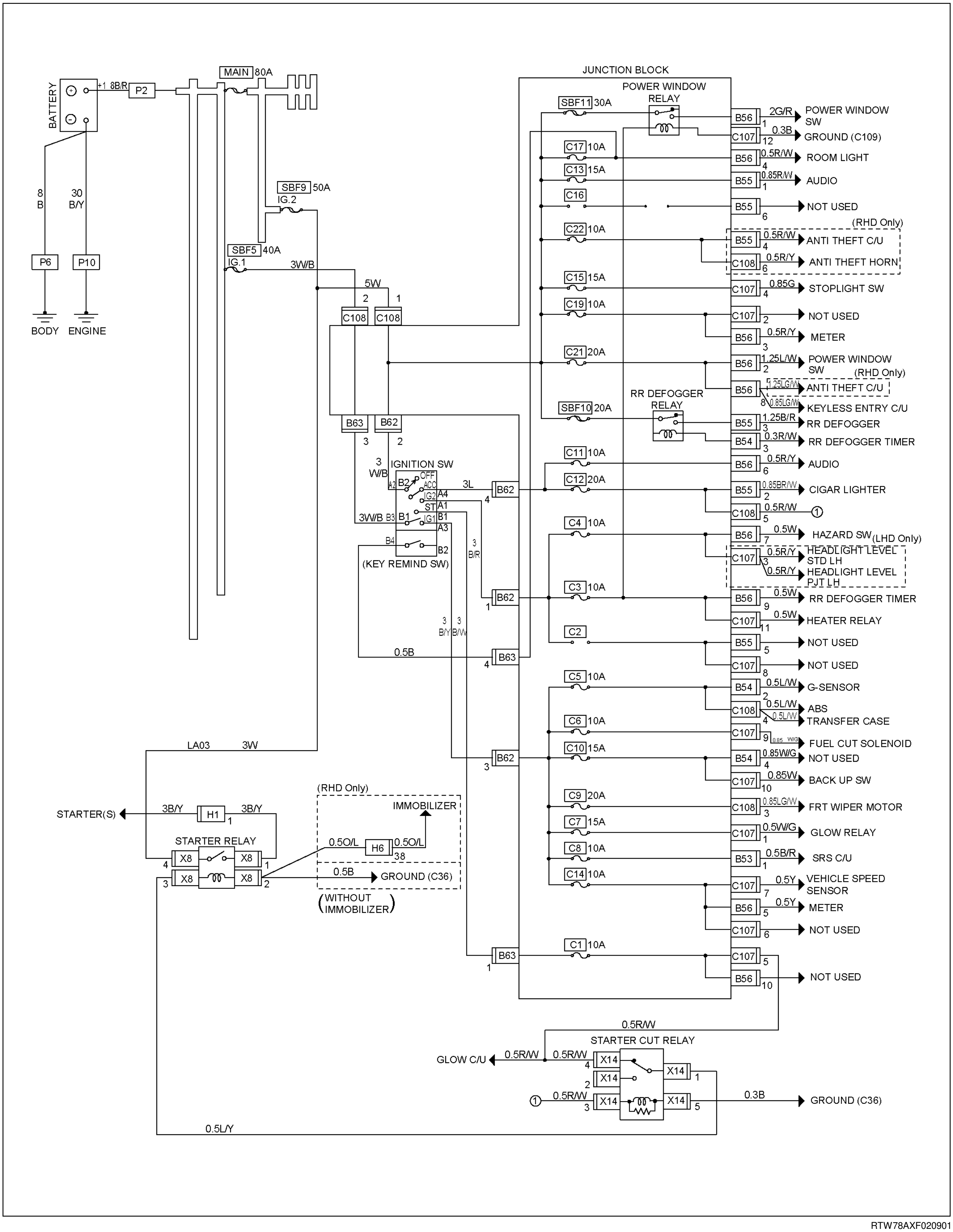
FUSE BLOCK CIRCUIT 4JA1T (L)

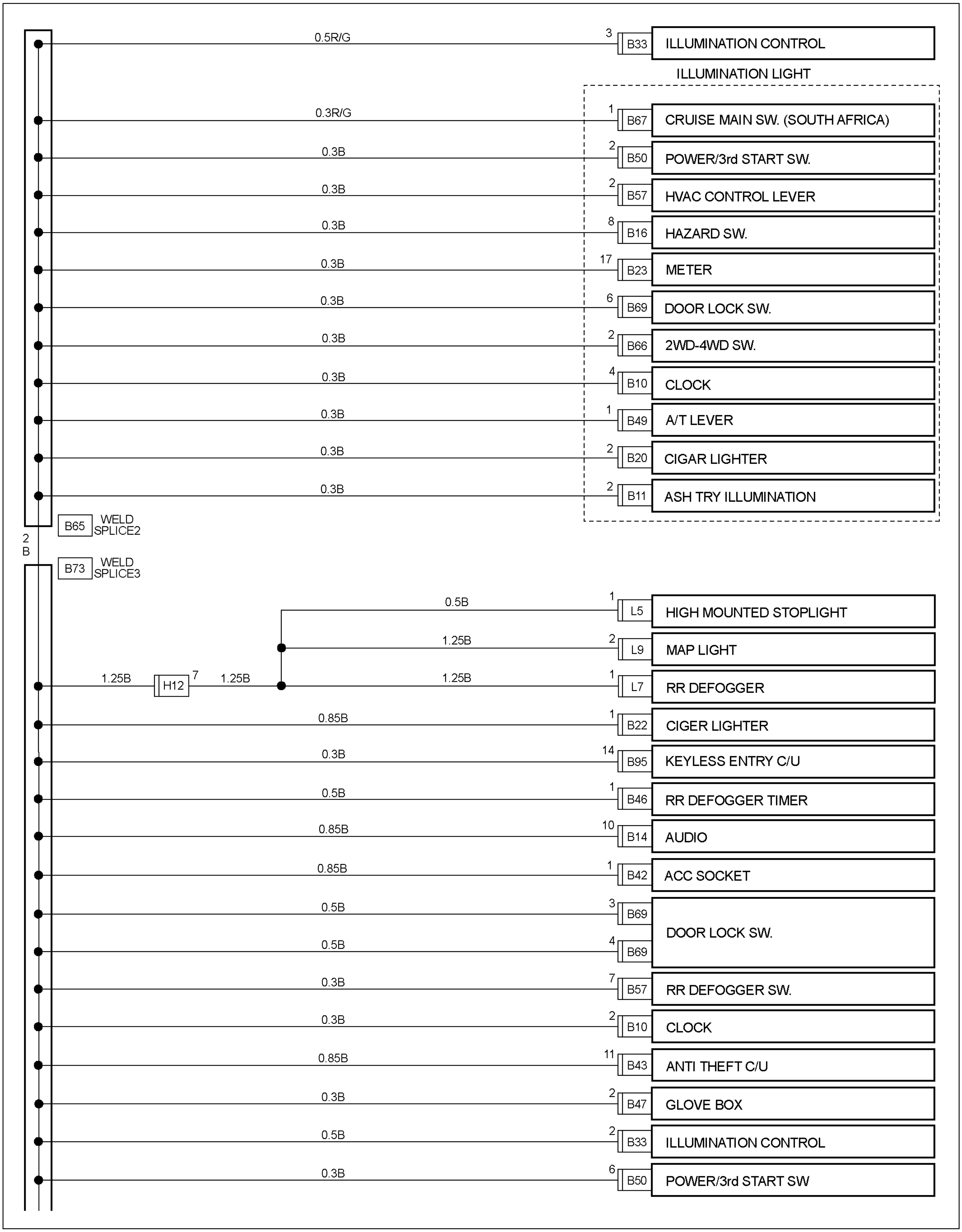
Sheet 2/2



Grounding Point

GROUND POINT C24SE (RHD) G.EXP

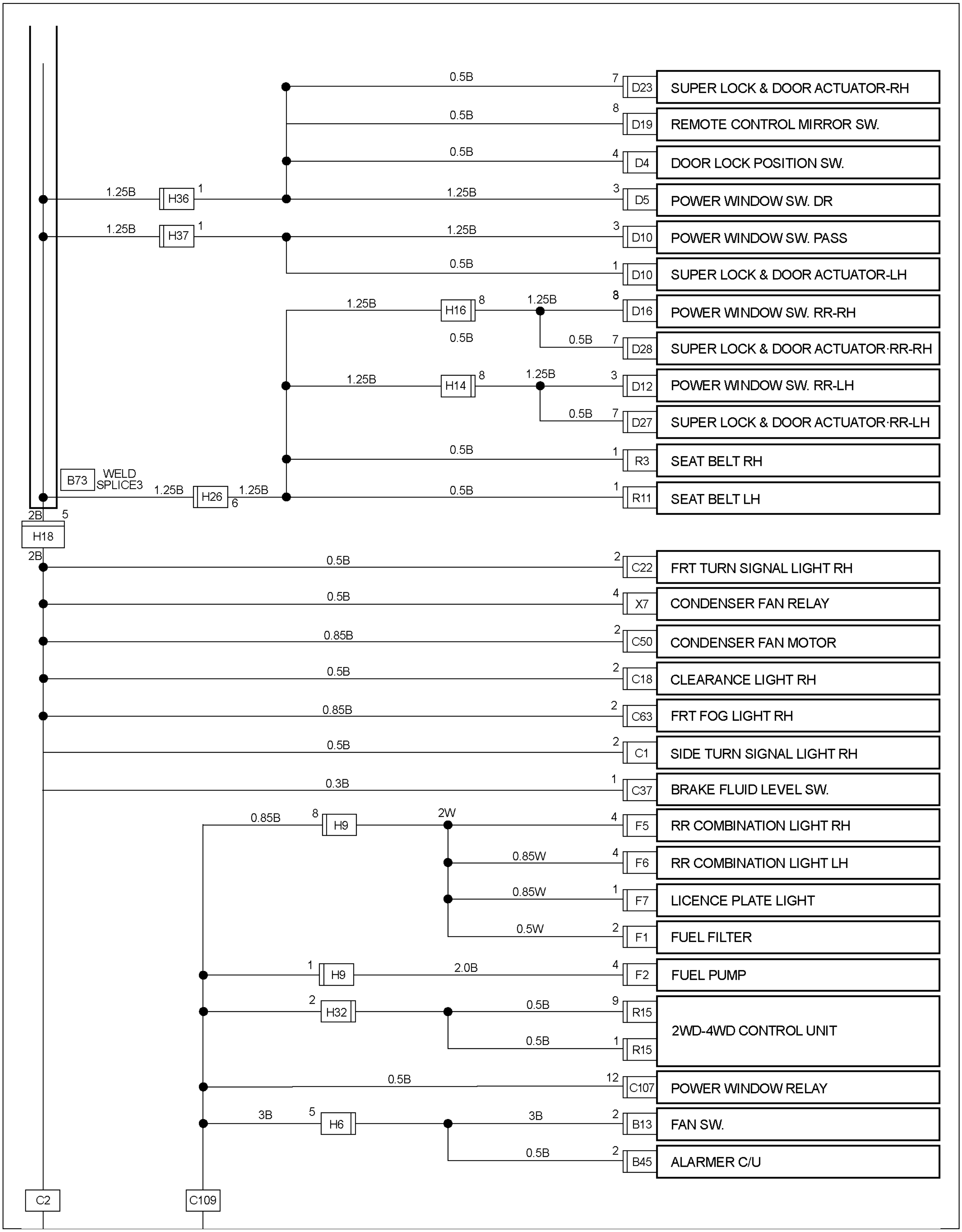
Sheet 1/4



RTW78AXF049501

GROUND POINT C24SE (RHD) G.EXP

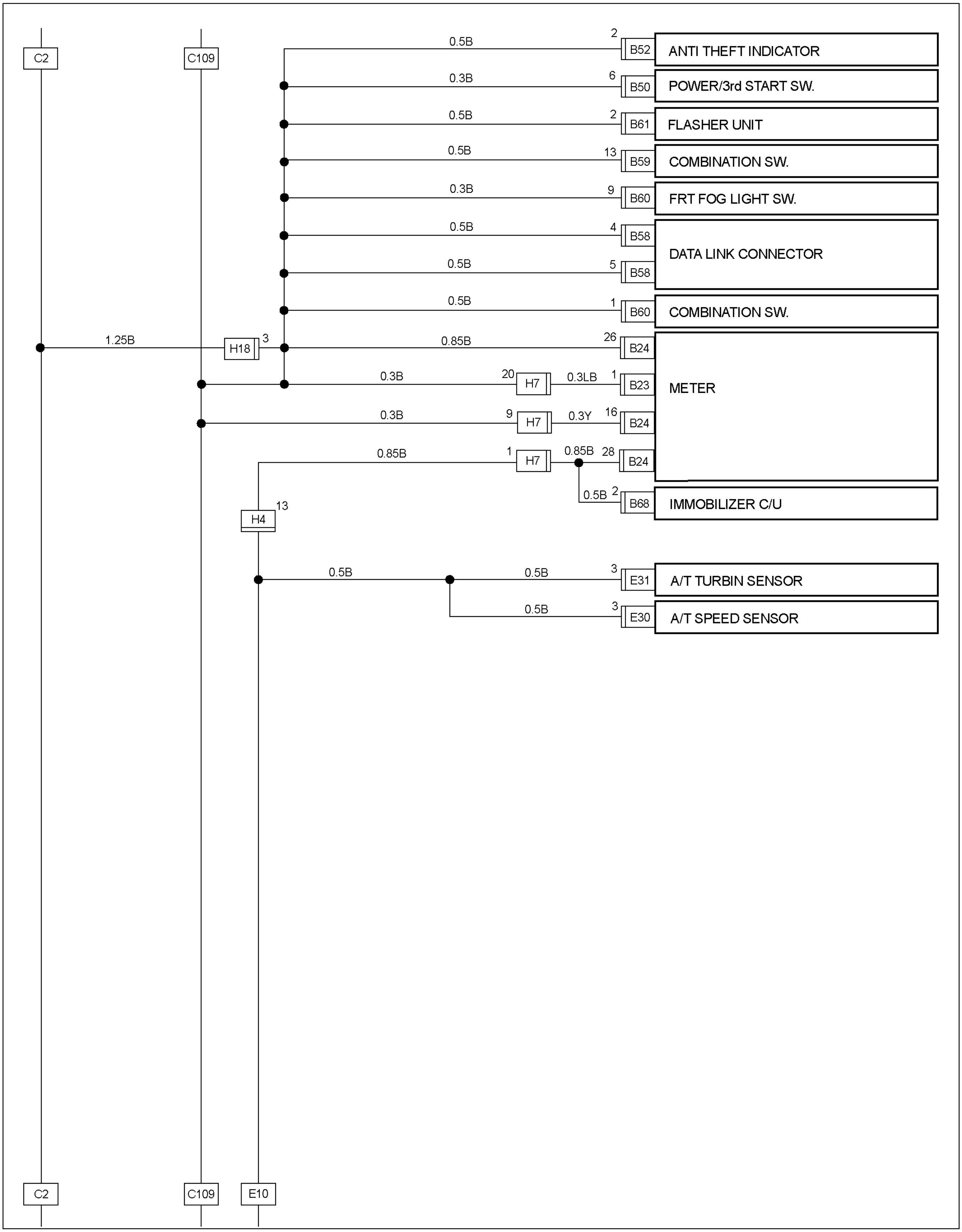
Sheet 2/4



RTW78AXF049601

GROUND POINT C24SE (RHD) G.EXP

Sheet 3/4



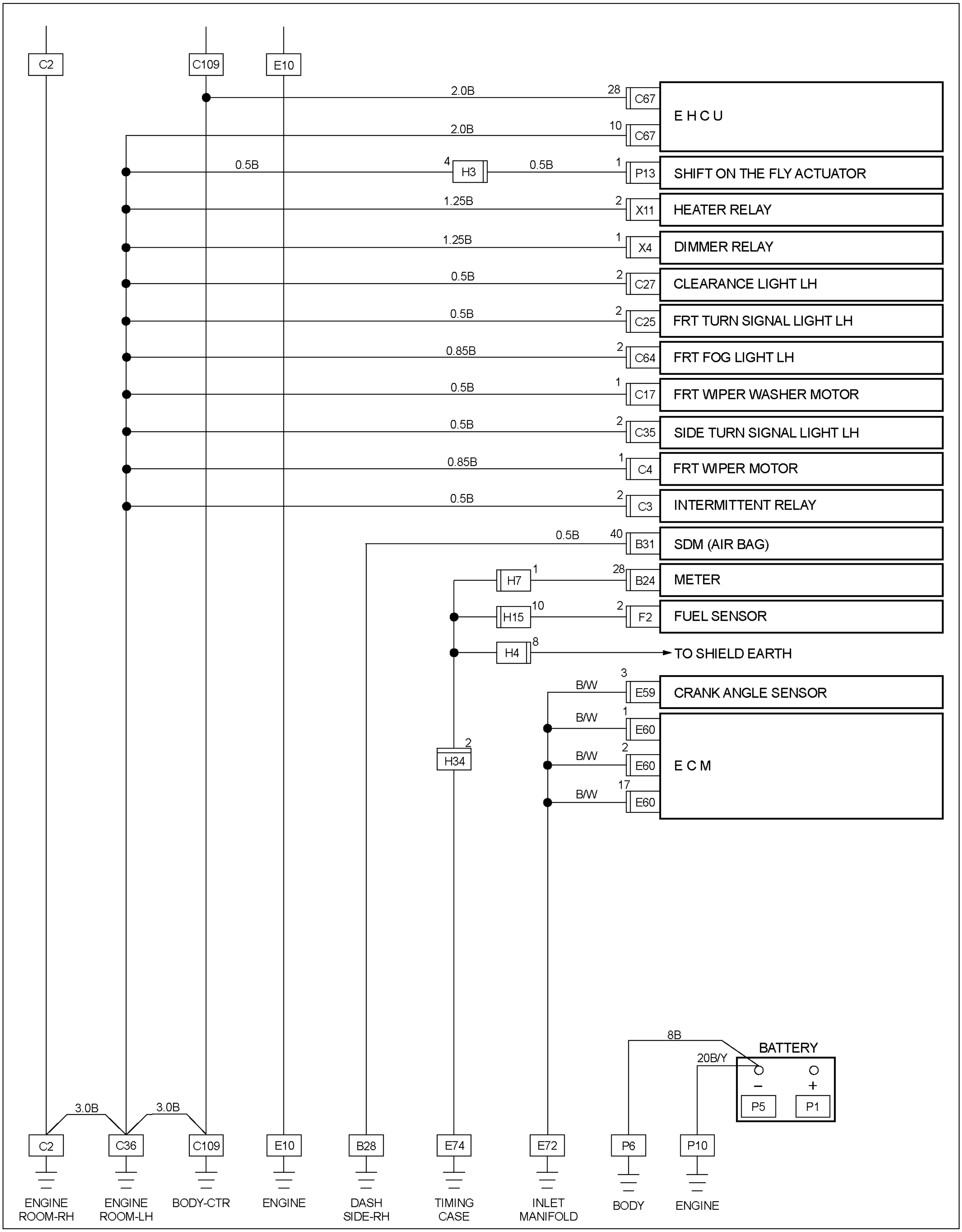
RTW78AXF049701

4. POWER NOT BEING TRANSMITTED TO THE WHEELS (PROPELLER SHAFT OPERATION IS NORMAL)

Checkpoint		Trouble Cause	Countermeasure
Rear axle shaft	NG	Broken rear axle shaft	Replace the rear axle shaft
OK			
Drive pinion and ring gear	NG	Broken drive pinion and/or ring gear	Replace the drive pinion and the ring gear as a set
OK			
Differential cage gears	NG	Broken differential cage gears and/or spider	Replace the differential gears and/or the spider

GROUND POINT C24SE (RHD) G.EXP

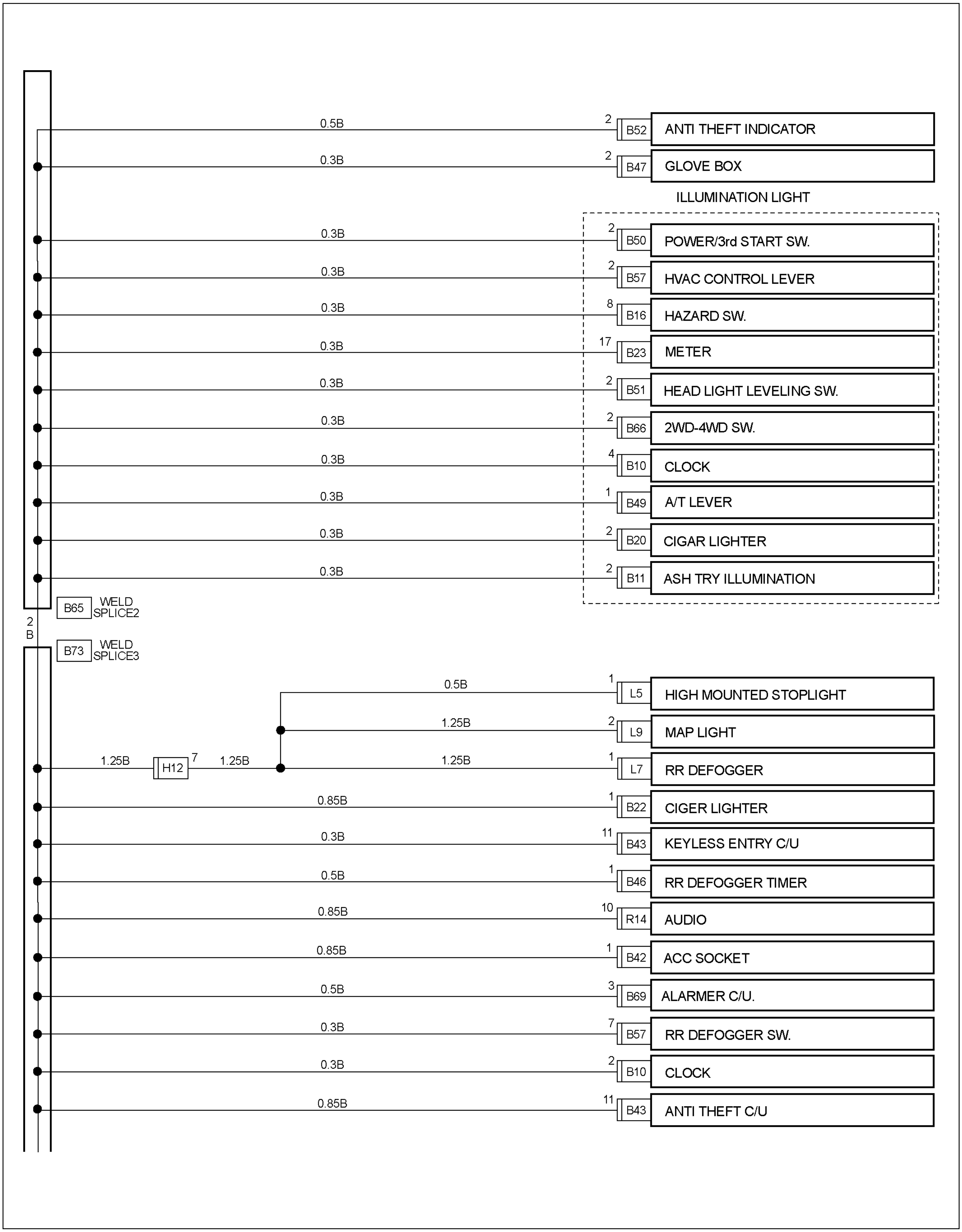
Sheet 4/4



RTW78AXF049801

GROUND POINT C24SE (LHD) G.EXP

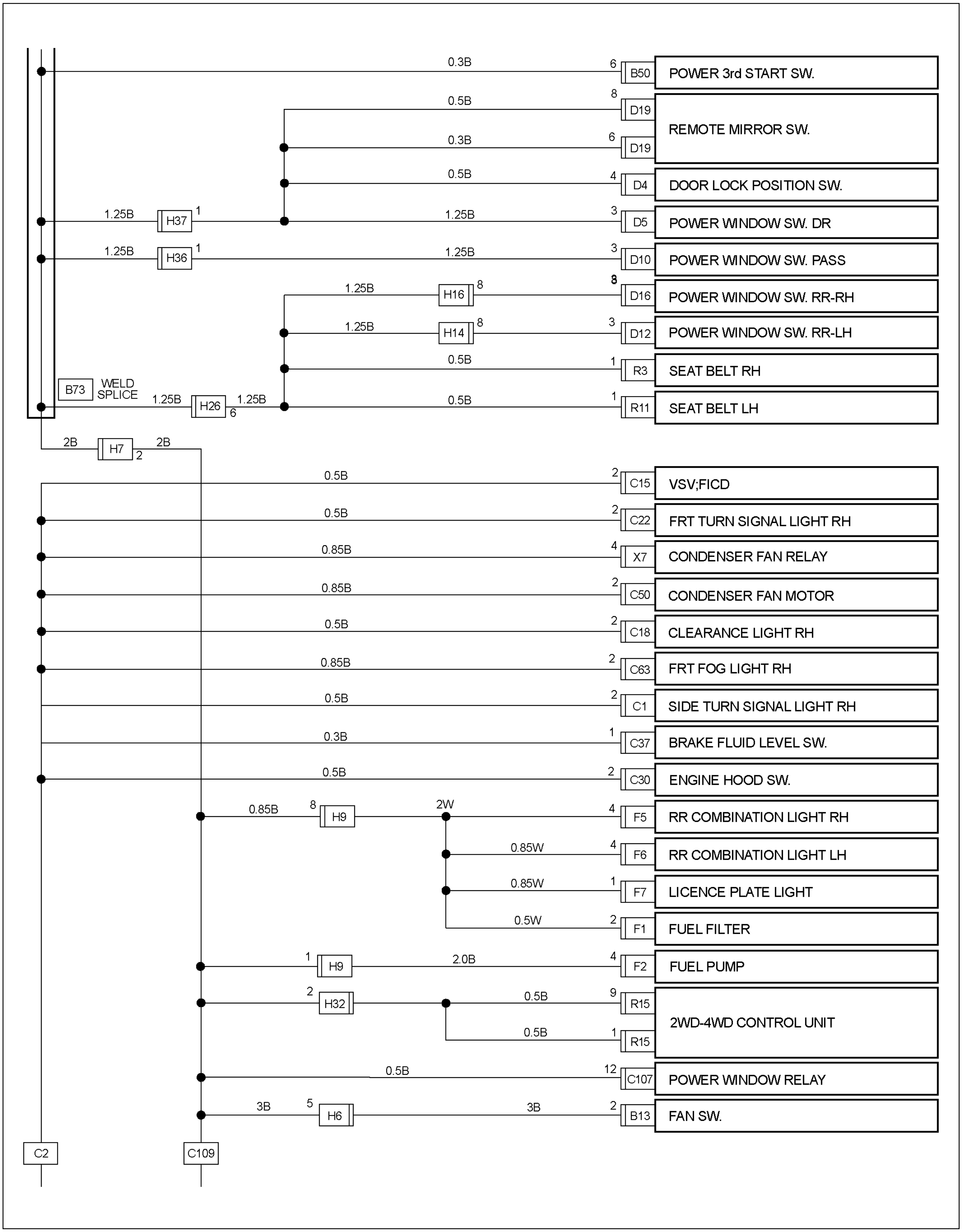
Sheet 1/4



RTW78AXF049901

GROUND POINT C24SE (LHD) G.EXP

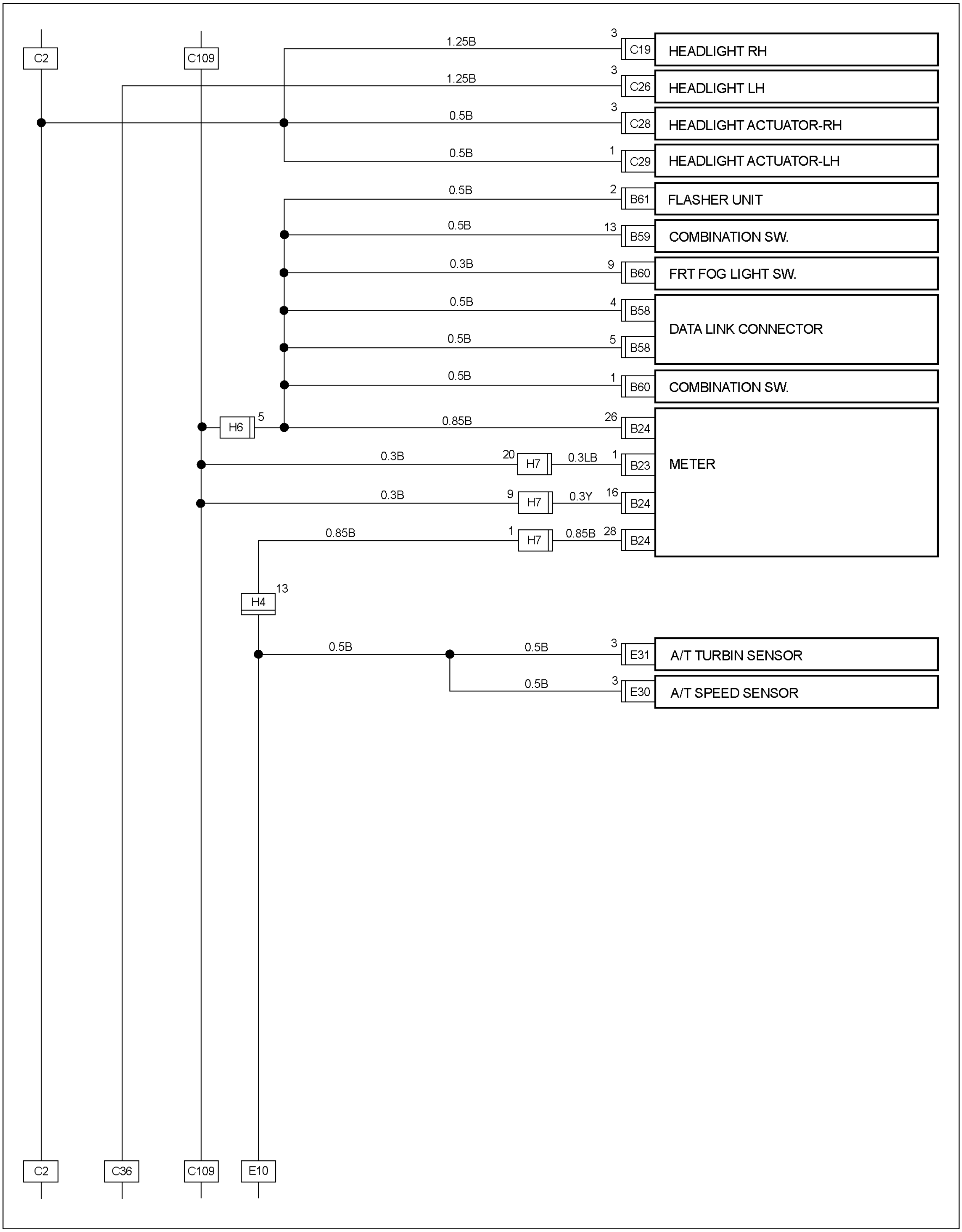
Sheet 2/4



RTW78AXF050001

GROUND POINT C24SE (LHD) G.EXP

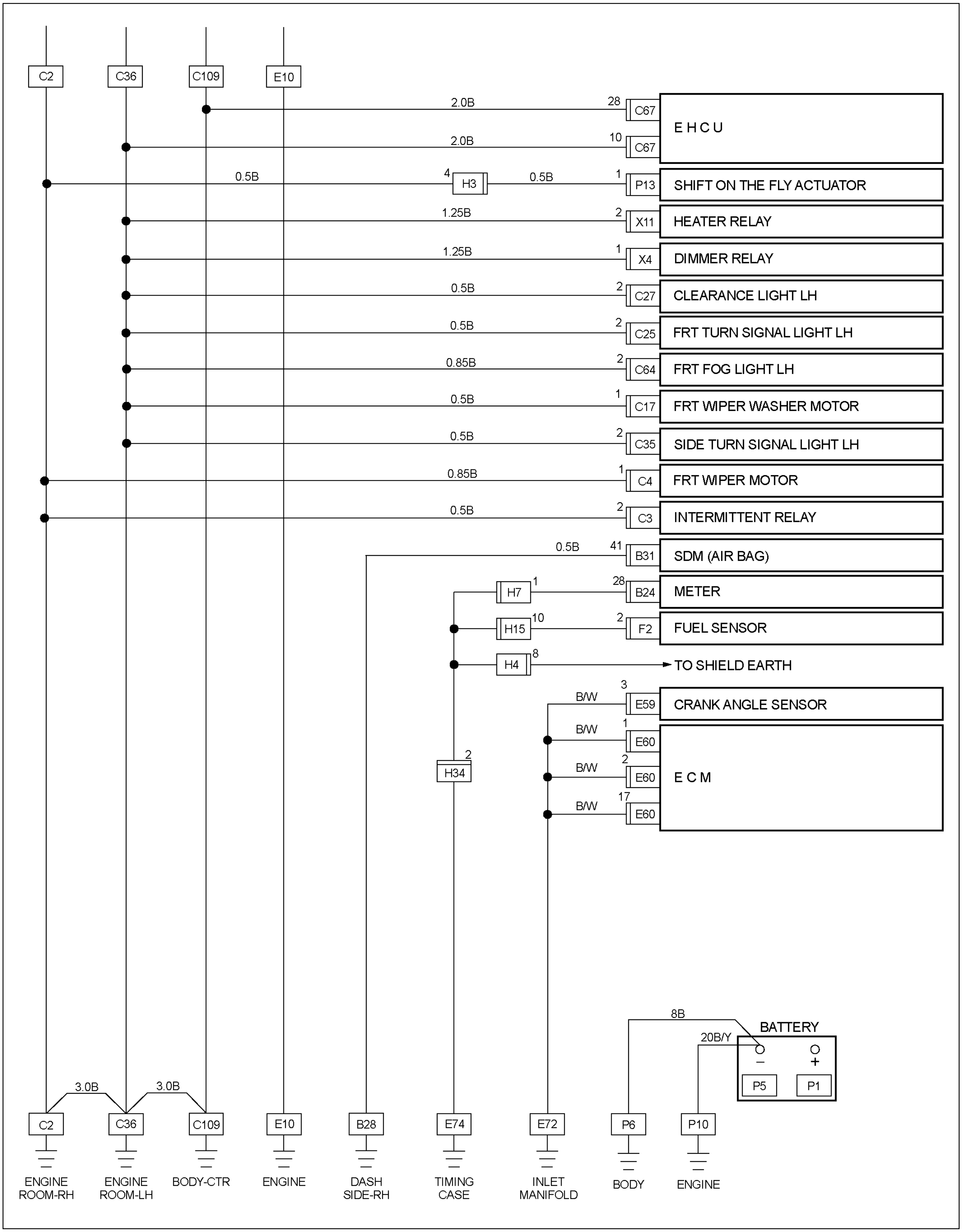
Sheet 3/4



RTW78AXF050101

GROUND POINT C24SE (LHD) G.EXP

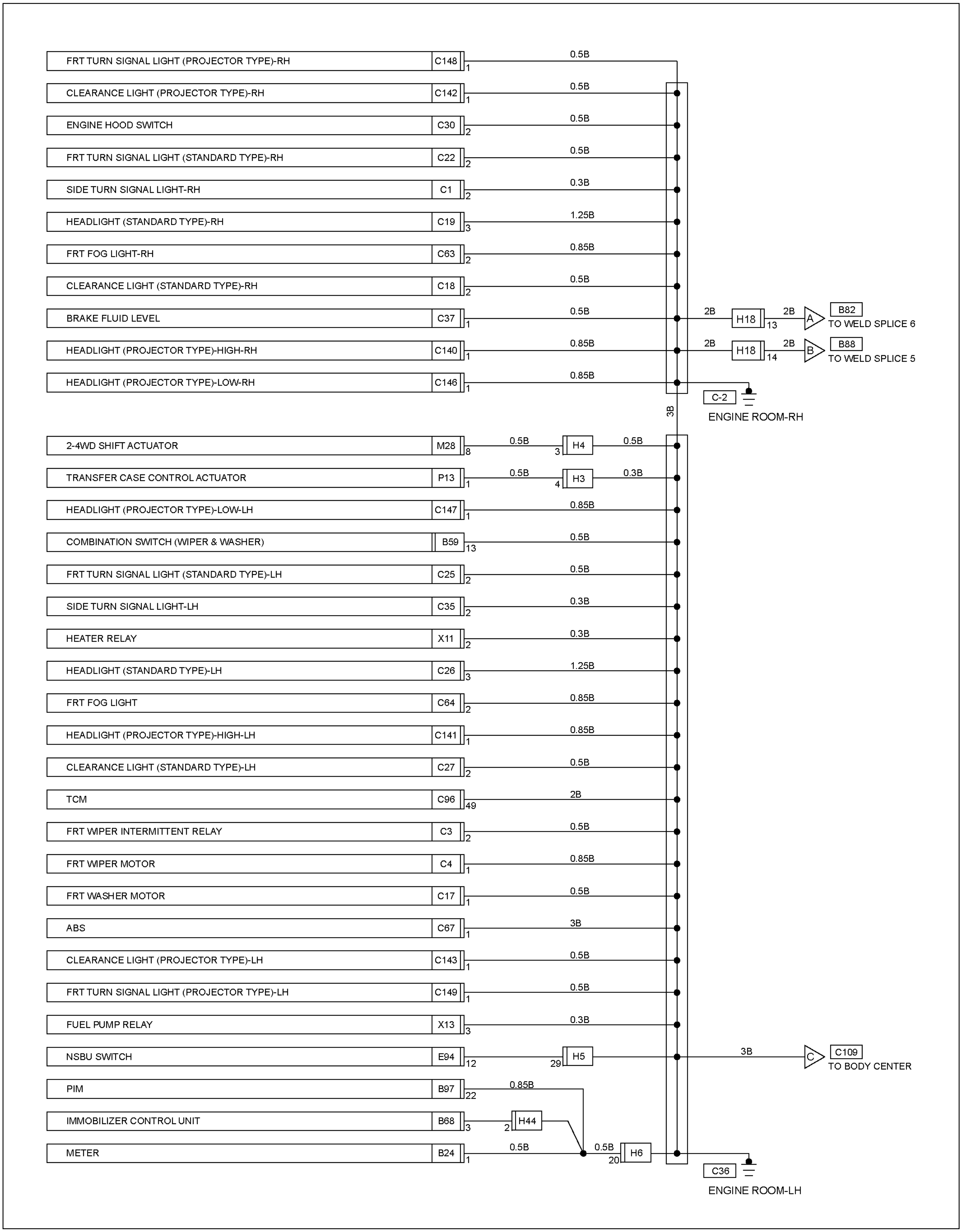
Sheet 4/4



RTW78AXF050201

GROUND POINT HFV6 (RHD)

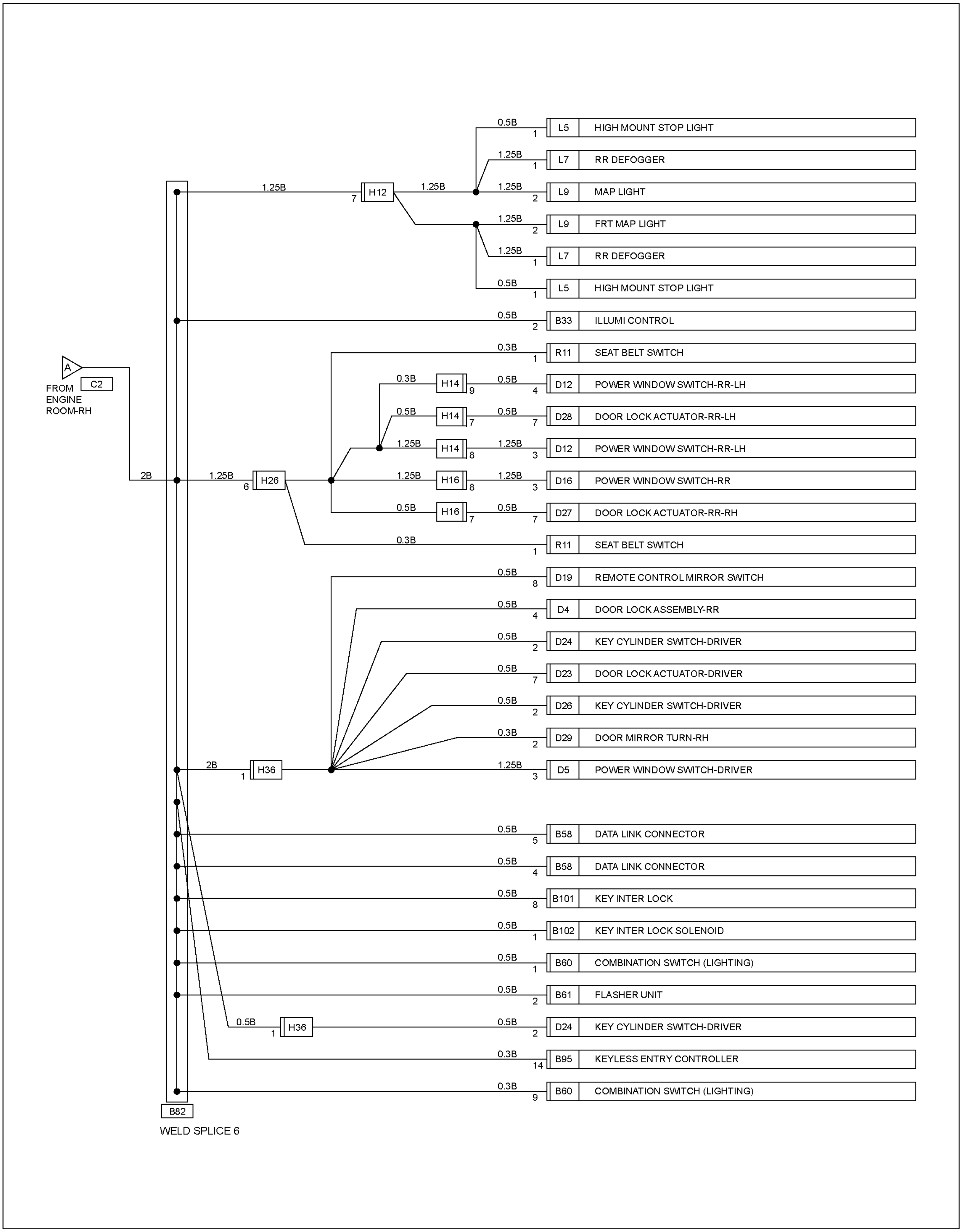
Sheet 1/4



RTW78AXF002601

GROUND POINT HFV6 (RHD)

Sheet 2/4



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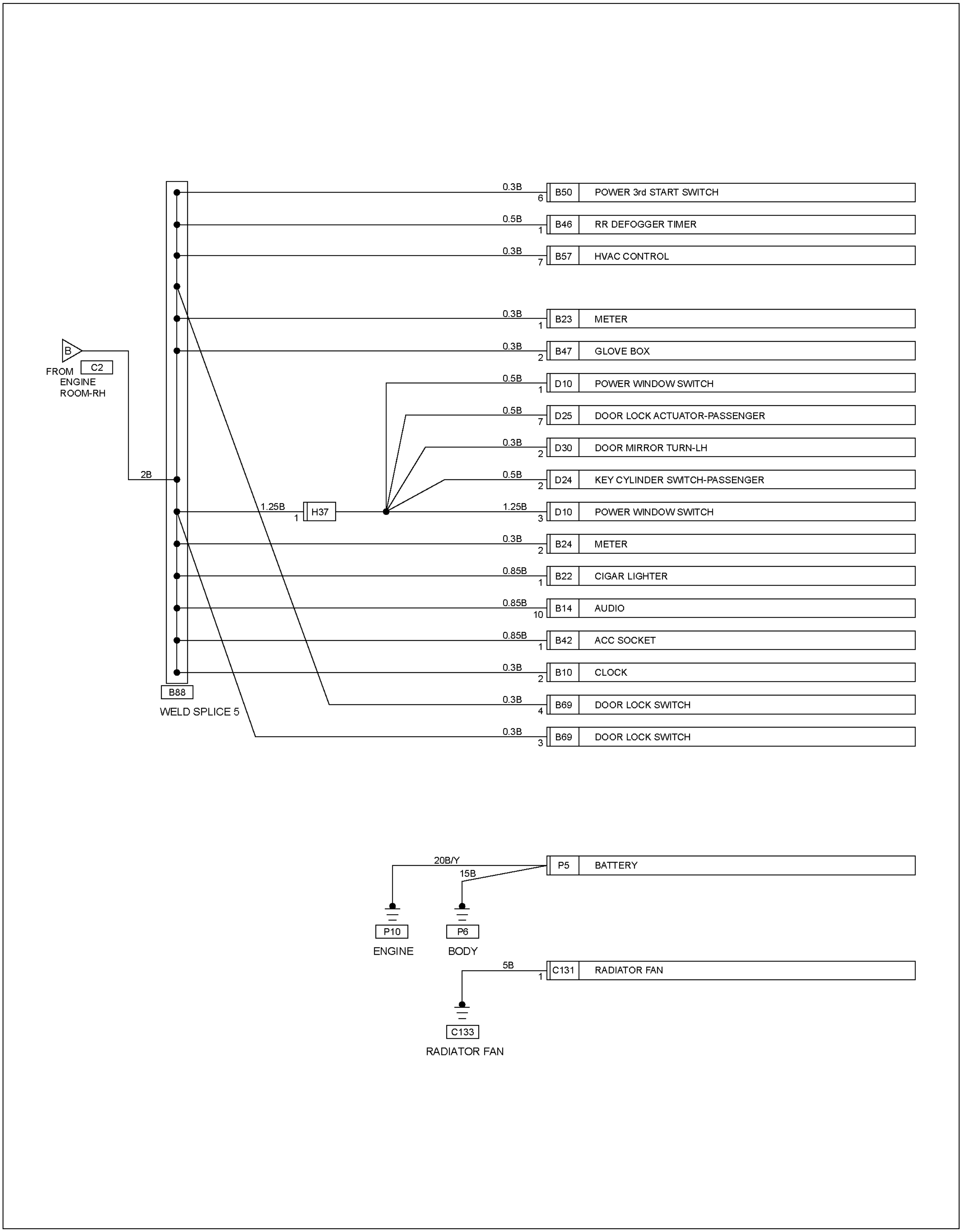
GROUND POINT HFV6 (RHD)

Sheet 3/4



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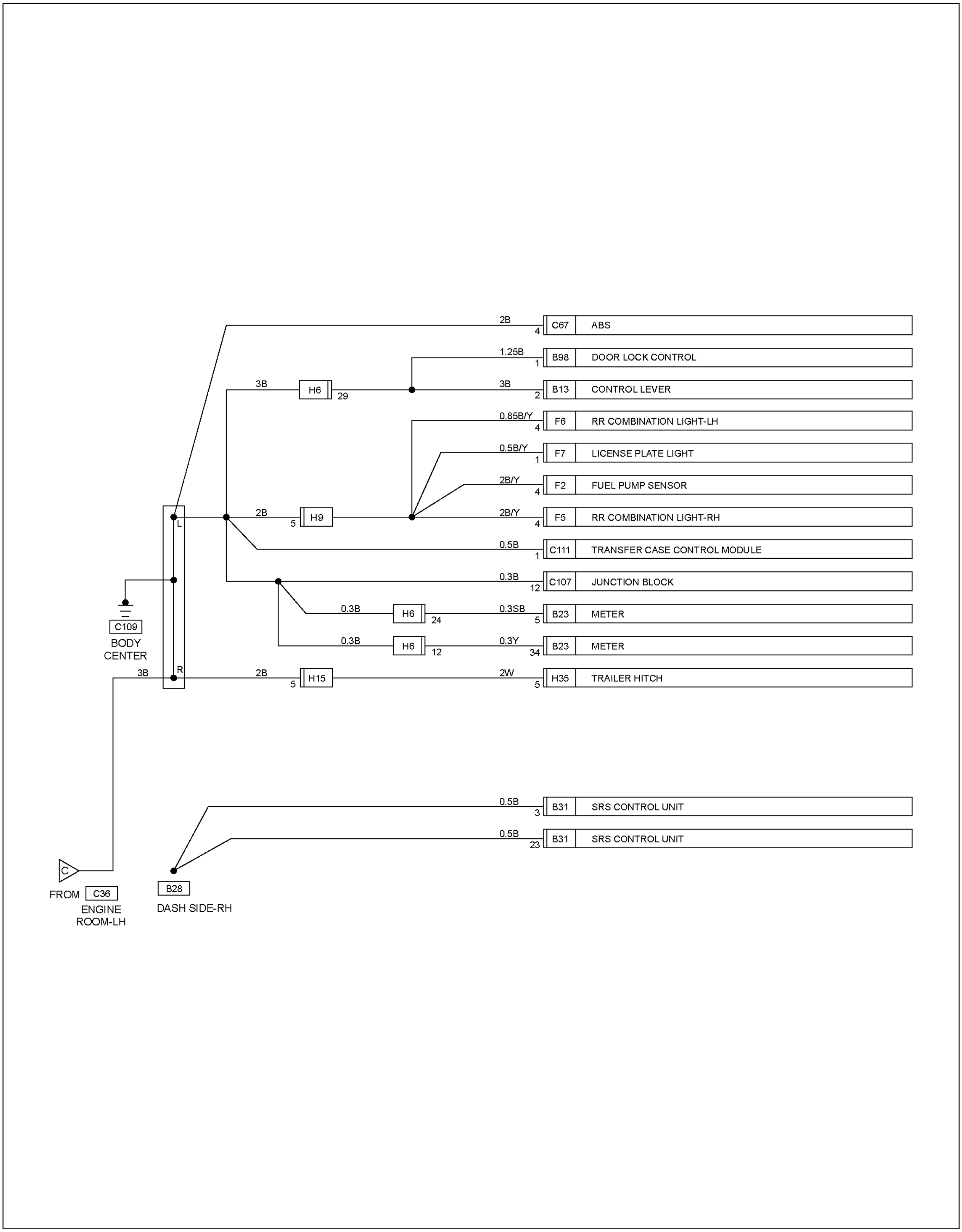
GROUND POINT HFV6 (RHD)

Sheet 4/4



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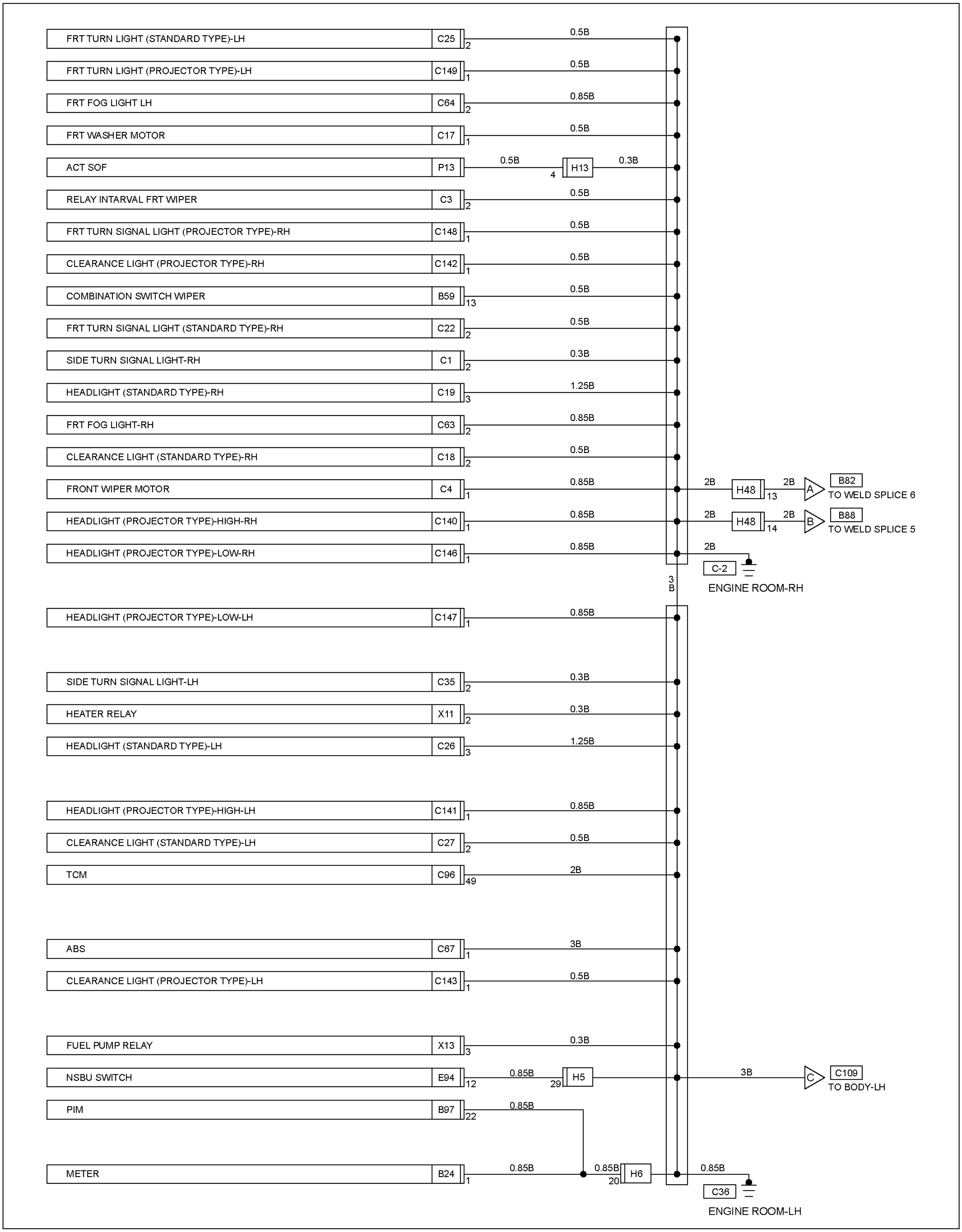
GROUND POINT HFV6 (LHD)

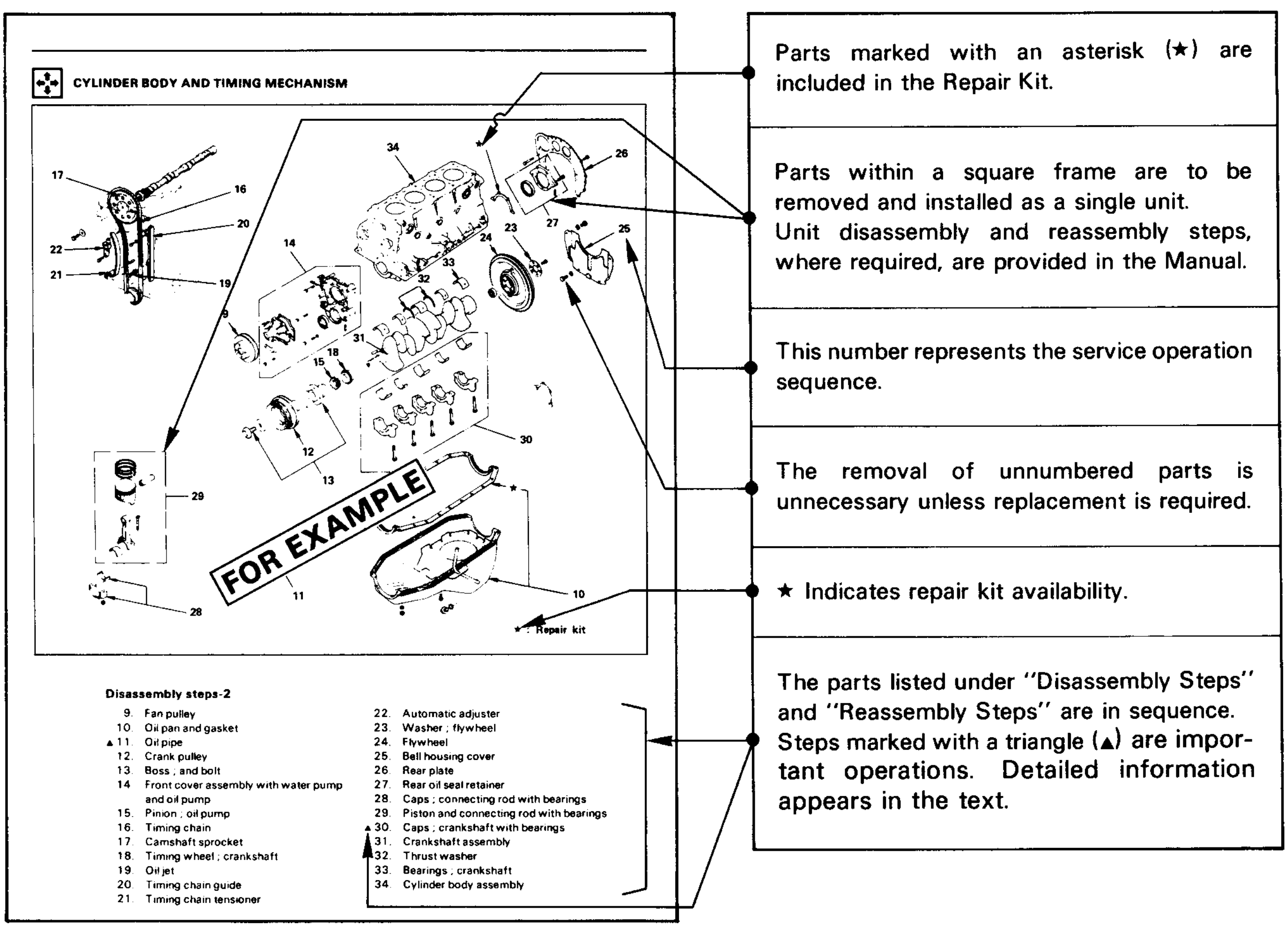
Sheet 1/4



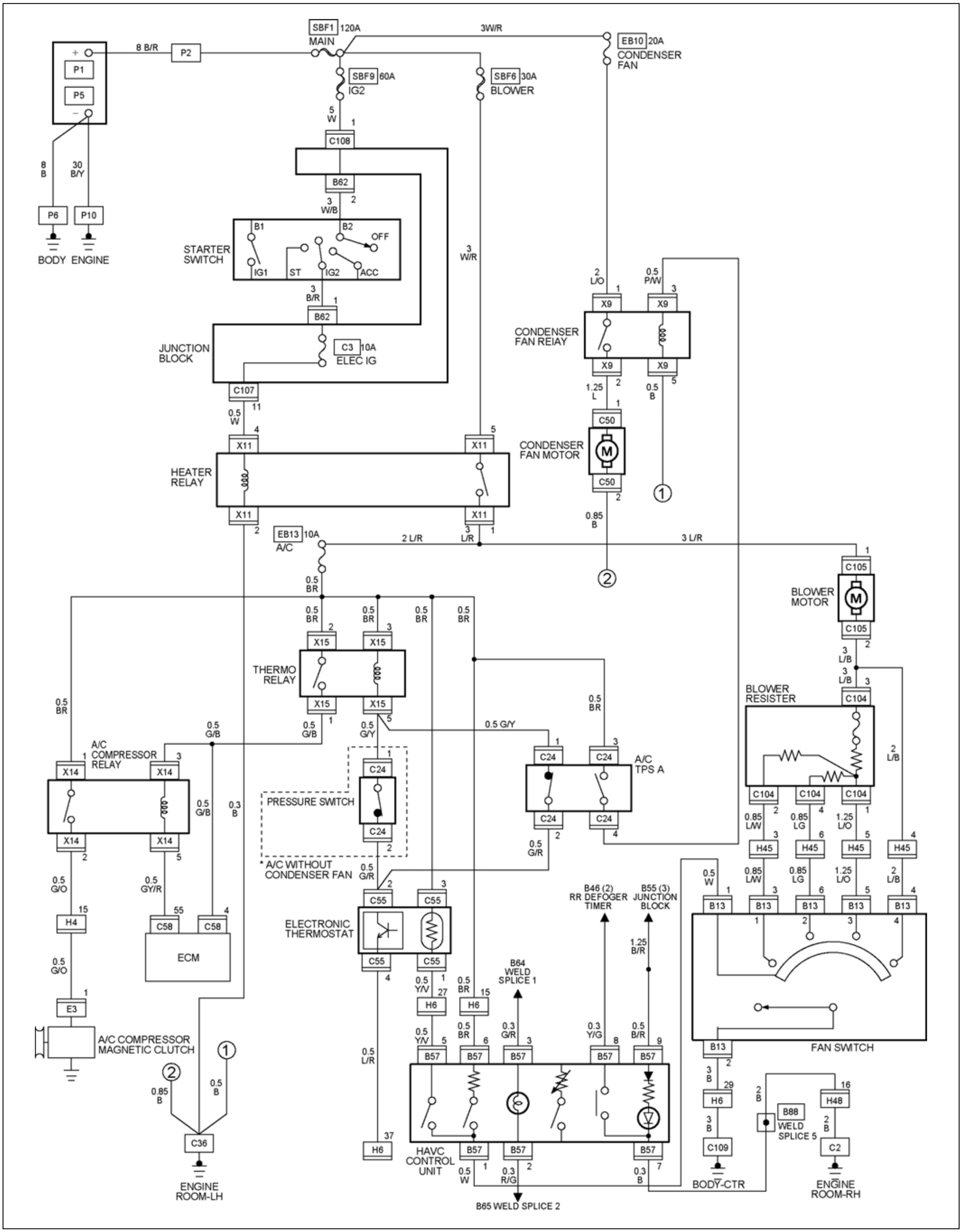
RTW78AXF015801

NOTES ON THE FORMAT OF THIS MANUAL

1. Find the applicable section by referring to the index at the front of the Workshop Manual binder.
2. The following technical service information is included in this Section:
    - Identification
    - Maintenance schedules
    - Recommended lubricants
    - Recommended fuels
    - Oil viscosity charts
3. Individual sections of this Workshop Manual are divided into the following categories:
    - Main data and specifications
    - Torque specifications
    - Recommended liquid gasket
    - Loctite application procedure
    - Servicing
    - Removal and installation
    - Disassembly
    - Inspection and repair
    - Reassembly
    - Troubleshooting
4. Each "Major Components" page of this Workshop Manual has an exploded view of the applicable area. A brief explanation of the notation used follows:



(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output LHD MODEL)



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SPECIAL SERVICE TOOL

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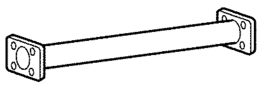
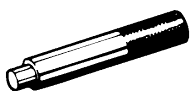
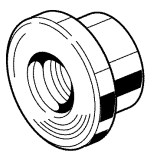
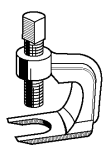
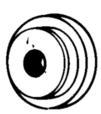
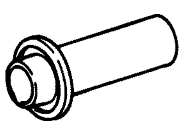
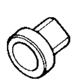
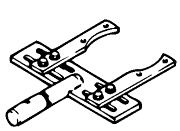
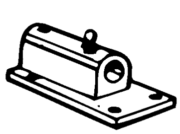
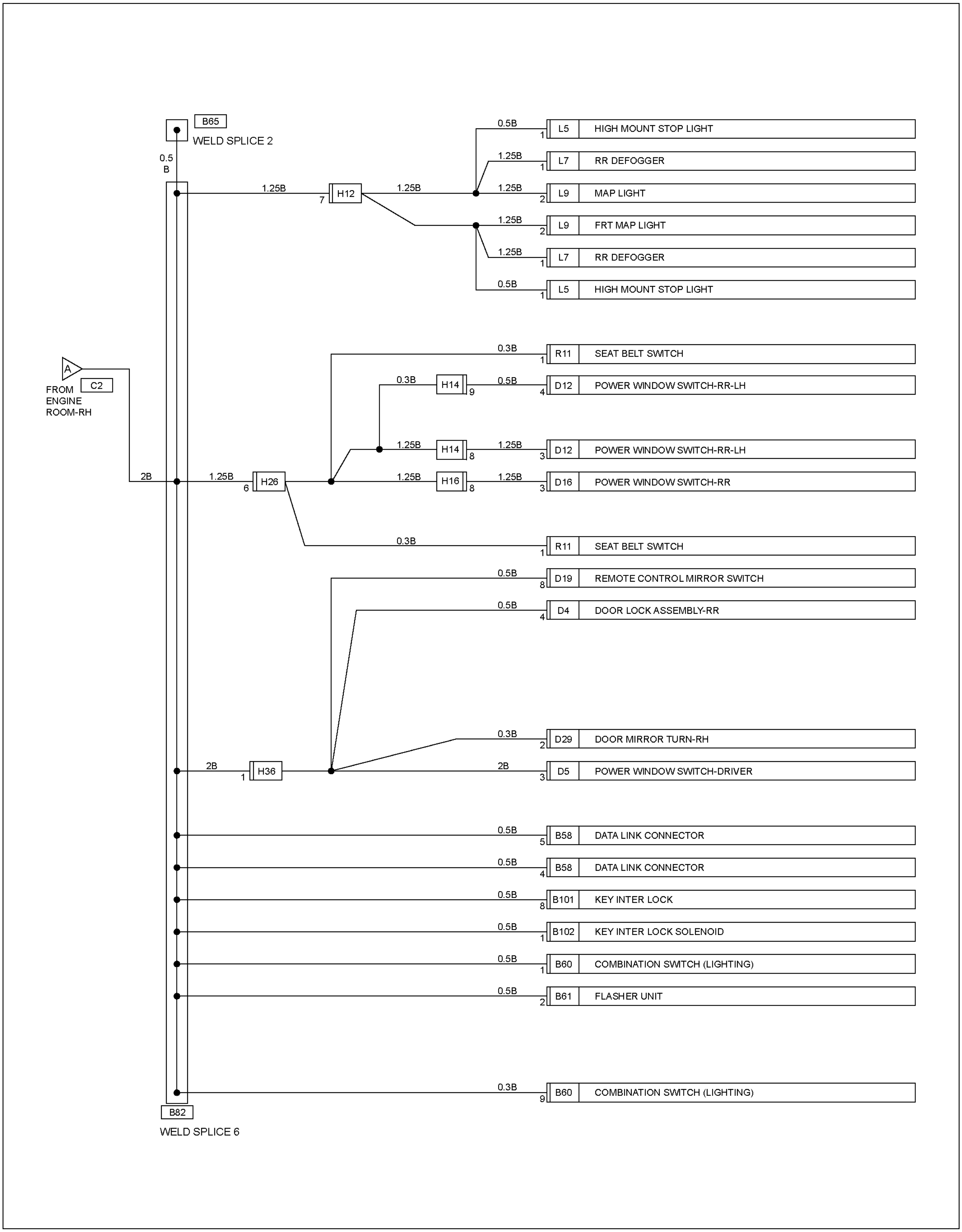
	5-8840-2831-0	Bearing Remover
	5-8840-0007-0 (J-8092)	Grip
	5-8840-2119-0 (J-36829)	Installer
	5-8840-0079-0 (J-6627-A)	Wheel Pin Remover
	5-8840-2202-0	Oil Seal Installer
	5-8840-2404-0	Oil Seal Installer
	9-8522-1271-0 (J-8609-01)	Support Stand
	5-8840-0275-0 (J-37264)	Holding Fixture
	5-8840-0003-0 (J-3289-20)	Holding Fixture Base

BACK TO CHAPTER INDEX

ISUZU KB P190 2007
TO MODEL INDEX

GROUND POINT HFV6 (LHD)

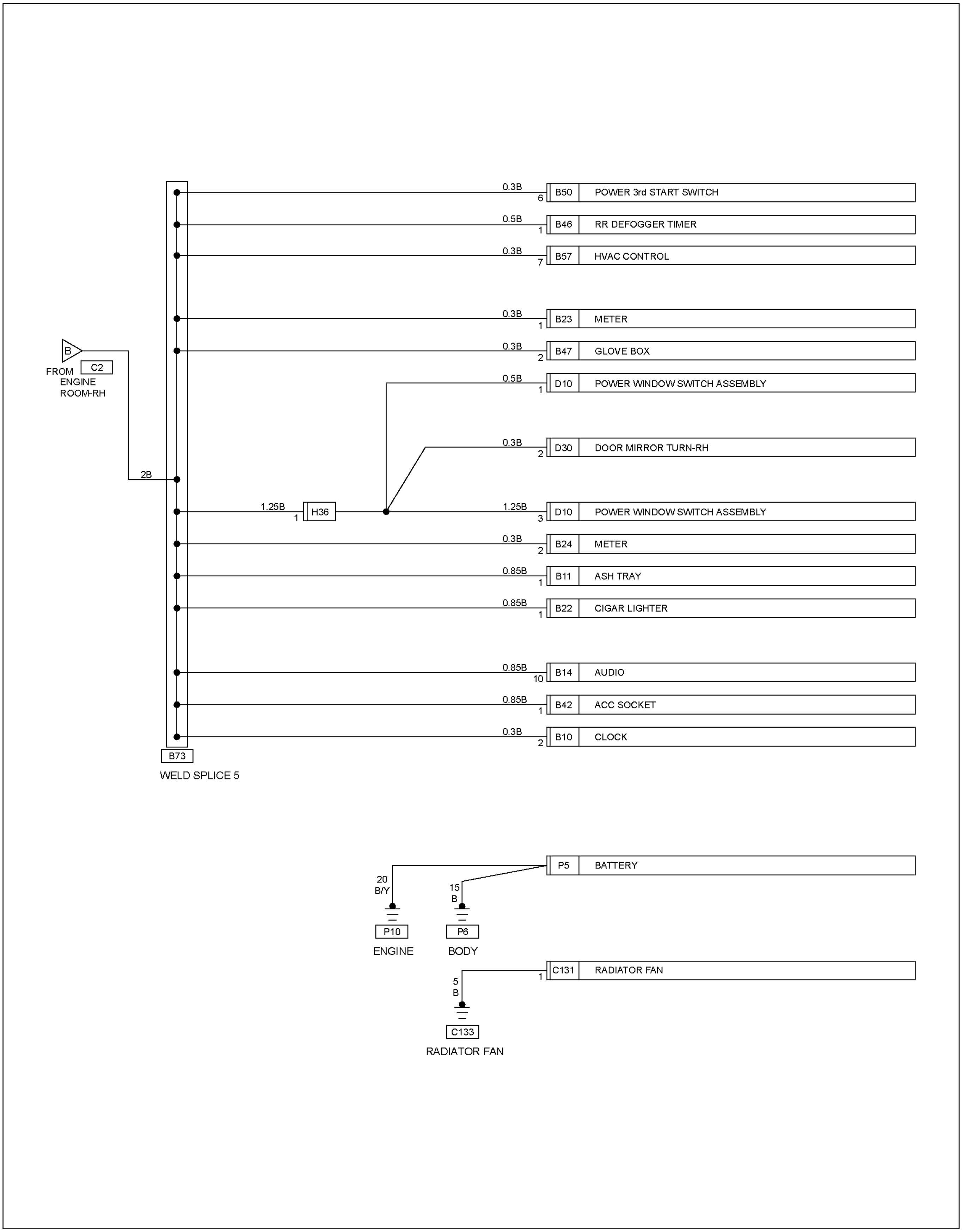
Sheet 2/4



RTW78AXF015901

GROUND POINT HFV6 (LHD)

Sheet 3/4



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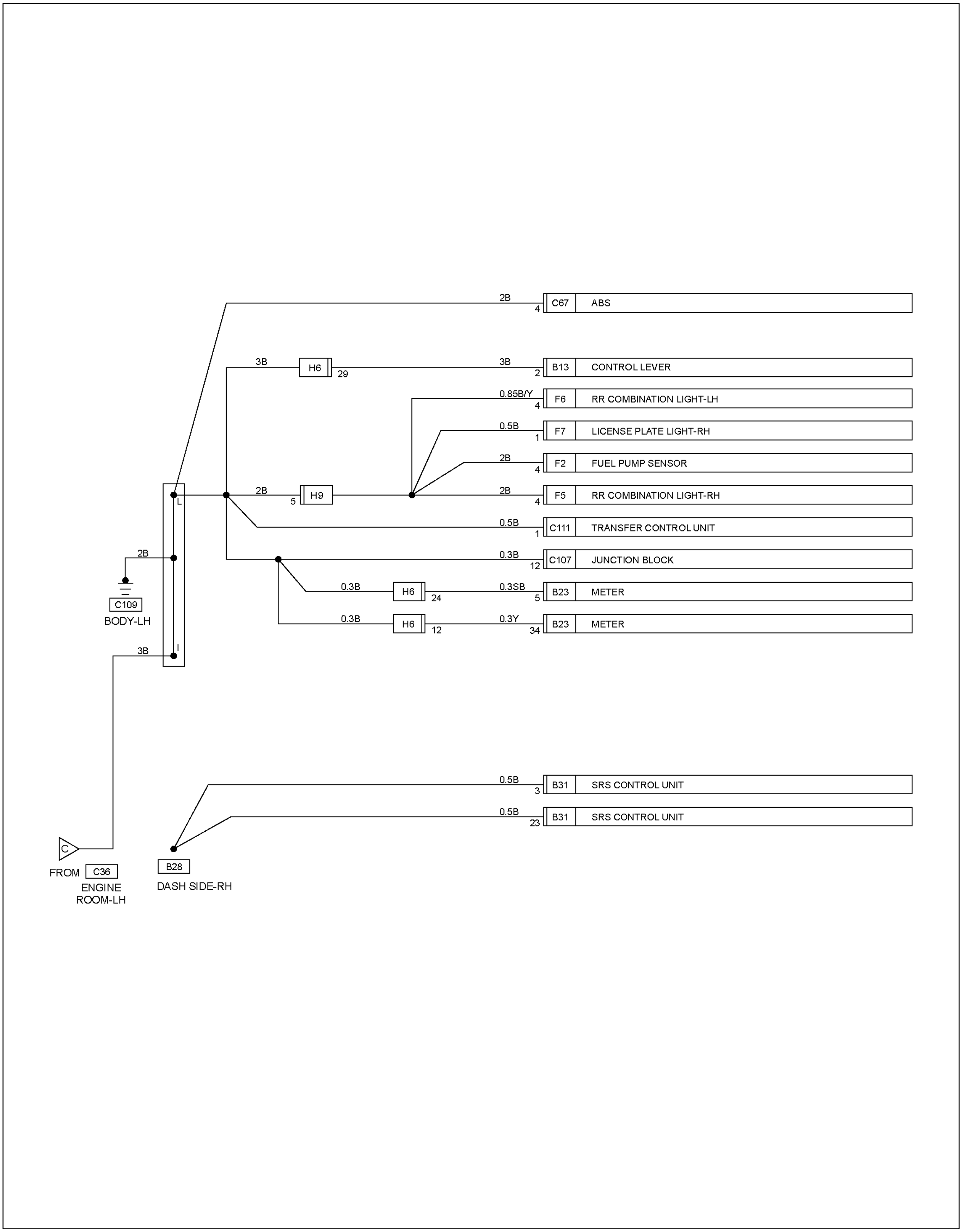
GROUND POINT HFV6 (LHD)

Sheet 4/4



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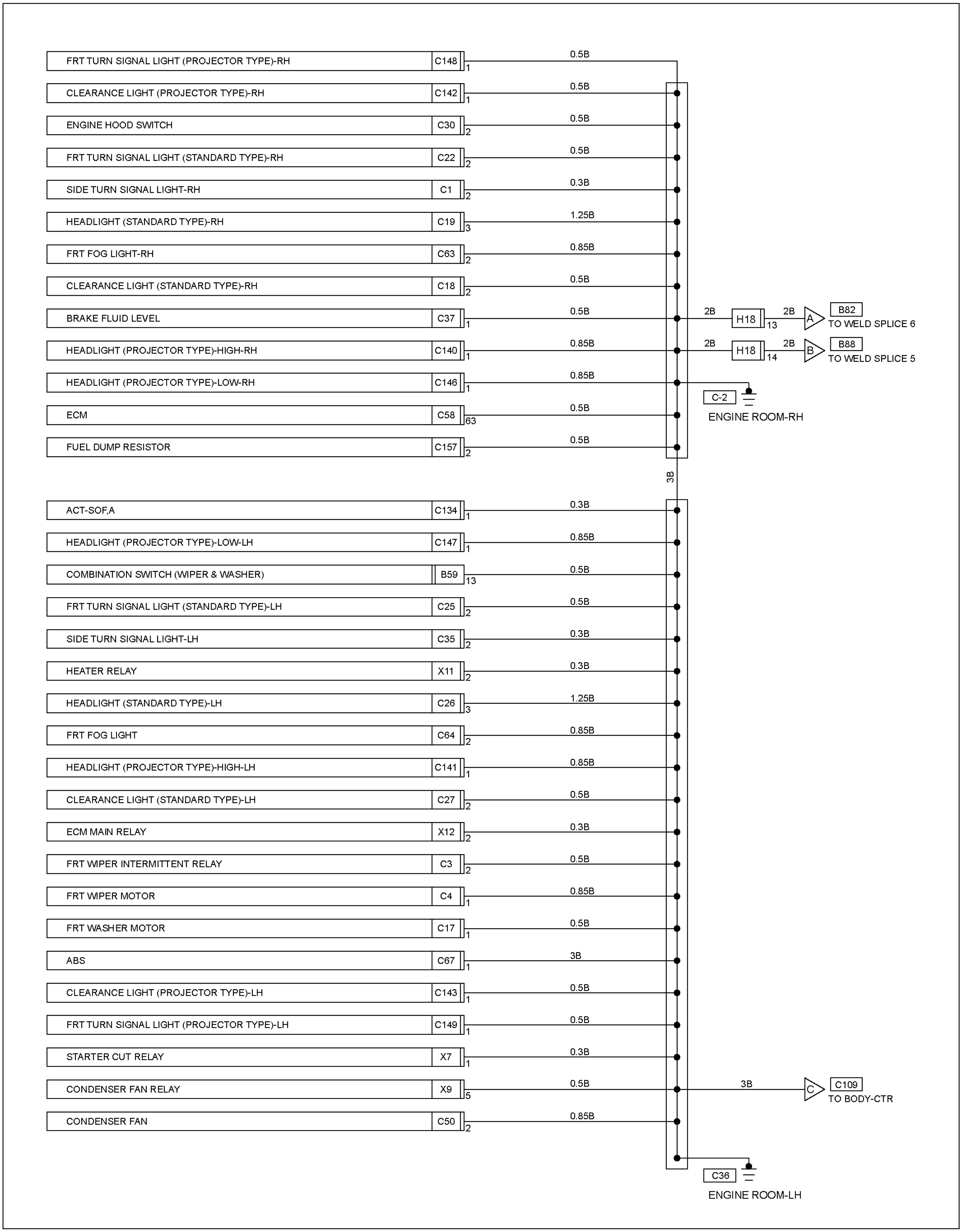
GROUND POINT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 1/4



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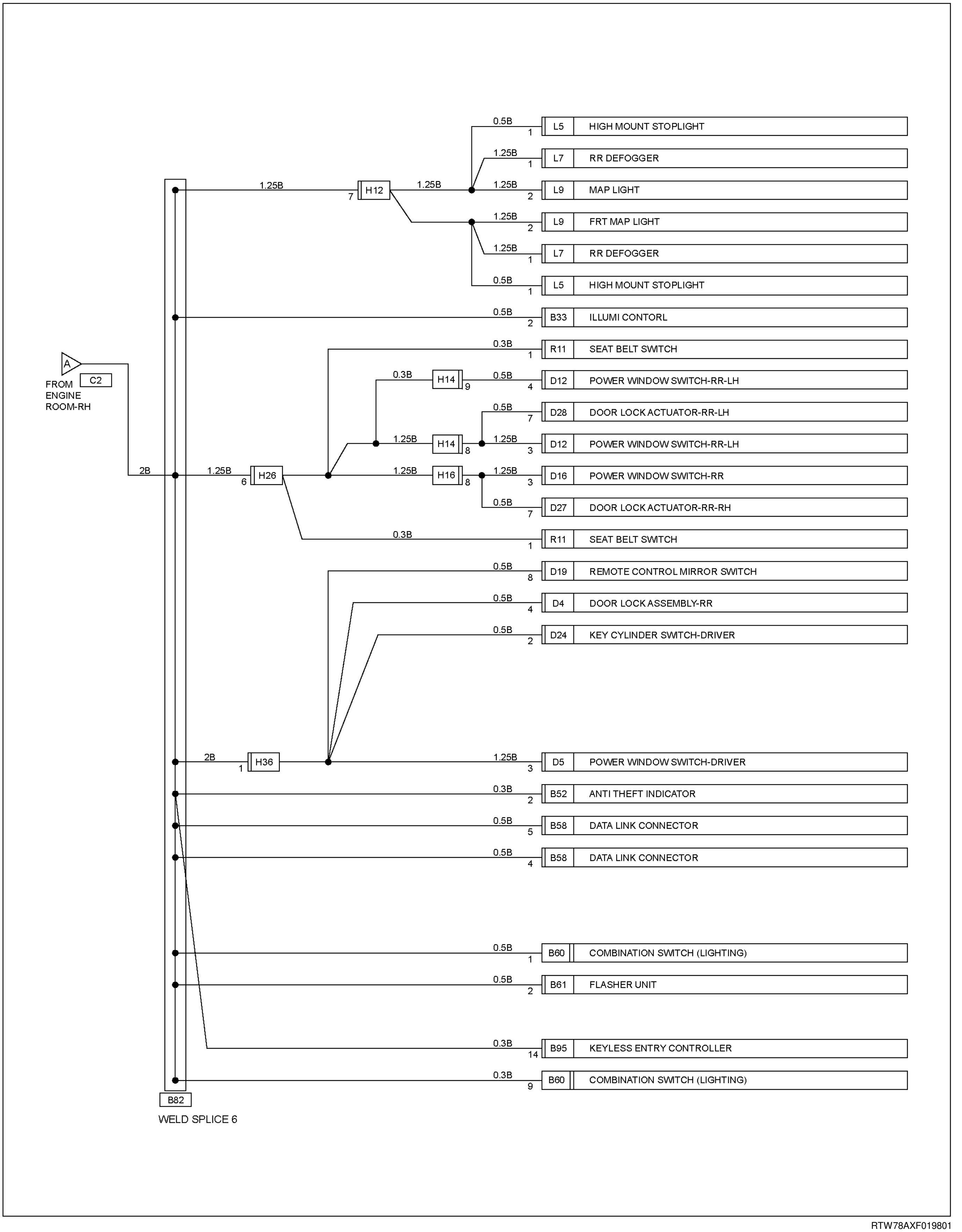
GROUND POINT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 2/4



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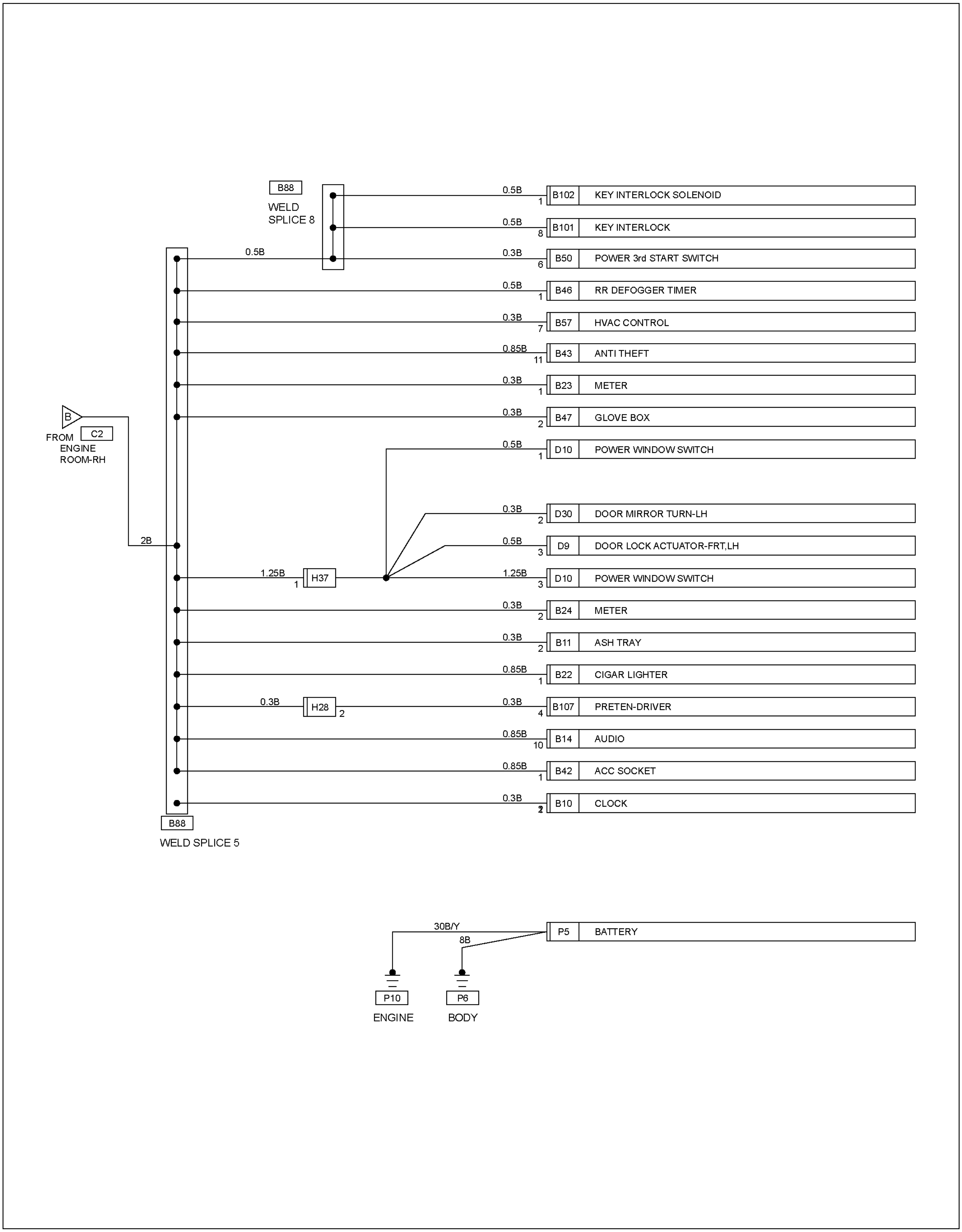
GROUND POINT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 3/4



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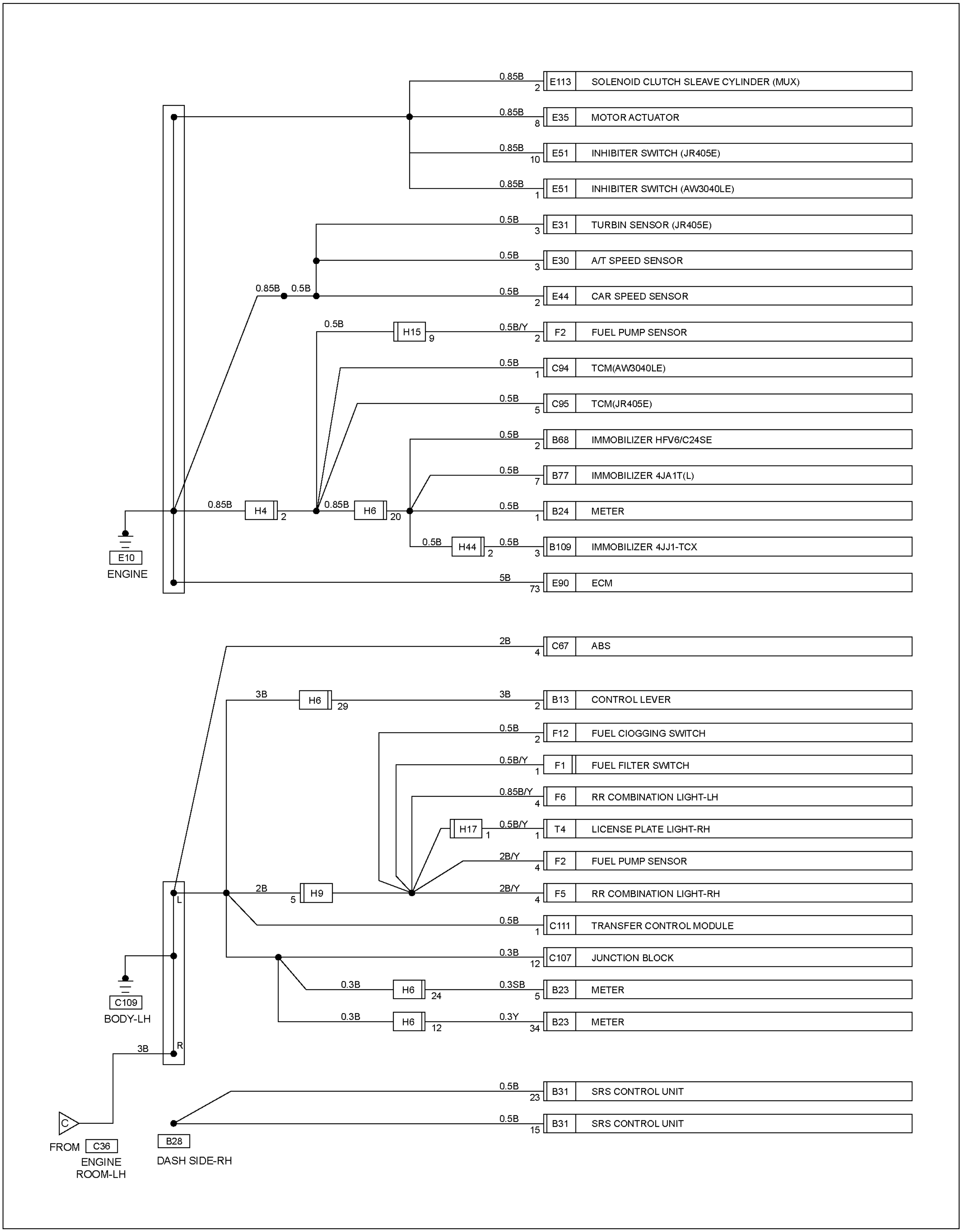
GROUND POINT 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 4/4



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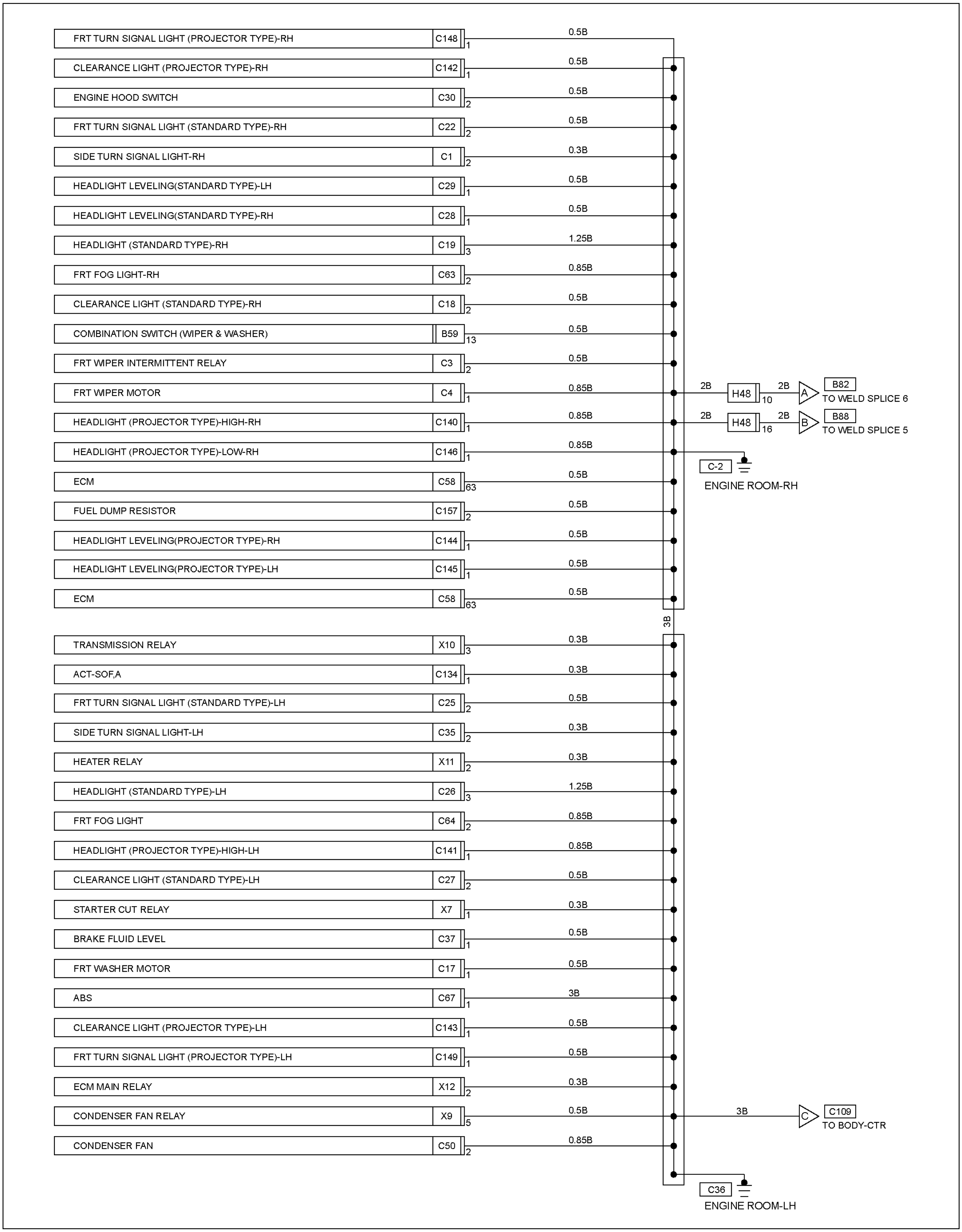
GROUND POINT 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 1/4



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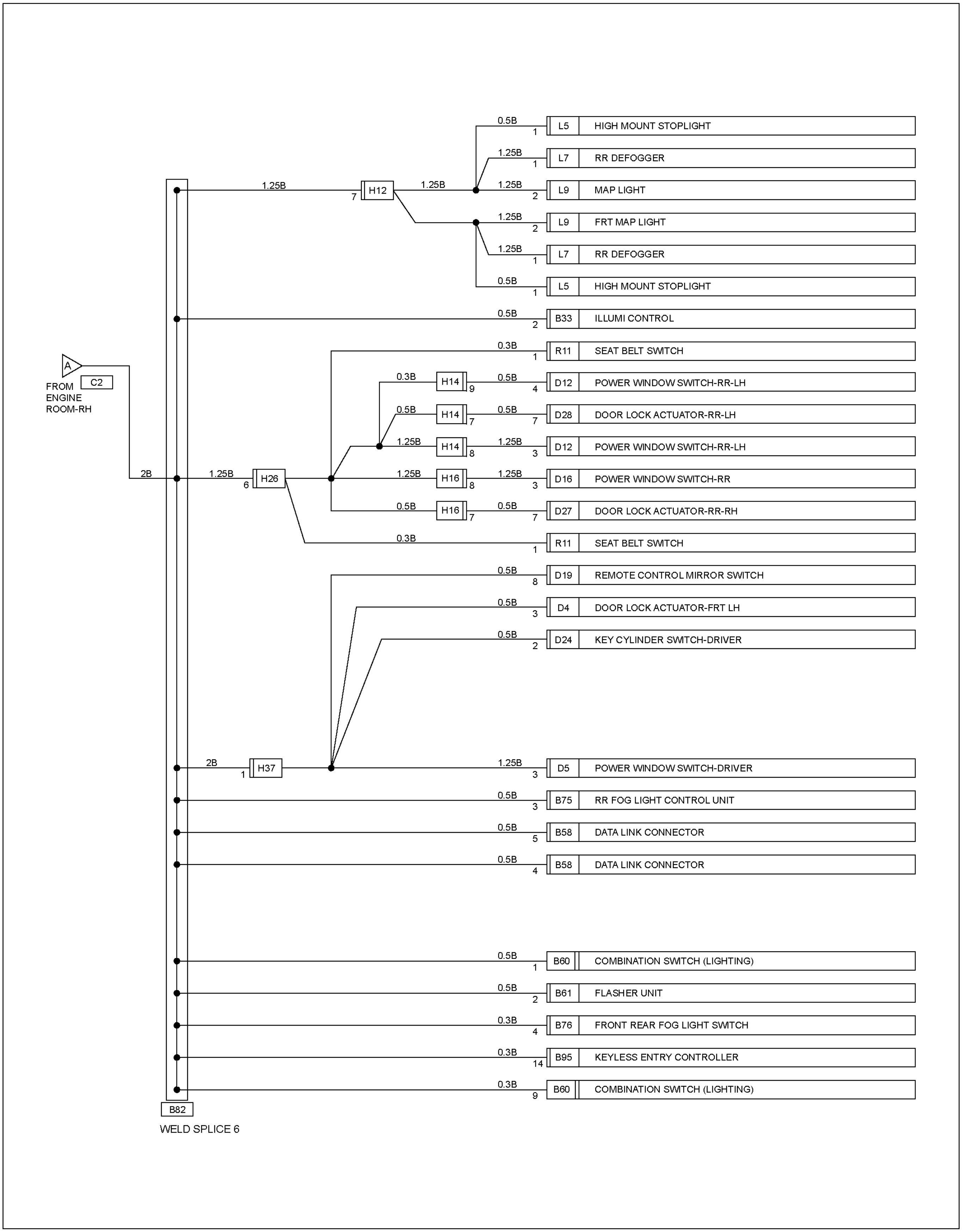
GROUND POINT 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 2/4



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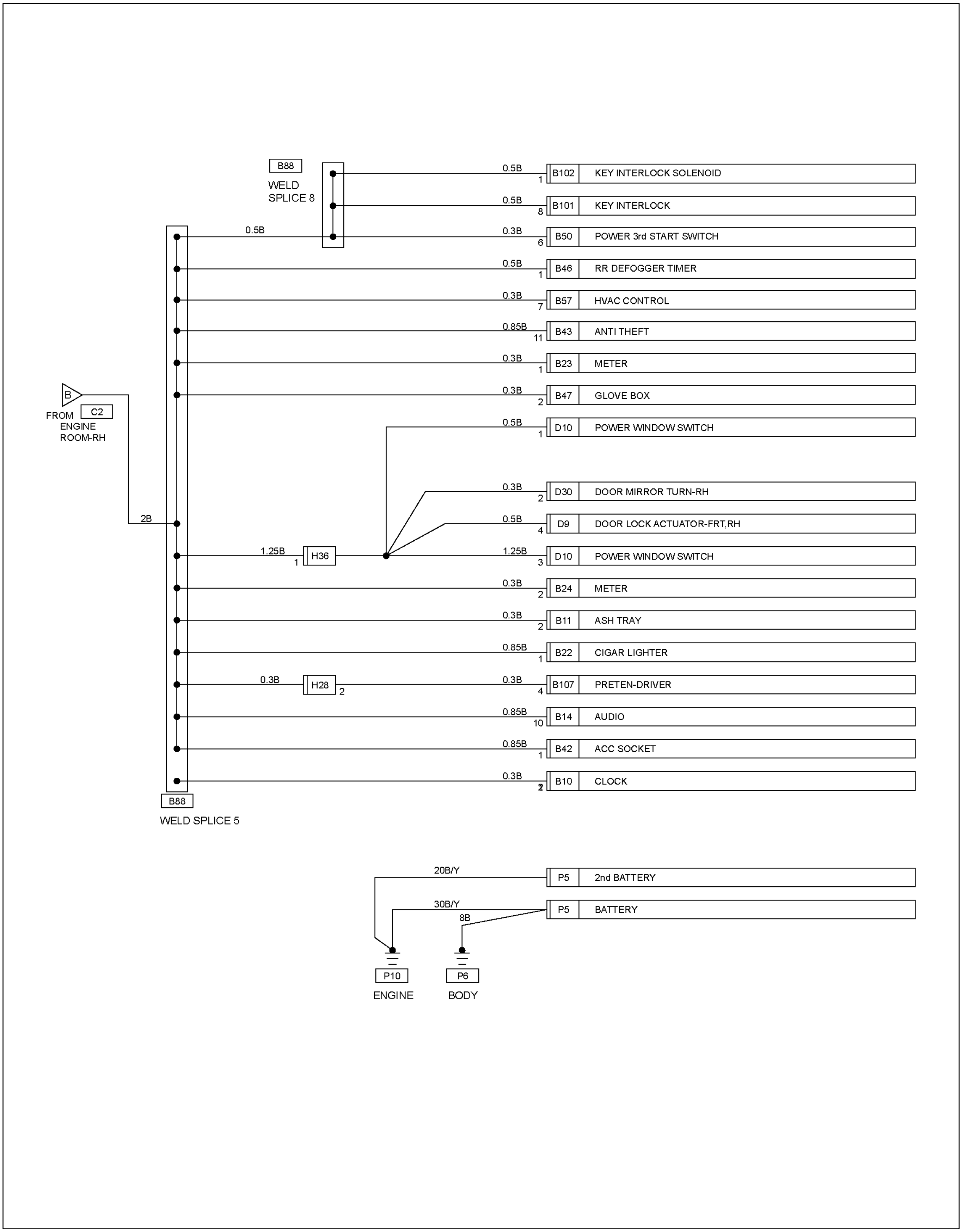
GROUND POINT 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 3/4



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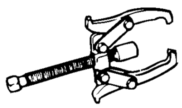
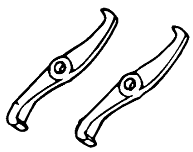
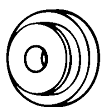
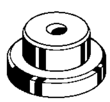
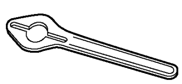
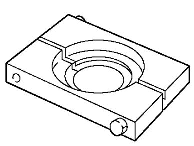
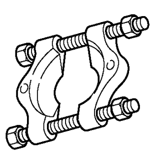
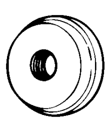
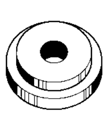
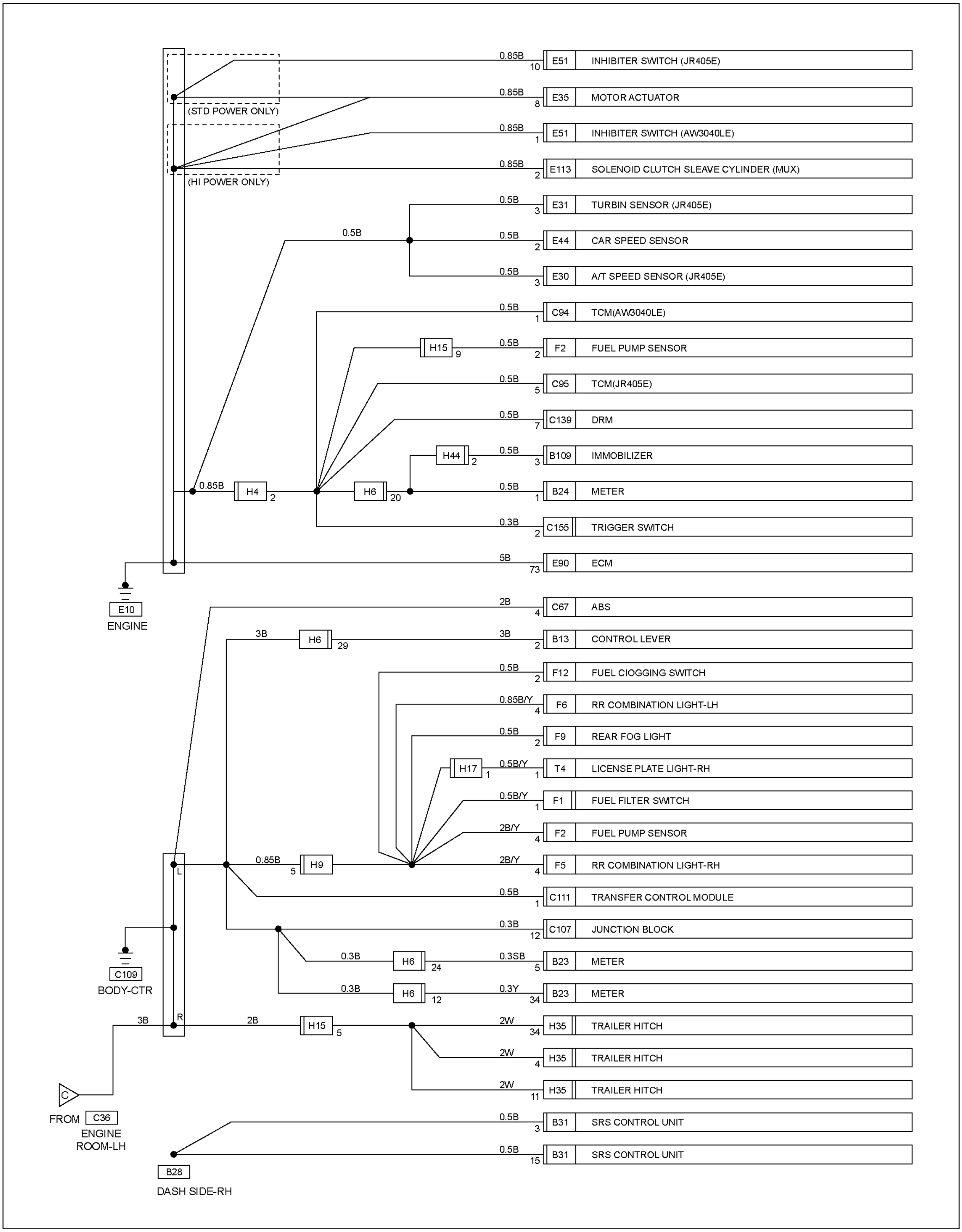
	5-8840-0013-0 (J-22888)	Remover
	5-8840-0014-0 (J-22888-30)	Remover
	5-8840-2196-0 (J-8107-4)	Adapter (ϕ220mm)
	9-8521-1743-0 (J-8107-2)	Adapter (ϕ194mm)
	5-8840-0133-0 (J-8614-01)	Flange Holder
	5-8840-2197-0 (J-37452)	Separator (ϕ220mm)
	5-8840-0015-0 (J-22912-01)	Separator (ϕ194mm)
	5-8840-2164-0 (J-37262)	Installer (ϕ220mm)
	9-8522-1141-0 (J-24256-A)	Installer (ϕ194mm)

GROUND POINT 4JJ1-TC/4JK1-TC (LHD) G.EXP

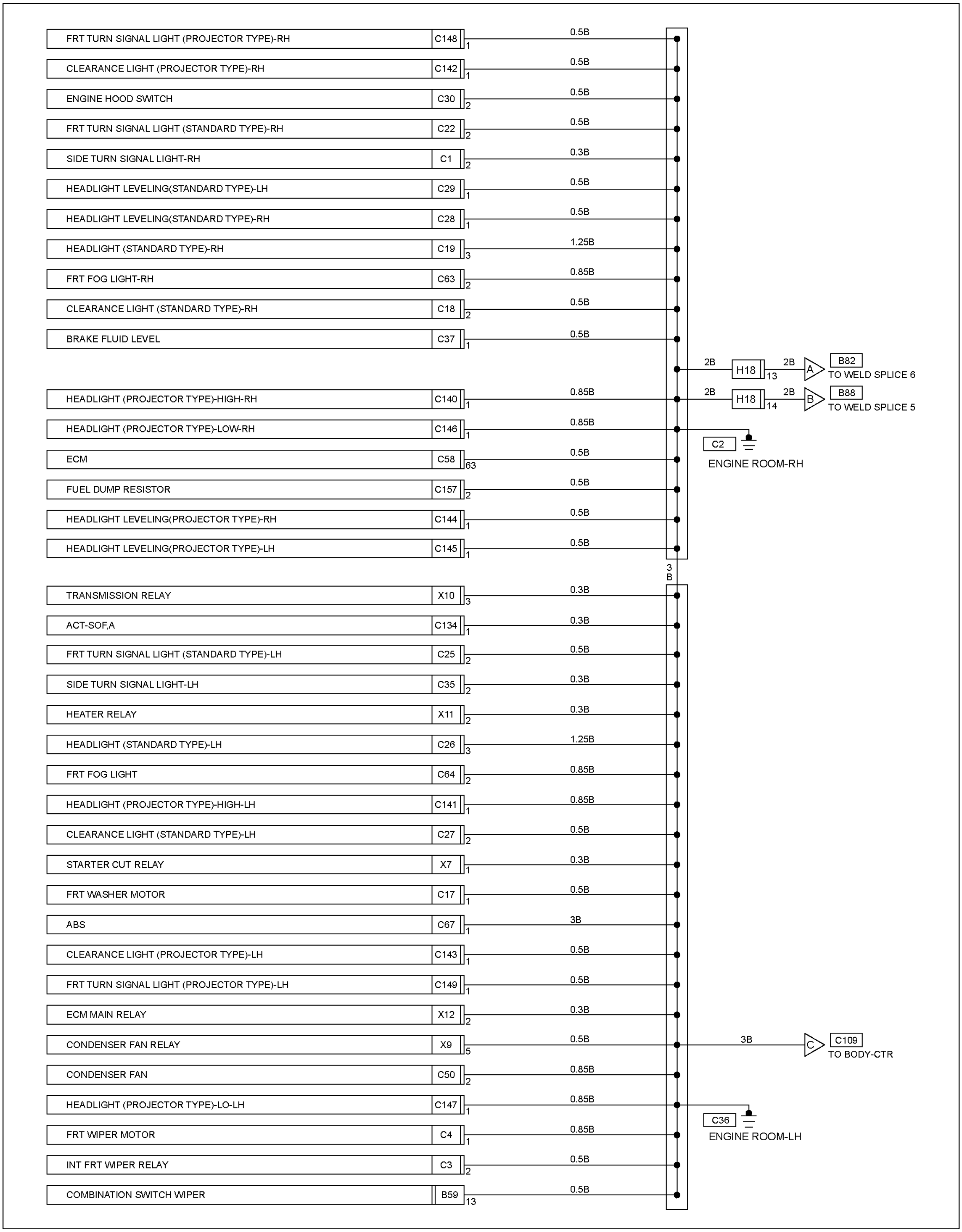
Sheet 4/4



RTW78AXF029601

GROUND POINT 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

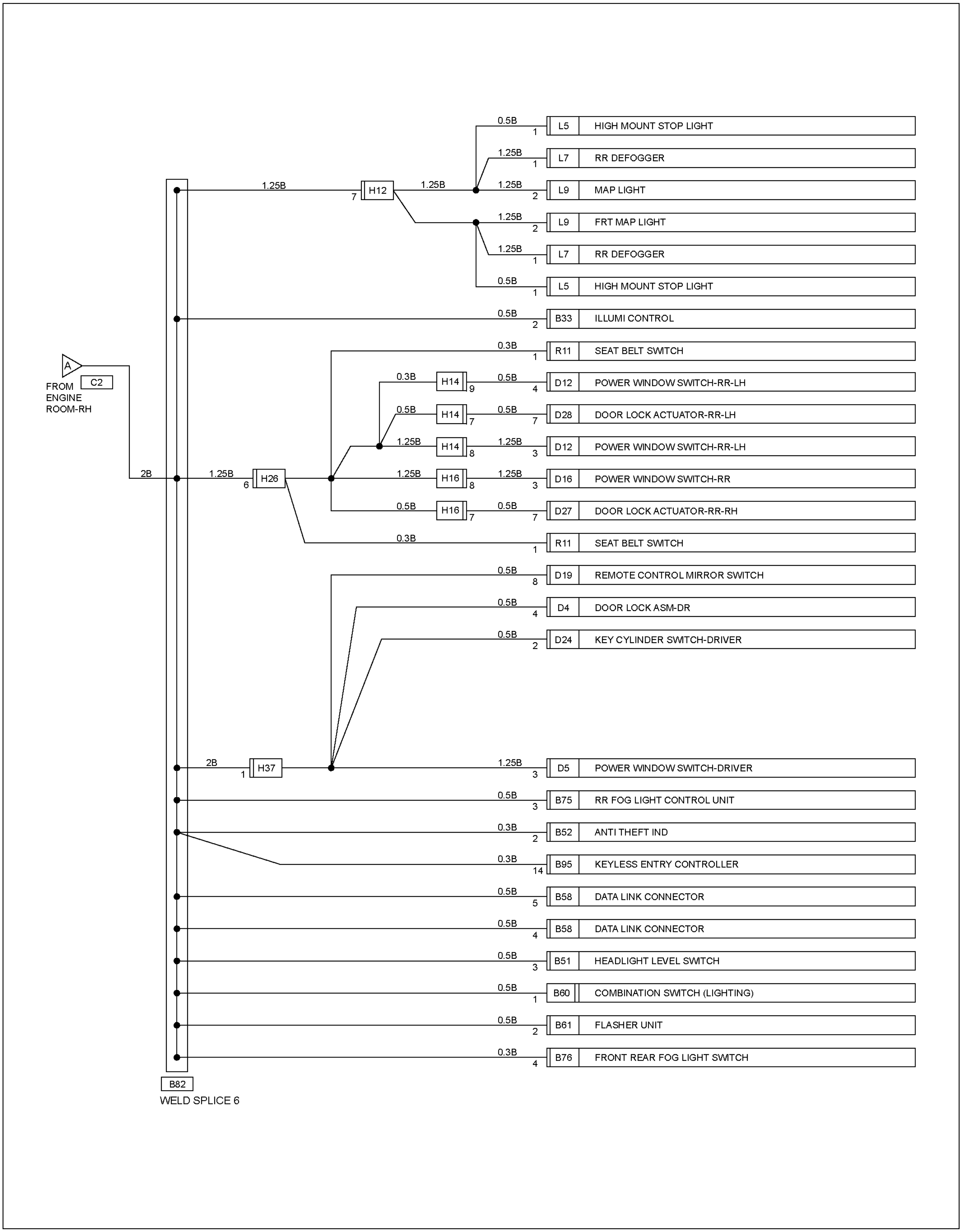
Sheet 1/4



RTW78AXF035101

GROUND POINT 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

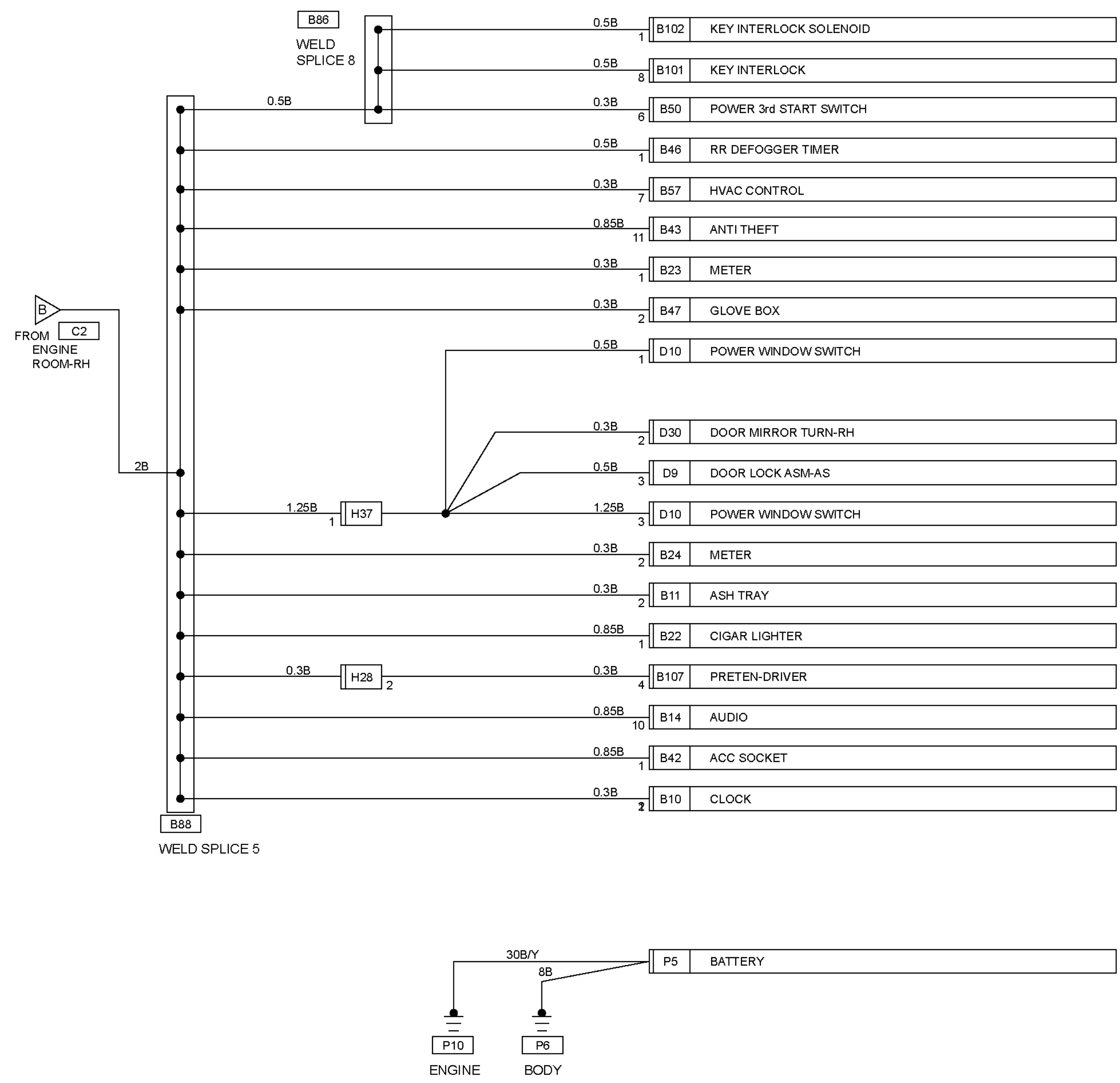
Sheet 2/4



RTW78AXF035201

GROUND POINT 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

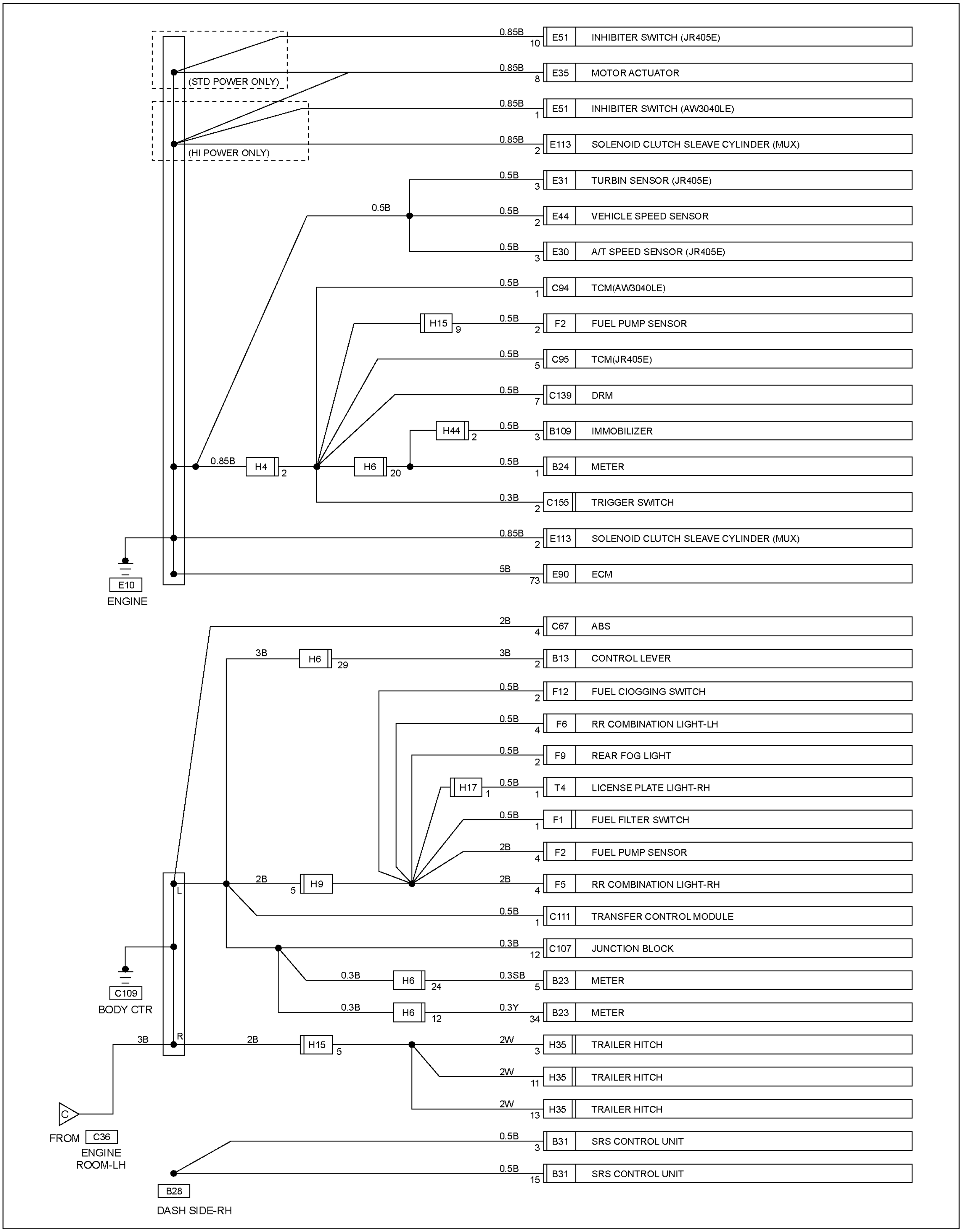
Sheet 3/4



RTW78AXF035301

GROUND POINT 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

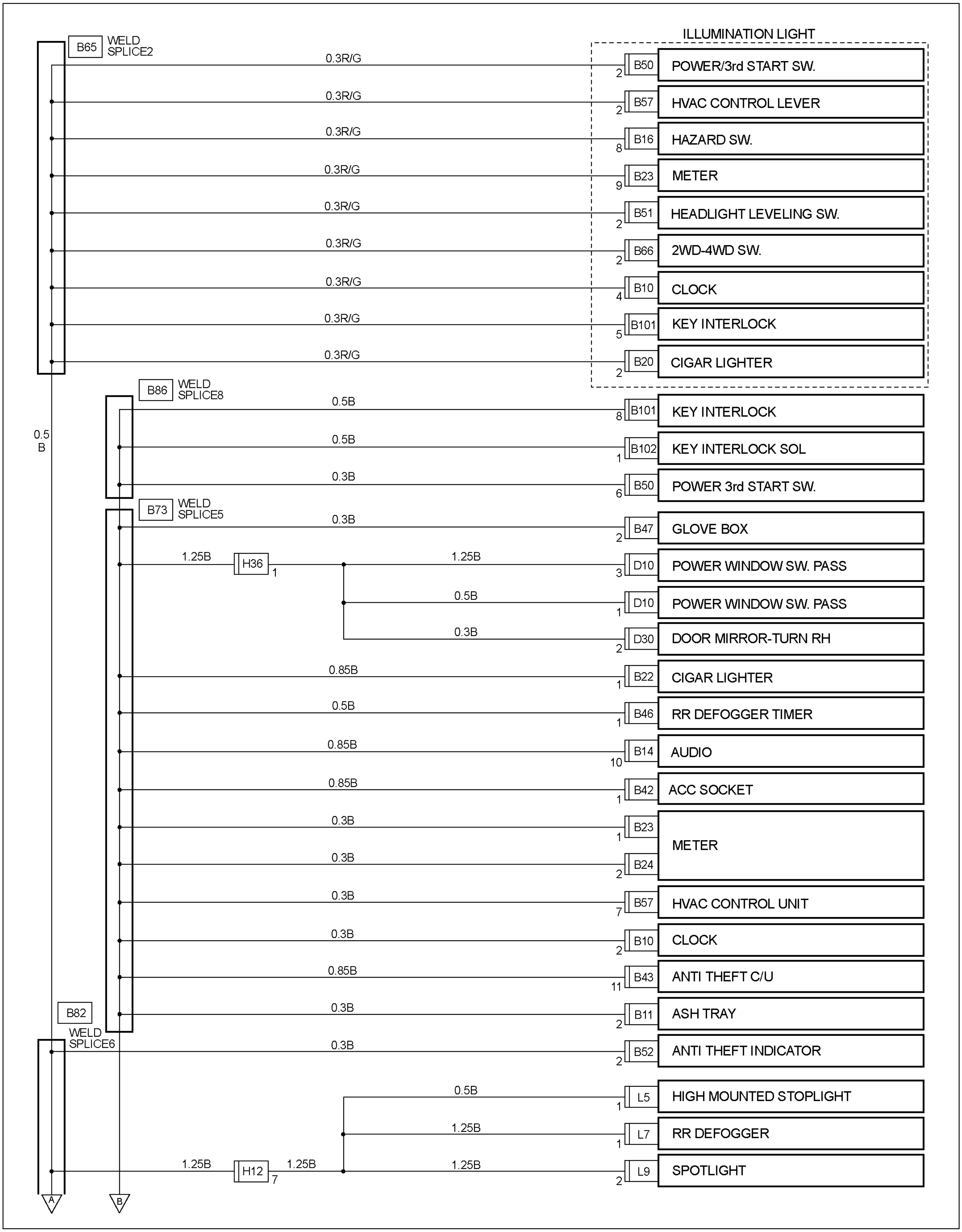
Sheet 4/4



RTW78AXF035401

GROUND POINT 4JH1-TC (LHD) G.EXP

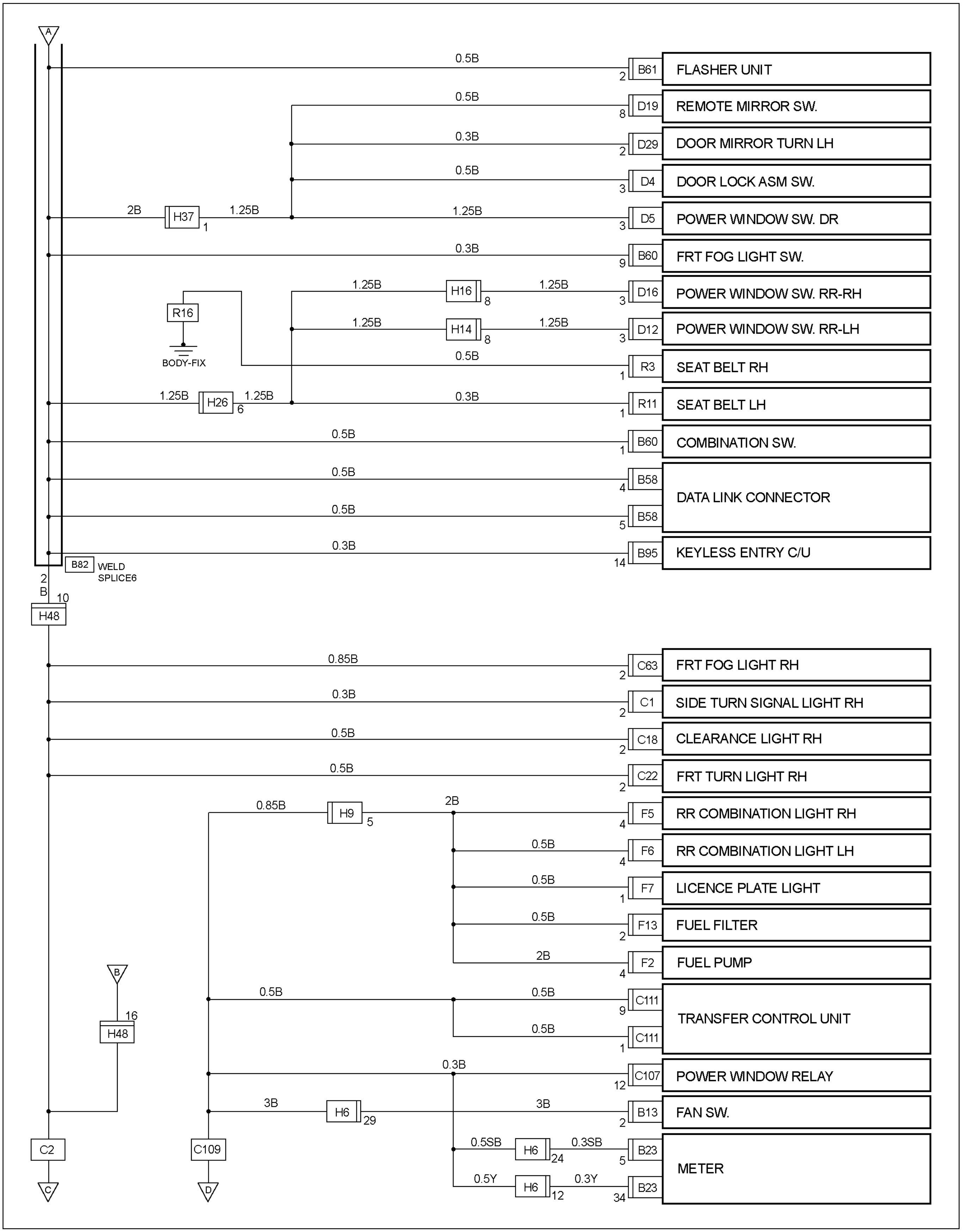
Sheet 1/4



RTW78AXF007501

GROUND POINT 4JH1-TC (LHD) G.EXP

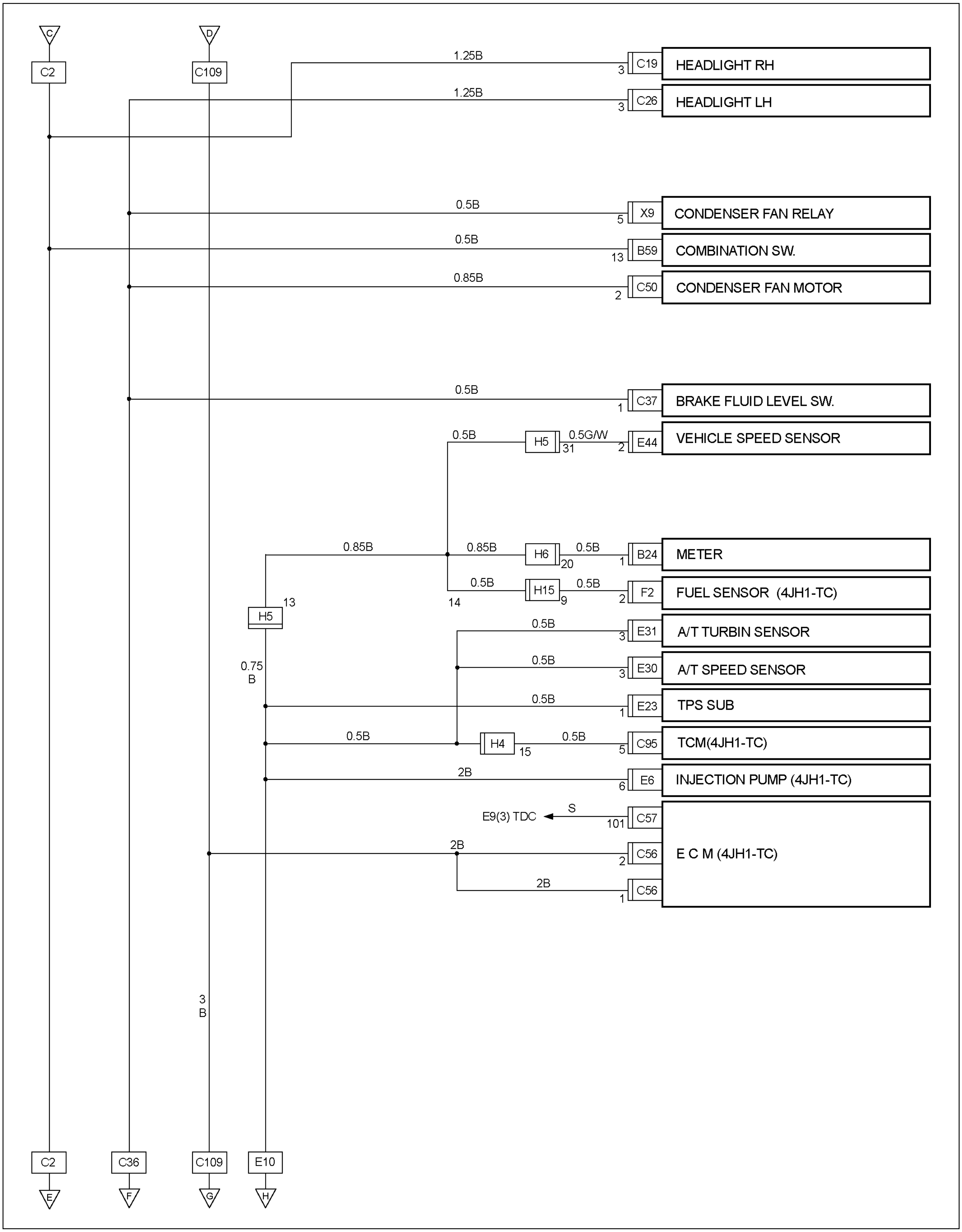
Sheet 2/4



RTW78AXF007601

GROUND POINT 4JH1-TC (LHD) G.EXP

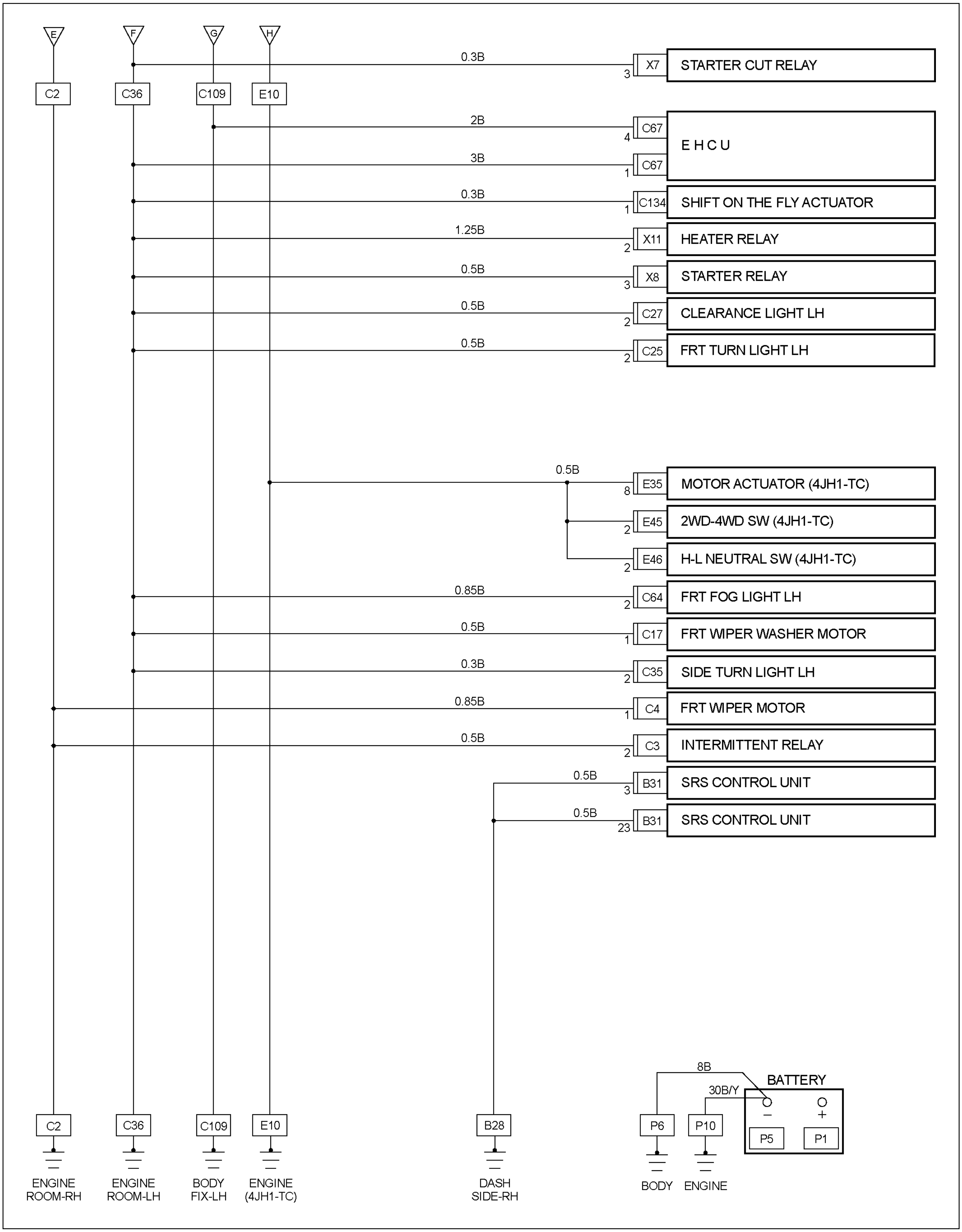
Sheet 3/4



RTW78AXF007701

GROUND POINT 4JH1-TC (LHD) G.EXP

Sheet 4/4



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GROUND POINT 4JA1T (L) (RHD)

Sheet 1/4

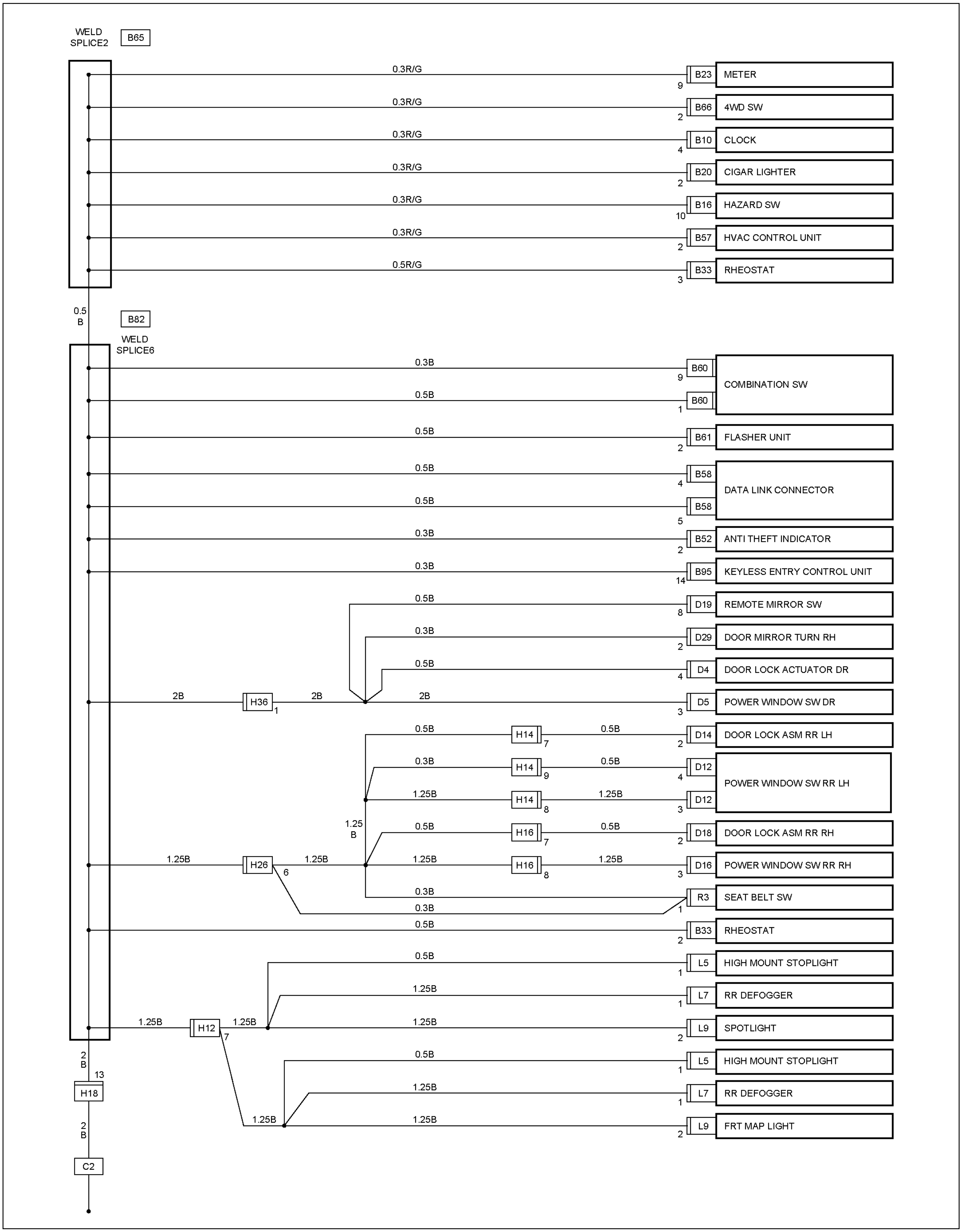

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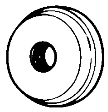
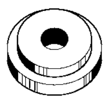
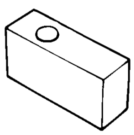
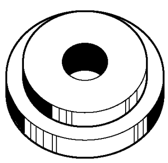
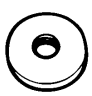
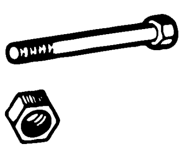
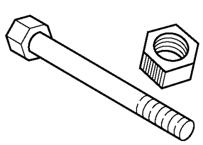
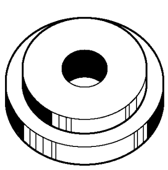
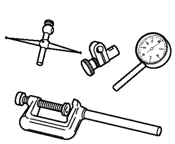
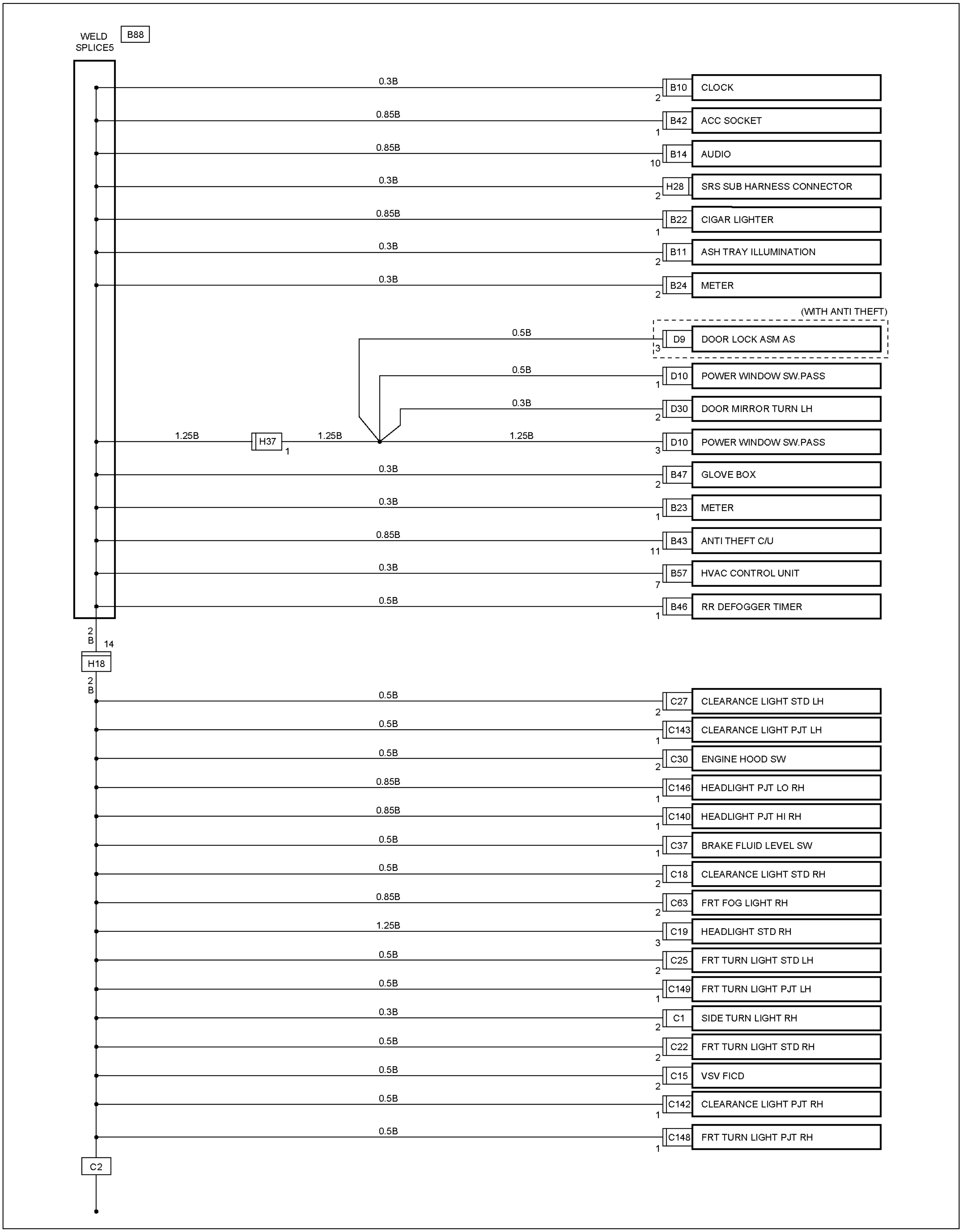
ILLUSTRATION	PART NO.	PART NAME
	5-8840-2163-0 (J-37261)	Installer (ϕ220mm)
	9-8522-1274-0 (J-24252)	Installer (ϕ194mm)
	5-8840-2166-0 (J-23597-43)	Gauge Plate (ϕ220mm)
	5-8840-2087-0 (J-23597-7)	Gauge Plate (ϕ194mm)
	5-8840-0129-0 (J-23597-12)	Inner Pilot (ϕ220mm)
	5-8840-0127-0 (J-21777-43)	Stud and Nut (ϕ220mm)
	5-8840-2089-0 (J-23597-9)	Stud and Nut (ϕ194mm)
	5-8840-2085-0 (J-21777-42)	Outer Pilot
	5-8840-0126-0 (J-8001)	Dial Indicator

GROUND POINT 4JA1T (L) (RHD)

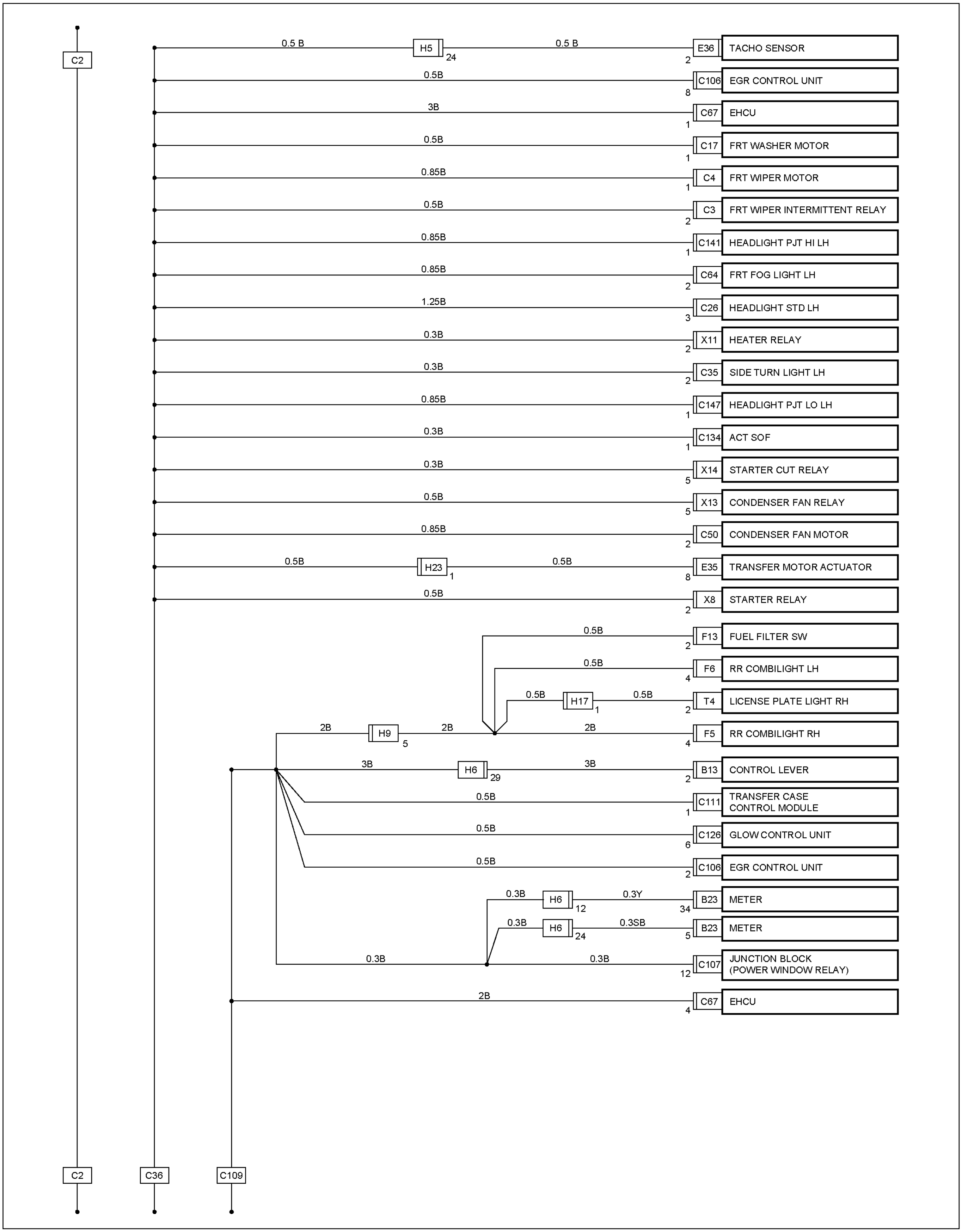
Sheet 2/4



RTW78AXF021201

GROUND POINT 4JA1T (L) (RHD)

Sheet 3/4



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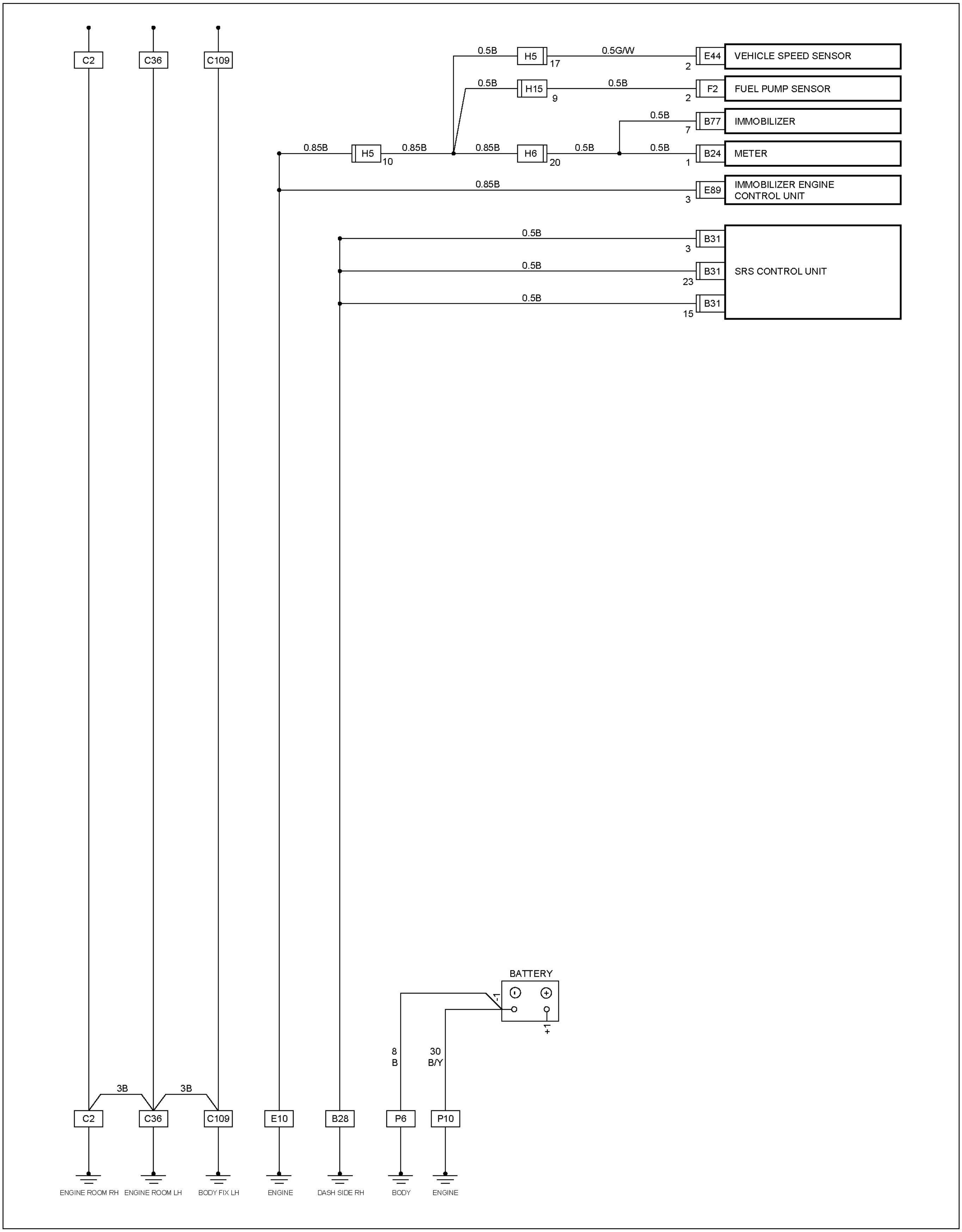
GROUND POINT 4JA1T (L) (RHD)

Sheet 4/4



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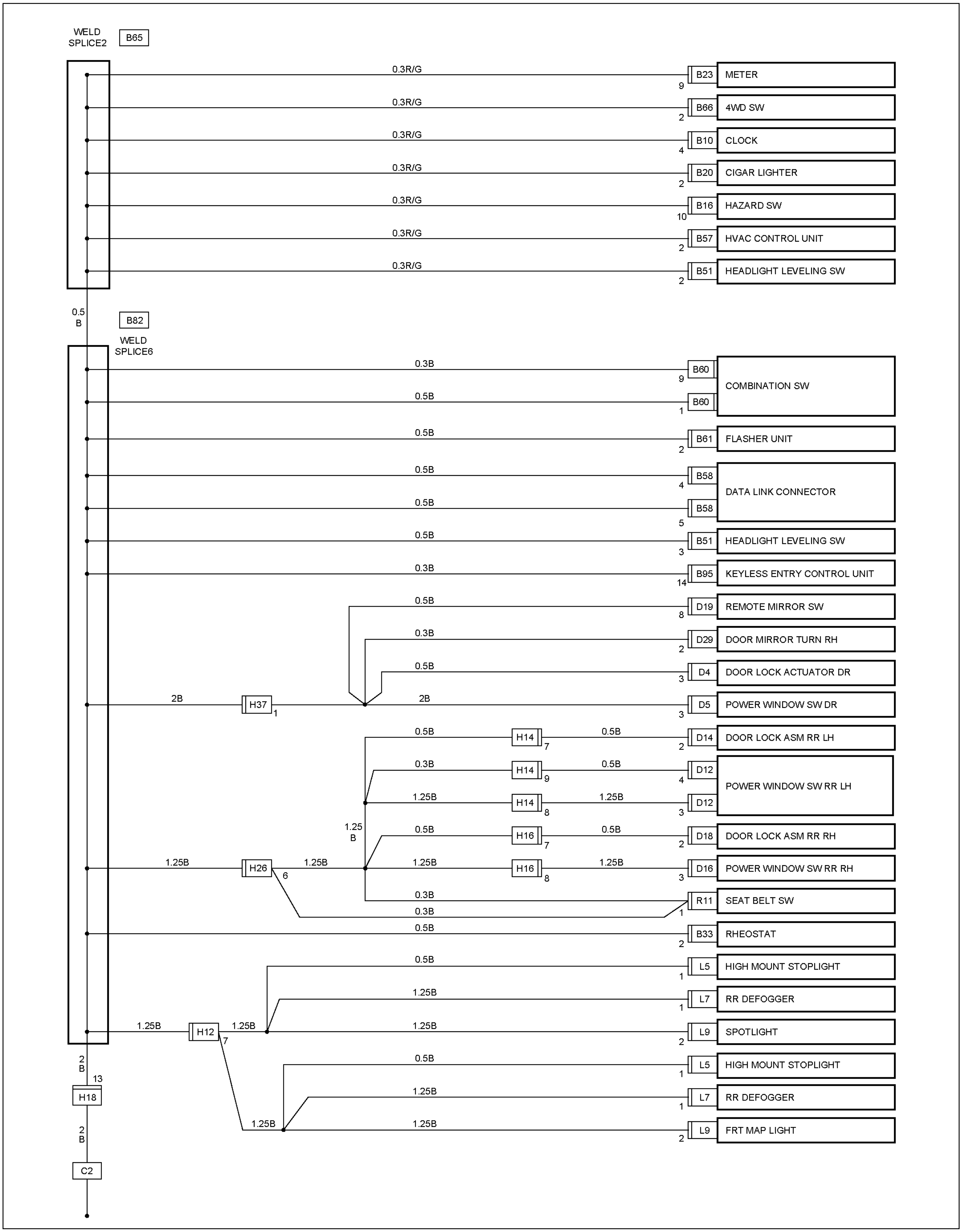
GROUND POINT 4JA1T (L) (LHD)

Sheet 1/4



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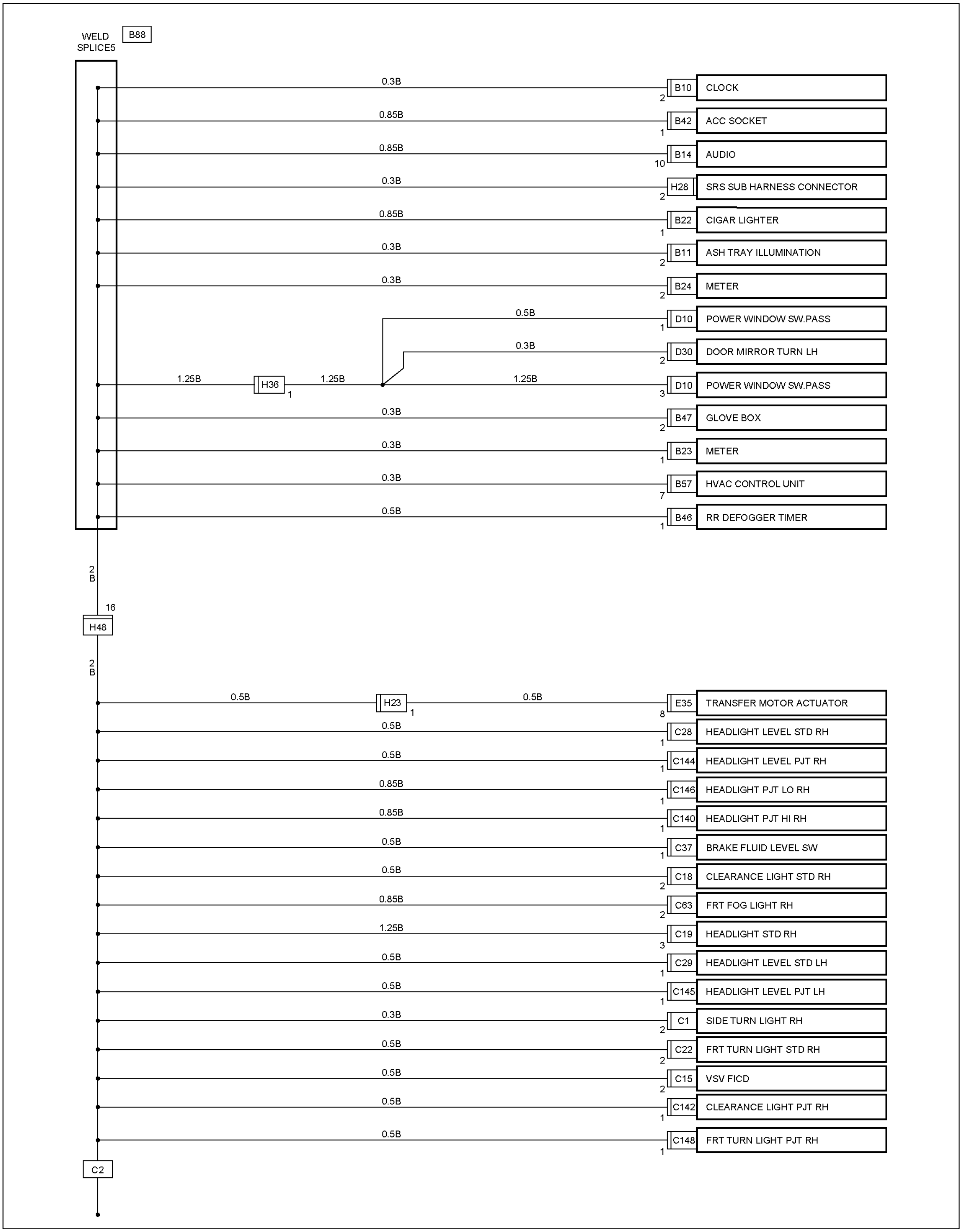
GROUND POINT 4JA1T (L) (LHD)

Sheet 2/4



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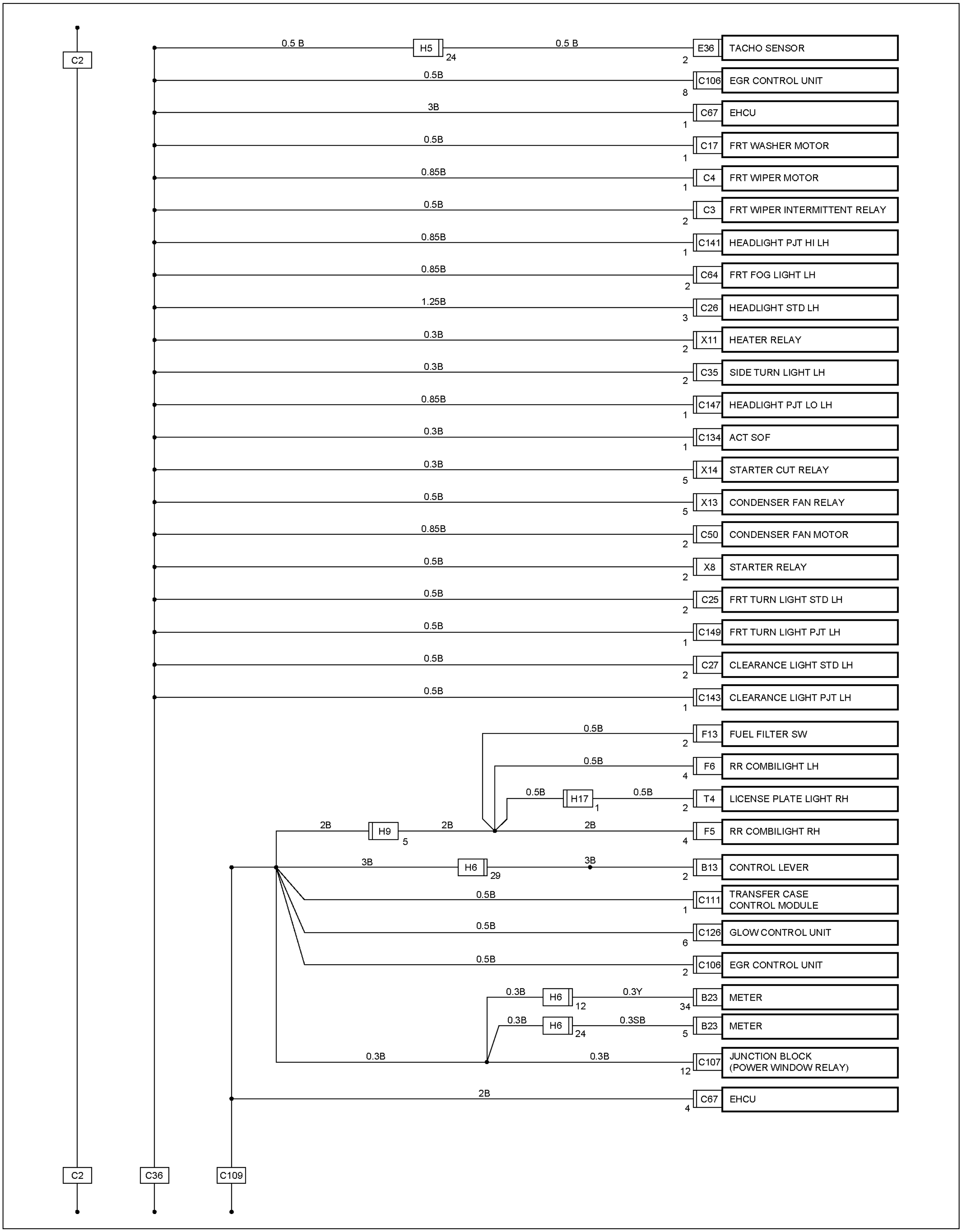
GROUND POINT 4JA1T (L) (LHD)

Sheet 3/4



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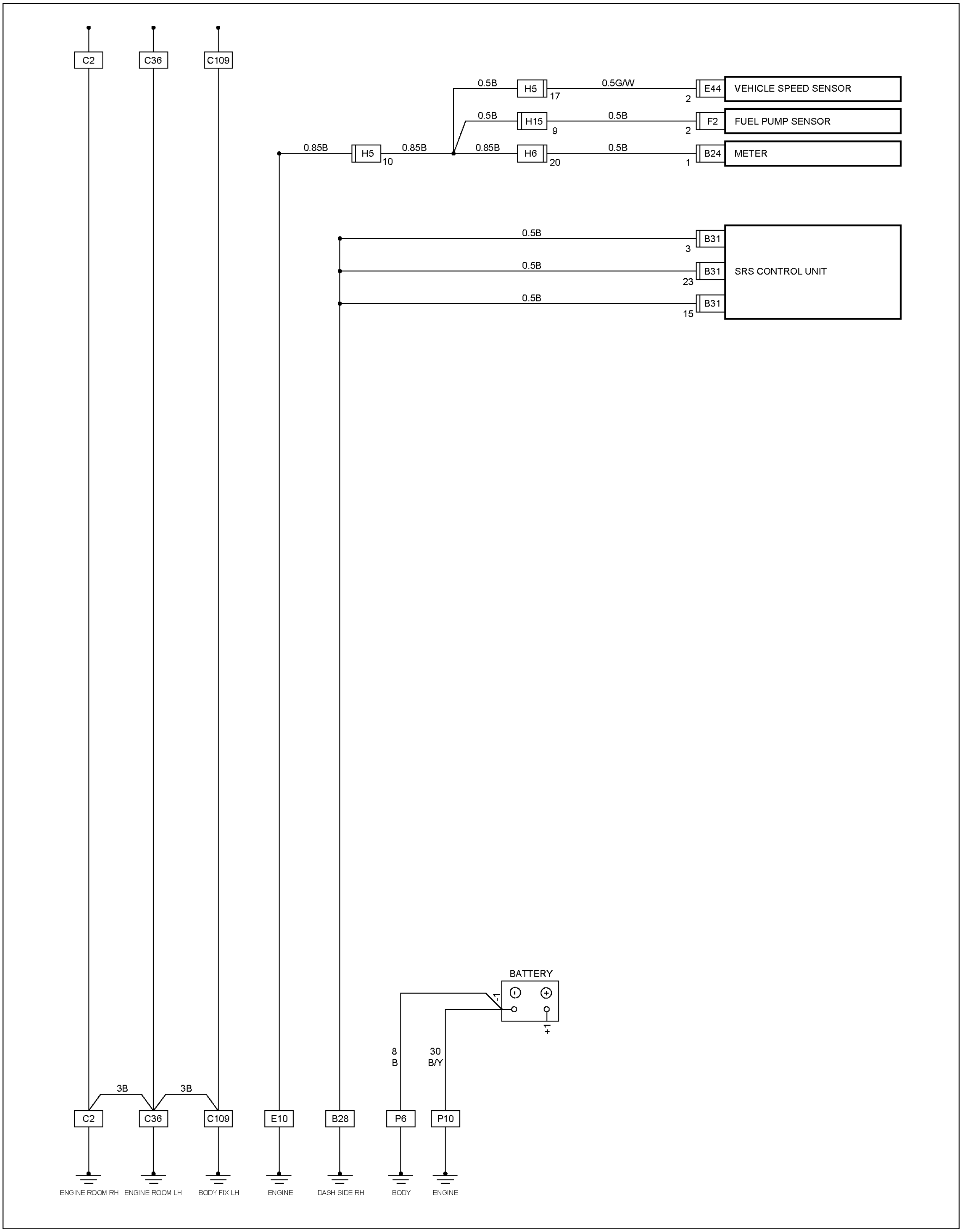
GROUND POINT 4JA1T (L) (LHD)

Sheet 4/4



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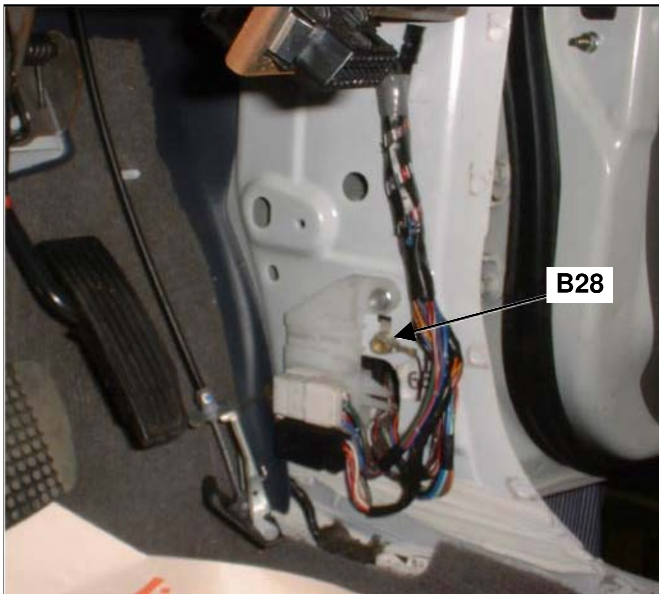
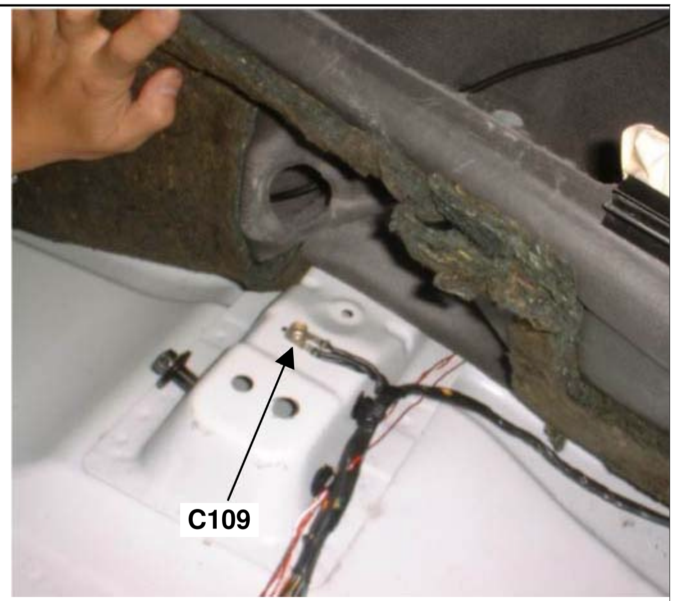
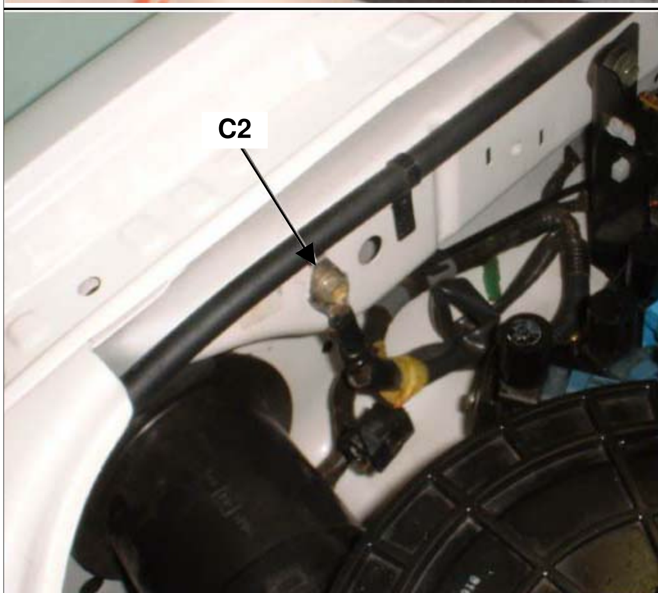
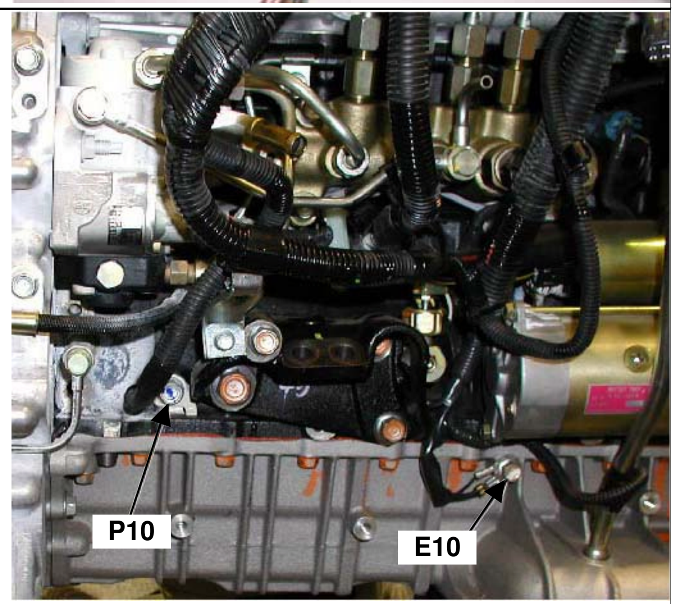
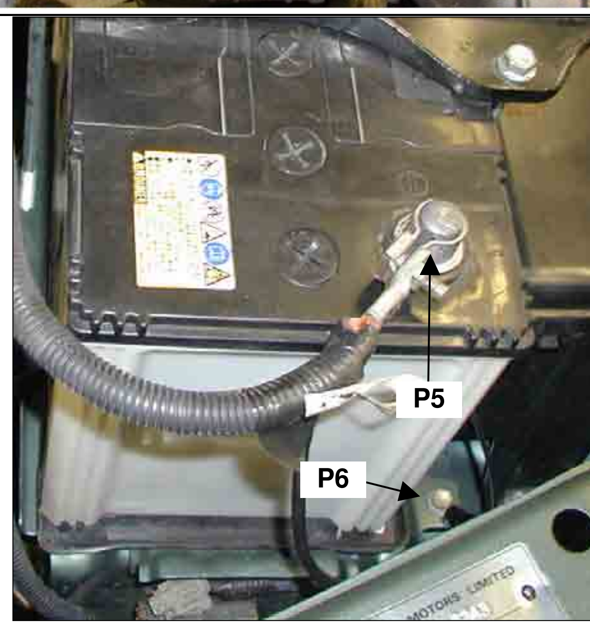
GROUND POINT LOCATION



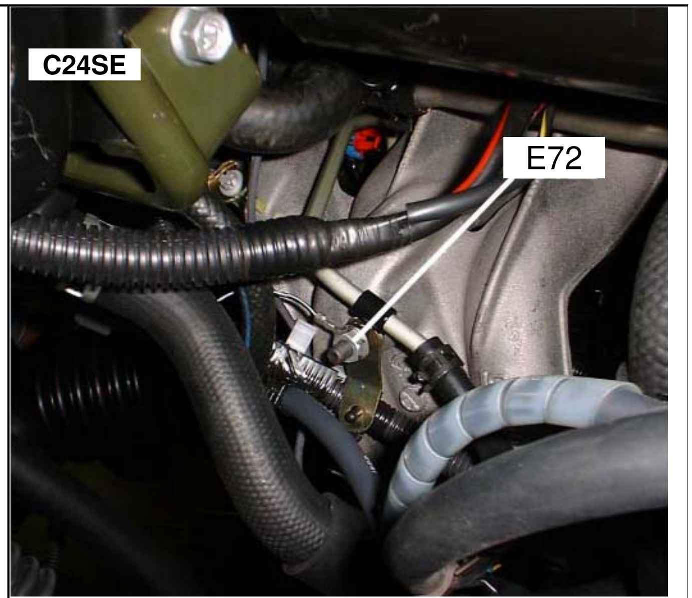


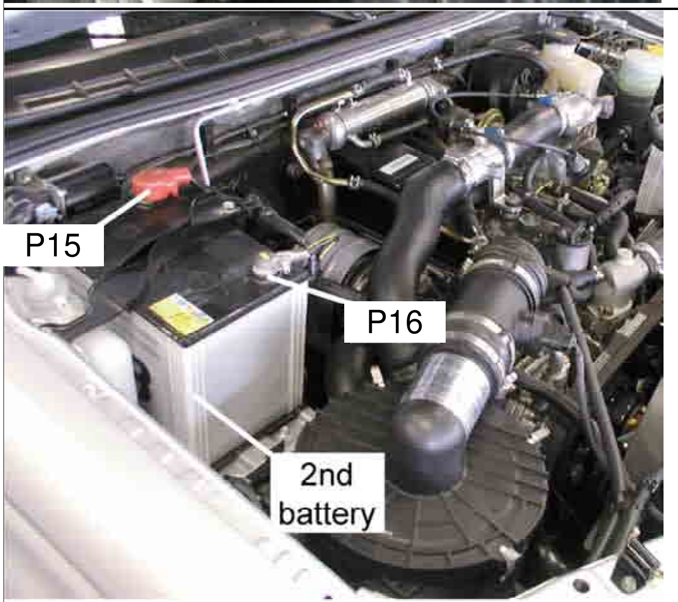


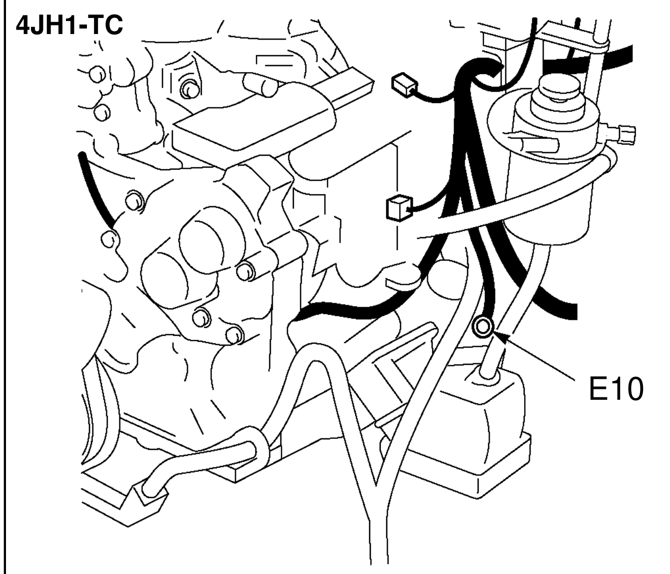




GROUND POINT LOCATION

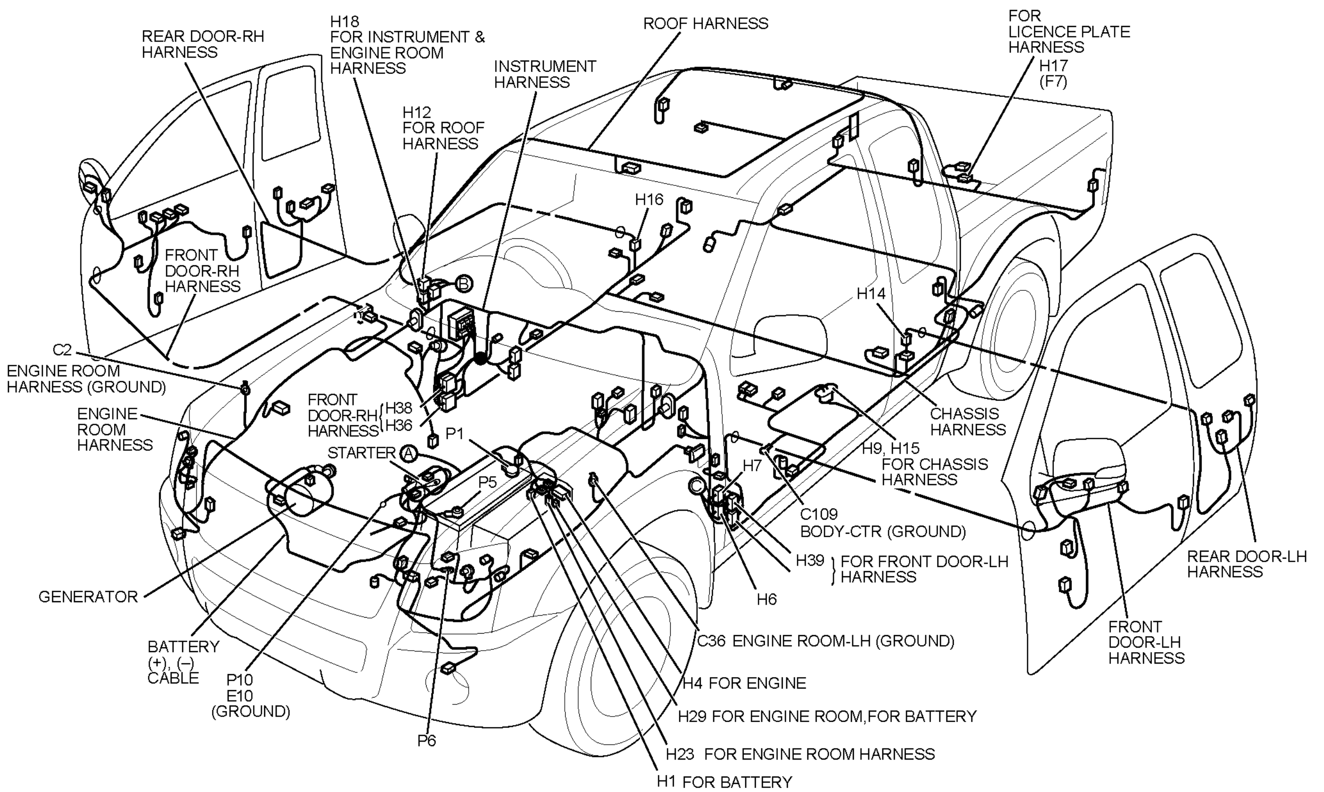






CABLE HARNESS ROUTING

MAIN CABLE HARNESS (RHD)



RTW780MF000101

ILLUSTRATION	PART NO.	PART NAME
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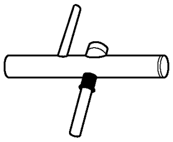
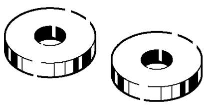
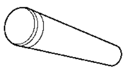
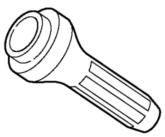
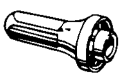
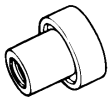
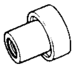
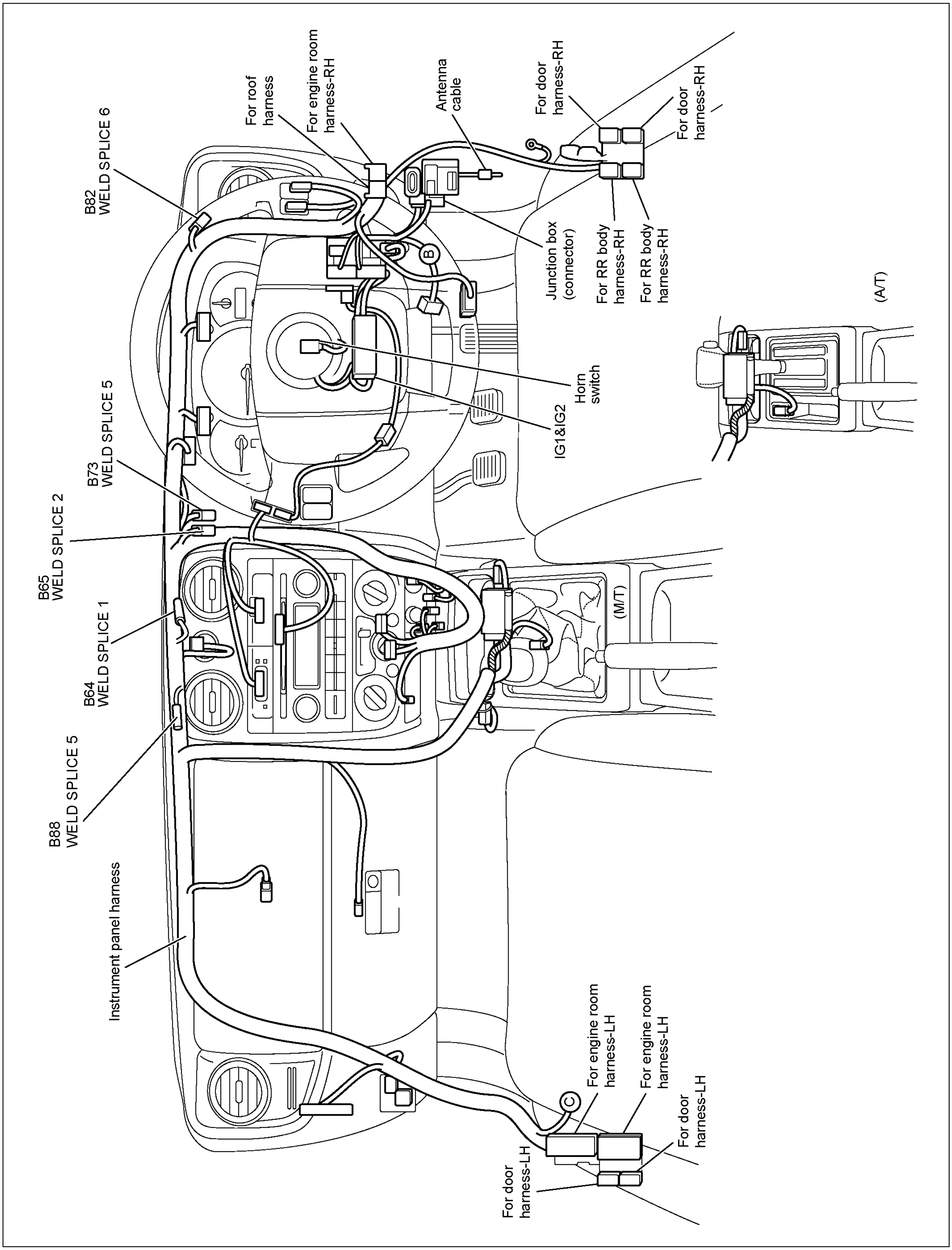
	5-8840-0128-0 (J-23597-1)	Arbor
	5-8840-2088-0 (J-23597-8)	Disc (ϕ194mm)
	9-8522-1165-0 (J-6133-01)	Installer
	5-8840-2165-0 (J-37263)	Installer (ϕ220mm)
	9-8522-1275-0 (J-24250-A)	Installer (ϕ194mm)
	5-8840-2293-0 (J-39209)	Punch
	5-8840-2162-0 (J-37257)	Installer (ϕ220mm)
	9-8522-1164-0 (J-24244)	Installer (ϕ194mm)

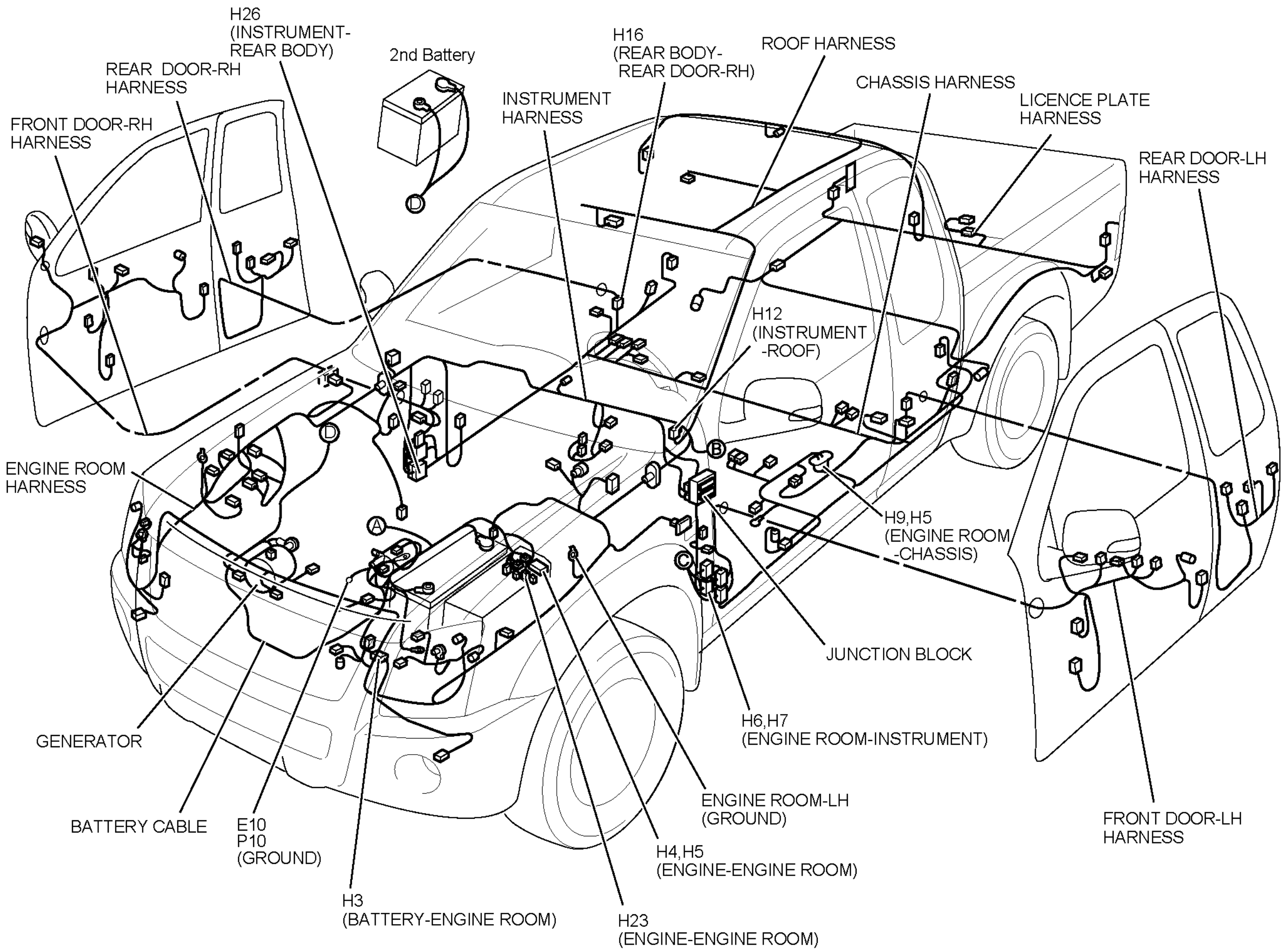
INSTRUMENT HARNESS (RHD)



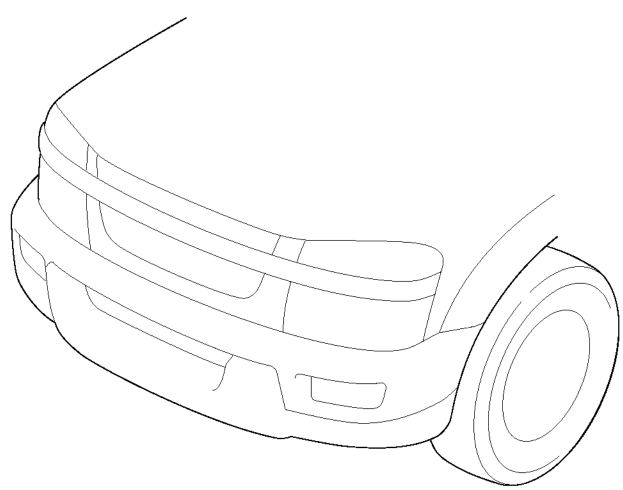
RTW780XF004301

MAIN CABLE HARNESS (LHD)

A type



B type



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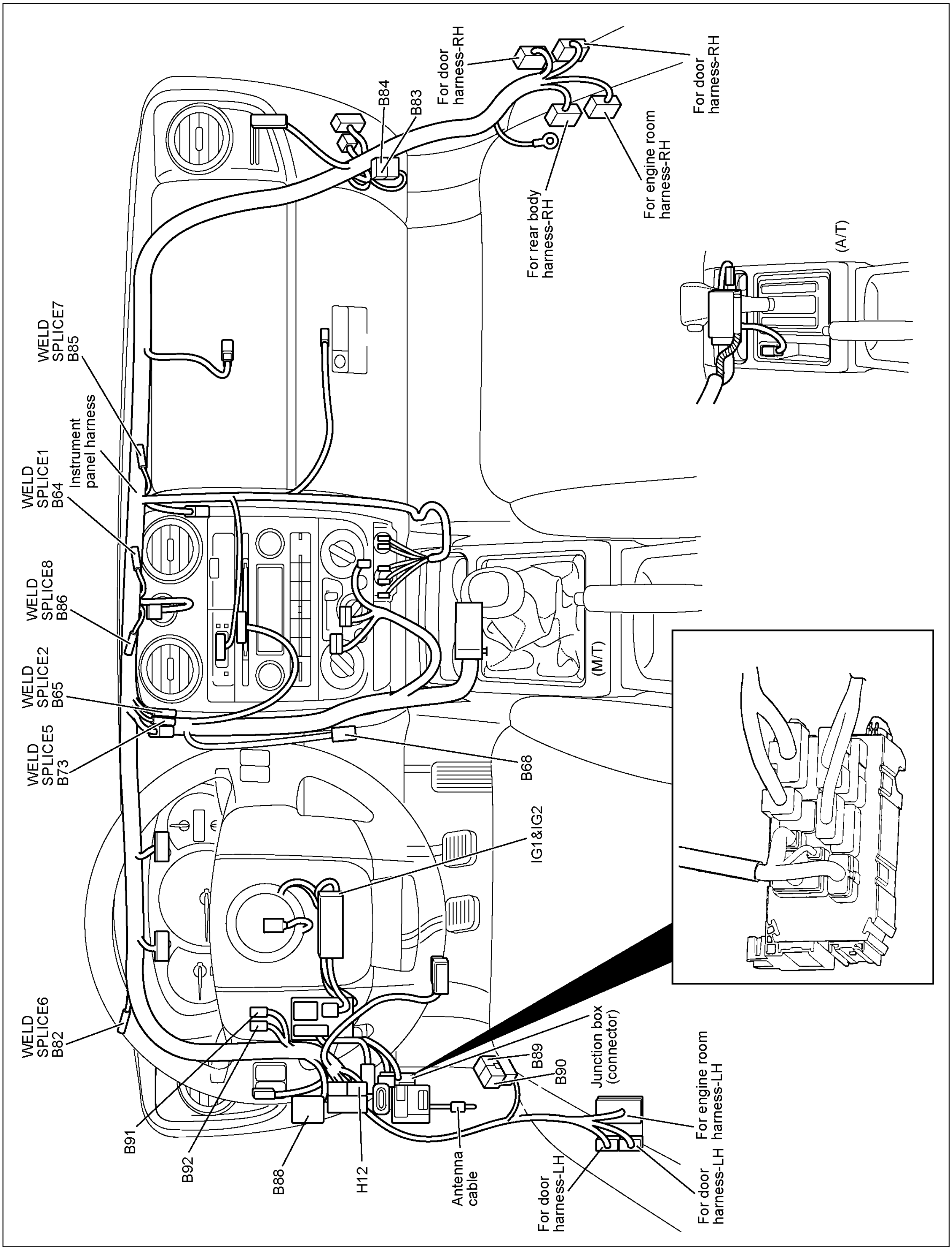
INSTRUMENT HARNESS (LHD)



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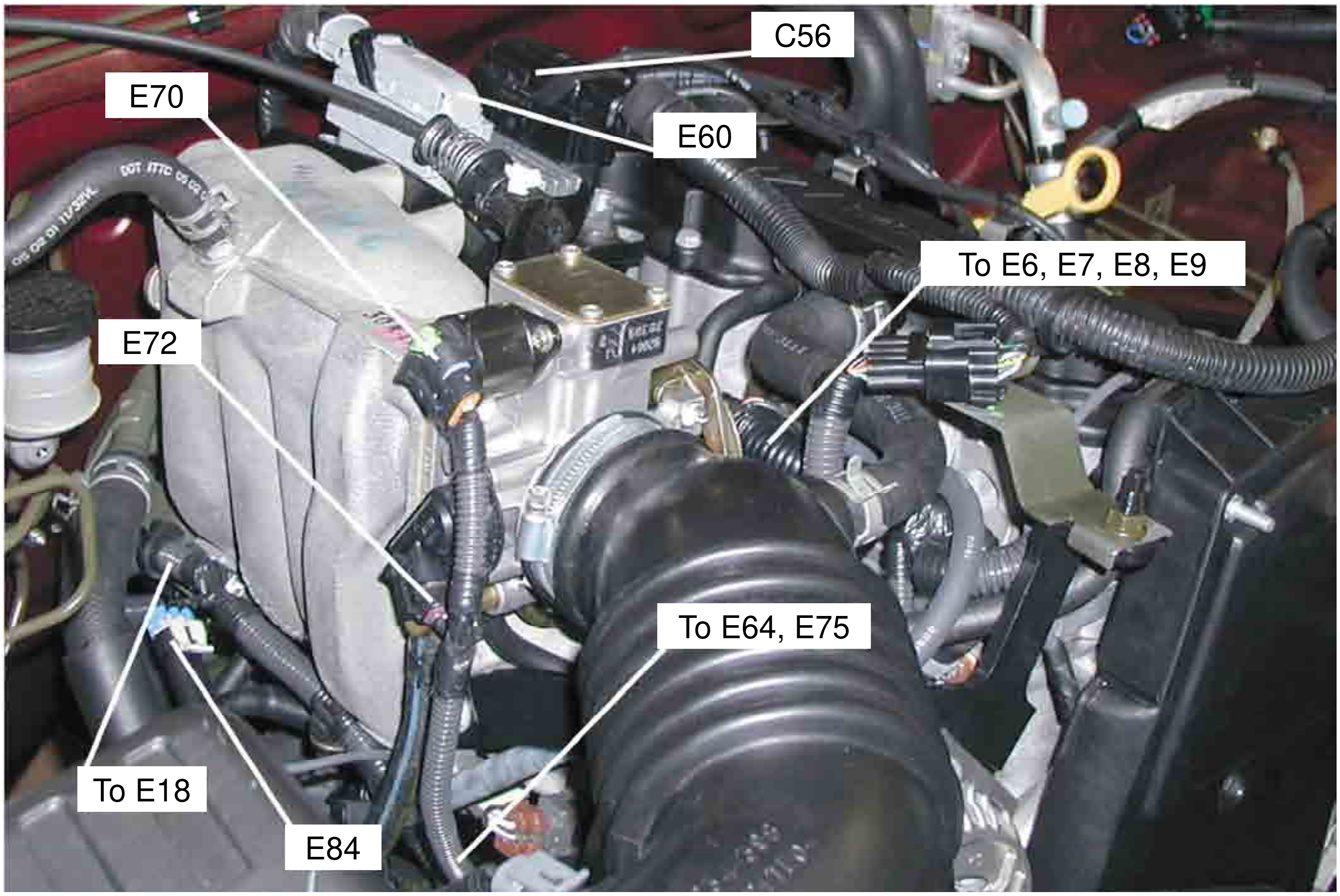
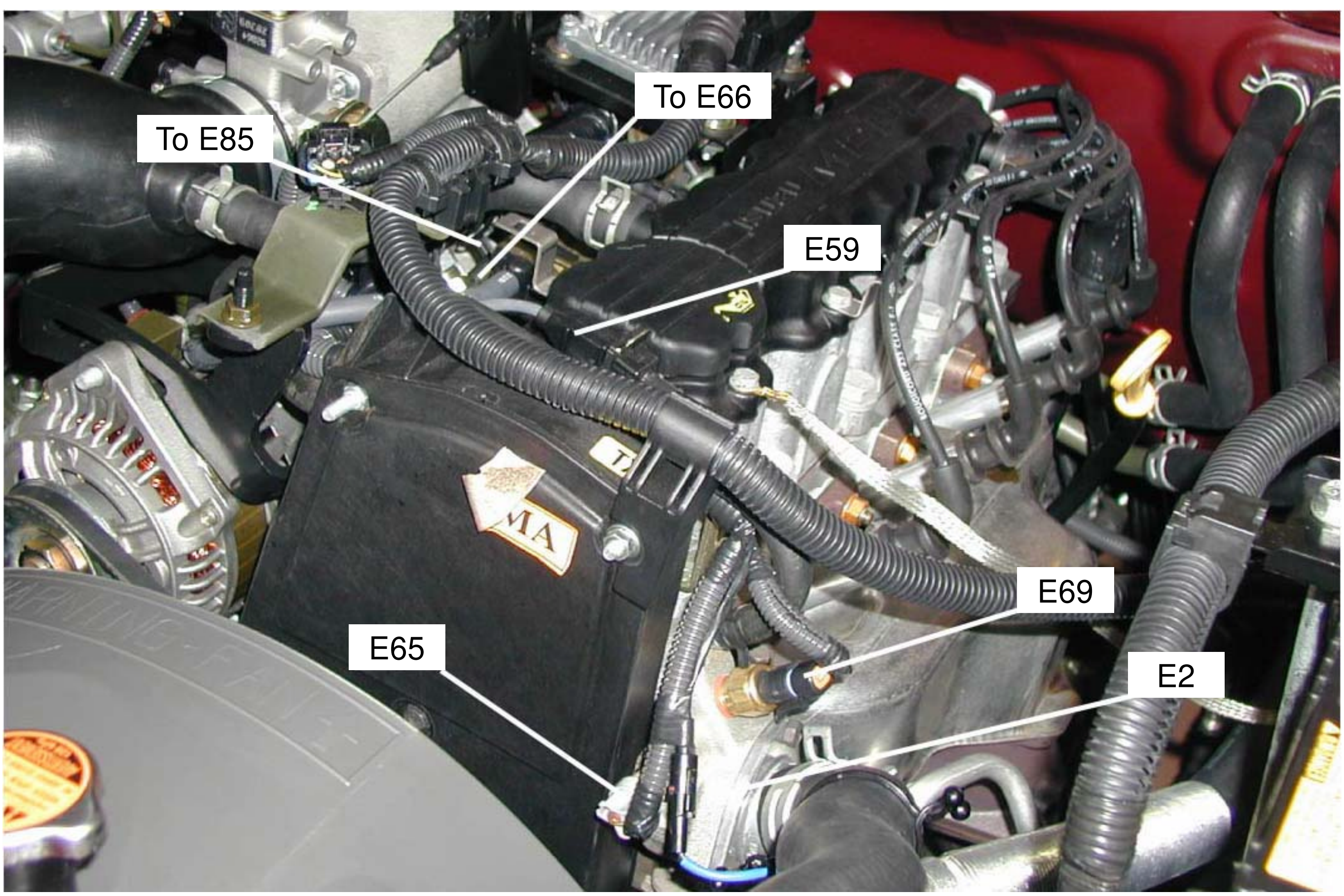
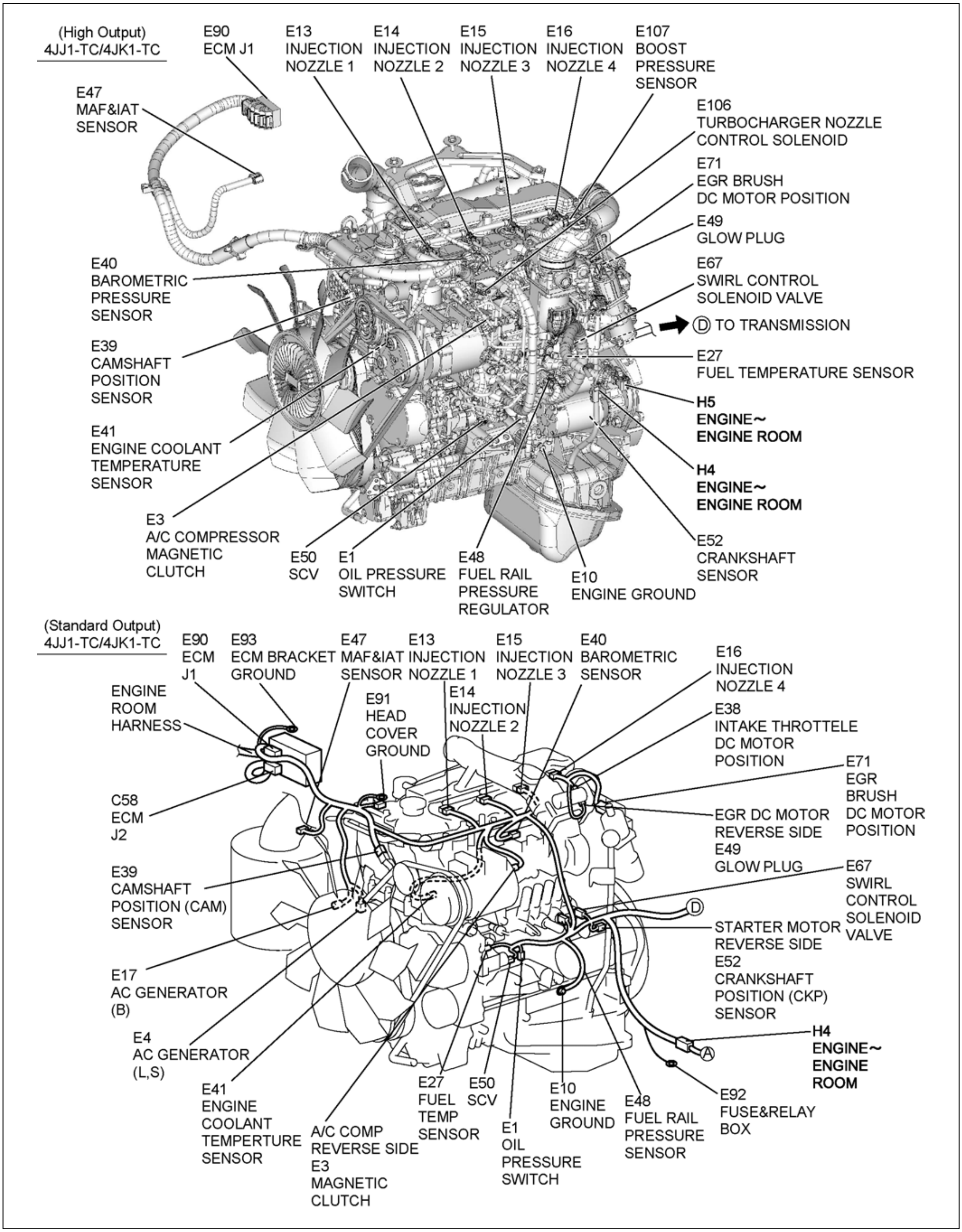
ENGINE HARNESS C24SE





ENGINE HARNESS 4JJ1-TC / 4JK-TC



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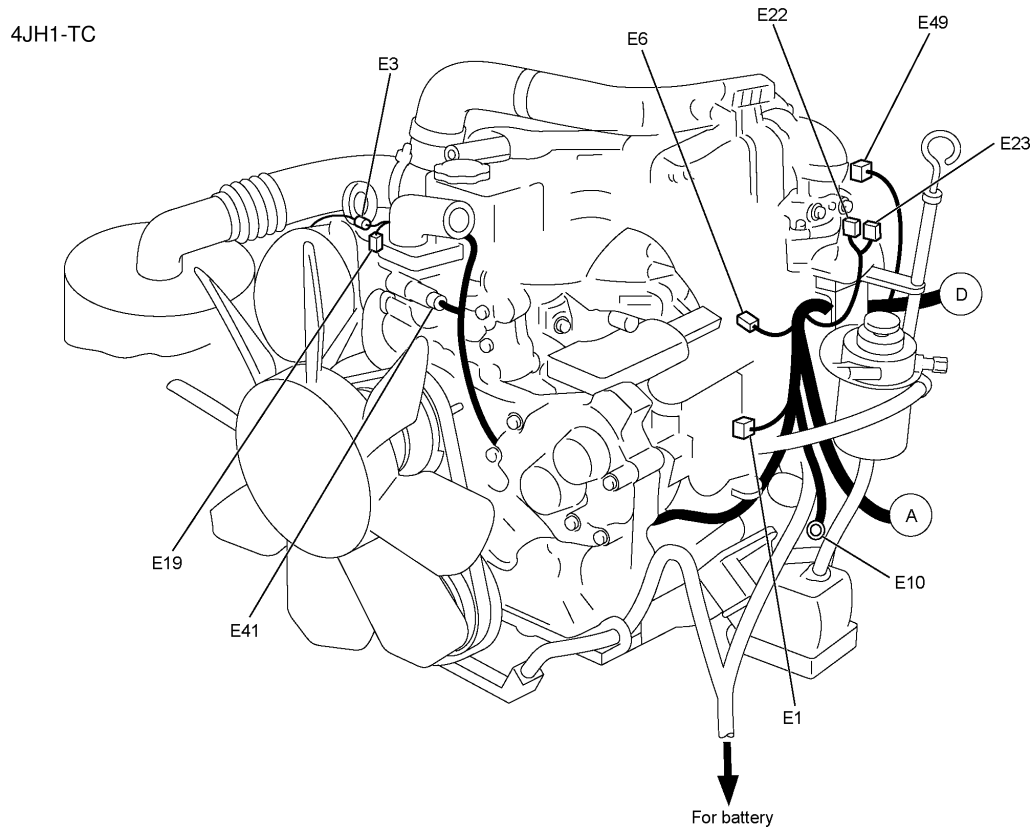
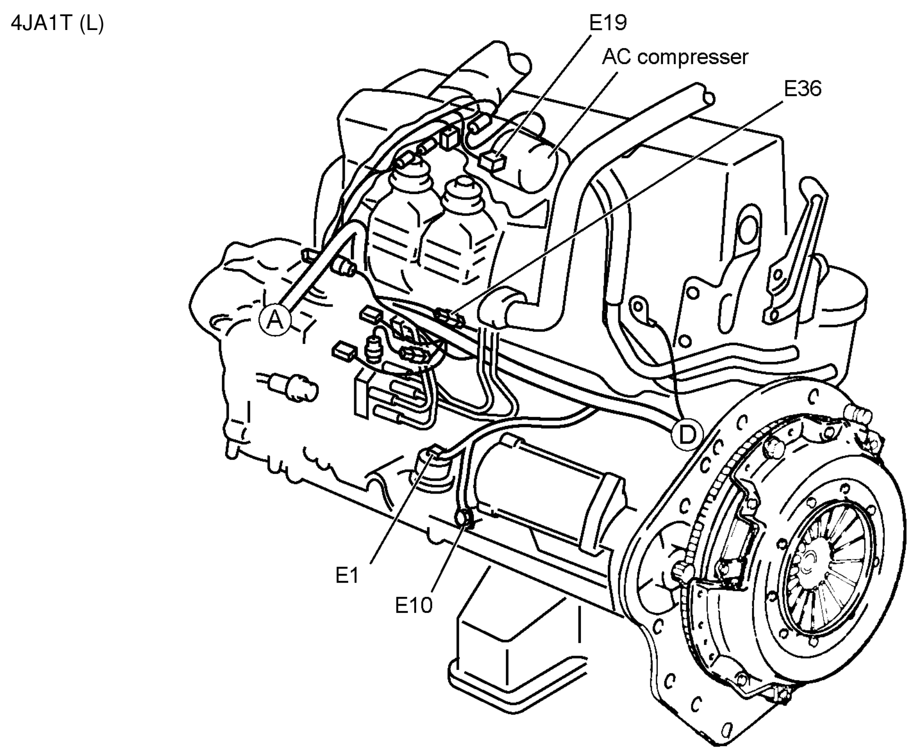
ENGINE HARNESS 4JH1-TC / 4JA1T (L)





4JA1-L

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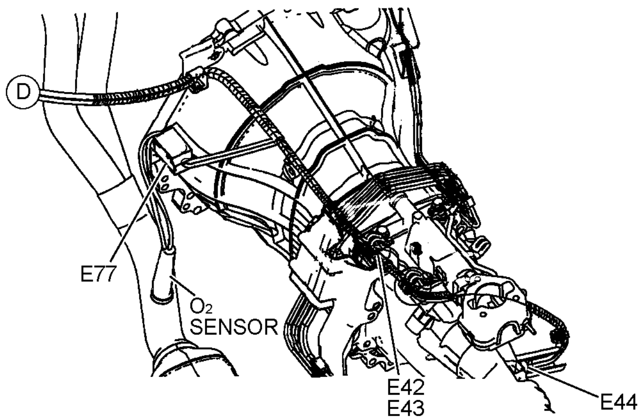
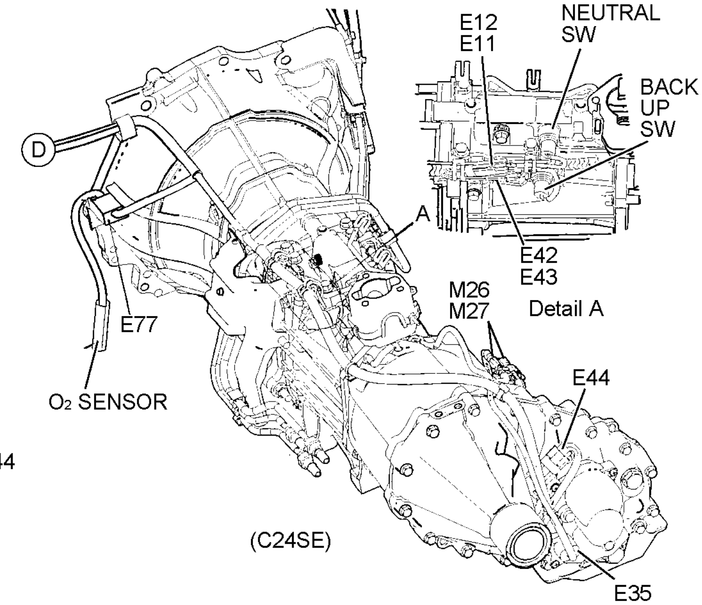
TRANSMISSION HARNESS

2WD M/T



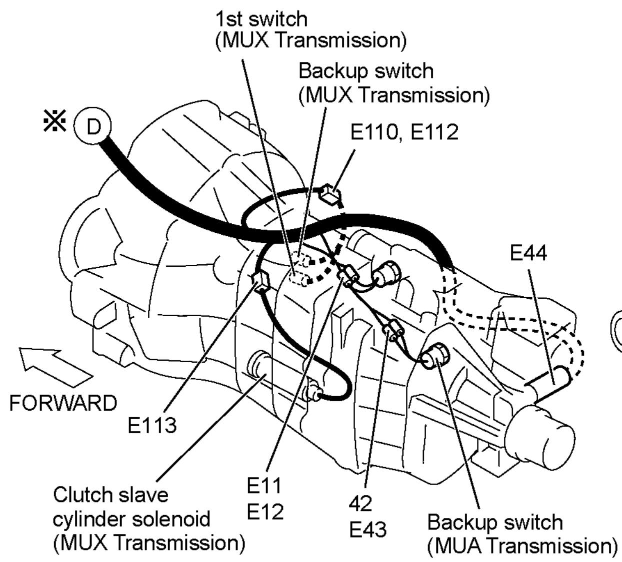
(C24SE)

4WD M/T

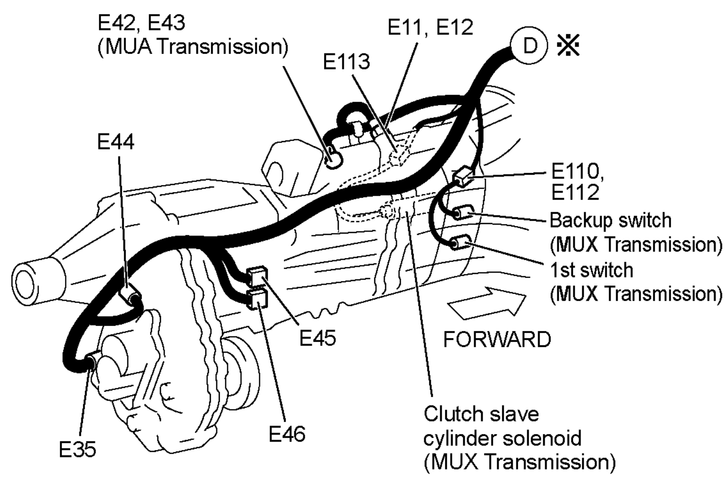


(C24SE)

2WD M/T



4WD M/T



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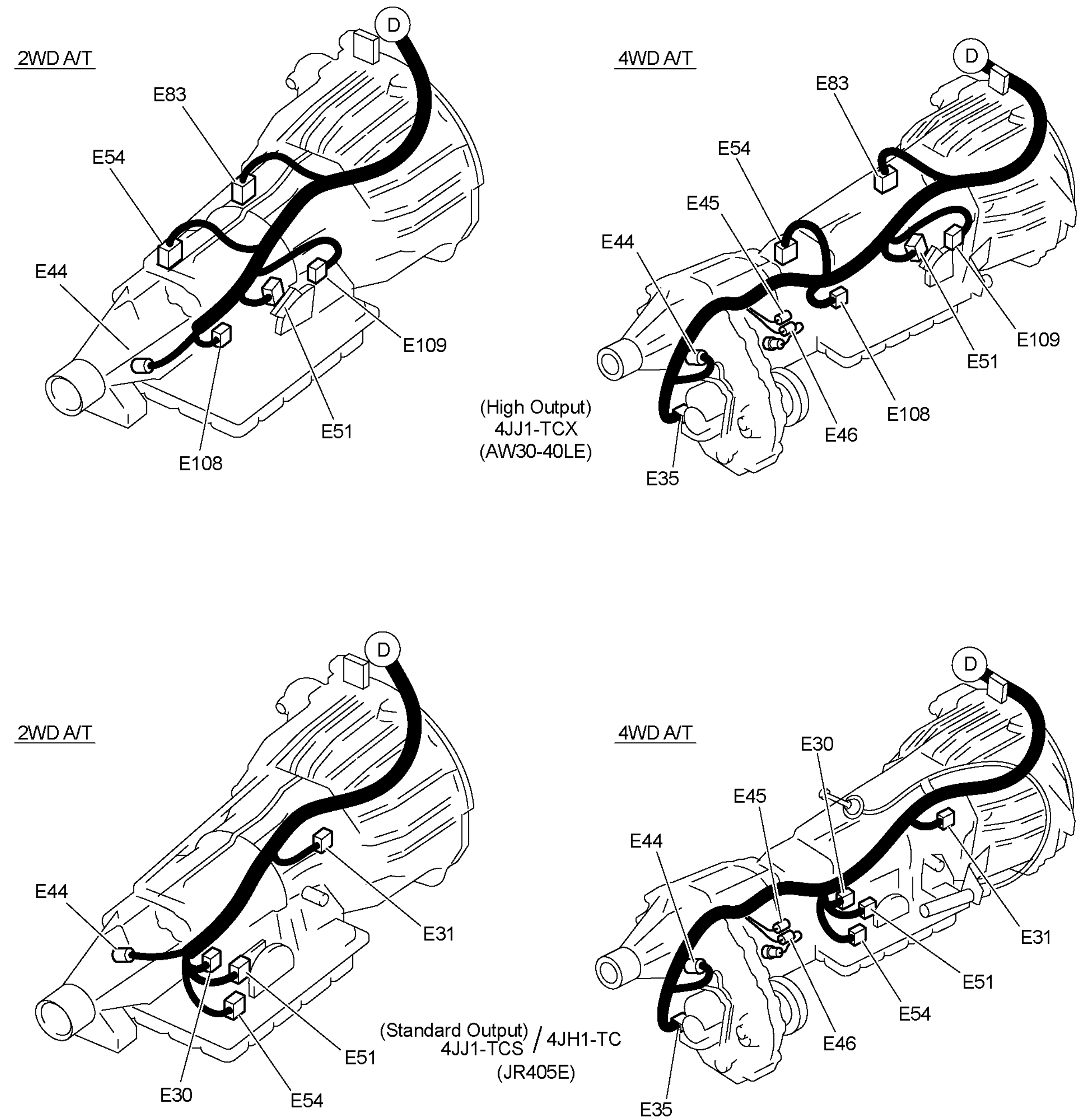
TRANSMISSION HARNESS

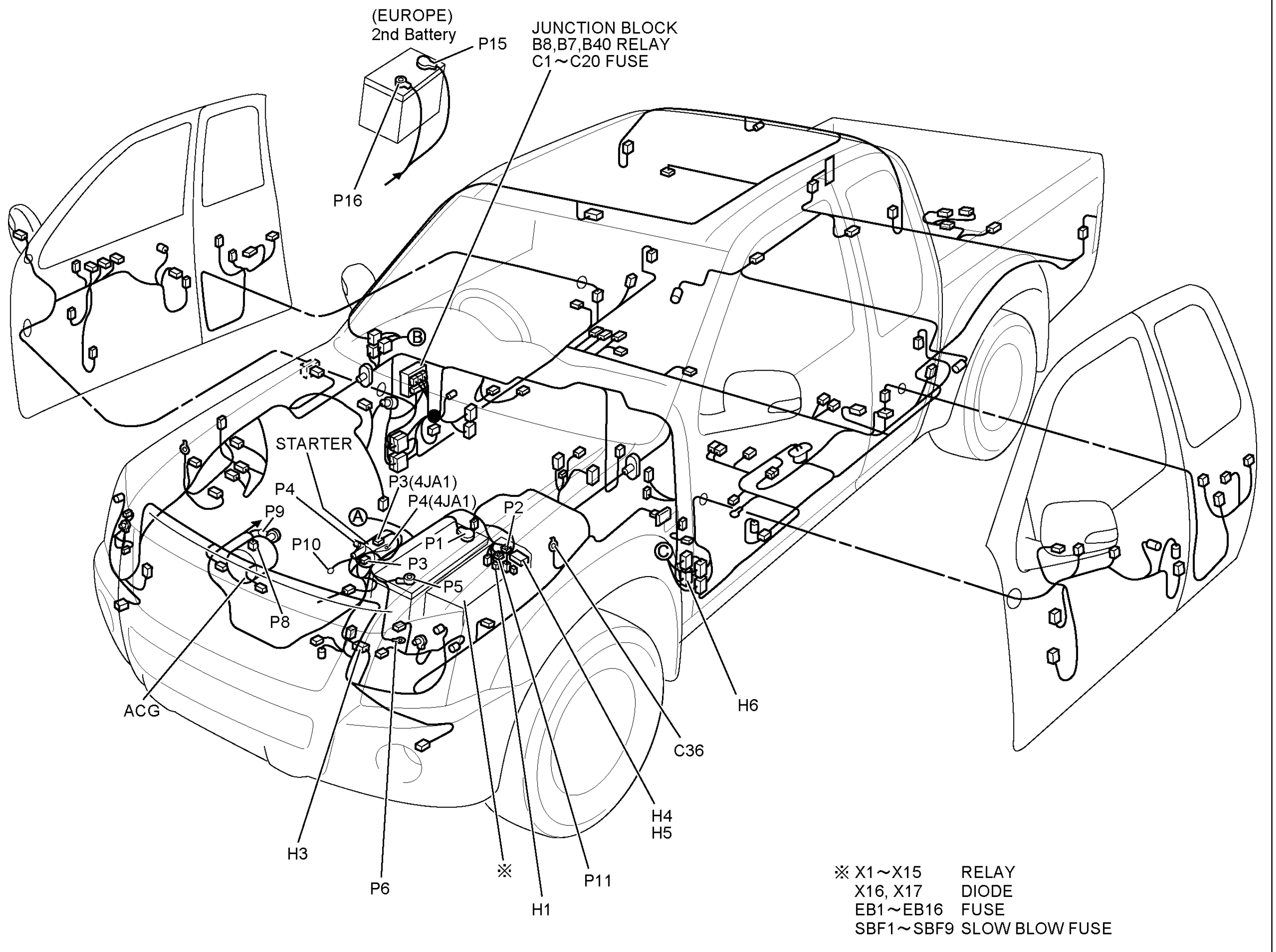


RTW78AXF035701

SYSTEM REPAIR

START AND CHARGING

PARTS LOCATION (RHD)



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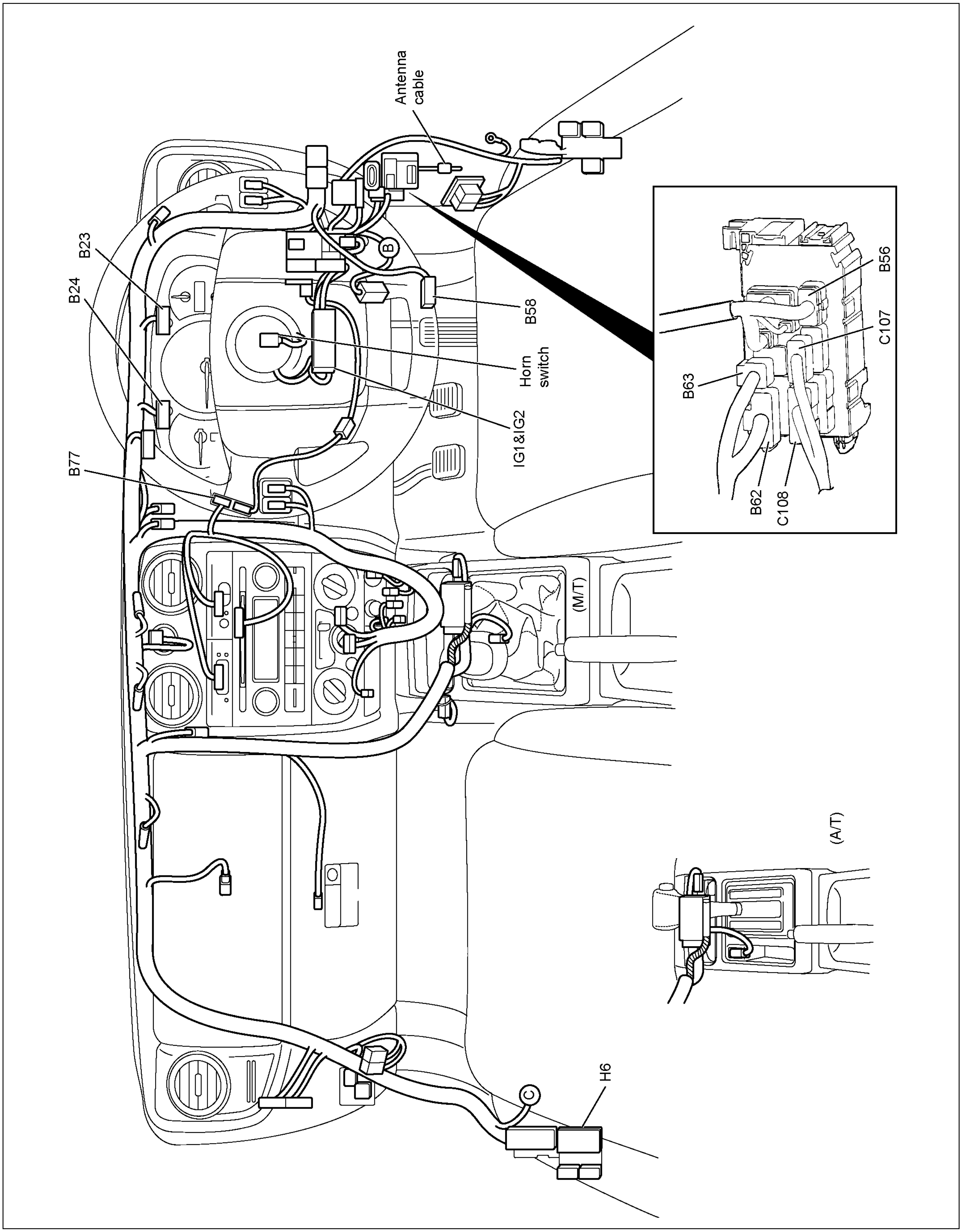
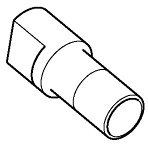
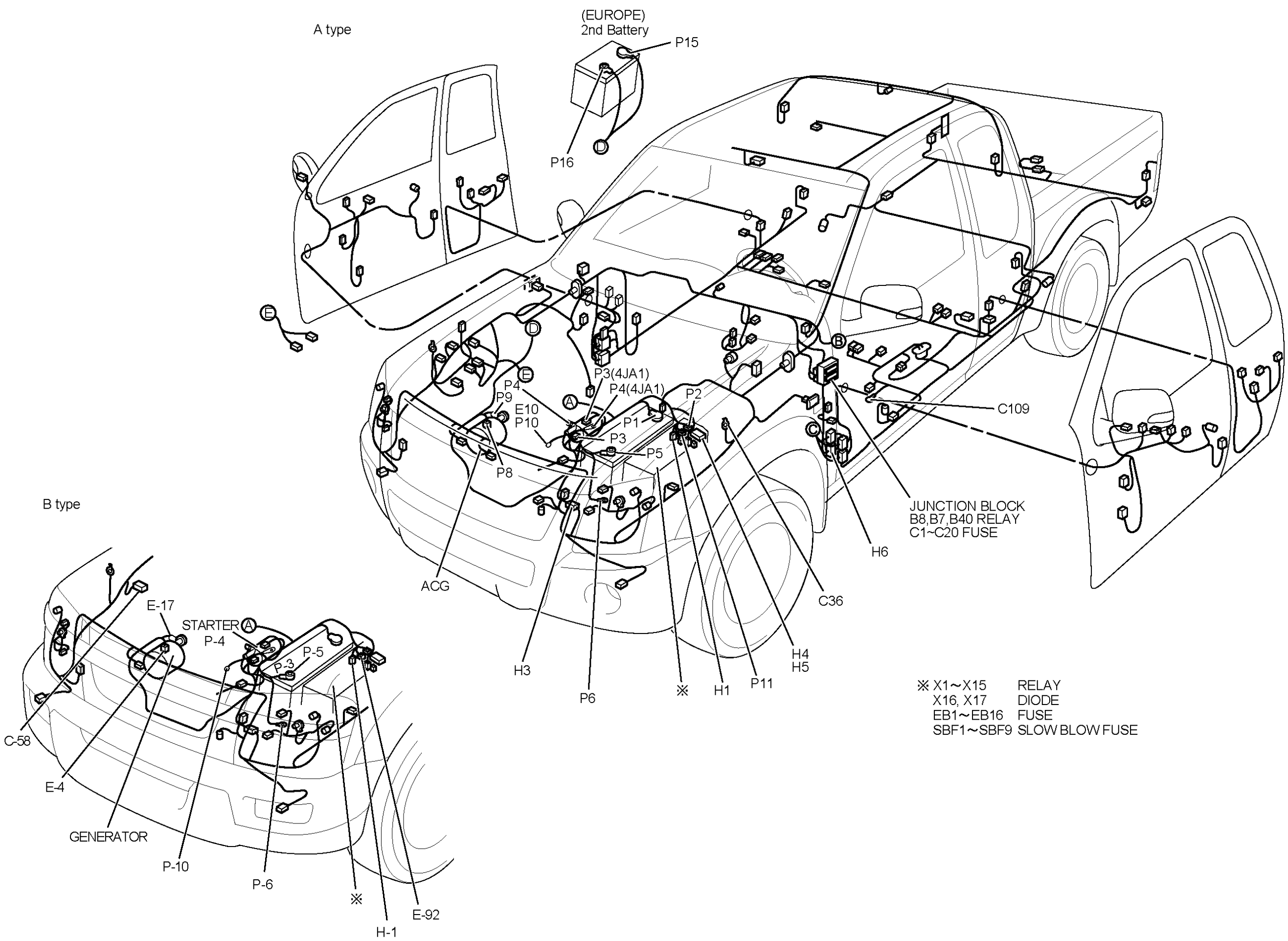
PARTS LOCATION (RHD)



RTW78AXF042301

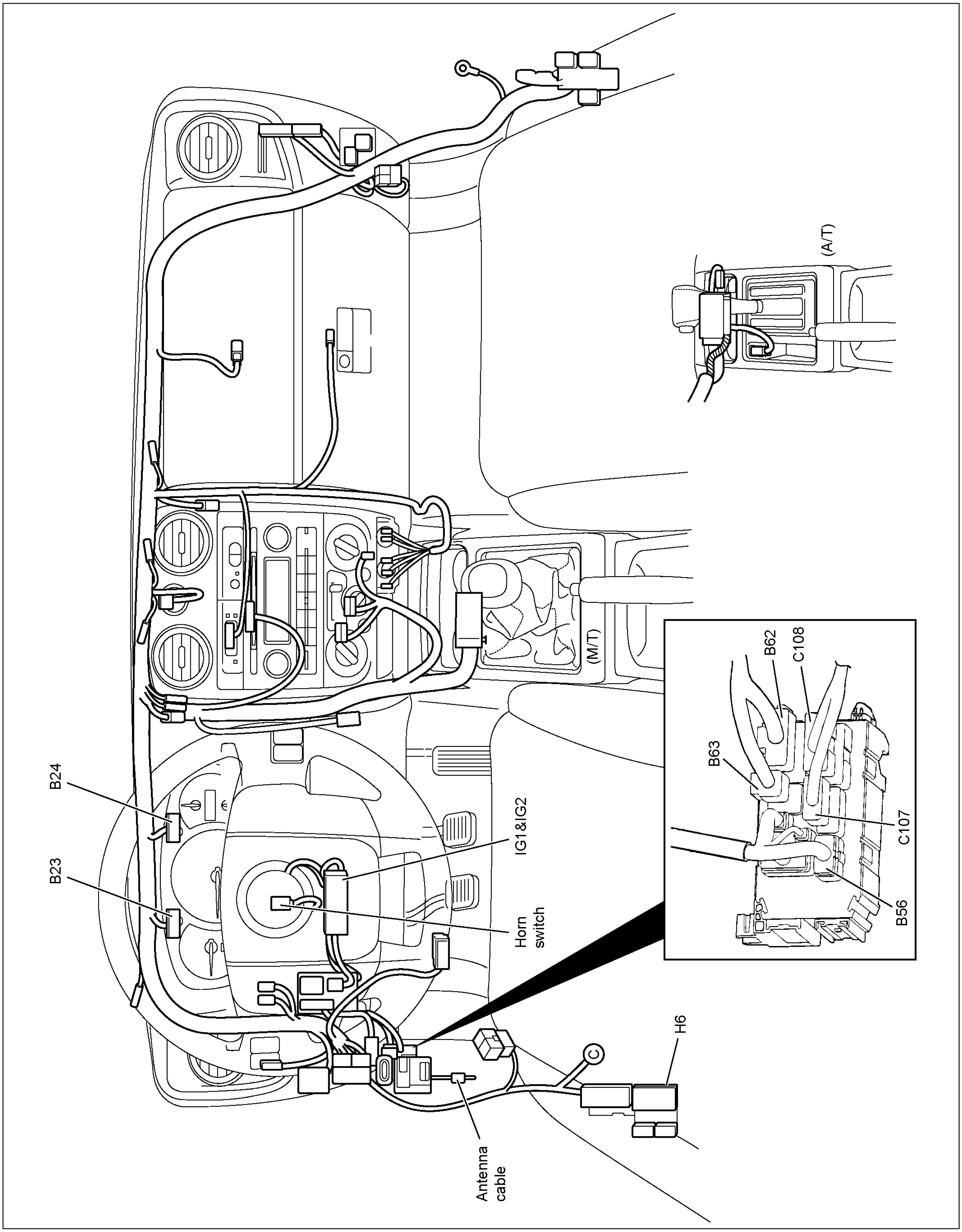
ILLUSTRATION	PART NO.	PART NAME
	5-8840-2682-0 (J-44450)	Sid Gear Holder

PARTS LOCATION (LHD)



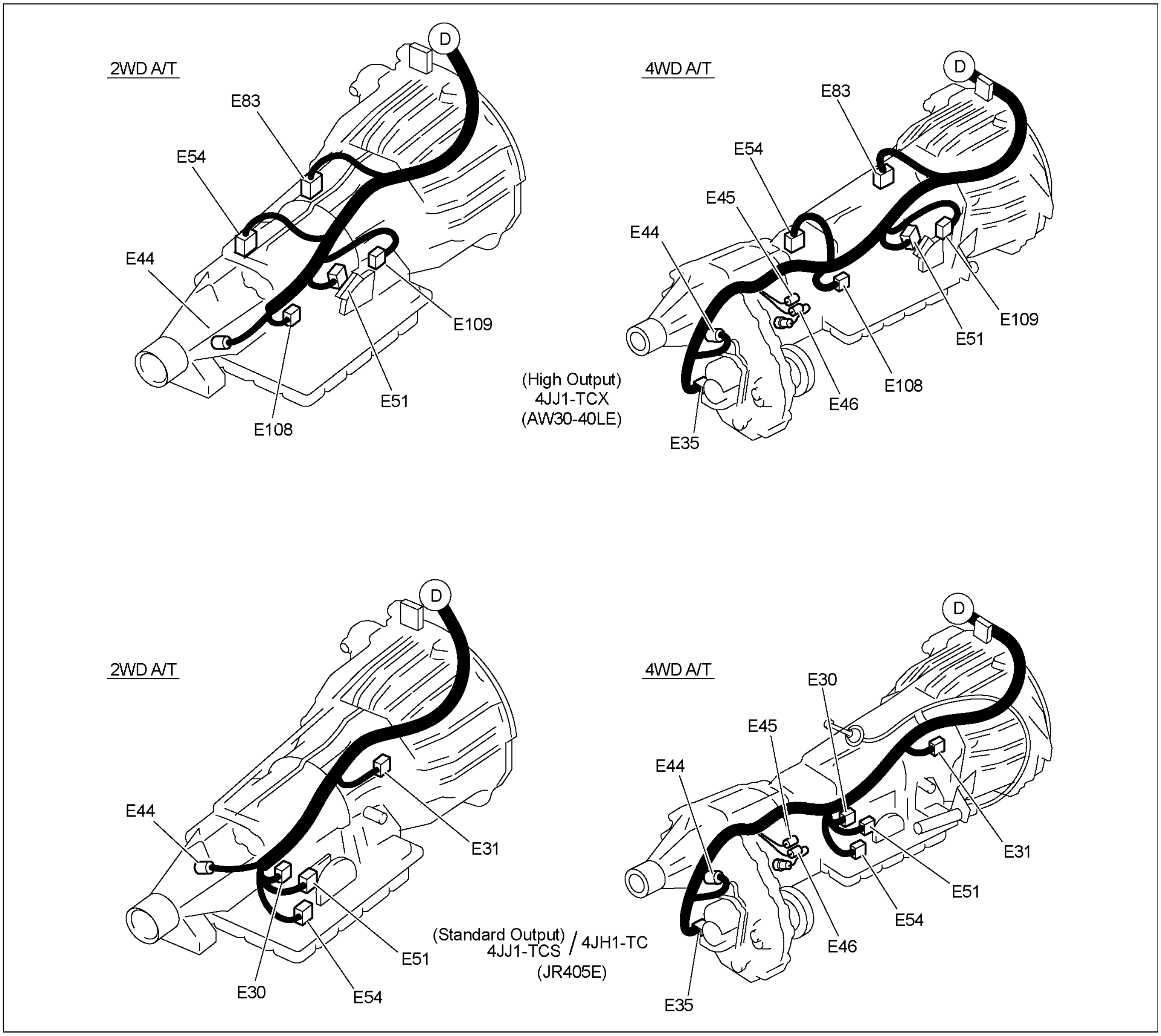
RTW78AXF036201

PARTS LOCATION (LHD)



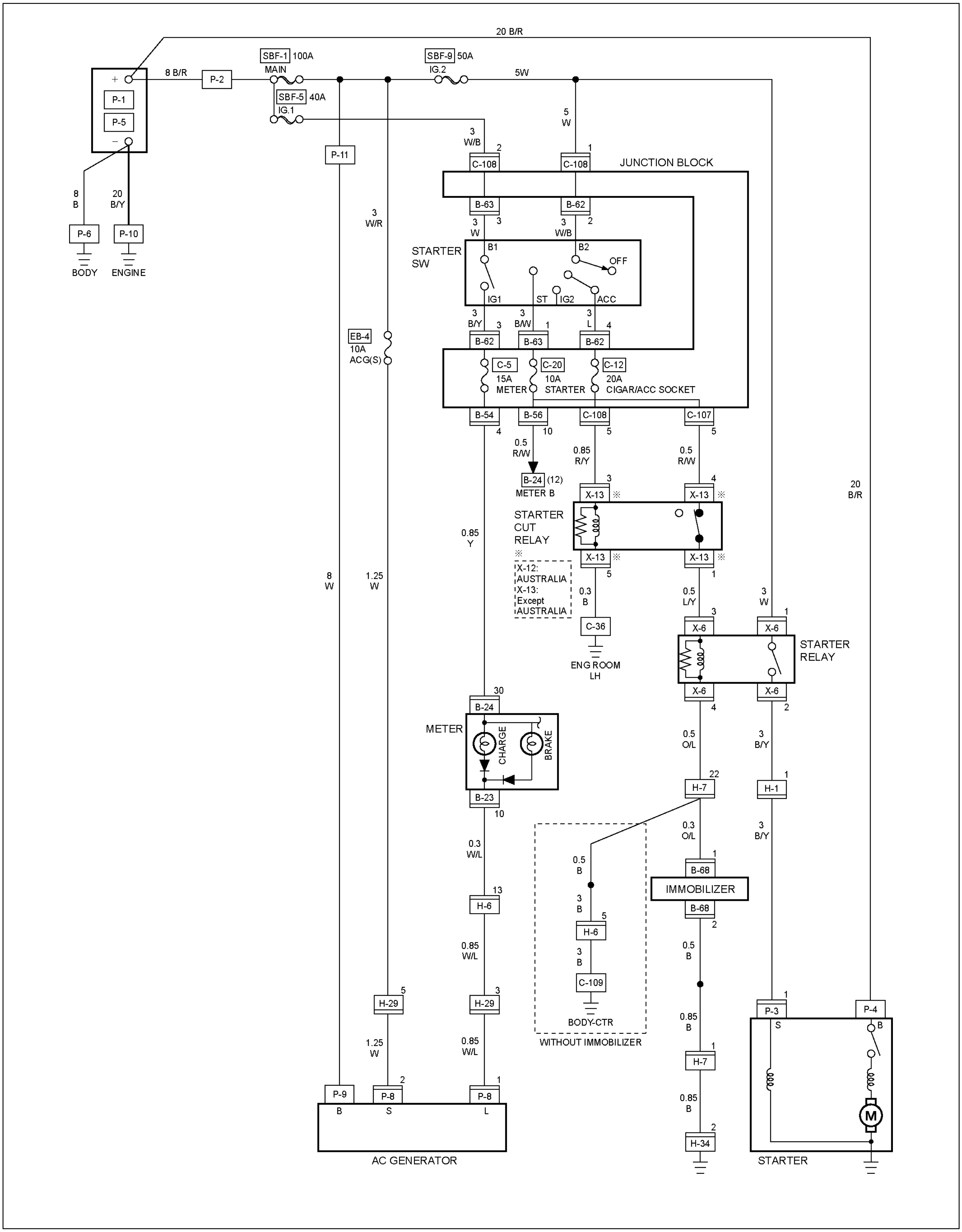
RTW78AXF042401

PARTS LOCATION



RTW78AXF035701

CIRCUIT DIAGRAM C24SE



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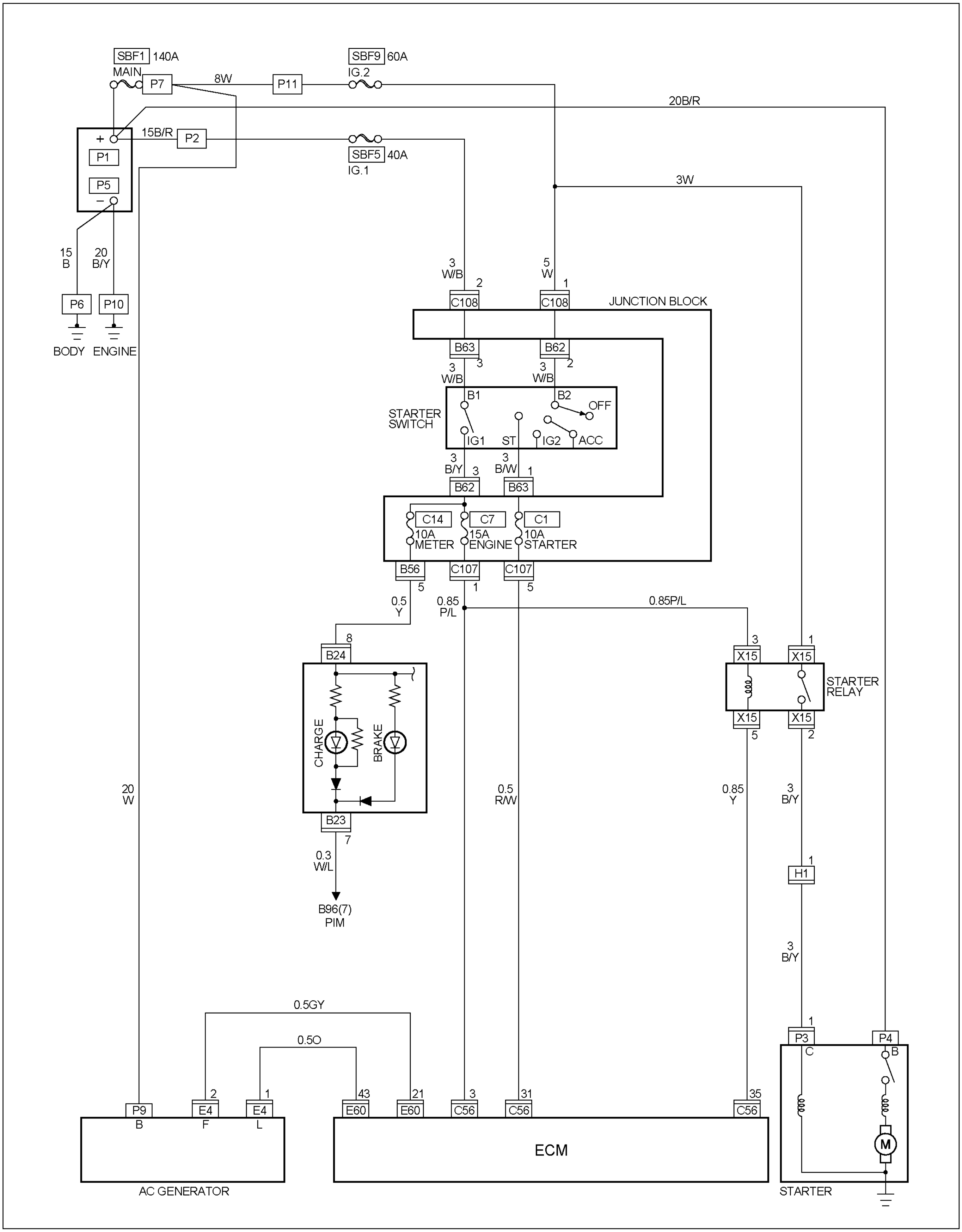
CIRCUIT DIAGRAM HFV6



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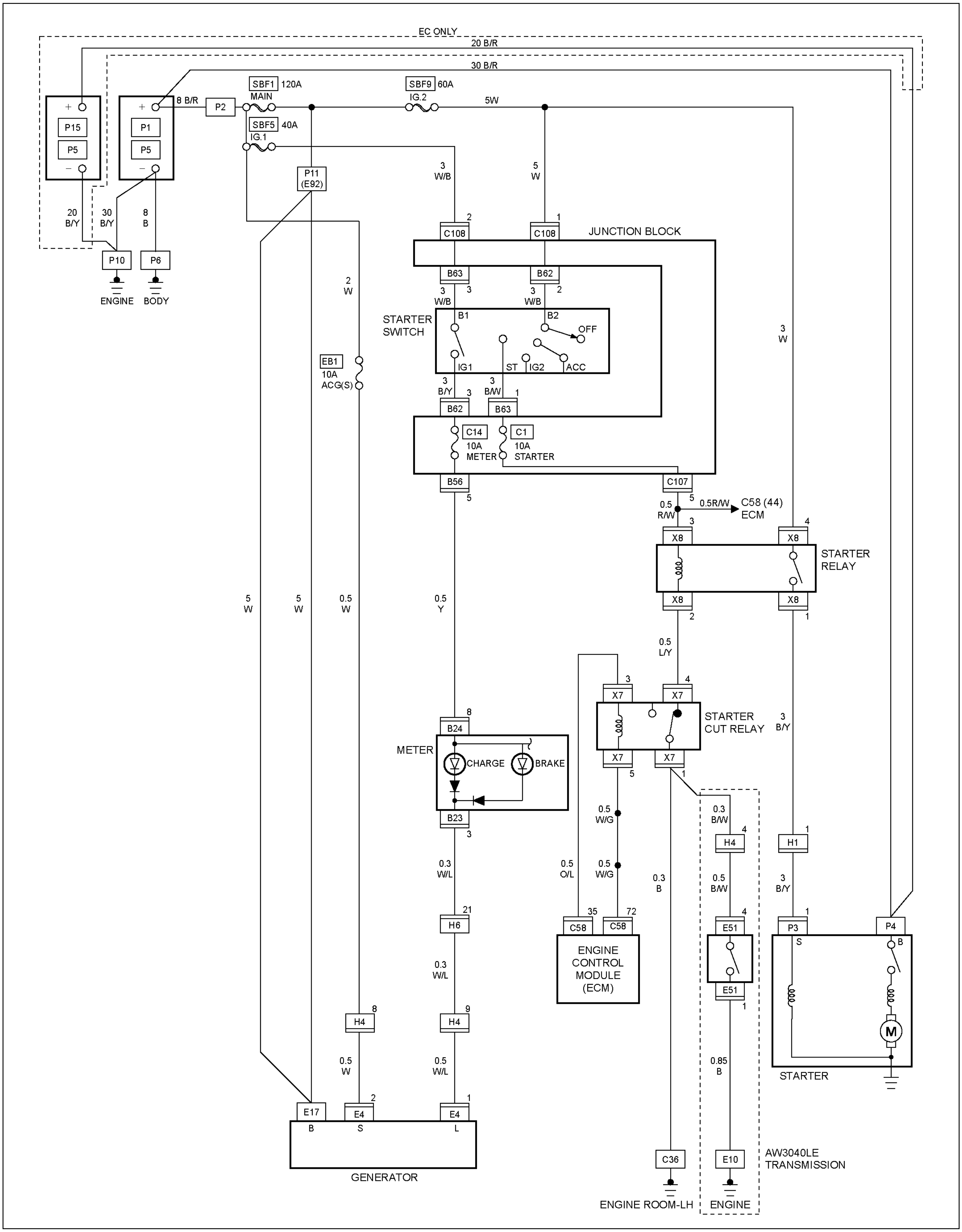
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC



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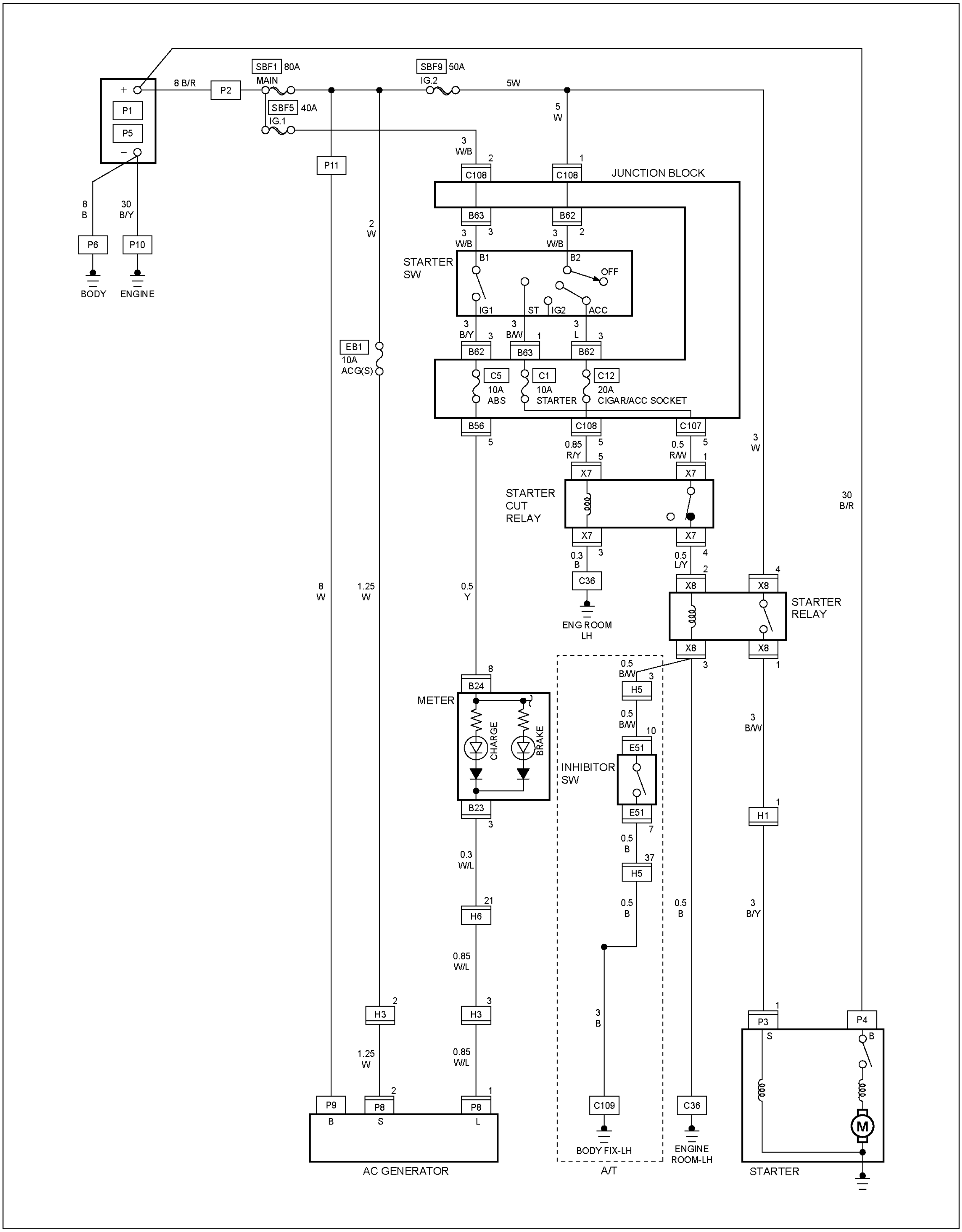
CIRCUIT DIAGRAM 4JH1-TC (LHD)



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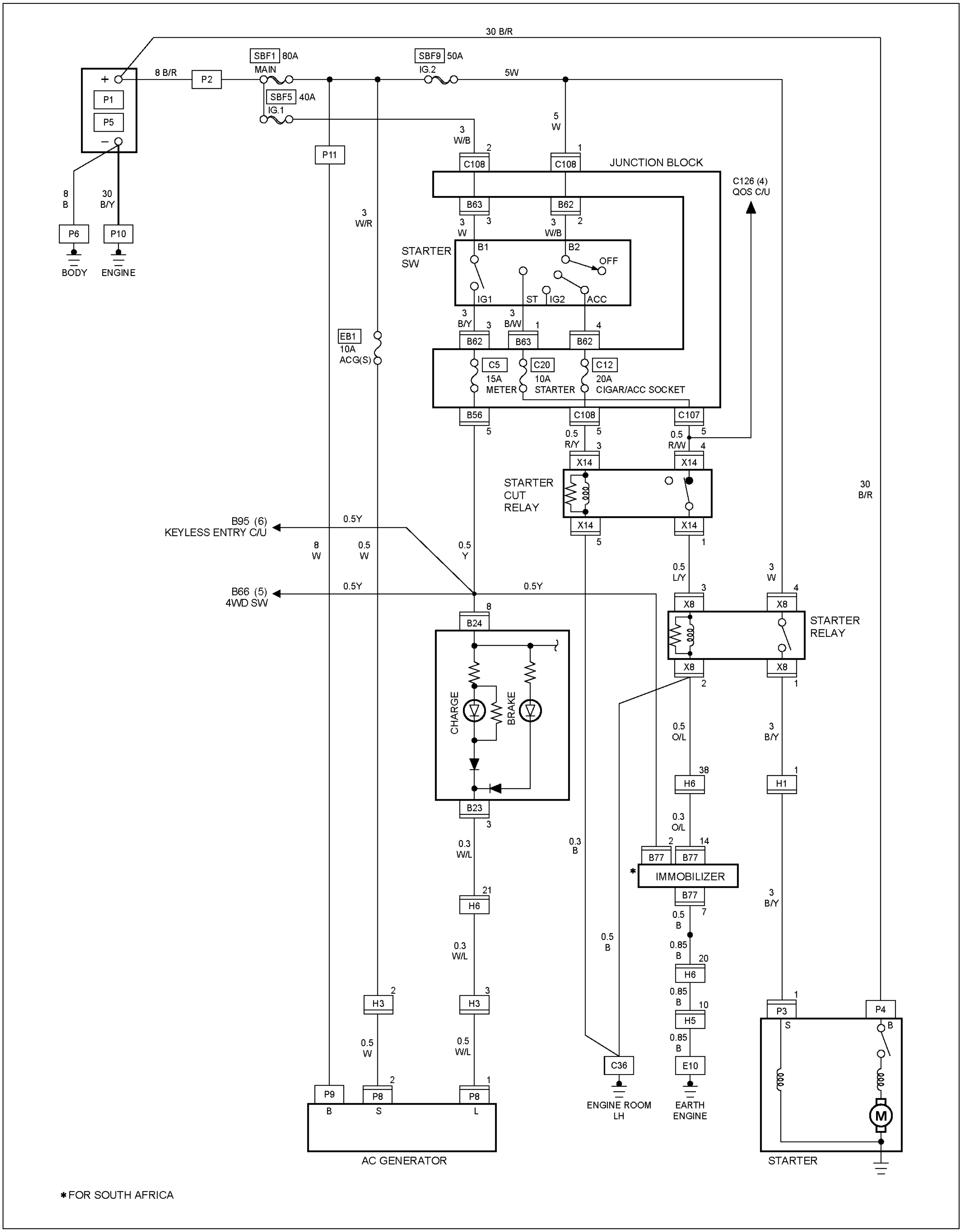
CIRCUIT DIAGRAM 4JA1T (L)



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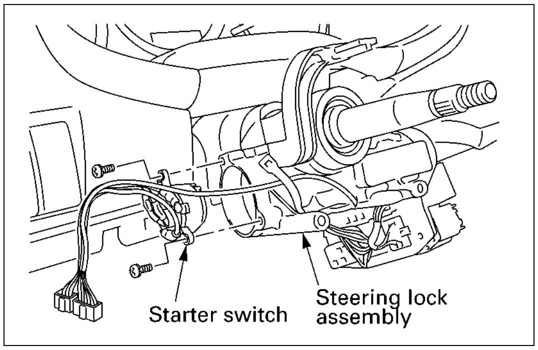
REMOVAL AND INSTALLATION



This illustration is based on RHD model

STARTER SWITCH

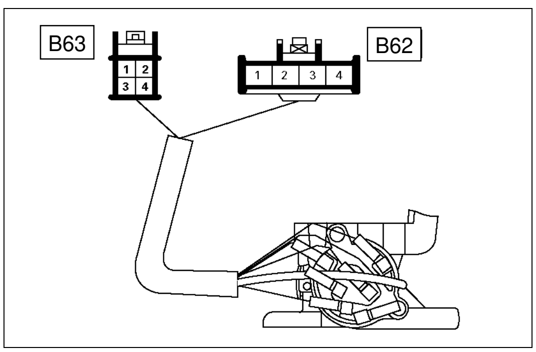
Removal

1. Steering Lock Assembly
   - Refer to Section 3B" STEERING COLUMN" for steering lock assembly removal steps.
2. Starter Switch

Installation

Follow the removal procedure in the reverse order to install the starter switch.

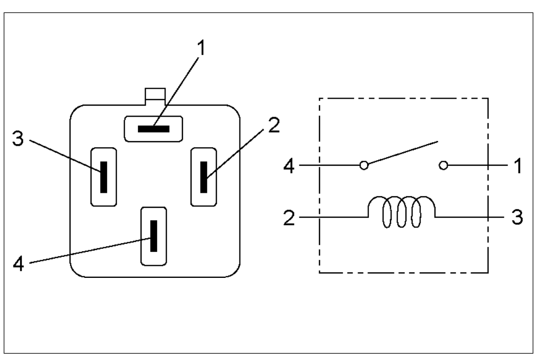
INSPECTION AND REPAIR



STARTER SWITCH

Switch Connections

Starter switch key position \ Terminal No.		B62 2 (B2)	B62 4 (ACC)	B62 1 (IG2)	B63 1 (ST)	B63 3 (B1)	B62 3 (IG1)
LOCK	Removed		⊗—	—⊗			
	Inserted						
OFF							
ACC		○—	—○				
ON		○—	—○—	—○		○—	—○
START		○—	—	—	—○	○—	—○



RTW78ASH003001

Starter relay

Check continuity between the relay terminals.

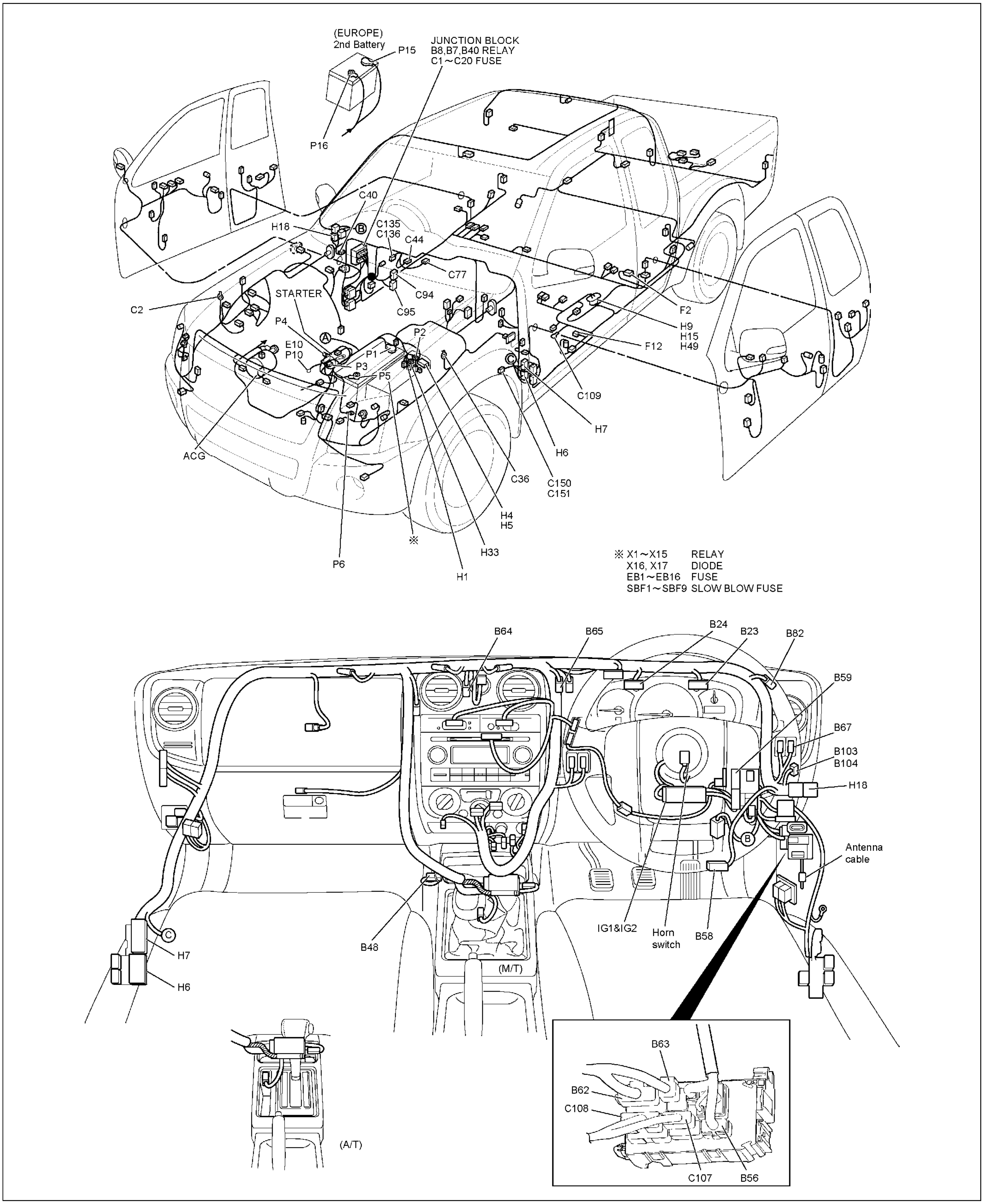
① - ④ .... No continuity

(When battery voltage is applied between ② and ③)

① - ④ .... Continuity

ENGINE CONTROL MODULE (ECM)

PARTS LOCATION (RHD)



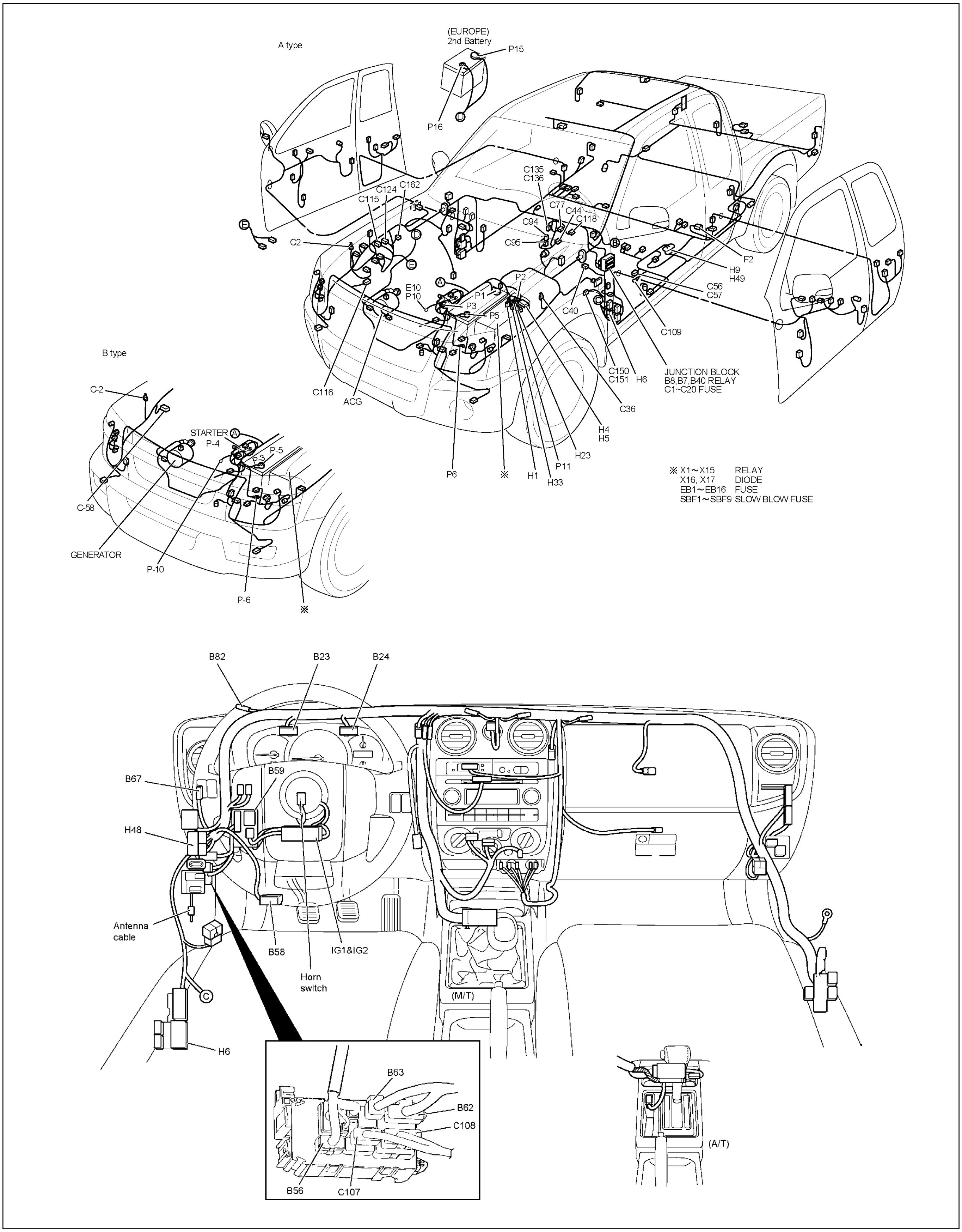
RTW78AXF036301 & RTW78AXF042501

SECTION 4C1

FRONT WHEEL DRIVE

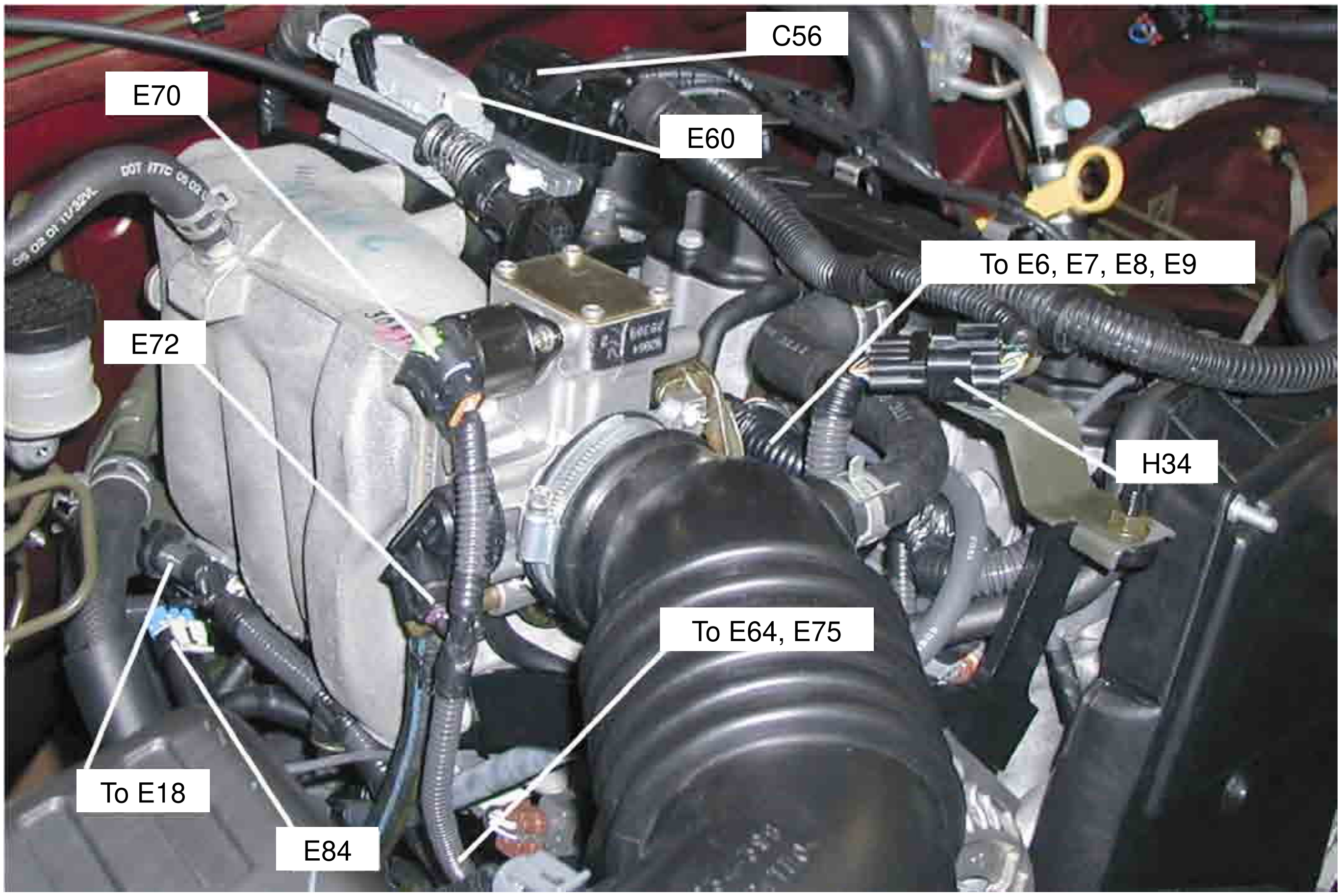
TABLE OF CONTENTS

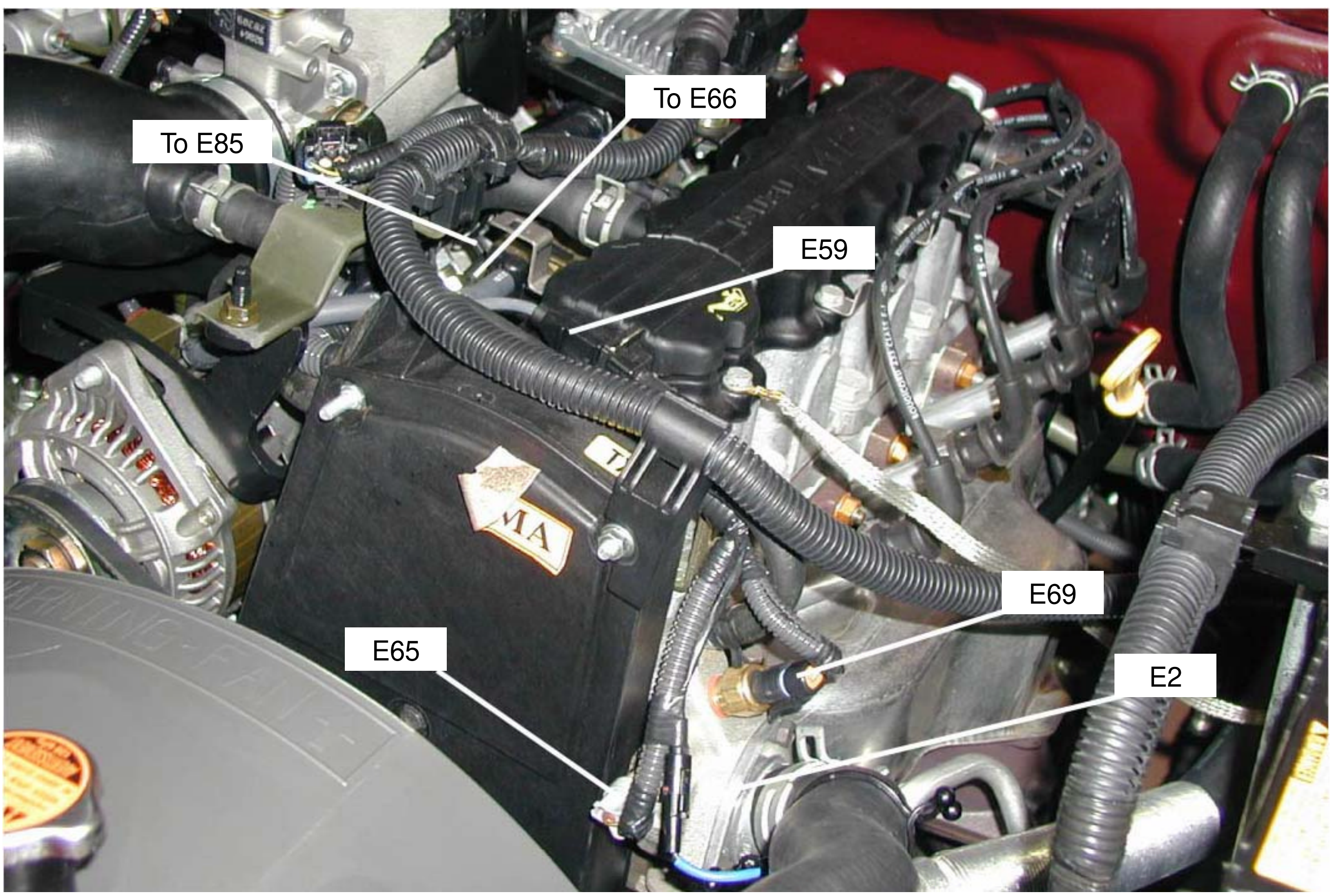
PARTS LOCATION (LHD)



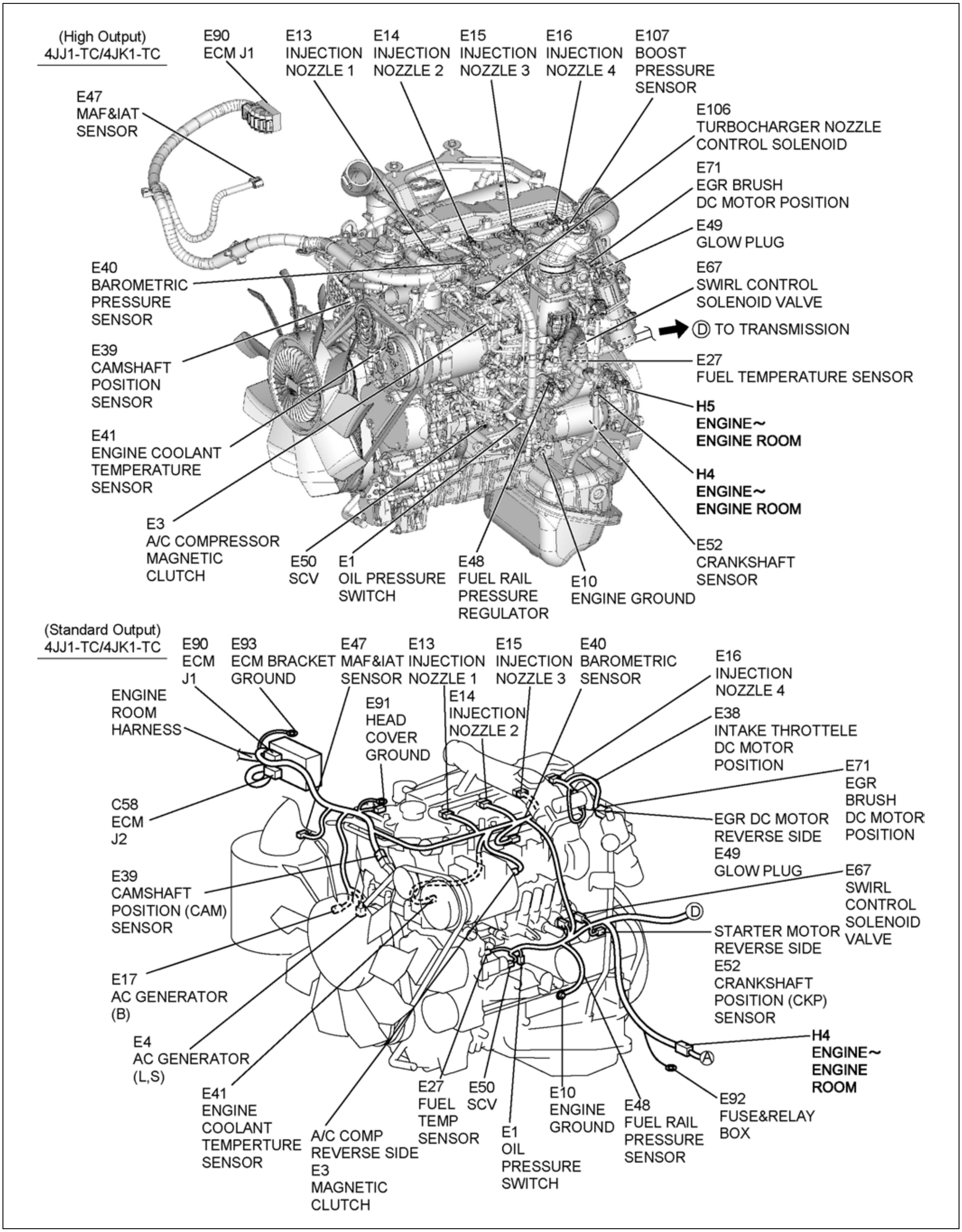
RTW78AXF036401 & RTW78AXF042601

PARTS LOCATION C24SE





PARTS LOCATION 4JJ1-TC/4JK1-TC



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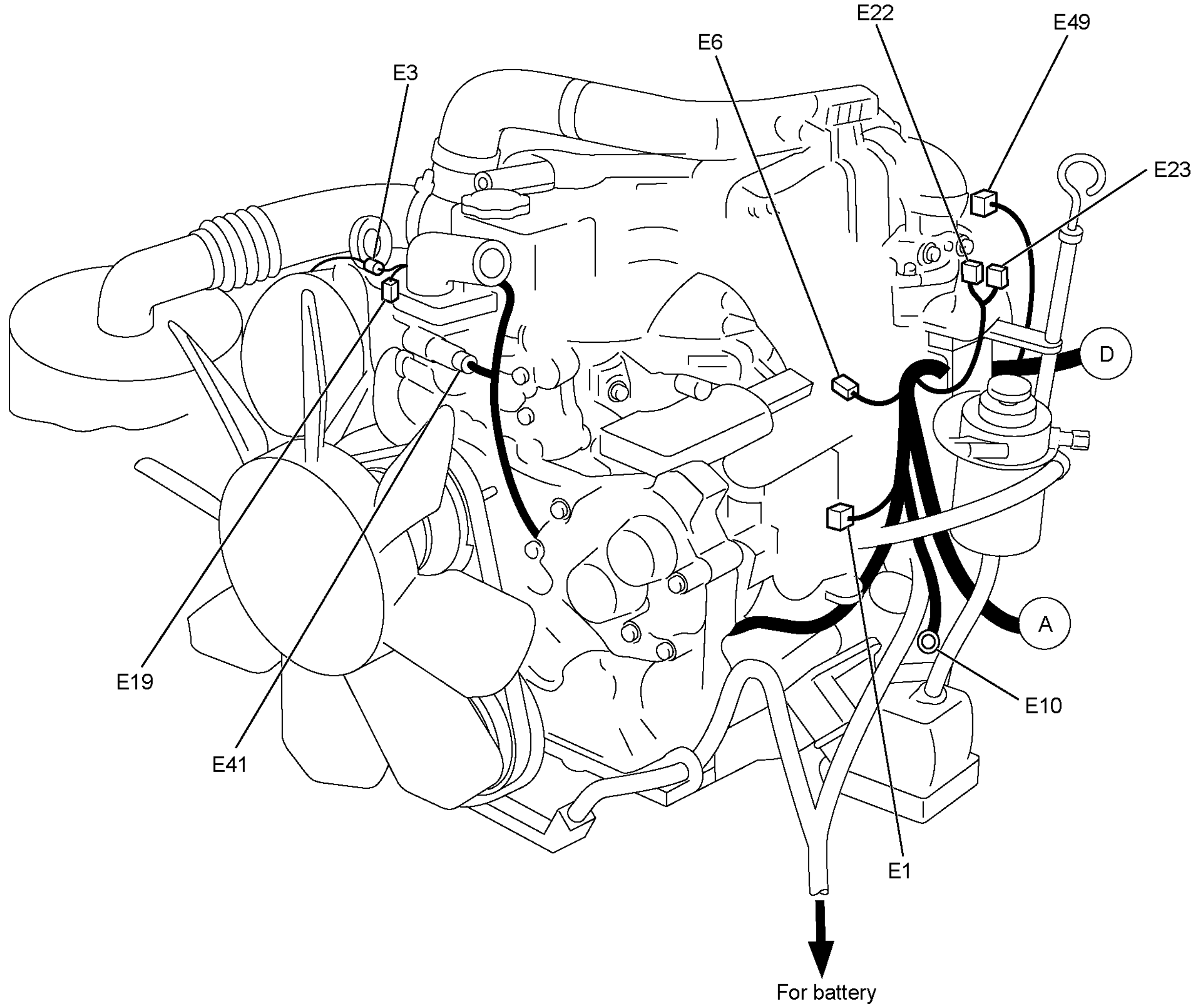
PARTS LOCATION 4JH1-TC



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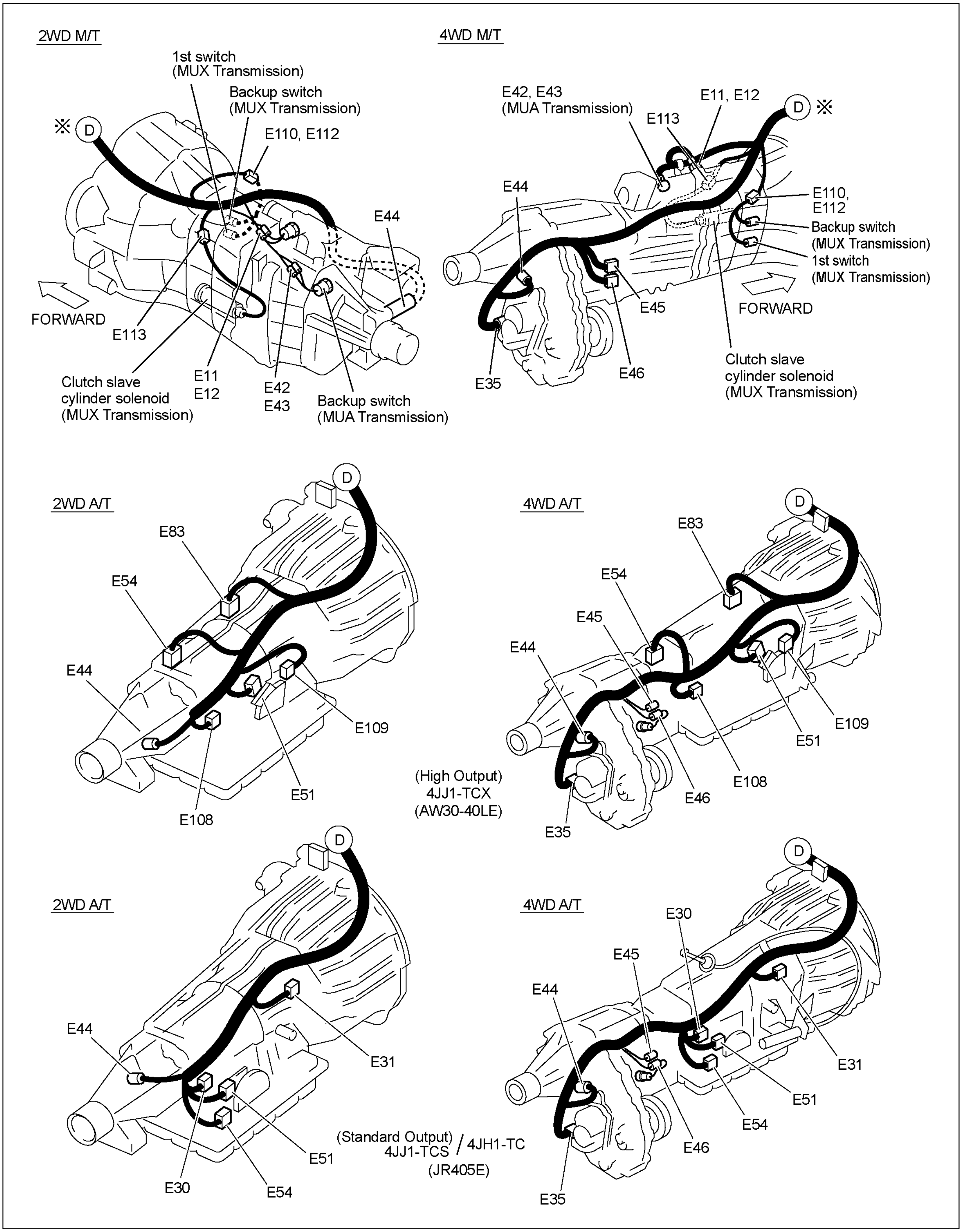

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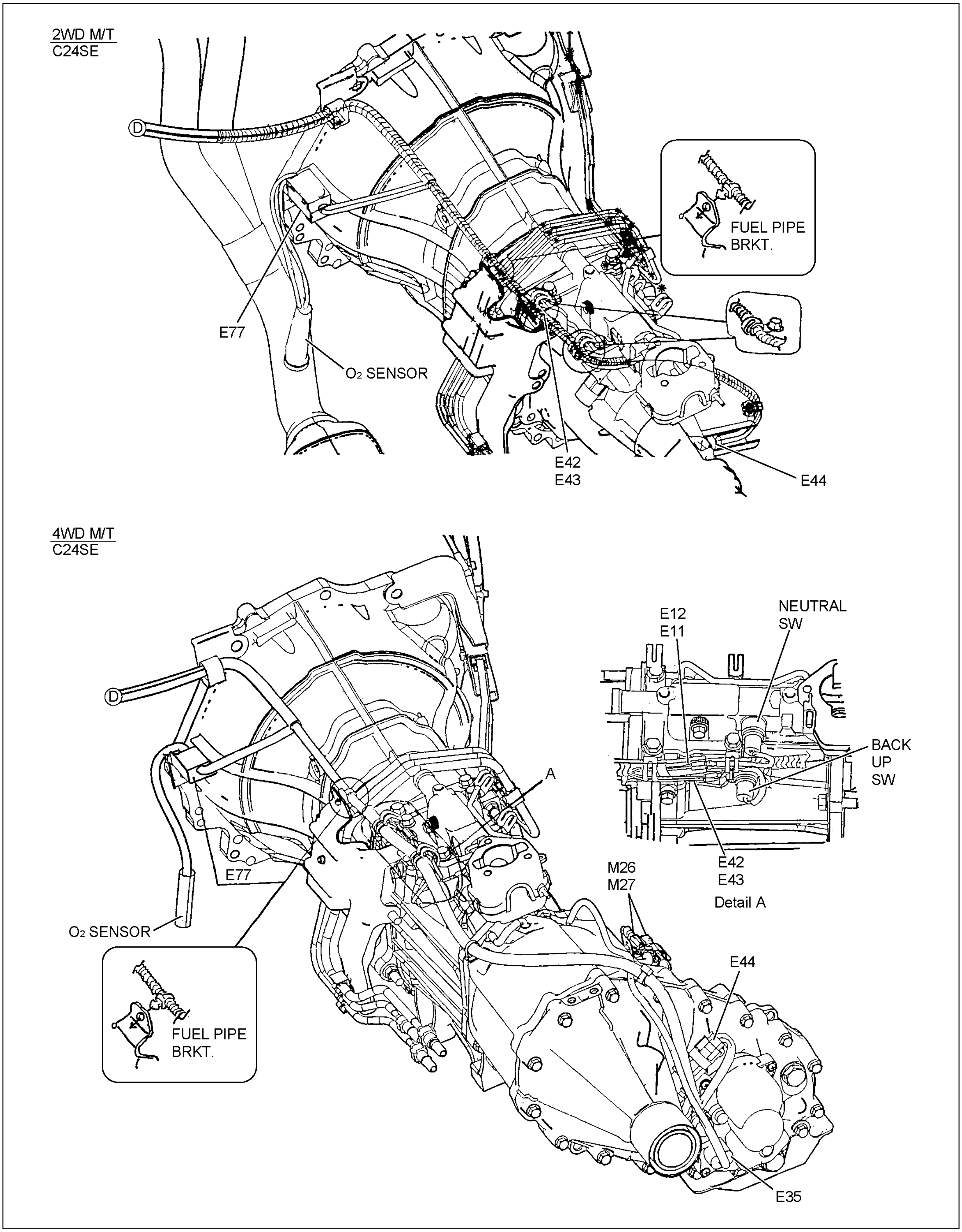
PARTS LOCATION



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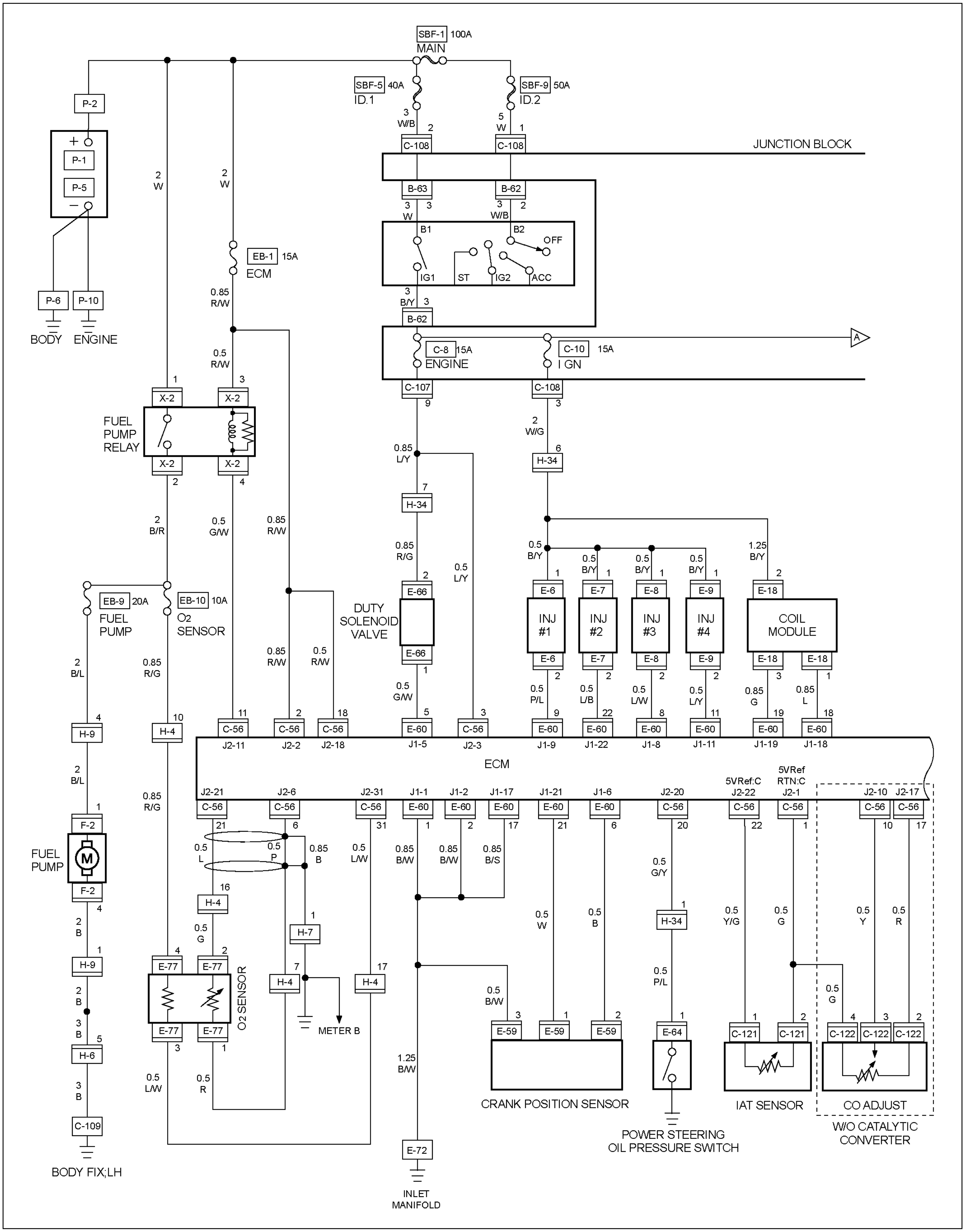
CIRCUIT DIAGRAM C24SE

Sheet 1/2



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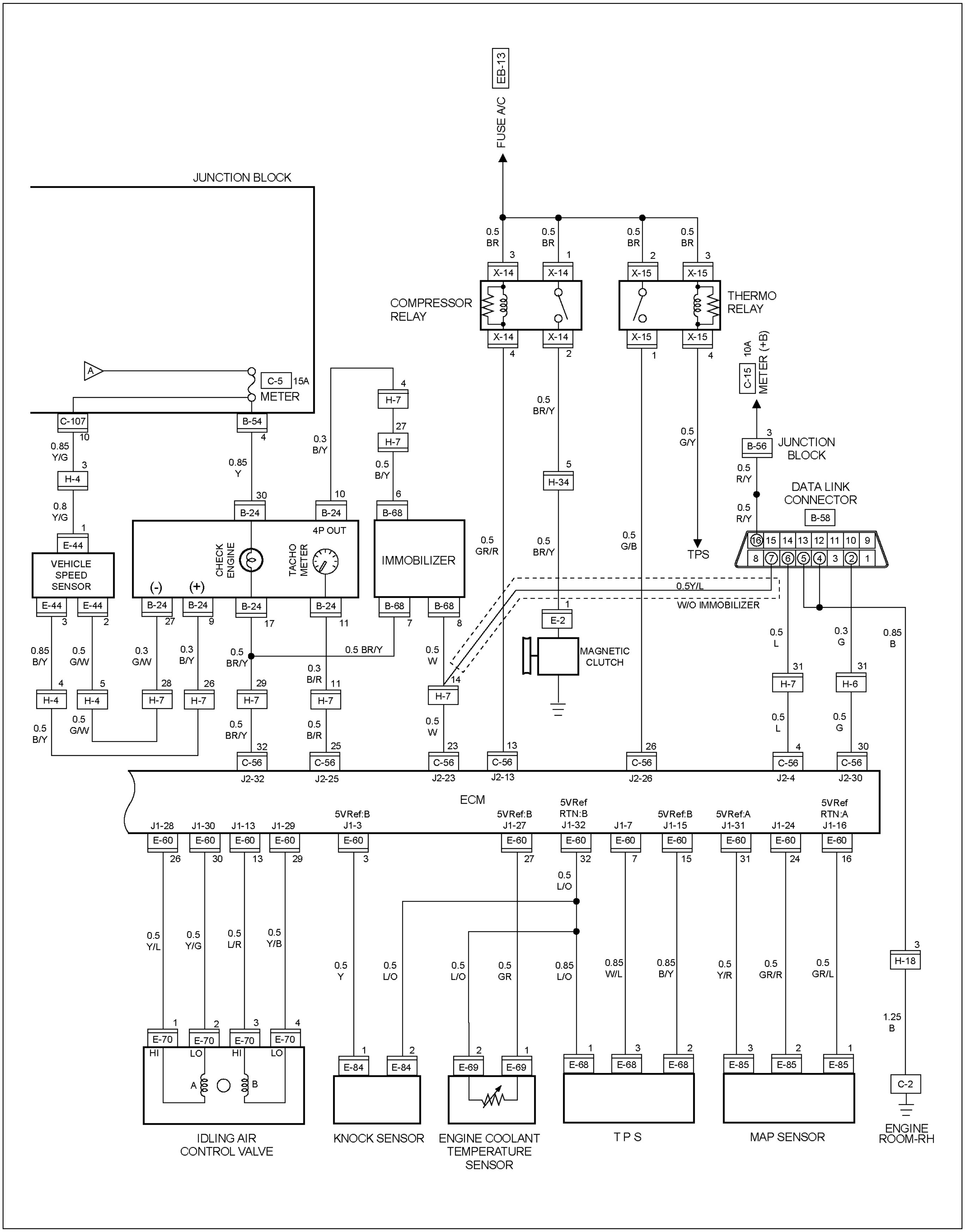
CIRCUIT DIAGRAM C24SE

Sheet 2/2



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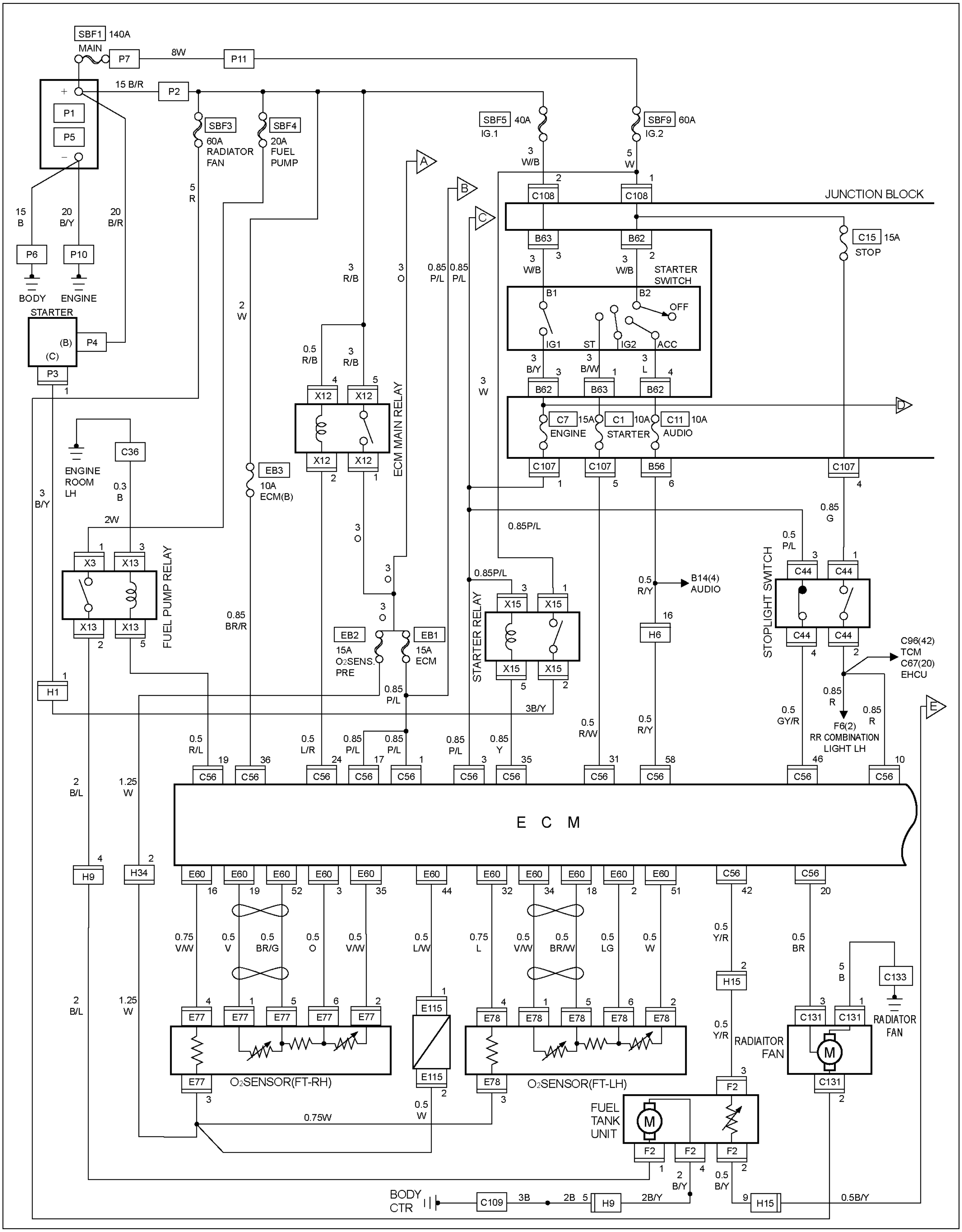
CIRCUIT DIAGRAM HFV6

Sheet 1/3



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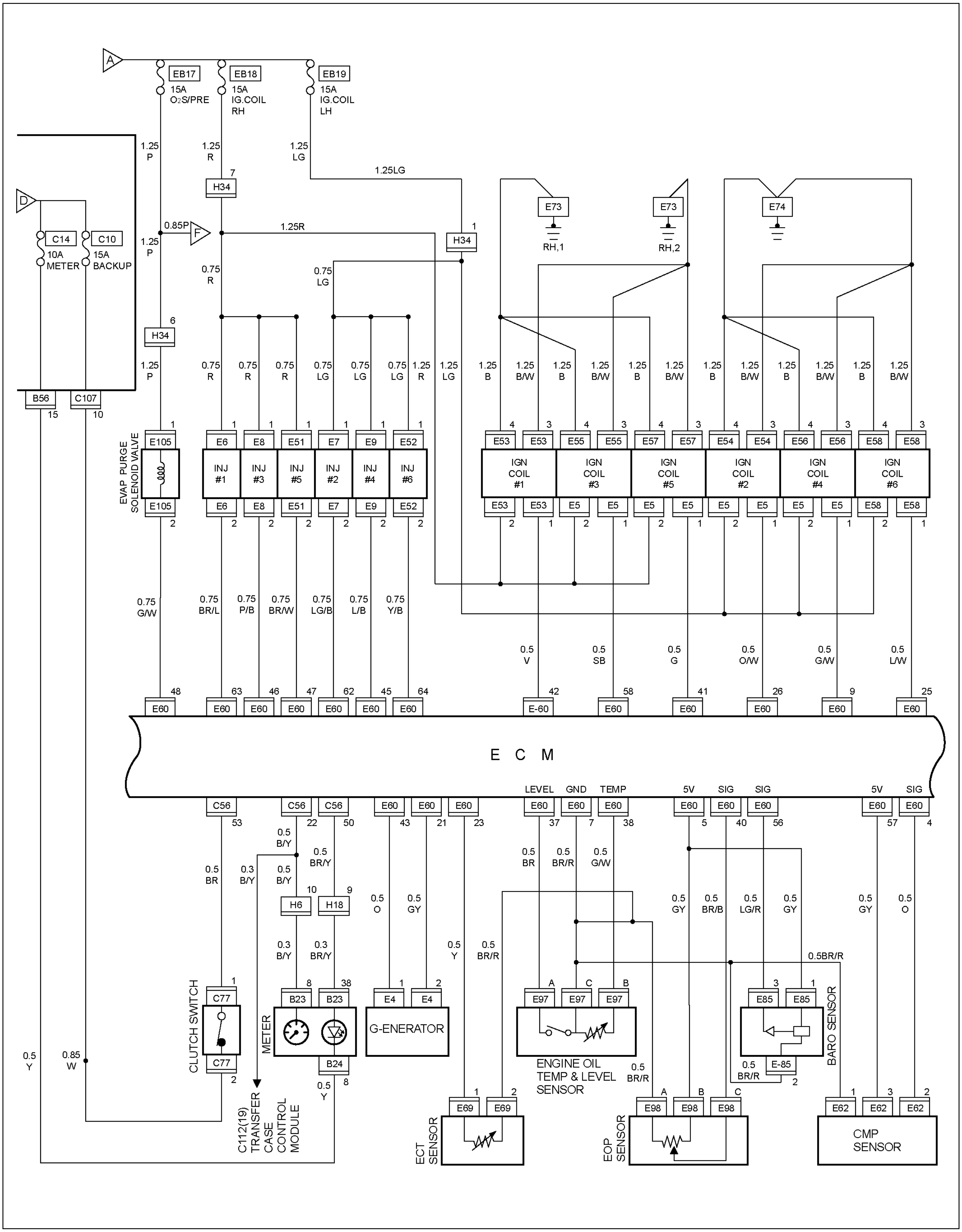
CIRCUIT DIAGRAM HFV6

Sheet 2/3



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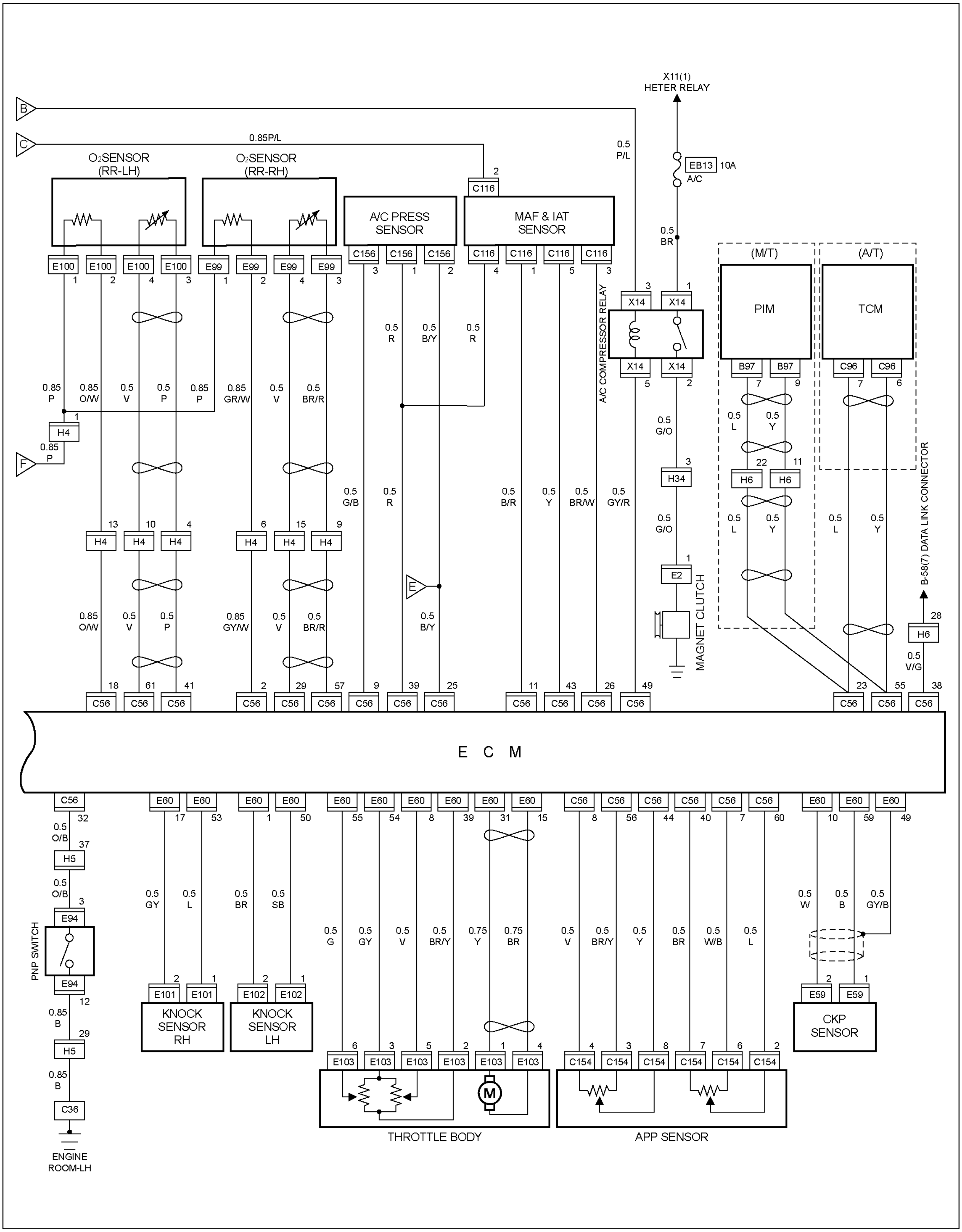
CIRCUIT DIAGRAM HFV6

Sheet 3/3



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BACK TO CHAPTER INDEX

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

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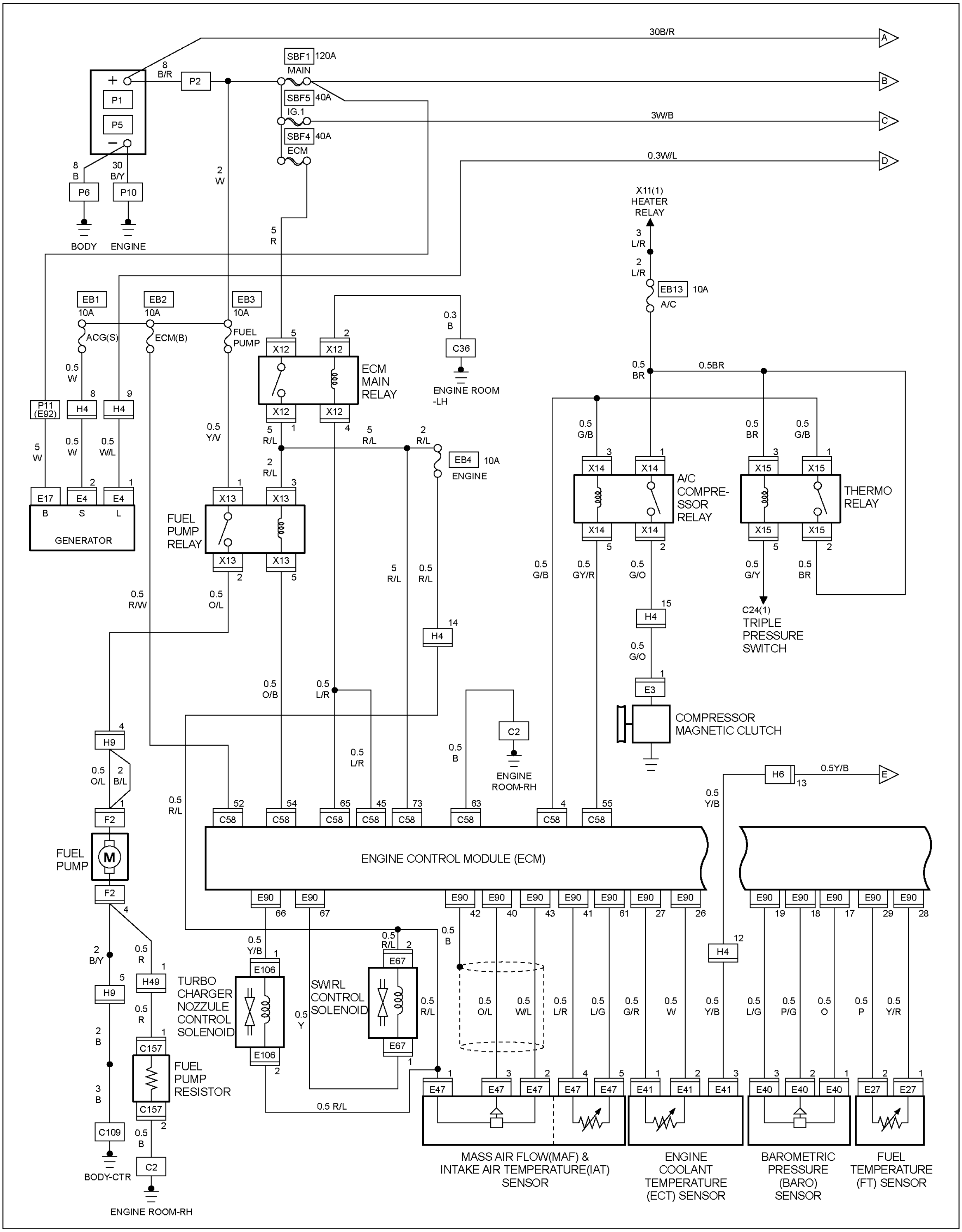

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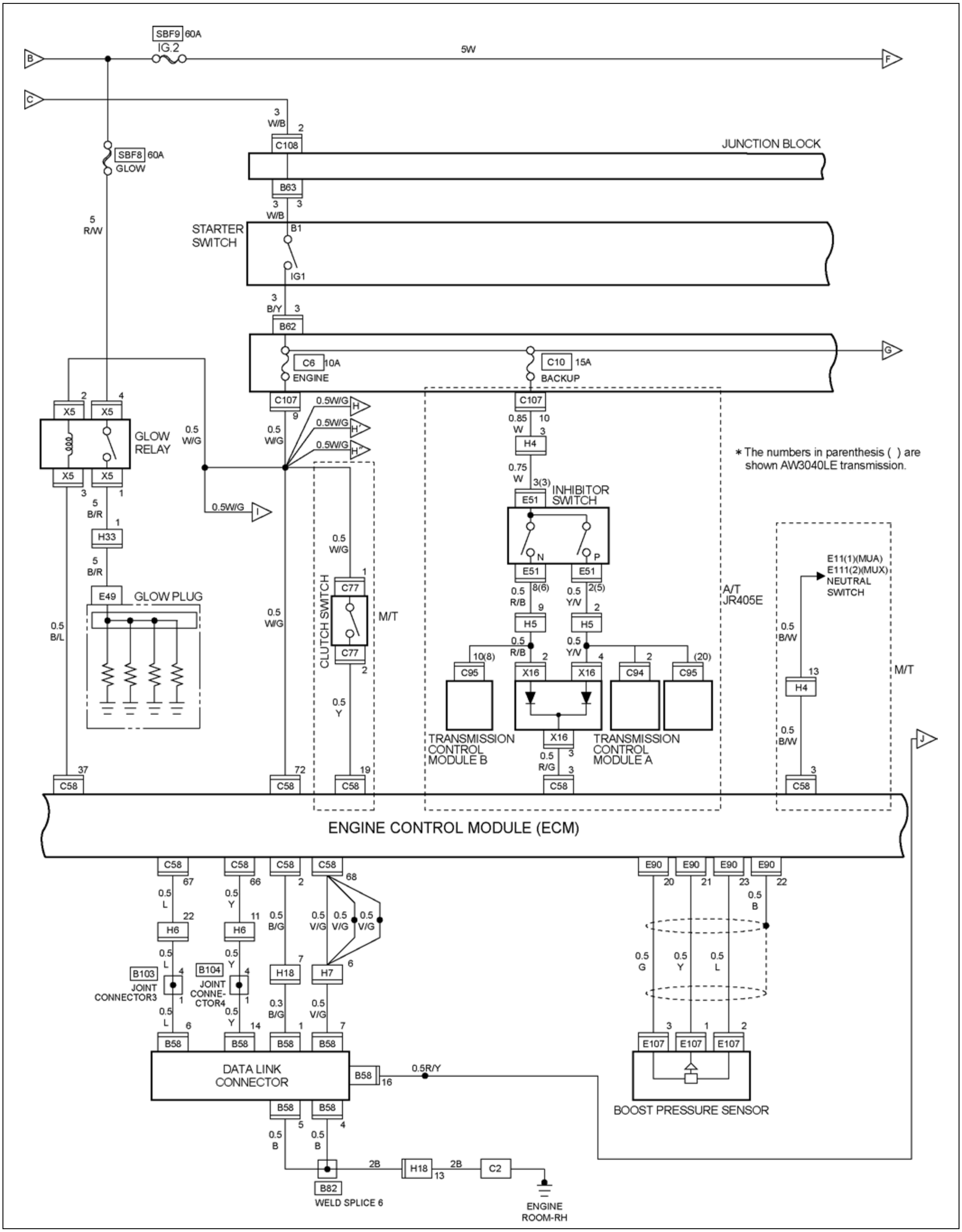
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 2/5



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CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

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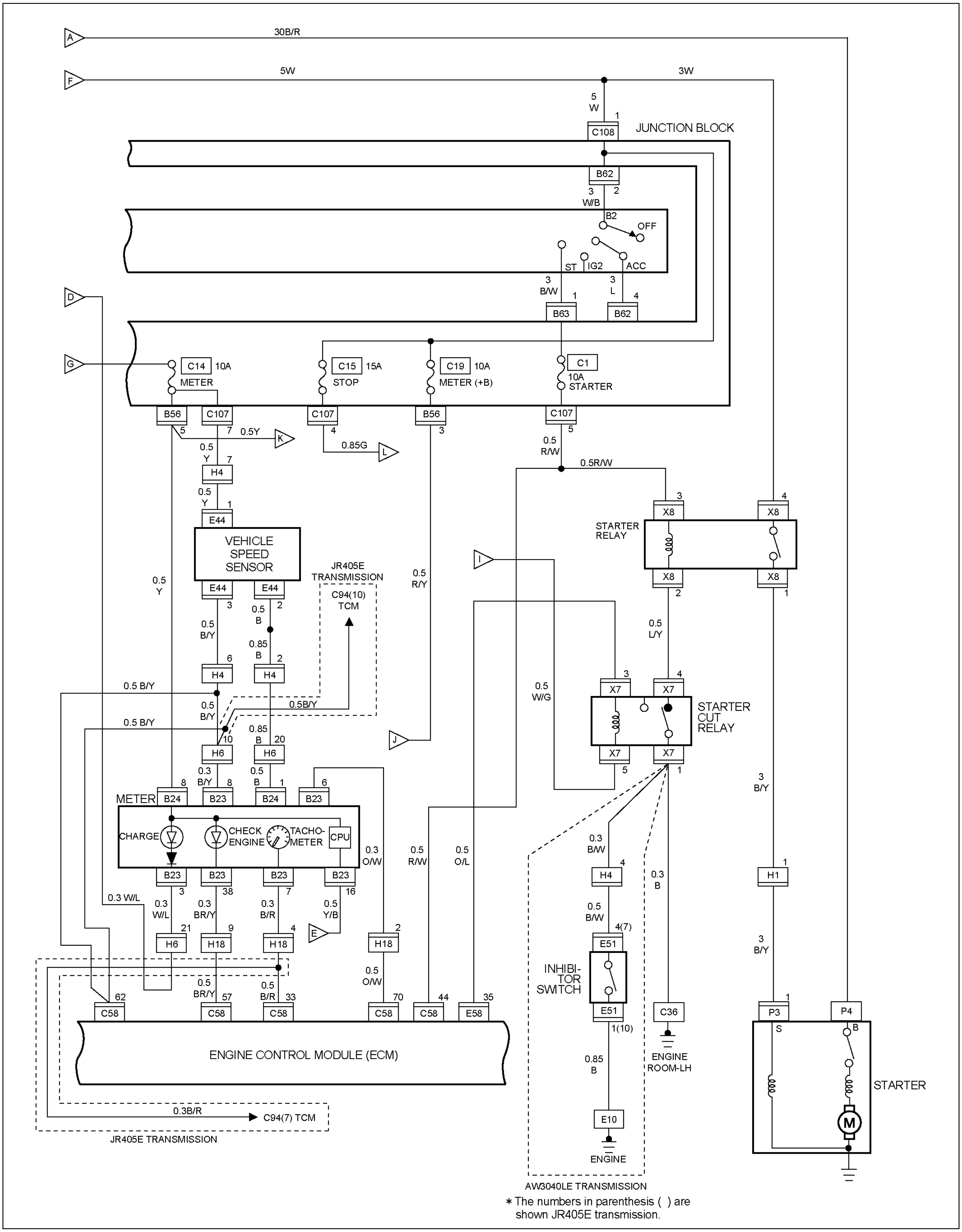

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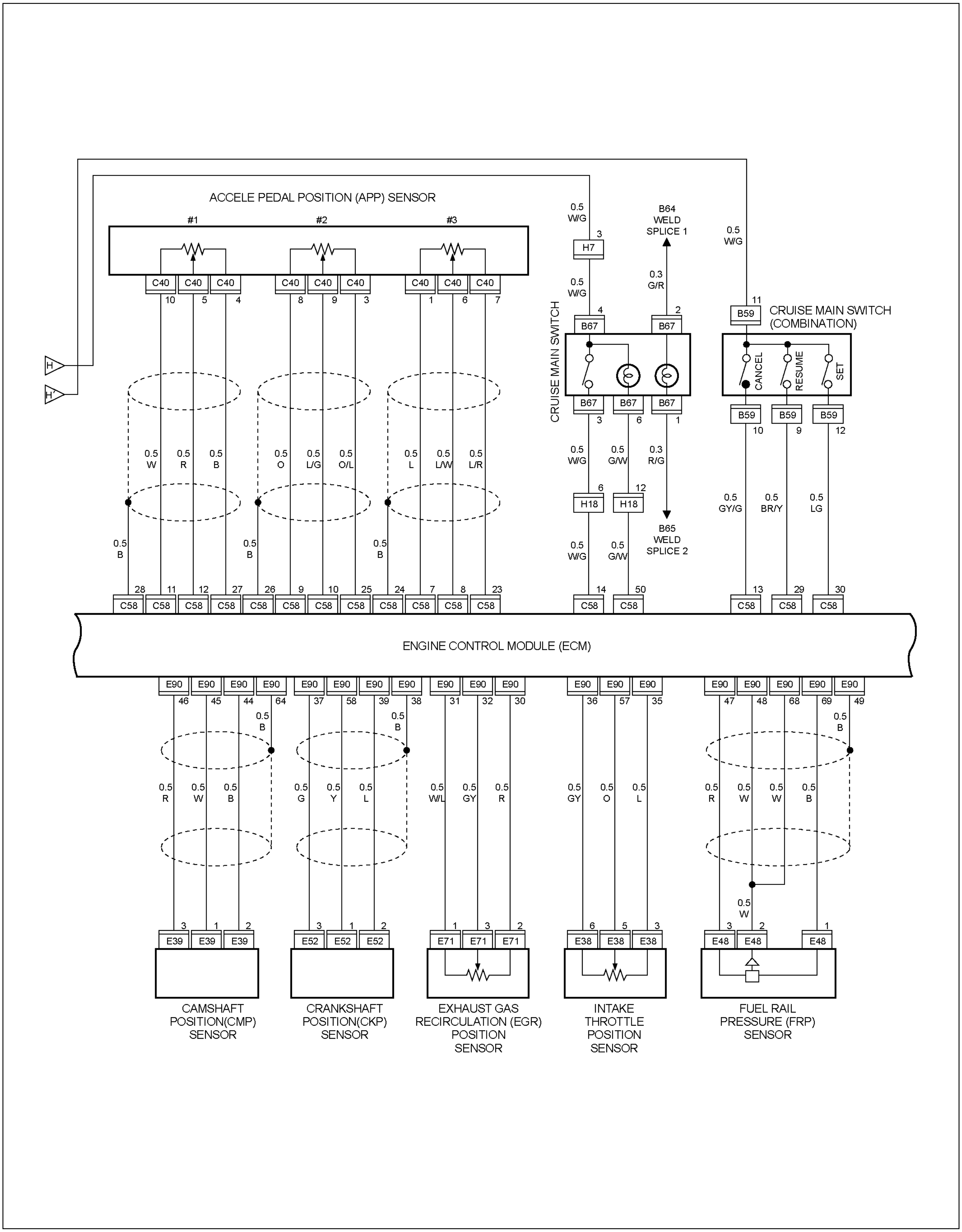
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 4/5



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CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

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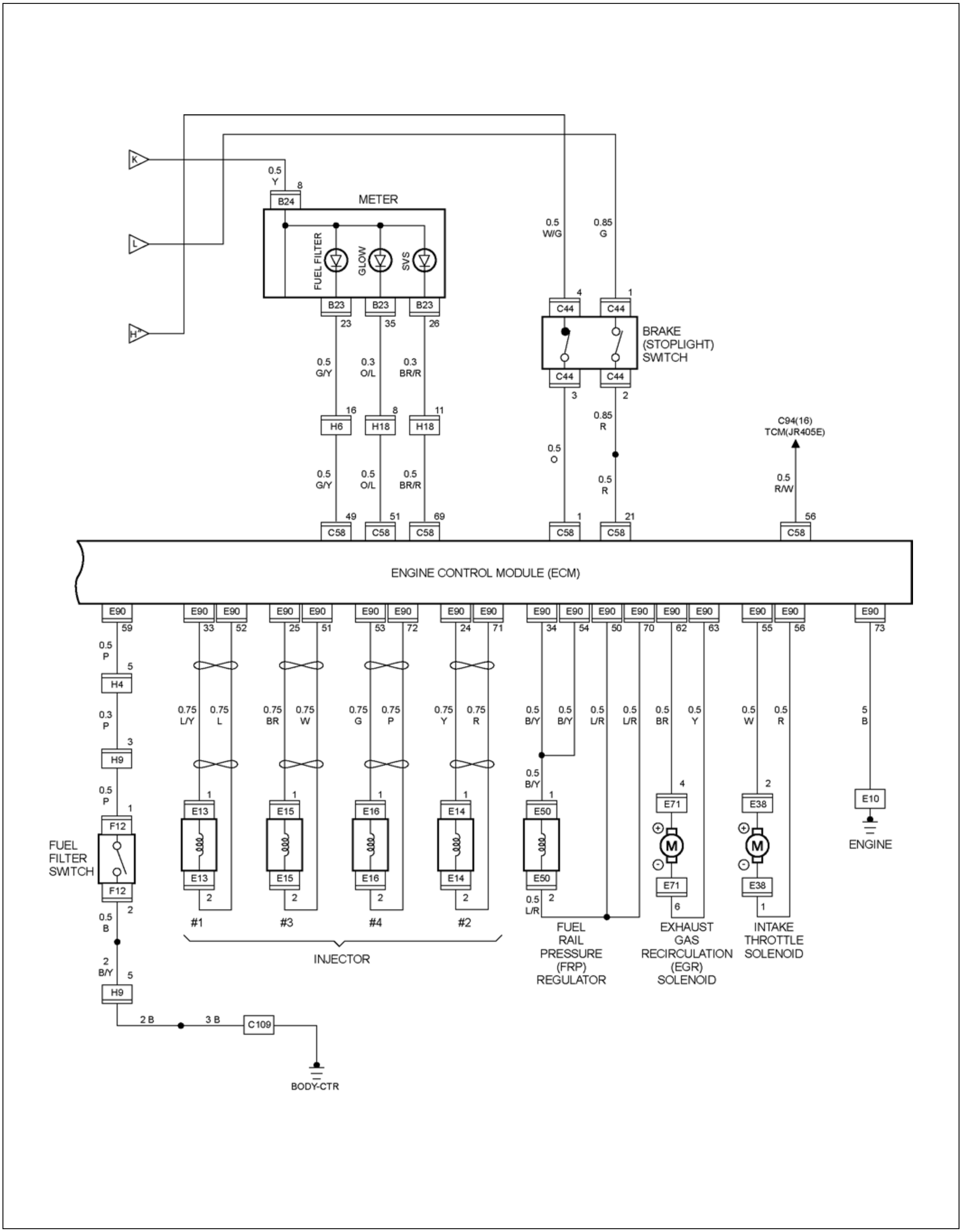

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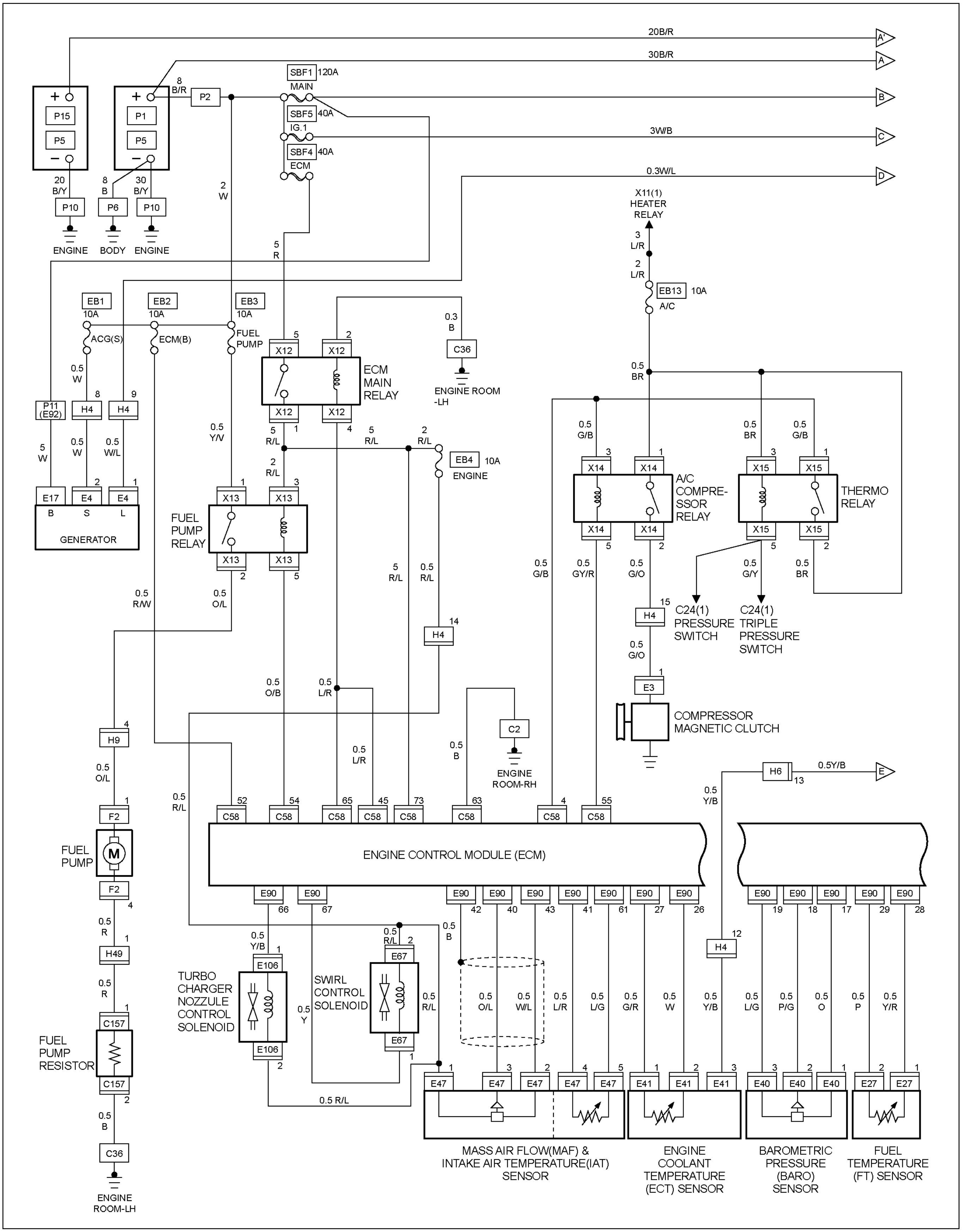
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 1/5



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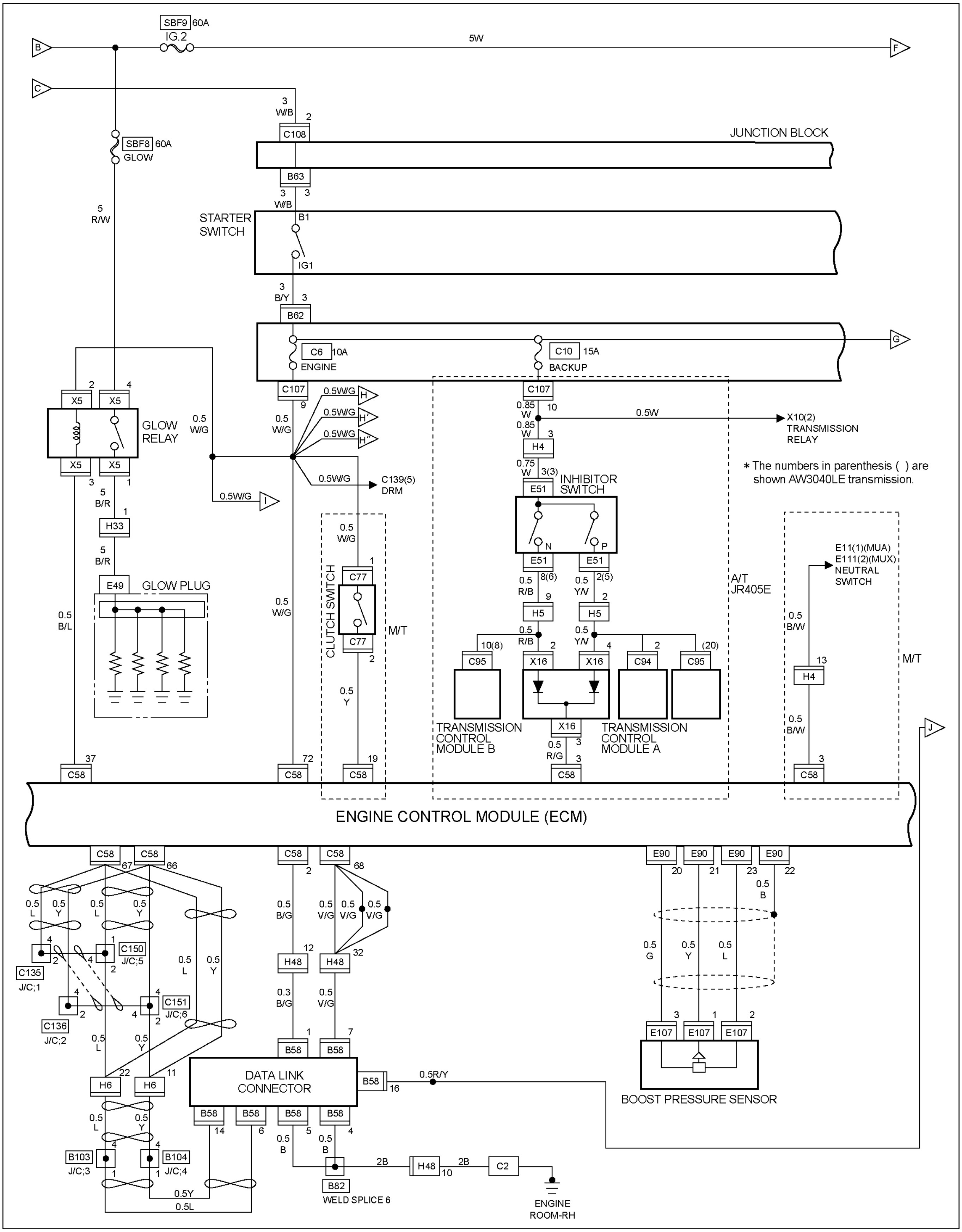
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 2/5



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CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

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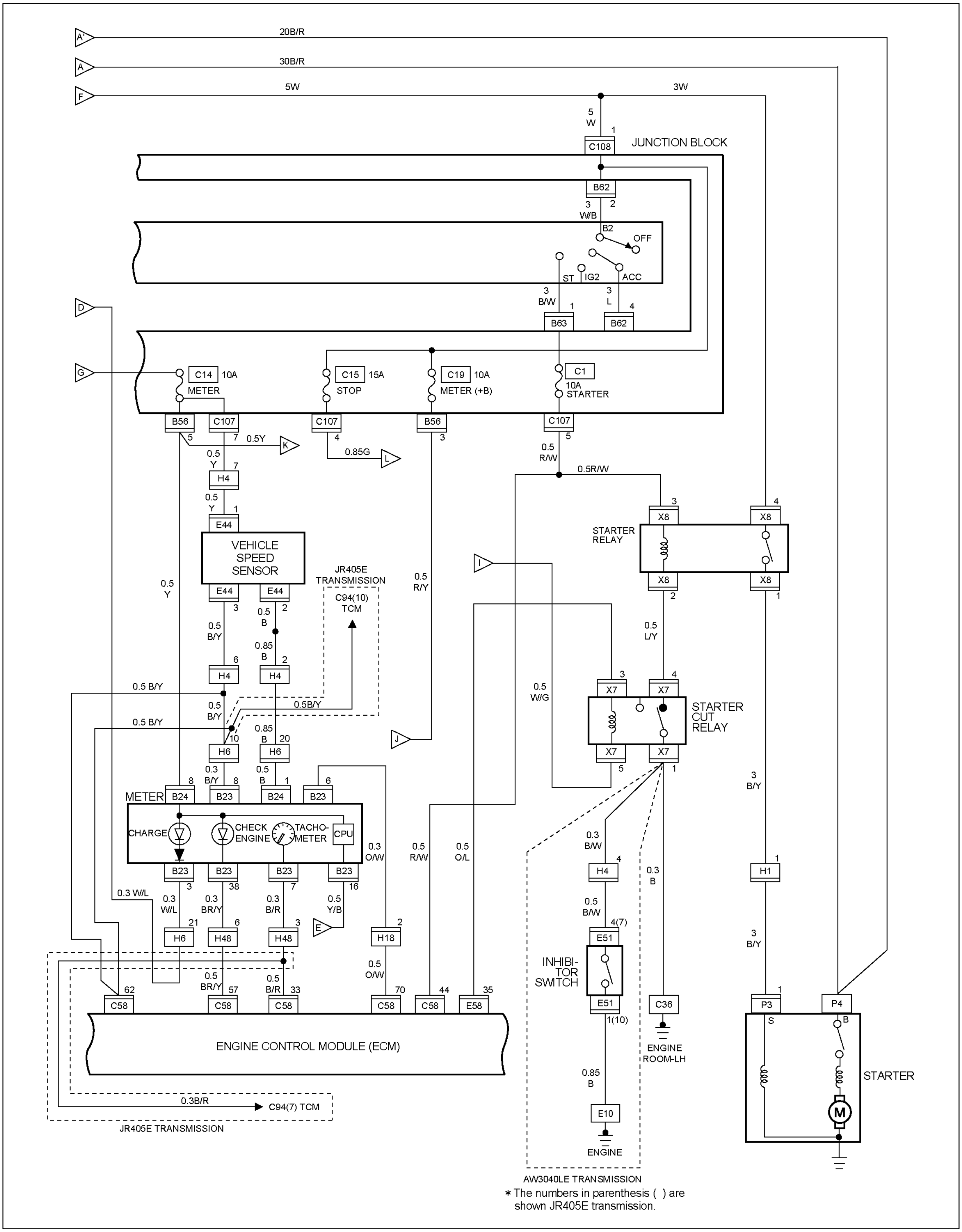

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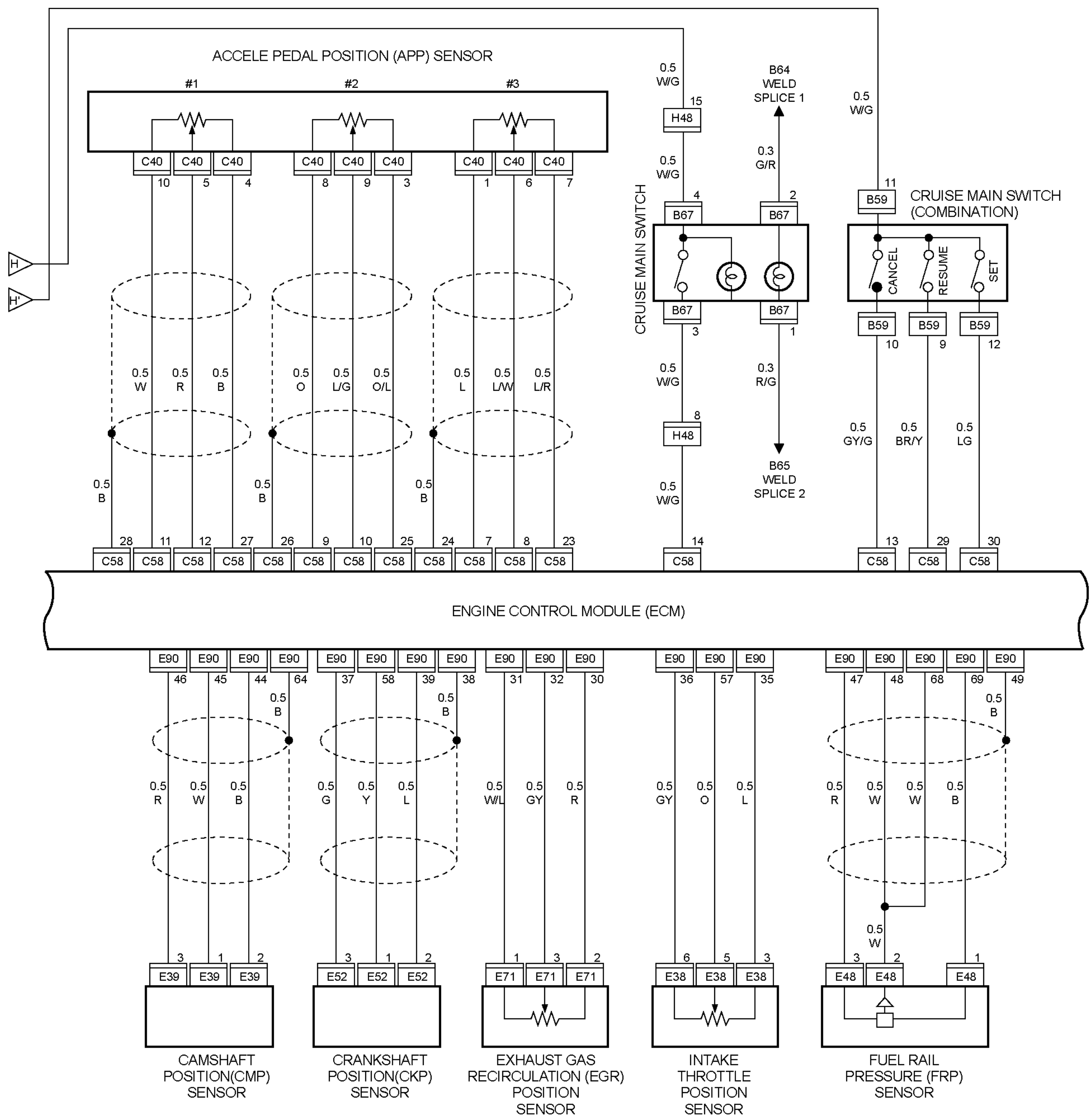
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 4/5



RTW78AXF026301

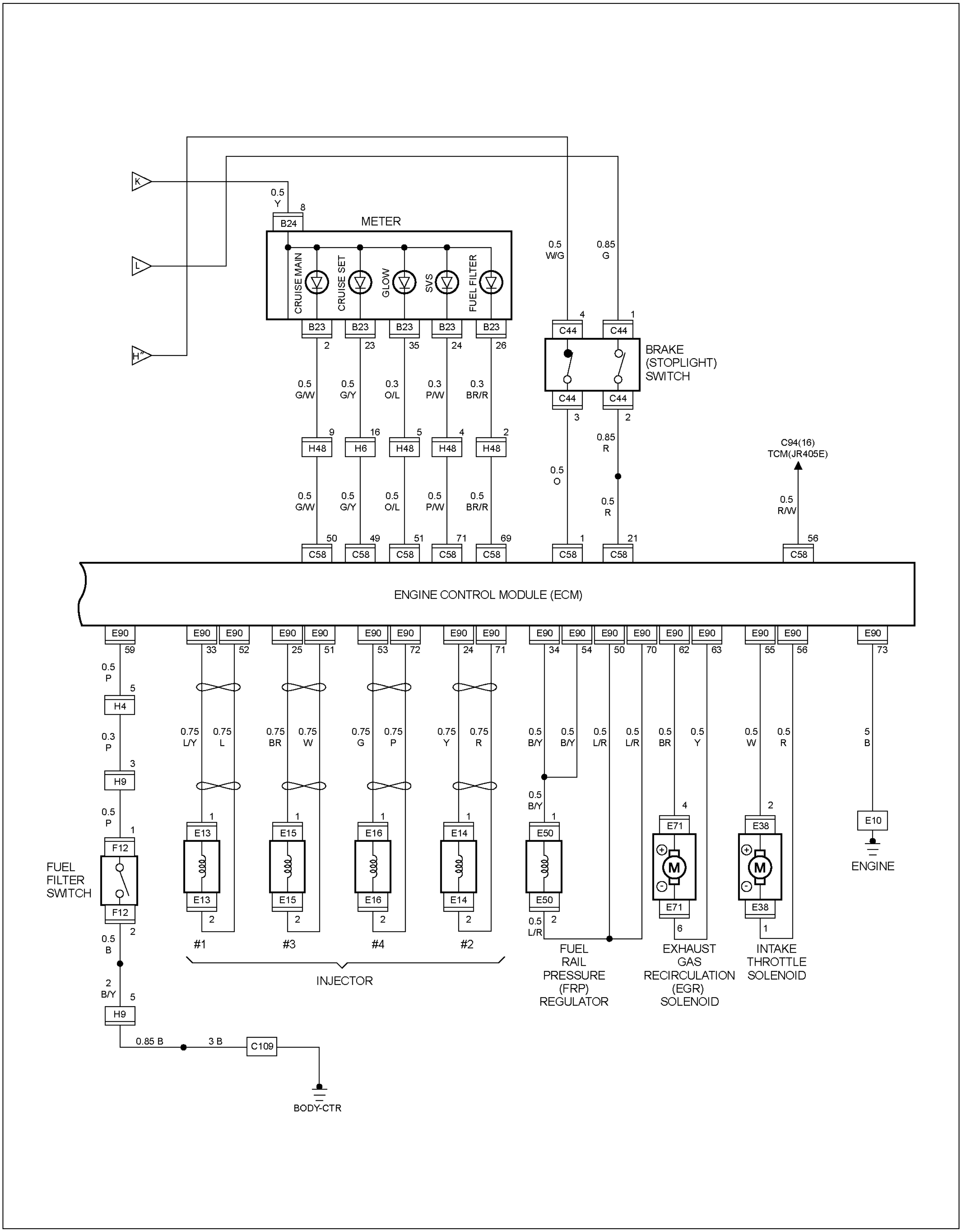
MAIN DATA AND SPECIFICATIONS

FRONT AXLE AND DIFFERENTIAL

Ring gear size mm (in)		ϕ194 (7.6)
Axle tube		
Type		It consists of the duce, a cast iron housing and the Axle tube.
Gear type		Hypoid
Gear ratio	(to 1)	3.583, 3.727, 3.909, 4.100, 4.300, 4.555, 4.777, 5.125
Differential type		Two pinion
Specified gear oil (APL grade)		GL-5
Oil capacity	liter	1.4
	(US/UK gal.)	(0.4/0.31)
Axle shaft type		Constant velocity joint (Barfield joint type and double offset joint).

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 5/5



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CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

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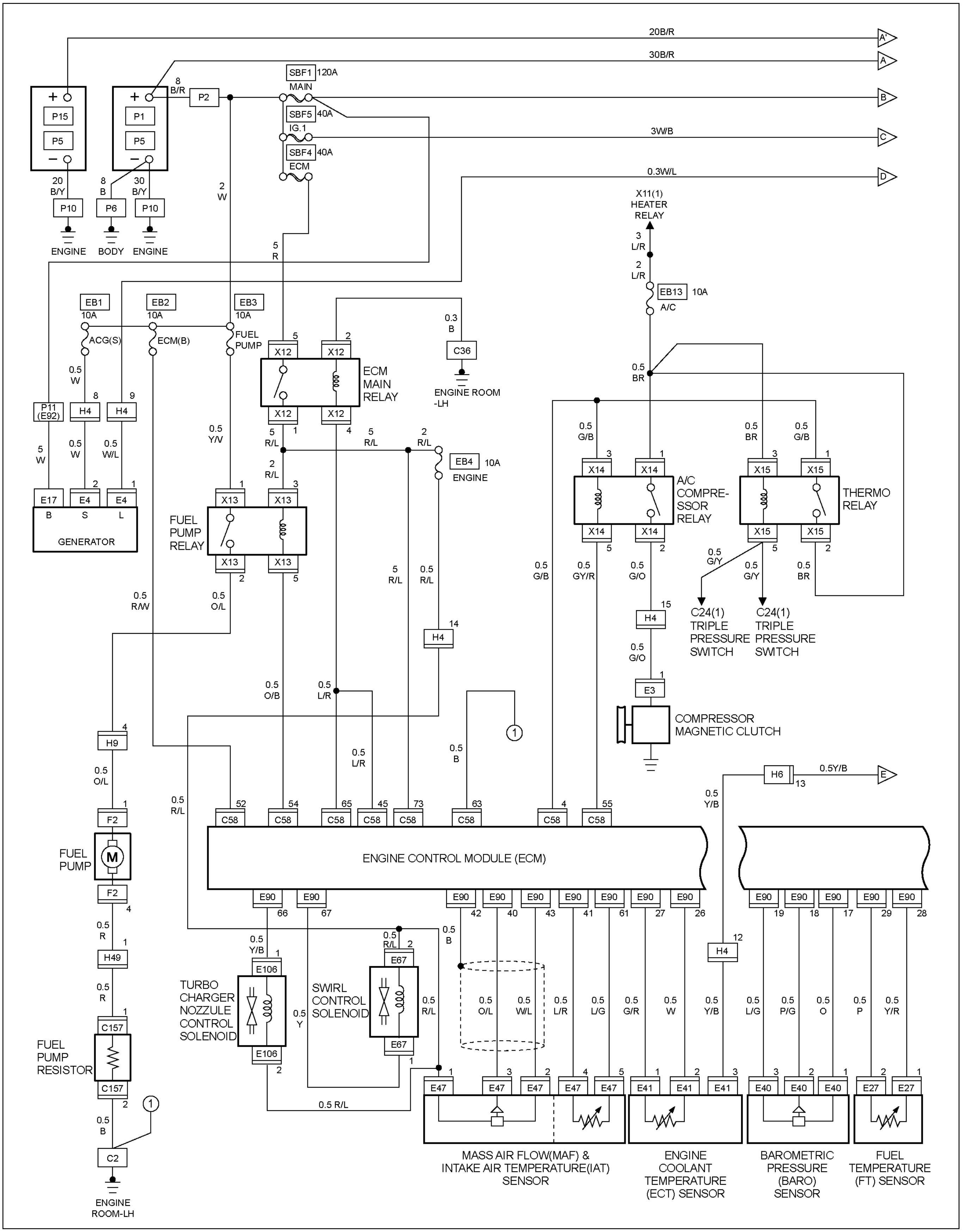

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CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

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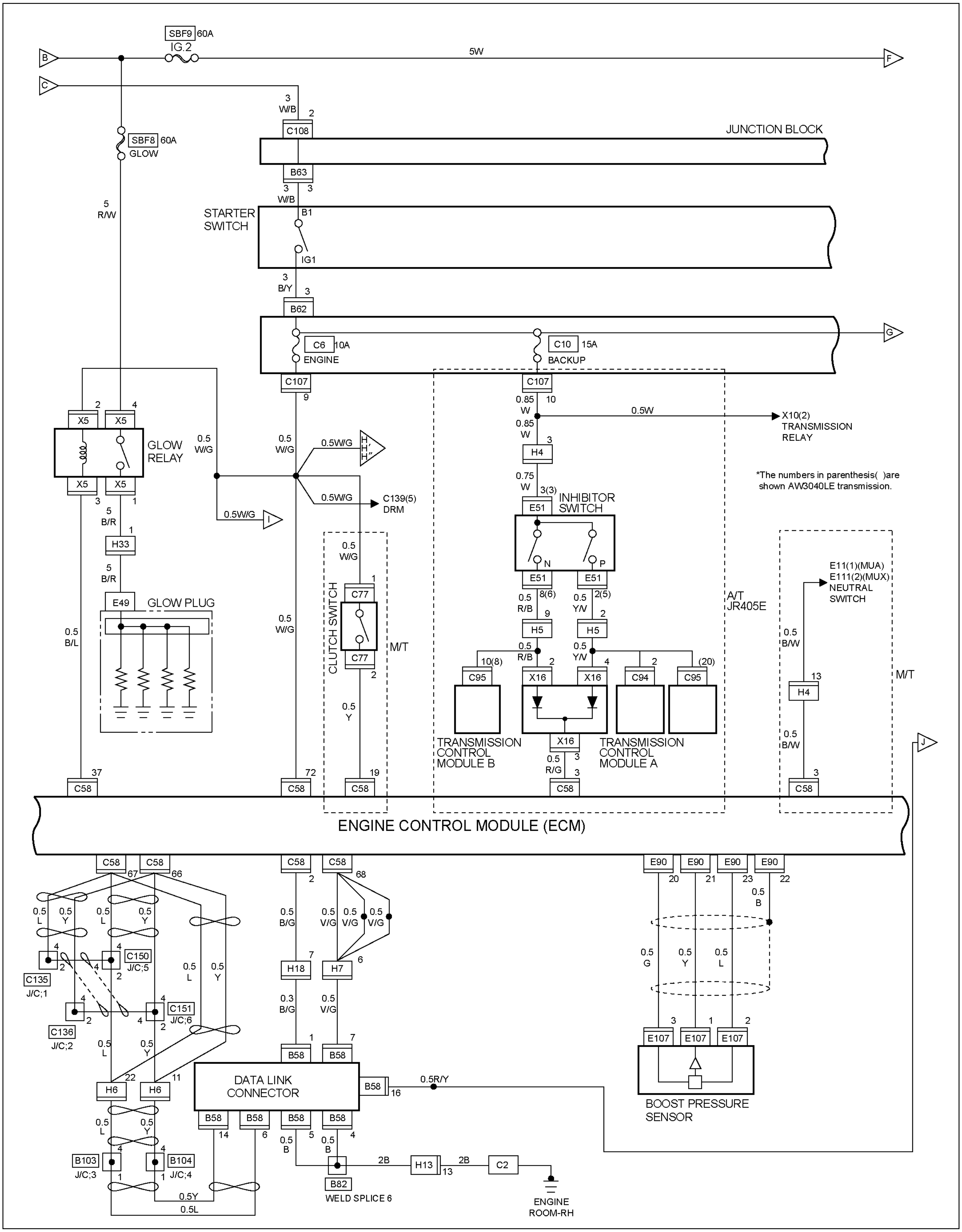

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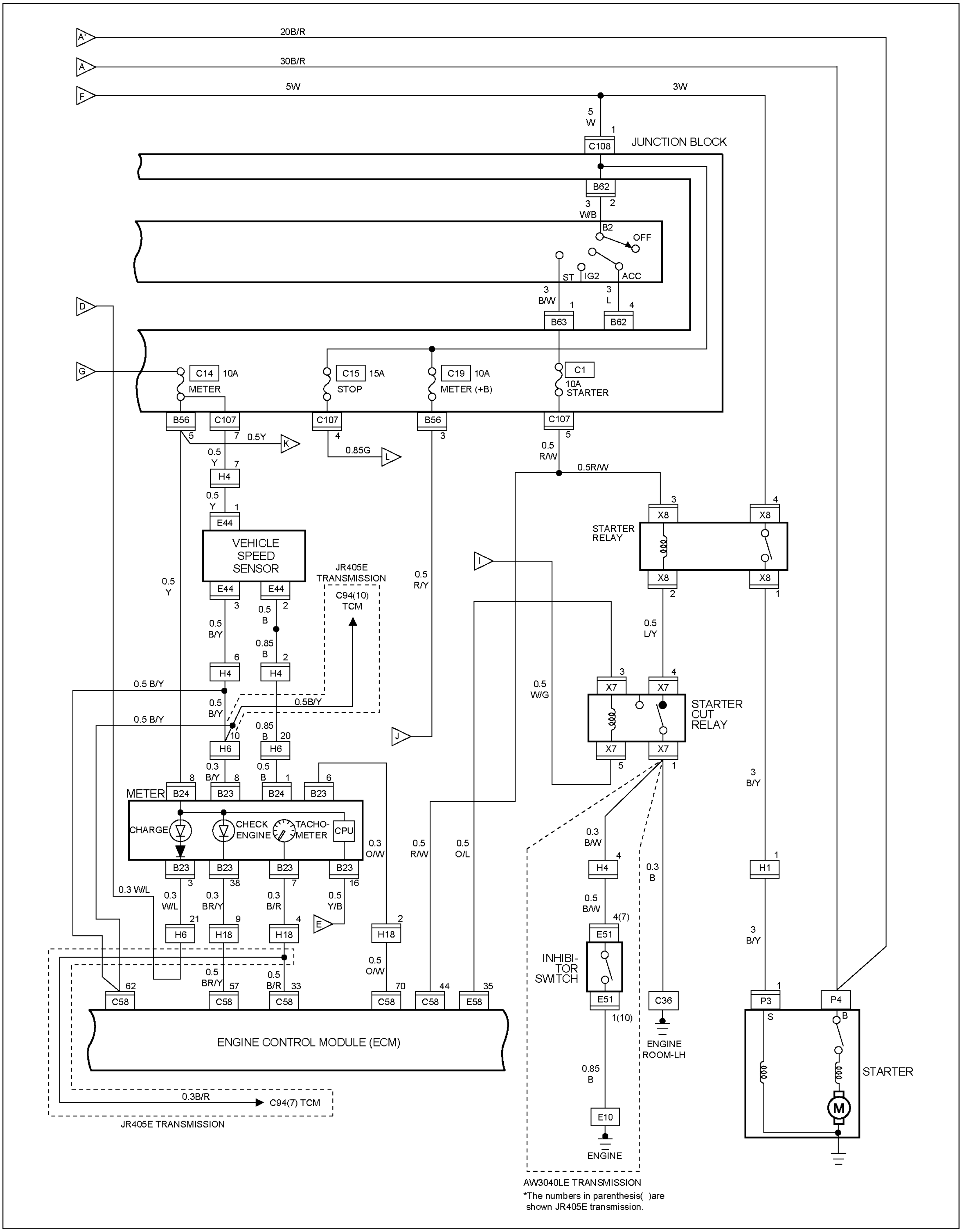
CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 3/5



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CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

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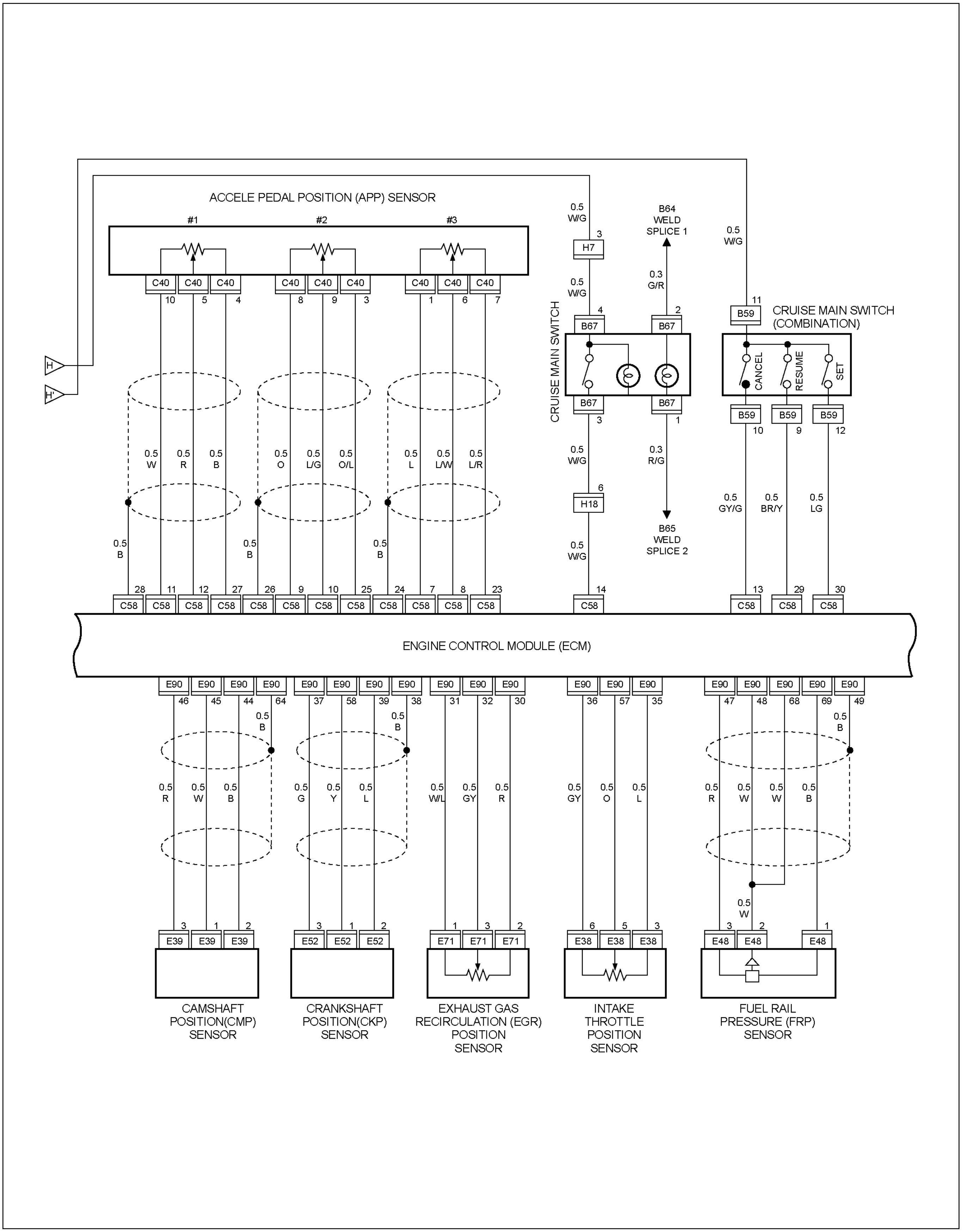

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CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA

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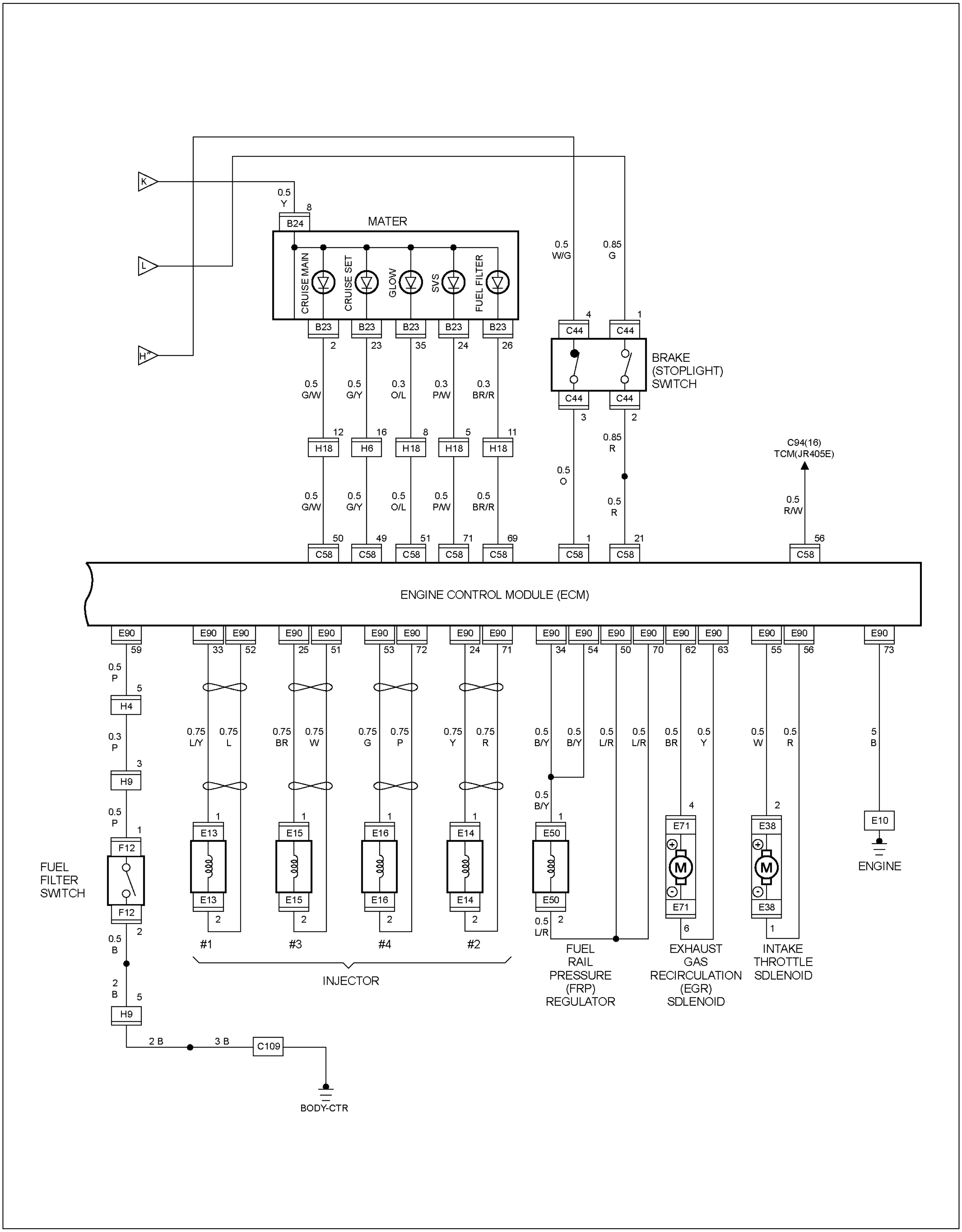

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CIRCUIT DIAGRAM 4JH1-TC (LHD)

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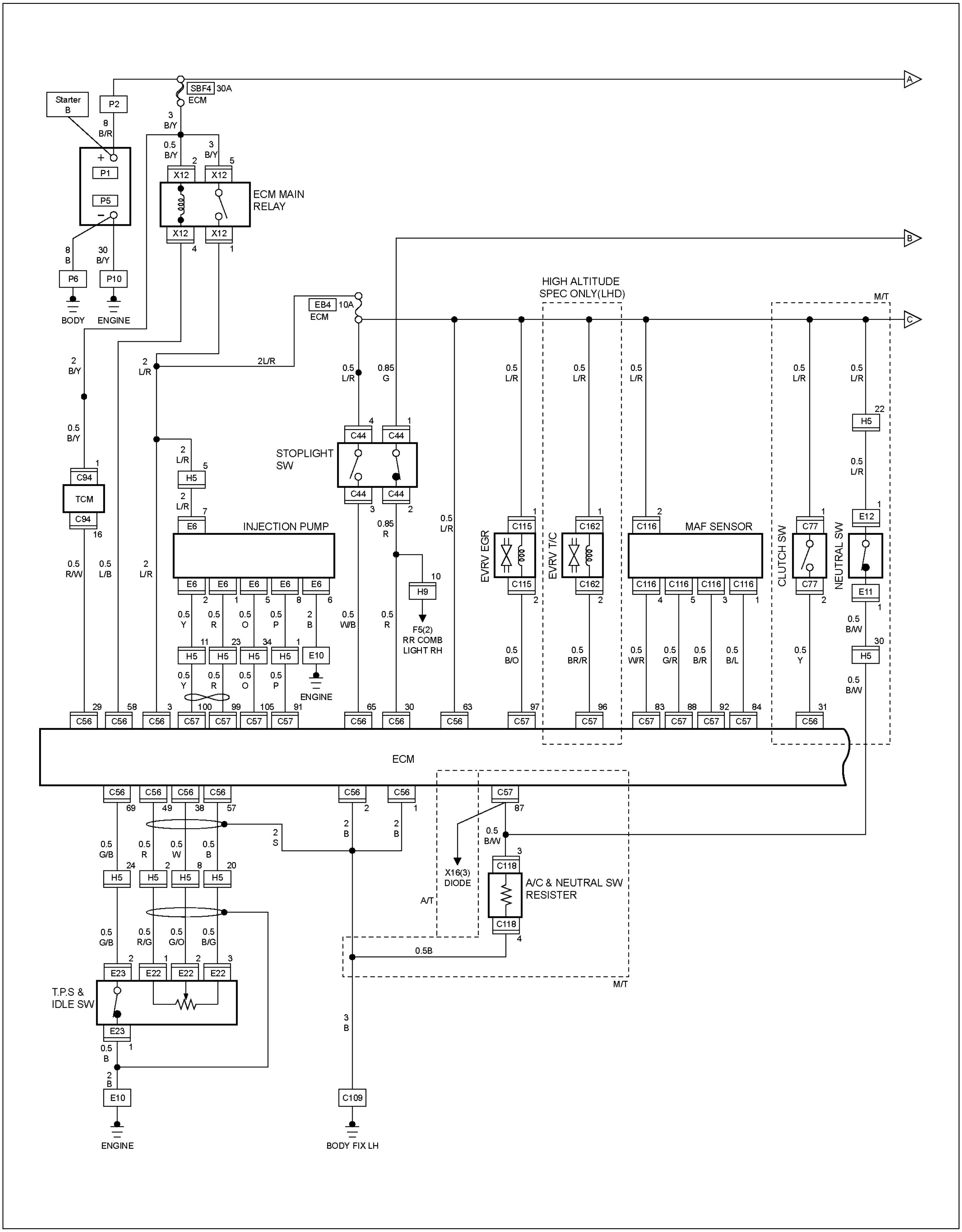

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CIRCUIT DIAGRAM 4JH1-TC (LHD)

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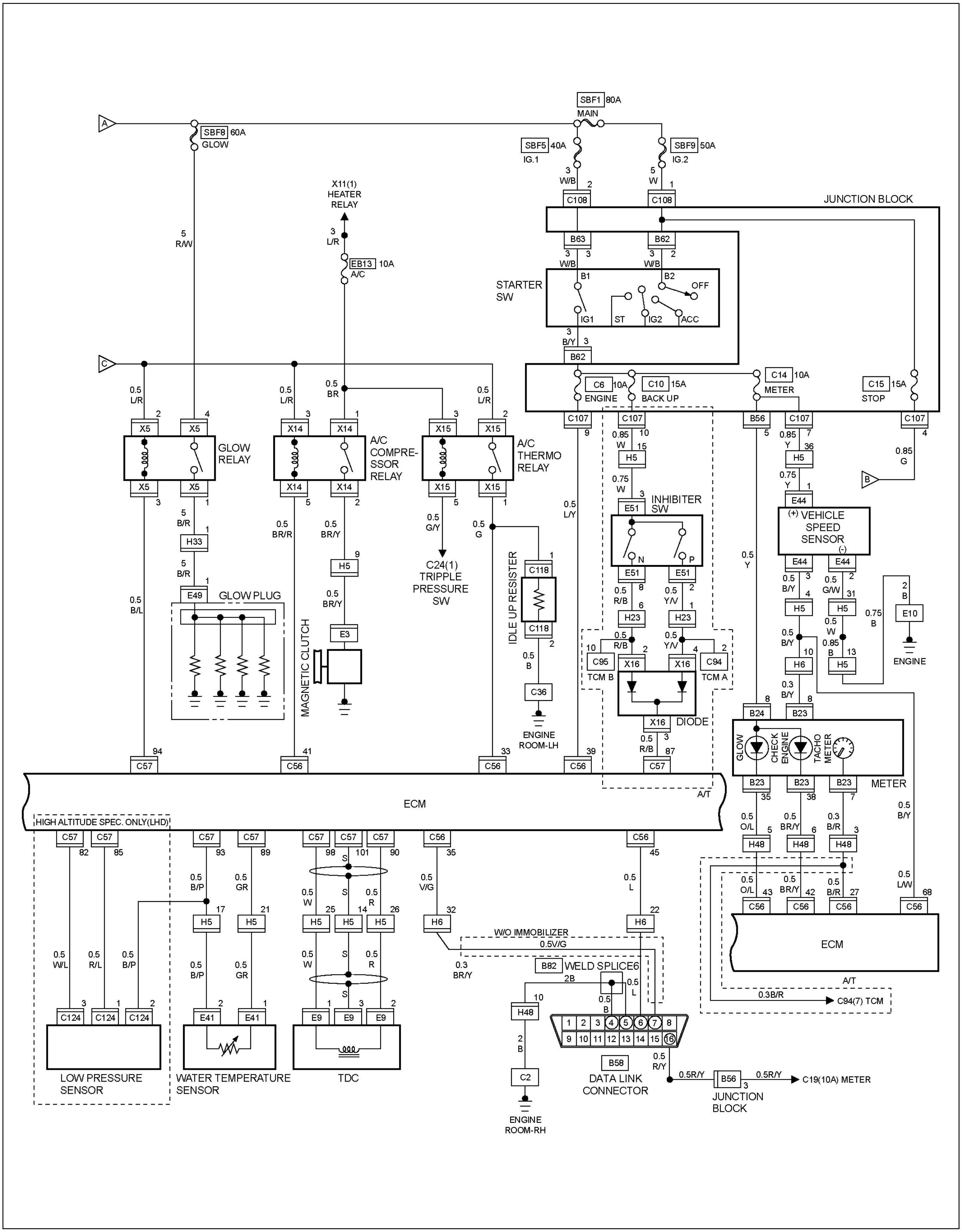


RTW78AXF004701

REMOVAL AND INSTALLATION

ECM (ENGINE CONTROL MODULE); C24SE

Removal

1. Lift both the ECM harness connector locking levers and remove the two harness connectors form the ECM.
2. Remove the four socket head screws securing the ECM to the mounting bracket.
3. Remove the ECM from the engine compartment.

4. Pull out the ECM.
5. Disconnect both red and tan connectors.

Refer to the Section 6E-ENGINE of this Manual.

IMPORTANT: The replacement ECM must be programmed.
"SPS (Service Programming System) and immobilizer programming (if equipped) is/are necessary"

Installation

Follow the removal procedure in the reverse order to install the ECM.

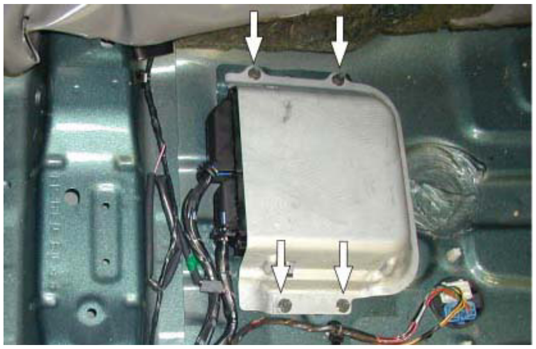
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that ECM is securely connected.
This will prevent a poor contact and open circuit.

REMOVAL AND INSTALLATION

ECM (ENGINE CONTROL MODULE); 4JH1-TC



Removal

1. Remove the passenger side front seat – refer to Section 10 CAB.
2. Remove the passenger side front door opening scuff plate.
3. Raise the carpet to gain access to the four hex-head bolts securing the ECM and ECM cover to the floor pan.
4. Remove the four hex-head bolts.
5. Pull the two harness connector locks away from the harness connectors and then remove the connectors form the ECM.
6. Remove the ECM from the vehicle.

Refer to the Section 6E-ENGINE of this Manual.

IMPORTANT: The replacement ECM must be programmed. ***"SPS (Service Programming System) and immobilizer programming (if equipped) is/are necessary"***

Installation

Follow the removal procedure in the reverse order to install the ECM.
Torque passenger seat securing bolts to the specified value – refer to Section 10 CAB
Pay close attention to the important points mentioned in the following paragraphs.

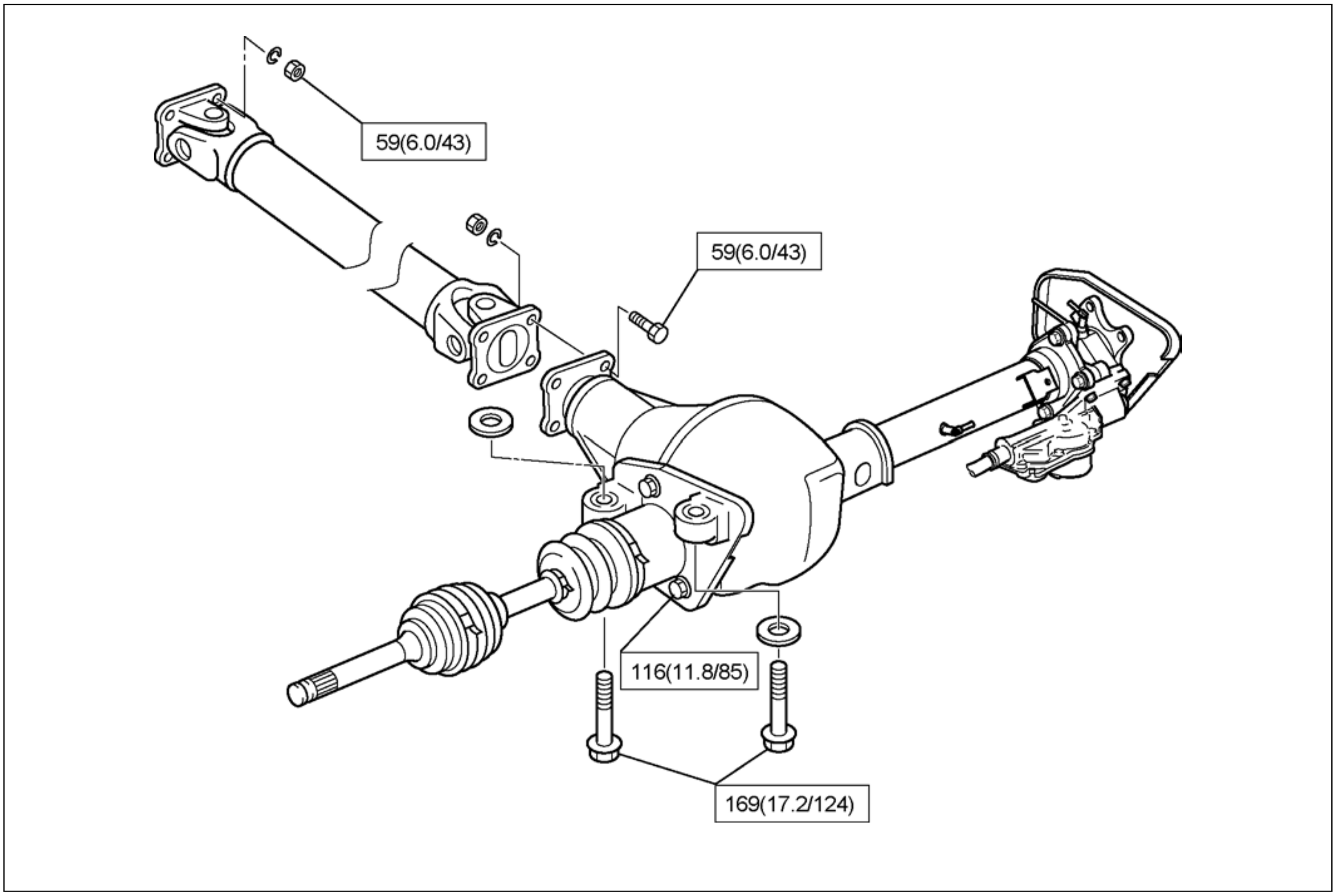
Connector

Be absolutely sure that ECM is securely connected.
This will prevent a poor contact and open circuit.

SPECIAL PARTS FIXING NUTS AND BOLTS

FRONT DRIVE AXLE AND PROPELLER SHAFT

N·m (kgf·m/lb·ft)



RTW74CMF000101

REMOVAL AND INSTALLATION

FUEL GAUGE UNIT AND SENDER ASSEMBLY

Removal

1. Remove the fuel gauge unit and sender assembly.
   Refer to the “ENGINE FUEL” Section 6C of this Manual.

Installation

To install the fuel gauge unit and sender assembly, follow the removal procedure in reverse order.
Pay close attention to the important points mentioned in the following paragraphs.

Rubber Seal

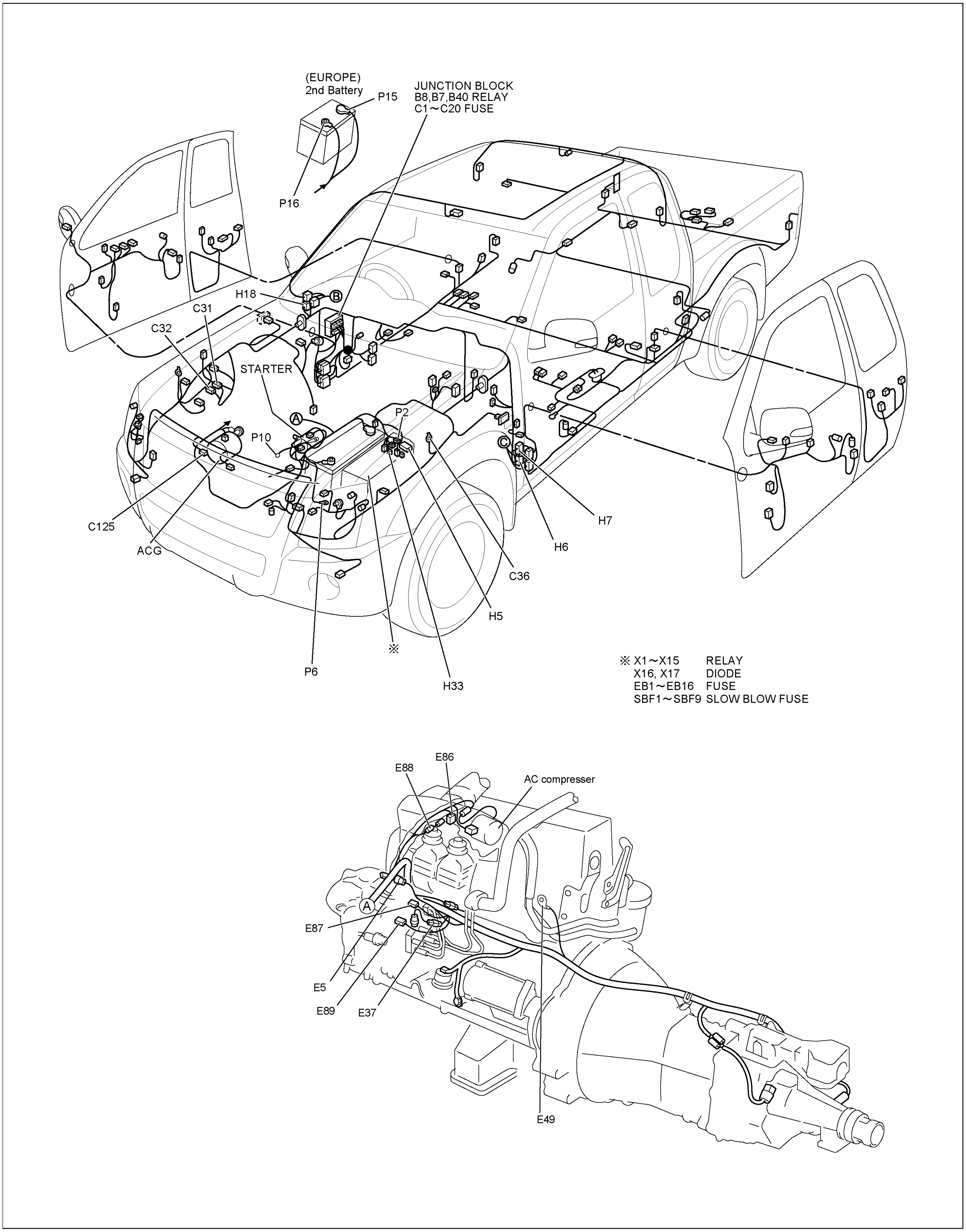
Be absolutely sure that the fuel sender rubber seals are correctly seated.

Connector

Be absolutely sure that the fuel gauge unit connector is securely connected.
This will prevent a poor contact and an open circuit.

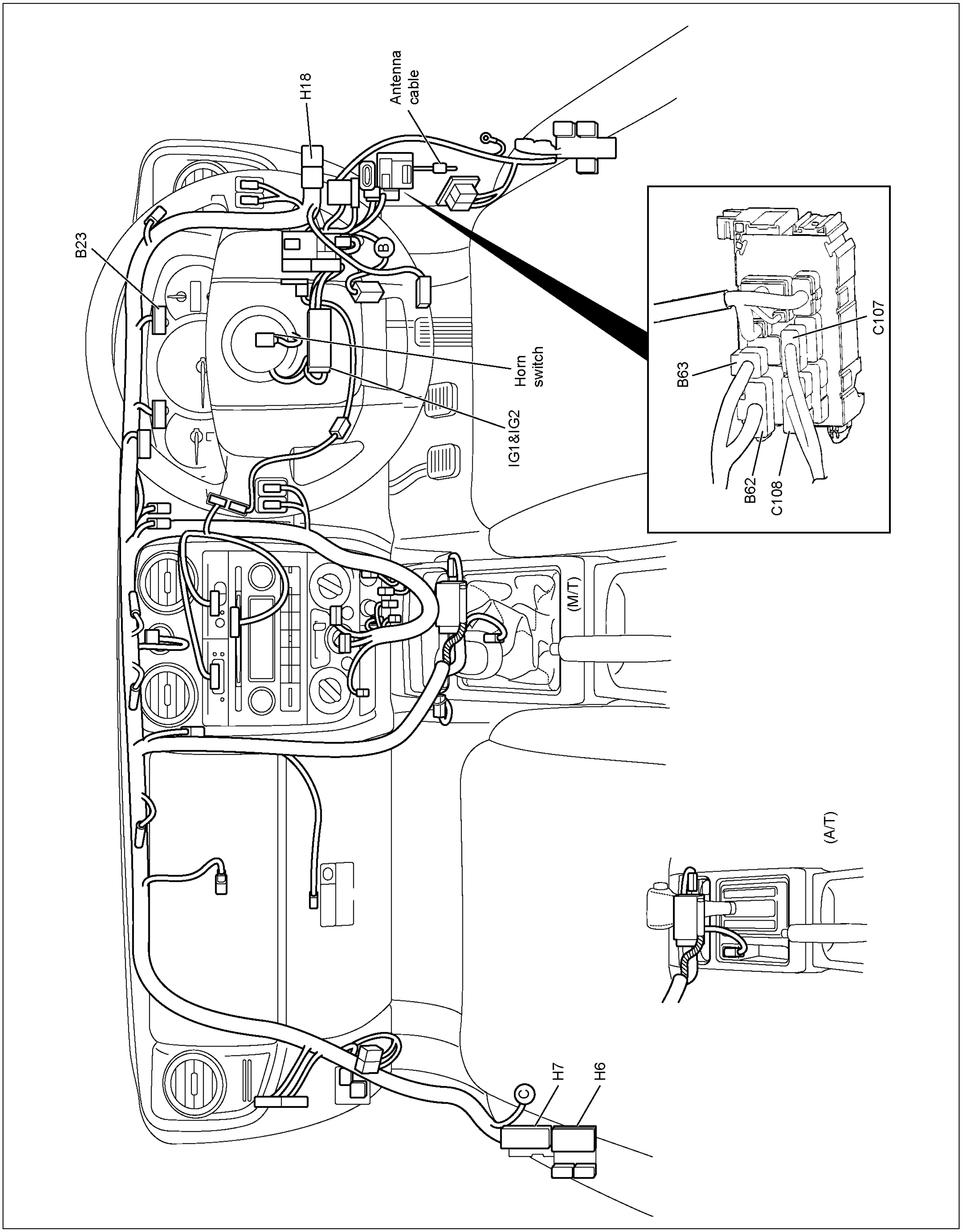
EXHAUST GAS RECIRCULATION (EGR) & GLOW; 4JA1T (L) ONLY

PARTS LOCATION (RHD)



RTW78AXF036501 & RTW78AMF001101

PARTS LOCATION (RHD)



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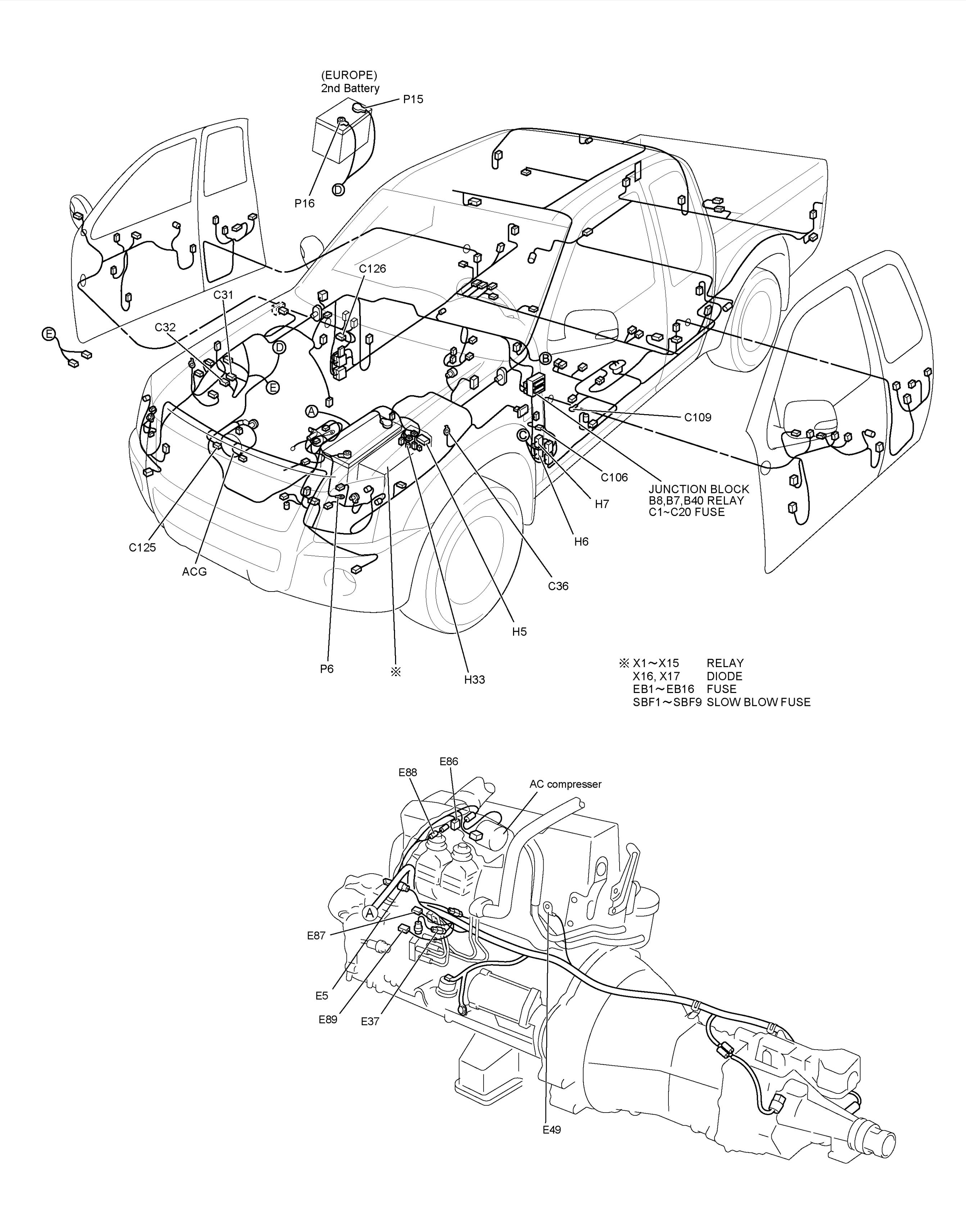
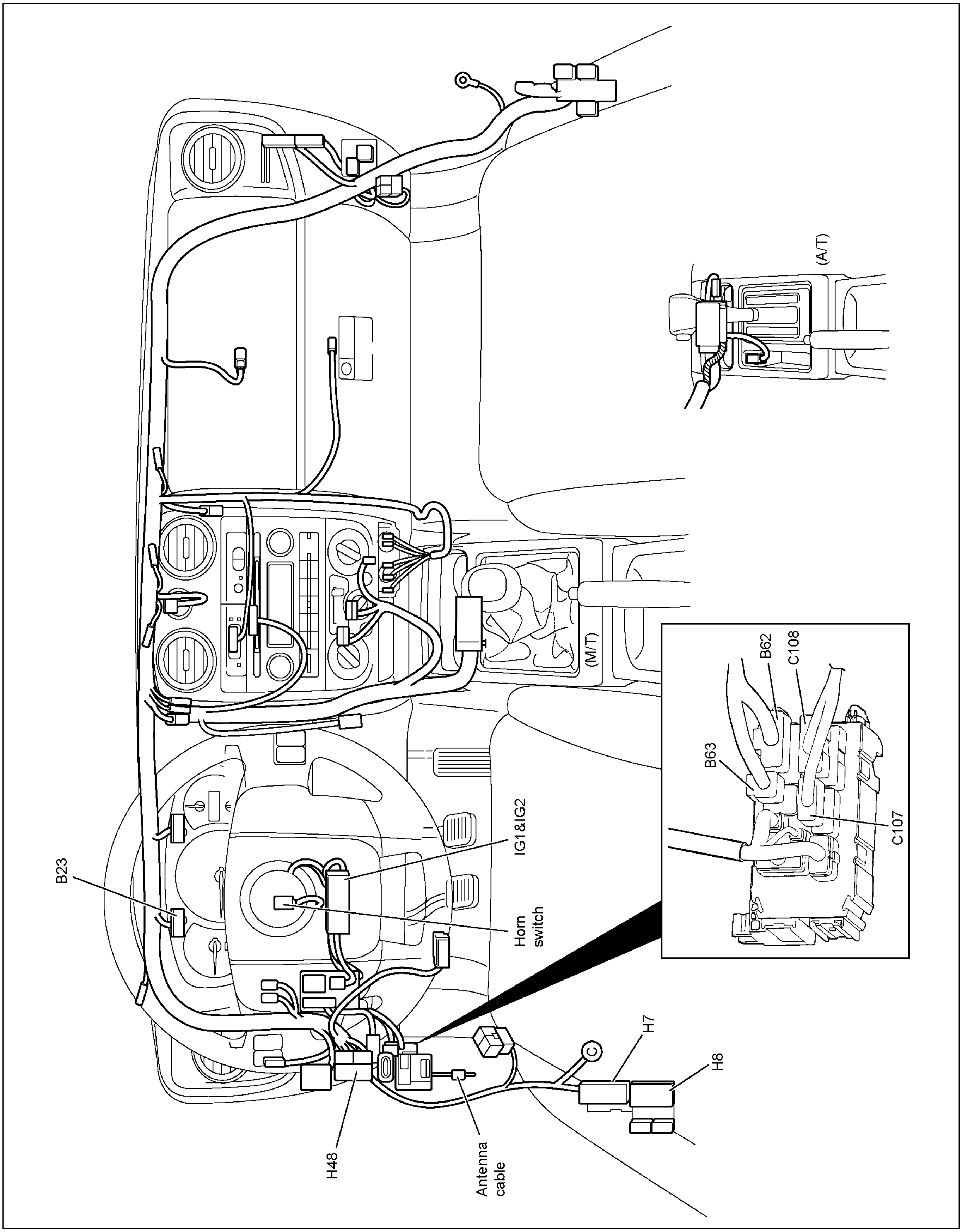
PARTS LOCATION (LHD)



RTW78AXF036601 & RTW78AMF001101

PARTS LOCATION (LHD)



RTW78AXF042801

CIRCUIT DIAGRAM 4JA1T (L)

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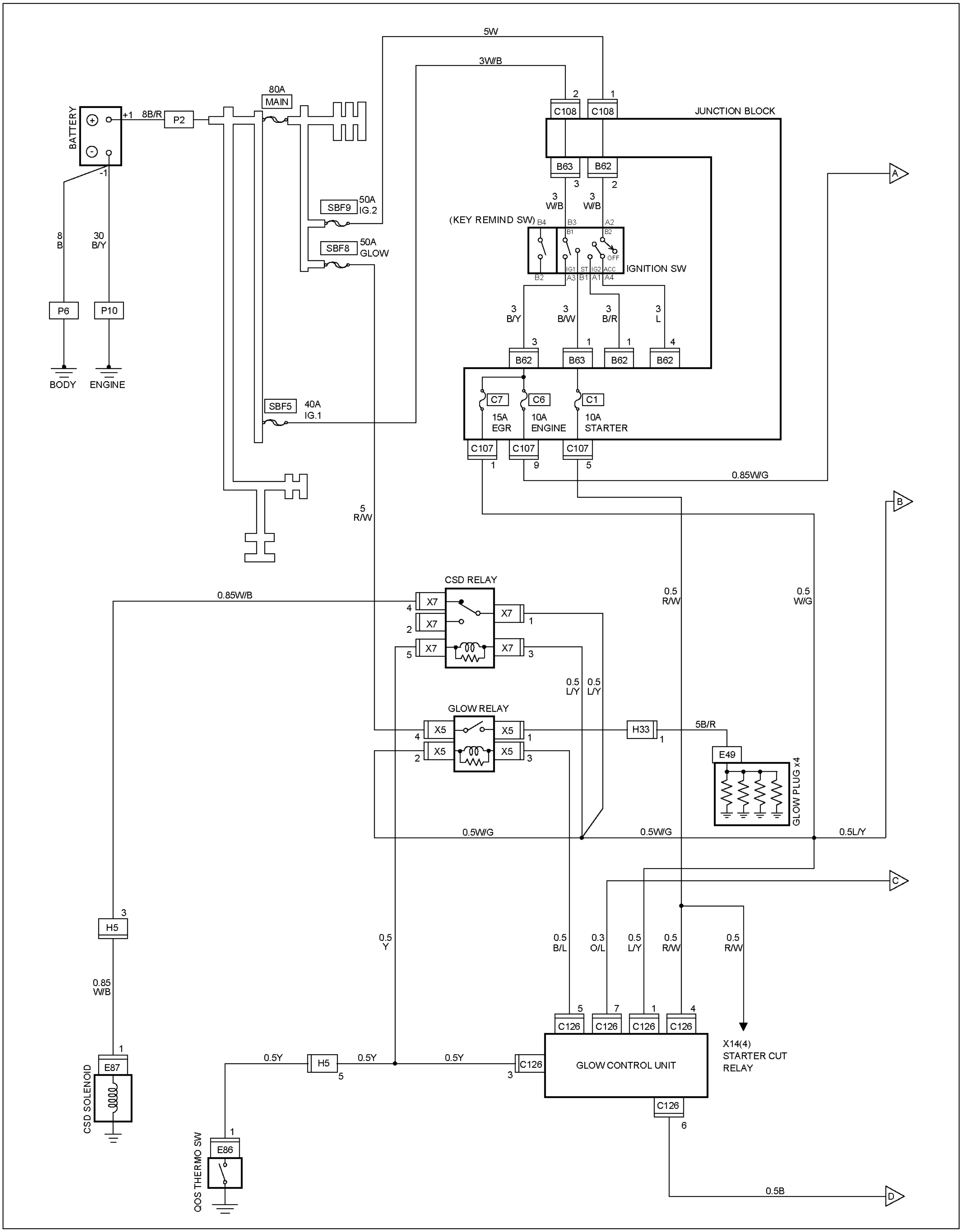

RTW78AXF008401

CIRCUIT DIAGRAM 4JA1T (L)

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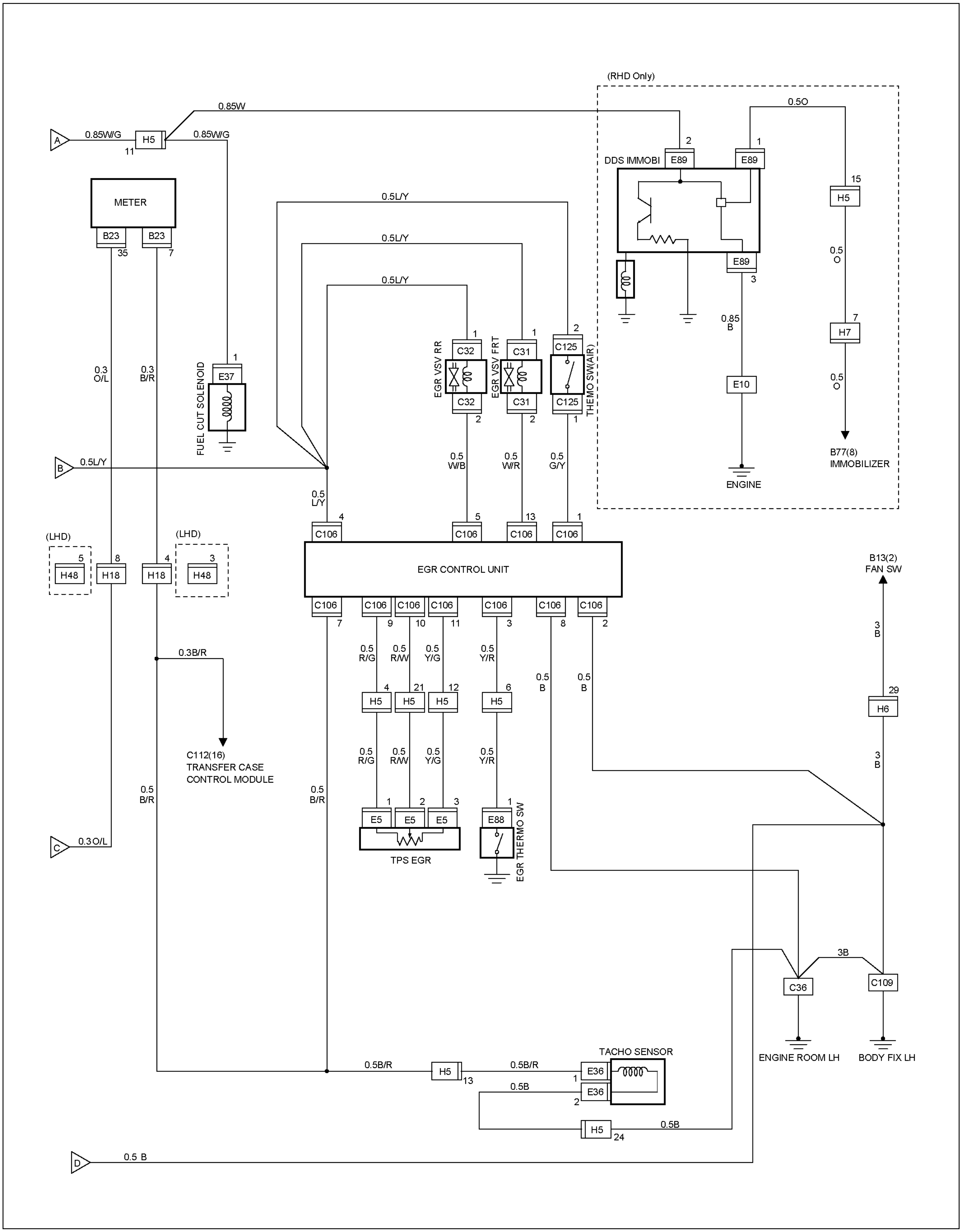
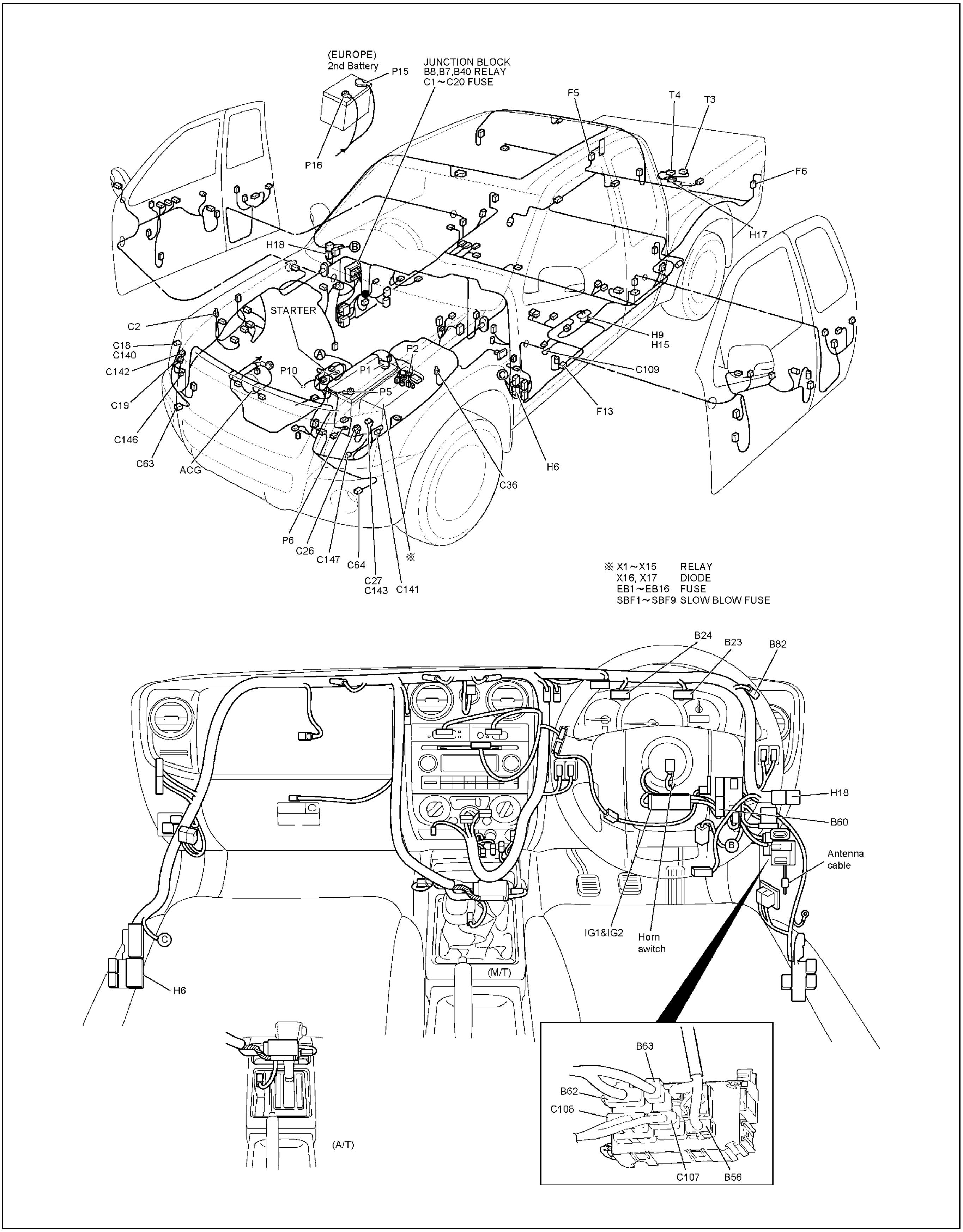


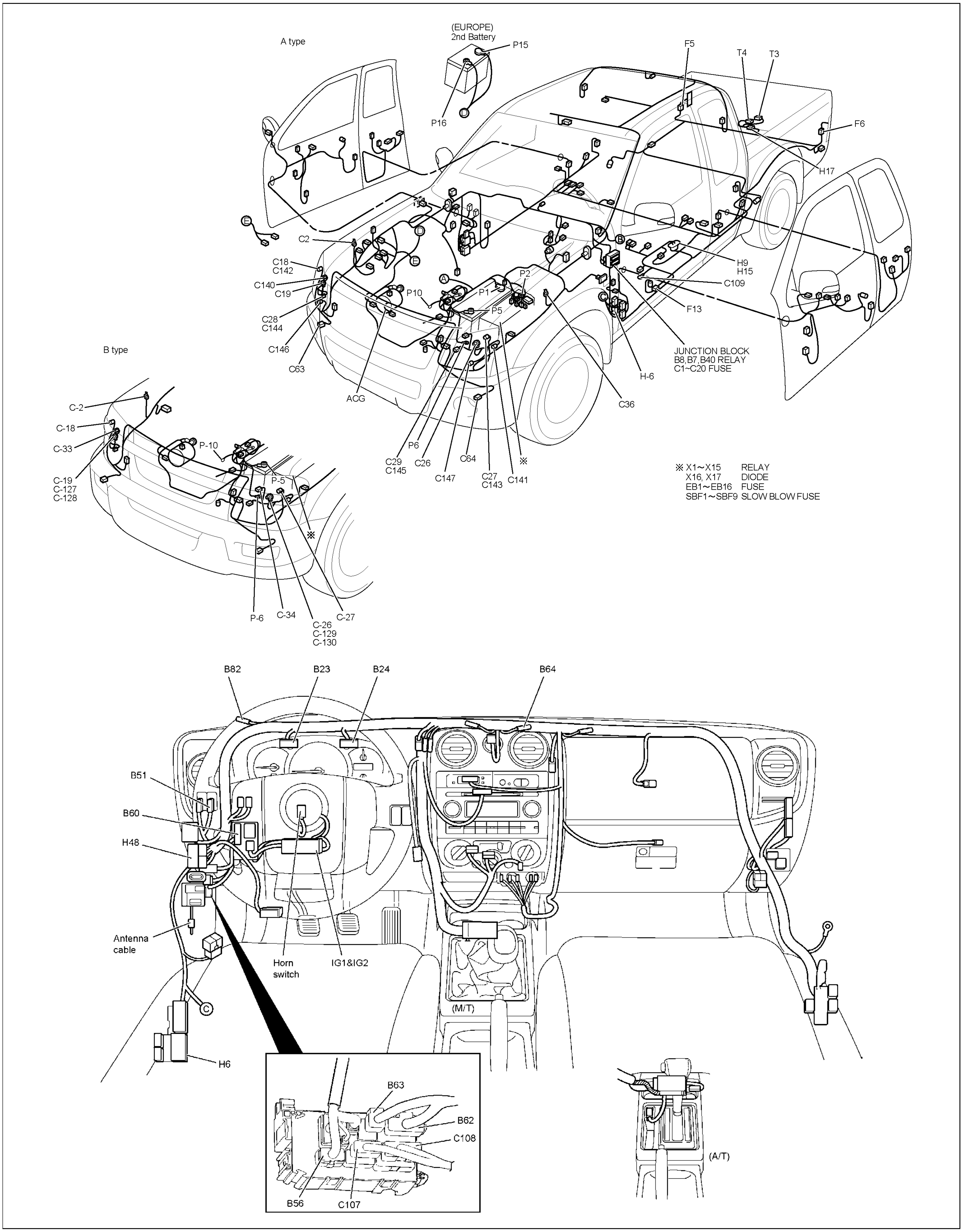
RTW78AXF008501

LIGHTING

PARTS LOCATION (RHD)

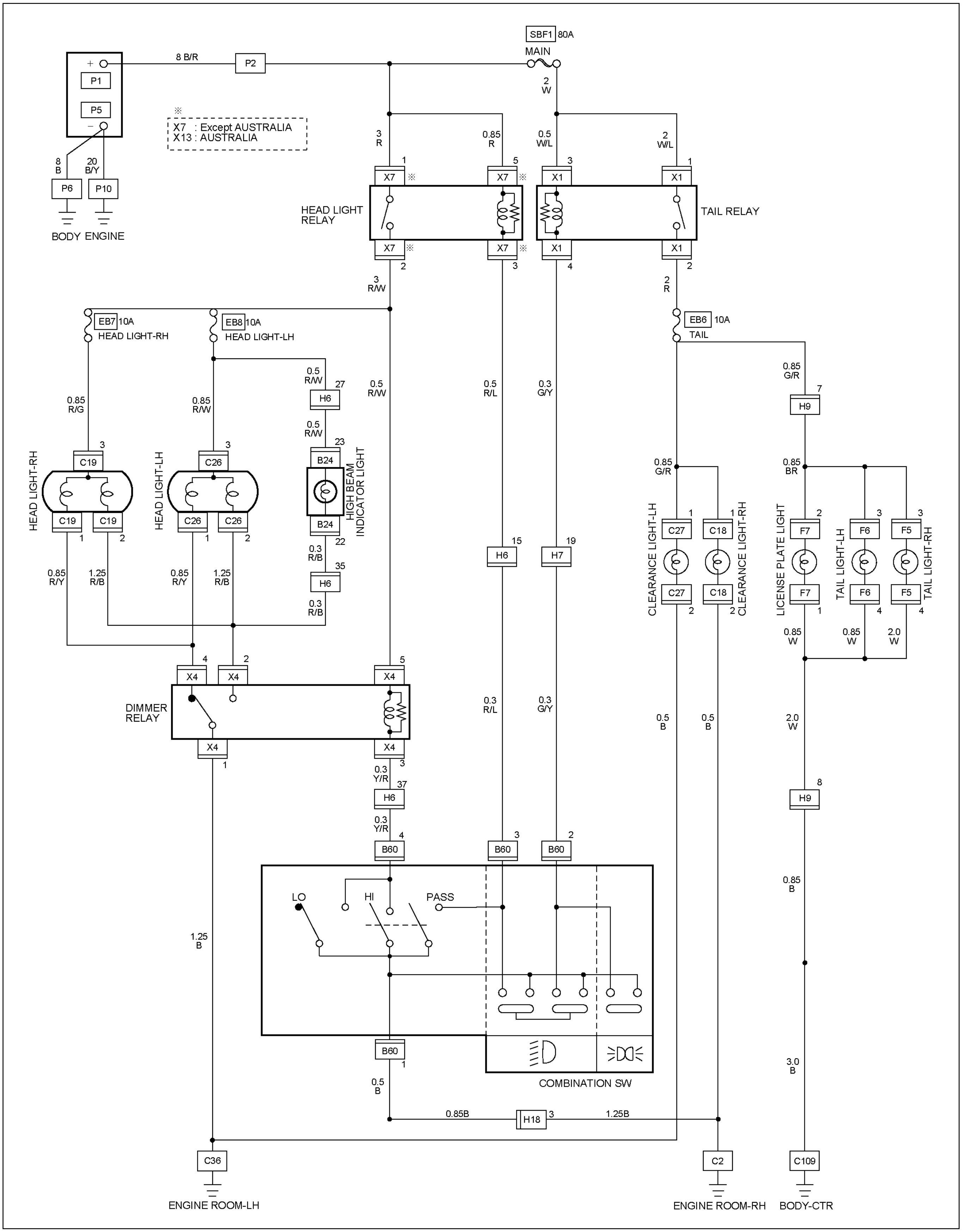


PARTS LOCATION (LHD)



RTW78AXF036801 & RTW78AXF043001

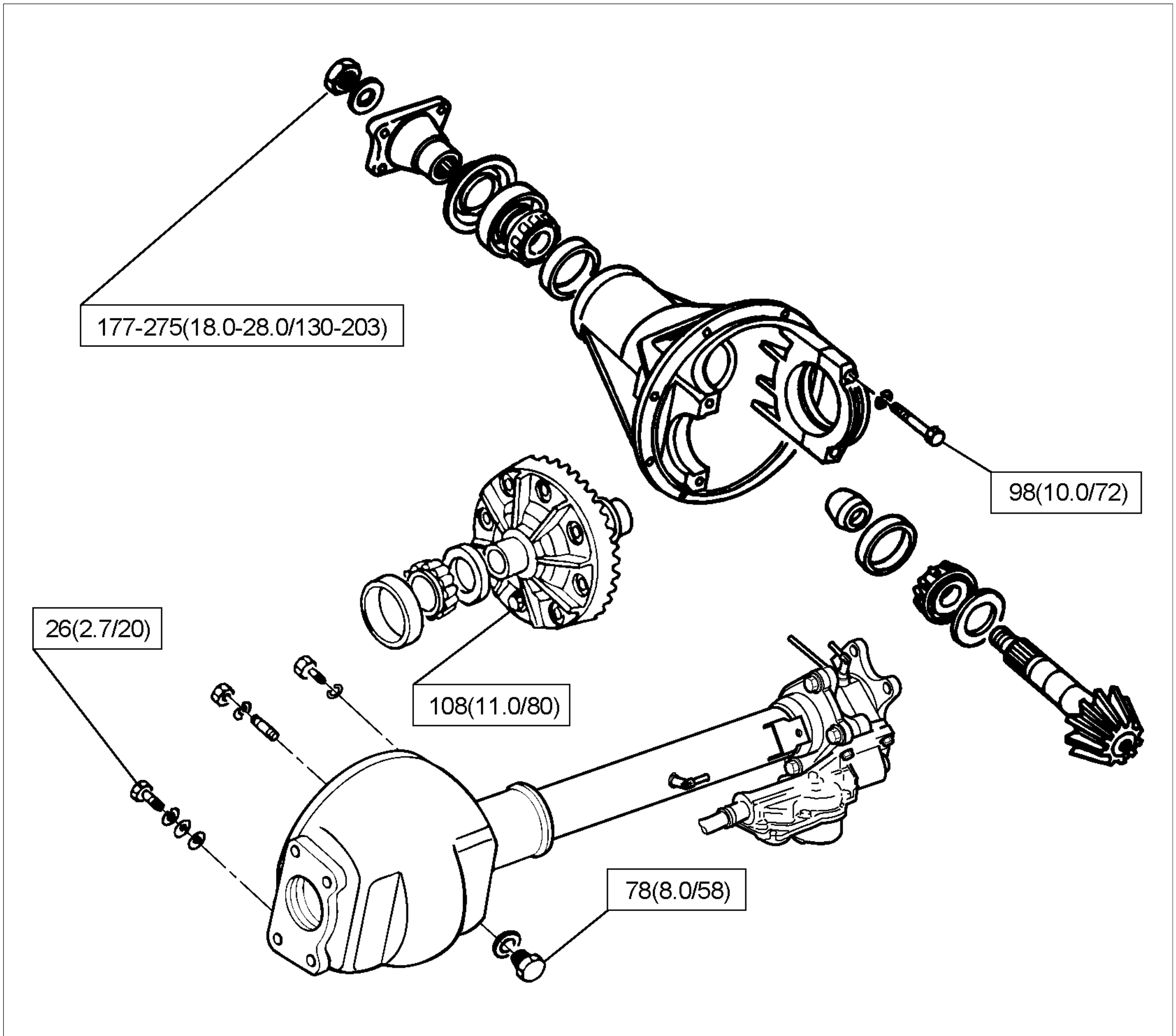
CIRCUIT DIAGRAM C24SE (RHD)



RTW780XF012201

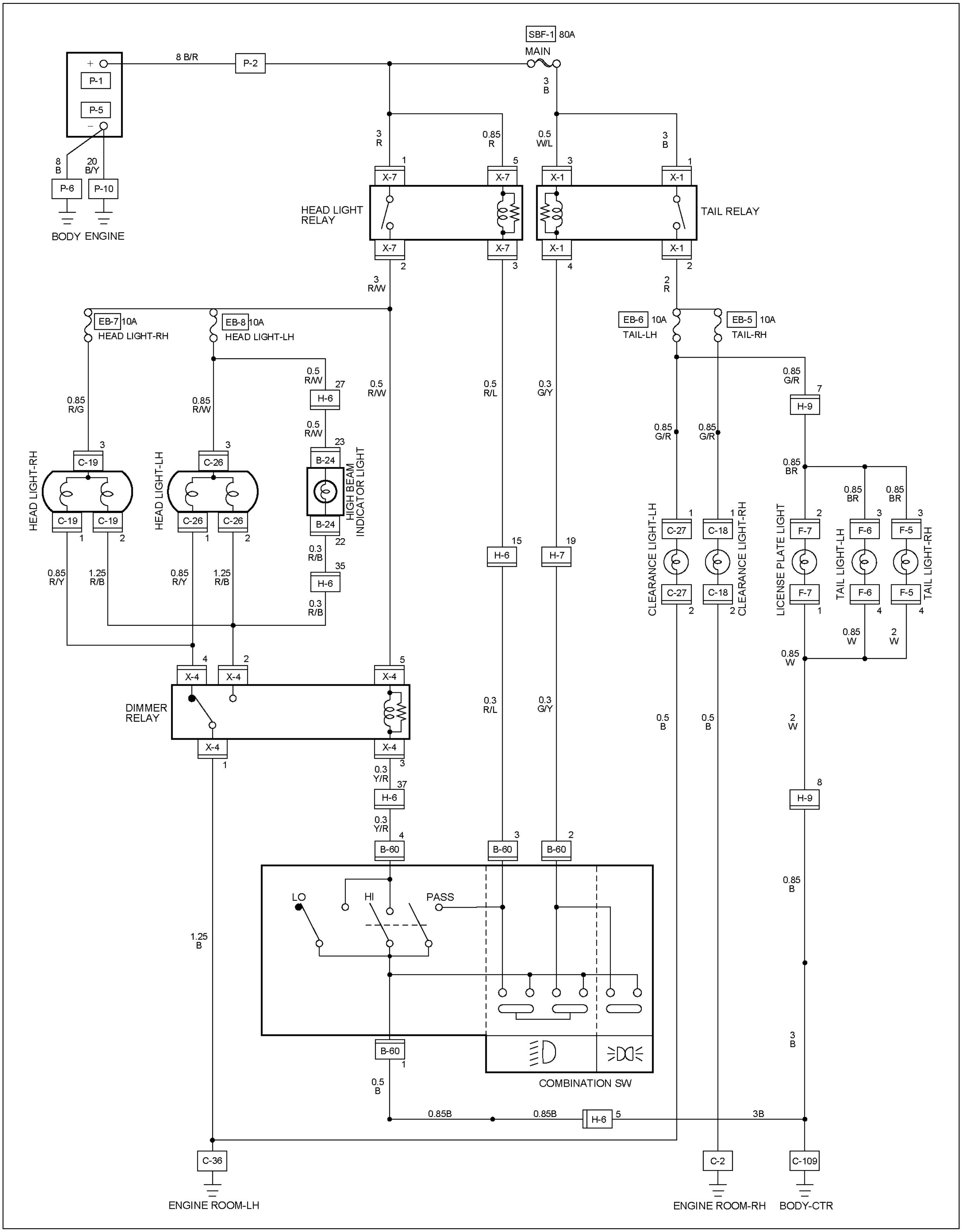
FRONT DIFFERENTIAL

N·m (kgf·m/lb·ft)



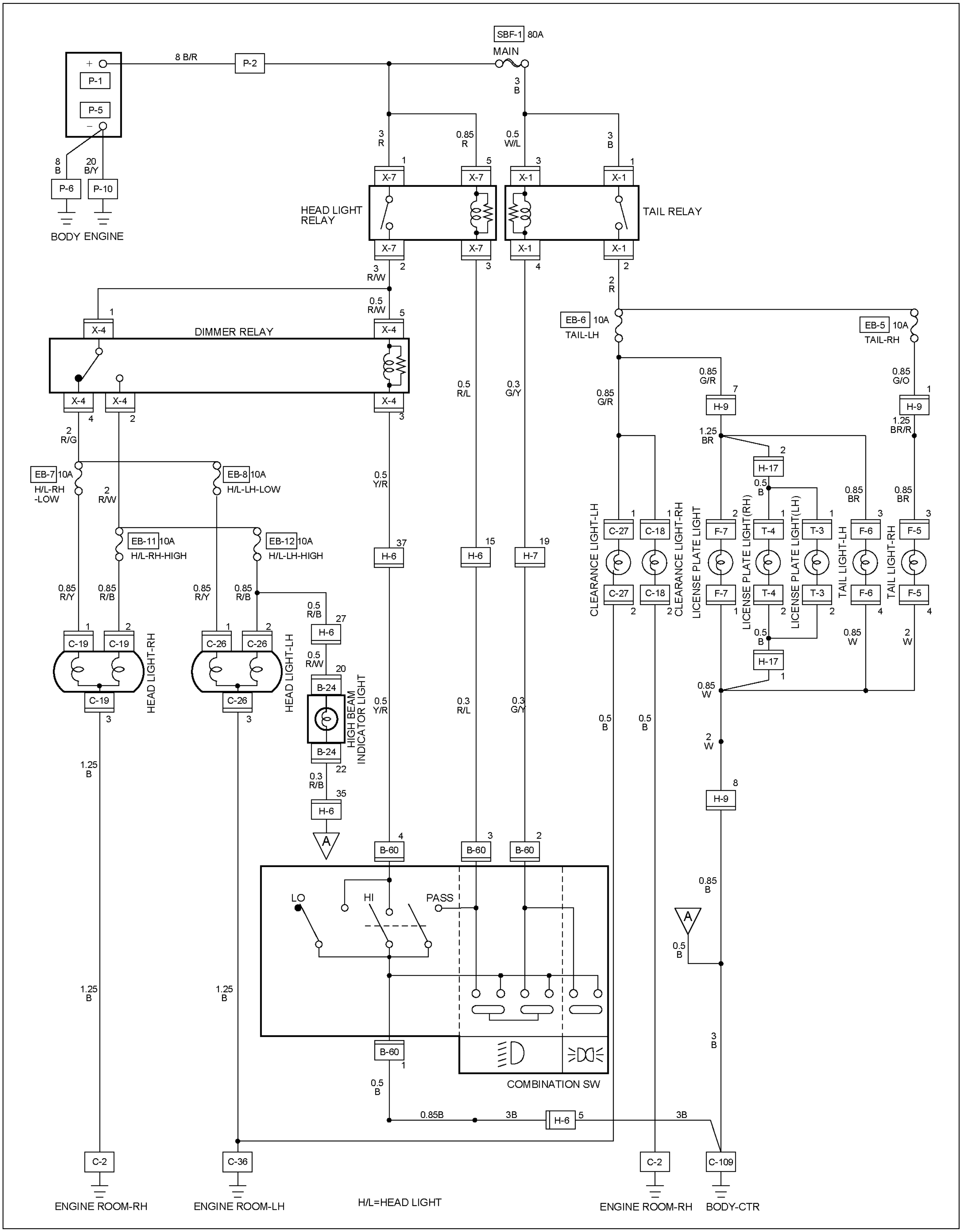
RTW440LF000901

CIRCUIT DIAGRAM C24SE (LHD) WITHOUT HEADLIGHTS LEVELING



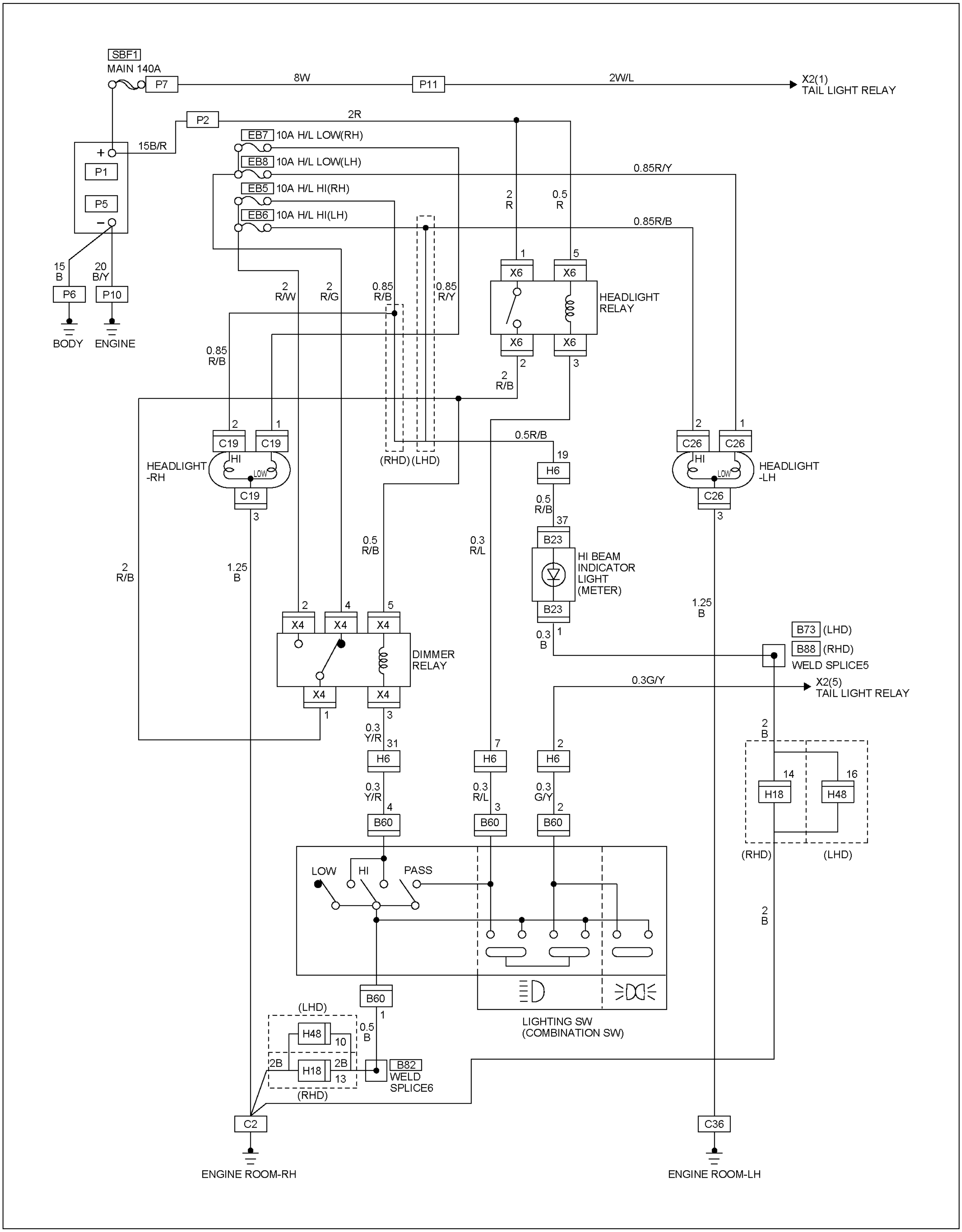
RTW680XF006701

CIRCUIT DIAGRAM C24SE (LHD) WITH HEADLIGHTS LEVELING



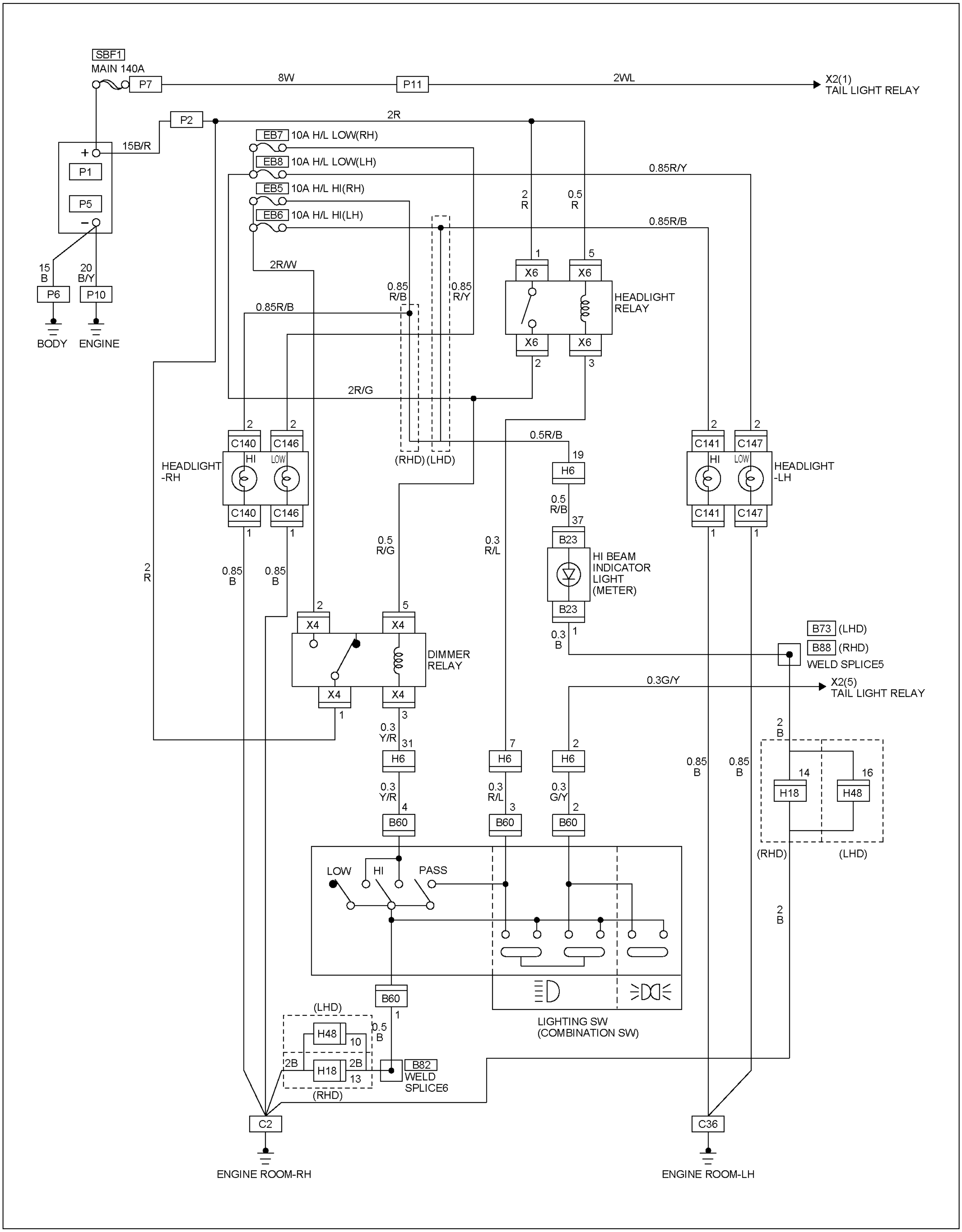
RTW680XF006801

CIRCUIT DIAGRAM HFV6 (HALOGEN STD TYPE)



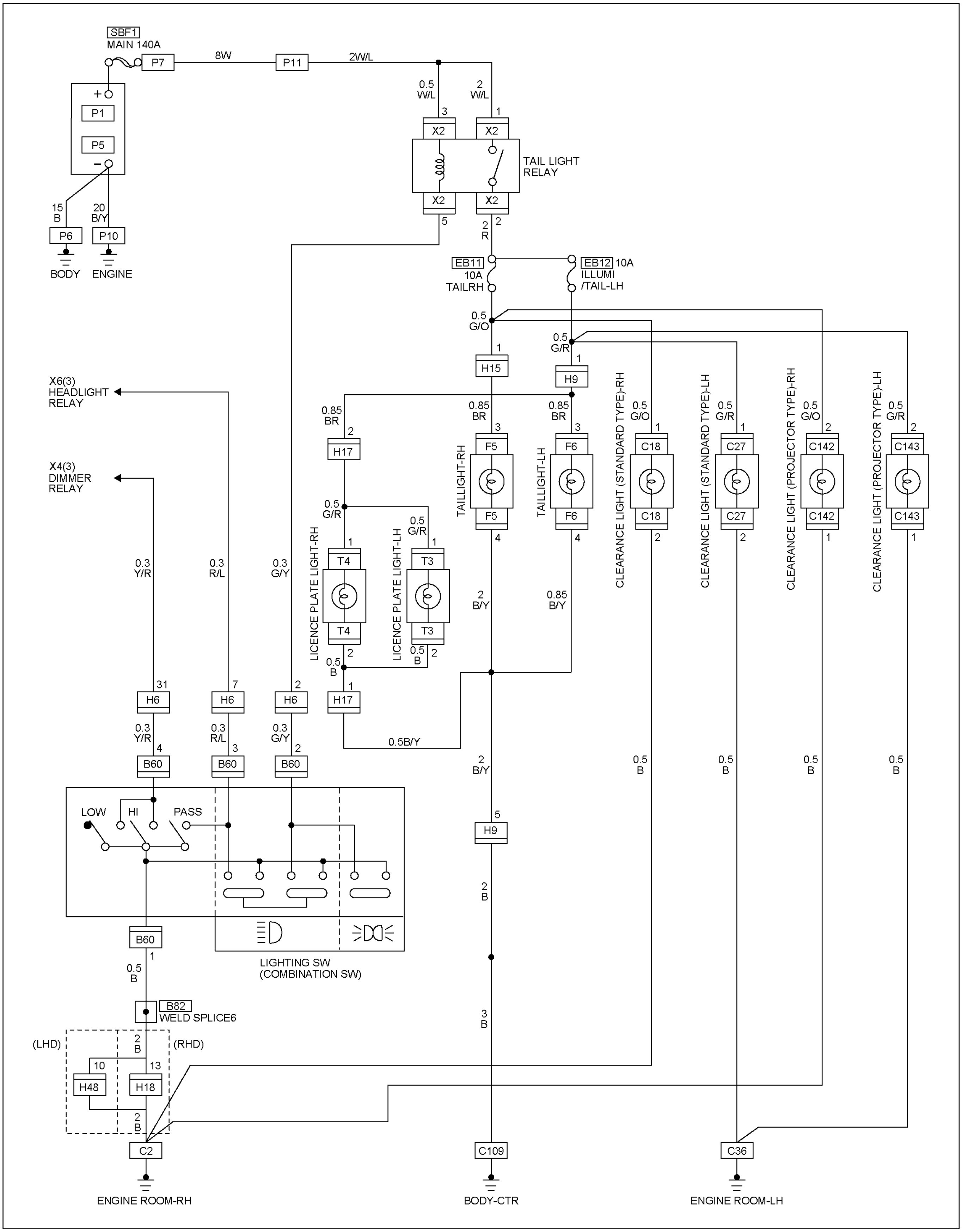
RTW78AXF009401

CIRCUIT DIAGRAM HFV6 (HALOGEN PROJECTOR TYPE)



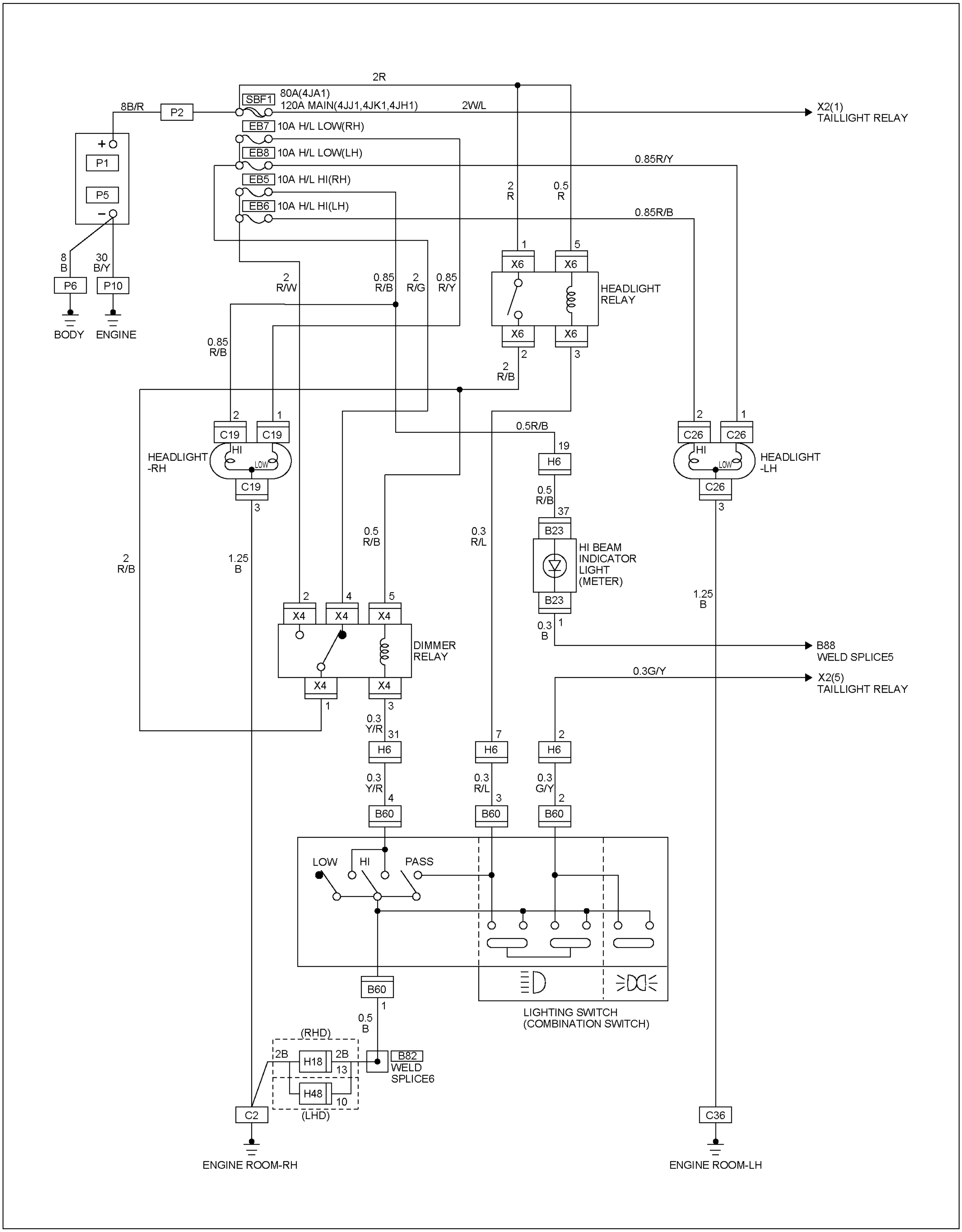
RTW78AXF009501

CIRCUIT DIAGRAM HFV6 (CLEARANCE LIGHT, LICENSE PLATE LIGHT, TAIL LIGHT)



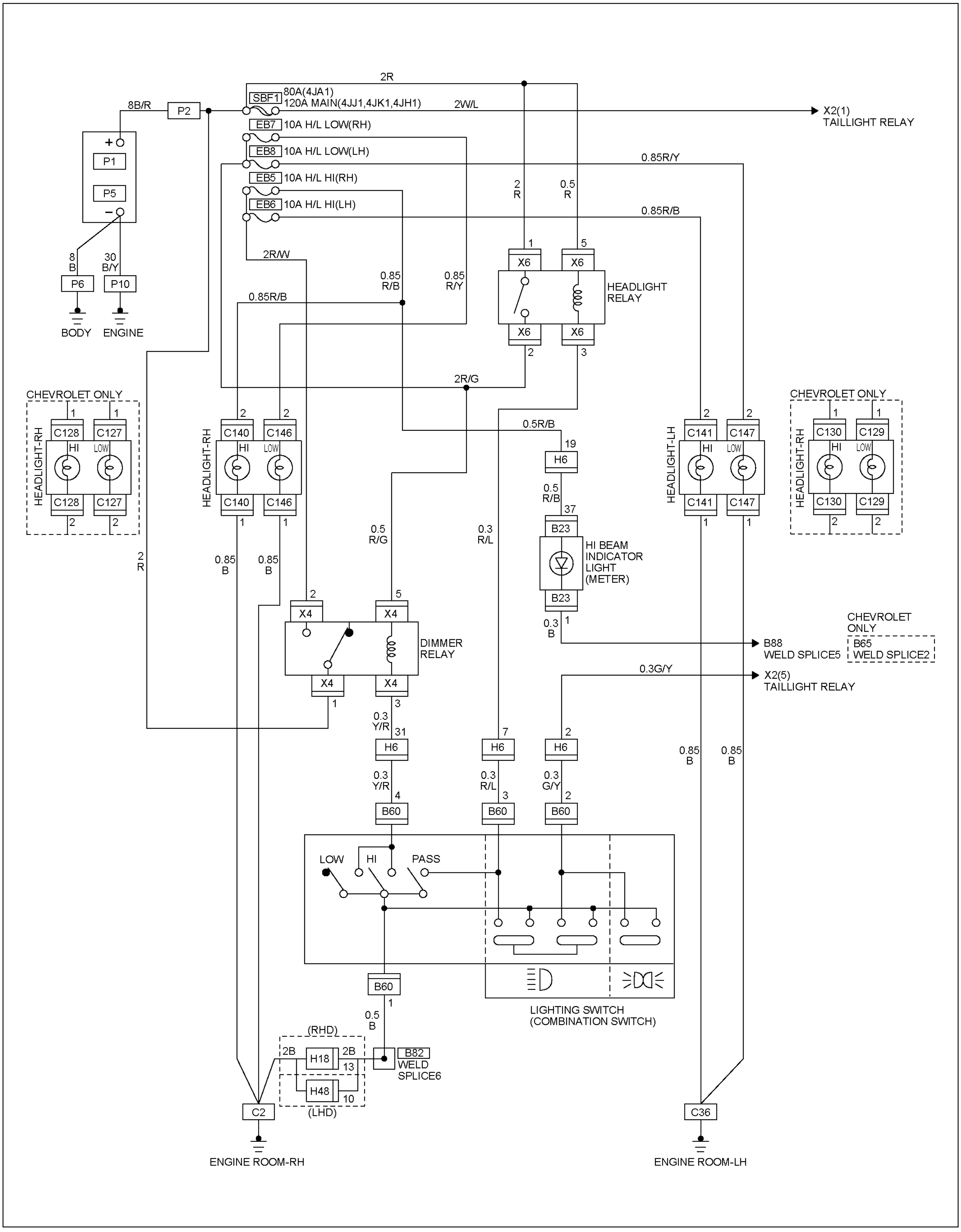
RTW78AXF009601

CIRCUIT DIAGRAM 4JA1T (L), 4JH1-TC, 4JJ1-TC, 4JK1-TC (HALOGEN STD TYPE)

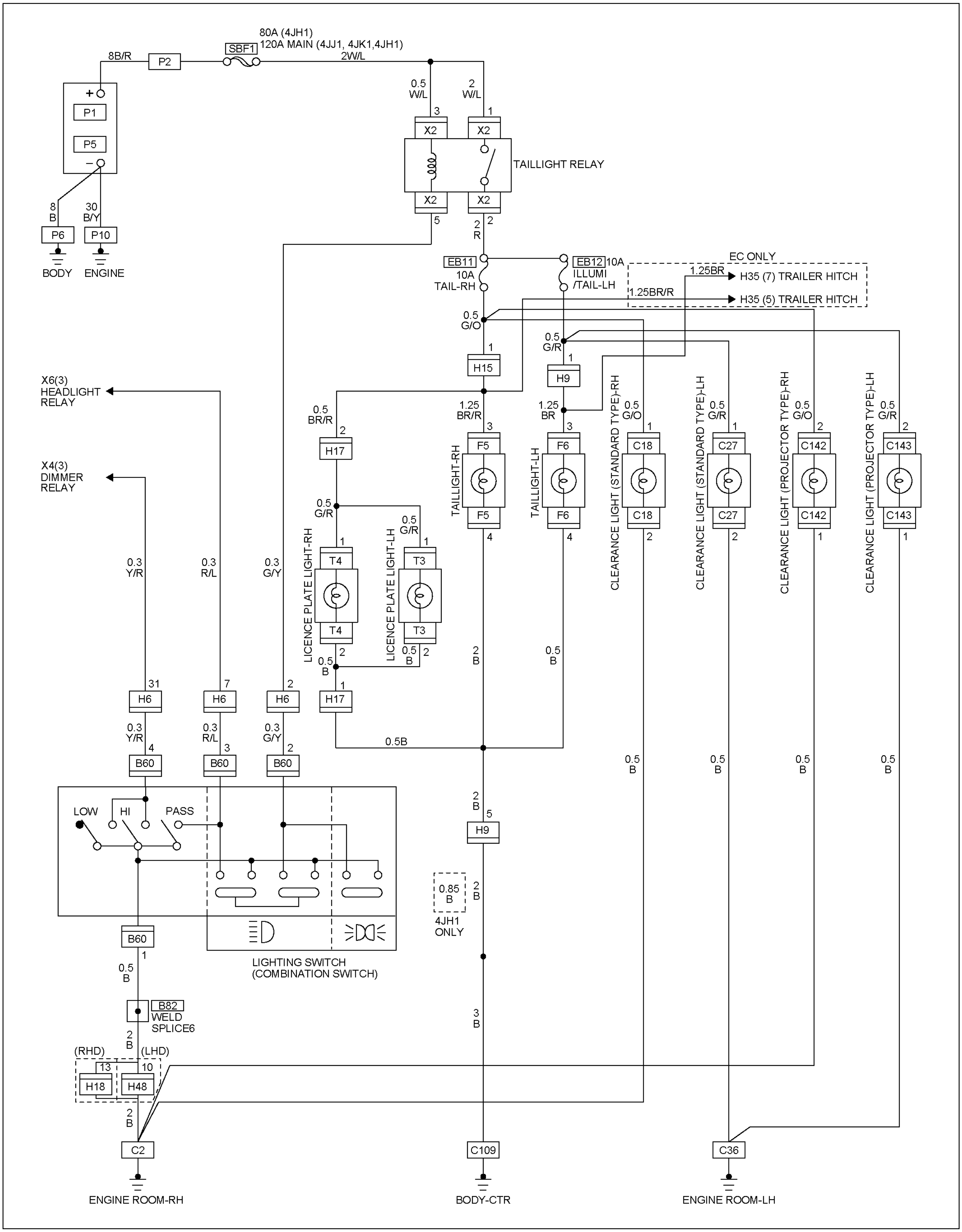


RTW78AXF004201

CIRCUIT DIAGRAM 4JA1T (L), 4JH1-TC, 4JJ1-TC, 4JK1-TC (HALOGEN PROJECTOR TYPE)



CIRCUIT DIAGRAM 4JA1T (L), 4JH1-TC, 4JJ1-TC, 4JK1-TC (CLEARANCE LIGHT, LICENSE PLATE LIGHT, TAIL LIGHT)



RTW78AXF026701

TROUBLE SHOOTING

HEADLIGHT

1. Both the headlights (high and low beam) do not light

Checkpoint		Trouble Cause	Countermeasure
Ground point contact (C2), (C36)	NG	Poor ground point contact	Repair the wiring
OK			
Combination switch continuity	NG	Poor switch contact or sw faulty	Repair or replace the combination switch
OK			
Lighting relay	NG	Poor relay contact or relay faulty	Reinstall or replace the lighting relay
OK			
Voltage between 5 X6 - ground and 2 X6 - ground	NG	Open circuit between battery positive terminal and lighting relay	Repair open circuit
OK			
Voltage between 1 B60 - ground	NG	Open circuit between lighting relay and lighting switch	Repair open circuit or connector contact
OK			
Wiring continuity between B60 - C2	NG	Open circuit	Repair open circuit

2. High or low beam does not light on both headlights

Checkpoint		Trouble Cause	Countermeasure
Dimmer·passing switch continuity	NG	Poor switch contact or switch faulty	Repair or replace the combination switch
OK ↓			
Voltage between 4 X4 - ground and 4 B60 - ground	NG	Open circuit between headlight and dimmer·passing switch	Repair open circuit or connector contact

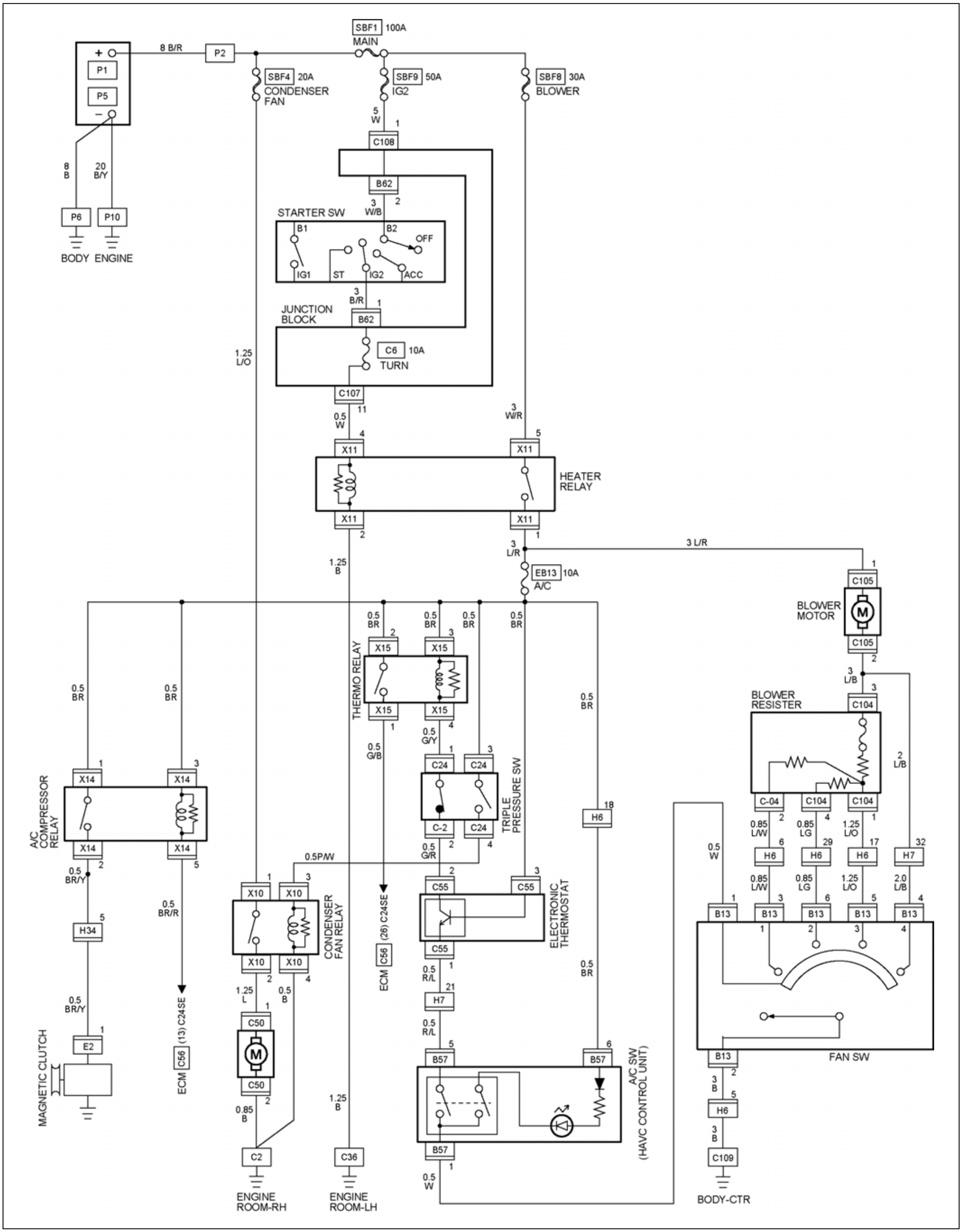
3. RH (or LH) high and low beam does not light

Checkpoint		Trouble Cause	Countermeasure
Fuse No. EB7 (10A) or No. EB8 (10A) (Relay and fuse box) (No. EB7 RH, No. EB8: LH)	NG	Poor installation or blown fuse	Reinstall or replace fuse No. EB7 or No. EB8
OK ↓			
Headlight connector continuity	NG	Blown filament or air leakage	Replace the headlight bulb
OK ↓			
Wiring continuity between connector 3 C19 - fuse No. EB7 or 3 C26 fuse No. EB8	NG	Open circuit and/or poor connector contact	Repair or replace the wire and/or connector

4. High or low beam does not light on one headlight (RH or LH)

Checkpoint		Trouble Cause	Countermeasure
Headlight connector continuity	NG	Blown filament	Replace the headlight assembly
OK ↓			
Wiring continuity between headlight and dimmer·passing switch	NG	Open circuit between headlight and dimmer·passing switch	Repair open circuit or connector contact

C24SE (A/C WITH HEATER)



RTW780XF013701

RECOMMENDED LIQUID GASKET

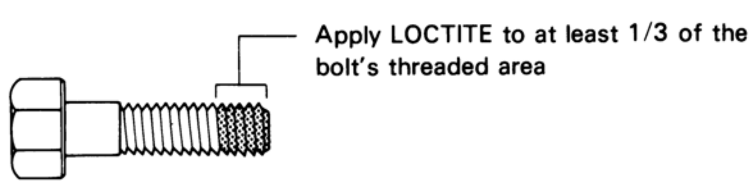
Type	Brand Name	Manufacture	Remarks
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215	Three Bond Three Bond Three Bond	For Engine Repairs For Axle Case Repairs, T/M
Water Base	ThreeBond 1141E	Three Bond	For Engine Repairs
Solvent	ThreeBond 1104 BelcoBond 4 BelcoBond 401 BelcoBond 402	Three bond Isuzu Isuzu Isuzu	For Engine Repairs
Anaerobic	LOCTITE 515 LOCTITE 518	Loctite Loctite	All

* RTV : Room Temperature Vulcanizer

Note :

1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacture's instructions at all times.
3. **Be absolutely sure to remove all lubricants and moisture from the connecting surfaces before applying the liquid gasket.**
   The connecting surfaces must be perfectly dry.
4. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.01 in). Poor adhesion will result.

RECOMMENDED THREAD LOCKING AGENTS

<table>
<tr><th>LOCTITE Type</th><th>LOCTITE Color</th><th>Application Steps</th></tr>
<tr><td>LOCTITE 242</td><td>Blue</td><td rowspan="4">1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined.
The surfaces must be perfectly dry.
2. Apply LOCTITE to the bolts.


3. Tighten the bolts to the specified torque.
4. Wait at least on hour before continuing the installation procedure.</td></tr>
<tr><td>LOCTITE 262</td><td>Red</td></tr>
<tr><td>LOCTITE 270</td><td>Green</td></tr>
<tr><td>LOCTITE 271</td><td>Red</td></tr>
</table>

5. Headlight does not go out

Checkpoint		Trouble Cause	Countermeasure
Lighting relay continuity between connector 1 X6 - 2 X6 (Should be no continuity)	NG	Relay point fused	Replace the lighting relay
OK			
Lighting switch continuity between connector 3 B60 -1 B60 when switch is OFF(Should be no continuity)	NG	point fused or faulty	Replay the combination switch
OK			
Dimmer·passing switch continuity between connector 3 B60 - 1 B60 when switch is not operating (Should be no continuity)	NG	Switch point fused or faulty	Repair or replace the combination switch
OK			
Check if headlight goes out when connector C2, C36 is disconnected	NG	Short circuit	Repair short circuit between 3 X6 - 3 B60 and 5 X2 - 2 B60

6. Insufficient headlight brightness

Checkpoint		Trouble Cause	Countermeasure
Headlight lens	NG	Lens dirty	Clean the light lens
OK			
Headlight bulb	NG	Bulb filament faulty	Replace the headlight bulb
OK			
Dimmer·passing switch Wire continuity between connector 1 B60 - C2	NG	Poor ground point contact	Repair the wiring

7. Passing light does not function when dimmer switch is operated

Checkpoint		Trouble Cause	Countermeasure
Dimmer switch	NG	Poor switch point contact	Repair or replace the dimmer switch
OK			
Voltage between 3 B60 - ground (Should be battery voltage present)	NG	Open circuit	Repair open circuit between 3 X6 - 3 B60

8. Headlight beam does not change when dimmer switch is operated

Checkpoint		Trouble Cause	Countermeasure
Dimmer switch	NG	Loose beam lever or foreign material in switch	Repair or replace the dimmer switch

TAIL LIGHT, LICENSE PLATE LIGHT, CLEARANCE LIGHT

1. All lights do not light

Checkpoint		Trouble Cause	Countermeasure
Fuse No. EB12 (LH) or EB11 (RH) (10A, Relay and fuse box)	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. EB12 (LH), EB11 (RH)
OK			
Lighting switch continuity between connector 2 B60 - 1 B60	NG	Poor switch point or connector contact	Repair or replace the combination switch
OK			
Tail relay	NG	Poor relay contact or relay faulty	Reinstall or replace the tail relay

2. Tail light does not light

Checkpoint		Trouble Cause	Countermeasure
Tail light bulb continuity	NG	Bulb burned out or poor connector contact	Replace the bulb or repair connector contact
OK			
Continuity between connector 3 F5 - 4 F5 (RH) or 3 F6 - 4 F6 (LH)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

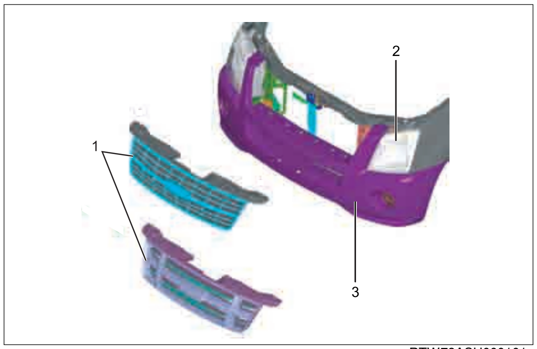
3. License plate light does not light

Checkpoint		Trouble Cause	Countermeasure
License plate light bulb continuity	NG	Bulb burned out or poor connector contact	Replace the bulb or repair connector contact
OK			
Continuity between connector 1 T4 - 2 T4 or 1 T3 - 2 T3	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

4. Clearance light does not light

Checkpoint		Trouble Cause	Countermeasure
Clearance light bulb continuity	NG	Bulb burned out or poor connector contact	Replace the bulb or repair connector contact

LIGHTING SYSTEM
REMOVAL AND INSTALLATION



RTW78ASH000101

FRONT COMBINATION LIGHT (A type)

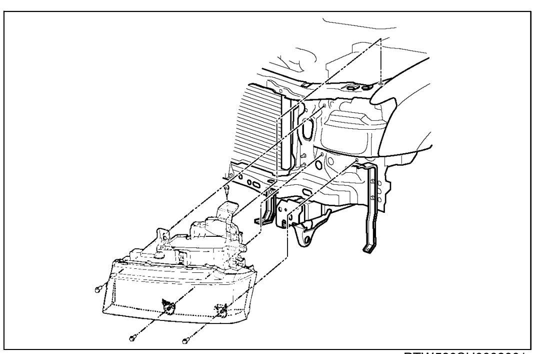
Removal

1. Remove the radiator grille ①.
   Refer to the removal procedure of the RADIATOR GRILLE in Section 2B “SHEET METAL”.
2. Remove the front bumper ③.
   Refer to the removal procedure of the FRONT BUMPER in Section 2A “FRAME AND BUMPER”.
3. Disconnect the headlight connector.
4. Disconnect the clearance light connector.
5. Disconnect the turn signal light connector.
6. Remove the front combination light assembly ②.
   - Remove four fixing screws.

HEADLIGHT ASSEMBLY (B type)

Removal

1. Open the bonnet.
2. Remove the front combination light assembly.
   - Refer to "Front Combination Light Assembly" removal procedure in this section.
3. Remove the radiator grille.
   - Refer to "Radiator grille" removal procedure in 2B section.
4. Remove the front bumper.
   - Refer to "Front Bumper" removal procedure in 2B section.
5. Disconnect headlight bulb connectors.
6. Remove the bolts of headlight assembly.
7. Remove the headlight assembly.


RTW580SH0008001

Installation

To install the front combination light assembly, follow the removal procedure in reverse order.

HEADLIGHT (HALOGEN STD TYPE) (A type)

Removal

1. Remove the head light socket.
2. Remove the headlight dust cover.

3. Slide out the lock spring.

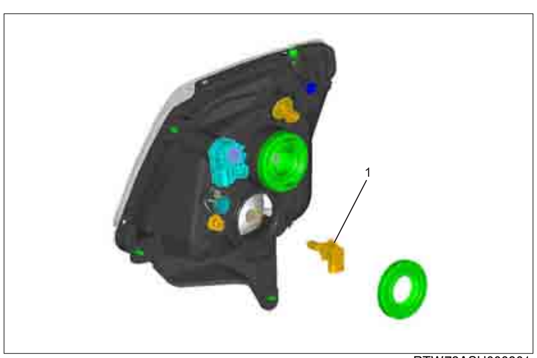
4. Remove the bulb.

RTW78ASH000801

HEADLIGHT (HALOGEN PROJECTOR TYPE)

Removal

1. Remove the head light socket.
2. Remove the headlight dust cover ①.



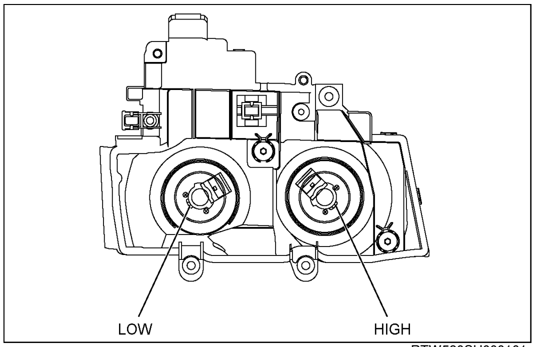
RTW78ASH000901

3. Turn the bulb socket counterclockwise to remove it.
4. Remove the headlight bulb ①.

HALOGEN HEADLIGHT BULB (B type)

Removal

1. Open the bonnet.
2. Disconnect the headlight bulb connectors.
3. Turn the bulb counterclockwise to remove it.



RTW580SH000101

Installation

To install the headlight, follow the removal procedure in reverse order.
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the headlight connector is securely connected.
This will prevent a contact and an open circuit.

Installation

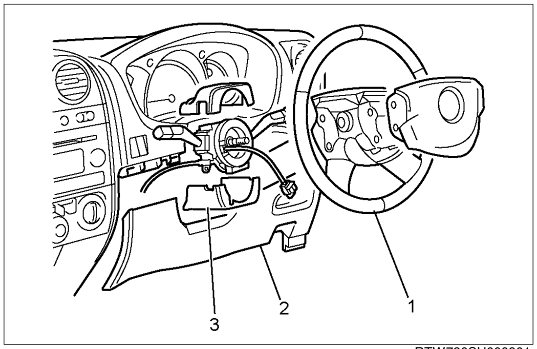
Follow the removal procedure in the reverse order to install the headlight.
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the headlight connector is securely connected.
This will prevent a contact and an open circuit.

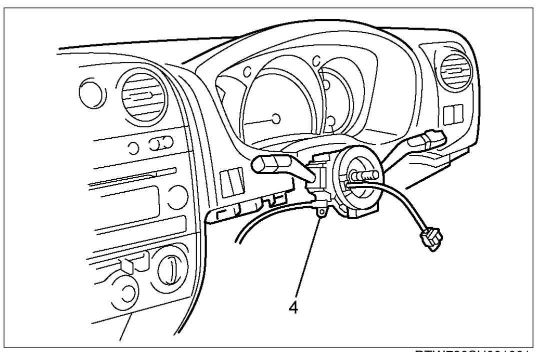
LIGHTING SWITCH

Removal



This illustration is based on RHD model

1. Disconnect the battery ground cable.
2. Remove the steering wheel ①.
   Refer to the “STEERING” Section of this manual.
3. Remove the Instrument panel lower cover ②.
4. Remove the steering column cover ③.



This illustration is based on RHD model

5. Disconnect the connector.
6. Remove the lighting switch ④ from the steering shaft.

Installation

Follow the removal procedure in the reverse order to install the lighting switch.
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the lighting switch connector is securely connected.
This will prevent a poor contact and an open circuit.

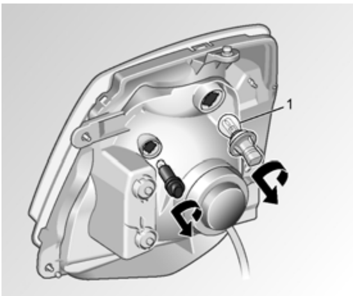
Wire Harness

Do not pinch the wire harnesses between the cluster and the meter hood during the cluster installation procedure.
Wire damage will result.

FRONT TURN SIGNAL LIGHT BULB (A type)

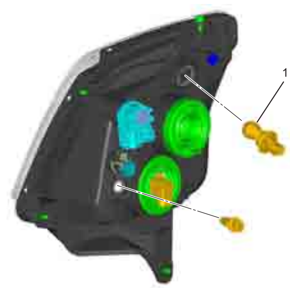
Removal

1. Turn the socket counterclockwise to disconnect it from the front turn signal light housing.
2. Turn the bulb ① counterclockwise to remove it.



HALOGEN STD TYPE

RTW78ASH000201



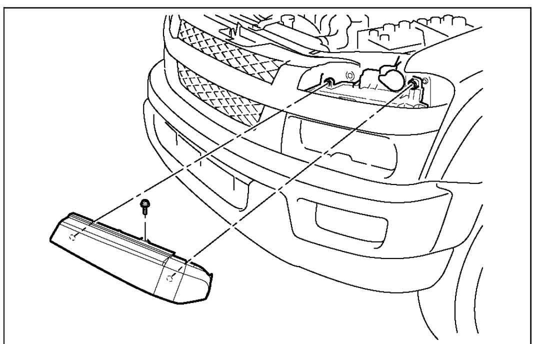
HALOGEN PROJECTOR TYPE

RTW78ASH001001

FRONT COMBINATION LIGHT ASSEMBLY (B type)

Removal

1. Open the bonnet.
2. Remove the bolt of front combination light assembly
3. Disconnect the front combination light harness connector.
4. Remove the front combination light assembly.



RTW580SH000901

Installation

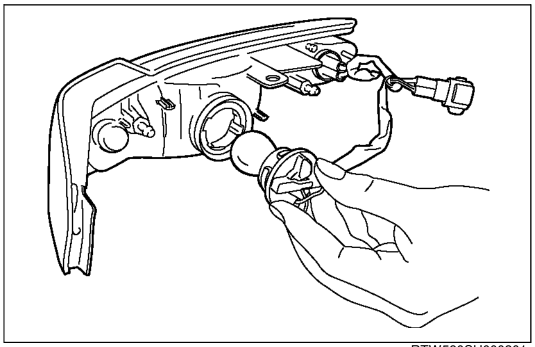
To install the front combination light assembly follow the removal procedure in the reverse order.

Connector

Be absolutely sure that the front combination light harness connector is correctly installed.
This will prevent a poor contact and an open circuit.

FRONT TURN SIGNAL LIGHT BULB

Removal



RTW580SH000201

1. Remove the front combination light assembly.
   - Refer to “FRONT COMBINATION LIGHT ASSEMBLY” removal procedure in this section.
2. Turn the bulb counterclockwise to remove it. (Gray socket side)

Installation

Follow the removal procedure in the reverse order to install the front turn signal light.
Pay close attention to the important points mentioned in the following paragraphs.

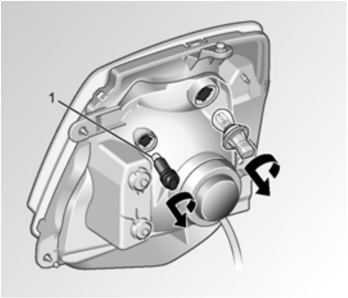
Connector

Be absolutely sure that the clearance light connector is securely connected.
This will prevent a poor contact and an open circuit.

CLEARANCE LIGHT BULB (A type)

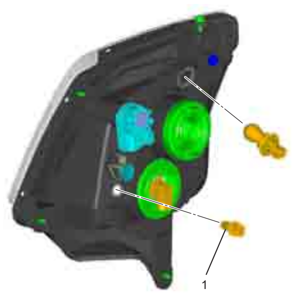
Removal

1. Turn the socket counterclockwise to disconnect it from the clearance light housing.
2. Turn the bulb ① counterclockwise to remove it.



HALOGEN STD TYPE

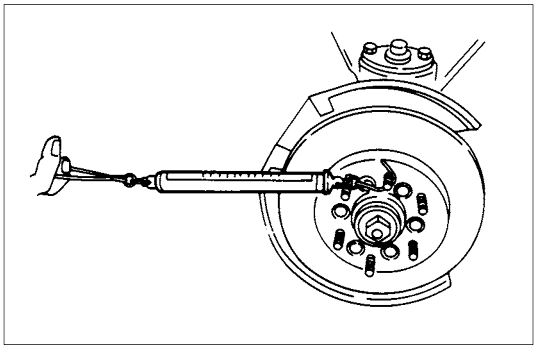
RTW78ASH000301



HALOGEN PROJECTOR TYPE

RTW78ASH001101

SERVICING



Hub Bearing Preload at the Wheel Pin

4×4, 4×2 (High Ride Suspension) Model N (kgf/lb)

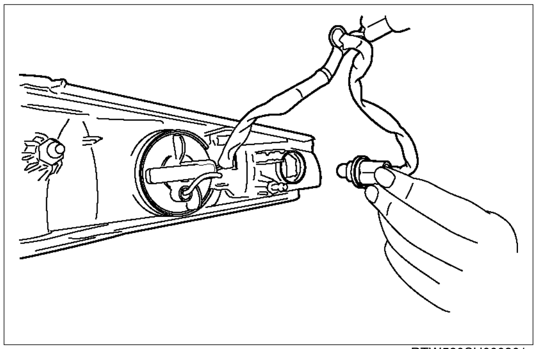
New bearing and New oil seal	22 - 27 (2.2 - 2.8 / 4.9 - 6.2)
Reuse bearing and New oil seal	14 - 20 (1.4 - 2.0 / 3.1 - 4.5)

4×2 (Except High Ride Suspension) Model N (kgf/lb)

New bearing and New oil seal	9.3 - 13.3 (0.95 - 1.36 / 2.09 – 3.00)
Reuse bearing and New oil seal	9.3 - 13.3 (0.95 - 1.36 / 2.09 – 3.00)

CLEARANCE LIGHT BULB (B type)

Removal



RTW580SH000301

1. Remove the front combination light assembly.
   - Refer to “FRONT COMBINATION LIGHT ASSEMBLY” removal procedure in this section.
2. Turn the bulb counterclockwise to remove it. (Black socket side)

Installation

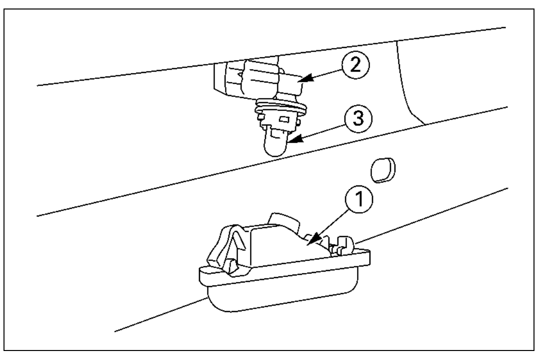
Follow the removal procedure in the reverse order to install the clearance light.
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the clearance light connector is securely connected.
This will prevent a poor contact and an open circuit.

LICENSE PLATE LIGHT

Removal



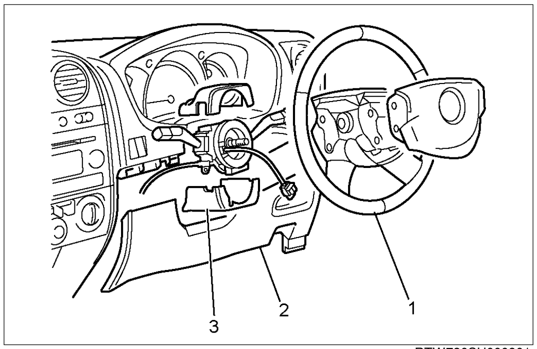
1. Remove the lens cover ① and the connector ②.
2. Pull the bulb ③ to remove it.

Installation

Follow the removal procedure in the reverse order to install the license plate light.
Pay close attention to the important points mentioned in the following paragraphs.

Bulb

Be absolutely sure that the license plate light bulb is correctly installed.
This will prevent a poor contact and open circuit.



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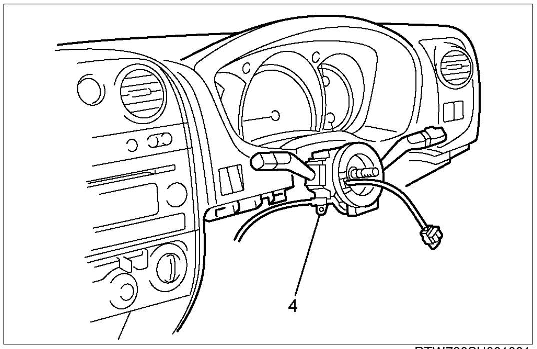


RTW780SH001001

HEADLIGHT BEAM SWITCH (COMBINATION SWITCH)

Removal

1. Disconnect the battery ground cable.
2. Remove the screws on the lower part of the steering wheel.
3. Remove the horn pad.
4. Remove the wiring connector.
5. Remove the steering wheel fixing nuts.
6. Remove the steering wheel ①.
   Refer to the "STEERING" Section of this manual.
7. Remove the Instrument panel lower cover ②.
8. Remove the steering column cover ③.
9. Disconnect the connector.
10. Remove the headlight beam switch (lever) from the steering shaft (combination switch).

Installation

Follow the removal procedure in the reverse order to install the headlight beam switch (lever).
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the headlight beam switch connector is securely connected.
This will prevent a poor contact and an open circuit.

Wire Harness

Do not pinch the wire harnesses between the cluster and the meter hood during the cluster installation procedure.
Wire damage will result.

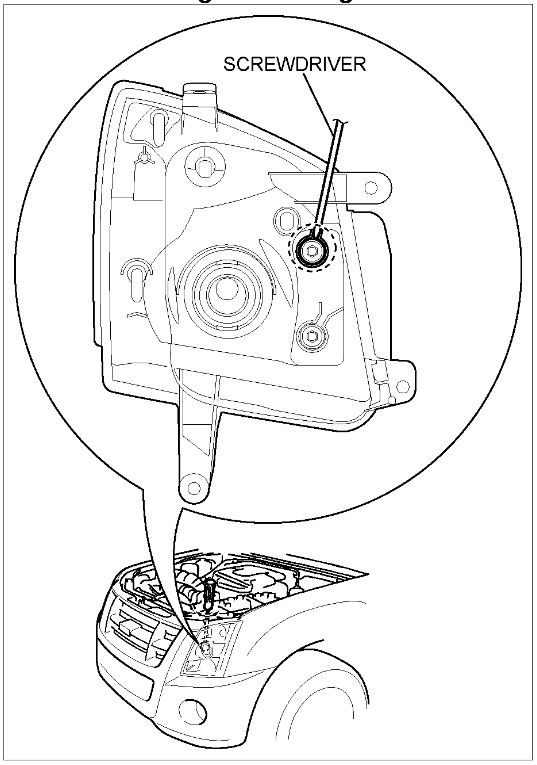
AIMING OF HEADLIGHT

Before adjusting the headlights, park the vehicle on a level surface. Remove any cargo from the vehicle to bring it to curb weight. Check the tire inflation pressures and correct as required. Clean the headlight lenses.

VERTICAL ADJUSTMENT (A type)

Use a Phillips-head screwdriver with a long shaft. Hold the screwdriver straight up-and-down as shown in the illustration.

Without Head light Leveling



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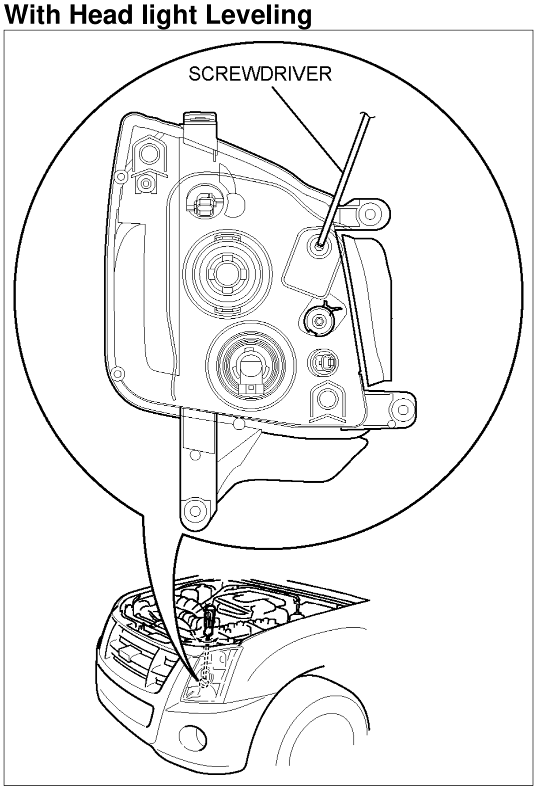
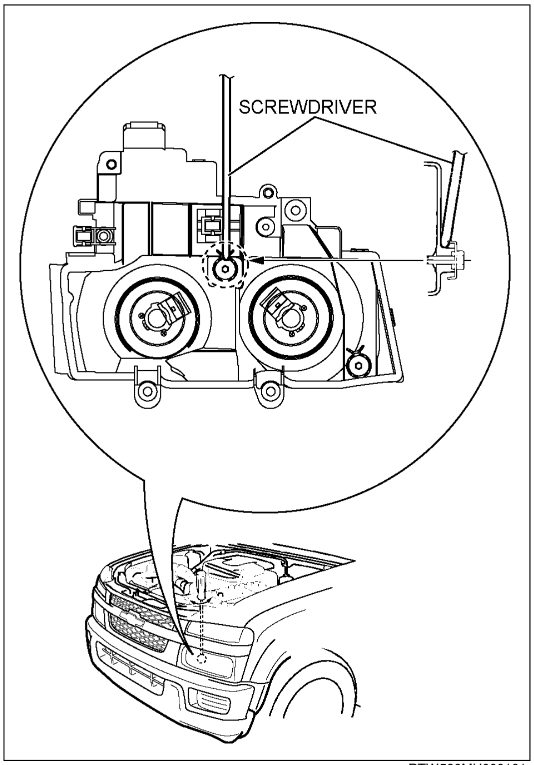
With Head light Leveling



RTW78AMH000101

VERTICAL ADJUSTMENT (B type)

Use a screwdriver with a long shaft. Hold the screwdriver straight up-and-down as shown in the illustration.

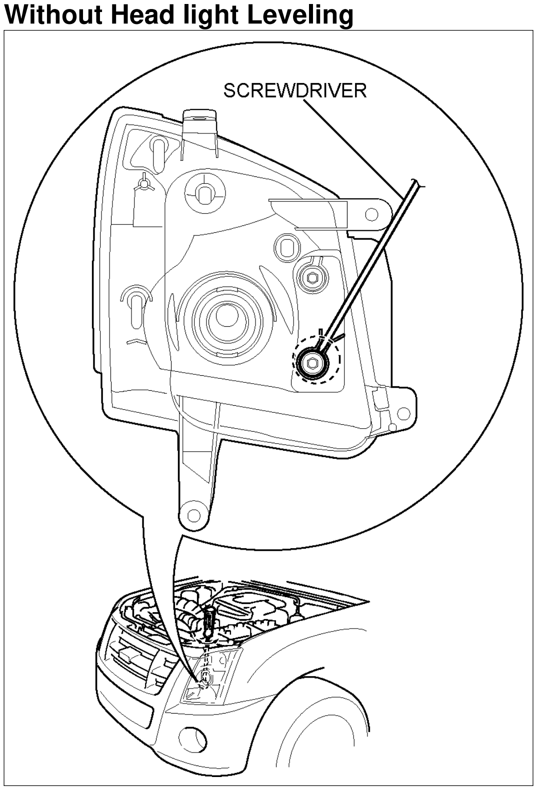


RTW580MH000101

HORIZONTAL ADJUSTMENT (A type)

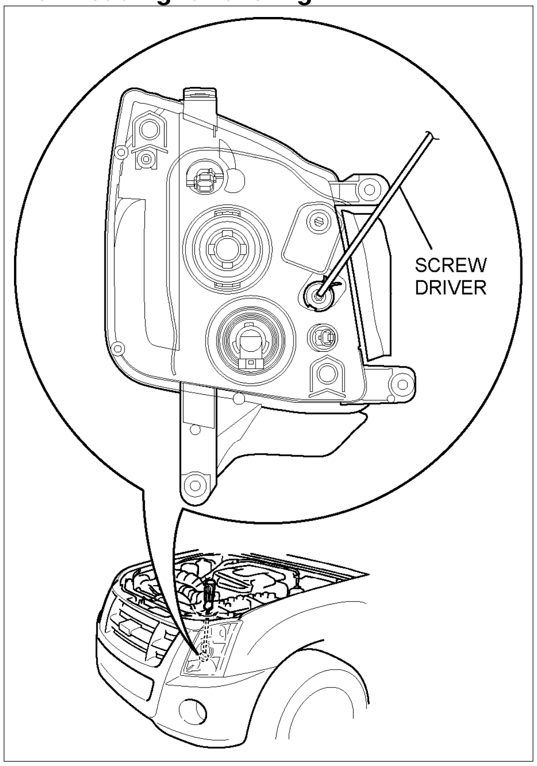
Use a Phillips-head screwdriver with a long shaft. Hold the screwdriver at an angle as shown by the arrow in the illustration.

Without Head light Leveling



RTW780MH000201

With Head light Leveling



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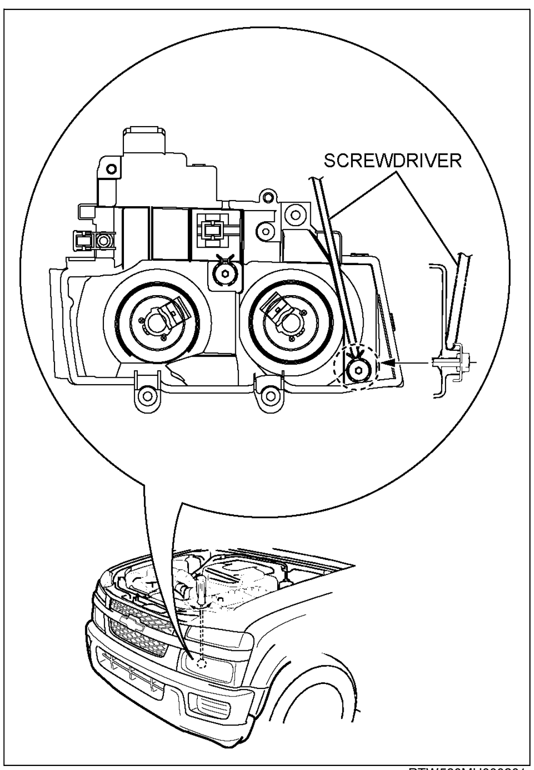


RTW580MH000201

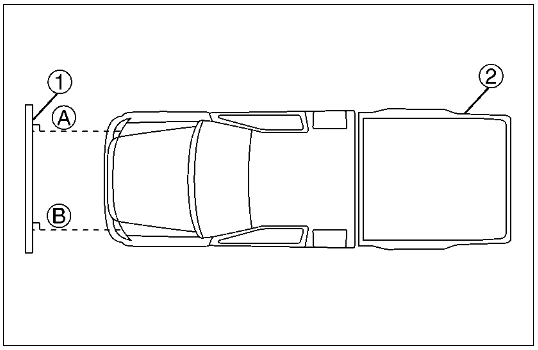
HORIZONTAL ADJUSTMENT (B type)

Use a screwdriver with a long shaft. Hold the screwdriver at an angle as shown by the arrow in the illustration.

Installation

To install, follow the removal steps in the reverse order. Noting the following point:

1. After installing the headlight, be sure to adjust the headlight aim.

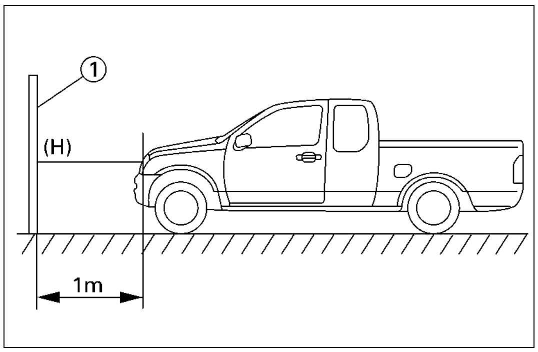


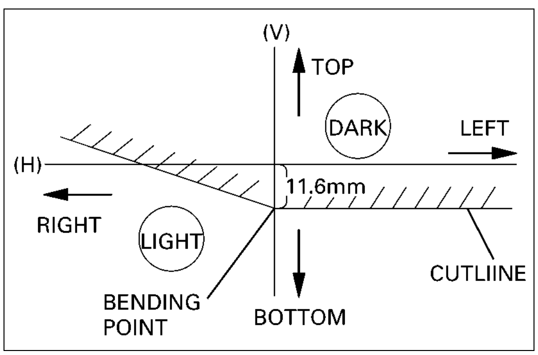
HEADLIGHT ADJUSTMENT

Preparation

Place the vehicle with 1 person in driver seat on a level surface and check to see if the inflation pressure of the tires is correct, the lenses are clean, the battery is sufficiently charged, and adjust to place vehicle by using the screen.

1. Set a vertical screen on a level surface.
2. Toward the screen ① from the bulb center mark of the headlight, extend parallel lines to the floor. Mark point Ⓐ and Ⓑ on the screen at the intersection of parallel line and the screen.
3. Draw vertical lines through point Ⓐ and Ⓑ on the screen.
4. Keep the vehicle ② 1m apart from the screen ①.
5. Draw a horizontal line through point Ⓐ and Ⓑ on the screen ①.



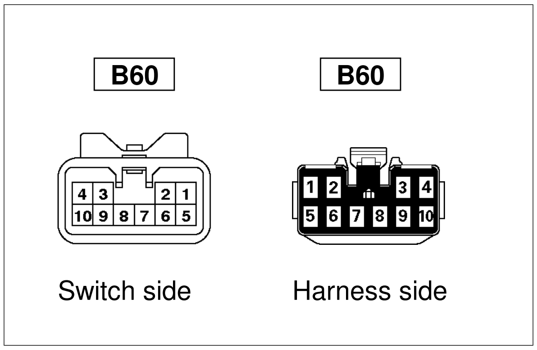


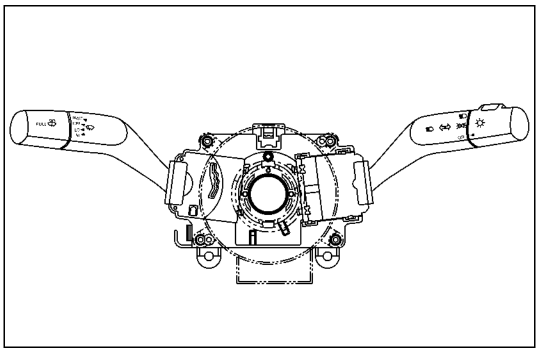
6. Turn the headlight low beam on.
7. Adjust the CUTLINE 11.6 mm below the horizontal line Ⓗ.
8. Adjust the BENDING POINT to the vertical line Ⓥ.

NOTE:

Always adjust vertical adjustment first.

INSPECTION AND REPAIR

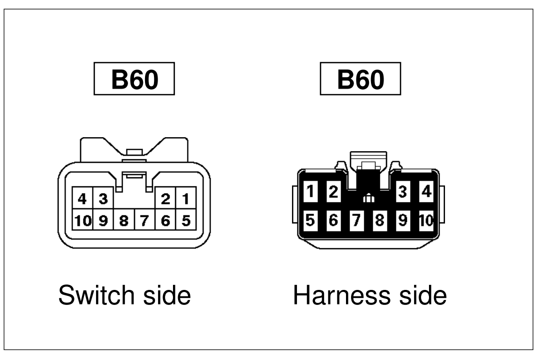




LIGHTING SWITCH

Lighting Switch Connections

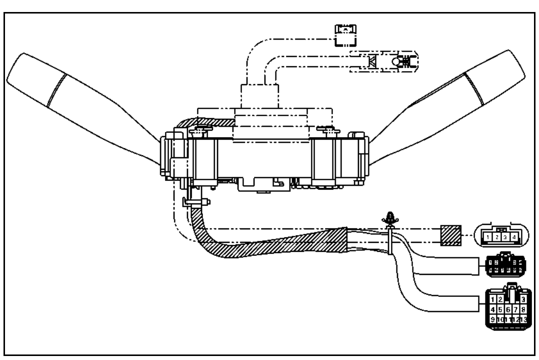
SW position \ Terminal No.	3	2	1
OFF			
Tail		○	○
⇕		○	○
Headlight	○	○	○

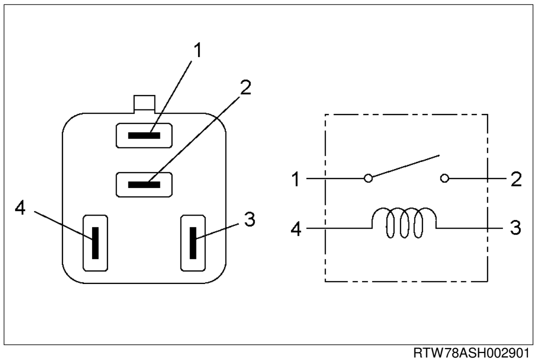


HEADLIGHT BEAM SWITCH

Headlight Beam and Passing Switch Connections

SW position \ Terminal NO.		1	4	
At “Dimmer” position	HI	○	○	
		○	○	
	LO			
At “Passing” Position		○	○	○

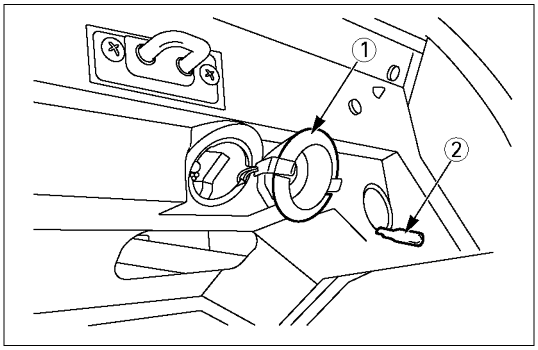




LIGHTING RELAY, TAIL RELAY

Check continuity between the relay terminals.

② - ①	No continuity
(When battery voltage is applied between ③ and ④)	
② - ①	Continuity



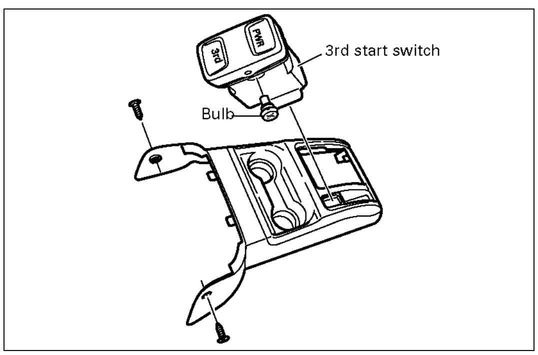
GLOVE BOX ILLUMINATION

Removal

1. Remove the bulb cover ①.
2. Remove the bulb ②.

Installation

To install, follow the removal steps in the reverse order.



POWER/3rd START SW

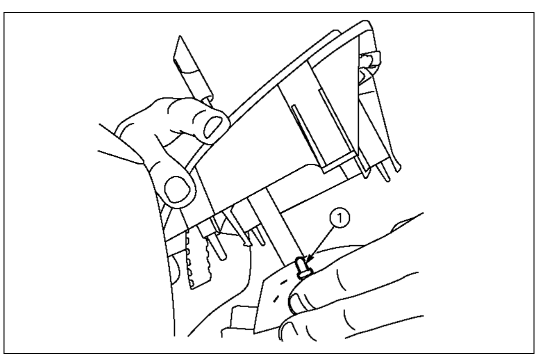
Removal

- Refer to the “Front consol” Section 10 of this manual.

1. Disconnect the battery ground cable.
2. Remove the power/3rd start switch.
3. Remove the bulb.

Installation

To install, follow the removal steps in the reverse order.



A/T LEVER LIGHT BULB

Removal

- Refer to the “Front consol” Section 10 of this manual.

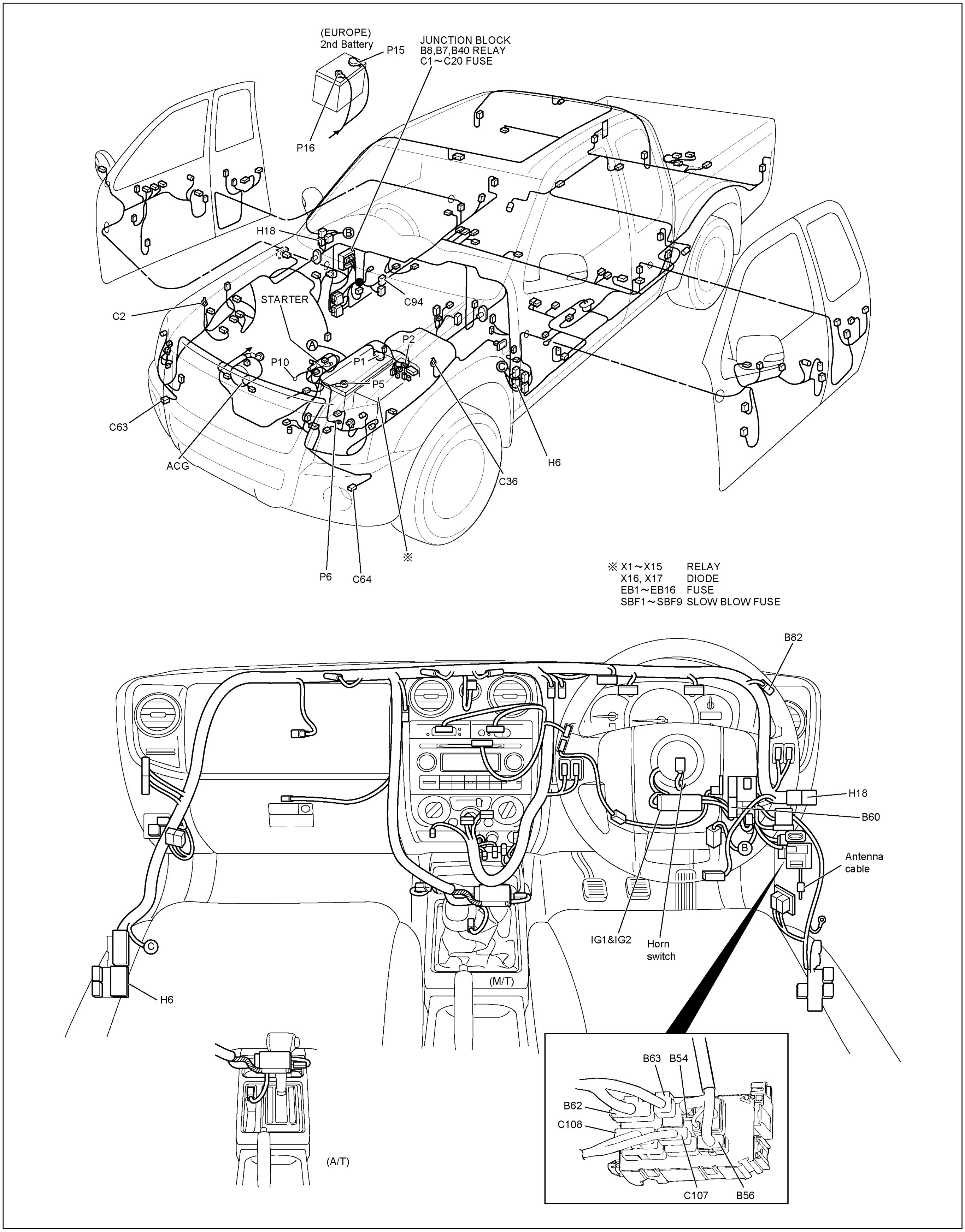
1. Remove the A/T lever cover.
2. Remove the light bulb ①.

Installation

To install, follow the removal steps in the reverse order.

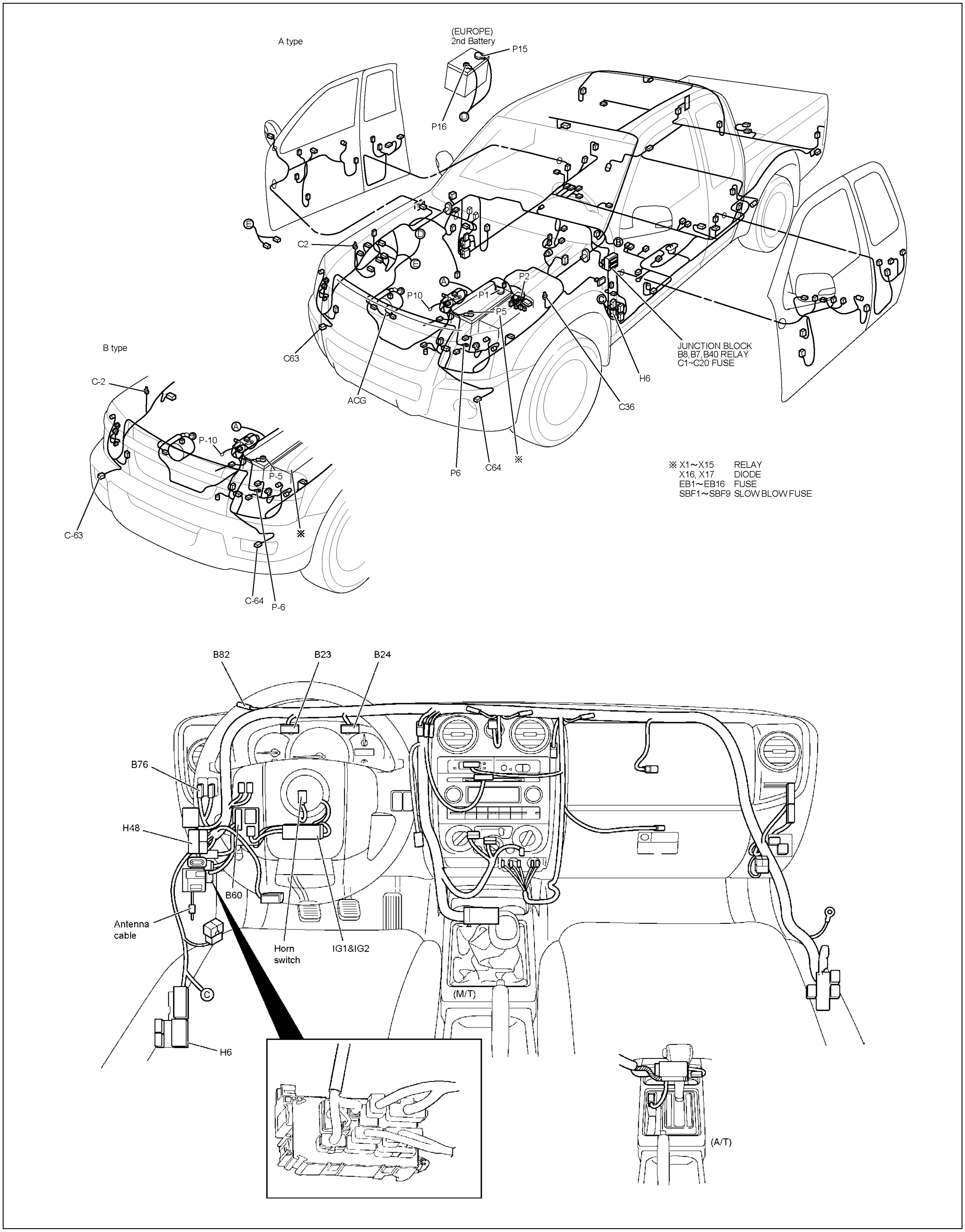
FRONT FOG LIGHT

PARTS LOCATION (RHD)



RTW78AXF036901 & RTW78AXF043101

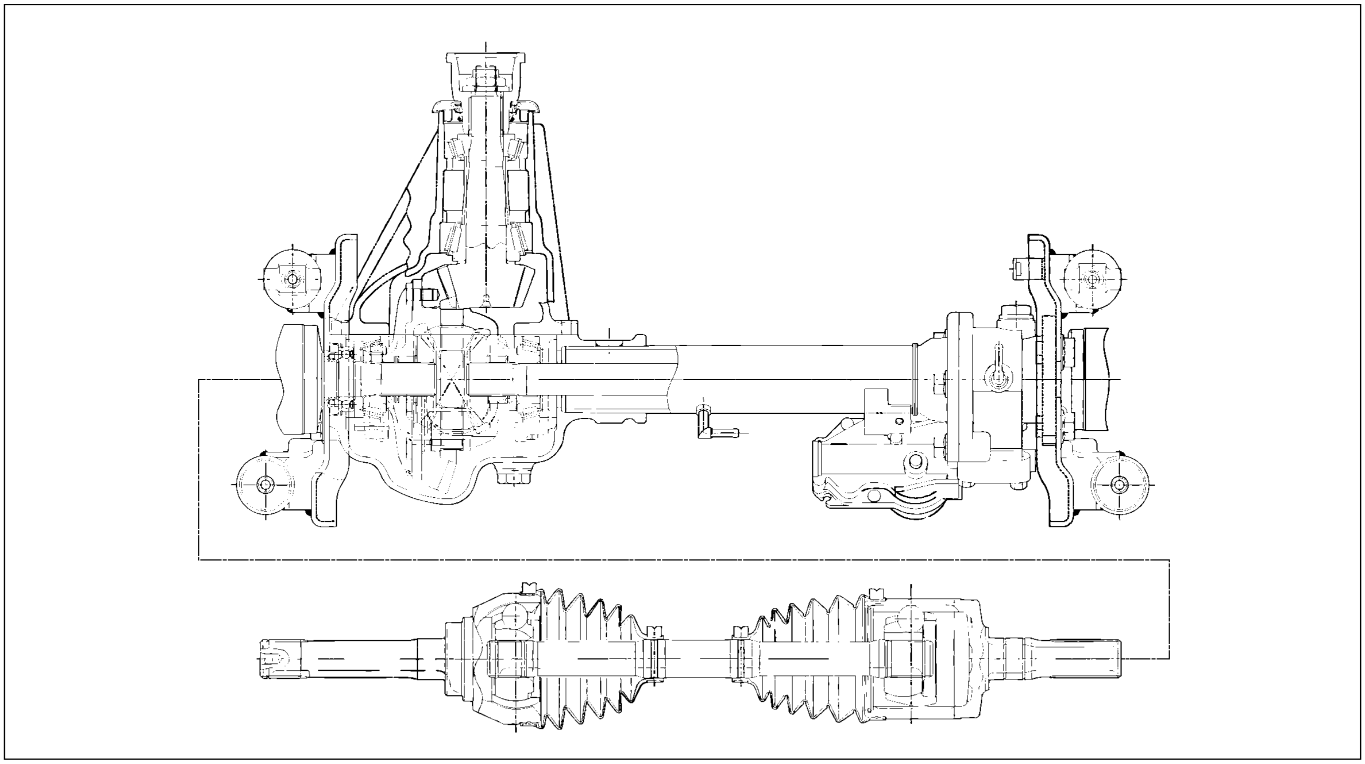
PARTS LOCATION (LHD)



RTW78AXF037001 & RTW78AXF043201

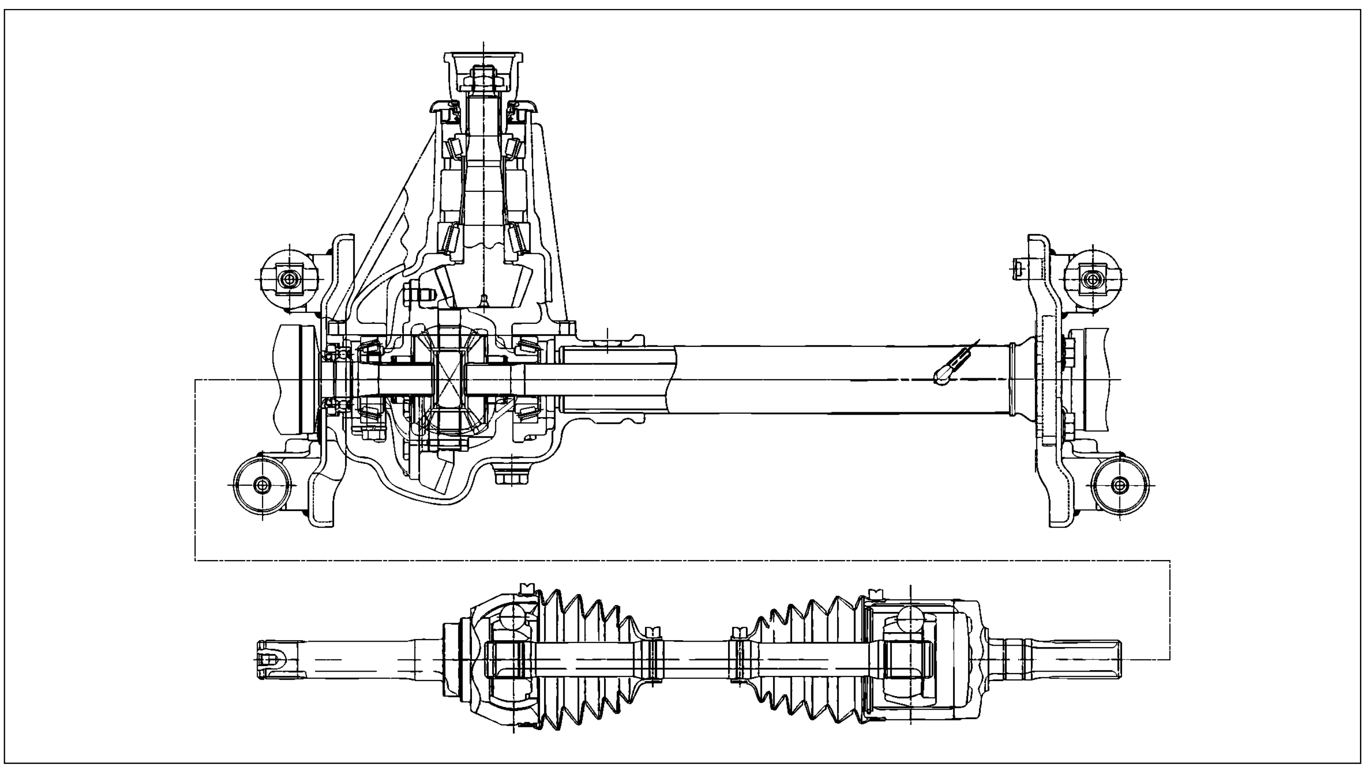
GENERAL DESCRIPTION

FRONT DRIVE AXLE (With Shift On The Fly)



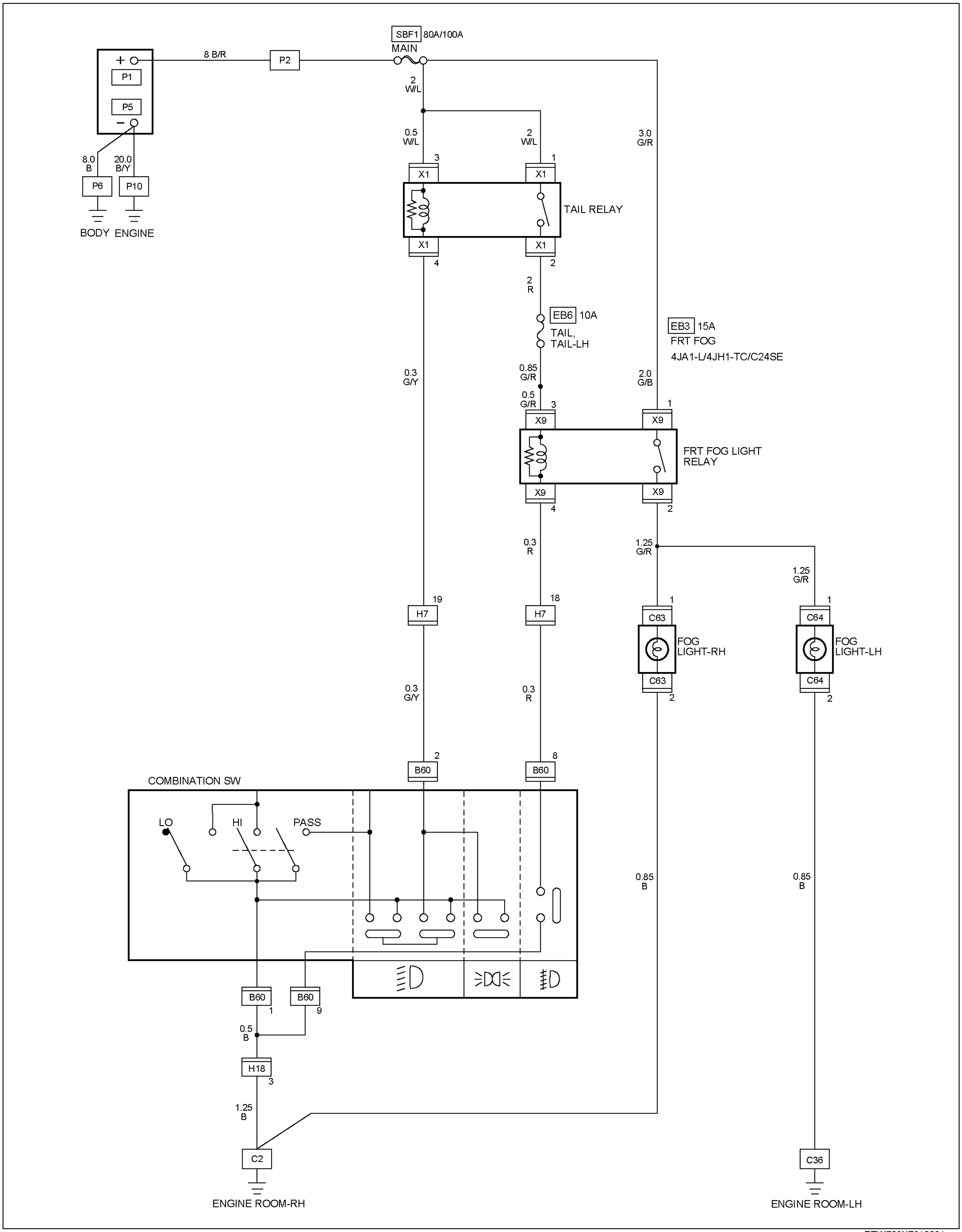
412R300015

(Without Shift On The Fly)



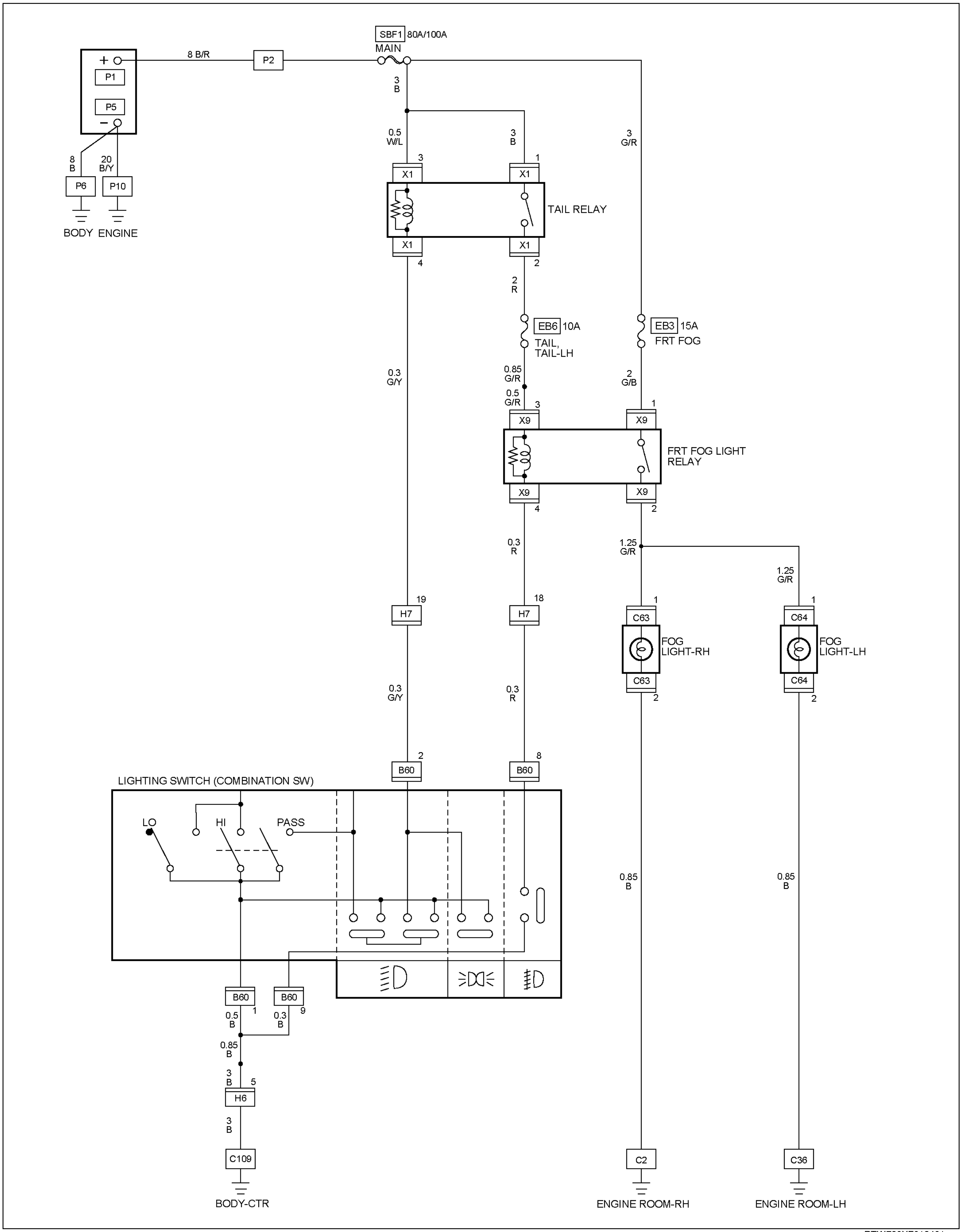
RTW440MF000101

CIRCUIT DIAGRAM C24SE (RHD) WITHOUT REAR FOG LIGHT



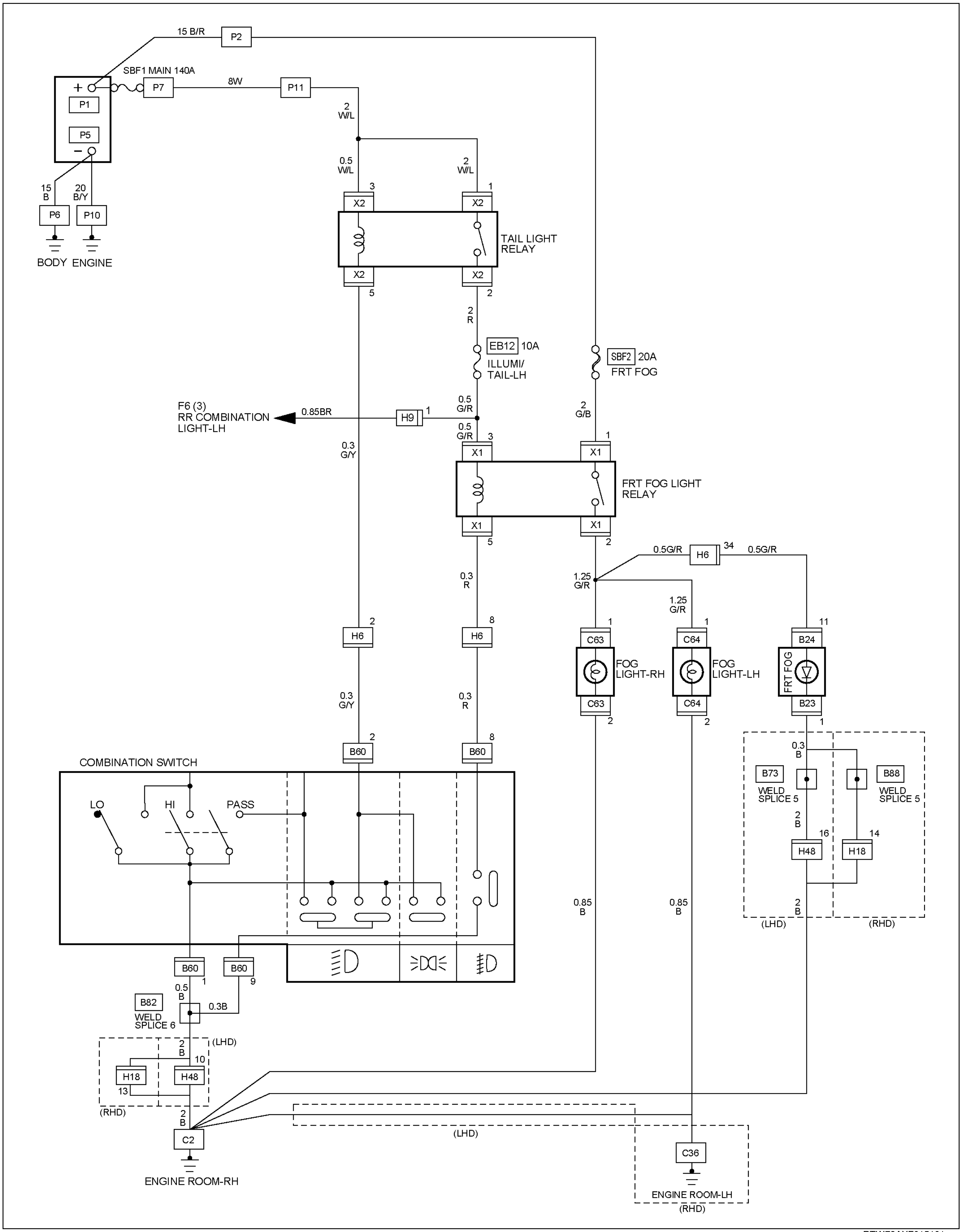
RTW780XF012301

CIRCUIT DIAGRAM C24SE (RHD) WITH REAR FOG LIGHT



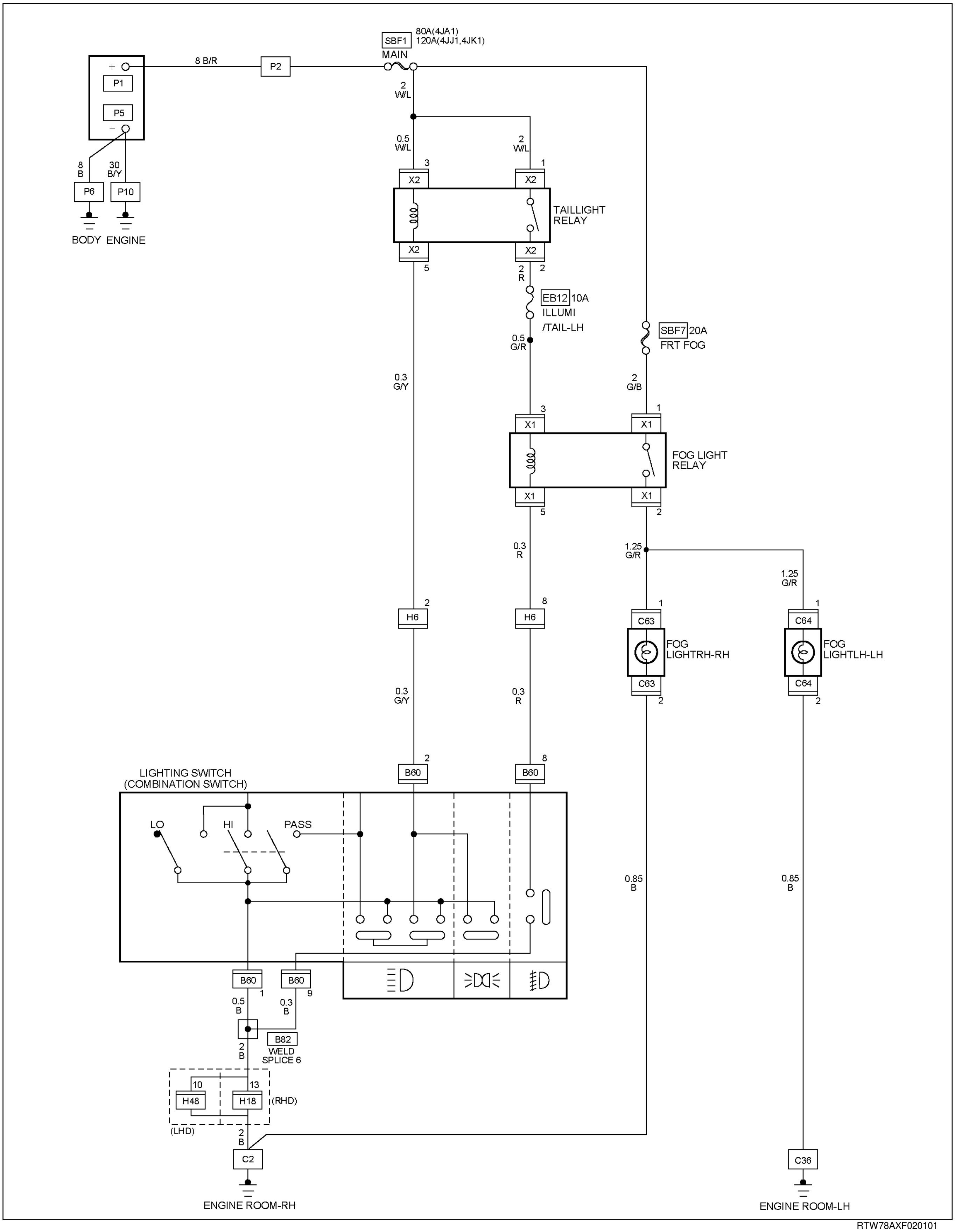
RTW780XF012401

CIRCUIT DIAGRAM HFV6

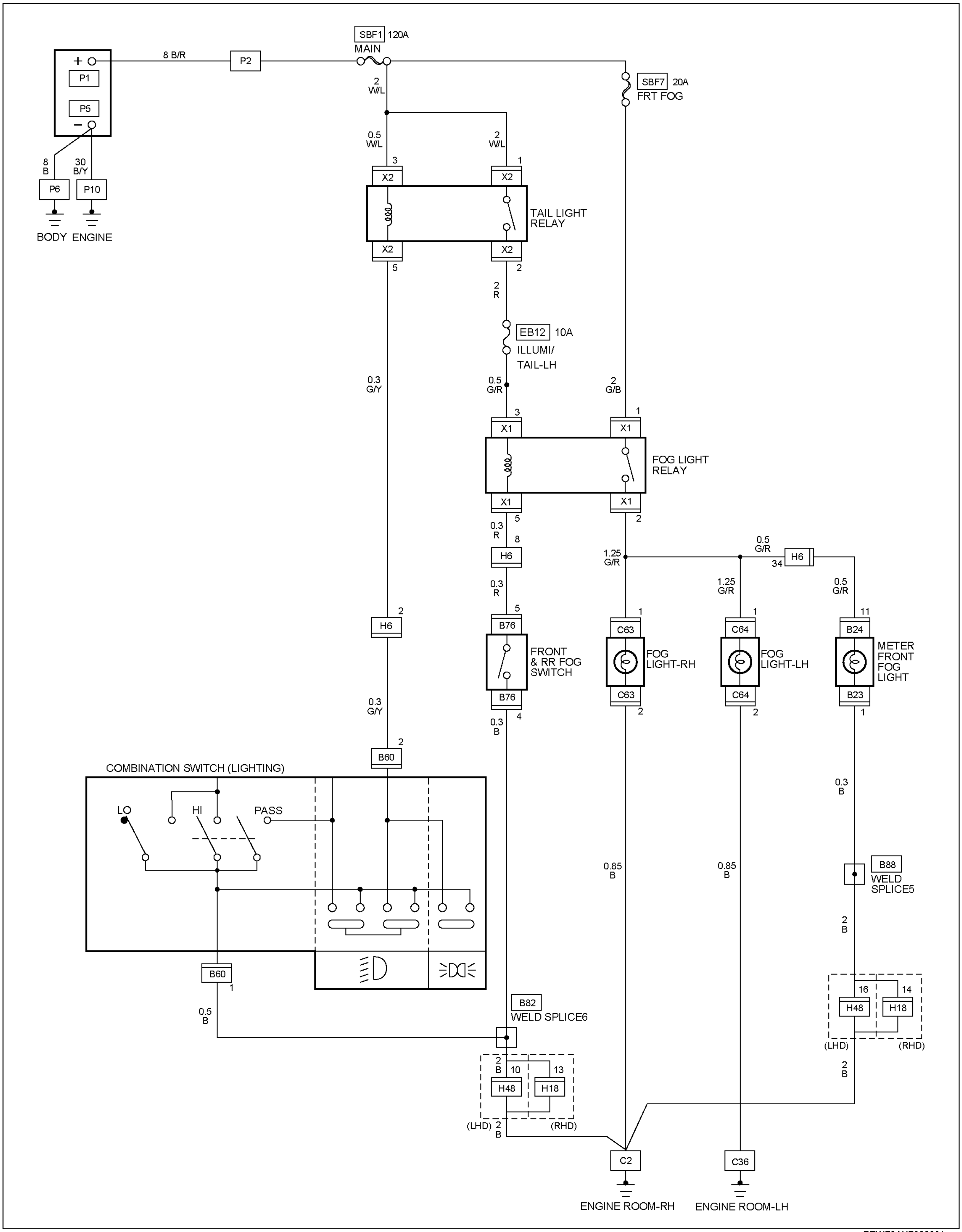


RTW78AXF015101

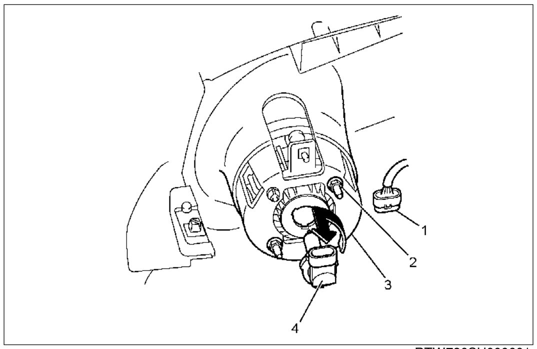
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA, 4JA1T (L)



CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP



RTW78AXF022901

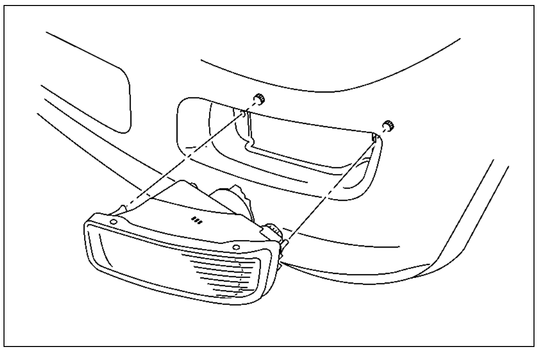


RTW780SH000601

FOG LIGHT (A type)

Removal

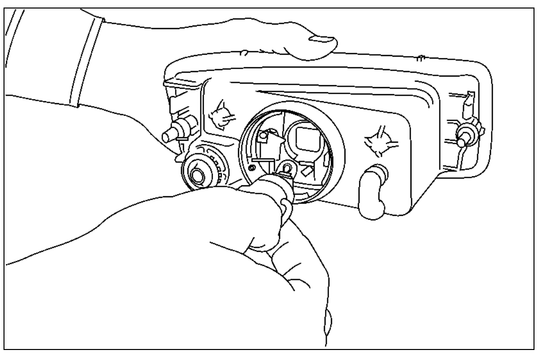
1. Disconnect the fog light connector ①.
2. Remove two attaching nuts ②.
3. Pull the fog light assembly toward the vehicle front to remove it from the holding bracket ③.
4. Remove the bulb with socket.
   - Turn the socket ④ counterclockwise to remove it.
5. Remove the bulb.
   - Release the lock spring.
   - Pull out the bulb.



FOG LIGHT (B type)

Removal

1. Remove the radiator grille.
2. Remove the front bumper
3. Disconnect the fog light connector.
4. Remove the fog light.



5. Remove the bulb from the socket.
   - Remove the cover by turning it counterclockwise out side the lock spring.
   - Remove the bulb.

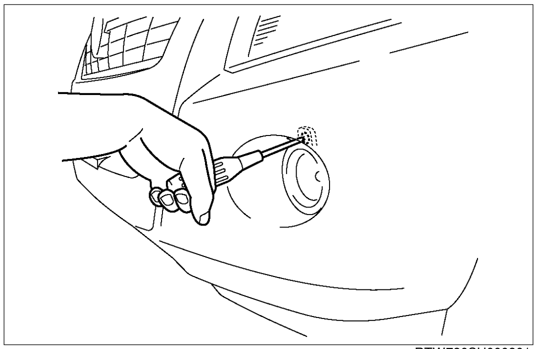
Hold the bulb by the flange when replacing it.
Do not touch the bulb with your hands.

Installation

To install the fog light, follow the removal procedure in reverse order.
Pay close attention to the important points mentioned in the following paragraphs.

Bulb

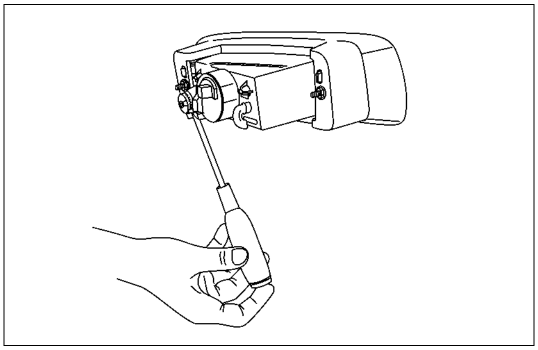
Be absolutely sure that the fog light bulb is correctly installed.
This will prevent a poor contact and open circuit.


RTW780SH000801

FOG LIGHT ADJUSTMENT (A type)

Vertical Adjustment

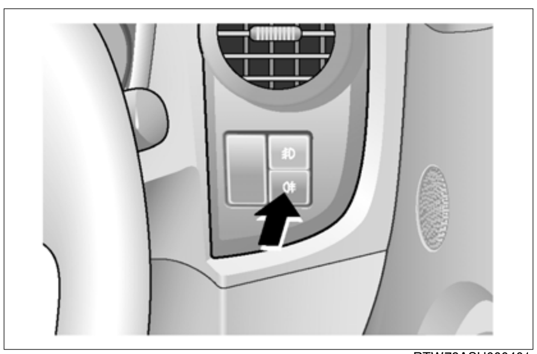
Turn the adjusting screw with a screwdriver to adjust the aim of the fog light vertically.



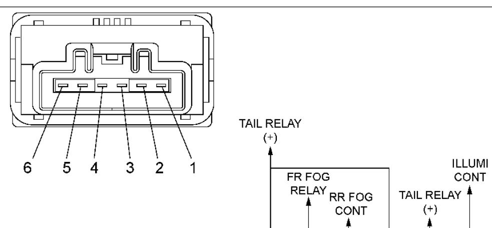
FOG LIGHT ADJUSTMENT (B type)

Vertical Adjustment

Turn the adjusting screw with a screwdriver to adjust the aim of the fog light vertically.


RTW78ASH000401

FRONT FOG & REAR FOG SWITCH



		TERMINAL / POSITION	5	4	3	2	1	6
FR FOG	‡D	FREE						
		LOCK	○—	—○				
RR FOG	D‡	FREE						
		FULL			○—	—○		

RTW48ASH000401

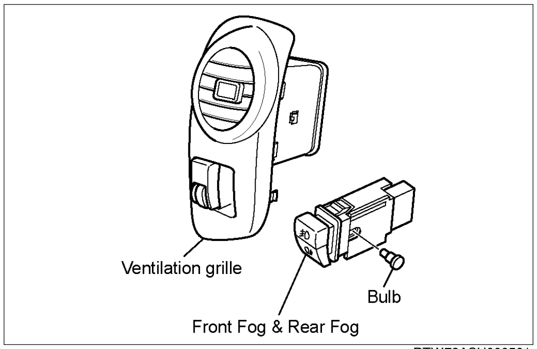
Inspection

Check to see if there is any continuity between the terminals of the front fog light switch.
Replace the switch when the result of inspection is found abnormal.

Removal

Preparation:
Disconnect the battery ground cable.

1. Ventilation grille
2. Harness connector
3. Front fog light & Rear fog light switch
   To remove the switch, push the lock from the back side of the cluster assembly.
4. Remove the bulb.



RTW78ASH000501

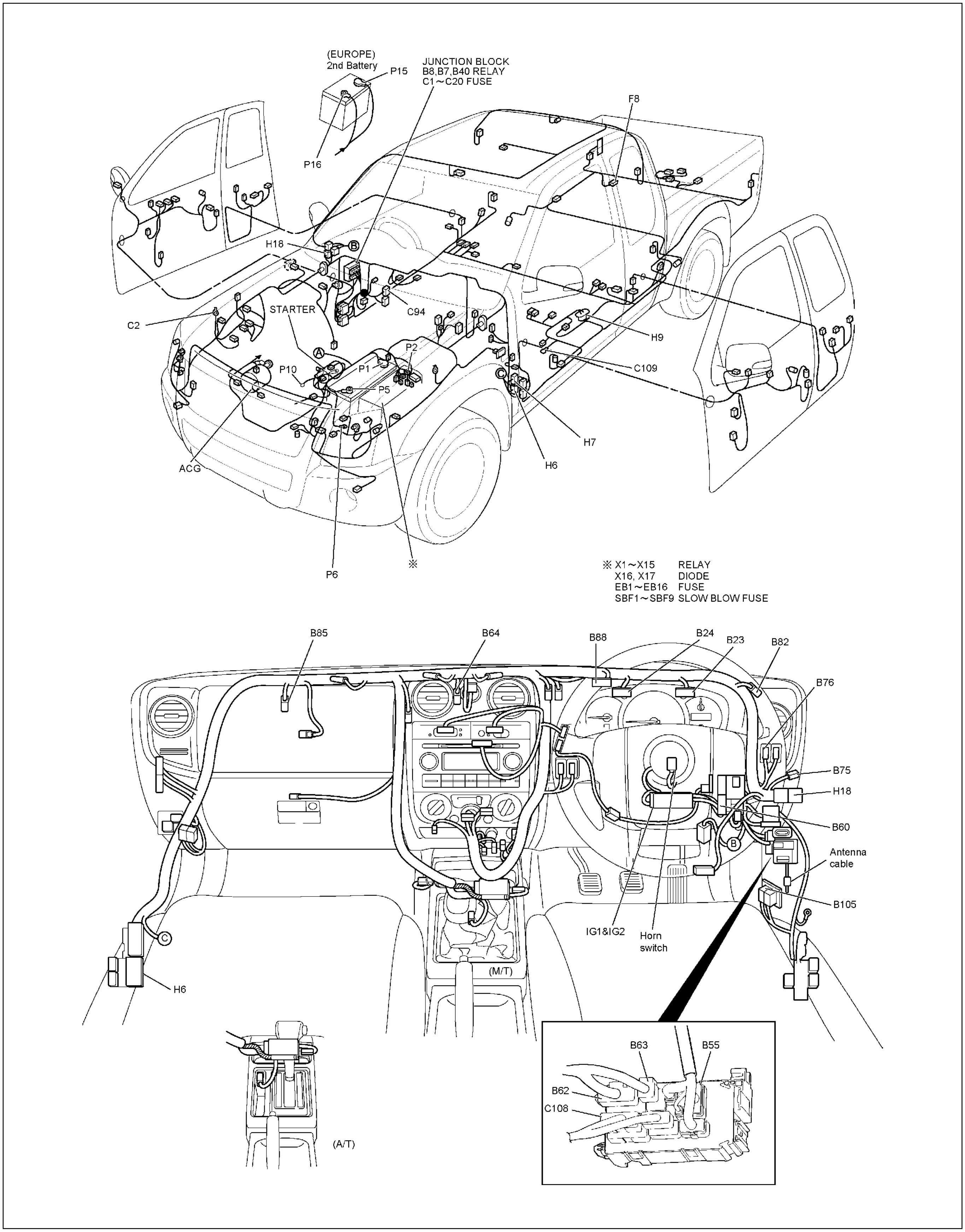
Installation

To install, follow the removal steps in the reverse noting the following point.

1. Push in the switch with your fingers until it locks securely.

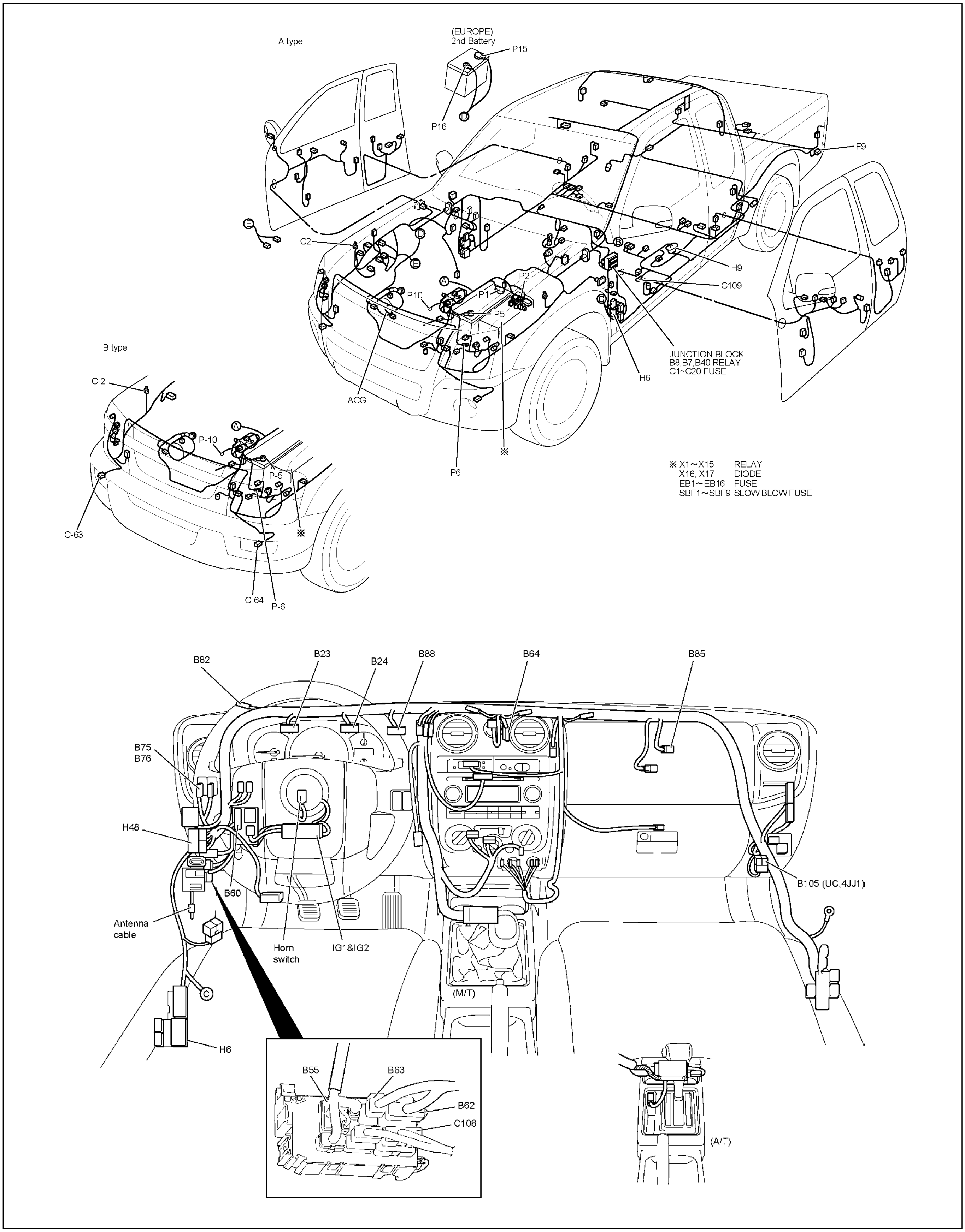
REAR FOG LIGHT

PARTS LOCATION (RHD)



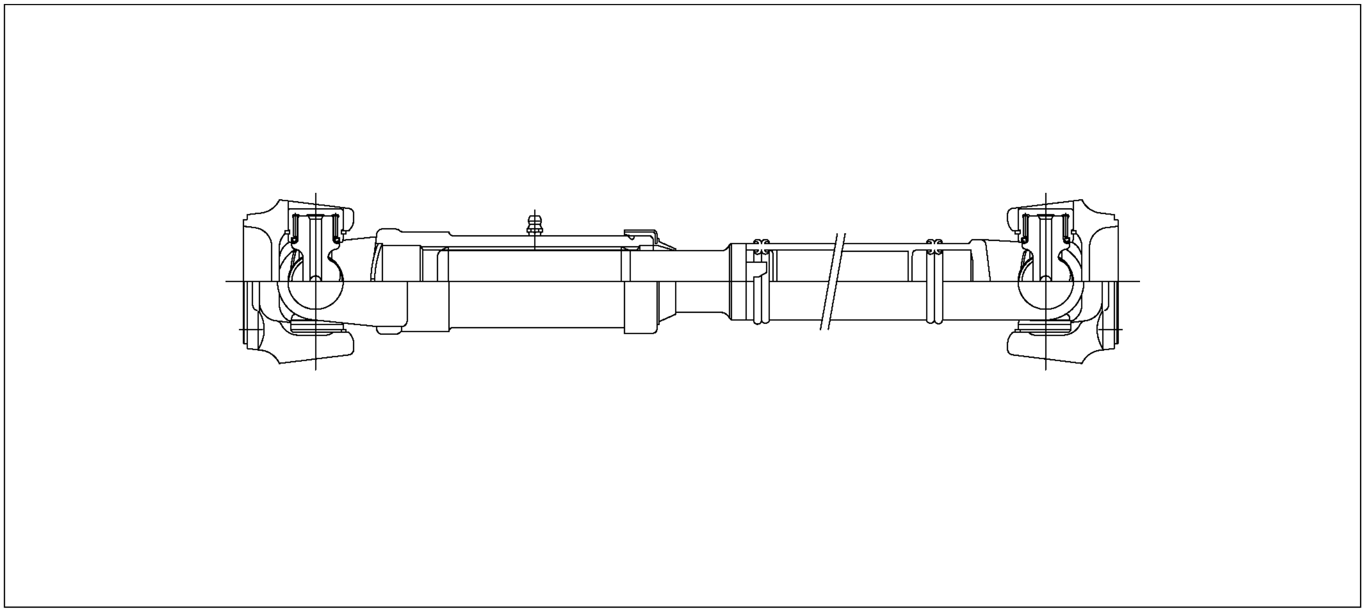
RTW78AXF037101 & RTW78AXF043301

PARTS LOCATION (LHD)



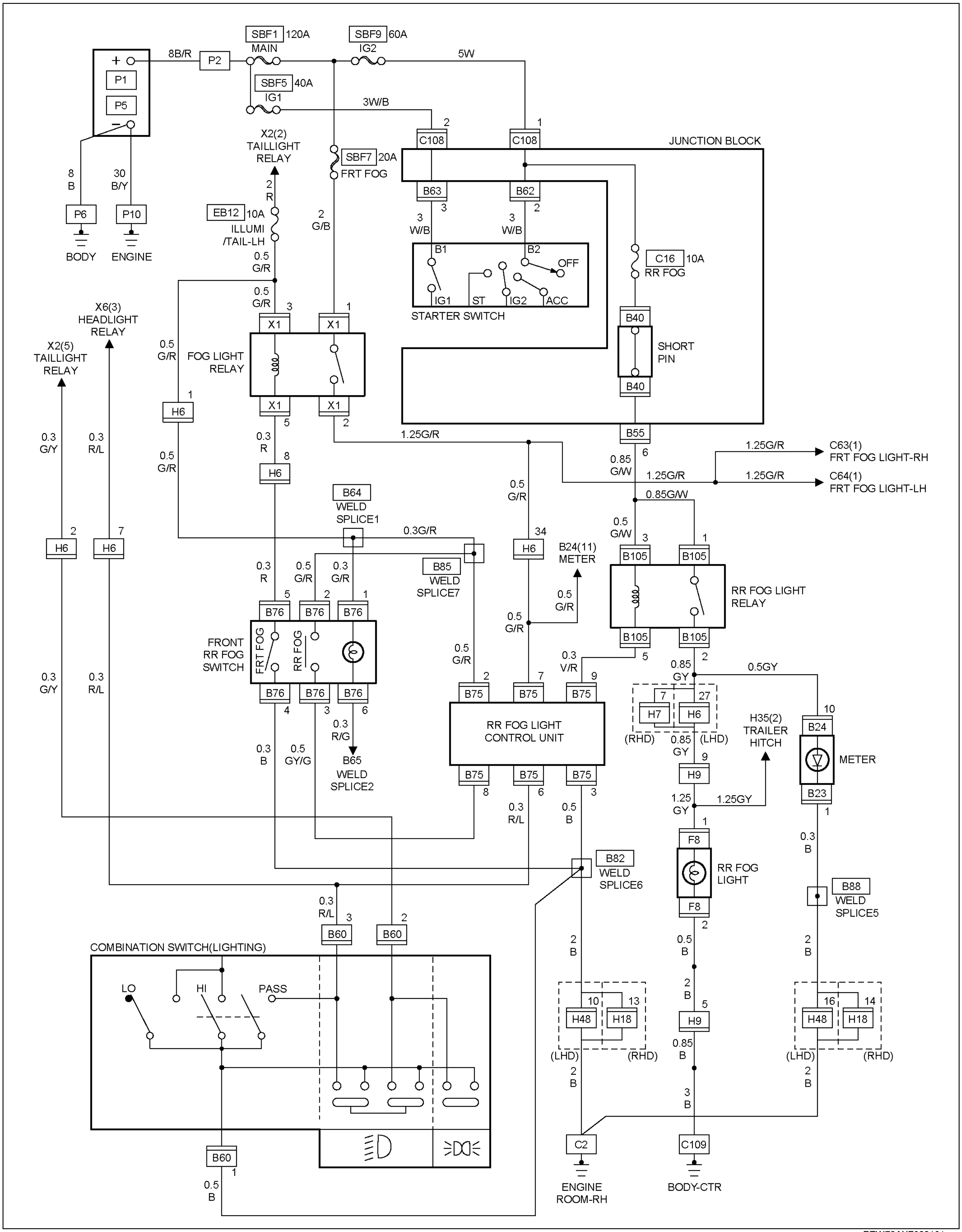
RTW78AXF037201 & RTW78AXF043401

FRONT PROPELLER SHAFT

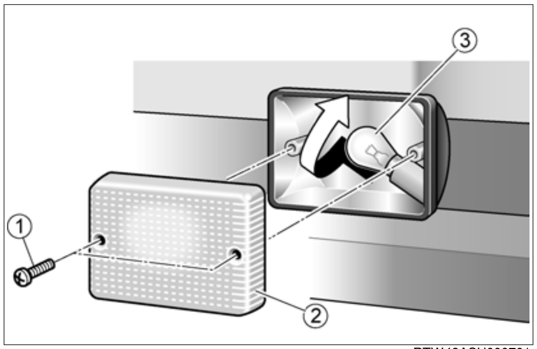


RUW54CSF000101

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP



RTW78AXF023101



RTW48ASH000701

REAR FOG LIGHT

Removal

1. Remove the screws ①.
2. Remove the lens cover ②.
3. Rear fog push turn the bulb ③ counterclockwise to disconnect it from the light housing.

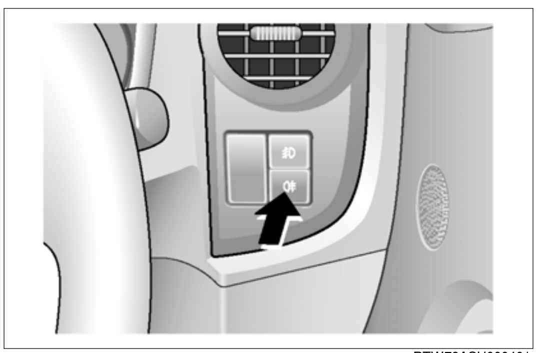
Installation

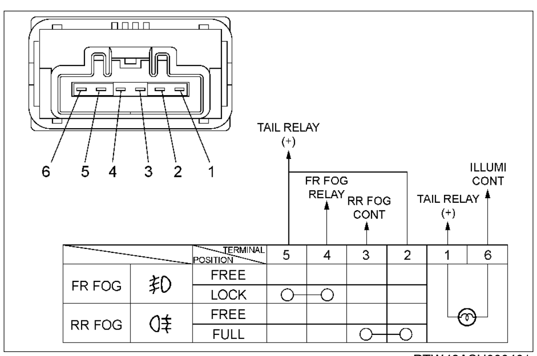
Follow the removal procedure in the reverse order to install the rear fog light.
Pay close attention to the important points mentioned in the following paragraphs.

Bulb

Be absolutely sure that the license plate light bulb is correctly installed.
This will prevent a poor contact and open circuit.

FRONT FOG & RR FOG SWITCH


RTW78ASH000401



RTW48ASH000401

Inspection

Check to see if there is any continuity between the terminals of the leveling switch.
Replace the switch when the result of inspection is found abnormal.

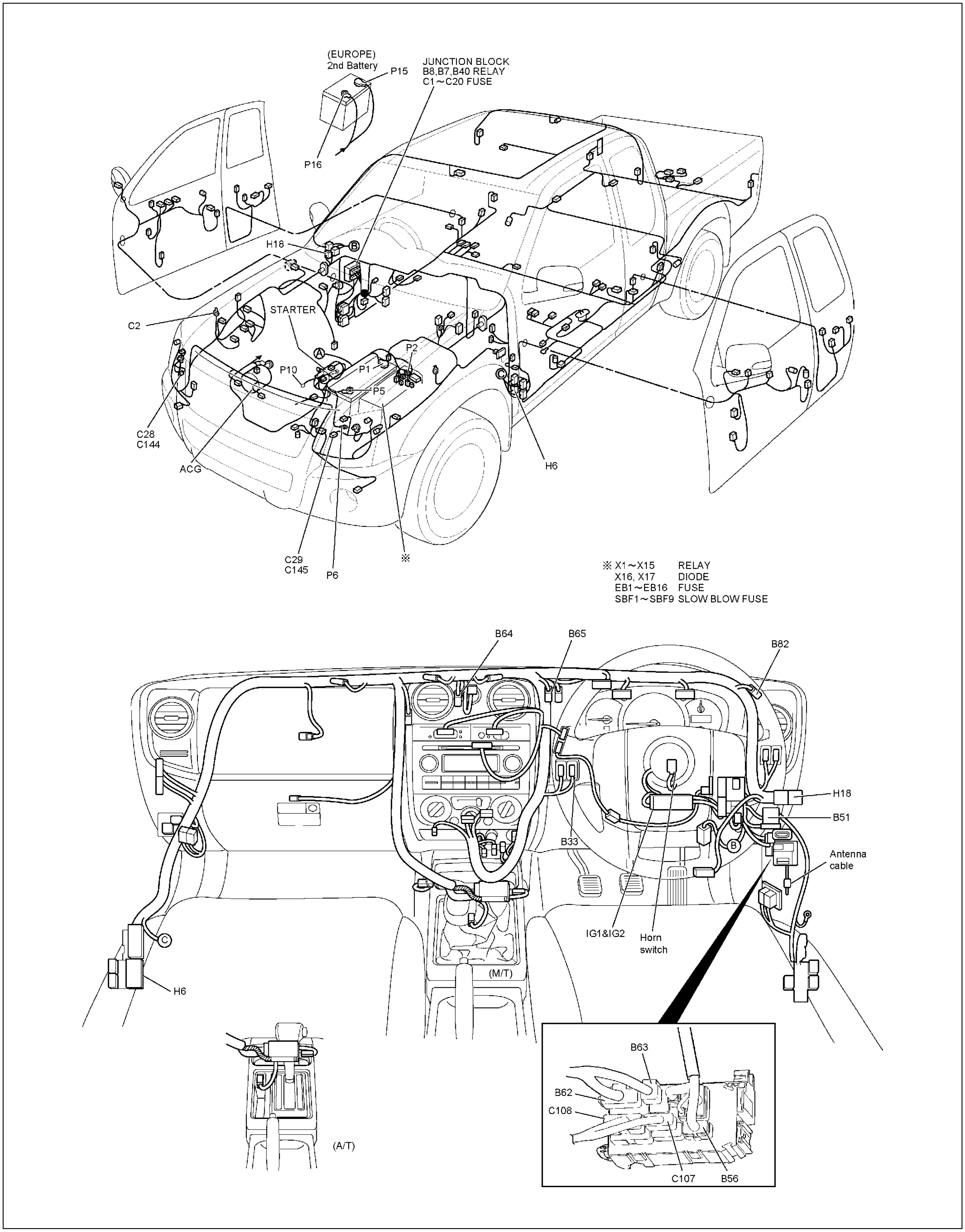
Removal

Preparation:
Disconnect the battery ground cable.

1. Ventilation grille
2. Harness connector
3. Front fog light & Rear fog light switch
   To remove the switch, push the lock from the back side of the cluster assembly.
4. Remove the bulb.

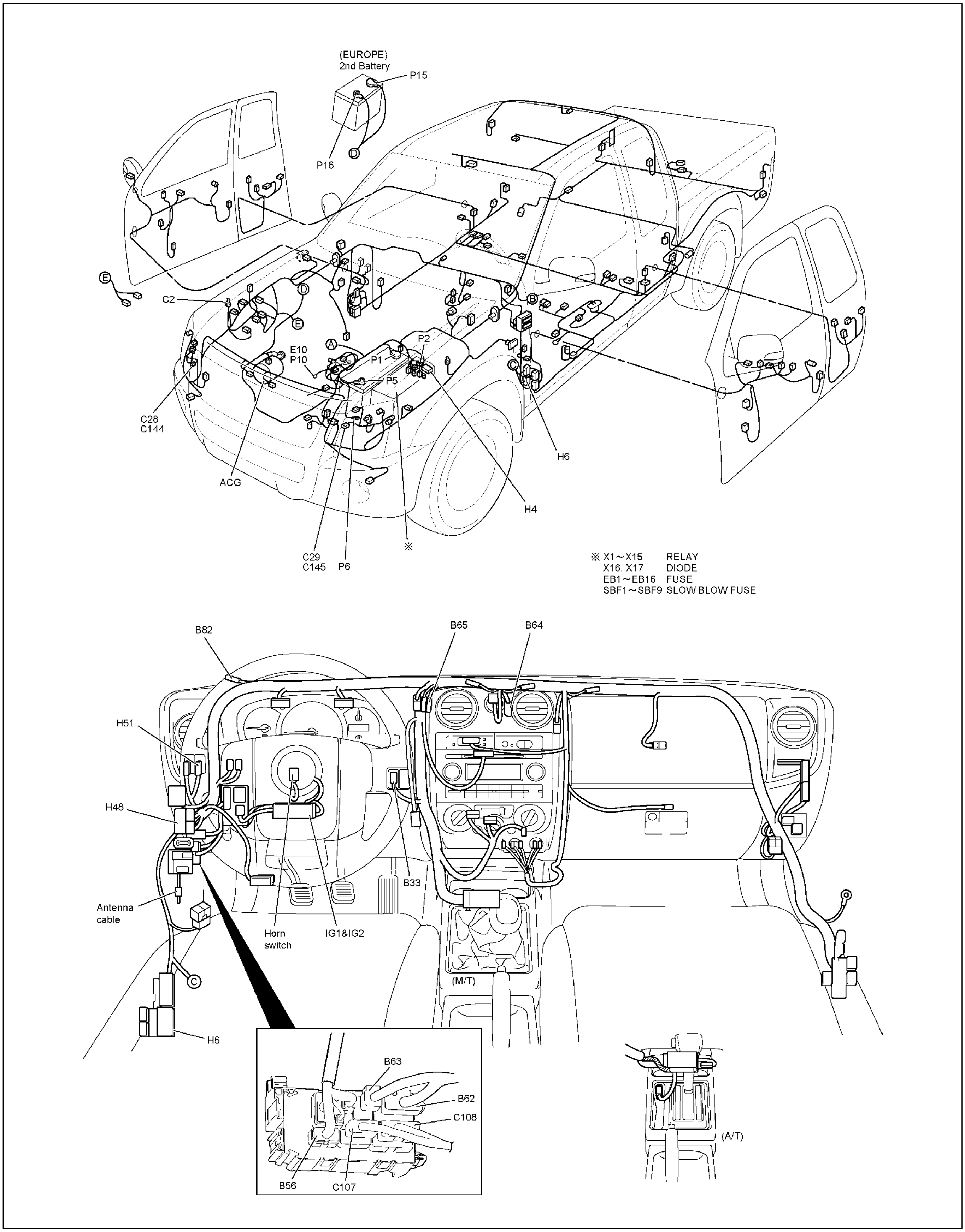
HEADLIGHT LEVELING

PARTS LOCATION (RHD)



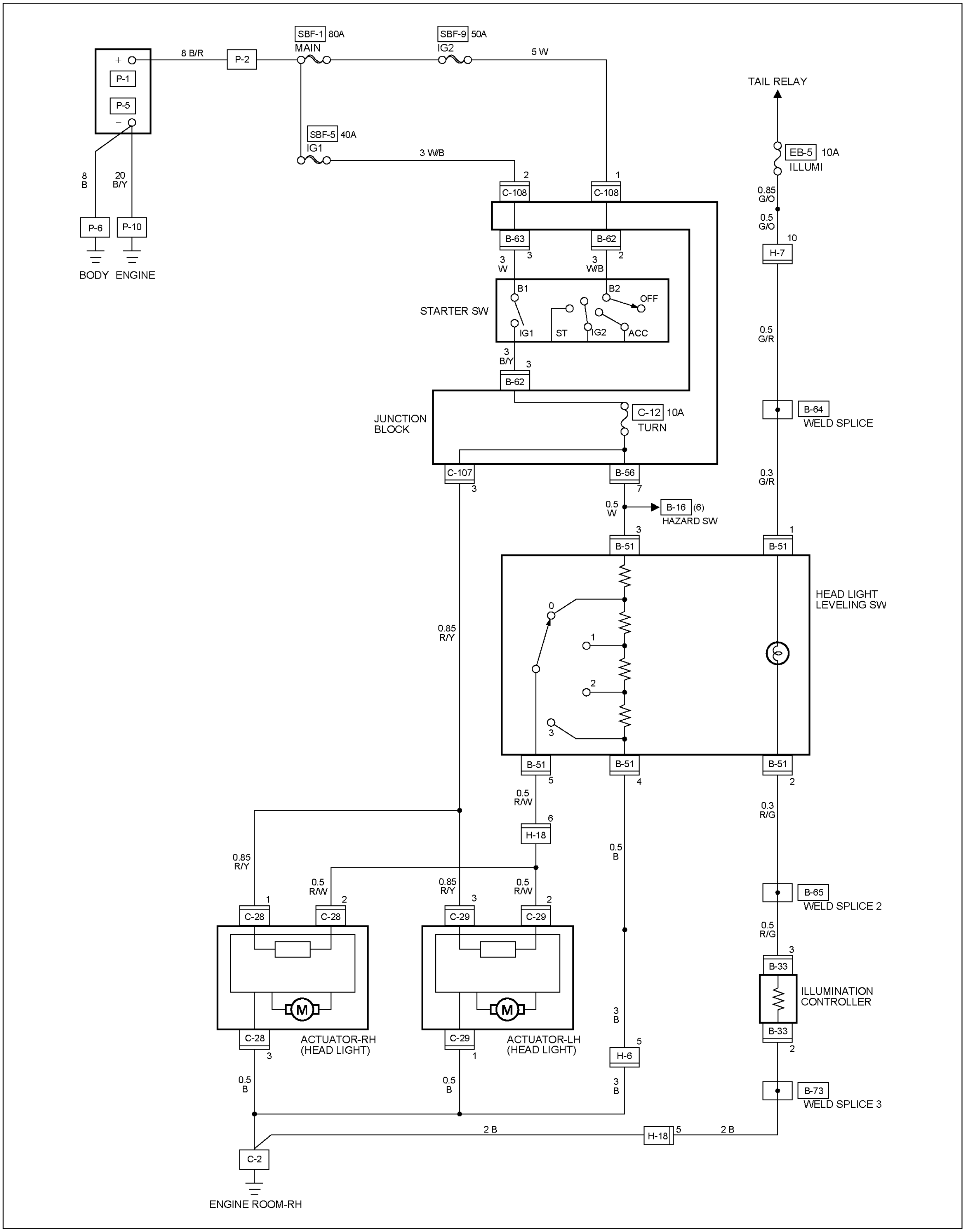
RTW78AXF037301 & RTW78AXF043501

PARTS LOCATION (LHD)



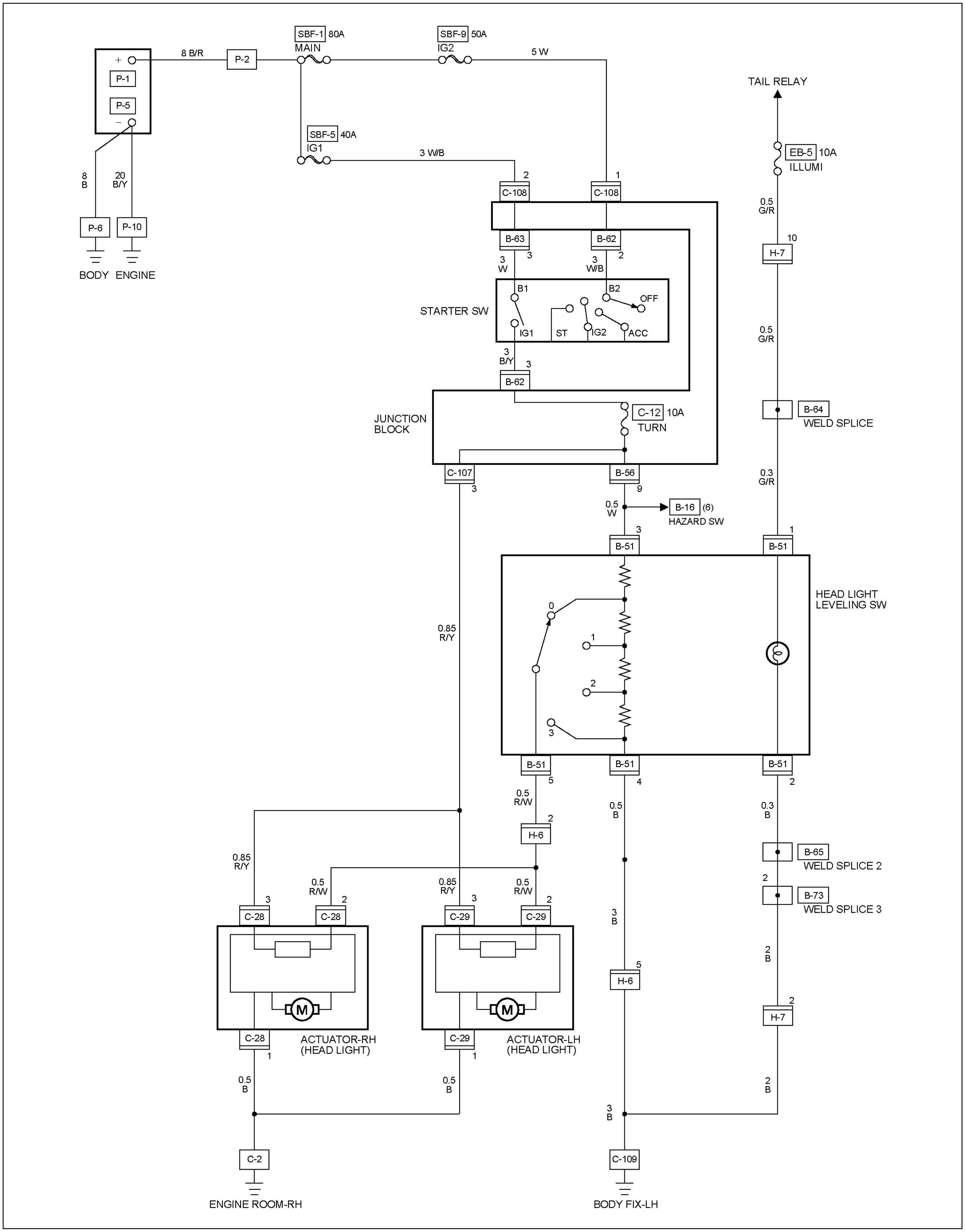
RTW78AXF037401 & RTW78AXF043601

CIRCUIT DIAGRAM C24SE (RHD)



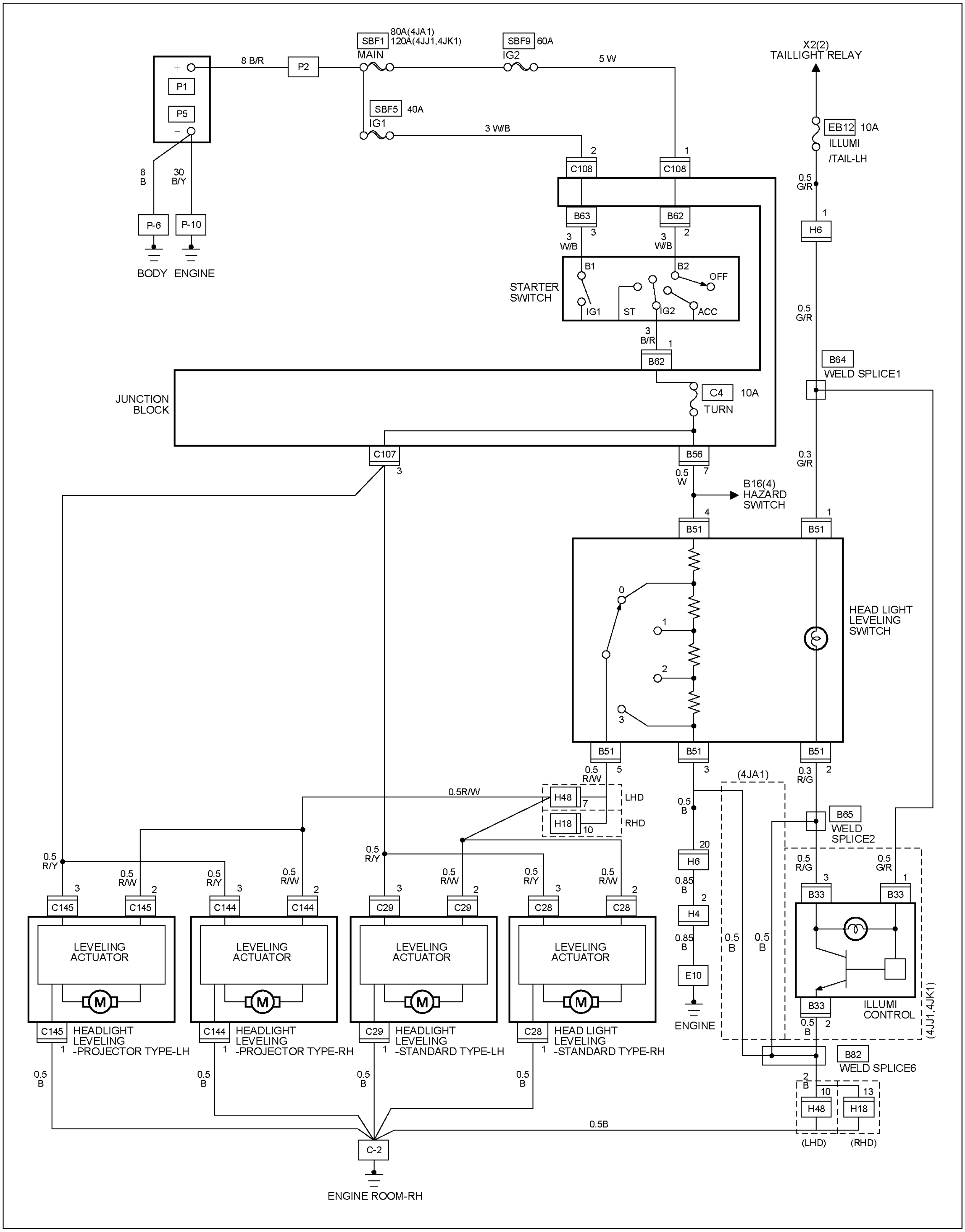
RTW680XF007601

CIRCUIT DIAGRAM C24SE (LHD)

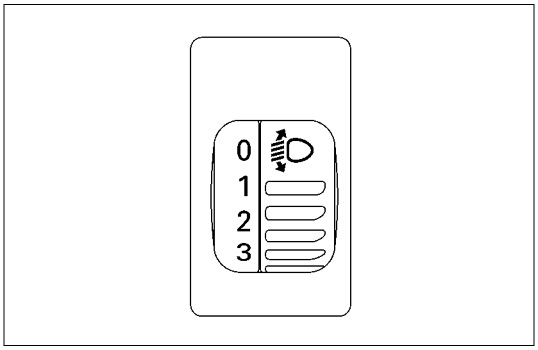


RTW680XF007501

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA, 4JA1T (L) (LHD)

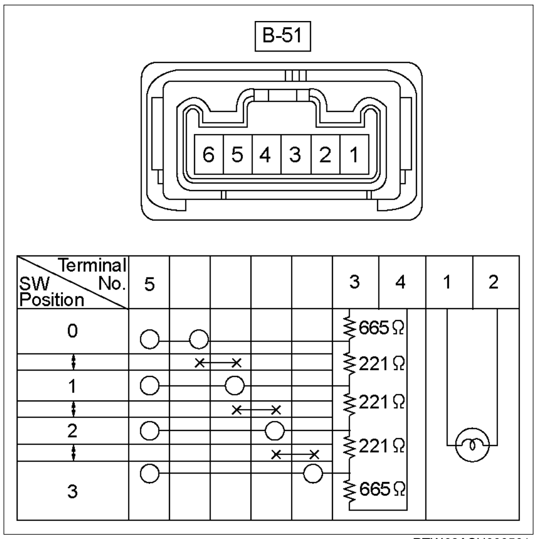


RTW78AXF023001



HEADLIGHT LEVELING SWITCH

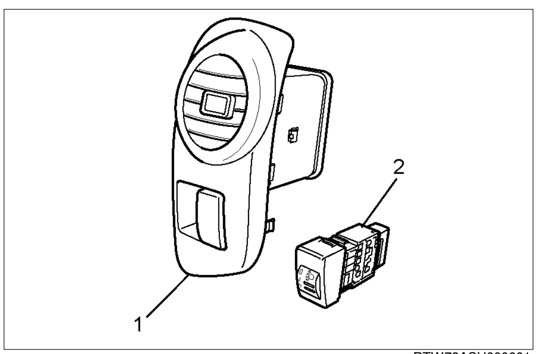
Incorrect beam angle due to load change can be corrected. A four position switch, 0-3, can alter the beam angle through 1.7 degrees on the long wheel base model and 2.17 degrees on the short wheel base model.



RTW68ASH000501

Inspection

Check to see if there is any continuity between the terminals of the leveling switch.
Replace the switch when the result of inspection is found abnormal.



RTW78ASH000601

Removal

Preparation:

Disconnect the battery ground cable.

1. Ventilation grille
2. Harness connector
3. Headlight leveling switch

   To remove the switch, push the lock from the back side of the cluster assembly.

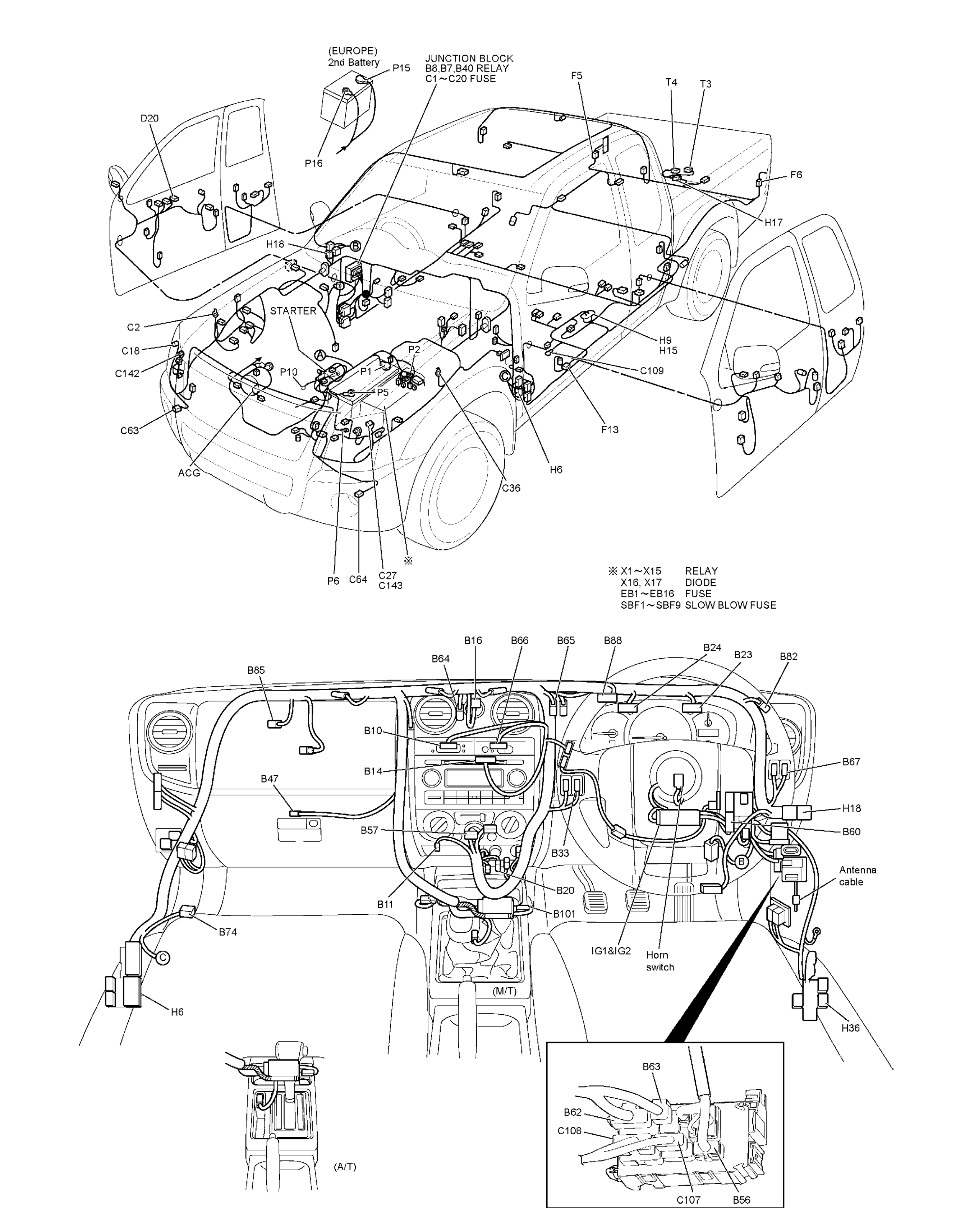
Installation

To install, follow the removal steps in the reverse noting the following point.

1. Push in the switch with your fingers until it locks securely.

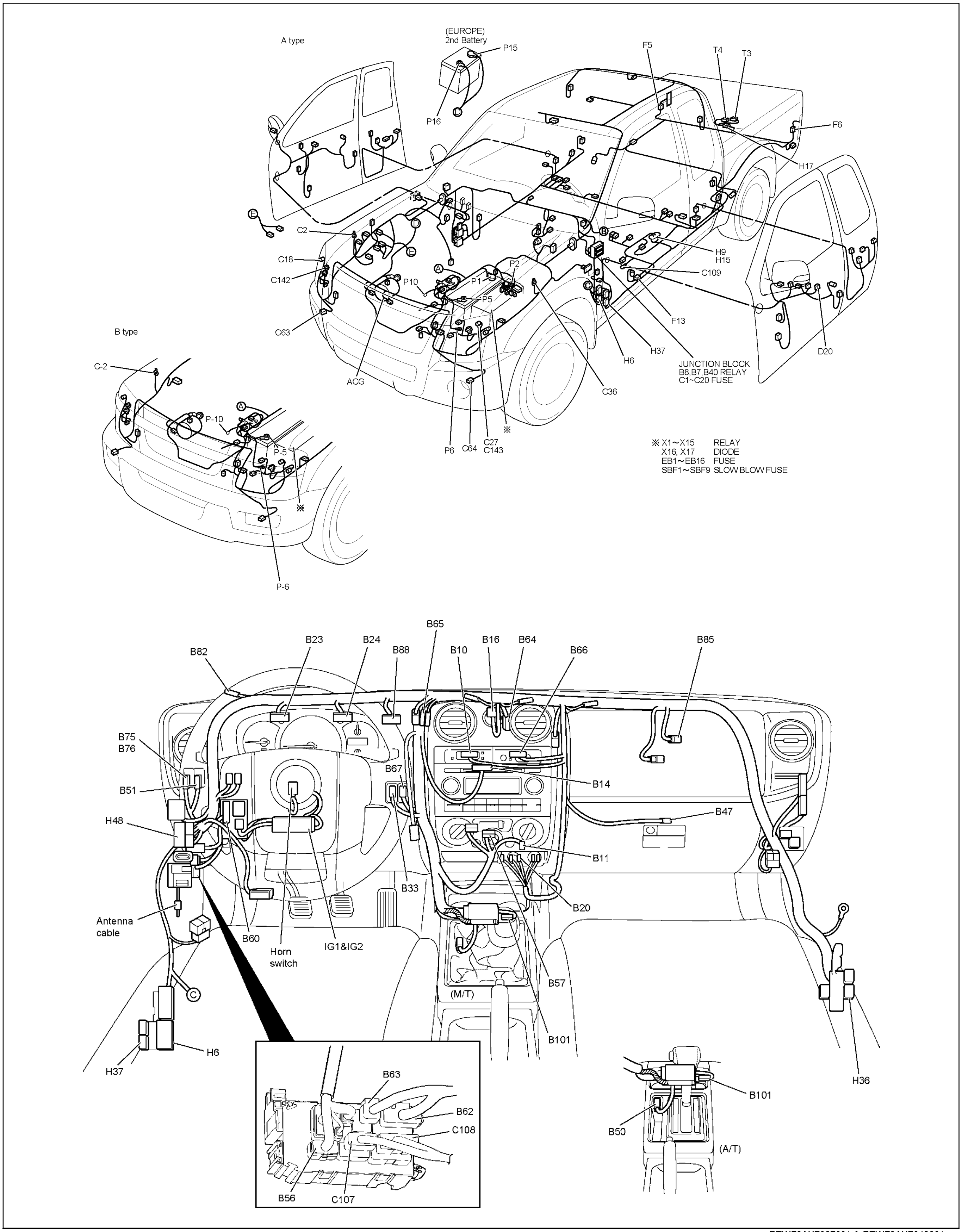
ILLUMINATION

PARTS LOCATION (RHD)



RTW78AXF037501 & RTW78AXF043701

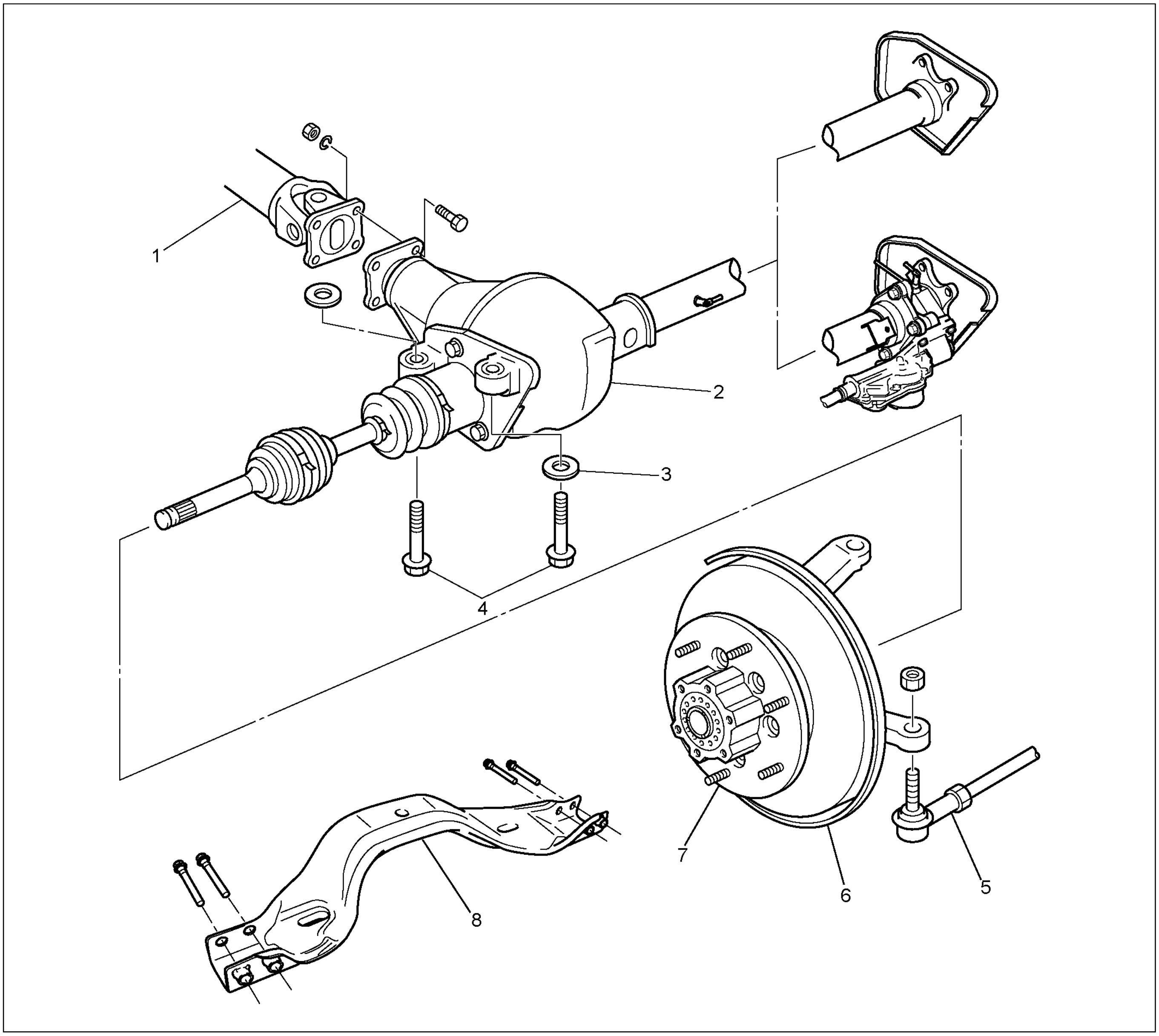
PARTS LOCATION (LHD)



RTW78AXF037601 & RTW78AXF043801

FRONT DRIVE AXLE ASSEMBLY

Front Drive Axle Assembly and Associated Parts

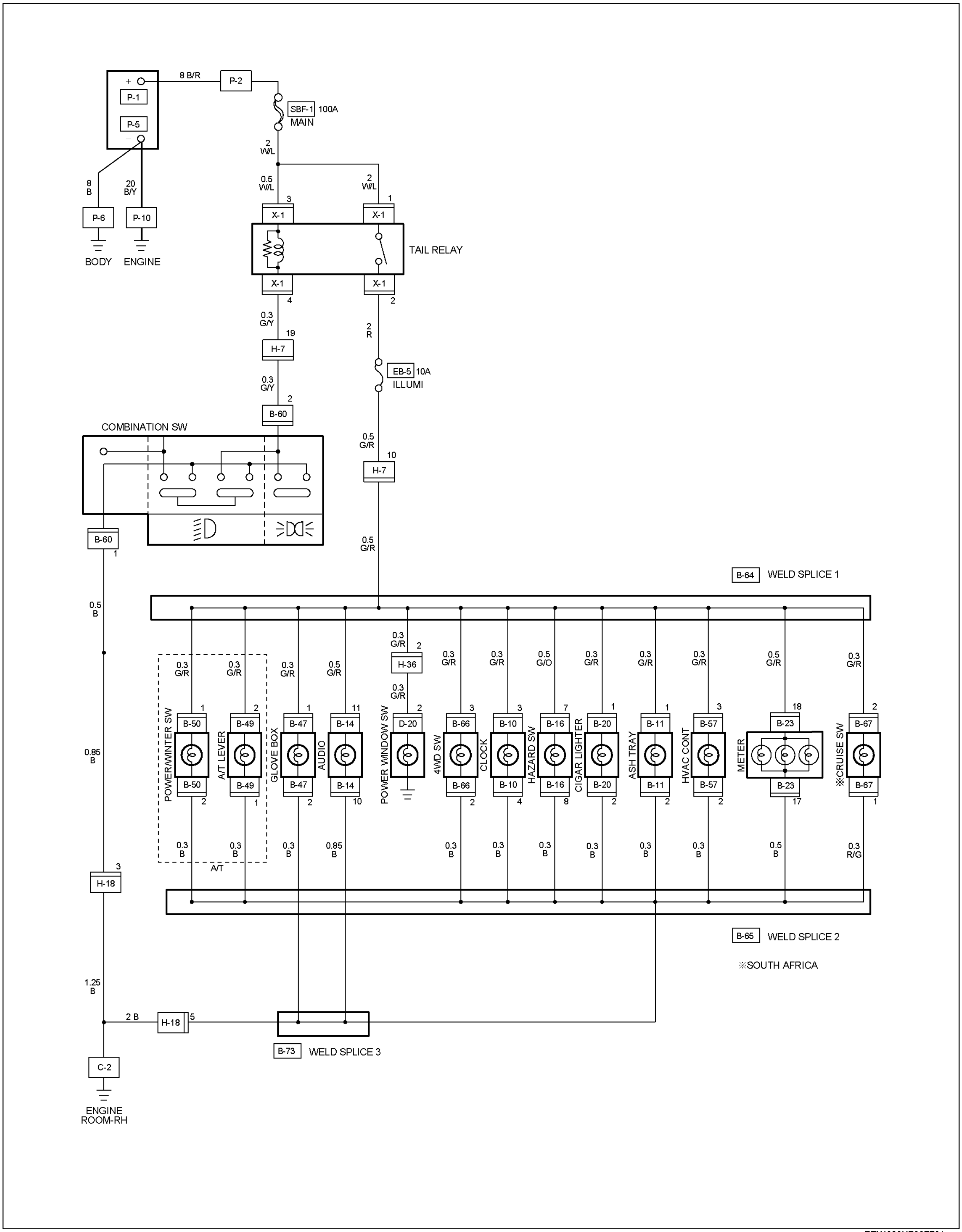


RTW440LF000501

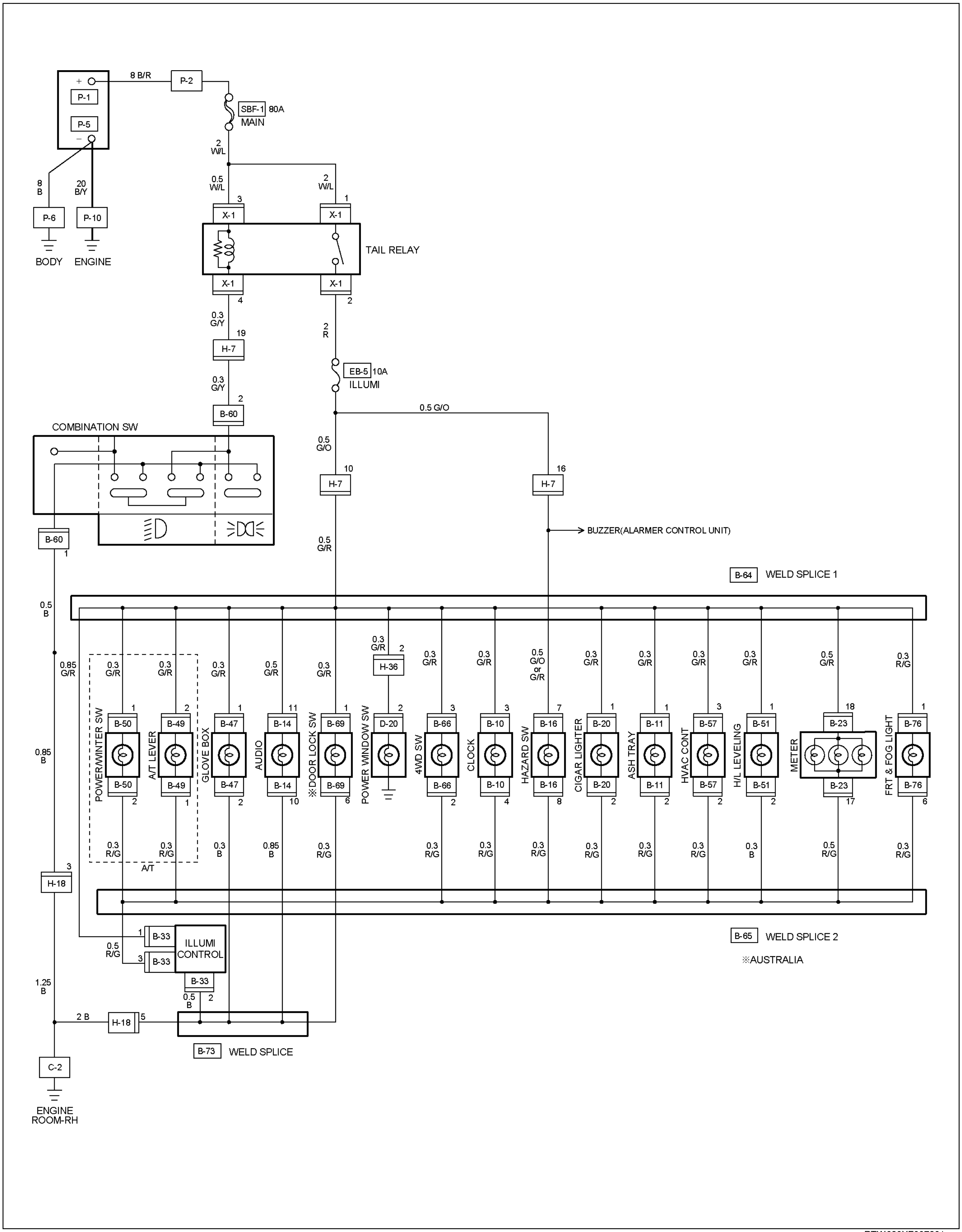
Legend

1. Propeller Shaft
2. Front Axle Case Assembly and Front Drive Shaft Assembly
3. Washer
4. Mounting Bolt
5. Tie-rod End ; Steering Unit
6. Knuckle and Back Plate
7. Hub and Disc Assembly
8. Suspension Crossmember

CIRCUIT DIAGRAM C24SE (RHD) WITHOUT ILLUMINATION CONTROL

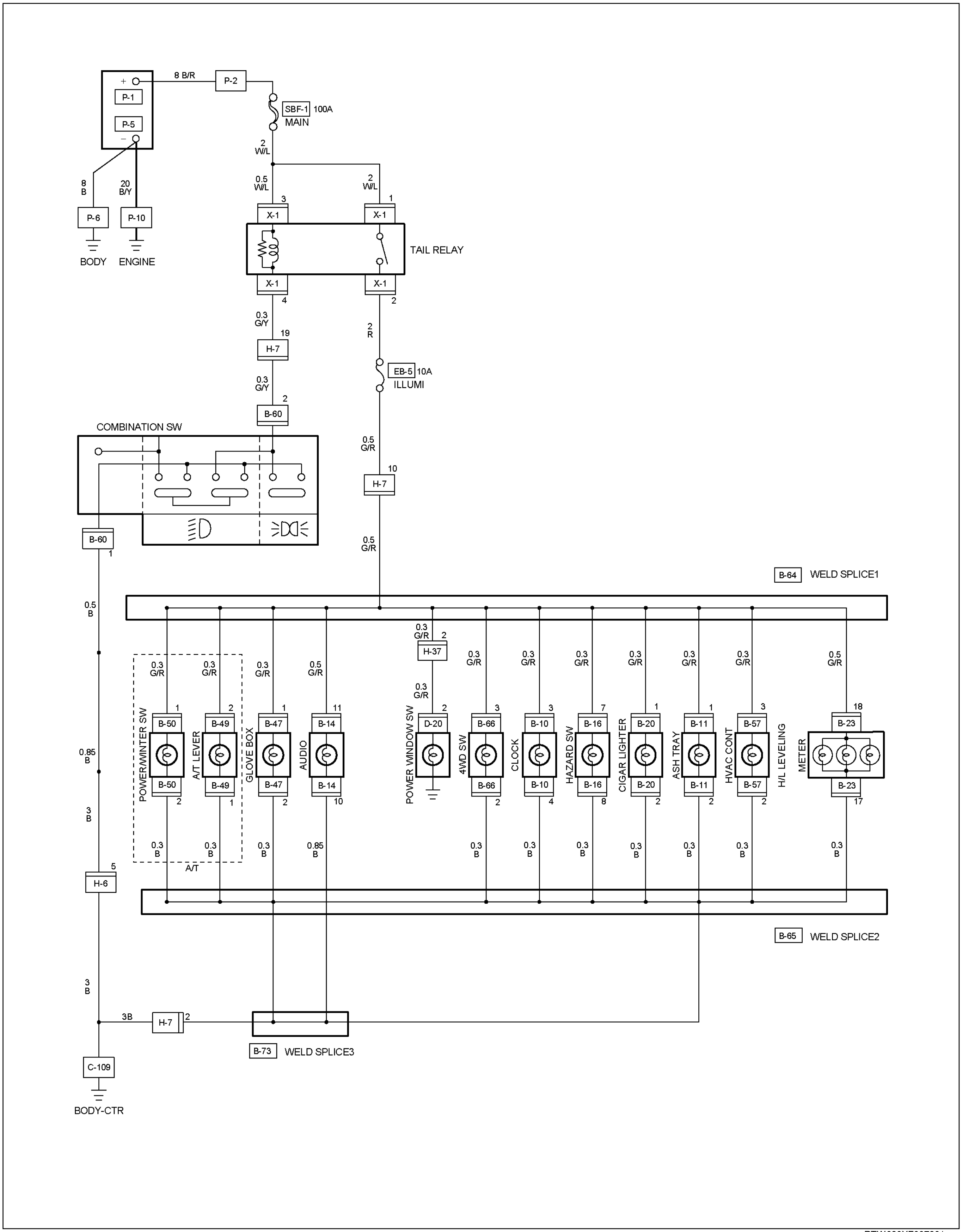


CIRCUIT DIAGRAM C24SE (RHD) WITH ILLUMINATION CONTROL

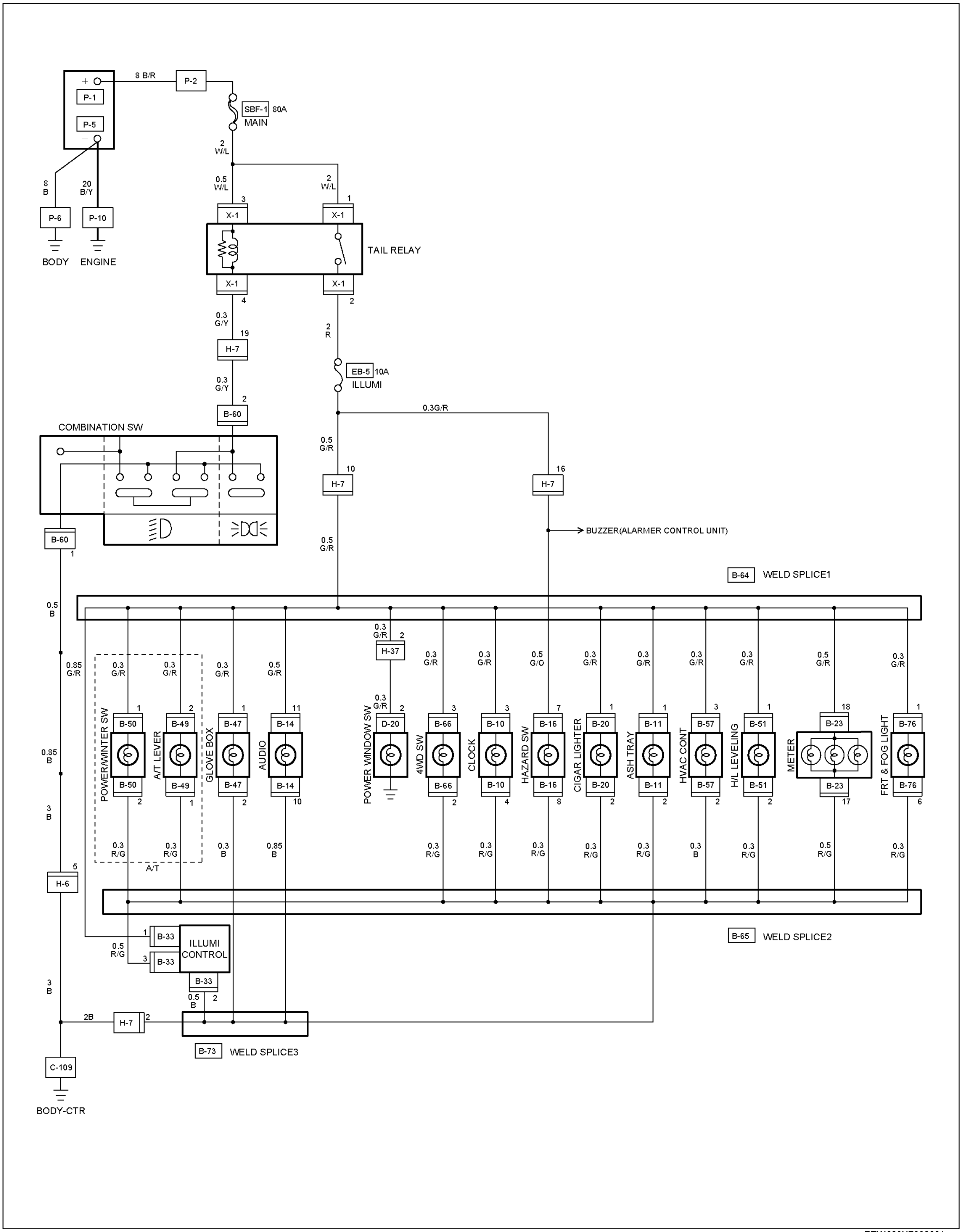


RTW680XF007801

CIRCUIT DIAGRAM C24SE (LHD) WITHOUT ILLUMINATION CONTROL

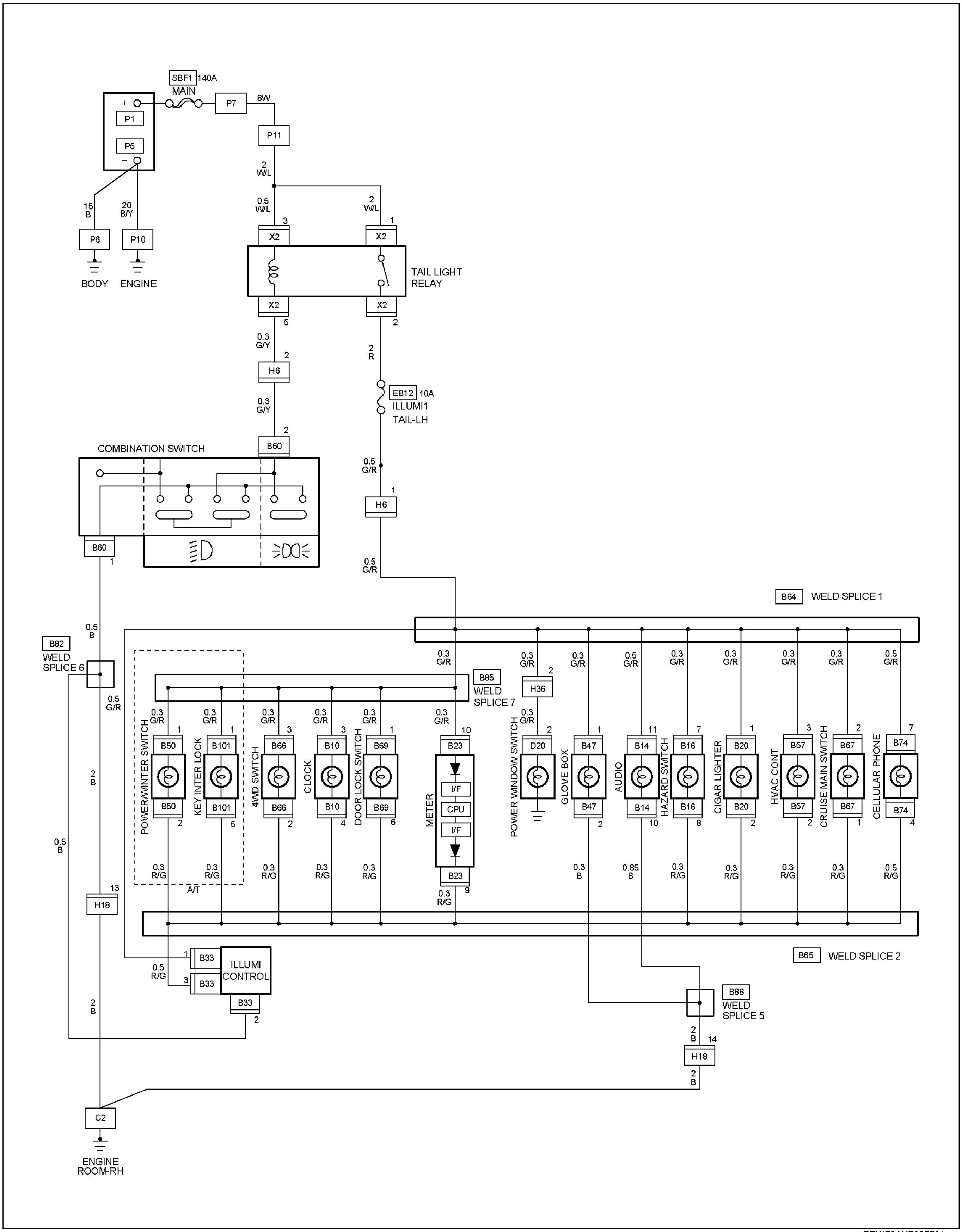


CIRCUIT DIAGRAM C24SE (LHD) WITH ILLUMINATION CONTROL



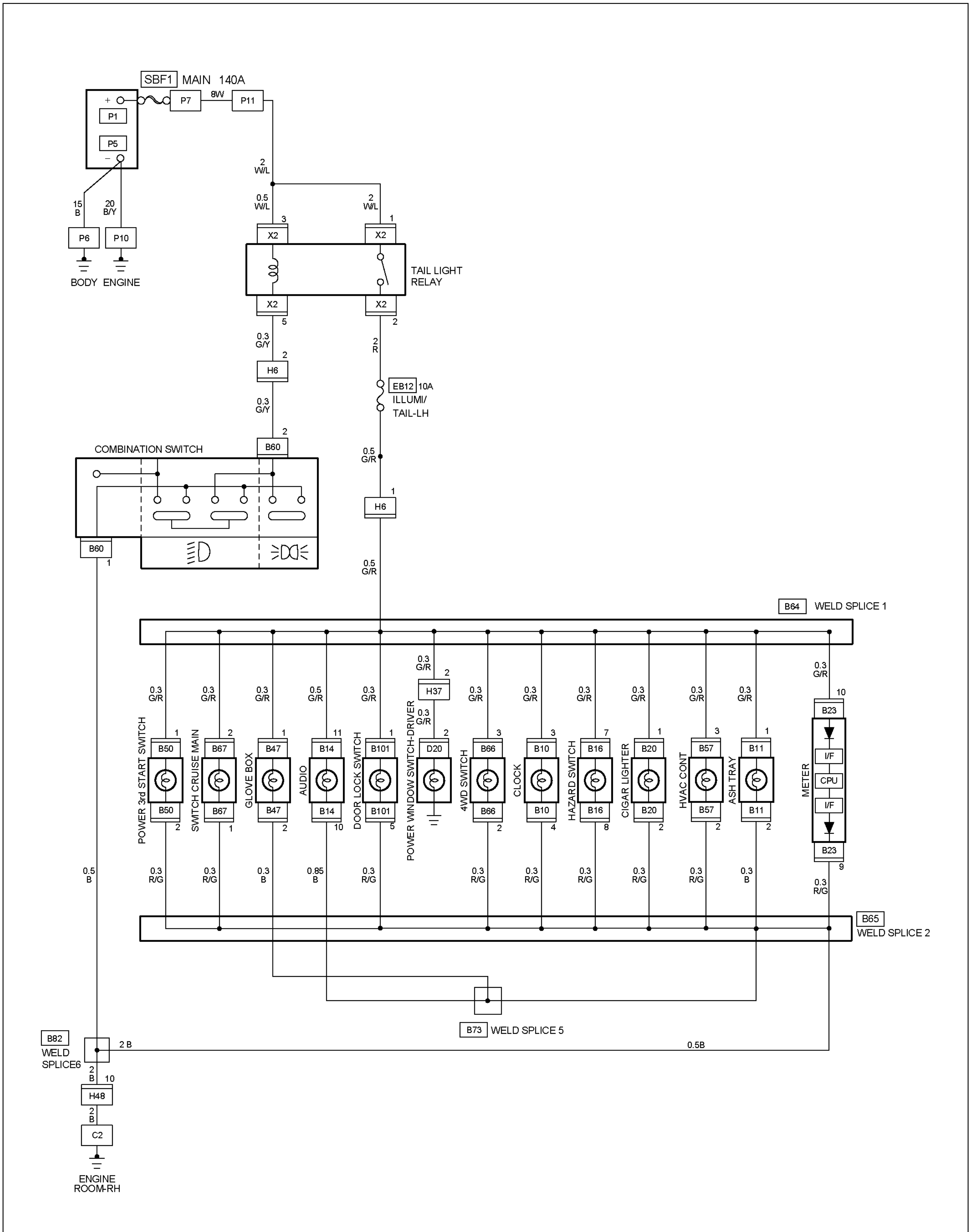
RTW680XF008001

CIRCUIT DIAGRAM HFV6 (RHD)



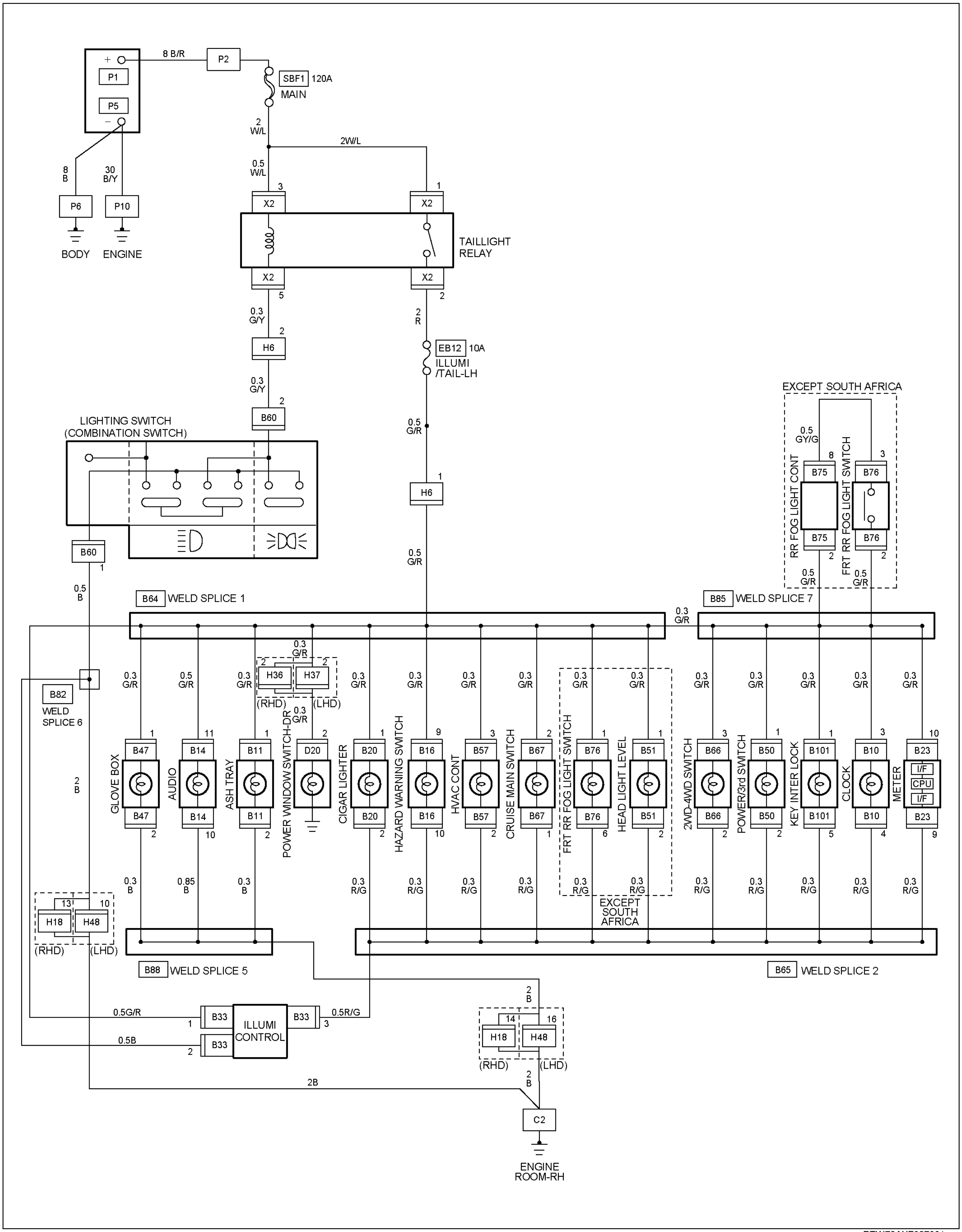
RTW78AXF025701

CIRCUIT DIAGRAM HFV6 (LHD)



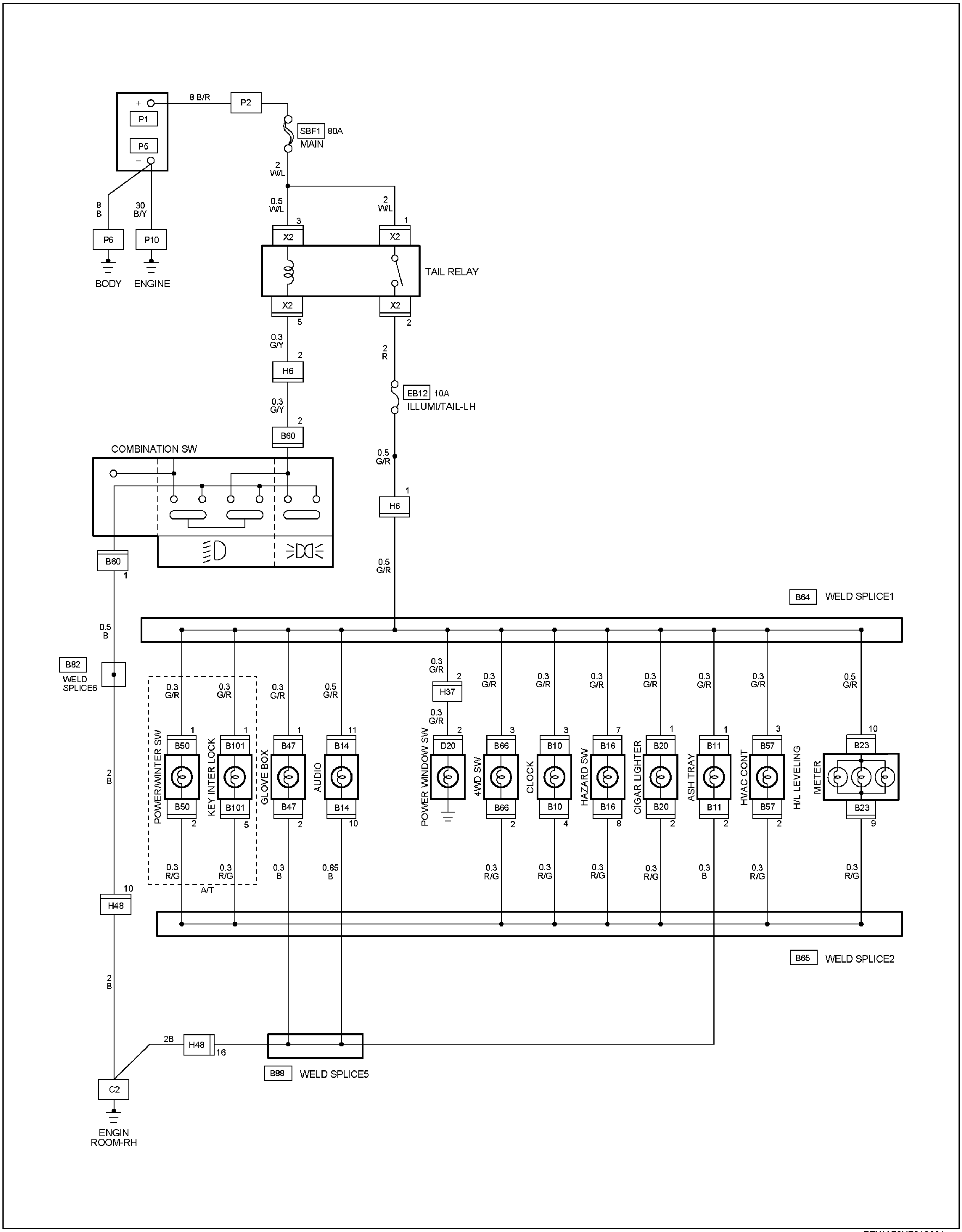
RTW78AXF017701

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC



RTW78AXF027001

CIRCUIT DIAGRAM 4JH1-TC (LHD)



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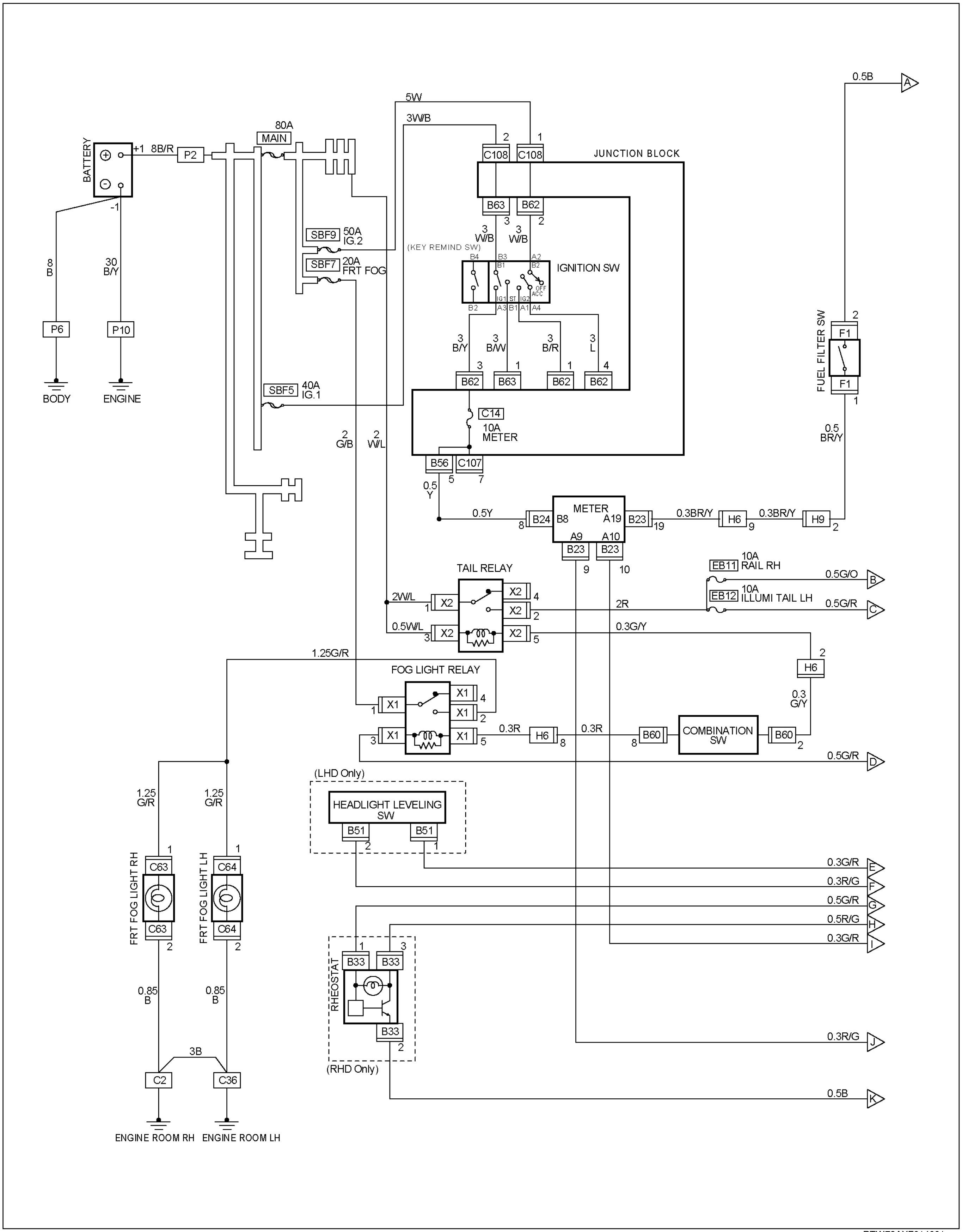
CIRCUIT DIAGRAM 4JA1T (L)



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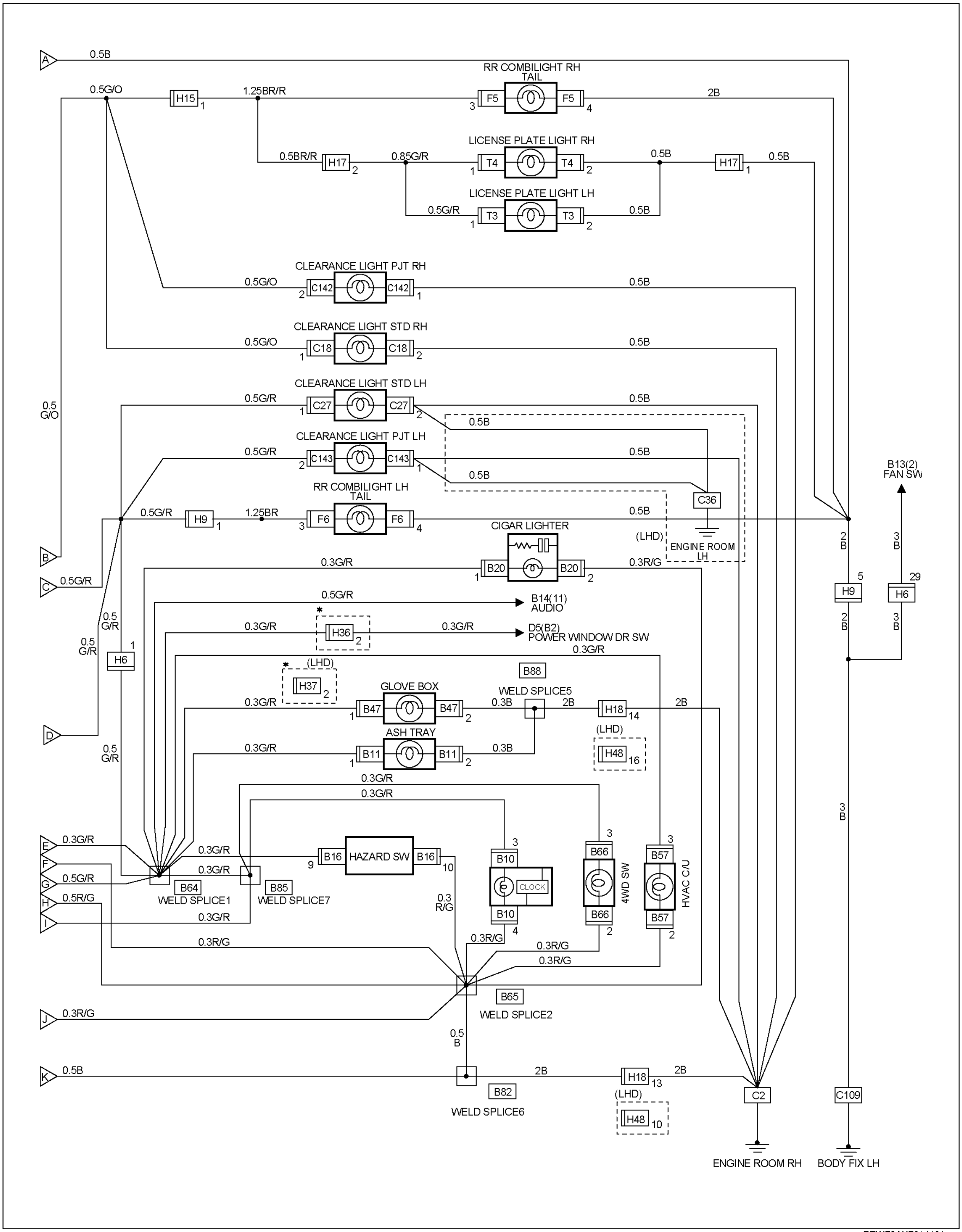
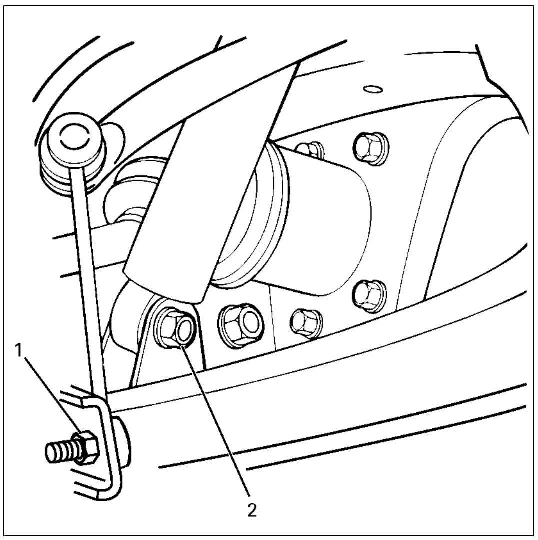
CIRCUIT DIAGRAM 4JA1T (L)



RTW78AXF014101

Removal

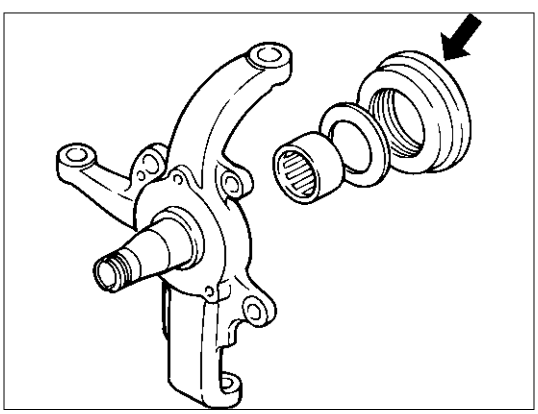
1. Jack up the vehicle and support it using jack stand.
2. Remove the tire and wheel.
3. Remove the stone guard.
4. Remove the brake caliper fixing bolt and hang the caliper. Refer to Disc Brakes in Brake section.
5. Remove the antilock brake system speed sensor.
   Refer to Front Wheel Speed Sensor in Brake section.
6. Remove the hub and disc assembly.
   Refer to Front Hub and Disc in this section.
7. Remove the propeller shaft, refer to Front Propeller Shaft in this section.
8. Loosen the height control arm of the torsion bar, then remove the torsion bar from lower control arm.
   Refer to Torsion Bar in Suspension section.
9. Remove the suspension crossmember.
10. Remove the lower nut (1) of the stabilizer link.
11. Remove the lower bolt and nut (2) of the shock absorber.



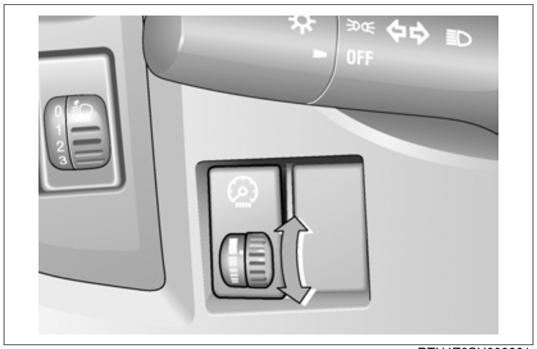
12. Remove the tie-rod end from the knuckle.
    Refer to Power Steering Unit in Steering Section.
13. Disconnect the breather hose of the front axle.
14. Disconnect the actuator connector.
15. Remove the bolts and nuts of the lower control arm (Frame side), then disconnect the lower control arm from frame.
16. Disconnect between the right side upper control arm and the knuckle, then remove the knuckle with lower control arm.

CAUTION :

When removing the knuckle, be careful not to damage the oil seal inside of the knuckle.



ILLUMINATION SWITCH



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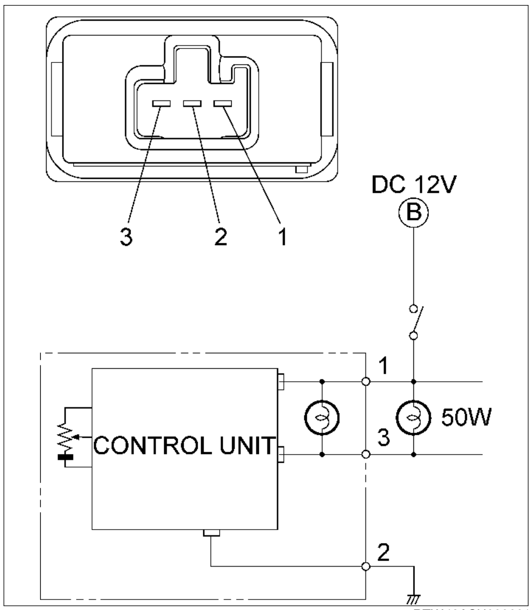
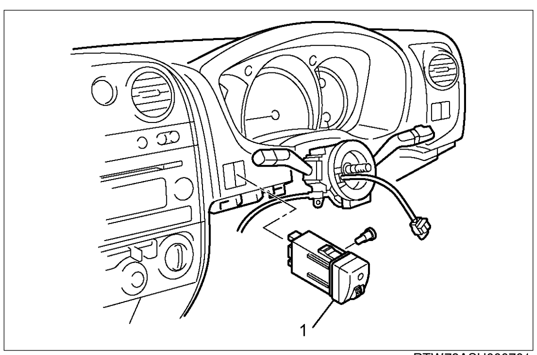


RTW48ASH000601

Inspection

Check to see if there is any continuity between the terminals of the switch.
Replace the switch when the result of inspection is found abnormal.



RTW78ASH000701

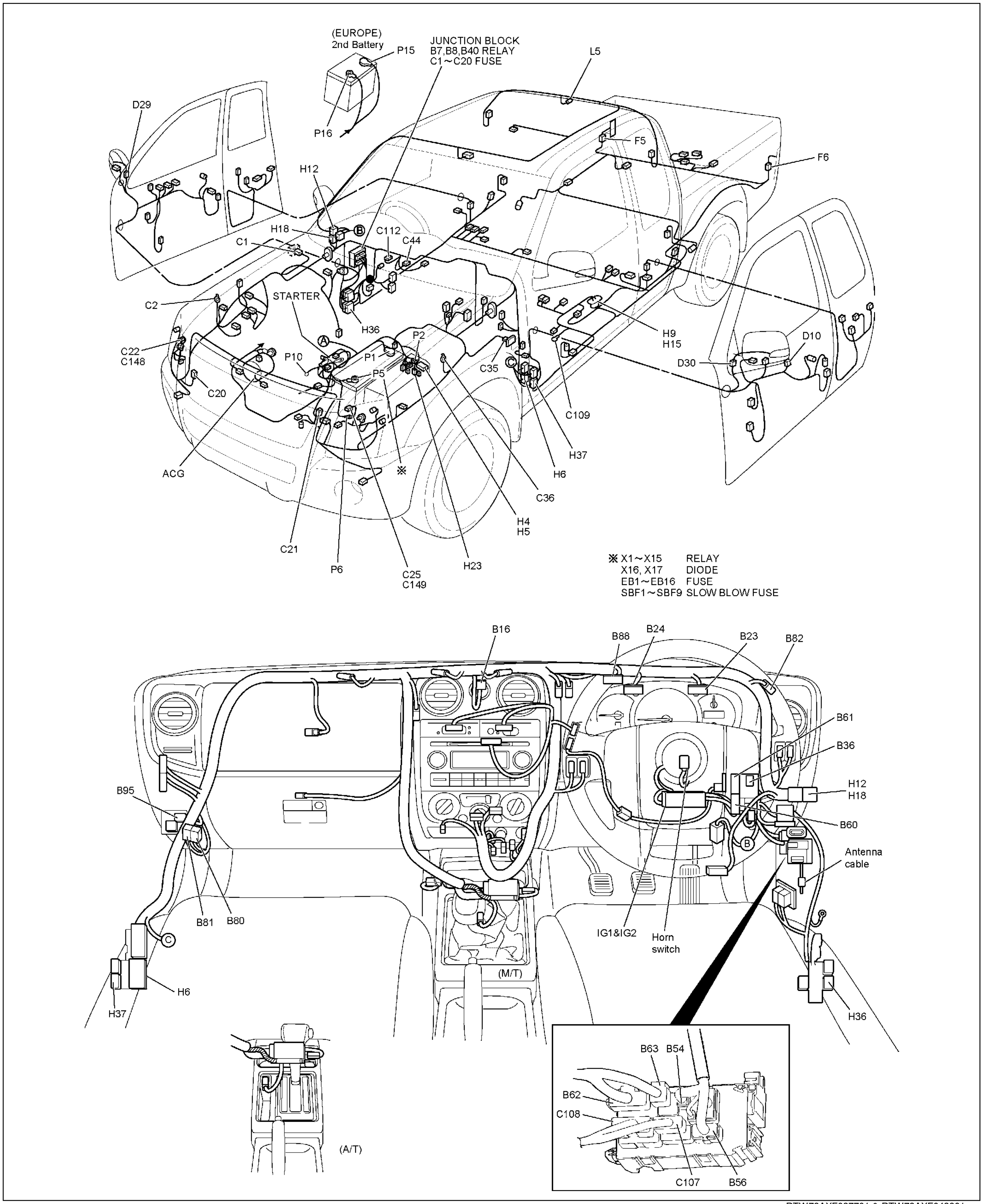
Removal

Preparation:
Disconnect the battery ground cable.

1. Instrument panel driver lower cover assembly
   Refer to the removal steps Sec.10
2. Harness switch
3. Illumination control ①
   To remove the switch, push the lock from the back side of the cluster assembly.
4. Remove the bulb.

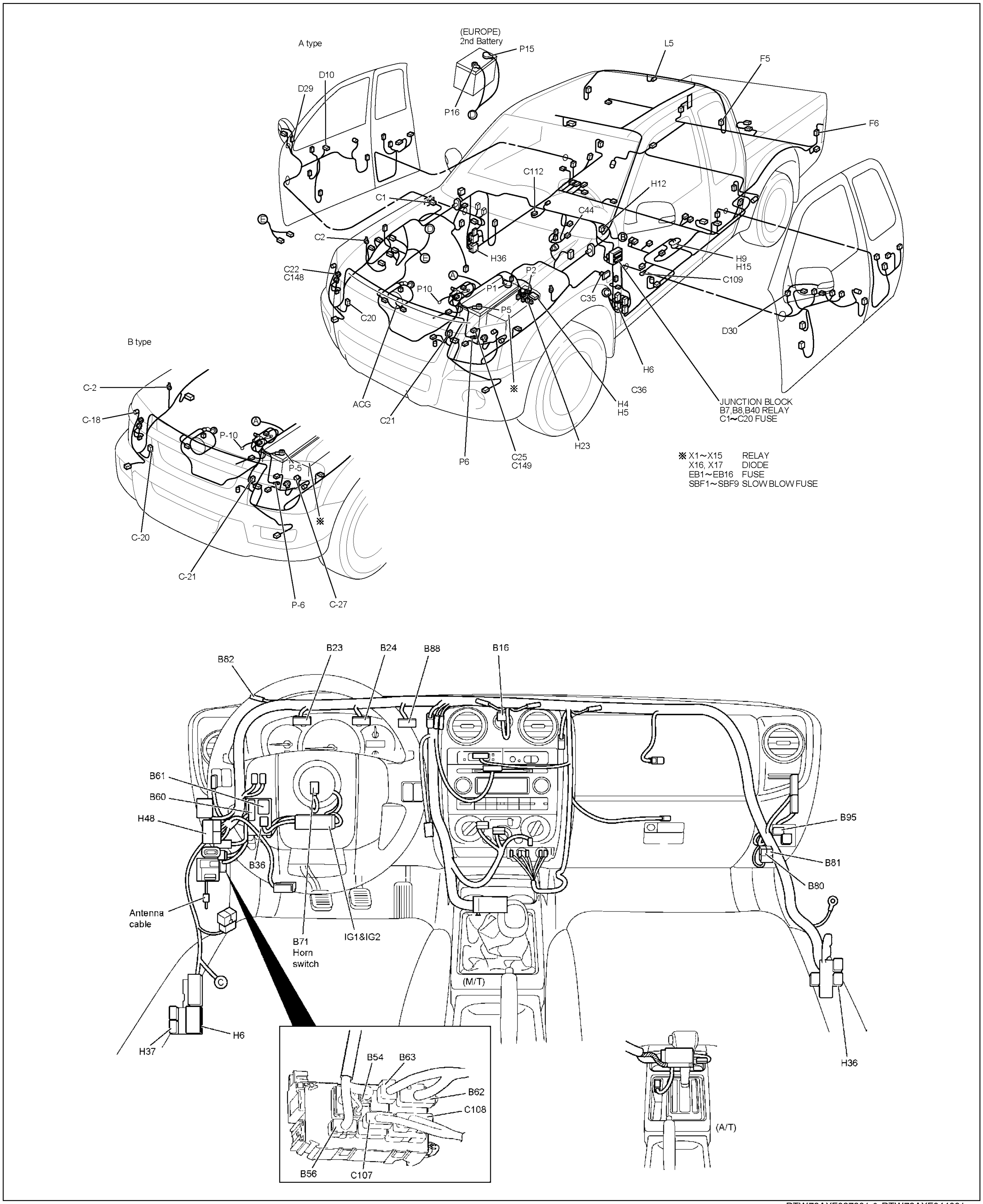
HAZARD WARNING FLASHER, TURN SIGNAL LIGHT, BACKUP LIGHT, HORN AND STOPLIGHT

PARTS LOCATION (RHD)



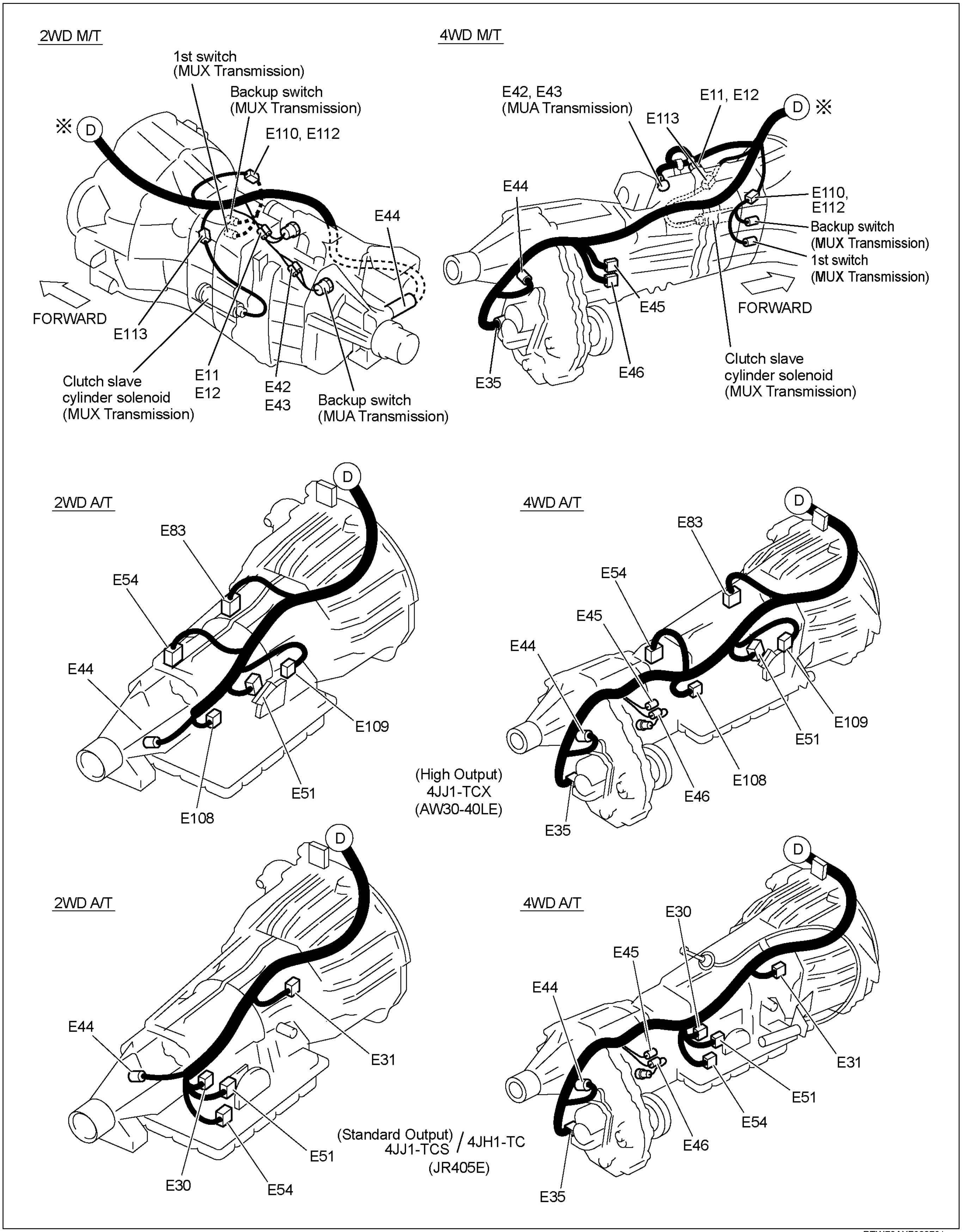
RTW78AXF037701 & RTW78AXF043901

PARTS LOCATION (LHD)



RTW78AXF037801 & RTW78AXF044001

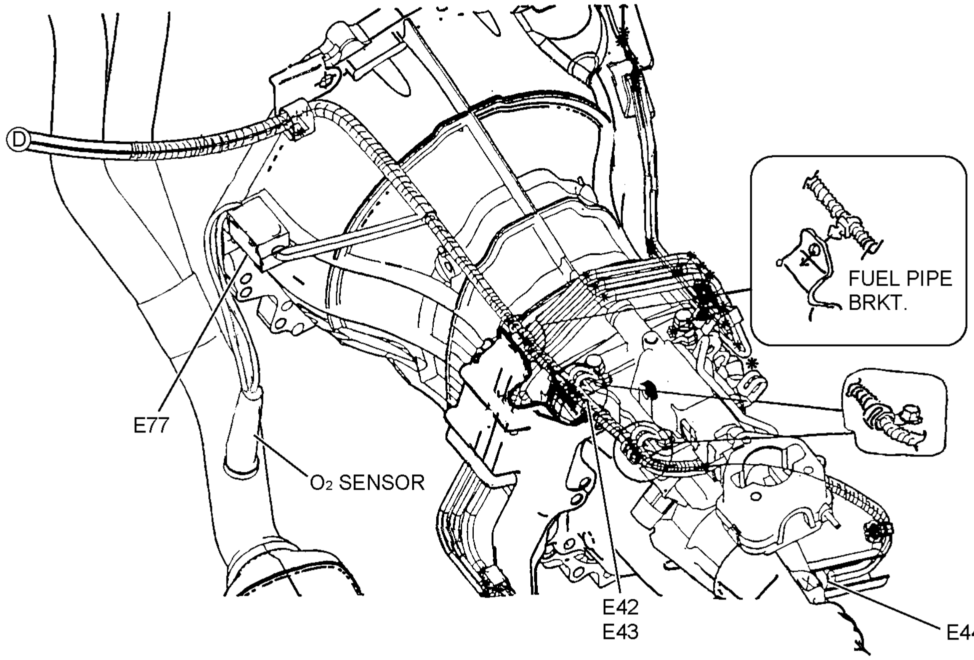
PARTS LOCATION



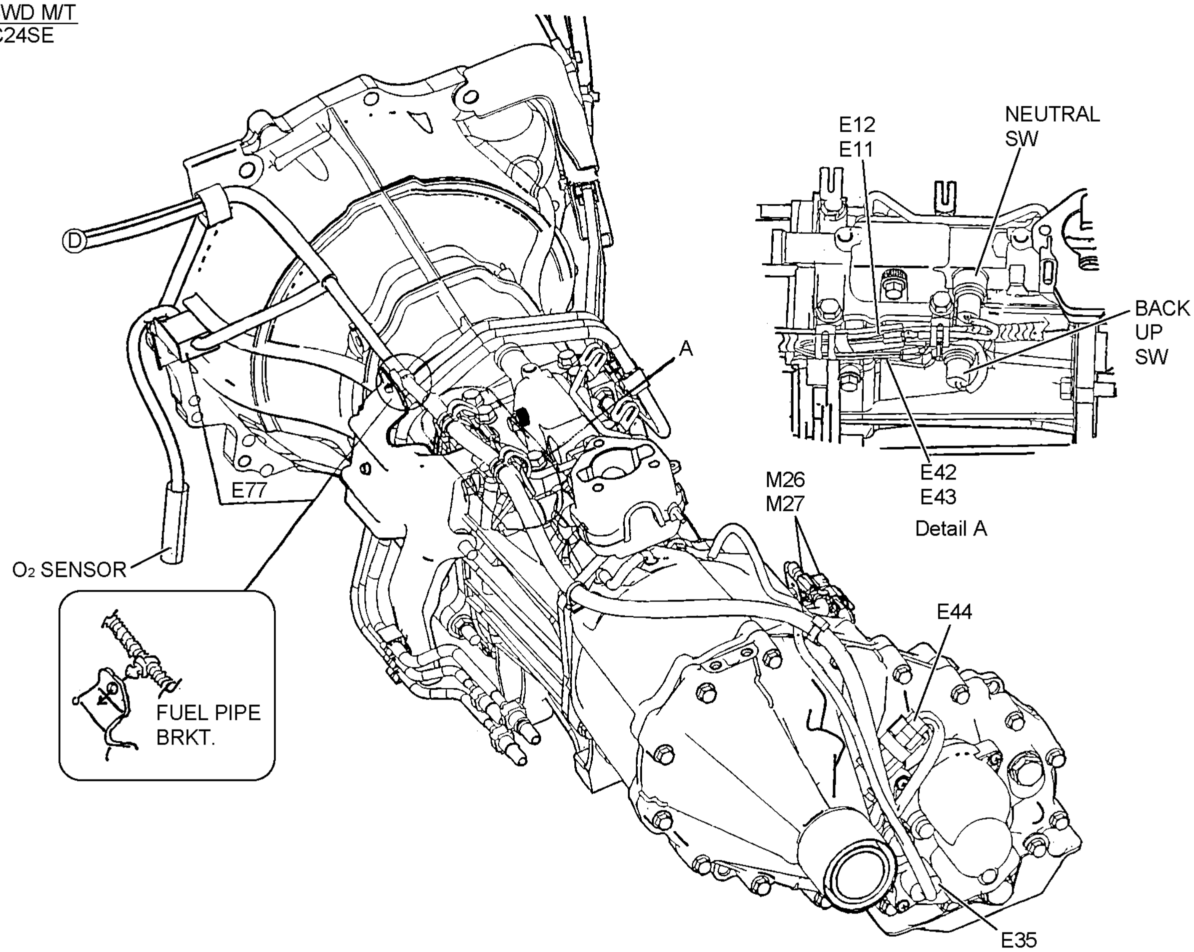
RTW78AXF023701

PARTS LOCATION

2WD M/T
C24SE



4WD M/T
C24SE



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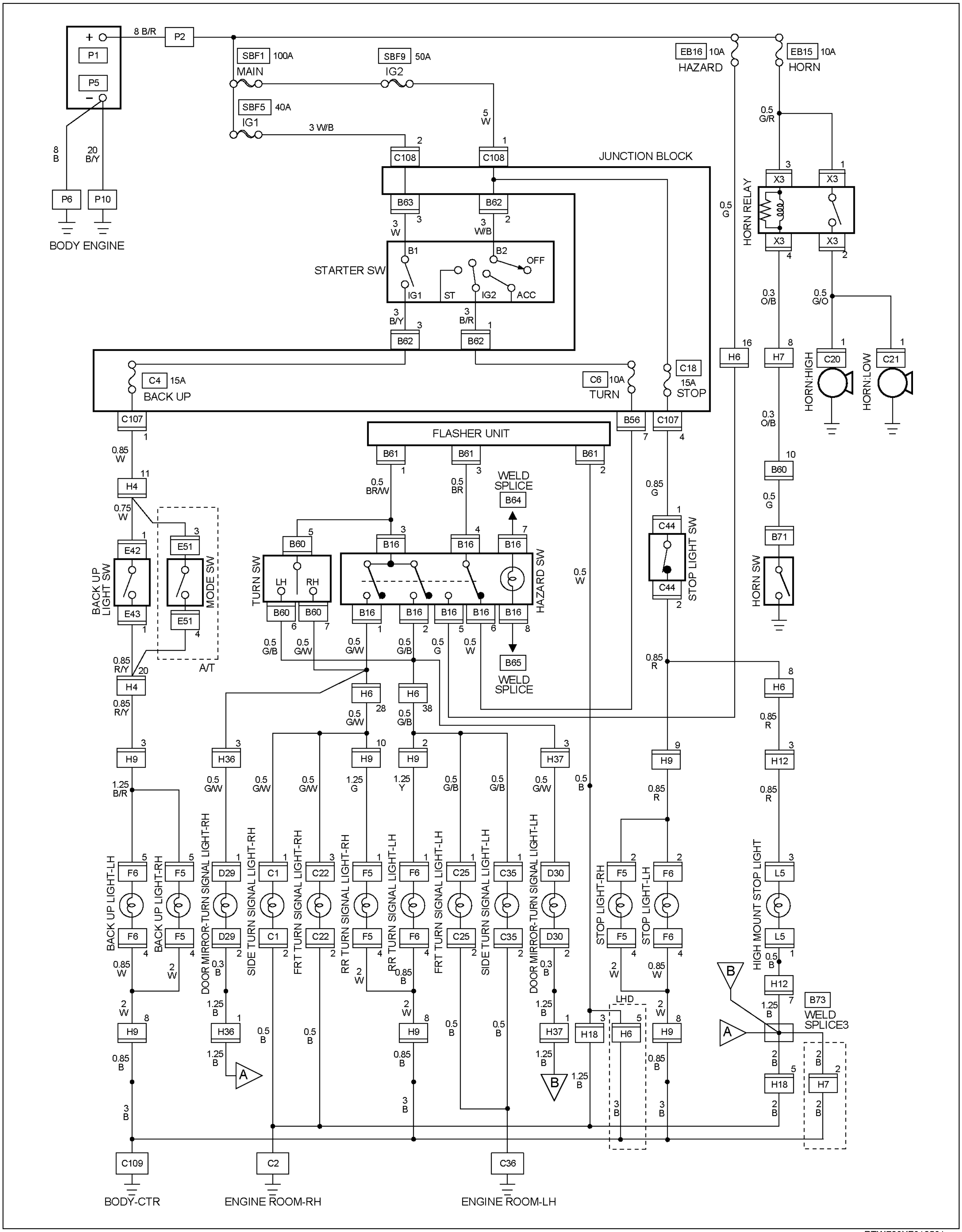
CIRCUIT DIAGRAM C24SE EXCEPT AUSTRALIA



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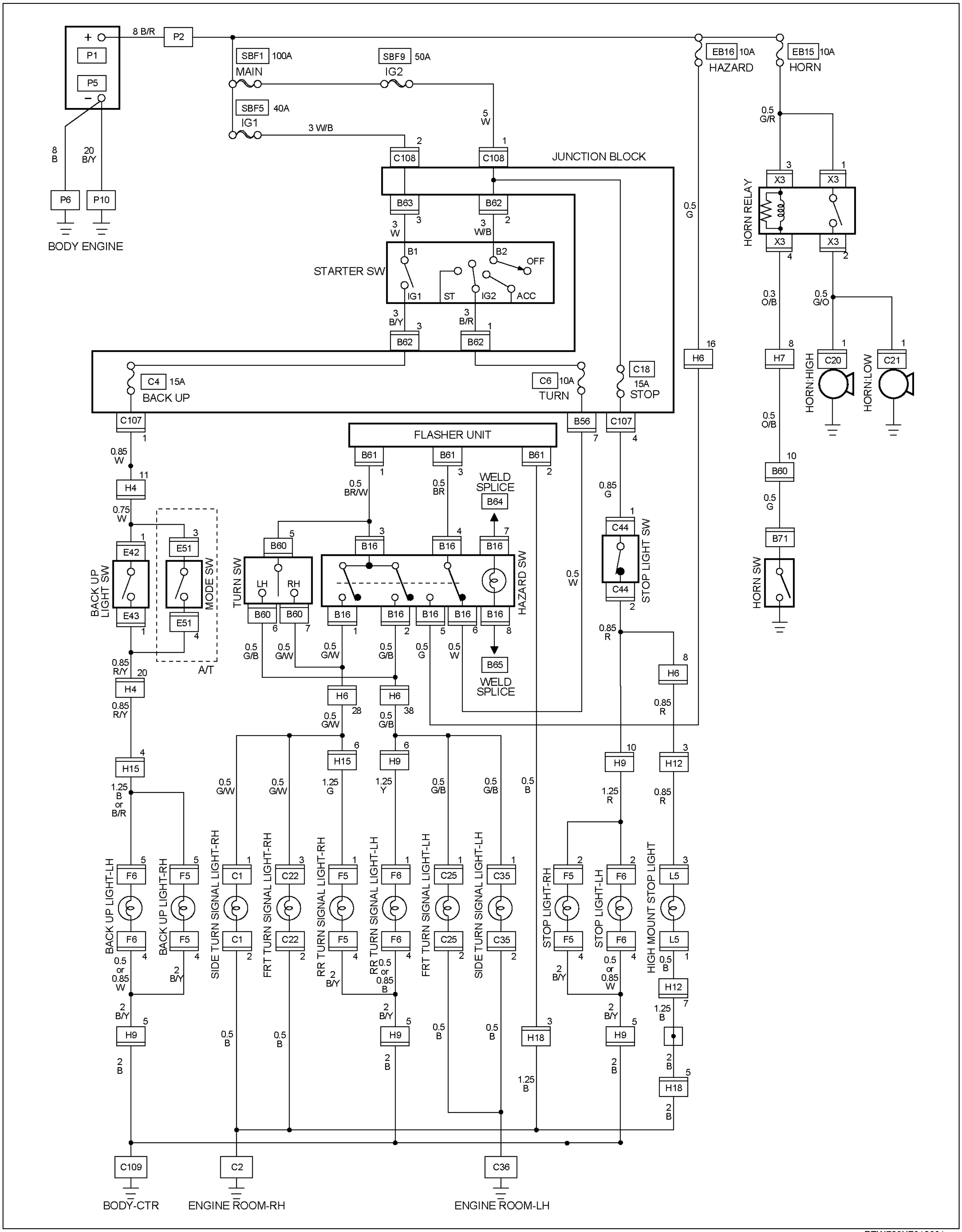
CIRCUIT DIAGRAM C24SE AUSTRALIA



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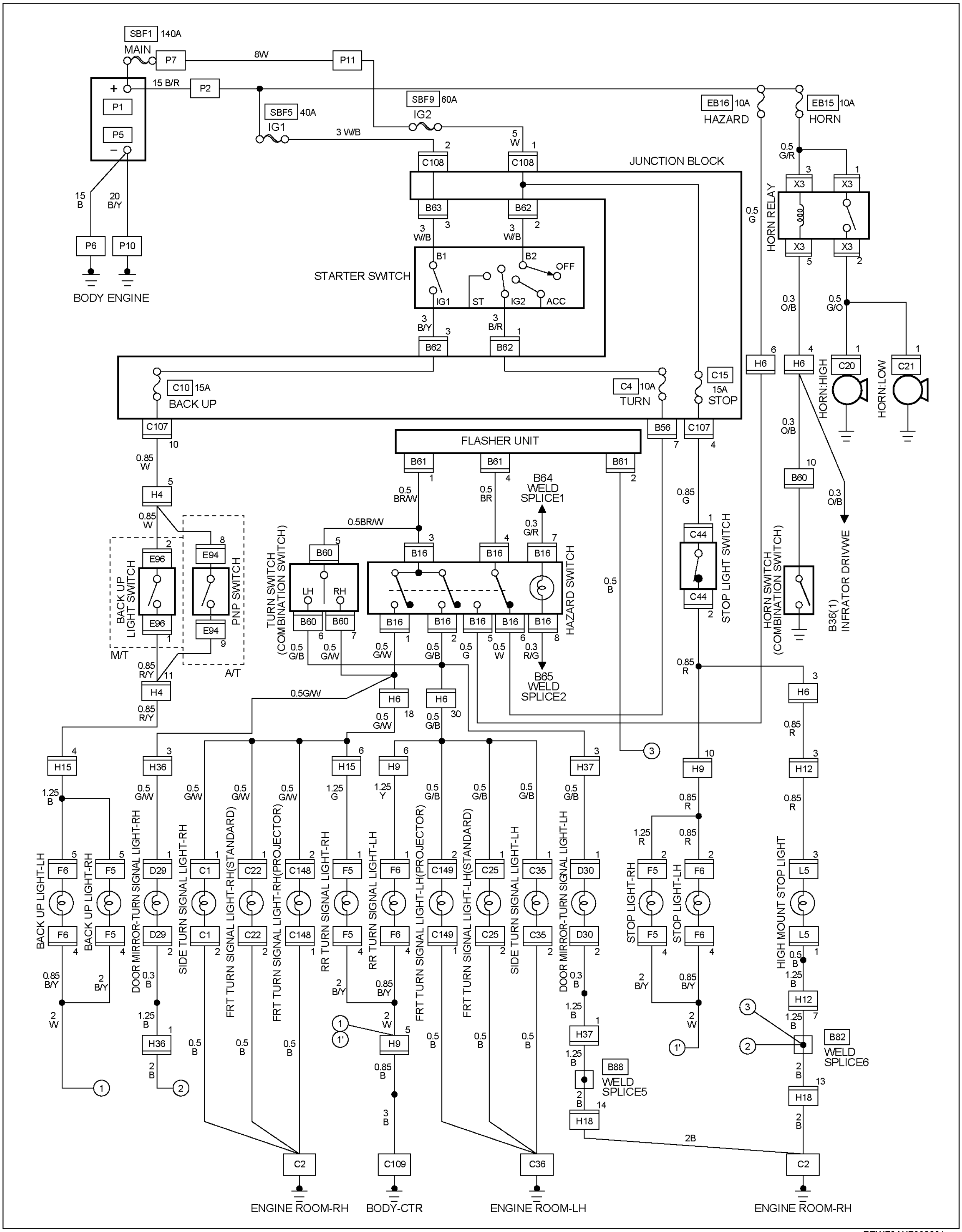
CIRCUIT DIAGRAM HFV6 (RHD)



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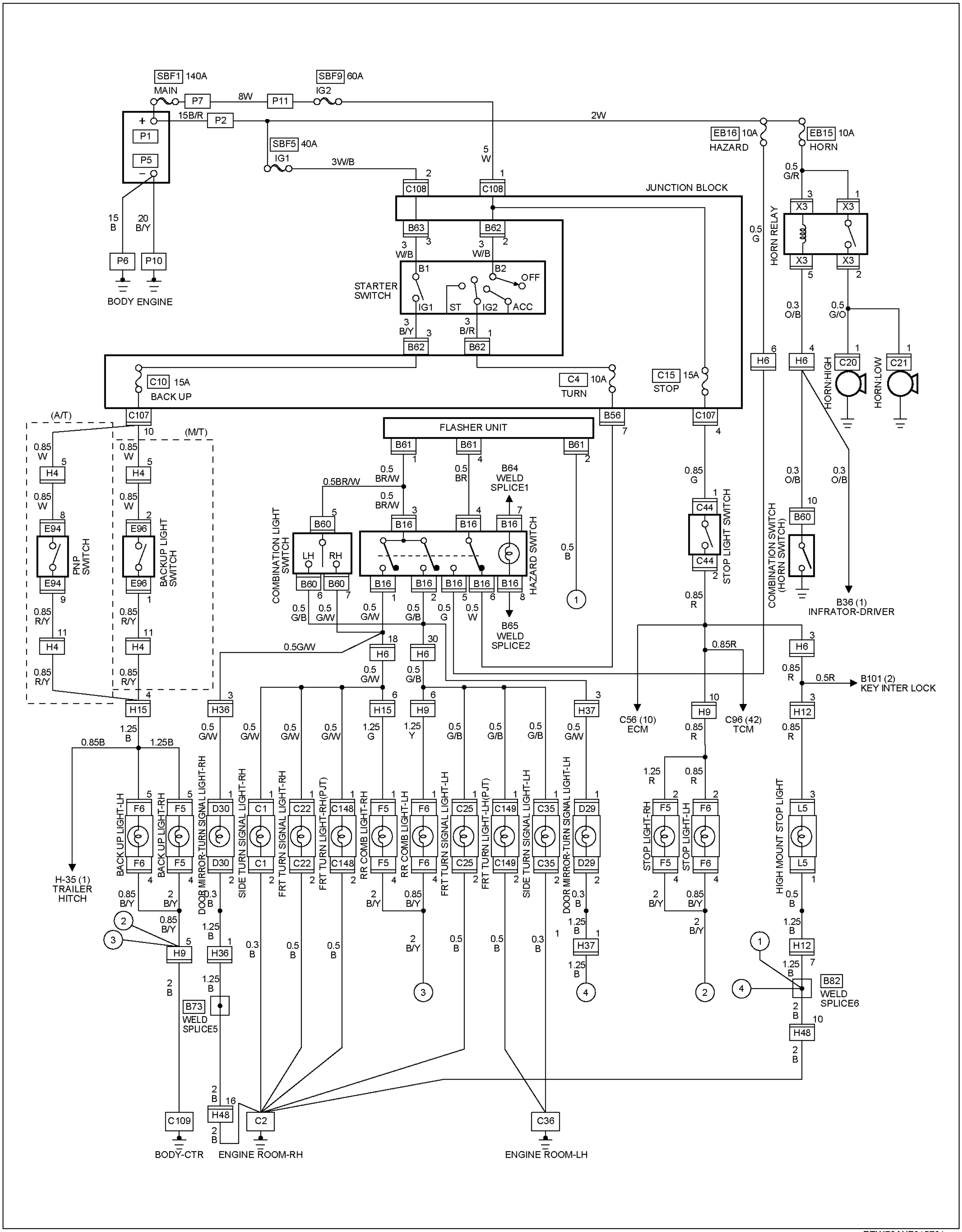
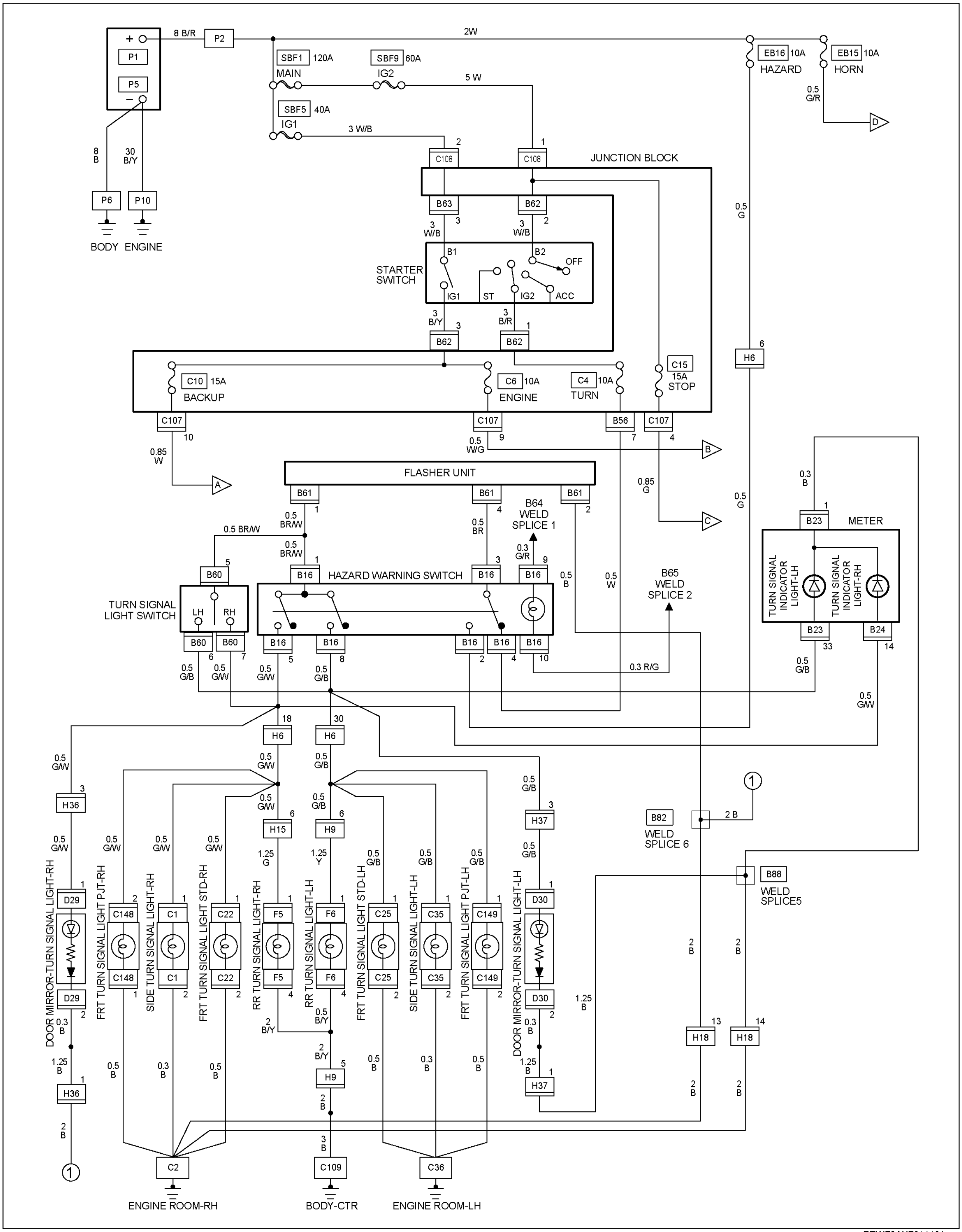
CIRCUIT DIAGRAM HFV6 (LHD)



CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD)

Sheet 1/2



17. Support the differential case by the jack.
18. Remove the front axle mounting bolts and nuts, lower the jack slowly. Remove the left side drive shaft end from the knuckle, then lower the axle assembly from the vehicle.

CAUTION :

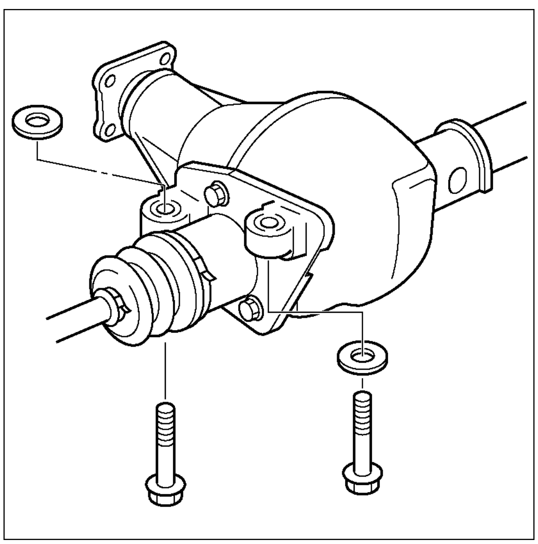
1. **During the work, be sure that the axle assembly is supported securely.**
2. **Be careful not to damage the bellows of the power steering unit by interference.**
3. **Be careful not to damage the breather pipe and breather pip bracket of the shift on the fly by interference.**

Installation

1. Support the differential case by the jack.
2. Jack up the front drive axle assembly, install the left side drive shaft to the knuckle, then install the mount bolts and nuts.

CAUTION :

1. **Be careful not to damage the bellows of the power steering unit by interference.**
2. **Be careful not to damage the breather pipe and breather pip bracket of the shift on the fly by interference.**
3. **When installing the drive shaft to the knuckle, be careful not to damage the oil seal inside of the knuckle.**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3. Tighten the mounting bolts and nuts to the specified torque.
   Torque : 169 N·m (17.2kgf·m/124 lb·ft)

4. Install the right side knuckle with lower control arm to the upper control arm.
   Refer to Knuckle in Suspension section.

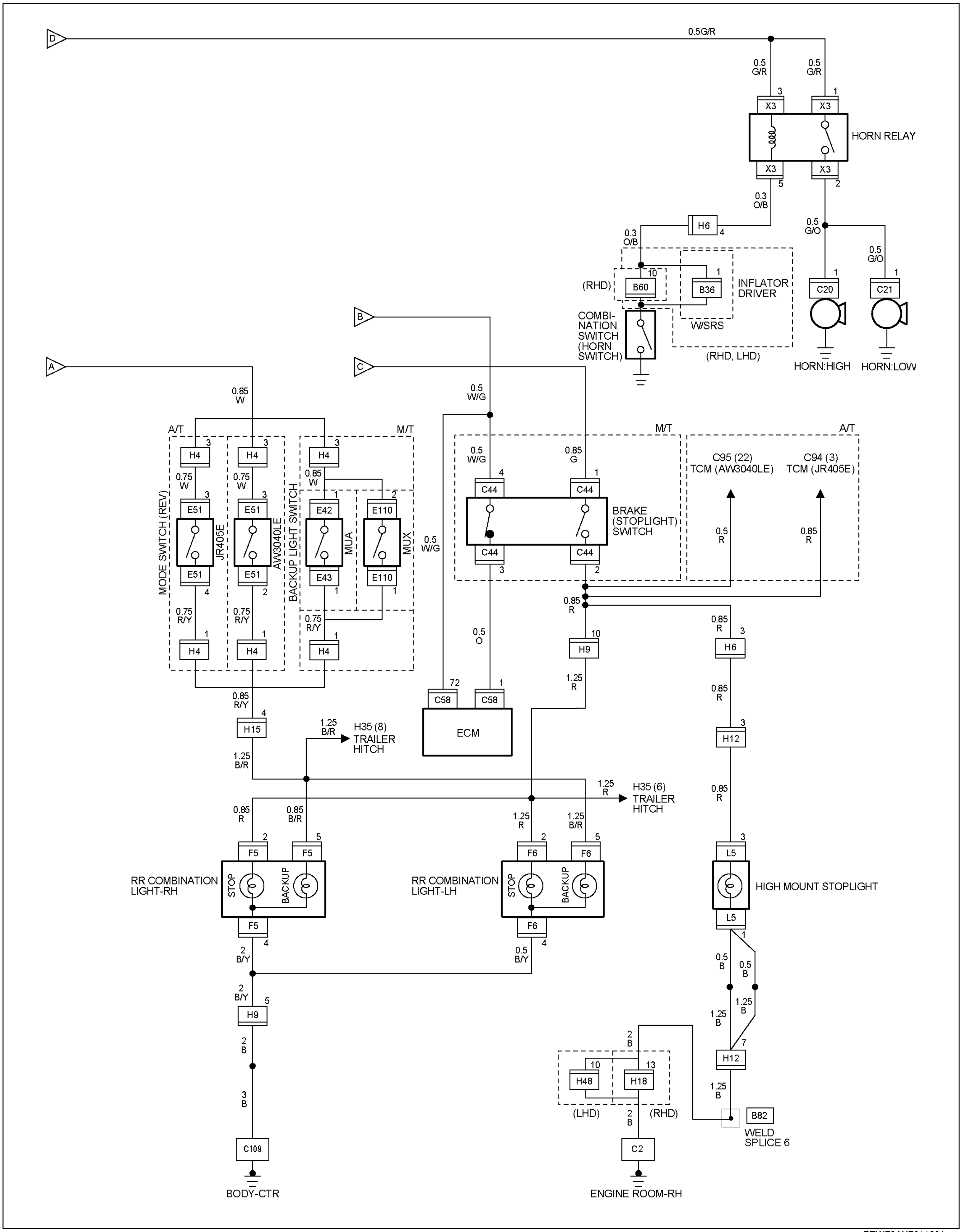
CAUTION :

When insert the drive shaft to the knuckle, be careful not to damage the oil seal inside of the knuckle.

5. Align the bolt hole of the lower control arm, install the bolts and nuts.

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD)

Sheet 2/2



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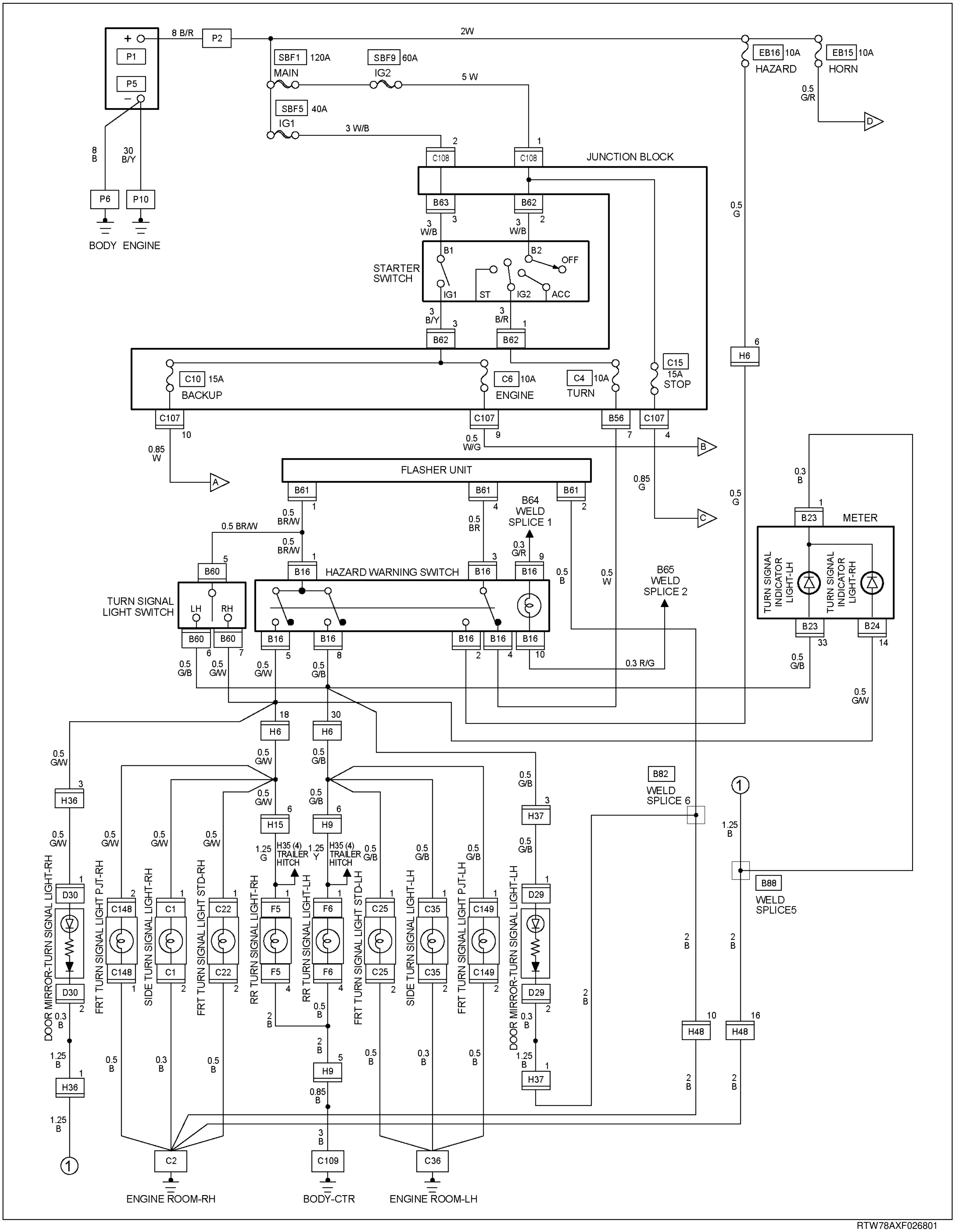
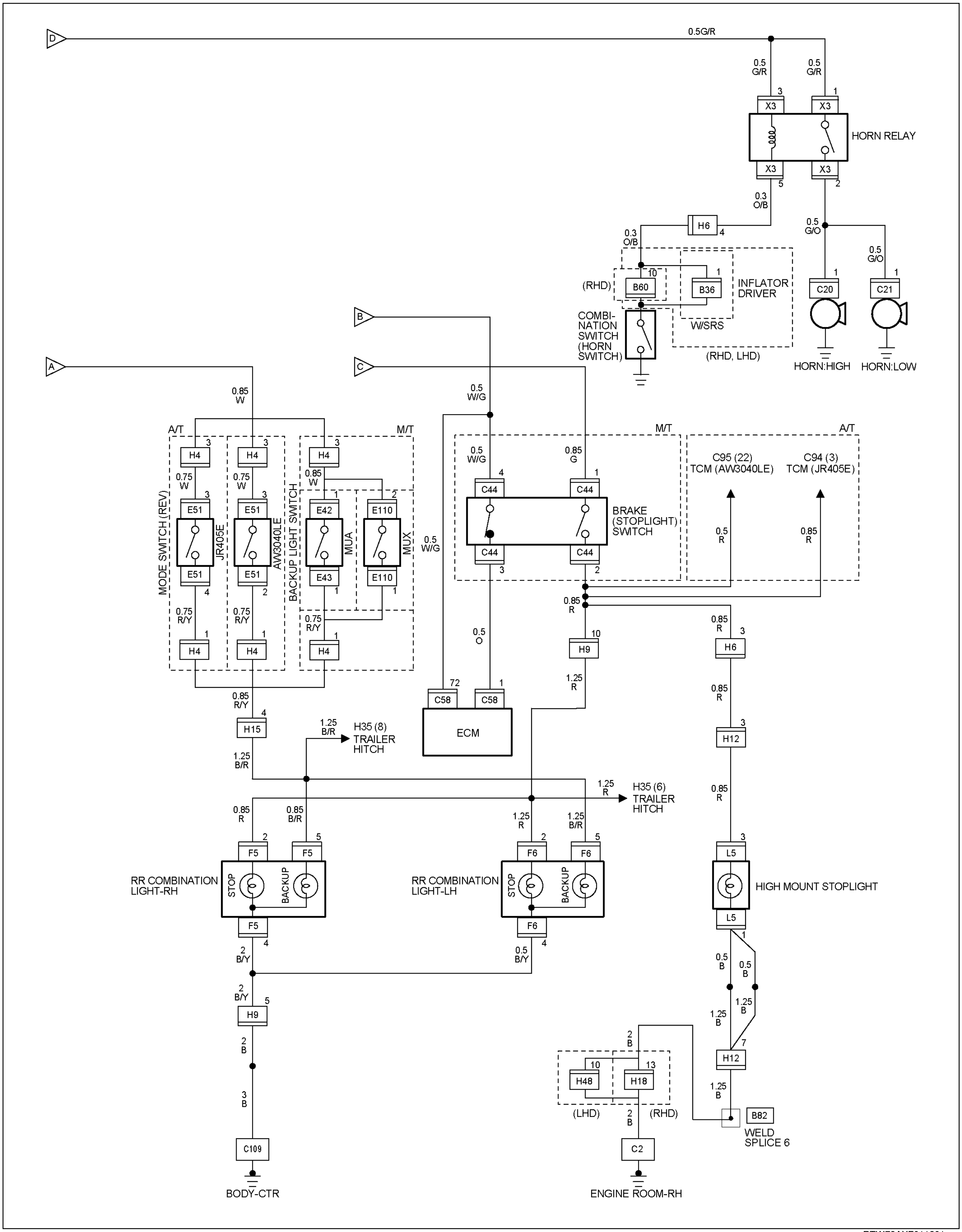
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD)

Sheet 1/2



CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD)

Sheet 2/2



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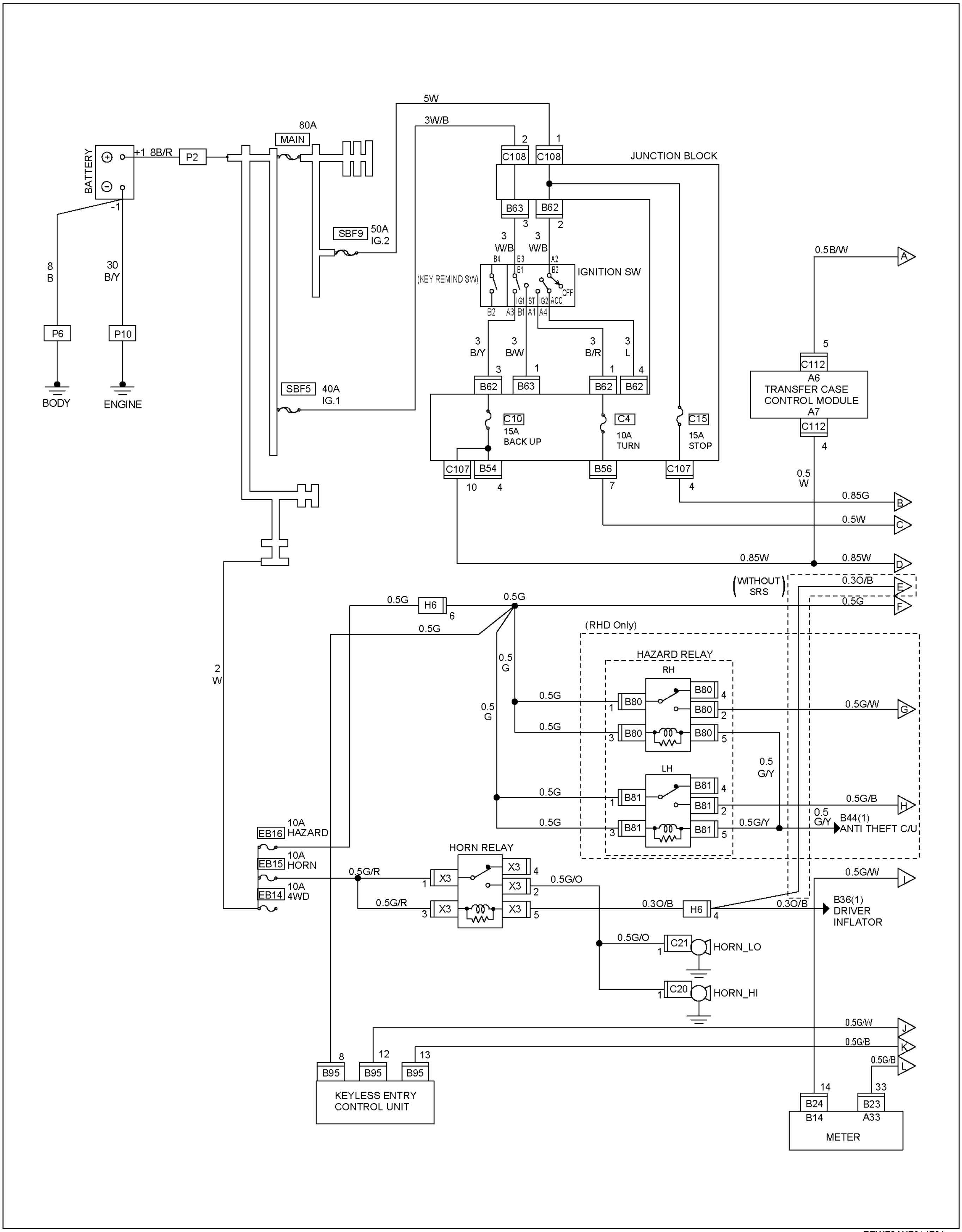
CIRCUIT DIAGRAM 4JA1T (L)

Sheet 1/3



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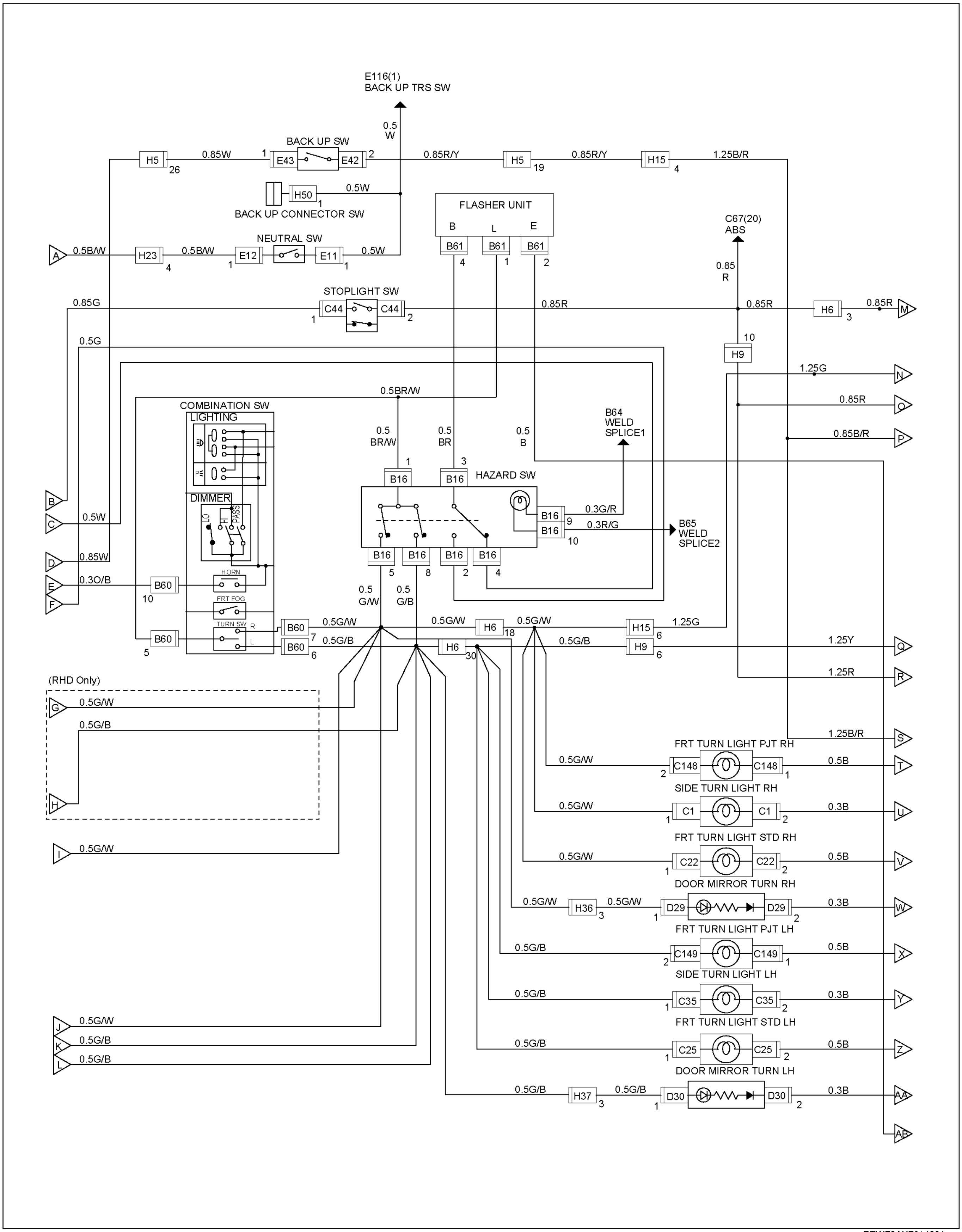
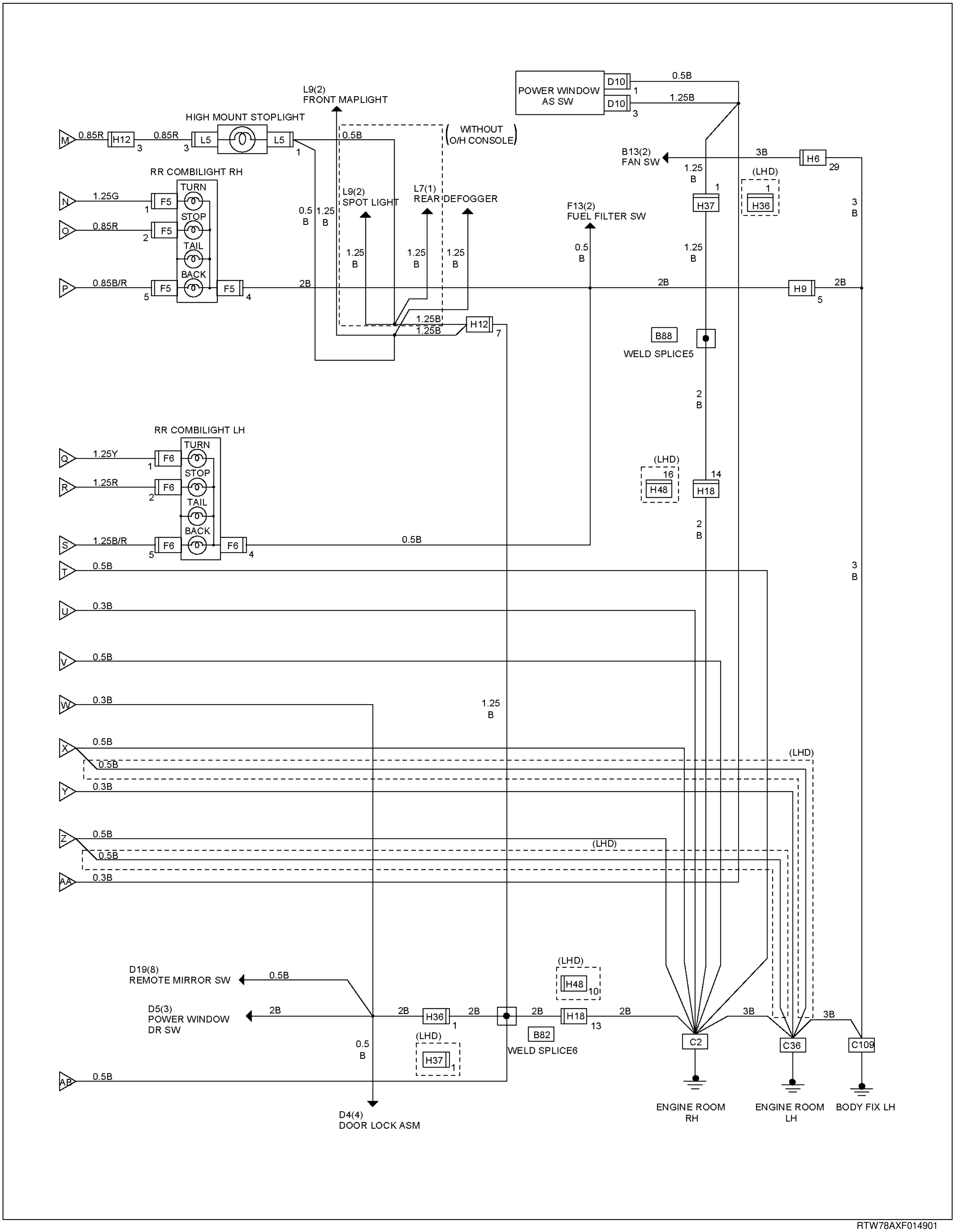
CIRCUIT DIAGRAM 4JA1T (L)

Sheet 2/3



CIRCUIT DIAGRAM 4JA1T (L)

Sheet 3/3



TROUBLESHOOTING

STOPLIGHT AND HIGH MOUNTED STOPLIGHT

1. One side of stoplight does not light

Checkpoint		Trouble Cause	Countermeasure
Stoplight bulb continuity	NG	Burned out bulb or poor connector contact	Replace the bulb or repair connector contact
OK			
Continuity between 9 H9 - 2 F6 (LH) (or 2 F5 (RH))	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Continuity between C109 - 4 F6 (LH) (or 4 F5 (RH))	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Both sides of stoplight do not light

Checkpoint		Trouble Cause	Countermeasure
Fuse No. SBF-9 (50A, Fuse and Relay box) or 1 C108 - 4 C107 Fuse No. C15 (15A)	NG	Poor fuse contact or blown	Reinstall or replace fuse No. SBF9 (50A or 60A) or 1 C108 - 4 C107 Fuse No. C15 (15A)
OK			
Stop light switch (or brake switch) function	NG	Incorrect the switch installation or adjustment	Adjust the switch installation position
OK			
Voltage between 2 F6 ground or 2 F5 - ground with brake pedal depressed (Should be battery voltage present)	NG	Open circuit or poor connector contact between stoplight switch (or brake switch) and stoplight	Repair open circuit or connector contact

3. High mounted stoplight does not light

Checkpoint		Trouble Cause	Countermeasure
Grounding point C2	NG	Poor grounding point contact	Repair grounding point contact C2
OK			
Continuity between 3 L5 - 1 L5	NG	High mounted stoplight malfunction	Repair or replace the high mounted stoplight
OK			
Voltage between 1 L5 - ground with brake pedal depressed (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair an open circuit or connector contact between 3 L5 - 13 H18 (RHD) or 10 H48 (LHD)

TURN SIGNAL LIGHT AND HAZARD WARNING LIGHT

1. Turn signal light does not light on both sides (RH and LH)

Checkpoint		Trouble Cause	Countermeasure
Fuse No. EB16 (10A, Fuse box)	NG	Poor fuse contact or blown fuse	Reinstall or replace fuse No. EB16 (10A)
OK			
Short circuit between connector 3 B61 - 1 B61 when turn signal switch operates with starter switch in "ON" position (Turn signal light should be ON)	NG	Flasher unit malfunction	Replace the flasher unit
OK			
Continuity between connector 2 B61 -ground (Should be continuity)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Turn signal switch continuity between connector 5 B60 - 6 B60 and 5 B60 - 7 B60 when turn signal switch operates	NG	Poor switch point contact or faulty switch	Repair or replace the combination switch

2. Turn signal light does not light on one side (RH or LH)

Checkpoint		Trouble Cause	Countermeasure
Turn signal switch continuity	NG	Poor switch point contact or faulty switch	Repair or replace the combination switch
OK			
(RH) Continuity between 1 C22 - 7 B60 (FRT), 1 C1 - 7 B60 (SIDE), 1 F5 - 7 B60 (RR)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
(LH) Continuity between 1 C25 - 6 B60 (FRT), 1 C35 - 6 B60 (SIDE), 1 F6 - 6 B60 (RR)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

3. Hazard warning light does not light

Checkpoint		Trouble Cause	Countermeasure
Fuse No. EB16 (10A, Relay and fuse box)	NG	Poor fuse contact or blown fuse	Reinstall or replace the fuse No. EB-16 (10A)
OK			
Hazard SW. continuity	NG	Hazard SW. malfunction	Repair or replace the hazard SW.
OK			
Voltage between 5 B16 - ground (Should be battery voltage present)	NG	Open circuit or poor connector contact between fuse No. EB16 (10A) - 5 B16	Repair open circuit or connector contact

4. Flashing rate too fast (One side)

Checkpoint		Trouble Cause	Countermeasure
Inspect bulb	NG	Burned out bulb	Replace the bulb or repair open circuit

NOTE :
Adjust the buffer clearance before tighten the bolts and nuts of the lower control arm.

6. Install the breather hose of the front axle.
7. Install the actuator connector of the shift on the fly.
8. Install the tie-rod end of the power steering unit to the knuckle, tighten the nut to the specified torque.
   Torque : 98 N·m (10.0kgf·m/73 lb·ft)
9. Install lower bolts and nuts of the shock absorber, tighten it to the specified torque.
   Torque : 93 N·m (9.5kgf·m/69 lb·ft)
10. Install lower nuts of the stabilizer link, tighten it to the specified torque.
    Torque : 50 N·m (5.1kgf·m/37 lb·ft)
11. Install the suspension crossmember.
12. Install the torsion bar.
    Refer to Torsion Bar in Suspension section.
13. Install the front propeller shaft.
    Refer to Front Propeller Shaft in this section.
14. Install the hub and disc assembly and adjust the bearing preload.
    Refer to Front Hub and Disc in this section.
15. Install the wheel speed sensor of the antilock brake system.
16. Install the brake caliper. Tighten the bolt of the caliper bracket to the specified torque.
    Torque : 226 N·m (23.0kgf·m/166 lb·ft)
17. Install the stone guard.
18. Install the tire and wheel.
19. Lower the vehicle, adjust the trim height.
    Refer to Trim Height Adjustment in Front Alignment section.
20. Tighten the bolts and nuts of the lower control arm to the specified torque.
    Refer to Lower Control Arm in Suspension section.

BACKUP LIGHT

1. Backup light does not light on one side (RH or LH)

Checkpoint		Trouble Cause	Countermeasure
Backup light bulb continuity	NG	Burned out bulb or poor connector contact	Replace the bulb or repair connector contact
OK			
Grounding point	NG	Poor ground contact	Repair grounding point contact

2. Backup light does not light on both sides

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C10 (15A, Fuse box)	NG	Poor fuse contact or blown fuse	Reinstall or replace fuse No. C10 (15A)
OK			
Back up light switch (mode switch) continuity	NG	Poor switch point contact of faulty switch	Repair or replace the switch
OK			
Voltage between 5 $\boxed{F6}$ (5 $\boxed{F5}$) - ground with starter switch ON and shift lever into reverse position (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

HORN

1. Both sides of horn do not sound

Checkpoint	Result	Trouble Cause	Countermeasure
Fuse No EB15 (10A, Relay and fuse box)	NG	Poor fuse contact or blown fuse	Reinstall or replace fuse No. EB15 (10A)
OK ↓			
Grounding point	NG	Poor ground contact	Repair the grounding point
OK ↓			
Horn relay	NG	Poor relay contact or faulty horn relay	Reinstall or replace the horn relay
OK ↓			
Voltage between connector 3 X3 - ground or 1 X3 - ground (Should be battery voltage present)	NG	Open circuit or poor connector contact between fuse No. EB15 (10A) and horn relay	Repair open circuit or reconnect the connector
OK ↓			
Remove steering pad and steering wheel			
OK ↓			
Horn switch continuity	NG	Poor switch point contact or faulty switch	Repair or replace the horn switch
OK ↓			
Continuity between 5 X3 - 10 B60 2 X3 - 1 C20 (1 C21)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. One side of horn does not blow

Checkpoint		Trouble Cause	Countermeasure
Horn continuity between connectors	NG	Faulty horn assembly	Replace the horn assembly
OK			
Voltage between 1 $\boxed{C20}$ (1 $\boxed{C21}$) - ground with horn switch depressed (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or reconnect the connector

3. Insufficient horn volume

Checkpoint		Trouble Cause	Countermeasure
Battery condition	NG	Discharged battery	Recharge or replace the battery
OK			
Horn	NG	Stain foreign material in the horn	Clfean and/or remove the foreign material

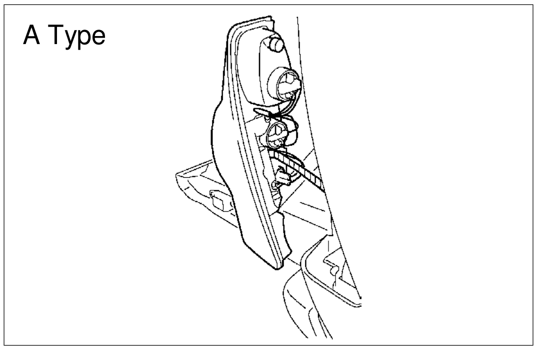
REMOVAL AND INSTALLATION

REAR COMBINATION LIGHT

Stoplight

Removal

1. Open the tail gate.
2. Remove the screws of rear combination light.
3. Remove the rear combination light assembly.



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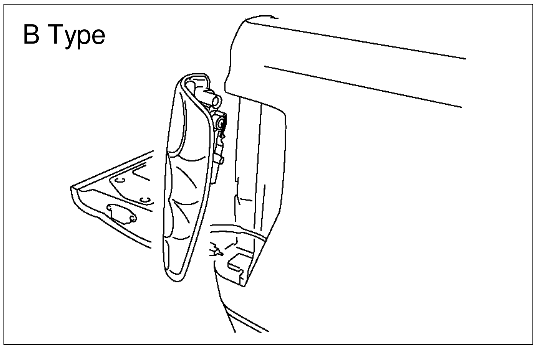

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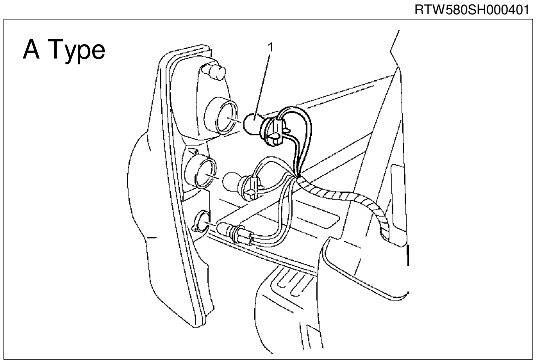
4. Turn the bulb (1) counterclockwise to remove it.



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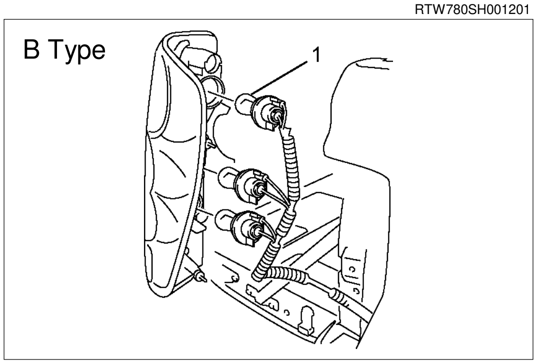


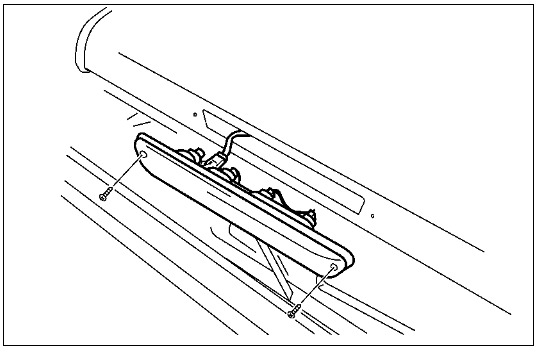
RTW580SH000501

Installation

Follow the removal procedure in the reverse order to install the rear combination light.
Pay close attention to the important points mentioned in the following paragraphs.

Bulb

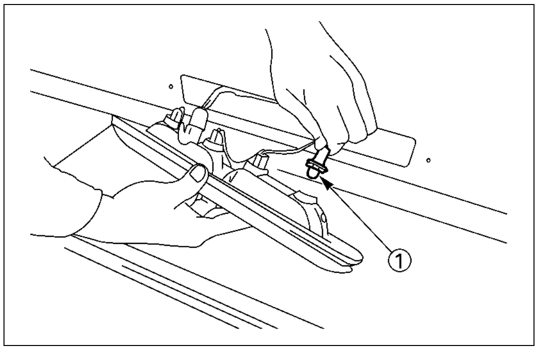
Be absolutely sure that each bulb is correctly installed.
This will prevent a poor contact and an open circuit.



HIGH MOUNTED STOPLIGHT

Remove the bulb socket

1. Remove the high mounted stoplight ASM.
   - Remove the screws.
   - Disconnect the connector.



2. Remove the bulb socket.
   - Turn the bulb ① counterclockwise to remove it.

Installation

Follow the removal procedure in the reverse order to install the rear combination light.
Pay close attention to the important points mentioned in the following paragraphs.

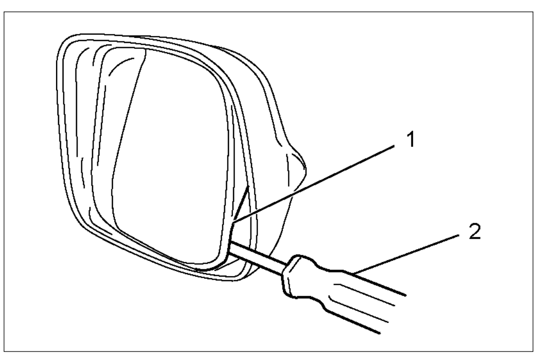
Bulb

Be absolutely sure that each bulb is correctly installed.
This will prevent a poor contact and an open circuit.

DOOR MIRROR - TURN SIGNAL LIGHT

Removal

1. Pull the lower outside corner of the mirror toward you.



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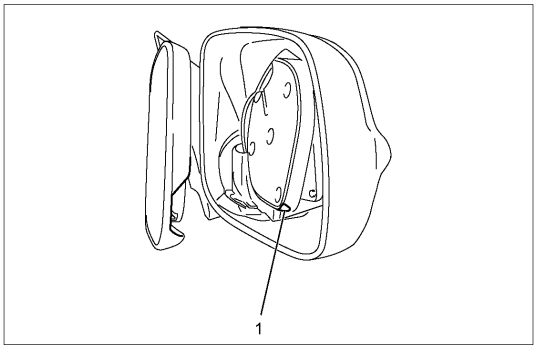
2. Press the blade of an ordinary screwdriver (2) into the mirror outside groove near the mirror base hole (1).



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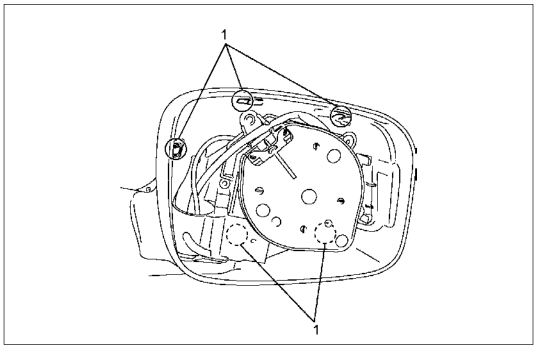
3. Turn the blade of the screwdriver 90 degrees to separate the parts (1).



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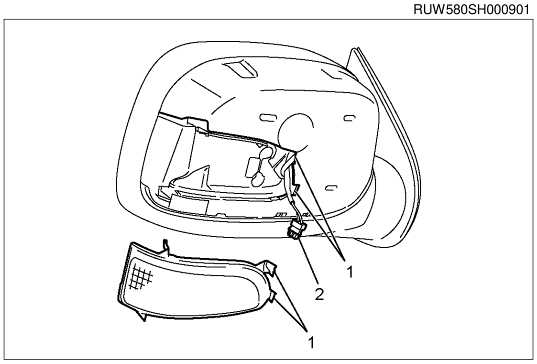
4. Use an ordinary screwdriver inserted into the inner groove (1) of the outside mirror case to pry off the outside panel (it pasts up on butyl tape). Do this at 5 points around the groove.



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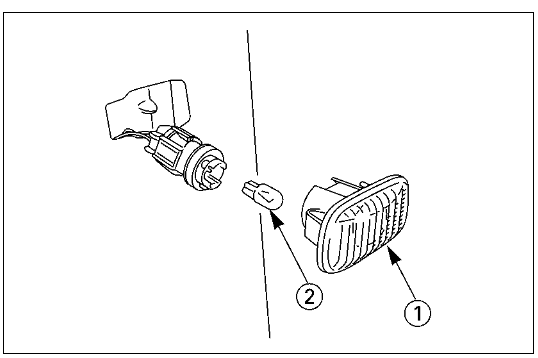
5. Insert an ordinary screwdriver into the inner groove (1) of the door mirror - turn signal light. Pry the light free.
6. Disconnect the connector (2).

Installation

Follow the removal procedure in the reverse order to install the door mirror - turn signal light.
Pay close attention to the important points mentioned in the following paragraphs.



SIDE TURN LIGHT

Removal

1. Remove the lens ①.
   - Pull the light/bulb toward you while pushing the light housing in the rear direction of the vehicle to release its lock.
   - Remove the socket by turning it counterclockwise.
2. Pull the bulb ② to remove it.

Installation

Follow the removal procedure in the reverse order to install the side turn light.
Pay close attention to the important points mentioned in the following paragraphs.

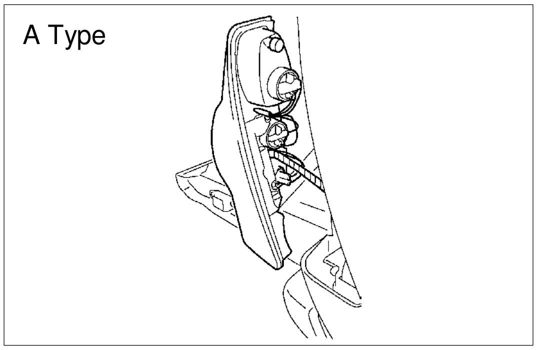
Bulb

Be absolutely sure that the side turn light bulb is correctly installed.
This will prevent a poor contact and an open circuit.

REAR COMBINATION LIGHT

Turn Signal Light

Removal



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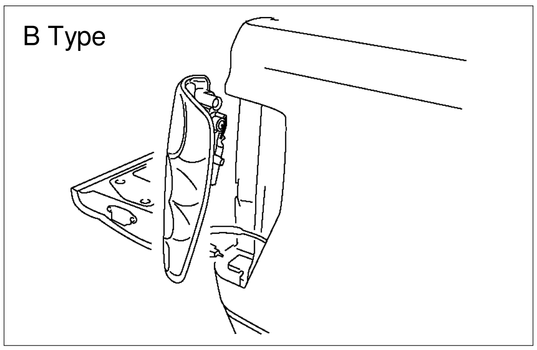
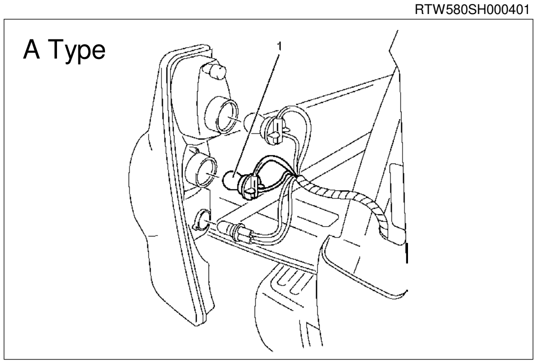


RTW580SH000401

1. Open the tail gate.
2. Remove the screws.
3. Remove the rear combination light assembly.



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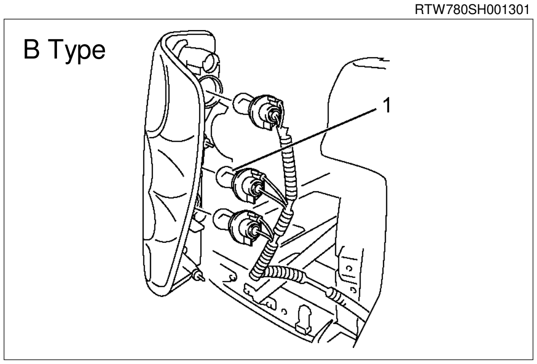


RTW78ASH002501

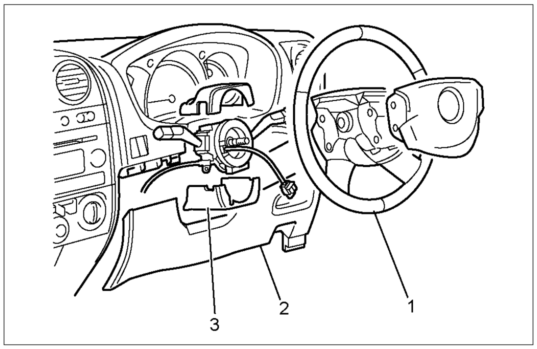
4. Turn the bulb ① counterclockwise to remove it.

Installation

Follow the removal procedure in the reverse order to install the rear combination light.
Pay close attention to the important points mentioned in the following paragraphs.

Bulb

Be absolutely sure that the rear combination light bulb is correctly installed.
This will prevent a poor contact and an open circuit.

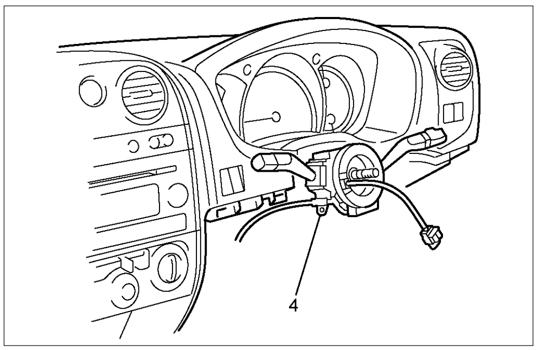


This illustration is based on RHD model

TURN SIGNAL LIGHT SWITCH

Removal

1. Disconnect the battery ground cable.
2. Remove the steering wheel ①.
   Refer to the “STEERING” Section of this Manual.
3. Remove the instruments panel lower cover ②.
4. Remove the steering column cover ③.



This illustration is based on RHD model

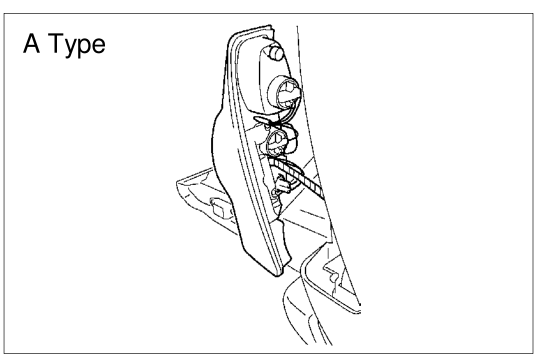
5. Disconnect the connector.
6. Remove the turn signal switch from the steering shaft.

Installation

Follow the removal procedure in the reverse order to install the turn signal switch (lever).
Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the turn signal switch connector is securely connected.
This will prevent a poor contact and at an open circuit.

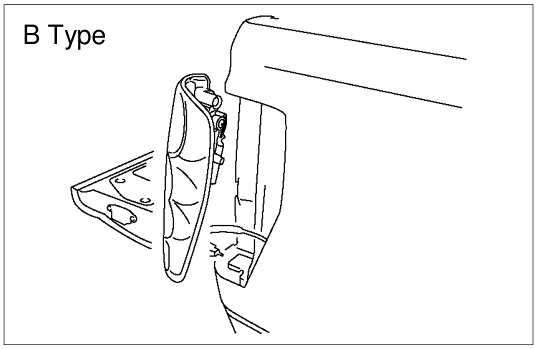


REAR COMBINATION LIGHT

Backup Light

Removal

1. Open the rear gate.
2. Remove the screws.
3. Remove the rear combination light assembly.



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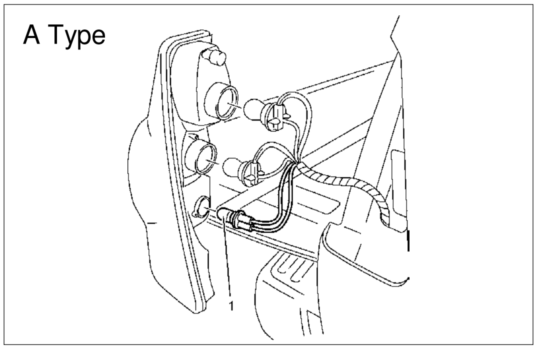
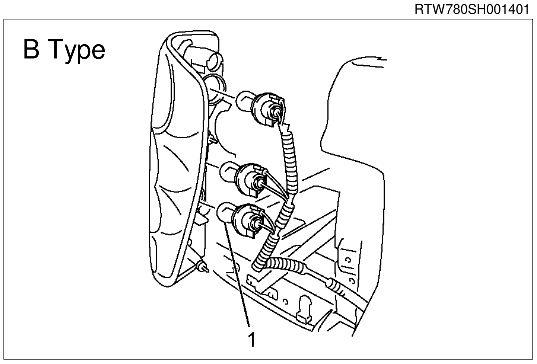


RTW780SH001401

4. Turn the bulb ① counterclockwise to remove it.



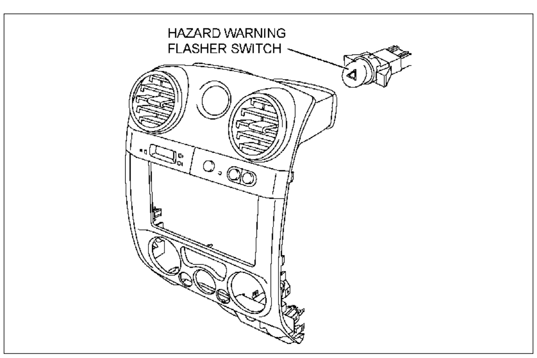
RTW78ASH002601

Installation

Follow the removal procedure in the reverse order to install the rear combination light.
Pay close attention to the important points mentioned in the following paragraphs.

Bulbs

Be absolutely sure that each bulb is correctly installed.
This will prevent a poor contact and an open circuit.



RTW780SH001501
This illustration is based on RHD model

HAZARD WARNING FLASHER SWITCH

Removal

1. Disconnect the battery ground cable.
2. Instrument Panel Cluster Assembly
   - Refer to Section 10 “BODY” for instrument panel cluster assembly removal steps.
3. Hazard Warning Switch
   - Disconnect the switch connector.
   - To remove the switch, push the lock from the back side of the cluster assembly.

Installation

To install, follow the removal procedure in the reverse order.

Connector

Be absolutely sure that the hazard warning flasher switch connector is securely connected.
This will prevent a poor contact and an open circuit.

BACKUP LIGHT SWITCH

Removal

1. Disconnect the battery ground cable.
2. Disconnect the connector ①.
3. Remove the backup light switch from the transmission ②.

Installation

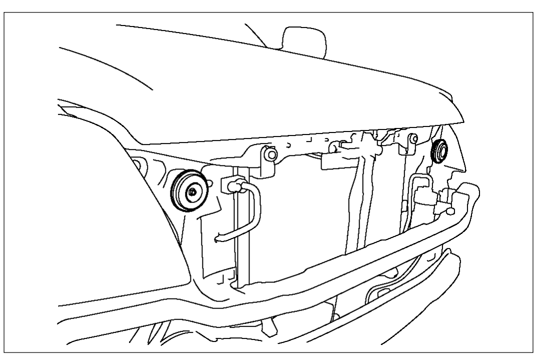
Follow the removal procedure in the reverse order to install the backup light switch.
Pay close attention to the important points mentioned in the following paragraphs.

Backup Light Switch Threads

Apply liquid gasket to the threaded portion and install the backup light switch.

Connector

Be absolutely sure that the backup light connector is securely connected.
This will prevent a poor contact and an open circuit.



HORN

Removal

1. Remove the radiator grille.
   Refer to the “HEADLIGHT” removal procedure.
2. Loosen the horn bolt.
3. Disconnect the horn connector.

Installation

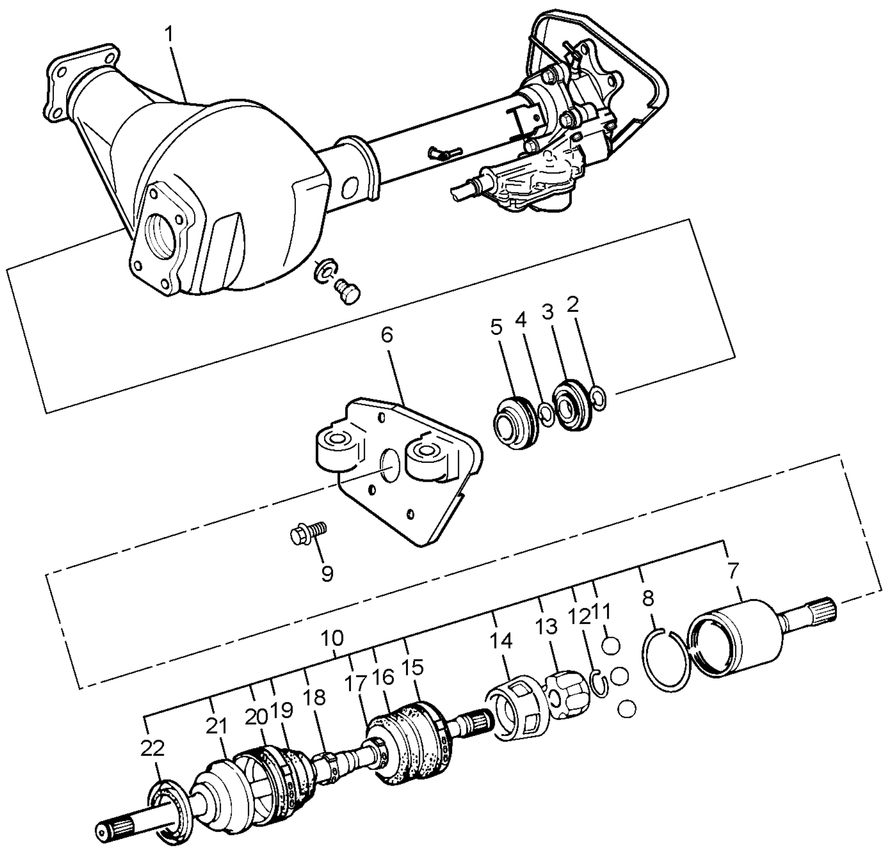
Follow the removal procedure in the reverse order to install the horn.
Pay close attention to the important point mentioned in the following paragraphs.

Connector

Be absolutely sure the horn connector is securely connected.
This will prevent a poor contact and open circuit.

FRONT AXLE DRIVE SHAFT

Front Axle Drive Shaft and Associated Parts



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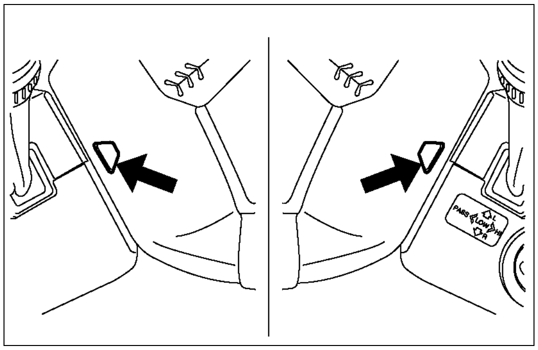
Legend

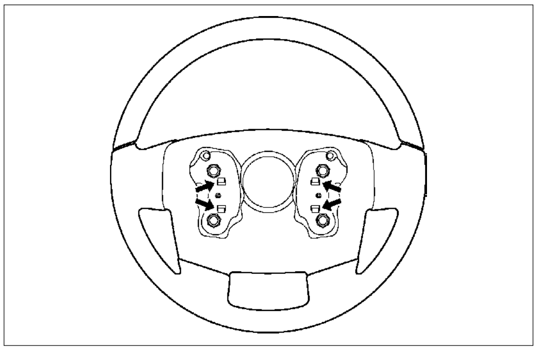
1. Axle Case and Differential
2. Snap Ring
3. Bearing
4. Snap Ring
5. Oil Seal
6. Bracket
7. DOJ Case
8. Circlip
9. Bolt
10. Drive shaft Joint Assembly
11. Ball
12. Snap Ring
13. Ball Retainer
14. Ball Guide
15. Band
16. Bellows
17. Band
18. Band
19. Bellows
20. Band
21. UJ Shaft
22. Dust Seal

HORN SWITCH

Removal



1. Disable the SRS (Refer to “Disabling the SRS” in Section 9A).
2. Insertion hole for pin push bar at below the steering wheel indicated arrow.



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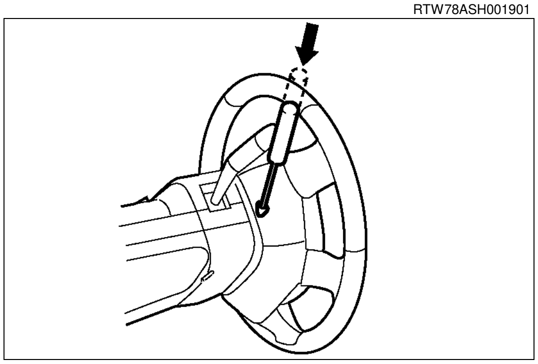
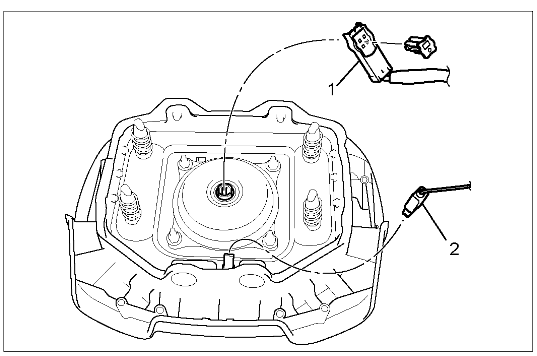
3. Check the position of the pins in the holes before insert the pin push bar. Push the pin in the direction of the arrow.



4. Push the four pins using the ϕ5~6 bar for cancel the lock on the four pins.



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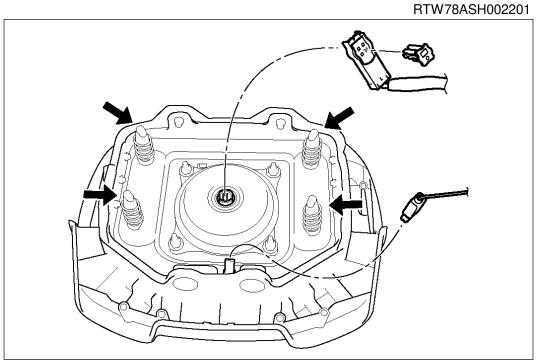
5. Disconnect the SRS air bag connector ① and horn lead connector ② and remove the air bag assembly.
6. Remove the horn switch.

Installation



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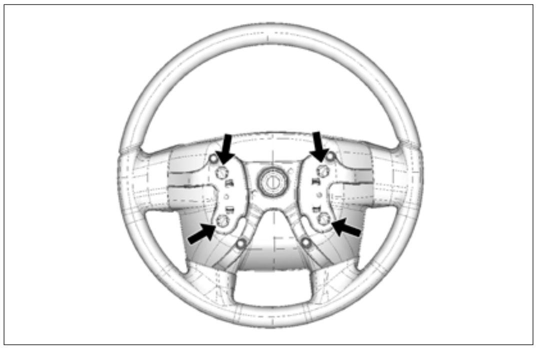
1. Connect the SRS bag connector and horn lead connector.
2. Align each snap stud of the driver air bag to the hole in the steering wheel.



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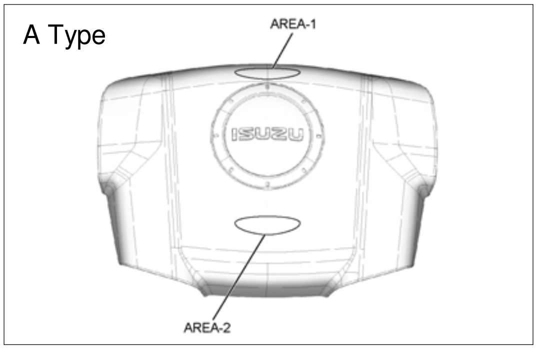

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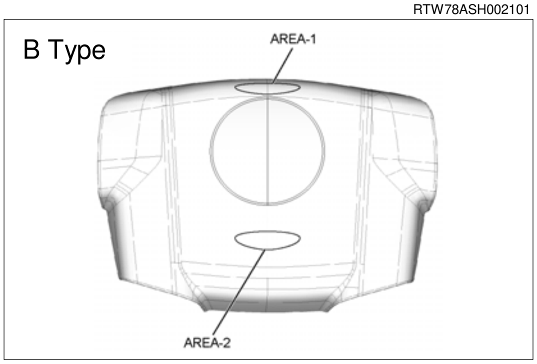
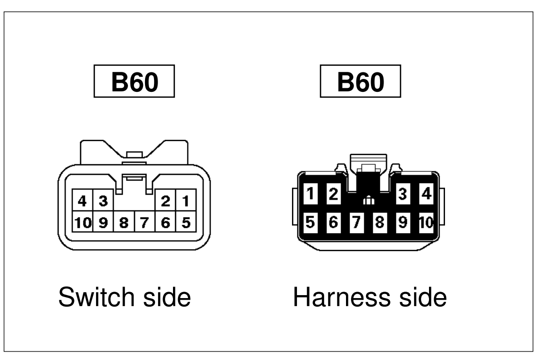


RTW780SH003101

3. Push the horn switch area1 and area-2. At that time check the audible noise from each snap stud. (Should be no noise present)
4. Enable the SRS (Refer to “Enabling the SRS” in Section 9A).

INSPECTION AND REPAIR

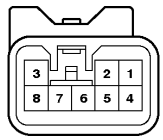


TURN SIGNAL SWITCH

Lighting Switch Connections

SW position \ Terminal No.		5	6	7
Turning direction	Left	○	○	
	⇕	×		×
	Neutral			
	⇕	×	×	
	Right	○		○

B16



Switch side

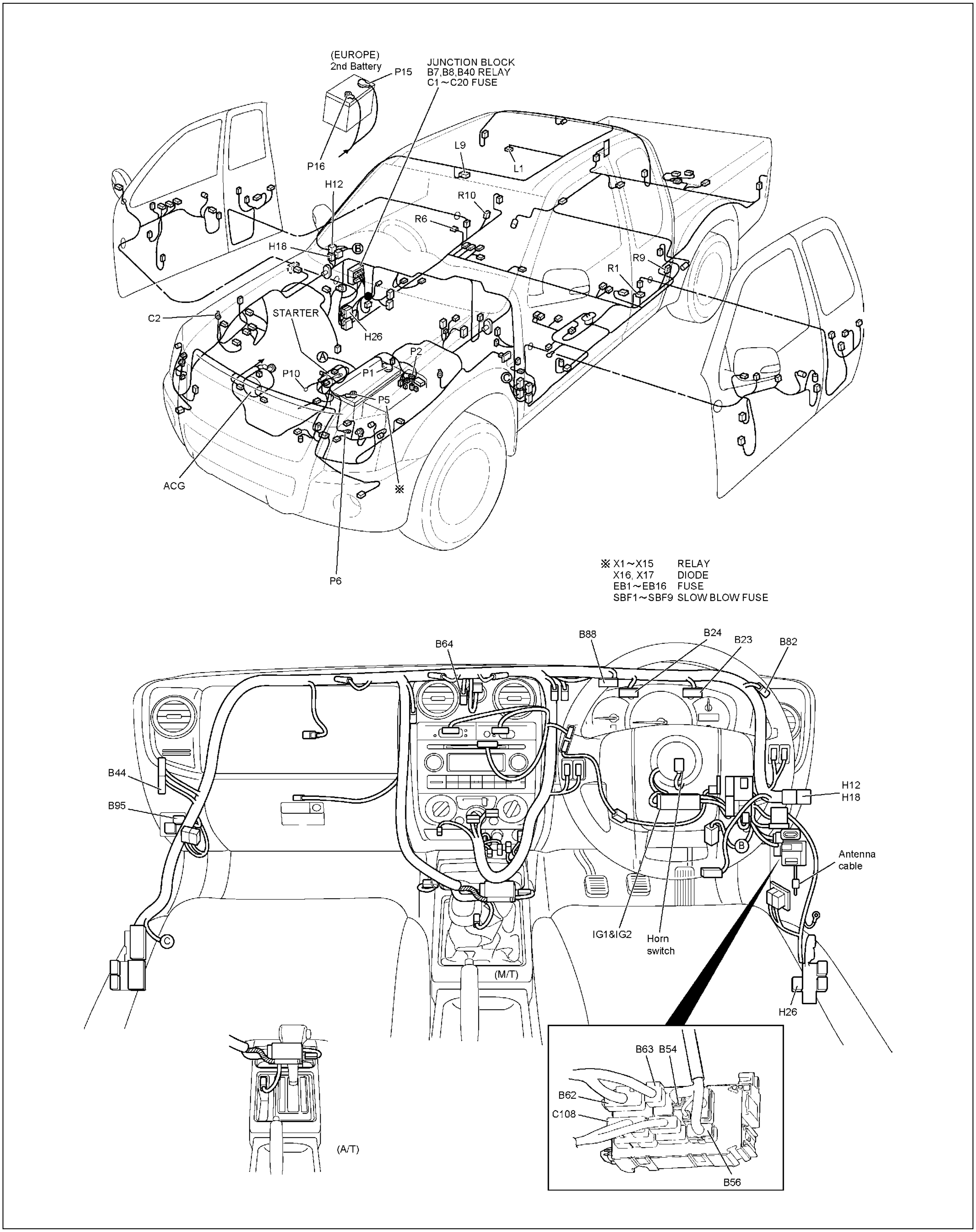
HAZARD WARNING FLASHER SWITCH

Hazard Warning Flasher Switch Connections

Terminal No. / SW position	4	6	5	3	2	1	7	8
ON	○		○	○	○	○		
OFF	○	○						

DOME LIGHT, SPOTLIGHT, MAP LIGHT AND WARNING BUZZER

PARTS LOCATION (RHD)



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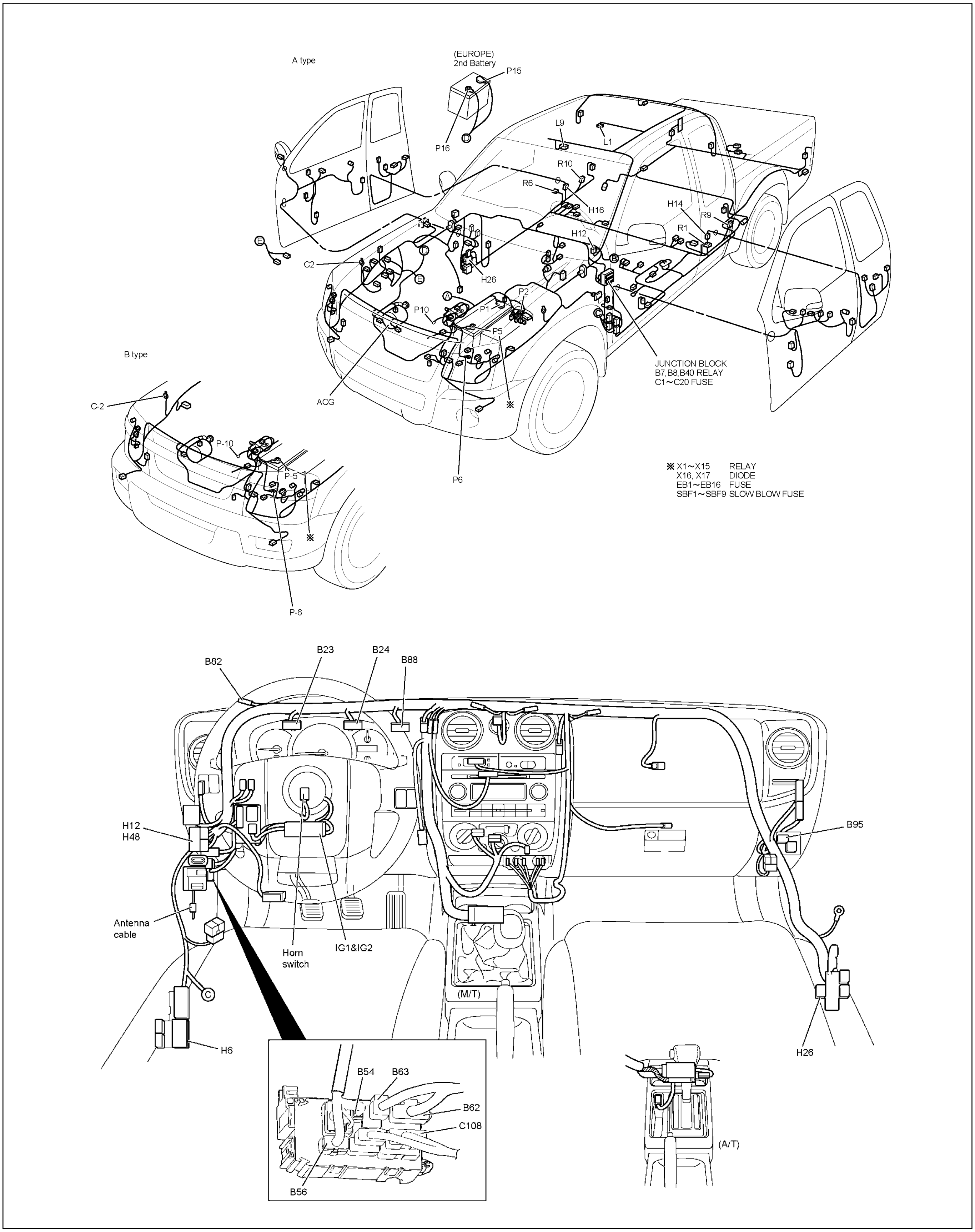
PARTS LOCATION (LHD)



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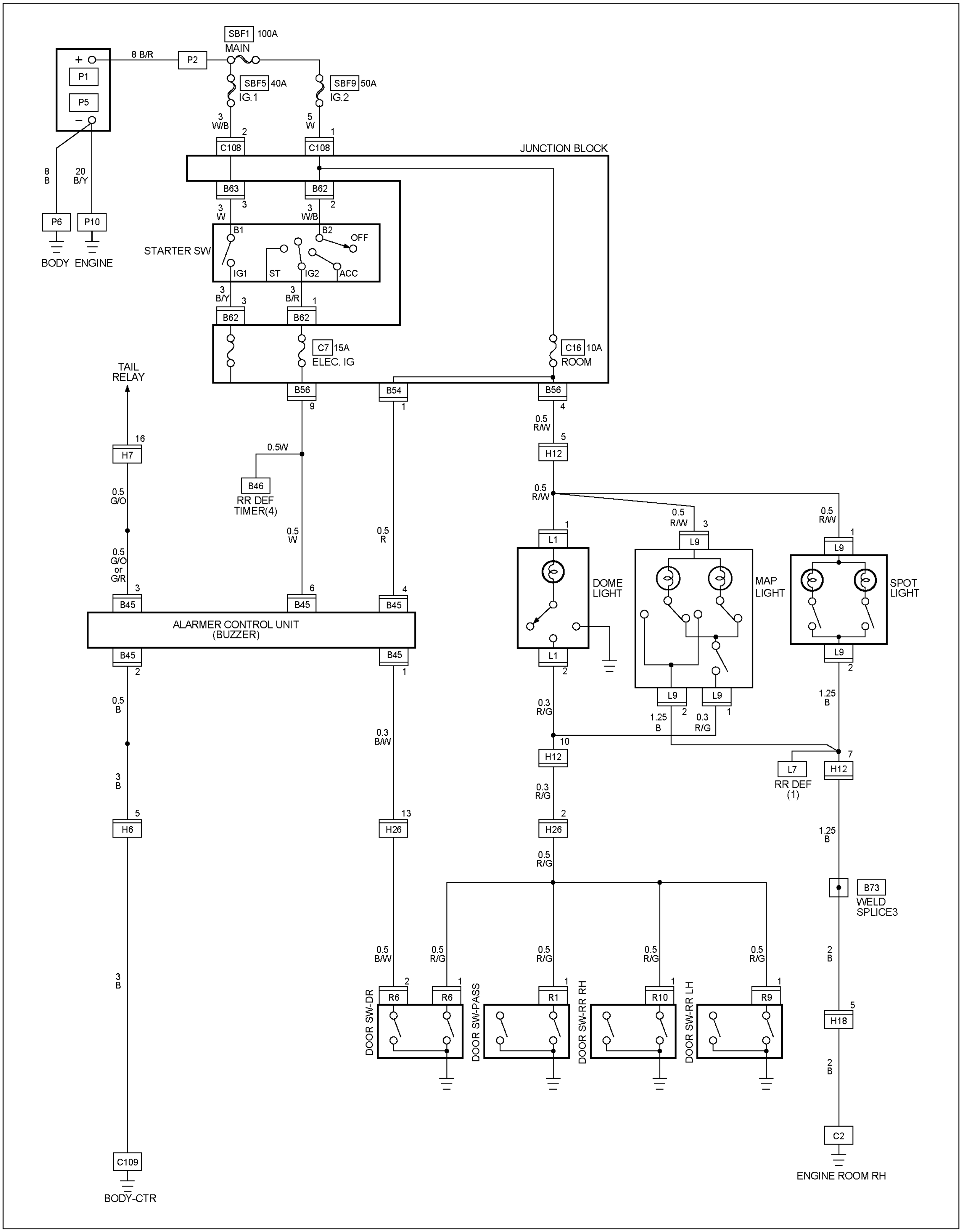
CIRCUIT DIAGRAM C24SE (RHD) WITHOUT ANTI THEFT



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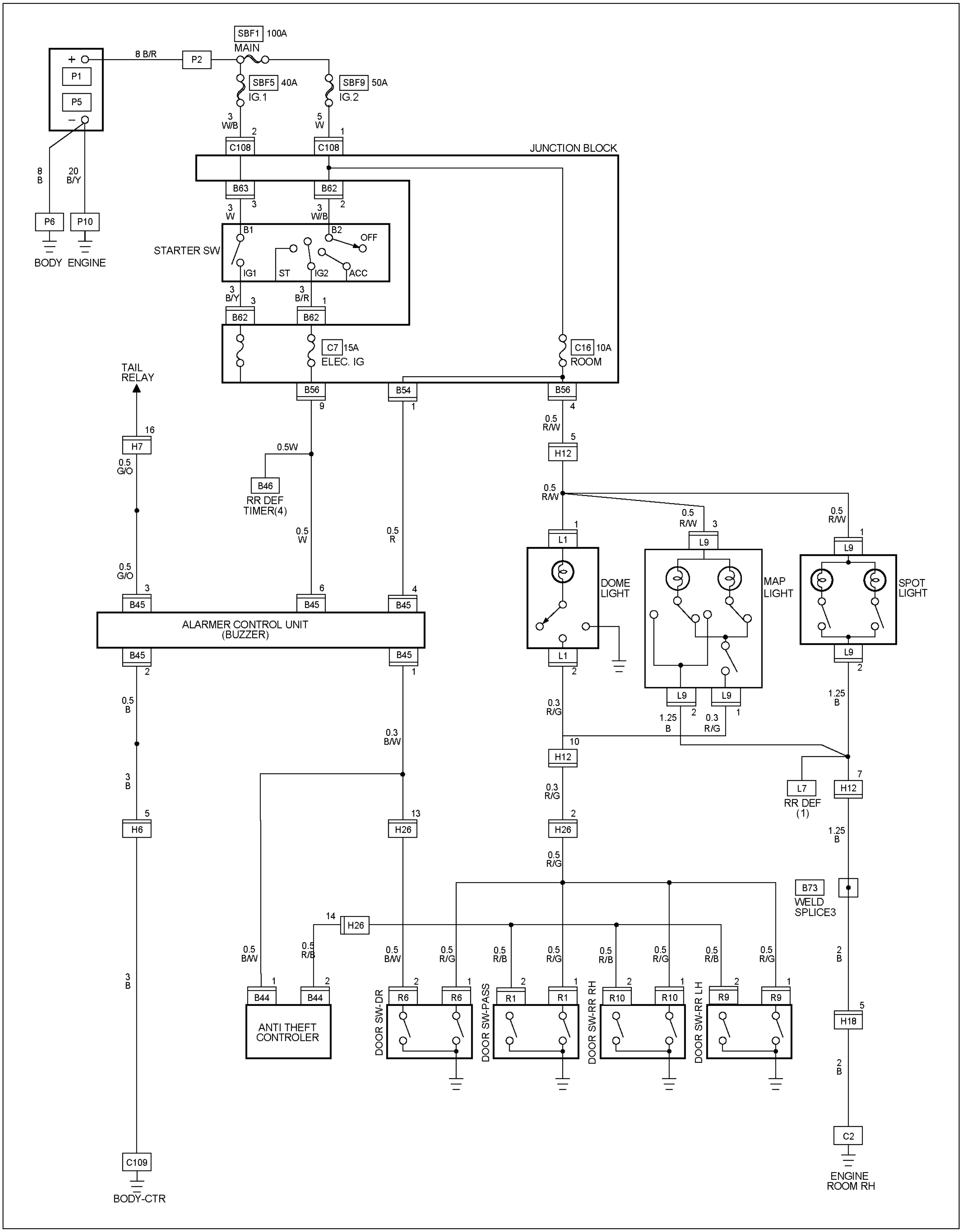
CIRCUIT DIAGRAM C24SE (RHD) WITH ANTI THEFT



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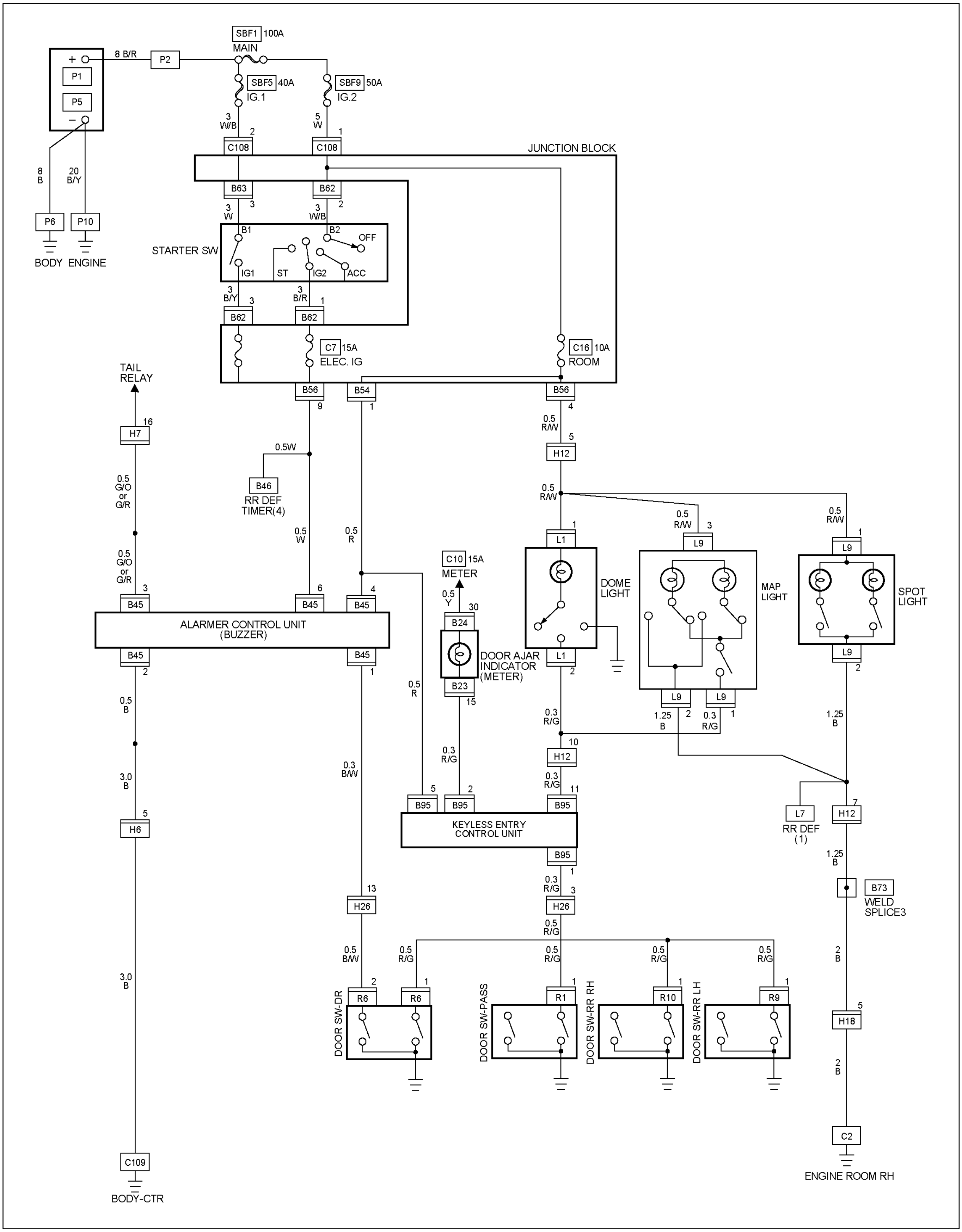
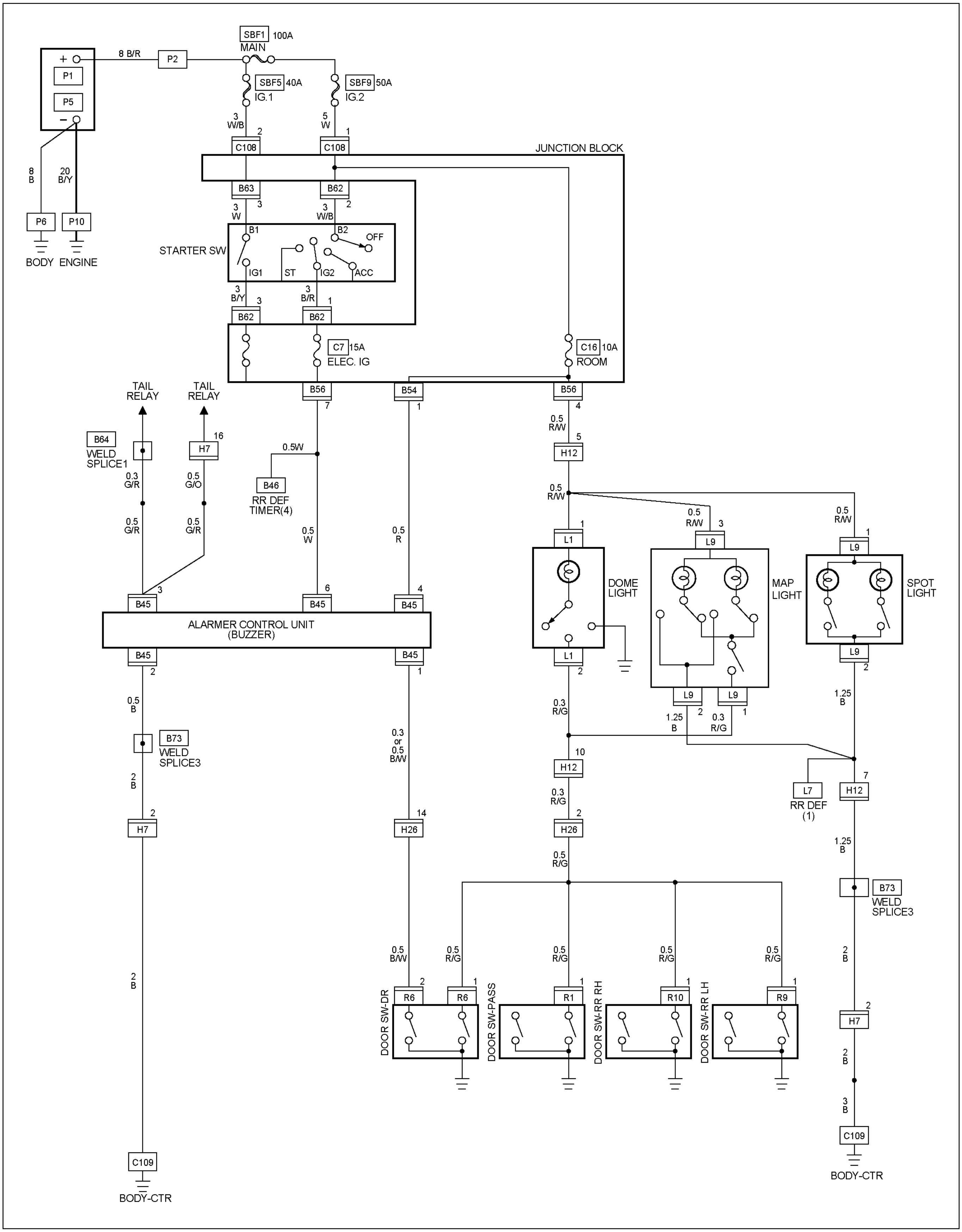
CIRCUIT DIAGRAM C24SE (RHD) WITH KEYLESS ENTRY



CIRCUIT DIAGRAM C24SE (LHD) WITHOUT ANTI THEFT



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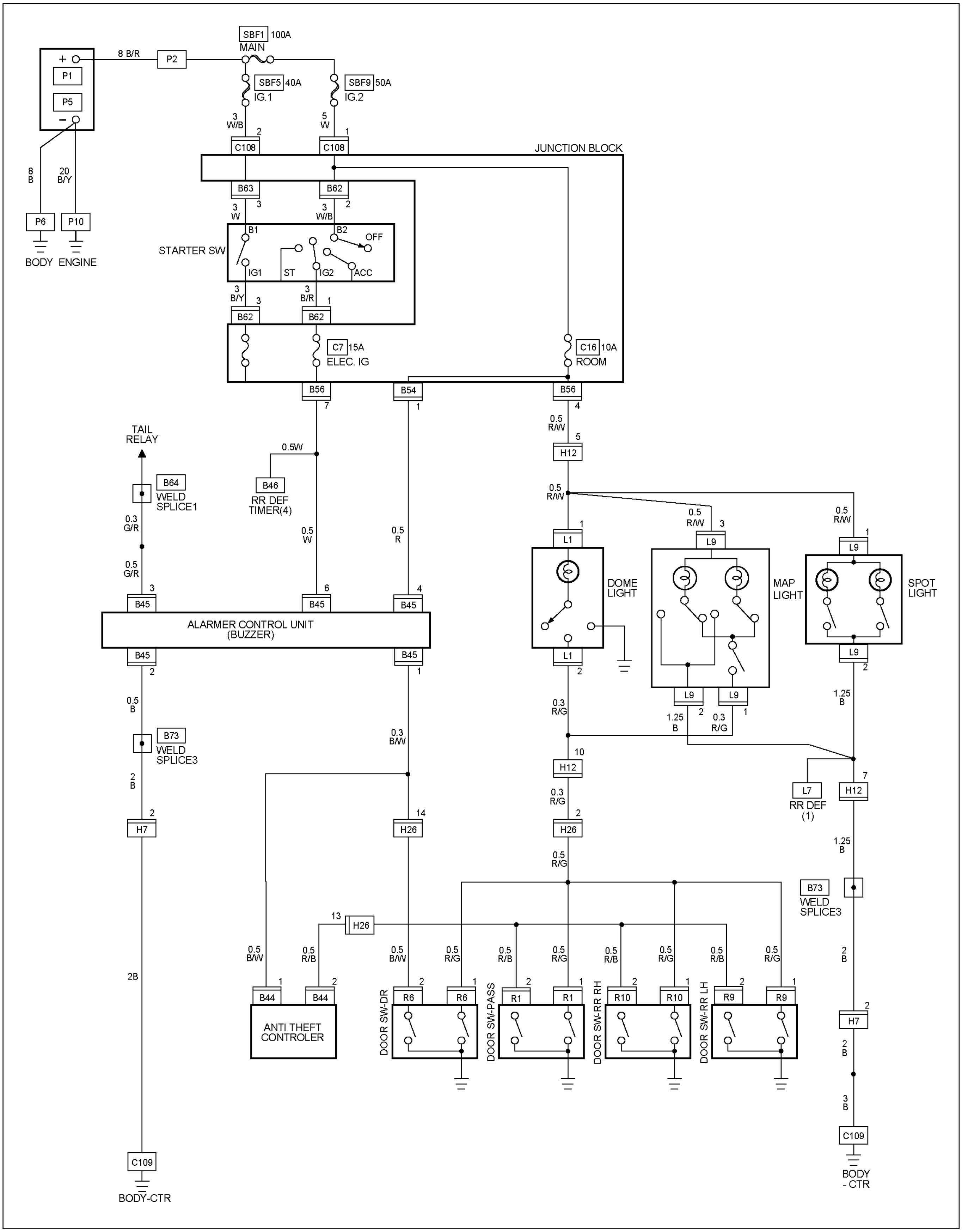
CIRCUIT DIAGRAM C24SE (LHD) WITH ANTI THEFT



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Disassembly

NOTE :

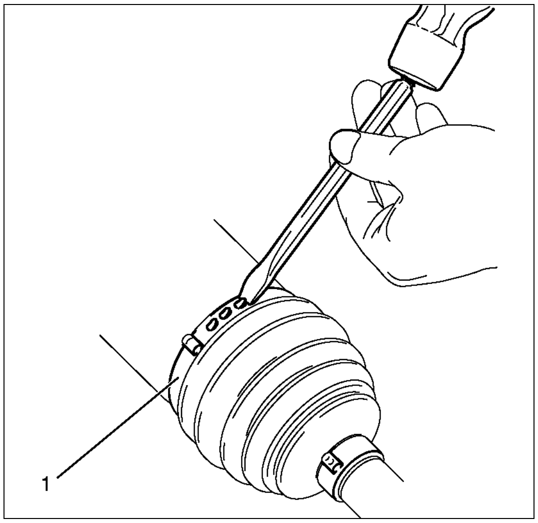
For the left side, follow the same steps as right side.

1. Use a hammer and chisel to remove the 3 pawls (above the large and small boot bands on the DOJ side).

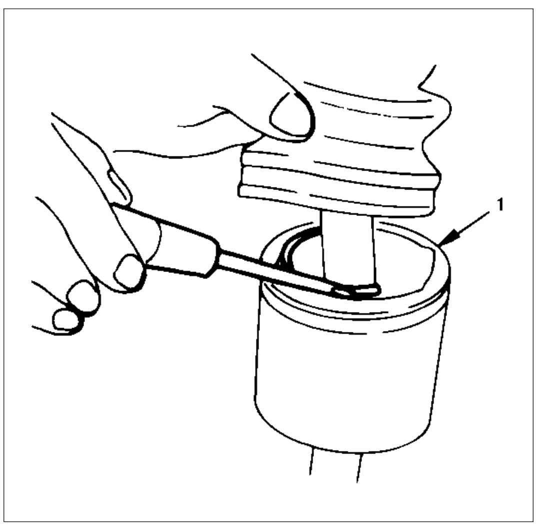
CAUTION :

Take care not to damage the bellows during band removal.

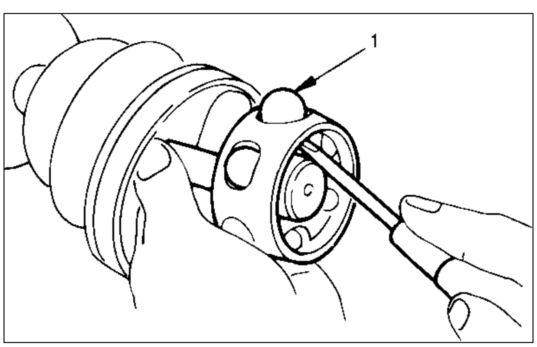
2. Remove band (1).



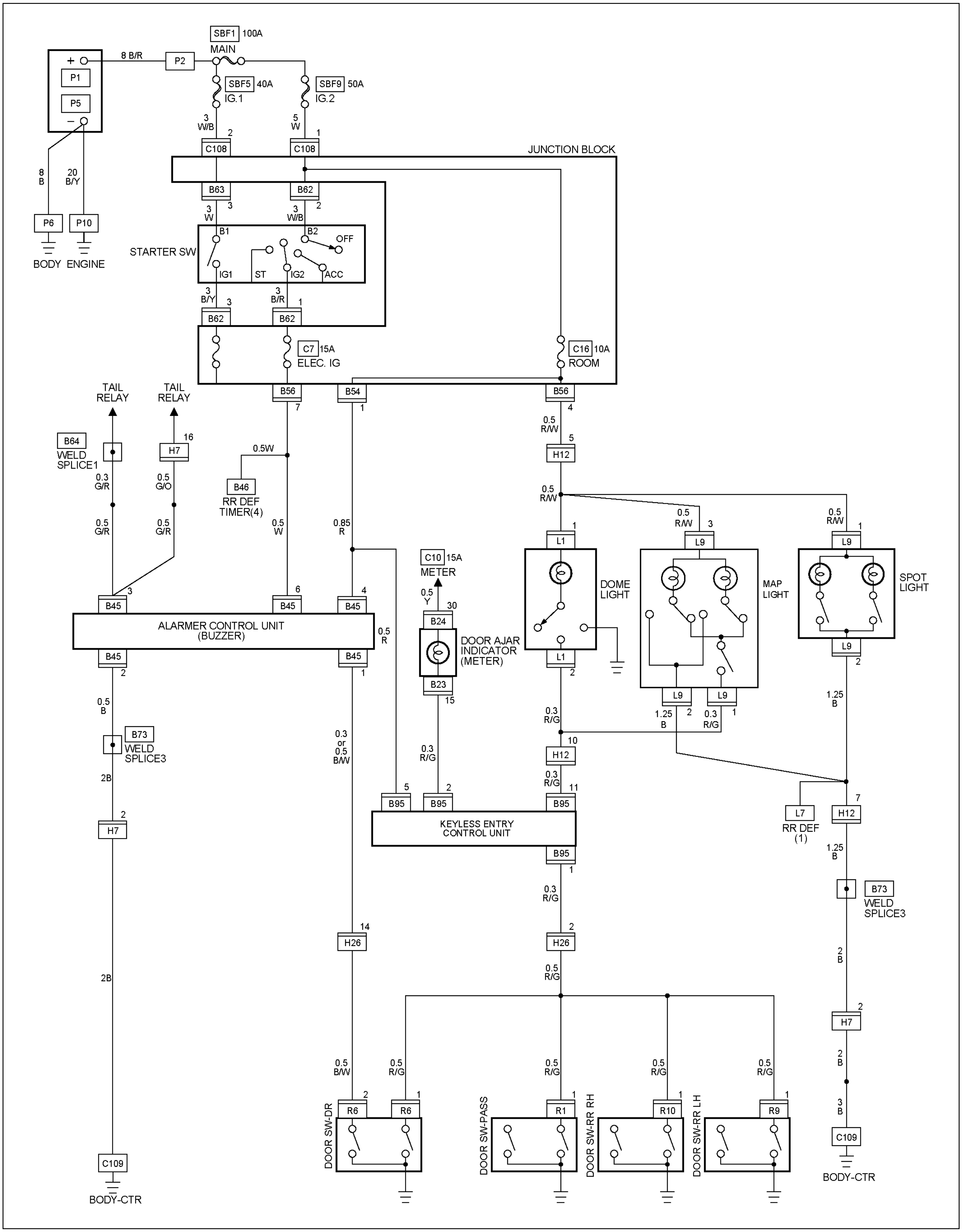
3. Pry off circlip (1) with a screwdriver or equivalent.



4. Remove drive shaft joint assembly.
5. Remove the six balls (1) with a screwdriver or equivalent.



CIRCUIT DIAGRAM C24SE (LHD) WITH KEYLESS ENTRY



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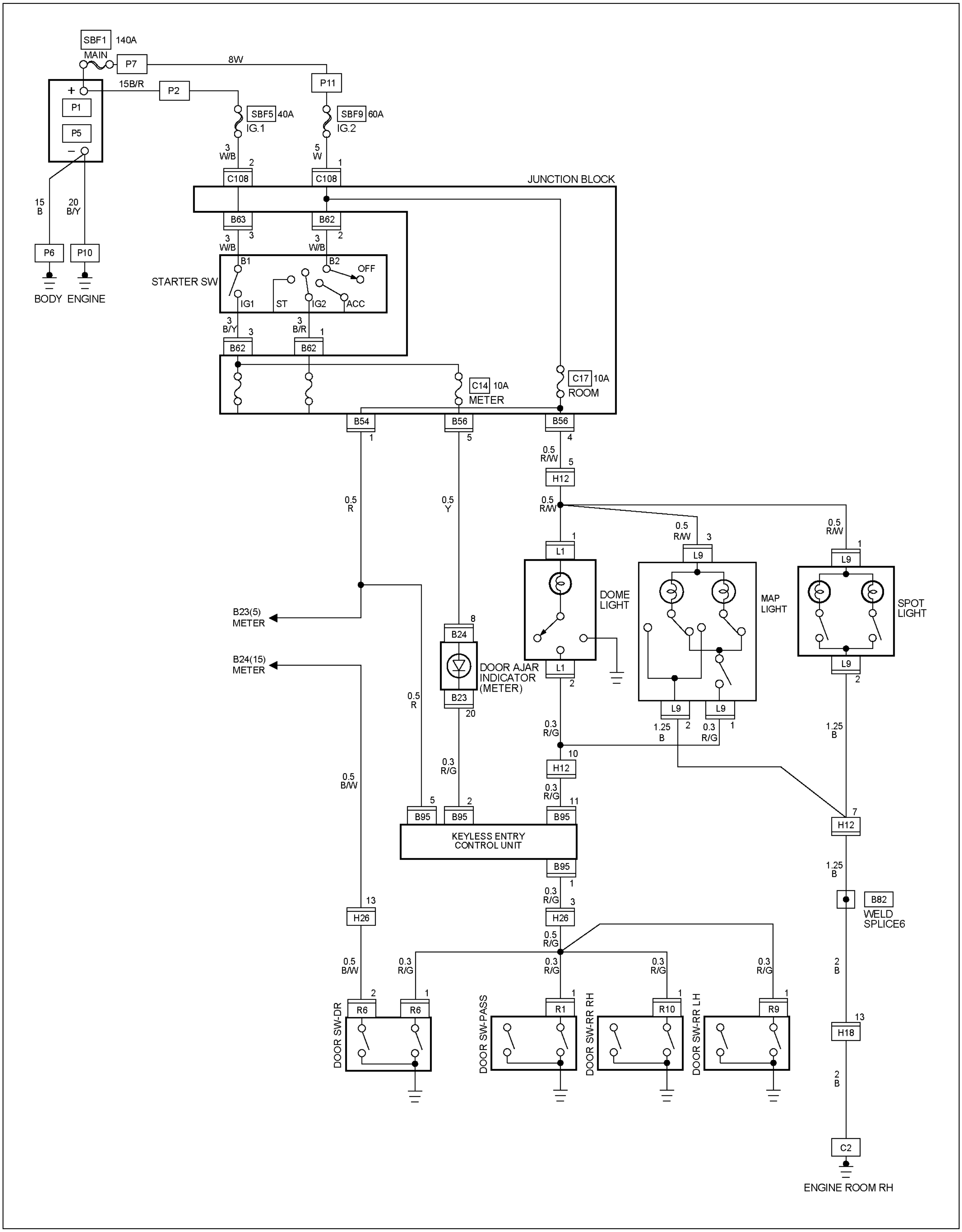
CIRCUIT DIAGRAM HFV6 (RHD)



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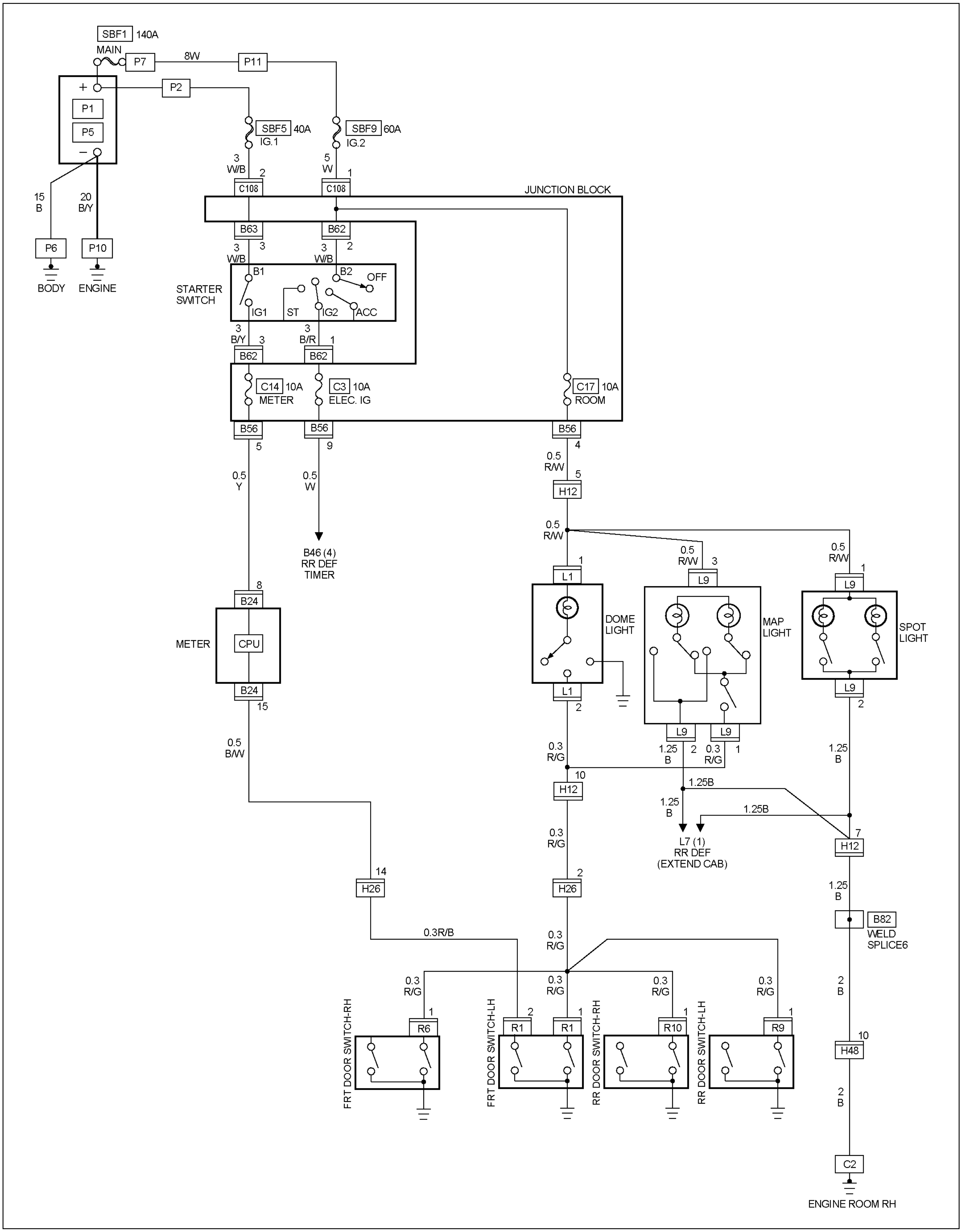
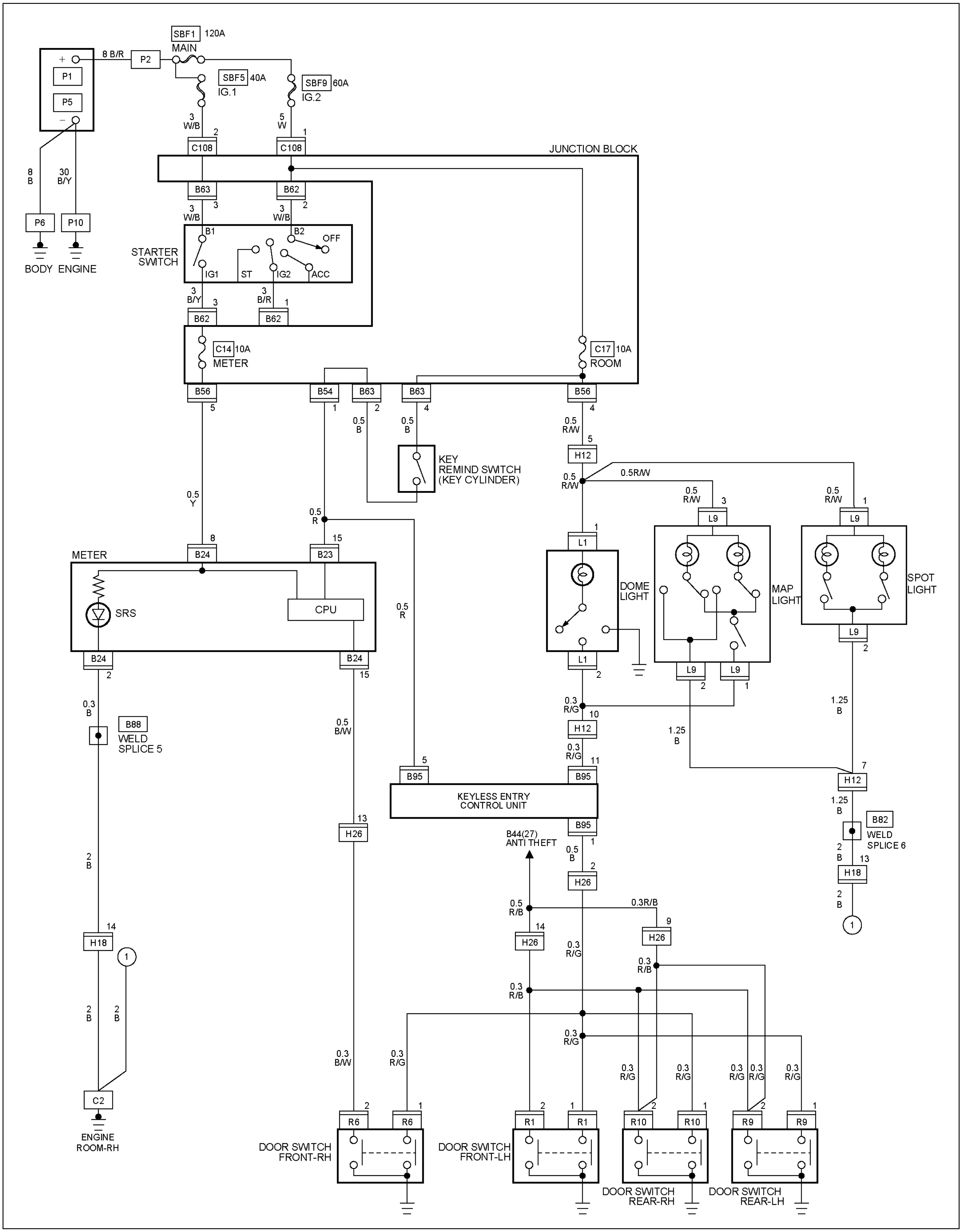
CIRCUIT DIAGRAM HFV6 (LHD)



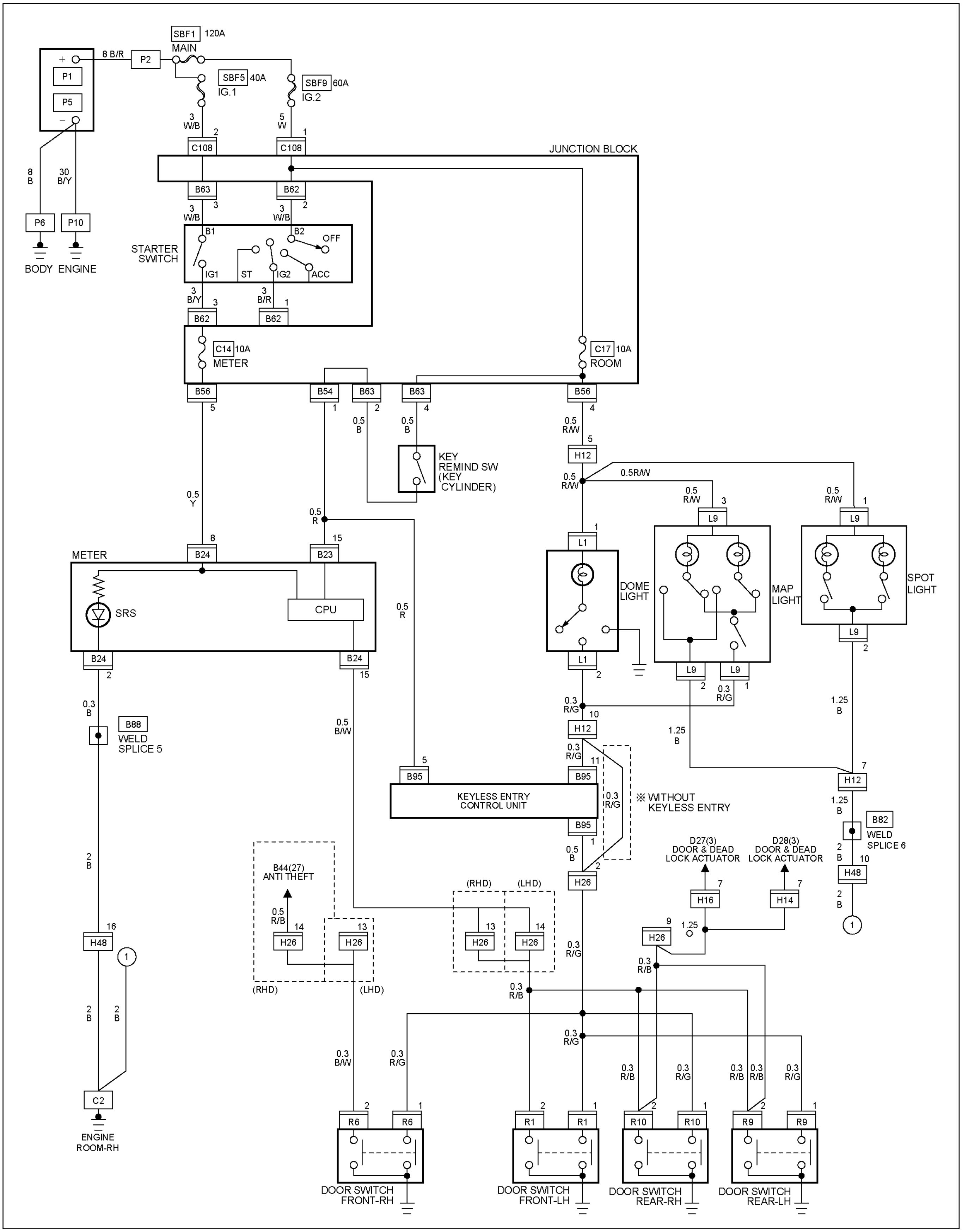
RTW78AXF015401

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC SOUTH AFRICA



RTW78AXF017001

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA



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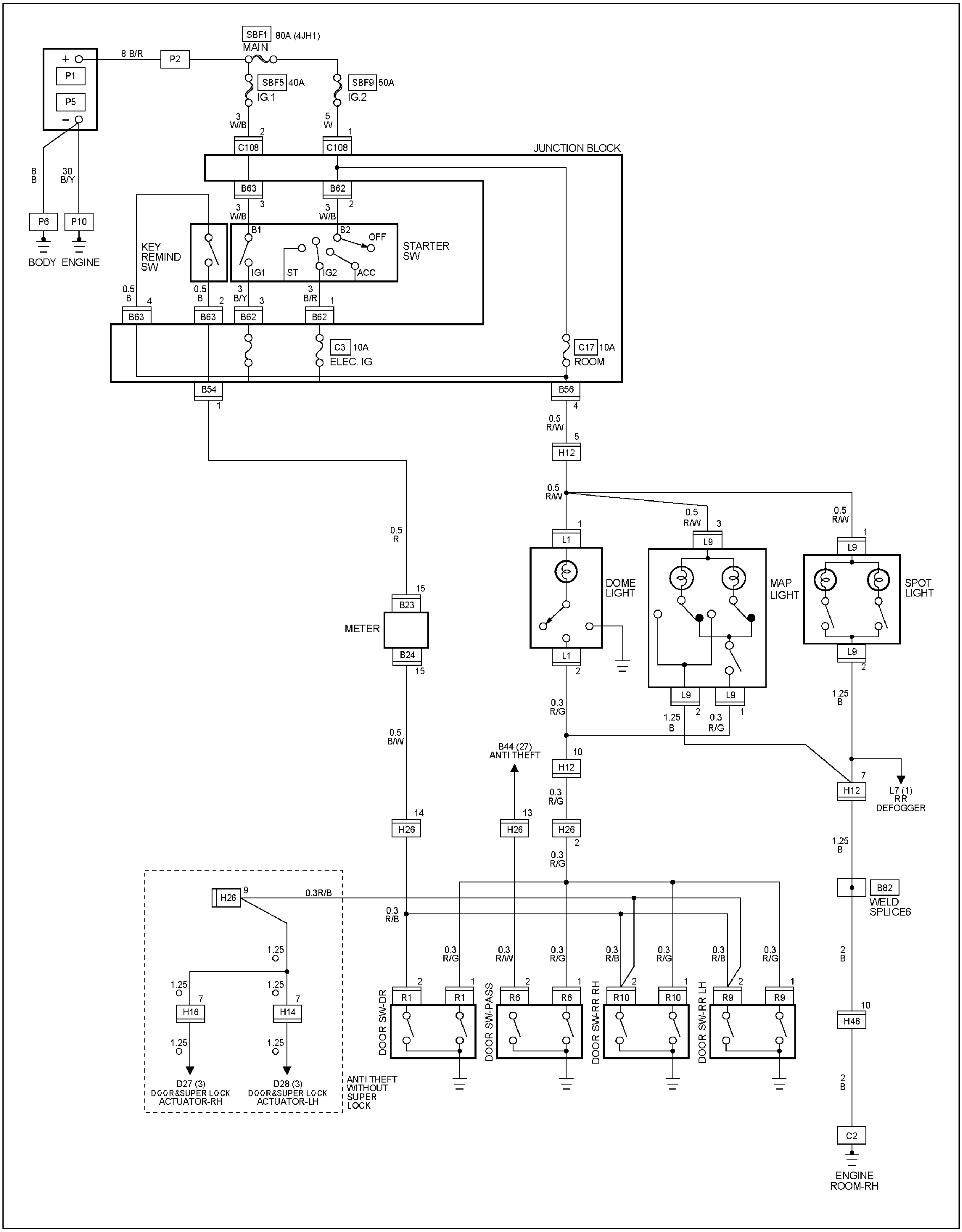
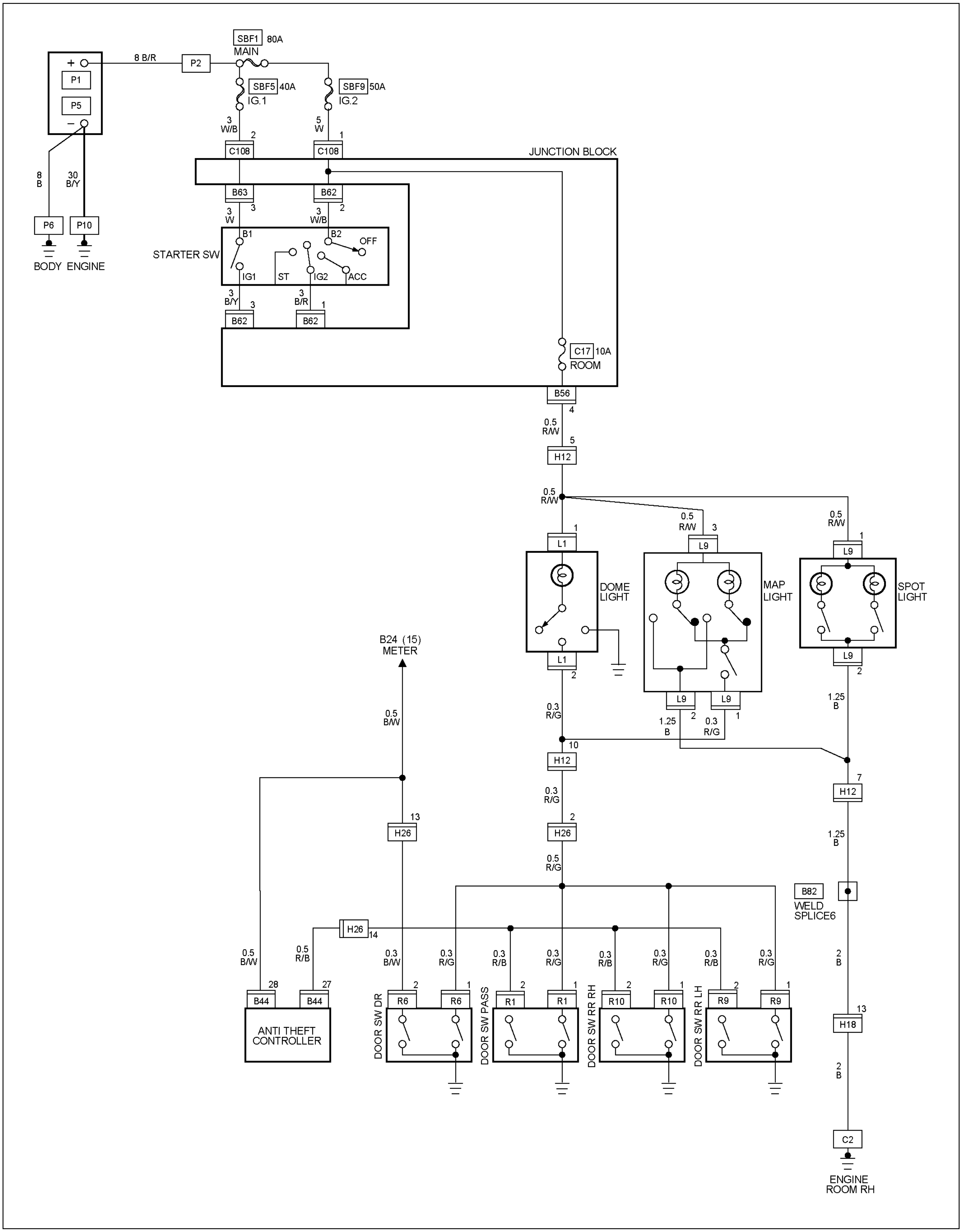
CIRCUIT DIAGRAM 4JH1-TC



RTW78AXF015001

CIRCUIT DIAGRAM 4JA1T (L)



RTW78AXF005901

TROUBLESHOOTING

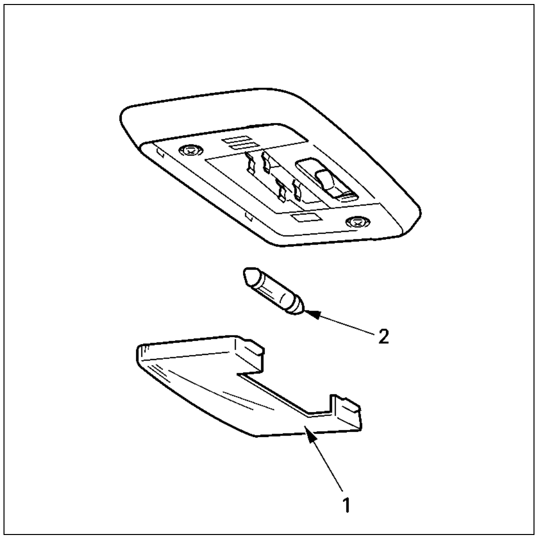
1. Dome light dose not light

Checkpoint		Trouble Cause	Countermeasure
Dome light bulb continuity	NG	Burned out the bulb	Replace the dome light bulb
OK			
Dome light switch function	NG	Switch malfunction	Repair or replace the dome light assembly
OK			
Continuity between connector 5 H12 - 1 L1	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Dome light does not go out

Checkpoint		Trouble Cause	Countermeasure
Door switch function (Both side)	NG	Switch malfunction or foreign material switch	Repair or replace the door switch
OK			
Continuity between connector 2 L1 -ground when shutting the door (Should be no continuity)	NG	Short circuit	Repair short circuit or connector contact

REMOVAL AND INSTALLATION



DOME LIGHT

Removal

1. Remove the dome light lens ① free.
2. Remove two dome light fixing screws.
3. Remove the wiring connector.
4. Remove the dome light.
5. Pull the bulb ② to remove it.

Installation

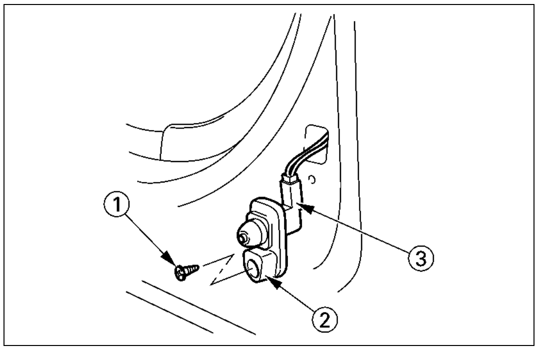
Follow the removal procedure in the reverse order to install the dome light.

Pay close attention to the important points mentioned in the following paragraphs.

Bulb

Be absolutely sure that the dome light bulb is correctly installed.

This will prevent a poor contact and an open circuit.



DOOR SWITCH

Removal

1. Disconnect the battery ground cable.
2. Loosen the screw ①.
3. Remove the door switch ②.
4. Disconnect the door switch connector ③.

Installation

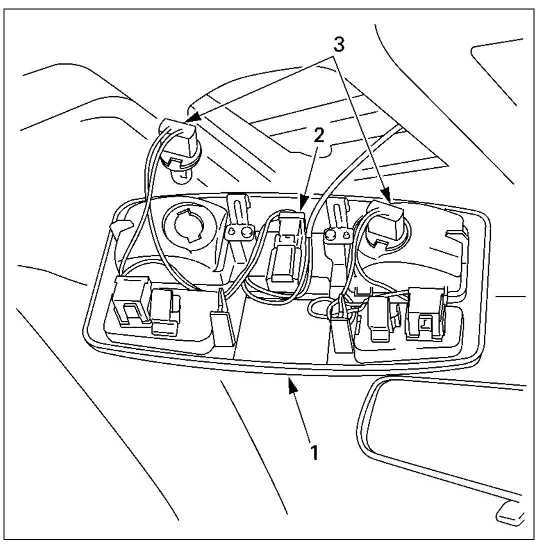
Follow the removal procedure in the reverse order to install the spot light.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the door switch connector is securely connected.

This will prevent a poor contact and an open circuit.

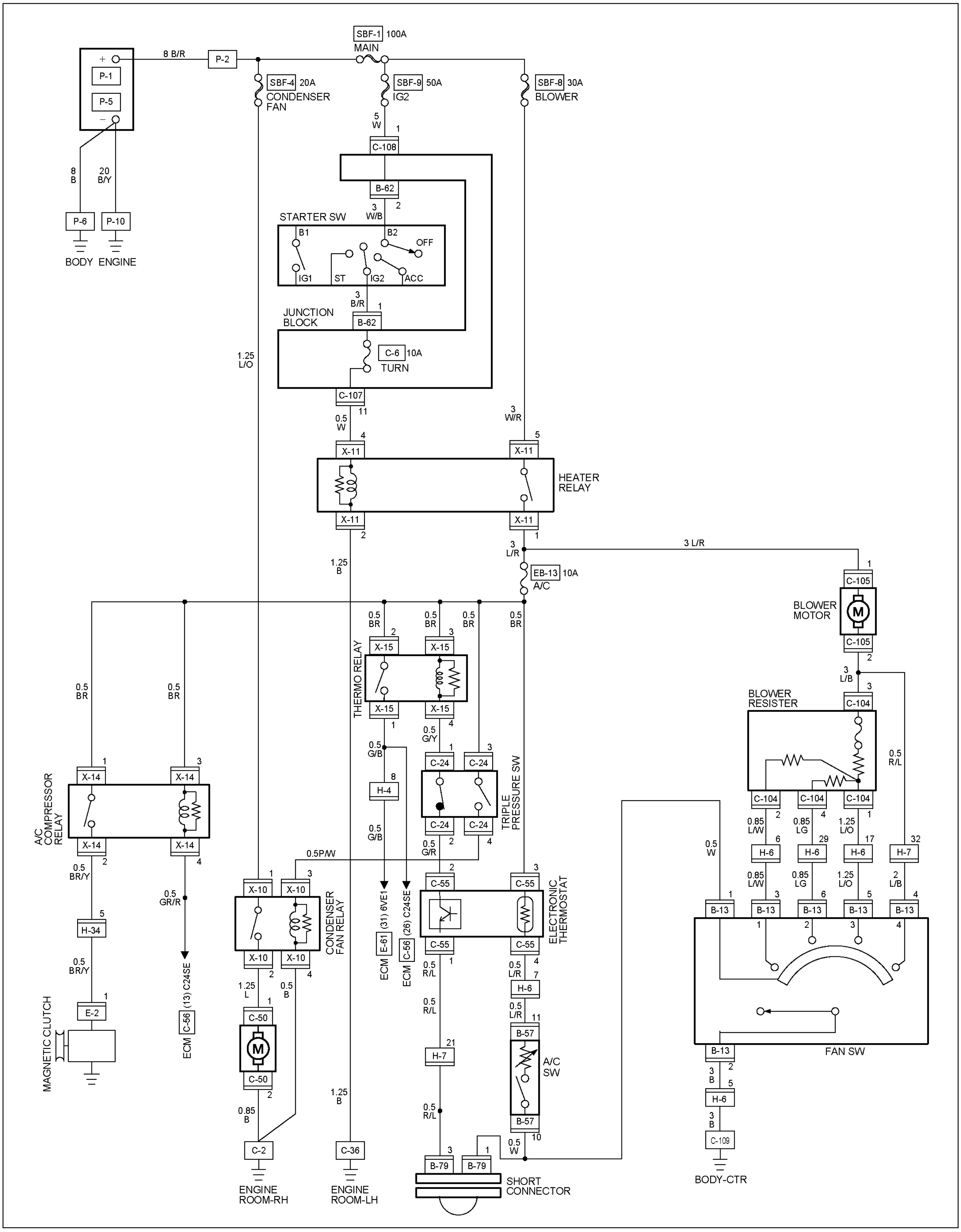


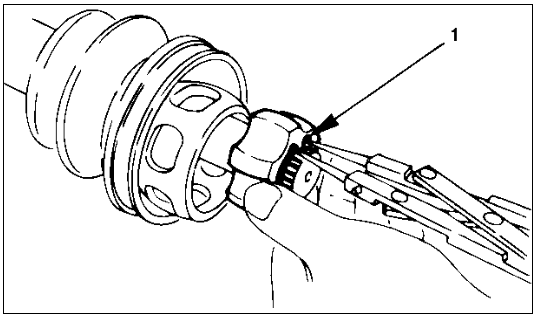
SPOTLIGHT (MAP Light)

Removal

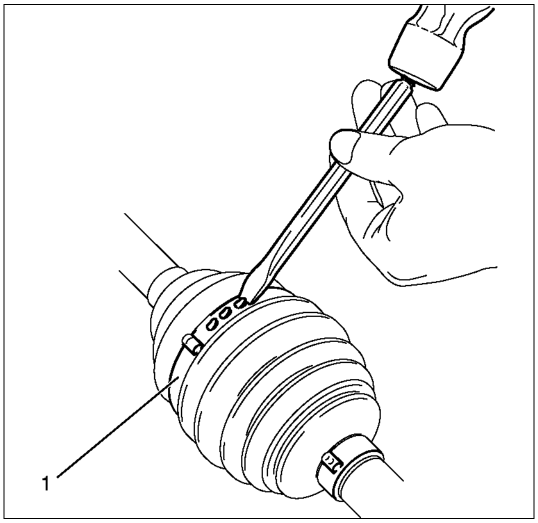
1. Grasp the spotlight housing ① with both hands.
   Pull the housing straight down.
   This will release the clip.
2. Disconnect the connector ②.
3. Turn socket ③ counterclockwise to remove it.

C24SE (COOLER WITHOUT HEATER)





6. Using snap ring pliers, remove the snap ring (1) fastening the ball retainer to the center shaft.
7. Remove ball retainer, ball guide and bellows.



8. Use a hammer and chisel to remove the 3 pawls (above the large and small boot bands on the UJ side).

CAUTION :

Take care not to damage the bellows during band removal.

9. Remove band (1).
10. Remove bellows.
11. Remove dust seal from UJ.
12. Remove UJ shaft assembly.
13. Remove the mounting bracket fixing bolts, and then remove DOJ case assembly from the axle case.
14. Remove snap ring and bearing.
15. Remove snap ring and oil seal.
16. Remove bracket.

Inspection and Repair

Make necessary correction or parts replacement if wear, damage, corrosion or any other abnormal condition are found through inspection.

Check the following parts.

1. Drive shaft joint assembly
2. DOJ case, ball, ball guide, ball retainer
3. Bellows
4. Bearing
5. Dust seal, oil seal

Installation

Follow the removal procedure in the reverse order to install the spot light.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

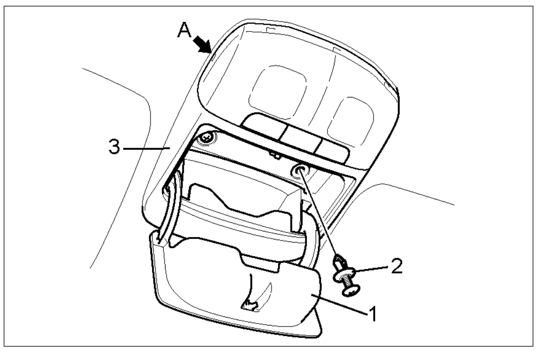
Be absolutely sure that the spot light connector is securely connected.
This will prevent a poor contact and an open circuit.

Bulb

Be absolutely sure that the spot light bulb is correctly installed.
This will prevent a poor contact and an open circuit.

OVER HEAD CONSOLE (MAP Light)

Removal



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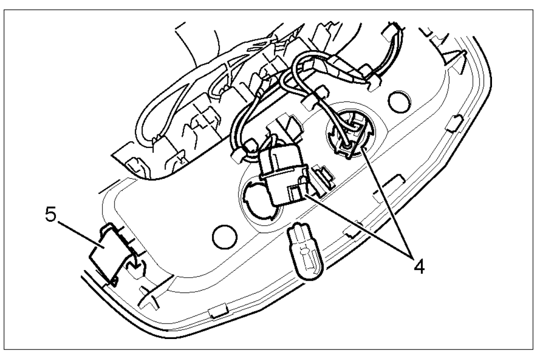
1. Open the lid (1) and remove the fastener (2).
2. A steel scale equivalent article is inserted in a lens side hook part and the crevice A section with roof lining, a metal clip (5) is pushed in, and a over head consol (3) is removed
3. Disconnect the connector.
4. Push the bulb socket (4) in and turn it counterclockwise to remove it.



RUW580SH001601

Installation

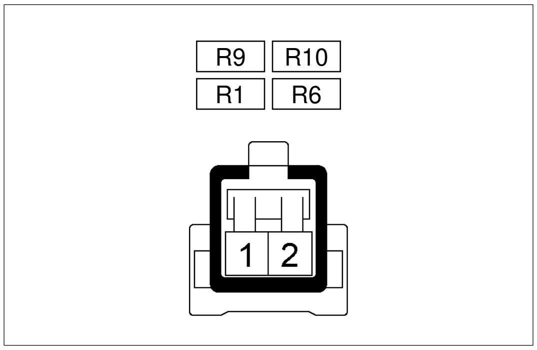
Follow the removal procedure in the reverse order to install the front map light.

Pay close attention to the important points mentioned in the following paragraphs.

Bulb

Be absolutely sure that the front map light bulb is correctly installed.
This will prevent a poor contact and an open circuit.

INSPECTION AND REPAIR

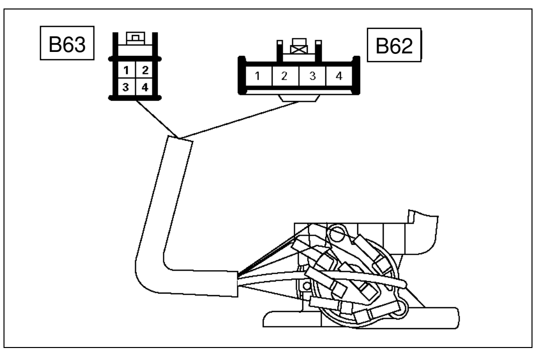


DOOR SWITCH

Door Switch Connections

SW position \ Connector No. / Terminal No.	R9 R10 R1 R6: 1	Body Ground
PUSHED		
RELEASED	○	○

Warning function	Operational conditions
Key left in starter switch	The buzzer sounds when both the key remind switch and the front door switch-driver side are turned on. To stop the sound of the buzzer, turn OFF the starter switch and remove the key from the starter switch.
Lighting switch left on	The buzzer sounds when the starter switch is turned from the “ON” to “OFF” position while the lighting switch is ON position. To stop the sound of the buzzer, turn OFF the lighting switch.



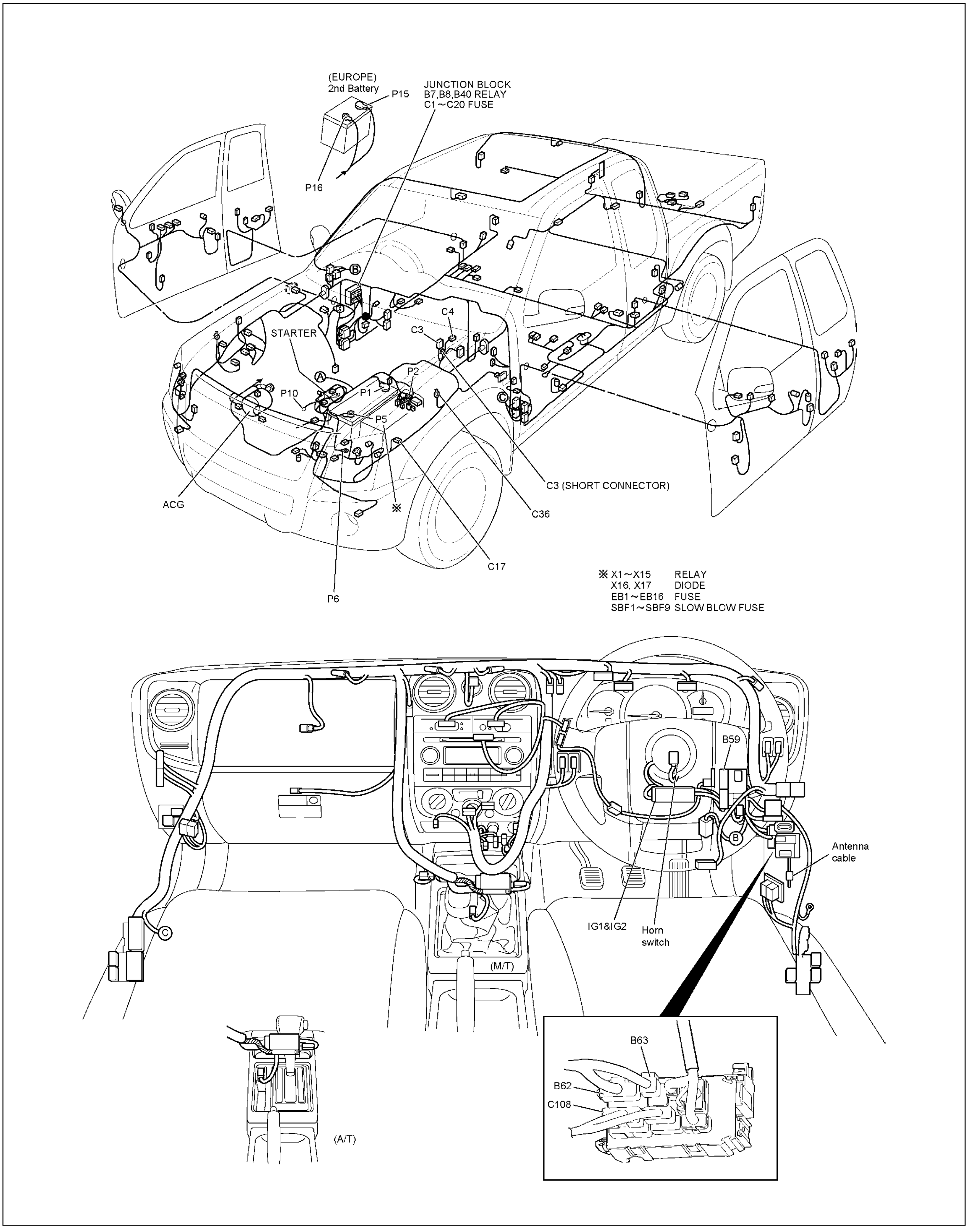
KEY REMIND SWITCH (STARTER SWITCH)

Switch Connections

<table>
<tr><th colspan="2" rowspan="2">Starter switch key position \ Connector No. / Terminal No.</th><th colspan="2">B63</th></tr>
<tr><th>2</th><th>4</th></tr>
<tr><td rowspan="2">LOCK</td><td>Removed</td><td></td><td></td></tr>
<tr><td rowspan="5">Inserted</td><td rowspan="5">○</td><td rowspan="5">○</td></tr>
<tr><td>OFF</td></tr>
<tr><td>ACC</td></tr>
<tr><td>ON</td></tr>
<tr><td>START</td></tr>
</table>

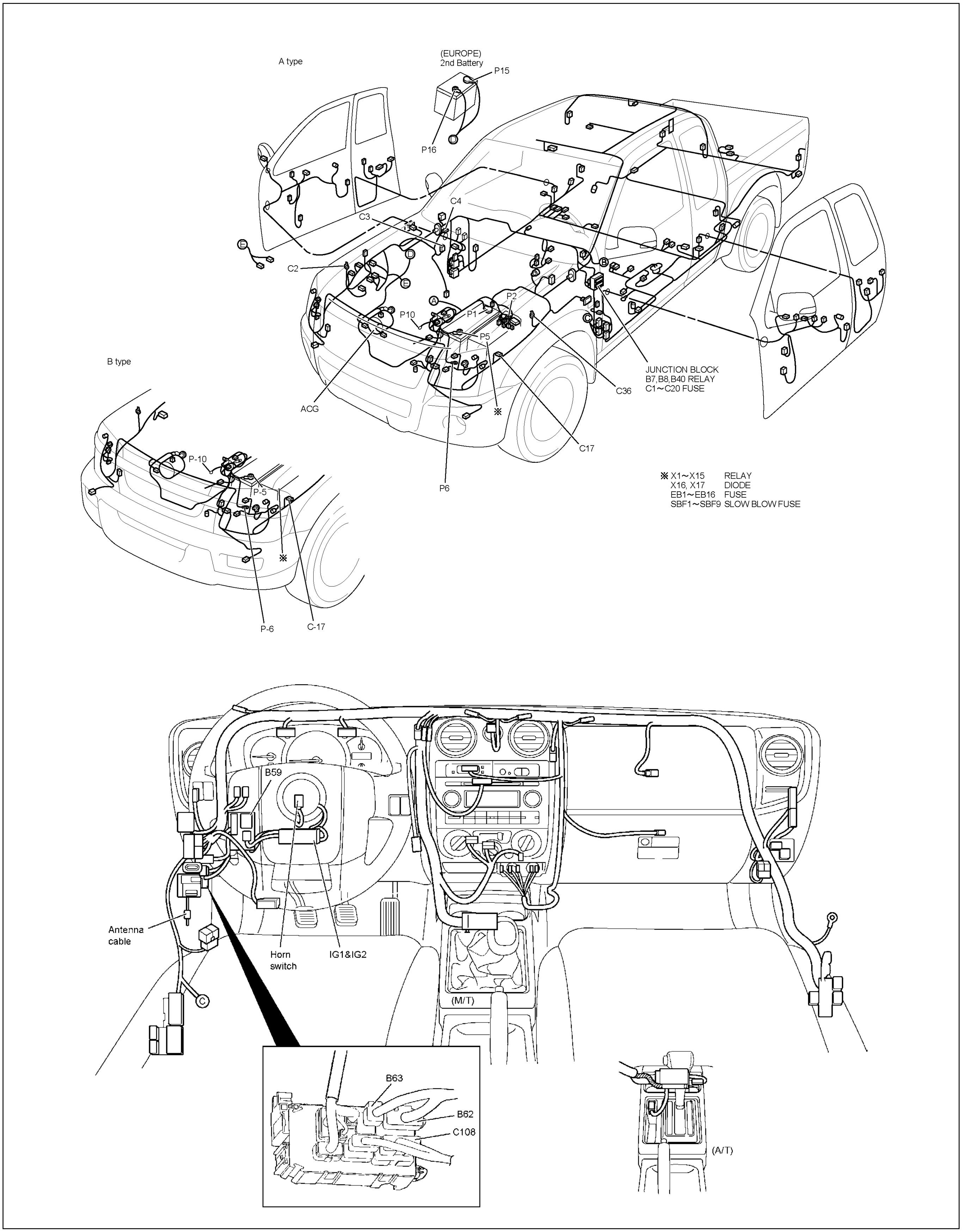
WINDSHIELD WIPER AND WASHER

PARTS LOCATION (RHD)



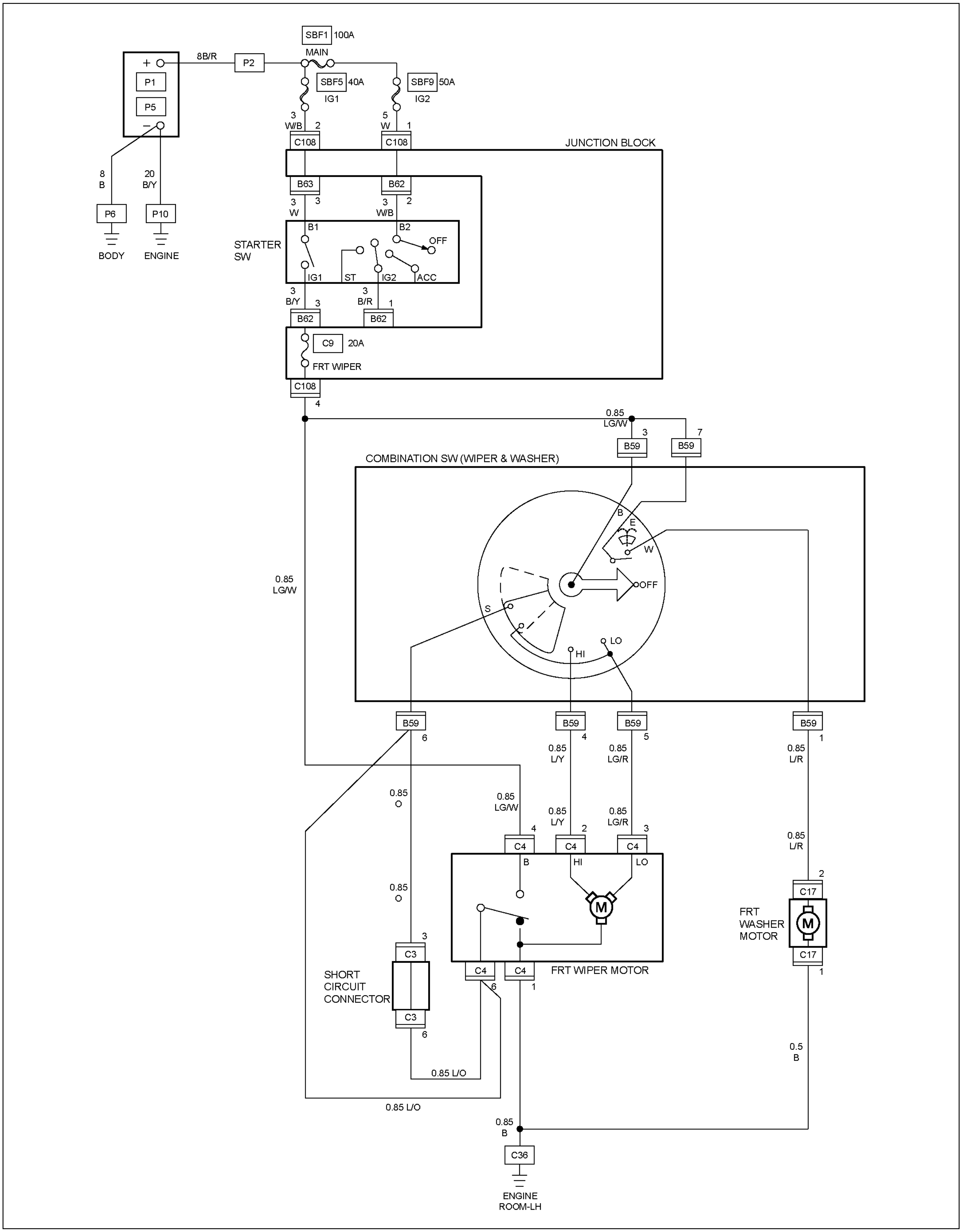
RTW78AXF038101 & RTW78AXF044301

PARTS LOCATION (LHD)



RTW78AXF038201 & RTW78AXF044401

CIRCUIT DIAGRAM C24SE (RHD) WITHOUT INTERMITTENT RELAY



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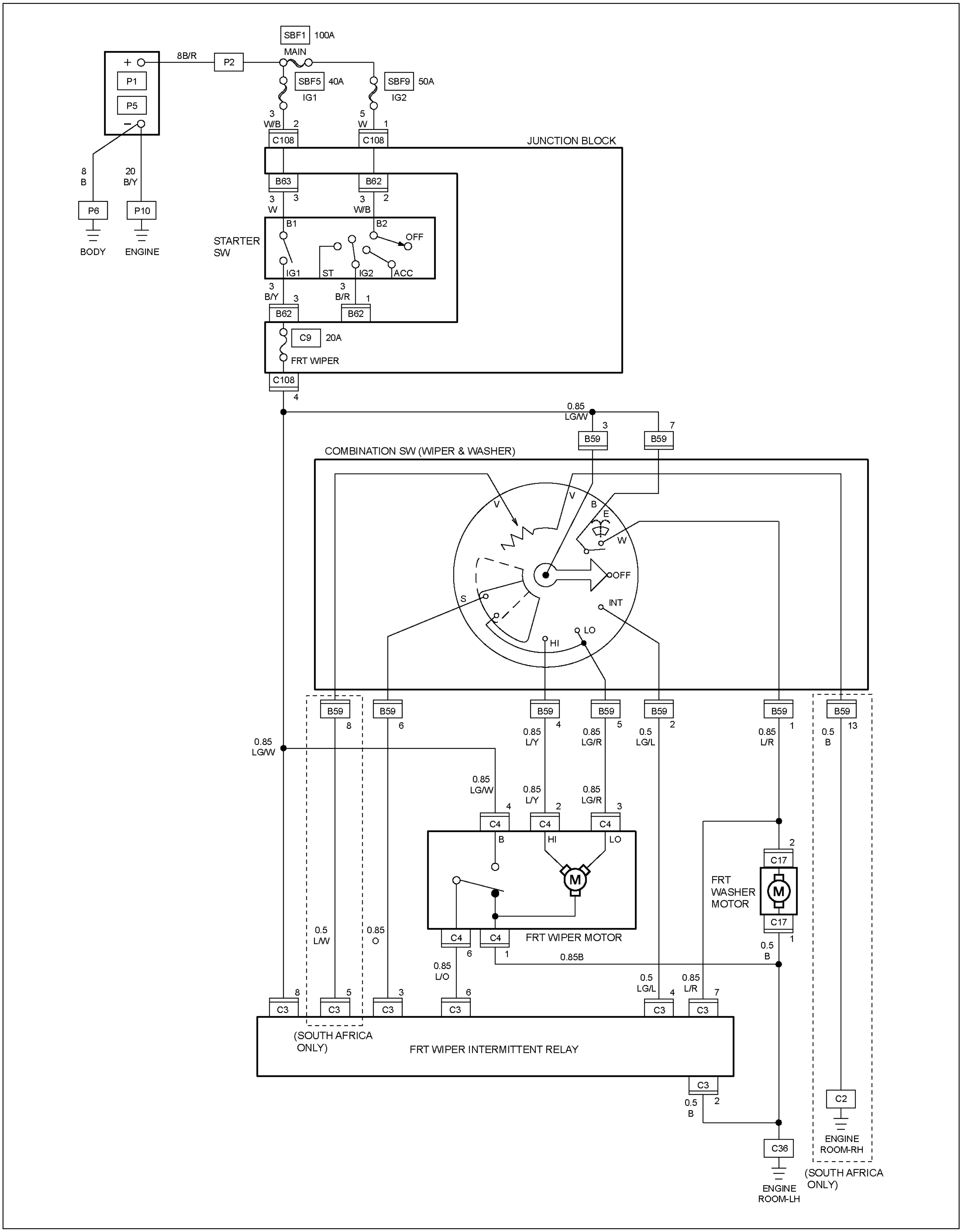
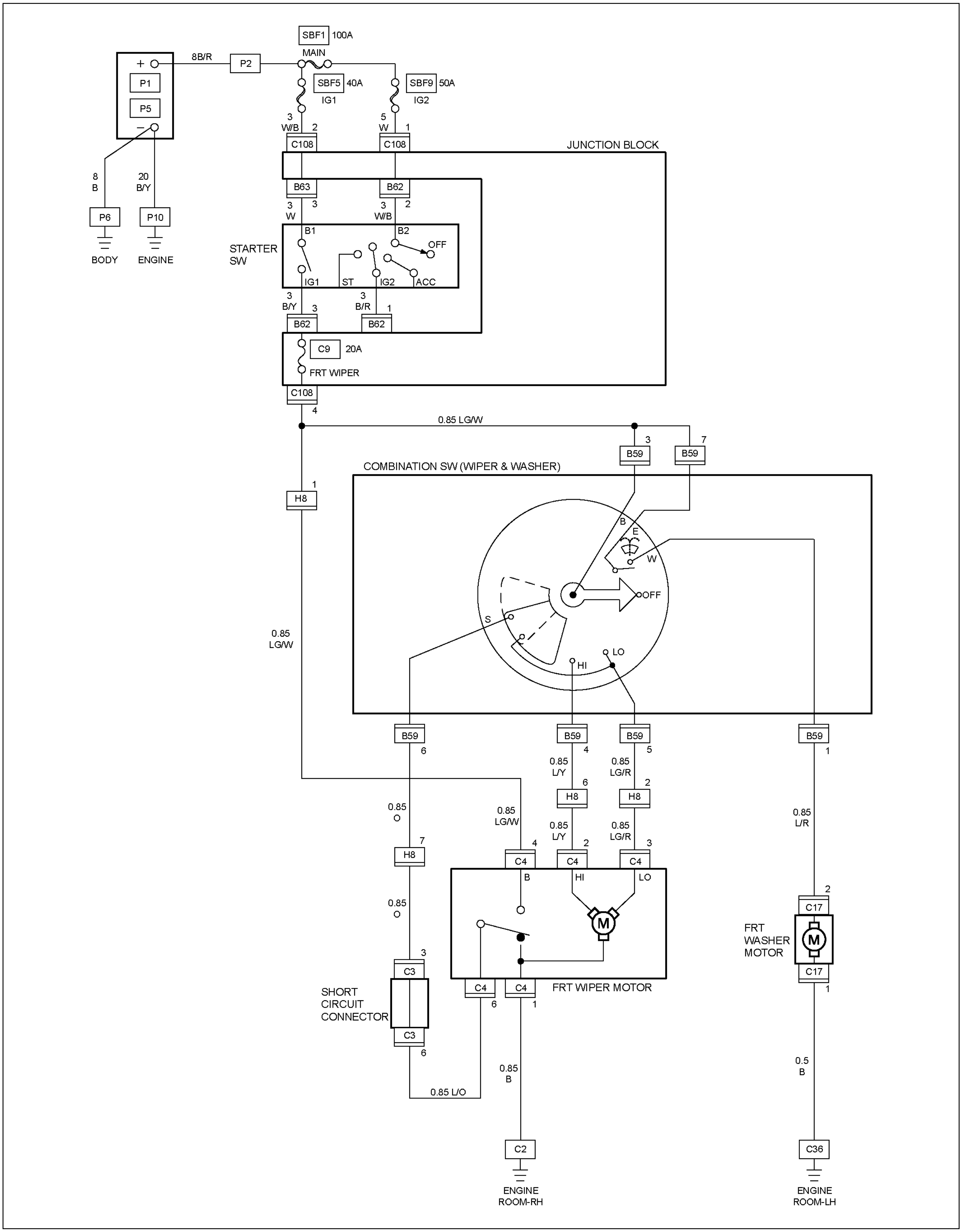
CIRCUIT DIAGRAM C24SE (RHD) WITH INTERMITTENT RELAY



CIRCUIT DIAGRAM C24SE (LHD) WITHOUT INTERMITTENT RELAY



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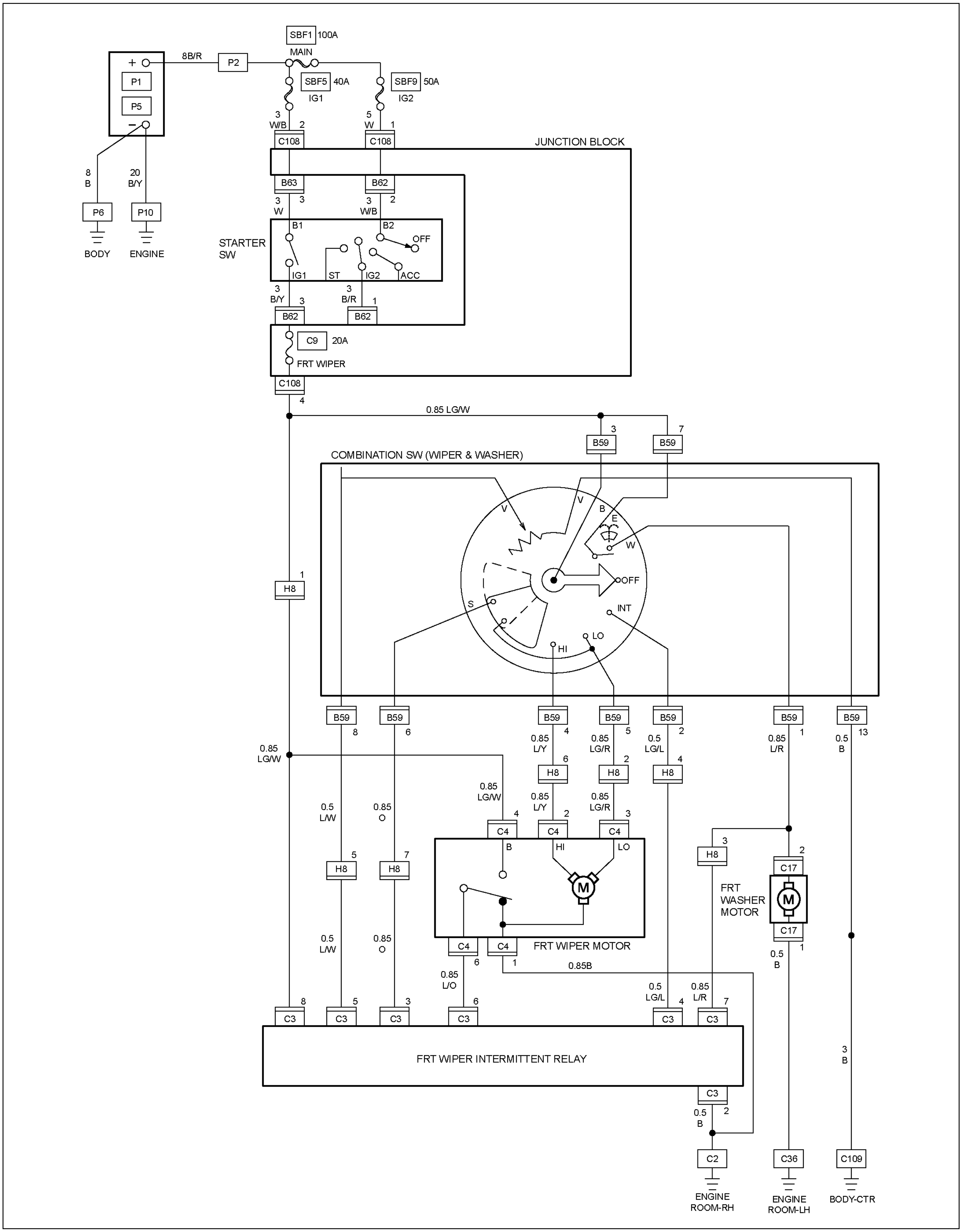
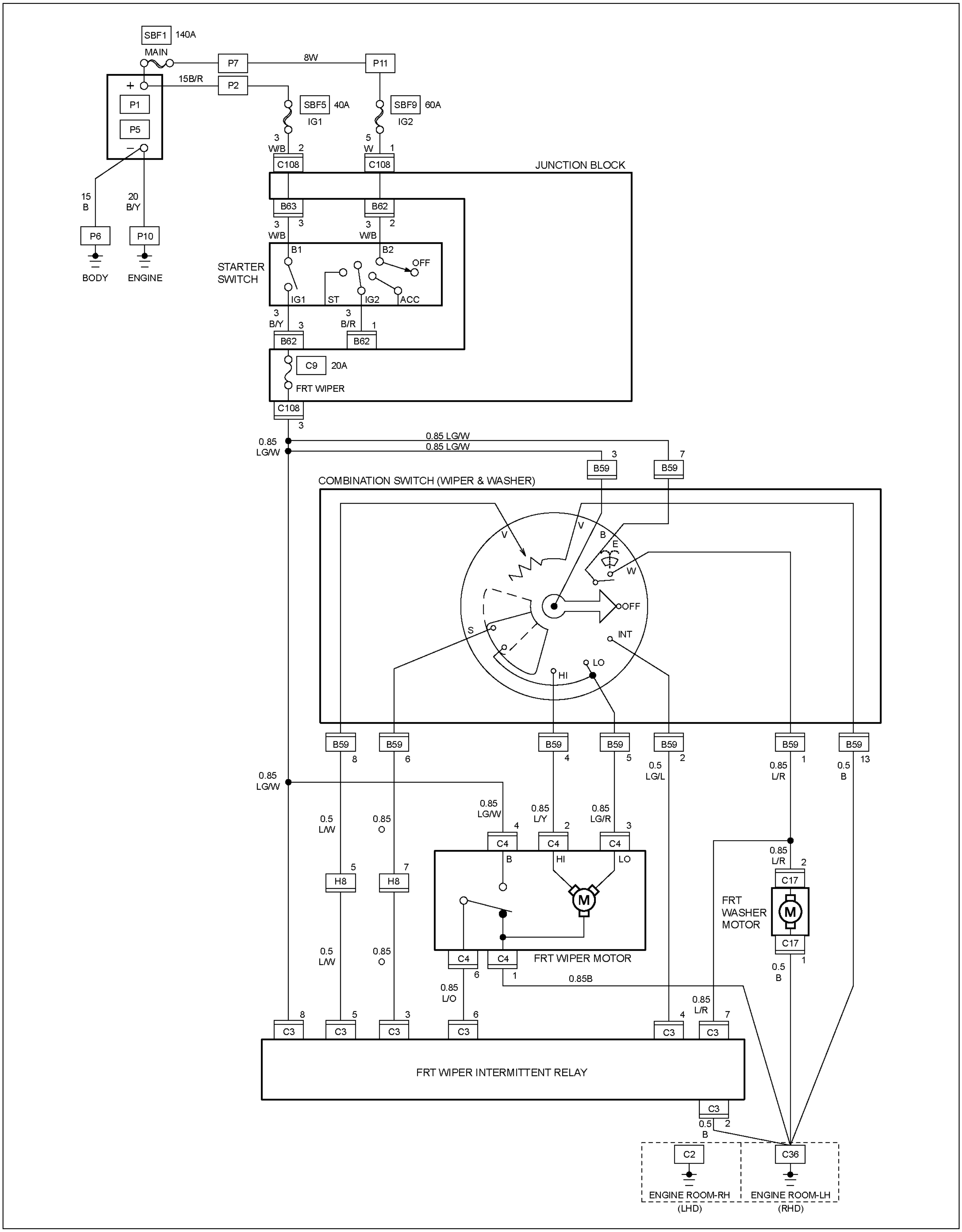
CIRCUIT DIAGRAM C24SE (LHD) WITH INTERMITTENT RELAY



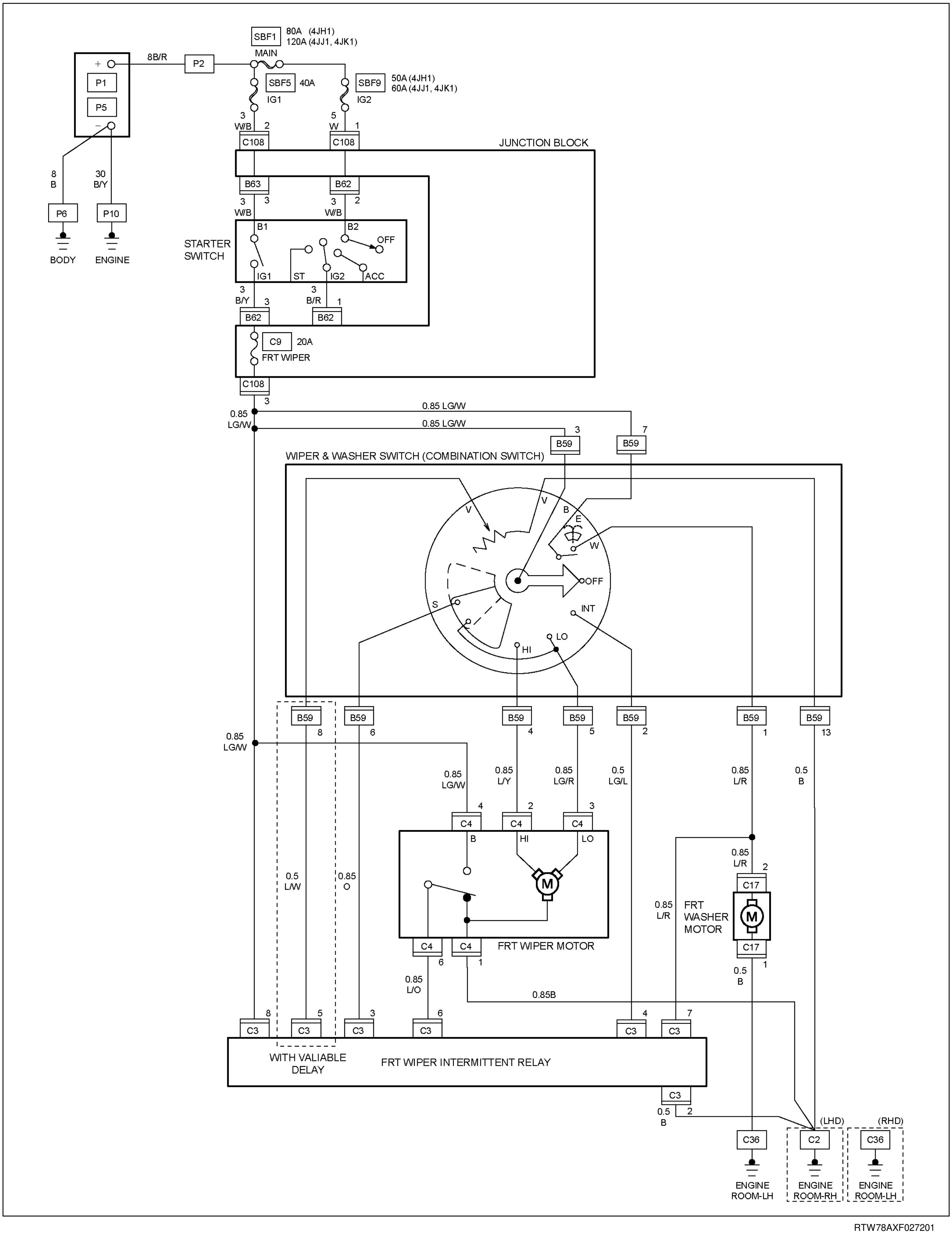
RTW780XF013401

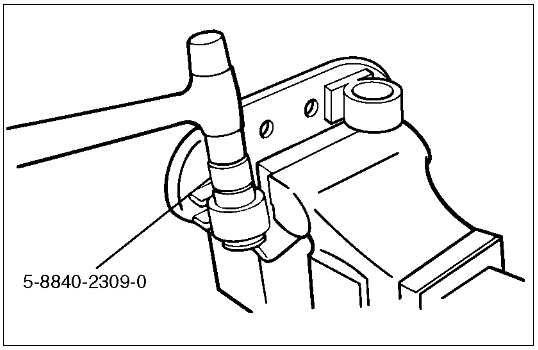
CIRCUIT DIAGRAM HFV6



RTW78AXF002201

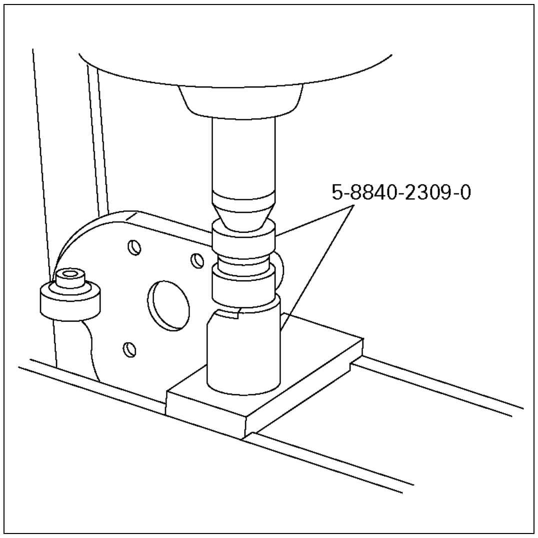
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC, 4JH1-TC





Bushing Replacement

- Remove the bushings using a remover 5-8840-2309-0 and hammer.



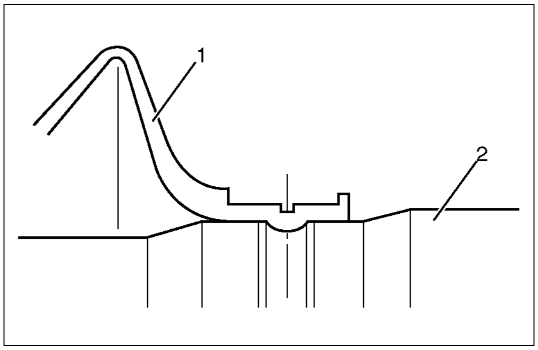
- By using installer and base 5-8840-2309-0, press fit the bushings into the bracket.

Reassembly

1. Install DOJ case to bracket.
2. Install oil seal and fix snap ring.
   Discard the used oil seal, snap ring and install a new one.
3. Install bearing and fix snap ring.
   Discard the used snap ring and install a new one.
4. Install bracket to axle case. Tighten the bracket bolt to the specified torque.
   Torque : 116 N·m (11.8kgf·m/85 lb·ft)
5. Apply 135g of the specified grease in UJ.
6. Install dust seal for UJ.
   Discard the used dust seal and install a new one.
7. Apply a thin coat of grease to the shaft for smooth installation then install bellows.

CAUTION :

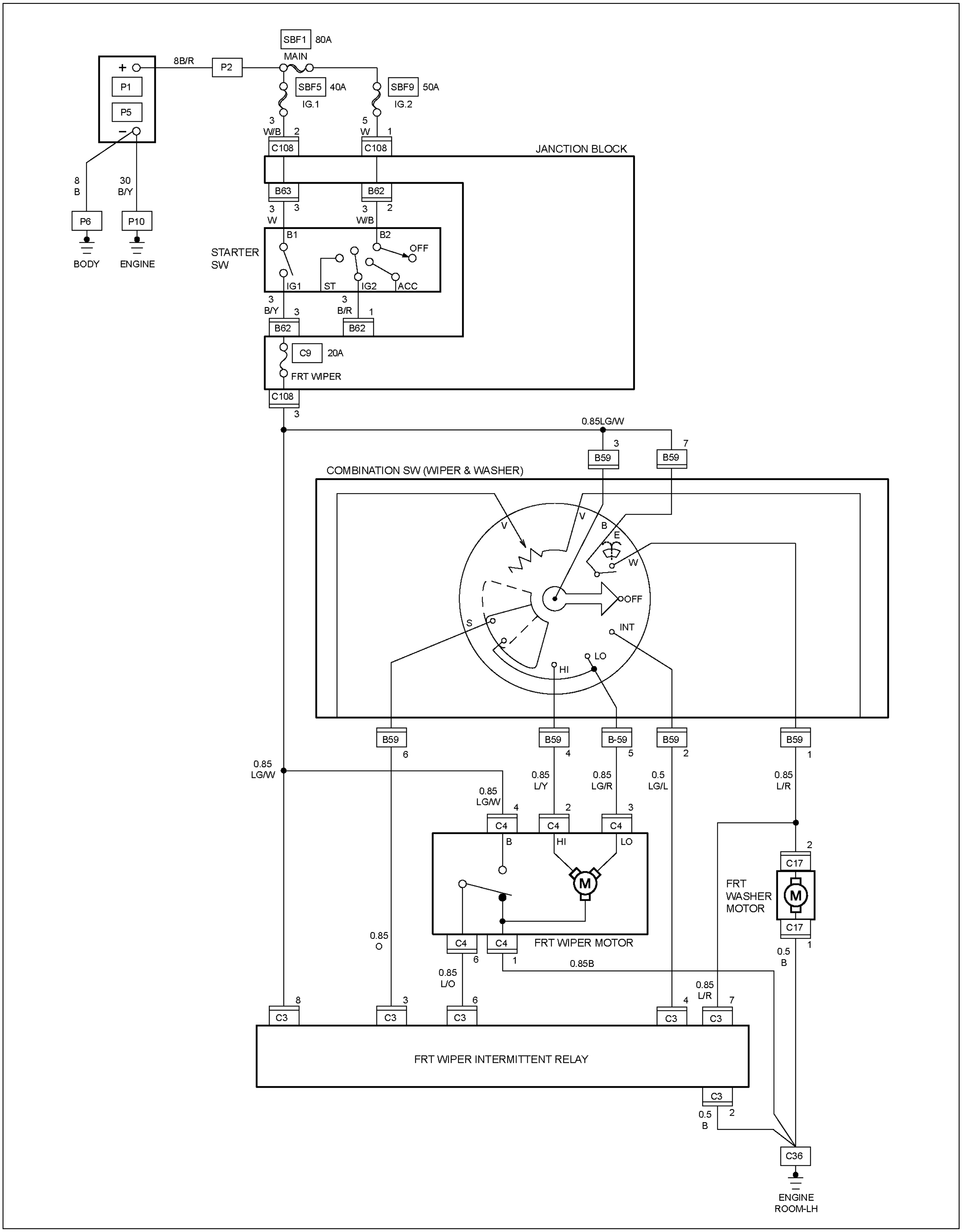
During bellows assembly, be sure to insert both ends of the bellows into the case and shaft grooves.



Legend

1. Bellows
2. Shaft

CIRCUIT DIAGRAM 4JA1T (L)



RTW78AXF005701

TROUBLESHOOTING

WINDSHIELD WIPER

1. Wiper dose not operate at any switch position

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C9 (20A)	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. C9 (20A)
OK			
Voltage between 3 B59 and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Continuity in the wiper & washer SW.	NG	SW. malfunction	Replace the wiper & washer SW.
OK			
Grounding point C2 (LHD), C C36 (RHD)	NG	Poor grounding point contact	Repair grounding point contact
OK			
1. Wiper motor function when connecting the motor connector 3 C4 to the battery (+) terminal, and 1 C4 to the (-) terminal (Should the wiper motor rotate at a low speed) 2. Wiper motor function when connecting the motor connector 2 C4 to the battery (+) terminal, 1 C4 to the (-) terminal (Should the wiper motor rotate at a high speed)	NG	Wiper motor malfunction	Replace the wiper motor
OK			
Continuity between 1 C4 and C36 (RHD), C2 (LHD)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Wiper dose not operate at " INT " position

Checkpoint		Trouble Cause	Countermeasure
Continuity between the wiper & washer SW connector terminals 4 B59 and 2 B59 at the " INT " position	NG	SW. malfunction	Replace the wiper & washer SW.
OK			
Grounding point C36 (RHD), C2 (LHD)	NG	Poor grounding point contact	Repair grounding point contact
OK			
Voltage between the intermittent relay harness side connector terminal 4 C3 and the ground at the "INT" position (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Intermittent relay function	NG	Relay malfunction	Replace the intermittent relay

3. Wiper does not operate at "LO" position

Checkpoint		Trouble Cause	Countermeasure
Wiper motor function 1. Disconnect the wiper & washer SW. connector 2. Turn the starter SW. on 3. Short-circuit between the wiper & washer SW. harness side connector terminal 3 B59 and 5 B59. 4. Check to see if the wiper motor rotates at a low speed	NG	Wiper motor malfunction	Replace the wiper motor
OK			
Wiper & washer SW. function	NG	SW. malfunction	Replace the wiper & washer SW.

4. Wiper does not operate at “HI” position

Checkpoint		Trouble Cause	Countermeasure
Continuity between the wiper & washer SW. connector terminals 4 B59 at the “HI” position	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Wiper motor function when connecting the motor connector 2 C4 to the battery (+) terminal, and 1 C4 to the (-) terminal (Should the wiper motor rotate at a high speed)	NG	Wiper motor malfunction	Replace the wiper motor
OK			
Continuity between 4 B59 and 2 C4	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

5. Rotation of the wiper motor does not stop

Checkpoint		Trouble Cause	Countermeasure
Continuity in the wiper & washer SW.	NG	SW. malfunction	Replace the wiper & washer SW.
OK			
Wiper motor function	NG	Wiper motor malfunction	Replace the wiper motor

6. Auto-stop function of the wiper motor does not operate

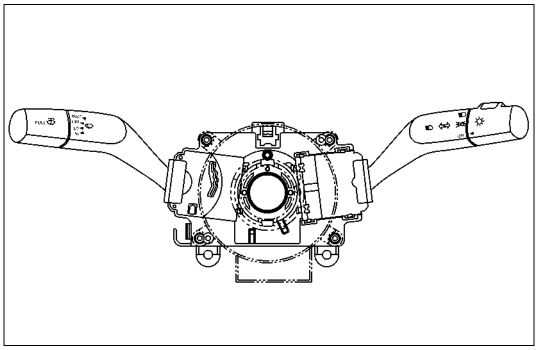
Checkpoint		Trouble Cause	Countermeasure
Continuity between the wiper & washer SW. connector terminals 5 $\boxed{B59}$ and 6 $\boxed{B59}$ at the "OFF" position	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK ↓			
Wiper motor function 1. Disconnect the wiper motor connector 2. Connect the motor connector 5 $\boxed{B59}$ to the battery (+) terminal and 1 $\boxed{C4}$ to the (-) terminal, and then change the connection of the battery (+) terminal to the connector 4 $\boxed{C4}$ while the motor rotating at a low speed 3. Check to see if the wiper motor stops at the auto stop position when connecting the connector terminals 3 $\boxed{C4}$ and 1 $\boxed{C4}$ in this condition	NG	Wiper motor malfunction	Replace the wiper motor
OK ↓			
Voltage between the wiper motor harness side connector terminal 4 $\boxed{C4}$ and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair an open circuit or a poor connection of the connectors between the fuse No. C9 (20A) and 4 $\boxed{C4}$
OK ↓			
Continuity between the intermittent relay harness side connector 6 $\boxed{C3}$ and the wiper motor harness side connector 6 $\boxed{C4}$	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK ↓			
Intermittent relay function	NG	Relay malfunction	Replace the intermittent relay

WASHER

1. Washer motor does not operate

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C9 (20A)	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. C9 (20A)
OK ↓			
Continuity between the wiper & washer SW. side connector terminals 1 B59 and 7 B59 when the washer button is depressed	NG	SW. malfunction	Replace the wiper & washer SW.
OK ↓			
Voltage between the wiper & washer SW. harness side connector terminal 7 B59 and the ground (Should be battery voltage preset)	NG	Open circuit or poor connector contact	Repair or an open circuit or a poor connection of the connectors between the fuse No. C-9 (20A) and 7 B59
OK ↓			
Voltage between the washer motor harness side connector terminal 2 C17 and the ground when the washer button is depressed (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair or an open circuit or a poor connection of the connectors between 2 C17 and 1 B59
OK ↓			
Grounding point C36	NG	Poor grounding point contact	Repair grounding point C36 contact
OK ↓			
Washer motor function when connecting the motor side connector 2 C17 to the battery (+) terminal, and the connector 1 C17 to the (-) terminal (Should the washer motor rotate)	NG	Motor malfunction	Replace the washer motor
OK ↓			
Continuity between 1 C17 and C36	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

REMOVAL AND INSTALLATION



WIPER AND WASHER SWITCH

Removal

Refer to the removal steps of the LIGHTING SWITCH (COMBINATION SWITCH) in “ LIGHTING “ of this section.

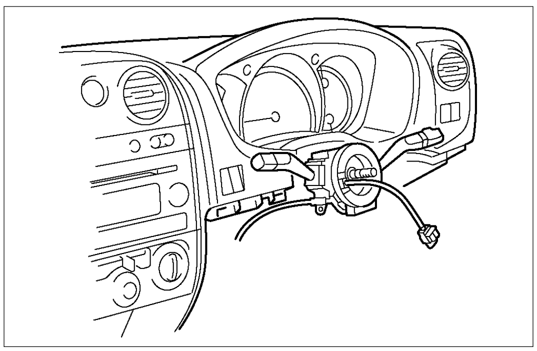
Installation

Follow the removal procedure in the reverse order to install the wiper and washer switch.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

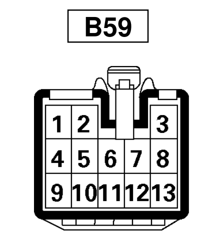
Be absolutely sure that the wiper and washer switch connector is securely connected.
This will prevent a poor contact and an open circuit.



RTW780SH001601

This illustration is based on RHD model

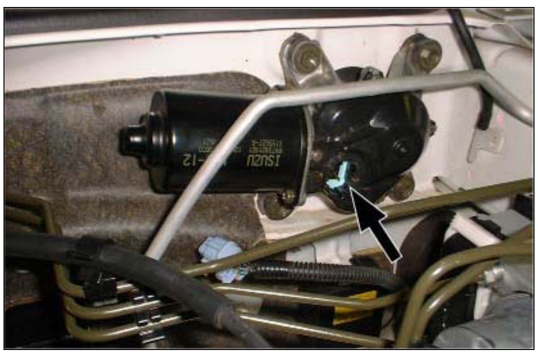
INSPECTION AND REPAIR



Switch side

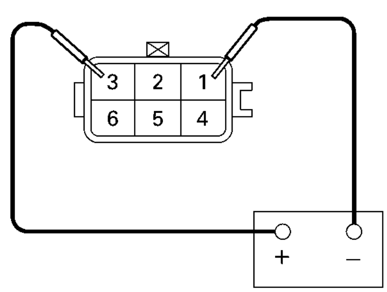
Control Switch Connections

SW position \ Terminal No.	6	3	5	4	2	7	1
Mist		○	○				
Off	○		○				
INT	○	 ○	○		 ○		
Lo		○	○				
Hi		○		○			
Wash						○	○



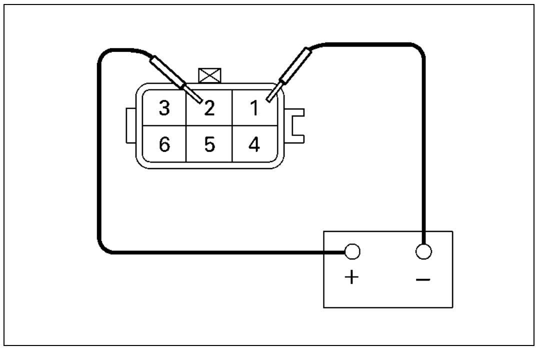
Wiper Motor Inspection

Connector



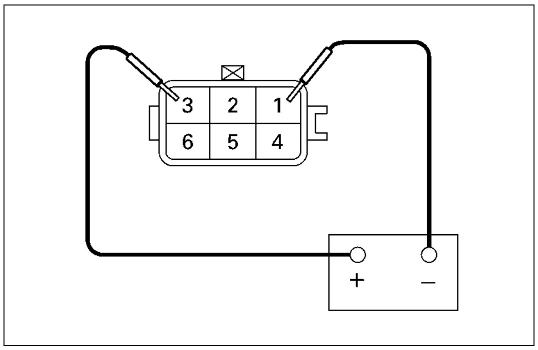
Low Speed Inspection

1. Clamp the wiper motor in a vise.
   The moving parts must be clear of the vise.
2. Connect the connector terminals to the battery.
   Refer to the illustration.
3. Check the wiper motor low speed operation.



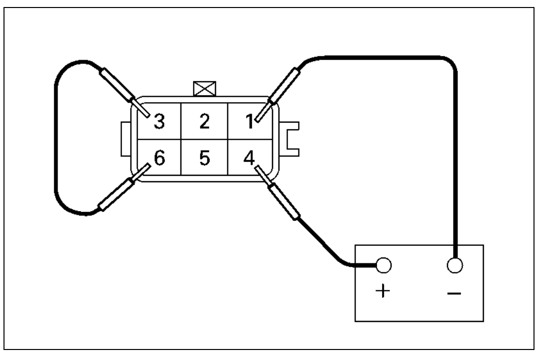
High Speed Inspection

1. Clamp the wiper motor in a vise.
   The moving parts must be clear of the vise.
2. Connect the connector terminals to the battery.
   Refer to the illustration.
3. Check the wiper motor high speed operation.



Auto-Stop Inspection

1. Clamp the wiper motor in a vise.
   The moving parts must be clear of the vise.
2. Connect the connector terminals to the battery.
   Refer to the illustration.
3. Check the wiper motor low speed operation.
4. Disconnect the positive battery terminal.
   This will stop the motor.



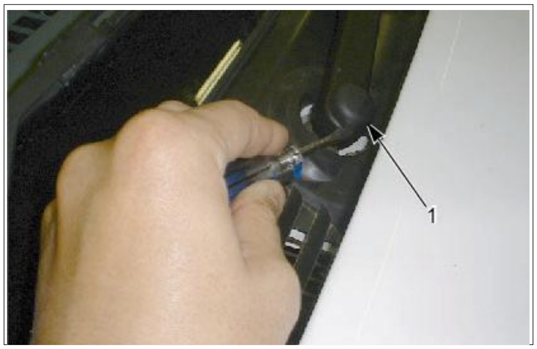
5. Connect the connector terminals No. 3 and No. 6 with a lead wire.
   Refer to the illustration.
6. Reconnect the positive battery terminal to connector terminal No. 4.
   This will restart the motor.
   Refer to the illustration.
7. Check the auto-stop operation.

Washer Motor Inspection

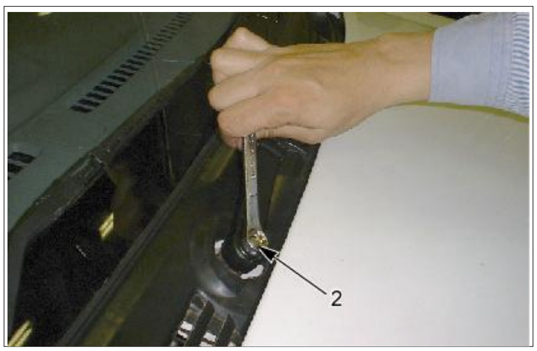
1. Fill the washer tank with washing solution.
2. Disconnect the motor connector.
3. Apply battery voltage to the washer motor connector.
4. Check the washer motor operation.

WIPER MOTOR AND LINKAGE

Removal



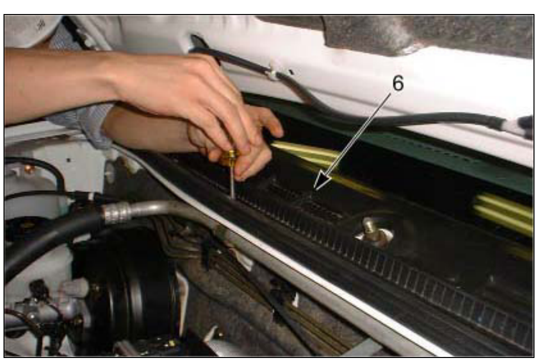
1. Disconnect the wiper arm nut cap ①.



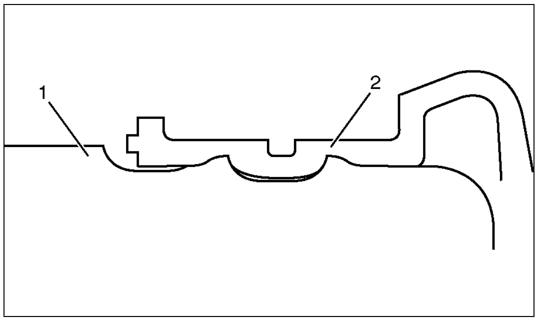
2. Remove the wiper arm nut ②.
3. Remove the wiper arm with blade.

4. Disconnect the wiper motor connector ③.
5. Remove the wiper motor bracket screws ④.

6. Disconnect the wiper motor from the wiper linkage at the crank arm ⑤.

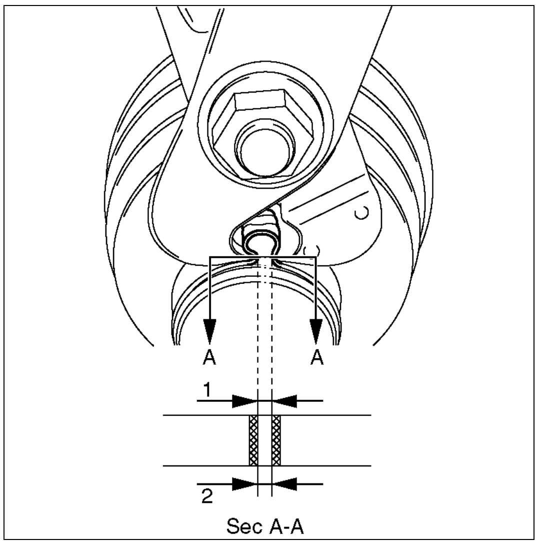


7. Remove the vent cowl cover ⑥.
   - Remove the 6 screw.



Legend

1. UJ Case
2. Bellows

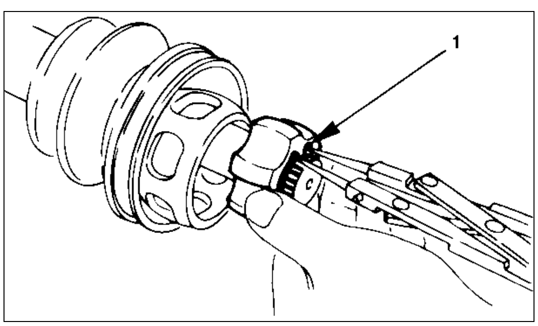


8. Install band. Note the setting direction. After installation, check Standard Caulk Measure.
   Discard the used band and install a new one.
   Use the special tool pliers 5-8840-2745-0 to caulk the band to the specified value.
   For both sides on UJ bellows.

Standard Caulk Measure

- 1.2mm (0.05in) <= (1), (2) <= 4.0mm (0.16in)
- (1) - (2) or (2) - (1) <= 0.4mm (0.016in)

9. Install another bellows and fix band.
   Discard the used band and install a new one.
10. Install the ball guide with the smaller diameter side ahead onto the shaft.
11. Install ball retainer.
12. Using snap ring pliers, install the snap ring (1) securing the ball retainer to the shaft.
    Discard the used snap ring and install a new one.



This illustration is based on RHD model

8. Remove the wiper linkage ⑦ from the access hole.

Installation

Follow the removal procedure in the reverse order to install the wiper motor and linkage.

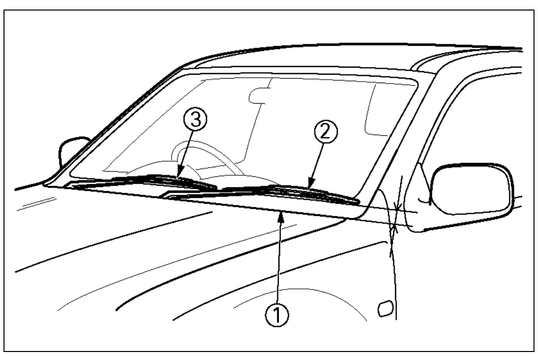
Pay close attention to the important points mentioned in the following paragraphs.

Wiper Linkage

Take care not to scratch the painted surfaces of the body when installing the wiper linkage to the body.

In case crank arm of wiper motor is removed, confirm the position of auto stop prior to reinstall the crank arm to the wiper motor.

Crank Arm Nut Torque	N·m (kg·m/lb ft)
20 – 26 (2.0 – 2.6 / 14.5 – 18.8)	



880R300006

Wiper Blade Position

Confirm the auto stop position of wiper motor prior to the installation of the wiper blade and arm.

The distance between the vent cowl cover rubber seal ① and the wiper blade edge ② is about 52±7.5 mm (2.05±0.3 in) ③ 40±7.5 mm (1.57±0.3 in).

Wiper Arm Nut

Tighten the wiper arm nut to the specified torque.

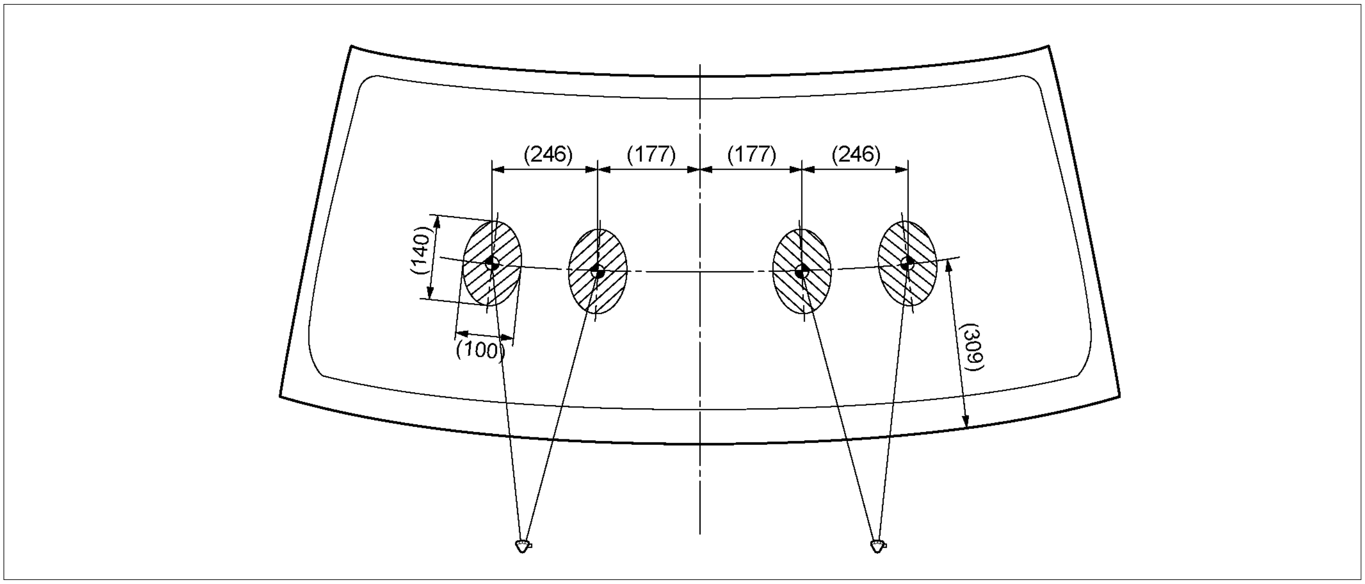
Wiper Arm Nut Torque	N·m (kg·m/lb ft)
27 – 35 (2.75 – 3.57/19.94 – 25.85)	

This illustration is based on RHD model

Windshield Washer Spray

Be sure that the engine hood is completely closed before checking the windshield washer spray adjustment.

Windshield Washer Spray Position: Refer to the illustration.



RTW38DSF000201

Connector

Be absolutely sure that the wiper motor connector is securely connected.

This will prevent a poor contact and an open circuit.

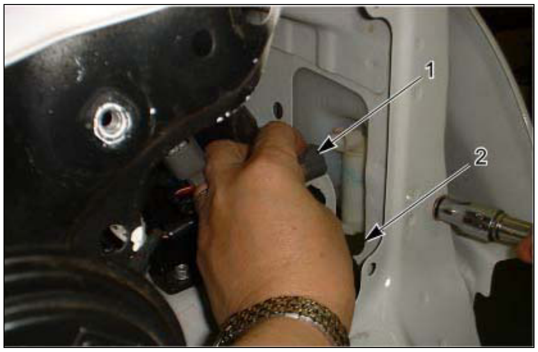
Note:
Windshield wiper arm and blade assembly configurations are different for the right-hand and left-hand side of the vehicle.
Be careful not to confuse the right-hand and left-hand side assemblies.

This illustration is based on RHD model

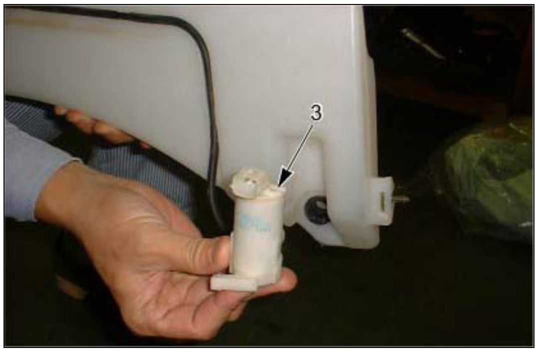
WASHER TANK MOTOR

Removal

1. Remove the head light.
   - Refer to the head light in this manual.
2. Remove the inner liner.
3. Pull out the clip washer filler.
4. Remove the washer tank nuts.



4. Disconnect the connector ①.
5. Disconnect the water hose ②.



6. Pull out the washer tank motor ③.

Installation

Follow the removal procedure in the reverse order to install the washer tank motor.

Pay close attention to the important points mentioned in the following paragraphs.

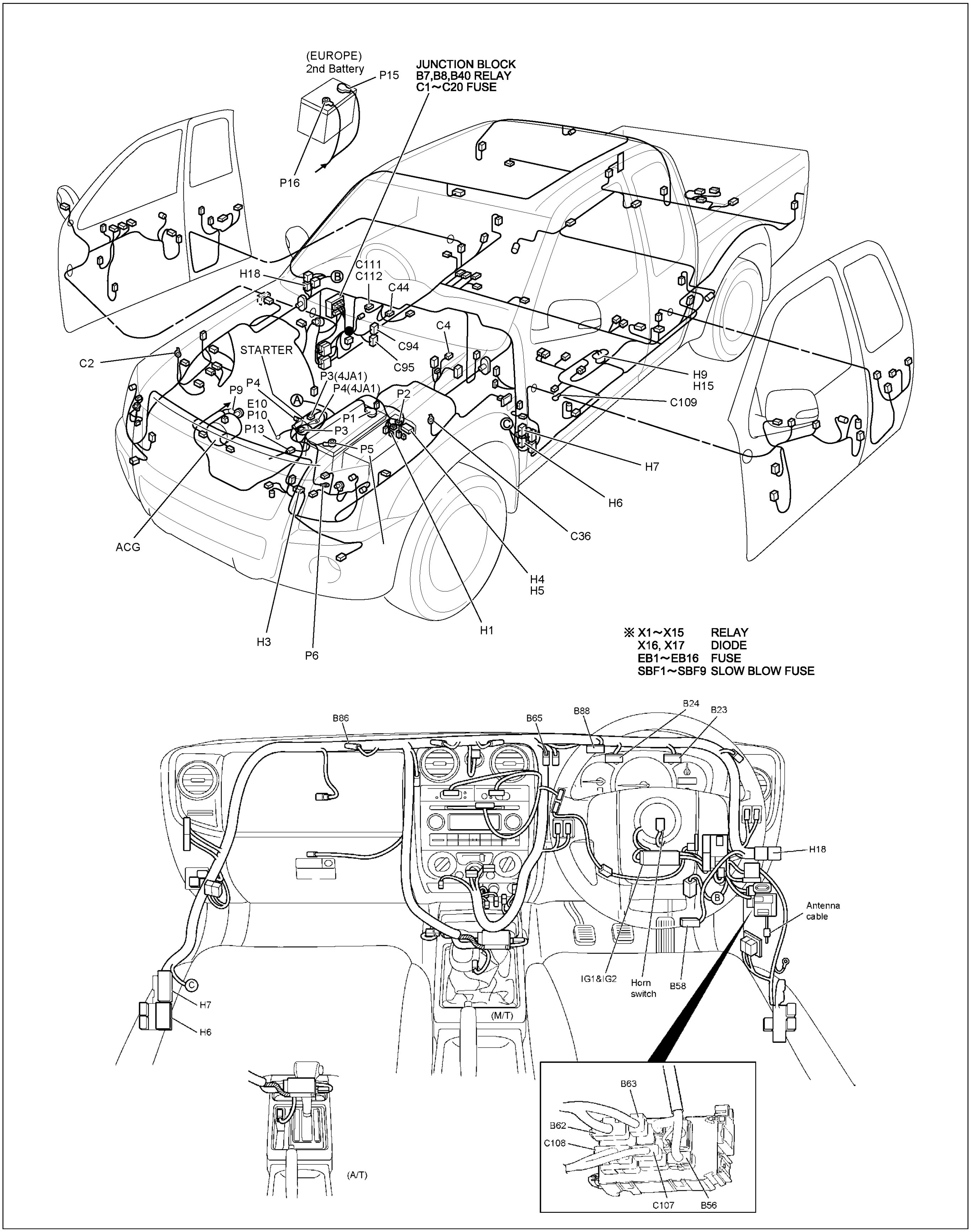
Connector

Be absolutely sure that the washer tank motor connector is securely connected.

This will prevent a poor contact and an open circuit.

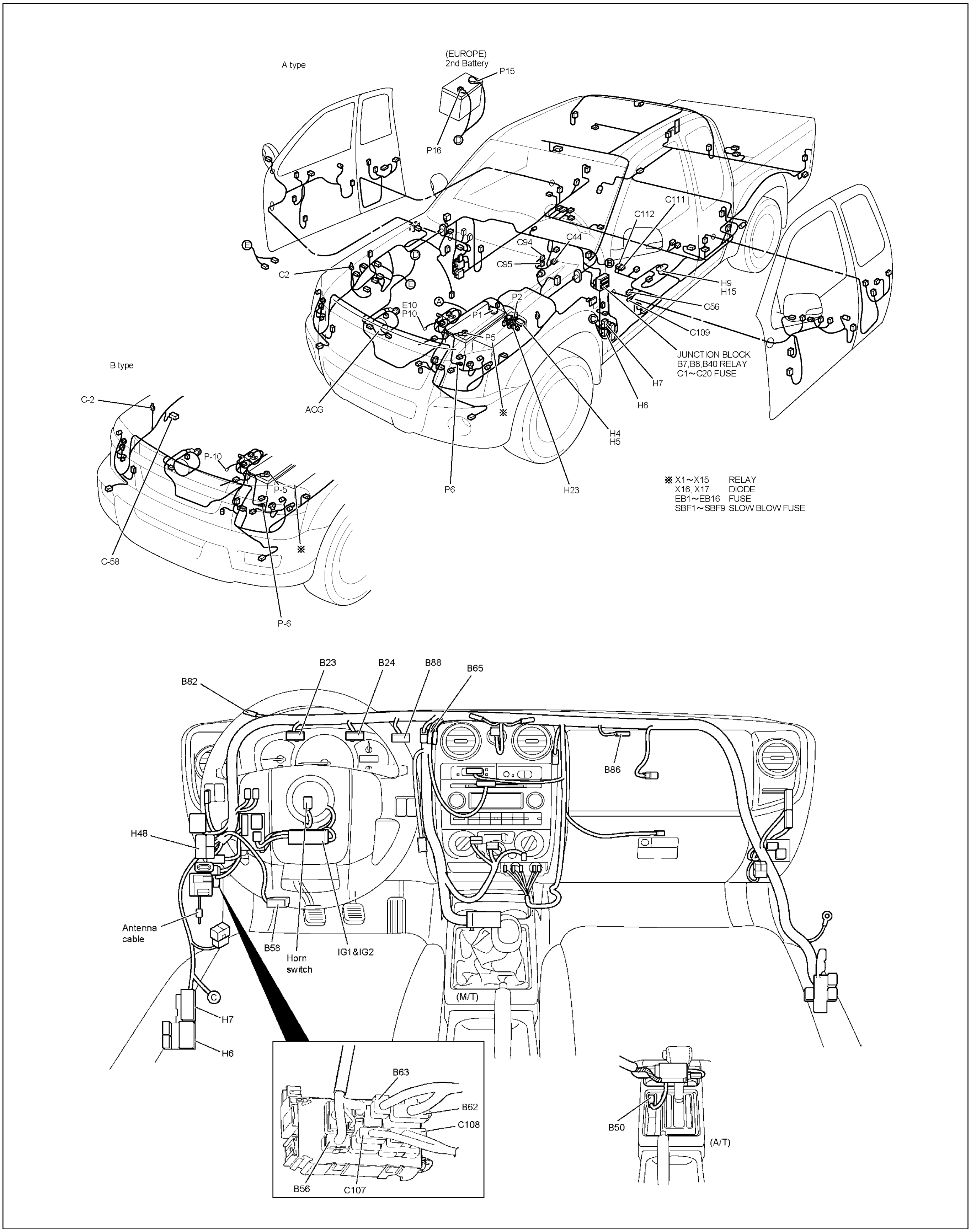
TRANSMISSION CONTROL MODULE (TCM)

PARTS LOCATION (RHD)



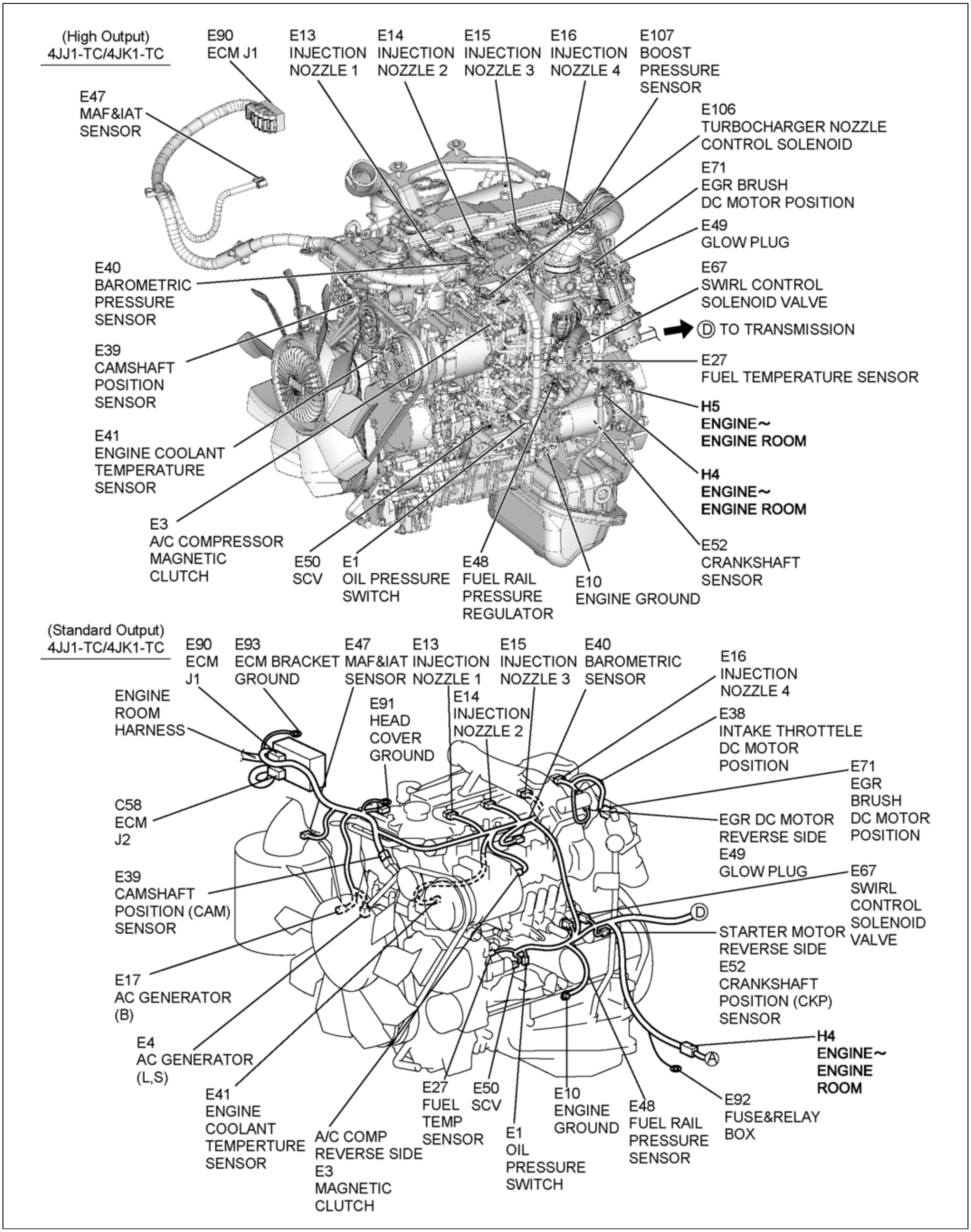
RTW78AXF038301 & RTW78AXF044501

PARTS LOCATION (LHD)



RTW78AXF038401 & RTW78AXF044801

PARTS LOCATION 4JJ1-TC



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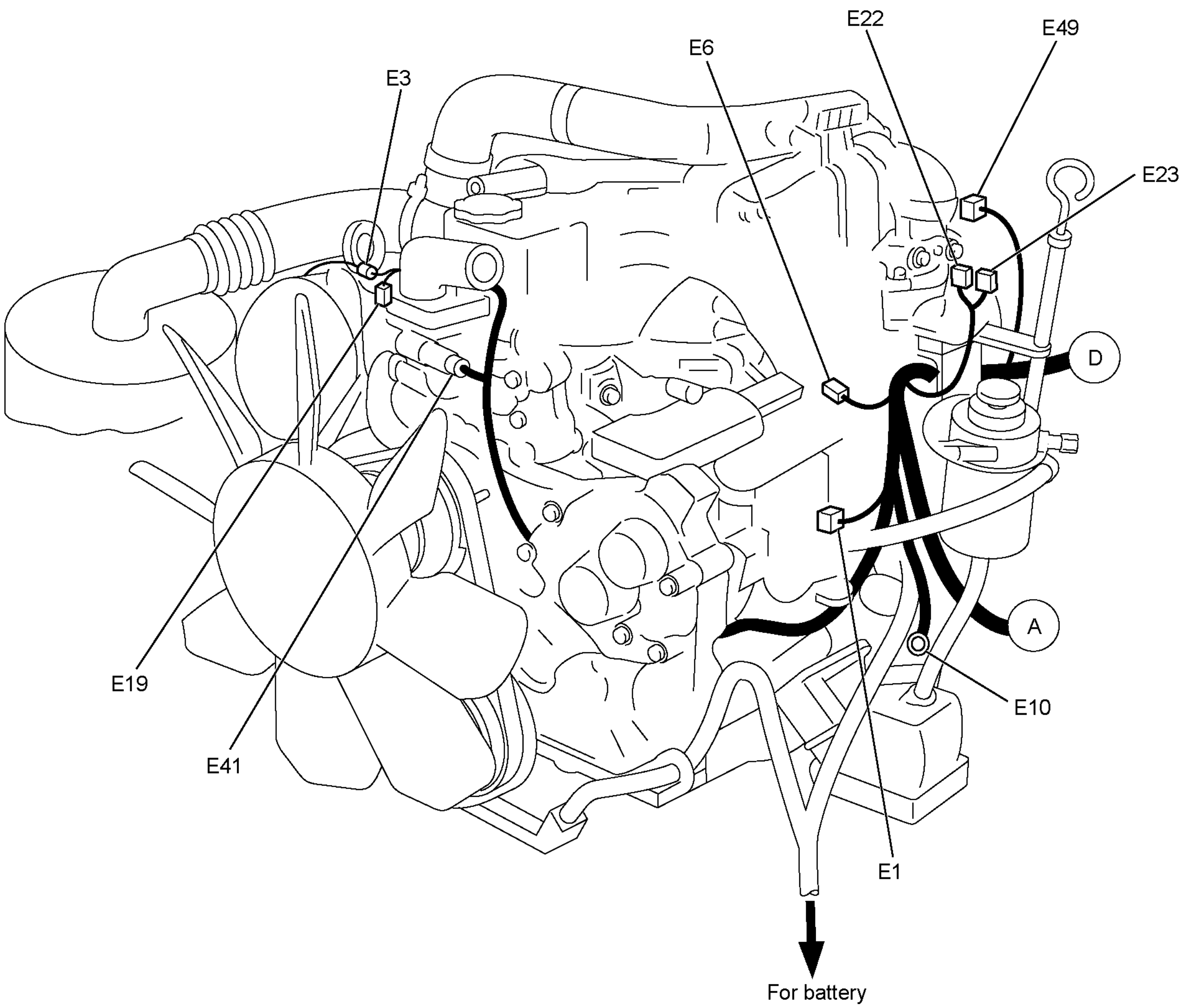
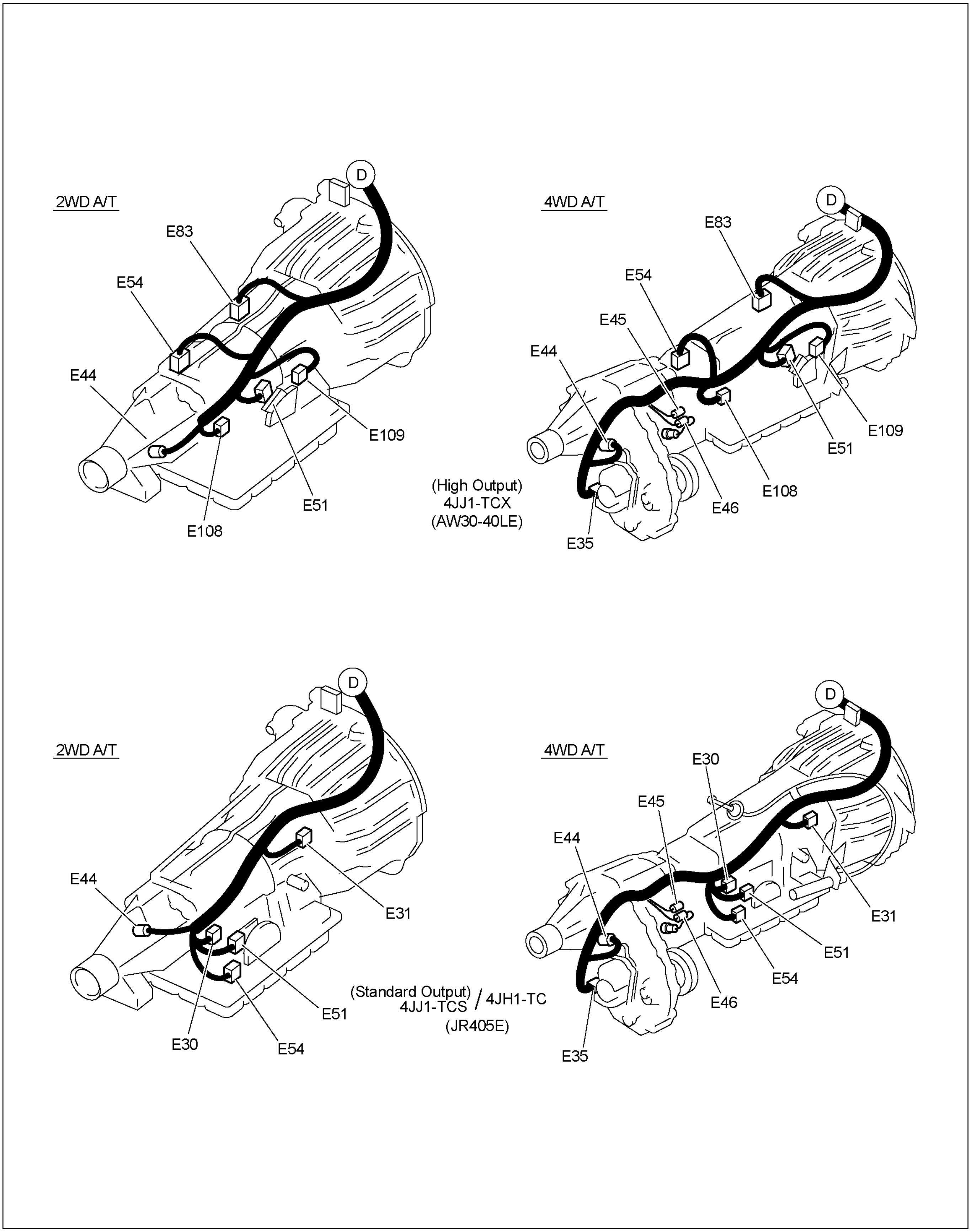
PARTS LOCATION 4JH1-TC



RTW78AXF049401

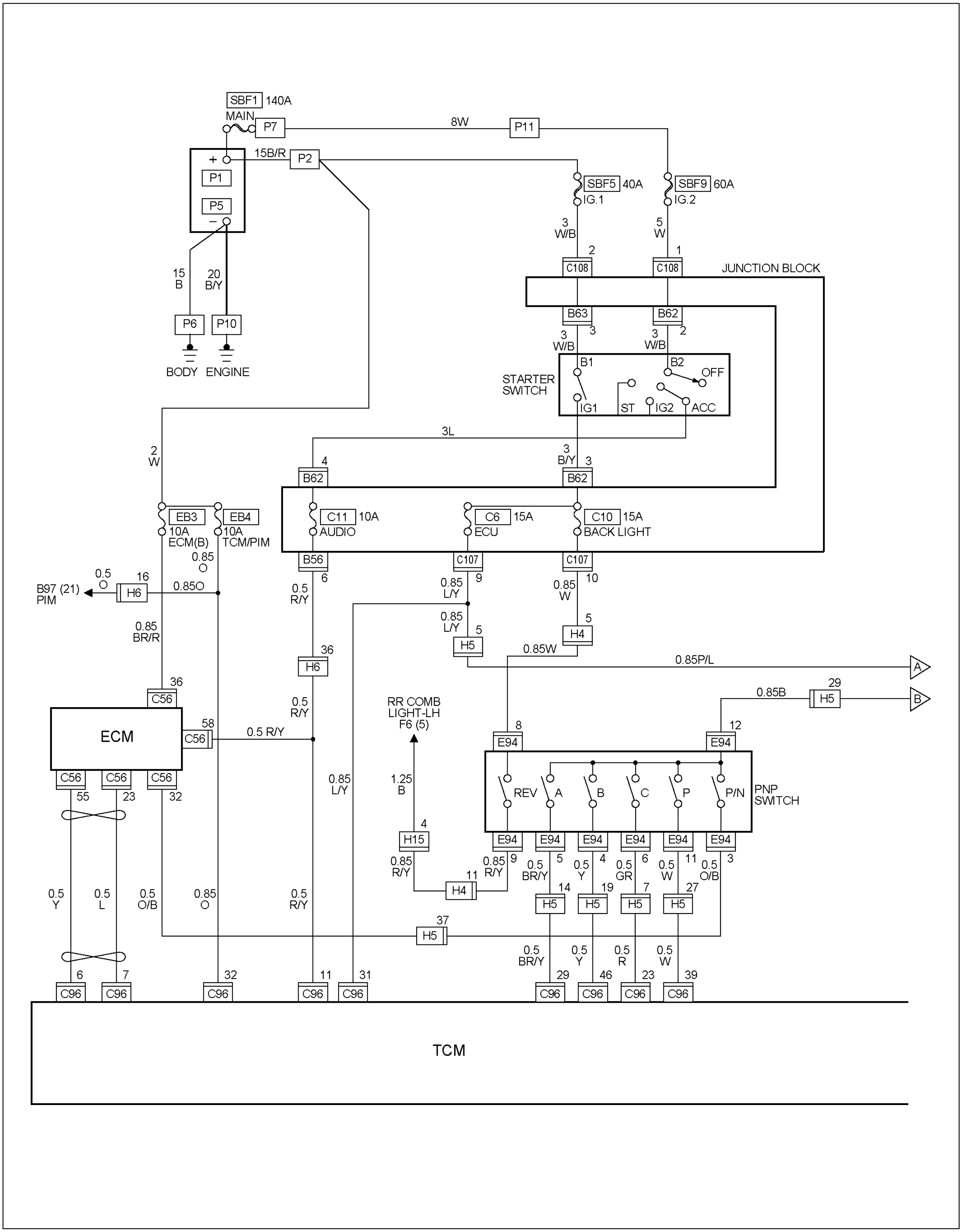
PARTS LOCATION



RTW78AXF035701

CIRCUIT DIAGRAM HFV6

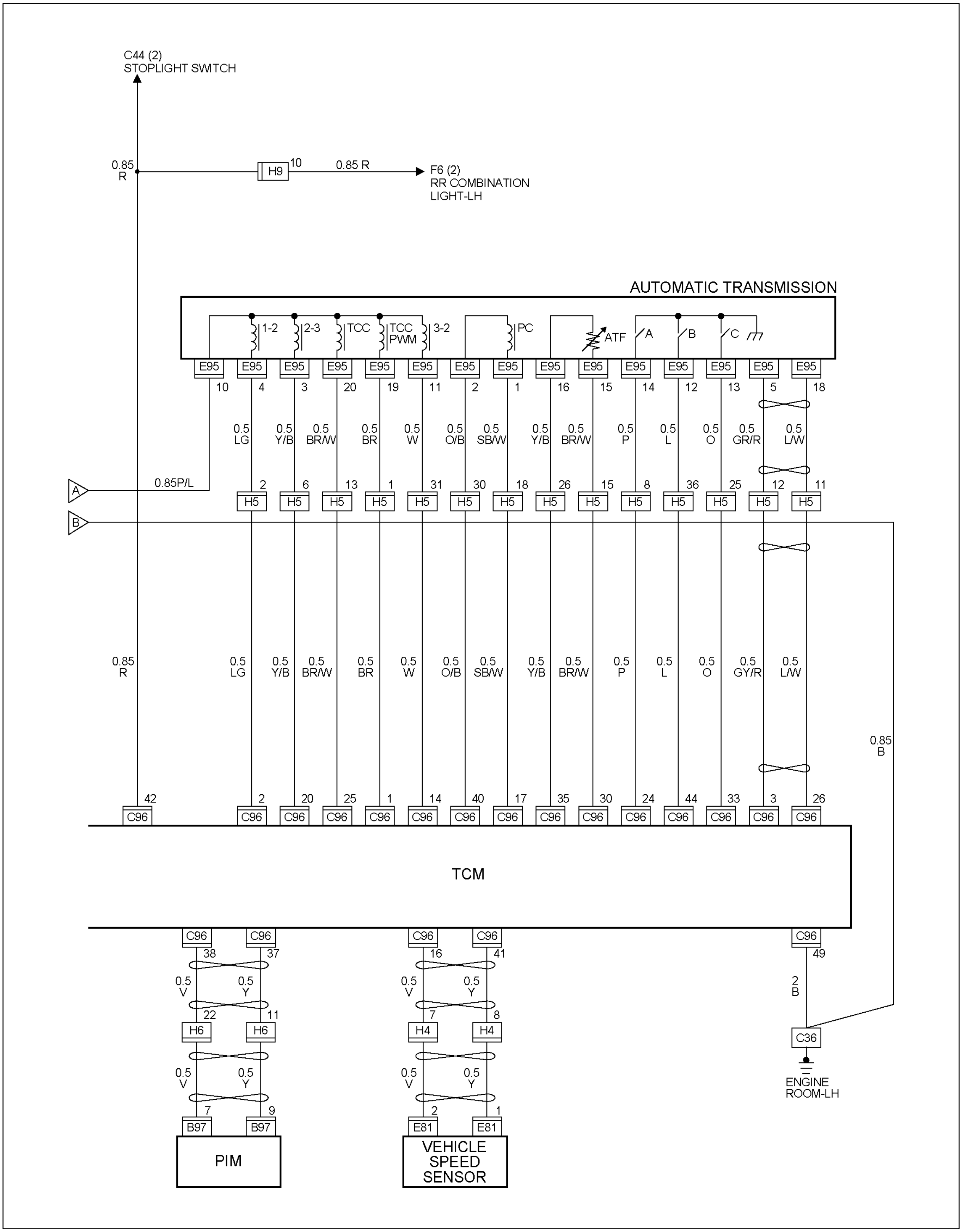
Sheet 1/2



RTW78AXF012501

CIRCUIT DIAGRAM HFV6

Sheet 2/2



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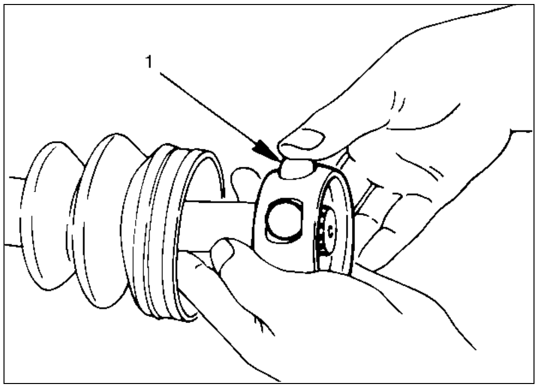
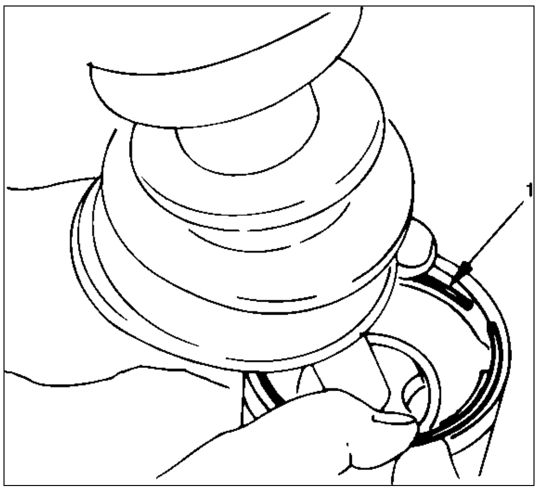
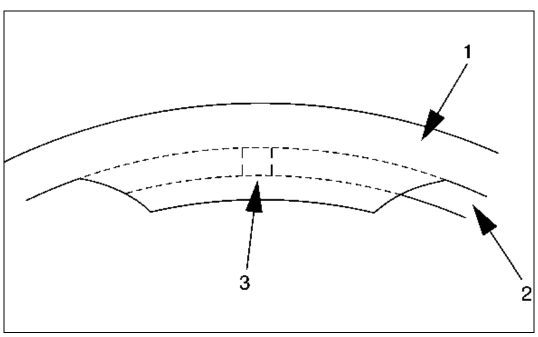


13. Align the track on the ball (1) retainer with the window in the cage, and install the six balls into position.



14. Pack 150g (5.3 oz) of the specified grease in DOJ case, then install drive shaft joint assembly. After reassembly, move the DOJ longitudinally several times to get to fit.
15. Install the circlip (1) so that open ends are positioned away from the ball groove.

    Discard the used circlip and install a new one.



Legend

1. Outer Case
2. Circlip
3. Open Ends

16. Install band. After installation, check that the bellows is free from distortion.

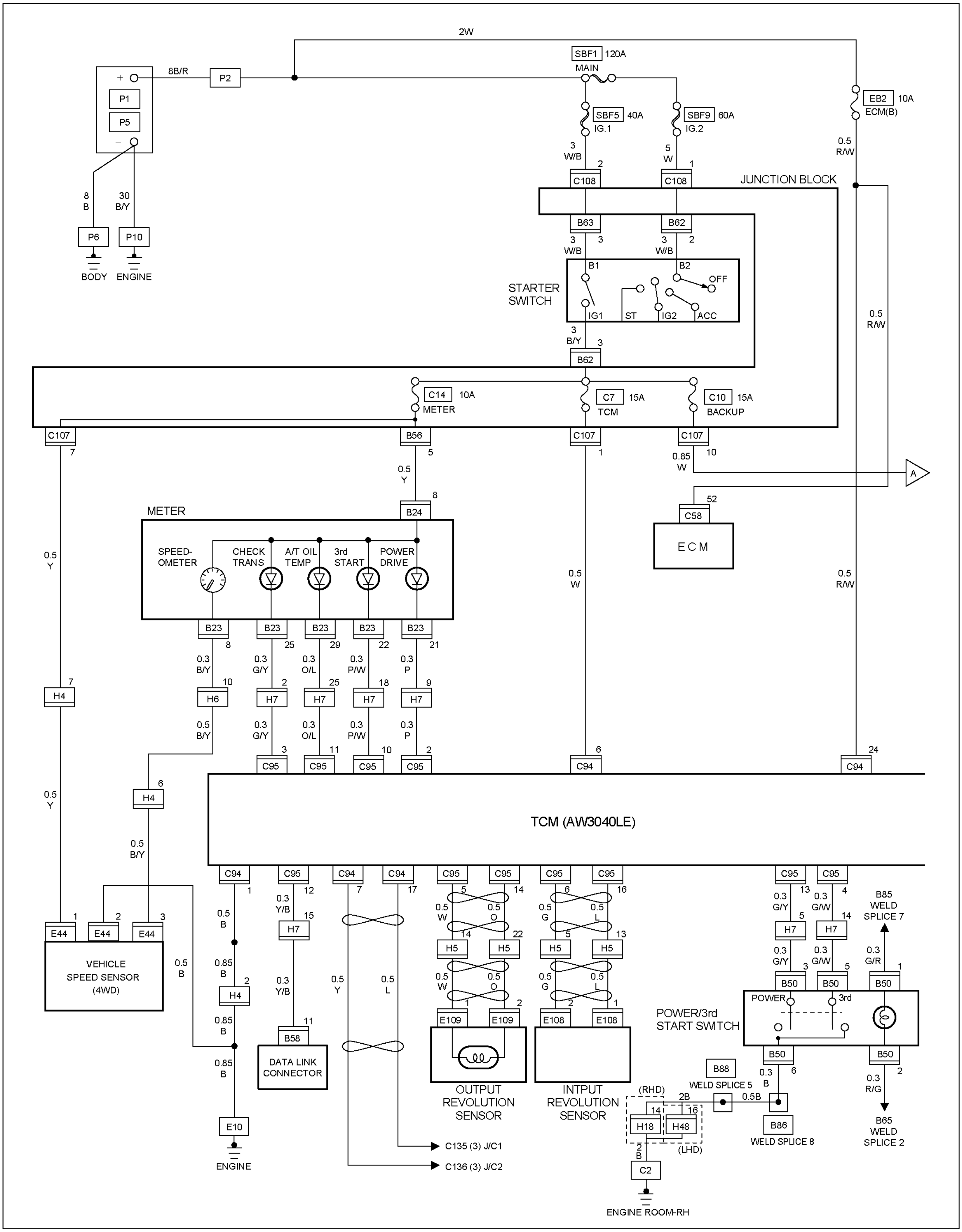
    Discard the used band and install a new one.

    Use the special tool pliers 5-8840-2745-0 to caulk the band to the specified valve.

    For both sides on UJ bellows.

CIRCUIT DIAGRAM 4JJ1-TC (AW30-40LE)

Sheet 1/2



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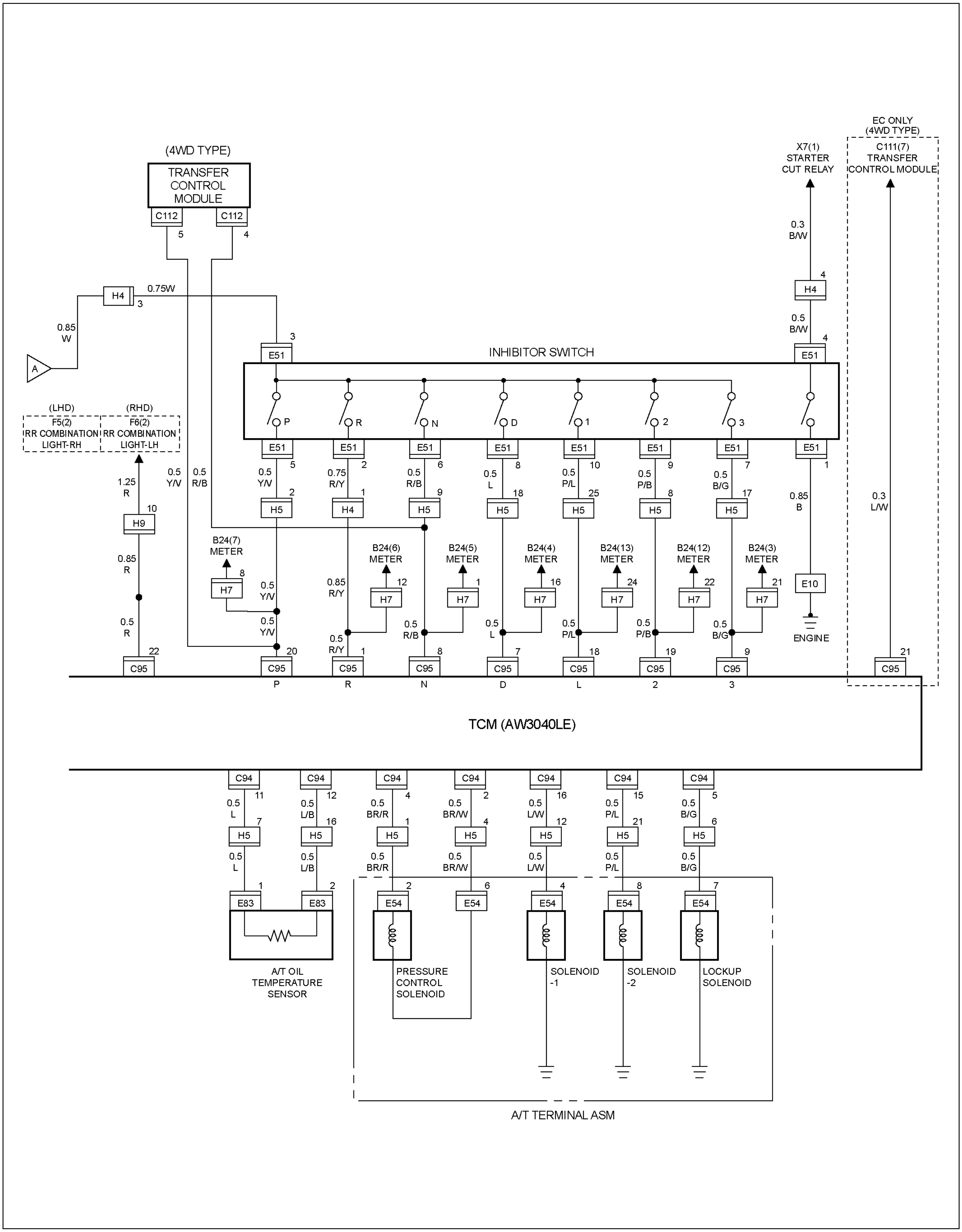
CIRCUIT DIAGRAM 4JJ1-TC (AW30-40LE)

Sheet 2/2



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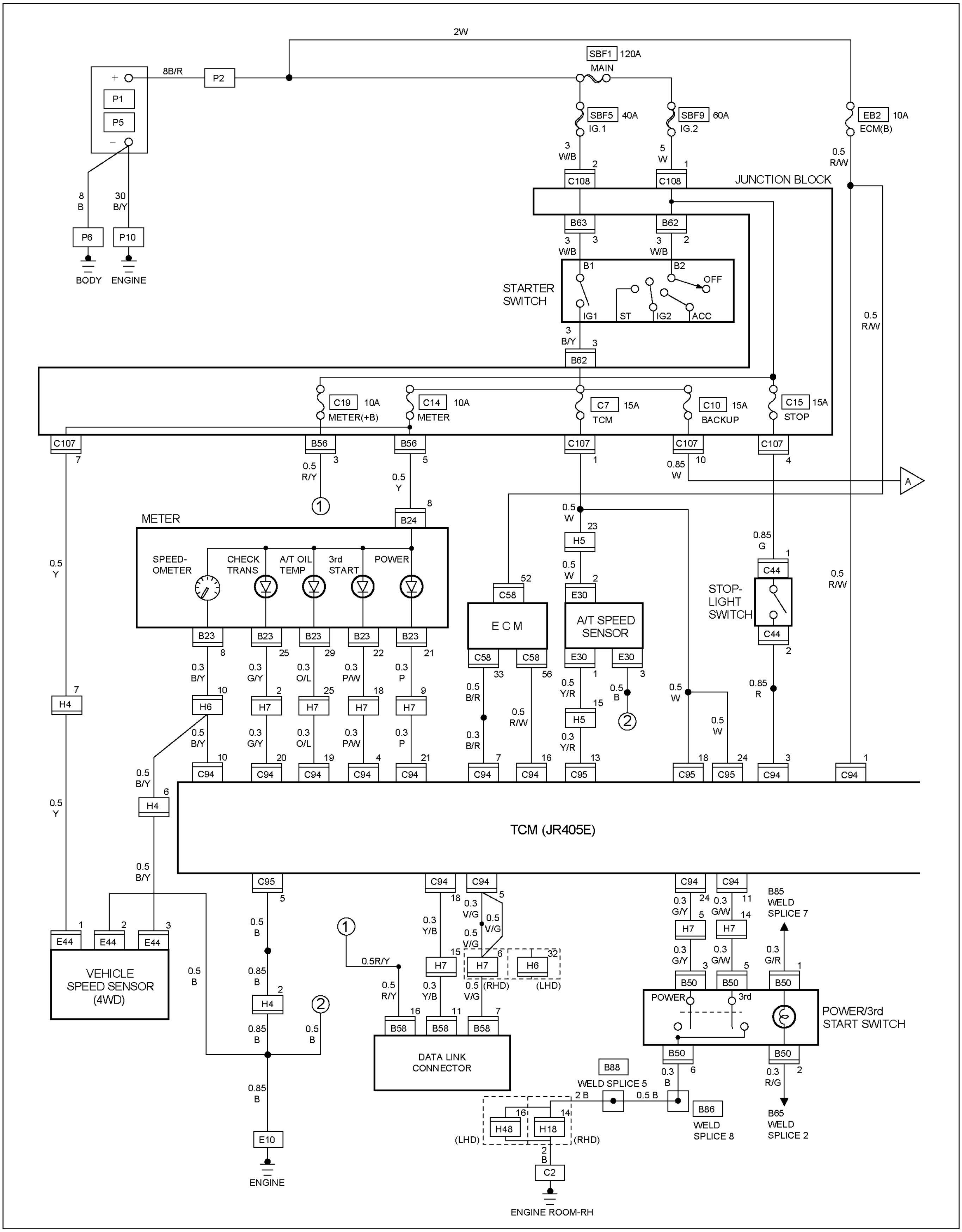
CIRCUIT DIAGRAM 4JJ1-TC (JR405E)

Sheet 1/2



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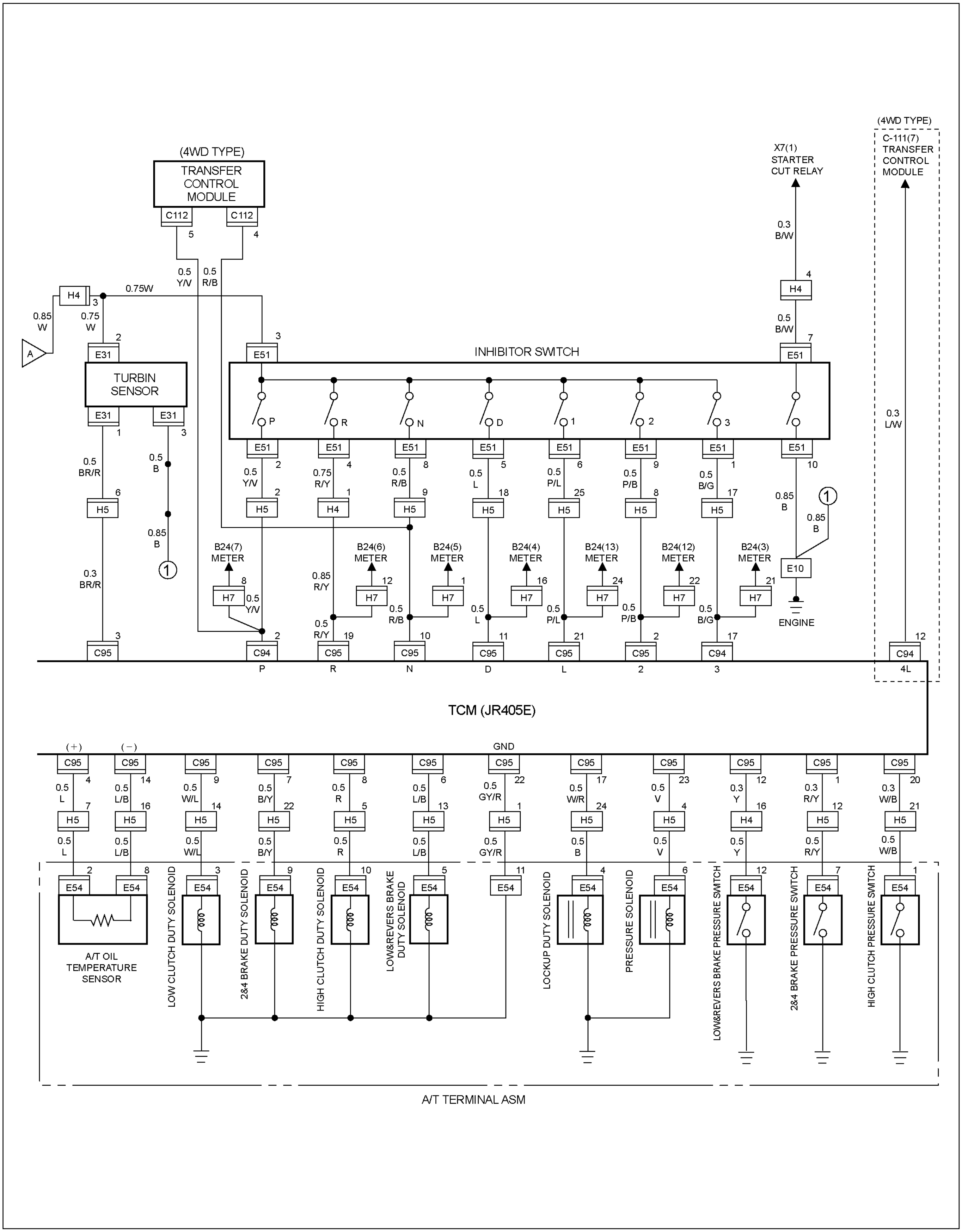
CIRCUIT DIAGRAM 4JJ1-TC (JR405E)

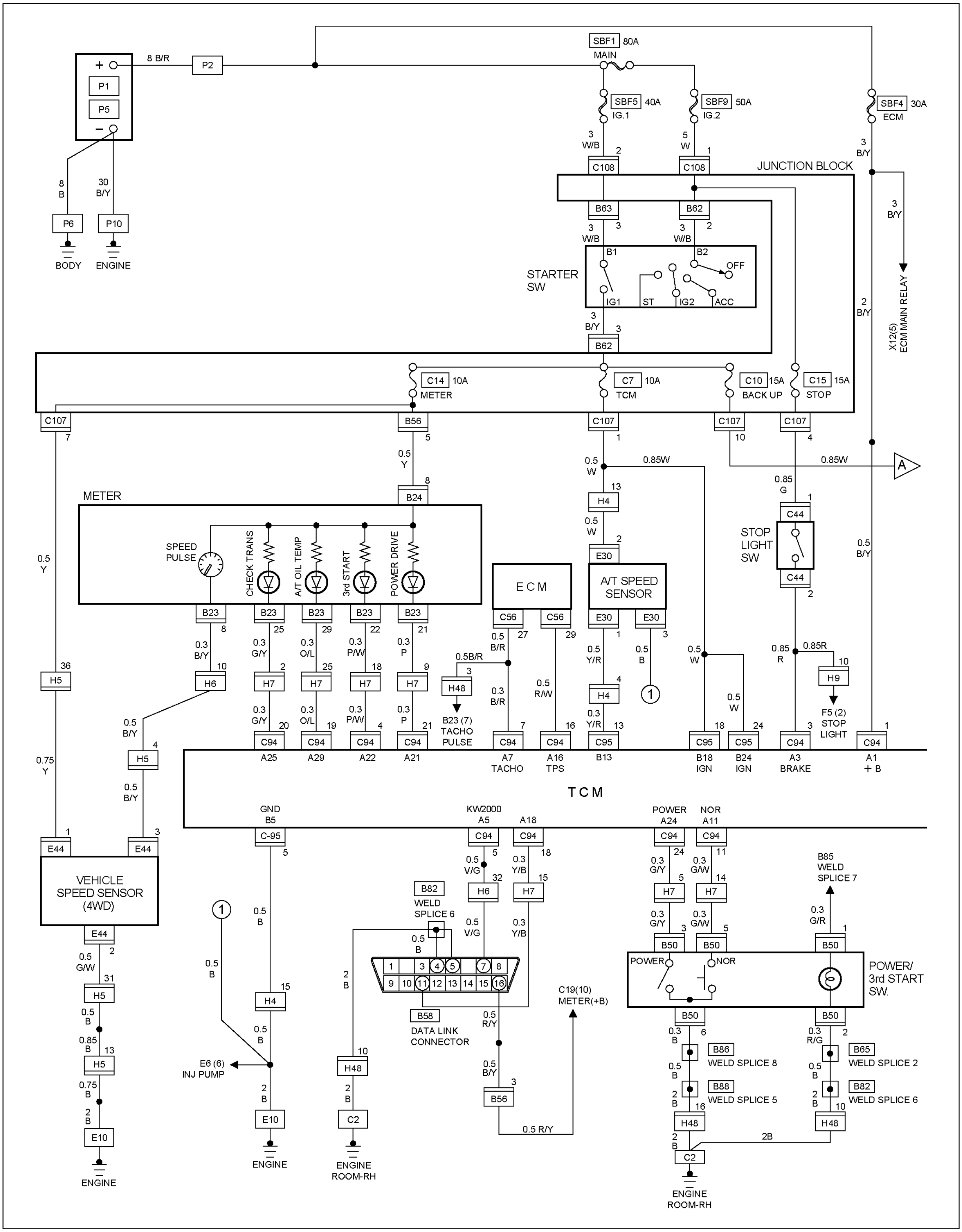
Sheet 2/2



RTW78AXF011501

CIRCUIT DIAGRAM 4JH1-TC (LHD) (JR405E)

Sheet 1/2



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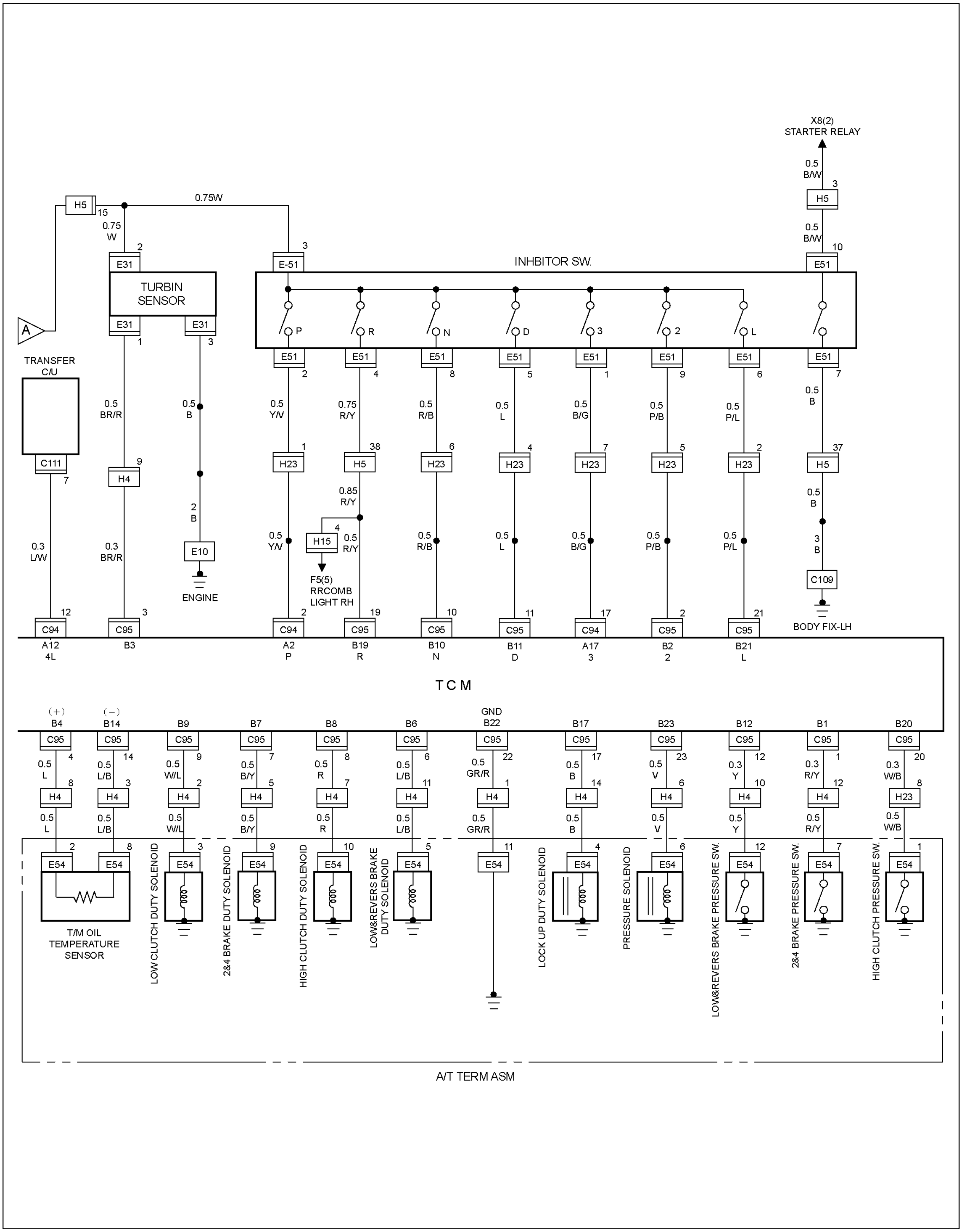
CIRCUIT DIAGRAM 4JH1-TC (LHD) (JR405E)

Sheet 2/2



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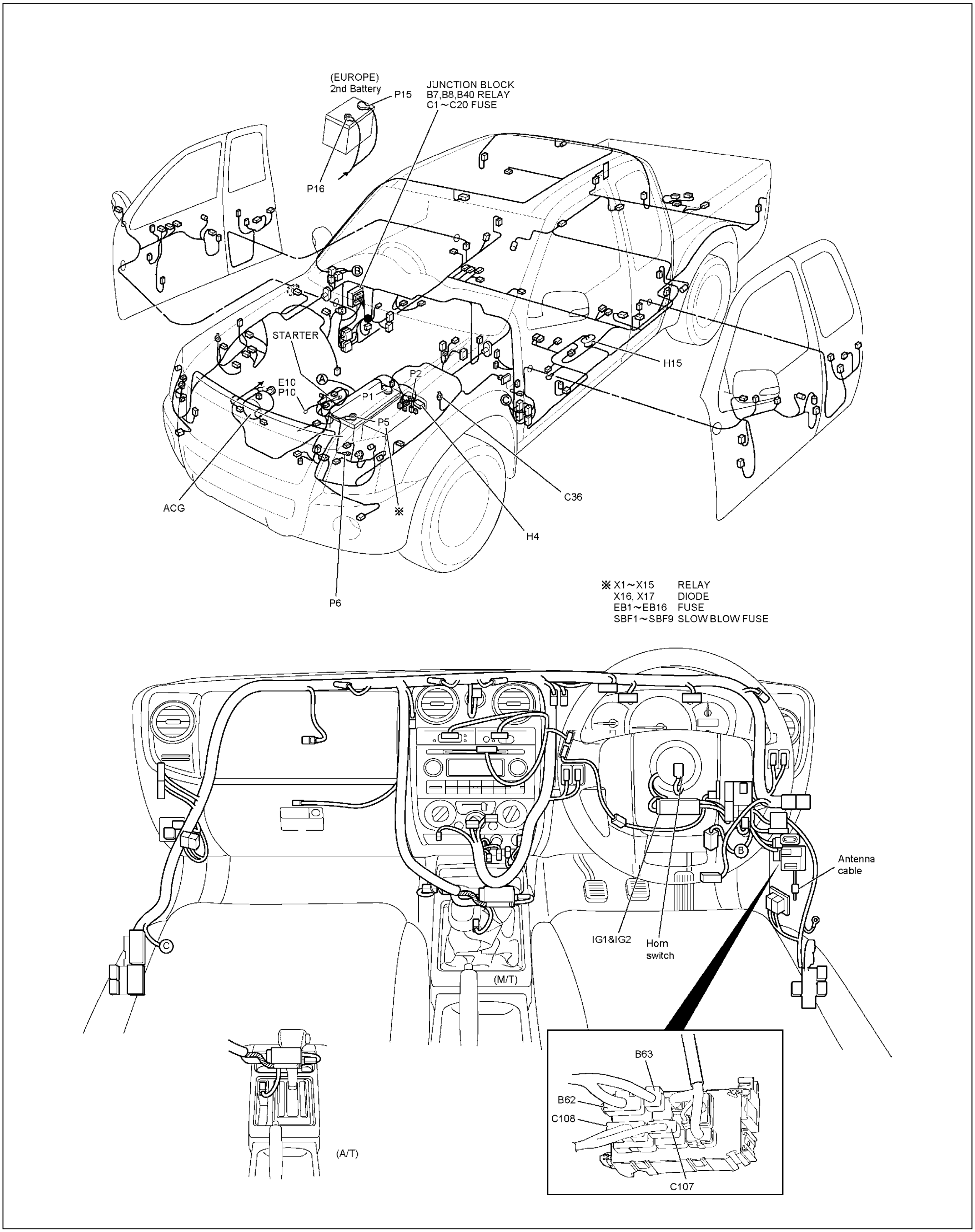
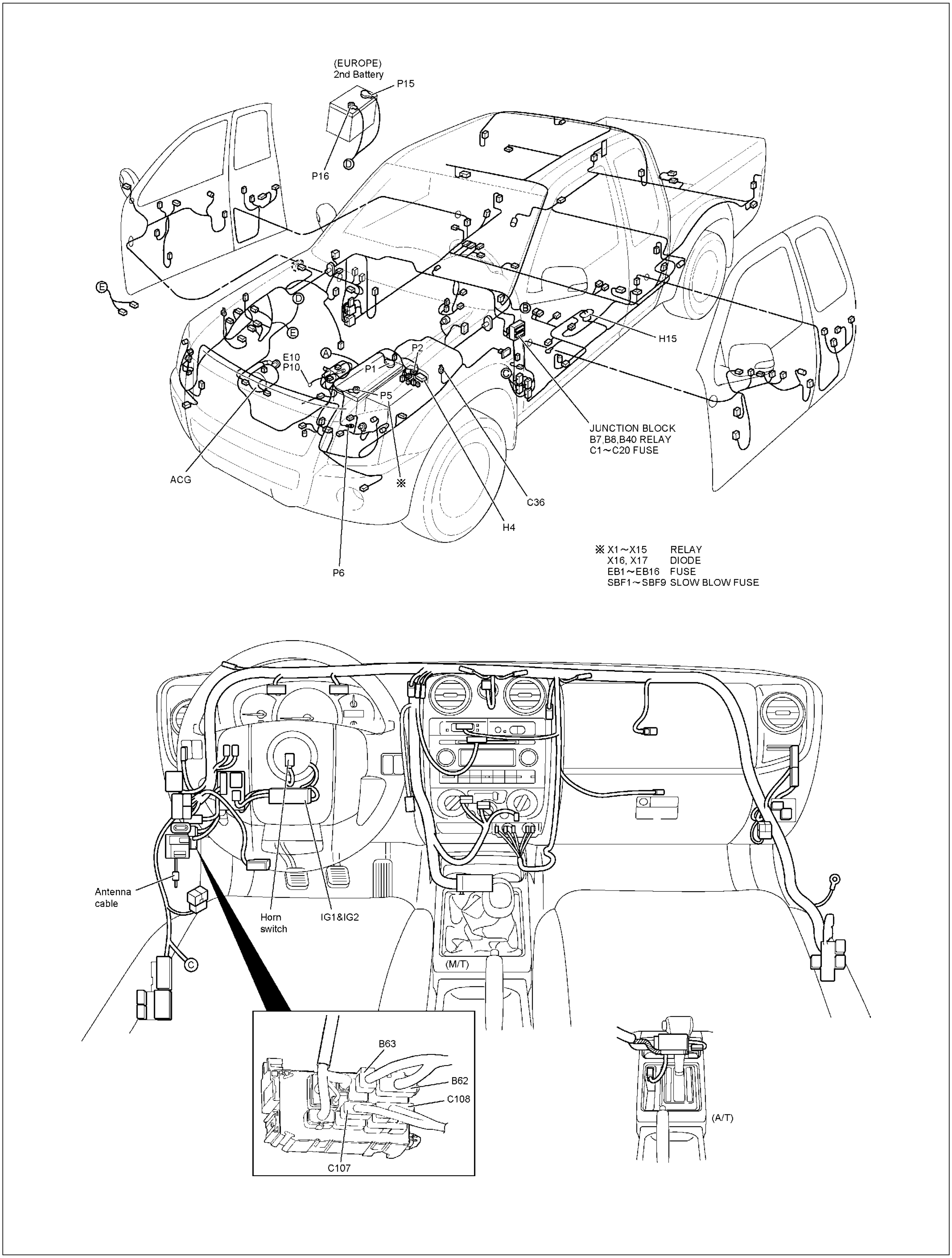
MANUAL TRANSMISSION SHIFT ASSIST

PARTS LOCATION (RHD)



RTW78AXF038701 & RTW78AXF044901

PARTS LOCATION (LHD)



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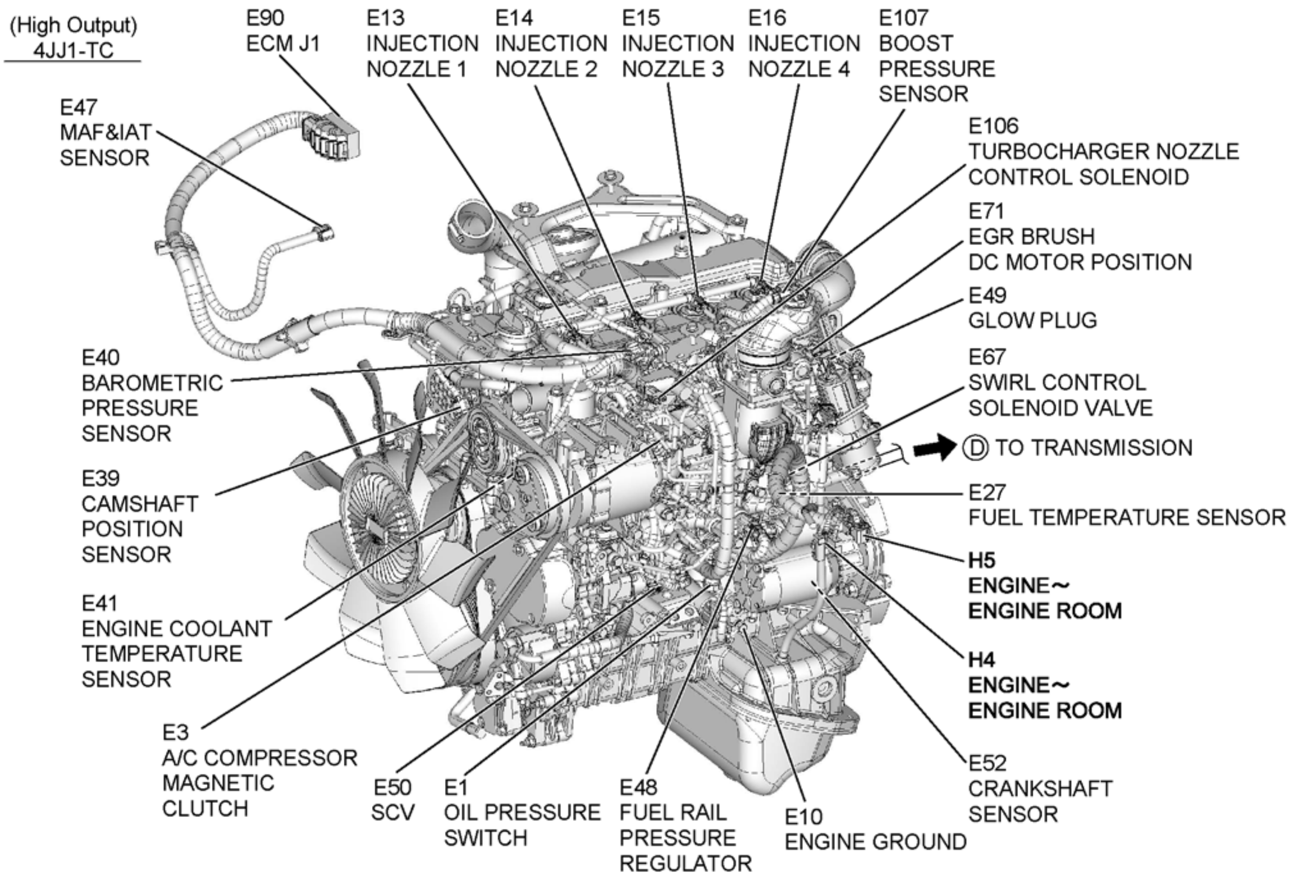
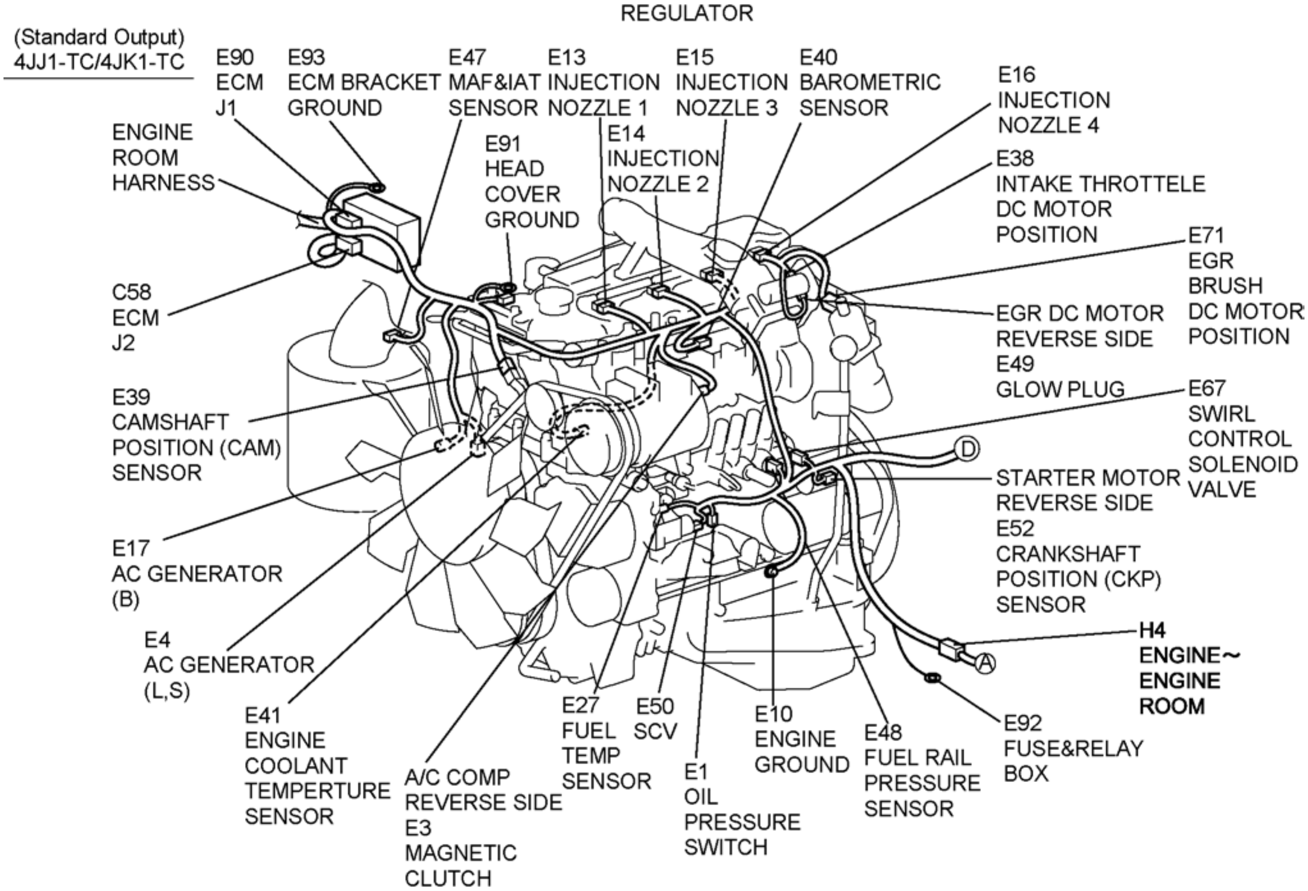
PARTS LOCATION





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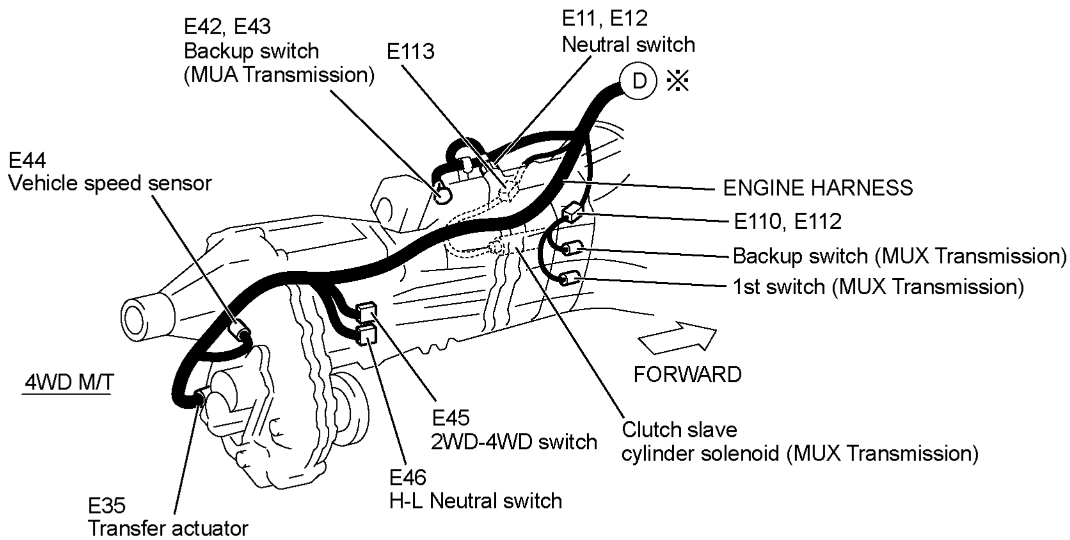
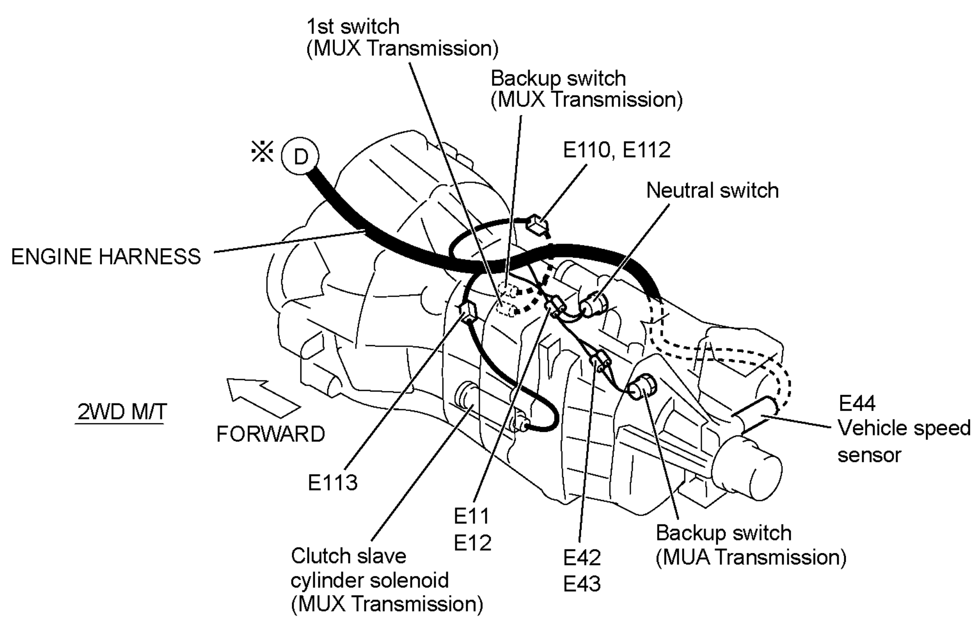
PARTS LOCATION



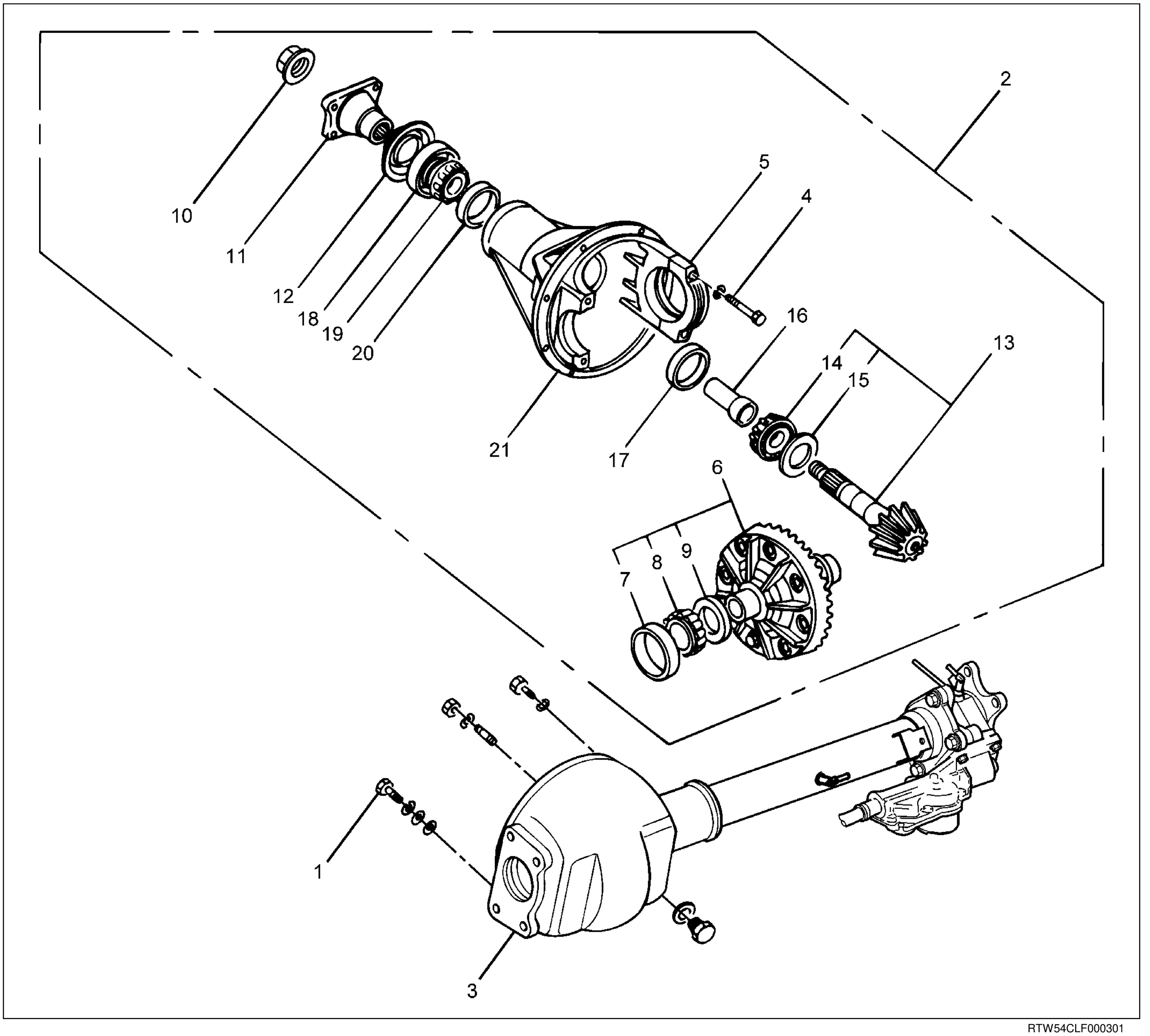


RTW780XF009401

DIFFERENTIAL

Disassembly

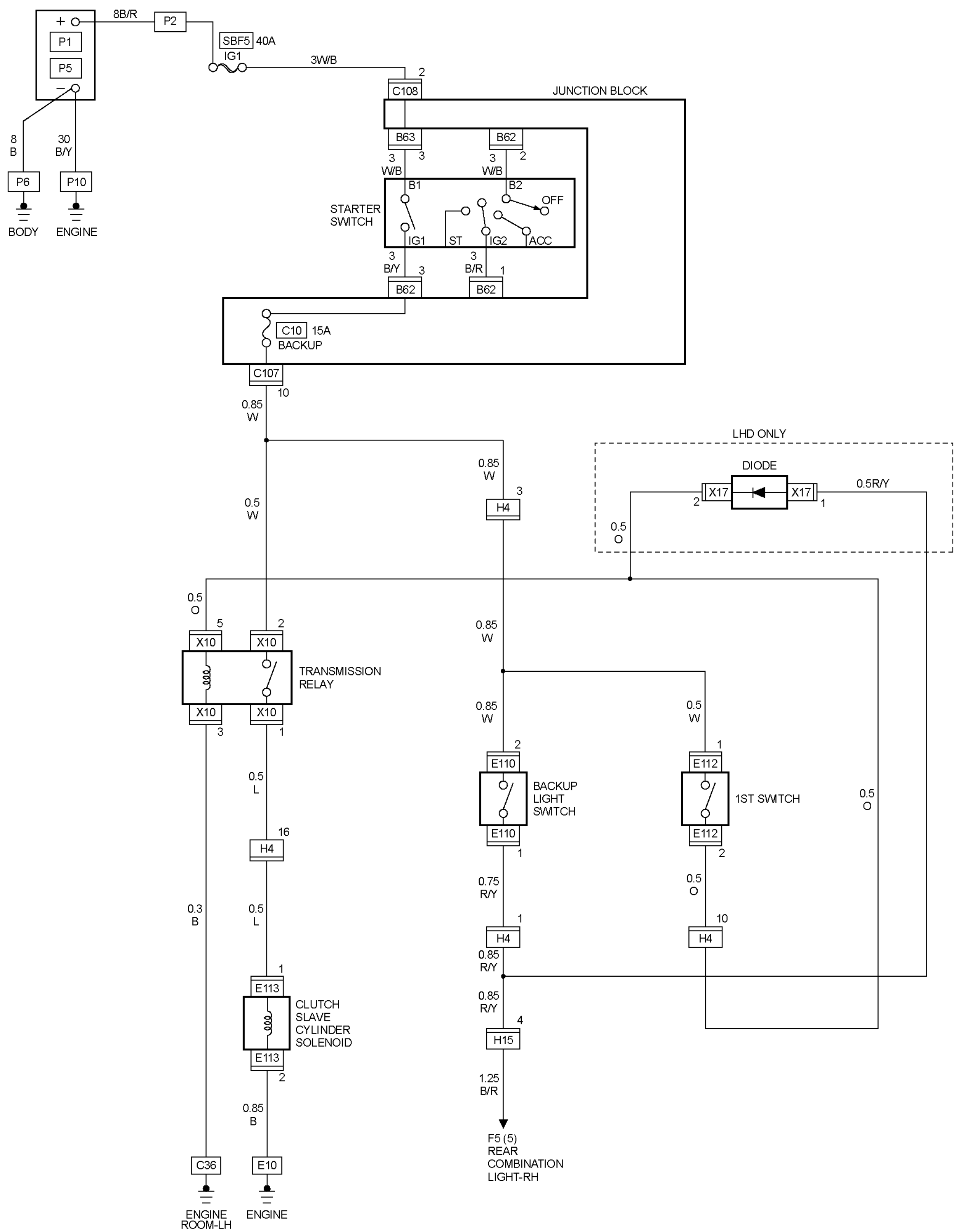
Major Components



Disassembly Steps

1. Bolt
2. Differential assembly
3. Axle case
4. Bolt
5. ▲ Bearing cap
6. Diff. cage assembly
7. ▲ Side bearing outer race
8. ▲ Side bearing
9. ▲ Adjust shims
10. ▲ Flange nut
11. Flange
12. Dust cover
13. ▲ Pinion gear
14. ▲ Inner bearing
15. Adjust shim
16. Collapsible spacer
17. ▲ Inner bearing outer race
18. Oil seal
19. Outer bearing
20. ▲ Outer bearing outer race
21. Diff. carrier

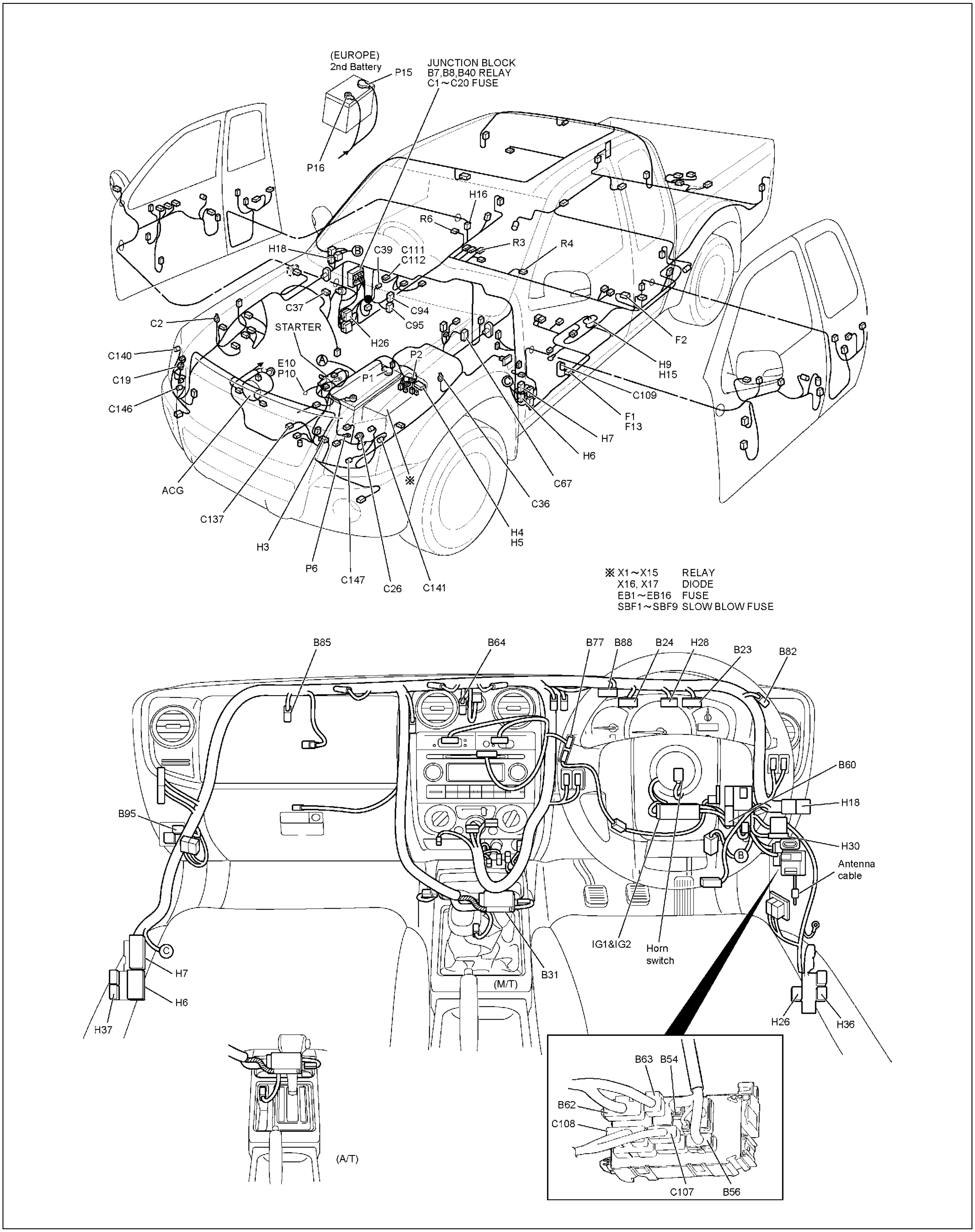
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA



RTW78AXF022801

METER, WARNING LIGHT AND INDICATOR LIGHT

PARTS LOCATION (RHD)



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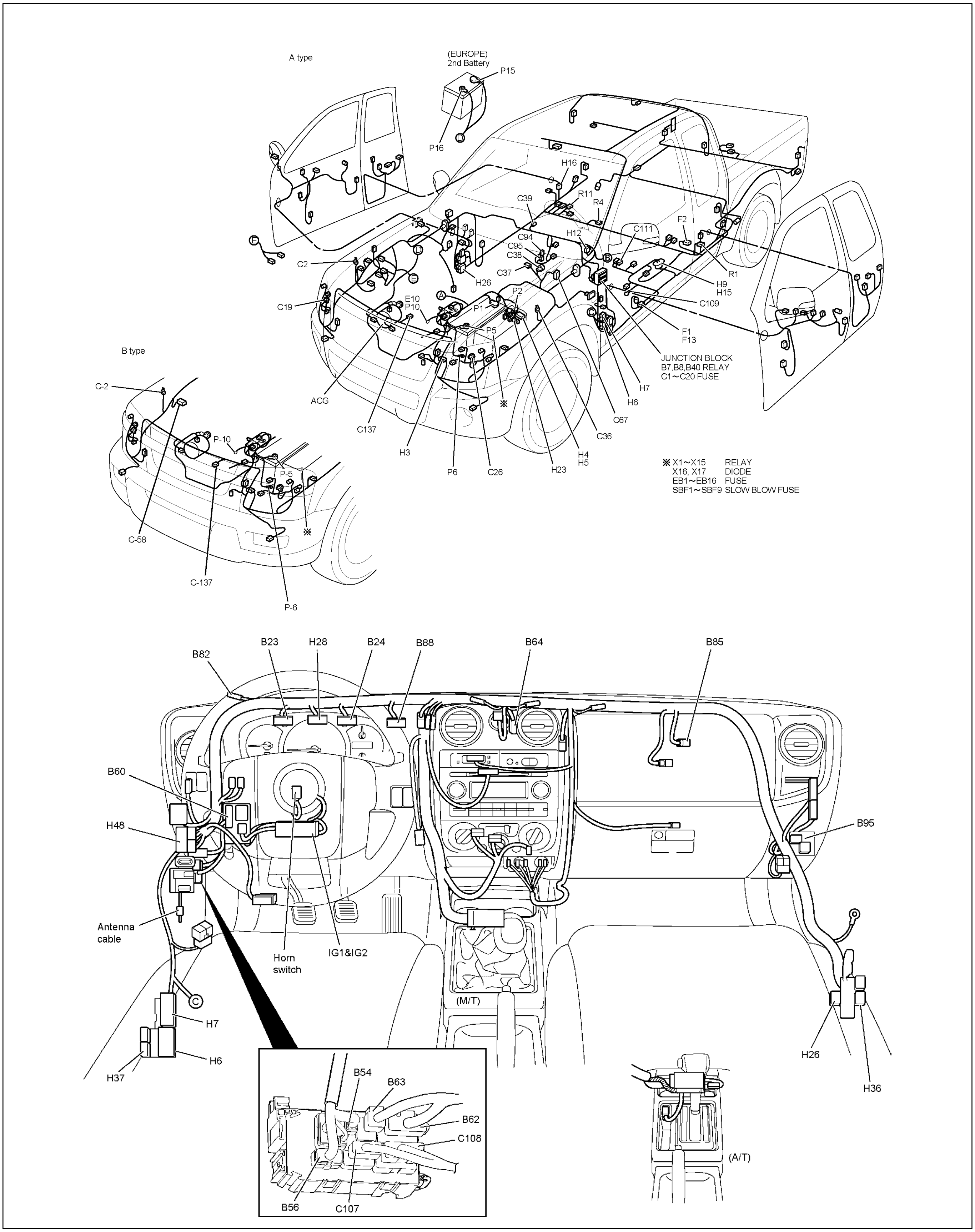
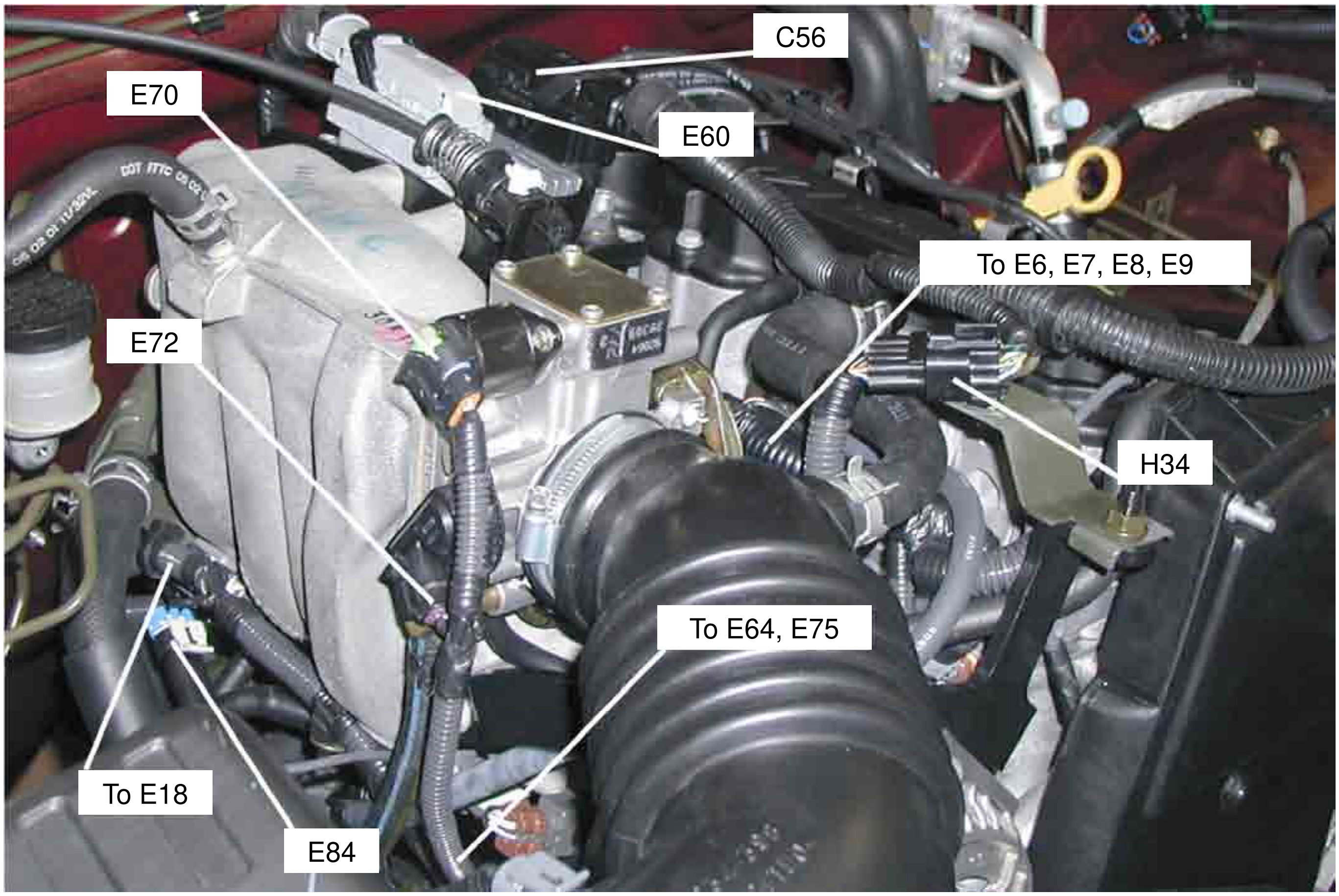
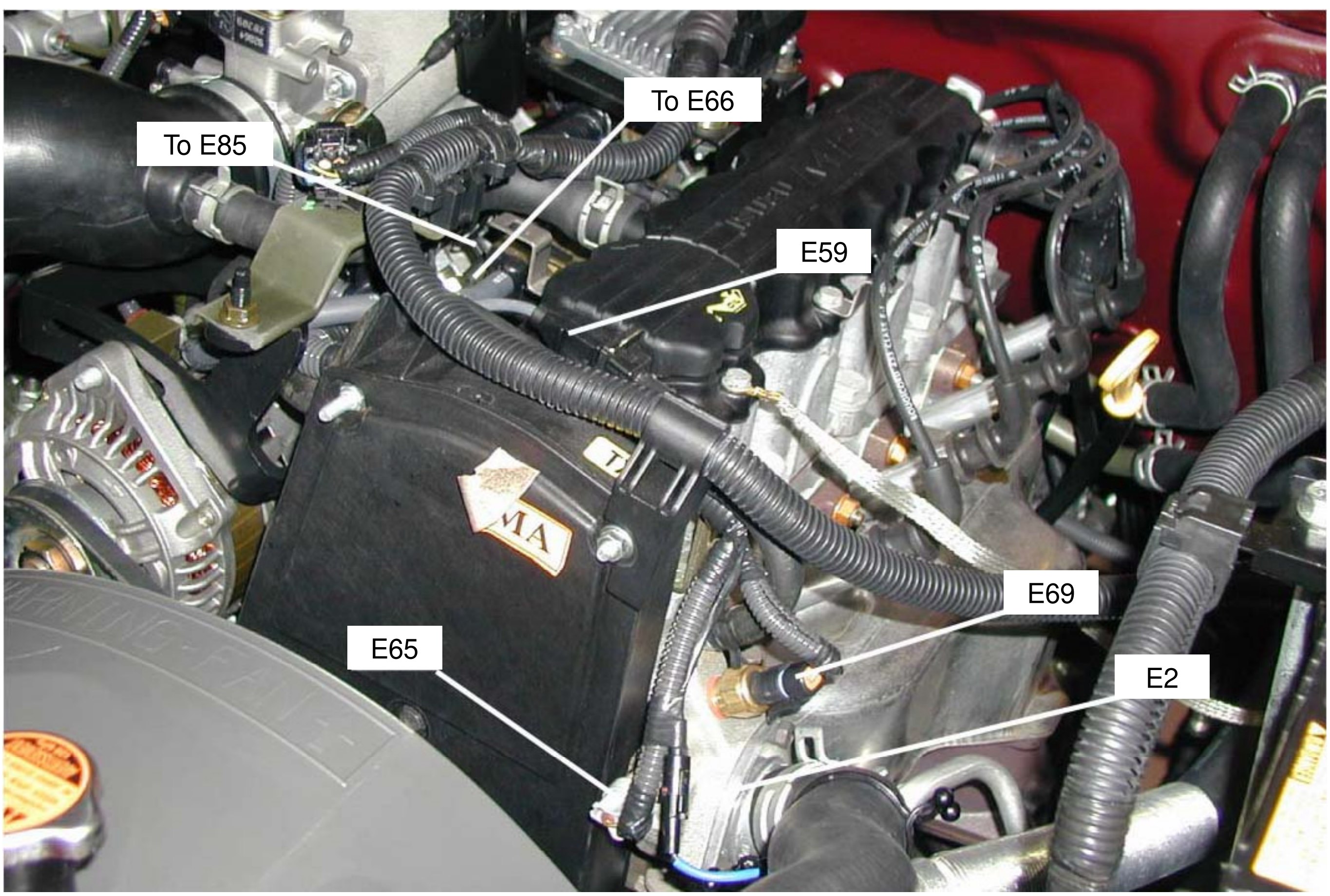
PARTS LOCATION (LHD)



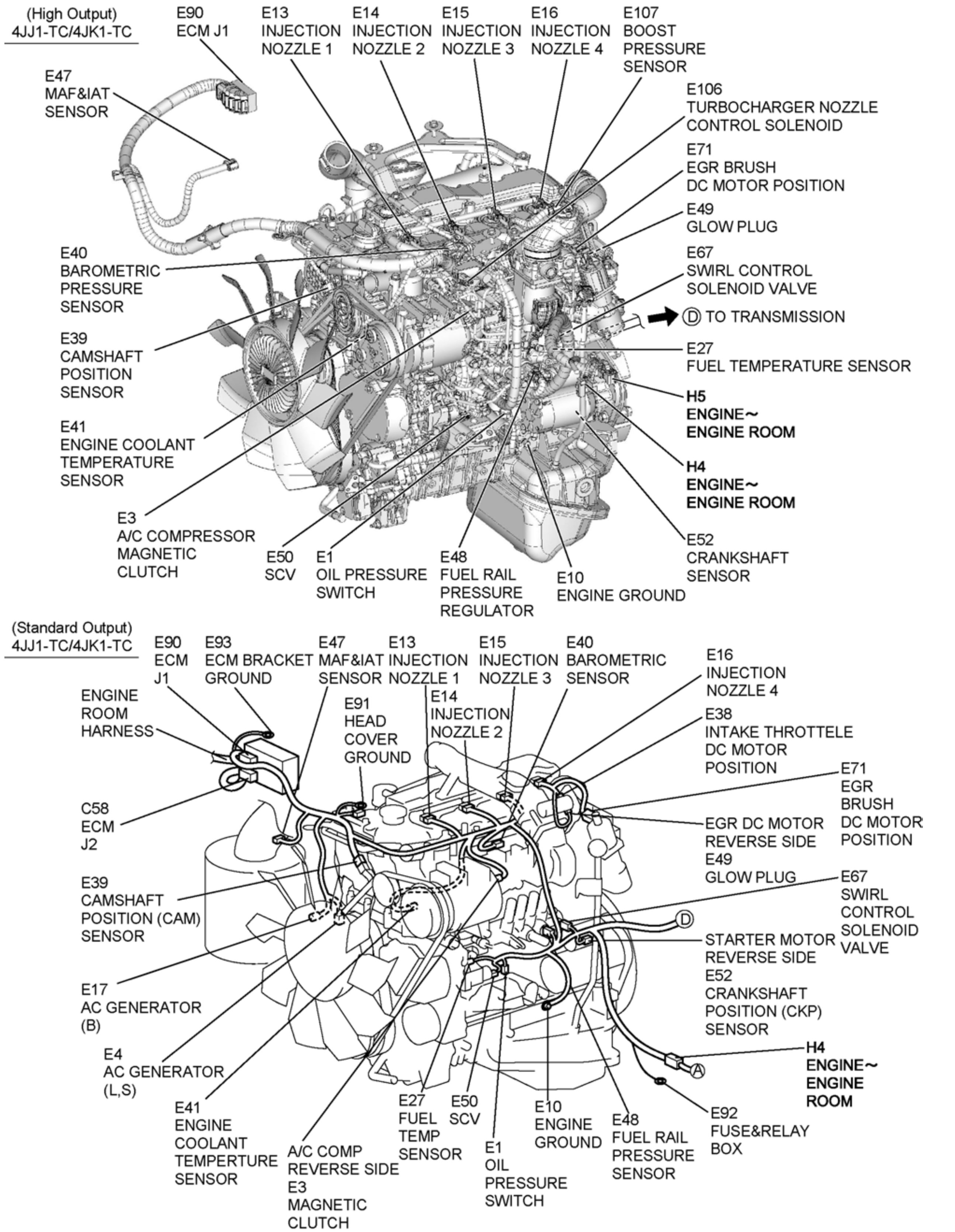
RTW78AXF039001 & RTW78AXF045201

PARTS LOCATION C24SE





PARTS LOCATION 4JJ1-TC/4JK1-TC



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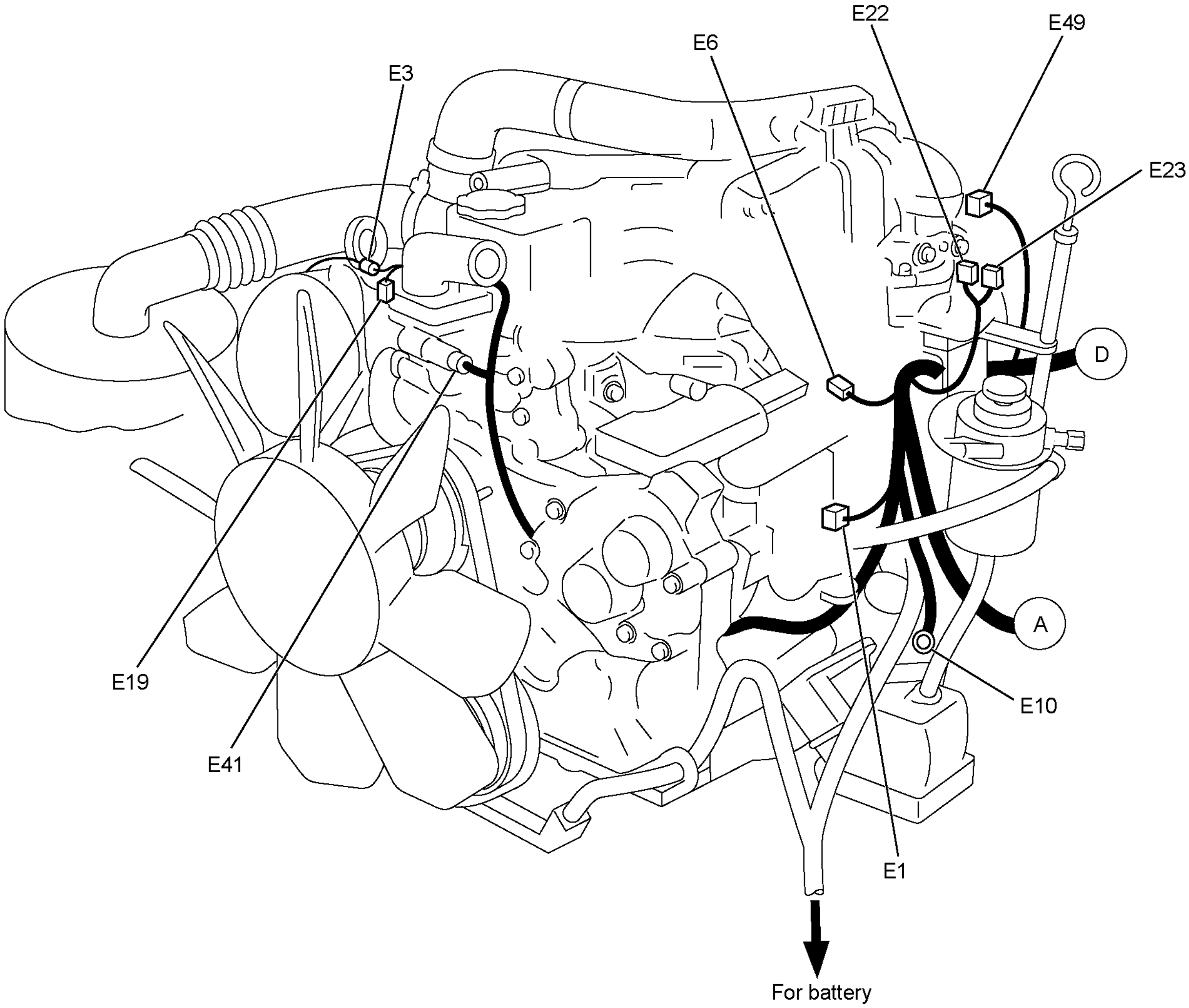
PARTS LOCATION 4JH1-TC



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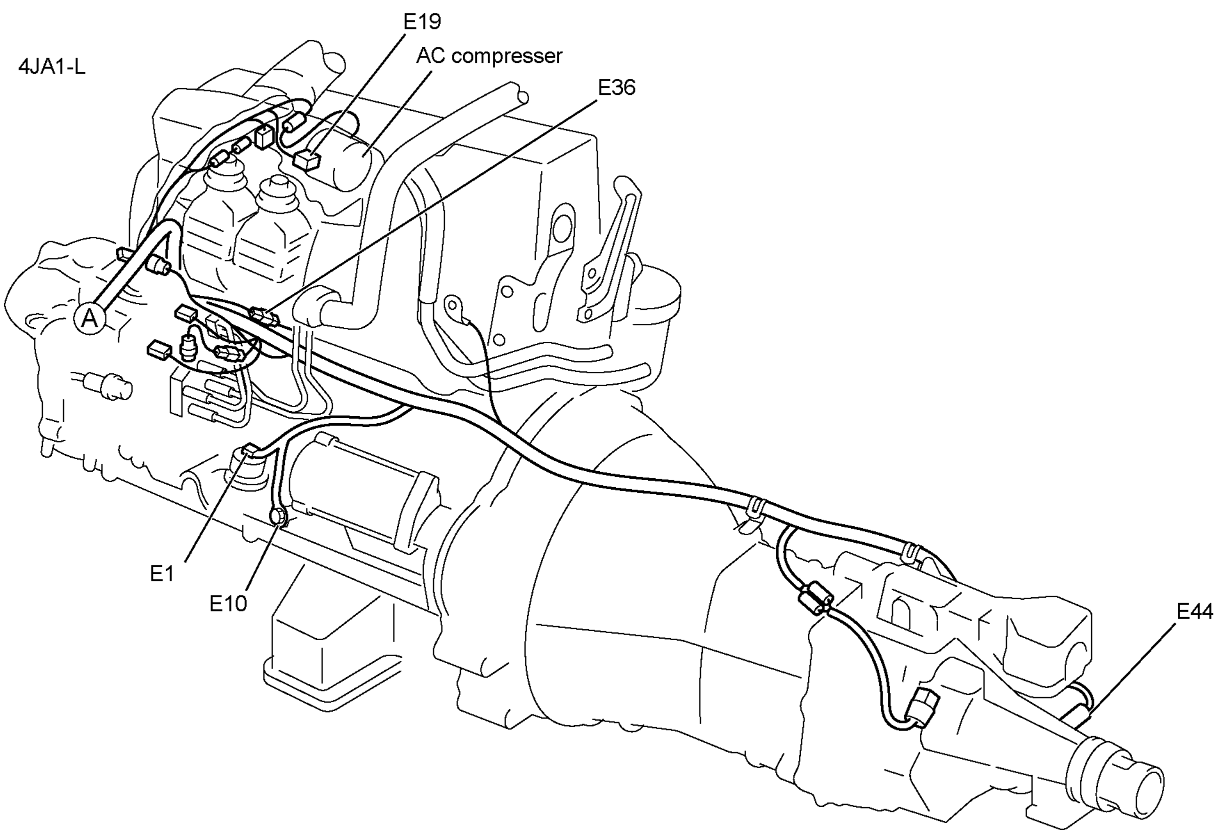
PARTS LOCATION 4JA1-L



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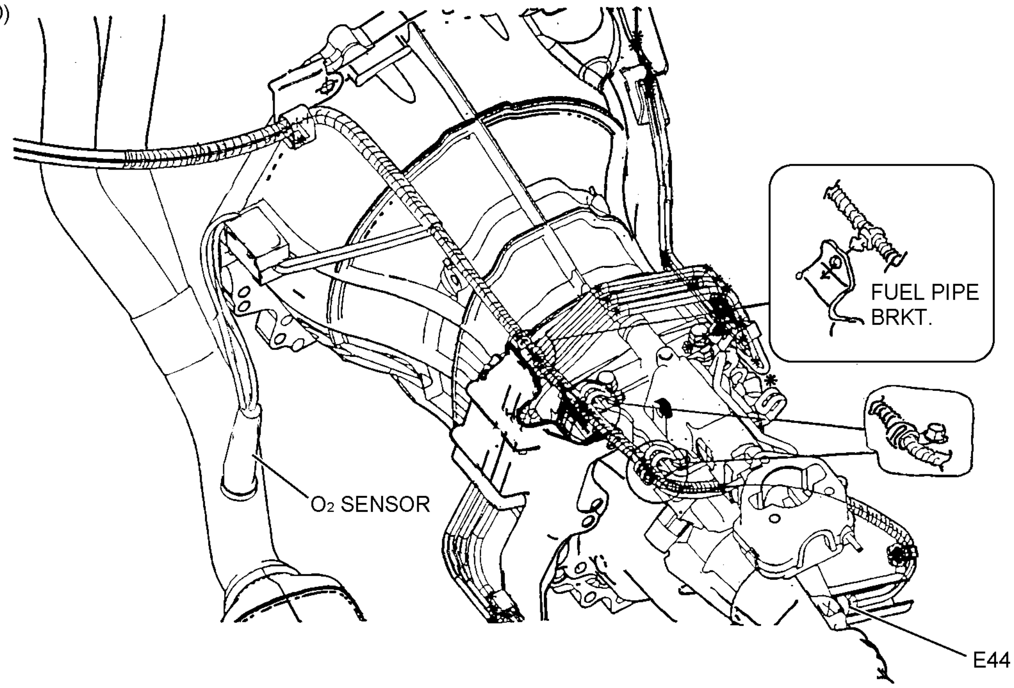
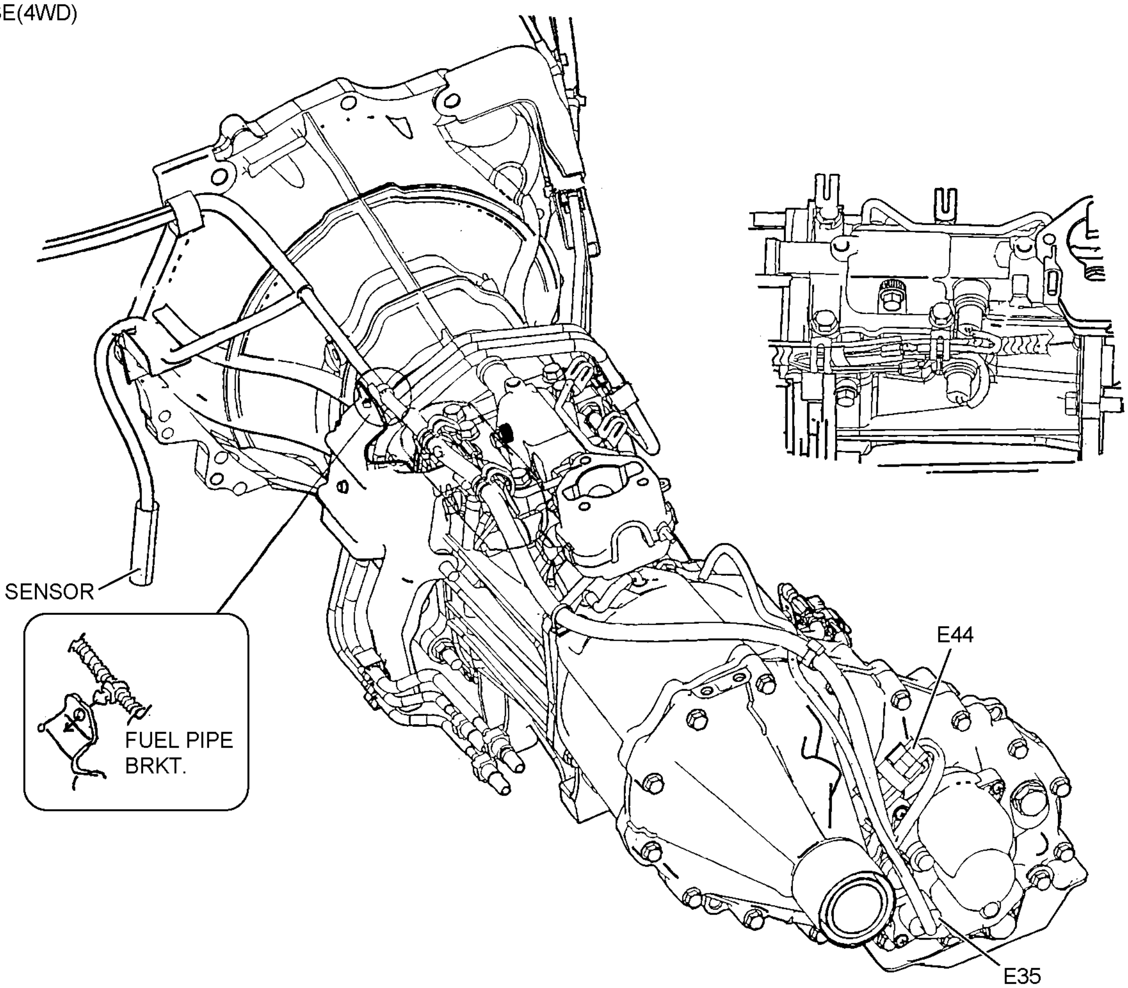
PARTS LOCATION

C24SE(2WD)



C24SE(4WD)



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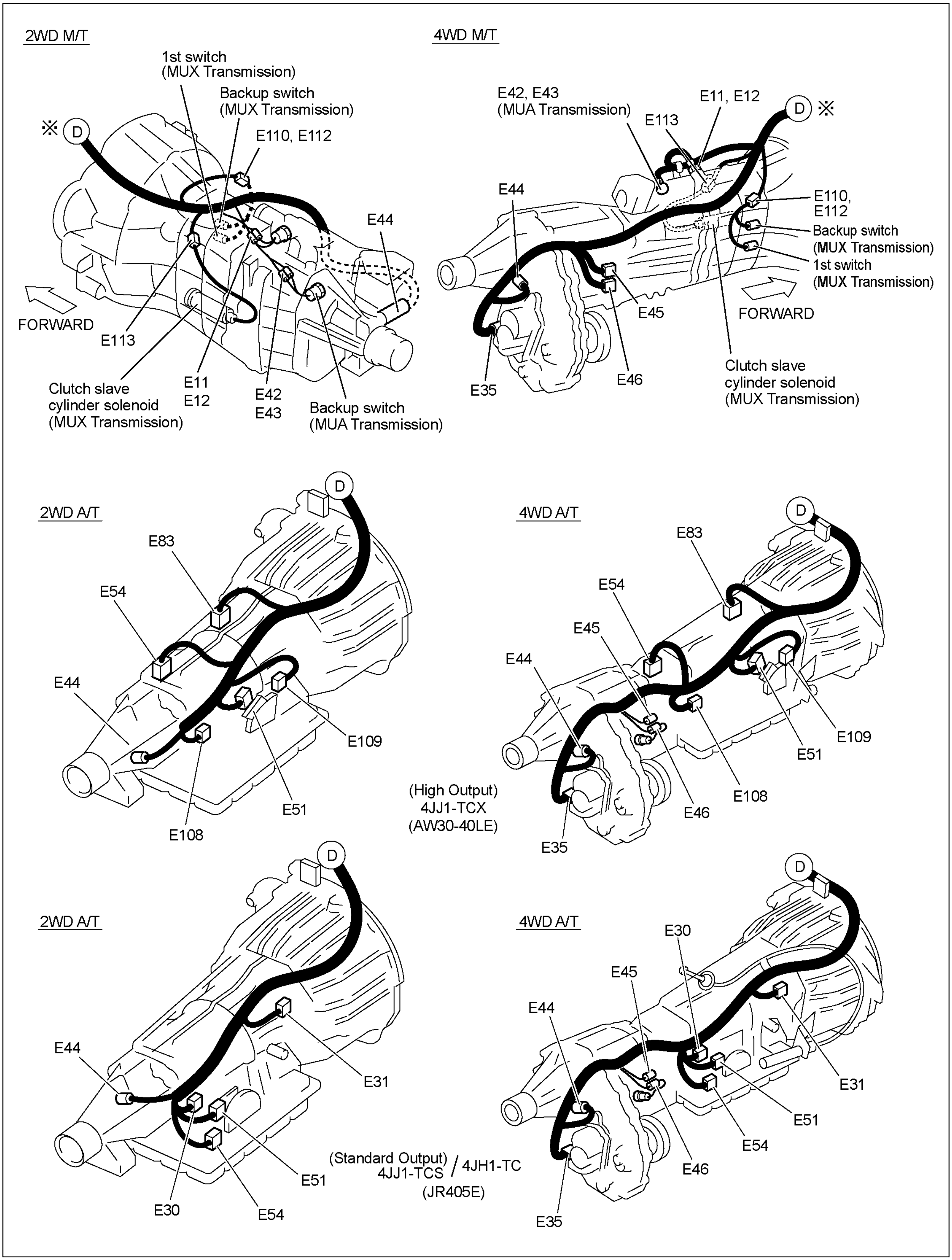
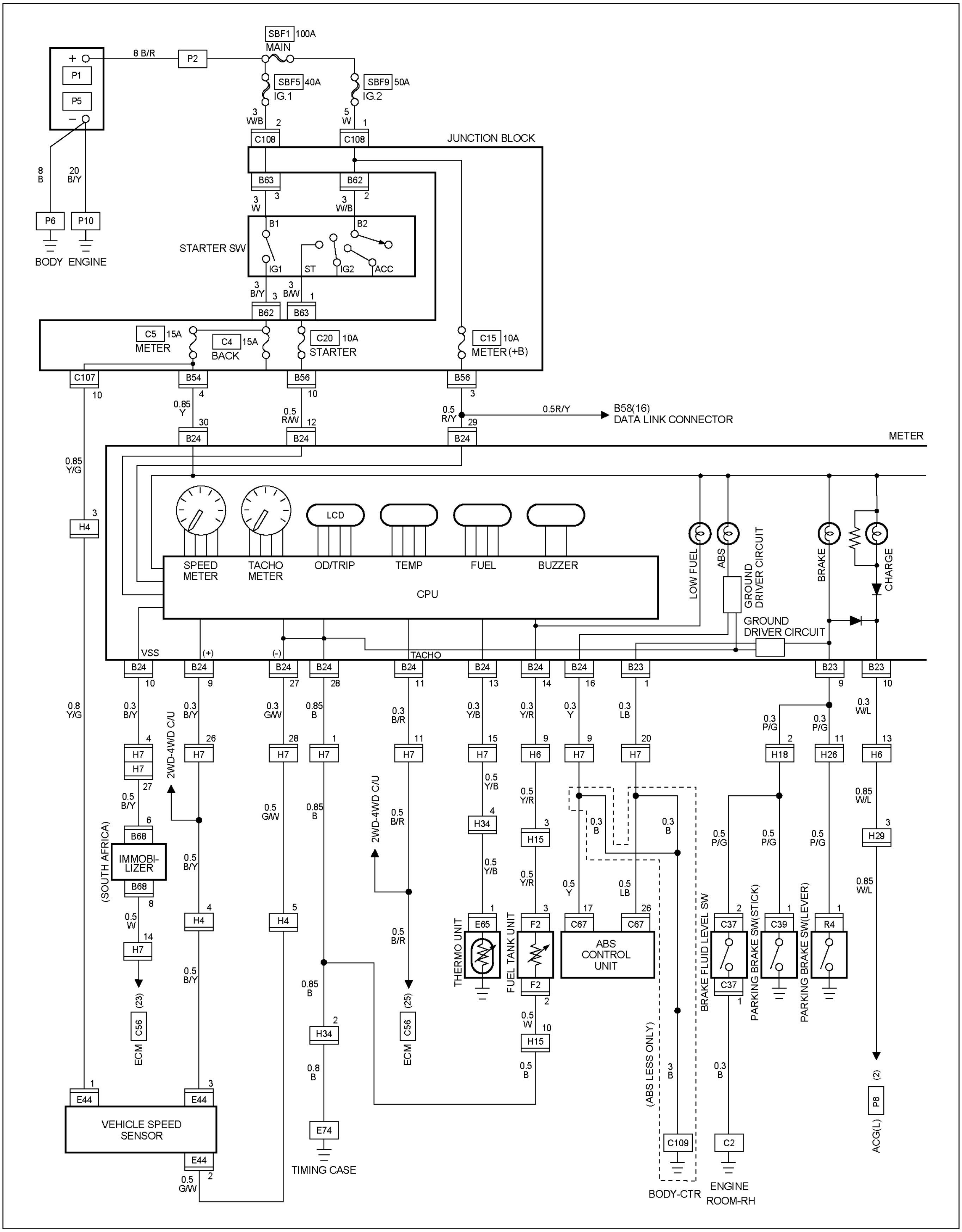
PARTS LOCATION



RTW78AXF023701

CIRCUIT DIAGRAM C24SE (RHD)

Sheet 1/3



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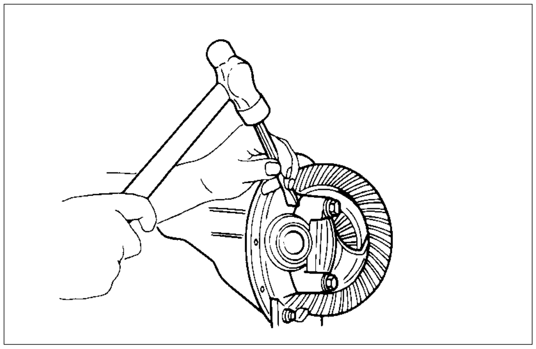
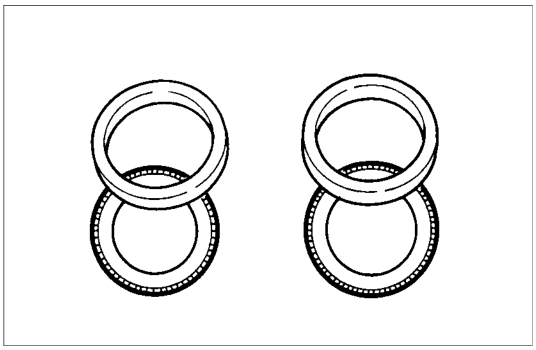
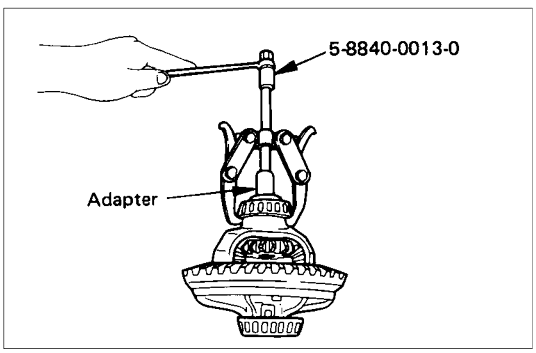


Important Operations

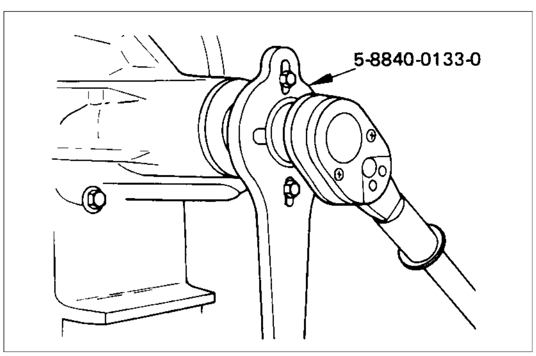
5. Bearing Cap
Apply a setting mark to the side bearing cap and the differential carrier.



7. Side Bearing Outer Race
After removal, keep the right and left hand side bearing assemblies separate to maintain inner and outer race combinations.



8. Side Bearing
Remover : 5-8840-0013-0
Adapter : 9-8521-1743-0

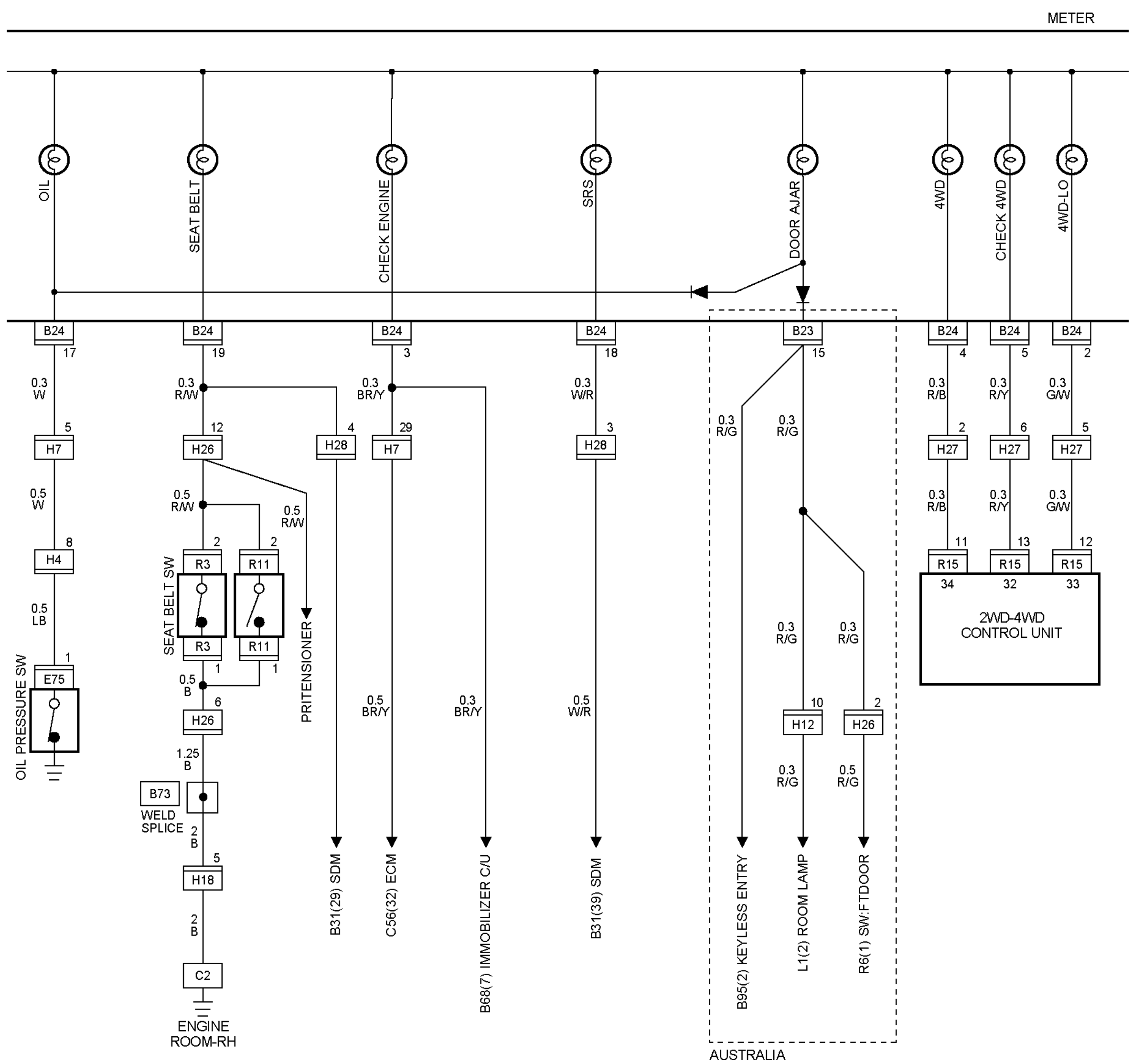


9. Adjust Shims
Note the thickness and position of the shims removed.

10. Flange Nut
Pinion flange holder : 5-8840-0133-0

CIRCUIT DIAGRAM C24SE (RHD)

Sheet 2/3



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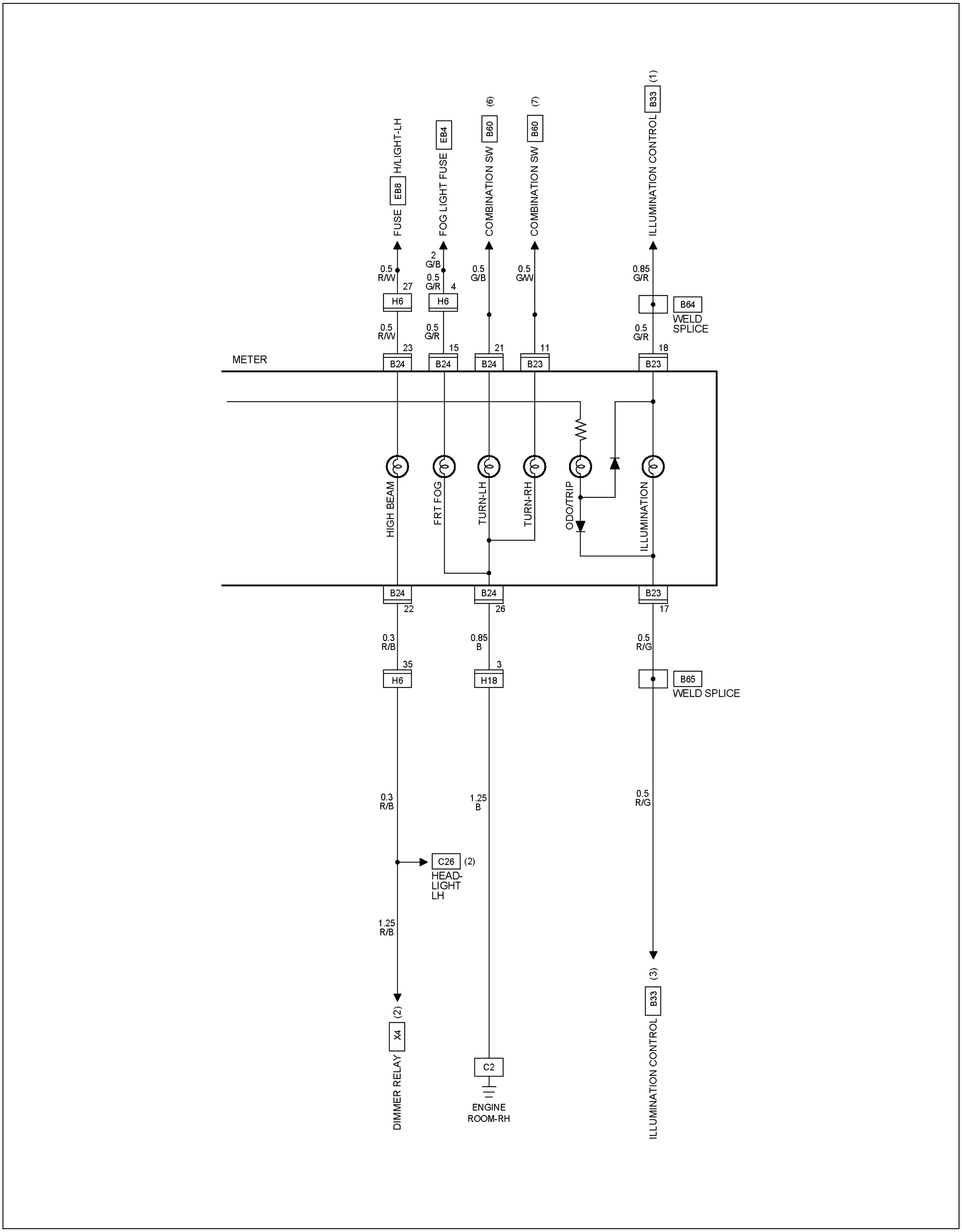
CIRCUIT DIAGRAM C24SE (RHD)

Sheet 3/3



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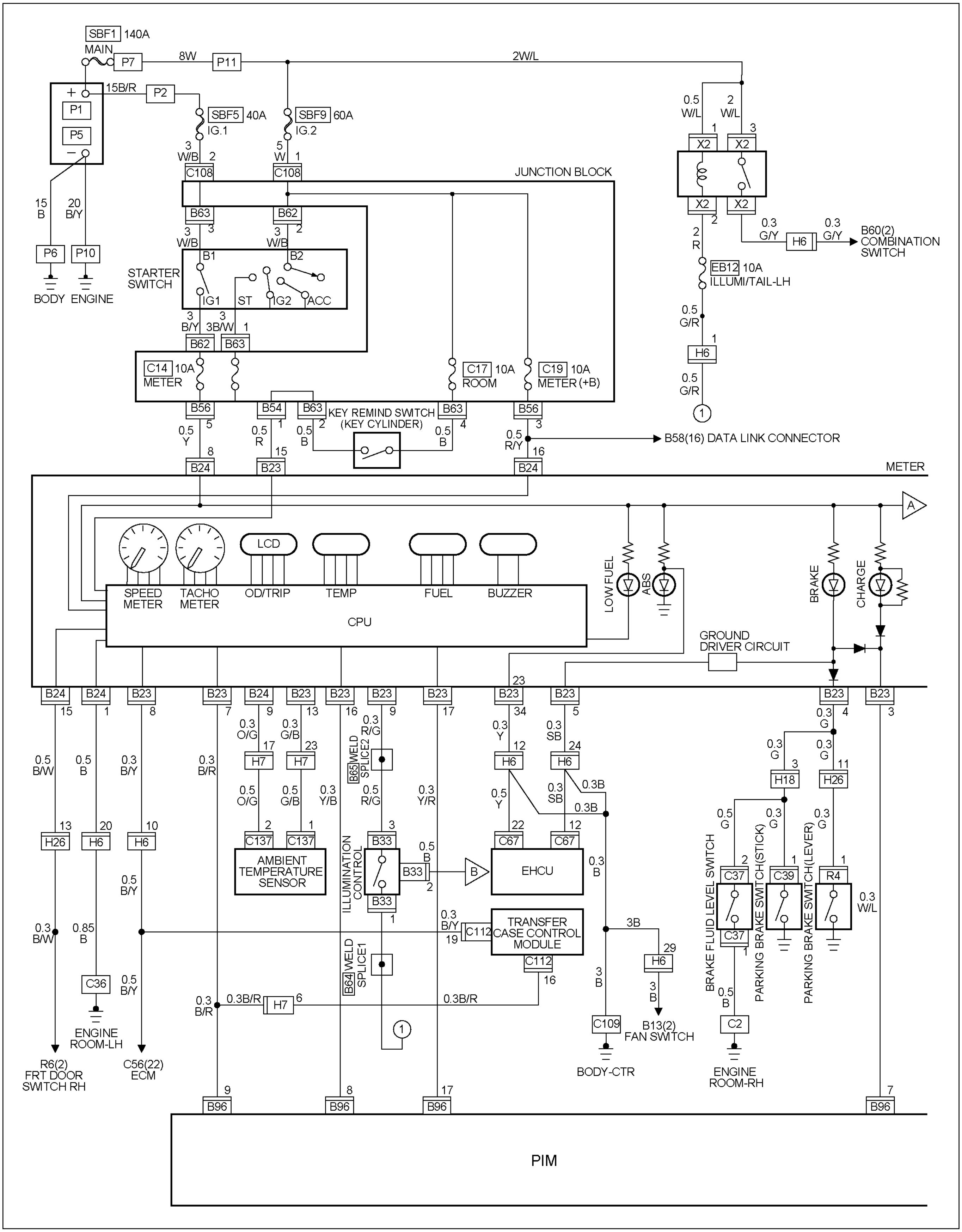
CIRCUIT DIAGRAM HFV6 (RHD) G.EXP

Sheet 1/3



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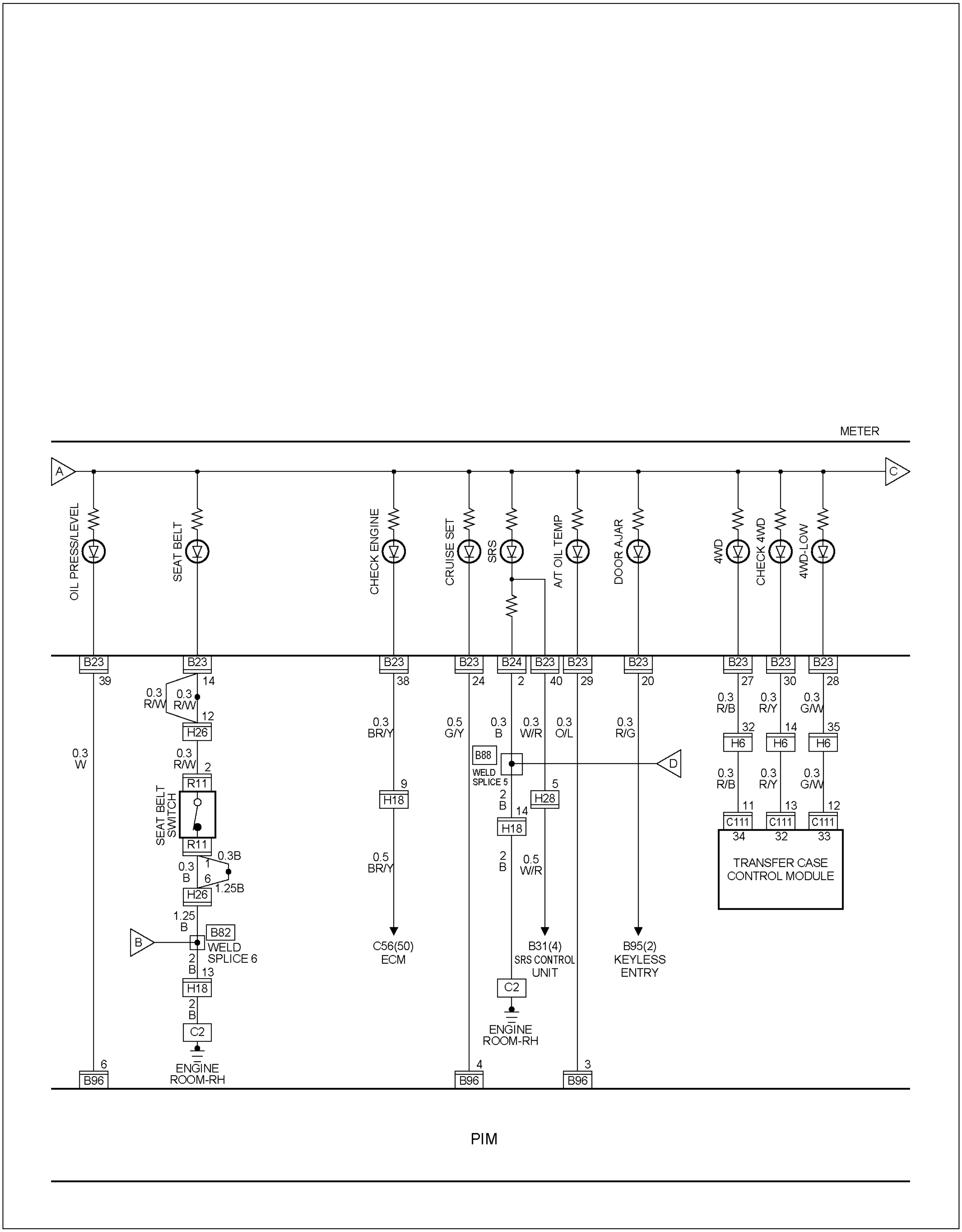
CIRCUIT DIAGRAM HFV6 (RHD) G.EXP

Sheet 2/3



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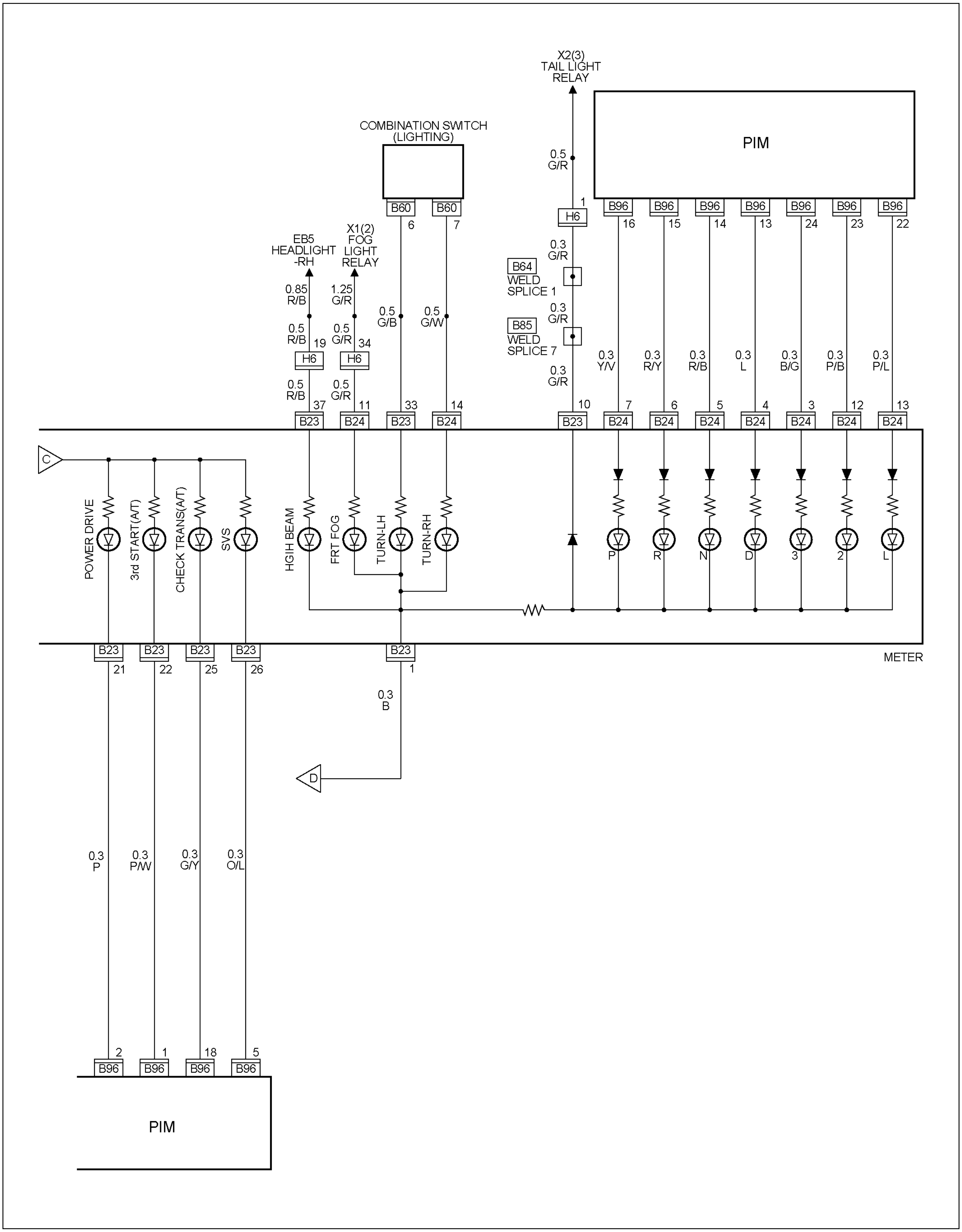
CIRCUIT DIAGRAM HFV6 (RHD) G.EXP

Sheet 3/3



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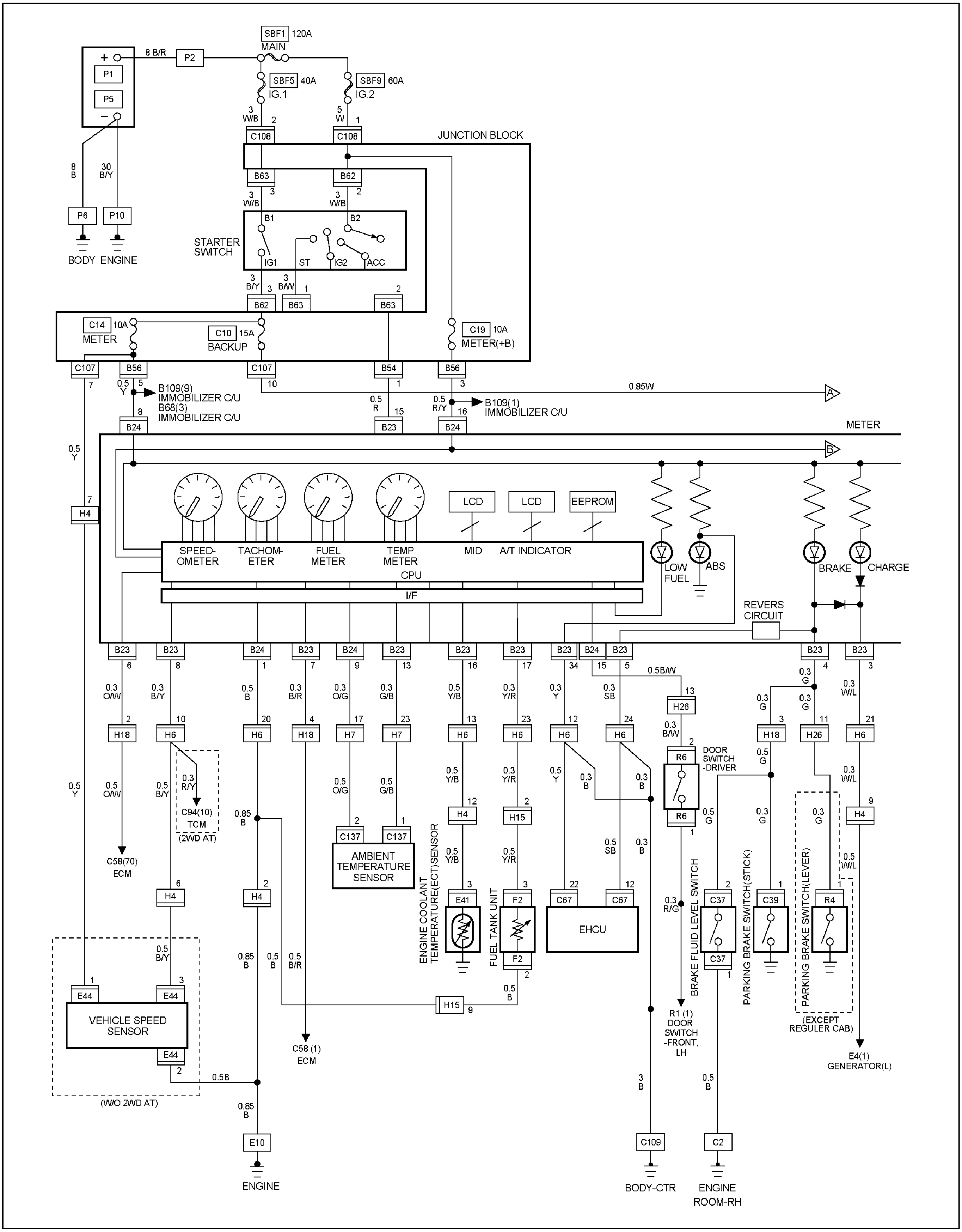
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 1/3



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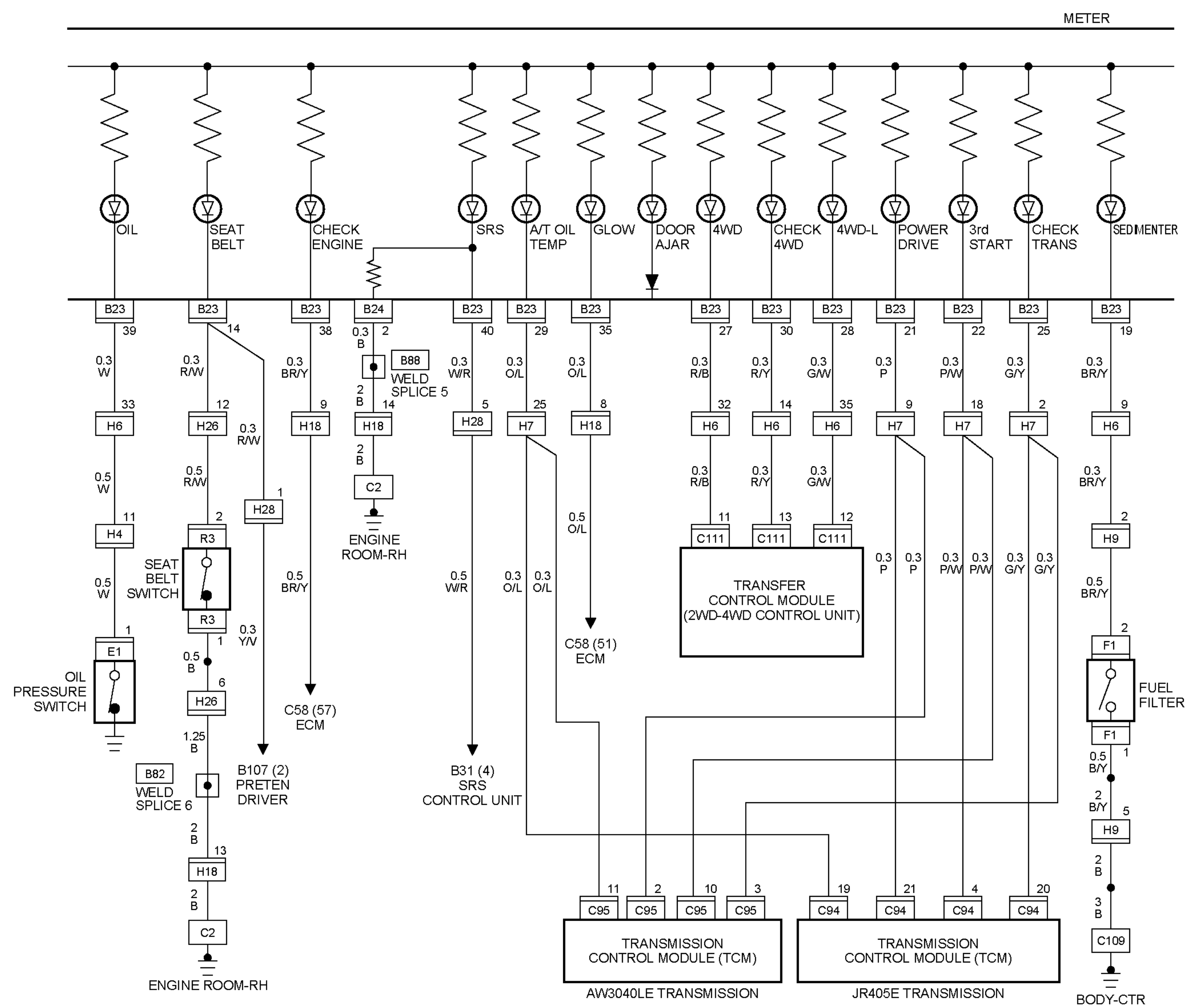
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 2/3



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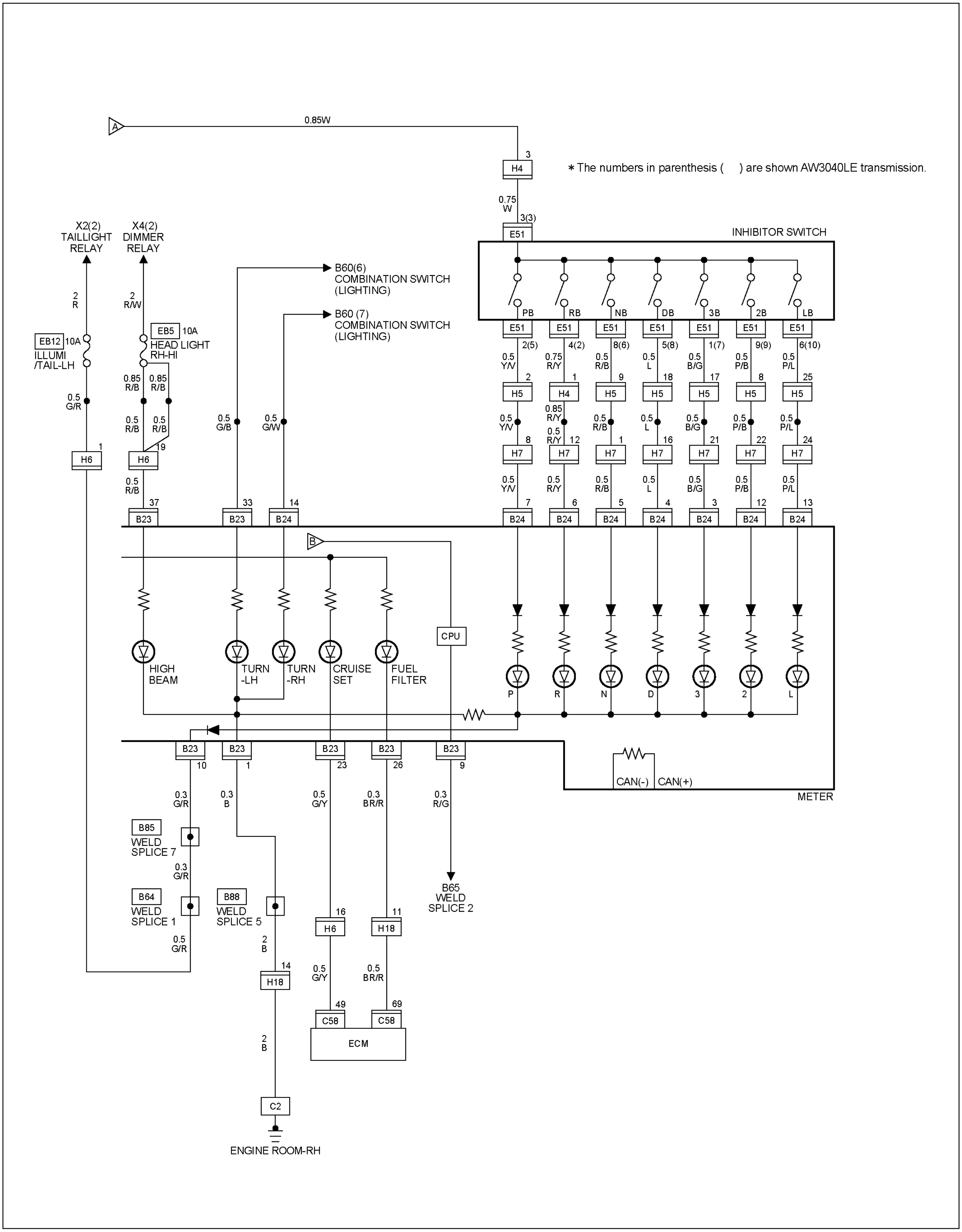
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

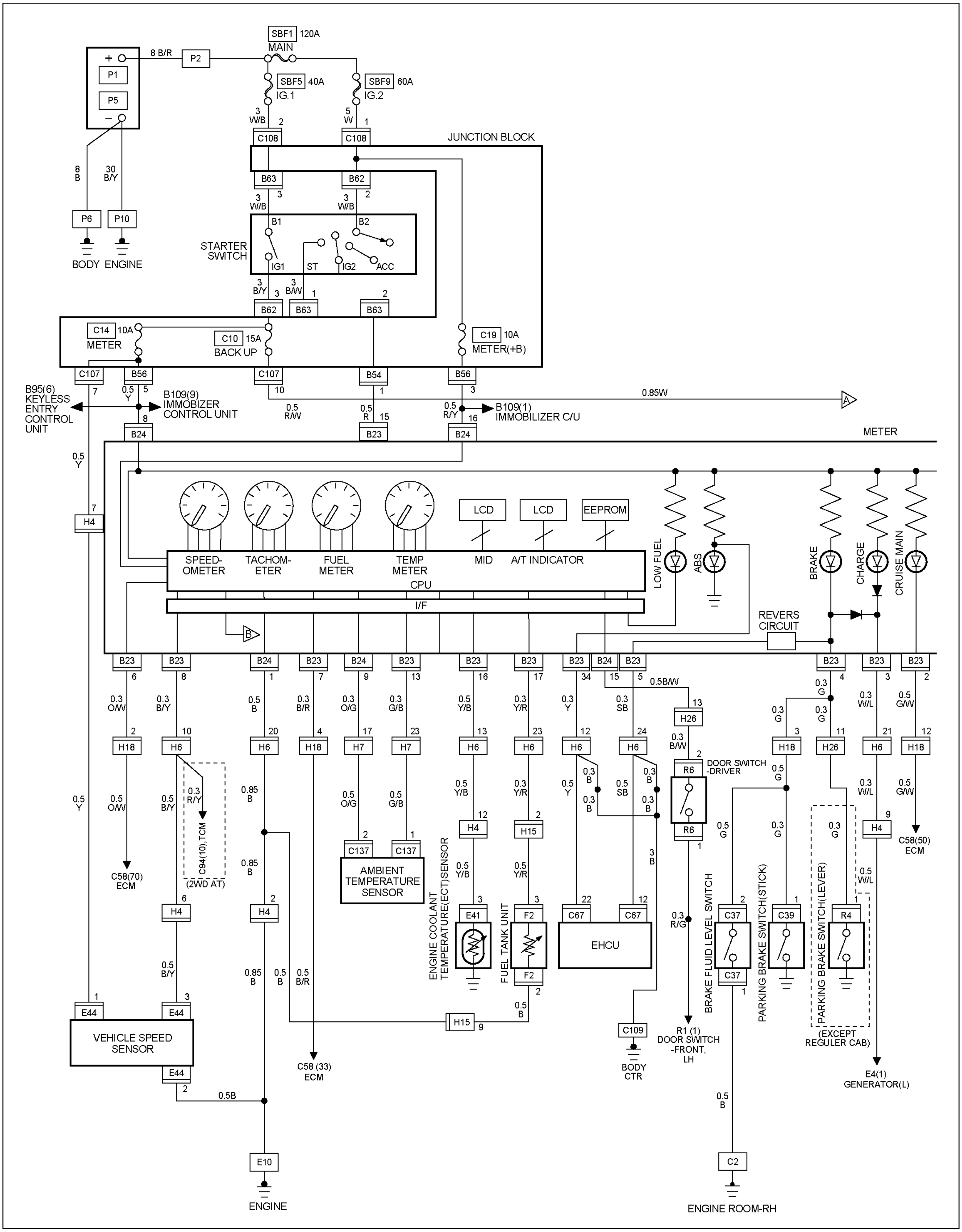
Sheet 3/3



RTW78AXF012001

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 1/3



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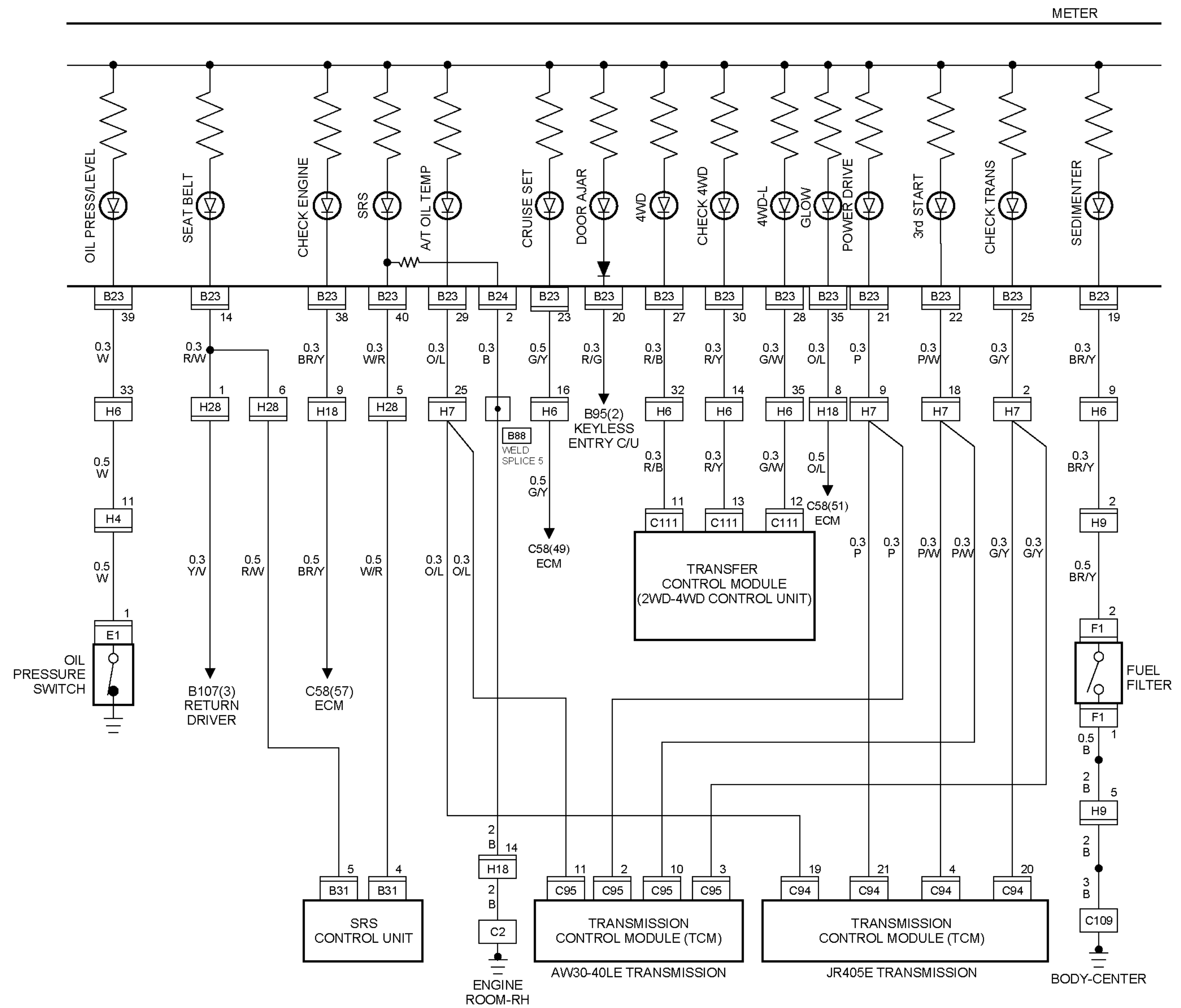
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 2/3



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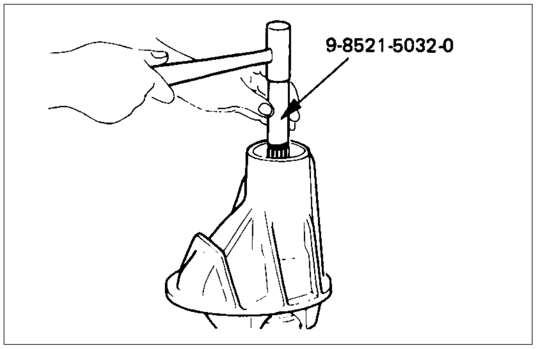
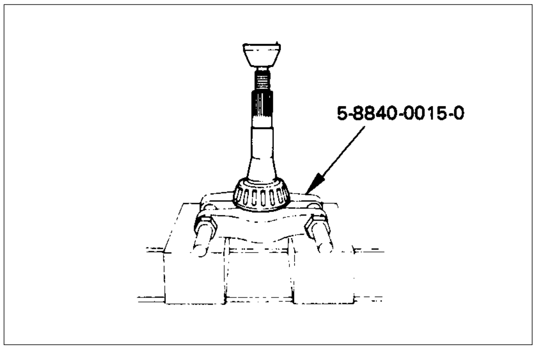


13.Pinion Gear

Remove the drive pinion assembly using a soft metal rod and a hammer.

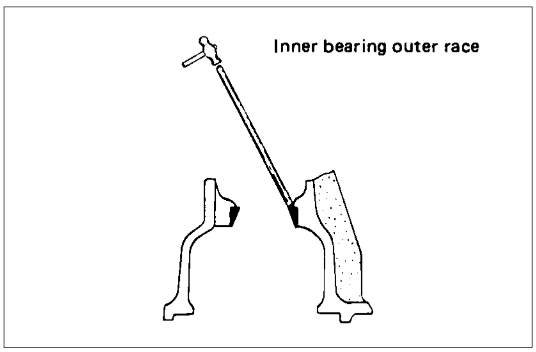
Spindle : 9-8521-5032-0



14.Inner Bearing

Remove the inner bearing using a separator and a press.

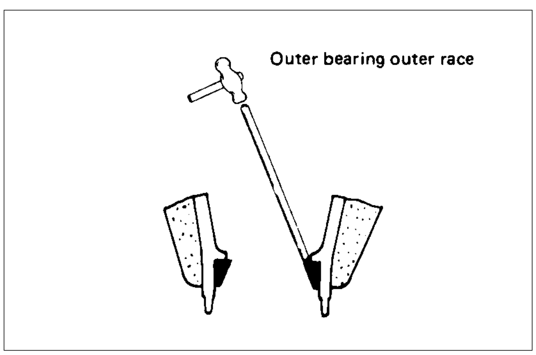
Separator : 5-8840-0015-0



17.Inner Bearing Outer Race

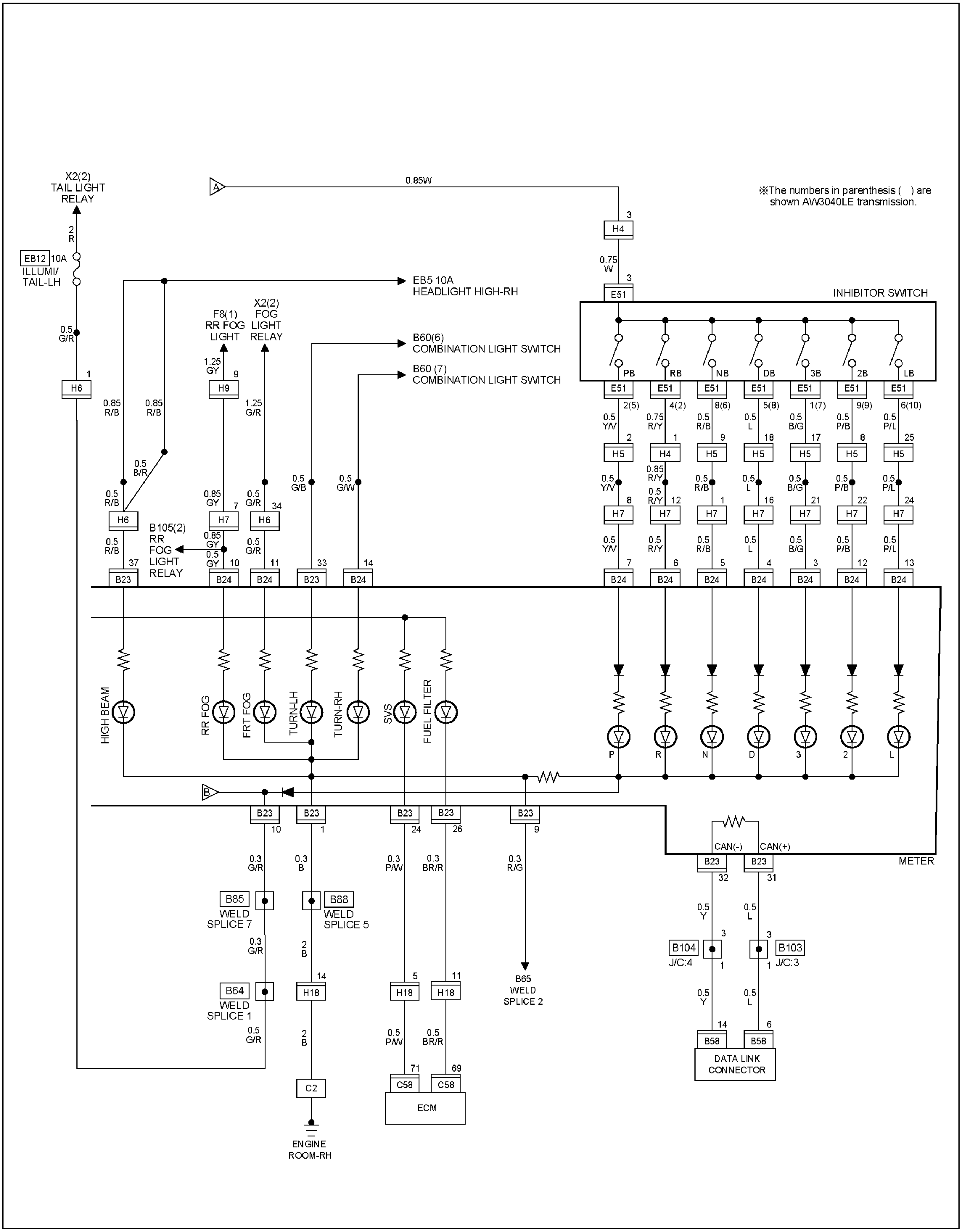
20.Outer Bearing Outer Race

Remove the inner bearing outer race and the outer bearing outer race by using a brass bar and a hammer.



CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 3/3



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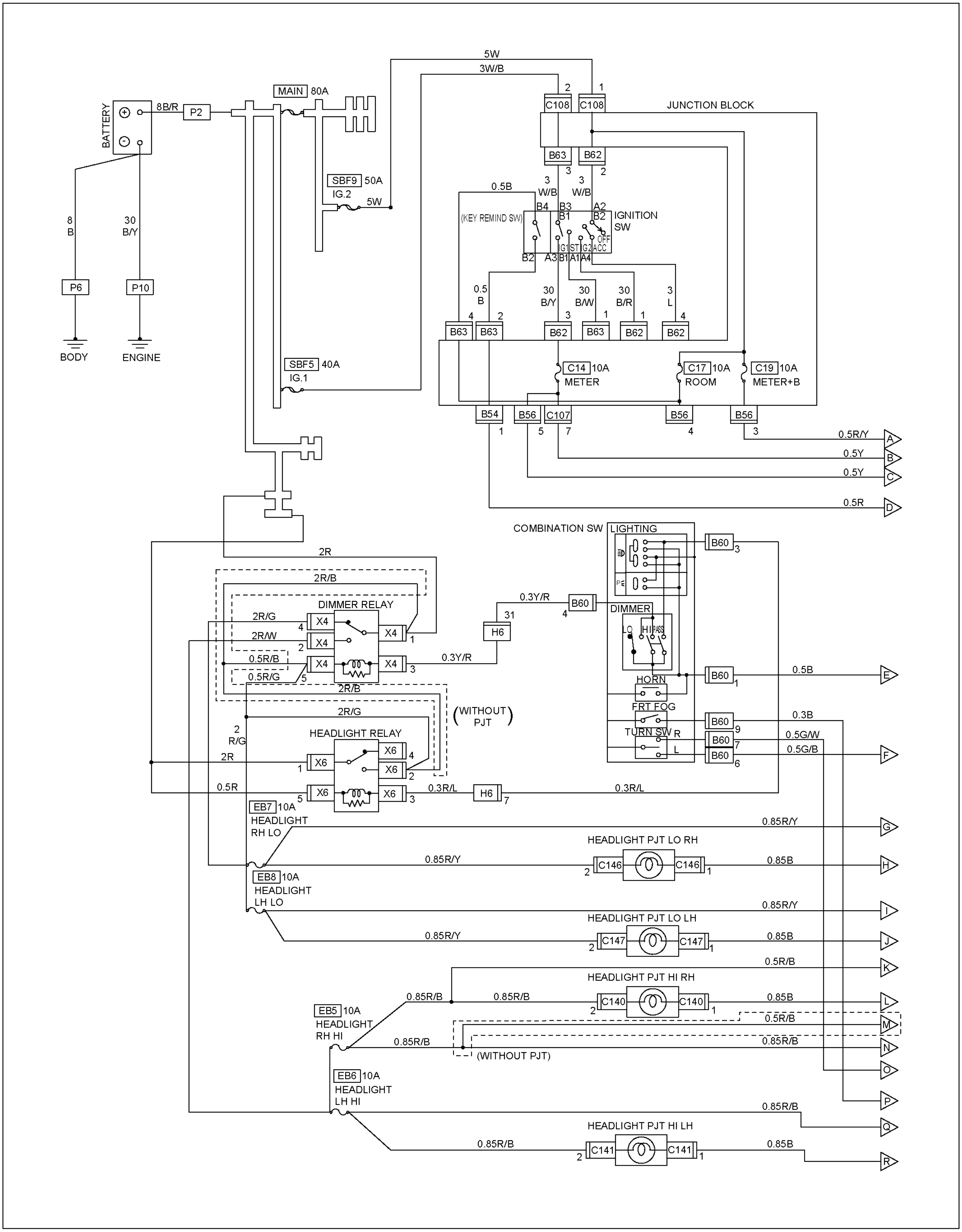
CIRCUIT DIAGRAM 4JA1T (L) (RHD)

Sheet 1/4



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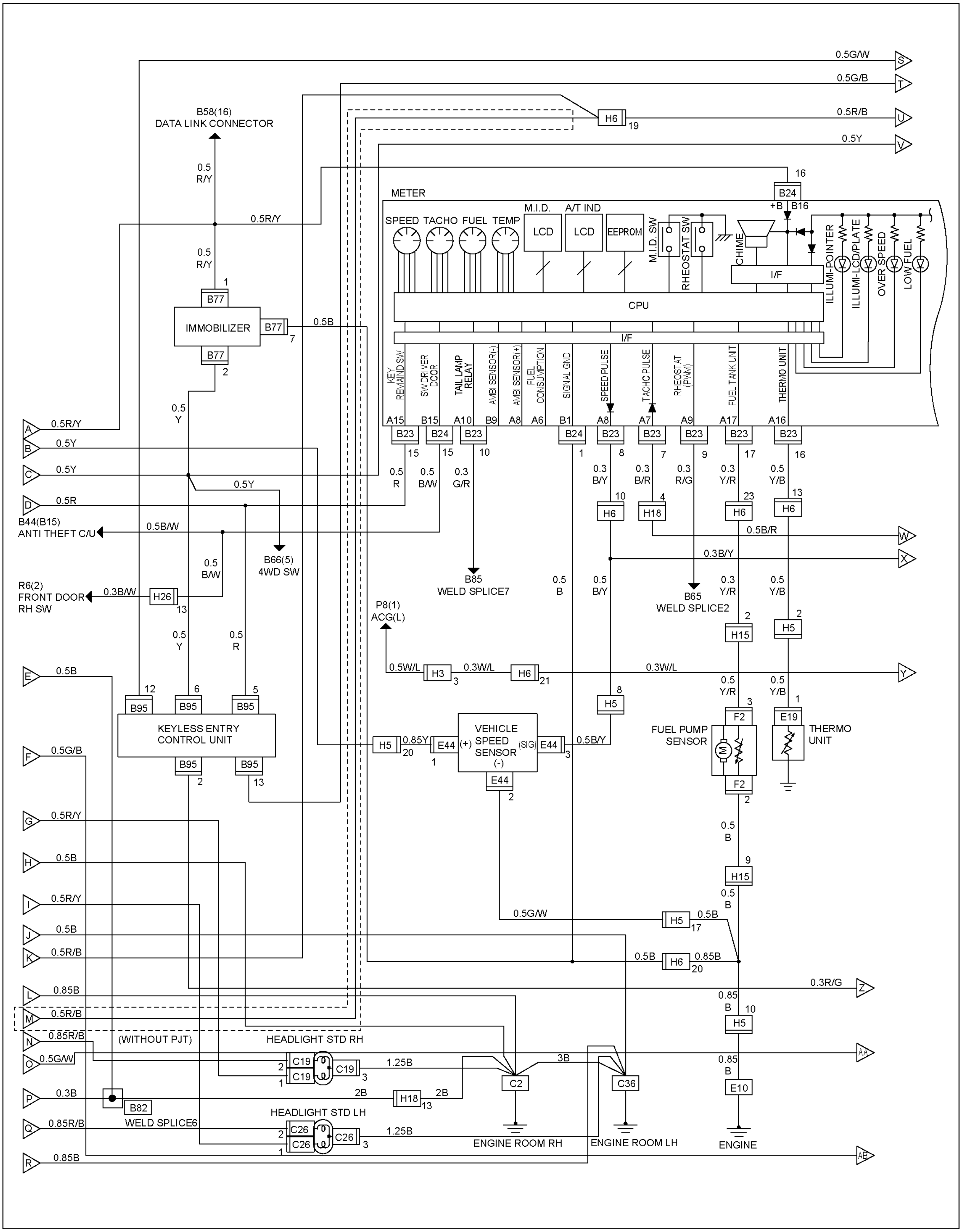
CIRCUIT DIAGRAM 4JA1T (L) (RHD)

Sheet 2/4



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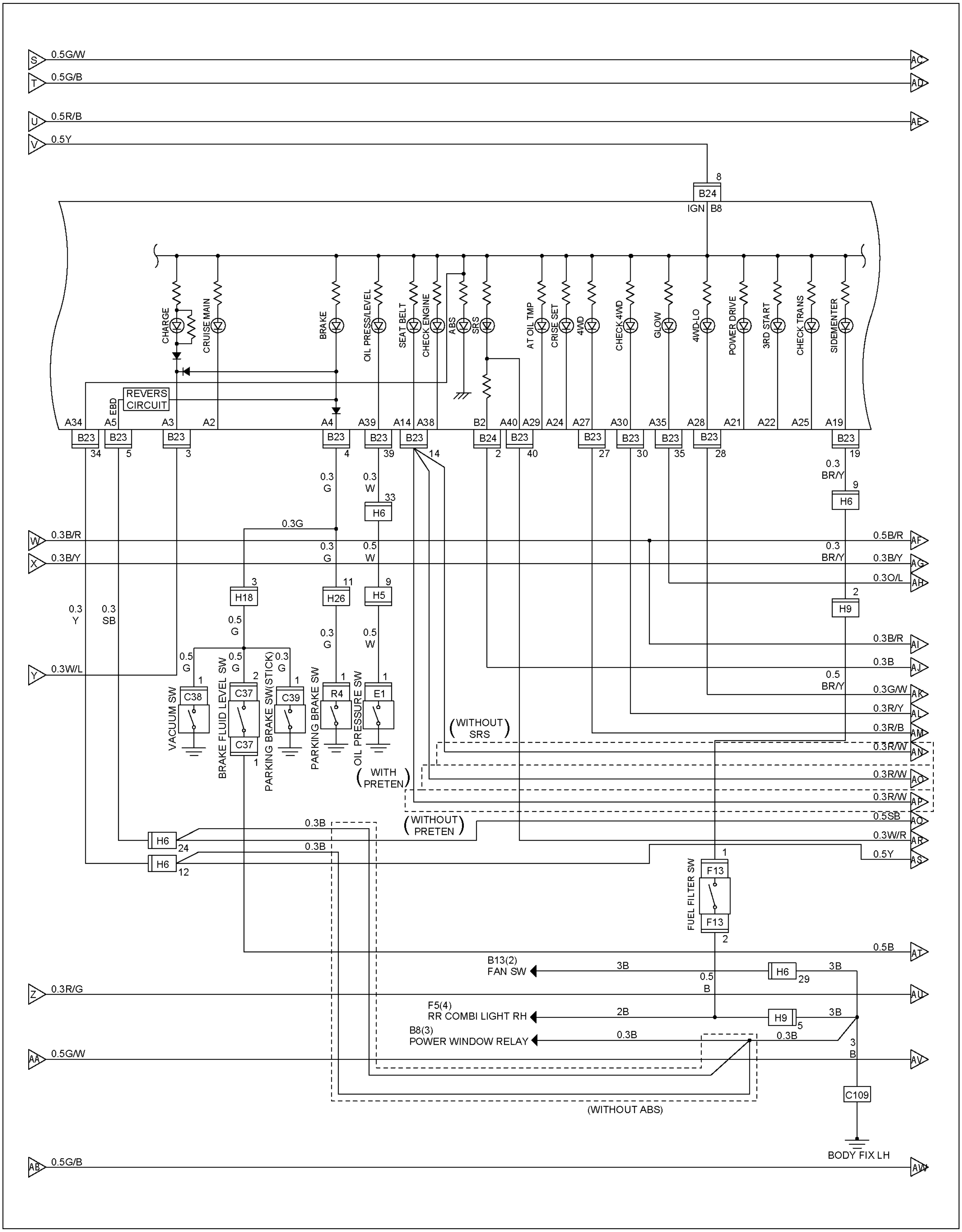
CIRCUIT DIAGRAM 4JA1T (L) (RHD)

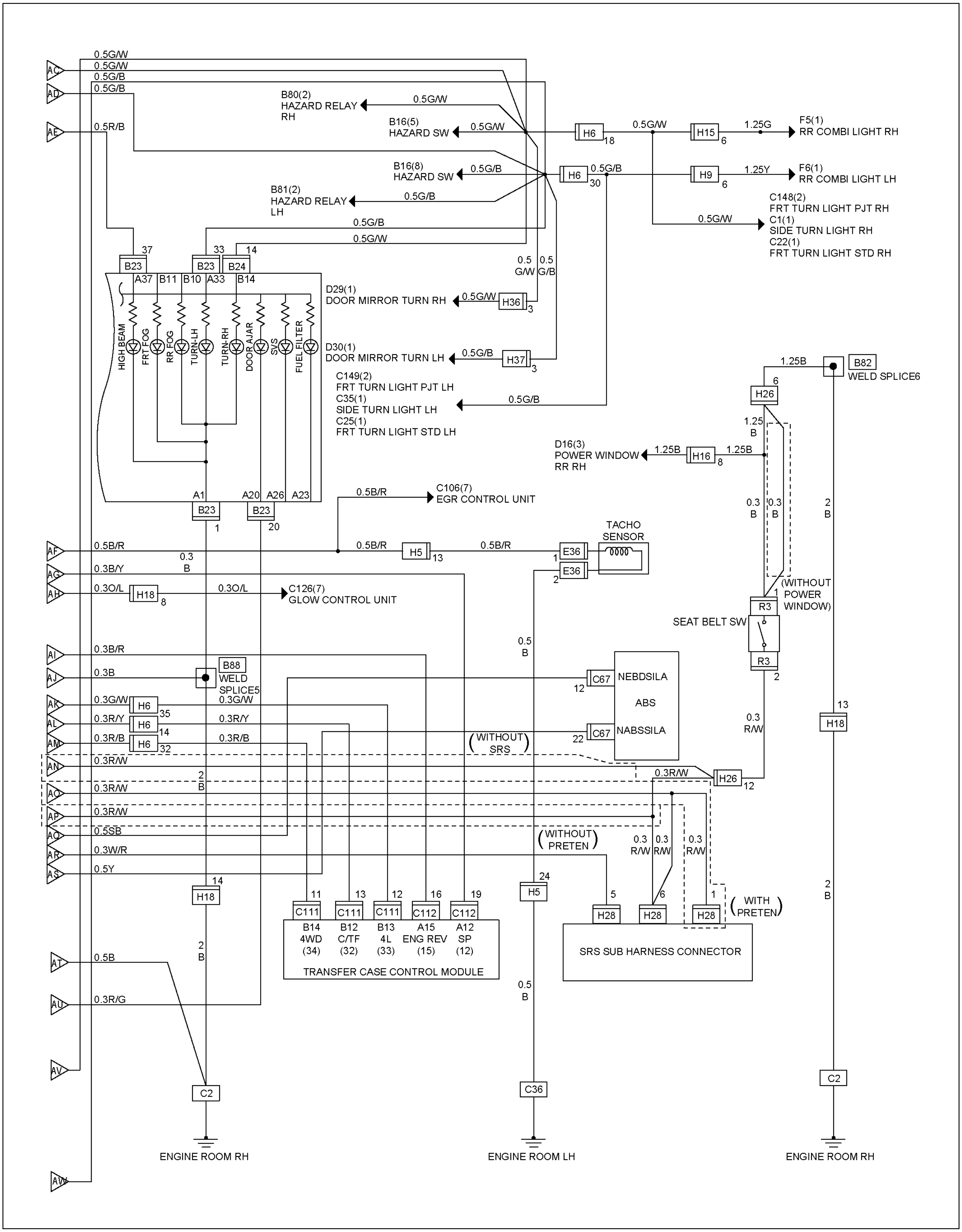
Sheet 3/4



RTW78AXF016501

CIRCUIT DIAGRAM 4JA1T (L) (RHD)

Sheet 4/4



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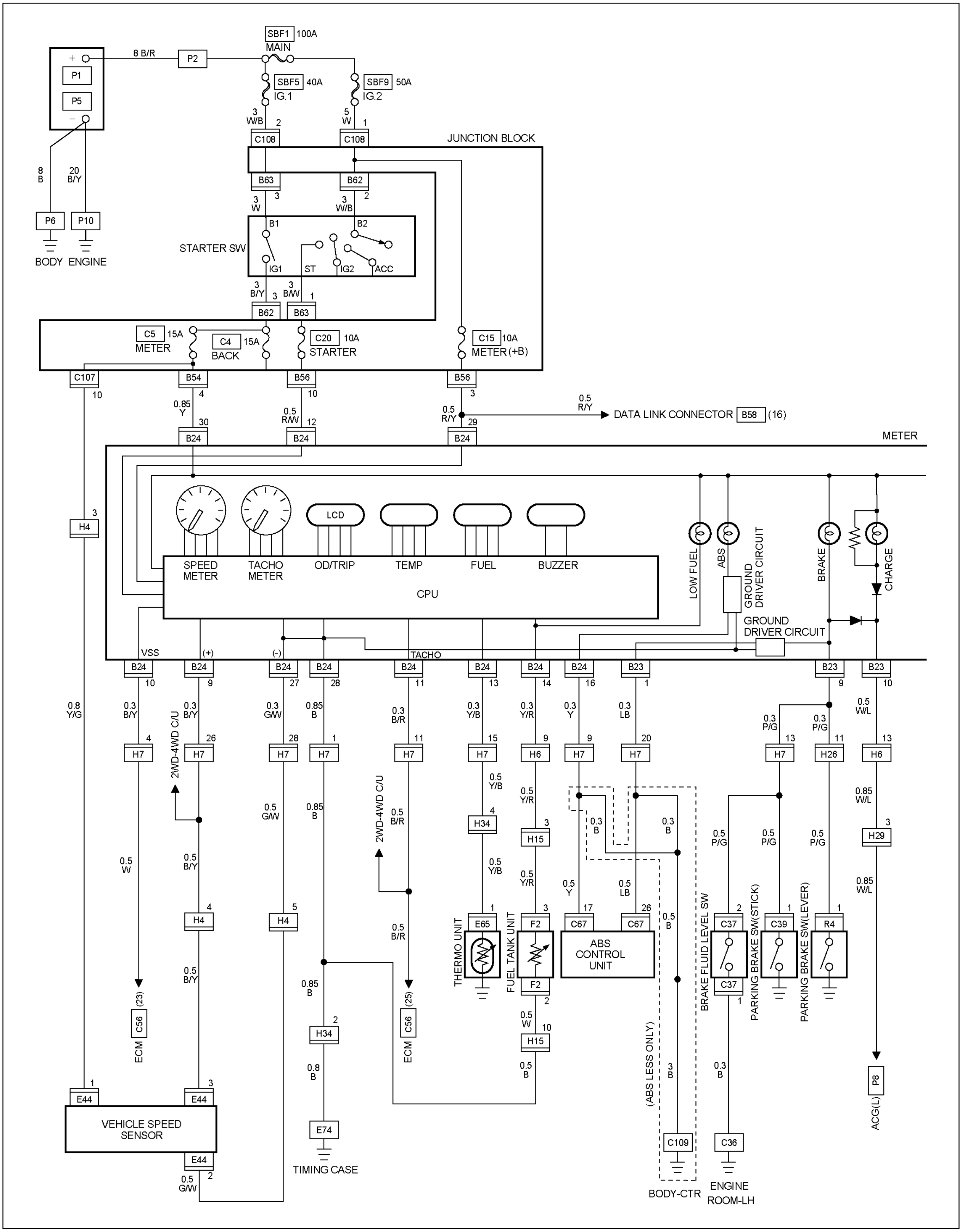
CIRCUIT DIAGRAM C24SE (LHD)

Sheet 1/3



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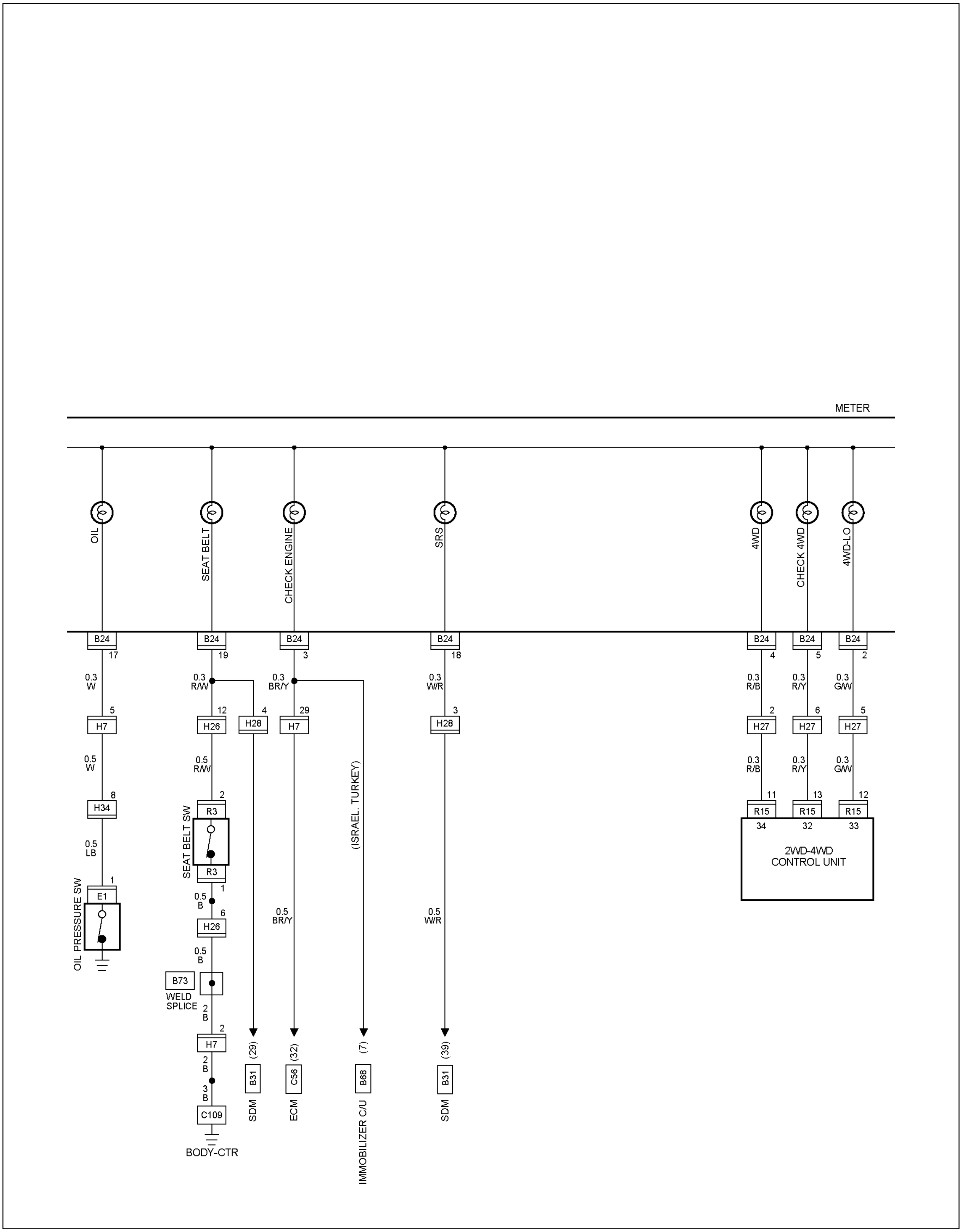
CIRCUIT DIAGRAM C24SE (LHD)

Sheet 2/3



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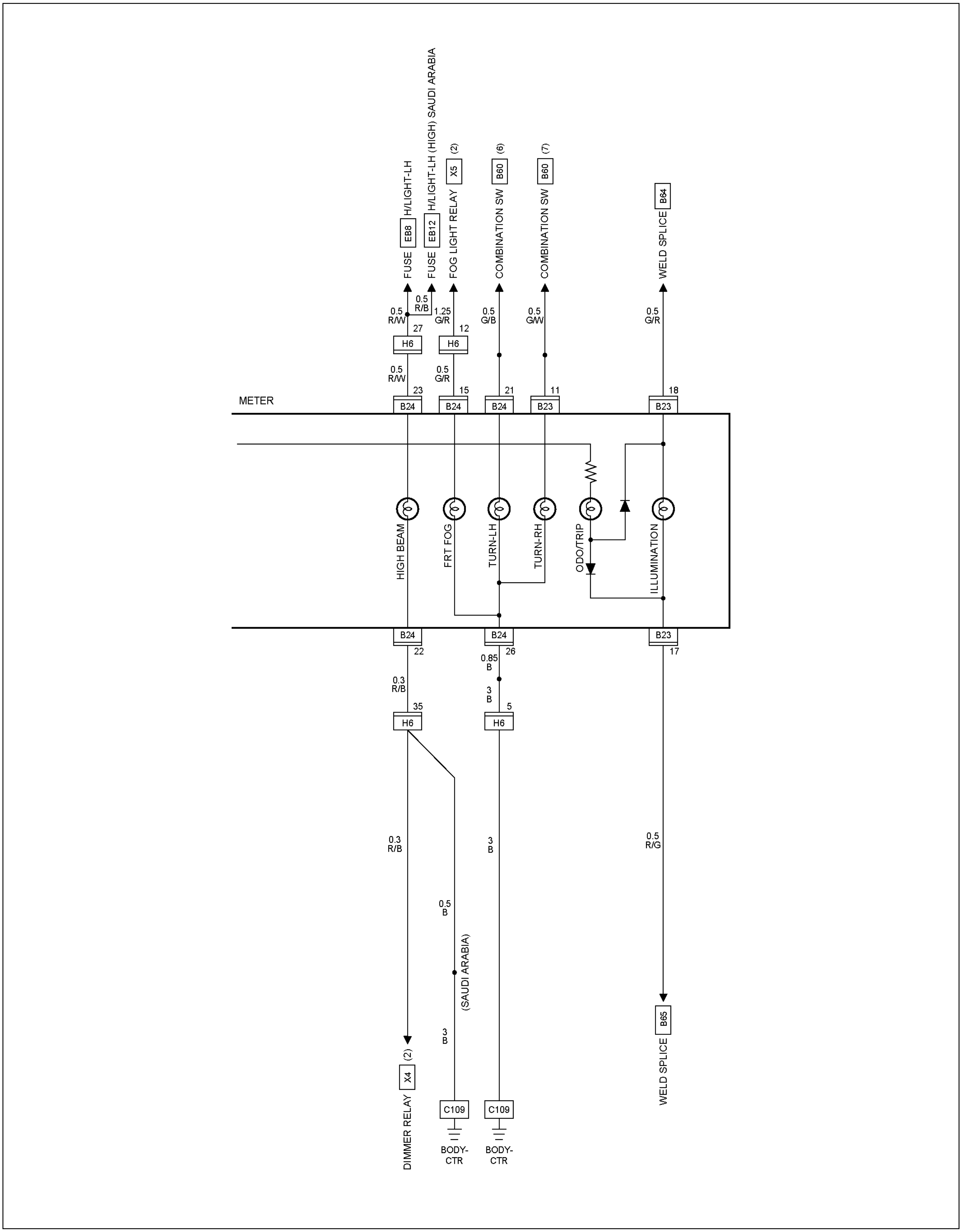
CIRCUIT DIAGRAM C24SE (LHD)

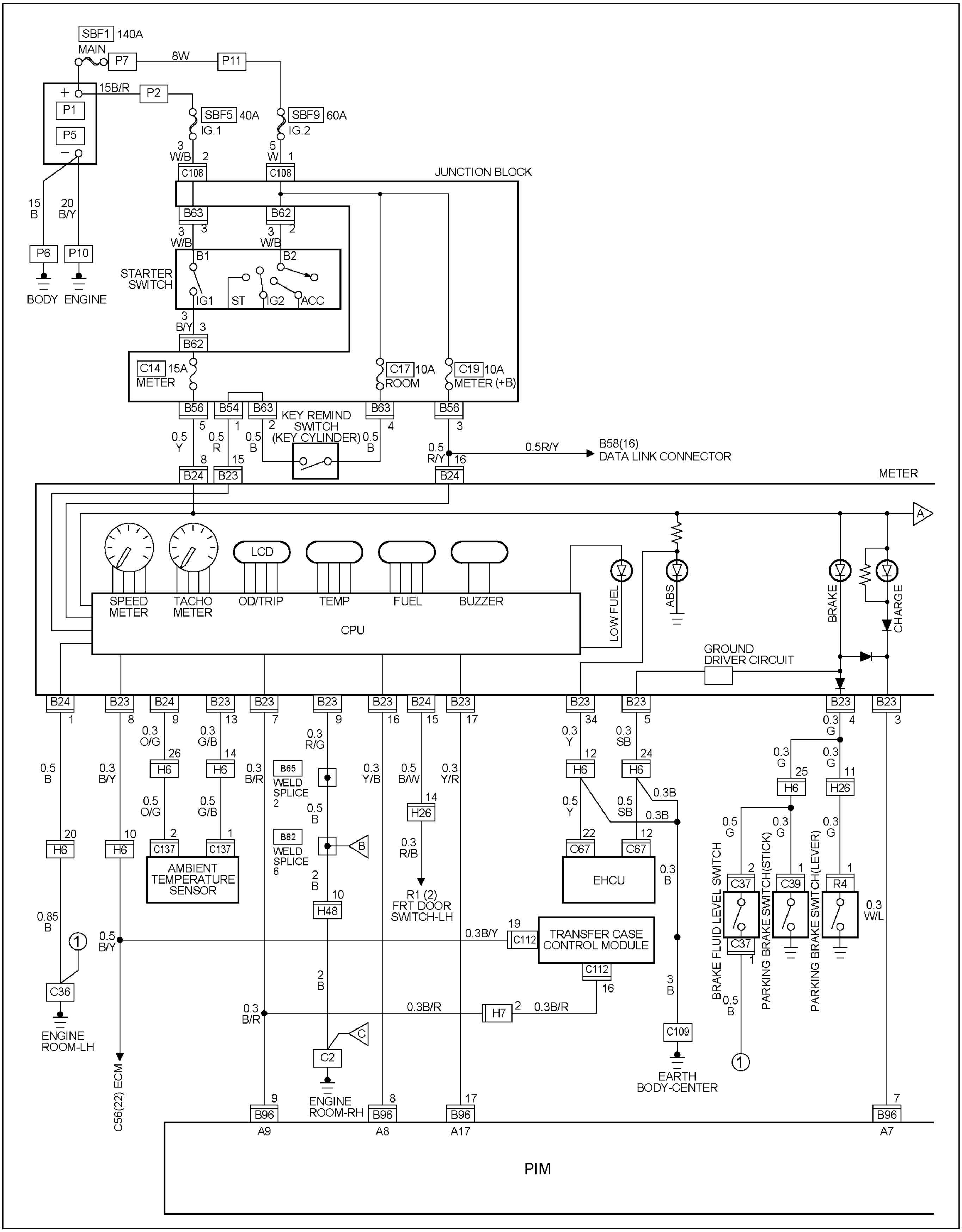
Sheet 3/3



RTW780XF015401

CIRCUIT DIAGRAM HFV6 (LHD) G.EXP

Sheet 1/3



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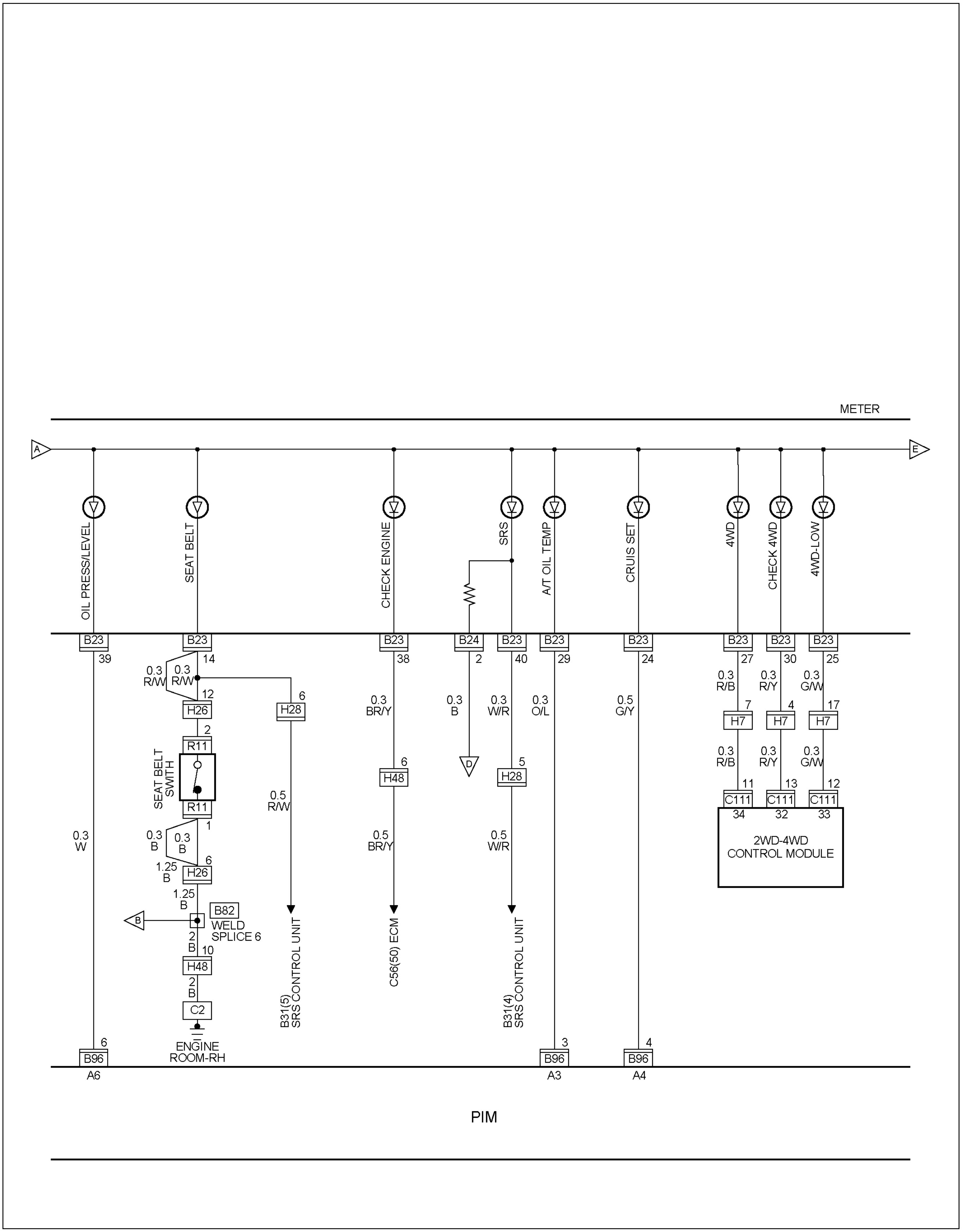
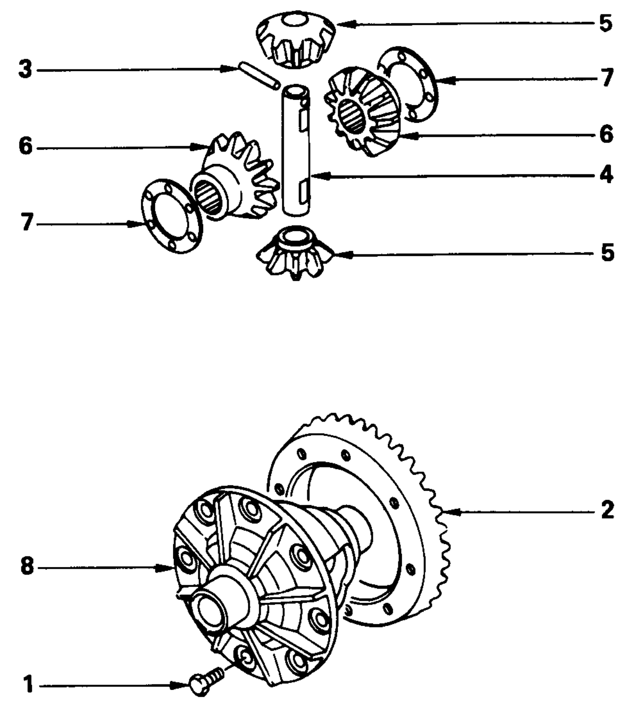
CIRCUIT DIAGRAM HFV6 (LHD) G.EXP

Sheet 2/3



RTW78AXF013101

Minor Components

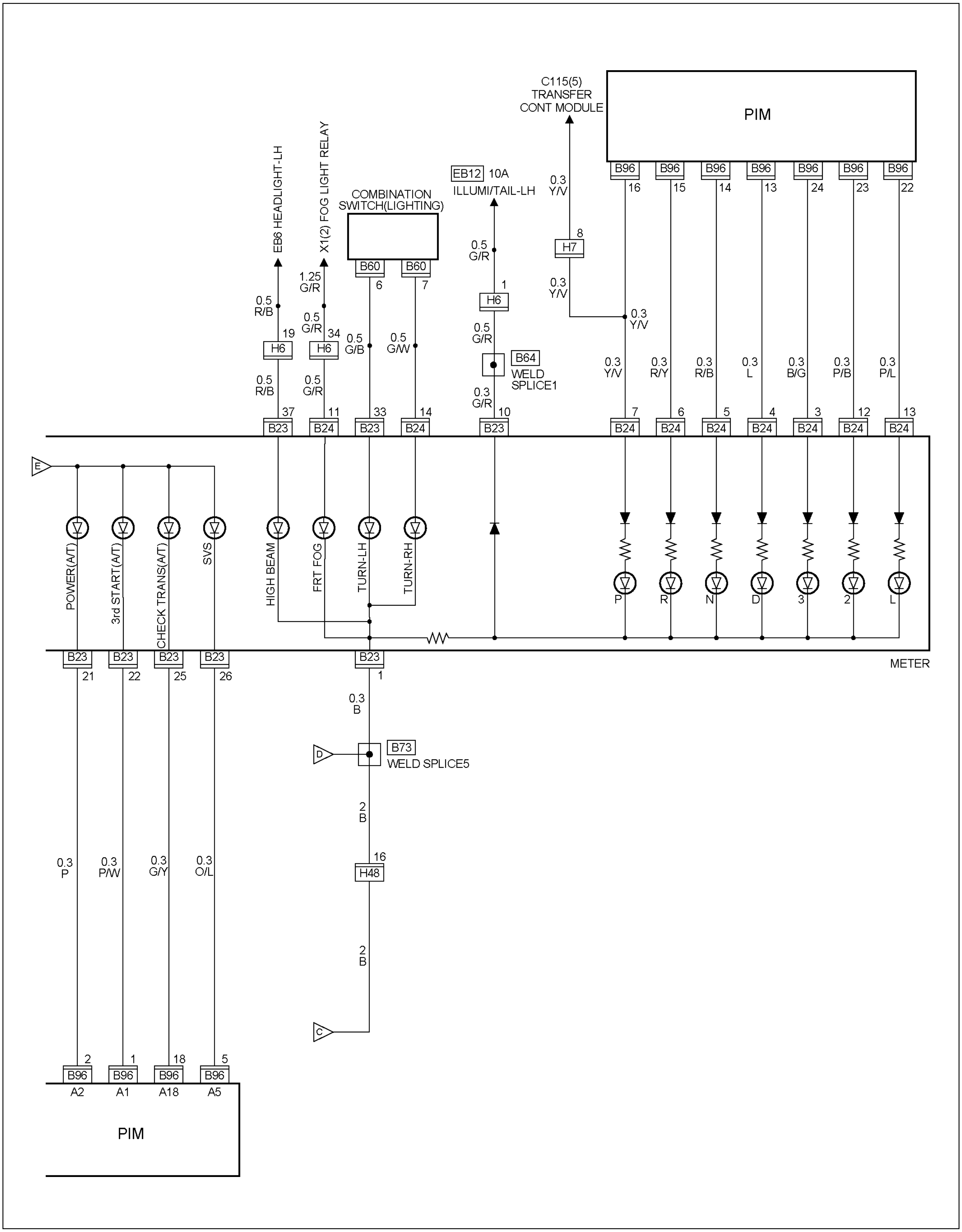


Disassembly Steps

1. Bolt
2. Ring gear
3. ▲ Lock pin
4. ▲ Cross pin
5. Pinion gear
6. Side gear
7. Thrust washer
8. Differential cage

CIRCUIT DIAGRAM HFV6 (LHD) G.EXP

Sheet 3/3



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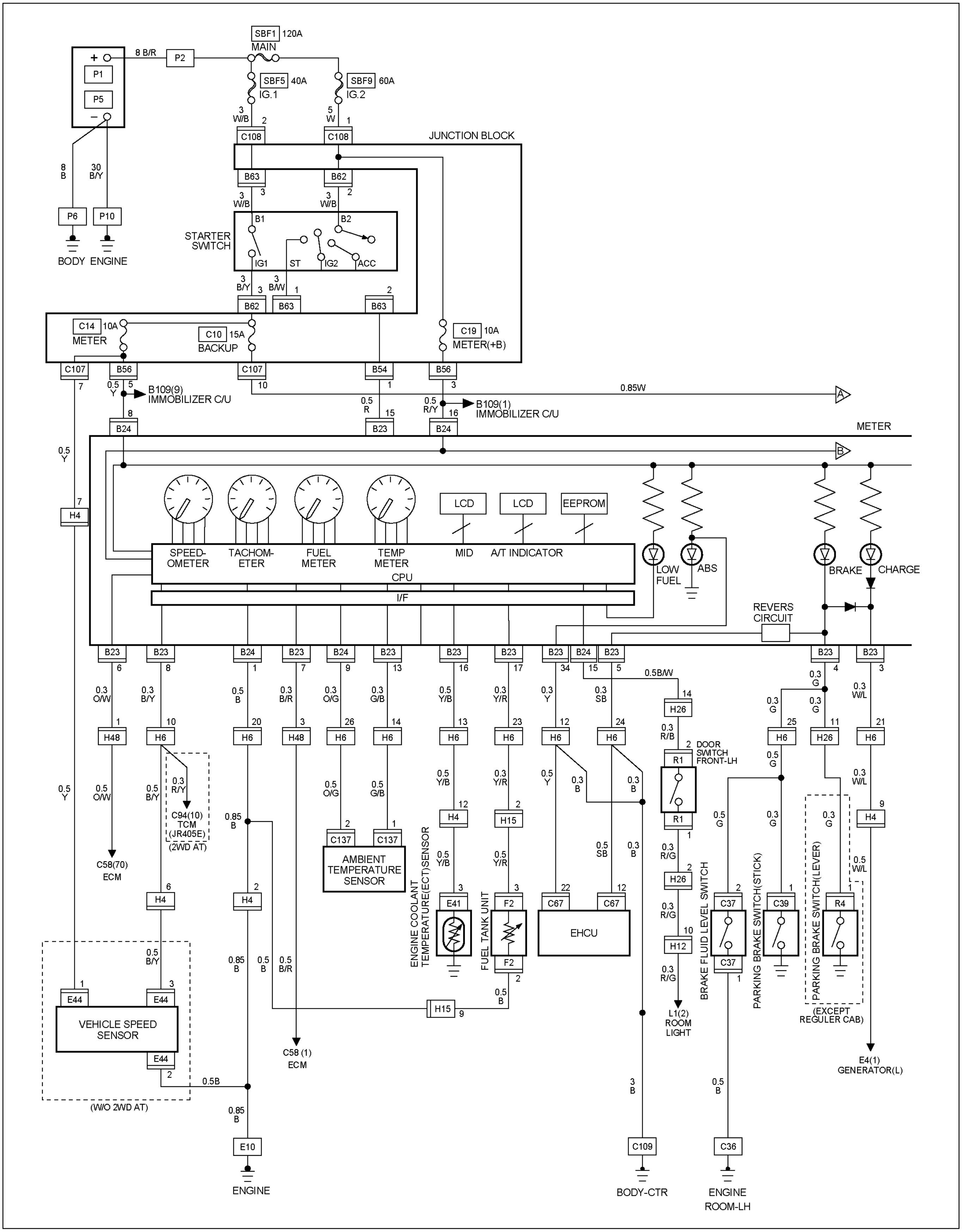
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 1/3



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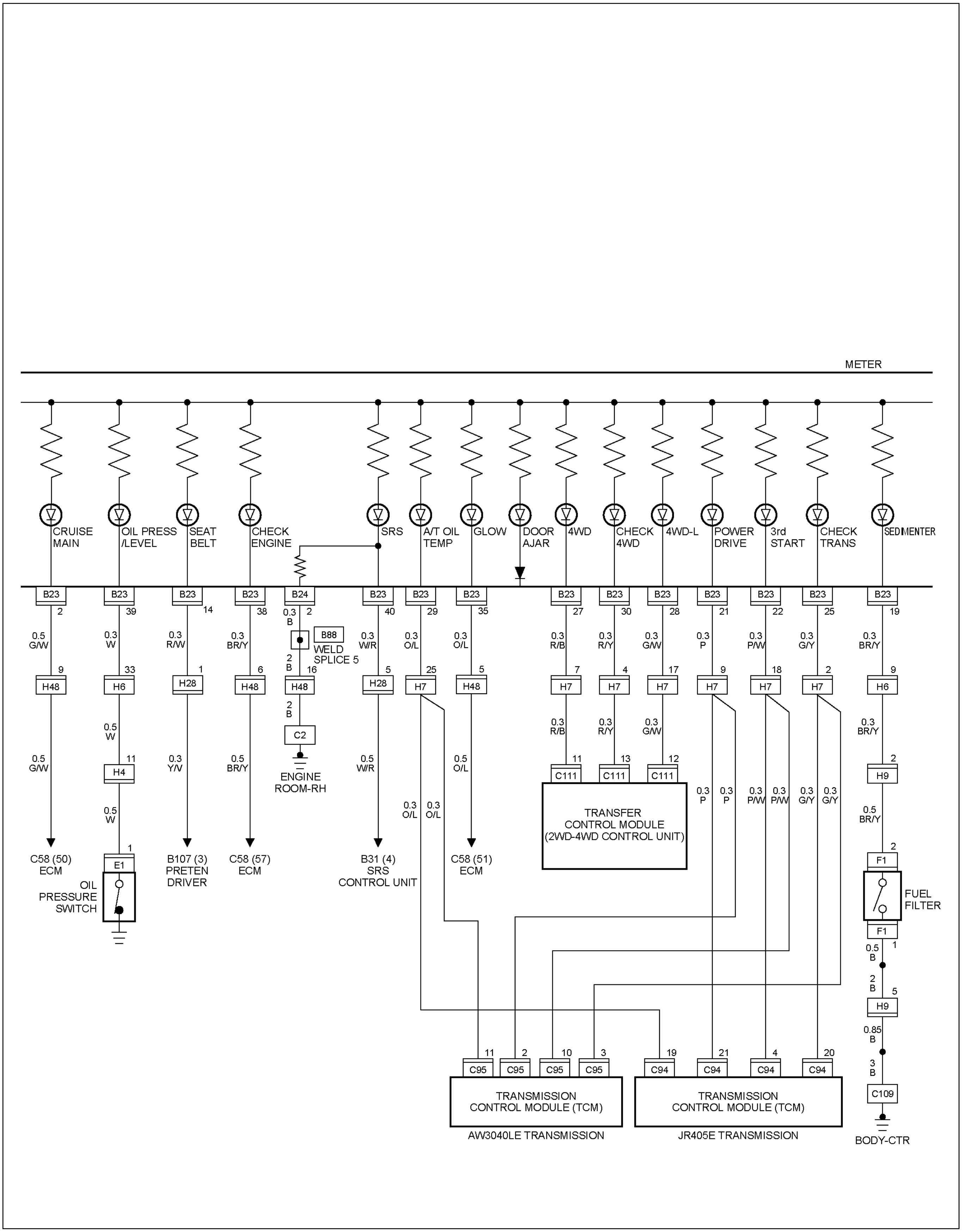
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 2/3



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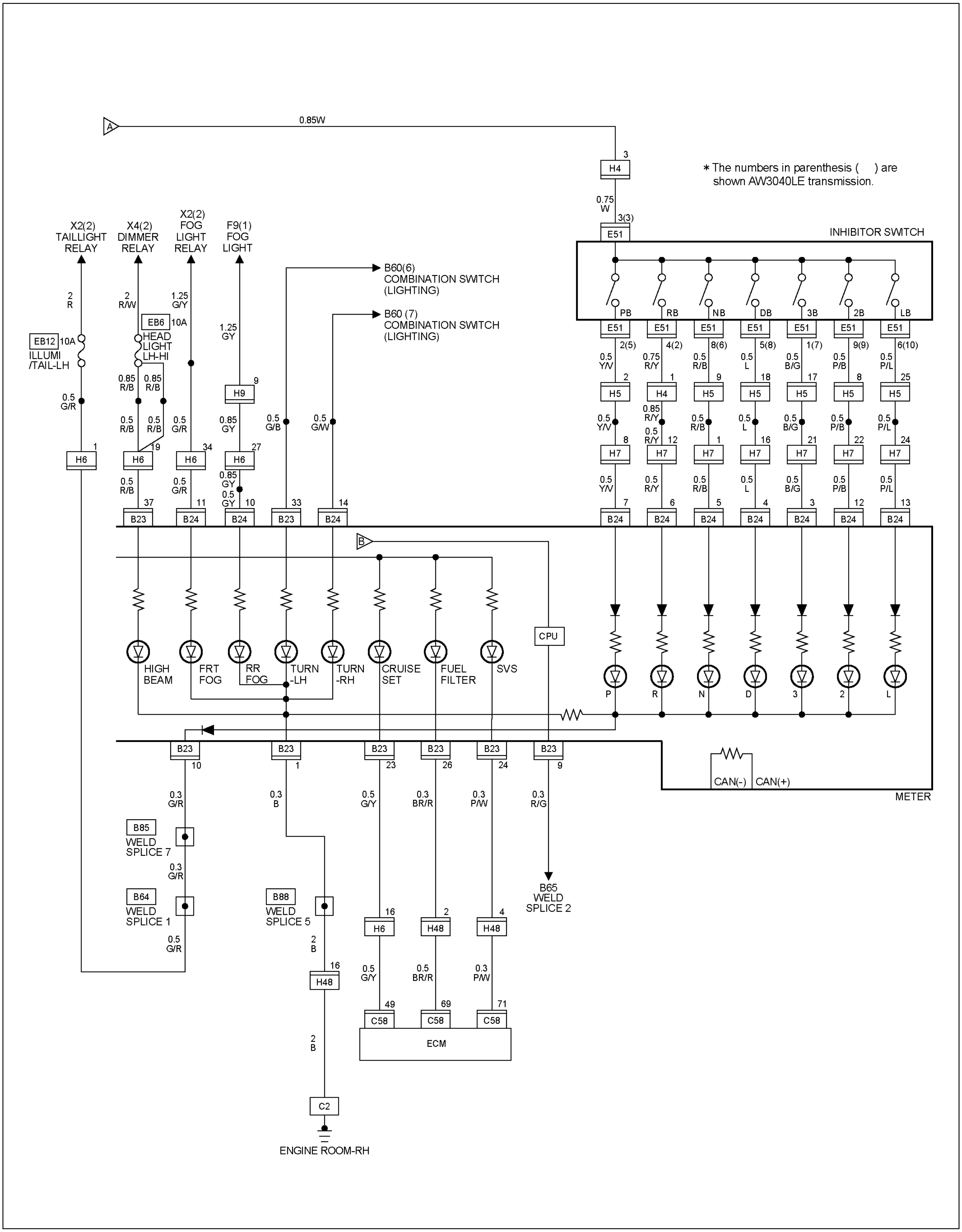
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP

Sheet 3/3



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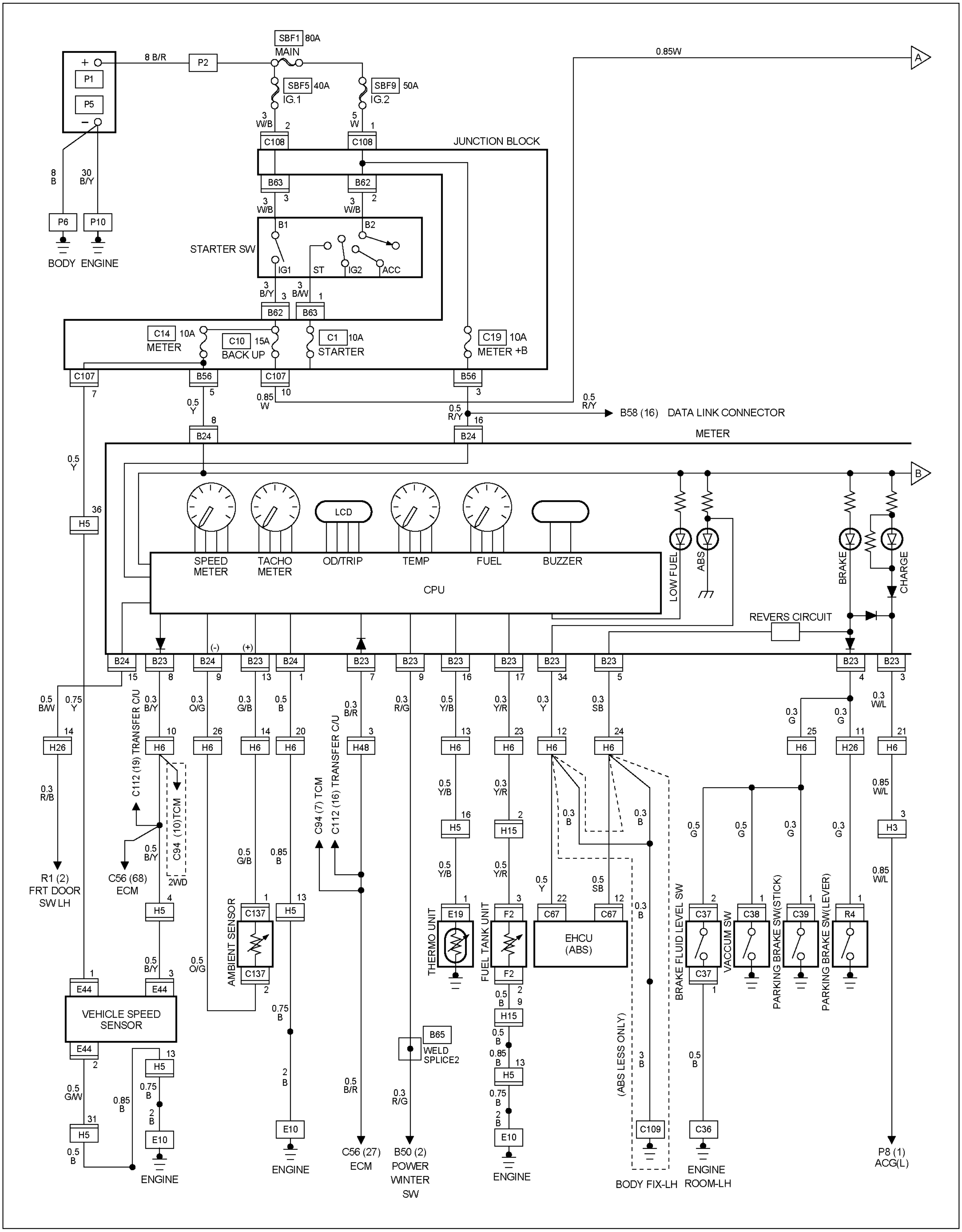
CIRCUIT DIAGRAM 4JH1-TC (LHD)

Sheet 1/3



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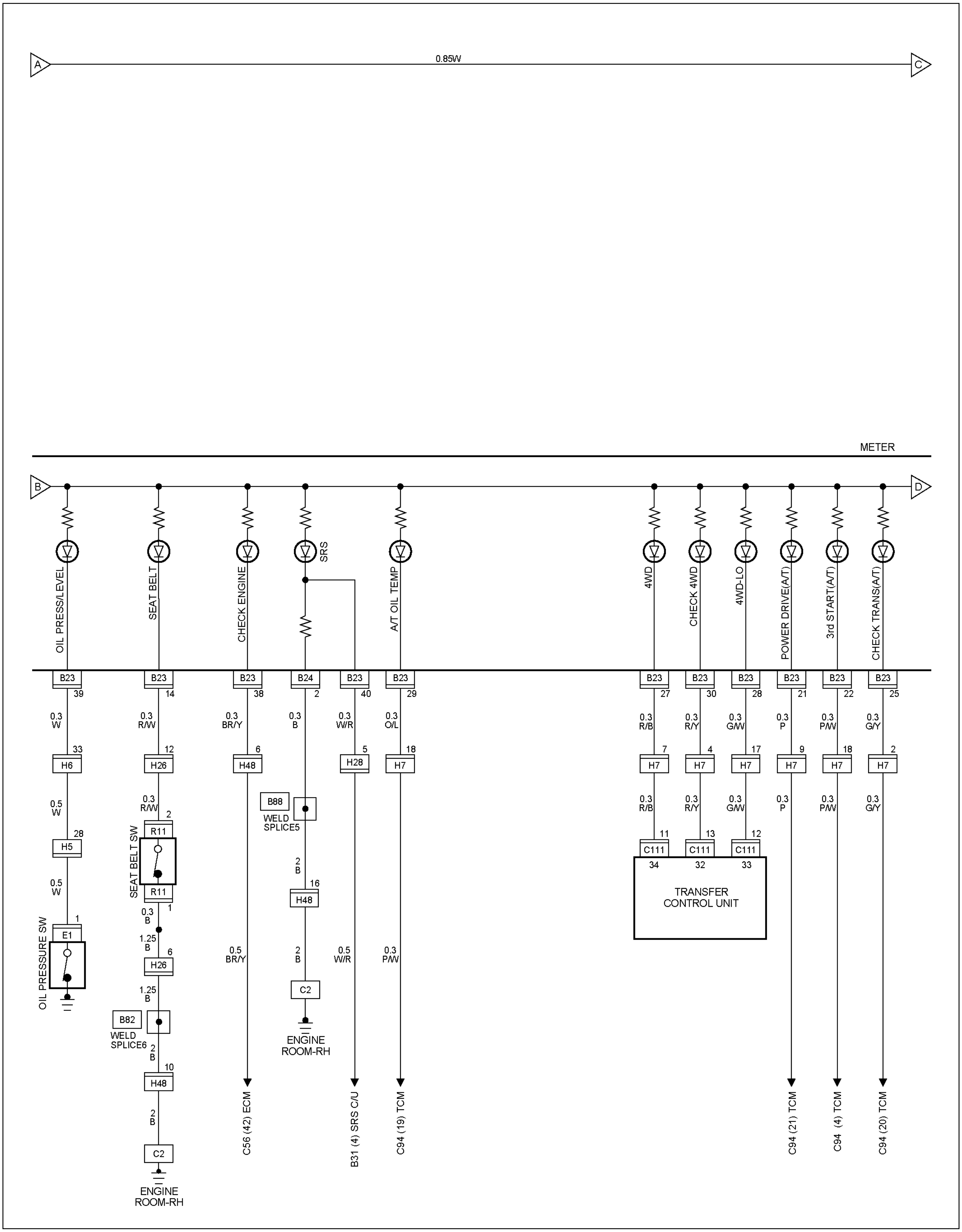
CIRCUIT DIAGRAM 4JH1-TC (LHD)

Sheet 2/3



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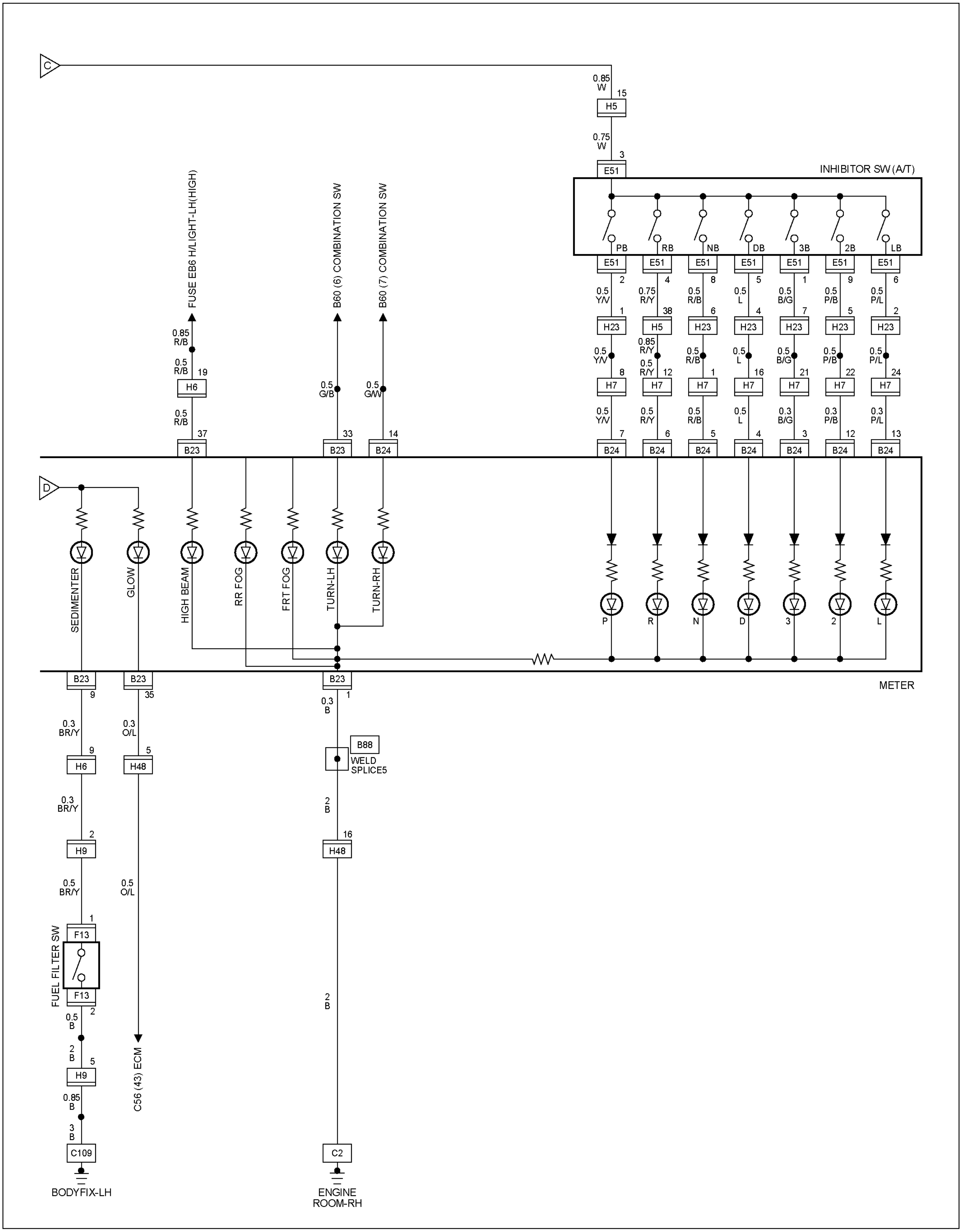
CIRCUIT DIAGRAM 4JH1-TC (LHD)

Sheet 3/3



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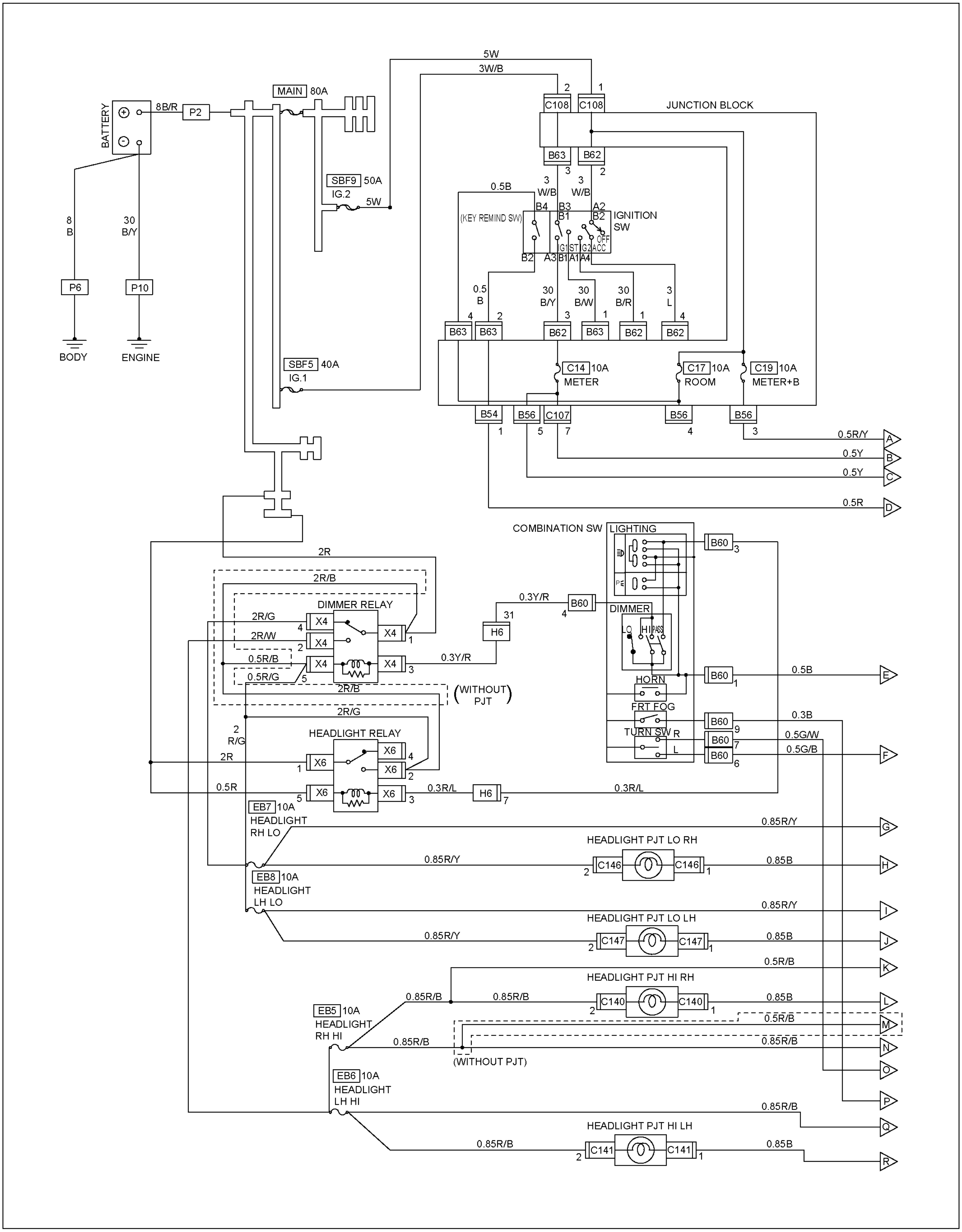
CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 1/4



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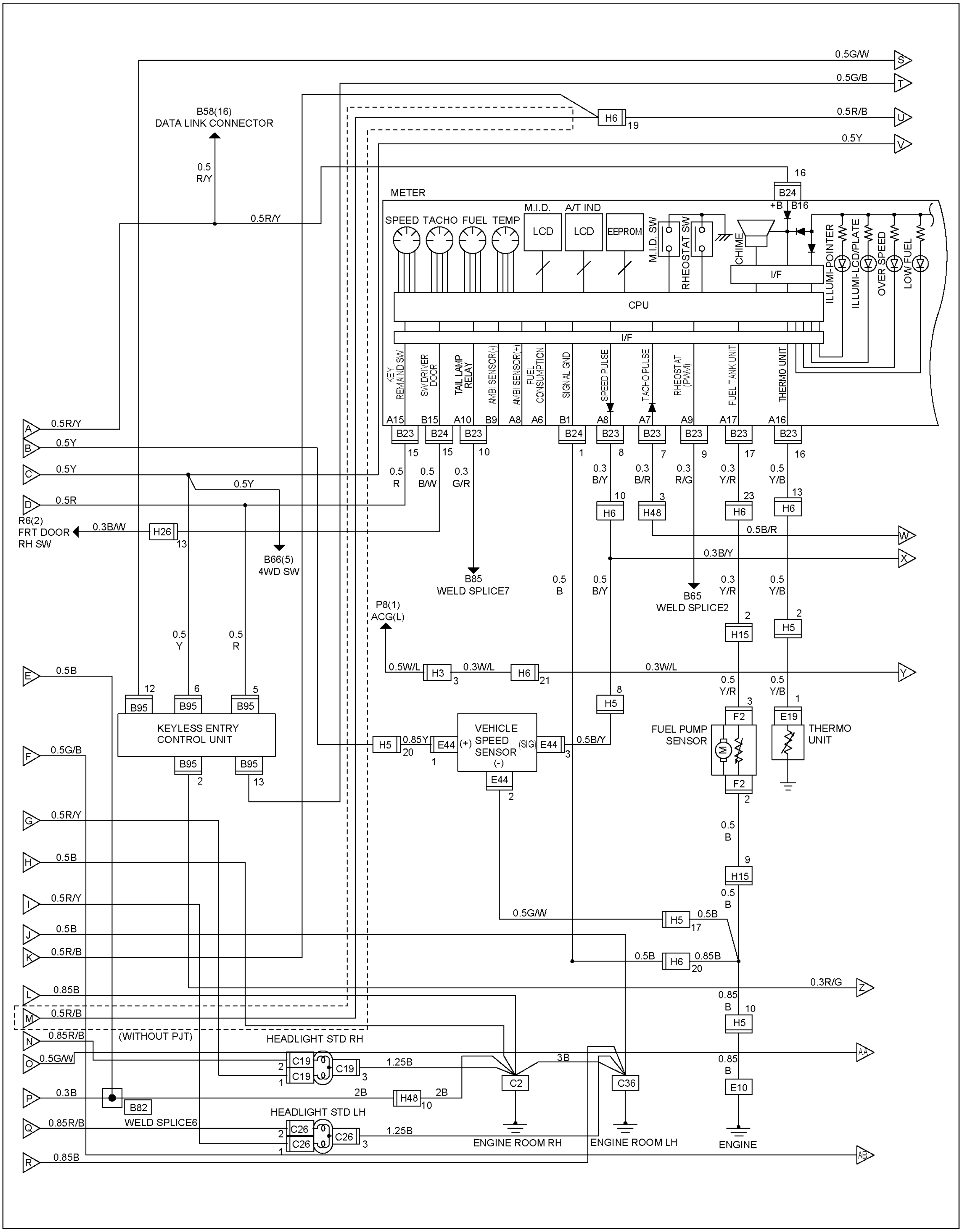
CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 2/4



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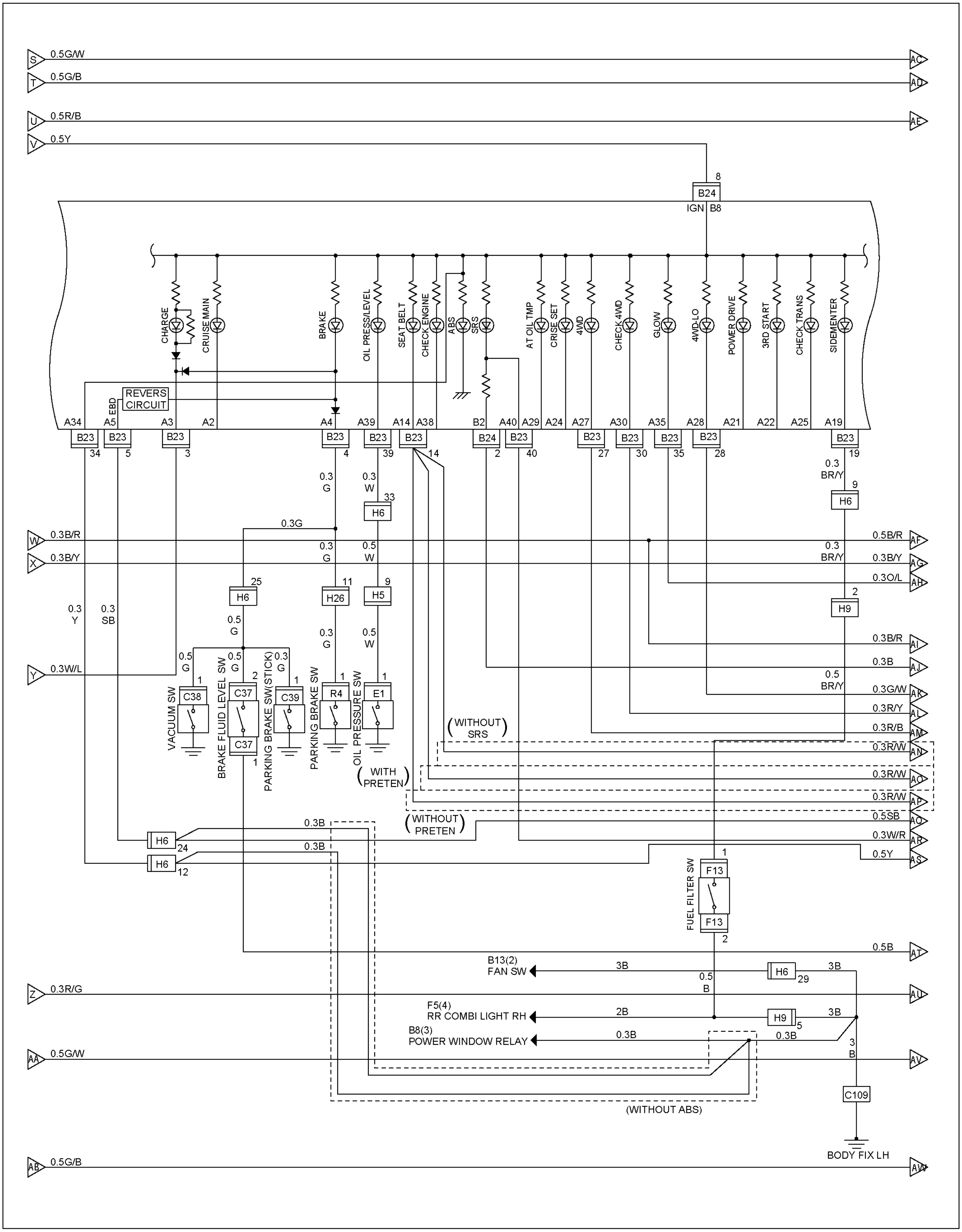
CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 3/4



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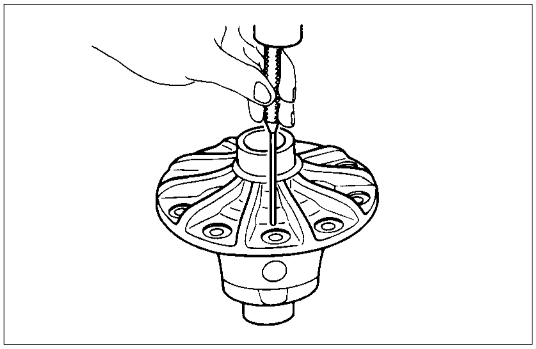
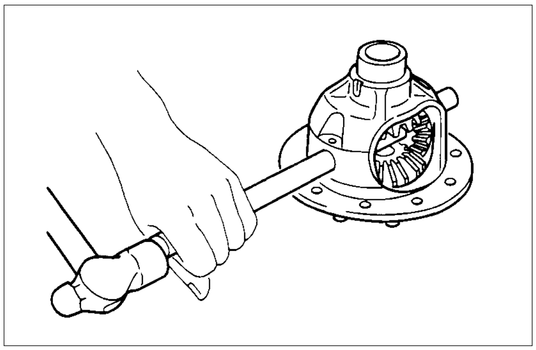


Important Operations

3. Lock Pin

Break staking on the lock pin using a 5 mm (0.20 in.) diameter drill.

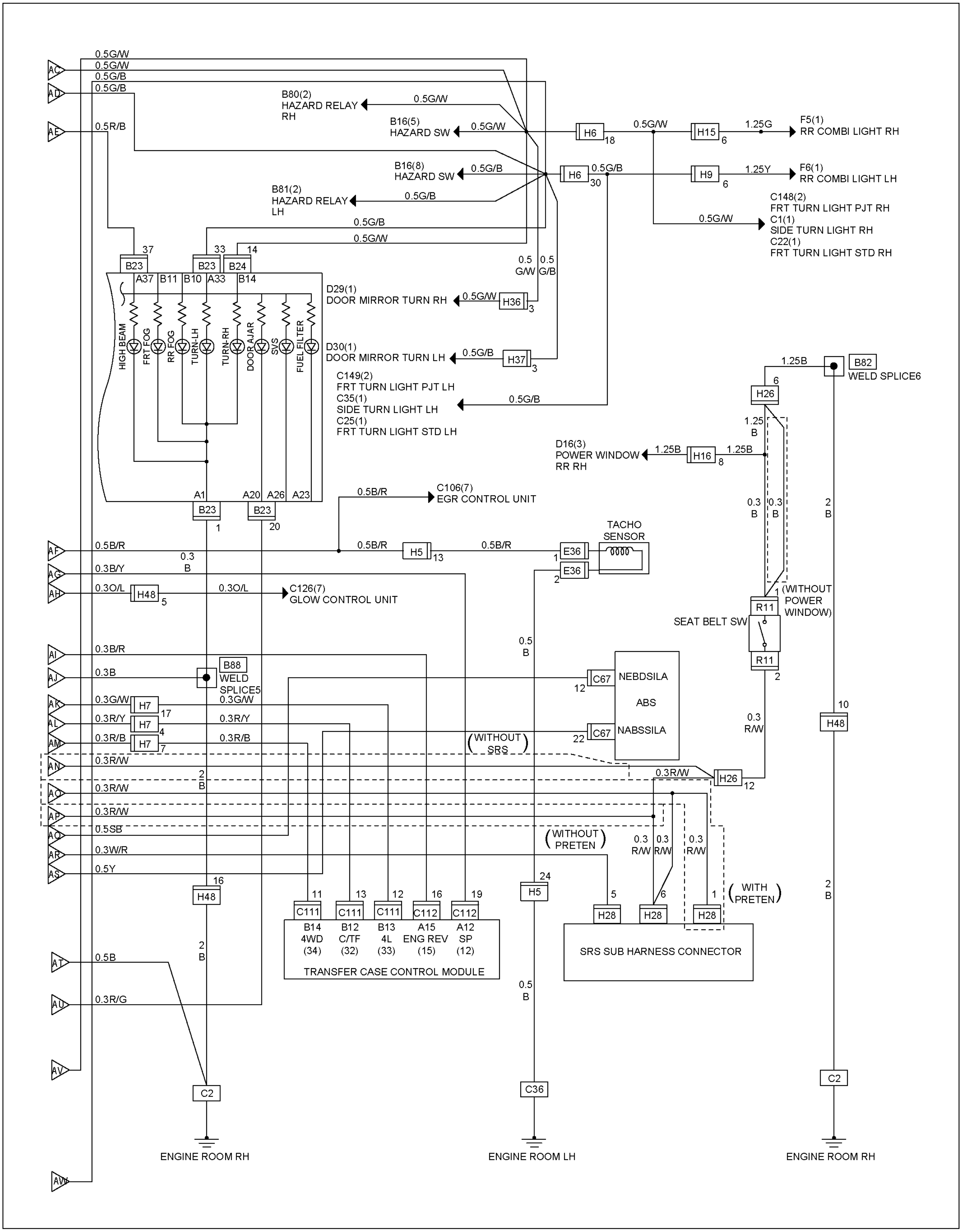


4. Cross Pin

Remove the cross pin using a soft metal rod and a hammer.

CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 4/4



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TROUBLESHOOTING

SPEEDOMETER

1. Speedometer and odometer do not function

Checkpoint		Trouble Cause	Countermeasure
Check the vehicle speed sensor output (4 pulses/1 rotation)	NG	Vehicle speed sensor malfunction	Replace the vehicle speed sensor
OK ↓			
Continuity between the vehicle speed sensor and the meter, or the fuse C14 (10A) and the ground	NG	Open circuit or poor connector contact	Repair an open circuit in the circuit or a poor connection at the connectors
OK ↓			
Use a meter tester to check the speedometer function	NG	Speedometer malfunction	Replace the case baseboard assy

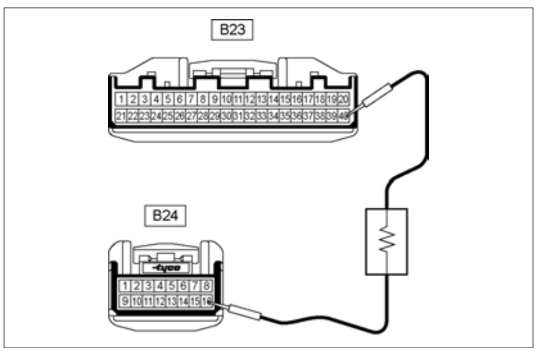
2. Speedometer pointer fluctuates (May be wide fluctuation)

Checkpoint		Trouble Cause	Countermeasure
Check the speed sensor output by using the oscilloscope	NG	Vehicle speed sensor malfunction, or open circuit or poor connector contact	Replace the vehicle speed sensor, or repair an open circuit in the circuit or a connectors
OK ↓			
Use a meter tester to check the speedometer function	NG	Speedometer malfunction	Replace the case baseboard assy

3. Speedometer pointer jumps erratically

Checkpoint		Trouble Cause	Countermeasure
Check the vehicle speed sensor output by using the oscilloscope	NG	Vehicle speed sensor malfunction, or open circuit or poor connector contact	Replace the vehicle speed sensor, or repair an open circuit in the circuit or a poor connection at the connectors
OK			
Use meter tester to check the speedometer function	NG	Speedometer malfunction	Replace the meter assembly

Inspection of a Waveform by Oscilloscope (Reference)



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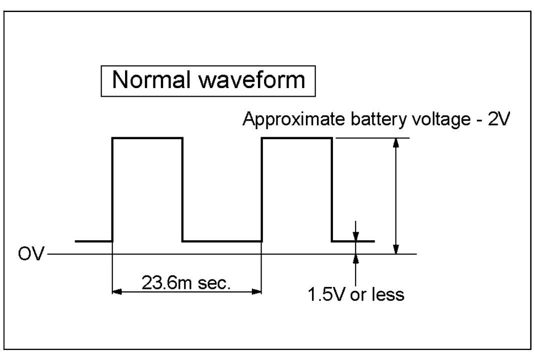
1. Connect a resistance of 1.3 to 5k ohm (1.4W or more) between the harness side connectors 40 B23 and 16 B24 of the meter.
2. Install a speedometer tester.
3. Turn on the starter SW.



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4. Check the waveform at the time when the vehicle speed is at 60km/h.

4. Trip odometer does not reset

Checkpoint		Trouble Cause	Countermeasure
Check at other kilometer figures given by meter tester (Reset should be made to zero kilometer)	NG	Faulty reset mechanism	Replace the meter assembly

TACHOMETER

1. Meter pointer fluctuates
(May be wide fluctuation)

Use a meter tester to check the tachometer function	NG	Tachometer malfunction	—	Replace the meter assembly

TEMPERATURE GAUGE AND THERMO UNIT (4JA1T(L), 4JH1-TC, C24SE)

1. No temperature indicates at all

Checkpoint		Trouble Cause	Countermeasure
Thermo unit continuity between connector 1 E19 (C24SE : 1 E65) and the ground	NG	Thermo unit malfunction	Replace the thermo unit
OK			
Gauge function 1. Disconnect the unit connector then connect 3.4W bulb to wire harness side with ground 2. Check indicating point when starter SW. is ON position (Temperature should indicate)	NG	Gauge malfunction	Replace the case baseboard assy
OK			
Continuity between 1 E19 (C24SE : 1 E65) and 16 B23 (C24SE : 13 B24)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Temperature gauge incorrect readings in all ranges

Checkpoint		Trouble Cause	Countermeasure
Thermo unit resistance between connector 1 E19 (C24SE: 1 E65) and the ground when disconnecting the connector (Specified resistance should indicate)	NG	Thermo unit malfunction	Replace the thermo unit

ENGINE COOLANT TEMPERATURE GAUGE (4JJ1-TC/4JK1-TC)

Refer to “Inspection and Repair” in this Manual for a detailed description of the coolant temperature gauge self-diagnosis procedure.

1. No engine coolant temperature indicates at all

Checkpoint		Trouble Cause	Countermeasure
Engine coolant temperature sensor continuity between connector 3 E41 and the ground	NG	Engine coolant temperature sensor malfunction	Replace the engine coolant temperature sensor
OK ↓			
Gauge function 1. Disconnect the sensor connector then connect 3.4W bulb to wire harness side with ground 2. Check indicating point when starter SW. is ON position (Temperature should indicate)	NG	Gauge malfunction	Replace the meter assembly
OK ↓			
Continuity between 3 E41 and 16 B23	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Engine coolant temperature gauge incorrect readings in all ranges

Checkpoint		Trouble Cause	Countermeasure
Engine coolant temperature sensor resistance between connector 3 E41 and the ground when disconnecting the connector (Specified resistance should indicate)	NG	The sensor malfunction	Replace the sensor

TEMPERATURE GAUGE AND THERMO UNIT (HFV6)

1. No temperature indicates at all

Checkpoint		Trouble Cause	Countermeasure
PIM (Thermo unit) continuity between connector 8 B96 and the ground	NG	Thermo unit malfunction	Replace the thermo unit
OK ↓			
Gauge function 1. Disconnect the unit connector then connect 3.4W bulb to wire harness side with ground 2. Check indicating point when starter SW. is ON position (Temperature should indicate)	NG	Gauge malfunction	Replace the case baseboard assy
OK ↓			
Continuity between 8 B96 and 16 B23	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Temperature gauge incorrect readings in all ranges

Checkpoint		Trouble Cause	Countermeasure
PIM (Thermo unit) resistance between connector 8 B96 and the ground when disconnecting the connector (Specified resistance should indicate)	NG	Thermo unit malfunction	Replace the thermo unit

FUEL GAUGE AND FUEL TANK UNIT (C24SE, 4JJA1T(L), 4JH1-TC, 4JJ1-TC/4JK1-TC)

1. No fuel level indicates at all

Checkpoint		Trouble Cause	Countermeasure
Tank unit continuity between connector 3 F2 and ground	NG	Open circuit inside the tank unit	Replace the tank unit
OK ↓			
Fuel gauge function 1. Disconnect the tank unit connector then connect 3.4W bulb to wire harness side 2. Check indicating point when starter SW. is ON position (Fuel level should indicate)	NG	Gauge malfunction	Replace the case baseboard assy
OK ↓			
Continuity between connectors 17 B23 (C24SE : 14 B24) and 3 F2	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Fuel gauge gives incorrect readings in all ranges

Checkpoint		Trouble Cause	Countermeasure
Tank unit resistance position with the float at checking points (Specified resistance should indicate)	NG	Tank unit malfunction	Replace the tank unit

FUEL GAUGE AND FUEL TANK UNIT (HFV6)

1. No fuel level indicates at all

Checkpoint		Trouble Cause	Countermeasure
PIM (Tank unit) continuity between connector 17 B96 and ground	NG	Open circuit inside the tank unit	Replace the tank unit
OK ↓			
Fuel gauge function 1. Disconnect the tank unit connector then connect 3.4W bulb to wire harness side 2. Check indicating point when starter SW. is ON position (Fuel level should indicate)	NG	Gauge malfunction	Replace the case baseboard assy
OK ↓			
Continuity between connectors 17 B23 and 17 B96	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Fuel gauge gives incorrect readings in all ranges

Checkpoint		Trouble Cause	Countermeasure
Tank unit resistance position with the float at checking points (Specified resistance should indicate)	NG	Tank unit malfunction	Replace the tank unit

WARNING AND INDICATOR LIGHT

1. When the parking brake lever is pulled, the brake indicator light does not light up

Checkpoint	Result	Trouble Cause	Countermeasure
Brake indicator light bulb continuity	NG	Bulb burned out or loose contact	Replace or reinstall the bulb
OK ↓			
Parking brake SW. installation position and function	NG	Incorrect SW. adjustment or poor SW. point contact	Adjust or replace the parking brake SW.
OK ↓			
Continuity between the parking brake SW. connector 1 C39 (stick type), 1 R4 (lever type), and 4 B23 (C24SE : 9 B23)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK ↓			
Continuity between the parking brake SW. connector 1 C39 (stick type), 1 R4 (lever type) and the ground when the parking brake is operated	NG	Parking brake SW. malfunction	Replace the parking brake SW.

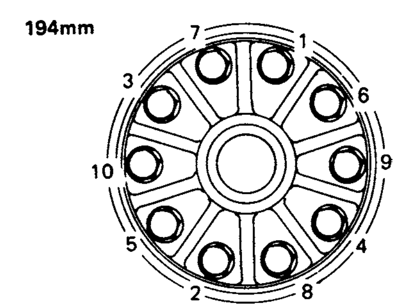
Inspection and Repair

Make all necessary adjustments, repairs, and part replacements if wear, damage, or other problems are discovered during inspection.

- Ring gear, pinion gear
- Bearing
- Side gear, pinion gear, cross pin
- Differential cage, carrier
- Thrust washer
- Oil seal

Visual Check

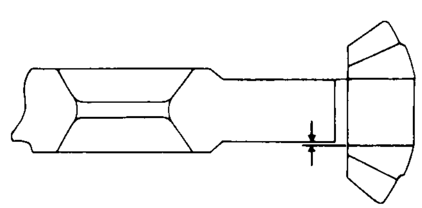
Inspect the following parts for wear, damage, or other abnormal conditions.



Ring Gear Replacement

(1) The ring gear should always be replaced with the drive pinion as a set.
(2) When installing the ring gear, apply LOCTITE 271 or equivalent to the threaded hole and bolt.
(3) Tighten the fixing bolts in a diagonal sequence as illustrated.
(4) Discard used bolts and install new ones.

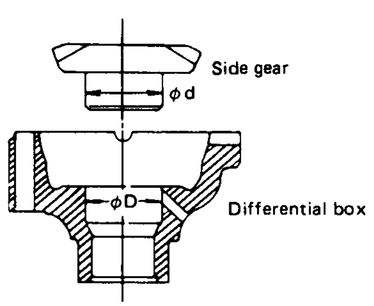
Bolt Torque	N·m (kgf·m/lb·ft)
108 ± 9.8 (11 ± 1/79.6 ± 7.2)	



Clearance Between the Differential Pinion and the Cross Pin

mm(in)

Standard	Limit
0.05 - 0.10 (0.002 - 0.004)	0.2 (0.008)



Clearance Between the Side Gear and the Differential Box

mm(in)

Standard	Limit
0.03 - 0.10 (0.001 - 0.004)	0.15 (0.006)

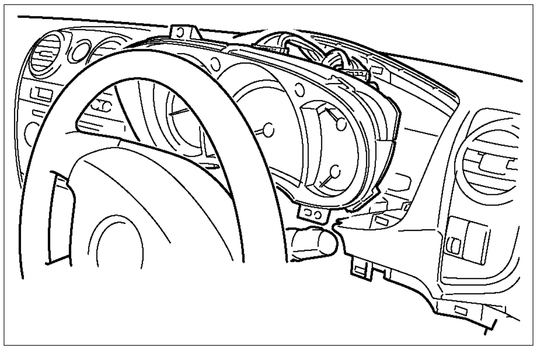
2. When the parking brake lever is released, the indicator light does not go off

Checkpoint		Trouble Cause	Countermeasure
Parking brake SW. installation position and function	NG	Incorrect the parking brake SW. adjustment or parking brake SW. faulty	Adjust the SW. installation position or replace the parking brake SW.
OK ↓			
Check to see if the indicator light goes off when the parking brake SW. connector 1 C39 (stick type), 1 R4 (lever type) is disconnected	NG	Brake fluid level SW. faulty or short circuit	Replace the brake fluid level SW., or repair a short circuit between the parking brake SW. connector 1 C39, 1 R4 and 4 B23 (C24SE : 9 B23) or the brake fluid level SW. connector 2 C37 and 4 B23 (C24SE : 9 B23)

3. Oil pressure warning light does not go off while engine is running

Checkpoint		Trouble Cause	Countermeasure
Engine oil pressure	NG	Refer to ENGINE Section	Refer to ENGINE Section
OK ↓			
Check to see the warning light goes off when the oil pressure SW. connector 1 E1 is disconnected or when the PIM (Oil pressure) connector 6 B96 (HFV6) is disconnected	NG	Short circuit	Repair a short circuit between 1 E1 and 39 B23 (C24SE : 17 B24) or 6 B96 and 39 B23 (HFV6)
OK ↓			
Continuity between the oil pressure SW. connector 1 E1 (HFV6 : 6 B96)and the body ground when the engine is operating	NG	Oil pressure SW. faulty	Replace the oil pressure SW.

REMOVAL AND INSTALLATION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This illustration is based on RHD model

METER ASSEMBLY

Removal

1. Meter Cluster Assembly
   - Refer to the removal steps of “INSTRUMENT PANEL” in Section 10 “CAB”
2. Meter Assembly
   - Remove three screws of the meter assembly.
   - Disconnect the meter connectors.

Installation

Follow the removal procedure in the reverse order to install the meter.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

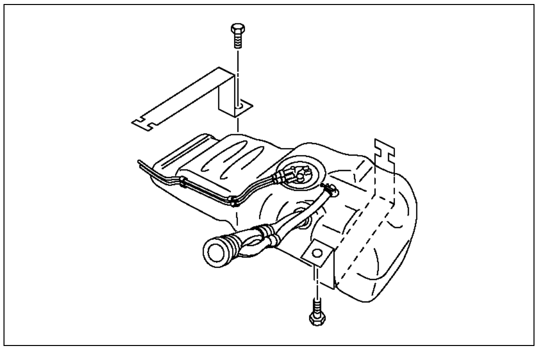
Be absolutely sure that the meter connectors are securely connected.
This will prevent a poor contact and an open circuit.

Wire Harness

Do not pinch the wire harness between the cluster and the meter hood during the meter assembly installation procedure.
Wire damage will result.

Installation

To Install, follow the removal steps in the reverse order.

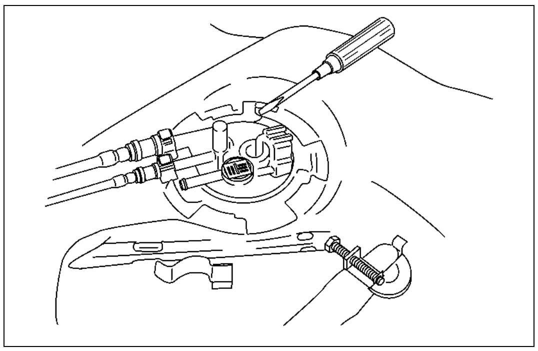


FUEL GAUGE UNIT

Removal

Dismount the fuel tank first, then remove the fuel gauge unit.

1. Remove the rear inner liner -LH
   - Remove the clip
2. Remove the filler neck.
   - Remove the screw
3. Remove the ground with cable.
4. Remove the fuel tank band.
   - Disconnect fuel line quick connectors.
5. Remove the fuel gauge unit from the fuel tank.



Installation

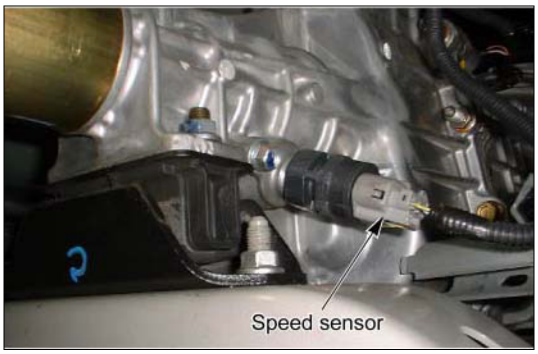
Follow the removal procedure in the reverse order to install the fuel gauge unit.
Pay close attention to the important points mentioned in the following paragraphs.

Rubber Seal

Be absolutely sure that the fuel gauge unit rubber seal is correctly seated.

Connector

Be absolutely sure that the fuel gauge unit connector is securely connected.
This will prevent a poor contact and an open circuit.



VEHICLE SPEED SENSOR (INSTALLED ON THE TRANSMISSION)

Removal

1. Disconnect the connector.
2. Remove the vehicle speed sensor body by rotating it.

Installation

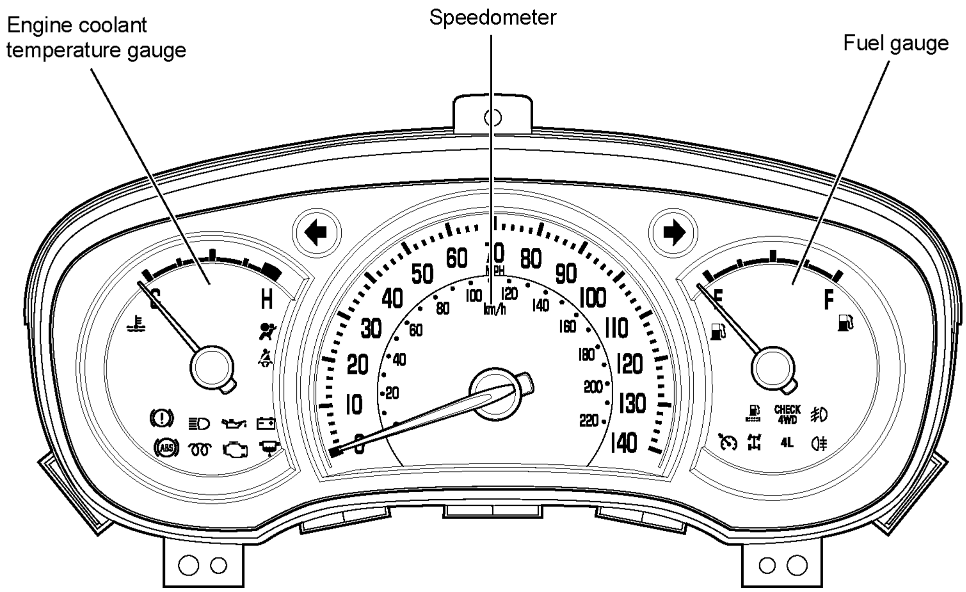
To Install, follow the removal steps in the reverse order, noting the following point.
Tighten the vehicle speed sensor to the specified torque.

Vehicle Speed Sensor Tightening Torque N·m (kg·m/lb.ft)
25 ± 4.9 (2.5 ± 0.5/18 ± 3.6)

INSPECTION AND REPAIR

METER AND INDICATOR LIGHT LAYOUT

Without tachometer (4JJ1-TC/4JK1-TC)



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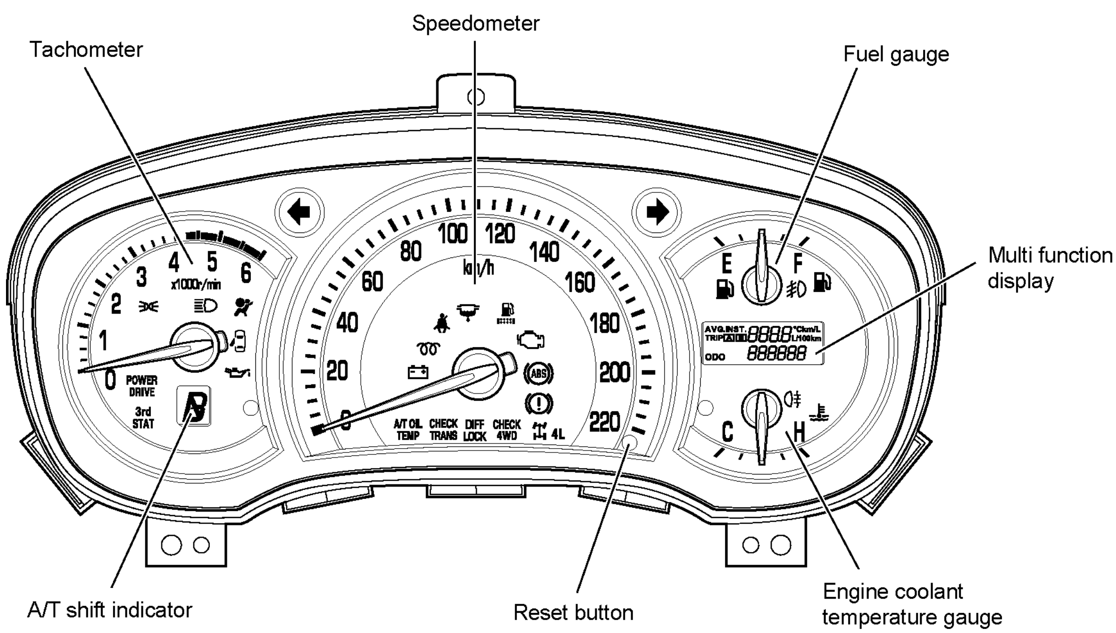
With tachometer (4JJ1-TC/4JK1-TC)



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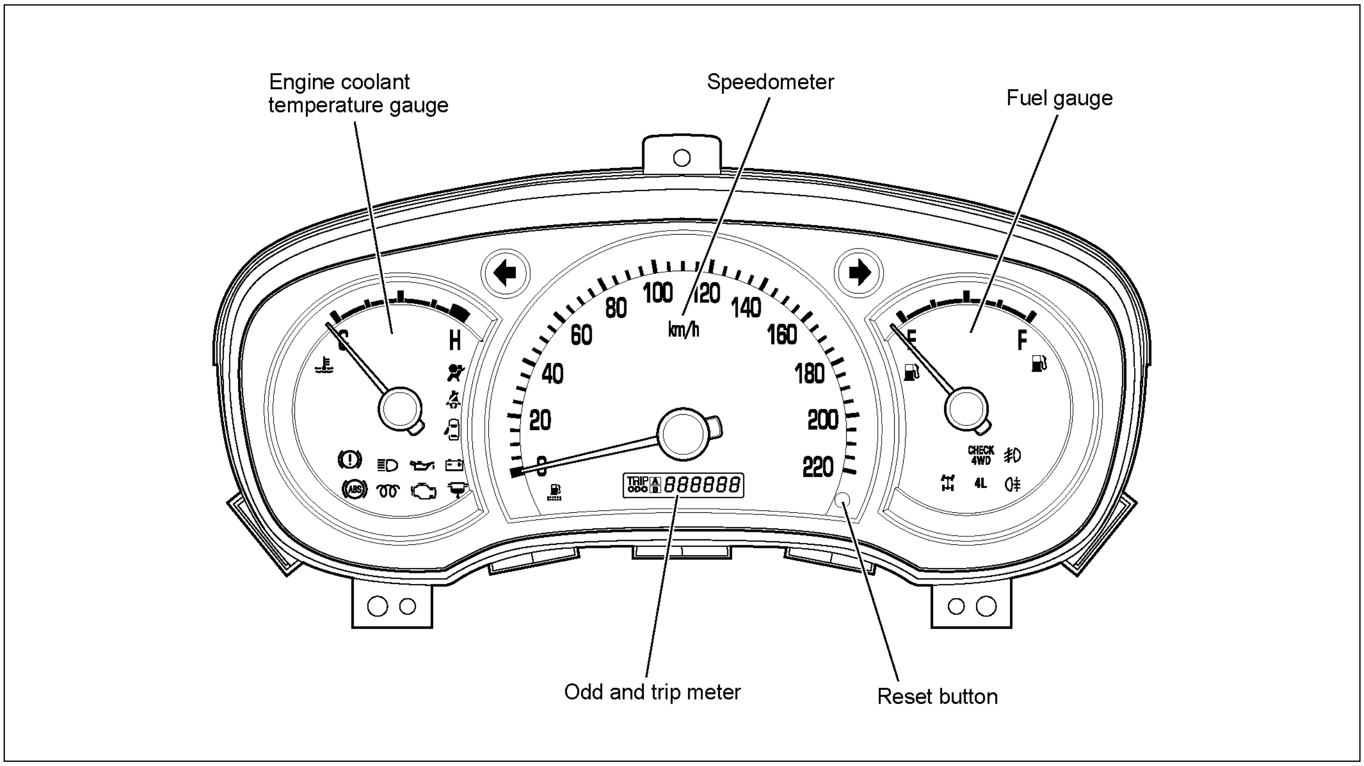
Without tachometer (4JA1T(L)/4JH1-TC)



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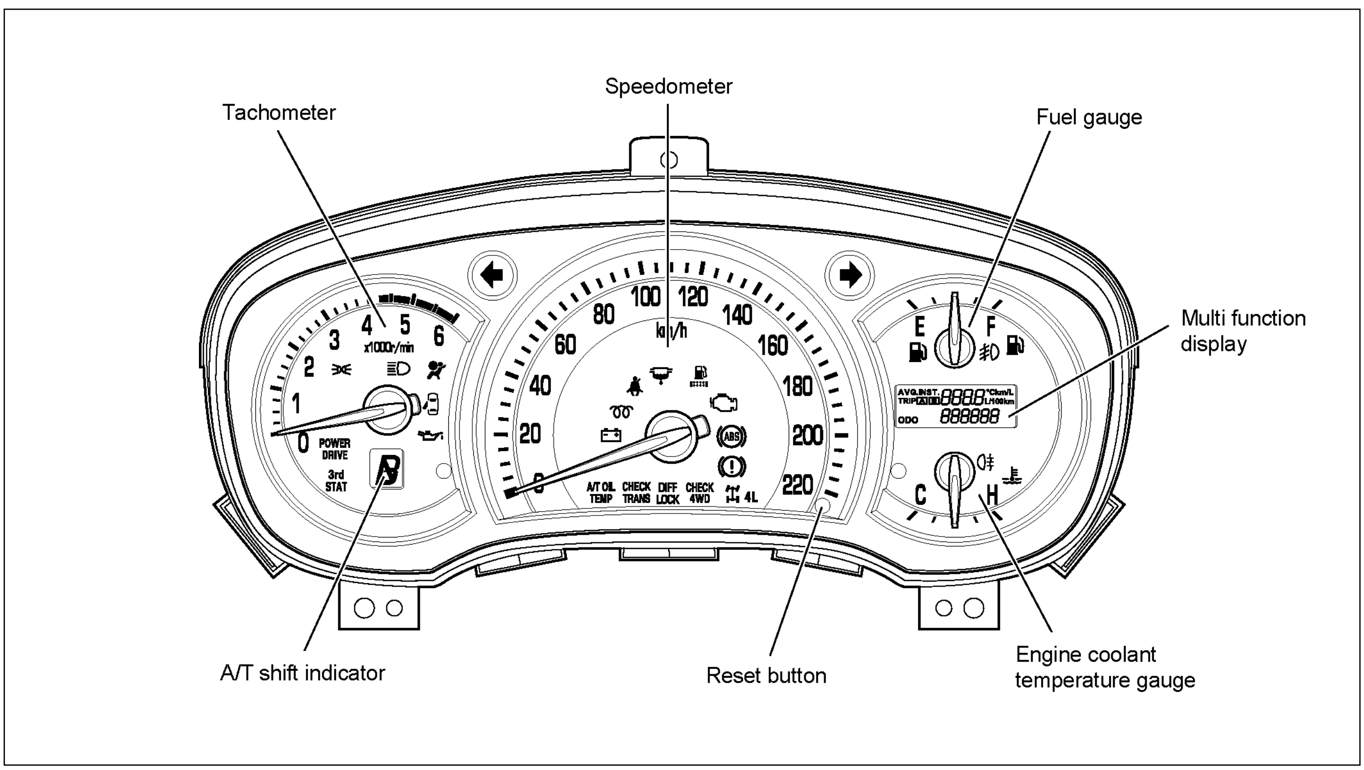
With tachometer (4JA1T(L)/4JH1-TC)



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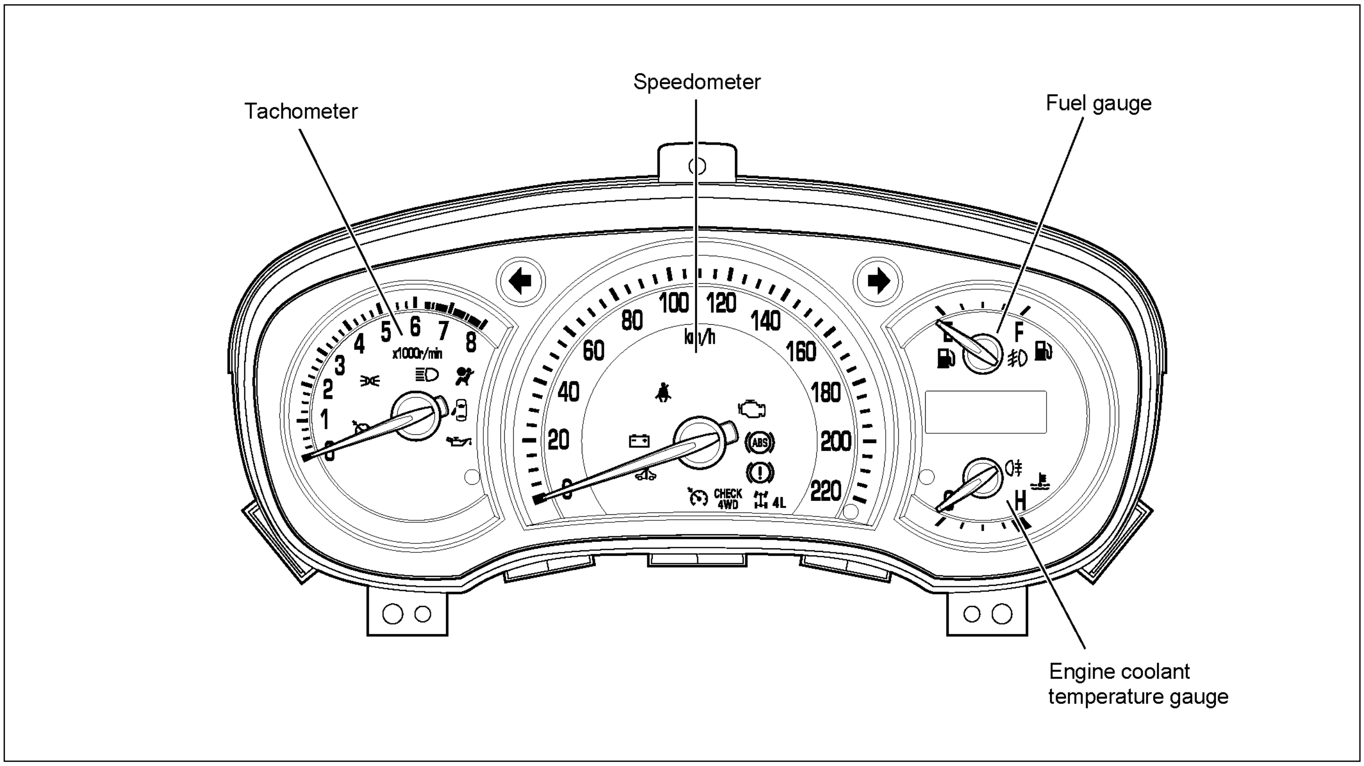
With tachometer (HFV6)



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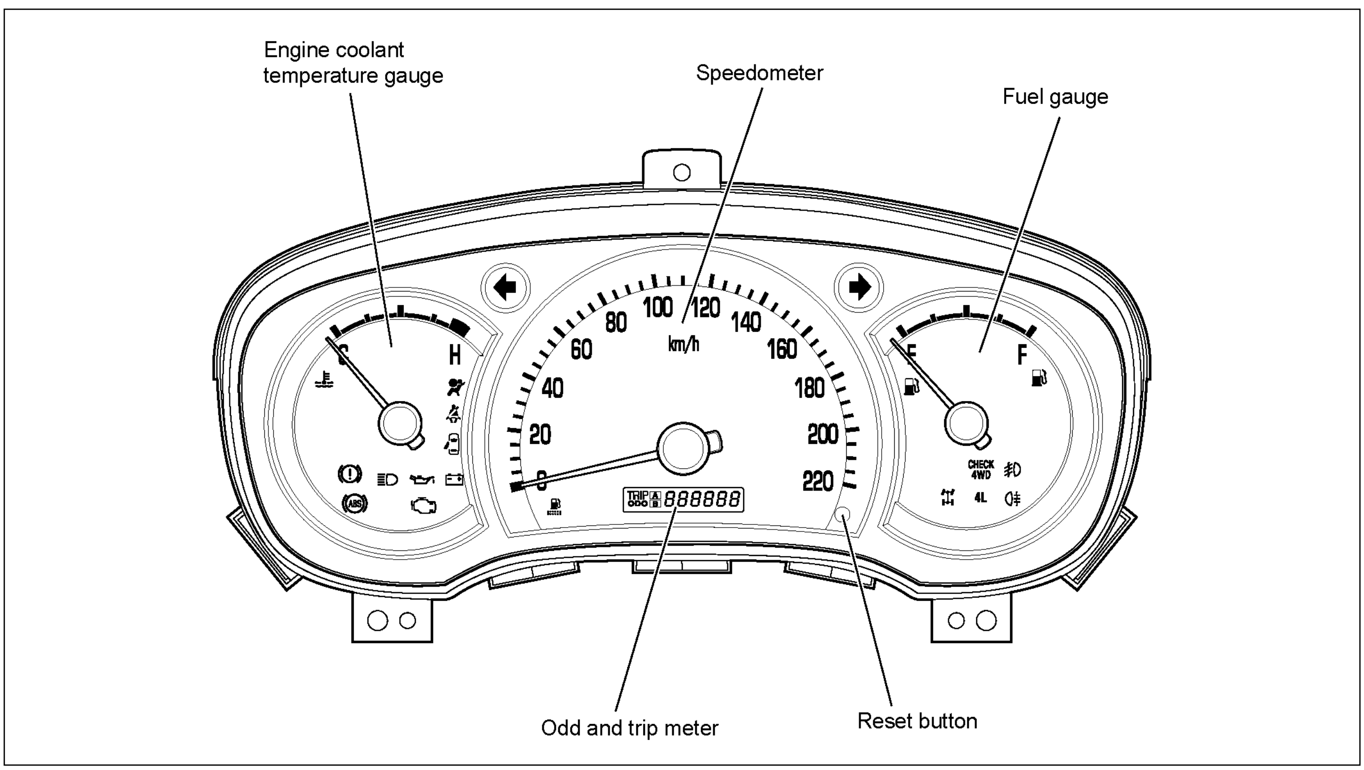
Without tachometer (C24SE)



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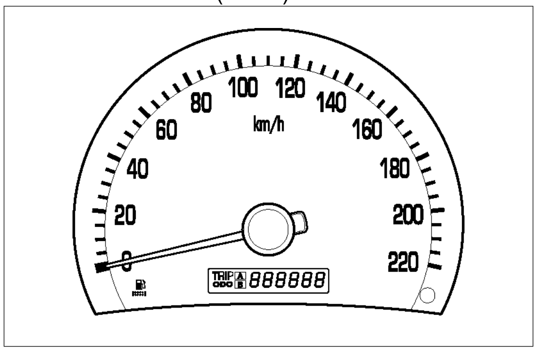
SPEEDOMETER AND TACHOMETER

Speedometer On-Vehicle Inspection

Check the speedometer accuracy with a speedometer tester. Carefully follow the tester manufacturer's instructions.

SPEEDOMETER (km/h)



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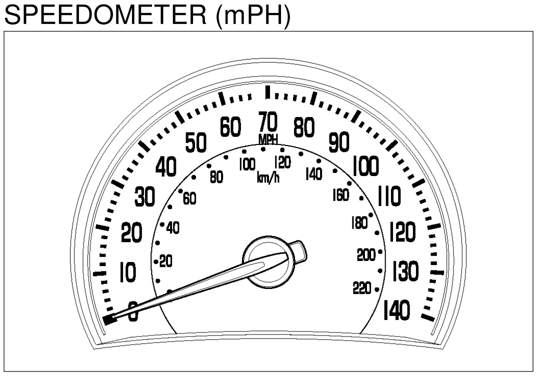
km/h meter

Indication	Permissible Range	
	EUROPE, G.EXP	AUSTRALIA
20	20.2-24.5	20.2-24.3
40	40.6-44.9	41.7-46.0
60	60.9-65.2	62.6-66.9
80	81.5-85.8	83.4-87.7
100	102.0-106.3	104.4-108.7
120	122.5-126.8	125.1-129.4
140	143.1-147.4	146.1-150.4
160	163.7-168.0	166.7-171.0
180	184.2-188.5	187.3-191.6
200	204.6-208.9	208.4-212.7

SPEEDOMETER (mPH)



RTW78ASH001201

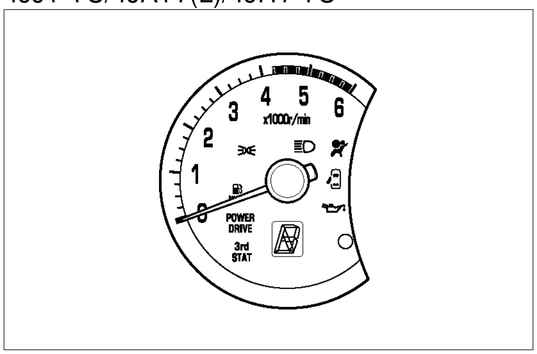
mPH meter

Indication	Permissible Range
	G.EXP, EUROPE
20	20.5-23.2
40	40.9-43.6
60	62.2-64.9
80	83.2-85.9
100	104.2-106.9
120	125.2-127.9

Tachometer On-Vehicle Inspection

1. Attach a tune-up tester to the engine.
2. Start the engine.
3. Compare the tachometer reading and the tester reading.
   If the tachometer indication is outside the permissible range, the tachometer must be replaced.
4. Gradually increase and decrease the engine speed.
   Note the movement of the tachometer needle.
   If the needle movement is sluggish, the tachometer must be replaced.

4JJ1-TC/4JA1T(L)/4JH1-TC

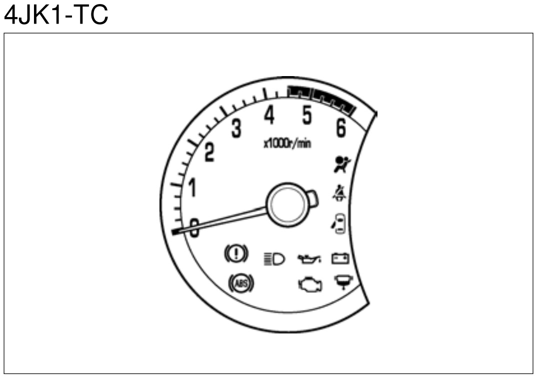


RTW780SH000401

rpm

Indication	Permissible Range
750	700-870
2,000	1915-2085
3,000	2915-3085
4,000	3950-4120
5,000	4950-5120

4JK1-TC

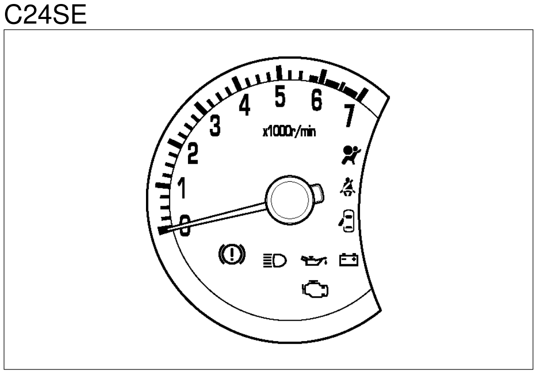


RTW780SH000501

Tachometer rpm

Indication	Permissible Range
750	700-870
2,000	1915-2085
3,000	2915-3085
4,000	3950-4120
5,000	4950-5120

C24SE

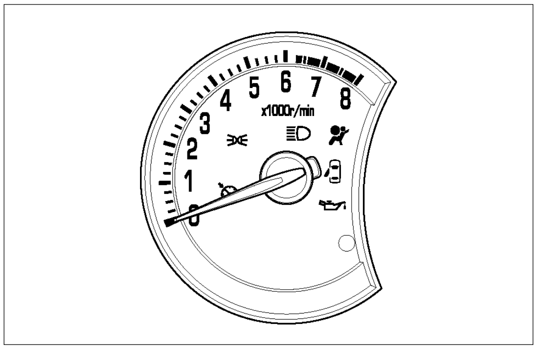


RTW78ASH001301

rpm

Indication	Permissible Range
1,000	950-1150
2,000	1900-2100
3,000	2900-3100
4,000	3900-4100
5,000	4900-5100
6,000	5950-6150

HFV6

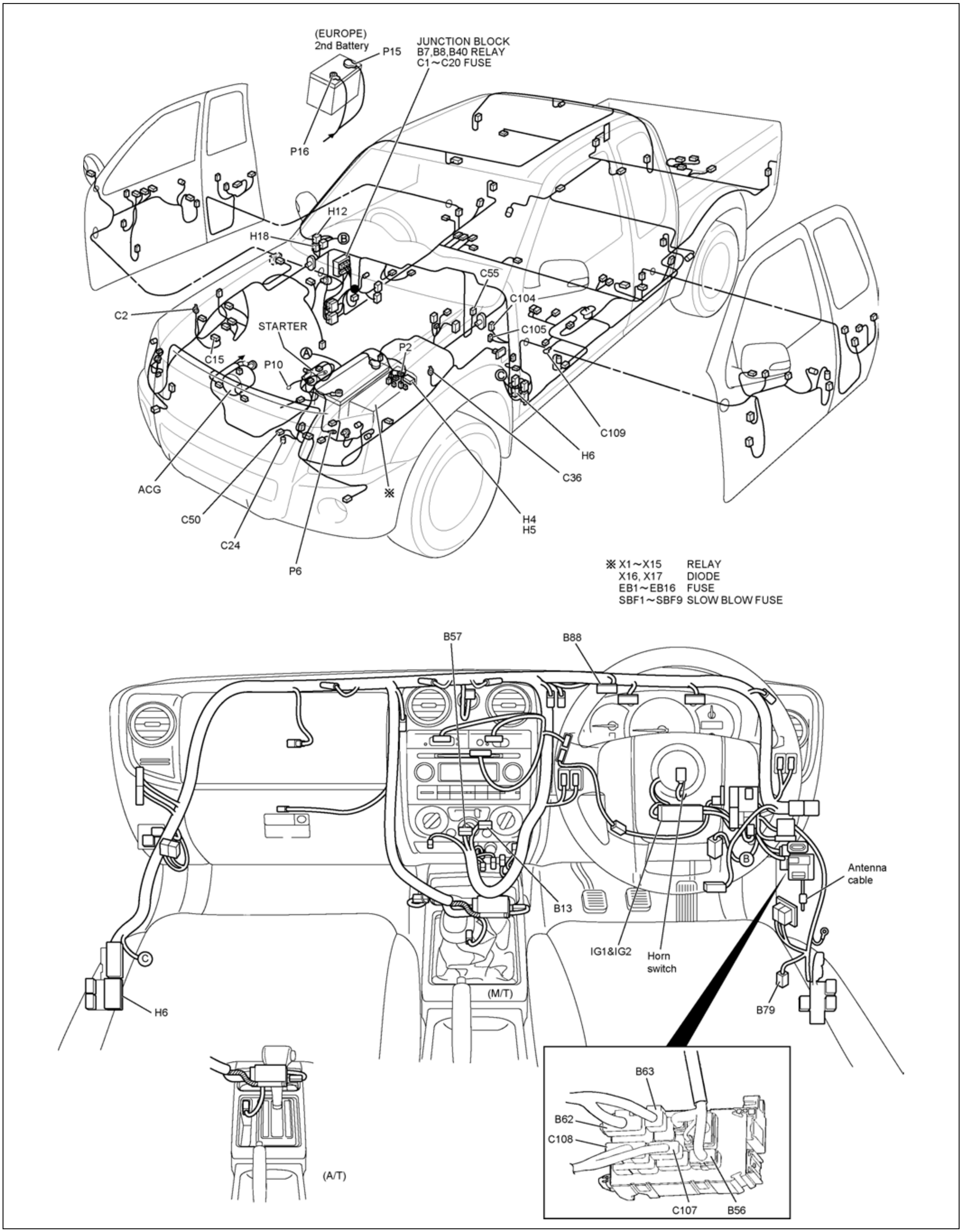


RTW78ASH001401

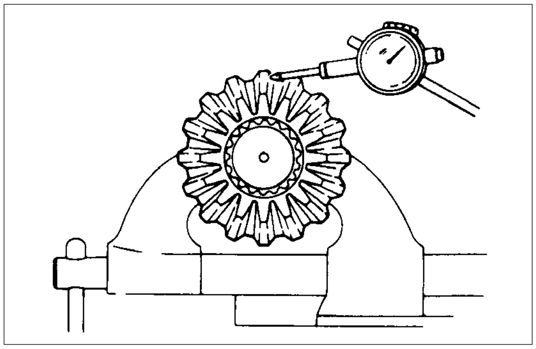
rpm

Indication	Permissible Range
750	690-910
1,000	890-1110
2,000	1890-2110
3,000	2890-3110
4,000	3890-4110
5,000	4890-5110
6,000	5940-6160
7,000	6940-7160

CONNECTOR LOCATION (RHD MODEL)



RTW78AXF039101&RTW78AXF045301



Play in Splines Between the Side Gear and the Axle Shaft

mm(in)

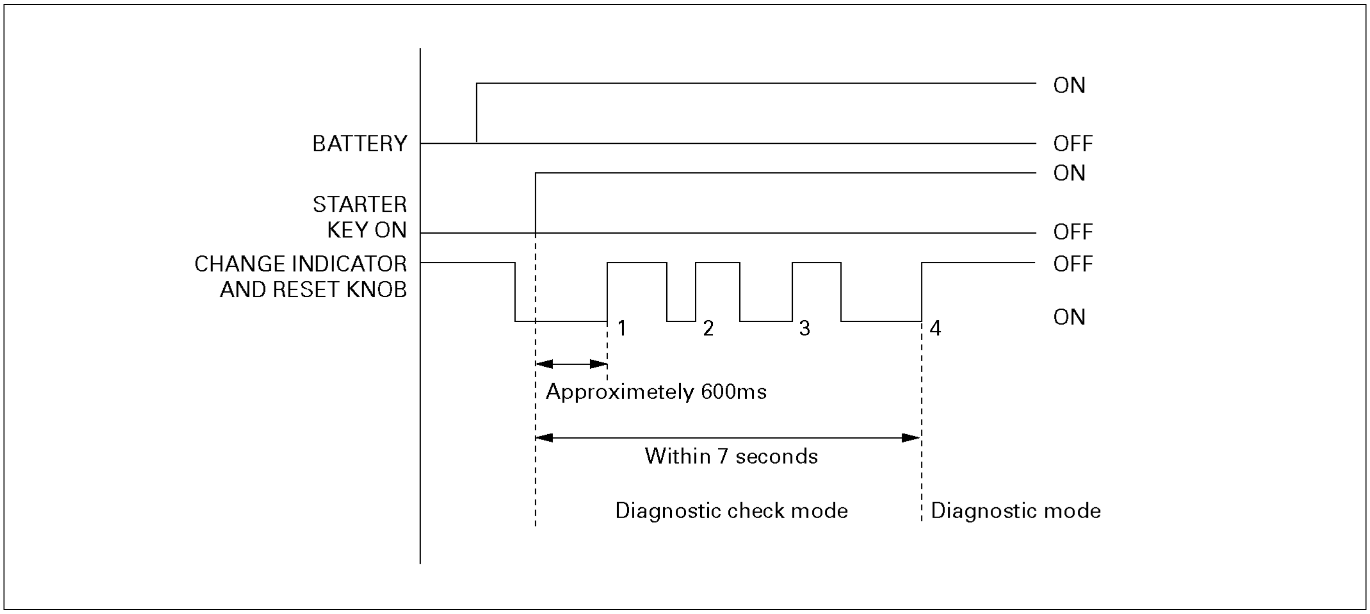
Standard	Limit
0.07 - 0.36 (0.003 - 0.014)	0.25 (0.010)

Tachometer Off-Vehicle Inspection

Remove the tachometer from the meter assembly and measure the resistance value and the current consumption between each terminal.

SELF DIAGNOSTIC FUNCTION

Check that the speedometer, tachometer, fuel gauge, and temperature gauge operate properly.



821R300033

Entering the self-diagnostic mode

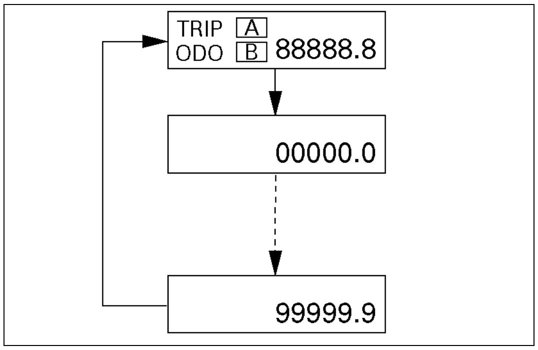
1. Push in and hold the “Change Indicator and Reset” knob.
2. Turn the ignition ON.
3. When the LCD odometer turns ON, release the “Change Indicator and Reset” knob.
4. Push in and release the “Change Indicator and Reset” knob three times in quick succession.

The meter cluster is now in “Self-diagnostic” mode.

NOTE: Steps 2-4 must be performed within 7 seconds.

The meter cluster will not enter “Self-diagnostic” mode if any of the following conditions occur:

1. The “Change Indicator and Reset” knob is not depressed when the ignition is turned ON.
2. The “Change Indicator and Reset” knob is released within 600ms of turning the ignition ON.
3. The “Change Indicator and Reset” knob is not depressed and released three times within 7 seconds.

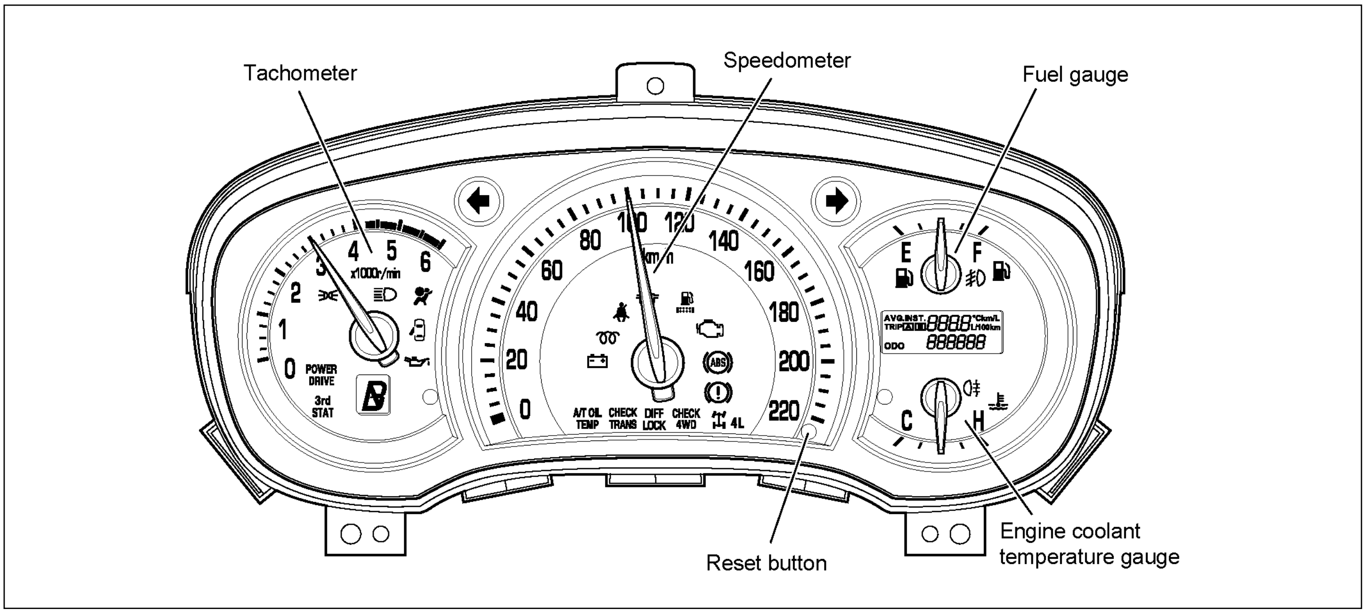


Self –diagnostic mode
LCD condition

- All LCDs are lit during the transition from self-diagnostic decision mode to self-diagnostic mode
- The odometer/trip indicator scrolls throng its entire range approximately once every 600 ms. All digits are lit (segment check indication). This continues until the self-diagnostic mode is terminated.

Meter and gauge indications

Meter and gauge indications with the change indicator and reset knob on (self-diagnostic mode) are as shown in the following table.

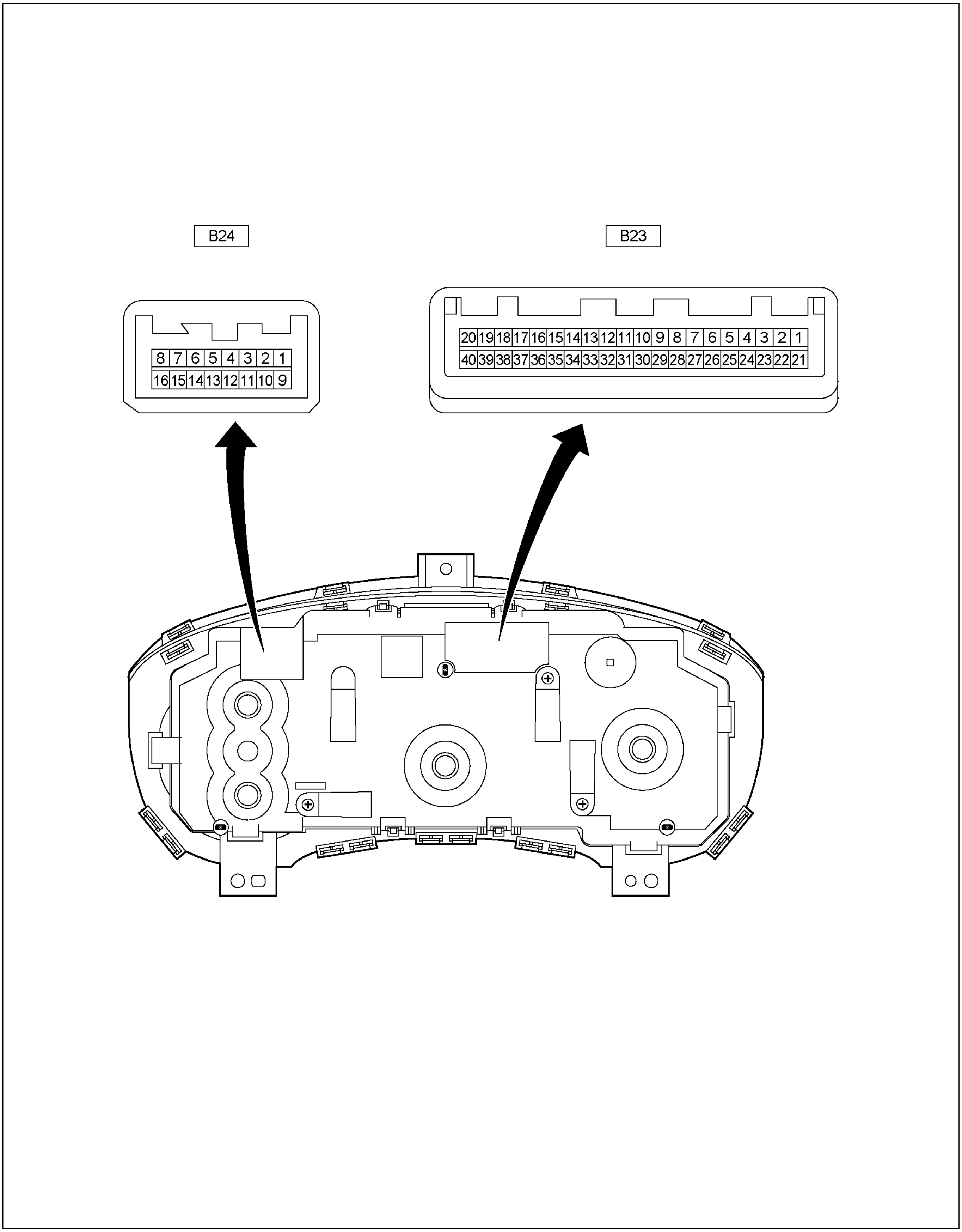


RTW78ASF000101

Speedometer	100 kilometers per hour
Tachometer	3,000 rpm
Fuel gauge	Mid-point on the dial
Temperature gauge	

All indications return to zero when the change indicator and reset knob is turned off.
The self-diagnostic mode and the self-diagnostic decision mode are cancelled when the ignition switch is turned to the OFF position. They also cancel when a speed pulse is sensed.
If either of the self-diagnostic modes are cancelled by turning the ignition switch to the OFF position, the diagnostic unit remains in the stand-by condition.
If cancellation occurs when a speed pulse is sensed, the unit remains in the ordinary operating condition.

Meter connector pin arrangement



RTW780XF007401

Connector No. / Terminal No.	B23
1	Power ground
2	Cruise main
3	Charge
4	Brake
5	ABS control unit
6	Fuel consumption
7	Tachometer pulse
8	Speedometer pulse
9	Rheostat
10	Taillight relay
11	-
12	-
13	Ambient temperature sensor
14	Seat belt
15	Key remind switch
16	Engine coolant temperature sensor
17	Fuel gauge unit and sender
18	Fuel level
19	Sedimenter
20	Door ajar
21	Power drive
22	3rd start
23	Fuel filter
24	Cruise set
25	Check trans
26	SVS
27	4WD
28	4WD - L
29	A/T oil temperature
30	Check 4WD
31	CAN (+)
32	CAN (-)
33	Turn signal - LH
34	ABS
35	Glow
36	-
37	Hi – beam (+)
38	Check engine
39	Oil pressure
40	SRS control unit

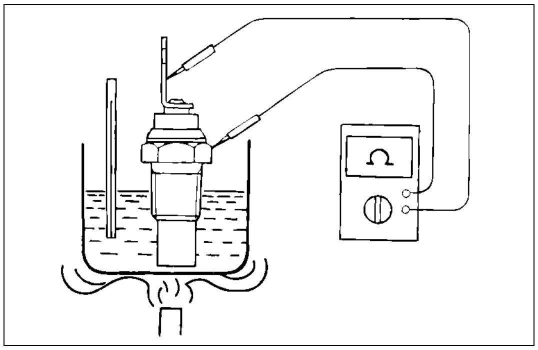
Connector No. / Terminal No.	B24
1	Signal ground
2	SRS ground
3	A/T shift indicator “3”
4	A/T shift indicator “D”
5	A/T shift indicator “N”
6	A/T shift indicator “R”
7	A/T shift indicator “P”
8	Ignition
9	Ambient temperature sensor
10	RR fog light
11	FRT fog light
12	A/T shift indicator “2”
13	A/T shift indicator “L”
14	Turn signal - RH
15	Door SW - driver
16	Power source

Connector No. B23

Terminal	Connector place	SOUTH AFRICA		SAUDI ARABIA		ISRAEL		EUROPE		OTHER			
		4JJ1-TC	HFV6	4JA1T(L)	HFV6	4JJ1-TC	HFV6	RHD	LHD	G.EXP RHD	4JJ1-TC	C24SE AUSTRALIA	HFV6 AUSTRALIA
1	Power ground	○	○	○	○	○	○	○	○	○	○	○	○
2	Cruise main	—	—	—	—	—	—	○	○	—	—	—	—
3	Charge	○	○	○	○	○	○	○	○	○	○	○	○
4	Brake	○	○	○	○	○	○	○	○	○	○	○	○
5	ABS control unit	○	○	○	○	○	○	○	○	○	○	○	○
6	Fuel consumption	○	—	○	—	○	—	○	○	○	○	—	—
7	Tachometer pulse	○	○	○	○	○	○	○	○	○	○	○	○
8	Speedometer pulse	○	○	○	○	○	○	○	○	○	○	○	○
9	Rheostat	○	○	○	○	○	○	○	○	○	○	○	○
10	Taillight relay	○	○	○	○	○	○	○	○	○	○	○	○
11	—	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	—	—	—	—	—	—	—	—	—	—	—
13	Ambient temperature sensor	○	○	○	○	○	○	○	○	○	○	—	○
14	Seat belt	○	○	○	○	○	○	○	○	○	○	○	○
15	Key remind switch	○	○	○	○	○	○	○	○	○	○	○	○
16	Engine coolant temperature sensor	○	○	○	○	○	○	○	○	○	○	○	○
17	Fuel gauge unit and sender	○	○	○	○	○	○	○	○	○	○	○	○
18	Fuel level	—	—	—	—	—	—	—	—	—	—	—	—
19	Sedimenter	○	—	○	—	○	—	○	○	○	○	—	—
20	Door ajar	—	—	—	—	—	—	—	—	—	—	—	○
21	Power drive	○	○	○	○	○	○	○	○	○	○	—	○
22	3rd start	○	○	○	○	○	○	○	○	○	○	—	○
23	Fuel filter	○	—	○	—	○	—	○	○	○	○	—	—
24	Cruise set	—	○	—	○	—	○	○	○	—	○	—	—
25	Check trans	○	○	○	○	○	○	○	○	○	○	—	○
26	SVS	○	○	○	○	○	○	○	○	○	○	—	○
27	4WD	○	○	○	○	○	○	○	○	○	○	—	○
28	4WD - L	○	○	○	○	○	○	○	○	○	○	—	○
29	A/T oil temperature	○	○	○	○	○	○	○	○	○	○	—	○
30	Check 4WD	○	○	○	○	○	○	○	○	○	○	—	○
31	CAN (+)	—	—	○	—	○	—	○	—	○	—	—	—
32	CAN (-)	—	—	○	—	○	—	○	—	○	—	—	—
33	Turn signal - LH	○	○	○	○	○	○	○	○	○	○	○	○
34	ABS	○	○	○	○	○	○	○	○	○	○	○	○
35	Glow	○	—	○	—	○	—	○	○	○	○	—	—
36	—	—	—	—	—	—	—	—	—	—	—	—	—
37	Hi – beam (+)	○	○	○	○	○	○	○	○	○	○	○	○
38	Check engine	○	○	○	○	○	○	○	○	○	○	○	○
39	Oil pressure	○	○	○	○	○	○	○	○	○	○	○	○
40	SRS control unit	○	○	○	○	○	○	○	○	○	○	○	○

Connector No. B24

Terminal	Connector place	SOUTH AFRICA		SAUDI ARABIA		ISRAEL		EUROPE		OTHER			
		4JJ1-TC	HFV6	4JA1T(L)	HFV6	4JJ1-TC	HFV6	RHD	LHD	G.EXP RHD	4JJ1-TC	C24SE AUSTRALIA	HFV6 AUSTRALIA
1	Signal ground	○	○	○	○	○	○	○	○	○	○	○	○
2	SRS ground	○	○	○	○	○	○	○	○	○	○	○	○
3	A/T shift indicator “3”	○	○	○	○	○	○	○	○	○	○	—	○
4	A/T shift indicator “D”	○	○	○	○	○	○	○	○	○	○	—	○
5	A/T shift indicator “N”	○	○	○	○	○	○	○	○	○	○	—	○
6	A/T shift indicator “R”	○	○	○	○	○	○	○	○	○	○	—	○
7	A/T shift indicator “P”	○	○	○	○	○	○	○	○	○	○	—	○
8	Ignition	○	○	○	○	○	○	○	○	○	○	○	○
9	Ambient temperature sensor	○	○	○	○	○	○	○	○	○	○	—	○
10	RR fog light	—	—	—	—	—	—	○	○	—	—	—	—
11	FRT fog light	—	—	—	○	—	○	○	○	—	—	—	○
12	A/T shift indicator “2”	○	○	○	○	○	○	○	○	○	○	—	○
13	A/T shift indicator “L”	○	○	○	○	○	○	○	○	○	○	—	○
14	Turn signal - RH	○	○	○	○	○	○	○	○	○	○	○	○
15	Door SW - driver	○	○	○	○	○	○	○	○	○	○	○	○
16	Power source	○	○	○	○	○	○	○	○	○	○	○	○



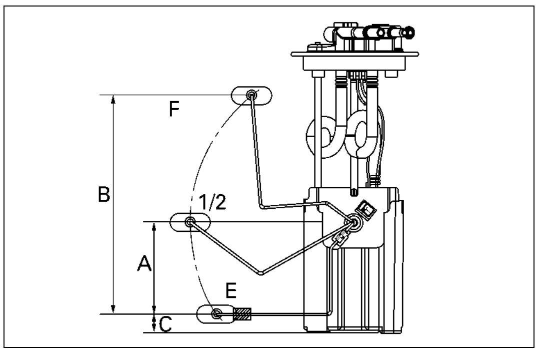
140R300007

Thermo Unit Inspection

INSPECTION

Use a circuit tester to measure the thermo unit resistance. Replace the unit when the result of inspection is found abnormal.

Check condition \ Temperature	60°C (140°F)	115°C (239°F)
Resistance value (Ω)	168 ±3.5	$30.9^{+2.5}_{-2.0}$



041R300002

Fuel Gauge Unit Inspection

Measure the fuel gauge unit resistance between the connector terminals 2 F2 and 3 F2 while shifting the float from "E" to "F" point.

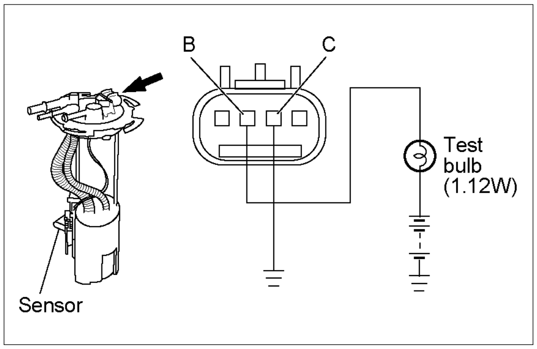
Fuel Tank Resistance

Level	Float position mm	Standard resistance Ω
F (B)	217.5	$17^{+2.2}_{-0.8}$
1/2 (A)	106.6 (4JJ1-TC/4JK1-TC)	45 ± 4.5
	105.1 (C24SE, 4JA1T(L))	
	112.8 (4JH1-TC)	
E (C)	16.2	120 ± 2.0

Low Fuel Indicator Light

1. Disconnect the fuel gauge unit wire connector.
2. Turn the key switch on. Check that the bulb lights.

If operation is not correct, remove and check the bulb or circuit.
or If check whether low fuel turns on fuel input (B-24) at the time of open and key on.
∗ meter is check at low fuel



RTW78ASH001501

Check level sensor operation

1. Remove the fuel gauge unit.
2. Apply battery voltage between terminal (B) and (C) through a 1.12 watt bulb. Check that the bulb lights.

Note:
It will take a short time for the bulb light.

3. Submerge the sensor in fuel. Check that the bulb goes out.

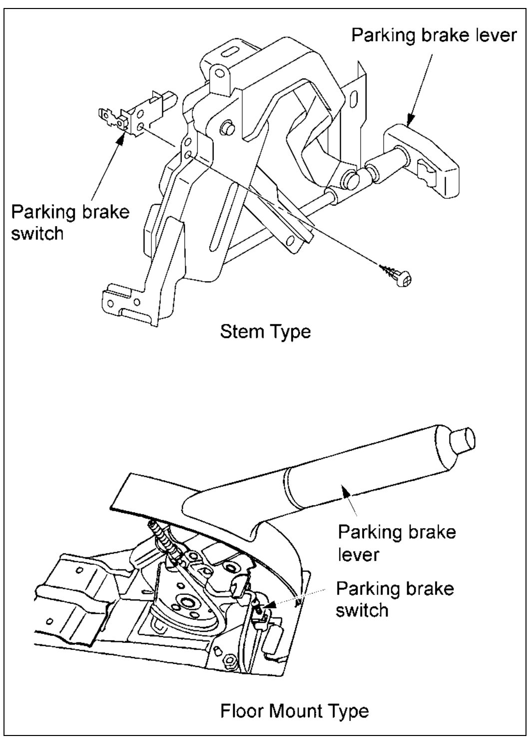
If operation is not correct, replace the fuel tank unit.

BRAKE SYSTEM WARNING LIGHT

The brake system warning light comes on while the parking brake is set and the engine run position.

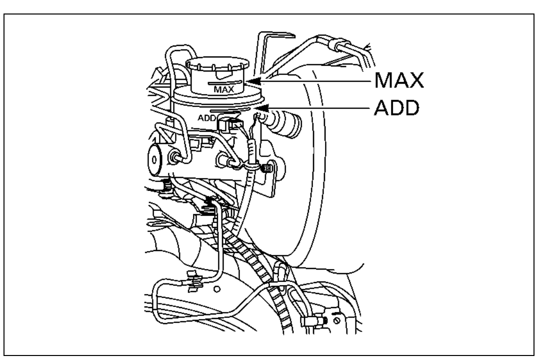
Note:
The parking brake indicator light circuit is designed to prevent driving of the vehicle with the parking brake on. It does not indicate the condition of the parking brake system.

The parking brake switch is in parallel with the brake fluid switch.



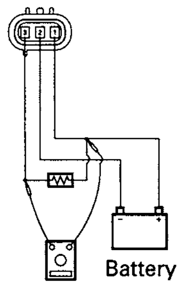
RTW48AMH000101

The brake system warning light also comes on when reservoir brake fluid level falls below the specified limit with the parking brake released and the engine run position.



VEHICLE SPEED SENSOR (INSTALLED ON THE TRANSMISSION)

The speed sensor is installed on the rear portion of the transmission.
The number of pulses generated is four pulses per one rotation of the pinion shaft.



Vehicle Speed Sensor Inspection

1. Connect the vehicle speed sensor connector 1 E44 to the battery (+) terminal and 2 E44 to the (-) terminal.
2. Connect a resistance of 1.3K ohm to 5K ohm (1/4 W or more) between connectors 1 E44 and 3 E44

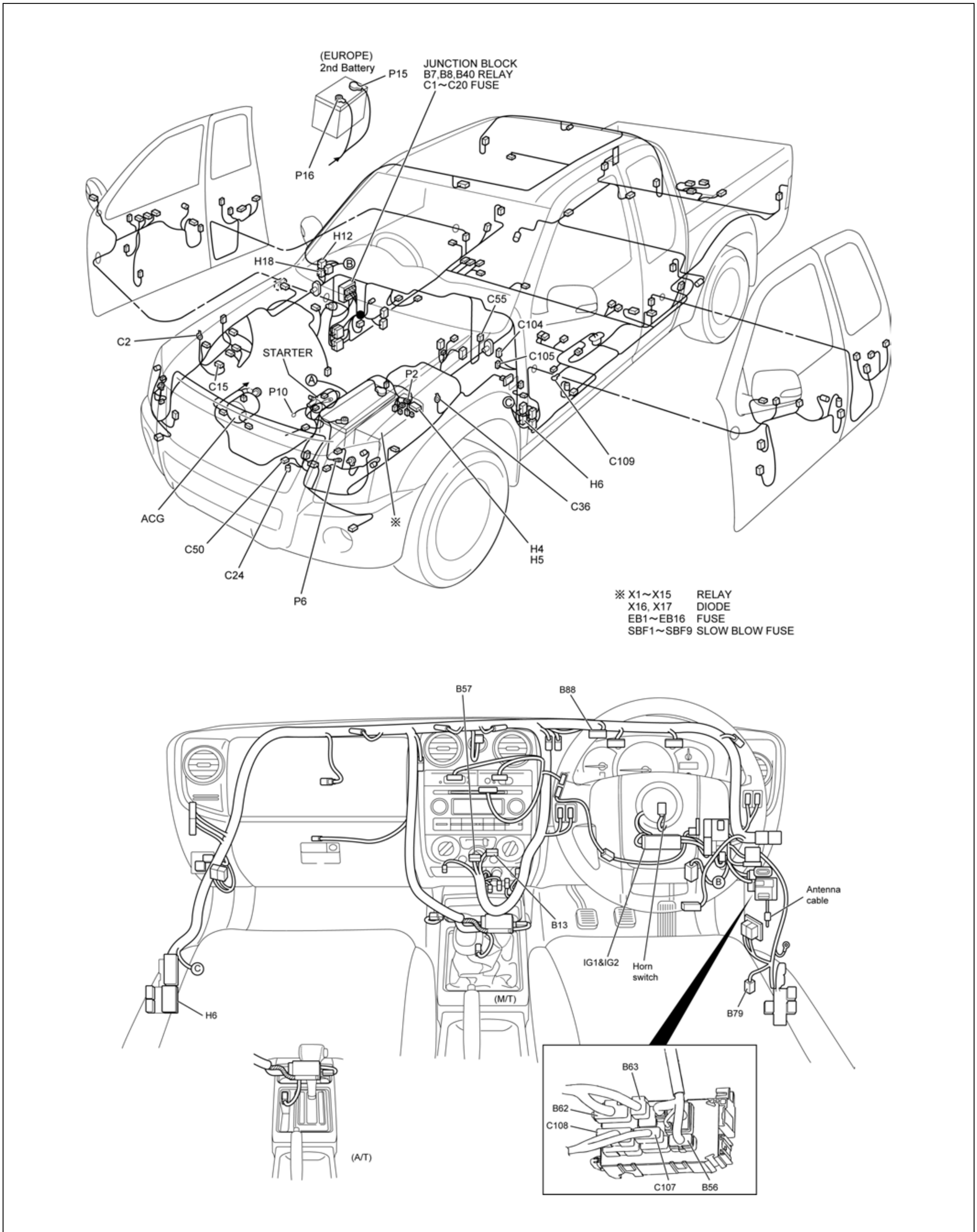
CAUTION:
Be extremely careful not to connect the battery (+) terminal to the connector 3 E44.
This may damage the vehicle speed sensor.

3. Rotate the shaft of the vehicle speed sensor slowly and measure the voltage at the both ends with a digital tester.

The voltage, with one rotation of shaft fluctuates four times in the following range: 10 to 14V - 2V or less.

HEATER AND AIR CONDITIONING

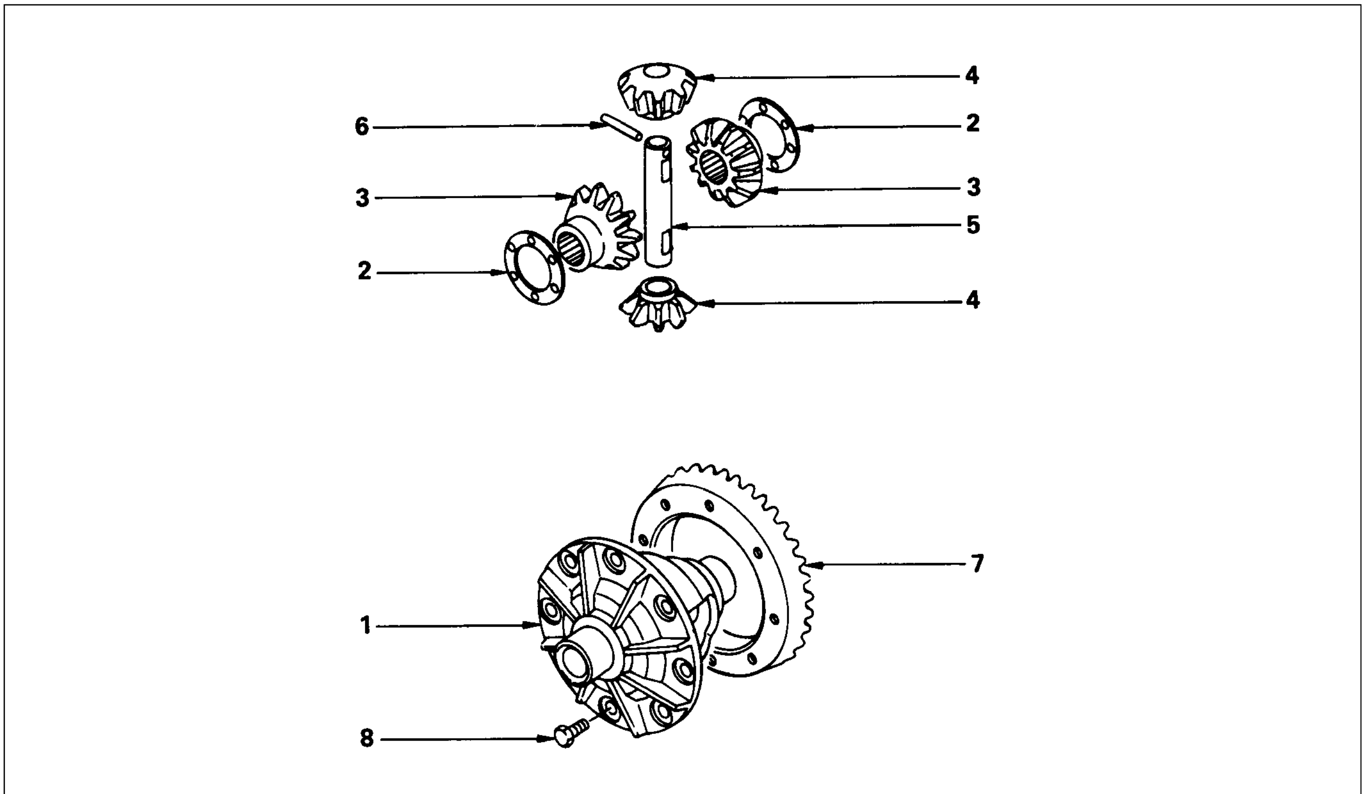
PARTS LOCATION (RHD)



RTW78AXF039101& RTW78AXF045301

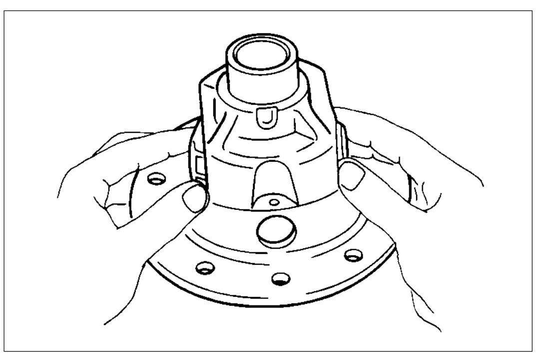
Reassembly

Minor Components



Reassembly Steps

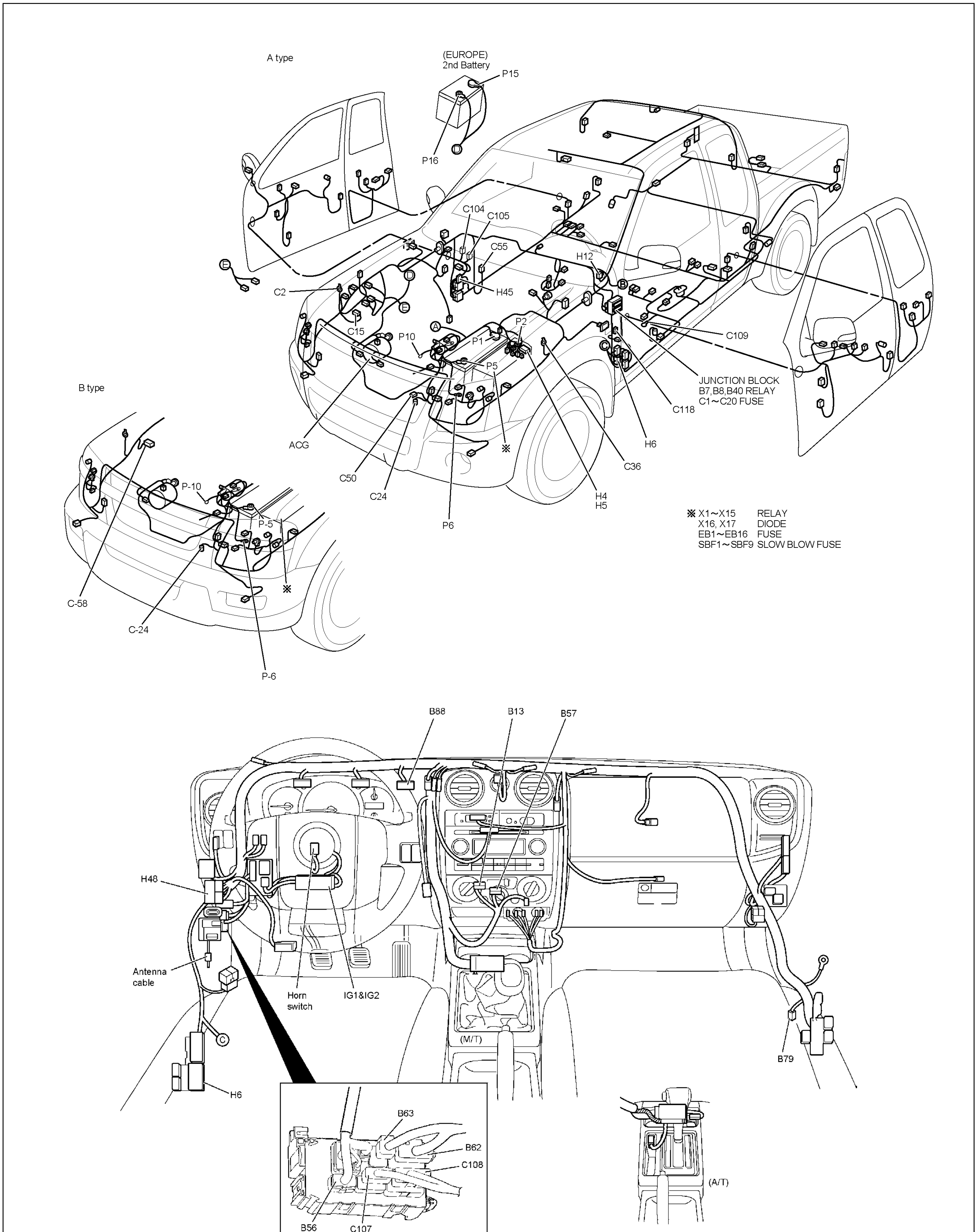
1. Differential cage
2. Thrust washer
3. Side gear
▲ 4. Pinion gear
▲ 5. Cross pin
▲ 6. Lock pin
▲ 7. Ring gear
▲ 8. Bolt



Important Operations

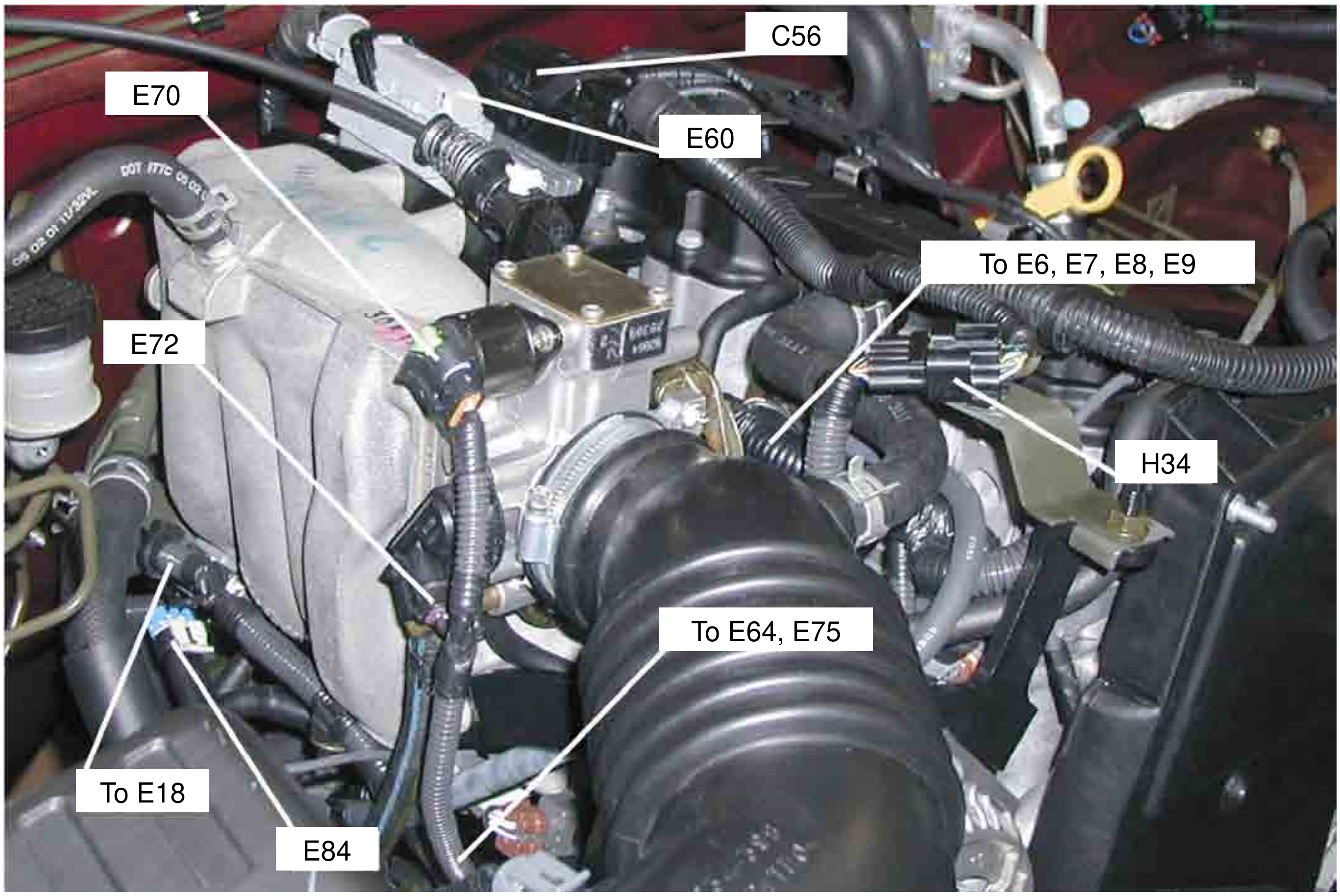
4. Pinion Gear
Install the pinion gear by engaging it with the side gears while turning both pinion gears simultaneously in the same direction.

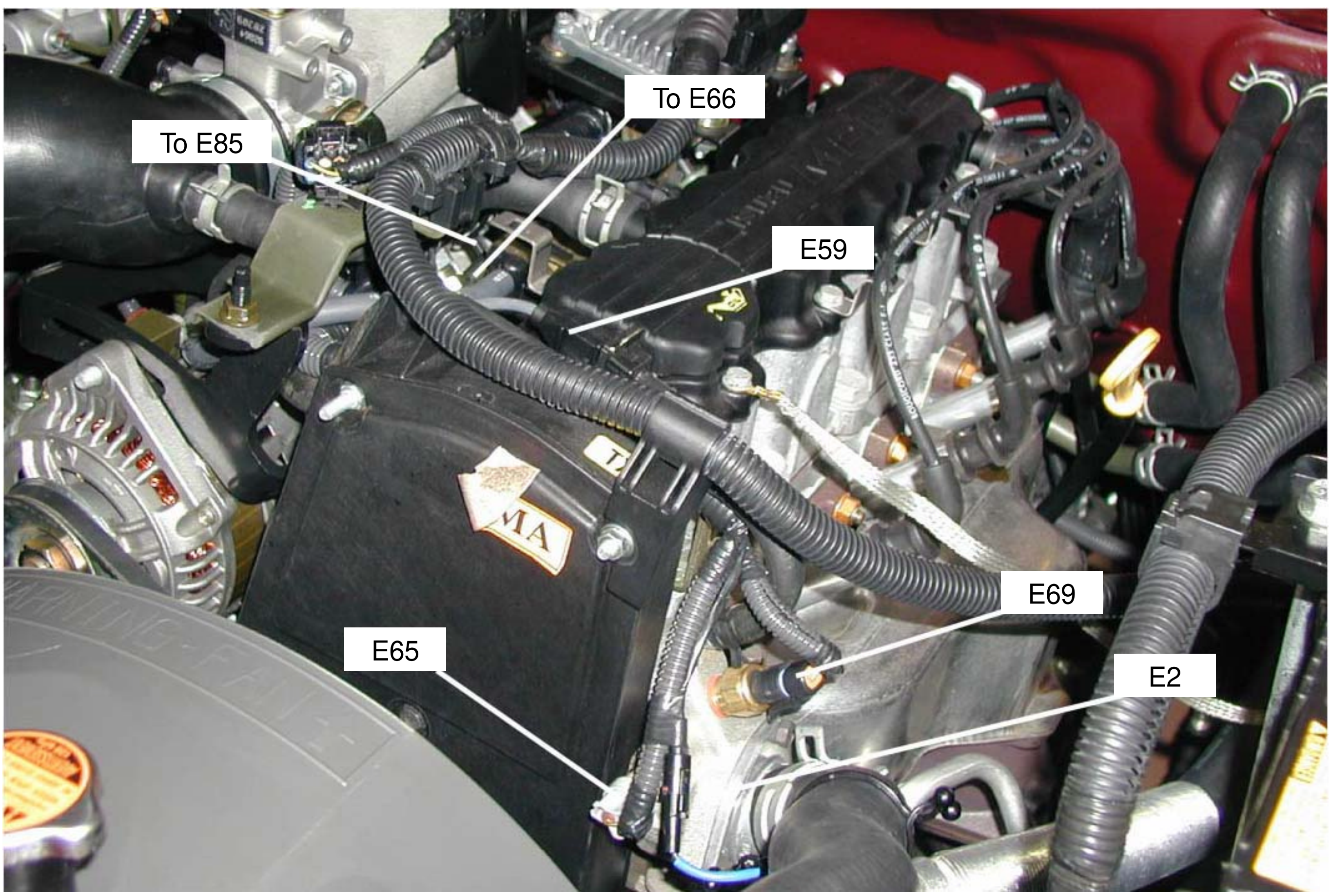
PARTS LOCATION (LHD)



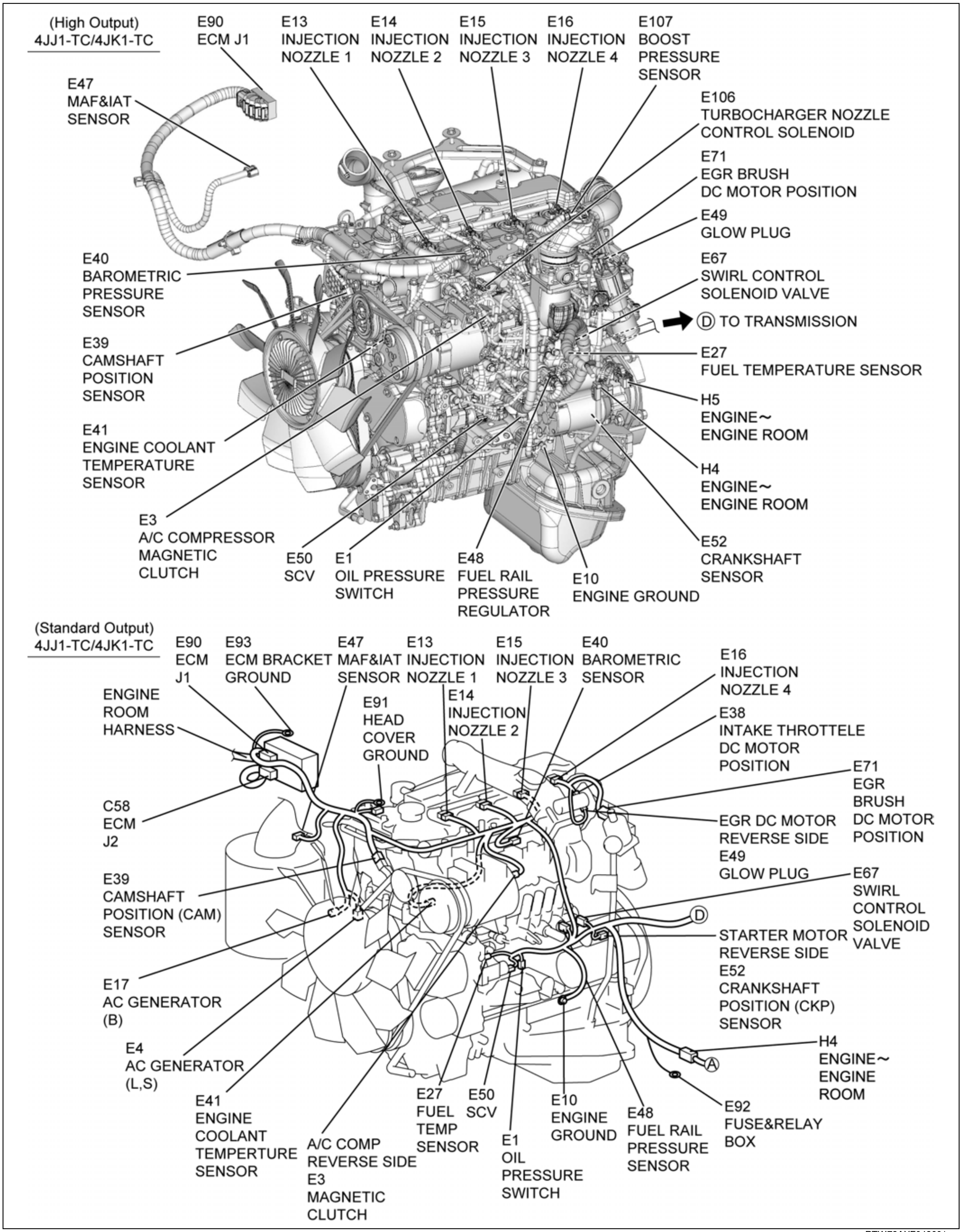
RTW78AXF039201 & RTW78AXF045401

PARTS LOCATION C24SE





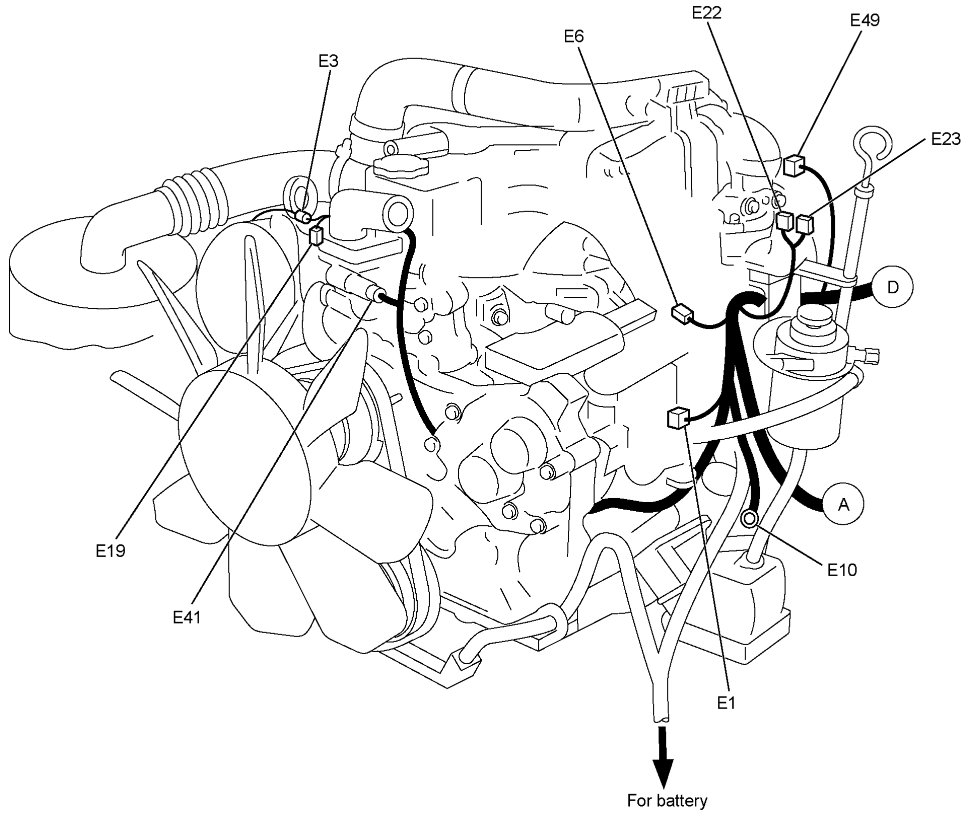
PARTS LOCATION 4JJ1-TC / 4JK1-TC



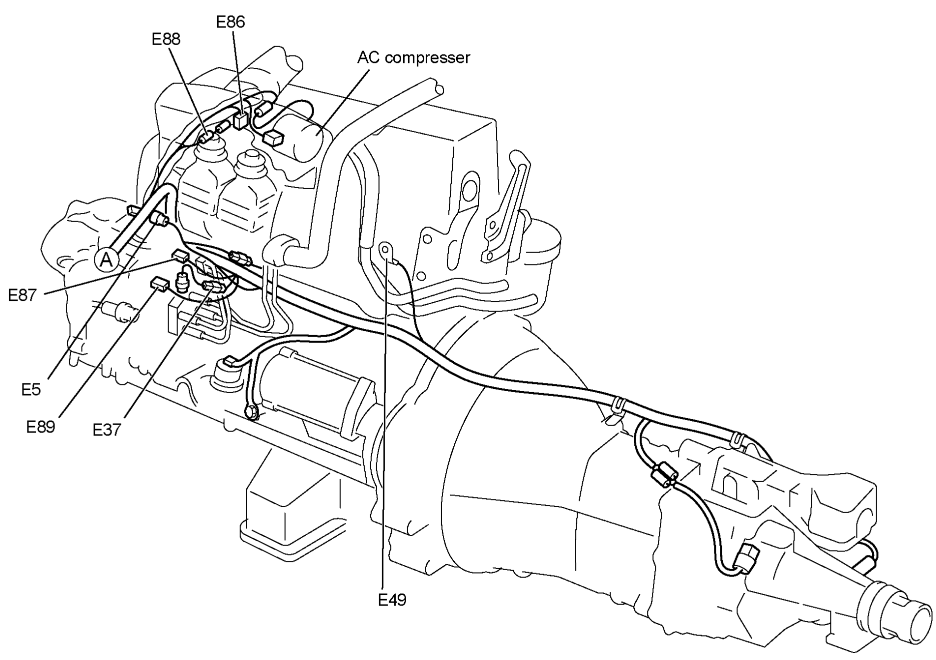
RTW78AXF048601

PARTS LOCATION

4JH1-TC

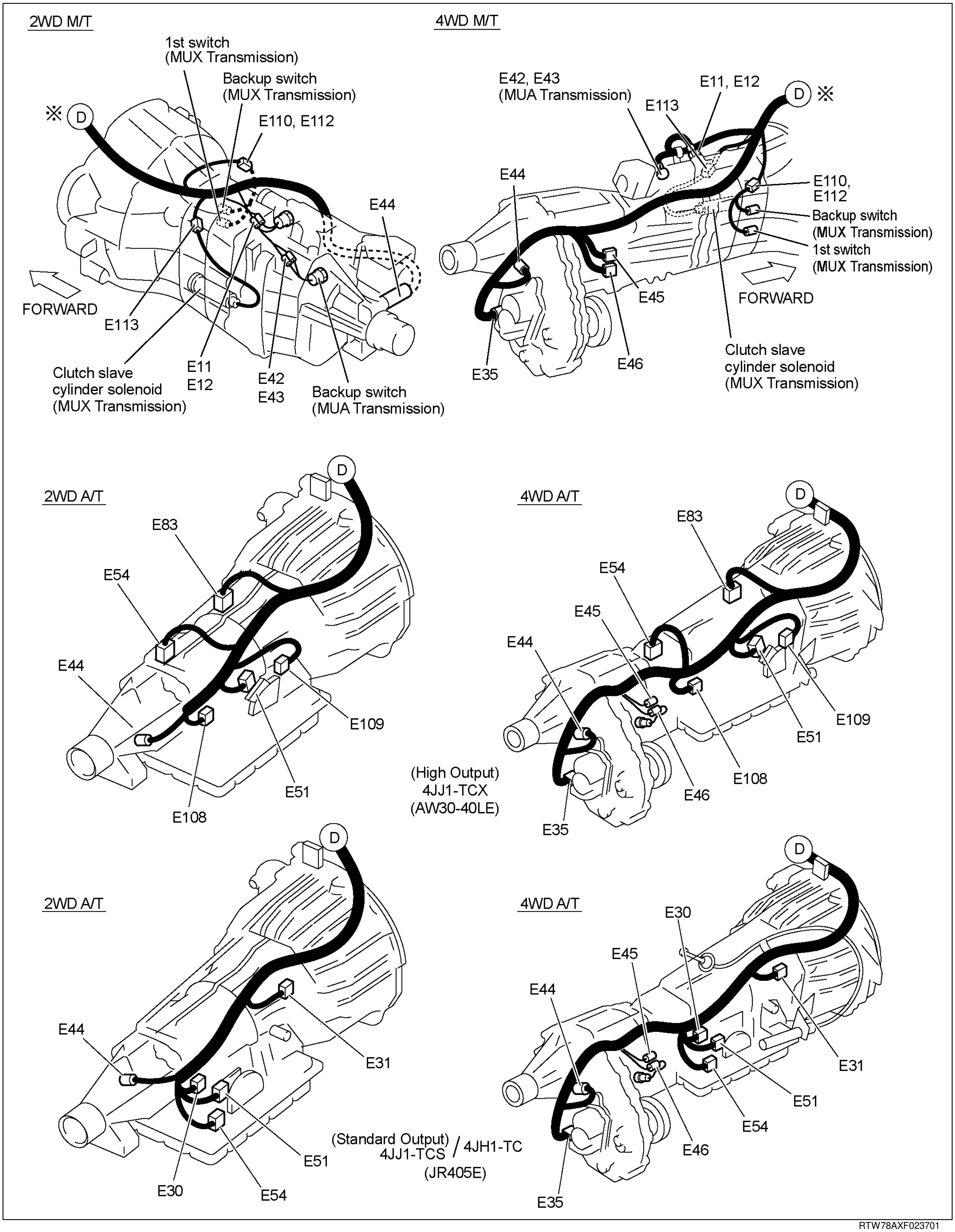


4JA1-L

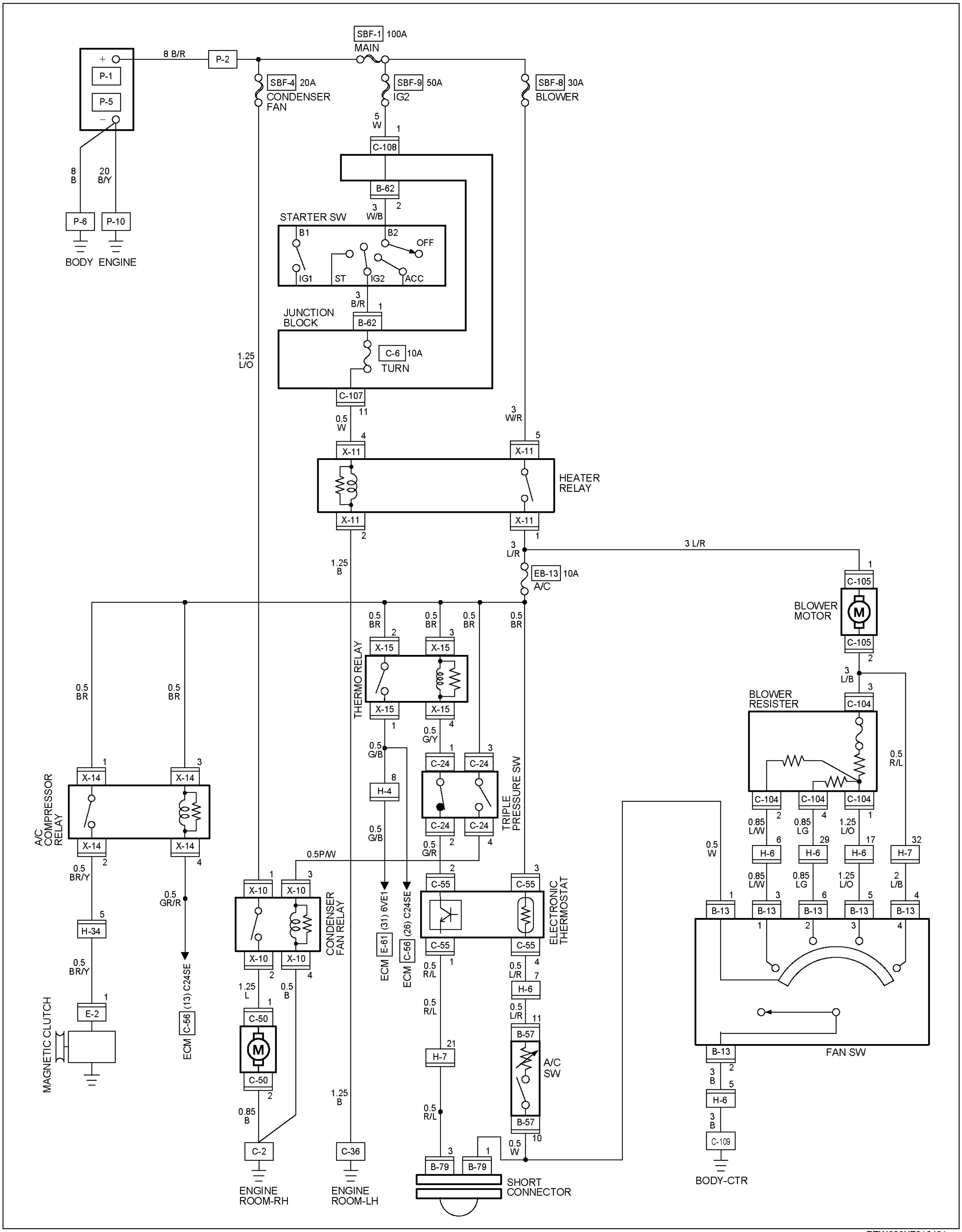


RTW78AXF049401 & RTW78AMF001101

PARTS LOCATION

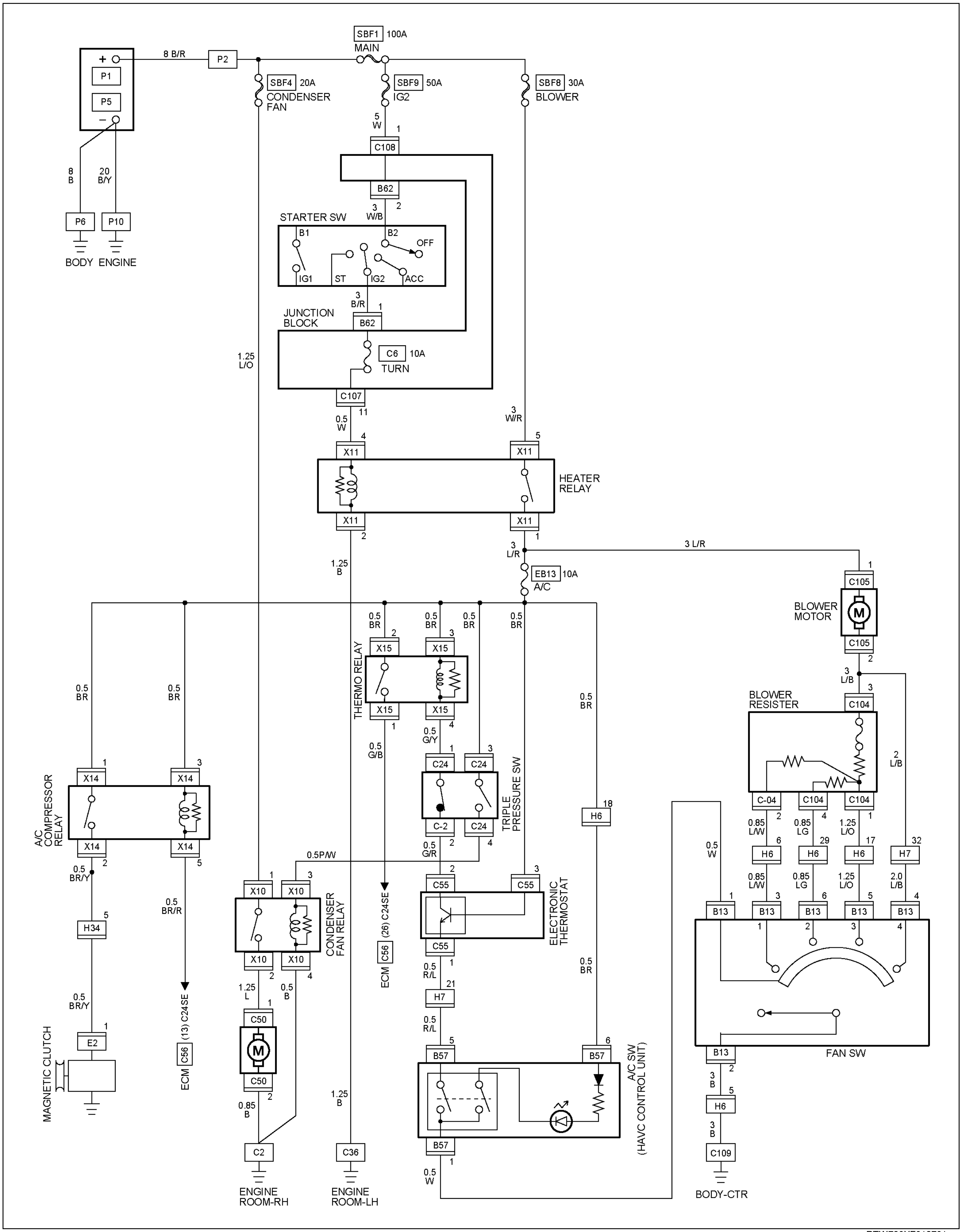


CIRCUIT DIAGRAM C24SE COOLER WITHOUT HEATER



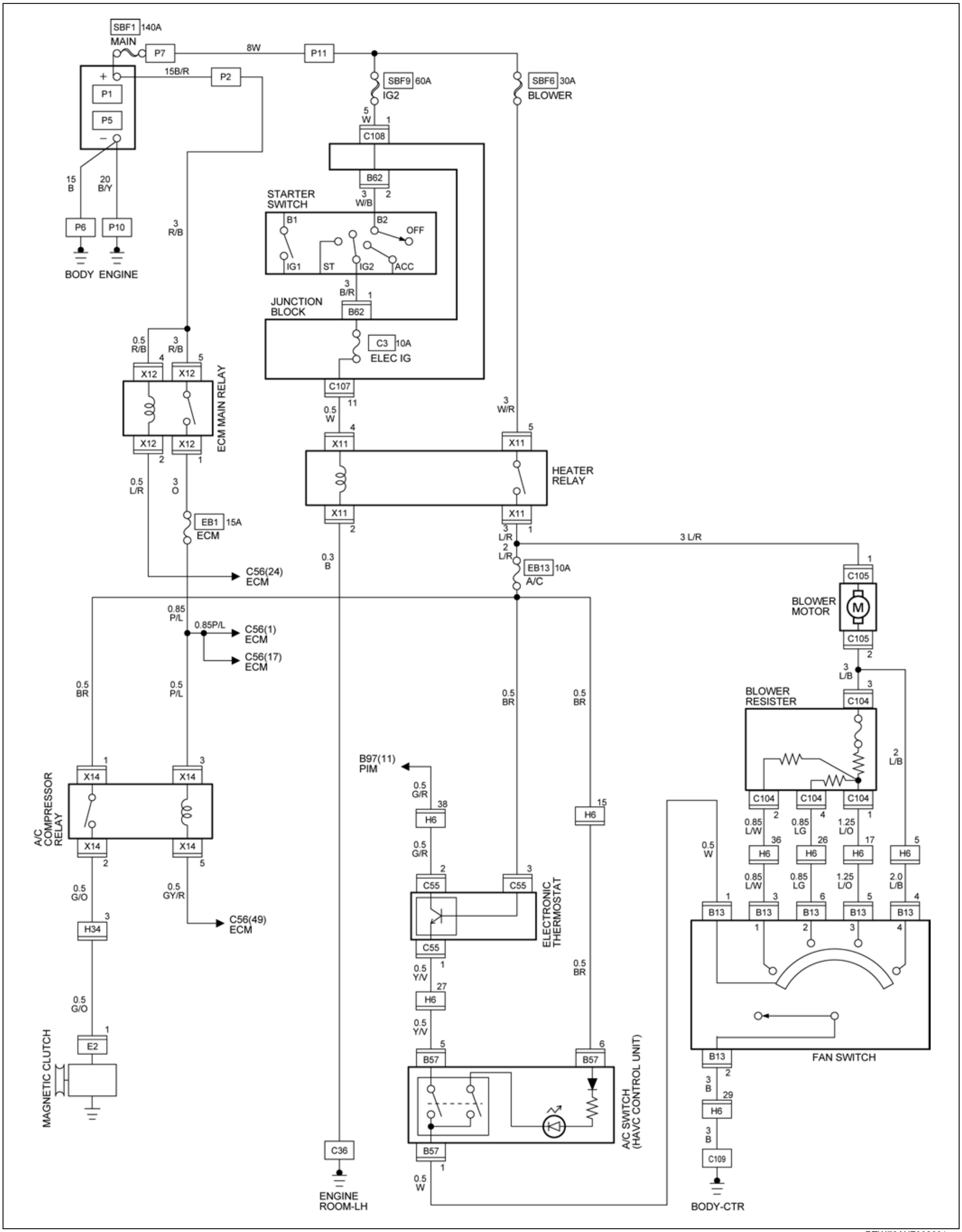
RTW680XF012401

CIRCUIT DIAGRAM C24SE A/C WITH HEATER



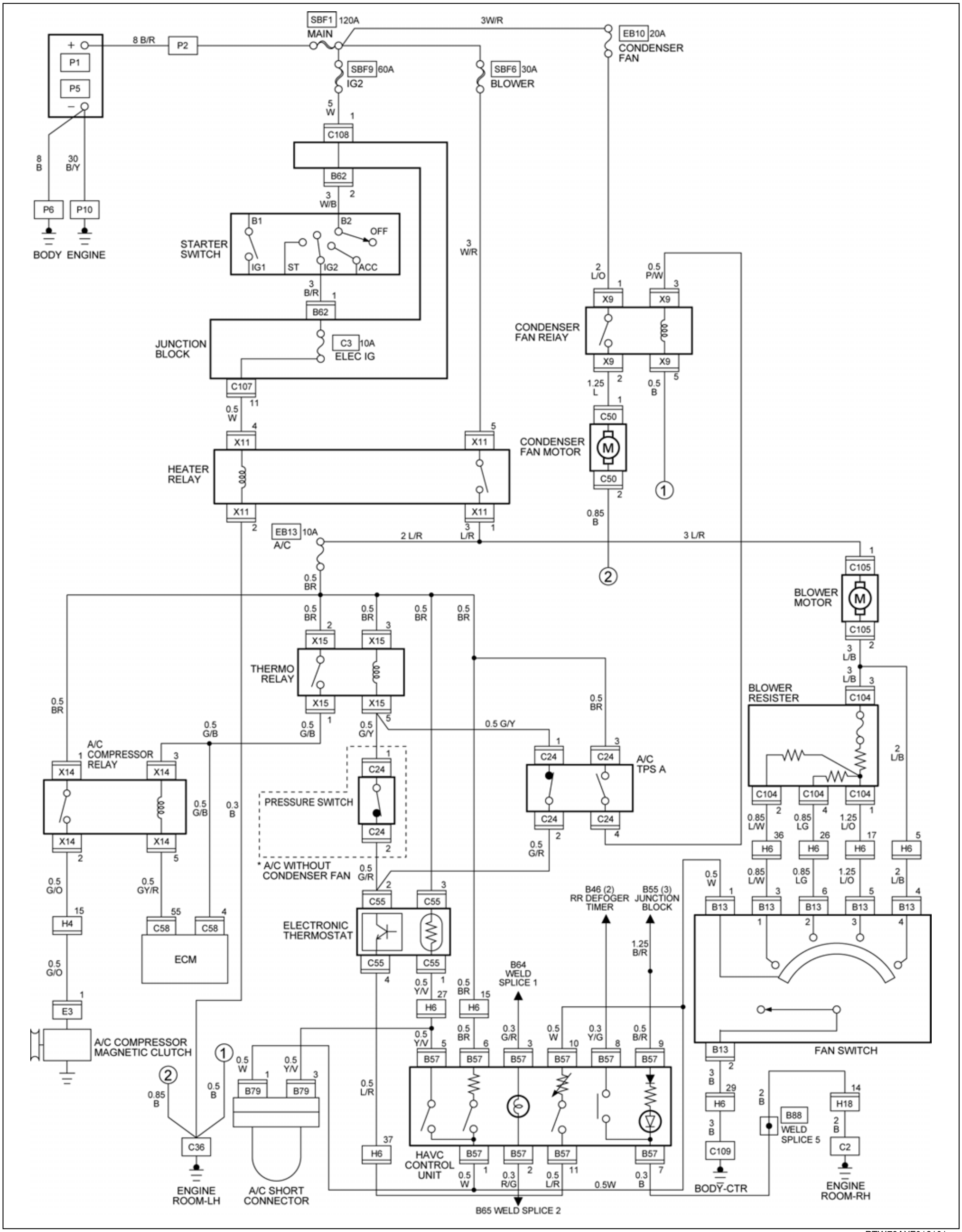
RTW780XF013701

CIRCUIT DIAGRAM HFV6 (RHD)



RTW78AXF003601

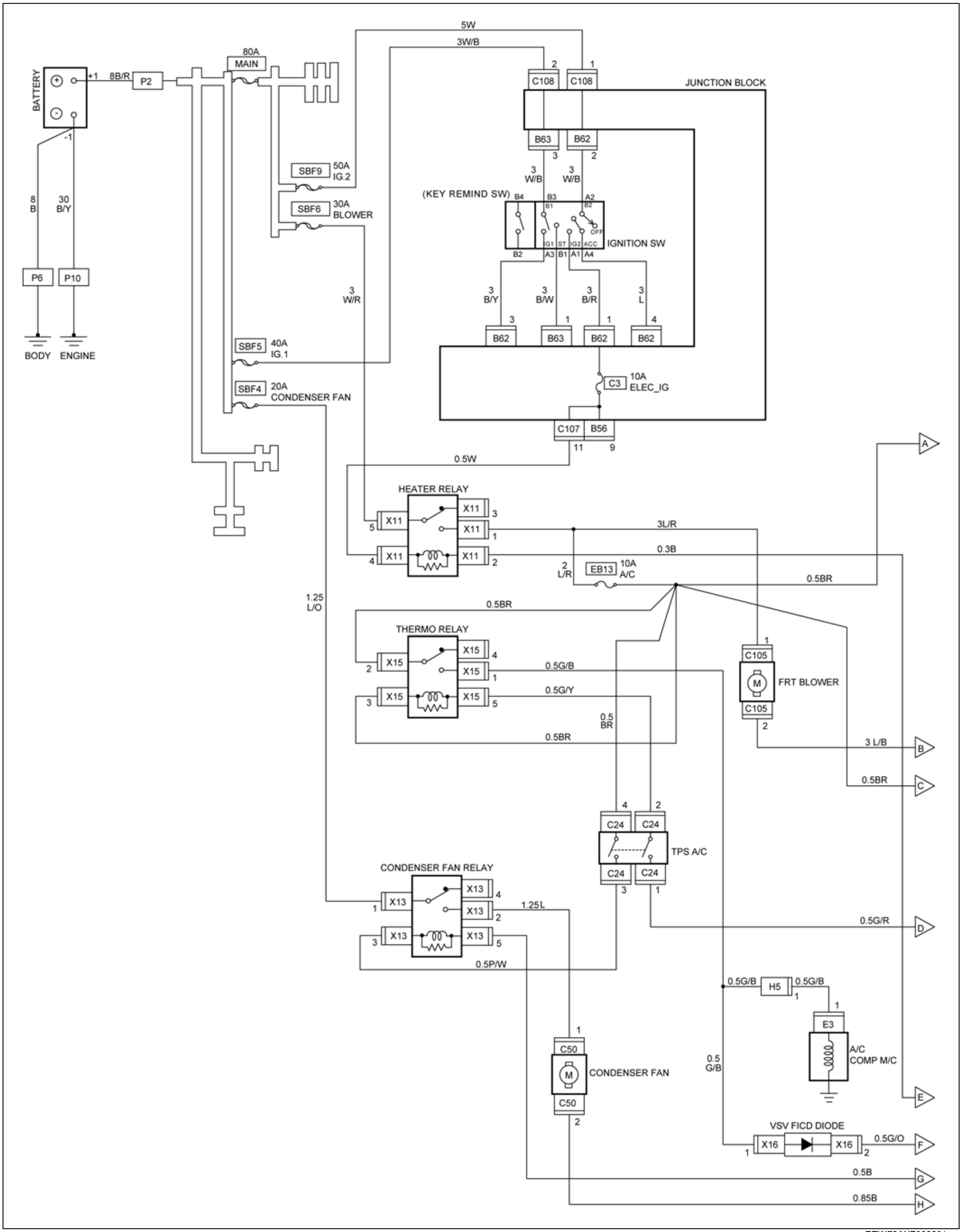
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD)



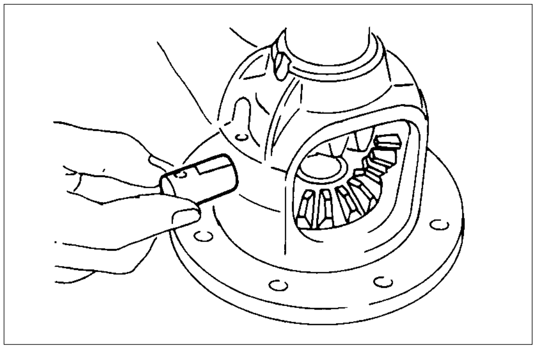
RTW78AXF012101

CIRCUIT DIAGRAM 4JA1T (L) A/C WITH HEATER

Sheet 1/2

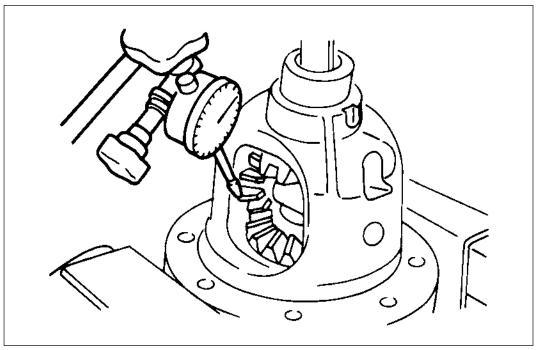


RTW78AXF008201



5. Cross Pin

(1) Be sure to install the cross pin so that it is in alignment with the lock pin hole in the differential cage.



(2) Adjust the backlash between the side gear and the pinion gear.

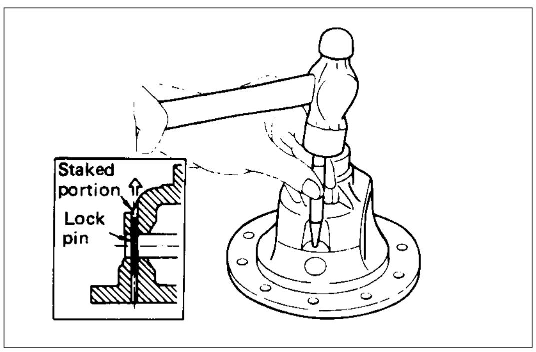
mm(in)

Backlash	0.10 - 0.20 (0.004 - 0.008)

Thickness of thrust washers available

mm(in)

1.00, 1.05, 1.10 (0.039, 0.041, 0.043)

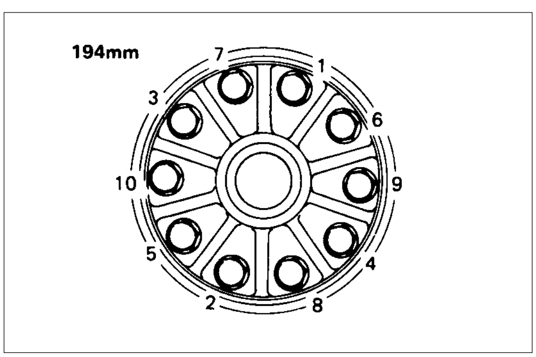


6. Lock Pin

After lock pin installation, stake the cage to prevent discharge of the lock pin.

7. Ring Gear

When installing the ring gear, apply LOCTITE 271 or equivalent to the threaded hole and bolt.



8. Bolt

Tighten the bolts in diagonal sequence as illustrated.

Bolt Torque	N·m (kgf·m/lb·ft)
108 (11.0/80)	

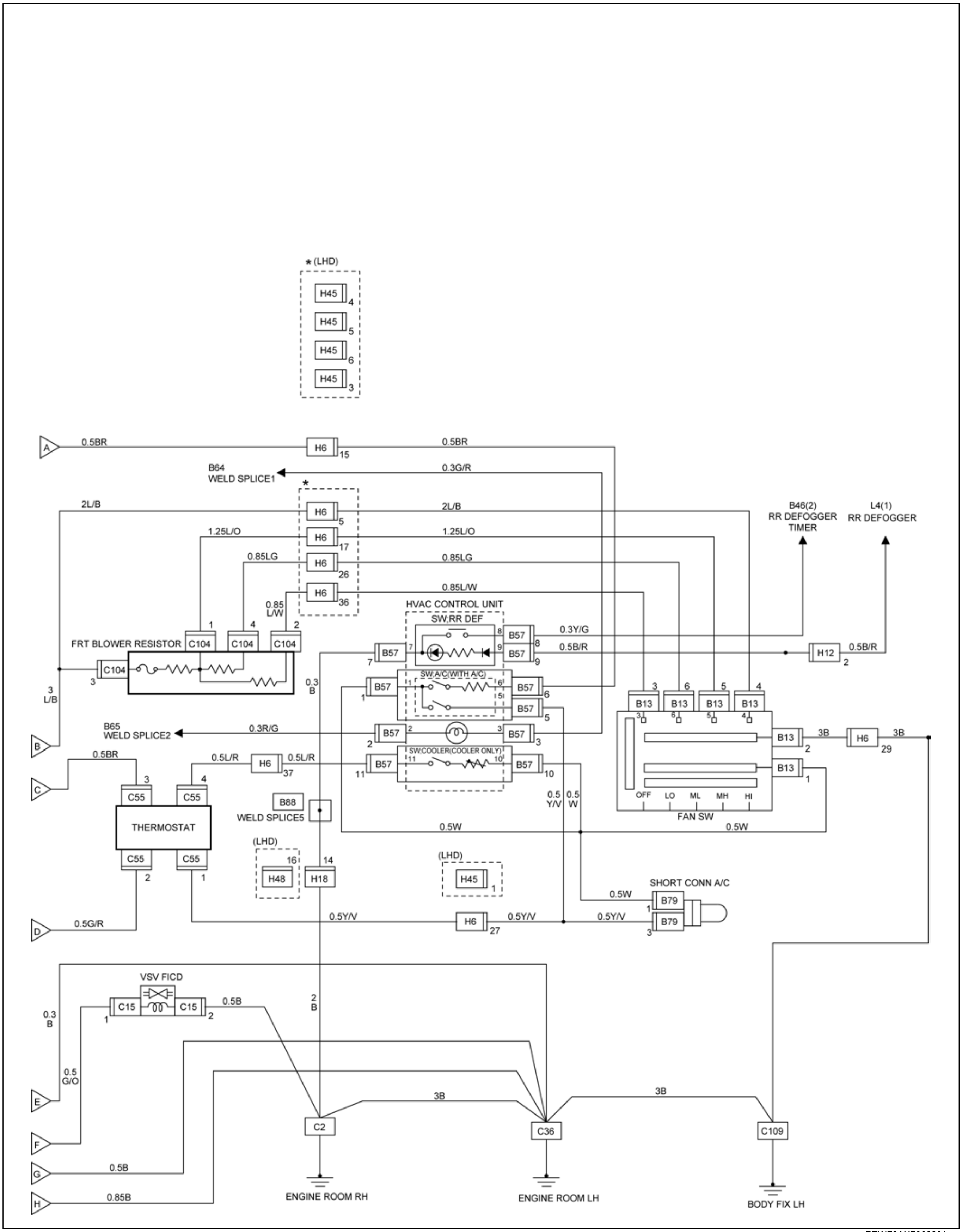
Note :

Discard used bolts and install new ones.

Note that all bolts have a left hand thread.

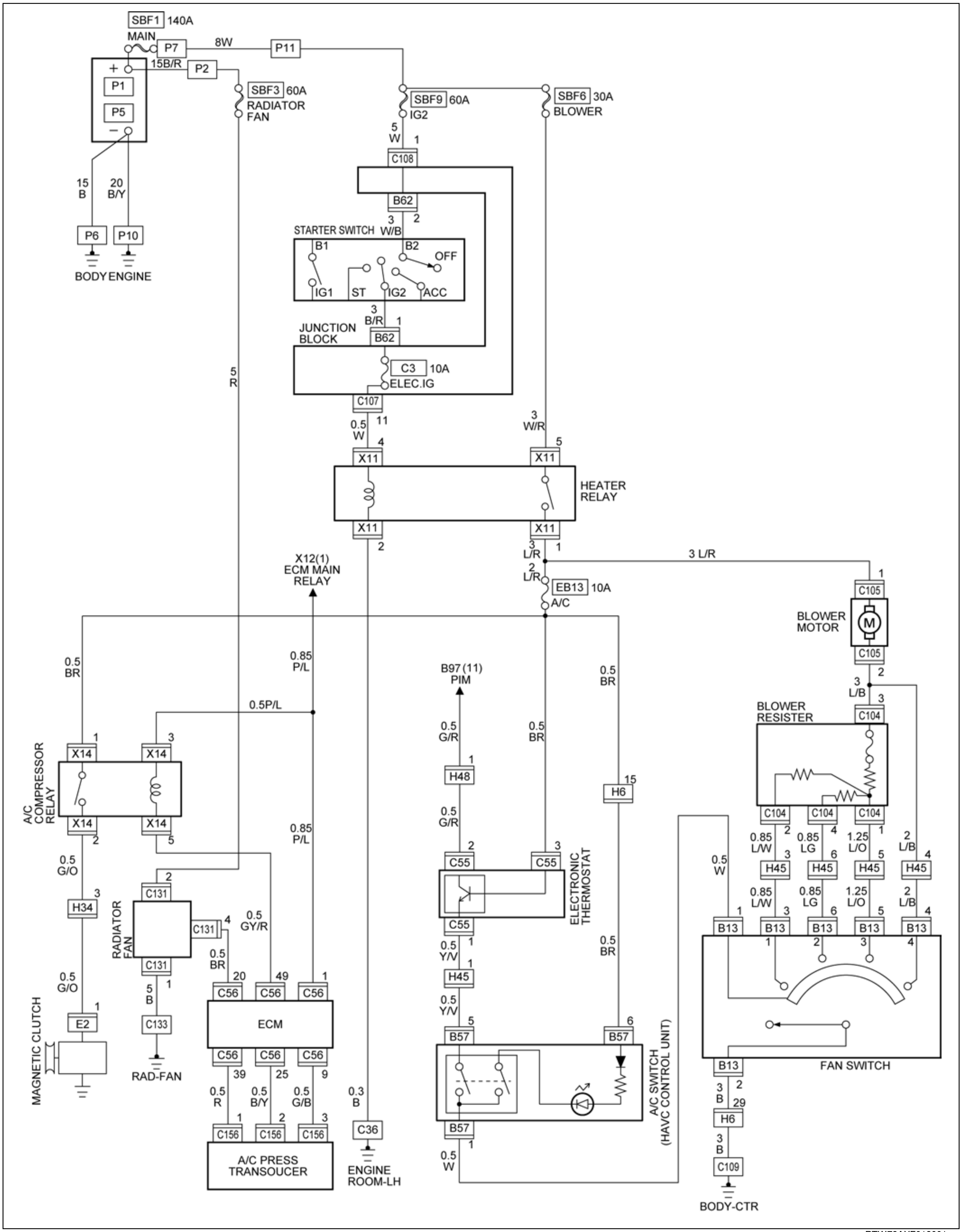
CIRCUIT DIAGRAM 4JA1T (L) A/C WITH HEATER

Sheet 2/2



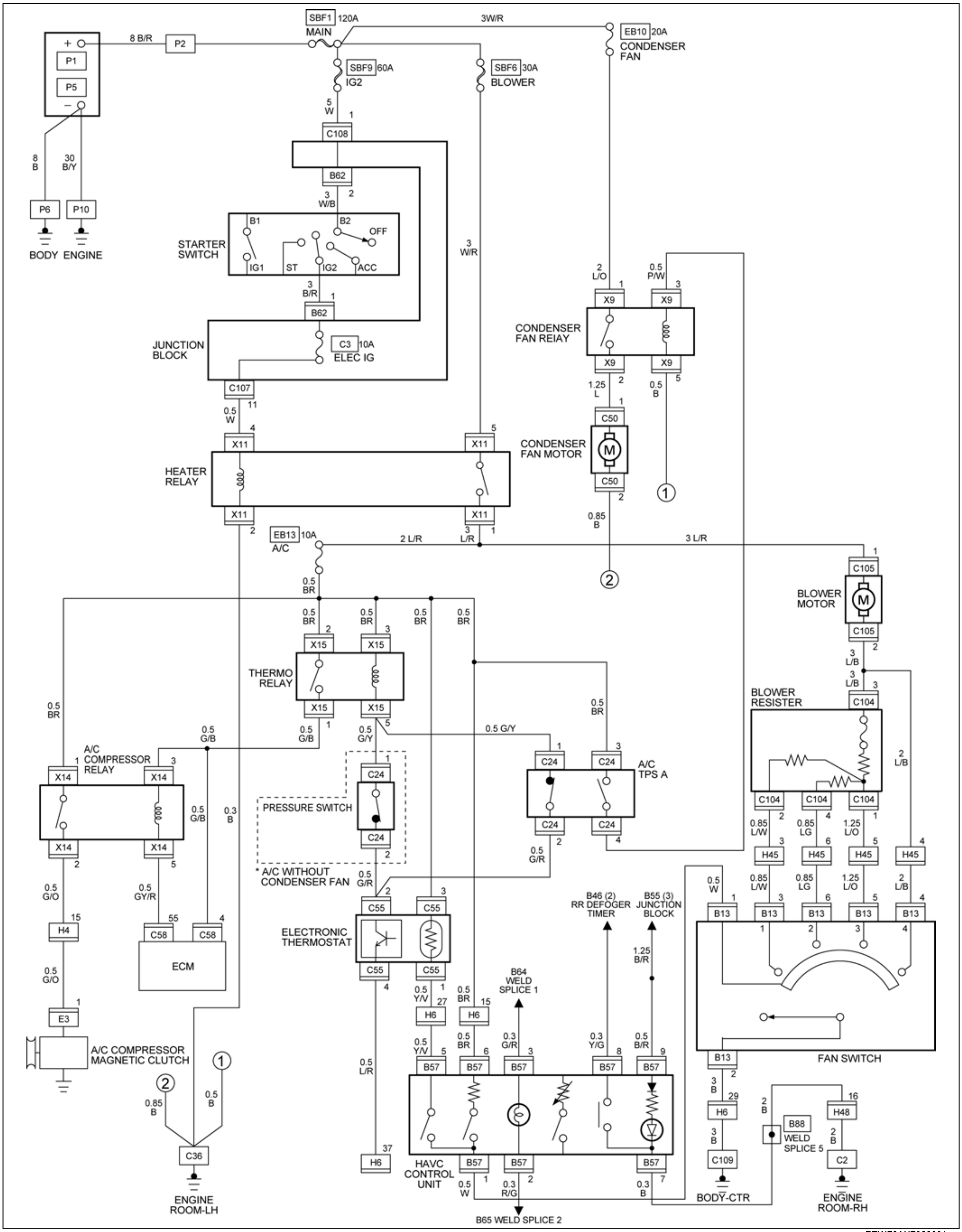
RTW78AXF008301

CIRCUIT DIAGRAM HFV6 (LHD)



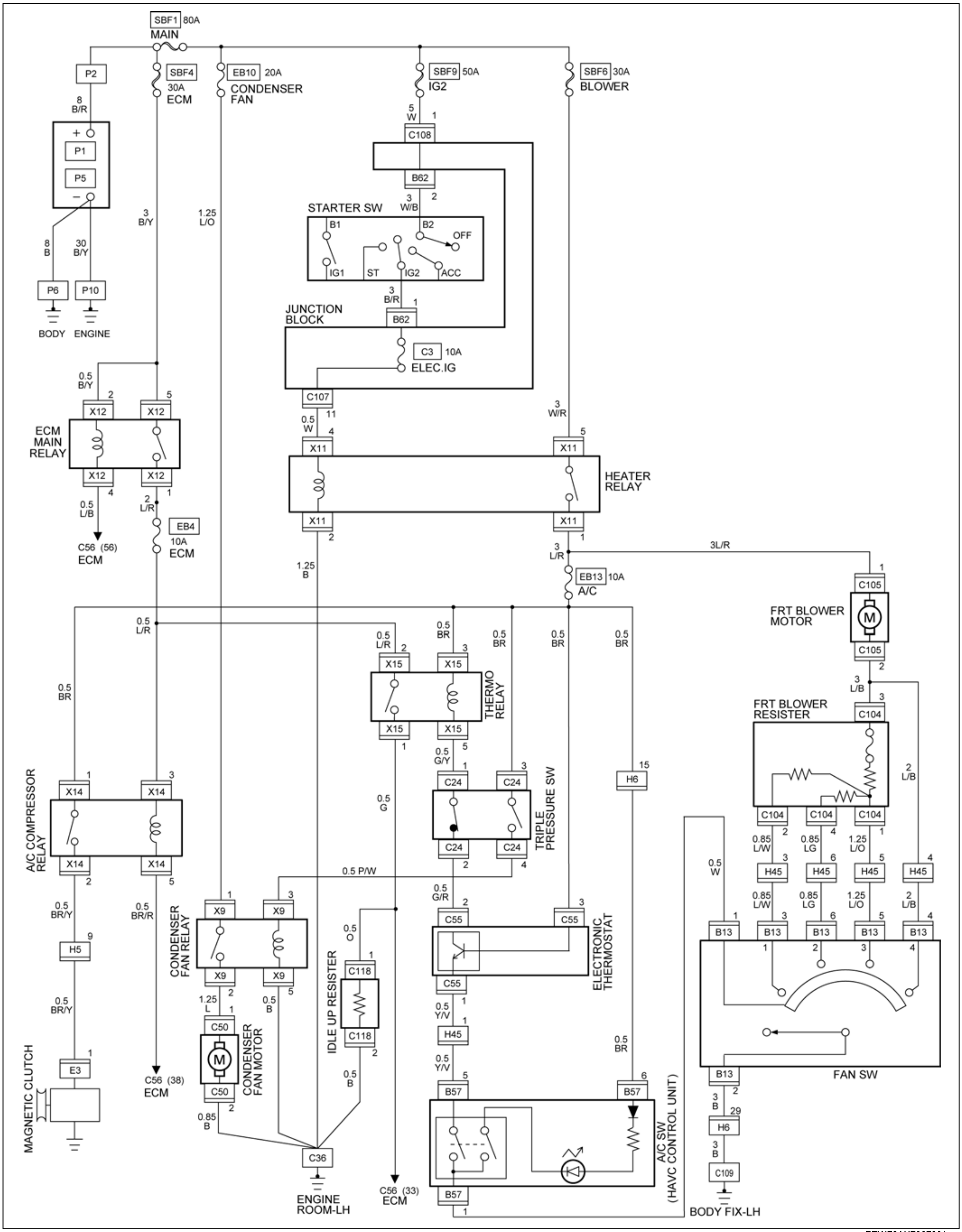
RTW78AXF018001

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD) G.EXP



RTW78AXF028001

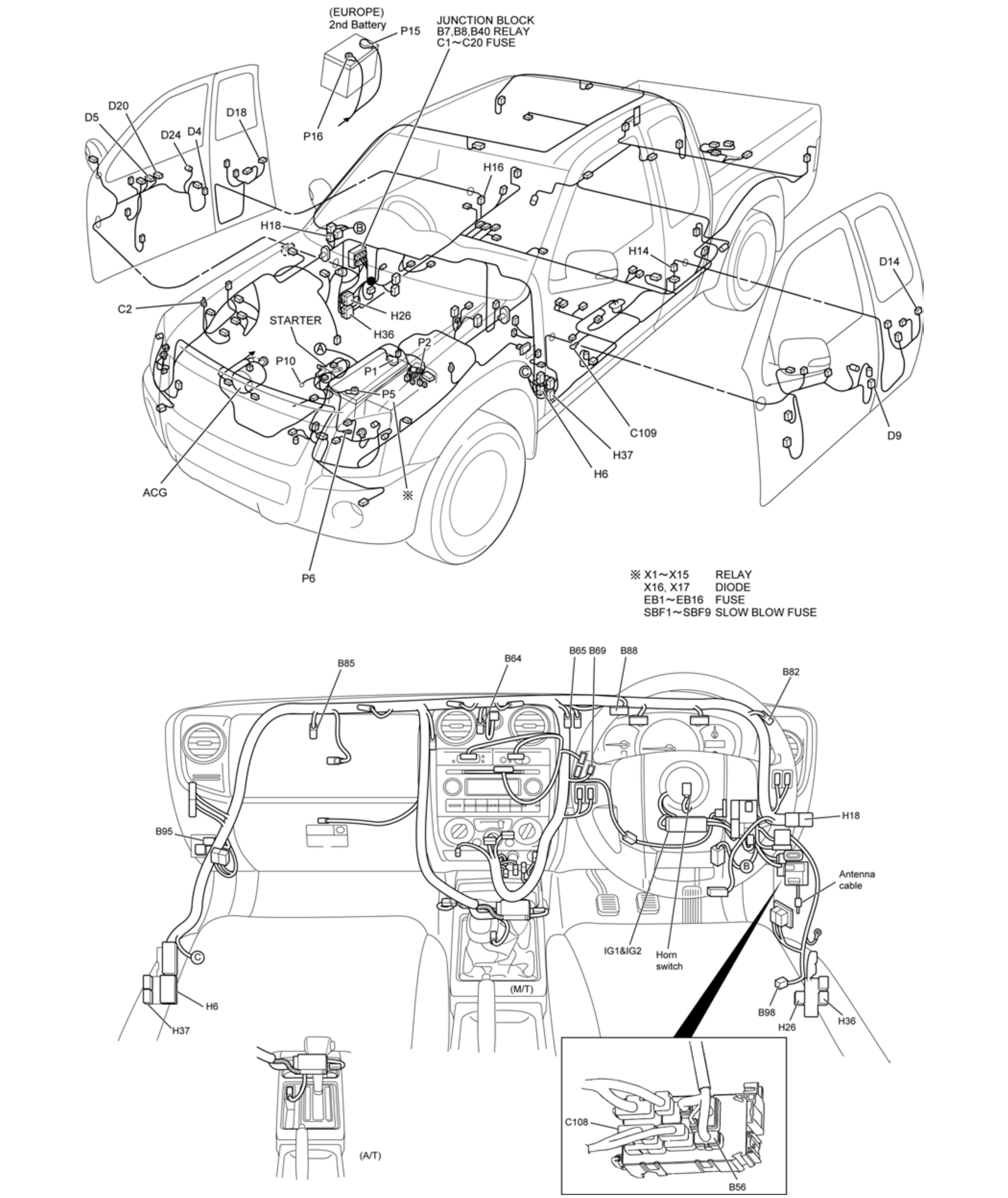
CIRCUIT DIAGRAM 4JH1-TC



RTW78AXF007901

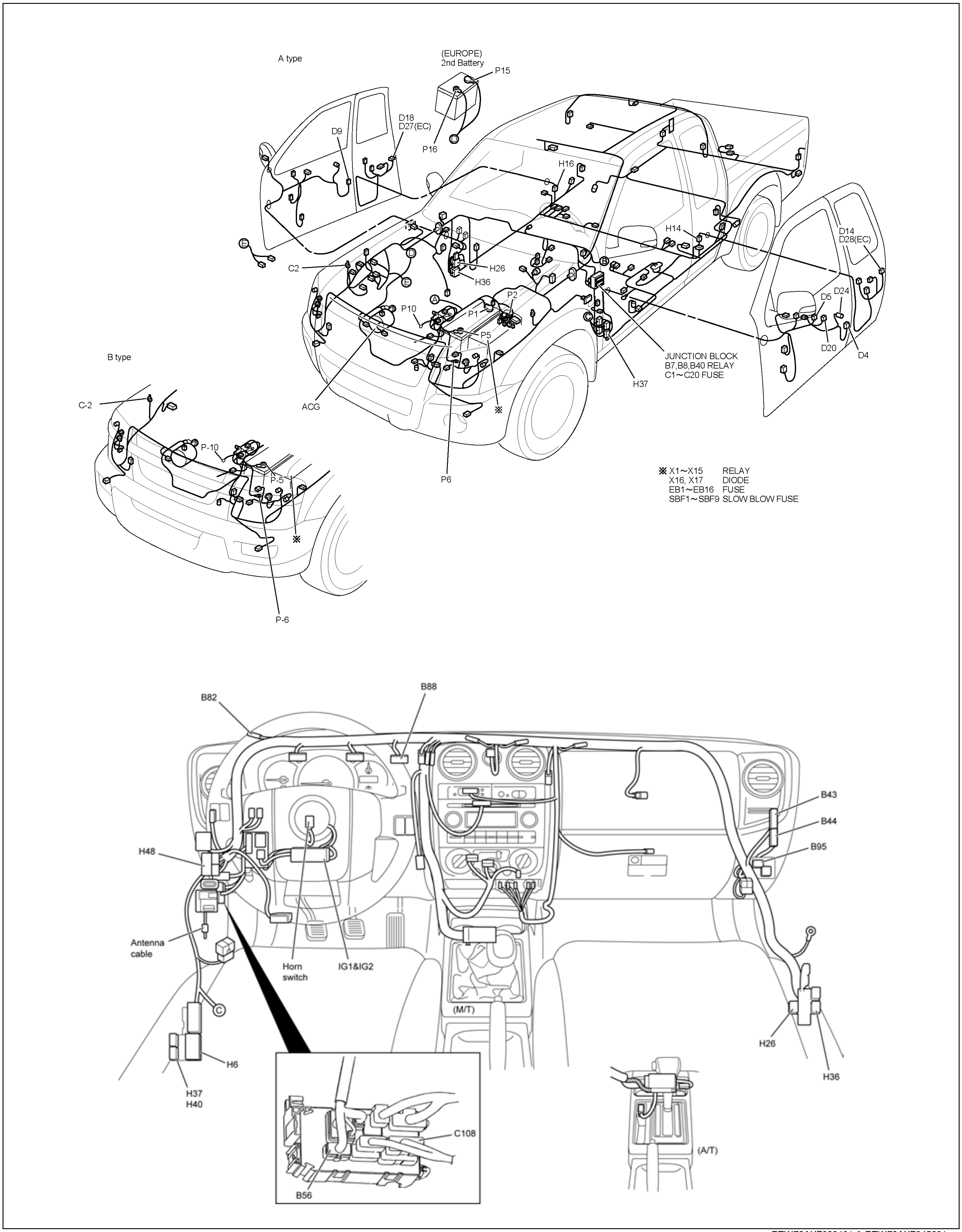
POWER DOOR LOCK

PARTS LOCATION (RHD)



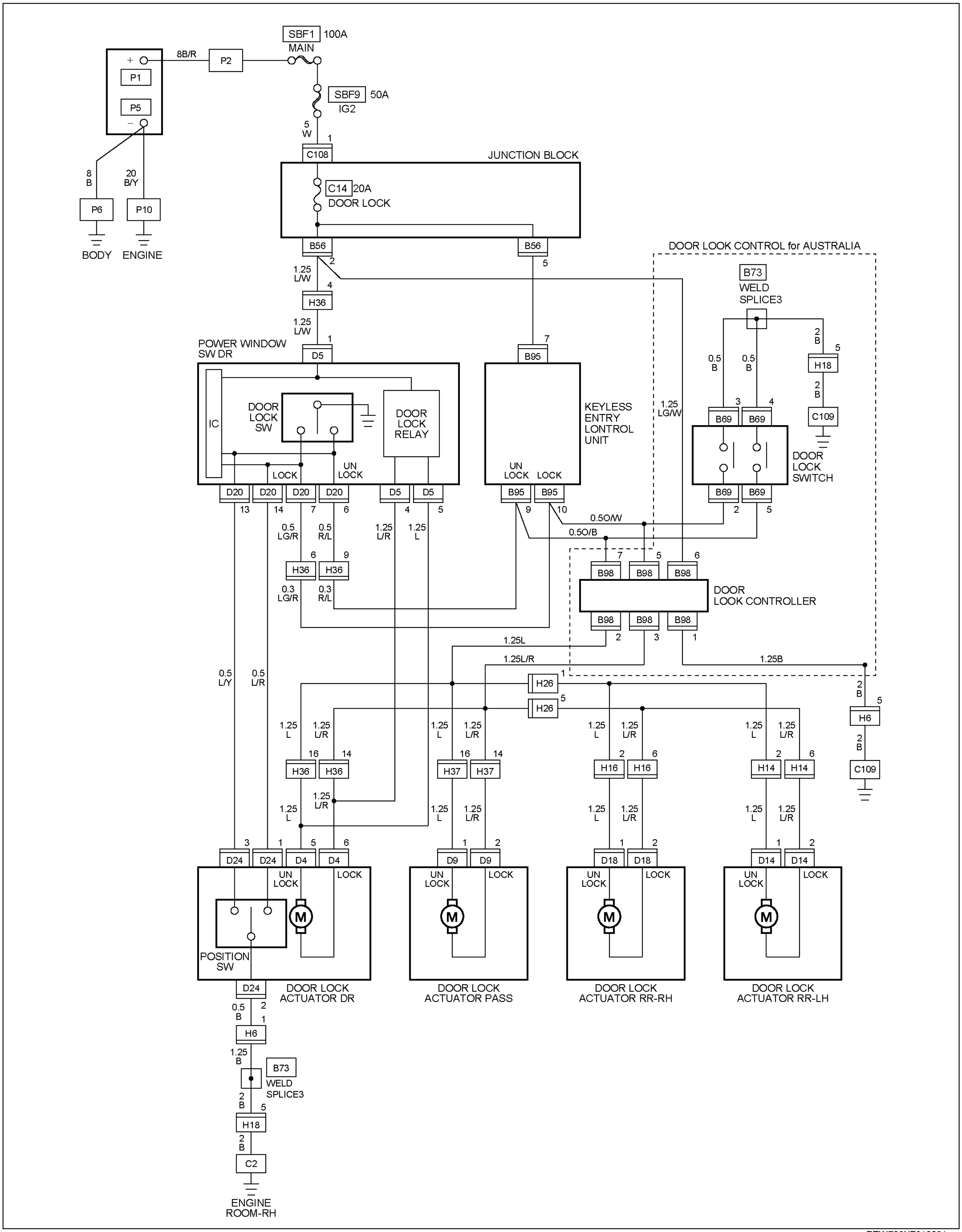
RTW78AXF039301 & RTW78AXF045501

PARTS LOCATION (LHD)



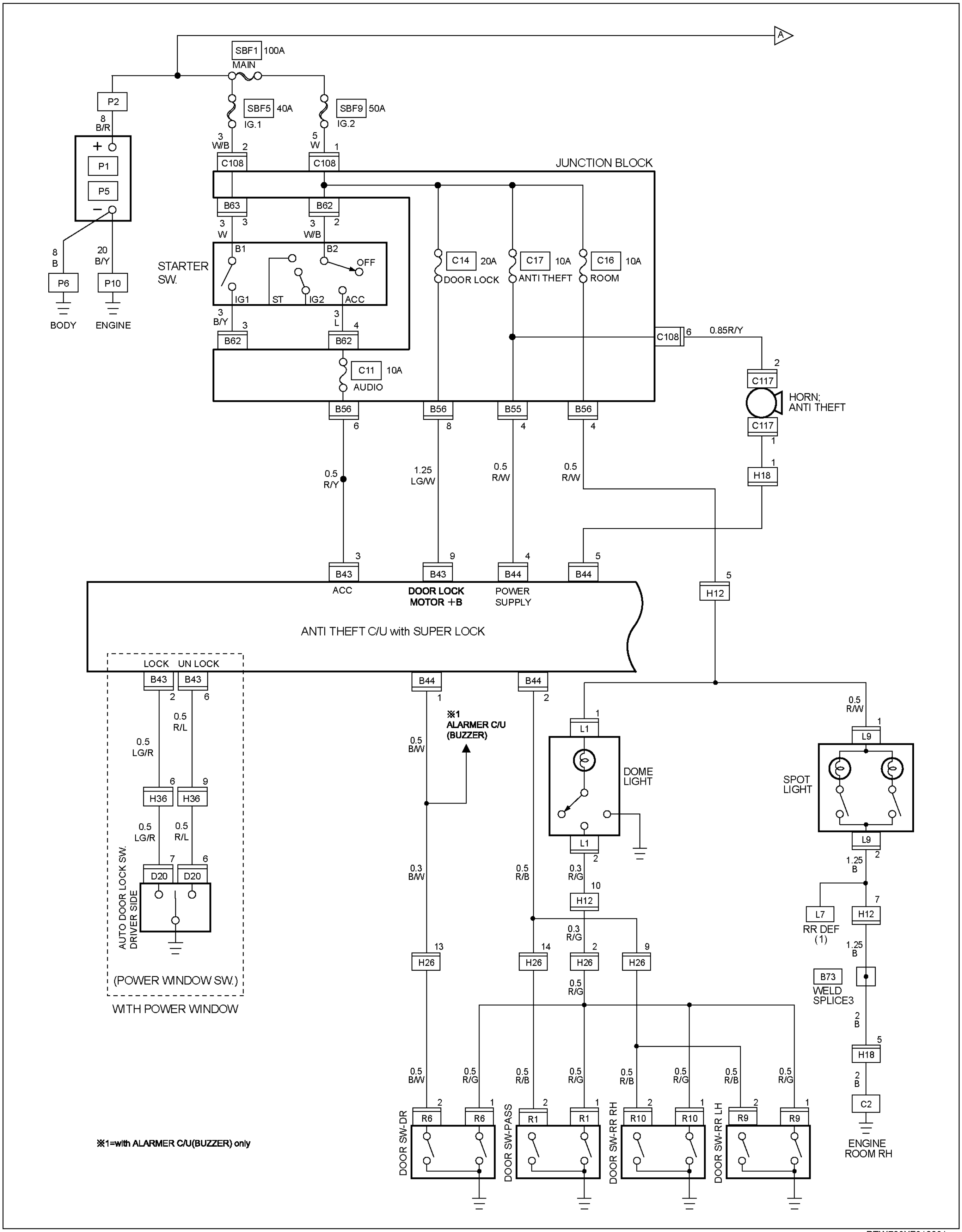
RTW78AXF039401 & RTW78AXF045601

CIRCUIT DIAGRAM C24SE (RHD) WITHOUT ANTI THEFT



CIRCUIT DIAGRAM C24SE (RHD) WITH SUPER LOCK

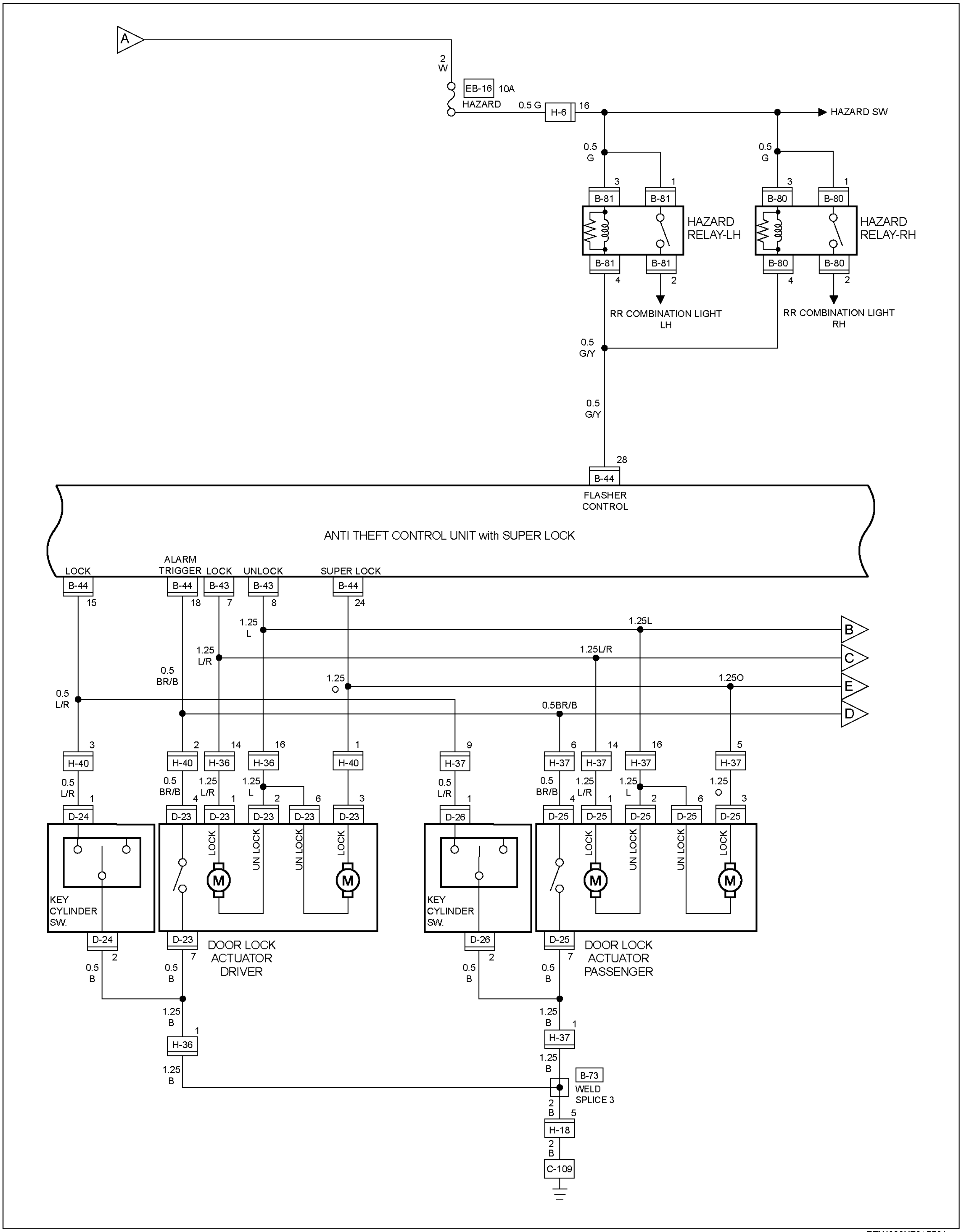
Sheet 1/3



RTW780XF013901

CIRCUIT DIAGRAM C24SE (RHD ONLY) WITH SUPER LOCK

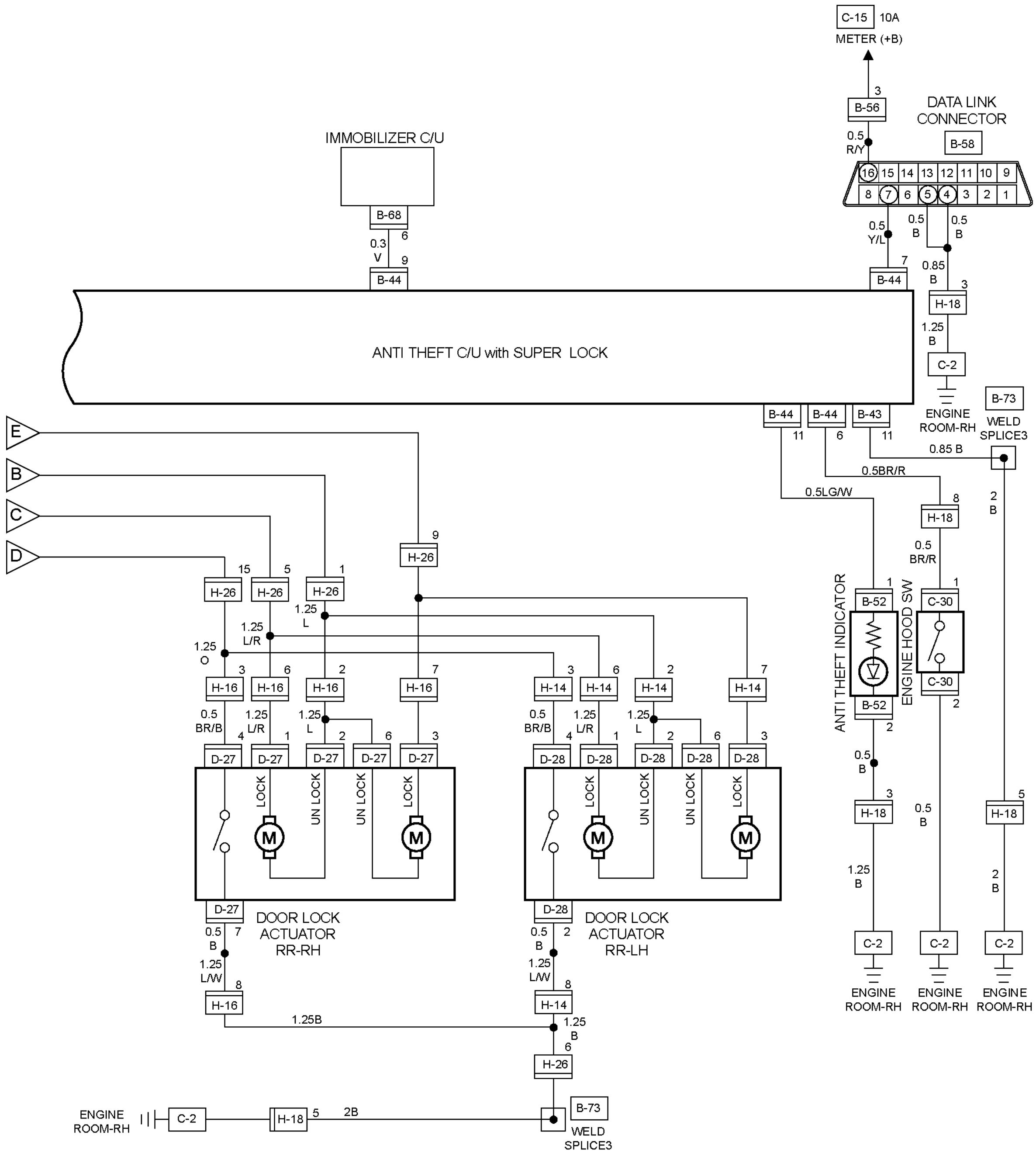
Sheet 2/3



RTW680XF015501

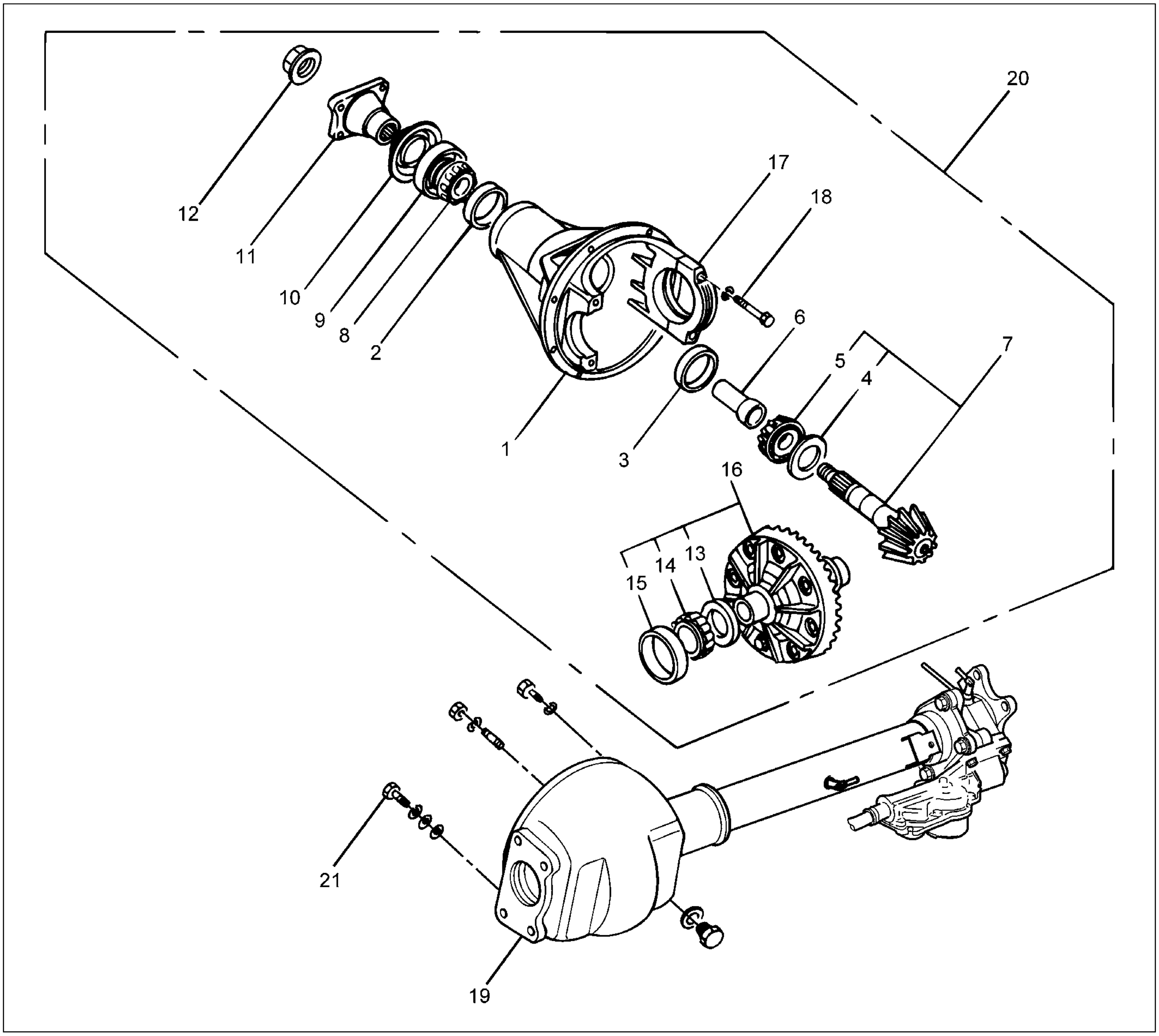
CIRCUIT DIAGRAM C24SE (RHD ONLY) WITH SUPER LOCK

Sheet 3/3



RTW680XF015601

Major Components

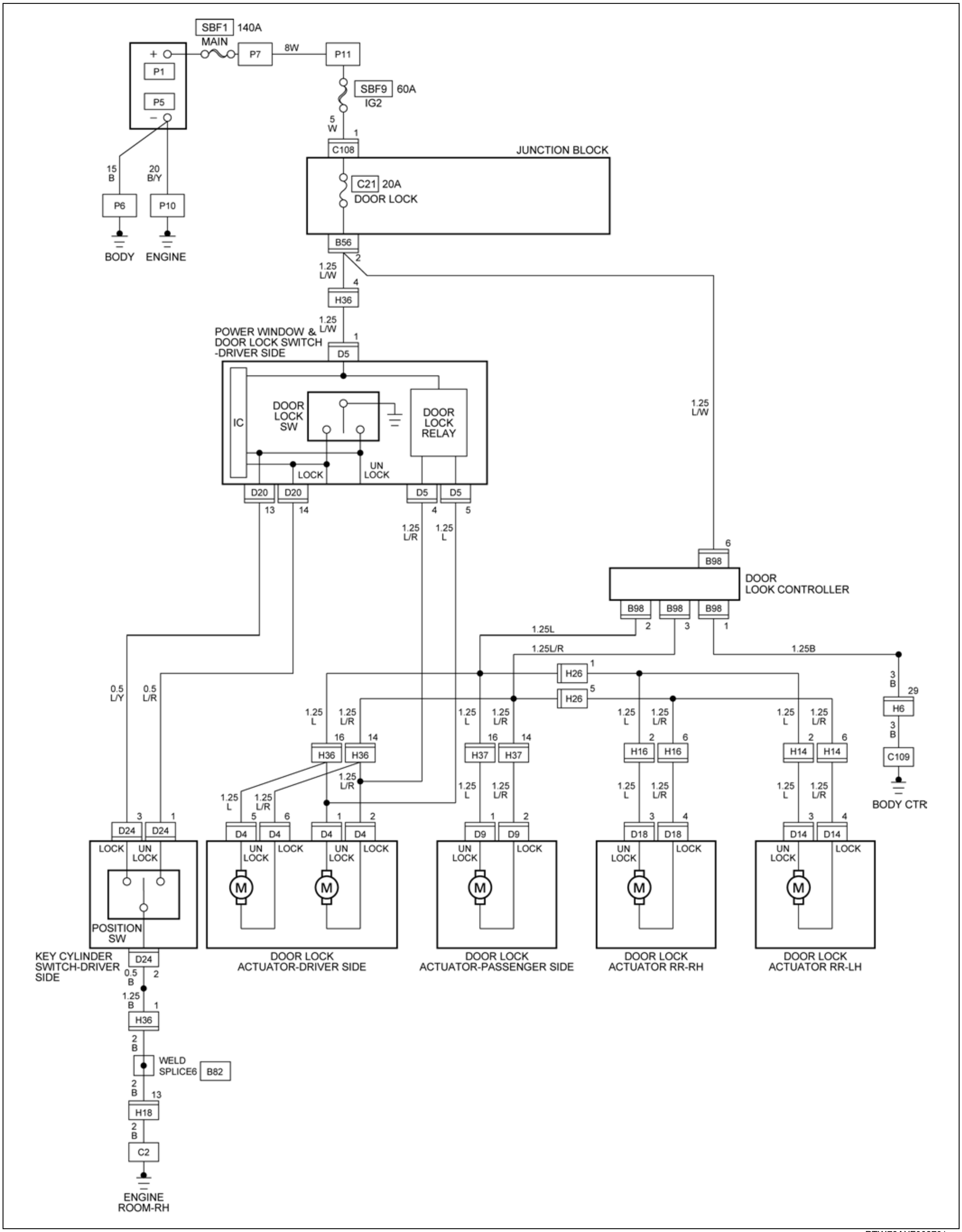


RTW54CLF000201

Reassembly Steps

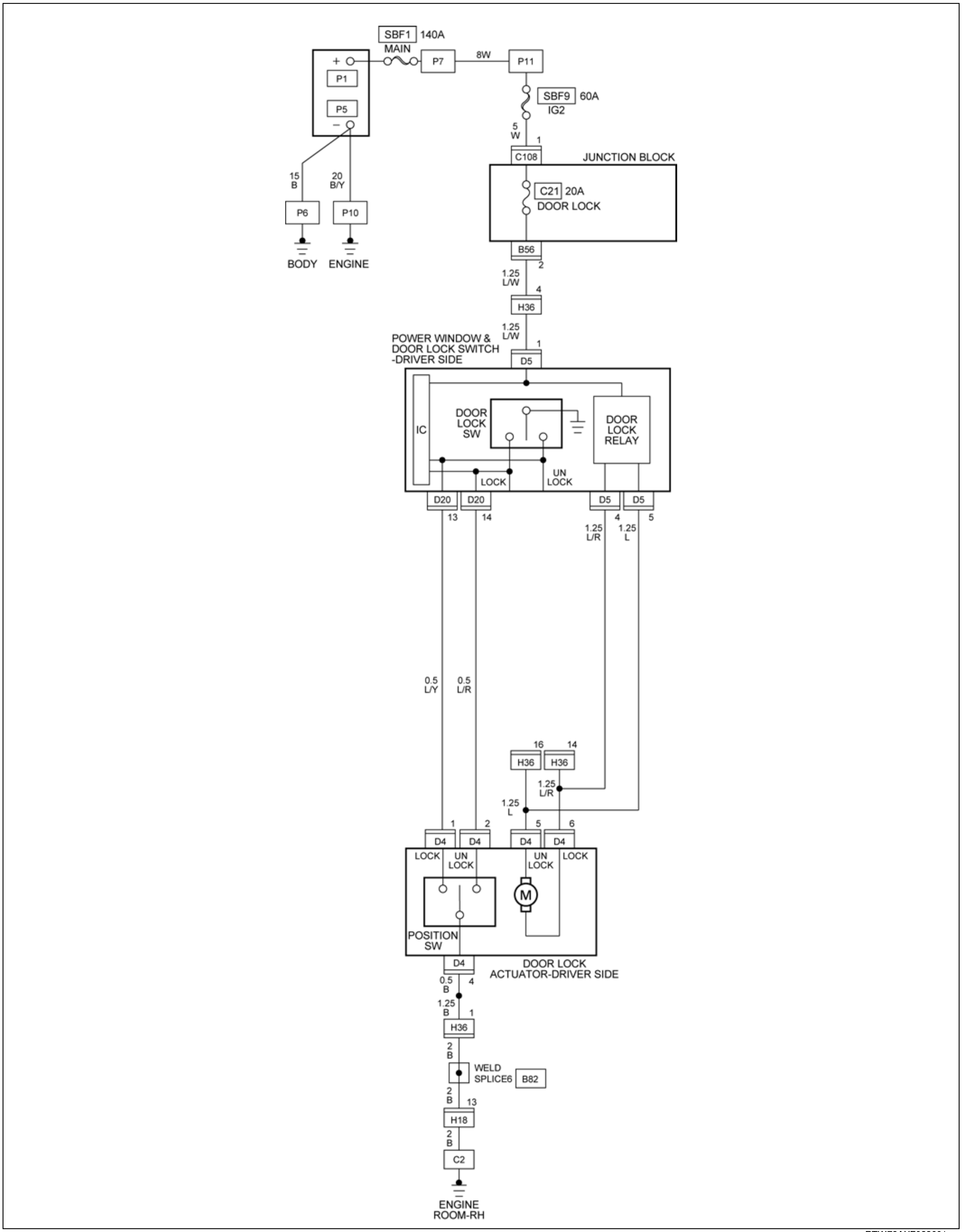
1. Diff. carrier
2. ▲ Outer bearing outer race
3. ▲ Inner bearing outer race
4. ▲ Adjust shim
5. ▲ Inner bearing
6. ▲ Collapsible spacer
7. Pinion gear
8. Outer bearing
9. ▲ Oil seal
10. Dust cover
11. Flange
12. ▲ Flange nut
13. ▲ Adjust shim
14. ▲ Side bearing
15. Bearing outer race
16. Diff. cage assembly
17. ▲ Bearing cap
18. ▲ Bolt
19. Axle case
20. ▲ Differential assembly
21. Bolt

CIRCUIT DIAGRAM HFV6 (RHD) STD TYPE



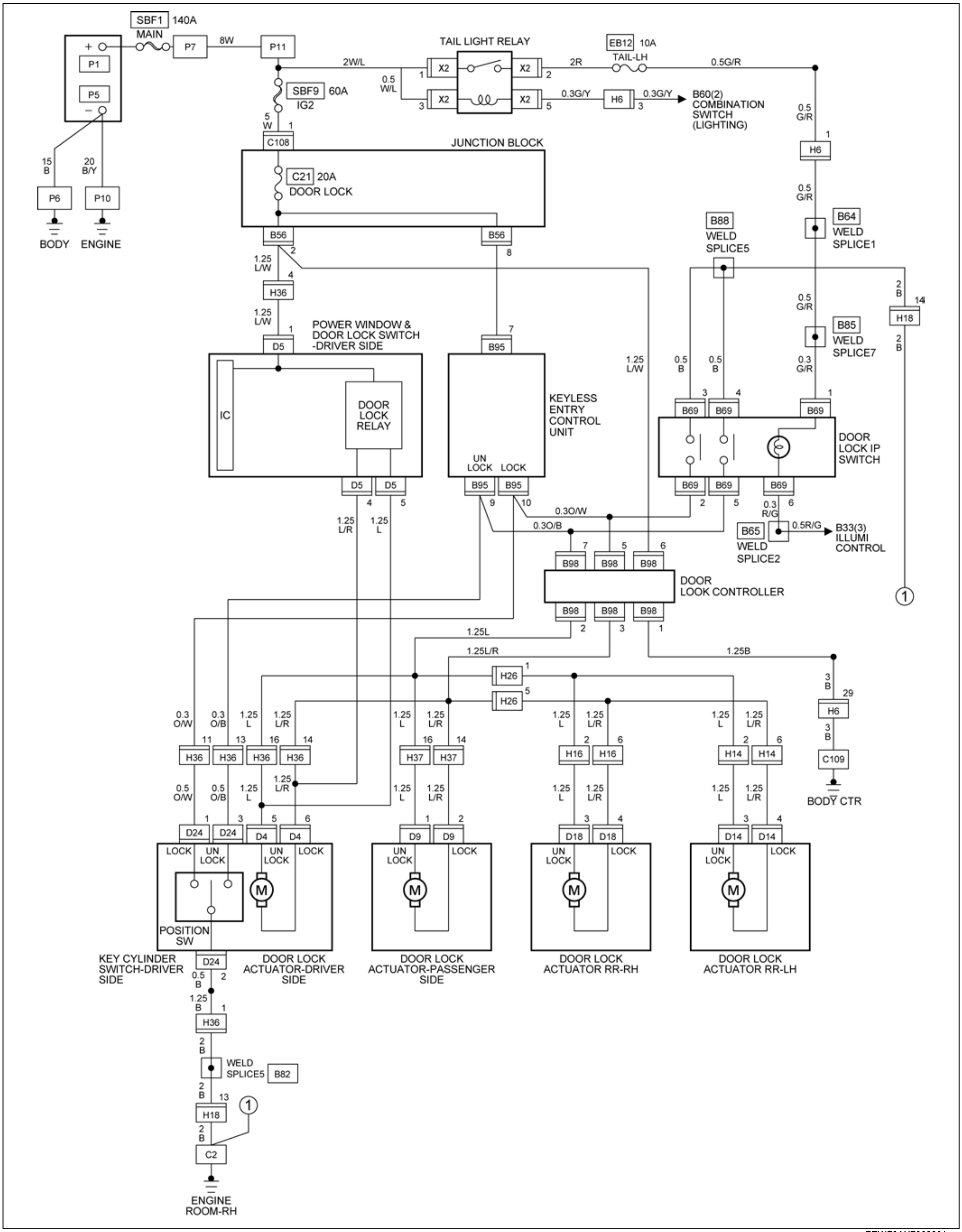
RTW78AXF003701

CIRCUIT DIAGRAM HFV6 (RHD) G.EXP TYPE



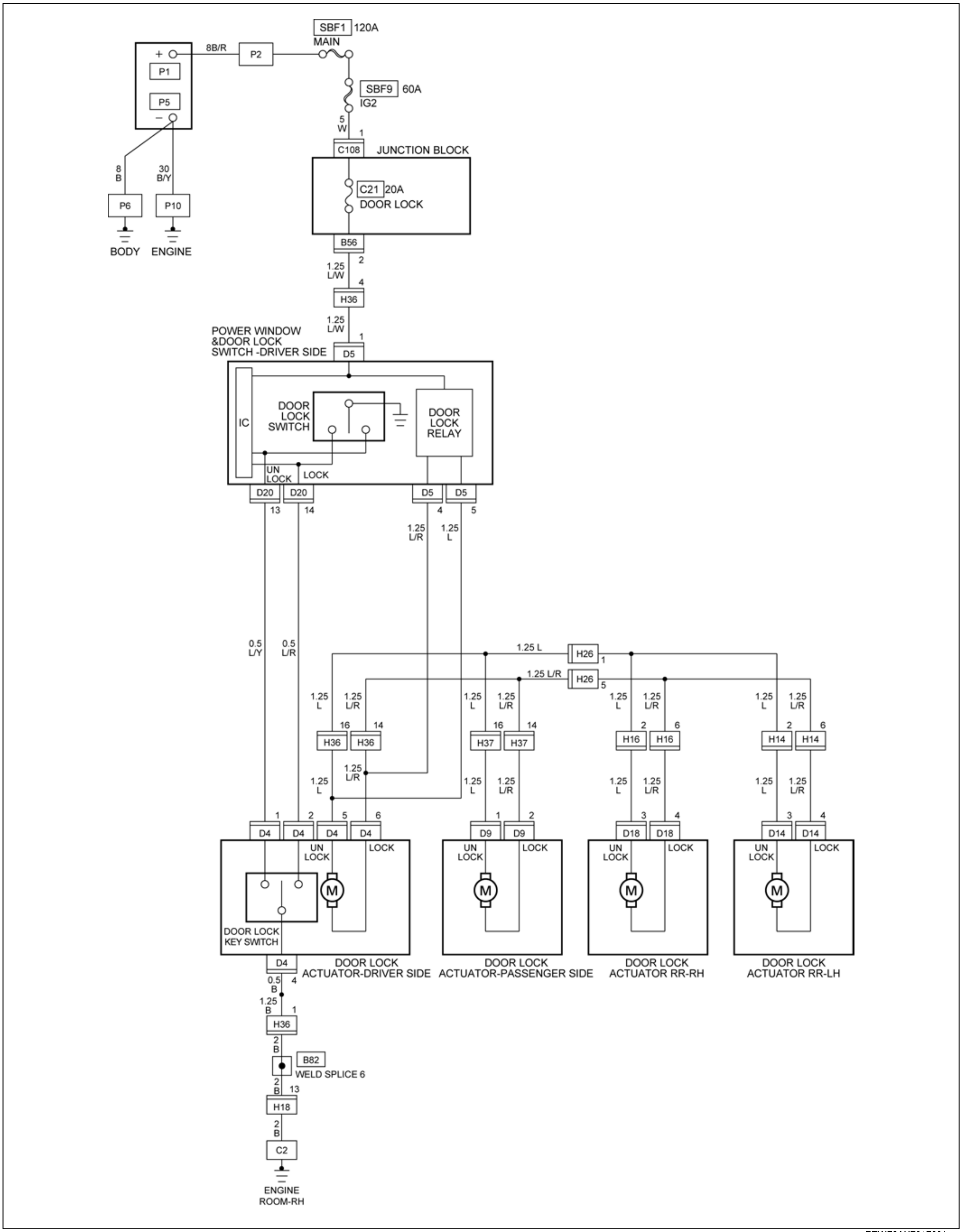
RTW78AXF023601

CIRCUIT DIAGRAM HFV6 (RHD) WITHOUT POWER WINDOW TYPE



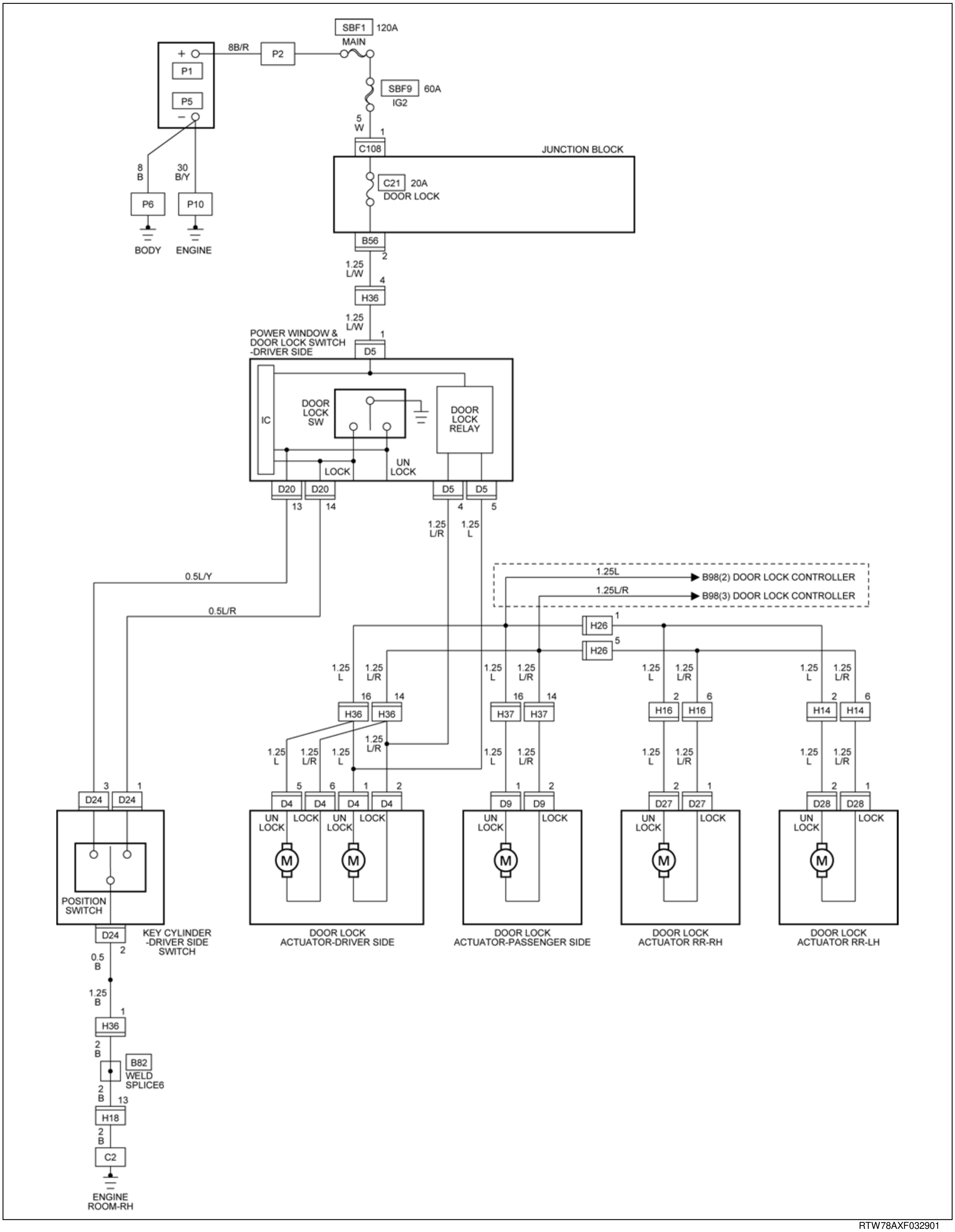
RTW78AXF003801

CIRCUIT DIAGRAM 4JJ1-TC (RHD) SOUTH AFRICA

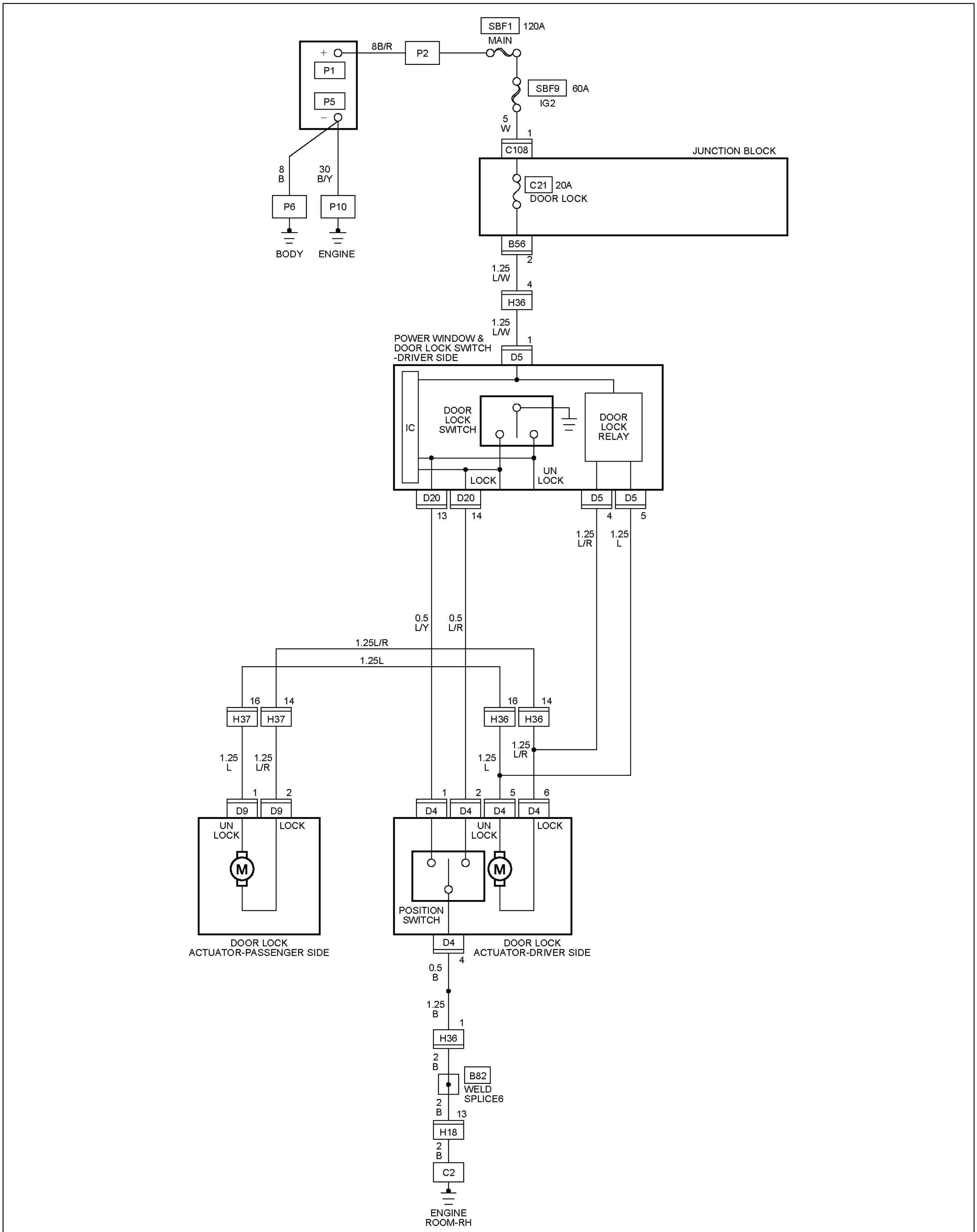


RTW78AXF017601

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA STD TYPE

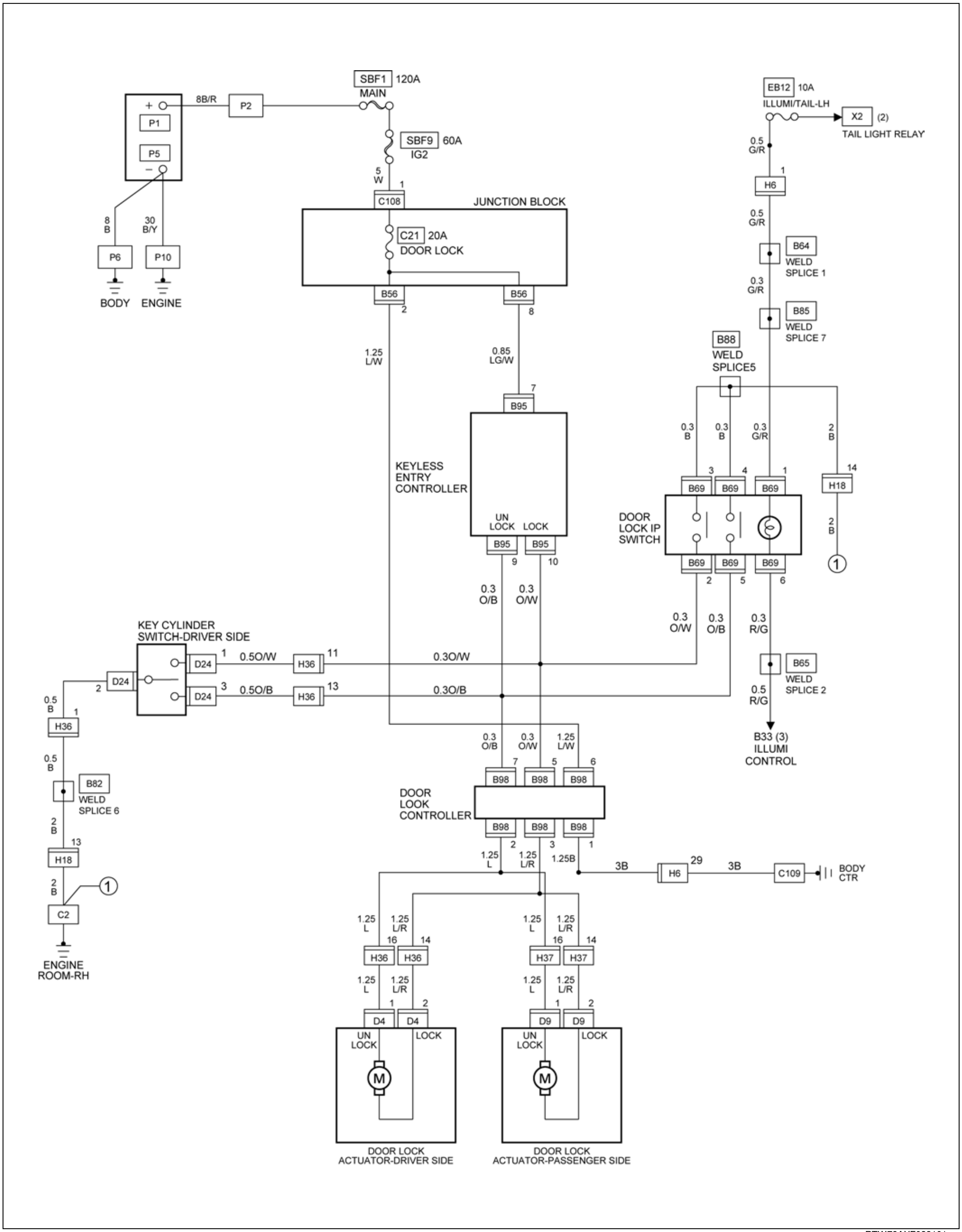


CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA G.EXP TYPE



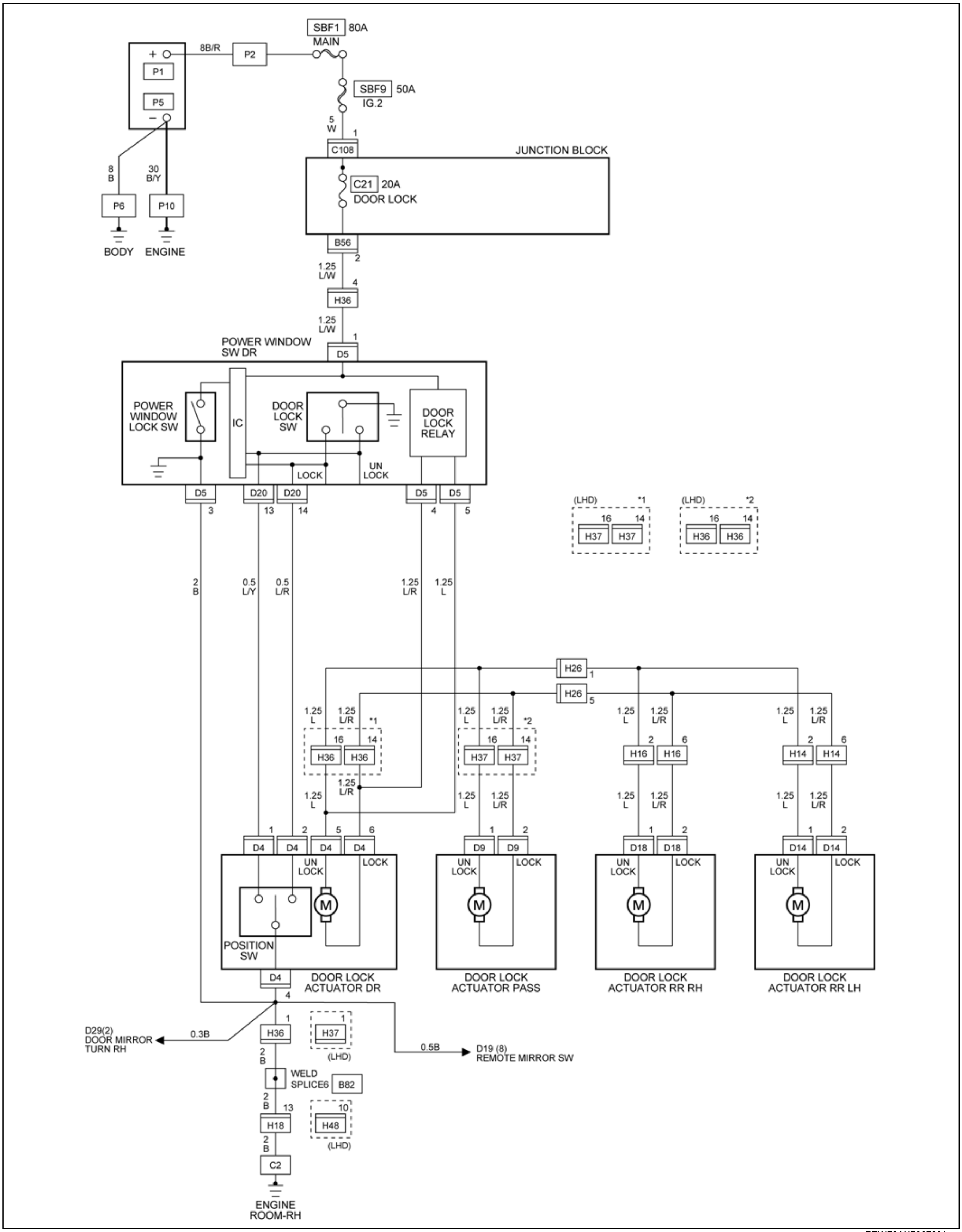
RTW78AXF033001

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA WITHOUT POWER WINDOW TYPE



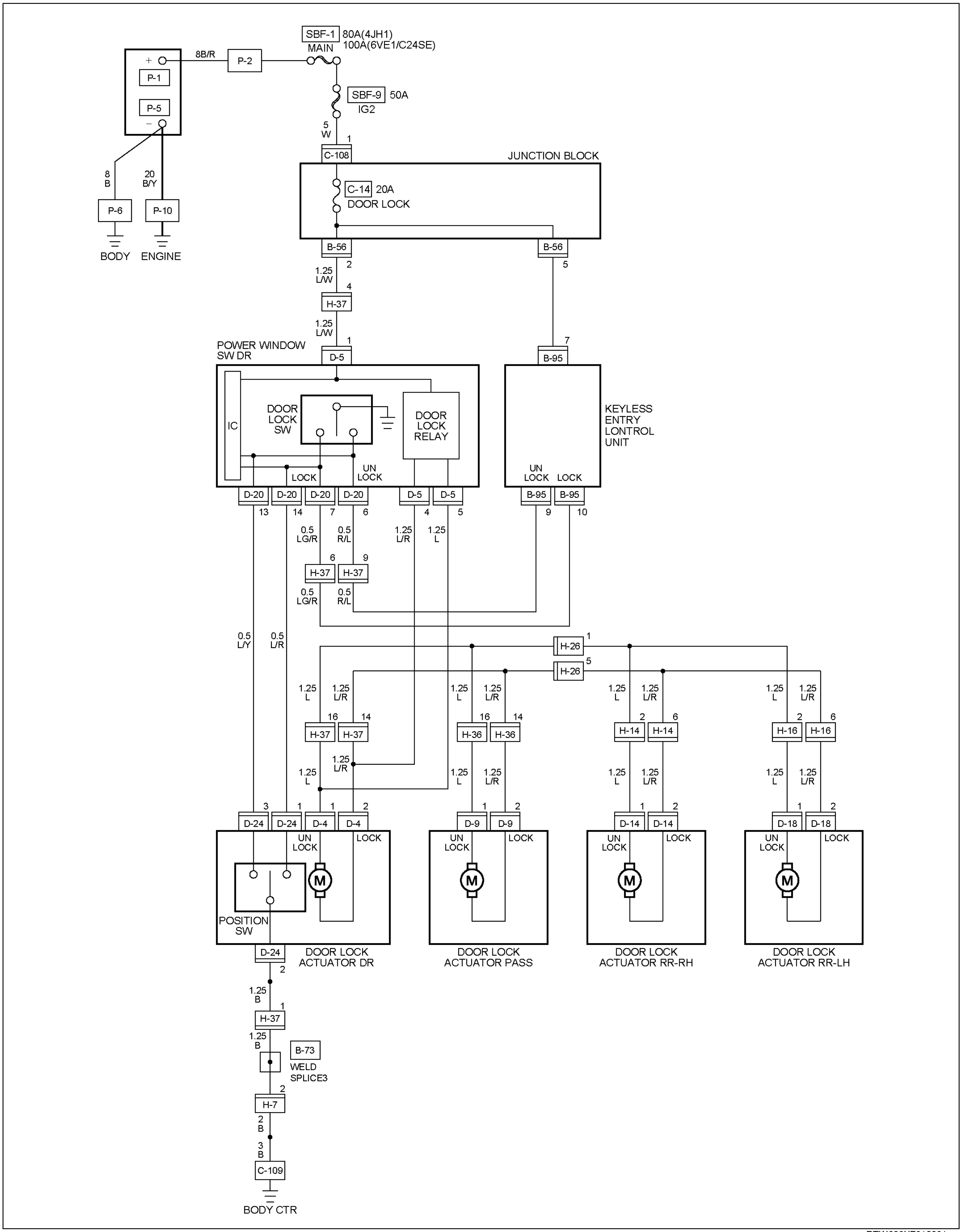
RTW78AXF033101

CIRCUIT DIAGRAM 4JA1T (L)



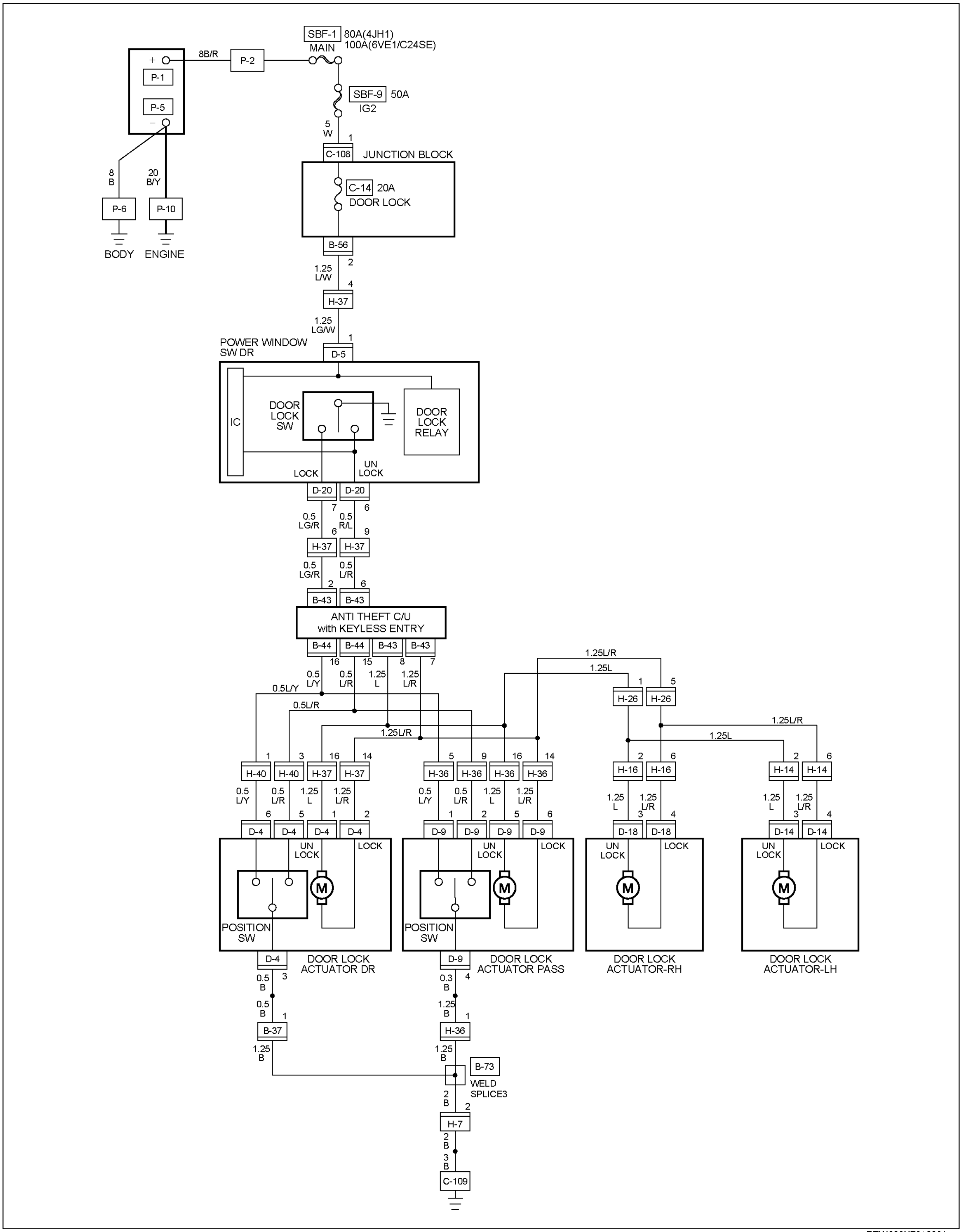
RTW78AXF007001

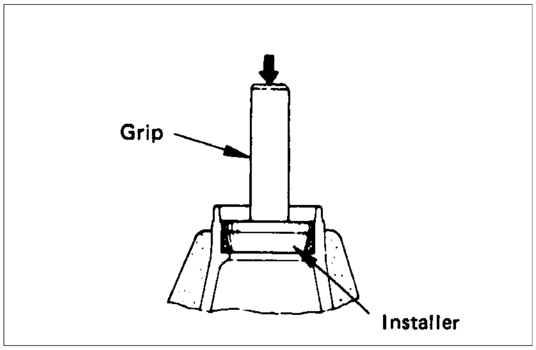
CIRCUIT DIAGRAM C24SE (LHD) WITHOUT ANTI THEFT



RTW680XF012801

CIRCUIT DIAGRAM C24SE (LHD) WITH ANTI THEFT



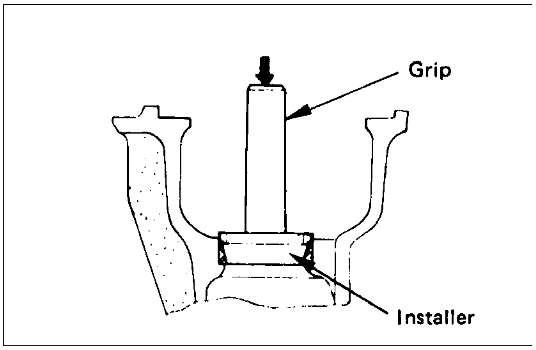


Important Operations

2. Outer Bearing Outer Race

Installer : 9-8522-1141-0

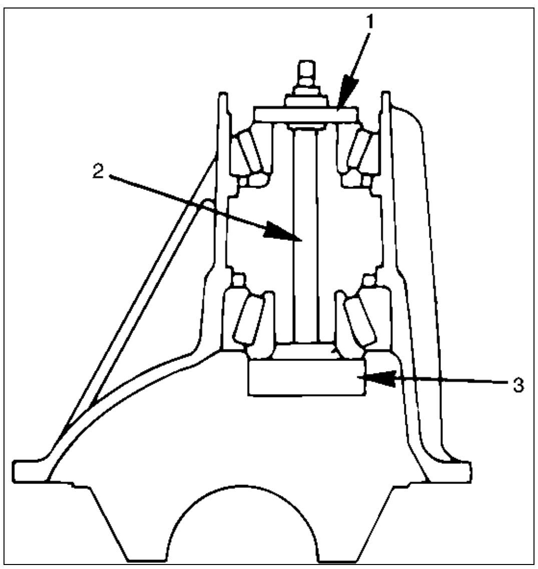
Grip : 5-8840-0007-0



3. Inner Bearing Outer Race

Installer : 9-8522-1274-0

Grip : 5-8840-0007-0



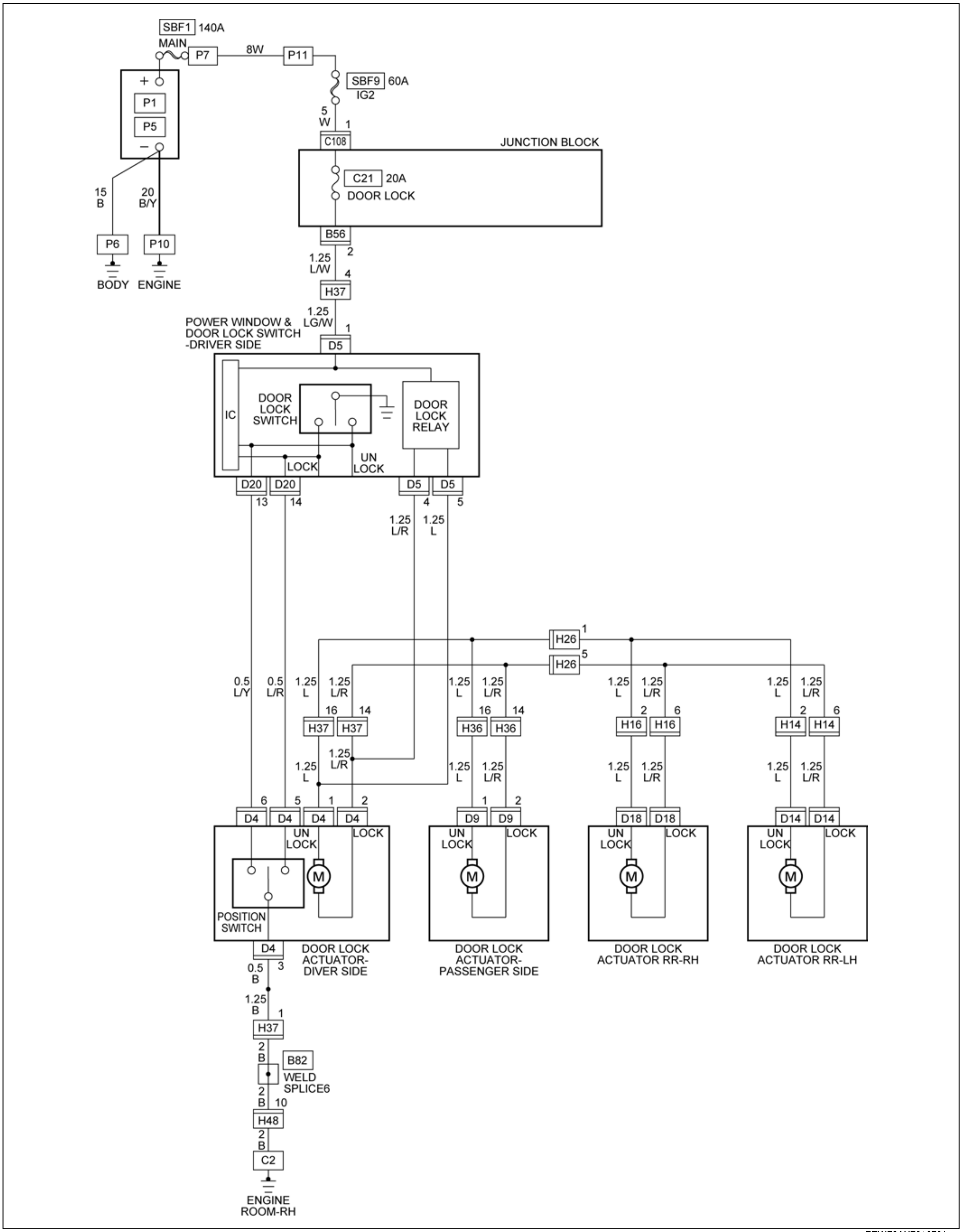
4. Adjust Shim

Adjustment of drive pinion mounting distance

(1) Apply gear oil to the inner and outer drive pinion bearing.
Clean the pinion setting gage set.
Then install the gage set together with the inner and outer bearings.

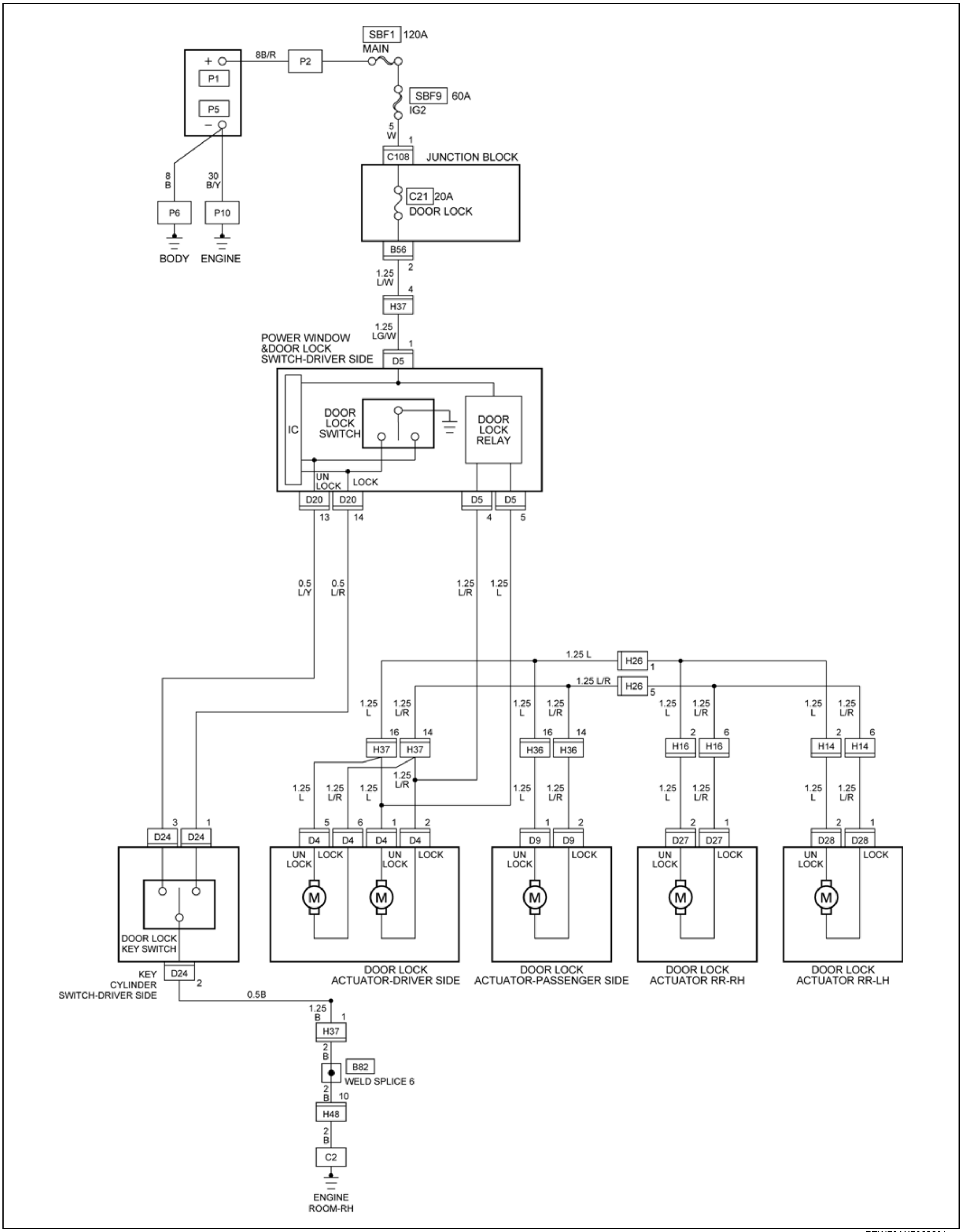
1. Pilot : 5-8840-2085-0
2. Nut and bolt : 5-8840-2089-0
3. Gage plate : 5-8840-2087-0

CIRCUIT DIAGRAM WITH SUPER LOCK HFV6 (LHD)



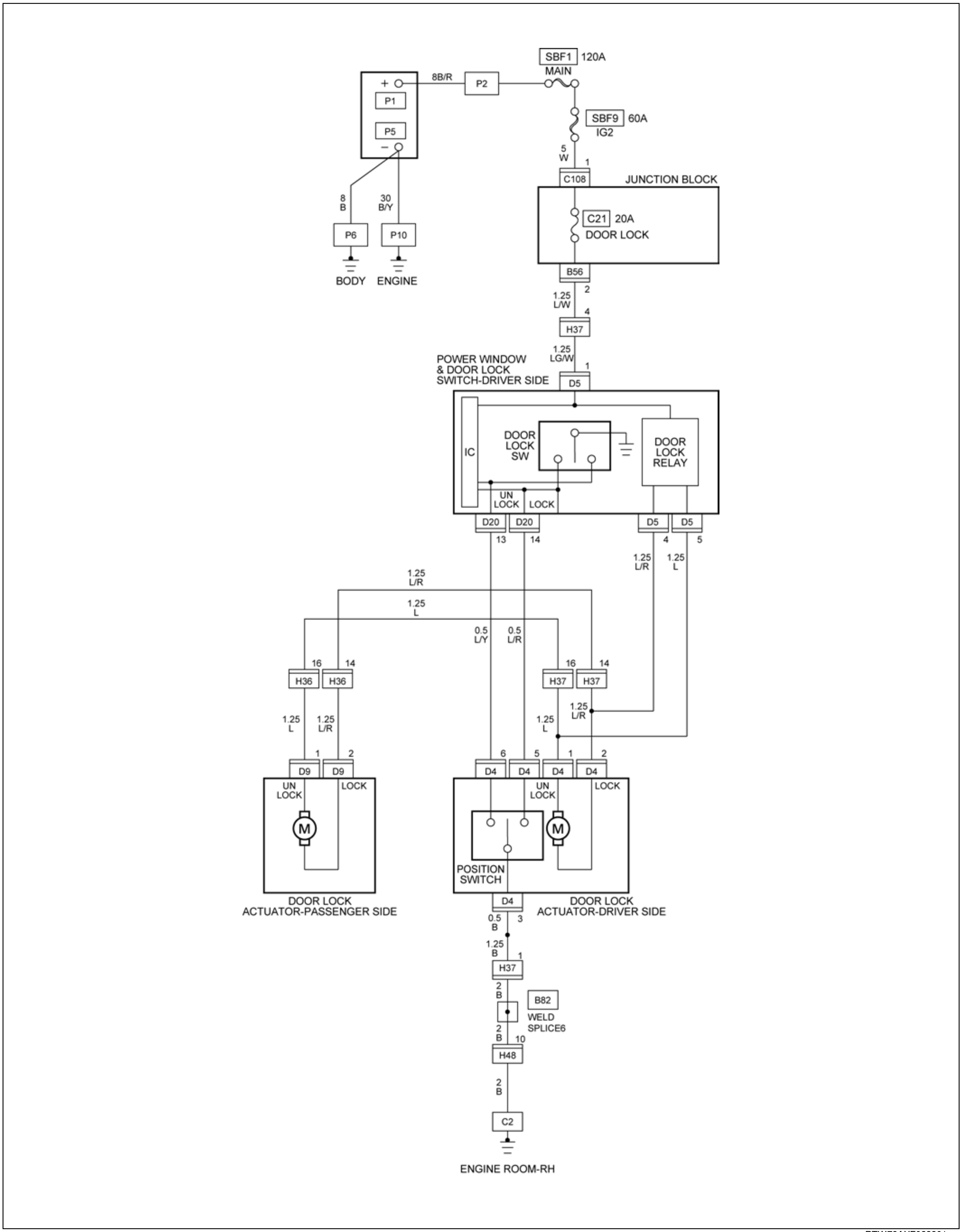
RTW78AXF016701

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP STD TYPE



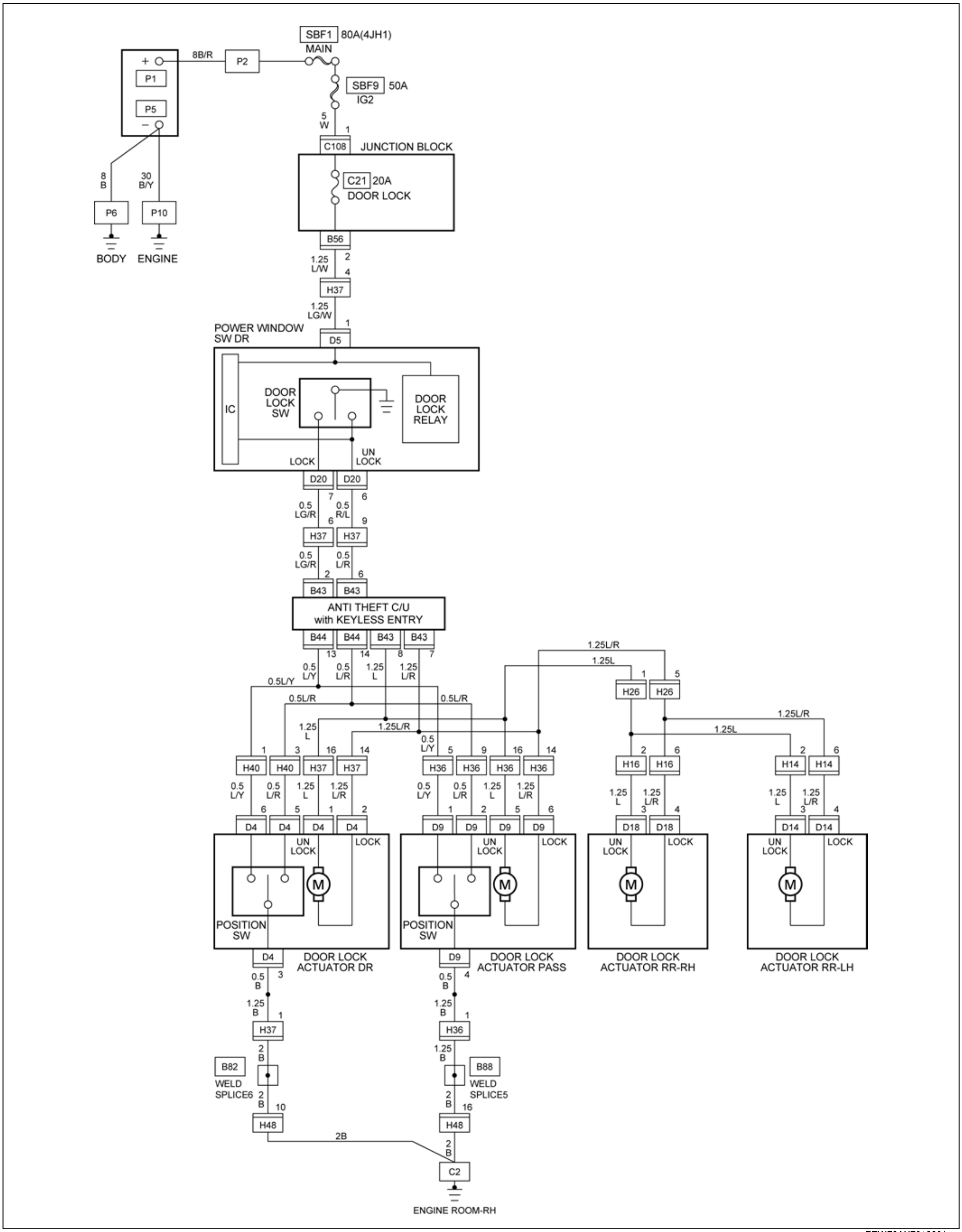
RTW78AXF023201

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (LHD) G.EXP G.EXP TYPE



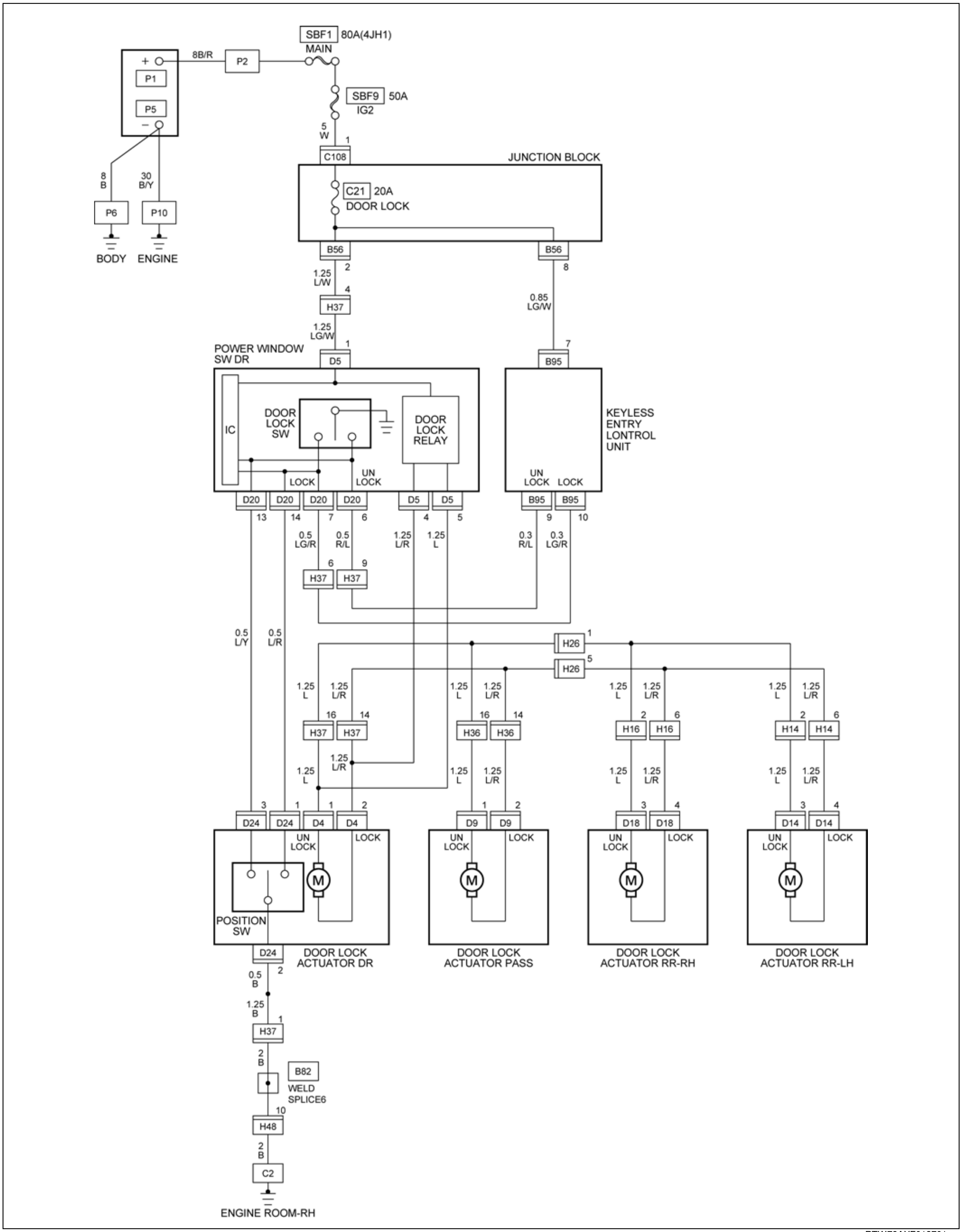
RTW78AXF023301

CIRCUIT DIAGRAM 4JH1 (LHD) STD TYPE



RTW78AXF013801

CIRCUIT DIAGRAM 4JH1 (LHD) WITHOUT ANTI THEFT G.EXP TYPE



RTW78AXF013701

TROUBLESHOOTING

QUICK CHART FOR CHECK POINTS

Check Points / Trouble Mode	Fuse C21 (20A)	Power Window & Door Lock Switch	Door Lock Switch	Key Cylinder switch		Door Lock Actuator			Cable Harness
		Driver's side	Driver's side	D/S	P/S	Passenger's side	RR-RH	RR-LH	
1. All the doors do not lock and unlock	○	○		○	○				○
2. All the doors do not get locked (or unlocked)		○							○
3. Driver's side door does not get locked (or unlocked)			○						○
4. FRT passenger's side door does not get locked (or unlocked)						○			○
5. RR door-RH does not get locked (or unlocked)							○		○
6. RR door-LH does not get locked (or unlocked)								○	○
7. Door lock does not operate when operating from the driver's seat side			○						○

1. All the doors do not lock and unlock

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C21 (20A, Fuse box)	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. C21 (20A)
OK			
Grounding point C2	NG	Poor grounding point contact	Repair grounding point contact
OK			
Voltage between the driver's side power window & door lock SW harness side connector terminal 1 D5 and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Continuity between 3 or 4 D4 or 2 D24 and C2	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Driver's side power window & door lock SW. function	NG	SW. malfunction	Replace the driver's side power window & door lock SW.

2. All the doors do not get locked (or unlocked)

Checkpoint		Trouble Cause	Countermeasure
Continuity between the driver's side power window & door lock SW harness side connector terminals 14 D20 and 6 D20	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Driver's side power window & door lock SW. function	NG	SW. malfunction	Replace the driver's side power window & door lock SW.

3. Driver's side door does not get locked (or unlocked)

Checkpoint		Trouble Cause	Countermeasure
Door lock SW. function	NG	SW. malfunction	Replace the door lock SW.

4. FRT passenger's side door does not get locked (or unlocked)

Checkpoint		Trouble Cause	Countermeasure
FRT passenger's side door lock actuator function	NG	Actuator malfunction	Replace the FRT passenger's side door lock actuator

5. RR door-RH does not get locked (or unlocked)

Checkpoint		Trouble Cause	Countermeasure
RR door lock actuator-RH function	NG	Actuator malfunction	Replace the RR door lock actuator-RH

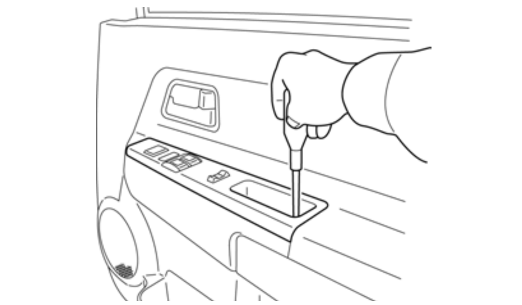
6. RR door-LH does not get locked (or unlocked)

Checkpoint		Trouble Cause	Countermeasure
RR door lock actuator-LH function	NG	Actuator malfunction	Replace the RR door lock actuator-LH

7. Door lock does not operate when operated from the driver's seat side

Checkpoint		Trouble Cause	Countermeasure
Grounding point C2 (RHD), C109 (LHD)	NG	Poor grounding point contact	Repair grounding point C2 contact
OK ↓			
Continuity between the door lock position SW. side connector terminals 1 D4, 5 D4 and 3 D4 or 1 D24 and 2 D24 and 4 D4 when the SW is locked and 2 D4 and 4 D4, 6 D4 and 3 D4 or 3 D4 and 2 D24 when the SW. unlocked	NG	SW. malfunction	Replace the door lock position SW.

REMOVAL AND INSTALLATION



This illustration is based on 2 doors and RHD

RTW780SH002601

DRIVER'S SEAT SIDE POWER WINDOW & DOOR LOCK SWITCH

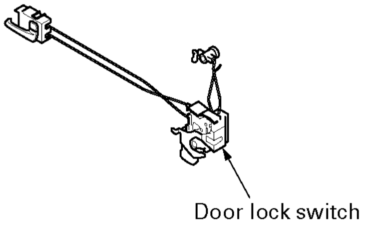
Removal

1. Disconnect the battery ground cable.
2. Removes the screw in pull cup with the screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front of the bezel.
It follows the front with the screwdriver.
The clip can break when lifting from the rear of the bezel.

Installation

To install, follow the removal steps in the reverse order.



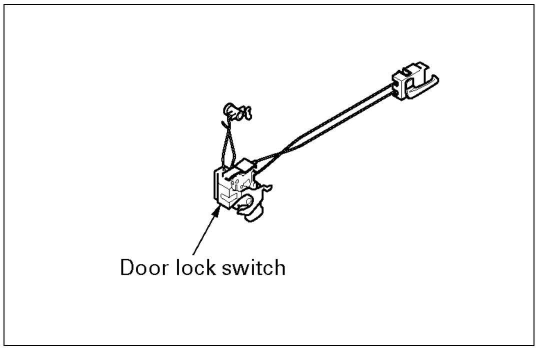
DRIVER'S SIDE DOOR LOCK SWITCH

Removal

1. **Door Lock ASM**
   - Refer to the removal steps of the DOORS in section 10 "BODY".
2. **Door Lock Switch**

Installation

To install, follow the removal steps in the reverse order.



FRT PASSENGER'S SIDE DOOR LOCK ACTUATOR

Removal

1. **Door Lock ASM**
   - Refer to the removal steps of the DOORS in Section 10 "BODY".
2. **Door Lock Actuator**
   - Remove the door lock switch fixing bolts.
   - Disconnect the door lock link rod.
   - Disconnect the door lock switch connector.

Installation

To install, follow the removal steps in the reverse order.

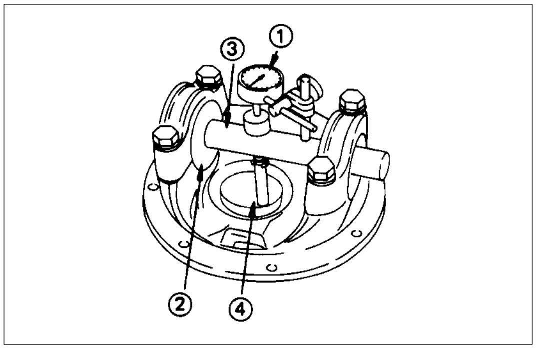
RR DOOR LOCK ACTUATOR-LH & RH

Removal

1. **Door Lock ASM**
   - Refer to the removal steps of the DOORS in section 10 "BODY".
2. **Door Lock Actuator**
   - Remove the actuator fixing bolts.
   - Disconnect the door lock link rod.
   - Disconnect the actuator connector.

Installation

To install, follow the removal steps in the reverse order.



Tighten the nut to the specified torque.

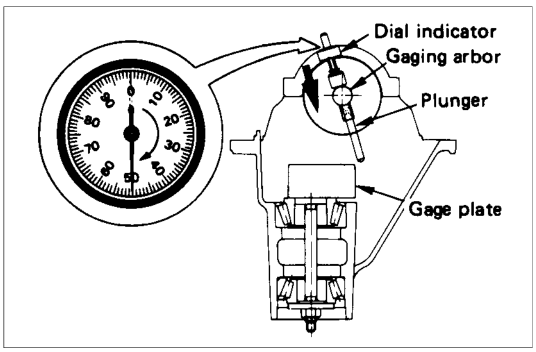
N·m (kgf·m/lb·in)

New bearing	2.3 (0.23/20)
Used bearing	0.98 - 1.18 (0.10 – 0.12/9 – 10)

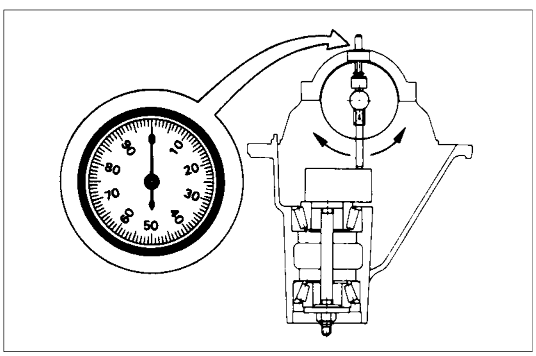
(2) Clean the side bearing bores. Install the dial indicator with the discs and Arbor. Install and tighten the bearing caps to the specified torque.

Torque	N·m (kgf·m/lb·ft)
98 (10.0/72)	

① Dial indicator : 5-8840-0126-0
② Disc (2 pcs.) : 5-8840-2088-0
③ Arbor : 5-8840-0128-0
④ Gage plate : 5-8840-2087-0

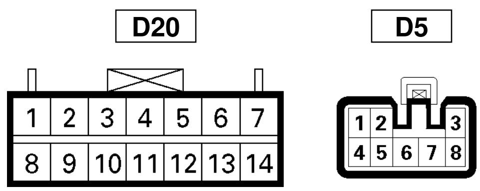


(3) Set the dial indicator to “0”. Place it on the mounting post of the gaging arbor with the contact button touching the indicator pad. Force the dial indicator downward until the needle has made a half turn clockwise. Tighten down the dial indicator in this position.



(4) Position the plunger on the gage plate. Move the gaging arbor slowly back and forth and locate the position at which the dial indicator shows the greatest deflection. At this point, once again set the dial indicator to “0”.
Repeat the procedure to verify the “0” setting.

INSPECTION AND REPAIR



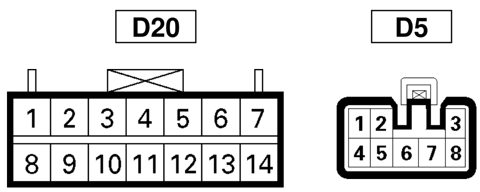
Harness side

Driver's Side Power Window & Door Lock Switch

1. Harness Side Connector Circuit

Check voltage and continuity between the switch harness side connector terminals as shown in the following table.

Terminal No.	Wire color	Connecting to	Check item	Connecting terminal	Check condition		Standard
14 (D20)	L/R	Door lock SW (Lock)	Continuity (Resistance)	14-Ground	Driver's side door	Lock	Continuity
						Unlock	No continuity
13 (D20)	L/Y	Door lock SW (Unlock)		13-Ground	Driver's side door	Lock	No continuity
						Unlock	Continuity
3 (D5)	L/R	Ground		3-Ground	-		Continuity
4 (D5)	L/R	Door lock actuator (Lock)		4-5	-		Continuity (There is some resistance)
5 (D5)	L	Door lock actuator (Unlock)		5-4	-		Continuity (There is some resistance)
1 (D5)	LG/W	Fuse C21 (20A)	Voltage	1- Ground	-		Battery voltage (Approx. 12V)



Harness side

2. Switch Side Connector Circuit

Remove the switch connector, and check continuity and voltage between the switch connector terminals.

(Connect the (+) terminal of the battery to 1 D5 and the (-) terminal to 3 D5.)

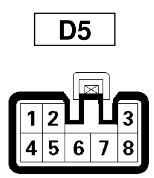
3 D5 - 4 D5 .... Continuity
3 D5 - 5 D5 .... Continuity

(Then, ground 3 D5.)

4 D5 .... Current flow for approx. 1 second

(Disconnect the ground of 14 D20, and ground 13 D20.)

5 D5 .... Current flow for approx. 1 second



Harness side

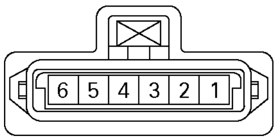
3. Door Lock Operation Test

After confirming that there is continuity between the switch harness side connector terminals 4 D5 and 5 D5, apply the battery voltage to each of the terminals to conduct the operation test.

When the door lock will not operate, check the door lock actuator for any trouble.

Connecting terminals		Operation
5 (L)	4 (L/R)	
⊕	⊖	Unlock
⊖	⊕	Lock

D4



Switch side

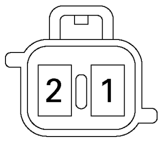
Driver's Side Door Lock Switch

1. Switch Side Connector Circuit

Check continuity between the switch connector terminals

Terminal No. / SW position	1	2	3
Lock	○	○	
Unlock		○	○

D9



Actuator side

Front Passenger's Side Door Lock Actuator

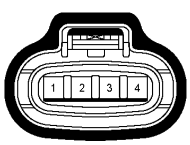
1. Actuator Side Connector Circuit

Apply the battery voltage to the actuator connector terminals to check the operation.

When the door lock actuator is checked on the vehicle and there is no continuity, and when the door lock actuator itself is checked and no trouble is found, check the circuit between the door lock actuator and the driver seat side power window & door lock switch for any failure.

Connecting terminals		Operation
1	2	
⊕	⊖	Lock
⊖	⊕	Unlock

D14 D18



Door lock actuator Rear – RH/LH
Harness side

Rear Door Lock Actuator -LH & RH

1. Actuator Side Connector Circuit

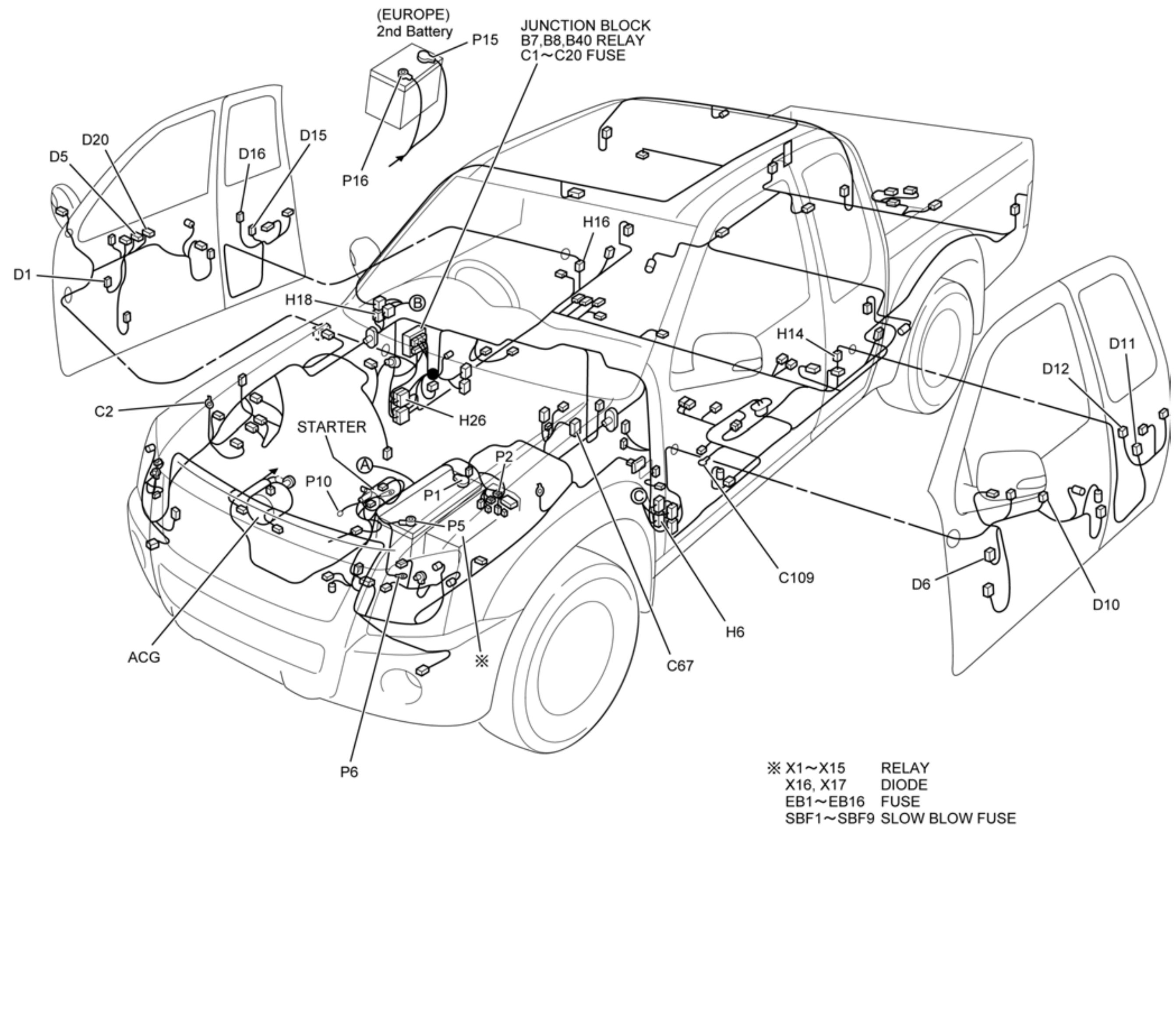
Apply the battery voltage to the actuator connector terminals to check the operation.

When the door lock actuator is checked on the vehicle and there is no continuity, and when the door lock actuator itself is checked and no trouble is found, check the circuit between the door lock actuator and the driver seat side power window & door lock switch for any failure.

Connecting terminals		Operation
1	2	
⊕	⊖	Lock
⊖	⊕	Unlock

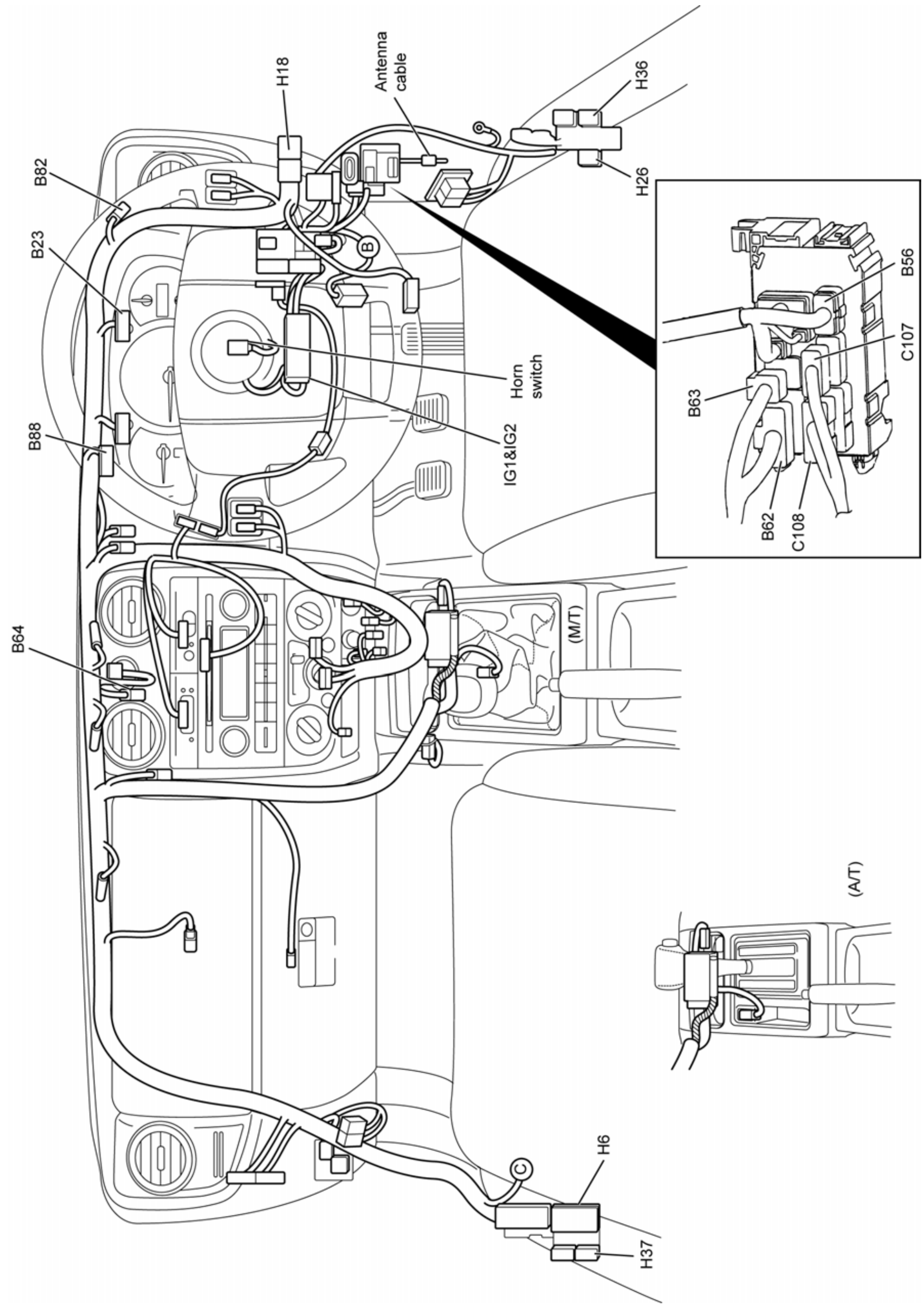
POWER WINDOW

PARTS LOCATION (RHD)



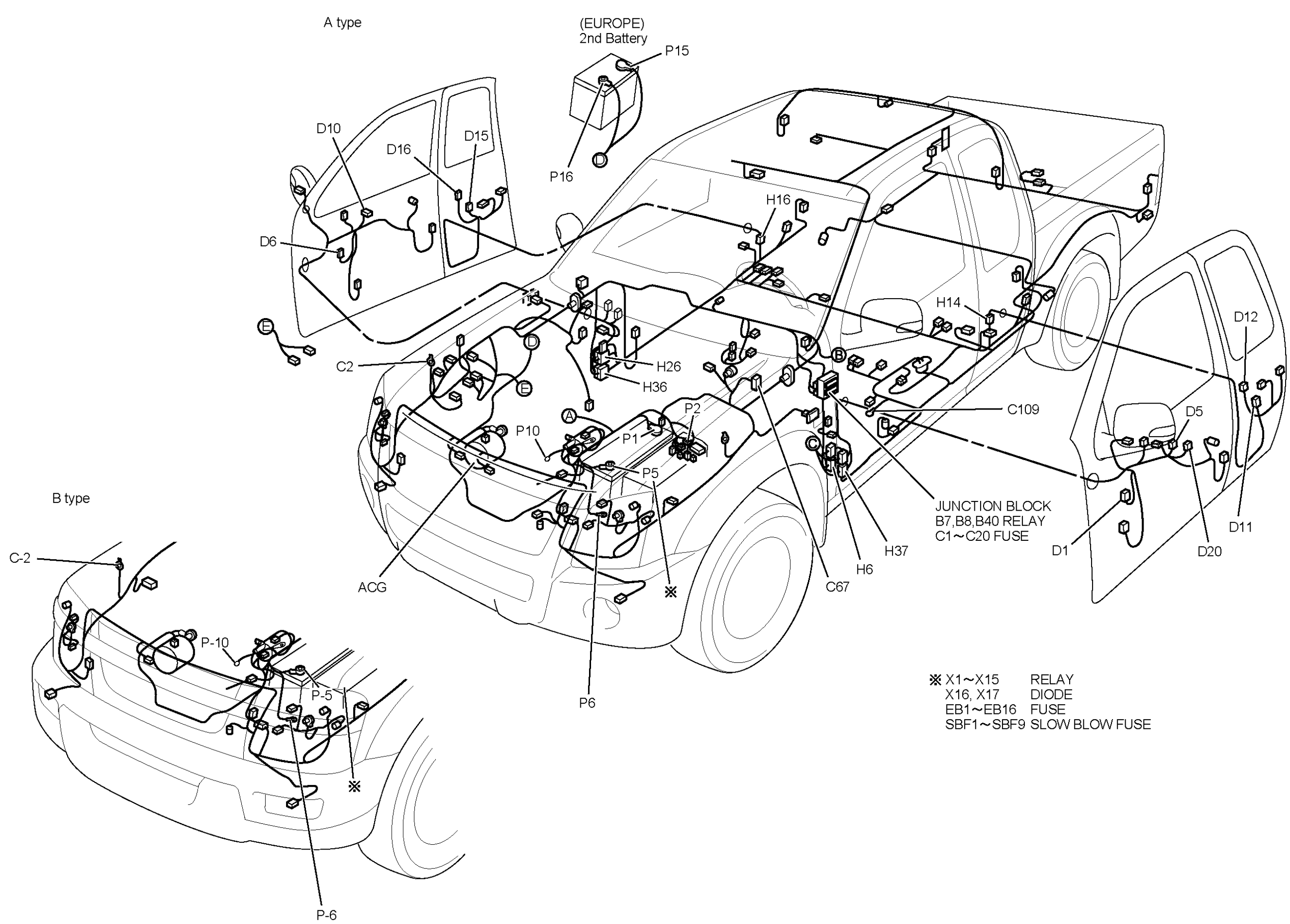
RTW78AXF039501

PARTS LOCATION (RHD)



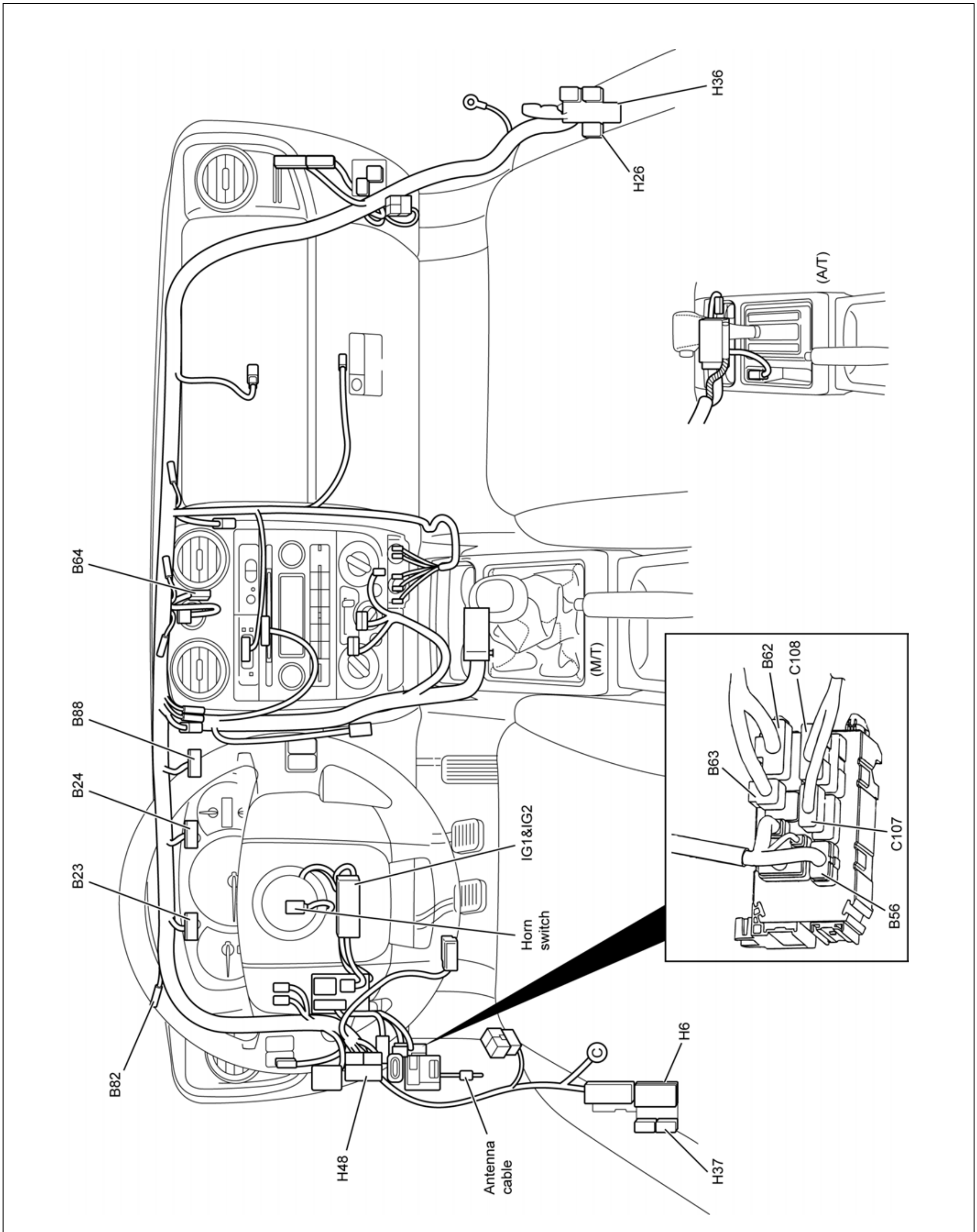
RTW78AXF045701

PARTS LOCATION (LHD)



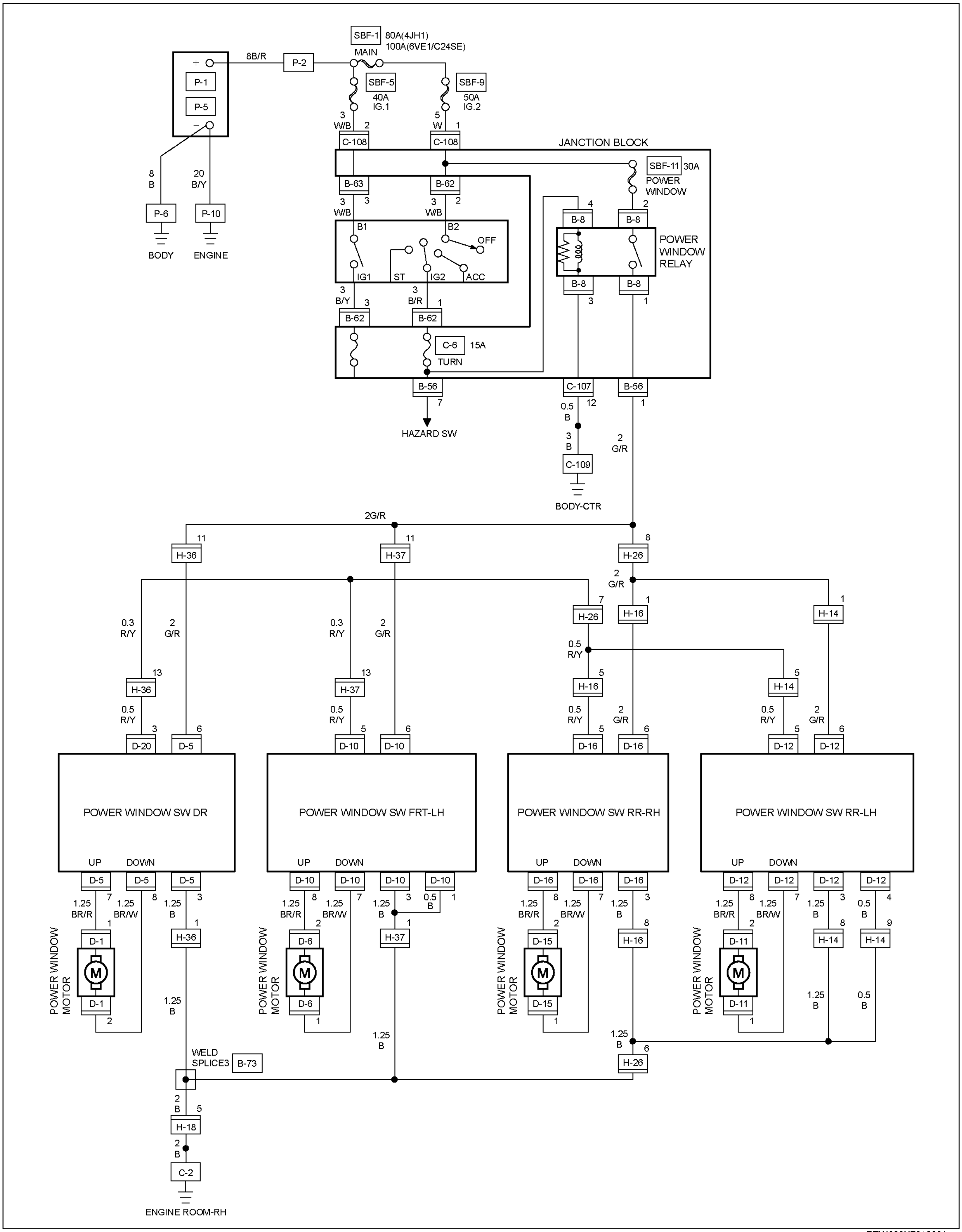
RTW78AXF039601

PARTS LOCATION (LHD)



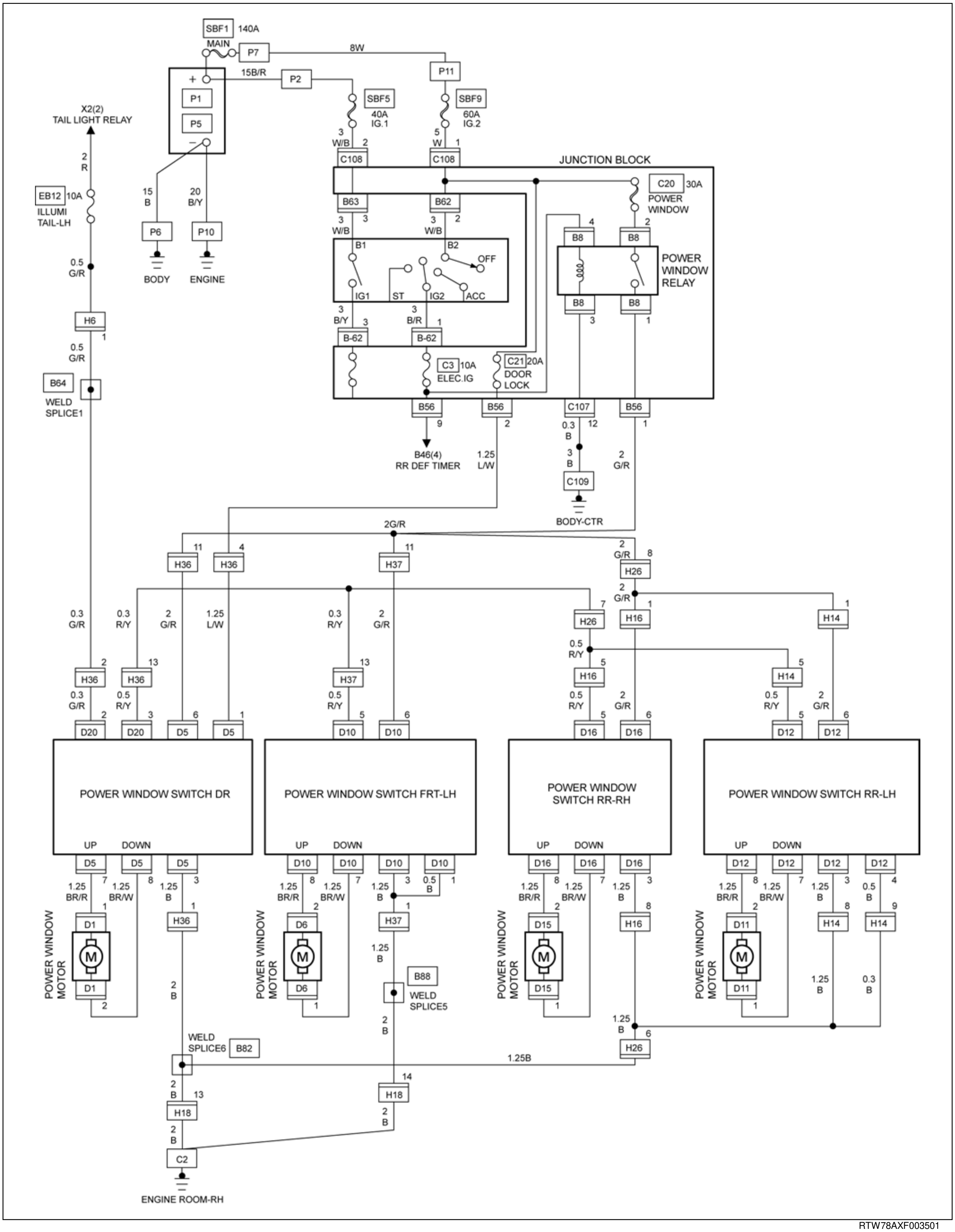
RTW78AXF045801

CIRCUIT DIAGRAM C24SE (RHD)

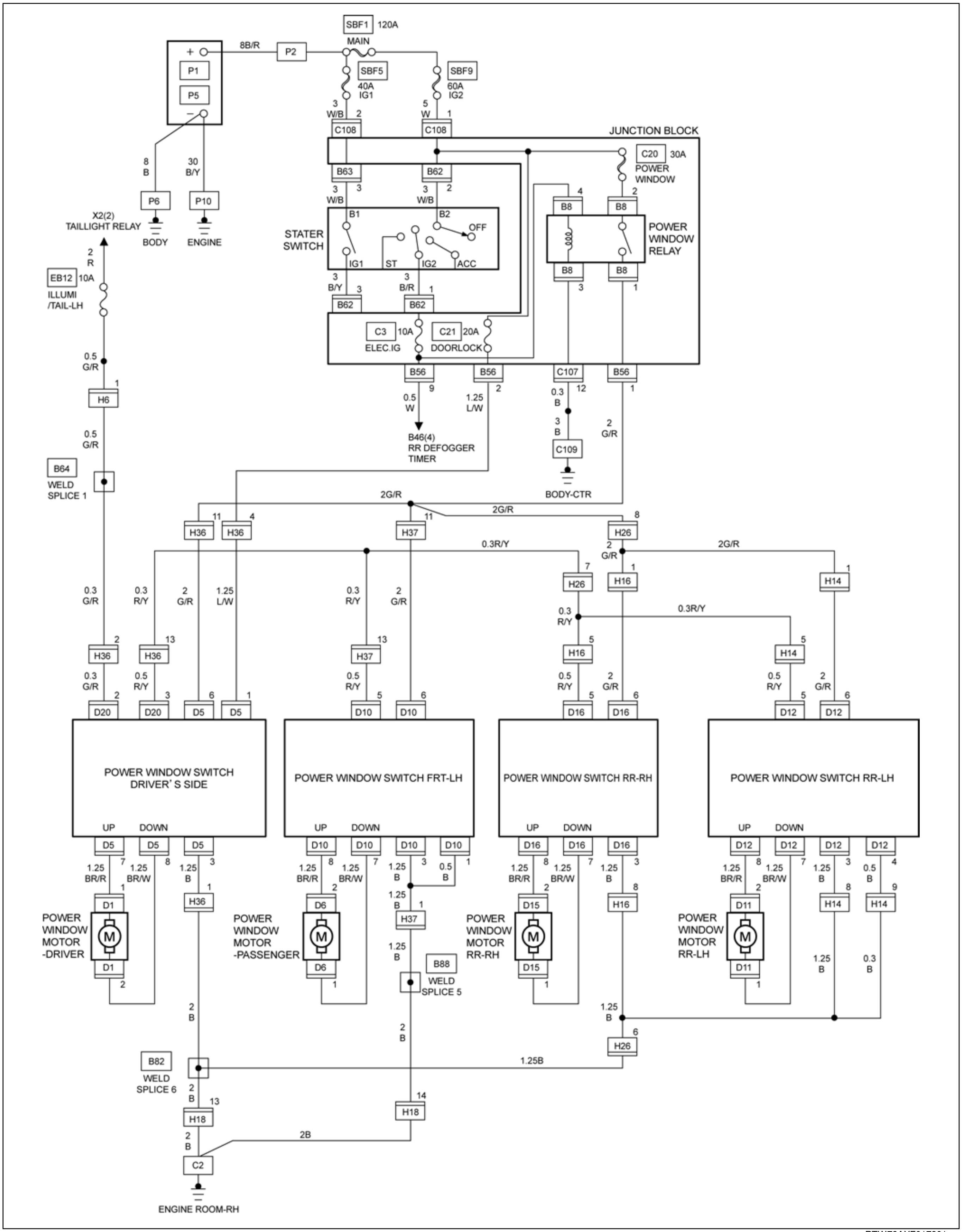


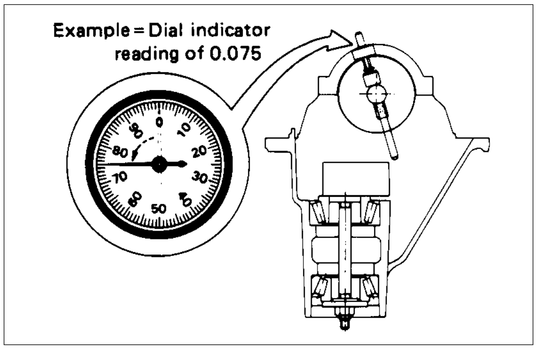
RTW680XF013001

CIRCUIT DIAGRAM HFV6 (RHD)

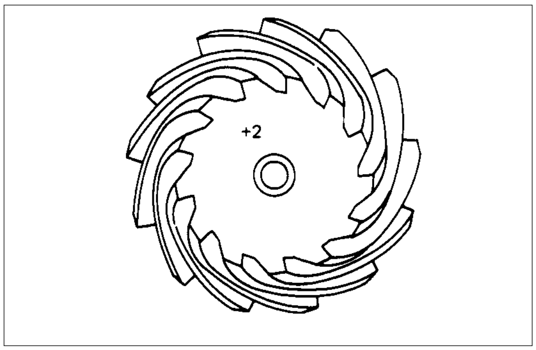


CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA





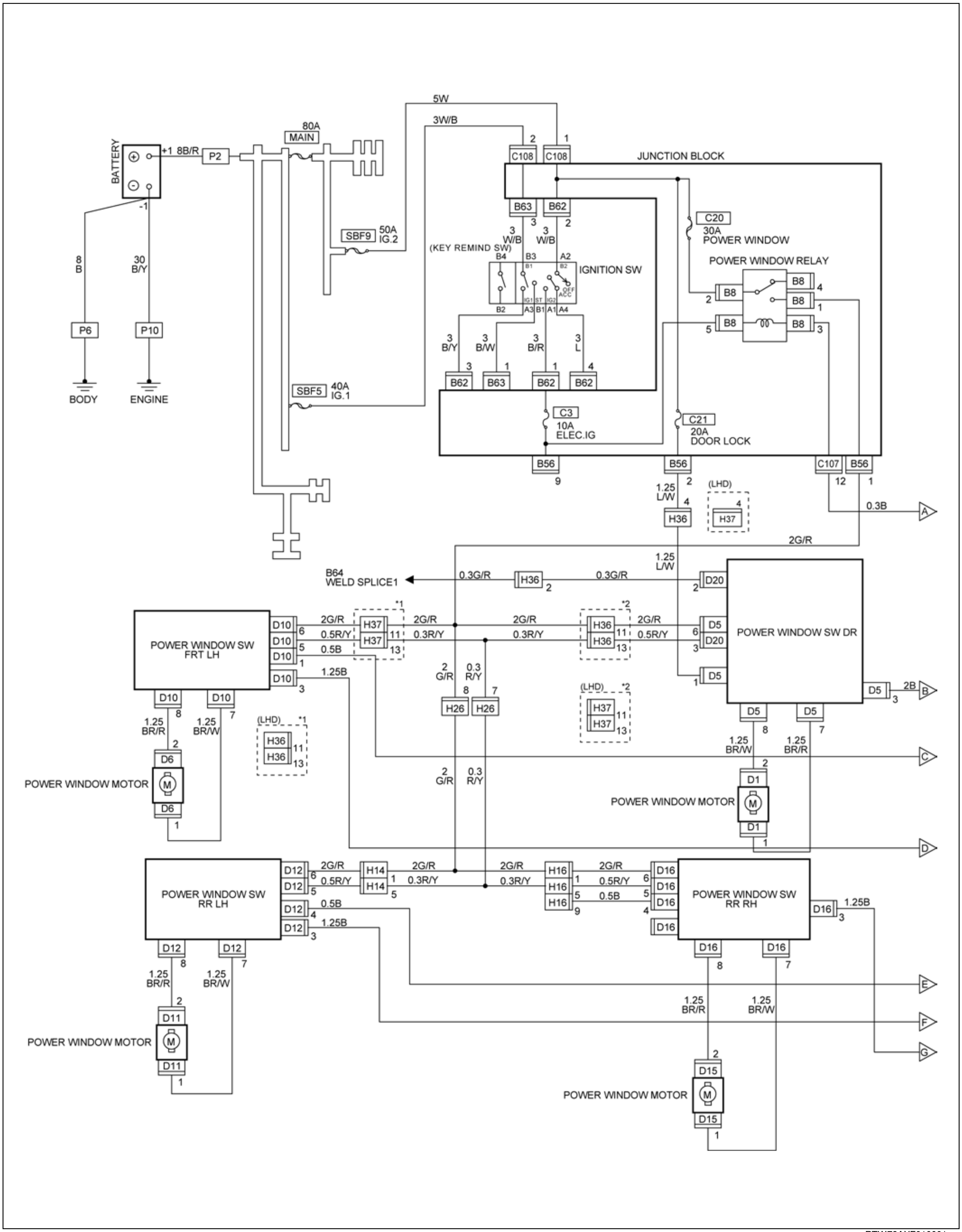
(5) After the ZERO setting is obtained, rotate the gaging arbor until the dial indicator rod does not touch the gaging plate. Record the number the dial indicator needle points to.



(6) Record the pinion depth code on the head of the drive pinion.
The number indicates a necessary change in the pinion mounting distance. A plus number indicates the need for a greater mounting distance (which can be achieved by decreasing the shim thickness). A minus number indicates the need for a smaller mounting distance (which can be achieved by increasing the shim thickness). If examination reveals pinion depth code “0”, the pinion is “nominal”.

CIRCUIT DIAGRAM 4JA1T (L)

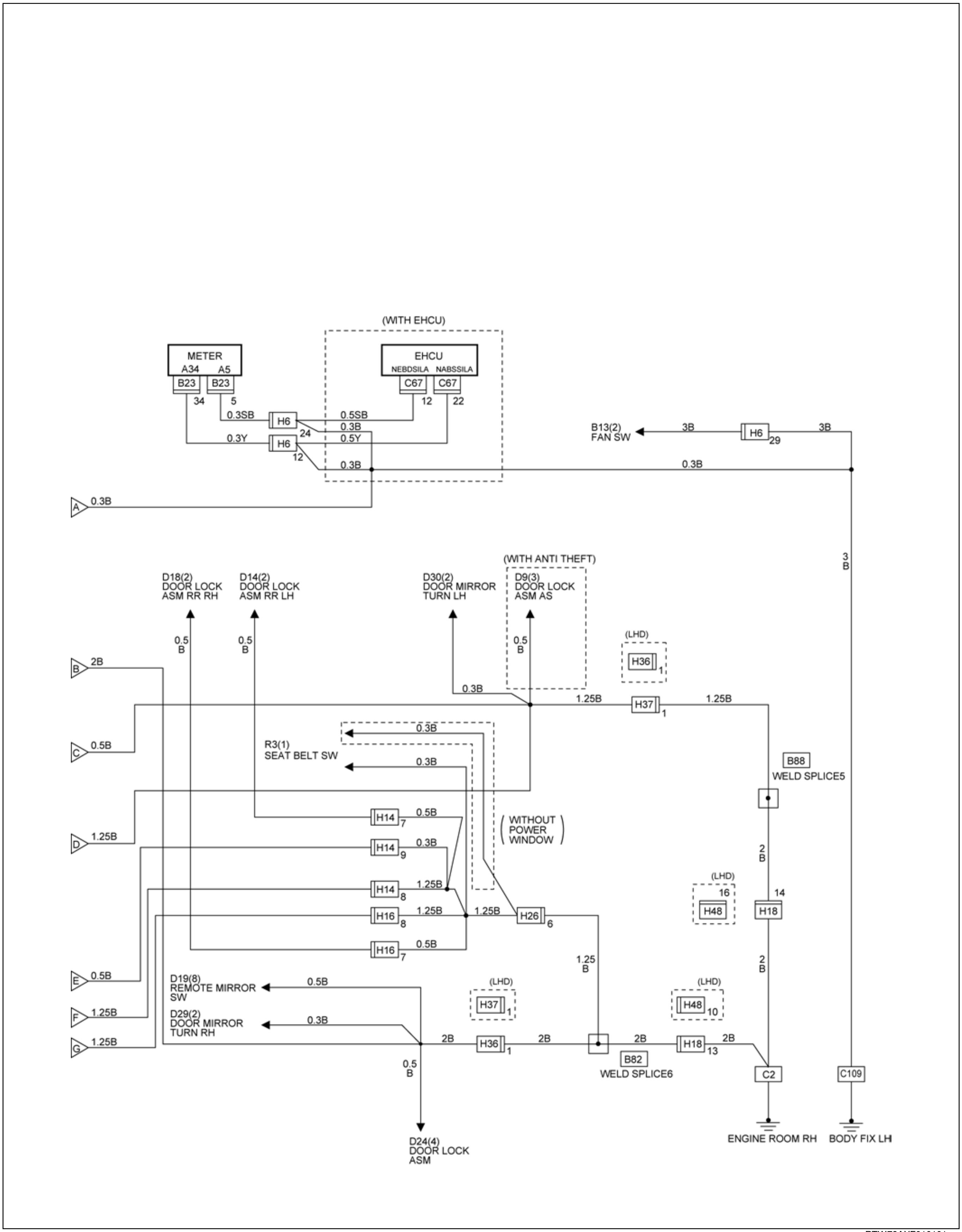
Sheet 1/2



RTW78AXF010001

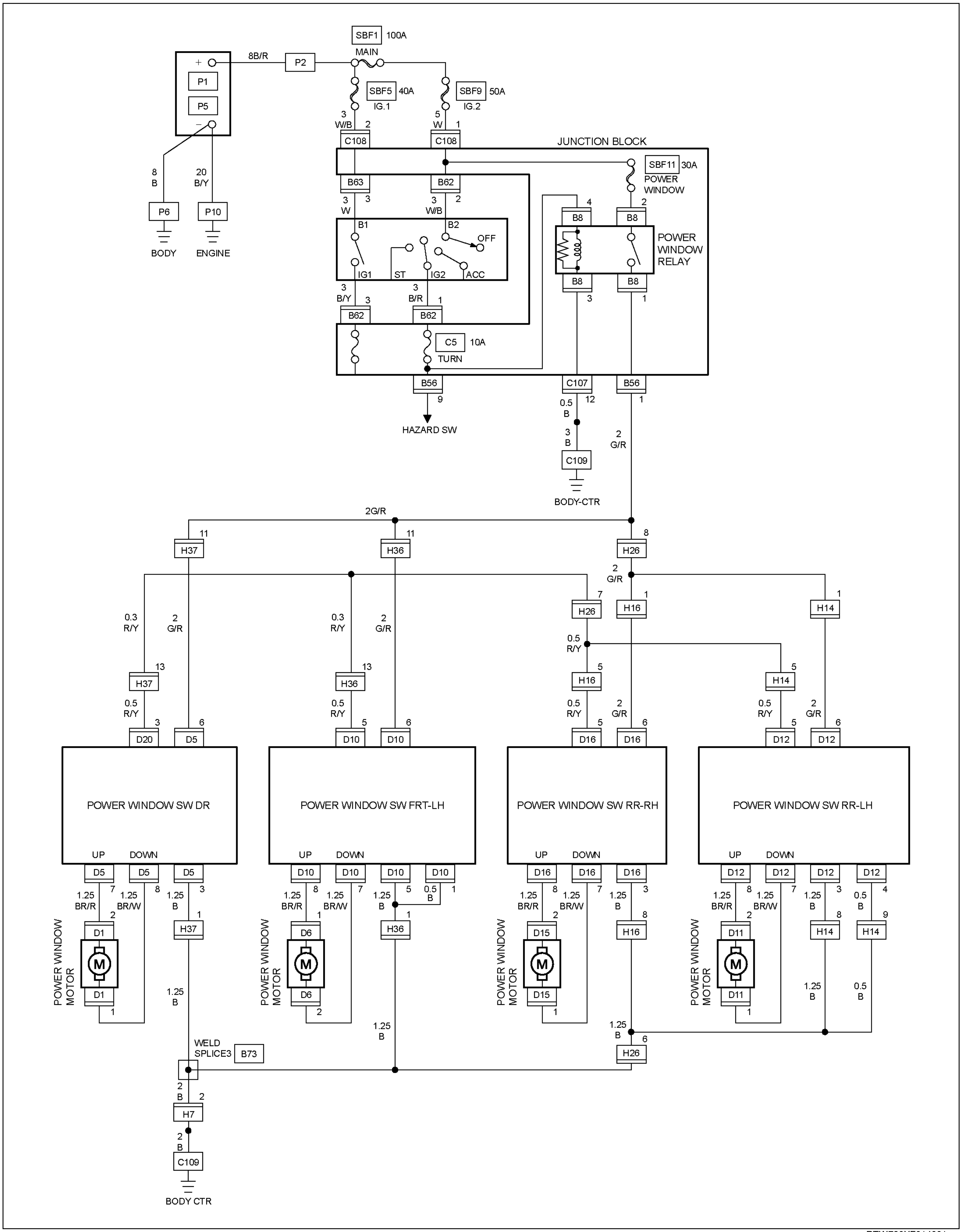
CIRCUIT DIAGRAM 4JA1T (L)

Sheet 2/2



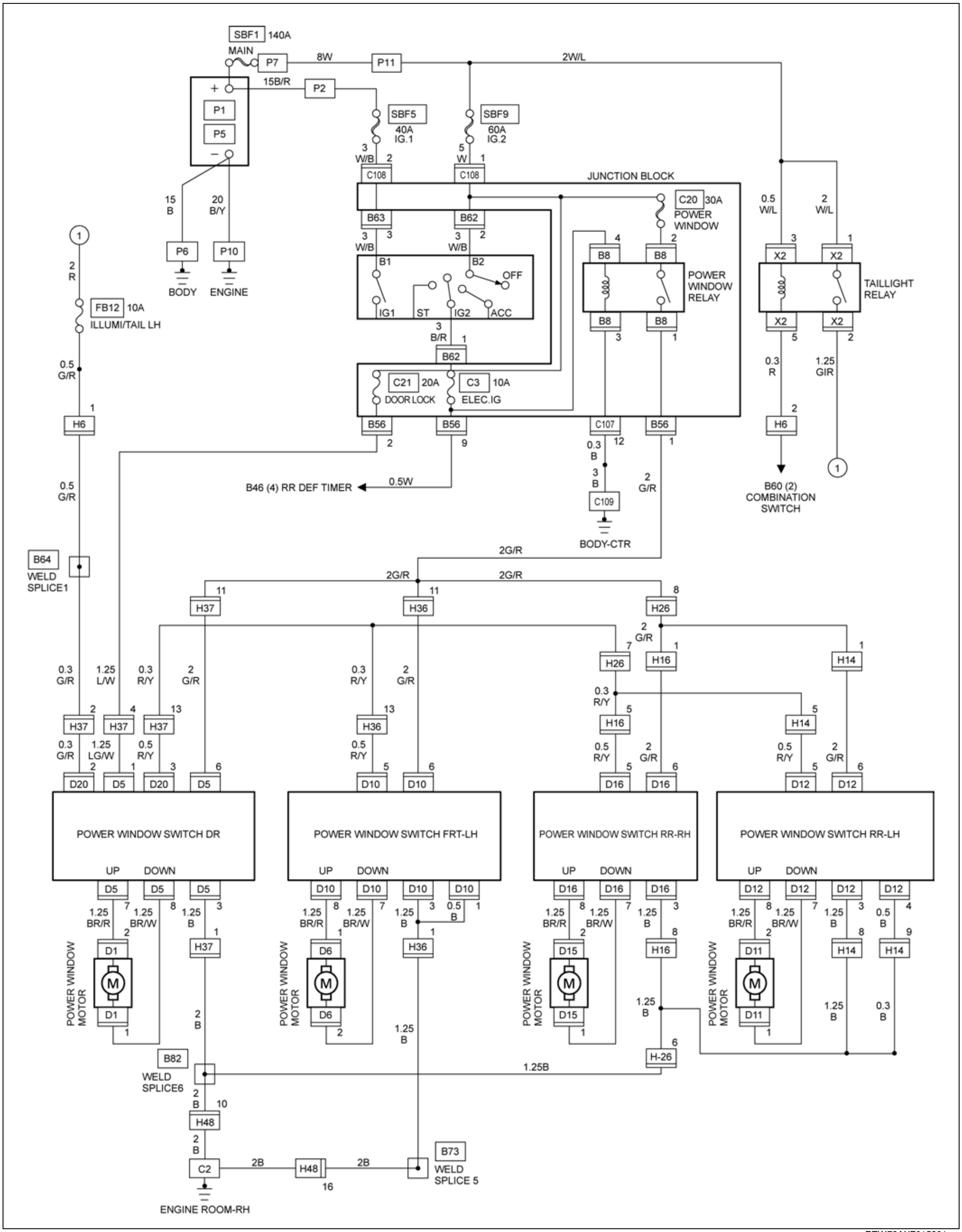
RTW78AXF010101

CIRCUIT DIAGRAM C24SE (LHD)



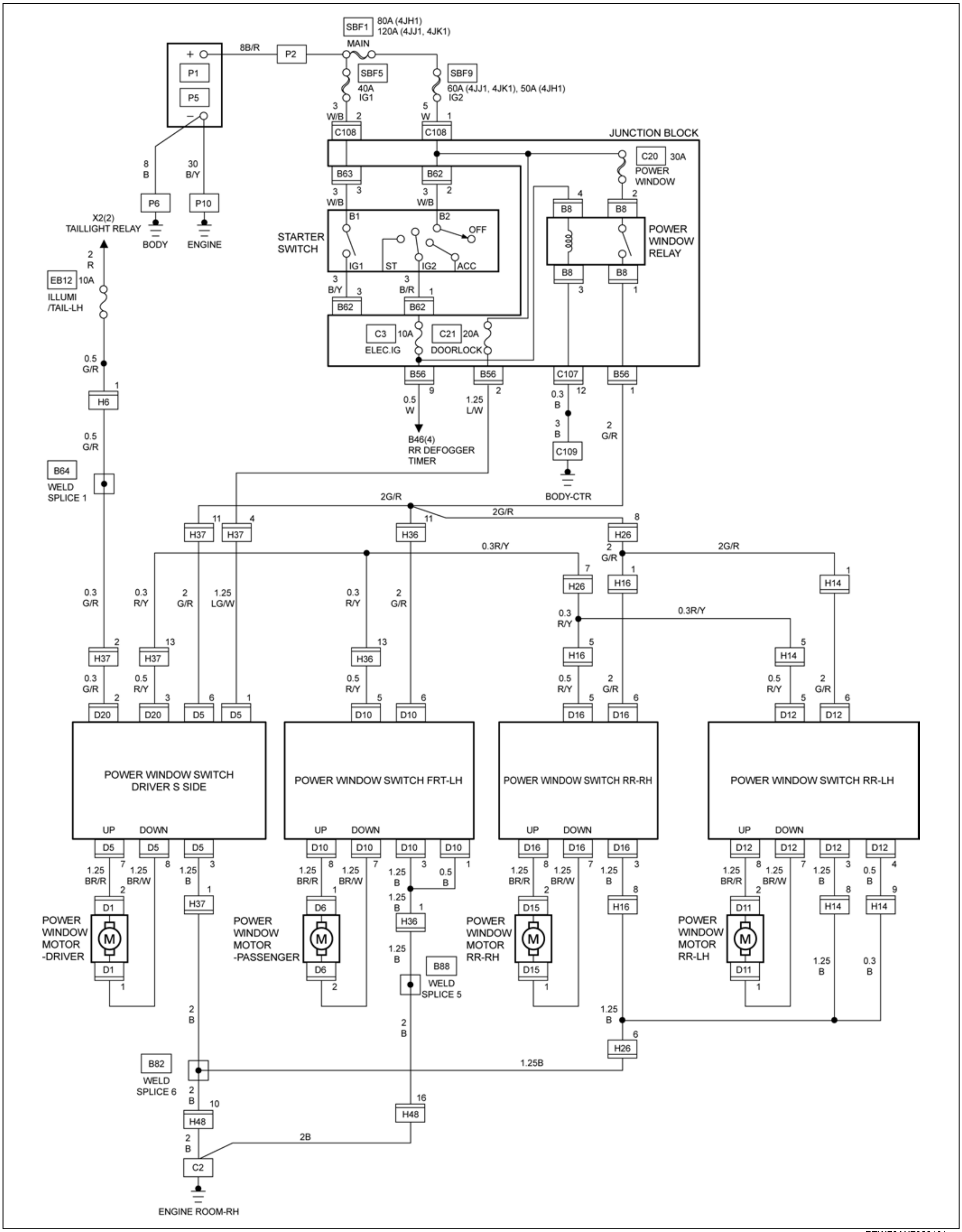
RTW780XF014001

CIRCUIT DIAGRAM HFV6 (LHD)



RTW78AXF015301

CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC 4JH1-TC G.EXP



RTW78AXF028101

TROUBLESHOOTING

QUICK CHART FOR CHECK POINTS

Trouble Mode	Check Points											
	C20	SBF9	Relay; Power Window	Power Window & Door Lock Switch	Power Window Switch			Power Window Motor				Cable Harness
				Driver's Side	Passenger's Side	RR-LH	RR-RH	Driver's Side	Passenger's Side	RR-LH	RR-RH	
All windows will not operate	○	○	○	○								○
Lock SW does not function				○								
Driver's Window:												
Window does not operate	○	○	○	○				○				○
One-touch operation for "DOWN" movement will not operate				○								
Window operates in only one direction				○								
Front window on passenger seat side:												
Window does not operate				○	○				○			○
Window does not operate when operating the driver's SW				○								
Window does not operate when operating the passenger's SW				○	○							○
Window does operate in only one direction when operating the driver's SW				○	○							
Window does operate in only one direction when operating the passenger's seat side SW					○							
Rear window on left (or right) side:												
Window on left (or right) side does not operate				○		○	○			○	○	○
Window does not operate when operating the driver's SW				○								
Window does operate in only one direction when operating the driver's SW				○								
Window does operate in only one direction when operating the RR-LH (or RH) side SW						○	○					○

1. All windows do not operate

Checkpoint		Trouble Cause	Countermeasure
Fuse C20 (30A, Fuse box)	NG	Poor fuse contact or blown	Reinstall or replace the fuse C20 (30A)
OK			
C20 (50A or 60A Fuse box) function	NG	Circuit breaker malfunction	Replace the circuit breaker C20 (50A or 60A)
OK			
Grounding points C2	NG	Poor grounding point contact	Repair grounding points contact
OK			
Power window relay function	NG	Power window relay malfunction	Replace the power window relay
OK			
Voltage between the power window relay harness side connector terminal 2 B8 and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair an open circuit or a poor connection of the connectors between 1 C108 and 2 B8
OK			
Voltage between 6 D5 and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair an open circuit or a poor connection of the connectors between 1 B8 and 1 B56 and 6 D5
OK			
Voltage between 3 D5 or 3 B8 and the ground	NG	Open circuit or poor connector contact	Repair an open circuit or a poor connection of the connectors between 3 D5 and C2, or 3 B8 (12 C107) and C109

Continued on the next page

Continued from the previous page

Checkpoint	Result	Trouble Cause	Countermeasure
(OK) Driver seat side power window & door lock SW. function	NG	SW. malfunction	Replace the driver seat side power window & door lock SW.

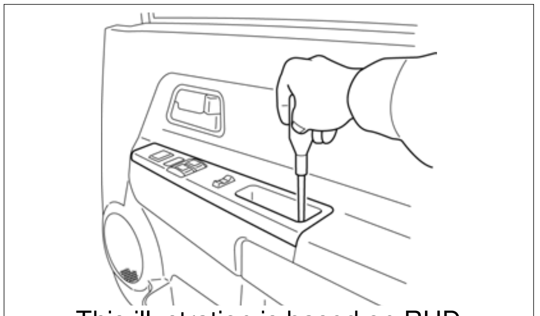
2. Lock switch does not function

Checkpoint	Result	Trouble Cause	Countermeasure
Driver seat side power window & door lock SW. function	NG	SW. malfunction	Replace the driver seat side power window & door lock SW.

3. Window on the driver's side does not operate

Checkpoint	Result	Trouble Cause	Countermeasure
Driver seat side power window & door lock SW. function	NG	SW. malfunction	Replace the driver seat side power window & door lock SW.
OK ↓			
1. Driver seat side power window motor function when connection the motor connector 1 D1 to the battery (+) terminal, and 2 D1 to the (-) terminal (Should the motor rotate in the "UP" direction of the window) 2. Driver seat side power window motor function when connecting the motor connector 2 D1 to the battery (+) terminal, and 1 D1 to the (-) terminal (Should the motor rotate in the "DOWN" direction of the window)	NG	Motor malfunction	Replace the driver seat side power window motor
OK ↓			
Continuity between 7 D5 and 1 D1, or 8 D5 and 2 D1	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

REMOVAL AND INSTALLATION


This illustration is based on RHD
RTW780SH002601

DRIVER'S SIDE POWER WINDOW & DOOR LOCK SWITCH (2 DOOR MODELS)

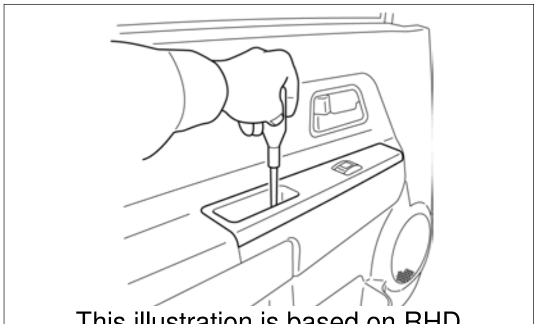
Removal

1. Disconnect the battery ground cable.
2. Remove the screw in the pull cup with the tip of a screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front in the bezel.
It follows the front with the screwdriver.
The clip has broken when lifting from the rear in the bezel.

Installation

To install, follow the removal steps in the reverse order.


This illustration is based on RHD
RTW780SH002701

FRONT PASSENGER'S POWER WINDOW SWITCH (2 DOOR MODELS)

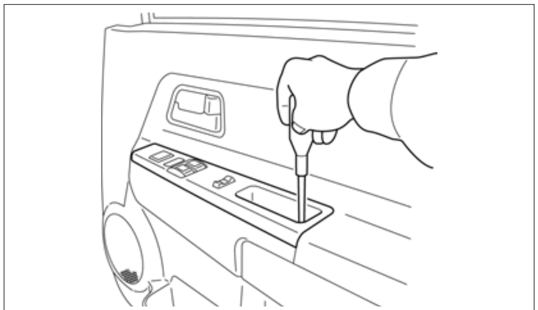
Removal

1. Disconnect the battery ground cable.
2. Removes the screw in the pull cup with the tip of a screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front in the bezel.
It follows the front with the screwdriver.
The clip has broken when lifting from the rear in the bezel.

Installation

To install, follow the removal steps in the reverse order.



This illustration is based on RHD

RTW780SH002601

DRIVER'S SIDE POWER WINDOW & DOOR LOCK SWITCH (4 DOOR MODELS)

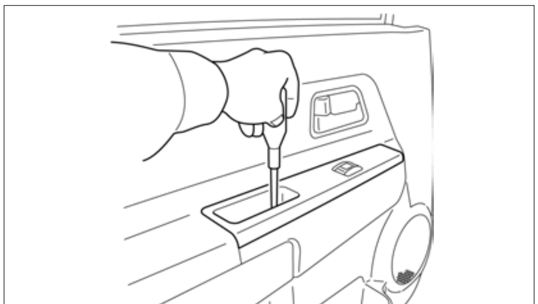
Removal

1. Disconnect the battery ground cable.
2. Removes the screw in pull cup with the tip of a screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front in the bezel.
It follows the front with the screwdriver.
The clip has broken when lifting from the rear in the bezel.

Installation

To install, follow the removal steps in the reverse order.



This illustration is based on RHD

RTW780SH002701

FRONT PASSENGER'S POWER WINDOW SWITCH (4 DOOR MODELS)

Removal

1. Disconnect the battery ground cable.
2. Removes the screw in pull cup with the tip of a screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front in the bezel.
It follows the front with the screwdriver.
The clip has broken when lifting from the rear in the bezel.

Installation

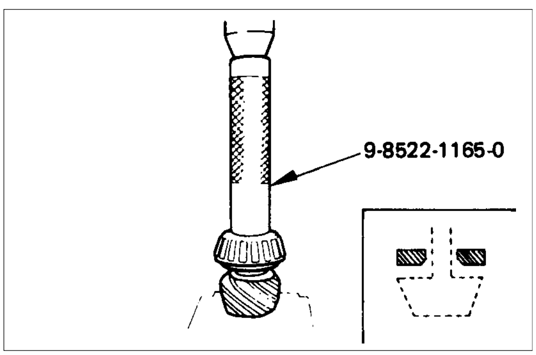
To install, follow the removal steps in the reverse order.

(7) Select the shim using the chart;

mm(in)

Pinion marking / Dial indicator reading (inches)	+10	+8	+6	+4	+2	0	-2	-4	-6	-8	-10
0.081											2.18 (0.0858)
0.082										2.18 (0.0858)	2.20 (0.0866)
0.083									2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)
0.084								2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)
0.085							2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)
0.086						2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)
0.087					2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)
0.088				2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)
0.089			2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)
0.090		2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)
0.091	2.18 (0.0858)	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)
0.092	2.20 (0.0866)	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)
0.093	2.24 (0.0882)	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)
0.094	2.26 (0.0890)	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)
0.095	2.28 (0.0898)	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)
0.096	2.32 (0.0913)	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)
0.097	2.34 (0.0921)	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)	
0.098	2.36 (0.0929)	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)		
0.099	2.38 (0.0937)	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)			
0	2.42 (0.0953)	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)				
0.001	2.44 (0.0961)	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)					
0.002	2.46 (0.0969)	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)						
0.003	2.48 (0.0976)	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)							
0.004	2.52 (0.0992)	2.54 (0.1000)	2.56 (0.1008)								
0.005	2.54 (0.1000)	2.56 (0.1008)									
0.006	2.56 (0.1008)										

Note :
When ordering shims, find the part number in the Parts Catalog by using the thickness of the shims listed in the above table.



5. Inner Bearing

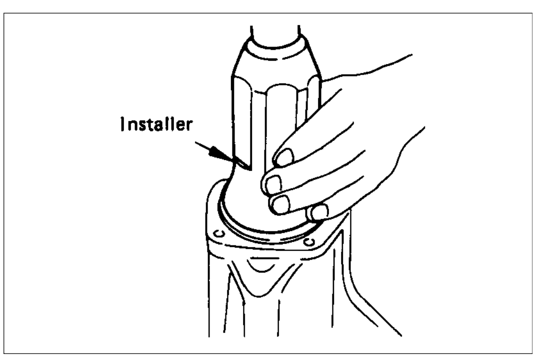
Place the shim on the drive pinion, with the chamfered side turned towards the pinion head then install the inner bearing on to the pinion using an installer and a press.

Installer : 9-8522-1165-0

Note:
Do not apply pressure to the roller cage.
Apply pressure only to the inner race.

6. Collapsible Spacer

Discard the used collapsible spacer and install a new one.

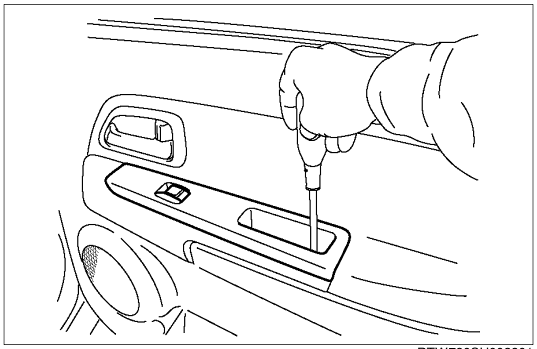


9. Oil Seal

Use oil seal installer to install a new oil seal that has been soaked in rear axle lubricant.

Installer : 9-8522-1275-0

Note :
Take care not to use a rear differential oil seal instead of the front differential oil seal.



RTW780SH002801

REAR POWER WINDOW & DOOR LOCK SWITCH-LH & RH

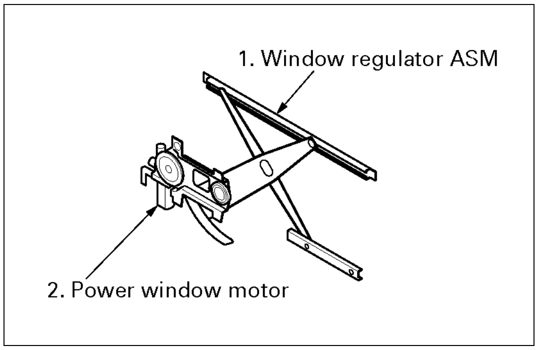
Removal

1. Disconnect the battery ground cable.
2. Remove the screw in the pull cup with the tip of a screwdriver.
3. Remove the switch bezel by pushing the spring with the tip of a screwdriver.
4. Disconnect the connector.

ATTENTION:
When removing a switch bezel lift from the front in the bezel.
It follows the front with the screwdriver.
The clip has broken when lifting from the rear in the bezel.

Installation

To install, follow the removal steps in the reverse order.



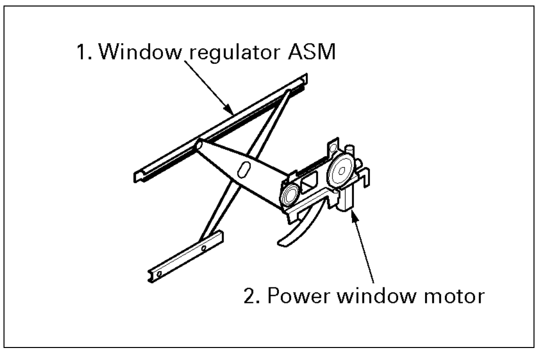
DRIVER'S SIDE POWER WINDOW MOTOR

Removal

1. **Window Regulator ASM**
   - Refer to the removal steps of the WINDOW REGULATOR/POWER WINDOW MOTOR in Section 10 "BODY".
2. **Power Window Motor**
   - Loosen the fixing bolts to remove the power window motor from the regulator.

Installation

To install, follow the removal steps in the reverse order.



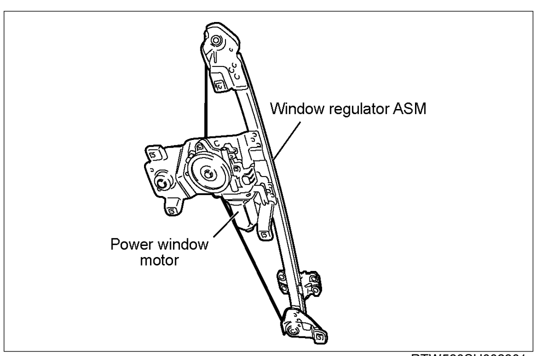
FRONT PASSENGER'S POWER WINDOW MOTOR

Removal

1. Window Regulator ASM
   - Refer to the removal steps of the WINDOW REGULATOR/POWER WINDOW MOTOR in Section 10 "BODY".
2. Power Window Motor
   - Loosen the fixing bolts to remove the power window motor from the regulator.

Installation

To install, follow the removal steps in the reverse order.



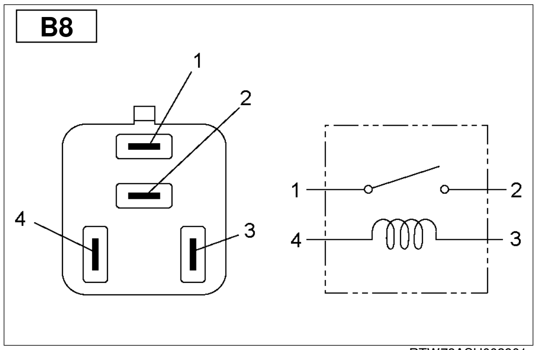
RTW580SH002901

REAR POWER WINDOW MOTOR-LH & RH

Removal and Installation

Refer to the "DRIVER'S SIDE POWER WINDOW MOTOR" removal and installation steps in this section.

INSPECTION AND REPAIR

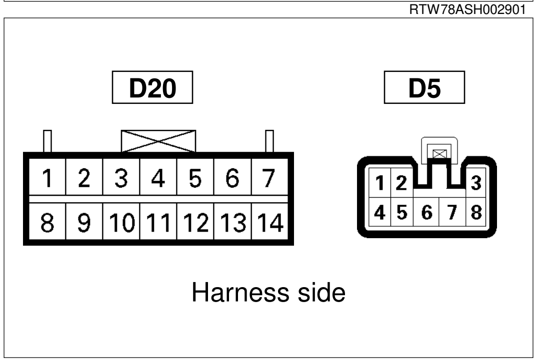


RTW78ASH002901

Power Window Relay

Check continuity between the relay terminals.

②- ① .... No continuity	
(When battery voltage is applied between ③ and ④)	
②- ① .... Continuity	

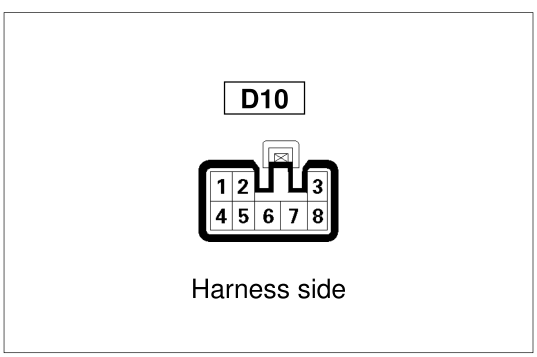


Driver's Side Power Window & Door Lock Switch

1. Harness Side Connector Circuit

Disconnect the switch connector, and check voltage and continuity between the harness side connector terminals as shown in the following table.

Terminal No.	Wire color	Connecting to	Check item	Connectin g terminal	Check condition	Standard
6	G/R	Power window relay	Voltage	6-Ground	Starter SW "ON"	Approx. 12V
7	BR/R	Power window motor	Continuity	7-8	-	Continuity
8	BR/W					
3	B	Ground	Continuity	3-Ground	-	Continuity

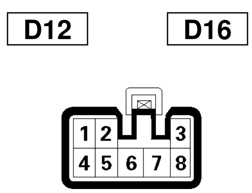


Front Passenger's Power Window Switch

1. Harness Side Connector Circuit

Disconnect the switch connector, and check voltage and continuity between the harness side connector terminals as shown in the following table.

Terminal No.	Wire color	Connecting to	Check item	Connecting terminal	Check condition	Standard
6	G/R	Power window relay	Voltage	6-Ground	Starter SW "ON"	Approx. 12V
8	BR/R	Power window motor	Continuity	8-7	-	Continuity
7	BR/W					
1,3	B	Ground	Continuity	1,3-Ground	-	Continuity

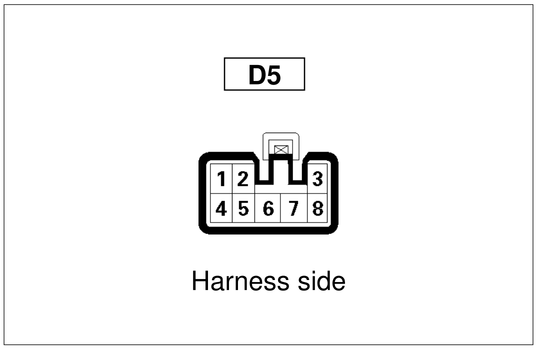


Harness side

Rear Power Window Switch-LH & RH

1. **Harness Side Connector Circuit**
   Disconnect the switch connector, and check voltage and continuity between the harness side connector terminals as shown in the following tables.

D12 (RR-LH)						
Terminal No.	Wire color	Connecting to	Check item	Connecting terminal	Check condition	Standard
6	G/R	Power window relay	Voltage	6-Ground	Starter SW "ON"	Approx. 12V
8	BR/R	Power window motor	Continuity	8-7	-	Continuity
7	BR/W					
3	B	Ground	Continuity	3,4-Ground	-	Continuity
4	B					
D16 (RR-RH)						
Terminal No.	Wire color	Connecting to	Check item	Connecting terminal	Check condition	Standard
6	G/R	Power window relay	Voltage	6-Ground	Starter SW "ON"	Approx. 12V
8	BR/R	Power window motor	Continuity	8-7	-	Continuity
7	BR/W					
3	B	Ground	Continuity	3-Ground	-	Continuity

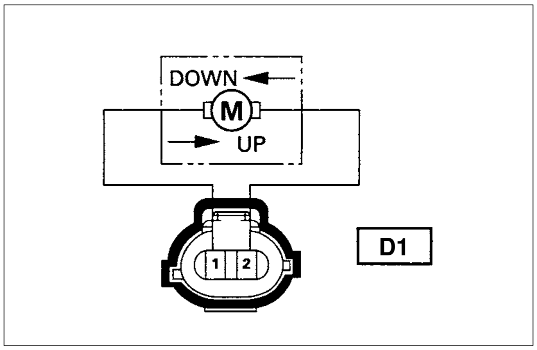


Driver's Side Power Window Motor

1. **Driver's Side Power Window & Door Lock Switch Connector Circuit**

   Disconnect the switch connector, apply the battery voltage (12V) to the harness side connector terminals and check operation.

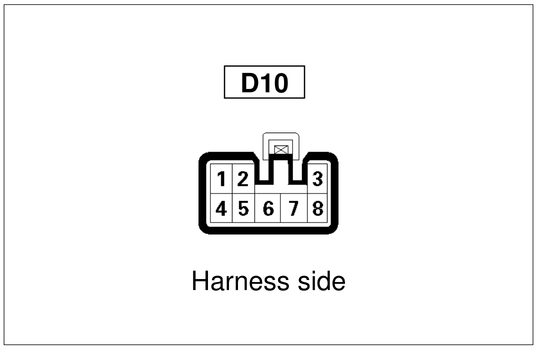
Connecting terminals		Operation direction
7 (BR/R)	8 (BR/W)	
⊖	⊕	DOWN
⊕	⊖	UP



2. **Driver's Side Power Window Motor Connector Circuit**

   Disconnect the switch connector, apply the battery voltage (12V) to the motor side connector terminals and check operation.

Connecting terminals		Operation direction
1	2	
⊕	⊖	DOWN
⊖	⊕	UP

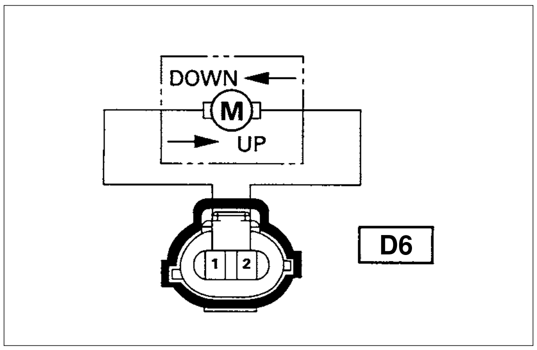


Front Passenger's Power Window Motor

1. Front Passenger's Power Window Switch Connector Circuit

Disconnect the motor connector, apply the battery voltage (12V) to the harness side connector terminals and check operation.

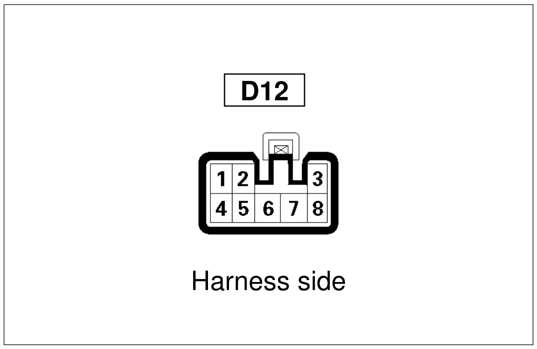
Connecting terminals		Operation direction
8 (BR/R)	7 (BR/W)	
⊝	⊕	DOWN
⊕	⊝	UP



2. Front Passenger's Power Window Motor Connector Circuit

Disconnect the switch connector, apply the battery voltage (12V) to the motor side connector terminals and check operation.

Connecting terminals		Operation direction
1	2	
⊕	⊝	DOWN
⊝	⊕	UP

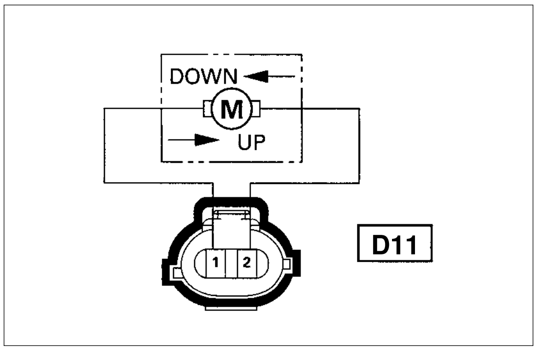


Rear Passenger's Power Window Motor-LH

1. Rear Power Window Switch-LH Connector Circuit

Disconnect the motor connector, apply the battery voltage (12V) to the harness side connector terminals and check operation.

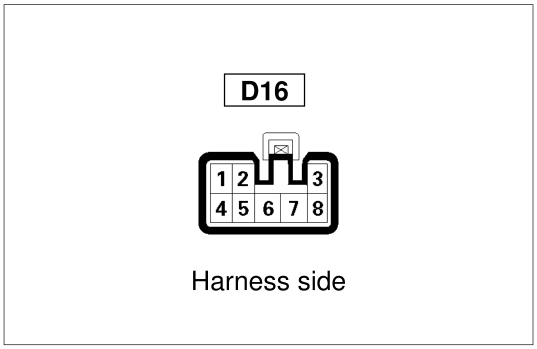
Connecting terminals		Operation direction
8 (BR/R)	7 (BR/W)	
⊖	⊕	DOWN
⊕	⊖	UP



2. Rear Power Window Motor-LH Connector Circuit

Disconnect the switch connector, apply the battery voltage (12V) to the motor side connector terminals and check operation.

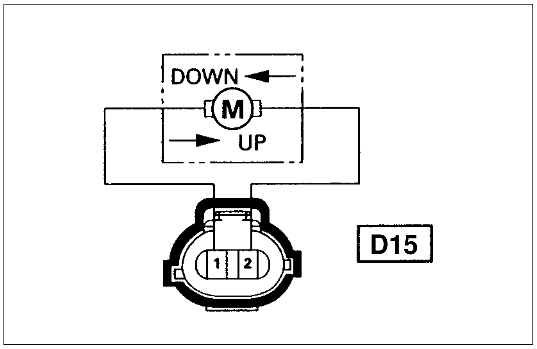
Connecting terminals		Operation direction
1	2	
⊕	⊖	DOWN
⊖	⊕	UP



Rear Power Window Motor-RH

1. **Rear Power Window Switch-RH Connector Circuit**
   Disconnect the motor connector, apply the battery voltage (12V) to the harness side connector terminals and check operation.

Connecting terminals		Operation direction
8 (BR/R)	7 (BR/W)	
⊖	⊕	DOWN
⊕	⊖	UP

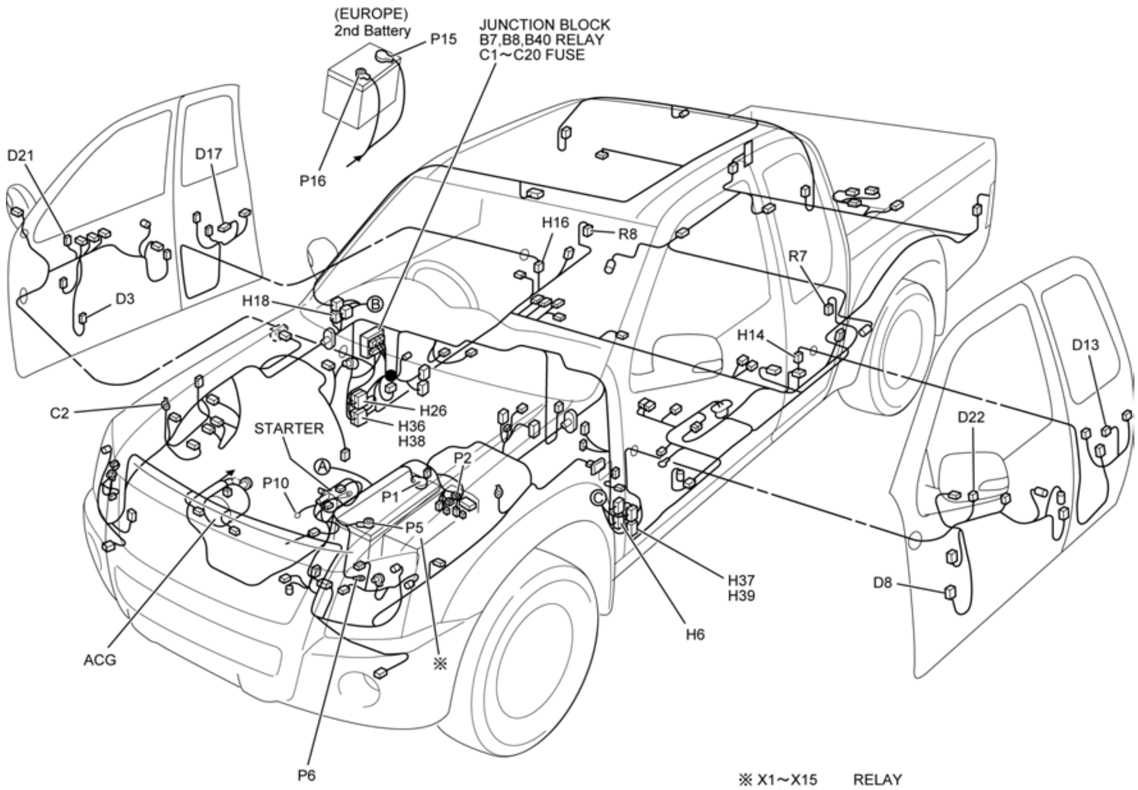


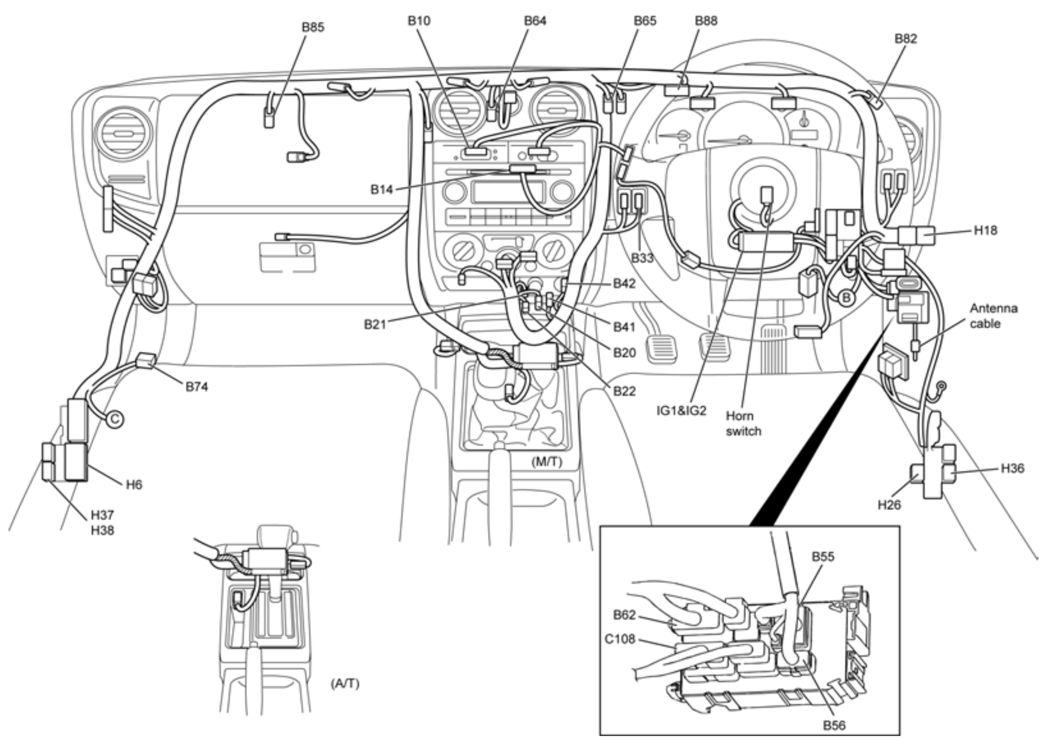
2. **Rear Power Window Motor-RH Connector Circuit**
   Disconnect the switch connector, apply the battery voltage (12V) to the motor side connector terminals and check operation.

Connecting terminals		Operation direction
1	2	
⊕	⊖	DOWN
⊖	⊕	UP

AUDIO, CLOCK AND CIGARETTE LIGHTER

PARTS LOCATION (RHD)





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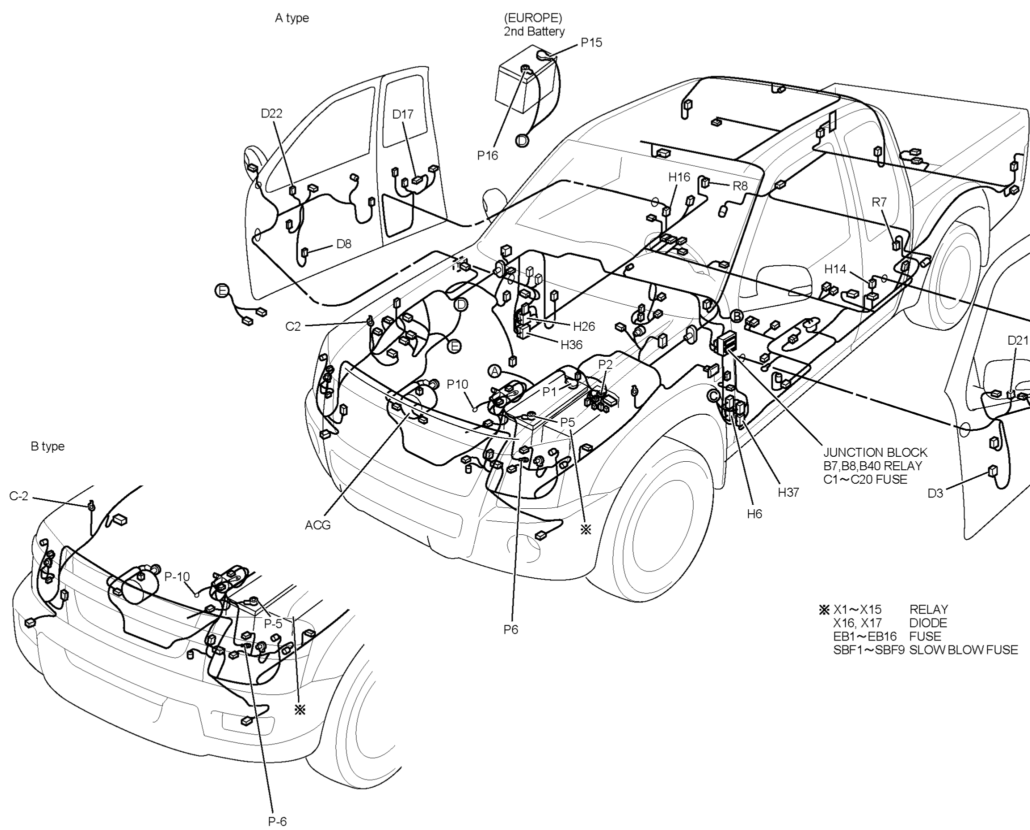
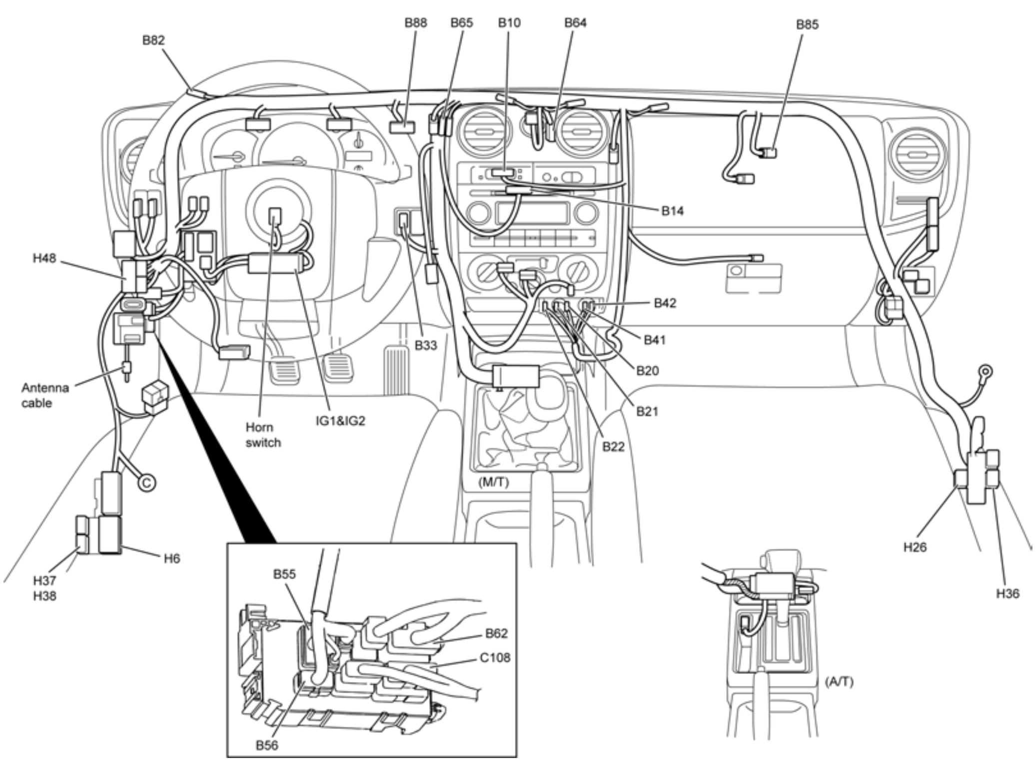
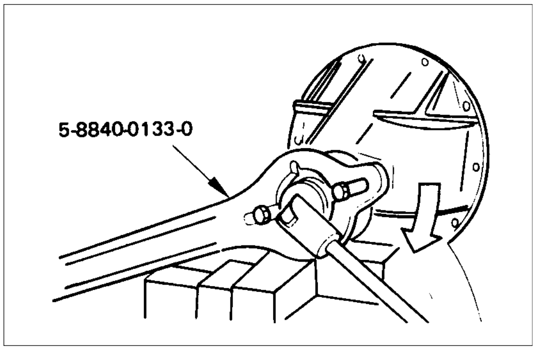
PARTS LOCATION (LHD)





RTW78AXF039801 & RTW78AXF046001

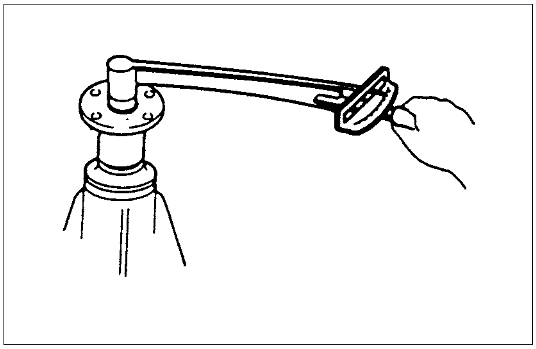


12. Flange Nut and Washer

(1) Apply lubricant to the pinion threads.
(2) Tighten the nut to the specified torque using the pinion flange holder.
Pinion flange holder : 5-8840-0133-0

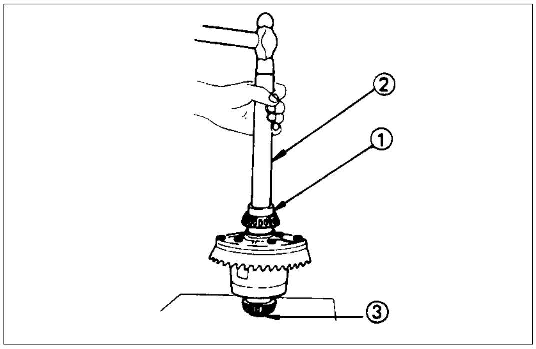
Torque	N·m (kgf·m/lb·ft)
177 - 275 (18 - 28/130 - 202)	

Discard used flange nut and install new one.



(3) Pinion bearing preload
(a) Measure the bearing preload by using a torque meter. Note the scale reading required to rotate the flange.
(b) continue tightening until the specified starting torque is obtained.

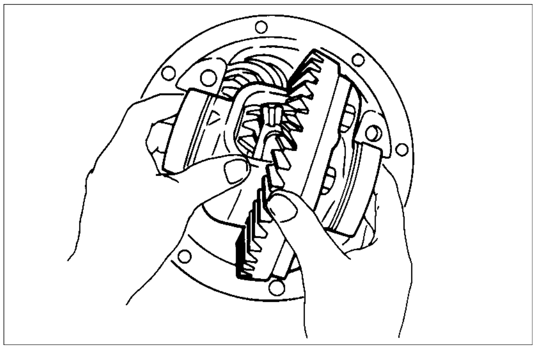
Starting Torque	N·m (kgf·m/lb·in)
0.63 - 1.13 (0.06 – 0.12/5 - 10)	



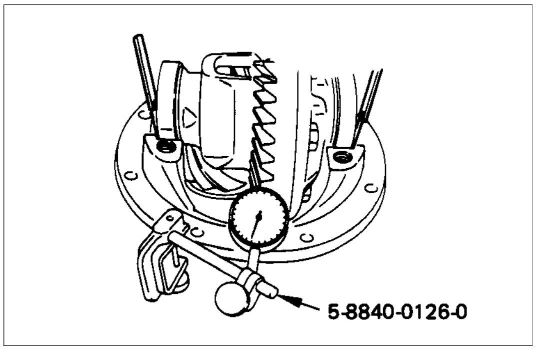
13. Adjust Shim

(1) Attach the side bearing to the differential assembly without shims. Support the opposite side using a pilot to prevent bearing damage.

① Installer : 9-8522-1164-0
② Drive handle : 5-8840-0007-0
③ Pilot : 9-8521-1743-0



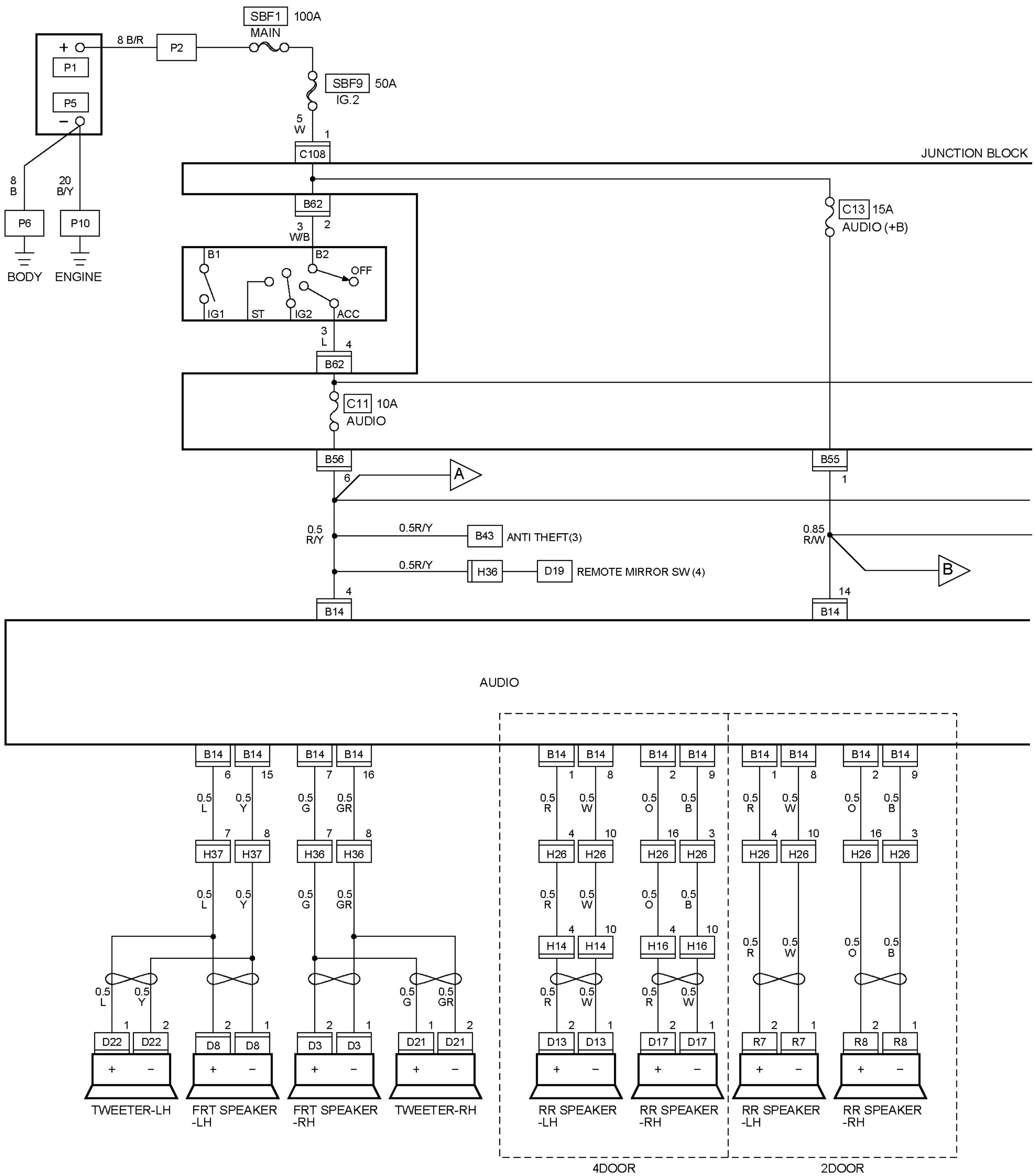
(2) Insert the differential cage assembly with bearing outer races into the side bearing bores of the carrier.



(3) Using two sets of feeler gauges, insert a feeler stock of sufficient thickness between each bearing outer race and the carrier to remove all end plat. Make certain the feeler stock is pushed to the bottom of the bearing bores.
Mount the dial indicator on the carrier so that the indicator stem is at right angles to a tooth on the ring gear.
Dial indicator : 5-8840-0126-0

CIRCUIT DIAGRAM C24SE (RHD)

Sheet 1/2



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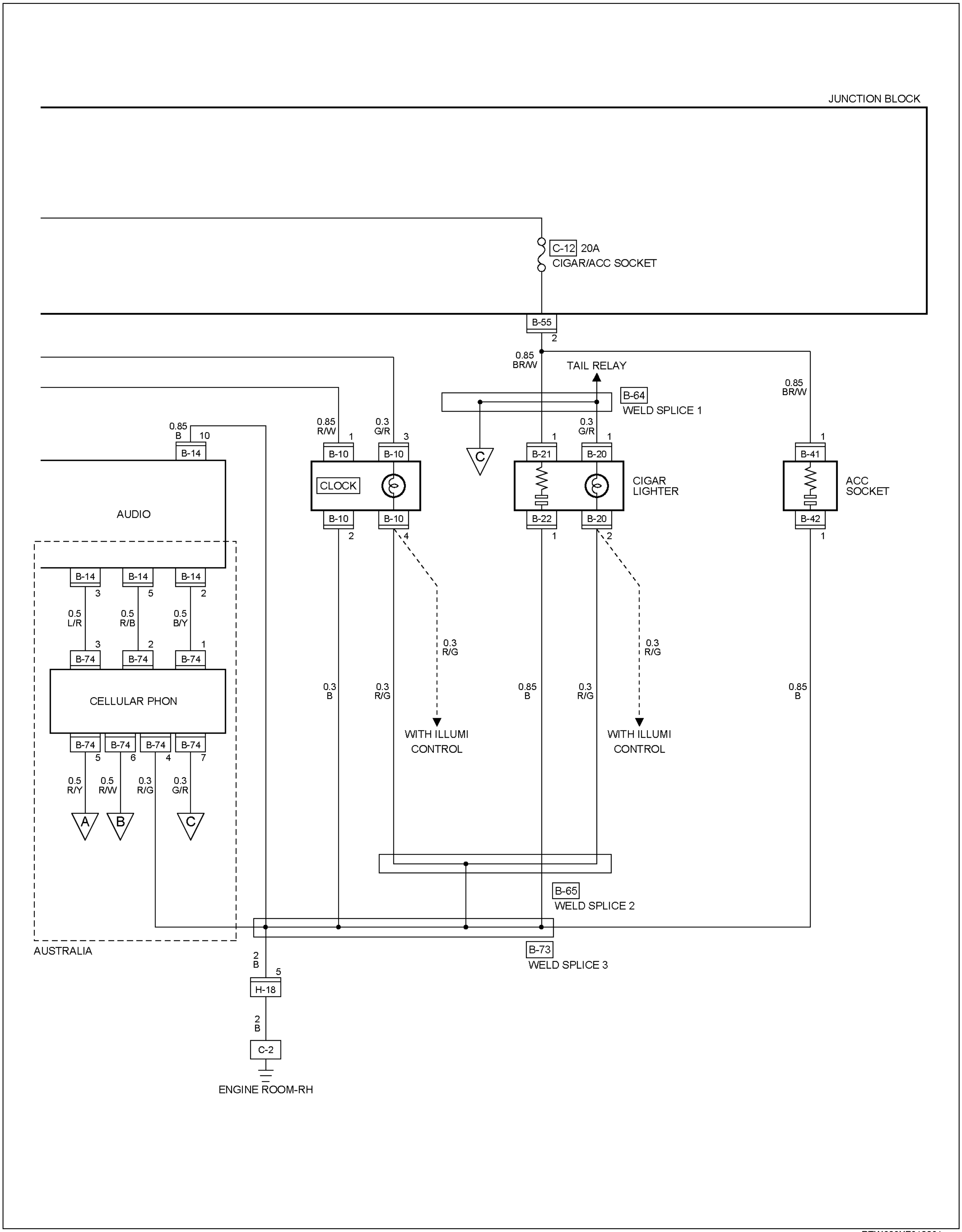
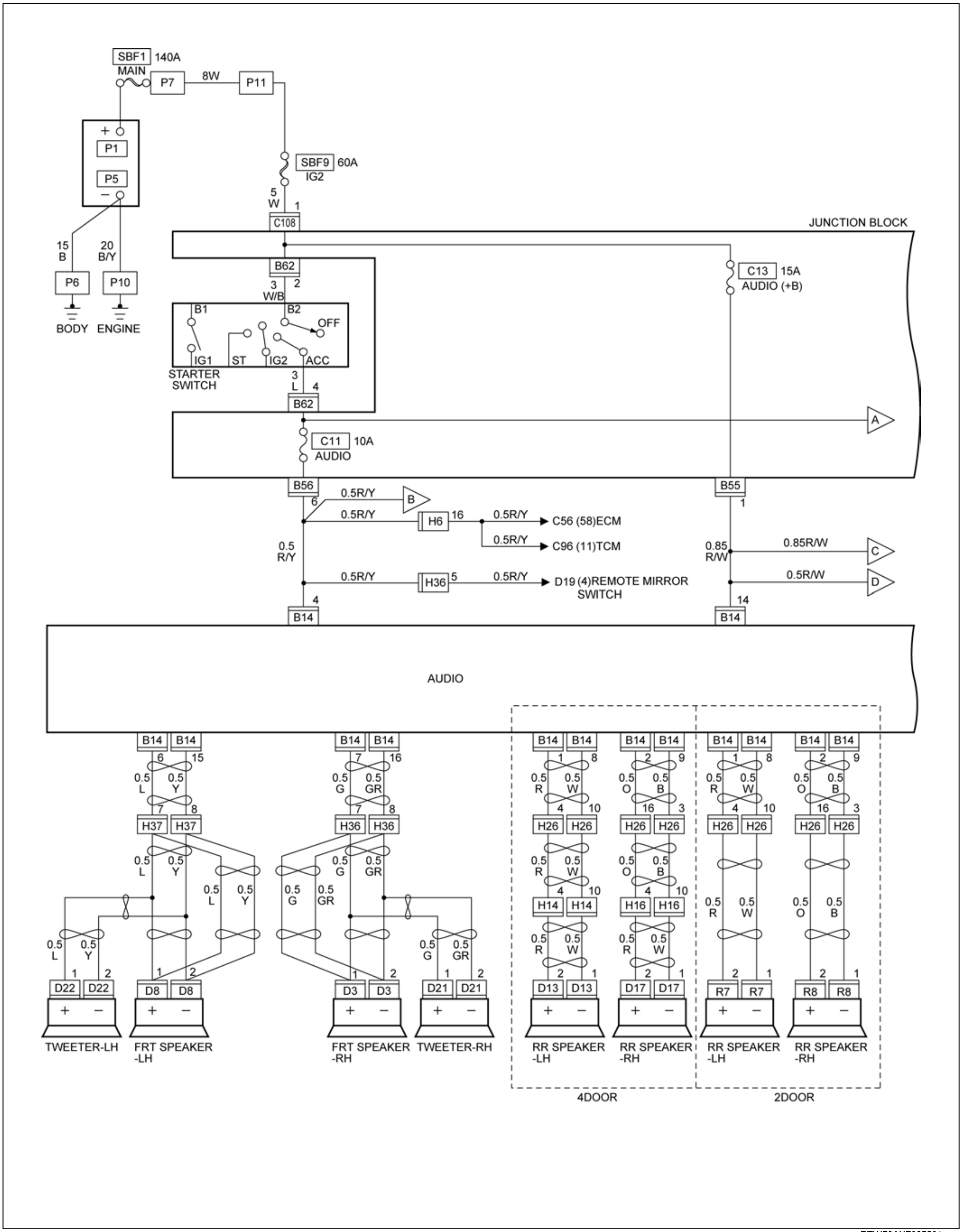
CIRCUIT DIAGRAM C24SE (RHD)

Sheet 2/2



CIRCUIT DIAGRAM HFV6 (RHD)

Sheet 1/2



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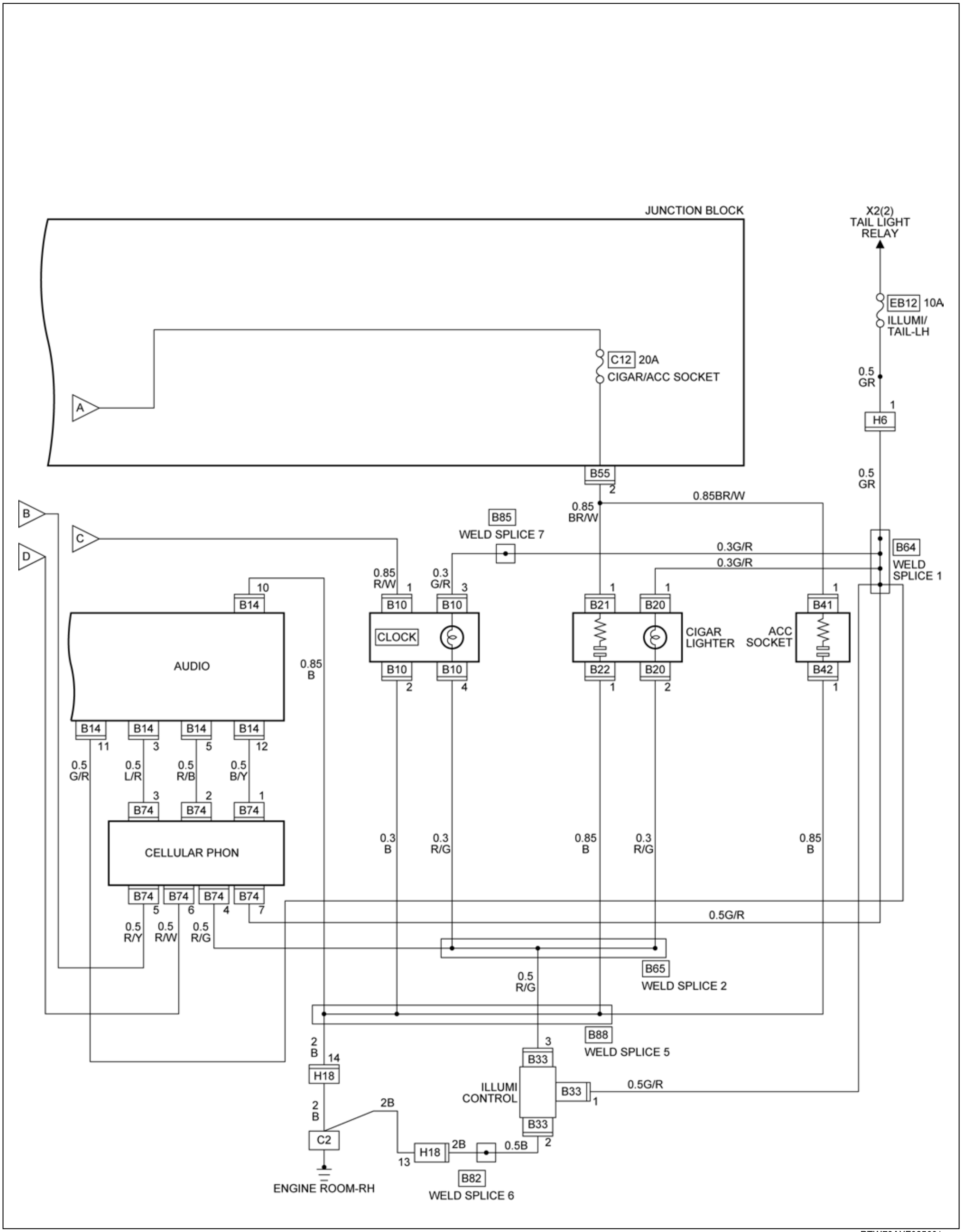
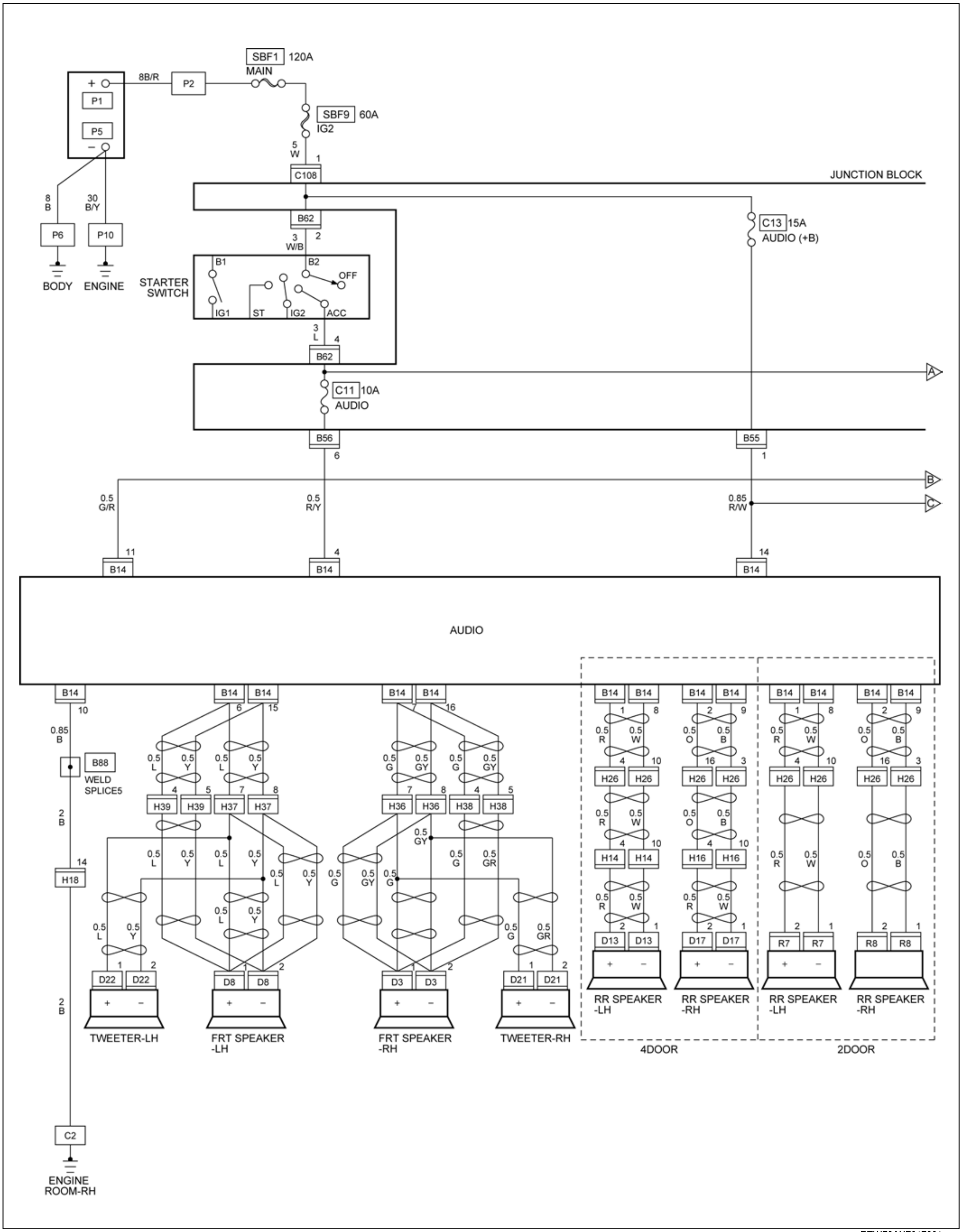
CIRCUIT DIAGRAM HFV6 (RHD)

Sheet 2/2



CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 1/2



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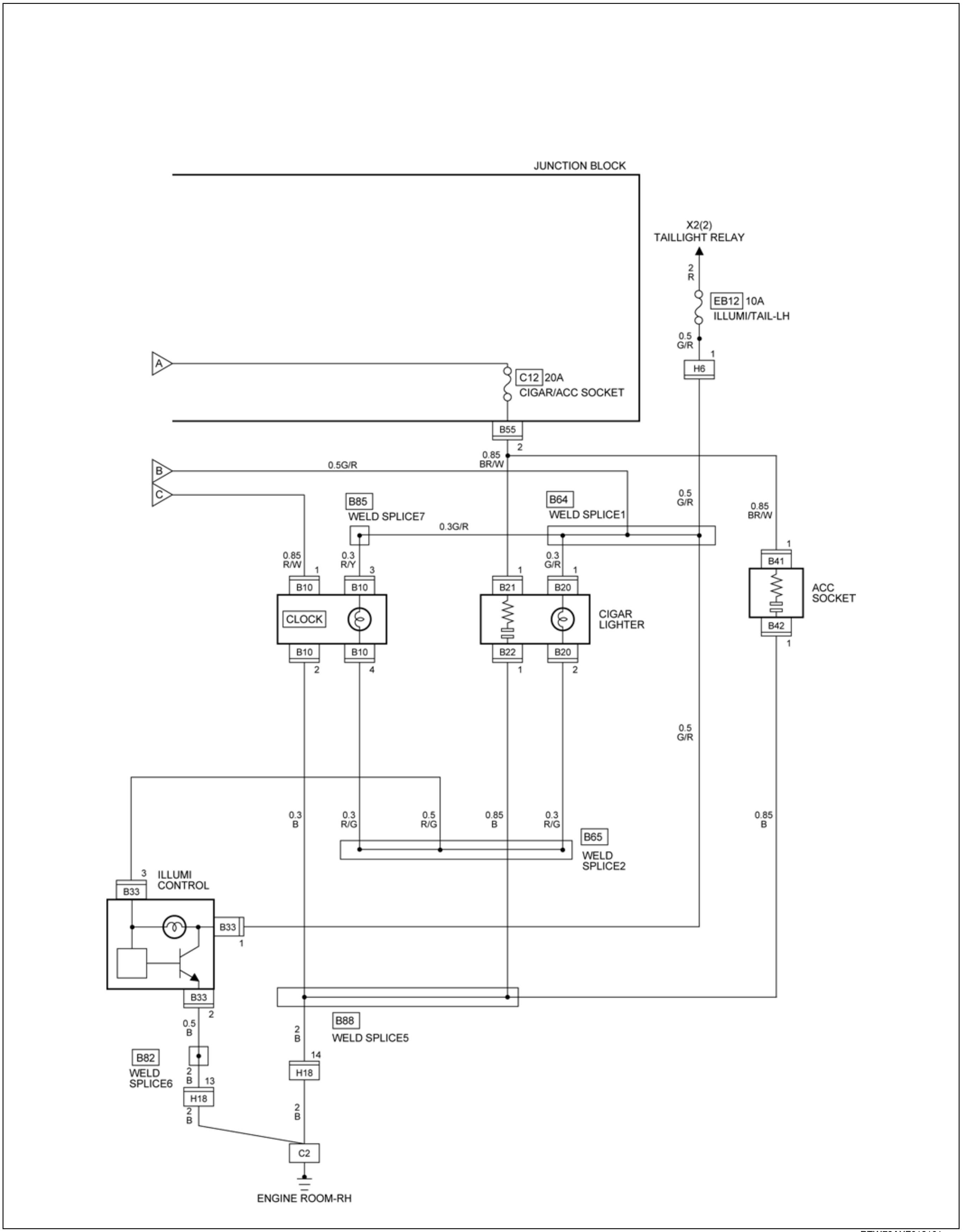
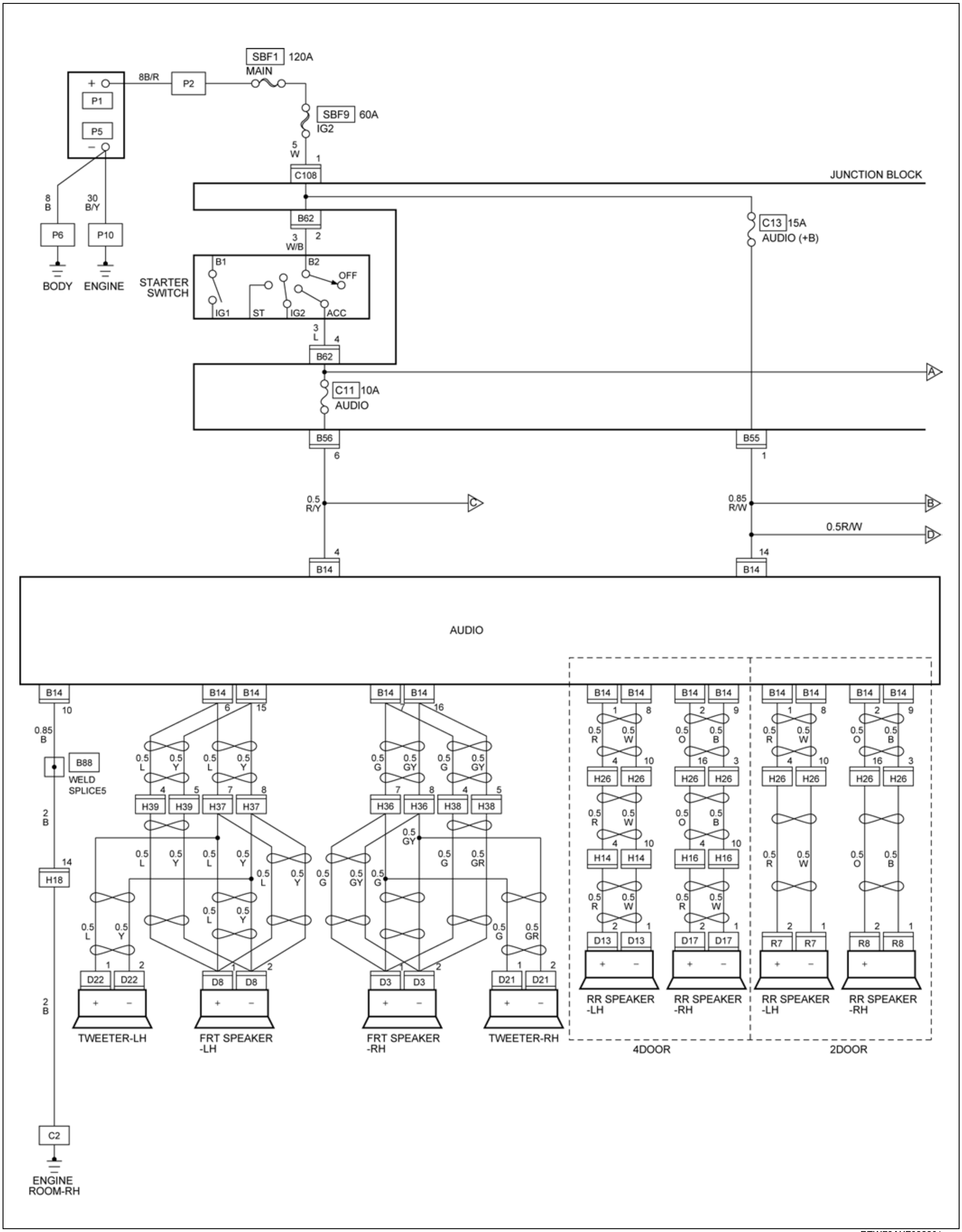
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) SOUTH AFRICA

Sheet 2/2



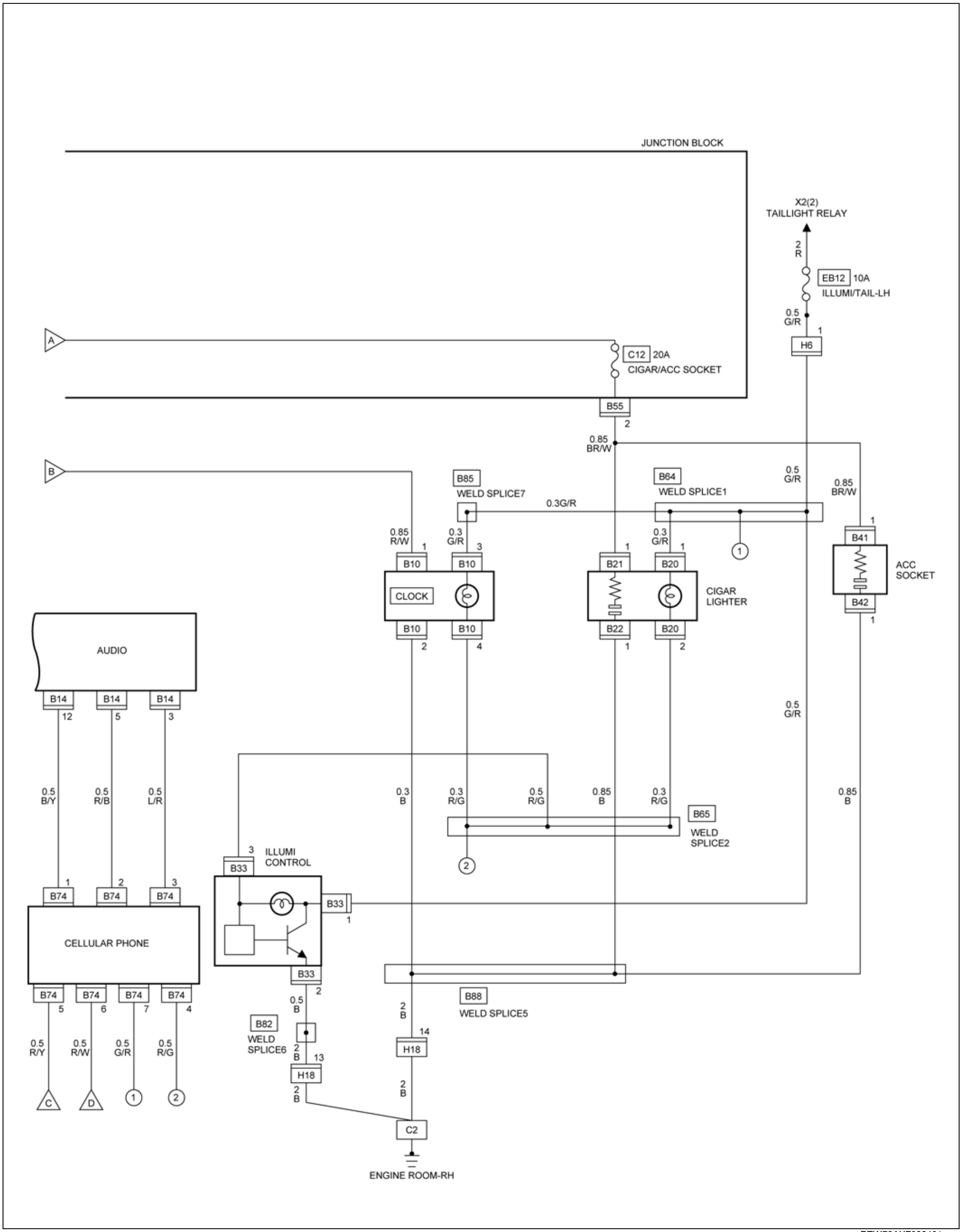
CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 1/2



CIRCUIT DIAGRAM 4JJ1-TC/4JK1-TC (RHD) EXCEPT SOUTH AFRICA

Sheet 2/2



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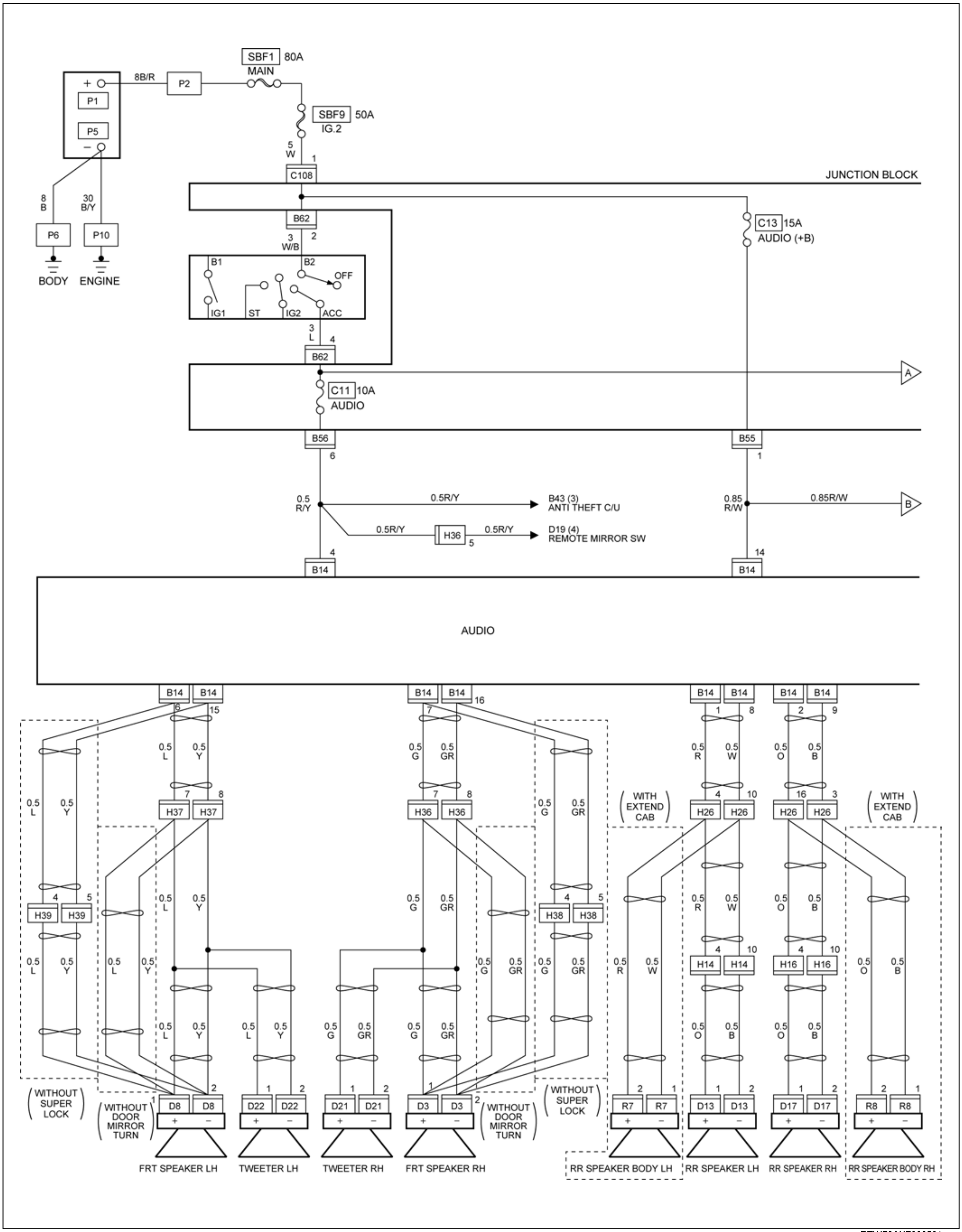
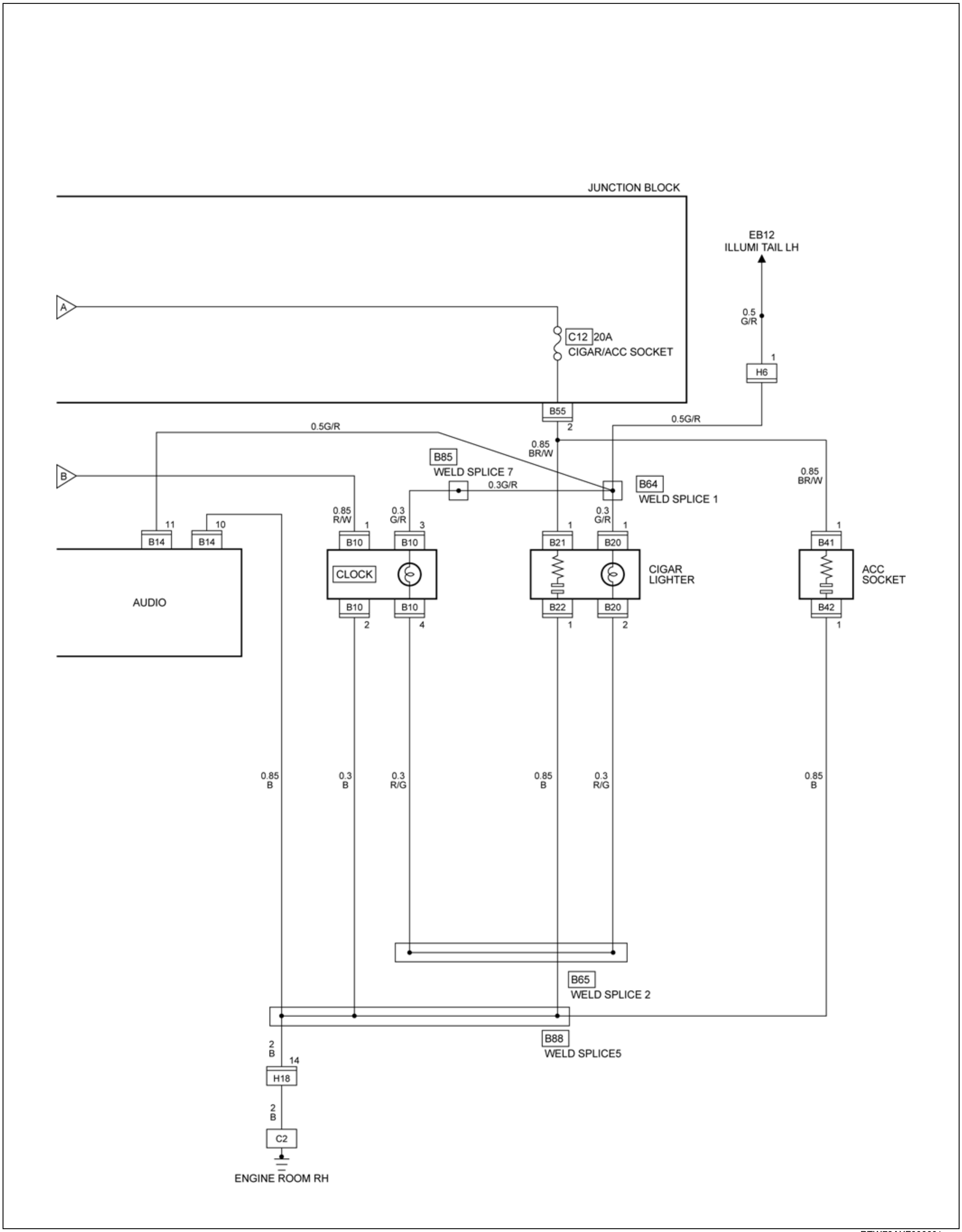
CIRCUIT DIAGRAM 4JA1T (L) (RHD)

Sheet 1/2



CIRCUIT DIAGRAM 4JA1T (L) (RHD)

Sheet 2/2



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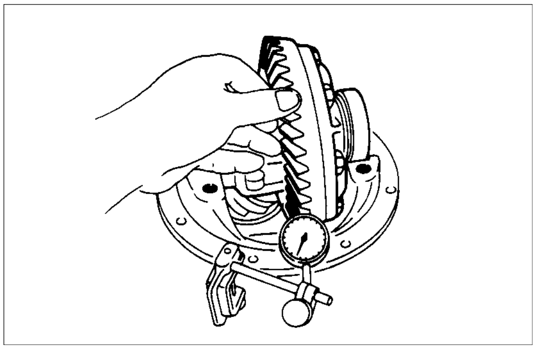
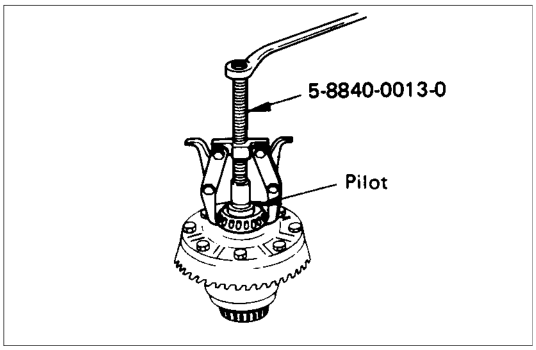


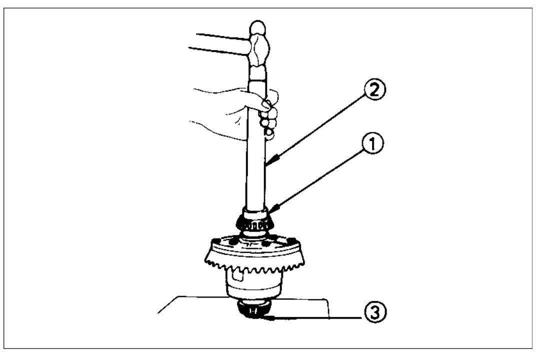
(4) Adjust feeler gauge thickness from side to side until ring gear backlash is in the specified range.

Backlash	mm(in)
0.13 - 0.18 (0.005 - 0.007)	

With zero end play and correct backlash established, remove the feeler gauge packs, determine the thickness of the shims required and add 0.05 mm (0.002 in) to each shim pack to provide side bearing preload. Always use new shims.

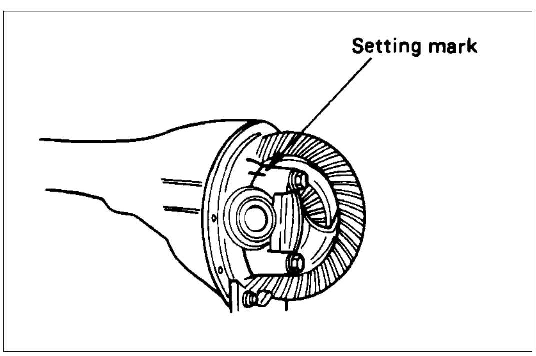


(5) Remove side bearing
Remover : 5-8840-0013-0
Pilot : 9-8521-1743-0



14.Side Bearing
Install the side bearings together with the selected shims.

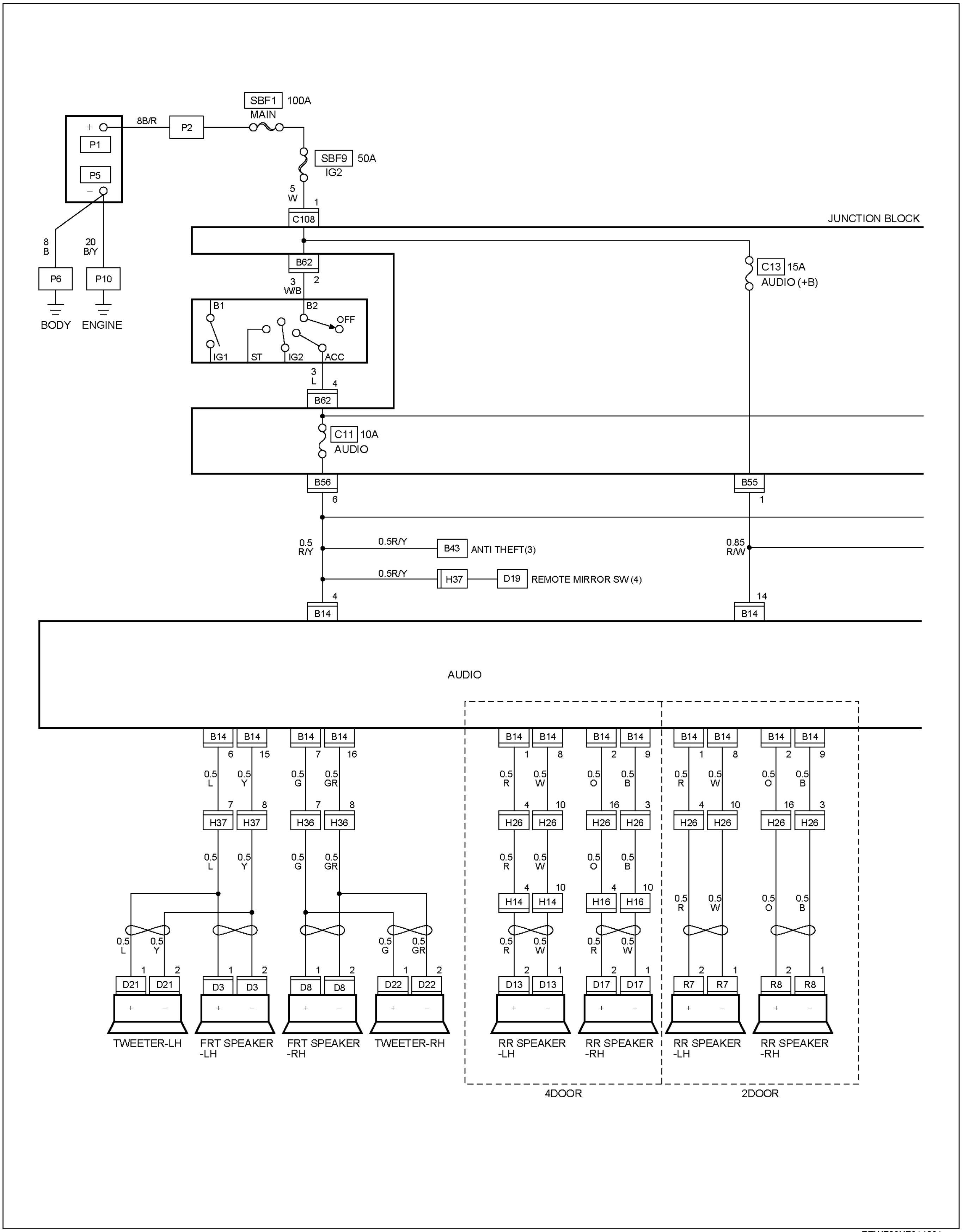
① Installer : 9-8522-1164-0
② Drive handle : 5-8840-0007-0
③ Pilot : 9-8521-1743-0



17.Bearing Cap
Align the setting marks applied at disassembly.

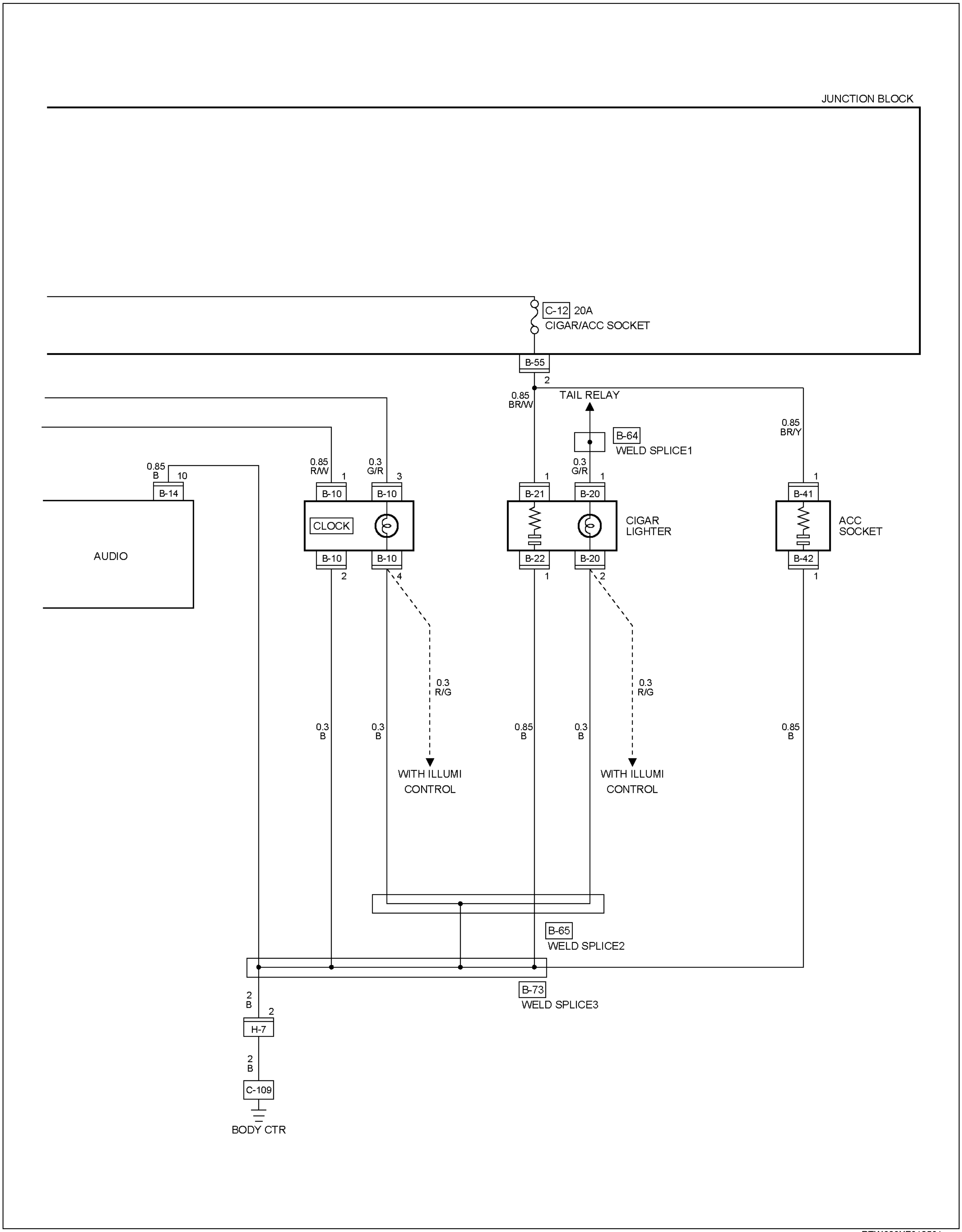
CIRCUIT DIAGRAM C24SE (LHD)

Sheet 1/2



CIRCUIT DIAGRAM C24SE (LHD)

Sheet 2/2



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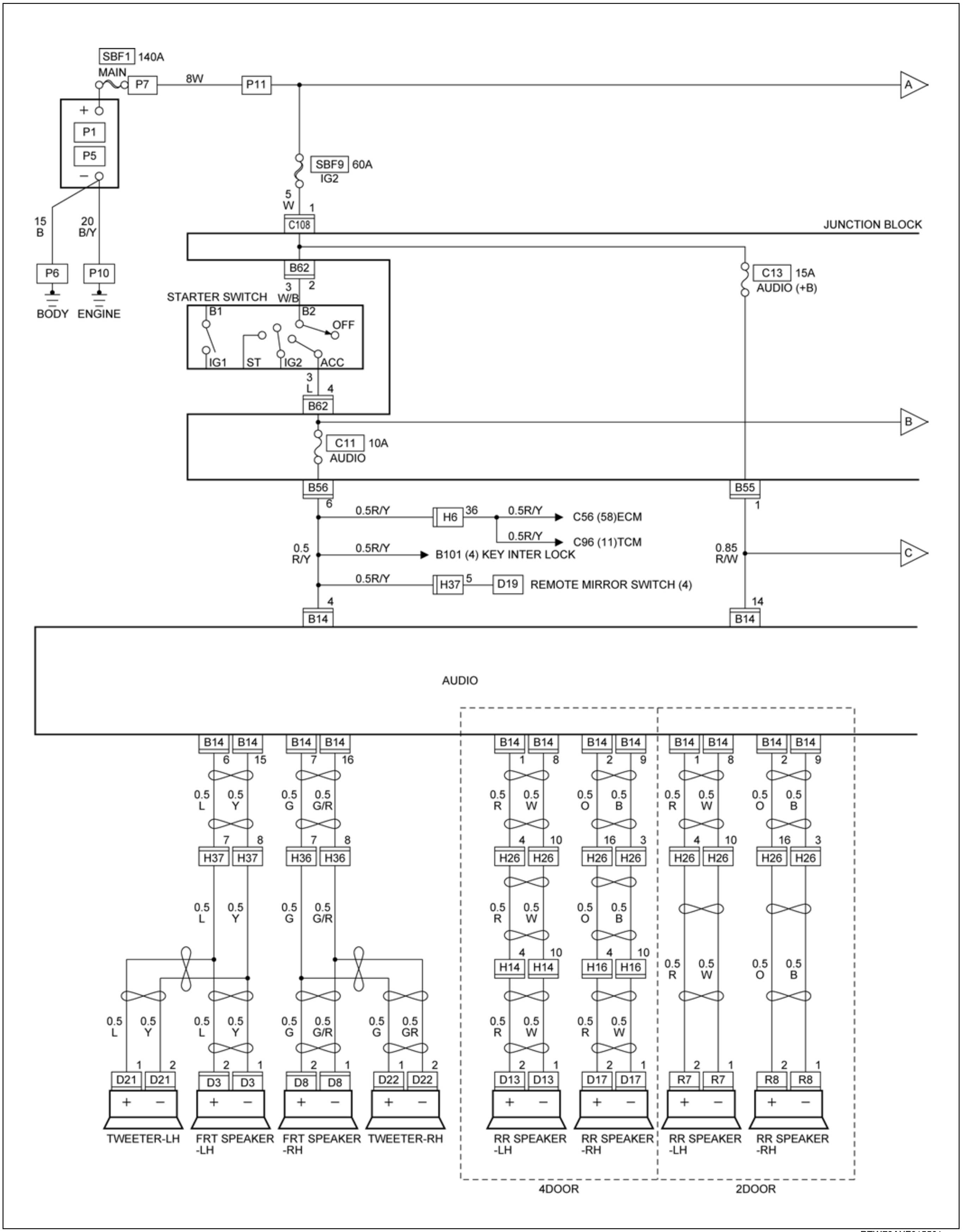
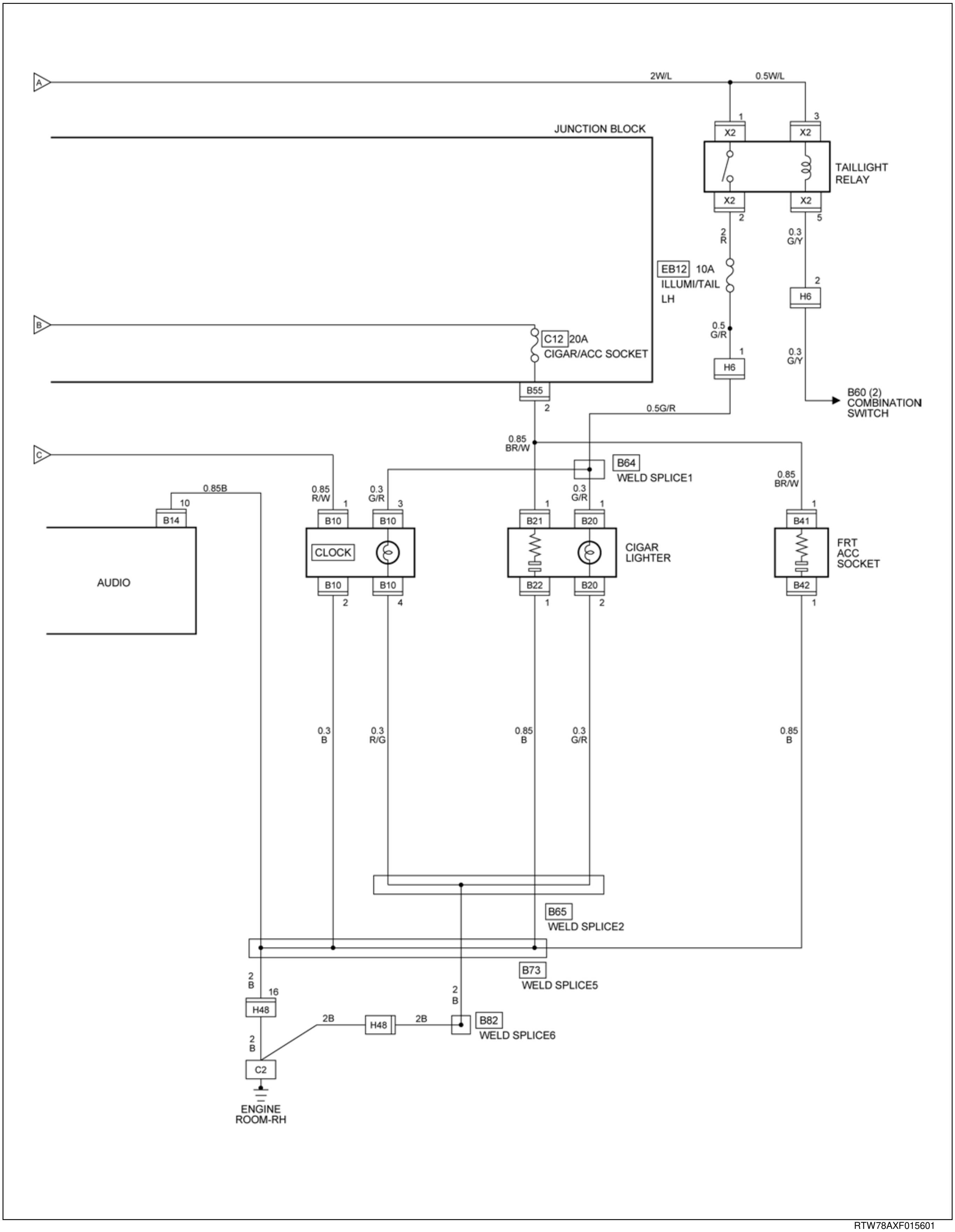
CIRCUIT DIAGRAM HFV6 (LHD)

Sheet 1/2



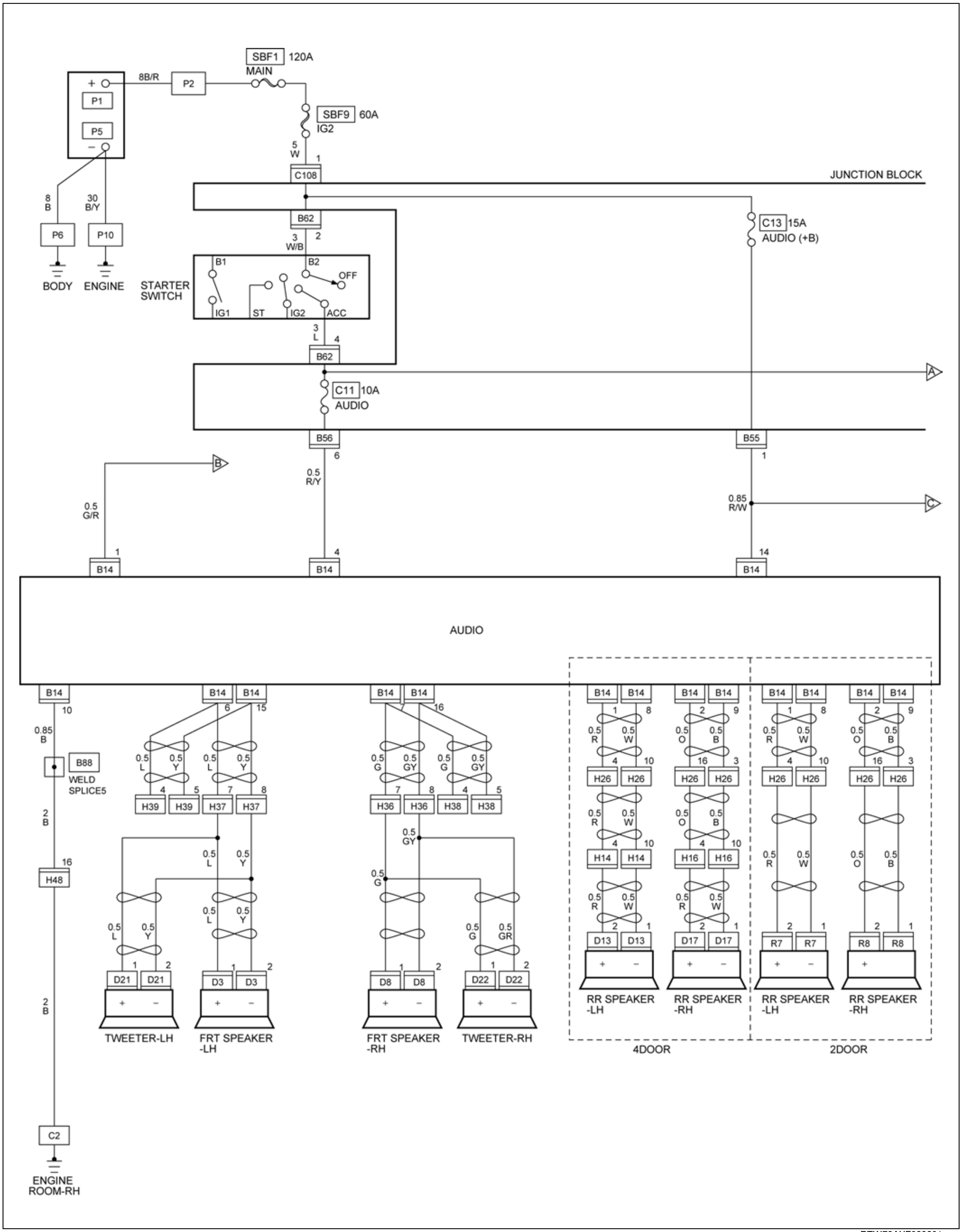
CIRCUIT DIAGRAM HFV6 (LHD)

Sheet 2/2



CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD) G.EXP

Sheet 1/2



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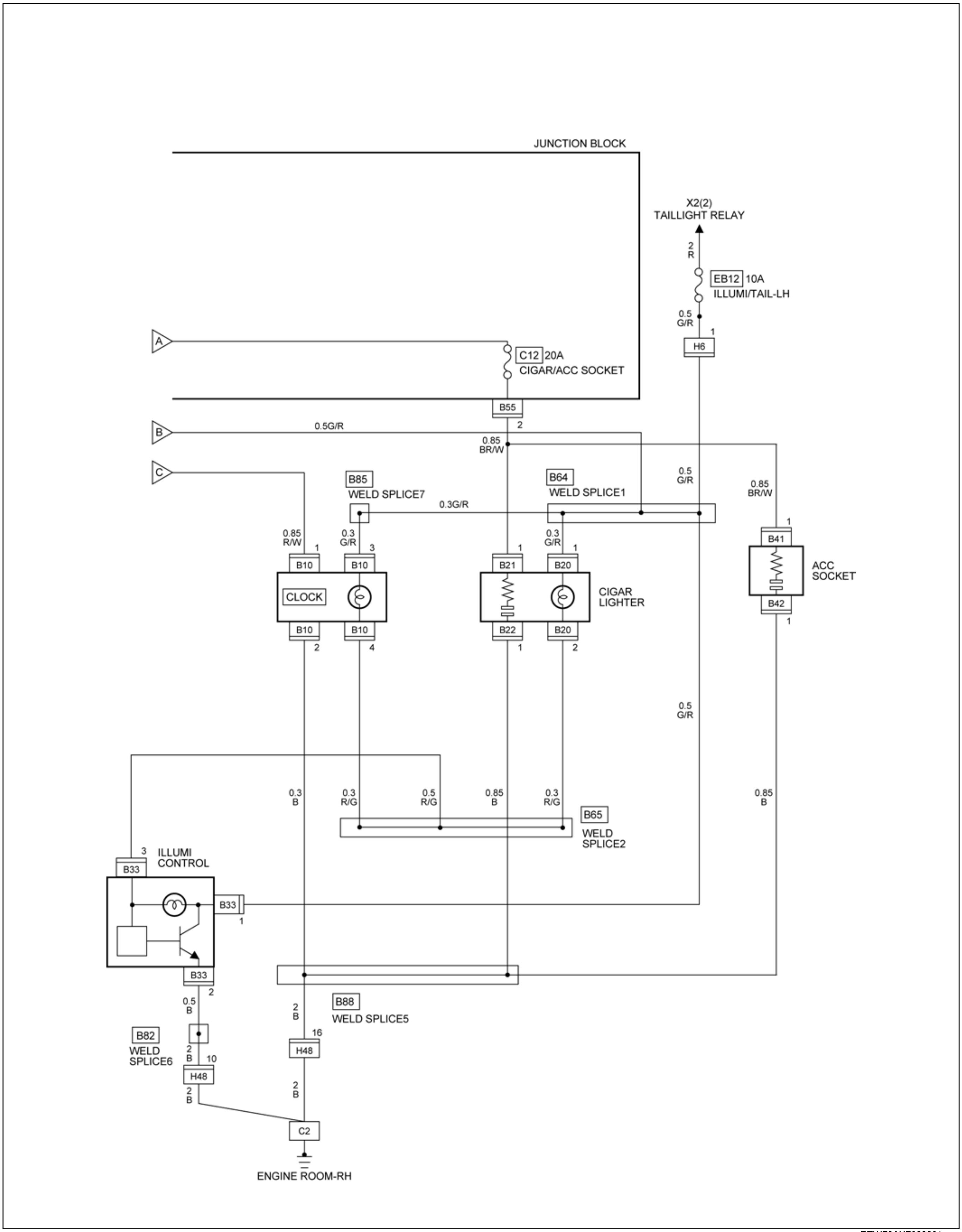
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD) G.EXP

Sheet 2/2



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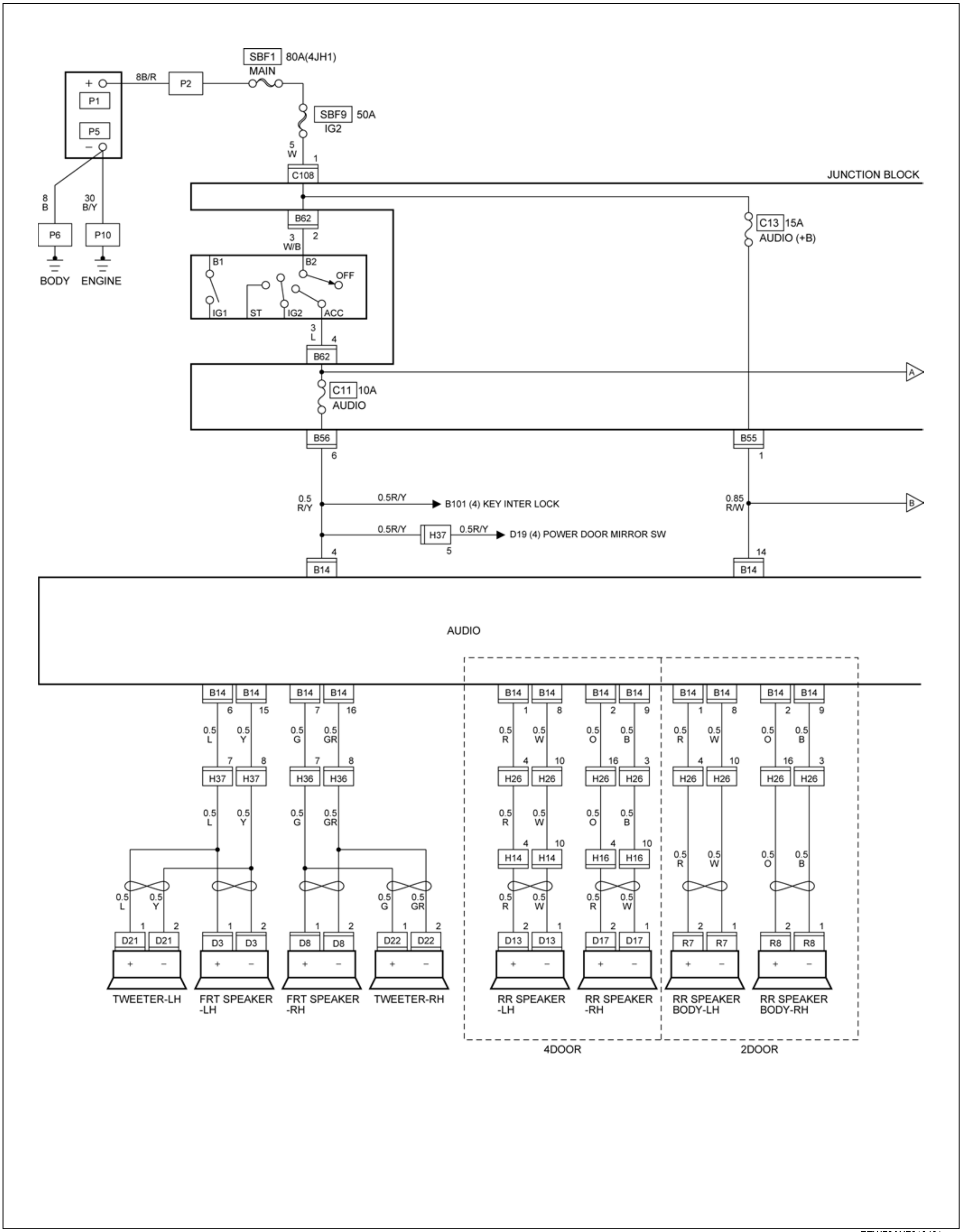
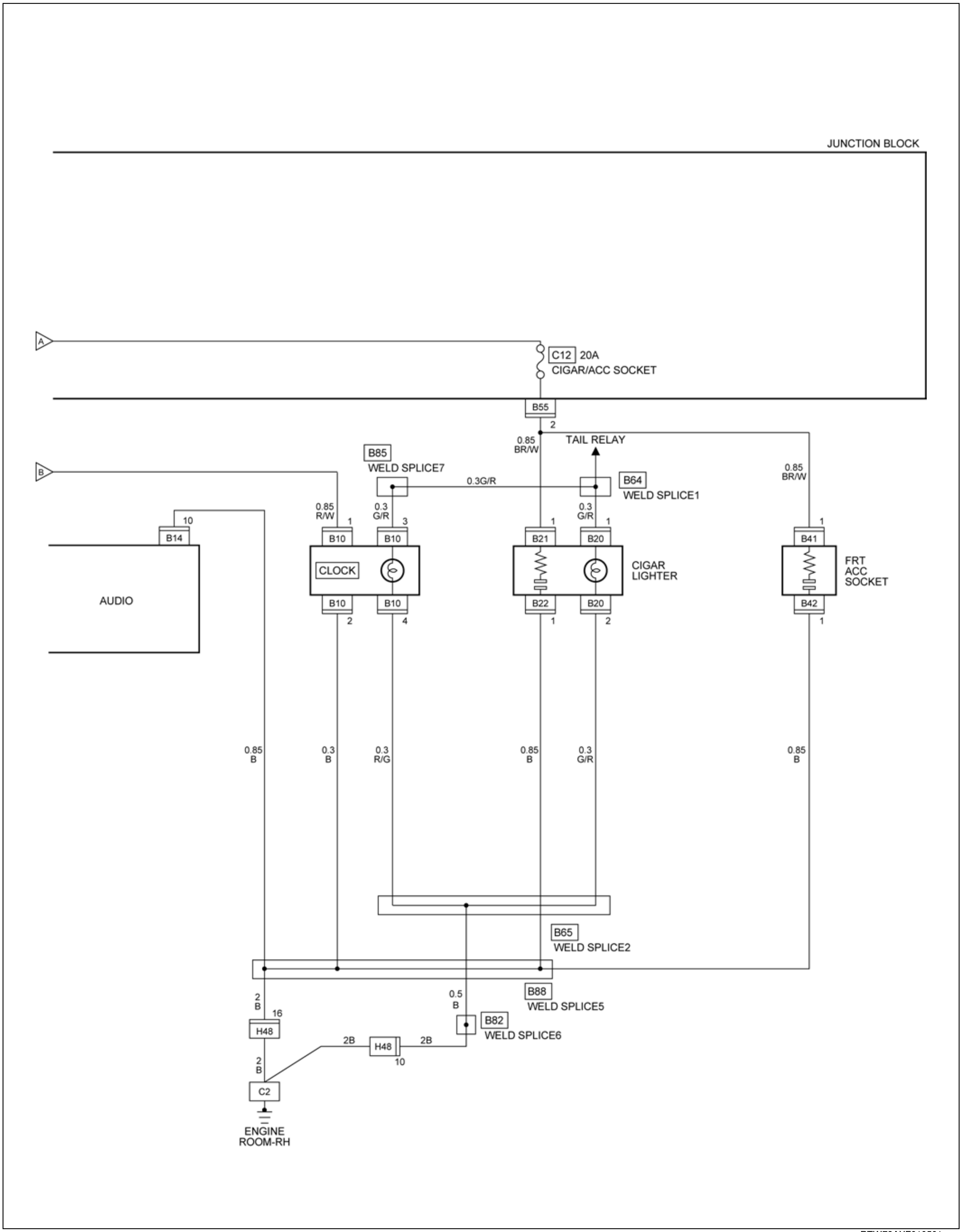
CIRCUIT DIAGRAM 4JH1-TC (LHD)

Sheet 1/2



CIRCUIT DIAGRAM 4JH1-TC (LHD)

Sheet 2/2



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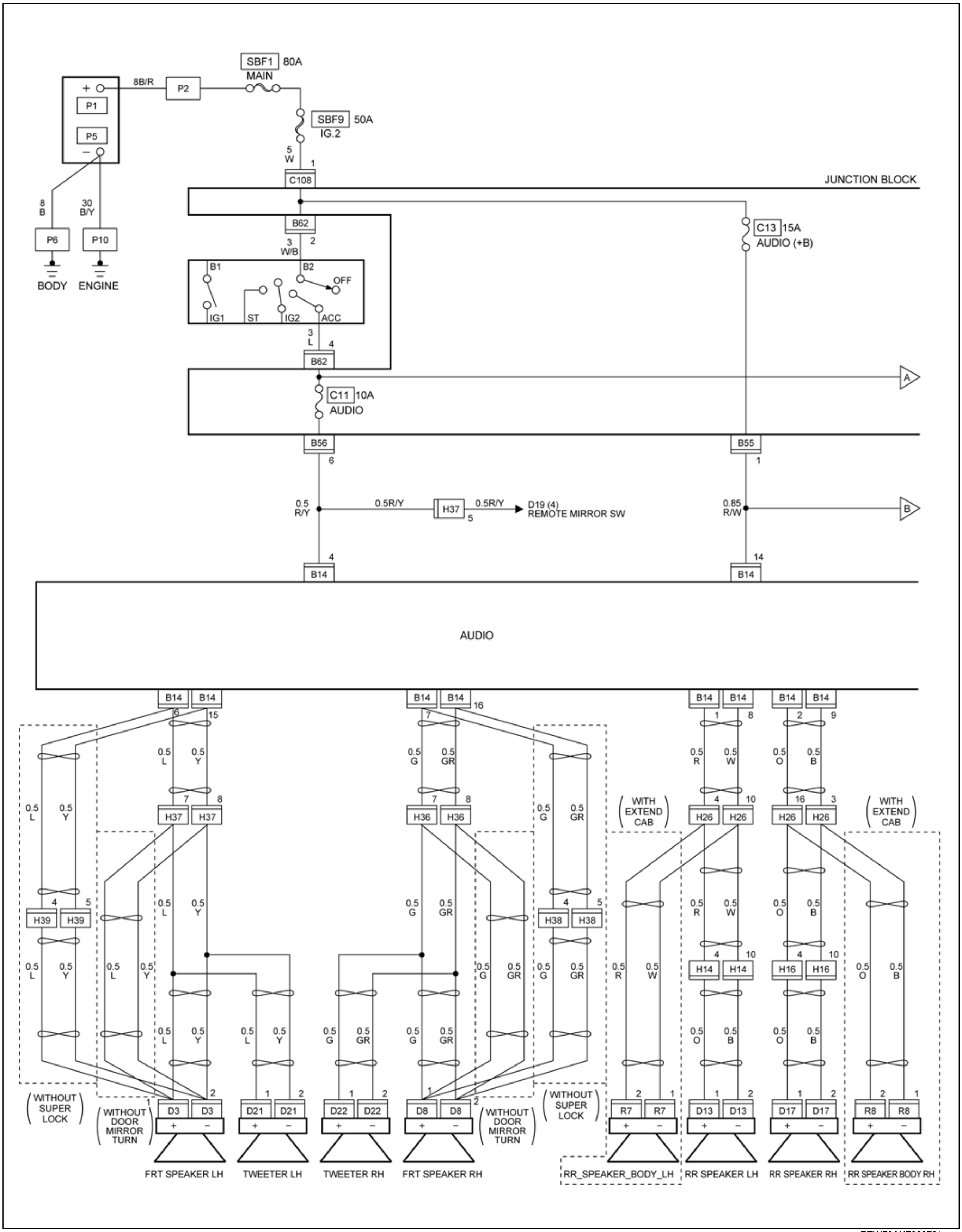
CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 1/2



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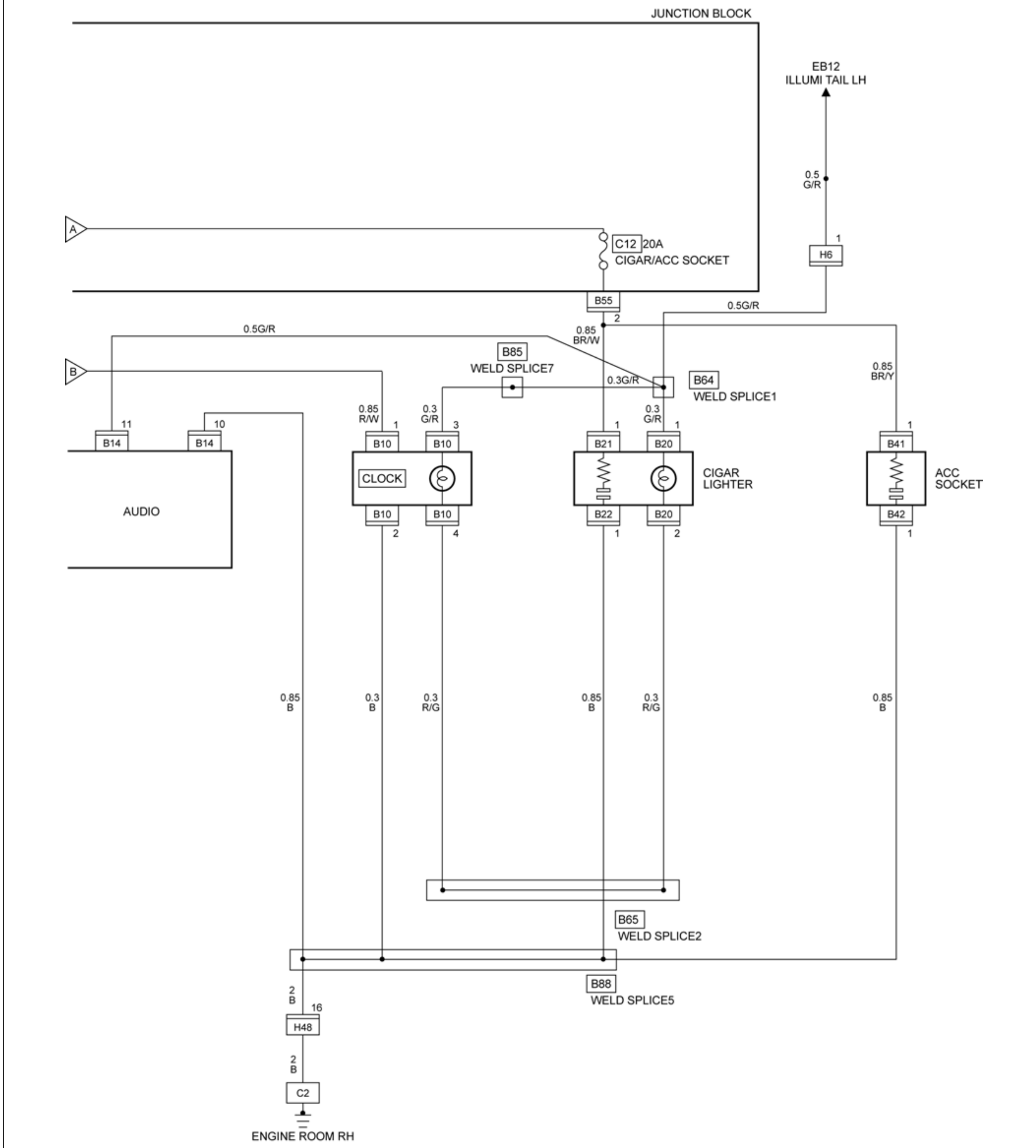
CIRCUIT DIAGRAM 4JA1T (L) (LHD)

Sheet 2/2



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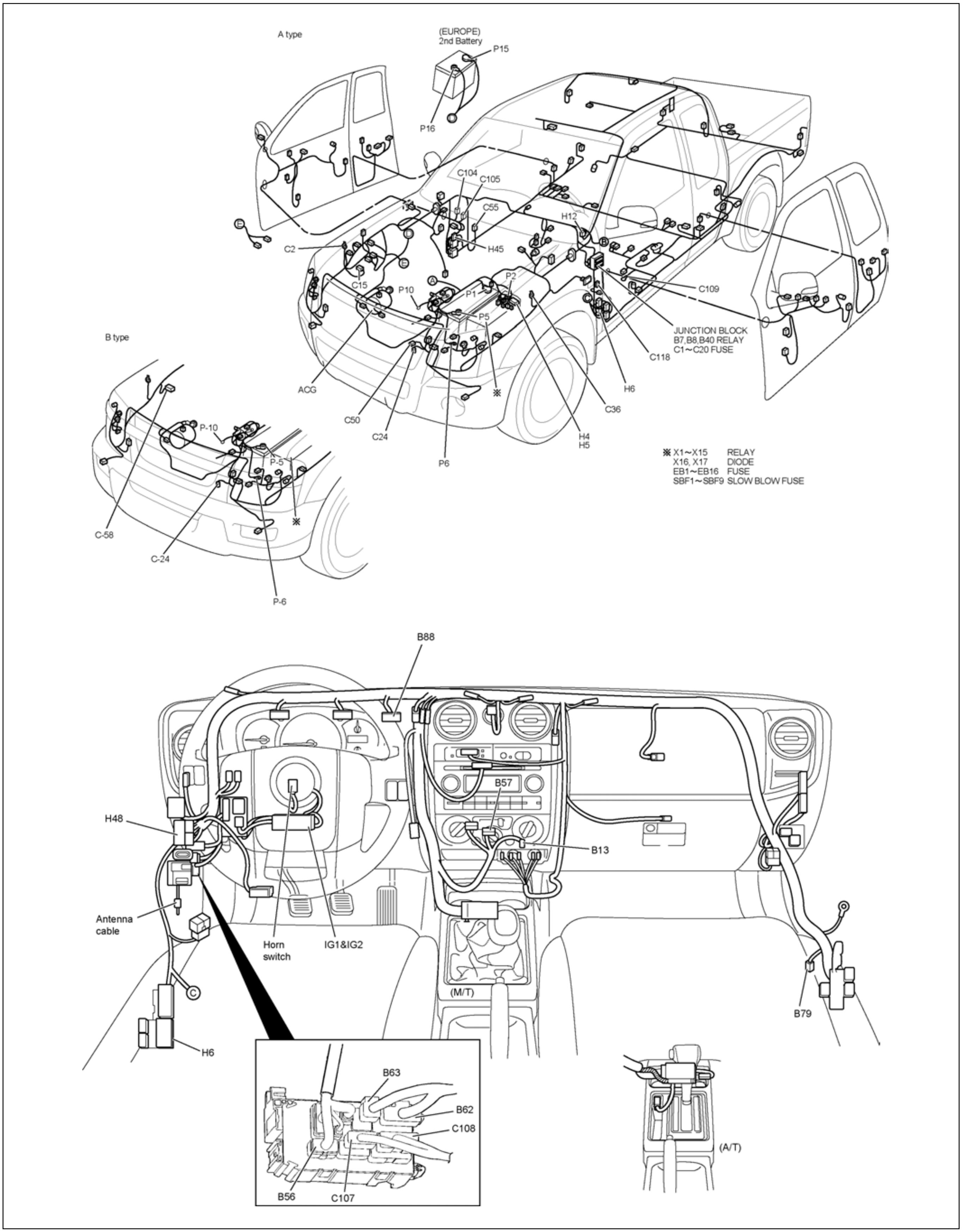
(LHD MODEL)



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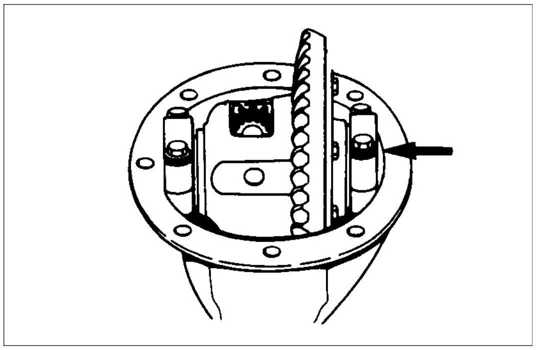
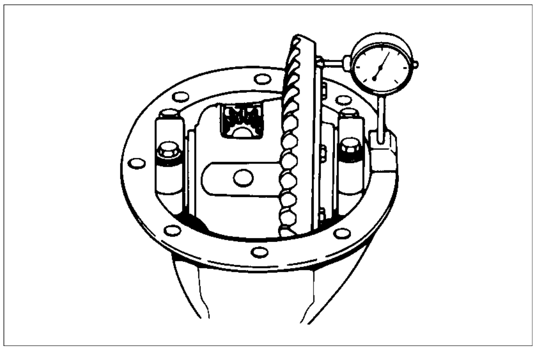


18. Bolt

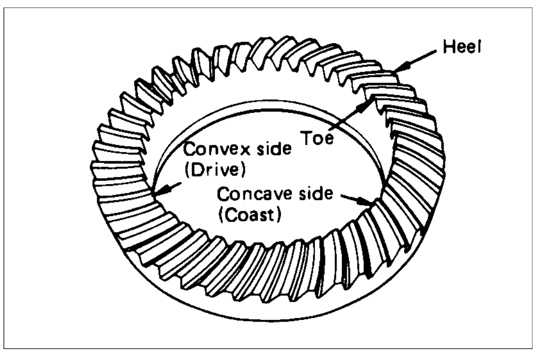
Bolt Torque	N·m (kgf·m/lb·ft)
98 (10.0/72)	



Measure the amount of run-out of the ring gear at its rear face.

mm(in)

Standard	Limit
0.02 (0.001)	0.05 (0.002)



Gear Tooth Contact Pattern Check and Adjustment

Apply a thin coat of prussian blue or equivalent to the faces of the 7 - 8 teeth of the ring gear. Check the impression of contact on the ring gear teeth and make necessary adjustment as described below if the contact is abnormal.

TROUBLESHOOTING

CIGARETTE LIGHTER

1. Lighter does not pop out after being pushed in. It does not become hot.

Checkpoint		Trouble Cause	Countermeasure
Audio system (System should receive power)	NG	Poor Fuse No. C-12 (20A, Fuse box) contact or blown	Reinstall or replace the fuse No. C12 (20A)
OK			
Lighter continuity between center part and outer area	NG	Open circuit or poor connector contact	Replace the lighter
OK			
Voltage between connector 1 B21 and the ground at starter SW. is ACC position (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Continuity between connector 1 B22 and the ground	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Lighter pops out prematurely before becoming hot

Checkpoint		Trouble Cause	Countermeasure
Lighter and casing	NG	Deformed lighter or casing	Repair or replace the lighter and/or casing

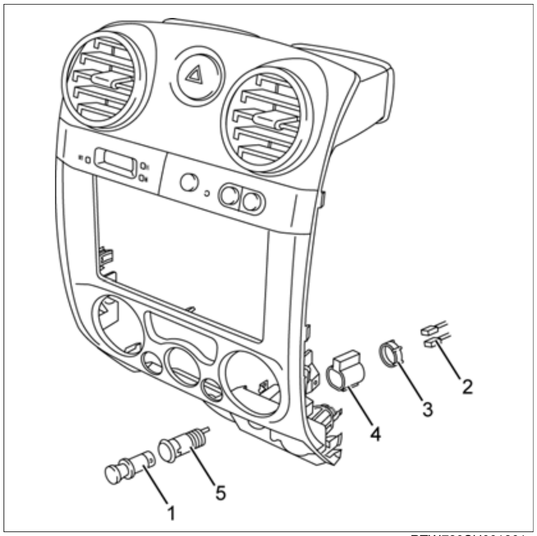
3. Lighter becomes too hot

Checkpoint		Trouble Cause	Countermeasure
Lighter and casing	NG	Deformed lighter and casing	Repair or replace the lighter and/or casing

REMOVAL AND INSTALLATION

AUDIO

Refer to Section 9 “ACCESSORIES” for details.



RTW780SH001801

CIGARETTE LIGHTER

Removal

1. Disconnect the battery ground cable.
2. Remove the center cluster ASM.
3. Remove the lighter ①.
4. Disconnect the connector ②.
5. Loosen the ring nut ③ at the back side.
6. Remove the outer case ④.
7. Remove the lighter holder ⑤ from the bezel.

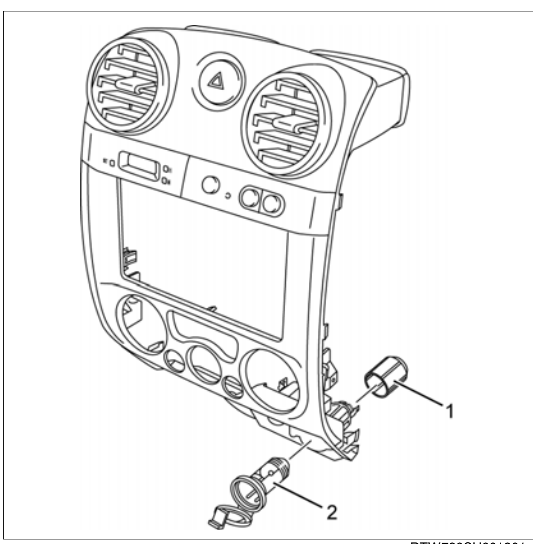
Installation

Follow the removal procedure in the reverse order to install the lighter.

Pay close attention to the important points mentioned in the following paragraphs.

Connector

Be absolutely sure that the lighter connector is securely connected.
This will prevent a poor contact and an open circuit.



RTW780SH001901

ACC SOCKET

Removal

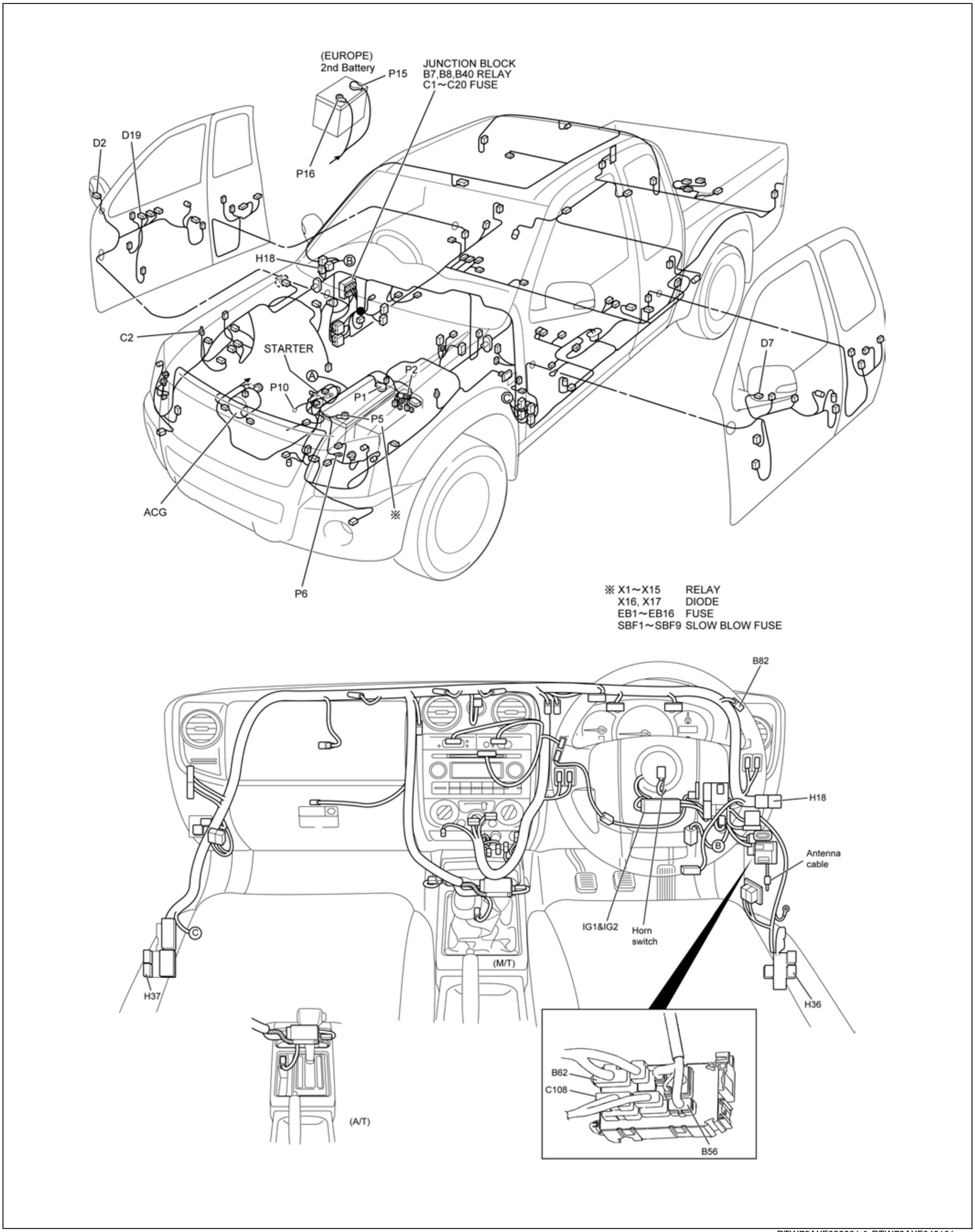
1. Disconnect the battery ground cable.
2. Remove the center cluster ASM.
3. Disconnect the connector.
4. Remove the holder nut ①.
5. Remove the ACC Socket ②

Installation

Follow the removal procedure in the reverse order to install the lighter.

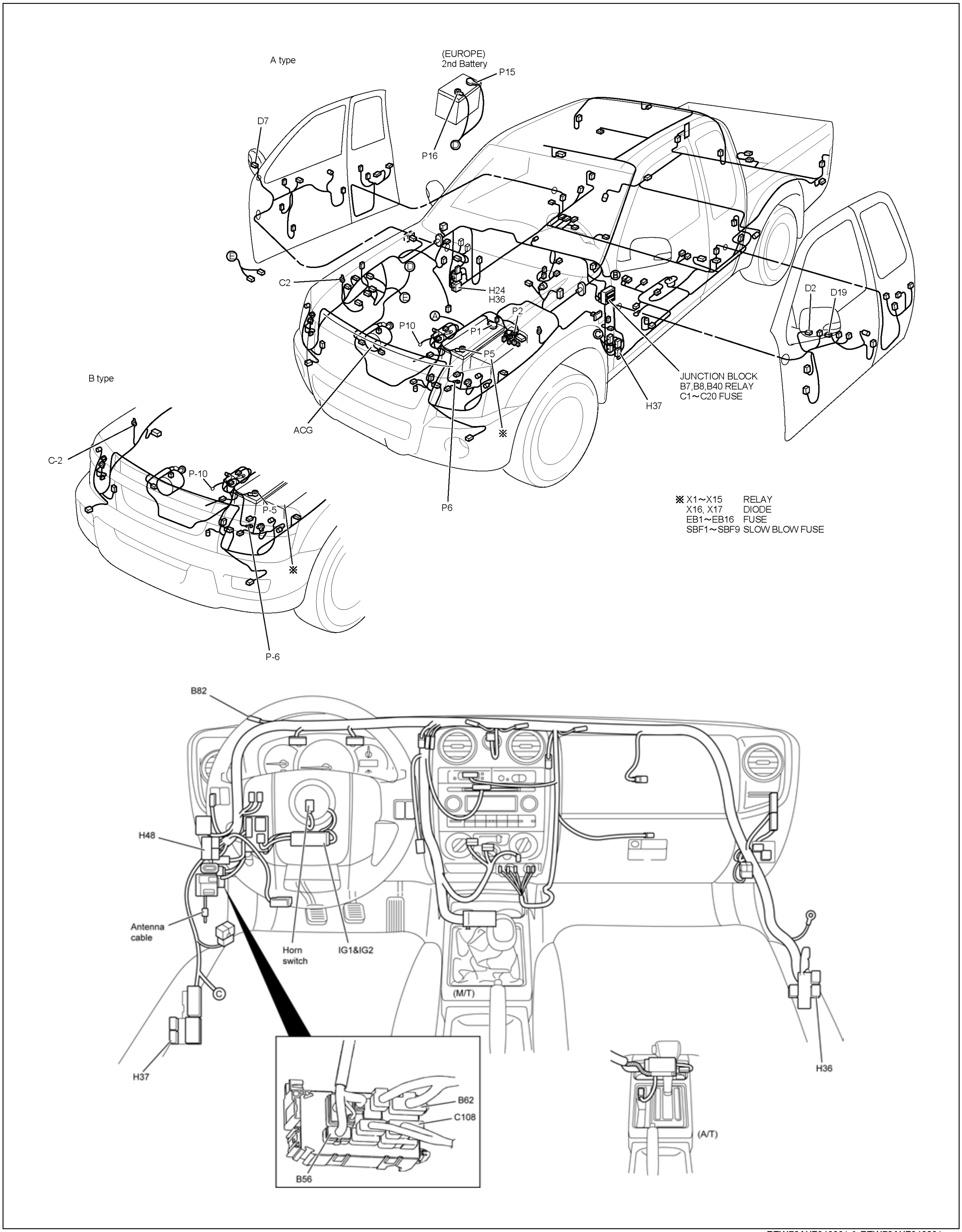
POWER DOOR MIRROR

PARTS LOCATION (RHD)



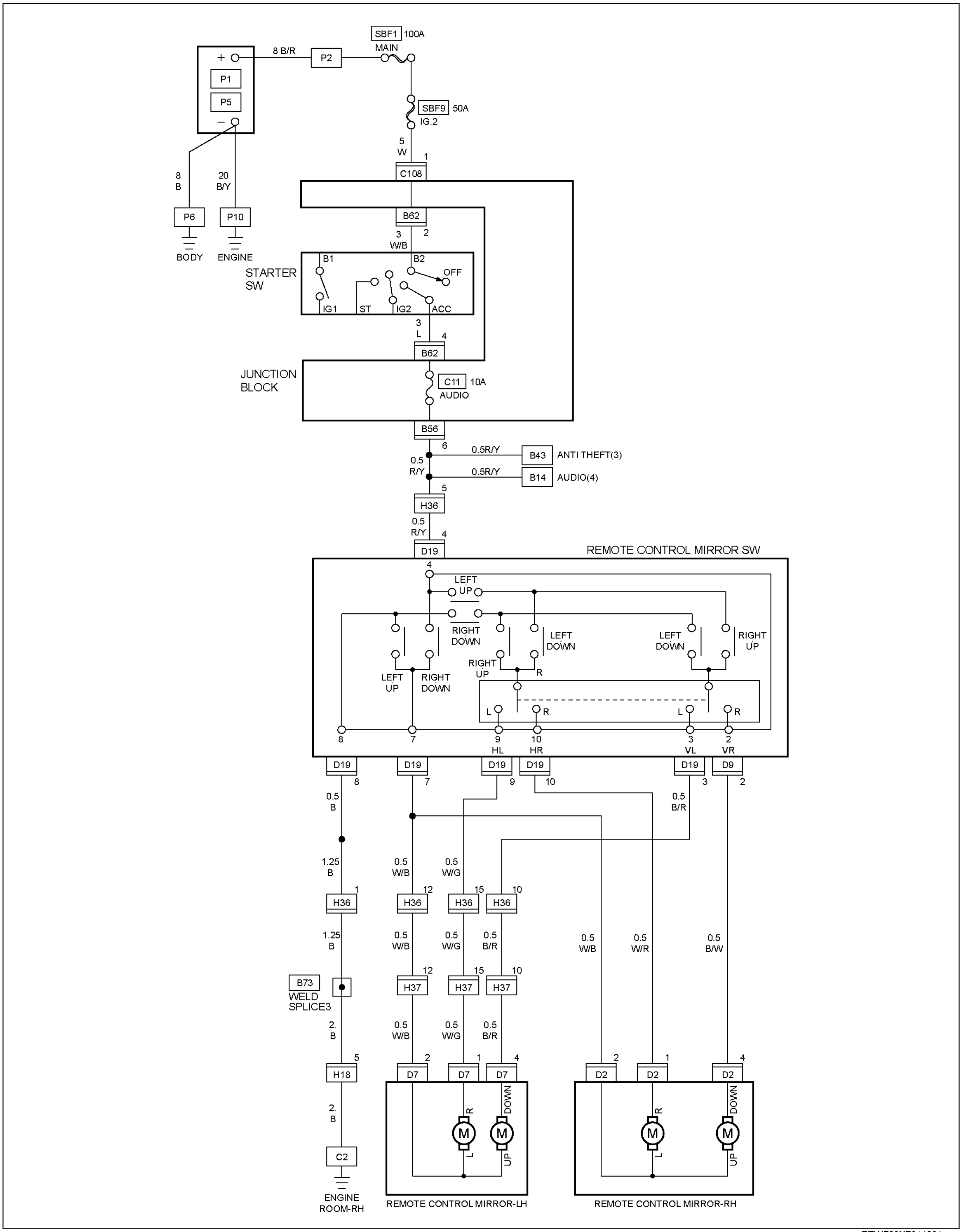
RTW78AXF039901 & RTW78AXF046101

PARTS LOCATION (LHD)

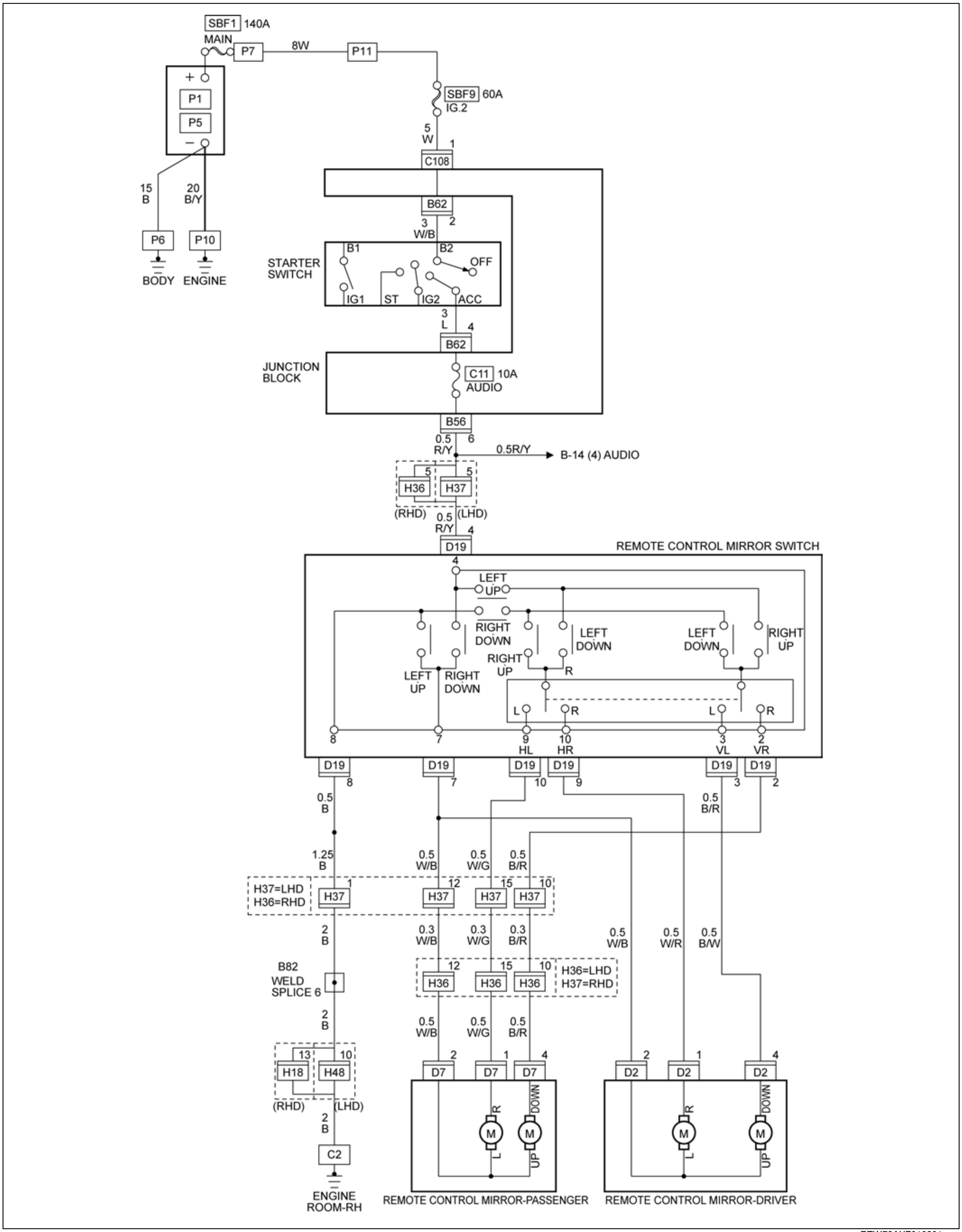


RTW78AXF040001 & RTW78AXF046201

CIRCUIT DIAGRAM C24SE (RHD)

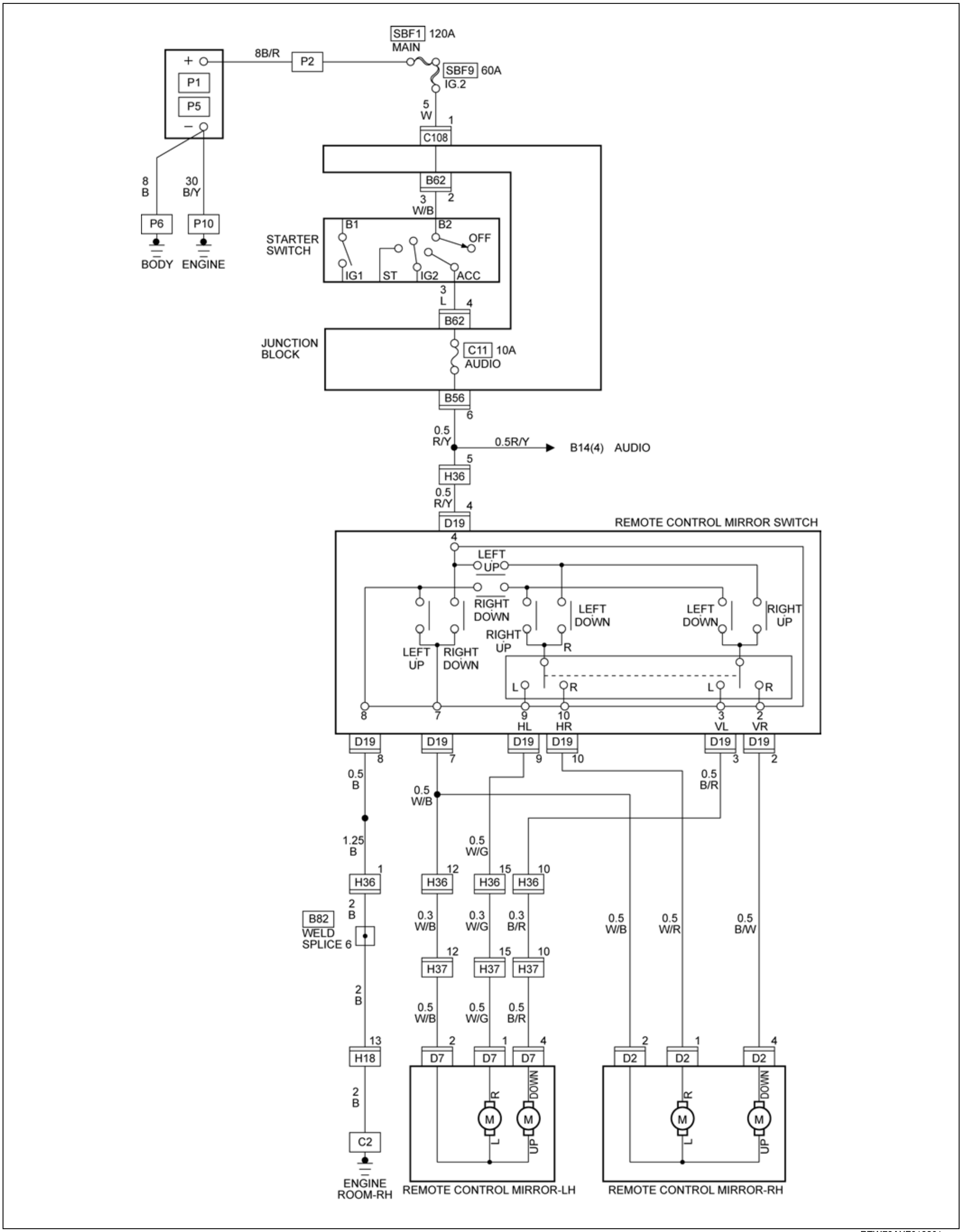


CIRCUIT DIAGRAM HFV6



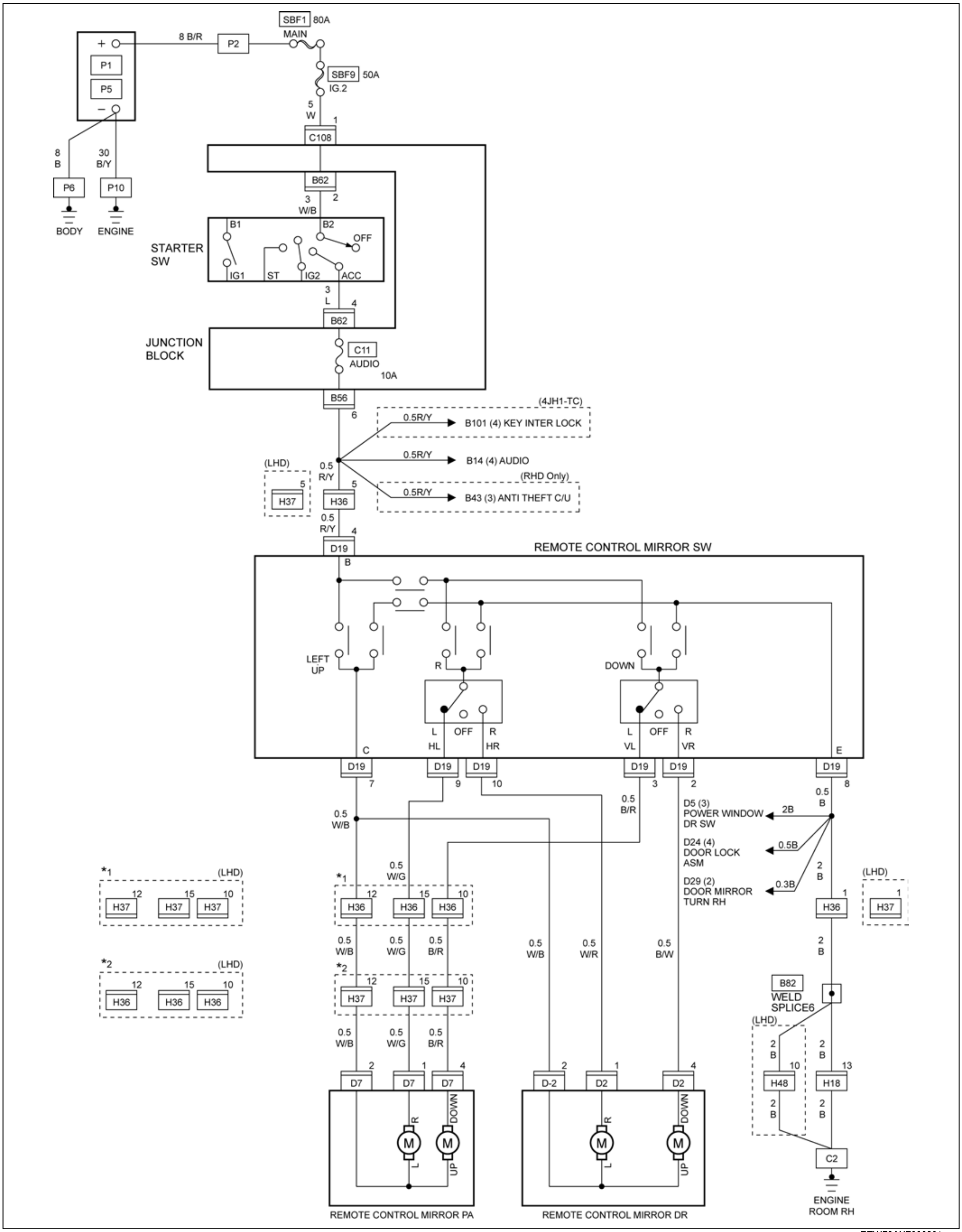
RTW78AXF016201

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD)

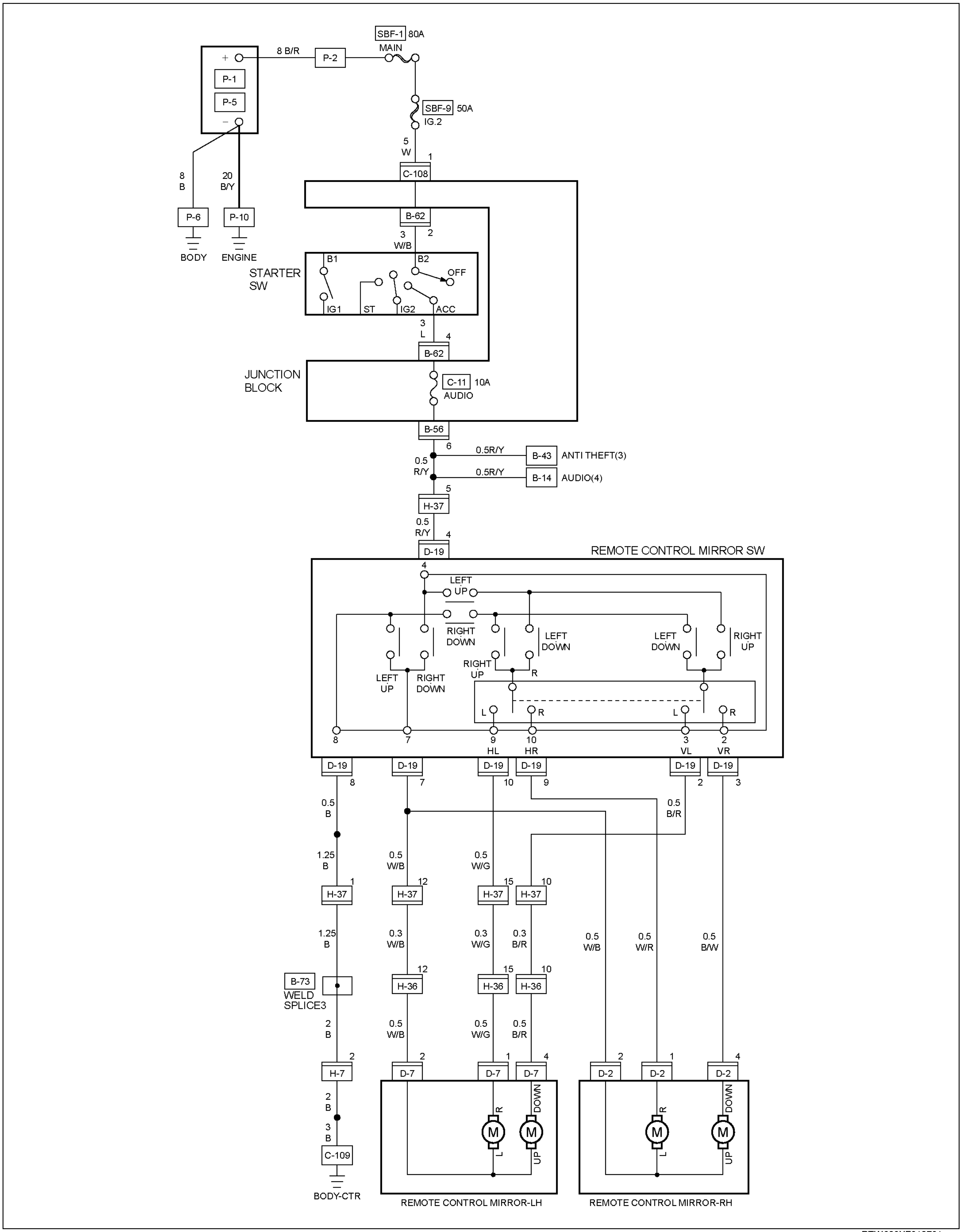


RTW78AXF018301

CIRCUIT DIAGRAM 4JA1T(L)



CIRCUIT DIAGRAM C24SE (LHD)



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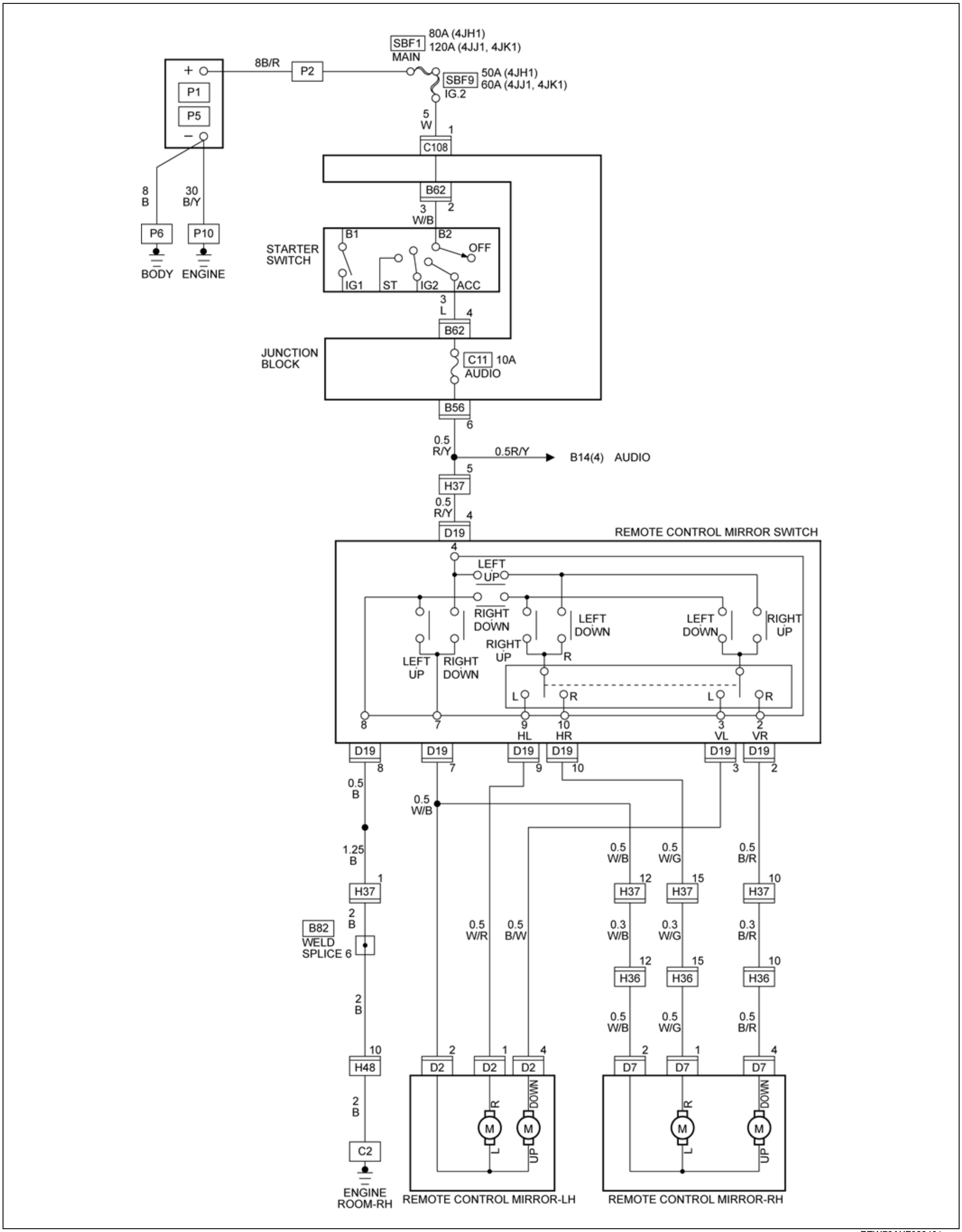
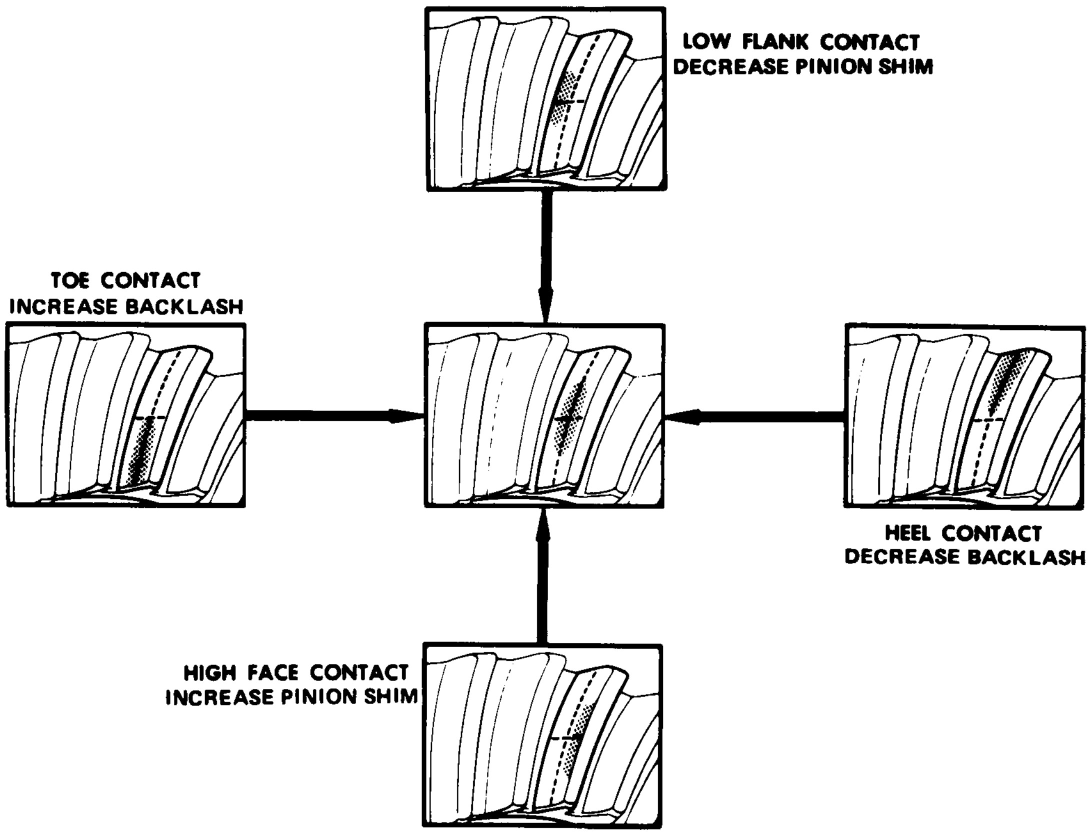
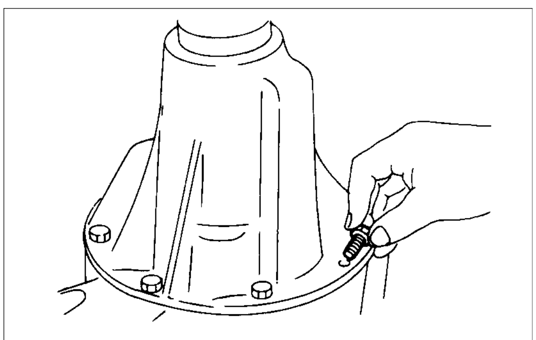
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC / 4JH1-TC (LHD)







20. Differential Assembly

(1) Clean the faces of the front axle case and differential carrier.

Apply the recommended liquid gasket or its equivalent to the sealing side of the axle case and the carrier.

(2) Attach the differential case and the carrier assembly to the front axle case and tighten the nuts and bolts. The axle case bolt is used for drainage.

Torque	N·m (kgf·m/lb·ft)
26 (2.7/20)	

(3) Install the axle shaft assemblies as instructed earlier in this section under "Axle Shaft Replacement".

(4) Fill the axle case with hypoid gear lubricant, to just below the filler hole.

Lubricant capacity	liter (US/UK gal)
1.4 (0.37/0.31)	

TROUBLESHOOTING

QUICK CHART FOR CHECK POINT

Check Point / Trouble Mode	Fuse C11 (10A)	Door Mirror Control Switch	Door Mirror LH	Door Mirror RH	Cable Harness
1. Mirrors on the both sides do not operate	○	○			○
2. Mirror on the left (or right) side does not operate		○	○	○	○
3. Mirrors on the both sides operate only in the vertical (or horizontal) direction		○			
4. Mirror on the left side operates only in the vertical (or horizontal) direction		○	○		○
5. Mirror on the right side operates only in the vertical (or horizontal) direction		○		○	○

DOOR MIRROR CONTROL SWITCH

1. Mirrors on the both sides do not operate

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C11 (10A, Fuse box)	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. C11 (10A)
OK			
Grounding point C2	NG	Poor grounding point contact	Repair grounding point C2 contact
OK			
Voltage between the door mirror control SW. harness side connector terminal 4 D19 and the ground (Should be battery voltage present)	NG	Open circuit or poor connector contact	Repair an open circuit or a poor connection of the connectors between the fuse No. C11 (10A) and 4 D19
OK			
Continuity between the door mirror control SW harness side connector terminal 8 D19 and C2	NG	Open circuit or poor connector contact	Repair open circuit or connector contact
OK			
Door mirror control SW. function	NG	SW. malfunction	Replace the door mirror control SW.
OK			
Continuity between 7 D19 and 12 H36 (or 12 H37)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

2. Mirror on the right side does not operate

Checkpoint		Trouble Cause	Countermeasure
Door mirror control SW. function	NG	SW. malfunction	Replace the door mirror control SW.
OK ↓			
Mirror function on the left (or right) side	NG	Mirror malfunction on the left (or right)	Repair or replace the door mirror
OK ↓			
Continuity between 7 D19 and 2 D7 (7 D19 and 2 D2)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

3. Mirrors on the both sides operate only in the vertical (or horizontal) direction

Checkpoint		Trouble Cause	Countermeasure
Door mirror control SW. function	NG	SW. malfunction	Replace the door mirror control SW.

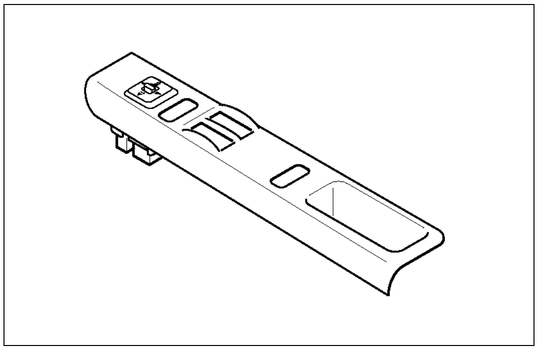
4. Mirror on the left side operates only in the vertical (or horizontal) direction

Checkpoint		Trouble Cause	Countermeasure
Door mirror control SW. function	NG	SW. malfunction	Replace the door mirror control SW.
OK			
Door mirror function	NG	Door mirror malfunction	Repair or replace the door mirror
OK			
Continuity between 4 D19 and 4 D7 (10 D19 and 1 D2)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

5. Mirror on the right side operates only in the vertical (or horizontal) direction

Door mirror control SW. function	NG	Door mirror control malfunction	Replace the door mirror control SW.
OK			
Door mirror function	NG	Door mirror malfunction	Repair or replace the door mirror
OK			
Continuity between 4 D19 and 4 D2 (10 D19 and 1 D2)	NG	Open circuit or poor connector contact	Repair open circuit or connector contact

REMOVAL AND INSTALLATION



DOOR MIRROR CONTROL SWITCH

Removal

1. **Disconnect the battery ground cable.**
2. **Door trim pad Assembly**
   - Refer to section 10 “BODY” for door trim pad assembly removal steps.
3. **Door Mirror Control Switch**
   Remove the power window switch bezel.
   - Remove the screw.
   - Disconnect the switch connector.
   - To remove the switch panel assembly.

Installation

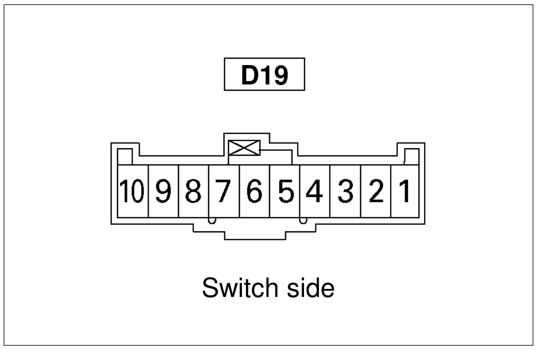
To install, follow the removal steps in the reverse order.

DOOR MIRROR

Removal and Installation

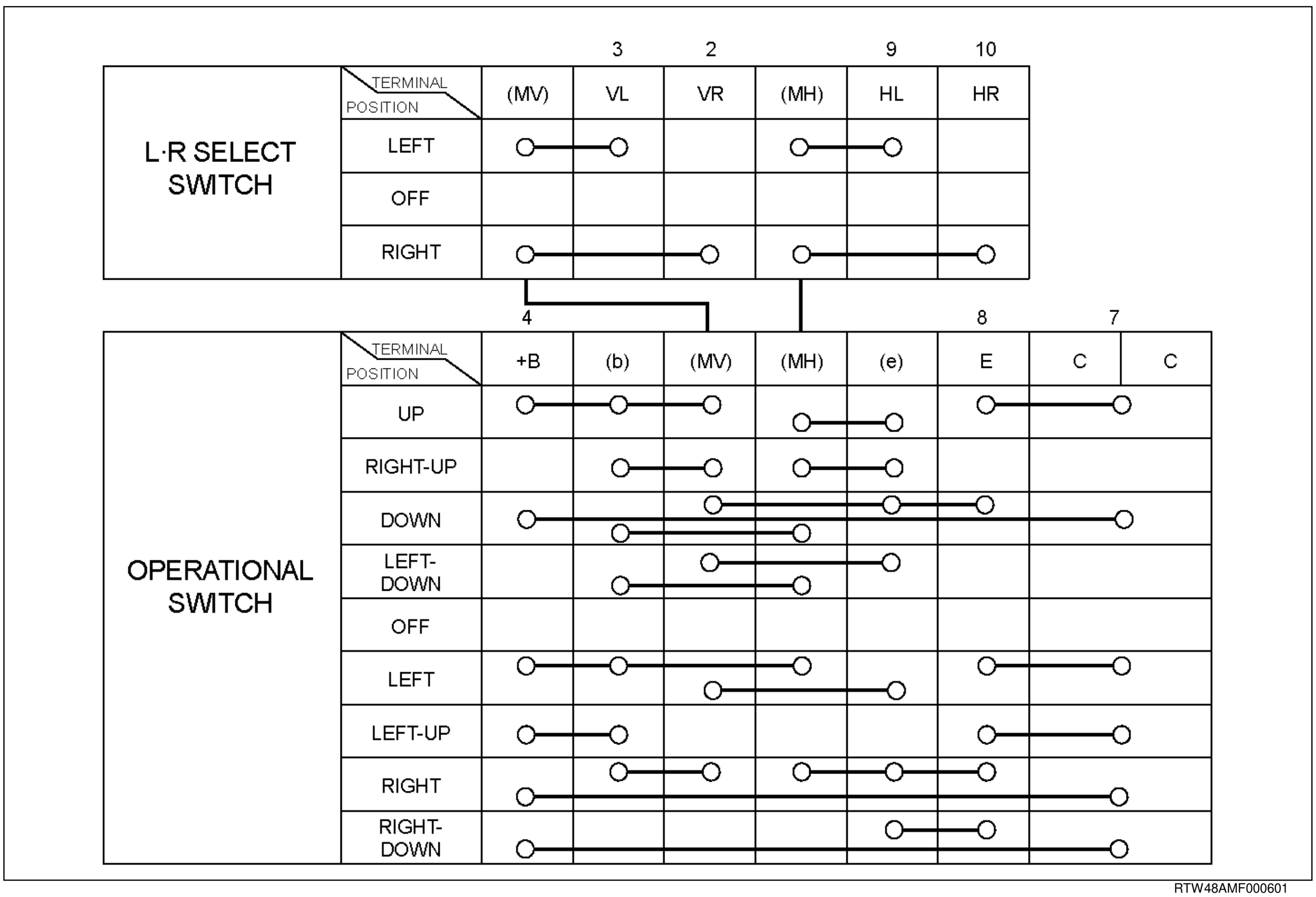
Refer to the DOOR MIRROR in section 10 “BODY”.

INSPECTION AND REPAIR

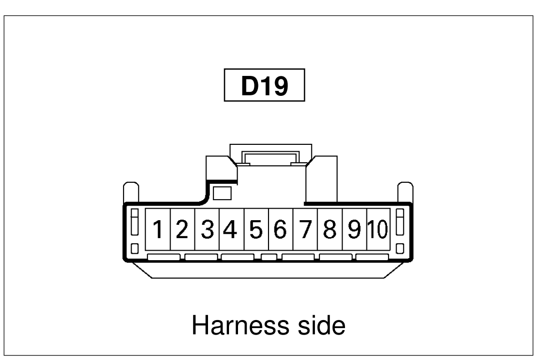


Door Mirror Control Switch

1. **Switch side Connector Circuit**
   Check continuity between the switch connector terminals while operating the door mirror control switch as shown in the following table.



MV, MH, b, and e terminals have internal connections (circuitry).
4-point switch (Will not operate at intermediate positions.)

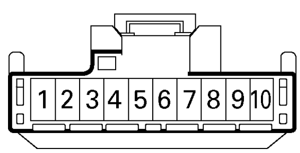


2. **Harness Side Connector Circuit**
   Remove the connector No. D19 of the mirror control switch and check voltage and continuity of the harness side connector.
   - When there is no continuity at the terminal No. 2, 3, 9 and 10, it is considered that the circuit with terminal No. 7 (W/B) is defective.

- When there is no continuity at either one of the circuit No, 5, 7, 8, or 10, the motor in the mirror of the circuit or the circuit itself is defective.

Terminal No.	Wire color	Connection to	Check item	Connecting terminal	Check condition	Standard
7	W/B	LH mirror & RH mirror	Continuity	7-Ground	-	No continuity
4	R/Y	Fuse C11 (10A)	Voltage	4-Ground	Starter SW “ACC” position	Approx. 12V
10	W/R	RH mirror-LH/RH	Continuity	10-7	-	Continuity
2	B/W	RH mirror-Up/Down		2-7	-	
3	B/R	LH mirror-Up/Down		3-7	-	
8	B	Ground		8-Ground	-	
9	W/G	LH mirror-LH/RH		9-7	-	

D19



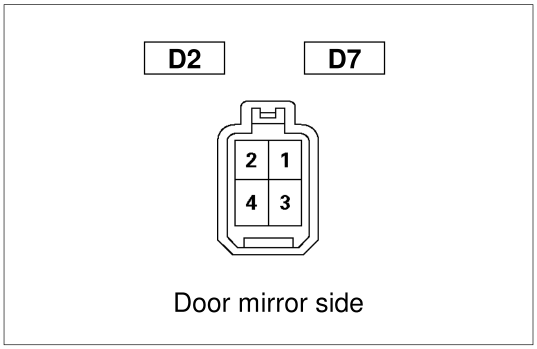
Harness side

Door Mirror

1. Door Mirror Control Switch Connector Circuit

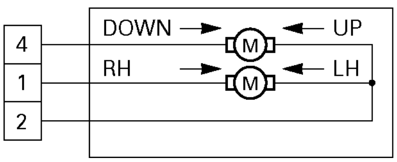
Disconnect the switch connector D19, apply the battery voltage to the harness side connector terminals and check its function.

Mirror \ Connector No. / Terminal No.	D19					Operating direction
	9	10	7	3	2	
Right		+	-			Left
		-	+			Right
			-		+	Up
			+		-	Down
Left	+		-			Left
	-		+			Right
			-	+		Up
			+	-		Down



2. Door Mirror Connector Circuit

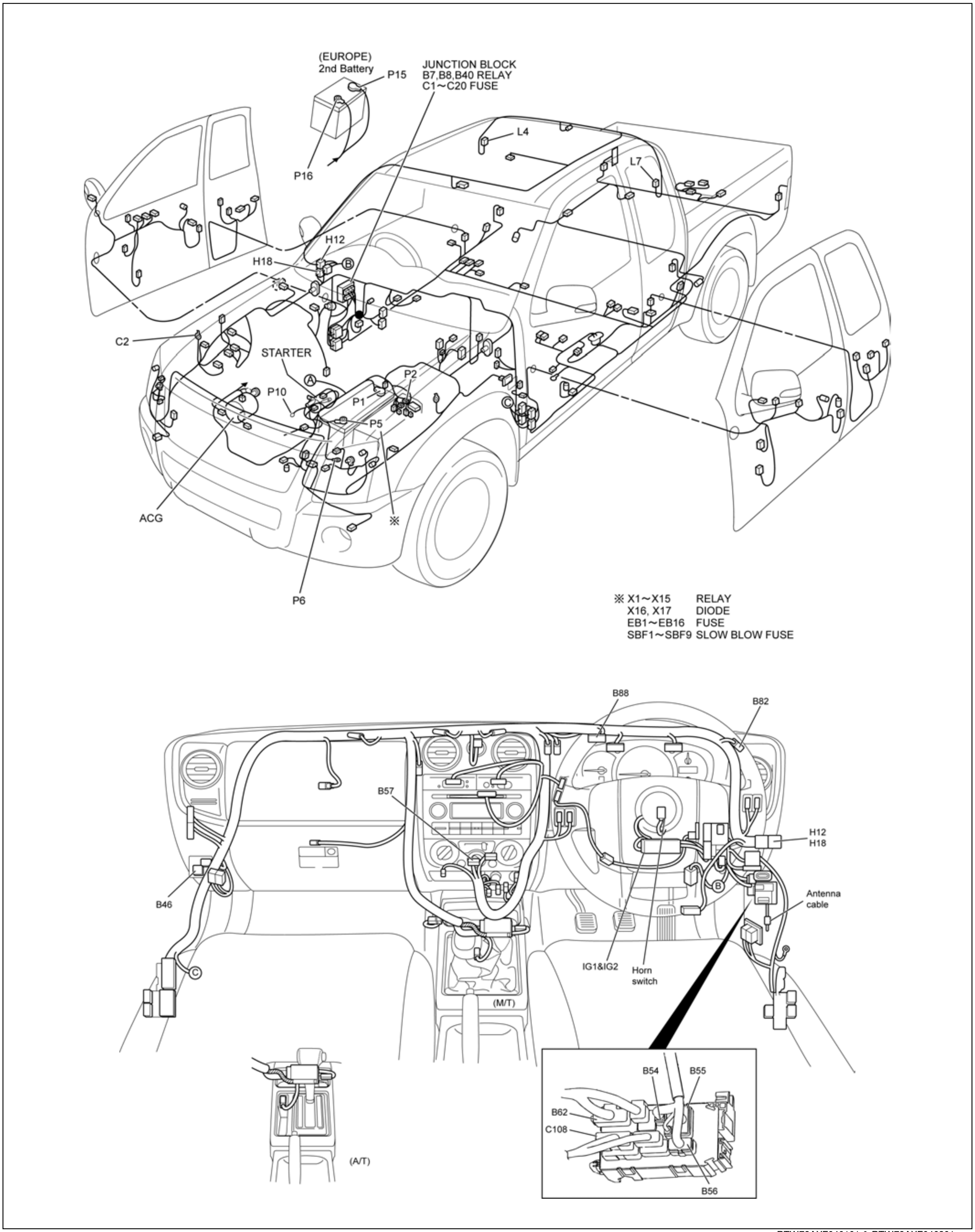
Disconnect the door mirror connector, apply the battery voltage to the door mirror side connector (D2 and D7) terminals and check its function.



Connector No. / Terminal No. / Operation	D2 D7		
	1	2	4
Up		-	+
Down		+	-
Left	+	-	
Right	-	+	

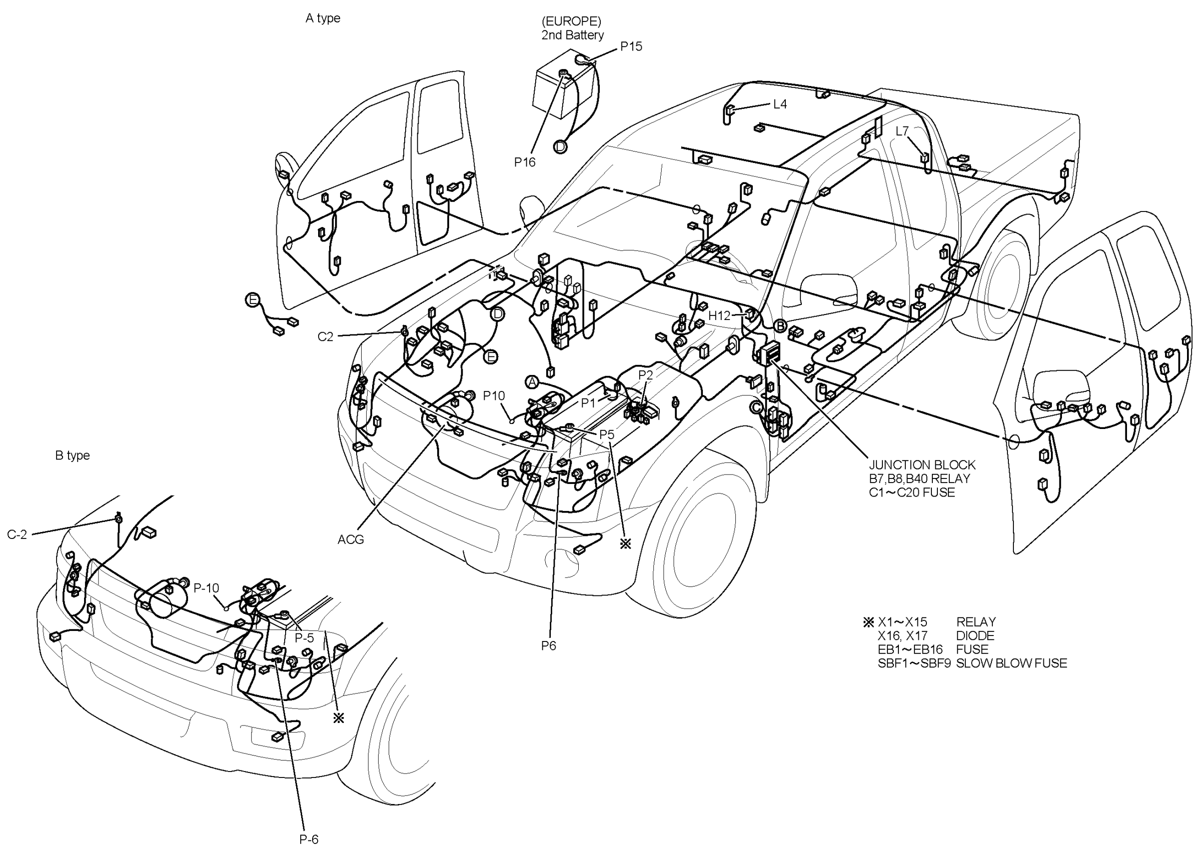
REAR DEFOGGER

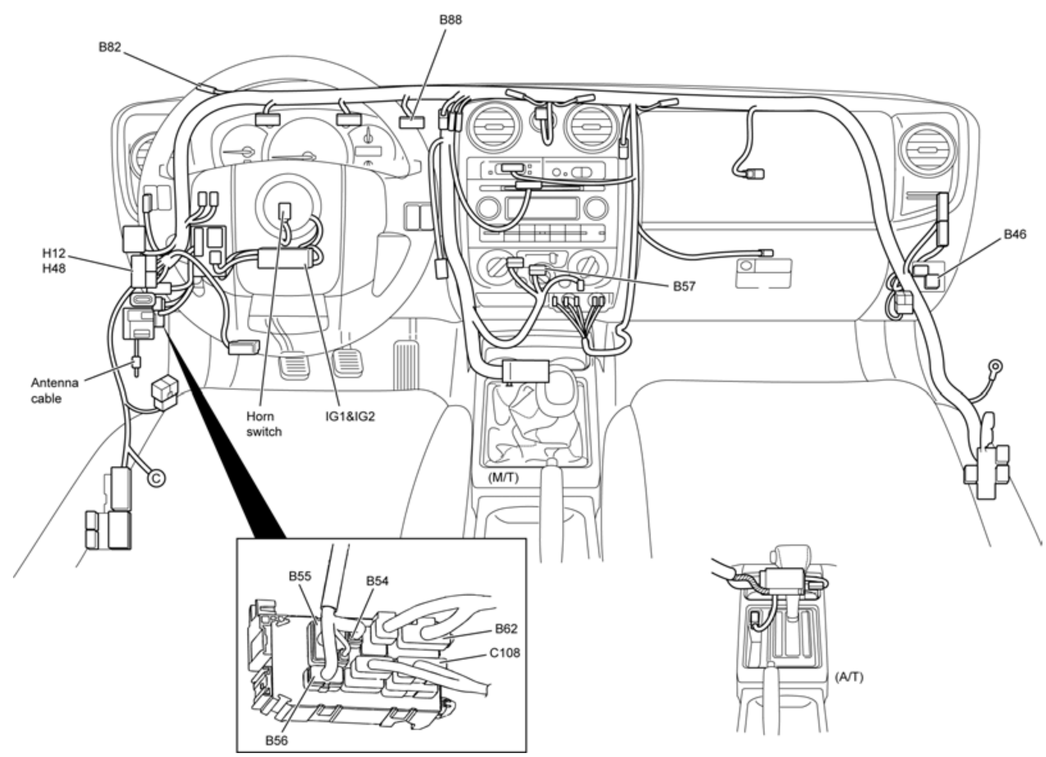
PARTS LOCATION (RHD)



RTW78AXF040101 & RTW78AXF046301

PARTS LOCATION (LHD)



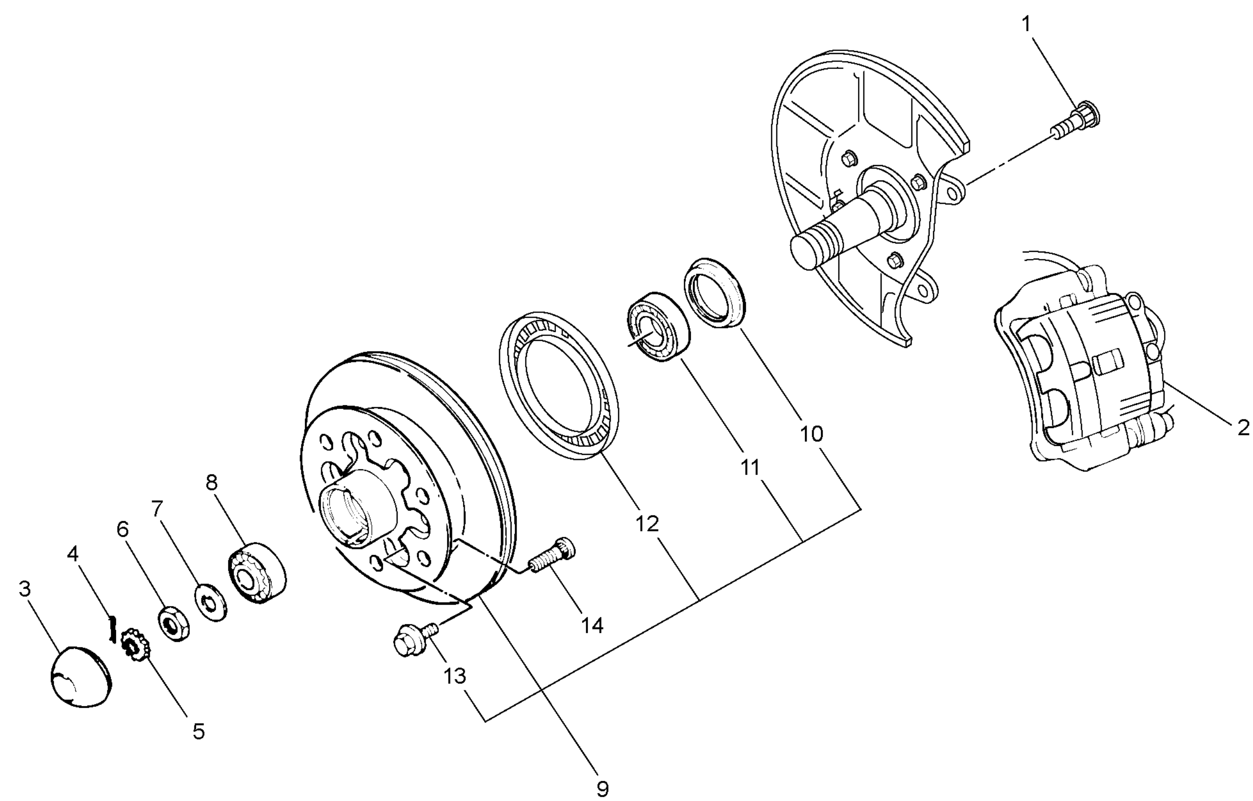


RTW78AXF040201 & RTW78AXF046401

FRONT HUB AND DISC (4×2 Except High Ride Suspension Model)

Disassembly

Refer to SECTION 3E “WHEELS AND TIRES” for wheel removal procedure.

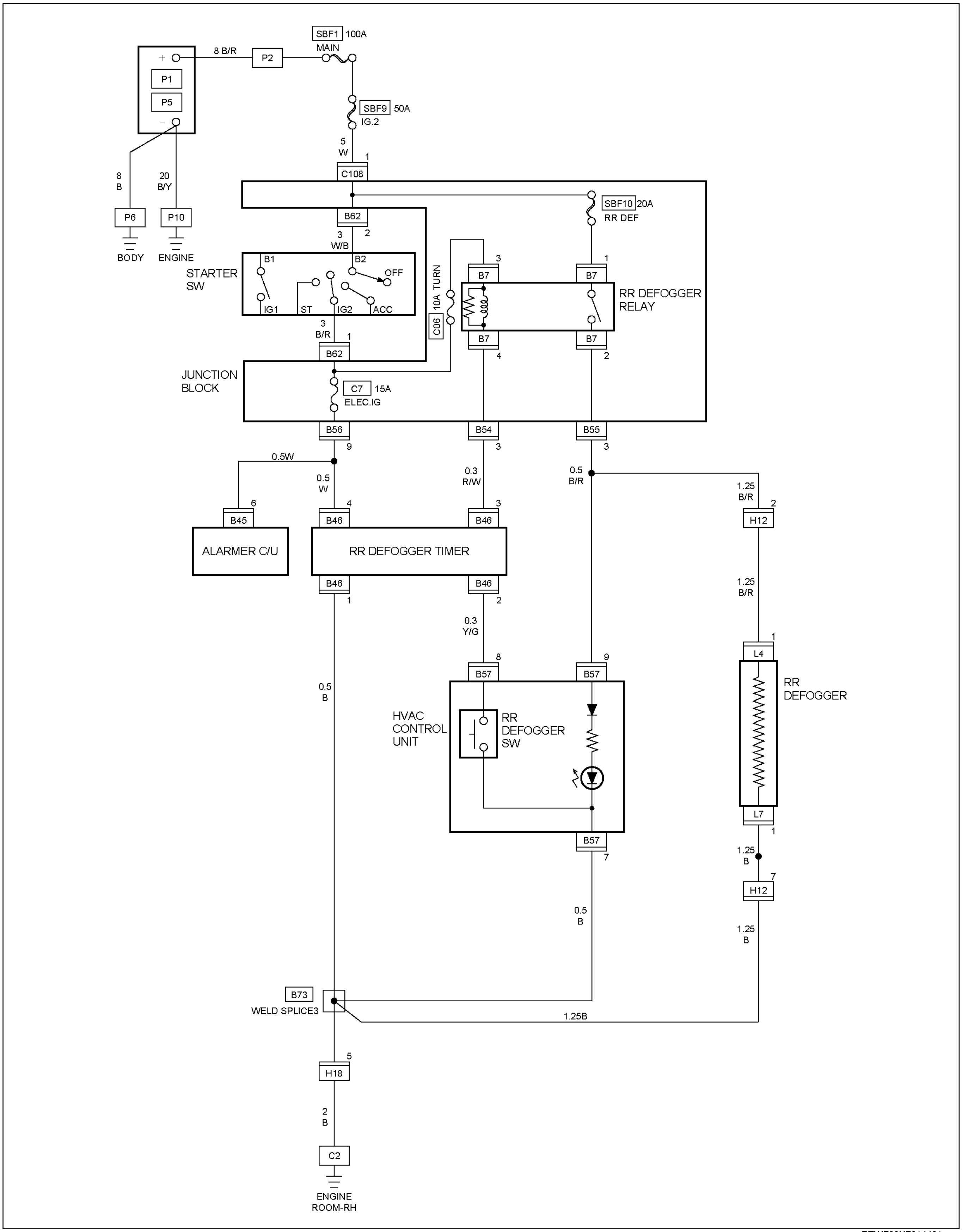


RTW34CLF000801

Disassembly Steps

1. Bolt
2. ▲ Brake caliper
3. ▲ Hub cap
4. Split pin
5. Nut retainer
6. Hub nut
7. Lock washer
8. Outer bearing
9. ▲ Hub and disc assembly
10. Oil seal
11. Inner bearing and outer race
12. ABS sensor rotor
13. ▲ Bolt
14. ▲ Wheel pin

CIRCUIT DIAGRAM C24SE (RHD)



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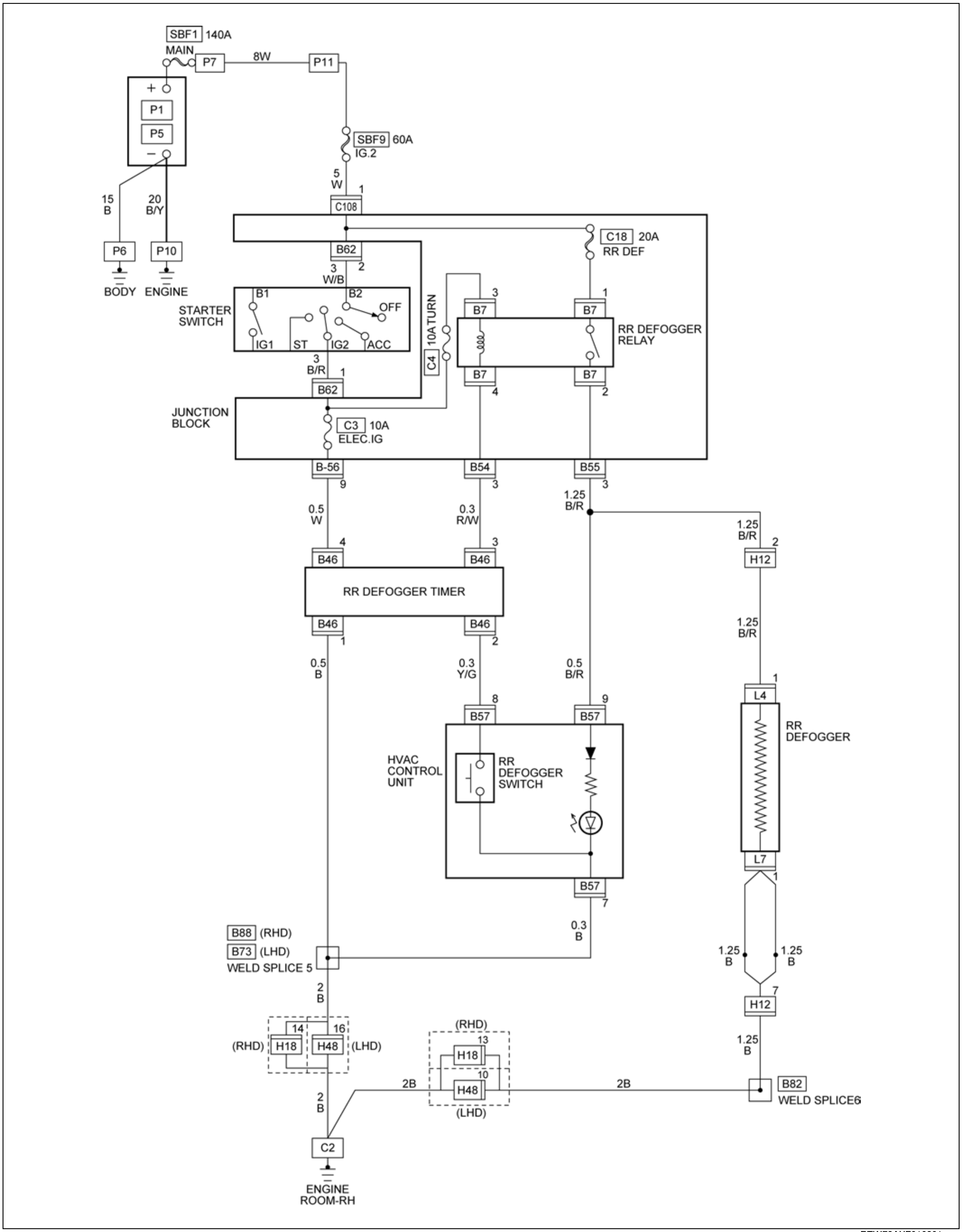
CIRCUIT DIAGRAM HFV6



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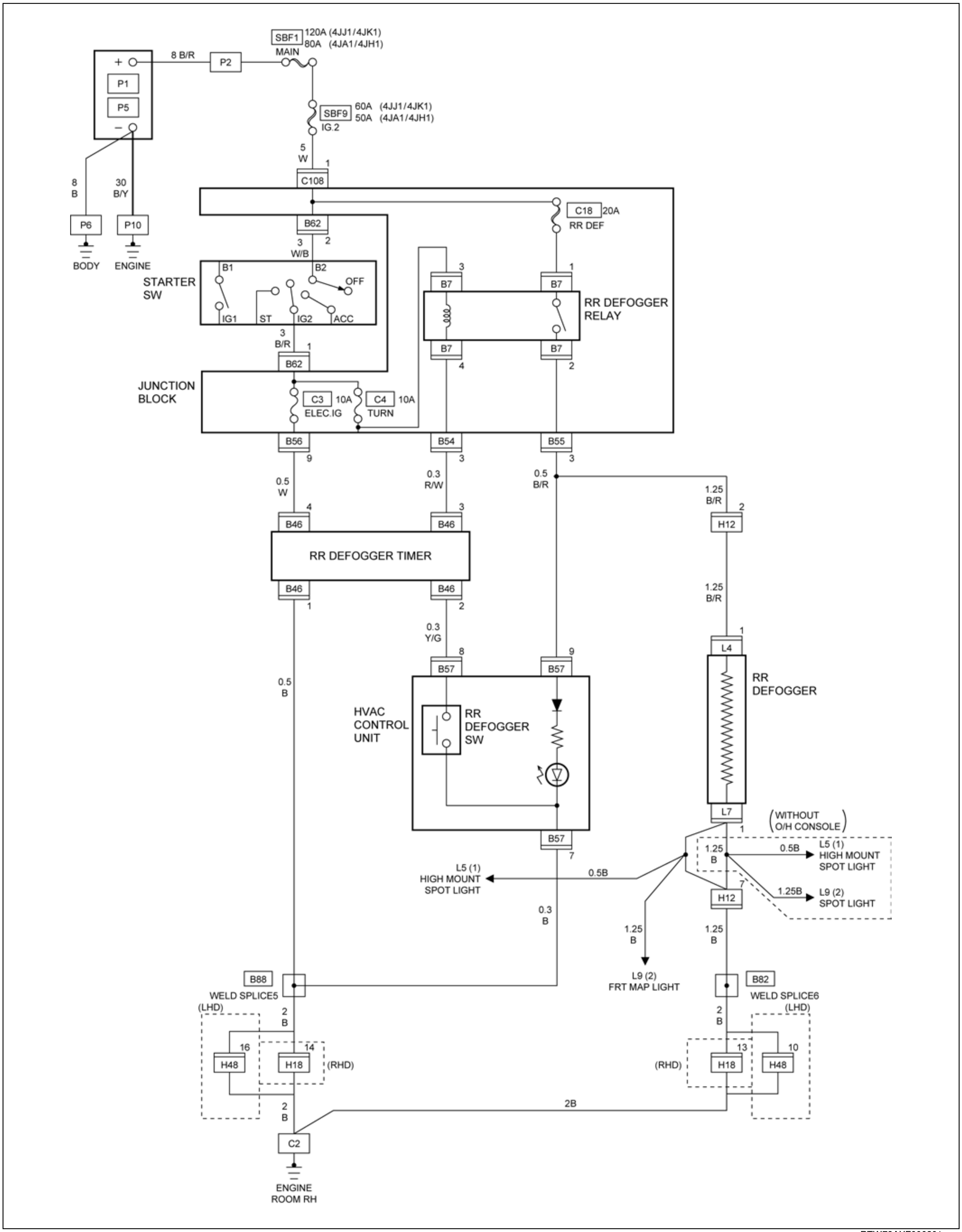
CIRCUIT DIAGRAM 4JA1T(L), 4JJ1-TC / 4JK1-TC, 4JH1-TC



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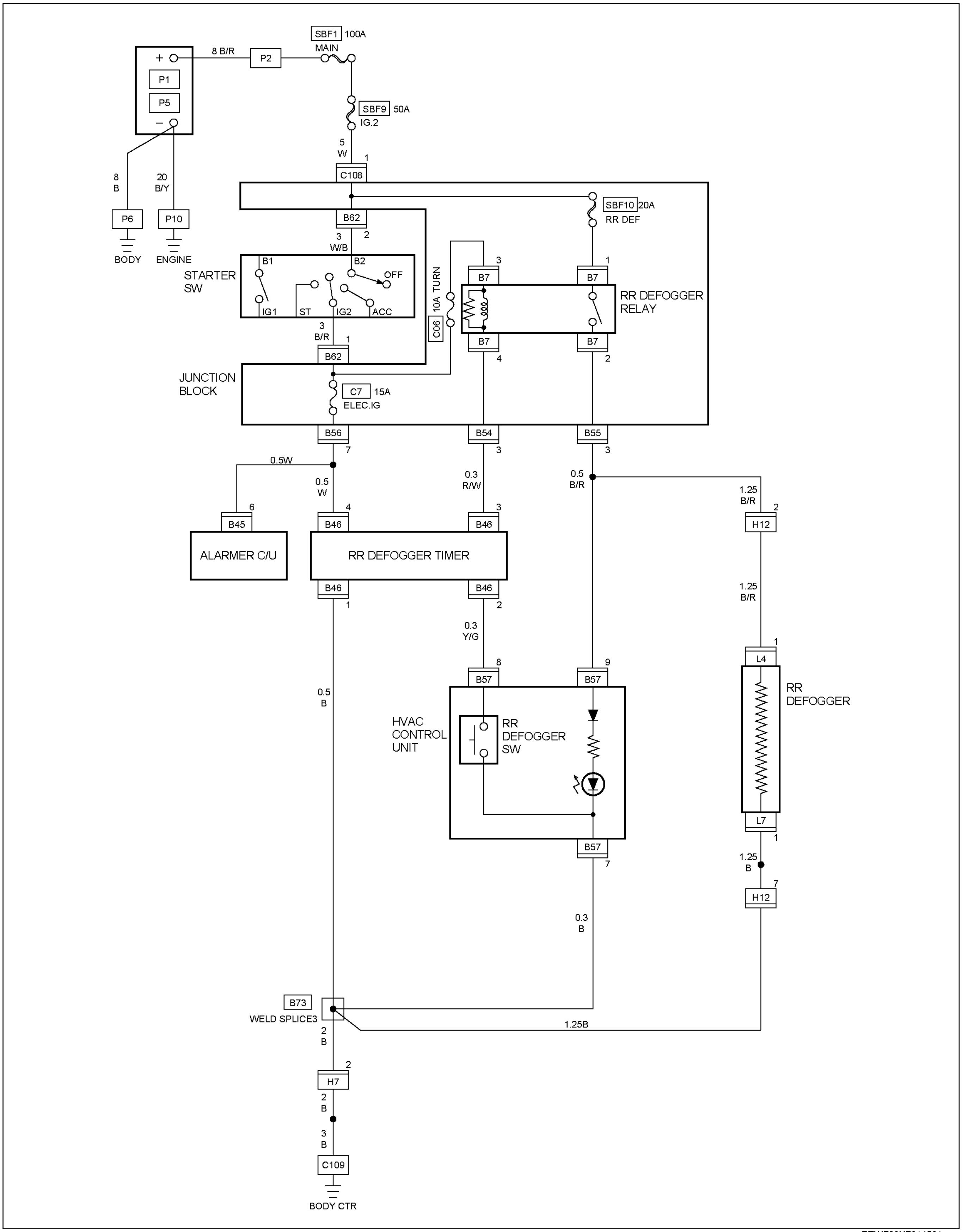
CIRCUIT DIAGRAM C24SE (LHD)



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TROUBLE SHOOTING

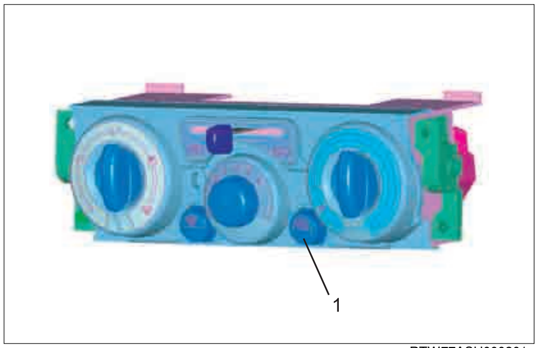
Rear defogger inoperative

Checkpoint		Trouble Cause	Countermeasure
Fuse No. C3 (10A, Fuse box) and 9 B56	NG	Poor fuse contact or blown	Reinstall or replace the fuse No. C7 (10A) and 9 B56
OK			
C18 (20A, Fuse box)	NG	Poor fuse contact or blown	Reinstall or replace the fuse C18 (20A)
OK			
Rear defogger switch function	NG	Switch malfunction	Replace the rear defogger switch
OK			
Rear defogger relay function	NG	Relay malfunction	Replace the rear defogger relay
OK			
Grounding point C2	NG	Poor grounding point contact	Repair grounding point contact
OK			
Voltage between 1 L4 - ground when the starter switch and the rear defogger switch are at on position (should be battery voltage present)	NG	Open circuit or poor connector contact	Repair open circuit or poor connector contact between fuse No. C3 (10A) and 3 B7, C18 (20A) and 1 B7, 2 B7 (3 B55) and 1 L4, 4 B7 (3 B54) and 3 B46 or 1 B46 and C2

Continued on the next page

Checkpoint		Trouble Cause	Countermeasure
Continued from the previous page			
OK			
Continuity between 1 L7 and C2	NG	Open circuit or poor connector contact	Repair open circuit or connector contact between 1 L7 and C2
OK			
Continuity between rear defogger terminals	NG	Broken heat wire of rear defogger	Repair heat wire

REMOVAL AND INSTALLATION



RTW77ASH000201

REAR DEFOGGER SWITCH

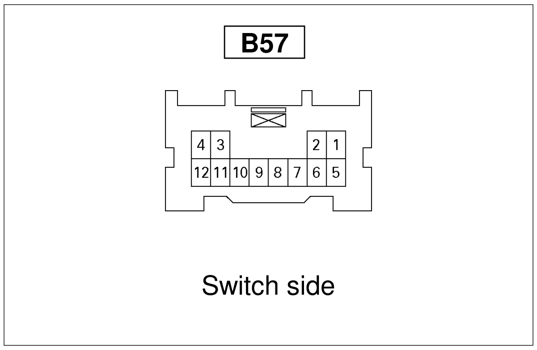
Removal

1. Instrument Panel Cluster Assembly
   - Refer to Section 10 “BODY” for center cluster panel assembly removal steps.
2. Rear Defogger Switch (With HVAC control unit) (1)
   Refer to Section 1 “HVAC” HVAC control unit assembly removal steps.

Installation

Follow the removal procedure in the reverse order to install the rear defogger switch.

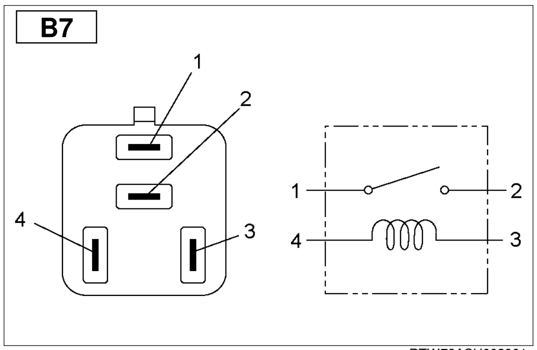
INSPECTION AND REPAIR



REAR DEFOGGER SWITCH

Rear Defogger Switch Connections

SW position \ Terminal No.	9	7	8
ON	○	○	○
OFF	○	○	



RTW78ASH002901

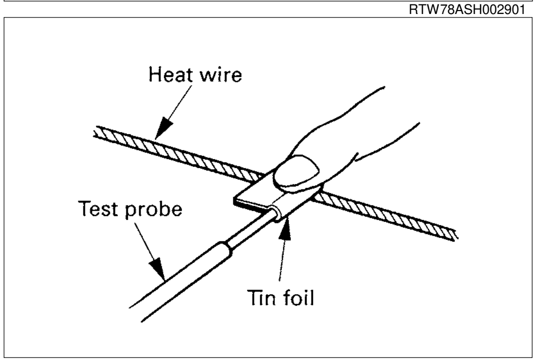
REAR DEFOGGER RELAY

Check continuity between the relay terminals.

②- ① .... No continuity

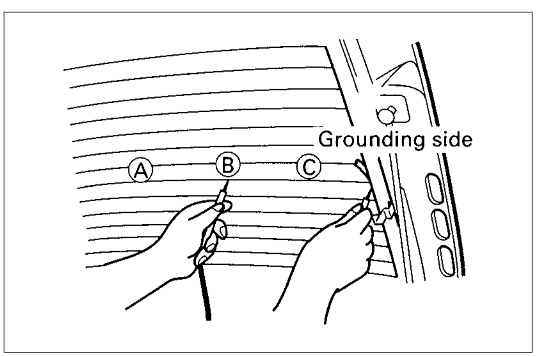
(When battery voltage is applied between ④ and ③)

②- ① .... Continuity

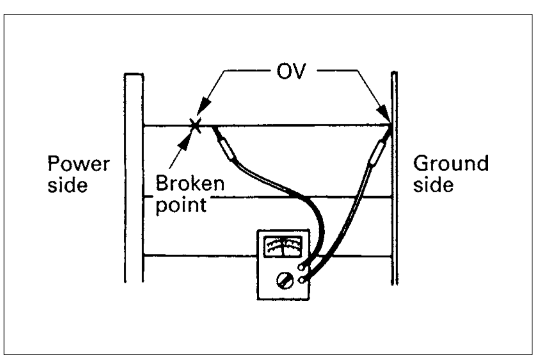


INSPECTION OF REAR DEFOGGER HEAT WIRE

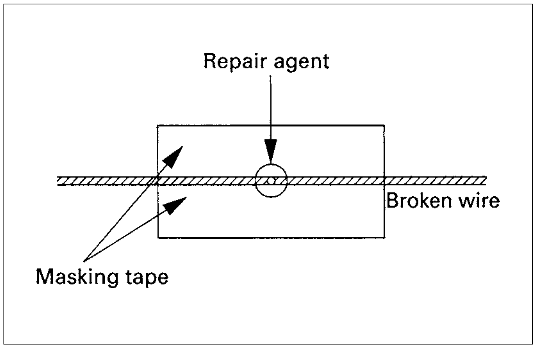
- Heat wires are printed on the inner side of glass. To clean, use a soft cloth and wipe horizontally along the wires.
- Never use glass cleaner or equivalent.
- When measuring voltage, wind a piece of tin foil around the tip of the negative probe and press the foil against the wire with your finger as shown.



(1) Turn the ignition switch on.
(2) Turn the defogger switch on.
(3) Measure the voltage between the three points on the heat wire and the (-) terminal with a voltmeter.
(4) Check that the voltage becomes smaller from Ⓐ to Ⓑ to Ⓒ.

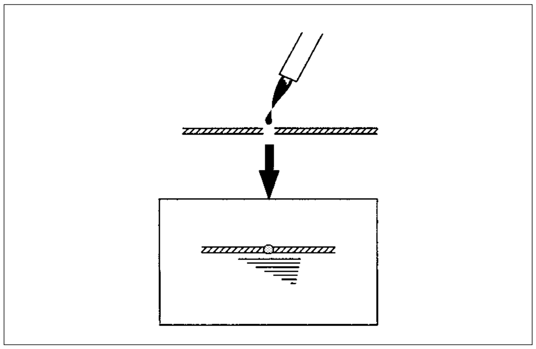


(5) If there is a place where the voltage suddenly changes to 0V, there is a broken wire between there and the power side.
(6) Move the tester probe from the position where the voltage changes to 0V toward the power side and find where the voltage suddenly increases.



REPAIR OF BROKEN HEAT WIRE

(1) Clean broken wire tips with white gasoline.
(2) Place masking tape along both sides of wire to be repaired.



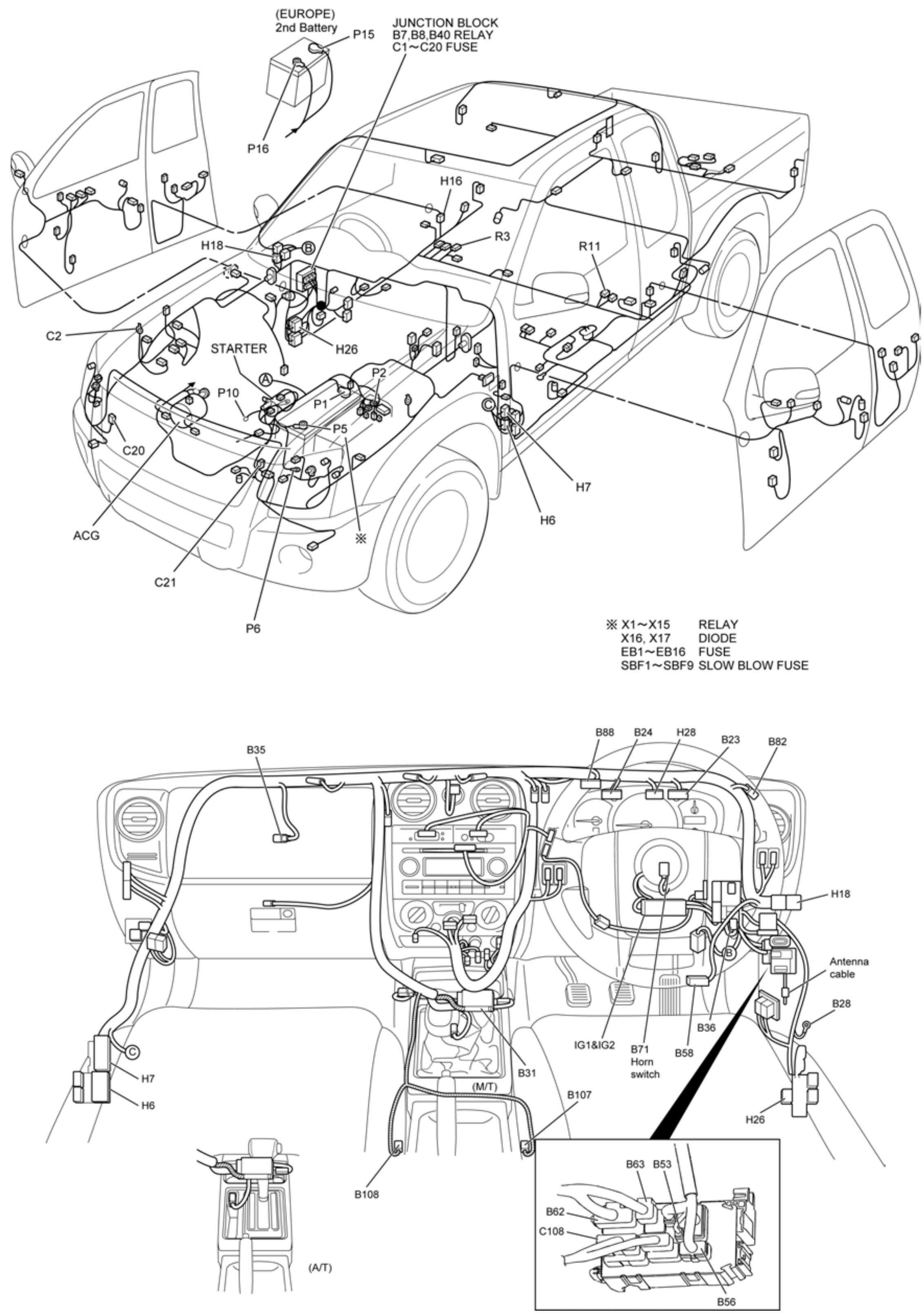
(3) Thoroughly mix the repair agent (Dupont paste No. 4817 or equivalent).
(4) Using a fine tip brush, apply a small amount to the wire.
(5) After a couple of minutes, remove the masking tape.
(6) Allow to stand at least 24 hours.

BACK TO CHAPTER INDEX

ISUZU KB P190 2007
TO MODEL INDEX

SUPPLEMENTAL RESTRAINT SYSTEM (SRS) -AIR BAG

PARTS LOCATION (RHD)



RTW78AXF040301 & RTW78AXF046501

Important Operations

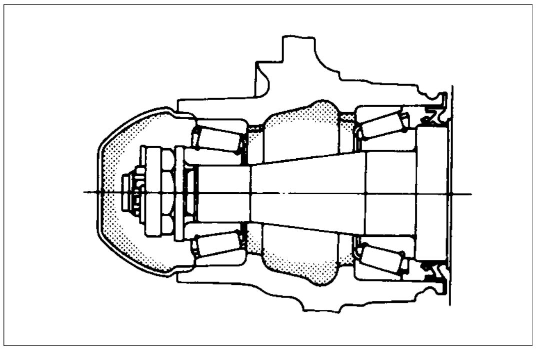
Before removal, jack up the front of vehicle and support frame with jack stands.

2. Brake Caliper

(1) Remove the two bolts from the rear side of the knuckle arm, then remove the brake caliper, with the brake hose attached.

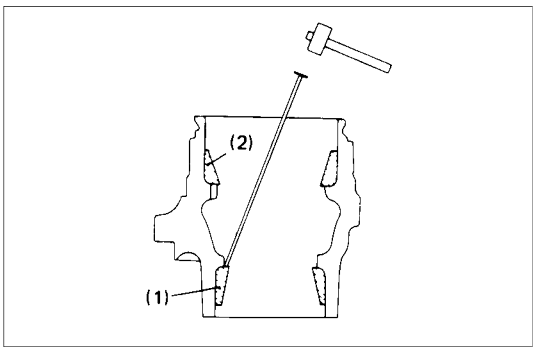
(2) Use a wire etc., for attaching the brake caliper to the upper link.

Refer to the section Brake.



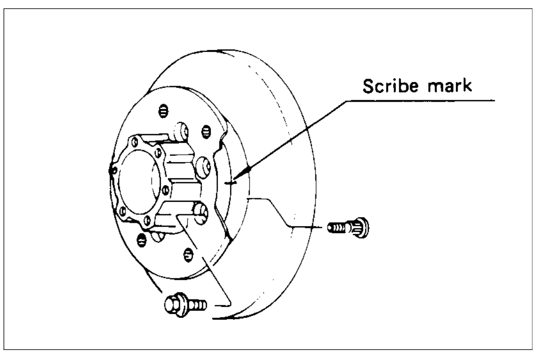
3. Hub Cap

When removing hub cap, exercise care so as not to scratch or distort hub fitting face.



9. Hub and Disc Assembly

Using a brass bar to remove the outer bearing outer race (1), oil seal, inner bearing and inner bearing outer race (2) from the hug.



If necessary, replace the wheel pin in the following manner.

13. Bolt

14. Wheel Pin ; Front Hub

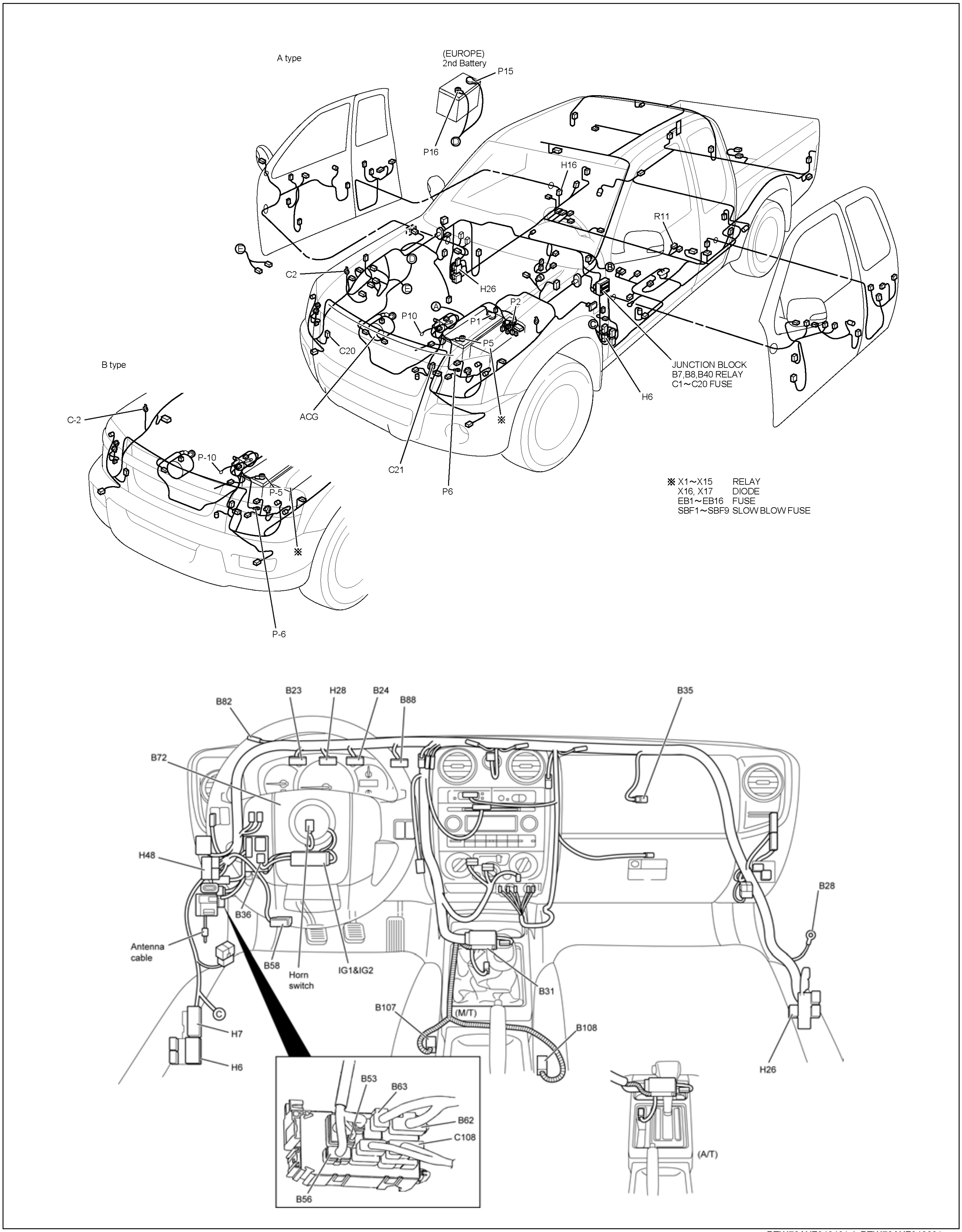
(1) Scribe mark on hub to disc before disassembly to insure proper assembly.

(2) Drive out the ABS sensor rotor using a metal bar and hammer through the two bolt holes.

- Discard the used ABS sensor rotor

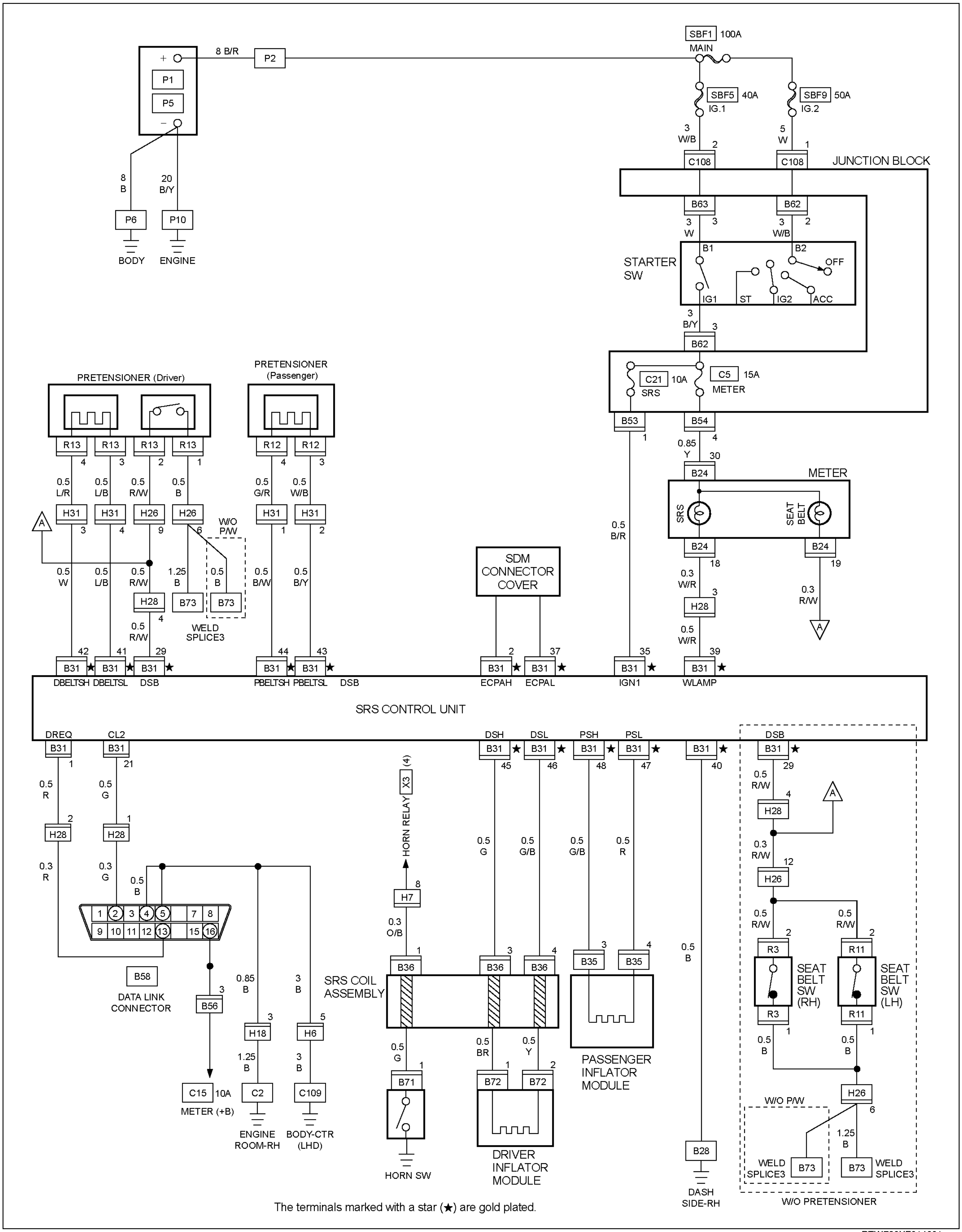
Refer to the section Brake.

PARTS LOCATION (LHD)

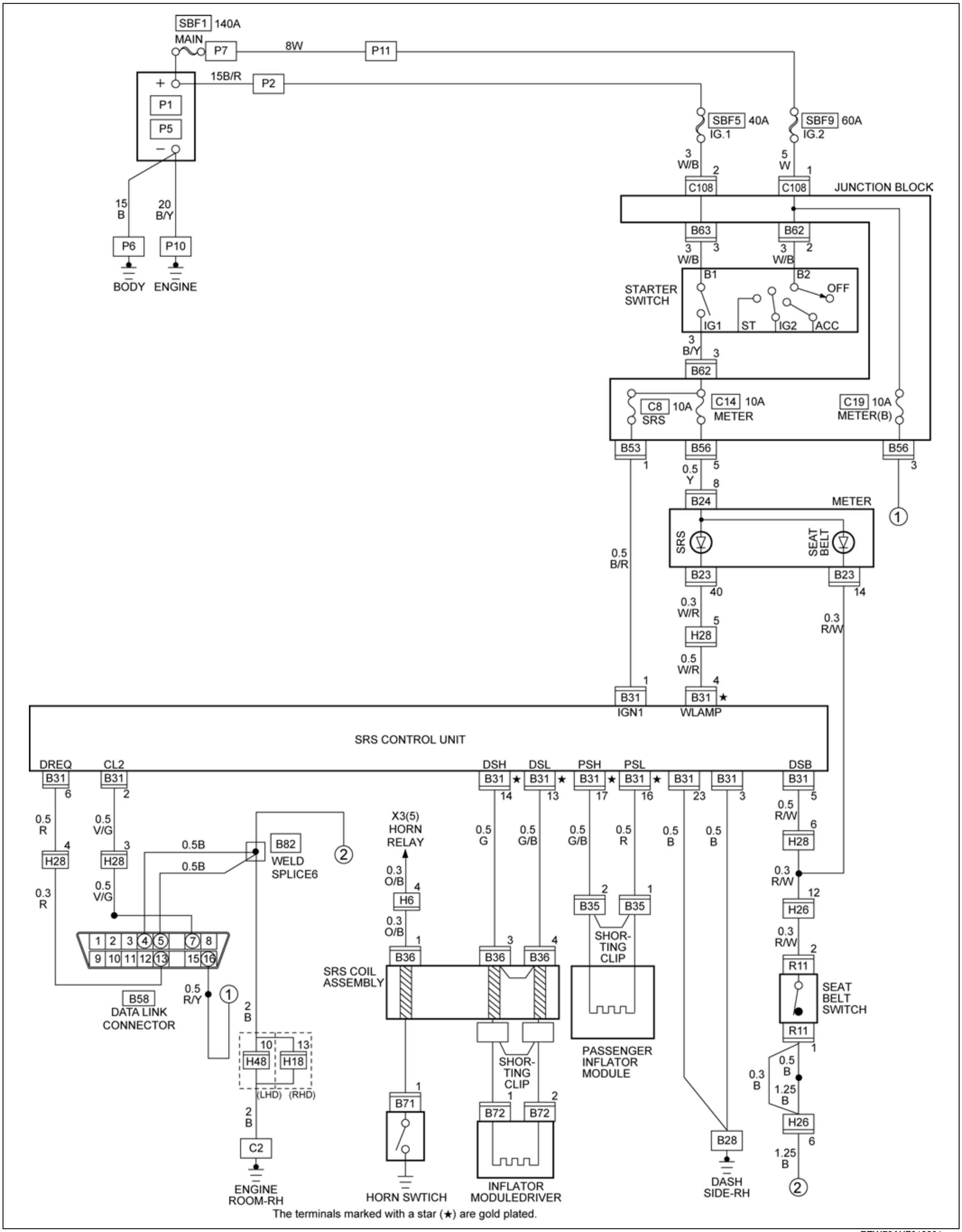


RTW78AXF040401 & RTW78AXF046601

CIRCUIT DIAGRAM C24SE

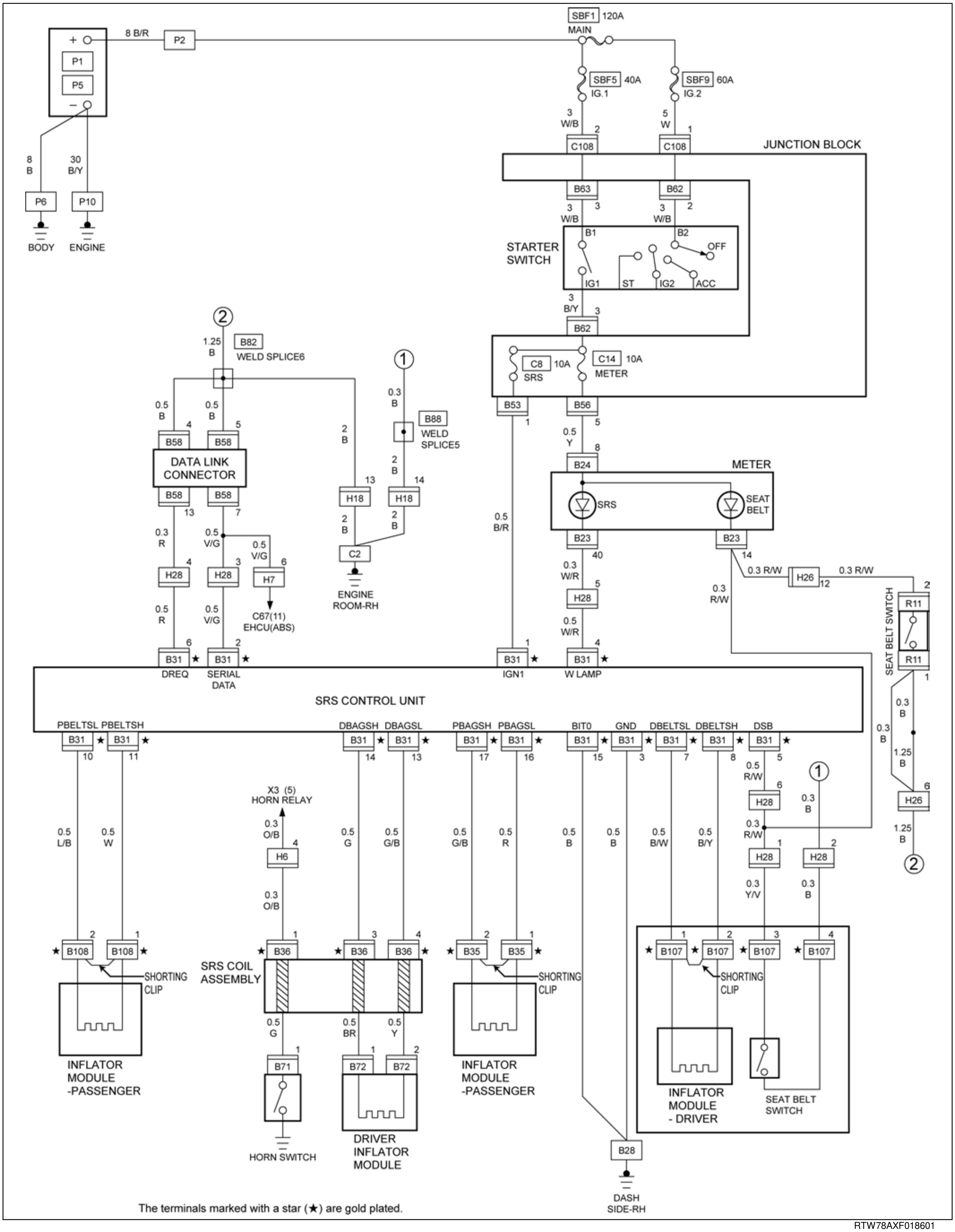


CIRCUIT DIAGRAM HFV6

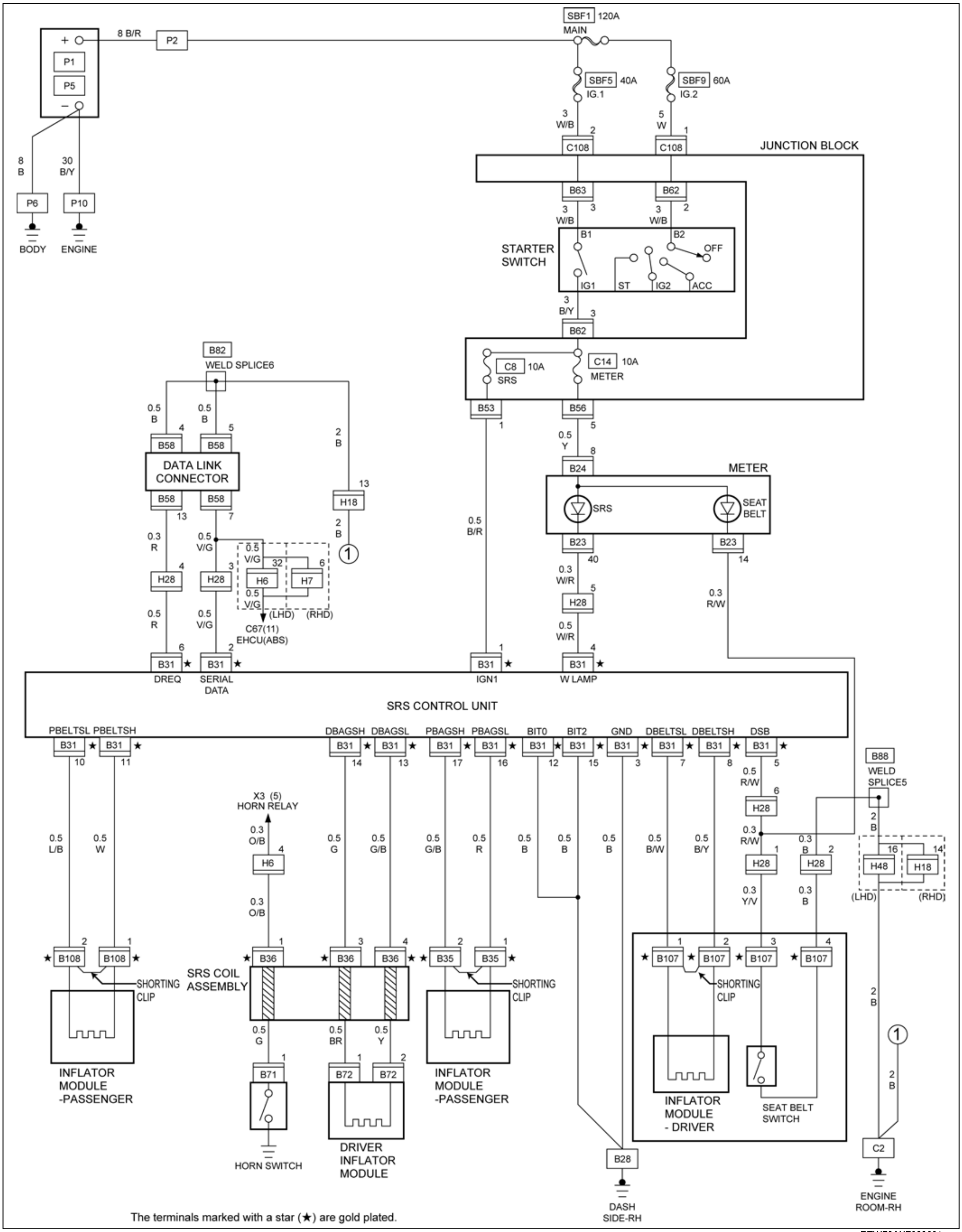


RTW78AXF013301

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) SOUTH AFRICA

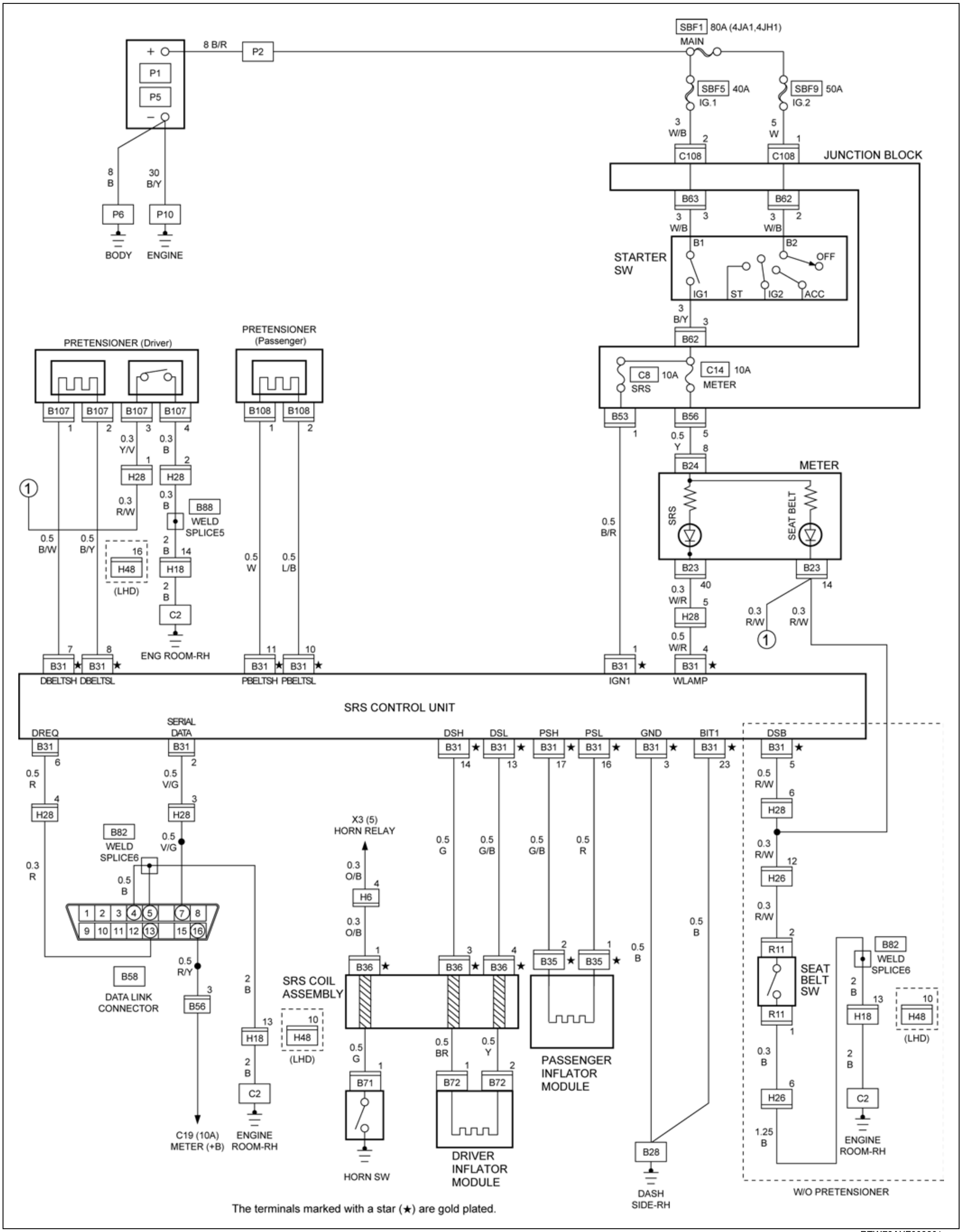


CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA



RTW78AXF028601

CIRCUIT DIAGRAM 4JA1T(L), 4JH1-TC

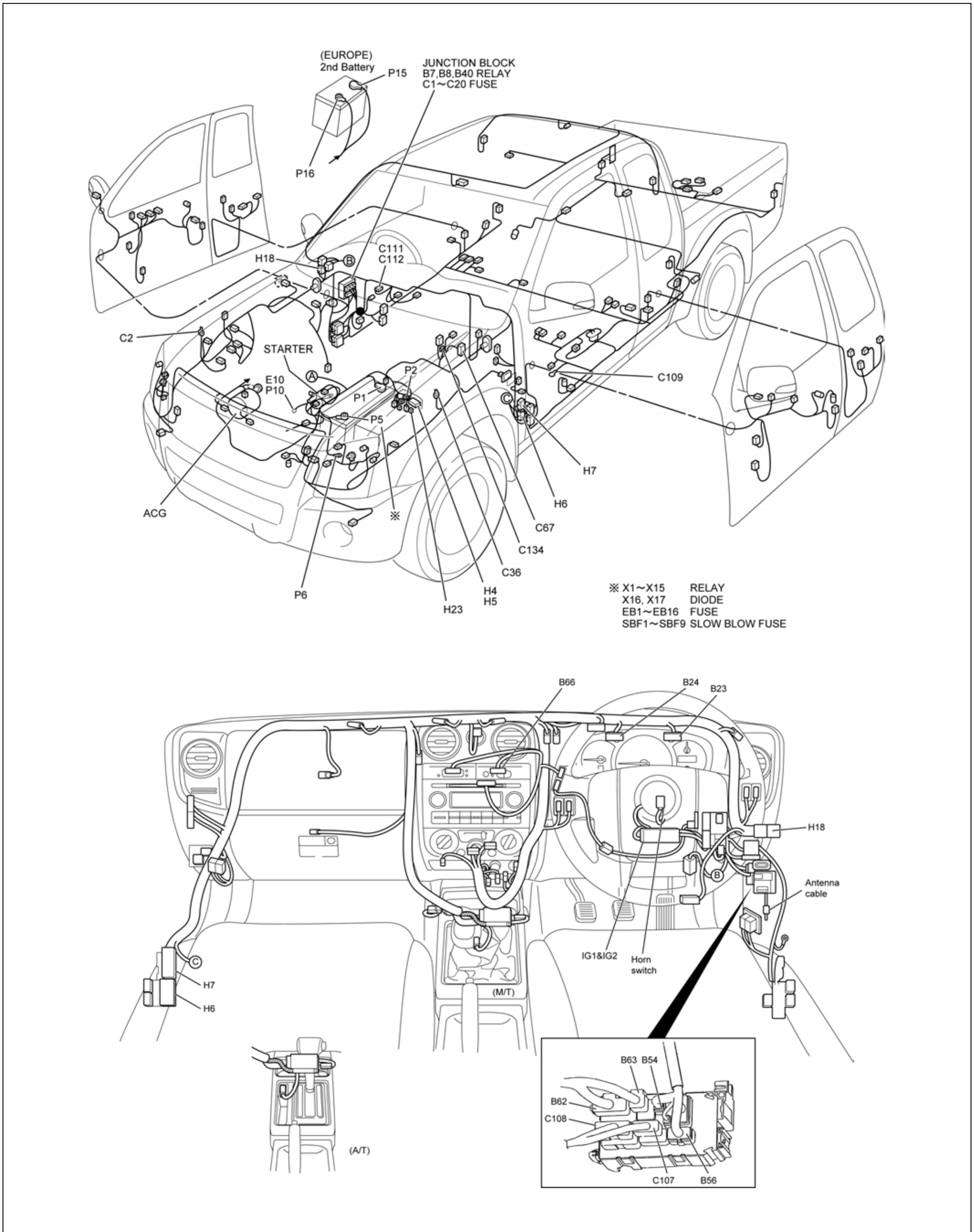


The terminals marked with a star (★) are gold plated.

RTW78AXF009801

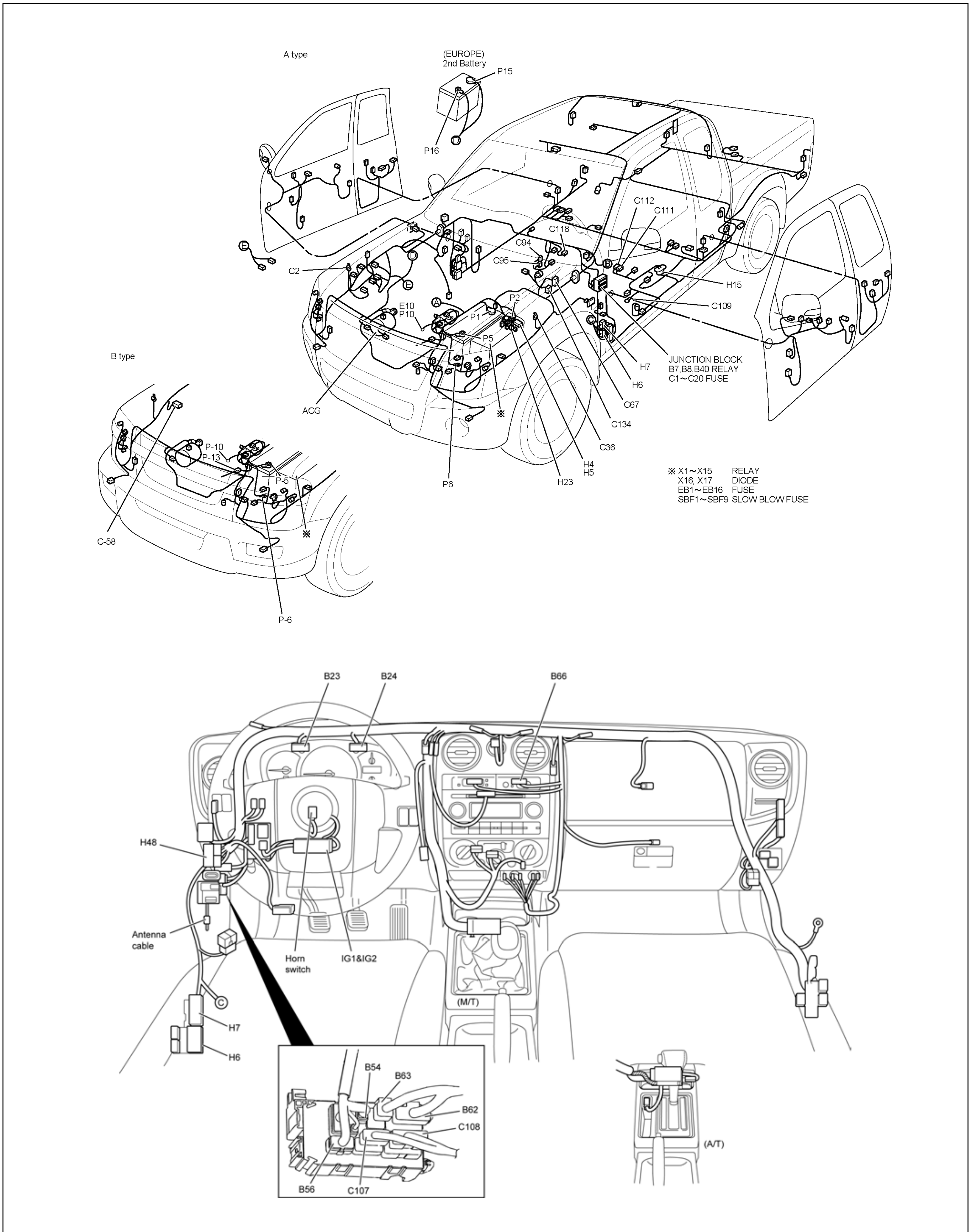
TRANSFER CASE CONTROL MODULE

PARTS LOCATION (RHD)



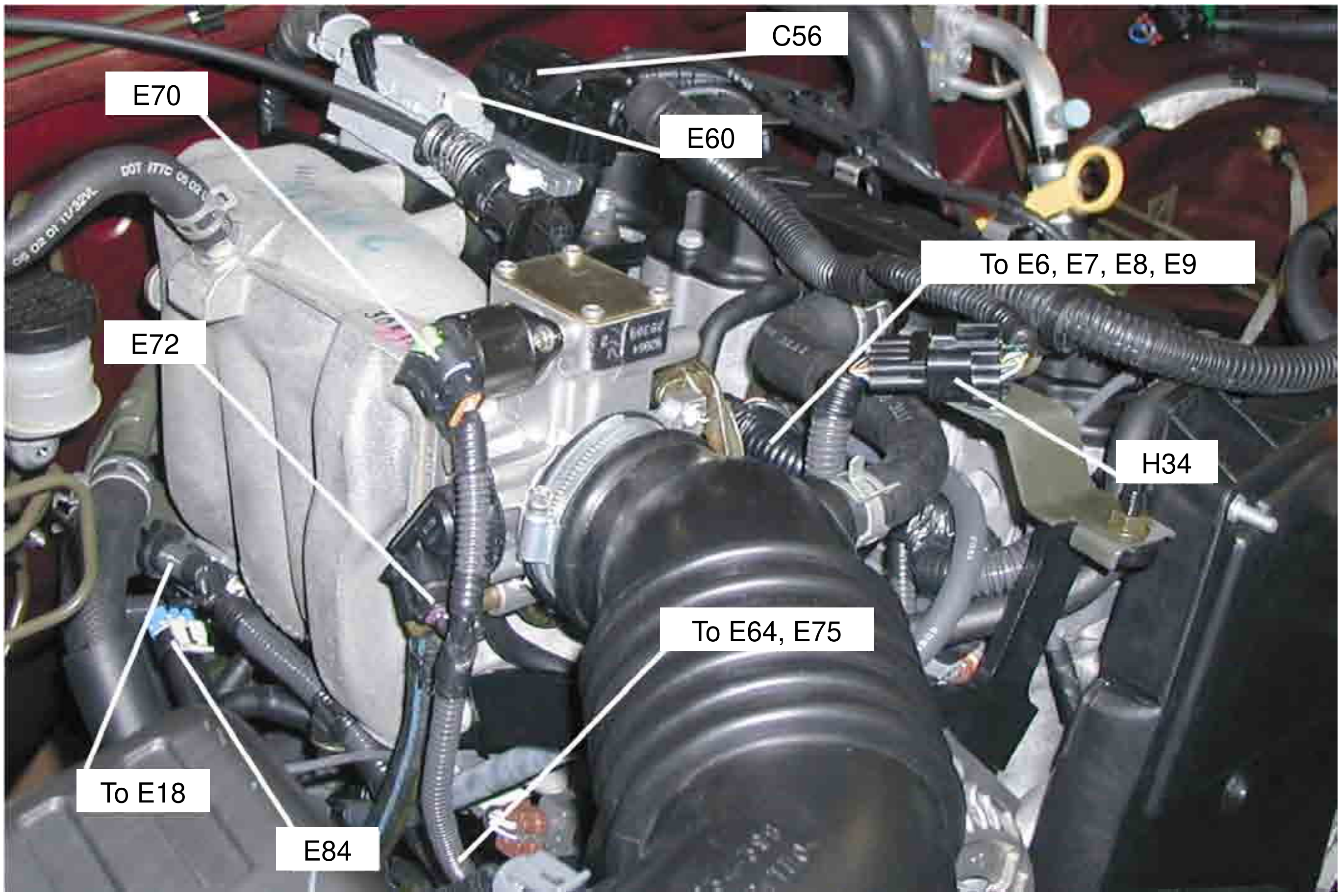
RTW78AXF040501 & RTW78AXF046701

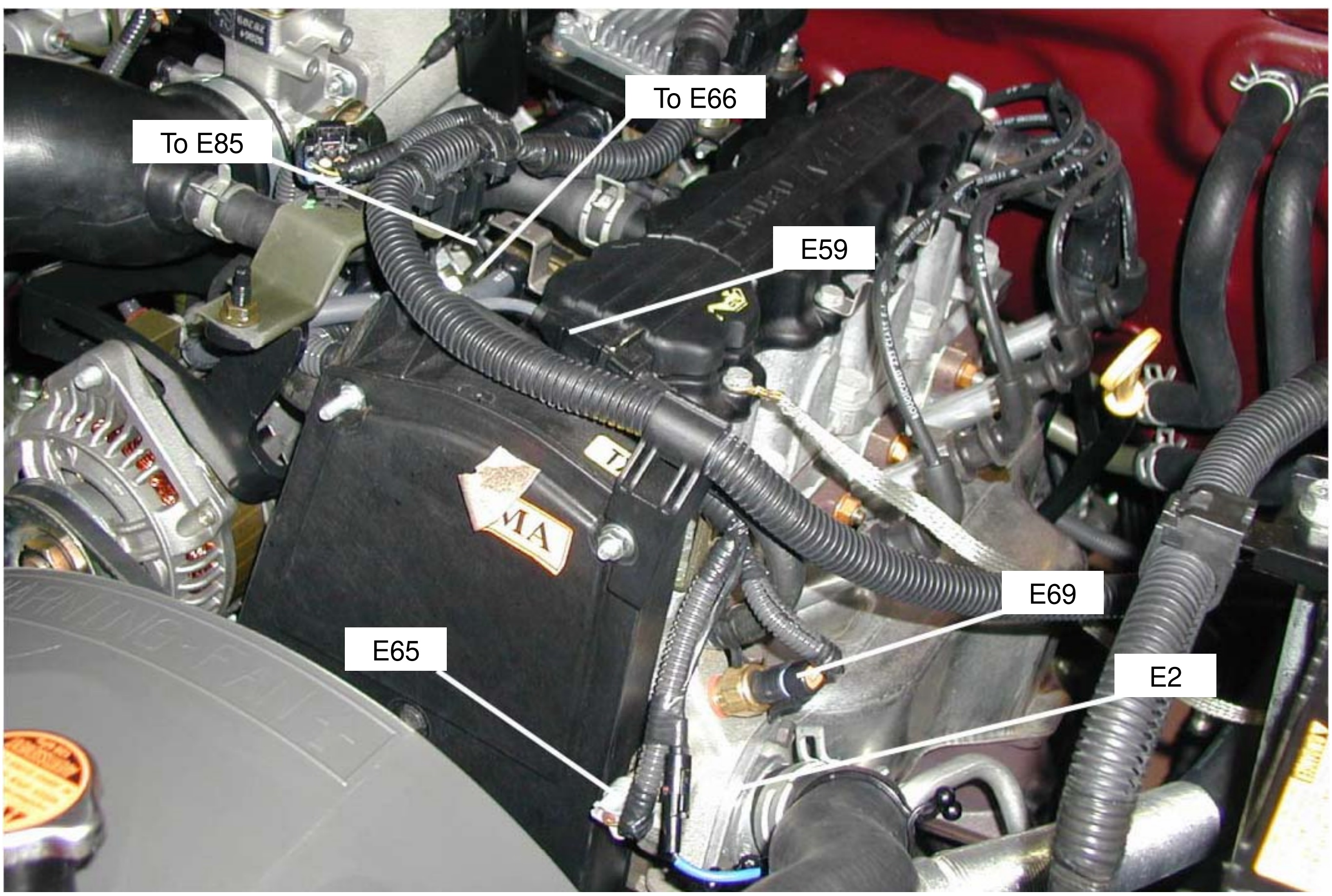
PARTS LOCATION (LHD)



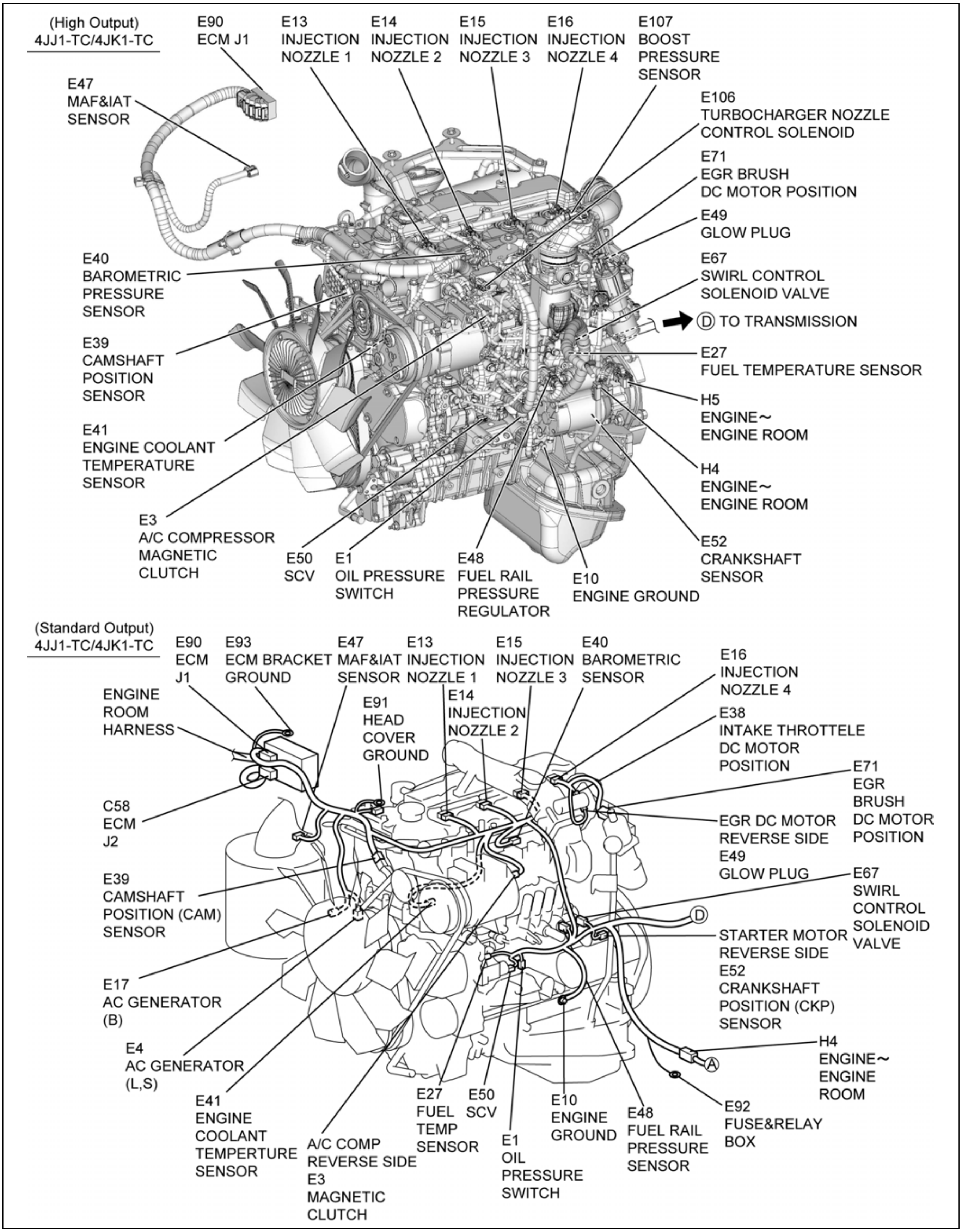
RTW78AXF040601 & RTW78AXF046801

PARTS LOCATION C24SE





PARTS LOCATION 4JJ1-TC / 4JK1-TC



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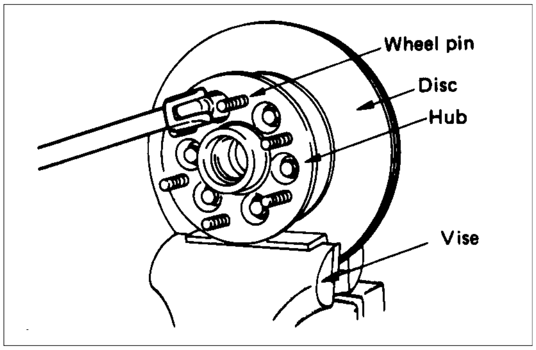
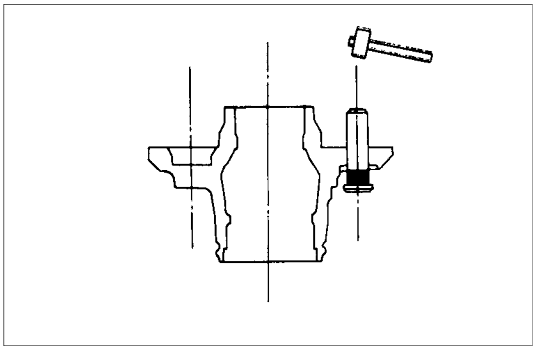
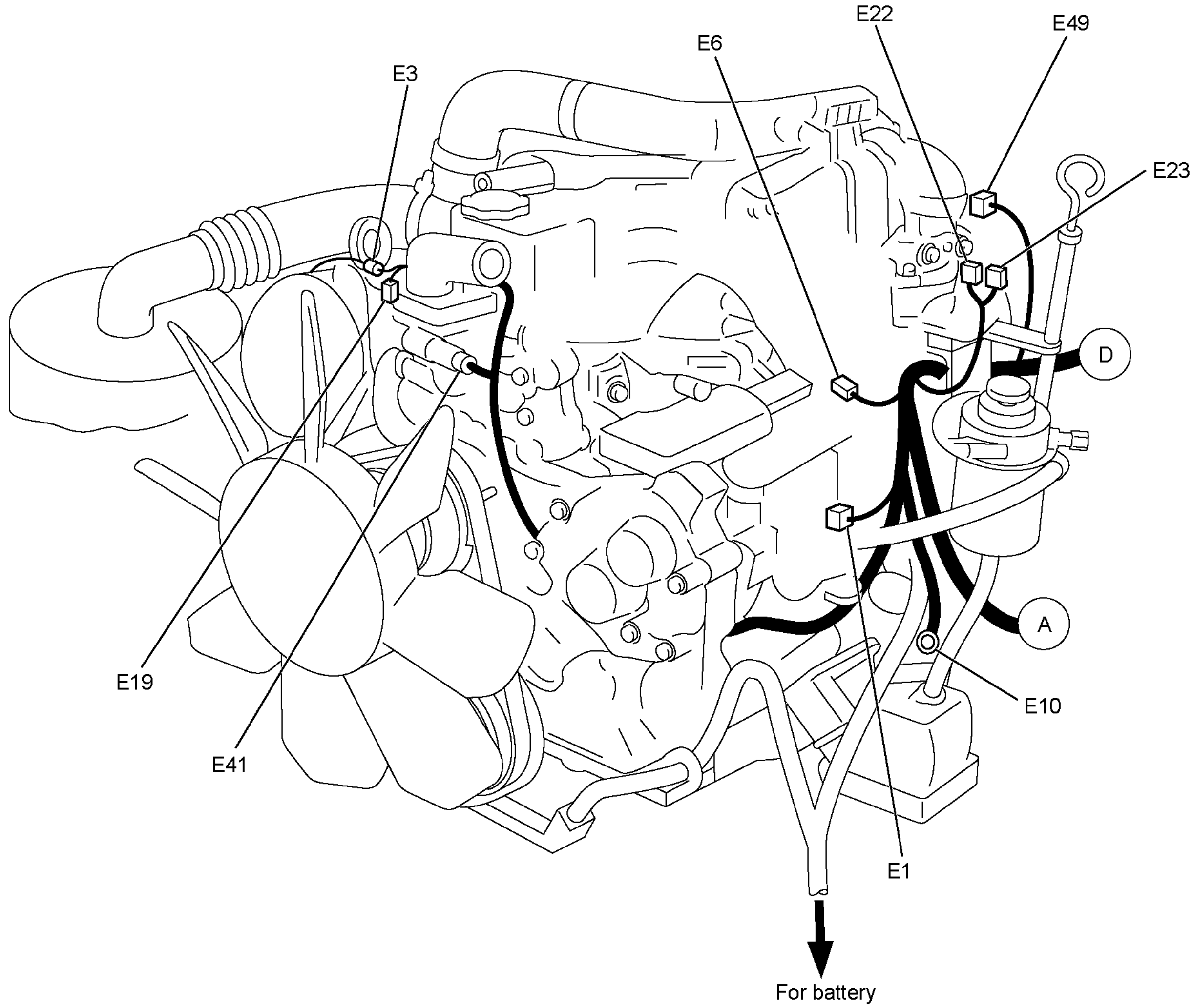


(3) Clamp hub and disc assembly in vise using protective pads and remove six (6) disc to hub retaining bolts.



(4) Place hub on a suitable work surface and remove wheel studs, as required, using a hammer.

PARTS LOCATION 4JH1-TC



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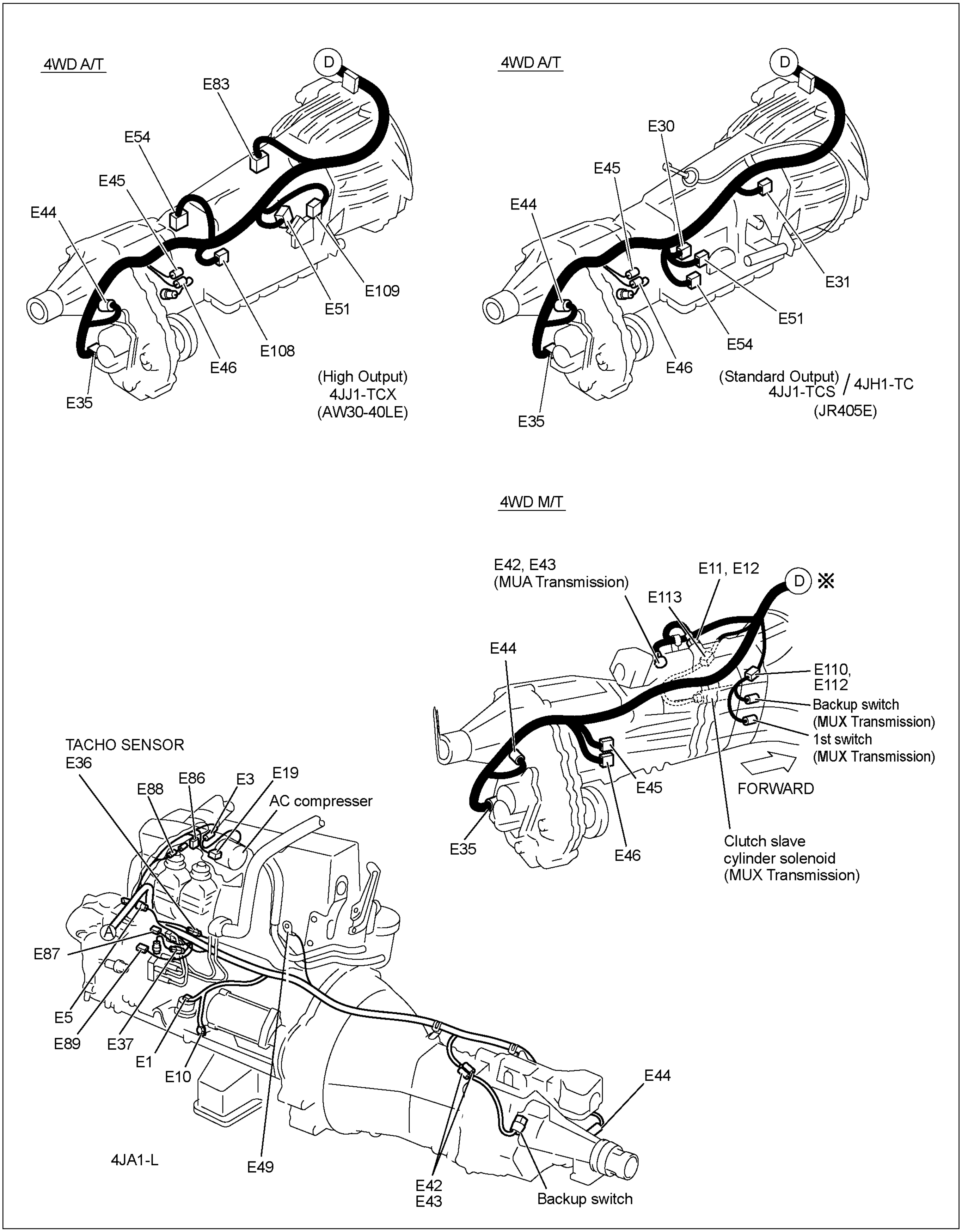
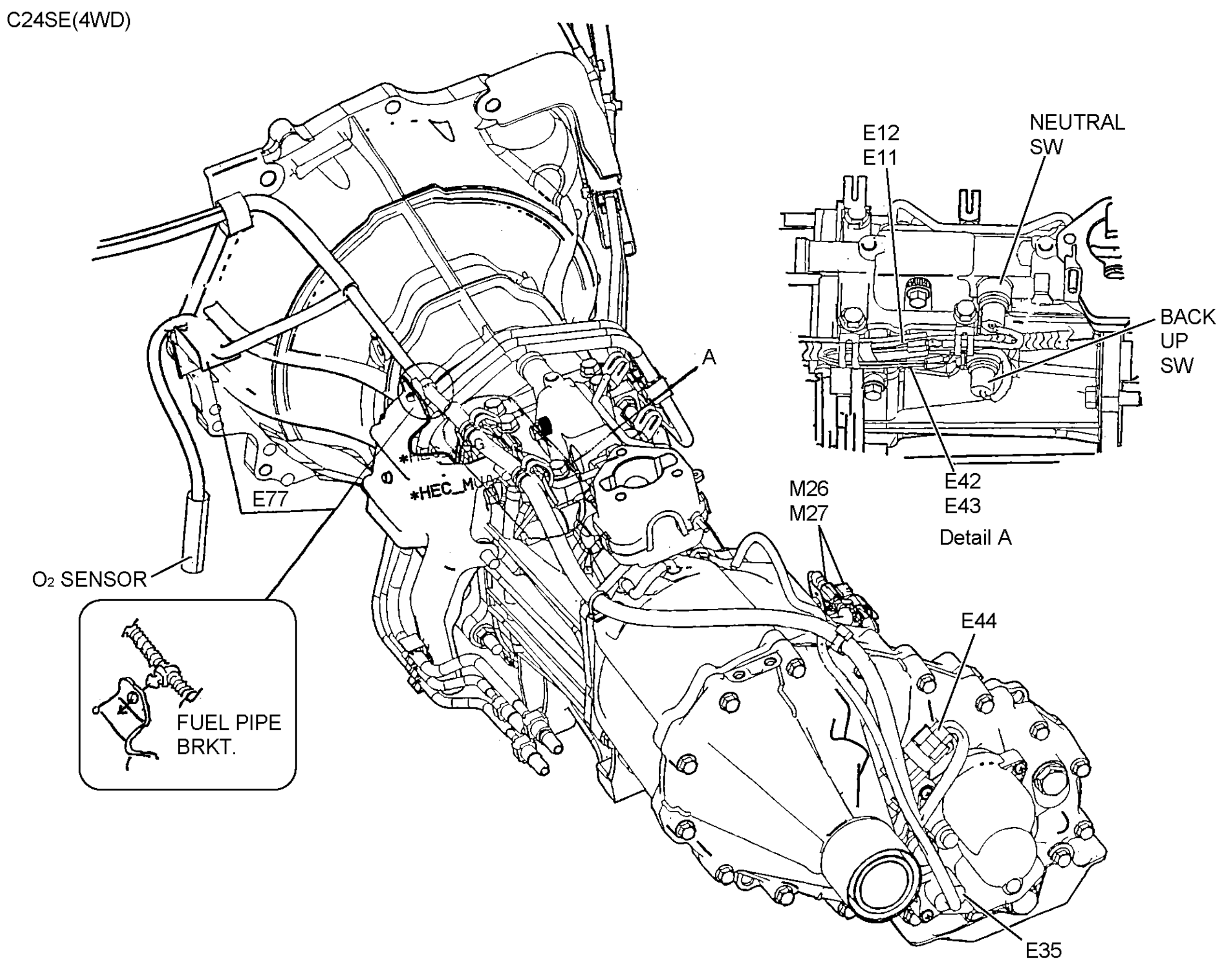
PARTS LOCATION



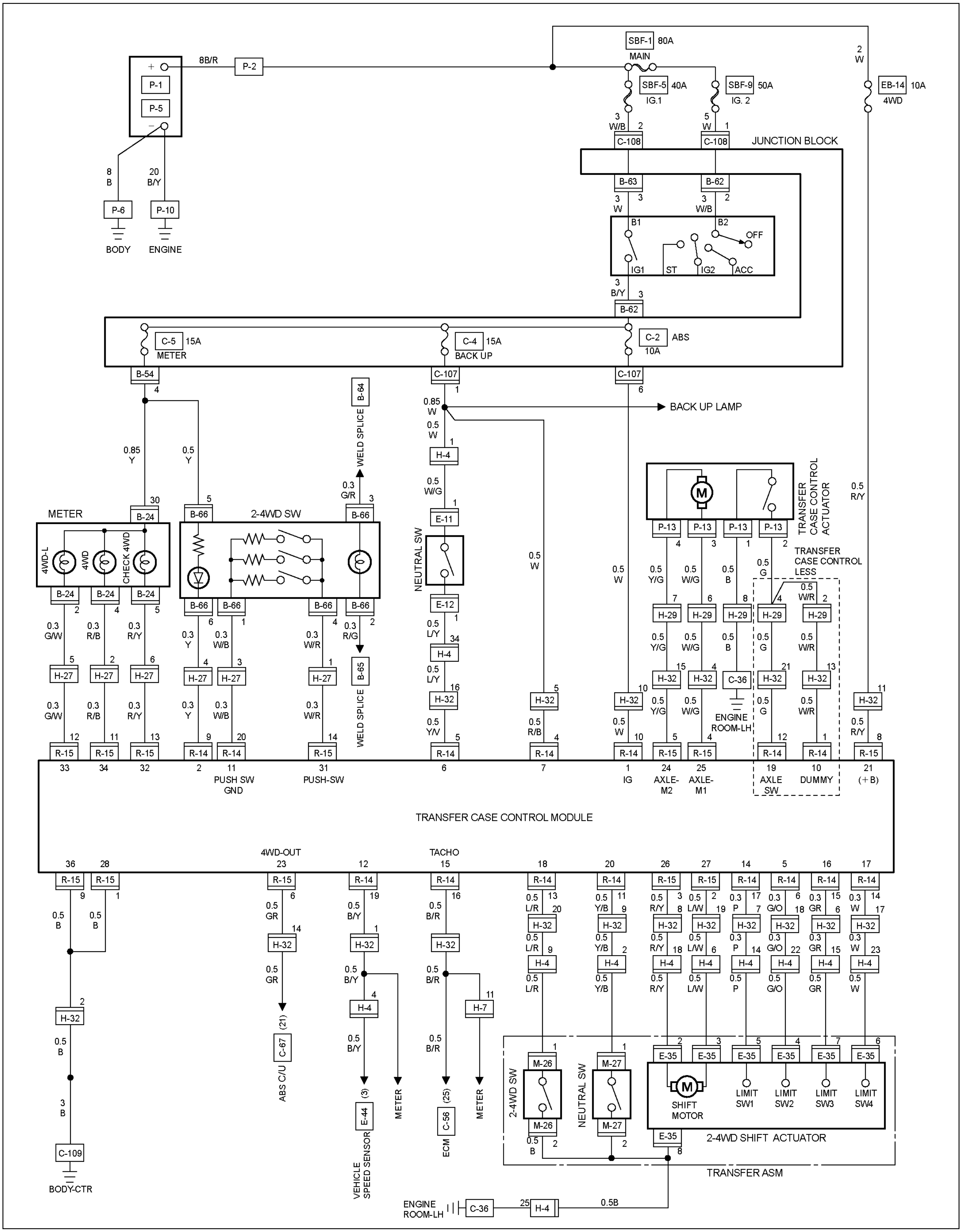
RTW78AXF035901

PARTS LOCATION



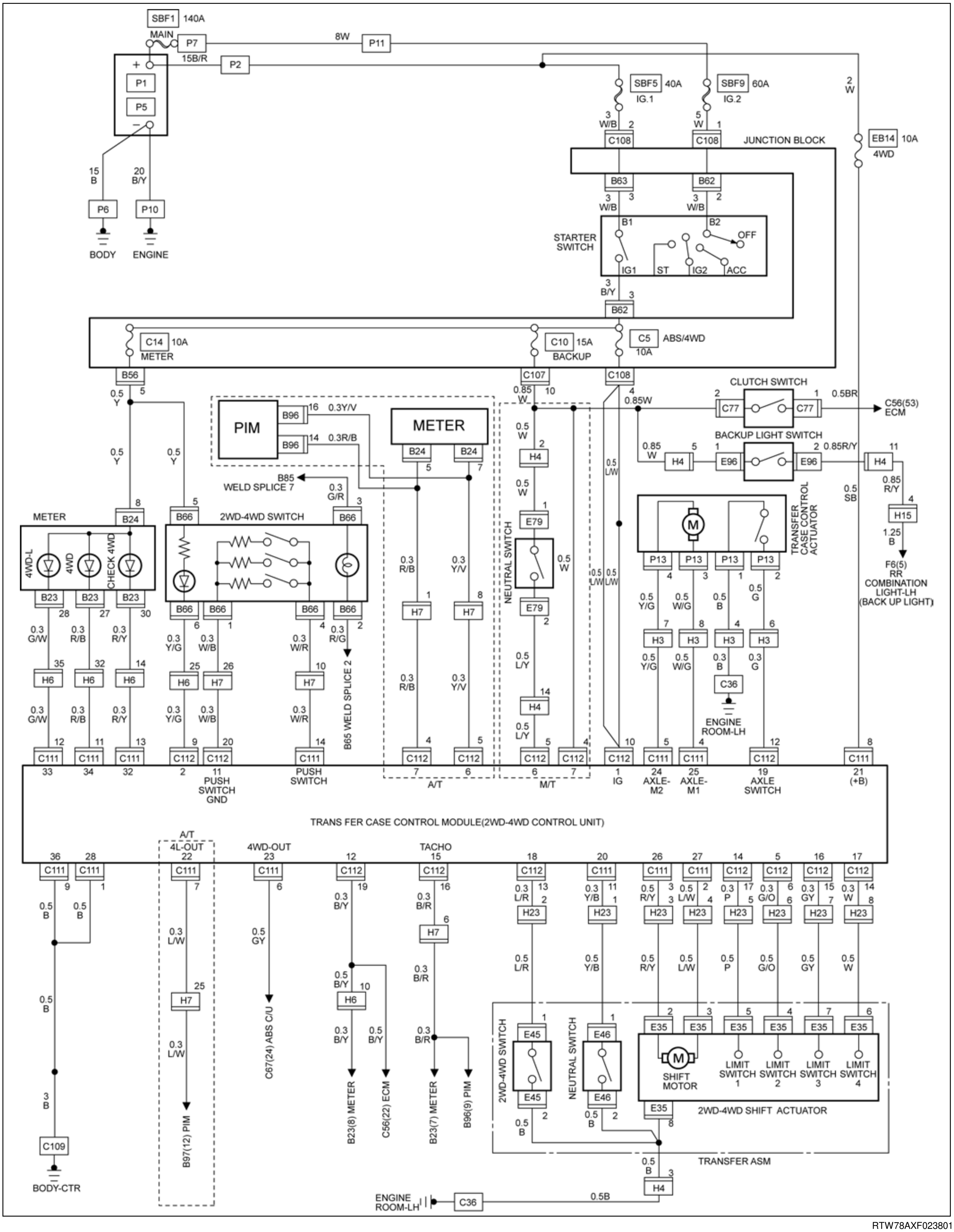
RTW78AXF036001

CIRCUIT DIAGRAM C24SE



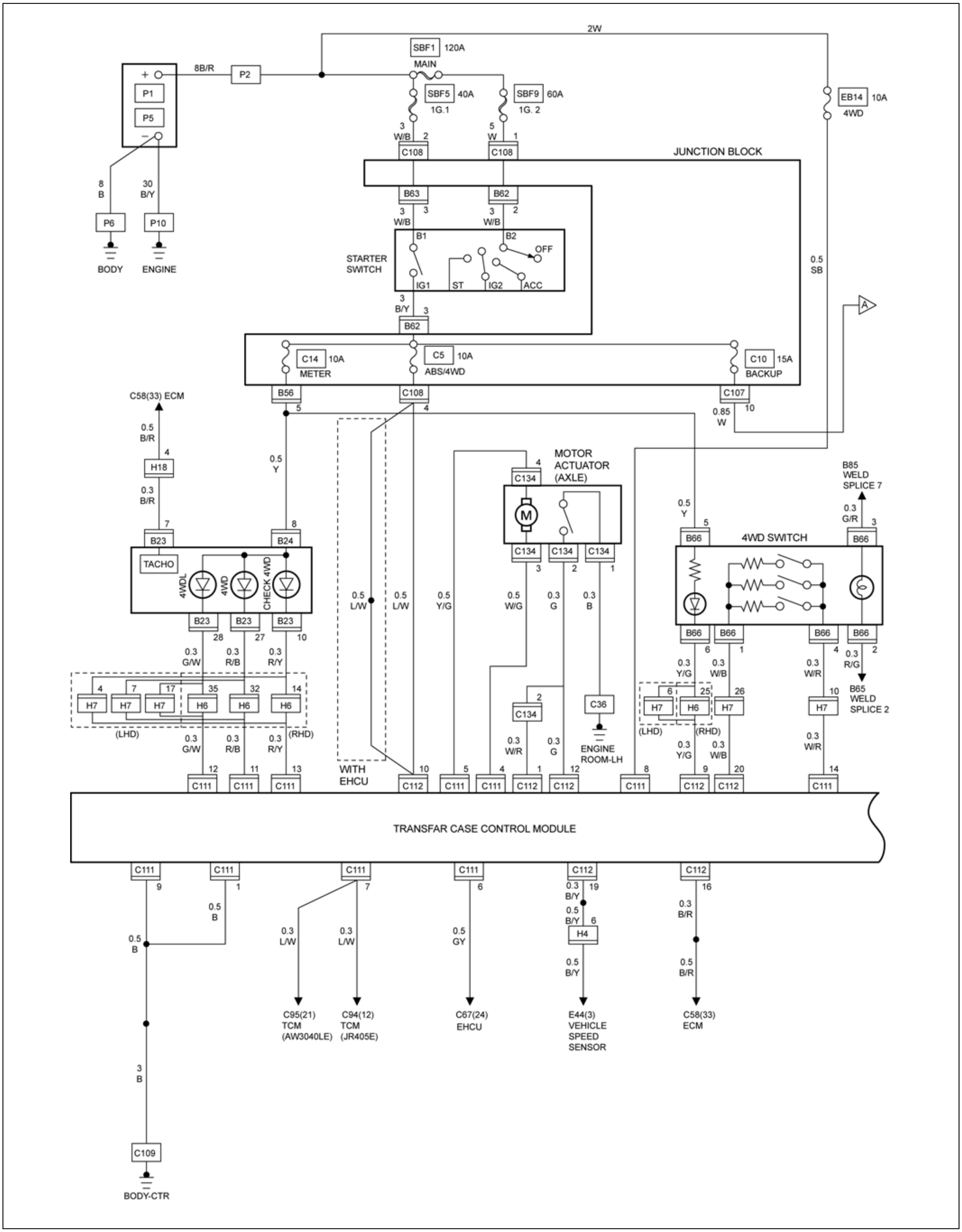
RTW680XF014201

CIRCUIT DIAGRAM HFV6 (RHD)



CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC

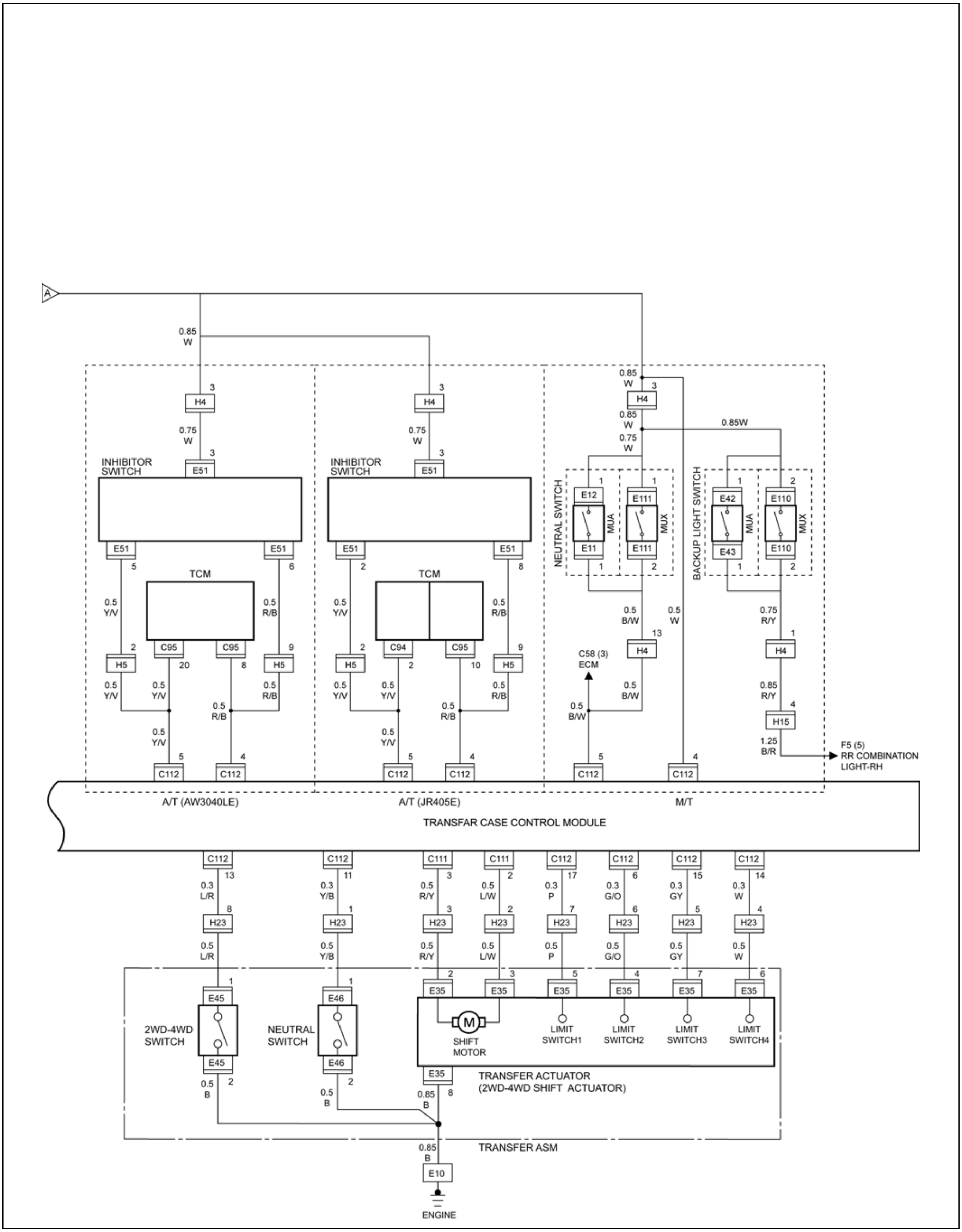
Sheet 1/2



RTW78AXF025801

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC

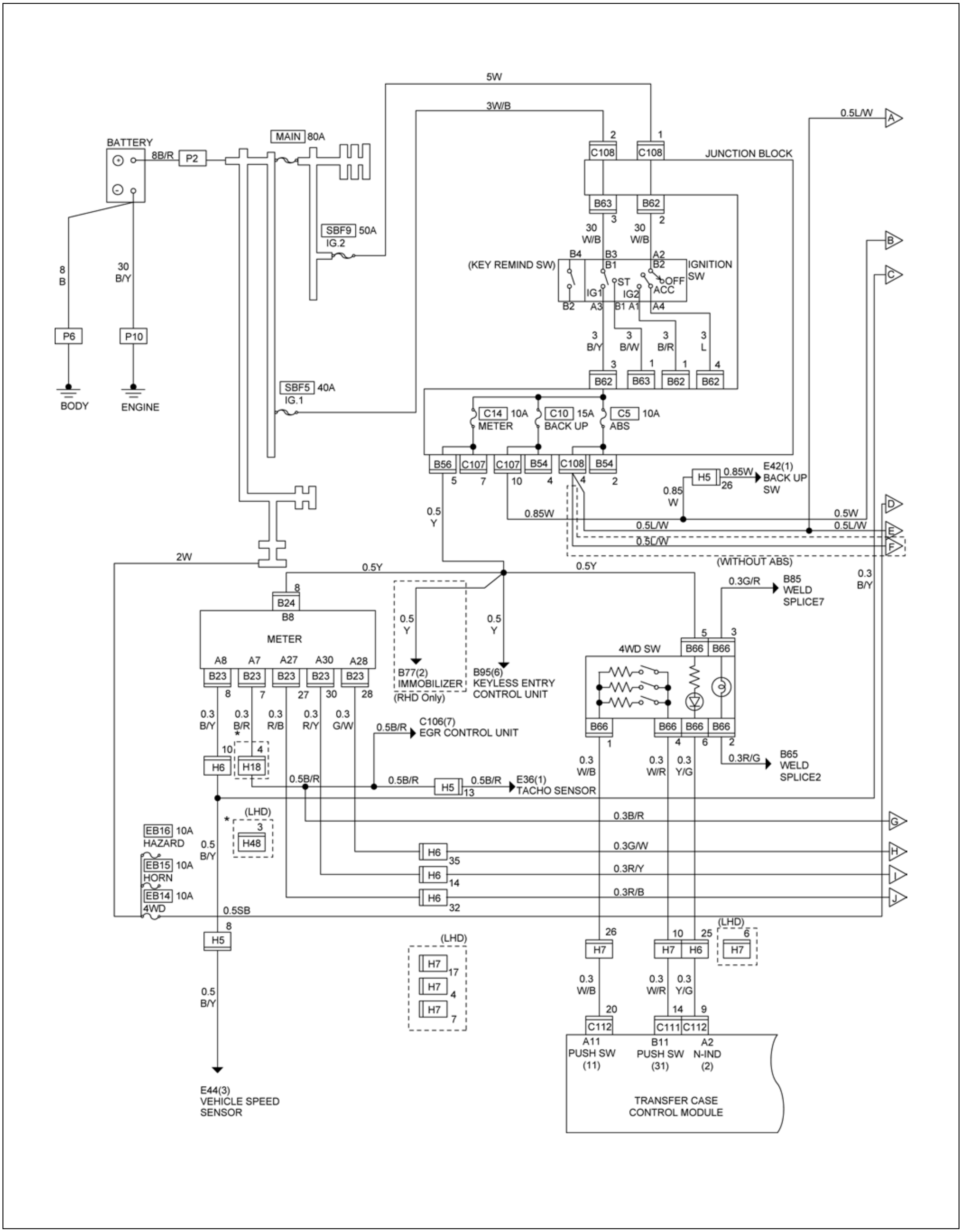
Sheet 2/2



RTW78AXF022501

CIRCUIT DIAGRAM 4JA1T(L)

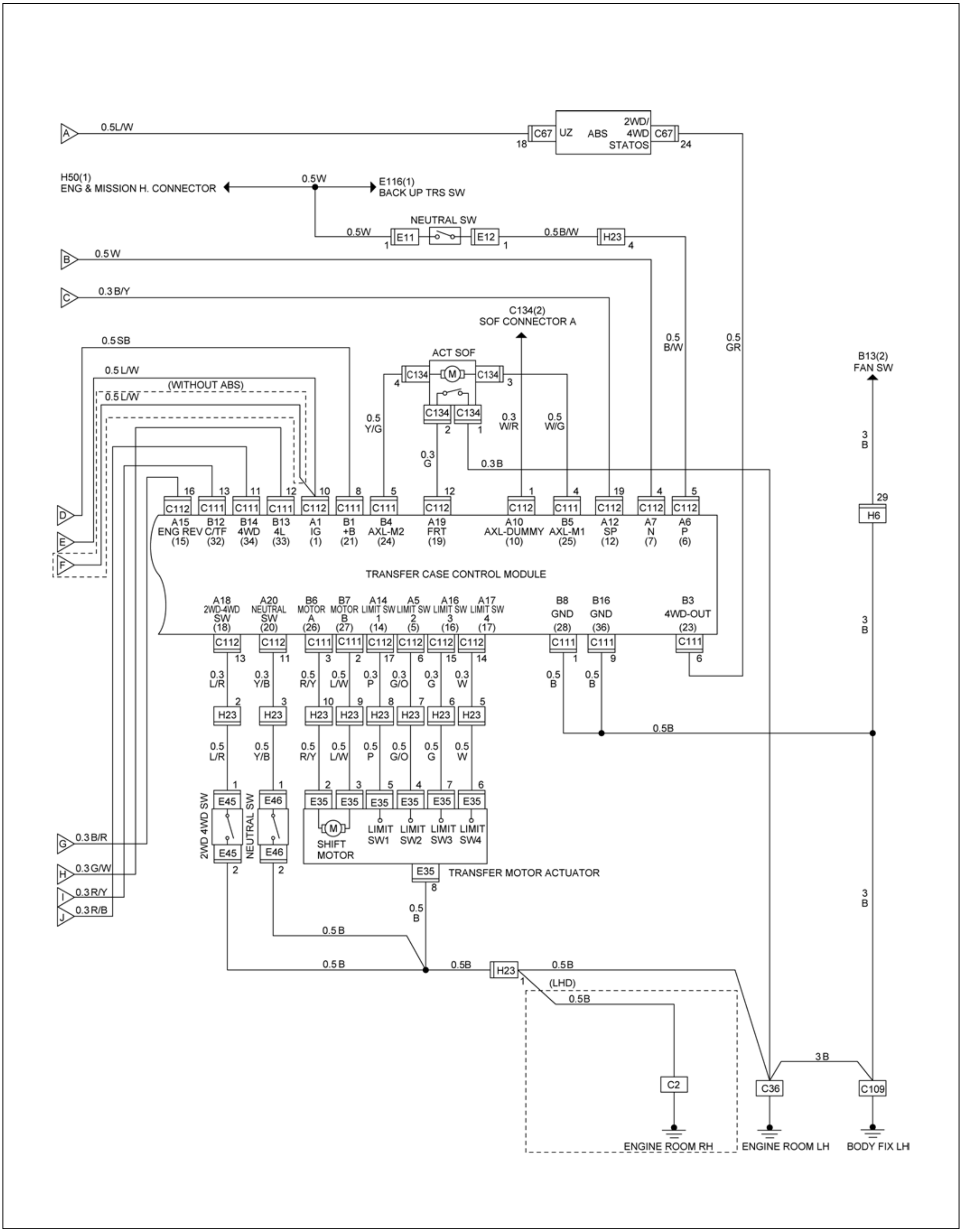
Sheet 1/2



RTW78AXF008901

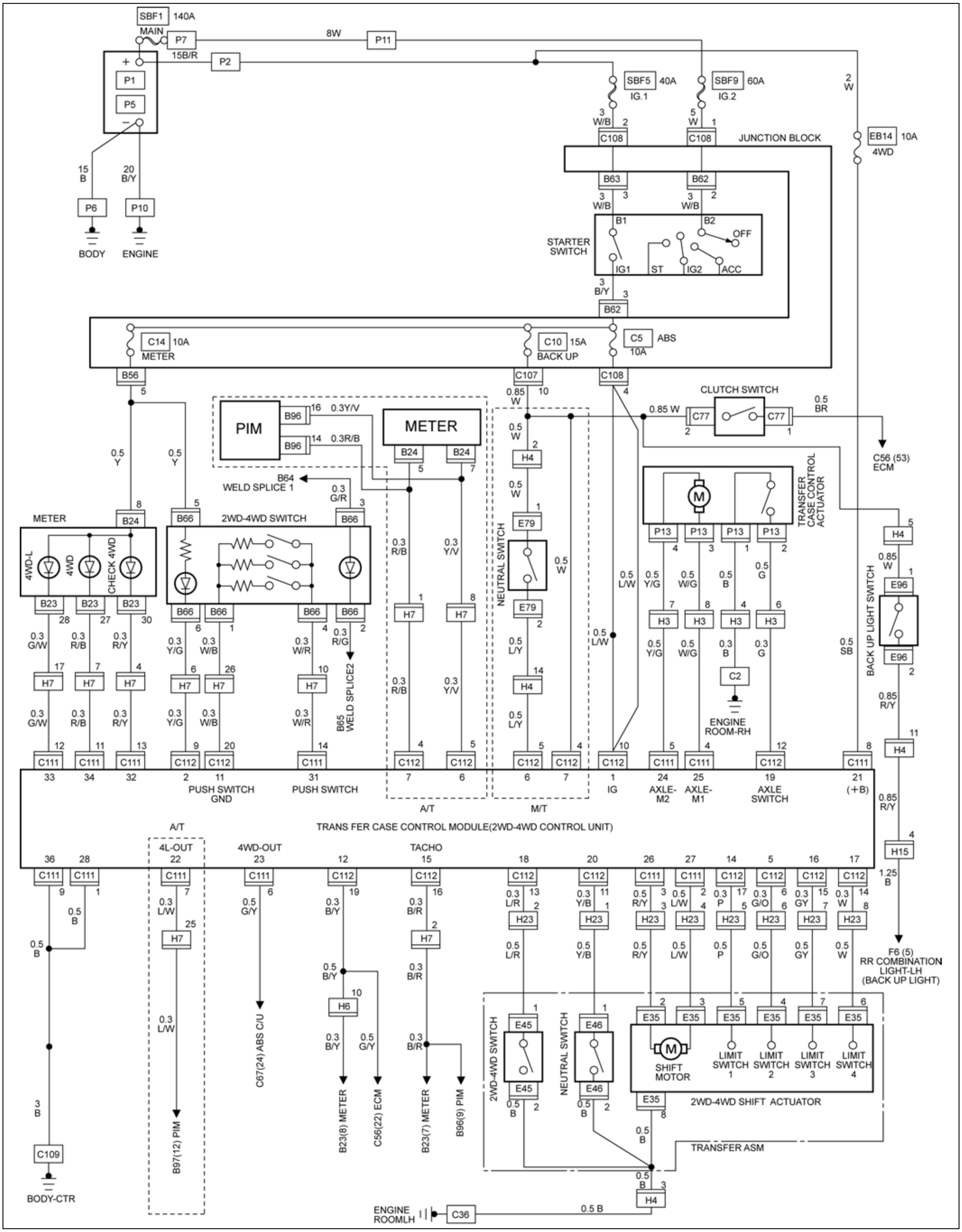
CIRCUIT DIAGRAM 4JA1T(L)

Sheet 2/2



RTW78AXF009001

CIRCUIT DIAGRAM HFV6 (LHD)



RTW78AXF012701

Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

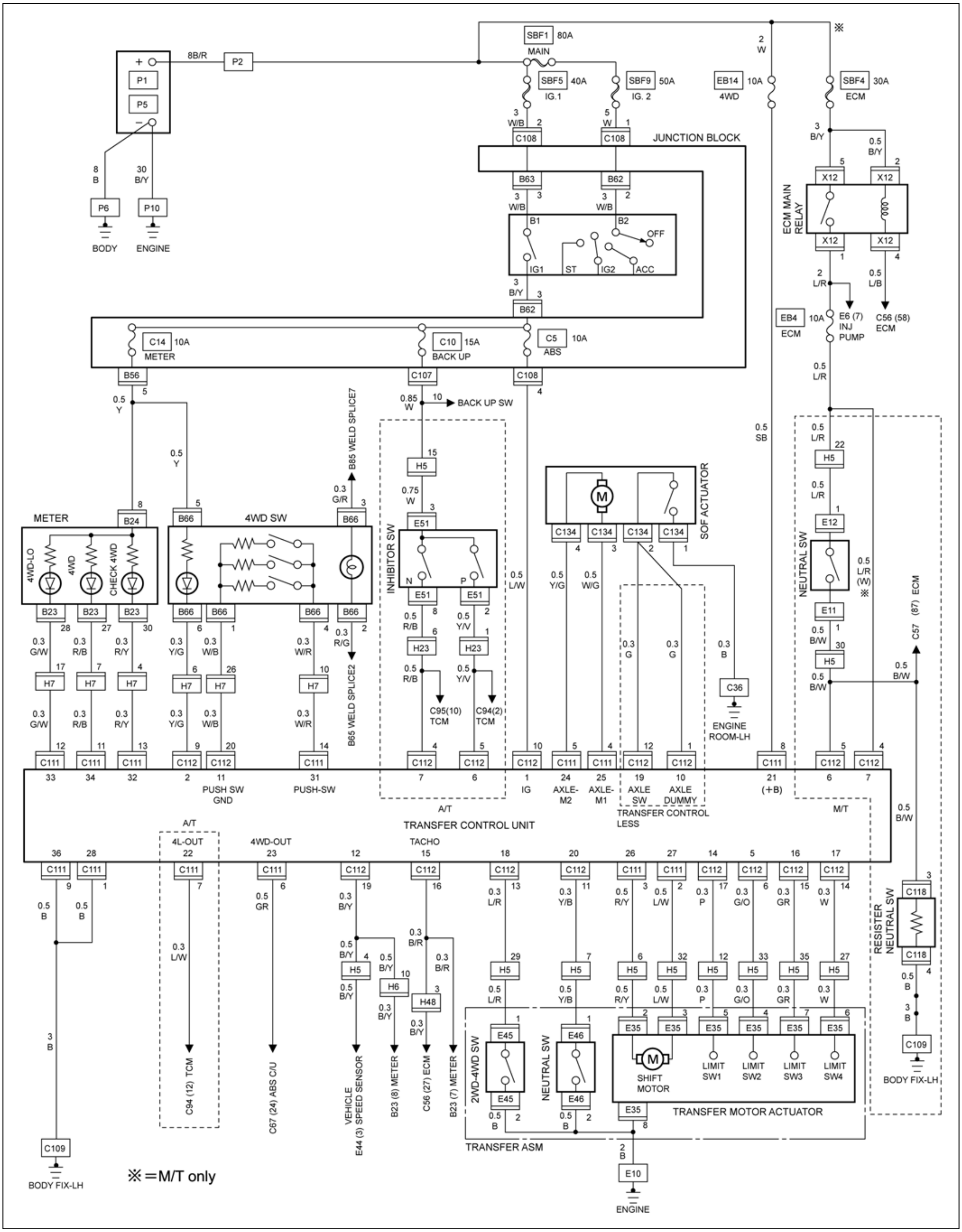
For inspection and servicing of disc caliper, and relative parts, and ABS parts, refer to section 5 Brakes.

- Hub
- Hub bearing
- Bearing outer race
- Disc
- Oil seal
- Knuckle spindle
- ABS sensor rotor
- Caliper

Visual Check

Check the following parts for wear, damage or other abnormal conditions.

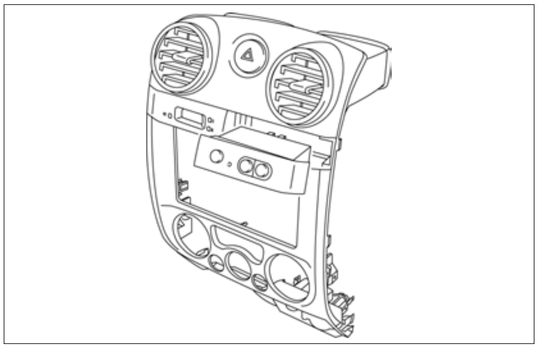
CIRCUIT DIAGRAM 4JH1-TC



RTW78AXF006901

2WD-4WD Switch

REMOVAL AND INSTALLATION



RTW780SH002001

Removal

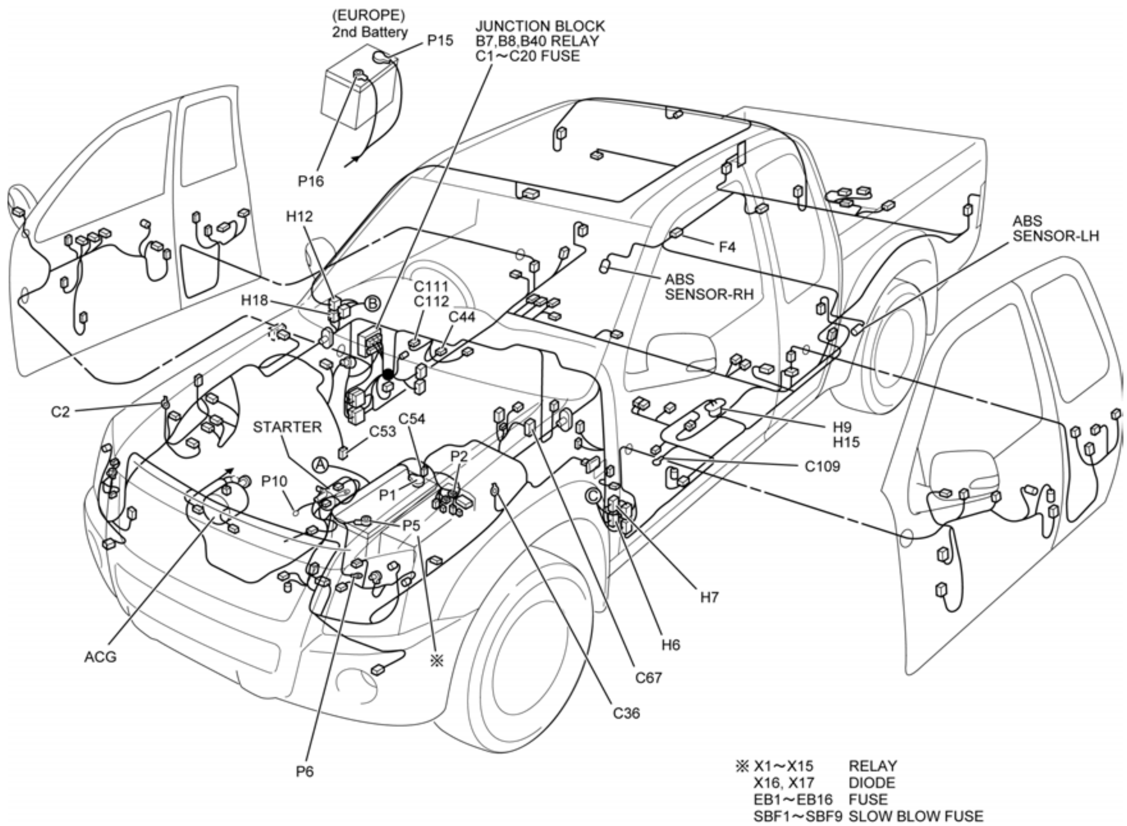
1. **Remove the center cluster ASM**
2. **Disconnect the connector.**
3. **Remove the 2WD-4WD switch.**

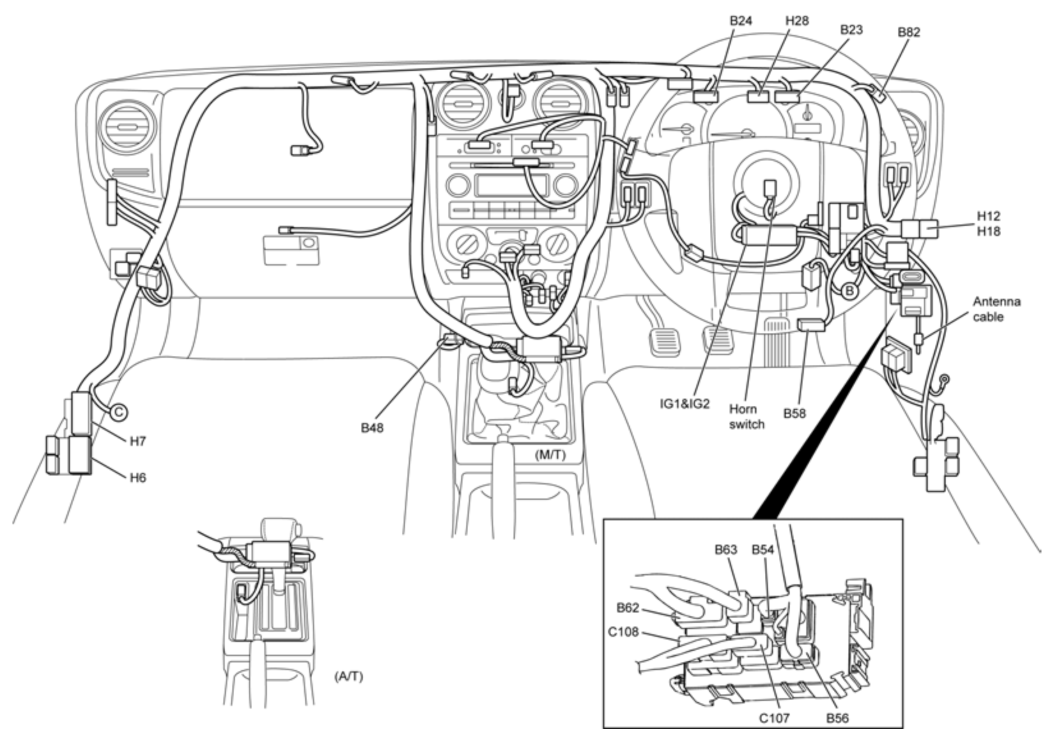
Installation

To install, follow the removal steps in the reverse order.

ANTI-LOCK BRAKE SYSTEM

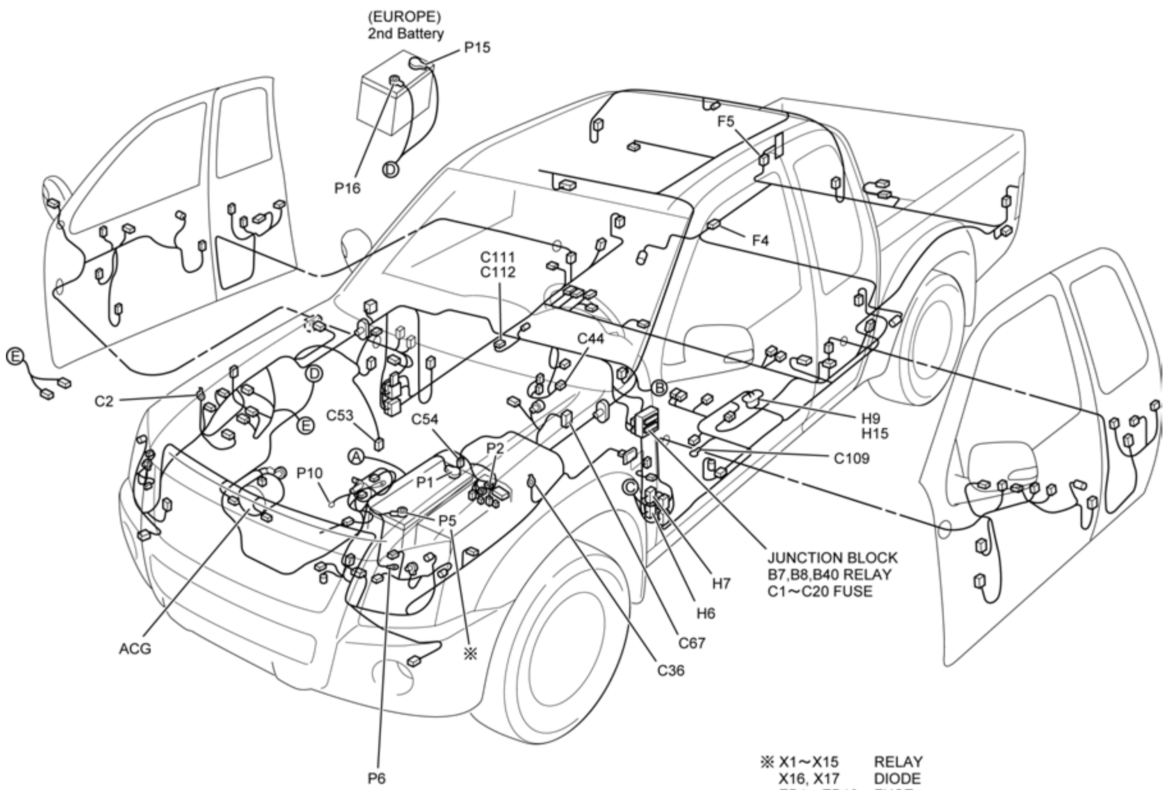
PARTS LOCATION (RHD)

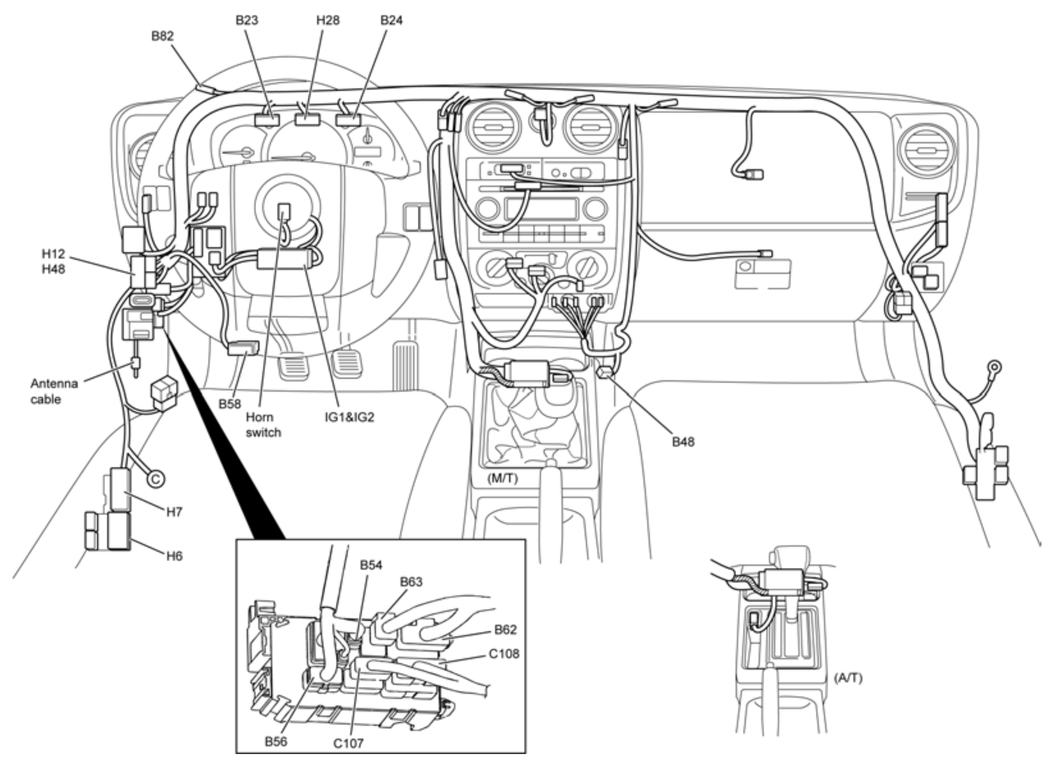




RTW78AXF040701 & RTW78AXF046901

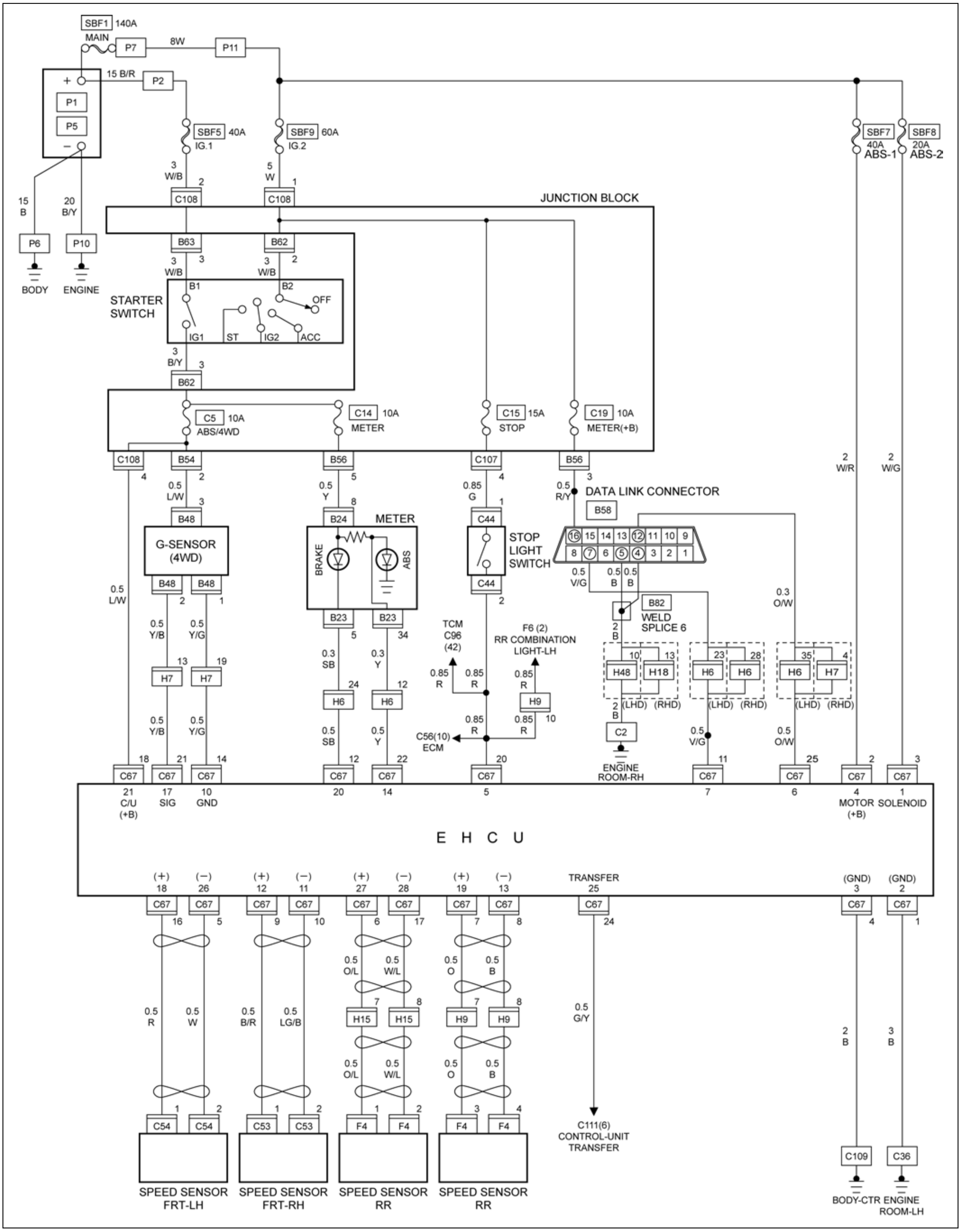
PARTS LOCATION (LHD)



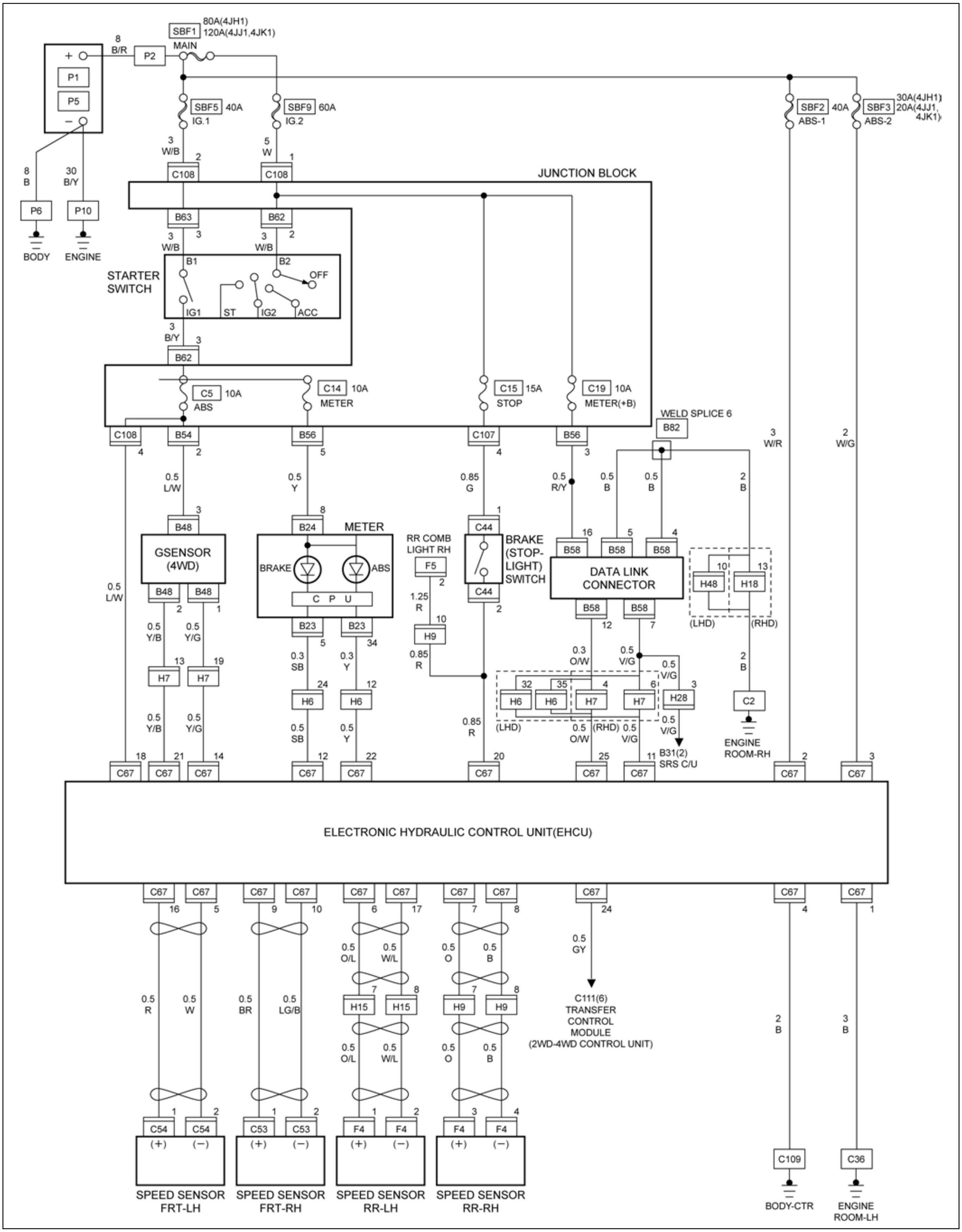


RTW78AXF040801 & RTW78AXF047001

CIRCUIT DIAGRAM HFV6

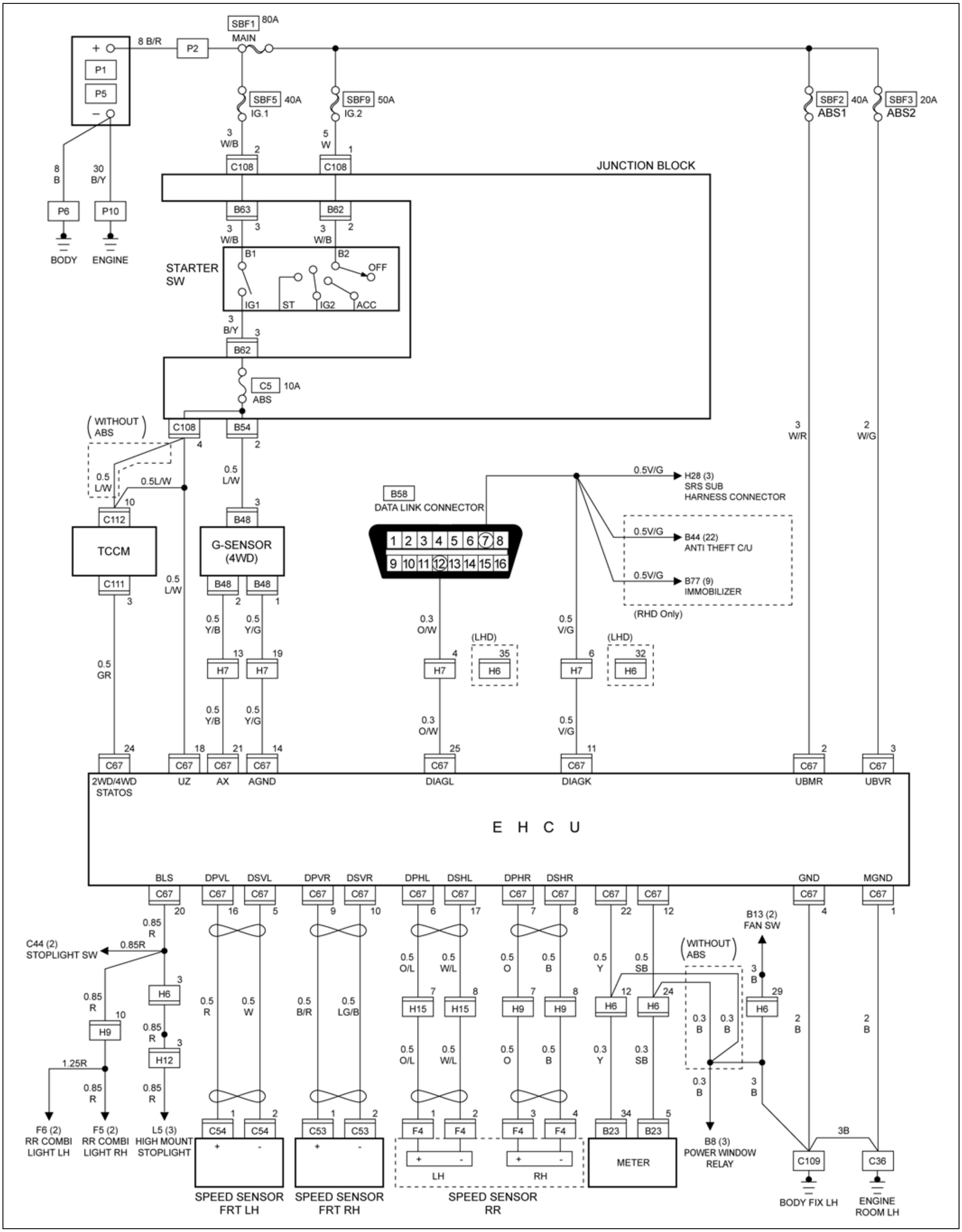


CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC / 4JH1-TC



RTW78AXF018701

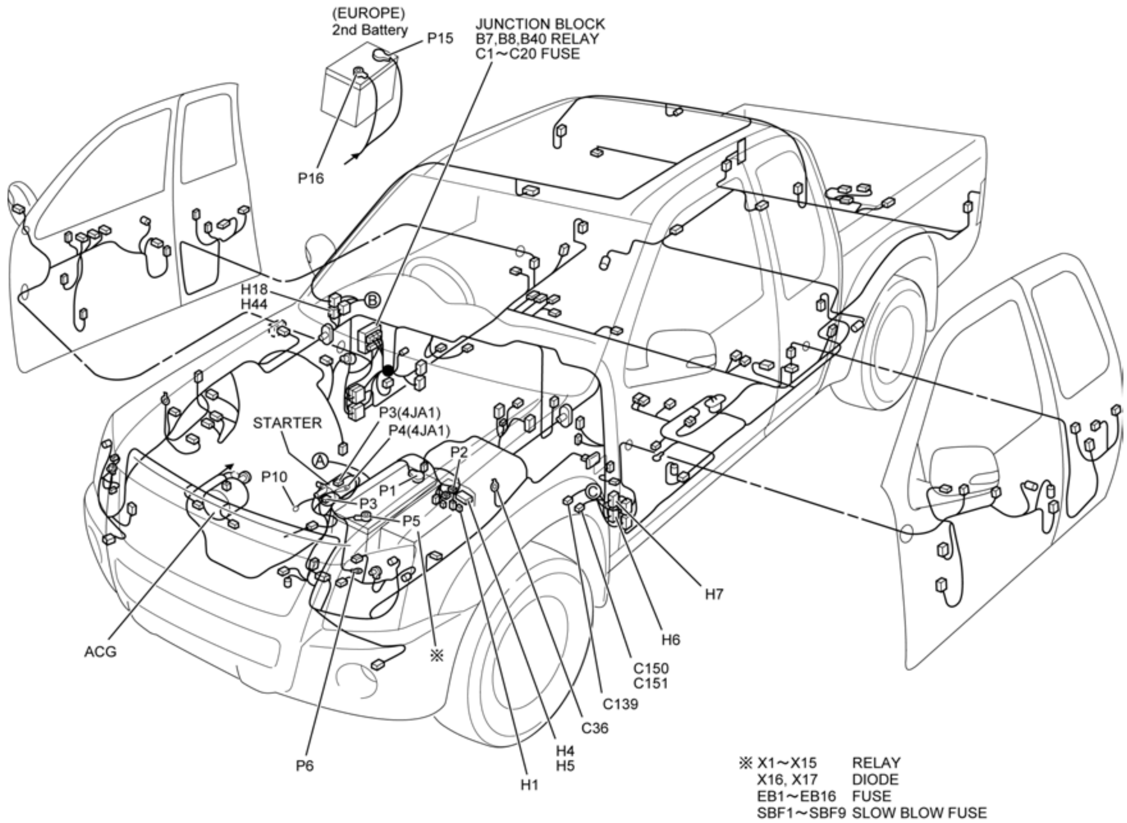
CIRCUIT DIAGRAM 4JA1T(L)

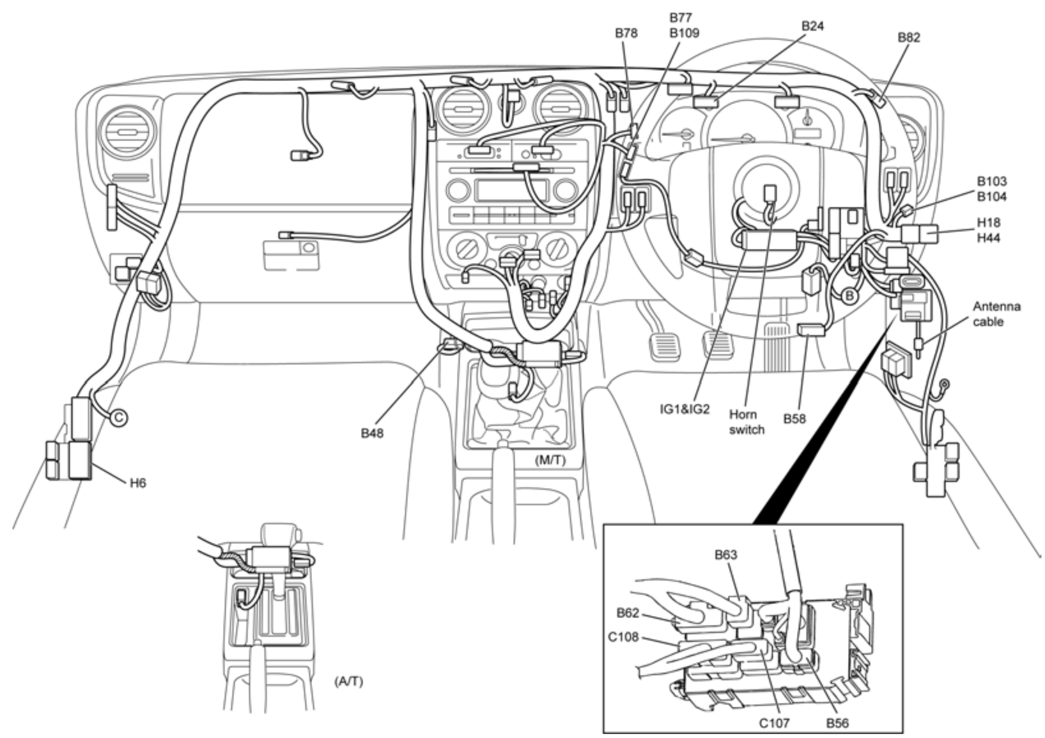


RTW78AXF007201

IMMOBILIZER

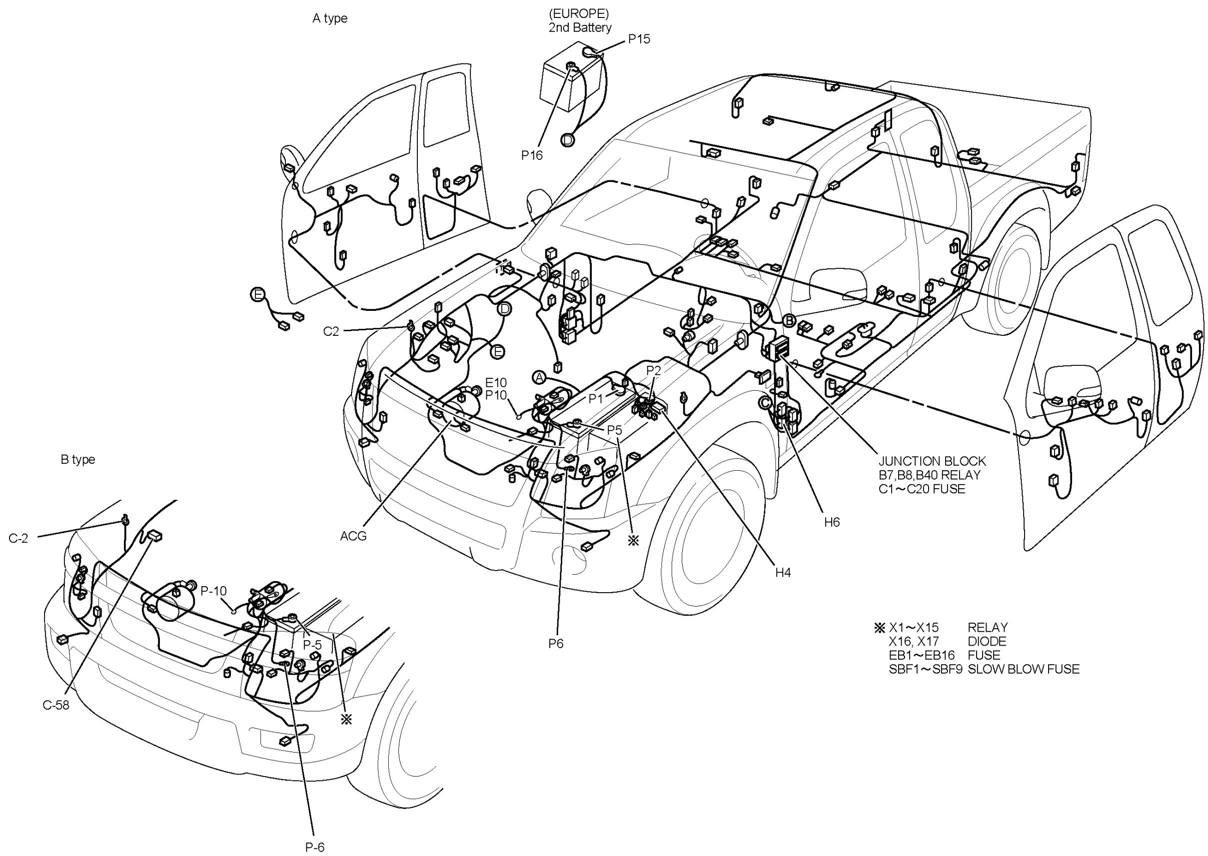
PARTS LOCATION (RHD)

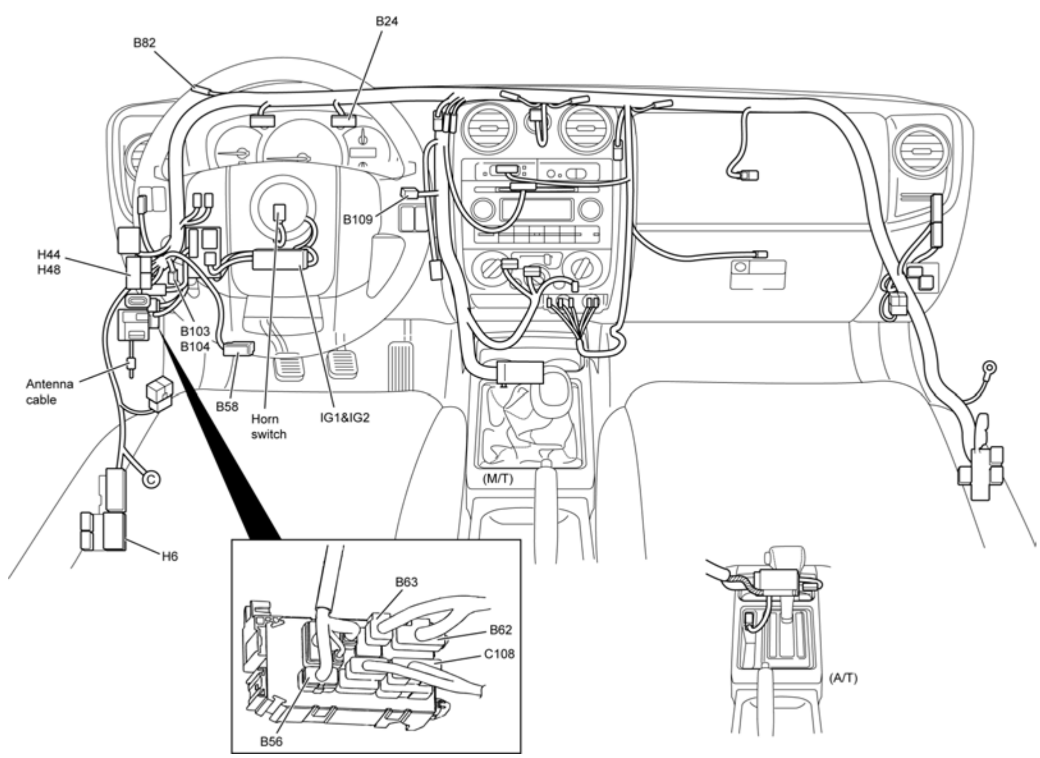




RTW78AXF040901 & RTW78AXF047101

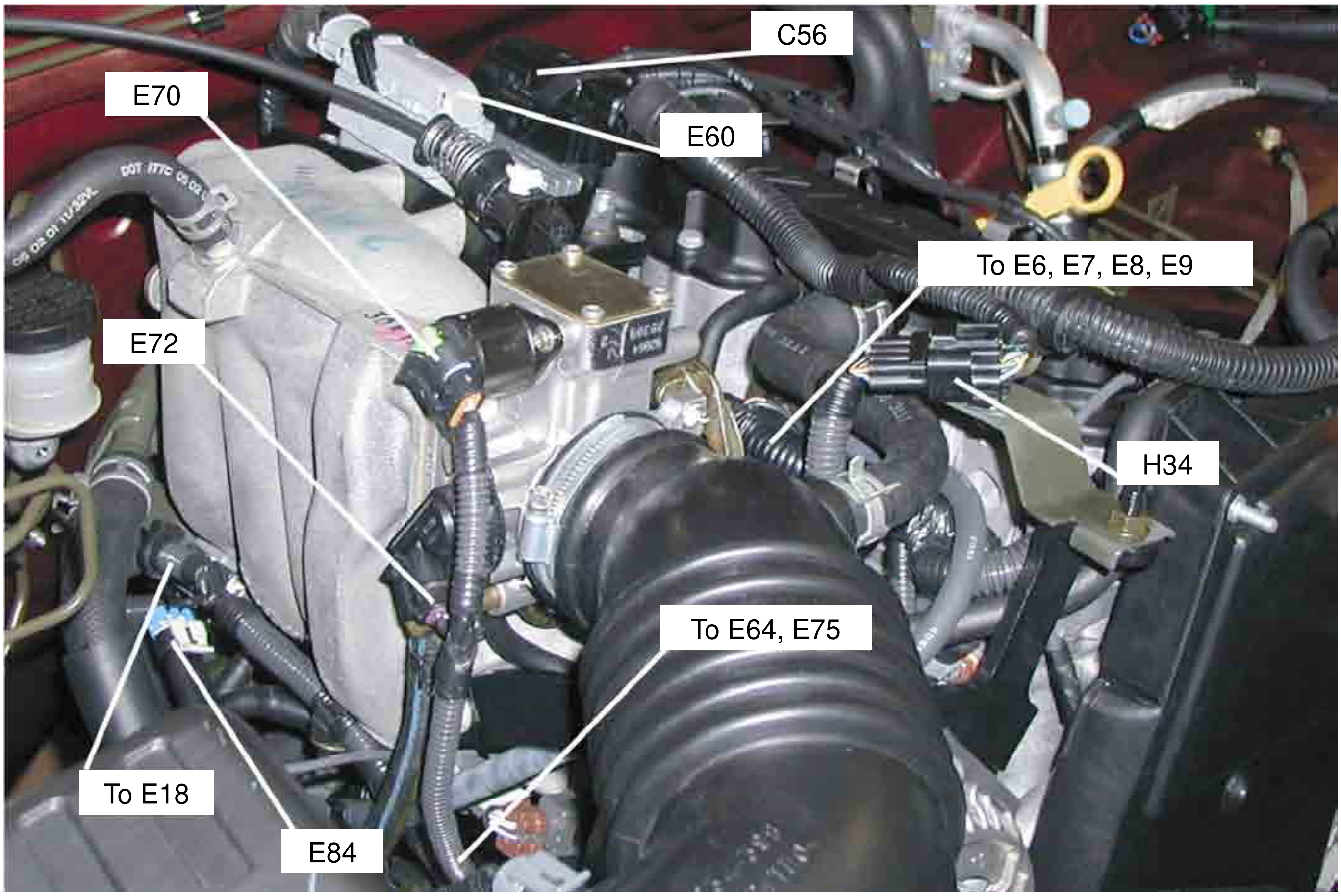
PARTS LOCATION (LHD)

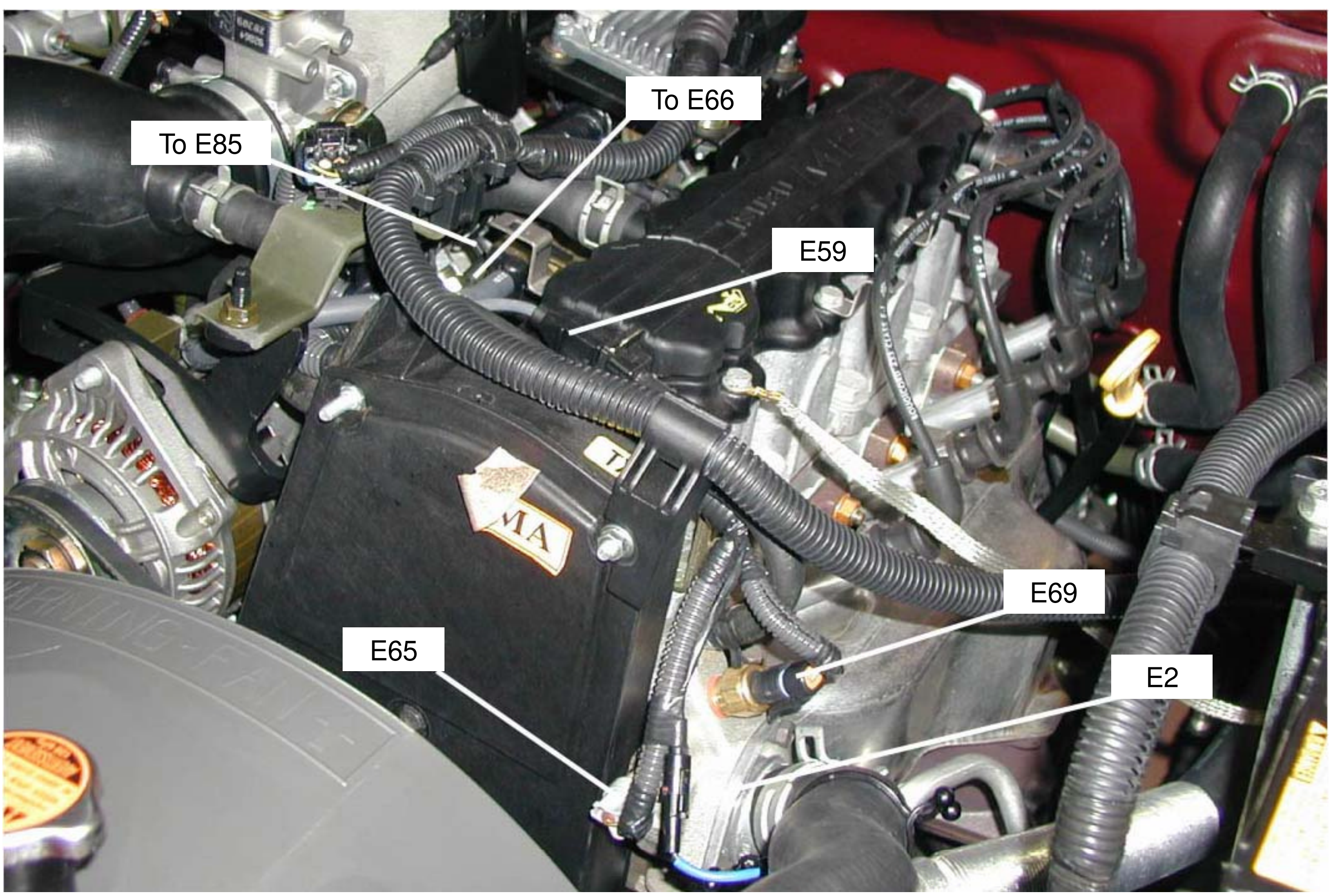




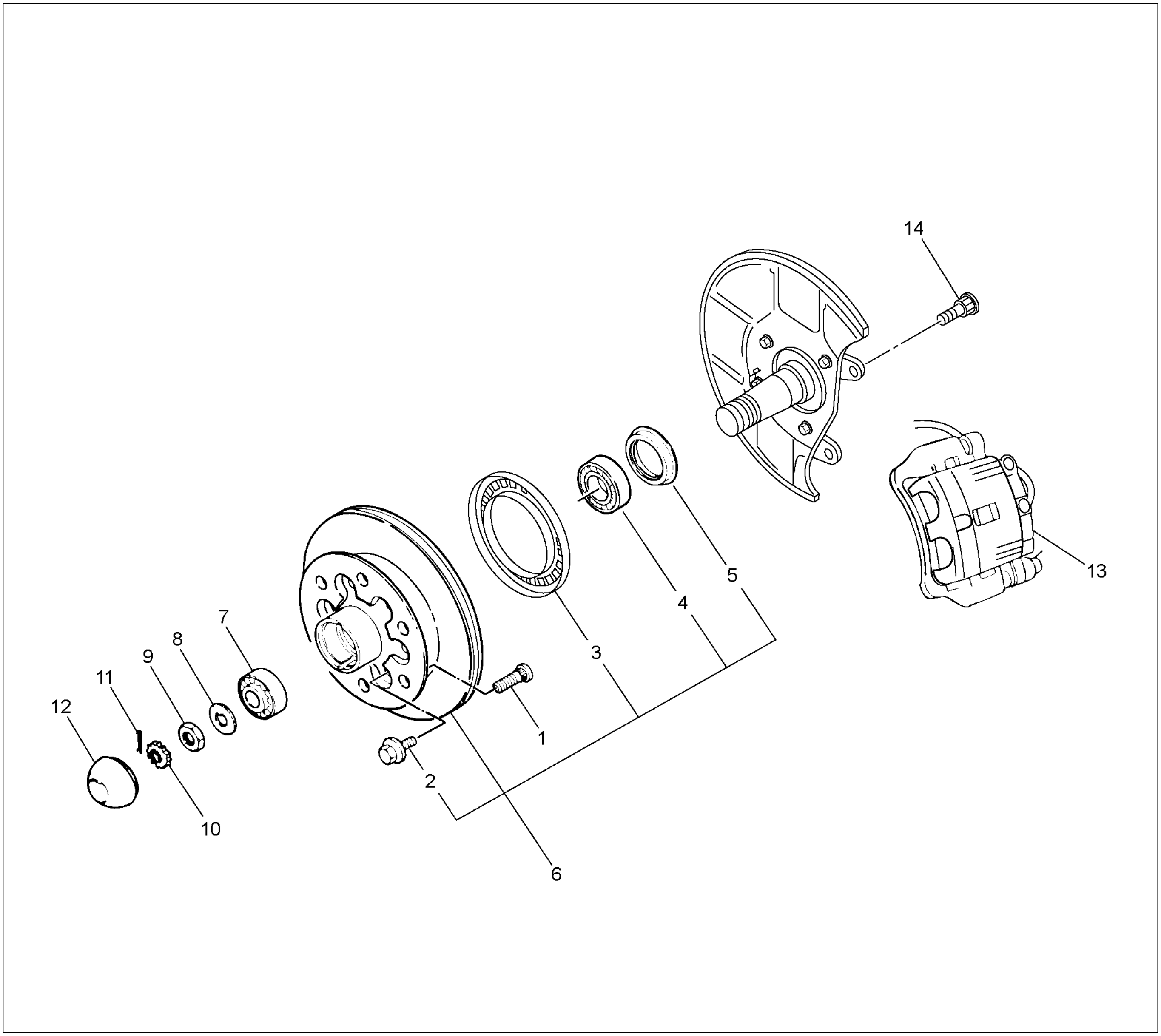
RTW78AXF041001 & RTW78AXF047201

PARTS LOCATION C24SE





Reassembly

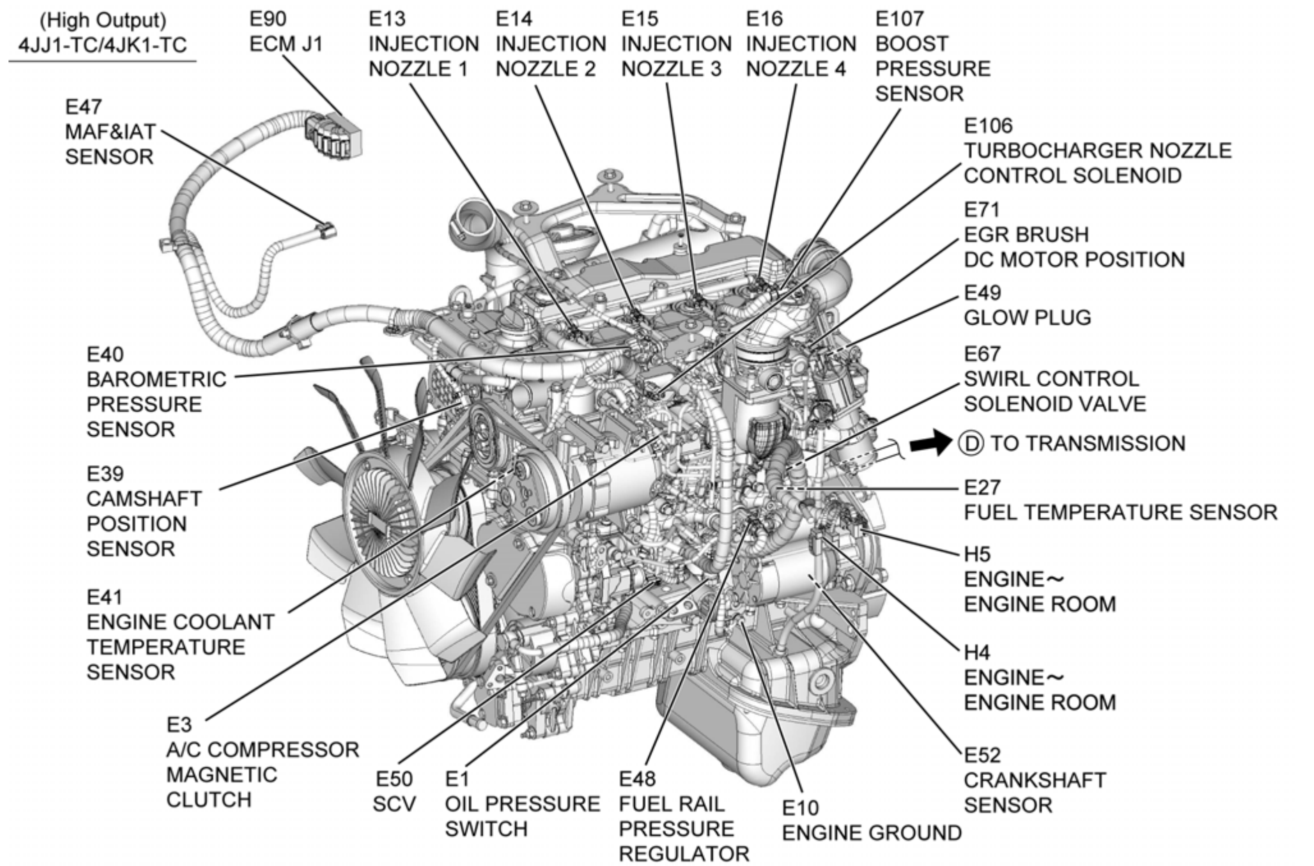


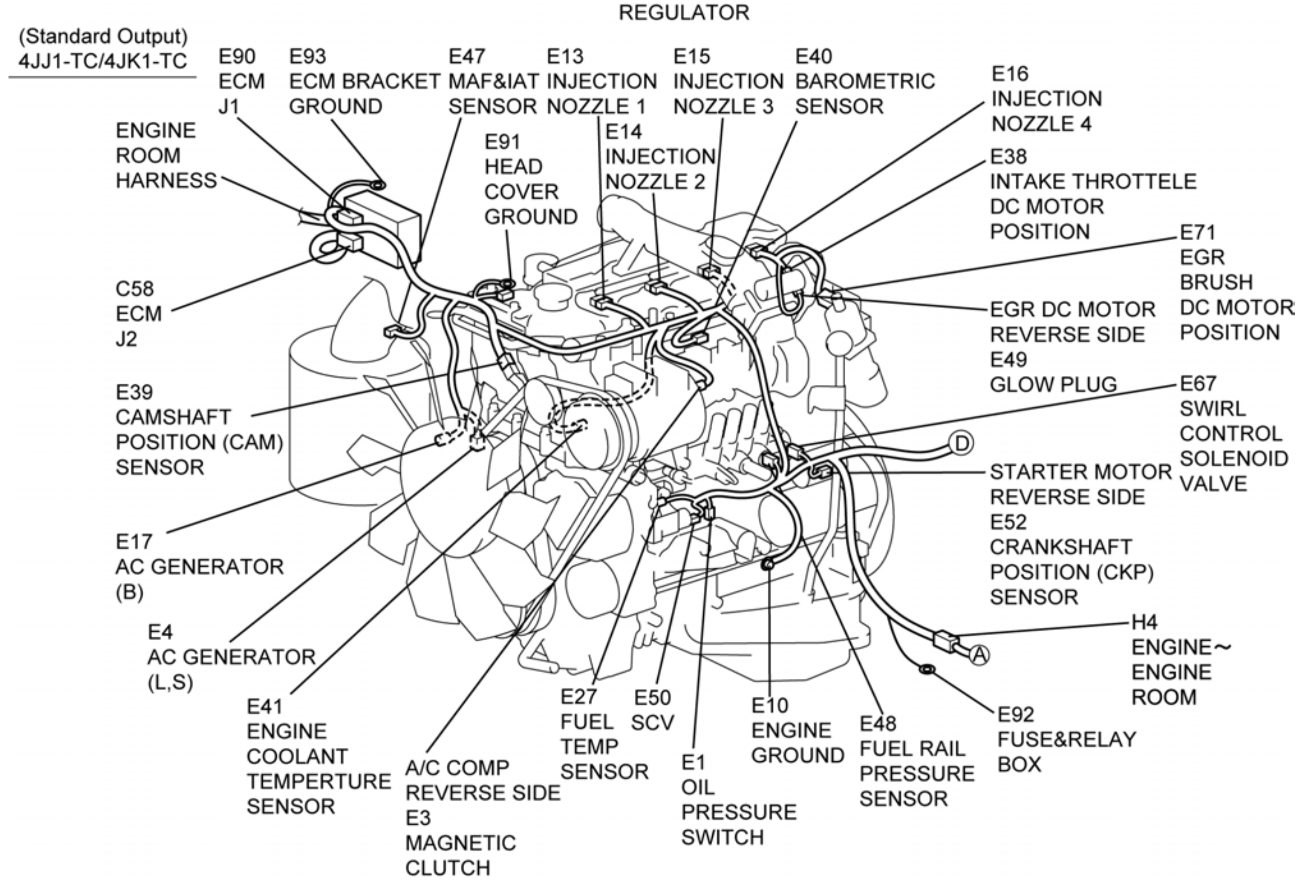
RTW34CLF000901

Reassembly Steps

- ▲ 1. Wheel pin
- ▲ 2. Bolt
- ▲ 3. ABS sensor rotor
- ▲ 4. Inner bearing and outer race
- ▲ 5. Oil seal
- ▲ 6. Hub and disc assembly
- 7. Outer bearing
- 8. Lock washer
- ▲ 9. Hub nut
- 10. Nut retainer
- 11. Split pin
- ▲ 12. Hub cap
- 13. Brake caliper
- ▲ 14. Bolt

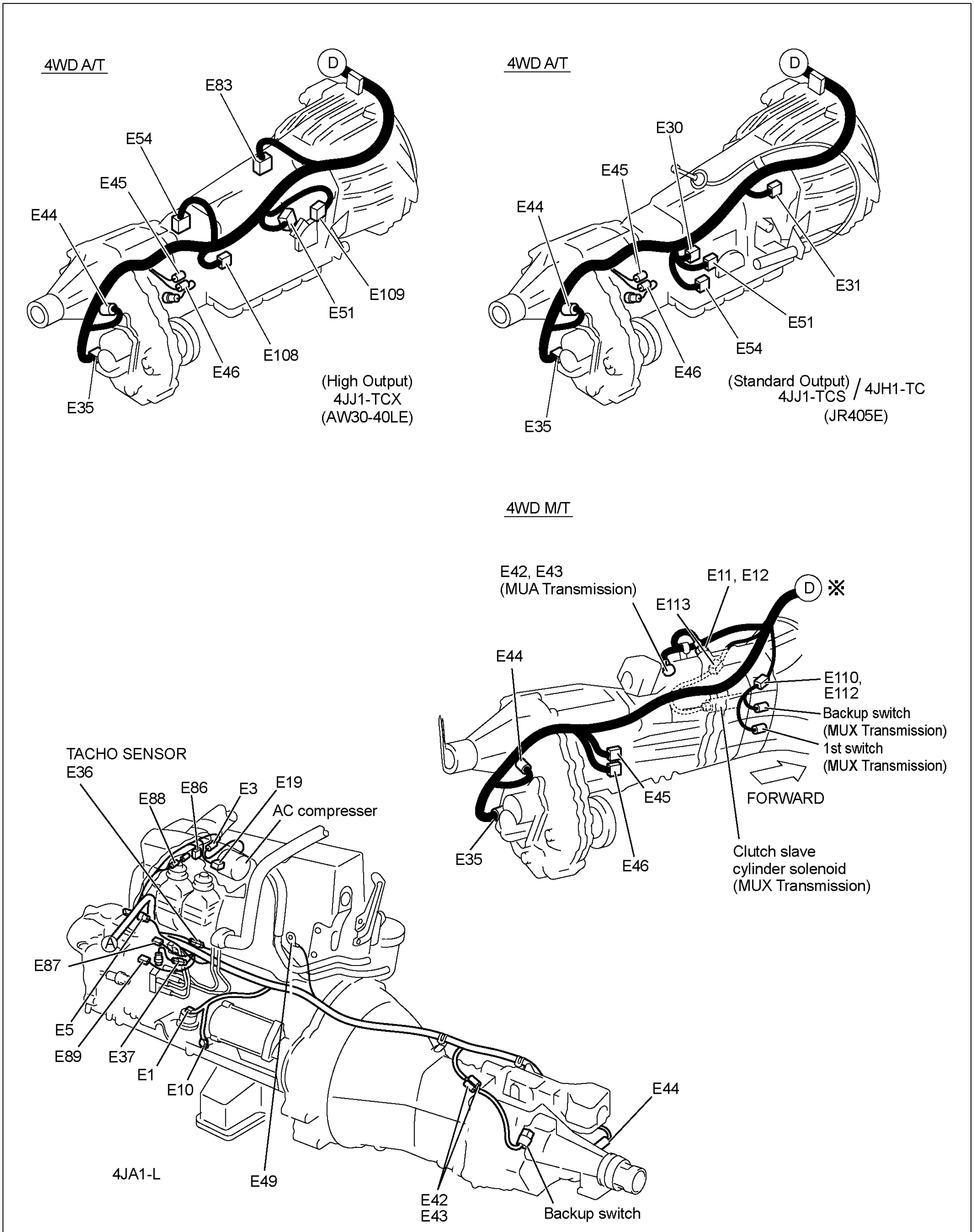
PARTS LOCATION 4JJ1-TC / 4JK1-TC





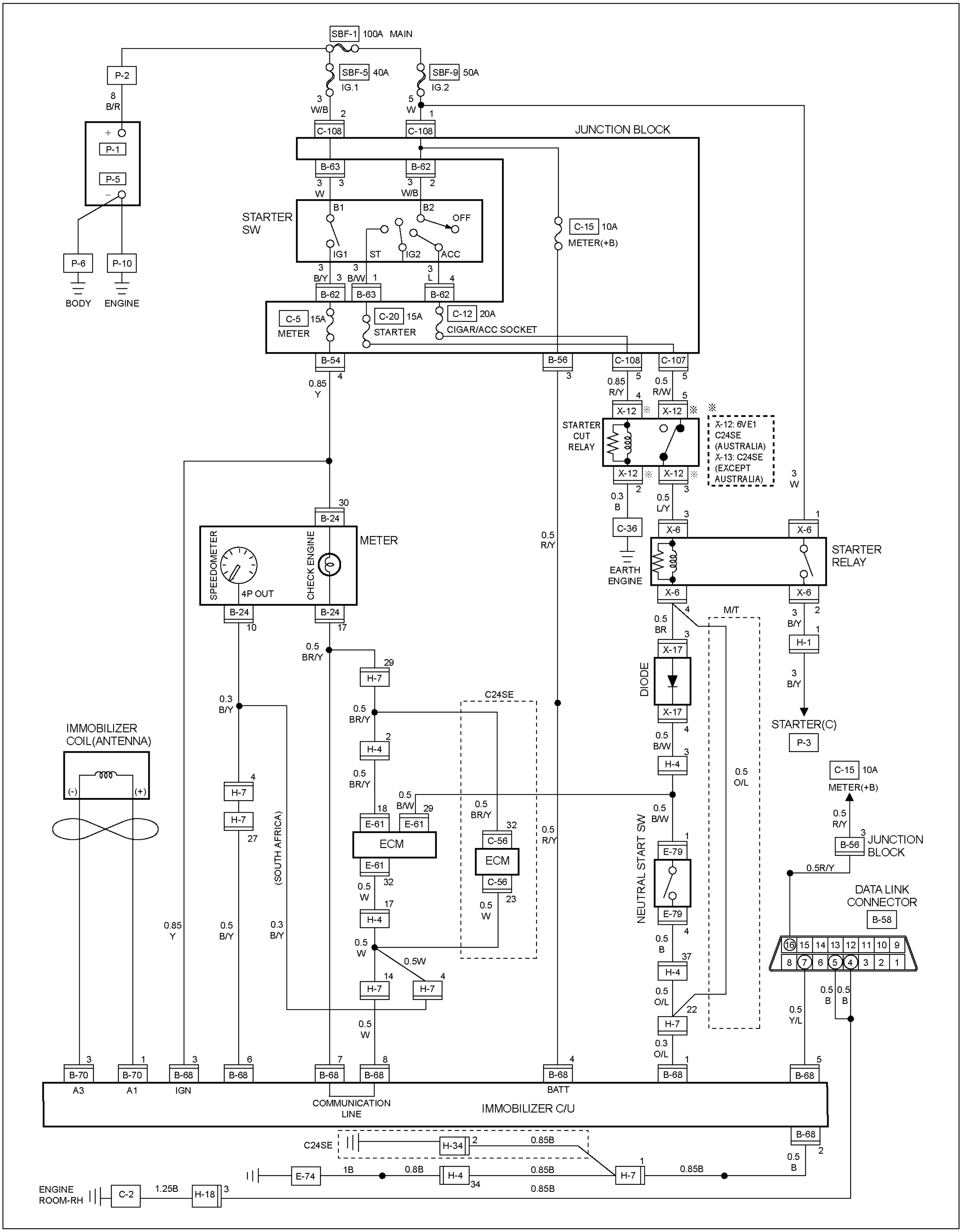
RTW78AXF048601

PARTS LOCATION



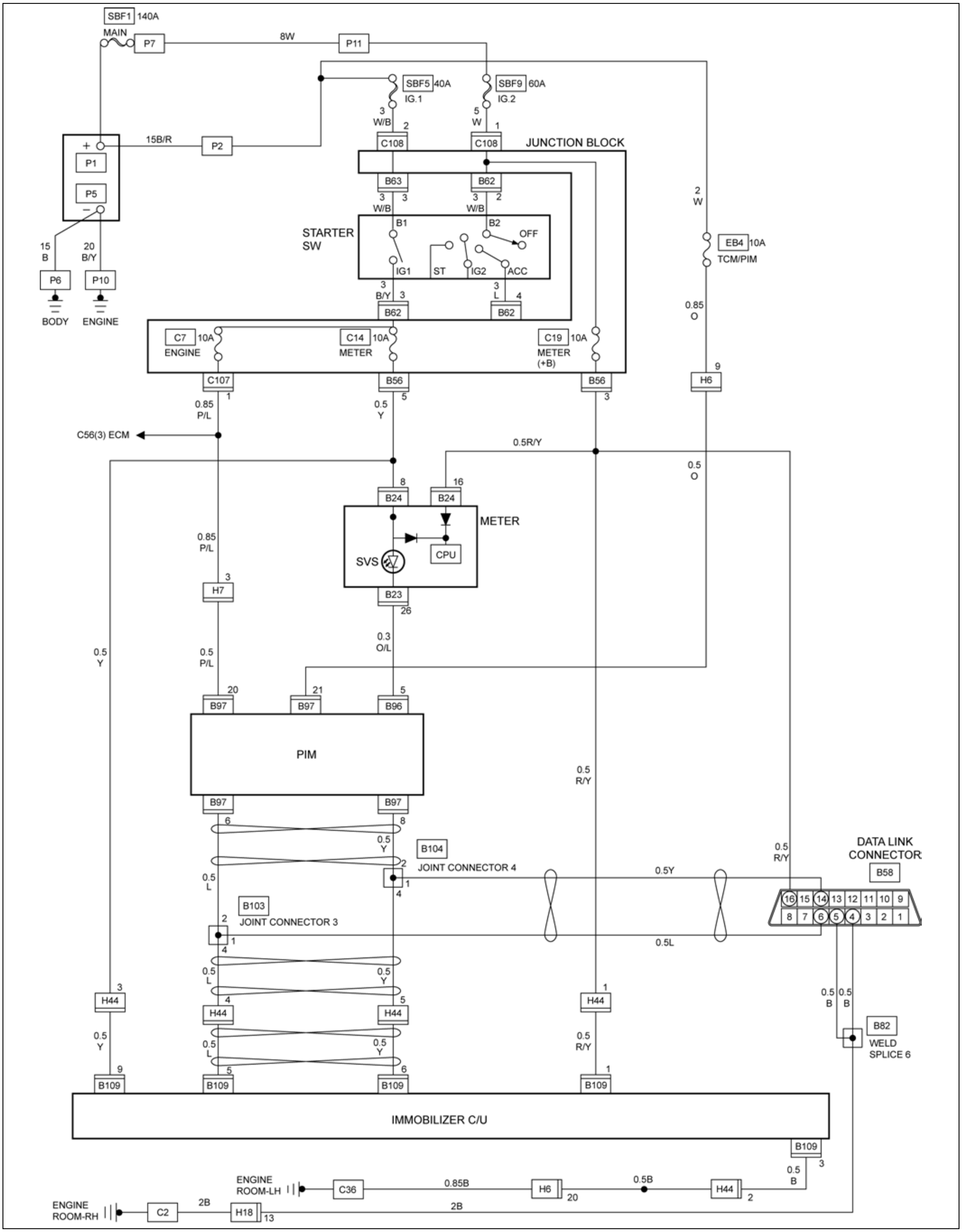
RTW78AXF035901

CIRCUIT DIAGRAM C24SE



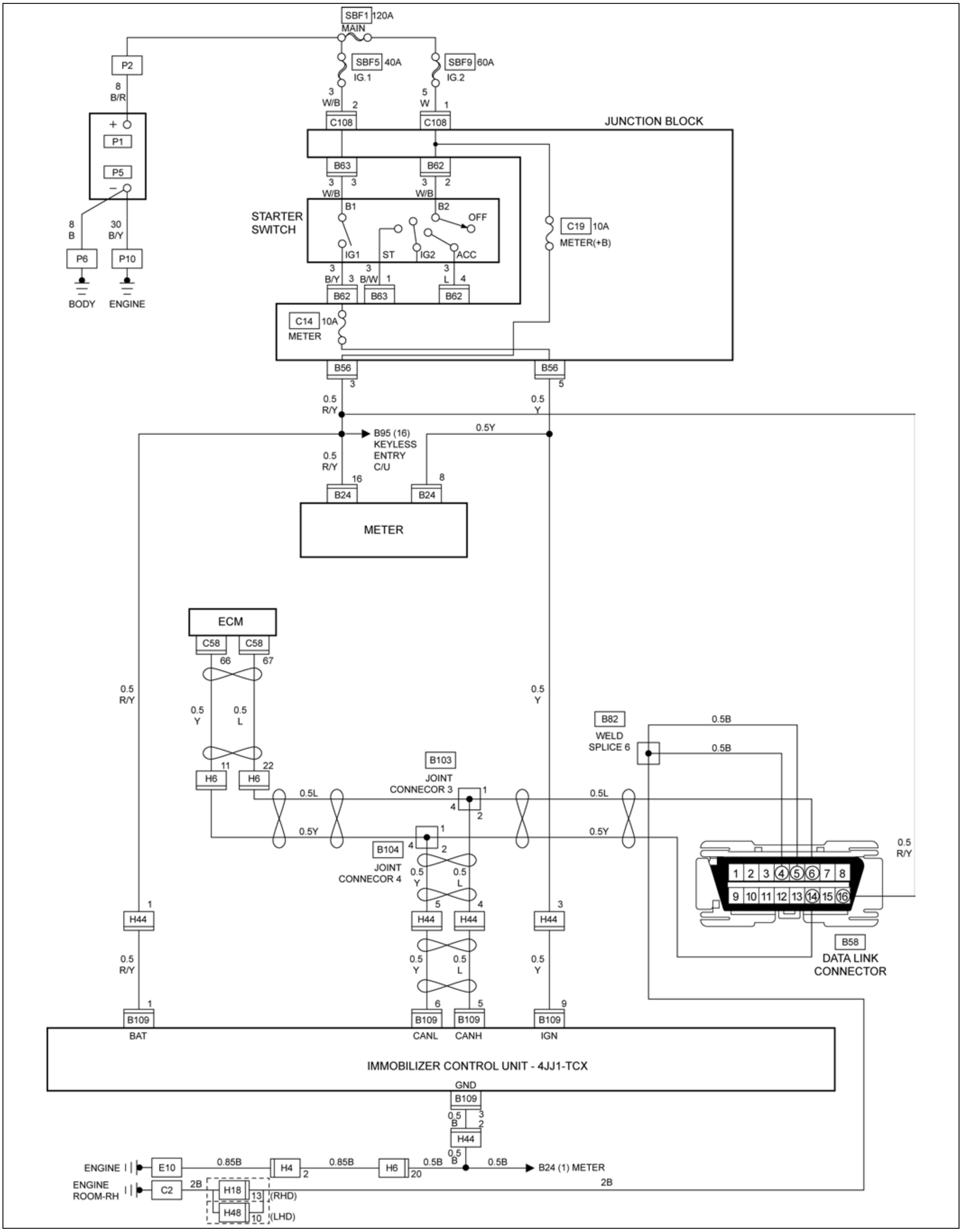
RTW680XF014601

CIRCUIT DIAGRAM HFV6 (RHD)

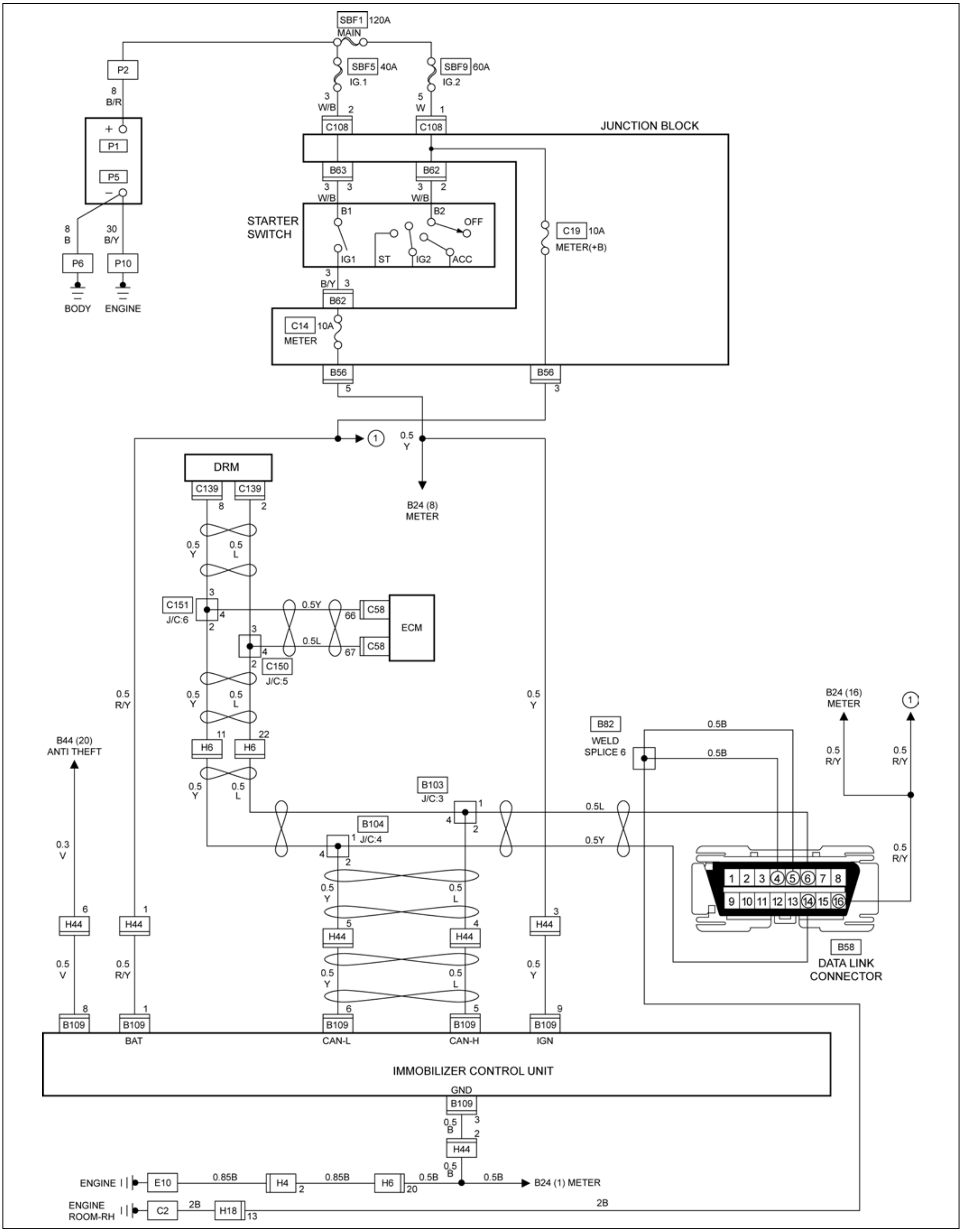


RTW78AXF002001

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) SOUTH AFRICA, (LHD) G.EXP, EXCEPT RHD EUROPE

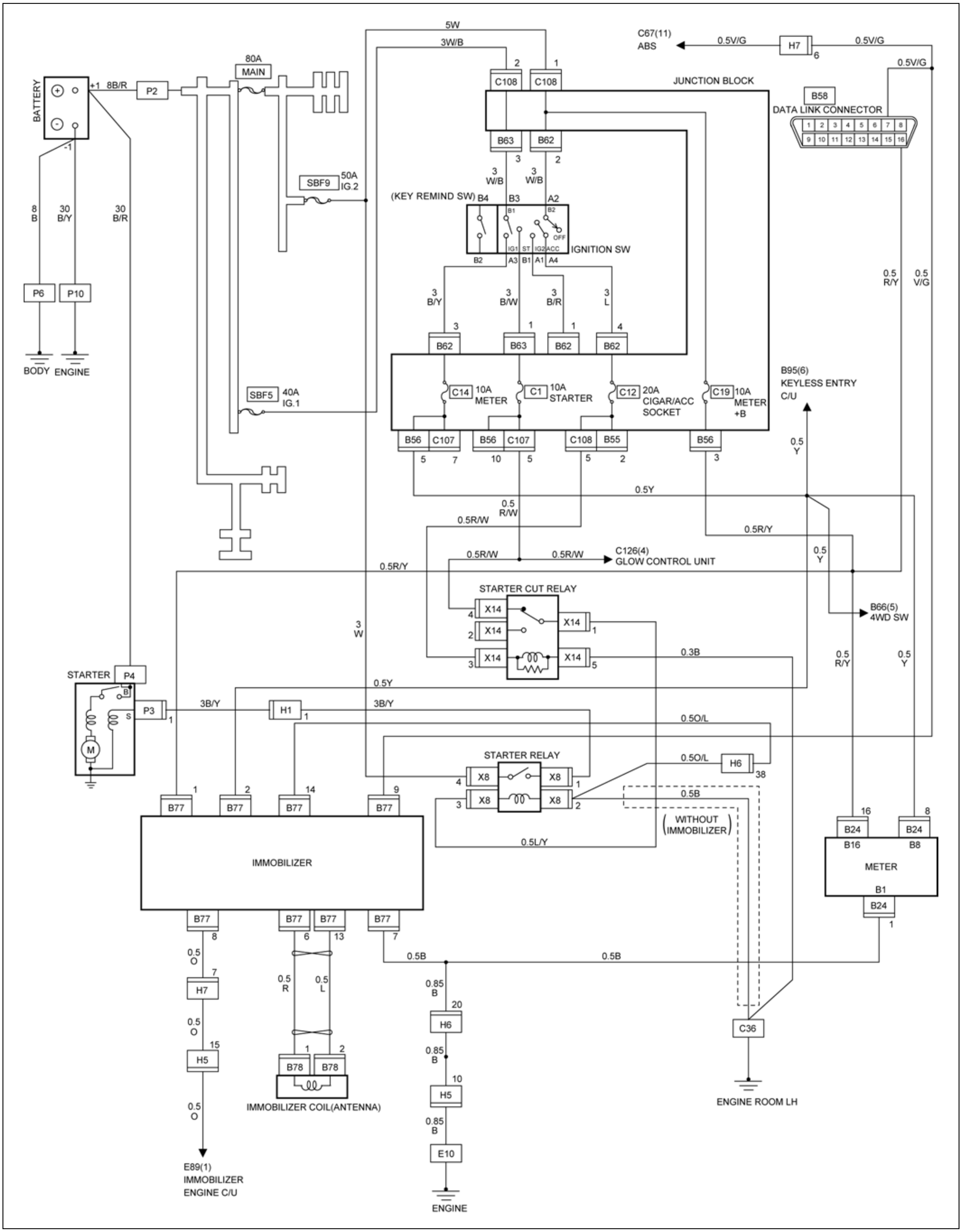


CIRCUIT DIAGRAM 4JJ1-TC (RHD) EXCEPT SOUTH AFRICA



RTW78AXF033801

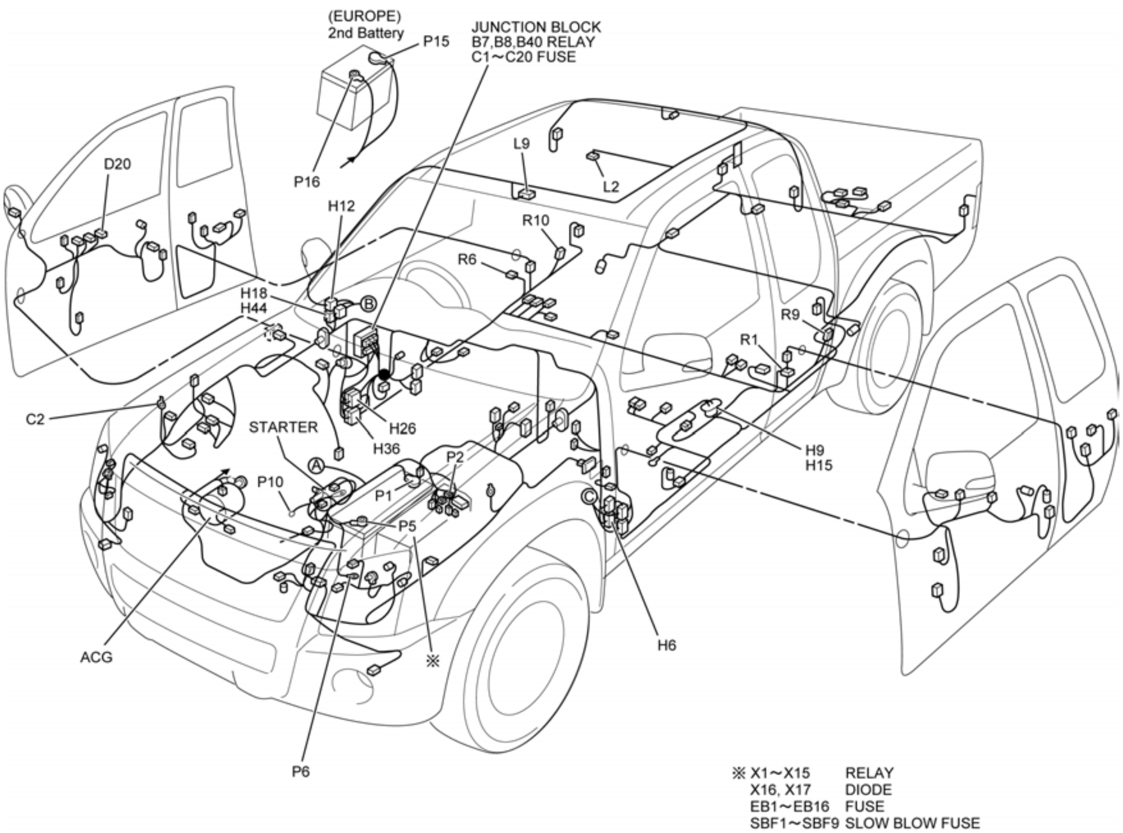
CIRCUIT DIAGRAM 4JA1T(L) (RHD)

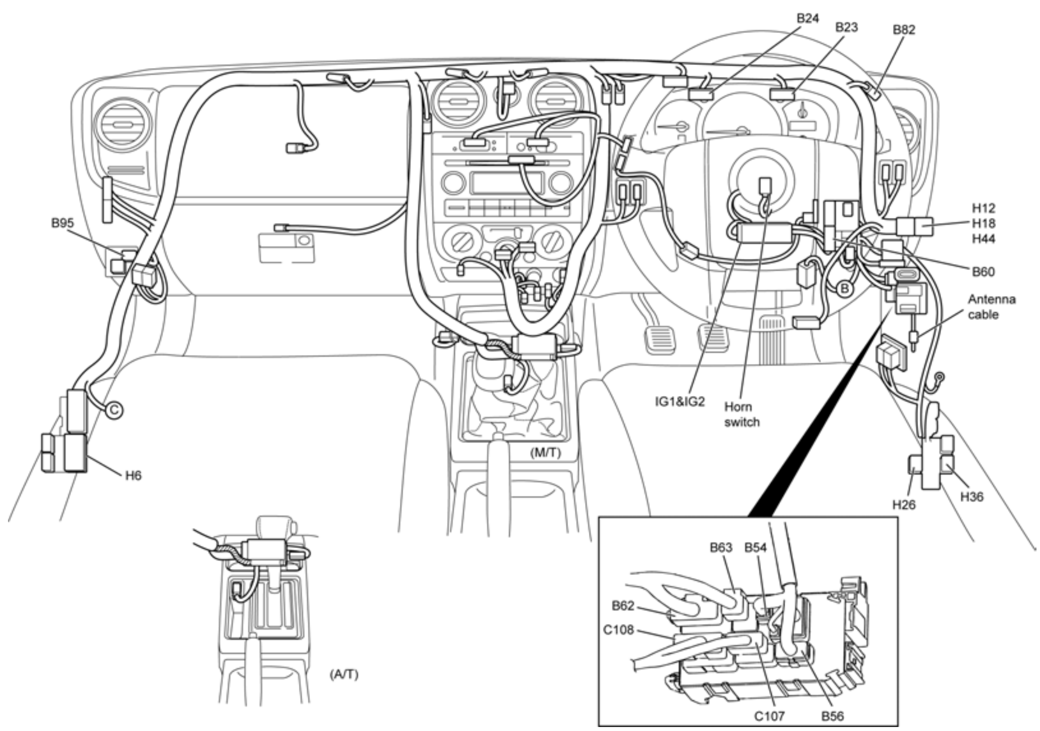


RTW78AXF008001

KEYLESS ENTRY

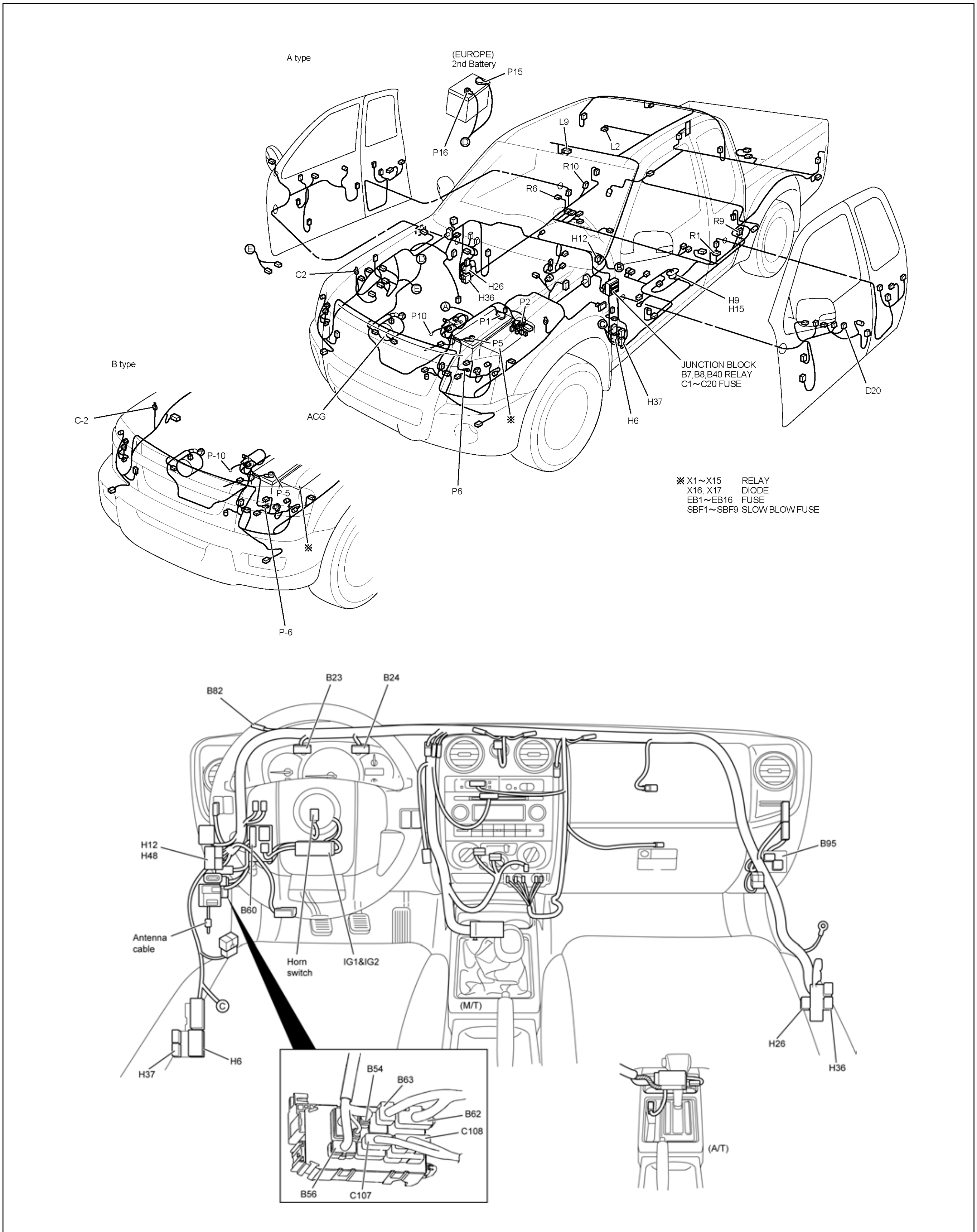
PARTS LOCATION (RHD)





RTW78AXF041101 & RTW78AXF047301

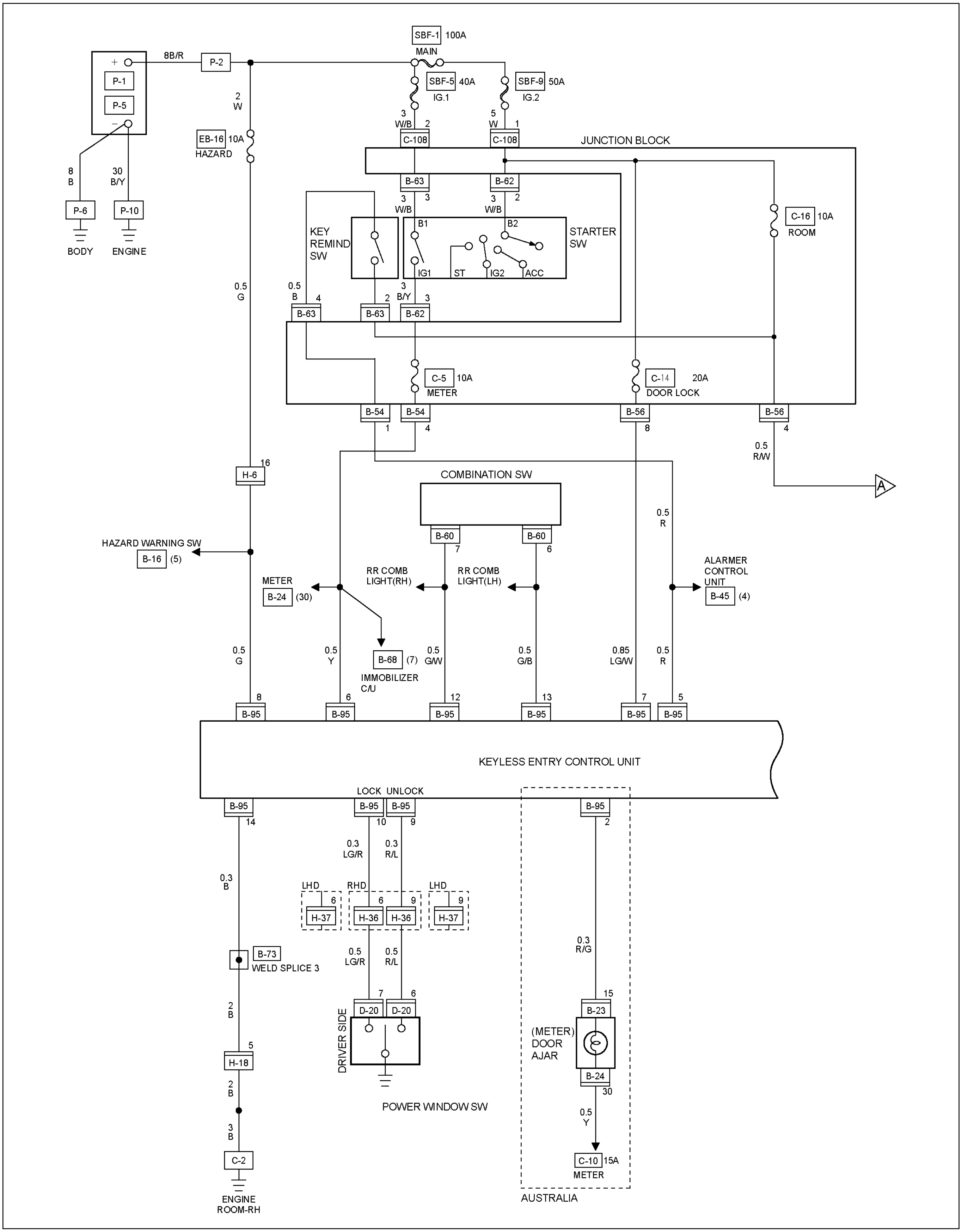
PARTS LOCATION (LHD)



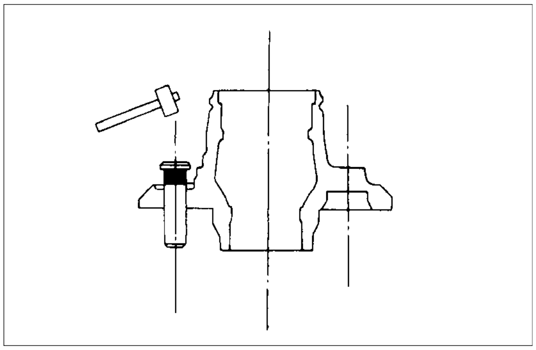
RTW78AXF041201 & RTW78AXF047401

CIRCUIT DIAGRAM C24SE

Sheet 1/2



RTW680XF015001

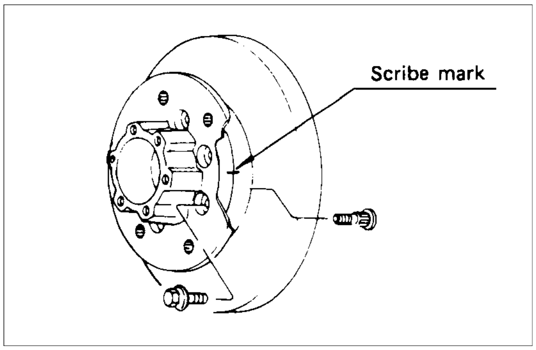


Important Operations

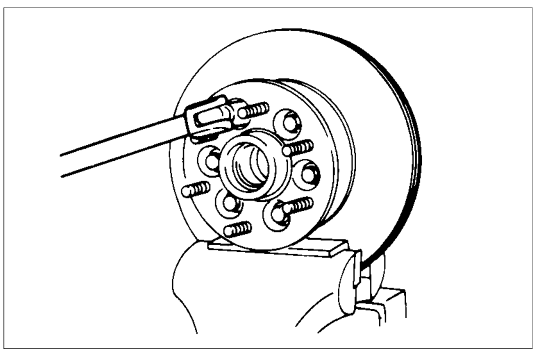
1. Wheel Pin

(1) Place hub on a wood workbench or a block of wood, approx. 6” by 6” to protect the wheel stud ends and threads.

(2) Install wheel stud using a hammer.
Be sure wheel stud is started squarely and seats completely.



(3) Align index marks and install hub to disc.



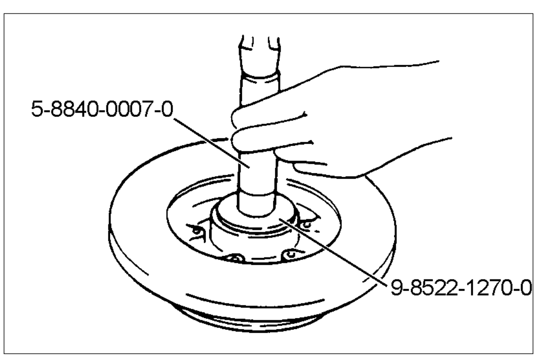
2. Bolt

Torque	N·m (kgf·m/lb·ft)
103 (10.5/76)	

3. ABS sensor rotor

(1) Set a new ABS sensor rotor, if replacement is required.

(2) Install the ABS sensor rotor in the hub, using special tools.
Installer : 5-8840-2789-0
Grip : 5-8840-0007-0
Refer to the section Brake.



RTW74CSH000201

4. Inner Bearing and Outer Race

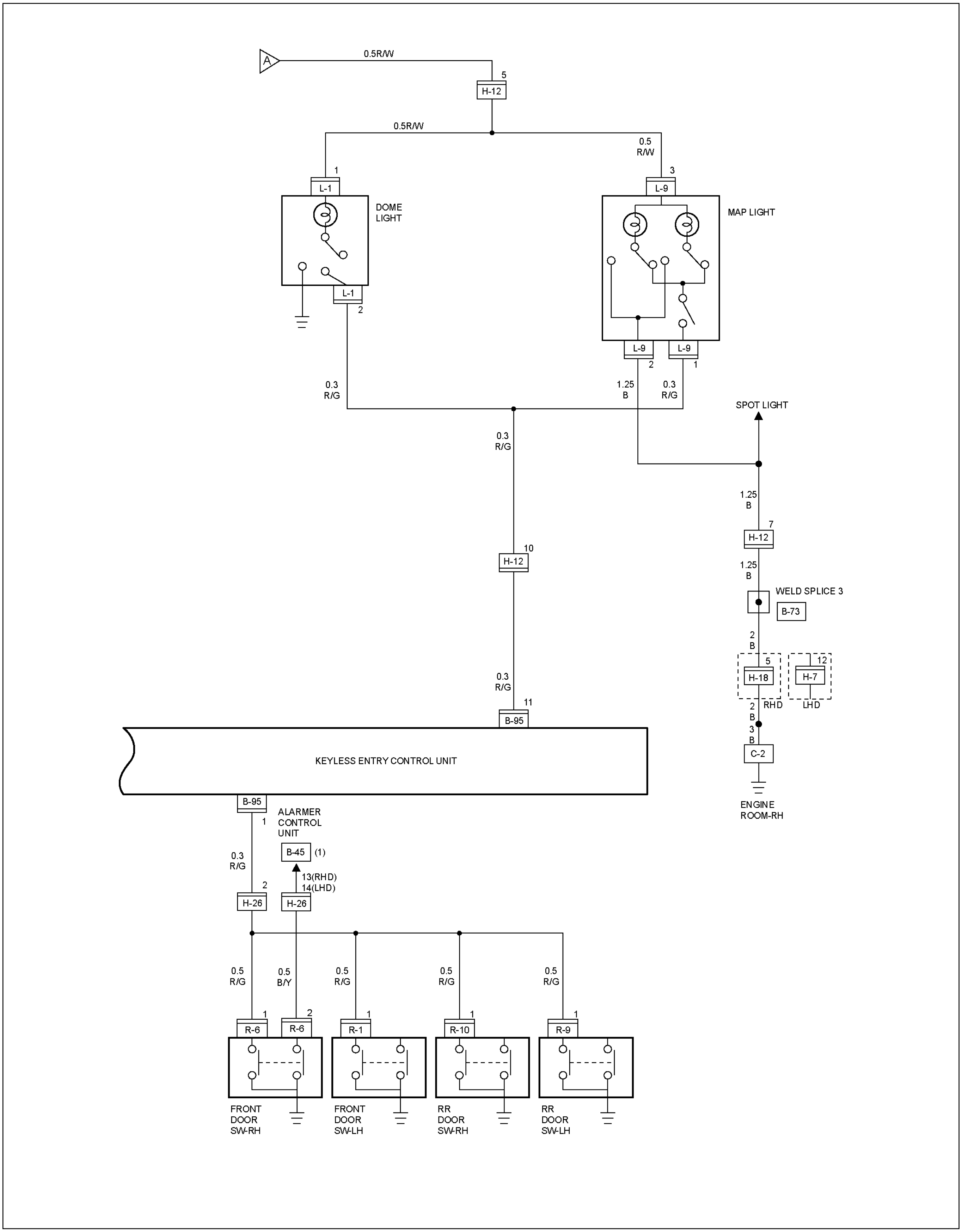
5. Oil Seal

- Outer Bearing Outer Race

(1) Install the bearing outer race by driving into the hub.
Installer (Outer) : 5-8840-2852-0
Installer (Inner) : 9-8522-1270-0
Grip : 5-8840-0007-0

CIRCUIT DIAGRAM C24SE

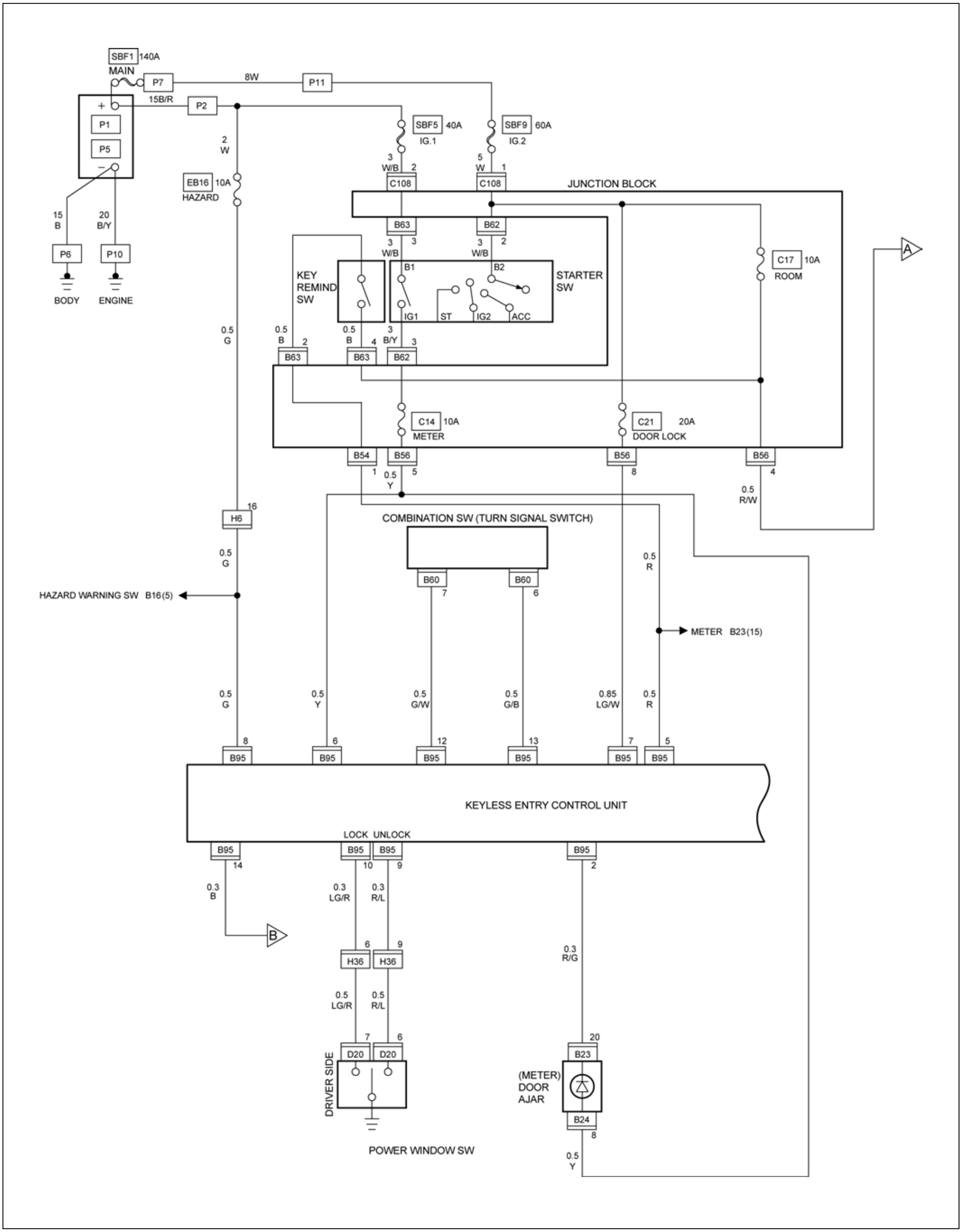
Sheet 2/2



RTW680XF015101

CIRCUIT DIAGRAM HFV6 (RHD)

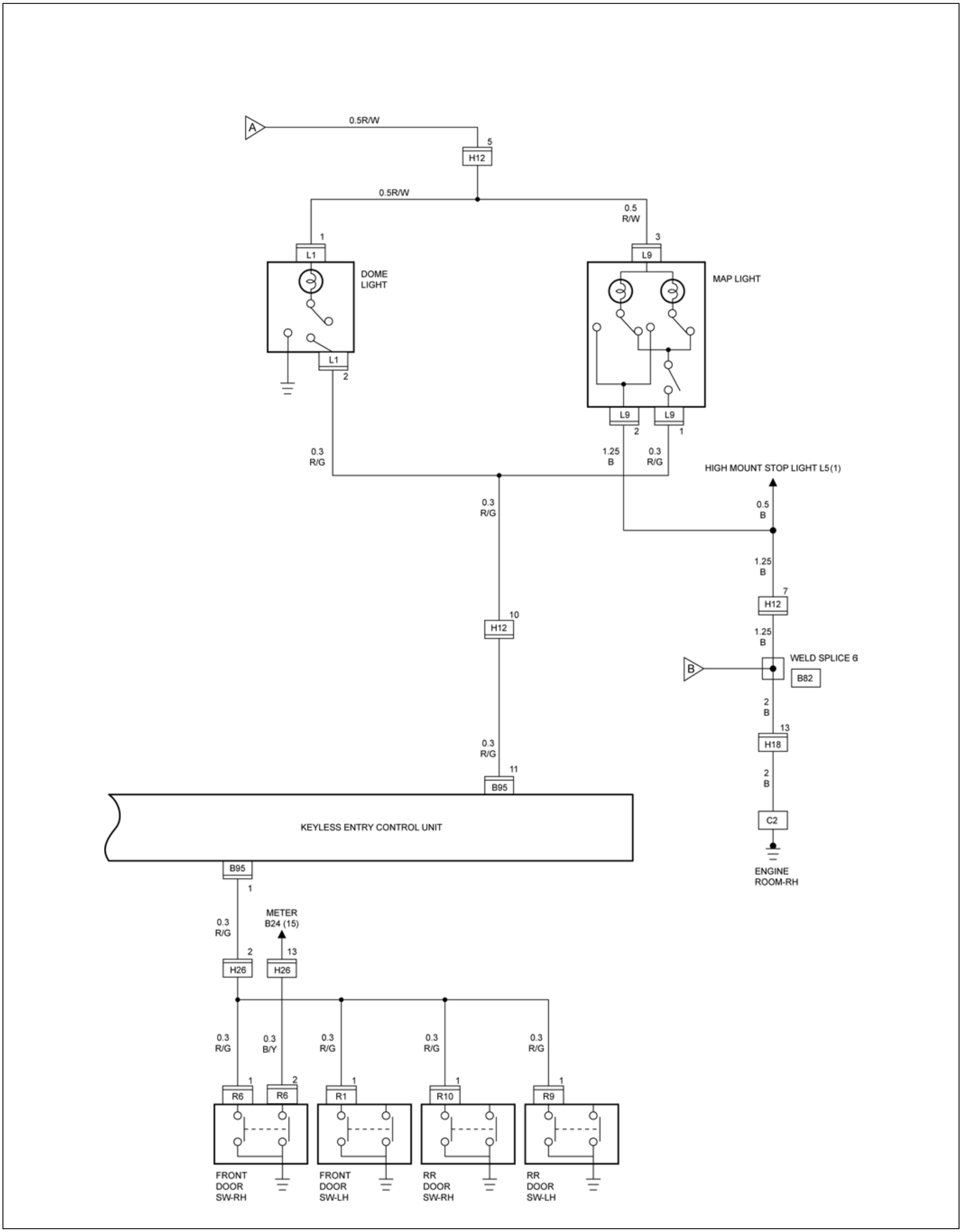
Sheet 1/2



RTW78AXF004001

CIRCUIT DIAGRAM HFV6 (RHD)

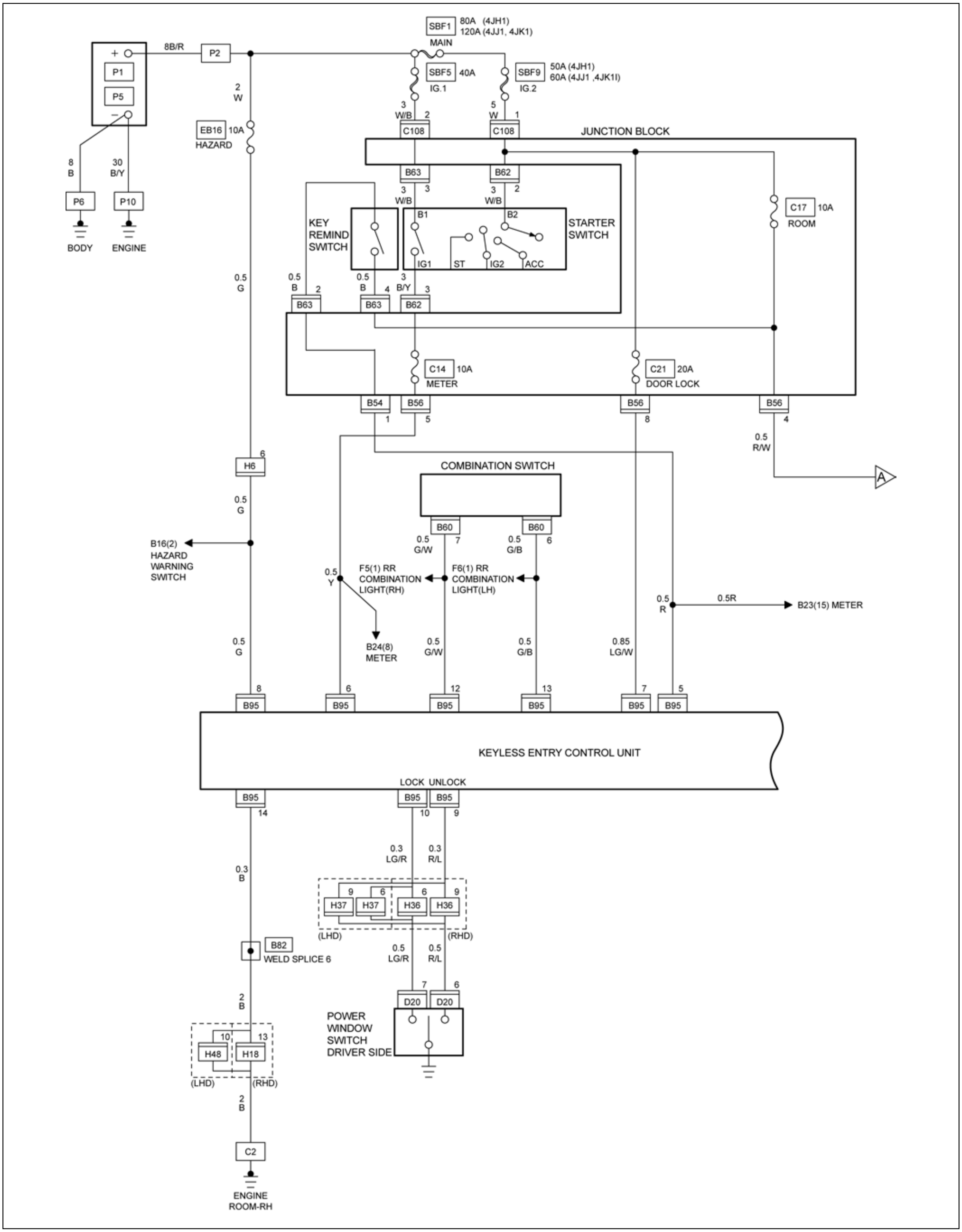
Sheet 2/2



RTW78AXF004101

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC, 4JH1-TC

Sheet 1/2



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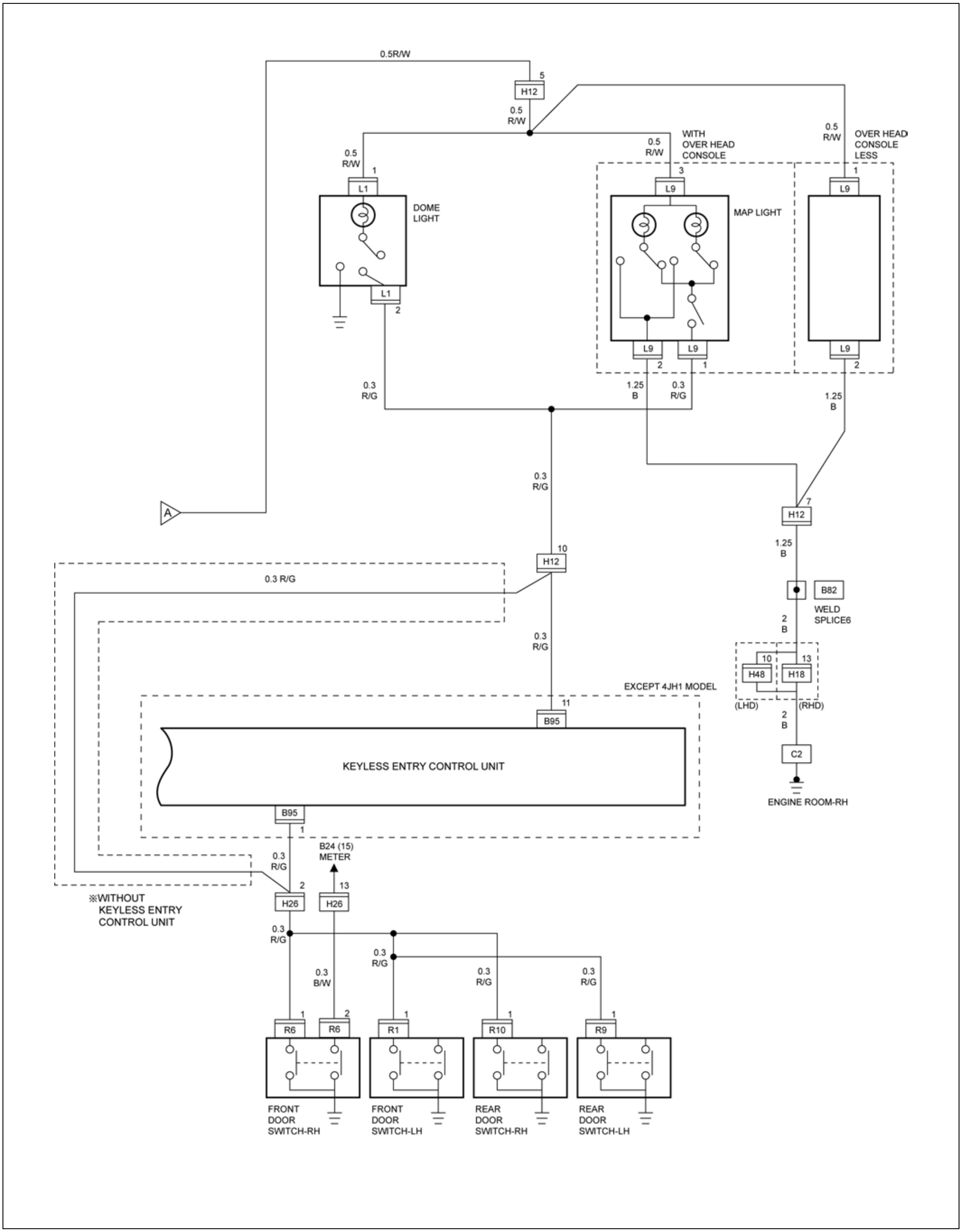
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC, 4JH1-TC

Sheet 2/2



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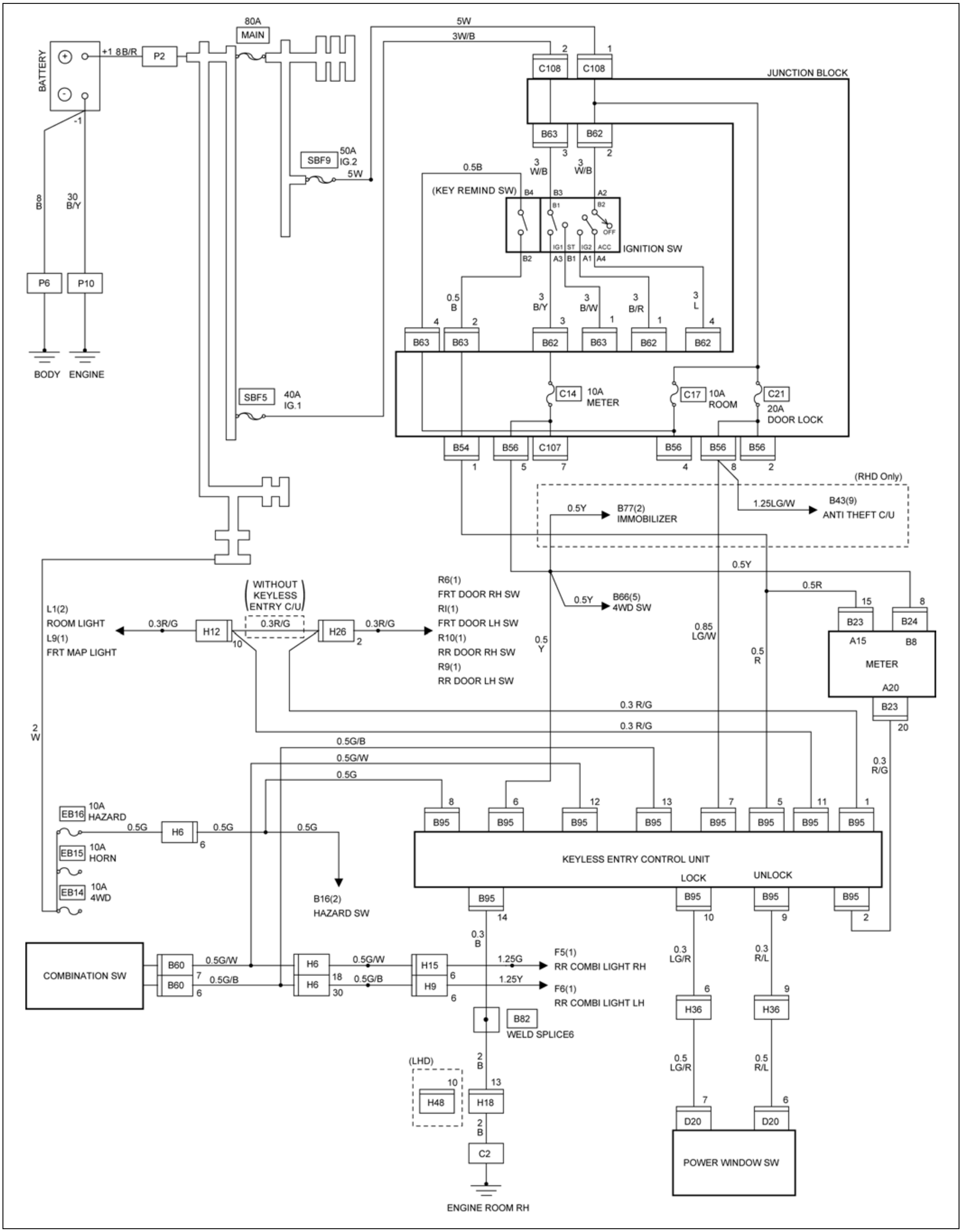
CIRCUIT DIAGRAM 4JA1T(L)



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TROUBLESHOOTING

Diagnostic procedure

- Check the operation "Lock / unlock" by using transmitter (remote key) on the vehicle.
- Check the operation "ON / OFF" for Driver side door SW on the vehicle.
- Perform the Keyless entry System Check.

Diagnostic Aids

An intermittent may be caused by the following:

- Poor connections.
- Miss routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Check for the following conditions:

- Poor connection at keyless entry control unit-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-Inspect the wiring harness for damage.

Check the Electro-Magnetic Interference (EMI)

- Location of vehicle check
  Move the vehicle to a new location and perform the check again.
- Non-OEM Parts.
  Switch is “OFF” or remove the Non-OEM parts and perform the check again.
- Other
  Remove the accessory and another key from key.

Check the other items.

- Battery voltage is low.
- Keyless entry programming functions.
- Registration for security code.
- Ignition switch operation.
- Meter system is malfunction.

Check the operation

Check the operation "Lock / unlock" by using transmitter (remote key) on the vehicle.

Notice

If so equipped the Anti Theft, Refer to ANTI THEFT SYSTEM in 11B Section.

Keyless Entry System Check

Step	Action	Value (s)	Yes	No
1	Check the fuse for the keyless entry power feed circuit. (EB16 10A) If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 2*
2	1. Check the KCU (Keyless Entry Control Unit) ground circuit for an open, or short to voltage. Also, check the KCU ignition feed circuit for an open or short to ground and the KCU ground circuit for an open. 2. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 3*
3	1. Check the front drive side SW circuit for an open, or short to voltage. 2. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	1. Check the operation "Lock / unlock" by using transmitter (Remote key) on the vehicle. Was the problem found?	—	Go to Diagnostic Chart	Go to Diagnostic Aids

ID Code not yet programmed

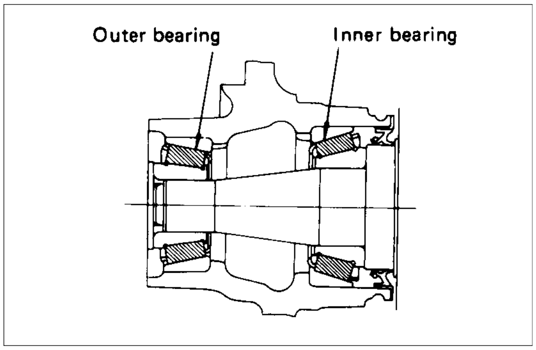
Step	Action	Value (s)	Yes	No
1	Was the Keyless entry System Check performed?	—	Go to *Step 2*	Go to *Keyless entry System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the Keyless entry programming functions. • All transmitters (Remote Key). If a problem is found, reprogramming as necessary. (Refer to “ID code new registration”) Was the action complete?	—	Go to *Step 4*	Go to ID code new registration
4	Check the operation "Lock / unlock" by using transmitter (Remote key) on the vehicle. Was the problem found?	—	Go to *Step 5*	Verify repair
5	Recheck the following condition. 1. Non-OEM parts switch is “OFF” or remove the Non-OEM parts. 2. Move the vehicle to a new location. 3. Check the operation "Lock / unlock" by using transmitter (Remote key) on the vehicle. Was the problem found?	—	Go to *Step 6*	Verify repair
6	Replace the Keyless entry control unit (KCU). **IMPORTANT:** The replacement KCU must be programmed the security code. Was the problem found?	—	Go to *Step 7*	Verify repair
7	Replace the key and lock cylinder assembly with Keyless entry system (KCU). **IMPORTANT:** • KCU is not replacing simultaneously. • After replace lock cylinders, perform the following below the items. • Replace the keys and key cylinders. • Program the Keyless entry system. (Refer to “ID code new registration”) Was the action complete?	—	Verify repair	—

No Remote Key Programmed

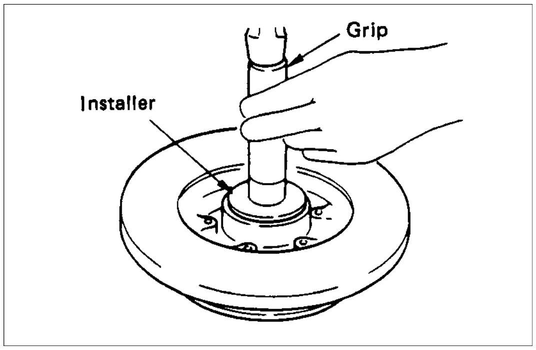
Step	Action	Value (s)	Yes	No
1	Was the Keyless entry System Check performed?	—	Go to *Step 2*	Go to *keyless entry System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the keyless entry programming functions. • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the keyless entry programming functions. • Transmitter (Remote Key). (Refer to “ID code new registration”) Was the action complete?	—	Go to *Step 5*	—
5	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement transmitter (Remote Key) must be programmed the ID code. Was the action complete?	—	Verify repair	—

Door Lock Actuators Short Circuit to Ground

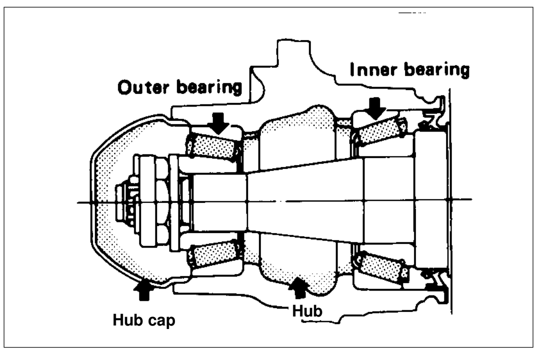
Step	Action	Value (s)	Yes	No
1	Was the Keyless entry System Check performed?	—	Go to *Step 2*	Go to *keyless entry System Check*
2	Check the door lock actuators circuit. 1. Ignition key position is “OFF”. 2. Disconnect the keyless entry control unit (KCU). 3. Check the door lock actuator circuit for short to ground. If the problem found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 3*
3	Check the operation "Lock / unlock" by using transmitter (Remote key) on the vehicle. Was the problem found?	—	Go to *Step 4*	Verify repair
4	Check the door lock actuator. If the problem found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 5*
5	Replace the Keyless entry control unit (KCU). **IMPORTANT:** The replacement KCU must be programmed the security code. Was the problem found?	—	Go to *Step 7*	Verify repair



(2) Install the outer and inner bearing into the hub with fingers.



(3) Install oil seal using special tools.
Discard the used oil seal and install a new one.
Installer : 5-8840-2853-0
Grip : 5-8840-0007-0

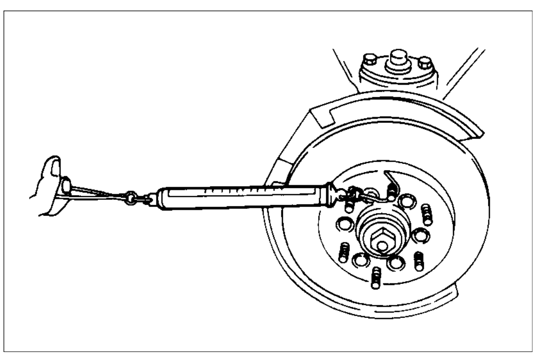


6. Hub and Disc Assembly

12. Hub Cap

Apply grease in the hub and hub cap.

Description	Amount g(oz)
Hub	50 (1.77)
Hub cap	20 (0.71)
Outer bearing	6.5 (0.23)
Inner bearing	12 (0.42)



9. Hub nut

Adjustment of front wheel hub bearing preload

1. Tighten spindle nut to 29 N·m (3.0 kgf·m/22 lb·ft) torque.
2. Turn the hub 2-3 turns and loosen the nut just enough so that it can be turned with the fingers.
3. Turn the nut all the way in with the fingers and check to be sure the hub has no free play.
4. Measure the bearing preload by pulling one of the wheel hub studs with a spring scale.
5. Tighten the spindle nut until specified bearing preload Is obtained.
6. Install the split pin in the nut retainer.
   Discard the used split pin and install a new one.

After reassembling, install the disc brake caliper assembly.

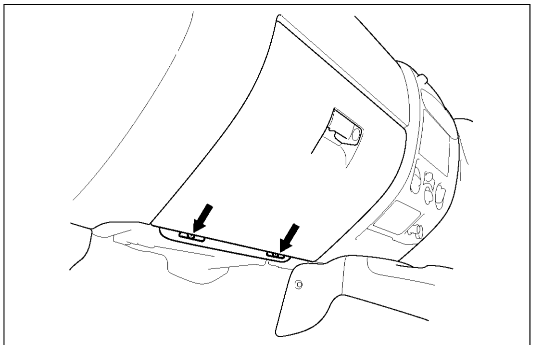
Bearing Preload N (kgf/lb)

New bearing and New oil seal	9.3 - 13.3 (0.95 - 1.36 / 2.09 – 3.00)
Reuse bearing and New oil seal	9.3 - 13.3 (0.95 - 1.36 / 2.09 – 3.00)

KEYLESS ENTRY CONTROL UNIT

Removal

1. Remove the glove box.
2. Disconnect the glove box lamp connector.



This Illustration is based on RHD

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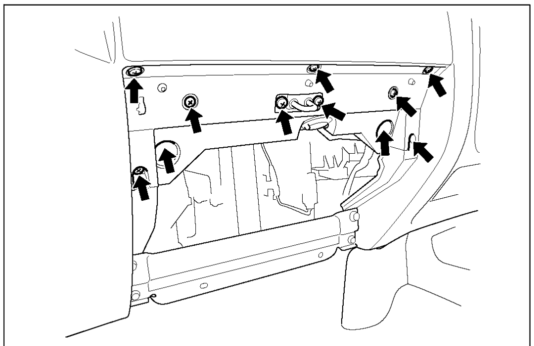
3. Remove the glove box cover.



This Illustration is based on RHD

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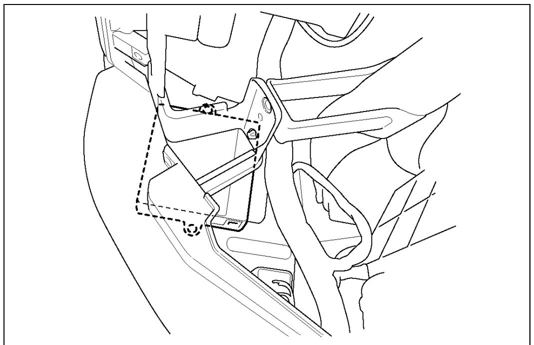
4. Remove the bolt of antitheft and keyless entry control unit.
5. Disconnect the keyless entry control unit connector.
6. Remove the keyless entry control unit.



This Illustration is based on RHD

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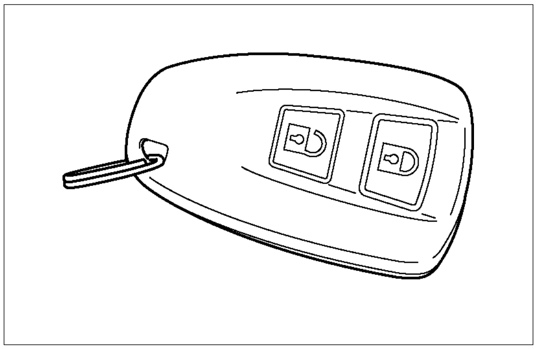
Installation

Follow the removal procedure in the reverse order to install the keyless entry control unit.

Connector

Be absolutely sure that the keyless entry control unit harness connector is correctly installed.
This will prevent a poor contact and an open circuit.



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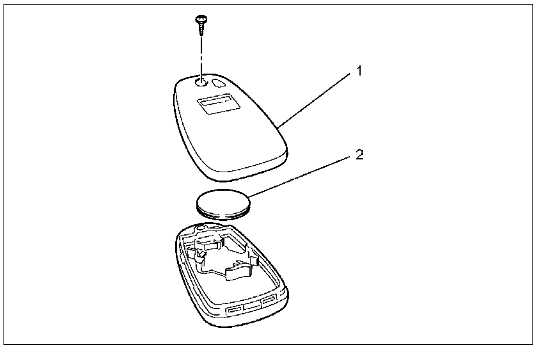

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Remove Transmitter (Remote Key)

Replacing the battery in the transmitter (remote key)

Replace the battery(2) as soon as the range of the remote control starts to become reduced.

Open the underside of the transmitter (remote key) by removing the battery cover(1) with a screwdriver as shown in the illustration.

Replace the battery, ensuring that it is inserted correctly.

Replace the battery cover so that it engages audibly. Make sure that you dispose of old batteries in accordance with environmental protection regulations.

Keyless Entry System

General Description

The system's main features are summarized as follows.

- Keyless entry with visual feedback
- Highly secure encrypted transmission format incorporating rolling code strategy
- Field programmable remote keys
- Door lock control
- Illuminated entry with fade out
- Illuminated exit
- Remote door lock / ignition key interlock
- Door ajar warning indicator in the cluster

Power Door Lock System

General Description

The circuit consists of the door lock (& power window) switch, door lock actuator for the front and rear door, tailgate lock actuator and the door lock key switch.
The front door lock switch - RH is always provided with the battery voltage.
The key or the inside lock button on both driver's and front passenger's door can activate the lock mechanism of all the doors (including the tailgate).
When the driver's door lock switch or the front passenger's door lock switch is turned on, current flows for about one second to the door lock actuator of each door connected in parallel with the front door lock (& power window) switch - LH to activate the actuator to lock and unlock the doors.

Door Lock Key Switch

Removal and Installation

- Refer to the Front Door Lock Assembly removal and installation steps in this section.

Front Door Lock Actuator

Removal and Installation

- Refer to the Front Door Lock Assembly removal and installation steps in this section.

Rear Door Lock Actuator

Removal and Installation

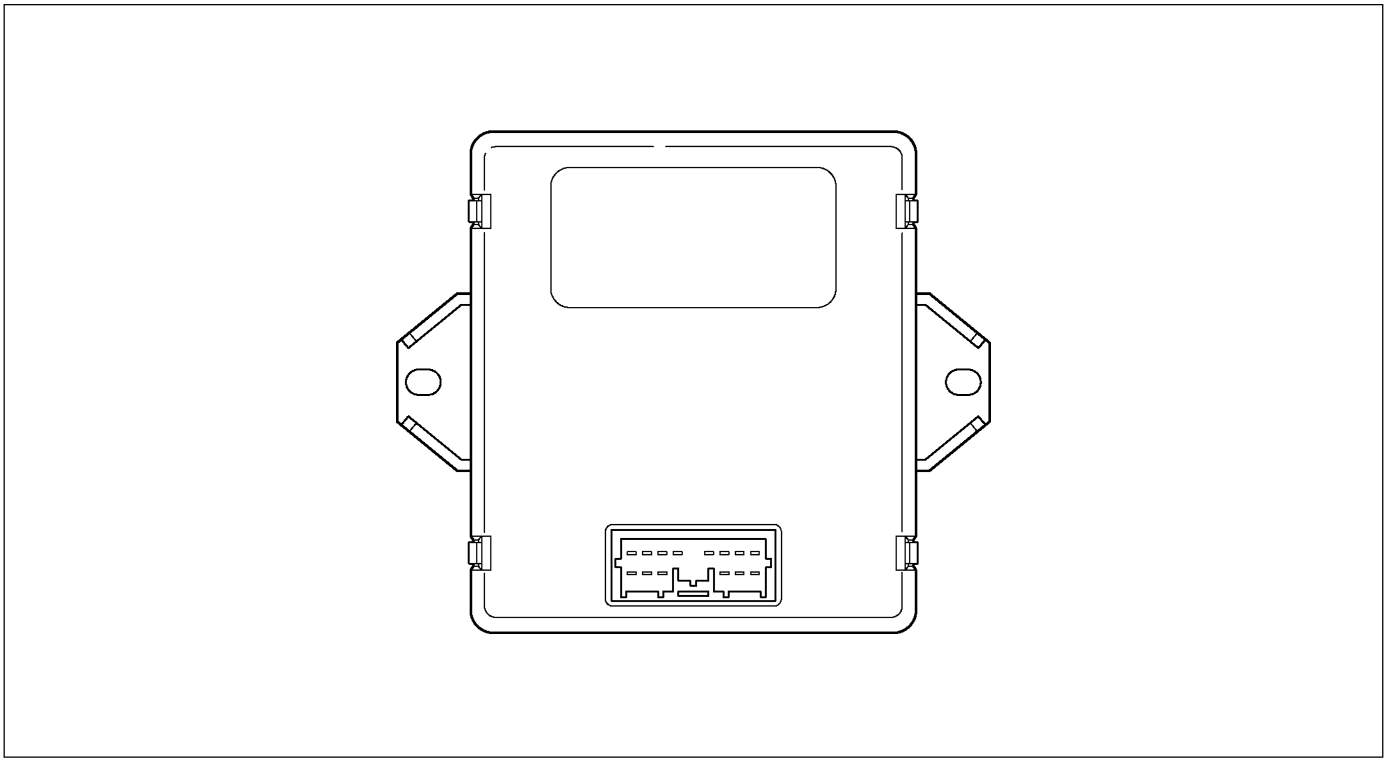
- Refer to the Rear Door Lock Assembly removal and installation steps in this section.

Tailgate Lock Actuator

Removal and Installation

- Refer to the Tailgate Lock Assembly removal and installation steps in this section.

Keyless entry control unit



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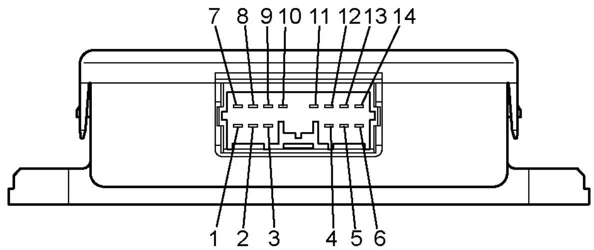
Pin-outs



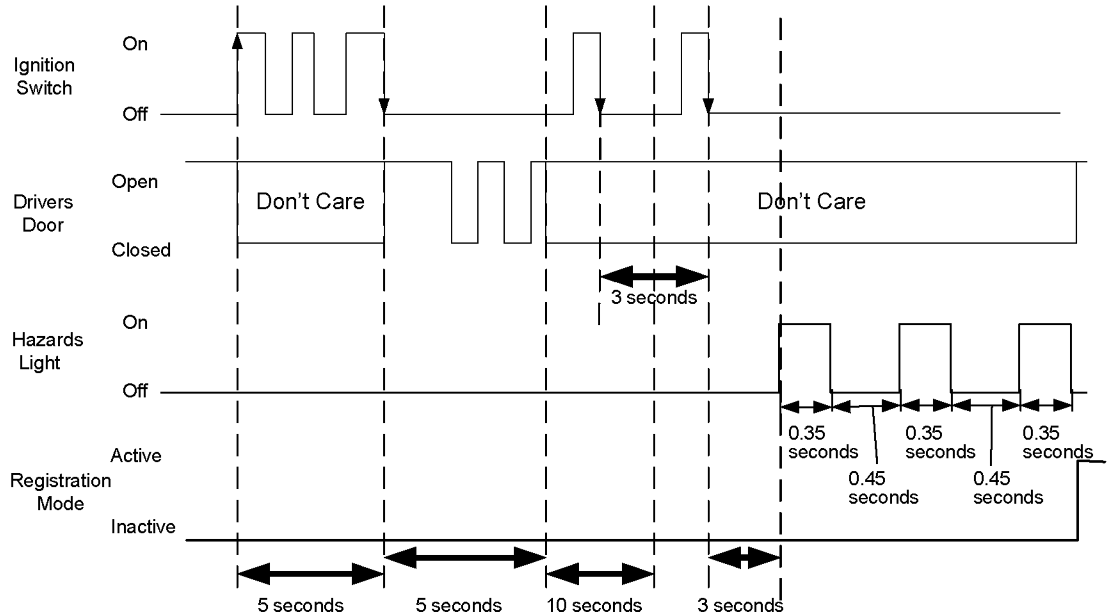
RUW580SF000301

No.	Pin Function
1	Door ajar switch
2	Door ajar indicator light
3	Tailgate switch
4	Test pin (Internal use only)
5	Key switch remote
6	Ignition switch
7	Battery
8	Hazard battery
9	Unlock
10	Lock
11	Front map light
12	Hazard-RH
13	Hazard-LH
14	Ground

ID Code New Registration

All registered ID codes shall be erased, and a new received
ID code shall be registered instead of old codes.
Carefully read each of the steps before beginning the operation.

Step	Action	Yes	No
1	**NOTE:** Make sure that the all the doors are closed and unlocked. Remove the ignition key from the ignition switch. 1. Open the driver's side door. 2. Insert the ignition key into the starter switch. Is the action complete?	Go to *Step 2*	—
2	Turn the ignition switch to ON position and return it to OFF position three times. **NOTE:** This step must be carried out within five seconds. Is the action complete?	Go to *Step 3*	Go to *Step 1*
3	Close and open the drive's side door twice. **NOTE:** This step must be carried out within five seconds after step 2 is finished. Is the action complete?	Go to *Step 4*	Go to *Step 1*
4	1. Turn the ignition switch to ON position and return it to OFF position twice. **NOTE:** This step must be carried out within ten seconds after step 3 is finished. Is the action complete?	Go to *Step 5*	Go to *Step 1*
5	Operate the lock or unlock button of the transmitter. **NOTE:** Confirm that the system is functioning by pressing the transmitter button to lock and unlock the doors. Listen for the sound of the actuator operation. Is the action complete?	—	Go to *Step 1*



Sequence and timing to enter New Registration Mode

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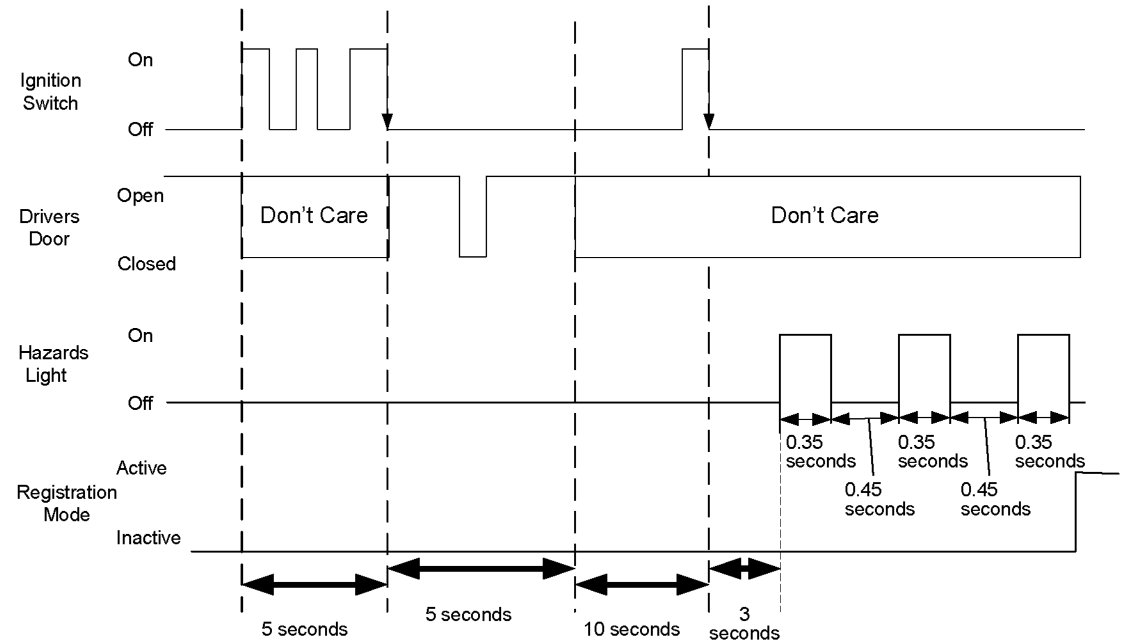
ID Code Additional Registration

A new received ID code shall be additionally registered with holding registered ID codes. When a total of already registered and newly registered ID code exceeds 4, the oldest one shall be erased.

Step	Action	Yes	No
1	**NOTE:** Make sure that the all the doors are closed and unlocked. Remove the ignition key from the ignition switch. 1. Open the driver's side door. 2. Insert the ignition key into the starter switch. Is the action complete?	Go to *Step 2*	—
2	Turn the ignition switch to ON position and return it to OFF position three times. **NOTE:** This step must be carried out within five seconds . Is the action complete?	Go to *Step 3*	Go to *Step 1*
3	Close and open the driver's side door once. **NOTE:** This step must be carried out within five seconds after step 2 is finished. Is the action complete?	Go to *Step 4*	Go to *Step 1*
4	1. Turn the ignition switch to ON position and return it to OFF position once. Check that the hazard lamp blinks 3 times. **NOTE:** This step must be carried out within ten seconds after step 3 is finished. Is the action complete?	Go to *Step 5*	Go to *Step 1*
5	Operate the lock or unlock button of the transmitter. **NOTE:** Confirm that the system is functioning by pressing the transmitter button to lock and unlock the doors. Listen for the sound of the actuator operation. Is the action complete?	—	Go to *Step 1*



Sequence and timing to enter Additional Registration Mode

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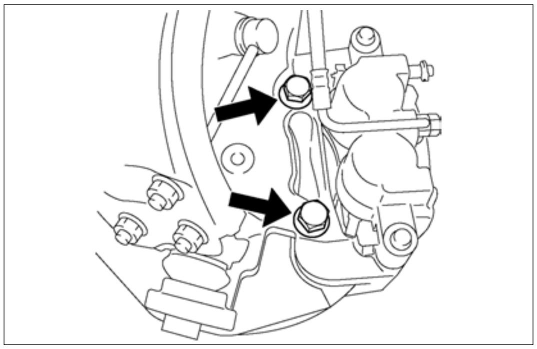

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14.Bolt

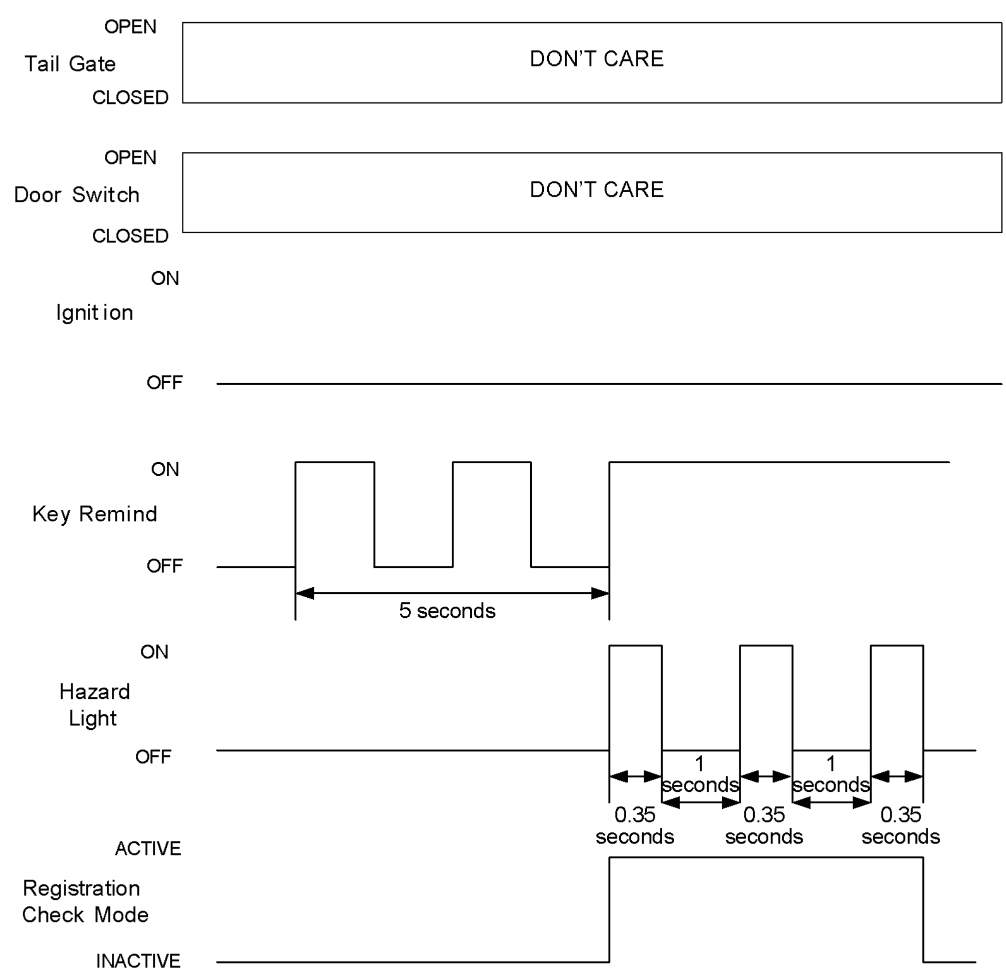
Torque	N·m (kgf·m/lb·ft)
226 (23.0/166)	

- Refer to SECTION 3E "WHEELS AND TIRES" for install procedure.

ID Code Check

Numbers of registered ID code shall be checked in this mode.

Step	Action	Yes	No
1	**NOTE:** Make sure that the all the doors are closed. Is the action complete?	Go to *Step 2*	—
2	Insert the ignition key into the key lock twice, and then re-inserted. **NOTE:** This step must be carried out within five seconds. Count the number of times the hazard lights flash on and off. This number is equal to the number of registrations. Is the action complete?	Go to *Step 1*	Go to *Step 1*



Example Registration Check Mode (Body Electronic Module with 3 ID's registered)

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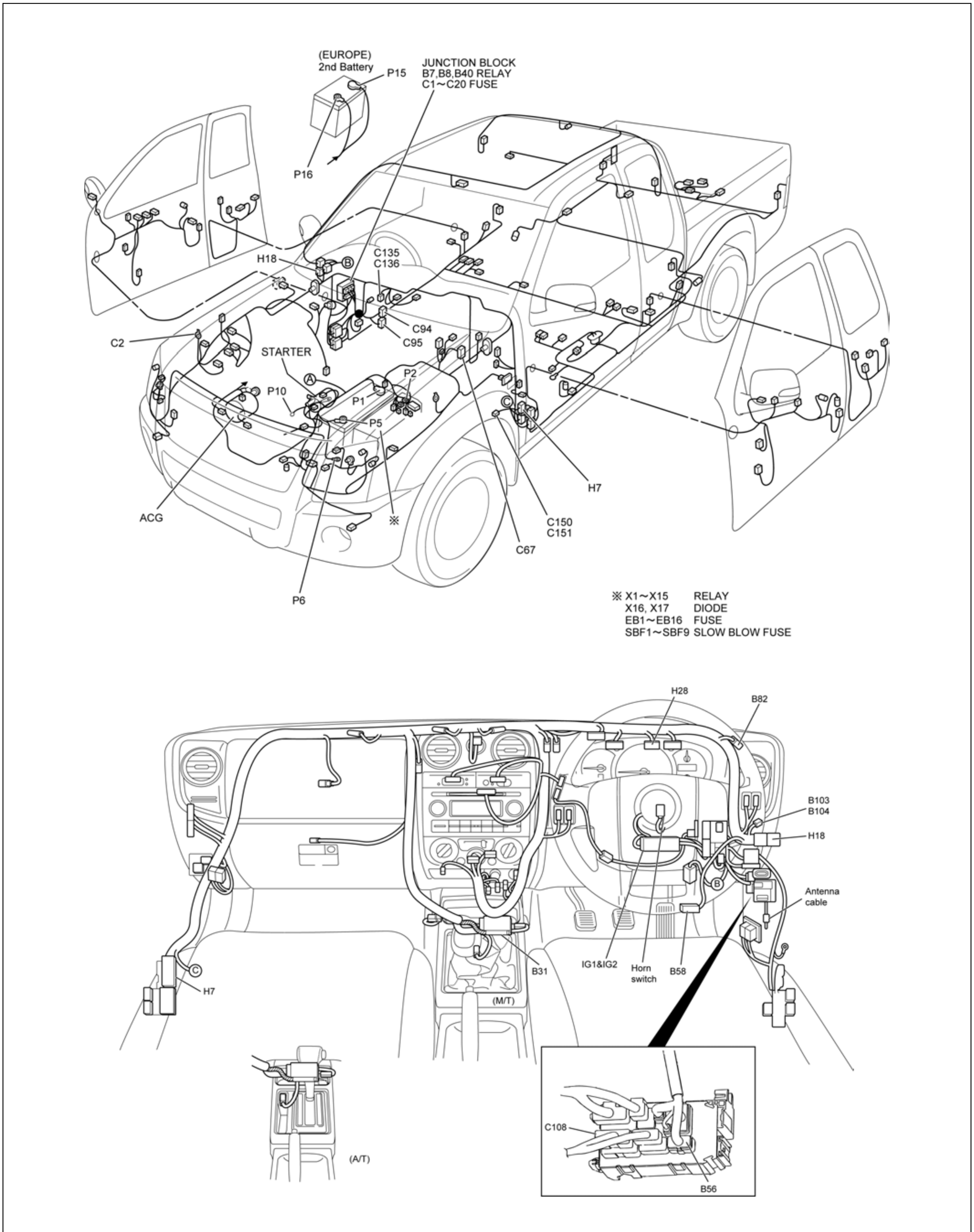
DATA LINK CONNECTOR

PARTS LOCATION



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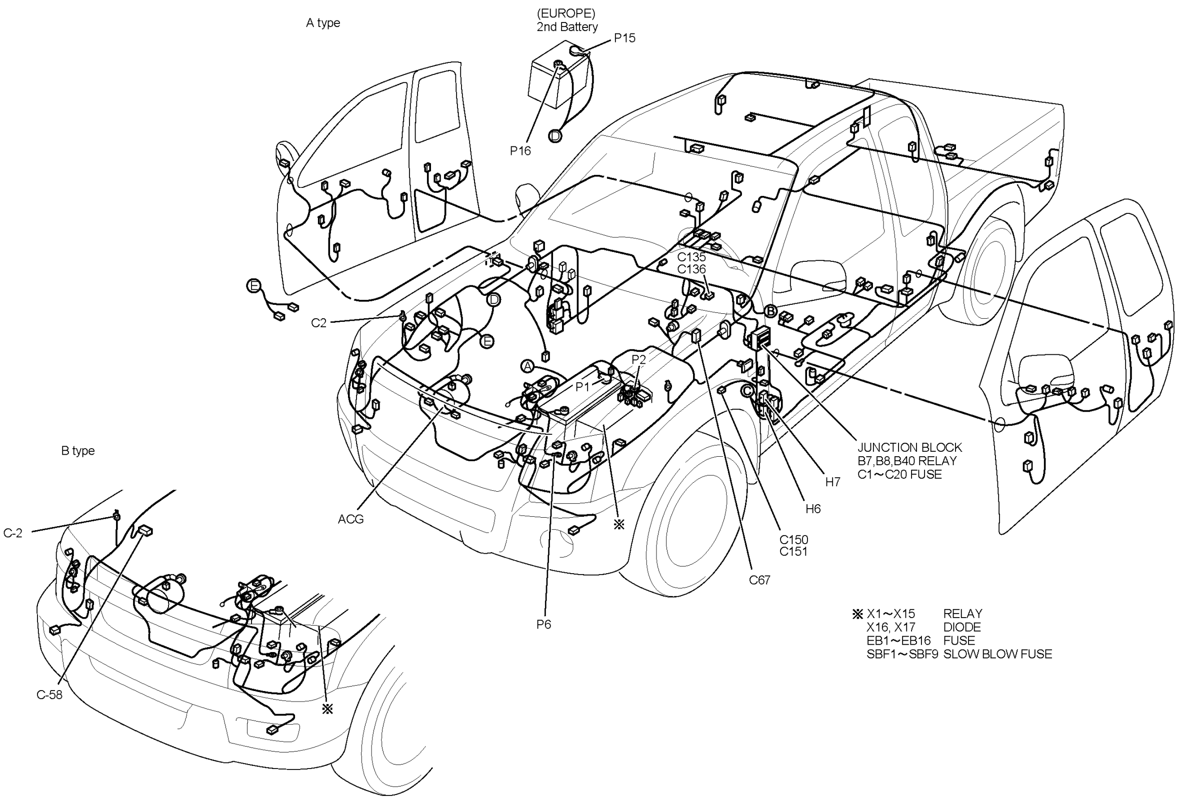
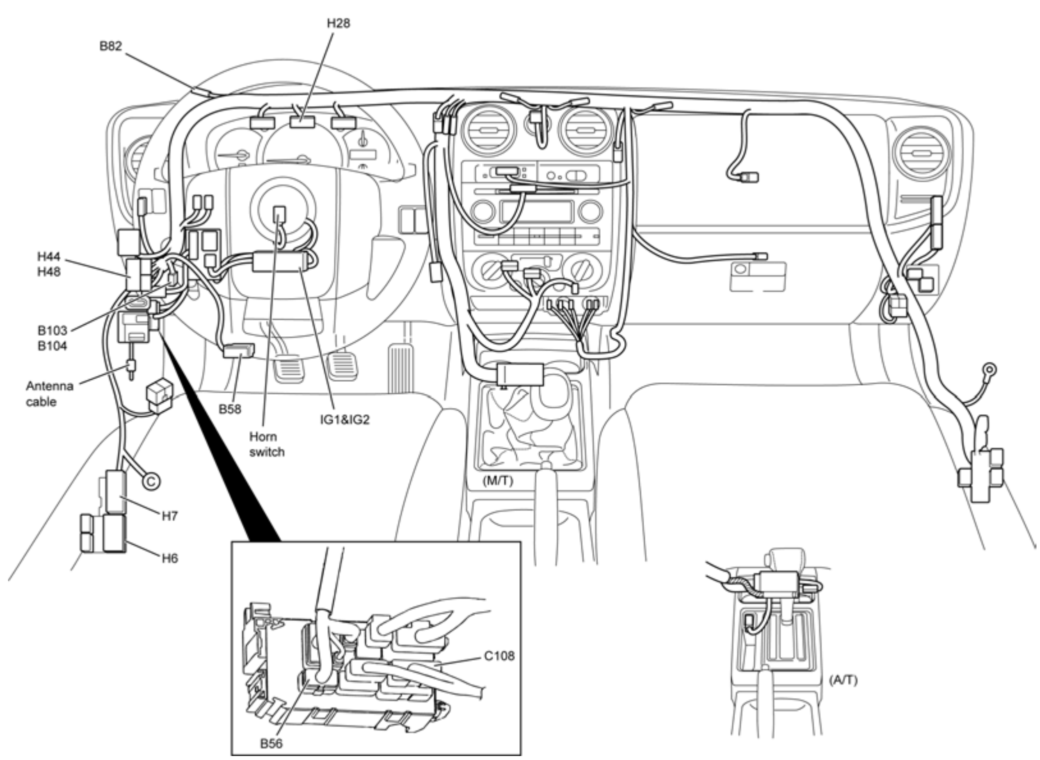
PARTS LOCATION





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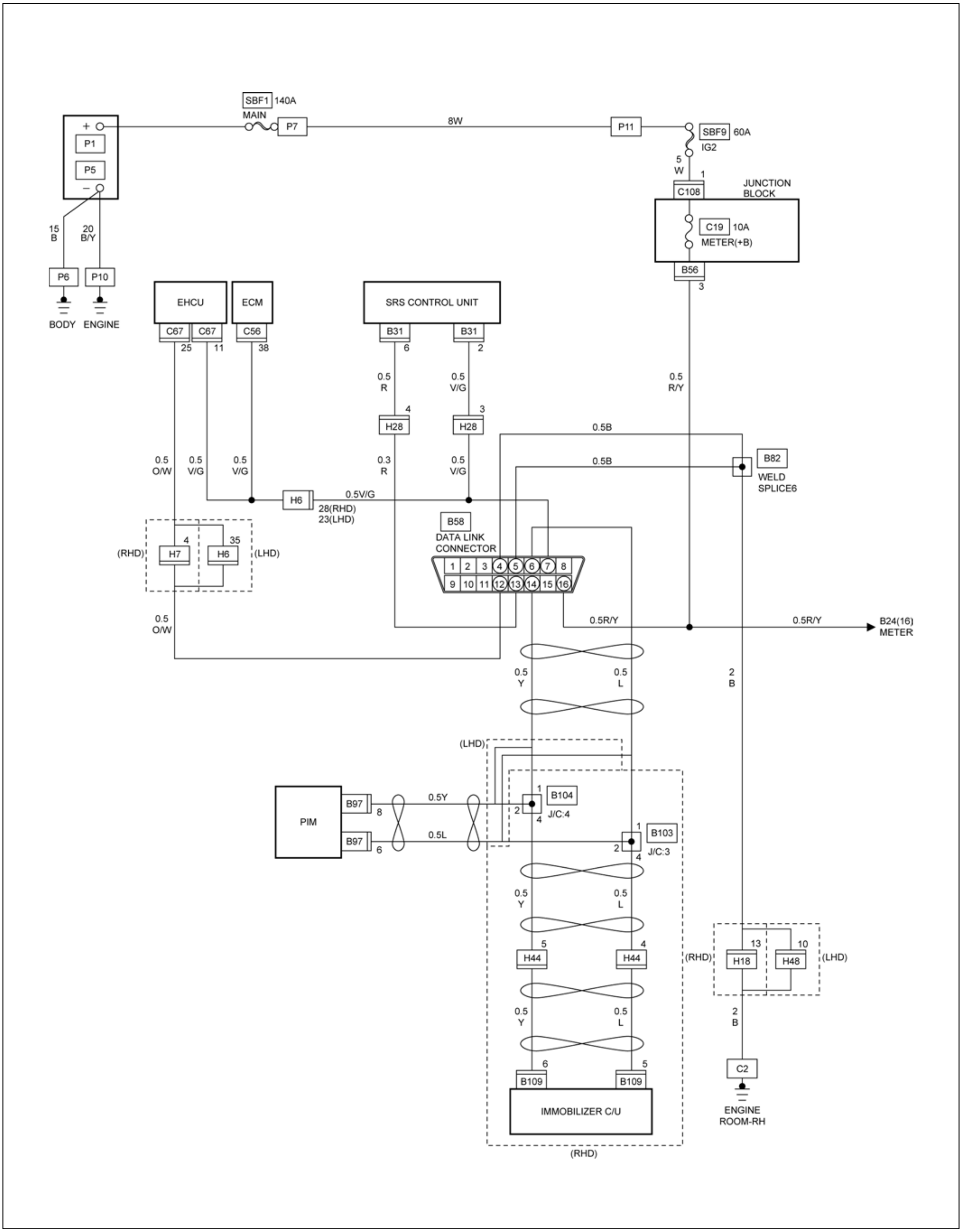
CIRCUIT DIAGRAM HFV6



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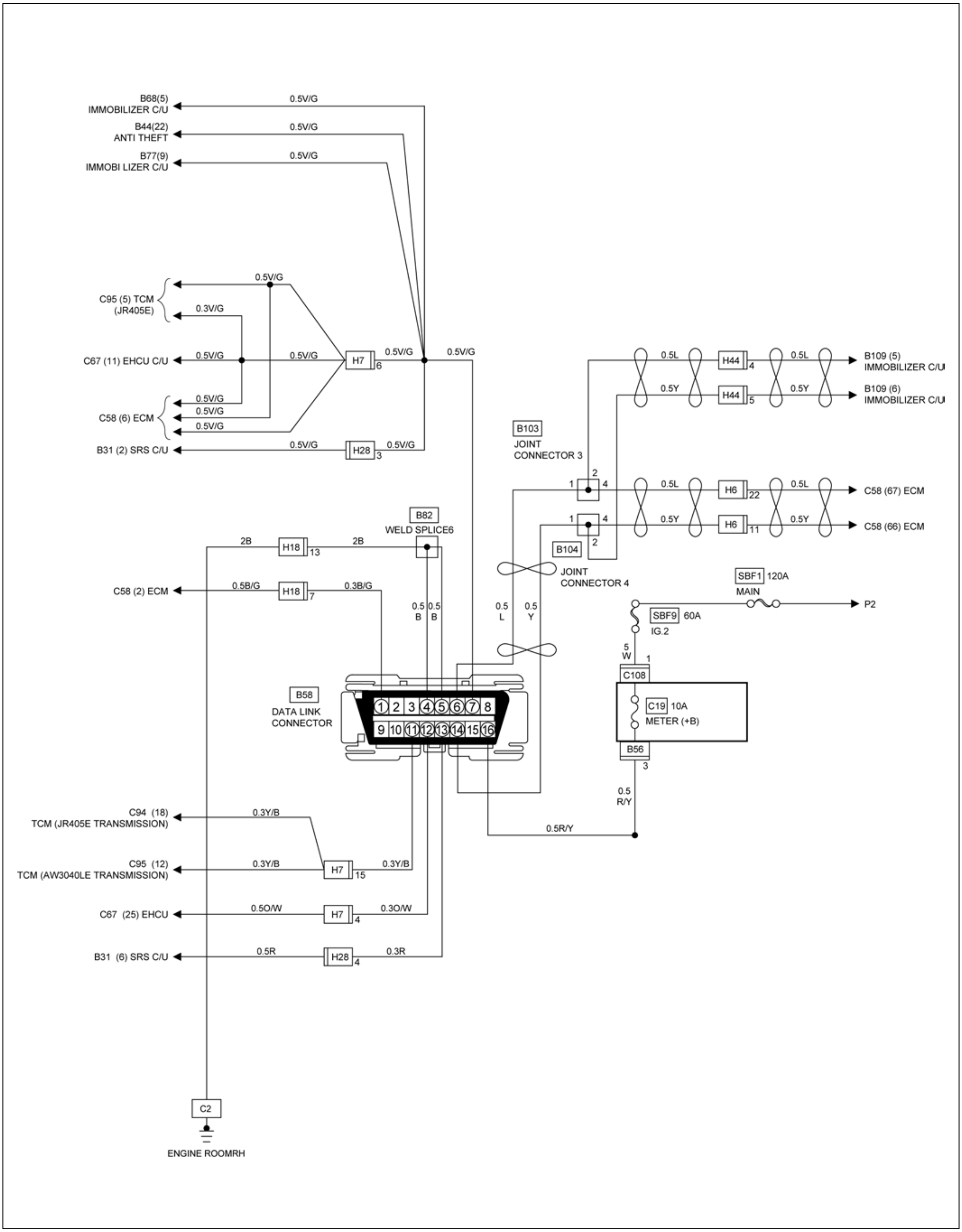
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) SOUTH AFRICA



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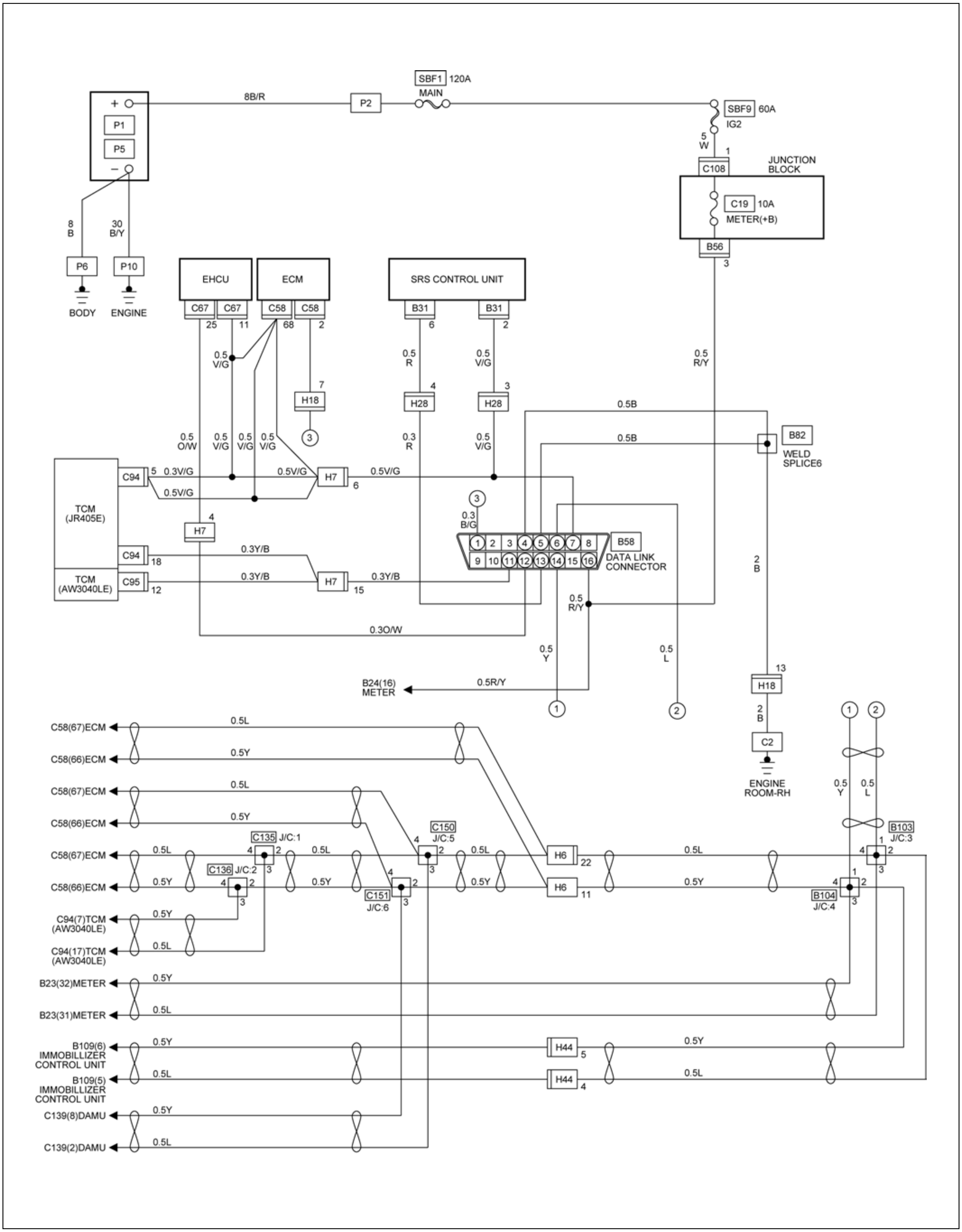
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) EXCEPT SOUTH AFRICA



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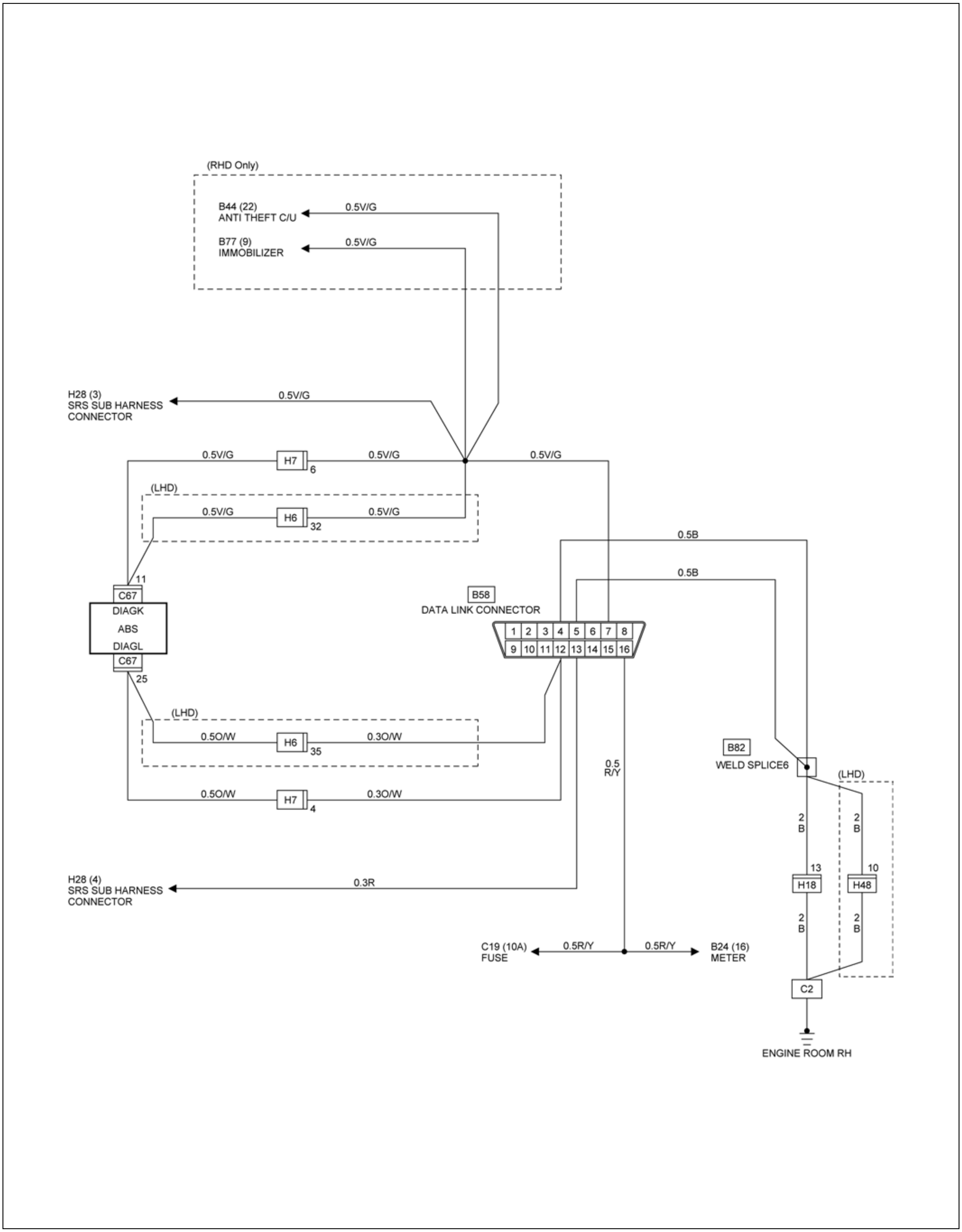
CIRCUIT DIAGRAM 4JA1T (L)



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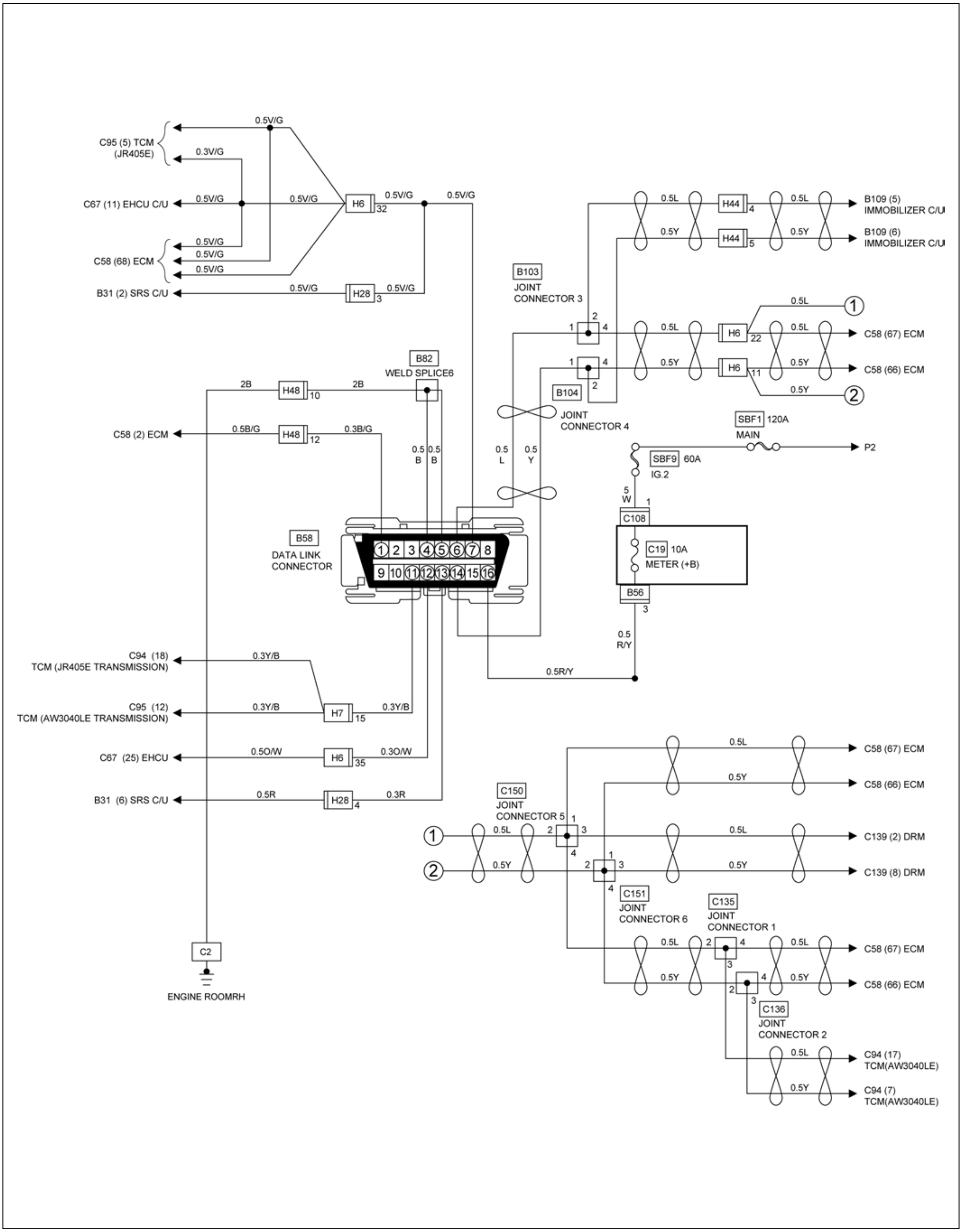
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD) G.EXP



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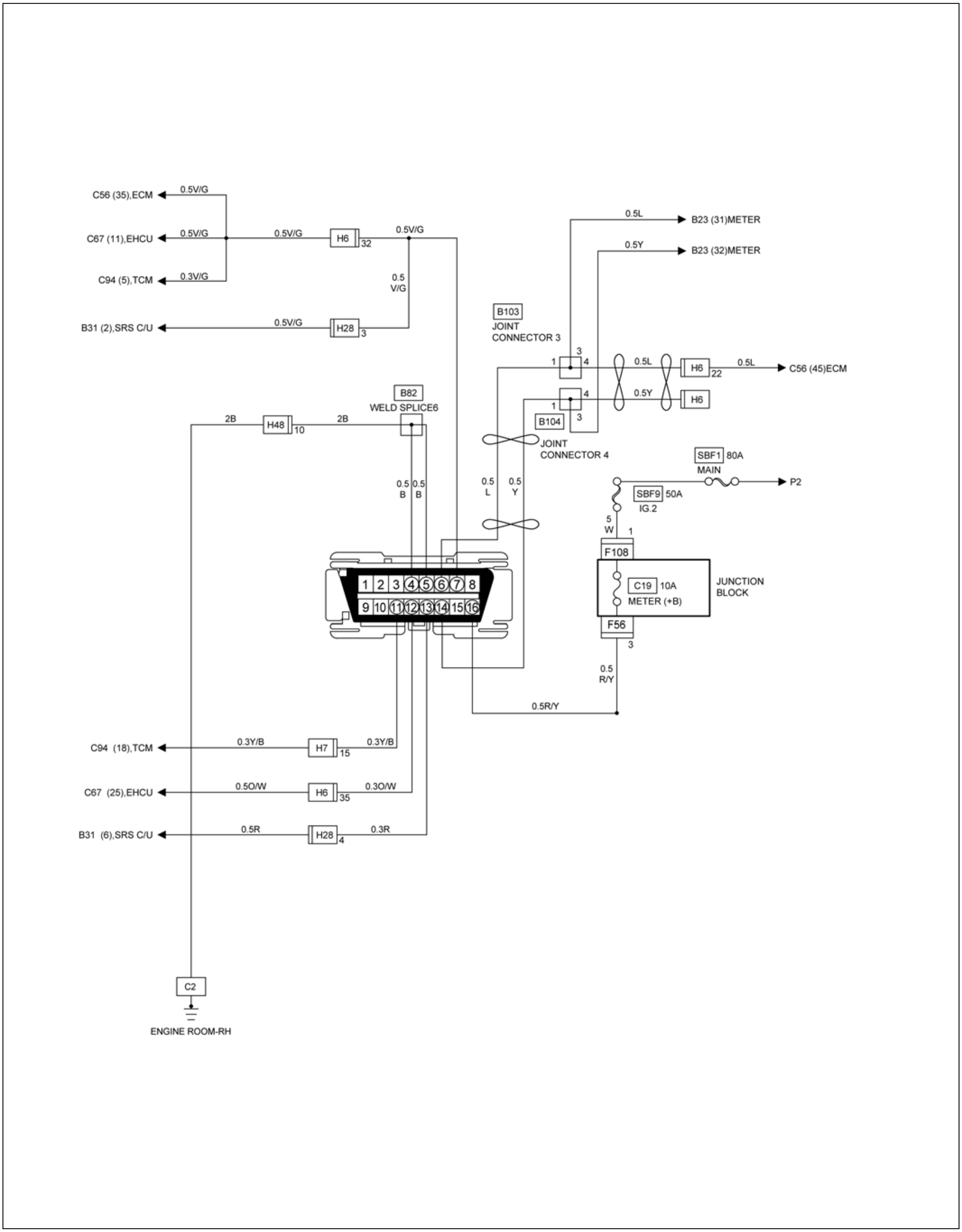
CIRCUIT DIAGRAM 4JH1-TC



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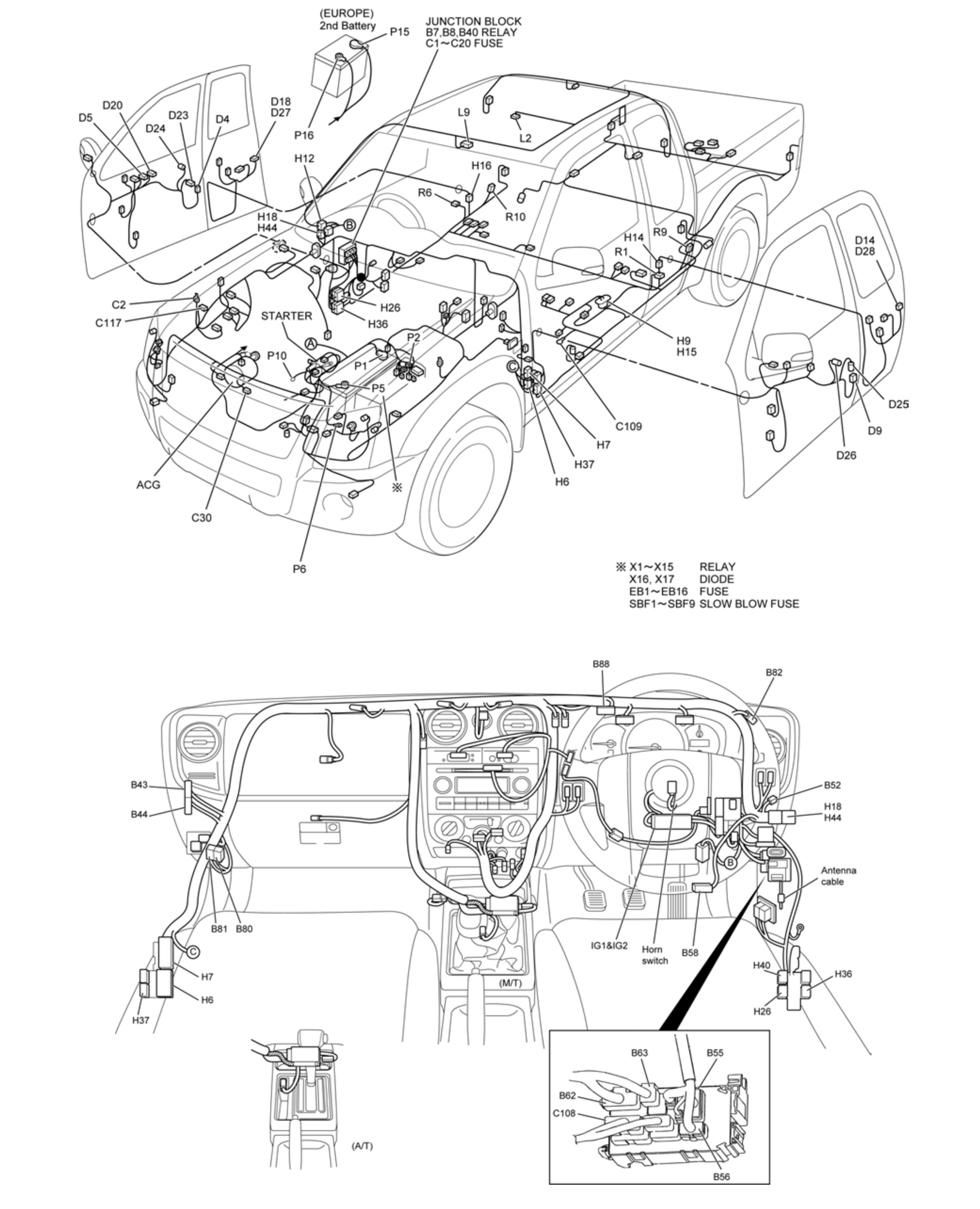
ANTI THEFT

PARTS LOCATION WITH SUPER LOCK (RHD)



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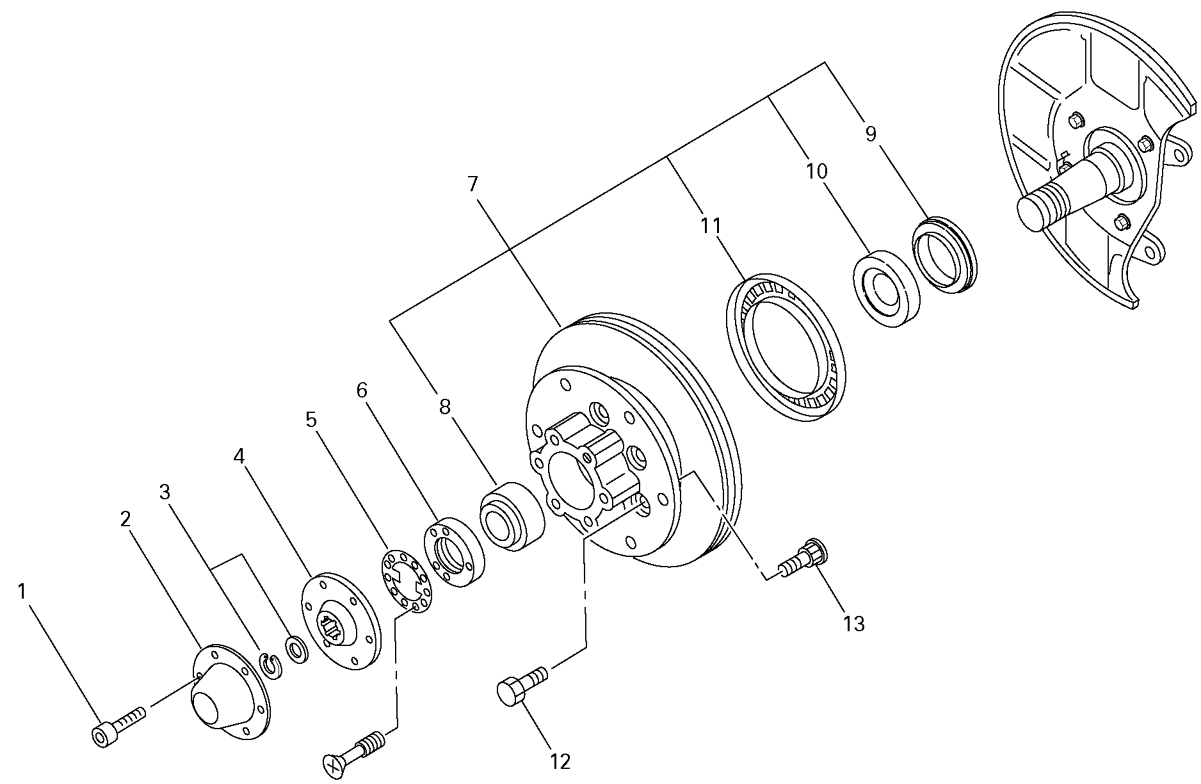
MAIN DATA AND SPECIFICATIONS

COMPRESSOR		
Model		CR-14
Type		5 Vane rotary type
Displacement	cm^3 (Imp fl oz)	144 (4.03)
Oil type		DH-PR
Oil capacity	cm^3 (Imp fl oz)	180 (5.07)
Magnetic clutch	mm (in)	Type: Dry single disc dia. 109 (4.3)
HEATING UNIT (VENT UNIT)		
Type		Reheat air mix
Core dimension	mm (in)	(L×H×W) 180 (7.09) × 182.3 (7.18) × 27 (1.06)
Capacity	(kcal/h)	4200
BLOWER UNIT		
Type		Sirocco fan type
COOLING UNIT		
Type		Fin and tube evaporator
Evaporator element dimensions	mm (in)	(L×H×W) 222 (8.74) × 213 (8.39) × 56 (2.2)
Air volume / Heat absorption	m^3/H / W	300/3440 500/5140
• Expansion Valve type		External pressure equalizer type
• Thermo Switch type (Cooler)		Variable electronic thermostat
• Maximum Cool position	°C (°F)	OFF 3±0.5 (37.4±0.9) DIFF 1.5±0.5 (34.7±0.9)
• Minimum Cool position	°C (°F)	OFF 11.6±2 (52.9±3.6) DIFF 2.9±2 (37.2±3.6)
• Thermo Switch type (A/C)	°C (°F)	Fixed electronic thermostat OFF 3 ± 0.5 (37.4 ± 0.9) DIFF 1.5 ± 0.5 (34.7 ± 0.9)
CONDENSER		
Type		Aluminum louvered fins
Capacity	kW (kcal/h)	• 4JA1-T, 4JH1-TC, C24SE 14 (12300) • 4JJ1-TC (Standard Output), 4JJ1- TC (High Output), 4JK1-TC (High Output), 17 (14620)

FRONT HUB AND DISC
(4×4, 4×2 High Ride Suspension, 4×4 Rigid Hub, 4×4 Shift On the Fly Model)

Disassembly

Refer to SECTION 3E "WHEELS AND TIRES" for wheel removal procedure

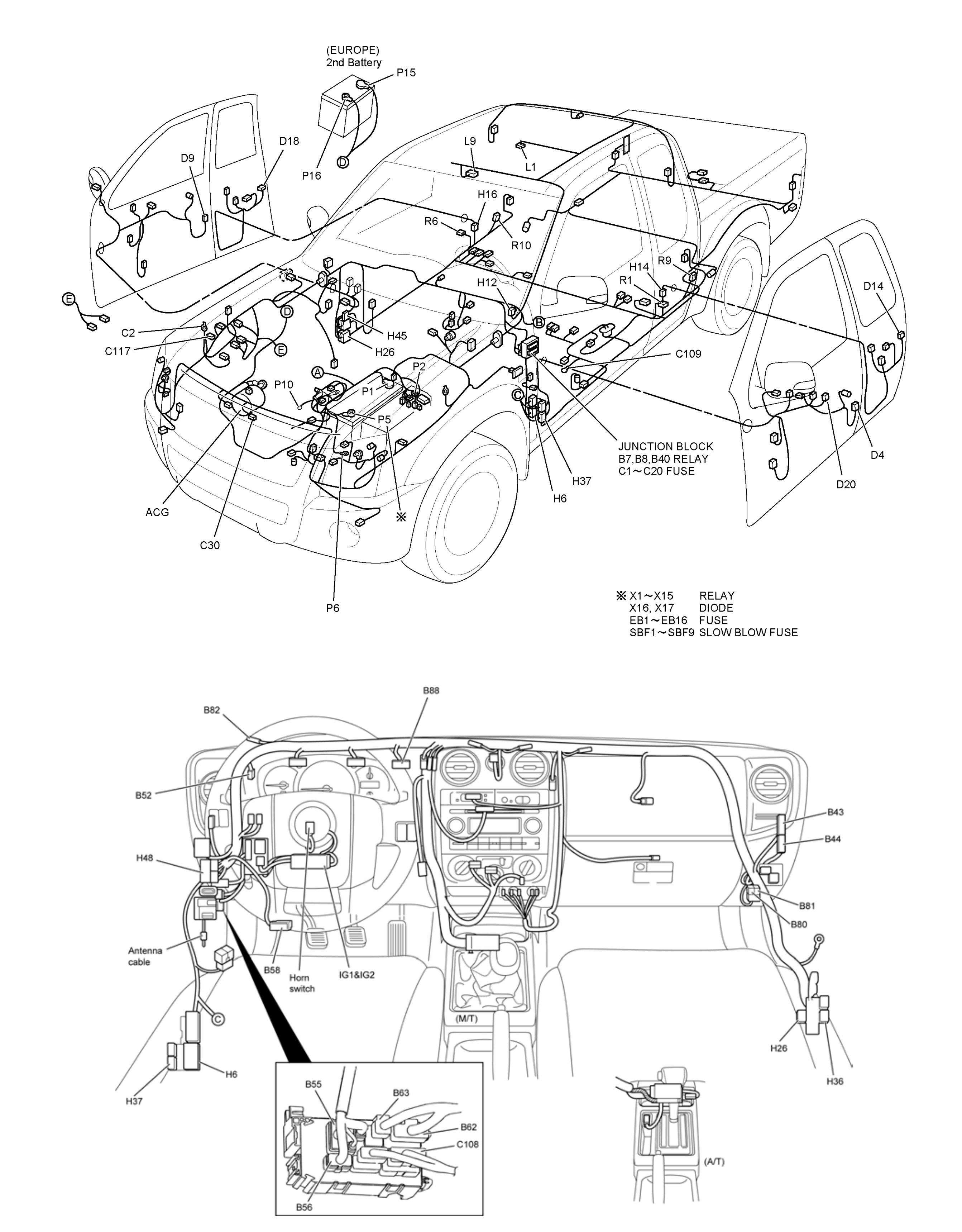


411R300011

Disassembly Steps

1. Bolt
2. Hub cap
3. Snap ring and shim (4×4 model only)
4. Flange (4×4 model only)
5. Lock washer
6. ▲ Hub nut
7. ▲ Hub and disc assembly
8. Outer bearing
9. Oil seal
10. Inner bearing
11. ABS sensor rotor
12. ▲ Bolt
13. ▲ Wheel pin

PARTS LOCATION (LHD)



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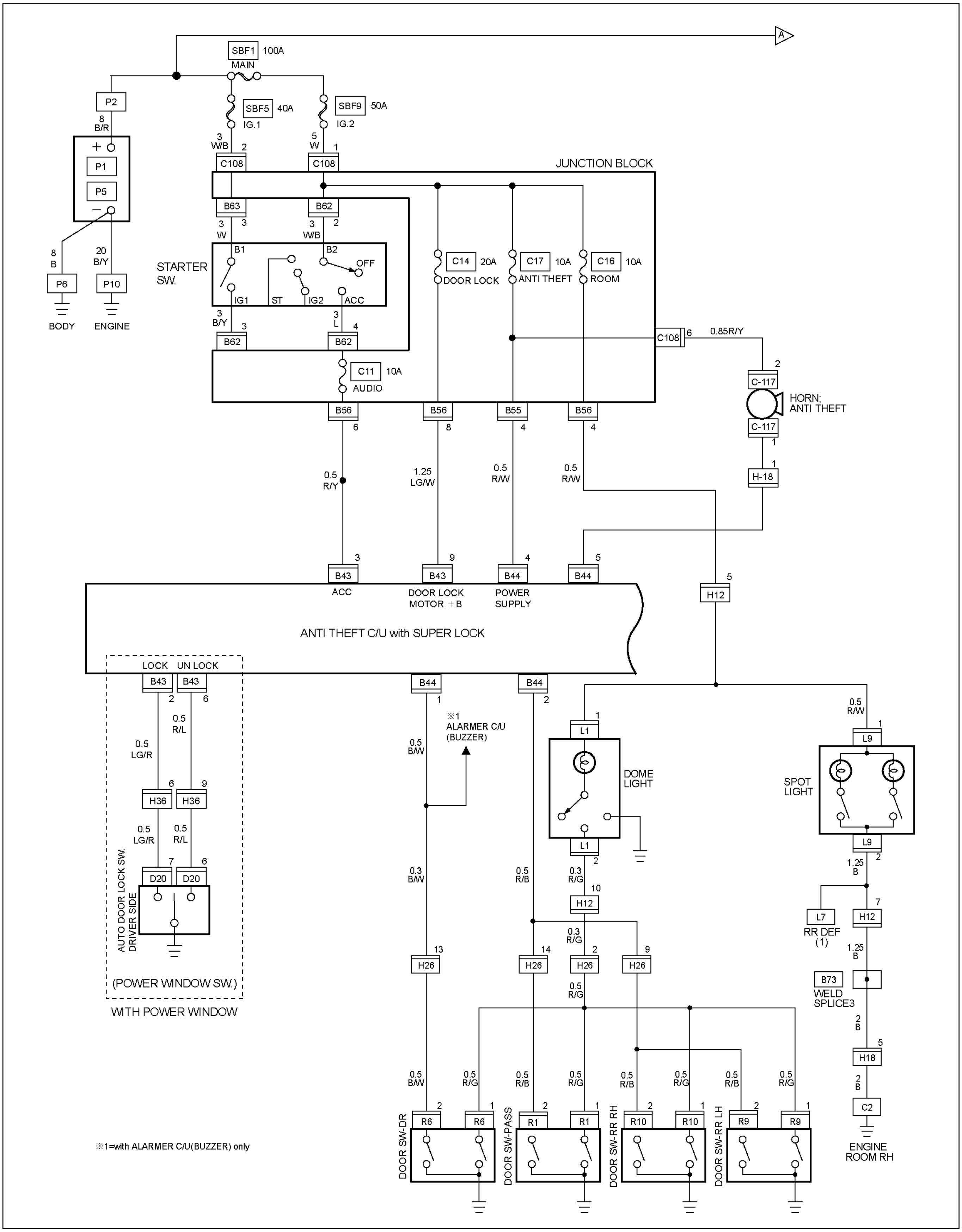
CIRCUIT DIAGRAM C24SE (RHD) WITH SUPER LOCK

Sheet 1/3

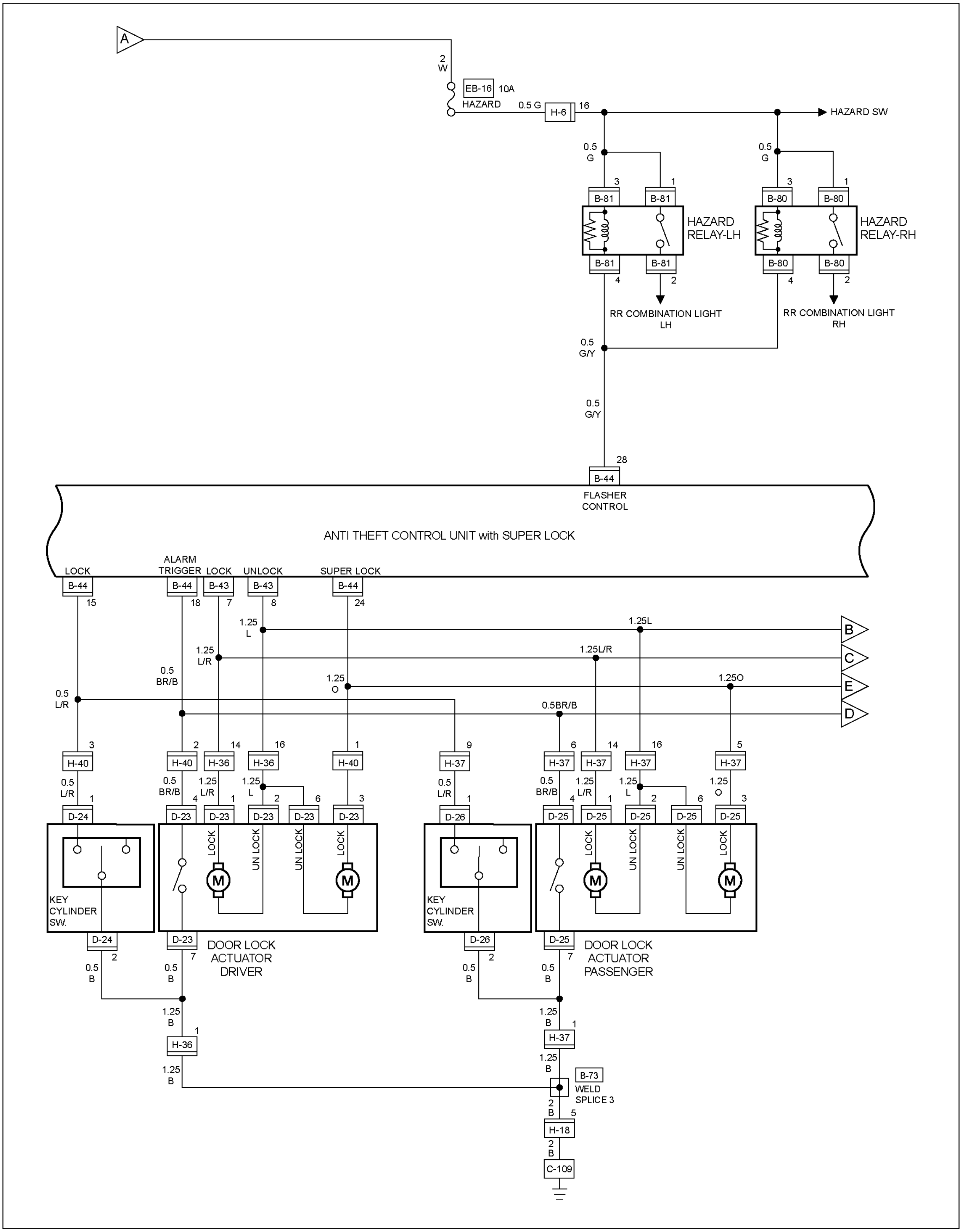


※1=with ALARMER C/U(BUZZER) only

RTW780XF014701

CIRCUIT DIAGRAM C24SE (RHD) WITH SUPER LOCK

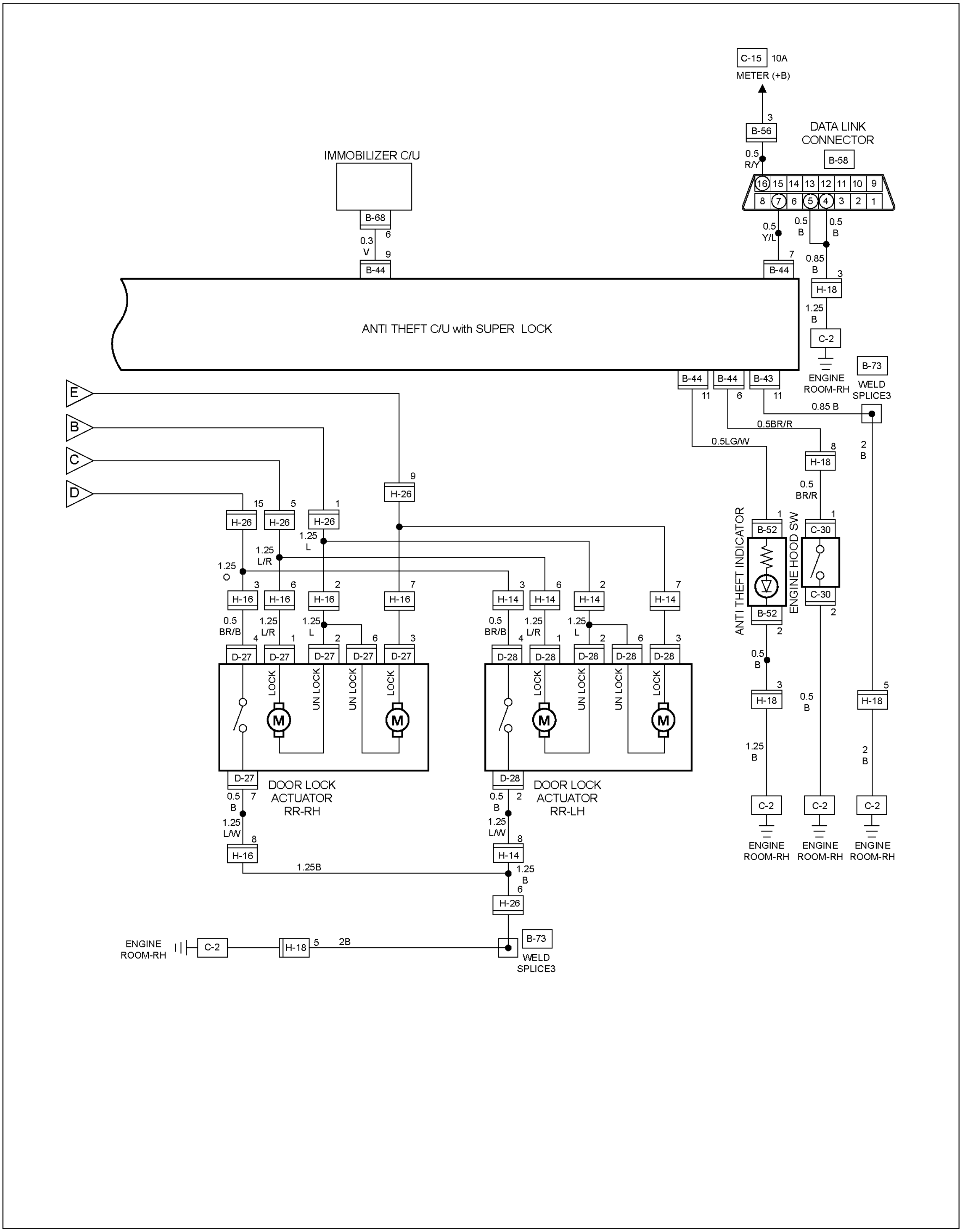
Sheet 2/3



RTW680XF015501

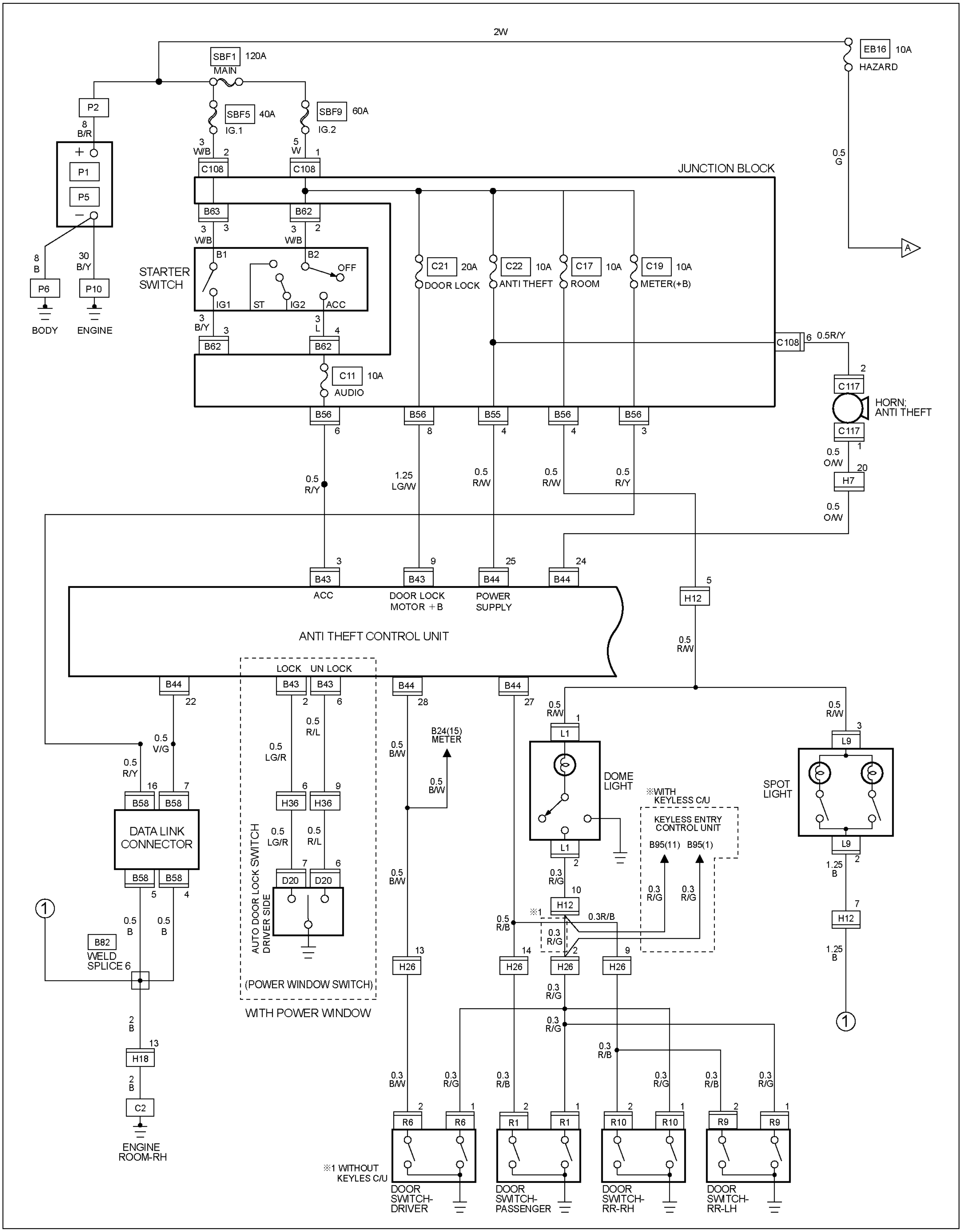
CIRCUIT DIAGRAM C24SE (RHD) WITH SUPER LOCK

Sheet 3/3



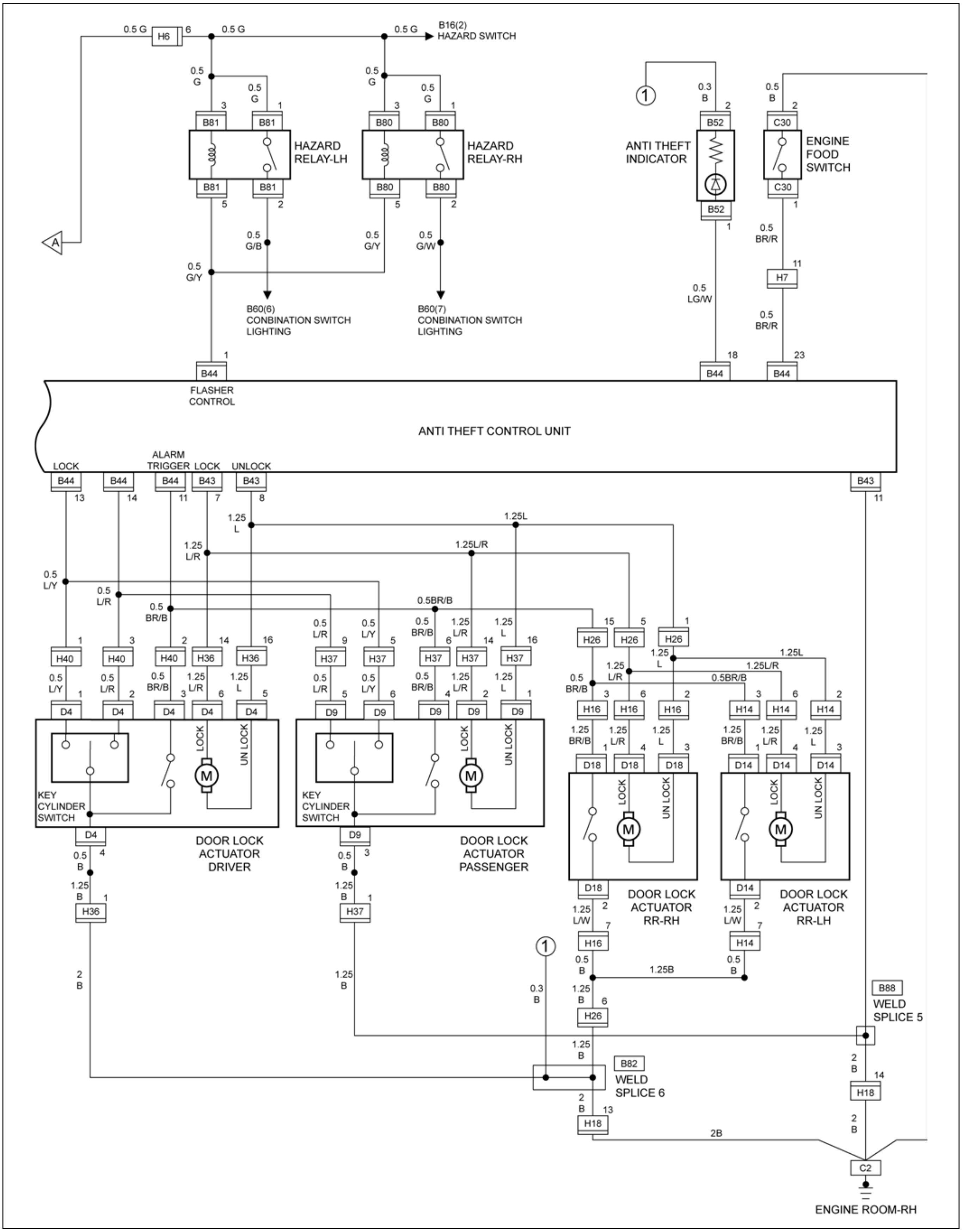
RTW680XF015601

CIRCUIT DIAGRAM WITH SUPER LOCK 4JJ1-TC / 4JK1-TC (RHD) SOUTH AFRICA Sheet 1/2



RTW78AXF019201

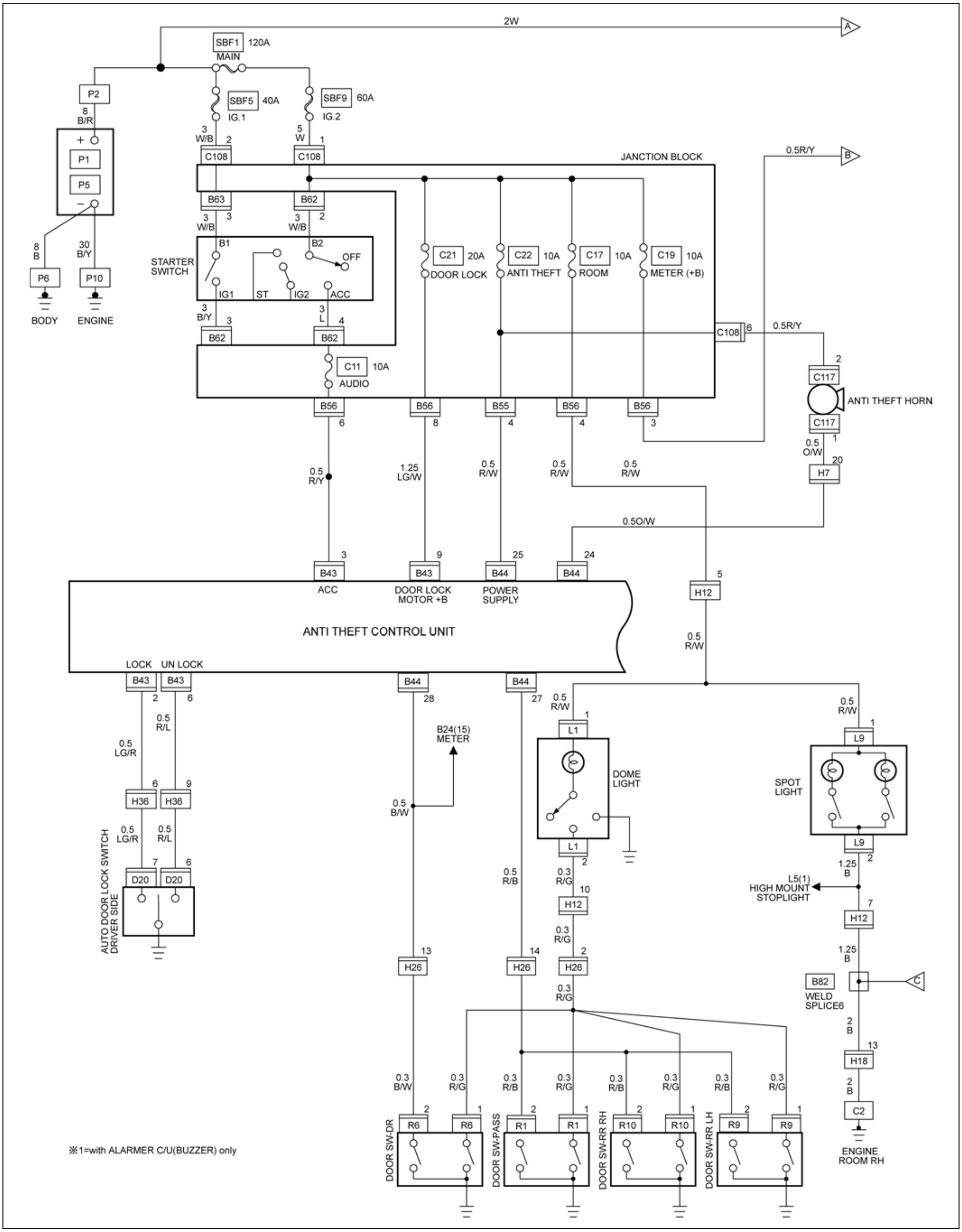
CIRCUIT DIAGRAM WITH SUPER LOCK 4JJ1-TC / 4JK1-TC (RHD) SOUTH AFRICA Sheet 2/2



RTW78AXF019301

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) EXCEPT SOUTH AFRICA

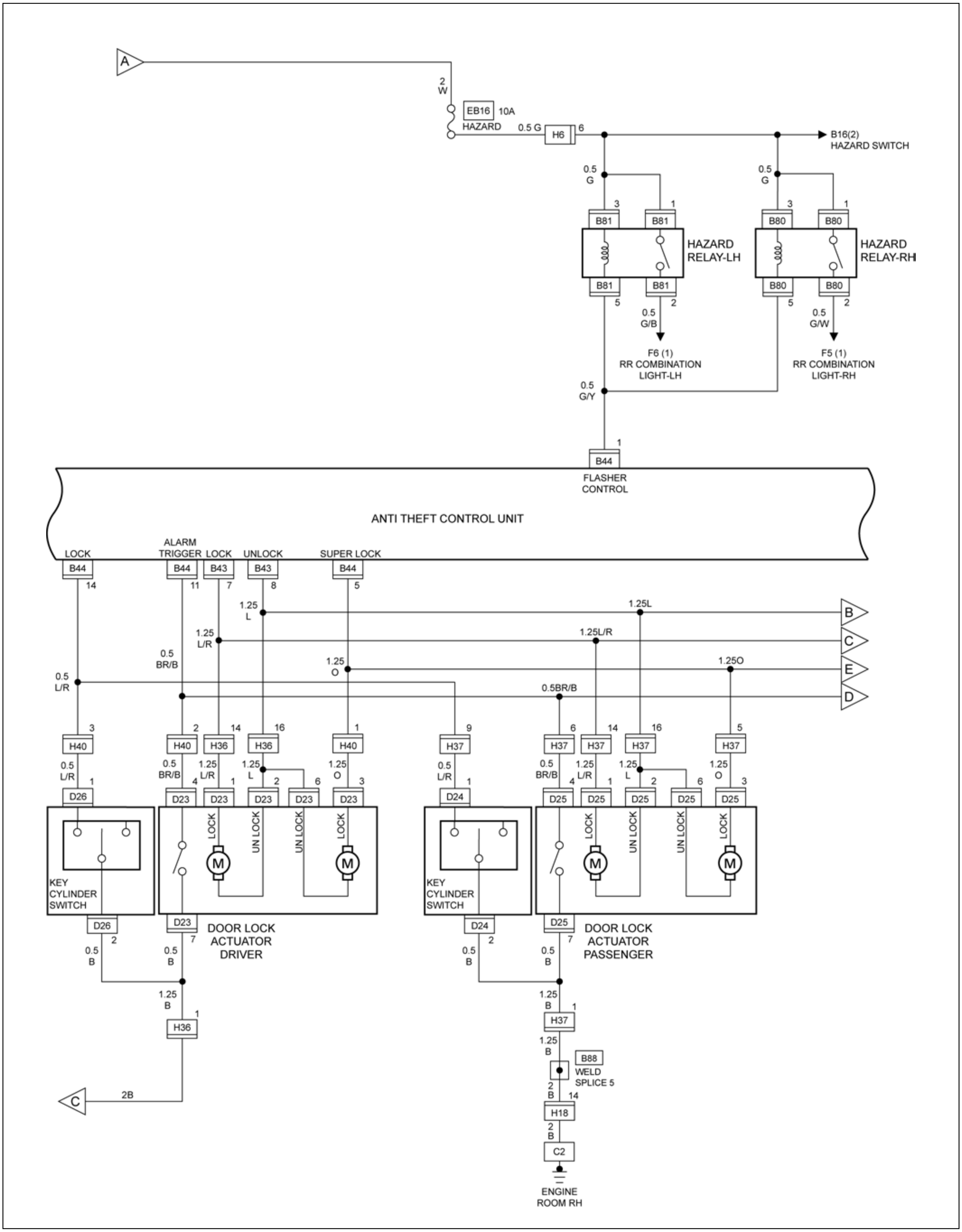
Sheet 1/3



RTW78AXF033901

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) EXCEPT SOUTH AFRICA

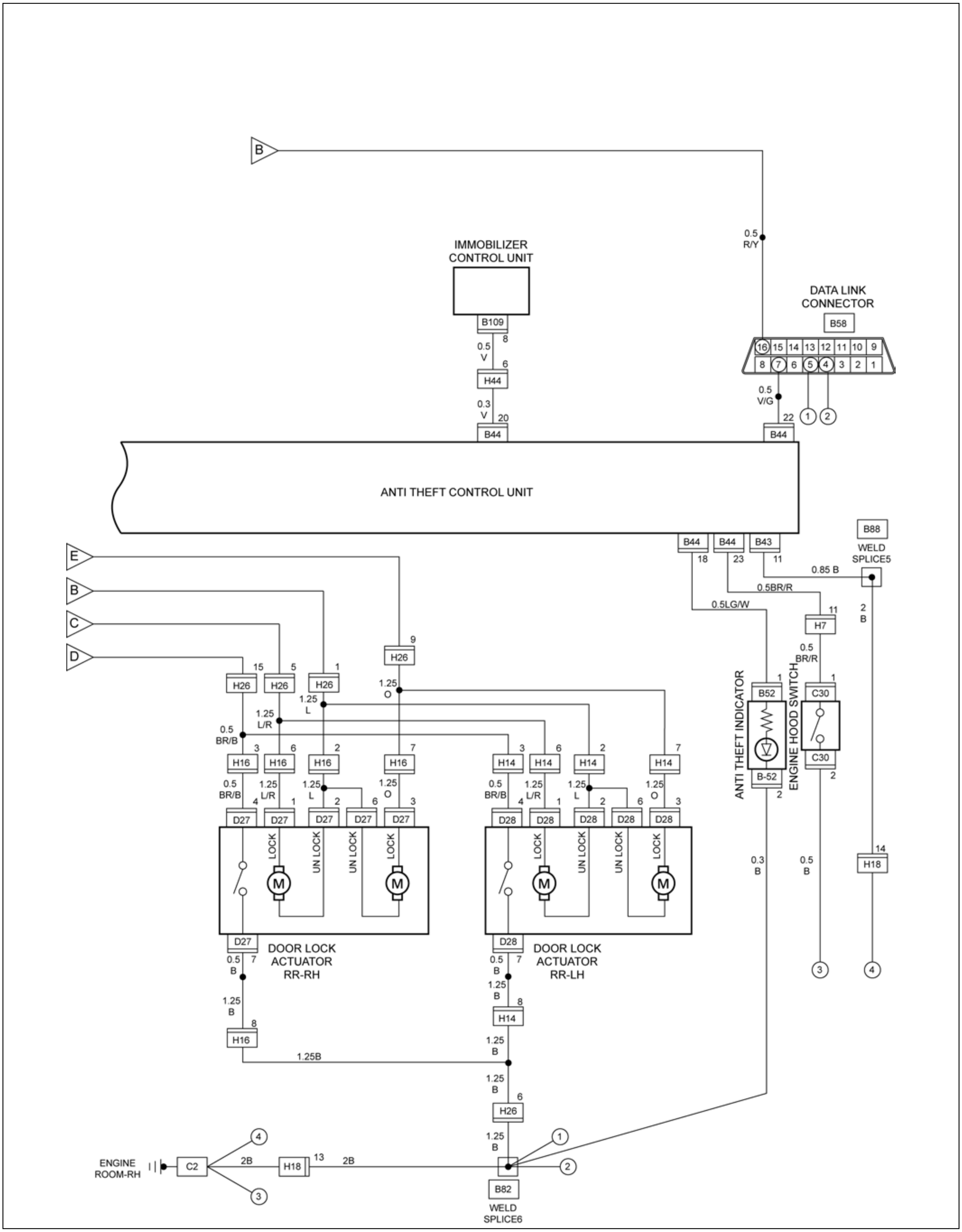
Sheet 2/3



RTW78AXF034001

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (RHD) EXCEPT SOUTH AFRICA

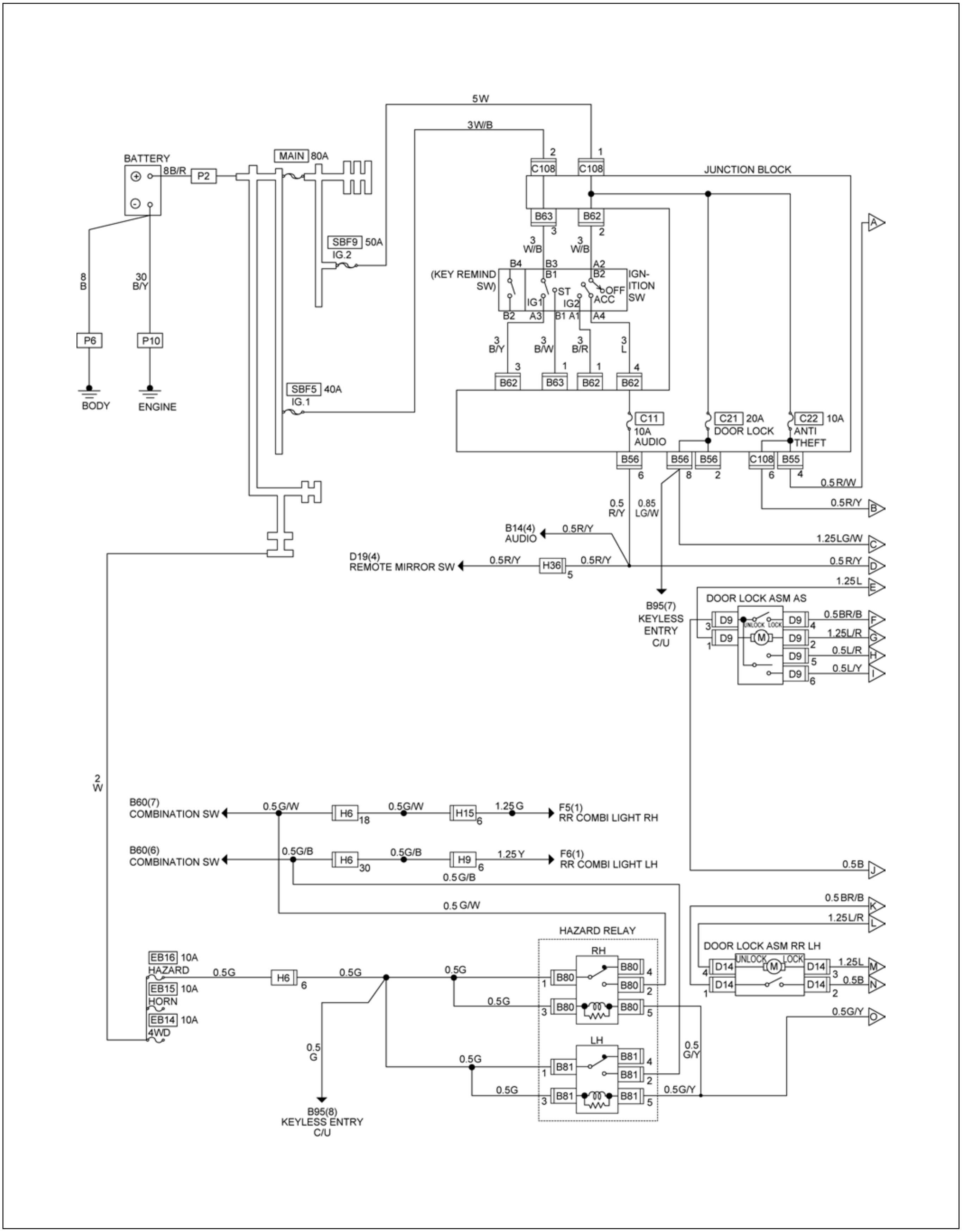
Sheet 3/3



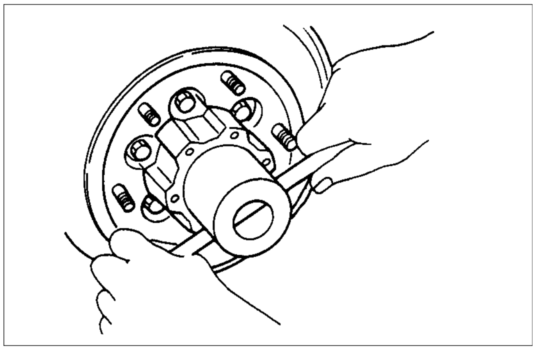
RTW78AXF034101

CIRCUIT DIAGRAM 4JA1T(L) (RHD)

Sheet 1/2



RTW78AXF009101



Important Operations

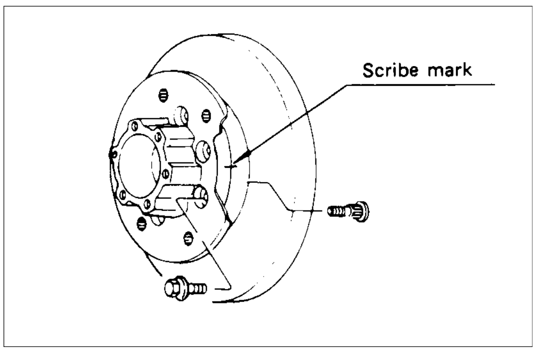
6. Hub nut

Wrench : 5-8840-2117-0

7. Hub and disc assembly

Before disassembly, remove the disc brake caliper assembly and hang it on the frame with wires.

Refer to Section "Brake" for disc brake caliper removal procedure.



12. Bolt

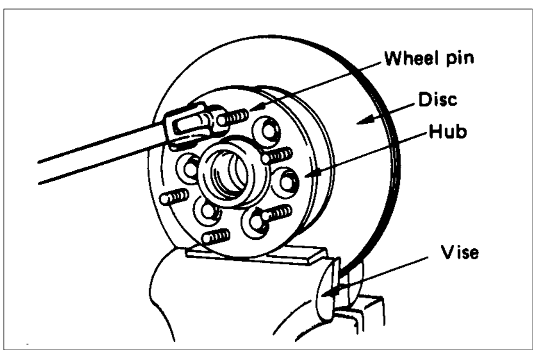
13. Wheel Pin ; Front Hub

(1) Scribe mark on hub to disc before disassembly to insure proper assembly.

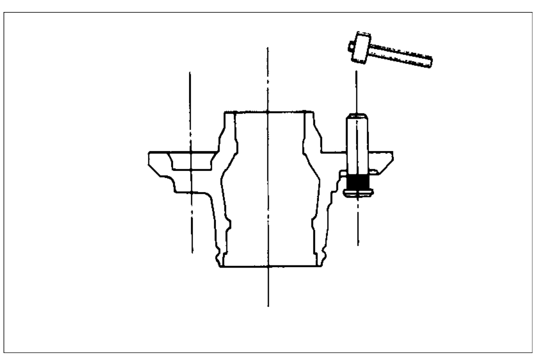
(2) Drive out the ABS sensor rotor using a metal bar and hammer through the two bolt holes.

- Discard the used ABS sensor rotor

Refer to the section Brake.



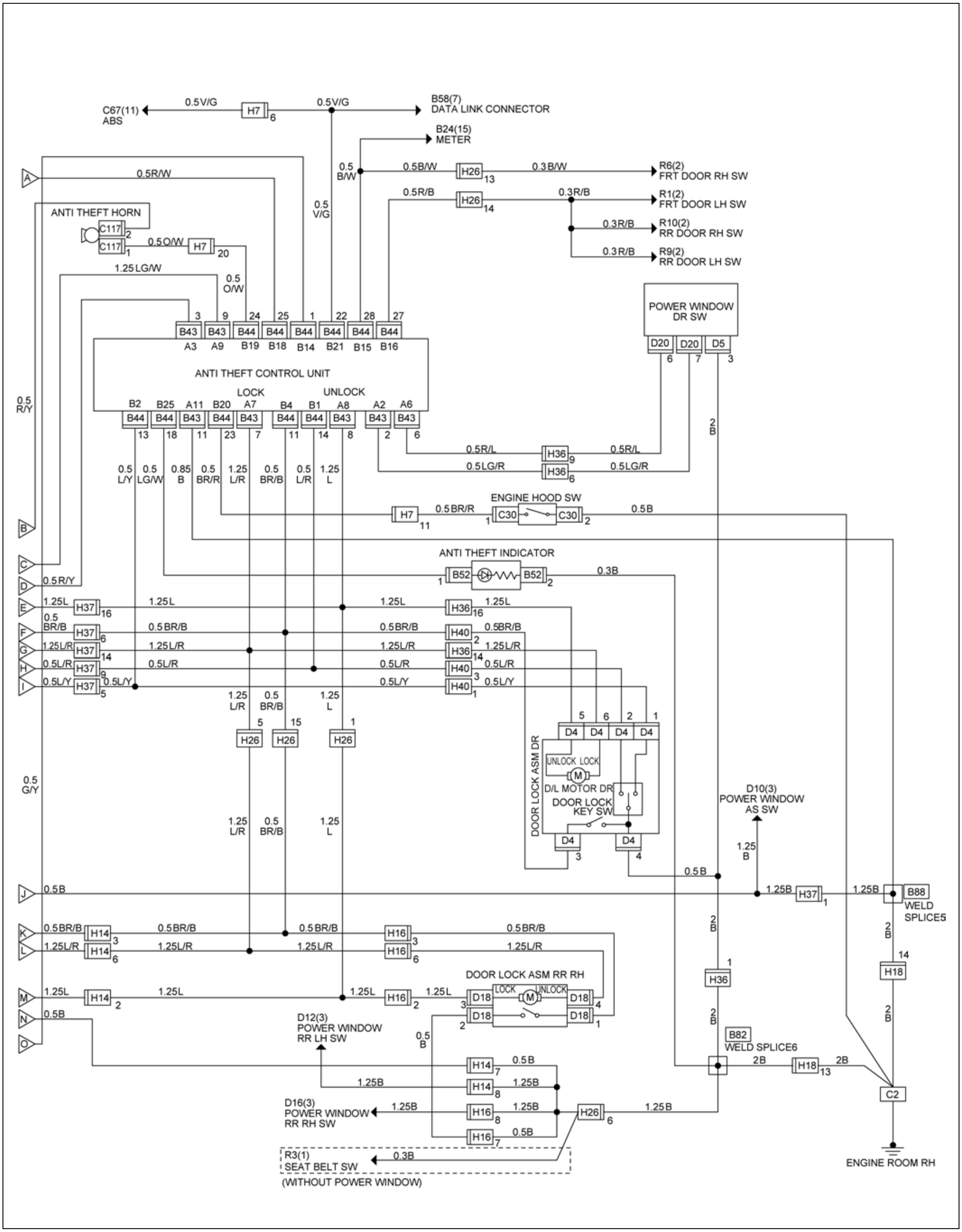
(3) Clamp hub and disc assembly in vise using protective pads and remove six (6) disc to hub retaining bolts.



(4) Place hub on a suitable work surface and remove wheel studs, as required, using a hammer.

CIRCUIT DIAGRAM 4JA1T(L) (RHD)

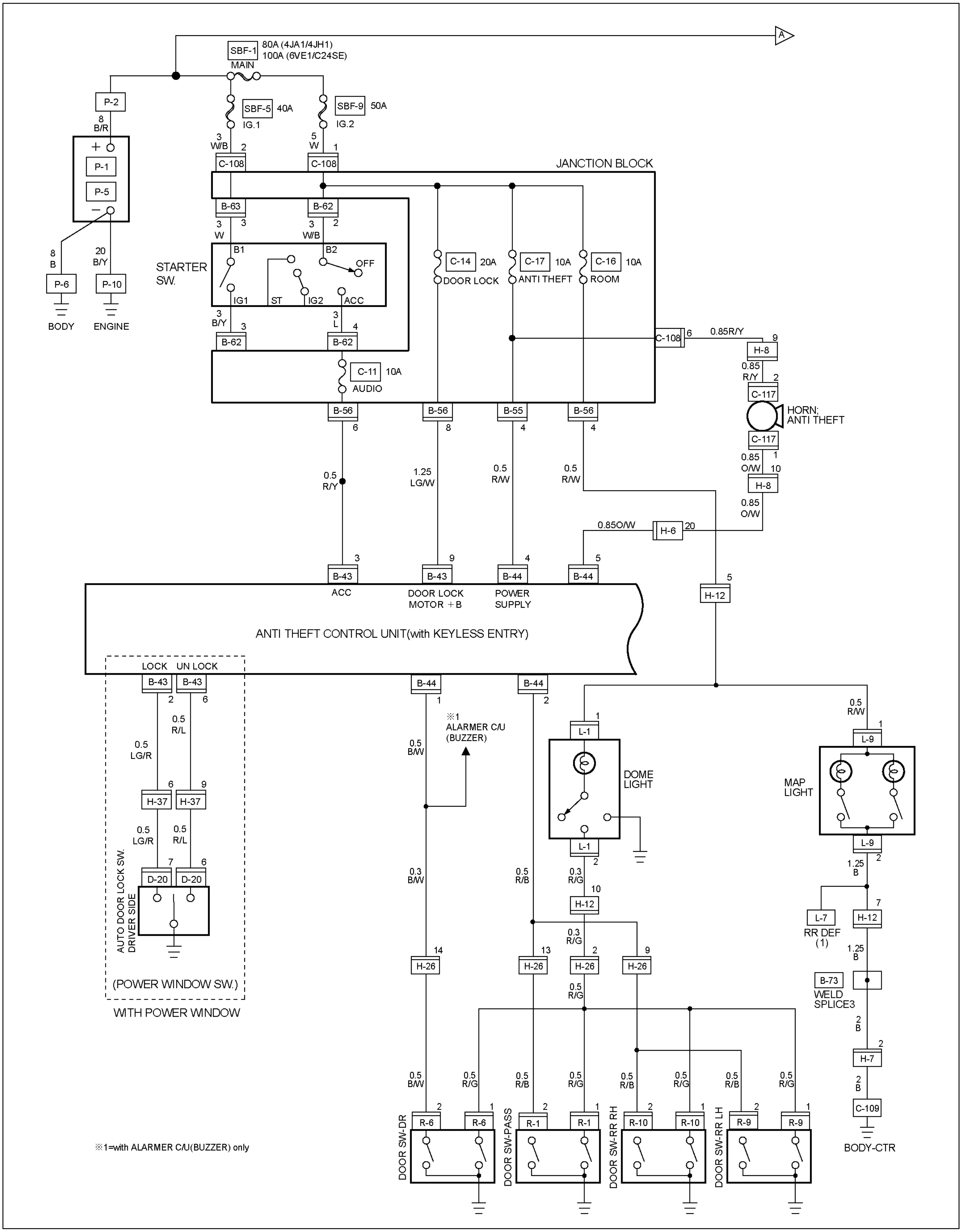
Sheet 2/2



RTW78AXF009201

CIRCUIT DIAGRAM C24SE (LHD)

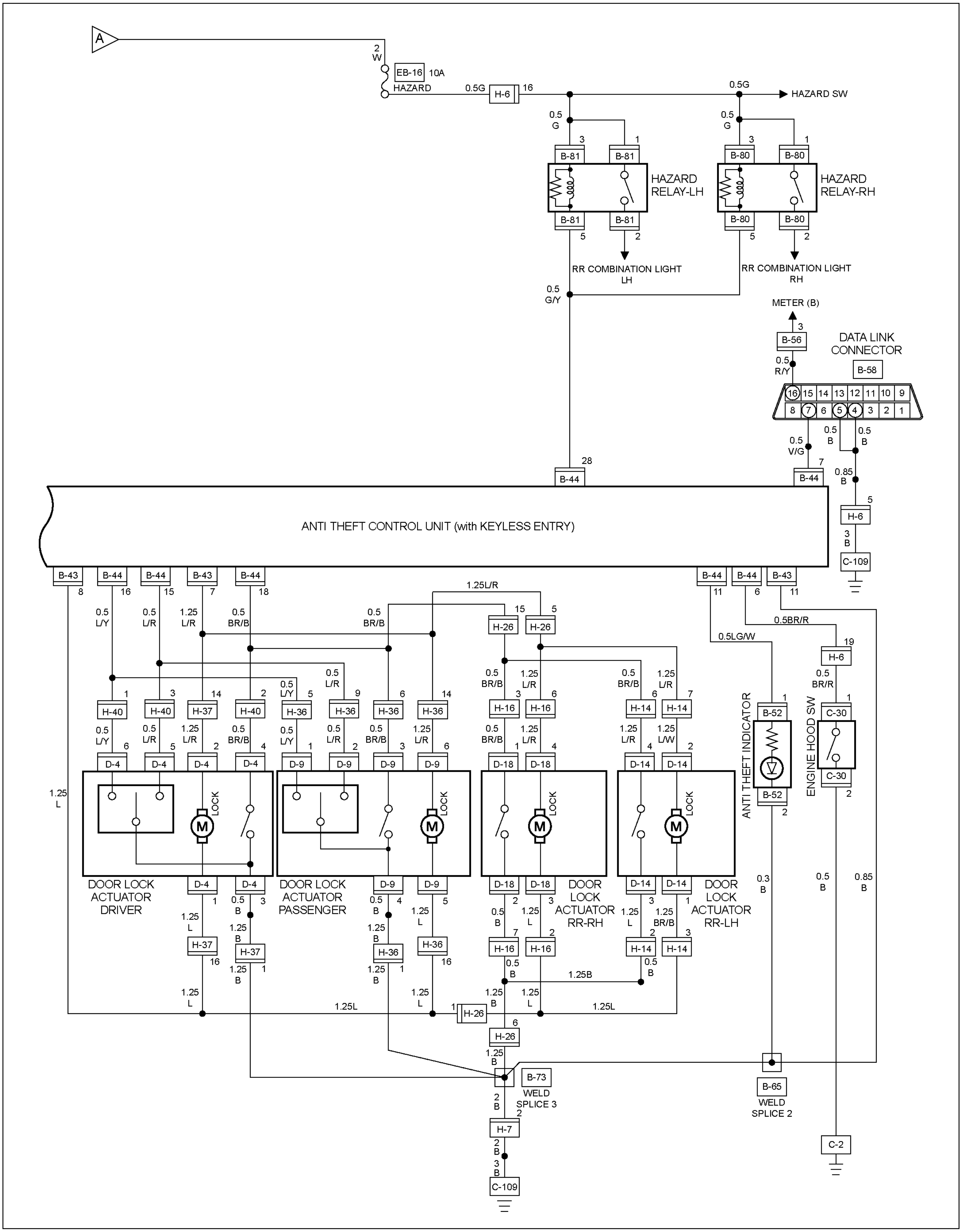
Sheet 1/2



RTW680XF015701

CIRCUIT DIAGRAM C24SE (LHD)

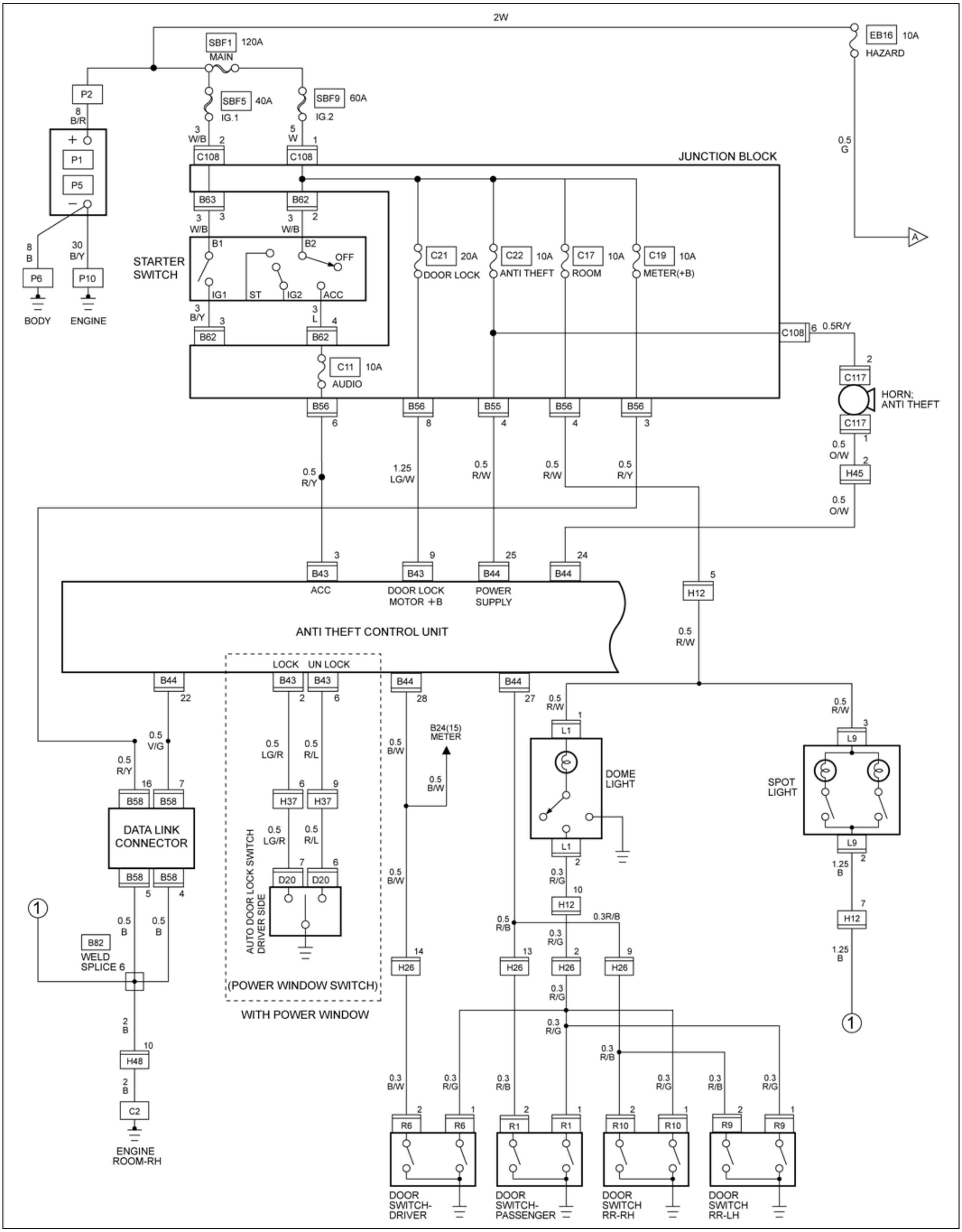
Sheet 2/2



RTW680XF015801

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD)

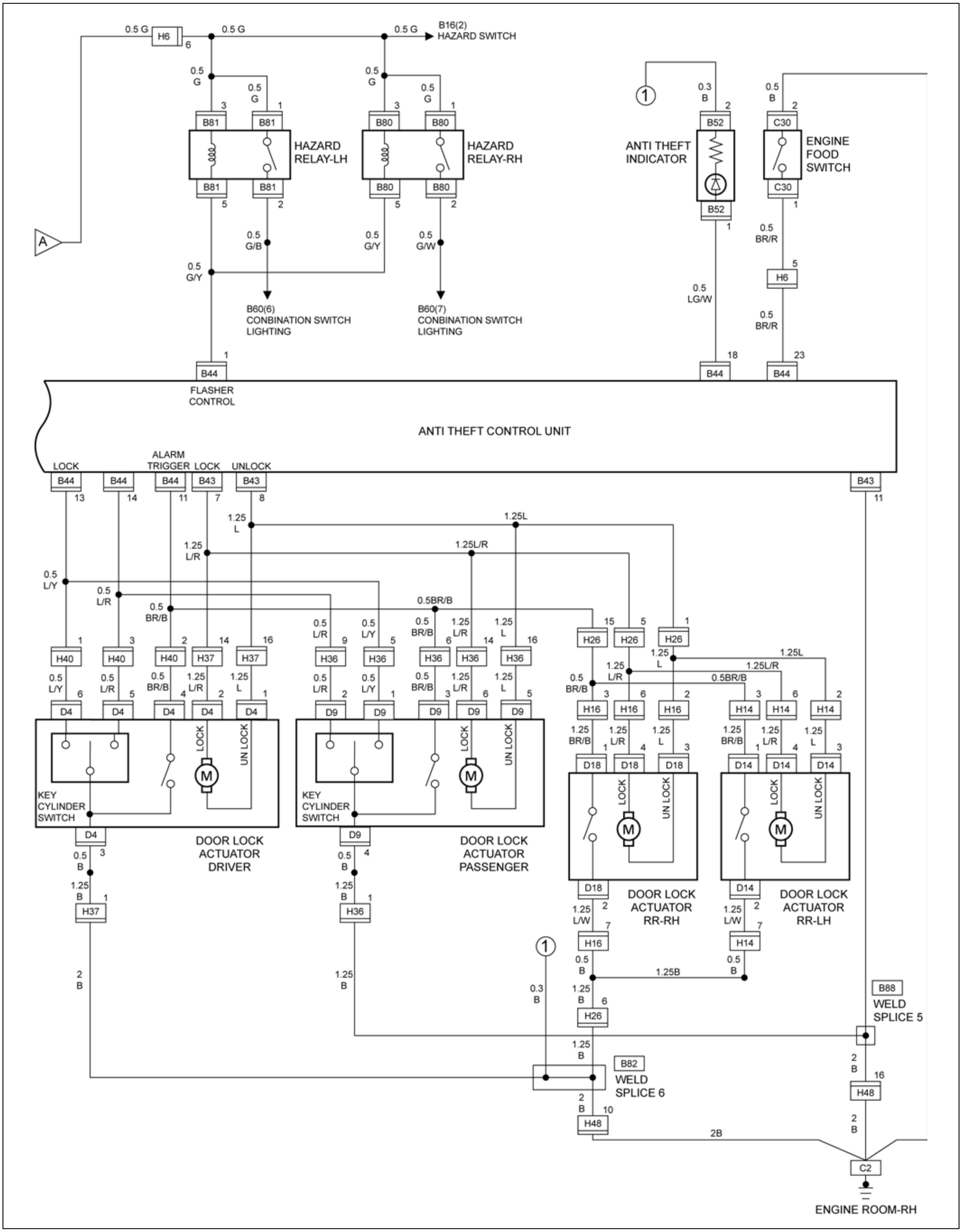
Sheet 1/2



RTW78AXF029701

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC (LHD)

Sheet 2/2

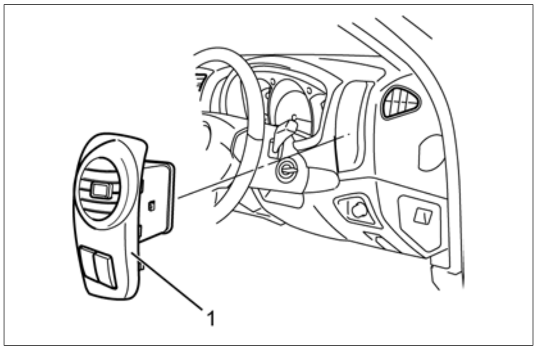


RTW78AXF029801

ANTI THEFT INDICATOR

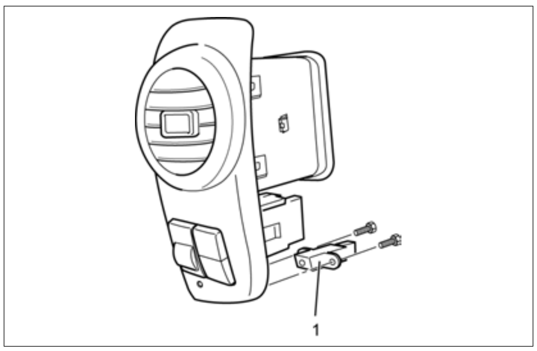
Removal

1. Disconnect the battery ground cable.
2. Remove the side ventilation grille (1).



RTW78ASH001801

3. Disconnect the indicator connector and screw from the backside of the side ventilation grille to remove the anti theft indicator (1).



RTW78ASH001701

Installation

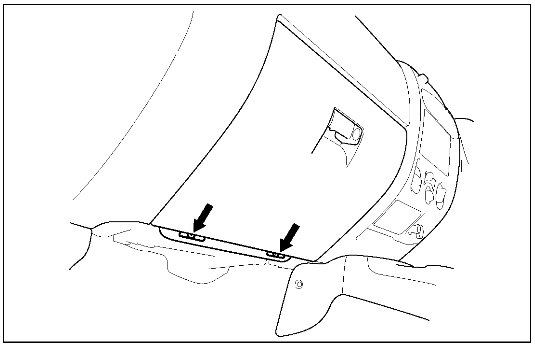
To install, follow the removal steps in the reverse order, noting the following point.

1. Push in the switch with your fingers until it locks securely.

KEYLESS ENTRY CONTROL UNIT

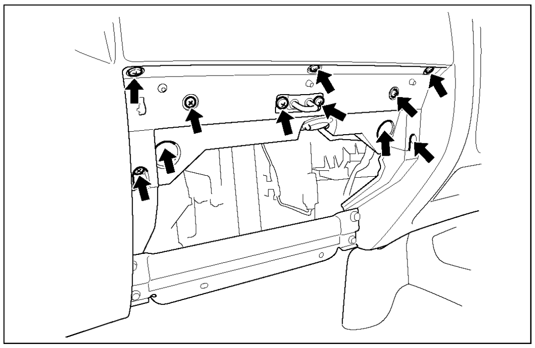
Removal

1. Remove the glove box.
2. Disconnect the glove box lamp connector.



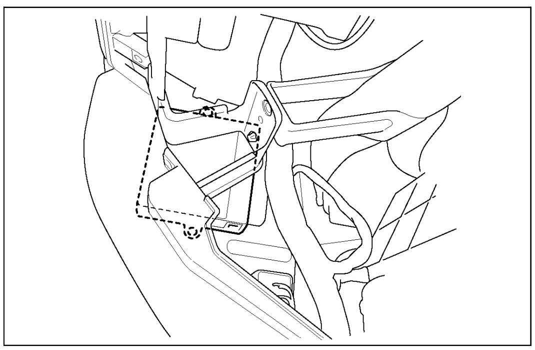
RTW580SH001601

3. Remove the glove box cover.



RTW580SH001701

4. Remove the bolt of antitheft and keyless entry control unit.
5. Disconnect the antitheft and keyless entry control unit connector.
6. Remove the antitheft and keyless entry control unit.



RTW580SH001801

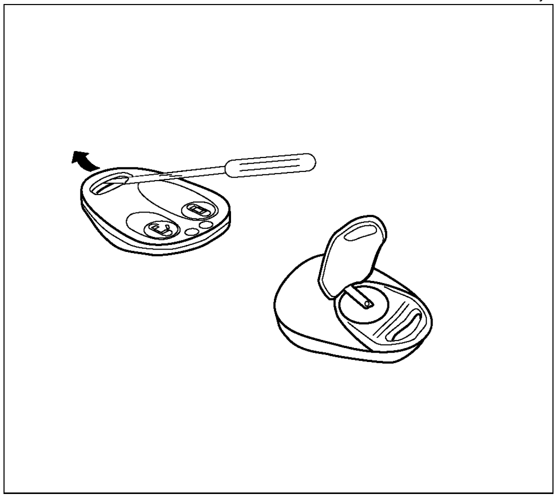
Installation

Follow the removal procedure in the reverse order to install the antitheft and keyless entry control unit.

Connector

Be absolutely sure that the antitheft and keyless entry control unit harness connector is correctly installed.
This will prevent a poor contact and an open circuit.

Remote key



604RW055

Remove Key Assembly

Replacing the battery in the remote control unit

Replace the battery as soon as the range of the remote control starts to become reduced.

Open the underside of the remote control unit by removing the battery cover with a screwdriver as shown in the illustration.

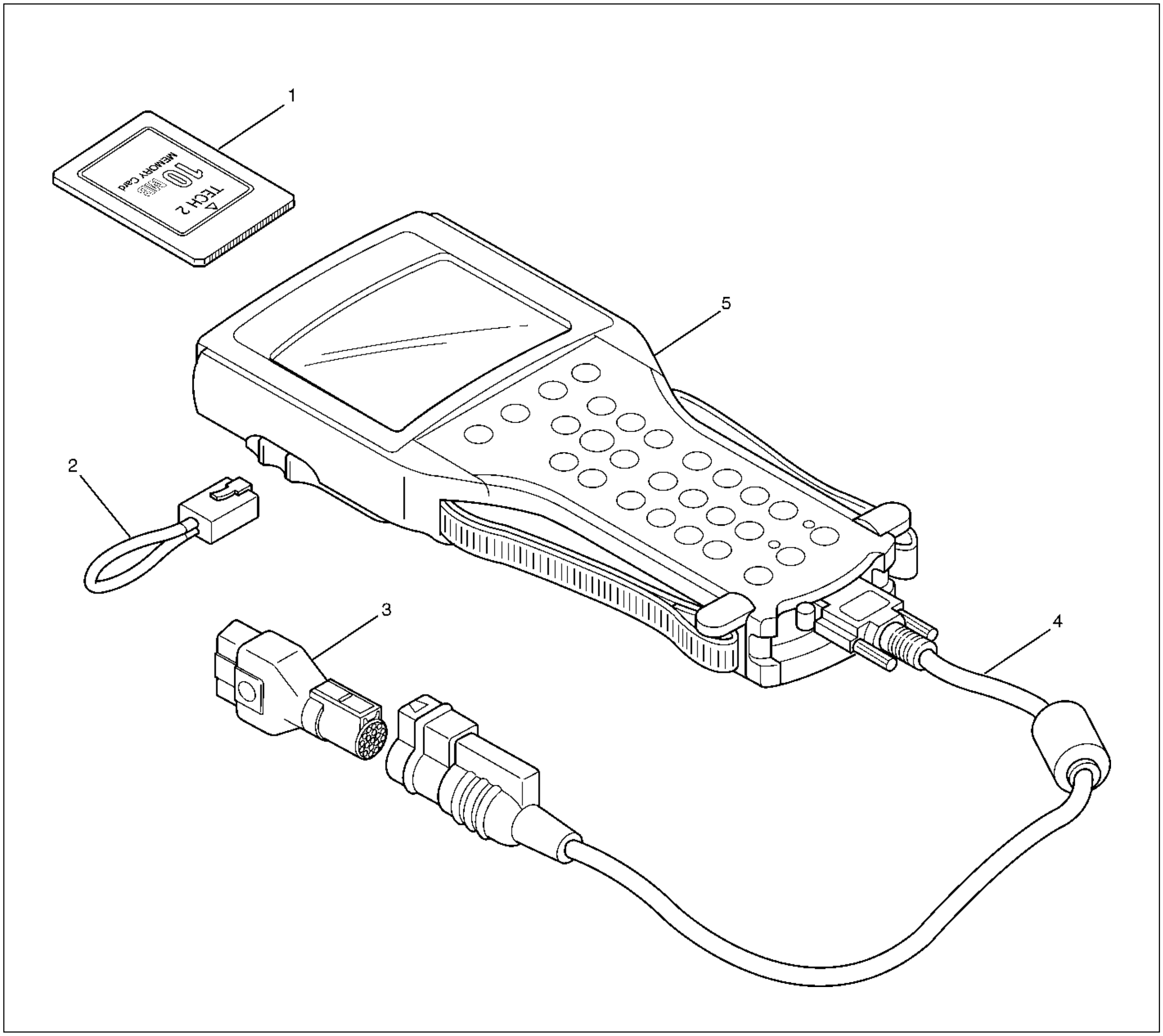
Replace the battery, ensuring that it is inserted correctly.

Replace the battery cover so that it engages audibly. The battery change must be performed within 3 minutes, otherwise the remote control will have to be reprogrammed. Make sure that you dispose of old batteries in accordance with environmental protection regulations.

TECH-2 OPERATION AND PROGRAMING KEYLESS ENTRY

General Description

When the anti-theft and keyless entry control unit and/or the transmitters (remote keys) are replaced, the security codes and/or transmitter ID codes must be programmed by using he Tech-2. The following pages show the procedures to program in regard to the anti-theft and keyless entry system. Please refer to Tech-2 scan tool user’s guide in detail.



901RW180

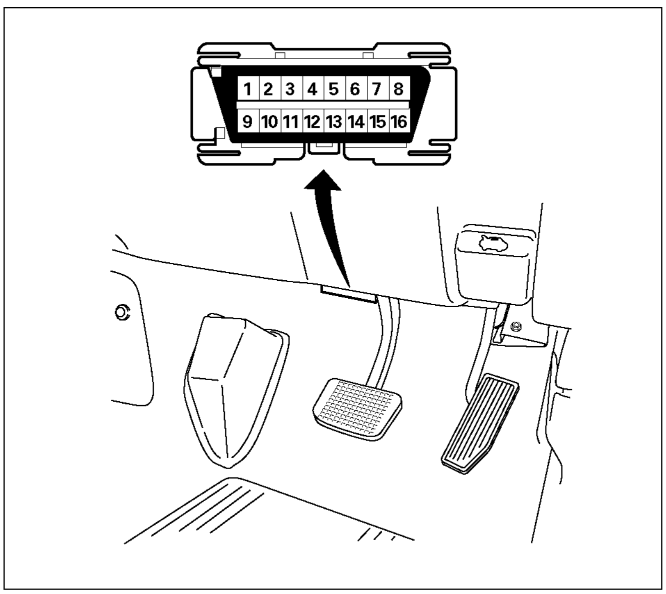
Legend

(1) PCMCIA Card
(2) RS 232 Loop Back Connector
(3) SAE 16/19 Adaptor
(4) DLC Cable
(5) Tech–2

060RW009

Tech-2 Features

1. Tech-2 is a 12volt system. Do not apply 24 volts.
2. After connecting and/or installing the vehicle communication interface (VCI) module, PCMCIA card and data link connector (DLC) to the Tech-2, connect the tool to the vehicle DLC.
3. Make sure the Tech-2 is OFF when removing or installing the PCMCIA card.
4. The Tech-2 has the capability of two snapshot.
5. The PCMCIA card is sensitive to magnetism and static electricity, so care should be taken in the handling of the card.
6. The Tech-2 can not plot a graph when replaying a snapshot.
7. Always return to the Main Menu by pressing the EXIT key several times before shutting down.
8. To clear diagnostic trouble codes (DTCs), open Application Menu and press "Clear DTC ".



060R300015

Getting Started

Before operating the Isuzu PCMCIA card with the Tech-2, the following steps must be performed:

1. The Isuzu System PCMCIA card inserts into the Tech-2.
2. Connect the SAE 16/19 adapter to the DLC cable.
3. Connect the DLC cable to the Tech-2.
4. Mark sure the vehicle ignition is off.
5. Connect the Tech-2 SAE 16/19 adapter to the vehicle DLC.

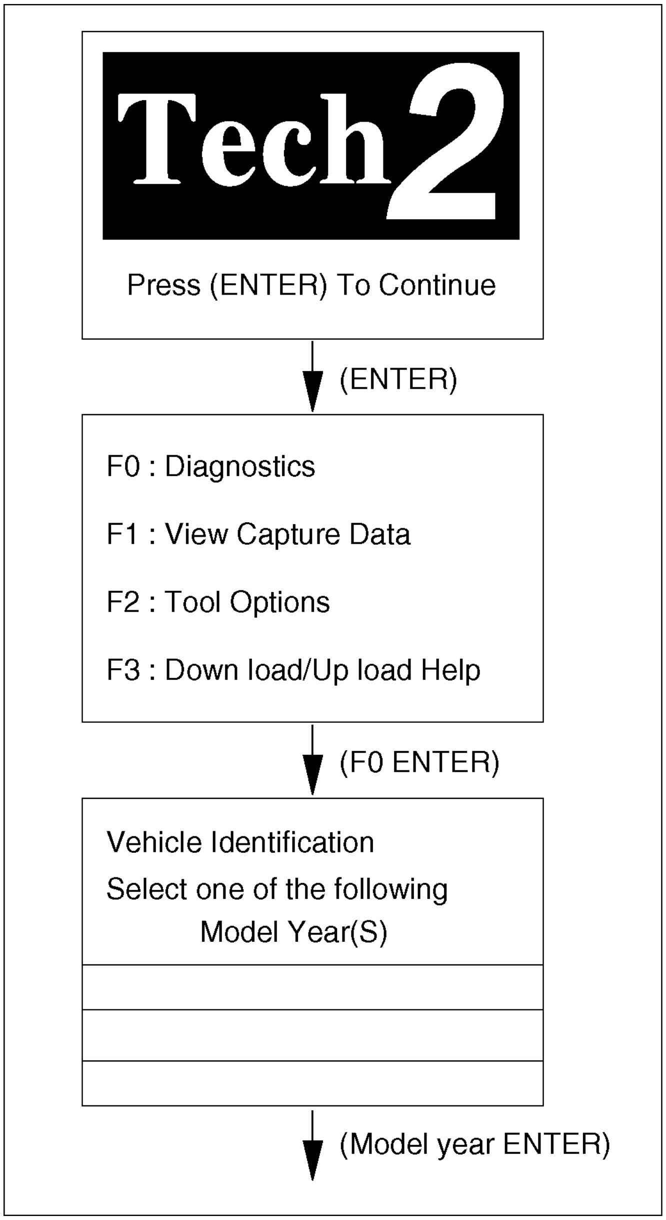
Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.
For inspection and servicing of disc caliper, and relative parts, and ABS parts, refer to Section Brakes.

Visual Check

Check the following parts for wear, damage or other abnormal conditions.

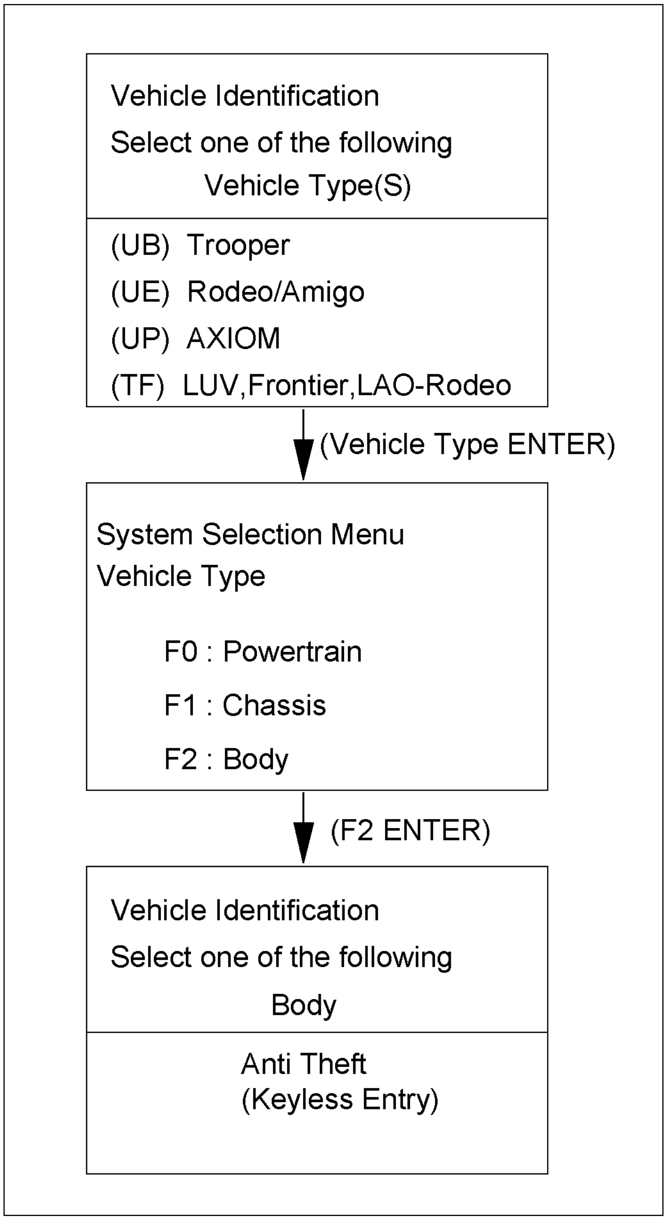
- Hub
- Hub bearing, oil seal
- Knuckle spindle
- Disc
- Caliper
- ABS sensor rotor
- Cap, Hub flange (4×4 model only), Shim (4×4 model only), Snap ring (4×4 model only)



060R100102

Operating Procedure

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card. Follow the operating procedure.



RTW38DLH000201

Menu

The left table shows witch functions are used for the available equipment versions.
NOTE: Marked items are not applied for keyless entry system.

F0: Diagnostic Trouble Code
- F0: Read DTC Info Ordered By Priority
- F1: Read DTC Infor As Stored By ECU
- F2: Clear DTC and Alarm Code Info
- F3: Read Alarm Codes

F1: Data Display

F2: Snapshot

F3: Actuator Test
- F0: Unlock/Lock Test
- F1: Arm/Disarm Signal Test
- F2: Horn Signal Test
- F3: Turn Signal Test
- F4: TTheft LED Test

F4: Programming
- F0: Erase Remote Key
- F1: Program Remote Key
- F2: Program Anti Theft Warning
- F3: Program Country Code
- F4: Program Vehicle Option

RTW38DLH000101

DTC

On OBD has three options available in the Tech-2 DTC mode to display the enhanced information available.

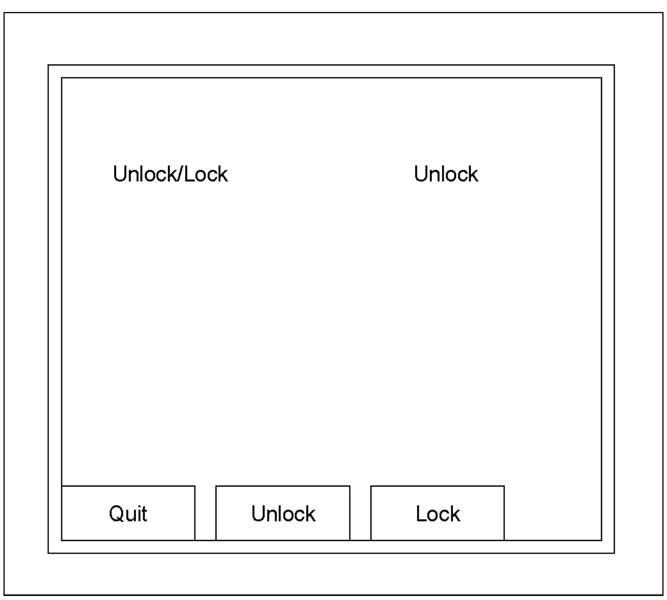
- Read DTC Info Ordered By Priority.
- Read DTC Info As Stored By ECU.
- Clear DTC and Alarm Code Info.

Clear DTC Information

To clear Diagnostic Trouble Codes (DTCs), Use the diagnostic scan tool “Clear DTC Information” function.

Tech-2 Data Display

The Tech-2 data values represent values that would be seen on a normally-keyless entry system.



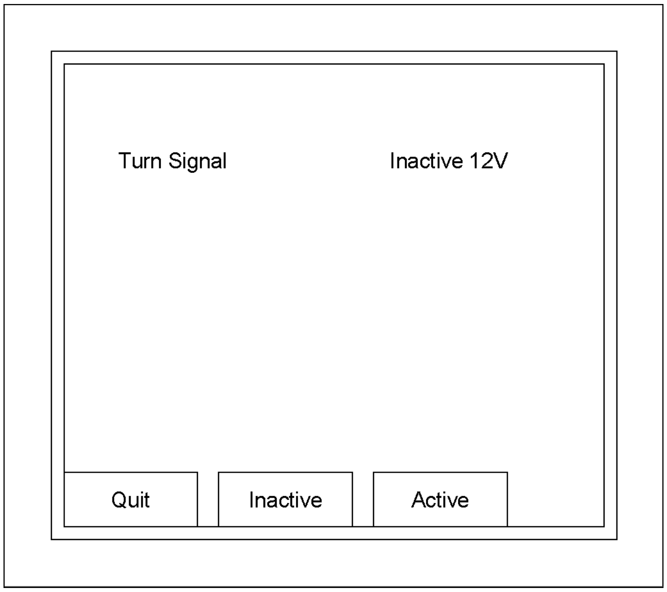
RTW38DSH001601

Actuator Test

Unlock/Lock Test

Check whether opening and closing of a door lock can be performed by operation of Tech-2.

1. Turn the key “OFF”.
2. Turn the key “ON”.
3. Check the display and test menu.
4. Operate the Tech-2.

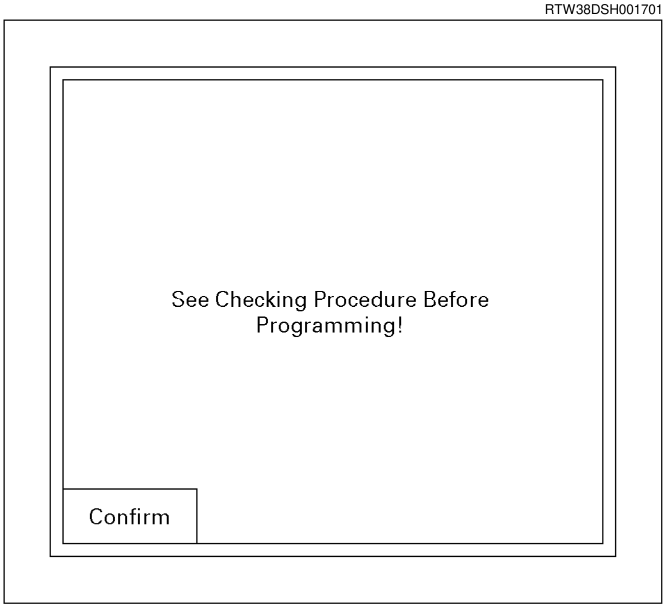


RTW38DSH001701

Turn Signal Test

Check the turn signal lamp lights up by operation of Tech-2.

1. Turn the key “OFF”.
2. Turn the key “ON”.
3. Check the display and test menu.
4. Operate the Tech-2.



060R200289

Programming

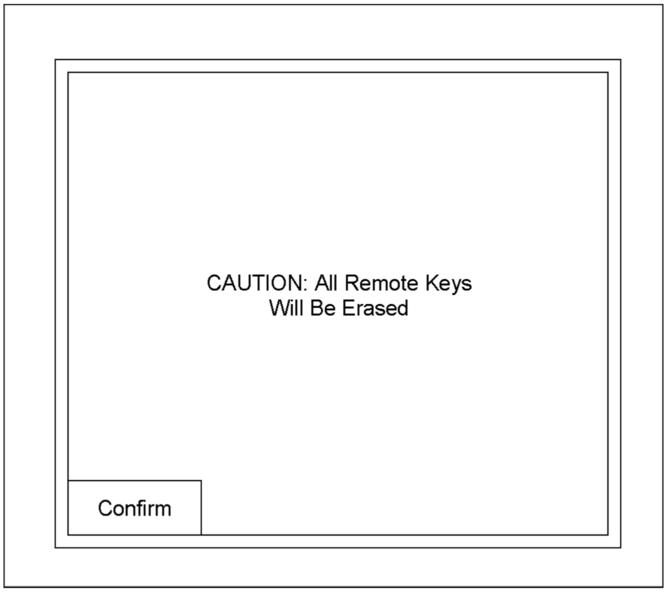
Erase Remove Key

To erase remove control key code in the control unit.

1. Check the display of Tech-2 and press “Confirm” key.

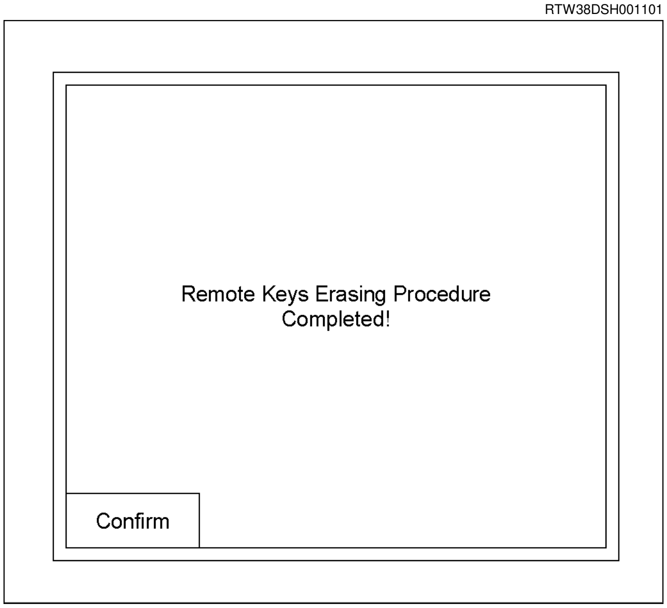
RTW38DSH001001

2. Enter security code.
3. Press “Not Okay” or “Okay” key.



RTW38DSH001101

4. Check the display of Tech-2 and press “Confirm” key.



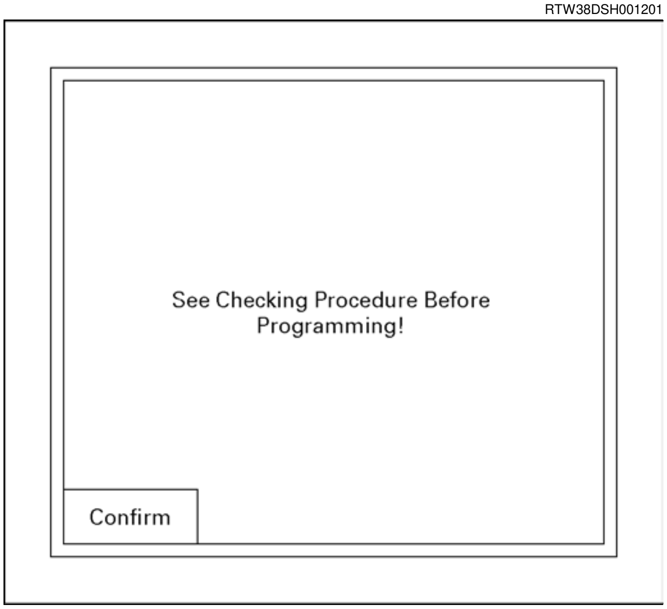
RTW38DSH001201

5. Check the display of Tech-2 and press “Confirm” key.

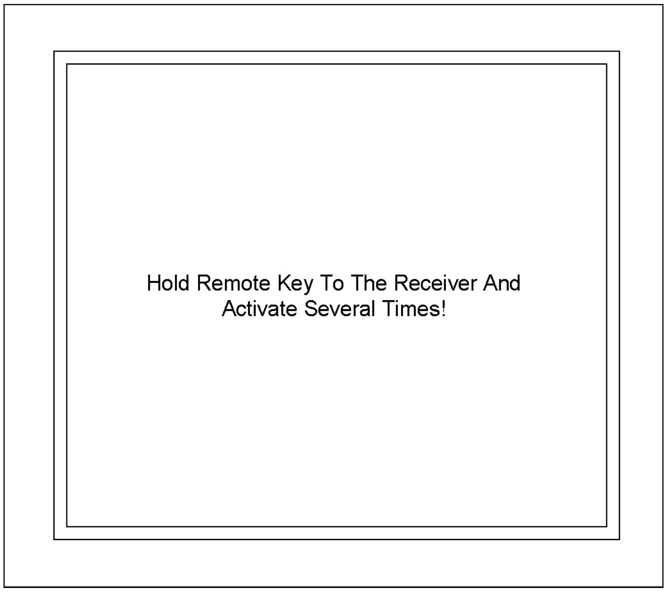
Program Remote Key

To program remote control key code in the control unit.

1. Check the display of Tech-2 and press “Confirm” key.

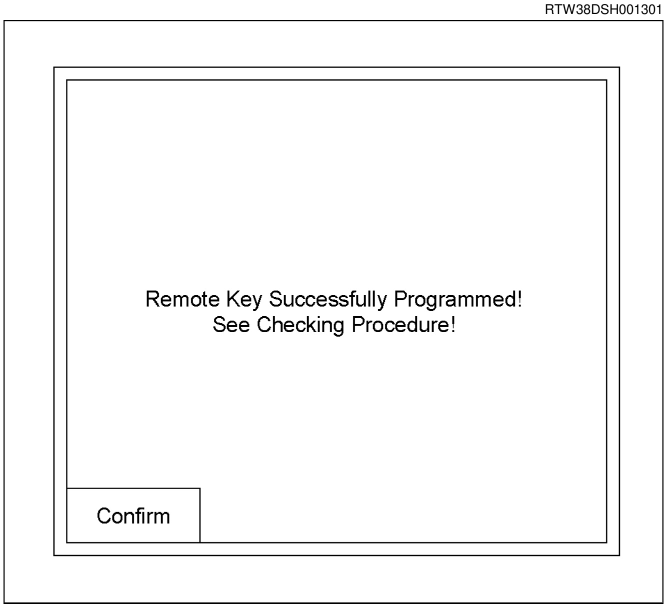


060R200289



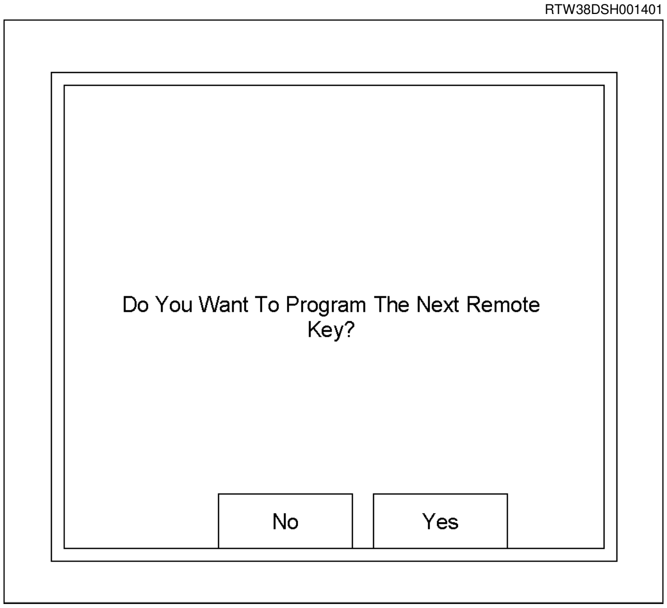
RTW38DSH001301

2. Check the following table in the display of Tech-2.
3. Operate the remote key.



RTW38DSH001401

4. Check the display of Tech-2 and press “Confirm” key.

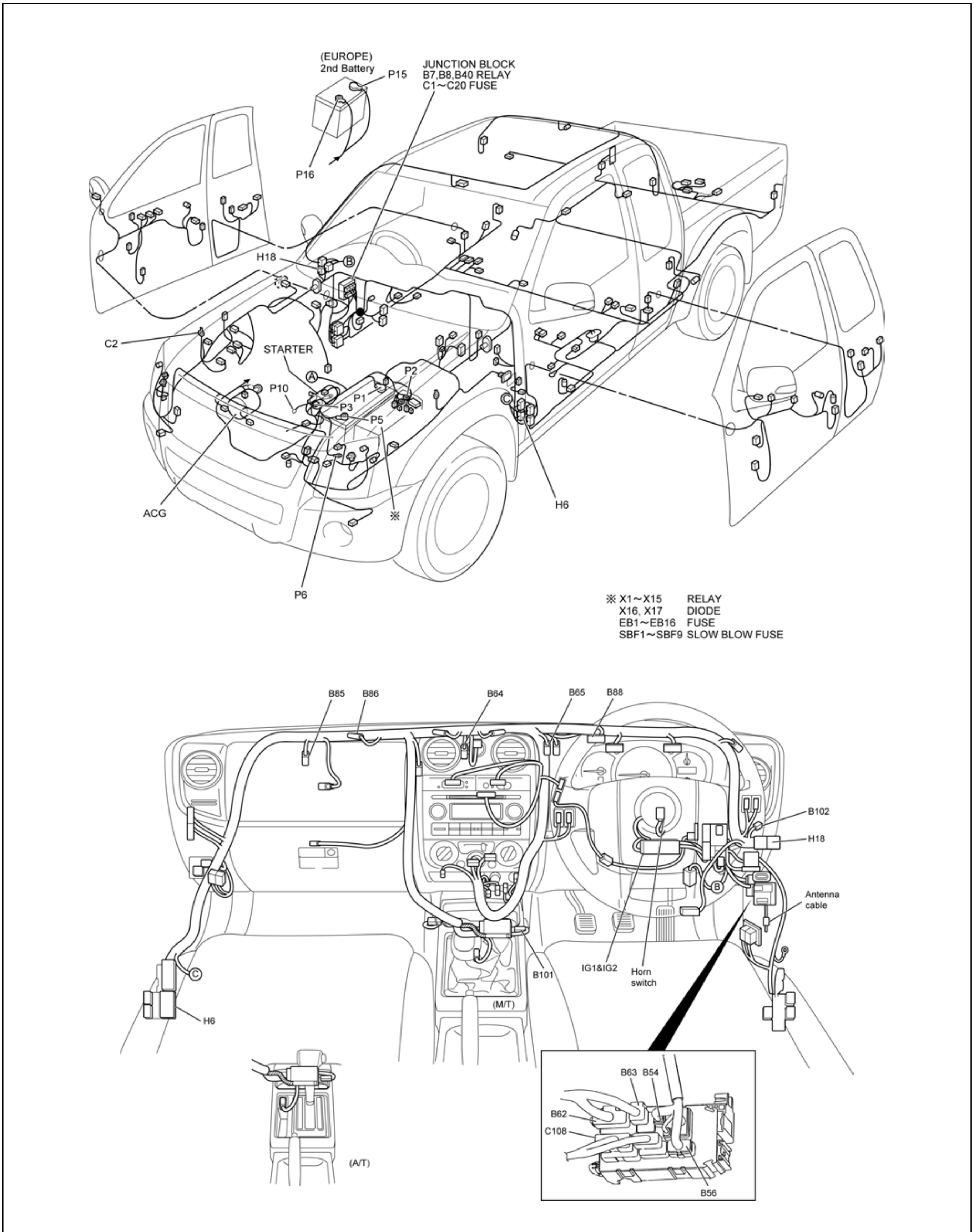


RTW38DSH001501

5. Check the display of Tech-2 and press “No” or “Yes” key.

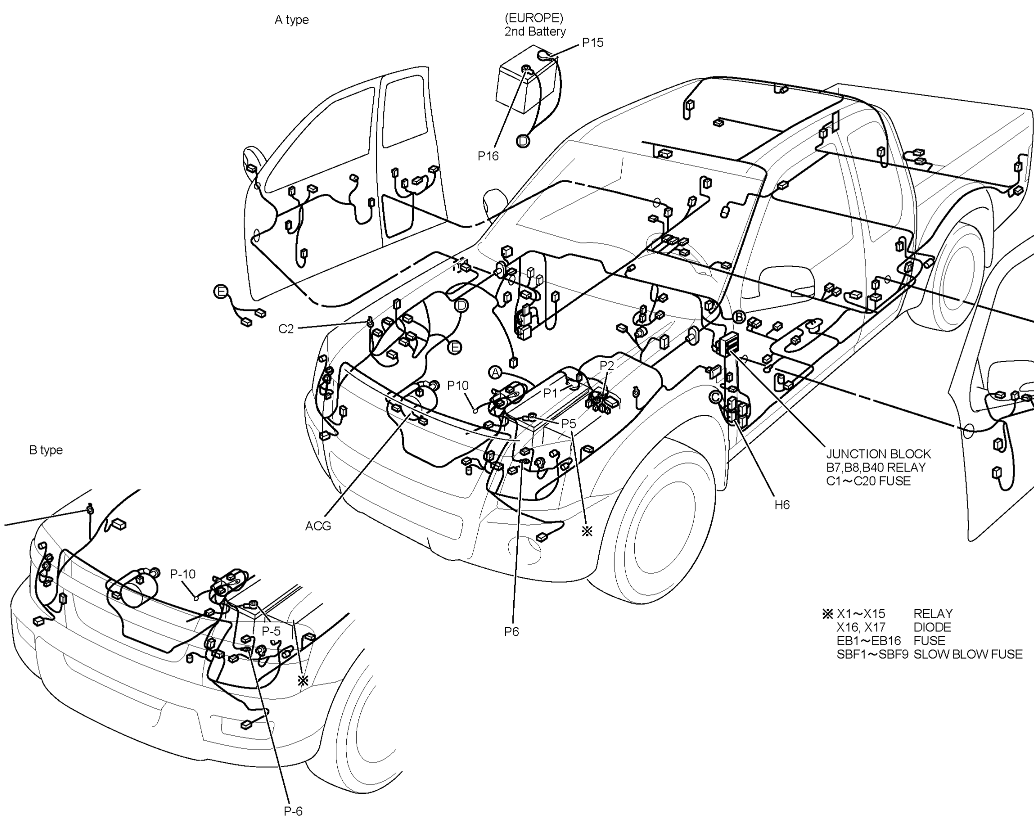
KEY INTER LOCK

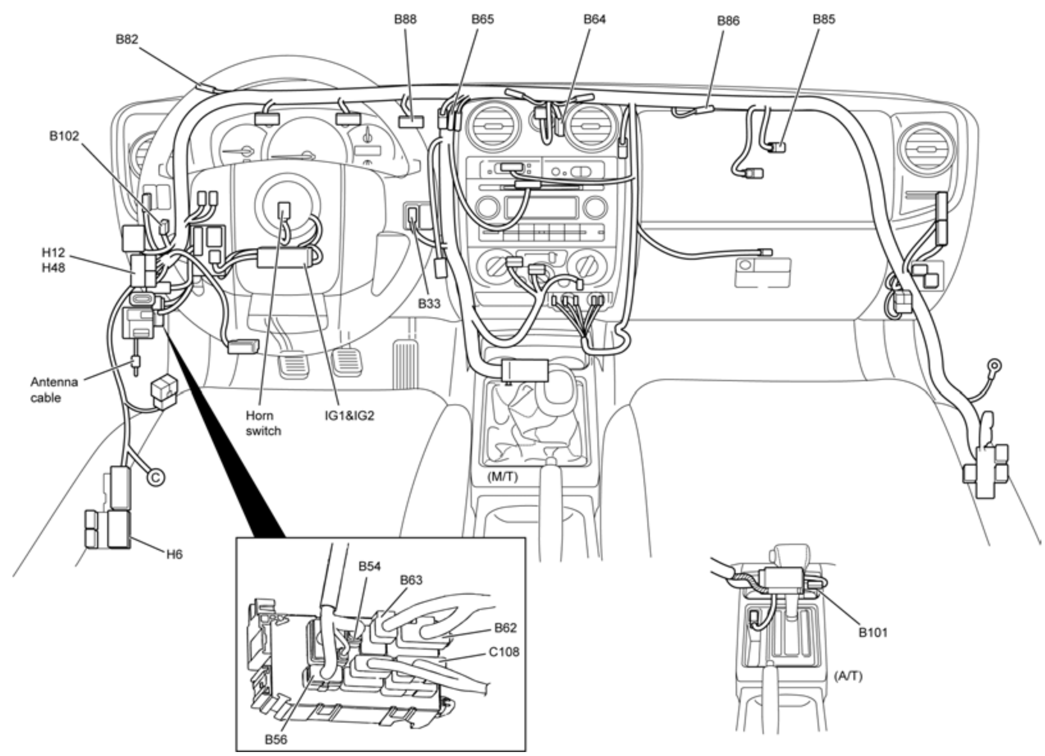
PARTS LOCATION



RTW78AXF041501 & RTW78AXF047701

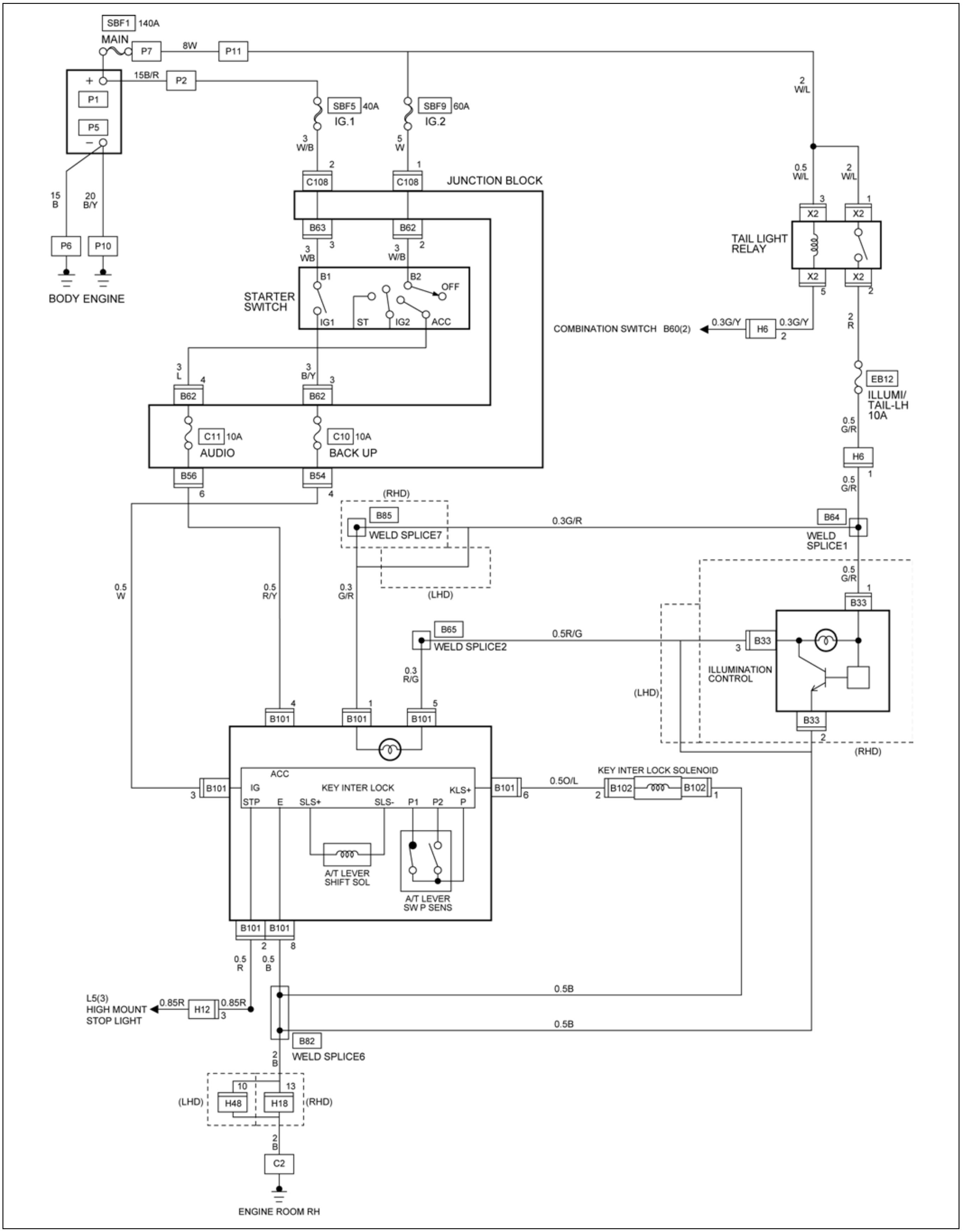
PARTS LOCATION





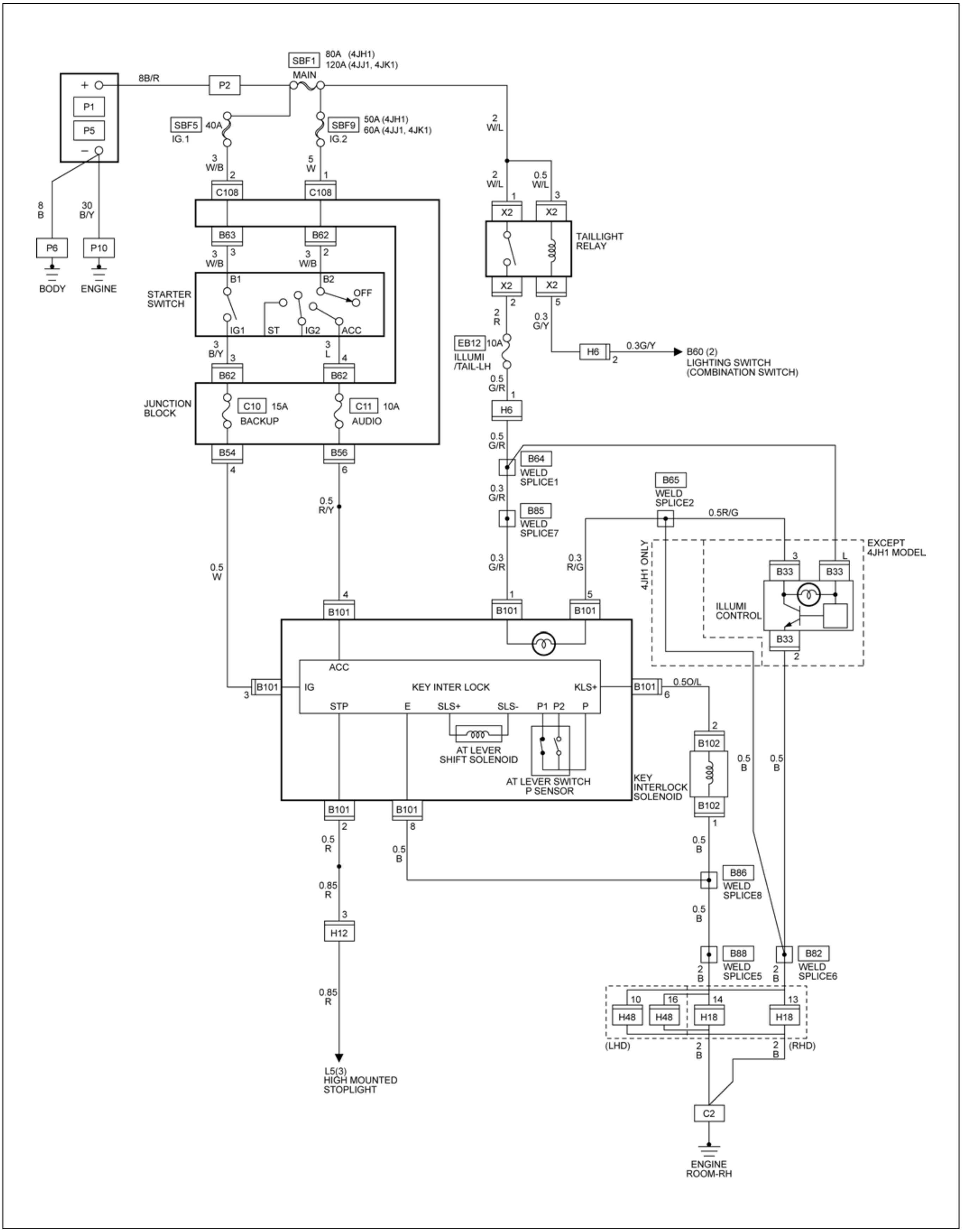
RTW78AXF041601 & RTW78AXF047801

CIRCUIT DIAGRAM HFV6



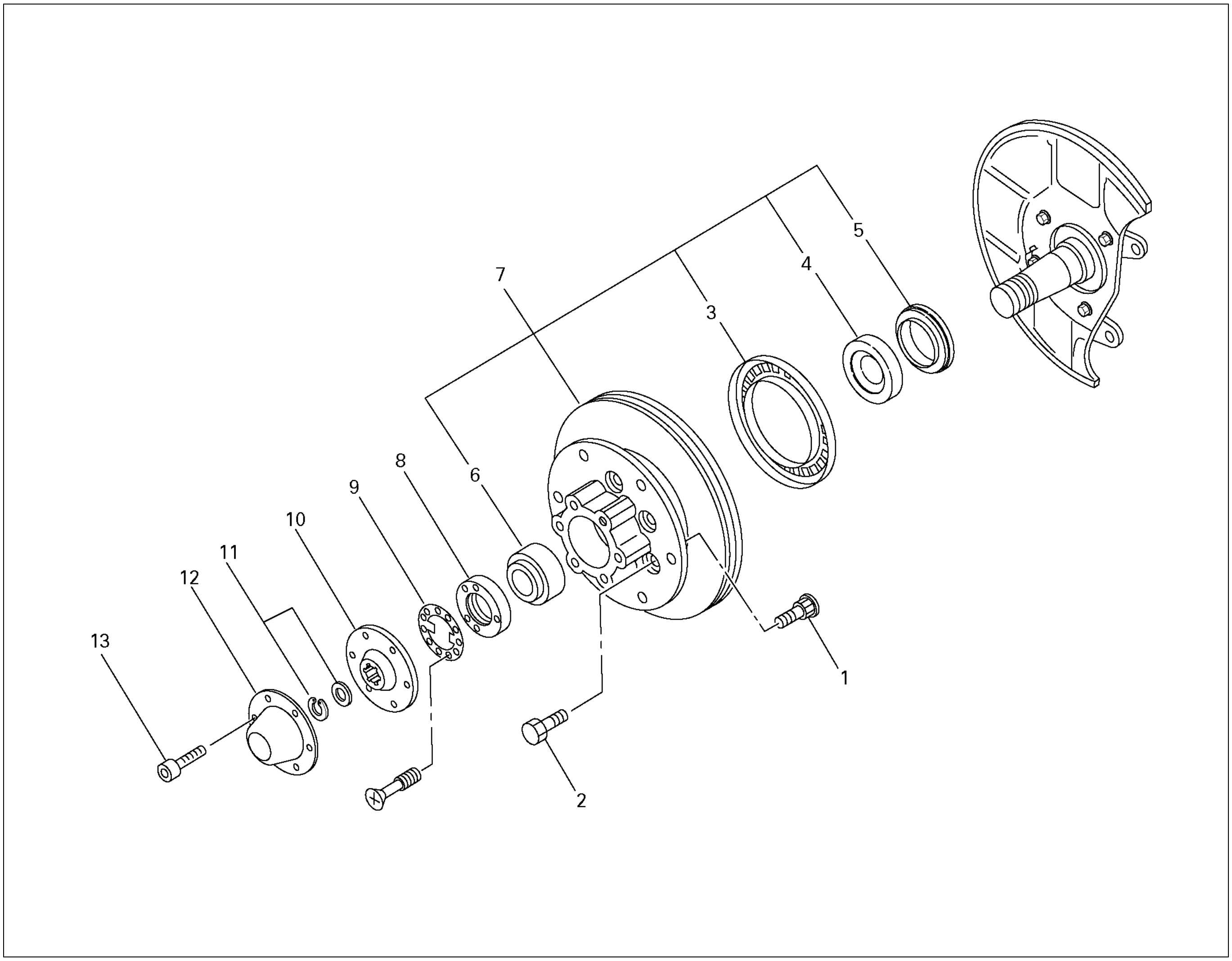
RTW78AXF003201

CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC, 4JH1-TC



RTW78AXF019501

Reassembly

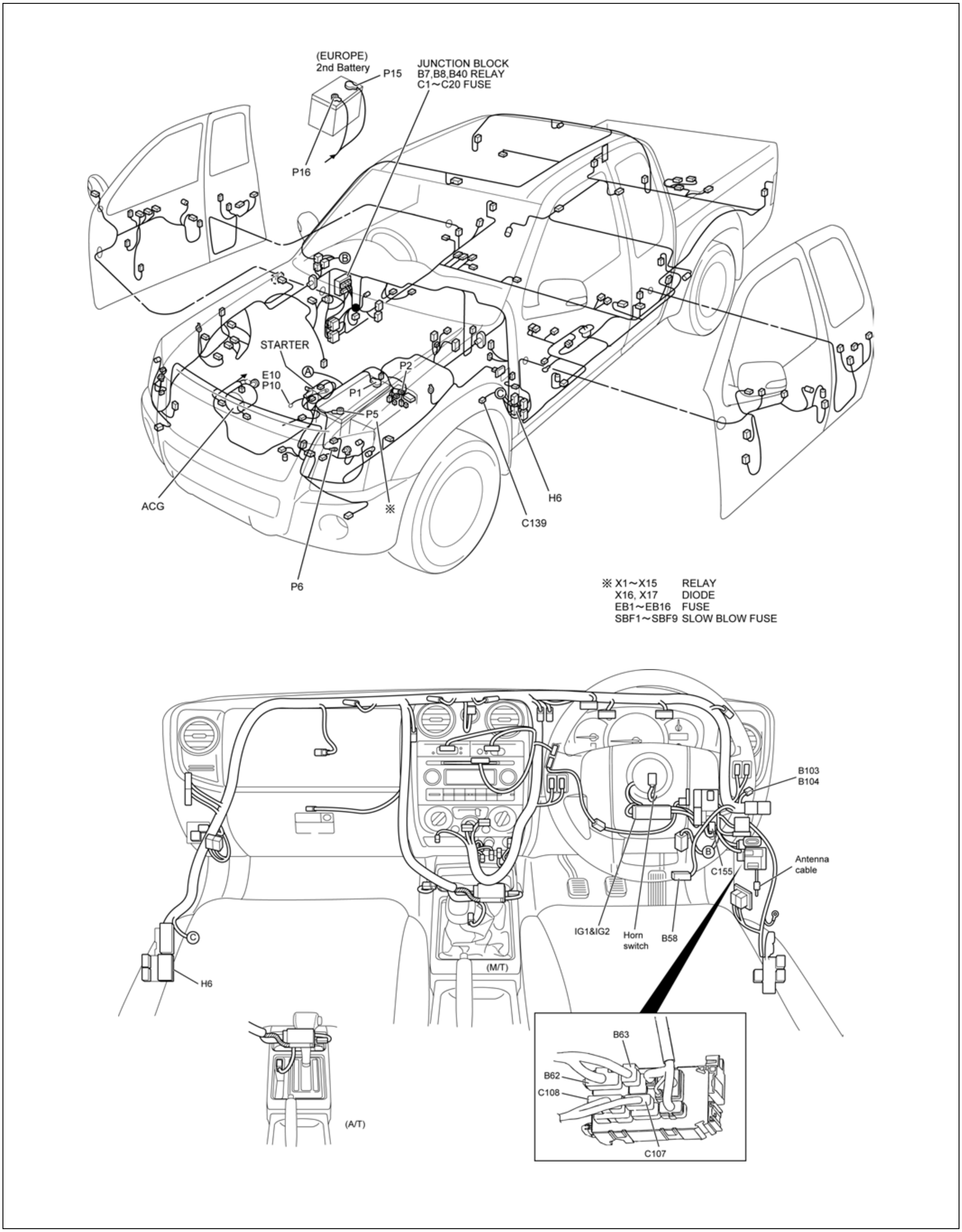


Reassembly Steps

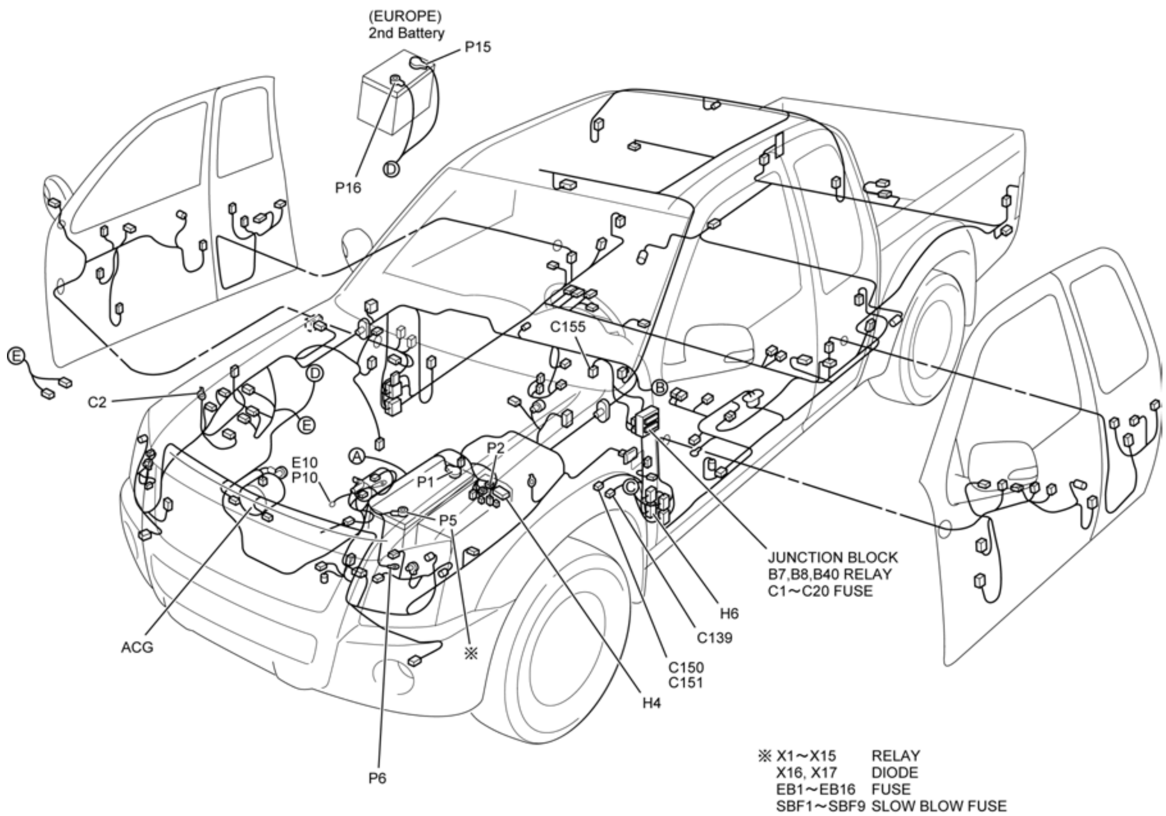
- ▲ 1. Wheel pin
- ▲ 2. Bolt
- ▲ 3. ABS sensor rotor
- ▲ 4. Inner bearing
- ▲ 5. Oil seal
- ▲ 6. Outer bearing
- ▲ 7. Hub and disc assembly
- ▲ 8. Hub nut
- ▲ 9. Lock washer
- ▲ 10. Flange (4×4 model only)
- ▲ 11. Snap ring and shim (4×4 model only)
- 12. Hub cap
- ▲ 13. Bolt

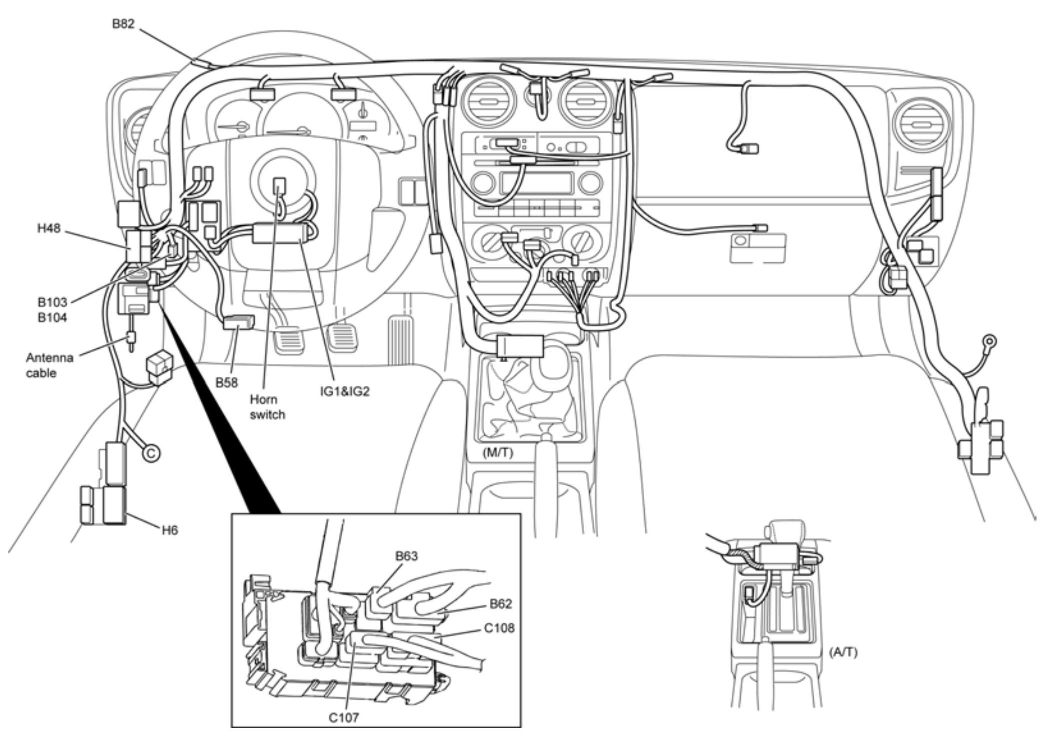
DRM

PARTS LOCATION



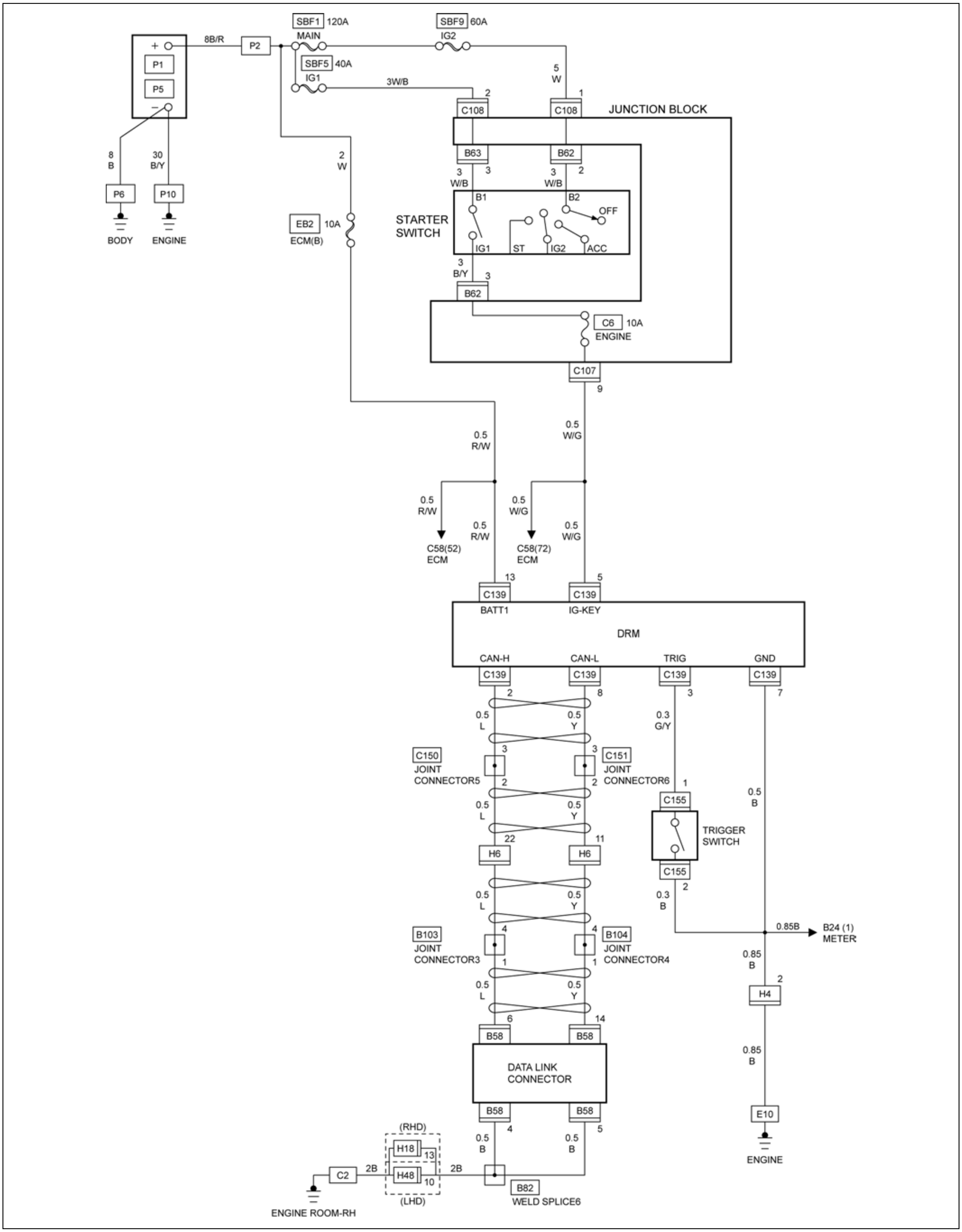
PARTS LOCATION





RTW78AXF041801 & RTW78AXF048001

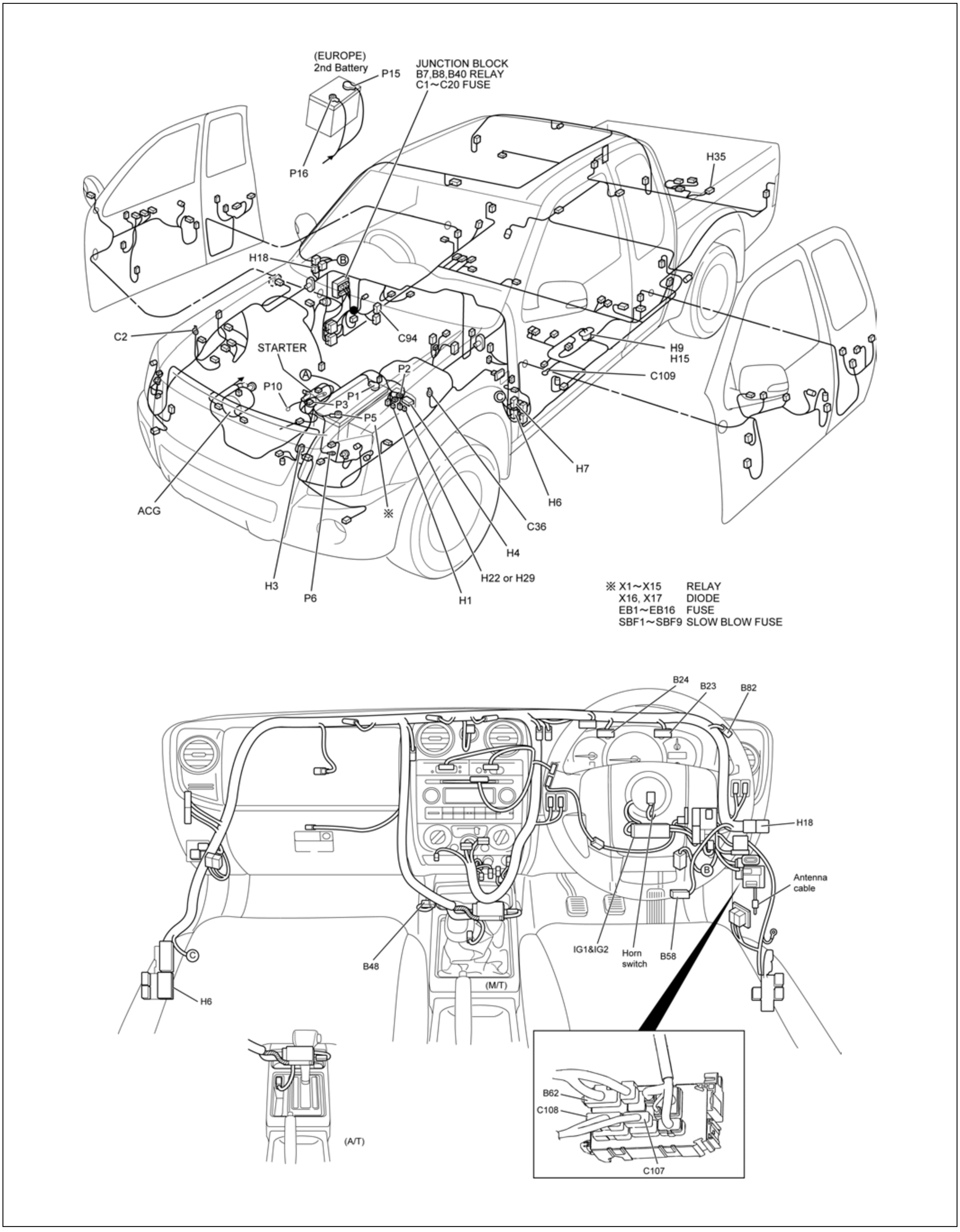
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA



RTW78AXF022701

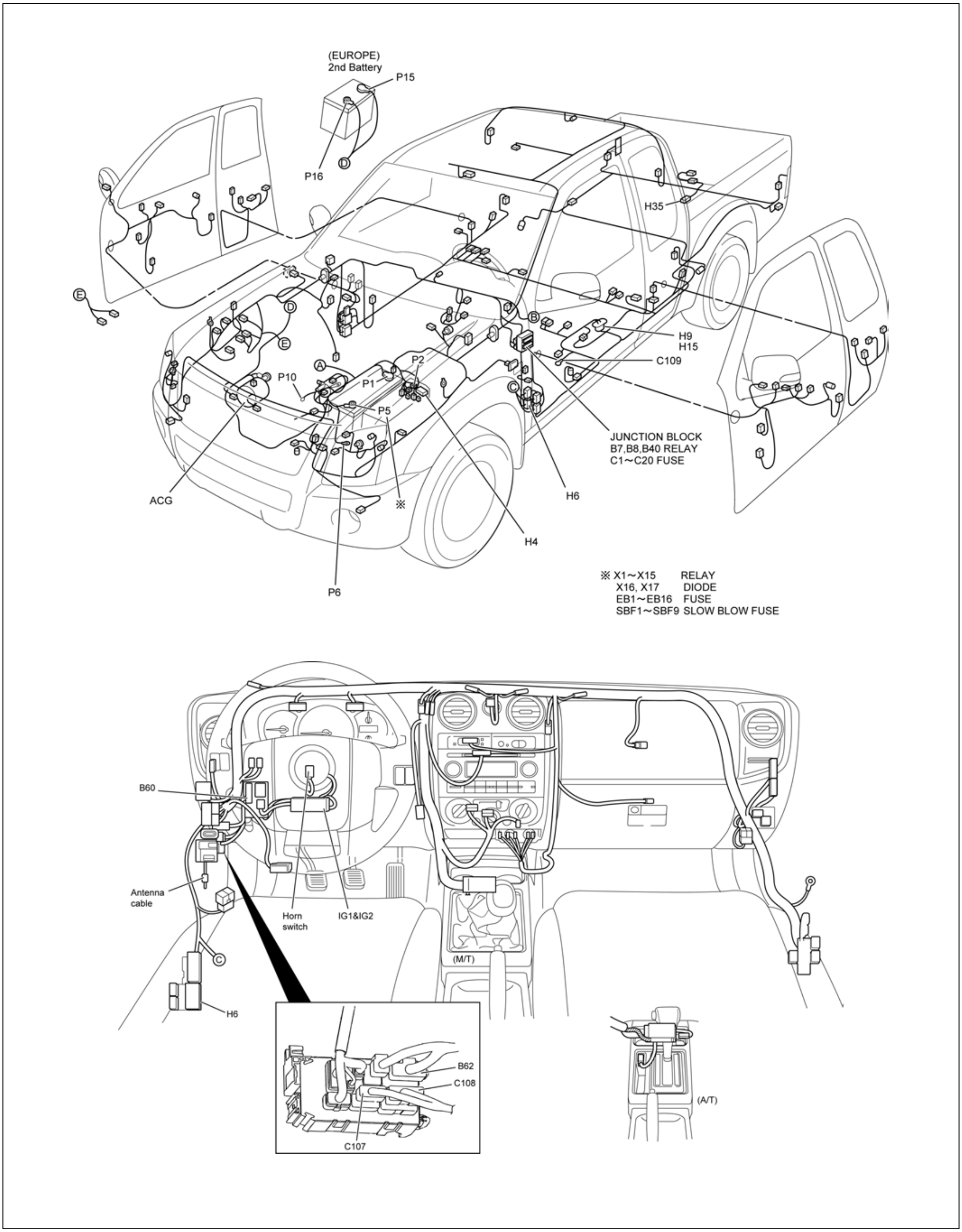
TRAILER HITCH

PARTS LOCATION (RHD)



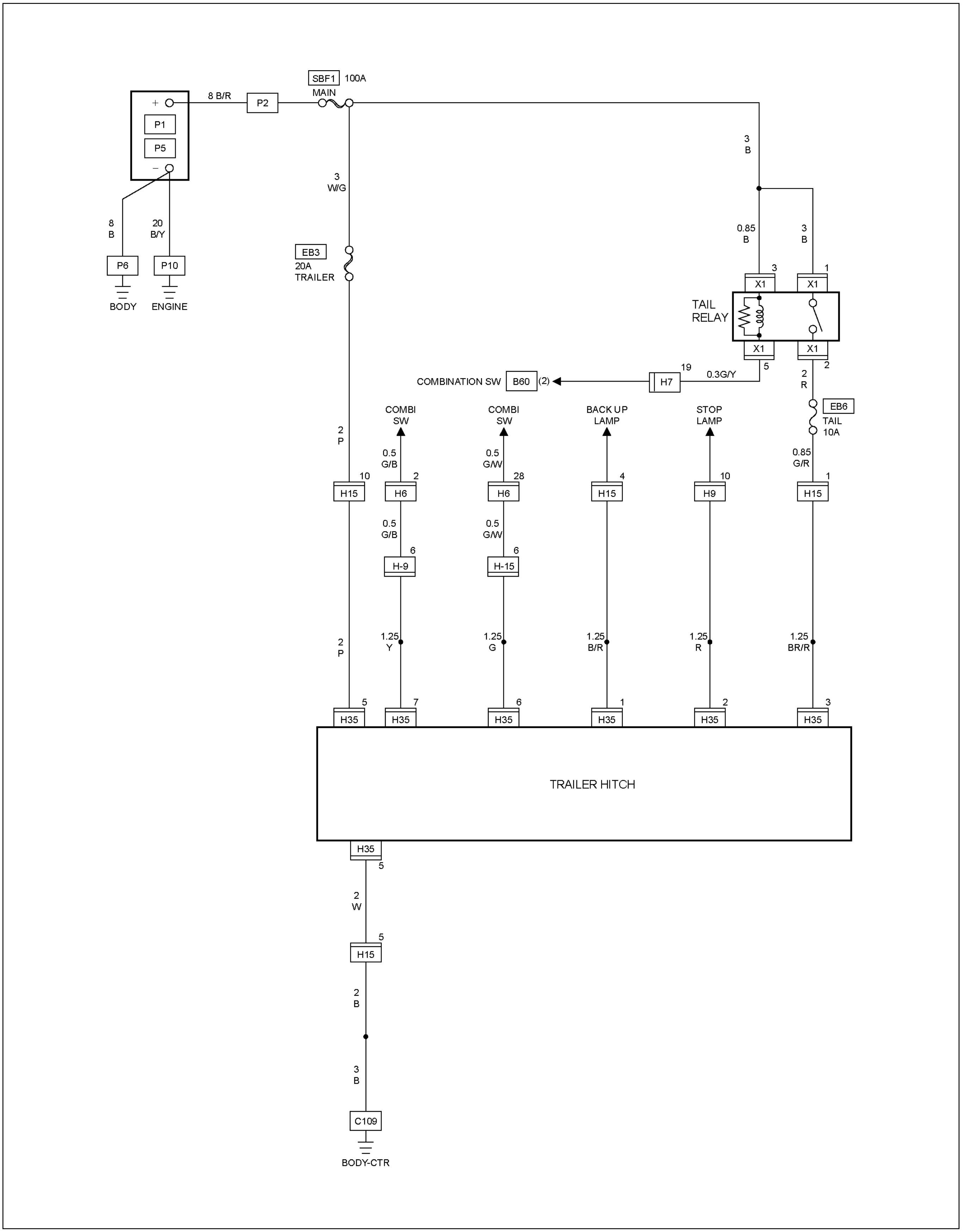
RTW78AXF041901 & RTW78AXF048101

PARTS LOCATION (LHD)



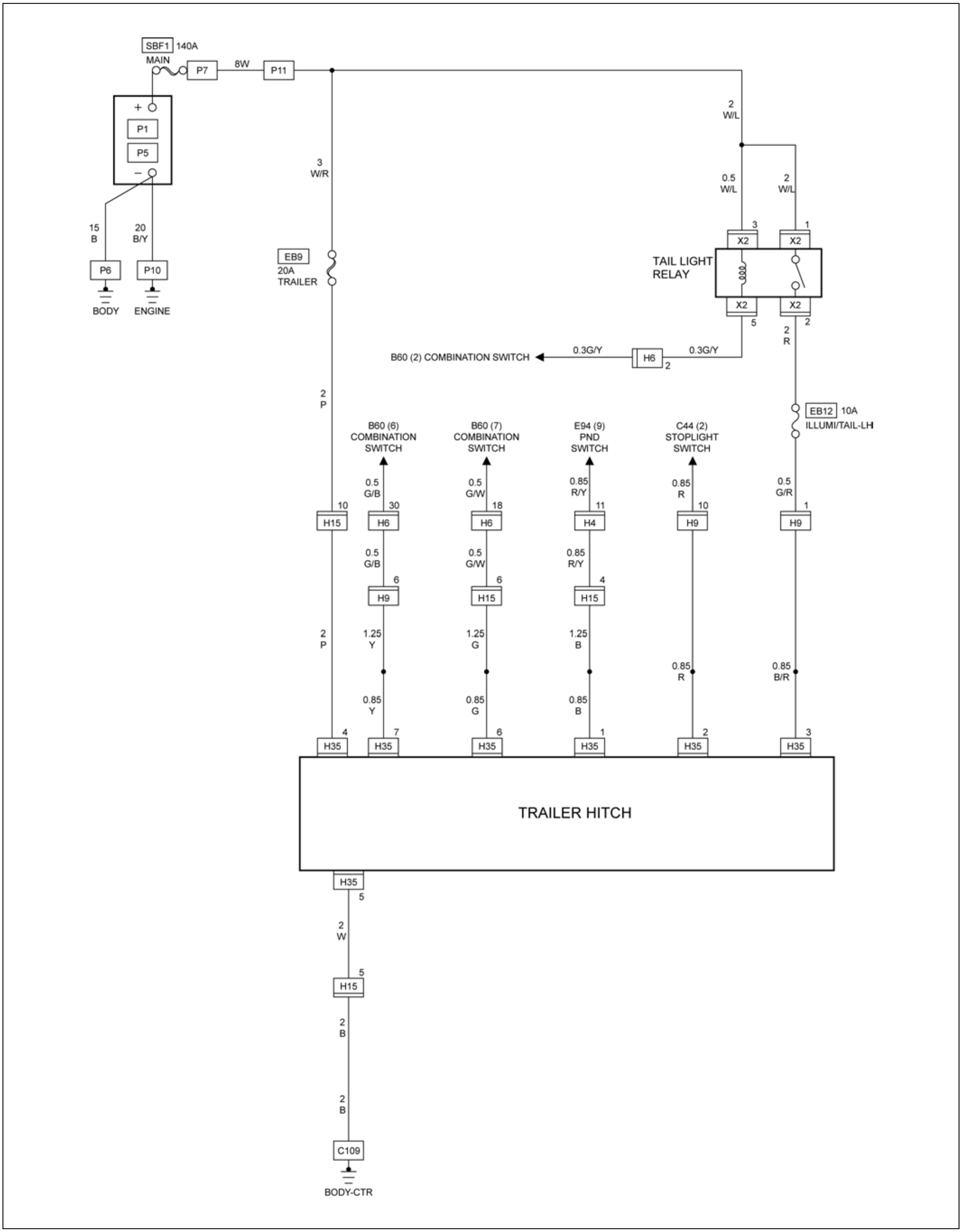
RTW78AXF042001 & RTW78AXF048201

CIRCUIT DIAGRAM C24SE AUSTRALIA



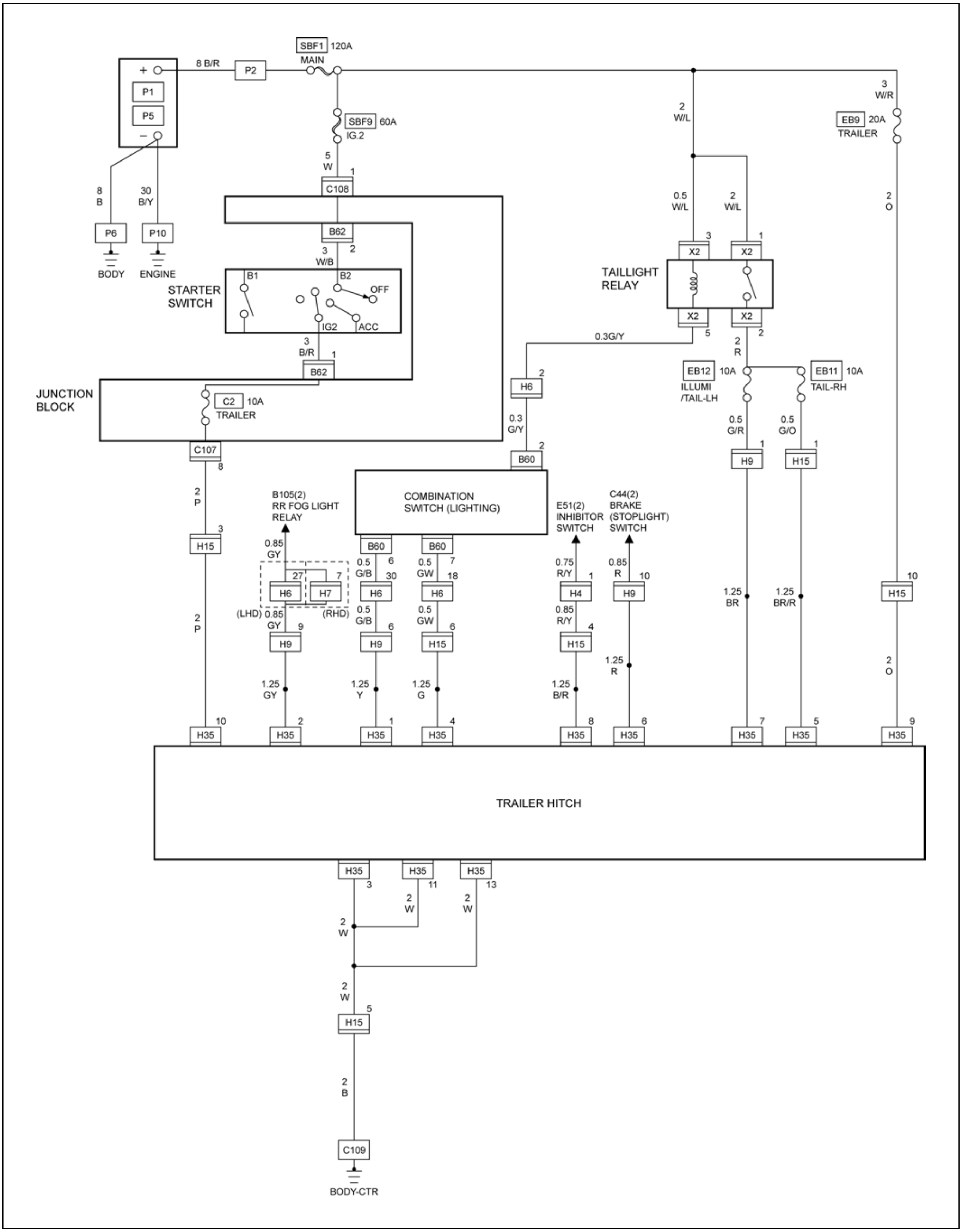
RTW780XF015601

CIRCUIT DIAGRAM HFV6 (RHD)



RTW78AXF025201

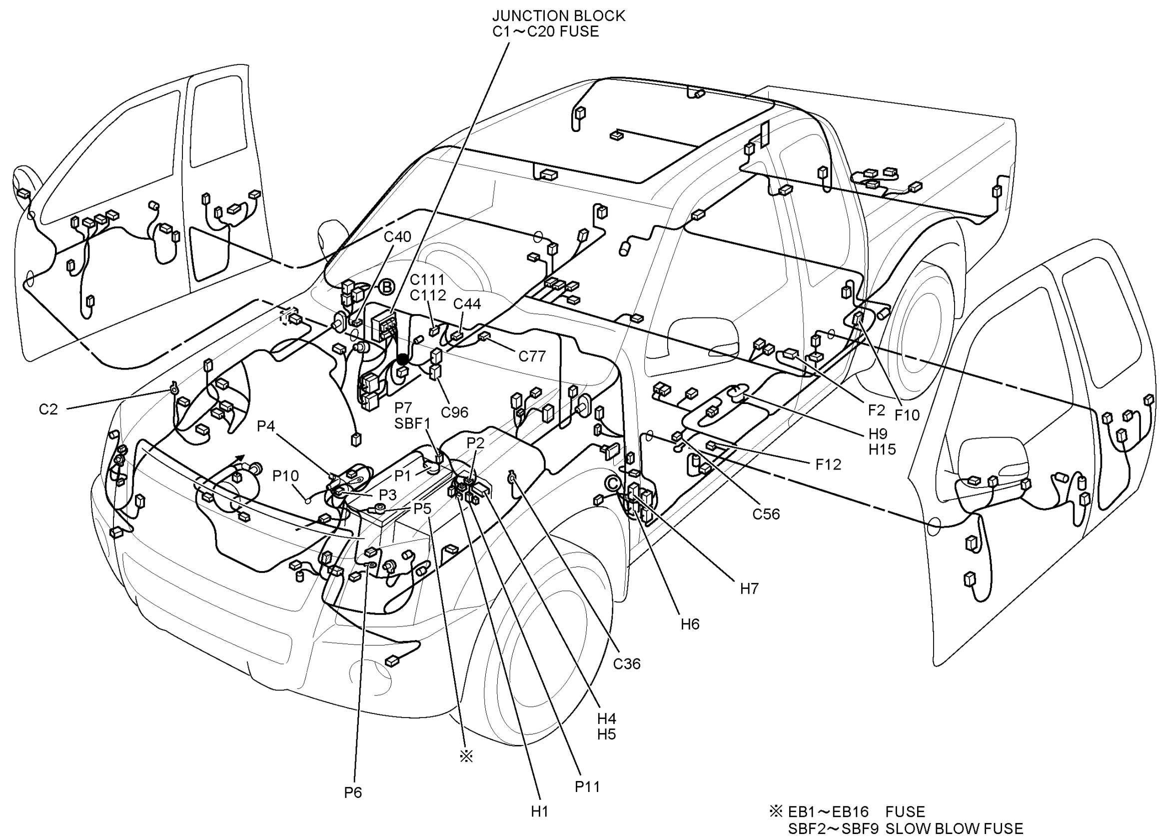
CIRCUIT DIAGRAM 4JJ1-TC / 4JK1-TC EXCEPT SOUTH AFRICA

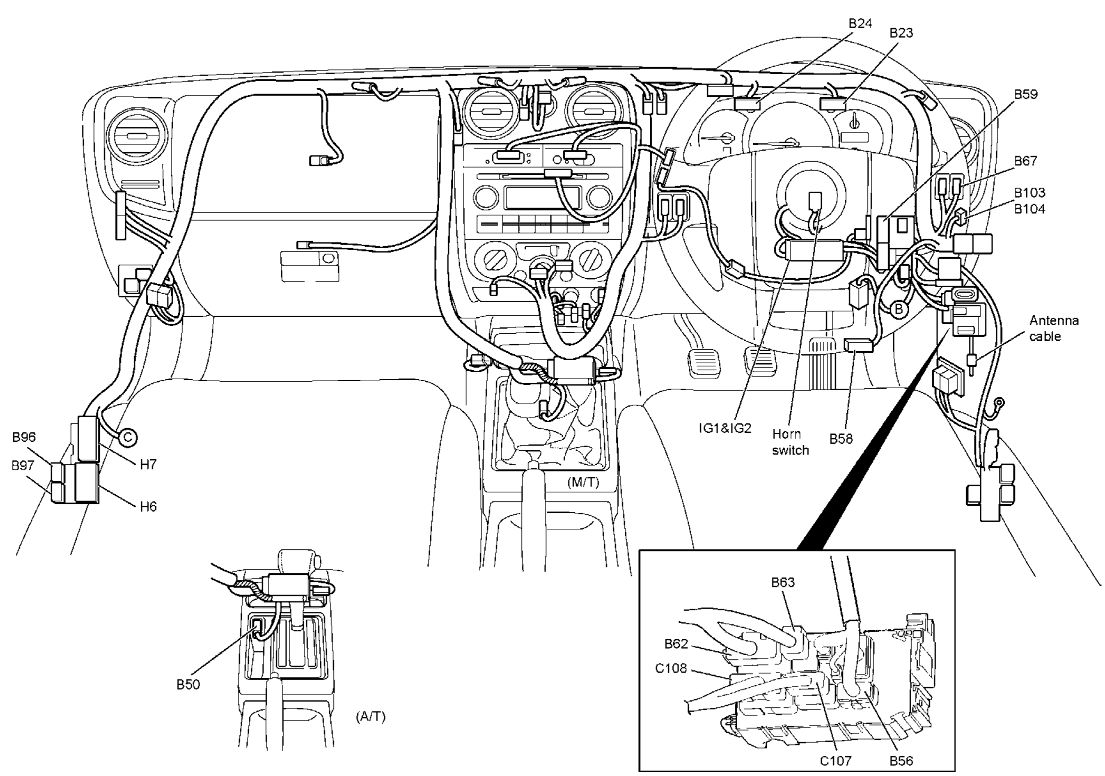


RTW78AXF022601

POWER TRAIN INTERFACE MODULE (PIM)

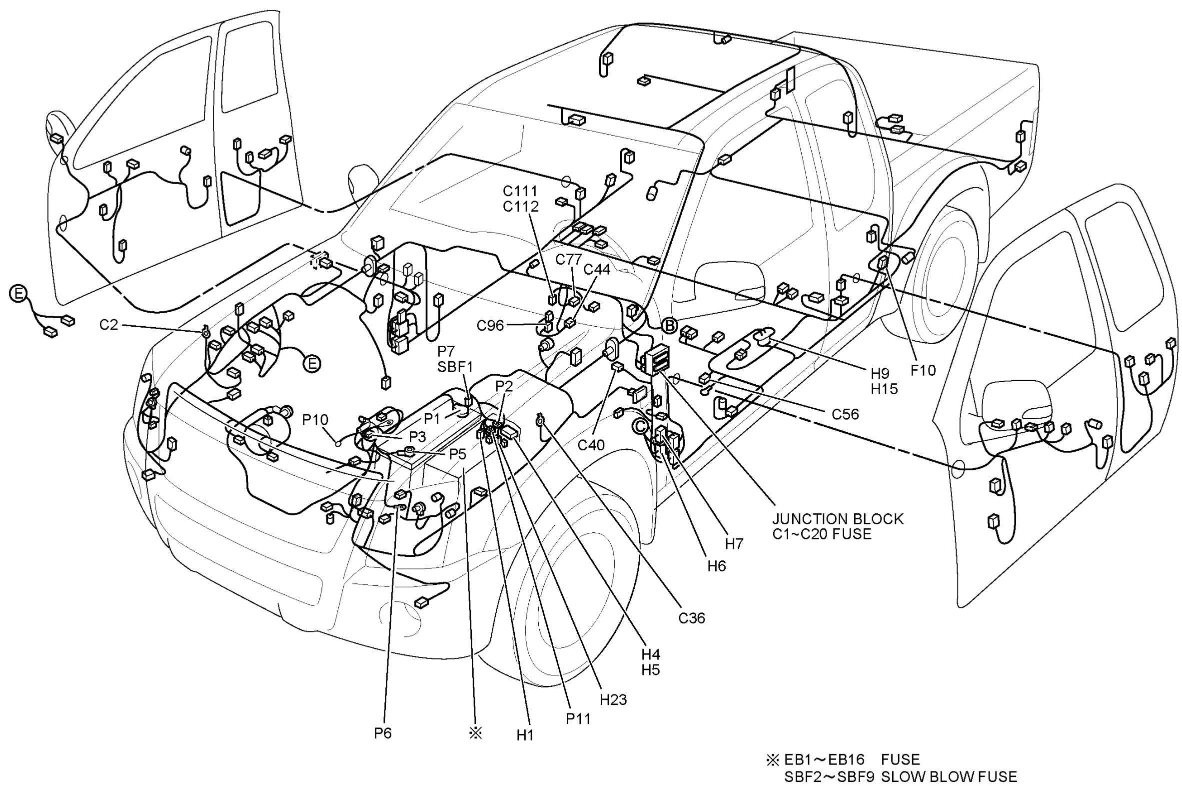
PARTS LOCATION (RHD)

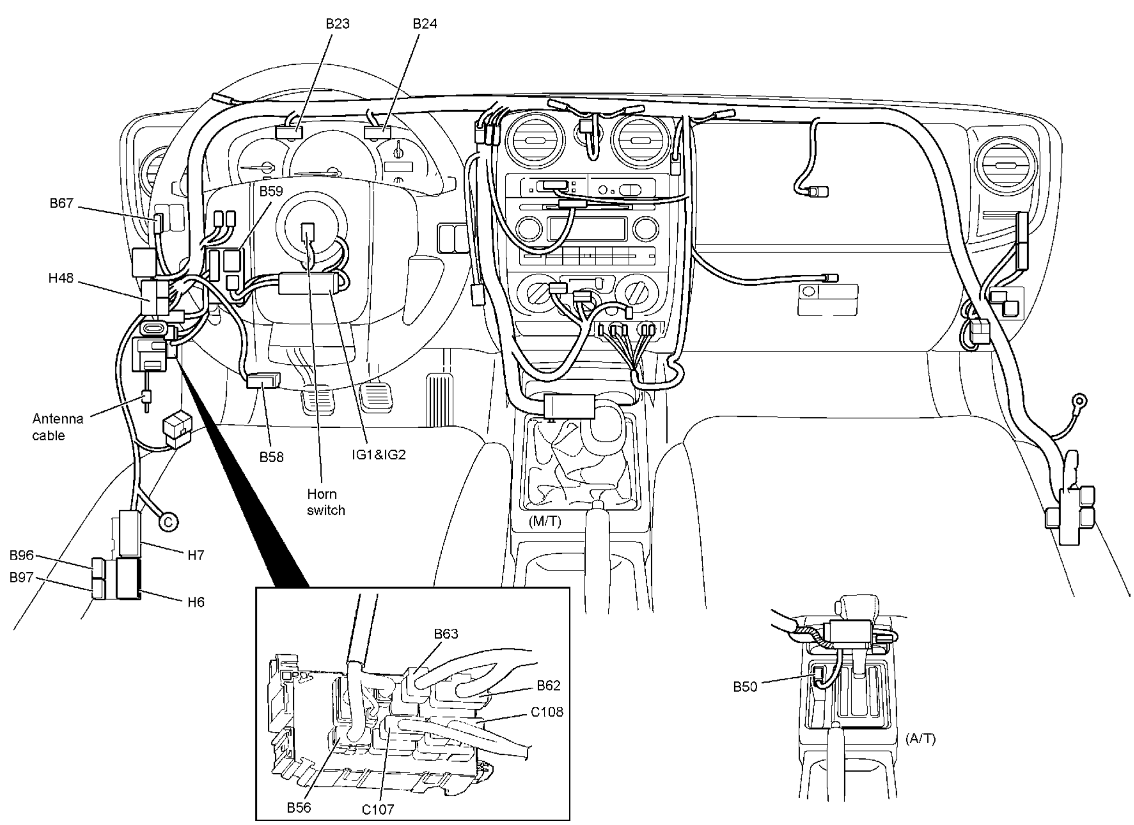




RTW78AXF048901 & RTW78AXF049101

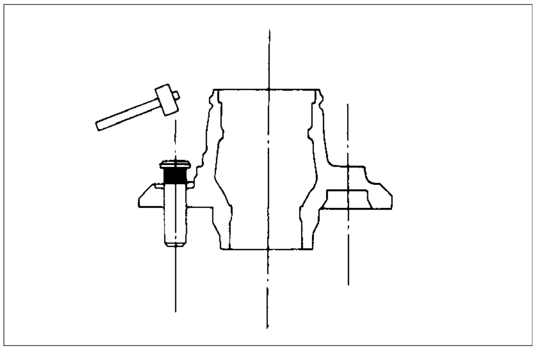
PARTS LOCATION (LHD)





RTW78AXF049001 & RTW78A049201

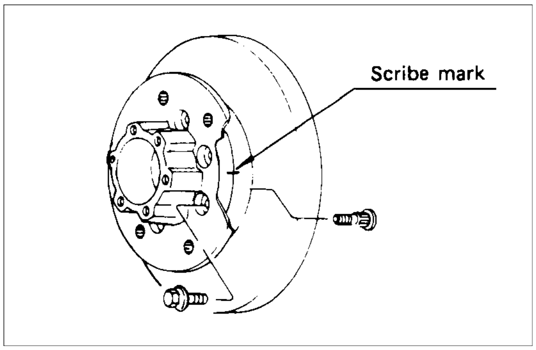
Important Operations



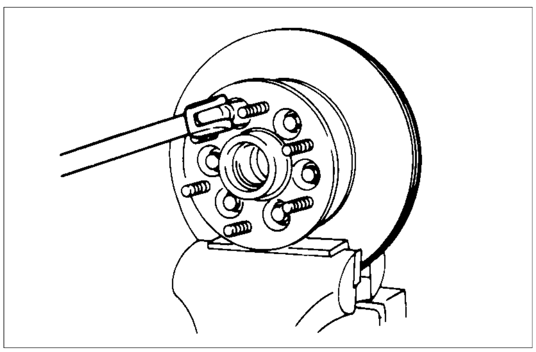
1. Wheel Pin

(1) Place hub on a wood workbench or a block of wood, approx. 6” by 6” to protect the wheel stud ends and threads.

(2) Install wheel stud using a hammer.
Be sure wheel stud is started squarely and seats completely.



(3) Align index marks and install hub to disc.



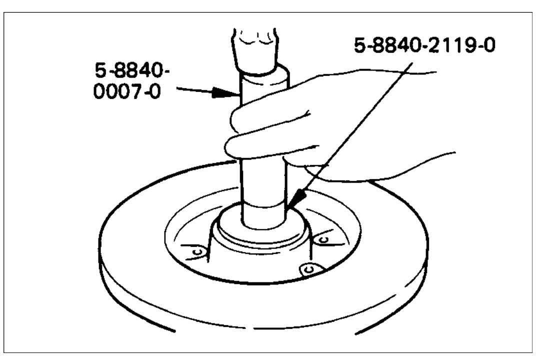
2. Bolt

Torque	N·m (kgf·m/lb·ft)
103 (10.5/76)	

3. ABS sensor rotor

(1) Set a new ABS sensor rotor, if replacement is required.

(2) Install the ABS sensor rotor in the hub, using special tools.
Installer : 5-8840-2789-0
Grip : 5-8840-0007-0
Refer to the section Brake.



4. Inner Bearing

Outer race ; outer bearing

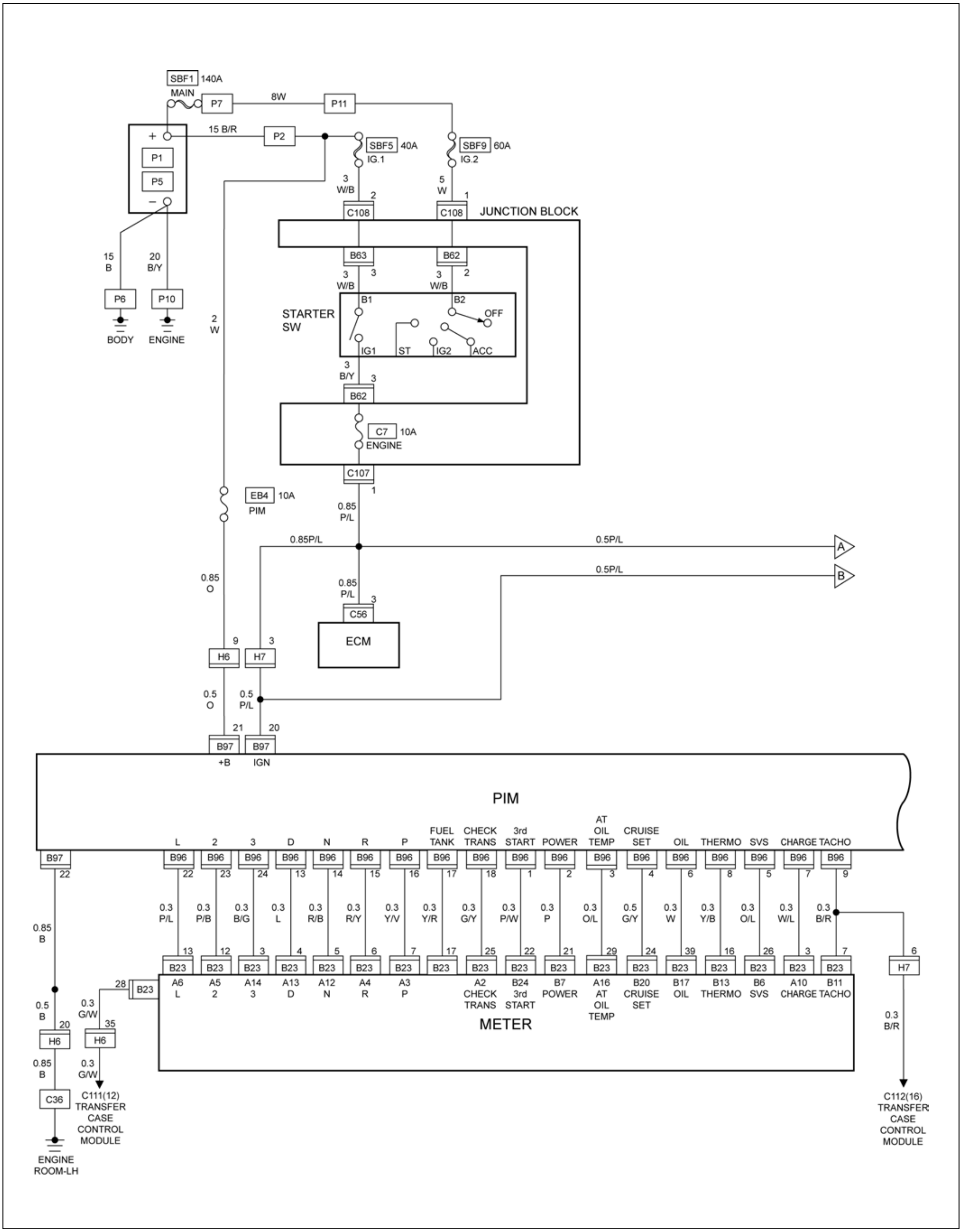
Install the outer race by driving it into the hub.

Installer : 5-8840-2119-0

Grip : 5-8840-0007-0

CIRCUIT DIAGRAM HFV6 (RHD)

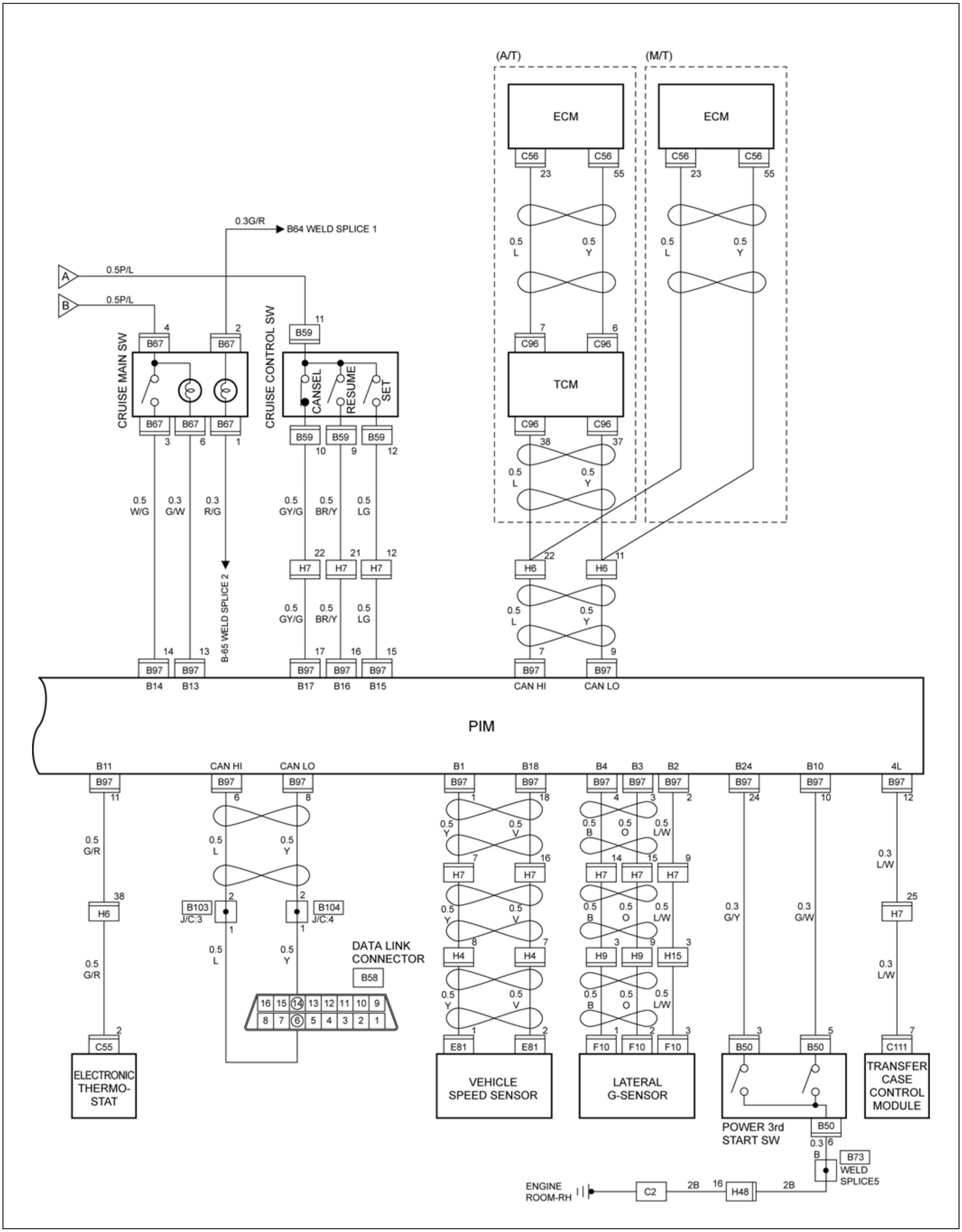
Sheet 1/2



RTW78AXF000501

CIRCUIT DIAGRAM HFV6 (RHD)

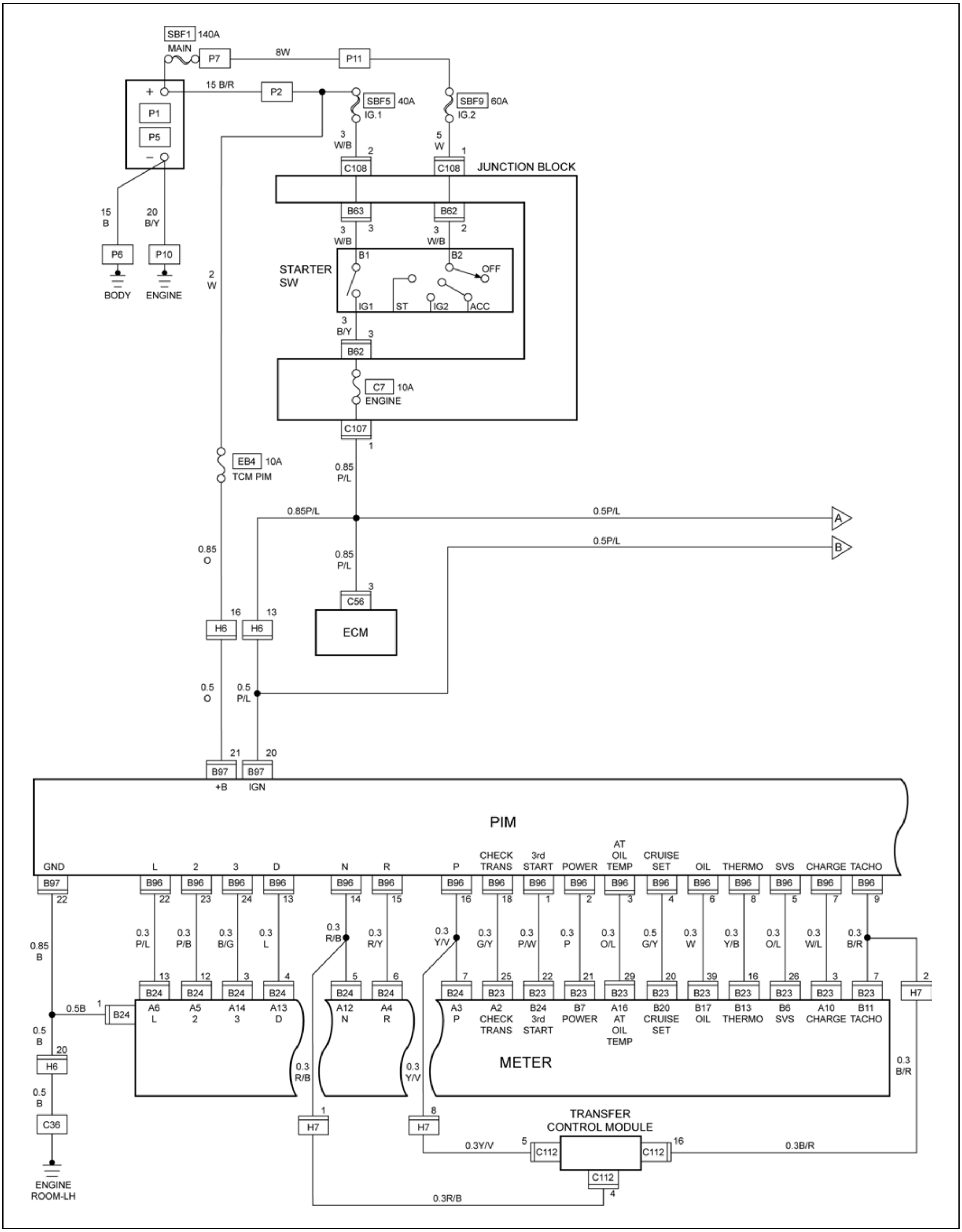
Sheet 2/2



RTW78AXF000601

CIRCUIT DIAGRAM HFV6 (LHD)

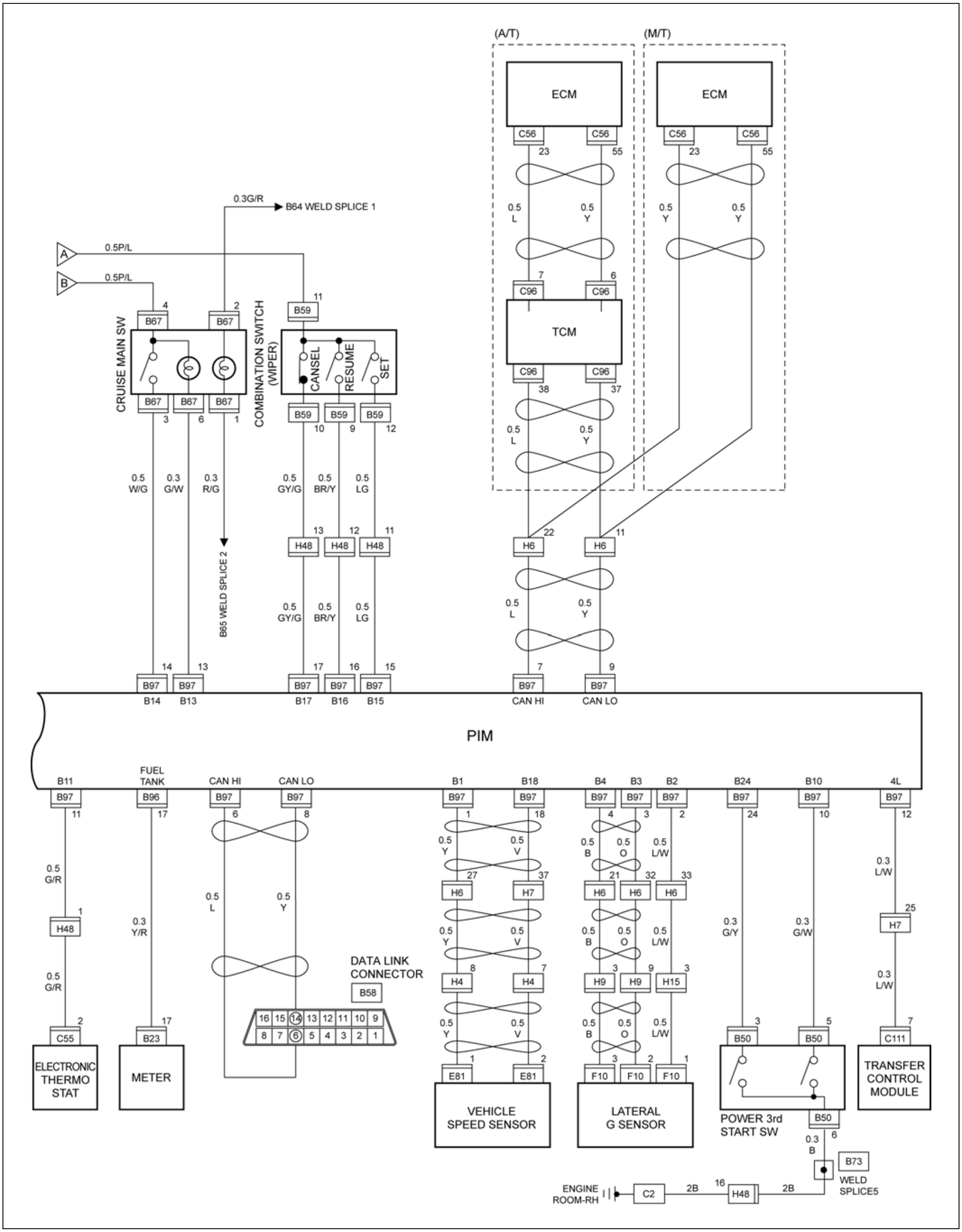
Sheet 1/2



RTW78AXF013401

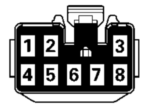
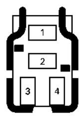
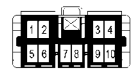
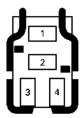
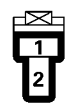
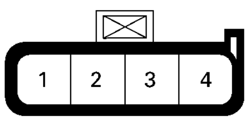
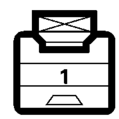
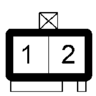
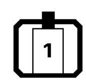
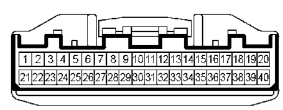
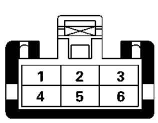
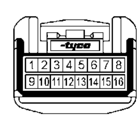
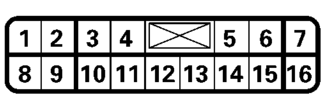
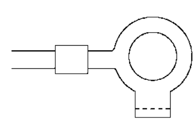
CIRCUIT DIAGRAM HFV6 (LHD)

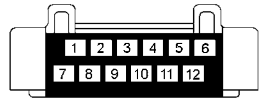
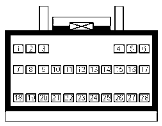
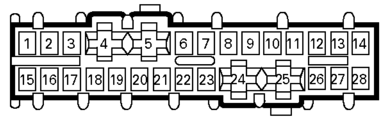
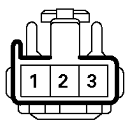
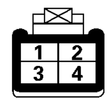
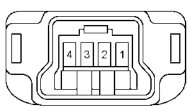
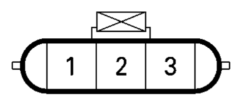
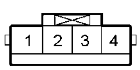
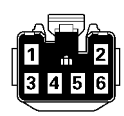
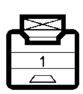
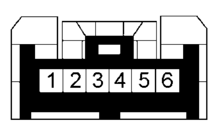
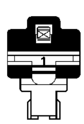
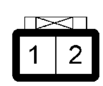
Sheet 2/2

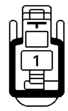
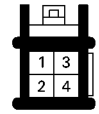
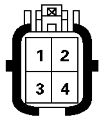
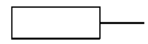
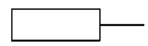
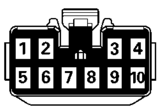
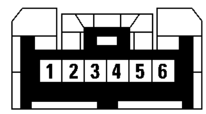
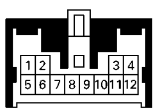
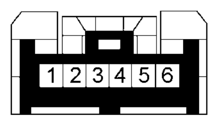
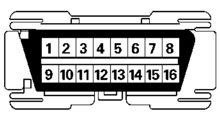
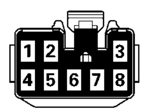
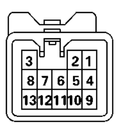
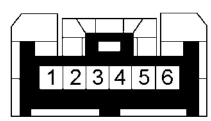
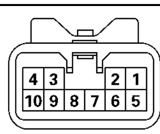
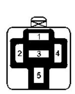
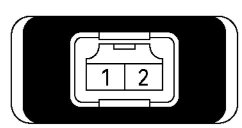
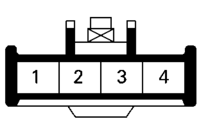
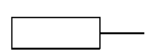


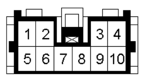
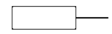
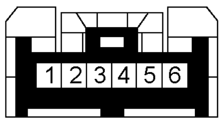
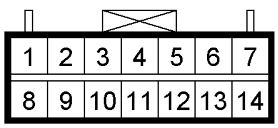
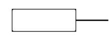
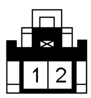
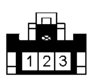
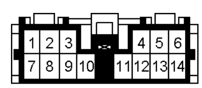
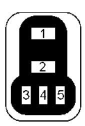
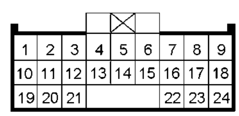
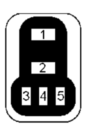
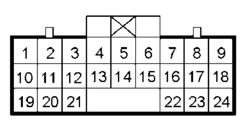
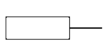
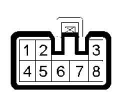
RTW78AXF013501

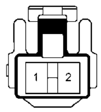
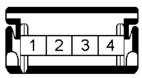
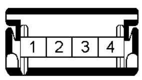
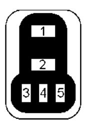
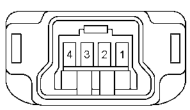
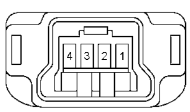
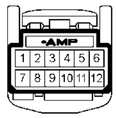
CONNECTOR LIST

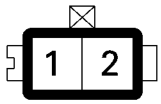
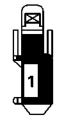
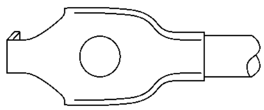
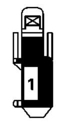
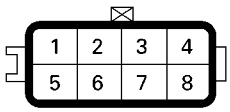
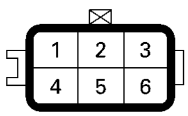
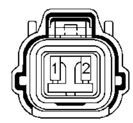
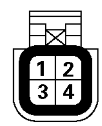
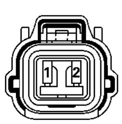
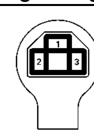
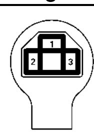
No.	Connector face	No.	Connector face
B1 ~ B6	**NOT USED**	B16 (HFV6 4JH1-TC) White	 Hazard switch
B7 Black	 Rear defogger relay	B16 (4JJ1-TC 4JA1T-(L)) Gray	 Hazard switch
B8 Black	 Power window relay	B17 ~ B19	**NOT USED**
B9	**NOT USED**	B20 White	 Cigar lighter illumination
B10 White	 Clock	B21 White	 Cigar lighter-1
B11 White	 Ash tray illumination	B22 Black	 Cigar lighter-2
B12	**NOT USED**	B23 White	 Meter-A
B13 White	 Fan switch	B24 White	 Meter-B
B14 Gray	 Audio	B25 ~ B27	**NOT USED**
B15	**NOT USED**	B28 Silver	 Dash side-RH

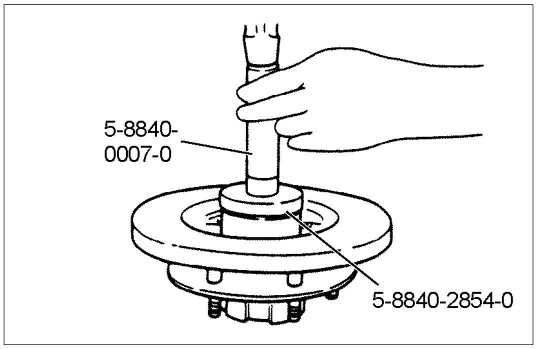
No.	Connector face	No.	Connector face
B29 ~ B30	**NOT USED**	B43 Black	 Anti theft control unit (A)
B31 Yellow	 SRS control unit	B44 Black	 Anti theft control unit (B)
B32	**NOT USED**	B45	**NOT USED**
B33 White	 Illumination control	B46 White	 Rear defogger timer
B34	**NOT USED**	B47 White	 Glove box illumination
B35 Yellow	 Infrator; passenger side	B48 Black	 G sensor
B36 Yellow	 Infrator; driver side	B49	**NOT USED**
B37 ~ B40	**NOT USED**	B50 White	 Power/3rd start switch
B41 White	 Acc socket	B51 White	 Headlight levering switch
B42 White	 Acc socket	B52 Black	 Anti theft indicator

No.	Connector face	No.	Connector face
B53 White	 J/B I1	B63 White	 Ignition switch (IGSUB: G2)
B54 White	 J/B I2	B64	 Weld splice 1 (Illumination)
B55 White	 J/B I3	B65	 Weld splice 2 (Ground)
B56 White	 J/B I4	B66 White	 4WD switch
B57 White	 HVAC control unit	B67 White	 Cruise main switch
B58 Black	 Data link connector	B68 White	 Immobilizer
B59 White	 Combination switch-A	B69 Gray	 Door lock switch
B60 Black	 Combination switch-B	B70 ~ B71	**NOT USED**
B61 Black	 Flasher unit	B72 Yellow	 Inflator module passenger
B62 White	 Ignition switch (IGSUB: G1)	B73	 Weld Splice 3

No.	Connector face	No.	Connector face
B74	**NOT USED**	B85	 Weld splice 7 (Ground)
B75 Black	 Rear fog light C/U	B86	 Weld splice 8 (Ground)
B76 White	 Front rear fog light switch	B87	**NOT USED**
B77 White	 Immobilizer C/U	B88	 Weld splice 5 (Ground)
B78 White	 Key cylinder antenna coil	B89 ~ B94	**NOT USED**
B79 White	 Short connector (cooler only)	B95 White	 Keyless entry control unit
B80 Black	 Hazard relay (RH)	B96 Gray	 PIM1
B81 Black	 Hazard relay (LH)	B97 White	 PIM2
B82	 Weld splice 6 (Ground)	B98 White	 Door lock C/U
B83 ~ B84	**NOT USED**	B101 White	 Key inter lock

No.	Connector face	No.	Connector face
B102 White	 Key inter lock solenoid		
B103 White	 Joint connector 3		
B104 White	 Joint connector 4		
B105 Black	 Rear fog light relay		
B106	**NOT USED**		
B107 Yellow	 Pretensioner (Dr)		
B108 Yellow	 Pretensioner (As)		
B109	 Immobilizer control unit		

No.	Connector face	No.	Connector face
C1 Gray	 Side turn light-RH	C20 Black	 Horn; high note
C2 Silver	 Engine room-RH ground	C21 Black	 Horn; low note
C3 Black	 Front wiper INT Relay	C22	 Front turn signal light STD-RH
C4 Sky blue	 Front wiper motor	C23	**NOT USED**
C5 ~ C14	**NOT USED**	C24 White	 Pressure switch
C15 Gray	 VSV FICD	C24 Black	 Triple pressure switch
C16	**NOT USED**	C25 White	 Front turn signal light STD-LH
C17 Gray	 Front washer motor	C26 Black	 Headlight STD-LH
C18 Black	 Clearance light STD-RH	C27 Black	 Clearance light STD-LH
C19 Black	 Headlight STD-RH	C28 Gray	 Headlight leveling acutuator STD-RH



RTW74CSH000301

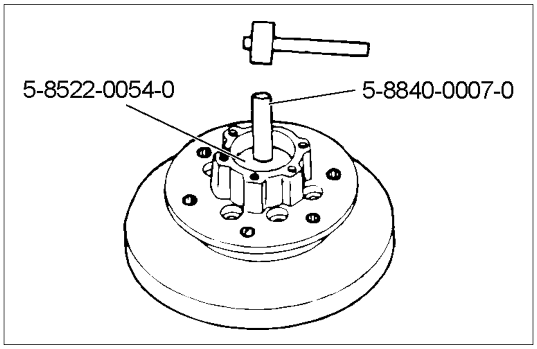
5. Oil Seal

Installer : 5-8840-2854-0

Grip : 5-8840-0007-0

Apply grease (Besco L-2 or equivalent) to the lip portion.

Discard the used oil seal and install a new one.



RTW44CSH000101

6. Outer bearing

Outer race ; outer bearing

Install the outer race by driving it into the hub.

Installer : 5-8522-0054-0

Grip : 5-8840-0007-0

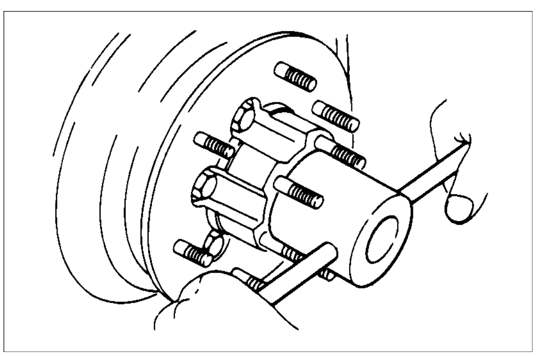
7. Hub and Disc Assembly

(1) Apply grease in the hub.

(2) Apply grease (Besco L-2 or equivalent) to the outer and inner bearing.

g(oz)

Hub	35 (1.24)
Outer bearing	10 (0.35)
Inner bearing	15 (0.53)



8. Hub Nut

(1) Turn the place where there is a chamfer in the tapped hole to the outer side, and attach the nut.

Wrench : 5-8840-2117-0

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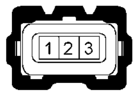
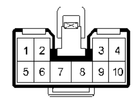
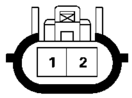
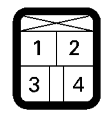
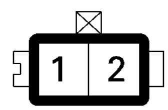
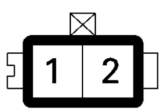
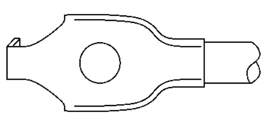
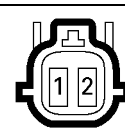
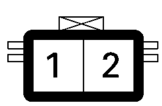
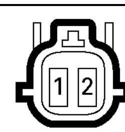
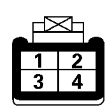
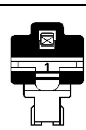
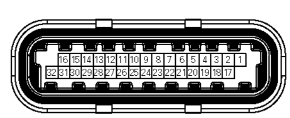
No.	Connector face	No.	Connector face
C29	 Headlight leveling acutuator STD-LH	C40 Black	 Accelerator pedal position sensor
C30 White	 Engine hood switch	C41 ~ C43	**NOT USED**
C31 Blue	 EGR VSV front	C44 White	 Stoplight switch
C32 Blue	 EGR VSV rear	C45 ~ C49	**NOT USED**
C33 ~ C34	**NOT USED**	C50 Black	 Condenser fan
C35 Gray	 Side turn light-LH	C51 ~ C52	**NOT USED**
C36 Silver	 Engine room-LH; ground	C53 Red	 ABS speed sensor front-RH
C37 Black	 Brake fluid level switch	C54 Red	 ABS speed sensor front-LH
C38 Light Gray	 Vacuum switch	C55 Brown	 Thermo AMP
C39 White	 Parking brake switch (stick type)	C56 (C24SE)	 ECM

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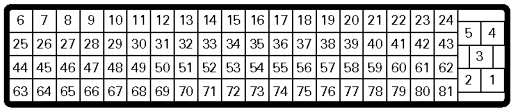
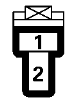
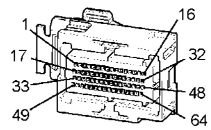
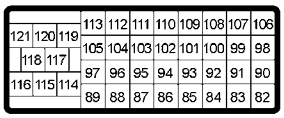
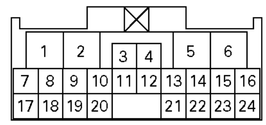
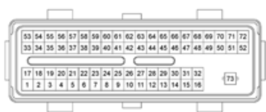
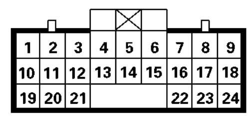
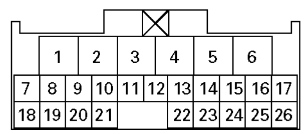
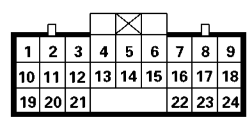
(4JH1-TC)
Black</td><td>
ECM-A</td><td>C77
White</td><td>
Clutch switch</td></tr>
<tr><td>C56
(HFV6)
Black</td><td>
ECM-A</td><td>C78
~
C93</td><td>NOT USED</td></tr>
<tr><td>C57
Black</td><td>
ECM-B</td><td>C94
White</td><td>
TCM-A (AW30-40LE TRANSMISSION)</td></tr>
<tr><td>C58
Black</td><td>
ECM J2</td><td>C94
Gray</td><td>
TCM-A (JR405E TRANSMISSION)</td></tr>
<tr><td>C59
~
C62</td><td>NOT USED</td><td>C95
White</td><td>
TCM-B (AW30-40LE TRANSMISSION)</td></tr>
<tr><td>C63
Brown</td><td>
Front fog light-RH</td><td>C95
White</td><td>
TCM-B (JR405E TRANSMISSION)</td></tr>
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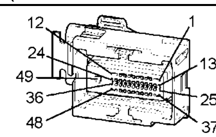
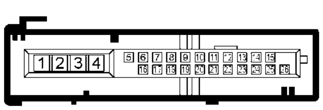
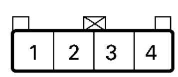
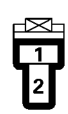
Brown</td><td>
Front fog light-LH</td><td>C96
Black</td><td>
TCM1</td></tr>
<tr><td>C65
~
C66</td><td>NOT USED</td><td>C97
~
C103</td><td>NOT USED</td></tr>
<tr><td>C67
Black</td><td>
EHCU</td><td>C104
Brown</td><td>
Front blower resister</td></tr>
<tr><td>C68
~
C76</td><td>NOT USED</td><td>C105
White</td><td>
Front blower motor</td></tr>
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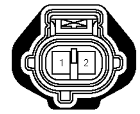
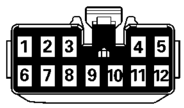
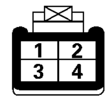
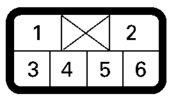
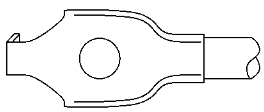
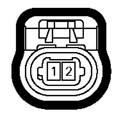
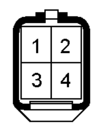
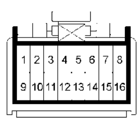
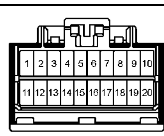
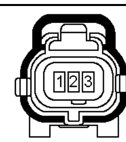
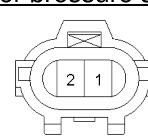
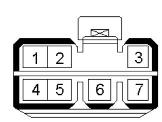
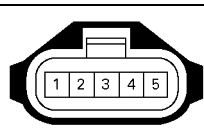
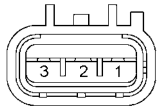
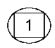
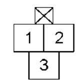
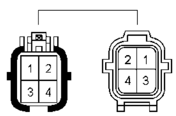
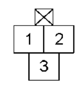
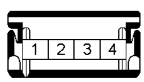
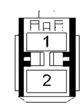
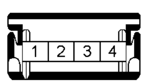
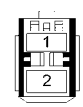
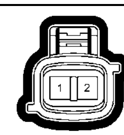
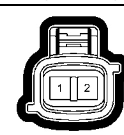
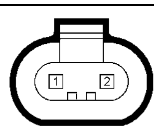
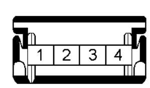
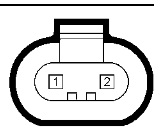
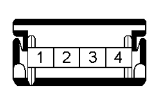
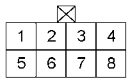
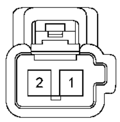
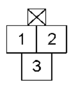
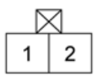
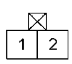
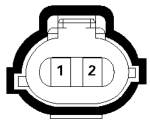
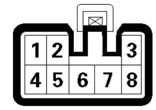
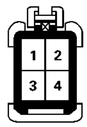
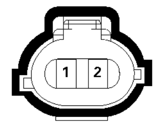
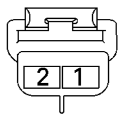
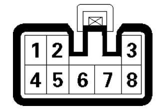
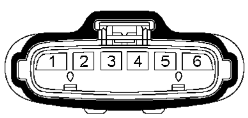
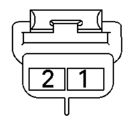
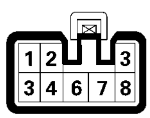
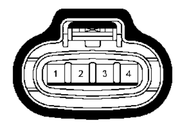
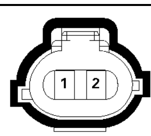
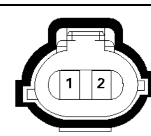
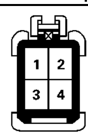
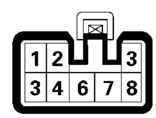
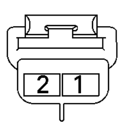
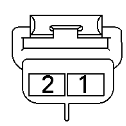
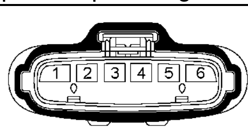
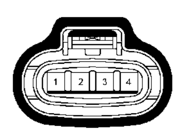
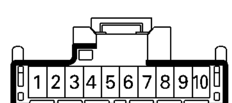
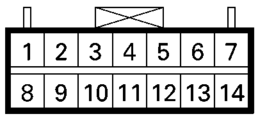
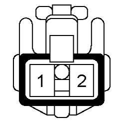
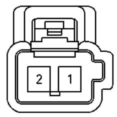
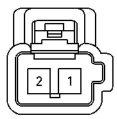
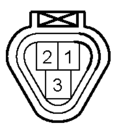
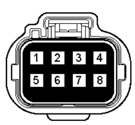
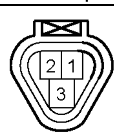
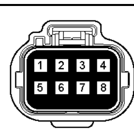
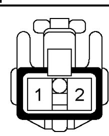
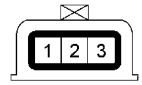
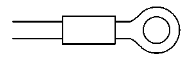
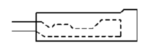
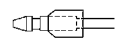
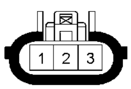
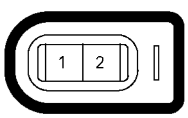
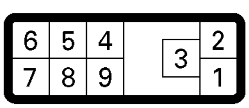
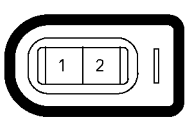
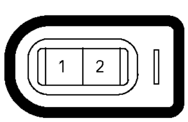
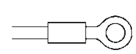
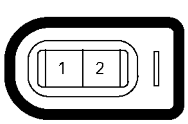
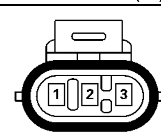
No.	Connector face	No.	Connector face
C106	**NOT USED**	C117 Black	 Anti theft horn
C107 White	 J/B E2	C118	 A/C Resister & Neutral switch
C108 White	 J/B E1	C119 ~ C120	**NOT USED**
C109 Silver	 Body-CTR; ground	C121 (C24SE)	 IAT sensor
C110	**NOT USED**	C122 (C24SE) White	 Co adjuster connector
C111 Black	 Transfer case control module	C123	**NOT USED**
C112 Black	 Transfer case control module	C124 Black	 Lower pressure sensor
C113 ~ C114	**NOT USED**	C125 White	 Thermo switch (Air)
C115 Brown	 EVRV EGR	C126 White	 Glow control unit
C116 Black	 MAF sensor	C127 ~ C130	**NOT USED**

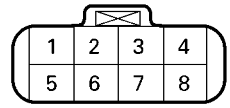
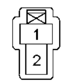
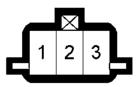
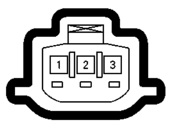
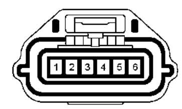
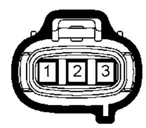
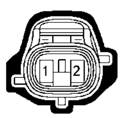
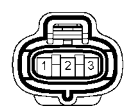
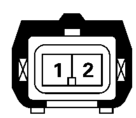
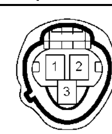
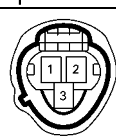
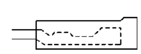
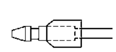
No.	Connector face	No.	Connector face
C131 Black	 Radiator fan	C142 Gray	 Clearance light PJT HI-RH
C132	**NOT USED**	C143 Gray	 Clearance light PJT HI-LH
C133 Silver	 Earth rad fan	C144 Gray	 Headlight levering PJT-RH
C134 Gray	 Motor actuator	C145 Gray	 Headlight levering PJT-LH
C135 White	 Joint connector 1	C146 Black	 Headlight PJT LOW-RH
C136 White	 Joint connector 2	C147 Black	 Headlight PJT LOW-LH
C137 Black	 Ambient sensor	C148 Gray	 Front turn signal light PJT-RH
C138 ~ C139	**NOT USED**	C149 Gray	 Front turn signal light PJT-LH
C140 Black	 Headlight PJT HI-RH	C150 White	 Joint connector 5
C141 Black	 Headlight PJT HI-LH	C151 White	 Joint connector 6

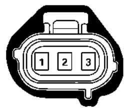
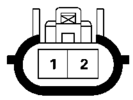
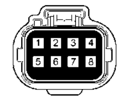
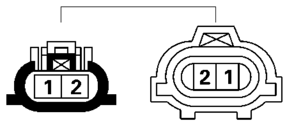
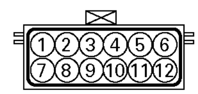
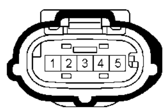
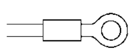
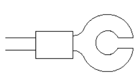
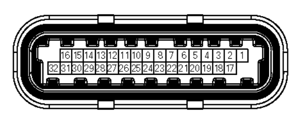
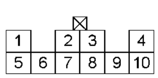
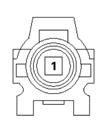
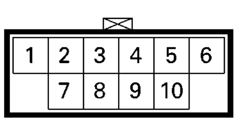
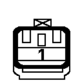
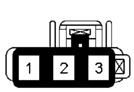
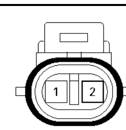
No.	Connector face	No.	Connector face
C152 ~ C153	**NOT USED**		
C154 Black	 ETC pedal		
C155 White	 Trigger switch		
C156 Black	 A-C transducer		
C157 Gray	 Fuel pump resistor		
C158 ~ C161	**NOT USED**		
C162 White	 EVRV T/C		

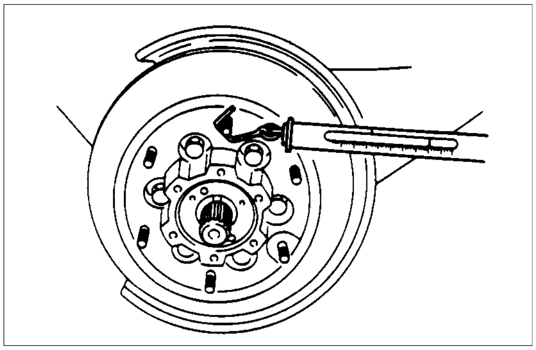
No.	Connector face	No.	Connector face
D1 Brown	 Power window motor-driver side	D10 White	 Power window switch-passenger side
D2 White	 Remote mirror-driver side	D11 Brown	 Power window motor rear-LH
D3 Black	 Front speaker-driver side	D12 White	 Power window switch rear-LH
D4 Black	 Door lock actuator-driver side	D13 Black	 Rear speaker-LH
D5 White	 Power window switch-driver side	D14 Black	 Door lock actuator rear-LH
D6 Brown	 Power window motor-passenger side	D15 Brown	 Power window motor rear-RH
D7 White	 Remote mirror-passenger side	D16 White	 Power window switch-RH
D8 Black	 Speaker-passenger side	D17 Black	 Rear speaker-RH
D9 Black	 Door lock actuator-passenger side (keyless & antitheft)	D18 Black	 Door lock actuator rear-RH
D9 Black	 Door lock actuator-passenger side	D19 White	 Remote mirror switch-driver side

No.	Connector face	No.	Connector face
D20 White	 Power window switch-driver side	D30 White	 Door mirror-turn signal light-passenger side
D21 White	 Tweeter-driver side		
D22 White	 Tweeter-passenger side		
D23 White	 Door lock & super actuator front (RH)		
D24 White	 Key cylinder switch-driver side		
D25 White	 Door lock actuator-passenger side		
D26 White	 Key cylinder switch-driver side		
D27 White	 Door lock & super lock actuator RR (RH)		
D28 White	 Door lock & super lock actuator RR (LH)		
D29 White	 Door mirror-turn signal light-driver side		

No.	Connector face	No.	Connector face
E1 Gray	 Oil pressure switch	E9 Gray	 T.D.C sensor
E2 (C24SE)	 Magnetic clutch	E10 Silver	 Engine ground
E3 Black	 Magnetic clutch AC COMP	E11 Natural green	 Neutral switch
E4 Green	 Generator	E12 Natural green	 Neutral switch
E5	 TPS EGR	E13 Gray	 Injector nozzle 1
E6 (C24SE)	 Fuel injector (C24SE)	E14 Gray	 Injector nozzle 2
E6	 Injector pump	E15 Gray	 Injector nozzle 3
E7 (C24SE)	 Fuel injector (C24SE)	E16 Gray	 Injector nozzle 4
E8 (C24SE)	 Fuel injector (C24SE)	E17 Silver	 Generator (B)
E9 (C24SE)	 Fuel injector (C24SE)	E18 (C24SE)	 Ignition coil

No.	Connector face	No.	Connector face
E19 Blue	 Thermo meter unit	E35 Black	 Motor actuator
E20 ~ E21	**NOT USED**	E36	 TACHO sensor
E22 Brown	 TPS 1 main	E37	 Fuel cut solenoid
E23 Gray	 TPS 2 main	E38 Black	 Intake throttle DC motor position
E24 ~ E26	**NOT USED**	E39 Black	 Camshaft position (CAM) sensor
E27 Gray	 Fuel temp sensor	E40 Black	 Barometric sensor
E28 ~ E29	**NOT USED**	E41 (4JH1-TC) Black	 Water temperature sensor
E30 Gray	 A/T speed sensor	E41 (4JJ1-TC) Black	 Engine coolant temperature sensor
E31 Gray	 Turbine sensor	E42 Natural green	 Backup light switch
E32 ~ E34	**NOT USED**	E43 Natural green	 Backup light switch

No.	Connector face	No.	Connector face
E44 Black	 Vehicle speed sensor	E53	NOT USED
E45 Gray	 2WD-4WD switch	E54	 A/T term ASM (AW30-40LE)
E46 Brown	 H-L neutral switch	E54 Black	 A/T term ASM (JR405E)
E47 Black	 MAF & IAT sensor	E55 ~ E58	NOT USED
E48 Black	 Fuel rail pressure sensor	E59 (C24SE)	 Crank position sensor (C24SE)
E49 Silver	 Glow plug	E60 (C24SE)	 ECM
E50 Gray	 Suction control valve (SVC)	E61 ~ E63	NOT USED
E51 Gray	 Inhibiter switch (AW30-40LE)	E64 (C24SE)	 Oil pressure switch (P/STRG)
E51 Black	 Inhibitor switch (JR405E)	E65 (C24SE)	 Thermo unit
E52 Black	 Crankshaft position (CKP) sensor	E66 (C24SE)	 Duty solenoid



Preload Adjustment

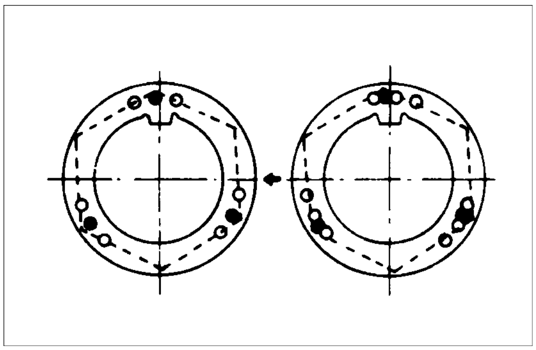
Tighten the hub nut at 29.4 N·m (3 kgf·m / 21.7 lb·ft), then loosen the nut to the full.

Tighten the hub nut at the value given below, using a spring scale on the wheel pin.

Bearing Preload N (kgf/lb)

New bearing and New oil seal	22 - 27 (2.2 - 2.8 / 4.9 - 6.2)
Used bearing and New oil seal	14 - 20 (1.4 - 2.0 / 3.1 - 4.5)

If the measured bearing preload is outside the specifications, adjust it by loosening or tightening the bearing nut.



9. Lock Washer

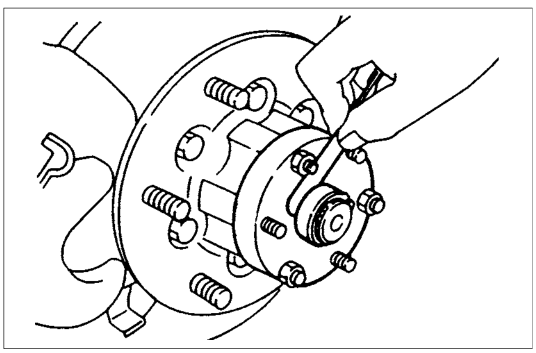
Turn the side with larger diameter of the tapered bore to the vehicle outer side, and attach the washer.

If the bolt holes in the lock plate are not aligned with the corresponding holes in the nut, reverse the lock plate.

If the bolt holes are still out of alignment, turn in the nut just enough to obtain alignment,. Screw is to be fastened tightly so its head may come lower than the surface of the washer.

10.Flange (4×4 model only)

Apply adhesive (LOCTITE 515 or equivalent) to both joining flange faces then install hub flange.

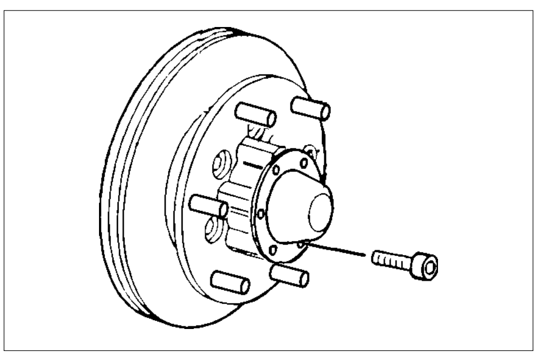


11.Snap ring, shims (4×4 model only)

Adjust the clearance between the flange and the snap ring.

Clearance	mm(in)
0 - 0.2 (0 - 0.008)	

Adjust shims available	mm(in)
0.2, 0.3, 0.5, 1.0 (0.008, 0.012, 0.020, 0.039)	

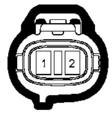
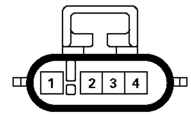
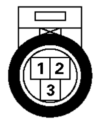
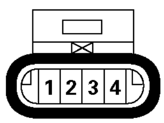
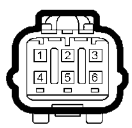
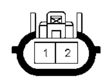
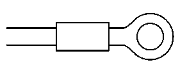
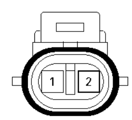
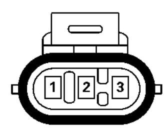
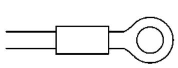
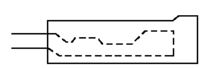
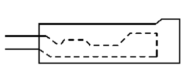
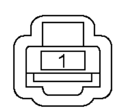
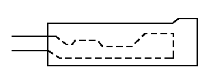


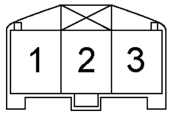
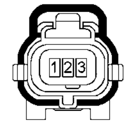
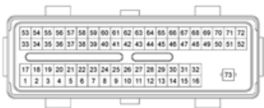
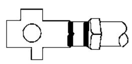
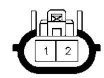
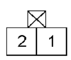
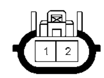
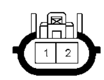
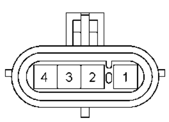
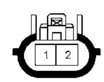
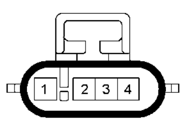
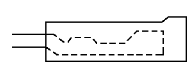
RTW440SH000901

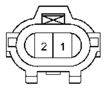
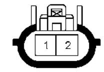
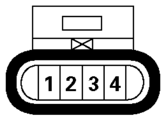
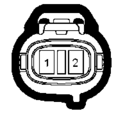
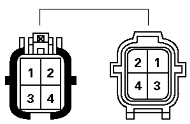
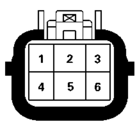
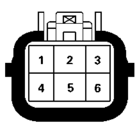
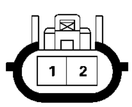
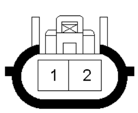
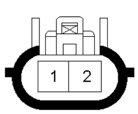
13.Bolt

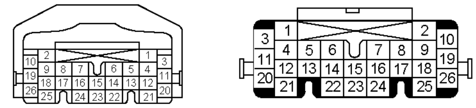
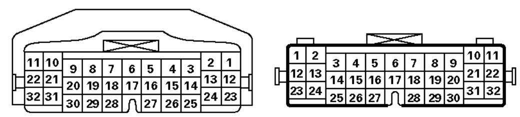
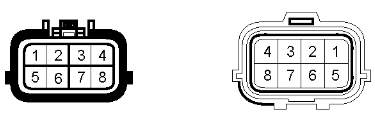
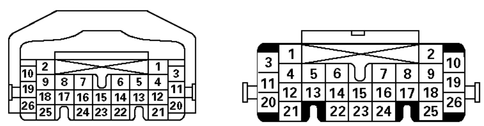
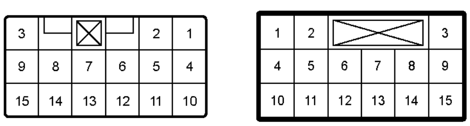
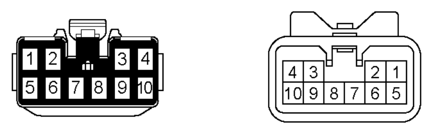
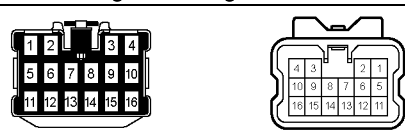
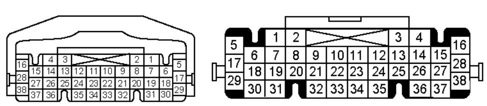
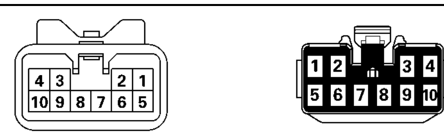
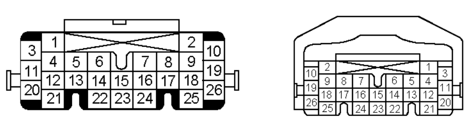
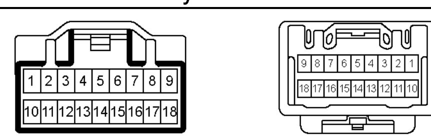
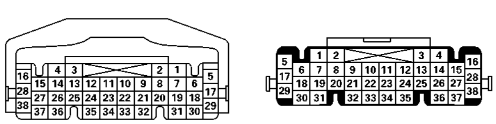
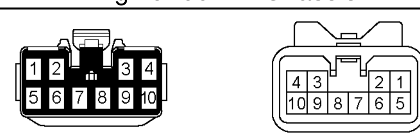
Torque	N·m (kgf·m/lb·ft)
59 (6.0 / 43)	

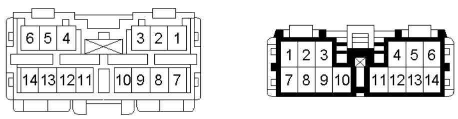
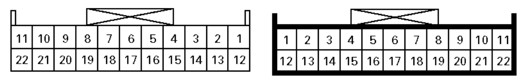
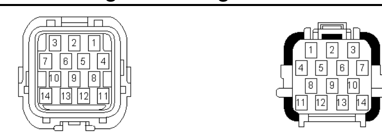
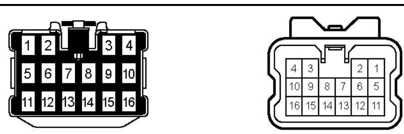
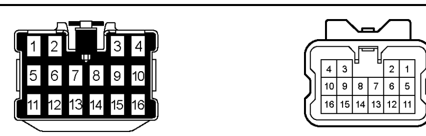
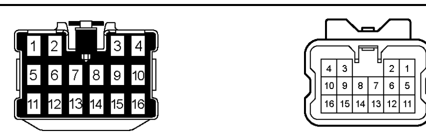
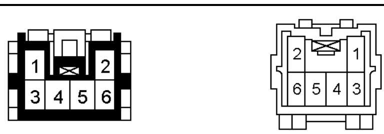
- Refer to SECTION 3E “WHEELS AND TIRES” for wheel install procedure.

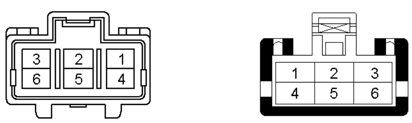
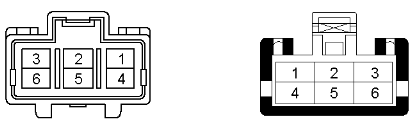
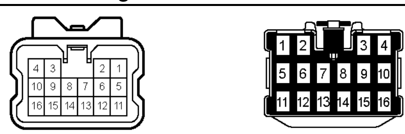
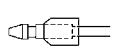
No.	Connector face	No.	Connector face
E67 Blue	 Swirl control solenoid valve	E77 (C24SE)	 O_2 sensor
E68 (C24SE)	 Throttle position sensor	E78 ~ E80	**NOT USED**
E69	**NOT USED**	E81	 Speed sensor
E70 (C24SE)	 IACV	E82	**NOT USED**
E71 Gray	 EGR brush DC motor position	E83 Gray	 A/T fluid temperature sensor
E72 (C24SE)	 Engine earth-A	E84 (C24SE)	 Knock sensor
E73	**NOT USED**	E85 (C24SE)	 MAP sensor
E74 (C24SE)	 Engine earth-B	E86 Silver	 Thermo switch: QOS
E75 (C24SE)	 Oil pressure switch	E87 White	 Solenoid CSD
E76	**NOT USED**	E88 Silver	 Thermo switch: EGR

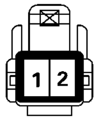
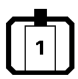
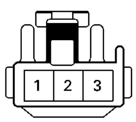
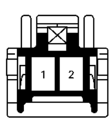
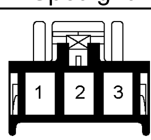
No.	Connector face	No.	Connector face
E89 White	 Immobilizer engine control unit	E107	 MAP sensor
E90 Black	 ECM J1	E108 Blue	 Cylinder revolution
E92 Silver	 Fuse & relay box	E109 Blue	 SPGA
E94 ~ E95	**NOT USED**	E110 Brown	 Backup light switch
E96 Black	 Reverse switch	E111 Brown	 Neutral switch
E97 ~ E98	**NOT USED**	E112 Gray	 1st switch
E99 Black	 O_2 sensor-RH	E113 Gray	 Clutch sleave cylinder
E100 Black	 O_2 sensor-LH	E114 ~ E115	**NOT USED**
E101 ~ E105	**NOT USED**	E116	 000-013 Backup light switch
E106	 EVRV: Turbo		

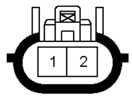
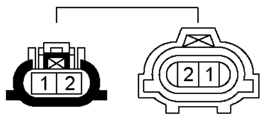
No.	Connector face	No.	Connector face
F1 Gray	 Fuel filter switch	F12 Black	 Fuel clogging switch
F2 Black	 Fuel pump sensor	F13 Brown	 Fuel filter switch
F3	**NOT USED**		
F4 Gray	 Rear ABS speed sensor		
F5 Gray	 Rear combination light-RH		
F6 Black	 Rear combination light-LH		
F7 White	 License plate light		
F8 Black	 Rear fog light – RH		
F9 Black	 Rear fog light - LH		
F10 ~ F11	**NOT USED**		

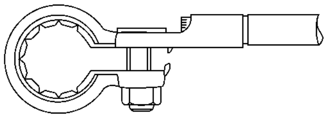
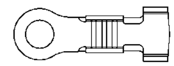
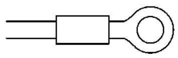
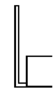
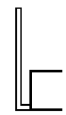
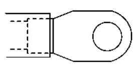
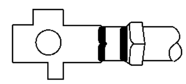
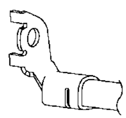
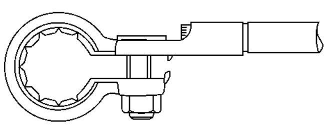
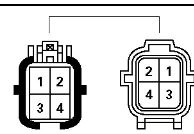
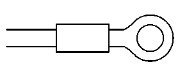
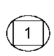
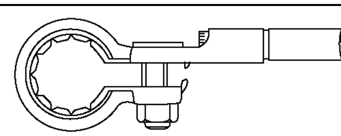
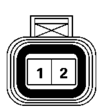
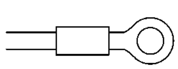
No.	Connector face	No.	Connector face
H1 White	 Battery (+) ~ Engine room	H7 White	 Engine room ~ INST
H2	**NOT USED**	H7 (4JJ1-TC) White	 Engine room ~ INST
H3 (HFV6 4JH1-TC) Gray	 Battery (+) ~ Engine room	H8	**NOT USED**
H3 (4JA1T- (L))	 Battery (+) ~ Engine room	H9 White	 Engine room ~ Chassis
H4 (HFV6) (C24SE) White	 Engine room ~ Mission	H10 ~ H11	**NOT USED**
H4 (4JH1-TC) White	 Engine ~ Engine room	H12 White	 INST ~ Roof
H4 (4JJ1-TC) White	 Engine ~ Engine room	H13	**NOT USED**
H5 (HFV6 4JH1-TC) White	 Engine room ~ Mission	H14 White	 Rear body ~ Rear door-LH
H5 (4JJ1-TC 4JA1T-(L)) White	 Engine ~ Engine room	H15 (HFV6 4JH1-TC) Black	 Engine room ~ Chassis
H6 White	 Engine room ~ INST	H15 (4JJ1-TC, 4JA1T-(L)) Black	 Engine room ~ Chassis

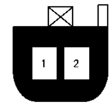
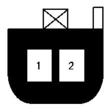
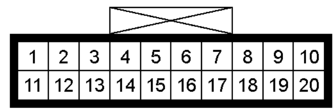
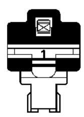
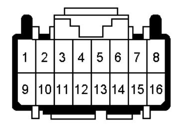
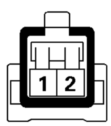
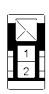
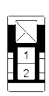
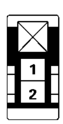
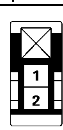
No.	Connector face	No.	Connector face
H16 White	 Rear body ~ Rear door-RH	H29 (C24SE)	 Battery (+) ~ Engine room
H17 Gray	 Chassis ~ License plate light	H30	**NOT USED**
H18 White	 Engine room ~ INST	H31 (C24SE)	 Engine room ~ Mission
H19 ~ H22	**NOT USED**	H32 (C24SE)	 Engine room ~ Rear body
H23 White	 Engine ~ Engine room B	H33 White	 Engine ~ Engine room
H23 (4JA1T-(L)) White	 Engine room B ~ T/misson	H34 Black	 Engine ~ Engine room
H24 ~ H25	**NOT USED**	H35 Gray	 Trailer hitch
H26 Black	 INST ~ Rear body	H36 White	 INST ~ Front door-RH
H27	**NOT USED**	H37 White	 INST ~ Front door-LH
H28 White	 Sub harness connector	H38 White	 INST ~ Front door-RH

No.	Connector face	No.	Connector face
H39 White	 INST ~ Front door-LH		
H40 White	 INST ~ Door-RH		
H41 ~ H43	**NOT USED**		
H44 White	 INST ~ Theft dtrnt WRG		
H45 White	 Engine room ~ INST		
H47 White	 Engine room ~ INST		
H48 White	 Engine room ~ INST		
H49 Gray	 Engine room ~ Chassis		
H50	 Engine & Mission ~		

No.	Connector face	No.	Connector face
L1 White	 Dome light		
L2	**NOT USED**		
L3	**NOT USED**		
L4 Black	 Rear defogger driver side		
L5 White	 High mounted stoplight		
L6	**NOT USED**		
L7 Black	 Rear defogger passenger side		
L8	**NOT USED**		
L9 Gray	 Spotlight		
L9 Light Gray	 Map light		

No.	Connector face	No.	Connector face
M26 (C24SE) Brown	 002-006 2WD-4WD switch		
M27 (C24SE) Brown	 002-041 Headlight leveling neutral switch		

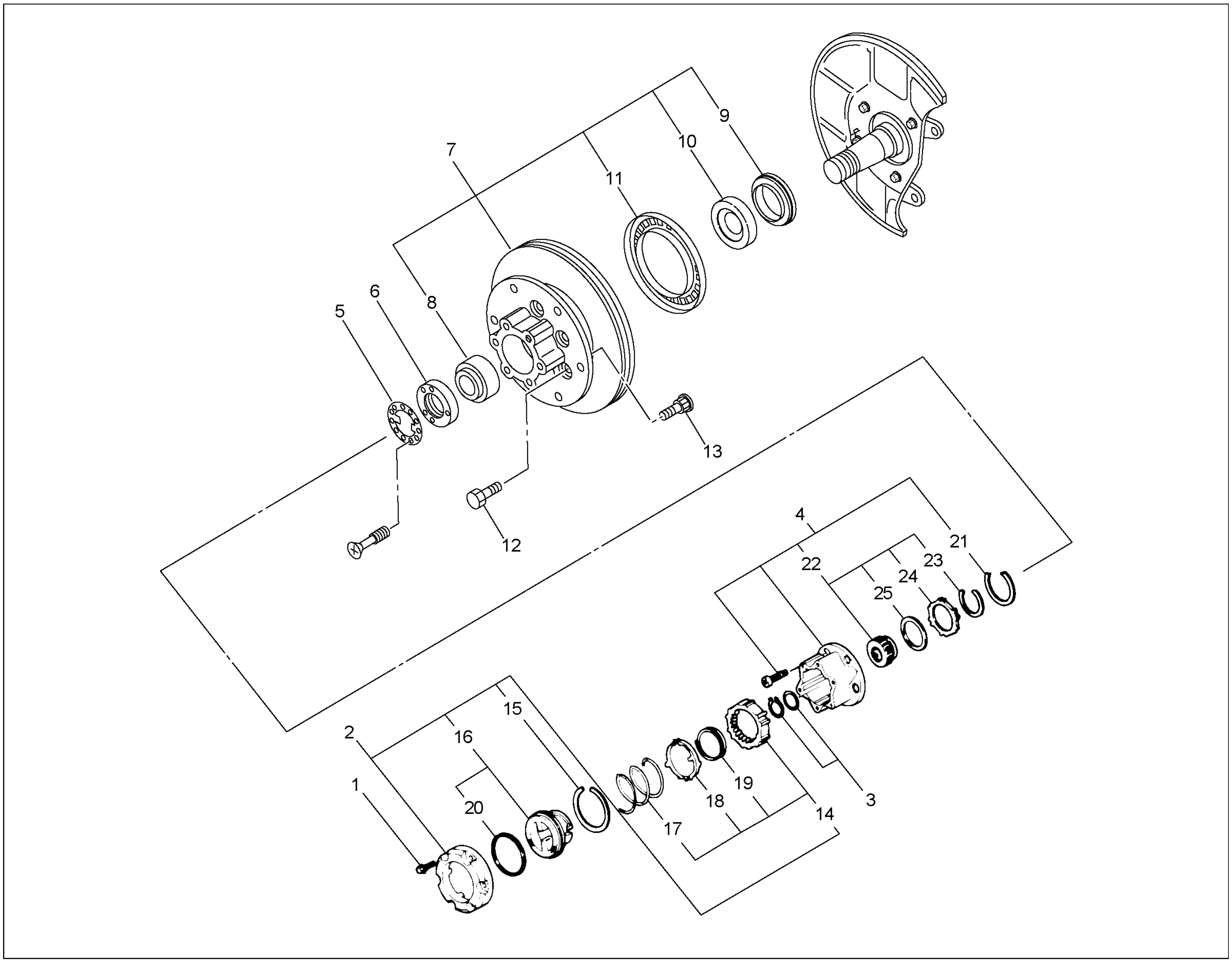
No.	Connector face	No.	Connector face
P1 Silver	 Battery (+)	P9 (4JA1T-(L)) Silver	 ACG (B)
P2 Silver	 Relay & Fuse box	P9 (4JH1-TC) Silver	 ACG (B)
P3 Black	 Starter (S)	P10 Silver	 Engine ground
P4 (HFV6) Silver	 Starter (B)	P11 Silver	 Fuse & relay box
P4 Silver	 Starter (B)	P12	**NOT USED**
P5 Silver	 Battery (-)	P13 Gray	 Shift on the fly actuator
P6 Silver	 Body earth (Ground)	P14	**NOT USED**
P7	 Battery (ALT)	P15 Silver	 2nd battery (+)
P8 Green	 ACG (L)		
P9 (HFV6) Silver	 ACG (B)		

No.	Connector face	No.	Connector face
R1 Black	 Front door switch-LH	R11 Gray	 Seat belt switch
R2	**NOT USED**	R12 ~ R13	**NOT USED**
R3 Gray	 Seat belt switch	R14 Black	 020-029 2WD – 4WD control unit
R4 White	 Parking brake switch (Lever type)	R15 Black	 016-034 2WD – 4WD control unit
R5	**NOT USED**		
R6 Black	 Front door switch-RH		
R7 White	 Rear speaker-LH		
R8 White	 Rear speaker-RH		
R9 Black	 Rear speaker-LH		
R10 Black	 Rear speaker-RH		

FRONT HUB AND DISC
(4×4 Manual Locking Hub Model)

DISASSEMBLY

Refer to SECTION 3E “WHEELS AND TIRES” for wheel removal procedure

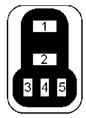
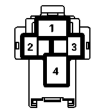
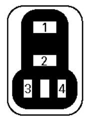
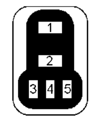
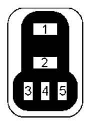
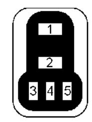
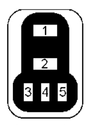
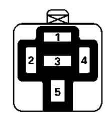
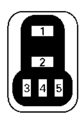
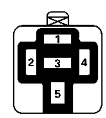
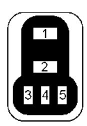
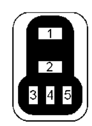
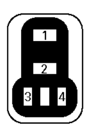
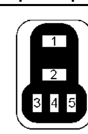
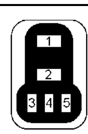
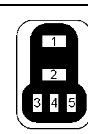
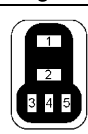
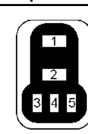
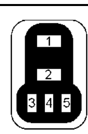
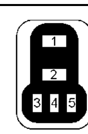


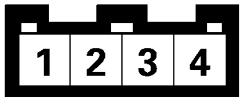
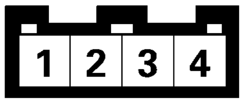
RTW440LF000301

Disassembly Steps

- ▲ 1. Bolt
- 2. Cover assembly
- 3. Snap ring and shim
- 4. Body assembly
- 5. Lock washer
- ▲ 6. Hub nut
- ▲ 7. Hub and disc assembly
- 8. Outer bearing
- 9. Oil seal
- 10. Inner bearing
- 11. ABS sensor rotor
- ▲ 12. Bolt
- ▲ 13. Wheel pin
- ▲ 14. Clutch assembly
- 15. Snap ring
- 16. Knob
- 17. Compression spring
- 18. Follower
- ▲ 19. Retaining spring
- 20. X-ring
- 21. Snap ring
- 22. Inner assembly
- 23. Snap ring
- 24. Ring
- 25. Spacer

No.	Connector face	No.	Connector face
T1	**NOT USED**		
T2	**NOT USED**		
T3 Gray	 License plate light-LH		
T4 Gray	 License plate light-RH		

No.	Connector face	No.	Connector face
X1 Black	 Fog light relay	X8 Black	 Starter relay
X2 (C24SE) Black	 Front fog light relay	X9 Black	 Condenser fan relay
X2 Black	 Taillight relay	X10 Black	 Transmission relay
X3 Black	 Horn relay	X11 Black	 Heater relay
X4 Black	 Dimmer relay	X12 Black	 ECM main relay
X5 Black	 Glow relay	X13 Black	 Fuel pump relay
X6 (C24SE)	 Starter relay	X13 (4JA1T- (L)) Black	 Condenser fan relay
X6 Black	 Headlight relay	X14 Black	 A/C compressor relay
X7 Black	 Starter cut relay	X14 (4JA1T- (L)) Black	 Starter cut relay
X7 (4JA1T- (L)) Black	 CSD relay	X15 Black	 Thermo relay

No.	Connector face	No.	Connector face
X16 Black	 DIODE		
X17 Black	 DIODE		

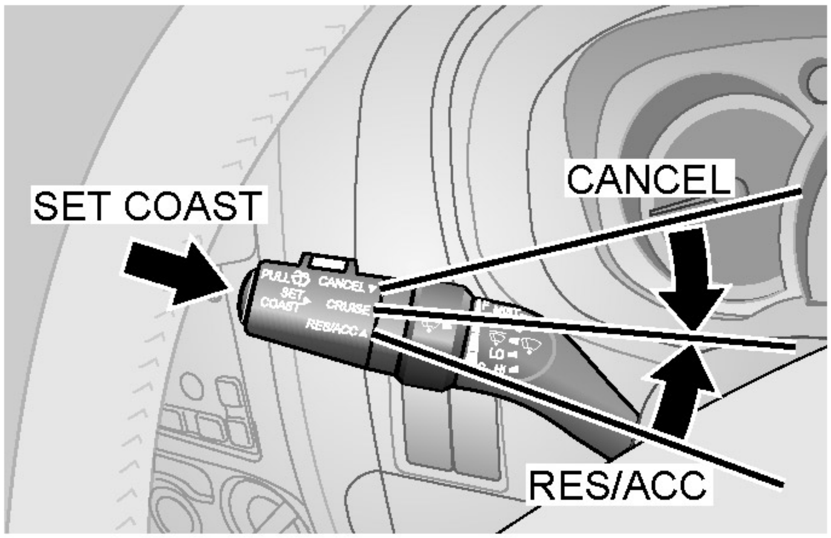
SECTION 8B

CRUISE CONTROL SYSTEM

TABLE OF CONTENTS

General Description

The cruise control keeps the vehicle running at a fixed speed until a signal canceling this fixed speed is received. When the main switch “AUTO CRUISE” is turned on with the vehicle in the running mode, the battery voltage is applied to the control unit (Engine control module). When a signal from the control unit while the vehicle is in this state, the cruise control actuator is activated to operate the system. Also, while the system is operating, the cruise control set indicator light in the meter assembly lights up.



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1. SET/COAST Switch Function

1. **Set Function:** When the SET/COAST switch is pressed and released with the main switch on, the speed at which the vehicle is running at that moment is stored in the memory, and the vehicle automatically runs at the stored speed.
2. **COAST-down Function:** When the SET/COAST switch is kept on while the vehicle in running, the vehicle decelerates during that time. The speed at which vehicle is running when the control switch is pressed in the memory, and the vehicle automatically returns to the stored speed.
3. **Tap-down Function:** When the SET/COAST switch is pressed and released instantaneously while the vehicle is running, the vehicle decelerates a mile for each on/off operation. The vehicle speed at which the vehicle was running when the SET/COAST was released last is stored in the memory, and the vehicle automatically returns to this stored speed.

2. RESUME/ACCEL Switch Function

1. **Resume Function:** When the RESUME/ACCEL switch is turned on/off after the system is temporarily deactivated by pressing the brake or clutch pedal while the vehicle is running, the vehicle resumes the speed stored before the system was released, and the vehicle automatically runs at the stored speed.
2. **Accelerate Function:** When the RESUME/ACCEL switch is kept on the vehicle accelerates its speed during that time. The vehicle speed at which the vehicle was running when the switch was turned off is stored in the memory, and the vehicle automatically returns to this speed.
3. **Tap-up Function:** When the RESUME/ACCEL switch is turned on and off instantaneously while the vehicle is running, the vehicle decelerates a mile for each on/off operation. The vehicle speed at which the vehicle was running when the switch was turned off last is stored in the memory, and the vehicle automatically returns to this stored speed.

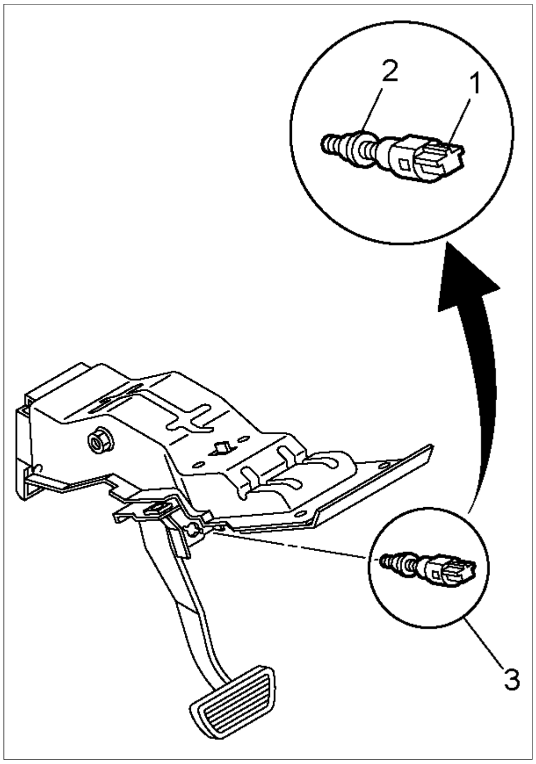
3. CANCEL Function

1. Temporary Cancellation:
   - Brake pedal is pressed.
   - Clutch pedal is pressed. (M/T)
   - Select lever is shifted to any position other than “D”, “3”, “2” or “L”. (A/T)
   - Cancel switch is operated.
   - Vehicle speed exceeds about 20 km/h over the vehicle speed stored in the memory.

Turning the RESUME/ACCEL switch will return the vehicle to the speed stored in the cruise control memory.

2. Complete Cancellation:
   - Starter switch or the main switch is turned off.
   - Fail-safe function is activated.
   - Vehicle speed is about 38 km/h.
   - Speed becomes 20 km/h or less form the speed memorized by control unit.

Brake Switch



RTW3A0MH000101

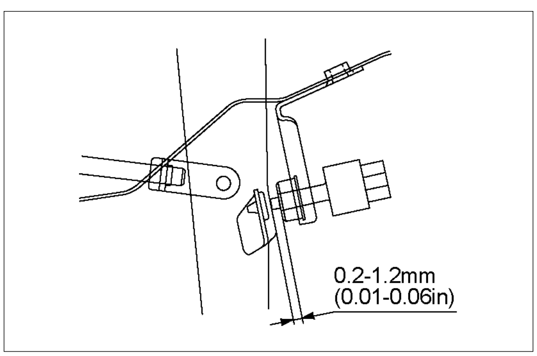
Removal

1. Disconnect the battery ground cable.
2. Remove the brake switch.
   - Disconnect the connector ①.
   - Loosen lock nuts of the switch ②.
   - Remove the switch by turning it ③.

Installation

To install, follow the removal procedure in reverse order, noting the following points.

1. Check to see if the brake pedal has been returned by the return spring to the specified position.
2. Turn the switch clock-wise until the tip of the threaded portion of the brake switch contacts the pedal arm.
3. Turn the switch counter-clock-wise until the space between the tip of the threaded portion and the pedal arm is 0.2 to 1.2 mm (0.01-0.06 in) as shown in the figure.



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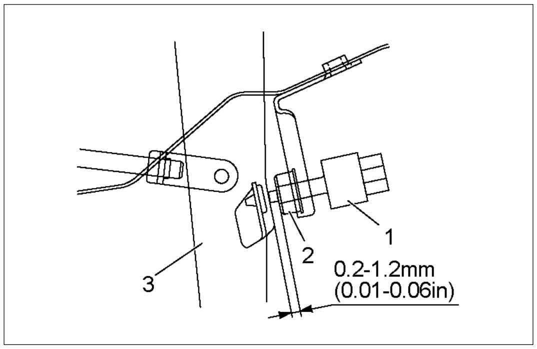
Adjustment



RTW780SH003301

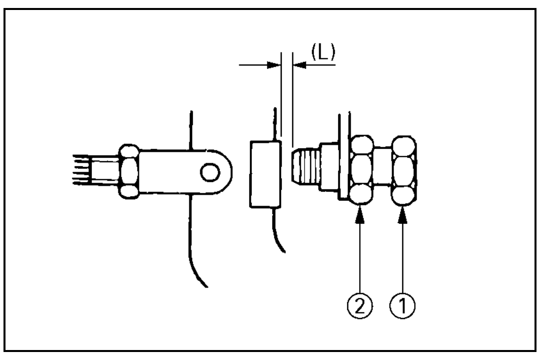
1. Check to be sure that the brake pedal has been completely returned by the return spring.
2. Disconnect the switch connector.
3. Release the lock ② by turning the switch ① counter-clockwise.
4. After doing so, pull the pedal arm ③ to you a little so that the pedal arm is not pushed in.
5. Making the pedal arm not movable with one hand, push in the whole switch with the other hand until the plunger of the switch is pushed in and the switch itself hits the rubber of the pedal arm.
   In the condition, turn the switch clock-wise until "click" sound is made and lock it.
   By doing this, the switch is adjusted at 0.2 to 1.2mm (0.01-0.06 in) clearance.

Clutch Switch

Removal and Installation

Refer to the Clutch Control removal and installation procedure in Clutch section.

Adjustment



1. Turn the clutch switch or stopper bolt ① until the switch bolt or stopper bolt just touches the clutch pedal arm.
2. Adjust clutch switch or stopper bolt by backing it out half a turn, and measure the clearance (L) between the clutch pedal arm and the clutch switch bolt end or stopper bolt.
3. Lock the lock nut ②.
4. Connect the clutch switch connector.

Clutch switch and clutch pedal clearance

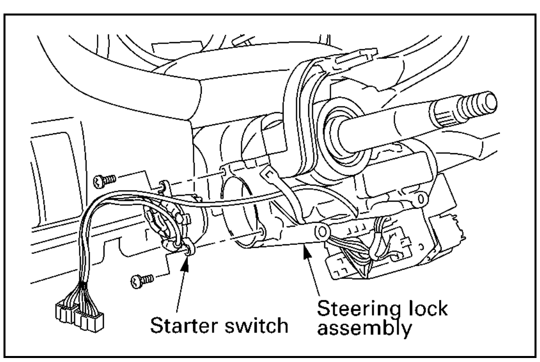
mm (in)

Clearance	0.5-1.5 (0.020-0.059)

Starter Switch

Removal and Installation

Refer to the Starter Switch removal and installation procedure of Start and Charging in Body and Chassis section.

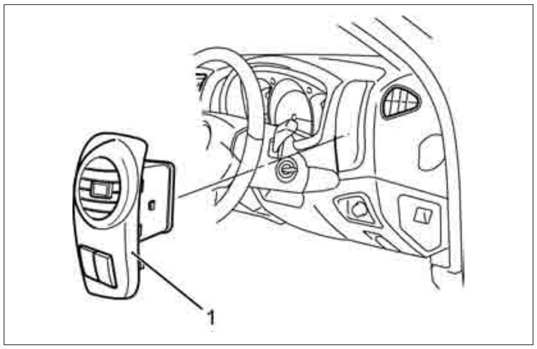


431R300001

Cruise Control Main Switch

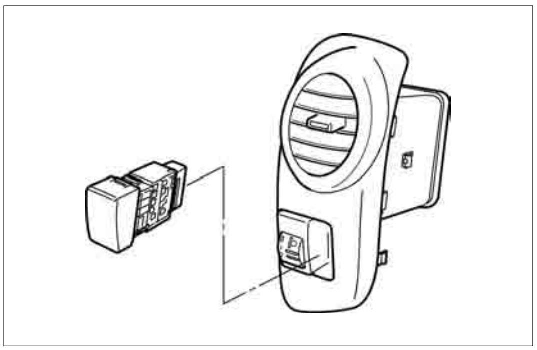
Removal

1. Disconnect the battery ground cable.
2. Remove the side ventilation grille ①.



RTW78ASH001801

3. Disconnect the switch connector and push the lock from the backside of the side ventilation grille to remove the cruise control main switch.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Installation

To install, follow the removal procedure in reverse order, noting the following point.

1. Push in the switch with your fingers until it locks securely.

Cruise Control Switch (Combination Switch)

Removal and Installation

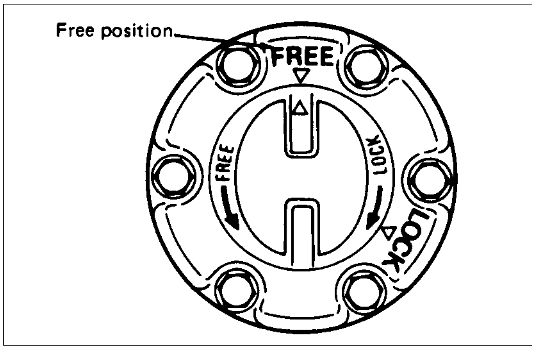
Refer to the Lighting Switch (Combination Switch) removal and installation procedure of Lighting in Body and Chassis section.

SECTION 8C

Cruise Control – HFV6

ATTENTION

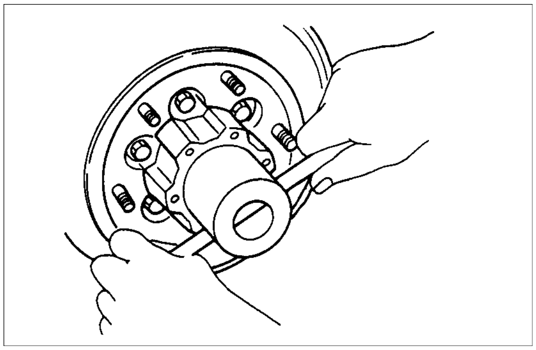
Before performing any Service Operation or other procedure described in this Section, refer to General Information Warnings, Cautions and Notes for correct workshop practices with regard to safety and/or property damage.



Important Operations

1. Bolt

Before removal, shift transfer lever into "2H" position and set free wheeling hub knob into "FREE" position.



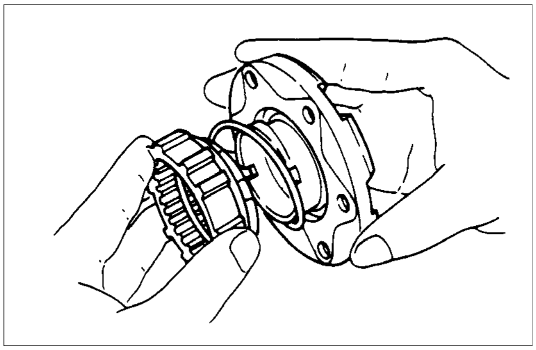
6. Hub nut

Wrench : 5-8840-2117-0

7. Hub and disc assembly

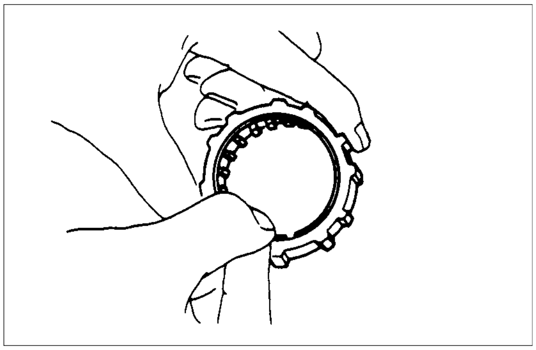
Before disassembly, remove the disc brake caliper assembly and hang it on the frame with wires.

Refer to Section "Brake" for disc brake caliper removal procedure.



14.Clutch Assembly

While pushing follower knob, turn clutch assembly clockwise and then remove clutch assembly from knob.



19.Retaining Spring

Remove retaining spring from clutch assembly by turning it counterclockwise.

1 General Information

A new cruise control system has been introduced due to changes in the powertrain architecture and components. There is no longer a cruise control module; instead the management has been taken over by the engine control module (ECM).

To the user, the system operates as previously, with all controls from the cruise control switch assembly and the cruise control messages presented by the instrument cluster. For vehicles fitted with the HFV6 engine refer to 1.3 System Operation .

CAUTION

The cruise control system now has an additional fail-safe feature. The brake pedal must be pressed in the ignition cycle for the cruise control to be engaged. The cruise control will not engage until this is done.

1.1 WARNINGS, CAUTIONS and NOTES

This Section contains various WARNINGS, CAUTIONS and NOTE statements that you must observe carefully to reduce the risk of death or injury during service, repair procedures or vehicle operation. Incorrect service or repair procedures may damage the vehicle or cause operational faults. WARNINGS, CAUTION and NOTE statements are not exhaustive. GM HOLDEN LTD can not possibly warn of all the potentially hazardous consequences of failure to follow these instructions.

Definition of WARNING, CAUTION and NOTE Statements

Diagnosis and repair procedures in this Section contain both general and specific WARNING, CAUTION and NOTE statements. GM HOLDEN LTD is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for proper operation of the vehicle. Certain procedures may present a hazard to the technician if they are not followed in the recommended manner. WARNING, CAUTION and NOTE statements are designed to help prevent these hazards from occurring, but not all hazards can be foreseen.

WARNING Defined

A WARNING statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in death or injury. A WARNING statement alerts you to take necessary action or not to take a prohibited action. If a WARNING statement is ignored, the following consequences may occur:

- Death or injury to the technician or other personnel working on the vehicle,
- Death or injury to other people in or near the workplace area, and / or
- Death or injury to the driver / or passenger(s) of the vehicle or other people, if the vehicle has been improperly repaired.

CAUTION Defined

A CAUTION statement immediately precedes an operating procedure or maintenance practice which, if not correctly followed, could result in damage to or destruction of equipment, or corruption of data. If a CAUTION statement is ignored, the following consequences may occur:

- Damage to the vehicle,
- Unnecessary vehicle repairs or component replacement,
- Faulty operation or performance of any system or component being repaired,
- Damage to any system or components which depend on the proper operation of the system or component being repaired,
- Faulty operation or performance of any systems or components which depend on the proper operation or performance of the system or component under repair,
- Damage to fasteners, basic tools or special tools and / or
- Leakage of coolant, lubricant or other vital fluids.

NOTE Defined

A NOTE statement immediately precedes or follows an operating procedure, maintenance practice or condition that requires highlighting. A NOTE statement also emphasises necessary characteristics of a diagnostic or repair procedure. A NOTE statement is designed to:

- Clarify a procedure,
- Present additional information for accomplishing a procedure,
- Give insight into the reasons for performing a procedure in the recommended manner, and / or
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease.

1.2 System Components

The main components of the electronic cruise control system are:

- cruise control ON / OFF switch (in dash panel).
- cruise control switch assembly (incorporated into wiper and washer switch assembly),
- instrument cluster assembly (cruise set lamp),
- clutch pedal switch assembly (manual transmission vehicles only),
- stop lamp switch assembly,
- powertrain interface module (PIM),
- engine control module (ECM),
- throttle actuator control (TAC) assembly, and
- electrical wiring (incorporated into the main wiring harness).

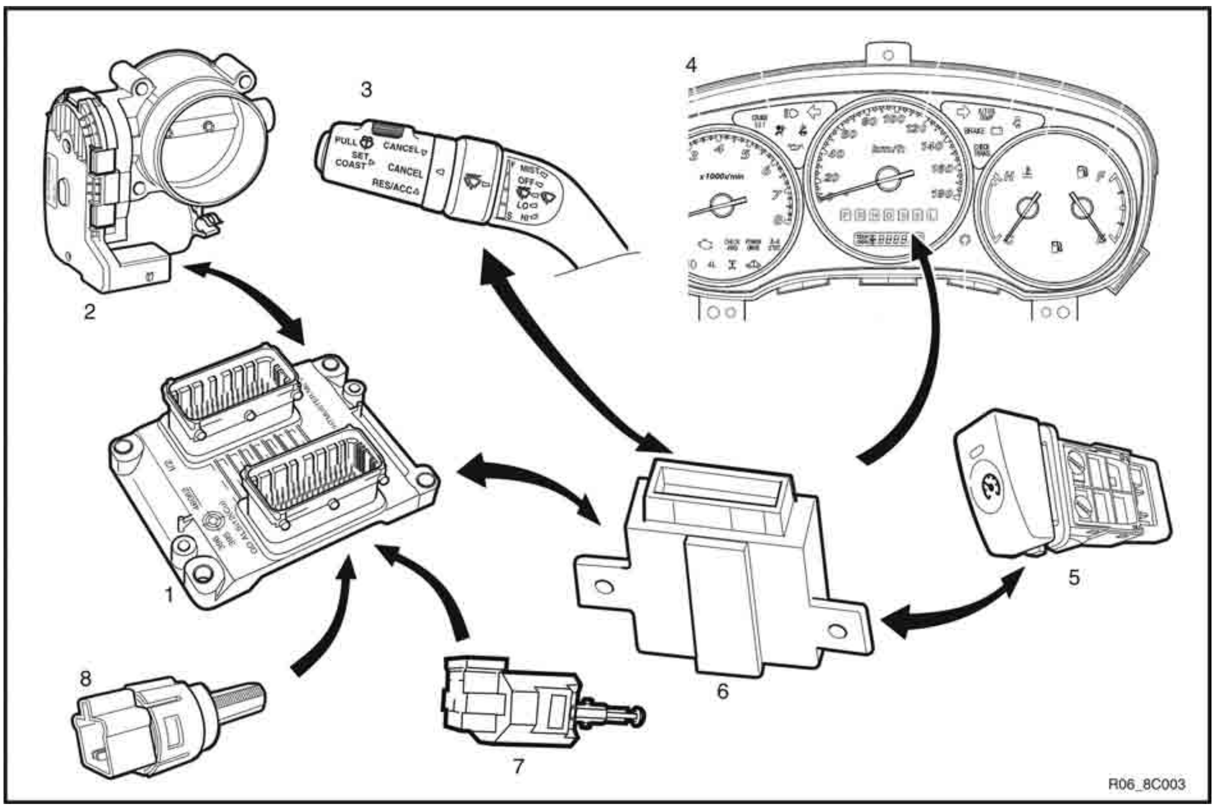


Figure 8C – 1

Legend

1	Engine Control Module	5	Cruise Control ON / OFF Switch
2	Throttle Actuator Control (TAC) Assembly	6	Powertrain Interface Module
3	Cruise Control Switch Assembly	7	Clutch Pedal Switch Assembly (Manual Only)
4	Instrument Cluster Assembly	8	Stop Lamp Switch Assembly

Cruise Control Switch Assembly

The cruise control switch assembly is located on the end of the wiper and washer switch assembly.

- For harness routing from the cruise control switch assembly to the powertrain interface module, refer to 8A Electrical – Body and Chassis.
- For wiring and to see how the switch integrates into the system, refer to 2.3 Wiring Diagrams.

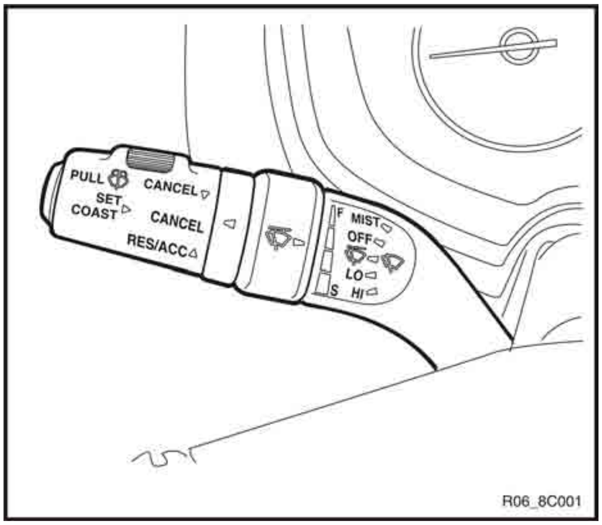


Figure 8C – 2

Instrument Cluster Assembly

The instrument cluster assembly displays the status of the cruise control system as well as other information via the warning indicators.

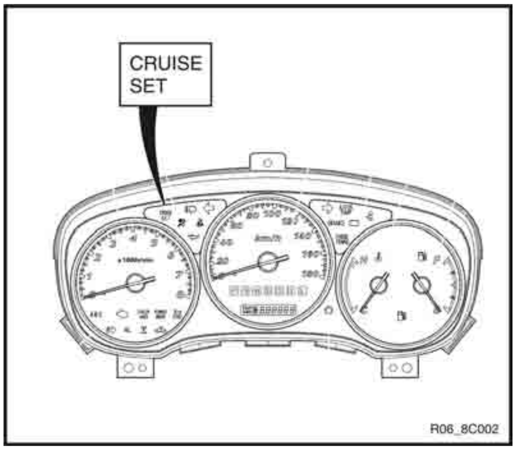


Figure 8C – 3

Clutch Pedal Switch (Manual Only)

This switch assembly is attached to the clutch pedal support bracket. The switch is normally closed when the clutch pedal is at rest, opening when the pedal is pressed. Activation of this switch removes the signal to the ECM, which will then deactivate the cruise control.

Stop Lamp Switch Assembly

The stop lamp switch assembly is located on the brake pedal support bracket. This switch has two sets of contacts with two independent functions. The function of the switch assembly in the cruise control system is to deactivate the cruise control when the brake pedal is pressed as well as an initial safety check of the switch operation prior to activating cruise control.

The stop lamp switch contacts are normally open with the brake pedal at rest and close when the brake pedal is pressed turning on the vehicles brake lamps. These switch contacts also double as the cruise cancel signal for the cruise control operation.

The cruise control initial brake apply signal function switch contacts are normally closed with the brake pedal at rest and open when the brake pedal is pressed. This switch function is a safety requirement of the vehicle as it ensures that the cruise control cannot be activated without the brake pedal first being pressed.

Powertrain Interface Module

The Powertrain Interface Module (PIM) is located on the driver's side, kick trim panel. The purpose of the PIM is to act as an interface between the drivetrain serial data bus (GMLAN protocol) and the body side data bus (UART Bus protocol). All inputs from the cruise control switch assembly are directly wired to the PIM. The PIM then takes these inputs, converts them to GMLAN protocol and sends the messages via the data bus to the engine control module (ECM). The PIM also receives signals for the cruise control system from the ECM. When the ECM activates cruise control, it sends a signal through the PIM (which converts it from GMLAN to UART protocol) to display the various cruise control messages on the instrument cluster assembly.

For further information on the operation of the PIM, refer to 6E1 Powertrain Interface Module – V6.

Engine Control Module

The Engine Control Module (ECM) is mounted on the front of the engine. The role of the ECM is to receive all the inputs from various sensors (vehicle speed (VSS) etc.) and switches to manage the engine. When a request is sent from the cruise control switch assembly via the PIM to the ECM, the ECM will activate cruise control providing given parameters are satisfied. Once the cruise is set, the ECM monitors the vehicle speed and controls the throttle actuator assembly thus controlling the speed of the vehicle.

For further information on the operation of the ECM, refer to 6C1-1 Engine Management – V6 – General Information.

Throttle Actuator Control (TAC) Assembly

The throttle actuator control assembly is located on the front of the inlet manifold. The throttle actuator control assembly receives signals from the ECM and controls the angle of the throttle plate. Refer to 6C1-1 Engine Management – V6 – General Information for further information.

1.3 System Operation

Preliminary Information

Enabled and Disabled

The cruise control is enabled / disabled by pressing the cruise control ON–OFF switch mounted on the lower right hand side of the dash panel. When cruise control is enabled, the cruise control ON–OFF switch illuminates and the cruise control is ready for a speed to be set (cruise control activated). When the cruise control is disabled, the cruise control cannot be activated.

Cruise Enabled

1. The cruise control ON–OFF switch (1) supplies 12 Volts to the Powertrain Interface Module (PIM) when it is pressed.
2. The cruise control ON–OFF switch lamp (2) turns on.

Cruise Disabled

1. When cruise control ON–OFF switch (1) is pressed again, power is removed from the PIM disabling the cruise control.
2. The cruise control ON–OFF switch lamp (2) turns off.

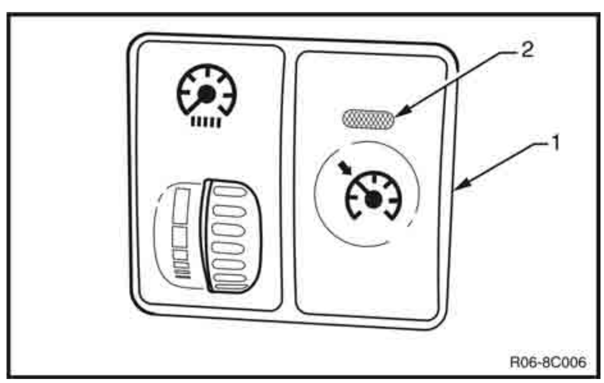


Figure 8C – 4

Activated and Deactivated

When the cruise control is enabled, the vehicle speed must be above 40 km/h and the cruise control switch assembly pressed to SET–COAST, the cruise control will be activated and the vehicle will maintain the set speed. When deactivated by the methods described within this section, the vehicle will no longer maintain the set speed, but the cruise control will still be engaged.

Cruise Active

When the cruise control is activated via the cruise control switch assembly, the cruise set warning lamp will illuminate the instrument cluster assembly.

Cruise Deactivated

Upon receiving a signal to deactivate the cruise control the ECM will provide a signal to the instrument cluster, via the PIM, to inform the user the cruise control is deactivated.

When the cruise control is deactivated via the cruise control switch assembly, the brake pedal, or the clutch pedal, the cruise set warning lamp will turn OFF within the instrument cluster assembly.

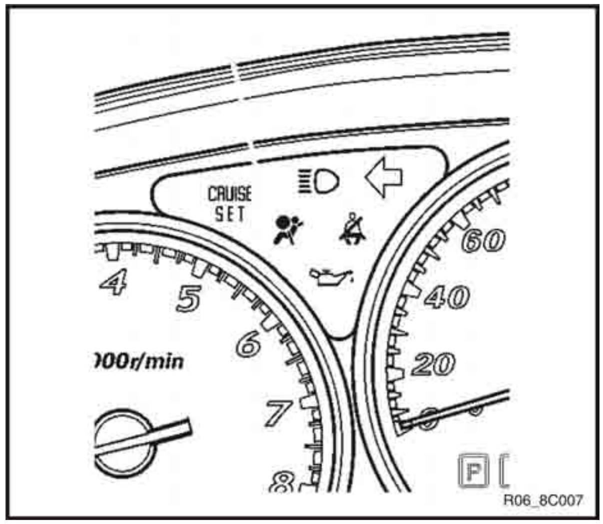


Figure 8C – 5

Enabling the Cruise Control

Refer to 2.3 Wiring Diagrams for the following description.

When the cruise control ON-OFF button is pressed, 12 V is applied to the powertrain interface module (PIM) connector B – 97 pin 14. This informs the PIM the user has requested the cruise control function be engaged or disengaged. This signal is then output by the PIM as GM LAN protocol along the bus to the engine control module (ECM). The ECM recognises the command from the PIM to engage the cruise control. The PIM then provides a ground signal to B – 97 pin 13 the cruise control ON-OFF switch indicator lamp, to inform the user the cruise control is engaged.

Brake Before Cruise

Before the cruise control can be activated the driver must have applied the brakes and the system received a valid response at least once per ignition cycle. If the driver manages to drive the vehicle without having used the brakes before pressing the cruise control ON–OFF button, the cruise control cannot be activated.

Activating the Cruise Control

The user activates the cruise control at a desired speed above 40 km/h by pressing the cruise control switch assembly SET–COAST button. This provides a 12 V signal to the PIM through connector B – 97 pin 15. The PIM then outputs this signal as GM LAN protocol through the data bus to the ECM. If the ECM already has cruise control engaged, upon receipt of the message from the PIM, the ECM will activate cruise control and set the speed. The ECM receives all the various inputs required to maintain the correct speed and then controls the throttle actuator control assembly depending on the load on the engine (ascending or descending hills, etc).

Deactivating the Cruise Control

When the cruise control is activated, it can be deactivated by any of the following:

Pressing the Brake Pedal

When the brake pedal is pressed, two signals are sent directly to the ECM by the circuits from the brake pedal switch assembly. The cruise cancel circuit will open (normally closed) thus dropping the supply voltage from the ECM connector C – 56 pin 46. Simultaneously, the stop lamp circuit will close (normally open) and supply 12 V to the ECM at connector C – 56 pin 10. This is a double redundancy system so that if either switch or circuit from the brake pedal switch assembly fails, the cruise control will still be deactivated.

Pressing the Cruise ON–OFF Button

Pressing the cruise control switch assembly ON–OFF button will send a signal via the PIM to the ECM to deactivate the cruise control.

Rotating the Cruise Control Switch Assembly

Rotating the cruise control switch assembly to the CANCEL position will send a signal via the PIM to the ECM to deactivate the cruise control.

Pressing the Clutch Pedal (Manual Vehicles Only)

When the clutch pedal is pressed, the cruise control cancel circuit will open (normally closed) thus removing the supply voltage from the ECM connector C – 56 pin 53. The ECM then deactivates the cruise control.

Decelerating While Cruise Control is Activated

When the cruise control is activated, the speed can be reduced by pressing and holding the cruise control switch assembly to SET–COAST. When this is done, 12 V is applied to PIM connector B – 97 pin 15. The PIM will then translate the command to GM LAN protocol and sends the request to the ECM to reduce the speed. The ECM will then temporarily disable the cruise control and close the throttle plate. The vehicle should then start to decelerate. Once the operator releases the cruise control switch assembly, the ECM will receive this signal through the PIM and will then set the speed according to the current VSS and maintain that speed.

Resuming a Speed After Cruise Control Has Been Deactivated

If the cruise control system is engaged but deactivated, the last speed at which it was activated can be resumed. Turning the cruise control switch assembly to RES–ACC will apply 12 V to the PIM at connector B – 97 pin 16. The PIM will then translate the command to GM LAN protocol and transmit the request to the ECM. The ECM will then recall the last stored speed at which the cruise control was activated and increase or reduce engine RPM to maintain that speed.

Accelerating While Cruise Control is Activated

Using the Cruise Control Switch Assembly

When the cruise control is active, rotating the cruise control switch assembly to RES–ACC will accelerate the vehicle. The cruise control switch assembly will supply a 12 V signal to the PIM connector B – 97 pin 16, which is continuous as long as the switch is held. While the PIM is receiving the 12 V signal, it will continuously transmit to the ECM to accelerate the vehicle. The ECM will open the throttle plate to accelerate the vehicle. When the desired speed is achieved and the cruise control switch assembly is released, the ECM will maintain the vehicle at that speed.

Pressing the Accelerator Pedal

When the cruise control is active, pressing the accelerator pedal will accelerate the vehicle.

Once pressure is removed from the accelerator pedal, the vehicle will return to the last stored speed at which the cruise control was activated and control the throttle plate to maintain that speed.

2 Diagnostics

2.1 Diagnostic General Information

Basic Knowledge Required

CAUTION

A lack of basic understanding regarding electronics, electrical wiring circuits and use of electrical circuit testing tools when performing the cruise control diagnostic procedures could result in incorrect diagnostic results or damage to components.

A general understanding of basic electronics, electrical wiring circuits and the correct use of the basic electrical circuit testing tools is required to perform the diagnostic procedures detailed in this Section. Refer to 8A Electrical – Body and Chassis Wiring Diagrams for information on electrical circuits.

In addition, a general understanding of the cruise control and its component operation is essential to prevent misdiagnosis and component damage.

Basic Diagnostic Tools Required

CAUTION

Use of incorrect electrical circuit diagnostic tools when performing the cruise control diagnostic procedures could result in incorrect diagnostic results or damage to components.

The following electrical circuit testing tools are required to perform the diagnostic procedures detailed in this Section:

- test lamp,
- digital multimeter with 10 meg ohms impedance, and
- connector test adapter kit Tool No. KM609.

For further information on the use of these tools, refer to 8A Electrical – Body and Chassis Wiring Diagrams.

Tech 2 Data List

The Tech 2 displays the status of certain cruise control system input parameters.

To view the data list:

1 Connect Tech 2 to the data link connector (DLC) and turn on the ignition.

2 On Tech 2 select **Body** / **Powertrain Interface Module** / **Diagnostic Data Display** / **Data List**.

Tech 2 Parameter	Units Displayed	Typical Display Values
Cruise Cancel Switch	Inactive / Active	Inactive
Cruise Resume Switch	Off / Enabled	Off
Cruise Set Switch	Inactive / Active	Inactive
Cruise Main Switch	Inactive / Active	Inactive
Cruise Control Set Lamp	Off / On	Off
Cruise Control On Lamp	Off / On	Off

3 On Tech 2 select **Engine** / **V6 Engine** / **Data Display** / **Data List** / **Cruise Control Data.**

Tech 2 Parameter	Units Displayed	Typical Display Values
Brake Lamp Switch	Inactive / Active	Inactive
Initial Brake Apply Sig	Inactive / Active	Inactive
Cruise Set / Decel Swit	Inactive / Active	Inactive
Cruise Resume / Accelerat	Inactive / Active	Inactive
Cruise Control Disengag	Engine Speed / Brake	Engine Speed

4 On Tech 2 select **Engine** / **V6 Engine** / **Data Display** / **Data List** / **Engine Data 1.**

Tech 2 Parameter	Units Displayed	Typical Display Values
Clutch Pedal Switch	Inactive / Active	Inactive

2.2 Diagnostic Systems Check

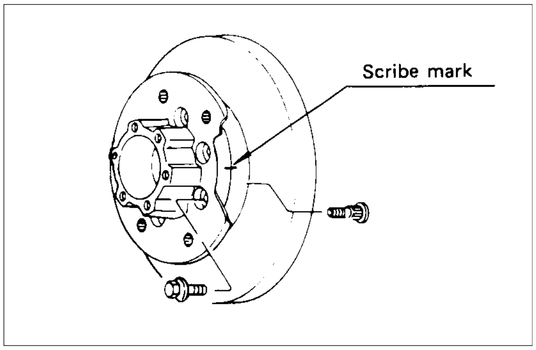
Diagnostic Systems Check

Refer to 2.3 Wiring Diagram to aid in the diagnosis of the cruise control system.

For the cruise control system to work effectively the following systems / components need to be serviceable:

Step	Action	Yes	No
1	Is the fault specifically isolated to this system / module?	Go to Step 2	Go to 6E1 Powertrain Interface Module – V6
2	1 Connect Tech 2 to the DLC. 2 Ignition ON, engine OFF. 3 On Tech 2 select **Body** / **Powertrain Interface Module** / **Diagnostic Trouble codes** / **Read DTCs'.** Are there any set DTC's?	Go to the appropriate DTC table in 6E1 Powertrain Interface Module – V6.	Go to Step 3

Step	Action	Yes	No
3	On Tech 2 select **Engine** / **V6 Engine** / **Diagnostic Trouble codes** / **Read DTCs'.** Are there any set DTC's?	Go to the appropriate DTC table in 6C1-2 Engine Management – V6 – Diagnostics	Go to Step 4
4	Is the instrument cluster assembly functioning correctly?	Go to 2.4 Cruise Control Inoperative / Malfunctioning	Refer to 8A Electrical – Body and Chassis.
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			



12. Bolt

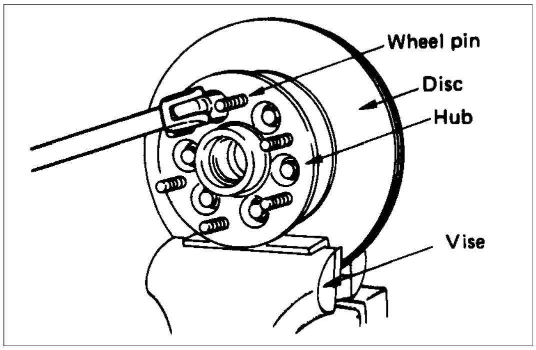
13. Wheel Pin ; Front Hub

(1) Scribe mark on hub to disc before disassembly to insure proper assembly.

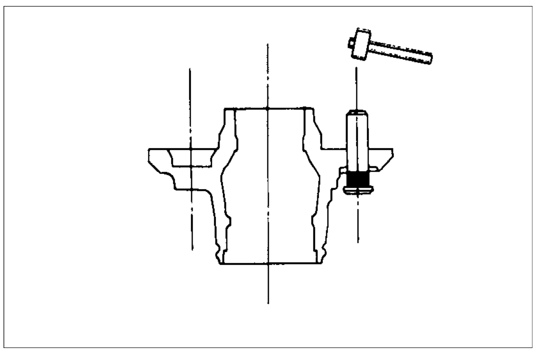
(2) Drive out the ABS sensor rotor using a metal bar and hammer through the two bolt holes.

- Discard the used ABS sensor rotor

Refer to the section Brake.



(3) Clamp hub and disc assembly in vise using protective pads and remove six (6) disc to hub retaining bolts.



(4) Place hub on a suitable work surface and remove wheel studs, as required, using a hammer.

2.3 Wiring Diagrams

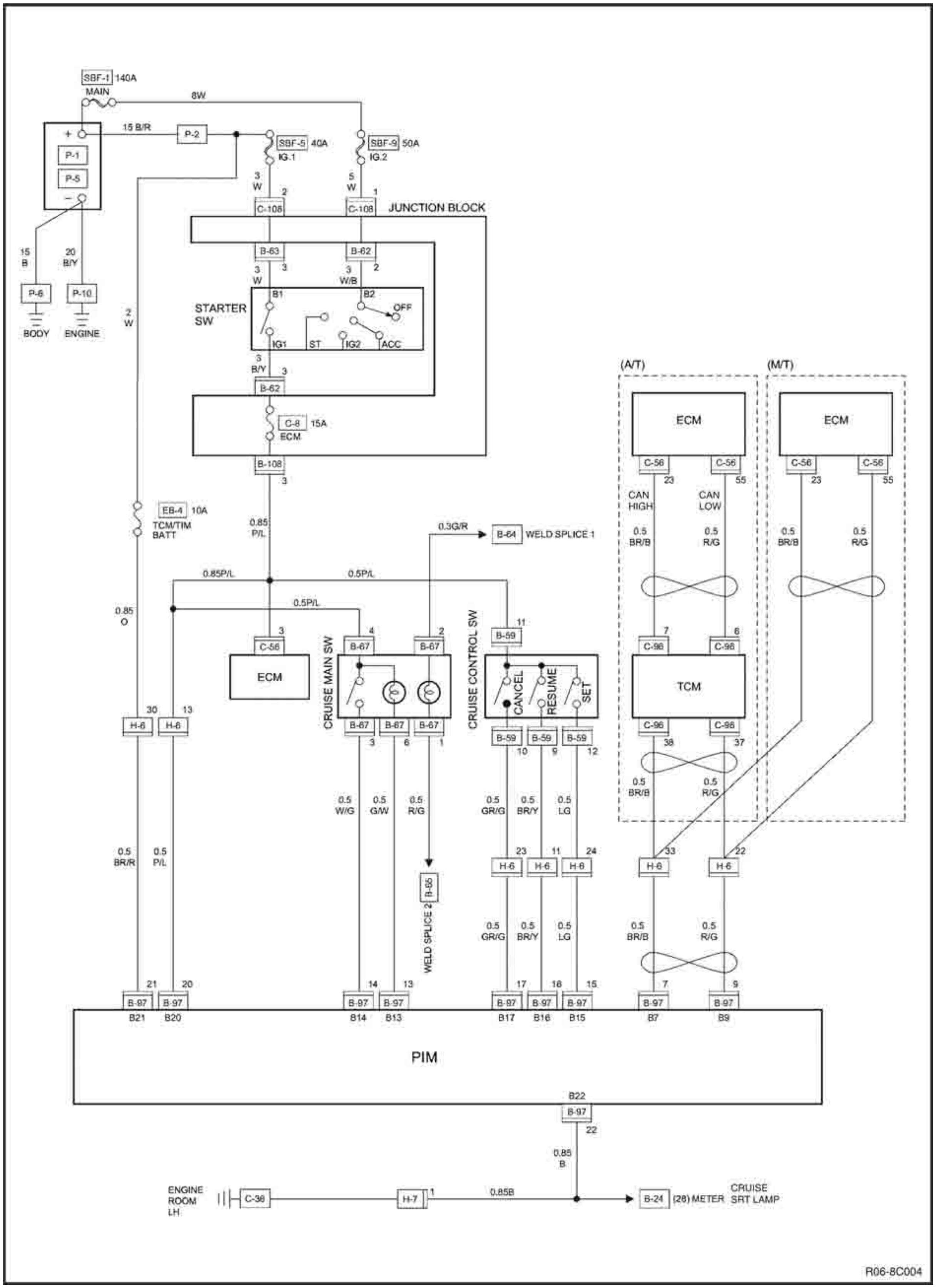


Figure 8C – 6

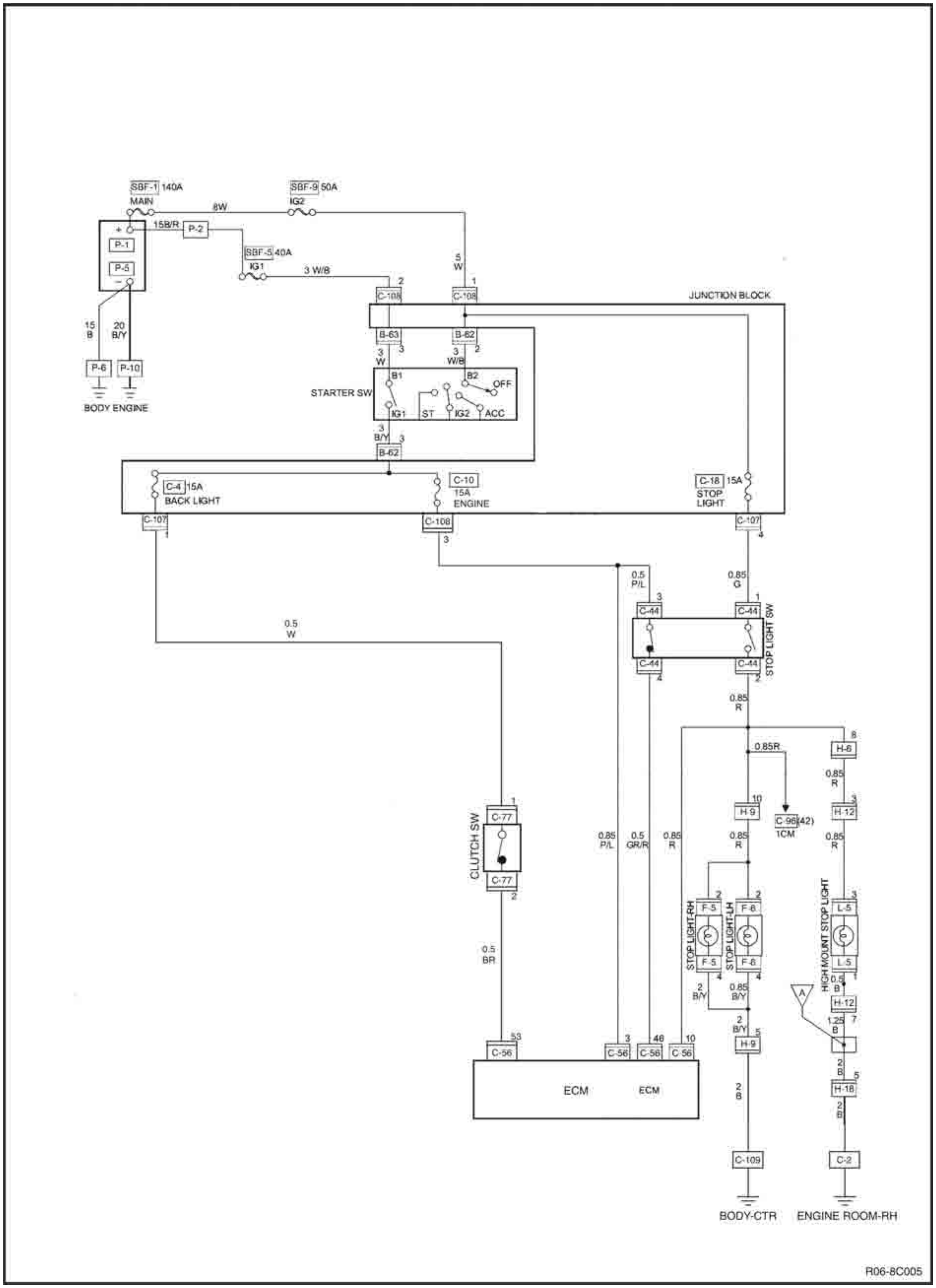

SBF-1 140A
MAIN
SBF-9 50A
IG2
8W
15B/R
P-2
P-1
P-5
SBF-5 40A
IG1
3 W/B
5
W
C-108
JUNCTION BLOCK
15
B
20
B/Y
P-6
P-10
BODY ENGINE
B-63
B-62
STARTER SW
B1
B2
OFF
IG1
ST
IG2
ACC
C-4 15A
BACK LIGHT
C-10
15A
ENGINE
C-18 15A
STOP
LIGHT
C-107
0.5
W
0.5
P/L
0.85
G
C-44
STOP LIGHT SW
0.85
R
0.85R
H-6
C-96 (42)
1CM
H-9
H-12
CLUTCH SW
C-77
0.5
BR
STOP LIGHT-RH
STOP LIGHT-LH
HIGH MOUNT STOP LIGHT
F-5
F-6
L-5
H-18
C-56
ECM
C-109
C-2
BODY-CTR
ENGINE ROOM-RH
R06-8C005

Figure 8C – 7

2.4 Cruise Control Inoperative / Malfunctioning

Circuit Description

When the ON-OFF button is pressed, 12 V is applied to the Powertrain Interface Module (PIM) connector B – 97 pin 14. This enables and disables cruise control operation.

Pressing the cruise control switch assembly to SET–COAST button activates the cruise control at a desired speed above 40 km/h. This provides a 12 V signal to the PIM through connector B – 97 pin 15.

Pressing and holding the cruise control switch to SET–COAST provides a 12 V signal to the PIM at connector B – 97 pin 15. Turning the cruise control switch to RES–ACC will apply a 12 V signal to the PIM at connector B – 97 pin 16. Turning the cruise control switch to CANCEL will apply a 12 V signal to the PIM at connector B – 97 pin 17.

Pressing the brake pedal opens the cruise Initial Brake Apply Signal circuit thus removing the supply voltage from the ECM connector C – 56 pin 46. Simultaneously, the stop lamp circuit will close (normally open) and supply 12 V to the ECM at connector C – 56 pin 10. Both these signals must be present so as to ensure the safe operation of the vehicle's cruise cancel function.

Manual Vehicles Only

Pressing the clutch pedal opens the cruise cancel circuit thus removing the supply voltage from the ECM at connector C – 56 pin 53.

For detailed information refer to 3.4 Clutch Pedal Switch (Manual Only) in this Section.

Test Description

The following numbers refer to the step numbers in the diagnostic table:

4–7 Checks the cruise control switch and associated circuits are functioning correctly.

8–9 Checks the brake pedal switch assembly and associated circuit are functioning correctly.

10 Checks the clutch pedal switch assembly and associated circuits are functioning correctly.

11–21 Covers the testing and replacement of system components.

22–28 Checks for intermittent faults in associated circuits and connectors.

Diagnostic Table Notes

1 For all wiring harness fault diagnoses and repairs, refer to 2.3 Wiring Diagrams in this Section.

2 Tech 2 can display a stored history of which system parameter or input caused the cruise control to disengage. This can aid diagnosis of intermittent faults.

Diagnostic Table

Step	Action	Yes	No
1	Did you review the System Operation?	Go to Step 2	Go to 1.3 System Operation
2	Did you read Diagnostic Systems Check ?	Go to Step 3	Go to Diagnostic Systems Check

Step	Action	Yes	No
3	Check the ignition supply circuits to the Stop Lamp Switch assembly connector C – 44 pin 1 is serviceable using a multimeter set to measure voltage, refer to 2.3 Wiring Diagrams in this Section Is there a +12 volt signal present at connector C – 44 pin 1?	Go to Step 4	Replace the faulty fusible link Main, IG2 or Stop Light fuse (refer to Note 1). If either of the fusible links or fuse blows again, repair or replace the faulty circuit (refer to Note 1)
4	1 Connect Tech 2 to the DLC. 2 On Tech 2 select: **Body** / **Powertrain Interface Module** / **Diagnostic Data Display.** 3 Scroll to **Cruise Main Switch.** 4 While monitoring Tech 2, press the cruise control switch ON–OFF button. Does Tech 2 display the following: • **Inactive** and **Active** as the cruise control switch is pressed?	Go to Step 5	Go to Step 11
5	1 Scroll to **Cruise Resume Switch.** 2 While monitoring Tech 2, rotate the cruise control switch. Does Tech 2 display the following: • **Inactive** when the cruise control switch is in the neutral position? • **Res** / **Acc** when the cruise control switch is rotated to the RES–ACC. Position?	Go to Step 6	Go to Step 12
6	1 Scroll to **Cruise Set Switch.** 2 While monitoring Tech 2, press the cruise control switch. Does Tech 2 display the following: • **Inactive** when the cruise control switch is in the neutral position? • **Set** / **Coast** when the cruise control switch is pressed to the SET–COAST position?	Go to Step 7	Go to Step 13
7	1 Scroll to **Cruise Cancel Switch.** 2 While monitoring Tech 2, rotate the cruise control switch. Does Tech 2 display the following: • **Inactive** when the cruise control switch is in the neutral position? • **Cancel** when the cruise control switch is rotated to the CANCEL position?	Go to Step 8	Go to Step 14

Step	Action	Yes	No
8	1 Return to the **Main Menu** on Tech 2. 2 On Tech 2 select: **Engine** / **V6 Engine** / **Data Display** / **Cruise Control Data.** 3 Scroll to **Brake Lamp Switch.** 4 While monitoring Tech 2, press and then release to the brake pedal. Does Tech 2 display the following: • **Active** as the brake pedal is pressed? • **Inactive** when the pedal is released?	Go to Step 9	Go to Step 15
9	1 Scroll to **Initial Brake Apply Sig.** 2 While monitoring Tech 2, press and then release to the brake pedal. Does Tech 2 display the following: • **Inactive** when the pedal is released? • **Active** as the brake pedal is pressed?	Go to Step 10	Go to Step 16
10	**NOTE** This procedure is only required on vehicles fitted with manual transmissions. If the vehicle is fitted with an automatic transmission, go to Step 24. 1 Scroll to **Cruise Control Active**. 2 While monitoring Tech 2, press and then release to the clutch pedal. Does Tech 2 display the following: • **Active** when the pedal is released? • **Inactive** as the clutch pedal is pressed?	Go to Step 30	Go to Step 17
11	Test the cruise control main switch, refer to 3.1 Cruise Control Main Switch Is the cruise control switch serviceable?	Go to Step 22	Go to Step 18
12	Test the cruise control switch assembly, refer to 3.2 Cruise Control Switch Assembly Is the cruise control switch assembly serviceable?	Go to Step 23	Go to Step 18
13	Test the cruise control switch assembly, refer to 3.2 Cruise Control Switch Assembly Is the cruise control switch assembly serviceable?	Go to Step 24	Go to Step 18
14	Test the cruise control switch assembly, refer to 3.2 Cruise Control Switch Assembly Is the cruise control switch assembly serviceable?	Go to Step 25	Go to Step 18
15	Test the stop lamp switch assembly, refer to 3.3 Stop Lamp Switch Assembly. Is the stop lamp switch serviceable?	Go to Step 26	Go to Step 19
16	Test the stop lamp switch assembly, refer to 3.3 Stop Lamp Switch Assembly. Is the stop lamp switch serviceable?	Go to Step 26	Go to Step 20

Step	Action	Yes	No
17	**NOTE** This procedure is only required on vehicles fitted with manual transmissions. If the vehicle is fitted with an automatic transmission go to Step 26. Test the clutch pedal switch, refer to 3.4 Clutch Pedal Switch. Is the clutch pedal switch serviceable?	Go to Step 28	Go to Step 21
18	Replace the faulty cruise control switch assembly with a serviceable item. To replace the switch assembly, refer to 8 B Cruise Control System.	Go to Step 32	—
19	Replace the faulty stop lamp switch, refer to 3.3 Stop Lamp Switch Assembly	Go to Step 32	—
20	Replace the faulty stop lamp switch, refer to 3.3 Stop Lamp Switch Assembly	Go to Step 32	—
21	Replace the faulty clutch pedal switch, refer to 3.4 Clutch Pedal Switch	Go to Step 32	—
22	1 Disconnect the PIM connector B – 97. 2 Using a multimeter set to measure voltage, back probe between the harness connector B – 97 pin 14 and a known ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and press and release the cruise control switch ON–OFF button. • With the button in the rest position, the multimeter should display 0 V. • With the button pressed, the multimeter should display battery voltage. Does the multimeter display as described?	Go to Step 30	Check for short to ground or open circuit. Repair as required (refer to Note 1). Go to Step 32
23	1 Disconnect the PIM connector B – 97. 2 Using a multimeter set to measure voltage, back probe between the harness connector B – 97 pin 16 and a known ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and rotate and release the cruise control switch to RES–ACC position. • With the switch in the rest position, the multimeter should display 0 V. • With the switch rotated, the multimeter should display battery voltage. Does the multimeter display as described?	Go to Step 30	Check for short to ground or open circuit on circuit. Repair as required (refer to Note 1). Go to Step 32

Step	Action	Yes	No
24	1 Disconnect the PIM connector B – 97. 2 Using a multimeter set to measure voltage, back probe between the harness connector B – 97 pin 15 and a known ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and press and release the cruise control switch to SET–COAST button. • With the switch in the rest position, the multimeter should display 0 V. • With the switch pressed, the multimeter should display battery voltage. Does the multimeter display as described?	Go to Step 30	Check for short to ground or open circuit on circuit. Repair as required (refer to Note 1). Go to Step 32
25	1 Disconnect the PIM connector B – 97. 2 Using a multimeter set to measure voltage, back probe between the harness connector B – 97 pin 17 and a known ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and rotate and release the cruise control switch to CANCEL position. • With the switch in the rest position, the multimeter should display 0 V. • With the switch rotated clockwise, the multimeter should display battery voltage. Does the multimeter display as described?	Go to Step 30	Check for short to ground or open circuit on circuit. Repair as required (refer to Note 1). Go to Step 32
26	1 Disconnect the ECM connector C – 56. 2 Using a multimeter set to measure voltage, back probe between the harness connector C – 56 pin 10 and ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and press and release the brake pedal. • With the brake pedal in the rest position, the multimeter should display 0 V • With the brake pedal pressed, the multimeter should display battery voltage Does the multimeter display as described?	Go to Step 30	Check for a blown fuse C-18. Check for short to ground or open circuit Repair as required (refer to Note 1). Go to Step 32
27	1 Disconnect the ECM connector C – 56. 2 Using a multimeter set to measure voltage, back probe between the harness connector C – 56 pin 46 and ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and press and release the brake pedal. • With the brake pedal in the rest position, the multimeter should display battery voltage • With the brake pedal pressed, the multimeter should display 0 V. Does the multimeter display as described?	Go to Step 28	Check for a blown fuse C-10. Check for short to ground or open circuit Repair as required (refer to Note 1). Go to Step 32

Step	Action	Yes	No
28	1 Disconnect the ECM connector C – 56. 2 Using a multimeter set to measure voltage, back probe between the harness connector C – 56 pin 53 and ground. 3 With the aid of an assistant, monitor the voltage on the multimeter and press and release the clutch pedal. • With the clutch pedal in the rest position, the multimeter should display battery voltage • With the clutch pedal pressed, the multimeter should display 0 V Does the multimeter display as described?	Go to Step 31	Check for a blown fuse C-4. Check for short to ground or open circuit Repair as required (refer to Note 2). Go to Step 32
29	Check all associated circuits and connectors for the following: • Loose or damaged connections • Intermittent faults. Refer to the Wiring Diagrams in this Section and repair as required. Was the repair completed?	Go to Step 32	—
30	Replace the PIM, refer to 6E1 Powertrain Interface Module – V6. Was the repair completed?	Go to Step 32	—
31	Replace the ECM module, refer to 6C1-3 Engine Management – V6 Service Operations. Was the repair completed?	Go to Step 32	—
32	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 1
When all diagnosis and repairs are completed, clear all DTCs and check the system for correct operation.			

3 Service Operations

3.1 Cruise Control Main Switch

Remove

To remove the cruise control main switch, refer to 8 B Cruise Control System.

Test

Test the cruise control main switch, using a multimeter set to measure ohms check the continuity.

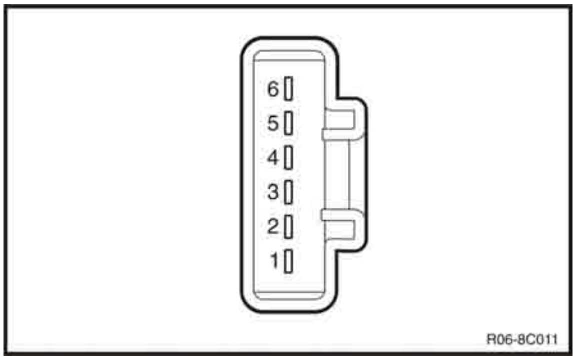


Figure 8C – 8

Terminal Testing

Cruise Control Main Switch		
Switch Terminals	**Switch Position**	**Indication if Switch is Serviceable**
1 and 2	Switch Illumination	Approx. 22 ohms
4 and 6	Cruise Lamp On Illumination	Approx. 22 ohms
4 and 3	Cruise Switch Released	Open circuit
4 and 3	Cruise Switch Pressed	Short circuit

Reinstall

To reinstall the cruise control main switch, refer to 8 B Cruise Control System.

3.2 Cruise Control Switch Assembly

Remove

To remove the cruise control switch assembly, refer to 8 B Cruise Control System.

Test

To test the cruise control switch assembly, use a multimeter to check the continuity.

1. Remove the lower dash trim panel and locate the cruise control switch assembly wiring harness that connects a white 13 pin male plug to a connector sub panel located on the right hand side below of the steering column.
2. Disconnect the 13 pin male plug B – 59 from its mating connector socket.
3. Place the turn signal and cruise control switch assembly into the positions detailed in the following table, refer to Terminal Testing. Position the contacts of the multimeter onto the terminals and take the reading. Compare the multimeter readings with the values in the table.
4. If the switch assembly fails any part of the test, replace the cruise control switch assembly with a serviceable item. To replace the switch assembly, refer to 8 B Cruise Control System.

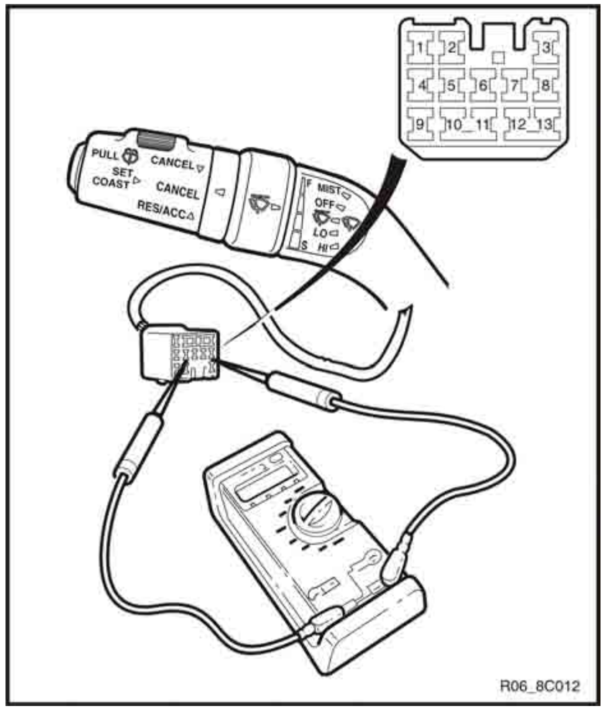


Figure 8C – 9

Terminal Testing

Cruise Control Switch Assembly		
Switch Terminals	**Switch Position**	**Indication if Switch is Serviceable**
11 and 10	CANCEL Applied	Open Circuit
11 and 10	CANCEL Released	Short Circuit
11 and 12	SET–COAST Pressed	Short Circuit
11 and 12	SET–COAST Released	Open Circuit
11 and 9	RES–ACC Applied	Short Circuit
11 and 9	RES–ACC Released	Open Circuit

Reinstall

To reinstall the cruise control switch assembly, refer to 8 B Cruise Control System.

RECEIVER/DRIER		
Capacity	cc (cu in)	250 (15.3) Assembly includes sight glass and pressure sensitive device
		(Dual pressure switch)
		• Low pressure control
	kPa (kg/cm²/psi)	OFF: 177±26 (1.8±0.25/26±4)
	kPa (kg/cm²/psi)	ON: 186±30 (1.9±0.3/27±4)
		• High pressure control
	kPa (kg/cm²/psi)	OFF: 2746±196 (28±2/398±28)
	kPa (kg/cm²/psi)	ON: 588±196 (6±2/85±28)
		(Triple pressure switch)
		• Low pressure control
	kPa (kg/cm²/psi)	OFF: 177±26 (1.8±0.25/26±4)
	kPa (kg/cm²/psi)	ON: 186±30 (1.9±0.3/27±4)
		• Medium pressure control
	kPa (kg/cm²/psi)	OFF: 1128±118 (11.5±1.2/164±17)
	kPa (kg/cm²/psi)	ON: 1521±88 (15.5±0.9/220±13)
		• High pressure control
	kPa (kg/cm²/psi)	OFF: 2746±196 (28±2/398±28)
	kPa (kg/cm²/psi)	ON: 588±196 (6±2/85±28)
ELECTRIC FAN		
Fan Dia		⌀250
Motor Power	(w)	90
REFRIGERANT		
Type		HFC-134a
Capacity	kg (lbs)	• 4JA1-T, 4JH1-TC, C24SE 0.72 (1.59) • 4JJ1-TC (Standard Output), 4JJ1-TC (High Output), 4JK1-TC (High Output) 0.65 (1.43)
IDLE SPEED-UP CONTROL		Idle speed controlled by solenoid switch (4JA1-T only)

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

For inspection and servicing of disc caliper, and relative parts, and ABS parts, refer to Section Brakes.

- Hub
- Hub bearing, oil seal
- Knuckle spindle
- Disc
- Caliper
- ABS sensor rotor
- Cap, Hub flange, Shim, Snap ring
- Free wheeling hub parts (Option)
- Clutch, Knob, follower, inner, ring and spring

Visual Check

Check the following parts for wear, damage or other abnormal conditions.

3.3 Stop Lamp Switch Assembly

Remove

1 Press the connector locking tab while pulling on the stop lamp connector (1) and remove from the switch assembly (2).

2 Twist the stop lamp switch assembly (2) anticlockwise a quarter of a turn and pull out of the brake pedal support bracket.

3 If required, remove the plastic clip (3) by pressing the locking tabs on the rear of the clip and pulling from the brake pedal support bracket.

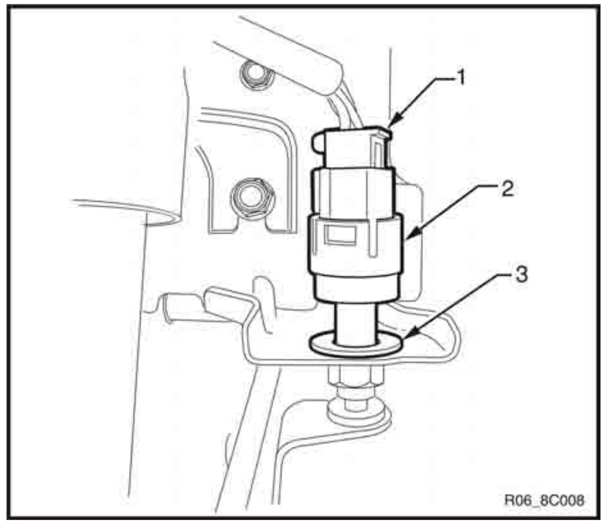


Figure 8C – 10

Test

Terminal Testing

1 Using a multimeter, probe the pins of the switch assembly and compare to the table below.

NOTE

The pins are as follows:

- C44 – pins 1 and 2
- C44 – pins 3 and 4

NOTE

Holding the plunger (5) with tape will help when performing the test with the plunger in the active position (plunger pressed).

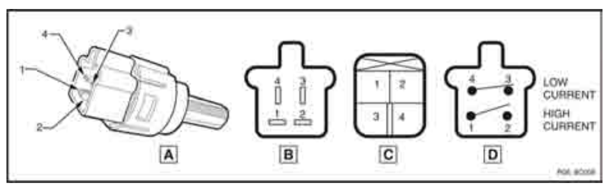


Figure 8C – 11

Plunger Position	Connector C44 – 1 and 2	Connector C44 – 3 and 4
Neutral position (plunger extended)	Open circuit	Continuity
Active position (plunger pressed)	Continuity	Open circuit

Reinstall

1 If removed, install the plastic clip (2) with the arrow pointing upwards, refer to Figure 8C – 11.

2 With the connectors pointing upwards (12 o'clock position), insert the switch assembly (1) into the plastic clip.

3 Ensure the brake pedal is in the rest position.

4 Push the switch assembly (1) so the plunger is pressed and the end switch barrel is against the brake pedal (2).

5 Twist the switch assembly clockwise to lock into place. The distance between the brake pedal and the switch barrel should be 0.7 ± 0.5 mm.

6 Install the wiring connector to the switch assembly.

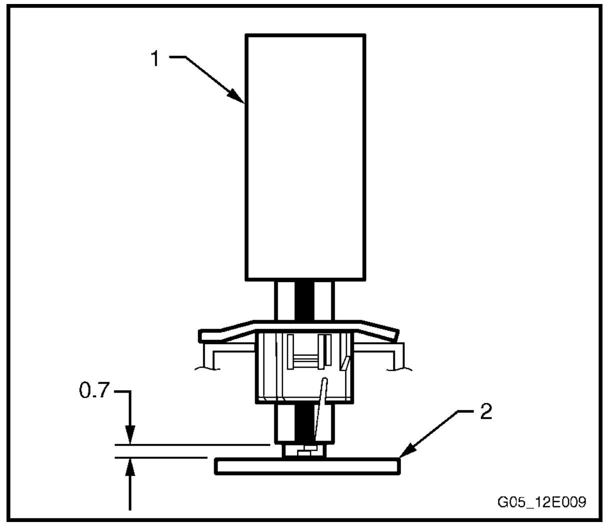


Figure 8C – 12

3.4 Clutch Pedal Switch (Manual Only)

Remove

1 Disconnect the electrical connector (1) from the clutch switch (2).

2 Loosen the lock nut (3) and remove the clutch switch from the pedal bracket.

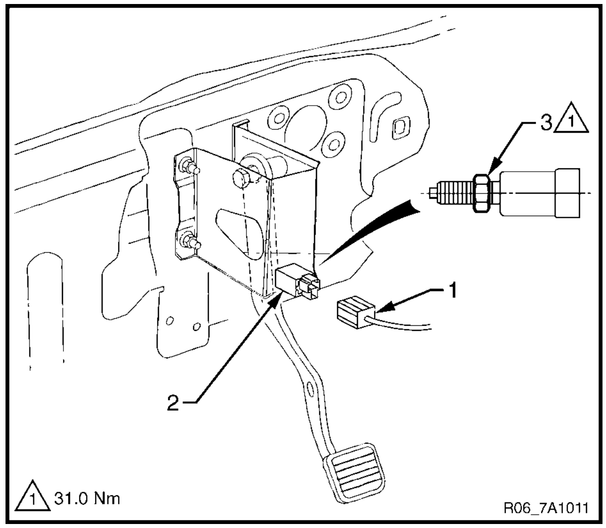


Figure 8C – 13

Test

1 Using a multimeter set to measure ohms, probe the pins (1) of the switch assembly.

2 In the neutral position (plunger extended) there should be an open circuit across the switch.

3 In the active position (plunger extended) there should be a closed circuit across the switch.

4 Replace the switch as per the following reinstall procedure if the tests prove the switch to be faulty.

5 If the test proves the switch to be serviceable, reinstall it as per the following procedure.

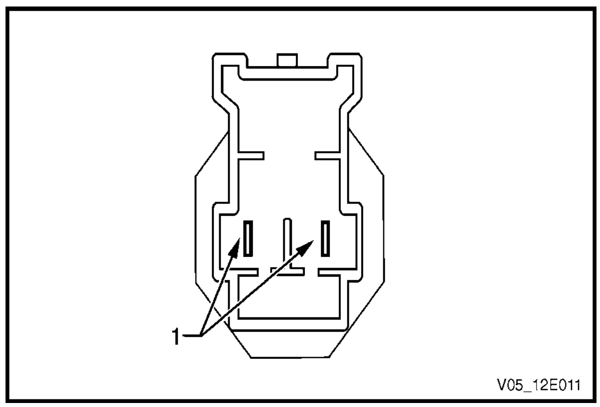


Figure 8C – 14

Reinstall

6 Install the clutch switch (1) as follows:

a Insert the switch into the clutch pedal bracket.

b Rotate the switch clockwise until obtaining the clearance (2) between the pedal (3) and the pedal stoper.

Clutch pedal and pedal stoper clearance specification............................... 0.5 – 1.5 mm

c Tighten the lock nut (4) to the correct torque specification.

Clutch switch lock nut torque specification...31.0 Nm

d Recheck the clutch switch clearance, readjust clearance if required.

NOTE

No adjustment is required for the clutch switch itself.

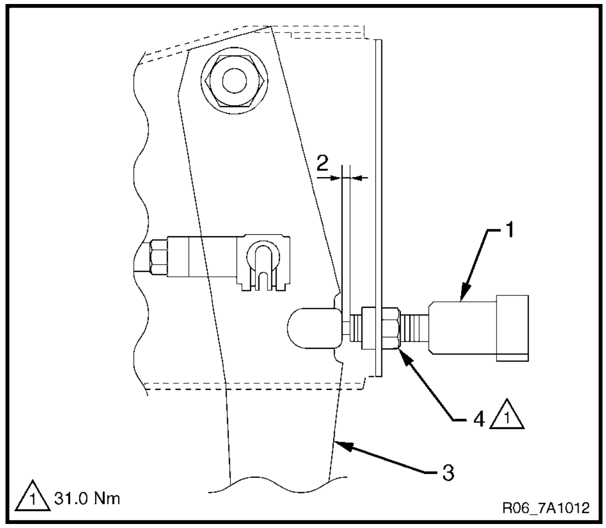
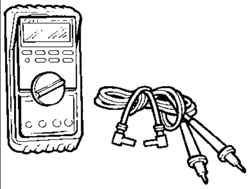
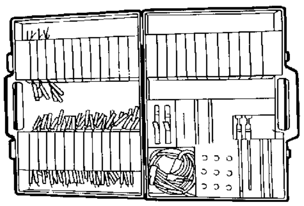
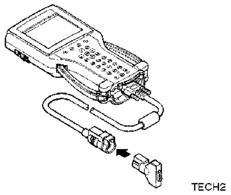


Figure 8C – 15

7 Reconnect the electrical connector to the clutch switch.

8 Verify the operation of the clutch switch by operating the cruise control and checking the clutch switch stops operation of the cruise control when the clutch pedal is pressed.

4 Special Tools

Tool Number	Illustration	Description	Tool Classification
3588		**Digital Multimeter** Previously released as J39200 or equivalent. NOTE: The instrument must have 10 meg ohms impedance and be capable of reading frequencies.	Mandatory
KM-609		**Electronic Kit.** Used in conjunction with a multimeter for measuring voltages and resistances without damaging wiring harness connectors.	Desirable.
70000861		**Tech 2 Diagnostic Scan Tool** Previously released.	Mandatory

SECTION 9

ACCESSORIES & RESTRAINTS

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SECTION 9

ACCESSORIES

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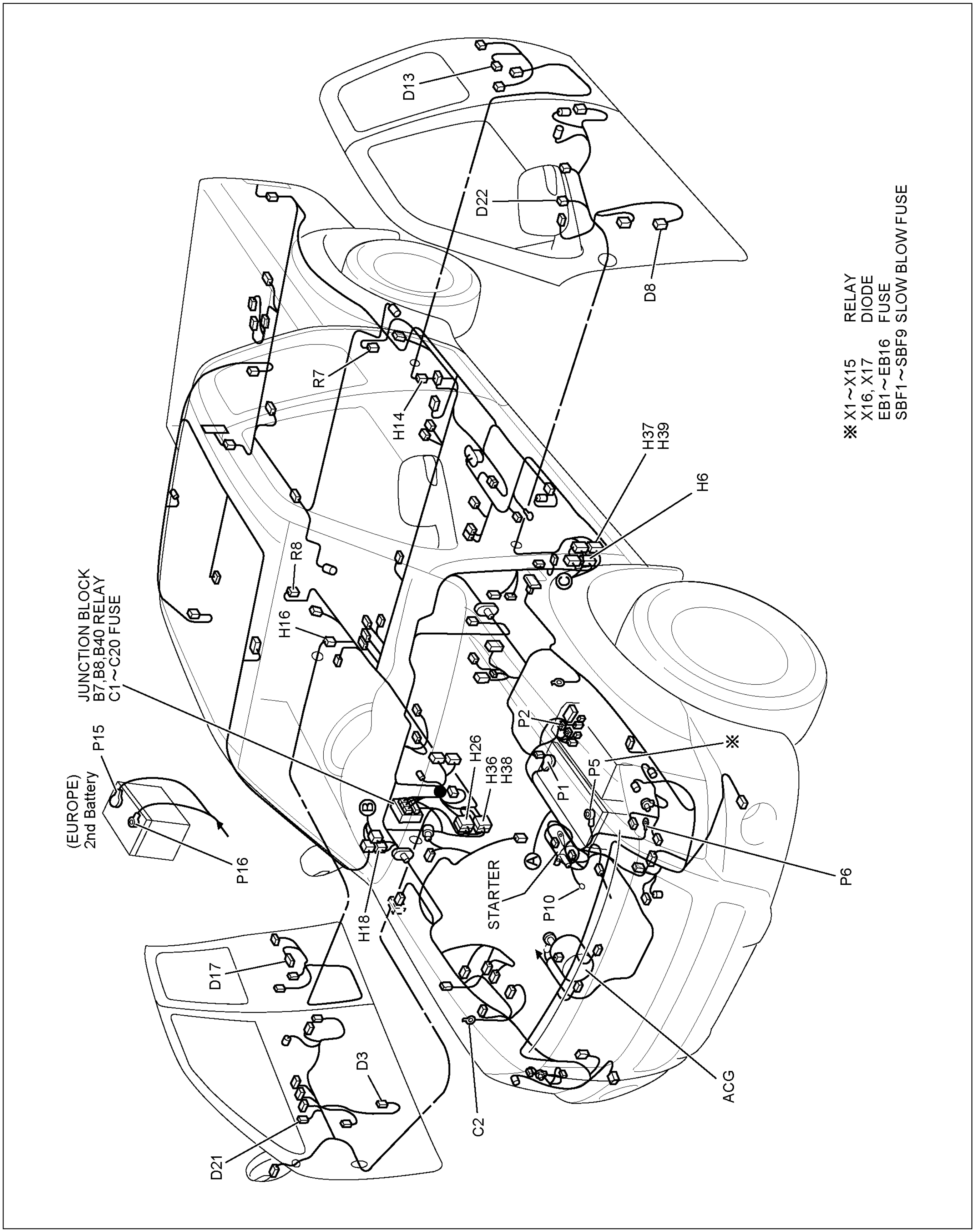
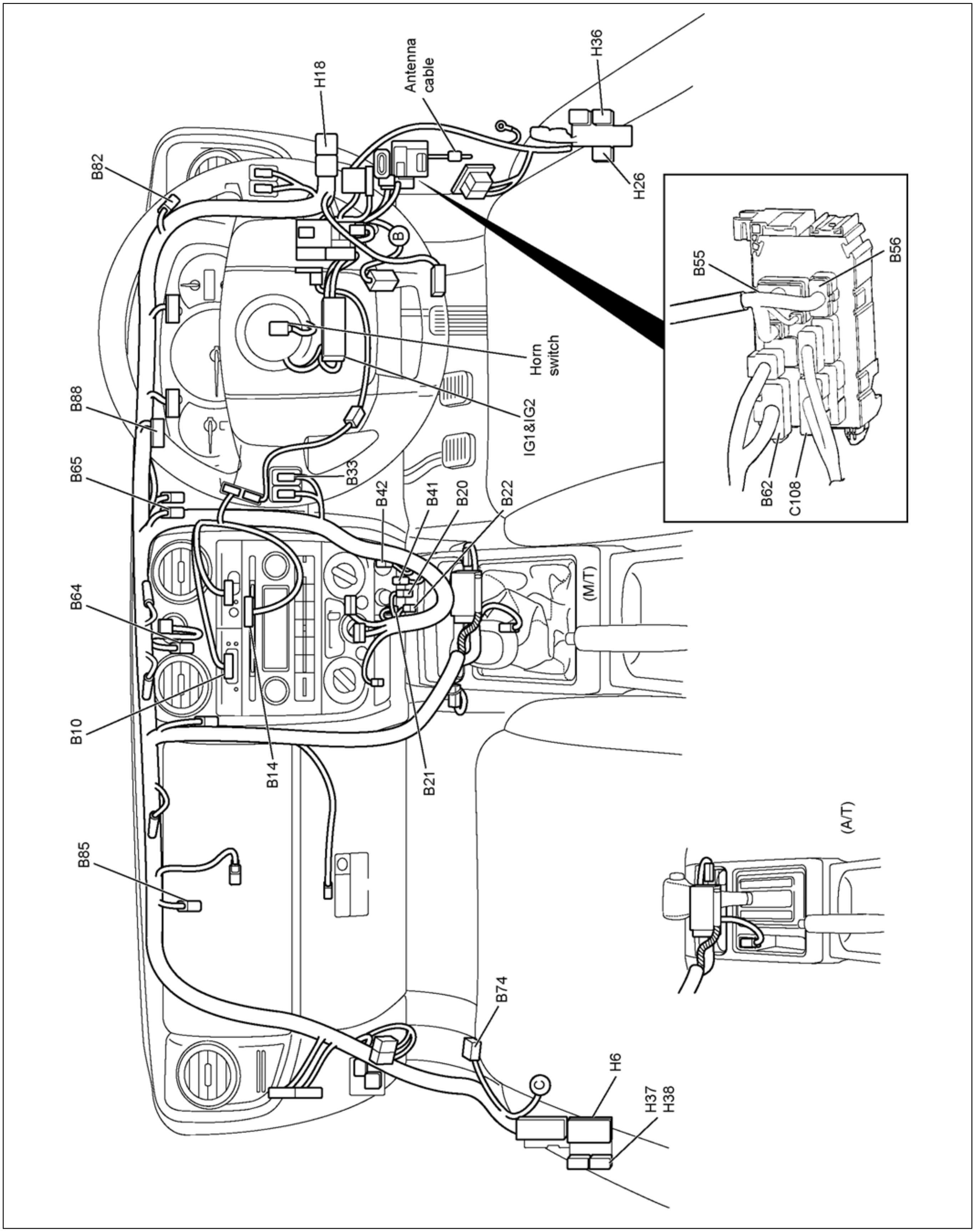
PARTS LOCATION

RHD (1)



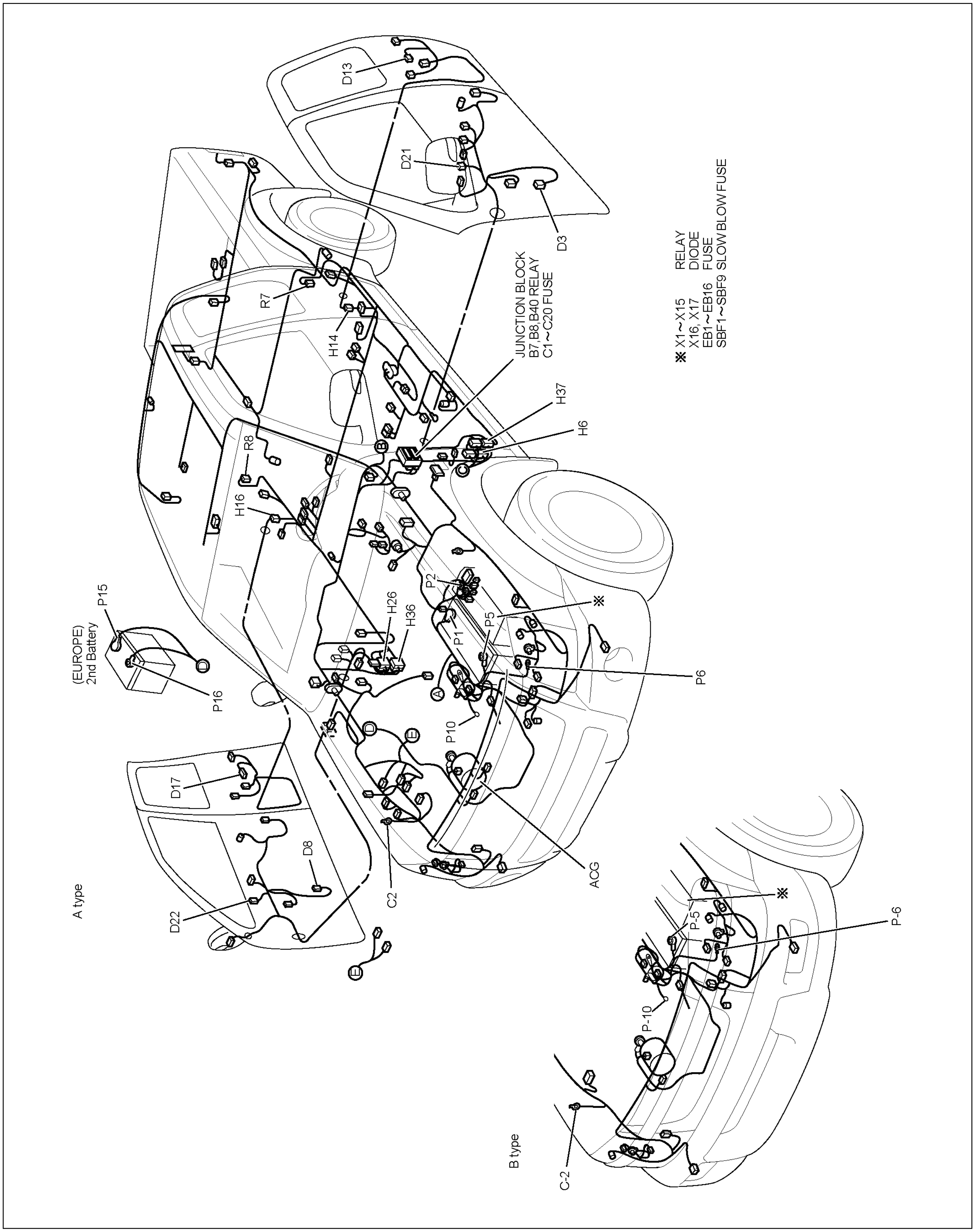
RTW78AXF039701

RHD (2)



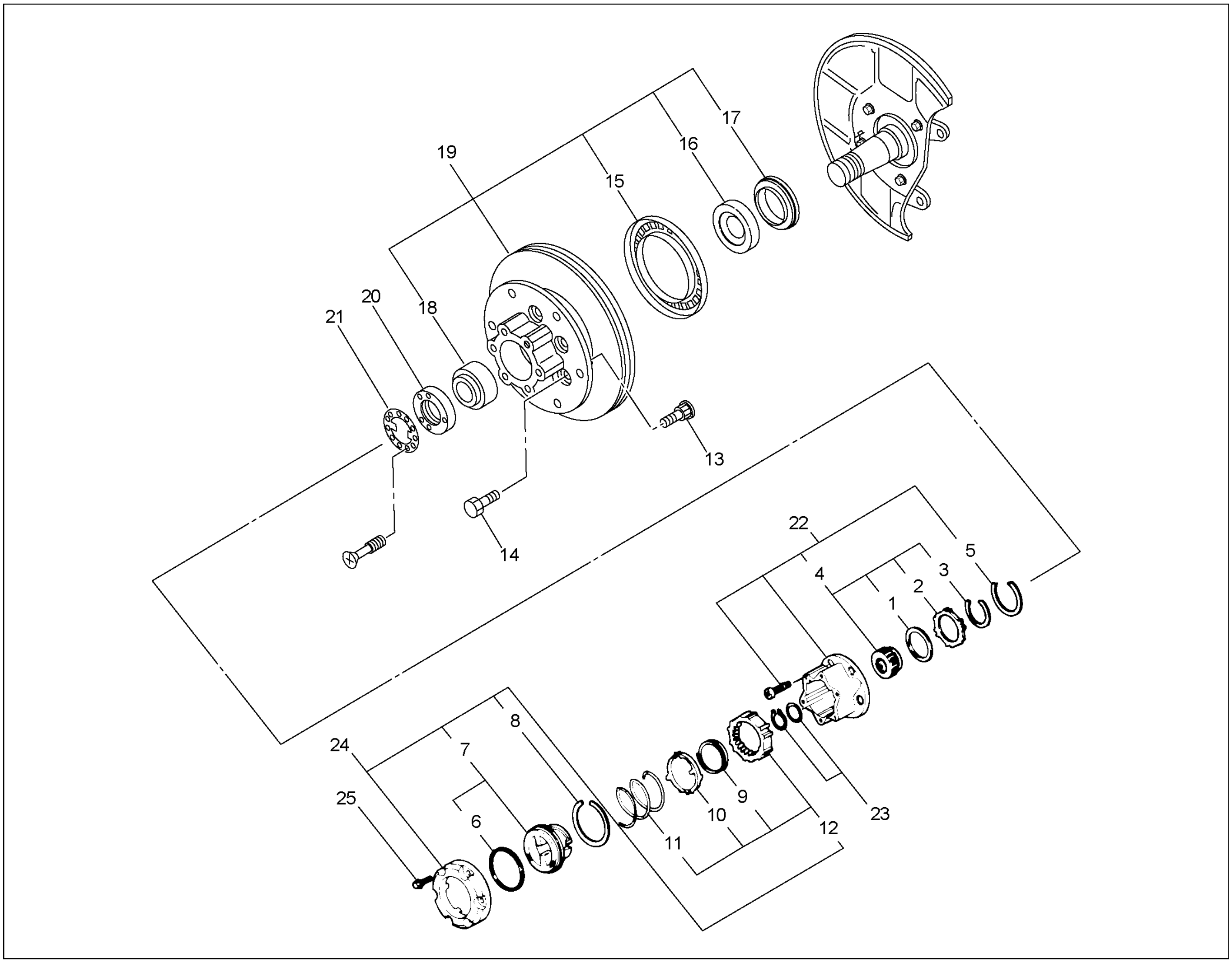
RTW78AXF045901

LHD (1)



RTW78AXF039801

REASSEMBLY

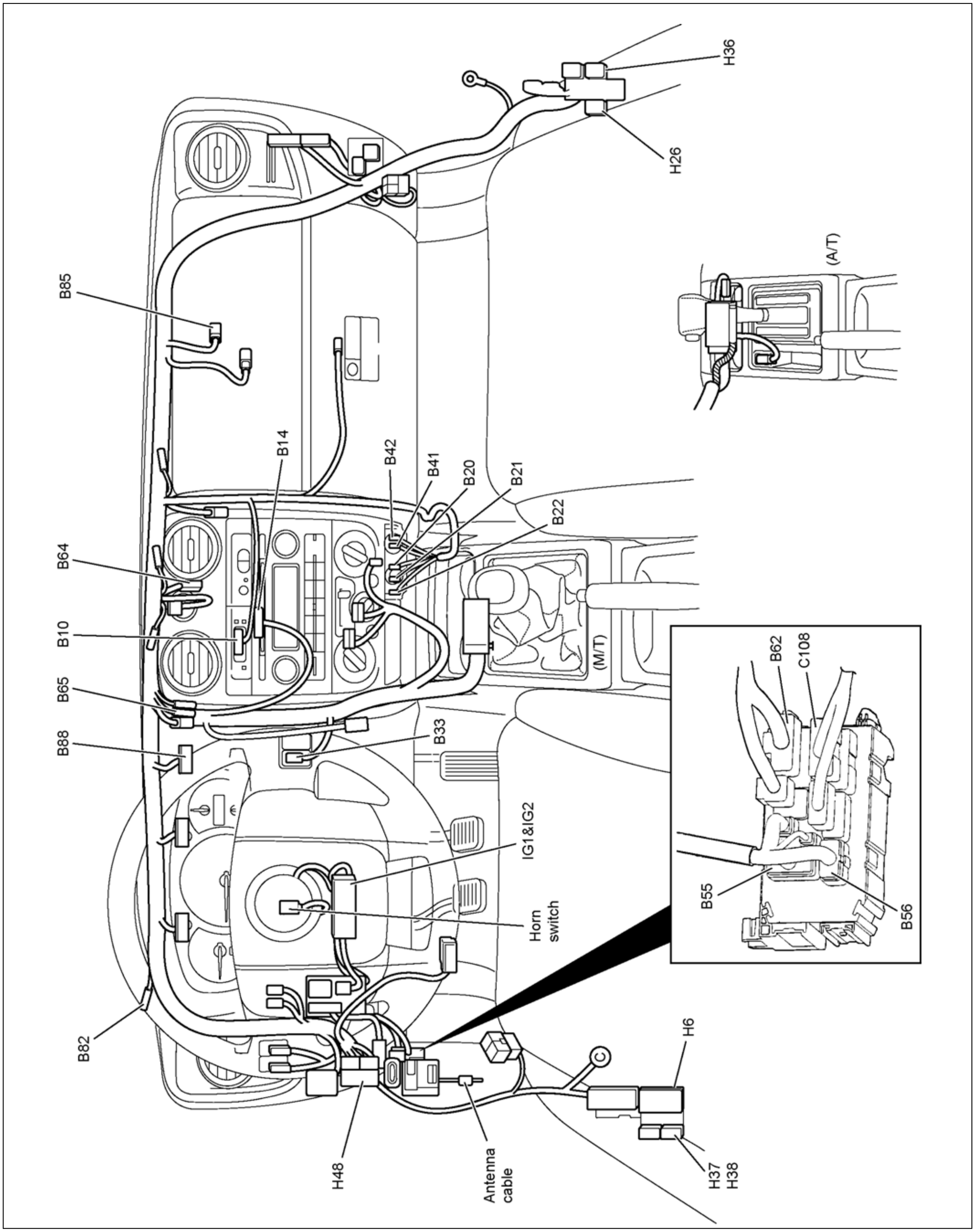


RTW440LF000401

Reassembly Steps

- ▲ 1. Spacer
- 2. Ring
- 3. Snap ring
- ▲ 4. Inner assembly
- 5. Snap ring
- 6. X-ring
- ▲ 7. Knob
- ▲ 8. Snap ring
- ▲ 9. Retaining spring
- ▲ 10. Follower
- ▲ 11. Compression spring
- ▲ 12. Clutch assembly
- ▲ 13. Wheel pin
- ▲ 14. Bolt
- ▲ 15. ABS sensor rotor
- ▲ 16. Inner bearing
- ▲ 17. Oil seal
- ▲ 18. Outer bearing
- ▲ 19. Hub and disc assembly
- ▲ 20. Hub nut
- ▲ 21. Lock washer
- ▲ 22. Body assembly
- ▲ 23. Snap ring and shim
- ▲ 24. Cover assembly
- ▲ 25. Bolt

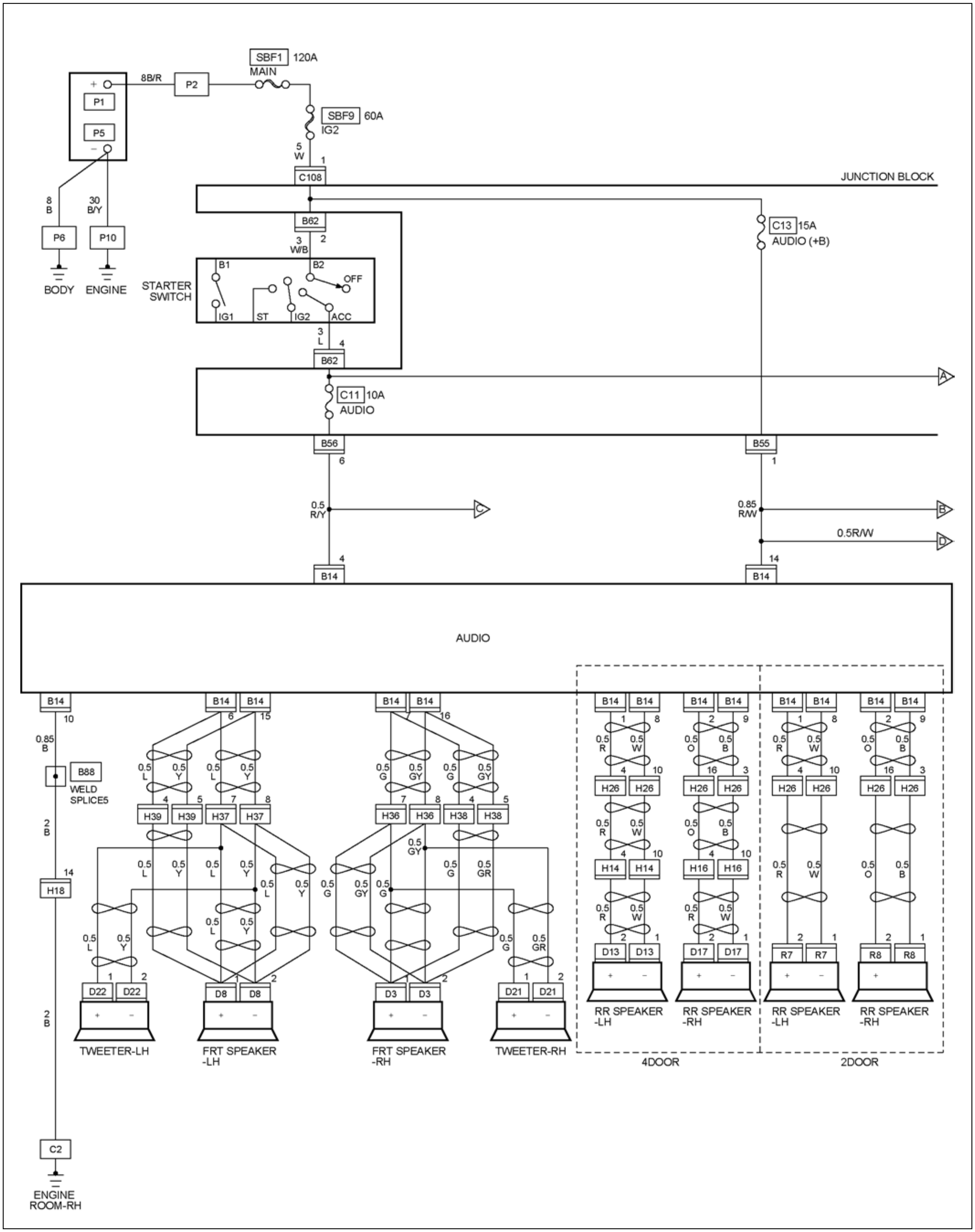
LHD (2)



RTW78AXF046001

CIRCUIT DIAGRAM

4JJ1-TC, 4JK1-TC (Except South Africa) (RHD)



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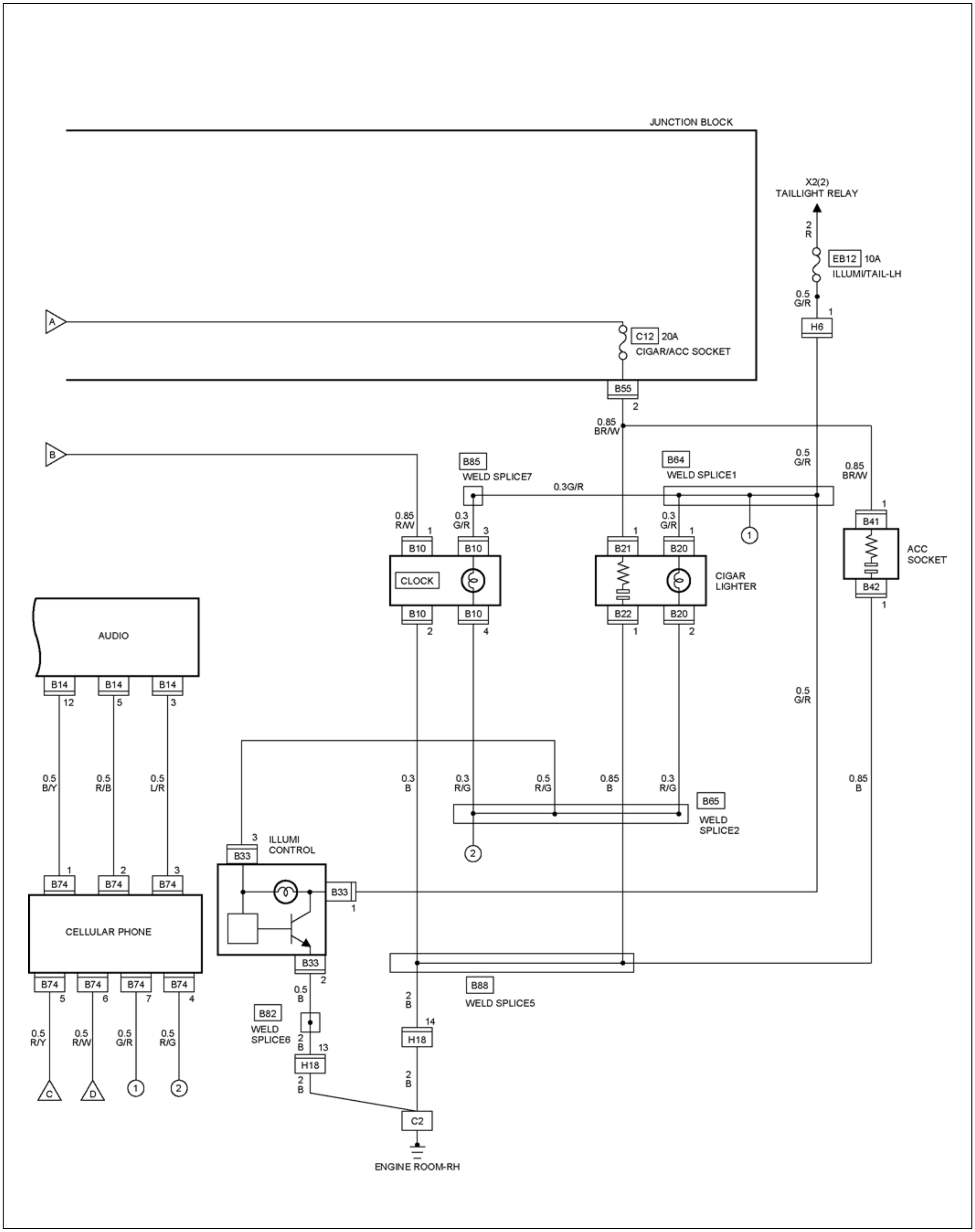
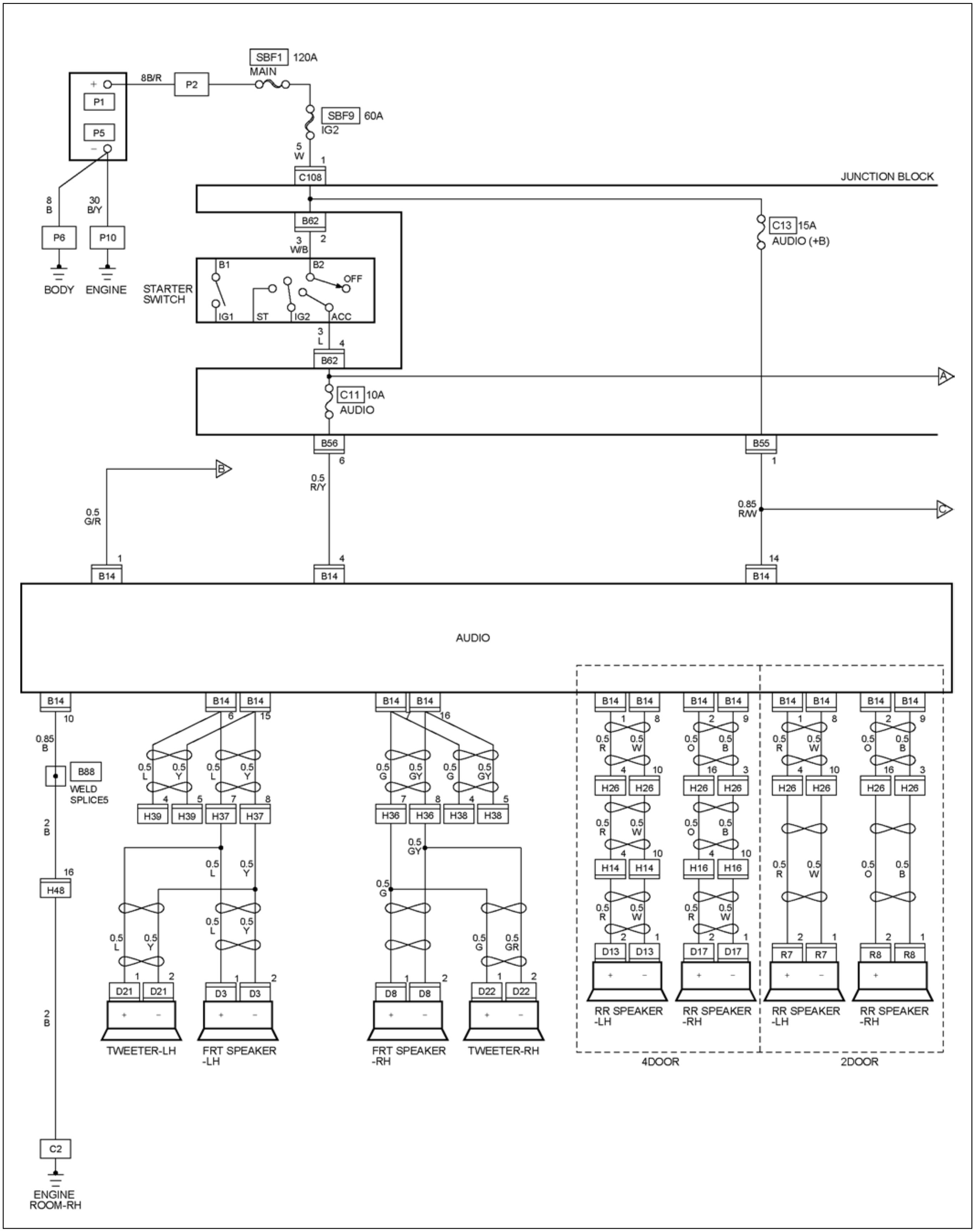
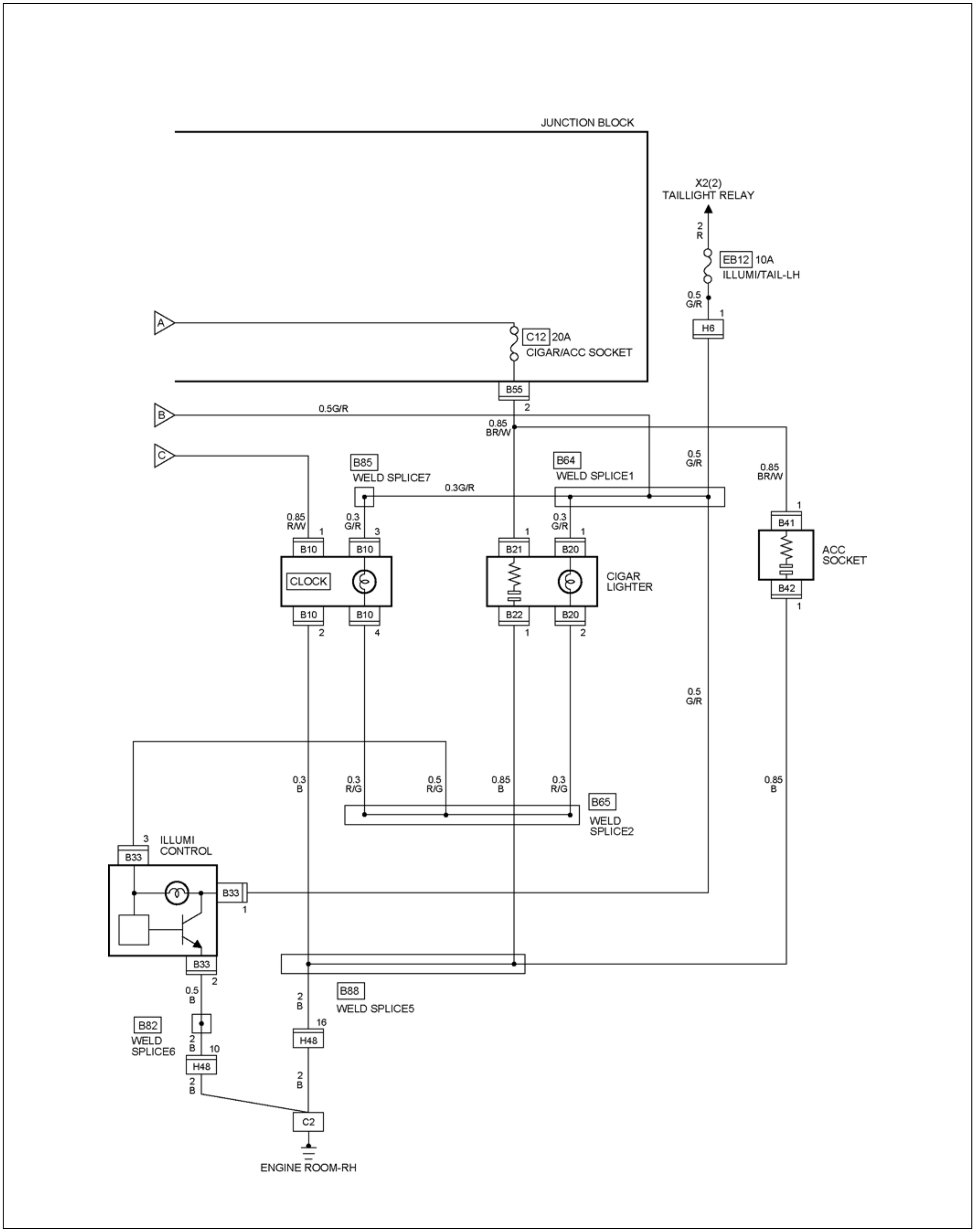


RTW78AXF032401

4JJ1-TC, 4JK1-TC (LHD)

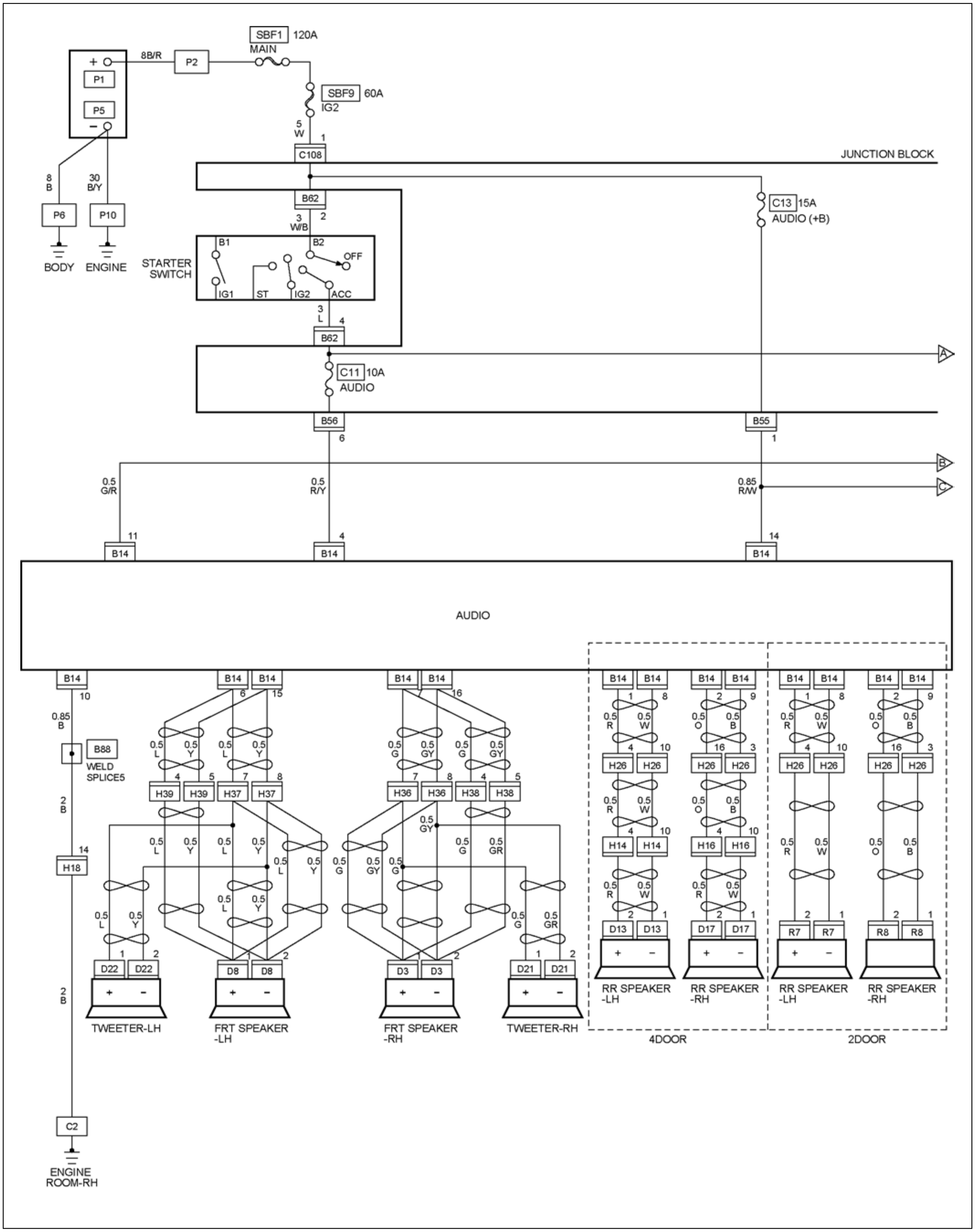


RTW78AXF028201



RTW78AXF028301

4JJ1-TC (South Africa)



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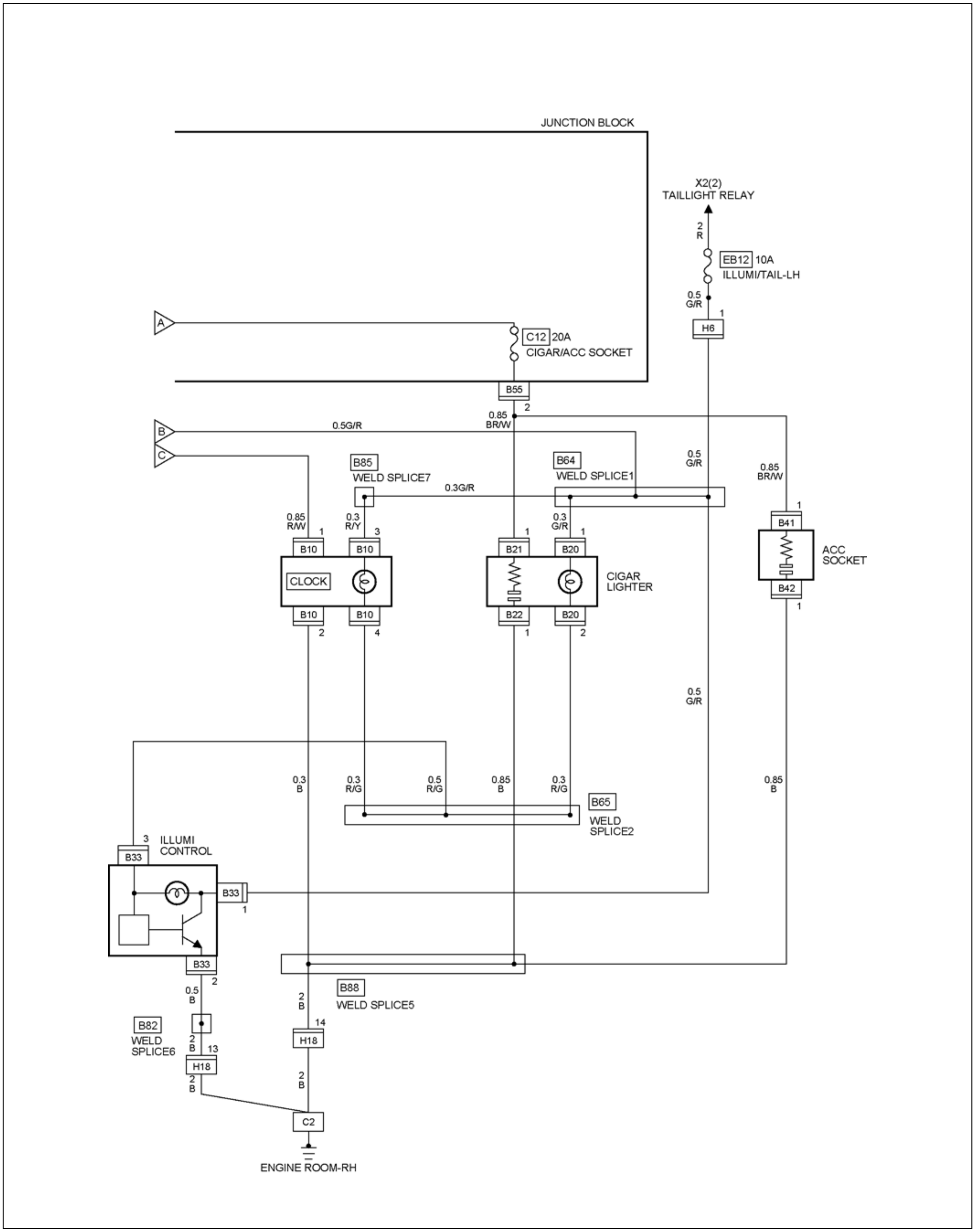
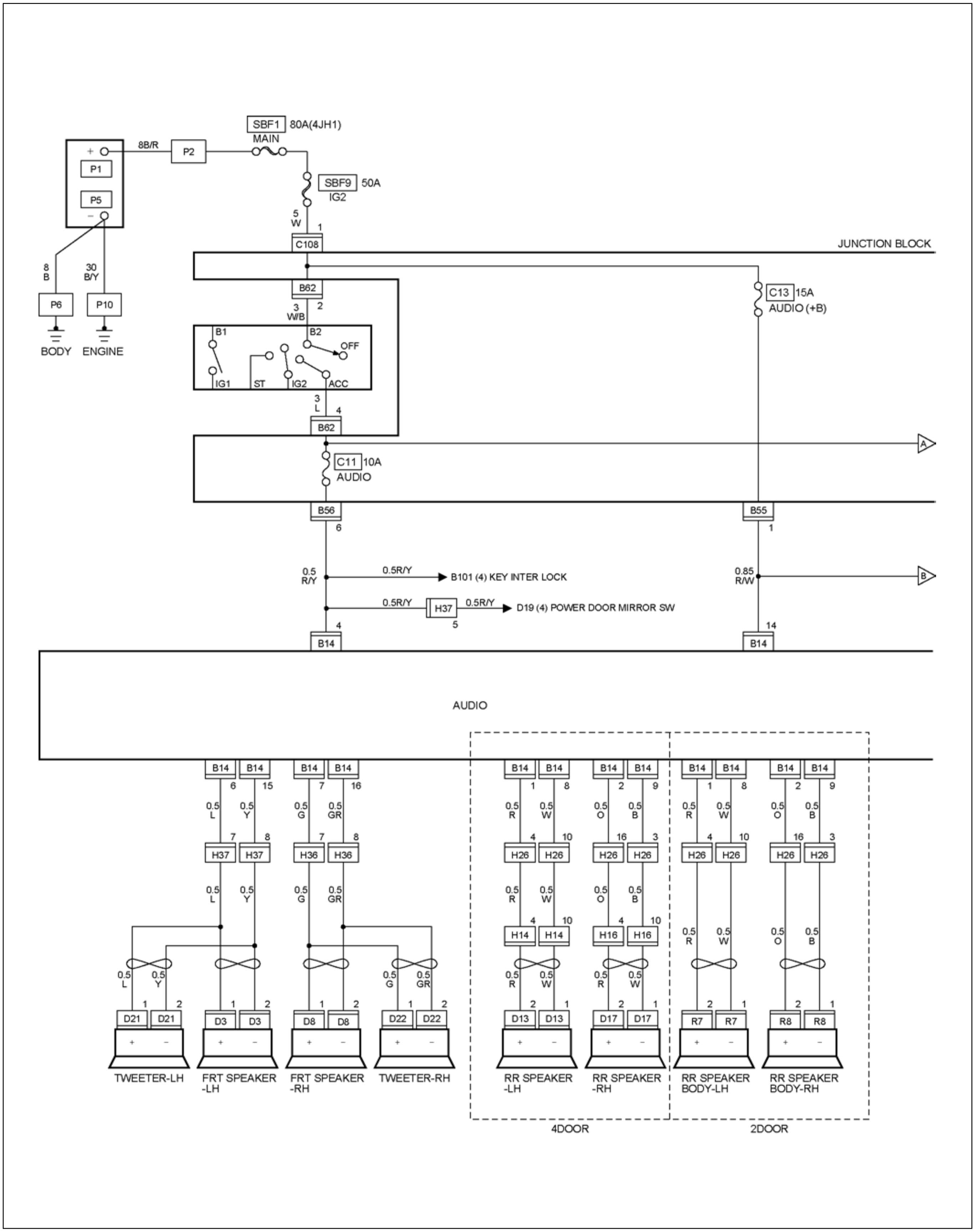


RTW78AXF018101

4JH1-TC



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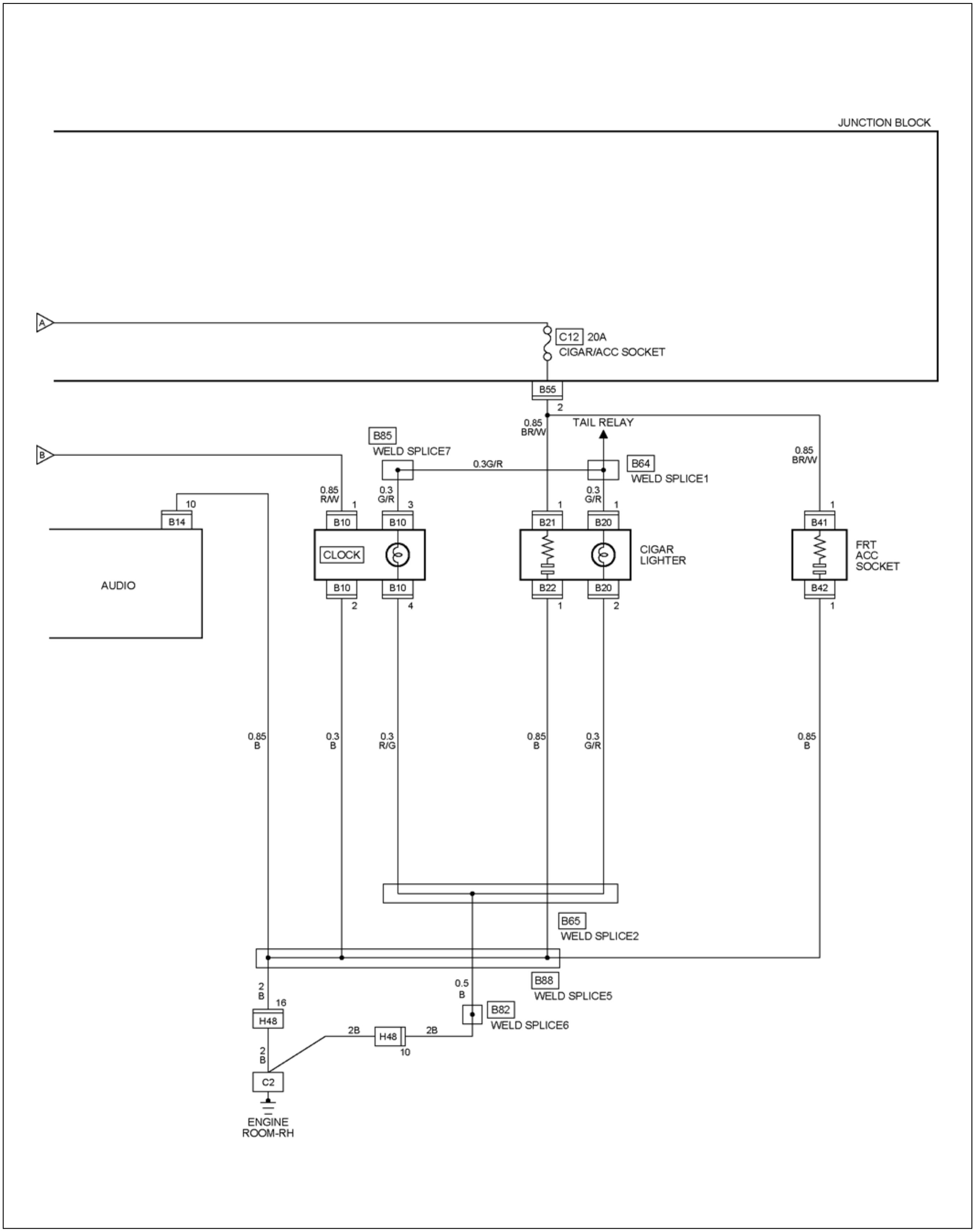

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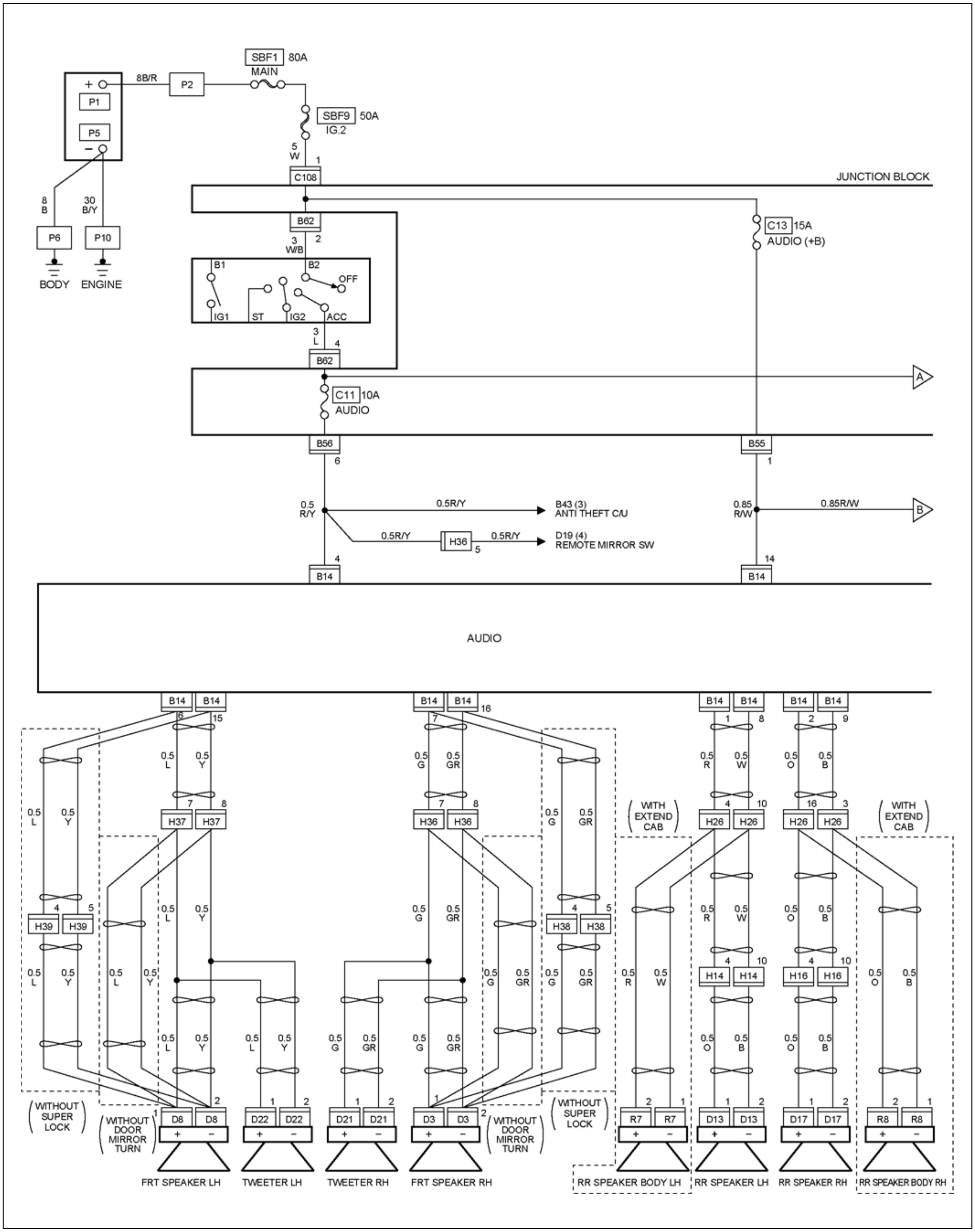
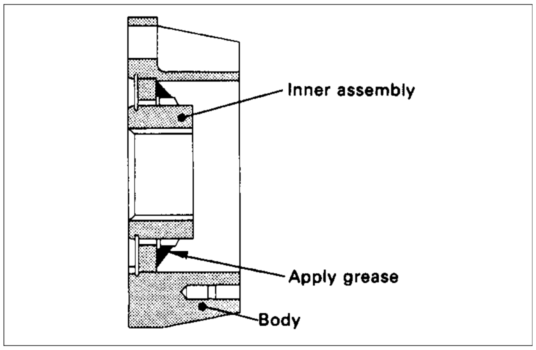
4JA1-L (RHD)



RTW78AXF006501



Important Operations

1. Spacer

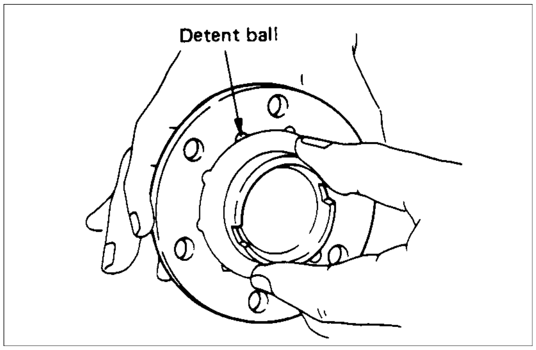
Apply grease to both faces of spacer.

4. Inner Assembly

Apply grease wheel bearing to inside face of ring.

g(oz)

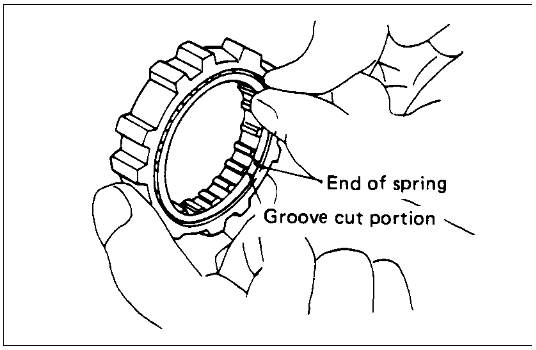
Amount of grease	6 (0.21)



7. Knob

(1) Apply grease Wheel bearing to outer circumference of knob and inner circumference of cover.

(2) Align detent ball to either groove of cover.

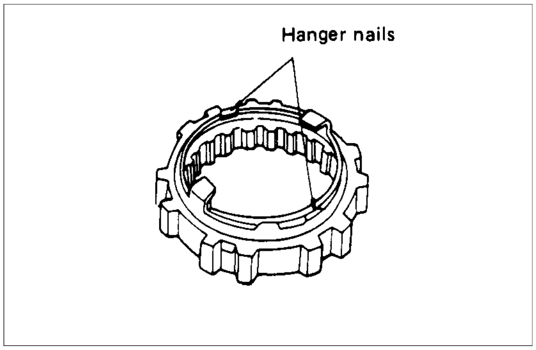


8. Snap Ring

Turn the smoother face to knob side.

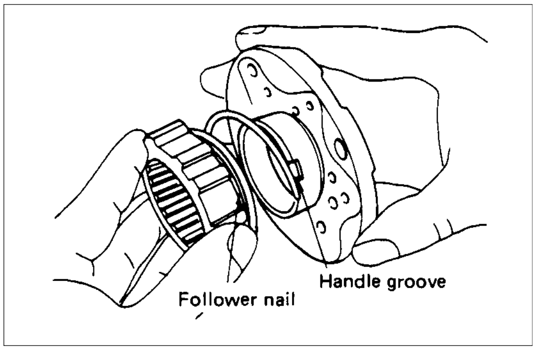
9. Retaining Spring

Align the end of spring to the end of cut portion of clutch spring groove.



10.Follower

Install follower to clutch so that follower nail will come closer to the bent portion of retaining spring by aligning follower stopper nail to outer teeth of clutch. Then, hook retaining spring onto upper portion of hanger nails of follower.

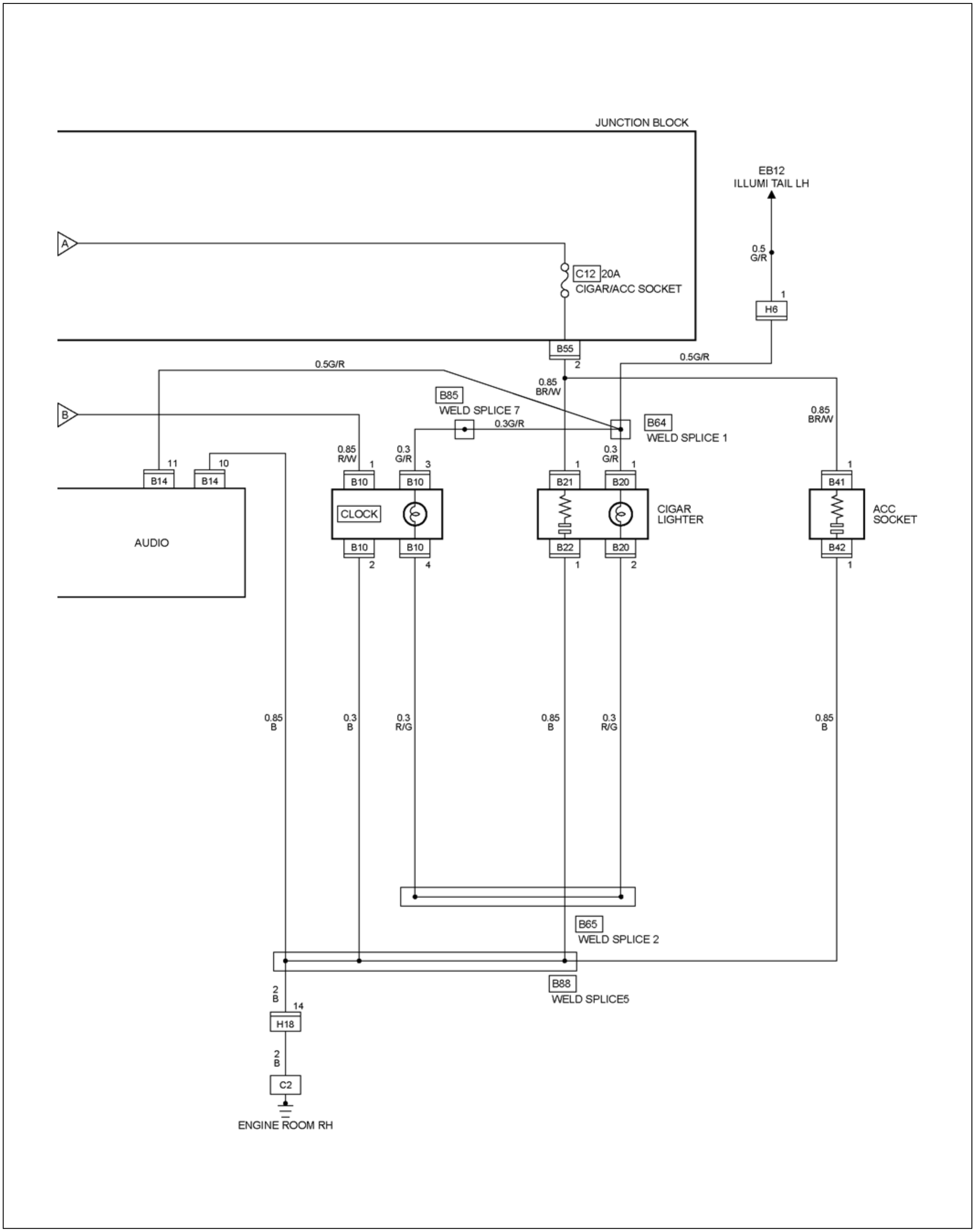


11.Compression Spring

Turn the smaller diameter side to follower.

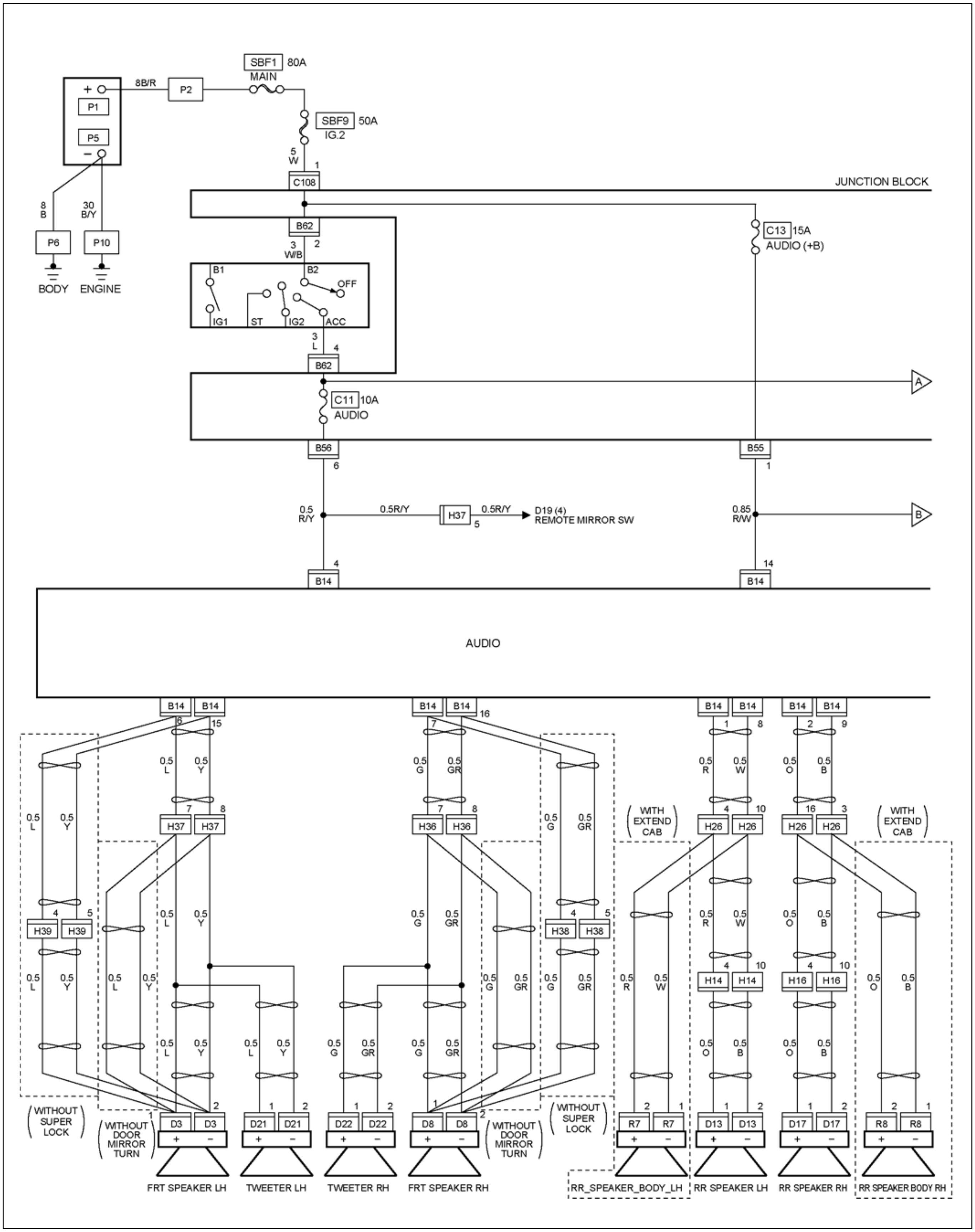
12.Clutch Assembly

Align follower nail to handle groove, and then assemble clutch with knob by pushing and turning clutch counterclockwise to knob.



RTW78AXF006601

4JA1-L (LHD)



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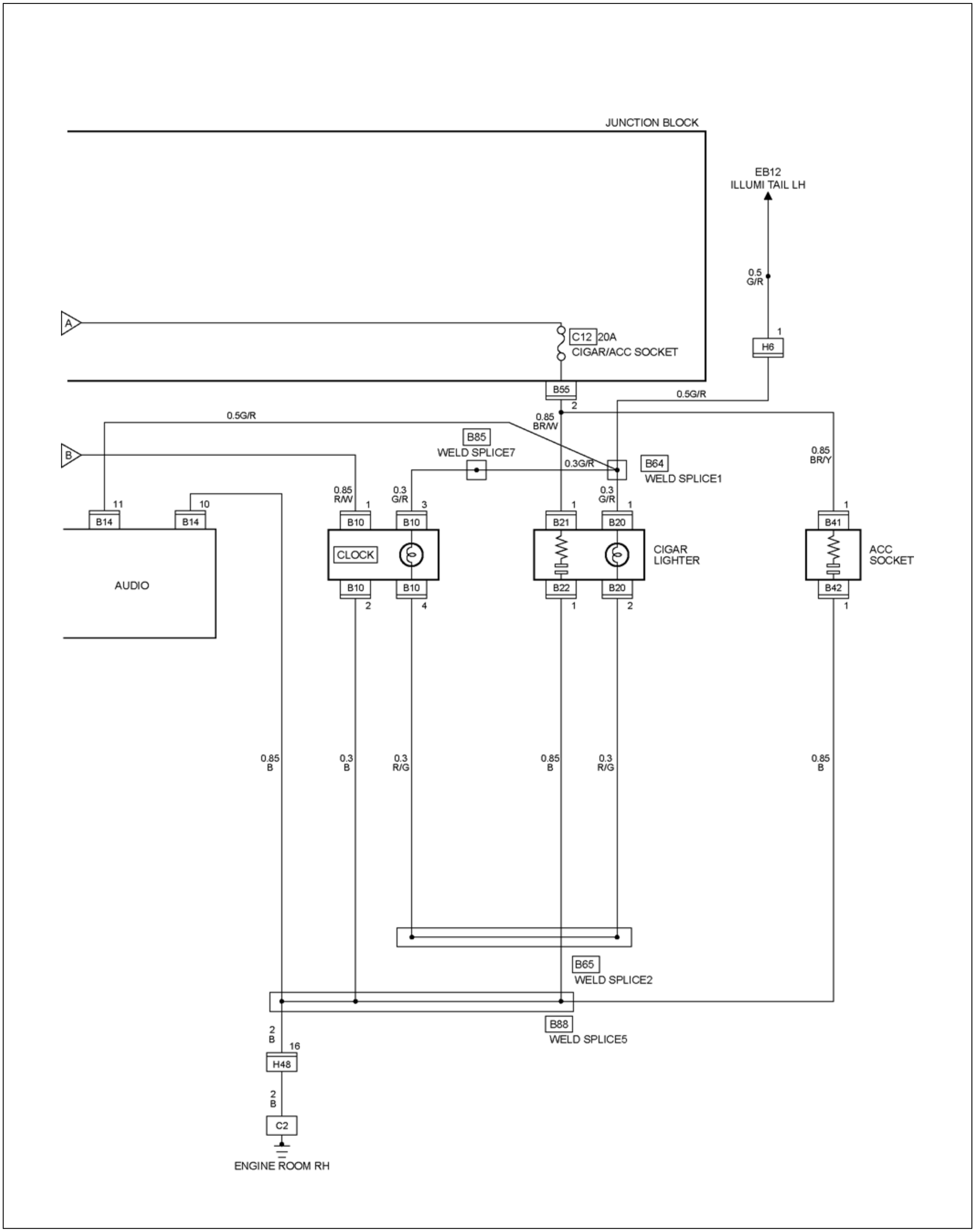

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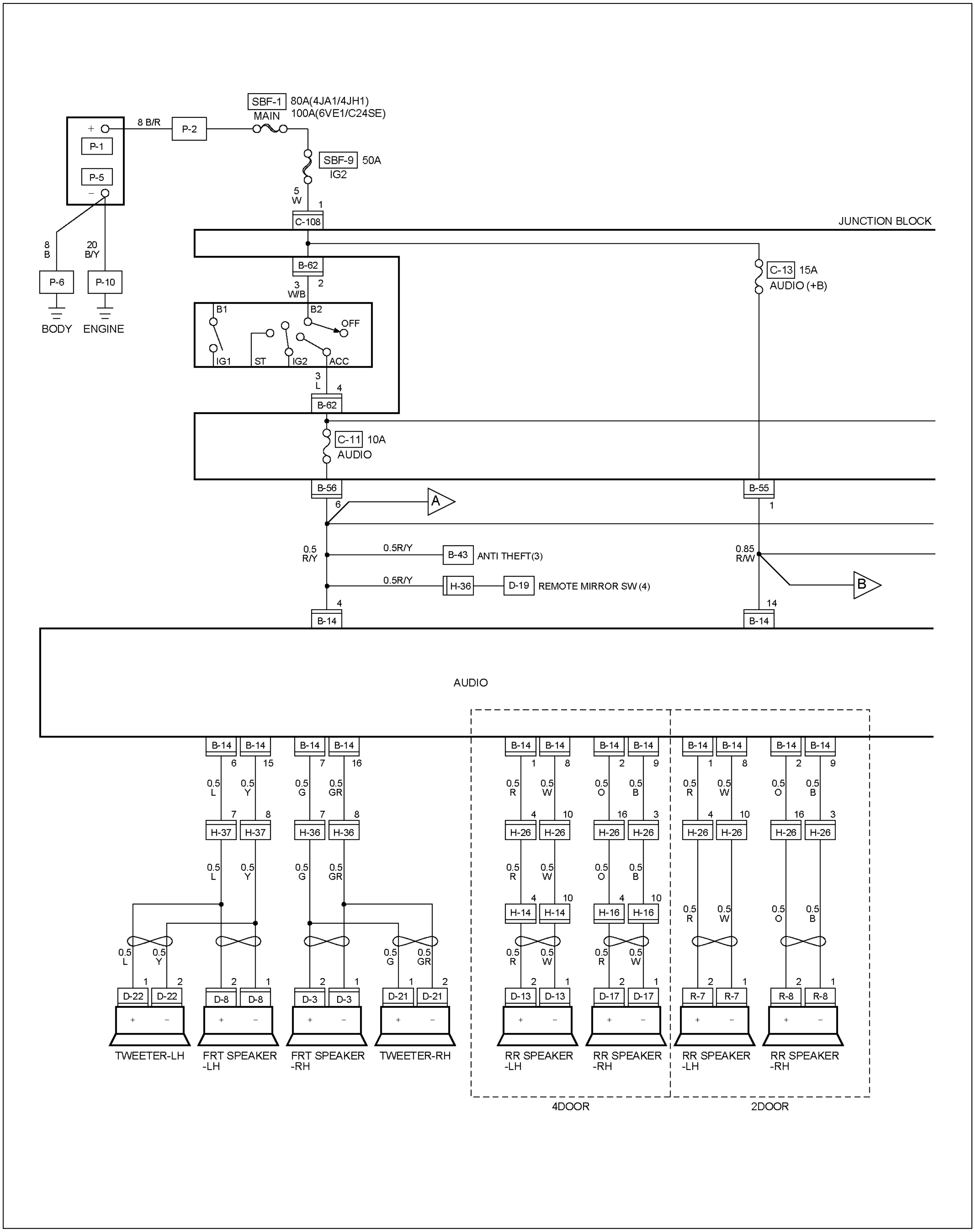
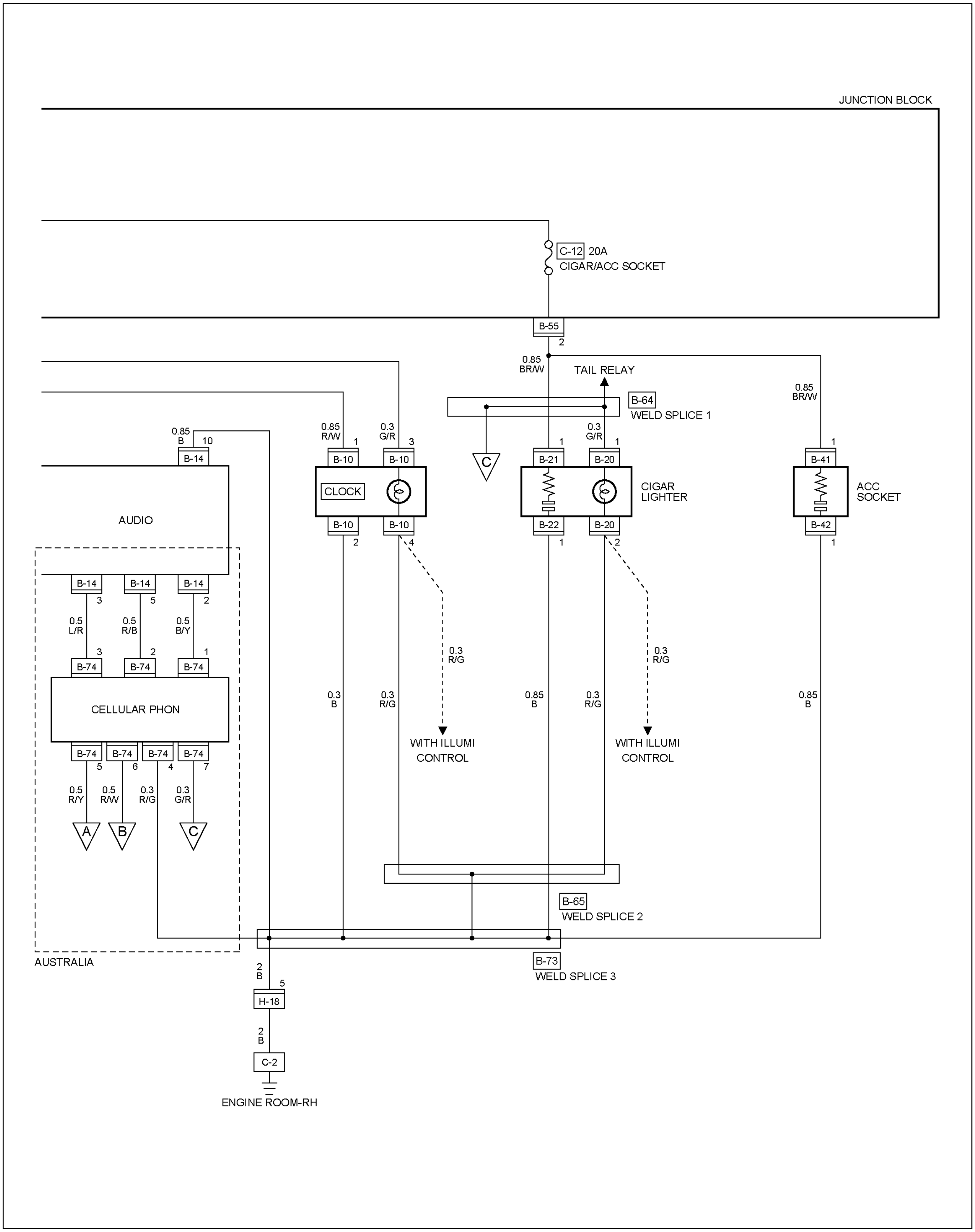
C24SE (RHD)



RTW680XF013201



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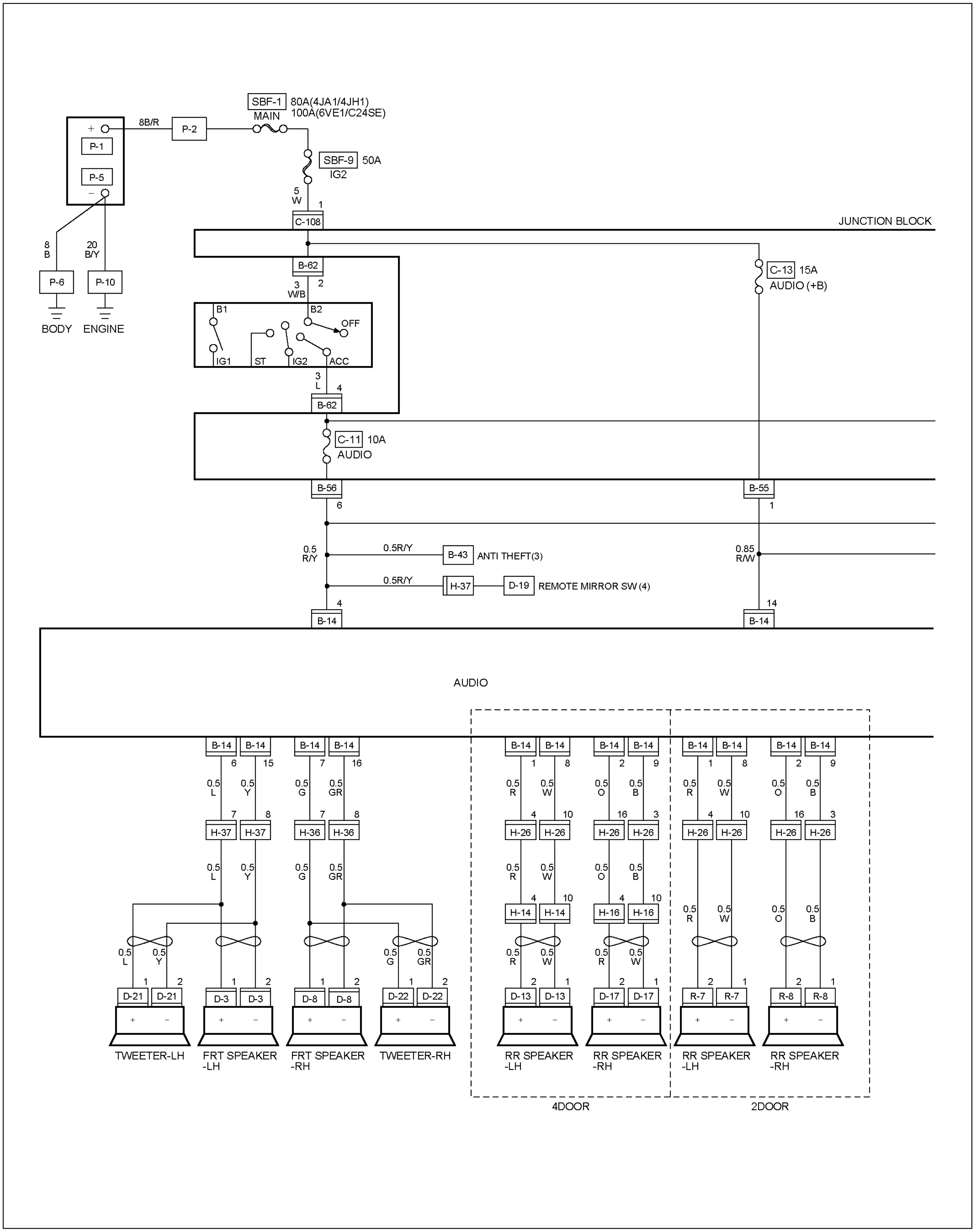
C24SE (LHD)



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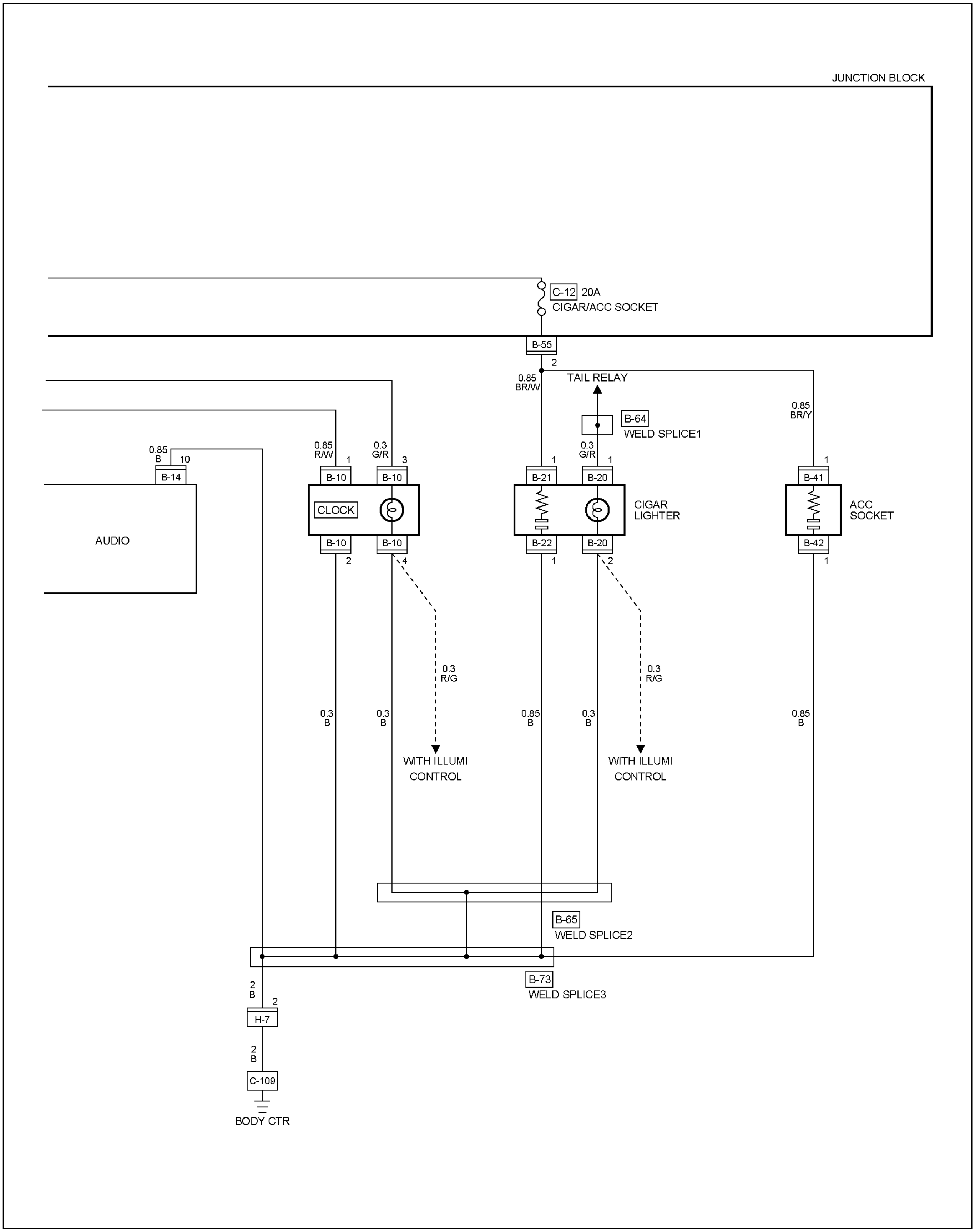
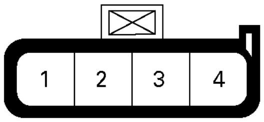
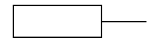
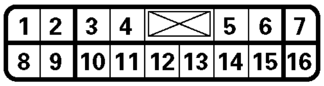
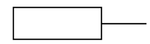
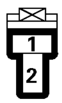
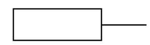
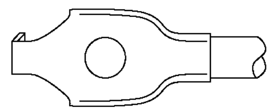
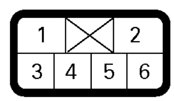
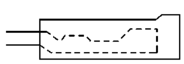
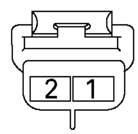
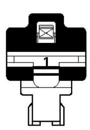
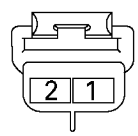
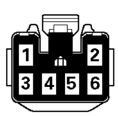
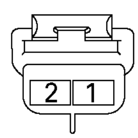
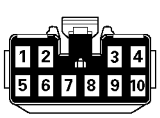
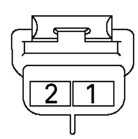
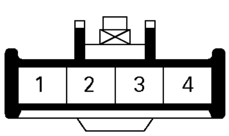
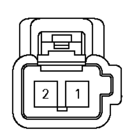
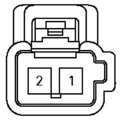
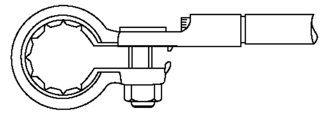
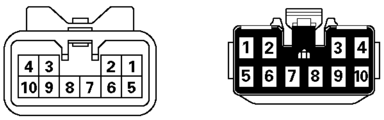
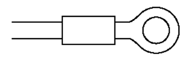
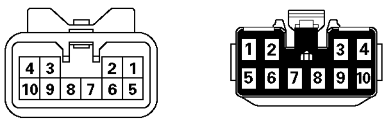
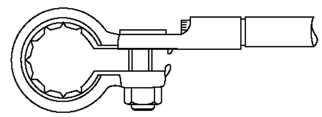
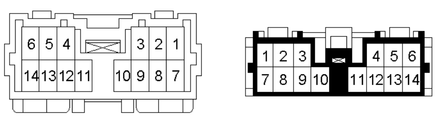
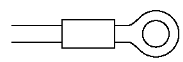
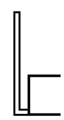
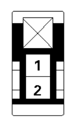
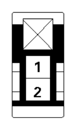
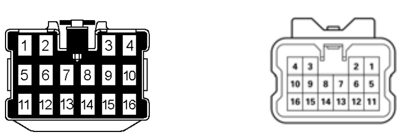
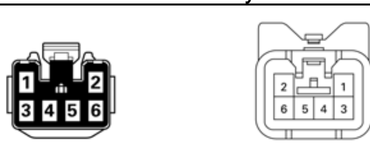


RTW680XF013501

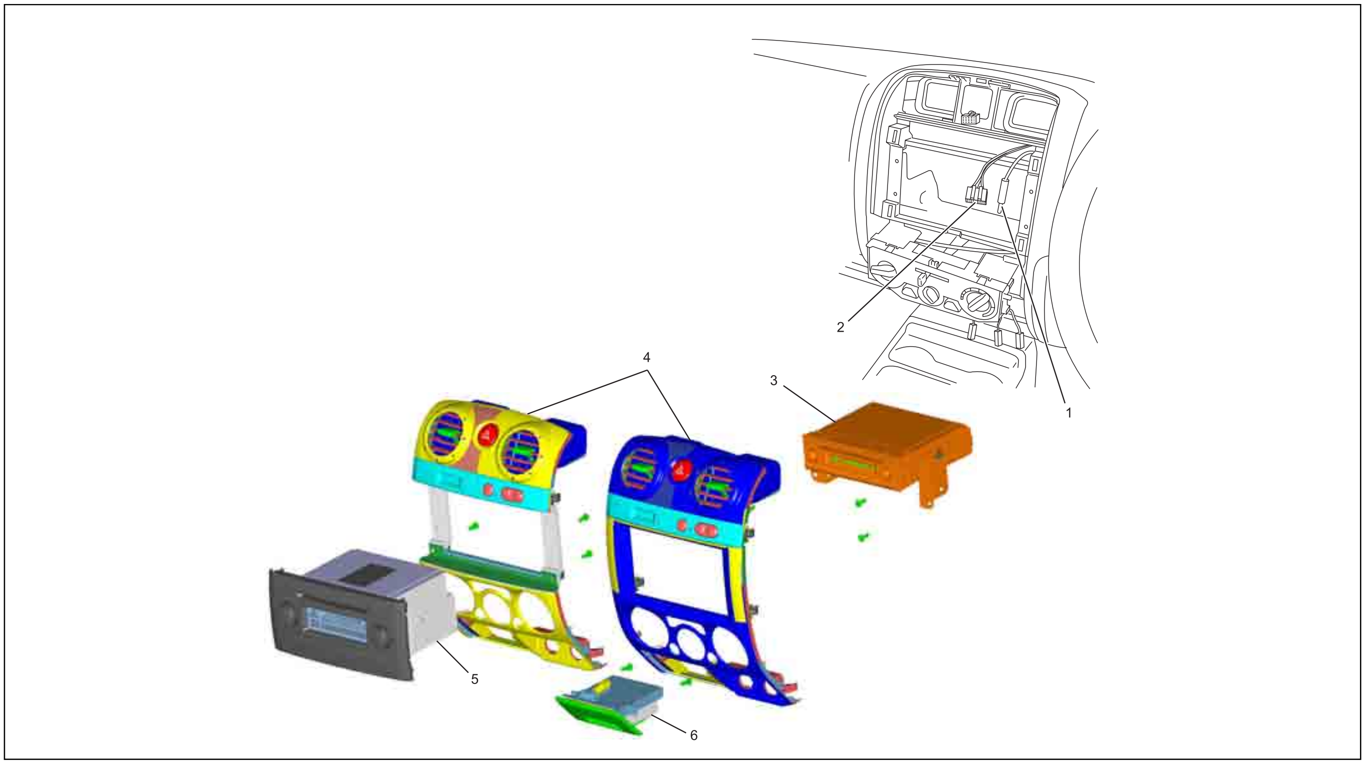
CONNECTOR LIST

No.	Connector face	No.	Connector face
B-10 White	 Clock	B-64 Silver	 Weld splice 1 (Illumination)
B-14 Gray	 Audio	B-65 Silver	 Weld splice 2 (Ground)
B-20 White	 Cigar lighter illumination	B-88 Silver	 Weld splice 5
B-21 White	 Cigar lighter	C-2 Silver	 Engine room –RH ground
B-22 Black	 Cigar lighter	C-108 White	 J/B E1
B-41 White	 Acc socket	D-3 Black	 Front speaker -RH
B-42 White	 Acc socket	D-8 Black	 Front speaker -LH
B-55 White	 J/B I3	D-13 Black	 Rear speaker -LH
B-56 White	 J/B I4	D-17 Black	 Rear speaker -RH
B-62 White	 Ignition switch (IGSUB: G1)	D-21 White	 Tweeter -RH

No.	Connector face	No.	Connector face
D-22 White	 Tweeter -LH	P-1 Silver	 Battery (+)
H-14 White	 Rear body ~ Rear door -LH	P-2 Silver	 Relay & Fuse box
H-16 White	 Rear body ~ Rear door -RH	P-5 Silver	 Battery (-)
H-18 White	 Engine room ~ INST	P-6 Silver	 Body earth
H-36 White	 INST ~ Front door-RH	P-10 Silver	 Engine ground
H-37 White	 INST ~ Front door-LH	R-7 Black	 Rear speaker -LH
H-39 White	 INST ~ Front door-LH	R-8 Black	 Rear speaker -RH
H-42 White	 INST ~ Front door-driver		
H-43	 INST ~ Body		
H-43 White	 INST ~ Body		

AUDIO

REMOVAL AND INSTALLATION



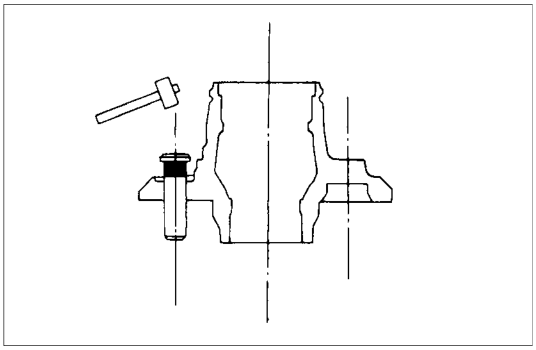
RTW790LF000101

Removal

1. Remove the ash try (6).
2. Remove the center cluster cover assembly (4).
3. Disconnect the connector for the clock, the 4×4 switch, the hazard switch.
4. Remove the 4 screws on the Audio.
5. Disconnect the connector for Audio (2).
6. Disconnect the Antenna feeder plug (1).
7. Pull out the audio (2 DIN: 5, 1 DIN: 3).

Installation

To install, follow the removal steps in the reverse order.

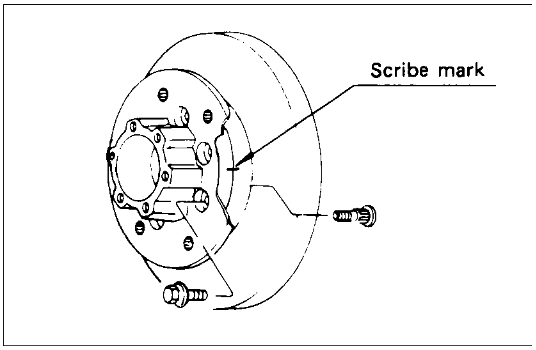


13. Wheel Pin

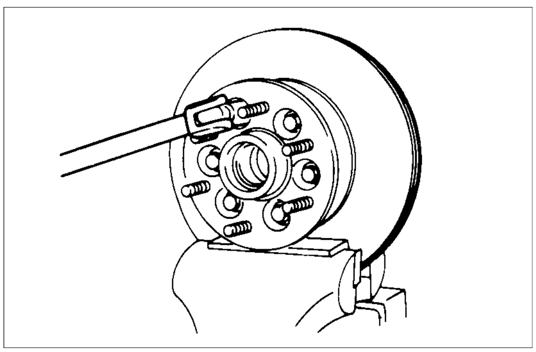
(1) Place hub on a wood workbench or a block of wood, approx. 6” by 6” to protect the wheel stud ends and threads.

(2) Install wheel stud using a hammer.

Be sure wheel stud is started squarely and seats completely.



(3) Align index marks and install hub to disc.



14. Bolt

Torque	N·m (kgf·m/lb·ft)
103 (10.5/76)	

15. ABS sensor rotor

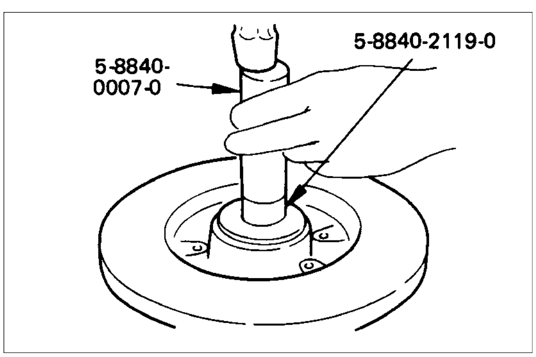
(1) Set a new ABS sensor rotor, if replacement is required.

(2) Install the ABS sensor rotor in the hub, using special tools.

Installer : 5-8840-2789-0

Grip : 5-8840-0007-0

Refer to the section Brake.



16. Inner Bearing

Outer race ; outer bearing

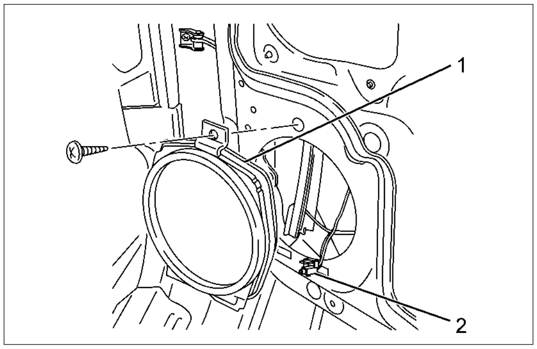
Install the outer race by driving it into the hub.

Installer : 5-8840-2119-0

Grip : 5-8840-0007-0

FRONT SPEAKER

REMOVAL AND INSTALLATION



Removal

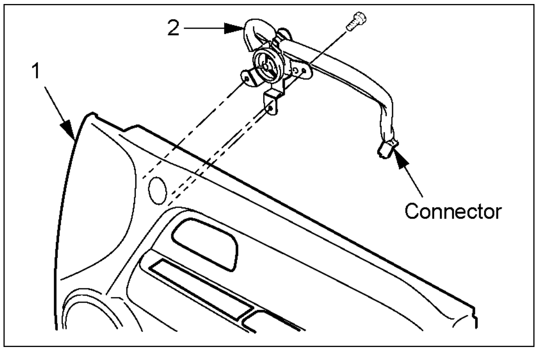
1. Remove the Front Door Trim Panel.
   - Refer to section 10 Cab for door trim panel removal steps.
2. Remove the Front Speaker (1).
   - Remove the screw.
   - Disconnect the connector (2).

Installation

To install, follow the removal steps in the reverse order.

TWEETER

REMOVAL AND INSTALLATION



RTW390SH000101

Removal

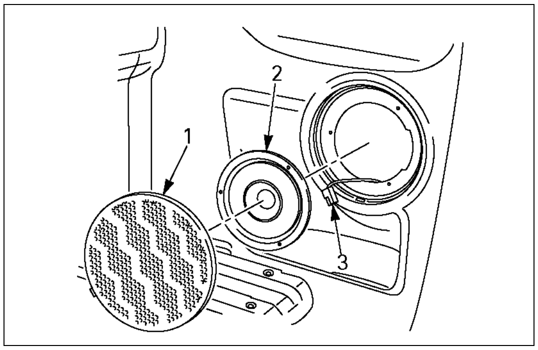
1. Remove the Door Trim Panel (1).
   - Refer to section 10 “FRONT DOOR ASSEMBLY” for door trim panel removal steps.
2. Remove the Tweeter (2).
   - Remove the three screws.
   - Disconnect the connector.

Installation

To install, follow the removal steps in the reverse order.

REAR SPEAKER (EXTEND CAB)

REMOVAL AND INSTALLATION



Removal

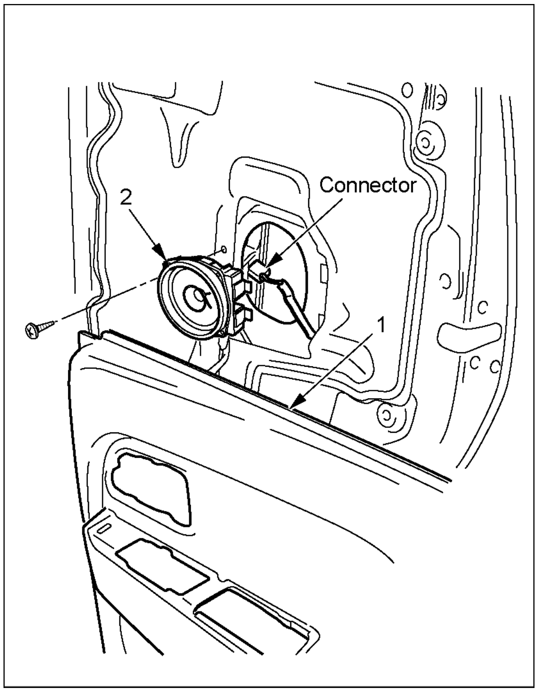
1. Remove the Speaker Grille.
   - Pull the grille (1) to release the locks.
2. Remove the Rear Speaker (2).
   - Remove the three screws.
   - Disconnect the connector (3).

Installation

To install, follow the removal steps in the reverse order.

REAR SPEAKER (CREW CAB)

REMOVAL AND INSTALLATION



RTW390MH000101

Removal

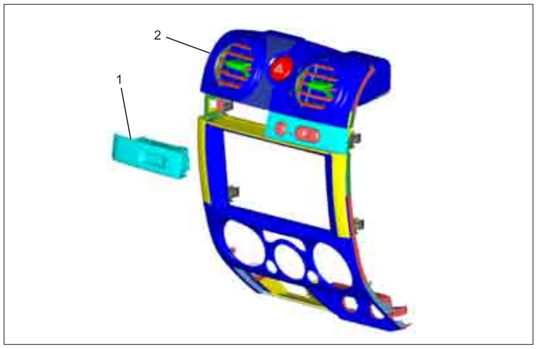
1. Remove the Rear Door Trim Panel (1).
   - Refer to section 10 “REAR DOOR ASSEMBLY” for door trim panel removal steps.
2. Remove the Rear Speaker (2).
   - Remove the screw.
   - Disconnect the connector.

Installation

To install, follow the removal steps in the reverse order.

CLOCK

REMOVAL AND INSTALLATION



RTW790SH000101

Removal

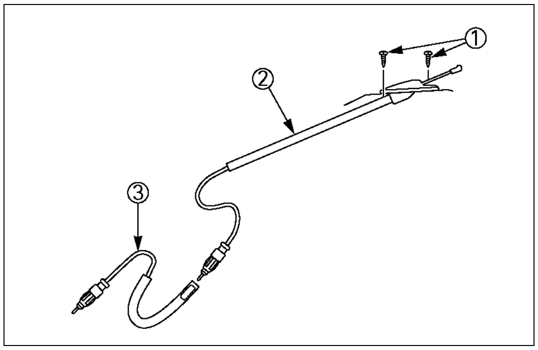
1. Remove the center cluster ASM (2).
2. Disconnect the connector.
3. Remove the clock (1).

Installation

To install, follow the removal steps in the reverse order.

ANTENNA

REMOVAL AND INSTALLATION



Removal

1. Remove the antenna screw ①.
2. Disconnect the feeder cable ③ connector.
3. Remove the antenna cable ②.
4. Pull out the antenna downward.

Remove and install the antenna as illustrated.
The antenna unit is located on the roof panel driver's side.
To install, follow the removal steps in the reverse order.

Installation

To install, follow the removal steps in the reverse order.

SECTION 9A

SUPPLEMENTAL RESTRAINT SYSTEM (SRS)

TABLE OF CONTENTS

PAGE 2 OF 3

PAGE

Service Precaution

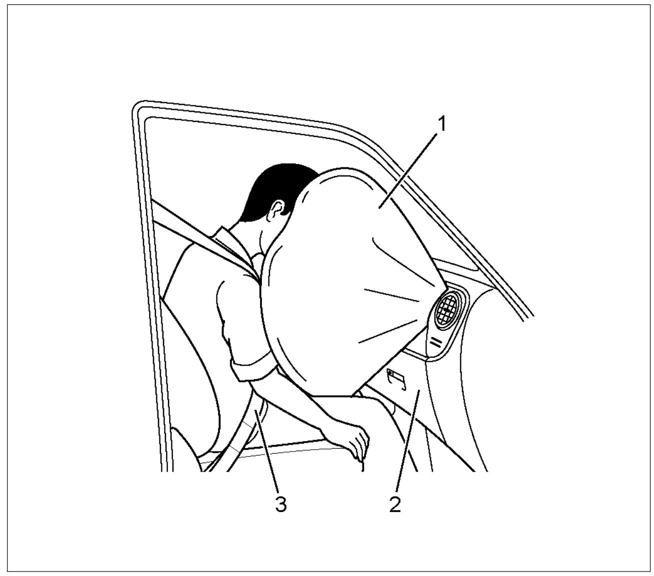
WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING A SERVICE ON, OR NEAR, THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING A SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

CAUTION: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

Restraint Devices



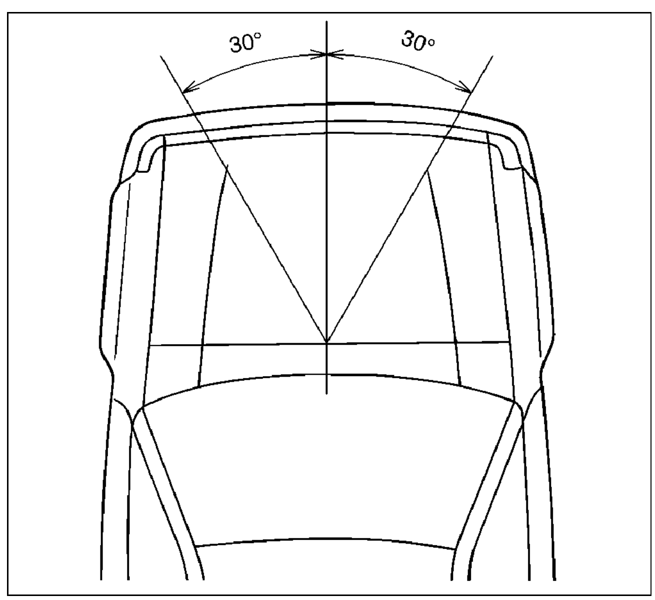
RTW79ASH000801

Legend

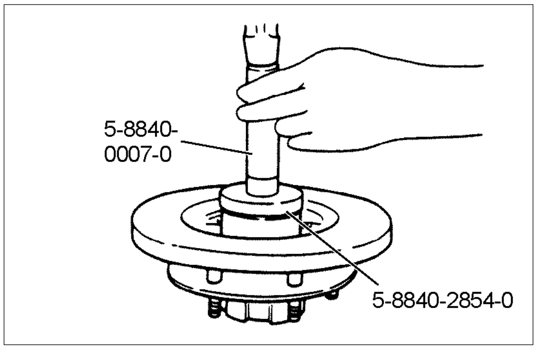
(1) Deployed Air Bag
(2) Knee Bolster
(3) Seat Belt

The Supplemental Restraint System (SRS) helps supplement the protection offered by the driver and front passenger seat belts by deploying an air bag from the center of the steering wheel and from the front of the passenger side of the instrument panel.

The air bag deploys when the vehicle is involved in a frontal crash of sufficient force up to 30 degrees off the centerline of the vehicle. To further absorb the crash energy there is a knee bolster located beneath the instrument panel for both the driver and passenger, and the steering column is collapsible.

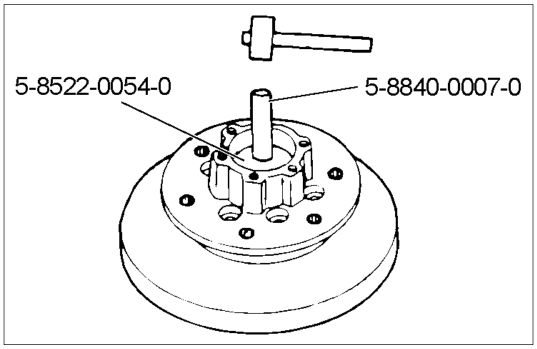


827RW005



RTW74CSH000301

17.Oil Seal
Installer : 5-8840-2854-0
Grip : 5-8840-0007-0
Apply grease (Besco L-2 or equivalent) to the lip portion.
Discard the used oil seal and install a new one.



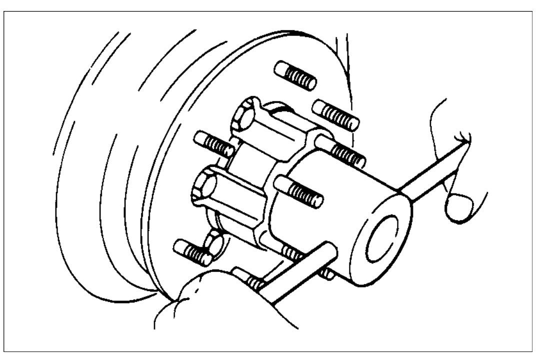
RTW44CSH000201

18.Outer bearing
Outer race ; outer bearing
Install the outer race by driving it into the hub.
Installer : 5-8522-0054-0
Grip : 5-8840-0007-0

19.Hub and Disc Assembly
(1) Apply grease in the hub.
(2) Apply grease (Besco L-2 or equivalent) to the outer and inner bearing.

g(oz)

Hub	35 (1.23)
Outer bearing	10 (0.35)
Inner bearing	15 (0.53)

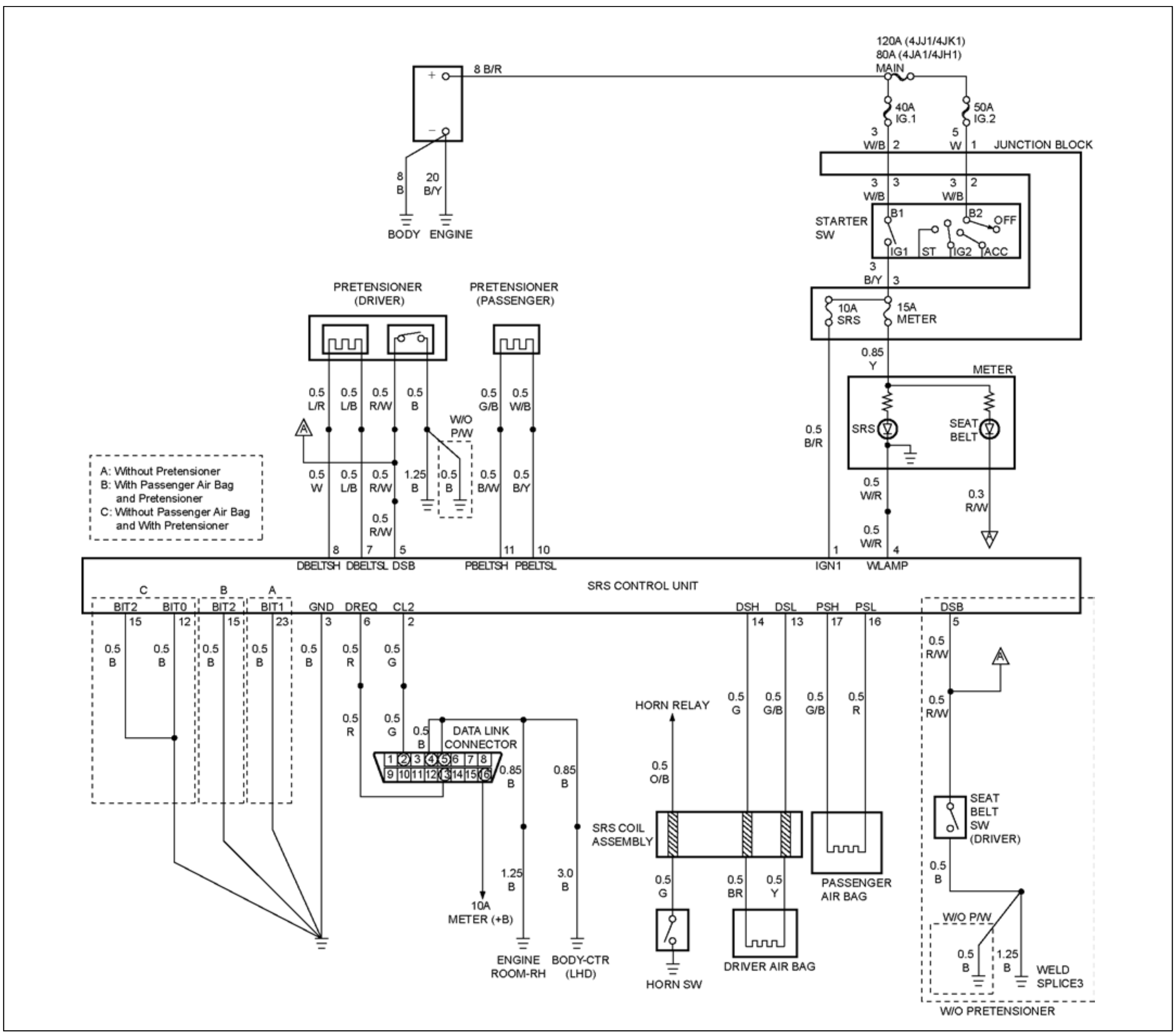


20.Hub Nut
(1) Turn the place where there is a chamfer in the tapped hole to the outer side, and attach the nut.
Wrench : 5-8840-2117-0

System Description

The SRS consists of the SRS control unit, the driver air bag assembly, the SRS coil assembly, the passenger air bag assembly and the “SRS” warning lamp in the instrument cluster. The SRS control unit, SRS coil assembly (driver side only), driver air bag assembly, passenger air bag assembly and connector wire make up the deployment loops. The function of the deployment loops is to supply current through the air bag assembly, which will cause deployment of the air bags in the event of a frontal crash of sufficient force, up to 30 degrees off the centerline of the vehicle. The air bag assemblies are only supplied enough current to deploy when the SRS control unit detects vehicle velocity changes severe enough to warrant deployment.

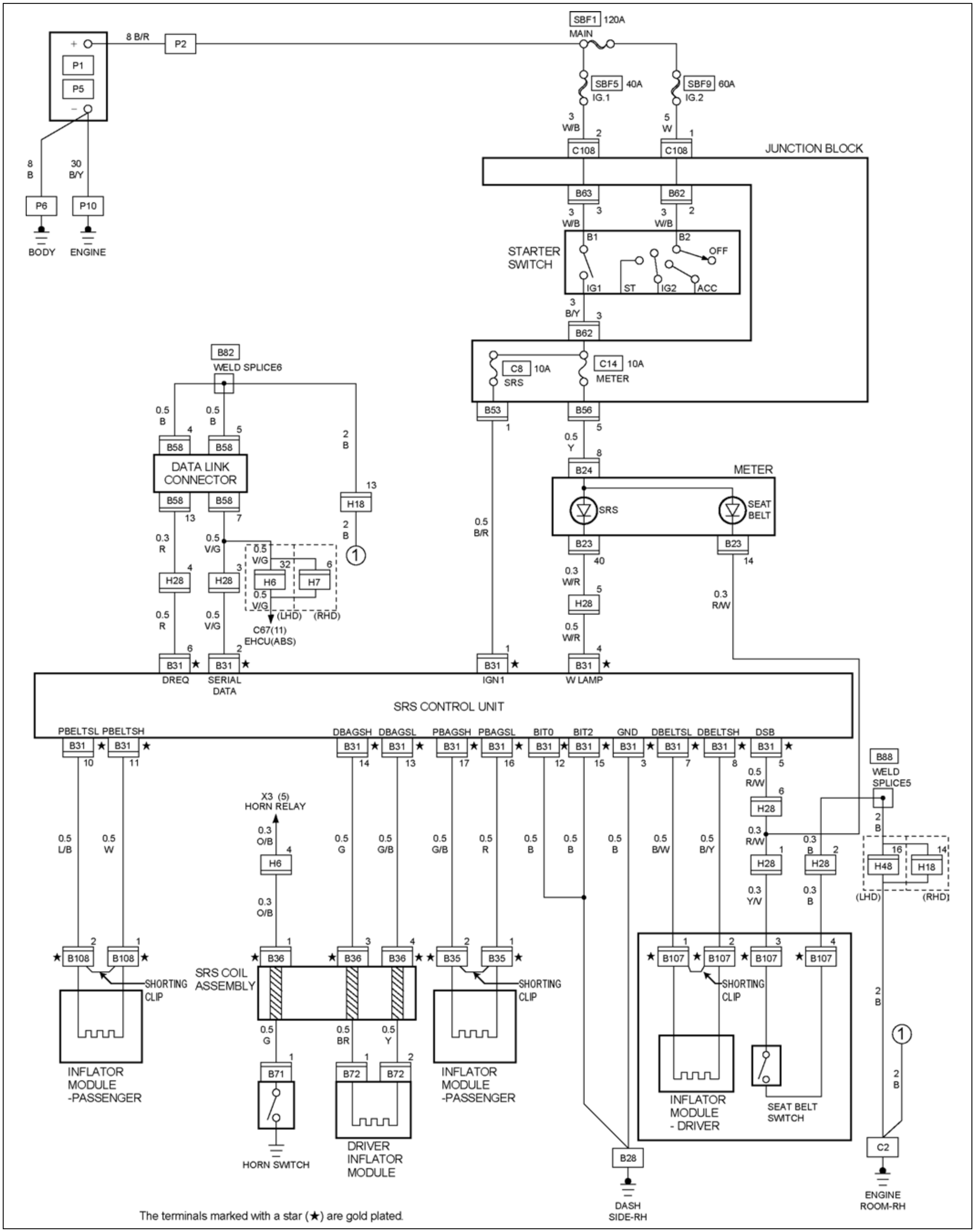
The SRS control unit contains a sensing device which converts vehicle velocity change to an electrical signal. The electrical signal generated is processed by the SRS control unit and then compared to a value stored in memory. When the generated signal exceeds the stored value, the SRS control unit will cause current to flow through the air bag assembly deploying the air bags.



RTW79ALF000301

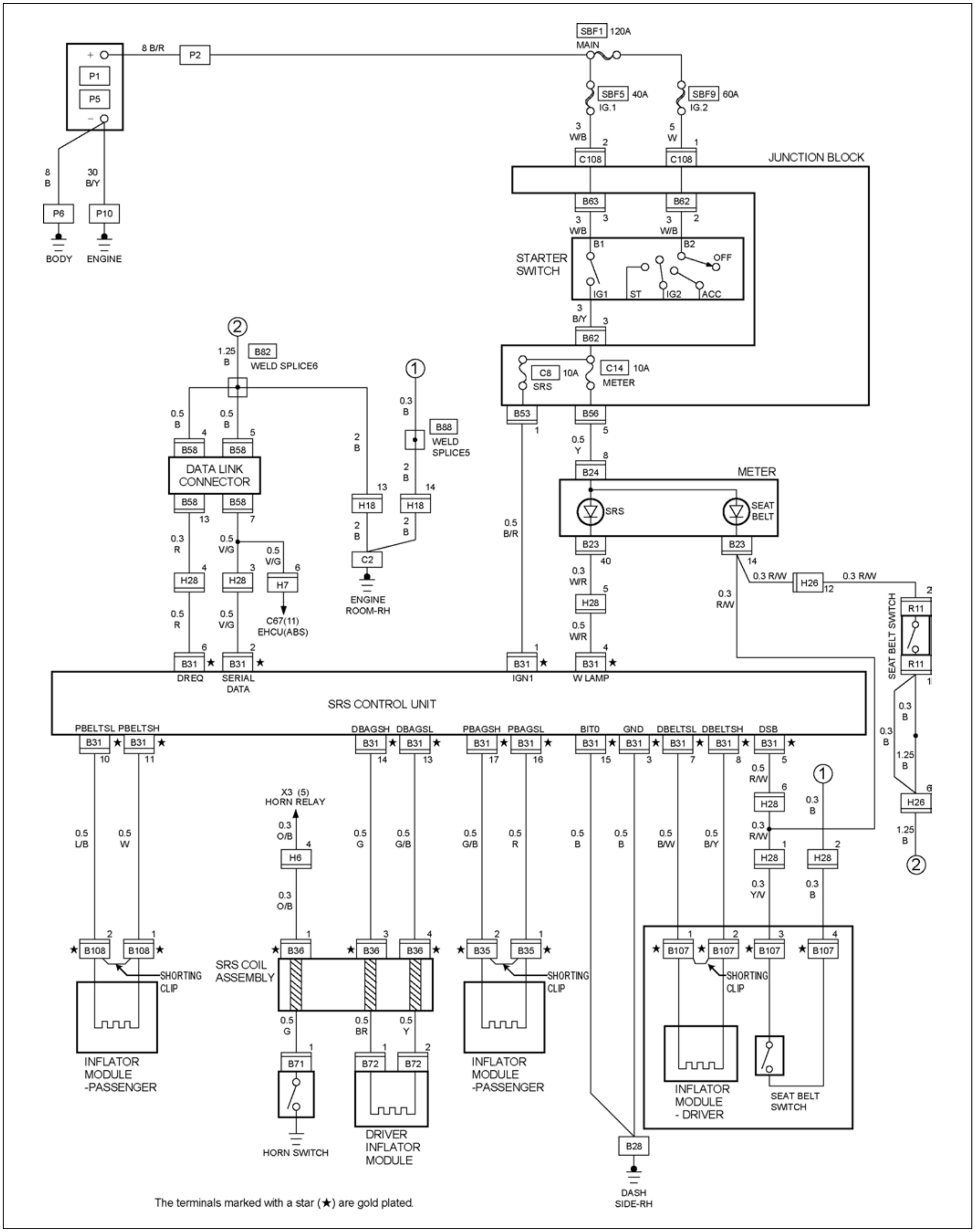
Circuit Diagram

4JJ1-TC, 4JK1-TC (Except South Africa)



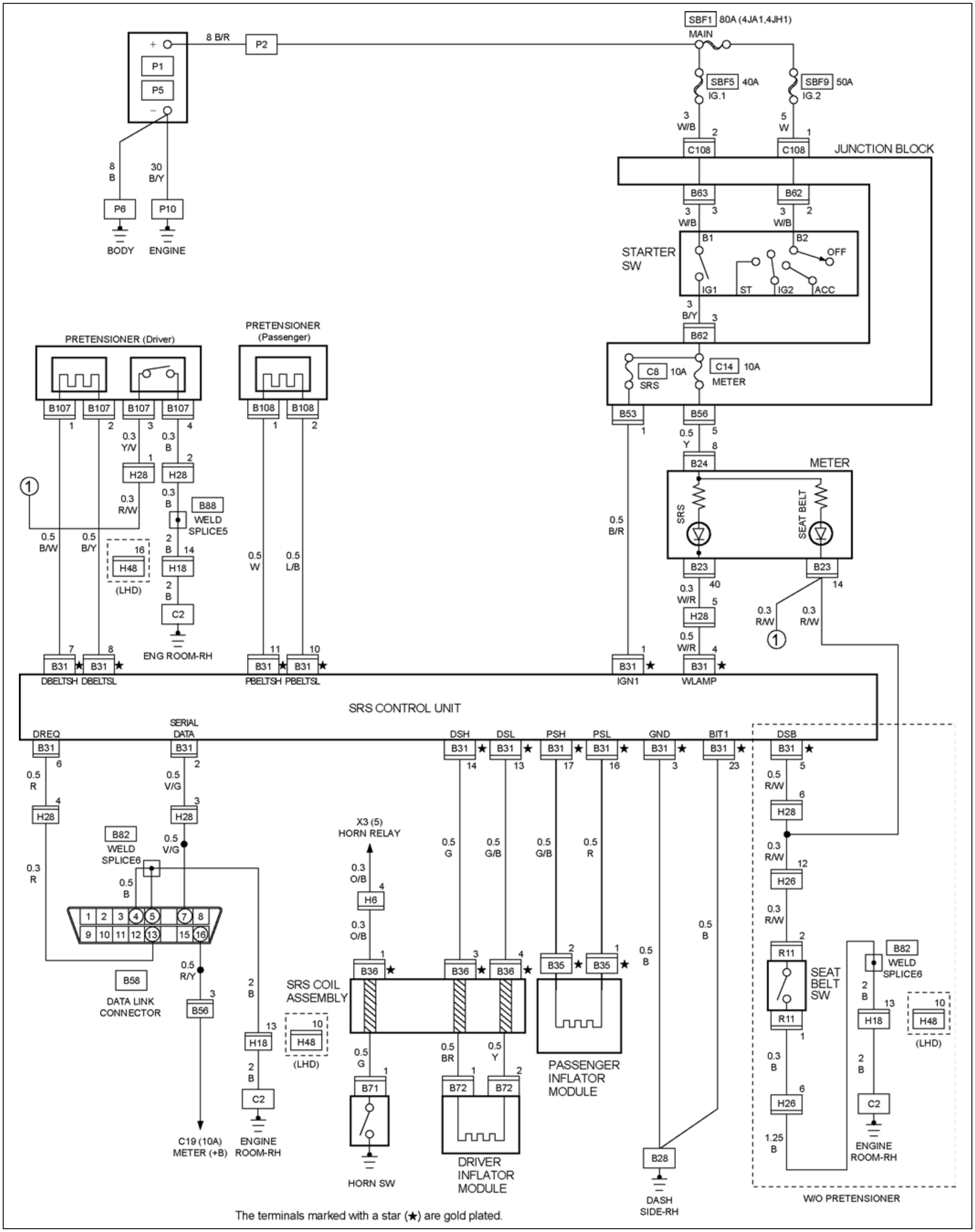
RTW78AXF028601

4JJ1-TC (South Africa)



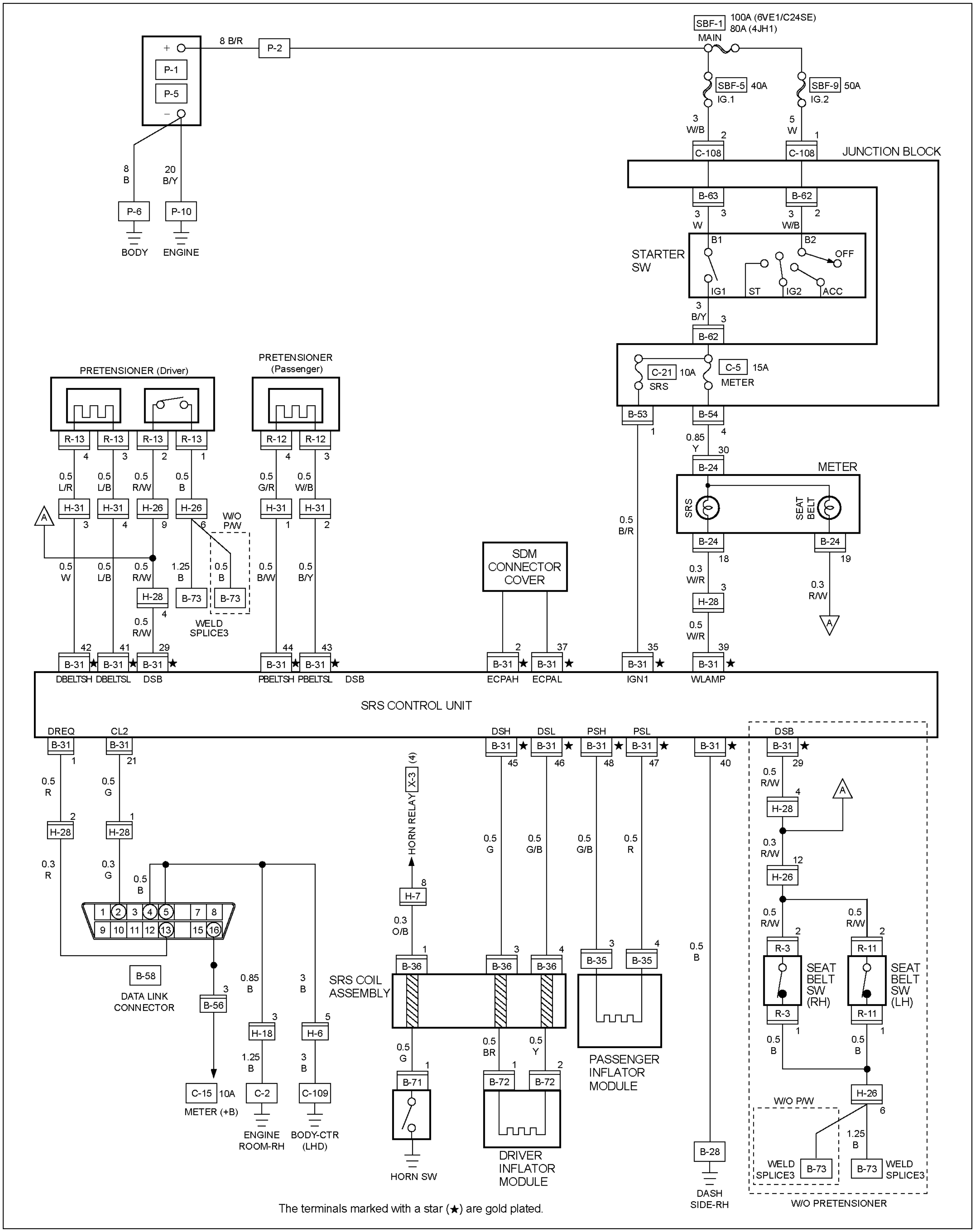
RTW78AXF018601

4JH1-TC, 4JA1-L



RTW78AXF009801

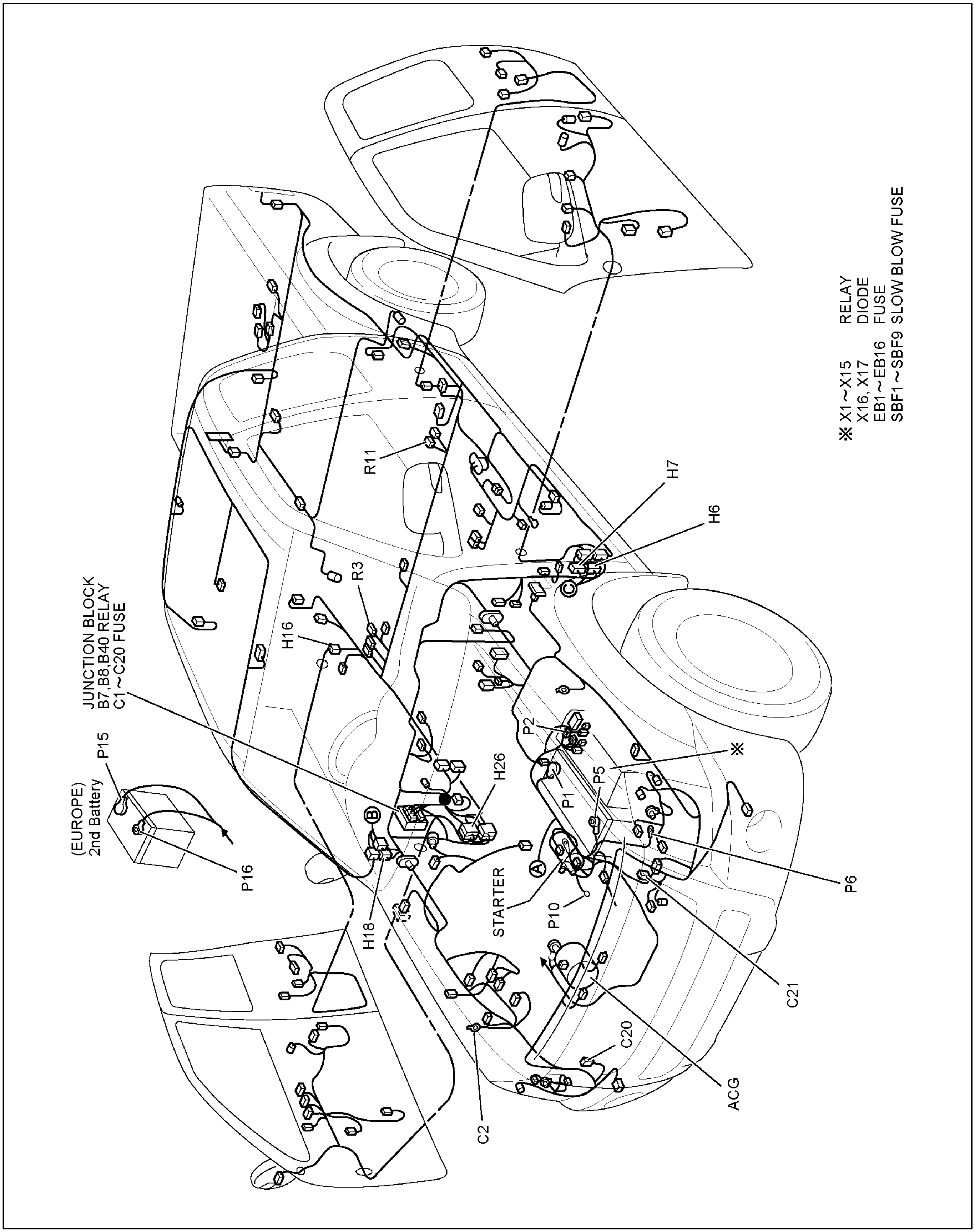
C24SE



RTW680XF014001

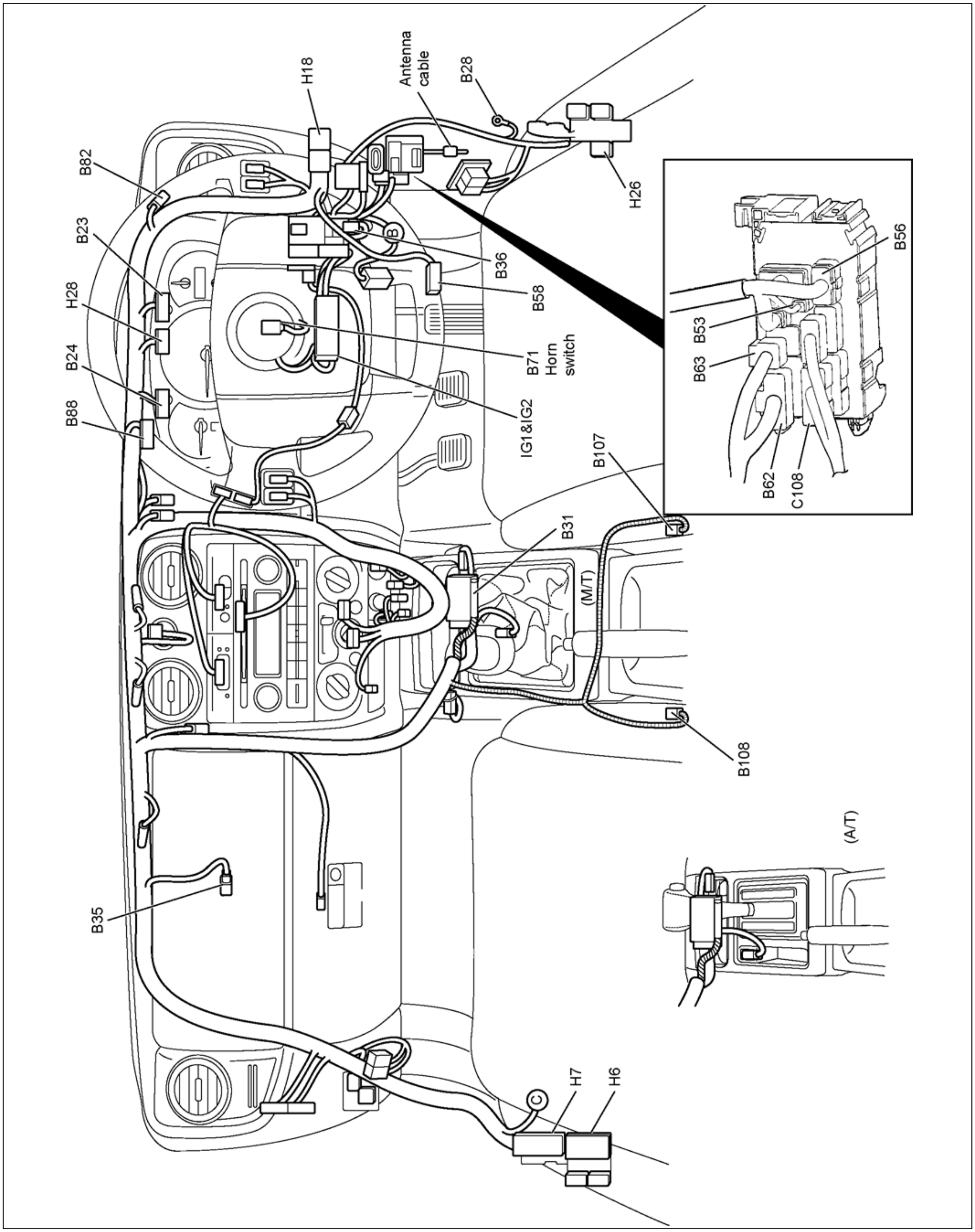
SRS Component And Wiring Location View

Parts Location (RHD) (1)



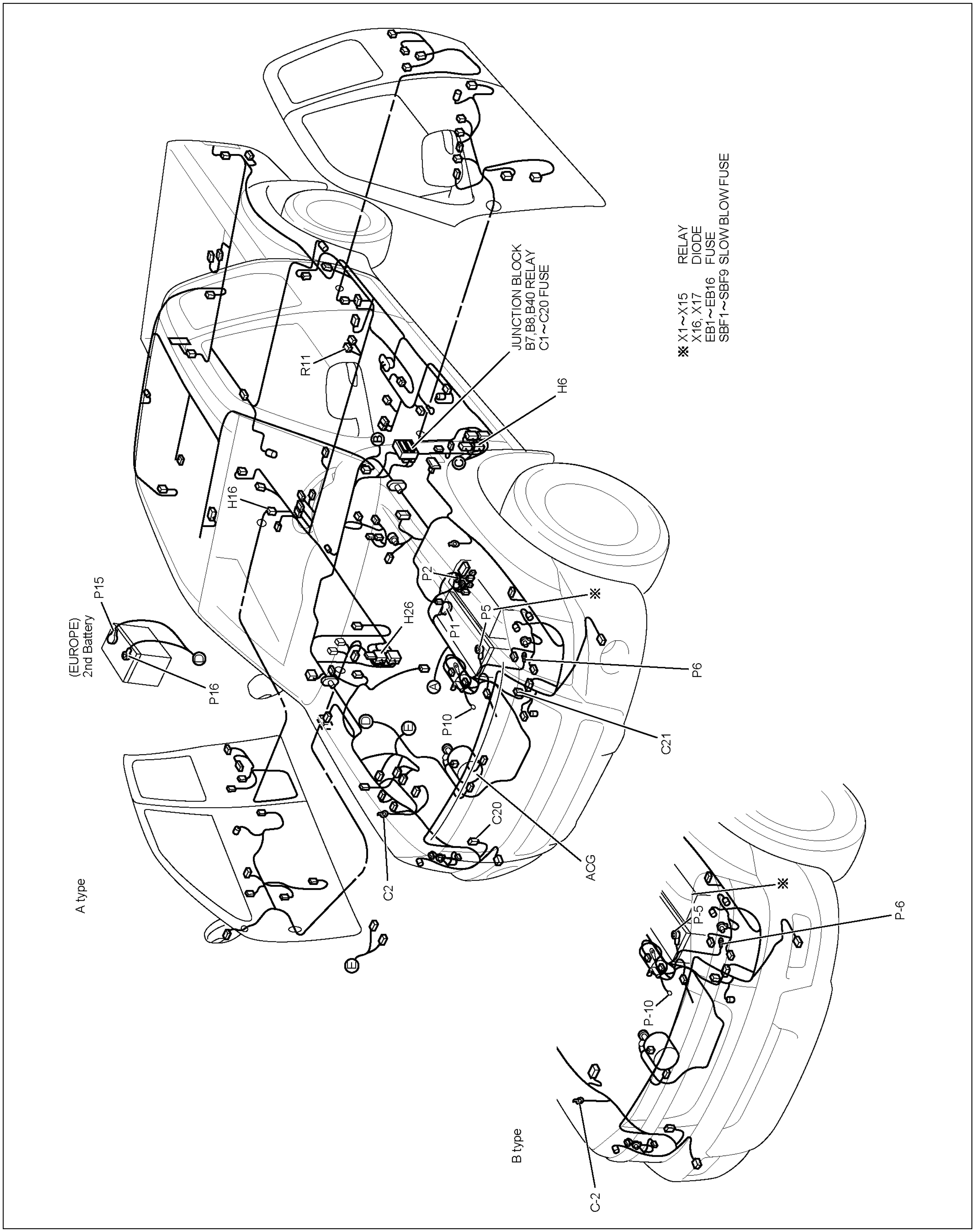
RTW78AXF040301

Parts Location (RHD) (2)



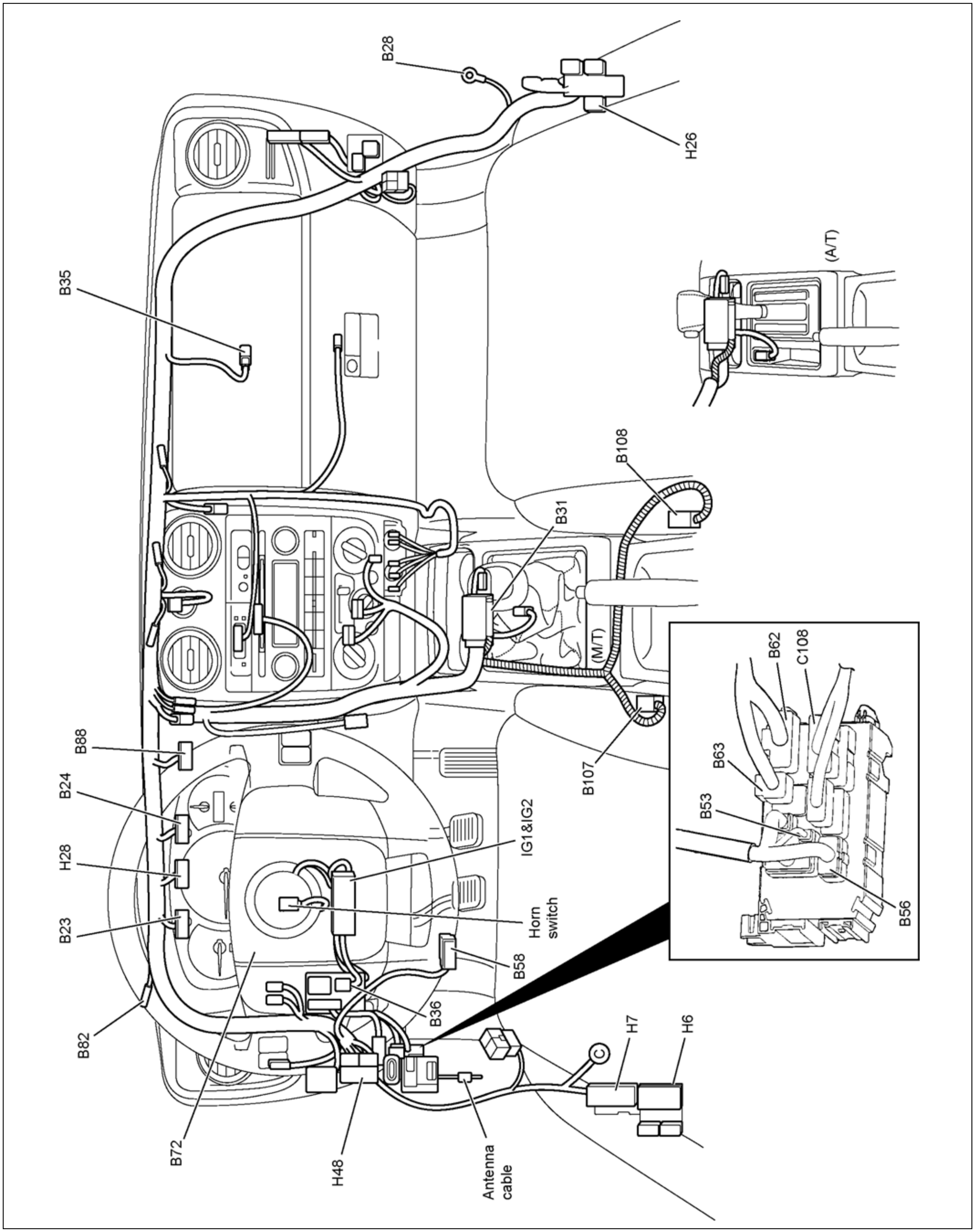
RTW78AXF046501

Parts Location (LHD) (1)



RTW78AXF040401

Parts Location (LHD) (2)



RTW78AXF046601

Component Description

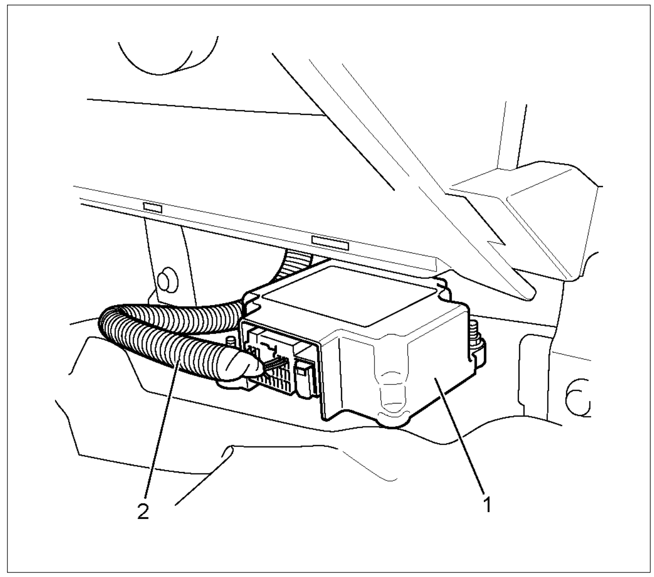
SRS Control Unit

WARNING: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING A SRS CONTROL UNIT. NEVER STRIKE OR JAR THE SRS CONTORL UNIT. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SRS CONTROL UNIT AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTED TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SRS. THE SRS CONTROL UNIT COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.

The SRS control unit is designed to perform the following functions in the SRS:

1. Energy Reserve — The SRS control unit maintains 30–Volt Loop Reserve (30VLR) energy supply to provide deployment energy when ignition voltage is lost in a frontal crash.
2. Frontal Crash Detection — The SRS control unit monitors vehicle velocity changes to detect frontal crashes which are severe enough to warrant deployment.
3. Air Bag Deployment — When a frontal crash of sufficient force is detected, the SRS control unit will cause enough current to flow through the air bag assembly to deploy the air bag.
4. Malfunction Detection — The SRS control unit performs diagnostic monitoring of SRS electrical components and sets a diagnostic trouble code when a malfunction is detected.
5. Frontal Crash Recording — The SRS control unit records information regarding SRS status during frontal crash.
6. Malfunction Diagnosis — The SRS control unit displays SRS diagnostic trouble codes and system status information through the use of a scan tool.
7. Driver Notification — The SRS control unit warns the vehicle driver of SRS malfunctions by controlling the “SRS” warning lamp.

The SRS control unit is connected to the SRS wiring harness by a 52–pin connector. This harness connector uses a shorting clip across certain terminals in the contact area. This shorting clip connects the “SRS” warning lamp to ground when the SRS control unit harness connector is disconnected or CPA (Connector Position Assurance) is not inserted even if completely connected. This will cause the “SRS” warning lamp to come “ON” steady whenever the ignition switch is at the ON or START positions with the SRS control unit disconnected.



RTW79ASH000401

Legend

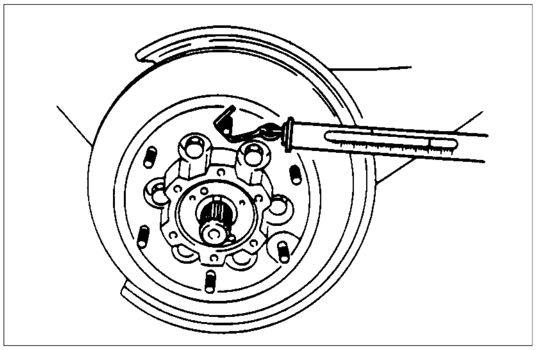
(1) SRS Control Unit
(2) SRS Harness

“SRS” Warning Lamp

Ignition voltage is applied to the “SRS” warning lamp when the ignition switch is at the ON or START positions. The SRS control unit controls the lamp by providing ground with a lamp driver. The “SRS” warning lamp is used in the SRS to do the following:

1. Verify lamp and SRS control unit operation by flashing SEVEN (7) times when the ignition switch is first turned “ON”.
2. Warn the vehicle driver of SRS electrical system malfunctions which could potentially affect the operation of the SRS. These malfunctions could result in nondeployment in case of a frontal crash or deployment for conditions less severe than intended.

The “SRS “ warning lamp is the key to driver notification of SRS malfunctions. For proper lamp operation, refer to the “SRS Diagnostic System Check” in this section.



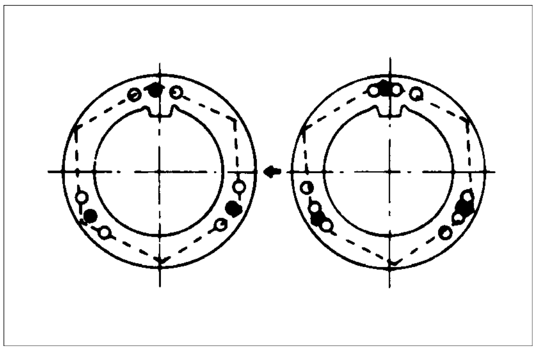
Preload Adjustment

Tighten the hub nut at 29 N·m (3.0 kgf·m / 22 lb·ft), then loosen the nut to the full.

Tighten the hub nut at the value given below, using a spring scale on the wheel pin.

Bearing Preload	N (kgf/lb)
New bearing and New oil seal	22 - 27 (2.2 - 2.8 / 4.9 - 6.2)
Used bearing and New oil seal	14 - 20 (1.4 - 2.0 / 3.1 - 4.5)

If the measured bearing preload is outside the specifications, adjust it by loosening or tightening the bearing nut.

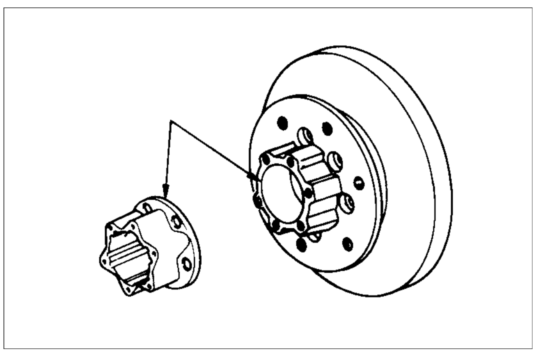


21. Lock Washer

Turn the side with larger diameter of the tapered bore to the vehicle outer side, and attach the washer.

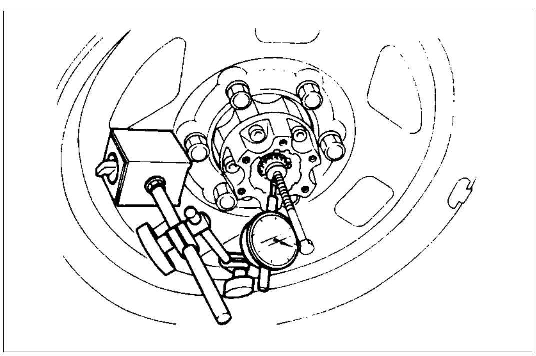
If the bolt holes in the lock plate are not aligned with the corresponding holes in the nut, reverse the lock plate.

If the bolt holes are still out of alignment, turn in the nut just enough to obtain alignment,. Screw is to be fastened tightly so its head may come lower than the surface of the washer.



22. Body Assembly

Apply adhesive (Loctite 515 or equivalent) to the both joining faces.

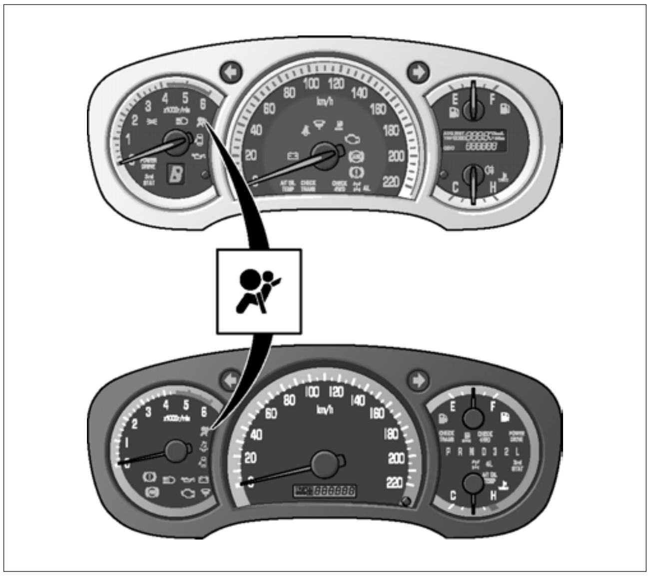


23. Snap Ring and Shims

Adjust the clearance between the free wheeling hub body and the snap ring.

Clearance	mm(in)
0 - 0.2 (0 - 0.08)	

Adjust Shims Available	mm(in)
0.2, 0.3, 0.5, 1.0 (0.008, 0.011, 0.020, 0.039)	



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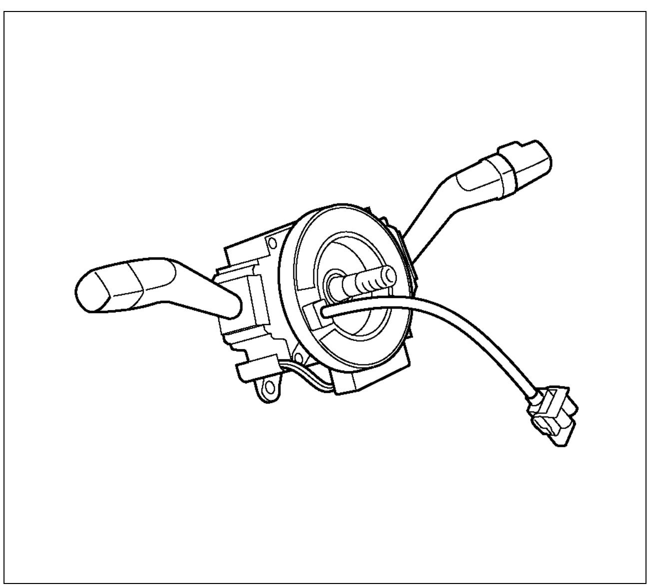
SRS Coil Assembly

The SRS coil assembly consists of two current carrying coils. This is attached to the steering column and allows rotation of the steering wheel while maintaining continuous contact of the driver deployment loop to the driver air bag assembly.

There is a shorting clip on the yellow connector near the base of steering column which connects the SRS coil to the SRS wiring harness.

The shorting clip shorts to the SRS coil and driver air bag assembly when the yellow connector is disconnected. The circuit to the driver air bag assembly is shorted in this way to help prevent unwanted deployment of the air bag when servicing the steering column or other SRS components.



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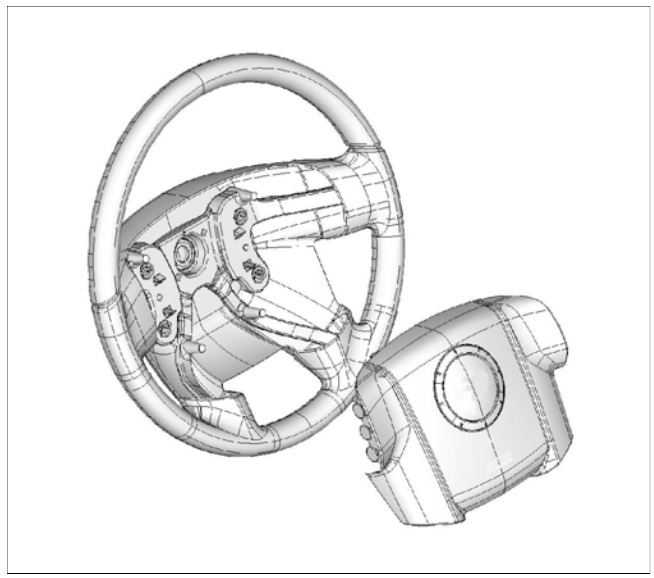
Air Bag Assemblies

The air bag assembly consists of an inflatable air bag assembly and an inflator. When the vehicle is in a frontal crash of sufficient force the SRS control unit causes current flow through the deployment loops. Current passing through the inflator ignites the material in the air bag assembly. The gas produced from this reaction rapidly inflates the air bag assembly.

There is a shorting clip on the driver air bag assembly connector which connects the SRS coil assembly. The shorting clip shorts across the driver air bag assembly circuits when the driver air bag assembly connector is disconnected.

The circuit to the driver air bag assembly is shorted in this way to help prevent unwanted deployment of the air bag when servicing the driver air bag assembly, the steering column or other SRS components.



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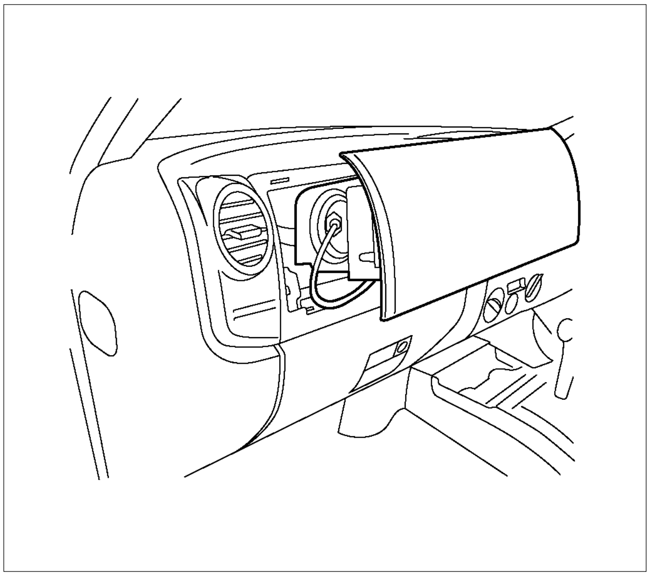
There is a shorting clip on the passenger air bag assembly connector which connects to the SRS harness. The shorting clip shorts across the passenger air bag assembly circuit when the passenger air bag assembly connector is disconnected. The circuit to the passenger air bag assembly is shorted in this way to help prevent unwanted deployment of the air bag when servicing the passenger air bag assembly, the instrument panel or other SRS components.



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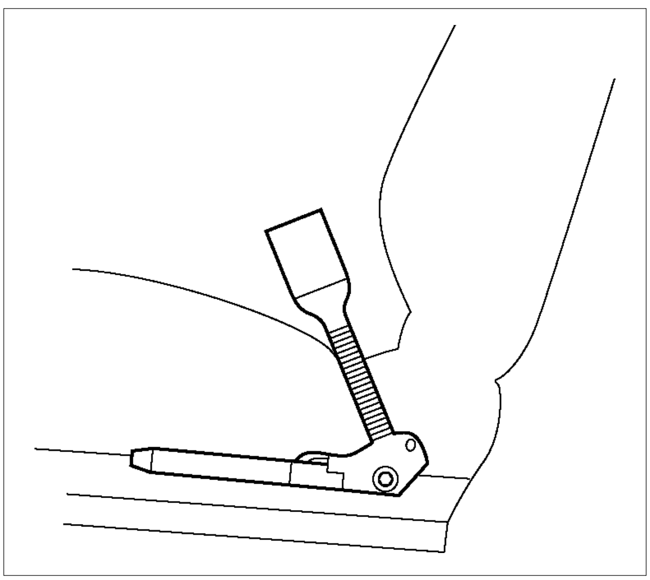
Seat Belt with Pretensioner (If so equipped)

The seat belt comprises a seat belt and a cylinder (a cylinder filled with powder and an ignition device). In cases of frontal collision which cause a shock exceeding a specified level, the controller lets current flow to the inflation circuit. The current ignites the cylinder of the seat belt, producing gas. The gas helps tighten the seat belt to restrain firmly the driver's upper half in his seat.



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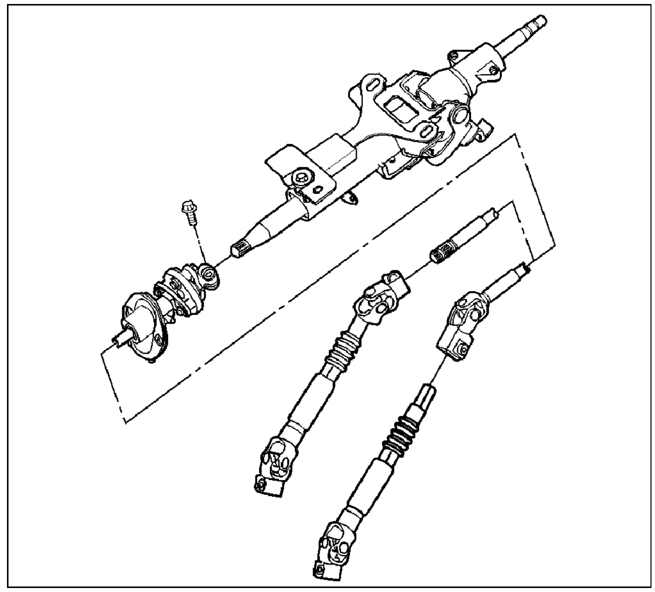
Steering Column

The steering column absorbs energy and is designed to compress in a frontal crash to decrease the chance of injury to the driver.



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Knee Bolster

The knee bolsters are used to absorb energy to protect knees and control the forward movement of the vehicle's front seat occupants during a frontal crash, by limiting leg movement.

Definitions

Air Bag
An inflatable cloth cushion designed to deploy in certain frontal crashes. It supplements the protection offered by the seat belts by distributing the impact load more evenly over the vehicle occupant's head and torso.

Asynchronous
Performed in a non-periodic fashion, (i.e., no defined time or interval).

B+
Battery voltage, (B+) The voltage available at the battery at the time of the indicated measurement. With the key "ON" and the engine not running, the system voltage will likely be between 12 and 12.5 volts. At idle, the voltage may be 14 to 16 volts. The voltage could be as low as 10 volts during engine cranking.

Bulb Check
The SRS control unit will cause the "SRS" warning lamp to flash seven times and then go "OFF" whenever the ignition switch transitions to the ON position from any other ignition switch position and no malfunctions are detected.

"Continuous Monitoring"
Tests are performed by the SRS control unit on the SRS every 100 milliseconds while "Ignition 1" voltage is in the normal operating voltage range at the SRS control unit.

Data Link Connector (DLC)
Formerly "DLC", a connector which allows communication with an external computer, such as a scan tool.

Datum Line
A base line parallel to the plane of the underbody or frame from which all vertical measurements originate.

Deploy
To inflate the air bag.

Deployment Loops
The circuits which supply current to the air bag assemblies to deploy the air bag.

Diagnostic Trouble Code (DTC)
Formerly "Code", a numerical designator used by the SRS control unit to indicate specific SRS malfunctions.

Driver Current Source
An output of the SRS control unit which applies current into the driver air bag assembly circuit during the "Initiator Assembly Resistance Test".

Driver Air Bag Assembly
An assembly located in the steering wheel hub consisting of an inflatable bag, an inflator and an initiator.

EEPROM
Electrically Erasable Programmable Read Only Memory. Memory which retains its contents when power is removed from the SRS control unit.

Ignition Cycle
The voltage at the SRS control unit "Ignition 1" input, with ignition switch "ON", is within the normal operating voltage range for at least ten seconds before turning the ignition switch "OFF".

Ignition 1
A battery voltage (B+) circuit which is only powered when the ignition switch is in the ON, or START position.

Initiator
The electrical component inside the air bag assembly which, when sufficient current flows, sets off the chemical reaction that inflates the air bag.

"Initiator Assembly Resistance Test"
Tests are performed once for each ignition cycle when no malfunctions are detected during "Turn–ON" or "Continuous Monitoring". This test checks for the correct SRS control unit configuration for the vehicle, shorts to "Ignition 1" in the deployment loops, high resistance or opens in the "Driver Side" and "Passenger Side" circuits and measures the resistance of the inflator assembly consisting of 1) Initiators, 2) SRS coil assembly (driver side only), 3) Connectors and associated wiring.

Normal Operating Voltage Range
The voltage measured between the SRS control unit "Ignition 1" terminals and "Ground" terminals is between 9 and 16 volts.

Passenger Current Source
An output of the SRS control unit which applies current into the passenger air bag assembly circuit during the "Initiator Assembly Resistance Test".

Passenger Air Bag Assembly
An assembly located in the front of the passenger side of the instrument panel consisting of an inflatable bag, an inflator and an initiator.

Scan Tool
An external computer used to read diagnostic information from on–board computers via the data link connector.

SRS control unit
SRS control unit which provides reserve energy to the deployment loops, deploys the air bags when required and performs diagnostic monitoring of all SRS components.

Serial Data
Information representing the status of the SRS.

SRS
Supplemental Restraint System.

SRS Coil Assembly
An assembly of two current–carrying coils in the driver deployment loop that allows the rotation of the steering wheel while maintaining the continuous contact of the driver deployment loop to the driver air bag assembly.

SRS Wiring Harness
The wires and connectors that electrically connect the components in the SRS.

"Turn–ON"
Test which the SRS control unit performs on the SRS once during each ignition cycle immediately after "Ignition 1" voltage is applied to the SRS control unit and before "Continuous Monitoring".

Diagnosis

WARNING: TO AVOID DEPLOYMENT WHEN TROUBLESHOOTING THE SRS, DO NOT USE ELECTRICAL TEST EQUIPMENT SUCH AS A BATTERY–POWERED OR AC–POWERED VOLTMETER, OHMMETER, ETC., OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN THAT SPECIFIED IN THIS MANUAL. DO NOT USE A NON-POWERED PROBE–TYPE TESTER. INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT.

Diagnostic Trouble Codes

The “SRS Diagnostic System Check” must always be the starting point of any SRS diagnosis. The “SRS Diagnostic System Check” checks for proper “SRS” warning lamp operation and checks for SRS diagnostic trouble codes using the scan tool.

1. Current diagnostic trouble codes – Malfunctions that are presently being detected. Current diagnostic trouble codes are stored in RAM (Random Access Memory).
2. History diagnostic trouble codes – All malfunctions detected since the last time the history memory was cleared. History diagnostic trouble codes are stored in EEPROM.

Scan Tool Diagnostics

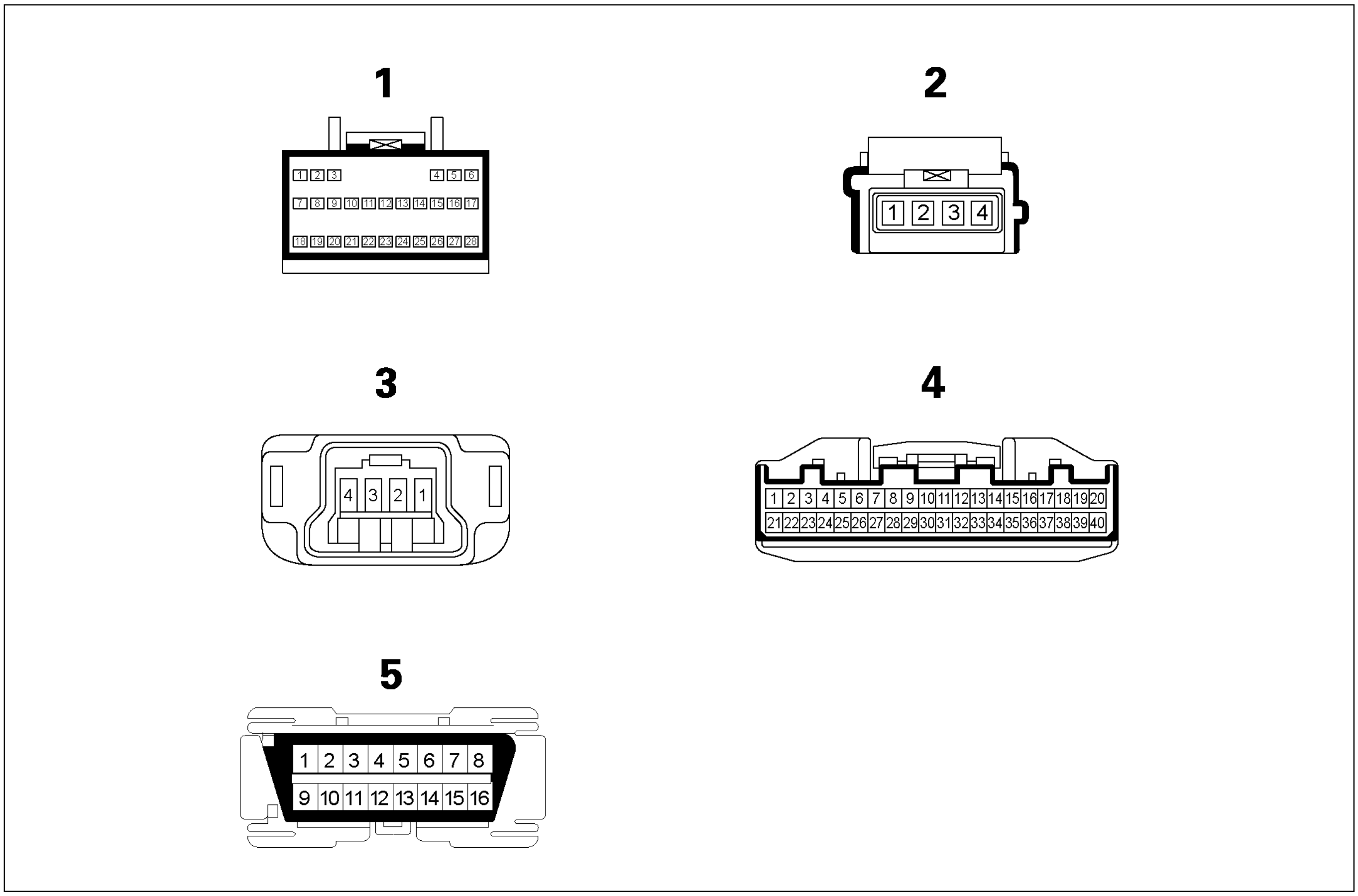
A scan tool is used to read current and history diagnostic trouble codes and to clear all diagnostic trouble codes after a repair is completed. The scan tool must be updated to communicate with the SRS through a replaceable cartridge before it can be used for SRS diagnostics. To use the scan tool, connect it to the data link connector and turn the ignition switch “ON”. The scan tool reads serial data from the SRS control unit “Serial Data” line terminal “21” to the data link connector terminal “2”.

Use Of Special Tools

WARNING: TO AVOID DEPLOYMENT WHEN TROUBLESHOOTING THE SRS, DO NOT USE ELECTRICAL TEST EQUIPMENT SUCH AS A BATTERY–POWERED OR AC–POWERED VOLTMETER, OHMMETER, ETC, OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN THAT SPECIFIED IN THIS MANUAL. DO NOT USE A NON-POWERED PROBE–TYPE TESTER. INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT. YOU SHOULD BE FAMILIAR WITH THE TOOLS LISTED IN THIS SECTION UNDER THE HANDLING SRS SPECIAL TOOLS.

You should be able to measure voltage and resistance. You should be familiar with proper use of a scan tool such as the Tech 2 Diagnostic Computer, SRS Driver/Passenger Load Tool 5-8840-2421-0, Connector Test Adapter Kit 5-8840-2835-0 and the DMM (Digital Multimeter) 5-8840-0366-0.

SRS Connector Body Face Views



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Legend

(1) SRS control unit
(2) Driver Air Bag Assembly
(3) Passenger Air Bag Assembly
(4) “SRS” Warning Lamp
(5) DLC

Repairs And Inspections Required After An Accident

If any SRS components are damaged, they must be replaced. If SRS component mounting points are damaged, they must be replaced.

- Never use SRS parts from another vehicle. This does not include remanufactured parts purchased from an authorized dealer; they may be used for SRS repairs.
- Do not attempt to service the SRS control unit, the SRS coil assembly, or the air bag assembly. Service of these items is by replacement only.
- Verify the part number of the replacement air bag assembly.

CAUTION: Never use the air bag assembly from another vehicle or different model year air bag assembly.

Use only a new air bag assembly matched to the TFR/S which is being repaired.

CAUTION: Proper operation of the sensors and supplemental restraint system (SRS) requires that any repairs to the vehicle structure return it to the original production configuration. Deployment requires, at a minimum, replacement of the SRS control unit, air bag assembly and dimensional inspection of the steering column. Any visible damage to the SRS control unit mounting bracket (s) requires replacement, and the steering column must be dimensionally inspected, whether deployment occurred or not.

Accident With Deployment – Component Replacement And Inspections

Certain SRS components must be replaced or inspected for damage after a frontal crash involving air bag deployment. Those components are:

- Air bag assembly
- SRS control unit

CAUTION: Refer to "SRS control unit Replacement Guidelines" below for important information on SRS control unit replacement in both deployment and non-deployment crashes.

- SRS coil assembly — Inspect wiring and connector for any signs of scorching, melting, or damage due to excessive heat. Replace if damaged. Refer to section "SRS Coil Assembly" in this manual.

Accident With or Without Deployment – Component Inspection

Certain SRS system components and rotation parts must be inspected after any crash, whether the air bag has been deployed or not. Those components are:

- Steering column — Refer to Inspection Required "After an Accident" in this manual.
- Knee bolsters and mounting points — Inspect for any distortion, bending, cracking, or other damage.
- I/P steering column reinforcement plate — Inspect for any distortion, bending, cracking, or other damage.
- I/P braces — Inspect for any distortion, bending, cracking, or other damage.
- Seat belts and mounting points — Refer to "Seat Belts" in Section "Seat Belt" of this workshop manual.

SRS Control Unit Replacement Guidelines

SRS control unit replacement policy requires replacement of the SRS control unit after a crash involving air bag deployment when the "SRS Warning Lamp" turned "ON", the "SRS Diagnosis" should be done according to Section "Restraint Control System."

Wiring Damage

If any SRS wire harness is damaged, it should be replaced. Don't repair the SRS harness. It is replacement only.

SRS Connector (Plastic Body And Terminal Metal Pin) Damage

If any connector or terminal in the SRS wire harness (except pigtails) is damaged, it should be replaced.

SRS Wire Pigtail Damage

If the wiring pigtail (a wire or wires attached directly to the device, not by a connector) is damaged, the entire component (with pigtail) must be replaced. Examples of "pigtail" components are the driver air bag assembly, the passenger air bag assembly, and the SRS coil assembly.

On–Vehicle Service

Service Precaution

WARNING: WHEN PERFORMING SERVICE ON OR AROUND SRS COMPONENTS OR SRS WIRING, FOLLOW THE PROCEDURES LISTED BELOW TO TEMPORARILY DISABLE THE SRS. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY OR OTHERWISE UNNECESSARY SRS REPAIRS.

The SRS control unit in Driver–Passenger SRS can maintain sufficient voltage to cause a deployment for up to 15 seconds after the ignition switch is turned "OFF," the battery is disconnected, or the fuse powering the SRS control unit is removed.

Many of the service procedures require removal of the "SRS" fuse, and disconnection of the air bag assembly from the deployment loop to avoid an accidental deployment. If the air bag assembly is disconnected from the deployment loop as noted in the "Disabling the SRS" procedure that follows, service can begin immediately without waiting for the 15 second time period to expire.

Disabling The SRS

Removal

Turn the ignition switch to "LOCK" and remove the key.

1. Remove the SRS fuse "SRS", from the side of the driver's side of the instrument panel fuse block or disconnect the battery.
2. Disconnect the yellow connector at the base of the steering column.
3. Remove the glove box assembly, refer to "Passenger Air Bag Assembly Replacement" in this manual.
4. Disconnect the yellow connector behind the glove box assembly.

CAUTION: With the "SRS" fuse removed and ignition switched "ON", the "SRS" warning lamp will be "ON". This is normal operation and does not indicate an SRS malfunction.

Enabling The SRS

Installation

CAUTION: Never use the air bag assembly from another vehicle or different model year air bag assembly.

Use only a new air bag assembly matched to the TFR/S which is being repaired.

Turn the ignition switch to "LOCK" and remove the key.

1. Connect the yellow connector passenger air bag assembly.
2. Install the glove box assembly. Refer to "Passenger air bag assembly replacement" in this manual.
3. Connect the yellow connector at the base of the steering column.
4. Install the "AIR BAG" fuse "SRS" to the side of the driver's side of the instrument panel fuse block or connect the battery.

Turn the ignition switch to "ON" and verify that the "SRS" warning lamp flashes seven times and then turns to "LOCK". If it does not operate as described, perform the "SRS Diagnostic System Check" in this manual.

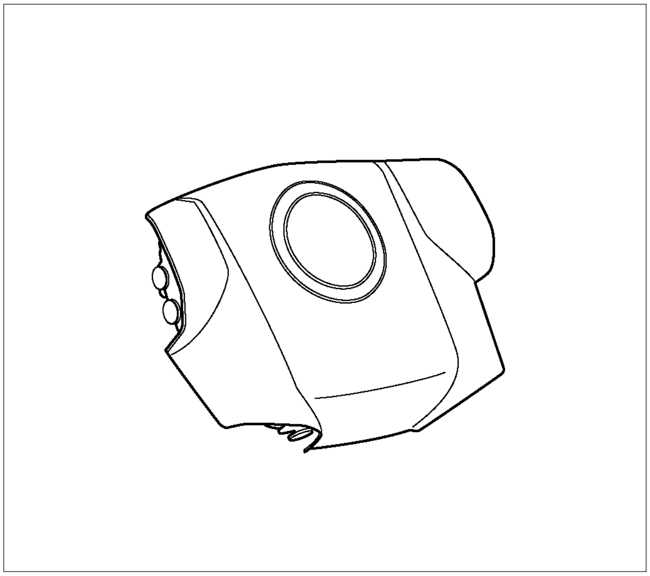
Handling / Installation / Diagnosis

1. The air bag assembly should not be subjected to temperatures above 65°C (150°F).
2. The air bag assembly, and SRS control unit, should not be used if they have been dropped from a height of 100 centimeters (3.28 feet) or more.
3. When the SRS control unit is replaced, it must be oriented with the arrow on the sensor pointing toward the front of the vehicle. It is very important for the SRS control unit to be located flat on the mounting surface, parallel to the vehicle datum line. It is important that the SRS control unit mounting surface is free of any dirt or other foreign material.
4. Do not apply power to the SRS unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.
5. The "SRS Diagnostic System Check" must be the starting point of any SRS diagnostics. The "SRS Diagnostic System Check" will verify proper "SRS" warning lamp operation and will lead you to the correct chart to diagnose any SRS malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacement.

Air Bag Assembly Handling / Shipping / Scrapping

Live (Undeployed) Air Bag Assembly

Special care is necessary when handling and storing a live (undeployed) air bag assembly. The rapid gas generation produced during deployment of the air bag could cause the air bag assembly, or an object in front of the air bag assembly, to be thrown through the air in the unlikely event of an accidental deployment.



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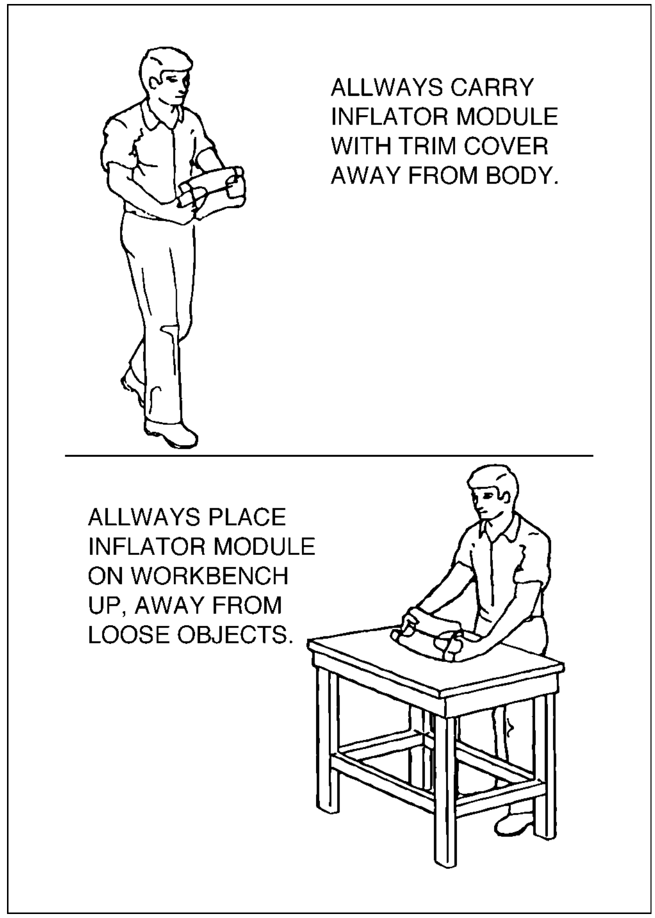
WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG OPENING IS POINTED AWAY FROM YOU. IN CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. NEVER CARRY THE AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE.



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Air Bag Assembly Shipping Procedure For Live (Undeployed) Air Bag Assemblies

Service personnel should refer to the latest Service Bulletins for proper SRS air bag assembly shipping procedures.

Deployed Air Bag Assembly (Driver Side)

You should wear gloves and safety glasses. After the air bag assembly has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present.

Air Bag Assembly Scrapping Procedure

During the course of a vehicle's useful life, certain situations may arise which will necessitate the disposal of a live (undeployed) air bag assembly. This information covers proper procedures for disposing of a live air bag assembly.

Before a live air bag assembly can be disposed of, it must be deployed. A live air bag assembly must not be disposed of through normal refuse channels.

WARNING: FAILURE TO FOLLOW PROPER SUPPLEMENTAL RESTRAINT SYSTEM (SRS) AIR BAG ASSEMBLY DISPOSAL PROCEDURES CAN RESULT IN AIR BAG DEPLOYMENT WHICH MAY CAUSE PERSONAL INJURY. AN UNDEPLOYED AIR BAG ASSEMBLY MUST NOT BE DISPOSED OF THROUGH NORMAL REFUSE CHANNELS. THE UNDEPLOYED AIR BAG ASSEMBLY CONTAINS SUBSTANCES THAT CAN CAUSE SEVERE ILLNESS OR PERSONAL INJURY IF THE SEALED CONTAINER IS DAMAGED DURING DISPOSAL. DISPOSAL IN ANY MANNER INCONSISTENT WITH PROPER PROCEDURES MAY BE A VIOLATION OF FEDERAL, STATE, AND / OR LOCAL LAW.

In situations which require deployment of a live air bag assembly, deployment may be accomplished inside or outside the vehicle. The method employed depends upon the final disposition of the particular vehicle, as noted in “Deployment Outside Vehicle” and “Deployment Inside Vehicle” in this section.

Deployment Outside Vehicle (Driver Air Bag Assembly)

Deployment outside the vehicle is proper when the vehicle is to be returned to service. This includes, for example, situations in which the vehicle will be returned to useful service after a functionally or cosmetically deficient air bag assembly is replaced. Deployment and disposal of a malfunctioning air bag assembly is, of course, subject to any required retention period.

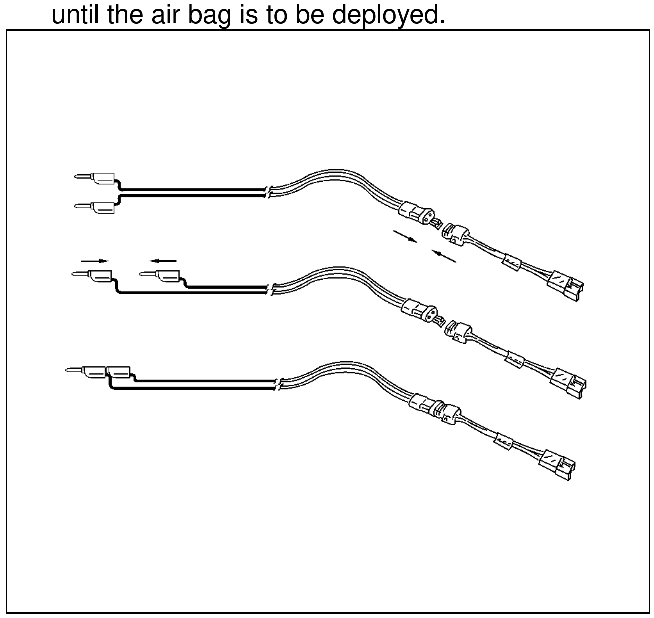
For deployment of a live (undeployed) air bag assembly outside the vehicle, the deployment procedure must be followed exactly. Always wear safety glasses during this deployment procedure until a deployed air bag assembly is scrapped or until an undeployed air bag assembly is shipped. Before performing the procedures you should be familiar with servicing the SRS and with proper handling of the air bag assembly. Procedures should be read fully before they are performed.

The following procedure requires use of a 5-8840-2468-06 SRS deployment harness with appropriate pigtail adapter. Do not attempt the procedure without a 5-8840-2468-0 adapter.

WARNING: FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED MAY RESULT IN PERSONAL INJURY. NEVER CONNECT THE DEPLOYMENT HARNESS TO ANY POWER SOURCE BEFORE CONNECTING THE DEPLOYMENT HARNESS TO THE DRIVER AIR BAG ASSEMBLY. DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. WEAR SAFETY GLASSES THROUGHOUT THIS ENTIRE DEPLOYMENT AND DISPOSAL PROCEDURE.

NOTE: This information applies only to driver air bag assembly. Refer to “Deployment Outside Vehicle (Passenger Air Bag assembly)” in this section for information on passenger air bag assembly scrapping.

1. Turn the ignition switch to “LOCK”, remove the key and put on safety glasses.
2. Inspect the 5-8840-2468-0 SRS Deployment Harness and appropriate pigtail adapter for damage. If the harness or pigtail adapter is damaged, discard and obtain a replacement.
3. Short the two SRS deployment harness leads together by fully seating one banana plug into the other. The SRS deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed.



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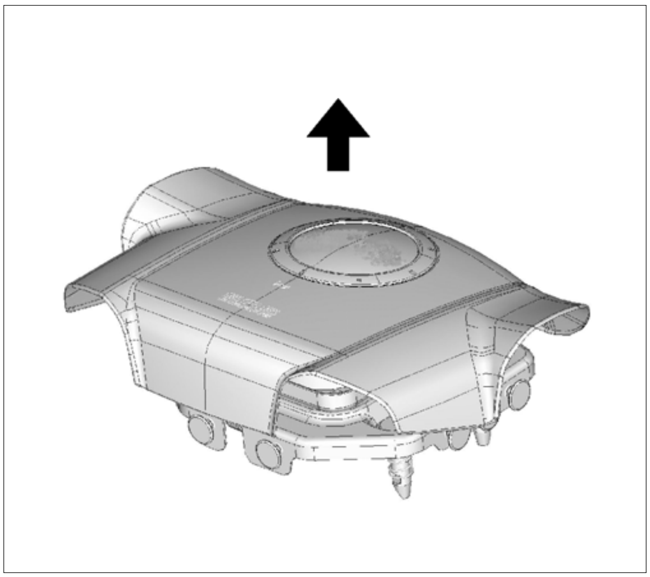
4. Connect the appropriate pigtail adapter to the SRS deployment harness.
5. Remove the driver air bag assembly from the vehicle. Refer to “Inflator Module Removal” in this manual.

WARNING: WHEN STORING A LIVE AIR BAG ASSEMBLY OR WHEN LEAVING A LIVE AIR BAG ASSEMBLY UNATTENDED ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE AIR BAG AND TRIM COVER UP AND AWAY FROM THE SURFACE. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. FAILURE TO FOLLOW PROCEDURES MAY RESULT IN PERSONAL INJURY.

6. Place the driver air bag assembly on a work bench or other surface away from all loose or flammable objects with its trim cover facing up, away from the surface.



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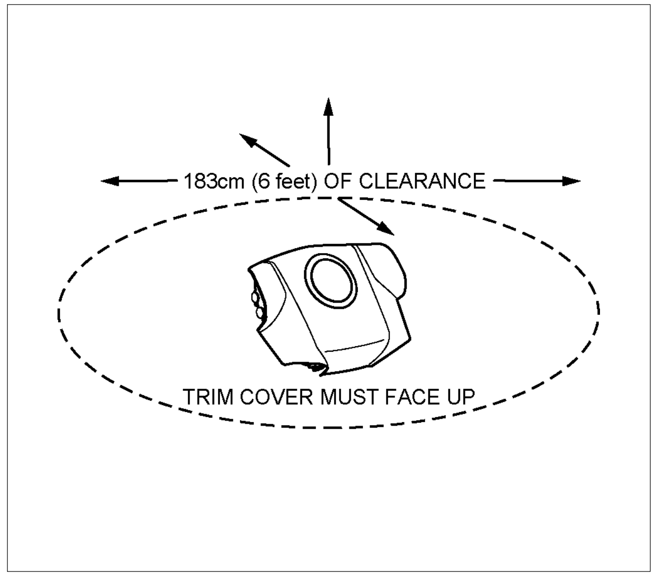
7. Clear a space on the ground about 183 cm (six feet) in diameter where the driver air bag assembly is to be deployed. A paved, outdoor location where there is no activity is preferred. If an outdoor location is not available, a space on the shop floor where there is no activity and there is sufficient ventilation is recommended. Ensure no loose or flammable objects are within the deployment area.



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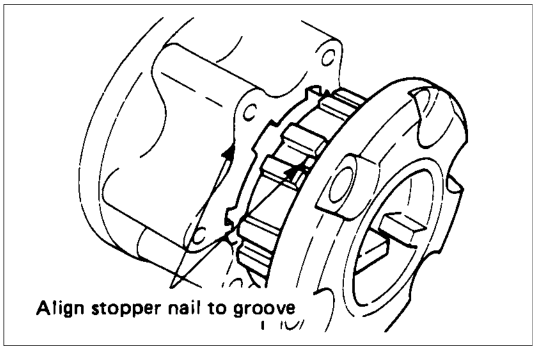
8. Place the driver air bag assembly, with its trim cover facing up, on the ground in the space just cleared.
9. Stretch the SRS deployment harness and pigtail adapter from the driver air bag assembly to its full length.
10. Place a power source near the shorted end of the SRS deployment harness. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
11. Connect the driver air bag assembly to the pigtail adapter on the SRS deployment harness. The deployment harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The driver air bag assembly will immediately deploy the air bag when a power source is connected to it.

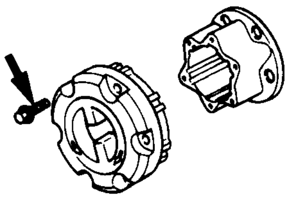
NOTE: Ensure that the pigtail adapter is firmly seated into the driver air bag assembly connector. Failure to fully seat the connectors may leave the shorting bar located in the driver air bag assembly connector functioning (shorted) and may result in no deployment of the driver air bag assembly.

12. Verify that the area around the driver air bag assembly is clear of all people and loose or flammable objects.
13. Verify that the driver air bag assembly is resting with its trim cover facing up.
14. Notify all people in the immediate area that you intend to deploy the driver air bag. The deployment will be accompanied by a substantial noise which may startle the uninformed.
15. Separate the two banana plugs on the SRS deployment harness.



24.Cover Assembly

Align stopper nails to grooves of body.



25.Bolt

Torque	N·m (kgf·m/lb·in)
12 (1.2 / 104)	

- Refer to SECTION 3E "WHEELS AND TIRES" for wheel install procedure.

NOTE: When the air bag deploys, the driver air bag assembly may jump about 30 cm (one foot) vertically. This is a normal reaction of the driver air bag to the force of the rapid gas expansion inside the air bag.

NOTE: When the air bag deploys, the rapid gas expansion will create a substantial noise. Notify all people in the immediate area that you intend to deploy the driver air bag.

WARNING: THE DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT HARNESS TO THE POWER SOURCE SHOULD ALWAYS BE THE LAST STEP IN THE AIR BAG ASSEMBLY DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED MAY RESULT IN PERSONAL INJURY.

16. Connect the SRS deployment harness wires to the power source to immediately deploy the driver air bag. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
17. Disconnect the SRS deployment harness from the power source.
18. Short the two SRS deployment harness leads together by fully seating one banana plug into the other.
19. In the unlikely event that the driver air bag assembly did not deploy after following these procedures, proceed immediately with Steps 24 through 26. If 19. the driver air bag assembly did deploy, proceed with Steps 20 through 23.
20. Put on a pair of shop gloves and safety glasses to protect your hands and eyes from possible irritation and heat when handling the deployed driver air bag assembly. After the air bag assembly has been deployed, the surface of the air bag may contain a powdery residue. This power consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with the atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment.

WARNING: SAFETY PRECAUTIONS MUST BE OBSERVED WHEN HANDING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE METAL SURFACES OF THE AIR BAG ASSEMBLY WILL BE VERY HOT. ALLOW THE INFLATOR MODULE TO COOL BEFORE HANDLING ANY METAL PORTION OF IT. DO NOT PLACE THE DEPLOYED AIR BAG ASSEMBLY NEAR ANY FLAMMABLE OBJECTS. FAILURE TO FOLLOW PROCEDURES MAY RESULT IN FIRE OR PERSONAL INJURY.

AFTER A DRIVER AIR BAG ASSEMBLY HAS BEEN DEPLOYED, THE METAL CANISTER AND SURROUNDING AREAS OF THE DRIVER AIR BAG ASSEMBLY WILL BE VERY HOT. DO NOT TOUCH THE METAL AREAS OF THE DRIVER AIR BAG ASSEMBLY FOR ABOUT TEN MINUTES AFTER DEPLOYMENT. IF THE DEPLOYED DRIVER AIR BAG ASSEMBLY MUST BE MOVED BEFORE IT IS COOL, WEAR GLOVES AND HANDLE BY THE AIR BAG OR TRIM COVER.

21. Disconnect the pigtail adapter from the driver air bag assembly as soon after deployment as possible. This will prevent damage to the pigtail adapter or SRS deployment harness due to possible contact with the hot driver air bag assembly canister. The pigtail adapter can be reused. They should, however, be inspected for damage after each deployment and replaced if necessary.
22. Dispose of the deployed driver air bag assembly through normal refuse channels after it has cooled for at least 30 minutes.
23. Wash your hands with mild soap and water afterward.

NOTE: The remaining steps are to be followed in the unlikely event that the driver air bag assembly did not deploy after following these procedures.

24. Ensure that the SRS deployment harness has been disconnected from the power source and that its two banana plugs have been shorted together by fully seating one banana plug into the other.
25. Disconnect the pigtail adapter from the driver air bag assembly.

WARNING: WHEN STORING A LIVE AIR BAG ASSEMBLY OR WHEN LEAVING A LIVE INFLATOR MODULE UNATTENDED ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP AND AWAY FROM THE SURFACE. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. FAILURE TO FOLLOW PROCEDURES MAY RESULT IN PERSONAL INJURY.

26. Temporarily store the driver air bag assembly with its trim cover facing up, away from the surface upon which it rests.

Deployment Outside Vehicle (Passenger Air Bag Assembly)

WARNING: FAILURE TO FOLLOW PROPER SRS AIR BAG ASSEMBLY DISPOSAL PROCEDURES CAN RESULT IN AIR BAG DEPLOYMENT WHICH MAY CAUSE PERSONAL INJURY. UNDEPLOYED AIR BAG ASSEMBLIES MUST NOT BE DISPOSED OF THROUGH NORMAL REFUSE CHANNELS. THE UNDEPLOYED AIR BAG ASSEMBLY CONTAINS SUBSTANCES THAT CAN CAUSE SEVERE ILLNESS OR PERSONAL INJURY IF THE SEALED CONTAINER IS DAMAGED DURING DISPOSAL. DISPOSAL IN ANY MANNER INCONSISTENT WITH PROPER PROCEDURES MAY BE A VIOLATION OF FEDERAL, STATE AND/OR LOCAL LAWS.

Deployment out of the vehicle is proper when the vehicle is to be returned to service. This includes, for example, situations in which a functionally or cosmetically deficient air bag assembly is replaced. Deployment and disposal of an air bag assembly is, of course, subject to any required retention period.

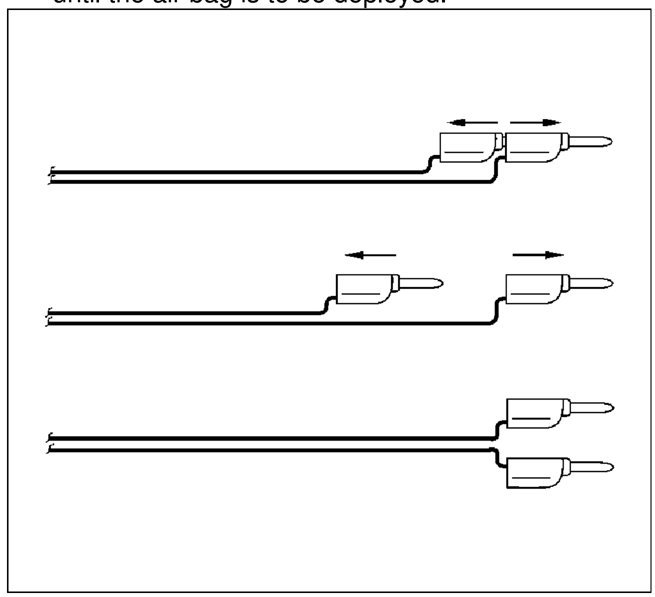
For deployment of a live air bag assembly out of the vehicle, the deployment procedure must be followed exactly. Always wear safety glasses during this deployment procedure until the deployed air bag assembly is scrapped. Before performing the procedures, you should be familiar with servicing the SRS system and with proper handling of the air bag assembly. Procedures should be read fully before they are performed.

The following procedure requires use of a 5-8840-2468-0 SRS Deployment Harness with the appropriate pigtail adapter. The procedure also requires the use of a 5-8840-2420-0 Passenger Side SRS Module Deployment Fixture. Do not attempt this procedure without a 5-8840-2468-0 and adapter, and a 5-8840-2420-0.

WARNING: FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED MAY RESULT IN PERSONAL INJURY. NEVER CONNECT THE DEPLOYMENT HARNESS TO ANY POWER SOURCE BEFORE CONNECTING THE DEPLOYMENT HARNESS TO THE AIR BAG ASSEMBLY. THE DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. WEAR SAFETY GLASSES THROUGHOUT THIS ENTIRE DEPLOYMENT AND DISPOSAL PROCEDURE.

NOTE: This information applies only to passenger air bag assembly. Information for disposing of a live driver air bag assembly can be found in "Deployment Outside Vehicle" (Driver Air Bag Assembly) in this section.

1. Turn the ignition switch to "LOCK", remove the key, and put on the safety glasses.
2. Inspect the 5-8840-2468-0 SRS Deployment Harness and appropriate pigtail adapter for damage. If the harness or pigtail is damaged, discard and obtain a replacement.
3. Short the two SRS Deployment Harness leads together by fully seating one banana plug into the other. The SRS Deployment Harness shall remain shorted and not be connected to a power source until the air bag is to be deployed.



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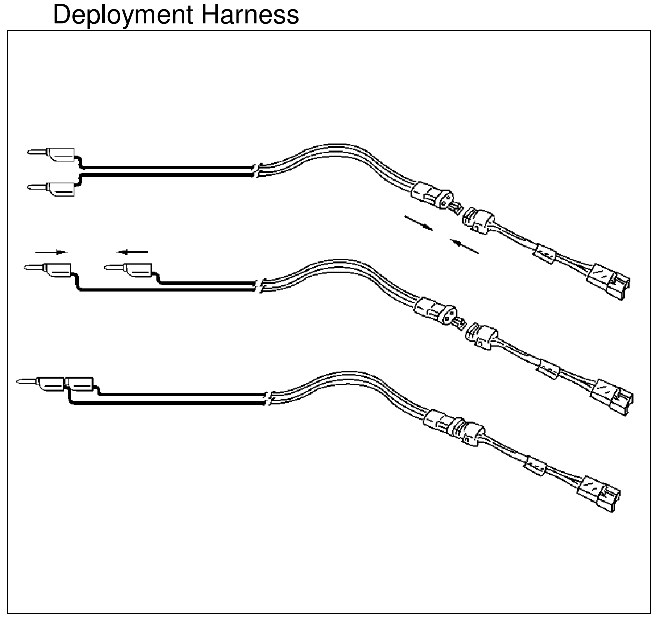
4. Connect the appropriate pigtail adapter to the SRS Deployment Harness



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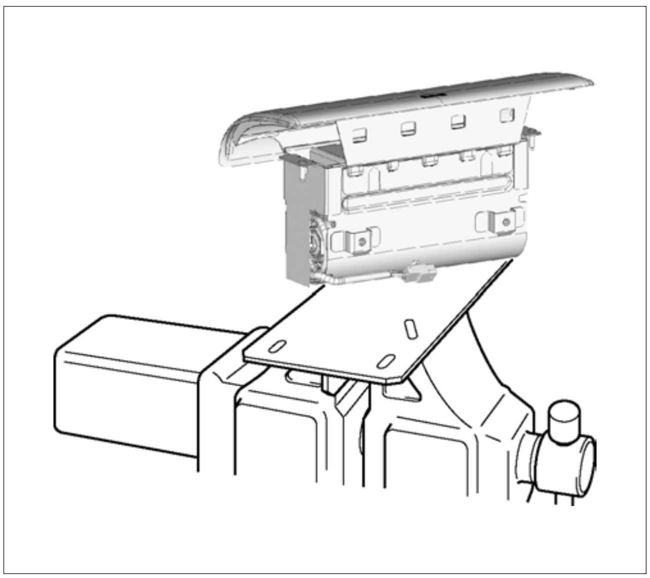
5. Remove the passenger air bag assembly from the vehicle. Refer to “Passenger Air Bag Assembly Removal “.
6. Clear a space on the ground approximately 183 cm (six feet) in diameter where the fixture with attached air bag assembly is to be placed for deployment. A paved outdoor location where there is no activity is preferred. If an outdoor location is not available, a space on the shop floor where there is no activity and there is sufficient ventilation is recommended. Ensure that no loose or flammable objects are within the deployment area.
7. Place the 5-8840-2420-0 on the bench vise. This is necessary to provide sufficient stabilization of the fixture during deployment.
8. Attach the passenger air bag assembly in the 5-8840-2420-0. The air bag assembly must be mounted such that the bag will deploy upward. SECURELY HAND–TIGHTEN ALL FASTENERS PRIOR TO DEPLOYMENT.



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9. Stretch the SRS Deployment Harness and pigtail adapter from the air bag assembly to its full length.
10. Place a power source near the shorted end of the SRS deployment harness. (Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.)
11. Connect the air bag assembly to the pigtail adapter on the SRS deployment harness. The SRS Deployment Harness shall remain shorted and not be connected to a power source until the air bag is to be deployed. The air bag assembly will immediately deploy the air bag when a power source is connected to it.

NOTE: Ensure that the pigtail adapter is firmly seated into the air bag assembly connector. Failure to fully seat the connectors may leave the shorting bar located in the air bag assembly connector functioning (shorting the deployment circuit) and may result in no deployment of the air bag assembly.

12. Verify that the area around the passenger air bag assembly is clear of all people and loose or flammable objects.
13. Verify that the passenger air bag assembly is firmly and properly in the 5-8840-2420-0.
14. Notify all people in the immediate area of your intention to deploy the passenger air bag assembly. The deployment will be accompanied by a substantial noise which may startle the uninformed.
15. Separate the two banana plugs on the SRS deployment harness.

NOTE: When the air bag deploys, the driver air bag assembly may jump about 30 cm (one foot) vertically. This is a normal reaction of the driver air bag to the force of the rapid gas expansion inside the air bag.

NOTE: When the air bag deploys, the rapid gas expansion will create a substantial noise. Notify all people in the immediate area that you intend to deploy the air bag assembly.

WARNING: THE DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT HARNESS TO THE POWER SOURCE SHOULD ALWAYS BE THE LAST STEP IN THE AIR BAG ASSEMBLY DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED MAY RESULT IN PERSONAL INJURY.

16. Connect the SRS deployment harness wires to the power source to immediately deploy the air bag assembly. Recommended application : 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
17. Disconnect the SRS deployment harness from the power source.
18. Short the two SRS deployment harness leads together by fully seating one banana plug into the other.
19. In the unlikely event that the passenger air bag assembly did not deploy after following these procedures, proceed immediately with Steps 24 through 26. If the passenger air bag assembly deployed as intended, proceed with Steps 20 through 23.

20. The passenger inflator requires no special precaution after deployment. 95% of the particulate emission is potassium chloride (KLC), which is commonly sold as an edible salt-substitute. Even if water is applied, post deployment products are relatively pH neutral. Disposing of the inflator by burying it in a landfill will not produce any hazardous products. As with any dusty environment, safety goggles, dust mask and gloves should be worn.

WARNING: SAFETY PRECAUTIONS MUST BE OBSERVED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE METAL SURFACES OF THE AIR BAG ASSEMBLY WILL BE HOT. ALLOW THE AIR BAG ASSEMBLY TO COOL BEFORE HANDLING ANY METAL PORTION OF IT. DO NOT PLACE THE DEPLOYED INFLATOR MODULE NEAR ANY FLAMMABLE OBJECTS. FAILURE TO FOLLOW PROCEDURES MAY RESULT IN FIRE OR PERSONAL INJURY. AFTER AN AIR BAG ASSEMBLY HAS BEEN DEPLOYED, THE METAL CANISTER AND SURROUNDING AREAS OF THE AIR BAG ASSEMBLY WILL BE HOT. DO NOT TOUCH THE METAL AREAS OF THE AIR BAG ASSEMBLY FOR ABOUT THIRTY MINUTES AFTER DEPLOYMENT. IF THE DEPLOYED AIR BAG ASSEMBLY MUST BE MOVED BEFORE IT IS COOL, WEAR GLOVES AND HANDLE BY THE AIR BAG ITSELF.

21. Disconnect the pigtail adapter from the air bag assembly as soon after deployment as possible to avoid damage to the pigtail adapter or SRS deployment harness from contacting the hot air bag assembly canister. The pigtail adapter and SRS deployment harness are designed to be reused. They should, however, be inspected for damage after each deployment and replaced if necessary.
22. Dispose of the deployed air bag assembly through normal refuse channels after it has cooled for at least 30 minutes.
23. Wash your hands with mild soap and water afterward.

NOTE: The remaining steps are to be followed in the unlikely event that the air bag assembly did not deploy after following the above procedures.

24. Ensure that the SRS deployment harness has been disconnected from the power source and that its two banana plugs have been shorted together by fully seating one banana plug into the other.
25. Disconnect the pigtail adapter from the air bag assembly.

WARNING: WHEN STORING A LIVE AIR BAG ASSEMBLY OR WHEN LEAVING A LIVE AIR BAG ASSEMBLY UNATTENDED ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG UP AND AWAY FROM THE SURFACE. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. FAILURE TO FOLLOW PROCEDURES MAY RESULT IN PERSONAL INJURY.

26. Temporarily store the air bag assembly with the bag facing up, away from the surface upon which it rests.

Deployment Inside Vehicle (Vehicle Scrapping Procedure)

Deployment inside the vehicle is proper when the vehicle is to be destroyed or salvaged for component parts. This includes, but is not limited to, the following situations:

1. The vehicle has completed its useful life.
2. The vehicle has been damaged beyond repair in a nondeployment type accident.
3. The vehicle has been stripped or damaged beyond repair in a theft.
4. The vehicle will be salvaged for component parts to be used on a vehicle with a different Vehicle Identification Number (VIN) as opposed to being rebuilt with the same VIN. Never use SRS components from another vehicle.

WARNING: FAILURE TO FOLLOW PROPER SRS AIR BAG ASSEMBLY DISPOSAL PROCEDURES CAN RESULT IN AIR BAG DEPLOYMENT WHICH MAY CAUSE PERSONAL INJURY. UNDEPLOYED AIR BAG ASSEMBLIES MUST NOT BE DISPOSED OF THROUGH NORMAL REFUSE CHANNELS. THE UNDEPLOYED AIR BAG ASSEMBLY CONTAINS SUBSTANCES THAT CAN CAUSE SEVERE ILLNESS OR PERSONAL INJURY IF THE SEALED CONTAINER IS DAMAGED DURING DISPOSAL. DISPOSAL IN ANY MANNER INCONSISTENT WITH PROPER PROCEDURES MAY BE A VIOLATION OF FEDERAL, STATE AND/OR LOCAL LAWS.

1. Turn the ignition switch to “LOCK,” remove the key and put on the safety glasses.
2. Remove all loose objects from the front seats.
3. Disconnect the driver air bag assembly yellow connector located at the base of the steering column.
4. Cut the driver air bag assembly yellow harness connector from the vehicle leaving at least 15 cm (six inches) of wire at the connector.

5. Strip 13 mm (1/2 inch) of insulation from the yellow – green and yellow – black wire lead of the connector.
6. Cut two 900 cm (30 feet) deployment wires from 0.8 mm^2 (18 gauge) or thicker multi–strand wire. These wires will be used to fabricate the driver deployment harness.
7. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
8. Short the wires by twisting together one end from each. Deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

WARNING: FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY. NEVER CONNECT DEPLOYMENT WIRES TO ANY POWER SOURCE BEFORE CONNECTING DEPLOYMENT WIRES TO THE AIR BAG ASSEMBLY LEADS. DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. WEAR SAFETY GLASSES THROUGHOUT THIS ENTIRE DEPLOYMENT AND DISPOSAL PROCEDURE.

9. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure.
10. Bend the twisted connection made in the previous step flat and wrap it tightly with electrical tape to insulate and secure.
11. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire.
12. Connect the deployment harness to the driver air bag assembly yellow connector at the base of the steering column. Route the deployment harness out through the driver's side of the vehicle.

WARNING: DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED.

THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT.

Connecting the deployment wires to the power source should always be the final step in the air bag assembly deployment procedure.

Failure to follow procedures in the order listed could result in personal injury.

13. Disconnect the passenger air bag assembly yellow connector located behind the glove box assembly.
14. Cut the passenger air bag assembly harness connector from the vehicle leaving at least 15 cm (six inches) of wire at the connector.
15. Strip 13 mm (1/2 inch) of insulation from the blue–white and pink–blue wire lead of the connector.
16. Cut two 900 cm (30 feet) deployment wires from 0.8 mm^2 (18 gauge) or thicker multi–strand wire. These wires will be used to fabricate the passenger deployment harness.
17. Strip 13 mm (1/2 inch) of insulation from both ends of the wires cut in the previous step.
18. Short the wires by twisting together one end from each. The deployment wires shall remain shorted and not be connected to a power source until the air bag is to be deployed.

WARNING: FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY. NEVER CONNECT DEPLOYMENT WIRES TO ANY POWER SOURCE BEFORE CONNECTING DEPLOYMENT WIRES TO THE AIR BAG ASSEMBLY LEADS. DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. WEAR SAFETY GLASSES THROUGHOUT THIS ENTIRE DEPLOYMENT AND DISPOSAL PROCEDURE.

19. Twist together one connector wire lead to one deployment wire. The connection should be mechanically secure.
20. Bend the twisted connection made in the previous step flat and wrap it tightly with electrical tape to insulate and secure.
21. Twist together, bend and tape the remaining connector wire lead to the remaining deployment wire.
22. Connect the deployment harness to the passenger air bag assembly yellow connector located behind the glove box assembly. Route the deployment harness out through the passenger side of the vehicle.

WARNING: DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT WIRES SHOULD ALWAYS BE THE FINAL STEP IN THE AIR BAG ASSEMBLY DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY.

23. Verify that the inside of the vehicle and the area surrounding the vehicle are clear of all people and loose or flammable objects.
24. Stretch the driver and passenger deployment harnesses to their full length.
25. Completely cover the windshield area and front door window openings with a drop cloth, blanket or similar item. This reduces the possibility of injury due to possible fragmentation of the vehicle's glass or interior.
26. Notify all people in the immediate area that you intend to deploy the air bags. The deployment will be accompanied by a substantial noise which may startle the uninformed.
27. Separate the two ends of the driver deployment harness wires.

WARNING: DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT WIRES TO THE POWER SOURCE SHOULD ALWAYS BE THE FINAL STEP IN THE AIR BAG ASSEMBLY DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY.

NOTE: When the air bag deploys, the rapid gas expansion will create a substantial noise. Notify all people in the immediate area that you intend to deploy the air bags.

28. Connect the driver deployment harness wires to a power source to immediately deploy the driver air bag assembly. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.
29. Separate the two ends of the passenger deployment harness wires.

WARNING: DEPLOYMENT WIRES SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE AIR BAG IS TO BE DEPLOYED. THE AIR BAG ASSEMBLY WILL IMMEDIATELY DEPLOY THE AIR BAG WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT WIRES TO THE POWER SOURCE SHOULD ALWAYS BE THE FINAL STEP IN THE AIR BAG ASSEMBLY DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY.

30. Connect the passenger deployment harness wires to a power source to immediately deploy the passenger air bag assembly. Recommended application: 12 volts minimum, 2 amps minimum. A vehicle battery is suggested.(Driver air bag assembly) Put on a pair of shop gloves and safety glasses to protect your hands and eyes from possible irritation and heat when handling the deployed air bag assembly. After an air bag assembly has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment (Passenger air bag assembly) The passenger inflator requires no special precaution after deployment. 95% of the particulate mission is potassium chloride (KLC), which is commonly sold as an edible salt-substitute. Even if water is applied, post deployment products are relatively pH neutral. Disposing of the inflator by burying it in a landfill will not produce any hazardous products. As with any dusty environment, safety goggles, dust mask and gloves should be worn.

WARNING: SAFETY PRECAUTIONS MUST BE OBSERVED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE METAL SURFACES OF THE AIR BAG ASSEMBLY WILL BE VERY HOT. ALLOW THE AIR BAG ASSEMBLY TO COOL BEFORE HANDLING ANY METAL PORTION OF IT. DO NOT PLACE THE HOT DEPLOYED AIR BAG ASSEMBLY NEAR ANY FLAMMABLE OBJECTS. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN FIRE OR PERSONAL INJURY.

After an air bag assembly has been deployed, the metal canister and surrounding areas of the air bag assembly will be very hot. Do not touch the metal areas of the air bag assembly for about 30 minutes after deployment. If the deployed air bag assembly must be moved before it is cool, wear gloves and handle by the air bag or trim cover.

31. Short the driver deployment harness wires by twisting together one end from each. Repeat this procedure for the passenger deployment harness.
32. Carefully remove the drop cloth from the vehicle and clean off any fragments or discard the drop cloth entirely.
33. Disconnect the driver deployment harness and the passenger deployment harness from the vehicle and discard.

34. In the unlikely event that either or both of the air bag assemblies did not deploy after following these procedures, proceed immediately with Steps 36 through 37. If the air bag assembly deployed, proceed to step 35.
35. With both air bags deployed, the vehicle may be scrapped in the same manner as a non–SRS equipped vehicle.

NOTE: The remaining steps are to be followed in the unlikely event that the air bag assembly did not deploy after following these procedures.

36. Remove the undeployed air bag assembly (s) from the vehicle. For driver air bag assembly refer to "Driver Air Bag Assembly Removal" in this manual. For passenger air bag assembly, refer to "Passenger Air Bag Assembly Removal" in this manual.

WARNING: WHEN STORING A LIVE AIR BAG ASSEMBLY OR WHEN LEAVING A LIVE AIR BAG ASSEMBLY UNATTENDED ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN PERSONAL INJURY.

37. Temporarily store the air bag assembly with the air bag opening facing up, away from the surface upon which it rests.

Deployed Air Bag Assembly Handling

Put on a pair of shop gloves and safety glasses to protect your hands and eyes from possible irritation and heat when handling the deployed air bag assembly.

After the air bag assembly has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment.

Service Precautions for SRS Component Service

CAUTION: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring a thread locking compound will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

WARNING: WHEN PERFORMING SERVICE ON OR AROUND SRS COMPONENTS OR SRS WIRING, FOLLOW THE PROCEDURES LISTED BELOW TO TEMPORARILY DISABLE THE SRS. FAILURE TO FOLLOW PROCEDURES COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY OR OTHERWISE UNNEEDED SRS REPAIRS.

The SRS control unit in the Driver–Passenger SRS can maintain sufficient voltage to cause a deployment for up to 15 seconds after the ignition switch is turned “OFF,” the battery is disconnected, or the fuse powering the SRS control unit is removed.

Many of the service procedures require removal of the “SRS” fuse, and disconnection of the air bag assembly from the deployment loop to avoid an accidental deployment. If the air bag assembly is disconnected from the deployment loop as noted in the “Disabling the SRS” procedure that follows, service can begin immediately without waiting for the 15 second time period to expire.

Disabling The SRS

Removal

Turn the ignition switch to “OFF” and turn the steering wheel so that the vehicle's wheels are pointing straight ahead.

1. Remove the SRS fuse “SRS” from the left dash side lower fuse block or disconnect the battery.
2. Disconnect the yellow connector at the base of steering column.
3. Remove the glove box assembly; Refer to “Passenger air bag assembly replacement” in this section.
4. Disconnect the passenger air bag assembly yellow connector behind the glove box assembly.

CAUTION: With the “SRS” fuse removed and the ignition switch to “ON,” the “SRS” warning lamp will be “ON.” This is normal operation and does not indicate an SRS malfunction.

Enabling The SRS

Installation

Turn the ignition switch to “LOCK” and remove the key.

1. Connect the yellow connector passenger air bag assembly.
2. Install the glove box assembly. Refer to “Passenger Air Bag Assembly Replacement” in this section.
3. Connect the yellow connector at the base of the steering column.
4. Install the “AIR BAG” fuse “SRS” to the left dash side lower fuse block or connect the battery.

Turn the ignition switch to “ON” and verify that the “SRS” warning lamp flashes seven times and then turns to “LOCK”. If it does not operate as described, perform the “SRS Diagnostic System Check” in this section.

Handling / Installation / Diagnosis

1. Air bag assembly should not be subjected to temperatures above 65°C (150°F).
2. Air bag assembly, and SRS control unit should not be used if they have been dropped from a height of 100 centimeters (3.28 feet) or more.
3. When a SRS control unit is replaced, it must be oriented with the arrow on the SRS control unit pointing toward the front of the vehicle. It is very important for the SRS control unit to be located flat on the mounting surface, parallel to the vehicle datum line. It is important that the SRS control unit mounting surface is free of any dirt or other foreign material.
4. Do not apply power to the SRS unless all components are connected or a diagnostic chart requests it, as this will set a diagnostic trouble code.
5. The “SRS Diagnostic System Check” must be the starting point of any SRS diagnostics. The “SRS Diagnostic System Check” will verify proper “SRS” warning lamp operation and will lead you to the correct chart to diagnose any SRS malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis, and incorrect parts replacements.

Inspections Required After An Accident

CAUTION: Certain SRS components must be replaced after a frontal crash involving air bag deployment.

In all types of accidents regardless of “Air Bag” deployment, visually inspect all of the following components and replace as required:

– Driver air bag assembly
– Passenger air bag assembly
– Steering wheel
– SRS coil assembly
– Steering column
– Knee bolster and instrument panel mounting attachments
– Driver seat and belt
– Passenger seat and belt
– SRS control unit

The SRS control unit should always be checked according to “SRS Control Unit Replacement Guidelines.”

CAUTION: Refer to “SRS control unit Replacement Guidelines” below for important information on SRS control unit replacement in both deployment and non–deployment crashes.

Inspect the SRS coil assembly wiring and the steering wheel for any sign of scorching, melting, or damage due to excessive heat. If the coil assembly wire or steering wheel is damaged, replace them. The steering column and wheel must be dimensionally checked to determine if they are damaged. Refer to “steering wheel” in this manual.

Never use SRS parts from another vehicle. This does not include remanufactured parts purchased from an authorized ISUZU/GM Retailer; they may be used for SRS repairs.

Do not attempt to repair the SRS control unit, the SRS harness, the SRS coil assembly, the air bag assembly, the steering wheel, or the steering column. Service of these items is replacement only. Verify replacement part numbers.

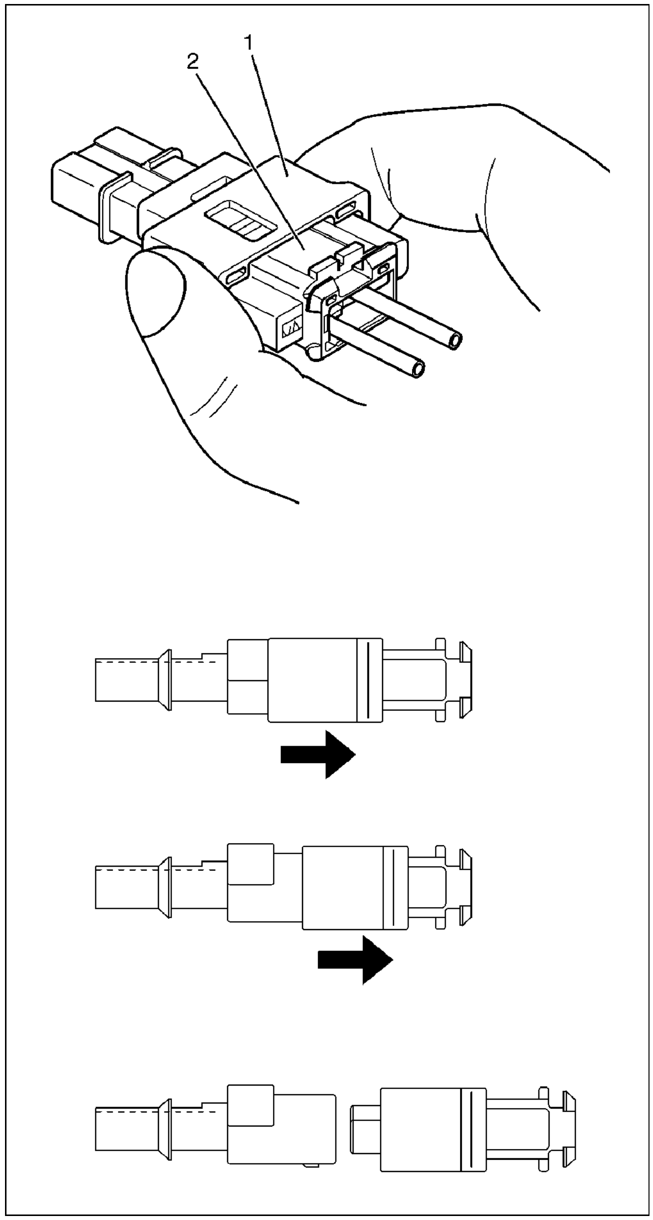
CAUTION: Proper operation of the SRS control unit and the supplemental restraint system (SRS) requires that any repairs to the vehicle structure return it to its original production configuration.

SRS Connectors

CAUTION: The special yellow color connectors are used for the supplemental restraint system-air bag circuit. When removing the cable harness, do not pull the cables otherwise cable disconnection may occur. When connecting the SRS connector, insert the connector completely. Imperfect locking may cause malfunction of the SRS circuit.

Removal

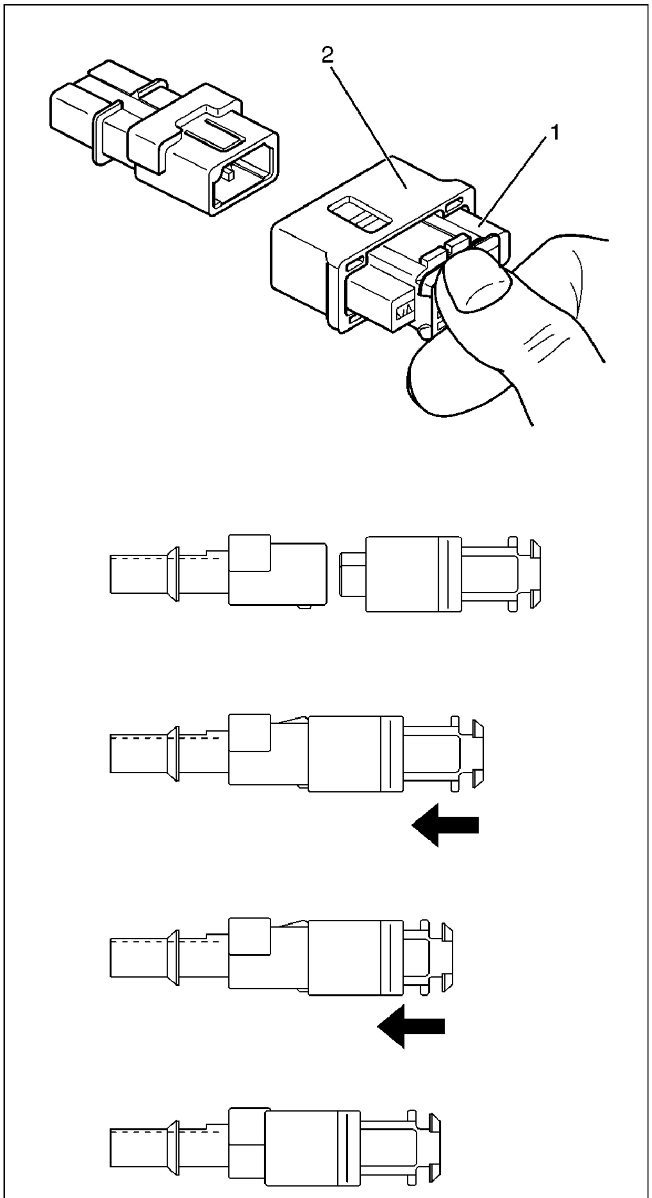
To remove the connector, hold the cover insulator (1) and pull it. The cover insulator slides and the lock will be released. Do not hold the socket insulator (2).



827RW028

Installation

To install the connector, hold the socket insulator (1) and insert it. The cover insulator slides and the connector will be locked. Do not hold the cover insulator (2).



827RW027

TROUBLESHOOTING

Refer to this Section to quickly diagnose and repair front axle problems. Each troubleshooting chart has three headings arranged from left to right.

(1) Checkpoint (2) Trouble Cause (3) Countermeasure

This Section is divided into ten sub-sections:

4×2 Model

1. Wanders and pulls
2. Front wheel shimmy

4×4 Model

1. Oil leak at front axle
2. Oil leak at pinion shaft
3. Noises in front axle drive shaft joint
4. Noises in front axle
5. Wanders and pulls
6. Front wheel shimmy

Propeller shaft

1. Noise
2. Vibration

SRS Control Unit

Service Precautions

WARNING: DURING SERVICE PROCEDURES, BE VERY CAREFUL WHEN HANDLING THE SRS CONTROL UNIT. NEVER STRIKE OR JAR THE SRS CONTROL UNIT. UNDER SOME CIRCUMSTANCES, IT COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY OR IMPROPER OPERATION OF THE SUPPLEMENTAL RESTRAINT SYSTEM (SRS). THE SRS CONTROL UNIT MOUNTING BRACKET BOLTS MUST BE CAREFULLY TORQUED TO ASSURE PROPER OPERATION. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. THE SRS CONTROL UNIT COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.

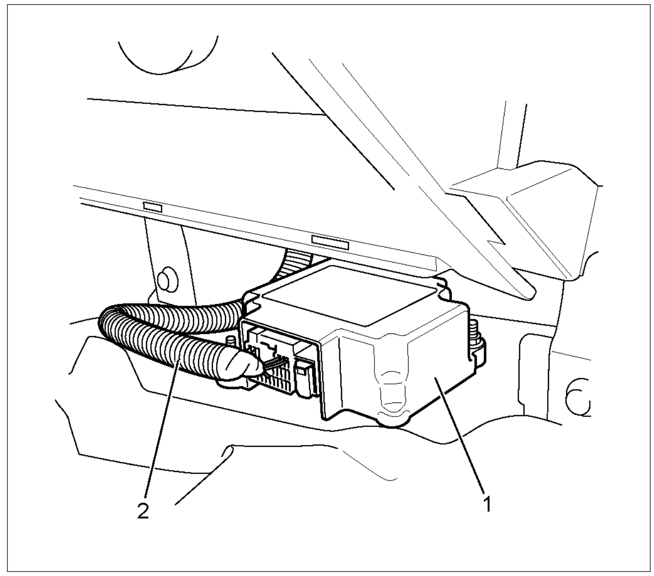
WARNING: PROPER OPERATION OF THE SRS CONTROL UNIT REQUIRES THE SRS CONTROL UNIT TO BE RIGIDLY ATTACHED TO THE VEHICLE STRUCTURE AND THAT THE ARROW ON THE SENSOR BE POINTING TOWARD THE FRONT OF THE VEHICLE.

The SRS control unit is specifically calibrated and is keyed to the SRS control unit location SRS wiring harness. Caution should be used to ensure proper location of the SRS control unit. The keying of the SRS control unit to its location and wiring harness connectors should never be modified in the field.

Removal

1. Disable the SRS (Refer to “Disabling the SRS” in this section).
2. Remove the transmission knob (for M/T) and transfer lever knob.
3. Remove the front console assembly and disconnect the wiring harness connector.
4. Disconnect the SRS control unit harness connector.
5. Remove the three nuts which are fixing the SRS control unit.

   And remove the SRS control unit.



RTW79ASH000401

Legend

(1) SRS control unit

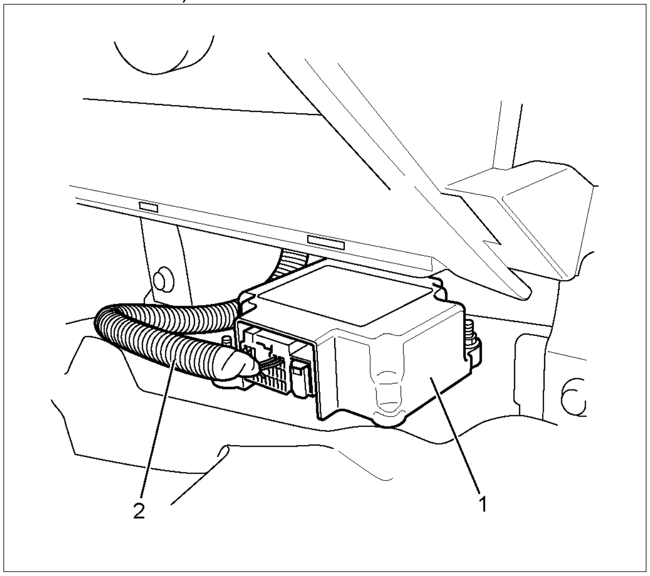
(2) SRS Harness

Installation

1. Install the SRS control unit on the bracket and fixing nuts and tighten the fixing nuts to the specified torque.

   Torque: 7 ± 2 N·m (0.7 ± 0.2 kgf·m/61 lb in)
2. Connect the SRS control unit harness connector.
3. Install the front console.
4. Install the transmission knob (for M/T) and transfer lever knob.

5. Enable the SRS. (Refer to “Enabling the SRS” in this section)



RTW79ASH000401

Legend

(1) SRS control unit
(2) SRS Harness

Driver Air Bag Assembly

Service Precautions

WARNING: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY–PRODUCT OF THE DEPLOYMENT REACTION THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY THE AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING ALIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

NOTE: In the event deployment has occurred, inspect the coil assembly wire for any signs of scorching, melting or any other damage due to excessive heat. If the coil has been damaged, replace it.

Removal

Refer to the “Inflator Module” in the “Power-Assisted Steering System” section.

Installation

Refer to the “Inflator Module” in the “Power-Assisted Steering System” section.

Steering Wheel

Service Precautions

WARNING: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY–PRODUCT OF THE DEPLOYMENT REACTION THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY AN AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING ALIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

In the event deployment has occurred, inspect the coil assembly wire for any signs of scorching, melting or any other damage due to excessive heat. If the coil has been damaged, replace it.

Removal

Refer to the “Steering Wheel” in the “Power-Assisted Steering System” section.

Installation

Refer to the “Steering Wheel” in the “Power-Assisted Steering Wheel” section.

SRS Coil Assembly

Service Precautions

WARNING: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY–PRODUCT OF THE DEPLOYMENT REACTION THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY AN AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING ALIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

NOTE: In the event deployment has occurred, inspect the coil assembly wire for any signs of scorching, melting or any other damage due to excessive heat. If the coil has been damaged, replace it.

Removal

NOTE: The SRS coil is a part of the combination switch assembly, which cannot be replaced separately. Therefore, be sure not to remove the SRS coil from the combination switch assembly.

Refer to the “Combination Switch” in the “Power-Assisted Steering System” section.

Installation

Refer to the “Combination Switch” in the “Power-Assisted Steering System” section.

Steering Column

Service Precautions

WARNING: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY–PRODUCT OF THE DEPLOYMENT REACTION THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY AN AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING ALIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

In the event deployment has occurred, inspect the coil assembly wire for any signs of scorching, melting or any other damage due to excessive heat. If the coil has been damaged, replace it.

Removal

Refer to the “Steering Column” in the “Power-Assisted Steering System” section.

Installation

Refer to the “Steering Column” in the “Power-Assisted Steering System” section.

Passenger Air Bag Assembly

Service Precautions

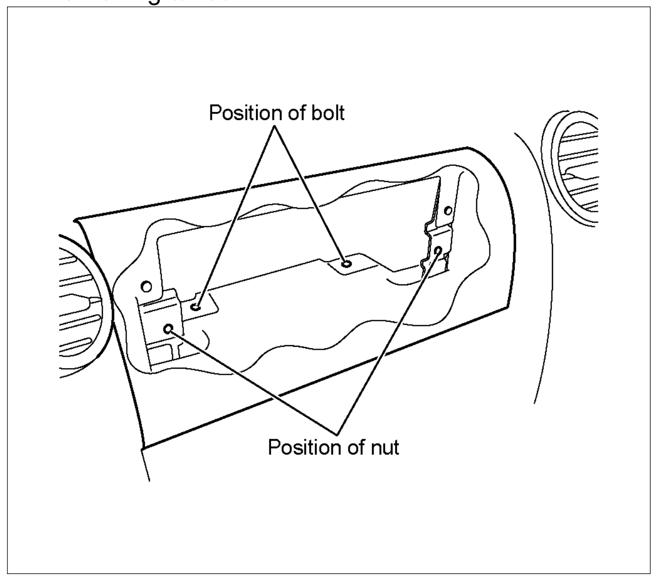
WARNING: SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY. AFTER DEPLOYMENT, THE AIR BAG ASSEMBLY SURFACE MAY CONTAIN A SMALL AMOUNT OF SODIUM HYDROXIDE, A BY–PRODUCT OF THE DEPLOYMENT REACTION THAT IS IRRITATING TO THE SKIN AND EYES. MOST OF THE POWDER ON THE AIR BAG ASSEMBLY IS HARMLESS. AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN HANDLING A DEPLOYED AIR BAG ASSEMBLY, AND WASH YOUR HANDS WITH MILD SOAP AND WATER AFTERWARDS.

WARNING: WHEN CARRYING A LIVE AIR BAG ASSEMBLY, MAKE SURE THE BAG AND TRIM COVER ARE POINTED AWAY FROM YOU. NEVER CARRY AN AIR BAG ASSEMBLY BY THE WIRES OR CONNECTOR ON THE UNDERSIDE OF THE MODULE. IN THE CASE OF AN ACCIDENTAL DEPLOYMENT, THE BAG WILL THEN DEPLOY WITH MINIMAL CHANCE OF INJURY. WHEN PLACING ALIVE AIR BAG ASSEMBLY ON A BENCH OR OTHER SURFACE, ALWAYS FACE THE BAG AND TRIM COVER UP, AWAY FROM THE SURFACE. NEVER REST A STEERING COLUMN ASSEMBLY ON THE STEERING WHEEL WITH THE AIR BAG ASSEMBLY FACE DOWN AND COLUMN VERTICAL. THIS IS NECESSARY SO THAT A FREE SPACE IS PROVIDED TO ALLOW THE AIR BAG ASSEMBLY TO EXPAND IN THE UNLIKELY EVENT OF ACCIDENTAL DEPLOYMENT. OTHERWISE, PERSONAL INJURY COULD RESULT.

WARNING: IN THE EVENT DEPLOYMENT HAS OCCURRED, INSPECT THE COIL ASSEMBLY WIRE FOR ANY SIGNS OF SCORCHING, MELTING OR ANY OTHER DAMAGE DUE TO EXCESSIVE HEAT. IF THE COIL HAS BEEN DAMAGED, REPLACE IT.

Removal

1. Disable the SRS. (Refer to “Disabling the SRS” in this section)
2. Remove the glove box.
3. Remove the glove box cover.
4. Remove the passenger air bag assembly fixing bolts and nuts. Universal joint is used when removing a nut.



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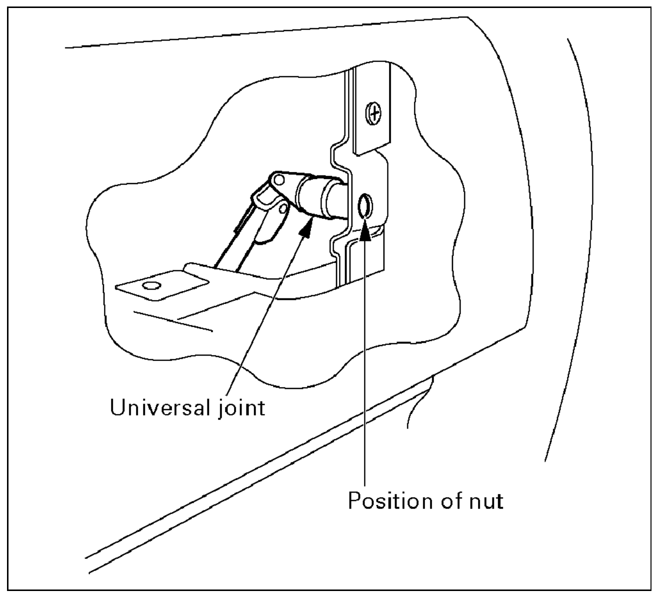


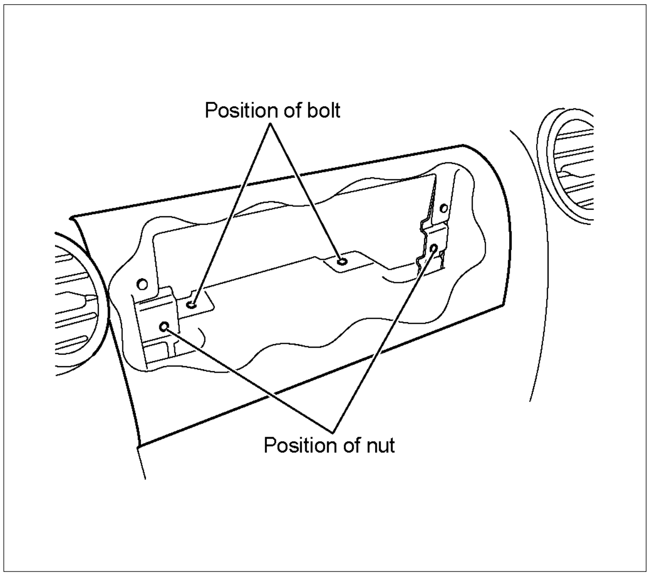
060R300044

5. Remove the passenger air bag assembly.
6. Disconnect the passenger air bag assembly harness connector.

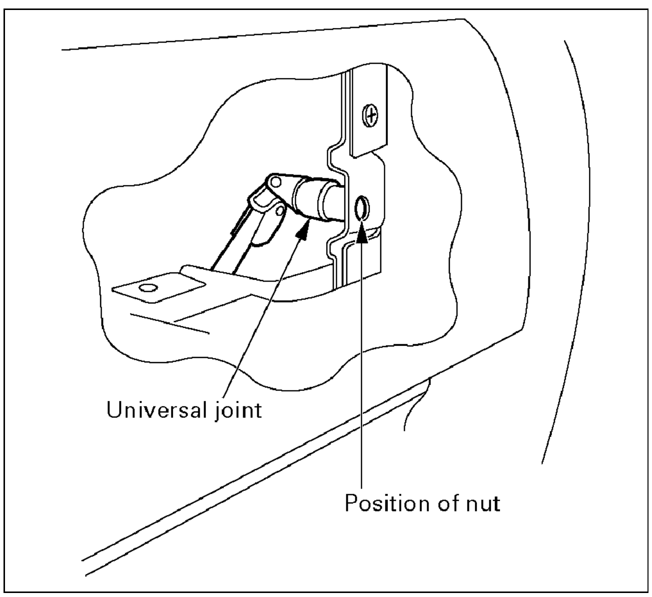
Installation

1. Connect the passenger air bag assembly harness connector.
2. Install the passenger air bag assembly.
3. Install the passenger air bag assembly fixing bolts and nuts. Universal joint is used when removing a nut.

   Torque: 8 N·m (0.8 kgf·m/78 lb in)



RTW79ASH001301



060R300044

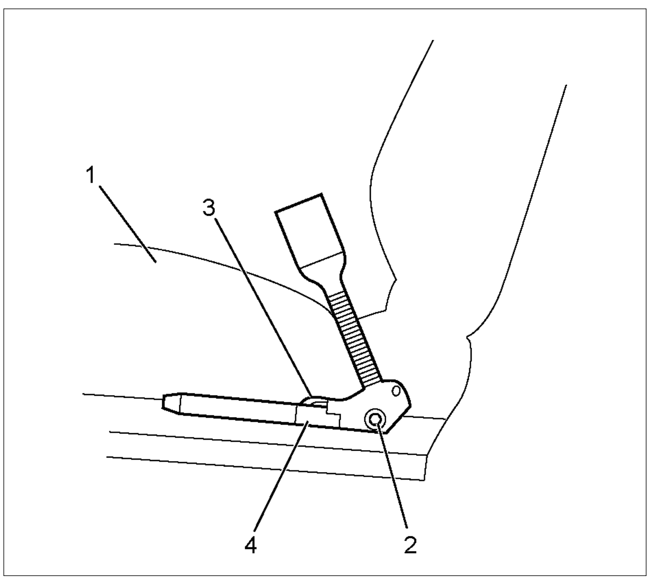
4. Install the glove box cover.
5. Install the glove box.
6. Enable the SRS. (Refer to “Enabling the SRS” in this section)

Pretensioner Seat Belt (If so equipped)

Service Precaution

WARNING: WHEN PERFORMING SERVICE ON OR AROUND THE PRETENSIONER SEAT BELT OR THE PRETENSIONER SEAT BELT WIRING, FOLLOW THE PROCEDURES LISTED BELOW TO TEMPORARILY DISABLE THE PRETENSIONER SEAT BELT.
FAILURE TO FOLLOW PROCEDURES COULD RESULT IN POSSIBLE THE PRETENSIONER SEAT BELT DEPLOYMENT, PERSONAL INJURY OR OTHERWISE UNNEEDED THE PRETENSIONER SEAT BELT REPAIR.
AS A PRECAUTION, WEAR GLOVES AND SAFETY GLASSES WHEN PERFORMING THE PRETENSIONER SEAT BELT. WHEN DEPLOY A LIVE PRETENSIONER SEAT BELT AT OUTSIDE THE VEHICLE, DEPLOYMENT HARNESS SHALL REMAIN SHORTED AND NOT BE CONNECTED TO A POWER SOURCE UNTIL THE PRETENSIONER SEAT BELT IS TO BE DEPLOYED. THE PRETENSIONER SEAT BELT WILL IMMEDIATELY DEPLOY WHEN A POWER SOURCE IS CONNECTED TO IT. CONNECTING THE DEPLOYMENT HARNESS SHOULED ALWAYS BE THE FINAL STEP IN THE PRETENSIONER SEAT BELT DEPLOYMENT PROCEDURE. FAILURE TO FOLLOW PROCEDURES IN THE ORDER LISTED COULD RESULT IN PERSONAL INJURY.

Parts Location



RTW49JSH000301

Legend

(1) Seat
(2) Bolt
(3) Pretensioner Harness
(4) Pretensioner

Removal

1. Turn ignition switch to “LOCK”, remove key.
2. Remove the foot rest located behind the seat.
3. Remove the cover on seat slide.
4. Disconnect the pretensioner connector at the base of the seat.
5. Remove four fixing bolts the seat slide and remove seat.
6. Remove the seat cover.
7. Remove the pretensioner seat belt assembly.

Installation

1. Install the pretensioner seat belt assembly.
2. Install the seat cover.
3. Install the seat on seat slide and four fixing bolts.
4. Connect the yellow pretensioner connector at the base of the seat.
5. Install the cover on seat slide.
6. Install the foot rest located behind the seat.

Main Data and Specifications

Fastener Tightening Specification

Application	N·m	kgf·m	lb·ft/lb·in
SRS control unit	7	0.7	61 lb·in
Steering wheel fixing bolt	35	3.6	26 lb·ft
Steering column (dash panel side fixing bolts)	20	2.0	14 lb·ft
Steering column (Pedal bracket fixing bolt)	20	2.0	14 lb·ft
Steering column (Universal joint fixing bolt)	31	3.2	23 lb·ft
Passenger Air Bag fixing bolt & nut	8	0.8	69 lb·in

4×2 Model

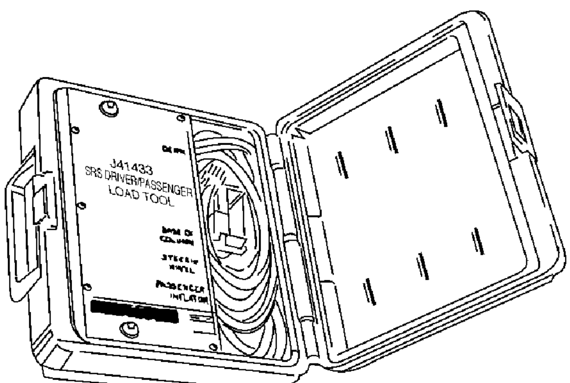
1. WANDERS AND PULLS

Checkpoint		Trouble Cause	Countermeasure
Wheel bearing preload	NG	Too tight	Adjust the wheel bearing preload
OK			
Front alignment	NG	Incorrect	Adjust the front alignment
OK			
Steering unit	NG	Loose or worn	Tighten or replace
OK			
Tire	NG	Worn or improperly inflated	Replace or adjust the inflation
OK			
Suspension	NG	Front or rear suspension parts loose or broken	Tighten or replace

Special Tools

WARNING: TO AVOID DEPLOYMENT WHEN TROUBLESHOOTING THE SRS, DO NOT USE ELECTRICAL TEST EQUIPMENT SUCH AS A BATTERY–POWERED OR AC–POWERED VOLTMETER, OHMMETER, ETC., OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN THAT SPECIFIED IN THIS MANUAL. DO NOT USE AN UNPOWERED PROBE–TYPE TESTER. INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT.

5-8840-2421-0 SRS Driver/Passenger Load Tool



901RS146

The SRS Driver/Passenger Load Tool 5-8840-2421-0 is used only when called for in this section. It is used as a diagnostic aid and safety device to prevent inadvertent air bag assembly deployment.

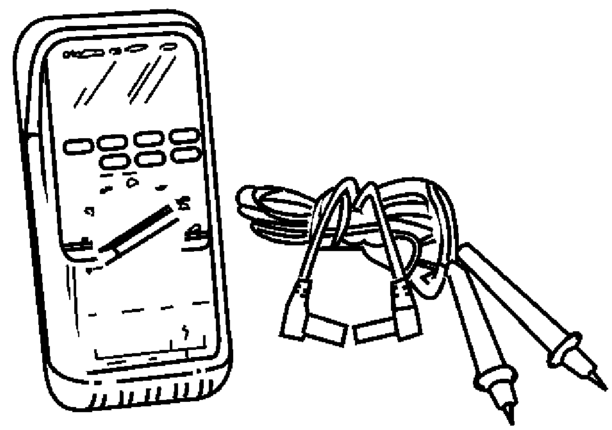
The load tool has three yellow connectors attached to its case.

The three small connectors are electrically functional and serve as resistive load substitutions.

No more than two connectors are used at any time. One of the small connectors is used to substitute for the load of the driver air bag assembly when it is connected at the top of the column to the SRS coil assembly. Another small connector is used to substitute for the load of the driver air bag assembly and the SRS coil assembly when it is connected at the base of the column to the SRS wiring harness. The third small connector is used to substitute for the load of the passenger air bag assembly when connected to the passenger air bag assembly harness connector.

By substituting the resistance of the load tool when called for, a determination can be made as to whether an inflator circuit component is causing system malfunction and which component is causing the malfunction. The load tool should be used only when specifically called for in the diagnostic procedures.

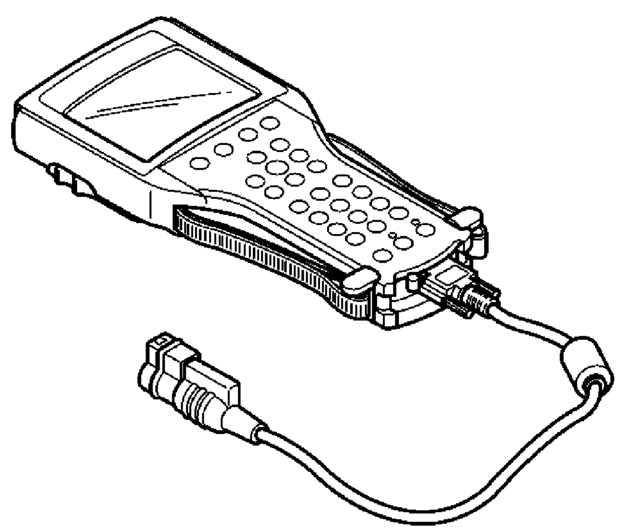
5-8840-0366-0 DMM



901RS163

The 5-8840-0366-0 DMM is the preferred DMM for use in SRS diagnosis and repair. No other DMMs are approved for SRS diagnosis and repair.

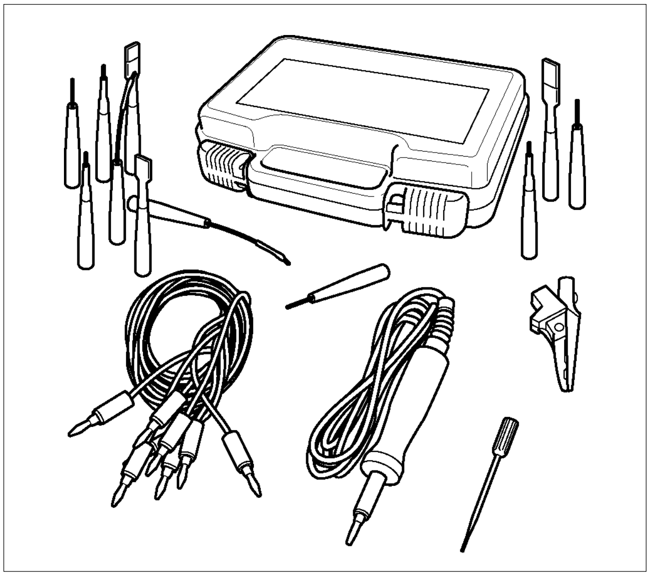
Scan Tool



901RW176

The Tech 2 is used to read and clear SRS Diagnostic Trouble Codes (DTCs). Refer to the Tech 2 Operators Manual for specific information on how to use the Tech 2.

5-8840-2835-0 Connector Test Adapter Kit



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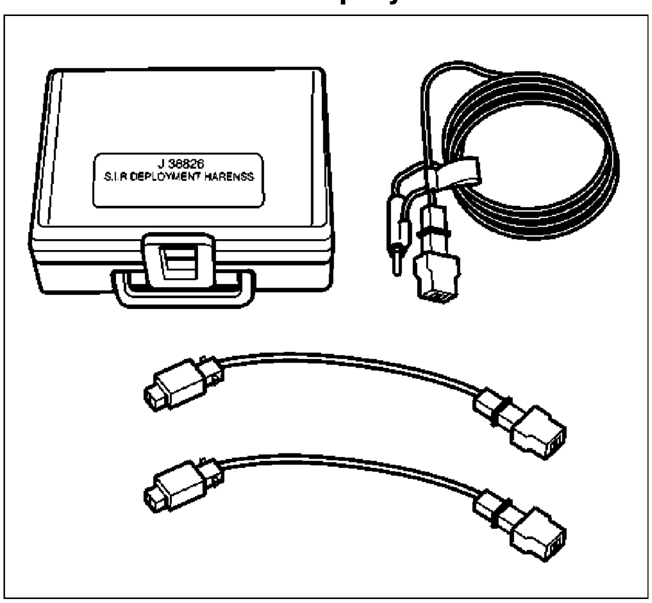
The 5-8840-2835-0 Connector Test Adapter Kit must be used whenever a diagnostic procedure requests checking or probing a terminal. Using the appropriate adapter will ensure that no damage to the terminal will occur from the DMM probe, such as spreading or bending. The adapter will also give an idea of whether contact tension is sufficient, helping to find an open or intermittent open due to poor terminal contact.

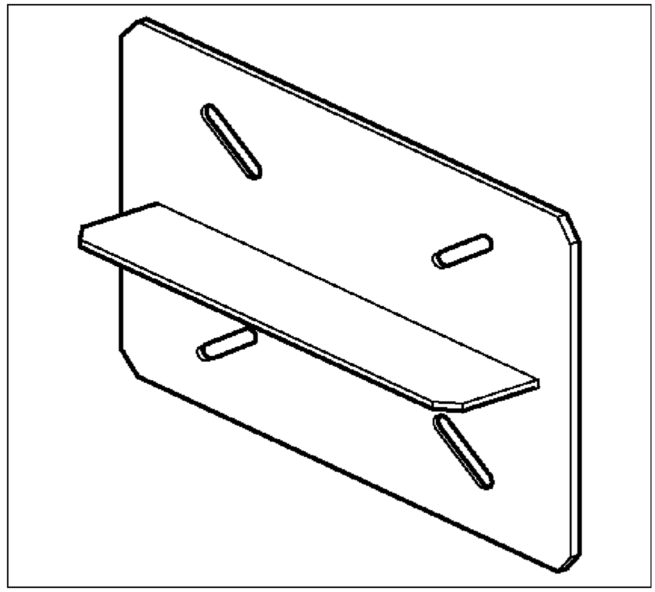
5-8840-2468-0 SRS Deployment Tool



901RW106

The 5-8840-2468-0 SRS Deployment Tool must be used for deployment of the undeployed air bag.

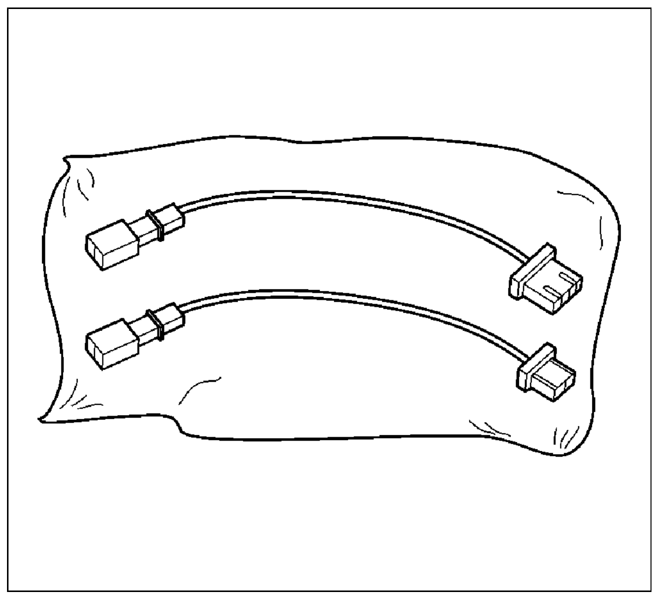
5-8840-2420-0 SRS Deployment Fixture



901RV056

The 5-8840-2420-0 SRS Deployment Fixture must be used for deployment of the undeployed passenger side air bag.

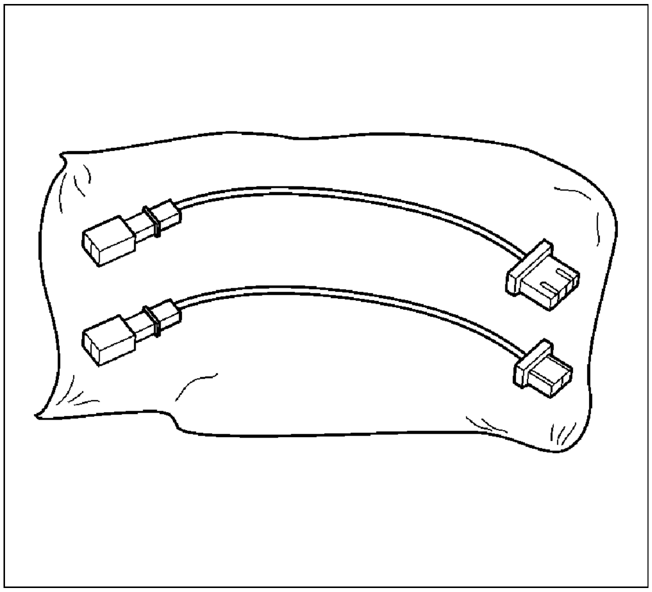
5-8840-2796-0 SRS Adapter for Load Tool



901RW107

The 5-8840-2796-0 SRS Adapter for Load Tool must be used with the 5-8840-2421-0 SRS Driver/Passenger Load Tool.

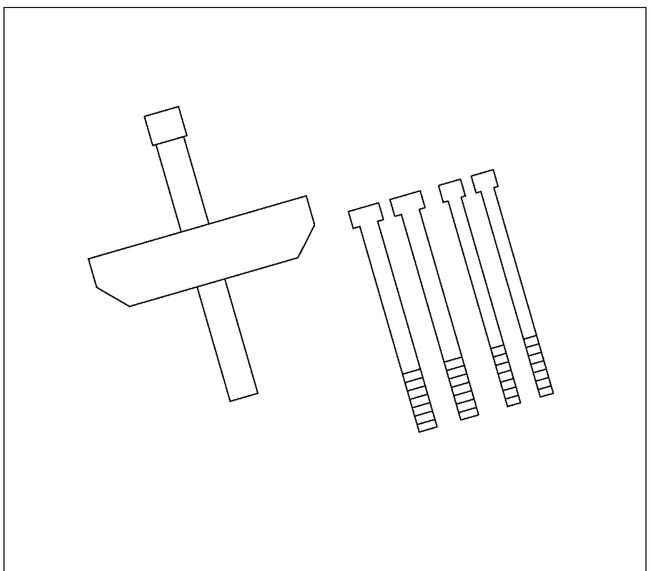
5-8840-2795-0 SRS Adapter for Deployment Tool



901RW107

The 5-8840-2795-0 SRS Adapter for Deployment Tool must be used with 5-8840-2468-0 SRS Deployment Tool.

5-8521-0016-0 Steering Wheel remover



LNW28BSH003101

SECTION 9A1

RESTRAINT CONTROL SYSTEM

TABLE OF CONTENTS

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING A SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING A SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Diagnostic Information

CAUTION: When fasteners are removed, always reinstall them at the same location from which they were removed. If a fastener needs to be replaced, use the correct part number fastener for that application. If the correct part number fastener is not available, a fastener of equal size and strength (or stronger) may be used. Fasteners that are not reused, and those requiring thread locking compound, will be called out. The correct torque value must be used when installing fasteners that require it. If the above conditions are not followed, parts or system damage could result.

Diagnostic Procedures

WARNING: TO AVOID DEPLOYMENT WHEN TROUBLESHOOTING THE SRS, DO NOT USE ELECTRICAL TEST EQUIPMENT SUCH AS A BATTERY-POWERED OR AC-POWERED VOLTMETER, OHMMETER, ETC., OR ANY TYPE OF ELECTRICAL EQUIPMENT OTHER THAN THAT SPECIFIED IN THIS MANUAL. DO NOT USE A NON-POWERED, PROBE-TYPE TESTER. INSTRUCTIONS IN THIS MANUAL MUST BE FOLLOWED CAREFULLY, OTHERWISE PERSONAL INJURY MAY RESULT.

The diagnostic procedures used in this section are designed to aid in finding and repairing SRS problems. Outlined below are the steps to find and repair SRS problems quickly and effectively. Failure to carefully follow these procedures may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.

1. **Perform The “SRS Diagnostic System Check”.**
   The “SRS Diagnostic System Check” should always be the starting point of any SRS diagnostics. The “SRS Diagnostic System Check” checks for proper “SRS” warning lamp operation and checks for SRS trouble codes using both “Flash Code” and “Scan Tool” Methods.
2. **Refer To The Proper Diagnostic Chart As Directed By The “SRS Diagnostic System Check”.**
   The “SRS Diagnostic System Check” will lead you to the correct chart to diagnose any SRS problems. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.
3. **Repeat The “SRS Diagnostic System Check” After Any Repair Or Diagnostic Procedures Has Been Performed.**
   Performing the “SRS Diagnostic System Check” after all repairs or diagnostic procedures, will assure that the repair has been made correctly and that no other conditions exist.

Diagnostic Codes

The SRS control unit maintains a history record of all diagnostic codes that have been detected since the SRS codes were last cleared during service.

1. Active Codes - Faults that are presently detected in this ignition cycle. Active codes are stored in RAM (Random Access Memory).
2. History Codes - All faults detected since the last time the history fault memory was cleared. History codes are stored in the EEPROM. (Electronically Erasable Programmable Read only Memory)

How To Read Trouble Codes

All codes (Active and history) can be read (or cleared) by using a scan tool or equivalent.

If a PDT is not available, have the vehicle serviced by a HOLDEN dealer.

How To Clear Trouble Codes

Trouble codes can only be cleared by using a Scan Tool. If a “scan tool” is not available then inform the owner of the stored codes and suggest that the codes are cleared upon the next visit to a ISUZU/GM dealership.

Scan Tool Diagnostics

A scan tool can be used to read current and history codes and to clear all history codes after a repair is complete. The scan tool must be updated to communicate with the SRS through a replaceable cartridge or a manufacturer's update before it can be used for SRS diagnostics. To use the scan tool, connect it to the DLC and turn the ignition switch “ON”. Then follow the manufacturer's directions for communication with the SRS. The scan tool reads serial data from the SRS control unit’s “Serial Data” output (terminal 21) to the DLC (terminal 2).

Basic Knowledge Required

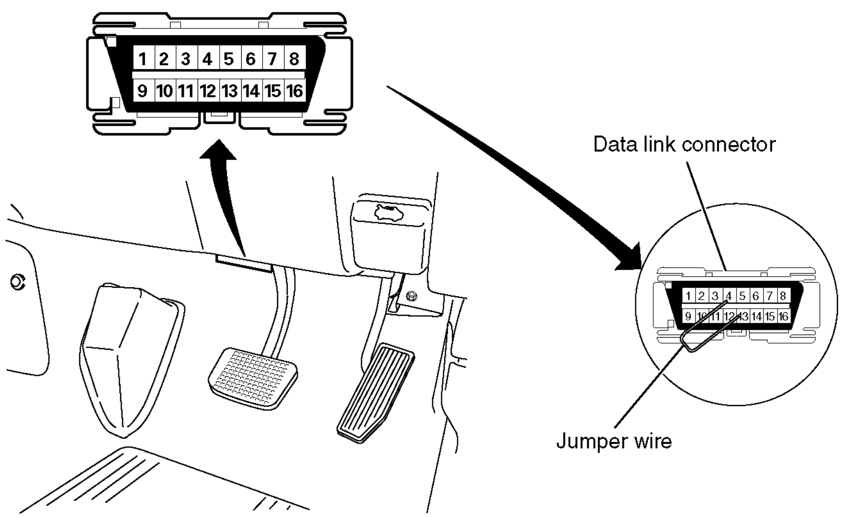
Before using this section of the Service Manual, some basic knowledge is required. Without this knowledge, you will have trouble using the diagnostic procedures in this section. Use care to prevent any harm or unwanted deployment. Read all cautions in the service manual and on warning labels attached to SRS components.

Basic Electrical Circuits

You should understand the basic theory of electricity including series and parallel circuits, and understand the voltage drops across series resistors. You should know the meaning of voltage (volts), current (amps), and resistance (ohms). You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram.

"Flash Code" Diagnostics

Flash code diagnostics can be used to read active codes and to determine if history codes are present but cannot be used to clear codes or read history codes. Flash code diagnostics is enabled by grounding terminal 4, shorting to terminal 13 of the DLC, with the ignition switched "ON". Grounding terminal 4 of the DLC pulls the "Diagnostics Request" input (Terminal 1) of the SRS control unit low and signals the SRS control unit to enter the flash code diagnostic display mode.



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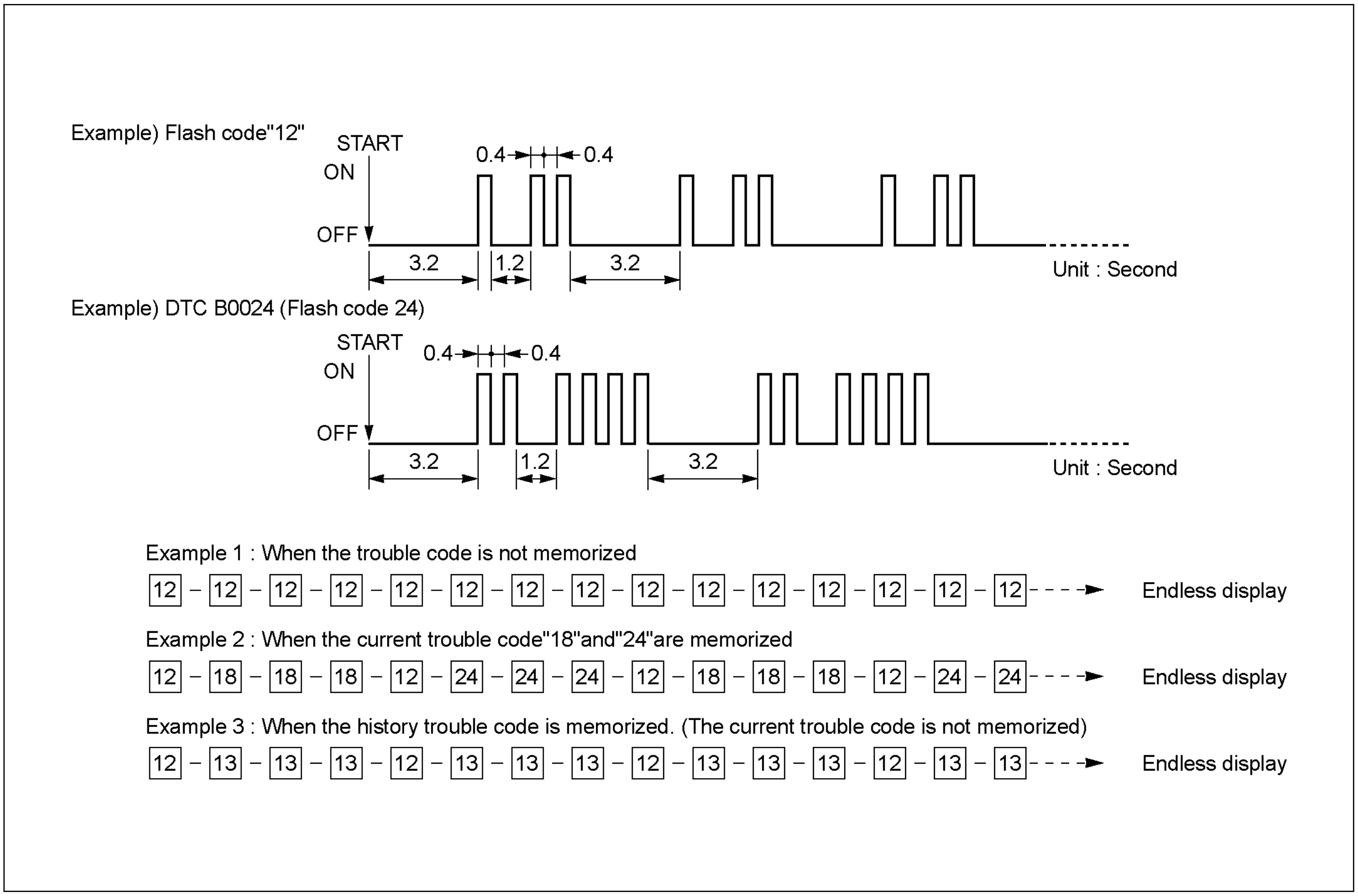
The SRS control unit displays the trouble codes by flashing the warning lamp. Each code that is displayed will consist of a number of flashes which represents the tens digit, a 1.2 second pause, followed by a number of flashes which represent the ones digit of the code. Each code is displayed once before moving on to the next code. After all the codes have been displayed, the entire code sequence will be continually repeated until ground is removed from terminal 4 of the DLC.

Two special codes exist when reading in the flash code mode (Flash Code 12 and Flash Code 13). "Flash Code 12" will always be the first code displayed when the flash code mode is enabled. Code 12 is not an indication of an SRS problem but an indication that the flash code mode has been enabled. If there are no active or history codes present, the SRS control unit will display code 12 until ground is removed from the DLC at terminal 4. "Flash Code 13" will be displayed if history codes are present. To read the history codes, a scan tool must be used.



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DATA LIST (Tech 2)

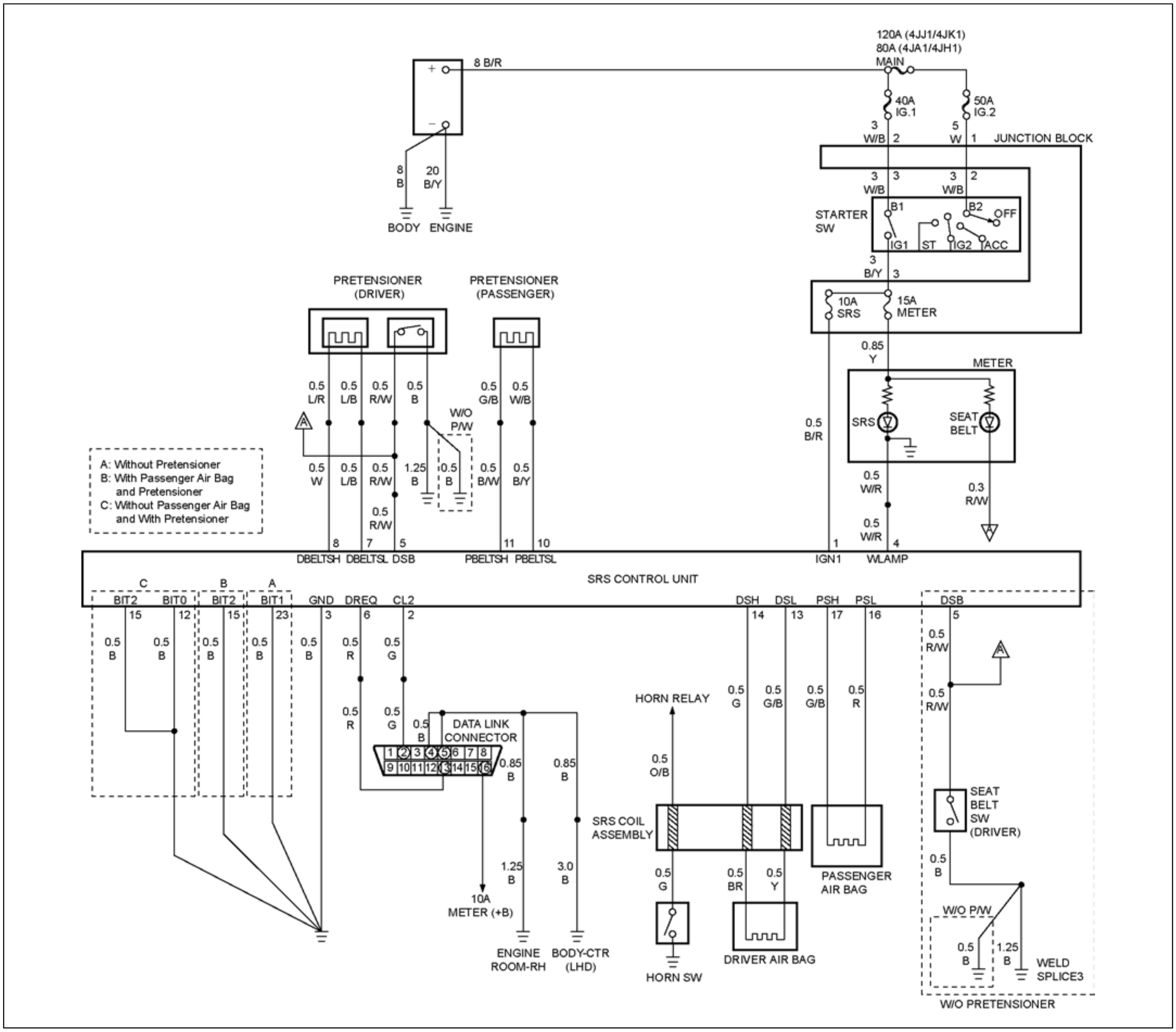
DISPLAY on Tech 2	UNIT	VALUE
Battery Voltage	V	12.0
Driver Airbag Squib Circuit Resistance	Ohm	1.70-4.33
Passenger Airbag Squib Circuit Resistance	Ohm	1.31-3.08
Driver Seatbelt Status	Buckled/ Not Buckled	Buckled/ Not Buckled

Diagnostic Trouble Codes

Choose and trace an appropriate flowchart by the numbers listed below to find fault and repair.

DTC	Flash Code	Description
–	12	Diagnostic Display Mode (Flash Code only)
–	13	Diagnostic Display Mode (Flash Code only)
B0015	15	Passenger Air Bag Squib Circuit High Resistance
B0016	16	Passenger Air Bag Squib Circuit Low Resistance
B0018	18	Passenger Air Bag Squib Circuit Short to GND
B0019	19	Passenger Air Bag Squib Circuit Short to Battery Voltage
B0021	21	Driver Air Bag Squib Circuit High Resistance
B0022	22	Driver Air Bag Squib Circuit Low Resistance
B0025	25	Driver Air Bag Squib Circuit Short to GND
B0026	26	Driver Air Bag Squib Circuit Short to Battery Voltage
B0029	29	Passenger Pretensioner Squib Circuit High Resistance
B0031	31	Passenger Pretensioner Squib Circuit Low Resistance
B0033	33	Passenger Pretensioner Squib Circuit Short to GND
B0034	34	Passenger Pretensioner Squib Circuit Short to Battery Voltage
B0041	41	Driver Pretensioner Squib Circuit High Resistance
B0042	42	Driver Pretensioner Squib Circuit Low Resistance
B0045	45	Driver Pretensioner Squib Circuit Short to GND
B0046	46	Driver Pretensioner Squib Circuit Short to Battery Voltage
B0051	51	Air Bag Squib Circuit Activated (Clash)
B0052	52	Pretensioner Squib Circuit Activated
B0055	55	Vehicle Variant Missing
B0061	61	Warning Lamp Circuit Failure
B0062	62	Battery Voltage Too High
B0063	63	Battery Voltage Too Low
B0071	71	SRS Control Unit Internal Fault

System Schematic



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SRS Diagnostic System Check

The diagnostic procedures used in this section are designed to find and repair SRS malfunctions. To get the best results, it is important to use the diagnostic charts and follow the sequence listed below:

A Perform the “SRS Diagnostic System Check.”
The “SRS Diagnostic System Check” must be the starting point of any SRS diagnostics. The “SRS Diagnostic System Check” checks for proper “SRS” warning lamp operation, the ability of the SRS control unit to communicate through the “Serial Data” line and whether SRS diagnostic trouble codes exist.

B Refer to the proper diagnostic chart as directed by the “SRS Diagnostic System Check.”
The “SRS Diagnostic System Check” will lead you to the correct chart to diagnose any SRS malfunctions. Bypassing these procedures may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.

C Repeat the “SRS Diagnostic System Check” after any repair or diagnostic procedures have been preformed.
Performing the “SRS Diagnostic System Check” after all repair or diagnostic procedures will ensure that the repair has been made correctly and that no other malfunctions exist.

2. FRONT WHEEL SHIMMY

Checkpoint		Trouble Cause	Countermeasure
Wheel bearing	NG	Worn or improperly adjusted	Adjust or replace
OK			
Front alignment	NG	Incorrect	Adjust the front alignment
OK			
Ball joint or bush	NG	Worn	Replace the ball joint or bush
OK			
Steering unit	NG	Loose or worn	Tighten or replace
OK			
Tire	NG	Worn or improperly inflated	Replace or adjust the inflation
OK			
Shock absorber	NG	Worn	Replace the shock absorber

Circuit Description

When the ignition switch is first turned “ON”, “Ignition 1” voltage is applied from the “SRS” fuse to the SRS control unit at the “Ignition 1” input terminals “1”. The SRS control unit responds by flashing the “SRS” warning lamp seven times, while performing tests on the SRS.

Notes On System Check Chart

1. The “SRS” warning lamp should flash seven times after the ignition is first turned “ON”.
2. After the “SRS” warning lamp flashes seven times, it should turn to “LOCK”
3. This test checks for the proper operation of the “Serial Data” line. This test will also determine whether history diagnostic trouble codes are stored and, if so, identify them.
4. Improper operation of the “SRS” warning lamp is indicated. This test differentiates between ‘a warning lamp stays “ON” condition’ and ‘a warning lamp does not come “ON” condition’.
5. This test checks for proper operation of the “Serial Data” line. This test will also identify the stored diagnostic trouble codes and whether they are current or history.

Diagnostic Aids

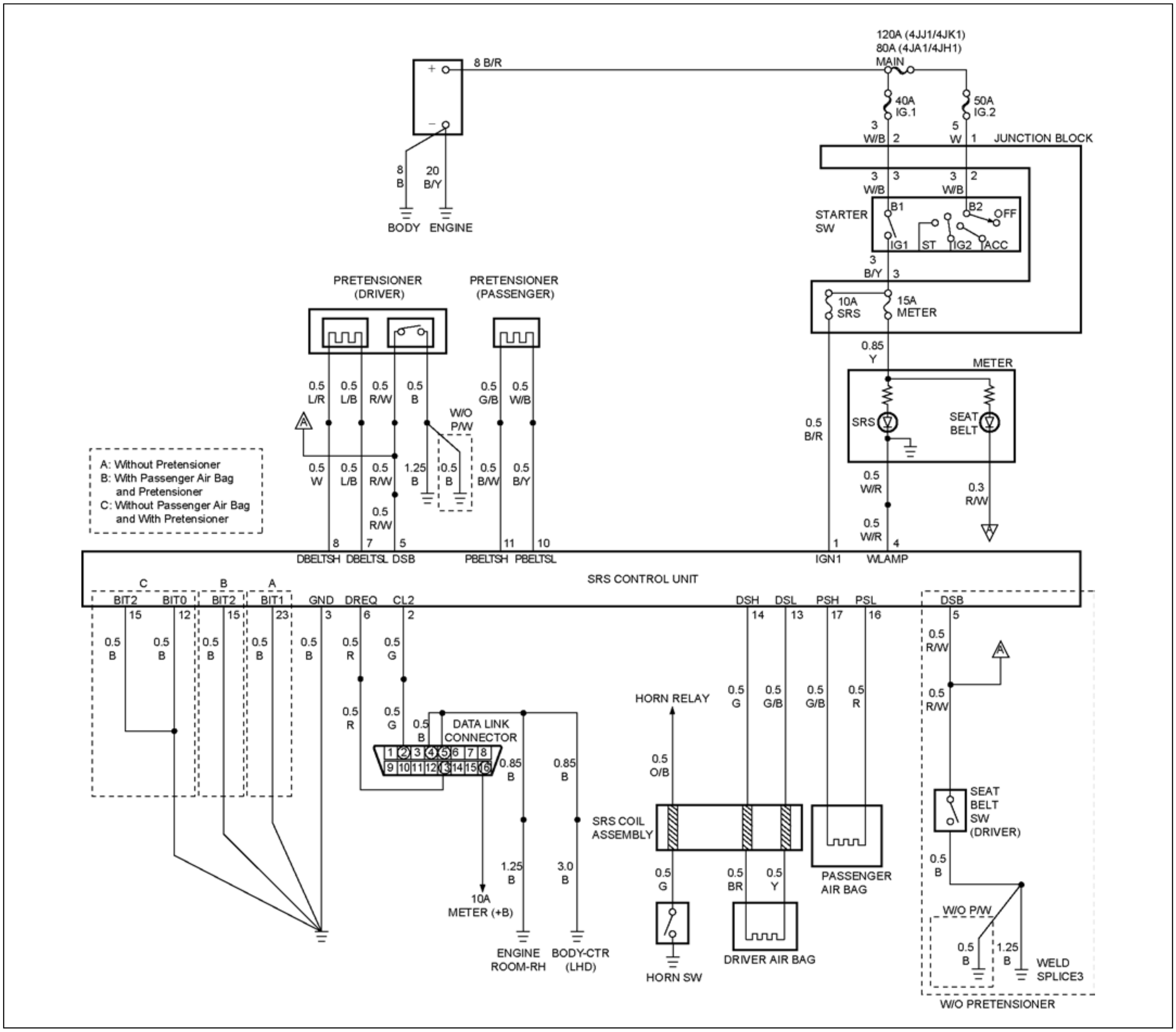
The order in which diagnostic trouble codes are diagnosed is very important. Failure to diagnose the diagnostic trouble codes in the order specified may result in extended diagnostic time, incorrect diagnosis and incorrect parts replacement.

SRS Diagnostic System Check

Step	Action	Yes	No
1	Note the “SRS” warning lamp as the ignition switch is turned “ON”. Does the “SRS” warning lamp flash seven (7) times?	Go to Step 2	Go to Step 3
2	Note the “SRS” warning lamp after it flashed 7 times. Does the “SRS” warning lamp go “OFF”?	Go to Step 4	Go to Step 5
3	Note the “SRS” warning lamp as the ignition switch is turned “ON”. Does the “SRS” warning lamp come “ON” steady?	Go to Chart B.	Go to Chart C.
4	1. Note the “SRS” warning lamp as the ignition switch is turned “ON”. Ignition switch is at “LOCK”. 2. Connect a scan tool to data link connector. 3. Follow direction given in the scan tool instruction manual. Ignition switch is “ON”. 4. Request the SRS diagnostic trouble code display, recode all history diagnostic trouble code(s), specifying as current or history in repair order. Is (are) diagnostic trouble code(s) displayed?	Ignition switch “LOCK”. When DTC B0071 is set, go to DTC B0071 Chart. For all other history codes refer to “Diagnostic Aids” For that specific DTC. A history DTC indicates the malfunction has been repaired or is intermittent.	SRS is functional and free of malfunctions, no further diagnosis is required. If scan tool indicated “NO DATA RECEIVED,” refer to chassis electrical section 8.

Step	Action	Yes	No
5	1. Ignition switch is at “LOCK”. 2. Connect a scan tool to data link connector. 3. Follow directions as given in the scan tool instruction manual. 4. Ignition switch is “ON”. 5. Request the SRS diagnostic trouble code display, Recode all diagnostic trouble code(s), specifying as current or history in repair order. Is (are) diagnostic trouble code (s) displayed?	Ignition switch “LOCK”. When the current DTC is set, go to applicable DTC chart. And then if DTC B0019, B0025, B0051, B0055 or B0071 is set, go to these DTC chart first. When only history DTCs exist, refer to “Diagnostics Aids” for that specific DTC. A history DTC indicates the malfunction has been repaired or is intermittent.	If scan tool indicates “No Data Received,” refer to chassis electrical section 8.

Chart A SRS Control Unit Integrity Check



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Circuit Description

When the SRS control unit recognizes that "Ignition 1" voltage, applied to terminals "1", is greater than 9 volts, the "SRS" warning lamp is flashed 7 times to verify operation. At this time the SRS control unit performs "Turn–ON" tests followed by "Continuous Monitoring" tests. When a malfunction is detected, the SRS control unit sets a current diagnostic trouble code and illuminates the "SRS" warning lamp. The SRS control unit will clear current diagnostic trouble codes and move them to a history file when the malfunction is no longer detected and/or the ignition switch is cycled, except for DTCs B0051 and B0055.

Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

1. This test confirms a current malfunction. If no current malfunction is occurring (history DTC set) the "Diagnostic Aids" for the appropriate diagnostic trouble code should be referenced. The SRS control unit should not be replaced for a history diagnostic trouble code.
2. This test checks for a malfunction introduced into the SRS during the diagnostic process. It is extremely unlikely that a malfunctioning SRS control unit would cause a new malfunction to occur during the diagnostic process.

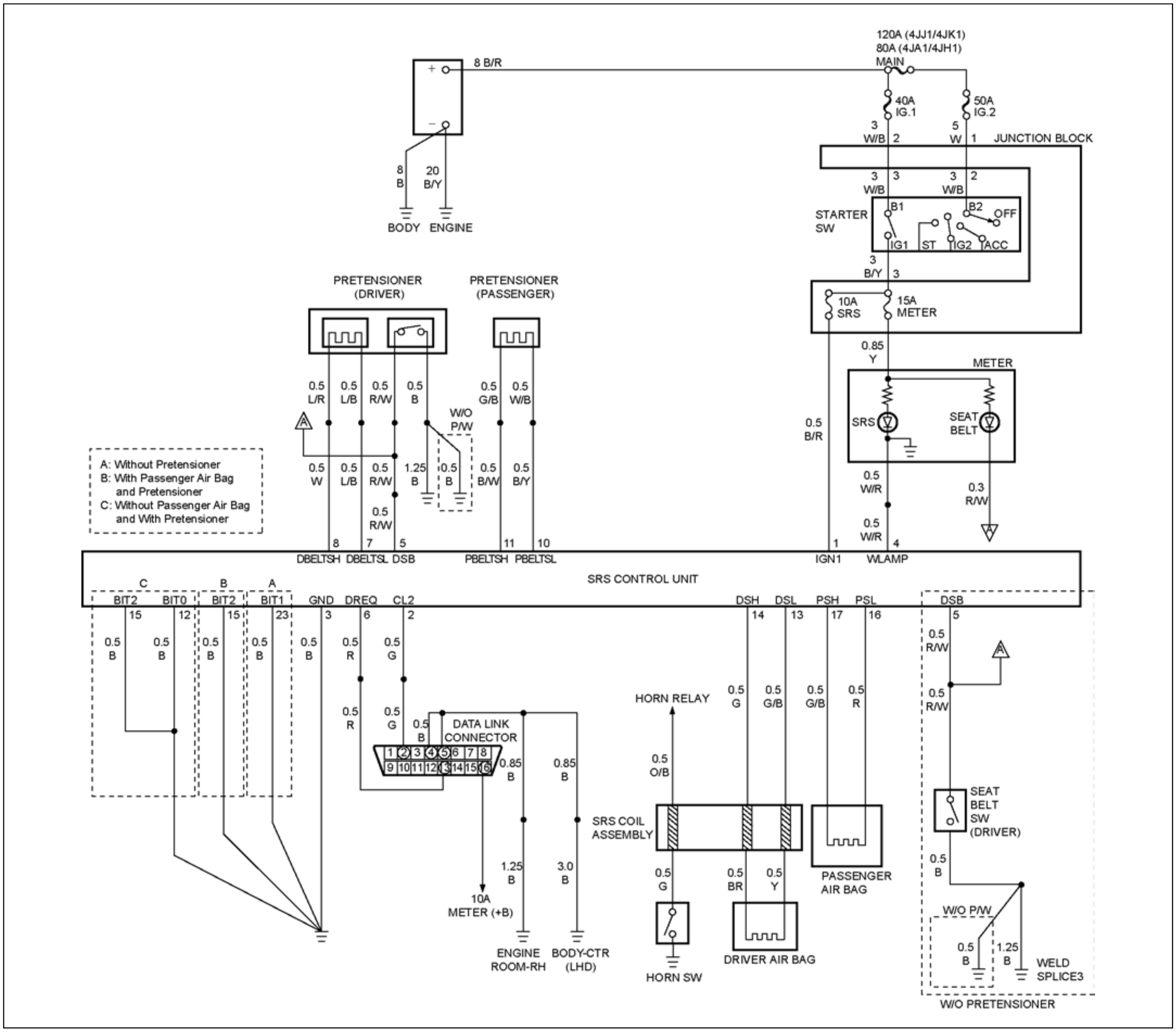
3. When all circuitry outside the SRS control unit has been found to operate properly, as indicated by the appropriate diagnostic chart, then and only then should the SRS control unit be replaced.

Chart A SRS control unit Integrity Check

WARNING: DURING SERVICE PROCEDURES. BE VERY CAREFUL WHEN HANDLING A SRS CONTROL UNIT. NEVER STRIKE OR JAR THE SRS CONTROL UNIT. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SRS CONTROL UNIT AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SRS. THE SRS CONTROL UNIT COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY

Step	Action	Yes	No
1	1. This chart assumes that the “SRS Diagnostic System Check” and either a symptom chart or a diagnostic trouble code chart diagnosis has been performed. When all circuitry outside the SRS control unit has been found to operate properly, as indicated by the appropriate diagnostic chart, and the symptom or DTC remains current, check the following. 2. Diagnostic procedures must be performed to verify the need for SRS control unit replacement. 3. Ignition switch is at “LOCK”. 4. Reconnect all SRS components and ensure all components are properly mounted. 5. Ensure the ignition switch has been in the “LOCK” position for at least 15 seconds. 6. Note the “SRS” warning lamp as the ignition switch is turned “ON”. Does the warning lamp flash 7 times then go “OFF”?	The symptom or DTC is no longer occurring. Clear SRS diagnostic trouble codes. Repeat “SRS Diagnostic System Check”	Go to Step 2
2	Using a scan tool, request the diagnostic trouble code display. Is the same symptom or DTC occurring that was occurring when the “SRS Diagnostic System Check” was first performed?	Go to Step 3	Ignition switch “LOCK”. Go to the appropriate chart for the indicated malfunction.
3	1. Clear the “SRS Diagnostic Trouble Codes”. 2. Ignition switch is in the “LOCK” position for at least two minutes. 3. Note the “SRS” warning lamp as the ignition switch is turned “ON”. Does warning lamp flash 7 times then go “OFF”?	SRS is functional and free of malfunctions. No further diagnosis is required. Go to Step 4	Ignition switch “LOCK”. Replace SRS control unit. Go to Step 4
4	Reconnect all SRS components, ensure all components are properly mounted. Is this step finished?	Repeat the “SRS Diagnostic System Check”	—

Chart B “SRS” Warning Lamp Comes “ON” Steady



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Circuit Description

When the ignition switch is first turned “ON”, “Ignition 1” voltage is applied from the “METER” fuse to the “SRS”, warning lamp which is connected to “SRS Warning Lamp”, terminal “4”. The “SRS” fuses apply system voltage to the “Ignition 1” inputs, terminals “1”. The SRS control unit responds by flashing the “SRS” warning lamp 7 times. If “Ignition 1” is less than 9 volts, the “SRS” warning lamp will come “ON” solid with no DTCs set.

Chart Test Description

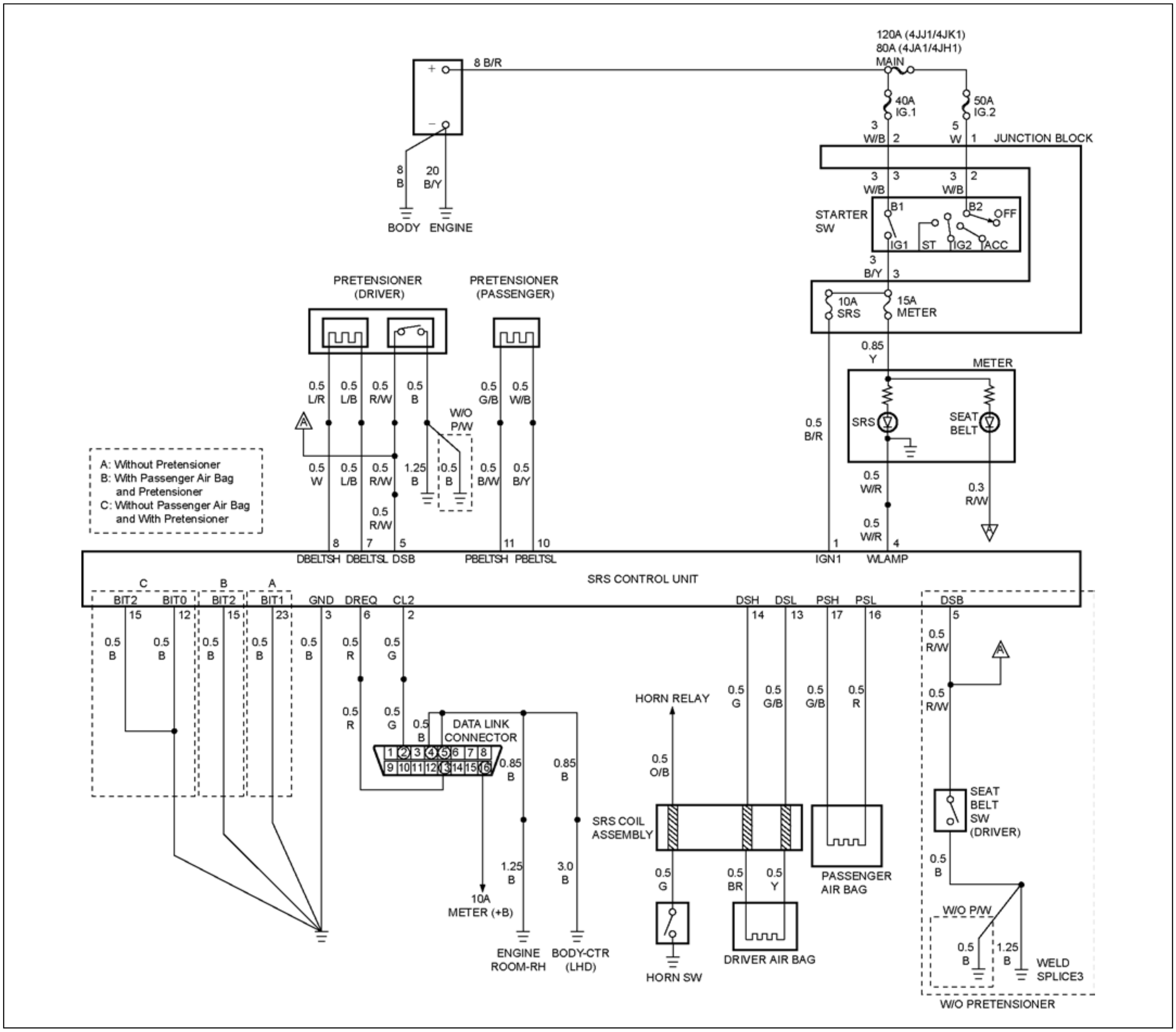
Number(s) below refer to step number(s) on the diagnostic chart:

2. This test checks for an open in the “Ignition 1” circuit to the SRS control unit.
3. This test checks for the voltage of “Ignition 1”.
4. This test determines whether the malfunction is a short to ground in the SRS warning lamp circuit.

Chart B "SRS" warning lamp comes "ON" Steady

Step	Action	Yes	No
1	1. When measurements are requested in this chart use a 5-8840-0366-0DMM with correct terminal adapter from 5-8840-0385-0. 2. Ignition switch is at "LOCK". 3. Connect the scan tool to the data link connector, following directions as given in the scan tool instruction MANUAL. 4. Ignition switch is "ON". 5. Request the SRS diagnostic trouble code display. Does the scan tool indicate "No Data Received"?	Go to Step 2	Go to Step 3
2	1. Ignition switch is at "LOCK". 2. Inspect the SRS control unit harness connector connection to the SRS control unit. Is it securely connected to the SRS control unit?	Ignition switch "LOCK". Replace SRS control unit. Go to Step 5	Connect SRS control unit securely to de–activate shorting clip in SRS control unit harness connector. Go to Step 5
3	Using scan tool, request the SRS data list. Is "ignition" more than 9 volts?	Go to Step 4	Ignition switch "LOCK". Replace SRS control unit. Go to Step 5
4	1. Ignition switch is at "LOCK". 2. Disconnect the SRS coil and the passenger air bag assembly yellow connector located at the base of the steering column and behind the glove box assembly. Disconnect the SRS control unit. 3. Disconnect the connector of the "SRS Warning Lamp" on the instrument cluster. 4. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "3" and "23" to ground (ground) (without the pretensioner) ● From terminals "3" and "15" to ground (ground) (with the pretensioner and the passenger air bag) ● From terminals "3", "12" and "15" to ground (with the pretensioner and without the passenger air bag) Does 5-8840-0366-0DMM display "OL" (Infinite)?	Go to Chart A	Replace SRS harness. Go to Step 5
5	Reconnect all SRS components and ensure all components are properly mounted. Is this step finished?	Repeat the "SRS Diagnostic System Check"	—

Chart C “SRS” Warning Lamp Does Not Come “ON” Steady



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Circuit Description

When the ignition switch is first turned “ON”, “Ignition 1” voltage is applied from the “METER” fuse to the “SRS” warning lamp which is connected to the “SRS Warning Lamp”, terminal “4”. The “SRS” fuse applies system voltage to the “Ignition 1” inputs, terminals “35”. The SRS control unit responds by flashing the “SRS” warning lamp seven times. If “Ignition 1” is more than 16 volts, the “SRS” warning lamp will still be “OFF” solid with no DTCs set.

Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

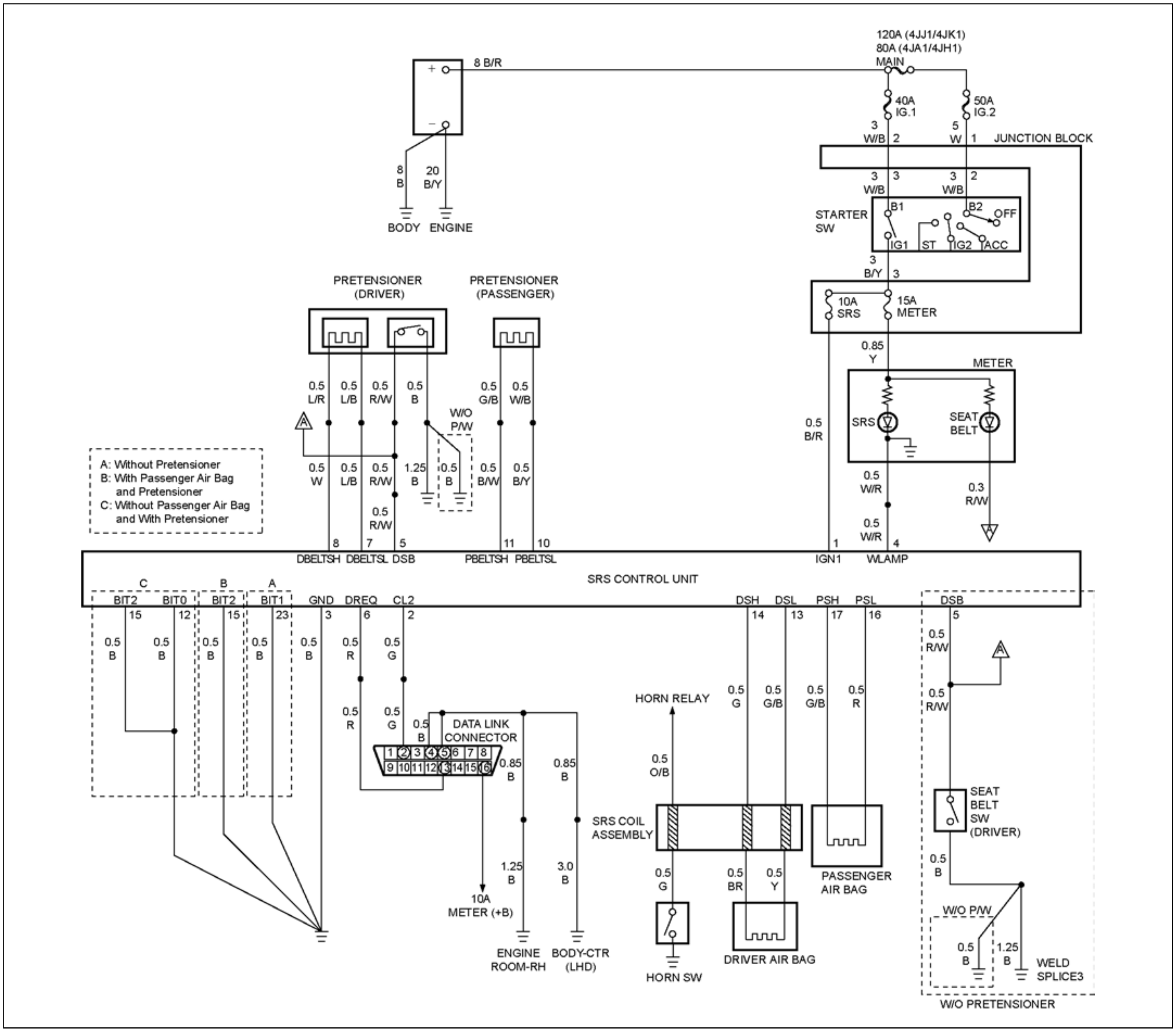
1. This test decides whether power is available to the SRS control unit warning lamp power feed circuit.
2. This test determines whether the voltage is present in the warning lamp circuit.
3. This test determines if the malfunction is in the instrument cluster.
4. This test checks for open in the warning lamp circuitry.
5. This test isolates the SRS warning lamp circuit and checks for a short in the SRS warning lamp circuit to B+.
8. This test checks for a short from the SRS control unit warning lamp power feed circuit to ground.
9. This test determines whether the short to ground is due to a short in the wiring.

Chart C "SRS" Warning Lamp Does Not Come "ON" Steady

Step	Action	Yes	No
1	1. When measurements are requested in this chart, use a 5-8840-0366-0DMM with a correct terminal adapter from 5-8840-0385-0. 2. Ignition switch is at "LOCK". 3. Remove and inspect the "METER" fuse to the "SRS" warning lamp. Is the fuse good?	Go to Step 2	Go to Step 7
2	1. Ignition switch is at "LOCK". 2. Disconnect the SRS coil and passenger air bag assembly yellow connector which is located at the base of the steering column and behind the glove box assembly. 3. Disconnect the SRS control unit. 4. Ignition switch is "ON". 5. Measure the voltage on the SRS control unit harness connector from the terminal "4" to terminal "3" (ground). Is system voltage present on terminal "4"?	Go to Step 4	Go to Step 3
3	1. Ignition switch is at "LOCK". 2. Remove instrument meter cluster. 3. Check for proper connection to instrument cluster at the SRS warning lamp circuit terminal. 4. If ok, then remove and inspect the "AIR BAG" bulb. Is the bulb good?	Go to Step 5	Replace bulb. Go to Step 6
4	1. Ignition switch is at "LOCK". 2. Disconnect instrument meter cluster harness connector. 3. Ignition switch is "ON". 4. Measure the voltage on the SRS control unit harness connector from terminal "4" to terminal "3" (ground). Is the voltage 1 volt or less?	Go to Chart A	Replace SRS harness. Go to Step 6
5	1. Install the bulb. 2. Measure the resistance from the instrument meter cluster harness connector SRS warning lamp circuit terminal to the SRS control unit harness connector terminal "4". Is the resistance 5.0 ohms or less?	Service instrument meter cluster. Install instrument meter cluster. Go to Step 6	Replace SRS harness. Go to Step 6
6	Reconnect all SRS components and ensure all components are properly mounted. Is this step finished?	Repeat the "SRS Diagnostic System Check"	Go to Step 6
7	Perform chart C. Is this step finished?	Go to Step 8	Go to Step 1
8	1. Replace the "METER" fuse. 2. Ignition switch is "ON". Wait 10 Seconds then ignition switch is at "LOCK". 3. Remove and inspect the "METER" fuse. Is the fuse good?	Install "METER" fuse. Go to Step 10	Go to Step 9

Step	Action	Yes	No
9	1. Disconnect the SRS coil and the passenger air bag assembly yellow connectors located at the base of the steering column and behind the glove box assembly. 2. Disconnect the SRS control unit. 3. Replace the “METER” fuse. 4. Ignition switch is “ON”-wait 10 seconds. 5. Ignition switch is at “LOCK”. 6. Remove and inspect the “METER” fuse. Is the fuse good?	Install “METER” fuse. Go to Chart A	Replace SRS harness. Replace “METER” fuse. Go to Step 10
10	Reconnect all the SRS components and ensure all the components are properly mounted. Is this step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0015 (Flash Code 15) Passenger Air Bag Squib Circuit High Resistance



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Circuit Description

When the ignition switch is turned to “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SRS control unit then proceeds with the “Resistance Measurement Test”. The “Passenger Bag Low” terminal “16” is grounded through a resister and the passenger current source connected to the “Passenger Bag High” terminal “17” and allows a known amount of current to flow. By monitoring the voltage difference between the “Passenger Bag High” and “Passenger Bag Low” the SRS control unit calculates the combined resistance of the passenger air bag assembly, harness wiring circuits “Passenger Bag High” and “Passenger Bag Low” connector terminal contact.

DTC Will Set When

The combined resistance of the passenger air bag assembly, harness wiring circuits “Passenger Bag High” and “Passenger Bag Low”, and connector terminal contact is above a specified value. This test is run once for each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”,
2. “Ignition 1” voltage is in the specified value.

Action Taken

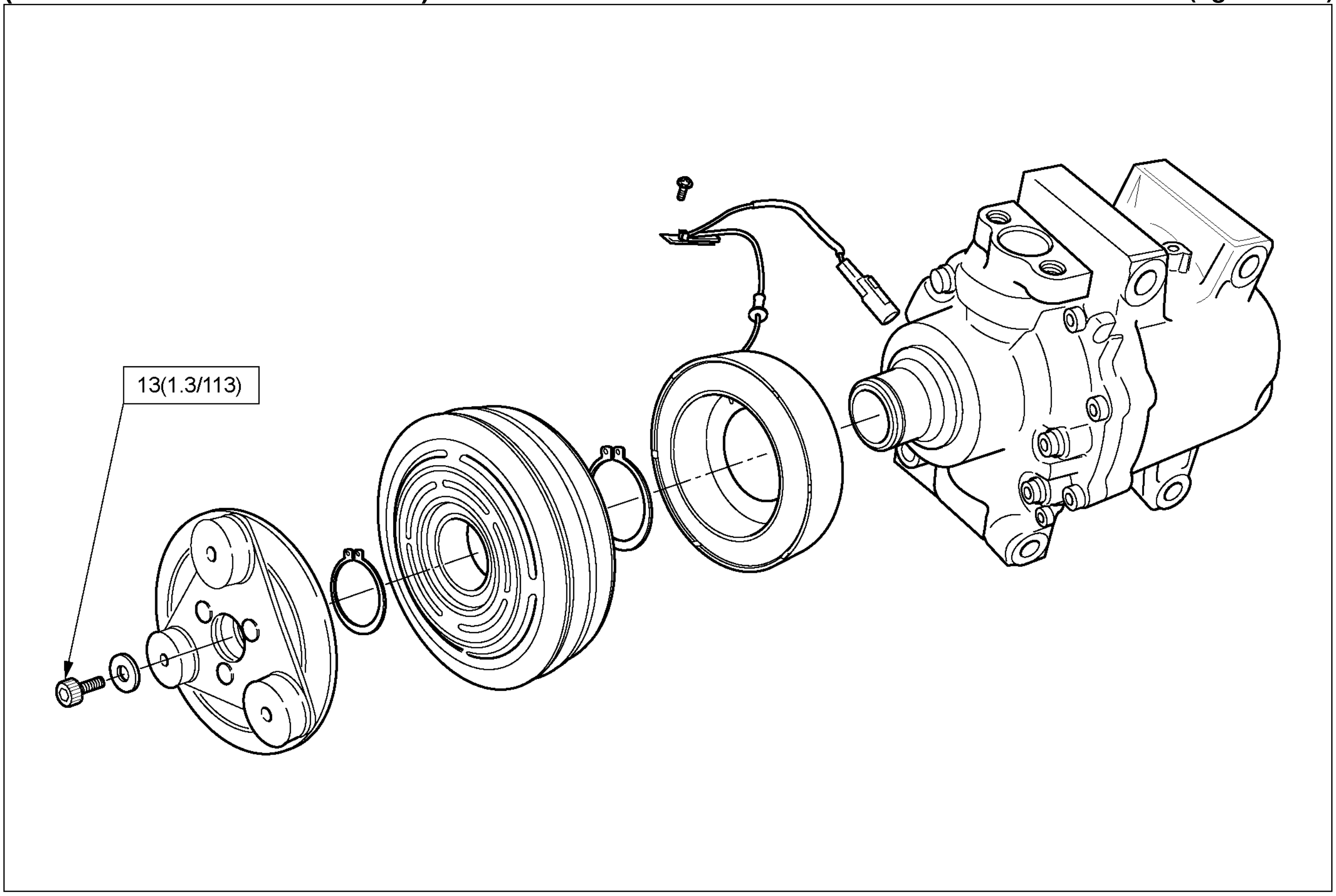
The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

SPECIAL PARTS FIXING NUTS AND BOLTS

FIXING TORQUE

(COMPRESSOR ASSEMBLY)

N·m (kgf·m/lb·in)



RTW510MF000501

4×4 MODEL

1. OIL LEAK AT FRONT AXLE

Checkpoint		Trouble Cause	Countermeasure
Oil seal	NG	Worn or defective oil seal	Replace the oil seal
OK ↓			
Front axle housing	NG	Cracked	Repair or replace

2. OIL LEAK AT PINION SHAFT

Checkpoint		Trouble Cause	Countermeasure
Gear oil level	NG	Too much gear oil	Correct the oil level
OK ↓			
Oil seal	NG	Worn or defective	Replace the oil seal
OK ↓			
Pinion flange	NG	Loose or damaged	Tighten or replace

3. NOISES IN FRONT AXLE DRIVE SHAFT JOINT

Checkpoint		Trouble Cause	Countermeasure
Drive shaft joints and bellows (UJ and DOJ)	NG	Broken or worn	Replace the drive shaft joints and bellows

DTC Will Clear When

Resistance value returns specified resistance value.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector.
4. This test checks for proper contact and/or corrosion of the yellow connector terminals.
5. This test checks for a malfunctioning passenger air bag assembly.
6. This test determines whether the malfunction is due to a high resistance in the wiring.

Diagnostic Aids

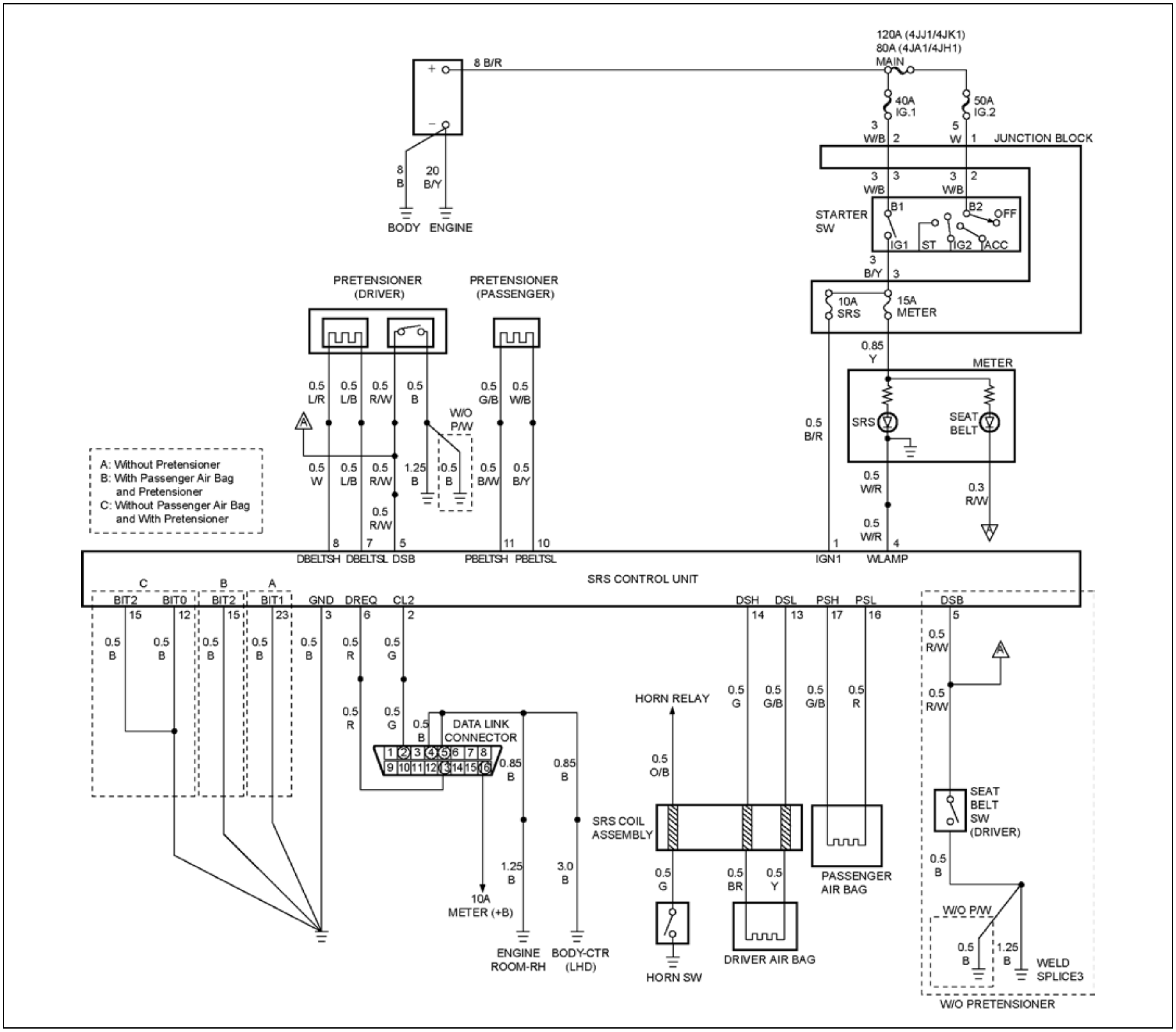
An intermittent condition is likely to be caused by a poor connection at the passenger air bag assembly harness connector terminals “1” and “2”, SRS control unit terminal “17” and “16”, or a poor wire to terminal connection in circuits “Passenger Bag High” and “Passenger Bag Low”. The test for this diagnostic trouble code is only run while the “SRS” warning lamp is performing the bulb check. When the scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0015 (Flash Code 15) Passenger Air Bag Squib Circuit High Resistance

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” Performed?	Go to Step 2	Go to The “SRS Diagnostic System Check”
2	1. Check the passenger air bag squib circuit for open. 2. If a problem is found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Make sure the passenger air bag assembly yellow connector located behind the glove box assembly is seated properly. Is the yellow connector connected properly?	Go to Step 4	Seat passenger Air Bag assembly yellow connector properly. Go to Step 7
4	1. Disconnect and inspect the passenger air bag assembly yellow connector located behind the glove box assembly. 2. If OK, reconnect the passenger air bag assembly connector. 3. Ignition switch is “ON”. Is DTC B0015 current?	Go to Step 5	Go to Step 7
5	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil and passenger air bag assembly, yellow connector located at the base of the steering column and behind the glove box assembly. 3. Connect a 5-8840-2421-0 SRS driver / passenger load tool and appropriate adapters to the SRS coil and passenger air bag assembly harness connectors. 4. Ignition switch is “ON”. Is DTC B0015 Current?	Go to Step 6	Ignition switch “LOCK”. Replace the passenger air bag assembly. Go to Step 7

Step	Action	Yes	No
6	1. Ignition switch is at “LOCK”. 2. There has been an increase in the total circuit resistance of the passenger inflator deployment loop. 3. Use the high resolution ohmmeter mode of the DMM while checking the circuits “Passenger Bag High” and “Passenger Bag Low”, and the SRS control unit connector terminal “17” and “16”, to locate the root cause. Was a fault found?	Replace SRS harness. Go to Step 7	Go to Chart A
7	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is This step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0016 (Flash Code 16) Passenger Air Bag Squib Circuit Low Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned to “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SRS control unit then proceeds with the “Resistance Measurement Test”. The “Passenger Bag Low” terminal “16” is grounded through a resistor and the passenger current source connected to the “Passenger Bag High” terminal “17” and allows a known amount of current to flow. By monitoring the voltage difference between the “Passenger Bag High” and “Passenger Bag Low”, the SRS control unit calculates the combined resistance of the passenger air bag assembly, harness wiring circuits “Passenger Bag High” and “Passenger Bag Low” connector terminal contact.

DTC Will Set When

The combined resistance of the passenger air bag assembly, harness wiring circuits “Passenger Bag High” and “Passenger Bag Low”, and connector terminal contact is above a specified value. This test is run once for each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”,
2. “Ignition 1” voltage is in the specified value.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

Resistance value returns to specified resistance value.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies connection of the yellow connector.
4. This test checks for proper operation of the shorting clip on the yellow connector.
5. This test checks for a malfunctioning passenger air bag assembly.
6. This test determines whether the malfunction is due to shortening in the wiring.

Diagnostic Aids

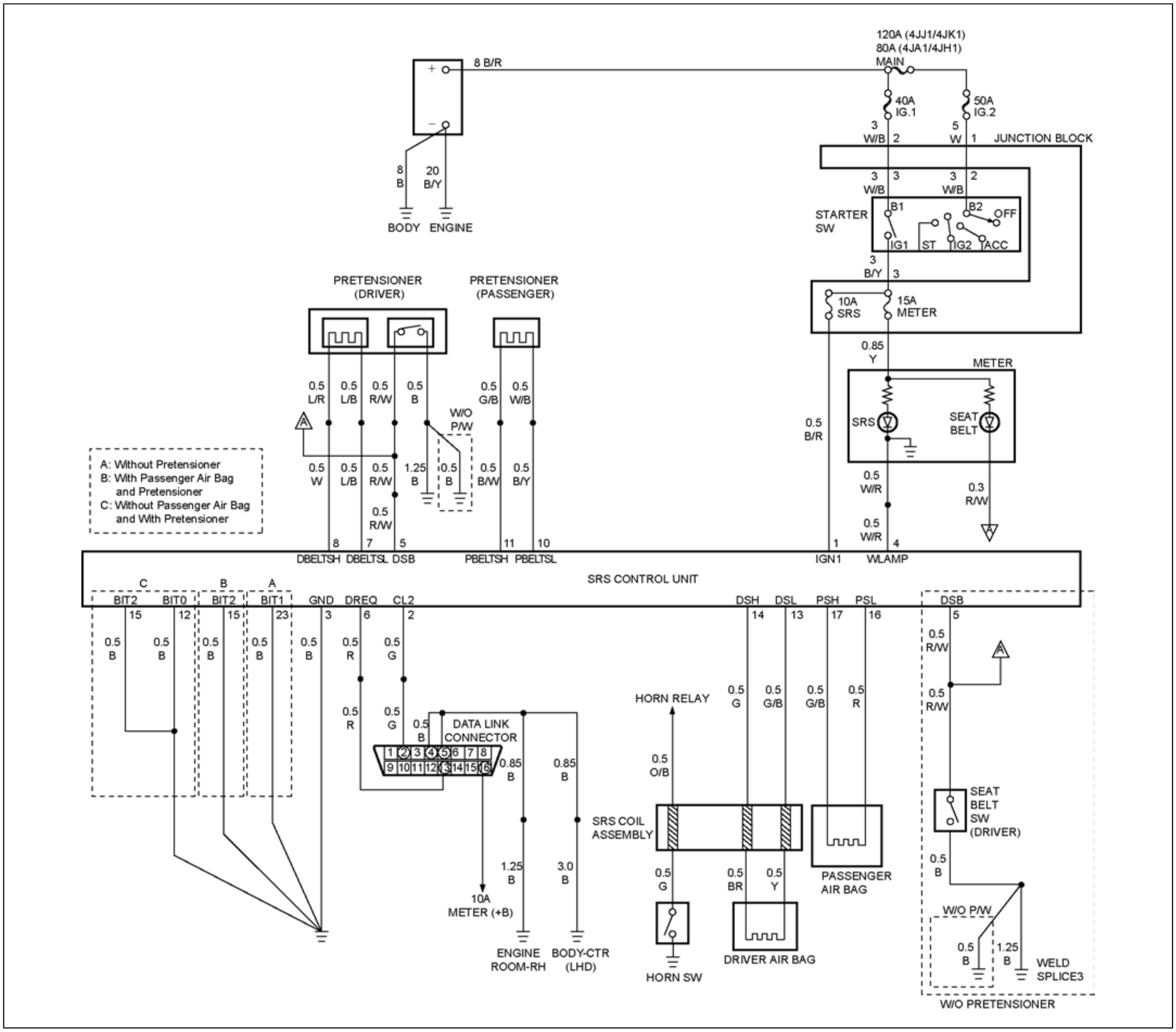
An intermittent condition is likely to be caused by a short between circuits “Passenger Bag High” and “Passenger Bag Low” or a malfunctioning shorting clip on the passenger air bag assembly which would require replacement of the air bag assembly. The test for this diagnostic trouble code is only run while the “SRS” warning lamp is performing the bulb check. When the scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0016 (Flash Code 16) Passenger Air Bag Squib Circuit Low Resistance

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Repeat the “SRS Diagnostic System Check”
2	1. Check the passenger air bag squib circuit for short to voltage or short to ground. 2. If a problem is found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Make sure the passenger air bag assembly yellow connector located behind the glove box assembly is seated properly. Is the yellow connector connected properly?	Go to Step 4	Seat passenger air bag assembly yellow connector properly. Go to Step 7
4	1. Disconnect and inspect the passenger air bag assembly yellow connector located behind the glove box assembly. 2. If ok, reconnect the passenger air bag assembly connector. 3. Ignition switch is “ON”. Is DTC B0016 Current?	Go to Step 5	Go to Step 7
5	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil and passenger air bag assembly yellow connector located at the base of the steering column and behind the glove box assembly. 3. Connect 5-8840-2421-0 SRS driver/passenger load tool and appropriate adapters to the SRS coil and the passenger air bag assembly harness connectors. 4. Ignition switch is “ON”. Is DTC B0016 current?	Go to Step 6	Ignition switch “LOCK”. Replace the passenger air bag assembly. Go to Step 7

Step	Action	Yes	No
6	1. Ignition switch is at “LOCK”. 2. There has been a decrease in the total circuit resistance of the passenger inflator deployment loop. 3. Use the high resolution ohmmeter mode of the DMM while checking the circuits “Passenger Bag High” and “Passenger Bag Low”, and the SRS control unit connector terminal “17” and “16” to locate the root cause. Was a fault found?	Replace SRS harness. Go to Step 7	Go to Chart A
7	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0018 (Flash Code 18) Passenger Air Bag Squib Circuit Short to GND



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and the deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at the “Driver Bag Low” terminal “13” and “Passenger Bag Low” terminal “16” to detect short to ground/+B in the air bag assembly circuits.

DTC Will Set When

“Ignition 1" is within the normal operating voltage range.

The voltage at “Passenger Bag Low" is below a specified value DTC B0018 will set.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The "Passenger Bag Low" voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the passenger air bag assembly yellow connector behind the glove box compartment.
4. This test determines whether the malfunction is in the "Passenger Bag High" circuit.
5. This test determines whether the malfunction is in the "Passenger Bag Low" circuit.

Diagnostic Aids

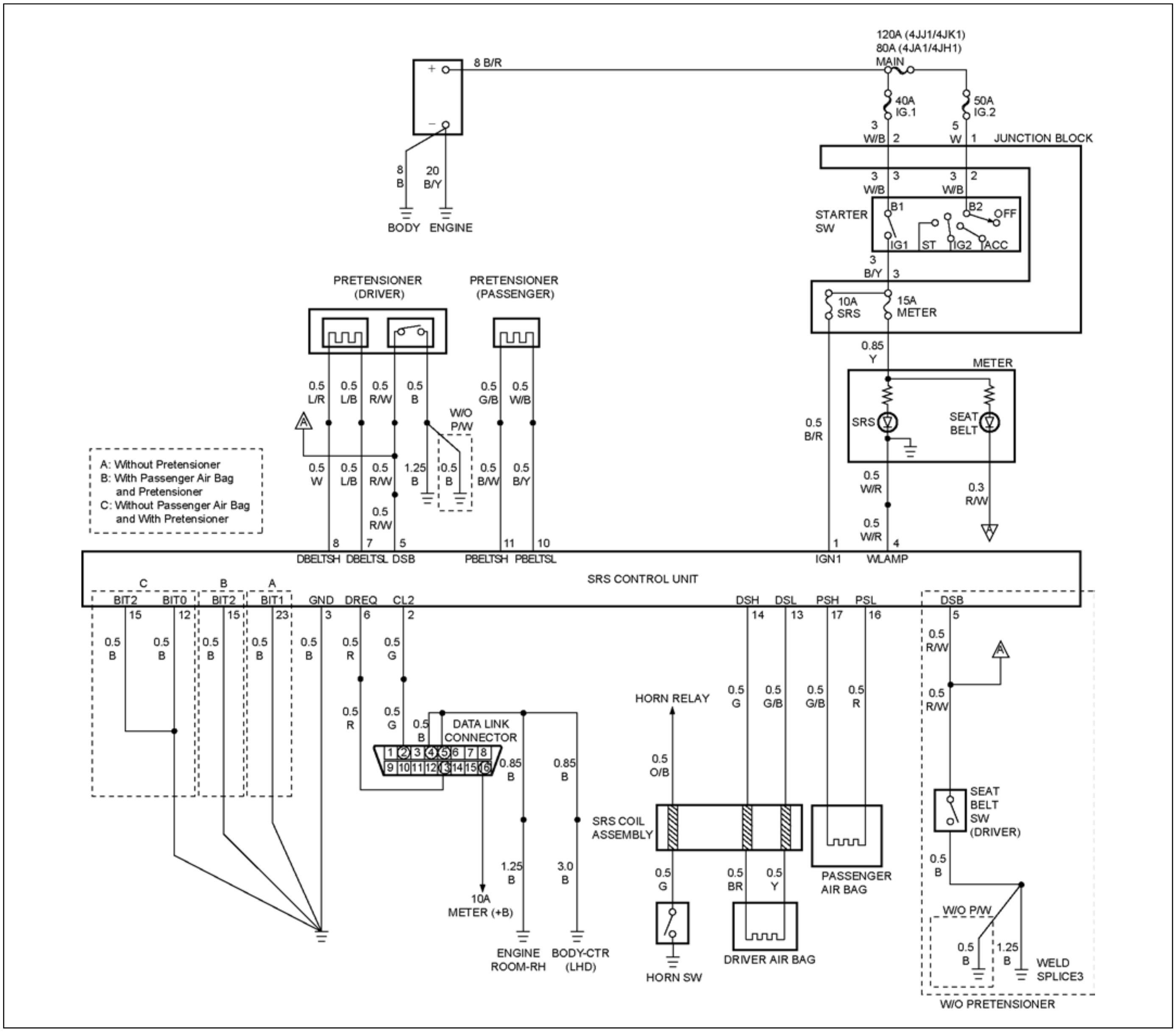
An intermittent condition is likely to be caused by a short to ground/+B in the passenger air bag assembly circuit. Inspect circuits "Passenger Bag High" and "Passenger Bag Low" carefully for cutting or chafing. If the wiring pigtail of the passenger air bag assembly is damaged, the component must be replaced.

DTC B0018 (Flash Code 18) Passenger Air Bag Squib Circuit Short to GND

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at "LOCK". 3. Ignition switch is "ON". 4. Check the passenger air bag squib circuit for a short to ground. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at "LOCK". 2. Disconnect the passenger air bag assembly yellow connector behind the glove box assembly. 3. Leave the driver air bag assembly connected. 4. Connect the SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to the passenger air bag assembly harness connector. 5. Ignition switch is "ON". Is DTC B0018 current?	Go to Step 4	Ignition switch is at "LOCK". Replace passenger air bag assembly . Go to Step 6
4	1. Ignition switch is at "LOCK". 2. Disconnect the SRS driver /passenger load tool. 3. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "17" to "3" and "23" (ground) (without the pretensioner) ● From terminals "17" to "3" and "15" (ground) (with the pretensioner) Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6

Step	Action	Yes	No
5	Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "16" to "3" and "23" (ground) (without the pretensioner) ● From terminals "16" to "3" and "15" (ground) (with the pretensioner) Does 5-8840-0366-0 display “OL” (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic system Check”	—

DTC B0019 (Flash Code 19) Passenger Air Bag Squib Circuit Short to Battery Voltage



RTW79ALF000301

Circuit Description

When the ignition switch is turned "ON", the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, "Ignition 1", and the deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at the "Driver Bag Low" terminal "13" and "Passenger Bag Low" terminal "16" to detect short to ground/+B in the air bag assembly circuits.

DTC Will Set When

"Ignition 1" is in the normal operating voltage range.

The voltage at "Passenger Bag Low" is above a specified value,

DTC B0019 will set.

Action Taken

The SRS control unit turns "ON" the "SRS" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The SRS control unit is replaced and the "Passenger Bag Low" voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the passenger air bag assembly yellow connector behind the glove box compartment.
4. This test determines whether the malfunction is in the "Passenger Bag High" circuit.
5. This test determines whether the malfunction is in the "Passenger Bag Low" circuit.

Diagnostic Aids

An intermittent condition is likely to be caused by a short to ground/+B in the passenger air bag assembly circuit. Inspect circuits "Passenger Bag High" and "Passenger Bag Low" carefully for cutting or chafing. If the wiring pigtail of the passenger air bag assembly is damaged, the component must be replaced.

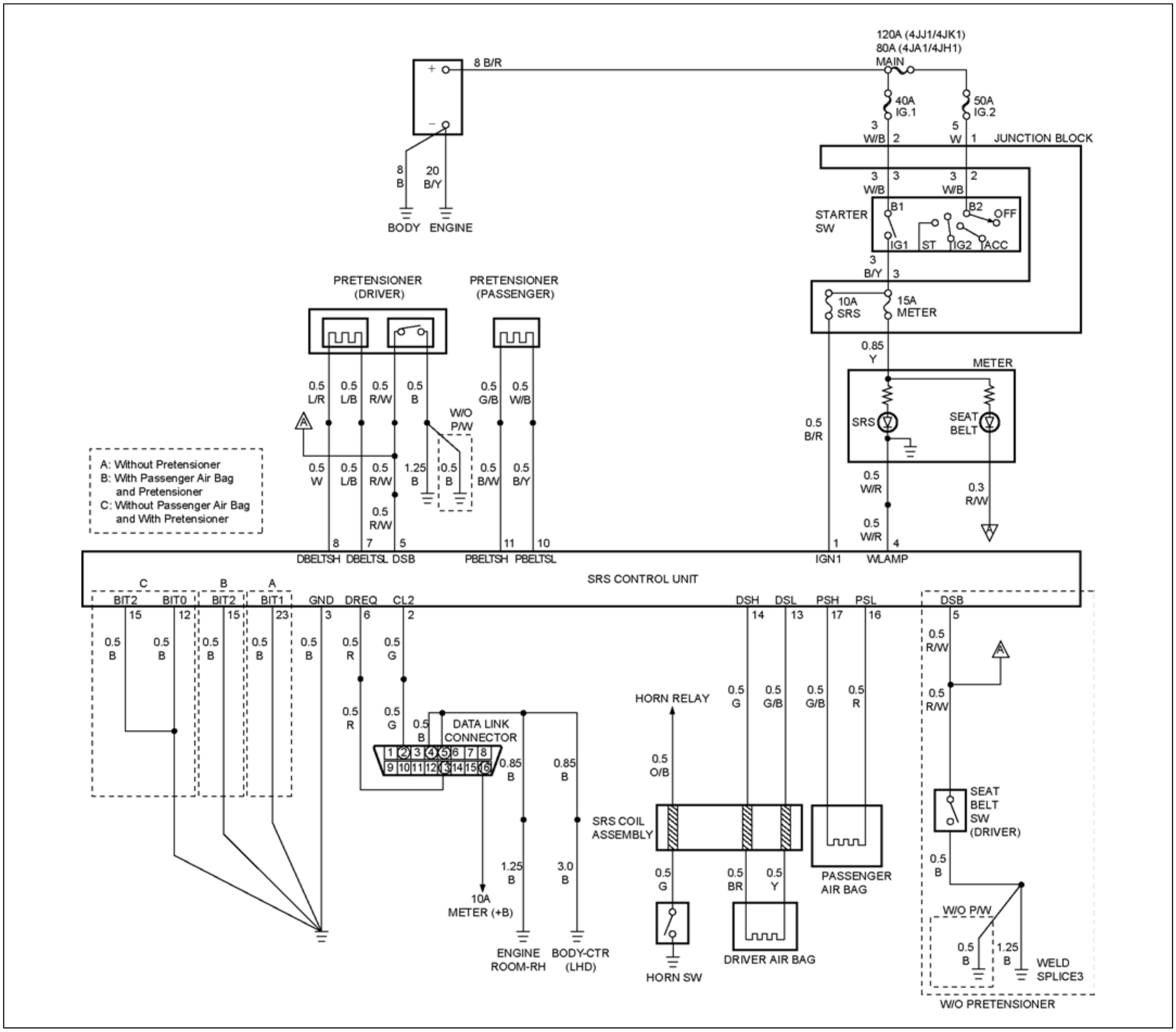
DTC B0019 (Flash Code 19) Passenger Air Bag Squib Circuit Short to Battery Voltage

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at "LOCK". 3. Ignition switch is "ON". 4. Check the passenger air bag squib circuit for a short to voltage, short to ground and open. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at "LOCK". 2. Disconnect the passenger air bag assembly yellow connector behind the glove box assembly. 3. Leave the driver air bag assembly connected. 4. Connect the SRS driver /passenger load tool 5-8840-2421-0 and appropriate adapter to the passenger air bag assembly harness connector. 5. Ignition switch is "ON". Is DTC B0019 current?	Go to Step 4	Ignition switch is at "LOCK". Replace passenger air bag assembly Go to Step 6
4	Measure the resistance on the SRS control unit harness connector from terminal "17" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6
5	Measure the resistance on the SRS control unit harness connector from terminal "16" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the "SRS Diagnostic system Check"	—

4. NOISES IN FRONT AXLE

Checkpoint		Trouble Cause	Countermeasure
Oil level	NG	Insufficient gear oil	Replenish the gear oil
	NG	Wrong or poor grade gear oil	Replace the gear oil
OK			
Drive pinion to ring gear backlash	NG	Too much or too little backlash	Adjust the backlash
OK			
Ring gear, pinion gear or side gear	NG	Worn or chipped	Replace the ring gear pinion gear or side gear
OK			
Pinion shaft bearing	NG	Worn	Replace the pinion shaft bearing
OK			
Wheel bearing	NG	Worn	Replace the wheel bearing
OK			
Differential bearing	NG	Loose or worn	Tighten or replace

DTC B0021 (Flash Code 21) Driver Air Bag Squib Circuit High Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and deployment loop voltages, are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit then proceeds with the “Resistance Measurement Test”. “Driver Bag Low” terminal “13” is grounded through a current sink and the driver current source connected to “Driver Bag High” terminal “14” allows a known amount of current to flow. By monitoring the voltage difference between “Driver Bag High” and “Driver Bag Low”, the SRS control unit calculates the combined resistance of the driver air bag assembly, SRS coil assembly, harness wiring circuits “Driver Bag High” and “Driver Bag Low” and connector terminal contact.

DTC Will Set When

The combined resistance of the driver air bag assembly, the SRS Coil assembly, the harness wiring circuits “Driver Bag High” and “Driver Bag Low”, and connector terminal contact is above a specified value. This test runs once for each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”.
2. “Ignition 1” voltage is in the specified value.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets DTC B0021.

DTC Will Clear When

Resistance value returns to specified resistance value.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector at the base of the steering column.
4. This test checks for proper contact and/or corrosion of the connector terminals at the base of the steering column.
5. This test isolates the malfunction to one side of the SRS coil assembly yellow connector located at the base of the steering column.
6. This test determines whether the malfunction is due to high resistance in the wiring.
7. This test determines whether the malfunction is in the SRS coil assembly or the driver air bag assembly.

Diagnostic Aids

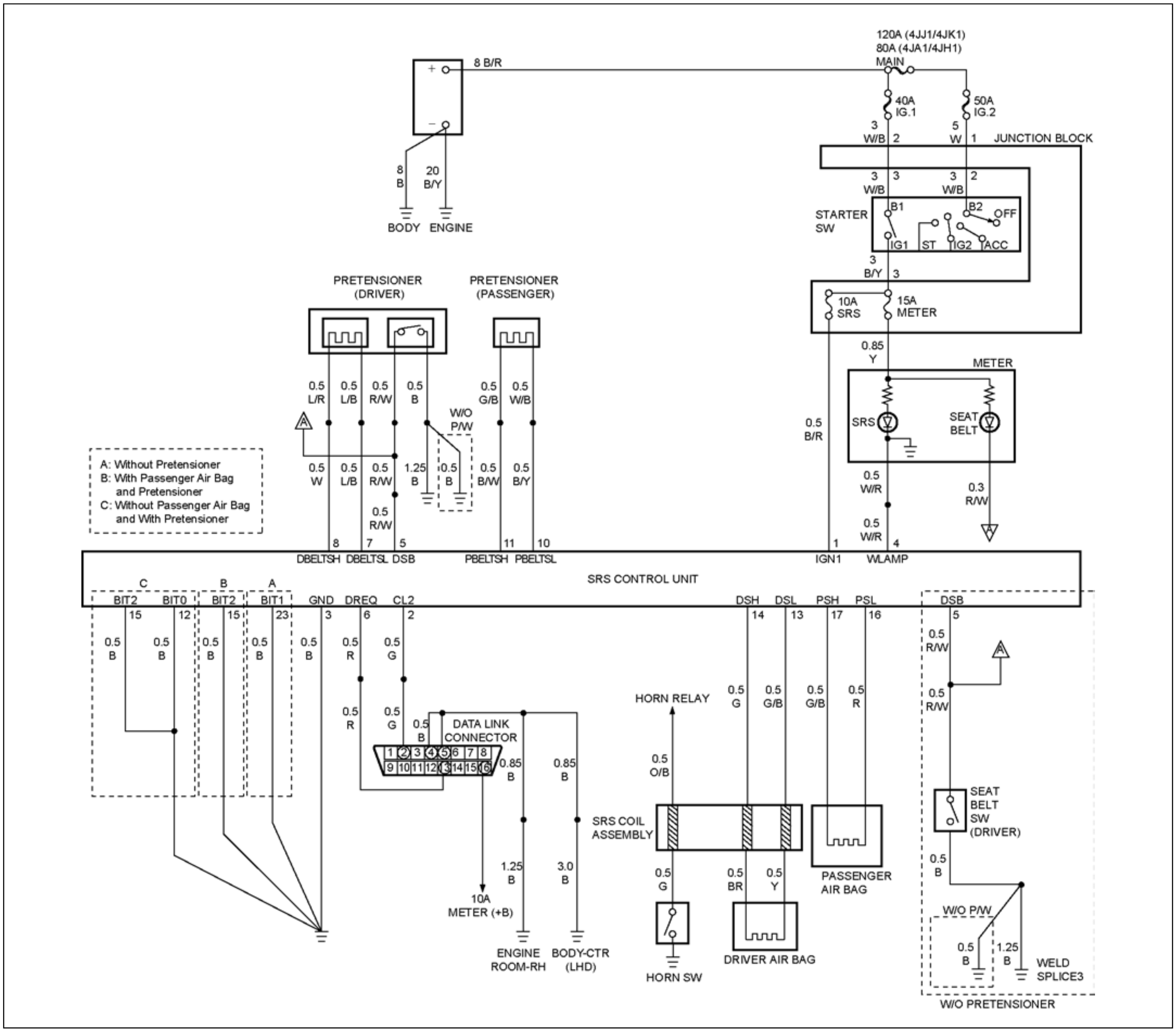
An intermittent condition is likely to be caused by a poor connection at terminals “1” and “2” of the SRS coil connector at the base of the steering column, terminal “1” and “2” of the driver air bag assembly connector at the top of the steering column, the SRS control unit terminals “14” and “13” or a poor wire to terminal connection in circuit “Driver Bag High” or “Driver Bag Low” The test for this diagnostic trouble code is only run while the “SRS” warning lamp is performing the bulb check. When a scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0021 (Flash Code 21) Driver Air Bag Squib Circuit High Resistance

Step	Action	Yes	No
1	Perform the “SRS Diagnostic System Check”. Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Repeat the “SRS Diagnostic System Check”
2	1. Check the driver air bag squib circuit for open. 2. If a the problem is found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch to “LOCK”. 2. Disconnect the SRS coil assembly yellow connector located at the base of the steering column and check it is seated properly. Is the connector connected properly?	Go to Step 4	Seat SRS coil assembly connector properly. Go to Step 8

Step	Action	Yes	No
4	1. Disconnect and inspect the SRS coil assembly yellow connector located at the base of the steering column. 2. If ok, reconnect the SRS coil assembly yellow connector. 3. Ignition switch is “ON”. Is DTC B0021 current?	Go to Step 5	Go to Step 8
5	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil and the passenger air bag assembly, yellow 2–pin connector located at the base of the steering column and behind the glove box assembly. 3. Connect the SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to the SRS coil and the passenger air bag assembly harness connectors. 4. Ignition switch is “ON”. Is DTC B0021 current?	Go to Step 6	Go to Step 7
6	1. Ignition switch is at “LOCK“. 2. There has been an increase in the total circuit resistance of the driver deployment loop. 3. Use the high resolution ohmmeter mode of the DMM while checking circuits “Driver Bag High” and “Driver Bag Low”, and the SRS control unit connector terminal “14” and “13” to locate the root cause. Was a fault found?	Replace SRS harness. Go to Step 8	Go to Chart A
7	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS driver / passenger load tool from the SRS coil assembly harness connector. 3. Connect the SRS driver / passenger load tool 5-8840-2421-0 on the top of the steering column. 4. Reconnect the SRS coil assembly harness connector at the base of the steering column. 5. Ignition switch is “ON”. Is DTC B0021 current?	Ignition switch “LOCK”. Replace SRS coil assembly. Go to Step 8	Ignition switch “LOCK”. Replace driver air bag assembly. Go to Step 8
8	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0022 (Flash Code 22) Driver Air Bag Squib Circuit Low Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests “Ignition 1”, and deployment loop voltages, are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit then proceeds with the “Resistance Measurement Test”. “Driver Bag Low” terminal “13” is grounded through a current sink and the driver current source connected to “Driver Bag High” terminal “14” allows a known amount of current to flow. By monitoring the voltage difference between “Driver Bag High” and “Driver Bag Low” the SRS control unit calculates the combined resistance of the driver air bag assembly, SRS coil assembly, harness wiring circuits “Driver Bag High” and “Driver Bag Low” and connector terminal contact.

DTC Will Set When

The combined resistance of the driver air bag assembly, SRS Coil assembly, harness wiring circuits "Driver Bag High" and "Driver Bag Low", and connector terminal contact is above a specified value. This test is run once for each ignition cycle during the "Resistance Measurement Test" when:

1. No "higher priority faults" are detected during "Turn–ON"
2. "Ignition 1" voltage is in the specified value.

Action Taken

The SRS control unit turns "ON" the "SRS" warning lamp and sets DTC B0022.

DTC Will Clear When

Resistance value returns to specified resistance value.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector at the base of the steering column.
4. This test checks for proper operation of the shorting clip in the yellow connector.
5. This test isolates the malfunction to one side of the SRS coil assembly yellow connector located at the base of the steering column.
6. This test determines whether the malfunction is due to shortening in the wiring.
7. This test determines whether the malfunction is in the SRS coil assembly or the driver air bag assembly.

Diagnostic Aids

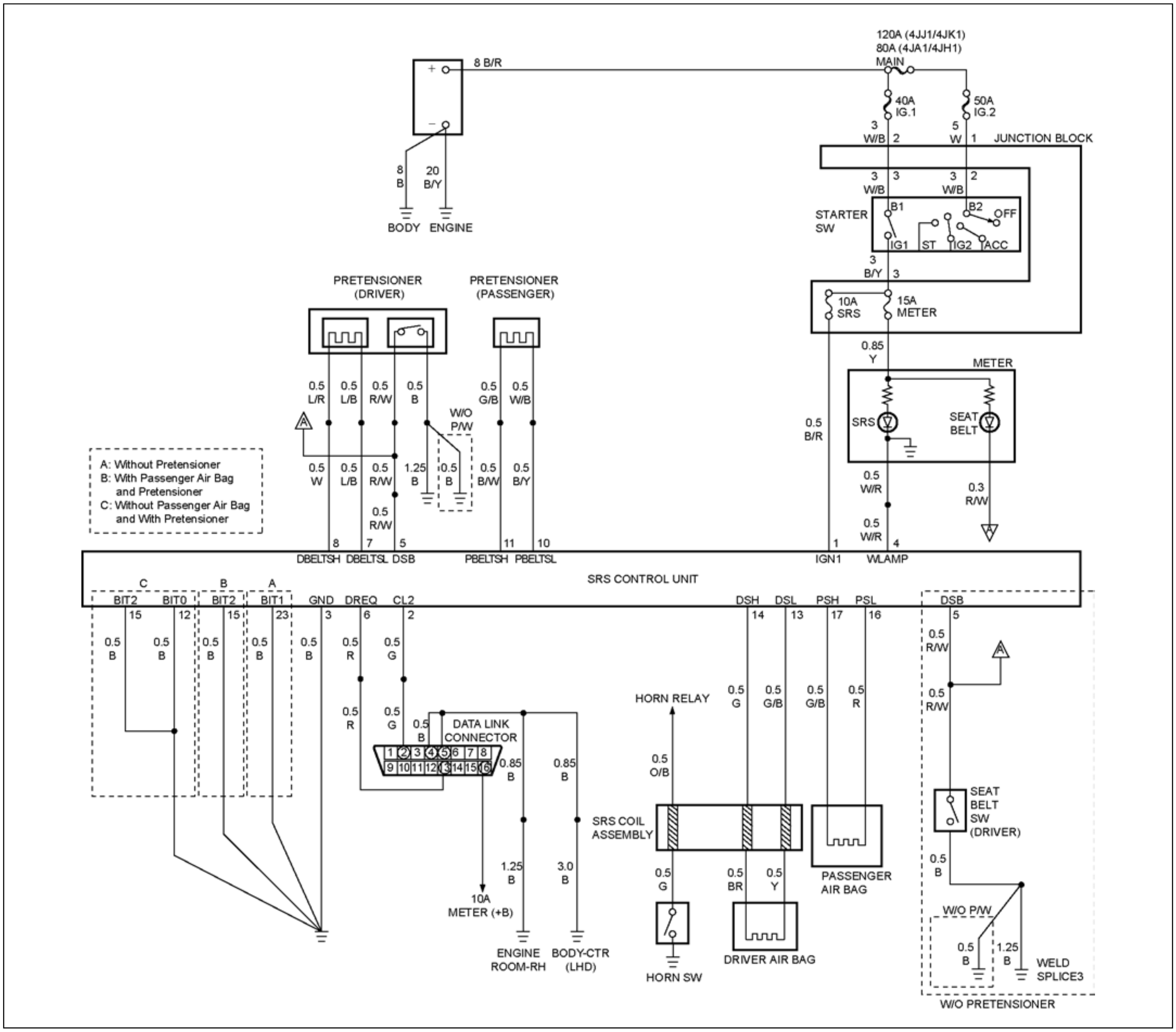
An intermittent condition is likely to be caused by a short between circuit "Driver Bag High" or "Driver Bag Low" and a malfunctioning shorting clip on the driver air bag assembly or the SRS coil assembly which would require replacement of the component. The test for this diagnostic trouble code is only run while the "SRS" warning lamp is performing the bulb check. When the scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0022 (Flash Code 22) Driver Air Bag Squib Circuit Low Resistance

Step	Action	Yes	No
1	Perform the "SRS Diagnostic System Check." Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. Check the driver air bag squib circuit for short to voltage or short to ground. 2. If a problem is found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch to "LOCK". 2. Make sure the SRS coil assembly yellow connector located at the base of steering column is seated properly. Is the connector connected properly?	Go to Step 4	Seat driver air bag assembly connector properly. Go to Step 8
4	1. Disconnect and inspect the SRS coil assembly yellow connector located at the base of the steering column. 2. If ok, reconnect the SRS coil assembly yellow connector. 3. Ignition switch is "ON". Is DTC B0022 current?	Go to Step 5	Go to Step 8

Step	Action	Yes	No
5	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil and passenger air bag assembly, yellow connector located at the base of the steering column and behind the glove box assembly. 3. Connect the SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to the SRS coil and passenger air bag assembly harness connectors. 4. Ignition switch is “ON”. Is DTC B0022 current?	Go to Step 6	Go to Step 7
6	1. Ignition switch to “LOCK”. 2. There has been a decrease in the total circuit resistance of the driver deployment loop. 3. Use the high resolution ohmmeter mode of the DMM while checking circuits “Driver Bag High” and “Driver Bag Low”, and the SRS control unit connector terminal “14” and “13” to locate the root cause. Was a fault found?	Replace SRS harness. Go to Step 8	Go to Chart A
7	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS driver / passenger load tool from the driver air bag assembly harness connector. 3. Connect the SRS driver / passenger load tool 5-8840-2421-0 to the top of the steering column connector. 4. Reconnect the SRS coil assembly harness connector at the base of the steering column. 5. Ignition switch is “ON”. Is DTC B0022 current?	Ignition switch “LOCK”. Replace SRS coil assembly. Go to Step 8	Ignition switch “LOCK”. Replace driver air bag assembly. Go to Step 8
8	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic System Check”	—

DTC B0025 (Flash Code 25) Driver Air Bag Squib Circuit Short to GND



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltage at “Driver Bag Low” terminal “13” and “Passenger Bag Low” terminal “16” to detect shorts to ground/+B in the air bag assembly circuits.

DTC Will Set When

“Ignition 1" is within the normal operating voltage range.

The voltage at “Driver Bag Low" is below a specified value DTC B0025 will set.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The “Driver Bag Low" voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the SRS coil assembly yellow 2–pin connector at the base of the steering column.
4. This test determines whether the malfunction is in the “Driver Bag High” circuit.
5. This test determines whether the malfunction is in the “Driver Bag Low” circuit.
6. This test determines whether the malfunction is in the SRS coil assembly or the driver air bag assembly.

Diagnostic Aids

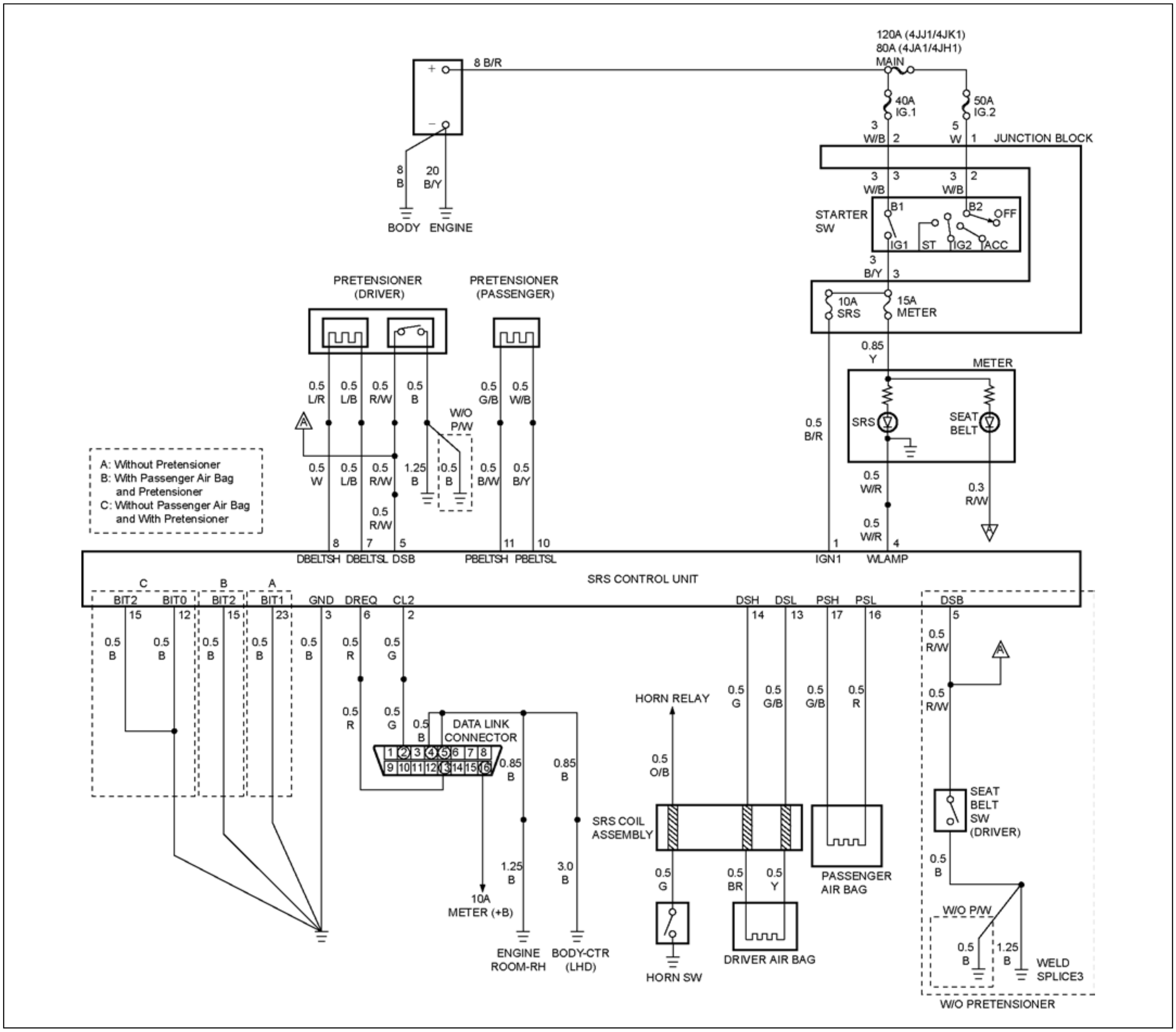
An intermittent condition is likely to be caused by a short to ground/+B in the driver air bag assembly circuit. Inspect circuits “Driver Bag High” and “Driver Bag Low” carefully for cutting or chafing.

DTC B0025 (Flash Code 25) Driver Air Bag Squib Circuit Short to GND

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at “LOCK”. 3. Ignition switch is “ON”. 4. Check the driver air bag squib circuit for short to voltage or short to ground and open. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil assembly yellow connector located at base of the steering column. Leave the passenger air bag assembly connected. 3. Connect the SRS driver /passenger load tool 5-8840-2421-0 and appropriate adapter to the SRS coil assembly harness connector. 4. Ignition switch is “ON”. Is DTC B0025 current?	Go to Step 4	Go to Step 6
4	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS control unit. 3. Disconnect the SRS driver /passenger load tool. 4. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "14" to "3" and "23" (ground) (without the pretensioner) ● From terminals "14" to "3" and "15" (ground) (with the pretensioner and the passenger air bag) ● From terminals "14" to "3", "12" and "15" (ground) (with the pretensioner and without the passenger air bag) Does 5-8840-0366-0 display “OL” (infinite)?	Go to Step 5	Replace SRS harness. Go to Step 7

Step	Action	Yes	No
5	Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "13" to "3" and "23" (ground) (without the pretensioner) ● From terminals "13" to "3" and "15" (ground) (with the pretensioner and the passenger air bag) ● From terminals "13" to "3", "12" and "15" (ground) (with the pretensioner and without the passenger air bag) Does 5-8840-0366-0 display “OL” (infinite)?	Go to Chart A	Replace SRS harness. Go to Step 7
6	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS driver /passenger load tool 5-8840-2421-0 from the SRS coil assembly harness connector. 3. Connect the SRS driver /passenger load tool 5-8840-2421-0 and appropriate adapter to the driver air bag assembly harness connector. located at top of the steering column connector. 4. Reconnect the SRS coil assembly harness connector at the base of the steering column. 5. Ignition switch is “ON”. Is DTC B0025 current?	Ignition switch is at “LOCK”. Replace SRS coil assembly. Go to Step 7	Ignition switch is at “LOCK”. Replace driver air bag assembly. Go to Step 7
7	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic System Check”	—

DTC B0026 (Flash Code 26) Driver Air Bag Squib Circuit Short to Battery Voltage



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltage at “Driver Bag Low” terminal “13” and “Passenger Bag Low” terminal “16” to detect shorts to ground/+B in the air bag assembly circuits.

DTC Will Set When

“Ignition 1" is in the normal operating voltage range.
The voltage at “Driver Bag Low" is above a specified value,
DTC B0026 will set.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The SRS control unit is replaced and the “Driver Bag Low" voltage comes to specified voltage.

5. WANDERS AND PULLS

Checkpoint	Trouble Cause	Countermeasure
Wheel bearing preload	NG: Too tight	Adjust the wheel bearing preload
OK ↓ Front alignment	NG: Incorrect	Adjust the front alignment
OK ↓ Steering unit	NG: Loose or worn	Tighten or replace
OK ↓ Tire	NG: Worn or improperly inflated	Replace or adjust the inflation
OK ↓ Suspension	NG: Front or rear suspension parts loose or broken	Tighten or replace

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the SRS coil assembly yellow 2–pin connector at the base of the steering column.
4. This test determines whether the malfunction is in the “Driver Bag High” circuit.
5. This test determines whether the malfunction is in the “Driver Bag Low” circuit.
6. This test determines whether the malfunction is in the SRS coil assembly or the driver air bag assembly.

Diagnostic Aids

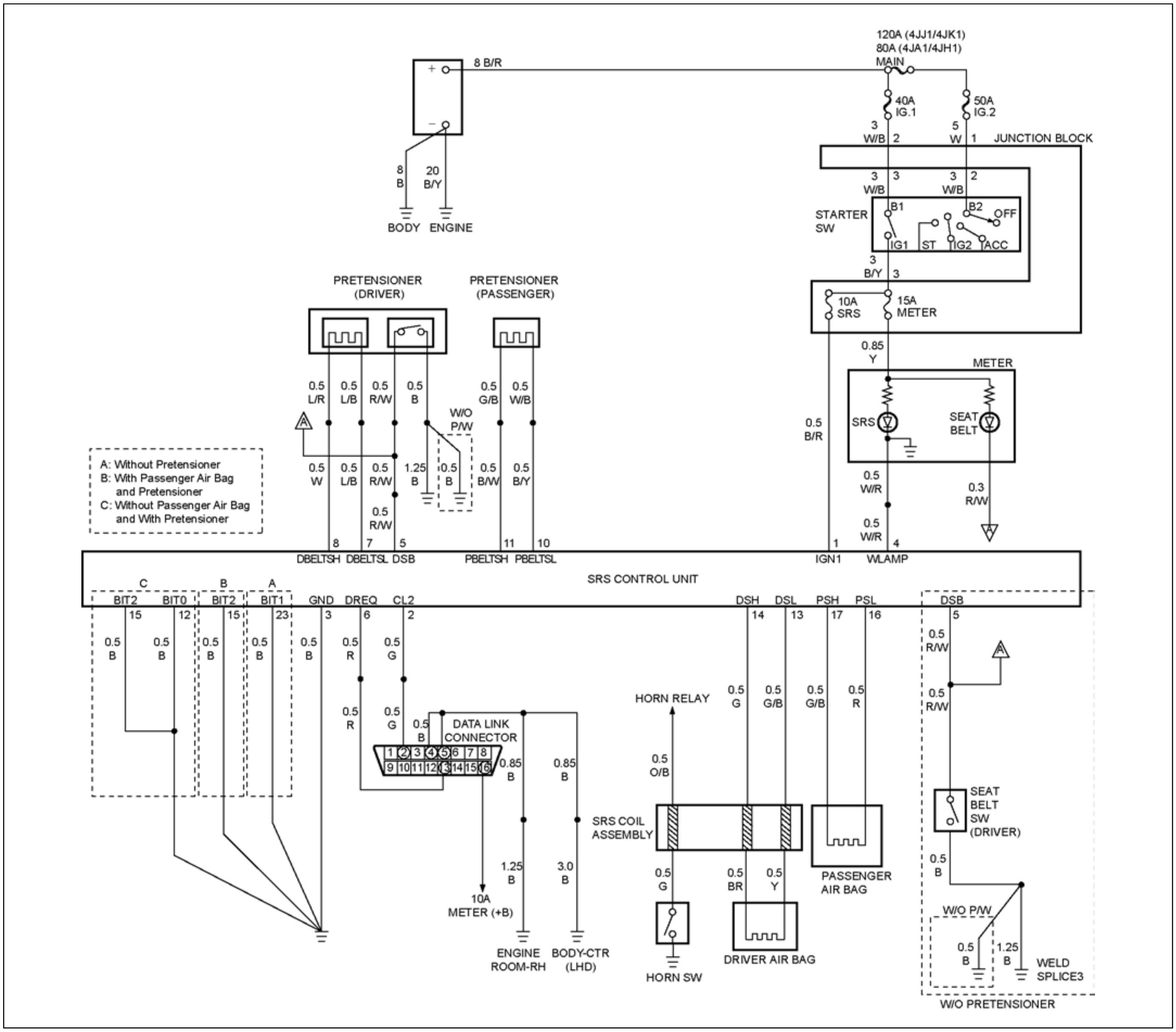
An intermittent condition is likely to be caused by a short to ground/+B in the driver air bag assembly circuit. Inspect circuits “Driver Bag High” and “Driver Bag Low” carefully for cutting or chafing.

DTC B0026 (Flash Code 26) Driver Air Bag Squib Circuit Short to Battery Voltage

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at “LOCK”. 3. Ignition switch is “ON”. 4. Check the driver air bag squib circuit for short to voltage or short to ground and open. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS coil assembly yellow connector located at base of the steering column. Leave the passenger air bag assembly connected. 3. Connect the SRS driver /passenger load tool 5-8840-2421-0 and appropriate adapter to the SRS coil assembly harness connector. 4. Ignition switch is “ON”. Is DTC B0026 current?	Go to Step 4	Go to Step 6
4	Measure resistance on SRS control unit harness connector from terminal “14” to terminal “1” (ignition). Does 5-8840-0366-0 display “OL” (infinite)?	Go to Step 5	Replace SRS harness. Go to Step 7
5	Measure the resistance on the SRS control unit harness connector from terminal “13” to terminal “1” (ignition). Does 5-8840-0366-0 display “OL” (infinite)?	Go to Chart A	Replace SRS harness. Go to Step 7

Step	Action	Yes	No
6	1. Ignition switch is at "LOCK". 2. Disconnect the SRS driver /passenger load tool 5-8840-2421-0 from the SRS coil assembly harness connector. 3. Connect the SRS driver /passenger load tool 5-8840-2421-0 and appropriate adapter to the driver air bag assembly harness connector. located at top of the steering column connector. 4. Reconnect the SRS coil assembly harness connector at the base of the steering column. 5. Ignition switch is "ON". Is DTC B0026 current?	Ignition switch is at "LOCK". Replace SRS coil assembly. Go to Step 7	Ignition switch is at "LOCK". Replace driver air bag assembly. Go to Step 7
7	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Go to the "SRS Diagnostic System Check"	—

DTC B0029 (Flash Code 29) Passenger Pretensioner Squib Circuit High Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SRS control unit then proceeds with the “Resistance Measurement Test”. “Passenger Pretensioner Low” terminal “10” is grounded through a resister and the passenger current source connected to “Passenger Pretensioner High” terminal “11” allows a known amount of current to flow.

By monitoring the voltage difference between “Passenger Pretensioner High” and “Passenger Pretensioner Low” the SRS control unit calculates the combined resistance of the passenger pretensioner assembly, harness wiring circuits “Passenger Pretensioner High” and “Passenger Pretensioner Low” connector terminal contact.

DTC Will Set When

The combined resistance of the passenger air pretensioner assembly, harness wiring circuits "Passenger Pretensioner High" and "Passenger Pretensioner Low", and connector terminal contact is above a specified value. This test is run once each ignition cycle during the "Resistance Measurement Test" when:

1. No "higher priority faults" are detected during "Turn–ON",
2. "Ignition 1" voltage is in the specified value.

Action Taken

SRS control unit turns "ON" the "AIR BAG" warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The ignition switch is at "LOCK".

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector.
4. This test checks for proper contact and/or corrosion of the yellow connector terminals.
5. The test checks for a malfunctioning passenger pretensioner assembly.
6. This test determines whether the malfunction is due to high resistance in the wiring.

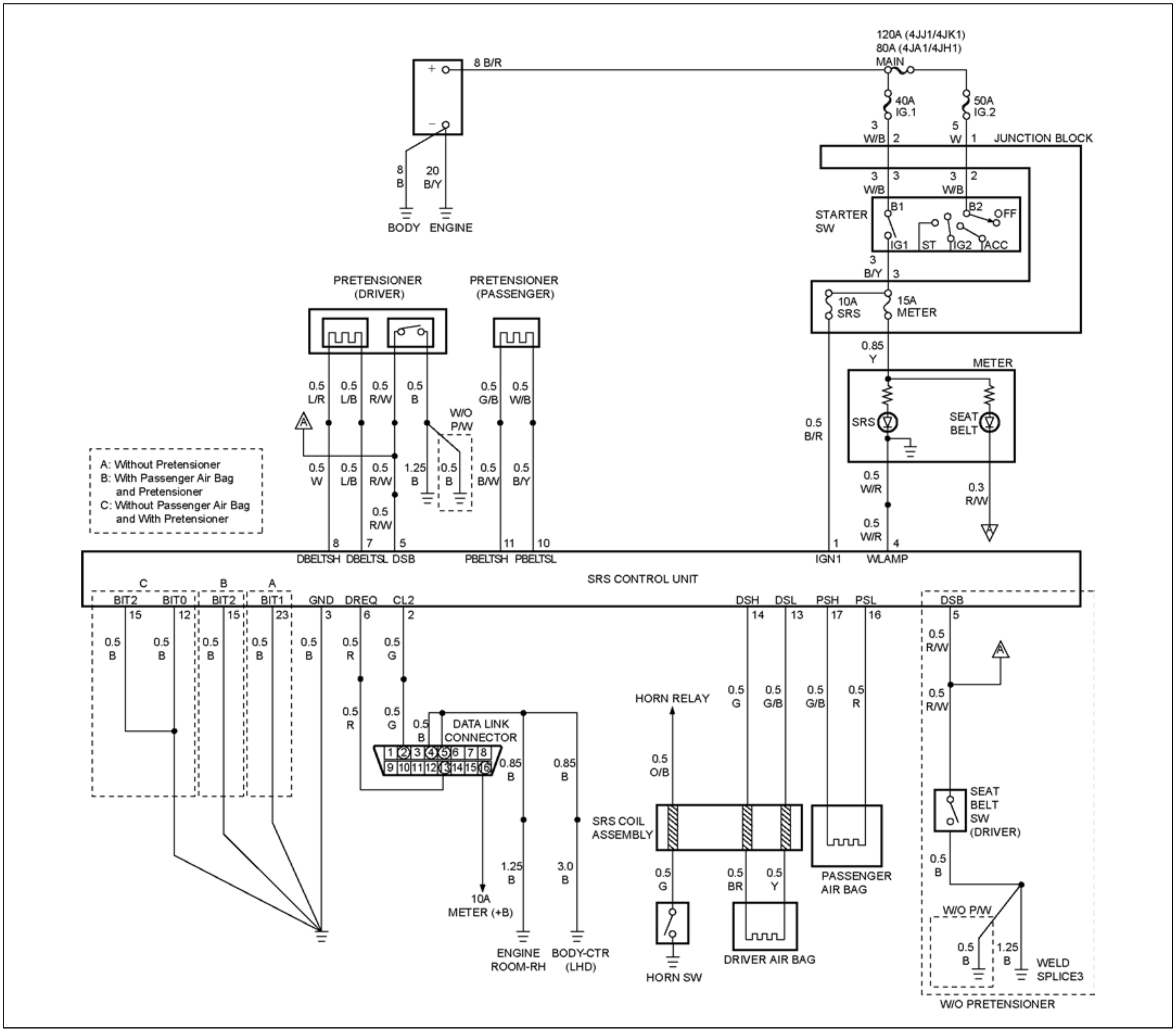
Diagnostic Aids

An intermittent condition is likely to be caused by a poor connection at the passenger pretensioner assembly harness connector terminals "1" and "2", SRS control unit terminal "11" and "10", or a poor wire to terminal connection in circuits "Passenger Pretensioner High" and "Passenger Pretensioner Low". This test for this diagnostic trouble code is only run while the "AIR BAG" warning lamp is performing the bulb check. When a scan tool "Clear Codes" command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0029 (Flash Code 29) Passenger Pretensioner Squib Circuit High Resistance

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” Performed?	Go to Step 2	Go to The “SRS Diagnostic System Check”
2	1. Check the passenger pretensioner circuit for open. 2. If the problem found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Make sure the passenger air bag assembly yellow connector located at the base of the passenger seat. Is the yellow connector connected properly?	Go to Step 4	Seat passenger pretensioner assembly yellow connector properly. Go to Step 7
4	1. Disconnect and inspect the passenger pretensioner assembly yellow connector located at the base of the passenger seat. 2. If ok, reconnect the passenger pretensioner assembly connector. 3. Ignition switch “ON”. Is DTC B0029 current?	Go to Step 5	Go to Step 7
5	1. Ignition switch is at “LOCK”. 2. Disconnect passenger pretensioner assembly, yellow connector located at the base of the passenger seat. 3. Connect 5-8840-2421-0 SRS driver / passenger load tool and appropriate adapters to passenger pretensioner assembly harness connectors. 4. Ignition switch “ON”. Is DTC B0029 Current?	Go to Step 6	Ignition switch is at “LOCK.” Replace the passenger pretensioner assembly. Go to Step 7
6	1. Ignition switch is at “LOCK”. 2. There has been an increase in the total circuit resistance of the passenger loop. 3. Use the high resolution ohmmeter mode of the DVM while checking circuits “Pasenger Pretensioner High” and “Passenger Pretensioner Low”, and SRS control unit connector terminal “11” and “10” to locate the root cause. Was a fault found?	Replace SRS harness or repair chassis harness. Go to Step 7	Go to Chart A
7	1. Reconnect all components ensure all component are properly mounted. 2. Clear diagnostic trouble codes. Was This step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0031 (Flash Code 31) Passenger Pretensioner Squib Circuit Low Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges. The SRS control unit then proceeds with the “Resistance Measurement Test”. “Passenger Pretensioner Low” terminal “10” is grounded through a resistor and the passenger current source connected to “Passenger Pretensioner High” terminal “11” allows a known amount of current to flow.

By monitoring the voltage difference between “Passenger Pretensioner High” and “Passenger Pretensioner Low”, the SRS control unit calculates the combined resistance of the passenger air bag assembly, harness wiring circuits “Passenger Pretensioner High” and “Passenger Pretensioner Low” connector terminal contact.

DTC Will Set When

The combined resistance of the passenger pretensioner assembly, harness wiring circuits “Passsenger Pretensioner High” and “Passenger Pretensioner Low”, and connector terminal contact is above a specified value. This test is run once each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”,
2. “Ignition 1” voltage is in the specified value.

Action Taken

SRS control unit turns “ON” the “AIR BAG” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The ignition switch is turned “LOCK”.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies connection of the yellow connector.
4. This test cheeks for proper operation of the shorting clip in the yellow connector.
5. The test checks for a malfunction passenger pretensioner assembly.
6. This test determines whether the malfunctioning is due to shortening in the wiring.

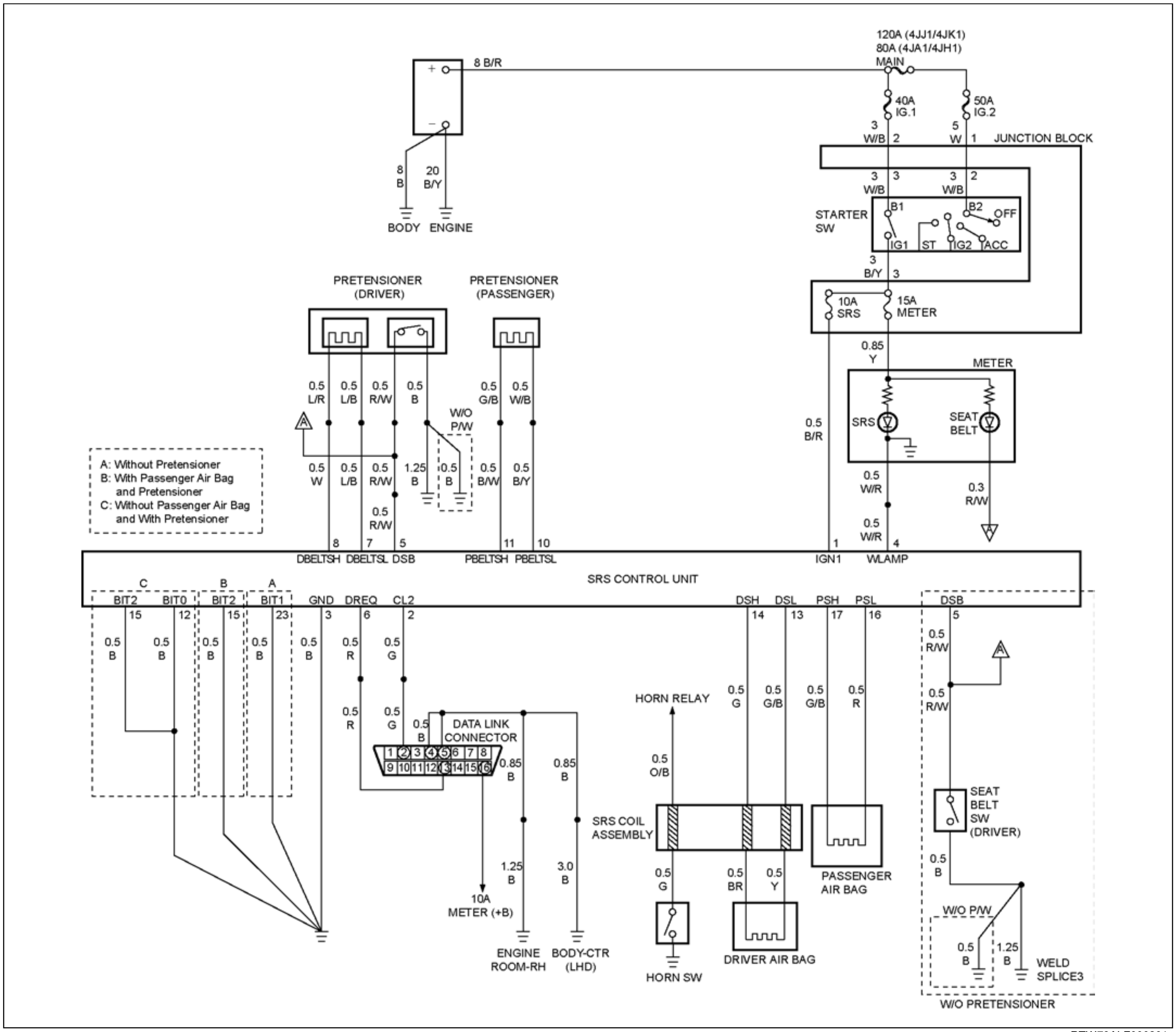
Diagnostic Aids

An intermittent condition is likely to be caused by a short between circuits “Passenger Pretensioner High” and “Passenger Pretensioner Low” or a malfunctioning shorting clip on the passenger pretensioner assembly which would require replacement of the pretensioner assembly. The test for this diagnostic trouble code is only run while “AIR BAG” warning lamp is performing the bulb check. When a scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0031 (Flash Code 31) Passenger Pretensioner Squib Circuit Low Resistance

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Repeat the "SRS Diagnostic System Check"
2	1. Check the passenger pretensioner squib circuit for short to valtage or short to ground. 2. If the broblem found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at "LOCK". 2. Make sure the passenger air bag assembly yellow connector located at the base of the passenger seat. Is the yellow connector connected properly?	Go to Step 4	Seat passenger pretensioner assembly yellow connector properly. Go to Step 7
4	1. Disconnect and inspect the passenger air bag assembly yellow connector located at the base of the passenger seat. 2. If ok, reconnect the passenger air bag assembly connector. 3. Ignition switch is at "ON". Is DTC B0031 Current?	Go to Step 5	Go to Step 7
5	1. Ignition switch is at "LOCK". 2. Disconnect SRS coil and passenger pretensioner assembly, yellow connector located at the base of the passenger seat. 3. Connect 5-8840-2421-0 SRS driver/passenger load tool and appropriate adapters to passenger pretensioner assembly harness connectors. 4. Ignition switch is at "ON". Is DTC B0031 current?	Go to Step 6	Ignition switch is at "OFF". Replace the passenger pretensioner assembly. Go to Step 7
6	1. Ignition switch is at "LOCK". 2. There has been a decrease in the total circuit resistance of the passenger inflator deployment loop. 3. Use the high resolution ohmmeter mode of the DVM while checking circuits "Passenger pretensioner High" and "Passenger Pretensioner Low", and SRS control unit connector terminal "11" and "10" to locate the root cause. Was a fault found?	Replace SRS harness or repair chassis harness. Go to Step 7	Go to Chart A
7	1. Reconnect all components, ensure all component are properly mounted. 2. Clear diagnostic trouble codes. Was this step finished?	Repeat the "SRS Diagnostic System Check"	—

DTC B0033 (Flash Code 33) Passenger Pretensioner Squib Circuit Short to GND



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and pretensioner loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at “Driver Pretensioner Low” terminal “7” and “Passenger Pretensioner Low” terminal “10” to detect short to ground/+B in the pretensioner assembly circuits.

DTC Will Set When

“Ignition 1" is in the normal operating voltage range.

The voltage at “Passenger Pretensioner Low " is below a specified value,

DTC B0033 will set.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The “Passenger Pretensioner Low " voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the passenger pretensioner assembly yellow connector at the base of the passenger seat.
4. This test determines whether the malfunction is in “Passenger Pretensioner High” circuit.
5. This test determines whether the malfunction is in “Passenger Pretensioner Low” circuit.

Diagnostic Aids

An intermittent condition is likely to be caused by a short to ground in the passenger pretensioner assembly circuit. Inspect circuits “Passenger Pretensioner High” and “Passenger Pretensioner Low” carefully for cutting or chafing. If the wiring pigtail of the passenger pretensioner assembly is damaged, the component must be replaced. A careful inspection of “Passenger Pretensioner High” and “Passenger Pretensioner Low”, including the passenger pretensioner assembly pigtail is essential to ensure that the replacement SRS control unit will not be damaged.

DTC B0033 (Flash Code 33) Passenger Pretensioner Squib Circuit Short to GND

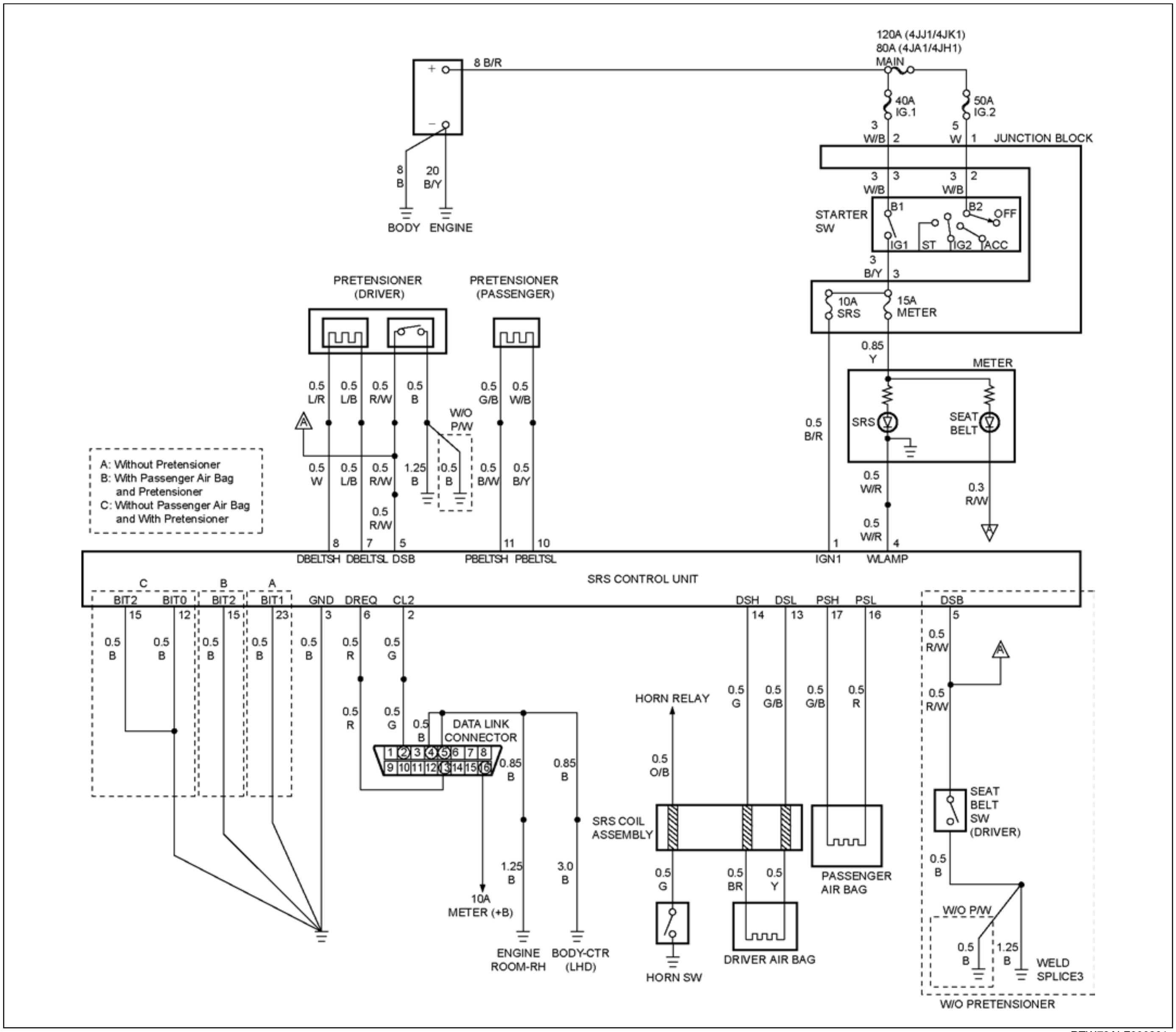
Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at “LOCK”. 3. Ignition switch is “ON”. 4. Check the passenger pretensioner air bag squib circuit for short to ground. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at “LOCK”. 2. Disconnect passenger pretensioner assembly yellow connector at the base of the passenger seat. 3. Leave driver air bag assembly connected. 4. Connect SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to passenger air bag assembly harness connector. 5. Ignition switch is at “ON”. Is DTC B0033 current?	Go to Step 4	Ignition switch is at “LOCK”. Replace passenger pretensioner assembly . Go to Step 6
4	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS driver /passenger load tool. 3. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "11" to "3" and "15" (ground) (with the passenger air bag) ● From terminals "11" to "3", "12" and "15" (ground) (without the passenger air bag) Does 5-8840-0366-0 display “OL” (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6

6. FRONT WHEEL SHIMMY

Checkpoint	Trouble Cause	Countermeasure
Wheel bearing	Worn or improperly adjusted	Adjust or replace
Front alignment	Incorrect	Adjust the front alignment
Ball joint or bush	Worn	Replace the ball joint or bush
Steering unit	Loose or worn	Tighten or replace
Tire	Worn or improperly inflated	Replace or adjust the inflation
Shock absorber	Worn	Replace the shock absorber

Step	Action	Yes	No
5	Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "10" to "3" and "15" (ground) (with the passenger air bag) ● From terminals "10" to "3", "12" and "15" (ground) (without the passenger air bag) Does 5-8840-0366-0 display “OL” (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic system Check”	—

DTC B0034 (Flash Code 34) Passenger Pretensioner Squib Circuit Short to Battery Voltage



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and pretensioner loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at “Driver Pretensioner Low” terminal “7” and “Passenger Pretensioner Low” terminal “10” to detect short to ground/+B in the pretensioner assembly circuits.

DTC Will Set When

“Ignition 1" is in the normal operating voltage range.

The voltage at “Passenger Pretensioner Low " is above a specified value,

DTC B0034 will set.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The "Passenger Pretensioner Low " voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the passenger pretensioner assembly yellow connector at the base of the passenger seat.
4. This test determines whether the malfunction is in "Passenger Pretensioner High" circuit.
5. This test determines whether the malfunction is in "Passenger Pretensioner Low" circuit.

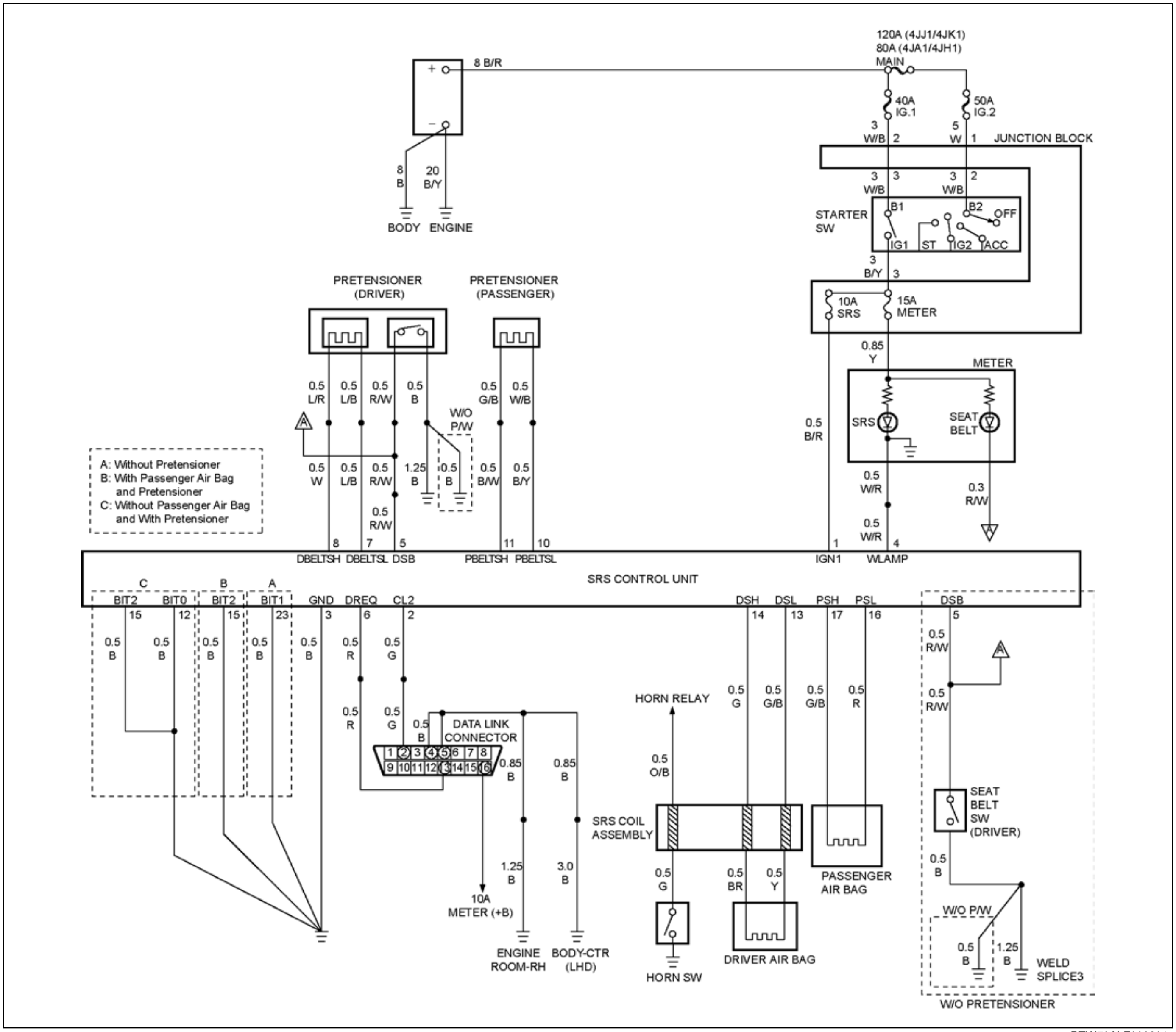
Diagnostic Aids

An intermittent condition is likely to be caused by a short to +B in the passenger pretensioner assembly circuit. Inspect circuits "Passenger Pretensioner High" and "Passenger Pretensioner Low" carefully for cutting or chafing. If the wiring pigtail of the passenger pretensioner assembly is damaged, the component must be replaced. A careful inspection of "Passenger Pretensioner High" and "Passenger Pretensioner Low", including the passenger pretensioner assembly pgtail is essential to ensure that the replacement SRS control unit will not be damaged.

DTC B0034 (Flash Code 34) Passenger Pretensioner Squib Circuit Short to Battery Voltage

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at "LOCK". 3. Ignition switch is "ON". 4. Check the passenger air bag squib circuit for a short to voltage. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at "LOCK". 2. Disconnect passenger pretensioner assembly yellow connector at the base of the passenger seat. 3. Leave driver air bag assembly connected. 4. Connect SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to passenger air bag assembly harness connector. 5. Ignition switch is at "ON". Is DTC B0034 current?	Go to Step 4	Ignition switch is at "LOCK". Replace passenger pretensioner assembly . Go to Step 6
4	Measure the resistance on the SRS control unit harness connector from terminal "11" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6
5	Measure the resistance on the SRS control unit harness connector from terminal "10" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the "SRS Diagnostic system Check"	—

DTC B0041 (Flash Code 41) Driver Pretensioner Squib Circuit Low Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests “Ignition 1”, and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit then proceeds with the “Resistance Measurement Test” “Driver Pretensioner Low” terminal “7” is grounded through a current sink and the driver current source connected to “Driver Pretensioner High” terminal “8” allows a known amount of current to flow. By monitoring the voltage difference between “Driver Pretensioner High” and “Driver Pretensioner Low” the SRS control unit calculates the combined resistance of the driver pretensioner assembly, harness wiring circuits “Driver Pretensioner High” and “Driver Pretensioner Low” and connector terminal contact.

DTC Will Set When

The combined resistance of the driver pretensioner assembly, harness wiring circuits “Driver Pretensioner High” and “Driver Pretensioner Low”, and connector terminal contact is above a specified value. This test is run once each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”
2. “Ignition 1” voltage is in the specified value.

Action Taken

SRS control unit turns “ON” the “AIR BAG” warning lamp and sets DTC B0041.

DTC Will Clear When

The ignition switch is turned “LOCK”.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector at the base of the driver seat.
4. This test checks for proper operation of the shorting clip in the yellow connector.
5. This test isolate the malfunction to one side of the SRS coil assembly yellow connector located at the base of the driver seat.
6. This test determines whether the malfunction is due to shortening in the wiring.
7. This test determines whether the malfunction is in the driver pretensionerassembly.

Diagnostic Aids

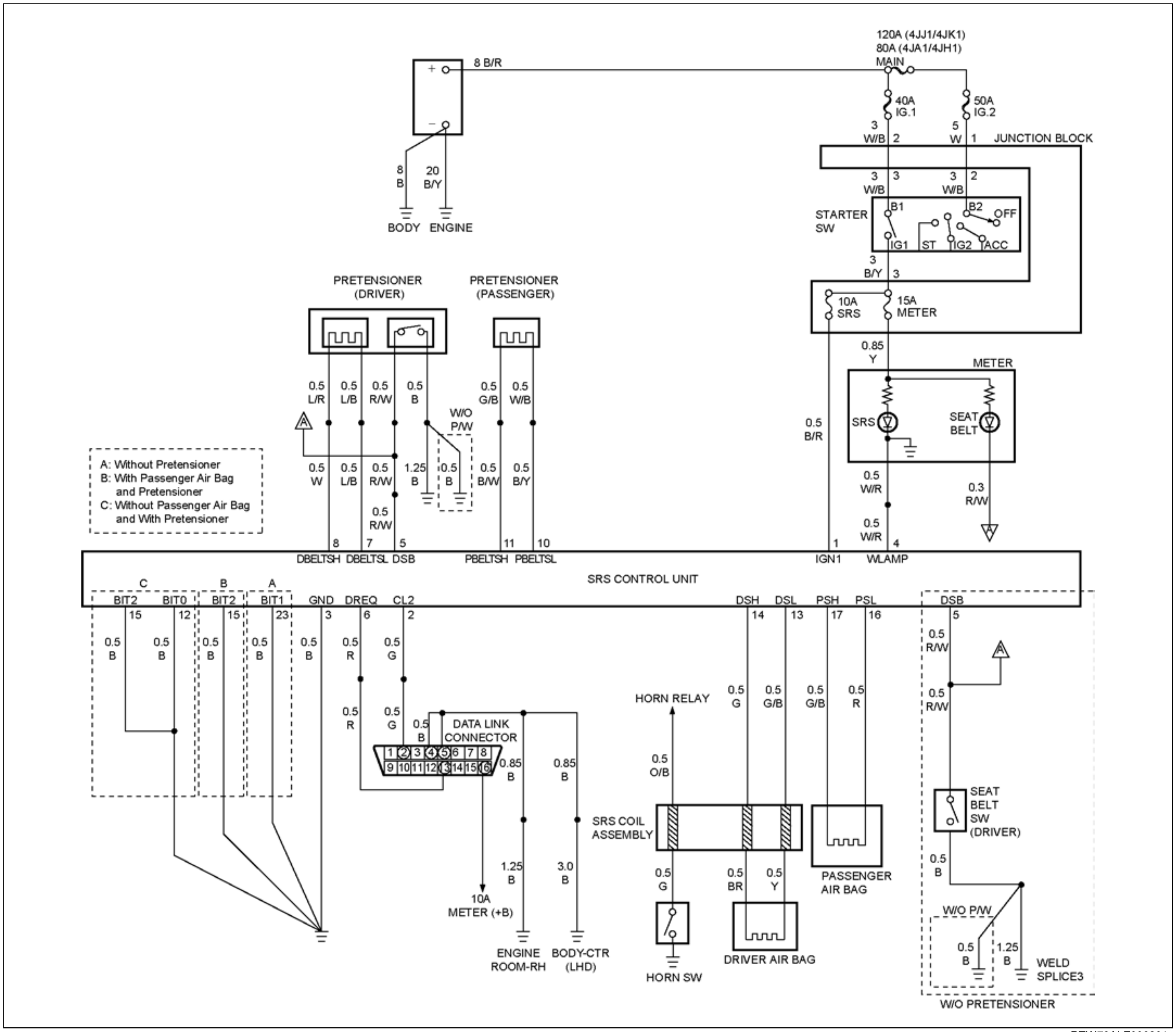
An intermittent condition is likely to be caused by a short between circuit “Driver Pretensioner High” or “Driver Pretensioner Low” or a malfunctioning shorting clip on the driver pretensioner assembly which would require replacement of the component. The test for this diagnostic trouble code is only run while the “AIR BAG” warning lamp is performing the bulb check. When a scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0041 (Flash Code 41) Driver Pretensioner Squib Circuit Low Resistance

Step	Action	Yes	No
1	Perform the “SRS Diagnostic System Check.” Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. Check the driver pretensioner squib circuit for short to voltage or short to ground. 2. If the problem found, repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Make sure the pretensioner assembly yellow connector located at the base of the driver seat connected properly. Is the connector connected properly?	Go to Step 4	Seat driver pretensioner assembly connector properly. Go to Step 8

Step	Action	Yes	No
4	1. Disconnect and inspect the pretensioner yellow connector located base of the driver seat. 2. If ok, reconnect the Pretensioner assembly yellow connector. 3. Ignition switch “ON.” Is DTC B0041 current?	Go to Step 5	Go to Step 8
5	1. Ignition switch is at “LOCK”. 2. Disconnect deive pretensioner assembly, yellow connector located at the base of the driver seat. 3. Connect SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to drive pretensioner assembly harness connectors. 4. Ignition switch “ON”. Is DTC B0041 current?	Go to Step 6	Go to Step 7
6	1. Ignition switch is at “LOCK”. 2. There has been a decrease in the total circuit resistance of the driver deployment loop. 3. Use the high resolution ohmmeter mode of the DVM while checking circuits “Driver Pretensioner High” and “Driver Pretensioner Low”, and SRS control unit connector terminal “8” and “7” to locate the root cause. Was a fault found?	Replace SRS harness or repair chassis harness. Go to Step 8	Go to Chart A
7	1. Ignition switch is at “LOCK”. 2. Disconnect SRS driver / passenger load tool from driver pretensioner assembly harness connector. 3. Connect SRS driver / passenger load tool 5-8840-2421-0 to the top of steering column connector. 4. Reconnect pretensioner harness connector as the base of the driver seat. 5. Ignition switch is at “ON”. Is DTC B0041 current?	Ignition switch is at “OFF”. Replace SRS coil assembly. Go to Step 8	Ignition switch is at “LOCK”. Replace driver pretensioner assembly. Go to Step 8
8	1. Reconnect all components, ensure all component are properly mounted. 2. Clear diagnostic trouble codes. Was this step finished?	Go to the “SRS Diagnostic System Check”	—

DTC B0042 (Flash Code 42) Driver Pretensioner Squib Circuit High Resistance



RTW79ALF000301

Circuit Description

When the ignition switch is turned "ON", the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, "Ignition 1", and deployment loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit then proceeds with the "Resistance Measurement Test" "Driver Pretensioner Low" terminal "7" is grounded through a current sink and the driver current source connected to "Driver Pretensioner High" terminal "8" allows a known amount of current to flow. By monitoring the voltage difference between "Driver Pretensioner High" and "Driver Pretensioner Low", the SRS control unit calculates the combined resistance of the driver pretensioner assembly, SRS coil assembly, harness wiring circuits "Driver Pretensioner High" and "Driver Pretensioner Low" and connector terminal contact.

DTC Will Clear When

The ignition switch is turned “LOCK”.

DTC Will Set When

The combined resistance of the driver pretensioner assembly, harness wiring circuits “Driver Pretensioner High” and “Driver Pretensioner Low”, and connector terminal contact is above a specified value. This test run once each ignition cycle during the “Resistance Measurement Test” when:

1. No “higher priority faults” are detected during “Turn–ON”
2. “Ignition 1” voltage is in the specified value.

Action Taken

SRS control unit turns “ON” the “AIR BAG” warning lamp and sets DTC B0042.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

2. This test determines whether the malfunction is in the SRS control unit.
3. This test verifies proper connection of the yellow connector at the base of the driver seat.
4. This test checks for proper contact and/or corrosion of the connector terminals at the base of the driver seat.
5. This test isolate the malfunction to one side of the SRS coil assembly yellow connector located at the base of the driver seat.
6. This test determines whether the malfunction is due to high resistance in the wiring.
7. This test determines whether the malfunction is in the driver pretensioner assembly.

Diagnostic Aids

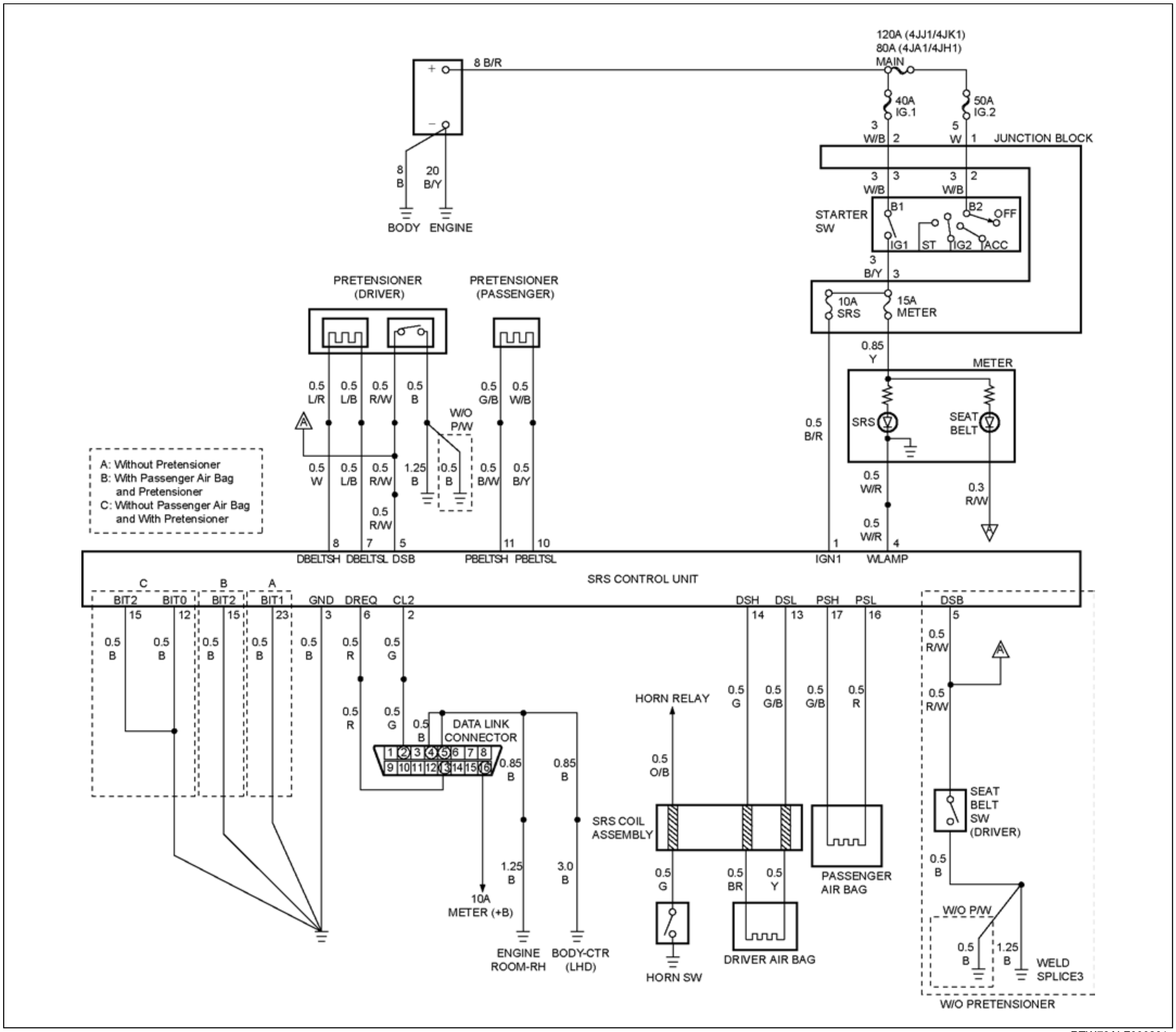
An intermittent condition is likely to be caused by a poor connection at the drive pretensioner harness connector terminals “1” and “2”, SRS control unit terminals “8” and “7”, or a poor wire to terminal connection in circuit “Driver Pretensioner High” or “Driver Pretensioner Low” The test for this diagnostic trouble code is only run while the “AIR BAG” warning lamp is performing the bulb check. When a scan tool “Clear Codes” command is issued and the malfunction is still present, the DTC will not reappear until the next ignition cycle.

DTC B0042 (Flash Code 42) Driver Pretensioner Squib Circuit High Resistance

Step	Action	Yes	No
1	Perform the “SRS Diagnostic System Check”. Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Repeat the “SRS Diagnostic System Check”
2	1. Check the driver pretensioner squib circuit for open. 2. If the problem found repair as necessary. Was a problem found?	Verify repair	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Disconnect SRS coil assembly yellow connector located at base of the driver seat. Is the connector connected properly?	Go to Step 4	Seat pretensioner assembly connector properly. Go to Step 8

Step	Action	Yes	No
4	1. Disconnect and inspect the pretensioner assembly yellow connector located base of the driver seat. 2. If ok, reconnect the pretensioner yellow connector. 3. Ignition switch is at “ON”. Is DTC B0042 current?	Go to Step 5	Go to Step 8
5	1. Ignition switch is at “LOCK”. 2. Disconnect diver pretensioner assembly, yellow connector located at the base of driver seat. 3. Connect SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to driver pretensioner assembly harness connectors. 4. Ignition switch is at “ON”. Is DTC B0042 current?	Go to Step 6	Go to Step 7
6	1. Ignition switch is at “LOCK“. 2. There has been a increase in the total circuit resistance of the driver deployment loop. 3. Use the high resolution ohmmeter mode of the DVM while checking circuits “Driver Pretensioner High” and “Driver Pretensioner Low”, and SRS control unit connector terminal “8” and “7” to locate the root cause. Was a fault found?	Replace pretensioner harness. Go to Step 8	Go to Chart A
7	1. Ignition switch is at “LOCK”. 2. Disconnect pretensioner load tool from pretensioner assembly harness connector. 3. Connect pretensioner load tool 5-8840-2421-0 and appropriate adapter to driver pretensioner assembly harness connector. 4. Reconnect pretensioner harness connector as the base of the driver seat. 5. Ignition switch is at “ON”. Is DTC B0065 current?	Ignition switch is at “LOCK”. Replace pretensioner assembly. Go to Step 8	Ignition switch is at “LOCK”. Replace driver pretensioner assembly. Go to Step 8
8	1. Reconnect all components ensure all component are properly mounted. 2. Clear diagnostic trouble codes. Was this step finished?	Repeat the “SRS Diagnostic System Check”	—

DTC B0045 (Flash Code 45) Driver Pretensioner Squib Circuit Short to GND



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and pretensioner loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at “Driver Pretensioner Low” terminal “7” and “Passenger Pretensioner Low” terminal “10” to detect short to ground/+B in the pretensioner assembly circuits.

DTC Will Set When

“Ignition 1" is in the normal operating voltage range.

The voltage at “Driver Pretensioner Low " is below a specified value,

DTC B0045 will set.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

PROPELLER SHAFT

1. NOISE

Checkpoint		Trouble Cause	Countermeasure
Yoke spline	NG	Damaged or worn	Replace
OK			
Spider bearing	NG	Worn or jammed	Replace

2. VIBRATION

Checkpoint		Trouble Cause	Countermeasure
Shaft runout	NG	Incorrect	Replace
OK			
Shaft balance	NG	Unbalance	Adjust
OK			
Transmission rear housing bushing, transfer case housing bushing	NG	Worn	Replace
OK			
Yoke spline	NG	Jammed	Replace

DTC Will Clear When

The “Driver Pretensioner Low " voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the driver pretensioner assembly yellow connector at the base of the driver seat.
4. This test determines whether the malfunction is in “Driver Pretensioner High” circuit.
5. This test determines whether the malfunction is in “Driver Pretensioner Low” circuit.

Diagnostic Aids

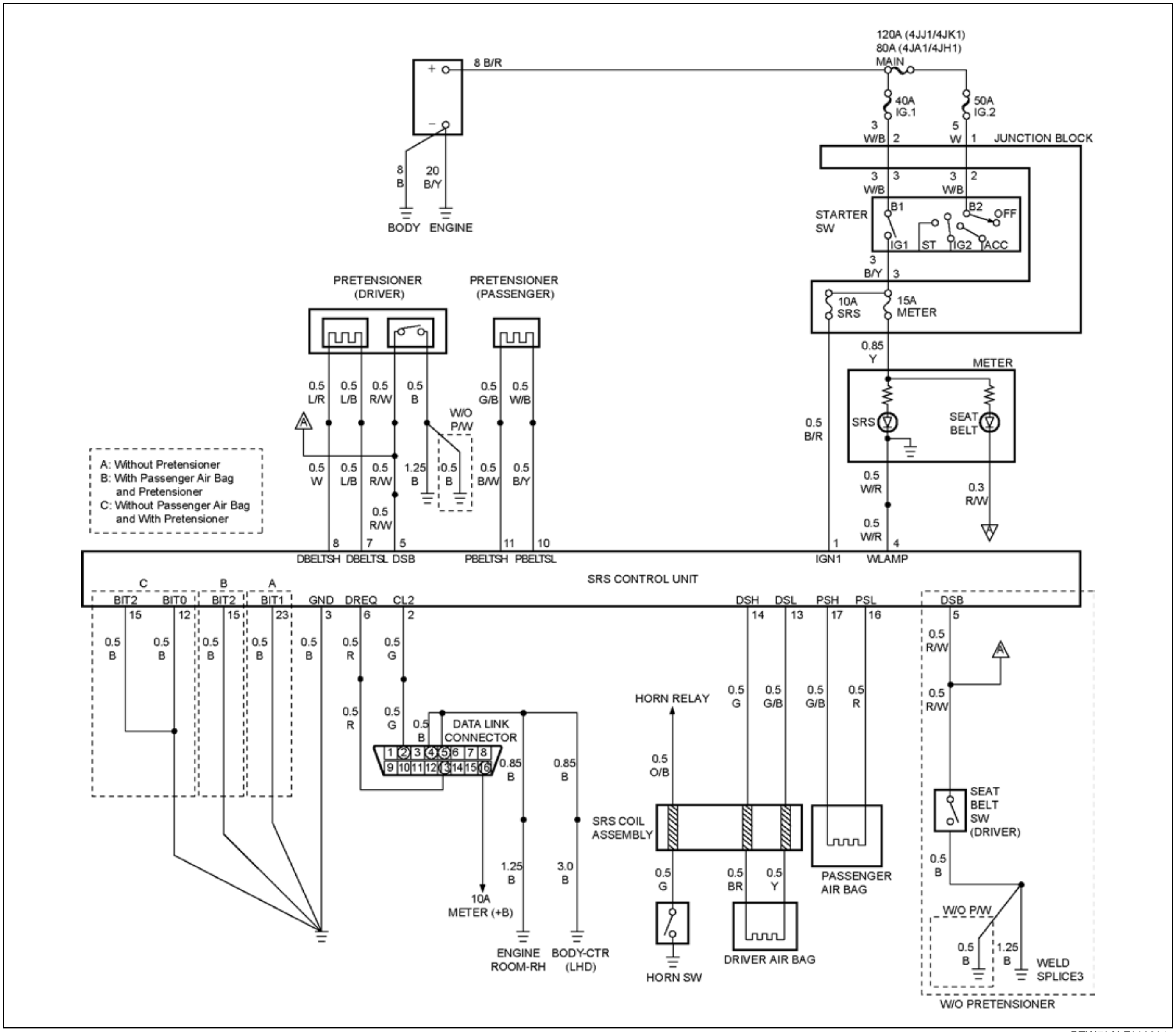
An intermittent condition is likely to be caused by a short to ground in the driver pretensioner assembly circuit. Inspect circuits “Driver Pretensioner High” and “Driver Pretensioner Low” carefully for cutting or chafing. If the wiring pigtail of the driver pretensioner assembly is damaged, the component must be replaced. A careful inspection of “Driver Pretensioner High” and “Driver Pretensioner Low”, including the driver pretensioner assembly pigtail is essential to ensure that the replacement SRS control unit will not be damaged.

DTC B0045 (Flash Code 45) Driver Pretensioner Squib Circuit Short to GND

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at “LOCK”. 3. Ignition switch is “ON”. 4. Check the driver pretensioner air bag squib circuit for short to ground. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at “LOCK”. 2. Disconnect driver pretensioner assembly yellow connector at the base of the driver seat. 3. Leave driver air bag assembly connected. 4. Connect SRS driver / driver load tool 5-8840-2421-0 and appropriate adapter to driver air bag assembly harness connector. 5. Ignition switch is at “ON”. Is DTC B0045 current?	Go to Step 4	Ignition switch is at “LOCK”. Replace driver pretensioner assembly . Go to Step 6
4	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS driver /driver load tool. 3. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "8" to "3" and "15" (ground) (with the passenger air bag) ● From terminals "8" to "3", "12" and "15" (ground) (without the passenger air bag) Does 5-8840-0366-0 display “OL” (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6

Step	Action	Yes	No
5	Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "7" to "3" and "15" (ground) (with the passenger air bag) ● From terminals "7" to "3", "12" and "15" (ground) (without the passenger air bag) Does 5-8840-0366-0 display “OL” (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic system Check”	—

DTC B0046 (Flash Code 46) Driver Pretensioner Squib Circuit Short to Battery Voltage



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON”, the SRS control unit will perform tests to diagnose critical malfunctions within itself. Upon passing these tests, “Ignition 1”, and pretensioner loop voltages are measured to ensure they are within their respective normal voltage ranges.

The SRS control unit monitors the voltages at “Driver Pretensioner Low” terminal “7” and “Passenger Pretensioner Low” terminal “10” to detect short to ground/+B in the pretensioner assembly circuits.

DTC Will Set When

“Ignition 1" is in the normal operating voltage range.

The voltage at “Driver Pretensioner Low " is above a specified value,

DTC B0046 will set.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The "Driver Pretensioner Low " voltage comes to specified voltage.

DTC Chart Test Description

Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.
3. This test isolates the malfunction to one side of the driver pretensioner assembly yellow connector at the base of the driver seat.
4. This test determines whether the malfunction is in "Driver Pretensioner High" circuit.
5. This test determines whether the malfunction is in "Driver Pretensioner Low" circuit.

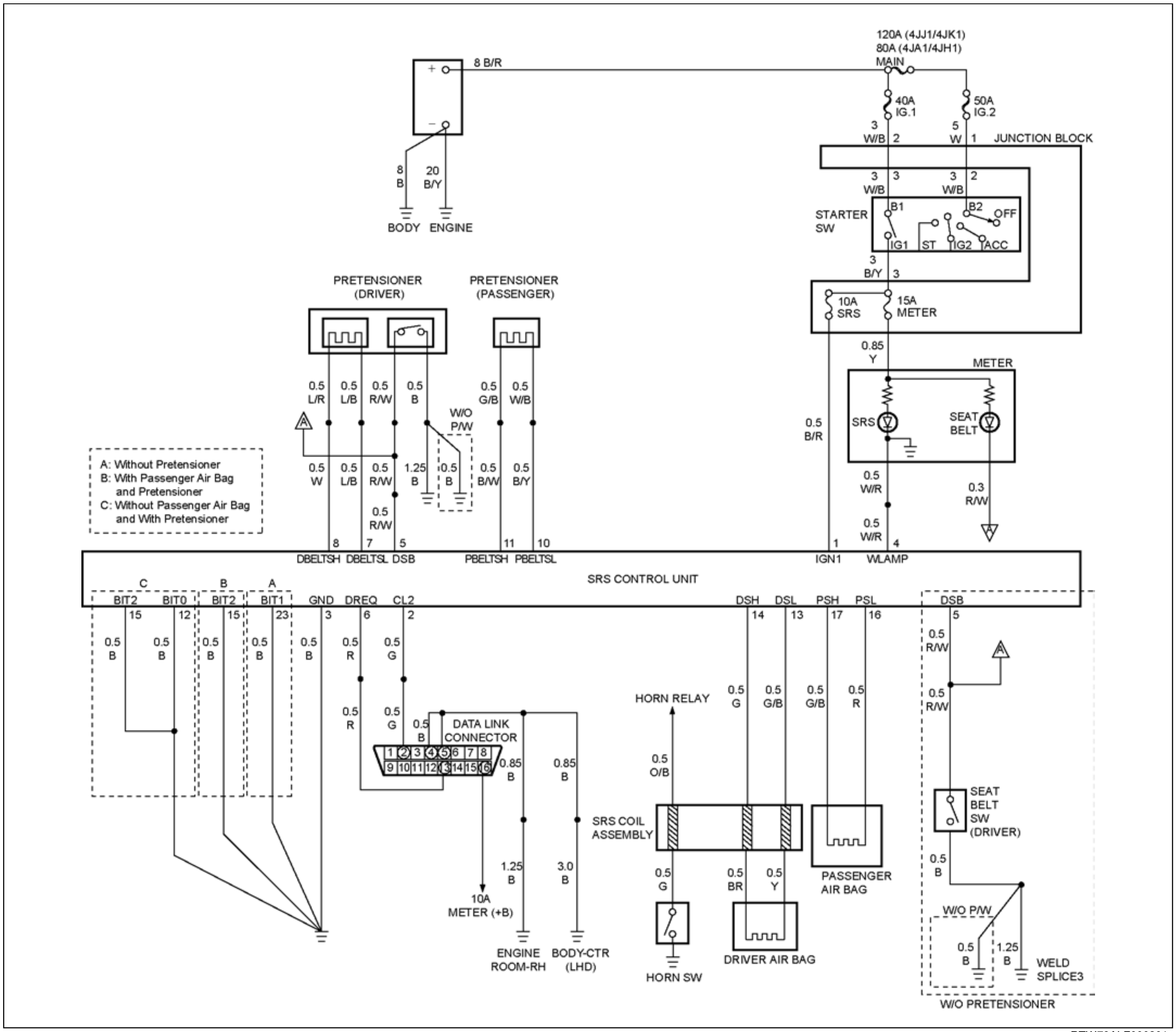
Diagnostic Aids

An intermittent condition is likely to be caused by a short to +B in the driver pretensioner assembly circuit. Inspect circuits "Driver Pretensioner High" and "Driver Pretensioner Low" carefully for cutting or chafing. If the wiring pigtail of the driver pretensioner assembly is damaged, the component must be replaced. A careful inspection of "Driver Pretensioner High" and "Driver Pretensioner Low", including the driver pretensioner assembly pgtail is essential to ensure that the replacement SRS control unit will not be damaged.

DTC B0046 (Flash Code 46) Driver Pretensioner Squib Circuit Short to Battery Voltage

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. When measurements are requested in this chart use a 5-8840-0366-0 DMM with a correct terminal adapter from 5-8840-2835-0. 2. Ignition switch is at "LOCK". 3. Ignition switch is "ON". 4. Check the driver air bag squib circuit for a short to voltage. Was a problem found?	Go to Step 3	—
3	1. Ignition switch is at "LOCK". 2. Disconnect driver pretensioner assembly yellow connector at the base of the driver seat. 3. Leave driver air bag assembly connected. 4. Connect SRS driver / passenger load tool 5-8840-2421-0 and appropriate adapter to driver air bag assembly harness connector. 5. Ignition switch is at "ON". Is DTC B0046 current?	Go to Step 4	Ignition switch is at "LOCK." Replace driver pretensioner assembly . Go to Step 6
4	Measure the resistance on the SRS control unit harness connector from terminal "8" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Step 5	Replace SRS Harness. Go to Step 6
5	Measure the resistance on the SRS control unit harness connector from terminal "7" to terminal "1" (ignition). Does 5-8840-0366-0 display "OL" (Infinite)?	Go to Chart A	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the "SRS Diagnostic system Check"	—

DTC B0051 (Flash Code 51) Air Bag Squib Circuit Activated (Crash)



RTW79ALF000301

Circuit Description

The SRS control unit contains a sensor which converts vehicle velocity changes to an electrical signal. The electrical signal generated is processed by the SRS control unit and then compared to a value stored in memory. When the generated signal exceeds the stored value, the SRS control unit will cause current to flow through the air bag assembly deploying the air bags and causing DTC B0051 to set.

DTC Will Set When

The SRS control unit detects a frontal crash, up to 30 degrees off the centerline of the vehicle, of sufficient force to warrant deployment of the air bags.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and records “Crash Data”, and sets a diagnostic trouble code.

DTC Will Clear When

The SRS control unit is replaced.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

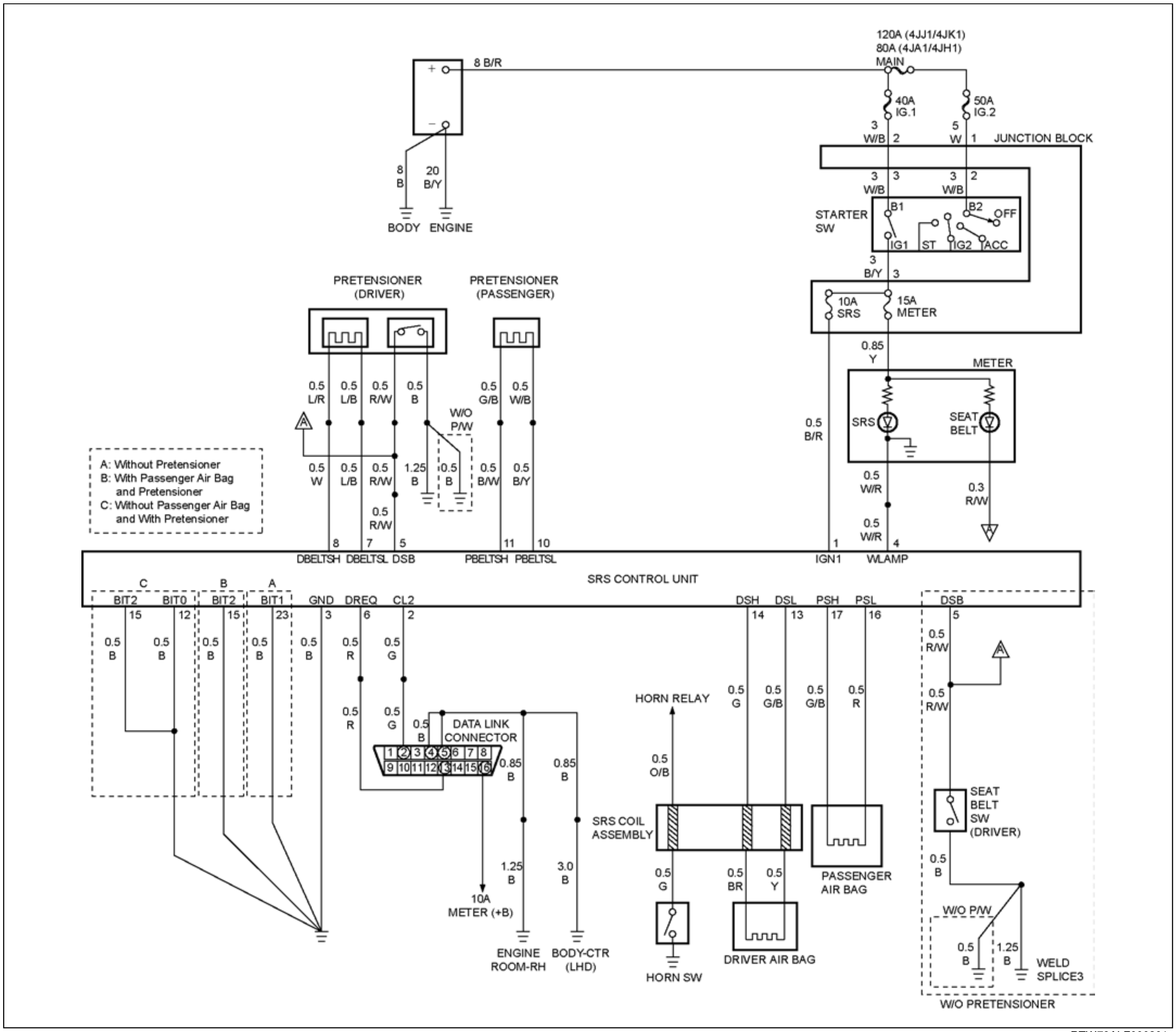
2. If the air bag assembly(s) has not deployed, DTC B0051 may have been falsely set.
3. If DTC B0051 has set with no signs of frontal impact, the diagnostic trouble code has been falsely set.

DTC B0051 (Flash Code 51) Air Bag Squib Circuit Activated (Crash)

WARNING: DURING SERVICE PROCEDURES. BE VERY CAREFUL WHEN HANDLING A SRS CONROL UNIT. NEVER STRIKE OR JAR THE SRS CONTROL UNIT. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SRS CONTROL UNIT AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SRS. THE SRS CONTROL UNIT COULD BE ACTIVATED AND CAUSE DEPLOYMENT RESULTING IN PERSONAL INJURY.

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2.	Go to the “SRS Diagnostic System Check”
2	Ignition switch is at “LOCK”. Have air bag assemblies been deployed?	Replace components and perform inspections as directed in “repairs and inspections required after an accident” in this section. clear diagnostic trouble codes. Repeat “SRS Diagnostic System Check”	Go to Step 3
3	Inspect the front of the vehicle and undercarriage for signs of impact. Were signs of impact found?	Replace components and perform inspections as directed in “Repairs and Inspections Required After An Accident” in this section. Clear diagnostic trouble codes. Repeat “SRS Diagnostic System Check”	Ignition switch “LOCK”. Replace SRS control unit. Reconnect all SRS system components, ensure all components are properly mounted. Repeat “SRS Diagnostic System Check”

DTC B0052 (Flash Code 52) Pretensioner Squib Circuit Activated (Crushed)



RTW79ALF000301

Circuit Description

The SDM contains a sensing device which converts vehicle velocity changes to an electrical signal. The electrical signal generated is processed by the SDM and then compared to a value stored in memory. When the generated signal exceeds the stored value, the SDM will cause current to flow through the pretensioner seat belt deploying the pretensioner seat belt and causing DTC B0052 to set.

DTC Will Set When

The SRS control unit detects a frontal crash, up to 30 degrees off the centerline of the vehicle, of sufficient force to warrant deployment of the pretensioner seat belt.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and records “Crash Data”, and sets a diagnostic trouble code.

DTC Will Clear When

The SRS control unit is replaced.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

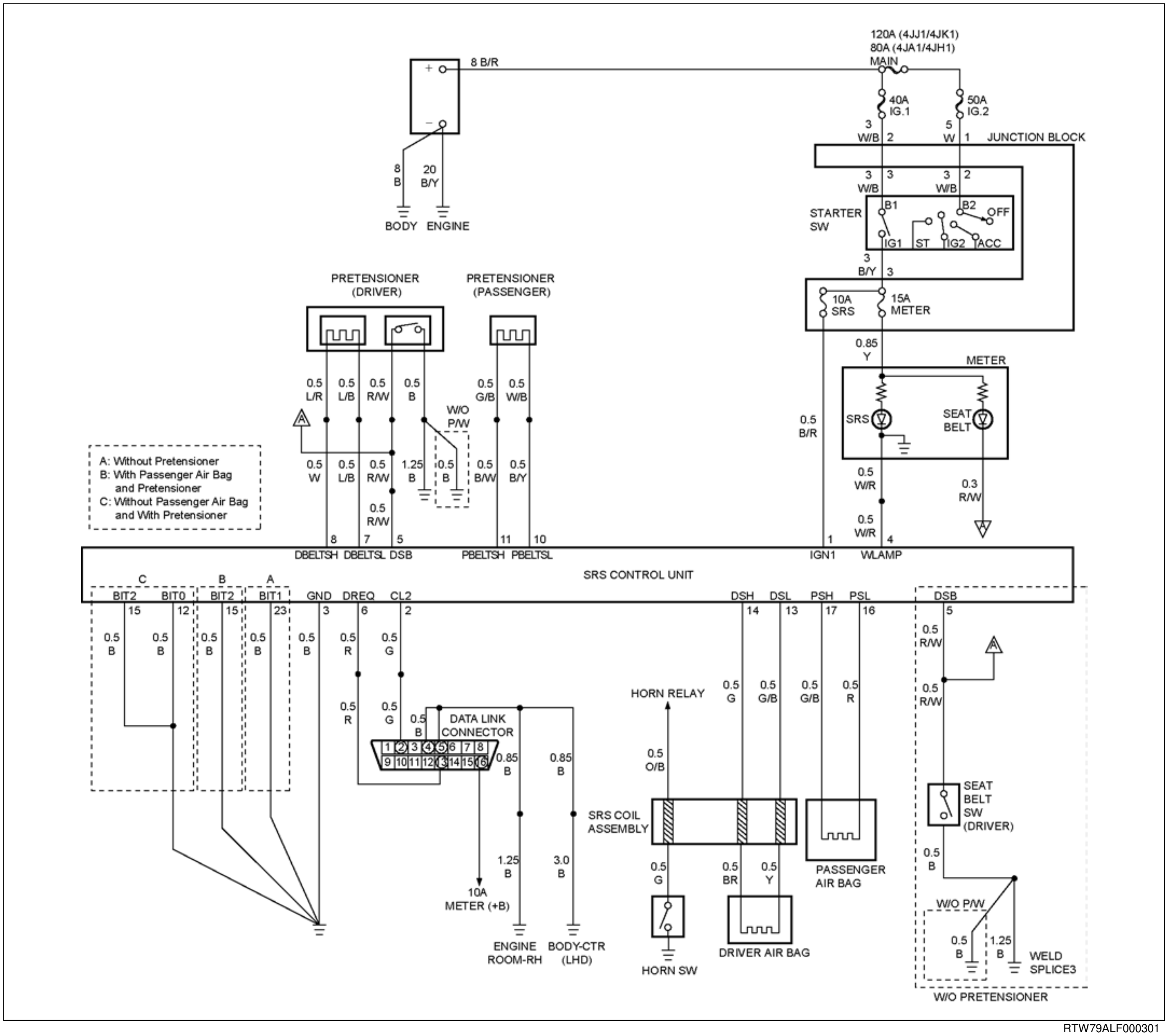
2. If the pretensioner seat belt assemblies have not deployed, DTC B0052 may have been falsely set.
3. If DTC B0052 has set with no signs of frontal impact, the diagnostic trouble code has been falsely set.

DTC B0052 (Flash Code 52) Pretensioner Squib Circuit Activated (Crash)

WARNING: DURING SERVICE PROCEDURES. BE VERY CAREFUL WHEN HANDLING A SRS CONROL UNIT. NEVER STRIKE OR JAR THE SRS CONTROL UNIT. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SRS CONTROL UNIT AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SRS. THE SRS CONTROL UNIT COULD BE ACTIVATED AND CAUSE DEPLOYMENT AND RESULTING IN PERSONAL INJURY.

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2.	Go to the “SRS Diagnostic System Check”
2	Ignition switch “LOCK”. Have the pretensioner seat belt assemblies been deployed?	Replace components and perform inspections as directed in “repairs and inspections required after an accident” in this section. clear diagnostic trouble codes. Repeat “SRS Diagnostic System Check”	Go to Step 3
3	Inspect the front of the vehicle and undercarriage for signs of impact. Were signs of impact found?	Replace components and perform inspections as directed in “Repairs and Inspections Required After An Accident” in this section. Clear diagnostic trouble codes. Repeat “SRS Diagnostic System Check”	Ignition switch is at “LOCK”. Replace SRS control unit. Reconnect all SRS system components, ensure all components are properly mounted. Repeat “SRS Diagnostic System Check”

DTC B0055 (Flash Code 55) Vehicle Variant Missing



Circuit Description

DTC B0055 will be set, if either the SRS control unit or the SRS control unit harness is not genuine parts.

The correct conditions of terminals on the SRS control unit and the SRS harness are as follows.

	Terminal No.			
	12	15	23	26
Without Pretensioner	-	-	used	-
With Pretensioner	-	used	-	-
With Pretensioner and Without Passenger Air Bg	used	used	-	-

DTC Will Set When

- Without the pretensioner:
  Terminals "12", "15" and "26" are shorted to ground.
  Terminal "23" is open (harness is not connected).
- With the pretensioner:
  Terminals "12", "23" and "26" are shorted to ground.
  Terminal "15" is open (harness is not connected).
- With the pretensioner and without the passenger air bag:
  Terminals "23" and "26" are shorted to ground.
  Terminals "12" and "15" are open (harness is not connected).

It is DTC set, if non genuine SRS control unit is installed with the SRS harness genuine part, or incase of terminal "12", "15", "23" and "26" are abnormal condition with the SRS control unit genuine part.

Action Taken

The SRS control unit turns “ON" the “SRS" warning lamp and sets a DTC B0055.

But if there is abnormal condition with the SRS control unit and/or SRS harness, the DTC is not set.

DTC Will Clear When

DTC B0055 can be cleared only by using the scan tool.

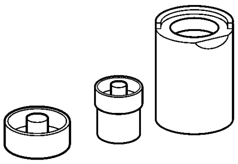
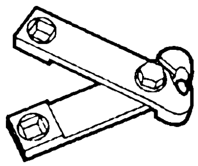
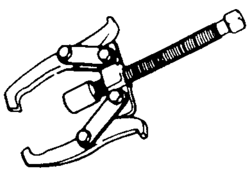
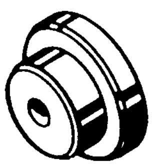
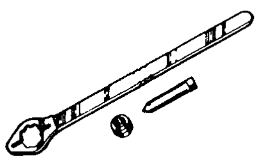
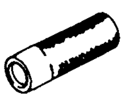
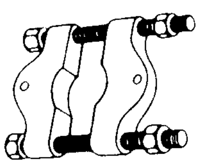
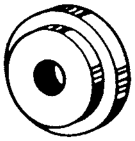
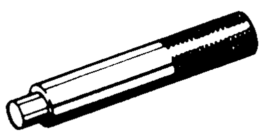
Diagnostic Aids

Ensure that terminal "12" is shorted to ground on the SRS harness. Terminal "15", "23" and "26" are open circuit.

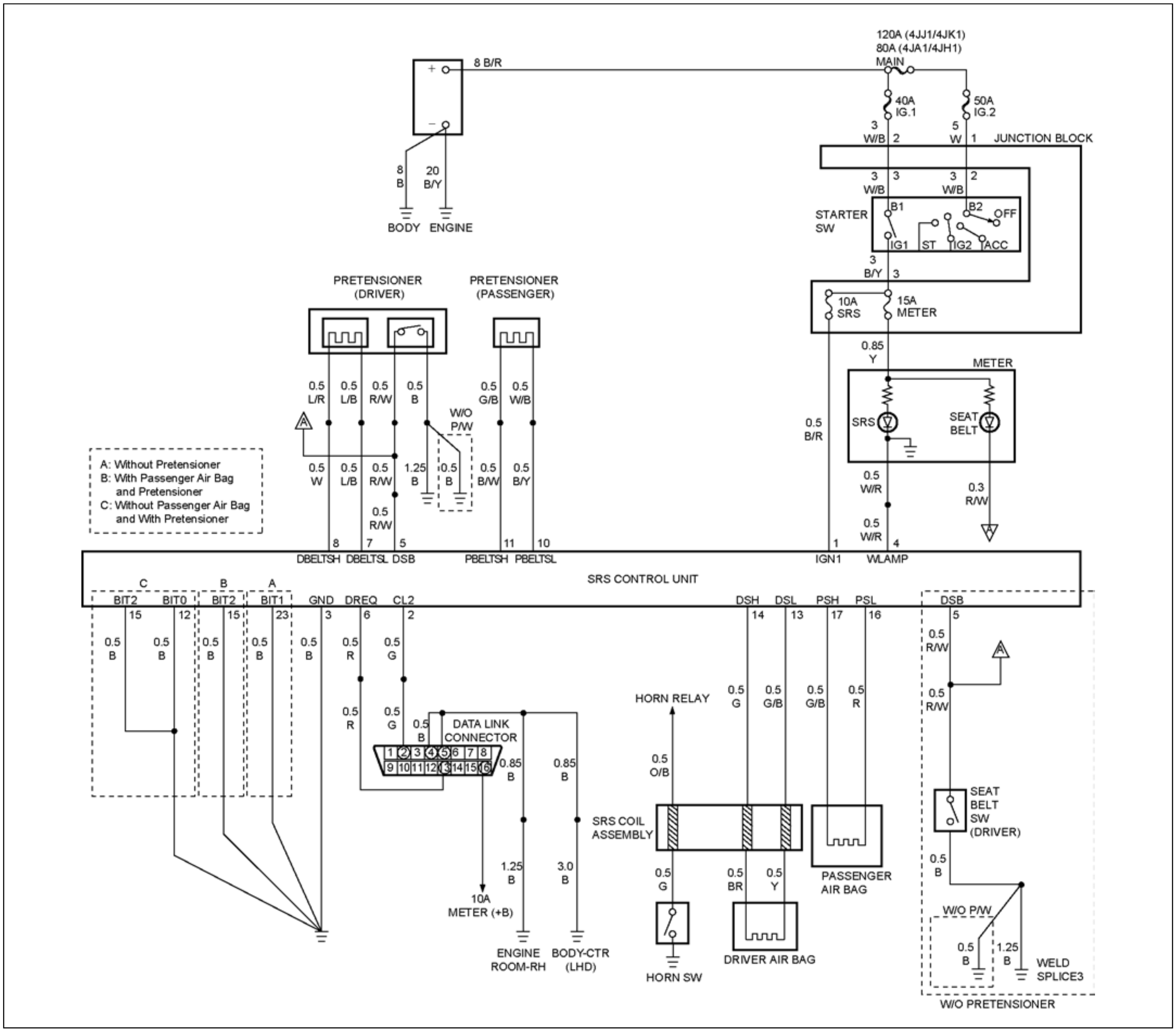
DTC B0055 (Flash Code 55) Vehicle Variant Missing

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS control unit. 3. Inspect the SRS control unit harness for the following condition. ● Without the pretensioner: - The wiring harness is not connected on terminal "23" - The wiring harness is connected on terminals "12", "15" and "26" ● With the pretensioner: - The wiring harness is not connected on terminal "15" - The wiring harness is connected on terminals "12", "23" and "26" ● Without the pretensioner and without the passenger air bag: - The wiring harness is not connected on terminals "12" and "15" - The wiring harness is connected on terminals "23" and "26" Was a problem found?	Replace the SRS control unit harness. Go to Step 3	Replace the SRS control unit. Go to Step 3
3	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic System Check”	—

SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	5-8840-2309-0	Ft axle mount bushing installer & remover
	5-8840-2745-0	Pliers
	5-8840-0013-0 (J-22888)	Side bearing remover
	9-8521-1743-0 (J-8107-2)	Side bearing plug adapter
	5-8840-0133-0 (J-8614-01)	Pinion flange holder
	9-8521-5032-0	Final pinion spindle
	5-8840-0015-0 (J-22912-01)	Separator
	9-8522-1141-0 (J-24256)	Outer bearing outer race installer
	5-8840-0007-0 (J-8092)	Grip

DTC B0061 (Flash Code 61) Warning Lamp Circuit Failure



RTW79ALF000301

Circuit Description

When the ignition switch is first turned “ON”, “Ignition 1” voltage is applied from the “METER” fuse to the “SRS” warning lamp which is connected to “SRS" warning lamp, terminal “4”. The “SRS” fuse applies system voltage to the “Ignition 1” inputs, terminal “1”. The SRS control unit responds by flashing the “SRS” warning lamp 7 times. The SRS control unit monitors the “SRS Warning Lamp" terminal "4" for conditions that are incorrect for the commanded state of the "SRS" warning lamp.

For example, a failure condition exists if the SRS control unit detects low voltage when the "SRS" warning lamp is commanded OFF, or high voltage when the "SRS" warning lamp is commanded ON. If the SRS control unit detects an improper voltage on the “SRS Warning Lamp" terminal "4", DTC B0061 will set.

DTC Will Set When

The SRS control unit try to turn "ON" the "SRS" warning lamp but the battery voltage is not supplied to terminal "4".

The SRS control unit try to turn "OFF" the "SRS" warning lamp but the battery voltage is supplied to terminal "4".

Action Taken

If circuits of the “SRS" warning lamp power supply and ground are normal condition, the SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The malfunction is no longer occurring and the ignition is turned to “LOCK”.

DTC Chart Test Description

Number(s) below refer to step number(s) on the diagnostic chart:

4. This test determines whether the SRS control unit is malfunctioning
5. This test determines whether the malfunction is in the “SRS Warning Lamp” circuit.
7. This test determines whether the SRS control unit is malfunctioning
8. This test determines whether the malfunction is in the “SRS Warning Lamp” circuit.
9. This test determines whether the malfunction is in the power supply circuit of the "SRS" warning lamp.

Diagnostic Aids

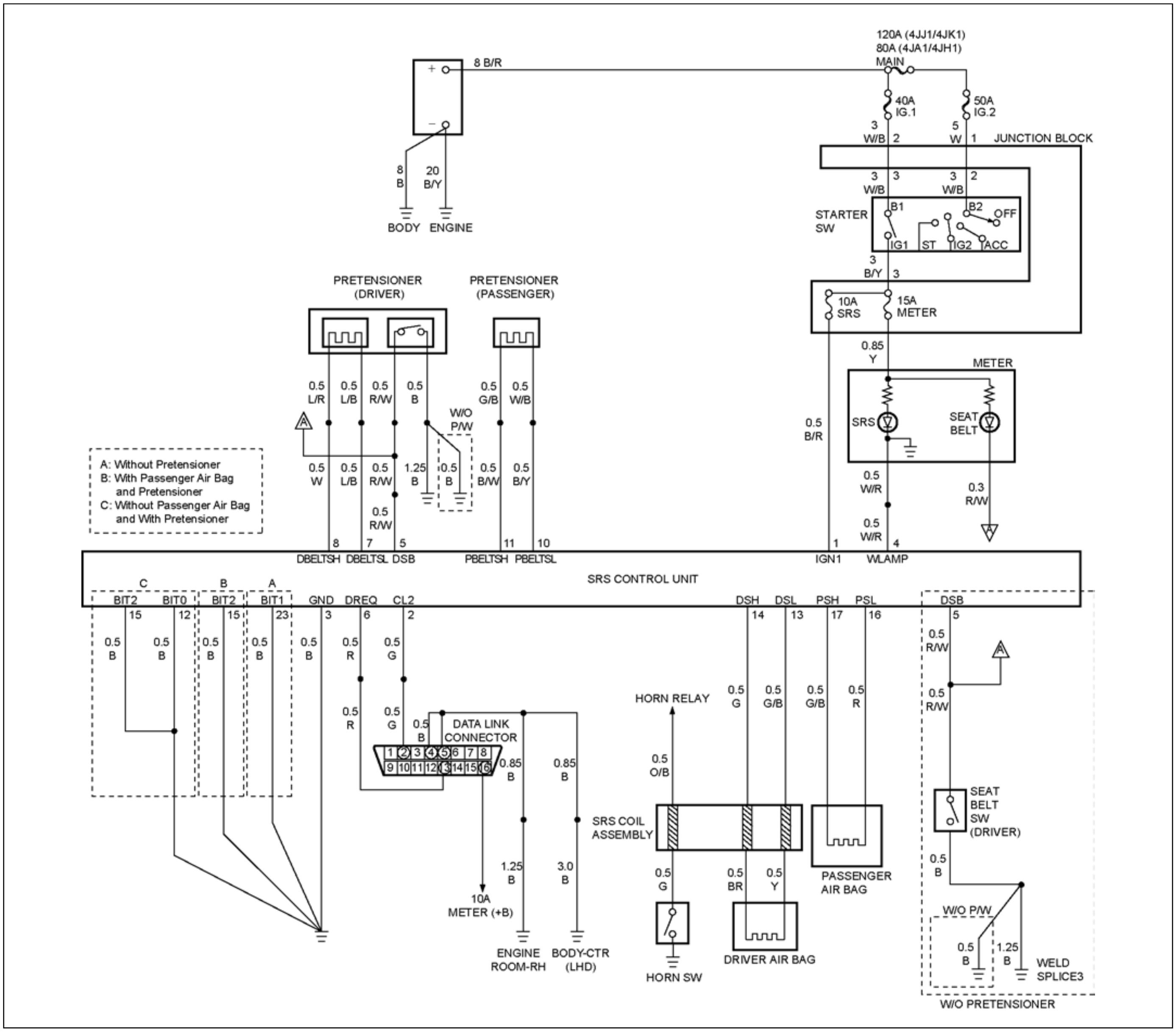
The warning lamp turns “ON" without relation SRS control unit, and turn the warning lamp “OFF" due to electric current to SRS control unit.

DTC B0061 (Flash Code 61) Warning Lamp Circuit Failure

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. Ignition switch is at “ON”. 2. Note the “SRS” warning lamp. Does the “SRS” warning lamp flash seven 7 times?	Repeat the “SRS Diagnostic System Check”	Go to Step 3
3	Did the “SRS” warning lamp come “ON” steady at Step 2?	Go to Step 4	Go to Step 6
4	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS control unit. 3. Ignition switch is at “ON”. 4. Note the “SRS” warning lamp. Does the “SRS” warning lamp go “OFF”?	Ignition switch is at “LOCK”. Replace the SRS control unit . Go to Step 10	Go to Step 5
5	Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "4" to "3" and "23" (ground) (without the pretensioner) ● From terminals "4" to "3" and "15" (ground) (with the pretensioner and the passenger air bag) ● From terminals "4" to "3", "12" and "15" (ground) (with the pretensioner and without the passenger air bag) Does 5-8840-0366-0 display “OL” (infinite)?	Service instrument meter cluster. Install instrument meter cluster. Go to Step 10	Replace the SRS harness. Go to Step 10
6	1. Ignition switch is at “LOCK”. 2. Remove and inspect “METER” fuse to the “SRS” warning lamp. Is the fuse good?	Go to Step 7	Replace the "METER" fuse. Go to Step 10
7	1. Disconnect the SRS control unit. 2. Ignition switch is at “ON”. 3. Measure the voltage on the SRS control unit harness connector from terminal “4” to terminal “3” (ground). Is system voltage present on terminal “4”?	Ignition switch is at “LOCK”. Replace the SRS control unit. Go to Step 10	Go to Step 8

Step	Action	Yes	No
8	1. Ignition switch is at “LOCK”. 2. Measure the resistance from the instrument meter cluster harness connector "SRS" warning lamp circuit terminal to the SRS control unit harness connector terminal “4”. Is the resistance 5.0 ohms or less?	Go to Step 9	Replace the SRS harness. Go to Step 10
9	1. Disconnect the instrument meter cluster harness connector. 2. Measure the resistance from the "METER" fuse to the instrument meter cluster harness connector "SRS" warning lamp power supply circuit terminal. Is the resistance 5.0 ohms or less?	Service instrument meter cluster. Install instrument meter cluster. Go to Step 10	Replace the "SRS" warning lamp power supply circuit harness. Go to Step 10
10	1. Reconnect all components and ensure all components are properly mounted. 2. Clear the diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic System Check”	—

DTC B0062 (Flash Code 62) Battery Voltage Too High



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON", the SRS control unit judge to "Ignition 1" voltage is normal or not.

DTC Will Set When

The "Ignition 1" voltage is above 21.4V.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The “Ignition 1" voltage comes to below 16.5V.

DTC Chart Test Description

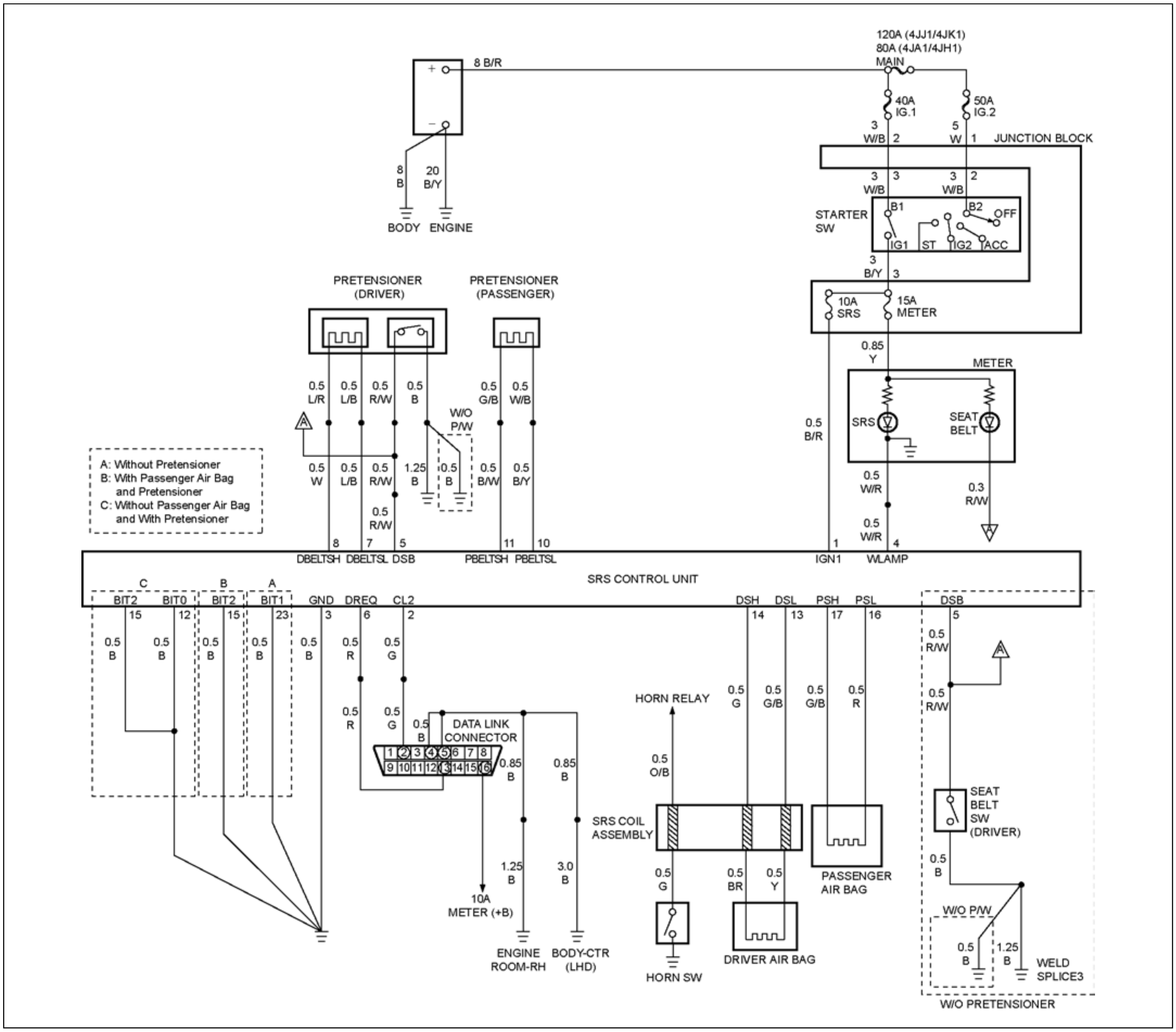
Number(s) below refer to circled number(s) on the diagnostic chart.

2. This test determines whether the SRS control unit is malfunctioning.

DTC B0062 (Flash Code 62) Battery Voltage Too High

Step	Action	Yes	No
1	Was the "SRS Diagnostic System Check" performed?	Go to Step 2	Go to the "SRS Diagnostic System Check"
2	1. Ignition switch is at "LOCK". 2. Disconnect the SRS control unit. 3. Ignition switch "ON". 4. Measure voltage on SRS control unit harness connector from terminal "1" to terminal "3" (ground). Is voltage on terminal "1" below 16.5V?	Ignition switch is at "LOCK". Replace the SRS control unit. Go to Step 3	Inspect the Charging System. Refer to the "Engine Electrical" section. Go to Step 3
3	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the "SRS Diagnostic system Check"	—

DTC B0063 (Flash Code 63) Battery Voltage Too Low



RTW79ALF000301

Circuit Description

When the ignition switch is turned “ON", the SRS control unit judge to "Ignition 1" voltage is normal or not.

DTC Will Set When

The "Ignition 1" voltage is below 7.2V.

Action Taken

The SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The “Ignition 1" voltage comes to above 10.6V.

DTC Chart Test Description

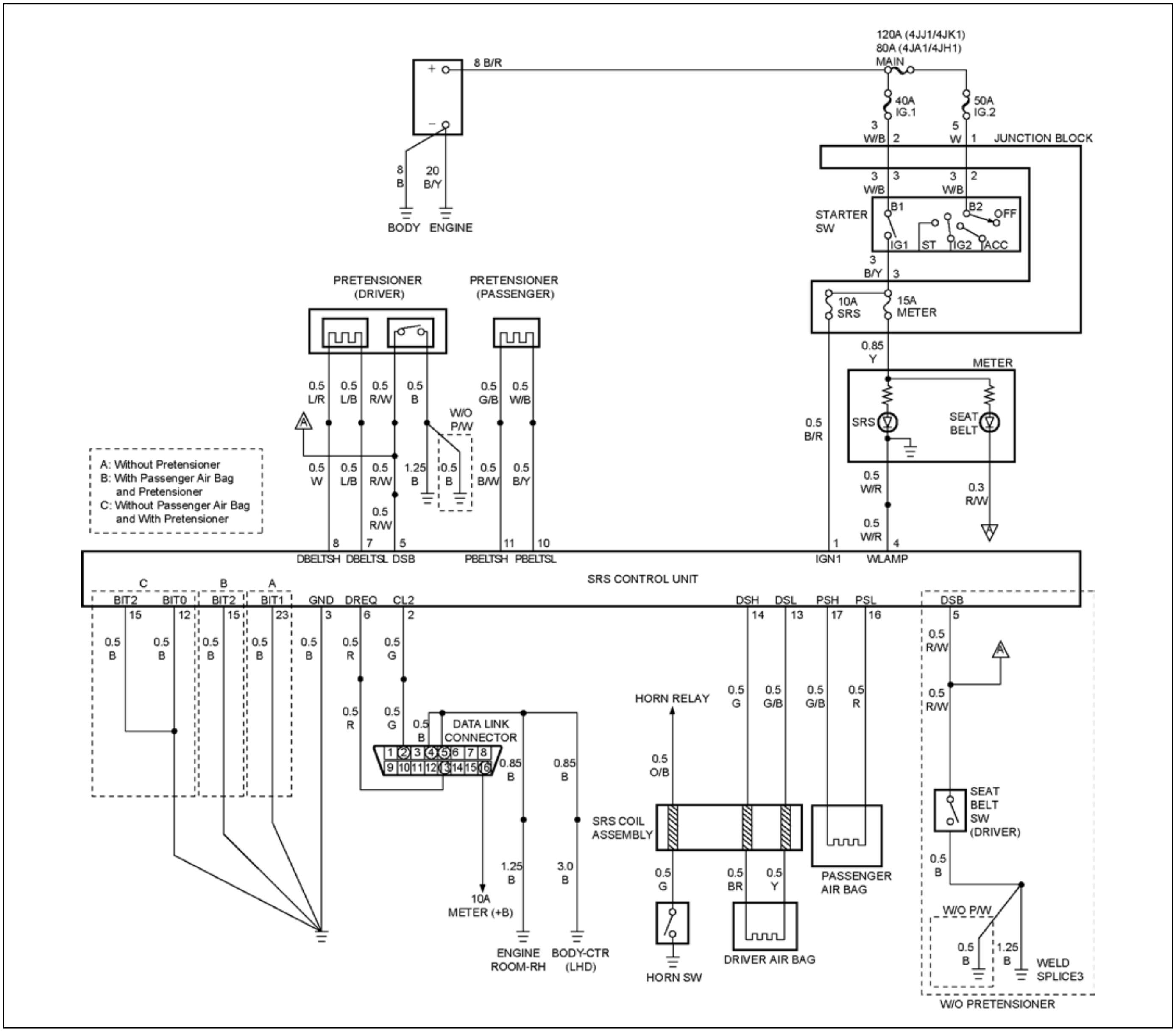
Number(s) below refer to circled number(s) on the diagnostic chart.

4. This test determines whether the malfunction is in the “Ignition 1” circuit.
5. This test determines whether the malfunction is in the “Ignition 1” circuit.

DTC B0063 (Flash Code 63) Battery Voltage Too Low

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Go to Step 2	Go to the “SRS Diagnostic System Check”
2	1. Ignition switch is at “LOCK”. 2. Disconnect the SRS control unit. 3. Ignition switch “ON”. 4. Measure voltage on SRS control unit harness connector from terminal “1” to terminal “3” (ground). Is voltage on terminal “1” above 10.6V?	Go to Step 5	Go to Step 3
3	1. Ignition switch is at “LOCK”. 2. Remove and inspect “SRS” fuse to the “Ignition 1”. Is fuse good?	Go to Step 4	Replace the "SRS" fuse. Go to Step 6
4	1. Ignition switch is at “LOCK”. 2. Measure resistance from "SRS" fusel to SRS control unit harness connector terminal “1”. Is resistance 5.0 ohms or less?	Inspect the Charging System. Refer to the "Engine Electrical" section. Go to Step 6	Replace the SRS harness. Go to Step 6
5	1. Remove the "SRS" fuse. 2. Measure the resistance on the SRS control unit harness connector as follow. ● From terminals "1" to "3" and "23" (ground) (without the pretensioner) ● From terminals "1" to "3" and "15" (ground) (with the pretensioner and the passenger air bag) ● From terminals "1" to "3", "12" and "15" (ground) (with the pretensioner and without the passenger air bag) Does 5-8840-0366-0 display “OL” (Infinite)?	Ignition switch is at “LOCK”. Replace the SRS control unit. Go to Step 6	Replace SRS Harness. Go to Step 6
6	1. Reconnect all the components and ensure all components are properly mounted. 2. Clear diagnostic trouble codes. Is this step finished?	Go to the “SRS Diagnostic system Check”	—

DTC B0071 (Flash Code 71) SRS Control Unit Internal Fault



RTW79ALF000301

Circuit Description

DTC B0071 is an indication of a potential internal SRS control unit malfunction and will set if any of the following conditions are detected:

1) Microprocessor energy reverse time failure.
2) EEPROM read / write failure.
3) ROM check sum.
4) Calibration check sum fault.
5) Inflators reserve voltage low.
6) Inflators electronic sensor active signal not detected during commanded deployment.
7) QSDD (High-side/Low-side) FET failure.
8) Frontal accelerometer failure.
9) Phase lock loop lost lock.
10) QSDD communication fault.

DTC Will Set When

Any of the above indicated malfunctions are detected by the SRS control unit. The malfunctions described above are tested mainly during “Continuous Monitoring” and some are run each ignition cycle.

Action Taken

SRS control unit turns “ON” the “SRS” warning lamp and sets a diagnostic trouble code.

DTC Will Clear When

The SRS control unit is replaced.

DTC B0071 (Flash Code 71) SRS Control Unit Internal Fault

WARNING: DURING SERVICE PROCEDURES. BE VERY CAREFUL WHEN HANDLING A SRS CONTROL UNIT. NEVER STRIKE OR JAR THE SRS CONTROL UNIT. NEVER POWER UP THE SRS WHEN THE SRS CONTROL UNIT IS NOT RIGIDLY ATTACHED TO THE VEHICLE. ALL SRS CONTROL UNIT AND MOUNTING BRACKET FASTENERS MUST BE CAREFULLY TORQUED AND THE ARROW MUST BE POINTING TOWARD THE FRONT OF THE VEHICLE TO ENSURE PROPER OPERATION OF THE SRS. THE SRS CONTROL UNIT COULD BE ACTIVATED WHEN POWERED WHILE NOT RIGIDLY ATTACHED TO THE VEHICLE WHICH COULD CAUSE DEPLOYMENT AND RESULT IN PERSONAL INJURY.

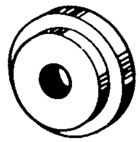
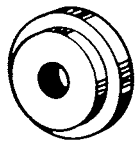
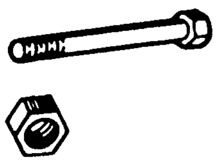
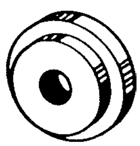
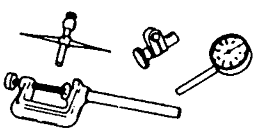
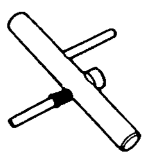
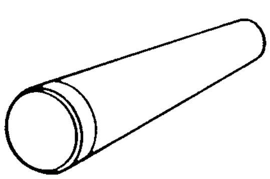
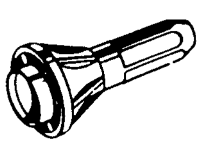
CAUTION: If DTC B0071 can not be cleared by Tech2, it is necessary to replace the SRS control unit.

Step	Action	Yes	No
1	Was the “SRS Diagnostic System Check” performed?	Ignition switch “LOCK”. Replace SRS control unit. Repeat the “SRS Diagnostic System Check”	Go to the “SRS Diagnostic System Check”

SECTION 10

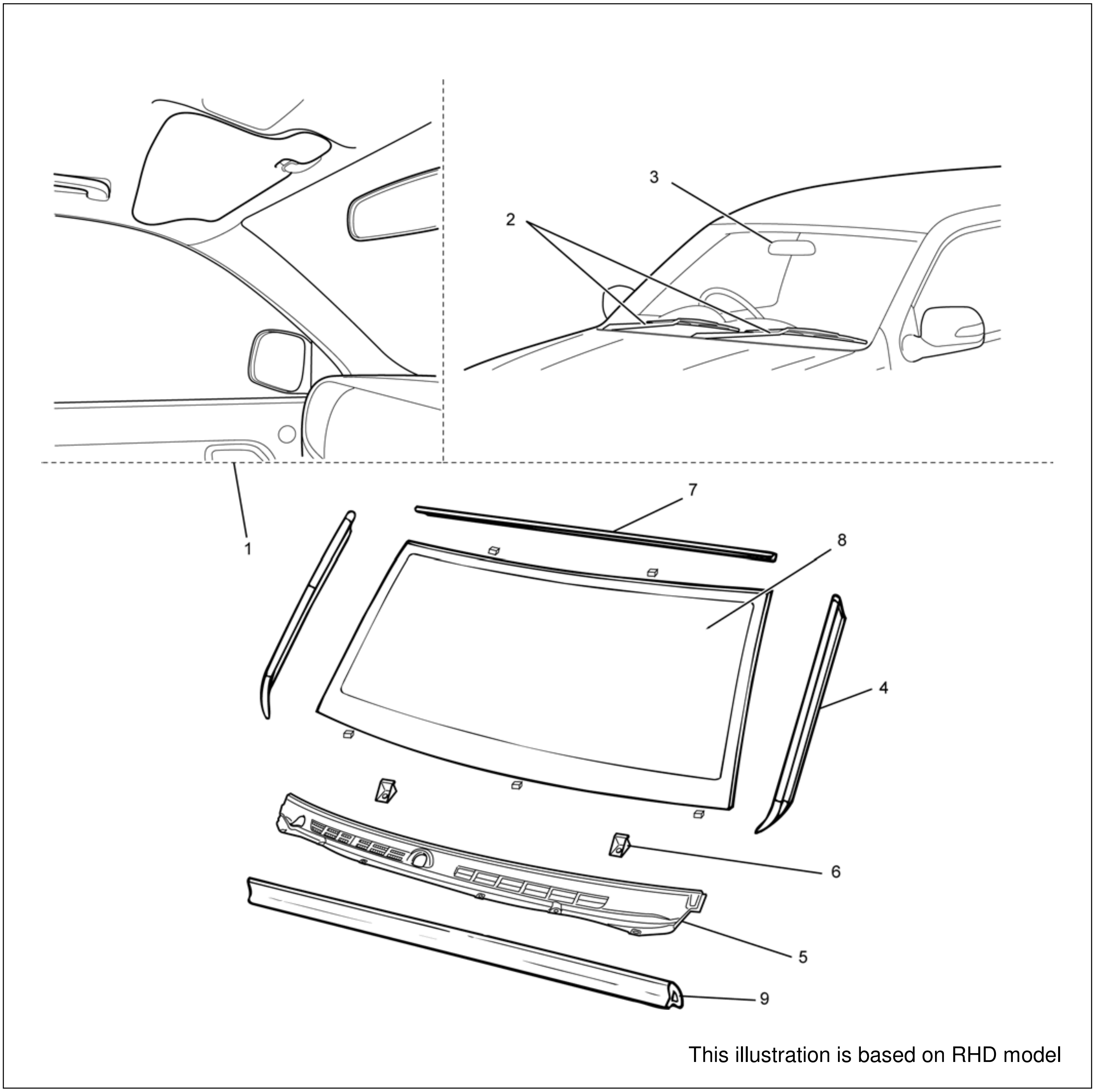
CAB

TABLE OF CONTENTS

ILLUSTRATION	PART NO.	PART NAME
	9-8522-1274-0 (J-24252)	Inner bearing outer race installer
	5-8840-2085-0 (J-21777-42)	Pilot
	5-8840-2089-0 (J-23597-9)	Nut & bolt
	5-8840-2087-0 (J-23597-7)	Gauge plate
	5-8840-0126-0 (J-8001)	Dial indicator
	5-8840-0128-0 (J-23597-1)	Arbor
	5-8840-2088-0 (J-23597-8)	Disc (2 pcs. required)
	9-8522-1165-0 (J-6133-01)	Pinion bearing installer (for 4WD)
	9-8522-1275-0 (J-24250)	Pinion oil seal installer

WINDSHIELD

REMOVAL AND INSTALLATION

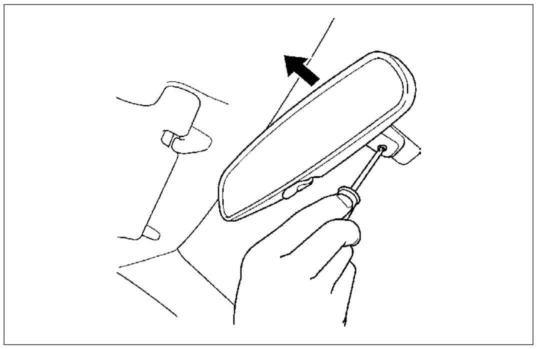


Removal Steps

1. Interior trim panels (Front side) /Headlining/Instrument panel assembly
2. Wiper arm assembly
▲ 3. Room mirror
4. Side molding
5. Vent cowl cover
6. Windshield stopper
7. Upper molding
▲ 8. Windshield
9. Engine hood rear seal

Installation Steps

▲ 9. Engine hood rear seal
▲ 8. Windshield
7. Upper molding
6. Windshield stopper
5. Vent cowl cover
4. Side molding
3. Room mirror
▲ 2. Wiper arm assembly
1. Interior trim panels (Front side) /Headlining/Instrument panel assembly



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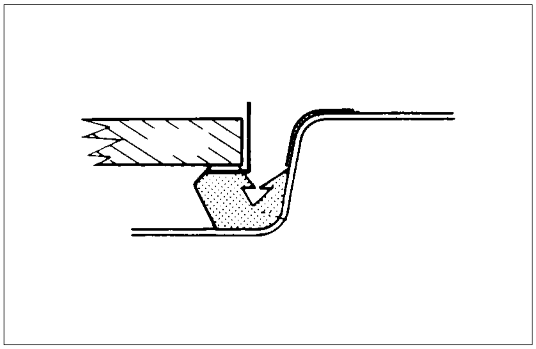
Important Operations - Removal

3. Room Mirror

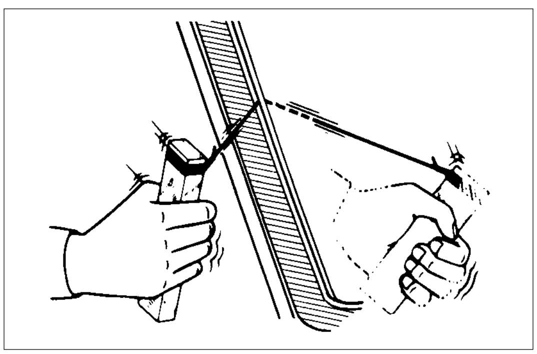
Remove the screw and pull the room mirror to the upper side.



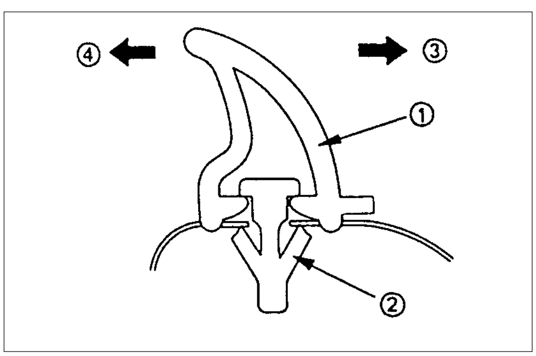
8. Windshield

Remove the windshield, carefully following the steps listed below:

1) Use a knife to cut through part of the adhesive caulking material.
2) Secure one end of a piece of steel piano wire (0.02 inches in diameter) to a piece of wood that can serve as a handle.
3) Use a pair of needle nose pliers to insert the other end of the piano wire through the adhesive caulking material at the edge of the windshield.
4) Secure the other end of the piano wire to another piece of wood.



5) With the aid of an assistant, carefully move the piano wire with a sawing motion to cut through the adhesive caulking material around the entire circumference of the windshield.
6) Lift the windshield from the body.
7) Clean any remaining adhesive caulking material from the area of the body which holds the windshield.
8) Use a soft rag and unleaded gasoline to wipe off any adhesive remaining on the windshield.

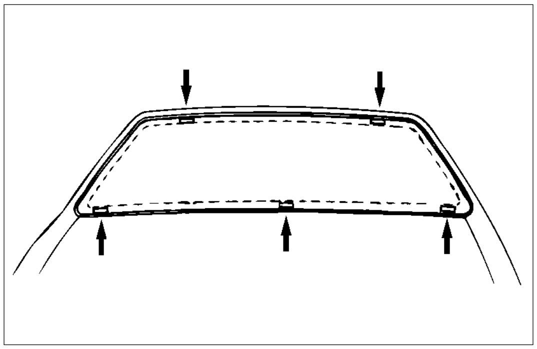


Important Operations - Installation

9. Engine Hood Rear Seal

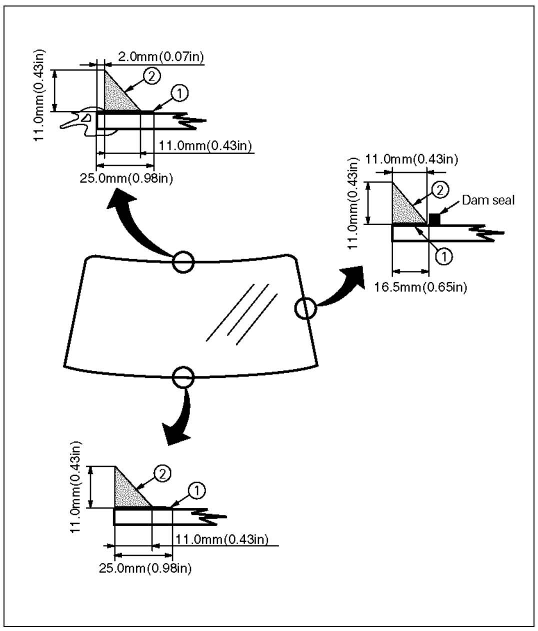
Install the engine hood rear seal as shown in the illustration.

① : Seal
② : Clip
③ : Rear (windshield side)
④ : Front

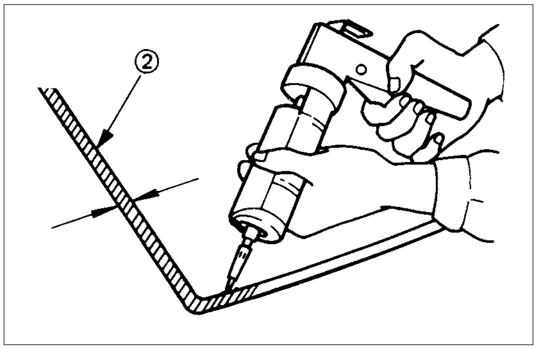


8. Windshield

1) Clean the windshield bonding surface.
2) Use a soft rag and unleaded gasoline to wipe off any adhesive remaining on the body.
3) Mount the body windshield as shown in the illustration. Attach spacers at five locations.
   - Always use new spacers.
4) Install the windshield upper molding.
   - Peel off the tear-away paper from the windshield upper molding, and start applying it with one end of the windshield and cut away the surplus at the other end of the windshield for length adjustment.
   - Always use new upper molding.
5) Temporarily install the windshield support.



6) Apply primer ① Sunstar #435-98 or equivalent to the body side bonding surface. The primer should extend at least 25 mm (0.98 in).
   Apply primer Sunstar #435-40 or equivalent to the windshield side bonding surface.
   The primer should extend 16.5 mm (0.65 in) and 25 mm (0.98 in) from end of the windshield.

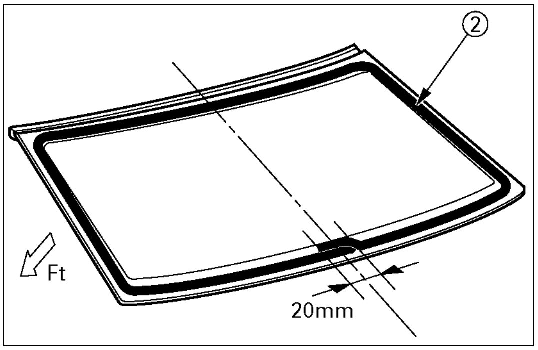


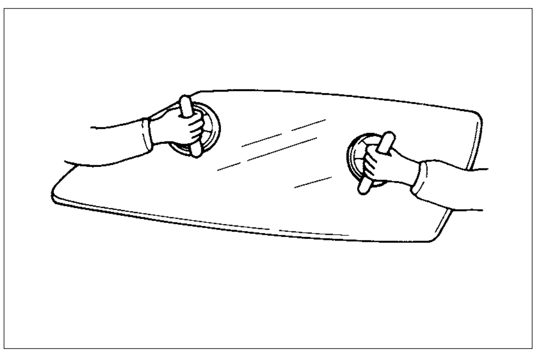
7) Apply the windshield sealing adhesive ②.
   If you are using an air gun, air pressure should be maintained at 147 - 294 kPa.
   After drying the primer completely, apply a sealing adhesive (Sunstar #557 or equivalent) along the edge of the windshield so that the sealing adhesive has a 20 mm (0.79 in) junction at the middle of the base of the windshield.

Note :

Open time (1 min. or more) should be set after application of the primer.

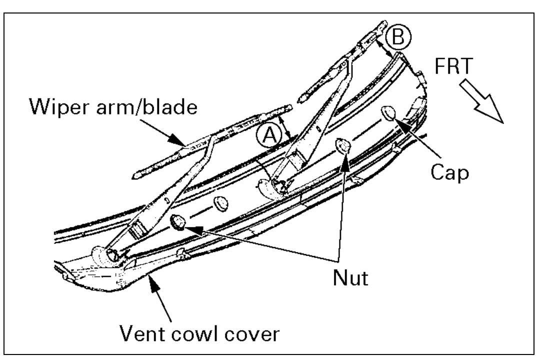
Bonding shall be done within 5 minutes after the sealing adhesive has been applied.





8) Adjust the setting of the windshield with suction discs.
   Set the windshield with sealing adhesive applied to the entire circumference on the body panel. Specifically, adjust the windshield support with the upper molding making contact with the body panel, press the windshield, and tighten the windshield support.

9) Use unleaded gasoline and a soft cloth to wipe away any excess adhesive.
   Cure the bonding at a temperature of 20 - 30°C (68 - 86°F) for twenty-four hours.
   Check that the windshield does not leak water.



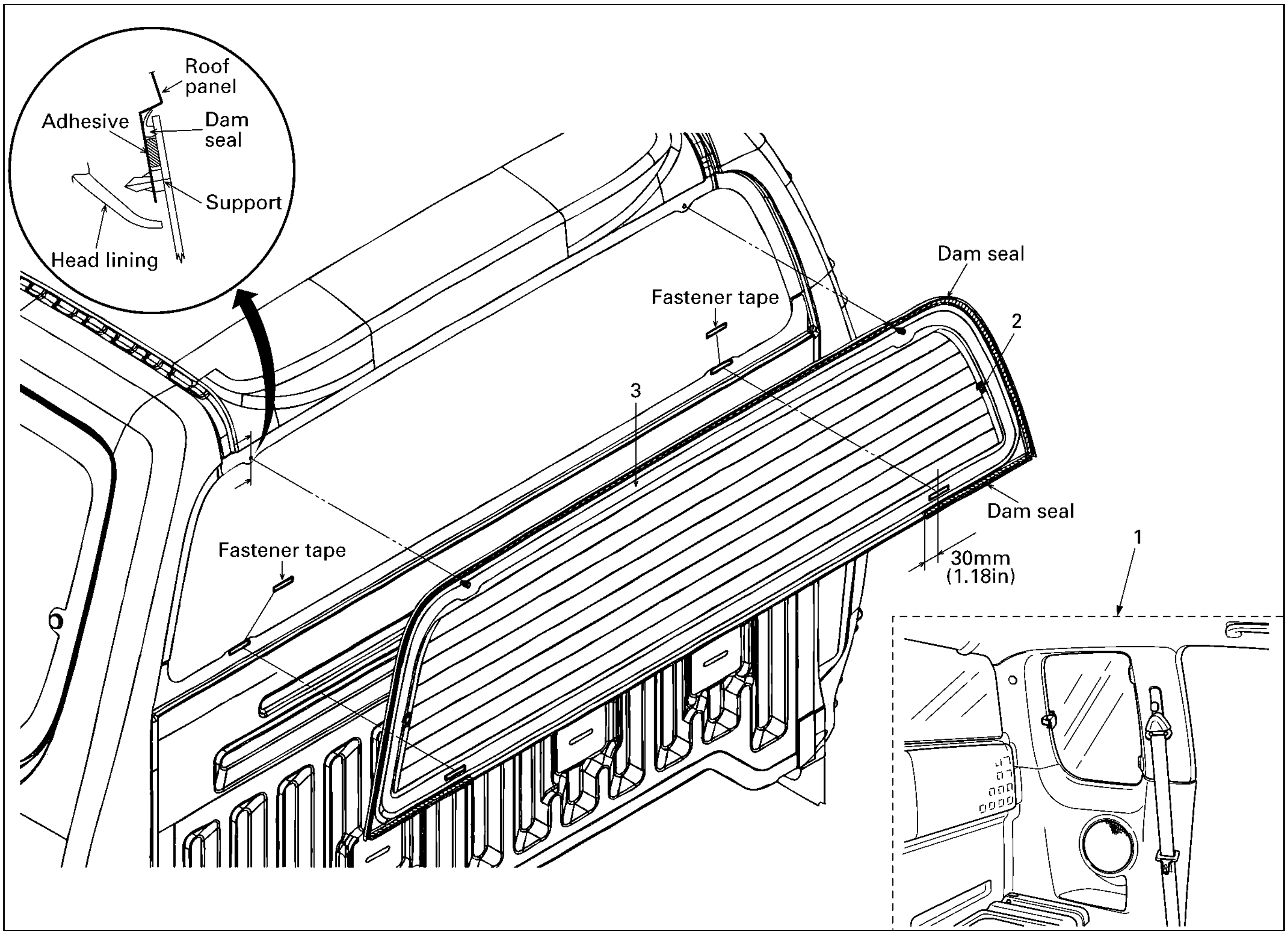
2. Wiper Arm Assembly

- Set the wiper arm/blade so that the tips of both blades are positioned to the specified value of Ⓐ and Ⓑ from the upper edge of the cowl cover as shown in the figure.
  Ⓐ 40 mm (1.57 in)
  Ⓑ 52 mm (2.05 in)
- Tighten the wiper arm assembly fixing nuts to the specified torque.

Torque	N·m (kgf·m/lb·ft)
31 (3.2/23)	

REAR WINDOW ASSEMBLY

REMOVAL AND INSTALLATION



Removal Steps

1. Interior trim panels/Headlining
2. Rear defogger connector (W/Rear defogger)

▲ 3. Rear window

Installation Steps

▲ 3. Rear window

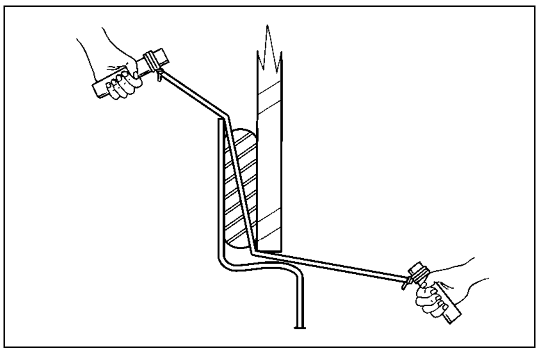
2. Rear defogger connector (W/Rear defogger)
1. Interior trim panels/Headlining

Important Operation - Removal

3. Rear Window

Remove the rear window, carefully following the steps listed below :

1) Use a knife to cut through part of the adhesive caulking material.
2) Secure one end of a piece of steel piano wire (0.02 inches in diameter) to a piece of wood that can serve as a handle.
3) Use a pair of needle nose pliers to insert the other end of the piano wire through the adhesive caulking material at the edge of the rear window.
4) Secure the other end of the piano wire to another piece of wood.

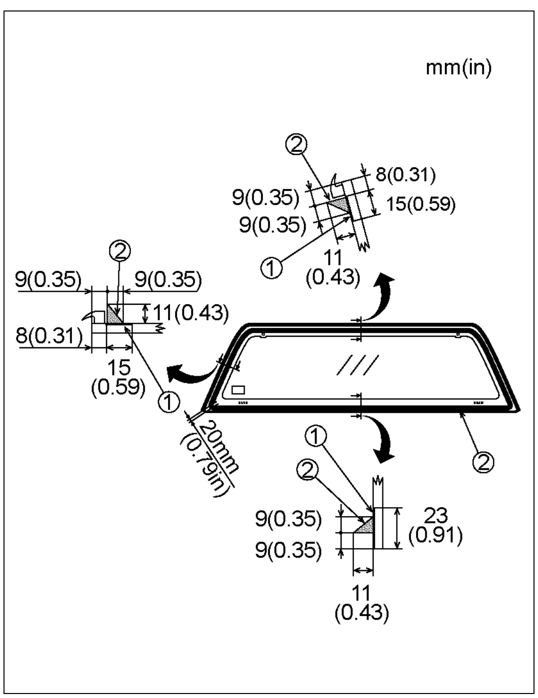


5) With the aid of an assistant, carefully move the piano wire with a sawing motion to cut through the adhesive caulking material around the entire circumference of the rear window.
6) Lift the rear window from the body.
7) Clean any remaining adhesive caulking material from the area of the body which holds the rear window.
8) Use a soft rag and unleaded gasoline to wipe off any adhesive remaining on the rear window.

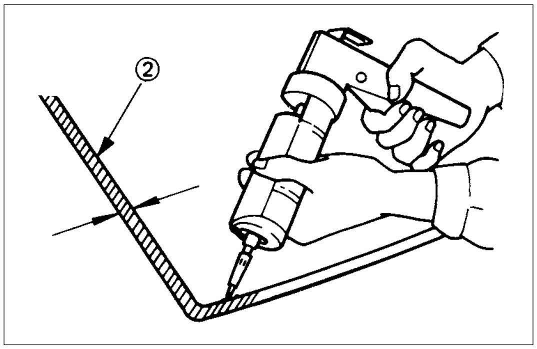
Important Operation - Installation

3. Rear Window

1) Clean the rear window bonding surface.
2) Use a soft rag and unleaded gasoline to wipe off any adhesive remaining on the body.
3) Install the fastener tape to the body panel flange.



4) Apply primer ① Sunster #435-98 or equivalent to the body side bonding surface.
Apply primer Sunstar #435-40 or equivalent to the rear window side bonding surface.
The primer should extend 23 mm (0.91 in.) from the end of the rear window.



5) Apply the rear window sealing adhesive ②.

If you are using an air gun, air pressure should be maintained at 147 – 294 kPa.

After drying the primer completely, apply a sealing adhesive (Sunstar #557 or equivalent) along the edge of the rear window so that the sealing adhesive has a 20 mm (0.79 in.) junction at left corner of the base of the rear window.

Note:

Open time (1 min. or more) should be set after application of the primer.

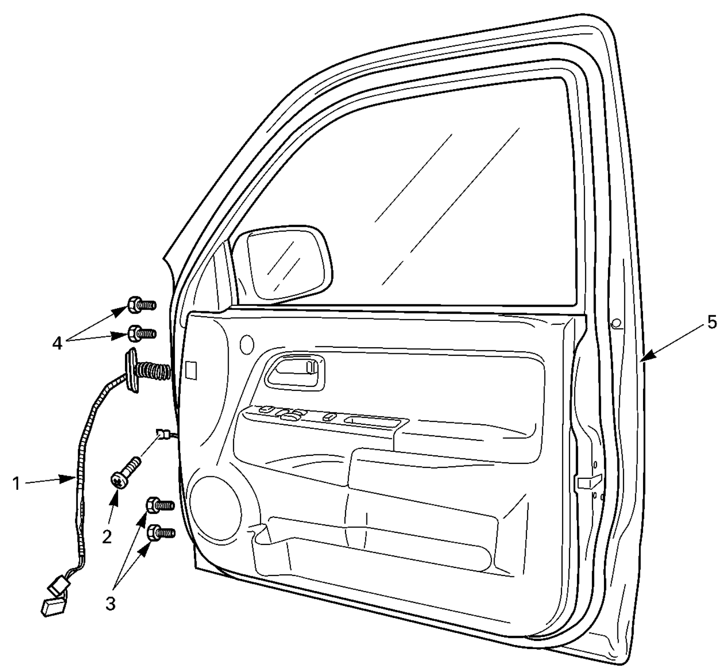
Bonding shall be done within 5 minutes after the sealing adhesive has been applied.

6) Insert the rear window supports into the panel and then push the rear window against the panel to fix it in place. Wipe away any adhesive that oozes out around the edges.

7) Check that the rear window does not leak water.

FRONT DOOR ASSEMBLY

REMOVAL AND INSTALLATION



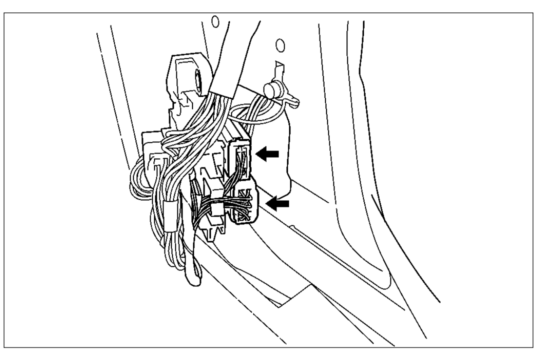
This illustration is based on RHD model

Removal Steps

▲ 1. Door harness
▲ 2. Check arm screw
▲ 3. Lower hinge bolt
4. Upper hinge bolt
5. Door assembly

Installation Steps

5. Door assembly
4. Upper hinge bolt
▲ 3. Lower hinge bolt
▲ 2. Check arm screw
1. Door harness



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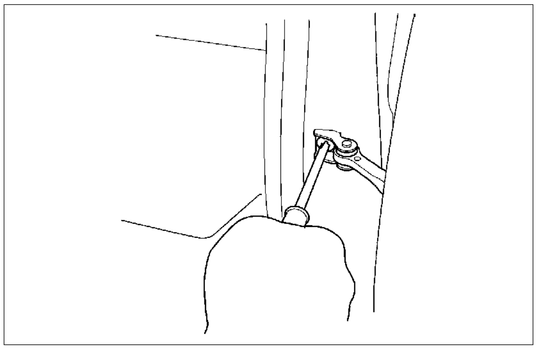
Important Operations - Removal

1. Door Harness

Remove the harness bracket and disconnect the door harness connectors.



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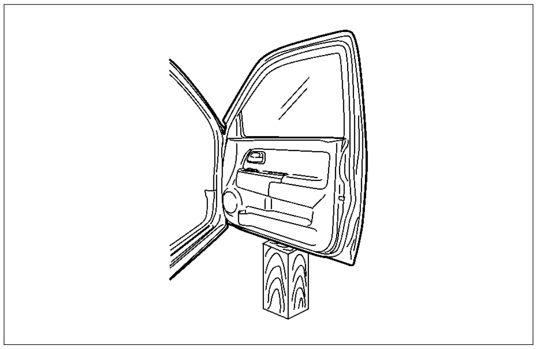
2. Check Arm Screw



3. Lower Hinge Bolt
Position a wood block under the door for protection and support the door assembly with hands at removal or installation.

Important Operations – Installation

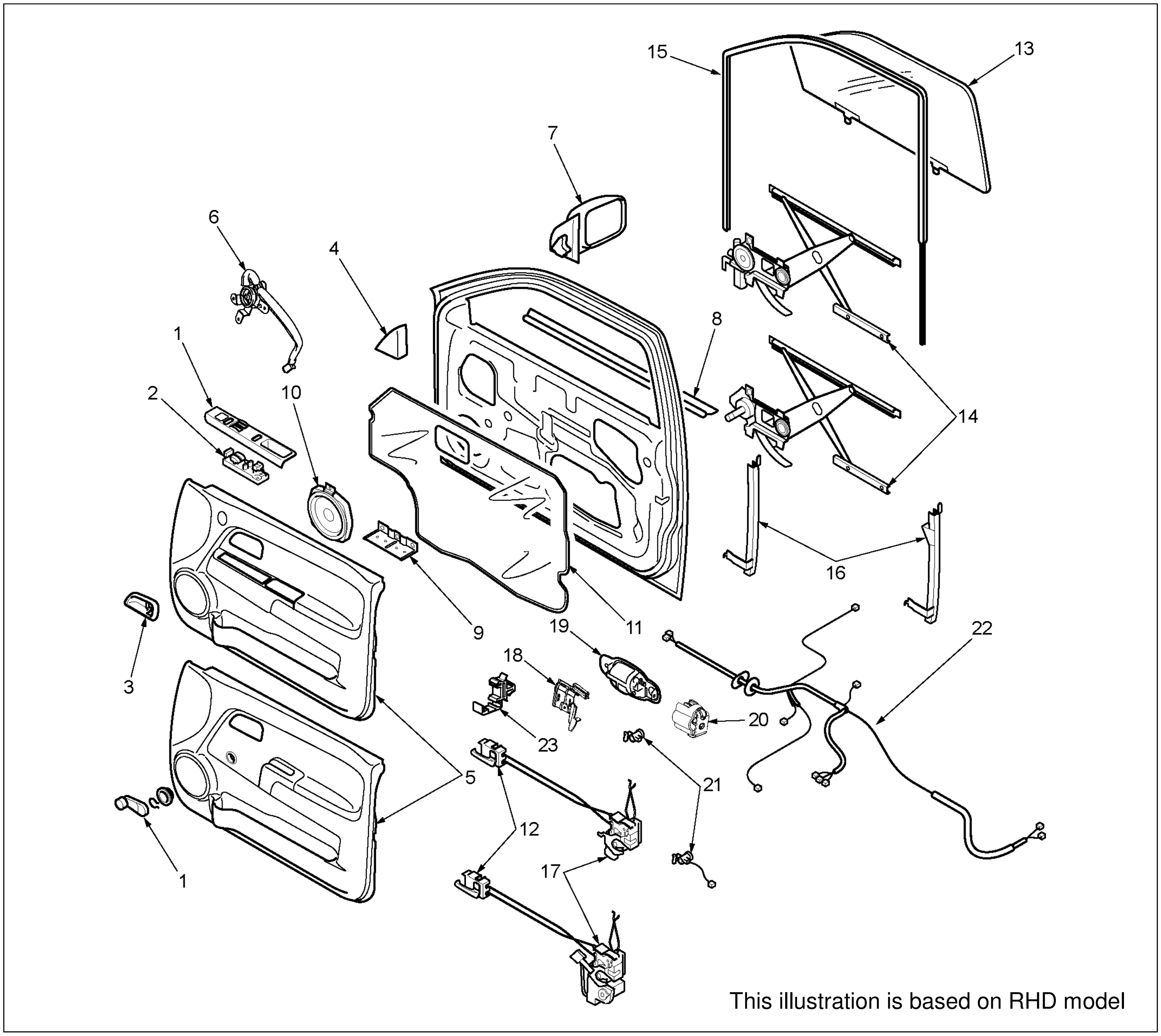
3. Lower Hinge Bolt; Hinge to Door

Torque	N·m (kgf·m/lb·ft)
34 (3.5/25)	

2. Check Arm Screw; Check Arm to Body

Torque	N·m (kgf·m/lb·ft)
24 (2.4/17)	

DISASSEMBLY



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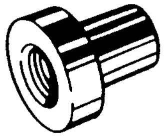
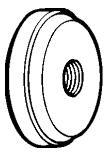
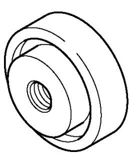
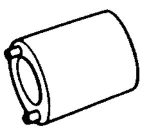
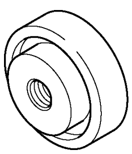
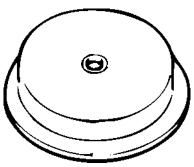
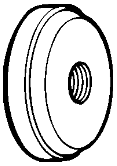
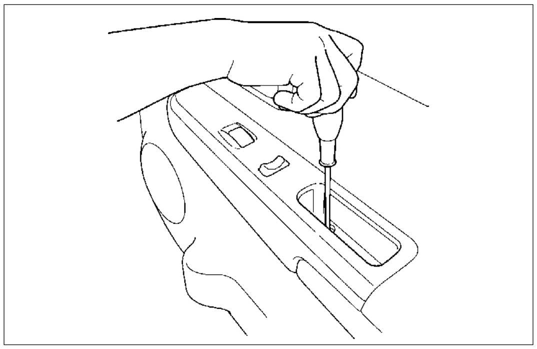
Disassembly Steps

▲ 1. Switch bezel/Window regulator handle
▲ 2. Power window switch
▲ 3. Bezel
▲ 4. Door mirror cover
▲ 5. Door trim panel
▲ 6. Tweeter (Required Option)
▲ 7. Door mirror assembly
▲ 8. Outer waste seal
▲ 9. Bracket
▲10. Speaker assembly
▲11. Waterproof sheet
▲12. Inside lever
▲13. Window glass
▲14. Window regulator/Power window regulator
▲15. Glass run
▲16. Glass run rear channel / Glass ran rear channel with Door lock control or Anti theft (European Countries)
▲17. Door lock assembly/Door lock assembly with super lock
▲18. Outside handle protector (EUROPE)
▲19. Outside handle
▲20. Door lock cylinder protector (EUROPE)
▲21. Door lock cylinder / Door lock cylinder with door lock switch (European Countries)
22. Door harness assembly
23. Anti rattler

ILLUSTRATION	PART NO.	PART NAME
	9-8522-1164-0 (J-24244)	Side bearing installer
	5-8840-2852-0	Outer bearing installer (for 2WD)
	5-8522-0054-0 (J-29015)	Inner bearing installer (for 4WD)
	5-8840-2853-0	Hub oil seal installer (for 2WD)
	5-8840-2117-0 (J-36827)	Hub nut wrench
	5-8840-2119-0 (J-36829)	Inner bearing installer (for 4WD)
	5-8840-2854-0	Oil seal installer (for 4WD)
	5-8840-2789-0	ABS sensor rotor installer
	9-8522-1270-0	Inner bearing installer (for 2WD)

Important Operations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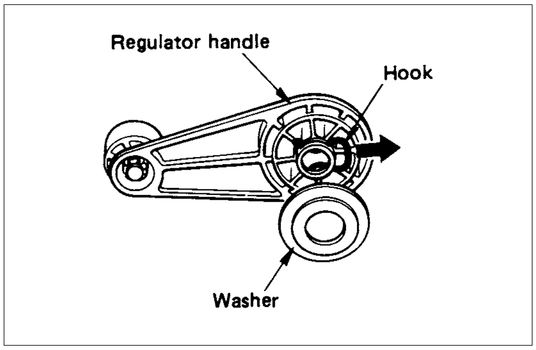
1. Switch Bezel/Window Regulator Handle

- Remove the 2 screws and disconnect the connectors.



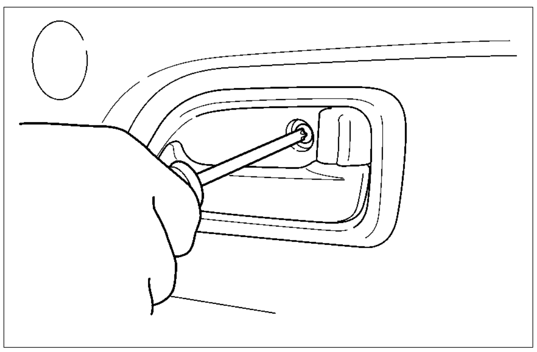
- To remove the regulator handle, remove the clip at the root of the handle by using wire.

2. Power Window Switch

- Remove the 2 screws.

3. Bezel

- Remove the screw.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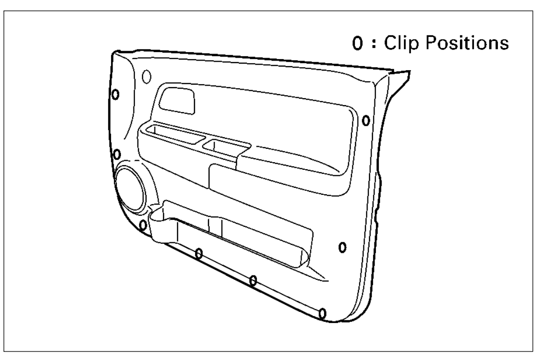
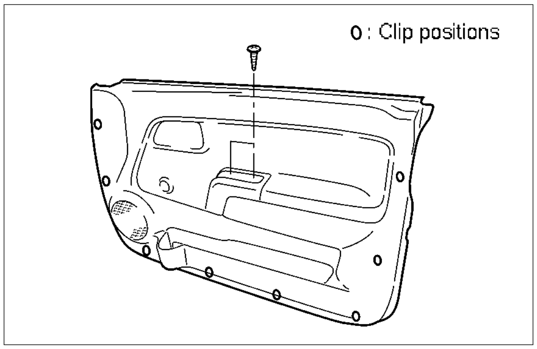
4. Door Mirror Cover

- Pull out the upper clip, and then take out the cover upward.

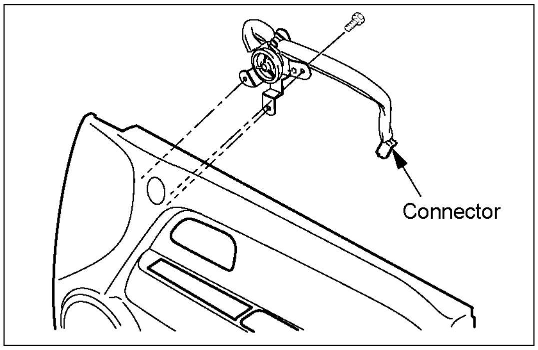
5. Door Trim Panel

- Pull out the trim panel at the 8 clip positions (Power window type).





- Remove the 2 screws and pull out the trim panel at the 8 clip positions (Window regulator handle type).



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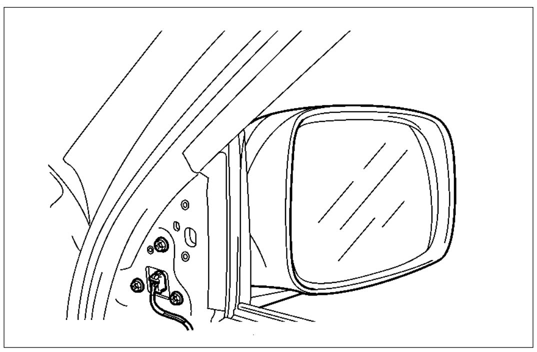
6. Tweeter (Required option)

- Disconnect the tweeter harness connector and remove the 3 screws.



7. Door Mirror Assembly

- Remove 3 fixing bolts and then remove the connector.

8. Outer Waste Seal

9. Bracket

10. Speaker Assembly

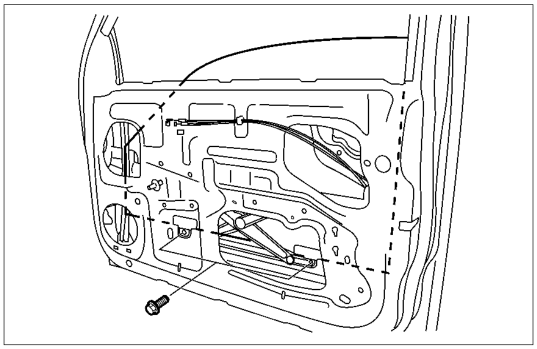
- Remove the fixing screw and then remove the connector.

11. Waterproof Sheet

- Take care not to damage the sheet when peeling it off.

12. Inside Lever

- Disconnect the door lock cables.



13. Window Glass

- Remove 2 bolts through the access hole and pull out the window glass upward.

14. Window Regulator/Power Window Regulator

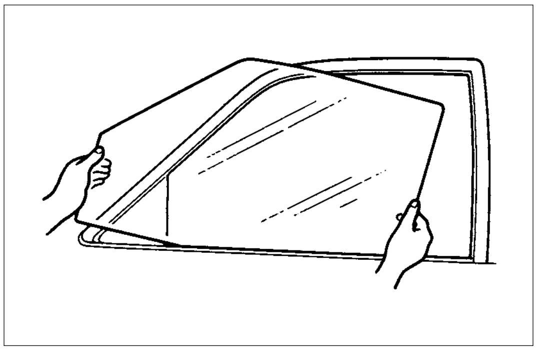
- Remove the 4 fixing bolts and the 2 fixing nuts.
- Disconnect the power window motor connector.

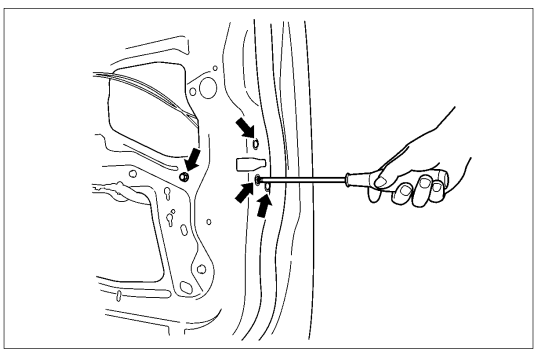
15. Glass Run

- Pull it out from the door frame of the channel.

16. Glass Run Rear Channel

- Remove the bolt.
- Bolt is removed after removing door lock cylinder switch harness. (Expect European Countries)





17. Door Lock Assembly

- Disconnect the lock cable from the anti rattler.
- Remove the 3 fixing screws and the bolt.
- Disconnect the linkage at the outside handle and the lock cylinder.
- Disconnect the harness connector.

18. Outside Handle Protector (EUROPE)

- Remove the fixing bolt from the outside handle.

19. Outside Handle

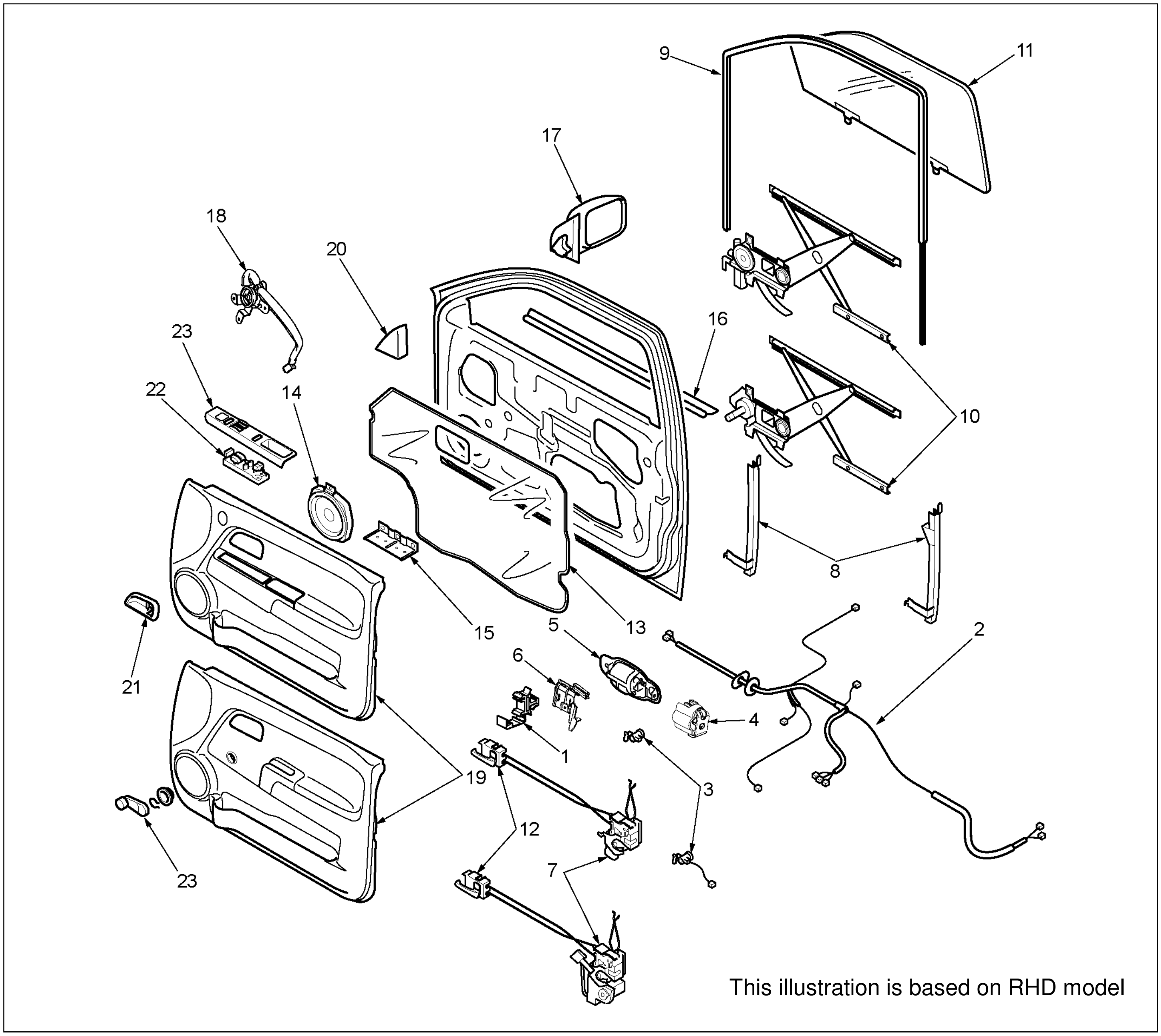
20. Door Lock Cylinder Protector (EUROPE)

- Remove the fixing bolt from the outside handle.

21. Door Lock Cylinder

- Remove the 2 fixing bolts from the outside handle.

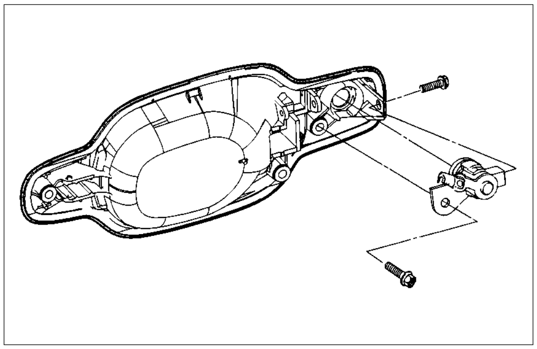
REASSEMBLY



RTW4A0LF000801

Reassembly Steps

1. Anti rattler
2. Door harness assembly
▲ 3. Door lock cylinder / Door lock cylinder with door lock switch (European Countries)
▲ 4. Door lock cylinder protector (EUROPE)
▲ 5. Outside handle
▲ 6. Outside handle protector (EUROPE)
7. Door lock assembly / Door lock assembly with super lock
8. Glass run rear channel / Glass ran rear channel with Door lock control or Anti theft (European Countries)
9. Glass run
10. Window regulator / Power window regulator
▲ 11. Window glass
12. Inside lever
13. Waterproof sheet
14. Speaker assembly
15. Bracket
16. Outer waste seal
17. Door mirror assembly
18. Tweeter (Required option)
19. Door trim panel
20. Door mirror cover
21. Bezel
22. Power window switch
▲ 23. Switch bezel / Window regulator handle



Important Operations

3. Door Lock Cylinder

- Tighten the door lock cylinder fixing bolts to the specified torque.

Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	

4. **Door Lock Cylinder Protector (EUROPE)**

- Tighten the door lock cylinder protector fixing bolt to the specified torque.

Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	

5. Outside Handle

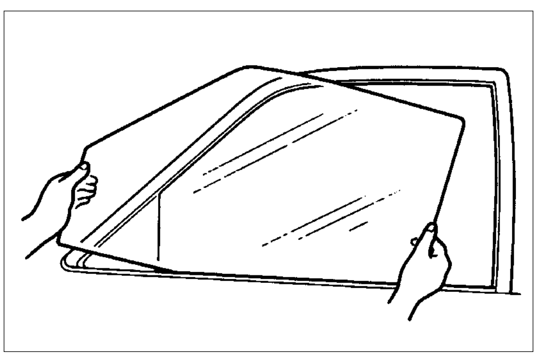
- Tighten the outside handle fixing bolts to the specified torque.

Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	

6. Outside Handle Protector (EUROPE)

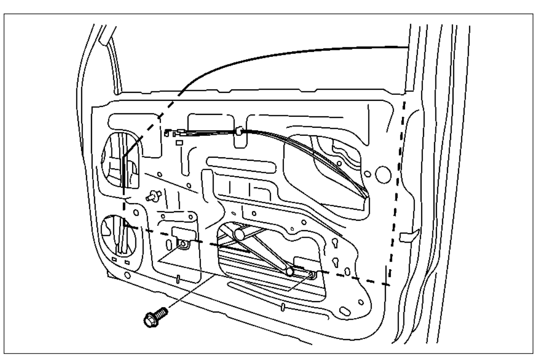
- Tighten the outside handle protector fixing bolt to the specified torque.

Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	

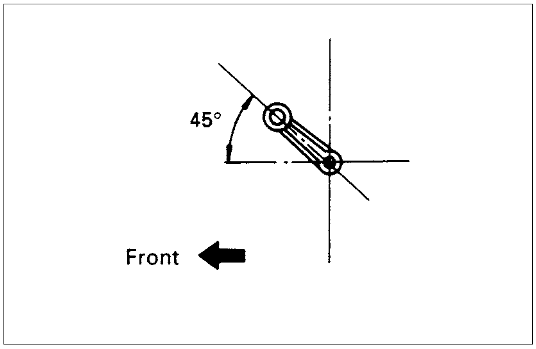


11.Window Glass

- Insert the window glass into position by tilting it as necessary, then set it against the channel of the window regulator.



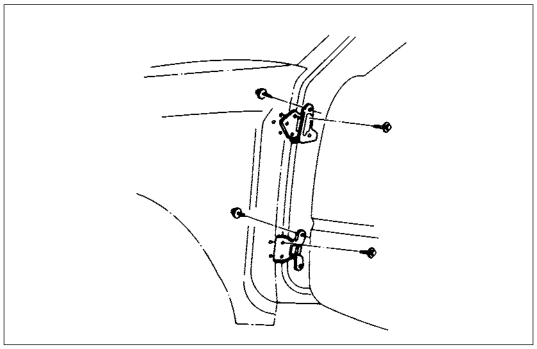
- Attach the window glass to the window regulator with the 2 bolts.



23. Window Regulator Handle

- Install the regulator handle as illustrated when closing the window glass.

ADJUSTMENT (FRONT)



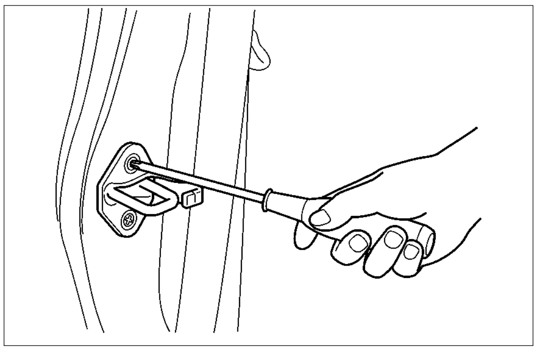
Door Hinge

Door alignment can be obtained by moving the door hinges.

Prior to adjustment, remove the fender and set the door temporarily.

Loosen the hinge to door bolts when adjusting steps between the door and body.

Loosen the hinge to body bolts to adjust the clearance between the door and body.



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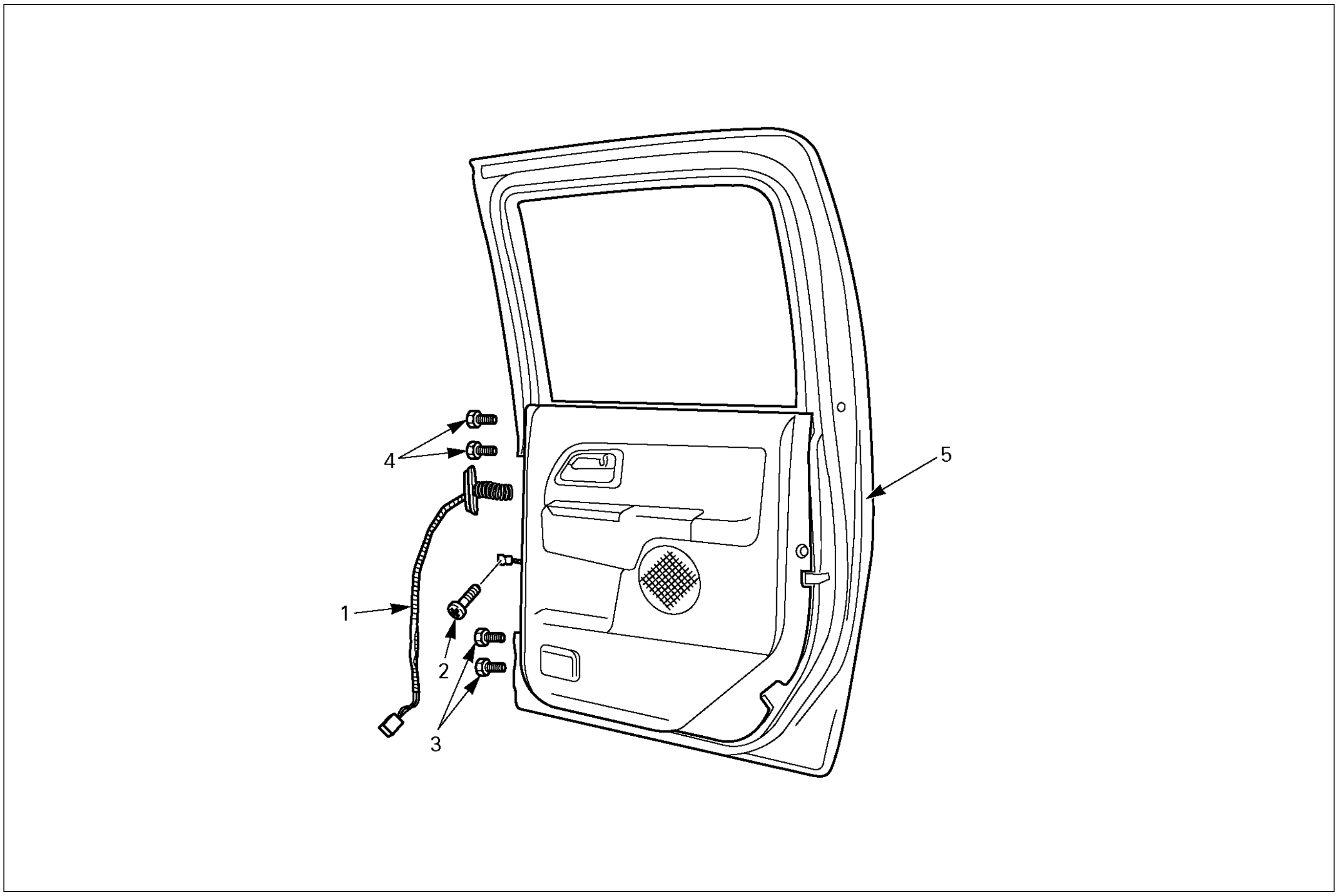
Door Striker

Loosen the striker screws and adjust the position of the striker by holding a piece of wood against the striker and tapping it with a hammer.

To obtain correct adjustment, move the position of the striker vertically so that the lower face of the dovetail becomes parallel to the striker.

REAR DOOR ASSEMBLY (CREW CAB)

REMOVAL AND INSTALLATION

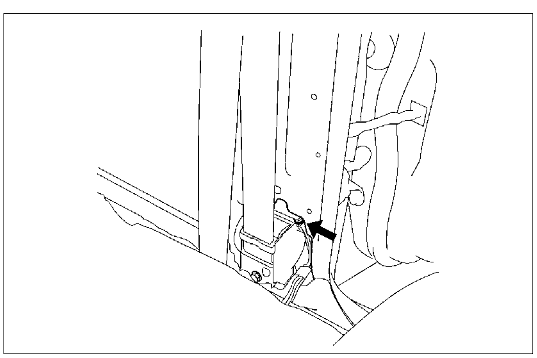


Removal Steps

▲ 1. Door harness
▲ 2. Check arm screw
▲ 3. Lower hinge bolt
4. Upper hinge bolt
5. Door assembly

Installation Steps

5. Door assembly
4. Upper hinge bolt
▲ 3. Lower hinge bolt
▲ 2. Check arm screw
1. Door harness



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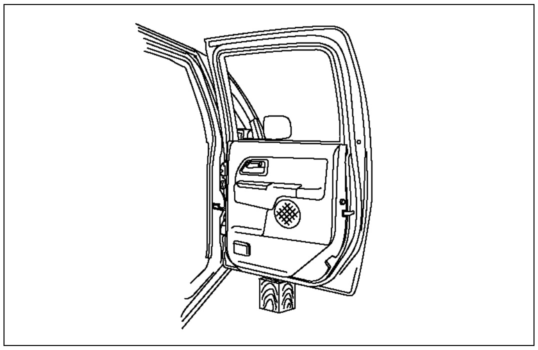
Important Operations - Removal

1. Door Harness

Remove the center pillar lower trim cover and disconnect the door harness connector.

2. Check Arm Screw



3. **Lower Hinge Bolt**
Position a wood block under the door for protection and support the door assembly with hands at removal or installation.

Important Operations – Installation

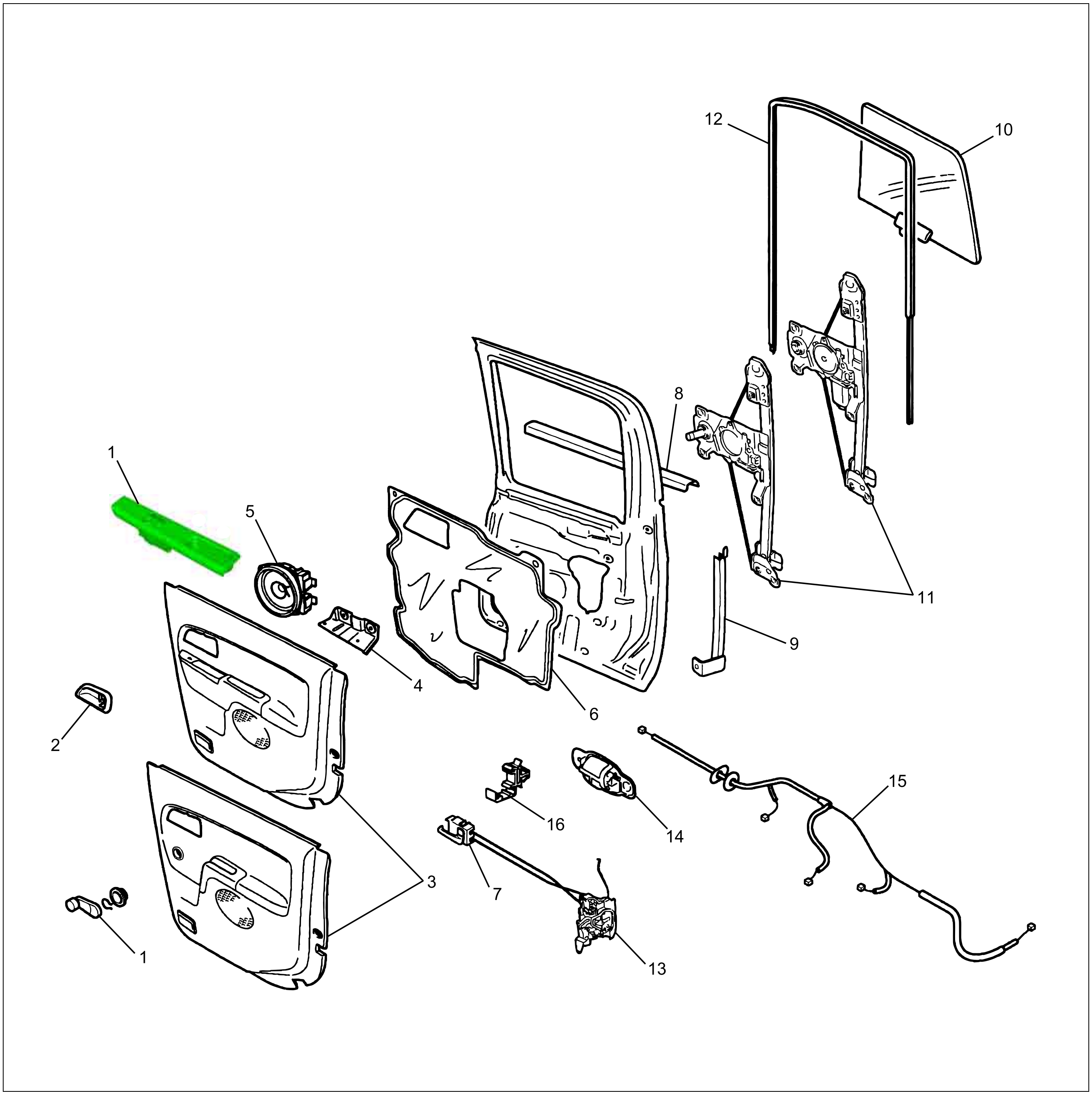
3. Lower Hinge Bolt; Hinge to Door

Torque	N·m (kgf·m/lb·ft)
34 (3.5/25)	

2. Check Arm Screw; Check Arm to Body

Torque	N·m (kgf·m/lb·ft)
24 (2.4/17)	

DISASSEMBLY



Disassembly Steps

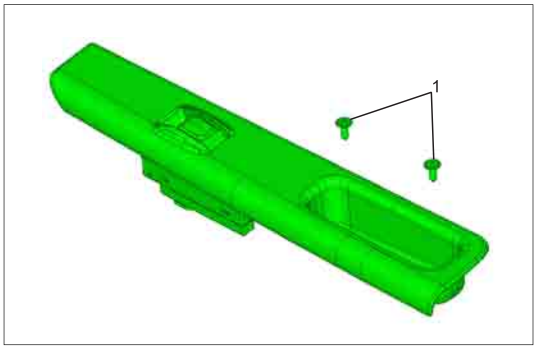
▲ 1. Power window switch/Window regulator handle
▲ 2. Bezel
▲ 3. Door trim panel
▲ 4. Bracket
▲ 5. Speaker assembly
▲ 6. Waterproof sheet
▲ 7. Inside lever
▲ 8. Outer waste seal
▲ 9. Glass run rear channel
▲ 10. Window glass
▲ 11. Window regulator/Power window regulator
▲ 12. Glass run
▲ 13. Door lock assembly
▲ 14. Outside handle
15. Door harness assembly
16. Anti rattler

SECTION 4C2

SHIFT ON THE FLY SYSTEM

TABLE OF CONTENTS

Important Operations



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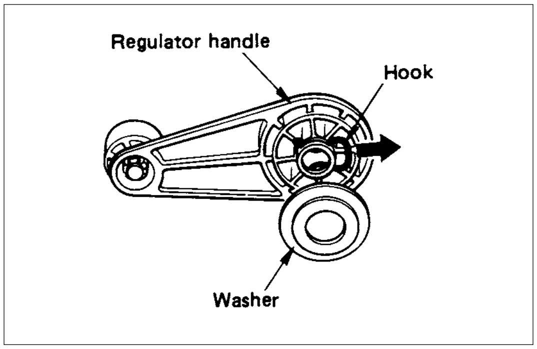
1. Power Window Switch/Window Regulator Handle

- Remove the 2 screws (1) and pry out the power window switch and disconnect the connector.



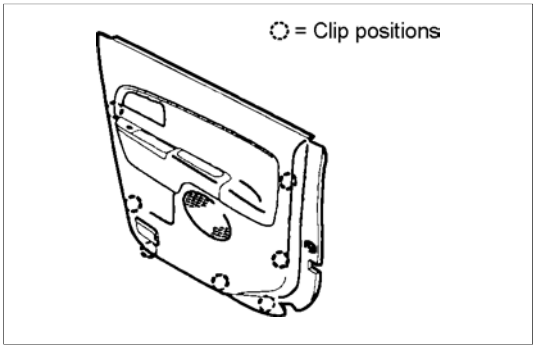
- To remove the regulator handle, remove the clip at the root of the handle using a wire.

2. Bezel

- Remove the screw.

3. Door Trim Panel

- Pull out the trim panel at the 7 clip positions (Power window type).



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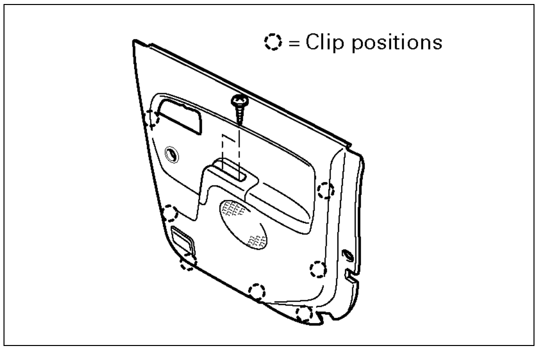
- Remove the 2 screws and pull out the trim panel at the 7 clip positions (Window regulator handle type).



4. Bracket

5. Speaker assembly

- Remove the fixing bolt and then remove the connector.

6. Waterproof Sheet

- Take care not to damage the sheet when peeling it off.

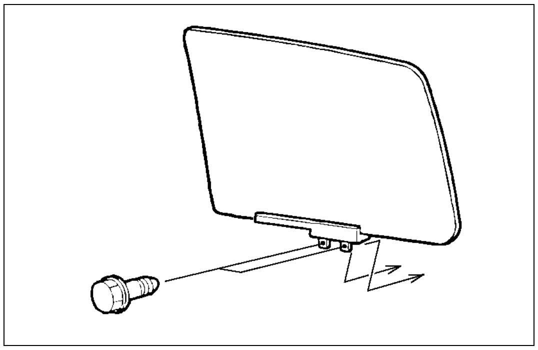
7. Inside Lever

- Disconnect the door lock cables.

8. Outer Waste Seal

9. Glass Run Rear Channel

- Remove the bolt.



10. Window Glass

- Remove 2 bolts through the access hole and pull out the window glass upward.

11. Window Regulator/Power Window Regulator

- Remove the 5 fixing bolts.
- Disconnect the power window motor connector.

12. Glass Run

- Pull it out from the door frame of the channel.

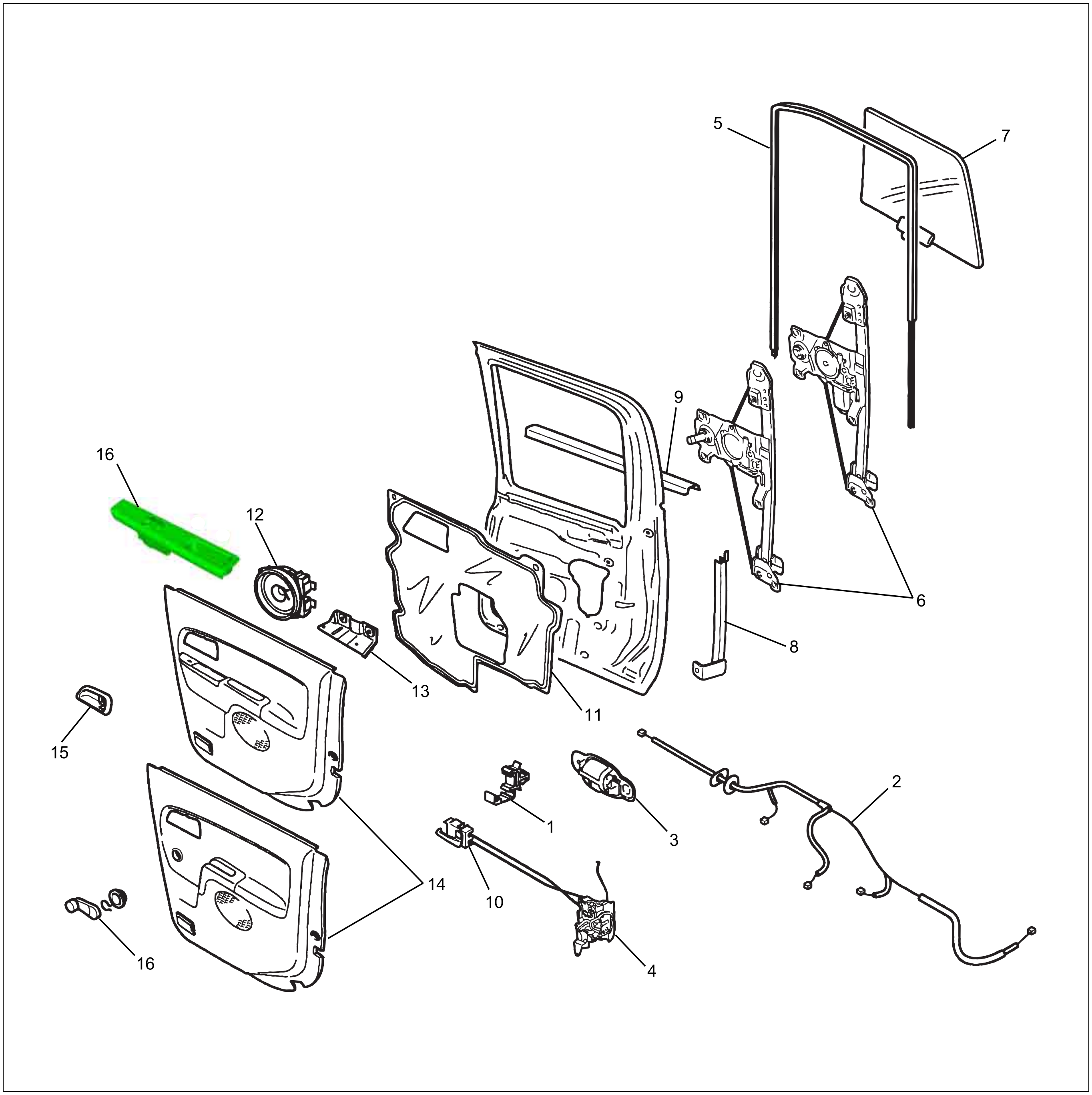
13. Door Lock Assembly

- Disconnect the lock cable from the anti rattler.
- Remove the 3 fixing screws and the bolt.
- Disconnect the linkage and harness connector.

14. Outside Handle

- Remove the 2 fixing bolts.

REASSEMBLY



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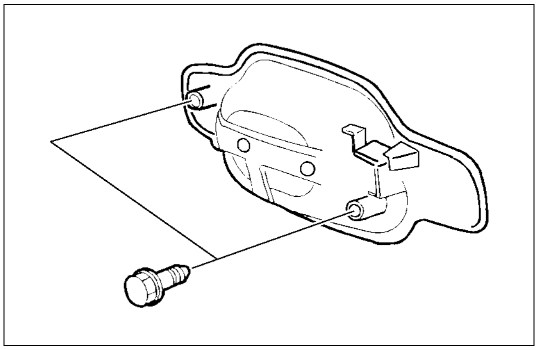
Reassembly Steps

1. Anti rattler
2. Door harness assembly
▲ 3. Outside handle
4. Door lock assembly
5. Glass run
6. Window regulator/Power window regulator
7. Window glass
8. Glass run rear channel
9. Outer waste seal
10. Inside lever
11. Waterproof sheet
12. Speaker assembly
13. Bracket
14. Door trim panel
15. Bezel
▲ 16. Power window switch/Window regulator handle

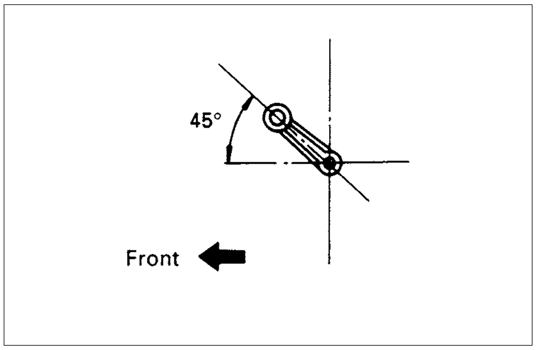


Important Operations

3. Outside Handle

- Tighten the outside handle fixing bolts to the specified torque.

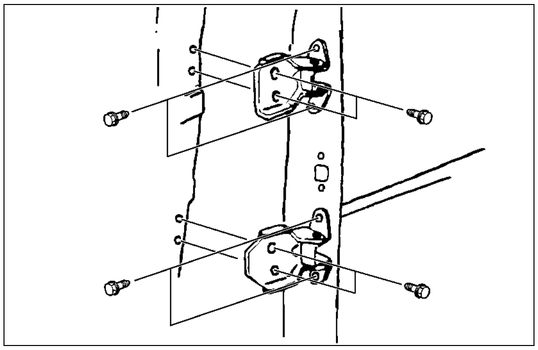
Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	



16. Window Regulator Handle

- Install the regulator handle as illustrated when closing the window glass.

ADJUSTMENT (REAR)



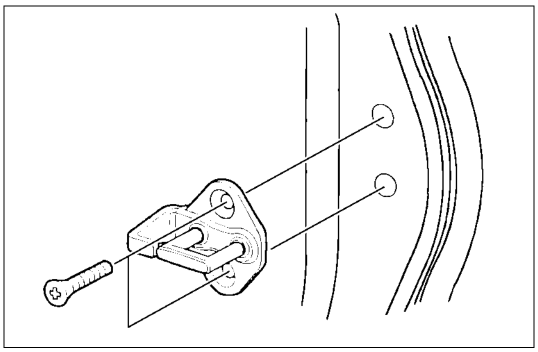
Door Hinge

Door alignment can be obtained by moving door hinges.

Prior to adjustment, set the door temporarily.

Loosen the hinge to door bolts when adjusting steps between the door and body.

Loosen the hinge to body bolts to adjust the clearance between the door and body.



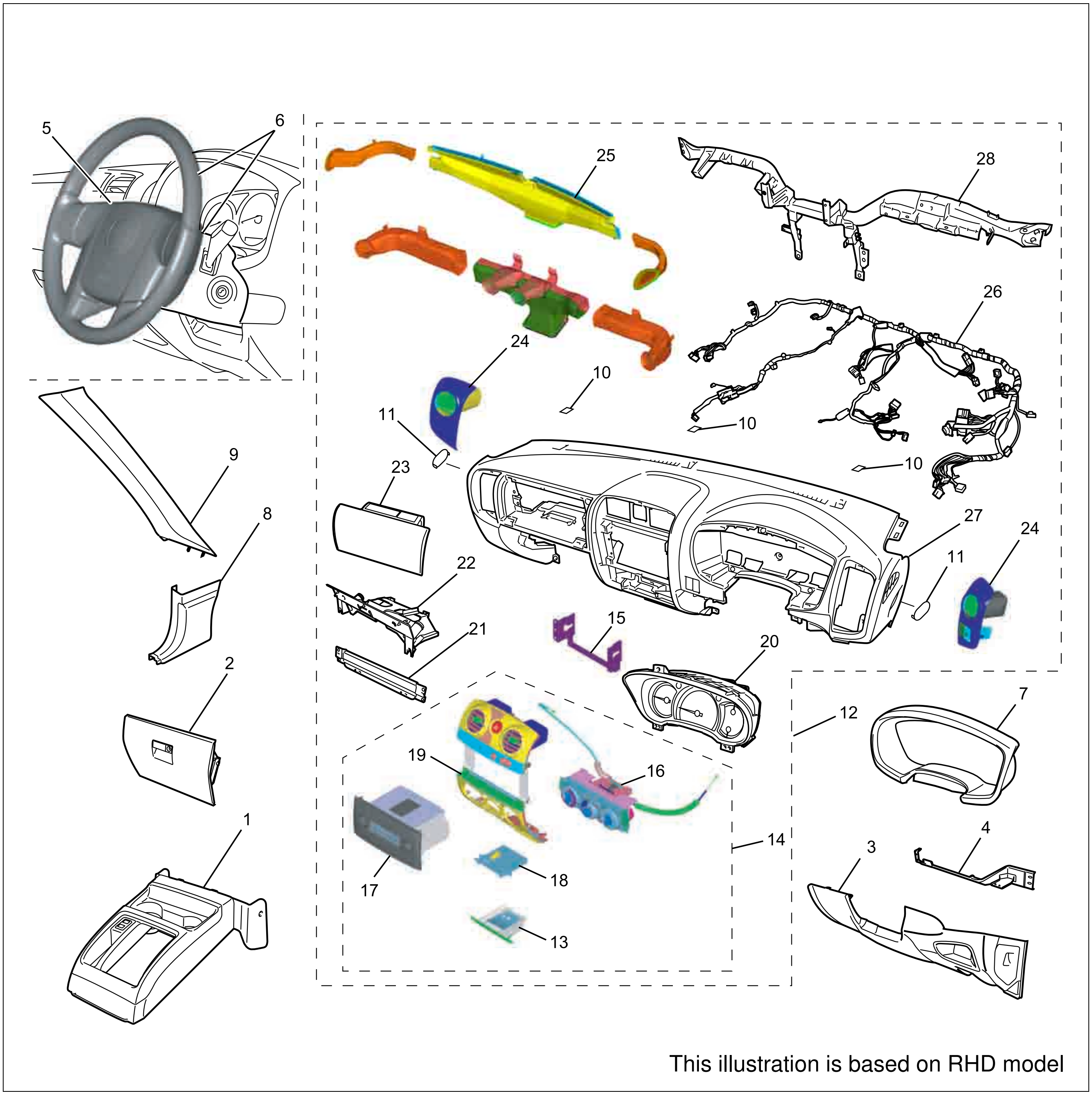
Door Striker

Loosen the striker screws and adjust the position of the striker by holding a piece of wood against the striker and tapping it with a hammer.

To obtain correct adjustment, move the position of the striker vertically so that the lower face of the dovetail becomes parallel to the striker.

INSTRUMENT PANEL

REMOVAL



RTW7A0LF001301

Disassembly Steps

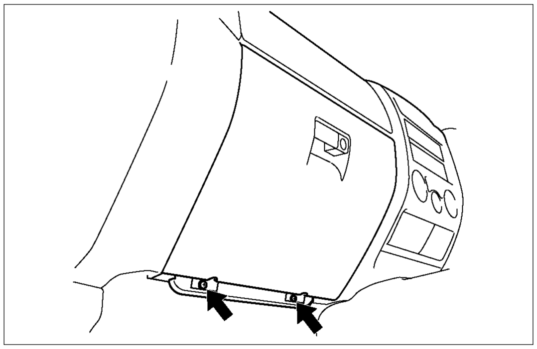
- ▲ 1. Front console assembly
- ▲ 2. Glove box
- ▲ 3. Instrument panel driver lower cover assembly
- ▲ 4. Driver knee bolster assembly
- ▲ 5. Driver air bag
- ▲ 6. Steering wheel/ steering cowl
- 8. Dash side trim cover
- 9. Front pillar trim cover
- 10. Front cover
- 11. Side cover
- ▲ 12. Instrument panel assembly & Cross beam
- ▲ 13. Ashtray case

▲ 7. Meter cluster assembly
15. Audio bracket
▲ 16. Control lever assembly
17. Audio assembly
▲ 18. Ashtray bracket
19. Center cluster
20. Meter assembly
21. Passenger lower bracket
22. Glove box cover
▲ 14. Center cluster assembly
▲ 23. Passenger air bag (if so equipped)
▲ 24. Side ventilation grille
▲ 25. Vent duct assembly/Defroster nozzle assembly
26. Instrument harness assembly
▲ 27. Instrument panel assembly
28. Cross beam

Important Operations

1. Front Console Assembly

- Refer to Floor Consol in this section.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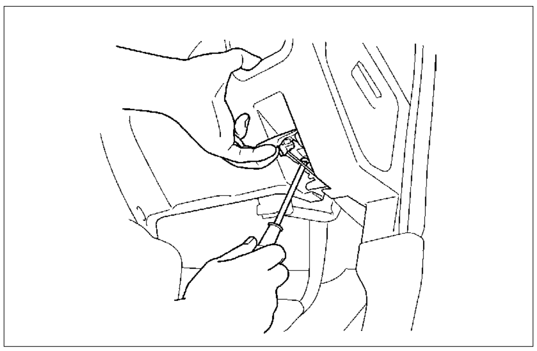
2. Glove Box

- Remove 2 fixing screws and pull on the handle.


RTW6A0SH000201

3. Instrument Panel Driver Lower Cover Assembly

1) Remove the engine hood opener 2 fixing screws.
2) Remove the lower cover one fixing screw.
3) Pull out the cover (Stick type parking brake only).
4) Pull out the lower cover assembly.

4. Driver Knee Bolster Assembly

- Remove 4 fixing bolts.

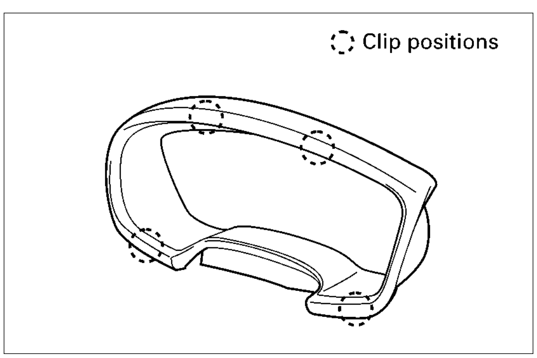
Caution:

For precautions on installation or removal of the SRS-air bag system, refer to section 9 “Supplemental Restraint System (SRS) - AIR BAG”

5. Driver Air Bag

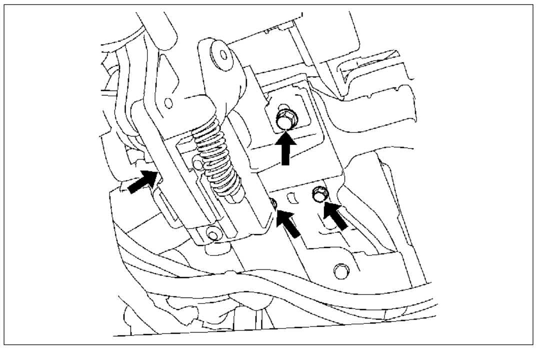
6. Steering Wheel/Steering Cowl

- Refer to Section 3B “STEERING COLUMN” for steering lock assembly removal steps.



7. Meter Cluster Assembly

- Pull out the 4 clip positions.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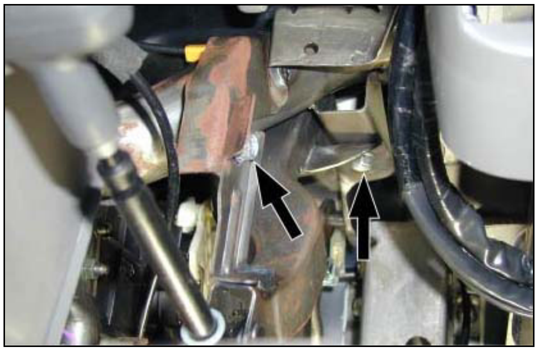
12.Instrument Panel Assembly & Cross Beam

1) Remove the two bolts fixing the steering column to the cross beam and the two bolts fixing the brake pedal bracket to the cross beam.

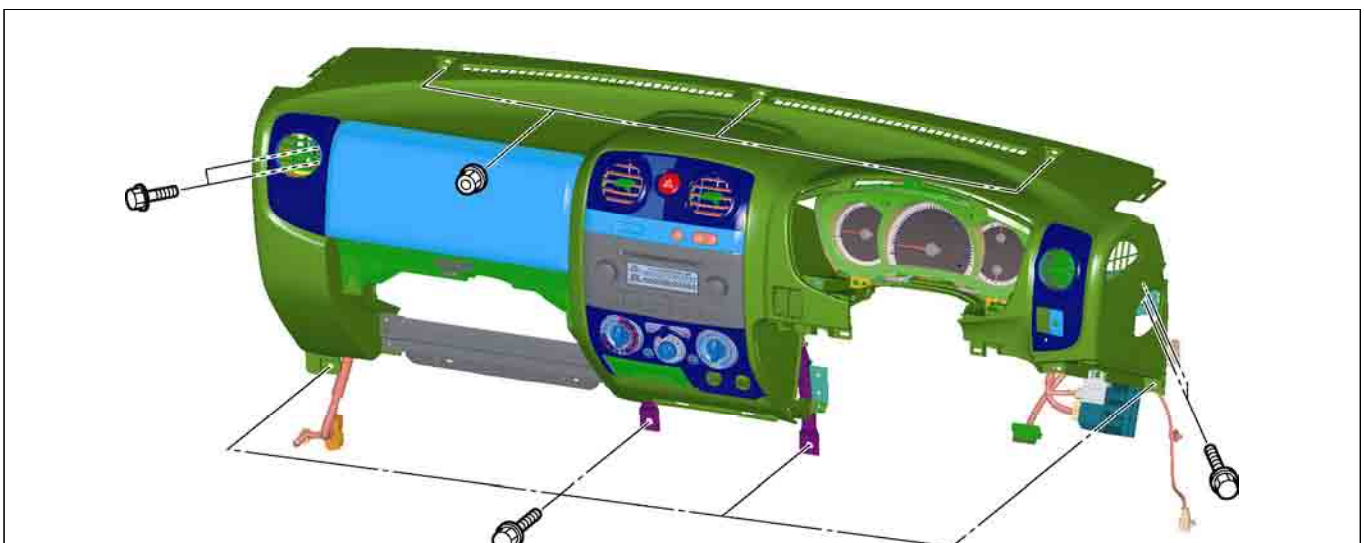


2) Remove the two bolts fixing the parking brake bracket to the cross beam (Stick type parking brake only).

3) Disconnect the control cables at the blower unit and vent unit.

4) Remove the fasteners fixing the instrument panel and cross beam assembly and the body panel.

5) Disconnect the instrument harness connectors.


This illustration is based on RHD model

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RTW7A0SH000301

13.Ashtray Case

- Pull out the ashtray case.

14.Center Cluster Assembly

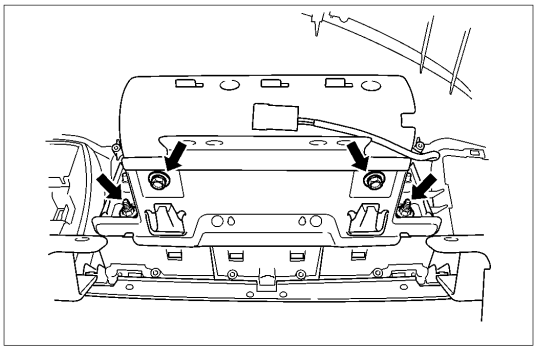
1) Pull out the cluster at the 8 clip positions.
2) Disconnect the cigarette lighter, accessory socket, hazard switch, clock and 4WD switch connectors.

16.Control Lever Assembly

- Remove the 2 fixing screws.

18.Ashtray Bracket

- Remove the 3 fixing screws and illumination connector.



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Caution:

For precautions on installation or removal of the SRS-air bag system, refer to section 9 "Supplemental Restraint System (SRS) - AIR BAG".

23.Passenger Air Bag

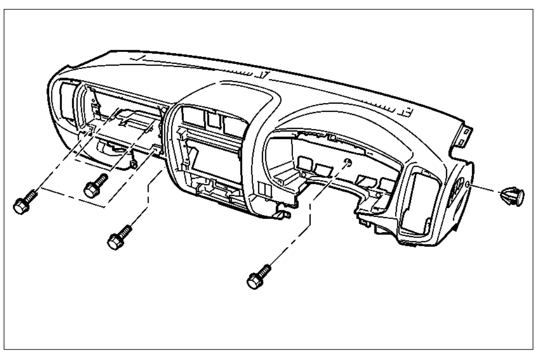
- Remove 2 fixing bolts, 2 fixing nuts and connector.

24.Side Ventilation Grille.

- Pull out the grilles and disconnect the switch connector (Driver’s side).

25.Vent Duct Assembly/Defroster Nozzle Assembly

- Refer to section 1 “HVAC” for the defroster nozzle and ventilation duct removal steps.



27.Instrument Panel Assembly

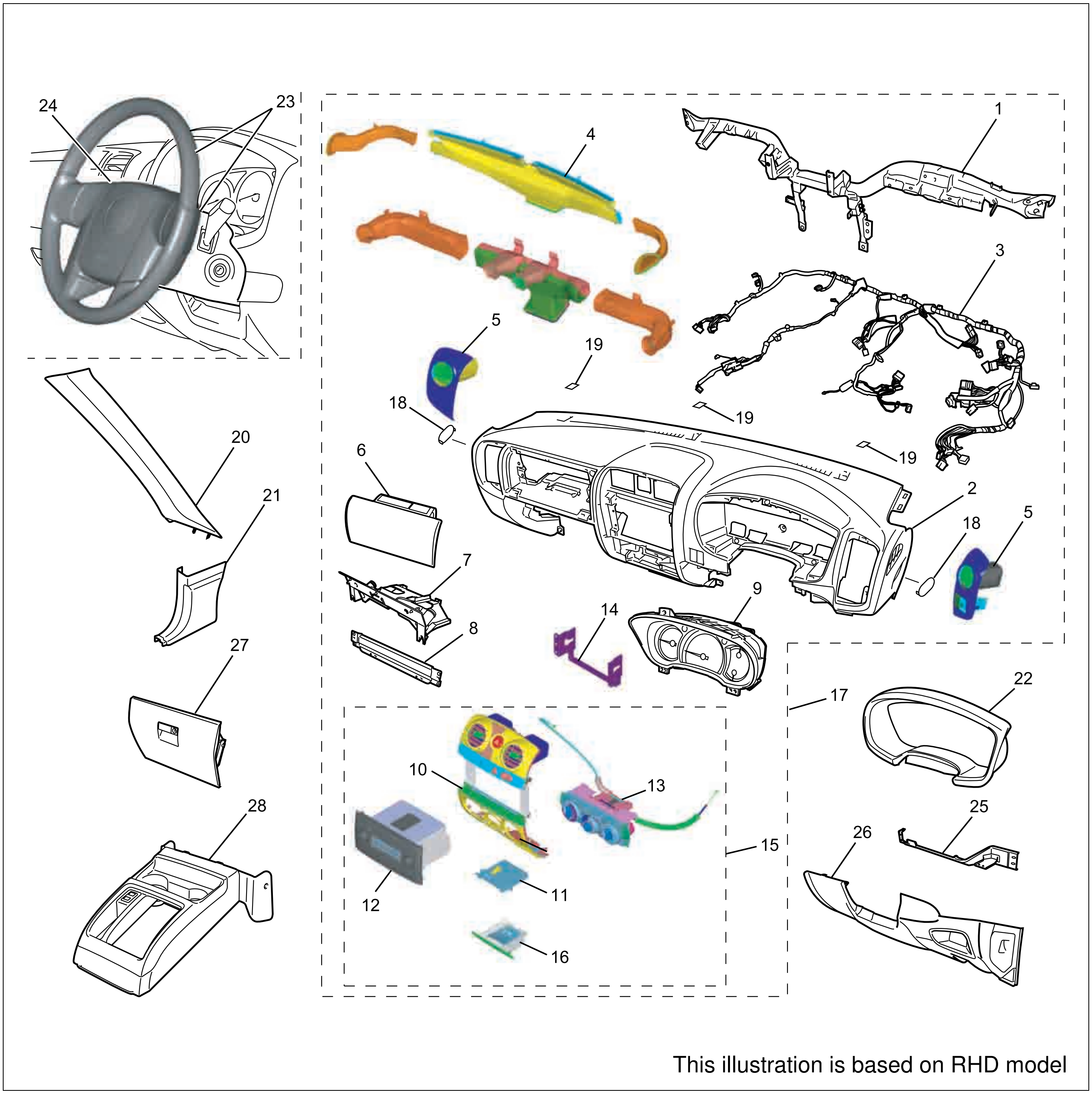
- Remove the clip and 6 fixing bolts.

SERVICE PRECAUTION

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

INSTALLATION



RTW7A0LF001401

Installation Steps

1. Cross beam
2. Instrument panel assembly
3. Instrument harness assembly
4. Vent duct assembly/Defroster nozzle assembly
5. Side ventilation grille
6. Passenger air bag
7. Glove box cover
8. Passenger lower bracket
9. Meter assembly
10. Center cluster
11. Ashtray bracket
12. Audio assembly
13. Control lever assembly
14. Audio bracket
15. Center cluster assembly
16. Ashtray case
17. ▲ Instrument panel assembly & Cross beam
18. Side cover

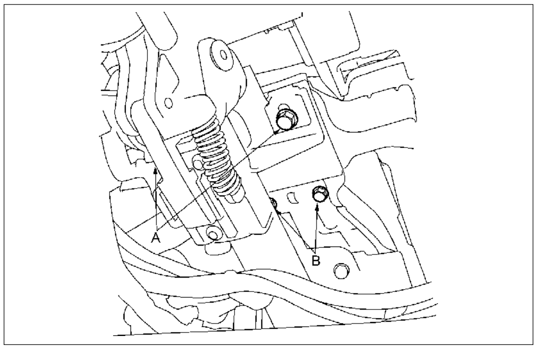
19. Front cover
20. Front pillar trim cover
21. Dash side trim cover
22. Meter cluster assembly
▲ 23. Steering wheel/Steering cowl
24. Driver air bag
25. Driver knee bolster assembly
26. Instrument panel driver lower cover assembly
27. Glove box
28. Front console assembly

Important Operations

17.Instrument Panel Assembly & Cross Beam

1) Tighten the 4 bolts fixing the cross beam and body panel to the specified torque.

Torque	N·m (kgf·m/lb·ft)
19 (1.9/14)	



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2) A Bolt: Steering Column to Cross Beam

Torque	N·m (kgf·m/lb·ft)
20 (2.0/14)	

B Bolt: Pedal Bracket to Cross Beam

Torque	N·m (kgf·m/lb·ft)
15 (1.5/11)	

3) C Bolt: Parking Brake Bracket to Cross Beam

Torque	N·m (kgf·m/lb·ft)
15 (1.5/11)	

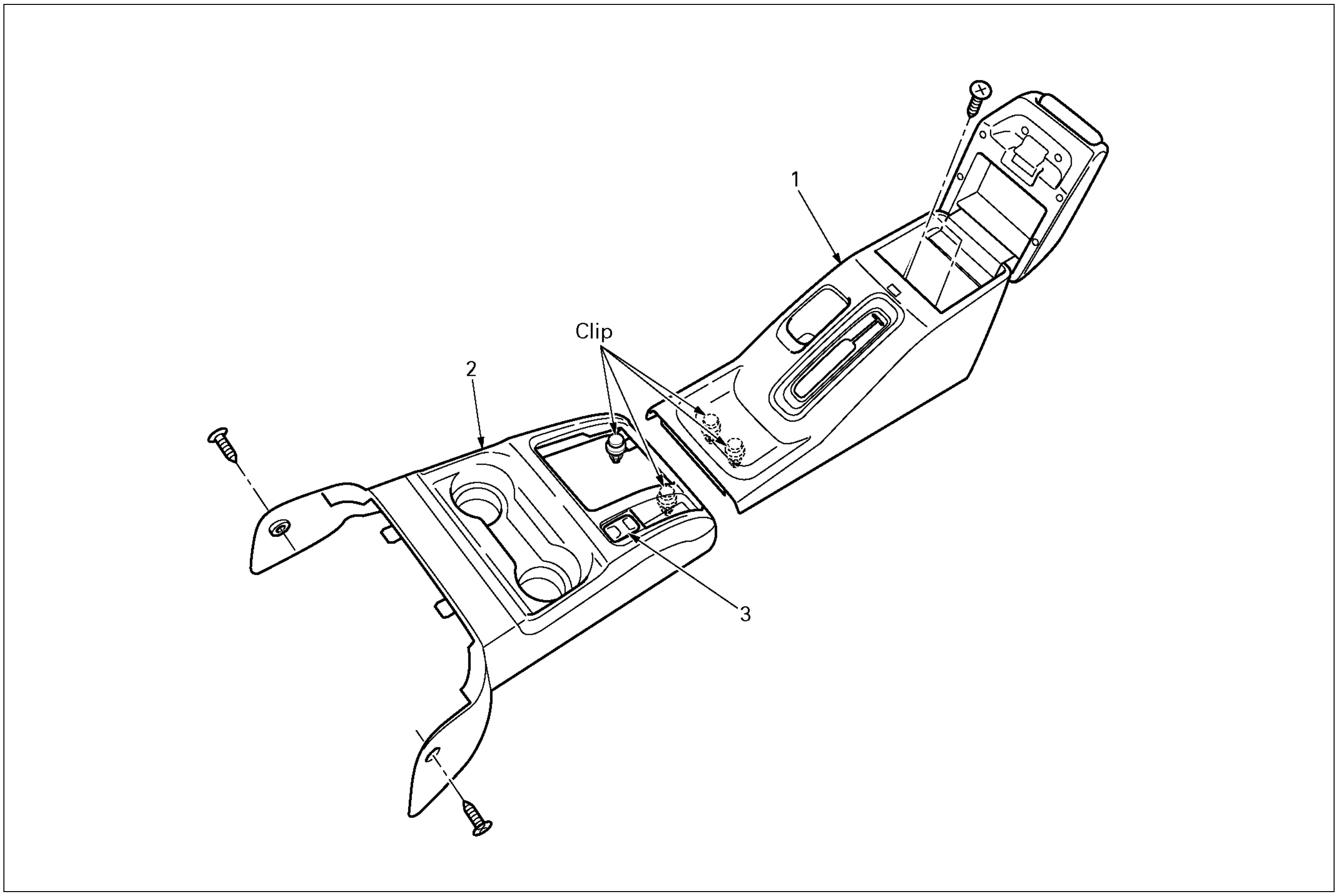
23.Steering Wheel/Steering Cowl

- Tighten the steering wheel fixing nut to the specified torque.

Torque	N·m (kgf·m/lb·ft)
34 (3.5/25)	

FLOOR CONSOLE

REMOVAL AND INSTALLATION



A/T Model

Removal Steps

▲ 1. Rear floor console (Bucket seat model only)
▲ 2. Front floor console
3. 3rd start switch

Installation Steps

3. 3rd start switch
2. Front floor console
1. Rear floor console (Bucket seat model only)

Important Operations - Removal

1. Rear Floor Console (Bucket Seat Model Only)

1) Open the rear console lid and remove 2 screws.

2) Pull out the front part of the rear console at the 2 clip positions.

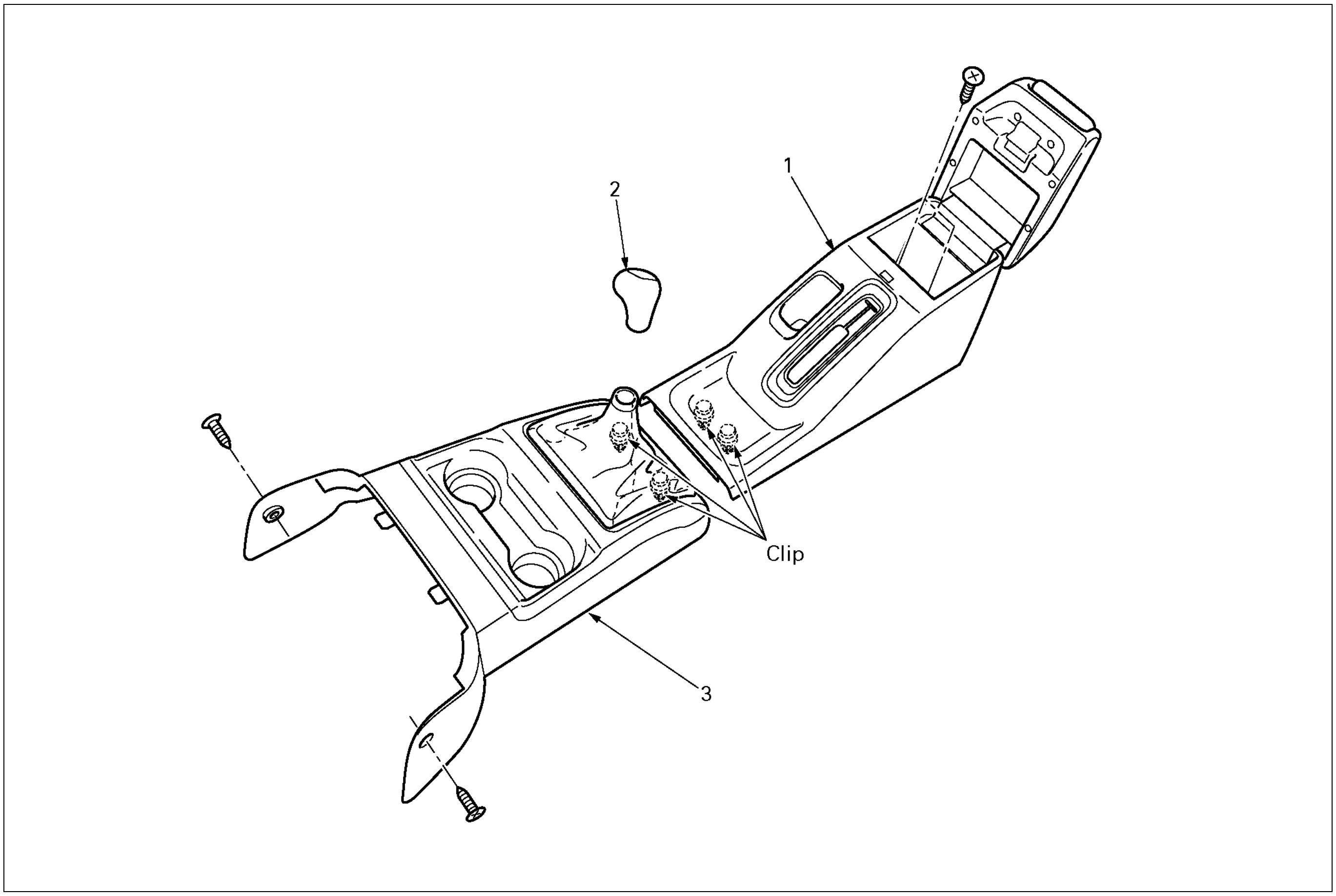
2. Front Floor Console

1) Remove the 2 screws.

2) Pull out the rear part of the front console at the 2 clip positions and disconnect the switch connecter.

3) Remove the front console by pull it out rear-ward.

REMOVAL AND INSTALLATION



M/T Model

Removal Steps

▲ 1. Rear floor console (Bucket seat model only)
2. Shift knob
▲ 3. Front floor console

Installation Steps

3. Front floor console
2. Shift knob
1. Rear floor console (Bucket seat model only)

Important Operations - Removal

1. Rear Floor Console (Bucket Seat Model Only)

1) Open the rear console lid and remove 2 screws.

2) Pull out the front part of the rear console at the 2 clip positions.

3. Front Floor Console

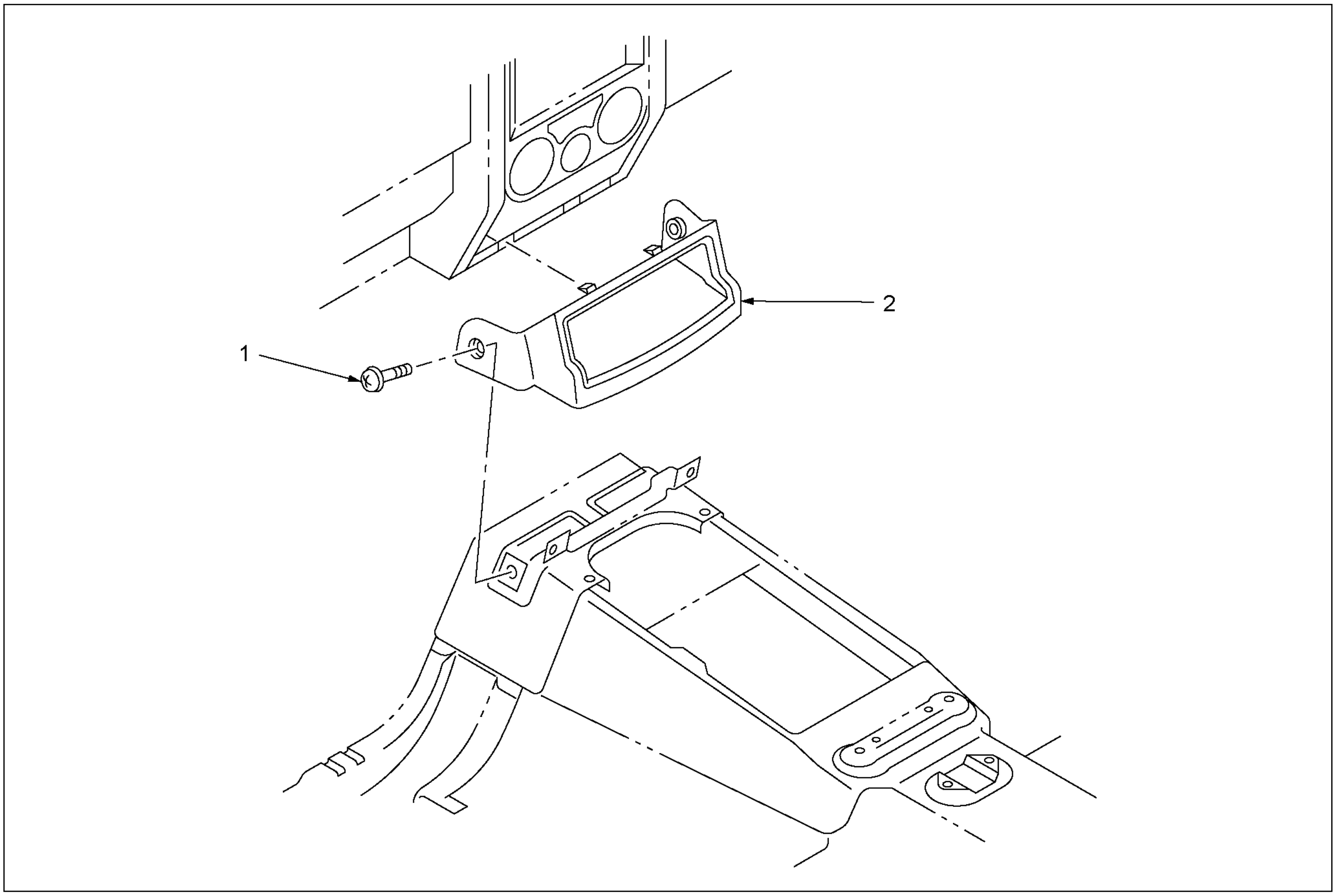
1) Remove the 2 screws.

2) Pull out the rear part of the front console at the 2 clip positions.

3) Remove the front console by pulling it out rear ward.

CONSOLE BOX (WITHOUT FLOOR CONSOLE)

REMOVAL AND INSTALLATION



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M/T Model

Removal Steps

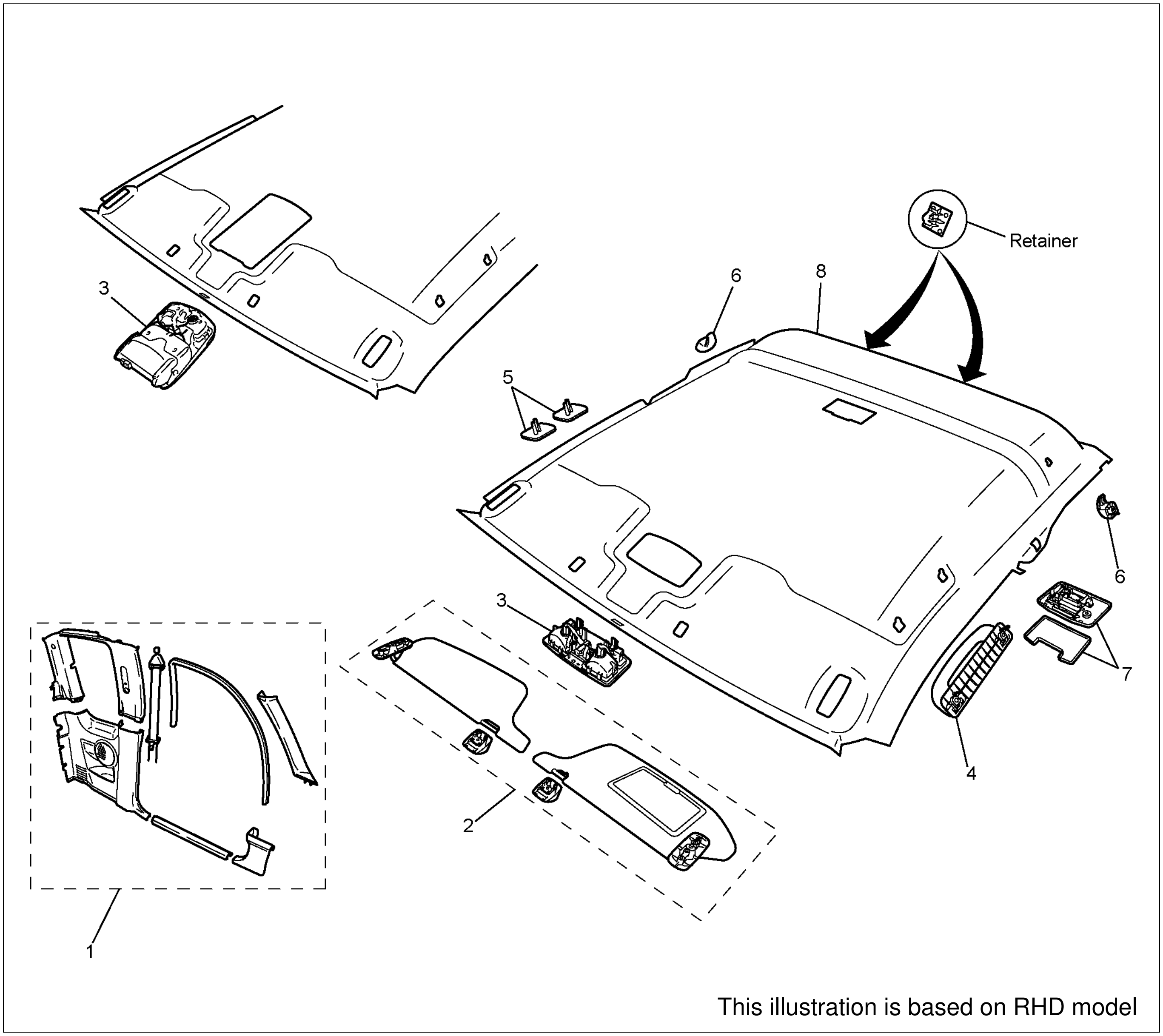
1. Screw
2. Console box

Installation Steps

2. Console box
1. Screw

HEADLINING

REMOVAL AND INSTALLATION



RTW6A0LF000101

Extend Cab Model

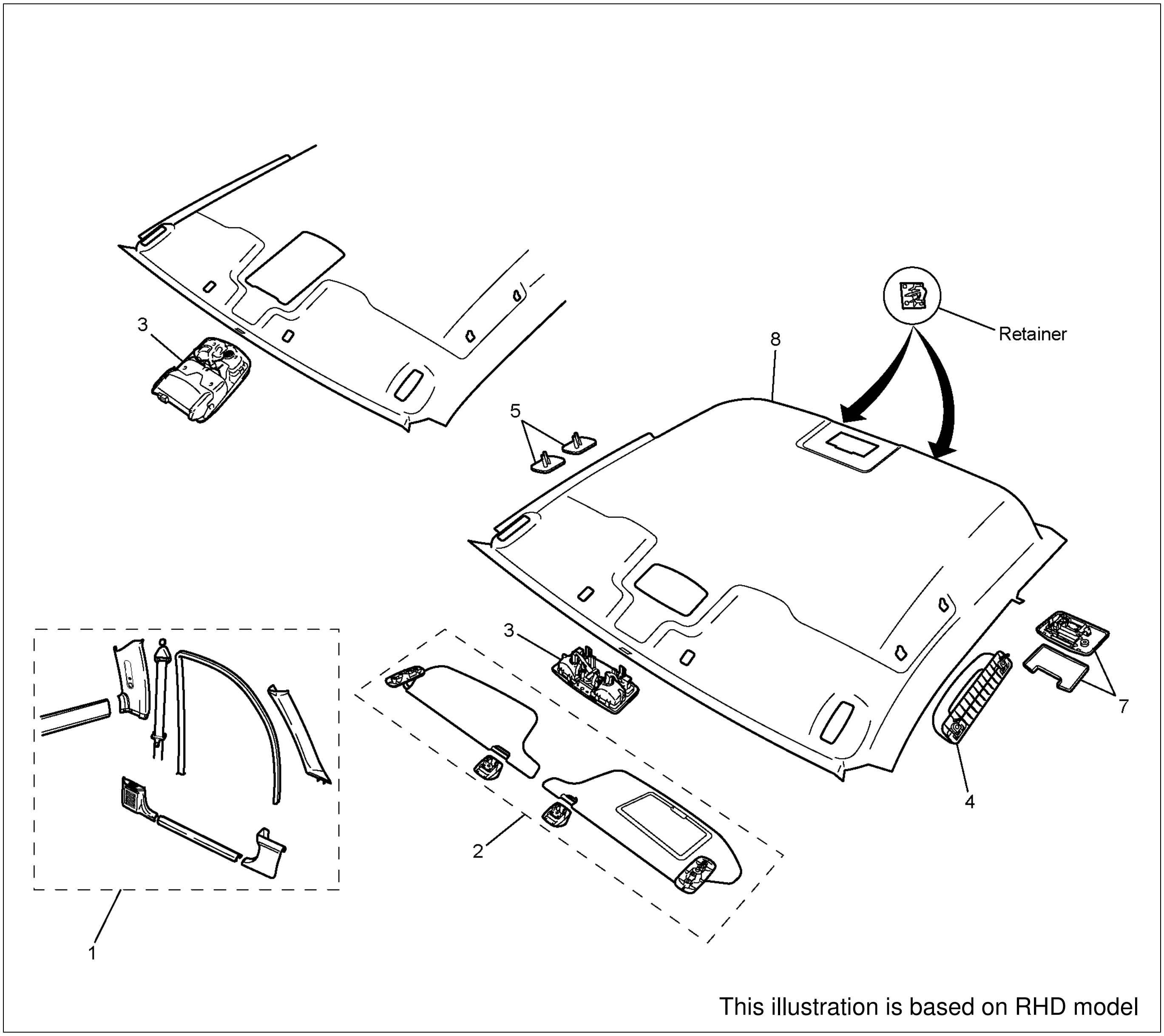
Removal Steps

▲ 1. Interior trim panels
▲ 2. Sun visor/Sun visor holder
▲ 3. Spot light/Over head console
▲ 4. Assist grip
5. Hole cover
▲ 6. Coat hook
▲ 7. Dome light
▲ 8. Headlining

Installation Steps

8. Headlining
7. Dome light
6. Coat hook
5. Hole cover
4. Assist grip
3. Spot light/Over head console
2. Sun visor/Sun visor holder
1. Interior trim panels

REMOVAL AND INSTALLATION



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Regular Cab Model

Removal Steps

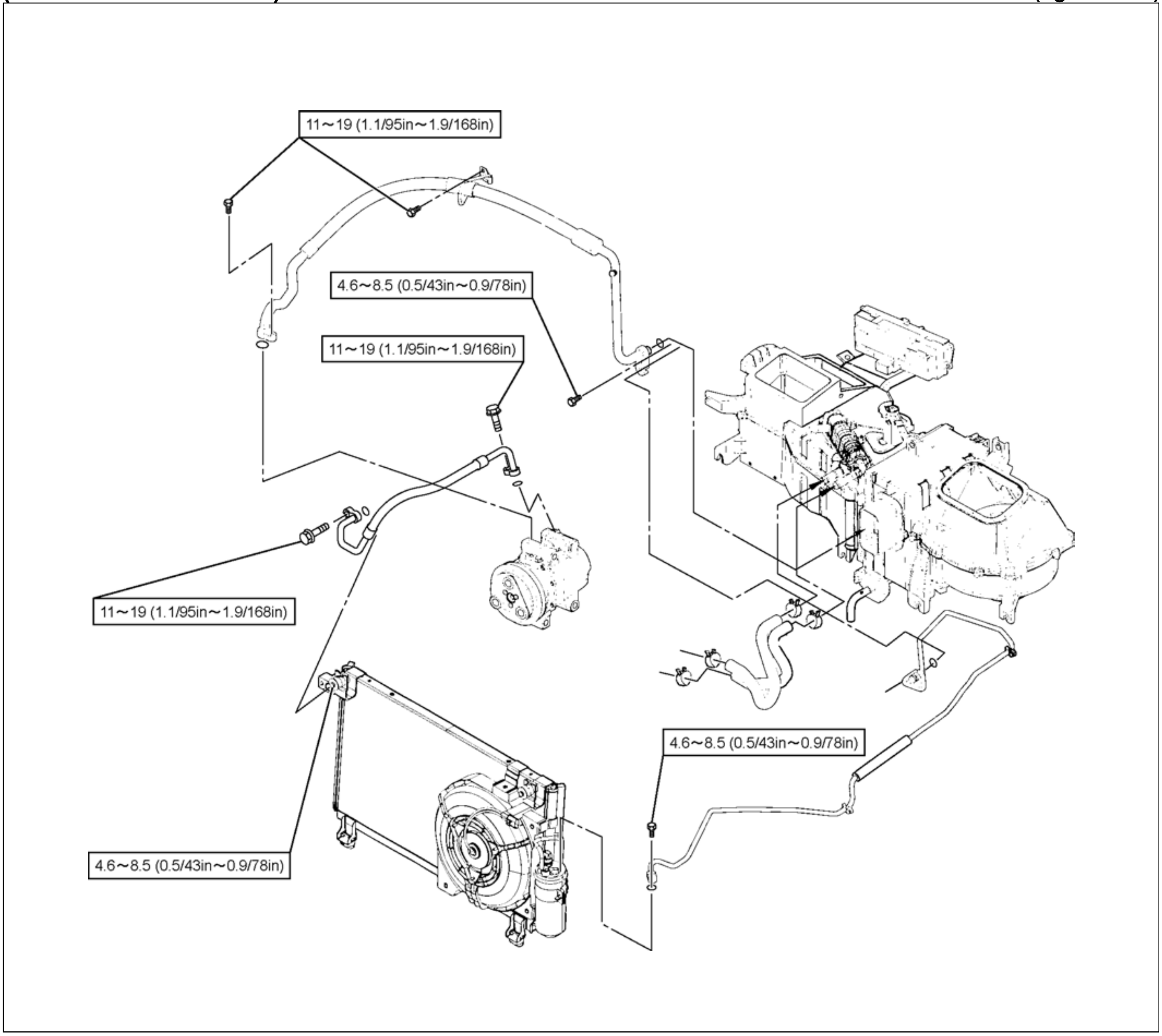
- ▲ 1. Interior trim panels
- ▲ 2. Sun visor/Sun visor holder
- ▲ 3. Spot light/Over head console
- ▲ 4. Assist grip
- 5. Hole cover
- ▲ 7. Dome light
- ▲ 8. Headlining

Installation Steps

8. Headlining
7. Dome light
5. Hole cover
4. Assist grip
3. Spot light/Over head console
2. Sun visor/Sun visor holder
1. Interior trim panels

(4JA1-T RHD MODEL)

N·m (kgf·m/lb·in)



RTW710LF003301

SHIFT ON THE FLY SYSTEM

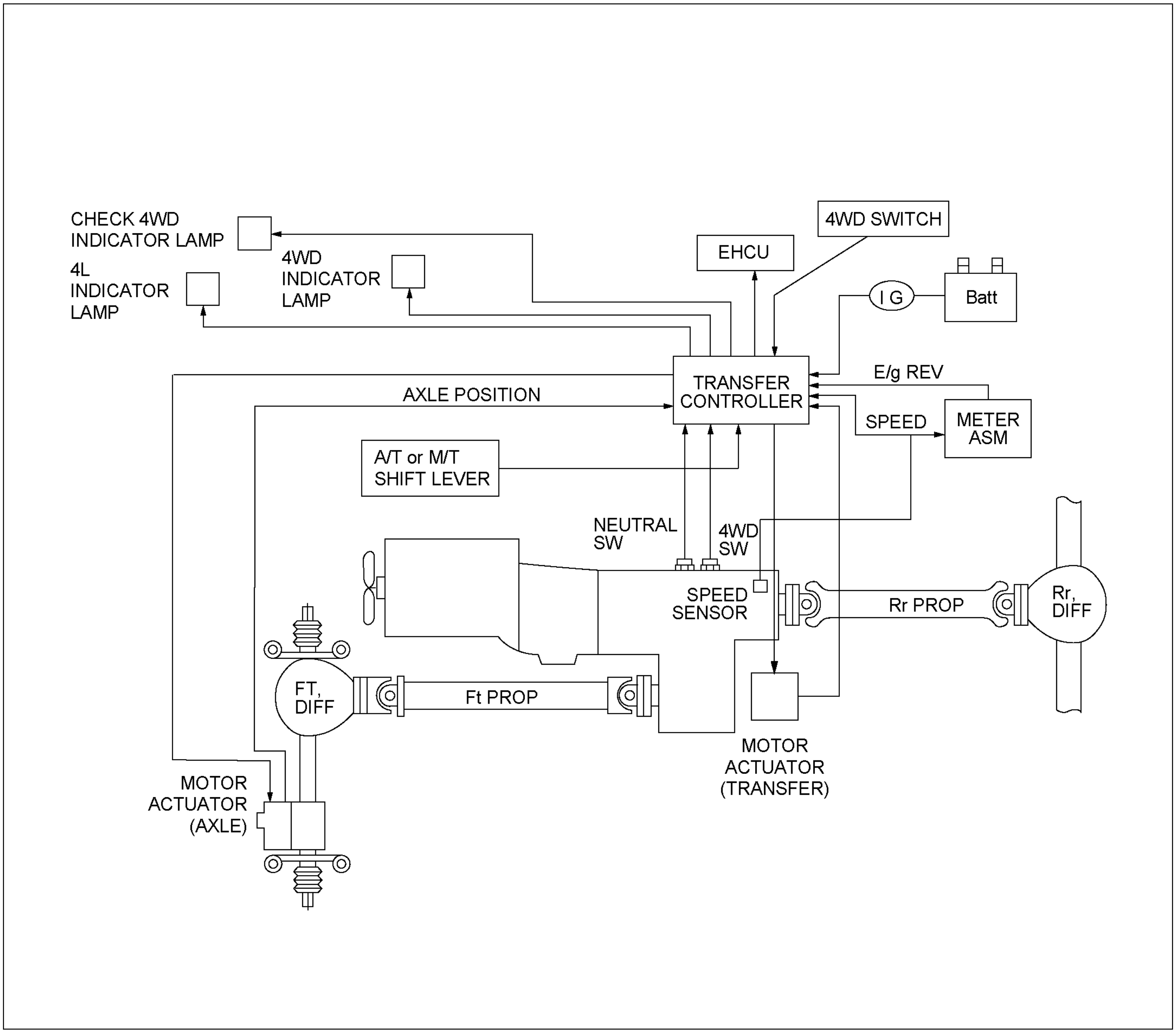
Outline of Shift on The Fly System

The shift on the fly system switches between 2 wheel drive (2WD) and 4 wheel drive (4WD) electrically by driver's pressing the 4WD switch (push button type) on instrument panel.

This system controls below operations.

1. Shifting the transfer front output gear (Connecting to, and disconnecting from, front propeller shaft by motor actuator).
2. Retrial of shifting the transfer front output gear.
3. Connecting front wheels to, and disconnecting them from, the front axles by axle motor actuator.
4. Indicator on instrument panel.
5. 4WD out signal to other Electronic Hydraulic Control Unit.

System Diagrams



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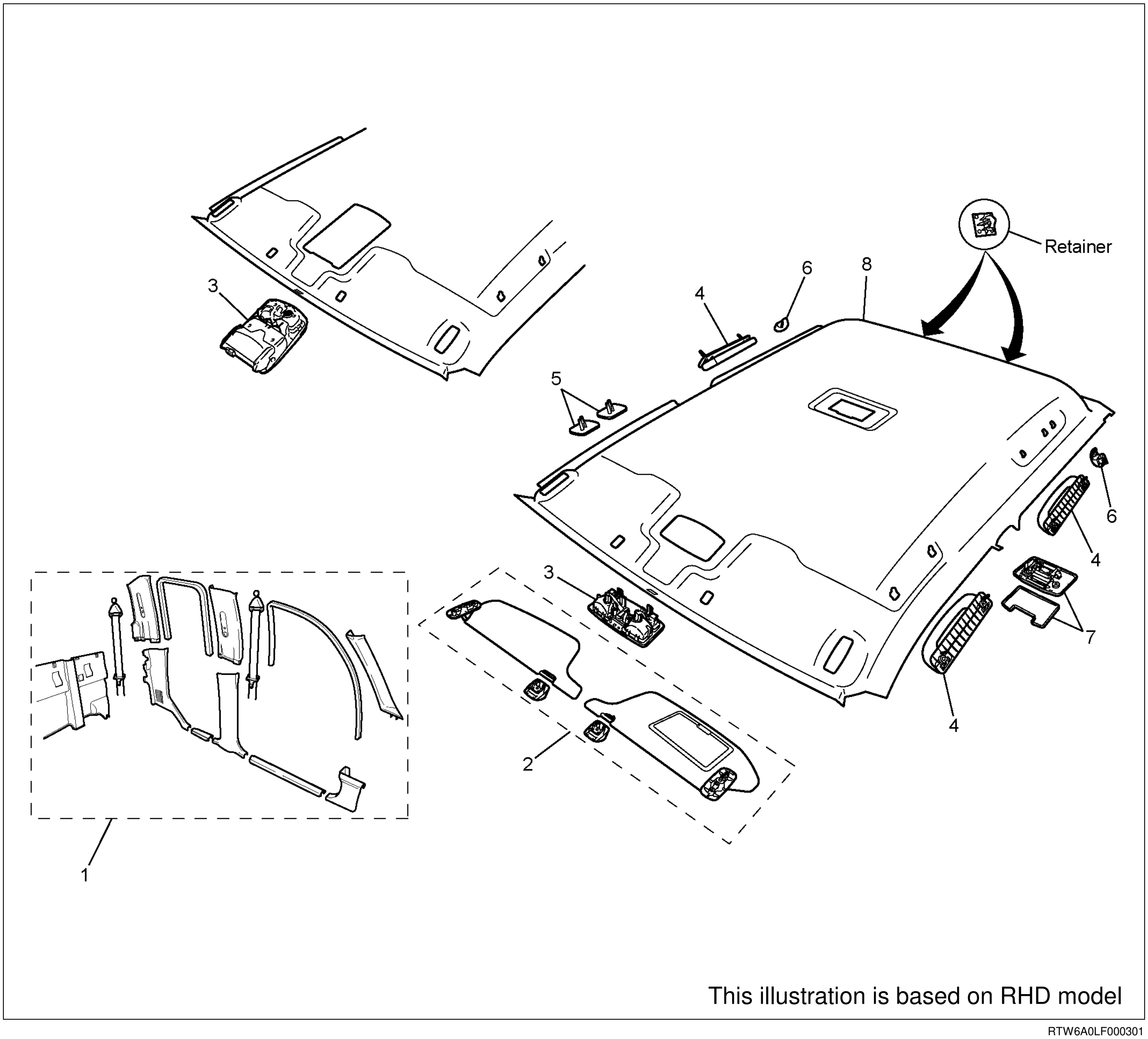
REMOVAL AND INSTALLATION



Crew Cab Model

Removal Steps

▲ 1. Interior trim panels
▲ 2. Sun visor/Sun visor holder
▲ 3. Spot light/Over head console
▲ 4. Assist grip
5. Hole cover
▲ 6. Coat hook
▲ 7. Dome light
▲ 8. Headlining

Installation Steps

8. Headlining
7. Dome light
6. Coat hook
5. Hole cover
4. Assist grip
3. Spot light/Over head console
2. Sun visor/Sun visor holder
1. Interior trim panels

Important Operations - Removal

1. Interior Trim Panels

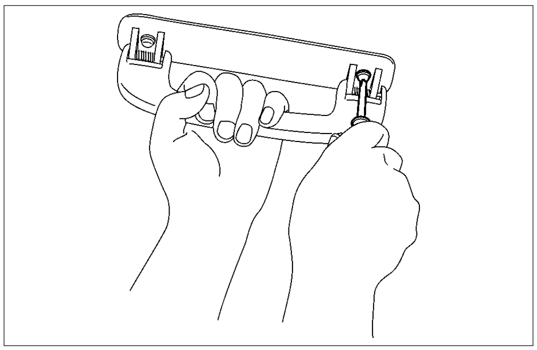
- Refer to Interior Trim Panels in this section.

2. Sun visor/Sun visor Holder

1) Remove the 2 screws fixing the sun visor.
2) Remove the screw fixing the sun visor holder.

3. Spot Light/Over Head Console

- Refer to section 8 Spot Light.
- Refer to section 8 Over Head Console.



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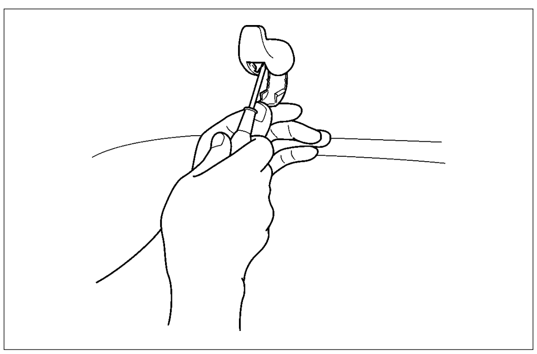
4. Assist Grip

- Remove the 2 fixing screws.



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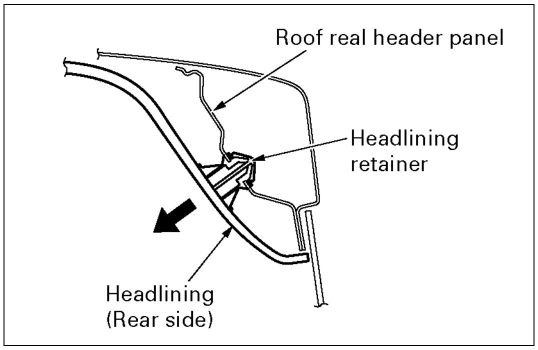
6. Coat Hook

- Open the cover and remove the fixing screw.

7. Dome Light

- Refer to Section 8 Dome Light.



8. Headlining

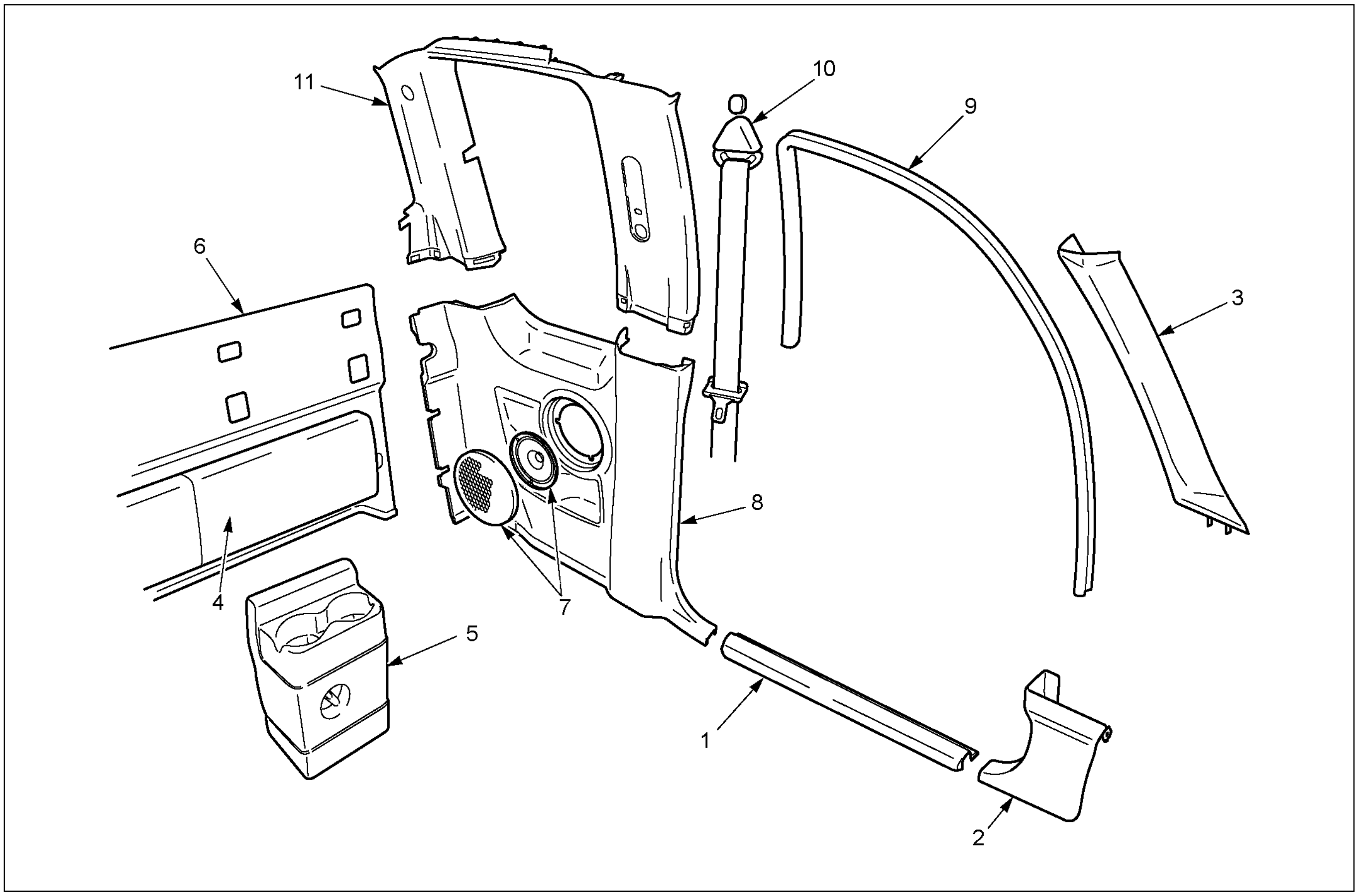
- Pull out the headlining with the retainer from the roof rear header panel in the direction shown in the illustration.

Note :

Removal steps (2-7) can be removed from the headlining in any order.

INTERIOR TRIM PANELS

REMOVAL AND INSTALLATION



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Extend Cab Model

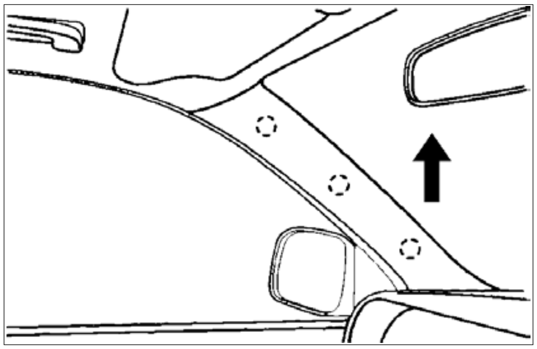
Removal Steps

1. Sill plate
2. Dash side trim cover
3. ▲ Front pillar trim cover
4. ▲ Rear upper cushion
5. Jack cover
6. ▲ Rear end trim cover
7. ▲ Rear speaker grille/Rear speaker
8. ▲ Body side rear lower trim cover
9. Door finisher
10. ▲ Tongue side seat belt
11. ▲ Body side rear upper trim cover

Installation Steps

11. Body side rear upper trim cover
10. ▲ Tongue side seat belt
9. Door finisher
8. Body side rear lower trim cover
7. Rear speaker grille/Rear speaker
6. ▲ Rear end trim cover
5. Jack cover
4. Rear upper cushion
3. Front pillar trim assembly
2. Dash side trim cover
1. Sill plate

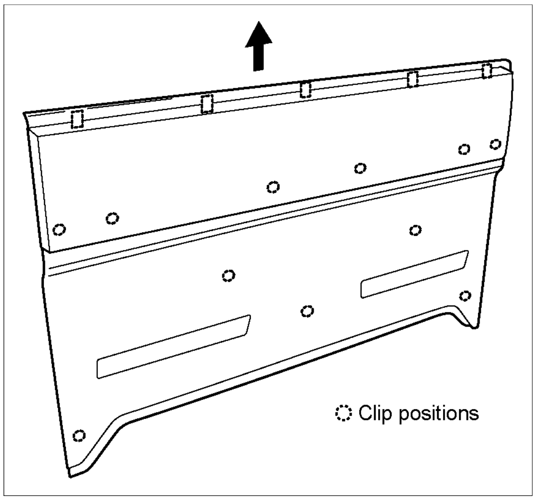
Important Operations - Removal


RTW710SH000501

3. Front Pillar Trim Cover

- Turn up the finisher and pry the trim cover clips free from the body panel.

  Remove the trim cover by pulling upward on the lower part of it.



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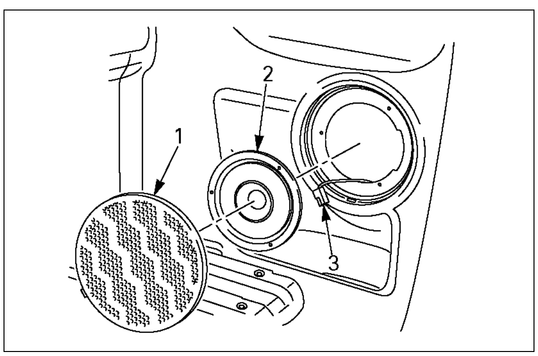
4. Rear Upper Cushion

- Slide the upper cushion upward to remove it.

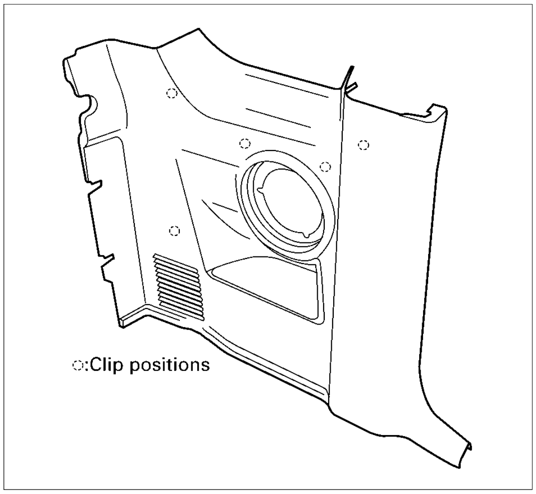
6. Rear End Trim Cover

- Pry the trim cover clips free from the body panel, and slide the trim cover upward to remove it.



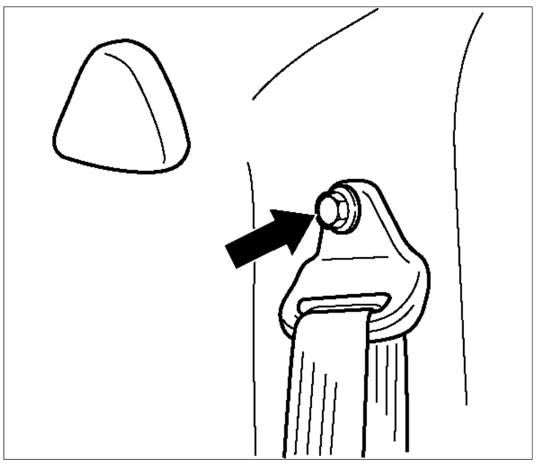
7. Rear Speaker Grille/Rear Speaker

1) Remove the rear speaker grille (1).
2) Remove the 3 screws fixing the rear speaker (2) and disconnect the connector (3).



8. Body Side Rear Lower Trim Cover

- Pry the trim cover clips free from the body panel.



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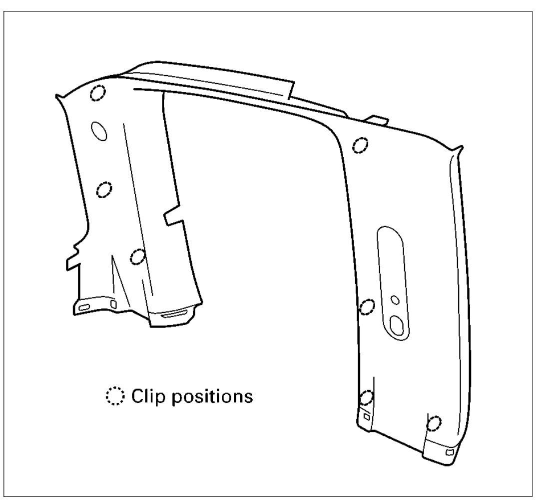
10. Tongue Side Seat Belt

1) Pull out the adjuster knob.
2) Remove the through ring anchor cover and remove the seat belt upper anchor bolt.

- Insert the blade of an ordinary screwdriver into the gap between the D-ring back surface and the cover. Carefully pry the D-ring latches open. Remove the cover.



11. Body Side Rear Upper Trim Cover

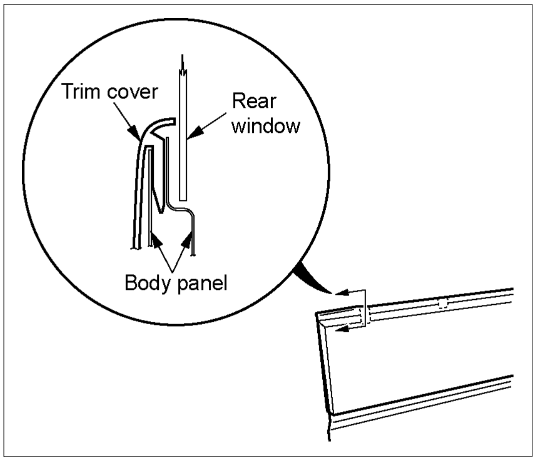
- Pry the trim cover clips free from the body panel.

Important Operations - Installation

10. Tongue Side Seat Belt

- Tighten the seat belt upper anchor bolt to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1/30)	



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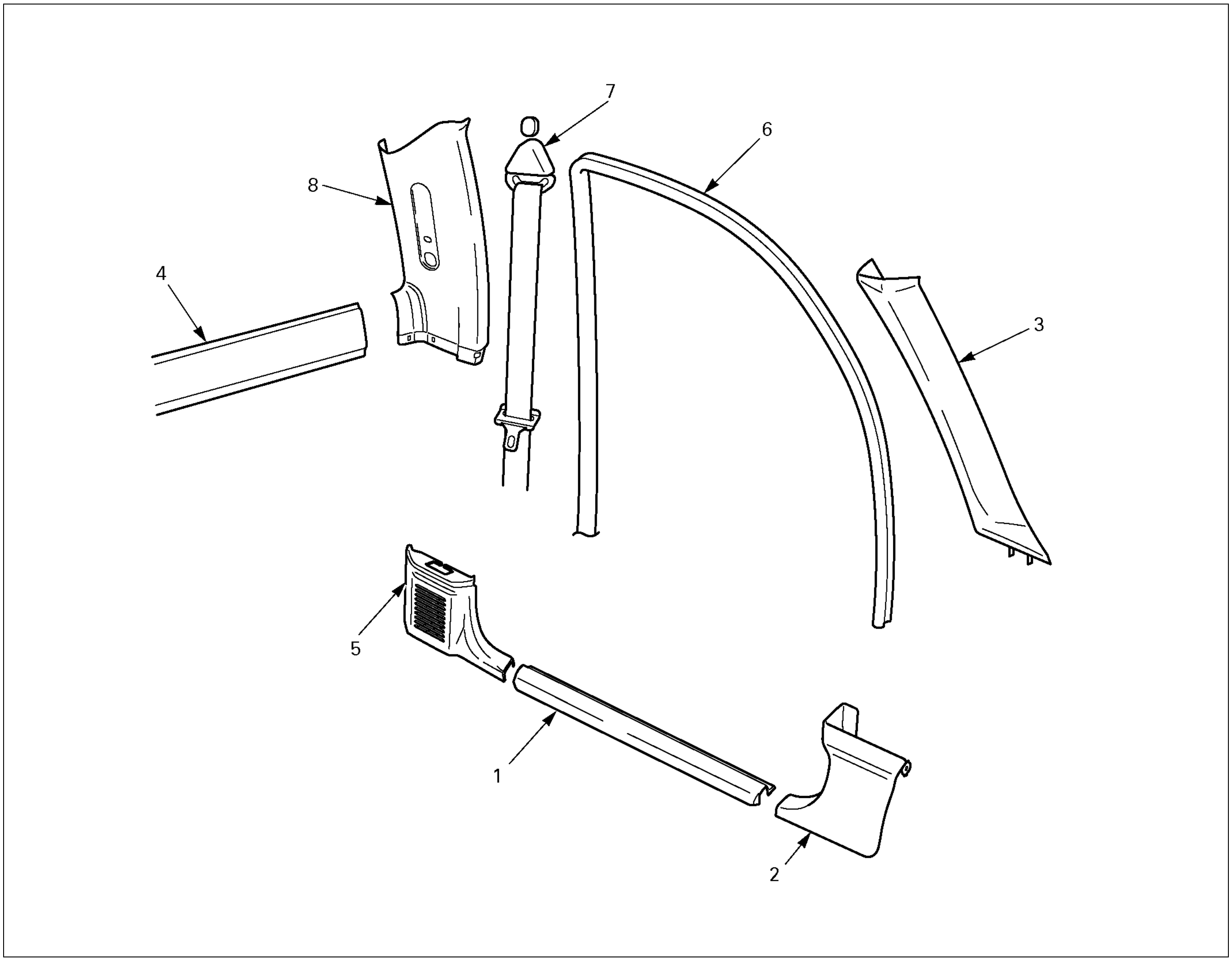
6. Rear End Trim Cover

- Insert the hooks on the back upper portion of the trim cover to the body panel.

REMOVAL AND INSTALLATION



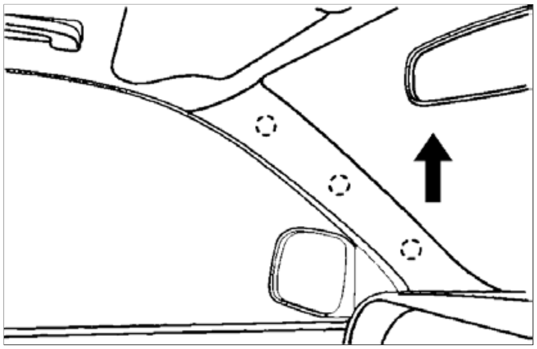
Regular Cab Model

Removal Steps

1. Sill plate
2. Dash side trim cover
3. ▲ Front pillar trim cover
4. ▲ Rear end trim cover
5. ▲ Body side rear lower trim cover
6. Door finisher
7. ▲ Tongue side seat belt
8. ▲ Body side rear upper trim cover

Installation Steps

8. Body side rear upper trim cover
7. ▲ Tongue side seat belt
6. Door finisher
5. Body side rear lower trim cover
4. ▲ Rear end trim cover
3. Front pillar trim assembly
2. Dash side trim cover
1. Sill plate



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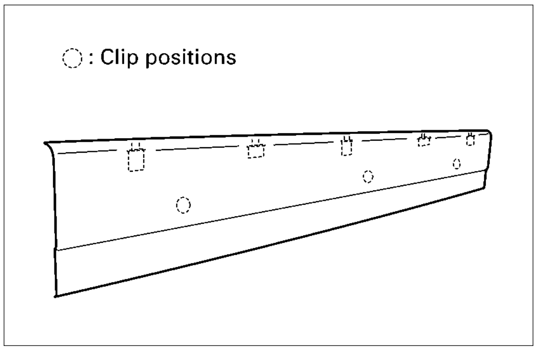
Important Operations - Removal

3. Front Pillar Trim Cover

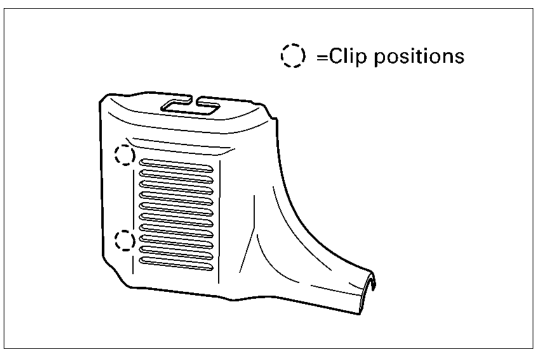
- Turn up the finisher and pry the trim cover clips free from the body panel.

  Remove the trim cover by pulling upward on the lower part of it.



4. Rear End Trim Cover

- Pry the trim cover clips free from the body panel, and slide the trim cover upward to remove it.



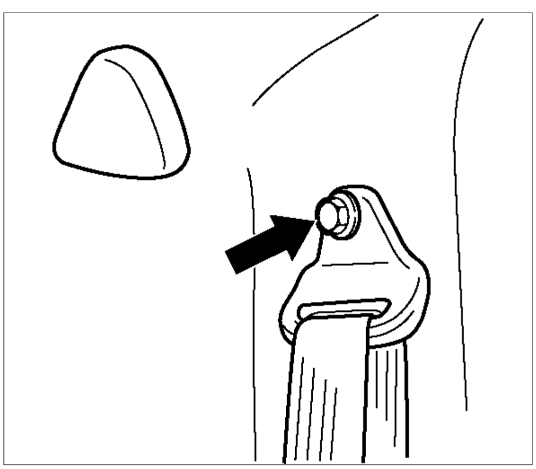
5. Body Side Rear Lower Trim Cover

- Pry the trim cover clips free from the body panel.

7. Tongue Side Seat Belt

1) Pull out the adjuster knob.
2) Remove the through ring anchor cover and remove the seat belt upper anchor bolt.

- Insert the blade of an ordinary screwdriver into the gap between the D-ring back surface and the cover. Carefully pry the D-ring latches open. Remove the cover.



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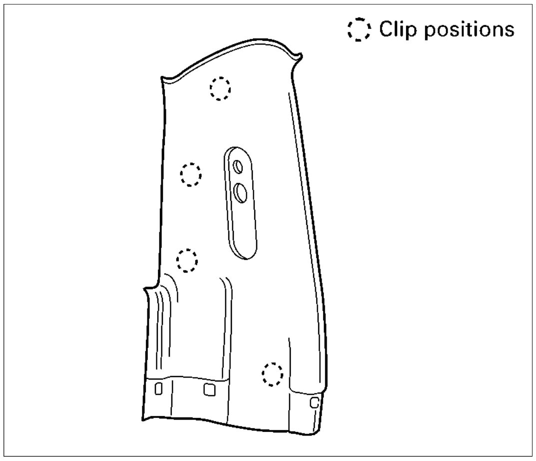


8. Body Side Rear Upper Trim Cover

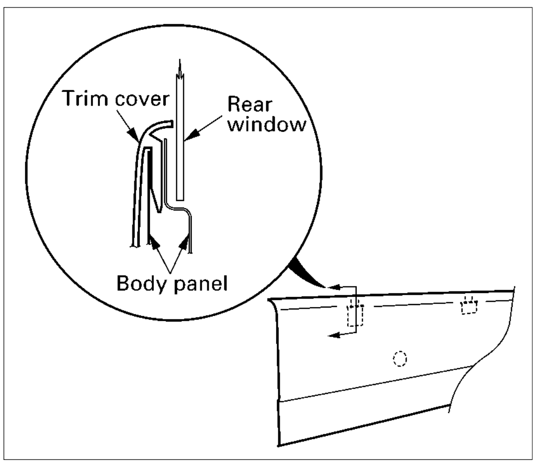
- Pry the trim cover clips free from the body panel.

Important Operations - Installation

7. Tongue Side Seat Belt

- Tighten the seat belt upper anchor bolt to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1/30)	

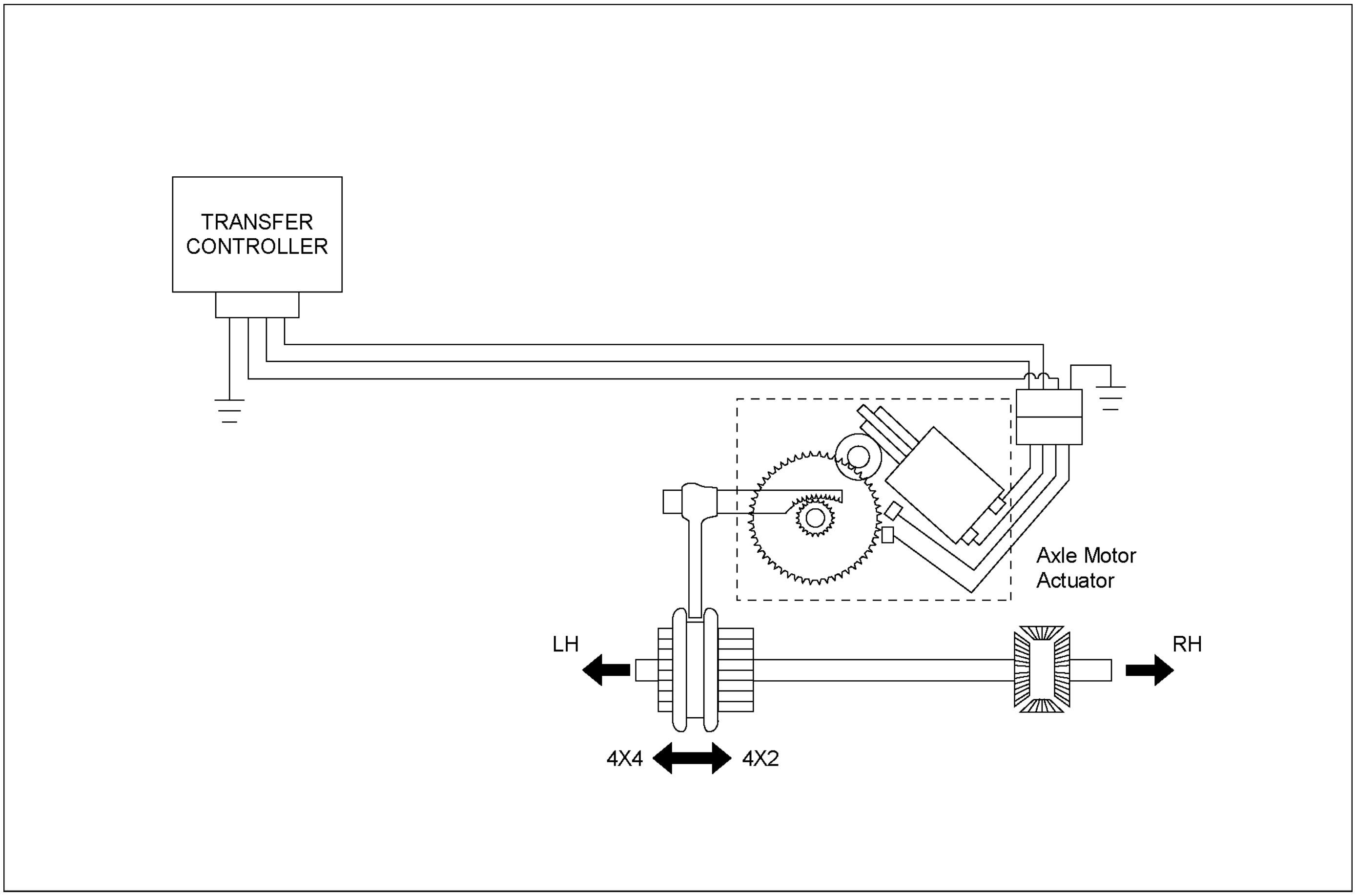


4. Rear End Trim Cover

- Insert the hooks on the back upper portion of the trim cover to the body panel.

SHIFT ON THE FLY ELECTRICAL EQUIPMENT

Axle Shaft Connection and Disconnection



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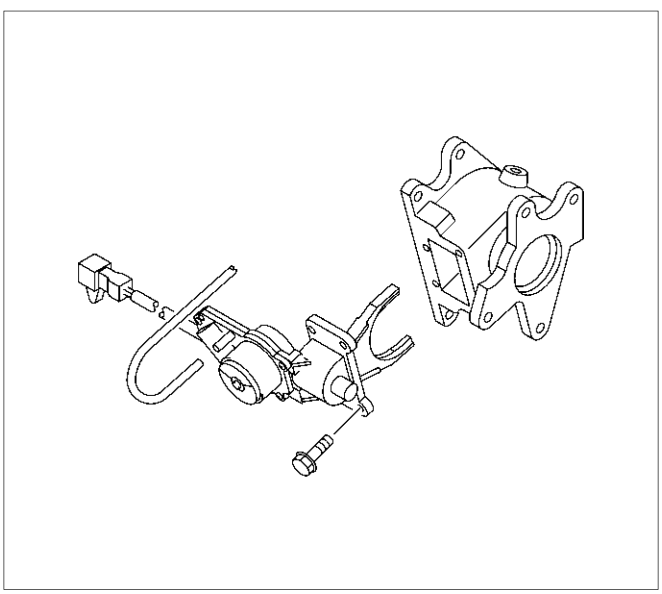
Actuator Assembly



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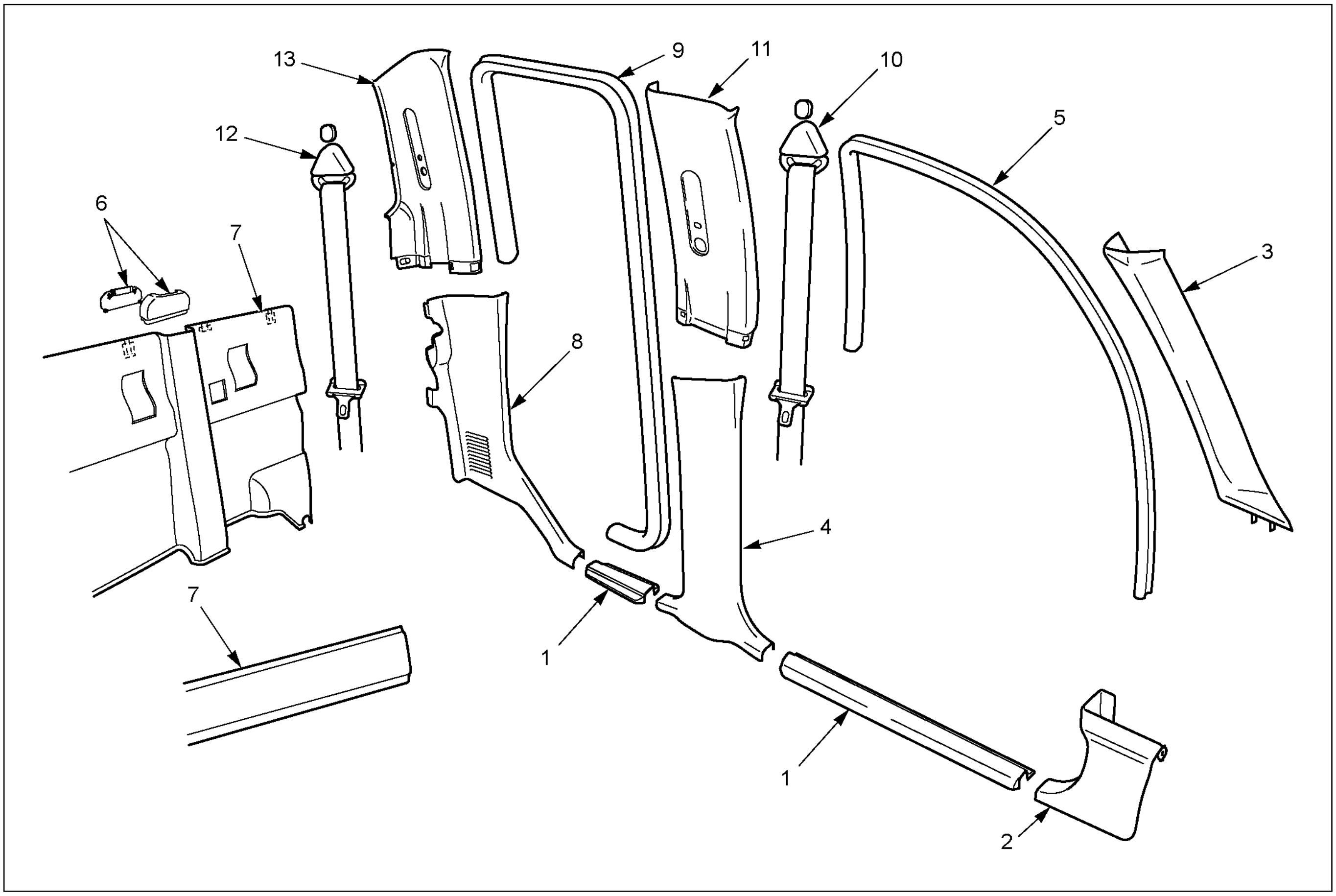
REMOVAL AND INSTALLATION



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Crew Cab Model

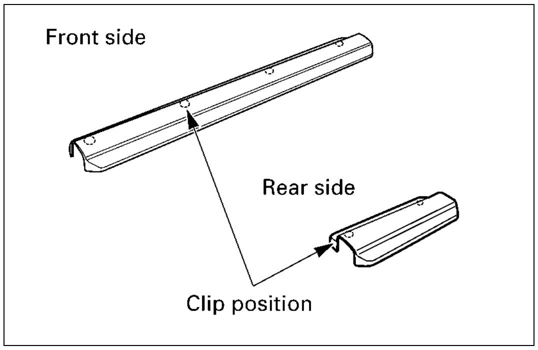
Removal Steps

▲ 1. Front sill plate/Rear sill plate
2. Dash side trim cover
▲ 3. Front pillar trim cover
▲ 4. Center pillar lower trim cover
5. Front door finisher
6. Cover
▲ 7. Rear end trim cover
▲ 8. Body side rear lower trim cover
9. Rear door finisher
▲10. Front tongue side seat belt
▲11. Center pillar upper trim cover
12. Rear tongue side seat belt
▲13. Body side rear upper trim cover

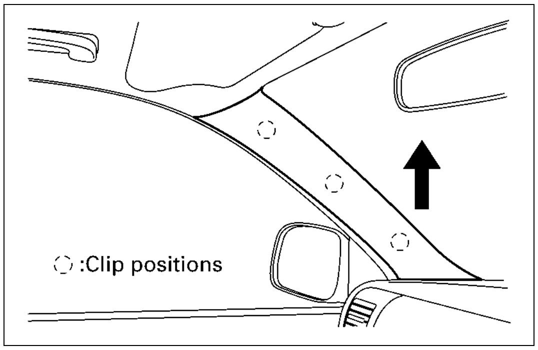
Installation Steps

13. Body side rear upper trim cover
▲12. Rear tongue side seat belt
11. Center pillar upper trim cover
▲10. Front tongue side seat belt
9 Rear door finisher
8. Body side rear lower trim cover
▲ 7. Rear end trim cover
6. Cover
5. Front door finisher
4. Center pillar lower trim cover
3. Front pillar trim cover
2. Dash side trim cover
1. Front sill plate/Rear sill plate

Important Operations - Removal

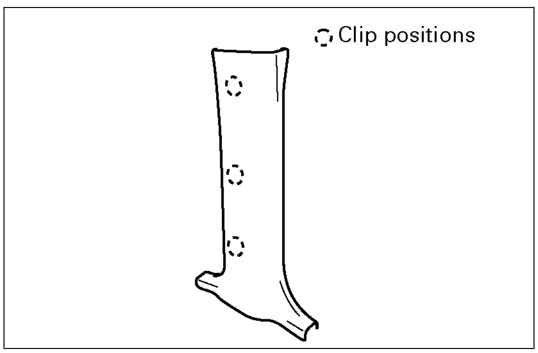


1. **Front Sill Plate/Rear Sill Plate**
   - Pull out the 4 clip positions (Front).
   - Pull out the 2 clip positions (Rear).

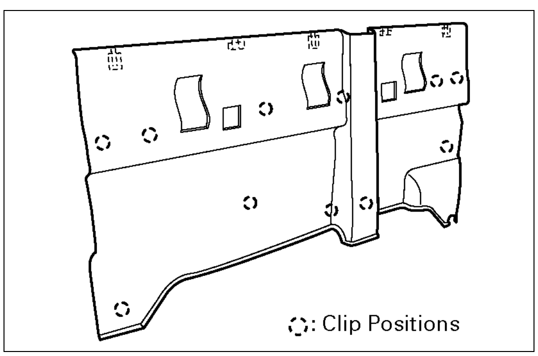


3. **Front Pillar Trim Cover**
   - Turn up the finisher and pry the trim cover clips free from the body panel.

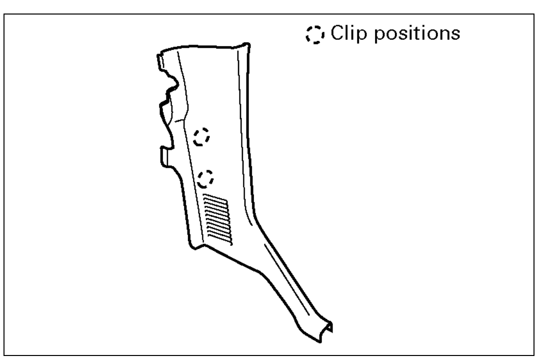
     Then remove the trim cover by pulling upward on the lower part of it.



4. **Center Pillar Lower Trim Cover**
   - Pry the trim cover clips free from the body panel.



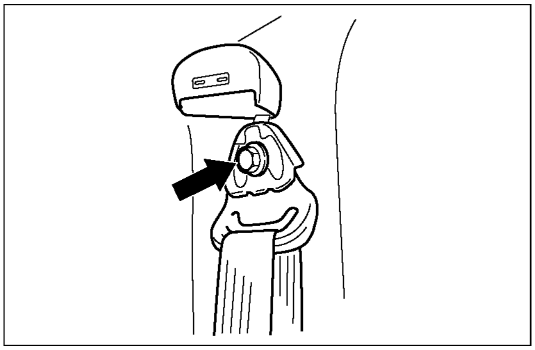
7. **Rear End Trim Cover**
   - Pry the trim cover clips free from the body panel, and slide the trim cover upward to remove it.



8. **Body Side Rear Lower Trim Cover**
   - Pry the trim cover clips free from the body panel.

10. Front Tongue Side Seat Belt

1) Pull out the adjuster knob.
2) Open the through ring anchor cover and remove the seat belt upper anchor bolt.



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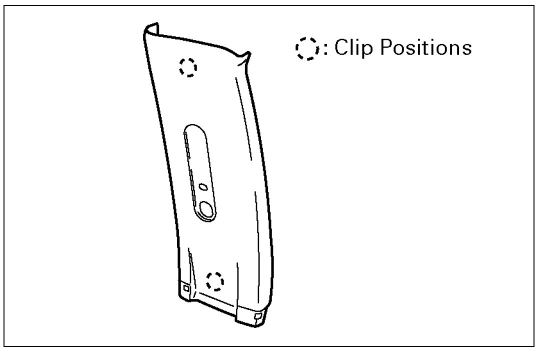
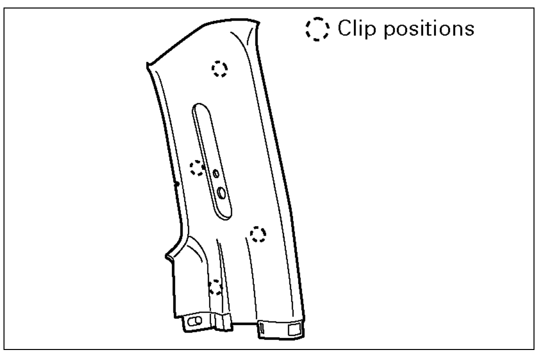
11. Center Pillar Upper Trim Cover

- Pry the trim cover clips free from the body panel.



13. Body Side Rear Upper Trim Cover

- Pry the trim cover clips free from the body panel.



Important Operations - Installation

12. Rear Tongue Side Seat Belt

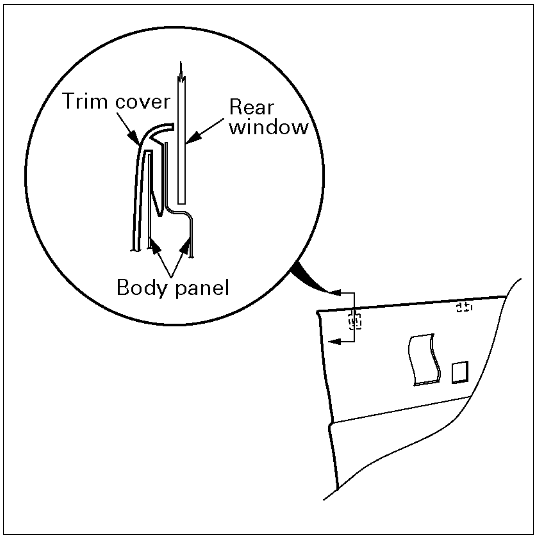
- Tighten the seat belt upper anchor bolt to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1/30)	

10. Front Tongue Side Seat Belt

- Tighten the seat belt upper anchor bolt to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1/30)	

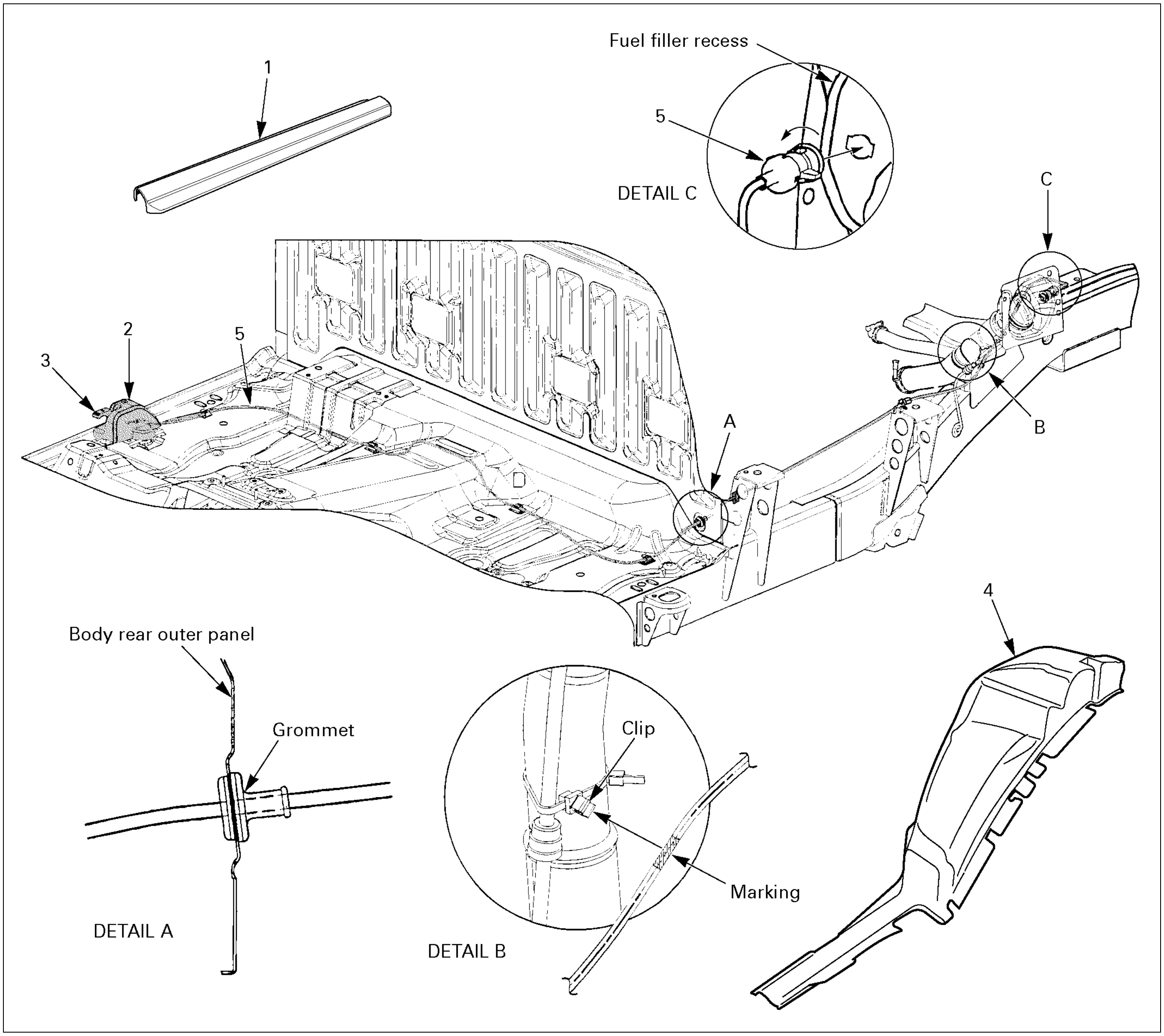


7. Rear End Trim Cover

- Insert the hooks on the back upper portion of trim cover to the body panel.

FUEL FILLER LID OPENER LEVER/CABLE

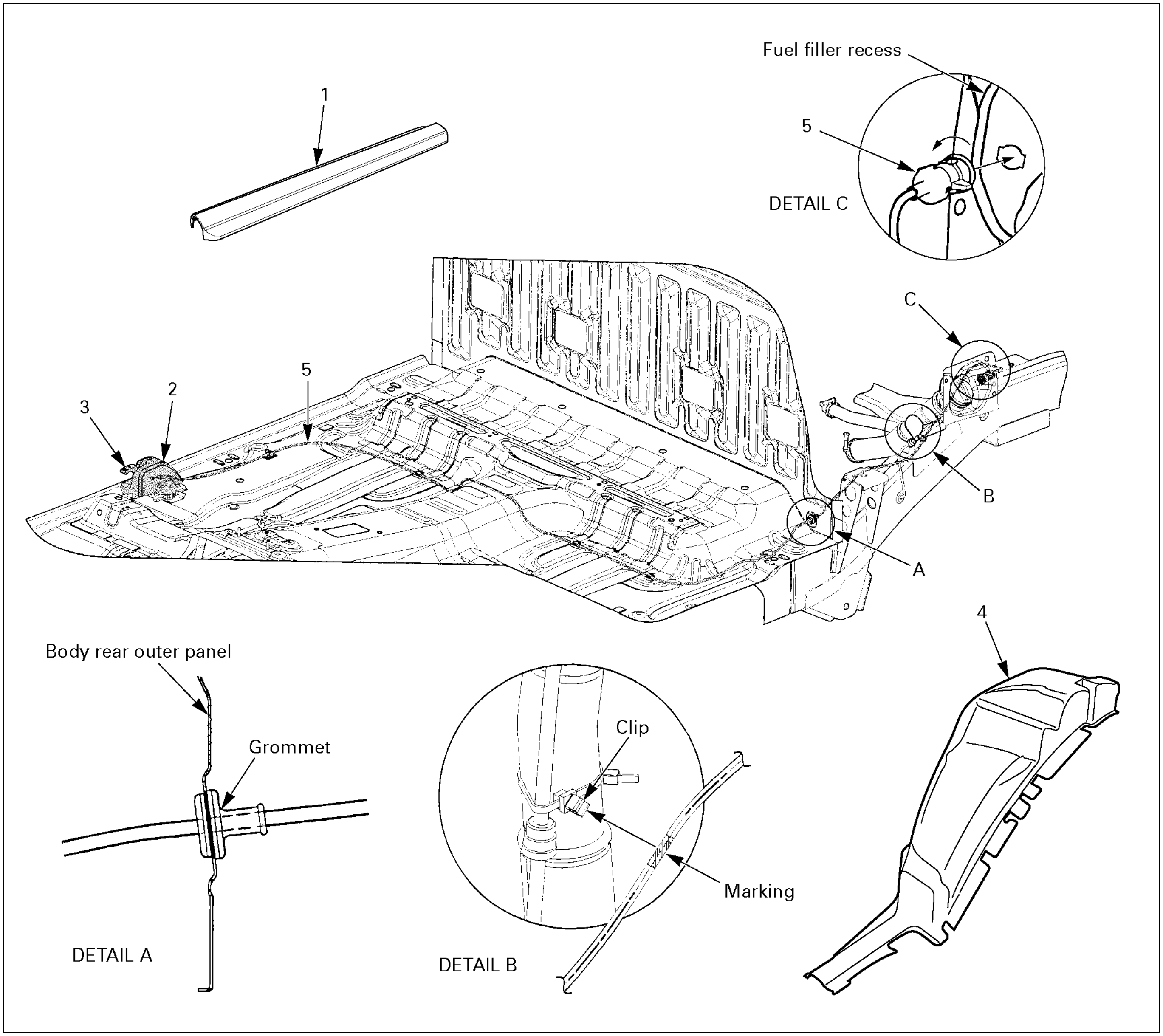
REMOVAL (REGULAR CAB RHD MODEL)



Removal Steps

▲ 1. Front sill plate
▲ 2. Fuel filler lid opener cover
▲ 3. Fuel filler lid opener lever
4. Rear wheel housing extension panel
▲ 5. Fuel filler lid cable assembly

REMOVAL (EXTEND CAB RHD MODEL)



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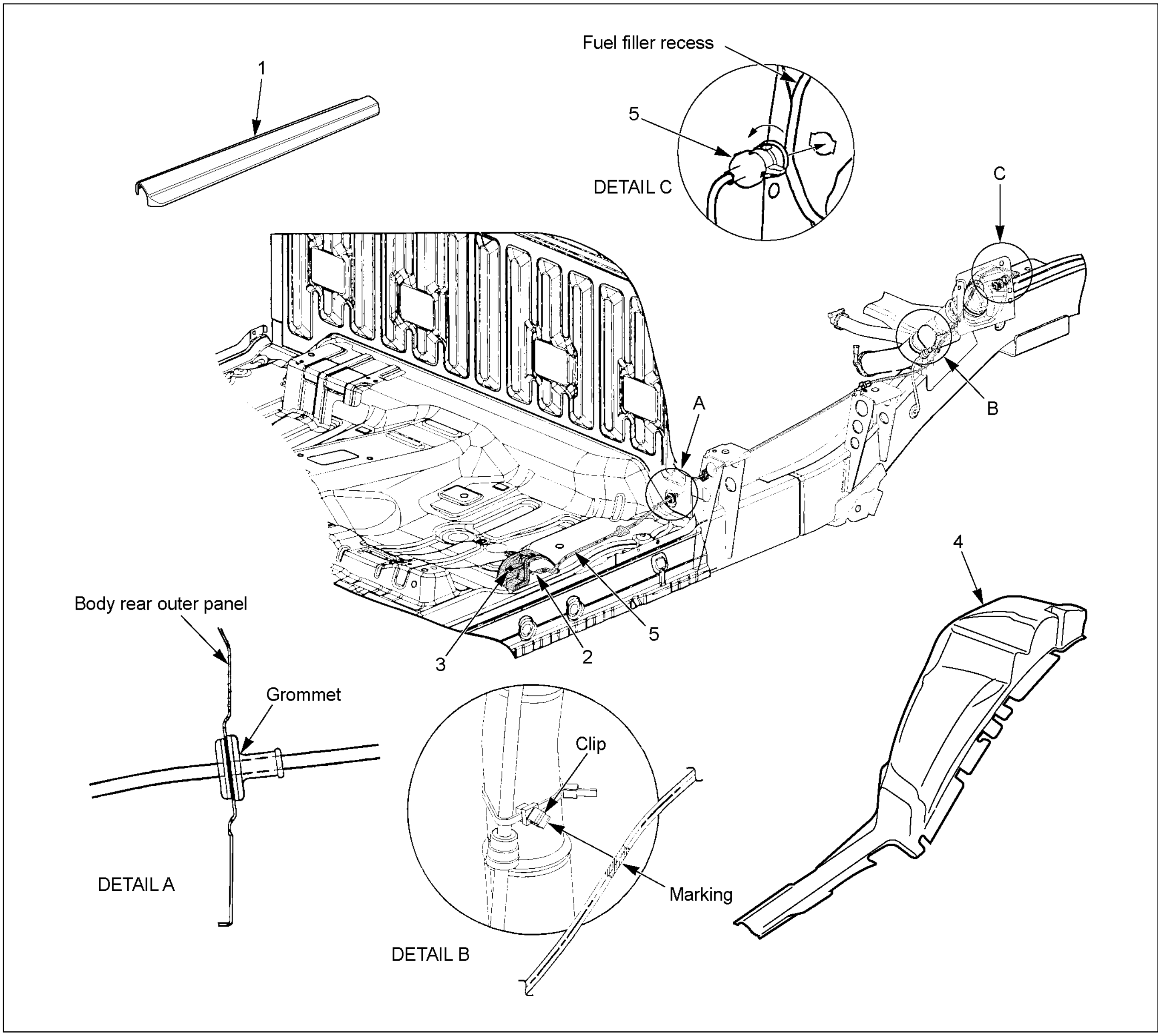
Removal Steps

▲ 1. Front sill plate
▲ 2. Fuel filler lid opener cover
▲ 3. Fuel filler lid opener lever
4. Rear wheel housing extension panel
▲ 5. Fuel filler lid cable assembly

REMOVAL (REGULAR CAB LHD MODEL)



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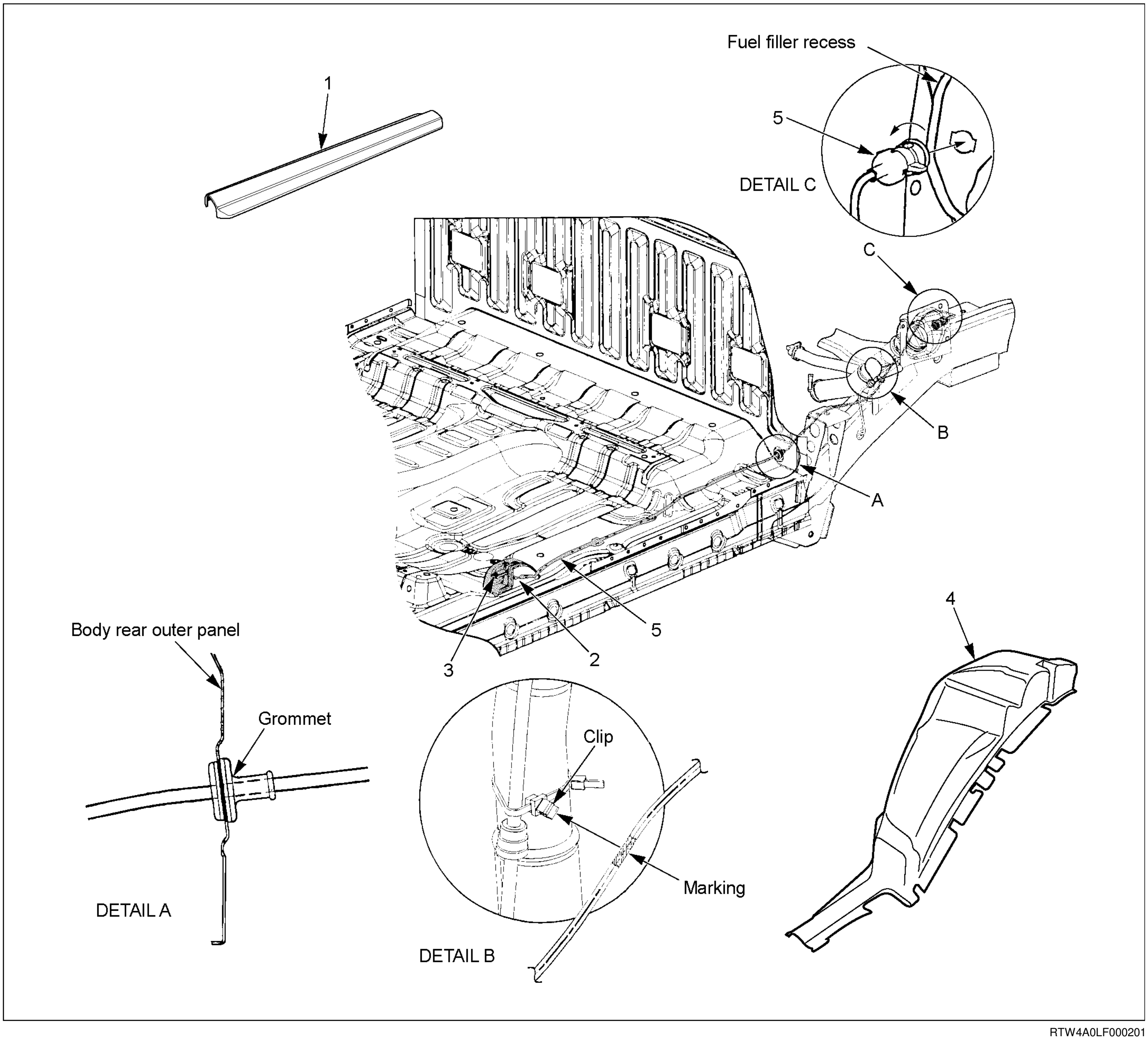
Removal Steps

▲ 1. Front sill plate
▲ 2. Fuel filler lid opener cover
▲ 3. Fuel filler lid opener lever
4. Rear wheel housing extension panel
▲ 5. Fuel filler lid cable assembly

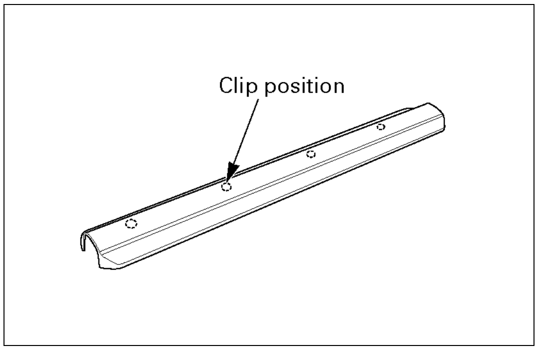
REMOVAL (EXTEND CAB LHD MODEL)



Removal Steps

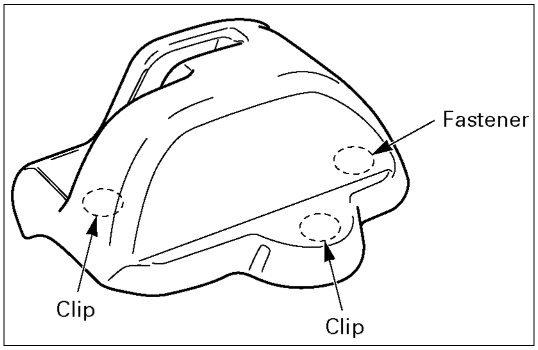
▲ 1. Front sill plate
▲ 2. Fuel filler lid opener cover
▲ 3. Fuel filler lid opener lever
4. Rear wheel housing extension panel
▲ 5. Fuel filler lid cable assembly

Important Operations - Removal



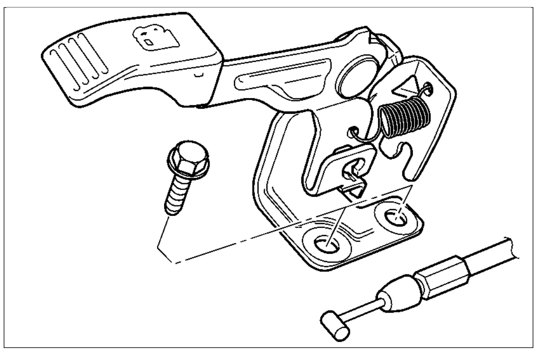
1. Front Sill Plate

- Pull out the 4 clip positions.



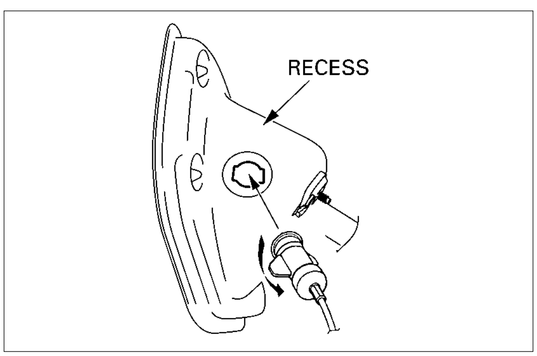
2. Fuel Filler Lid Opener Cover

- Pull out the 3 clip positions.



3. Fuel Filler Lid Opener Lever

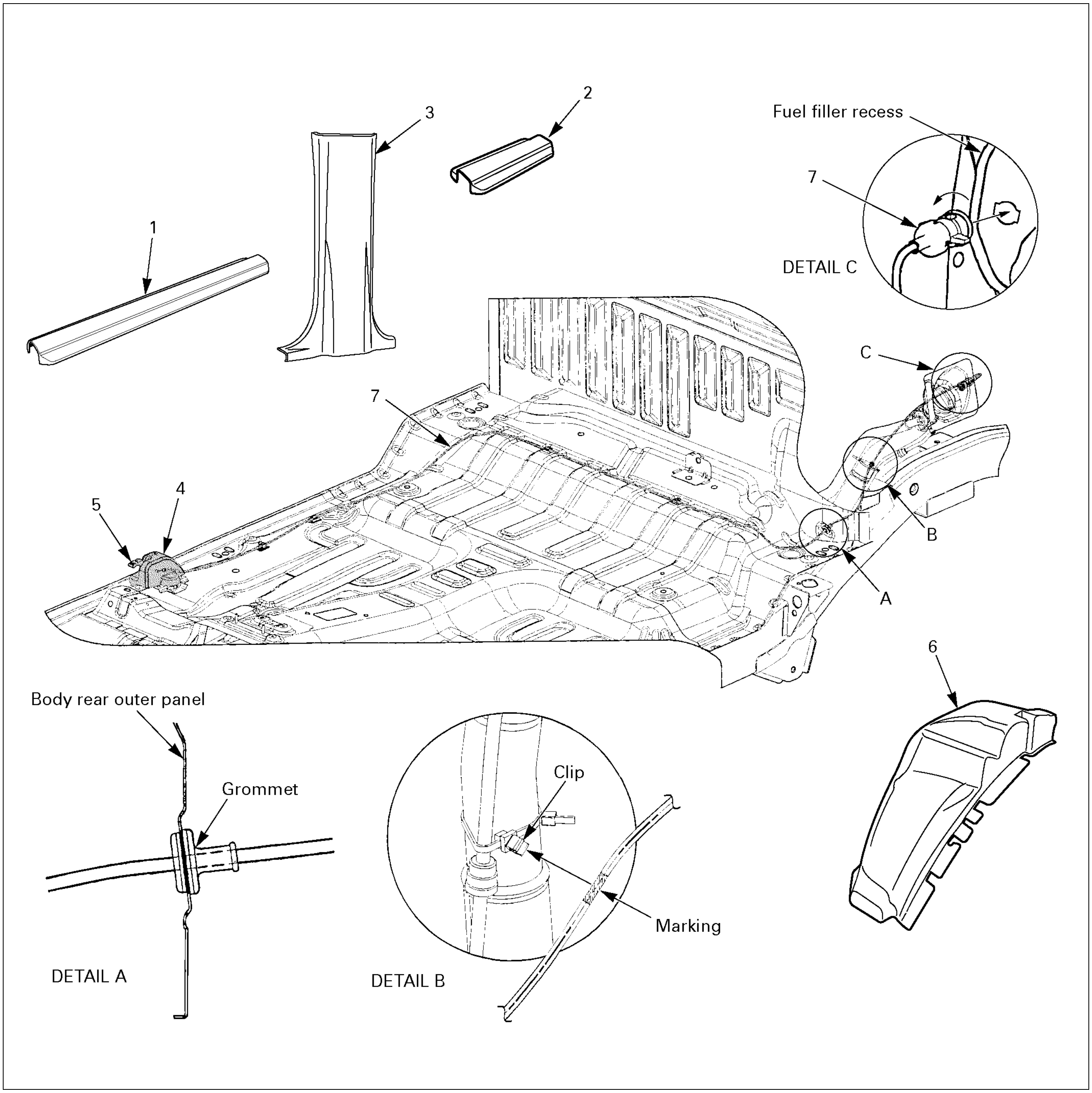
- Remove the 2 opener fixing bolts and disconnect the cable.



5. Fuel Filler Lid Cable Assembly

- Remove some fixing clips, turn the cable holder on the side of the recess at 90° counterclockwise and remove it from the recess. Pull out the grommet in the direction of the front of the vehicle and remove the cable assembly.

REMOVAL (CREW CAB RHD MODEL)

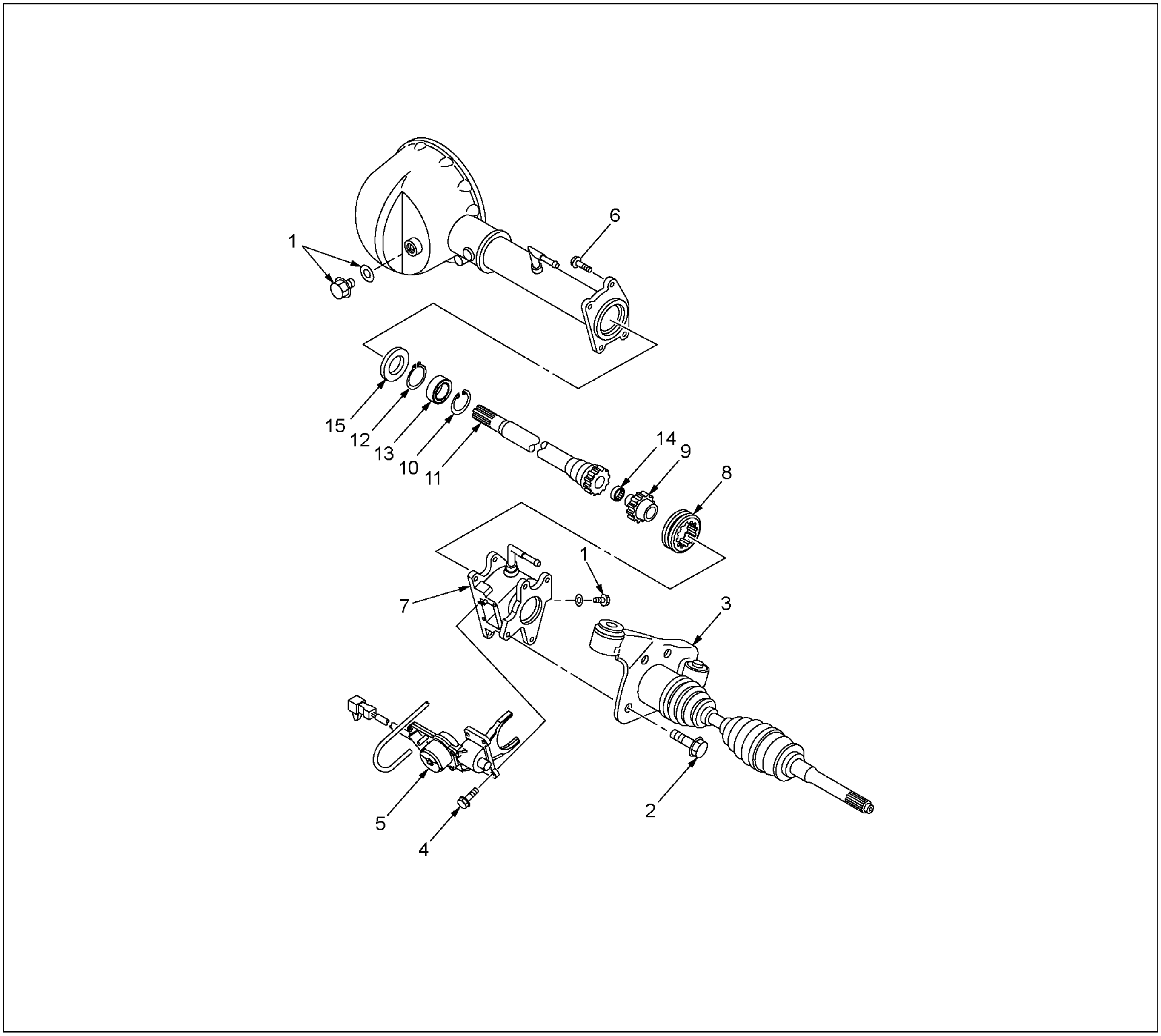


686R300010

Removal Steps

▲ 1. Front sill plate
▲ 2. Rear sill plate
3. Center pillar lower trim cover
▲ 4. Fuel filler lid opener cover
▲ 5. Fuel filler lid opener lever
6. Rear wheel housing extension panel
▲ 7. Fuel filler lid cable assembly

SHIFT ON THE FLY SYSTEM AND ASSOCIATION PARTS



RTW440LF000701

Disassembly steps

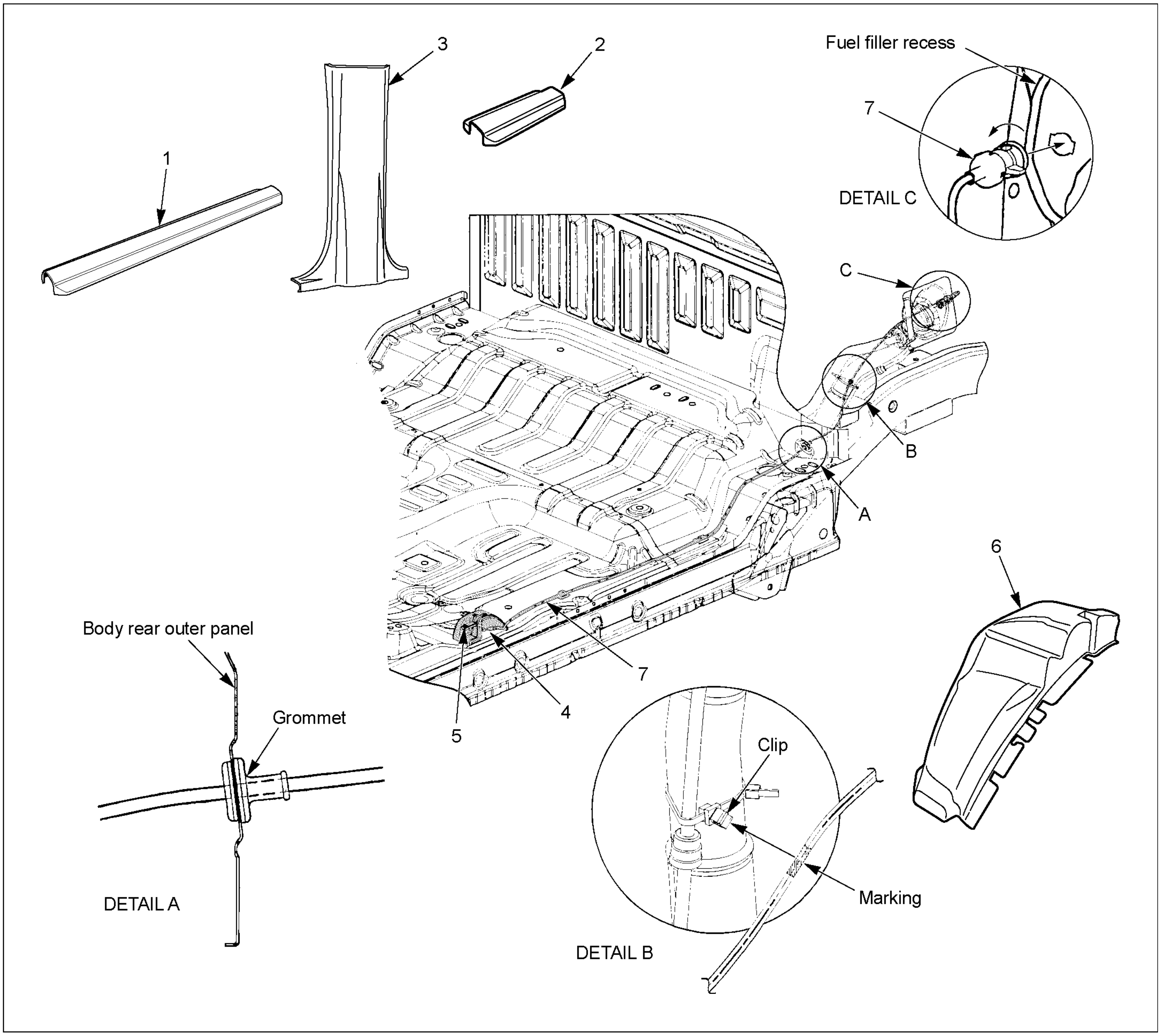
1. Filler plug
2. Bolt
3. Front axle drive shaft (LH side)
4. Bolt
5. Actuator assembly
6. Bolt
7. Housing
8. Sleeve
9. Clutch gear
10. Snap ring
11. Inner shaft
12. Snap ring
13. Inner shaft bearing
14. Needing bearing
15. Oil seal

Reassembly steps

To reassemble, follow the disassembly steps in the reverse order.

BACK TO CHAPTER INDEX

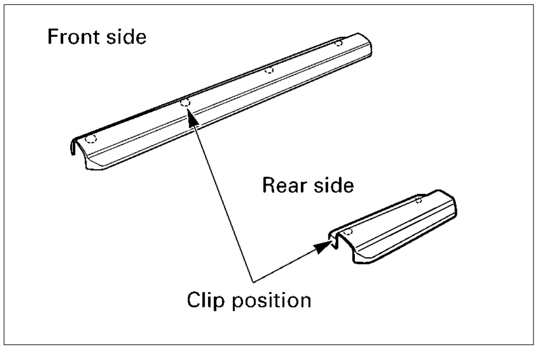
REMOVAL (CREW CAB LHD MODEL)



RTW4A0LF000301

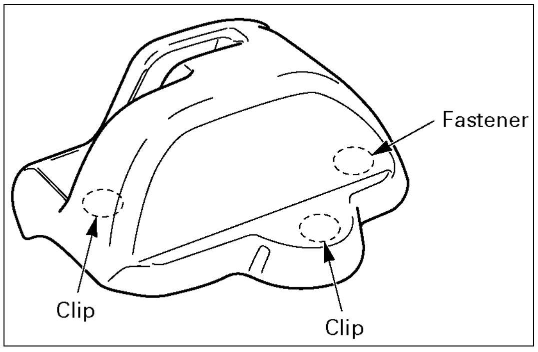
Removal Steps

- ▲ 1. Front sill plate
- ▲ 2. Rear sill plate
- 3. Center pillar lower trim cover
- ▲ 4. Fuel filler lid opener cover
- ▲ 5. Fuel filler lid opener lever
- 6. Rear wheel housing extension panel
- ▲ 7. Fuel filler lid cable assembly

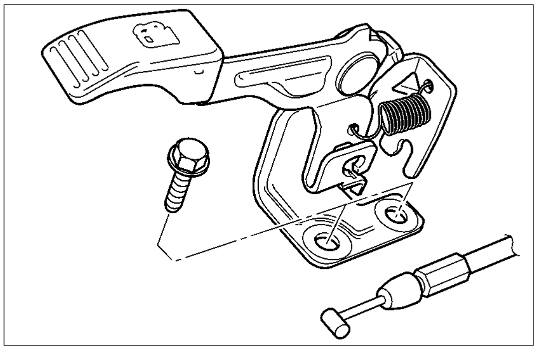


Important Operations - Removal

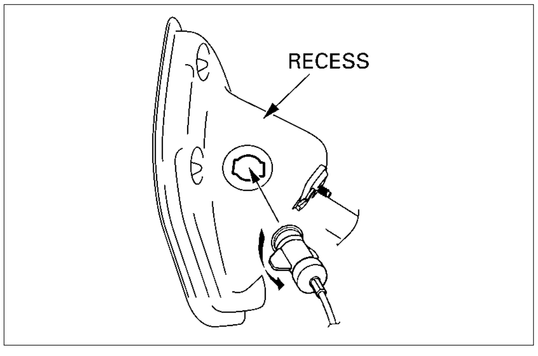
1. **Front Sill Plate**
   - Pull out the 4 clip positions.
2. **Rear Sill Plate**
   - Pull out the 2 clip positions.



4. **Fuel Filler Lid Opener Cover**
   - Pull out the 3 clip positions.

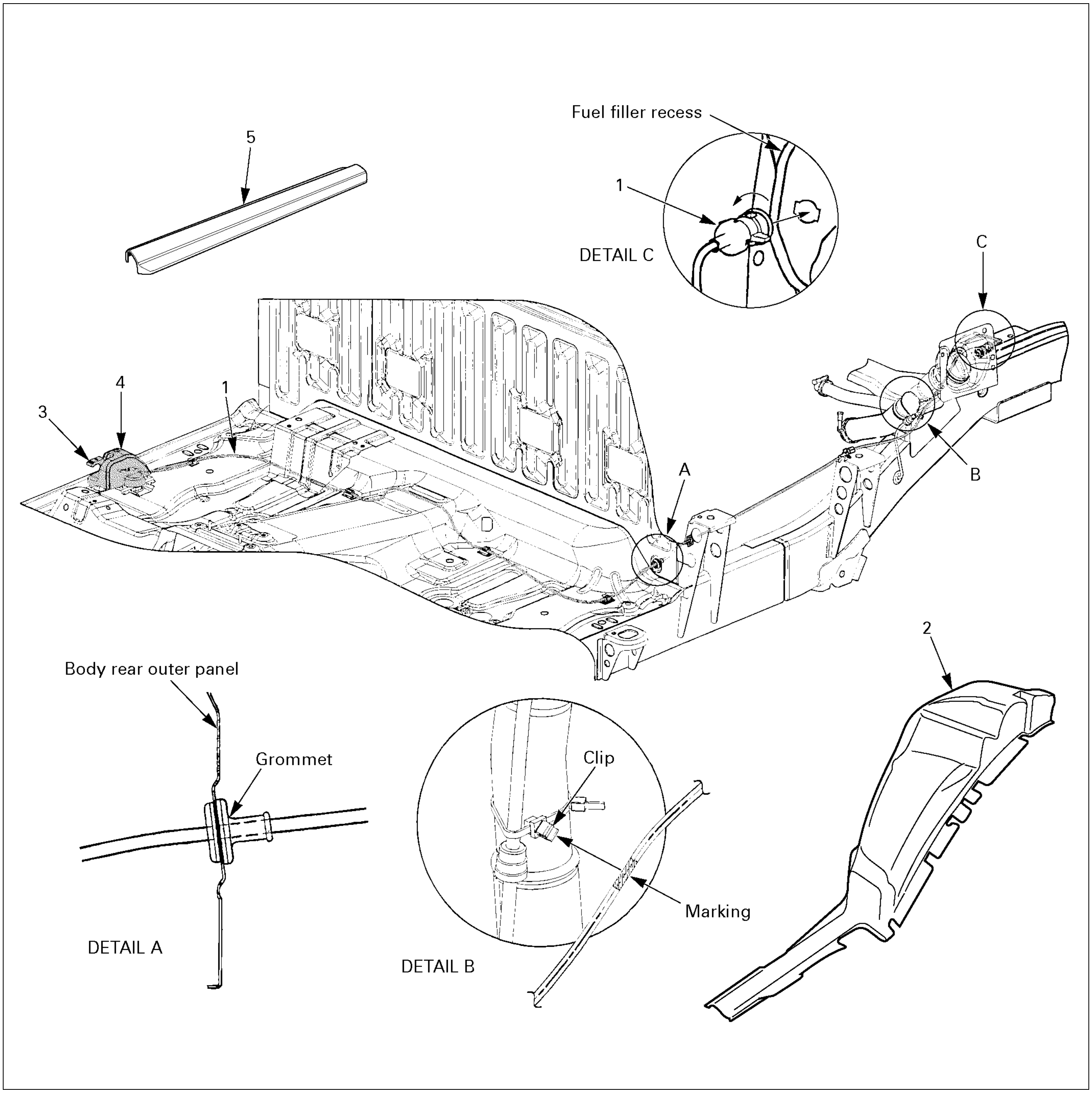


5. **Fuel Filler Lid Opener Lever**
   - Remove the 2 opener fixing bolts and disconnect the cable.



7. **Fuel Filler Lid Cable Assembly**
   - Remove some fixing clips, turn the cable holder on the side of the recess at 90° counterclockwise and remove it from the recess. Pull out the grommet in the direction of the front of the vehicle and remove the cable assembly.

INSTALLATION (REGULAR CAB RHD MODEL)

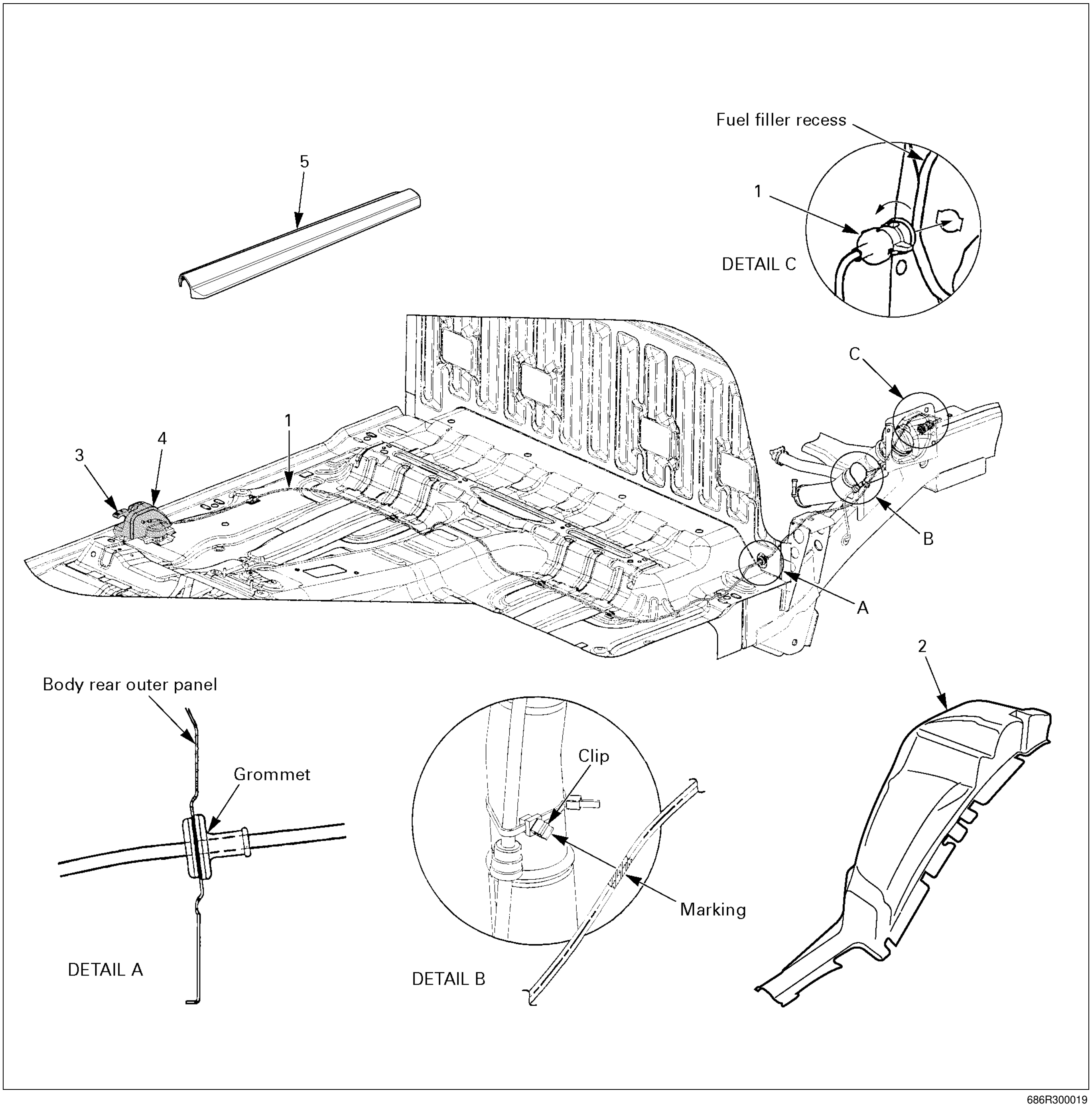


686R300017

Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Front sill plate

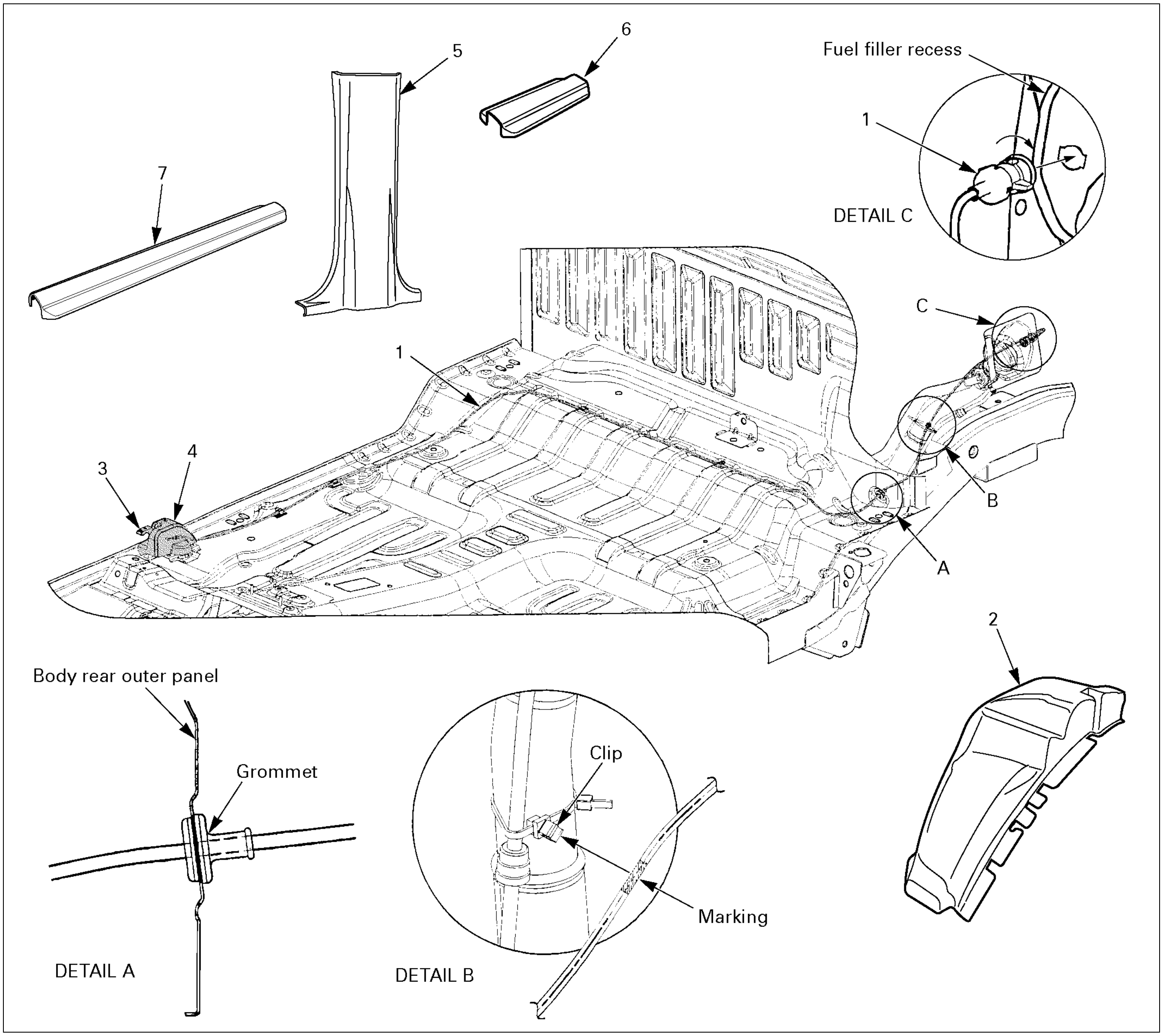
INSTALLATION (EXTEND CAB RHD MODEL)



Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Front sill plate

INSTALLATION (CREW CAB RHD MODEL)

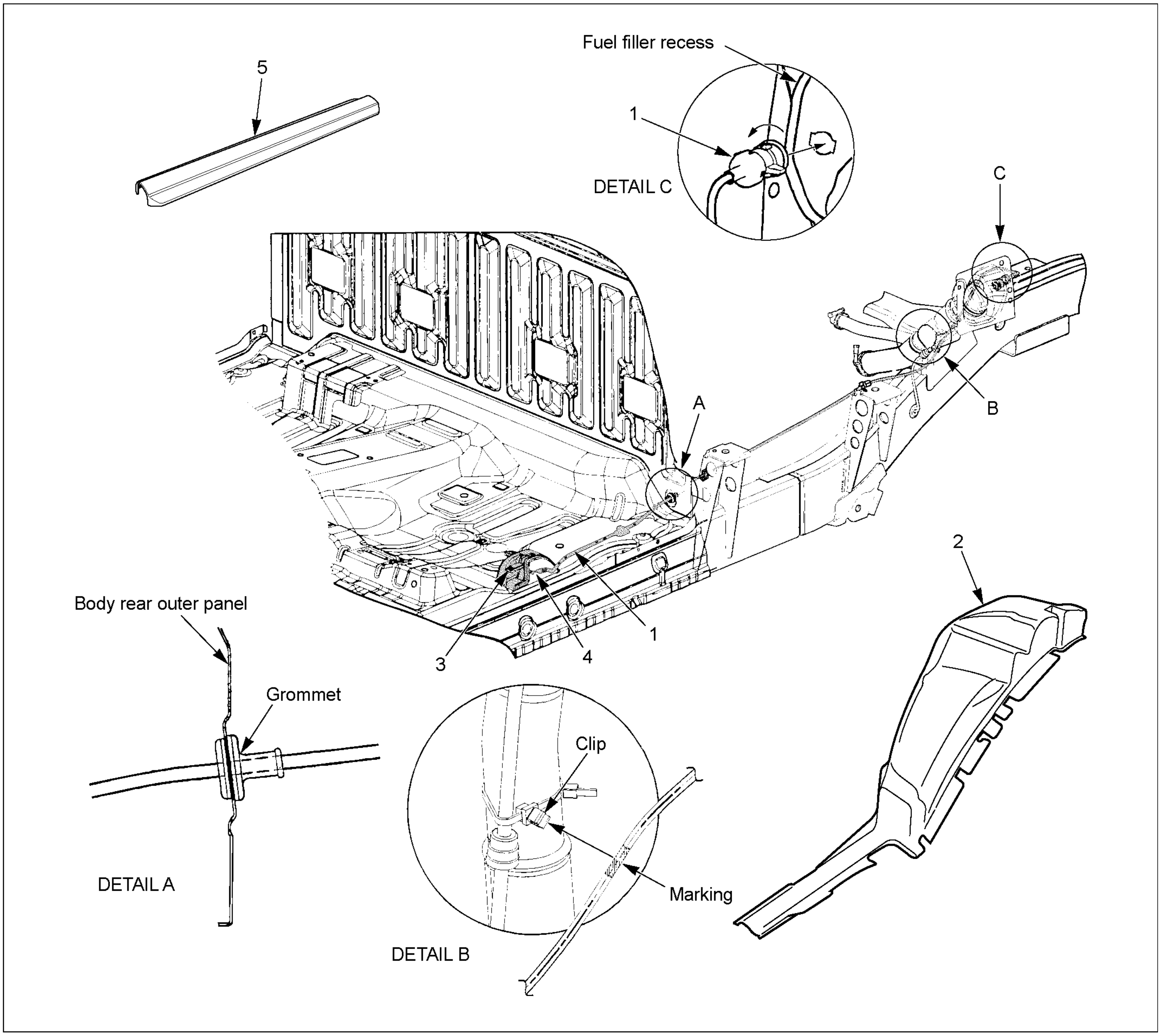


686R300013

Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Center pillar lower trim cover
6. Rear sill plate
7. Front sill plate

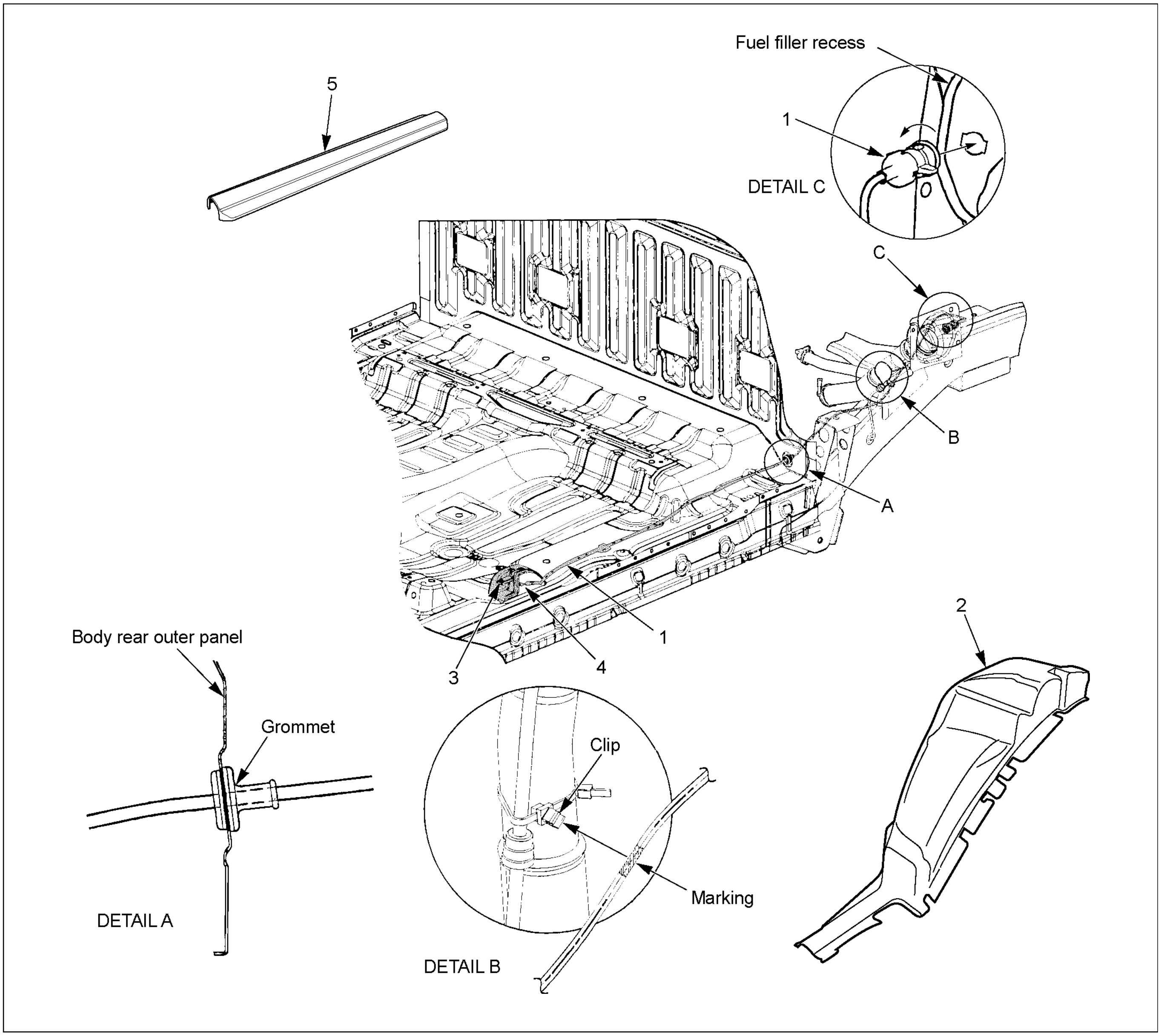
INSTALLATION (REGULAR CAB LHD MODEL)



Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Front sill plate

INSTALLATION (EXTEND CAB LHD MODEL)

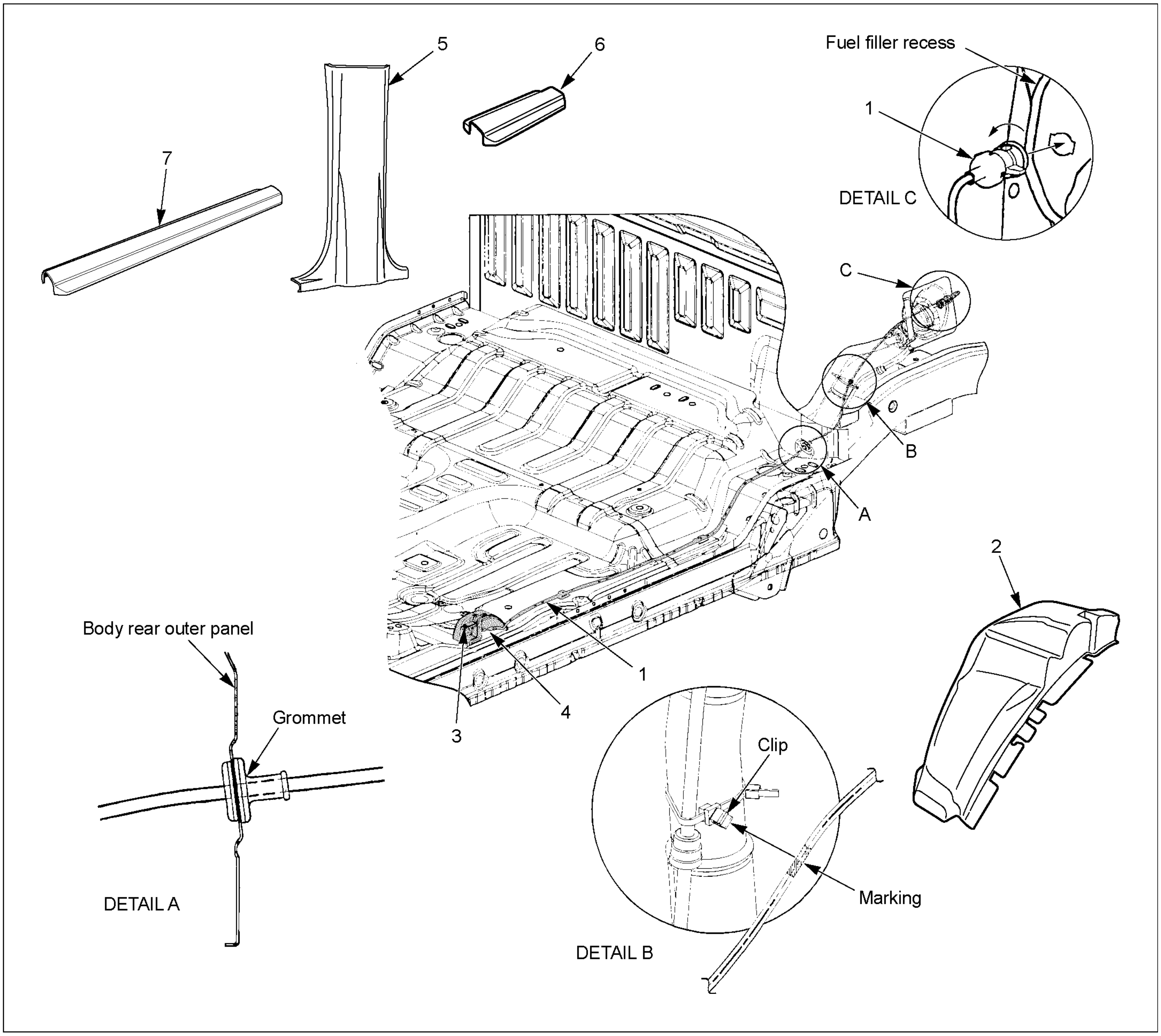


RTW4A0LF000501

Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Front sill plate

INSTALLATION (CREW CAB LHD MODEL)



Installation Steps

▲ 1. Fuel filler lid cable assembly
2. Rear wheel housing extension panel
3. Fuel filler lid opener lever
4. Fuel filler lid opener cover
5. Center pillar lower trim cover
6. Rear sill plate
7. Front sill plate

Important Operation - Installation

1. Fuel Filler Lid Cable Assembly

- Install the cable holder of the cable assembly to the recess and push the grommet in to the back panel. Fix the clips to the appointed places.

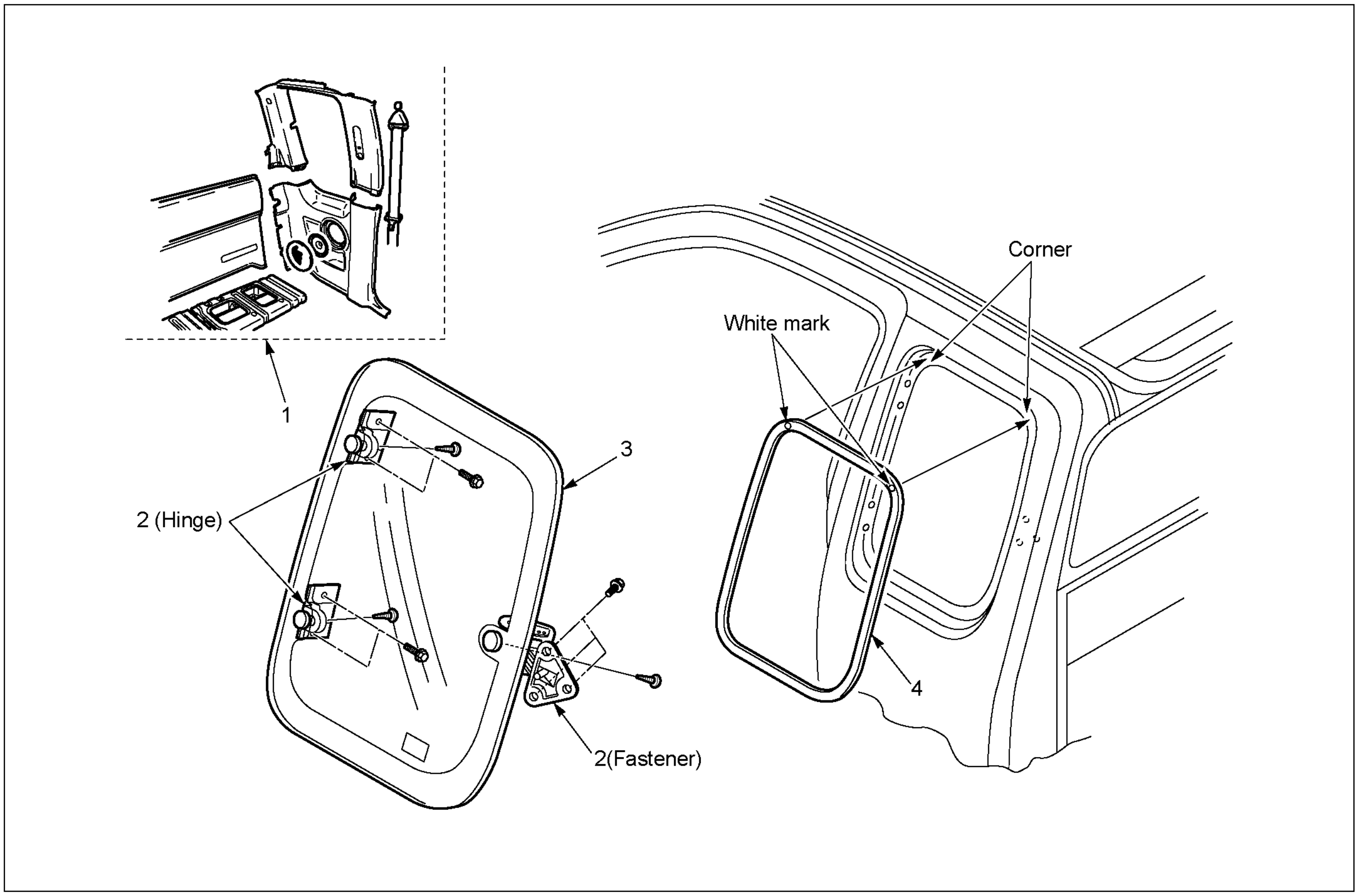
Note:

To install, follow the removal steps in the reverse order, noting the following points.

- **Do not make an extreme curve on the cable.**
- **Install the cable from inside the cab.**

QUARTER GLASS (EXTEND CAB)

REMOVAL AND INSTALLATION



RTW5A0MF000501

Removal Steps

▲ 1. Body side rear trim covers
2. Hinge/Fastener
3. Quarter glass
4. Weather strip

Installation Steps

▲ 4. Weather strip
3. Quarter glass
2. Hinge/Fastener
1. Body side rear trim covers

Important Operation - Removal

1. Body Side Rear Trim Covers

- Refer to Interior Trim Panels in this section.

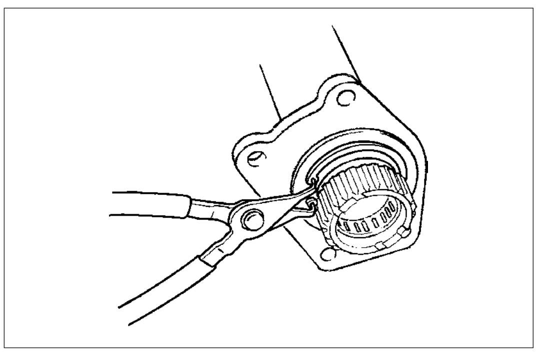
Important Operation – Installation

4. Weather Strip

- Install the weather strip by aligning the corners with a white mark to the upper corners on the body panel.

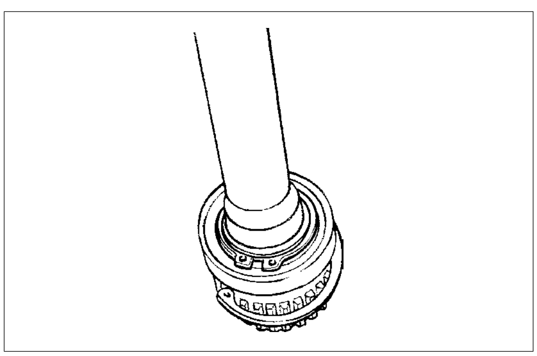
Disassembly

1. **Filler Plug**
   Remove filler plug and packing and drain oil.
2. **Bolt**
   Loosen mounting bracket fitting bolts and remove front axle drive shaft from front axle case.
3. **Front Axle Drive Shaft (LH side)**
4. **Bolt**
   Loosen actuator ASM fitting bolts.
5. **Actuator Assembly**
   Draw out actuator ASM.
6. **Bolt**
   Remove hosing fitting bolts.
7. **Housing**
8. **Sleeve**
9. **Clutch Gear**
10. **Snap Ring**
    Remove snap ring from front axle case by using a snap ring pliers.

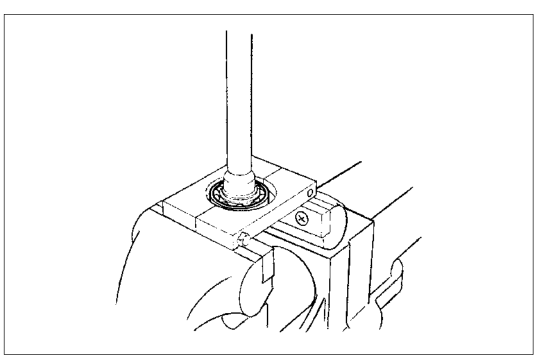


412RW017

11. **Inner Shaft**
    Take out inner shaft from front axle case.
12. **Snap Ring**
    Remove snap ring from inner shaft by using a snap ring pliers.



412RW016



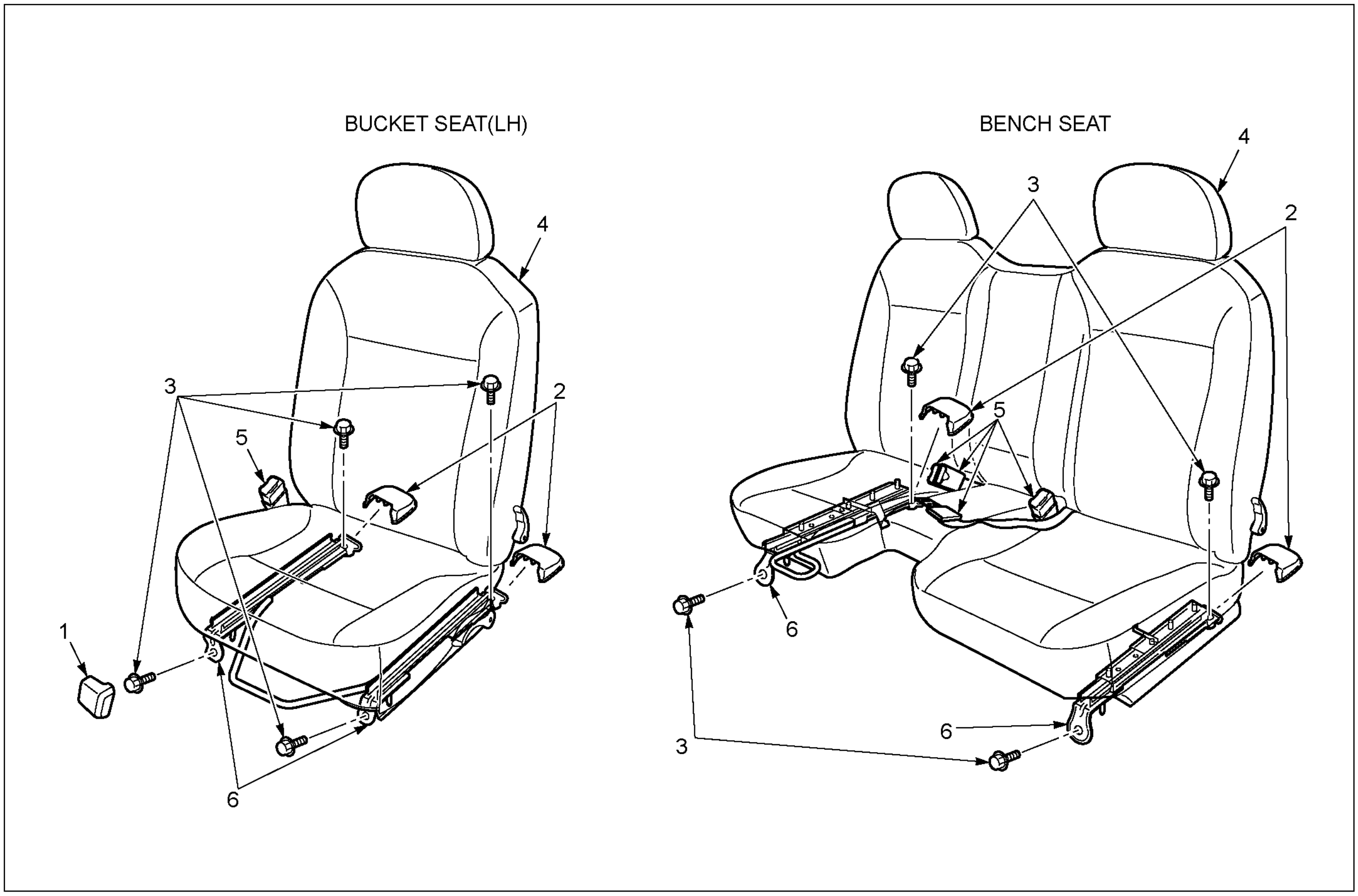
412RW015

13. **Inner Shaft Bearing**
    Remove inner shaft bearing by using a special tool and press.
    Remover : 5-8840-2197-0

NOTE:
Be careful not to damage the shaft.

FRONT SEAT

REMOVAL AND INSTALLATION



Removal Steps

- ▲ 1. Front cover
- 2. Rear cover
- 3. Bolt
- ▲ 4. Seat assembly
- ▲ 5. Buckle side seat belt/center seat belt
- 6. Seat adjuster

Installation Steps

- 6. Seat adjuster
- ▲ 5. Buckle side seat belt/center seat belt
- 4. Seat assembly
- ▲ 3. Bolt
- 2. Rear cover
- 1. Front cover

Important Operations - Removal

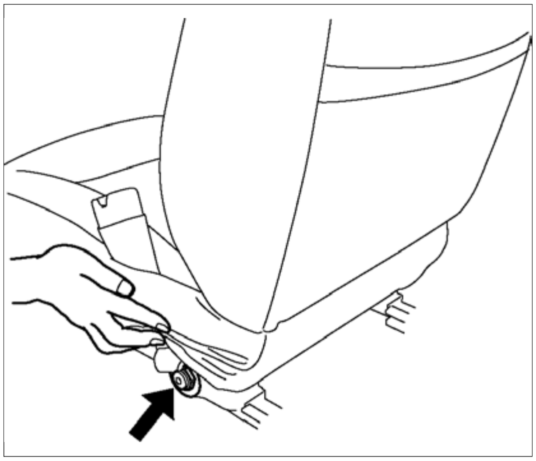
1. Front Cover

- While pushing the cover downward, pull it.

4. Seat Assembly

- Disconnect the seat belt warning harness connector (Driver's side only).

5. Buckle Side Seat Belt/Center Seat Belt



RUW7A0SH000201

- Remove the seat belt fixing screw and the warning harness connector clip (Bucket seat model).

- Remove the seat belt fixing screws and the warning harness connector clip (Bench seat model).

Important Operations – Installation

5. Buckle Side Seat Belt/Center Seat Belt

- Tighten the seat belt fixing screws to the specified torque.

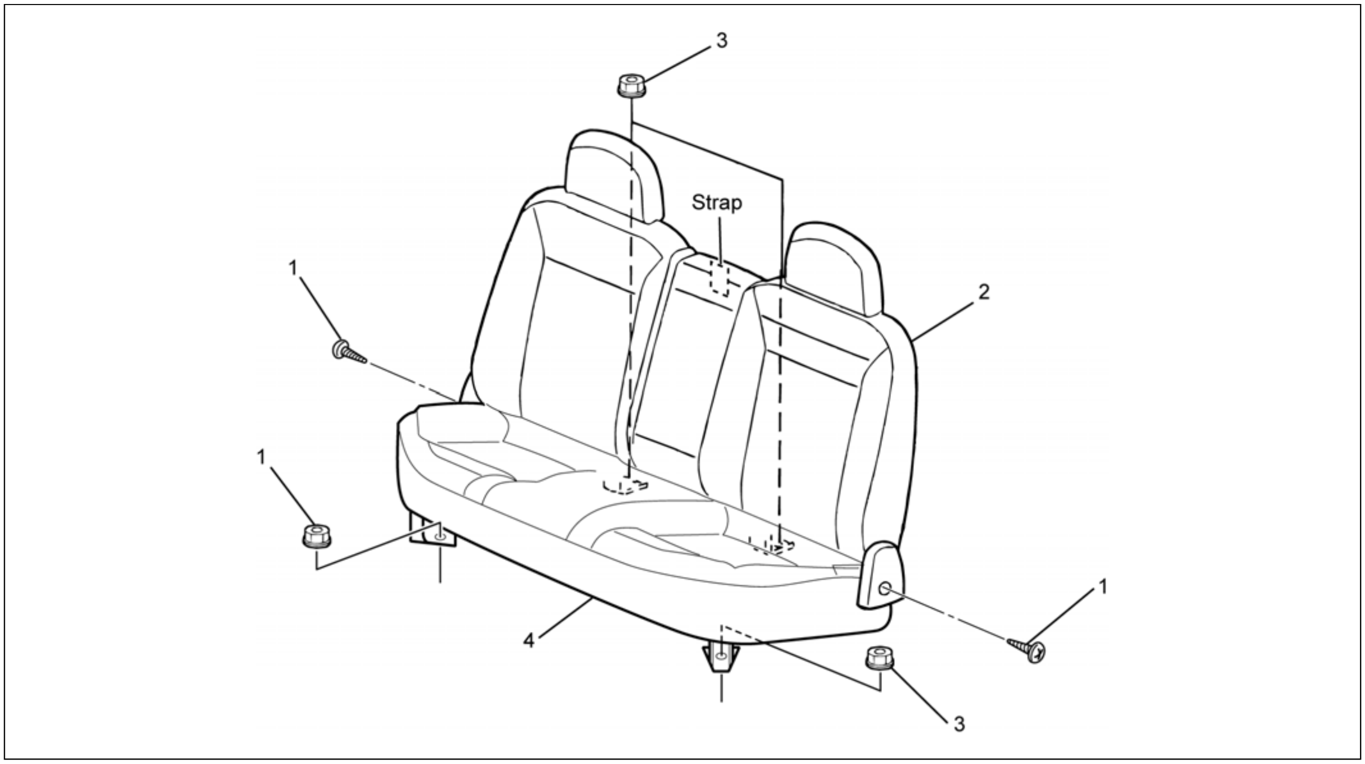
Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

3. Bolt: Seat Assembly to Floor Panel

Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

REAR SEAT (CREW CAB)

REMOVAL AND INSTALLATION



RTW7A0MF000801

Removal Steps

1. Screw
2. ▲ Rear seat back
3. Nut
4. Rear seat cushion

Installation Steps

4. Rear seat cushion
3. ▲ Nut
2. ▲ Rear seat back
1. Screw

Important Operation - Removal

2. Rear Seat Back

- Pull the strap in trim cover to release the seat back from the rear panel.

Important Operations - Installation

3. Nut

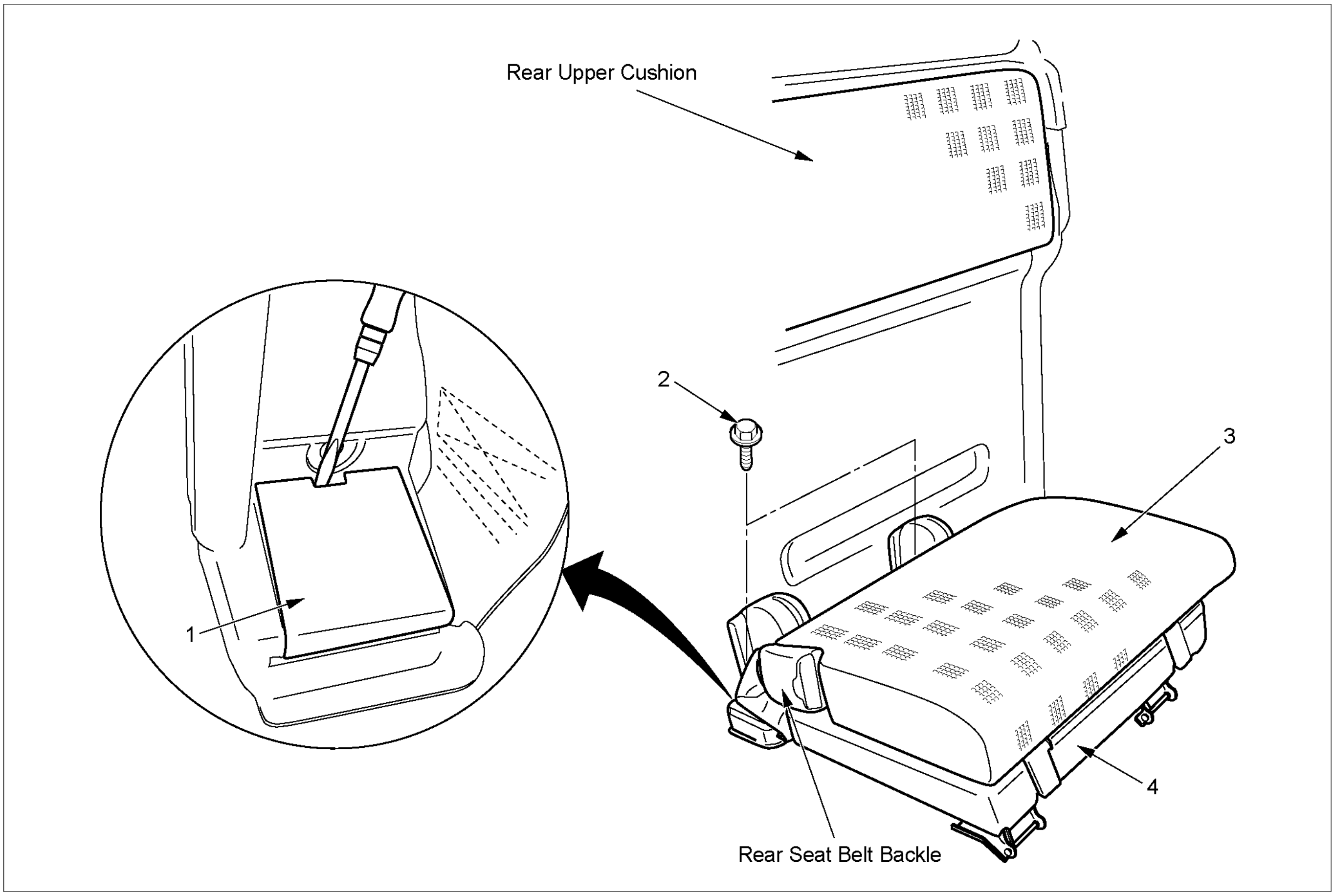
Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

2. Rear Seat Back

- Lock the seat back to the rear panel and insert the strap into the trim cover.

JUMP SEAT (EXTEND CAB)

REMOVAL AND INSTALLATION



RTW3A0MF001201

Removal Steps

1. Cover
2. Bolt
3. Jump seat assembly
4. Storage box

Installation Steps

4. Storage box
3. Jump seat assembly
▲ 2. Bolt
1. Cover

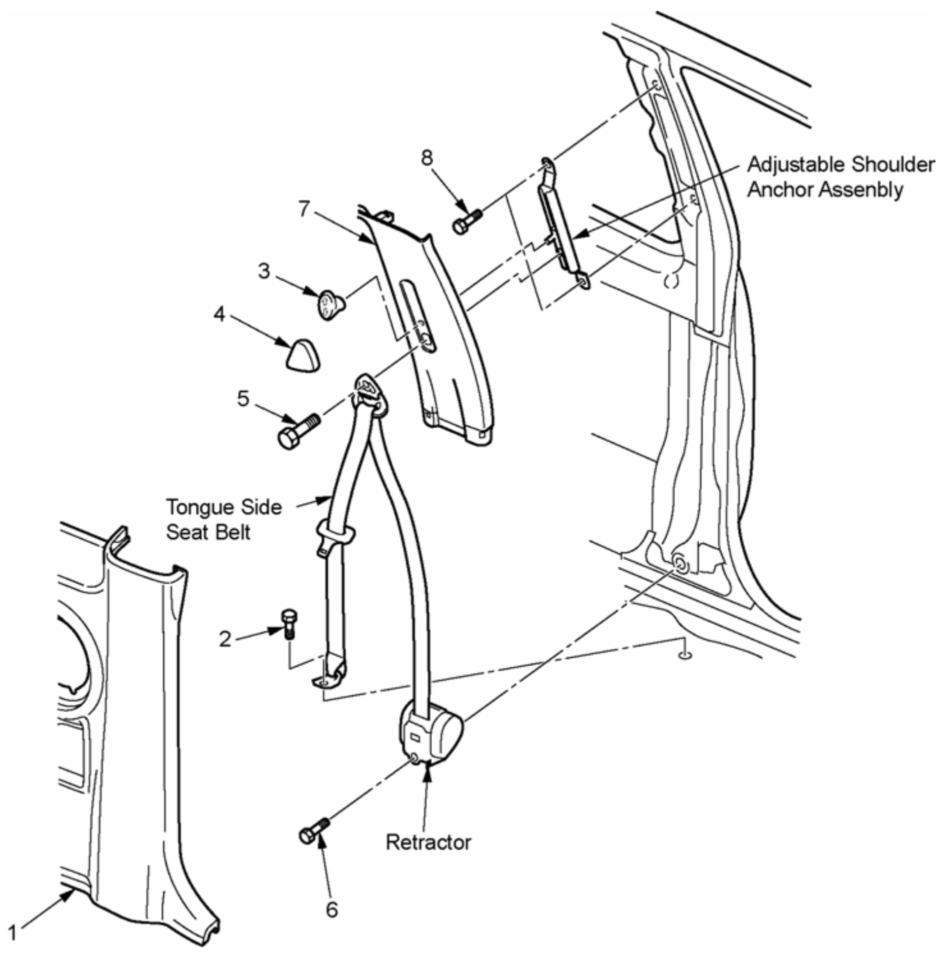
Important Operation - Installation

2. Bolt

Bolt Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

FRONT SEAT BELT

REMOVAL AND INSTALLATION (TONGUE SIDE SEAT BELT)



RTW5A0LF001101

Removal Steps

1. Body side rear lower trim cover
2. Lower anchor bolt
3. ▲ 3. Knob
4. ▲ 4. Cover
5. ▲ 5. Upper anchor bolt
6. Retractor fixing bolt
7. Body side rear upper trim cover
8. Adjustable shoulder anchor fixing bolt

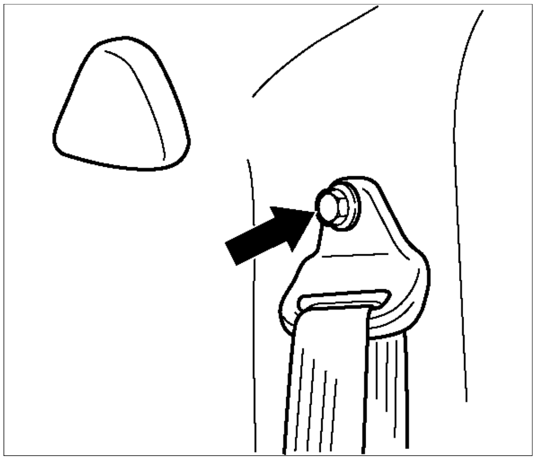
Installation Steps

▲ 8. Adjustable shoulder anchor fixing bolt
7. Body side rear upper trim cover
▲ 6. Retractor fixing bolt
▲ 5. Upper anchor bolt
4. Cover
3. Knob
▲ 2. Lower anchor bolt
1. Body side rear lower trim cover

Important Operations - Removal

3. Knob

- Pull out the knob.



RTW5A0SH000501

4. Cover

5. Upper Anchor Bolt

- Remove the seat belt upper anchor bolt.
- Insert the blade of an ordinary screwdriver into the gap between the D-ring back surface and the cover. Carefully pry the D-ring latches open. Remove the cover.

Important Operations - Installation

8. Adjustable Shoulder Anchor Fixing Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

6. Retractor Fixing Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

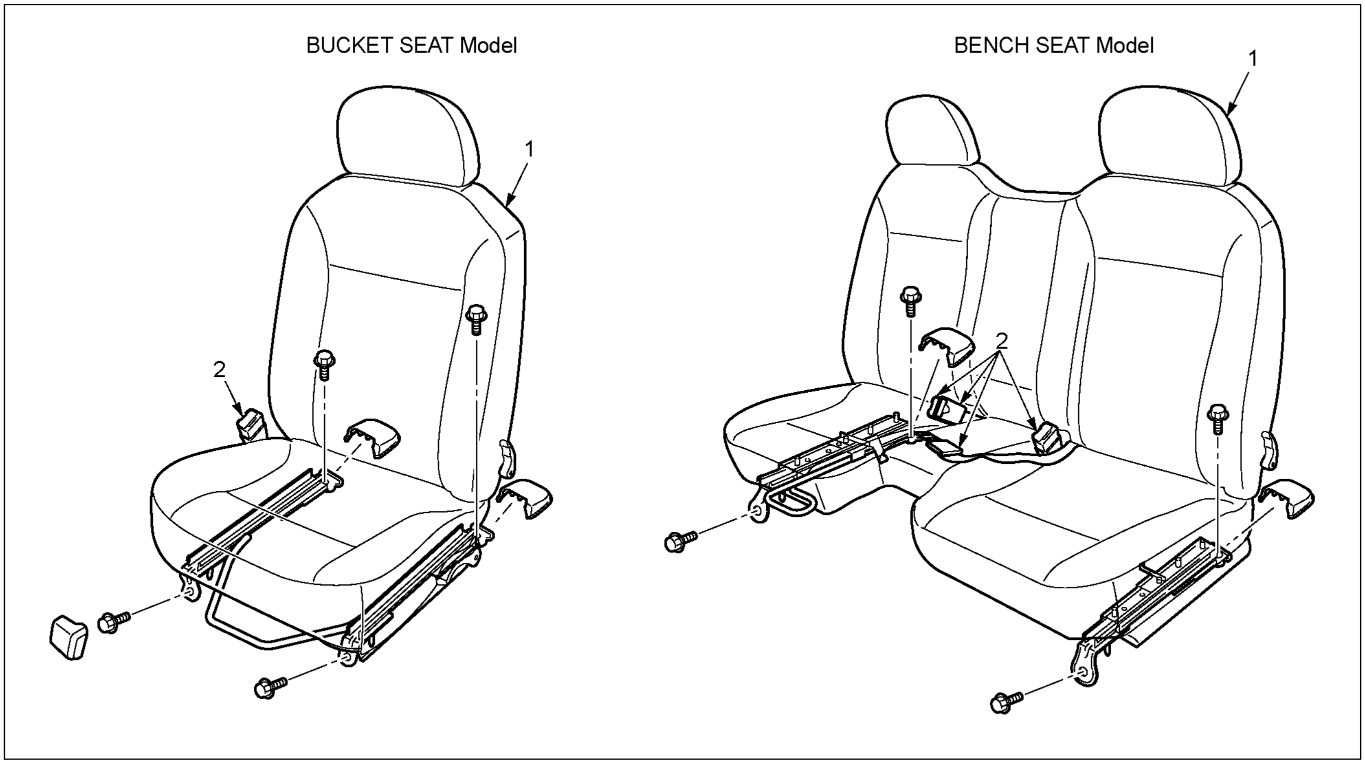
5. Upper Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

2. Lower Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

REMOVAL AND INSTALLATION (BUCKLE SIDE SEAT BELT/CENTER SEAT BELT)



RTW3A0MF000401

Removal Steps

▲ 1. Front seat assembly
▲ 2. Buckle side seat belt/center seat belt

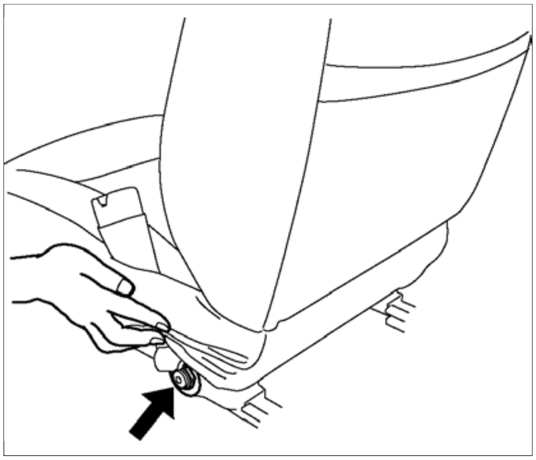
Installation Steps

▲ 2. Buckle side seat belt/center seat belt
▲ 1. Front seat assembly

Important Operations - Removal

1. Front Seat Assembly

- Refer to Front Seat in this section.



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2. Buckle Side Seat Belt/Center Seat Belt

- Remove the seat belt fixing screw and the warning harness connector clip (Bucket seat model).

- Remove the seat belt fixing screws and the warning harness connector clip (Bench seat model).

Important Operations - Installation

2. Buckle Side Seat Belt/Center Seat Belt

- Tighten the seat belt fixing screws to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

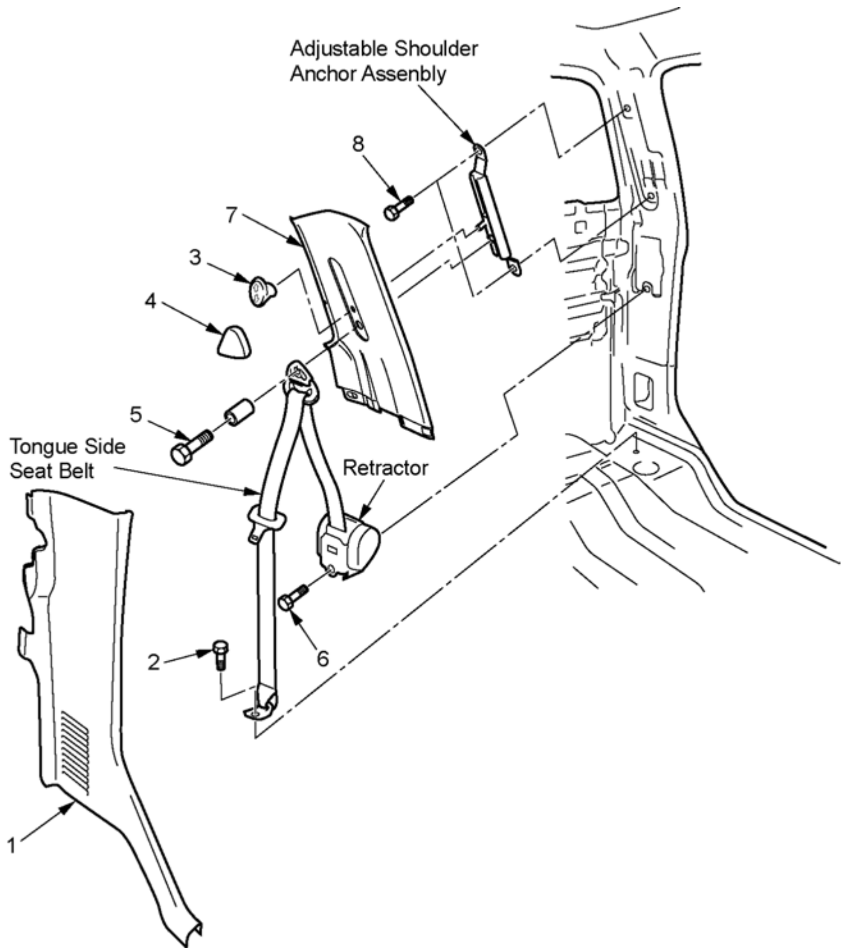
1. Front Seat Assembly

- Tighten the seat assembly fixing bolts to the specified torque.

Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

REAR SEAT BELT (CREW CAB)

REMOVAL AND INSTALLATION (TONGUE SIDE SEAT BELT)



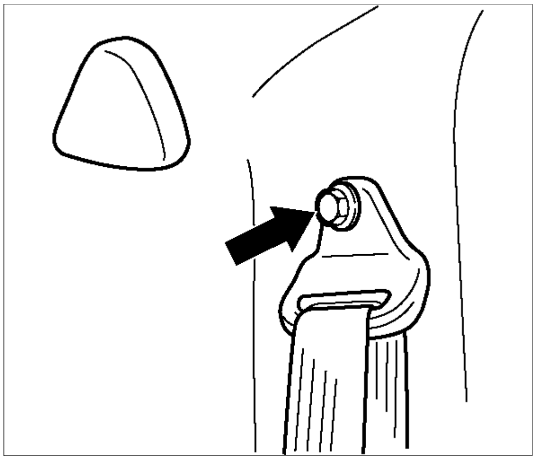
RTW5A0LF001001

Removal Steps

1. Body side rear lower trim cover
2. Lower anchor bolt
▲ 3. Knob
▲ 4. Cover
▲ 5. Upper anchor bolt
6. Retractor fixing bolt
7. Body side rear upper trim cover
8. Adjustable shoulder anchor fixing bolt

Installation Steps

▲ 8. Adjustable shoulder anchor fixing bolt
7. Body side rear upper trim cover
▲ 6. Retractor fixing bolt
▲ 5. Upper anchor bolt
4. Cover
3. Knob
▲ 2. Lower anchor bolt
1. Body side rear lower trim cover



RTW5A0SH000501

Important Operations - Removal

3. Knob

- Pull out the knob.

4. Cover

5. Upper Anchor Bolt

- Remove the seat belt upper anchor bolt.
- Insert the blade of an ordinary screwdriver into the gap between the D-ring back surface and the cover. Carefully pry the D-ring latches open. Remove the cover.

Important Operations - Installation

8. Adjustable Shoulder Anchor Fixing Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

6. Retractor Fixing Bolt

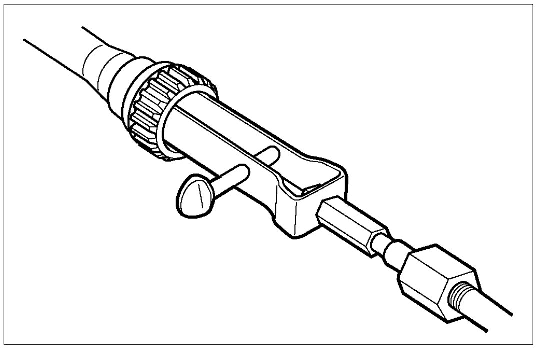
Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

5. Upper Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

2. Lower Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	


412RS045

14.Needle Bearing

Remove needle bearing from inner shaft by using a special tool.

Remover : 5-8840-0027-0

Sliding hammer : 5-8840-0084-0

NOTE:

Be careful not to damage the shaft.

15.Oil Seal

Remove oil seal from front axle case.

NOTE:

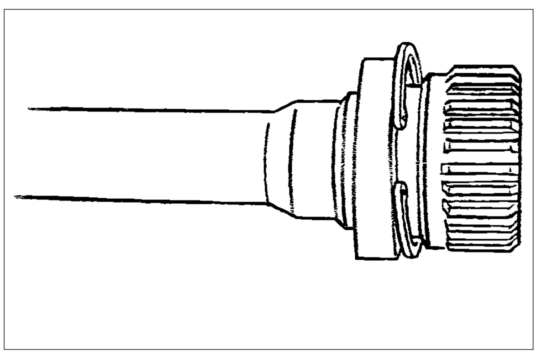
Be careful not to damage the front axle case.

Inspection and Repair

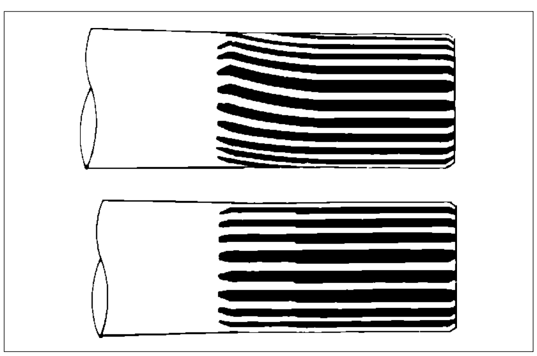
Inspect the removed parts. If there are abnormalities such as wear and damage, take corrective action or replace.

Visual Check

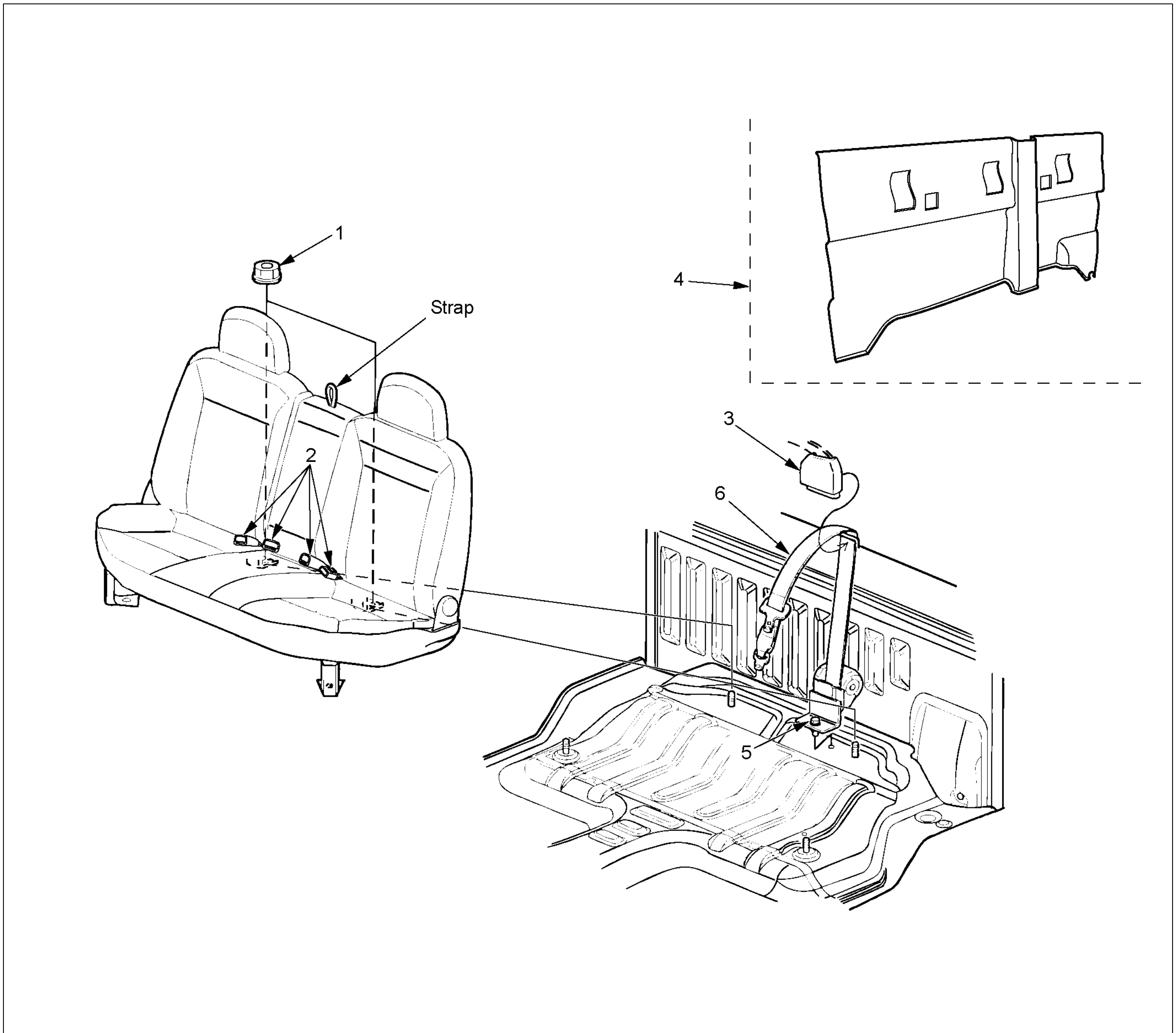
- Check and see if the inner shaft has such abnormalities as wear and damage.


412RW014

- When inspecting the inner shaft, be sure to check and see if its splined part is twisted, worn, or cracked. If so, replace with a new shaft. In case such an abnormality in its gear part (a slide with sleeve), replace the shaft.


412RS008

REMOVAL AND INSTALLATION (REAR CENTER SEAT BELT/REAR SEAT BELT BACKLE)



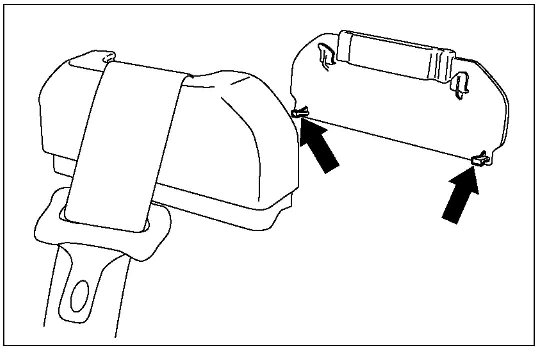
RTW3A0LF000901

Removal Steps

1. Nut
2. Rear seat belt buckle
3. ▲ Cover
4. ▲ Rear end trim cover
5. Bolt
6. Rear center seat belt

Installation Steps

▲ 6. Rear center seat belt
▲ 5. Bolt
4. Rear end trim cover
3. Cover
2. Rear seat belt buckle
▲ 1. Nut



RTW3A0SH000601

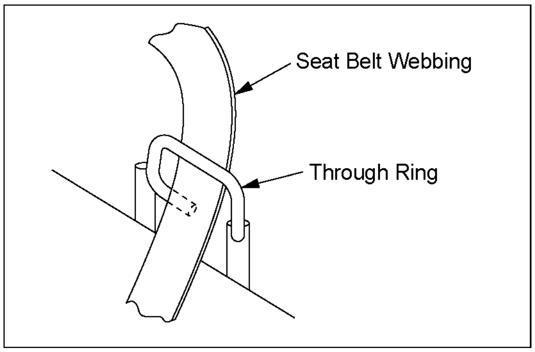
Important Operations - Removal

3. Cover

- Pry the lower portion of the cover and remove it.

4. Rear End Trim Cover

- Refer to Interior Trim Panels in this section.



RTW3A0SH001601

Important Operations - Installation

6. Rear Center Seat Belt

- Install the seat belt webbing through the through ring on the back panel as shown in the illustration.

5. Bolt: Rear Center Seat Belt to Floor Panel

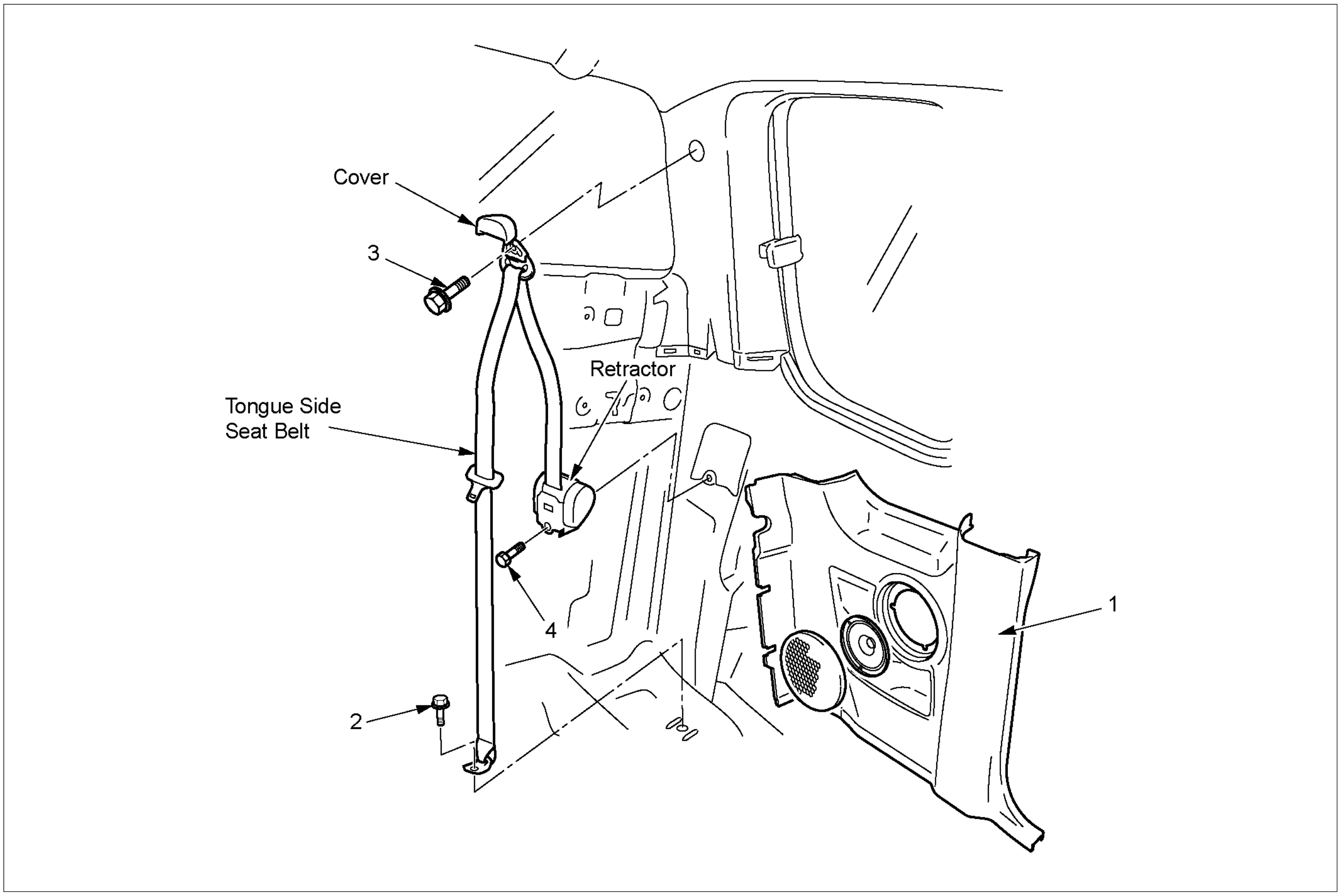
Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

1. Nut: Rear Seat Assembly/Rear Seat Belt Buckle to Floor Panel

Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

REAR SEAT BELT (EXTEND CAB)

REMOVAL AND INSTALLATION (TONGUE SIDE SEAT BELT)



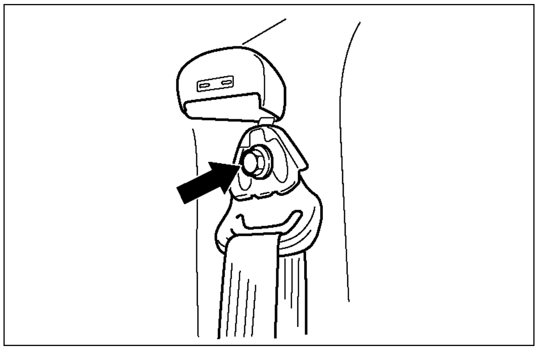
RTW3A0MF000701

Removal Steps

▲ 1. Body side rear lower trim cover
2. Lower anchor bolt
▲ 3. Upper anchor bolt
4. Retractor fixing bolt

Installation Steps

▲ 4. Retractor fixing bolt
▲ 3. Upper anchor bolt
▲ 2. Lower anchor bolt
1. Body side rear lower trim cover


RTW3A0SH000301

Important Operations - Removal

1. Body Side Rear Lower Trim Cover

- Refer to Interior Trim Panels in this section.

3. Upper anchor bolt

- Open the through ring anchor cover and remove the seat belt upper anchor bolt

Important Operations - Installation

4. Retractor Fixing Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

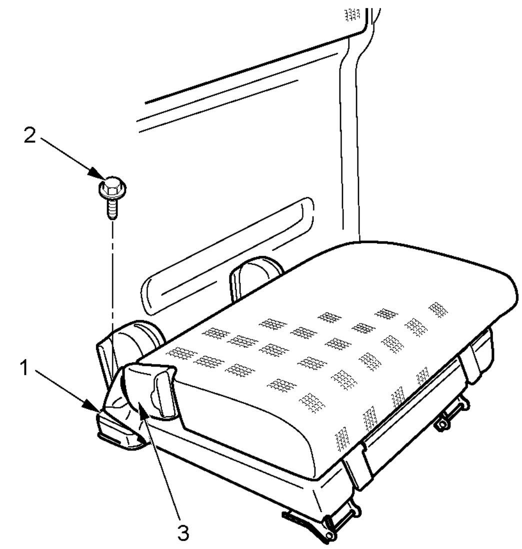
3. Upper Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

2. Lower Anchor Bolt

Bolt torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

REMOVAL AND INSTALLATION (REAR SEAT BELT BACKLE)



RTW3A0SF000201

Removal Steps

▲ 1. Cover
2. Bolt
3. Rear seat belt buckle

Installation Steps

3. Rear seat belt buckle
▲ 2. Bolt
1. Cover

Important Operation - Removal

1. Cover

- Refer to Jump Seat (Extend Cab) in this section.

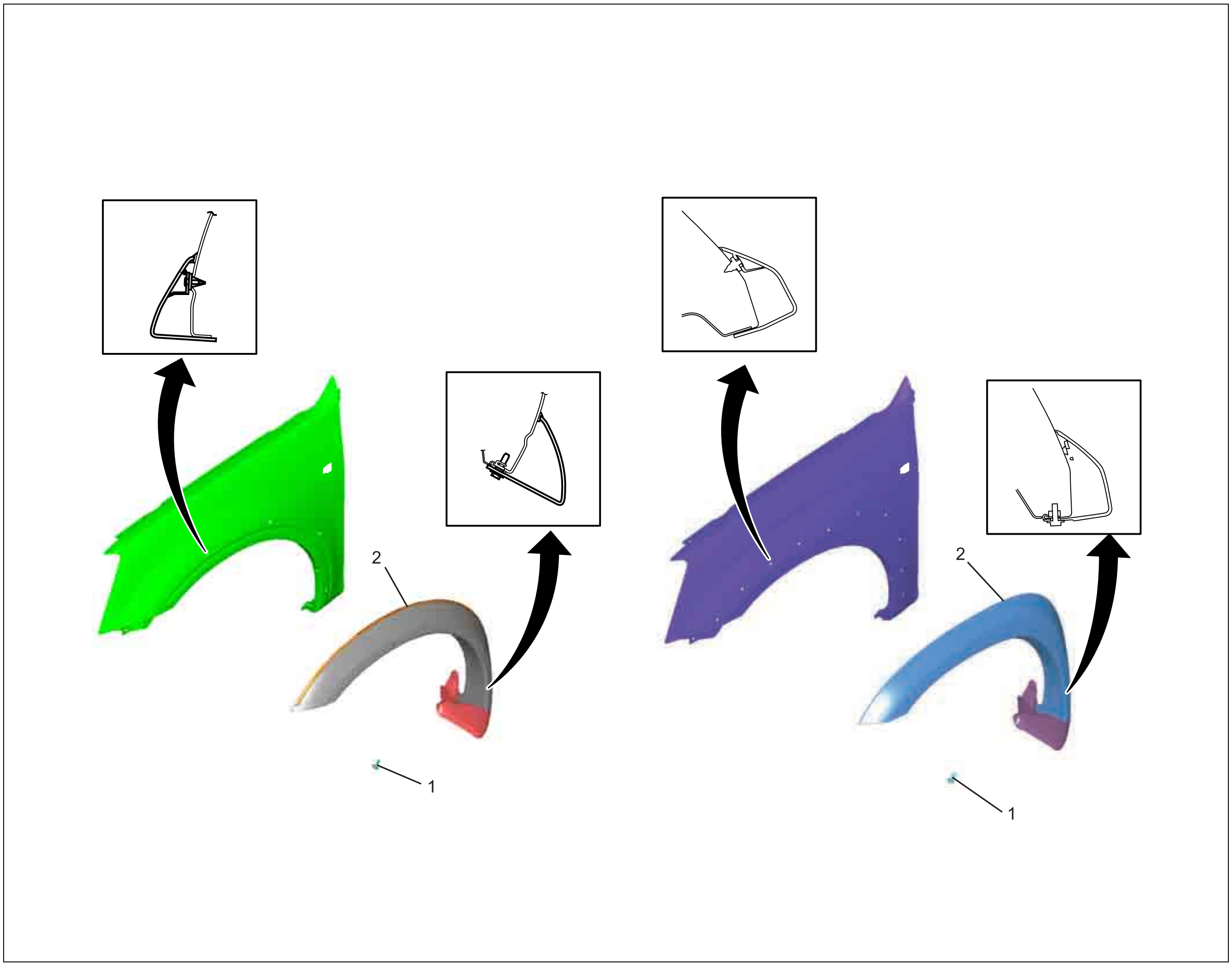
Important Operation - Installation

2. Bolt: Jump Seat Assembly/Rear Seat Belt Buckle to Floor Panel

Torque	N·m (kgf·m/lb·ft)
40 (4.1 / 30)	

FRONT WHEEL EXTENSION (A TYPE)

REMOVAL AND INSTALLATION



RTW7A0LF001101

Removal Steps

1. Screw
▲ 2. Front wheel extension

Installation Steps

2. Front wheel extension
1. Screw

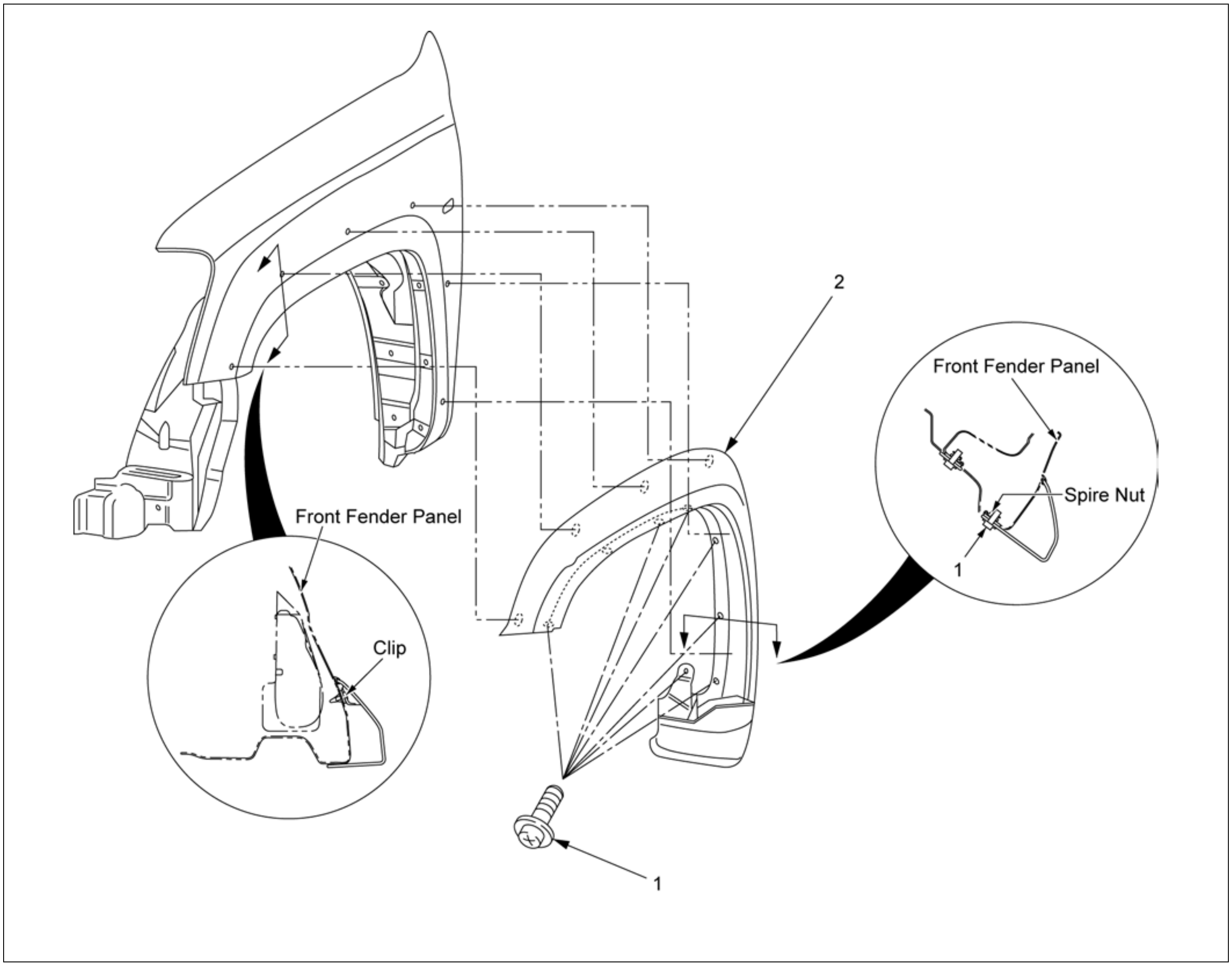
Important Operation - Removal

2. Front Wheel Extension

- Pull out the 10 clip positions

FRONT WHEEL EXTENSION (B TYPE)

REMOVAL AND INSTALLATION



RTW5A0LF000601

Removal Steps

1. Screw
▲ 2. Front wheel extension

Installation Steps

2. Front wheel extension
1. Screw

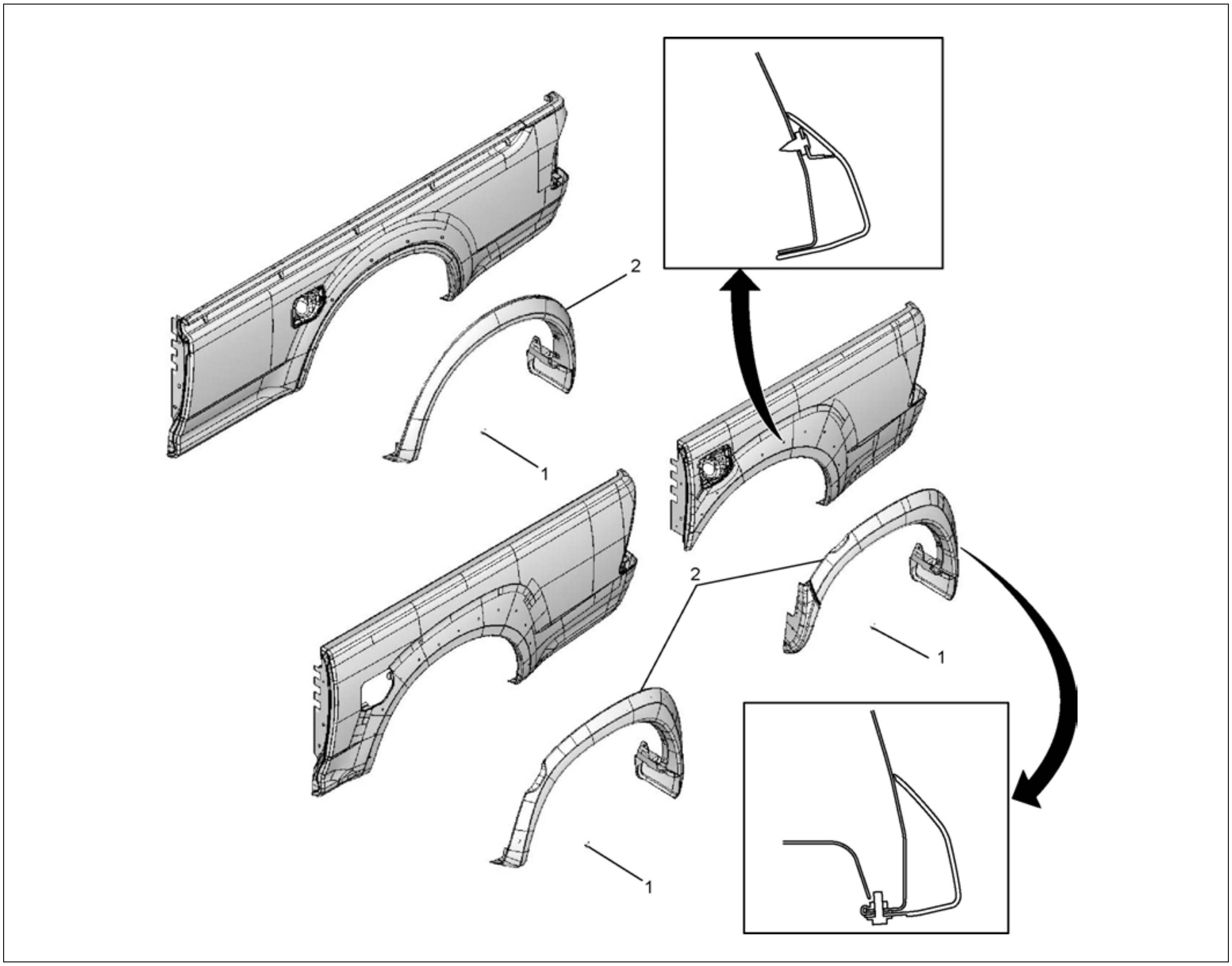
Important Operation - Removal

2. Front Wheel Extension

- Pull out the 6 clip positions

REAR WHEEL EXTENSION (A TYPE)

REMOVAL AND INSTALLATION



RTW7A0LF001601

Removal Steps

1. Screw
▲ 2. Rear wheel extension

Installation Steps

2. Rear wheel extension
1. Screw

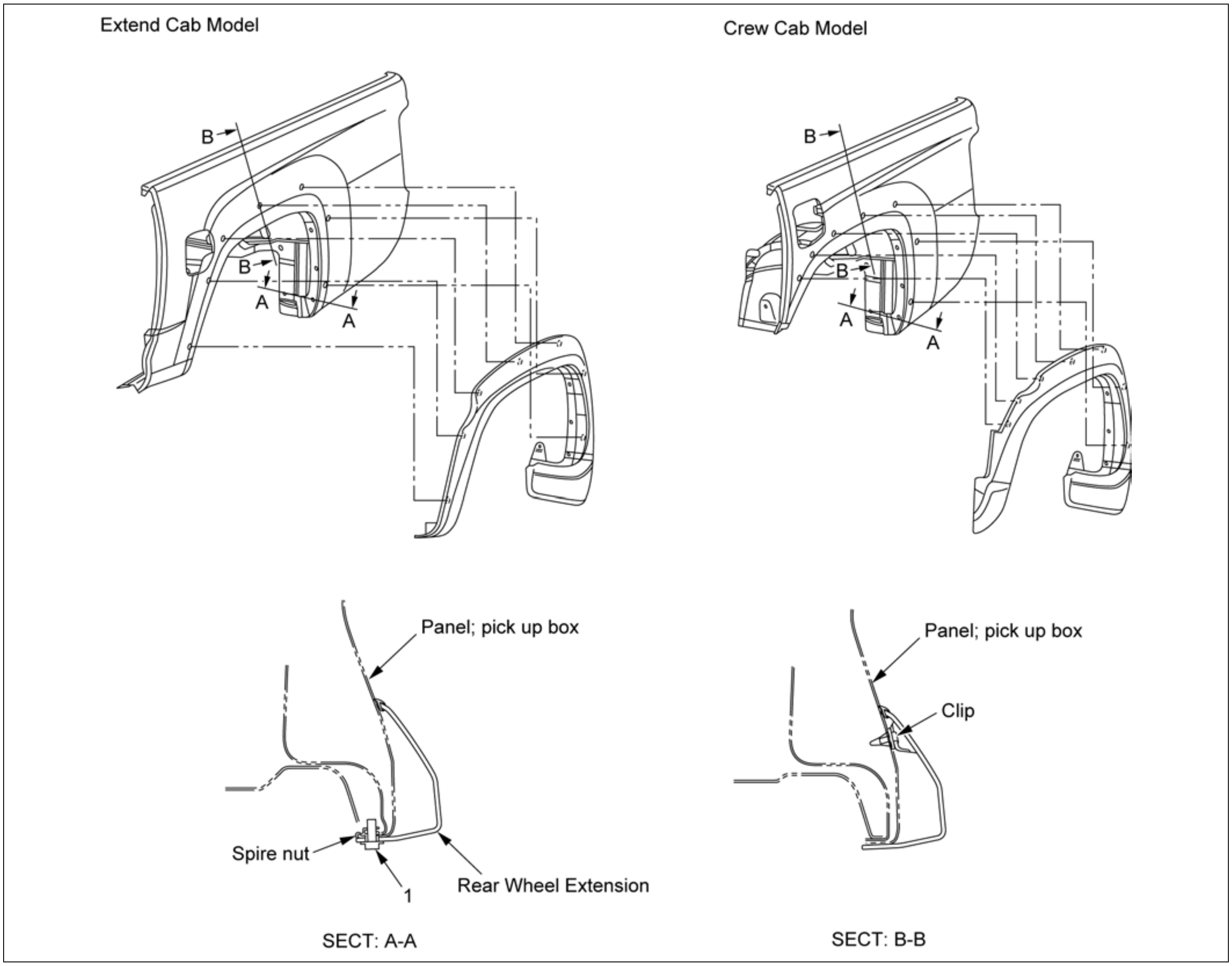
Important Operation - Removal

2. Rear Wheel Extension

- Pull out the 6 clip positions (Regular cab)
- Pull out the 13 clip positions (Extend cab)
- Pull out the 10 clip positions (Crew cab)

REAR WHEEL EXTENSION (B TYPE)

REMOVAL AND INSTALLATION



RTW5A0LF000501

Removal Steps

1. Screw
▲ 2. Rear wheel extension

Installation Steps

2. Rear wheel extension
1. Screw

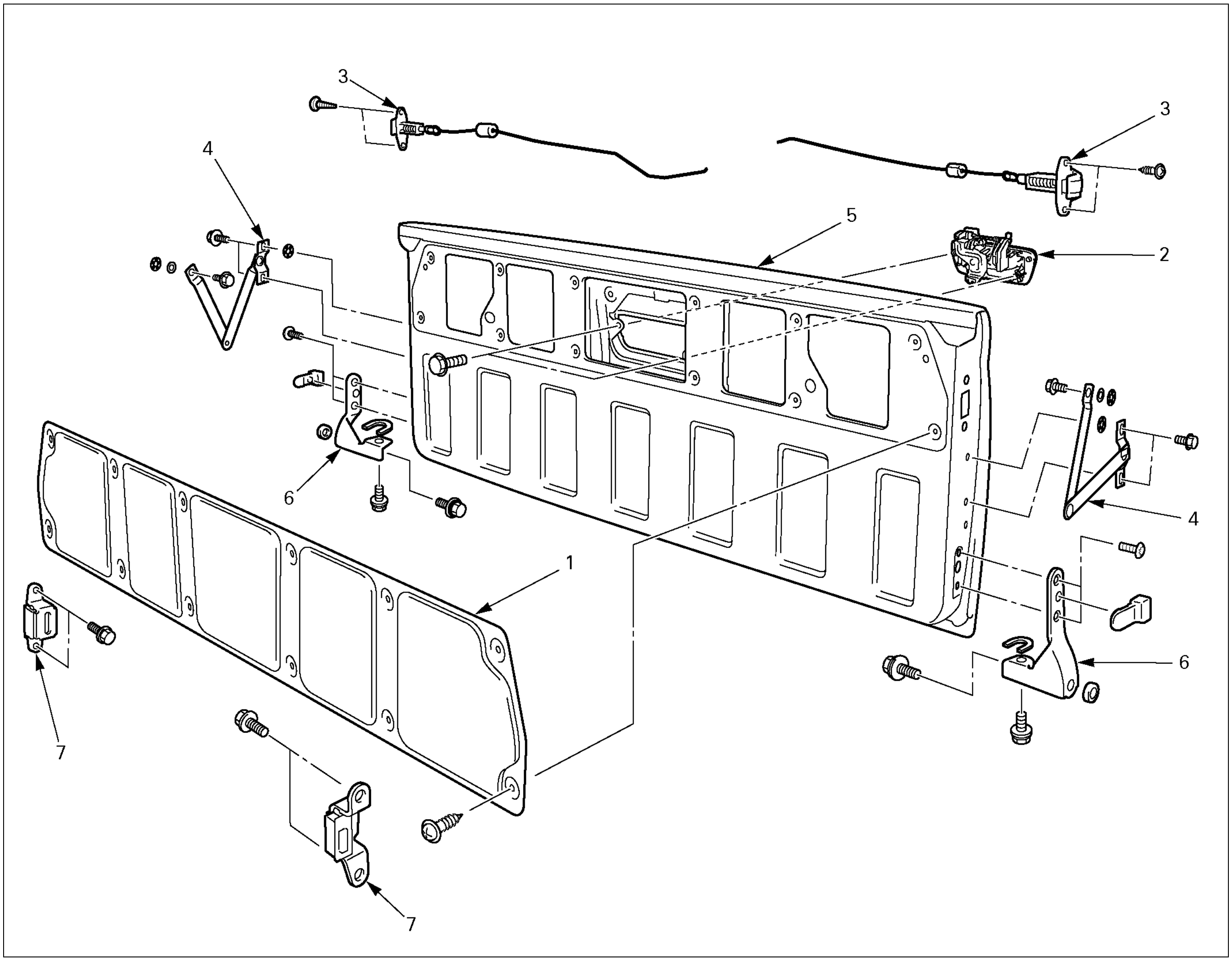
Important Operation - Removal

2. Rear Wheel Extension

- Pull out the 7 clip positions

TAIL GATE ASSEMBLY

REMOVAL AND INSTALLATION



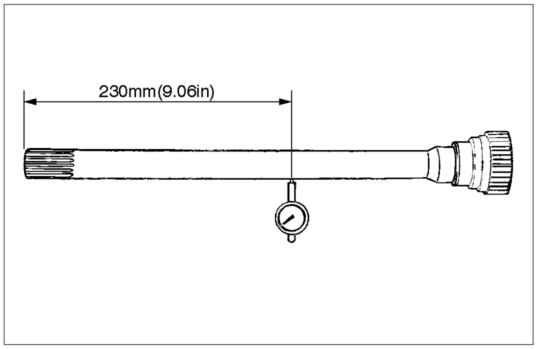
Center Pull Handle Model

Removal Steps

1. Hole cover plate
2. ▲ Outside handle assembly
3. Tail gate lock assembly
4. Tail gate link
5. ▲ Tail gate
6. Tail gate hinge
7. Tail gate lock striker

Installation Steps

7. ▲ Tail gate lock striker
6. ▲ Tail gate hinge
5. ▲ Tail gate
4. Tail gate link
3. ▲ Tail gate lock assembly
2. ▲ Outside handle assembly
1. Hole cover plate



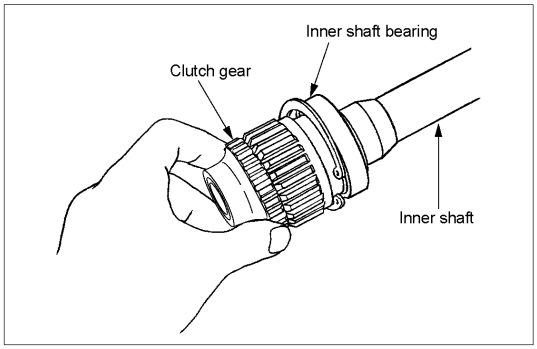
412RS026

Inner Shaft Run-Out

With both end centers supported, rotate the shaft slowly and measure deflection with a dial gauge.

Inner Shaft Run-Out (Limit) mm (in)
0.5 (0.02)

NOTE:
Do not heat the shaft to correct its bend.



RTW440SH000101

Inner Shaft Bearing

Inspect the state of inner shaft bearing. If any abnormality such as smooth less is found, replace with a new inner shaft bearing.

Insert a clutch gear and check the state of needle bearing.

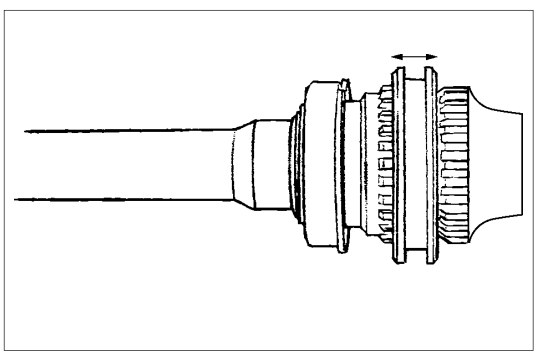
If there is an abnormality such as smooth less, replace the needle bearing.

Sleeve

Visual Check

Check and see that there is not wear, damage, or checking in the sleeve.

NOTE:
Close inspection of the groove and inner gear are required because those are important parts.

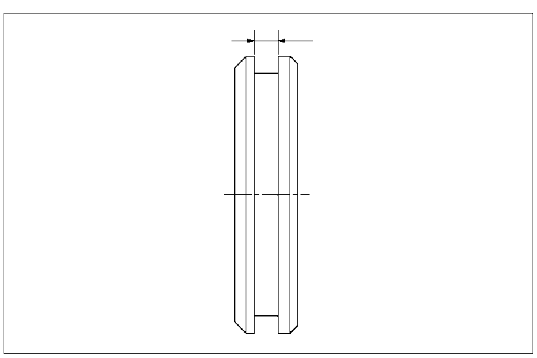

412RW011

Functional Check

Operate the sleeve with the inner shaft combined with the clutch gear.

If smooth less is felt, replace the sleeve.

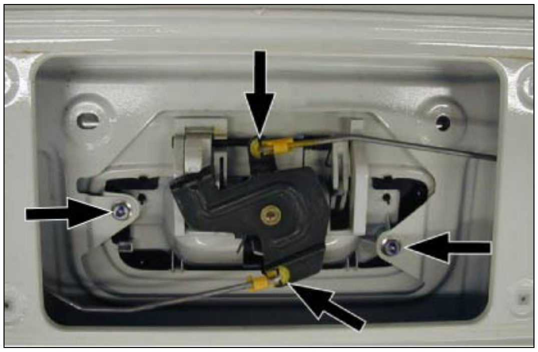
NOTE:
Gear oil should be applied to the contact surface of gear.


412RW022

Dimensional Check

Check the width of sleeve center groove.

Sleeve Center Groove (Limit) mm (in)
7.1 (0.28)



Important Operations - Removal

2. Outside handle assembly

- Disconnect the lock link and remove the 2 fixing bolts.

5. Tail Gate

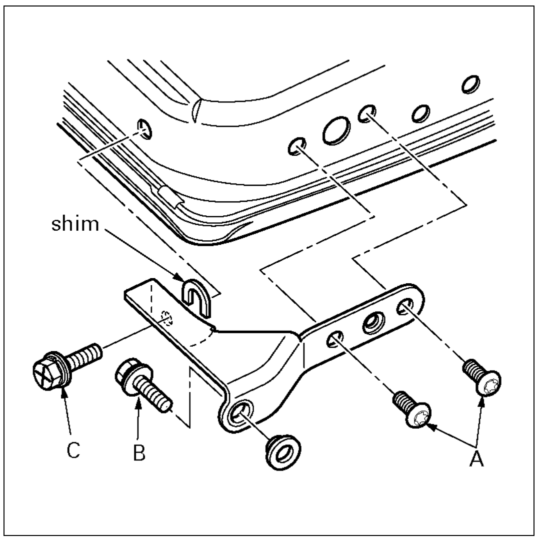
1) Removing the tailgate assembly may require two people.
2) Remove the tailgate hinge fixing bolts.

Important Operations - Installation

7. Tail Gate Lock Striker

- Tighten the lock striker fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·ft)
15 (1.5 / 11)	



6. Tail Gate Hinge

- Tighten the hinge fixing bolts to the specified torque.
  C: Bolt

Torque	N·m(kgf·m/lb·ft)
40 (4.1 / 30)	

5. Tail Gate

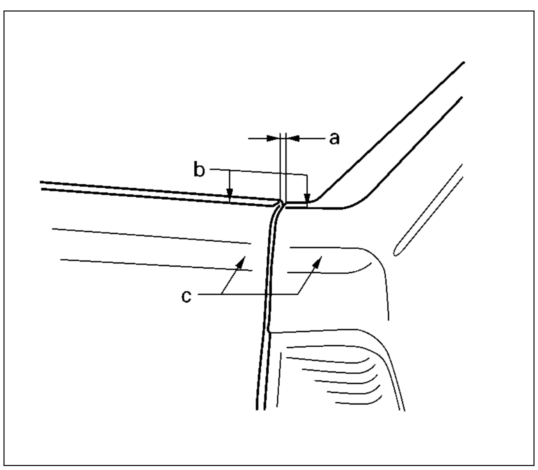
1) A: Bolts

Torque	N·m(kgf·m/lb·in)
13 (1.3 / 113)	

2) B: Bolt

Torque	N·m(kgf·m/lb·in)
13 (1.3 / 113)	

3) Check the tailgate and rear body.
   a. Clearance: 5.0 mm (0.20 in.)
   b. Height (Step): Flush
   c. Height (Step): Flush



3. Tail Gate Lock Assembly

- Tighten the lock assembly fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·ft)
15 (1.5 / 11)	

2. Outside Handle Assembly

- Tighten the outside handle assembly fixing bolts to the specified torque.

Torque	N·m(kgf·m/lb·in)
9 (0.9 / 78)	

SECTION 11

SECURITY

TABLE OF CONTENTS

IMMOBILIZER CONTROL SYSTEM (4JK1/4JJ1/HFV6)

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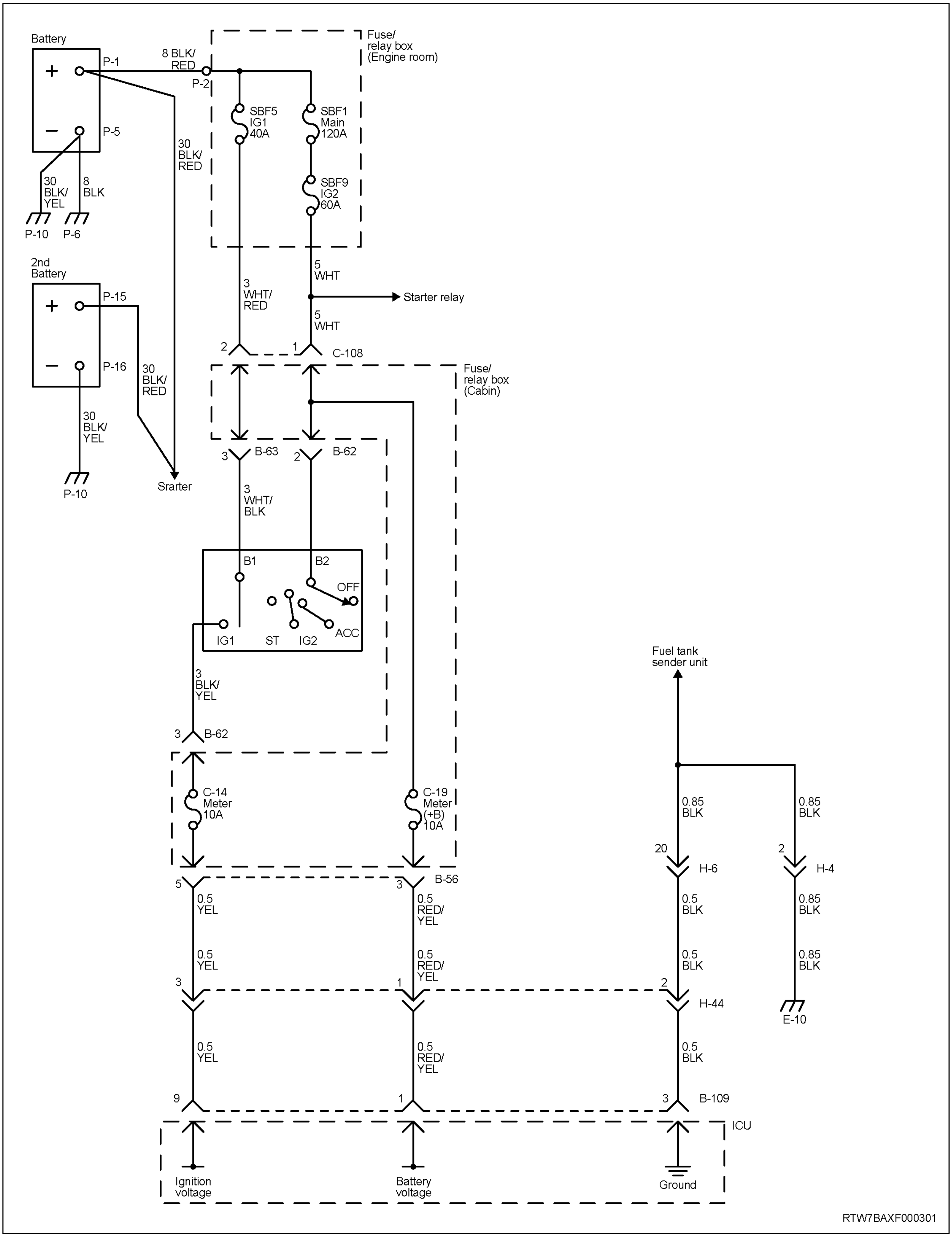
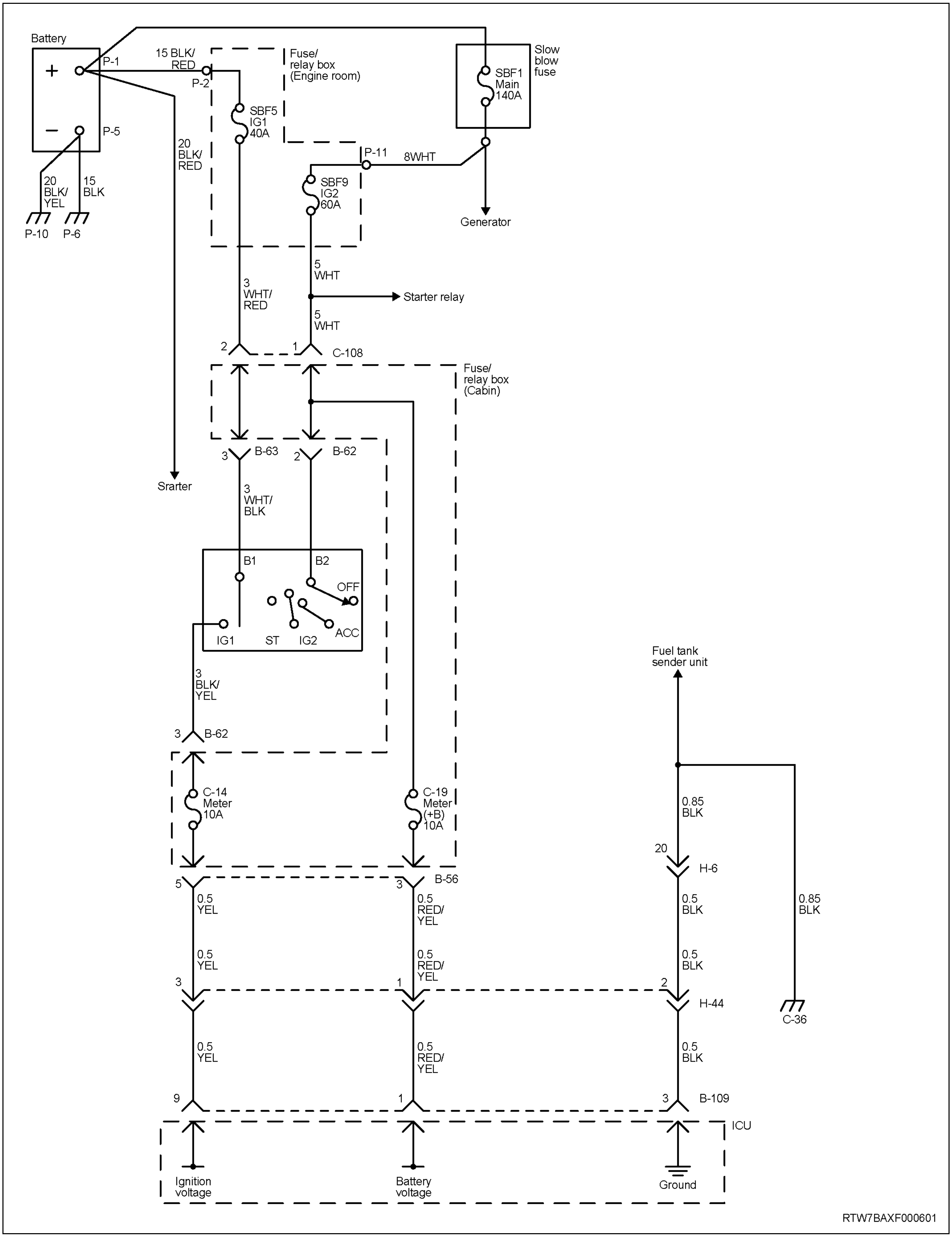
Schematic and Routing Diagrams

Immobilizer Controls Schematics

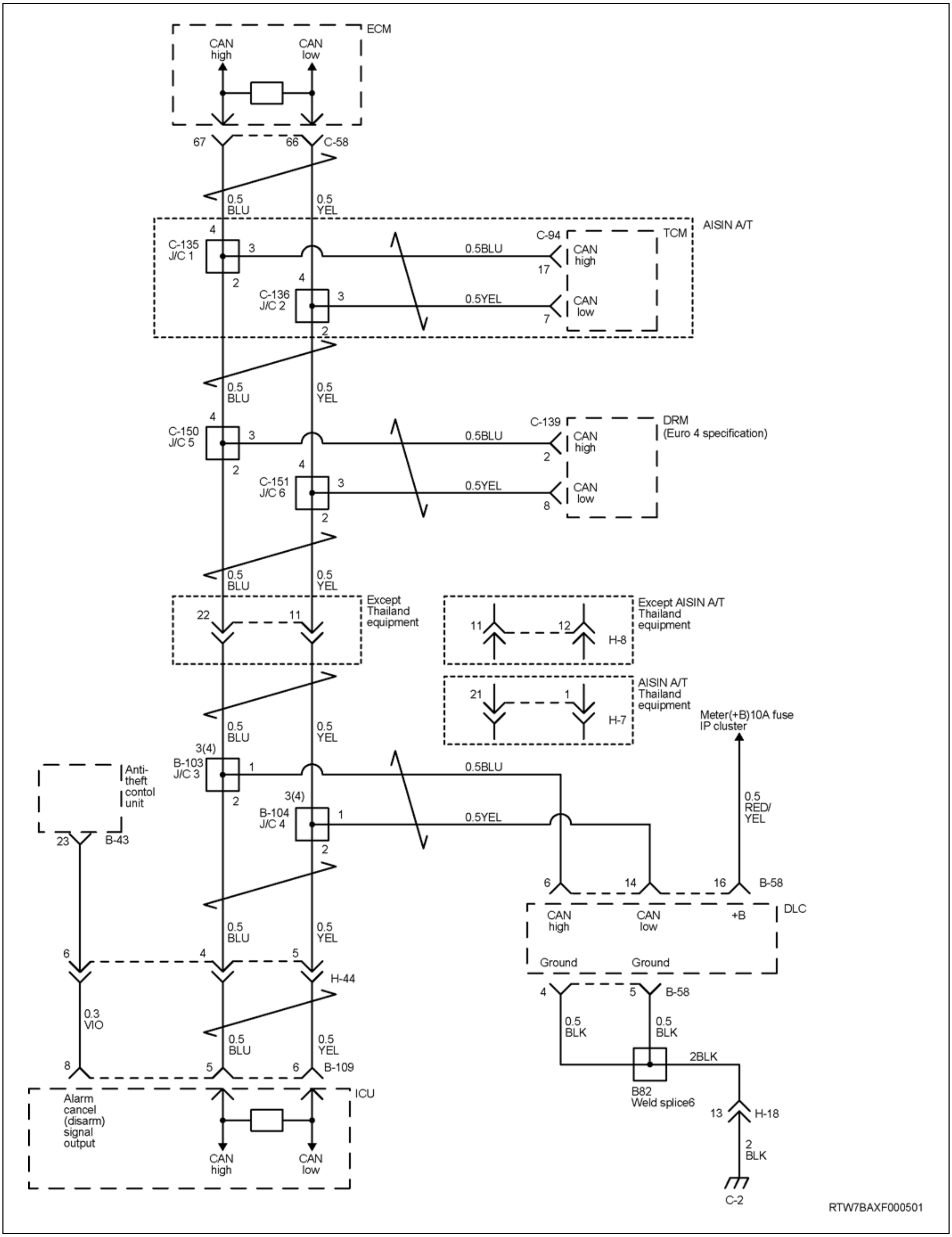
Power Distribution (4JK1/4JJ1)



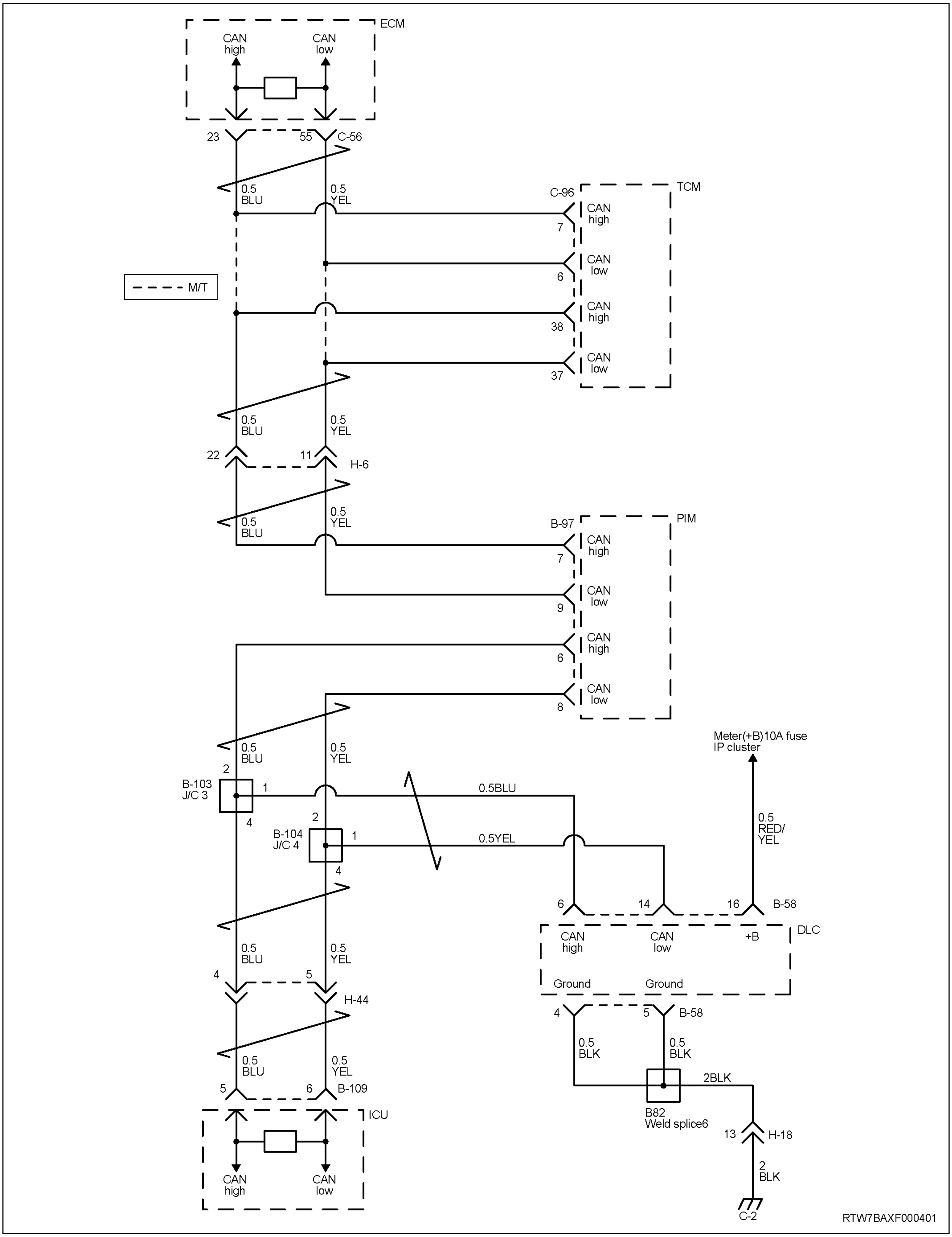
Power Distribution (HFV6)



ICU Communication (4JK1/ 4JJ1)



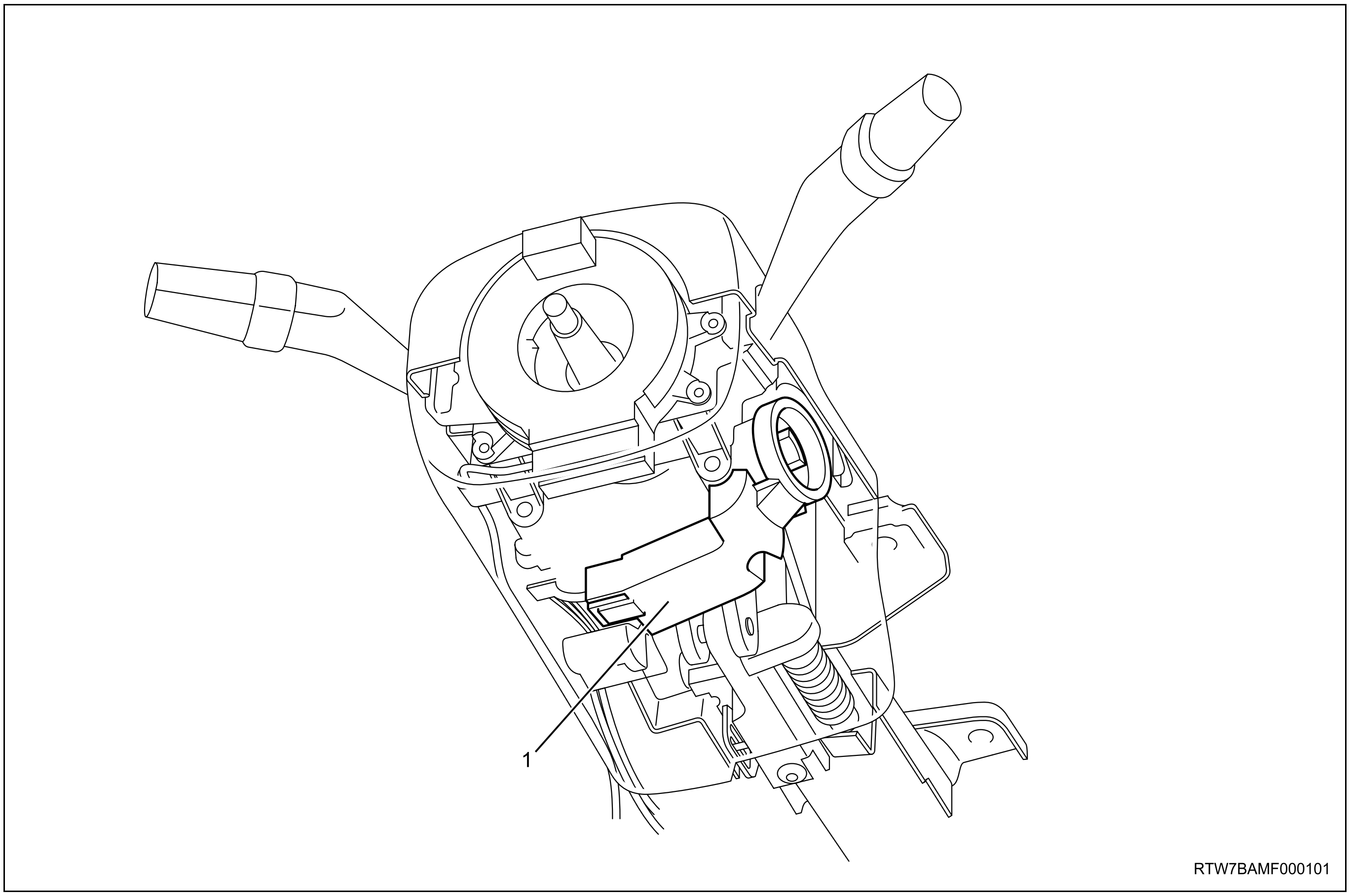
ICU Communication (HFV6)



Component Locator

Immobilizer Controls Component View

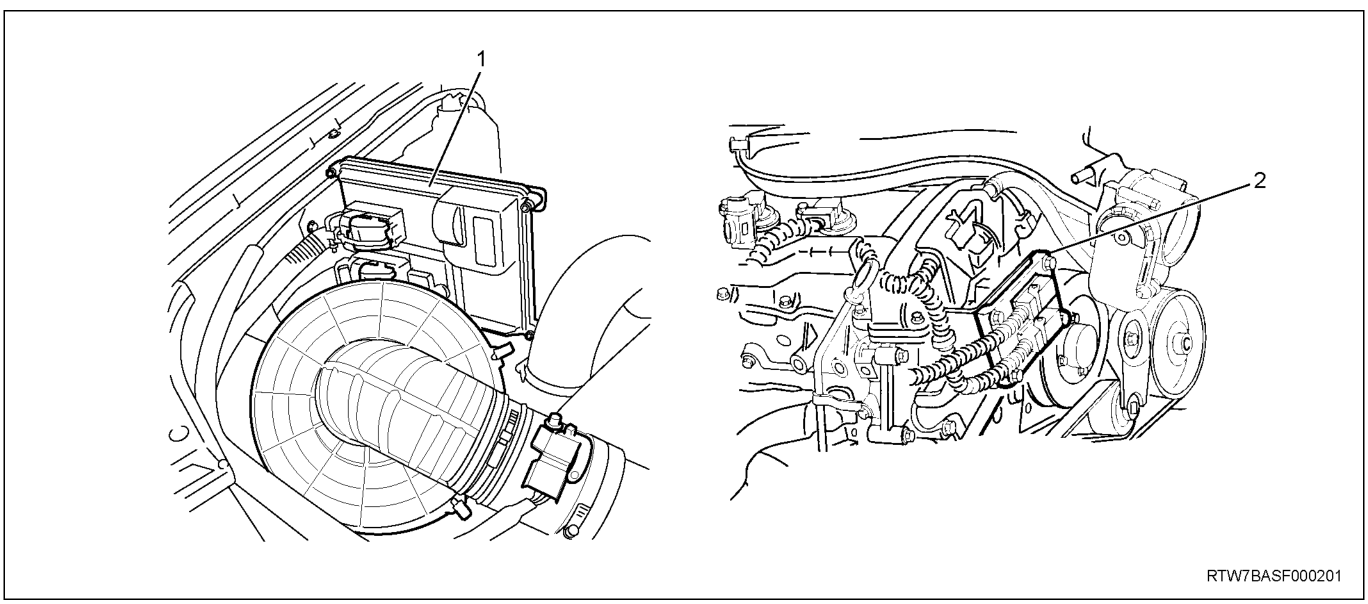
Immobilizer Controls unit (ICU)



Legend

1. Immobilizer controls unit (ICU)

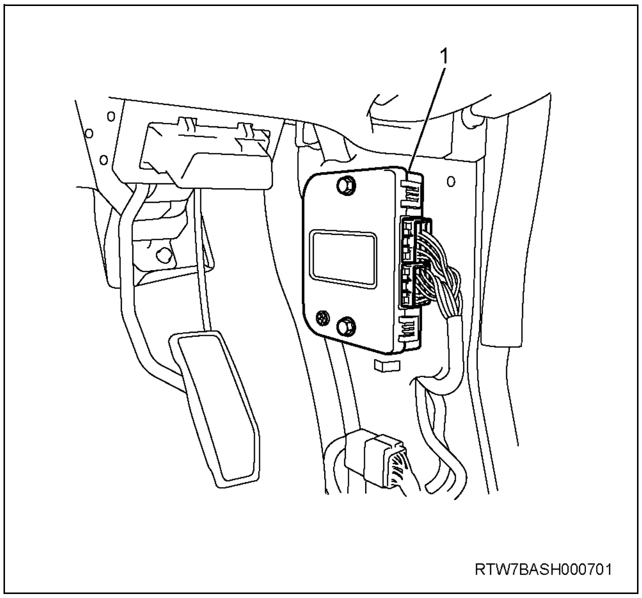
Engine Control Module (ECM)



Legend

1. Engine control module (ECM) (4JK1/ 4JJ1)
2. Engine control module (ECM) (HFV6)

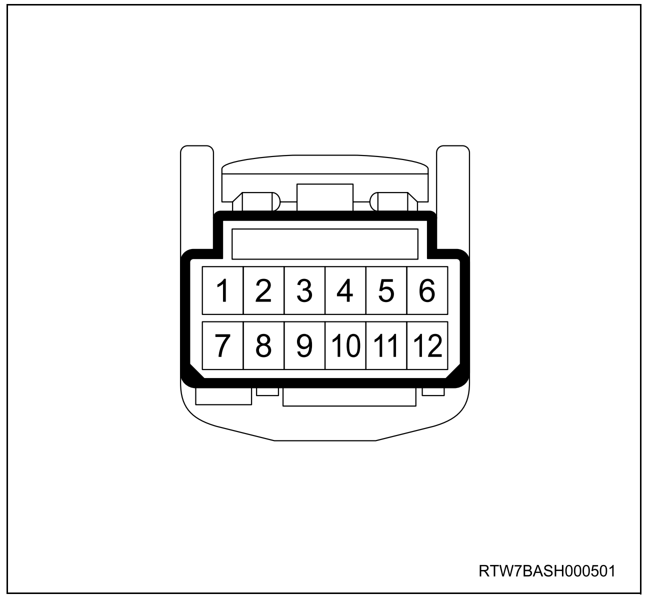
Powertrain Interface Module (PIM)



Legend

1. Powertrain interface module (PIM)

Immobilizer Control Unit (ICU) Connector End View



Connector No.		B-109
Connector Color		White
Test Adapter No.		J-35616-64A
Pin No.	Wire Color	Pin Function
1	RED/YEL	Battery voltage
2	-	Not used
3	BLK	Ground
4	-	Not used
5	BLU	CAN high
6	YEL	CAN low
7	-	Not used
8	VIO	Alarm cancel (disarm) signal output (with anti-theft system)
9	YEL	Ignition voltage
10	-	Not used
11	-	Not used
12	-	Not used

Diagnostic Information and Procedures

Diagnostic Starting Point - Immobilizer Controls

Begin the system diagnosis with Diagnostic System Check - Immobilizer Controls. The Diagnostic System Check - Immobilizer Controls will provide the following information:

- The identification of the control modules which command the system.
- The ability of the control modules to communicate through the serial data circuit.
- The identification of any stored diagnostic trouble codes (DTCs) and the their statuses.

The use of the Diagnostic System Check - Immobilizer Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

Diagnostic System Check - Immobilizer Controls

Description

The Diagnostic System Check - Immobilizer Controls is an organized approach to identifying a condition that is created by a malfunction in the electronic immobilizer control system. The Diagnostic System Check must be the starting point for any immobilizer system concern. The Diagnostic System Check directs the service technician to the next logical step in order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

Test Description

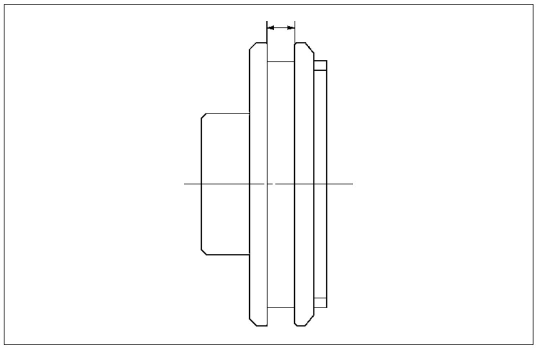
The numbers below refer to the step numbers on the diagnostic table.
2. Lack of communication may be because of a partial or a total malfunction of the serial data circuit.
6. The presence of DTCs which begin with U, indicate that some other module is not communicating.
9. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure.

Important:

- DO NOT perform this diagnostic if there is not an immobilizer system concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (-) are clean and tight.
- Ensure the ICU ground is clean, tight, and in the correct location.
- Ensure the ICU harness connector is clean and correctly connected.
- Ensure the ICU terminals are clean and correctly mating.
- Ensure the immobilizer security information is correctly programmed into the ICU, ECM and PIM.
- Ensure the ICU is correctly installed to the steering lock.
- Ensure objects does not block transponder key in the steering lock.
- Ensure another transponder key is not attached to the key ring.

Diagnostic System Check - Immobilizer Controls

Step	Action	Value(s)	Yes	No
1	Install a scan tool. Does the scan tool turn ON?	—	Go to Step 2	Go to Scan Tool Does Not Power Up
2	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. • ICU • Engine control module (ECM) • Powertrain interface module (PIM) • Transmission control module (TCM) (AISIN A/T or 4L-60E) Does the scan tool communicate with all the listed control modules?	—	Go to Step 3	Go to Scan Tool Does Not Communicate with CAN Device



RTW440SH000201

Clutch Gear

Visual Check

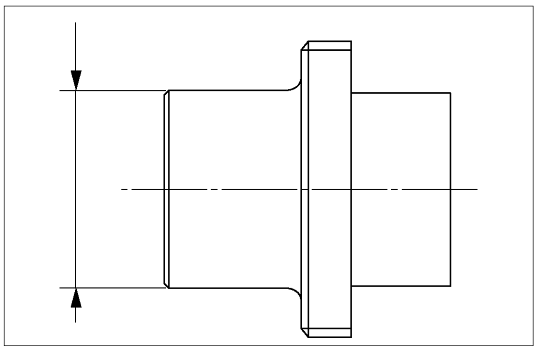
Check and see the there is not wear, damage, crack, or any other abnormality in the clutch gear.

Functional Check

If there is an abnormality such as smooth less when operated in combination with sleeve, replace the clutch gear.

NOTE:

When inspection, gear oil should be applied to the contact surface of gear.



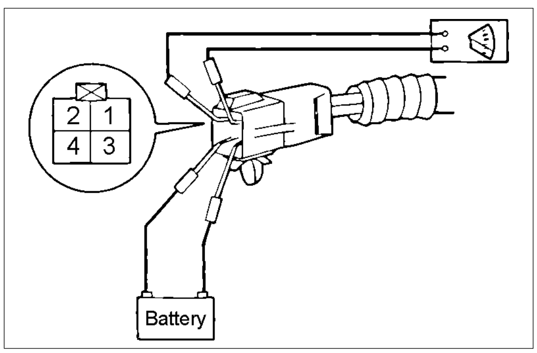
RTW440SH000301

Dimensional Check

Make sure of the size illustrated.

Clutch Gear Out Side Diameter (Limit) mm (in)

36.98 (1.46)



RTW440SH000501

Actuator

Visual Check

Check and see that there is no damage, cracking, or other abnormality.

Functional Check

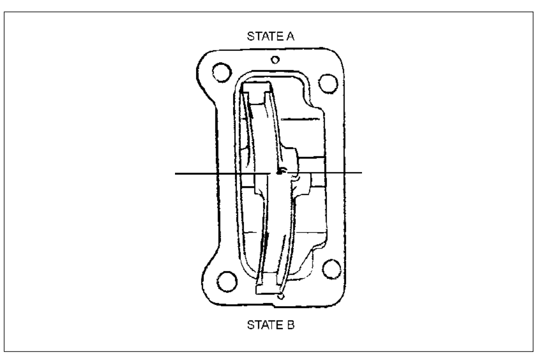
Make sure of function with voltage (12V) applied to terminal ③, ④ and set the tester to terminal ①, ② in accordance with the table below.

State	Port ③	Port ④	Port ①, ② Conducting	Function
A	+	–	○	C
B	–	+	×	D

If there is an abnormality, replace the actuator as an assembly.

NOTE:

Be careful not to permit the entry of water or dust into the ports of the actuator.
Do not open the actuator cover, if the actuator will be reused.



RTW440SH000401

Step	Action	Value(s)	Yes	No
3	Observe the Ignition Status parameter on the immobilizer data display function. Does the scan tool indicate ON and OFF with each ignition switch transition?	—	Go to Step 5	Go to Step 4
4	Repair the open circuit or high resistance between the Meter (10A) fuse and the ICU (pin 9 of B-109). Check Meter (10A) fuse first. Did you complete the repair?	—	Go to Step 5	—
5	Select the DTC display function for the following control modules: • ICU • ECM • PIM • TCM (AISIN A/T or 4L-60E) Does the scan tool display any DTCs?	—	Go to Step 6	Go to Step 12
6	Does the scan tool display DTCs which begin with a U or other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 7
7	Does the scan tool displays ICU DTC B0001?	—	Go to Applicable DTC	Go to Step 8
8	Does the scan tool displays ICU DTCs B0002 or B0012?	—	Go to Applicable DTC	Go to Step 9
9	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 10
10	Is the customer's concern with the engine?	—	Go to Diagnostic System Check - Engine Controls	Go to Step 11
11	Is the customer's concern with the transmission?	—	Go to Diagnostic System Check - Transmission Controls	Go to Step 12
12	Attempt to crank the engine. Does the engine crank?	—	Go to Step 13	Problem is relating to starting system. Refer to the applicable diagnostic chart in starting system section
13	Attempt to start the engine. Does the engine start and idle?	—	System OK	Go to Engine Cranks but Does Not Run in engine control section

Scan Tool Data List

The Immobilizer Scan Tool Data List contains all immobilizer related parameters that are available on the scan tool. Use the Immobilizer Scan Tool Data List only after the following is determined:

- The Immobilizer Controls - Diagnostic System Check is completed.
- On-board diagnostics are functioning properly.

A scan tool that displays faulty data should not be used. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis.

Scan Tool Parameter	Units Displayed	Typical Data Value
Operating Conditions: Ignition switch ON/ Two transponder keys programmed		
Ignition Status	On/ Off	On
Transponder Key	Transponder Key 1 to 5/ Invalid/ Not Programmed Key/ No Transponder Key	Transponder Key 1 or 2
Transponder Status	Correct Transponder-Key/ Wrong Transponder-Key/ New Transponder-Key/ No Transponder Detected	Correct Transponder-Key
Transponder-Key 1 Status	Programmed/ Not Programmed	Programmed
Transponder-Key 2 Status	Programmed/ Not Programmed	Programmed
Transponder-Key 3 Status	Programmed/ Not Programmed	Not Programmed
Transponder-Key 4 Status	Programmed/ Not Programmed	Not Programmed
Transponder-Key 5 Status	Programmed/ Not Programmed	Not Programmed
Security Code Programmed	Yes/ No	Yes
Security Wait Time	Inactive/ Time (hour: minute: second)	Inactive
While Security Lock	Inactive/ Active	Inactive

Scan Tool Data Definitions

This information will assist in immobilizer problems. Always perform the Diagnostic System Check - Immobilizer Controls first. The Diagnostic System Check will confirm proper system operation.

Ignition Status
This parameter displays the state of the ignition switch input to the ICU. On indicates the ignition switch is turned ON position.

Transponder Key
This parameter displays the state of the transponder key in the steering lock. Transponder Key 1 to 5 indicates a correctly programmed transponder key is used. The number 1 to 5 indicates which transponder key is used. Invalid indicates an incorrect key is in used. Not Programmed Key indicates a non-programmed new transponder key is used. No Transponder Key indicates ICU does not recognize a transponder key.

Transponder Status
This parameter displays the state of the transponder key in the steering lock. Correct Transponder-Key indicates a correctly programmed transponder key is used. Wrong Transponder-Key indicates an incorrect key is in used. New Transponder-Key indicates a non-programmed new transponder key is used. No Transponder Detected indicates ICU does not recognize a transponder key.

Transponder-Key 1 to 5 Status
This parameter displays the state of number of programmed transponder key(s). Programmed indicates transponder key 1 to 5 is correctly programmed. The number 1 to 5 indicates programmed order.

Security Code Programmed
This parameter displays the state of the security code programming. Yes indicates a security code is correctly programmed. No indicates a security code is not programmed.

Security Wait Time

This parameter displays the security wait time length in the ICU. Inactive indicates not in security wait time. Time indicates under security wait time. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed. The wait time will increase each time an incorrect security code is entered. Note that this parameter is not count downed. It keeps displaying the same time until that wait time has elapsed. The ignition switch must be kept at ON position during the wait time period.

While Security Lock

This parameter displays the state of the security wait time. Inactive indicates not in security wait time. Active indicates under security wait time.

Scan Tool Does Not Power Up

Circuit Description

The data link connector (DLC) is a standardized 16-cavity connector. Connector design and location is dictated by an industry wide standard, and is required to provide the following:

- Scan tool power battery positive voltage at terminal 16.
- Scan tool power ground at terminal 4.
- Common signal ground at terminal 5.

The scan tool will power up with the ignition OFF. Some modules however, will not communicate unless the ignition is ON.

Schematic Reference: Immobilizer Controls Schematics

Connector End View Reference: ICU Connector End View

Circuit/ System Testing Scan Tool Does Not Power Up

Step	Action	Value(s)	Yes	No
1	**Important**: Make sure the scan tool works properly on another vehicle before using this chart. 1. Turn OFF the ignition. 2. Inspect the Meter (+B) (10A) fuse in the cabin fuse block. Is the Meter (+B) (10A) fuse open?	—	Go to Step 2	Go to Step 3
2	Replace the Meter (+B) (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (+B) (10A) fuse or replace the shorted attached component. Did you complete the repair?	—	Go to Step 7	—
3	1. Check each circuit at the data link connector (DLC) (B-58) for a backed out, spread or missing terminal. 2. Repair the terminal as necessary. Did you find and complete the repair?	—	Go to Step 7	Go to Step 4
4	Connect a test lamp between the +B circuit (pin 16 of B-58) at the DLC and a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 5
5	Repair the open in the battery voltage circuit to the DLC. Did you complete the repair?	—	Go to Step 7	—
6	1. Test each ground circuit at the DLC (pins 4 and 5 of B-58) for an open circuit or high resistance. 2. Repair the circuit(s), clean or tighten ground as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Intermittent Conditions
7	1. Connect the scan tool to the DLC. 2. Attempt to turn ON the scan tool. Does the scan tool ON?	—	System OK	Go to Step 1

Scan Tool Does Not Communicate with CAN Device

Circuit Description

The engine control module (ECM), transmission control module (TCM) (AISIN A/T only) and ICU all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. (4JK1/ 4JJ1)
The ECM, TCM, powertrain interface module (PIM) and ICU all communicate with the scan tool over the CAN link. (HFV6)

Diagnostic Aids

The following conditions will cause a loss of CAN serial data communication between the ECM, TCM and PIM or between the scan tool and any control module:

- A CAN serial data circuit open
- A CAN serial data circuit shorted to ground
- A CAN serial data circuit shorted to voltage
- An internal condition within a module or connector on the CAN serial data circuit, that causes a short to voltage or ground to the CAN serial data circuit

Schematic Reference: Immobilizer Controls Schematics

Connector End View Reference: ICU Connector End View

Circuit/ System Testing Scan Tool Does Not Communicate with CAN Device (4JK1/ 4JJ1)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	**Important**: Make sure the CANdi module is not malfunctioning. When functioning properly, the CANdi module LED will be flashing. In the event of a problem, the LED will be continually illuminated or not illuminated. 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the listed control modules. • Immobilizer Control Unit (ICU) • Engine control module (ECM) • Transmission control module (TCM) (AISIN A/T only) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 7
3	Does the scan tool communicate with the ECM?	—	Go to Step 4	Go to Diagnostic System Check - Engine Controls
4	**Notice:** If no AISIN automatic transmission is installed, skip to Step 5. Does the scan tool communicate with the TCM?	—	Go to Step 5	Go to Diagnostic System Check - Transmission Controls
5	Does the scan tool communicate with the ICU?	—	Go to Step 6	Go to Lost Communication with The Immobilizer Control Unit (ICU)

Step	Action	Value(s)	Yes	No
6	Test the CAN Low and High serial data circuit for an intermittently short to ground, intermittently short to voltage or short circuit each other. Then, test the CAN Low and High serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 17	System OK
7	1. Inspect for an intermittent, for poor connections and for corrosion at the data link connector (DLC) (pins 6 and 14 of B-58) 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 8
8	**Notice:** If no data recording module (DRM) is installed, skip to Step 9. 1. Turn OFF the ignition. 2. Disconnect the DRM C-139 harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	Go to Step 13	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the DRM C-139 harness connector if disconnected. 3. Disconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the TCM and ICU. Does the scan tool communicate with the TCM and ICU?	—	Go to Step 14	Go to Step 10
10	**Notice:** If no AISIN automatic transmission is installed, skip to Step 11. 1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors. 3. Disconnect the TCM C-94 and C-95 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM and ICU. Does the scan tool communicate with the ECM and ICU?	—	Go to Step 15	Go to Step 11

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Reconnect the ECM J1 (E-90) and J2 (C-58) harness connectors if disconnected. 3. Reconnect the TCM C-94 and C-95 harness connectors if disconnected. 4. Disconnect the ICU B-109 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ECM and TCM. Does the scan tool communicate with the ECM and TCM?	—	Go to Step 16	Go to Step 12
12	Repair the open circuit, short to ground, short to voltage or short circuit each other on the CAN Low or High serial data circuit between the DLC and ECM, TCM, ICU or DRM. Did you complete the repair?	—	Go to Step 17	—
13	Replace the DRM. Refer to DRM Replacement. Did you complete the replacement?	—	Go to Step 17	—
14	**Important**: Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 17	—
15	**Important**: Replacement TCM must be programmed. Replace the TCM. Refer to TCM Replacement. Did you complete the replacement?	—	Go to Step 17	—
16	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 17	—
17	Attempt to establish communication with the ECM, TCM and ICU. Does the scan tool communicate with the ECM, TCM and ICU?	—	System OK	Go to Step 2

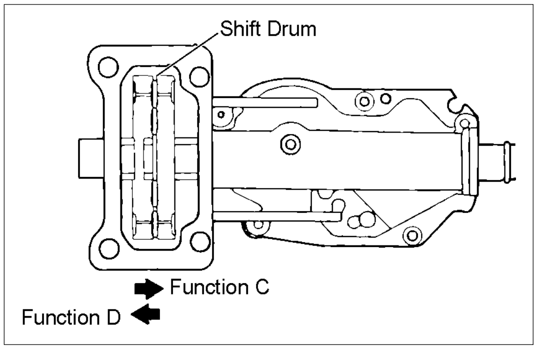
Circuit/ System Testing Scan Tool Does Not Communicate with CAN Device (HFV6)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls

Step	Action	Value(s)	Yes	No
2	**Important:** Make sure the CANdi module is not malfunctioning. When functioning properly, the CANdi module LED will be flashing. In the event of a problem, the LED will be continually illuminated or not illuminated. 1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the listed control modules. • Immobilizer Control Unit (ICU) • Engine control module (ECM) • Transmission control module (TCM) • Powertrain Interface module (PIM) Does the scan tool communicate with any of the listed control modules?	—	Go to Step 3	Go to Step 8
3	Does the scan tool communicate with the PIM?	—	Go to Step 4	Go to Diagnostic System Check - Powertrain Interface Module
4	Does the scan tool communicate with the ECM?	—	Go to Step 5	Go to Diagnostic System Check - Engine Controls
5	**Notice:** If no automatic transmission is installed, skip to Step 6. Does the scan tool communicate with the TCM?	—	Go to Step 6	Go to Diagnostic System Check - Transmission Controls
6	Does the scan tool communicate with the ICU?	—	Go to Step 7	Go to Lost Communication with The Immobilizer Control Unit (ICU)
7	Test the CAN Low and High serial data circuit for an intermittently short to ground, intermittently short to voltage or short circuit each other. Then, test the CAN Low and High serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 20	System OK
8	1. Inspect for an intermittent, for poor connections and for corrosion at the data link connector (DLC) (pins 6 and 14 of B-58). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 9
9	1. Turn OFF the ignition. 2. Disconnect the ECM C-56 and E-60 harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the TCM, PIM and ICU. Does the scan tool communicate with the TCM, PIM and ICU?	—	Go to Step 16	Go to Step 10

Step	Action	Value(s)	Yes	No
10	**Notice:** If no automatic transmission is installed, skip to Step 11. 1. Turn OFF the ignition. 2. Reconnect the ECM C-56 and E-90 harness connectors. 3. Disconnect the TCM C-96 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the PIM and ICU. Does the scan tool communicate with the PIM and ICU?	—	Go to Step 13	Go to Step 11
11	1. Turn OFF the ignition. 2. Reconnect the ECM C-56 and E-90 harness connectors if disconnected. 3. Reconnect the TCM C-96 harness connector if disconnected. 4. Disconnect the PIM B-96 and B-97 harness connectors. 5. Turn ON the ignition, with the engine OFF. 6. Attempt to communicate with the ICU. Does the scan tool communicate with the ICU?	—	Go to Step 14	Go to Step 12
12	1. Turn OFF the ignition. 2. Reconnect the PIM B-96 and B-97 harness connectors. 3. Disconnect the ICU B-109 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM, TCM and PIM. Does the scan tool communicate with the ECM, TCM and PIM?	—	Go to Step 19	Go to Step 15
13	1. Test the CAN Low and High circuits between the ECM (pins 23 and 55 of C-56) and the TCM (pins 6 and 7 of C-96) for the following conditions: • A short to ground • A short to battery or ignition voltage • A short circuit each other 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
14	1. Test the CAN Low and High circuits between the PIM (pins 7 and 9 of B-97) and the TCM (pins 37 and 38 of C-96) or ECM (pins 23 and 55 of C-56) for the following conditions: • A short to ground • A short to battery or ignition voltage • A short circuit each other 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18

Step	Action	Value(s)	Yes	No
15	Repair the open circuit, short to ground, short to voltage or short circuit each other on the CAN Low or High circuits between the DLC and PIM or ICU. Did you complete the repair?	—	Go to Step 20	—
16	**Important:** Replacement ECM must be programmed and learned. Replace the ECM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 20	—
17	**Important:** Replacement TCM must be programmed. Replace the TCM. Refer to ECM Replacement. Did you complete the replacement?	—	Go to Step 20	—
18	**Important:** Replacement PIM must be programmed. Replace the PIM. Refer to PIM Replacement. Did you complete the replacement?	—	Go to Step 20	—
19	**Important:** Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 20	—
20	Attempt to establish communication with the ICU, ECM, TCM and PIM. Does the scan tool communicate with the ICU, ECM, TCM and PIM?	—	System OK	Go to Step 2



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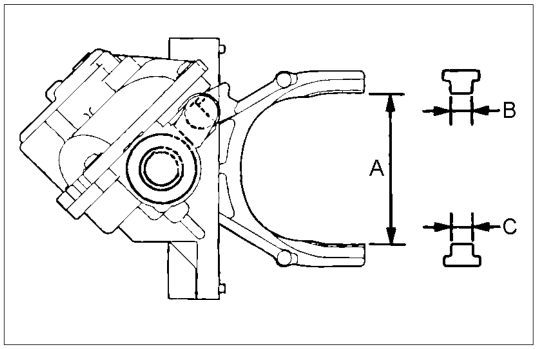

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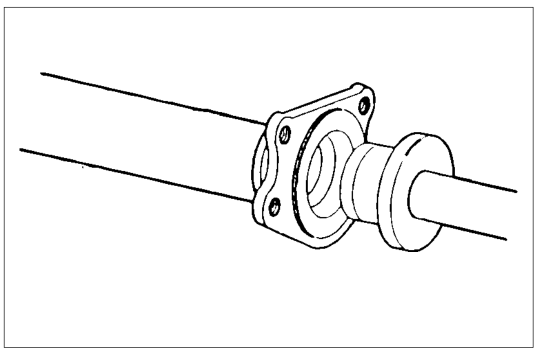
Dimension Check

Measure illustration sized A, B, and C

Limit mm (in)

A	64.3 (2.53)
B	6.7 (0.26)
C	6.7 (0.26)


RTW440SH000701

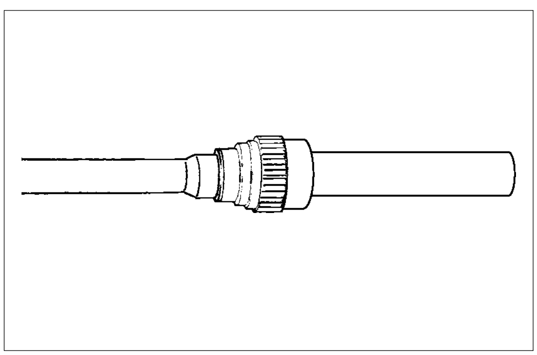
Reassembly

15. Oil seal

Install the new oil seal which has been immersed in differential gear oil, by using an oil seal installer.

Installer 5-8840-2407-0

Grip 5-8840-0007-0


412RS051

14. Needle Bearing

Force a new needle bearing into inner shaft by using a special tool.

Installer : 5-8840-2408-0

Grip : 5-8840-0007-0

Lost Communication with The Immobilizer Control Unit (ICU)

Circuit Description

The engine control module (ECM), transmission control module (TCM) (AISIN A/T only) and ICU all communicate with the scan tool over the controller area network (CAN) link. The ECM, TCM, ICU and the data recording module (DRM) communicate with each other over the same CAN link. (4JK1/ 4JJ1)

The ECM, TCM, powertrain interface module (PIM) and ICU all communicate with the scan tool over the CAN link. (HFV6)

Schematic Reference: Immobilizer Controls Schematics

Connector End View Reference: ICU Connector End View

Circuit/ System Testing Lost Communication with The Immobilizer Control Unit (ICU)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	Attempt to establish communication with the ICU. Does the scan tool communicate with the ICU?	—	Go to Intermittent Conditions	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the scan tool from the data link connector (DLC) if connected. 3. Measure the resistance across the CAN Low and High circuits by probing the DLC (pins 6 and 14 of B-58). Is the resistance within the specified value (parallel resistance of the 120Ω resistor in the ECM and the 120Ω resistor in the ICU should be 60Ω)?	50 to 70 Ω	Go to Step 5	Go to Step 4
4	1. Test the CAN Low and High circuits between the ICU (pins 5 and 6 of B-109) and the data link connector (DLC) (pins 6 and 14 of B-58) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
5	1. Turn OFF the ignition. 2. Disconnect the ICU harness connector. 3. Connect a test lamp between the battery voltage feed circuit (pin 1 of B-109) and a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 7
6	Connect a test lamp across the battery voltage feed circuit and the ground circuit (pins 1 and 3 of B-109) Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	Repair the open circuit or high resistance between the Meter (+B) (10A) fuse and the ICU (pin 1 of B-109). Did you complete the repair?	—	Go to Step 11	—
8	Repair the open circuit or high resistance between the ICU (pin 3 of B-109) and ground terminal. Did you complete the repair?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Disconnect the ICU harness connector. 3. Inspect for an intermittent, for poor connections and for corrosion at the harness connector of the ICU (pins 1, 3, 5 and 6 of B-109) 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
10	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 11	—
11	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse or harness connector(s). 3. Turn the ignition ON, with the engine OFF. 4. Attempt to establish communication with the ICU. Does the scan tool communicate with the ICU?	—	System OK	Go to Step 3

Diagnostic Trouble Code (DTC) List

DTC	DTC Descriptor
B0001	Replace Electronic Control Unit (ECU)
B0002	Immobilizer Not Programmed
B0003	Transponder Key Problem
B0004	Immobilizer Coil Circuit
B0007	No Engine Request Received
B0008	Wrong Transponder Key
B0009	No Transponder Key Programmed
B0010	Unknown Transponder Key
B0012	Default Transponder Detected
B0013	Previously Erased Transponder
B0014	Secret Key Error
U0100	Lost Communication With ECM

DTC B0001

Description

This diagnostic applies to internal microprocessor integrity conditions within the ICU.

Condition for Setting the DTC

- The ECM detects a faulty writing in its internal electrically erasable & programmable read only memory (EEPROM).

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Circuit/ System Testing DTC B0001

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0002

Description

The electrically erasable programmable read only memory (EEPROM) memorizes immobilizer security code and transponder key information. If the ICU detects immobilizer security code is not programmed into the ICU, this DTC will set.

Condition for Setting the DTC

- The ICU detects that the security code is not programmed.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Non-programmed ICU sets this DTC.

Circuit/ System Testing DTC B0002

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program immobilizer security information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0003

Description

When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock through the antenna coil. Once the ICU transmits a signal, the transponder must send back a specific response signal. If the ICU never receives a response signal from the transponder, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU does not receive a response signal from the transponder key.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Electromagnetic interference may affect intermittent condition.
- An antenna coil problem may set this DTC.
- Objects that block transponder key in the steering lock may set this DTC.
- Another key that is attached to the key ring may affect this DTC to set.
- If the ignition switch has been turned ON without transponder key this DTC sets.

Circuit/ System Testing DTC B0003

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC B0004 also set?	—	Go to DTC B0004	Go to Step 3
3	1. Inspect the transponder key(s) and the ICU for the following conditions: • Physical damage of transponder key(s) or ICU • Improper installation of ICU • Improper transponder key • Objects such as key ring or metal that touch transponder key or antenna coil • Objects such as key ring or metal that cover transponder key or antenna coil 2. Repair the condition(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	Inspect all programmed transponder key while observing the Transponder Key parameter with a scan tool. Is there a transponder key that indicates No Transponder Key when ignition switch is ON?	—	Go to Step 5	Go to Diagnostic Aids
5	Does only specific transponder key indicate No Transponder Key?	—	Go to Step 6	Go to Step 7

Step	Action	Value(s)	Yes	No
6	**Important**: Replacement transponder key must be programmed. Replace the transponder key that indicates No Transponder Key at Step 4. Refer to Resetting and Programming Guidelines in this section. Did you complete the replacement?	—	Go to Step 8	—
7	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0004

Circuit Description

An antenna coil is a part of the ICU and it is located around steering key lock cylinder. An antenna coil is energized when the ICU is performing an authentication of the transponder key. If the ICU detects an open circuit or short circuit on the antenna coil circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU detects an open circuit or short circuit on the antenna coil circuit.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Improper installation of ICU will set this DTC.

Circuit/ System Testing DTC B0004

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Inspect the ICU for the following conditions: • Physical damage of ICU • Improper installation of ICU 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 4	Go to Step 3
3	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 5	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0007

Circuit Description

When the transponder key authentication is completed, the ICU begins authentication of the ECM. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus. If the ICU does not detect a request signal from the ECM, this DTC will set.

Condition for Setting the DTC

- The ICU does not receive a request signal from the ECM.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Electromagnetic interference may affect intermittent condition.
- If the ignition switch is cycled (ON > OFF > ON) rapidly, this DTC may set but engine starts. This is normal and a current DTC clears once ignition cycle has been normally occurred.

Circuit/ System Testing DTC B0007

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the Engine in the system selection menu. 5. Attempt to communicate with the ECM via the Engine Data table. Does the scan tool communicate with the ECM?	—	Go to Step 3	Go to Diagnostic System Check - Engine Controls
3	Monitor the ECM DTC Information with a scan tool. Is DTC U0001 set?	—	Go to DTC U0001 in Engine Control Section	Go to Step 4
4	Refer to Scan Tool Does Not Communicate with The CAN Device in this section. Did you complete the action?	—	Go to Step 5	—
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0008

Description

When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock through the antenna coil. Once the ICU transmits a signal, the transponder must send back a specific response signal. If the ICU receives a wrong response signal from the transponder, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU receives a wrong response signal from the transponder key.

Action Taken When the DTC Sets

- The engine will not start if the fault occurs before starting the engine.

Condition for Clearing the DTC

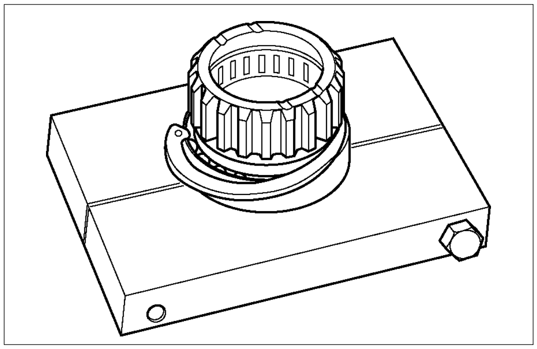
- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- If the transponder key or ICU is transferred (swapped) from another vehicle, this DTC will set.

Circuit/ System Testing DTC B0008

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC B0009 also set?	—	Go to DTC B0009	Go to Step 3
3	Inspect all programmed transponder keys while observing the Transponder Key parameter with a scan tool. Is there a transponder key that indicates Invalid when ignition switch is ON?	—	Go to Step 4	Go to Diagnostic Aids
4	Does only specific transponder key indicate Invalid?	—	Go to Step 5	Go to Step 6
5	**Important**: Replacement transponder key must be programmed. Replace the transponder key that indicates Invalid at Step 3. Refer to Resetting and Programming Guidelines in this section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 7	—
7	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK



412RS044

13. Inner Shaft Bearing

- Place a new snap ring in inner shaft.
- Force a new inner shaft bearing into the inner shaft.

Installer : 5-8840-2197-0

12.Snap Ring

NOTE;

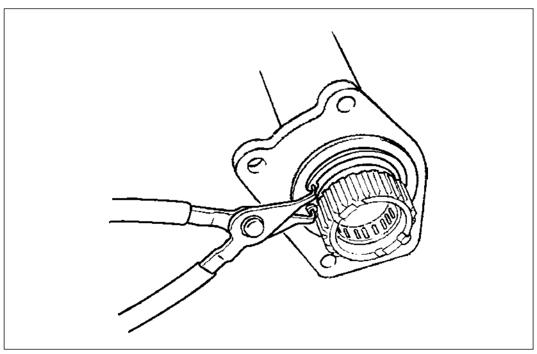
Be careful not to damage the inner shaft.

11.inner Shaft

- Clean the housing contact surface of the front axle case.
- Insert inner shaft assembly into the front axle case.

NOTE:

Be careful not to damage oil seal.



412RW017

10.Snap Ring

Install snap ring in the groove of front axle case.

NOTE:

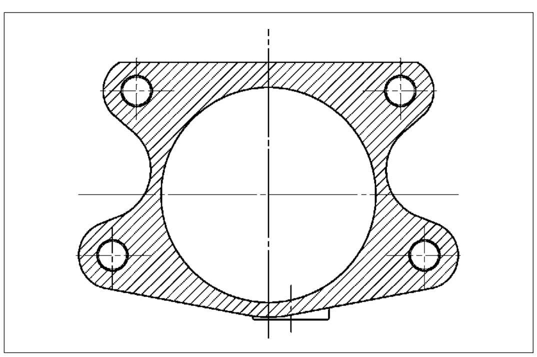
Be sure to install the snap ring properly.

9. Clutch Gear

Apply differential gear oil to clutch oil.

8. Sleeve

Apply differential gear oil to sleeve.



412RW023

7. Housing

- Clean contact surface with the front axle and actuator mounting surface.
- Apply liquid gasket to the contact surface on the front axle case and install in the housing.

6. Bolt

Tighten bolts to specified tightening torque.

Housing Bolt Torque	N·m (kgf·m/lb·ft)
75 (7.6/55)	

DTC B0009

Description

The electrically erasable programmable read only memory (EEPROM) memorizes immobilizer security code and transponder key information. If the ICU detects any transponder key is not programmed into the ICU, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU detects any transponder key is not programmed.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Circuit/ System Testing DTC B0009

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC B0002 also set?	—	Go to DTC B0002	Go to Step 3
3	Program transponder key information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0010

Description

When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock through the antenna coil. Once the ICU transmits a signal, the transponder must send back a specific response signal. If the ICU receives an unknown response signal from the transponder, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU receives an unknown response signal from the transponder key.

Action Taken When the DTC Sets

- The engine will not start if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Non-programmed transponder key sets this DTC.

Circuit/ System Testing DTC B0010

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Is DTC B0009, B0012 or B0013 also set?	—	Go to Applicable DTC	Go to Step 3
3	Inspect all programmed transponder keys while observing the Transponder Key parameter with a scan tool. Is there a transponder key that indicates Invalid when ignition switch is ON?	—	Go to Step 4	Go to Diagnostic Aids
4	Does only specific transponder key indicate Invalid?	—	Go to Step 5	Go to Step 7
5	Program transponder key information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
6	**Important**: Replacement transponder key must be programmed. Replace the transponder key that indicates Invalid at Step 3. Refer to Resetting and Programming Guidelines in this section. Did you complete the replacement?	—	Go to Step 8	—
7	**Important**: Replacement ICU must be programmed. Replace the ICU. Refer to ICU Replacement. Did you complete the replacement?	—	Go to Step 8	—
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9

Step	Action	Value(s)	Yes	No
9	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0012

Description

When a transponder key is replaced or added, transponder key information must be programmed into the ICU. If the ICU detects a default transponder key, this DTC set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU detects a non-programmed (new) transponder key.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Circuit/ System Testing DTC B0012

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	Program transponder key information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0013

Description

When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock through the antenna coil. Once the ICU transmits a signal, the transponder must send back a specific response signal. If the ICU receives a response signal that was previously erased transponder key, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU detects a previously erased transponder key.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- This DTC is caused by a transponder key that was previously erased by some reason.

Circuit/ System Testing DTC B0013

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program transponder key information into the ICU. Refer to Resetting and Programming Guidelines in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC B0014

Description

When the transponder key authentication is completed, the ICU begins authentication of the ECM. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus. If the ICU receives a wrong request signal from the ECM, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ICU detects a wrong request signal from the ECM.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Non-programmed ECM may set this DTC.
- If the ECM is transferred (swapped) from another vehicle, this DTC will set.

Circuit/ System Testing DTC B0014

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the DTC Information with a scan tool. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Program immobilizer security information into the ECM. Refer to Resetting and Programming Guidelines in this section. Did you complete the programming?	—	Go to Step 4	—
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

DTC U0100

Circuit Description

When the transponder key authentication is completed, the ICU begins authentication of the ECM. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus. The ICU monitors CAN operational status by expecting a constant flow of messages from the ECM. If the ICU fails to send an expected message to the ECM, this DTC will set.

Condition for Setting the DTC

- The ICU detects that the CAN Bus OFF status.

Action Taken When the DTC Sets

- The engine will fail to run if the fault occurs before starting the engine.

Condition for Clearing the DTC

- A current DTC clears once ignition cycle has occurred without the fault recurring.
- A history DTC will clear after 50 consecutive ignition cycles, if the condition for malfunction is no longer present.
- Use a scan tool to clear the DTC.

Diagnostic Aids

- Electromagnetic interference may affect intermittent condition.
- Any communication fault with the ECM may set this DTC.

Circuit/ System Testing DTC U0100

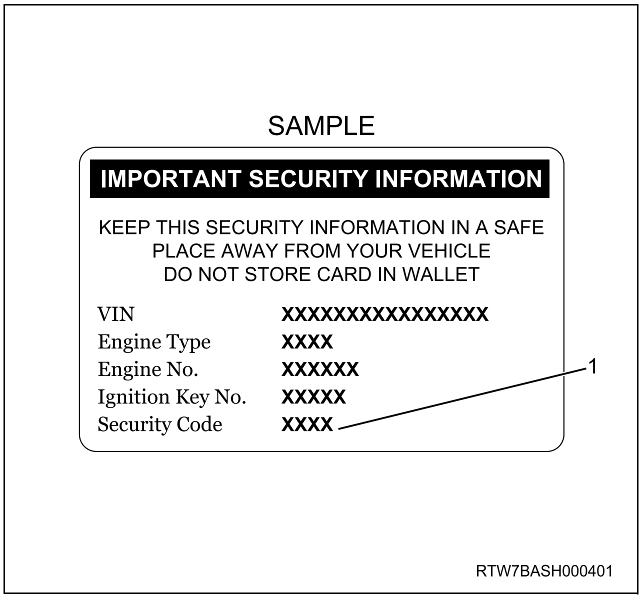
Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Immobilizer Controls?	—	Go to Step 2	Go to Diagnostic System Check - Immobilizer Controls
2	1. Install a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Select the Engine in the system selection menu. 5. Attempt to communicate with the ECM via the Engine Data table. Does the scan tool communicate with the ECM?	—	Go to Step 3	Go to Diagnostic System Check - Engine Controls
3	Monitor the ECM DTC Information with a scan tool. Is DTC U0001 set?	—	Go to DTC U0001 in Engine Control Section	Go to Step 4
4	Refer to Scan Tool Does Not Communicate with The CAN Device in this section. Did you complete the action?	—	Go to Step 5	—
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 6
6	Observe the DTC Information with a scan tool. Are there any DTCs that you have not diagnosed?	—	Go to DTC List	System OK

Resetting and Programming

Resetting and Programming Guidelines

Notice: The security information must be programmed when the ICU, ECM, PIM or transponder key(s) is replaced, or transponder key(s) is added.

Vehicle Security Information Card (If issued)



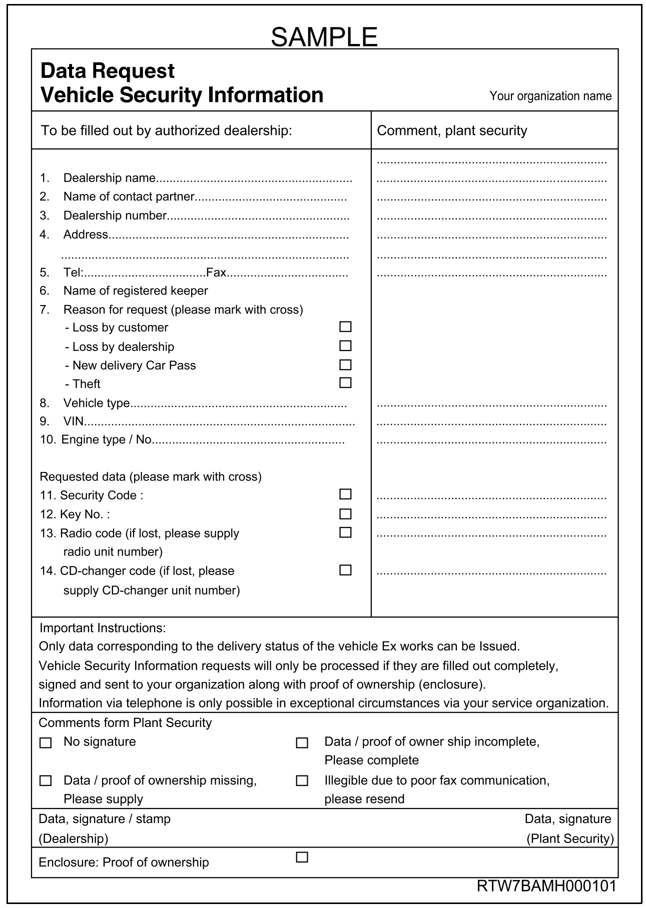
RTW7BASH000401

When performing ICU, ECM, PIM or transponder key(s) resetting or programming functions using a scan tool, you will be prompted to enter four digits of security code (1). This information is found on the vehicle security information card issued with the vehicle when new. If the card is unavailable, contact a distributor's service department to obtain the relevant security code. For new owners, distributor or dealership must provide vehicle security information card that has identification numbers of owner's vehicle immobilizer system. This information is very important in case of repair or transponder key is lost. It is necessary to provide following items in your responsibility.

- Vehicle security information card to a new owner.
- Blank vehicle security information card it is for reissue.
- Instruction to your dealership how to use it.

Your organization must keep security code for all vehicles as confidential data. In case of vehicle security information card is lost, the data can be requested from a distributor's service department. This request will only be processed if accompanied by the enclosed form and proof of ownership. Once the data is received, it can be entered in a blank card and given to the customer. The unused card should be destroyed. Instructions on filling out the Data Request Vehicle Security Information Card as follows.

- The data requested under items 1 to 10 must be provided completely, including the authorized dealership number, the vehicle identification number (VIN) and engine type/ number.
- Complete the form by entering data and signature/ authorized dealership stamp and send it along with proof of ownership to address provided in the form.
- The requested data will be sent by fax to dealership that made the request after your organization has confirmed that the information is correct.



SAMPLE

Data Request
Vehicle Security Information — Your organization name

To be filled out by authorized dealership:	Comment, plant security
1. Dealership name............	....
2. Name of contact partner............	....
3. Dealership number............	....
4. Address............	....
....	....
5. Tel:............Fax............	....
6. Name of registered keeper	
7. Reason for request (please mark with cross)	
- Loss by customer ☐	
- Loss by dealership ☐	
- New delivery Car Pass ☐	
- Theft ☐	
8. Vehicle type............	....
9. VIN............	....
10. Engine type / No............	....
Requested data (please mark with cross)	
11. Security Code : ☐	....
12. Key No. : ☐	....
13. Radio code (if lost, please supply radio unit number) ☐	....
14. CD-changer code (if lost, please supply CD-changer unit number) ☐	....

Important Instructions:
Only data corresponding to the delivery status of the vehicle Ex works can be Issued.
Vehicle Security Information requests will only be processed if they are filled out completely, signed and sent to your organization along with proof of ownership (enclosure).
Information via telephone is only possible in exceptional circumstances via your service organization.

Comments form Plant Security
☐ No signature ☐ Data / proof of owner ship incomplete, Please complete
☐ Data / proof of ownership missing, Please supply ☐ Illegible due to poor fax communication, please resend

Data, signature / stamp (Dealership) — Data, signature (Plant Security)

Enclosure: Proof of ownership ☐

RTW7BAMH000101

Security Code

The security code is required when performing ICU, ECM, PIM or transponder key(s) resetting or programming functions. When a scan tool requests the security code to be entered, and an incorrect code is entered, the ICU, ECM or PIM will go into a security wait time stage. This wait time stage will prevent any further attempts to enter the security code until the wait time has elapsed. Should a second incorrect security code be entered after the initial wait time has elapsed, the ICU, ECM or PIM will go into a second wait time stage. The wait time will increase each time an incorrect code is entered. When the correct code is entered the wait time will rest back to its original value of 10 seconds.

- Stage 1 = 10 seconds
- Stage 2 = 10 seconds
- Stage 3 = 10 minutes
- Stage 4 = 20 minutes
- Stage 5 = 40 minutes

- Stage 6 = 80 minutes (1 hour 20 minutes)
- Stage 7 = 160 minutes (2 hours 40 minutes)
- Stage 8 = 320 minutes (5 hours 20 minutes)
- Stage 9 = 640 minutes (10 hours 40 minutes)
- Stage 10 = 1280 minutes (21 hours 20 minutes)

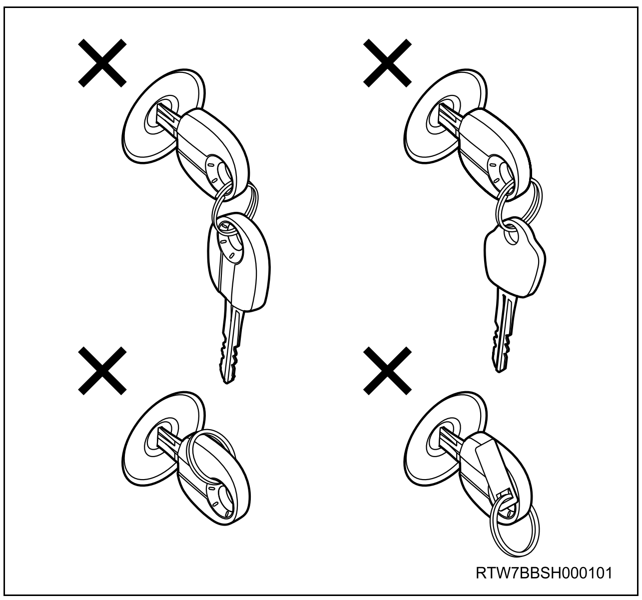
Notice: The ignition switch must be kept at ON position during the wait time period.

Transponder Key

Normally two or three transponder keys are provided with a vehicle when new. Maximum five transponder key can be provided by additional programming if owner requests additional key(s).

Notice: During programming of the new transponder key(s), an authentication code is programmed into the transponder chip and it cannot be reprogrammed again. Once this programming has been performed, the transponder keys cannot be installed in any other vehicle.

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program. Otherwise, transponder key(s) programming may be failed.



Transponder Key Erasing Procedure must be done whenever the following condition is met:

- Owner lost transponder key(s)

Notice: If an owner lost transponder key, currently programmed transponder key(s) information must be erased from an ICU memory to avoid vehicle theft. Because information on all key(s) is erased at the same time by this procedure, reprogram remaining key(s) and/or program new key(s).

Transponder Key Programming Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to replace transponder key(s)
- Diagnostic chart instructs you to program transponder key(s)
- Transponder keys are erased and to do reprogramming
- Owner requests additional key(s)

ICU Resetting Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to replace ICU
- ICU replacement without spare parts

Notice: When an ICU has been installed into a vehicle, it must be security linked to the ECM/ PIM using the programming procedure. Once this linking has been performed, the ICU cannot be installed in any other vehicle, unless the security linking between both modules have been reset using the resetting procedure in an ORIGINAL vehicle before transferring (swapping) to the complaint vehicle.

ICU Programming Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to program ICU
- New ICU is installed
- ICU is reused that was reset in an original vehicle

ECM Resetting Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to replace ECM
- ECM replacement without spare parts

Notice: When an ECM has been installed into a vehicle, it must be security linked to the ICU/ PIM using the programming procedure. Once this linking has been performed, the ECM cannot be installed in any other vehicle, unless the security linking between both modules have been reset using the resetting procedure in an ORIGINAL vehicle before transferring (swapping) to the complaint vehicle.

ECM Programming Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to program ECM
- New ECM is installed
- ECM is reused that was reset in an original vehicle

PIM Resetting Procedure must be done whenever any of the following conditions are met:

- Diagnostic chart instructs you to replace PIM
- PIM replacement without spare parts

Notice: When a PIM has been installed into a vehicle, it must be security linked to the ICU/ ECM using the programming procedure. Once this linking has been performed, the PIM cannot be installed in any other vehicle, unless the security linking between both modules have been reset using the resetting procedure in an ORIGINAL vehicle before transferring (swapping) to the complaint vehicle.

PIM Programming Procedure must be done whenever any of the following condtions are met:

- Diagnostic chart instructs you to program PIM
- New PIM is installed
- PIM is reused that was rest in an original vehicle

ICU & PIM Programming Procedure must be done whenever any of the following condition is met:

- New or resued ICU and PIM are installed at the same time

ECM & PIM Programming Procedure must be done whenever any of the following condition is met:

- New or reused ECM and PIM are installed at the same time

ICU & ECM Programming Procedure must be done whenever any of the following condition is met:

- New or reused ICU and ECM are installed at the same time (transponder key(s) also replaced)

ICU, ECM & PIM Programming Procdure must be done whenever any of the following condition is met:

- New or reused ICU, ECM and PIM are installed at the same time (transponder key(s) also replaced)

Notice: During programming of the new transponder key(s), an authentication code is programmed into the transponder chip and it cannot be reprogrammed again. When replacing both ICU and ECM at the same time, a new authentication code to be programmed into the newly installed ECM is based on information of newly installed ICU. However, the transponder keys cannot be reprogrammed therefore it must be replaced. Do not replace the ICU and the ECM at the same time to avoid needless transponder key(s) replacement simultaneously unless complete damaging was encountered (e.g. both modules cannot be communicated with a scan tool).

Transponder Key Erasing Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Additional Functions > Erase Transponder Keys.
4. The on-screen displays a message "See Checking Procedure Before Programming!", then press Confirm.
5. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions.

Notice: An incorrect security code input causes a security wait time.

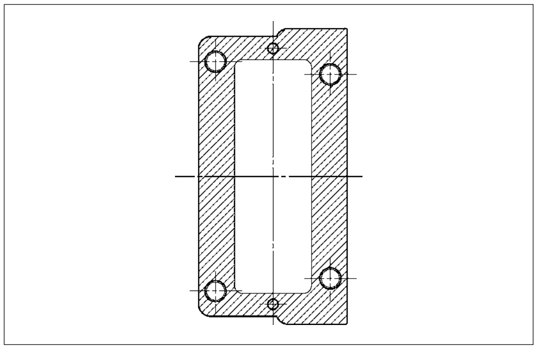
6. The on-screen displays a message "Caution All Transponder Keys Will Be Erased!", then press Confirm.
7. Operate the ignition switch by following the on-screen instructions.
8. The on-screen displays a message "Erase Transponder Keys Erasing Completed Successfully!" if transponder erasing has been completed, then press Confirm.
9. Turn OFF the ignition for 30 seconds.
10. Verify the engine fails to run using all transponder key(s).

Transponder Key Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Transponder Keys.
4. In order to get a programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Transponder Keys.
8. The on-screen displays a message "See Checking Procedure Before Programming!", then press Confirm.
9. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions.

Notice: An incorrect security code input causes a security wait time.

10. Operate the ignition switch by following the on-screen instructions.



5. Actuator

- Clean the actuator contact surface with the housing.
- Apply liquid gasket to the contact surface on the actuator side.
- Align shift arm with the groove of sleeve and install the actuator.

4. Bolt

Tighten bolts to specified torque.

Actuator Bolt Torque	N·m (kgf·m/lb·in)
9 (0.9/78)	

3. Front Axle Drive Shaft (LH side)

2. Bolt

- Install front axle drive shaft and mounting bracket.
- Tighten fitting bolts to specified tightening torque.

Bolt Torque	N·m (kgf·m/lb·ft)
116 (11.8/85)	

1. Filler Plug

- Pour specified amount of differential gear oil.

Front Differential Oil Capacity	liter (US/UK gal)
1.4 (0.37/0.31)	

Actuator Housing Oil Capacity	liter (US/UK gal)
0.12 (0.03/0.03)	

- Install filler plug through packing and tighten to specified torque.

Filler Plug Torque	N·m (kgf·m/lb·ft)
78 (8.0/58)	

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program.

11. The on-screen displays a message "Program more Transponder Keys?" If all transponder key(s) has been programmed, press No and go to next step. If more transponder key(s) need to be programmed, press Yes and repeat from previous step.
12. The on-screen displays a message "Program Transponder Keys Programming Completed Successfully!" if all transponder key(s) programming has been completed, then press Confirm.
13. Turn OFF the ignition for 30 seconds.
14. Verify the engine starts using all programmed transponder key(s).

ICU Resetting Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Additional Functions > Reset Immobilizer.
4. The on-screen displays a message "See Checking Procedure Before Programming!", then press Confirm.
5. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions.

Notice: An incorrect security code input causes a security wait time.

6. The on-screen displays a message "Warning Engine will not start after Reset!", then press Confirm.
7. The on-screen displays a message "Reset Immobilizer Reset Completed Successfully!" if ICU resetting has been completed, then press Confirm.
8. Turn OFF the ignition for 30 seconds.
9. Verify the engine fails to run using all transponder key(s).

ICU Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
8. The on-screen displays a message "See Checking Procedure Before Programming!", then press Confirm.
9. Select "Immobilizer Installed" or select "Imoobilizer Replaced" Yes.
10. Select "PIM or ECM Replaced" No, if displayed.
11. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction may repeat twice.

Notice: An incorrect security code input causes a security wait time.

12. Input 17 digits of correct VIN that is based on stamped VIN or affixed VIN plate on this vehicle.
13. Operate the ignition switch by following the on-screen instructions.

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program.

14. The on-screen displays a message "Program more Transponder Keys?" If all transponder key(s) has been programmed, press No and go to next step. If more transponder key(s) need to be programmed, press Yes and repeat from previous step.
15. The on-screen displays a message "Programming Successfully!" if ICU and all transponder key(s) programming has been completed, then press Confirm.
16. Turn OFF the ignition for 30 seconds.
17. Verify the engine starts using all programmed transponder key(s).

ECM Resetting Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.

3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Additional Functions > Reset Engine Control Module. (4JK1/4JJ1)
   Select Diagnostics > Appropriate vehicle identification > Engine > V6 Engine > Programming > Reset ECU. (HFV6)
4. The on-screen may display a message "See Checking Procedure Before Programming!", then press Confirm.
5. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions.

Notice: An incorrect security code input causes a security wait time.

6. The on-screen displays a message "Warning! Engine will not start after Reset!", then press Reset.
7. The on-screen displays a message "Reset Successfully!" if ECM resetting has been completed, then press Confirm.
8. Turn OFF the ignition for 30 seconds.
9. Verify the engine fails to run using all transponder key(s).

ECM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
8. The on-screen may display a message "See Checking Procedure Before Programming!", then press Confirm.
9. Select "Imoobilizer Replaced" No and select "PIM or ECM Replaced" Yes, if displayed.
10. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction may repeat twice.

Notice: An incorrect security code input causes a security wait time.

11. Select "Engine Controller Installed" or select "ECM Replaced".
12. Operate the ignition switch by following the on-screen instructions.
13. The on-screen displays a message "Programming Successfully!" if ECM programming has been completed, then press Confirm.
14. Turn OFF the ignition for 30 seconds.
15. Verify the engine starts using all transponder key(s).

PIM Resetting Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Powertrain Interface Module > Security > Reset PIM.
4. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions.

Notice: An incorrect security code input causes a security wait time.

5. The on-screen displays a message "Warning! Engine will not start after Reset!", then press Reset.
6. The on-screen displays a message "Reset Completed Successfully!" if PIM resetting has been completed, then press Confirm.
7. Turn OFF the ignition for 30 seconds.

PIM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the onscreen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:

a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
b. Turn ON the scan tool and keep at title screen.
c. Launch the TIS application.
d. Select the Security Access at the main screen.
e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
f. Click "Close" on the Security Access Enabled screen.
g. Turn OFF the scan tool.
h. Disconnect the scan tool from the terminal.

5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
8. Select "Immobilizer Replaced" No and select "PIM or ECM Replaced" Yes.
9. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction repeats twice.

Notice: An incorrect security code input causes a security wait time.

10. Select "PIM Replaced".
11. Operate the ignition switch by following the on-screen instructions.
12. The on-screen displays a message "Programming Successfully!" if PIM programming has been completed, the press Confirm.

ICU & PIM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the onscreen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
8. Select "Immobilizer Replaced" Yes and select "PIM or ECM Replaced" Yes.
9. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction repeats twice.

Notice: An incorrect security code input causes a security wait time.

10. Select "PIM Replaced".
11. Input 17 digits of correct VIN that is based on stamped VIN or affixed VIN plate on this vehicle.
12. Operate the ignition switch by following the onscreen instructions.

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program.

13. The on-screen displays a message "Program more Transponder Keys?" If all transponder key(s) has been programmed, press No and go to next step. If more transponder key(s) need to be programmed, press Yes and repeat from previous step.
14. The on-screen displays a message "Programming Successfully!" if ICU, PIM and all transponder key(s) programming has been completed, the press Confirm.
15. Turn OFF the ignition for 30 seconds.
16. Verify the engine starts using all programmed transponder key(s).

ECM & PIM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the onscreen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.

   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
8. Select "Immobilizer Replaced" No and select "PIM or ECM Replaced" Yes.
9. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction repeats twice.

Notice: An incorrect security code input causes a security wait time.

10. Select "PIM and ECM Replaced".
11. Operate the ignition switch by following the on-screen instructions.
12. The on-screen displays a message "Programming Successfully!" if ECM and PIM programming has been completed, the press Confirm.

ICU & ECM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the on-screen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.
   e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
   f. Click "Close" on the Security Access Enabled screen.
   g. Turn OFF the scan tool.
   h. Disconnect the scan tool from the terminal.
5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Program Immobilizer Function or Immobilizer Link To ECM/ PIM.
8. The on-screen may display a message "See Checking Procedure Before Programming!", then press Confirm.
9. Select "Immobilizer and ECM Installed" or select "Immobilizer Replaced" Yes.
10. Select "PIM or ECM Replaced" Yes, if displayed.
11. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction repeats twice.

Notice: An incorrect security code input causes a security wait time.

12. Select "ECM Replaced" if displayed.
13. Input 17 digits of correct VIN that is based on stamped VIN or affixed VIN plate on this vehicle.
14. Operate the ignition switch by following the on-screen instructions.

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program.

15. The on-screen displays a message "Program more Transponder Keys?" If all transponder key(s) has been programmed, press No and go to next step. If more transponder key(s) need to be programmed, press Yes and repeat from previous step.
16. The on-screen displays a message "Programming Successfully!" if ICU, ECM and all transponder key(s) programming has been completed, then press Confirm.
17. Turn OFF the ignition for 30 seconds.
18. Verify the engine starts using all programmed transponder key(s).

ICU, ECM & PIM Programming Procedure

1. Install a scan tool.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
4. In order to get a programming approval, the onscreen displays a message to user. Get programming approval from the TIS 2000 using the following procedure:
   a. Connect a scan tool to the terminal that installed TIS 2000 with the latest software and the hardware key is plugged into port.
   b. Turn ON the scan tool and keep at title screen.
   c. Launch the TIS application.
   d. Select the Security Access at the main screen.

e. Highlight "Tech 2" on the Diagnostic Tool Selection screen and click "Next".
f. Click "Close" on the Security Access Enabled screen.
g. Turn OFF the scan tool.
h. Disconnect the scan tool from the terminal.

5. Reinstall a scan tool to the vehicle.
6. Turn ON the ignition, with the engine OFF.
7. Select Diagnostics > Appropriate vehicle identification > Body > Immobilizer > Programming > Immobilizer Link To ECM/ PIM.
8. Select "Immobilizer Replaced" Yes and select "PIM or ECM Replaced" Yes.
9. Input four digits of correct security code that belongs to this vehicle and follow the on-screen instructions. The on-screen instruction repeats twice.

Notice: An incorrect security code input causes a security wait time.

10. Select "PIM and ECM Replaced".
11. Input 17 digits of correct VIN that is based on stamped VIN or affixed VIN plate on this vehicle.
12. Operate the ignition switch by following the onscreen instructions.

Notice: Keep away another key, another transponder key, key number plate or other metal items from the transponder key that is going to program.

13. The on-screen displays a message "Program more Transponder Keys?" If all transponder key(s) has been programmed, press No and go to next step. If more transponder key(s) need to be programmed, press Yes and repeat from previous step.
14. The on-screen displays a message "Programming Successfully!" if ICU, ECM, PIM and all transponder key(s) programming has been completed, the press Confirm.
15. Turn OFF the ignition for 30 seconds.
16. Verify the engine starts using all programmed transponder key(s).

Repair Instructions

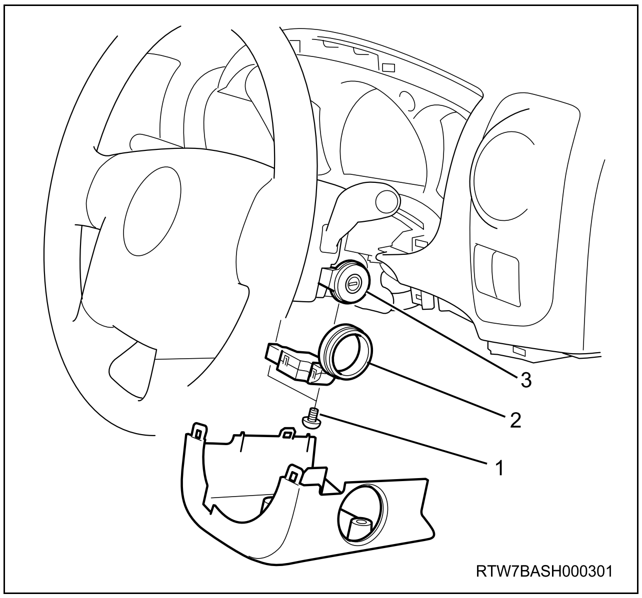
Immobilizer Control Unit (ICU) Replacement

Resetting ICU

Reset immobilizer security information in the old ICU. Refer to Resetting and Programming Guidelines in this section. If the old ICU cannot be communicated with a scan tool, go to the next procedure.

Removal Procedure

1. Disconnect the negative battery cable.
2. Remove the steering column cover.
3. Disconnect the ICU harness connector.
4. Loose screws (1) and remove the ICU (2) from the steering lock(3).



Installation Procedure

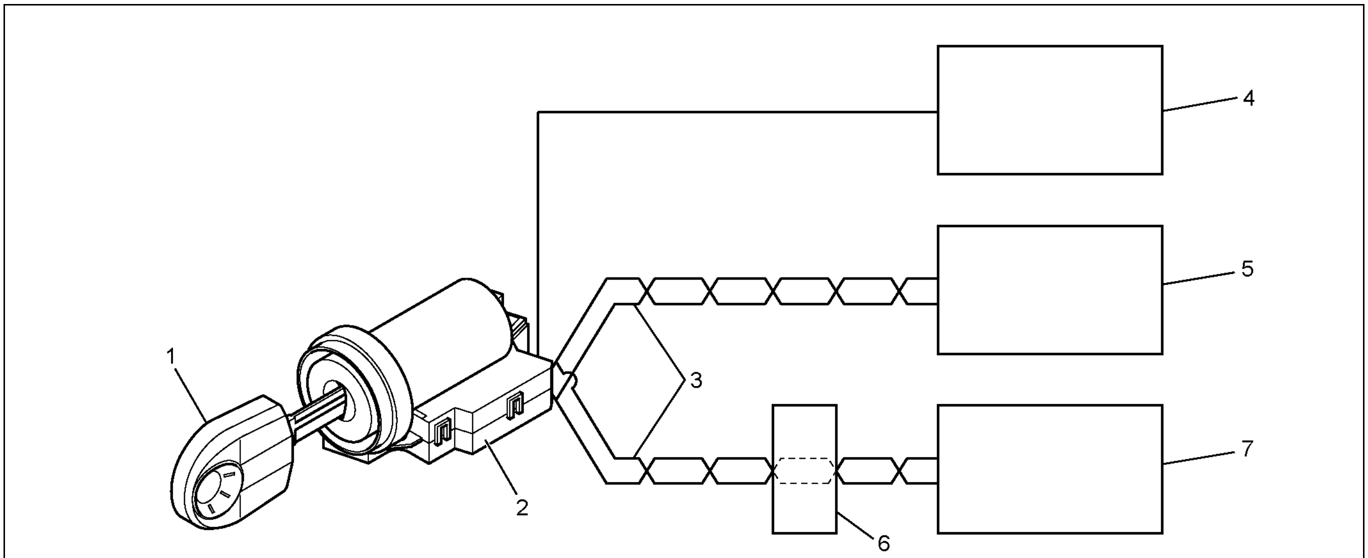
1. Install the ICU (2) to the steering lock (3) and tighten screws (1).
2. Connect the ICU harness connector.
3. Install the steering column cover.
4. Connect the negative battery cable.

Programming ICU

Program immobilizer security information into the ICU. Refer to Resetting and Programming Guidelines in this section.

Description and Operation

Immobilizer System Description



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Legend

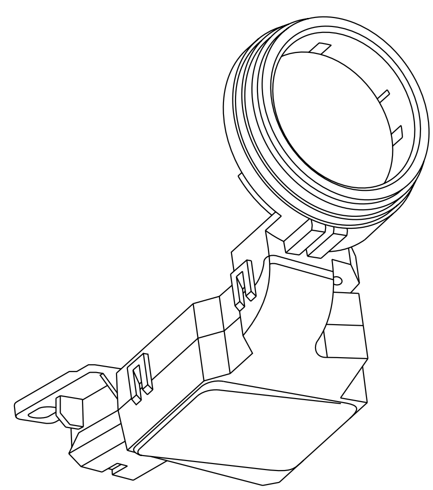
1. Transponder key
2. ICU
3. Controller area network (CAN) communication bus lines
4. Anti-theft control unit (with anti-theft system)
5. Engine control module (ECM) (4JK1/ 4JJ1)
6. Powertrain interface module (PIM)
7. Engine control module (ECM) (HFV6)

The immobilizer controls engine starting along with the engine control module (ECM). The main system components are the ICU, the ECM, the PIM (HFV6) and the transponder key. The immobilizer system is activated (immobilized) by an incorrectly programmed or non-programmed transponder key, the ICU or the ECM. While this system is activated, the ECM controls the fuel injection system and starter cut relay in order to fail to engine running. A typical engine starting sequence is below.

1. When the ignition switch is ON, the ICU begins authentication of the transponder key in the steering lock. The ICU transmits a specific request signal to the transponder key and the transponder key sends back a response signal to the ICU. Both communication signals are carried out via antenna coil.
2. Because the anti-theft system alarms if a key or other methods unlock the door, when the transponder key is correctly authenticated the ICU transmits an alarm cancel (disarm) signal to the anti-theft control unit. (With anti-theft system)
3. After the transponder key authentication is completed, the ICU begins authentication of the ECM. The ECM transmits a specific request signal to the ICU and the ICU sends back a response signal to the ECM. Both communication signals are carried out via a controller area network (CAN) communication bus.
4. After the ECM authentication is completed, the ECM enables engine running.

Immobilizer System Componenet Description

Immobilizer Control Unit (ICU)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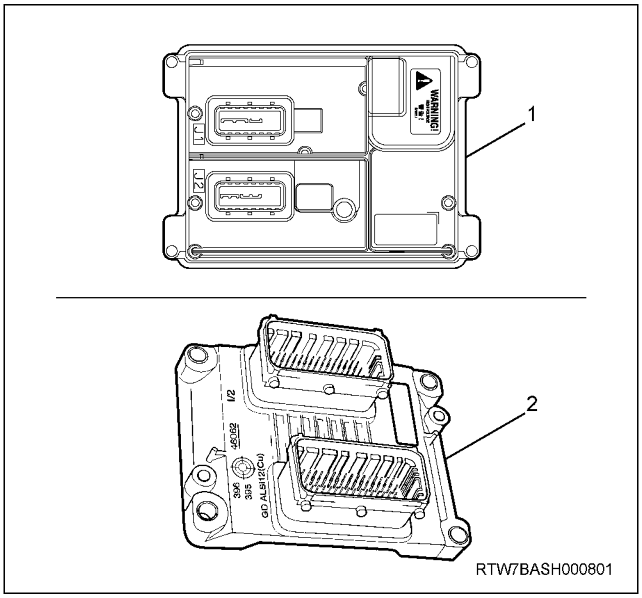
The ICU is installed to the steering lock. The ICU controls the immobilizer system by authentication of the transponder key and the ECM. An antenna coil is a part of the ICU and it is located around steering key lock cylinder. An antenna coil is energized when the ICU is performing an authentication of the transponder key.

Engine Control Module (ECM)

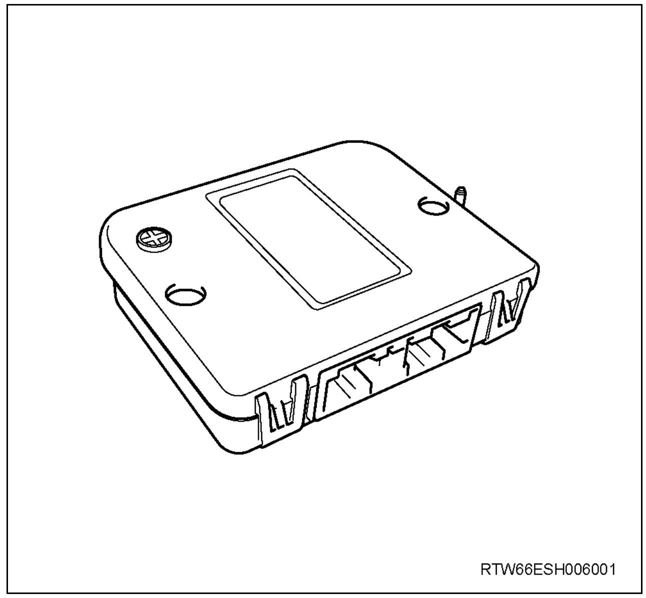


Legend

1. ECM (4JK1/ 4JJ1)
2. ECM (HFV6)

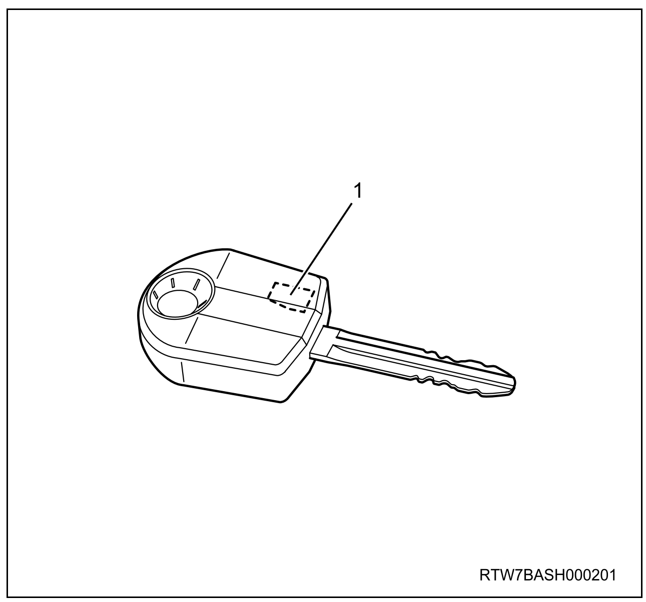
The ECM is located inside of engine compartment via mounting bracket and is behind air cleaner case (4JK1/ 4JJ1) or attached to the engine (HFV6). The ECM mainly controls the engine control and also exchanges a request signal and a response signal to an ICU. If fault occurs on immobilizer system, the ECM sets DTC(s) and illuminates the service vehicle soon (SVS) lamp or the malfunction indicator lamp (MIL).

Powertrain Interface Module (PIM)



The PIM is located behind the driver's side lower hinge pillar trim. The PIM acts as the communication gateway between the CAN communication protocol and other protocol. The PIM converts analog signals from some switches into serial data. The PIM upon inputs received from the ECM, TCM and ICU controls the operation of instruments and indicator lamps. (HFV6)

Transponder Key



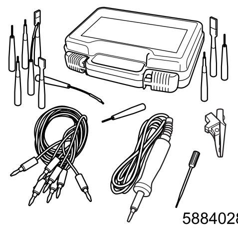
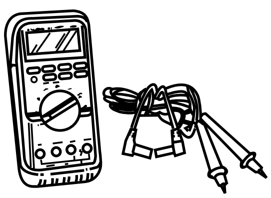
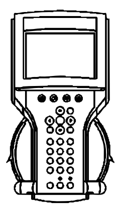
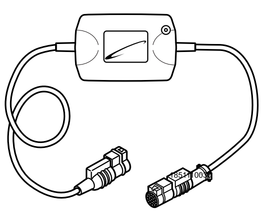
Legend

1. Transponder chip

The transponder key accommodates a transponder chip in the grip portion. The transponder keys have no conventional power supply. The transponder chip is energized via a radio wave supplied from an antenna coil fitted around the steering lock cylinder. Only transponder key that is correctly programmed key is possible to engine run. Maximum five transponder keys can be provided by additional programming.

Special Tools and Equipment

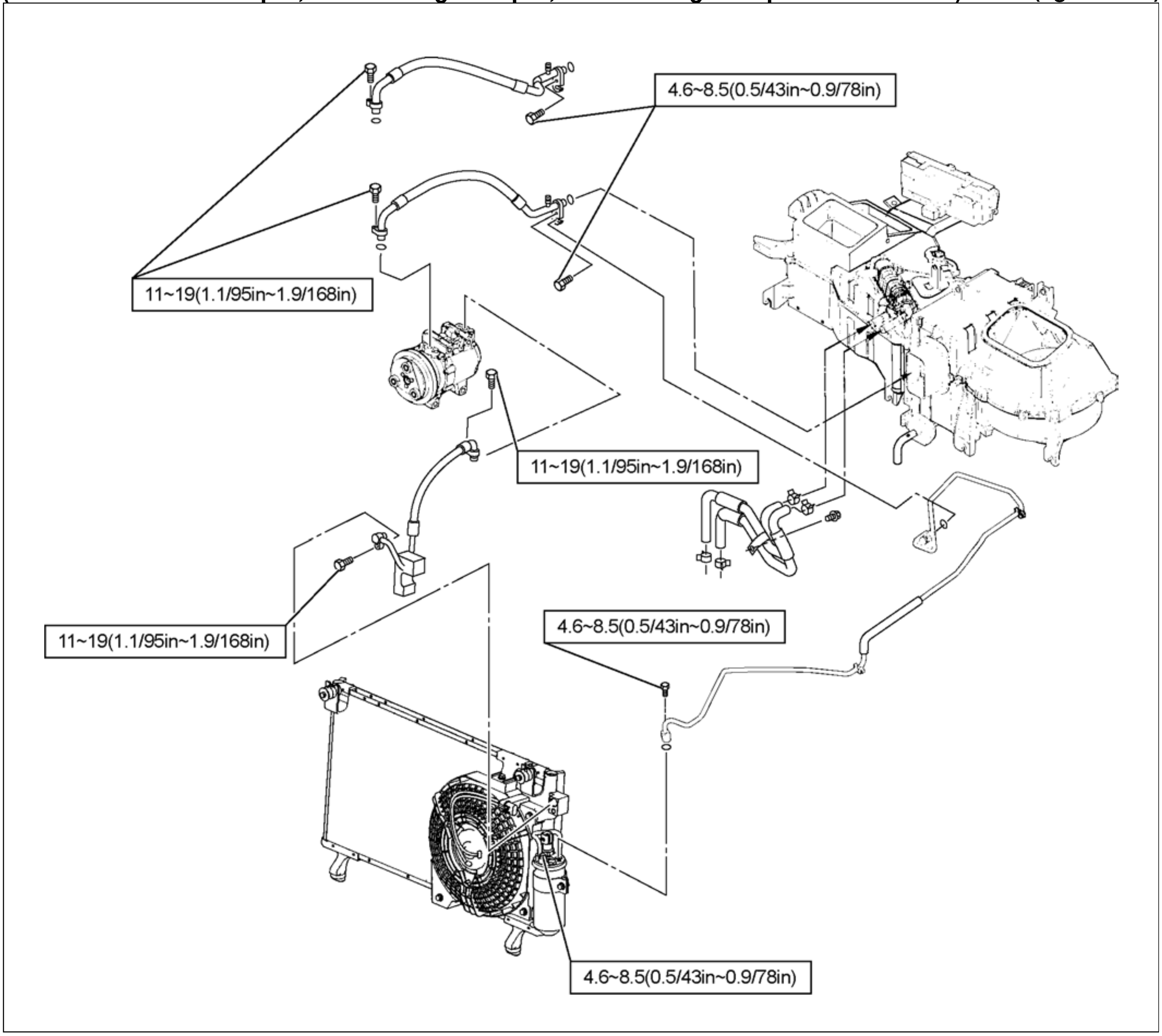
Special Tools and Equipment

Illustration	Tool Number/ Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
 AAW0Z0SH015701	Tech2 Kit
	CAN-di Module

IMMOBILIZER SYSTEM
(C24SE, 4JA1-T)

CONTENTS

(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output RHD MODEL) **N·m (kgf·m/lb·in)**



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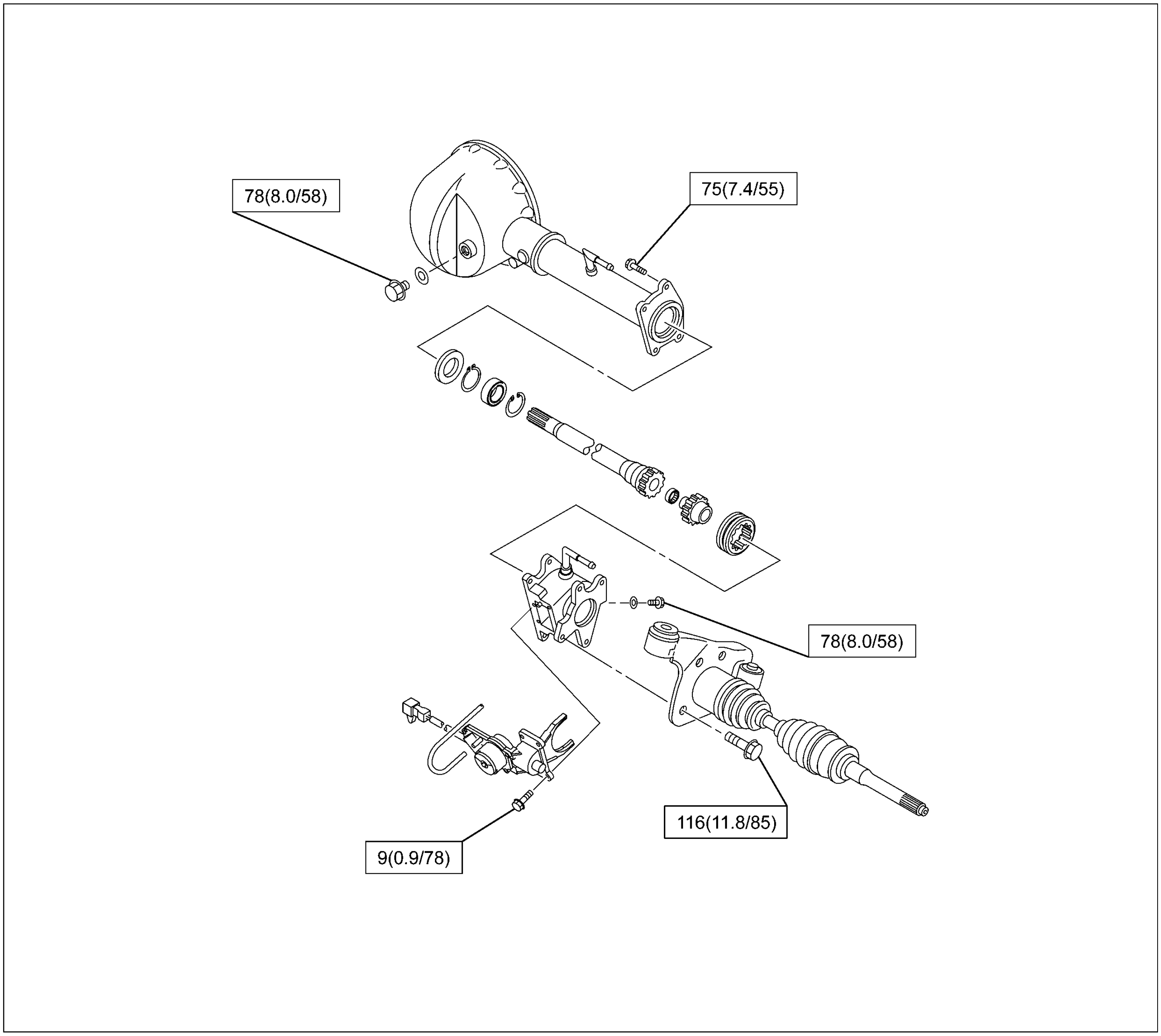
Torque Specifications

N·m (kgf·m / lb·ft)



RTW440LF001501

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

The immobilizer system consists of the four major components which are Engine Control Module (ECM), Immobilizer Control Unit (ICU), transponder, and scan tool (Tech-2).

This system can be activated by a correctly programmed transponder and starter switch is set to OFF.

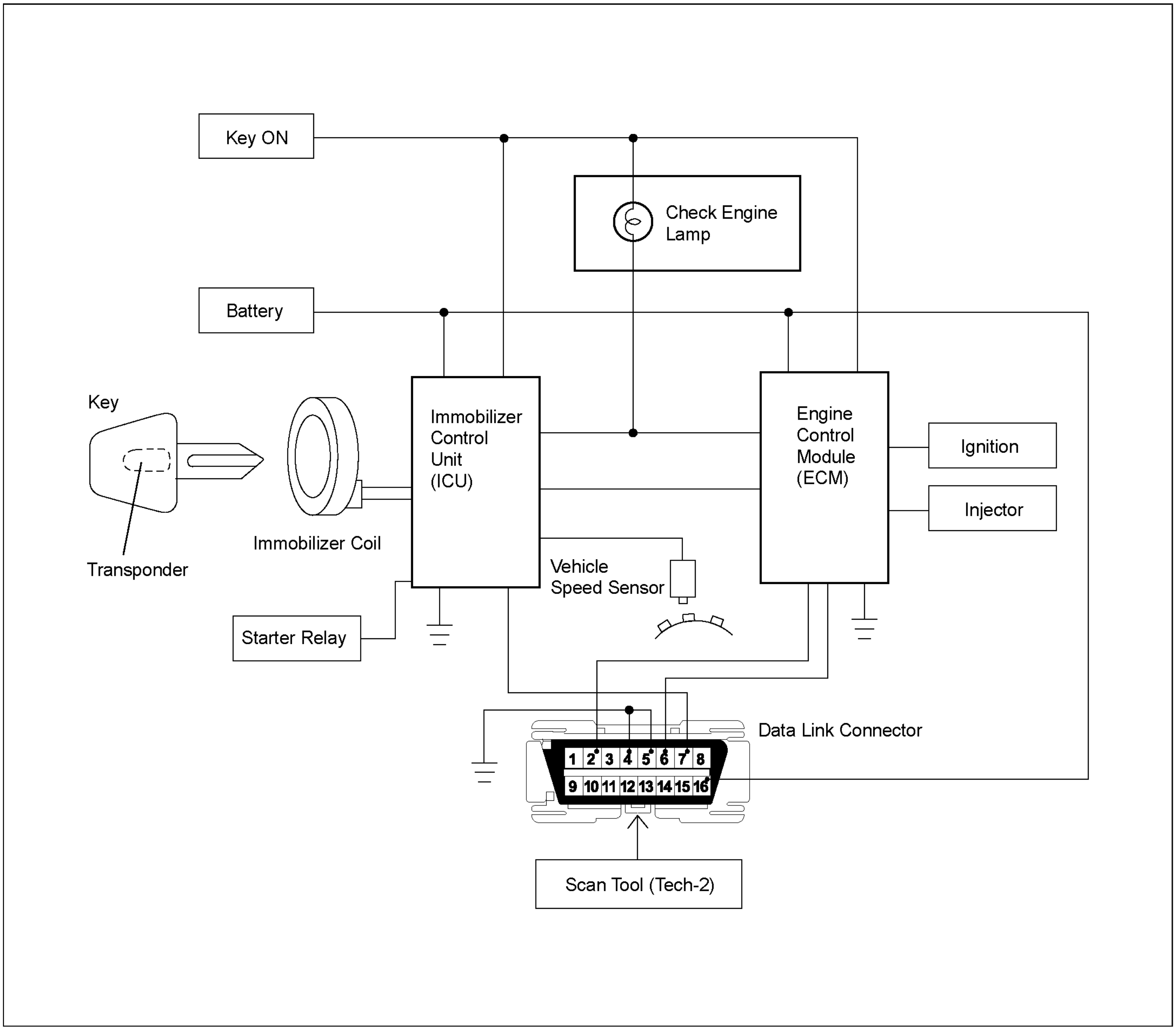
This system can be deactivated by a correctly programmed transponder key connected with a correctly programmed ECM and a correctly programmed ICU.

While the system is on :

The starter cut off relay deactivates function of starter, and the fuel injector power source is deactivated also.

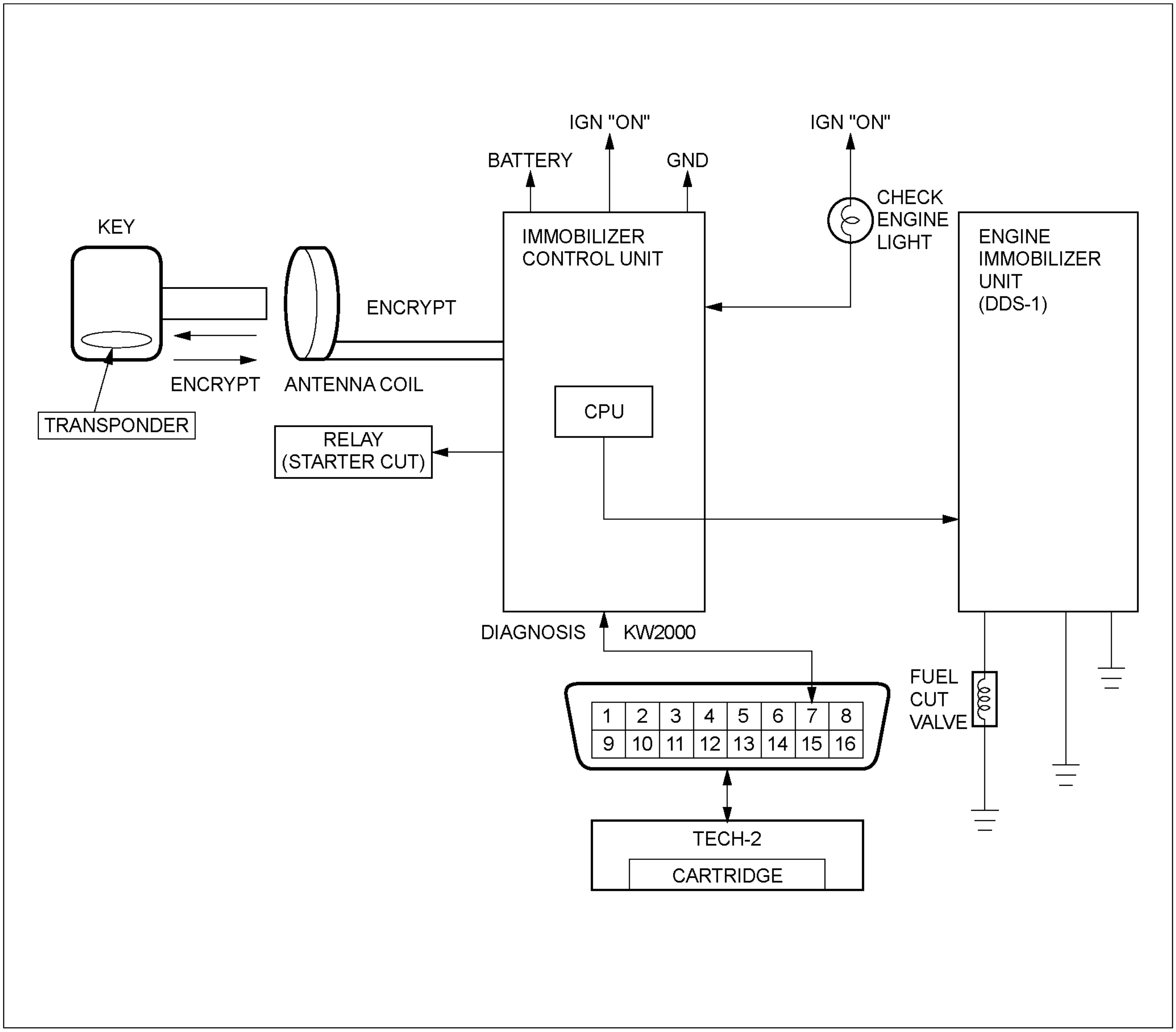
- Check Engine lamp is flashing.
- Warning buzzer is operating.
  (With antitheft system)

- **Gasoline Engine (C24SE)**



LTW3BALF000101

Diesel Engine With Engine Immobilizer Unit (4JA1-T Mechanical Control Engine)



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What happens without proper transponder operation?

One of the function of transponder is to deactivate or activate starter function. If the proper transponder is not used, starter cannot be operated. Because starter relay stays off, cranking engine is not possible.

After the starter relay is activated, transponder signal triggers to let ICU calculate by transponder address signal and immobilizer algorithm.

When the result matches with necessary condition, it makes injector power source be activated.

If transponder does not send correct signal, ICU and ECM do not activate injector system on.

Therefore the vehicle cannot be operated.

No proper transponder is available, what should be done for the system?

When any proper transponder is not available, a new transponder should be programmed. Up to 5 transponders can be provided with a scan tool (Tech-2) and by proper procedure.

In addition to the absence of proper transponder, it may happen particular secret code to the particular vehicle is missing. In this case, the secret code must be provided by your organization.

Otherwise transponder cannot be programmed in any way.

If the essential for a scan tool (Tech-2) for programming and proper software for Tech-2 are not available, there is no permanent way to fix system. Temporary replace with new ECM, new ICU and new transponder without any secret code can make the system be deactivated, but it does not last long. Such a replacement does not solve any condition. Even after replacement, the system is activated automatically in short time and then no operation of the vehicle can be made in any way.

Tech-2 should be provided in your organization.

Caution to the operation

If an attempt is made to start the engine while the immobilizer system is activated, the check engine lamp flashes and the engine will not start.

Summary of operation

Switch on: Set the ignition and starter switch to OFF.

(Activate)

Switch off: Set the ignition and starter switch to ON by using the transponder key. (Deactivate)

What your organization should provide for your customer

• Car Pass

For a new owner, your dealership must hand Car Pass card, which has identification numbers of new owner's vehicle immobilizer system. This information is very important in case of repair or lost of transponder.

The followings are necessary items provided by your responsibility.

1) Car pass with identification for a new owner
2) Blank car pass card when it is for reissue
3) Instruction to dealers how to use car pass card

• Security code management

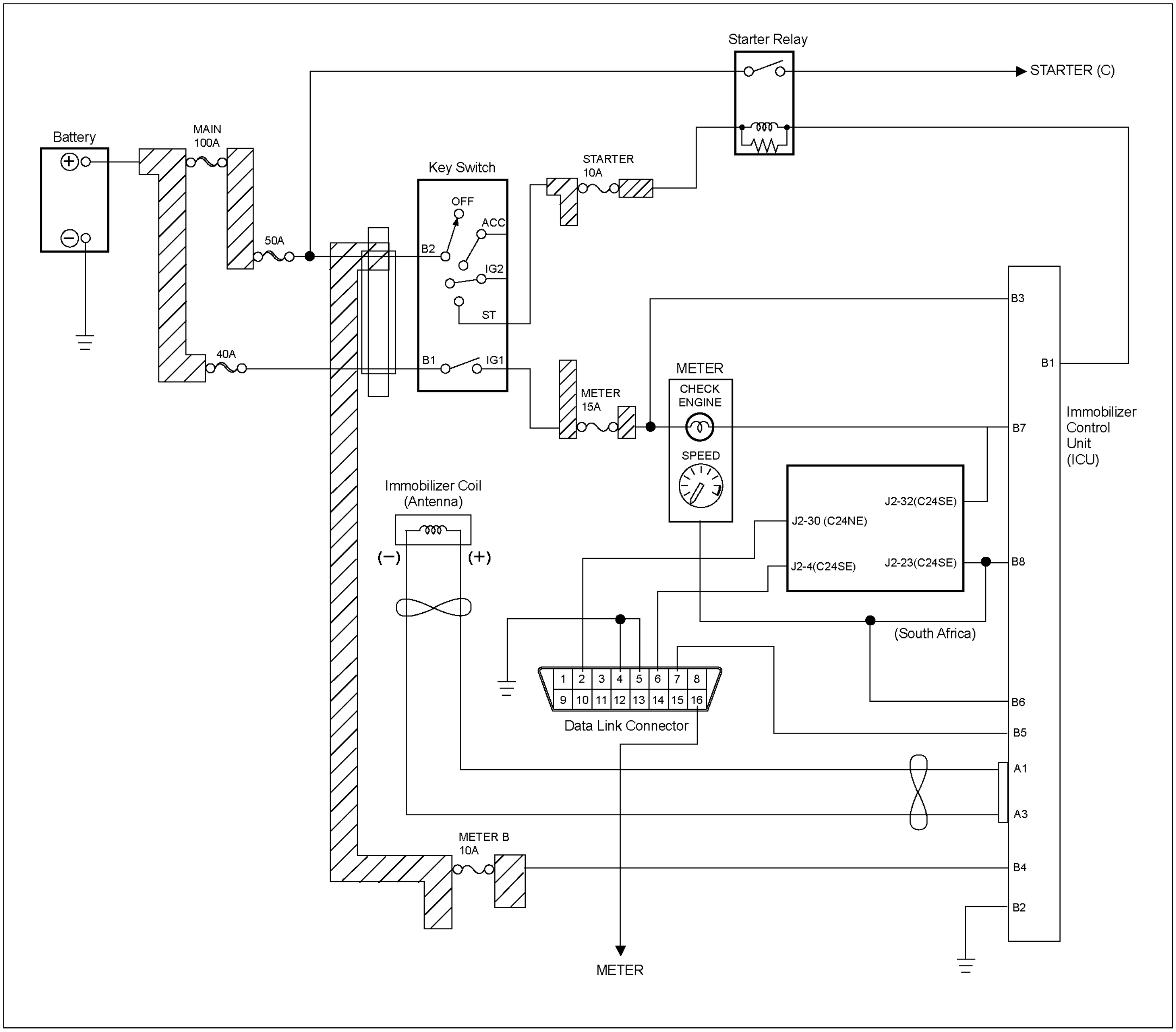
Your organization must keep security codes for all vehicles as confidential data. Once the security codes are lost, anybody who have the security code can access immobilizer system. Your organization has responsibility of any missing vehicles caused by stolen security code.

• Essential tool (Scan tool : Tech-2)

Your dealership must have Tech-2, and Tech-2 updated software for immobilizer system.

Circuit Diagram

- **Gasoline Engine (C24SE)**



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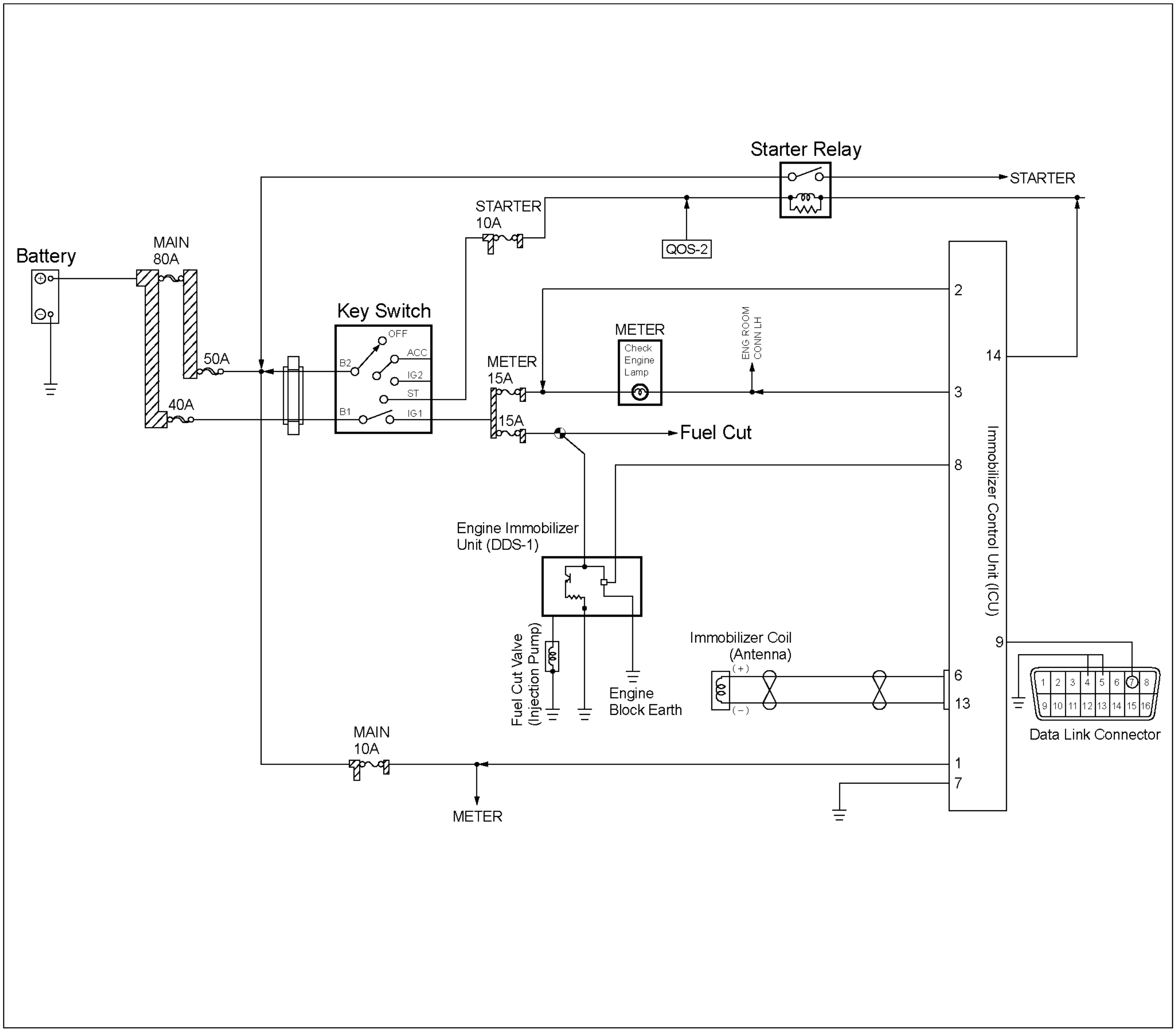
Diesel Engine With Engine Immobilizer Unit (4JA1-T Mechanical Control Engine)



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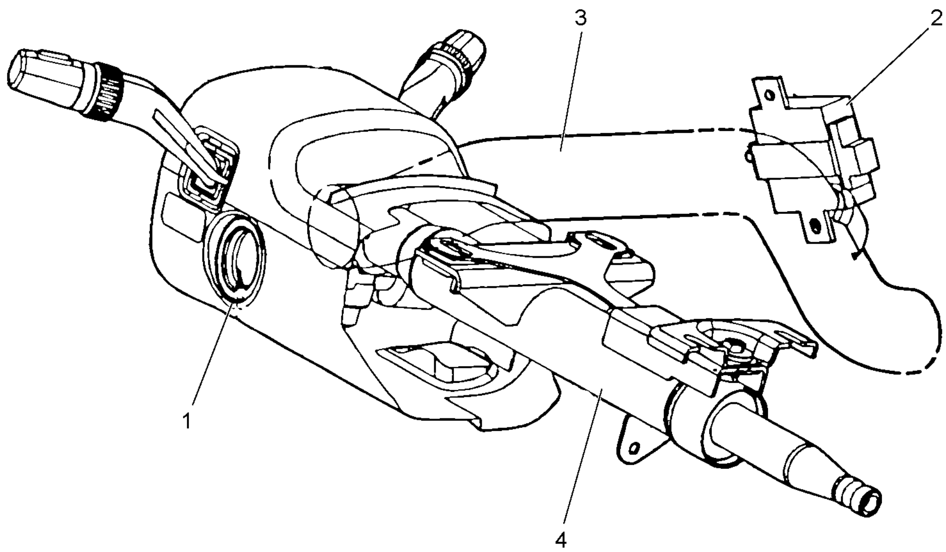
Parts Location



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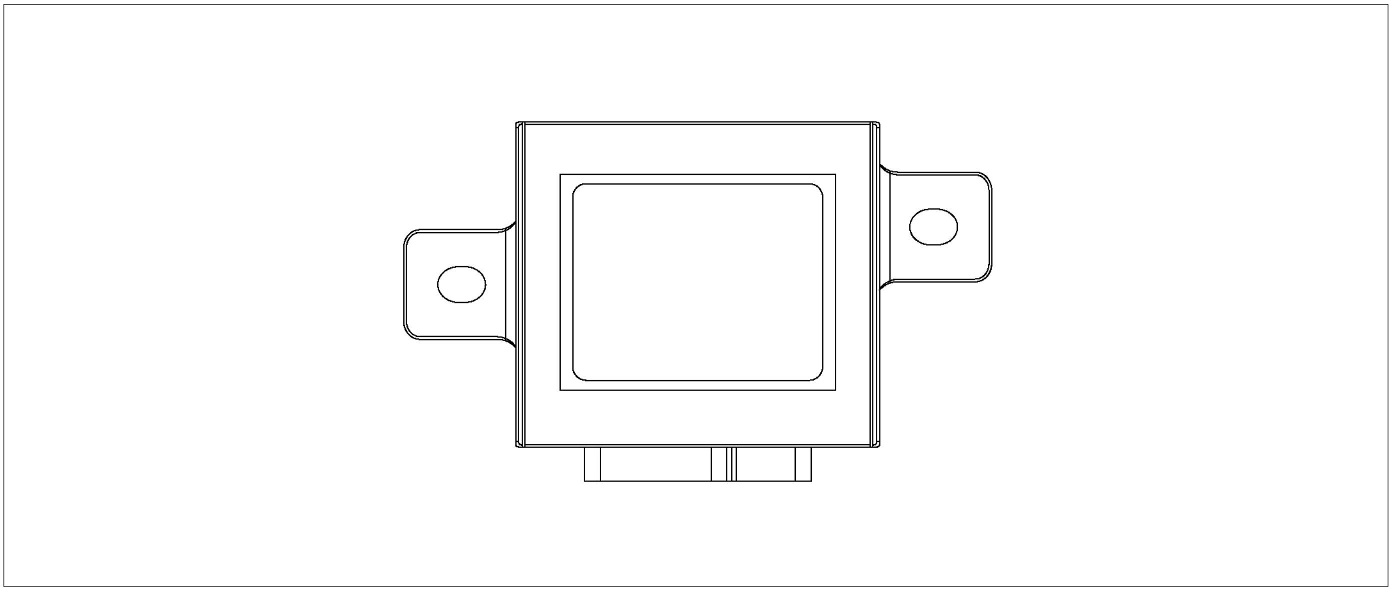
Legend

(1) Immobilizer Coil
(2) Immobilizer Control Unit (ICU)
(3) Cross Beam
(4) Steering Shaft

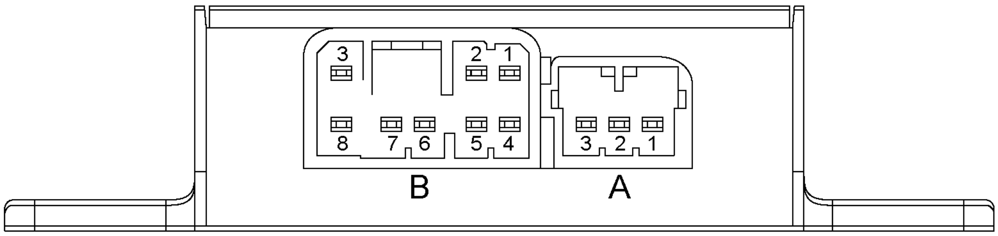
Immobilizer control unit (ICU); For Electronic Control Engine (C24SE)

Immobilizer control unit (ICU) permits engine starting, when the security code which compares the security code registered into the transponder (key) and the security code registered into ICU, and is similarly registered into ICU and engine control unit (ECM) is compared and it is judged that it is normal. When the code registered into the key is unusual, and when not recognizing a security code, ICU does not permit starting of engine.



RUW38HSF000101

Pin-outs; For Electronic Control Engine (C24SE)



RUW38HSF000201

No.	Pin Function
A-1	Antenna coil positive
A-2	—
A-3	Antenna coil negative
B-1	Starter Relay
B-2	Ground
B-3	Voltage from ignition switch ON
B-4	Back up voltage supply
B-5	To Tech-2
B-6	Vehicle speed sensor
B-7	Communication: carry on line from ECM to ICU (Check engine lamp)
B-8	Communication: carry on line from ICU to ECM (Communication line W)

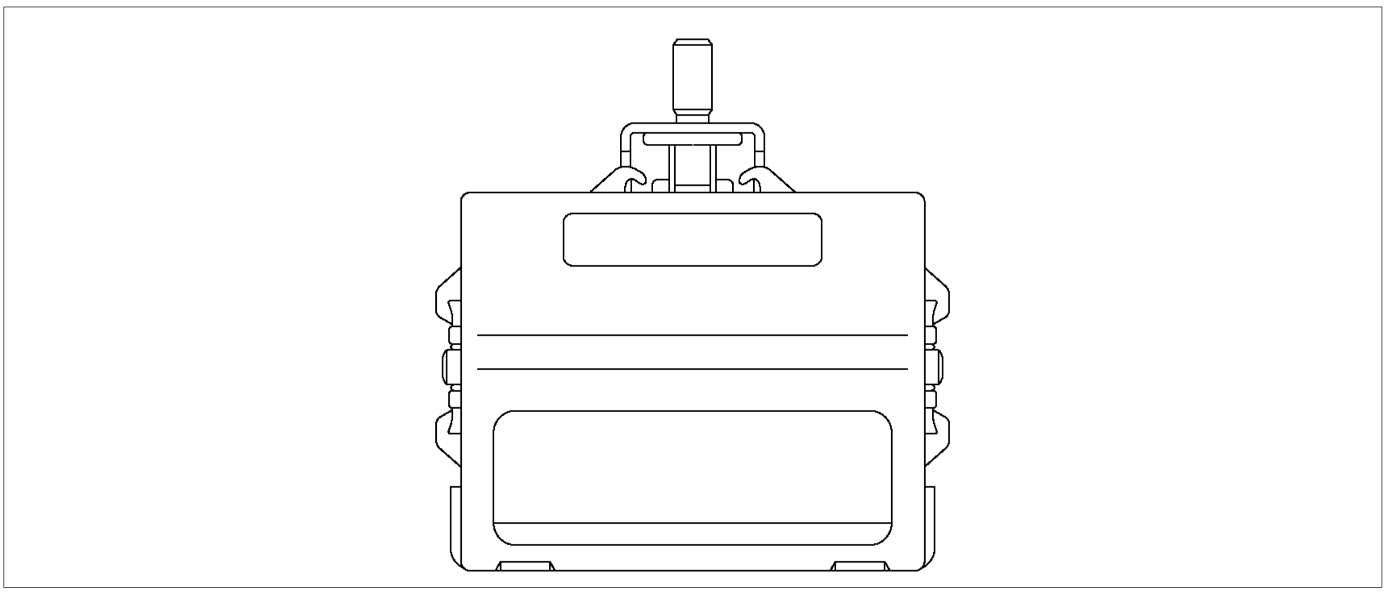
Immobilizer control unit (ICU); Mechanical Control Engine (4JA1-T)

Immobilizer control unit (ICU) permits engine starting, when the security code which compares the security code registered into the transponder (key) and the security code registered into ICU, and is similarly registered into ICU and engine immobilizer unit (DDS-1) is compared and it is judged that it is normal. When the code registered into the key is unusual, and when not recognizing a security code, engine immobilizer unit does not permit starting of engine by the fuel cut valve on the fuel pump.

The engine immobilizer unit is located with fuel cut valve on fuel pump 4JA1-T engine.

The immobilizer control unit decides whether there is an abnormality the security code based on the engine immobilizer unit security code.

When the problem found, the engine immobilizer unit stops fuel supply by the fuel cut valve.



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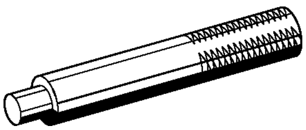
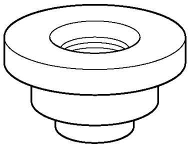
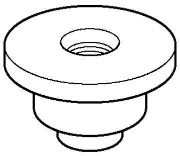
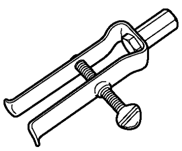
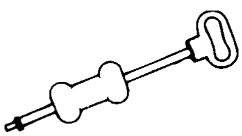
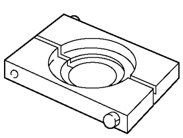
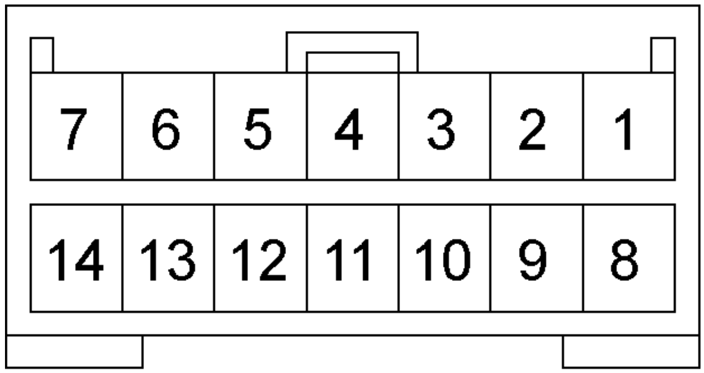
SPECIAL SERVICE TOOL

ILLUSTRATION	PART NO.	PART NAME
	5-8840-0007-0 (J-8092)	Grip
	5-8840-2407-0 (J-41693)	Installer: Oil seal
	5-8840-2408-0 (J-41694)	Installer: Bearing needle
	5-8840-0027-0 (J-26941)	Remover: Bearing needle
	5-8840-0084-0 (J-2619-01)	Hammer: Sliding
	5-8840-2197-0 (J-37452)	Remover: Bearing inner shaft

Pin-outs

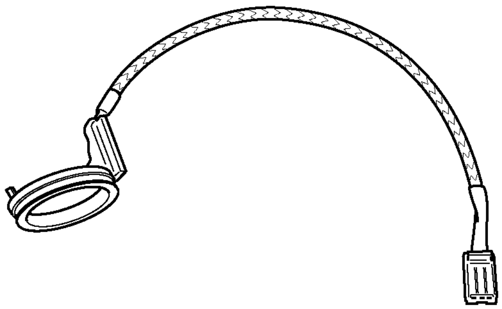


RUW48HSF000201

No.	Pin Function
1	Back up voltage supply
2	Voltage from ignition switch ON
3	Lamp
4	—
5	—
6	Antenna coil positive
7	Ground
8	Engine immobilizer unit
9	To Tech2
10	—
11	—
12	—
13	Antenna coil negative
14	Starter cut relay

Immobilizer coil (Antenna)

Immobilizer coil is install in order that ICU may check the security code memorized by the transponder (key).



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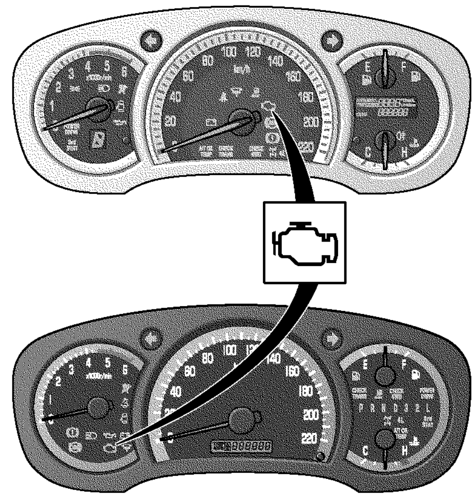
Check engine lamp

Check engine lamp displays failure or a system operation of a immobilizer system by flash of a lamp.



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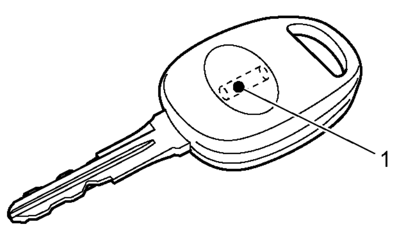
RTW76ESH004001

Transponder (Key)

Transponder is installed in the inside of a key.

Transponder has memorized the security code of a immobilizer system.



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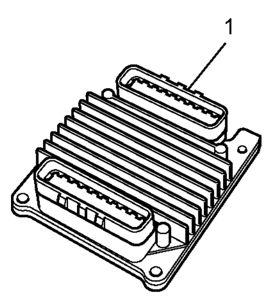
Legend

(1) Transponder (Key)

Engine control module (ECM)

ECM will stop engine, if it communicates with ICU and abnormalities are detected by a key and the immobilizer system.



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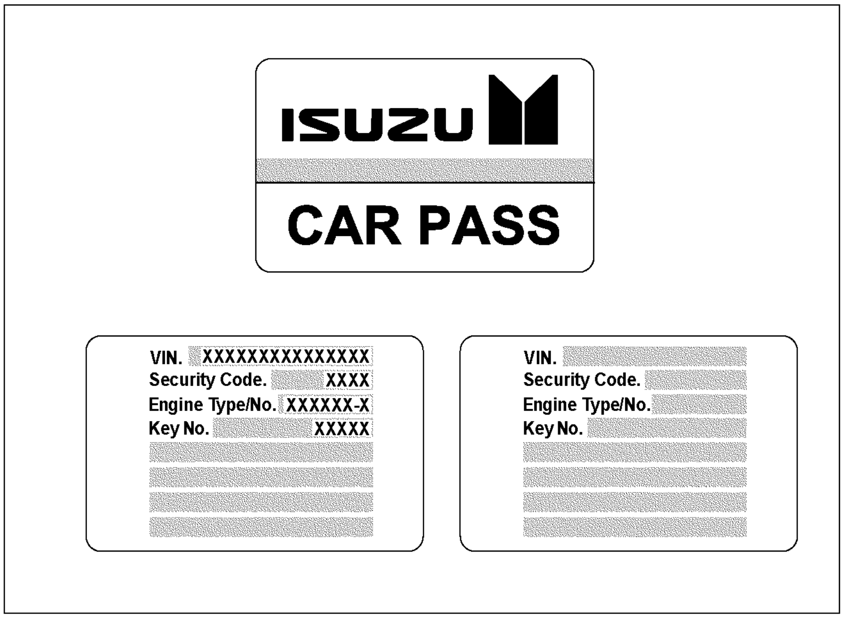
Legend

(1) ECM (C24SE engine)

Car Pass Card

Issue of a car pass card is based on distributer. A car pass card is issued to the customer on delivery of the vehicle along with the other papers.



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Notes:

This car pass card is an important document and must be treated with the same care as the vehicle papers.

It must not be kept in the vehicle. The customer must present the car pass card for operations involving the immobilizer or the engine control unit.

Loss of car pass card

If the car pass card is lost, the data can be requested from your proper organization name. This request will only be processed if accompanied by the enclosed form and proof of ownership. Once the data is received, it can be entered in a blank car pass and given to the customer.

The unused car pass should be destroyed.

Instructions on Filling Out the form "Data request, car pass"

To be provided by the dealership.

The data requested under items 1-10 must be provided completely, including the authorized dealership number, the vehicle Identification number (VIN) and engine type/number (Engine type/No).

Mark missing data / desired data with a cross:

- Security code (for diagnosis and programming with Tech-2)
- Mechanical key Number

Complete the form by entering the data and signature/authorized dealership stamp and send it along with proof of ownership (Vehicle ID or invoice) to address provided in the form. The requested data will be sent by Fax to the dealership that made the request after your organization has confirmed that the info is corrected.

Important Instructions

Only data corresponding to the delivery status of the vehicle can be issued. Car pass data requests will only be processed if the first column is filled out completely.

Signed and sent to your organization along with proof of ownership.

Information via telephone is only possible in exceptional circumstances via your service organization.

As for the delivery of new vehicles, the customer must be informed about all features of the car pass that are relevant to vehicle security, for example, that the car pass card should be kept in a safe place(not in the vehicle) and should be presented when an authorized your organization name workshop is visited, The exact phrasing can be found in the relevant Owner's Manual.

Data Request
Car Pass

Your organization name

To be filled out by authorized dealership:	Comment, plant security
	....
1. Dealership name..	....
2. Name of contact partner..	....
3. Dealership number..	....
4. Address..	....
....	....
5. Tel:.................................Fax.................................	....
6. Name of registerde keeper	
7. Reason for request (please mark with cross)	
- Loss by customer ☐	
- Loss by dealership ☐	
- New delivery Car Pass ☐	
- Theft ☐	
8. Vehicle type..	....
9. VIN...	....
10. Engine type / No..	....
Requested data (please mark with cross)	
11. Security Code : ☐	....
12. Key No. : ☐	....
13. Radio code (if lost, please supply radio unit number) ☐	....
14. CD-changer code (if lost, please supply CD-chnger unit number) ☐	....

Important Instructions:

Only data corresponding to the delivery status of the vehicke Ex works can be Issued.

Car pass requests will only be processed if they are filled out completely, signed and sent to your organization along with proof of ownership (enclosure).

Information via telephone is only possible in exceptional circumstances via your service organization.

Comments form Plant Security

- ☐ No signature
- ☐ Data / proof of owner ship incomplete, Please complate
- ☐ Data / proof of ownership missing, Please supply
- ☐ Illegible due to poor fax communication, please resend

Data, signature / stamp (Dealership)	**Data, signature (Plant Security)**

Enclosure: Proof of ownership ☐

RUW38HXF000201

Important information on Programming

Security code

The security code protects the immobilizer control unit against unauthorized programming and data access from Tech-2. The security code consists of a 4 digit code number and is programmed into the immobilizer control unit and Engine Control Module (ECM).

New control units are not programmed with a security code.

If the control units are replaced, the security code entered in the car pass, transponder ID, etc.

Must be programmed into the new control unit with Tech-2.

The security code can only be programmed with Tech-2 once and must therefore be performed with great care.

Once programmed, the security code cannot be overwritten. An already used immobilizer can be reused in a different car by initializing the immobilizer. After that you can program the security code again. For initializing command you need the current security code.

If the immobilizer control unit is returned, always enclosed the security code that is allocated to that control unit. If this is not done, we can not process the case and the warranty will not be recognized.

Entering a code

If the Tech-2 display requests that the

- security code
- mechanical key number
- Vehicle Identification No.

be entered, process as follows;

To input a digit you need to use the up and down buttons of the Tech-2. By using the numeric buttons the according digit will be displayed at the current position and the cursor will move to the next position.

For letters you need to use the up and down buttons of the Tech-2. The up and down key might be used for digits as well. By using the up and down buttons the displayed digit or letter will be increased or decreased.

To move to the next position you need to use the move-to-right-button.

With the two buttons, move-to-right and move-to-left you can select the position of number you want to change.

This will allow you to correct a wrong number.

After the number is completed you need to press the Enter button to accept the number. Correction is now no longer possible.

Use the OKAY soft key to program the number and the NOT OKAY soft key to abort the programming.

Transponder (Key)

• If a transponder key is lost:

If a transponder key is lost, all transponder keys in the immobilizer control system must be erased. Transponder keys can be ordered via the "Your proper organization name such as part and accessory department" as previously by providing the mechanical key number.

The mechanical key number is provided on the car pass card.

Thereafter, existing and new transponder keys are programmed consecutively using Tech-2. The vehicle can then no longer be started using lost key.

• 5 transponder keys can be provided:

Each transponder has different Identifications. If a customer wants more than 2 transponder keys, maximum 5 transponder keys can be provided by additional programming by Tech-2.

• If a new ignition key with different mechanical key number needs to be installed:

If installation of an ignition lock with a different mechanism key number is necessary (an ignition lock which belongs to the mechanical key number has to be ordered first), all transponder keys must first be erased and the two transponder keys which belong to the ignition lock that is now installed must be programmed.

The new mechanical key number must be programmed now into the immobilizer. The mechanical key number in the car pass is to be changed as well.

Important:

After successful programming, the engine control can only be used for vehicles with immobilizer and transponder.

Faults that occur in connection with the immobilizer control unit are recognized by the engine control unit and as long as "IMMOBILOZER" is not programmed, are indicated by a flashing of the check engine lamp.

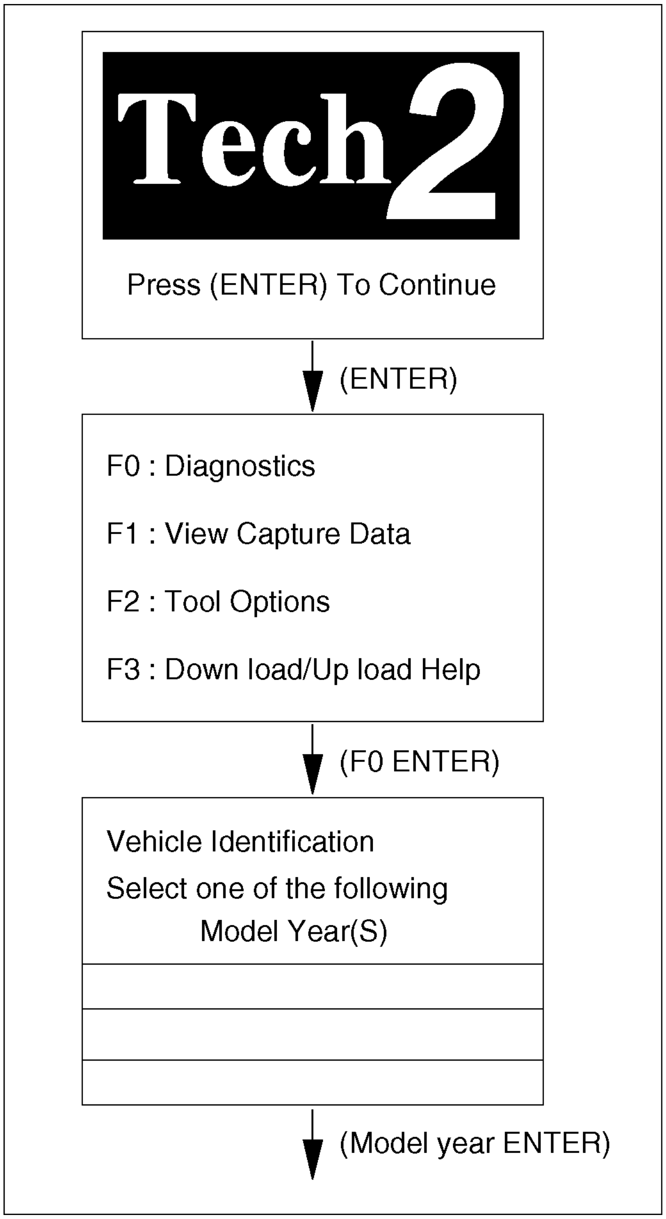
If the immobilizer and engine control unit are replaced at the same time, the immobilizer control unit must be programmed first before the "IMMOBILIZER" function in the engine control unit can be activated.

Tech 2 Scan Tool

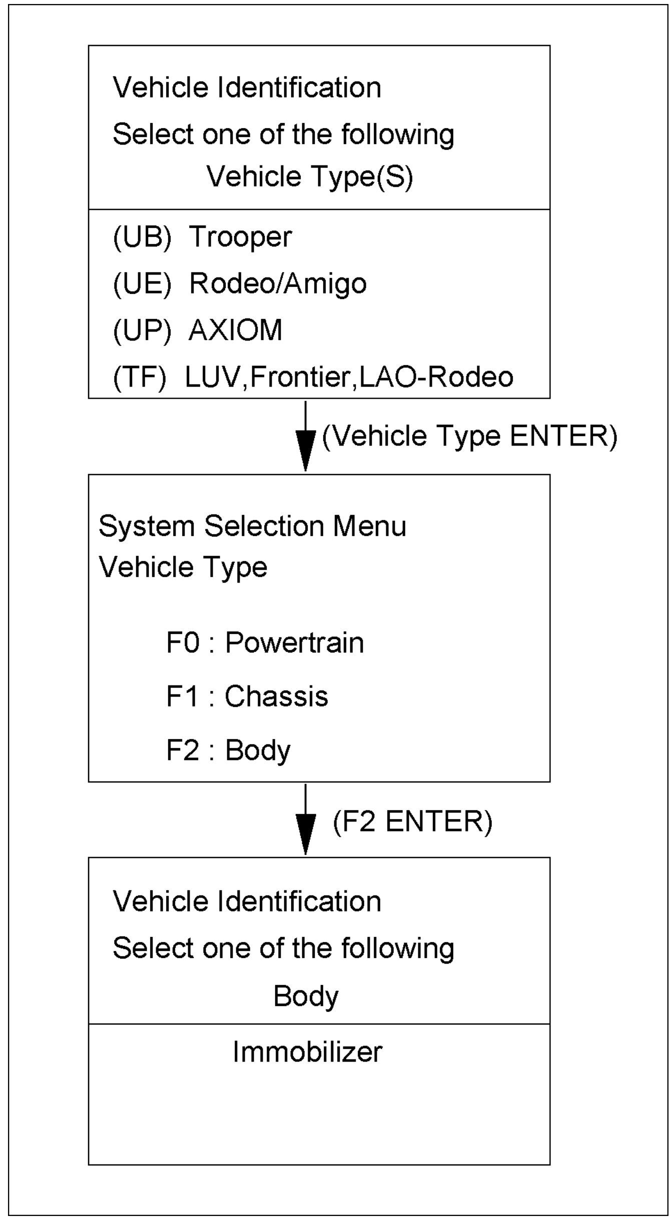
Operating Procedure

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card.

Follow the operating procedure below.



060R100102



LTW3BALH000101

Menu

The following table shows which functions are used for the available equipment versions.

F0: Diagnostic Trouble Codes
- F0: Read DTC Info Ordered By Priority
- F1: Read DTC Info As Stored By ECU
- F2: Clear DTC Information

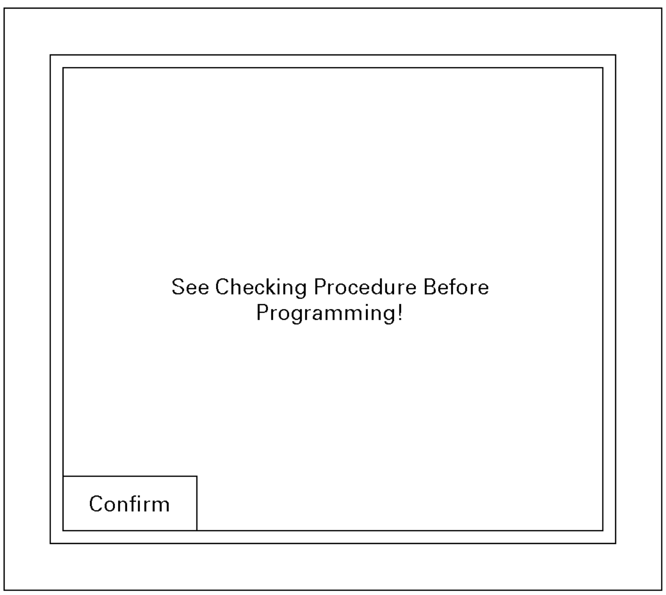
F1: Data Display

F2: Snap Shot

F3: Additional Function
- F0: Read ECU Identification
- F1: Reset Immobilizer
- F2: Reset Engine Control Module
- F3: Erase Transponder–Keys

F4: Programming
- F0: Program Immobilizer Function
- F1: Program Transponder–Keys

NOTE: Before going to programming process, Tech-2 indicates instruction as follows.



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DTC

On OBD has two options available in the Tech 2 DTC mode to display the enhanced information available.

- Read DTC Info Ordered By Priority
- Read DTC Info As Stored By ECU

Clear DTC Information

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTC information" function.

Tech-2 Data Display

Use the Tech 2 Data Values only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly.

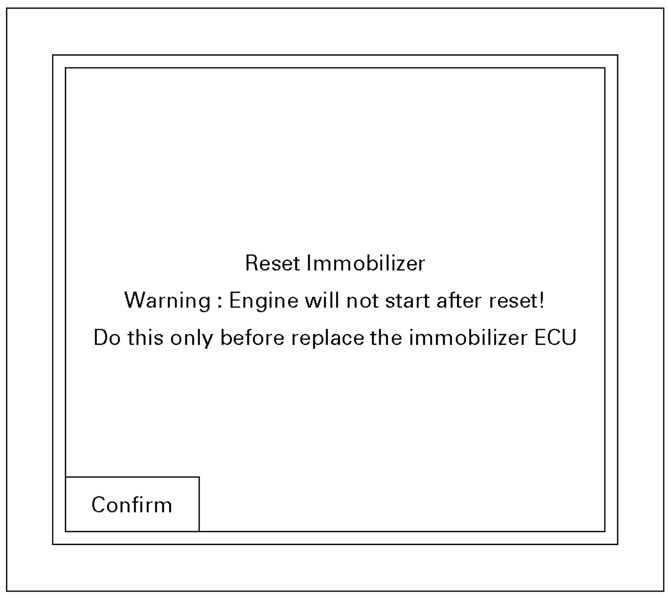
The Tech 2 data values represent values that would be seen on a normally-immobilizer system.

Check Vehicle Identification Number (VIN)

1. Select "Body" and "Immobilizer".
2. Select "Additional Function" and "Read ECU Identification".
3. Shows up VIN on tech-2 display.

Reset Immobilizer (Reset Immobilizer Control Unit)

1. Select "Body" and "Immobilizer".
2. Select "Additional Function" and "Reset Immobilizer".
3. Enter the security code and press Confirm.
4. Reset Immobilizer screen shows up with warning. See the following screen.



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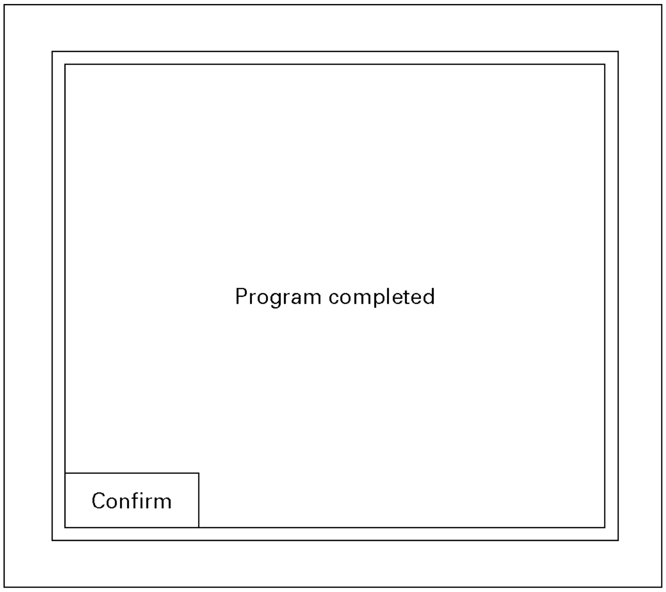
5. When reset is completed, the following screen shows up.



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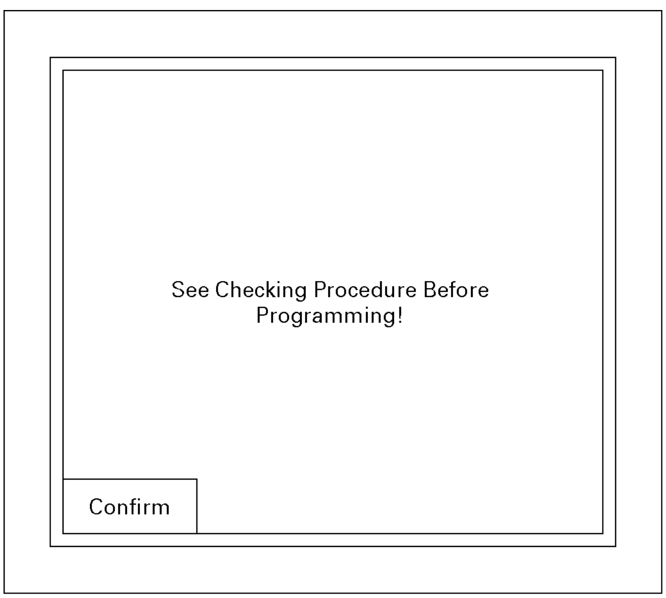
Reset Engine Control Module (Reset ECM)

1. Select "Body" and "Immobilizer".
2. Select "Additional Function" and "Reset Engine Control Module".
3. The following screen shows up.



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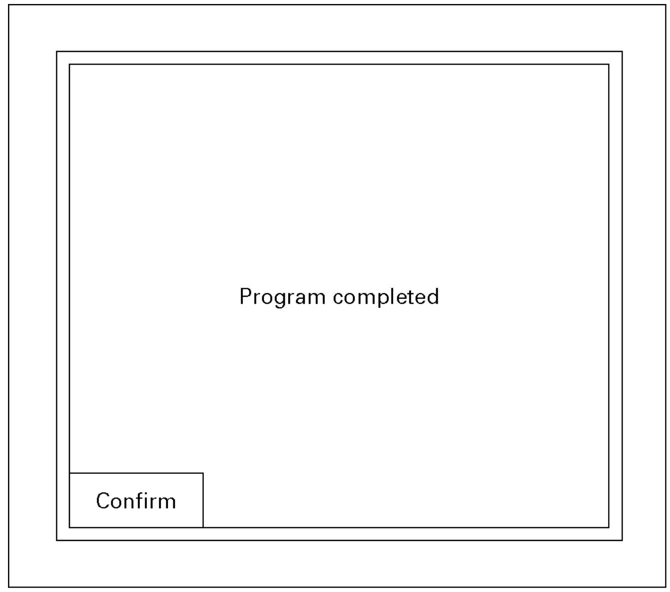
4. Confirm the following screen shows up.
5. Input the security code, then press the soft key of "Not Okay" or "Okay".
6. The following screen shows up.
7. Programming is completed.



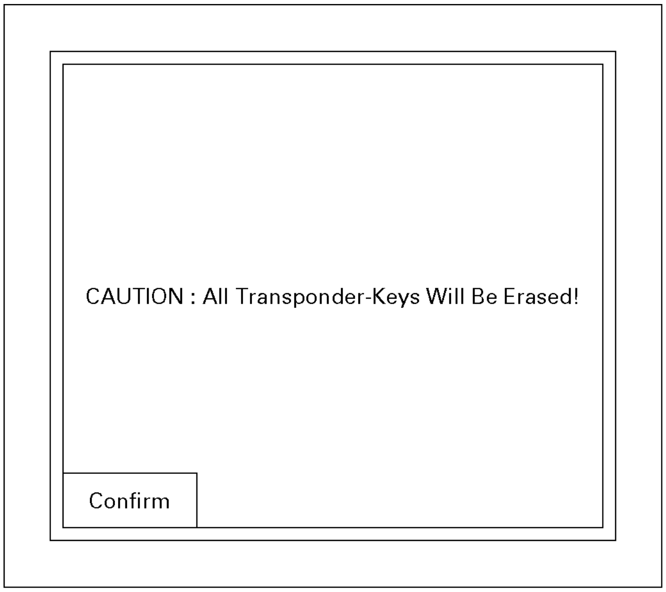
060R200278

8. When the procedure is completed waits 10 seconds and then turn the Key on.
   The fail lamp begins to flash.
9. Turn the ignition on, then engine dose not run.
10. Reset is completed.

Erase transponder key

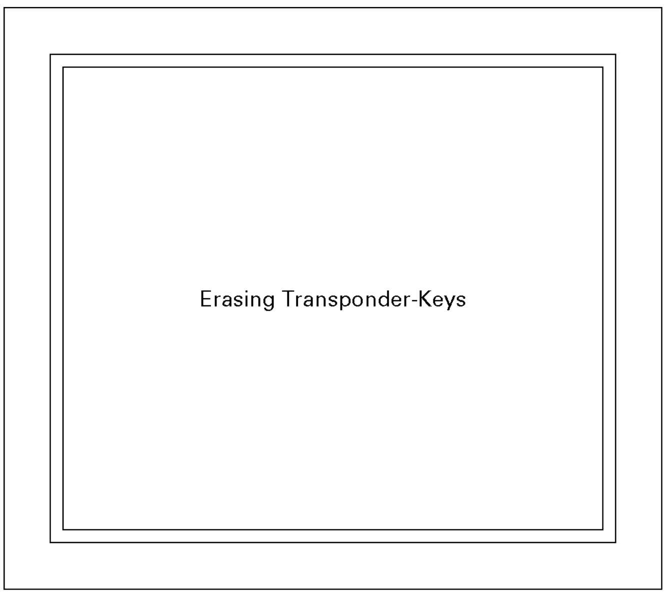
1. Select "Body" and "Immobilizer".
2. Select "Additional Function” and "Erase Transponder-Keys".
3. See immobilizer status on Tech-2 screen and type security code. If the status dose not allow the programming, only immobilizer status is displayed.
4. See illustration of caution.

• **CAUTION**



060R200286

• **Erase**



060R200285

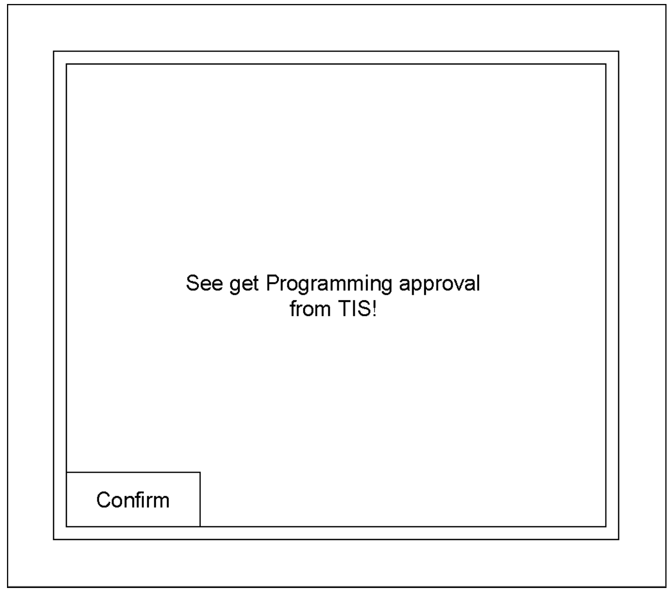
4. See programming result on display.

Programming Immobilizer Function

Caution:

1) Do not replace ICU and ECM at the same time
2) Change ICU at first or ECM and other one change follows.

1. Select "Body" and "immobilizer".
2. Select "Programming" on Tech-2 display.
3. Check the display, then press the "Confirm" key.



LTW3BASH000401

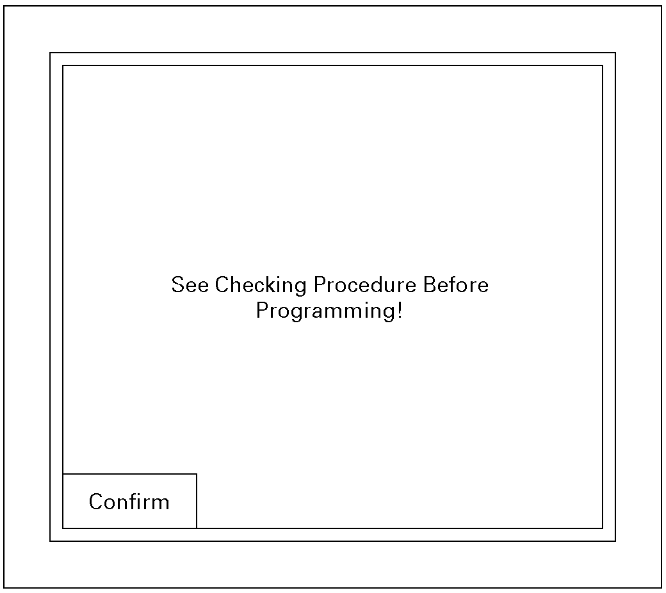
4. Install the "Hardware Key" on PC.
5. Connect RS232 cable to the PC and Tech2.
6. Turn on the PC, then start software "TIS 2000".
7. Select "Security Access" in the TIS 2000 screen.

SECTION 5

BRAKES

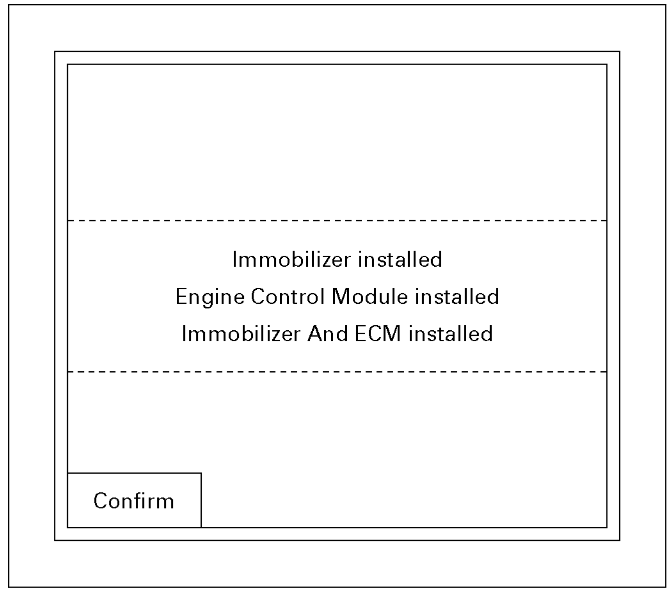
TABLE OF CONTENTS

8. Select "Next" in the TIS 2000 screen and wait a few seconds.
9. When programming is enabled (Approved), then press "close" in the TIS 2000 screen.
   (Finish the "TIS 2000" operation.)
10. Select "Program Immobilizer Function" on Tech-2 display.
11. The following screen shows up.



060R200289

12. Confirm the following screen shows up.
13. Input the security code, then press the soft key of "Not Okay" or "Okay".
14. Select the engine type then, press "Enter" key.
15. Input a program option, by moving the cursor on the selection, then press "Enter" key.
    - Programming ICU
    - Programming ECM
    - Programming ICU and ECM



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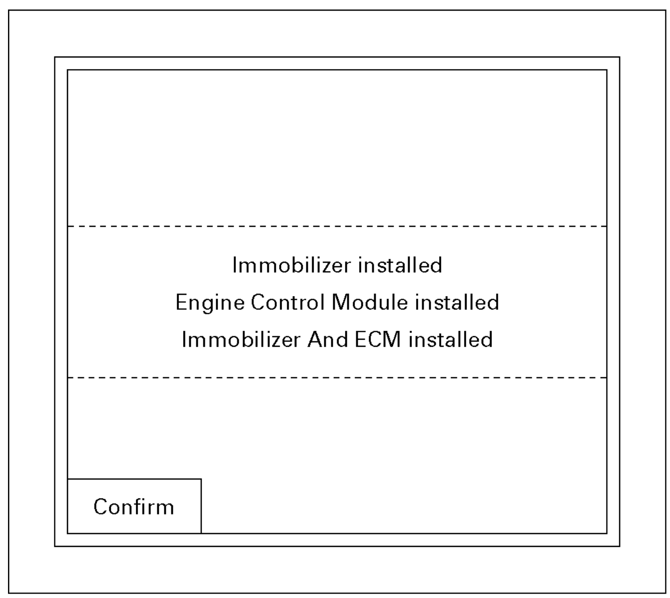
Programming ICU

1. Follow Programming Immobilizer Function steps 1 through 14.
2. Input a program option, by moving the cursor on the selection, then pres "Enter" key.



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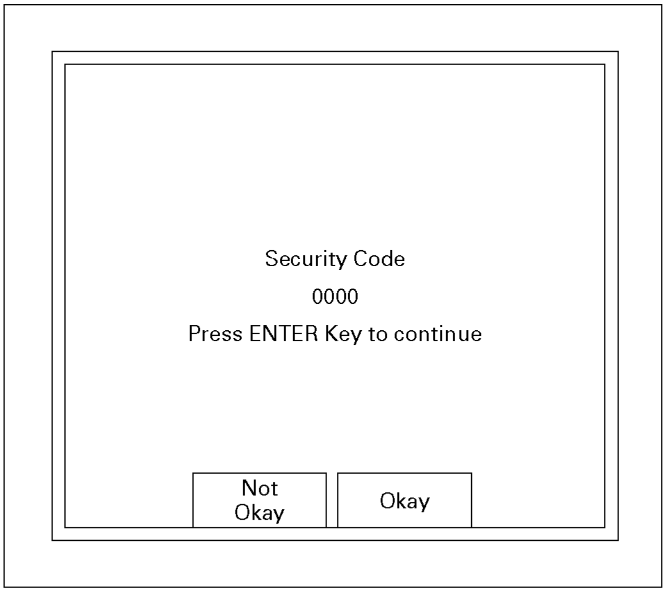
3. Enter the security code.

4. Input the security code, then press the soft key of "Okay" or "Not Okay".

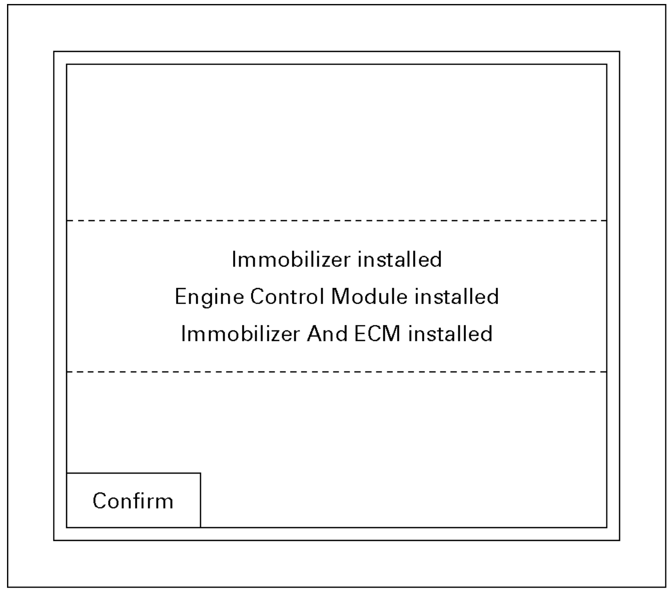


060R200284

5. Enter VIN.
6. Enter Mechanical key number.
7. Turn ON ignition.
8. Select an engine system.
9. See the programming result.
   Tech-2 displays the result of programming as the following.
   Follow those instructions
   - Selected Programming is not possible due to wrong System Status!
   - Immobilizer Not Programmed!
   - Immobilizer Already Programmed!
   - ECM Not Programmed!
   - ECM Already Programmed!
10. Transponder key must be reprogrammed, because all transponder information is erased.
    When ICU is programmed. See Transponder programming.

Programming ECM

1. Follow Programming Immobilizer Function steps 1 through 14.
2. Input a program option, by moving the cursor on the selection, then pres "Enter" key.



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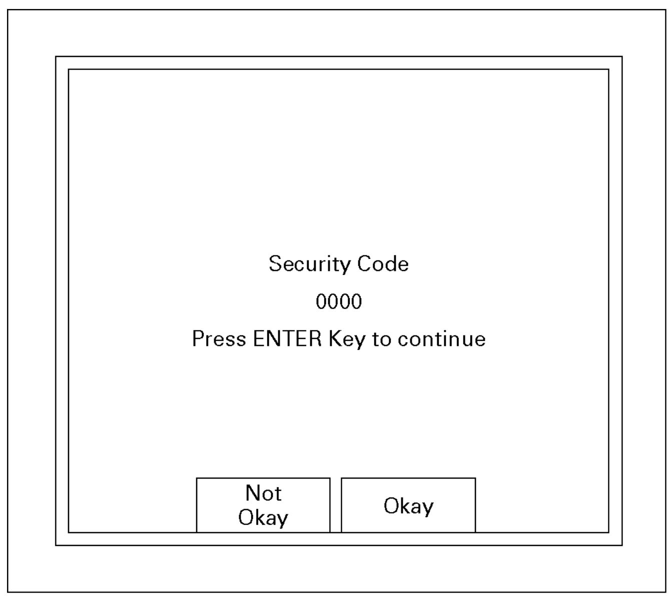
3. Enter the security code.
4. Input the security code, then press the soft key of "Okay" or "Not Okay".



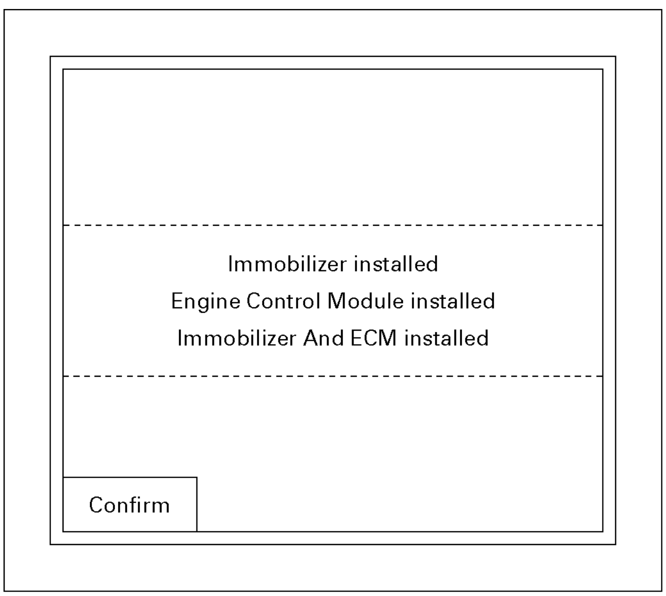
060R200284

5. Turn on the Ignition.
6. Select an Engine system.

7. See the display of programming result.
   Tech-2 displays the result of programming as the following.
   Follow those instructions
   - Selected Programming is not possible due to wrong System Status!
   - Immobilizer Not Programmed!
   - Immobilizer Already Programmed!
   - ECM Not Programmed!
   - ECM Already Programmed!
8. Transponder key must be reprogrammed, because all transponder information is erased. When ICU is programmed. See Transponder programming.

Programming ICU and ECM

1. Follow Programming Immobilizer Function steps 1 through 14.
2. Input a program option, by moving the cursor on the selection, then press "Enter" key.



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3. Enter the security code.
4. Input the security code, then press the soft key of "Okay" or "Not Okay".

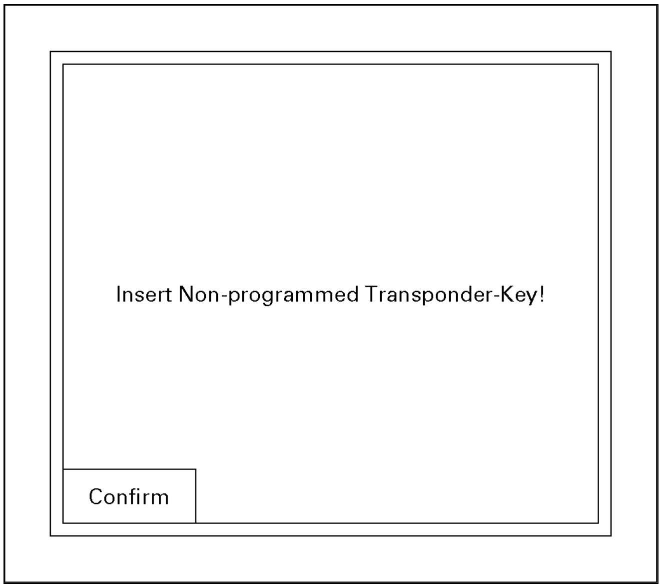
060R200284

5. Input the security code.
6. Enter VIN.
7. Enter Key No.
8. Select an engine system.
   See programming result display and follow instructions of the display.
9. Transponder key must be reprogrammed, because all transponder information on ICU is erased when ICU is programmed. See Transponder programming.
10. Follow Programming ECM steps 2 through 8.

Transponder program

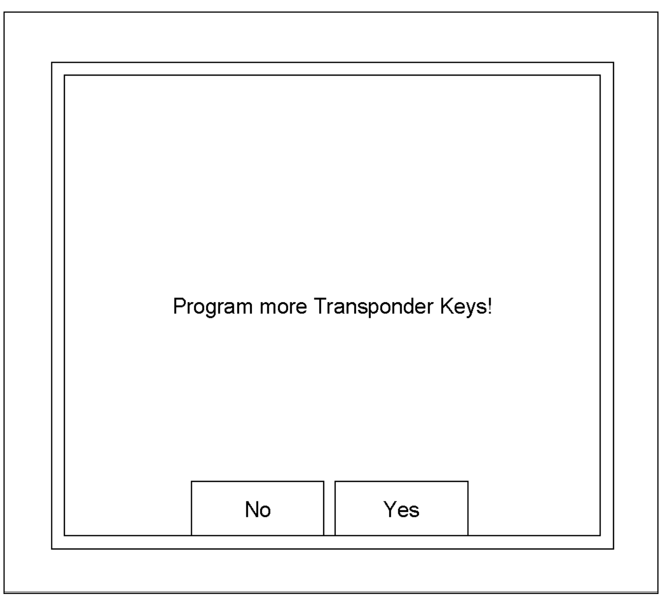
1. Select "Body" and "Immobilizer".
2. Select "Programming" and "Program Transponder-Keys".
   (Follow Programming Immobilizer Function steps 1 through 14.)
3. See immobilizer status on Tech-2 screen, and enter security code. If the status does not allow the programming, only immobilizer status is displayed.

4. Insert Non-programmed Transponder-key and press soft key of "Confirm".



060R200288

5. "Turn On ignition key", is displayed if the ignition is off.
6. The transponder status is displayed if the status does not allow the programming.
7. When programming starts "Programming Transponder - key!" is displayed.
8. Turn off Ignition key.
9. Turn On Ignition key.
10. If the programming was not successful, the transponder status is only displayed.
11. To program more illustration press soft key.



RUW38SH000601

12. See programming result.

Data List

No.	Strings		Note
1	Ignition Status	On 12V /Off 0V	
2	Transponder-Key	Transp. Key #	The number of the key currently programmed
3	Transponder Status	Correct/Incorrect TP-Key	
4	Transponder-Key 1 Status	Programmed / Not Programmed	
5	Transponder-Key 2 Status	Programmed / Not Programmed	
6	Transponder-Key 3 Status	Programmed / Not Programmed	
7	Transponder-Key 4 Status	Programmed / Not Programmed	
8	Transponder-Key 5 Status	Programmed / Not Programmed	
9	Immobilizer signal	Transmitted / Not Transmitted	
10	Engine Request	Received / Not Received	
11	Vehicle Speed Output	Veh. Speed signal	
12	Immobilizer Relay	Active 0V / Inactive 12V	
13	Security Wait Time	Active / Inactive	

Diagnostic procedure

- Once the cause of DTC is repaired or gone, engine can be operated normally, and present DTC becomes history code.
- History code is canceled by no repeat failure on 25 consequence ignition key on afterward.
- History code cannot be canceled by battery connector disconnected.

Clearing Diagnostic Trouble Codes

IMPORTANT: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with immobilizer system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on immobilizer systems. Failure to follow these steps could result in unnecessary repairs.

Diagnostic Aids

Check the condition for system parts.

- Installation condition, poor connection, damage, system parts malfunction. Harness, Fuse, Relay, Immobilizer coil (antenna), Key, Meter, Immobilizer control unit (ICU), Engine control module (ECM).

NOTE: Breakage of immobilizer fuse does not operate immobilizer system. Check engine lamp flashes at this time.

Check the Electro-Magnetic Interference (EMI)

- Location of vehicle check
  Move the vehicle to a new location and perform the check again.
- Non-OEM Parts.
  Switch is "OFF" or remove the Non-OEM parts and perform the check again.
- Other
  Remove the accessory and another key from key.

Check the other items.

- Battery voltage is low.
- Immobilizer programming functions.
  Must be programmed immobilizer system.
- Registration for security code, immobilizer control unit parts number.
- Key switch operation.
  Immobilizer system may detect a history DTC by the timing of ON-OFF of a key switch.
- Active the immobilizer system.
- Keyless entry system is malfunction.
- Anti theft system is malfunction.

Check the operation

Check the operation "Lock / unlock" by using transmitter (key) on the vehicle.

Diagnostic Trouble Code (DTC) list with ECM

• Immobilizer Control Unit (ICU)

DTC	Description	Note
B0001	REPLACE ELECTRONIC CONTROL UNIT (ECU) (IMMOBILIZER FAULT)	This error code appears if a RAM /ROM Error was detected or the EEPROM is defect.
B0002	IMMOBILIZER NOT PROGRAMMED	Immobilizer control unit is not programmed.
B0003	TRANSPONDER KEY PROBLEM	･Reading of Transponder information failed with ignition on transponder has a fault. ･Hardware fault in reading circuit.
B0004	IMMOBILIZER COIL CIRCUIT (ANTENNA COIL FAULT)	Immobilizer coil has a fault.
B0005	COMMUNICATION LINE W VOLTAGE LOW	Short circuit to ground or open circuit.
B0006	COMMUNICATION LINE W VOLTAGE HIGH	Short circuit to 12V.
B0007	NO ENGINE REQUEST RECEIVED	No ECM Challenge.
B0008	WRONG TRANSPONDER KEY	Incorrect security code response received.
B0009	NO TRANSPONDER KEY PROGRAMMED	Transponder security code table empty
B0010	UNKNOWN TRANSPONDER KEY	Transponder security code not valid.

• Engine Control Module (ECM: Gasoline Engine {C24SE})

DTC	Description	Note
P1626	No Response From Immobilizer	Refer to Engine Control system section
P1631	Received Response Was Not Correct	Refer to Engine Control system section
P1648	Received Incorrect Security Code	Refer to Engine Control system section
P1649	Security Code & Security Key Not Programmed	Refer to Engine Control system section

Diagnostic Trouble Code (DTC) list with Engine Immobilizer Unit (4JA1-T Diesel Engine)

• **Engine Immobilizer Unit**

Code (DTC)	Description	Detecting Condition
B0011	TRANSPONDER KEY PROBLEM	Transponder code unsuccessfully read 5 consecutive time. (No completely read in 500ms transponder code)
B0012	WRONG TRANSPONDER KEY	Immobilizer program no executed.
B0013	IMMOBILIZER NOT PROGRAMMED	Processing program no executed.
B0014	NO TRANSPONDER KEY PROGRAMMED	Processing to save the transponder key in the control unit not Executed.
B0015	FREQUENCY SIGNAL Lo	Lo level (less than 2.5) input during the Hi level was being output to the communication line.
B0016	FREQUENCY SIGNAL Hi (Diesel)	Hi level (more than 2.5v) input during the Lo level was being output to the communication line.
B0023	ANTENNA COIL OPEN	Antenna coil not connected.
B0024	WRONG TRANSPONDER RESPONSE	Transponder response signal with challenge is wrong.
B0055	EEPROM ERROR	Write and read cannot be correctly made to and from the EEPROM in the control unit.

IMMOBILIZER SYSTEM CHECK

Step	Action	Value(s)	Yes	No
1	1. Key position is "ON," engine "OFF." 2. Observe the check engine lamp. Note: When a key switch is turned ON, check engine lamp will turn on and a check engine lamp will be turned off after a few seconds. Is the check engine lamp "ON"?	—	Go to *Step 2*	Go to *"No Immobilizer warning lamp"*
2	1. Key position is "ON," engine "OFF." 2. Observe the check engine lamp. Note: When a key switch is turned ON, check engine lamp will turn on and a check engine lamp will be turned off after a few seconds. Is the check engine lamp "OFF"? (Check engine lamp does not flash)	—	Go to *Step 3*	Go to *"Immobilizer warning lamp on steady"*
3	1. Key position is "OFF." 2. Install a scan tool. 3. Key position is "ON." 4. Attempt to display immobilizer data with the scan tool. Does the scan tool display immobilizer data?	—	Go to *Step 9*	Go to *Step 4*
4	1. Key position is "OFF," disconnect the immobilizer control unit (ICU). 2. Check the DLC (Data Link Connector) circuit for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. Was a problem found?	—	Go to *Step 5*	Go to *Step 6*
5	Repair or replace the DLC (Data Link Connector) circuit. Was the action complete?	—	Go to *Step 3*	—
6	1. Check the ICU circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. 2. If a problem is found, repair as necessary. Was a problem found?	—	Go to *Step 7*	Go to *Step 8*
7	Repair or replace the ICU ignition feed and ground circuits. Was the action complete?	—	Go to *Step 3*	—
8	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the immobilizer data by the scan tool. Was the action complete?	—	Go to *Step 3*	—
9	Select "Display DTCs" with the scan tool. Are any DTCs stored?	—	Go to *Step 10*	Go to *Step 13*

Step	Action	Value(s)	Yes	No
10	Review and record for scan tool Failure Records data and DTCs. Was the action complete?	—	Go to *Step 11*	—
11	Following the DTC is stored. Are there DTC B0001 or B0055 stored?		Go to *applicable DTC table after* Go to *Step 12*	Go to *Step 12*
12	Clear the DTCs by "Clear the Information "with scan tool. Did the DTCs Cleared?	—	Go to *Step 12*	—
13	Select "Display DTCs" with the scan tool. Are any DTCs stored?	—	Go to *applicable DTC table*	Go to *Step 14*
14	1. Key position is "ON," engine "OFF." 2. Observe the check engine lamp. Note: If a key switch is turned ON, check engine lamp will turn on and a check engine lamp will be turned off after a few seconds. Is the check engine lamp "flash"?	—	Go to Step 15	Go to *Step 20*
15	Check the engine control system. If a problem is found, repair as necessary. (Refer to section 6E: system check and DTCs) **IMPORTANT:** The replacement ECM must be programmed the immobilizer data by scan tool. (Except 4JA1-L Engine) Was the action complete?	—	Go to *Step 16*	—
16	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 18*	Go to *Step 17*
17	Change into a peculiar key. **IMPORTANT:** If replace the key, after replace lock cylinders, perform the following below the items. • Replace the keys and key cylinders. • Program the immobilizer system. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 18*	—
18	Check the immobilizer programming functions. • Immobilizer control unit (ICU). • Engine control module (ECM). • Transponder (Key). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 19*	—
19	Operate the DTCs by "Clear the Information" with scan tool. Was the action complete?	—	Go to *Step 20*	—
20	Attempt to start the engine. Did the engine start?	—	System OK	Refer to *Diagnostic Aids*

SECTION 5A

BRAKE CONTROL SYSTEM

TABLE OF CONTENTS

NO IMMOBILIZER WARNING LAMP

Step	Action	Value(s)	Yes	No
1	Check the meter fuse for the instrument cluster ignition feed circuit. Is the fuse normal?	—	Go to *Step 3*	Go to *Step 2*
2	Replace the fuse. Is the action complete?	—	Verify repair Go to *Step 3*	—
3	1. Key position is "OFF". 2. Disconnect the meter. 3. Disconnect the engine control module (ECM). 4. Check the circuit between meter and ECM for an open, short to round, or short to voltage. Also, check the meter circuit for an open or short to ground and the DLC ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the meter circuit. Was the action complete?	—	Go to *Step 5*	—
5	1. Key position is "ON," engine "OFF." 2. Observe the check engine lamp. Is the check engine lamp "ON"?	—	Go to *Step 6*	Go to *Step 7*
6	Repair or replace the meter. Was the action complete?	—	Go to *Step 7*	—
7	1. Key position is "OFF". 2. Check the check engine lamp bulb. Is the check engine lamp bulb normal?	—	Go to *Step 9*	Go to *Step 8*
8	Replace the check engine lamp bulb. Is the action complete?	—	Verify repair Go to *Step 9*	—
9	1. Key position is "OFF". 2. Connect the meter. 3. Connect the engine control module (ECM). 4. Key position is "ON". 5. Observe the check engine lamp. Note: If a key switch is turned ON, check engine lamp will turn on and a check engine lamp will be turned off after a few seconds. Is the check engine lamp "ON"?	—	Verify repair	Go to *Step 10*
10	Replace the engine control module (ECM). **IMPORTANT:** The replacement ICU must be programmed the immobilizer data by scan tool. Was the action complete?	—	Verify repair	—

CHECK IMMOBILIZER WARNING LAMP ON STEADY

Step	Action	Value(s)	Yes	No
1	1. Key position is "OFF". 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the engine control module (ECM). 4. Key position is "ON," engine "OFF." 5. Observe the check engine lamp. Is the check engine lamp "ON"?	—	Go to *Step 2*	Go to *Step 5*
2	1. Key position is "OFF". 2. Disconnect the meter. 3. Key position is "ON," engine "OFF." 4. Observe the check engine lamp. Is the check engine lamp "ON"?	—	Go to *Step 3*	Go to *Step 4*
3	Repair or replace the meter. Was the action complete?	—	Verify repair Go to *Step 5*	—
4	Repair or replace the meter circuit. (Between meter and ICU/ECM) Was the action complete?	—	Verify repair Go to *Step 5*	—
5	Check the immobilizer control unit (ICU) circuit. 1. Ignition "OFF," disconnect the ICU. 2. Check the ICU circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 6*	Go to *Step 7*
6	Repair or replace the immobilizer unit (ICU) circuit. Was the action complete?	—	Verify repair Go to *Step 7*	—
7	1. Key position is "OFF". 2. Connect the meter. 3. Connect the immobilizer control unit (ICU). 4. Connect the engine control module (ECM). 5. Key position is "ON". 6. Observe the check engine lamp. Is the check engine lamp "ON"?	—	Verify repair	Refer to *Diagnostic Aids*

B0001 REPLACE ELECTRONIC CONTROL UNIT (ECU) (IMMOBILIZER FAULT)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the scan tool on vehicle. 3. Key position is “ON”. 4. Check the DTC on scan tool. Is DTC B0001 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer control unit (ICU) circuit. 1. Ignition "OFF," disconnect the ICU. 2. Check the ICU circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer unit (ICU) circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0002 IMMOBILIZER NOT PROGRAMMED

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to Immobilizer System Check
2	Check the immobilizer programming functions. • Immobilizer control unit (ICU). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 3*	Go to *Step 5*
3	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0002 stored?	—	Go to *Step 4*	Verify repair
4	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—
5	Check the immobilizer programming functions. • Engine control module (ECM). • Immobilizer control unit (ICU). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Verify repair	Go to *Step 6*
6	Replace the key and lock cylinder assembly and immobilizer system (ICU and ECM). **IMPORTANT:** • ICU and ECM are not replacing simultaneously. • After replace lock cylinders, perform the following below the items. • Program the immobilizer system. (Refer to "Important information on Programming") Was the action complete?	—	Verify repair	—

B0003 TRANSPONDER KEY PROBLEM

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • All transponder (Key). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 4*	Go to *Step 5*
4	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0003 stored?	—	Go to *Step 5*	Verify repair
5	Recheck the DTC. 1. Non-OEM parts switch is "OFF" or remove the Non-OEM parts. 2. Remove the accessory and another key from key. 3. Move the vehicle to a new location. 4. Key position is “OFF” and keep the position for more than 30 seconds. 5. Key position is “ON”. 6. Check the DTC on scan tool. Is DTC B0003 stored?	—	Go to *Step 6*	Verify repair
6	Check the immobilizer coil (antenna) circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). (immobilizer coil circuit : 3 pin connector) 3. Check the immobilizer coil circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to Step 7	Go to *Step 8*
7	Repair or replace the immobilizer coil (antenna) circuit. Was the action complete?	—	Verify repair	—
8	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0003 stored?	—	Go to *Step 9*	Verify repair

Step	Action	Value(s)	Yes	No
9	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 10*	—
10	Check the immobilizer programming functions. • Immobilizer control unit (ICU). • All transponder (Key). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 11*	—
11	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0003 stored?	—	Go to *Step 12*	Verify repair
12	Replace the transponder (Key). **IMPORTANT:** The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0004 IMMOBILIZER COIL CIRCUIT (ANTENNA COIL FAULT)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the immobilizer coil (antenna) circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). (immobilizer coil circuit : 3 pin connector) 3. Check the immobilizer coil circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 3*	Go to *Step 4*
3	Repair or replace the immobilizer coil (antenna). Was the action complete?	—	Verify repair	—
4	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0004 stored?	—	Go to *Step 5*	Verify repair
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0005 COMMUNICATION LINE W VOLTAGE LOW

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the scan tool on vehicle. 3. Key position is “ON”. 4. Check the DTC on scan tool. Is DTC B0005 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer communication W line circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the engine control module (ECM). 4. Check the immobilizer communication W line circuit for an open, short to ground, or short to voltage. Also, check the ICU and ECM ignition feed circuits for an open or short to ground and the ICU and ECM ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer communication W line circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0006 COMMUNICATION LINE W VOLTAGE HIGH

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the scan tool on vehicle. 3. Key position is "ON". 4. Check the DTC on scan tool. Is DTC B0006 stored?	—	Go to Step 3	Refer to *Diagnostic Aids*
3	Check the immobilizer communication W line circuit. 1. Key position is "OFF". 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the engine control module (ECM). 4. Check the immobilizer communication W line circuit for an open, short to ground, or short to voltage. Also, check the ICU and ECM ignition feed circuits for an open or short to ground and the ICU and ECM ground circuit for an open. Was a problem found?	—	Go to Step 4	Go to *Step 5*
4	Repair or replace the immobilizer communication W line circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0007 NO ENGINE REQUEST RECEIVED

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC on ICU. 1. Key position is “OFF”. 2. Install the scan tool on vehicle. 3. Key position is “ON”. 4. Check the DTC on scan tool. Is DTC B0007 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer communication line circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the engine control module (ECM). 4. Check the immobilizer communication line circuit for an open, short to ground, or short to voltage. Also, check the ICU and ECM ignition feed circuits for an open or short to ground and the ICU and ECM ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer communication line circuit. Was the action complete?	—	Verify repair	—
5	Recheck the DTC on ICU. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0007 stored?	—	Go to *Step 6*	Verify repair
6	Recheck the DTC on ECM. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Are below DTCs stored? P1649 (C24SE)	—	Go to *Step 7*	Go to *Step 9*
7	Perform the immobilizer programming functions. (Refer to "Important information on Programming") • Engine control module (ECM). Was the action complete?	—	Go to *Step 8*	Go to *Step 11*
8	Recheck the DTC on ECM. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Are below DTCs stored? P1649 (C24SE)	—	Go to *Step 11*	Go to *Step 12*

Step	Action	Value(s)	Yes	No
9	Check the immobilizer programming functions. • Engine control module (ECM). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 10*	Go to Step 11
10	Recheck the DTC on ECM. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Are below DTCs stored? P1649 (C24SE)	—	Go to Step 11	Go to *Step 12*
11	Replace the engine control module (ECM). **IMPORTANT:** The replacement ECM must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 12*	—
12	Recheck the DTC on ECM. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Are below DTCs stored? P1626 (C24SE)	—	Go to *Step 13*	Go to *Step 2*
13	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0008 WRONG TRANSPONDER KEY

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to Step 3	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0008 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT**: The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to Step 7	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0008 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT**: The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0009 NO TRANSPONDER KEY PROGRAMMED

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0009 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT:** The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0009 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0010 UNKNOWN TRANSPONDER KEY

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0010 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT:** The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0010 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0011 TRANSPONDER KEY PROBLEM (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to Immobilizer System Check
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to Diagnostic Aids
3	Check the immobilizer programming functions. • All transponder (Key). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 4*	Go to Step 5
4	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0011 stored?	—	Go to *Step 5*	Verify repair
5	Recheck the DTC. 1. Non-OEM parts switch is "OFF" or remove the Non-OEM parts. 2. Remove the accessory and another key from key. 3. Move the vehicle to a new location. 4. Key position is “OFF” and keep the position for more than 30 seconds. 5. Key position is “ON”. 6. Check the DTC on scan tool. Is DTC B0011 stored?	—	Go to *Step 6*	Verify repair
6	Check the immobilizer coil (antenna) circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). (immobilizer coil circuit : 3 pin connector) 3. Check the immobilizer coil circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 7*	Go to *Step 8*
7	Repair or replace the immobilizer coil (antenna) circuit. Was the action complete?	—	Verify repair	—
8	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0011 stored?	—	Go to *Step 9*	Verify repair

Step	Action	Value(s)	Yes	No
9	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 10*	—
10	Check the immobilizer programming functions. • Immobilizer control unit (ICU). • All transponder (Key). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 11*	—
11	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0011 stored?	—	Go to *Step 12*	Verify repair
12	Replace the transponder (Key). **IMPORTANT:** The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0012 WRONG TRANSPONDER KEY (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0012 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT**: The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0012 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT**: The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0013 IMMOBILIZER NOT PROGRAMMED (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to Immobilizer System Check
2	Check the immobilizer programming functions. • Immobilizer control unit (ICU). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 3*	Go to *Step 5*
3	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0013 stored?	—	Go to *Step 4*	Verify repair
4	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—
5	Check the immobilizer programming functions. • Engine control immobilizer unit. • Immobilizer control unit (ICU). If a problem is found, repair as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Verify repair	Go to *Step 6*
6	Replace the key and lock cylinder assembly and immobilizer system (ICU and Engine immobilizer unit). **IMPORTANT:** • ICU and Engine immobilizer unit are not replacing simultaneously. • After replace lock cylinders, perform the following below the items. • Program the immobilizer system. (Refer to "Important information on Programming") Was the action complete?	—	Verify repair	—

B0014 NO TRANSPONDER KEY PROGRAMMED (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0014 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT:** The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC B0014 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0015 FREQUENCY SIGNAL LOW (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the scan tool on vehicle. 3. Key position is "ON". 4. Check the DTC on scan tool. Is DTC B0015 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer communication W line circuit. 1. Key position is "OFF". 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the Engine immobilizer unit. 4. Check the immobilizer communication W line circuit for an open, short to ground, or short to voltage. Also, check the ICU and Engine immobilizer unit ignition feed circuits for an open or short to ground and the ICU and Engine immobilizer unit ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer communication W line circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0016 FREQUENCY SIGNAL HIGH (Only 4JA1-L Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to Step 2	Go to Immobilizer System Check
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the scan tool on vehicle. 3. Key position is "ON". 4. Check the DTC on scan tool. Is DTC B0016 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer communication W line circuit. 1. Key position is "OFF". 2. Disconnect the immobilizer control unit (ICU). 3. Disconnect the engine control module (Engine immobilizer unit). 4. Check the immobilizer communication W line circuit for an open, short to ground, or short to voltage. Also, check the ICU and Engine immobilizer unit ignition feed circuits for an open or short to ground and the ICU and Engine immobilizer unit ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer communication W line circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0023 IMMOBILIZER COIL CIRCUIT (ANTENNA COIL FAULT) (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the immobilizer coil (antenna) circuit. 1. Key position is “OFF”. 2. Disconnect the immobilizer control unit (ICU). (immobilizer coil circuit : 3 pin connector) 3. Check the immobilizer coil circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 3*	Go to *Step 4*
3	Repair or replace the immobilizer coil (antenna). Was the action complete?	—	Verify repair	—
4	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0023 stored?	—	Go to *Step 5*	Verify repair
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

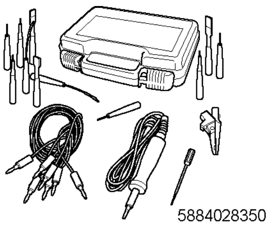
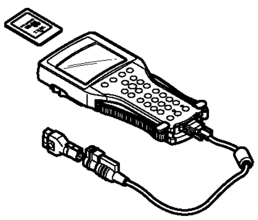
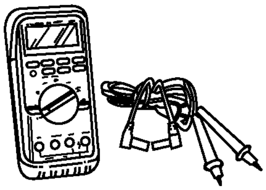
B0024 WRONG TRANSPONDER KEY (Only 4JA1-T Engine)

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer programming functions. • Transponder (Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the immobilizer programming functions. • Transponder (Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0024 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transponder (Key). **IMPORTANT**: The replacement transponder (key) must be programmed the security data by scan tool. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC B0024 stored?	—	Go to *Step 8*	Verify repair
8	Replace the immobilizer control unit (ICU). **IMPORTANT**: The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

B0055 EEPROM ERROR

Step	Action	Value(s)	Yes	No
1	Was the "Immobilizer System Check" performed?	—	Go to *Step 2*	Go to *Immobilizer System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the scan tool on vehicle. 3. Key position is “ON”. 4. Check the DTC on scan tool. Is DTC B0055 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the immobilizer control unit (ICU) circuit. 1. Ignition "OFF," disconnect the ICU. 2. Check the ICU circuit for an open, short to ground, or short to voltage. Also, check the ICU ignition feed circuit for an open or short to ground and the ICU ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the immobilizer unit (ICU) circuit. Was the action complete?	—	Verify repair	—
5	Replace the immobilizer control unit (ICU). **IMPORTANT:** The replacement ICU must be programmed the security data by scan tool. Was the action complete?	—	Verify repair	—

Special Tools

ILLUSTRATION	PART NO. PART NAME
	**5-8840-2835-0** **(J-35616-C)** Connector Test Adapter Kit (With Test Lamp)
	**Tech2 Kit** Scan Tool
	**5-8840-0285-0** **(J-39200)** Digital Multimeter

SECTION 11B

ANTITHEFT SYSTEM

TABLE OF CONTENTS

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNEEDED SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU will call out those fasteners that require a replacement after removal. ISUZU will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (Paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

The Antitheft system consists of the four major components which are Antitheft Control Unit (ACU), Antitheft horn, key (remote key), and scan tool (Tech-2).

This system can be activated by a correctly programmed key (remote key) and starter switch is set to OFF.

This system can be deactivated by a correctly programmed key (remote key) connected with a correctly programmed ACU and a correctly programmed ICU.

When the vehicle doors, and engine hood are locked, the antitheft alarm system is designed to protect your vehicle and valuables from theft.

Any attempt to forcibly open any door, the engine hood without using the vehicle key (or remote control) will cause the hazard lights to flash on and off and the horn to sound intermittently. This will continue for 30 seconds (Hazard lamp flash; For 5 minutes) before the system automatically shuts itself off.

Please operate the door either the key lock or remote key after closing all doors to arm the alarm system.

Miss waning will be detected when the passenger door is opened with locked condition and then this door is closed.

During the first 10 seconds:

- LED lights up; Test, switch - on delay
- LED rapidly flashes (2Hz); Door, bonnet, open or system fault

After approx. 10 seconds:

- LED slowly flashes; System on (0.5Hz)

RTU7Z0SH019101

Activating the anti-theft system

1. When the key switch is turned to the ACC position or removed from the starter switch.
2. Closing and locking all the doors by the keylock or remote key, and the engine hood will cause the indicator light to come on.
3. Approximately 10 seconds later, the indicator light will slow flash. The anti-theft system is now in operation.

Antitheft system alarm operating conditions

When the antitheft system is engaged, the alarm will operate under the following condition;

1. Whenever some forcibly attempts to open a door, the engine hood without using the key.
2. Whenever someone unlocks a door with door lock knob.
3. Whenever the engine hood release handle is operated.

Function of a keyless entry system

With a keyless entry system the car can be locked or unlocked from any position around the car up to a specified distance, by using the potable radio remote transmitter inside key (remote key).

Status LED

While the system is in delay the alarm system is active and LED flashes at 0.5Hz with or without activated interior protection.

Hazard relay

The hazard warning lights will be activated by an external relay. The output is low active.

Switches

All switches to ground. This makes it possible for failure analysis to detect a short circuit or a broken wire to each switch. To use this feature it is necessary to place a 1.8kΩ resistor in parallel to the required switch.

Receiver

The receiver is integrated into the control unit.

To lower the idle current the receiver is equipped with a standby mode. The antenna is integrated on the printed circuit board.

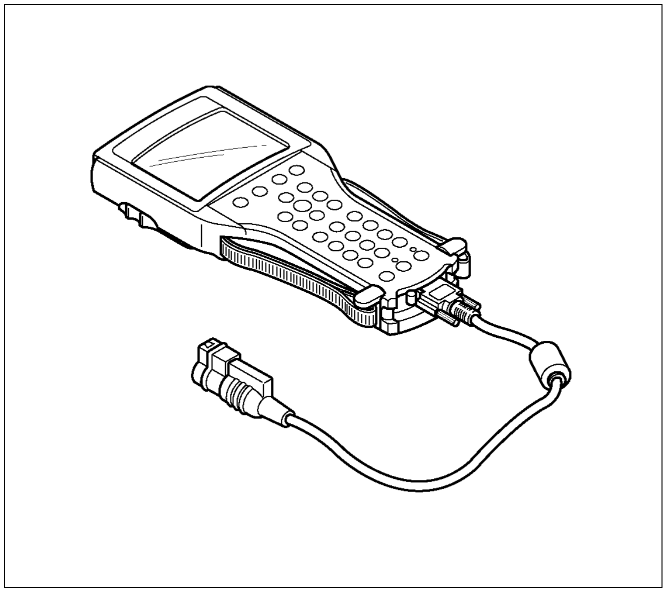
Depending on the mounting position of the control unit the antenna can be connected externally.

Range of communication

The range of communication between remote key and receiver is intended to be least 3 m from centre of the car.

Diagnosis

For diagnostic purpose the communication with an internal diagnostic device (Tech-2) is possible.



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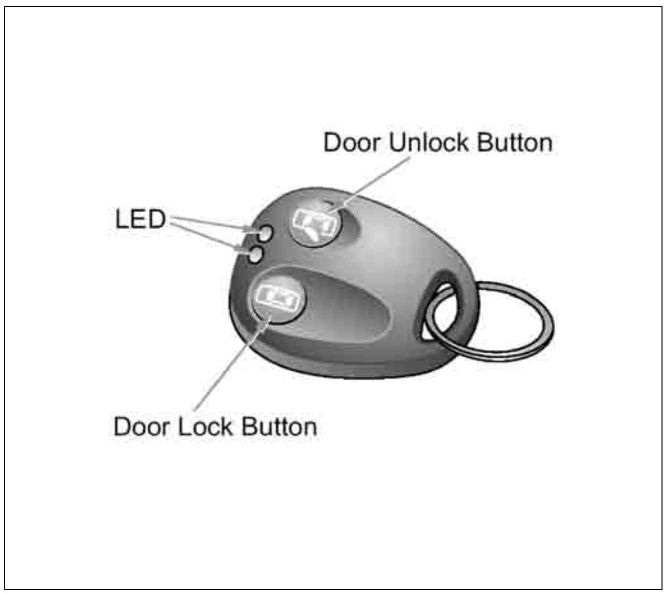
Transmitter (into remote key)

- Electronics integrated in remote key container for TFR/TFS.
- Antenna integrated in remote key container.
- Frequency band is 433.92 MHz.
- Two function buttons (Door lock/Door unlock)
- Two status LED for TF (Door lock/Door unlock)



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Transmitter (into remote key) power

The transmitted power is less than 10 m W.

Battery life time for transmitter power

The minimum life time of battery is 2 years with 15 lock/unlock cycles per day.

While the battery is changed, the data retention will be at least 3 minutes without pressing a button.

Super lock

(Mechanical anti-theft locking system)

To Lock:

All doors must be closed; press the lock button on the remote control unit again within 10 seconds after locking or turn key in driver's door lock towards rear of vehicle again within 10 seconds after locking, then turn it back to the vertical position and remove.

Lock buttons on all doors are positioned such that doors cannot be opened.

To unlock:

Press unlock button on remote key or turn key in driver's door lock towards front of vehicle, then turn it back to the vertical position and remove. If the key is used, antitheft alarm sound operate which continues until ignition switch turn ON. If a problem is found, open the driver door as necessary.

No proper transmitter is available, what should be done for the system?

When any proper transmitter is not available, a new transmitter should be programmed. Up to 5 transmitters can be provided with a scan tool (Tech-2) and by proper procedure.

In addition to the absence of proper transmitter, it may happen particular secret code to the particular vehicle is missing. In this case, the secret code must be provided by your organization.

Otherwise transmitter cannot be programmed in any way.

If the essential for a scan tool (Tech-2) for programming and proper software for Tech-2 are not available, there is no permanent way to fix system. Temporary replace with new ACU, new ICU and new transmitter without any secret code can make the system be deactivated, but it does not last long. Such a replacement does not solve any condition. Even after replacement, the system is activated automatically in short time and then no operation of the vehicle can be made in any way.

Tech-2 should be provided in your organization.

- **Security code management**

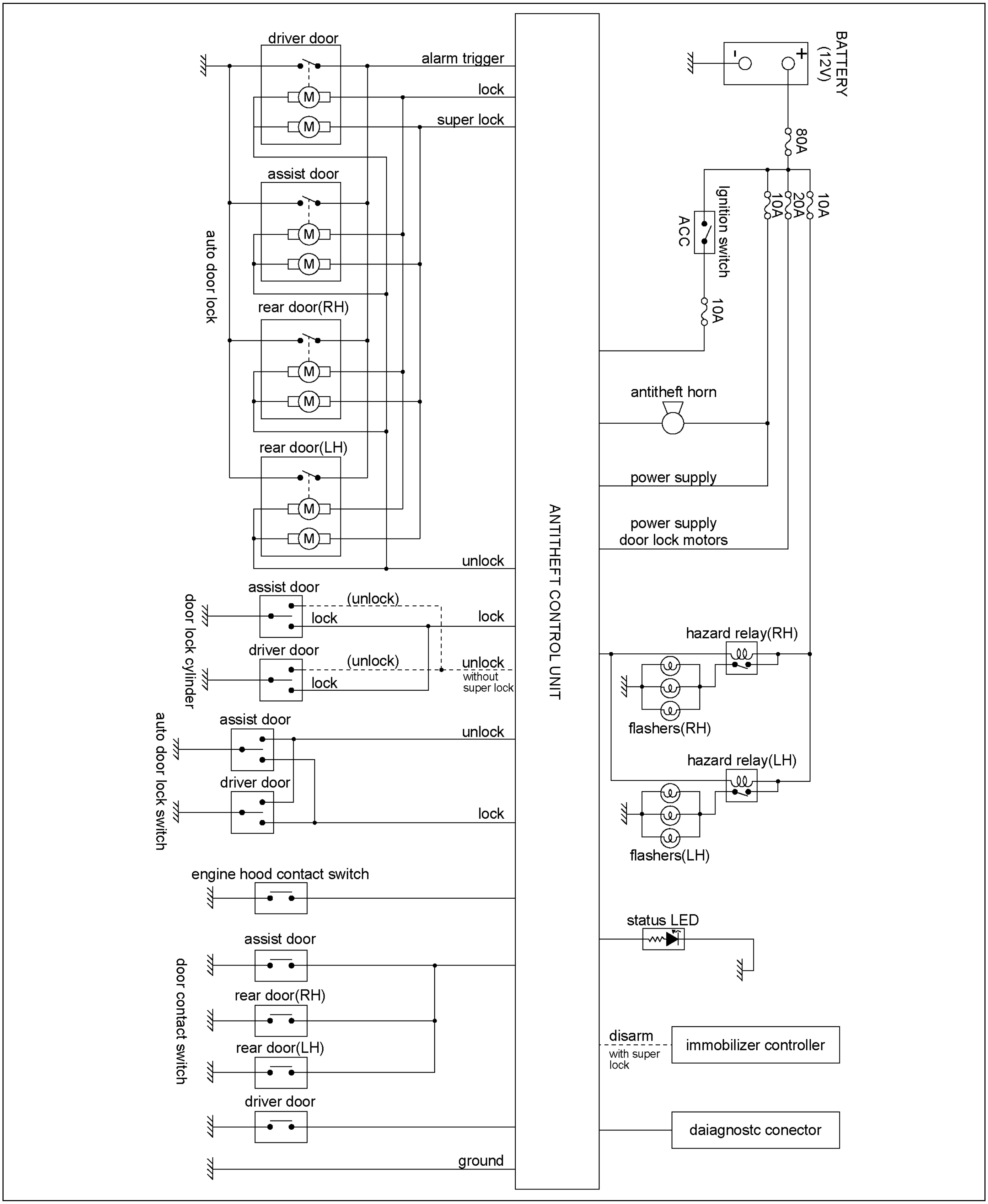
Your organization must keep security codes for all vehicles as confidential data. Once the security codes are lost, anybody who have the security code can access antitheft system. Your organization has responsibility of any missing vehicles caused by stolen security code.

- **Essential tool (Scan tool: Tech-2)**

Your dealership must have Tech-2, and Tech-2 updated software for immobilizer system.

Diagrams and Schematics

System Wiring Diagrams



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Service Precaution

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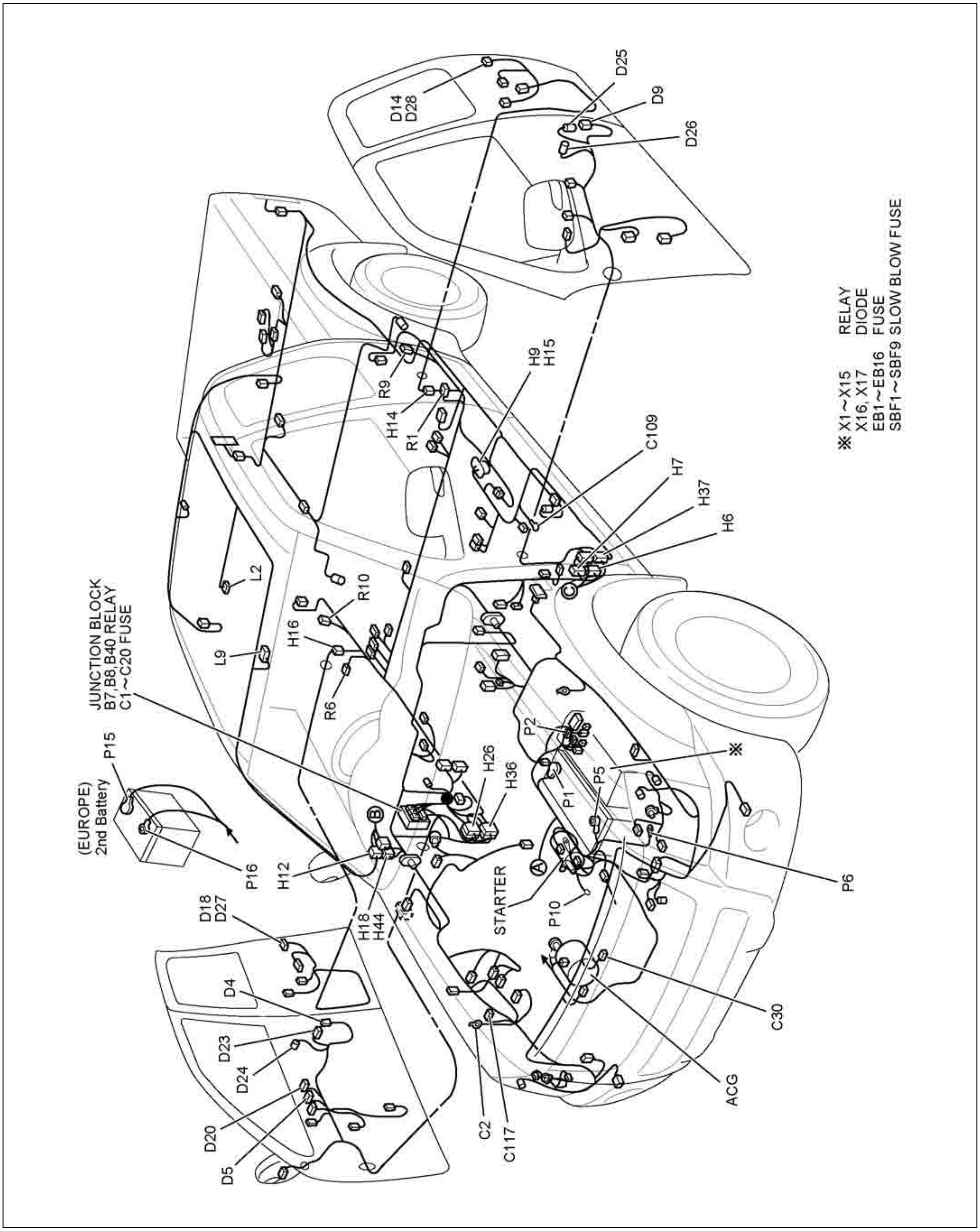
Parts Location (RHD) (1)



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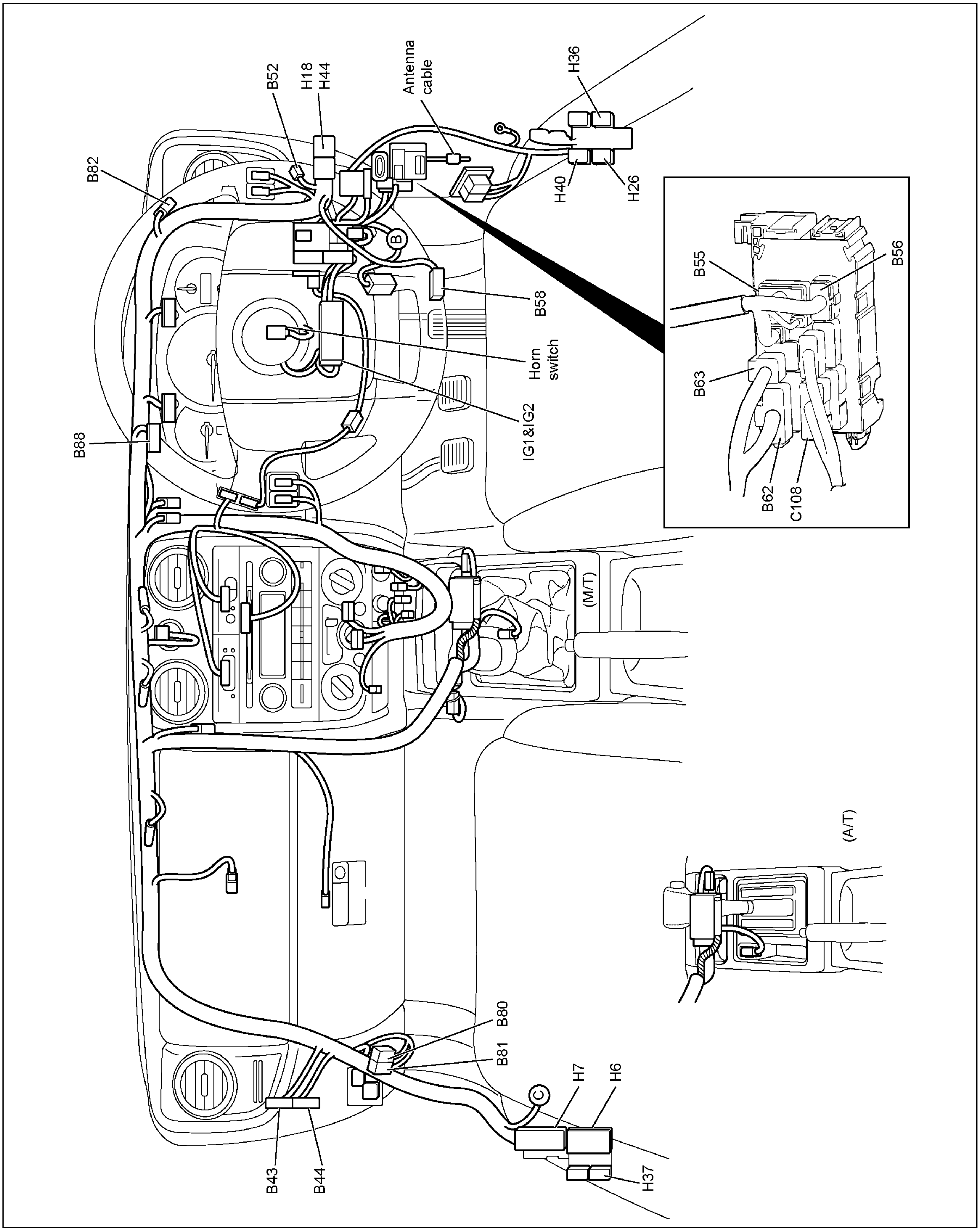
Parts Location (RHD) (2)



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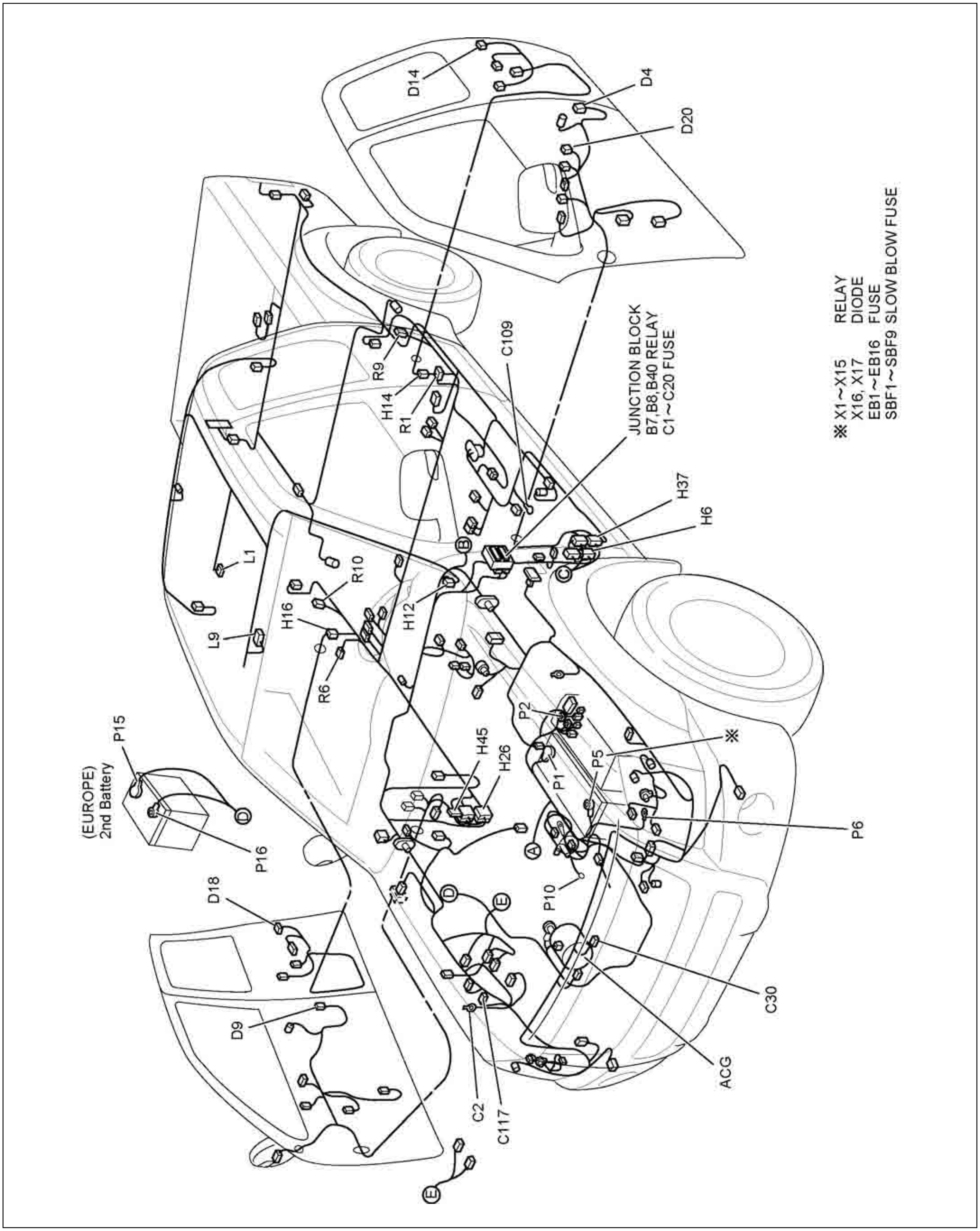

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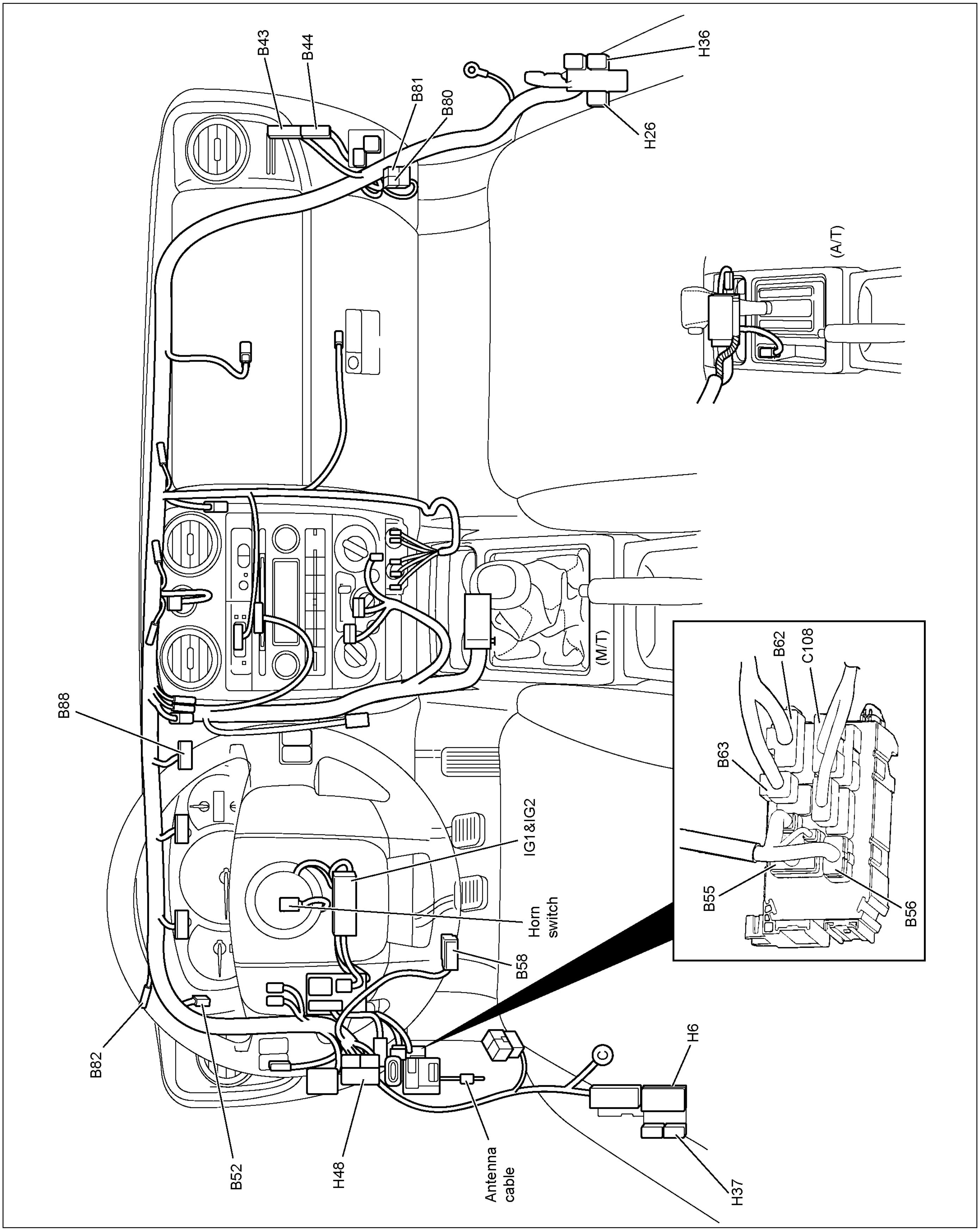

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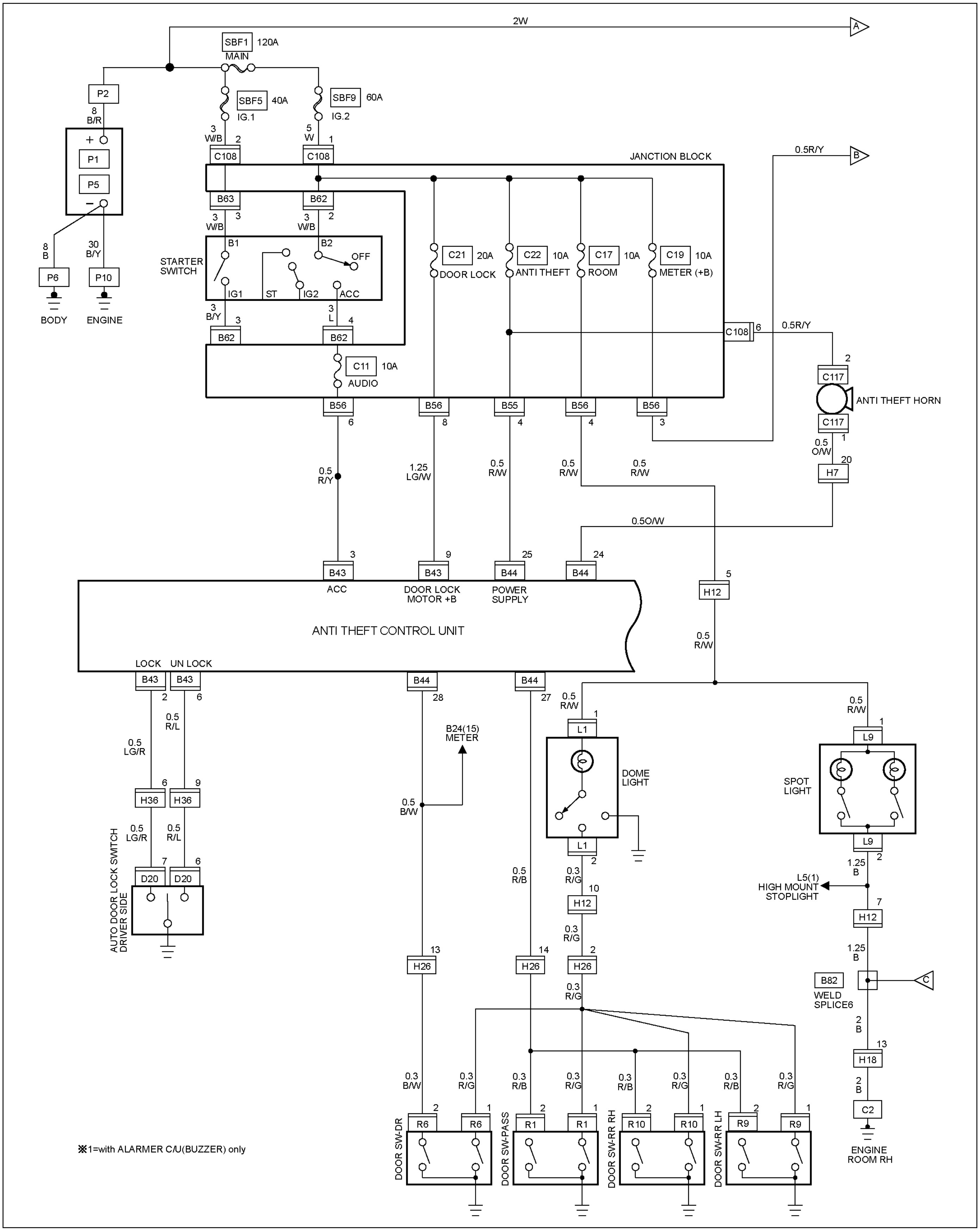
Circuit Diagram
4JJ1-TC, 4JK1-TC (except South Africa) (RHD)



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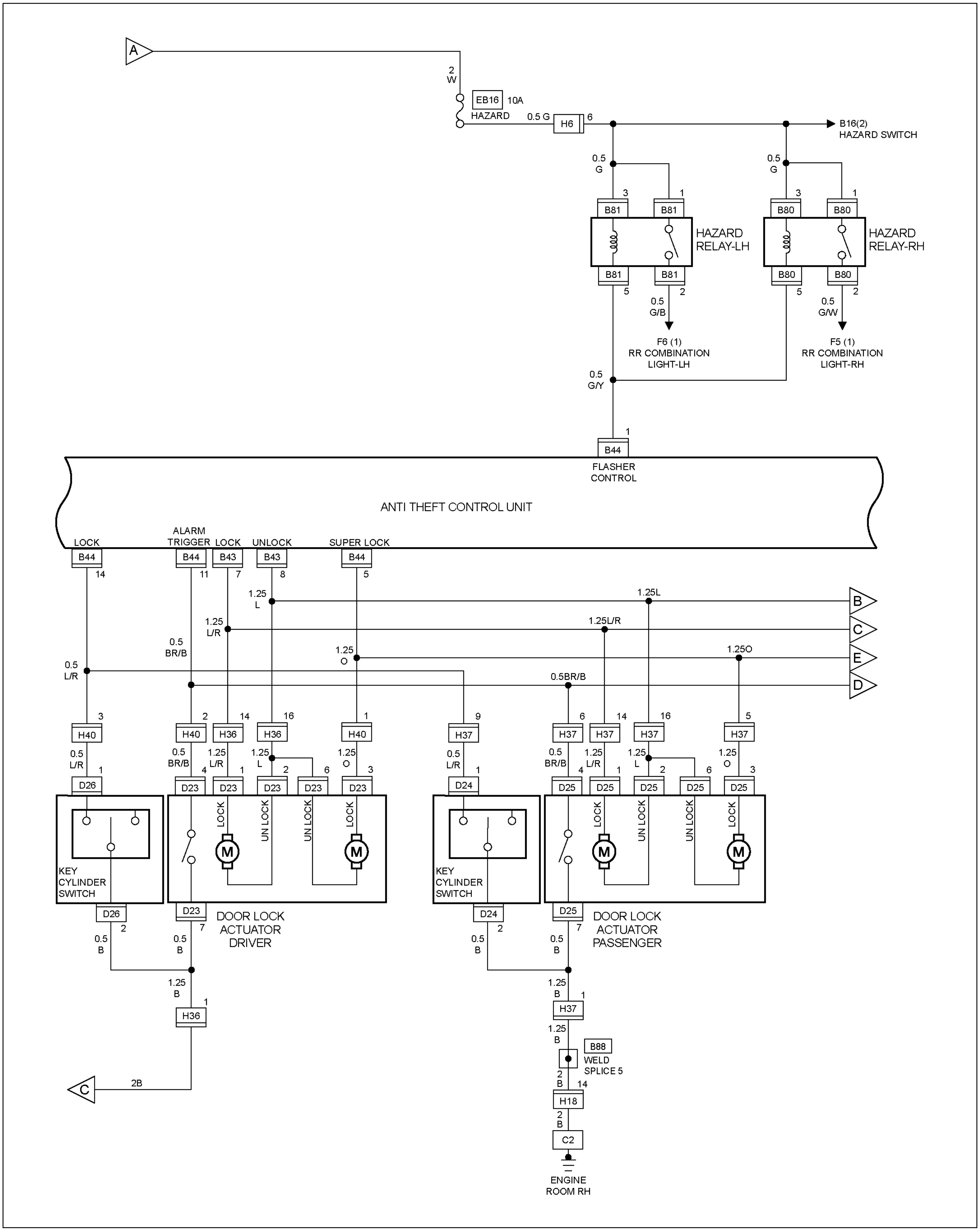

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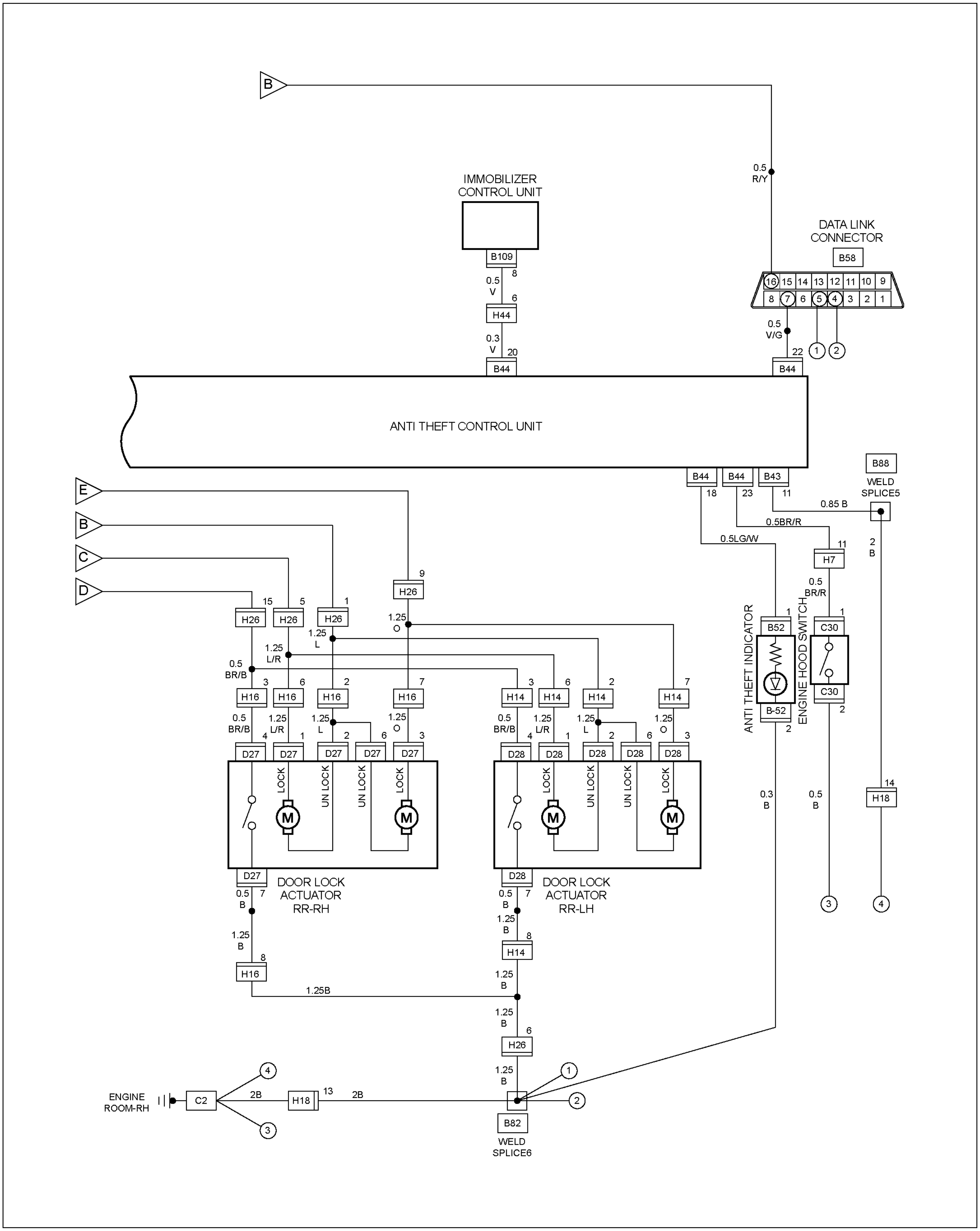
11B-12 ANTITHEFT SYSTEM



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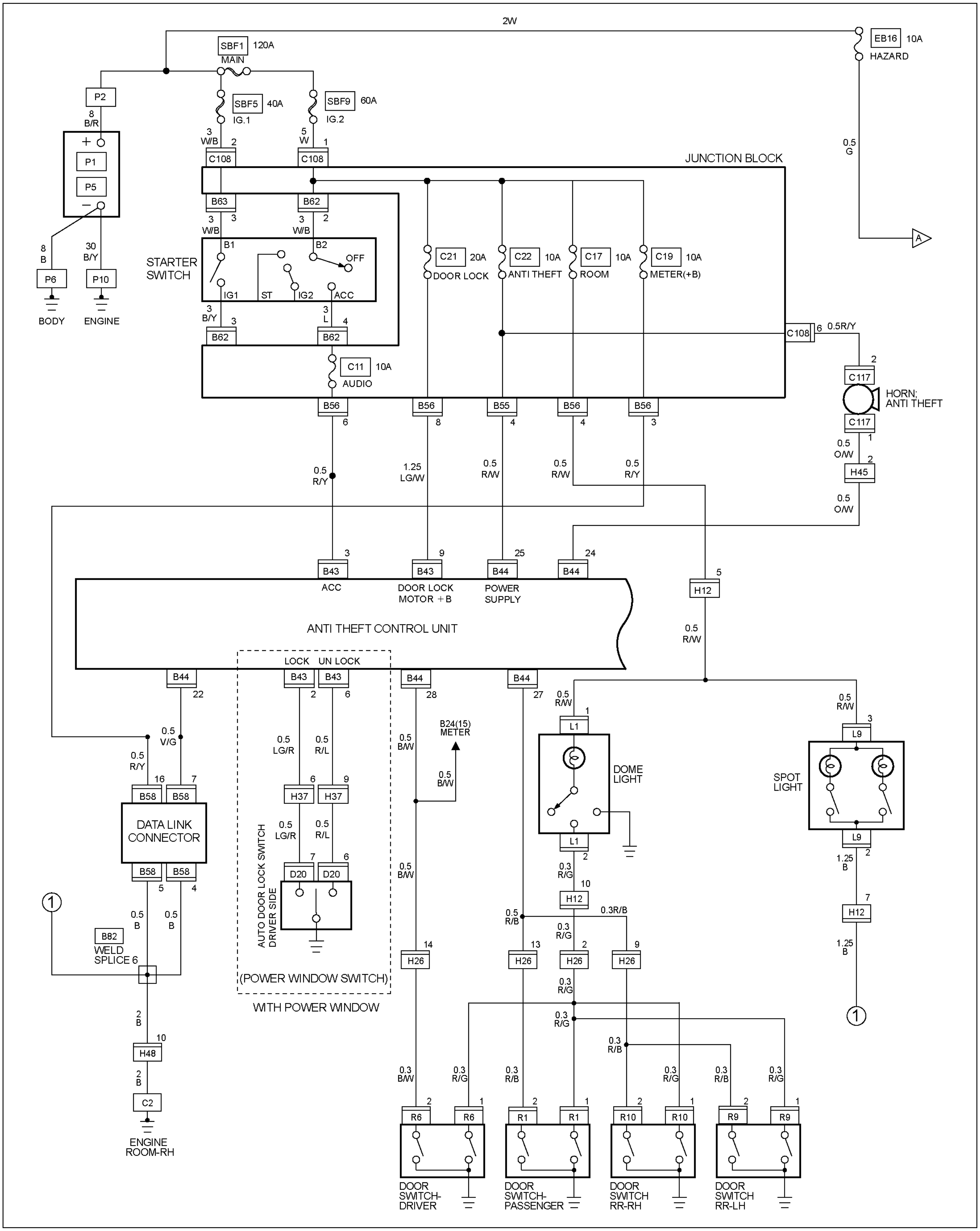
4JJ1-TC, 4JK1-TC (except South Africa) (LHD)



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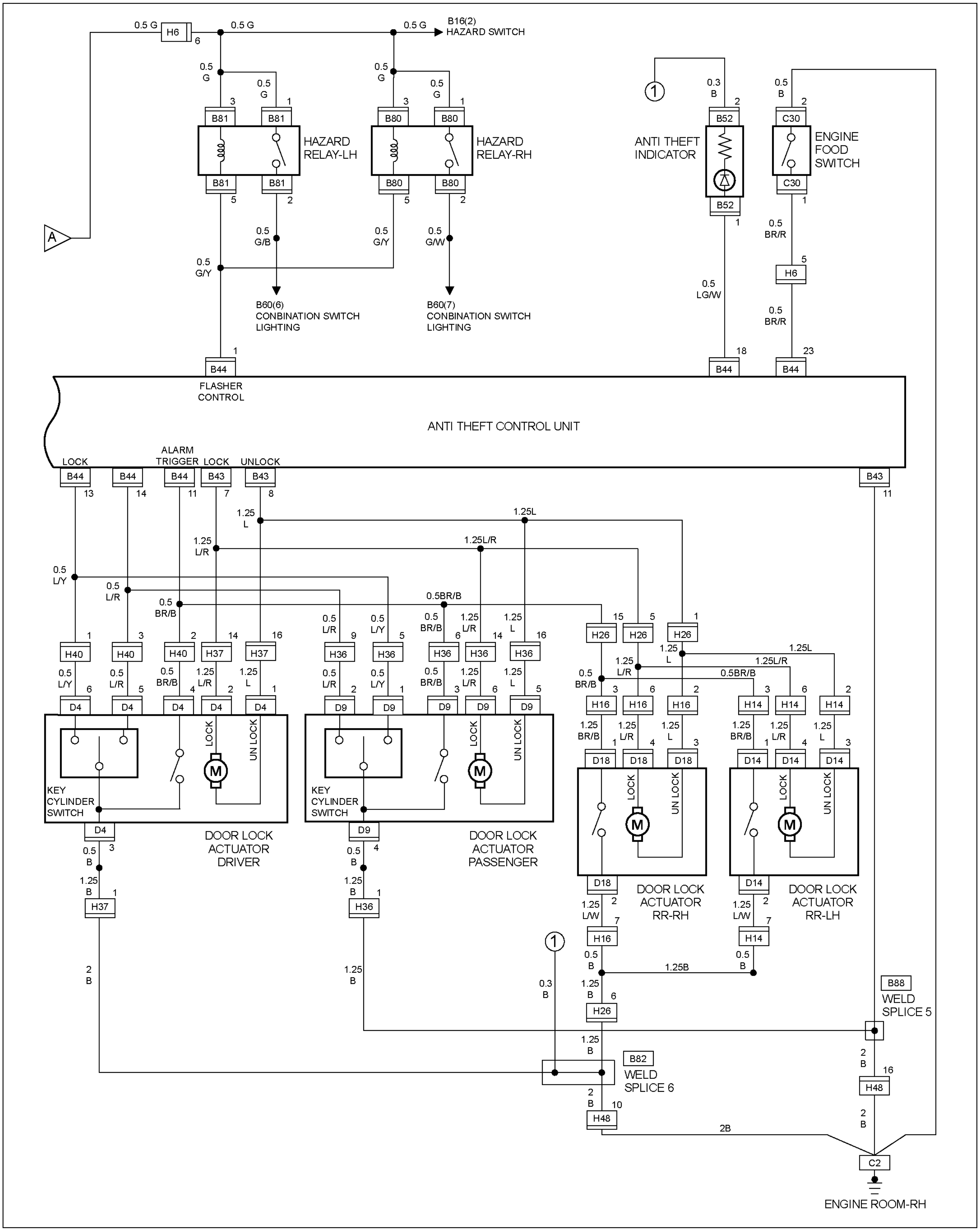
11B-14 ANTITHEFT SYSTEM



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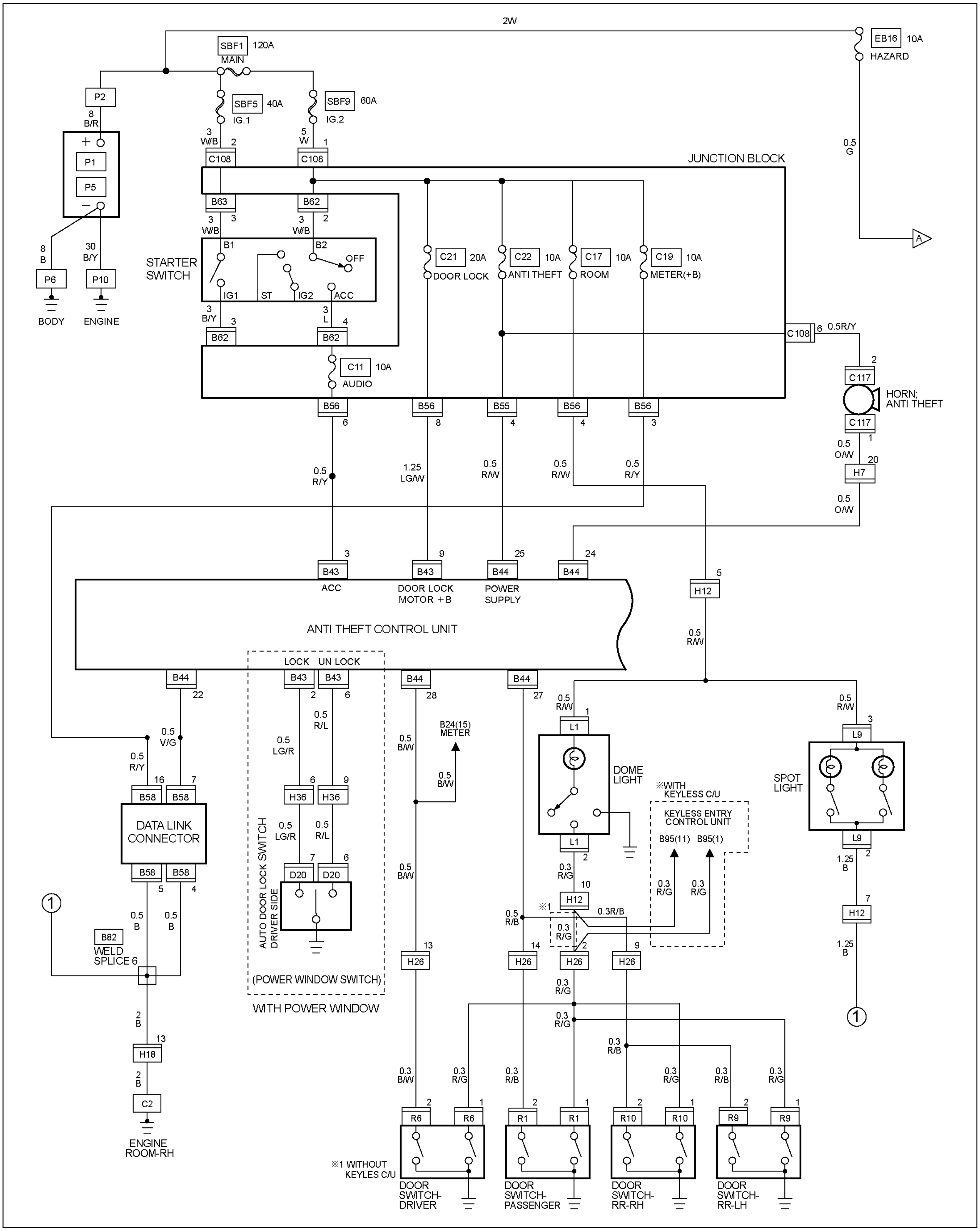
4JJ1-TC (South Africa)



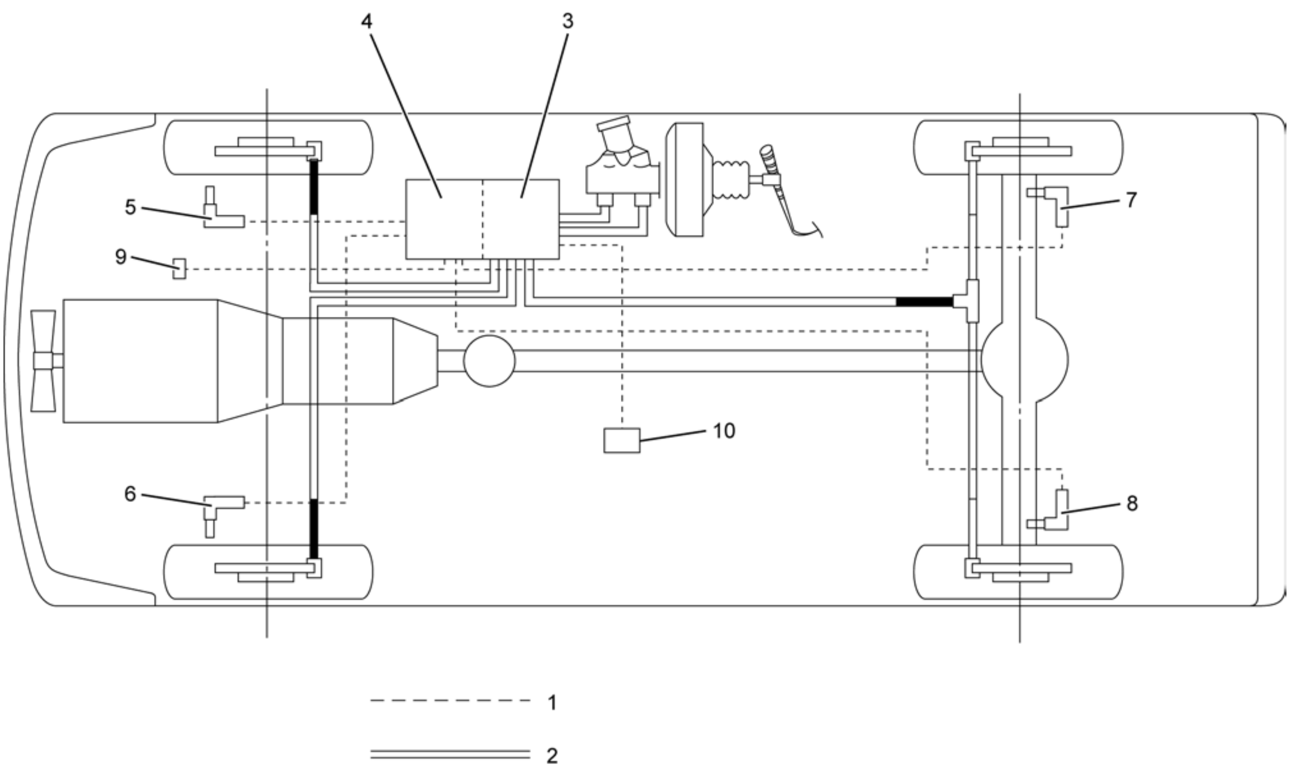
RTW78AXF019201

General Description

EHCU has controlled ABS (Anti-lock Brake System) and EBD (Electronic Brake-force Distribution System). ABS works on all four wheels. EBD system works on rear 2 wheels. A combination of wheel speed sensor and Electronic Hydraulic Control Unit (EHCU) can determine when a wheel is about to stop turning and adjust brake pressure to maintain best braking.

This system helps the driver maintain greater control of the vehicle under heavy braking conditions.

Note: The Electronic Hydraulic Control Unit (EHCU) comprises the Hydraulic Unit (H/U) and Control Unit.



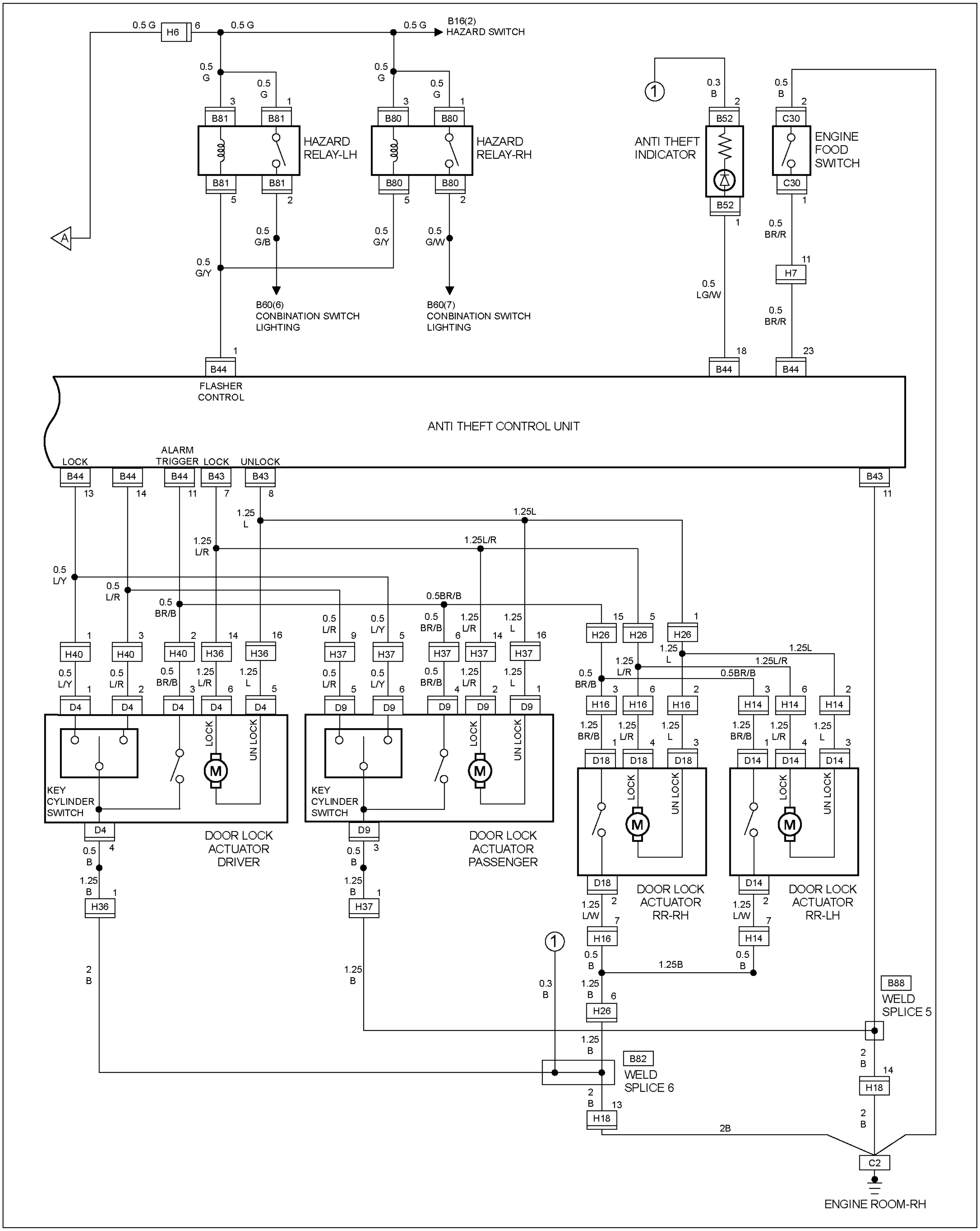
This illustration is based on RHD model

RTW75AMF001101

Legend

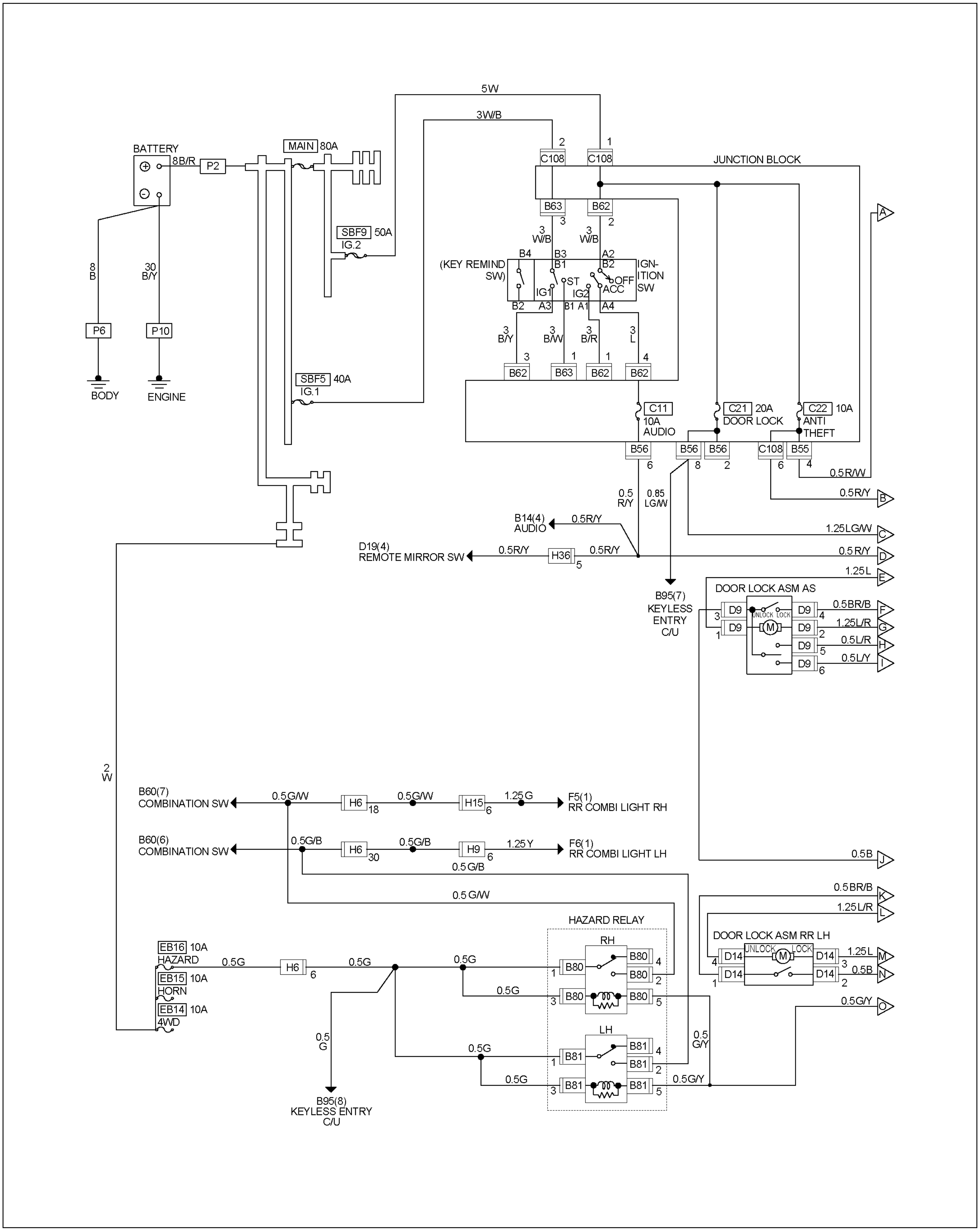
- (1) Electronic
- (2) Hydraulic
- (3) Hydraulic Unit (H/U)
- (4) Control Unit
- (5) Front Right Wheel Speed Sensor
- (6) Front Left Wheel Speed Sensor
- (7) Rear Right Wheel Speed Sensor
- (8) Rear Left Wheel Speed Sensor
- (9) G sensor (4WD only)
- (10) 2-4WD Control Unit (4WD only)

11B-16 ANTITHEFT SYSTEM



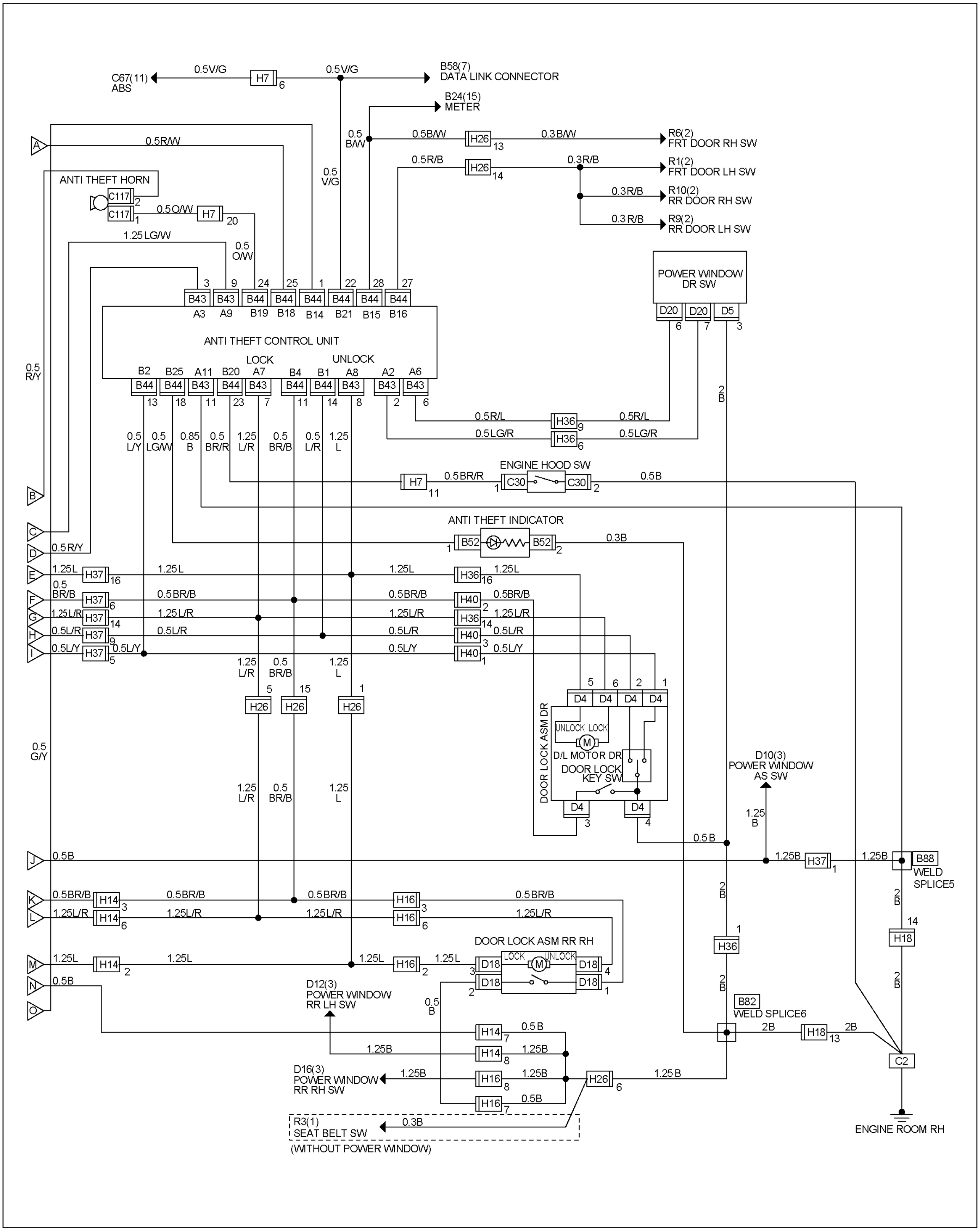
RTW78AXF019301

4JA1-L (RHD)



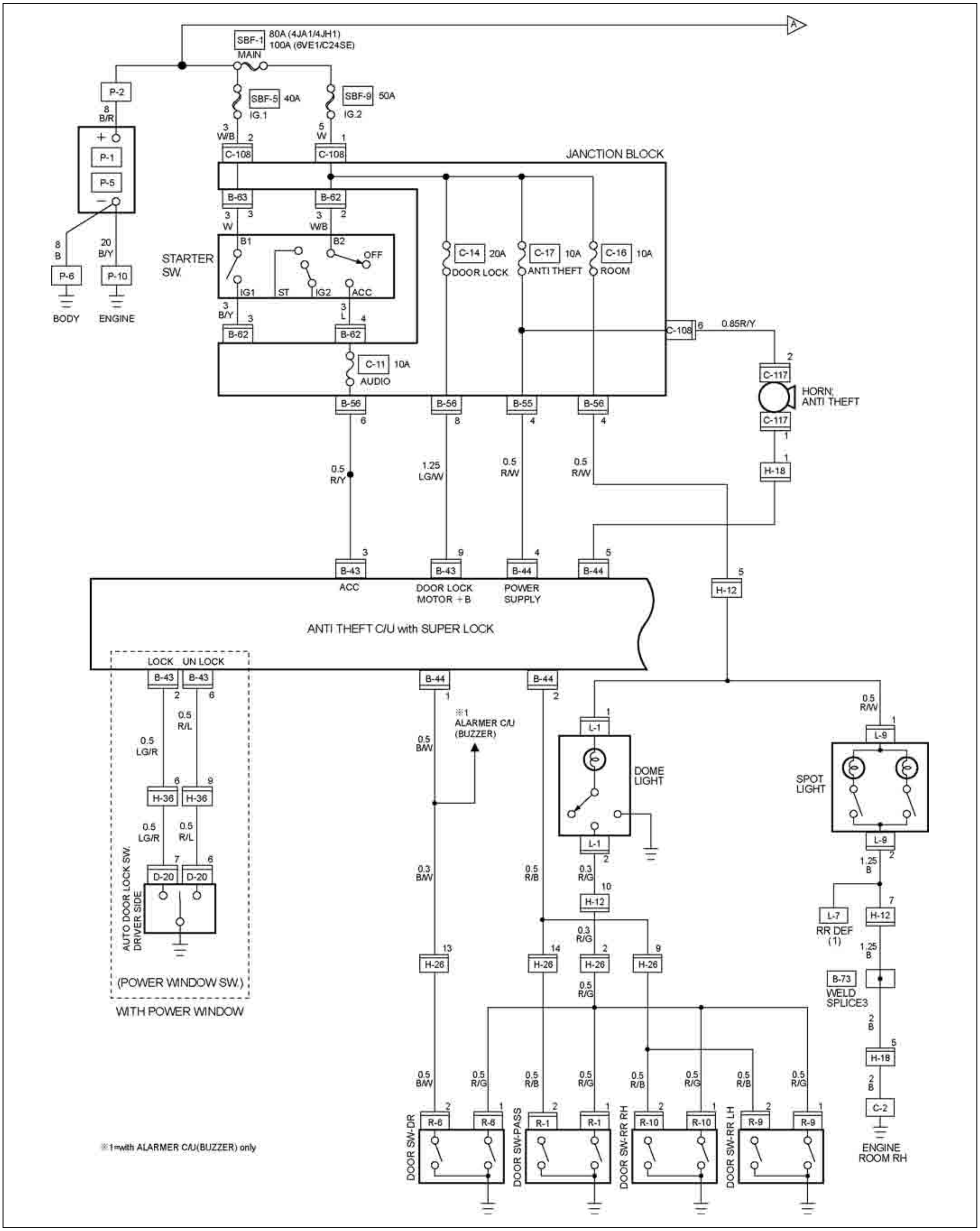
RTW78AXF009101

11B-18 ANTITHEFT SYSTEM



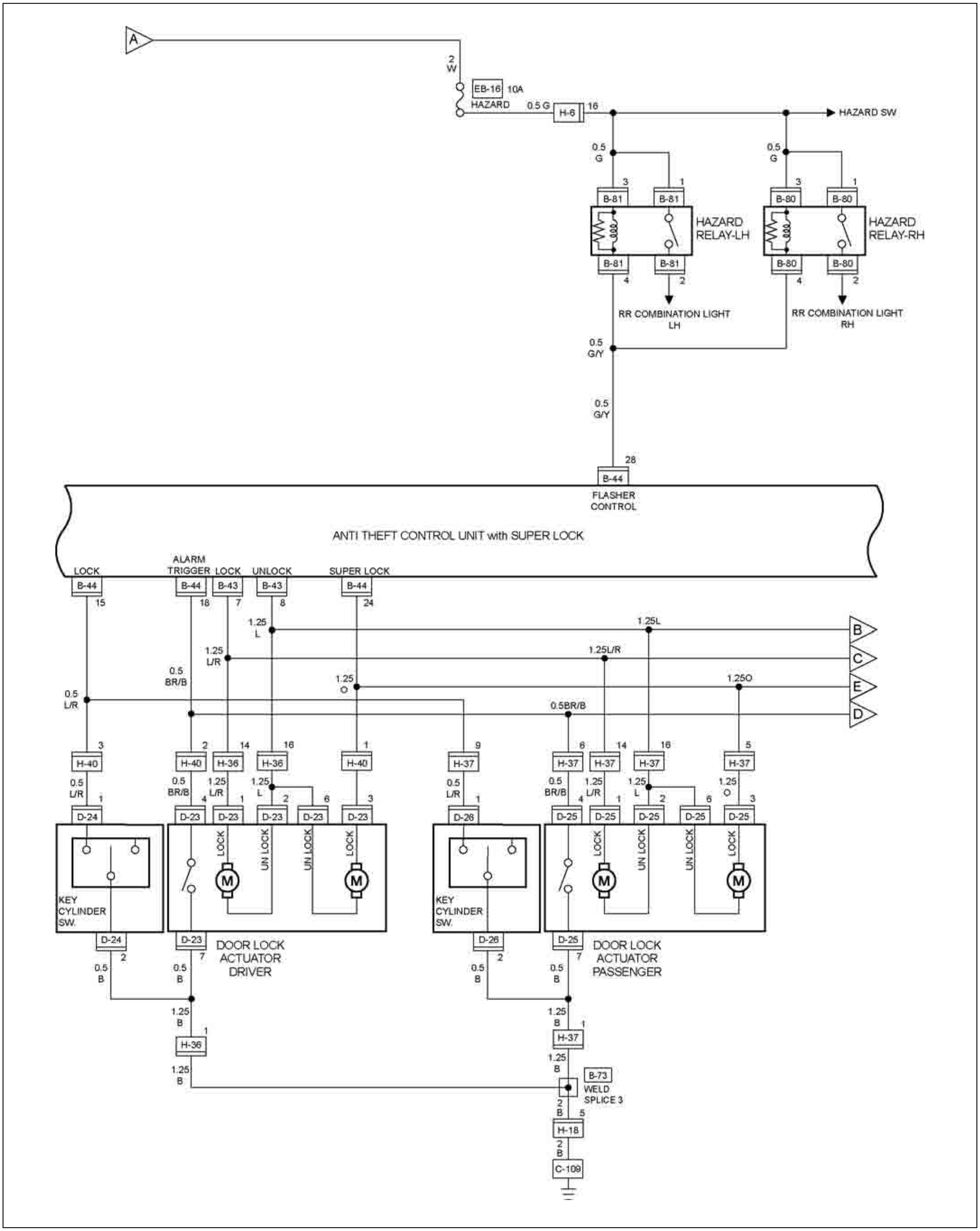
RTW78AXF009201

C24SE (RHD)



RTW680XF015401

11B-20 ANTITHEFT SYSTEM



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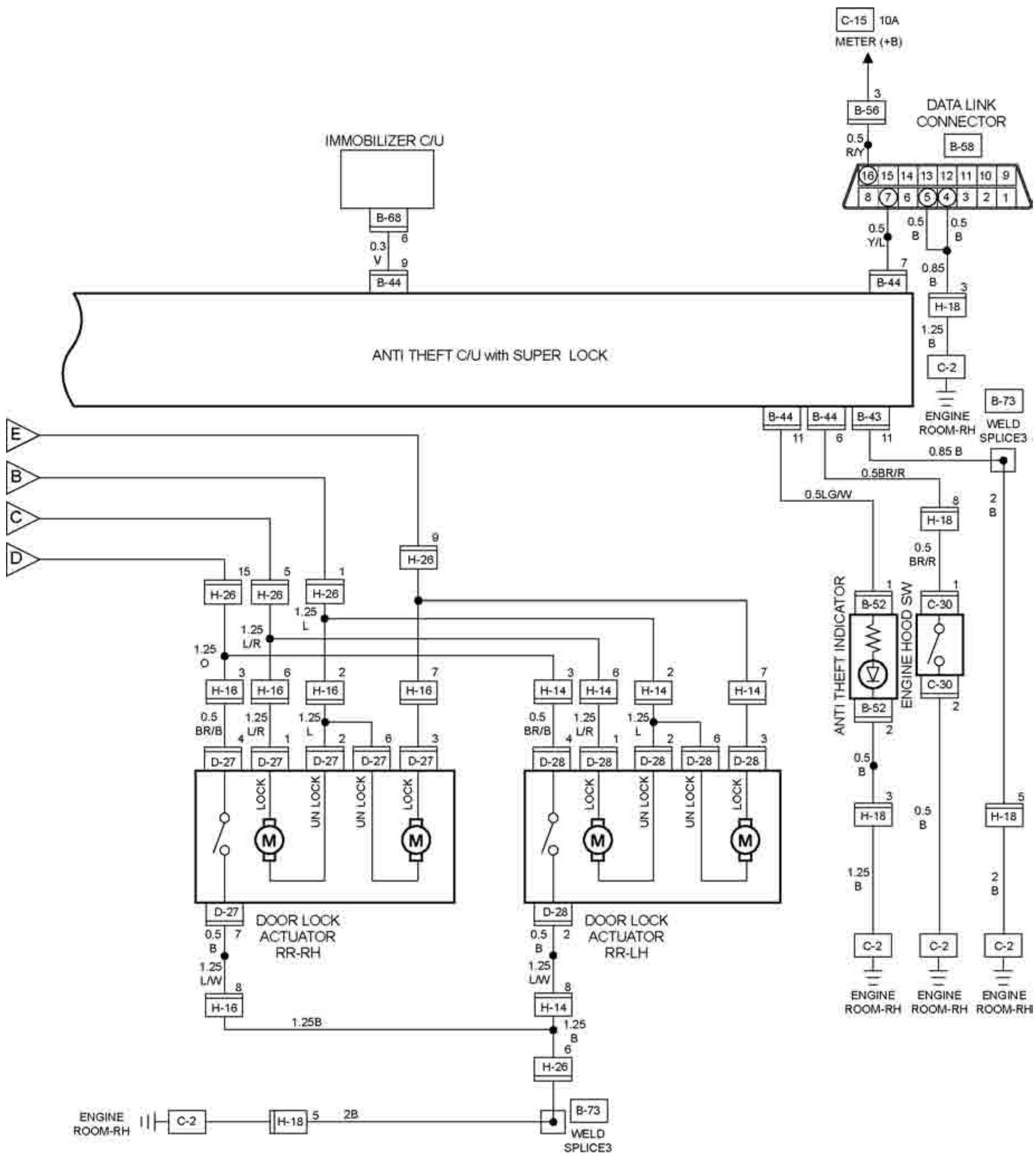
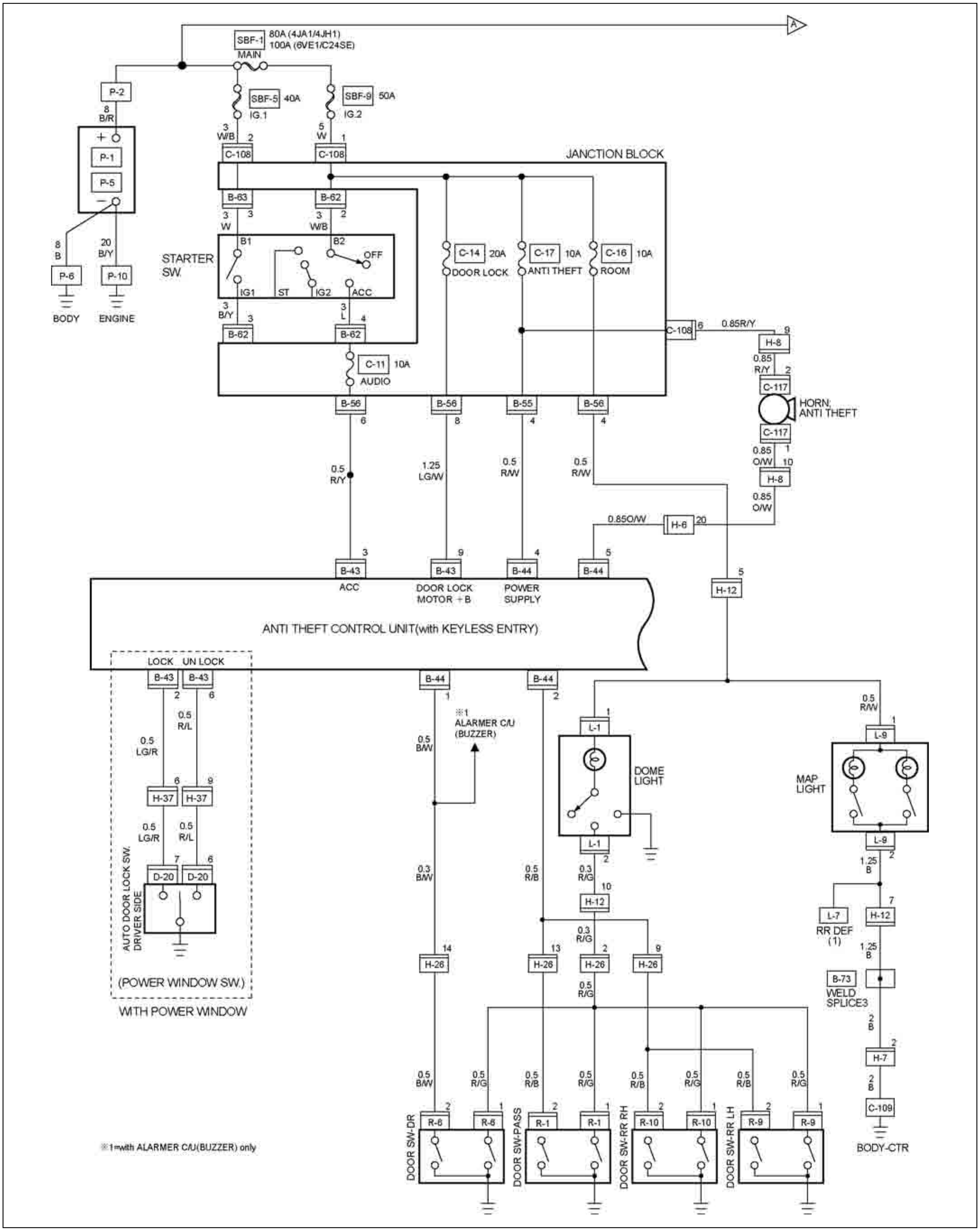
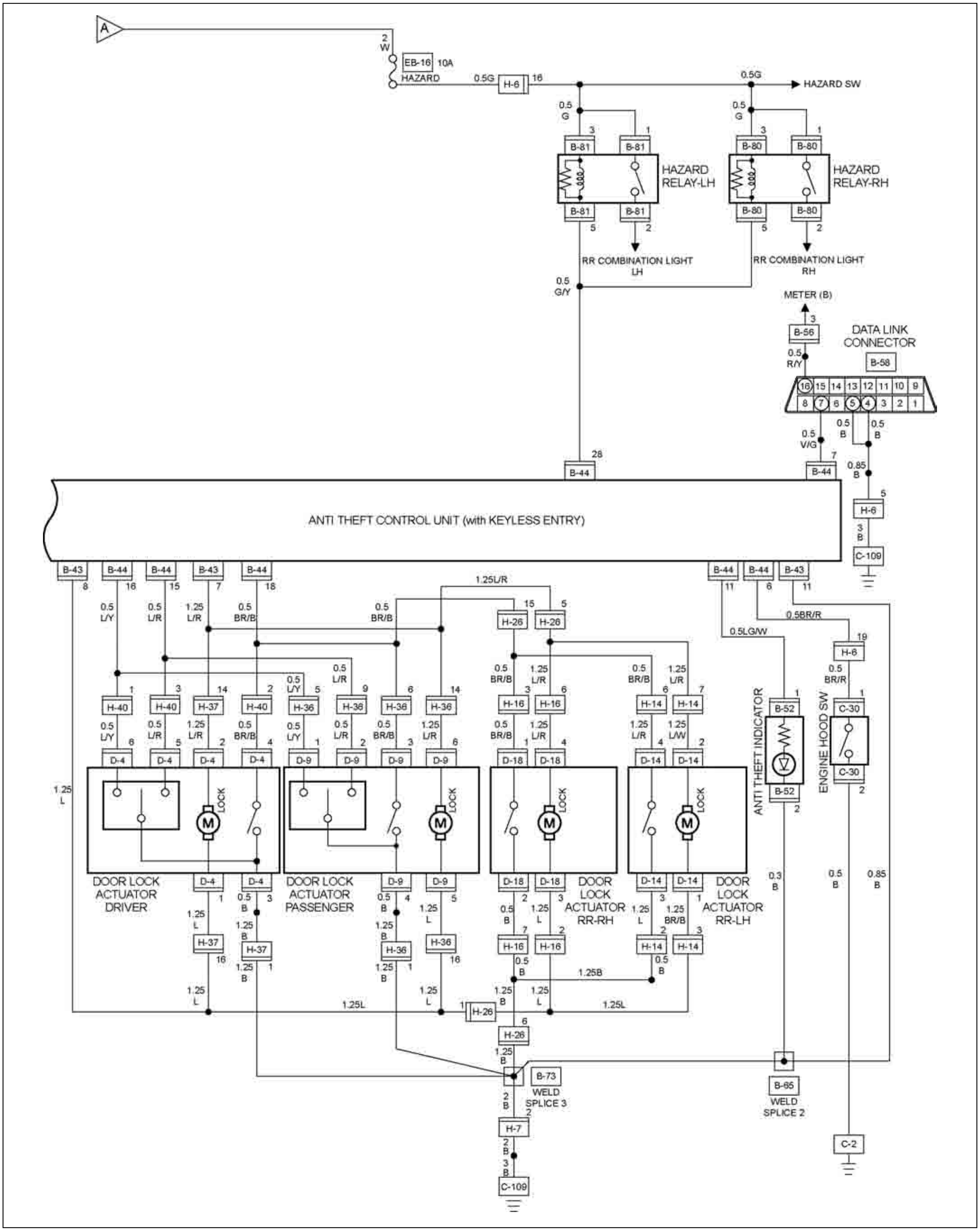


RTW680XF015601

C24SE (LHD)

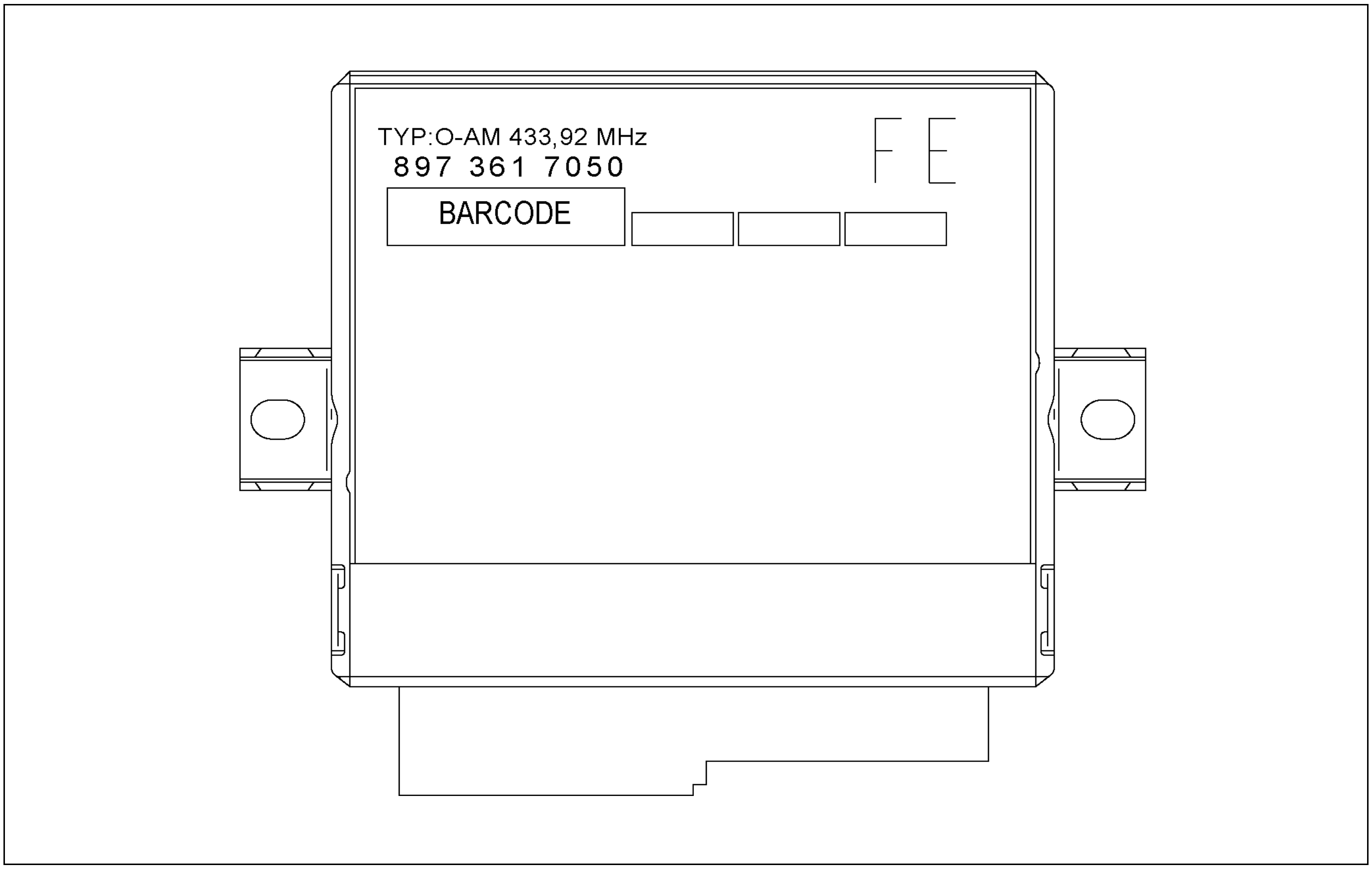


RTW680XF015701



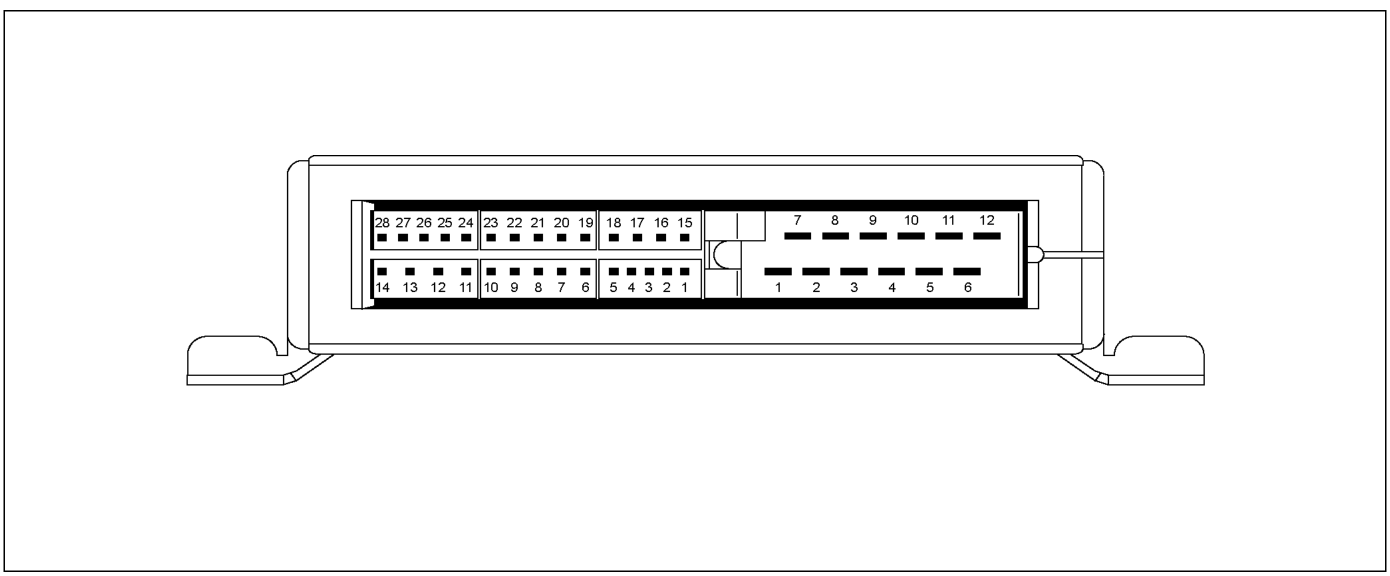
RTW680XF015801

Antitheft control unit (A)



RAA4C0MF000101

Pin-outs



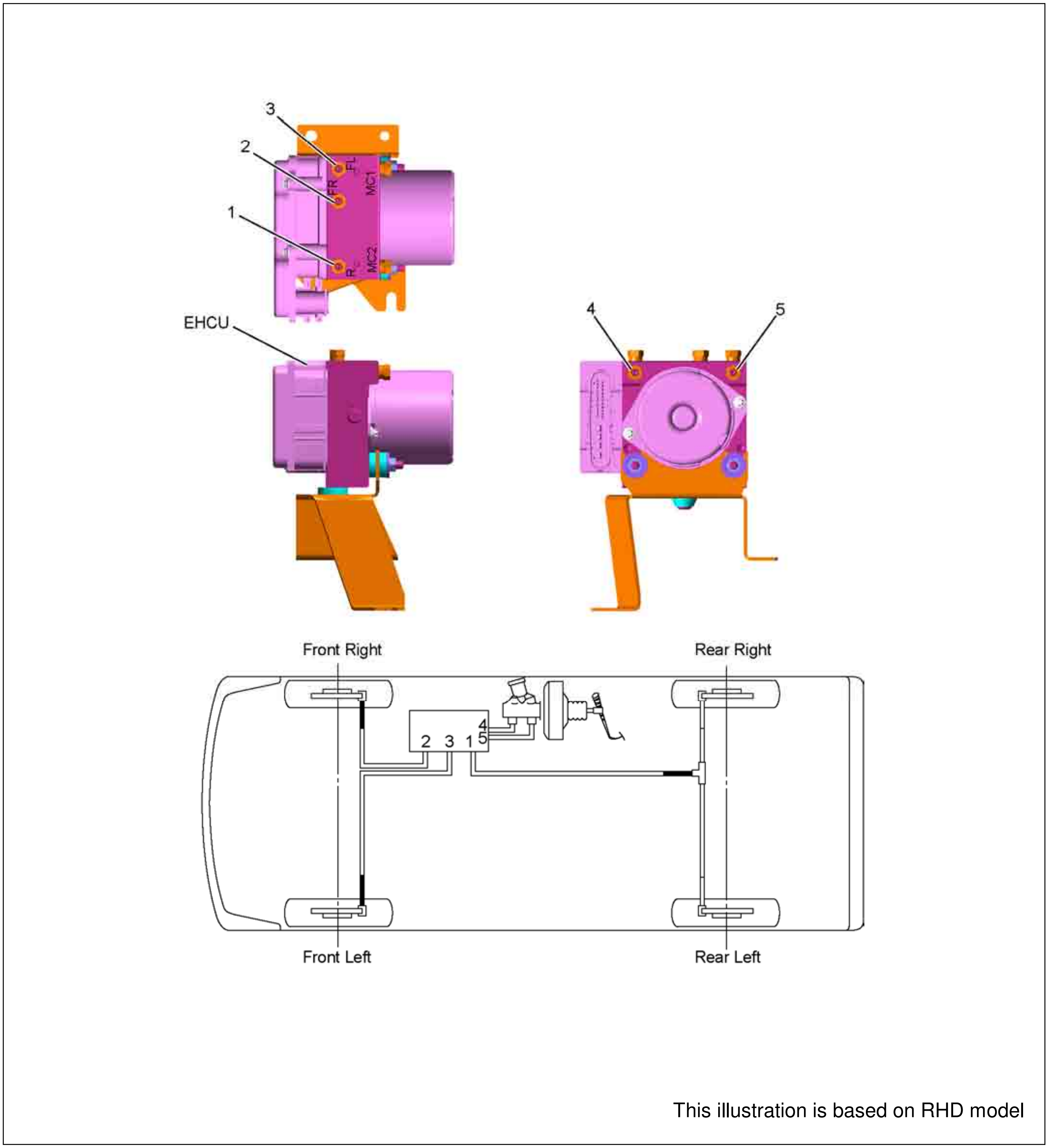
RAA4C0MF000201

Pin-Assignment

No.	Pin Assignment 28 PIN
1	Contact switch driver door
2	Contact switch doors
3	—
4	Power supply antitheft
5	horn
6	Contact switch engine compartment
7	Diagnosis
8	—
9	—
10	—
11	Status LED
12	—
13	—
14	—
15	Lock driver side door lock cylinder
16	Unlock driver side door lock cylinder
17	—
18	Micro Switch, lock / unlock door lock motor
19	—
20	—
21	—
22	—
23	—
24	—
25	—
26	—
27	—
28	Flasher control

No.	Pin Assignment 12 PIN
1	—
2	—
3	Key in
4	—
5	—
6	Micro Switch, unlock, auto door lock
7	Lock, locking motors
8	Unlock, locking motors
9	Power supply locking motors
10	—
11	Ground
12	—

EHCU, Brake Pipe Diagram



RTW75ALF000101

Legend

(1) Rear Brake Port (out)

(2) Front Right Brake Port (out)

(3) Front Left Brake Port (out)

(4) Rear Brake Port (in)

(5) Front Brake Port (in)

Important information on Programming

Security code

The security code protects the antitheft control unit against unauthorized programming and data access from Tech-2. The security code consists of a 4 digit code number and is programmed into the antitheft Control Module (ACU).

New control units are not programmed with a security code.

If the control units are replaced, the security code entered in the transmitter (into remote key).

Must be programmed into the new control unit with Tech-2.

The security code can only be programmed with Tech-2 once and must therefore be performed with great care.

Once programmed, the security code cannot be overwritten. An already used antitheft can be reused in a different car by initializing the antitheft. After that you can program the security code again. For initializing command you need the current security code.

If the antitheft control unit is returned, always enclosed the security code that is allocated to that control unit. If this is not done, we can not process the case and the warranty will not be recognized.

Entering a code

If the Tech-2 display requests that the

- security code
- Vehicle Identification No.
- Country code (Select 213 Germany in all items)

be entered, process as follows;

To input a digit you need to use the up and down buttons of the Tech-2. By using the numeric buttons the according digit will be displayed at the current position and the cursor will move to the next position.

For letters you need to use the up and down buttons of the Tech-2. The up and down key might be used for digits as well. By using the up and down buttons the displayed digit or letter will be increased or decreased.

To move to the next position you need to use the move-to-right-button.

With the two buttons, move-to-right and move-to-left you can select the position of number you want to change.

This will allow you to correct a wrong number.

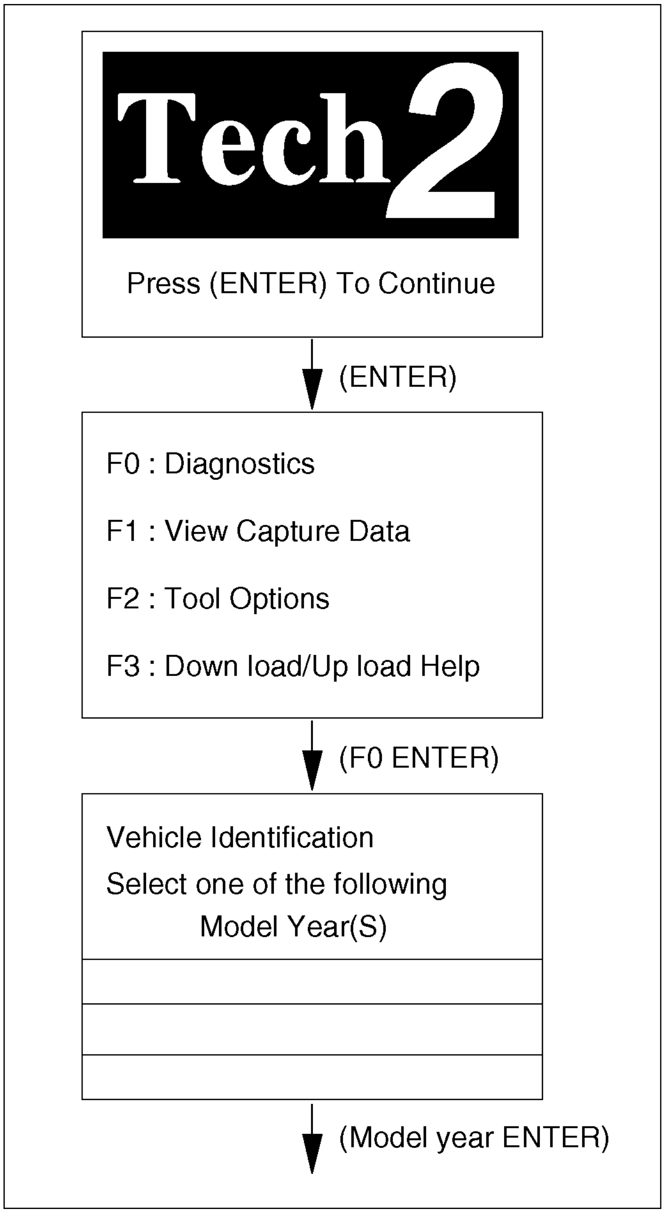
After the number is completed you need to press the Enter button to accept the number. Correction is now no longer possible.

Use the OKAY soft key to program the number and the NOT OKAY soft key to abort the programming.

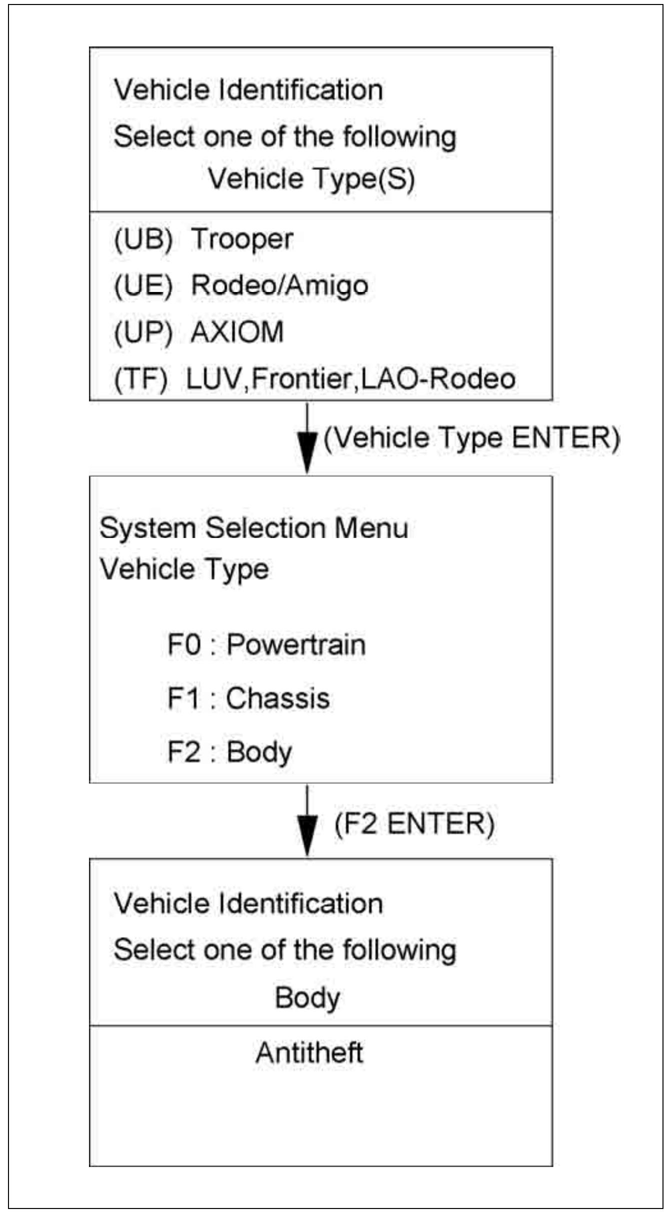
Tech-2 Scan Tool

Operating Procedure

The power up screen is displayed when you power up the tester with the Isuzu systems PCMCIA card.
Follow the operating procedure below.



060R100102



RAW4B0LH000101

Menu

The following table shows which functions are used for the available equipment versions.

F0: Diagnostic Trouble Codes
- F0: Read DTC Info Ordered By Priority
- F1: Read DTC Info As Stored By ECU
- F2: Clear DTC Information
- F3: Read Alarm Codes

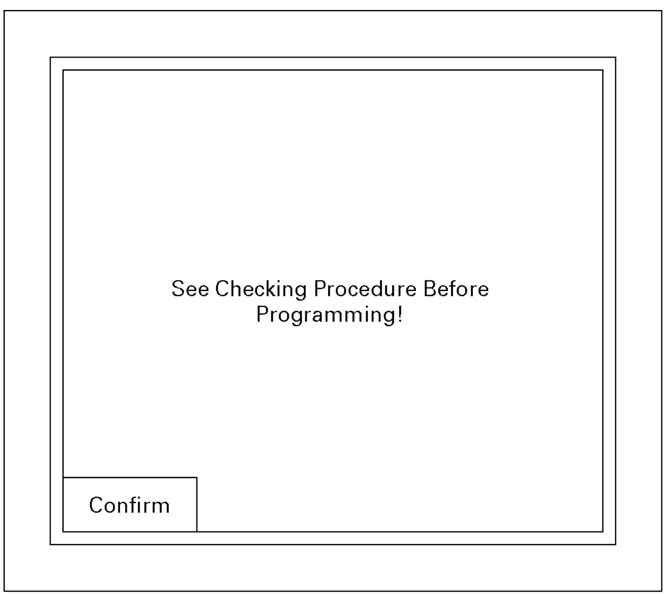
F1: Data Display

F2: Snap Shot

F3: Actuator Test
- F0: Unlock/Lock Test
- F1: Arm/Disarm Signal Test
- F2: Horn Signal Test
- F3: Turn Signal Test
- F4: Theft LED Test

F4: Programming
- F0: Erase Remote Keys
- F1: Program Remote Keys
- F2: Program Anti Theft Warning
- F3: Program Country Code
- F4: Program Vehicle Options

NOTE: Before going to programming process, Tech-2 indicates instruction as follows.



060R200289

DTC

On OBD has two options available in the Tech 2 DTC mode to display the enhanced information available.

- Read DTC Info Ordered By Priority
- Read DTC Info As Stored By ECU

Clear DTC Information

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTC information" function.

Tech-2 Data Display

Use the Tech 2 Data Values only after the On-Board Diagnostic System Check has been completed, no DTC(s) were noted, and you have determined that the on-board diagnostics are functioning properly.

The Tech 2 data values represent values that would be seen on a normally-immobilizer system.

Actuator Test

The actuator tests are used to check abnormalities in the antitheft control system.

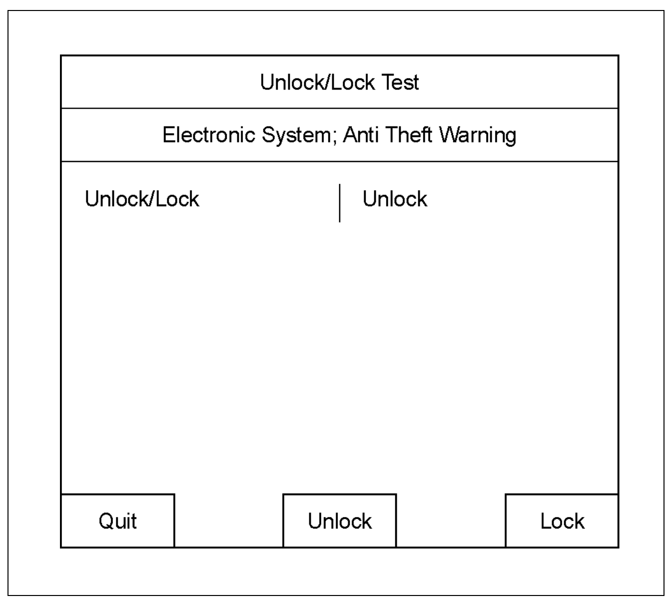
The actuators are operated by the ECU based on the Tech-2 command signal.

Observe the actuators to check abnormalities in the antitheft system.

Unlock/Lock Test

The unlock/lock test is used to check abnormalities in the door lock control system.

1. Select “Body” and “Antitheft”.
2. Select ”Actuator Test” and “Unlock/Lock Test”.
3. Observe the door lock function.
4. Press the lock bottom.
5. Press the unlock bottom.

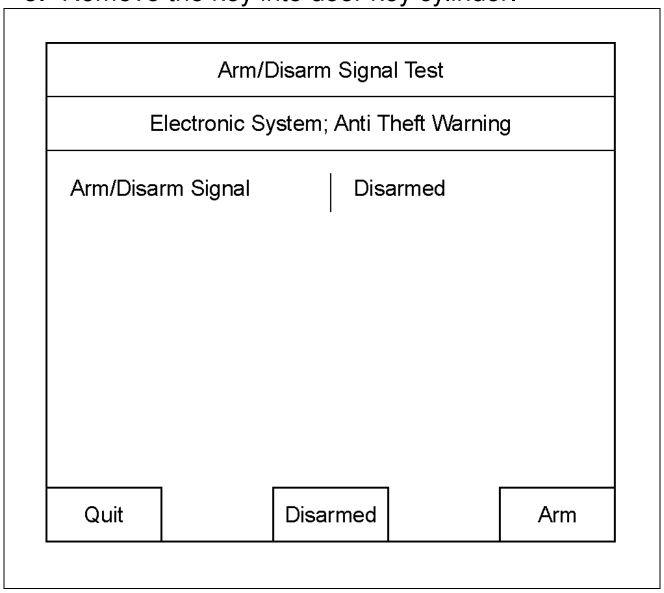


060R200279

Arm/Disarm Signal Test

Arm/Disarm signal test is used to check abnormalities in arm/disarm signal circuit.

1. Select “Body” and “Antitheft”.
2. Select “Actuator Test” and “Arm/Disarm Signal Test”.
3. Observe the data list.
4. Insert the key into door key cylinder.
5. Remove the key into door key cylinder.

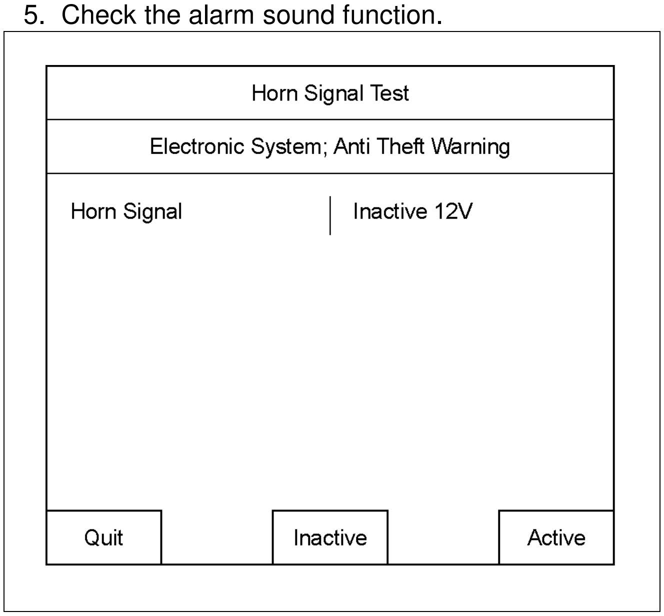


RAW4B0SH000201

Horn Signal Test

Horn signal test is used to check abnormalities in horn signal circuit.

1. Select “Body” and “Antitheft”.
2. Select “Actuator Test” and “Horn Signal Test”.
3. Observe the alarm sound.
4. Push “active bottom”.
5. Check the alarm sound function.

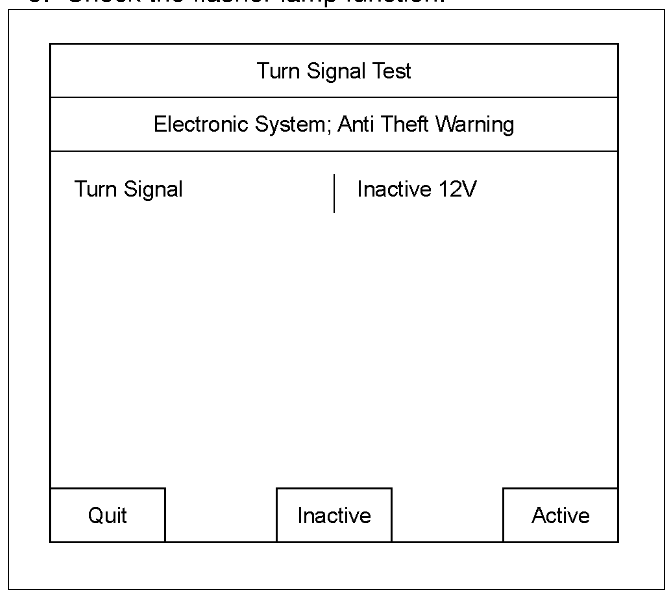


RAW4B0SH000301

Turn Signal Test

Turn signal test is used to check abnormalities in turn signal circuit.

1. Select “Body” and “Antitheft”.
2. Select “Actuator Test” and “Turn Signal Test”.
3. Observe the flasher lamp.
4. Push “active bottom”.
5. Check the flasher lamp function.

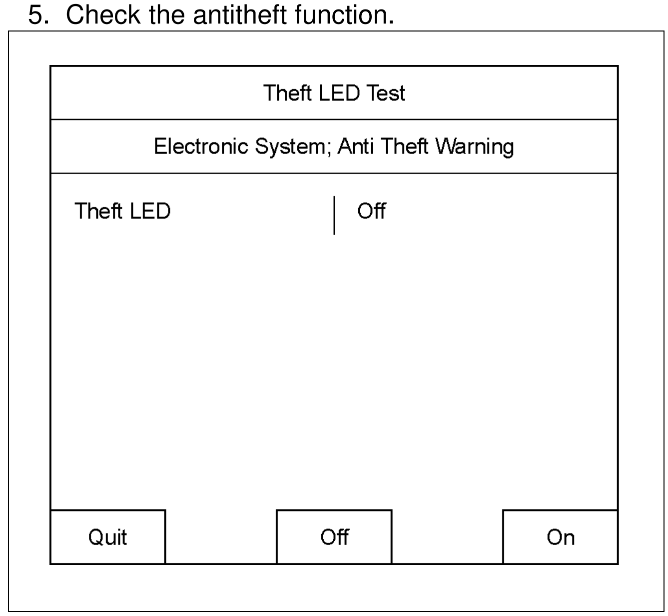


RAW4B0SH000401

Theft LED Test

Theft LED test is used to check abnormalities in theft LED signal circuit.

1. Select “Body” and “Antitheft”.
2. Select “Actuator Test” and “Turn Signal Test”.
3. Observe the antitheft LED.
4. Push “active bottom”.
5. Check the antitheft function.



RAW4B0SH000501

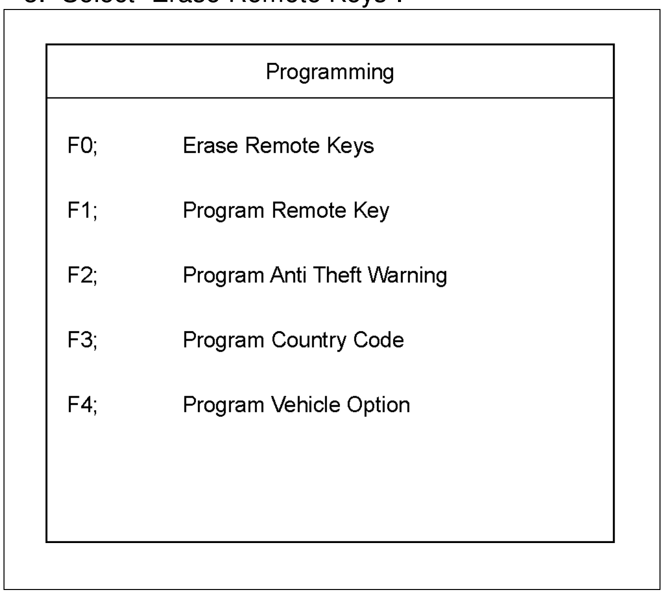
Programming

Programming antitheft function is used to input security code for the antitheft system by tech 2.

If the remote key or ECU replaced, program as necessary.

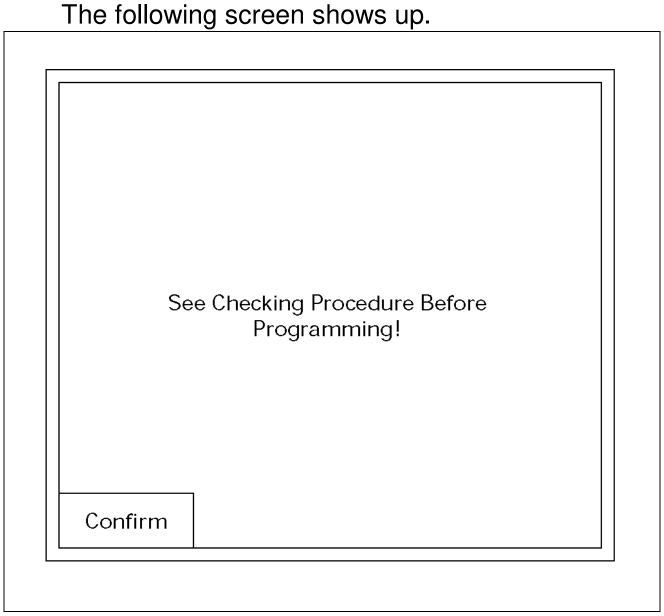
Erase Remote Keys

1. Select “Body” and “Antitheft”.
2. Select “Programming”.
3. Select “Erase Remote Keys”.



RAW4B0SH000601

The following screen shows up.



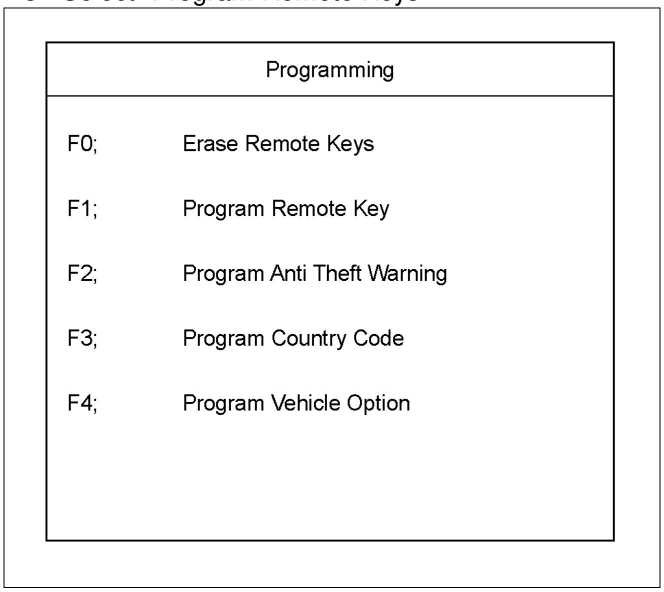
060R200289

4. Confirm the following screen shows up.

060R200284

Program Remote Keys

1. Select “Body” and “Antitheft”.
2. Select “”Programming”.
3. Select “Program Remote Keys”.



RAW4B0SH000601

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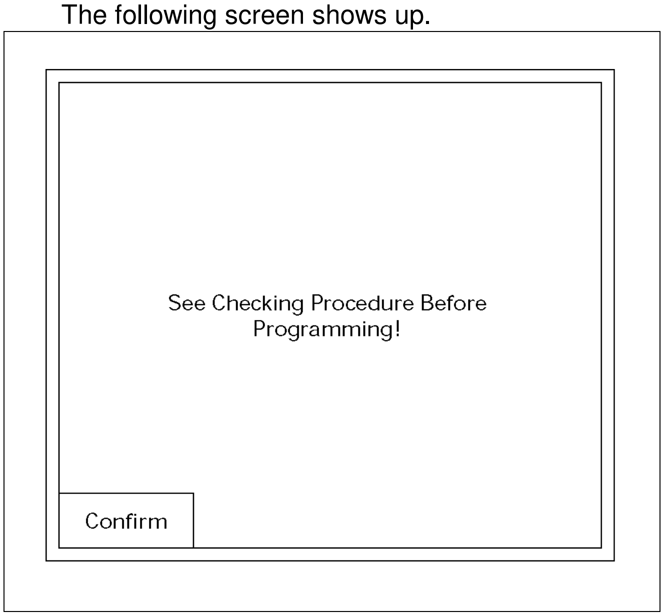


060R200289

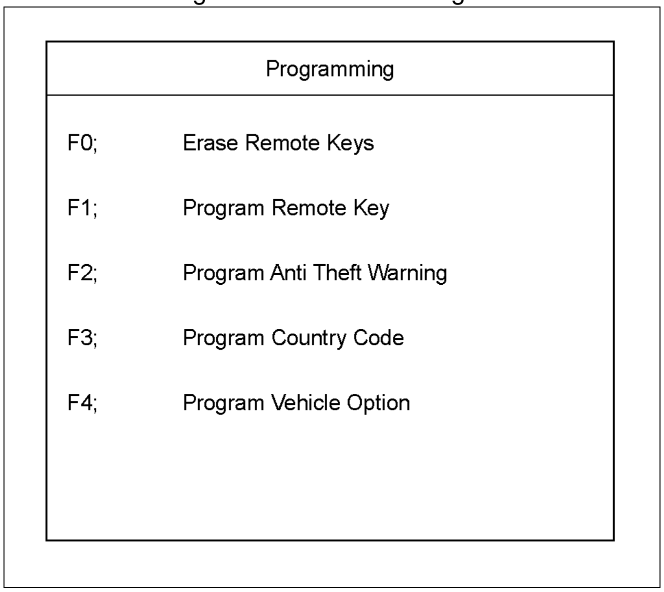
4. Confirm the following screen shows up.

060R200284

5. Input the security code.

Program Antitheft Warning

1. Select “Body” and “Antitheft”.
2. Select “Programming”.
3. Select “Program Antitheft Warning”.



RAW4B0SH000601

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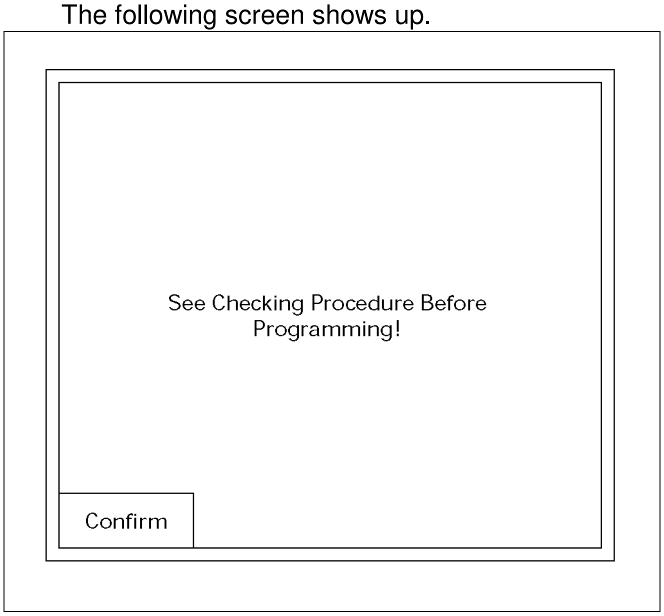


060R200289

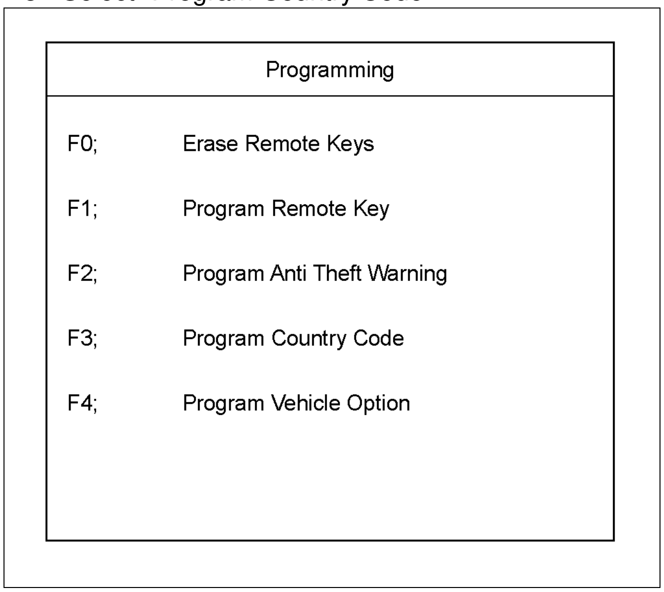
4. Confirm the following screen shows up.

060R200284

5. Input the security code.

Program Country Code

1. Select “Body” and “Antitheft”.
2. Select “Programming”.
3. Select “Program Country Code”.



RAW4B0SH000601

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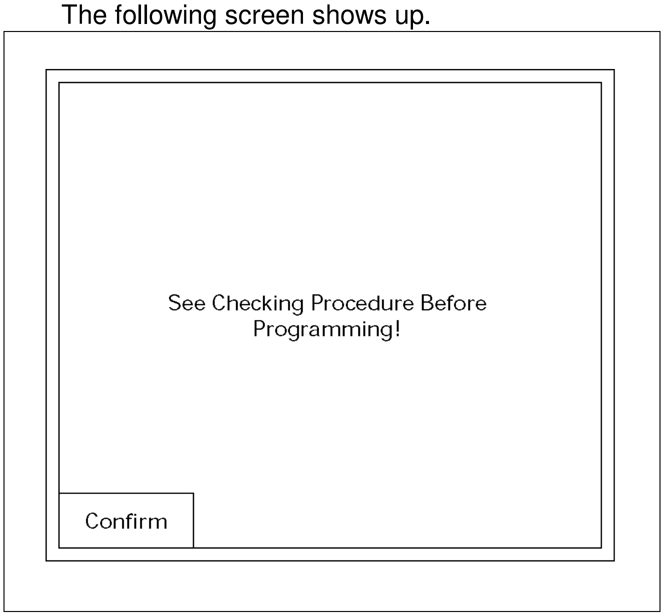


060R200289

4. Confirm the following screen shows up.

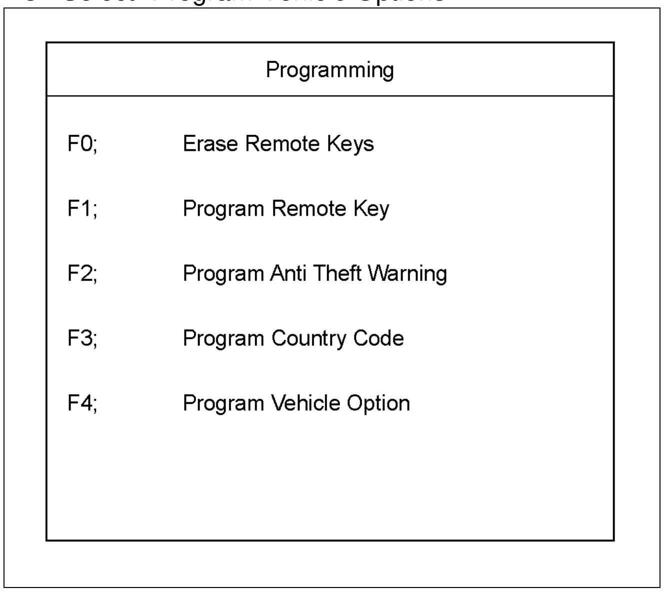
060R200284

5. Input the security code.

- Select 213 Germany in all items.

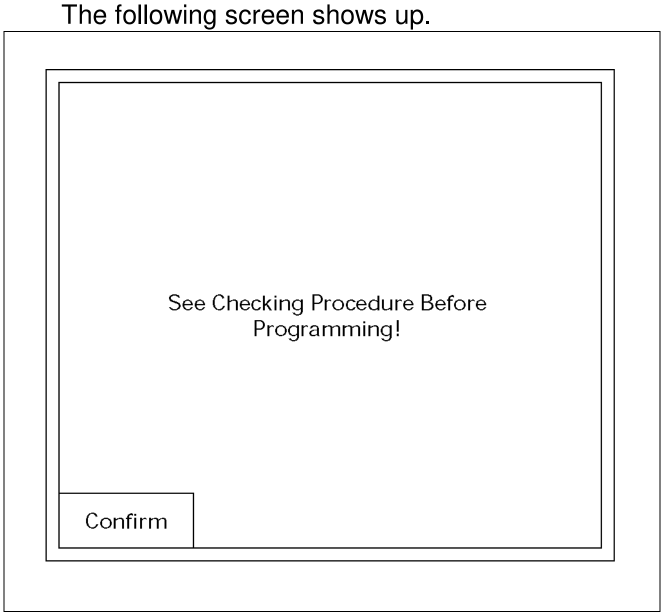
Program Vehicle Options

1. Select “Body” and “Antitheft”.
2. Select “Programming”.
3. Select “Program Vehicle Options“.



RAW4B0SH000601

The following screen shows up.



060R200289

4. Confirm the following screen shows up.

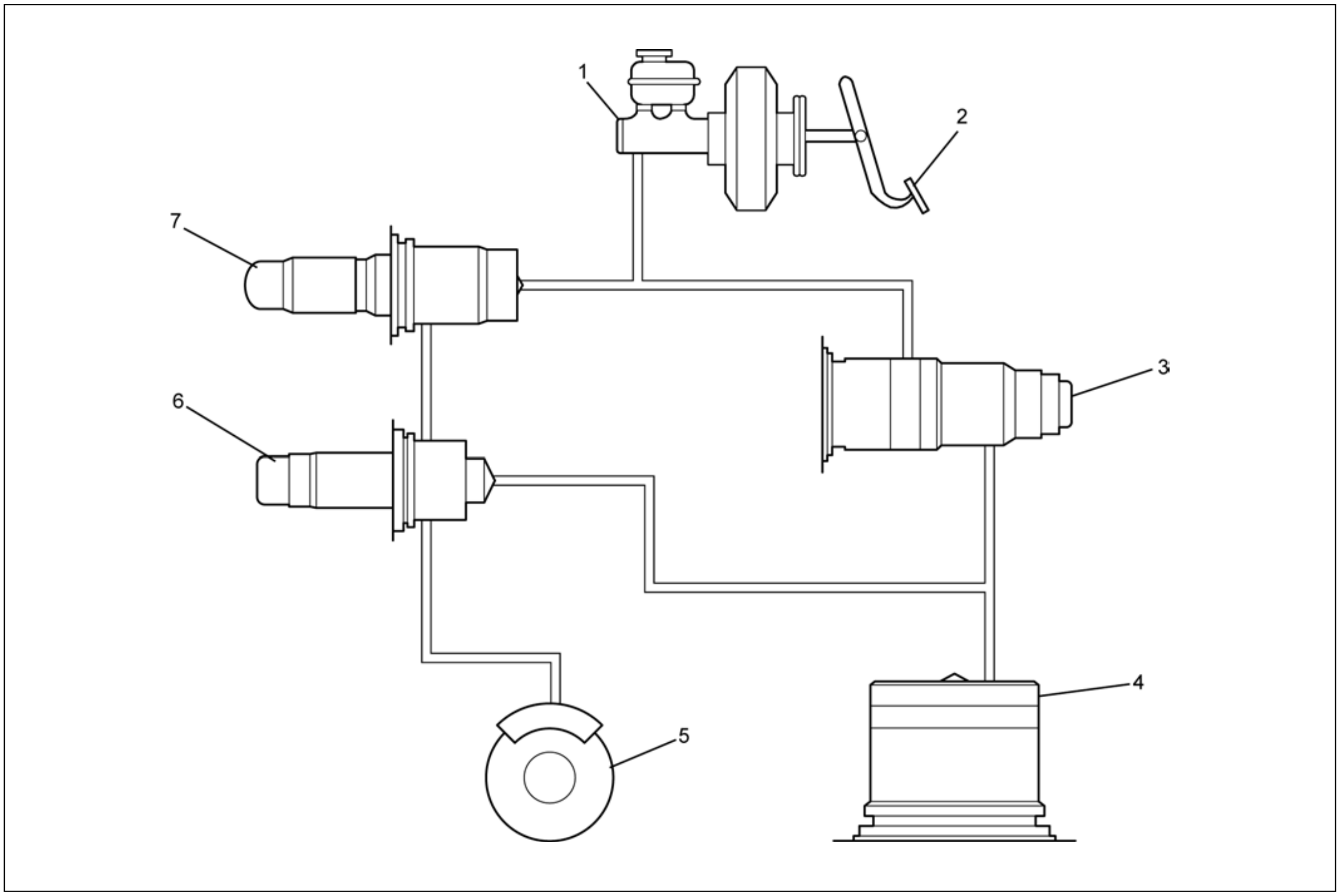
060R200284

5. Input the vehicle options.

Tech-2 Data List

No.	Data List	Units
1	Battery Voltage	V
2	'KEY-IN' Status	ON/OFF
3	CDLS-Motor Voltage (Central Door Locking System)	V
4	Accident Sensor (Crash Sensor)	Active/Inactive
5	Remote Key	Active/Inactive
6	Remote-Key Detected	Remote Key No.
7	Key Function Detected	Lock/Unlock
8	Prev. Detected Remote-Key (Previously)	Remote Key No.
9	Previously Key Function	Lock/Unlock
10	Remote-Key 1 Status	In Range/Not Programmed
11	Remote-Key 2 Status	In Range/Not Programmed
12	Remote-Key 3 Status	In Range/Not Programmed
13	Remote-Key 4 Status	In Range/Not Programmed
14	Remote-Key 5 Status	In Range/Not Programmed
15	Front Door Unlock Switch	Active/Inactive
16	Front Door Lock Switch	Active/Inactive
17	Front Door Lock Status	Active/Inactive
18	Auto Door Unlock Switch	Active/Inactive
19	Auto Door Lock Switch	Active/Inactive
20	Auto Door Lock Status	Active/Inactive
21	Trunk Signal Switch	*Not used Open/Closed
22	Doorknob Switch	Open/Closed
23	Doorknob Status	Lock/Unlock
24	Trunk Doorknob Switch	*Not used Open/Closed
25	Trunk Doorknob Status	*Not used Lock/Unlock
26	Driver Door Switch	Open/Closed
27	Driver Door Status	Open/Closed
28	All Door Switch	Open/Closed
29	All Door Status	Open/Closed
30	Door lock Tamper Switches	Open/Closed
31	Engine Hood Switch	Open/Closed
32	Engine Hood Status	Open/Closed
33	Trunk Switch	*Not used Open/Closed
34	Trunk Status	*Not used Open/Closed
35	Pane Breakage Connected	*Not used Yes/No
36	Pane Breakage Status	*Not used Disabled/Abled
37	CDLS-Motor Current (Central Door Locking System)	A
38	CDLS-Motor Unlock (Central Door Locking System)	V
39	CDLS-Motor Lock (Central Door Locking System)	V
40	Overflow Protection	Active/Inactive
41	Turn Signal	Active/Inactive
42	Horn Connected	Yes/No
43	Horn Signal	Active/Inactive
44	Theft LED	ON/OFF
45	CDLS-Status (Central Door Locking System)	Lock/Unlock
46	Selftest Request	Active/Inactive
47	Last Use	—
48	Theft Status	Disabled/Abled
49	Alarm Status	Active/Inactive
50	Security Wait Time	Active/Inactive

Hydraulic Unit (H/U)



RTW75AMF000101

Legend

(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

Diagnosis

Diagnostic procedure

- Once the cause of DTC is repaired or gone, engine can be operated normally, and present DTC becomes history code.
- History code is canceled by no repeat failure on 25 consequence ignition key on afterward.
- History code cannot be canceled by battery connector disconnected.

Clearing Diagnostic Trouble Codes

IMPORTANT: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

Verifying Vehicle Repair

Verification of vehicle repair will be more comprehensive for vehicles with immobilizer system diagnostic. Following a repair, the technician should perform the following steps:

1. Review and record the Fail Records for the DTC which has been diagnosed.
2. Clear DTC (s).
3. Operate the vehicle within conditions noted in the Fail Records.
4. Monitor the DTC status information for the DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying repairs on immobilizer systems. Failure to follow these steps could result in unnecessary repairs.

Diagnostic Aids

An intermittent may be caused by the following:

- Poor connections.
- Miss routed harness.
- Rubbed through wire insulation.
- Broken wire inside the insulation.

Check for the following conditions:

- Poor connection at ACU-Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Damaged harness-Inspect the wiring harness for damage.

  If the harness appears to be OK, observe the data display on the Tech2 while moving connectors and wiring harnesses related to the switch or actuator.
  A change in the display will indicate the location of the fault.
  If DTC cannot be duplicated, the information included in the Failure Records data can be useful in determined vehicle mileage since the DTC was last set.
  If it is determined that the DTC occurs intermittently, performing the DTC Diagnostic Chart may isolate the cause of the fault.

NOTE: Breakage of antitheft fuse does not operate antitheft system. Check LED lamp flashes at this time.

Check the Electro-Magnetic Interference (EMI)

- Location of vehicle check
  Move the vehicle to a new location and perform the check again.
- Non-OEM Parts.
  Switch is "OFF" or remove the Non-OEM parts and perform the check again.
- Other
  Remove the accessory and another key from key.

Check the other items.

- Battery voltage is low.
- Antitheft programming functions.
  Must be programmed antitheft system.
- Registration for security code, antitheft control unit parts number.
- Key switch operation.
  Antitheft system may detect a history DTC by the timing of ON-OFF of a key switch.
- Active the antitheft system.
- Keyless entry system is malfunction.
- Immobilizer system is malfunction.

Check the operation

Check the operation "Lock / unlock" by using transmitter (key) on the vehicle.

Diagnostic Trouble Code (DTC) List For Antitheft

DTC	Description
13	Security code not yet programmed
14	No remote key programmed
16	Door lock actuators short circuit to ground
20	Broken wire to door lock actuators
21	Remote key 1 with random code out of capture range
22	Remote key 2 with random code out of capture range
23	Remote key 3 with random code out of capture range
24	Remote key 4 with random code out of capture range
25	Remote key 5 with random code out of capture range
28	Input immobilizer short circuit to ground
29	Broken wire to immobilizer
31	Actuator driver door defect
32	Actuator passenger door defect
36	Broken wire to driver door
37	Broken wire to passenger door
41	Driver door switch unlock defect
42	Driver door switch lock defect
43	Driver door switch dead lock defect
44	Passenger door switch lock defect
45	Passenger door switch unlock defect
47	Battery voltage for door lock actuators is missing
50	A/D converter defect or battery voltage less than 9 volt
51	EEPROM defect
52	EEPROM not programmed by ISUZU
55	Control unit defect
123	Output flasher short circuit to ground or broken wire
125	Output alarm horn broken wire

Antitheft System Check

Step	Action	Value (s)	Yes	No
1	1. Key position is "ACC", shut all doors and bonnet. 2. Observe the antitheft lamp. Note: When a key switch is "ACC", antitheft lamp will turn on and a antitheft lamp (LED) will be flashing after 10 seconds. Is the antitheft lamp "ON" or flashing?	—	Go to *Step 2*	Go to *"No antitheft lamp"*
2	1. Key position is "ON", engine "OFF". 2. Observe the antitheft lamp. 3. Key position is turned "ACC". 4. Check the antitheft lamp will be turned flashing and lamp will be turned ACC after 10 seconds. Is the antitheft lamp flashing?	—	Go to *DTC table*	Go to *Step 3*
3	1. Key position is "OFF". 2. Install the Tech-2. 3. Key position is "ON" or "OFF". 4. Attempt to display antitheft data with the Tech-2. Does the Tech-2 display antitheft data?	—	Go to *Step 9*	Go to *Step 4*
4	1. Key position is "OFF", disconnect the antitheft control unit (ACU). 2. Check the DLC (Data Link Connector) circuit for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. Was a problem found?	—	Go to *Step 5*	Go to *Step 6*
5	Repair or replace the DLC (Data Link Connector) circuit. Was the action complete?	—	Go to *Step 3*	—
6	1 Check the ACU ground circuit for an open, or short to voltage. Also, check the ACU ignition feed circuit for an open or short to ground and the ACU ground circuit for an open. 2 If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 7*
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the antitheft data by Tech-2. Was the action complete?	—	Go to *Step 8*	—
8	Select "Display DTCs" with the Tech-2. Are any DTCs stored?	—	Go to applicable DTC table	—
9	1 Observe the antitheft data list on Tech-2. 2 If a problem is found, repair as necessary. Was the problem found?	—	System OK	Go to *applicable section*

No Antitheft Lamp

Step	Action	Value (s)	Yes	No
1	Check the fuse for the antitheft power feed circuit. (10A) If a problem found, repair as necessary. Was the problem found? Is the action complete?	—	Verify repair	Go to *Step 2*
2	1. Check the ACU ground circuit for an open, or short to voltage. Also, check the ACU ignition feed circuit for an open or short to ground and the ACU ground circuit for an open. 2. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 3*
3	1. Check the antitheft lamp LED circuit for an open, or short to voltage. 2. If a problem is found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	1. Key position is “OFF”. 2. Install the Tech-2. 3. Key position is “ACC” or “OFF”. 4. Observe to display lamp data with the Tech-2. Does the Tech-2 display antitheft lamp data ON?	—	Go to *Step 5*	Go to *Step 6*
5	Replace the antitheft lamp.	—	Verify repair	—
6	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the antitheft data by Tech-2. Was the action complete?	—	Verify repair	—

DTC 13 Security Code not yet programmed

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *Antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the Antitheft programming functions by Tech-2. • All transmitters (Remote Key). If a problem is found, reprogramming as necessary. (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 4*	Go to *Step* 5
4	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on Tech-2. Is DTC 13 stored?	—	Go to *Step 5*	Verify repair
5	Recheck the DTC. 1. Non-OEM parts switch is "OFF" or remove the Non-OEM parts. 2. Remove the accessory and another key from key. 3. Move the vehicle to a new location. 4. Key position is "OFF" and keep the position for more than 30 seconds. 5. Key position is "ON". 6. Check the DTC on Tech-2. Is DTC 13 stored?	—	Go to *Step 6*	Verify repair
6	Replace the Antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Is DTC 13 stored?	—	Go to *Step 7*	Verify repair
7	Replace the key and lock cylinder assembly with Antitheft system (ACU). **IMPORTANT:** • ACU is not replacing simultaneously. • After replace lock cylinders, perform the following below the items. • Replace the keys and key cylinders. • Program the Antitheft system. (Refer to "Important information on Programming") Was the action complete?	—	Verify repair	—

DTC 14 No Remote Key Programmed

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions. • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to “Important information on Programming”) Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on the Tech-2. Is DTC 14 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement transmitter (Remote Key) must be programmed the security data by the Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on the Tech-2. Is DTC 14 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 16 Door Lock Actuators Short Circuit to Ground

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the door lock actuators circuit. 1. Key position is “OFF”. 2. Disconnect the antitheft control unit (ACU). 3. Check the door lock actuator circuit for short to ground. If the problem found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Step 3*
3	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on the Tech-2. Is DTC 16 stored?	—	Go to *Step 4*	Verify repair
4	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 20 Broken wire to door lock actuators

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 20 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the door lock actuator circuit. 1. Key position is “OFF”. 2. Disconnect the antitheft control unit (ACU). 3. Disconnect the door lock motor. 4. Check the antitheft/door lock motor line circuit for an open, short to ground. Also, check the ignition feed circuits for an open or short to ground and the ACU ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the antitheft/door lock motor circuit. Was the action complete?	—	Verify repair	—
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the tech2. Was the action complete?	—	Verify repair	—

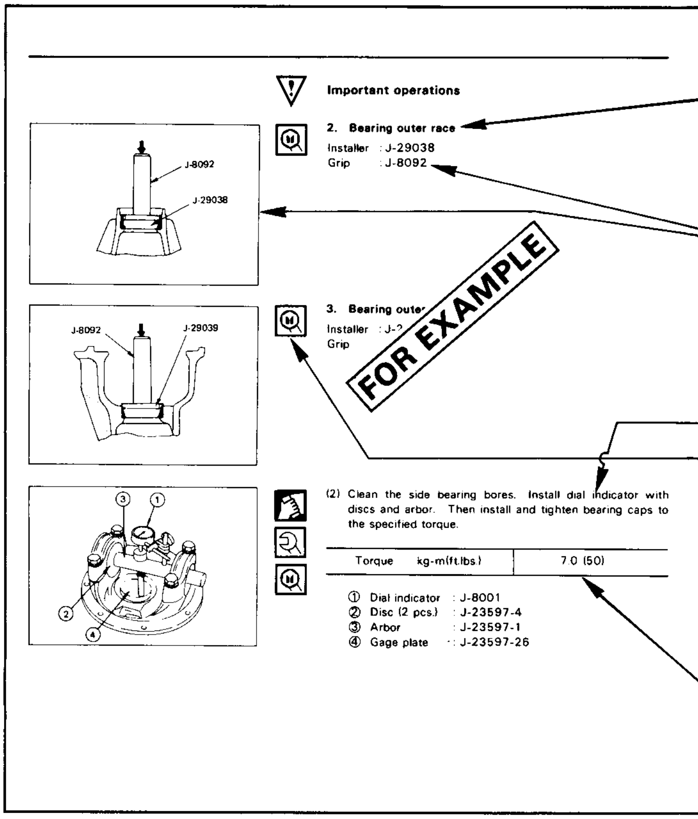
DTC 21 Remote Key 1 With Random Code Out Of Capture Range

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions to the peculiar key with the Tech-2 • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 21 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement transmitter (Remote Key) must be programmed the security data by Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 21 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 22 Remote Key 2 With Random Code Out Of Capture Range

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions to the peculiar key with the Tech-2 • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 22 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement Transmitter (Remote Key) must be programmed the security data by Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 22 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

5. Below is a sample of the Workshop Manual text following the " Major Components " page.
   A brief explanation of the notation used follows:



This is the item shown in the illustration. It is marked with a triangle (▲) on the "Major Components" page.

Special or recommended tools are identified by the tool name and/or number. The illustration shows how the tool is to be used.

Letters and numbers within a circle refer to identically labeled parts or measurements in the illustraion.

This symbol indicates the type of service operation to be performed. A more detailed explanation of the various symbols follows.

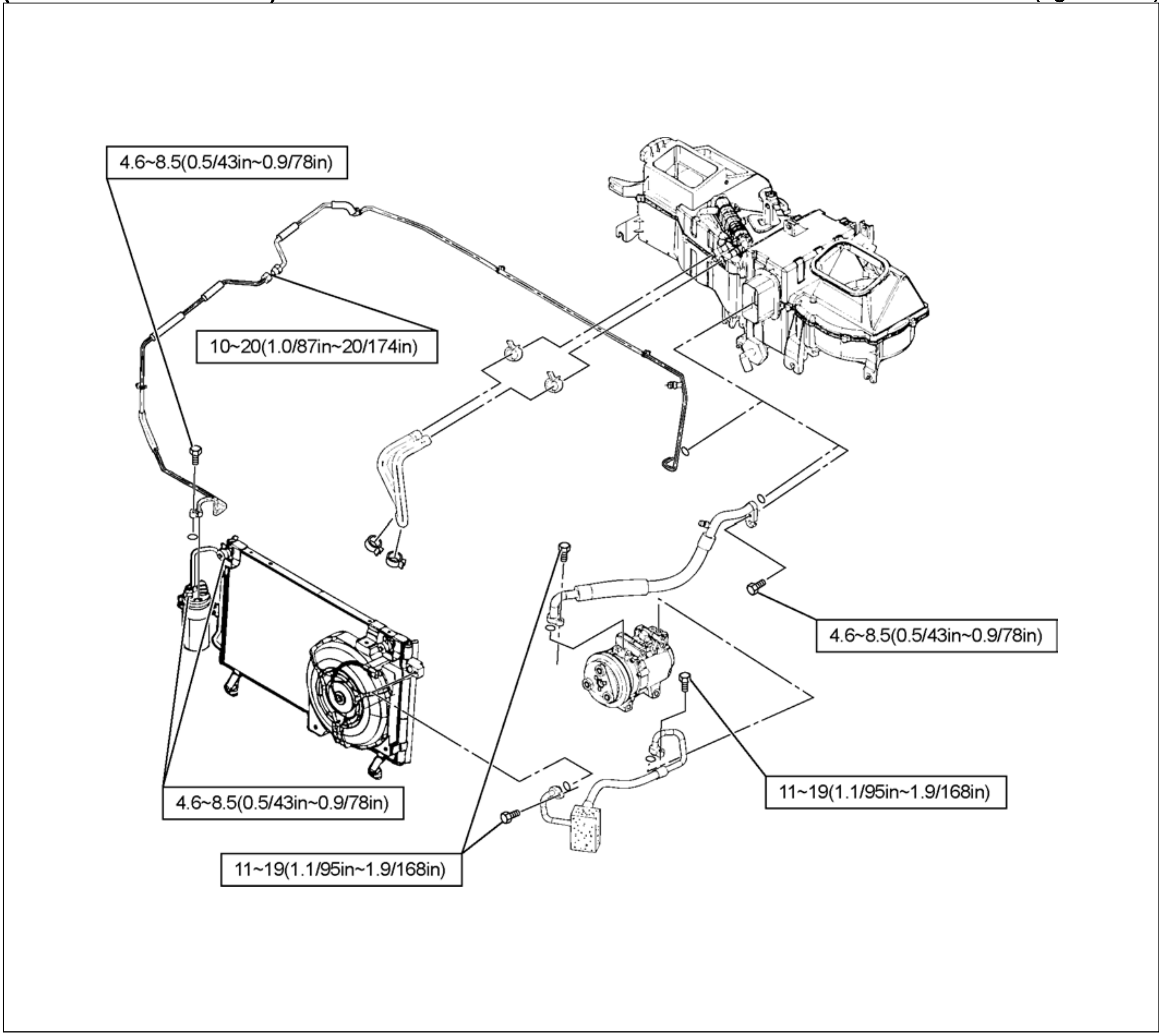
This table gives important service specifications and data.

6. The following symbols appear throughout the Workshop Manual.
   They tell you at a glance the type of service operation to perform.

- ········ Removal
- ········ Installation
- ········ Disassembly
- ········ Reassembly
- ········ Alignment
- ········ Directional indication
- ········ Inspection
- ········ Measurement
- .... Torque angle method
- ········ Adjustment
- ········ Cleaning
- ········ Important operation requiring extra care
- ········ Specified torque
- ········ ISUZU special tool(s) required or recommended
- ········ Other special tool(s) required or recommended
- ········ Lubrication (Oil)
- ········ Lubrication (Grease)
- ········ Liquid gasket application

(C24SE RHD MODEL)

N·m (kgf·m/lb·in)

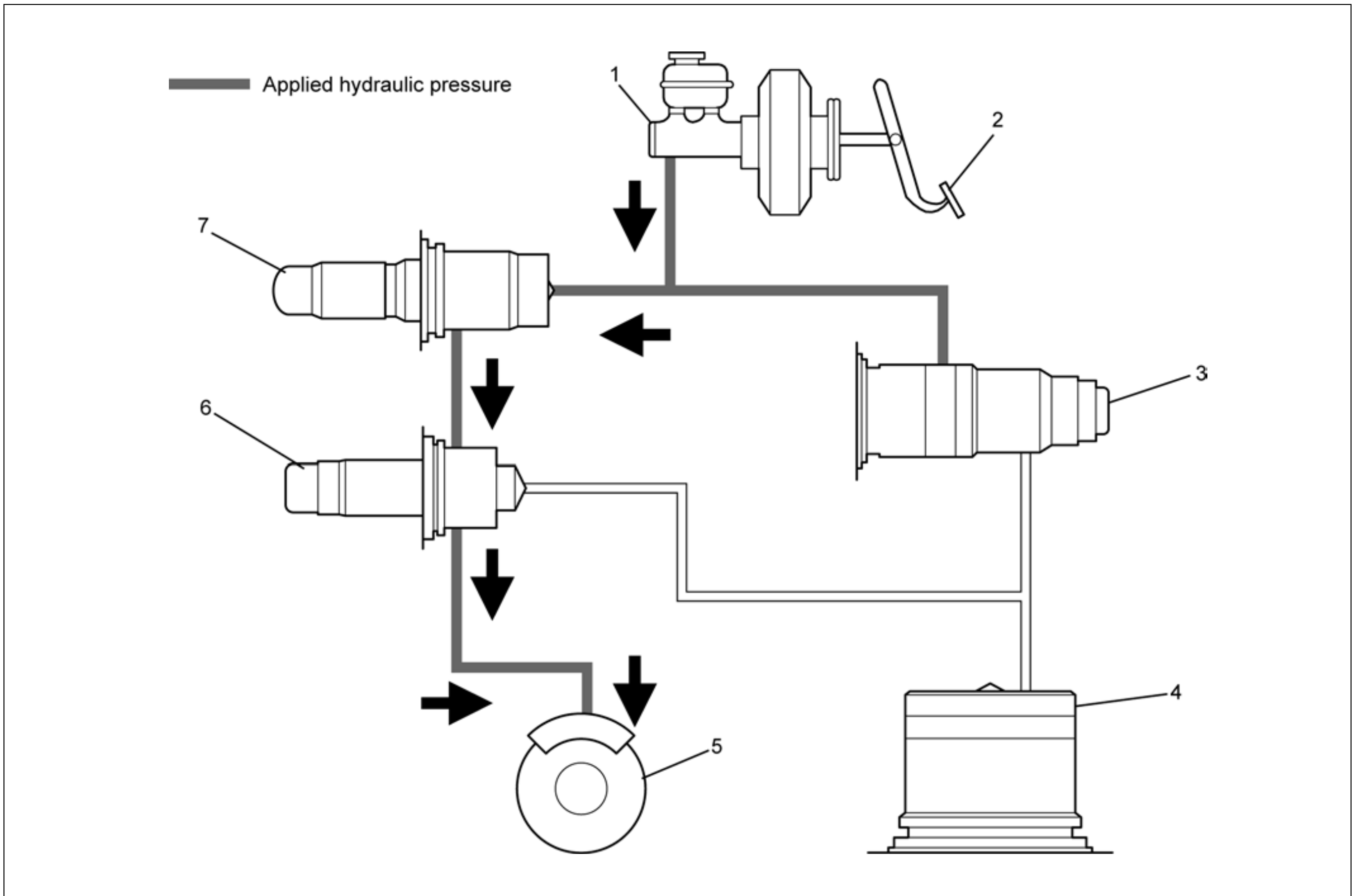


RTW710LF003501

Normal Braking

During normal (non anti-lock) braking, the solenoid valve has current flow.

Brake fluid travels through the center of the inlet valve around the outlet valve then to the brake pistons.



RTW75AMF000201

Legend

(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

DTC 23 Remote Key 3 With Random Code Out Of Capture Range

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions to the peculiar key with the Tech-2 • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 23 stored?	—	Go to *Step 6*	Verify repair
6	Replace the Transmitter (Remote Key). **IMPORTANT:** The replacement Transmitter (Remote Key) must be programmed the security data by Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 23 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 24 Remote Key 4 With Random Code Out Of Capture Range

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions to the peculiar key with the Tech-2 • Transmitter (Remote Key). Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to "Important information on Programming") Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 24 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement transmitter (Remote Key) must be programmed the security data by Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on the Tech-2. Is DTC 24 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 25 Remote Key 5 With Random Code Out Of Capture Range

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the key. Is a key peculiar to a vehicle?	—	Go *to Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft programming functions to the peculiar key with the Tech-2 • Transmitter (Remote Key). Was a problem found?	—	Go to Step 4	Go to *Step 5*
4	Perform the antitheft programming functions. • Transmitter (Remote Key). (Refer to “Important information on Programming”) Was the action complete?	—	Go to *Step 5*	—
5	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on the Tech-2. Is DTC 25 stored?	—	Go to *Step 6*	Verify repair
6	Replace the transmitter (Remote Key). **IMPORTANT:** The replacement transmitter (Remote Key) must be programmed the security data by Tech-2. Was the action complete?	—	Go to *Step 7*	—
7	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on the Tech-2. Is DTC 25 stored?	—	Go to *Step 8*	Verify repair
8	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 28 Input Immobilizer short circuit to ground

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 28 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the driver door locking motor function. line circuit. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the antitheft/Immobilizer communication line circuit for short to voltage, short to ground. Also, check the ICU and ACU ignition feed circuits for an open or short to ground and the ICU and ACU ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the antitheft/Immobilizer communication line circuit. Was the action complete?	—	Verify repair	—
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 29 Broken Wire To Immobilizer

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the scan tool on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 29 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antitheft/immobilizer communication line circuit. 1. Key position is “OFF”. 2. Disconnect the antitheft control unit (ACU). 3. Disconnect the immobilizer control unit (ICU). 4. Check the antitheft/Immobilizer communication line circuit for an open, short to ground. Also, check the ICU and ACU ignition feed circuits for an open or short to ground and the ICU and ACU ground circuit for an open. Was a problem found?	—	Go to *Step 4*	Go to *Step 5*
4	Repair or replace the antitheft/Immobilizer communication line circuit. Was the action complete?	—	Verify repair	—
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 31 Actuator Driver Door Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 31 stored?	—	Go to *Step 3*	Refer to *Diagnostic* Aids
3	Check the driver door locking motor function. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “OFF”. 4. Observe to display locking motor data with the Tech-2. 5. Turn ON by driver door lock. Does the Tech-2 display ON voltage?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is “OFF”. 2. Observe to display unlocking motor data with the Tech-2. 3. Turn OFF by driver door lock. Does the Tech-2 display ON voltage?	—	Refer to *Diagnostic Aids, and then go to step 5*	Go to *Step 5*
5	1. Check the driver door locking motor circuit for an open, short to ground, or short to voltage. Also, check the motor connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the driver door locking motor. 2. Check the DTC on the Tech-2. Is DTC 31 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 32 Actuator Passenger Door Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 32 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the passenger locking motor function. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “OFF”. 4. Observe to display locking motor data with the Tech-2. 5. Turn ON by passenger door lock. Does the Tech-2 display ON voltage?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is “OFF”. 2. Observe to display unlocking motor data with the Tech-2. 3. Turn OFF by passenger door lock. Does the Tech-2 display ON voltage?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the passenger door locking motor circuit for an open, short to ground, or short to voltage. Also, check the motor connector for damage. . If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the passenger door locking motor. 2. Check the DTC on the Tech-2. Is DTC 32 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 36 Broken Wire To Driver Door

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check" performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 36 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the driver door lock function. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “OFF”. 4. Observe to display door lock data with the Tech-2. 5. Turn ON by driver door lock. Does the Tech-2 display Closed?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is “ON”. 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by driver door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the driver door lock circuit for an open, short to ground, or short to voltage. Also, check the motor connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the driver door lock. 2. Check the DTC on the Tech-2. Is DTC 36 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 37 Broken Wire To Passenger Door

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the Tech-2. Is DTC 37 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the passenger door lock function. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "OFF". 4. Observe to display door lock data with the Tech-2. 5. Turn ON by passenger door lock. Does the Tech-2 display Closed ?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is "ON". 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by passenger door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the passenger door lock circuit for an open, short to ground, or short to voltage. Also, check the motor connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the passenger door lock. 2. Check the DTC on the Tech-2. Is DTC 37 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 41 Driver Door Lock Switch Unlock Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 41 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the driver door lock function. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “OFF”. 4. Observe to display door lock switch data with the Tech-2. 5. Turn ON by driver door lock. Does the Tech-2 display Closed?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is “OFF”. 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by driver door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the driver door lock switch circuit for an open, short to ground, or short to voltage. Also, check the door lock connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the driver door lock switch. 2. Check the DTC on the Tech-2. Is DTC 41 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

BACK TO CHAPTER INDEX

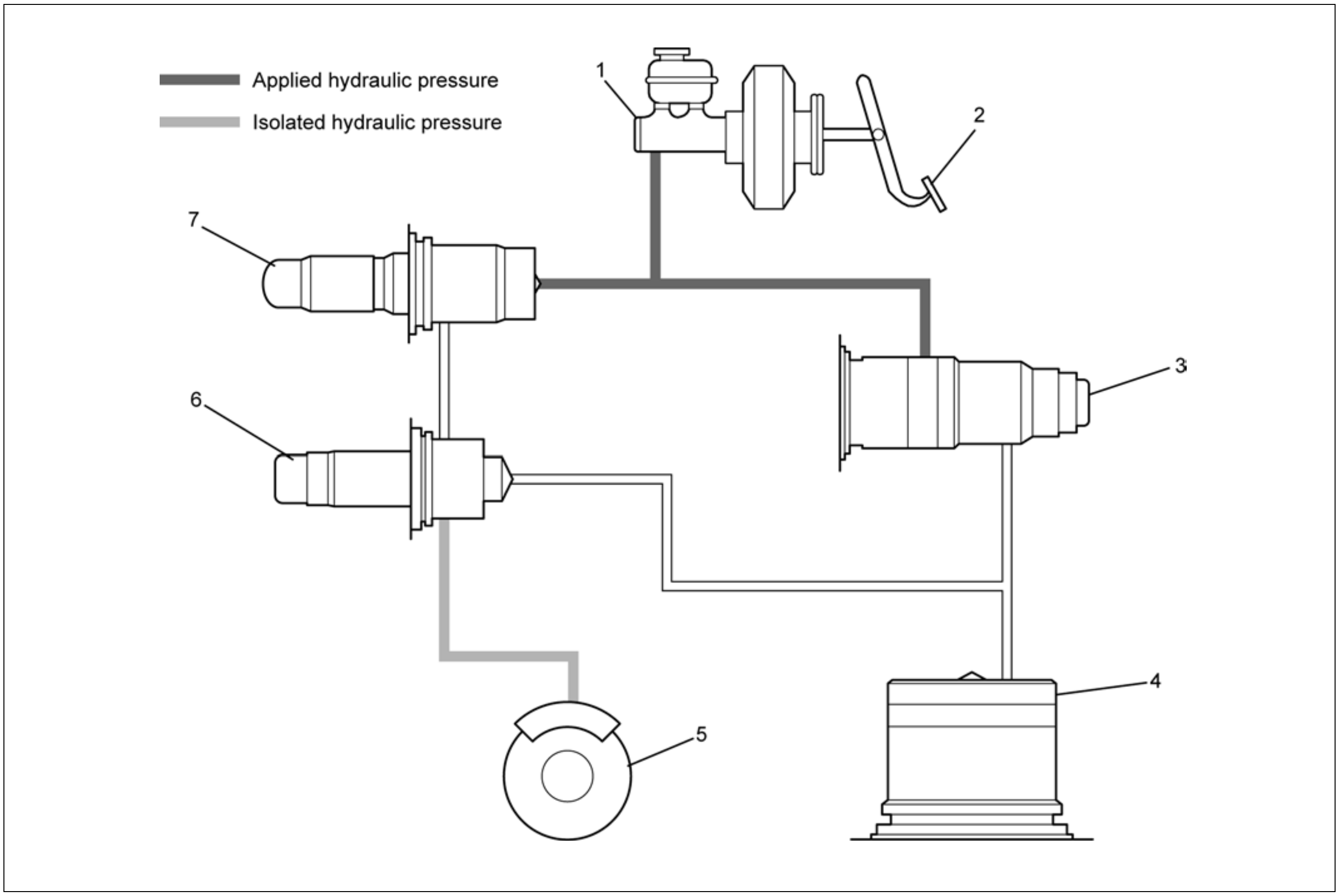
TO MODEL INDEX

Pressure Isolation (Pressure Maintain)

The electronic-hydraulic control unit is activated when the brakes are applied.

If the information from the wheel speed sensors indicates excessive wheel deceleration (imminent lockup), the first step in the anti-lock sequence is to isolate the brake pressure being applied by the brake pedal.

The microprocessor in the Control Unit sends a voltage to the coil to energize and close the outlet valve. This prevents any additional fluid pressure applied by the brake pedal from reaching the wheel. With the outlet valves closed, unnecessary increase in the brake pressure is prevented.



RTW75AMF000301

Legend

(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

DTC 42 Driver Door Lock Switch lock Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the Tech-2. Is DTC 42 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the driver door lock function. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "OFF". 4. Observe to display door lock switch data with the Tech-2. 5. Turn ON by driver door lock. Does the Tech-2 display Closed?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is "OFF". 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by driver door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the driver door lock switch circuit for an open, short to ground, or short to voltage. Also, check the door lock connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the driver door lock switch. 2. Check the DTC on the Tech-2. Is DTC 42 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 43 Driver Door Lock Switch Super lock Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the Tech-2. Is DTC 43 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the driver door lock function. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "OFF". 4. Observe to display door lock switch data with the Tech-2. 5. Turn ON by driver door lock. Does the Tech-2 display Closed?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is "OFF". 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by driver door lock. Does the Tech-2 display Open?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the driver door lock switch circuit for an open, short to ground, or short to voltage. Also, check the door lock connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the driver door lock switch. 2. Check the DTC on the Tech-2. Is DTC 43 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 44 Passenger Door Lock Switch lock Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 44 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the passenger door lock function. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “OFF”. 4. Observe to display door lock switch data with the Tech-2. 5. Turn ON by passenger door lock. Does the Tech-2 display Closed?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is “OFF”. 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by passenger door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids*, and then go to *step 5*	Go to *Step 5*
5	1. Check the passenger door lock switch circuit for an open, short to ground, or short to voltage. Also, check the door lock connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the passenger door lock switch. 2. Check the DTC on the Tech-2. Is DTC 44 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 45 Passenger Door Lock Switch Unlock Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the Tech-2. Is DTC 44 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the passenger door lock function. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "OFF". 4. Observe to display door lock switch data with the Tech-2. 5. Turn ON by passenger door lock. Does the Tech-2 display Closed ?	—	Go to *Step 4*	Go to *Step 5*
4	1. Key position is "OFF". 2. Observe to display door lock data with the Tech-2. 3. Turn OFF by passenger door lock. Does the Tech-2 display Open ?	—	Refer to *Diagnostic Aids,* and then go to *step 5*	Go to *Step 5*
5	1. Check the passenger door lock switch circuit for an open, short to ground, or short to voltage. Also, check the door lock connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 6*
6	1. Repair or replace the passenger door lock switch. 2. Check the DTC on the Tech-2. Is DTC 45 stored?	—	Go to *Step 7*	Verify repair
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 47 Battery Voltage For Door Lock Actuators Is Missing

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 47 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antilock system voltage. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Observe to display system voltage data with the Tech-2. Is the voltage near the specified value ?	—	Go to *Step 5*	Go to *Step 4*
4	1. Key position is “OFF”. 2. Check the battery voltage. 3. If a problem found, repair as necessary. (Chage battery) Was the problem found?	—	Verify repair	Refer to *Diagnostic Aids*
5	Check the door lock motor output voltage. 1. Key position is “OFF”. 2. Connect a digital volt meter to measure voltage. between ACU terminal 7 and body ground. 3. Key position is “ON”. 4. Observe to display voltage with the DVM. 5. Door lock ON. Is the voltage near the specified value ?	—	Go to *Step 6*	Go to *Step 7*
6	1. Check the door lock motor circuit for an open, short to ground, or short to voltage. Also, check the door lock motor connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	—
7	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 50 A/D Converter Defect Or Battery Voltage Less Than 9 Volt

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the Tech-2. Is DTC 50 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Check the antilock system voltage. 1. Key position is "OFF". 2. Install the Tech-2 on vehicle. 3. Key position is "ON". 4. Observe to display system voltage data with the Tech-2. Is the voltage near the specified value ?	—	Go to *Step 6*	Go to *Step 4*
4	1. Key position is "OFF". 2. Check the battery voltage. 3. If a problem found, repair as necessary. (Chage battery) Was the problem found?	—	Verify repair	Go to *Step 5*
5	1. Check the ignition feed circuit for an open, short to ground. Also, check the ACU ground circuit for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Refer to *Diagnostic Aids*
6	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 51 EEPROM Defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 51 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 52 EEPROM Not Programmed By ISUZU

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Check the antitheft programming functions for EOL information with the Tech-2. Was a problem found?	—	Go to *Step 3*	Go to *Step 4*
3	Perform the antitheft programming functions. • IOL information (Refer to “Important information on Programming”) Was the action complete?	—	Go to *Step 4*	—
4	Recheck the DTC. 1. Key position is “OFF” and keep the position for more than 30 seconds. 2. Key position is “ON”. 3. Check the DTC on scan tool. Is DTC 52 stored?	—	Go to *Step 5*	Verify repair
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

DTC 55 Control unit defect

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF" and keep the position for more than 30 seconds. 2. Key position is "ON". 3. Check the DTC on scan tool. Is DTC 55 stored?	—	Go to *Step 3*	Verify repair
3	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the tech2. Was the action complete?	—	Verify repair	—

DTC 123 Output flasher short circuit to ground or broken wire

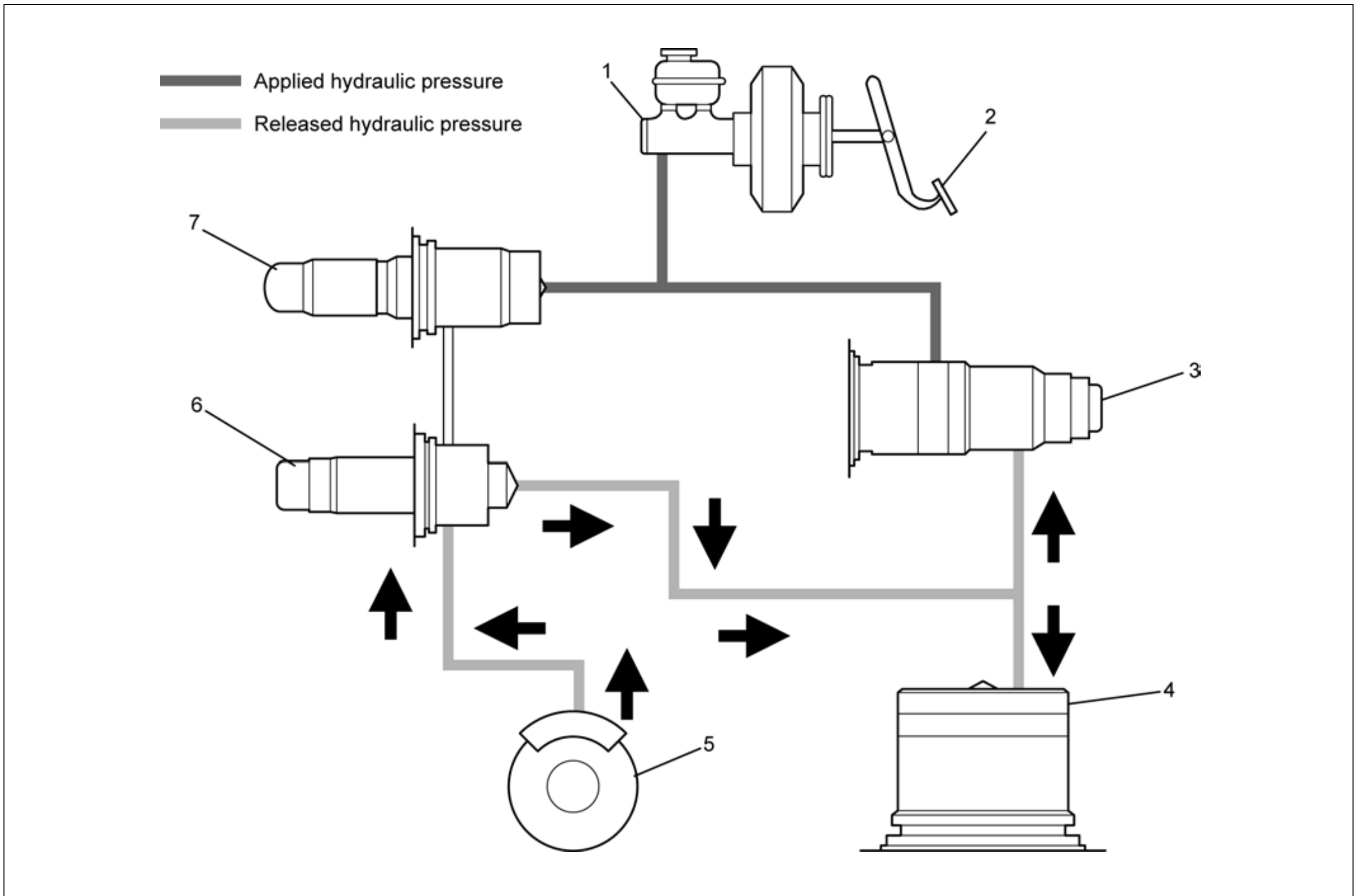
Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is "OFF". 2. Install the tech2 on vehicle. 3. Key position is "ON". 4. Check the DTC on the tech2. Is DTC 123 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Check the flasher circuit for an open, short to ground, or short to voltage. Also, check the flasher connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	Check the flasher function. 1. Key position is "OFF". 2. Connect a jumper wire between ACU terminal 28 and body ground. 3. Key position is "ON". 4. Observe to operate flasher lamp. If the problem found about the flasher lamp circuit, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 5*
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the tech2. Was the action complete?	—	Verify repair	—

Pressure Reduction

Once the brake pressure is isolated, it must be reduced to allow the wheels to unlock. This is accomplished by dumping a portion of the brake fluid pressure into the accumulator.

The microprocessor activates the normally closed outlet valve to open, allowing fluid from the wheels to be dumped into the accumulator. This is done with very short activation pulses opening and closing the outlet valve passageway. Brake pressure is reduced at the wheel and allows the wheel to begin rotating again. The fluid from the brake piston is stored in the accumulator against spring pressure and a portion of this fluid also primes the pump.

The outlet valves are operated independently to control the deceleration of the wheel.



RTW75AMF000401

Legend

(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

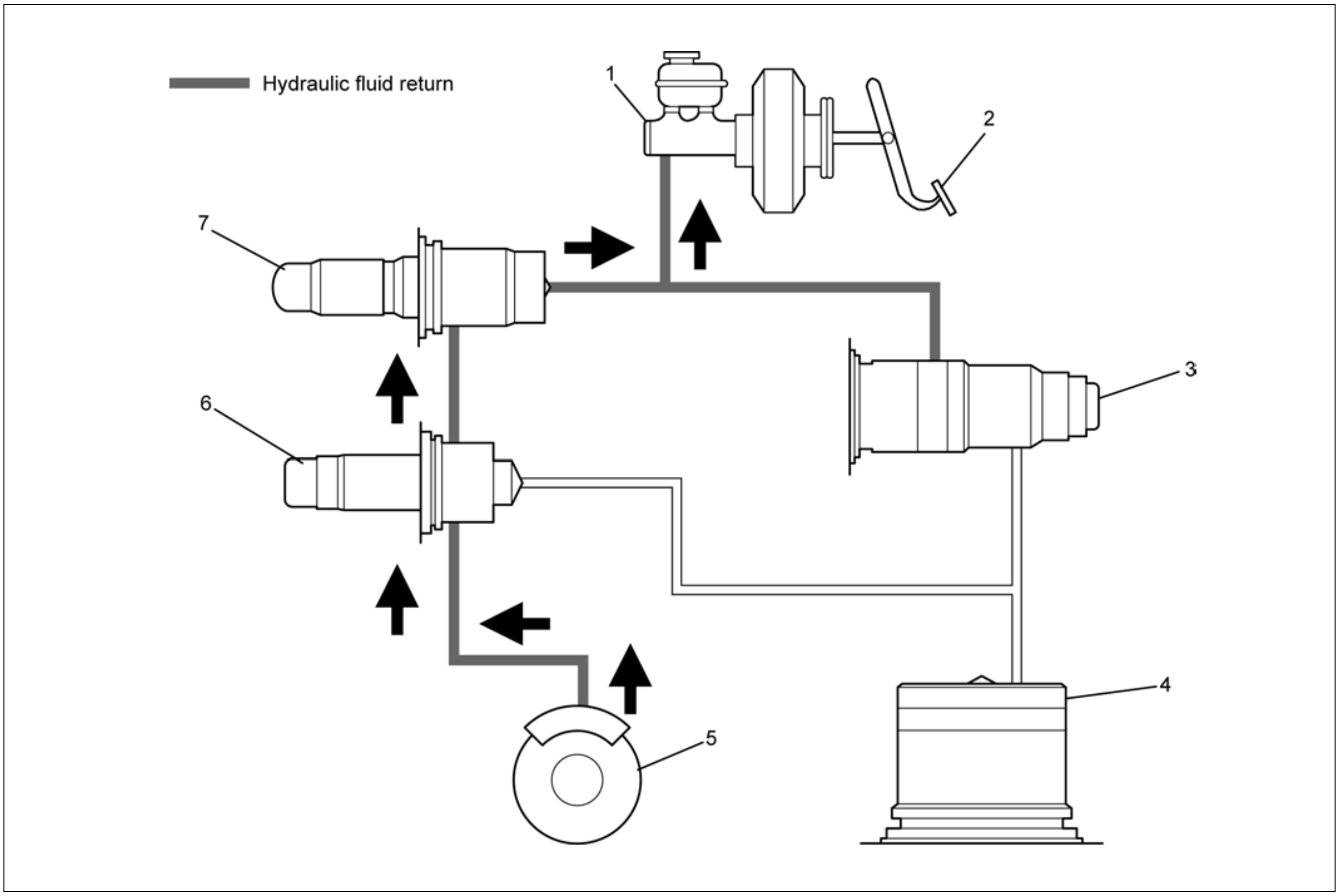
DTC 125 Output Alarm Horn Broken Wire

Step	Action	Value (s)	Yes	No
1	Was the Antitheft System Check performed?	—	Go to *Step 2*	Go to *antitheft System Check*
2	Recheck the DTC. 1. Key position is “OFF”. 2. Install the Tech-2 on vehicle. 3. Key position is “ON”. 4. Check the DTC on the Tech-2. Is DTC 125 stored?	—	Go to *Step 3*	Refer to *Diagnostic Aids*
3	1. Check the alarm horn circuit for an open, short to ground, or short to voltage. Also, check the alarm horn connector for damage. 2. If a problem found, repair as necessary. Was the problem found?	—	Verify repair	Go to *Step 4*
4	Check the alarm horn function. 1. Key position is “OFF”. 2. Connect a jumper wire between ACU terminal 5 and body ground. 3. Key position is “ON”. 4. Observe to operate sound with the alarm horn. If the problem found about the alarm horn, replace as necessary. Was the problem found?	—	Verify repair	Go to *Step 5*
5	Replace the antitheft control unit (ACU). **IMPORTANT:** The replacement ACU must be programmed the security data by the Tech-2. Was the action complete?	—	Verify repair	—

Brake Release

At the end of the anti-lock stop, when the brake pedal is released, the pump will remain running for a short time to help drain any fluid from the accumulator. As this fluid returns into the system, the spring forces the piston back to its original position.

The inlet valve opens and fluid may return to the master cylinder. Conventional braking is then resumed.

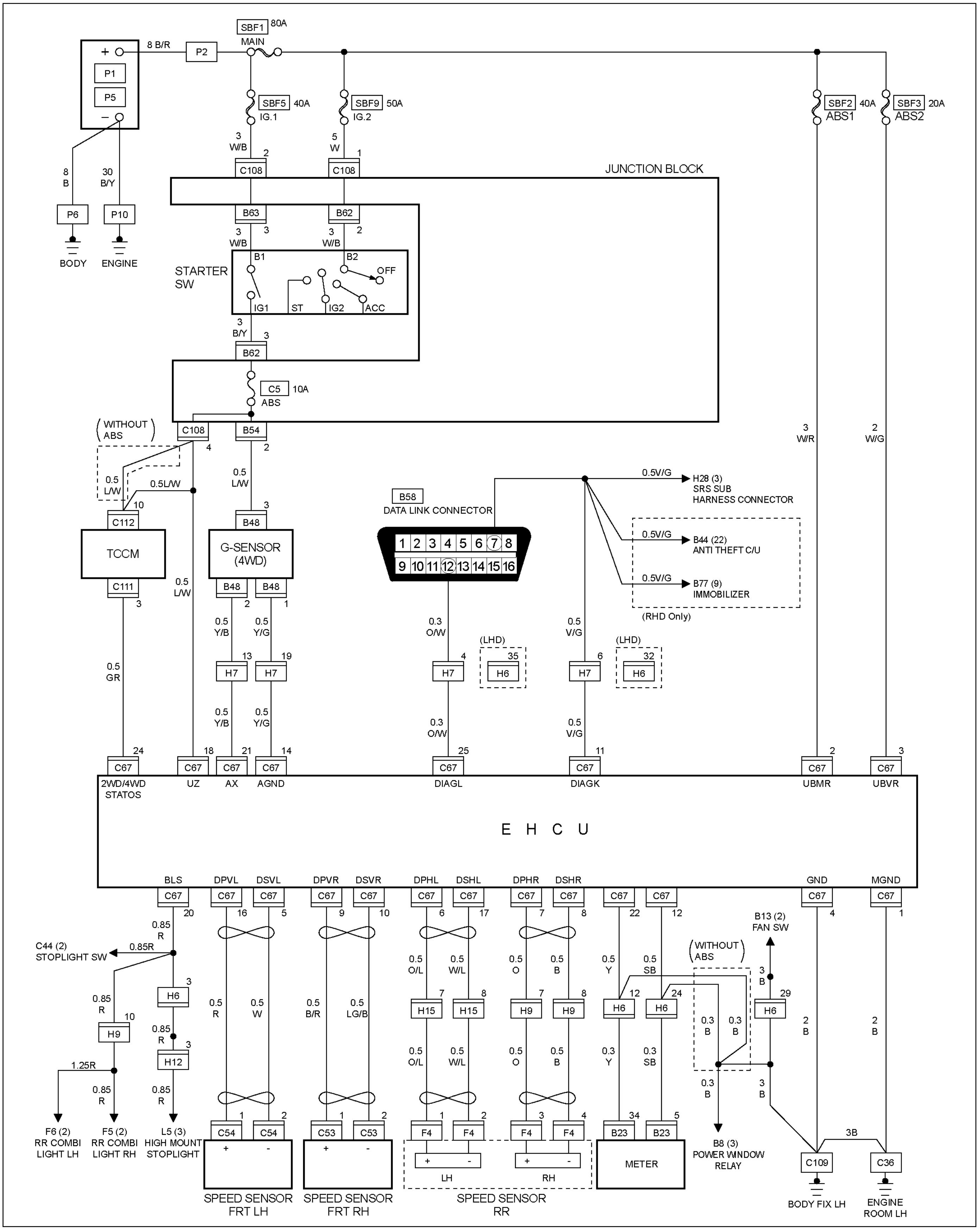


RTW75AMF000501

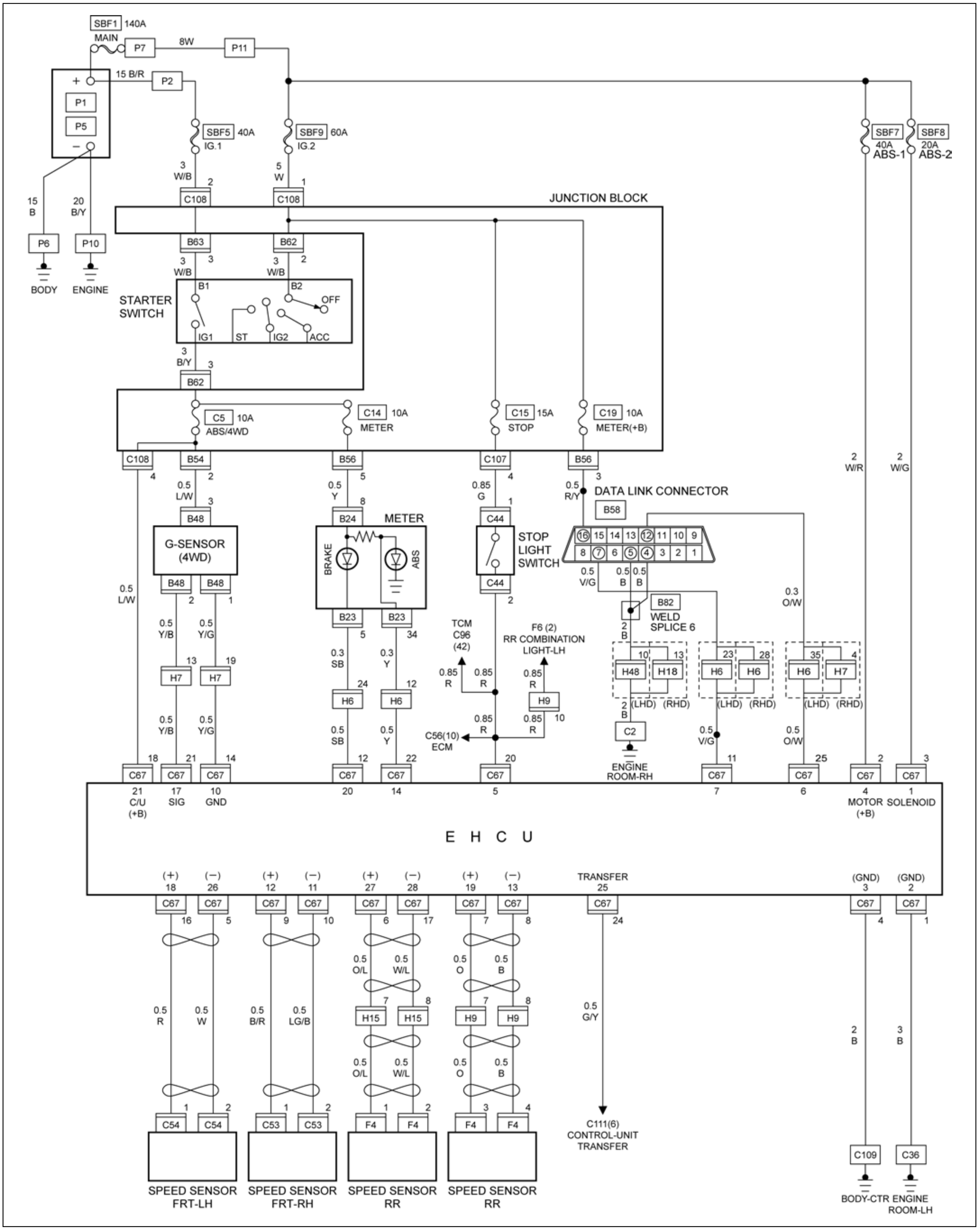
Legend

(1) Master Cylinder
(2) Brake Pedal
(3) Motor and Pump
(4) Accumulator
(5) Brake
(6) Outlet Valve
(7) Inlet Valve

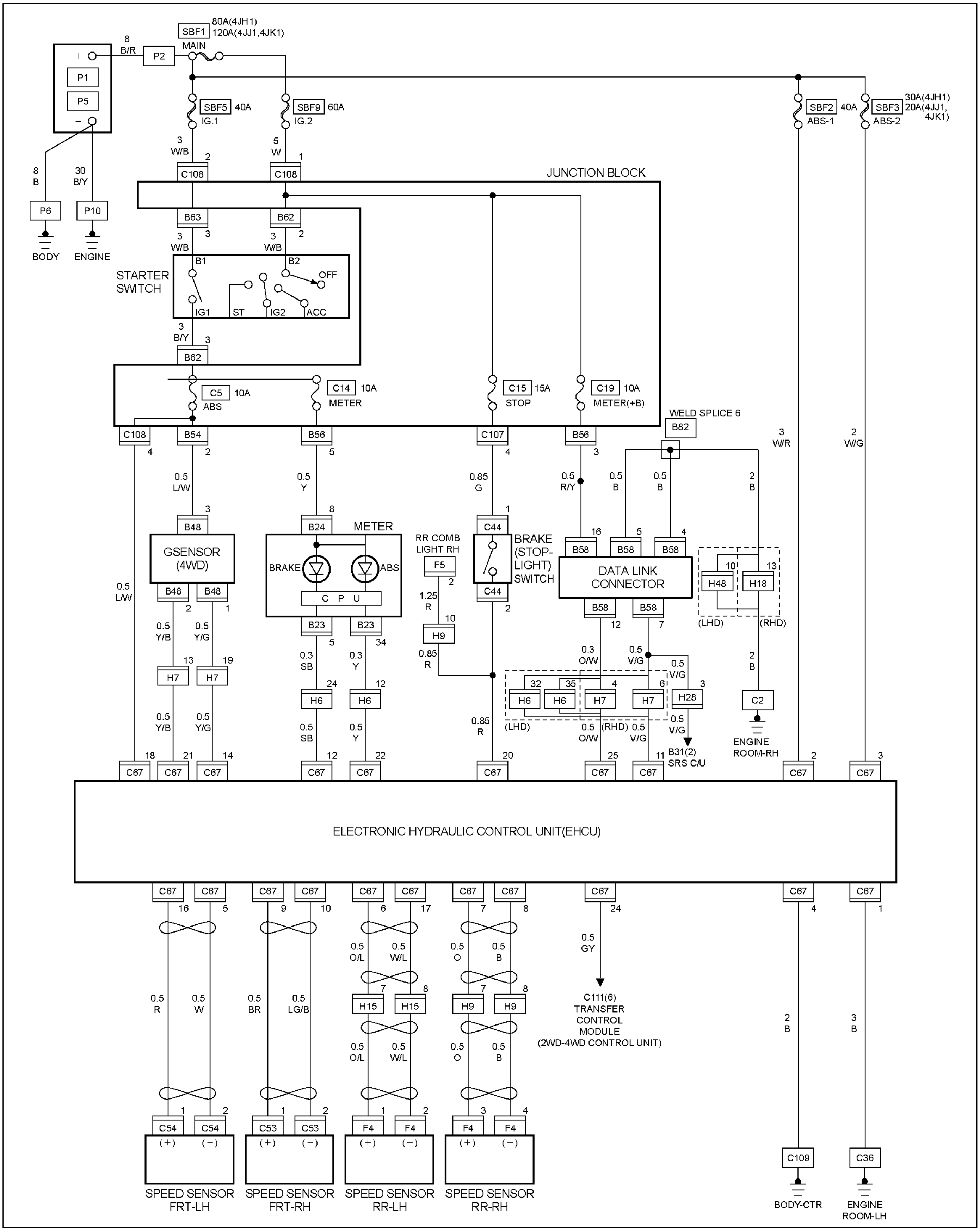
Circuit Diagram
With 4JA1 engine



With HFV6 engine



Except with 4JA1, HFV6 engine



RTW78AXF018701

Connector List

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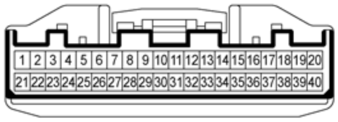
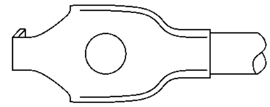
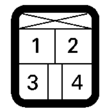
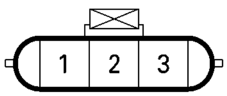
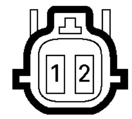
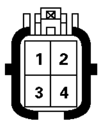
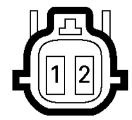
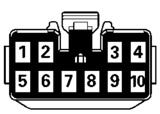
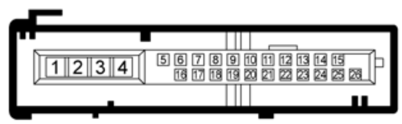
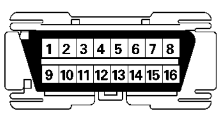
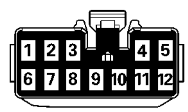
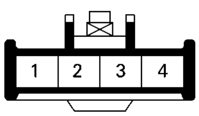
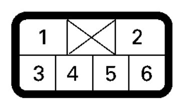
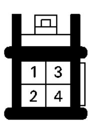
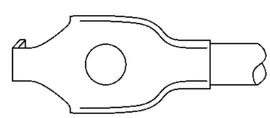
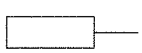
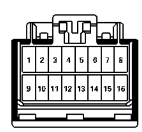
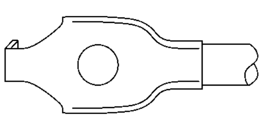
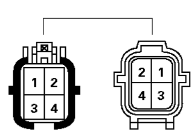
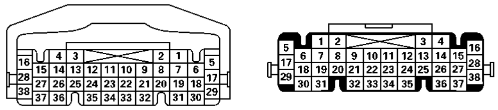
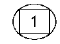
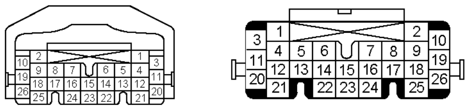
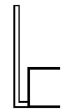
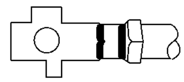
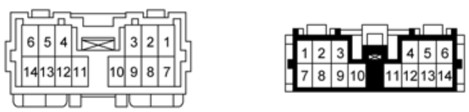
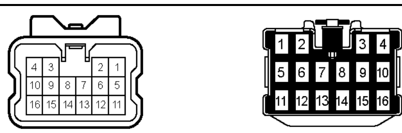
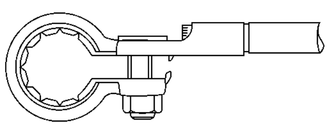
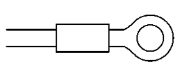
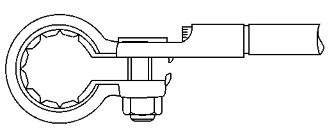
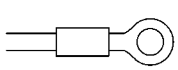
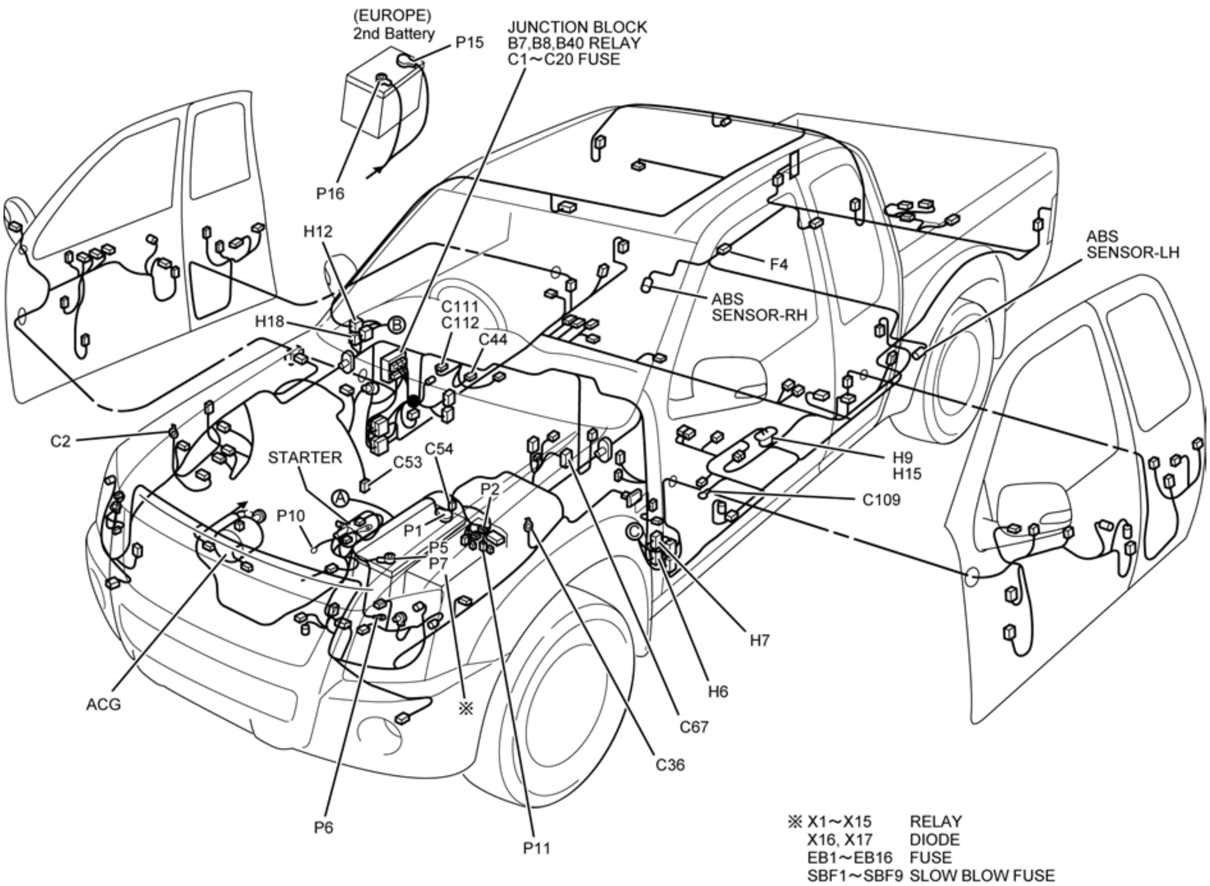
B-23 White	 Meter-A	C-36 Silver	 Engine room - LH ; Ground
B-24 White	 Meter-B	C-44 White	 Stoplight switch
B-48 Black	 G sensor	C-53 Orange	 ABS sensor Front-RH
B-54 White	 J/B I2	C-54 Orange	 ABS sensor Front-LH
B-56 White	 J/B I4	C-67 Black	 EHCU
B-58 Black	 Data link connector	C-107 White	 J/B E2
B-62 White	 Ignition switch (IGSUB : G1)	C-108 White	 J/B E1
B-63 White	 Ignition switch (IGSUB : G2)	C-109 Silver	 Body-LH ; ground
B-82 Silver	 Weld splice 6 (Ground)	C-111 Black	 Transfer case control module
C-2 Silver	 Engine room - RH ground	F-4 Gray	 ABS sensor

No.	Connector face	No.	Connector face
H-6 White	 Engine room ~ INST	P-7	 Battery (ALT)
H-7 White	 Engine room ~ INST	P-10 Silver	 Engine ground
H-9 White	 Engine room ~ Chassis	P-11 Silver	 Fuse & relay box
H-15 White	 Engine room ~ Chassis		
H-18 White	 Engine room ~ INST		
H-48 White	 Engine room ~ INST		
P-1 Silver	 Battery (+)		
P-2 Silver	 Relay & Fuse box		
P-5 Silver	 Battery (-)		
P-6 Silver	 Body ground		

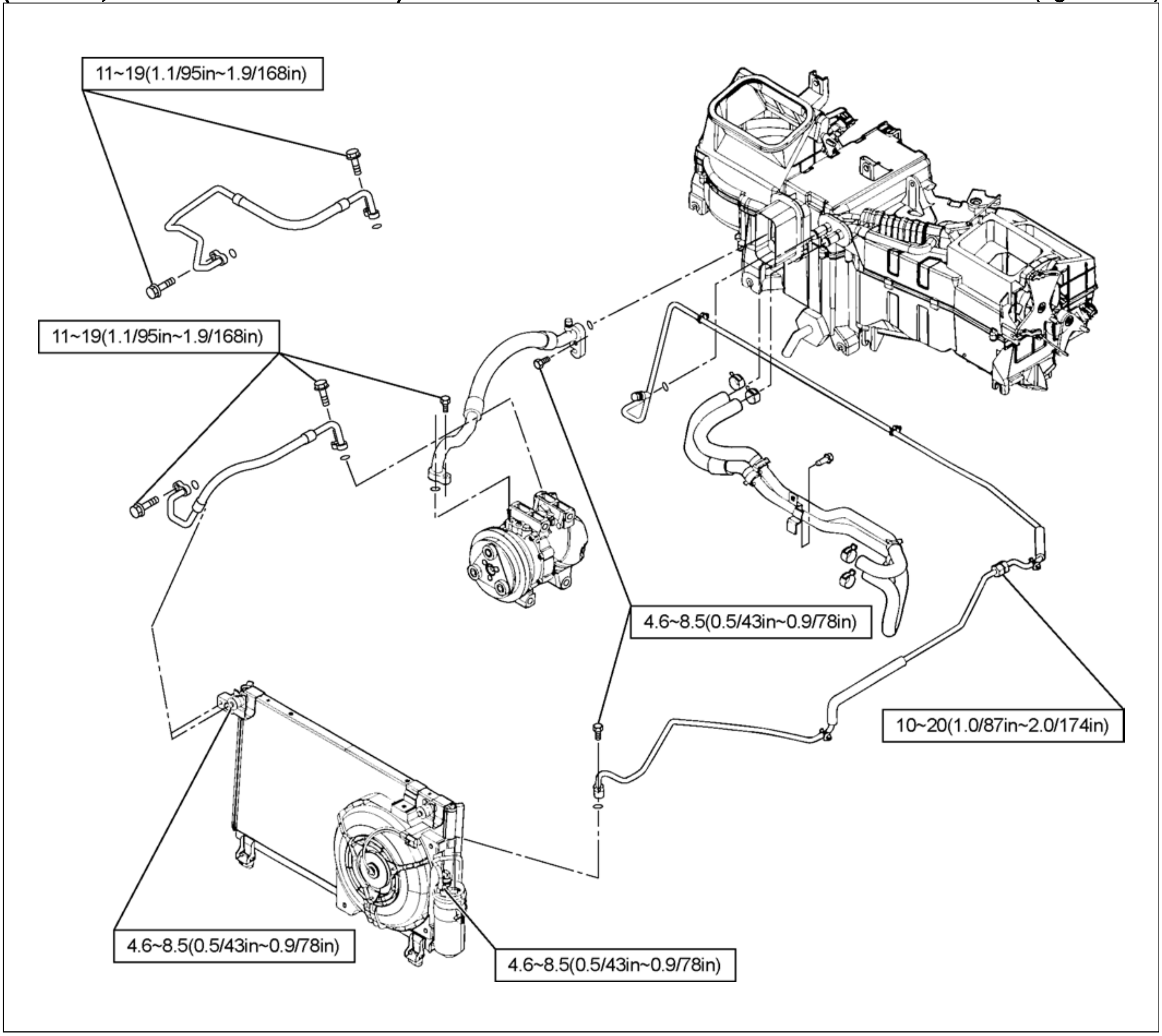
Parts Location (RHD) (1)



RTW78AXF050601

(4JA1-T, 4JH1-TC LHD MODEL)

N·m (kgf·m/lb·in)



RTW710LF003601

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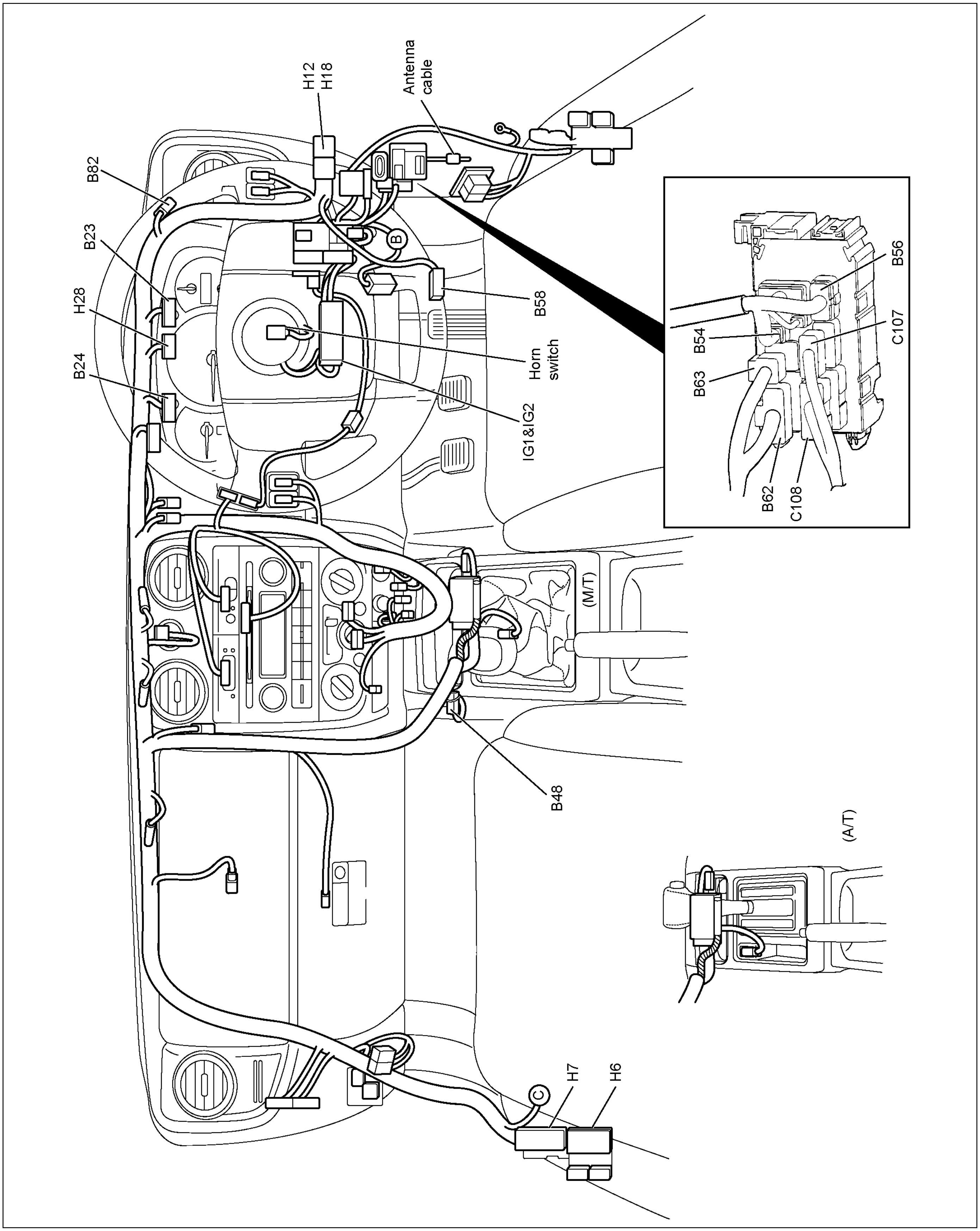

RTW78AXF046901

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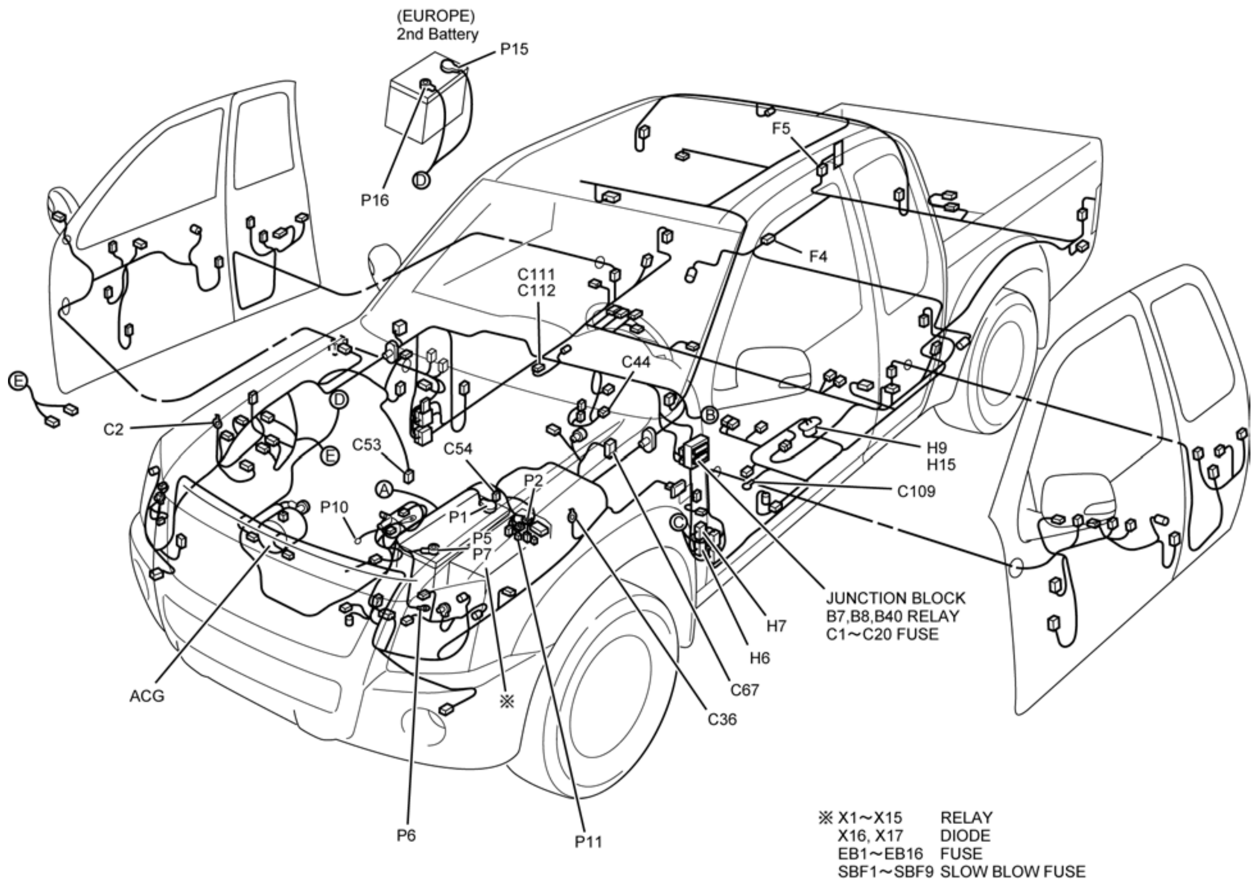
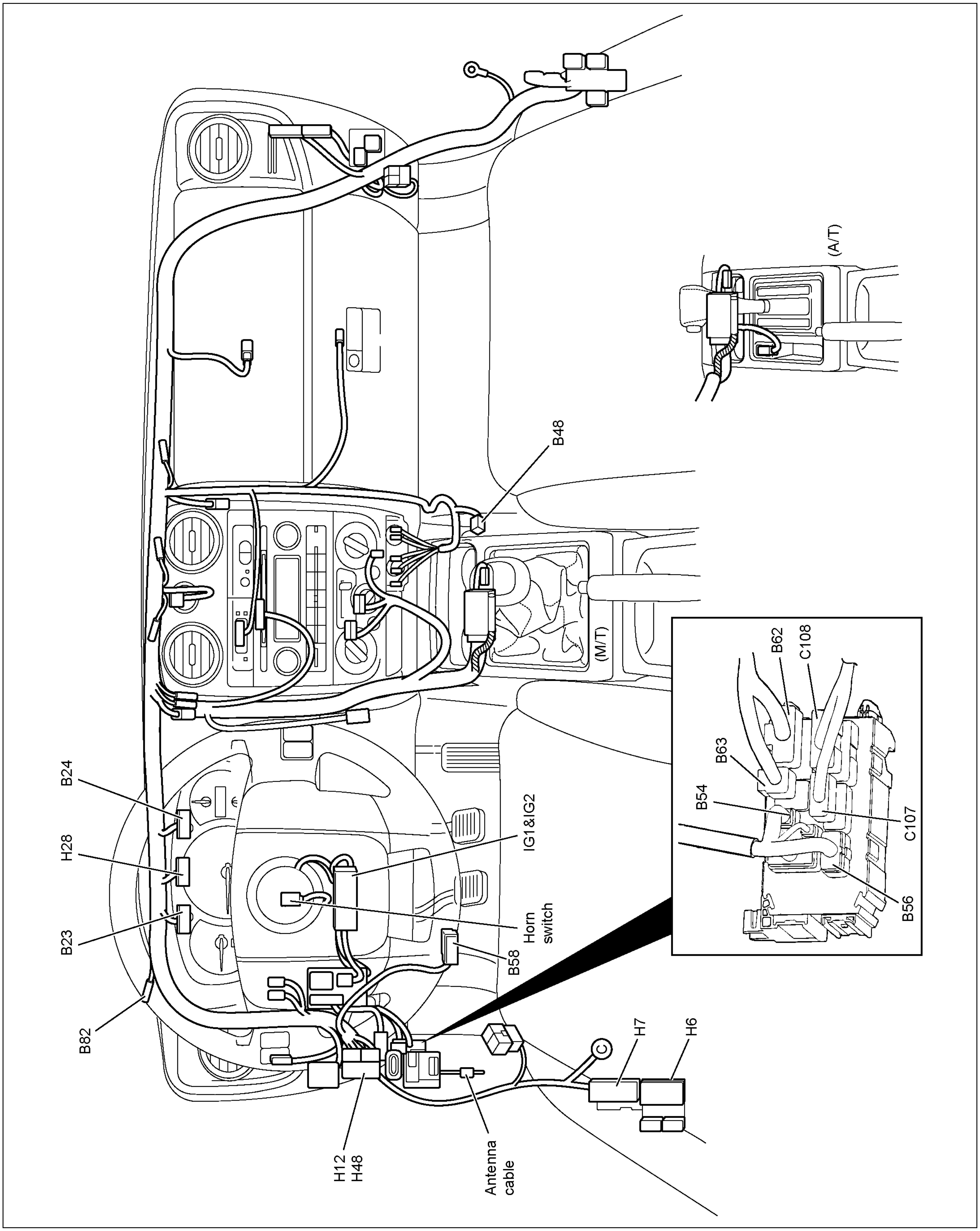


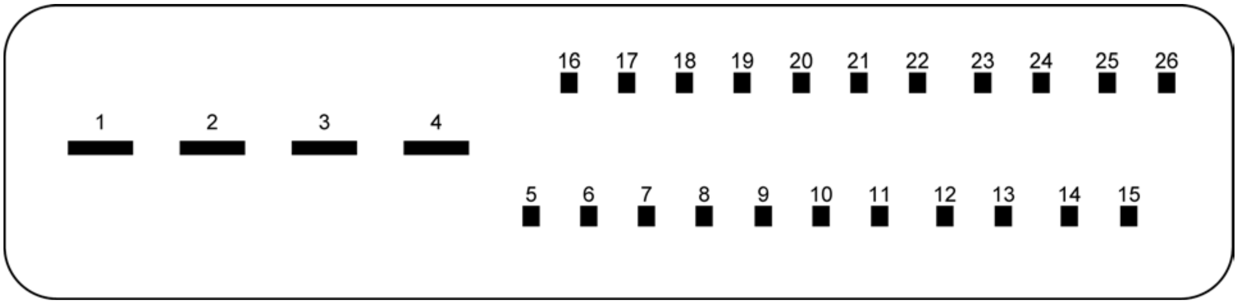
RTW78AXF050701

Parts Location (LHD) (2)



RTW78AXF047001

EHCU Pin-Assignment



RTW75ASF000101

EHCU Side Pin No.	Pin Function	Wire Color	Typical Value	Note
1	Ground 1	BLK	0V (Less than 0.1V)	Motor
2	Power Supply	WHT/RED	Battery Voltage	Motor
3	Power Supply	WHT/GRN	Battery Voltage	Solenoid
4	Ground 2	BLK	0V (Less than 0.1V)	Solenoid, Control Unit
5	Front Left Wheel Speed Sensor (-)	WHT	High Level: 0.8~1.3V Low Level: 0.4~0.7V	DTC C0225, C0226
6	Rear Left Wheel Speed Sensor (+)	WHT/BLU	12±1.5V	DTC C0235, C0236
7	Rear Right Wheel Speed Sensor (+)	ORN	12±1.5V	DTC C0231, C0232
8	Rear Right Wheel Speed Sensor (-)	BLK	High Level: 0.8~1.3V Low Level: 0.4~0.7V	DTC C0231, C0232
9	Front Right Wheel Speed Sensor (+)	BRN	12±1.5V	DTC C0221, C0222
10	Front Right Wheel Speed Sensor (-)	LT GRN/BLK	High Level: 0.8~1.3V Low Level: 0.4~0.7V	DTC C0221, C0222
11	Serial	VIO/GRN	-	Keyword 2000
12	EBD (Brake) Warning Lamp	LT BLU	More than 10V	-
13	Not Used	-	-	-
14	G Sensor Ground	YEL/GRN	0V (Less than 0.1V)	4WD Only DTC C0276, C0285
15	Not Used	-	-	-
16	Front Left Wheel Speed Sensor (+)	RED	12±1.5V	DTC C0225, C0226
17	Rear Left Wheel Speed Sensor (-)	WHT/BLU	High Level: 0.8~1.3V Low Level: 0.4~0.7V	DTC C0235, C0236
18	Starter Switch ON (Power Supply and Switch Position)	BLU/WHT	Battery Voltage	Control Unit DTC C0277, C0278
19	Not Used	-	-	-

EHCU Side Pin No.	Pin Function	Wire Color	Typical Value	Note
20	Stop Light Switch	RED	Open: 0V Close: Battery Voltage	Close Condition: Step on the Brake Pedal
21	G Sensor Signal	YEL/BLK	2.0~3.0V (MAX 4.0V, MIN 1.0V)	4WD Only It checks in a flat place (0G: 2.5V) DTC C0276, C0285
22	ABS Warning Lamp	YEL	More than 10V	-
23	Not Used	-	-	-
24	Transfer (2-4WD Control Unit)	GRY	Pulse Signal (High 4.5V, Low 1.5V)	4WD Only DTC C0282
25	Serial	ORN/WHT	-	Short to GND: Flash out DTCs
26	Not Used	-	-	-

System Components

Electronic Hydraulic Control Unit (EHCU), four Wheel Speed Sensors, two Warning Lamps, and G sensor.

Electronic Hydraulic Control Unit (EHCU)

The EHCU consists of ABS control circuits, fault detector, and a fail-safe. It drives the EHCU according to the signal from each sensor, cancelling ABS to return to normal braking when a malfunction has occurred in the ABS.

The EHCU has a self-diagnosing function which can indicate faulty circuits during diagnosis.

The EHCU is mounted on the engine compartment rear left side. It consists of a motor, solenoid valves and a fail safe relay.

Solenoid Valves: Reduces or holds the caliper fluid pressure for each front brake or both rear brakes according to the signal sent from the EHCU.

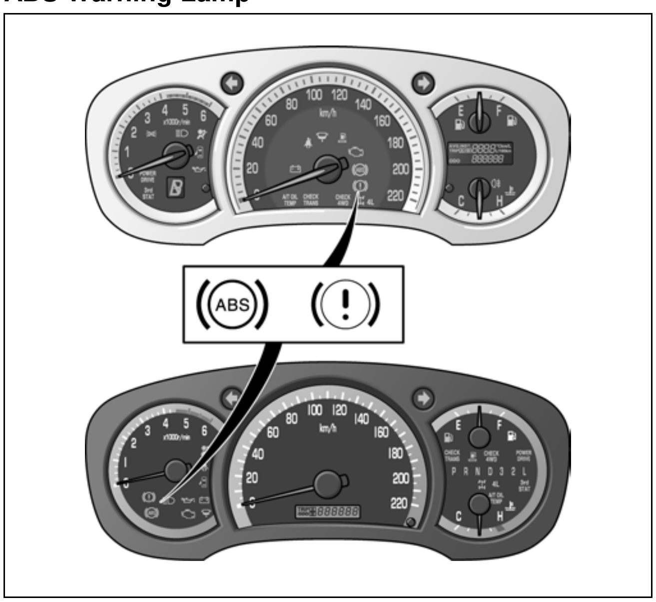
Buffer chamber: Temporarily holds the brake fluid that returns from the front and rear brake so that pressure of front brake can be reduced smoothly.

Motor: Drives the pump according to the signal from EHCU.

Fail safe Relay: When failure occurs in ABS.

The power supply to solenoid Valve is cut.

ABS Warning Lamp



RTW75ASH000101

Vehicles equipped with the Anti-lock Brake System have an amber “ABS” warning lamp on the instrument panel. The “ABS” warning lamp will illuminate if a malfunction in the Anti-lock Brake System is detected by the Electronic Hydraulic Control Unit (EHCU). In the case of an electronic malfunction, the EHCU will turn “ON” the “ABS” warning lamp and disable the anti-lock braking function.

The “ABS” warning lamp will turn “ON” for approximately three seconds after the ignition switch is in the “ON” position.

If the “ABS” warning lamp stays “ON” after the ignition switch is in the “ON” position, or comes “ON” and stays “ON” while driving, the Anti-lock Brake System should be inspected for a malfunction according to the diagnostic procedure.

Wheel Speed Sensor (WSS)

It consists of a sensor and a rotor. The sensor is attached to the knuckle on the front wheels and to the rear wheels.

The rotor is press-fit in the axle shaft.

G Sensor

The G sensor detects the vehicle deceleration speed and sends a signal to the EHCU. In 4WD operation, all four wheels may be decelerated in almost the same phase, since all wheels are connected mechanically.

This tendency is noticeable, particularly on roads with low friction coefficient, and the ABS control is adversely affected.

The G sensor judges whether the friction coefficient of the road surface is low or high, and changes the EHCU's operating system to ensure ABS and EBD control.

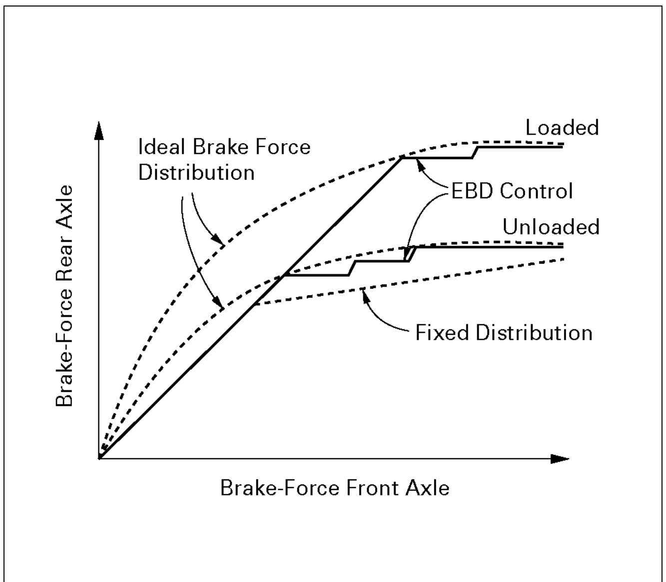
Normal and Anti-lock Braking

Under normal driving conditions, the Anti-lock Brake System functions the same as a standard power assisted brake system. However, with the detection of wheel lock-up, a slight bump or kick-back will be felt in the brake pedal. This pedal “bump” will be followed by a series of short pedal pulsations which occurs in rapid succession. The brake pedal pulsation will continue until there is no longer a need for the anti-lock function or until the vehicle is stopped. A slight ticking or popping noise may be heard during brake applications when the anti-lock feature is being used.

When the anti-lock feature is being used, the brake pedal may rise even as the brakes are being applied. This is also normal. Maintaining a constant force on the pedal will provide the shortest stopping distance.

Electronic Brake-force Distribution (EBD) System

ABS has the EBD function. EBD is a function which controls braking force distribution of a front wheel and a rear wheel, and makes brake fluid pressure of a rear wheel the optimal. If the rate of slip of a rear wheel becomes greater compared to a front wheel, the brake fluid pressure of a rear wheel will be controlled in order to perform braking force distribution between the front and rear wheels. EBD enables the braking power of a rear wheel to always be utilized for the maximum according to the load change concerning the back axis according to the vehicle's loading state (No luggage, loading, etc.), deceleration, etc. Brake fluid pressure control to a rear wheel is performed by the EBD function which uses the ABS function without the mechanical proportioning valve.



C05L300016

Brake Pedal Travel

Vehicles equipped with the Anti-lock Brake System may be stopped by applying normal force to the brake pedal. Although there is no need to push the pedal beyond the point where it stops or holds the vehicle, by applying more force the pedal will continue to travel toward the floor.

This extra brake pedal travel is normal.

Acronyms and Abbreviations

Several acronyms and abbreviations are commonly used throughout this section:

ABS

Anti-lock Brake System

CKT

Circuit

DLC

Data Link Connector

EBD

Electronic Brake-force Distribution

EHCU

Electronic Hydraulic Control Unit

FL

Front Left

FR

Front Right

GEN

Generator

H/U

Hydraulic Unit

MV

Millivolts

RR

Rear

RPS

Revolutions per Second

VDC

DC Volts

VAC

AC Volts

W/L

Warning Lamp

WSS

Wheel Speed Sensor

General Diagnosis

General Information

ABS problems can be classified into two types, those which can be detected by the ABS warning lamp and those which can be detected as a vehicle abnormality by the driver.

In either case, locate the fault in accordance with the "BASIC DIAGNOSTIC FLOWCHART" and repair.

Please refer to Section 5C for the diagnosis of mechanical troubles such as brake noise, brake judder (brake pedal or vehicle vibration felt when braking), uneven braking, and parking brake trouble.

ABS Service Precautions

Required Tools and Items:

- Box Wrench
- Brake Fluid
- Special Tool

Some diagnosis procedures in this section require the installation of a special tool.

5-8840-0366-0 High Impedance Multimeter

When circuit measurements are requested, use a circuit tester with high impedance.

Computer System Service Precautions

The Anti-lock Brake System and Electronic Brake-force Distribution interfaces directly with the Electronic Hydraulic Control Unit (EHCU) which is a control computer that is similar in some regards to the Engine Control Module. These modules are designed to withstand normal current draws associated with vehicle operation. However, care must be taken to avoid overloading any of the EHCU circuits. In testing for opens or shorts, do not ground or apply voltage to any of the circuits unless instructed to do so by the appropriate diagnostic procedure. These circuits should only be tested with a high impedance multimeter 5-8840-0366-0 or special tools as described in this section. Power should never be removed or applied to any control module with the ignition in the “ON” position.

Before removing or connecting battery cables, fuses or connectors, always turn the ignition switch to the “OFF” position.

General Service Precautions

The following are general precautions which should be observed when servicing and diagnosing the Anti-lock Brake System and/or other vehicle systems. Failure to observe these precautions may result in Anti-lock Brake System and Electronic Brake-force Distribution damage.

- If welding work is to be performed on the vehicle using an electric arc welder, the EHCU and valve block connectors should be disconnected before the welding operation begins.
- The EHCU and valve block connectors should never be connected or disconnected with the ignition “ON”.

Note:

- If only rear wheels are rotated using jacks or drum tester, the system will diagnose a speed sensor malfunction and the “ABS and Brake” warning lamp will illuminate. But actually no trouble exists. When the DTC is not detected and the ABS and BRAKE warning lamp is on, “How to erase code” is performed and an ABS and BRAKE warning lamp are off.

If the battery has been discharged

The engine may stall if the battery has been completely discharged and the engine is started via jumper cables. This is because the Anti-lock Brake System (ABS) and Electronic Brake-force Distribution (EBD) System requires a large quantity of electricity. In this case, wait until the battery is recharged, or set the ABS and EBD to a non-operative state by removing the fuse for the ABS. After the battery has been recharged, stop the engine and install the ABS fuse. Start the engine again, and confirm that the ABS warning Lamp does not light.

Note on Intermittents

As with virtually any electronic system, it is difficult to identify an intermittent failure. In such a case duplicating the system malfunction during a test drive or a good description of vehicle behavior from the customer may be helpful in locating a “most likely” failed component or circuit. The symptom diagnosis chart may also be useful in isolating the failure. Most intermittent problems are caused by faulty electrical connections or wiring. When an intermittent failure is encountered, check suspect circuits for:

- Suspected harness damage.
- Poor mating of connector halves or terminals not fully seated in the connector body (backed out).
- Improperly formed or damaged terminals.

Test Driving ABS Complaint Vehicles

If there has been an abnormality in the lighting pattern of the “ABS” warning lamp, the fault can be located in accordance with the “DIAGNOSIS BY “ABS” WARNING LAMP ILLUMINATION PATTERN”. Although such problems can be detected by the driver as a vehicle symptom, it is still necessary to perform a test drive following the test procedure mentioned below, in order to reproduce the symptom for problem diagnosis on a symptom basis:

1. Start the engine and make sure that the “ABS” W/L goes OFF. If the W/L remains ON, it means that the Diagnostic Trouble Code (DTC) is stored. Therefore, read the code and locate the fault.

Note: The DTC cannot be cleared if the vehicle speed does not exceed about 10km/h (6mph) at DTC, even though the repair operation is completed.

2. Start the vehicle and accelerate to about 30 km/h (19 mph) or more.
3. Slowly brake and stop the vehicle completely.
4. Then restart the vehicle and accelerate to about 40 km/h (25 mph) or more.
5. Brake at a time so as to actuate the ABS and stop the vehicle.
6. Be cautious of abnormality during the test. If the W/L is actuated while driving, read the DTC and locate the fault.
7. If the abnormality is not reproduced by the test, make best efforts to reproduce the situation reported by the customer.
8. If the abnormality has been detected, repair in accordance with the “SYMPTOM DIAGNOSIS”.

Note:

- Be sure to perform a test drive on a wide, even road with light traffic.
- If an abnormality is detected, be sure to suspend the test and start trouble diagnosis at once.

"ABS" Warning Lamp

When ABS and problems occur that actuate the "ABS" warning lamp, the code corresponding to the problem is stored in the EHCU. Only ordinary braking is available when the ABS is deactivated. Even when the "ABS" warning lamp is actuated, if the starter switch is set ON after setting it OFF once, the EHCU checks up on the entire system. If there is no abnormality, the EHCU judges ABS to work correctly and the warning lamp is lit normally, even though the problem code is stored.

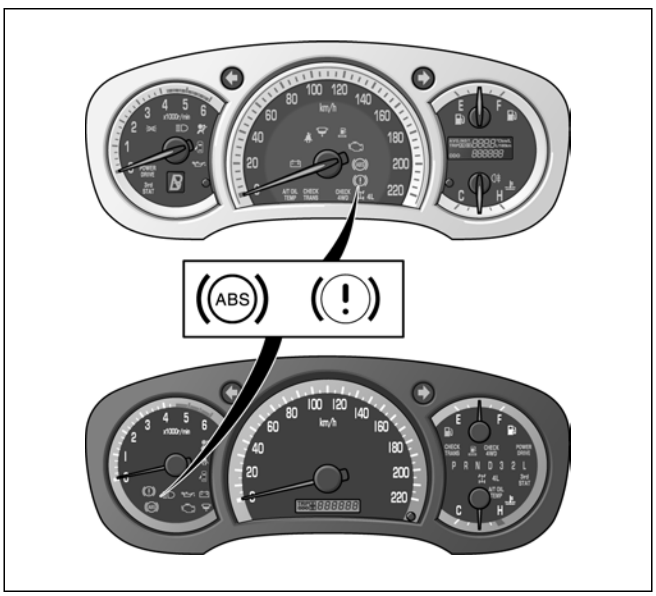
NOTE: Illumination of the "ABS" warning lamp indicates that anti-lock braking is no longer available. Power assisted braking without anti-lock control is still available.

Normal Operation

"ABS " Warning Lamp

When the ignition is first moved from "OFF" to "RUN", the amber "ABS" warning lamp will turn "ON". The "ABS" warning lamp will turn "ON" during engine starting and will usually stay "ON" for approximately three seconds after the ignition switch is returned to the "ON" position. The warning lamp should remain "OFF" at all other times.

Brake (EBD) Warning Lamp



RTW75ASH000101

Vehicles equipped with the EBD (Electronic Brake-force Distribution) System have a "Brake" warning lamp on the instrument panel.

If the ABS warning lamp and Brake warning lamp are turned "ON", then EBD has failed. (Parking brake switch is "OFF")

In the following conditions, the EBD warning lamp is "ON".

- Starter switch is "ON", engine "OFF".
  (Parking brake switch is "OFF")

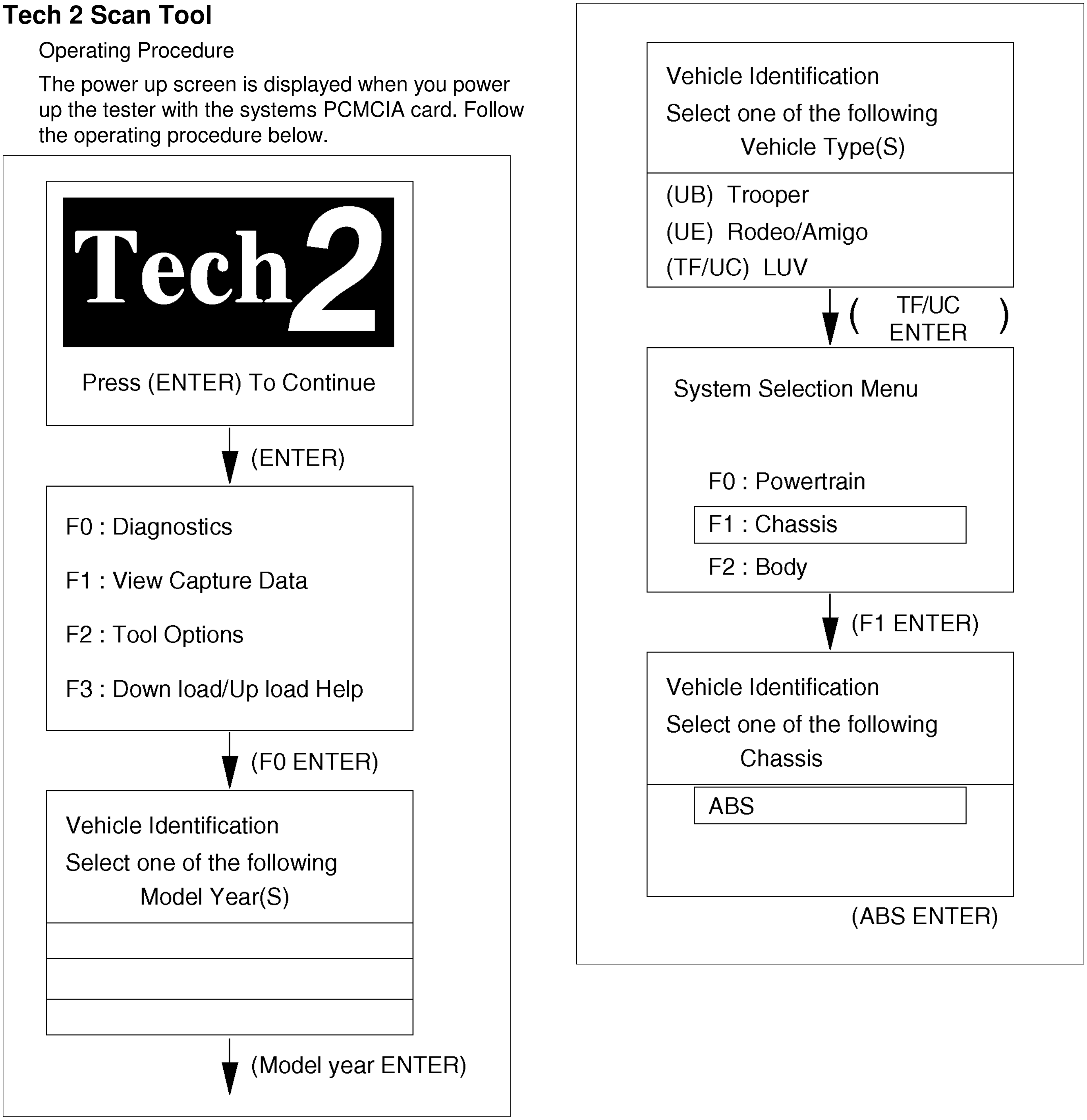
If engine is started, then EBD warning lamp is "OFF".
(Parking brake switch is "OFF")

BACK TO CHAPTER INDEX

Tech 2 Scan Tool

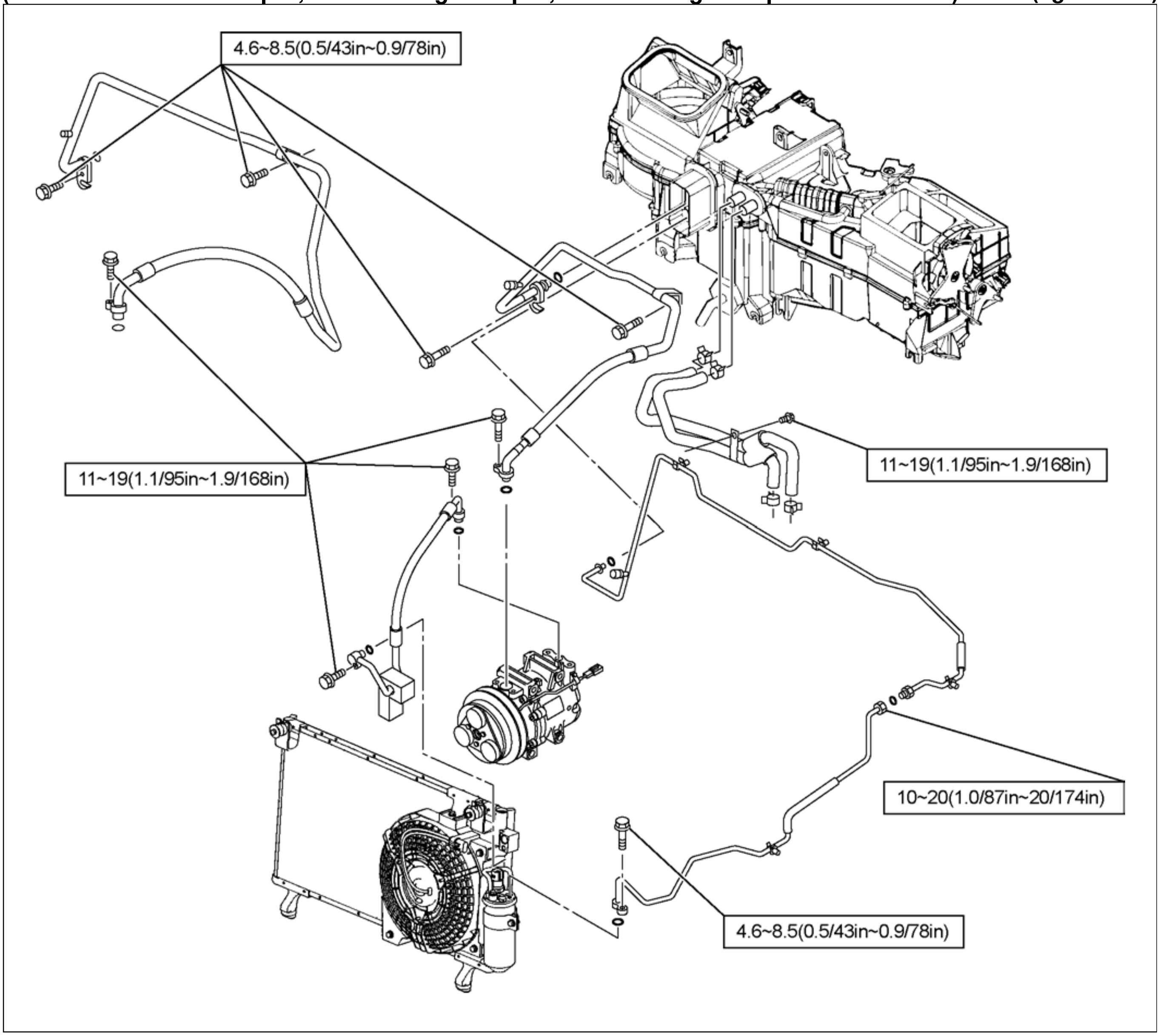
Operating Procedure

The power up screen is displayed when you power up the tester with the systems PCMCIA card. Follow the operating procedure below.



060R100102

(4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output LHD MODEL) **N·m (kgf·m/lb·in)**



RTW710LF003701

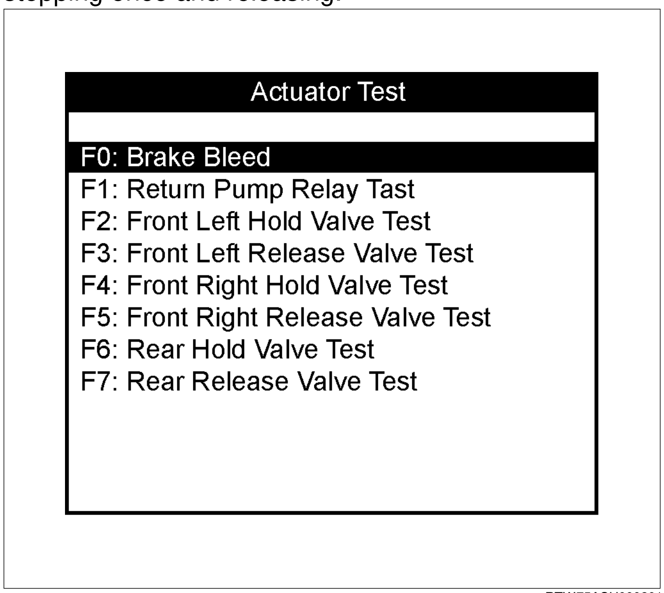
Actuator Test

There are 8 different menus available for this test.

The state of each circuit can be tested by using these menus. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing each circuit by means of these menus.

Even when DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical fault and an electrical fault.

In all cases test condition; Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.



RTW75ASH000201

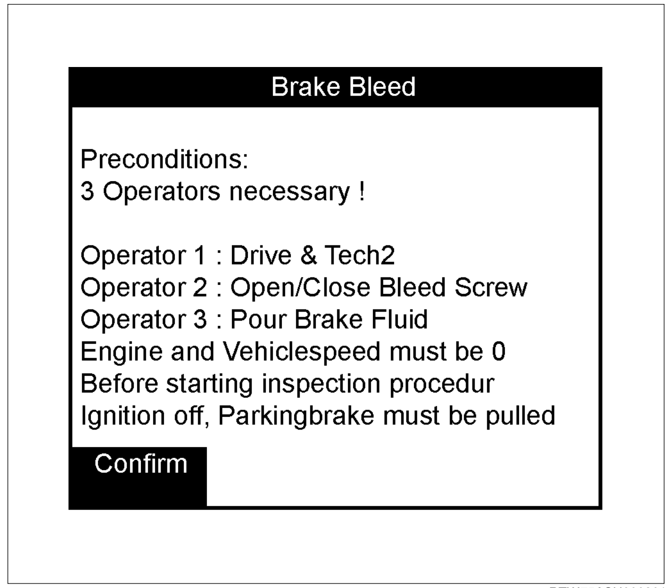
Brake Bleed

Purpose: The purpose of this command is air bleeding of brakes line.

Using the Tech 2 at following operation.

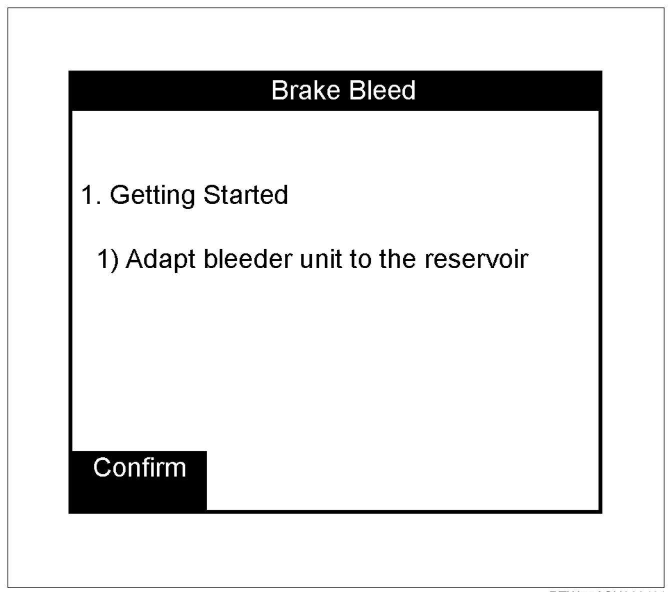
Air Bleeding procedure:

1. Connect the Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Brake Bleed" menu from the "Actuator Test" menus.



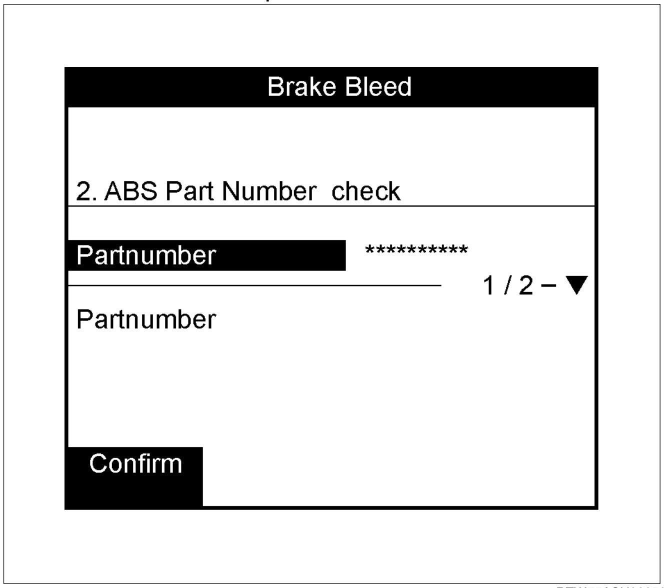
RTW75ASH000301

3. According to indication of Tech 2 press the "Confirm".



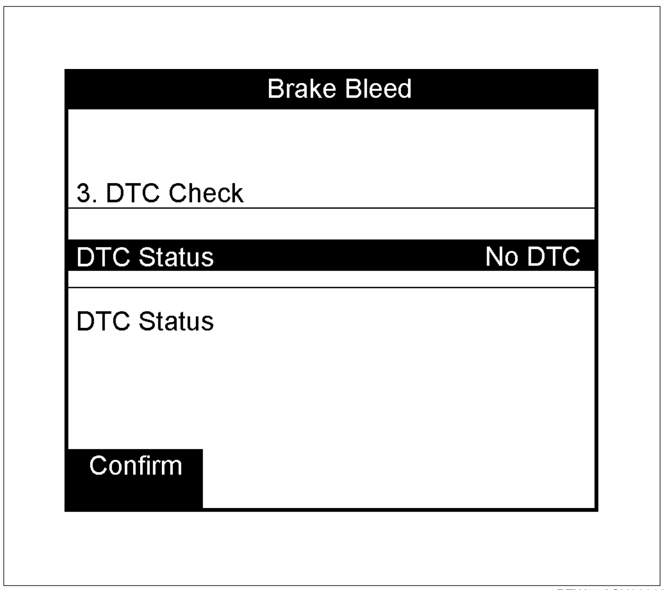
RTW75ASH000401

4. Check the EHCU part number. Press the "Confirm".



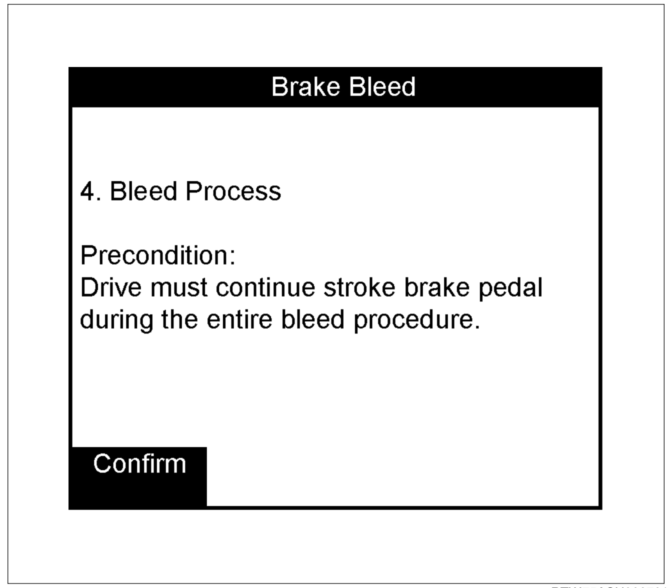
RTW75ASH000501

5. Check a DTC is not detected. Press the "Confirm".



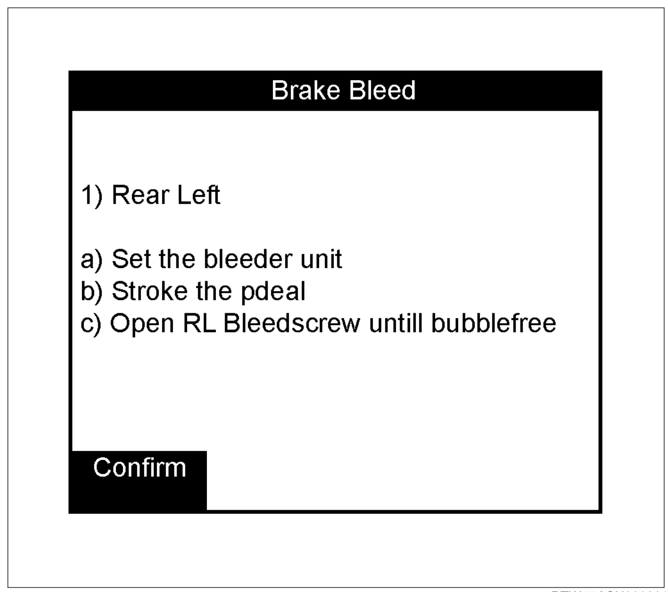
RTW75ASH000601

6. According to indication of Tech 2 press the "Confirm".



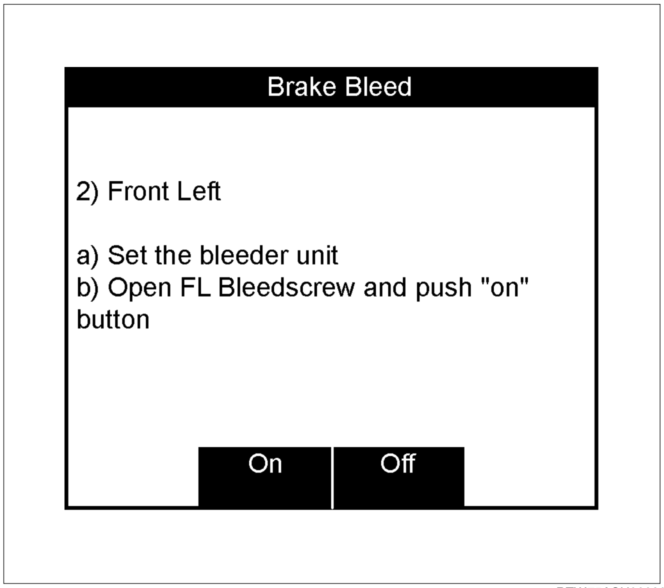
RTW75ASH000701

7. According to indication of Tech 2 press the "Confirm".



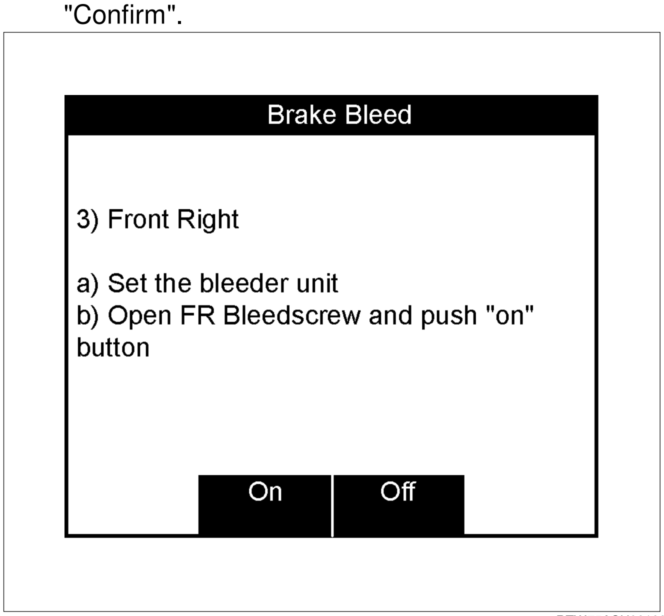
RTW75ASH000801

8. According to indication of Tech 2 press the "Confirm".



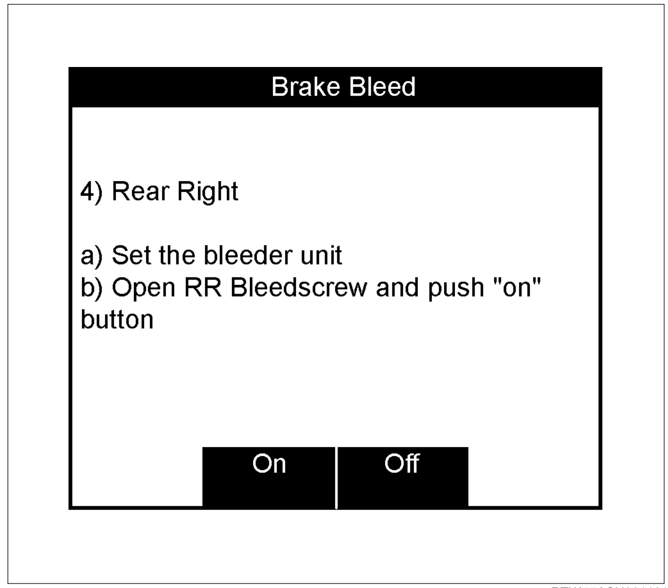
RTW75ASH000901

9. According to indication of Tech 2 press the "Confirm".



RTW75ASH001001

10. According to indication of Tech 2 press the "Confirm".



RTW75ASH001101

Return Pump Relay Test

Test condition: Engine stops with the key turned to the "ON" position. To be more specific, the test is conducted with the brake pedal stepped on after stepping once and releasing.

Test Procedure:

1. Connect the Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a " Return Pump Relay Test " menu from the "Actuator Test" menus.

The circuit is normal if the pump motor is operated in accordance with Tech 2 instruction.

Front Left Hold Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Front Left Hold Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.

4. Release the brake pedal.
5. Make sure that the front left hold solenoid valve "ON" aimed at by Tech 2 and the wheel locked position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Front Left Release Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Front Left Release Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.
4. Make sure that the front left release solenoid valve "ON" aimed at by Tech 2 and the wheel released position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Front Right Hold Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Front Right Hold Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.
4. Release the brake pedal.
5. Make sure that the front right hold solenoid valve "ON" aimed at by Tech 2 and the wheel locked position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Front Right Release Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Front Right Release Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.
4. Make sure that the front right release solenoid valve "ON" aimed at by Tech 2 and the wheel released position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Rear Hold Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.

2. Select a "Rear Hold Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.
4. Release the brake pedal.
5. Make sure that the rear hold solenoid valve "ON" aimed at by Tech 2 and the wheel locked position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Rear Release Valve Test

Purpose: The purpose of this test is to detect brake pipe and valve line harness wire for incorrect connections and valve problem.

This test will help you confirm the result of your repair service including the removal/ reinstallation of brake pipe, valve line harness and valve.

Test conditions: The ignition key is in the "ON" position with the four wheels lifted up. The brake pedal is stepped on, released and stepped on again with the parking brake released.

Test Procedure:

1. Connect Tech 2 with the vehicle, and select "Actuator Test" menus.
2. Select a "Rear Release Valve Test" menu from the "Actuator Test" menus.
3. Step on the brake pedal.
4. Make sure that the rear release solenoid valve "ON" aimed at by Tech 2 and the wheel released position are the same.

If different, check brake pipe, valve line harness wiring and hydraulic unit. Repair is needed if abnormality is found.

Data List (Tech 2)

The data displayed by DATA LIST are as follows:

Strings	Units	Description
FL Wheel Speed (Front Left)	Km/h (MPH)	Start the vehicle and make sure of linear change in each wheel speed.
FR Wheel Speed (Front Right)	Km/h (MPH)	
RL Wheel Speed (Rear Left)	Km/h (MPH)	
RR Wheel Speed (Rear Right)	Km/h (MPH)	
Brake Switch	On/Off	Brake switch is “On” when brake pedal is stepped on.
4 Wheel Drive Status	2 Wheel Drive/ 4 Wheel Drive	
ABS Warning lamp	On/Off	To be “Off” usually
EBD Warning Lamp	On/Off	To be “Off” usually
ABS State	On/Off	To be “Off” usually
Valve Relay Command	Active/Inactive	To be “Active” usually
Return Pump Relay Command	Active/Inactive	To be “Inactive” usually
EBD State		
DTC Status	No DTC/ DTCs Set	To be “No DTC” usually
FL Release Solenoid Commanded (Front Left)	Active/Inactive	Each valve is “Active” when each valve is operated.
FL Hold Solenoid Commanded (Front Left)	Active/Inactive	
FR Release Solenoid Commanded (Front Right)	Active/Inactive	
FR Hold Solenoid Commanded (Front Right)	Active/Inactive	
Rear Release Solenoid Valve Commanded	Active/Inactive	
Rear Hold Solenoid Valve Commanded	Active/Inactive	
FL Release Solenoid Feedback (Front Left)	Active/Inactive	
FL Hold Solenoid Feedback (Front Left)	Active/Inactive	
FR Release Solenoid Feedback (Front Left)	Active/Inactive	
FR Hold Solenoid Feedback (Front Left)	Active/Inactive	
Rear Release Solenoid Feedback	Active/Inactive	
Rear Hold Solenoid Valve Feedback	Active/Inactive	
Deceleration Sensor	V	2.0~3.0V when vehicle speed is 0km/h (flat place)
Battery Voltage	V	The voltage value currently supplied to EHCU

Diagnostic Trouble Codes

Choose and trace an appropriate flowchart by the numbers listed below to find the fault and repair.

Note:
A DTC cannot be erased when the DTC is present.

DTC (Flash Code)	Description	Warning Lamp		System Control		Main Items
		ABS	Brake (EBD)	ABS	EBD	
- (12)	Normal Condition	×	×	○	○	-
C0221 (21)	Front Right Wheel Speed Sensor Short Circuit or Circuit Open	○	×*A	×	○	Sensor or Wiring
C0222 (22)	Front Right Wheel Speed Sensor Signal Malfunction	○*B	×*A	×	○	Sensor or install condition
C0225 (25)	Front Left Wheel Speed Sensor Short Circuit or Circuit Open	○	×*A	×	○	Sensor or Wiring
C0226 (26)	Front Left Wheel Speed Sensor Signal Malfunction	○*B	×*A	×	○	Sensor or install condition
C0231 (31)	Rear Right Wheel Speed Sensor Short Circuit or Circuit Open	○	×*A	×	○	Sensor or Wiring
C0232 (32)	Rear Right Wheel Speed Sensor Signal Malfunction	○*B	×*A	×	○	Sensor or install condition
C0235 (35)	Rear Left Wheel Speed Sensor Short Circuit or Circuit Open	○	×*A	×	○	Sensor or Wiring
C0236 (36)	Rear Left Wheel Speed Sensor Signal Malfunction	○*B	×*A	×	○	Sensor or install condition
C0238 (38)	Front Speed Sensor Correlation	○	○	×	×	Vehicle , Sensor or Tire
C0241 (41)	Front Right Hold Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0242 (42)	Front Right Release Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0245 (45)	Front Left Hold Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0246 (46)	Front Left Release Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0251 (51)	Rear Hold Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0252 (52)	Rear Release Solenoid Valve Circuit	○	○	×	×	Solenoid (EHCU)
C0265 (65)	Valve Relay Circuit Malfunction	○	× ○	×	○ ×	Relay (EHCU)
C0267 (67)	Return Pump Circuit Malfunction	○	○	×	○	Motor (EHCU)
C0271 (71)	ECU Malfunction	○	○	×	×	EHCU
C0276 (76)	G Sensor Malfunction	○	×	×	○	Sensor or Wiring

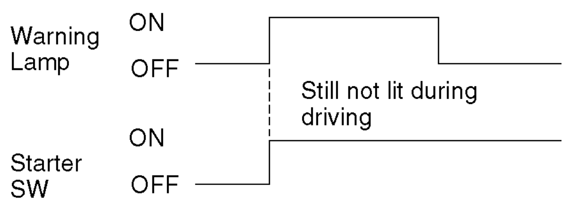
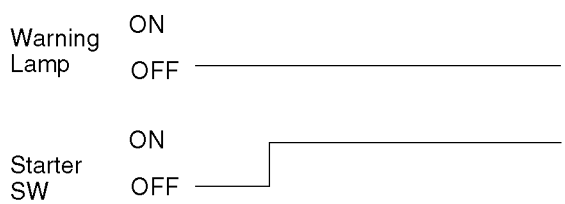
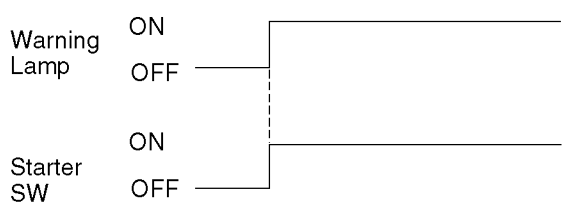
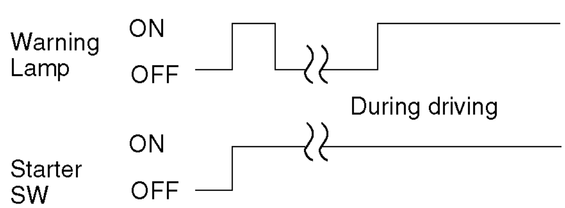
DTC (Flash Code)	Description	Warning Lamp		System Control		Main Items
		ABS	Brake (EBD)	ABS	EBD	
C0277 (77)	System Voltage Low	○	○	×	×	Battery, Wiring or EHCU (less than 8V)
		○	×	×	○	Battery or Wiring (less than 10V)
C0278 (78)	System Voltage High	○	○	×	×	Battery or Wiring EHCU
C0282 (82)	4 Wheel Drive State Input Signal Failure	○	×	×	○	Wiring
C0285 (85)	Control Module Vehicle Options Incorrect	○	×	×	○	Vehicle (Sensor or EHCU)

*A : When three or more failures are detected, the EBD warning lamp is "ON" and control is canceled.

*B : The ABS lamp is “OFF” when the ABS lamp is “ON” after a repair, until the vehicle’s speed becomes more than 10km/h (6mph) in the following ignition cycle and failure is not detected.

Diagnosis By “ABS” Warning Lamp Illumination Pattern

In the event that there is abnormality in the “ABS” Warning Lamp Illumination Pattern while the key is in the “ON” position or if the warning lamp is actuated during driving, the fault should be diagnosed on an illumination pattern basis as follows:

No.	Condition	“ABS” Warning Lamp Illumination Pattern	Diagnostic
1	Warning Lamp is actuated normally		Normal
2	Warning Lamp is not lit		Warning Lamp lighting circuit trouble. Go to No ABS Warning Lamp.
3	Warning Lamp remains ON		Diagnostic trouble codes are stored. Display diagnostic trouble codes and diagnose on a code basis according to the flow charts. If diagnostic trouble codes are not stored, it means warning lamp lighting circuit or meter trouble. Go to ABS warning Lamp On Steady.
4	Warning Lamp is actuated while driving		Diagnostic trouble codes are stored. Display diagnostic trouble codes and diagnose on a code basis according to the flow charts.

Diagnostic Trouble Codes (DTCs)

When the warning lamp in the meter remains ON, the EHCU stores the fault identification and disables the ABS.

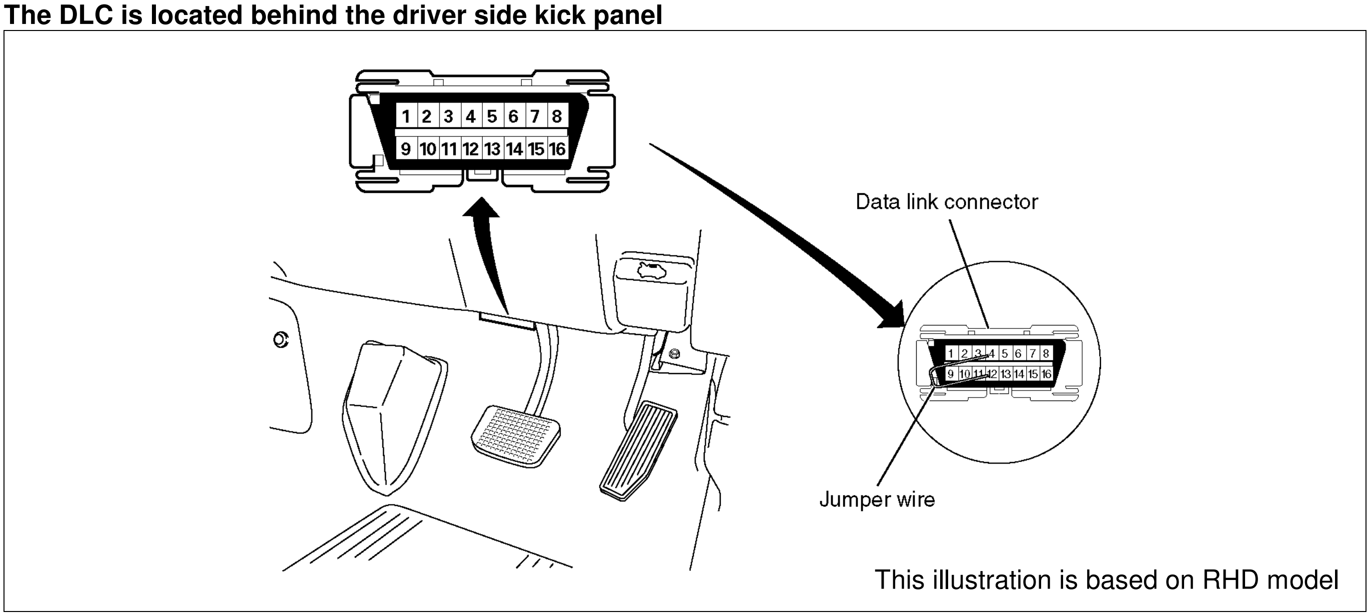
How to display and erase DTCs:

Note:

- DTCs can be displayed also by TECH 2 use "Diagnostic Trouble Codes" mode.

1. How to start DTC display:
   - Confirm that the vehicle has come to a complete stop (with the wheels standing still) and that the brake pedal is not depressed. (Unless these two conditions are satisfied, the DTC display cannot be started.)
   - With IGN OFF, connect #12 terminal with #4 terminal or # 5 terminal (GND) . Then turn IGN ON.

The DLC is located behind the driver side kick panel



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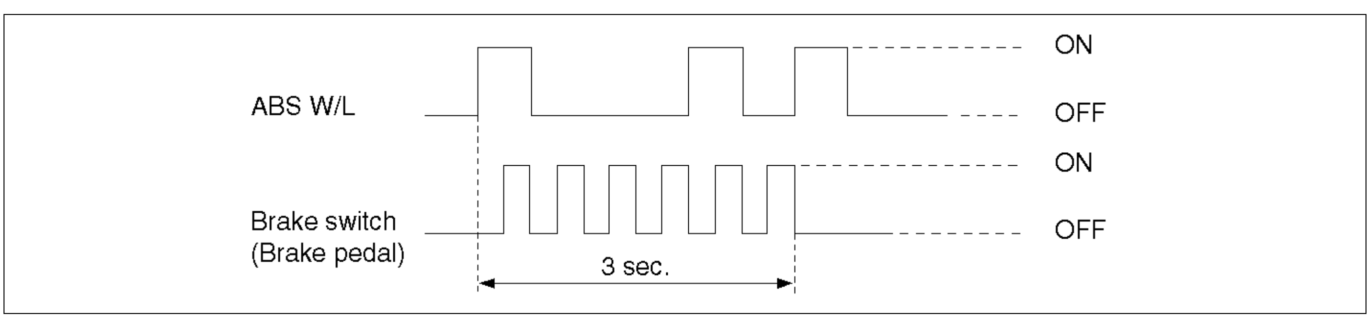
   - Keep #12 terminal connected with #4 terminal or # 5 terminal (GND) during DTC display. (If #12 terminal is separated from #4 terminal or # 5 terminal (GND) during display, display will stop.)
2. DTC display:
   - DTC is displayed by blinking warning lamp.
   - Double-digit display.
   - First, normal DTC 12 is displayed three times and then any other DTCs are displayed three times. (If no other DTCs have been stored, the display of DTC 12 will be repeated.)
3. How to erase code:
   - Conduct brake switch ON/OFF operation 6 or more times within 3 seconds of self-diagnosis startup.
   - The code cannot be erased if more than 3 seconds have passed since self-diagnosis startup, or if self-diagnosis has started with brake switched on (brake pedal depressed).



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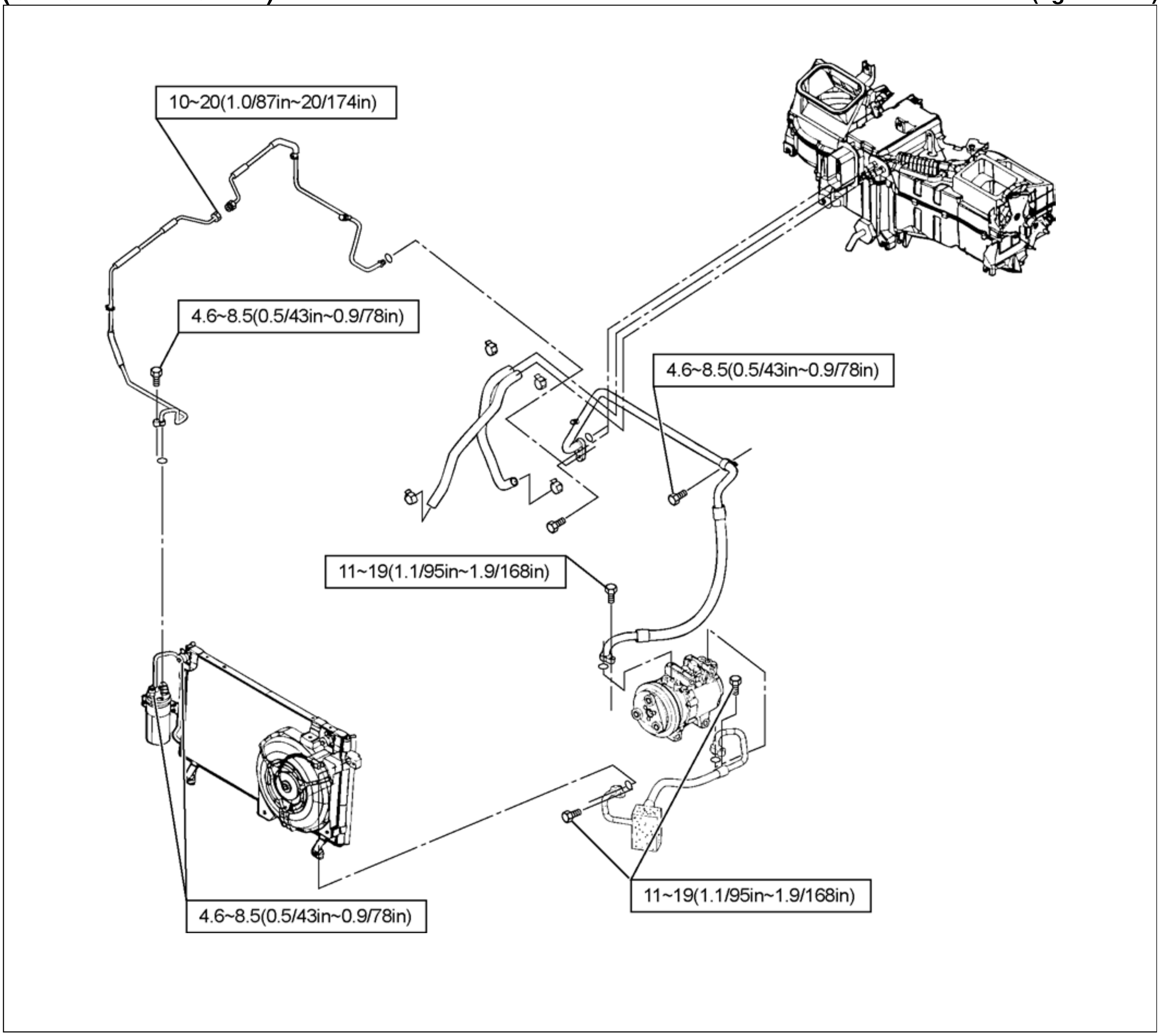
(C24SE LHD MODEL)

N·m (kgf·m/lb·in)



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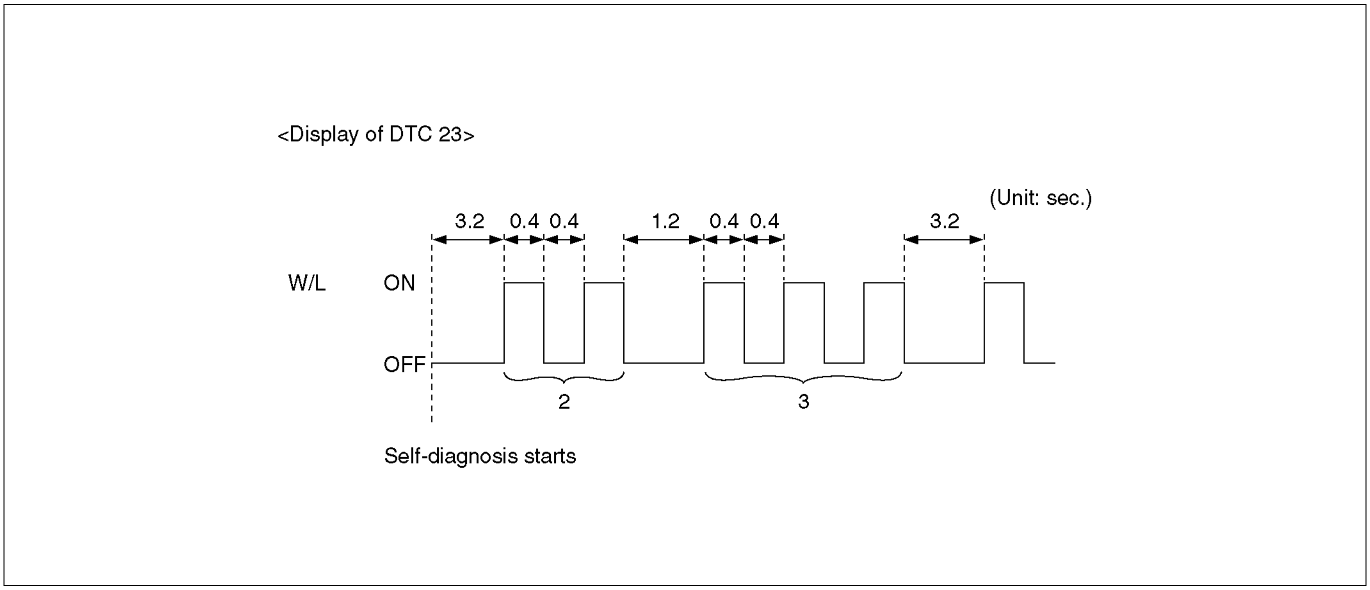
4. Notes
- If the following should occur during Diagnostic Trouble Code (DTC) display, the display will be discontinued. After initial check, the status that is under the control of ABS will be returned :
  – The vehicle starts (The wheels turn) or the brake pedal is depressed.
- Up to 3 different codes can be stored.
- If the ABS should turn OFF due to an intermittent defect, the system will be restored at the next key cycle, if the initial check finds no abnormality (when IGN is switched from OFF to ON).

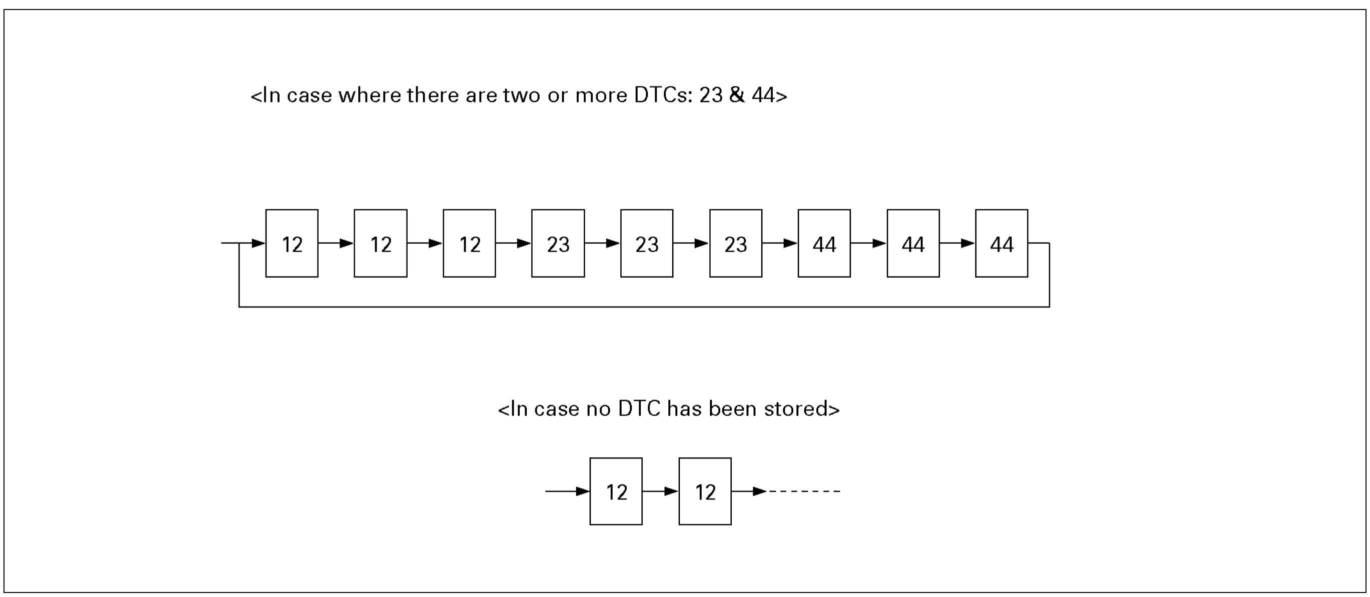
5. An example of DTC display

Display of DTC 23



B05R100001

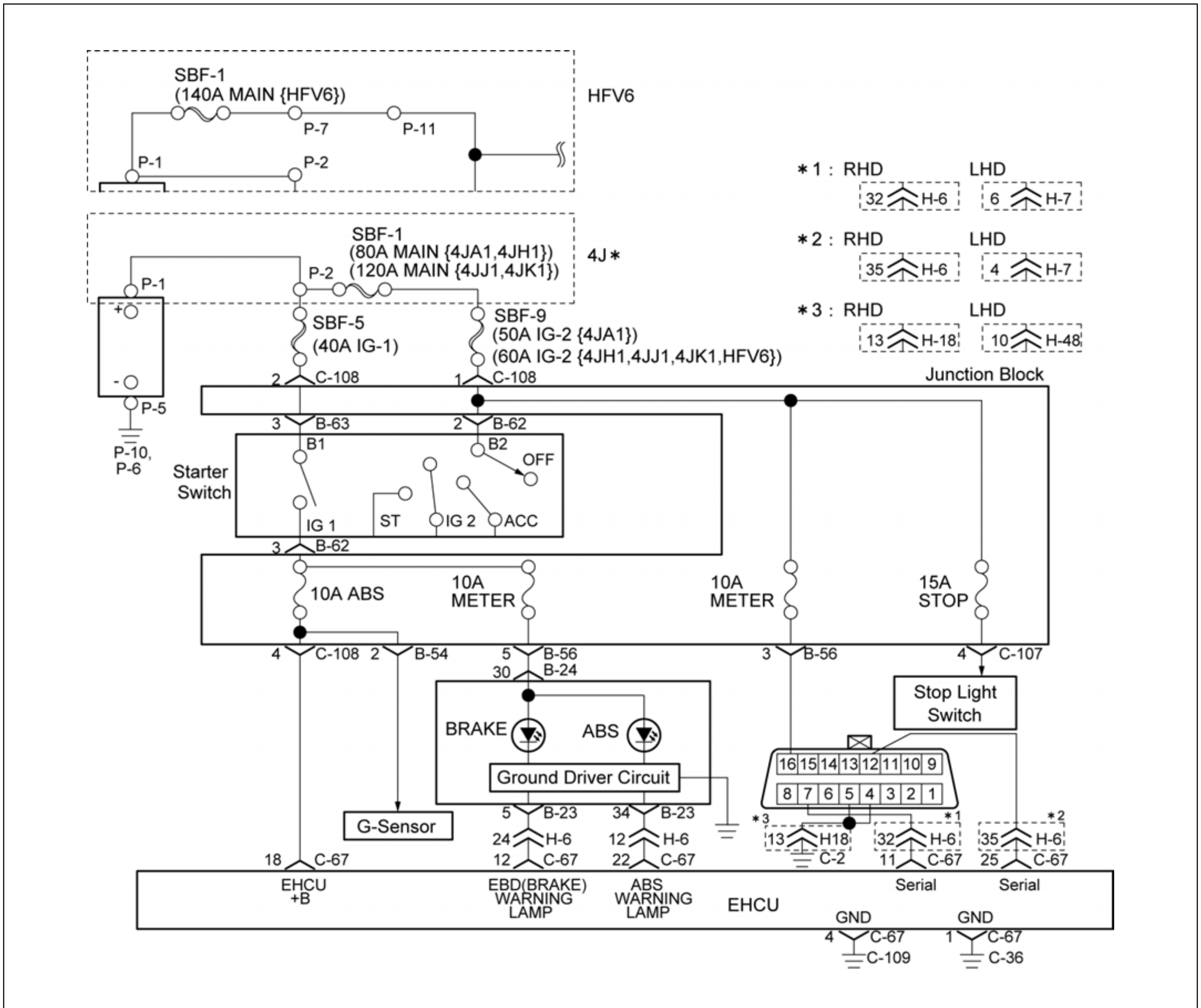
After displaying DTC 12 three times, one DTC after another is displayed. DTC is displayed in numeric order.



C05L300017

The DTC 12 is displayed repeatedly.

Basic Diagnostic Flow Chart



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Step	Action	Value(s)	Yes	No
1	1. Ignition “ON”, engine “OFF”. 2. Observe the ABS warning lamp. Note: If the starter switch is turned ON, the ABS warning lamp will turn on and then turn off after 3 seconds. Is the ABS warning lamp “ON”?	-	Go to Step 2	Go to “No ABS warning lamp”
2	1. Ignition “OFF”. 2. Install Tech 2. 3. Ignition “ON”. 4. Attempt to display ABS data with the Tech 2. Does the Tech 2 display ABS data?	-	Go to Step 5	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Ignition “OFF”, disconnect the EHCU. 2. Check the DLC (Data Link Connector) circuit for an open, short to ground, or short to voltage. Also, check the DLC ignition feed circuit for an open or short to ground and the DLC ground circuit for an open. 3. If a problem is found, repair as necessary. Was a problem found?	-	Go to Step 2	Go to Step 4
4	1. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open. 2. If a problem is found, repair as necessary. Was a problem found?	-	Go to Step 2	Go to Step 11
5	Select “Display DTCs” with the Tech 2. Are any DTCs stored?	-	Go to Step 6	Go to Step 10
6	Review and record for Tech 2 Failure Records data and DTCs. Is the action complete?	-	Go to Step 7	-
7	The DTC is then stored. Is this DTC C0271 stored?	-	Go to applicable DTC table after Go to step 8	Go to Step 8
8	Clear the DTCs by “Clear the Information“ with Tech 2. Did the DTCs clear?	-	Go to Step 9	-
9	Select “Display DTCs” with the Tech 2. Are any DTCs stored?	-	Go to applicable DTC table	Go to Step 10
10	Review and record for Tech 2 data. Is the action complete?	-	Go to Symptom Diagnosis and Go to Basic Inspection Procedure	-
11	Replace the EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification; 2WD Model or 4WD Model) Is the action complete?	-	Verify repair	-

Basic Inspection Procedure

1. Basic Inspection of Service Brake

Step	Action	Value(s)	Yes	No
1	Is the fluid level normal?	-	Go to Step 2	Replenish with fluid Go to Step 2
2	Does fluid leak?	-	Repair Go to Step 3	Go to Step 3
3	Is the booster function normal?	-	Go to Step 4	Repair Go to Step 4
4	Is the pad and rotor normal?	-	Go to Step 5	Repair Go to Step 5
5	Reconnect all components. Ensure all components are properly mounted. Is this step finished?	-	Finished	Go to Step 5

2. Ground Inspection

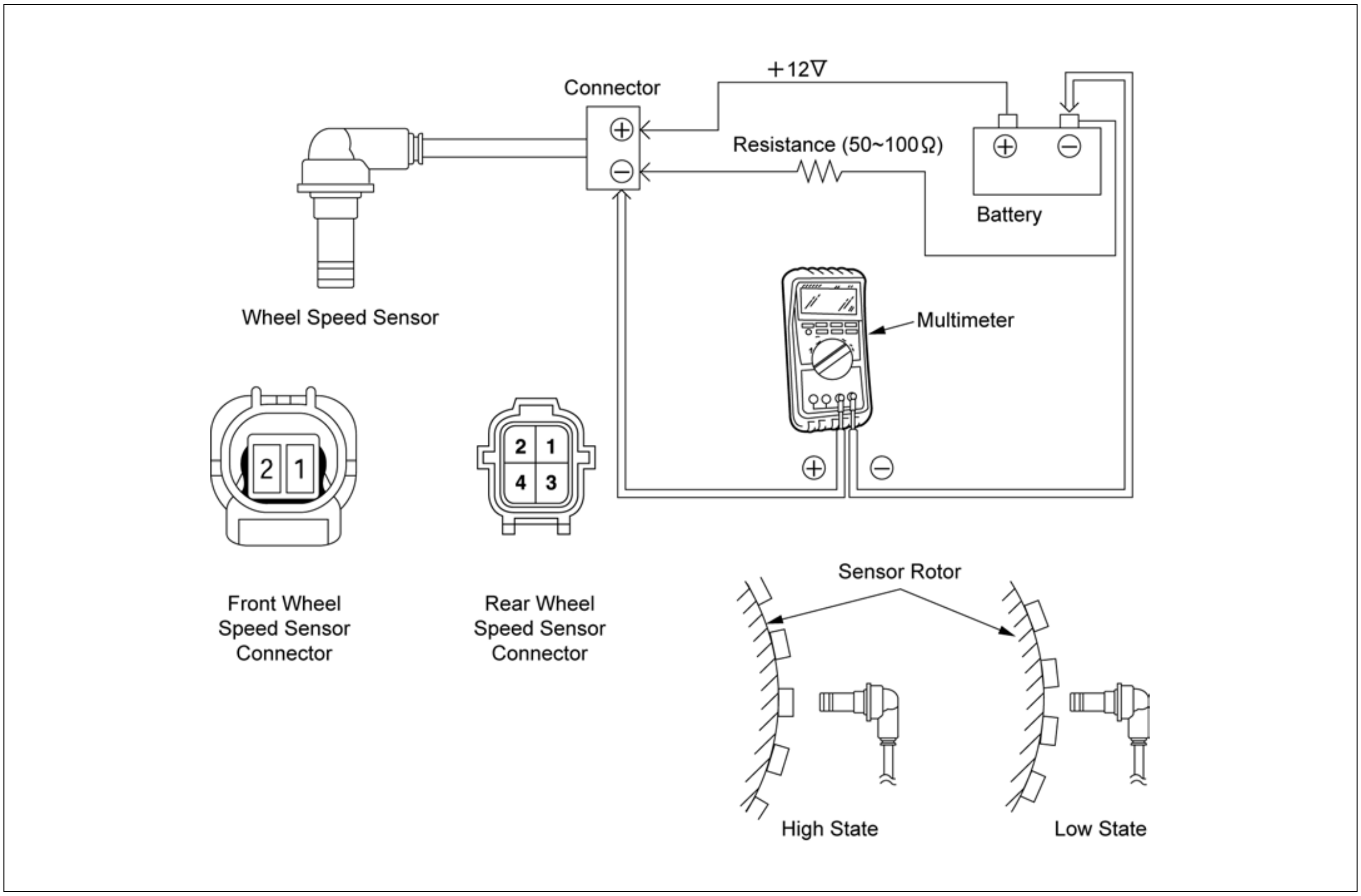
Step	Action	Value(s)	Yes	No
1	Are ABS related ground points normal?	-	Go to Step 2	Repair Go to Step 2
2	Reconnect all components. Ensure all component are properly mounted. Is this step finished?	-	Finished	Go to Step 2

Wheel Speed Sensor Inspection Procedure

Procedure

1. Ignition "OFF".
2. Disconnect each of the wheel speed sensors.
3. Connect the resistance (50Ω~100Ω) as follows.
4. Check the voltage at sensor harness connector.

Note: Voltage measurement is performed in the phase where the wheel speed sensor is installed in vehicles.



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Connector Pin-outs

・Front Wheel Speed Sensor

1	(+) (+12V)
2	(-) (signal)

・Rear Wheel Speed Sensor

1	LH (+) (+12V)
2	LH (-) (signal)
3	RH (+)(+12V)
4	RH (-) (signal)

Output Value

High State	0.7~1.4V (±30%)
Low State	0.4~0.7V (±30%)

Symptom Diagnosis

The symptoms that cannot be indicated by warning lamp can be divided into the following six categories:

1. ABS works frequently but vehicle does not decelerate.
2. Uneven braking occurs while ABS works.
3. The wheels are locked.
4. Brake pedal feel is abnormal.
5. Braking sound (from EHCU) is heard while not braking.
6. No ABS warning lamp

These are all attributable to problems which cannot be detected by EHCU self-diagnosis. Use the customer complaint and a test to determine which symptom is present.

ABS Works Frequently But Vehicle Does Not Decelerate

Step	Action	Value(s)	Yes	No
1	Is braking force distribution normal between front and rear of vehicle?	-	Go to Step 2	Repair brake parts. Go to Step 7
2	Are axle parts installed normally?	-	Go to Step 3	Repair axle parts. Go to Step 7
3	Is there play in each or any wheel speed sensor?	-	Repair wheel speed sensor. Go to Step 7	Go to Step 4
4	Is there damage, or powered iron sticking to each or any wheel speed sensor/sensor rotor?	-	Replace wheel speed sensor or sensor rotor. Go to Step 7	Go to Step 5
5	Is the speed sensor of each wheel output normal?	-	Go to Step 6	Replace wheel speed sensor or repair harness. Go to Step 7
6	Is the 4WD control system function normal?	-	2-4WD Repair or Go to Step 7	Repair or replace 2-4WD control System. Go to Step 7
7	Reconnect all components, ensure all components are properly mounted. Is this step finished?	-	Repeat the “Basic diagnostic flow chart”	Go to Step 7

Uneven Braking Occurs While ABS Works

Step	Action	Value(s)	Yes	No
1	Is there play in each or any sensor?	-	Repair. Go to Step 5	Go to Step 2
2	Damage or powdered iron sticking to each or any sensor/sensor rotor?	-	Repair. Go to Step 5	Go to Step 3
3	Is the output normal for each sensor?	-	Go to Step 4	Replace sensor or repair harness. Go to Step 5
4	Is brake pipe connecting order correct? Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification; 2WD Model or 4WD Model)	-	Replace EHCU. Go to Step 5	Reconnect brake pipe correctly. Go to Step 5
5	Reconnect all components, ensure all components are properly mounted. Is this step finished?	-	Repeat the “Basic diagnostic flow chart”	Go to Step 5

The Wheels Are Locked

Step	Action	Value(s)	Yes	No
1	Is ABS working?	-	Go to Step 2	Go to Step 4
2	Is vehicle speed under 5 km/h?	-	Go to Step 3	Normal.
3	Is the output for each normal?	-	Go to Step 4	Replace sensor or repair harness. Go to Step 6
4	Is 2-4WD system function normal?	-	Go to Step 5	Replace 2-4WD control unit or repair harness. Go to Step 6
5	Is EHCU grounded properly? Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification; 2WD Model or 4WD Model)	-	Replace EHCU. Go to Step 6	Repair. Go to Step 6
6	Reconnect all components, ensure all components are properly mounted. Is this step finished?	-	Repeat the “Basic diagnostic flow chart”	Go to Step 6

Brake Pedal Feed Is Abnormal

Step	Action	Value(s)	Yes	No
1	Is the stop light actuated when the brake pedal is depressed?	-	Go to Step 2	Go to Step 3
2	1. Turn the ignition switch off. 2. Disconnect EHCU connector. Is the check voltage for EHCU connector terminals when brake pedal is depressed than battery voltage?	-	Go to Step 4	Harness NG between stop light SW and EHCU. Go to Step 6
3	Is stop light fuse normal?	-	Go to Step 5	Replace stop light fuse. Go to Step 6
4	Is the check continuity between EHCU connector to body grounded?	-	Go to Step 6	Repair body grounded harness. Go to Step 6
5	Is stop light switch operation normal?	-	Repair stop light harness. Go to Step 6	Replace stop light switch. Go to Step 6
6	Reconnect all components, ensure all components are properly mounted. Is this step finished?	-	Repeat the “Basic diagnostic flow chart”	Go to Step 6

Braking Sound (From EHCU) Is Heard While Not Braking

Step	Action	Value(s)	Yes	No
1	Is this the first vehicle start after engine start?	-	It is self checking sound Normal.	Go to Step 2
2	Is vehicle speed at 15 km/h or 30 km/h?	-	It is self checking sound Normal.	Go to Step 3
3	Check for the following condition: • At the time of shift down or clutch operation. • At the time of low road friction drive (ice or snow on road) or rough road drive. • At the time of high-speed turn. • At the time of passing curb. • At the time of operating electrical equipment switches. • At the time of racing the engine. Did it occur under any of the conditions above?	-	ABS may sometimes be actuated even when brake pedal is not applied.	Go to Step 4
4	Is there play in each or any sensor/wheel speed sensor rotor?	-	Repair. Go to Step 7	Go to Step 5
5	Damage or powdered iron sticking to each or any sensor/wheel speed sensor rotor?	-	Repair. Go to Step 7	Go to Step 6
6	Is each sensor normal? Note: Check the EHCU type for specification, the EHCU is replaced. (Specification; 2WD or 4WD Model)	-	Check harness/ connector for suspected disconnection If no disconnection is found, replace EHCU Go to Step 7	Repair. Go to Step 7
7	Reconnect all components, ensure all components are properly mounted. Is this step finished?	-	Repeat the “Basic diagnostic flow chart”	Go to Step 7

No ABS Warning Lamp

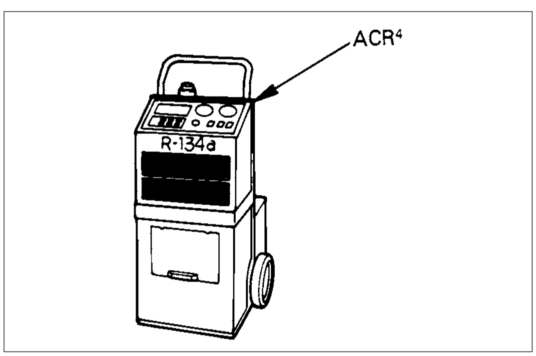
Step	Action	Value(s)	Yes	No
1	Check the meter fuse for the instrument cluster ignition feed circuit. Is the fuse OK?	-	Go to Step 3	Go to Step 2
2	Replace the fuse. Is the action complete?	-	Verify repair Go to Step 3	-
3	1. Ignition "OFF", disconnect the EHCU. 2. Ignition "ON", engine "OFF". 3. Observe the ABS warning lamp. Is the ABS warning lamp "ON"?	-	Go to Step 5	Go to Step 4
4	Repair or replace the meter circuit or meter. Is the action complete?	-	Verify repair	-
5	1. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 6
6	1. Ignition "OFF", reconnect the EHCU. 2. Ignition "ON",engine "OFF". 3. Observe the ABS warning lamp. Is the ABS warning lamp "ON"?	-	Verify repair	Go to Step 7
7	Replace EHCU. Note: Check the EHCU type for specification, the EHCU is replaced. (Specification; 2WD or 4WD Model) Is the action complete?	-	Verify repair	-

ON-VEHICLE SERVICE

PRECAUTIONS FOR REPLACEMENT OR REPAIR OF AIR CONDITIONING PARTS

There are certain procedures, practices and precautions that should be followed when servicing air conditioning systems:

- Keep your work area clean.
- Always wear safety goggle and protective gloves when working on refrigerant systems.
- Beware of the danger of carbon monoxide fumes caused by running the engine.
- Beware of discharged refrigerant in enclosed or improperly ventilated garages.
- Always disconnect the negative battery cable and discharge and recover the refrigerant whenever repairing the air conditioning system.
- When discharging and recovering the refrigerant, do not allow refrigerant to discharge too fast; it will draw compressor oil out of the system.
- Keep moisture and contaminants out of the system. When disconnecting or removing any lines or parts, use plugs or caps to close the fittings immediately.
  Never remove the caps or plugs until the lines or parts are reconnected or installed.
- When disconnecting or reconnecting the lines, use two wrenches to support the line fitting, to prevent from twisting or other damage.
- Always install new O-rings whenever a connection is disassembled.
- Before connecting any hoses or lines, apply new specified compressor oil to the O-rings.
- When removing and replacing any parts which require discharging the refrigerant circuit, the operations described in this section must be performed in the following sequence:

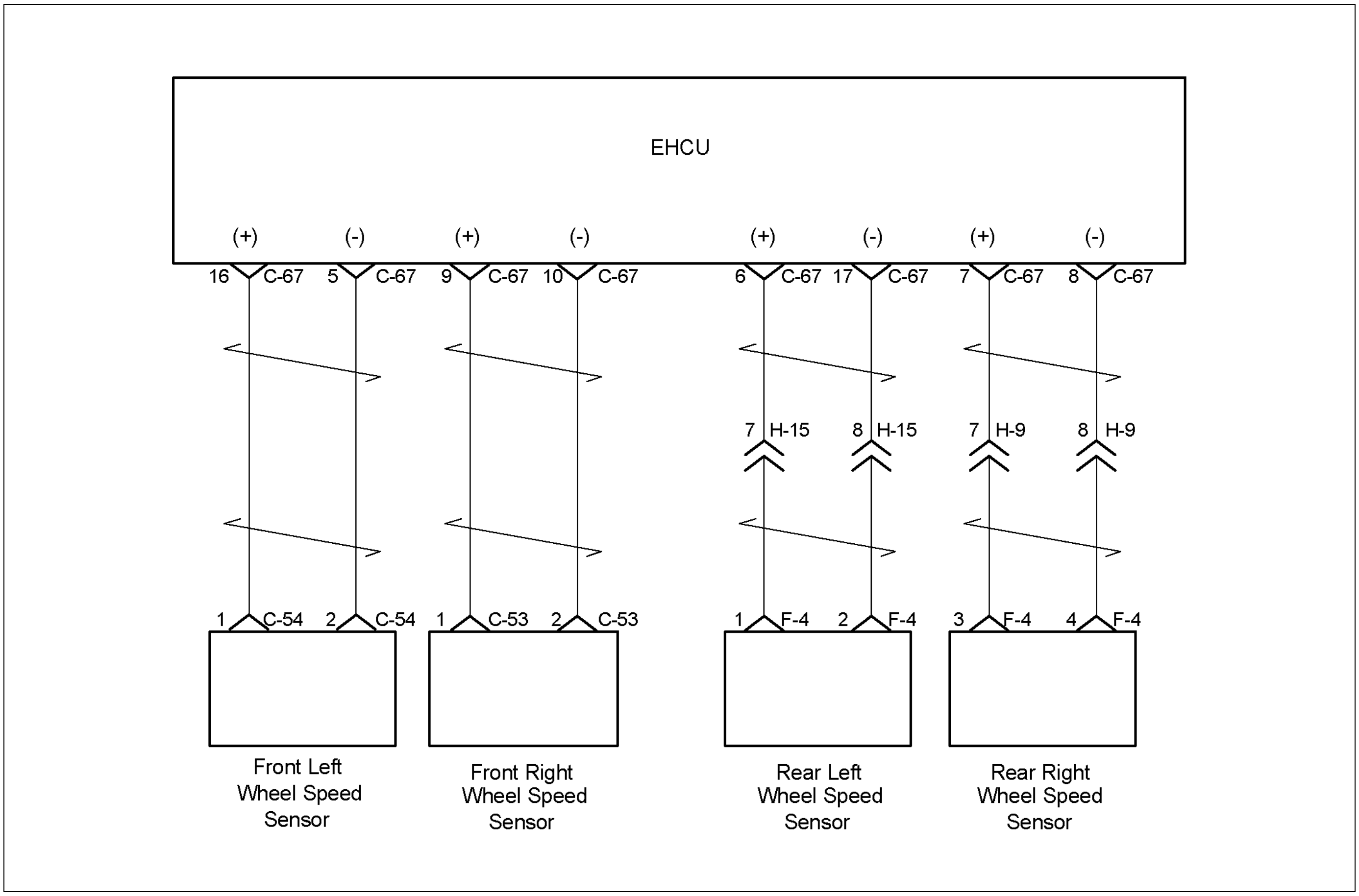


1) Using the ACR4 (HFC-134a Refrigerant Recovery/ Recycling/Recharging/System) or equivalent to thoroughly discharge and recover the refrigerant.
   ACR4 (115V 60Hz) : 5-8840-0629-0 (J-39500-A)
   ACR4 (220-240V 50/60Hz)
   : 5-8840-0630-0 (J-39500-220A)
   ACR4 (220-240V 50/60Hz Australian model)
   : 5-8840-0631-0 (J-39500-220ANZ)
2) Remove and replace the defective part.
3) After evacuation, charge the air conditioning system and check for leaks.

ABS Warning Lamp ON Steady

Step	Action	Value(s)	Yes	No
1	1. Check the ABS warning lamp lighting circuit for a short. 2. If a problem found, repair as necessary. Was a problem found?	-	Go to Step 3	Go to Step 2
2	1. Check the ABS warning lamp lighting circuit at the meter for a short. Refer to METER, WARNING LIGHT AND INDICATOR LIGHT in 8 section. 2. If a problem is found, repair or replace the meter. Was a problem found?	-	Go to Step 3	Go to Step 4
3	1. Connect all connectors. 2. Ignition “ON”, engine “OFF”. 3. Wait for about 10 seconds. 4. Observe the ABS warning lamp. Is the ABS warning lamp turned “OFF”?	-	Verify repair	Go to Step 4
4	Replace EHCU. Note: Check the EHCU type for specification, the EHCU is replaced. (Specification; 2WD or 4WD Model) Is the action complete?	-	Verify repair	-

DTC C0221 (Flash Code 21) Front Right Wheel Speed Sensor Short Circuit or Circuit Open



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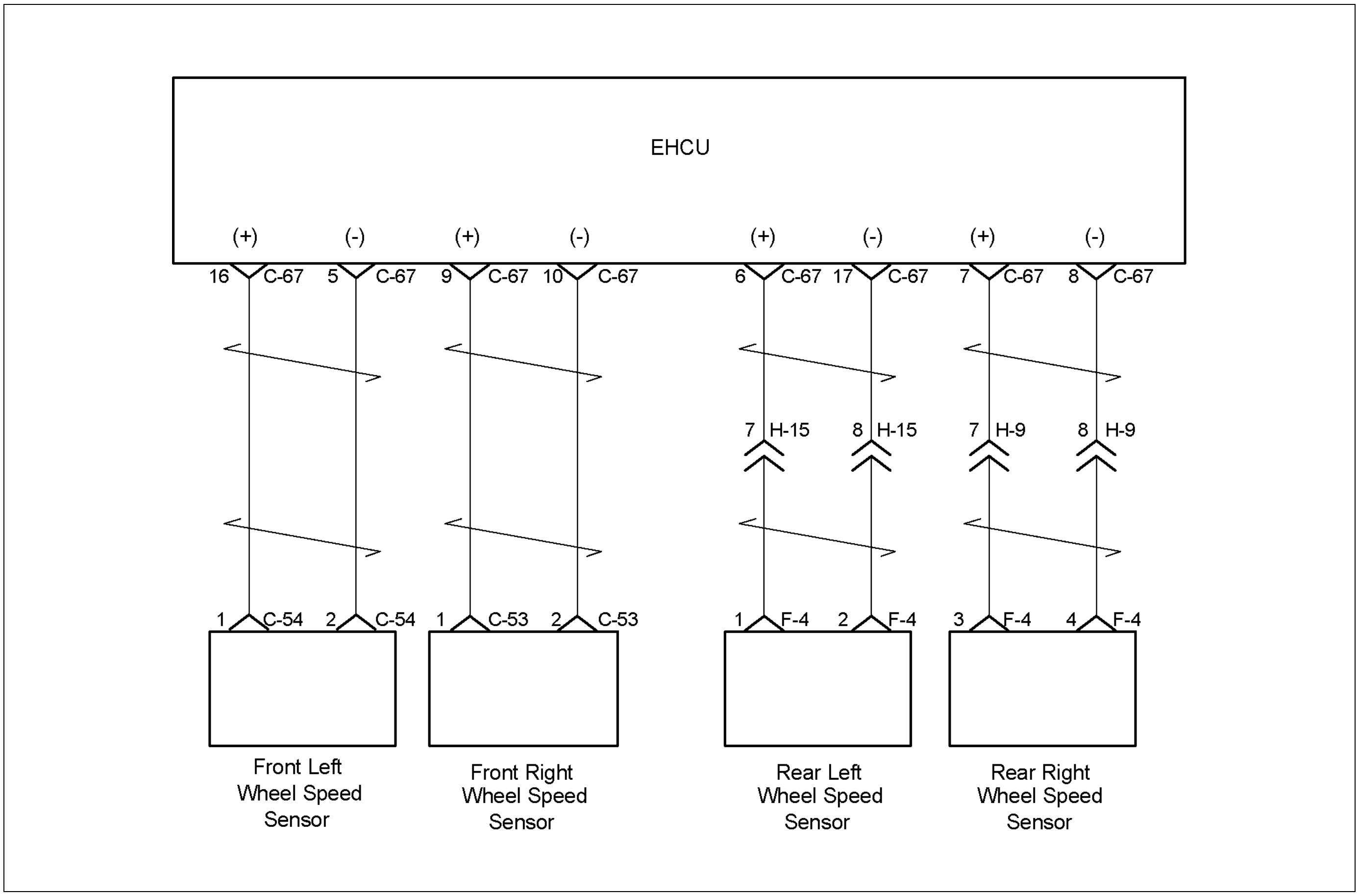
Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at the front right wheel speed sensor harness connector. 2. Check installation condition for front right wheel speed sensor. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition “OFF”, disconnect the EHCU and front right wheel speed sensor. 2. Check the circuit between EHCU and front right wheel speed sensor. (Circuit for an open, short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Replace front right wheel speed sensor. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 5	Verify repair
5	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0222 (Flash Code 22) Front Right Wheel Speed Sensor Signal Malfunction

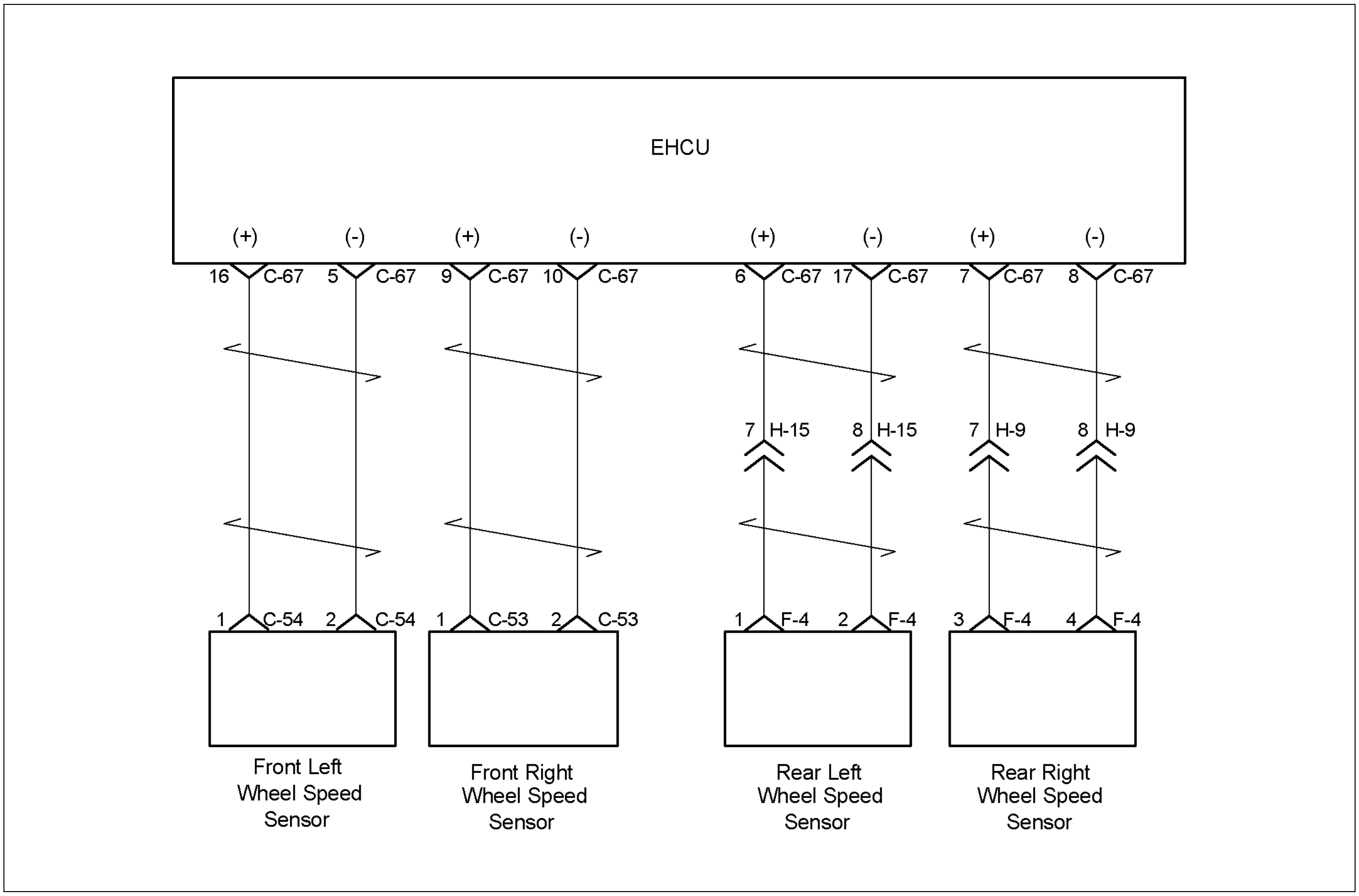


RTW75AMF001301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check the tire for the following conditions. • Tire specification • Wear of the outer surface 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	**Note:** This DTC is set when certain tire is rotated alone. Has certain tire been rotated alone by performing for lift-up or roller tester?	-	Verify repair	Go to Step 4
4	Is the front right wheel bearing rattling?	-	Go to Step 11	Go to Step 5
5	Is the front right wheel speed sensor or the sensor rotor rattling?	-	Go to Step 12	Go to Step 6
6	Is iron powder attached to the front right wheel speed sensor or the sensor rotor?	-	Go to Step 13	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Check the front right wheel speed sensor. Refer to "Wheel Speed Sensor Inspection procedure" Was a problem found?	-	Go to Step 10	Go to Step 8
8	Does the sensor rotor have missing tooth or saw-toothed?	-	Go to Step 14	Go to Step 9
9	1. Clear the DTC. 2. Test run the vehicle, and check the DTC. Is the DTC displayed repeatedly?	-	Go to Step 18	Go to Step 17
10	Is the wheel speed sensor damaged or saw-toothed?	-	Go to Step 15	Go to Step 16
11	Adjust the preload of the wheel bearing. Is the action complete?	-	Verify repair	-
12	Repair or replace the front right speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
13	Repair the front right speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
14	Replace the sensor rotor. Is the action complete?	-	Verify repair	-
15	Replace the front right wheel speed sensor. Is the action complete?	-	Verify repair	-
16	Repair or replace the front right speed sensor circuits. Is the action complete?	-	Verify repair	-
17	Check the connection btween the EHCU and the front right wheel speed sensor and repair as necessary Refer to "Note on Intermittents". Is the action complete?	-	Verify repair	-
18	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0225 (Flash Code 25) Front Left Wheel Speed Sensor Short Circuit or Circuit Open



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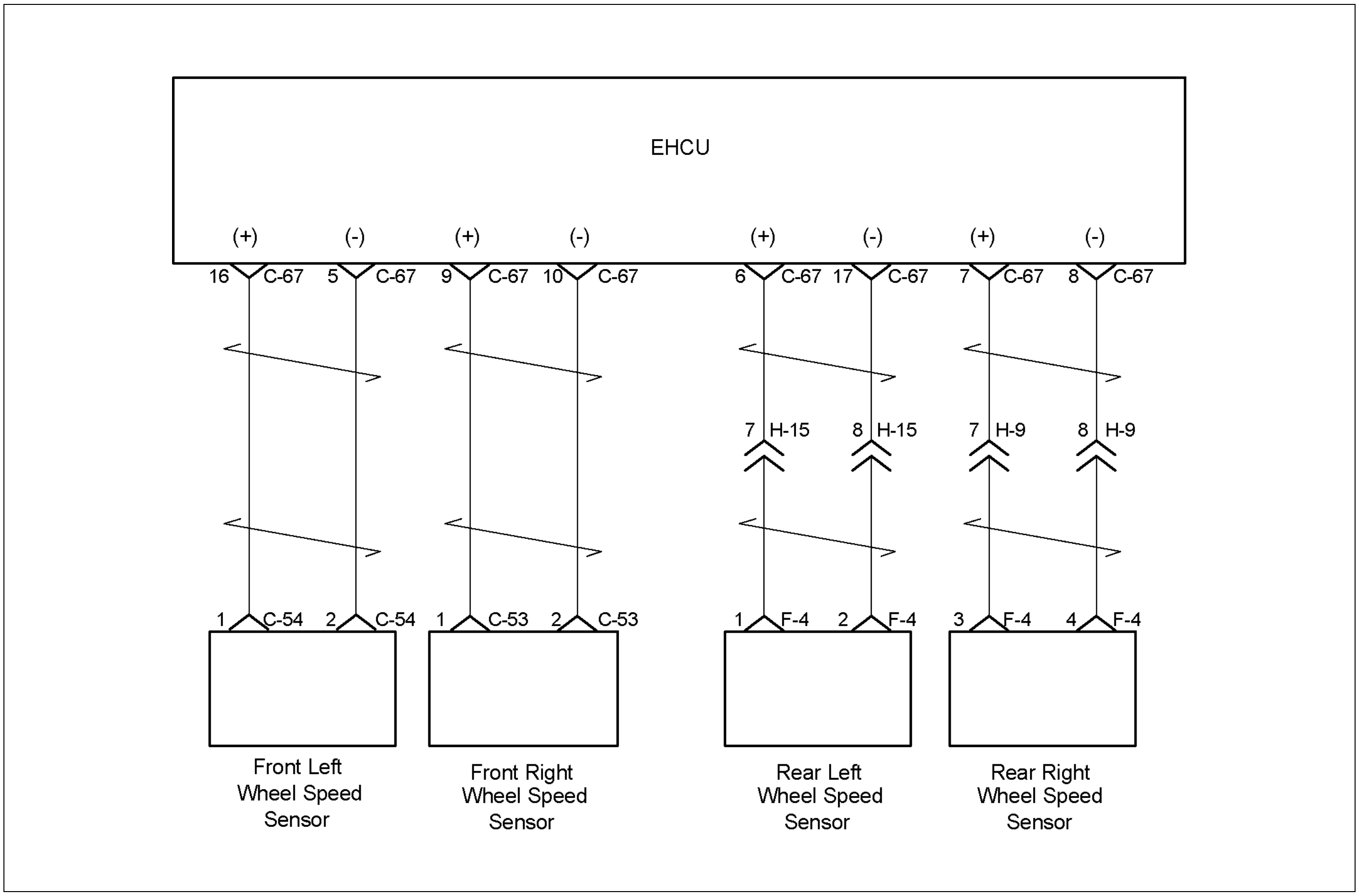
Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at the front left wheel speed sensor harness connector. 2. Check installation condition for front left wheel speed sensor. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition “OFF”, disconnect the EHCU and front left wheel speed sensor. 2. Check the circuit between EHCU and front left wheel speed sensor. (Circuit for an open, short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Replace front left wheel speed sensor. 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 5	Verify repair
5	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0226 (Flash Code 26) Front Left Wheel Speed Sensor Signal Malfunction

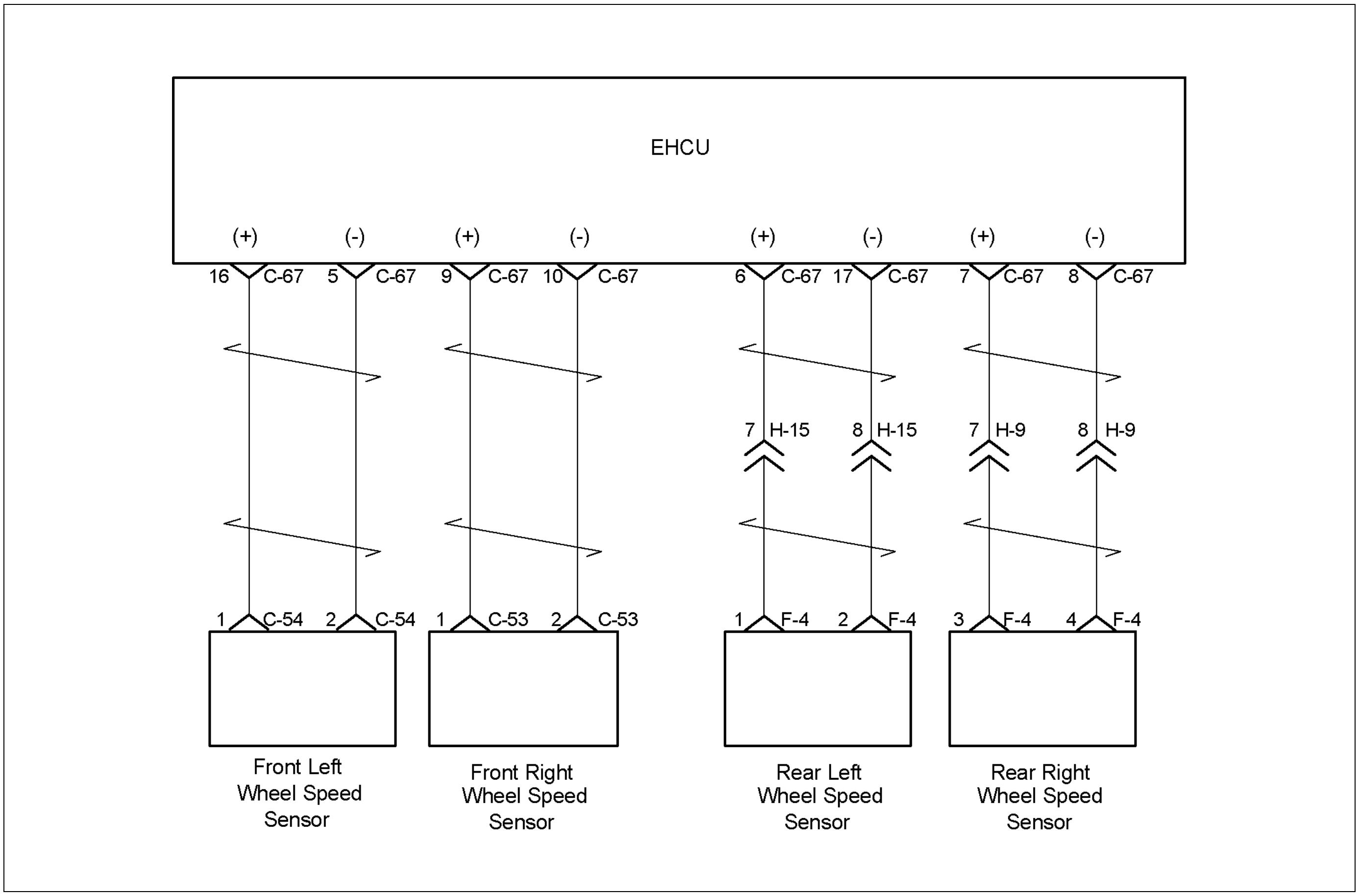


RTW75AMF001301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check the tire for the following conditions. • Tire specification • Wear of the outer surface 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	**Note:** This DTC is set when certain tire is rotated alone. Has certain tire been rotated alone by performing for lift-up or roller tester?	-	Verify repair	Go to Step 4
4	Is the front right wheel bearing rattling?	-	Go to Step 11	Go to Step 5
5	Is the front right wheel speed sensor or the sensor rotor rattling?	-	Go to Step 12	Go to Step 6
6	Is iron powder attached to the front left wheel speed sensor or the sensor rotor?	-	Go to Step 13	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Check the front left wheel speed sensor. Refer to "Wheel Speed Sensor Inspection procedure" Was a problem found?	-	Go to Step 10	Go to Step 8
8	Does the sensor rotor have missing tooth or saw-toothed?	-	Go to Step 14	Go to Step 9
9	1. Clear the DTC. 2. Test run the vehicle, and check the DTC. Is the DTC displayed repeatedly?	-	Go to Step 18	Go to Step 17
10	Is the wheel speed sensor damaged or saw-toothed?	-	Go to Step 15	Go to Step 16
11	Adjust the preload of the wheel bearing. Is the action complete?	-	Verify repair	-
12	Repair or replace the front left speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
13	Repair the front left speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
14	Replace the sensor rotor. Is the action complete?	-	Verify repair	-
15	Replace the front left wheel speed sensor. Is the action complete?	-	Verify repair	-
16	Repair or replace the front left speed sensor circuits. Is the action complete?	-	Verify repair	-
17	Check the connection btween the EHCU and the front left wheel speed sensor and repair as necessary Refer to "Note on Intermittents". Is the action complete?	-	Verify repair	-
18	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0231 (Flash Code 31) Rear Right Wheel Speed Sensor Short Circuit or Circuit Open



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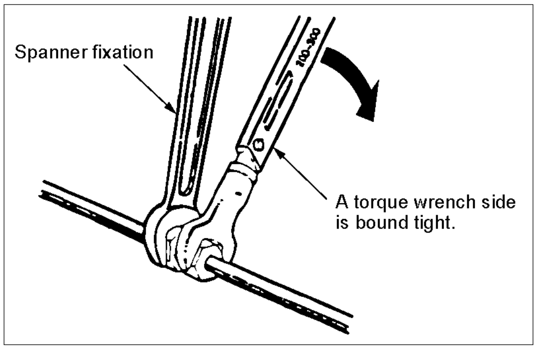
Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at the rear right wheel speed sensor harness connector. 2. Check installation condition for rear right wheel speed sensor. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition "OFF", disconnect the EHCU and rear right wheel speed sensor. 2. Check the circuit between EHCU and rear right wheel speed sensor. (Circuit for an open, short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4

REPAIR OF REFRIGERANT LEAKS

Refrigerant Line Connections



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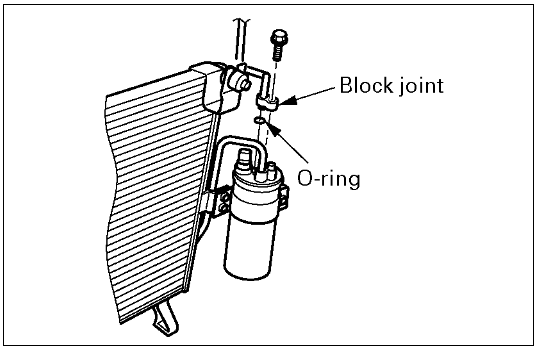
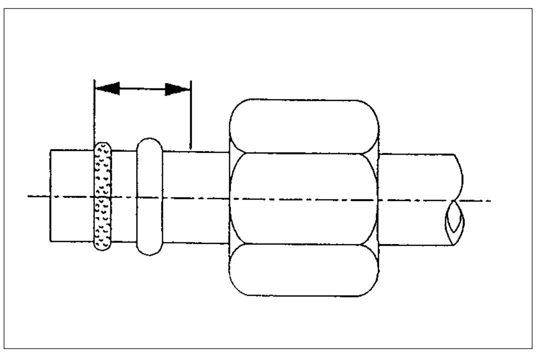
Install new O-ring, if required. When disconnecting or connecting lines, use two wrenches to prevent the connecting portion from twisting or becoming damaged.

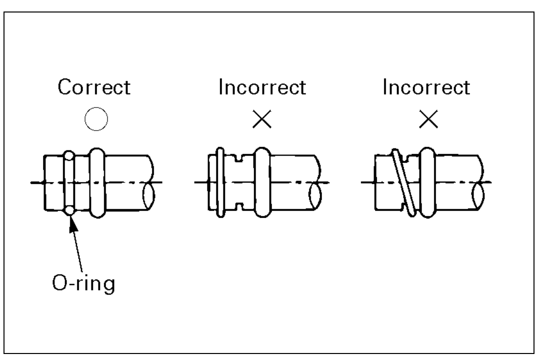


When connecting the refrigerant line at the block joint, securely insert the projecting portion of the joint portion into the connecting hole on the unit side and secure with a bolt.



Apply specified compressor oil to the O-rings prior to connecting.

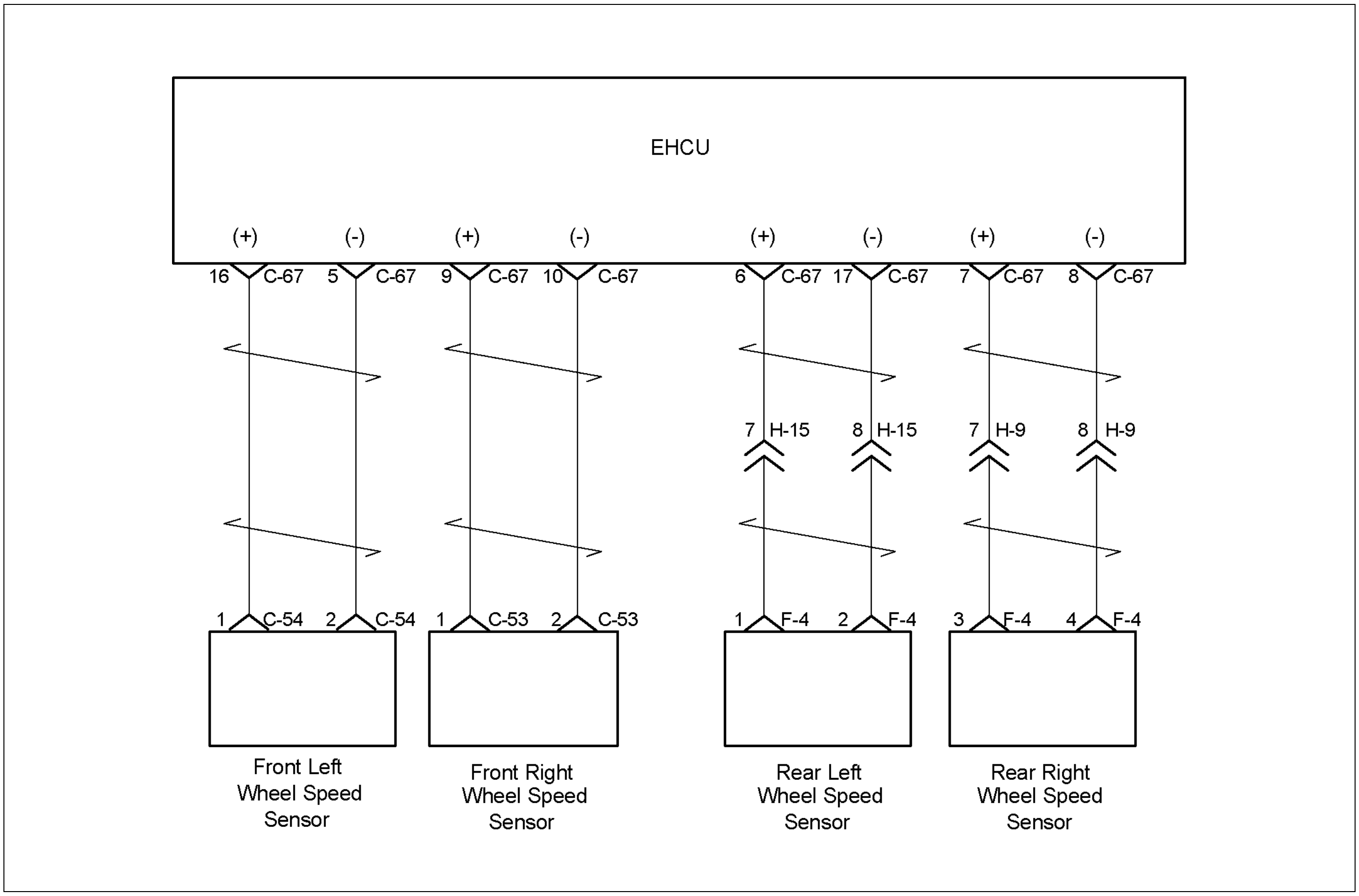
CAUTION:
Compressor (PAG) oil to be used varies according to compressor model. Be sure to apply oil specified for the model of compressor.



O-rings must be closely aligned with raised portion of refrigerant line.

Step	Action	Value(s)	Yes	No
4	1. Replace rear right wheel speed sensor. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 5	Verify repair
5	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0232 (Flash Code 32) Rear Right Wheel Speed Sensor Signal Malfunction

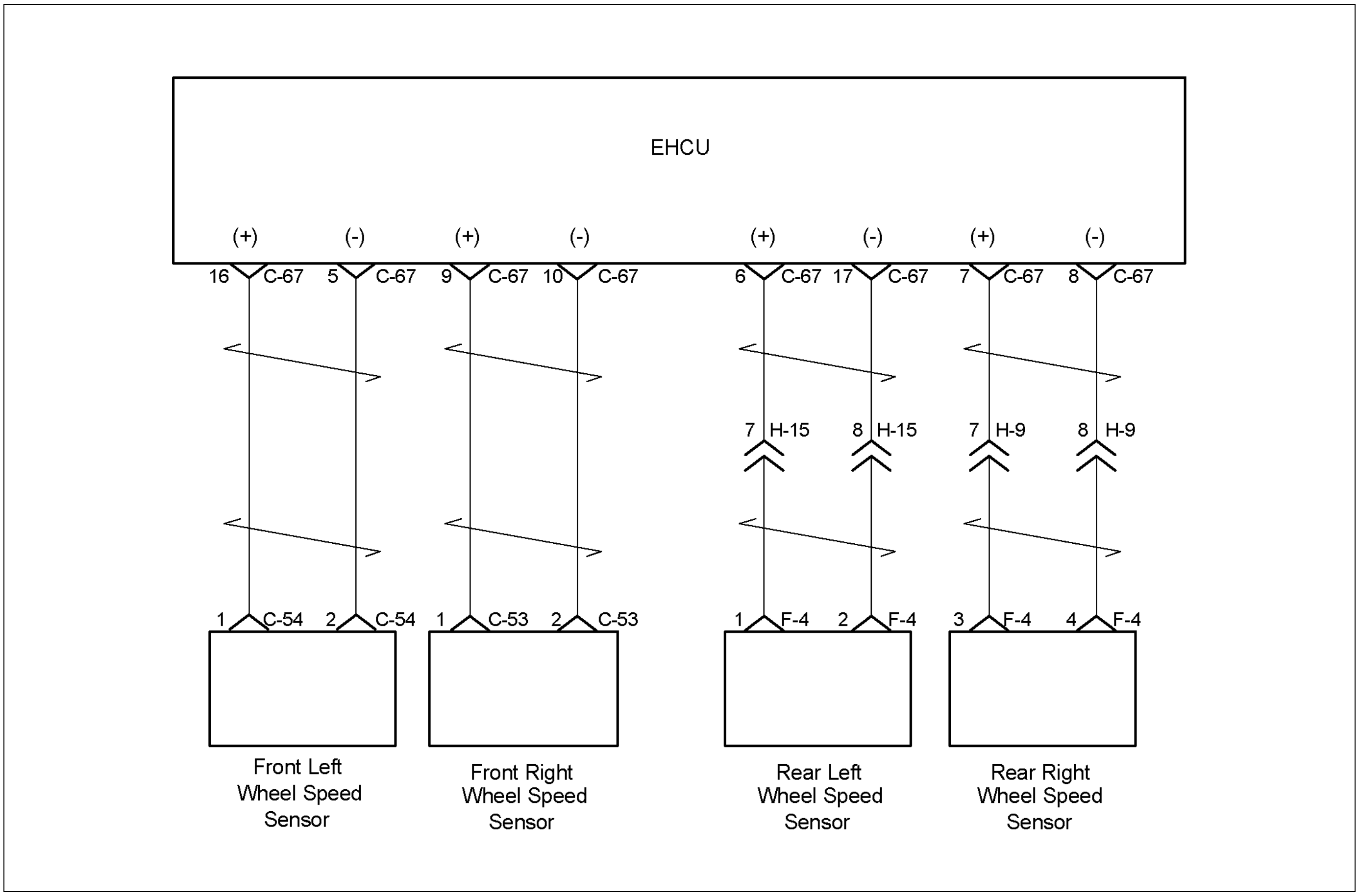


RTW75AMF001301

Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check the tire for the following conditions. • Tire specification • Wear of the outer surface 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	**Note:** This DTC is set when certain tire is rotated alone. Has certain tire been rotated alone by performing for lift-up or roller tester?	-	Verify repair	Go to Step 4
4	Is the rear right wheel bearing rattling?	-	Go to Step 11	Go to Step 5
5	Is the rear right wheel speed sensor or the sensor rotor rattling?	-	Go to Step 12	Go to Step 6
6	Is iron powder attached to the rear right wheel speed sensor or the sensor rotor?	-	Go to Step 13	Go to Step 7

Step	Action	Value(s)	Yes	No
7	Check the rear right wheel speed sensor. Refer to "Wheel Speed Sensor Inspection procedure" Was a problem found?	-	Go to Step 10	Go to Step 8
8	Does the sensor rotor have missing tooth or saw-toothed?	-	Go to Step 14	Go to Step 9
9	1. Clear the DTC. 2. Test run the vehicle, and check the DTC. Is the DTC displayed repeatedly?	-	Go to Step 18	Go to Step 17
10	Is the wheel speed sensor damaged or saw-toothed?	-	Go to Step 15	Go to Step 16
11	Repair or replace the wheel bearing. Is the action complete?	-	Verify repair	-
12	Repair or replace the rear right speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
13	Repair the rear right speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
14	Replace the sensor rotor. Is the action complete?	-	Verify repair	-
15	Replace the rear right wheel speed sensor. Is the action complete?	-	Verify repair	-
16	Repair or replace the rear right speed sensor circuits. Is the action complete?	-	Verify repair	-
17	Check the connection btween the EHCU and the rear right wheel speed sensor and repair as necessary Refer to "Note on Intermittents". Is the action complete?	-	Verify repair	-
18	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0235 (Flash Code 35) Rear Left Wheel Speed Sensor Short Circuit or Circuit Open

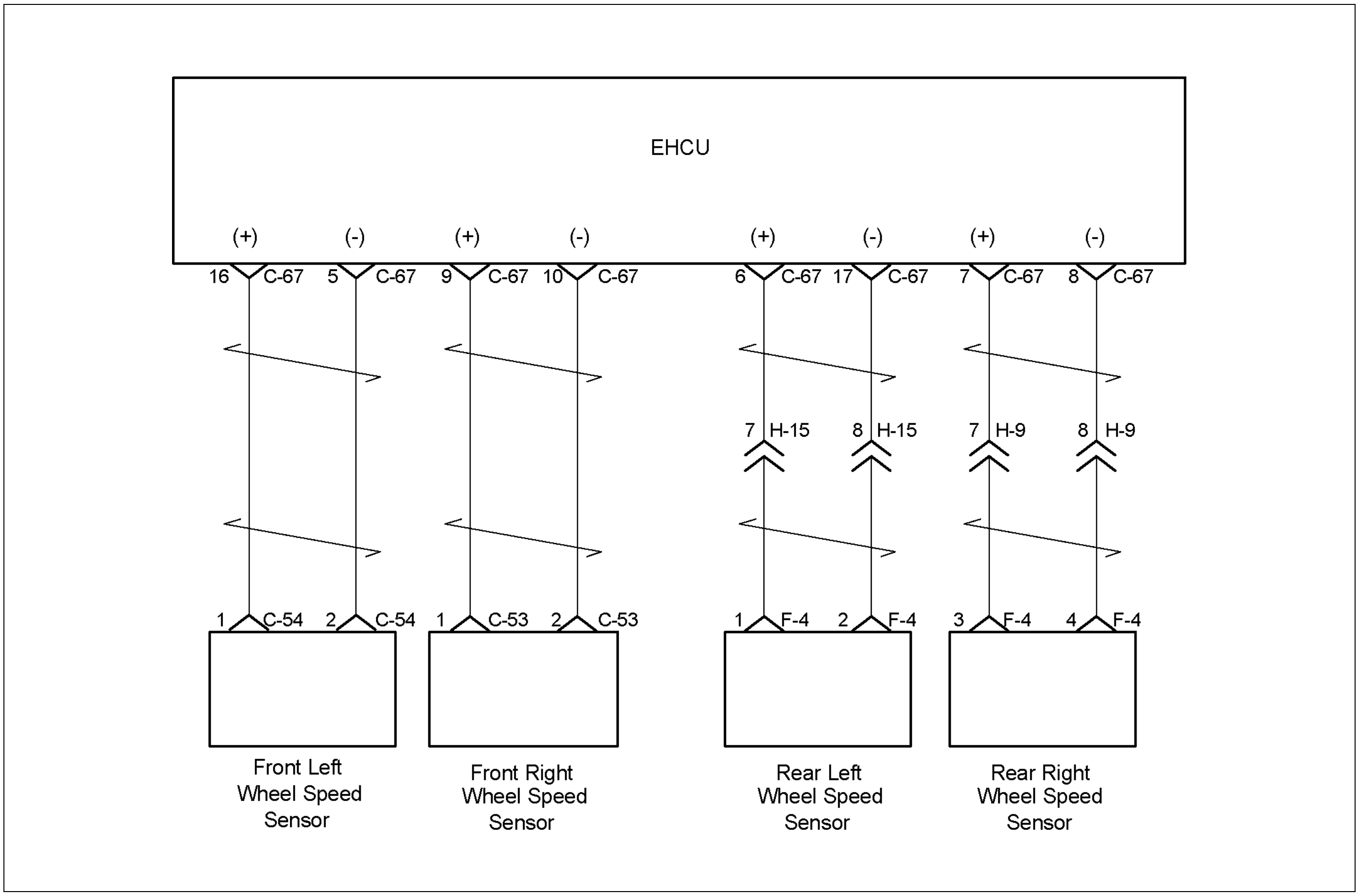


RTW75AMF001301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at the rear left wheel speed sensor harness connector. 2. Check installation condition for rear left wheel speed sensor. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition “OFF”, disconnect the EHCU and rear left wheel speed sensor. 2. Check the circuit between EHCU and rear left wheel speed sensor. (Circuit for an open, short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Replace rear left wheel speed sensor. 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 5	Verify repair
5	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0236 (Flash Code 36) Rear Left Wheel Speed Sensor Signal Malfunction



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Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check the tire for the following conditions. • Tire specification • Wear of the outer surface 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	**Note:** This DTC is set when certain tire is rotated alone. Has certain tire been rotated alone by performing for lift-up or roller tester?	-	Verify repair	Go to Step 4
4	Is the rear left wheel bearing rattling?	-	Go to Step 11	Go to Step 5
5	Is the rear left wheel speed sensor or the sensor rotor rattling?	-	Go to Step 12	Go to Step 6
6	Is iron powder attached to the rear left wheel speed sensor or the sensor rotor?	-	Go to Step 13	Go to Step 7
7	Check the rear left wheel speed sensor. Refer to "Wheel Speed Sensor Inspection procedure" Was a problem found?	-	Go to Step 10	Go to Step 8

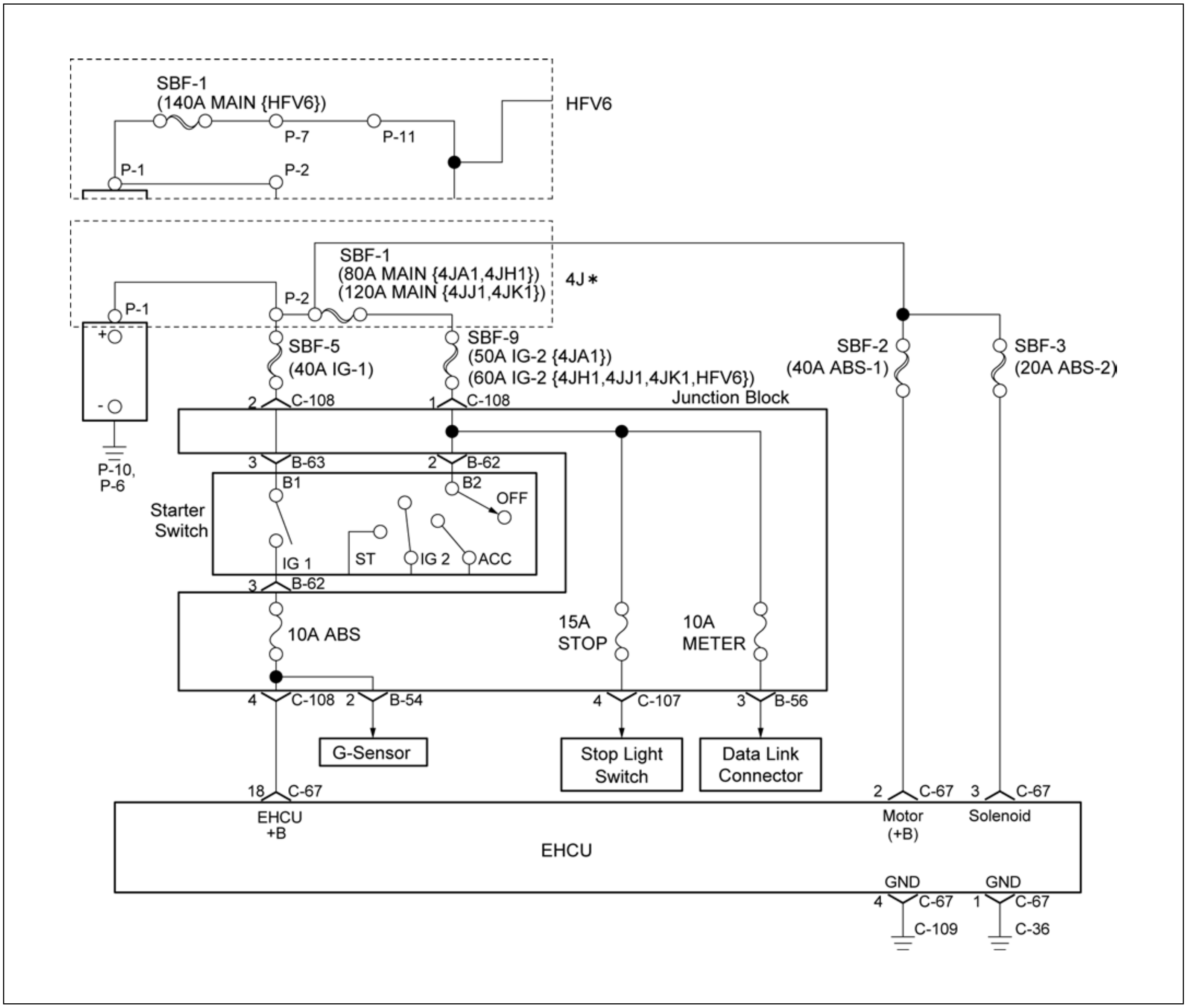
Step	Action	Value(s)	Yes	No
8	Does the sensor rotor have missing tooth or saw-toothed?	-	Go to Step 14	Go to Step 9
9	1. Clear the DTC. 2. Test run the vehicle, and check the DTC. Is the DTC displayed repeatedly?	-	Go to Step 18	Go to Step 17
10	Is the wheel speed sensor damaged or saw-toothed?	-	Go to Step 15	Go to Step 16
11	Repair or replace the wheel bearing. Is the action complete?	-	Verify repair	-
12	Repair or replace the rear left speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
13	Repair the rear left speed sensor or the sensor rotor. Is the action complete?	-	Verify repair	-
14	Replace the sensor rotor. Is the action complete?	-	Verify repair	-
15	Replace the rear left wheel speed sensor. Is the action complete?	-	Verify repair	-
16	Repair or replace the rear left speed sensor circuits. Is the action complete?	-	Verify repair	-
17	Check the connection btween the EHCU and the rear left wheel speed sensor and repair as necessary Refer to "Note on Intermittents". Is the action complete?	-	Verify repair	-
18	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0238 (Flash Code 38) Front Speed Sensor Correlation

Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for the tire size of each wheels. 2. If the tire size is different, replace the tire. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Check for the gear ratio of a front axle differential gear and a rear axle differential gear. 2. If the gear ratio is different, repair the gear ratio. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4
4	Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 5	Verify repair
5	1. Check for a poor connection at the wheel speed sensor harness connector. 2. Check installation condition for wheel speed sensor. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 6
6	1. Check condition for sensor rotor. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 7
7	1. Ignition "OFF" disconnect the EHCU and wheel speed sensor. 2. Check the circuit between EHCU and wheel speed sensor. (short ground, or short to voltage) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 8
8	1. Ignition "OFF". 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 9
9	1. Ignition "ON", engine "OFF". 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 10	Verify repair

Step	Action	Value(s)	Yes	No
10	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification; 2WD model or 4WD model) Was the action complete?	-	Verify repair	-

DTC C0241 (Flash Code 41) Front Right Hold Solenoid Valve Circuit
DTC C0242 (Flash Code 42) Front Right Release Solenoid Valve Circuit



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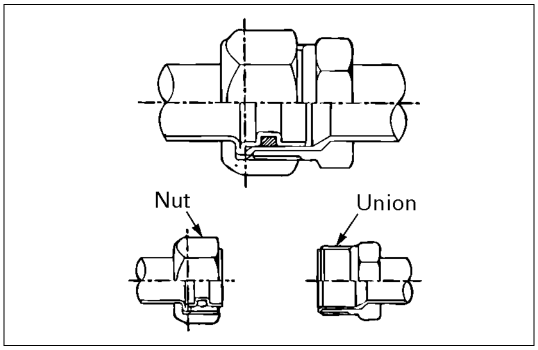
Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3



Insert nut into union. First tighten nut by hand as much as possible. Then, tighten nut to specified torque.
(Refer to "Special Parts Fixing Nuts and Bolts" in this section)

LEAK AT REFRIGERANT LINE CONNECTIONS

1) Check the torque on the refrigerant line fitting and, if too loose, tighten to the specified torque.
   - Use two wrenches to prevent twisting and damage to the Line.
   - Do not over tighten.
2) Perform a leak test on the refrigerant line fitting.
3) If the leak is still present, discharge and recover the refrigerant from the system.
4) Replace the O-rings.
   - O-rings cannot be reused. Always replace with new ones.
   - Be sure to apply specified compressor oil to the new O-rings.
5) Retighten the refrigerant line fitting to the specified torque.
   - Use two wrenches to prevent twisting and damage to the line.
6) Evacuate, charge and retest the system.

LEAK IN THE HOSE

If the compressor inlet or outlet hose is leaking, the entire hose must be replaced. Refrigerant hose must not be cut or spliced for repair.

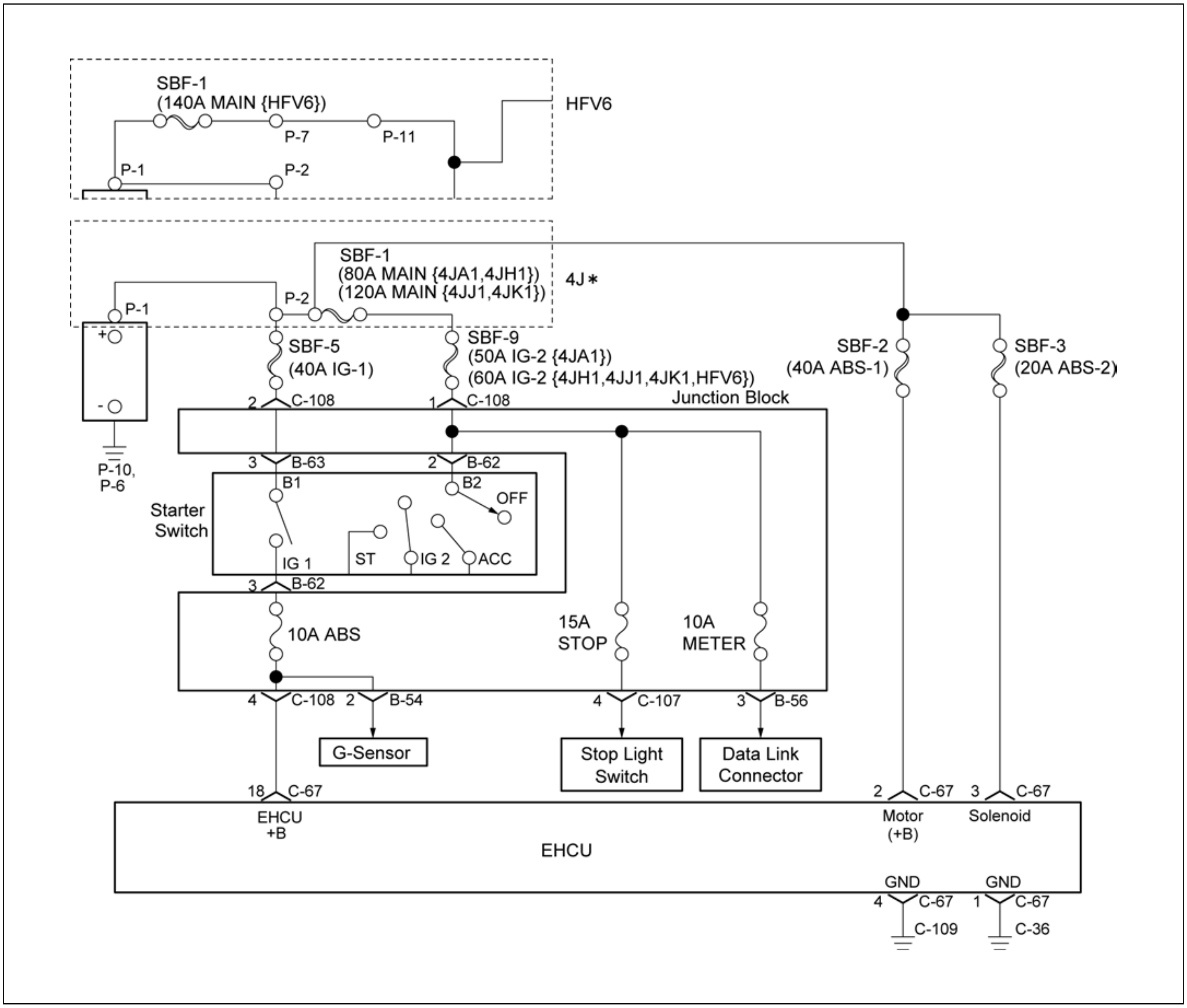
1) Locate the leak.
2) Discharge and recover the refrigerant.
3) Remove the hose assembly.
   - Cap the open connections at once.
4) Connect the new hose assembly.
   - Use two wrenches to prevent twisting or damage to the hose fitting.
   - Tighten the hose fitting to the specified torque.
5) Evacuate, charge and test the system.

COMPRESSOR LEAKS

If leaks are located around the compressor shaft seal or shell, replace or repair the compressor.

Step	Action	Value(s)	Yes	No
3	1. Ignition "ON", engine "OFF". 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0245 (Flash Code 45) Front Left Hold Solenoid Valve Circuit
DTC C0246 (Flash Code 46) Front Left Release Solenoid Valve Circuit



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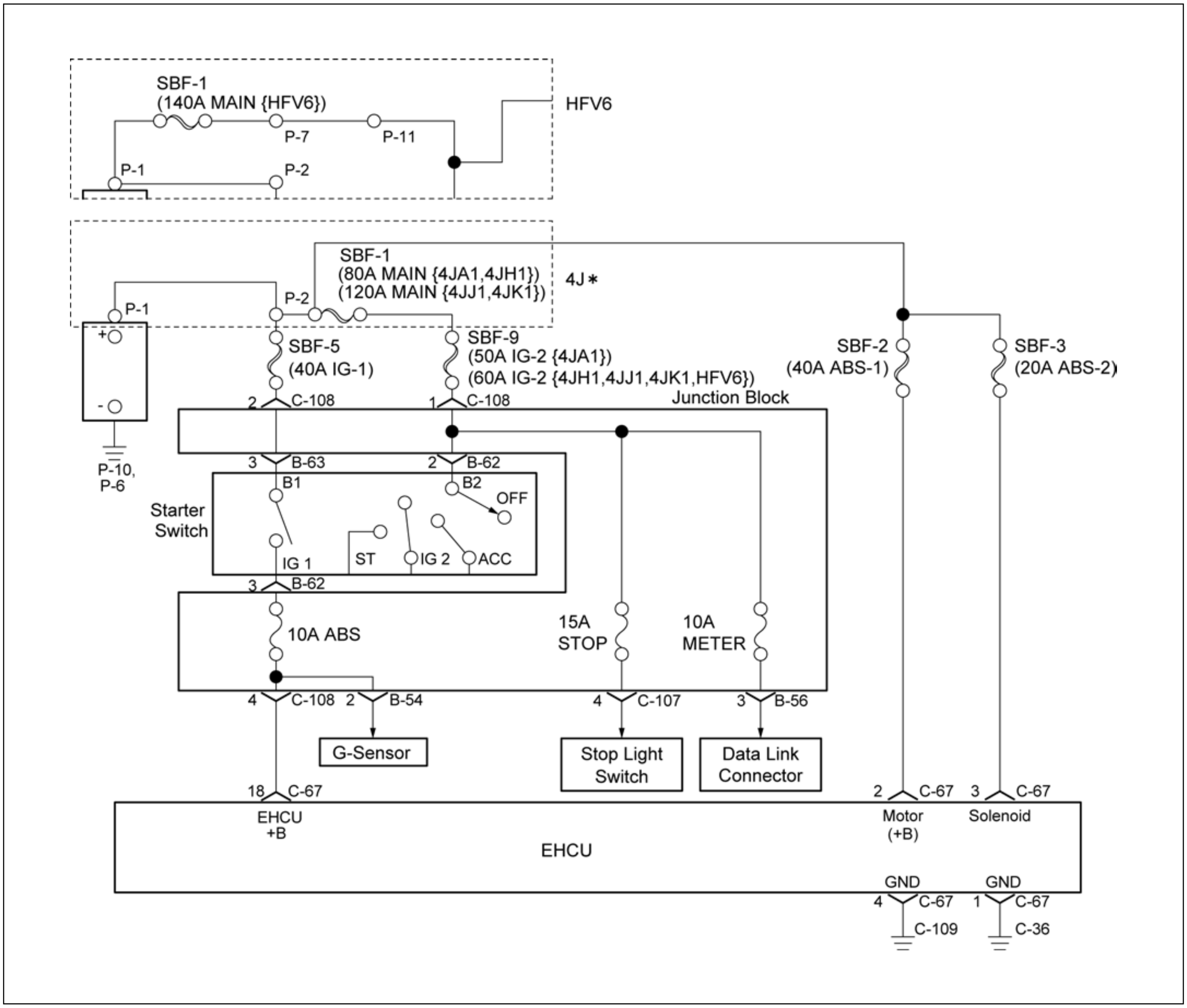
Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Ignition "ON", engine "OFF". 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0251 (Flash Code 51) Rear Hold Solenoid Valve Circuit
DTC C0252 (Flash Code 52) Rear Release Solenoid Valve Circuit

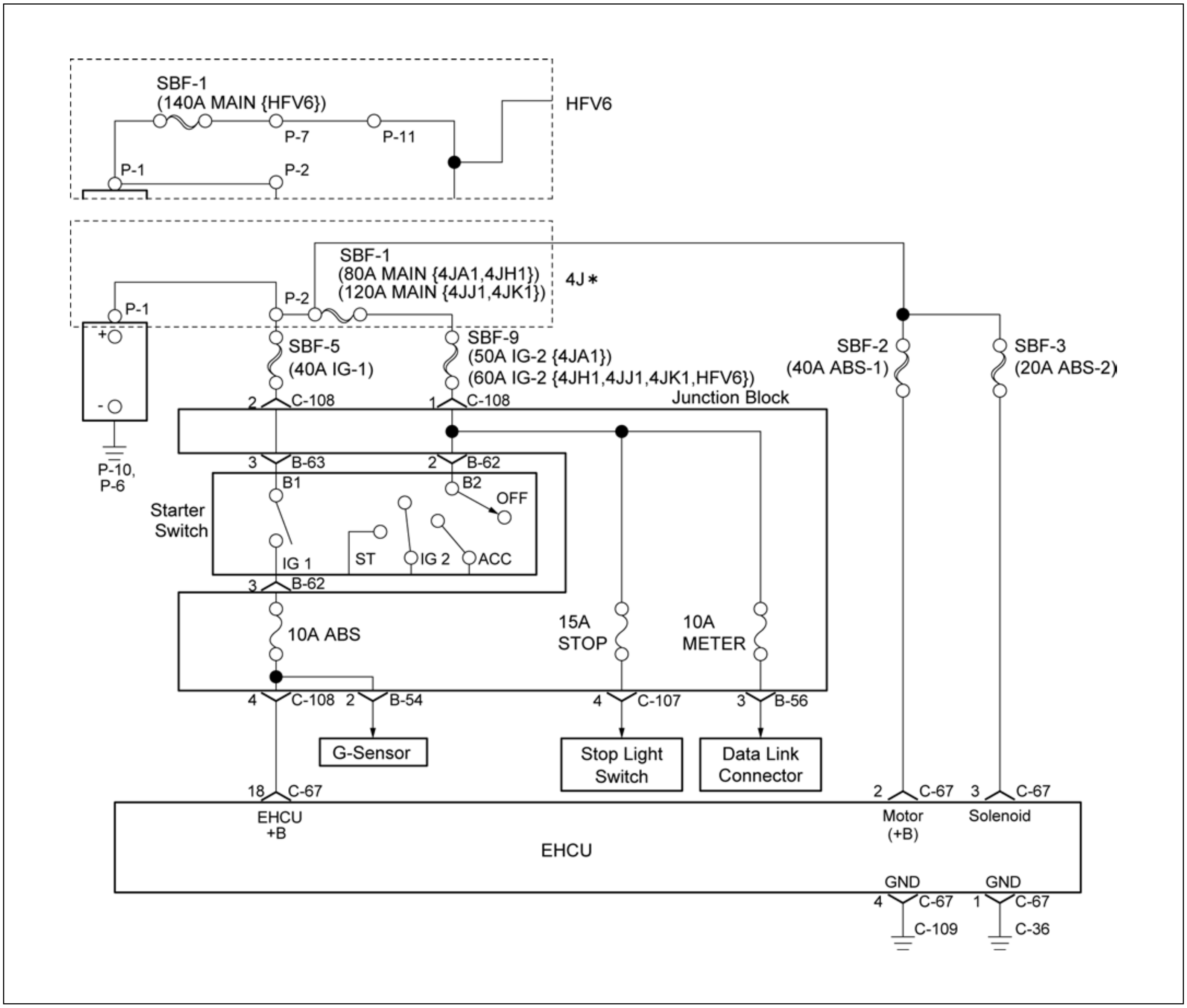


RTW75ALF000301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Ignition “ON”, engine “OFF”. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0265 (Flash Code 65) Valve Relay Circuit Malfunction

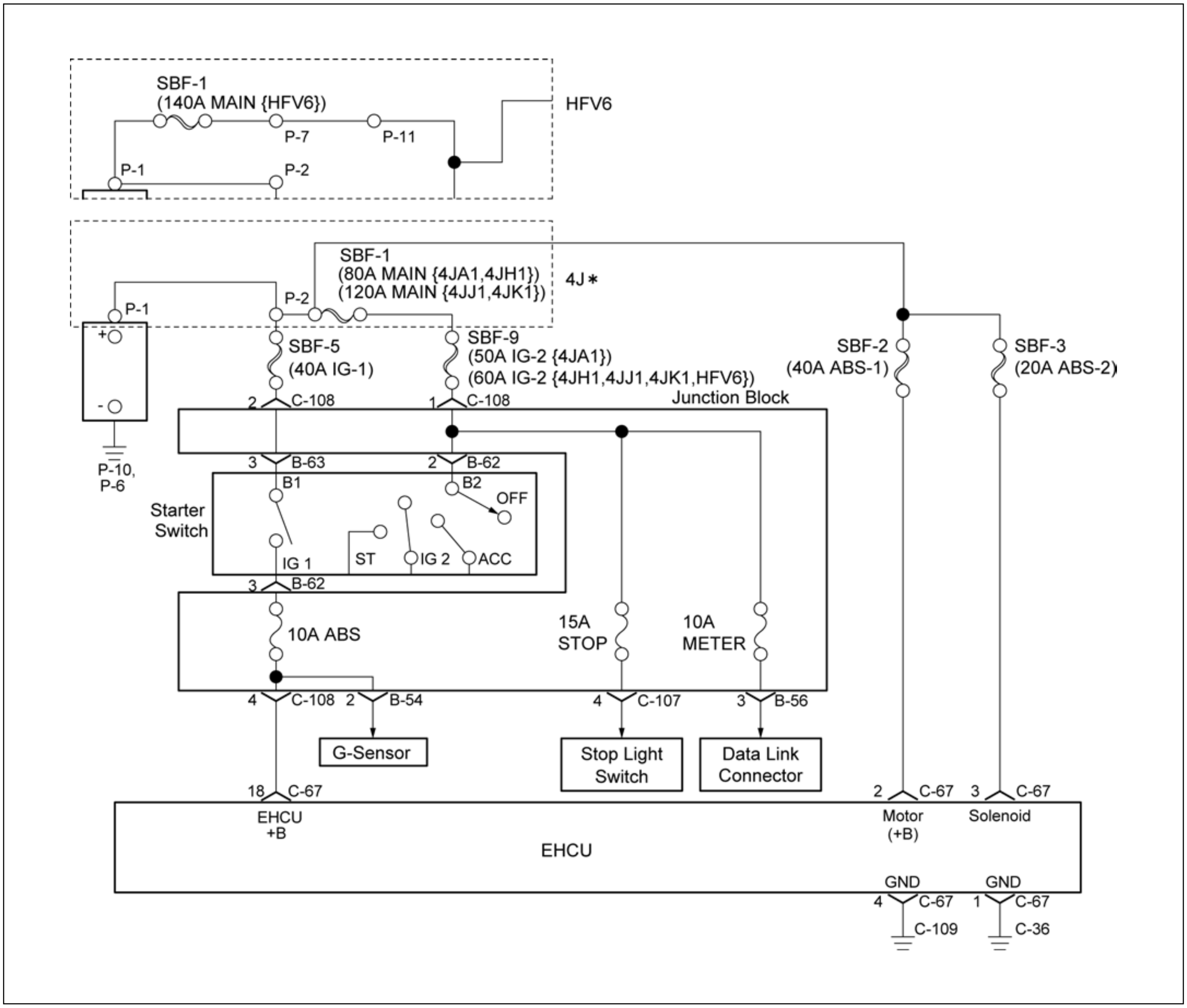


RTW75ALF000301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Ignition "ON", engine "OFF". 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0267 (Flash Code 67) Return Pump Circuit Malfunction

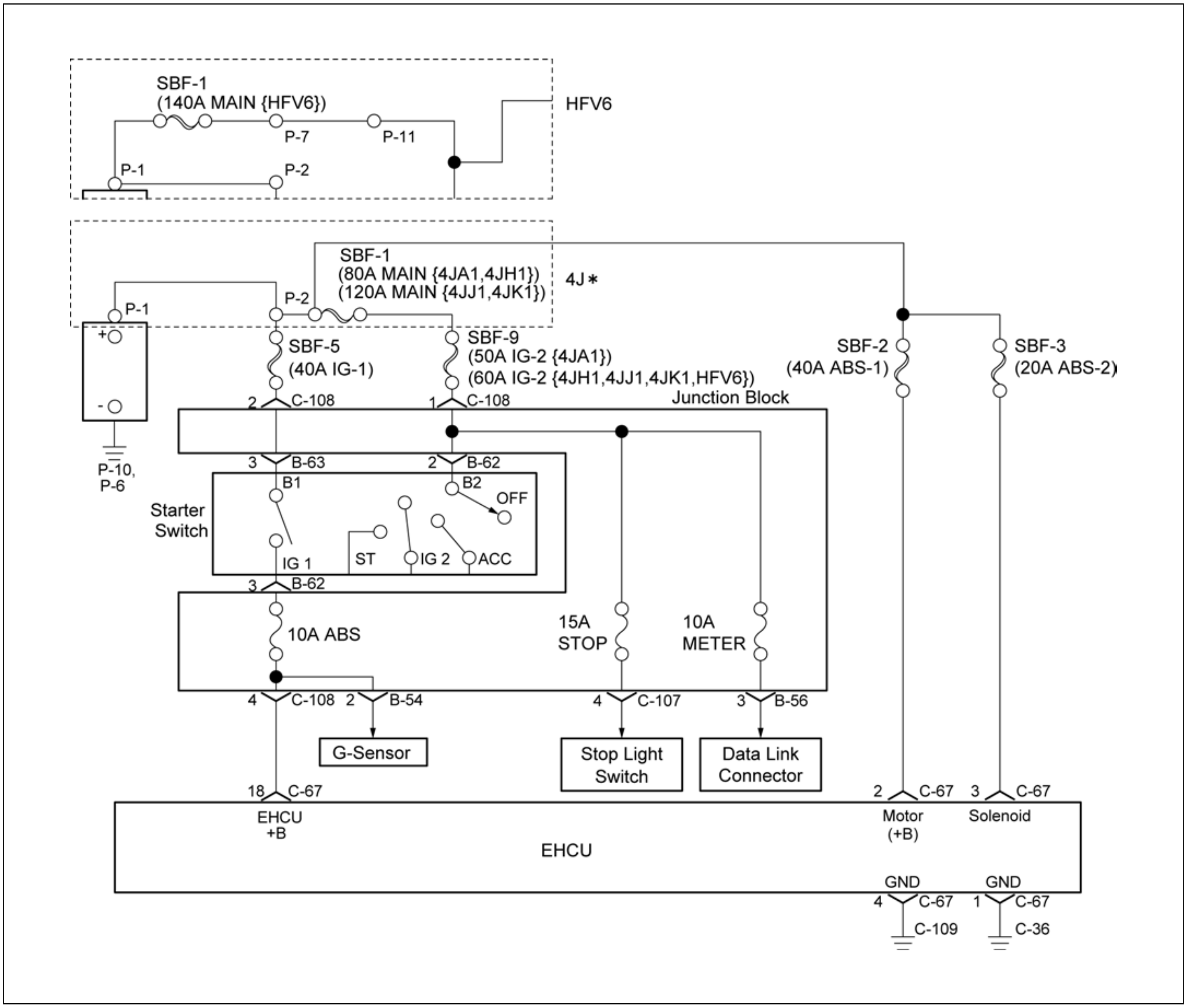


RTW75ALF000301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Ignition “ON”, engine “OFF”. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0271 (Flash Code 71) ECU Malfunction



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Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition "OFF". 2. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3

RECOVERY, RECYCLING, EVACUATION AND CHARGING

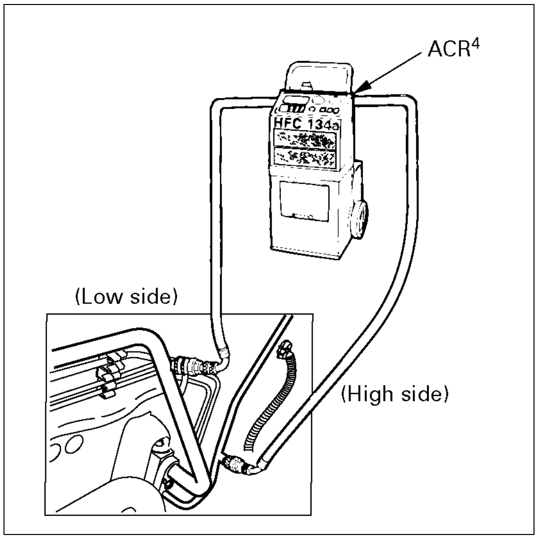
Handling Refrigerant-134a (HFC-134a)

Air conditioning systems contain HFC-134a.
This is a chemical mixture, which requires special handling procedures to avoid personal injury.

- Always wear safety goggles and protective gloves.
- Always work in a well-ventilated area. Do not weld or steam clean on or near any vehicle-installed air conditioning lines or components.
- If HFC-134a should come in contact with any part of the body, flush the exposed area with cold water and immediately seek medical help.
- If it is necessary to transport or carry any container of HFC-134a in a vehicle, do not carry it in the passenger compartment.
- If it is necessary to fill a small HFC-134a container from a large one, never fill the container completely. Space should always be allowed above the liquid for expansion.
- Keep HFC-134a containers stored below 40°C (104°F).

WARNING

- **SHOULD HFC-134a CONTACT YOUR EYE(S), CONSULT A DOCTOR IMMEDIATELY.**
- **DO NOT RUB THE AFFECTED EYE(S). INSTEAD, SPLASH QUANTITIES OF FRESH COLD WATER OVER THE AFFECTED AREA TO GRADUALLY RAISE THE TEMPERATURE OF THE REFRIGERANT ABOVE THE FREEZING POINT.**
- **OBTAIN PROPER MEDICAL TREATMENT AS SOON AS POSSIBLE. SHOULD THE HFC-134a TOUCH THE SKIN, THE INJURY MUST BE TREATED THE SAME AS SKIN WHICH HAS BEEN FROSTBITTEN OR FROZEN.**



F06R300012

REFRIGERANT RECOVERY

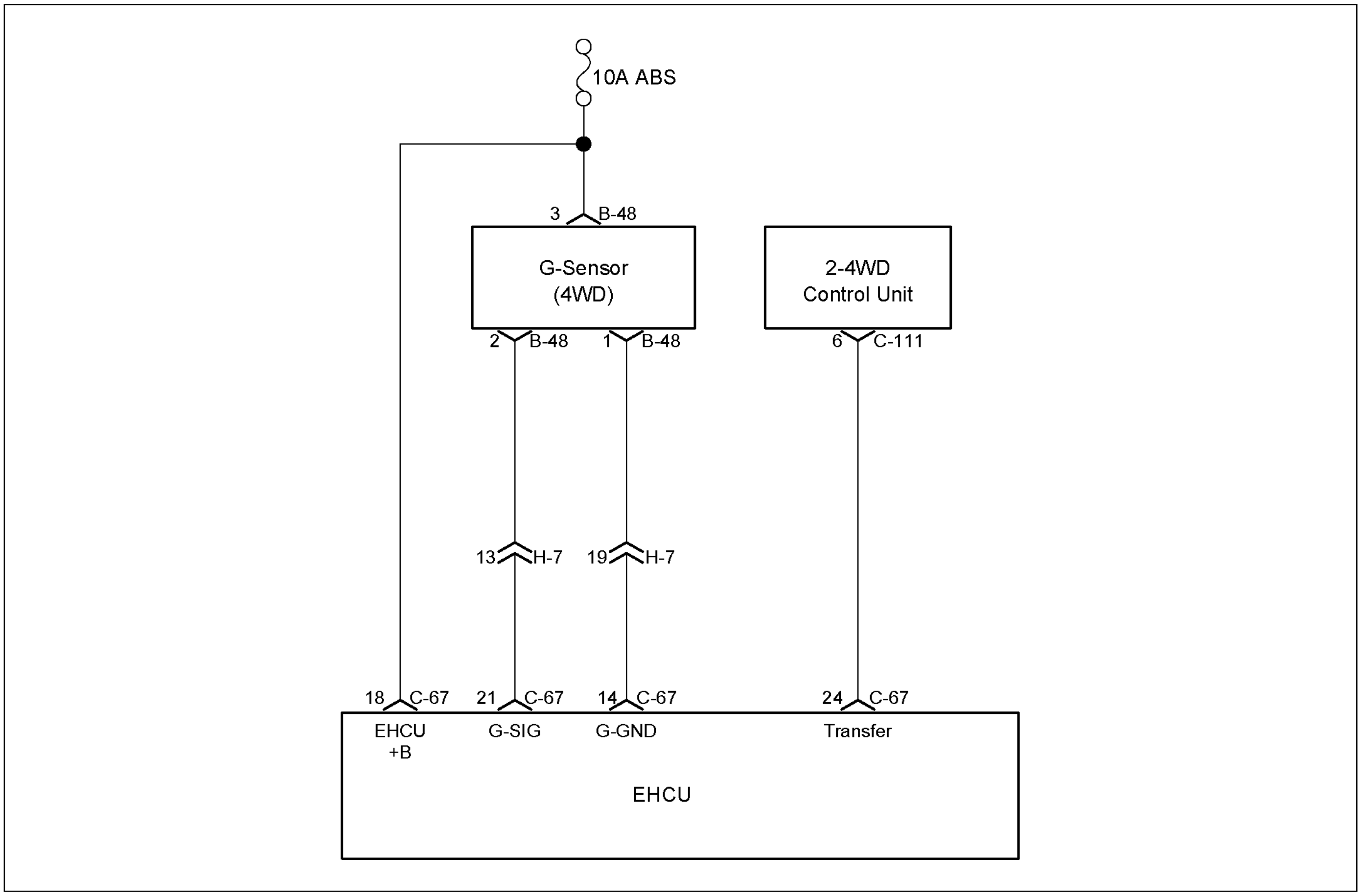
The refrigerant must be discharged and recovered by using ACR^4 (HFC-134a Refrigerant Recovery/Recycling/Recharging/ System) or equivalent before removing or installing air conditioning parts.

ACR^4 (115V 60Hz) :5-8840-0629-0 (J-39500-A)
ACR^4 (220-240V 50/60Hz)
: 5-8840-0630-0 (J-39500-220A)
ACR^4 (220-240V 50/60Hz Australian model)
: 5-8840-0631-0 (J-39500-220ANZ)

1) Connect the high and low charging hoses of the ACR^4 (or equivalent) as shown.
2) Recover the refrigerant by following the ACR^4 Manufacturer's Instructions.
3) When a part is removed, put a cap or a plug on the connecting portion so that dust, dirt or moisture cannot get into it.

3	1. Ignition "ON", engine "OFF". 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 4	Verify repair
4	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0276 (Flash Code 76) G Sensor Malfunction

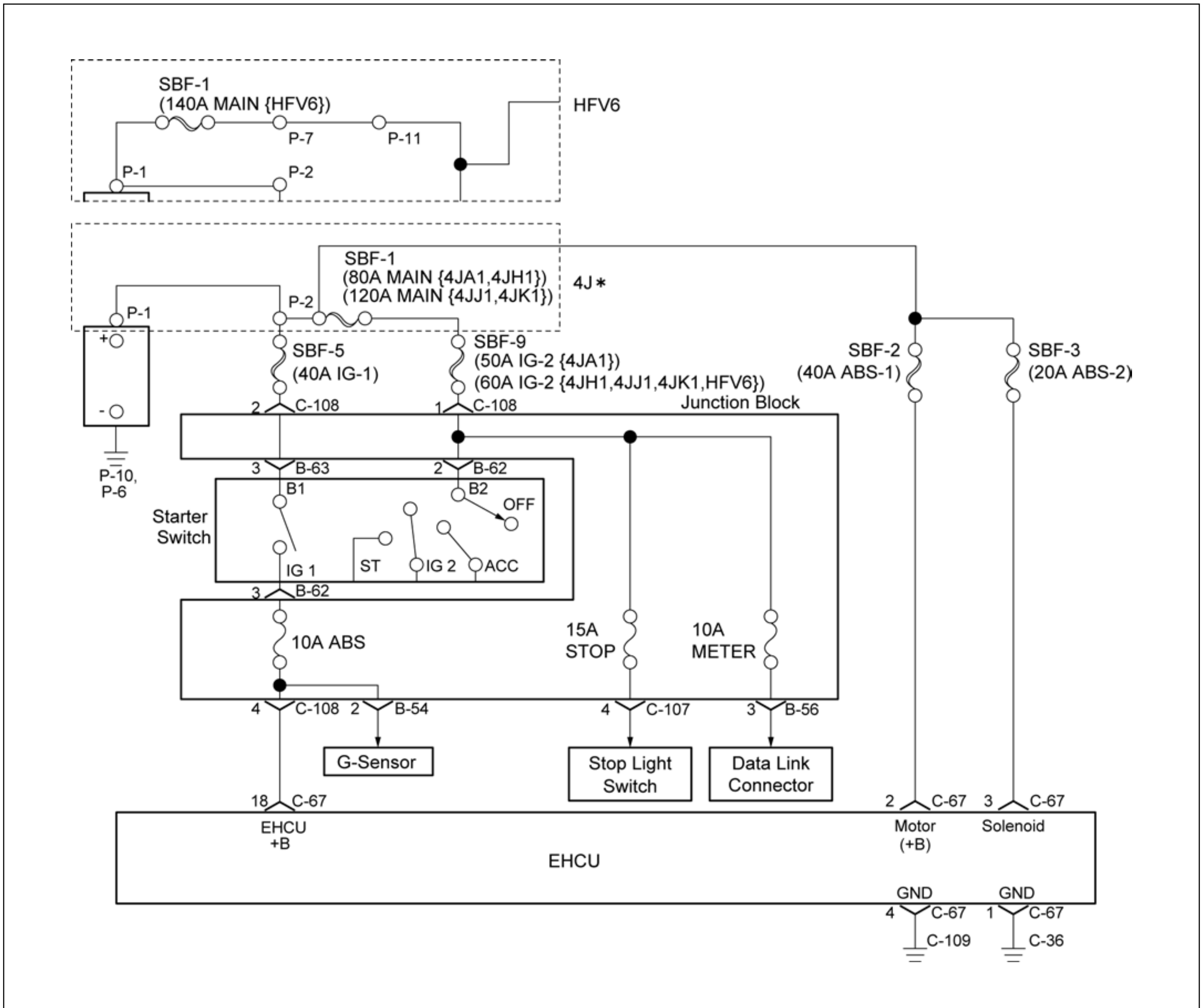


RTW75AMF001501

Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at the G sensor harness connector. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition "OFF", disconnect the G sensor and EHCU. 2. Ignition "ON", engine "OFF". 3. Check the supply voltage to G sensor. Was the value normal?	Battery Voltage	Go to Step 5	Go to Step 4
4	Repair or replace the power supply circuit. Is the action complete?	-	Verify repair	-
5	1. Check the circuit between EHCU and G sensor. (Check circuit for an open, short to ground, or short to voltage.) 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Remove the G sensor. 2. Reconnect G sensor and EHCU 3. Install the Tech 2. 4. Ignition "ON", engine "OFF". 5. Observe the G sensor reading on Tech 2. If G sensor inclines, reading voltage will change. Is the reading voltage between specified values?	1.0 - 4.0V	Go to Step 7	Go to Step 8
7	1. Ignition "OFF". 2. Install the G sensor. 3. Install the Tech 2. 4. Ignition "ON", engine "OFF". 5. Select "Display DTCs" with the Tech 2. Are any DTCs stored?	-	Go to Step 8	Verify repair
8	1. Replace G sensor. 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 9	Verify repair
9	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0277 (Flash Code 77) System Voltage Low
DTC C0278 (Flash Code 78) System Voltage High

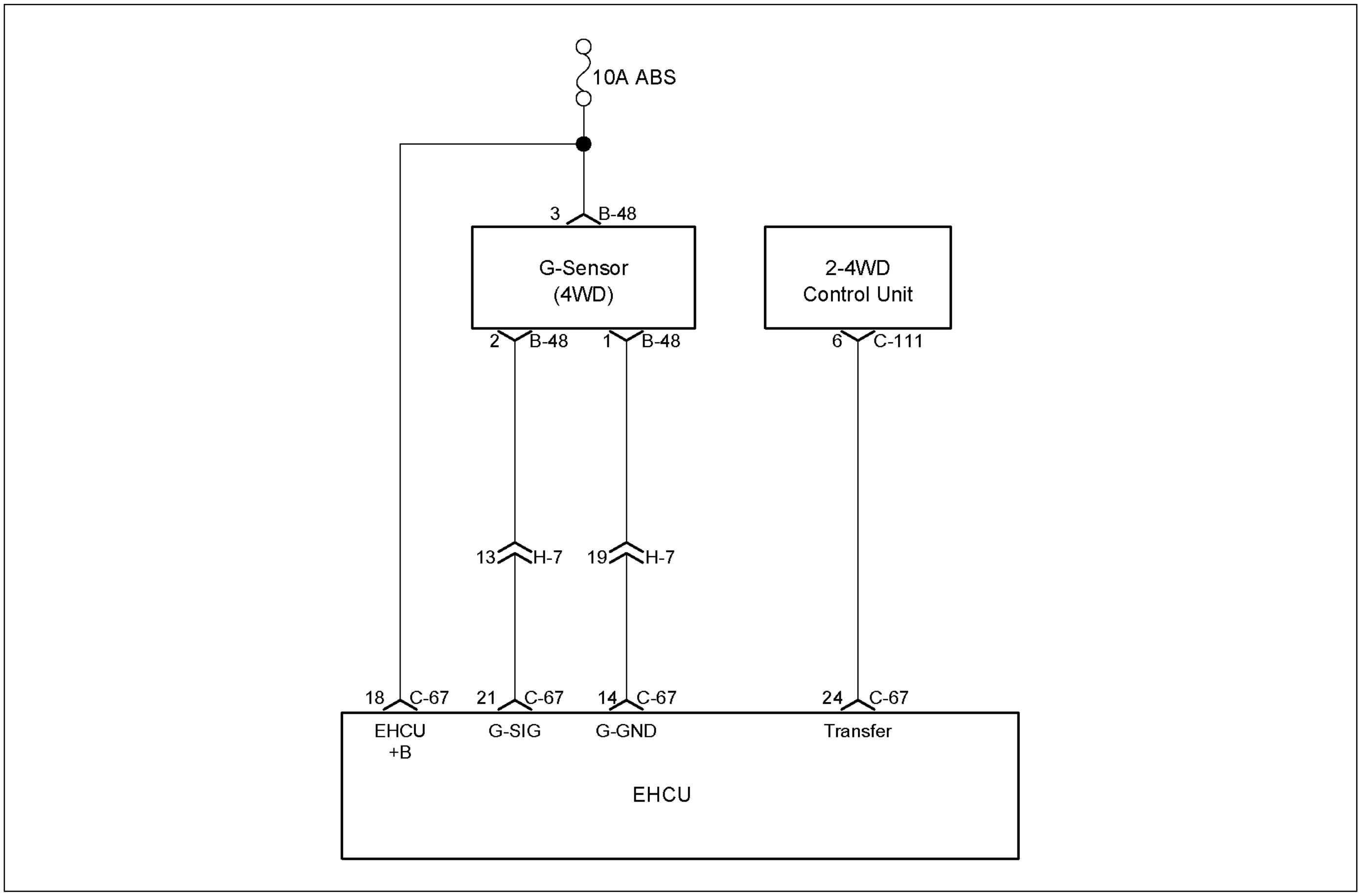


RTW75ALF000301

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at EHCU 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition “OFF”, disconnect EHCU. 2. Ignition “ON”, engine “OFF”. 3. Check the supply voltage to EHCU. Is the value normal?	Battery Voltage	Go to Step 5	Go to Step 4
4	Repair or replace the power supply circuit. Is the action complete?	-	Verify repair	-

Step	Action	Value(s)	Yes	No
5	1. Check the power supply circuit. (Check circuit for an open, short to ground, or short to voltage.) 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 6
6	1. Ignition “ON”, engine “OFF”. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 7	Verify repair
7	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0282 (Flash Code 82) 4 Wheel Drive State Input Signal Failure

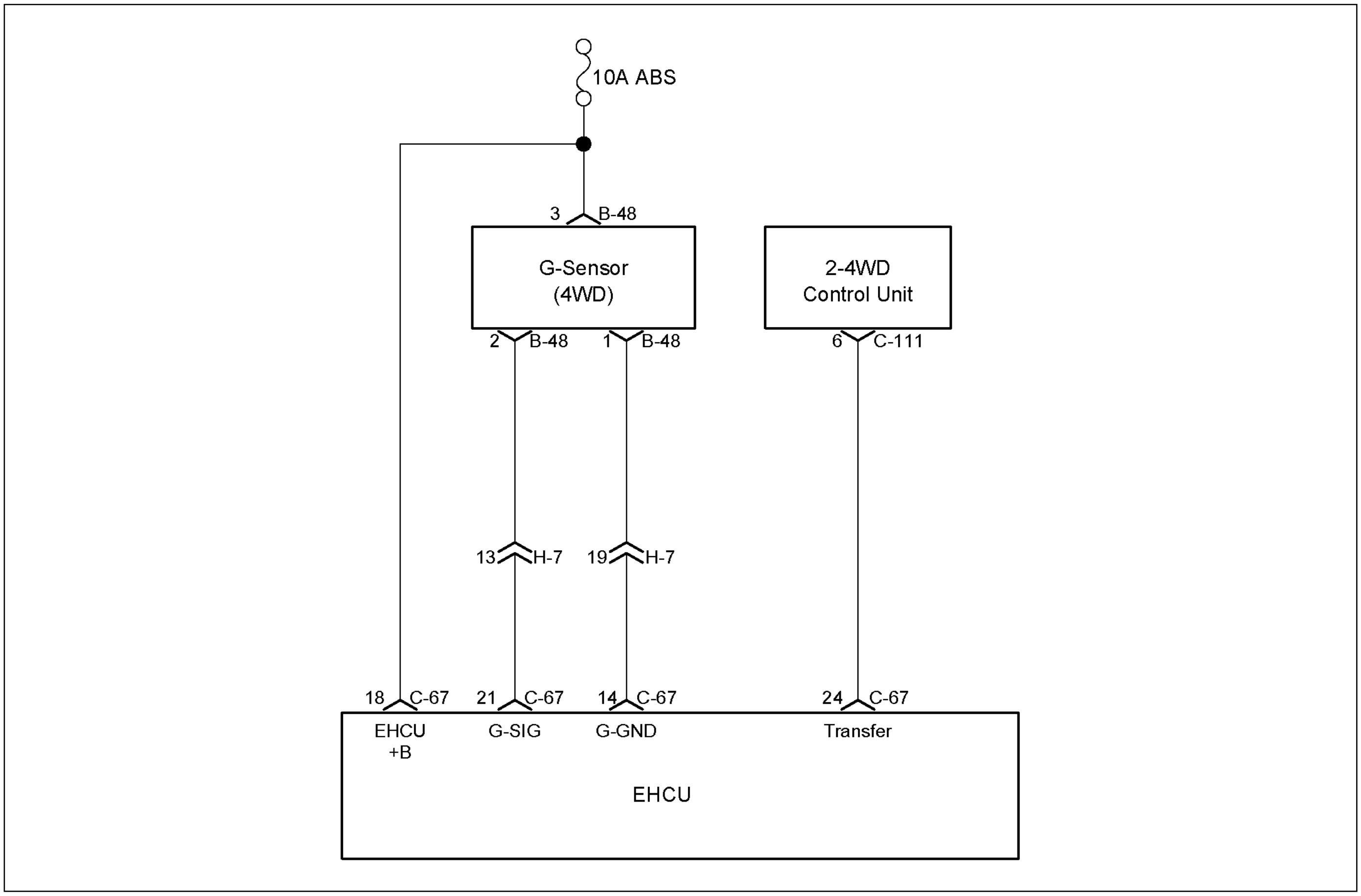


RTW75AMF001501

Step	Action	Value(s)	Yes	No
1	Were the steps of the "Basic Diagnostic Flow Chart" performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Check for a poor connection at EHCU and 2-4WD control unit. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 3
3	1. Ignition "OFF", disconnect the EHCU and 2-4WD control unit. 2. Check the circuit between EHCU and 2-4WD control unit. (Circuit for an open, short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 4
4	1. Check the 2-4WD Control system. 2. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Ignition "OFF". 2. Connect 2-4WD control unit. 3. Disconnect EHCU. 4. Ignition "ON," engine "OFF." 5. Install the high impedance digital multimeter. 6. Check the transfer (2-4WD control unit) signal value. (Battery voltage is more than 10V.) Was the value normal?	Transfer 2WD Mode: 8.3Hz (±15%) Transfer 4WD Mode: 4.2Hz (±15%)	Go to Step 7	Go to Step 6
6	Replace 2-4WD control unit. Is the action complete?	-	Go to Step 7	-
7	1. Ignition “ON”, engine “OFF”. 2. Select “Display DTCs” with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 8	Verify repair
8	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

DTC C0285 (Flash Code 85) Control Module Vehicle Options Incorrect

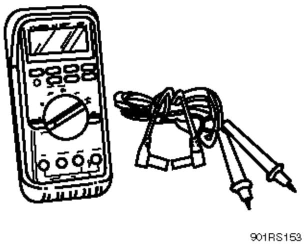
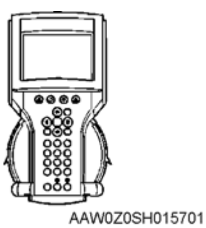


RTW75AMF001501

Step	Action	Value(s)	Yes	No
1	Were the steps of the “Basic Diagnostic Flow Chart” performed?	-	Go to Step 2	Go to Basic Diagnostic Flow Chart
2	1. Ignition “OFF”. 2. Check for vehicle type and EHCU type. (Vehicle type : 2WD or 4WD) 3. Check that the EHCU type is the same as the vehicle type. If the EHCU type differs from the vehicle type, EHCU is replaced. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Go to Step 3	-
3	1. Check for vehicle type. (Vehicle type : 2WD or 4WD) Is vehicle type 2WD?	-	Go to Step 4	Go to Step 5

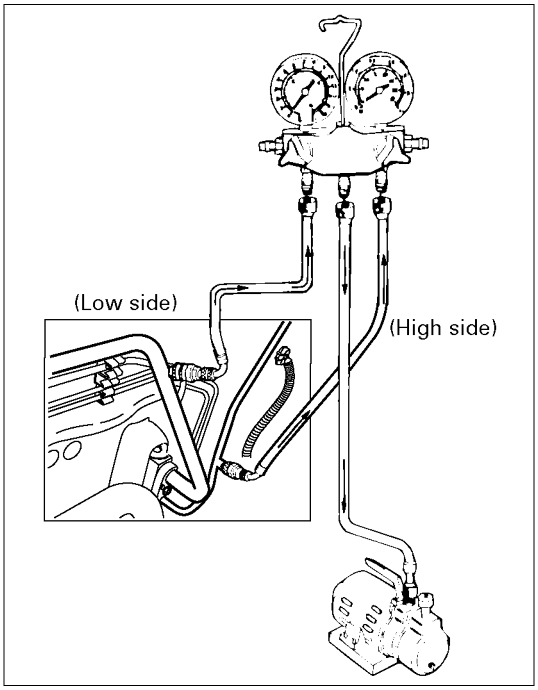
Step	Action	Value(s)	Yes	No
4	1. Ignition "OFF". 2. Check for a poor condition at the EHCU harness connector. 3. Check the EHCU circuit for an open, short to ground, or short to voltage. Also, check the EHCU ignition feed circuit for an open or short to ground and the EHCU ground circuit for an open or short to voltage. 4. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair	Go to Step 9
5	1. Ignition "OFF", disconnect the EHCU and G sensor. 2. Check the circuit between EHCU and G sensor. (short to ground, or short to voltage.) 3. If a problem is found, repair as necessary. Was a problem found?	-	Verify repair Go to Step 6	Go to Step 6
6	1. Remove the G sensor. 2. Reconnect G sensor and EHCU 3. Install the Tech 2. 4. Ignition "ON", engine "OFF". 5. Observe the G sensor reading on Tech 2. If G sensor inclines, reading voltage will change. Is the reading voltage between specified values?	1.0 – 4.0 V	Go to Step 7	Go to Step 8
7	1. Ignition "OFF". 2. Install the G sensor. 3. Install the Tech 2. 4. Ignition "ON", engine "OFF". 5. Select "Display DTCs" with the Tech 2. Are any DTCs stored?	-	Go to Step 8	Verify repair
8	1. Replace G sensor. 2. Select "Display DTCs" with the Tech 2. Note: Perform the various tests (actuator test, test run, brake test, etc.) then observe the DTC with a Tech 2. Are any DTCs stored?	-	Go to Step 9	Verify repair
9	Replace EHCU. Note: Check the EHCU type for specification, when the EHCU is replaced. (Specification ; 2WD model or 4WD model) Is the action complete?	-	Verify repair	-

Special Tools

ILLUSTRATION	TOOL NO. TOOL NAME
	**5–8840–0366–0** High impedance multimeter
	**5–8840–2835–0** Connector Test Adapter Kit (With Test Lamp)
	Tech2 Kit

REFRIGERANT RECYCLING

Recycle the refrigerant recovered by ACR^4 or equivalent.
For the details of the actual operation, follow the steps in the ACR^4 Manufacturer's Instructions.
ACR^4 (115V 60Hz) :5-8840-0629-0 (J-39500-A)
ACR^4 (220-240V 50/60Hz)
: 5-8840-0630-0 (J-39500-220A)
ACR^4 (220-240V 50/60Hz Australian model)
: 5-8840-0631-0 (J-39500-220ANZ)



F06R300014

EVACUATION OF THE REFRIGERANT SYSTEM

NOTE:
Explained below is a method using a vacuum pump. Refer to the ACR^4 (or equivalent) Manufacturer's Instructions when evacuating the system with ACR^4 (or equivalent).

Air and moisture in the refrigerant will cause problems in the air conditioning system.
Therefore, before charging the refrigerant, be sure to evacuate air and moisture thoroughly from the system.

1) Connect the gauge manifold.
   - High-pressure valve (HI) - Discharge-side
   - Low-pressure valve (LOW) - Suction-side
2) Discharge and recover the refrigerant.
3) Connect the center hose of the gauge manifold set to the vacuum pump inlet.
4) Operate the vacuum pump, open shutoff valve and then open both hand valves.
5) When the low-pressure gauge indicates approx. 100kPa (750 mmHg/30 inHg), continue the evacuation for 5 minutes or more.
6) Close both hand valves and stop the vacuum pump.
7) Check to ensure that the pressure does not change after 10 minutes or more.
   - If the pressure changes, check the system for leaks.
   - If leaks occur, retighten the refrigerant line connections and repeat the evacuation steps.
8) If no leaks are found, again operate the vacuum pump for 20 minutes or more. After confirming that the gauge manifold pressure is at 100 kPa (750 mmHg/30 inHg), close both hand valves.
9) Close positive shutoff valve.
   Stop the vacuum pump and disconnect the center hose from the vacuum pump.

SECTION 5B

ANTI-LOCK BRAKE SYSTEM

TABLE OF CONTENTS

Service Precaution

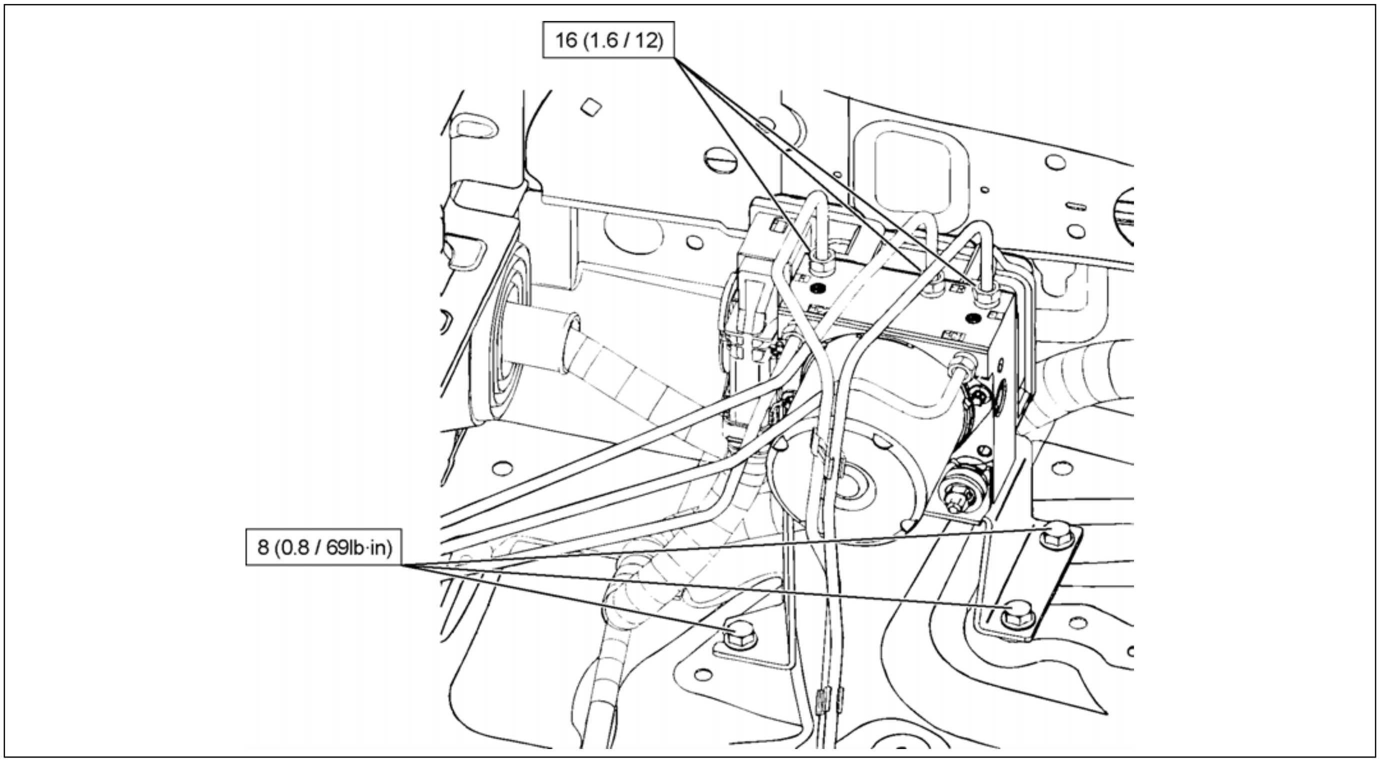
WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

Torque Specifications

Electronic Hydraulic Control Unit

N·m (kgf·m/lb·ft)



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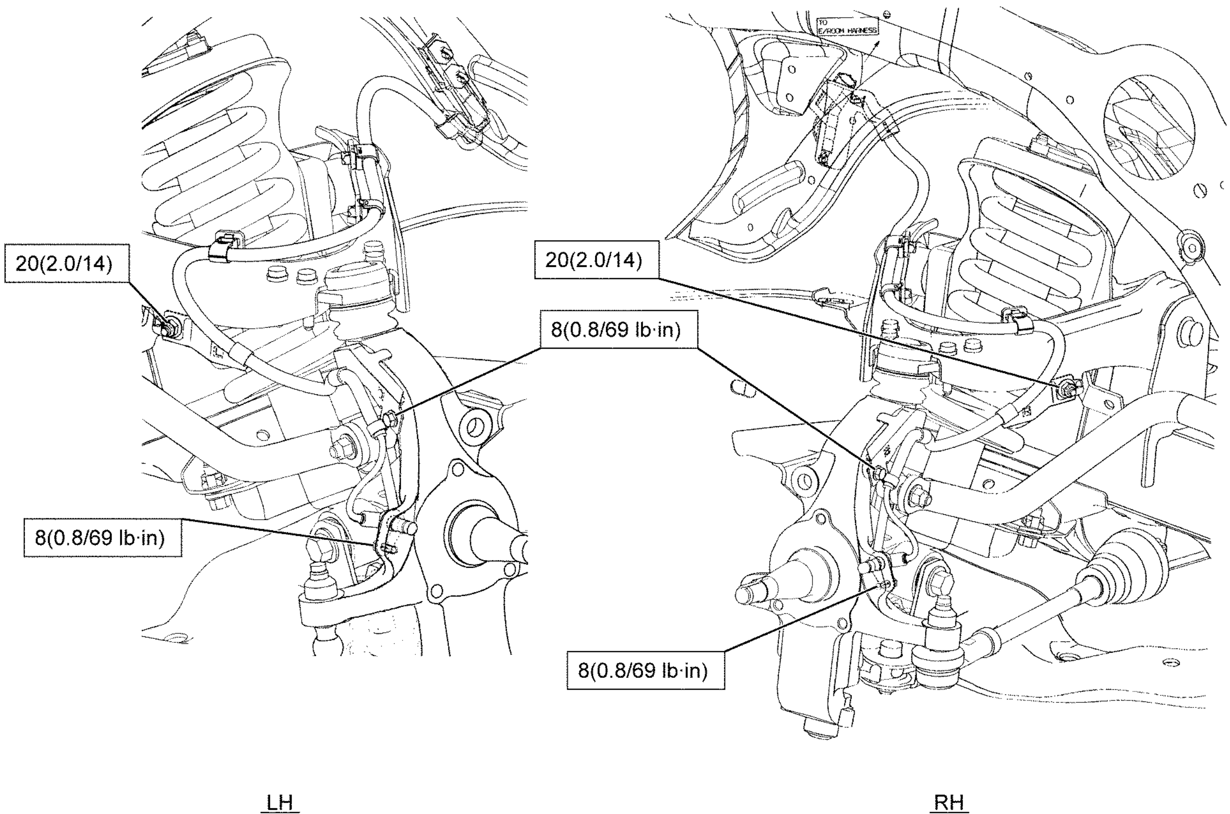
4×2 (Except High Ride Suspension) Front Wheel Speed Sensor N·m (kgf·m/lb·ft)



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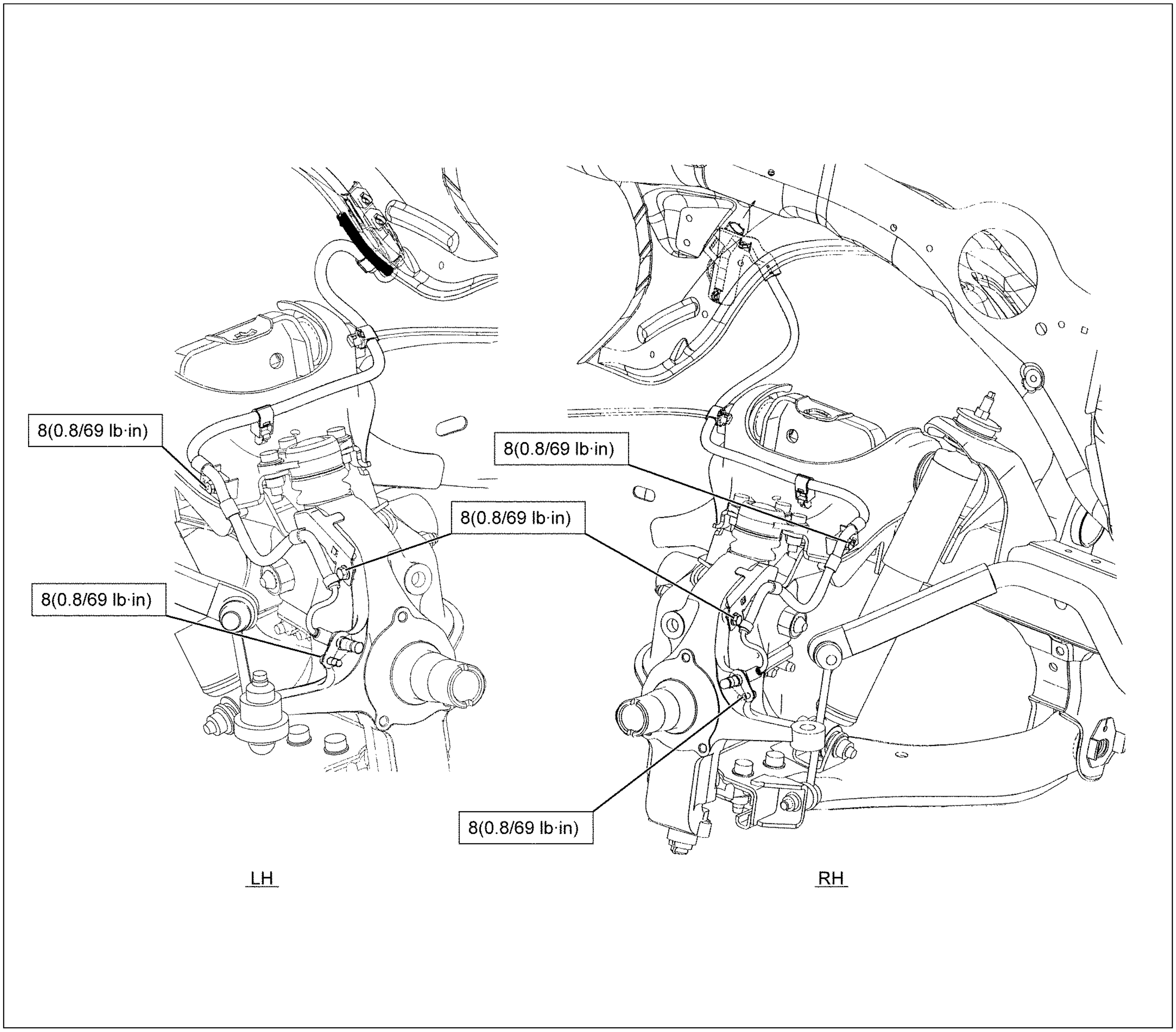
4×2 High Ride Suspension, 4×4 Front Wheel Speed Sensor N·m (kgf·m/lb·ft)



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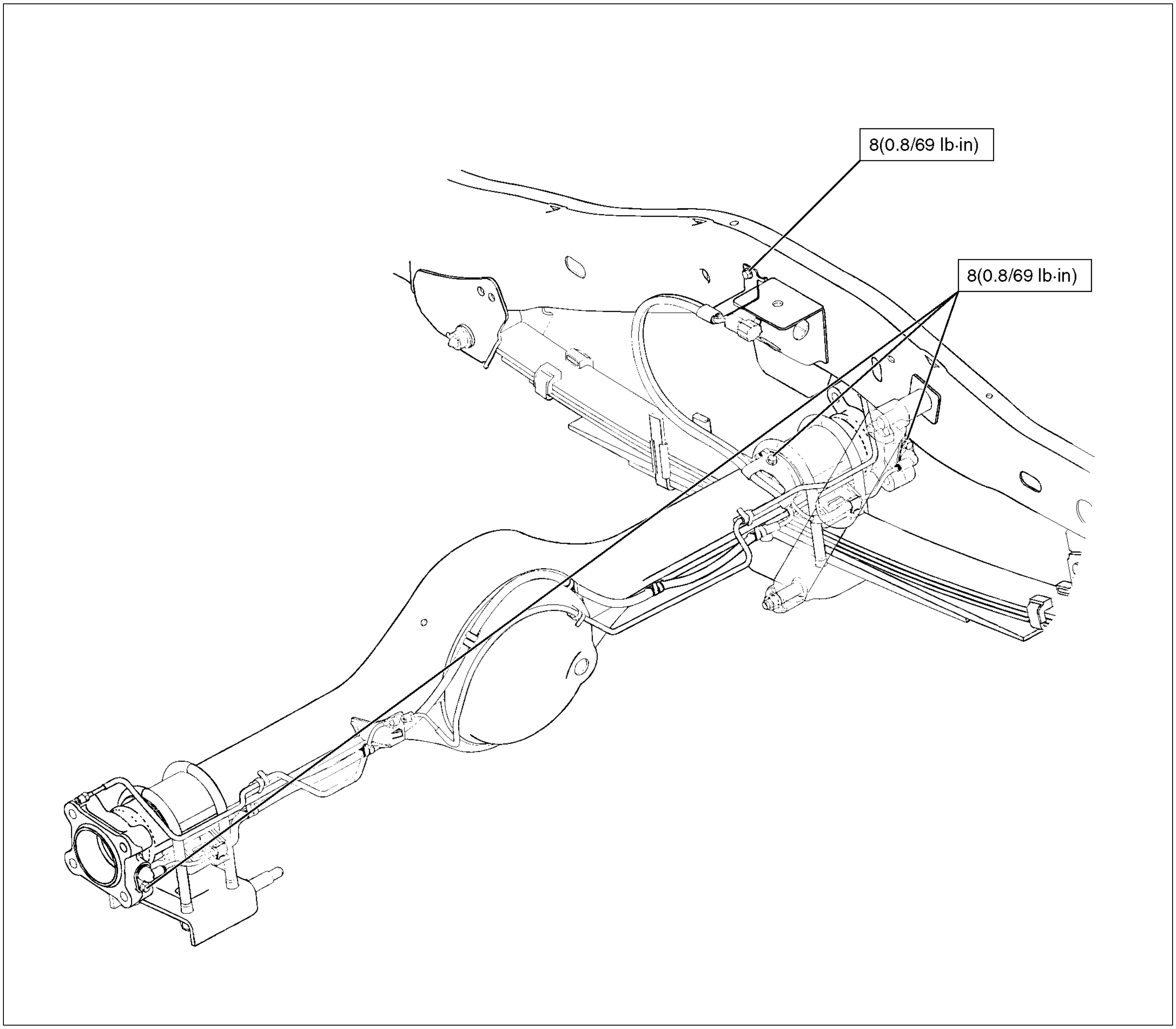
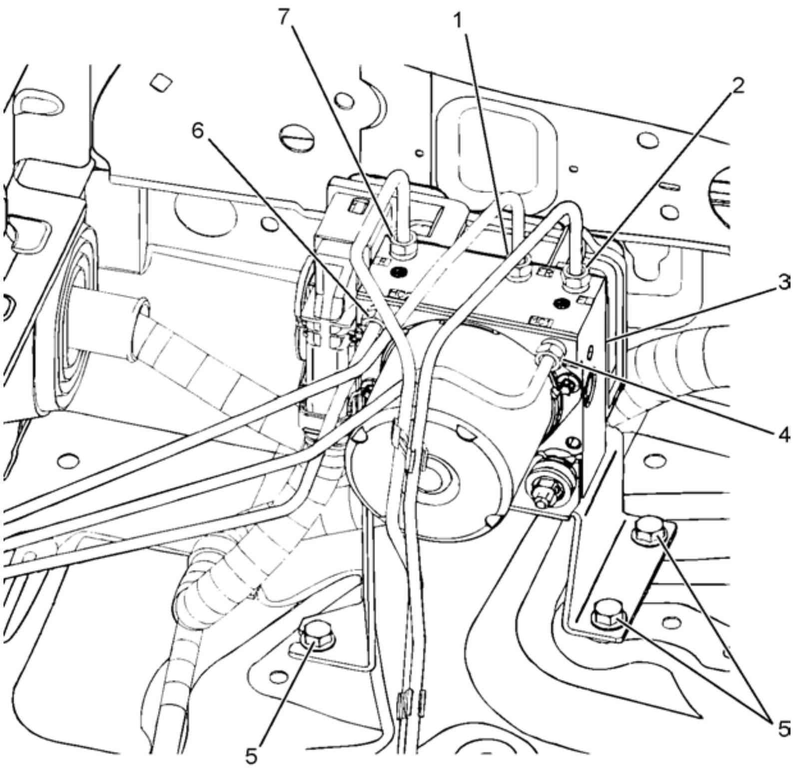
Rear Wheel Speed Sensor

N·m (kgf·m/lb·ft)



Electronic Hydraulic Control Unit

Electronic Hydraulic Control Unit and Associated Parts



RTW75BMF000301

Legend

(1) Flare Nut to front right wheel cylinder
(2) Flare Nut to front left wheel cylinder
(3) Electronic Hydraulic Control Unit (EHCU)
(4) Flare Nut from master cylinder front
(5) Bolt
(6) Flare Nut from master cylinder rear
(7) Flare Nut to rear wheel cylinder

Removal

1. Disconnect the harness connector.
2. Loosen five flare nuts and remove brake pipes.
   - After disconnecting brake pipe, cap or tape the openings of the brake pipe to prevent the entry of foreign matter.
3. Remove three bracket fixing bolts.

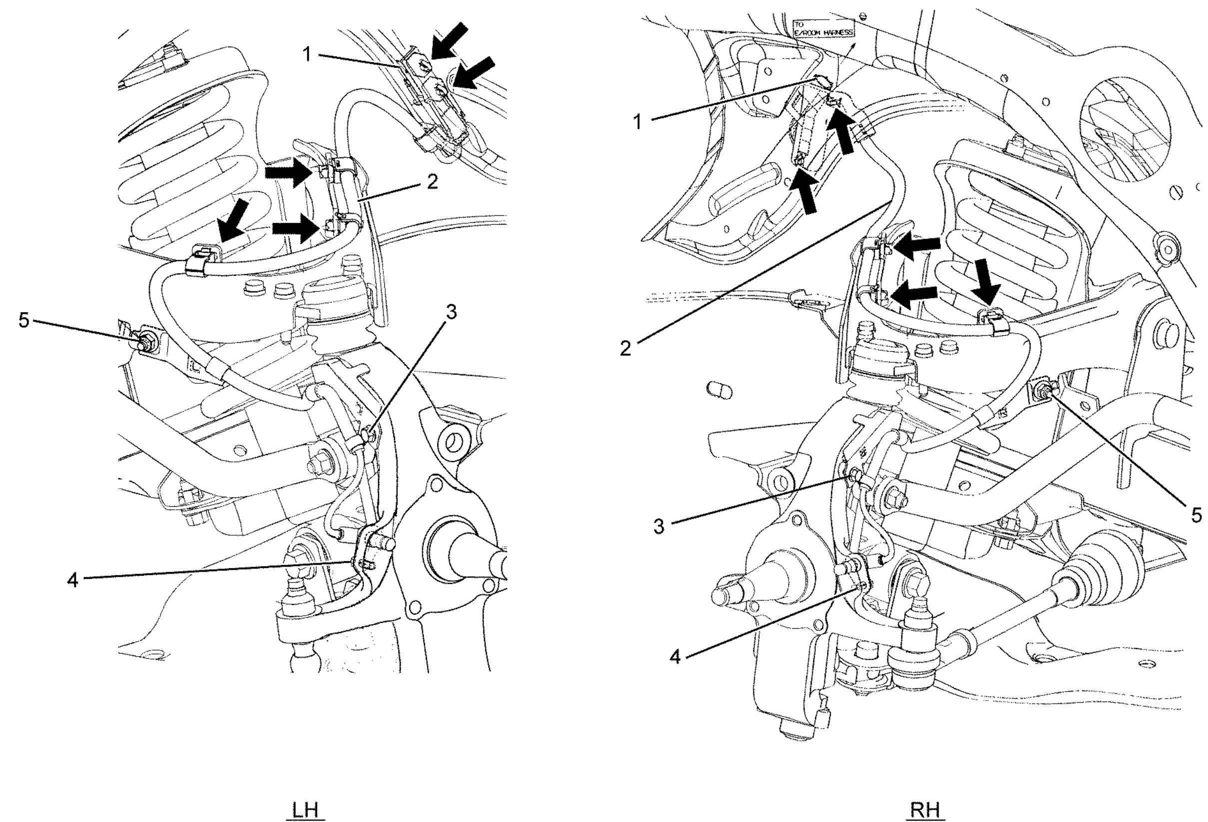
Installation

1. Install EHCU and tighten the bolt to the specified torque.
   Torque: 8 N·m (0.8 kgf·m /69 lb·in)
2. Tighten the flare nuts to the specified torque.
   Torque: 16 N·m (1.6 kgf·m /12 lb·ft)
3. Connect the harness connector.

Front Wheel Speed Sensor

Front Wheel Speed Sensor and Associated Parts

4×2 (Except High Ride Suspension)

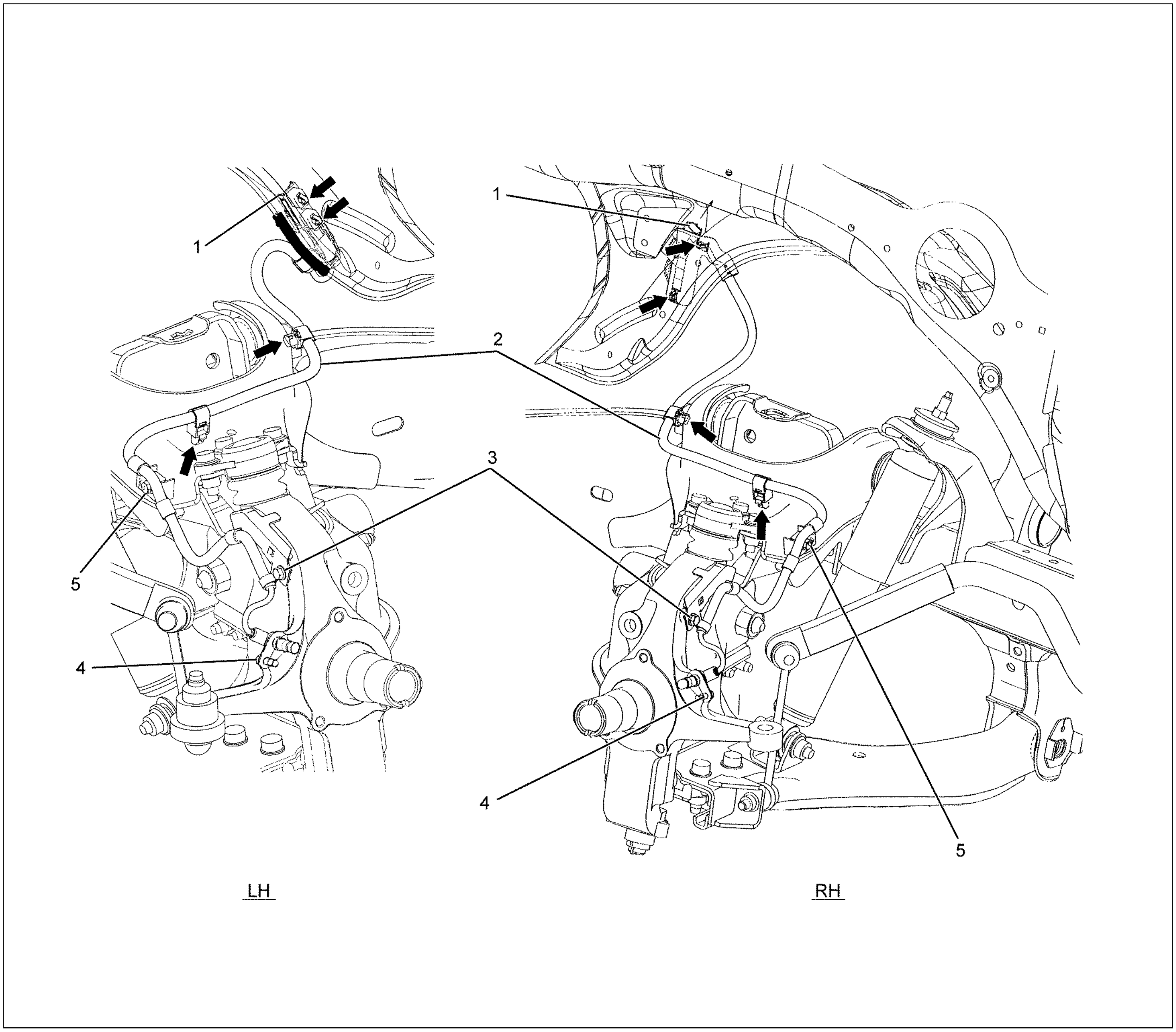


RTW55ALF000401

Legend

(1) Connector Portion
(2) Front Speed Sensor Assembly
(3) Bolt: Cable to Knuckle
(4) Bolt: Sensor to Knuckle
(5) Nut: Cable to Upper Link

4×2 High Ride Suspension, 4×4



RTW55ALF000201

Legend

- (1) Connector Portion
- (2) Front Speed Sensor Assembly
- (3) Bolt: Cable to Knuckle
- (4) Bolt: Sensor to Knuckle
- (5) Bolt: Cable to Upper Link

Removal

1. Remove speed sensor connector at connector portion.
2. Remove sensor fixing bolt (4).
3. Remove cable fixing bolts and nut (4×2).
4. Disconnect the arrow mark locks of the cable clips.
5. Remove the speed sensor assembly.

Inspection and Repair

1. Check the speed sensor head for presence of foreign materials; remove any dirt, etc.
2. Check the head for damage; replace speed sensor if necessary.
3. Check the speed sensor cable for short or open circuit, and replace with a new one if necessary.
   To check for cable short or open, bend or stretch the cable while checking for continuity.

Installation

1. Install the speed sensor in the knuckle and take care not to hit the speed sensor head during installation.
2. Install speed sensor fixing bolt and tighten the fixing bolt to the specified torque.
   Torque: 8 N·m (0.8 kgf·m /69 lb·in)
3. Connect the cable clips at the arrow mark places.
4. Install the cable fixing bolt and tighten the fixing bolt to the specified torque.
   Torque:
   Bolt 8 N·m (0.8 kgf·m /69 lb·in)

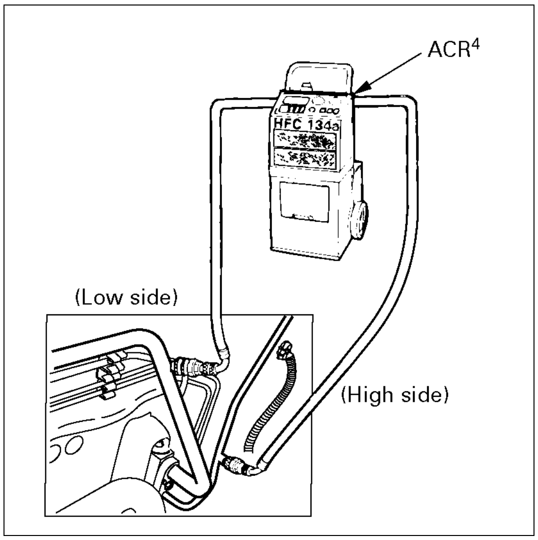
NOTE: Confirm that the cable is not twisted when connecting the speed sensor cable.

5. Connect the speed sensor connector.

CHARGING THE REFRIGERANT SYSTEM

There are various methods of charging refrigerant into the air conditioning system.
These include using the ACR^4 (HFC-134a Refrigerant Recovery/ Recycling/Recharging/System) or equivalent and direct charging with a manifold gauge charging station.

ACR^4 (115V 60Hz) : 5-8840-0629-0 (J-39500-A)
ACR^4 (220-240V 50/60Hz)
: 5-8840-0630-0 (J-39500-220A)
ACR^4 (220-240V 50/60Hz Australian model)
: 5-8840-0631-0 (J-39500-220ANZ)



F06R300012

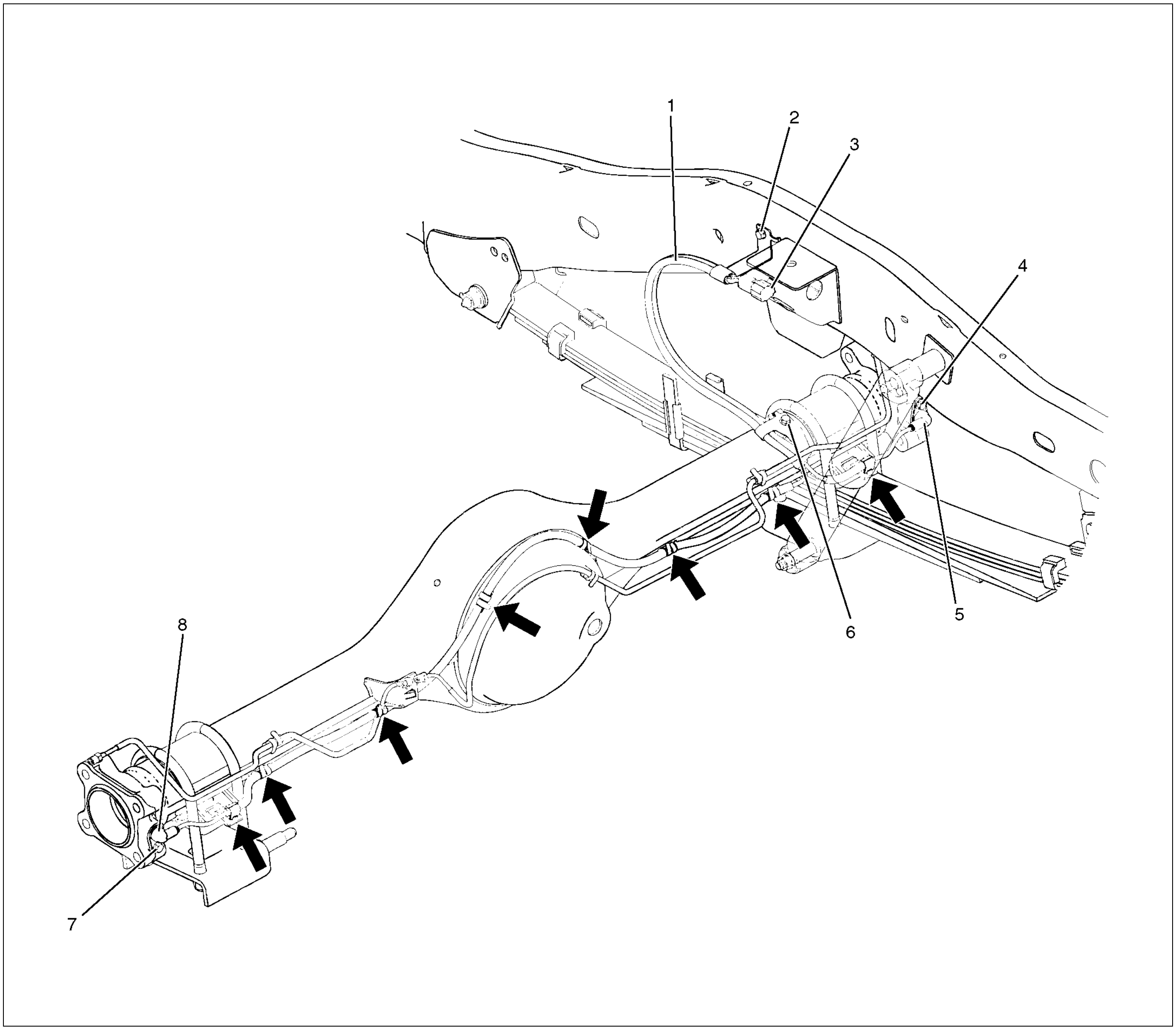
Charging procedure

- **ACR^4 (or equivalent) method**

For the charging of refrigerant recovered by ACR^4, follow the Manufacturer's Instruction.

Rear Wheel Speed Sensor

Rear Wheel Speed Sensor and Associated Parts



Legend

(1) Rear Speed Sensor Assembly
(2) Bolt: Cable to frame
(3) Connector
(4) Bolt: Sensor to rear axle
(5) Speed Sensor
(6) Bolt: Cable to axle
(7) Bolt: Sensor to rear axle
(8) Speed Sensor

Removal

1. Disconnect the harness connector.
2. Remove the cable fixing bolt.
3. Disconnect the cable fixing clips (arrow marked).
4. Remove the speed sensor fixing bolts and speed sensor.

Inspection and Repair

1. Check speed sensor head for presence of foreign materials; remove any dirt, etc.
2. Check the head for damage, and replace speed sensor if necessary.

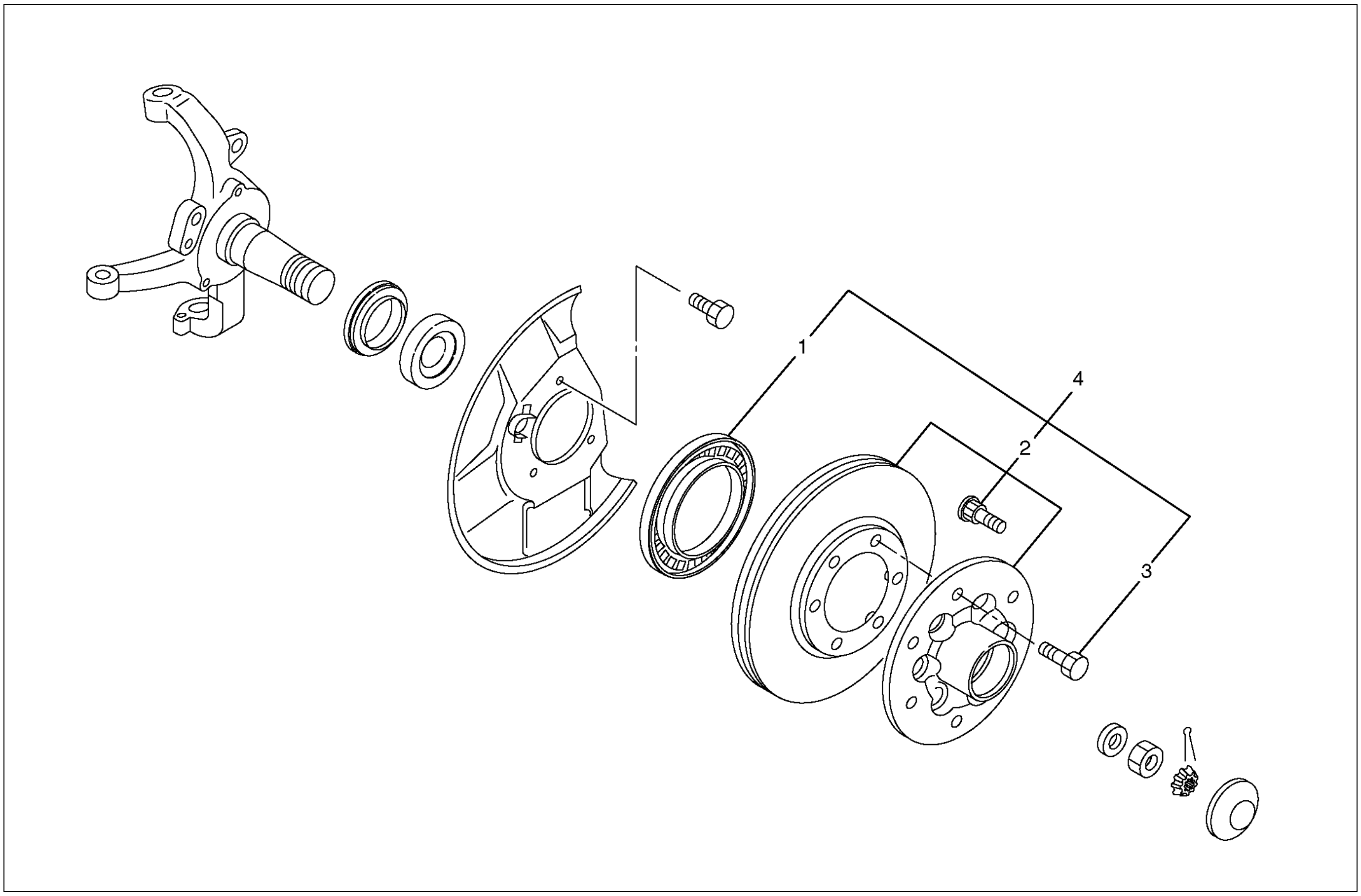
3. Check speed sensor cable for short or open, and replace with a new one if necessary. To check for cable short or open, bend or stretch the cable while checking for continuity.

Installation

1. Install the speed sensor.
2. Tighten the sensor fixing bolts to the specified torque.
   Torque: 8 N·m (0.8 kgf·m / 69 lb·in)
3. Connect the cable fixing clips (arrow marked).
4. Install the cable fixing bolts and tighten it to the specified torque.
   Torque: 8 N·m (0.8 kgf·m / 69 lb·in)
5. Connect the harness connector.

Front Sensor Rotor

Front Sensor Rotor and Associated Parts

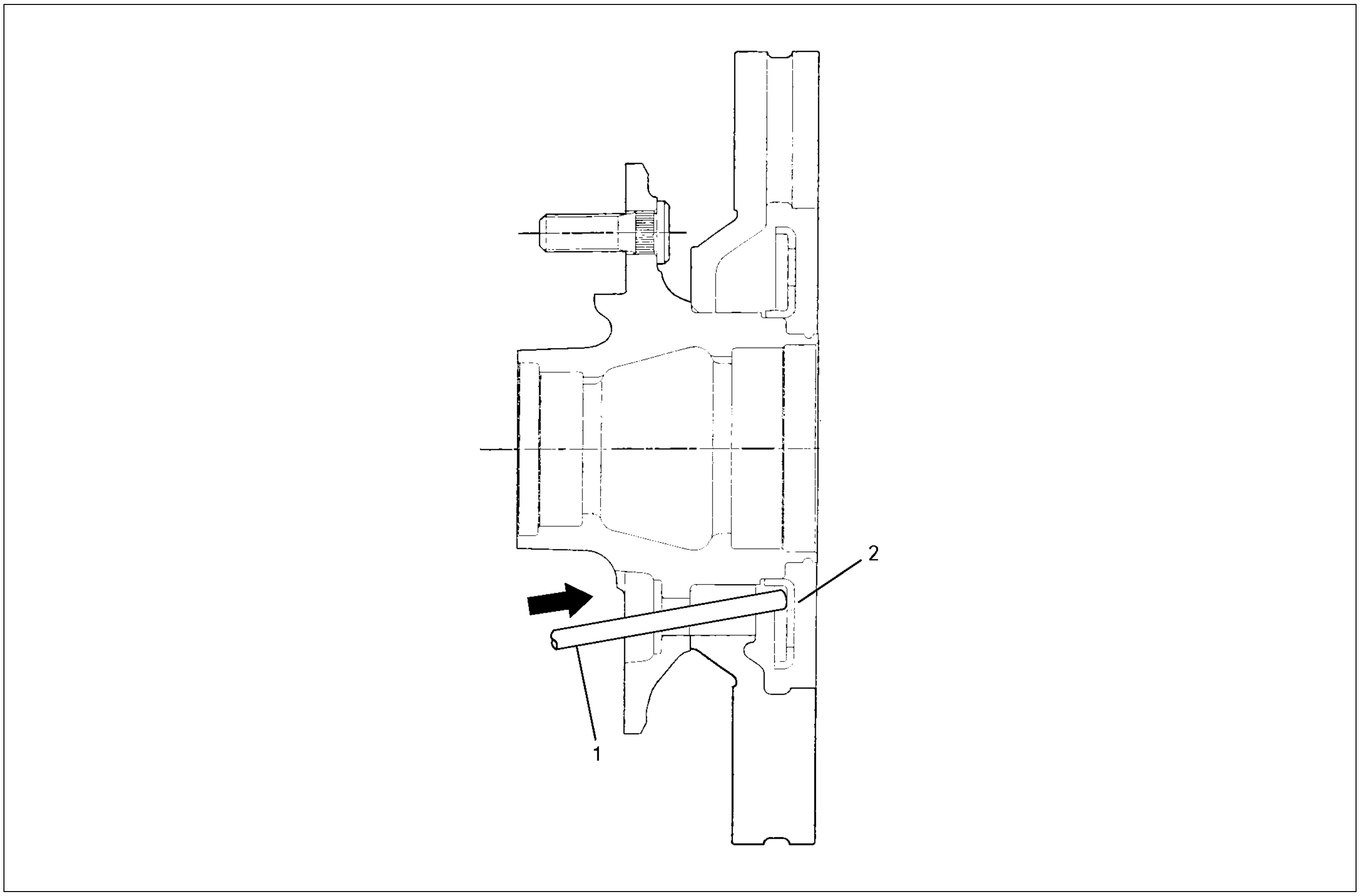


Legend

(1) Sensor Rotor
(2) Hub and Disc
(3) Disc Rotor fixing Bolt
(4) Hub and Disc Assembly

Removal

1. Remove the hub and disc assembly. (Refer to the section Front wheel Drive).
2. Remove two disc rotor fixing bolts on a diagonal.
3. Drive out the sensor rotor using a metal bar and hammer through the two bolt holes.
   - Discard the used sensor rotor.
4. Install disc rotor fixing bolts and tighten them to the specified torque.
   Torque: 103 N·m (10.5 kgf·m / 76 lb·ft)



411R300007

Legend

(1) Metal Bar

(2) Sensor Rotor

Inspection and Repair

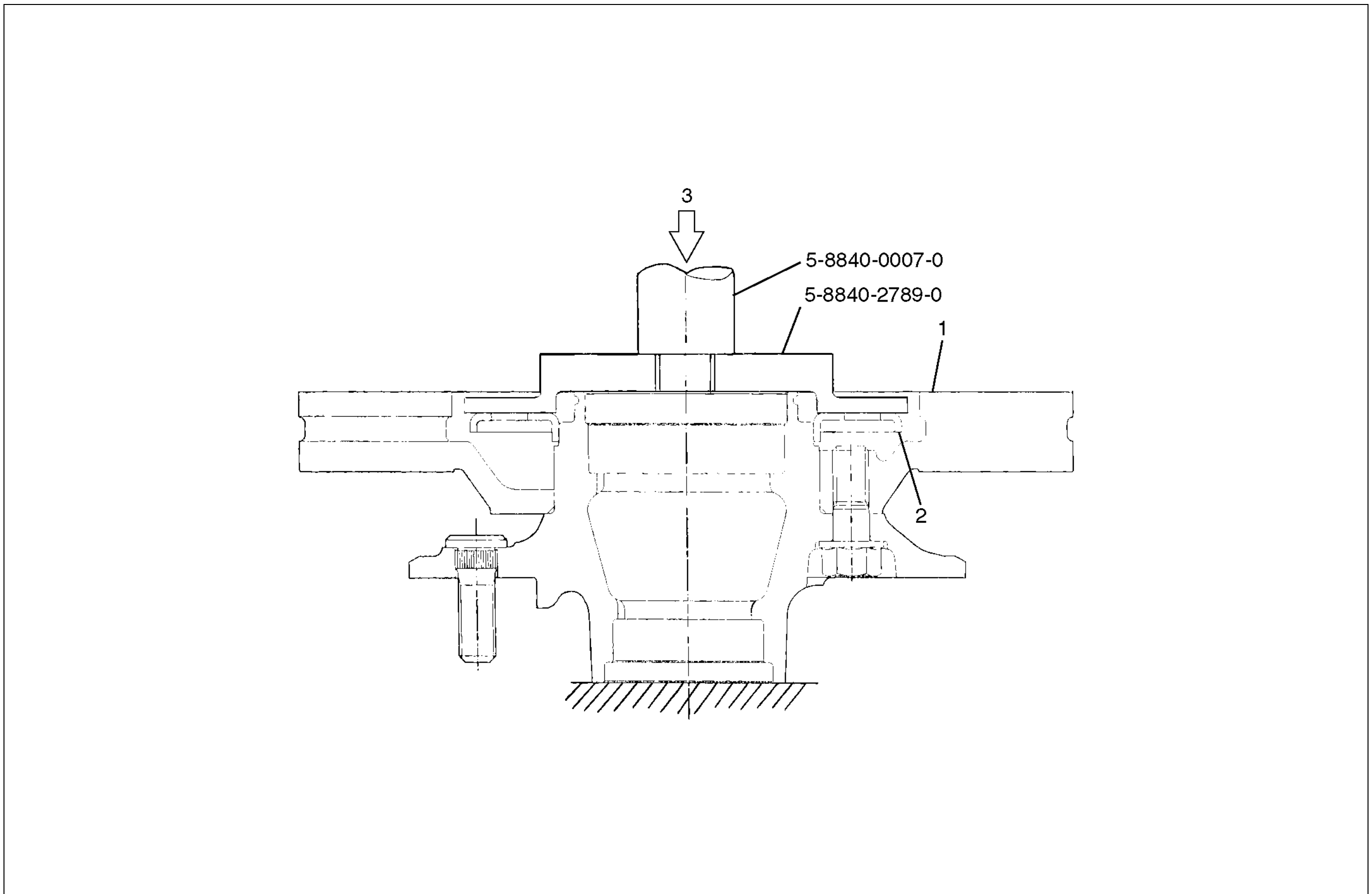
Make all necessary adjustments, repairs or part replacement.

- Check damage or powdered iron sticking to the sensor rotor.
- Check play in the sensor rotor.
- Check a broken tooth or indentation in the sensor rotor.

Installation

1. Set a new sensor rotor.
2. Install the new sensor rotor in the hub, using installer 5-8840-2789-0 and grip 5-8840-0007-0.

NOTE: Sensor rotor is surely using a new article.



411R300006

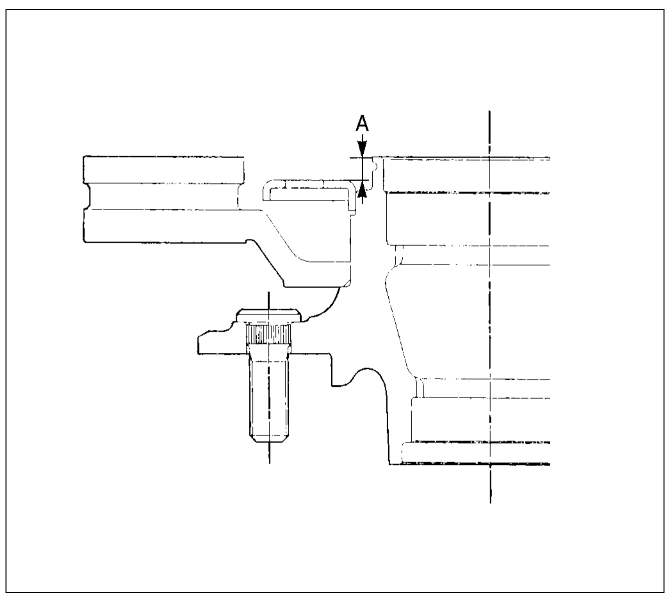
Legend

(1) Hub and Disc
(2) Sensor Rotor
(3) Press

3. Measure the gap “A” at 4 points at intervals of 90° (degrees).
   Confirm that the gap “A” should be within the specified range.

Range

Type	A
4 × 2 (Except High Ride Suspension)	7.0 – 7.4 mm (0.276 – 0.291 in)
4 × 4 4 × 2 High Ride Suspension	7.2 – 7.6 mm (0.283 – 0.299 in)

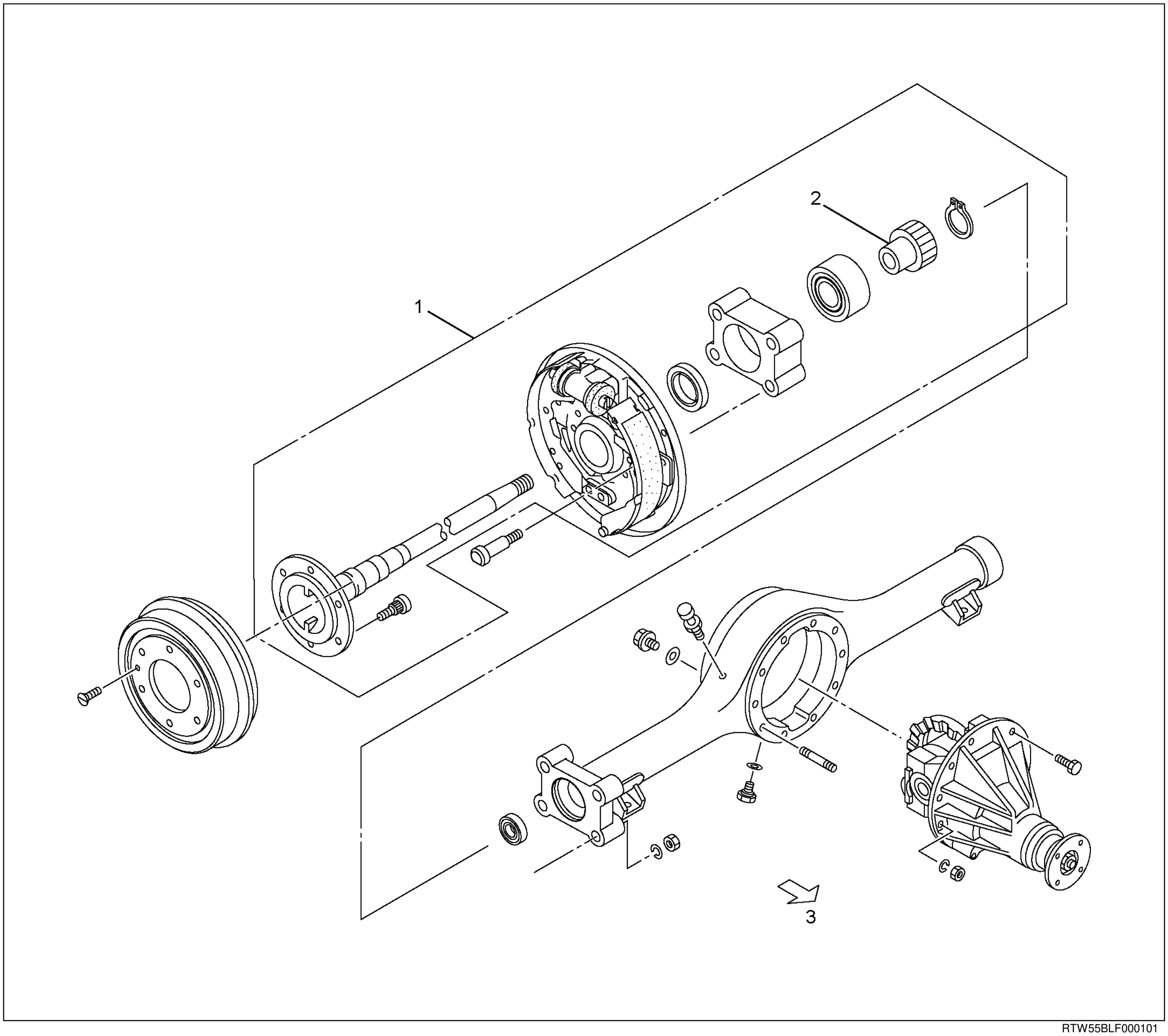


411R300016

4. Install the hub and disc assembly. (Refer to the section Front wheel Drive).

Rear Sensor Rotor

Rear Sensor Rotor and Associated Parts



Legend

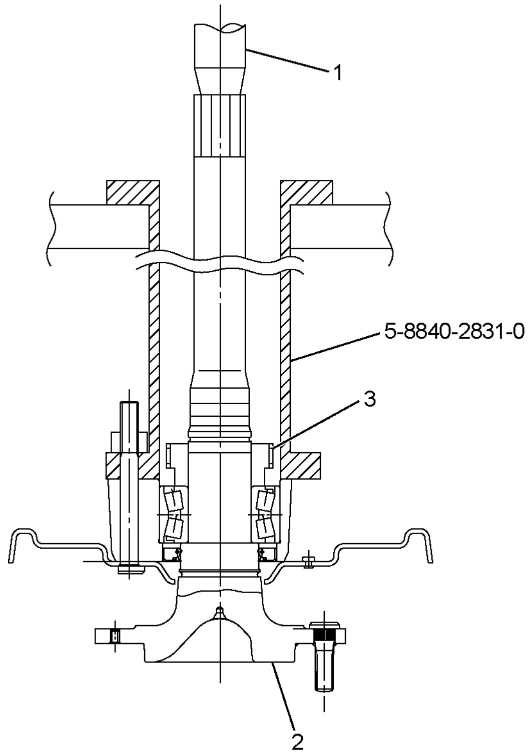
(1) Axle Shaft Assembly with Brake

(2) Sensor Rotor

(3) Front

Removal

1. Remove the axle shaft assembly with brake. (Refer to the section Rear Axle)



RUW55BMF000101

Legend

(1) Bench Press Fitting
(2) Axle Shaft
(3) Sensor Rotor

Inspection and Repair

Make all necessary adjustments, repairs or part replacement.

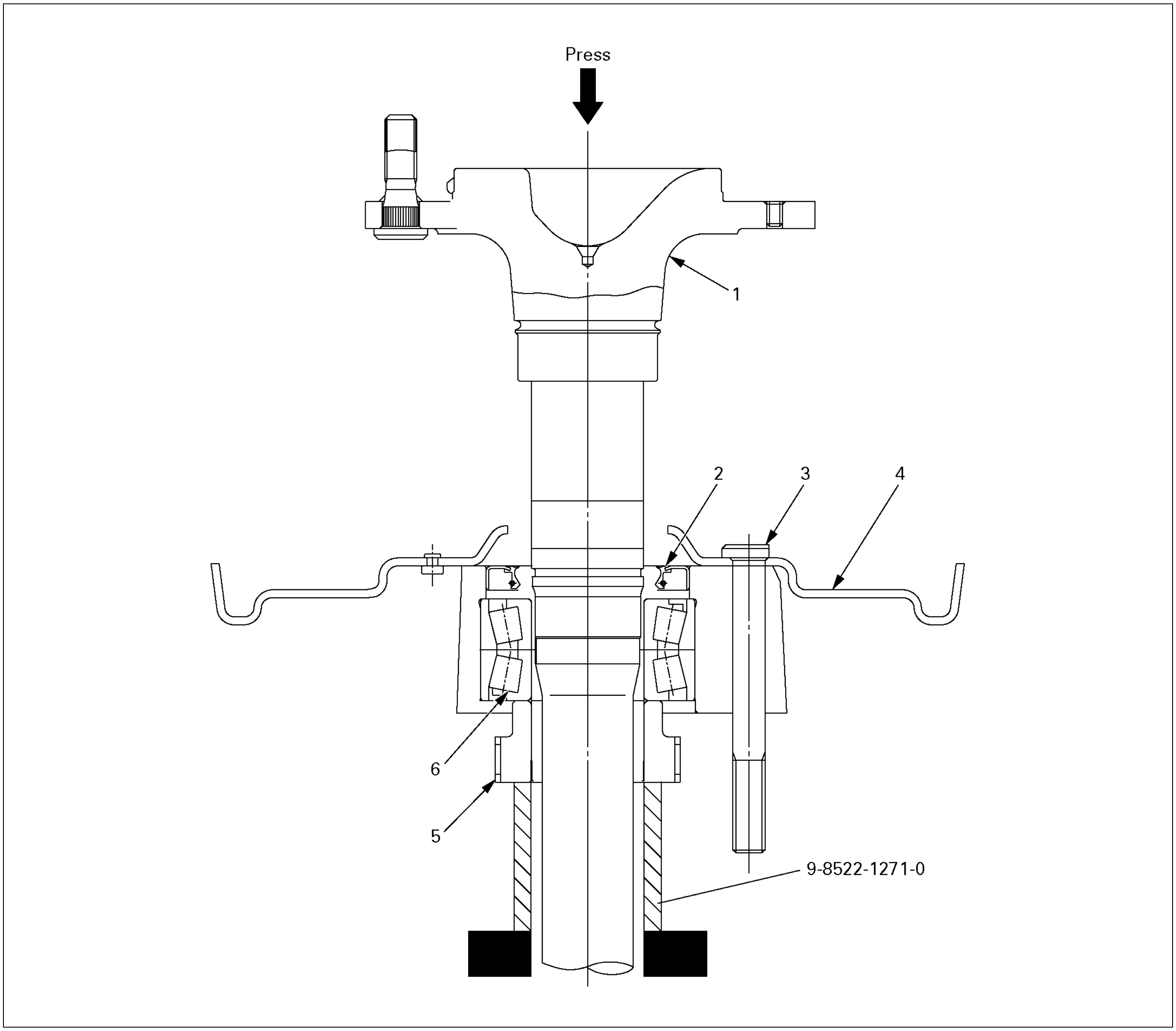
- Check damage or powdered iron sticking to the sensor rotor.
- Check play in the sensor rotor.
- Check a broken tooth or indentation in the sensor rotor.

NOTE: If replacement is required, remove the sensor rotor from the axle shaft assembly with brake. (Refer to the section Rear Axle).

- Discard the used sensor rotor.
  (Snap ring, Oil seal and Bearing)

Installation

1. Install the sensor rotor and assemble it into the axle shaft assembly with back plate, using setting tool 9-8522-1271-0. (Refer to the section Rear Axle)



420R300005

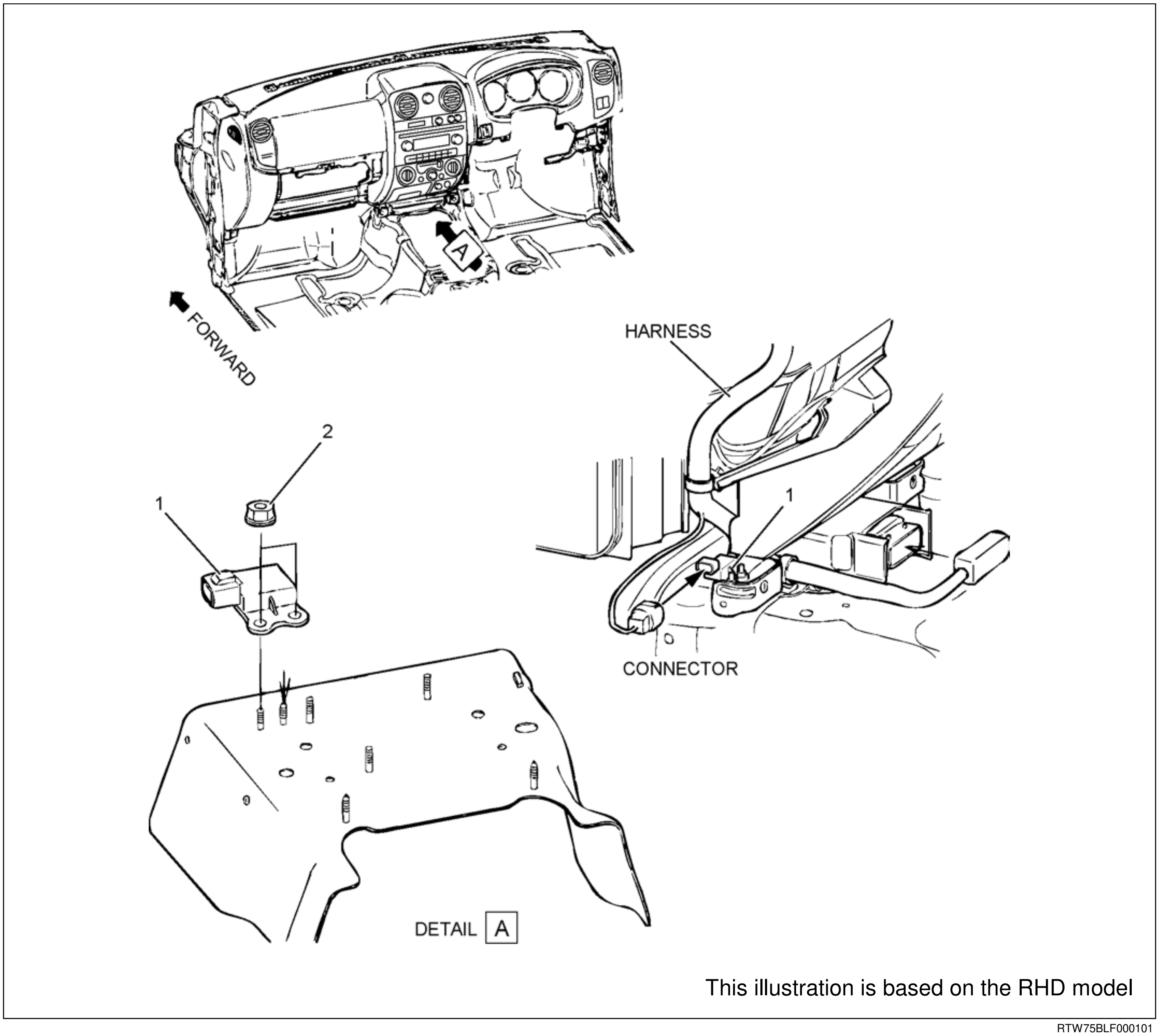
Legend

(1) Axle Shaft
(2) Oil Seal
(3) Bolt
(4) Back Plate
(5) Sensor Rotor
(6) Double Taper Roller Bearing

2. Install the axle shaft assembly with brake in the rear axle. (Refer to the section Rear Axle).

G-Sensor

G-Sensor and Associated Parts



RTW75BLF000101

Legend

(1) G-Sensor

(2) Nut

Removal

1. Remove the front floor console. (Refer to the section Floor Console)
2. Disconnect the connector.
3. Remove the nuts.
4. Take out the G-sensor.

Installation

1. Set the G-sensor.
2. Install the nut and tighten it to specified torque.
   Torque: 8 N·m (0.8 kgf·m / 69 lb·in)
3. Connect the connector.
4. Install the front floor console. (Refer to the section Floor Console)

Special Tools

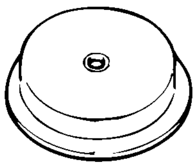
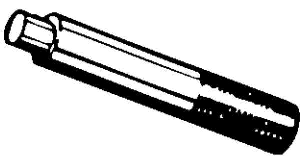
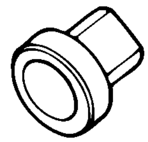
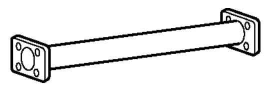
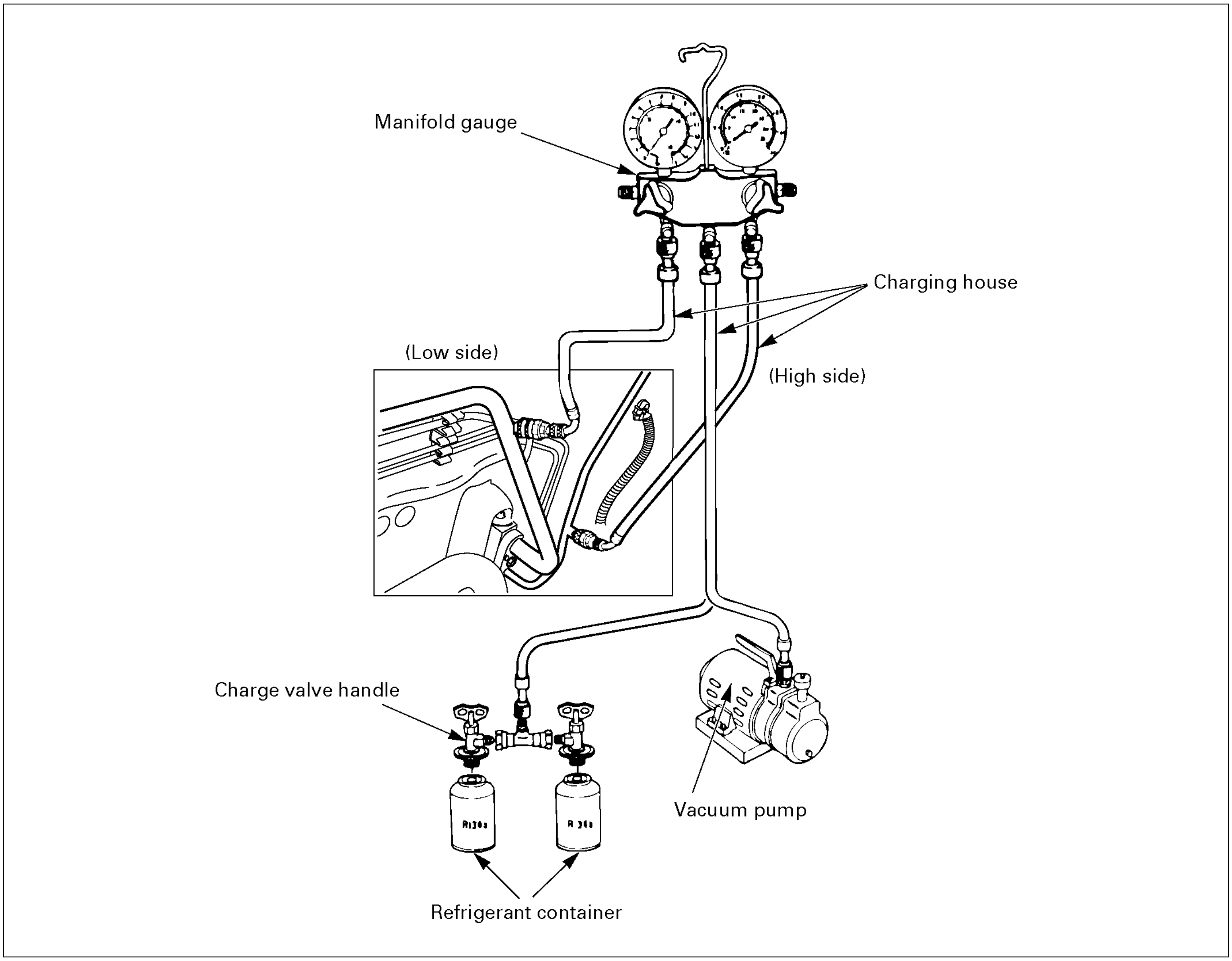
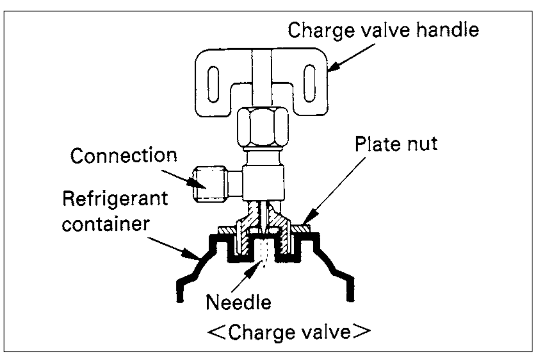
ILLUSTRATION	PART NO. PART NAME
	**5-8840-2789-0** Installer
 901RS268	**5-8840-0007-0** **(J-8092)** Grip

ILLUSTRATION	PART NO. PART NAME
	**9-8522-1271-0** **(J-8609-01)** Setting Tool
	**5-8840-2831-0** Bearing Remover

7. Measurement criteria are defined by the terms "standard" and "limit".
   A measurement falling within the "standard" range indicates that the applicable part or parts are serviceable.
   "Limit" is an absolute value.
   A measurement falling outside the "limit" indicates that the applicable part or parts must be repaired or replaced.
8. Components and parts are listed in the singular form throughout the Workshop Manual.
9. The following directional criteria are used throughout the Workshop Manual:
   Front:
   The cooling fan side of the engine.
   Right:
   The right-hand side of the engine viewed from the flywheel.
   Left:
   The left-hand side of the engine viewed from the flywheel.
   Rear:
   The flywheel side of the engine.
   Cylinder numbers are counted from the front of the engine towards the rear.
   The engine's rotation is clockwise viewed from the front of the engine.



F06R300013



- **Direct charging with a manifold gauge charging station method.**

Handling the charging valve handle when installing refrigerant container.

1) Before attaching the charge valve to the refrigerant container, turn the charge valve handle counterclockwise until the needle is fully retracted.
2) Turn the plate nut counterclockwise until it reaches its highest position relative to the charge valve.
3) Install the charge valve onto the refrigerant container.
4) Turn the plate nut clockwise and connect the center hose of the manifold gauge to the charge valve.
5) Tighten the plate nut sufficiently by hand. Then turn the charge valve handle clockwise to lower the needle and bore a hole in the refrigerant container.
6) Turn the charge valve handle counterclockwise to raise the needle. The refrigerant in the refrigerant container is charged into the air conditioning system by the operation of the manifold gauge.

- **Be absolutely sure not to reuse the emptied**

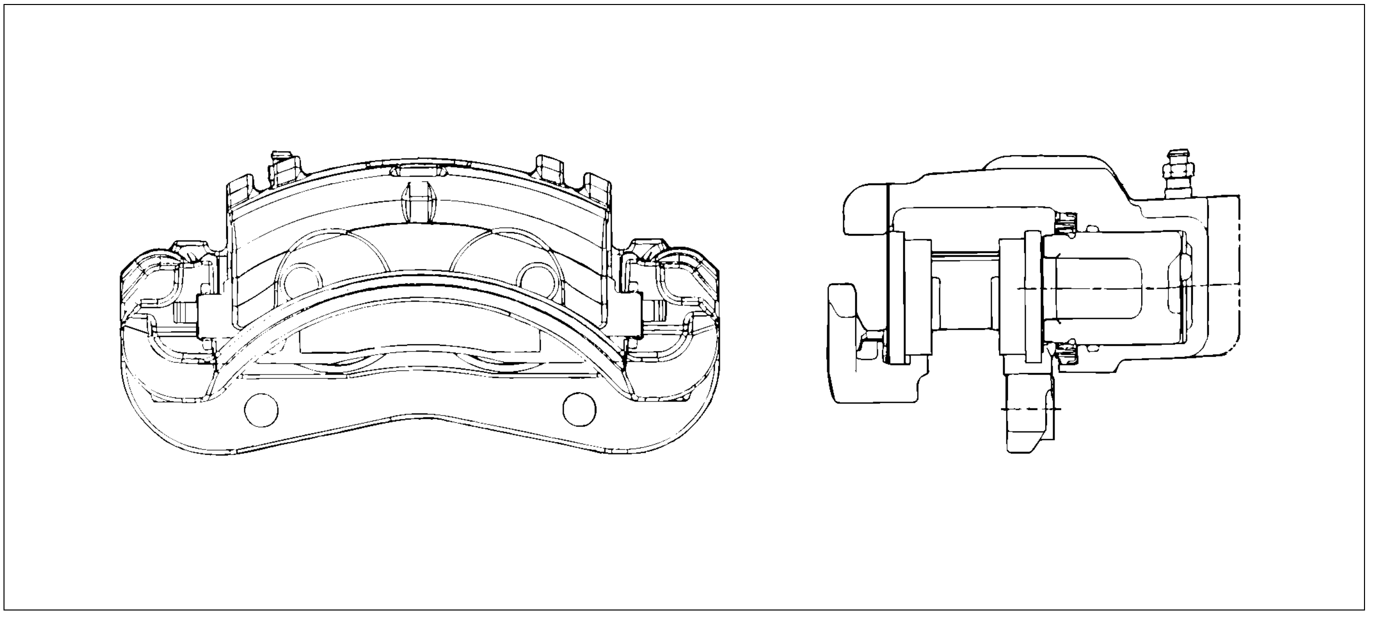
SECTION 5C

BRAKES

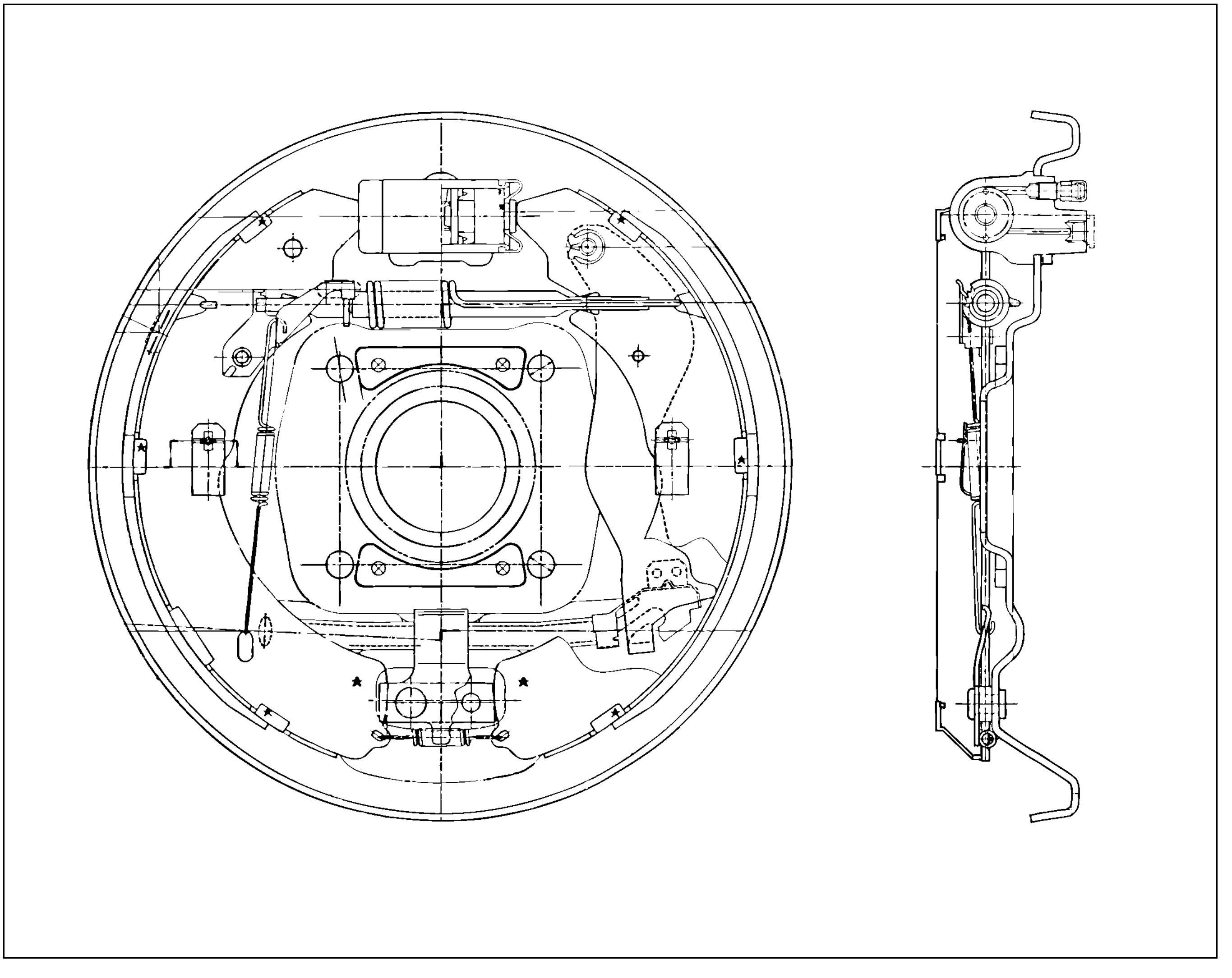
TABLE OF CONTENTS

GENERAL DESCRIPTION

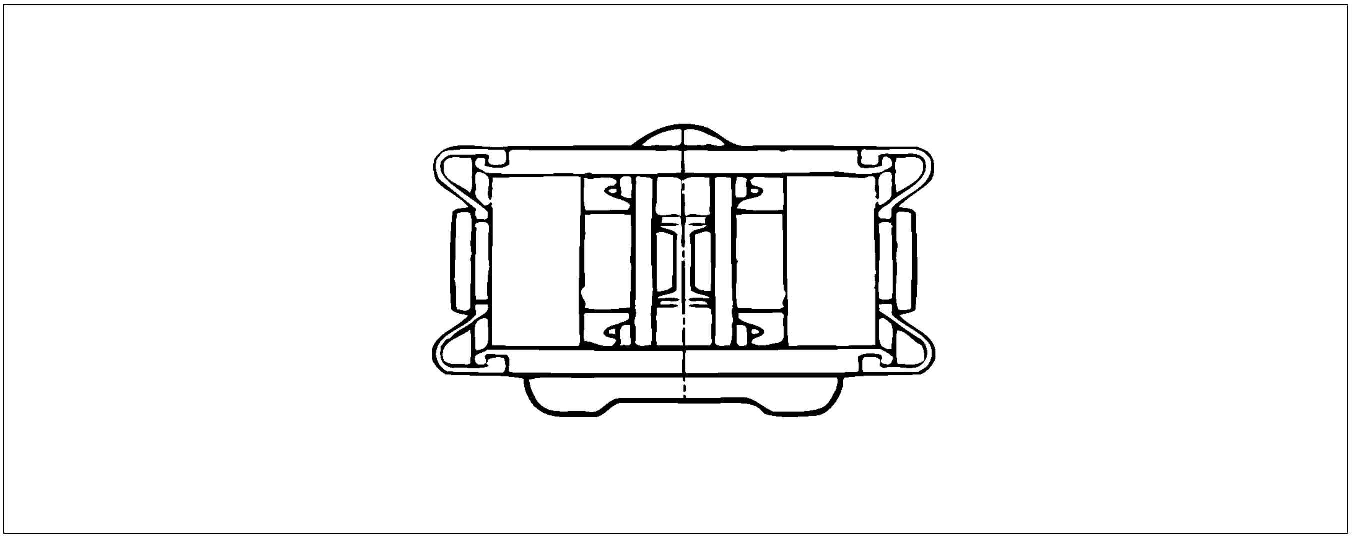
FRONT DISC BRAKE



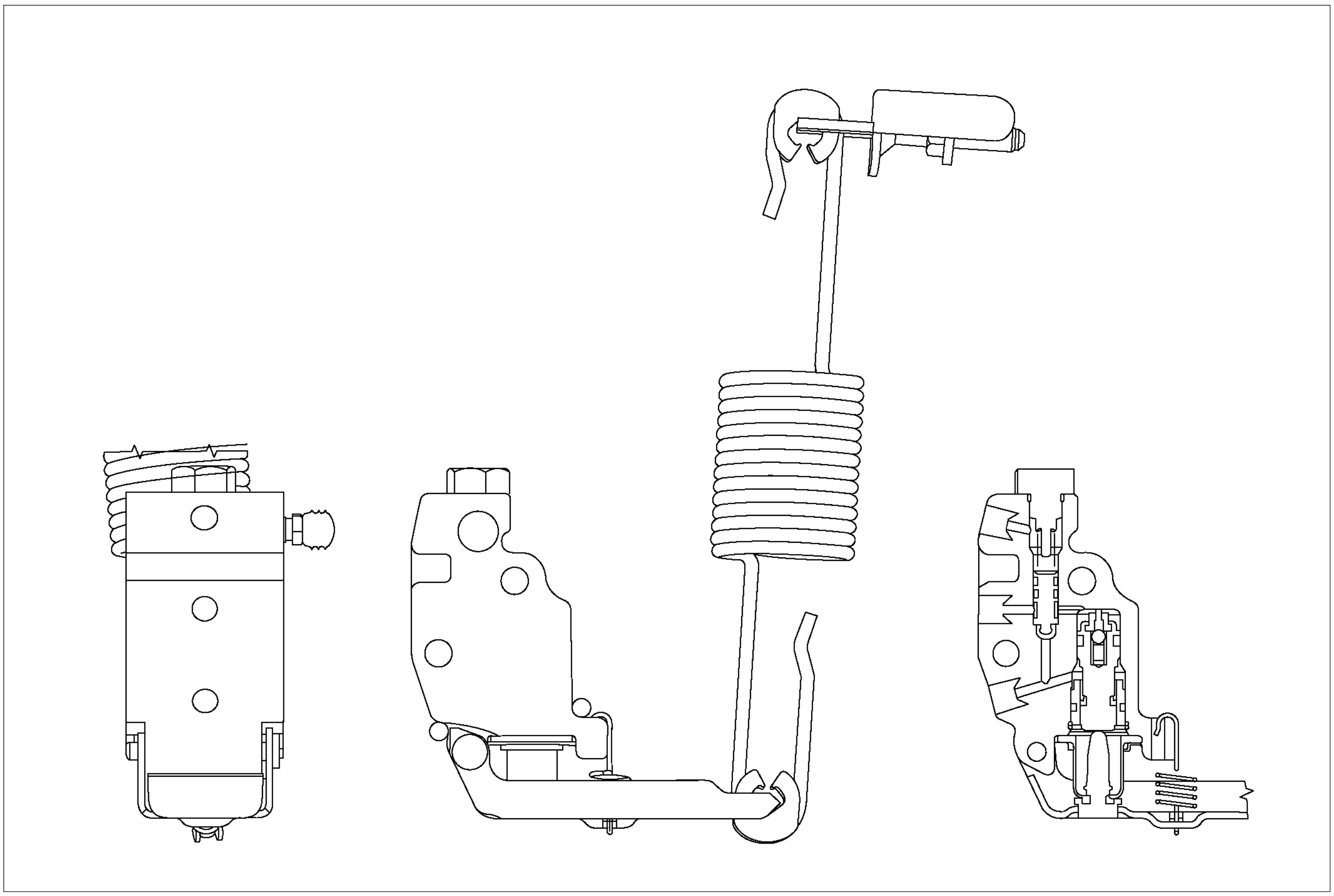
REAR DRUM BRAKE



REAR WHEEL CYLINDER

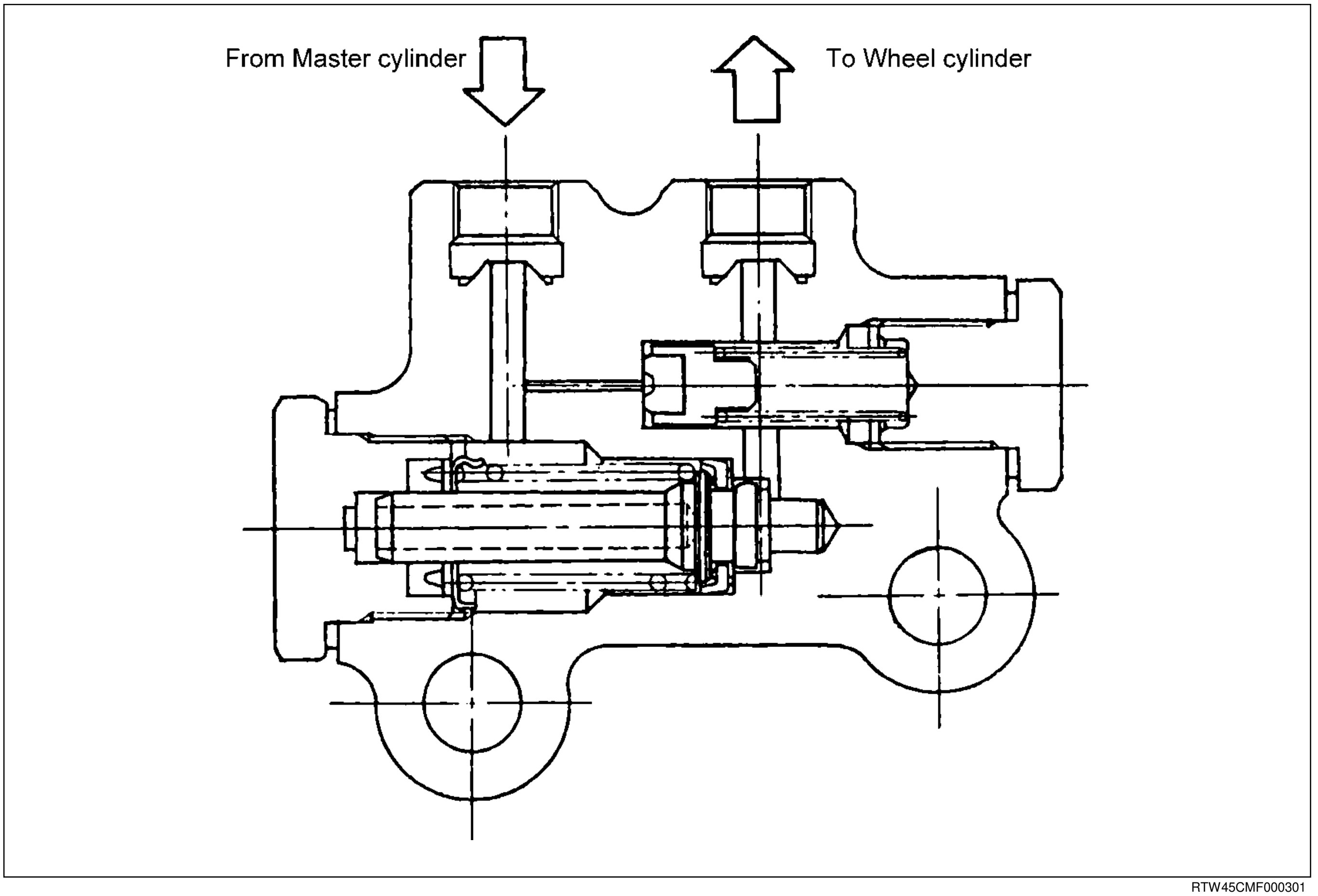


LOAD SENSING PROPORTIONING VALVE (LSPV)



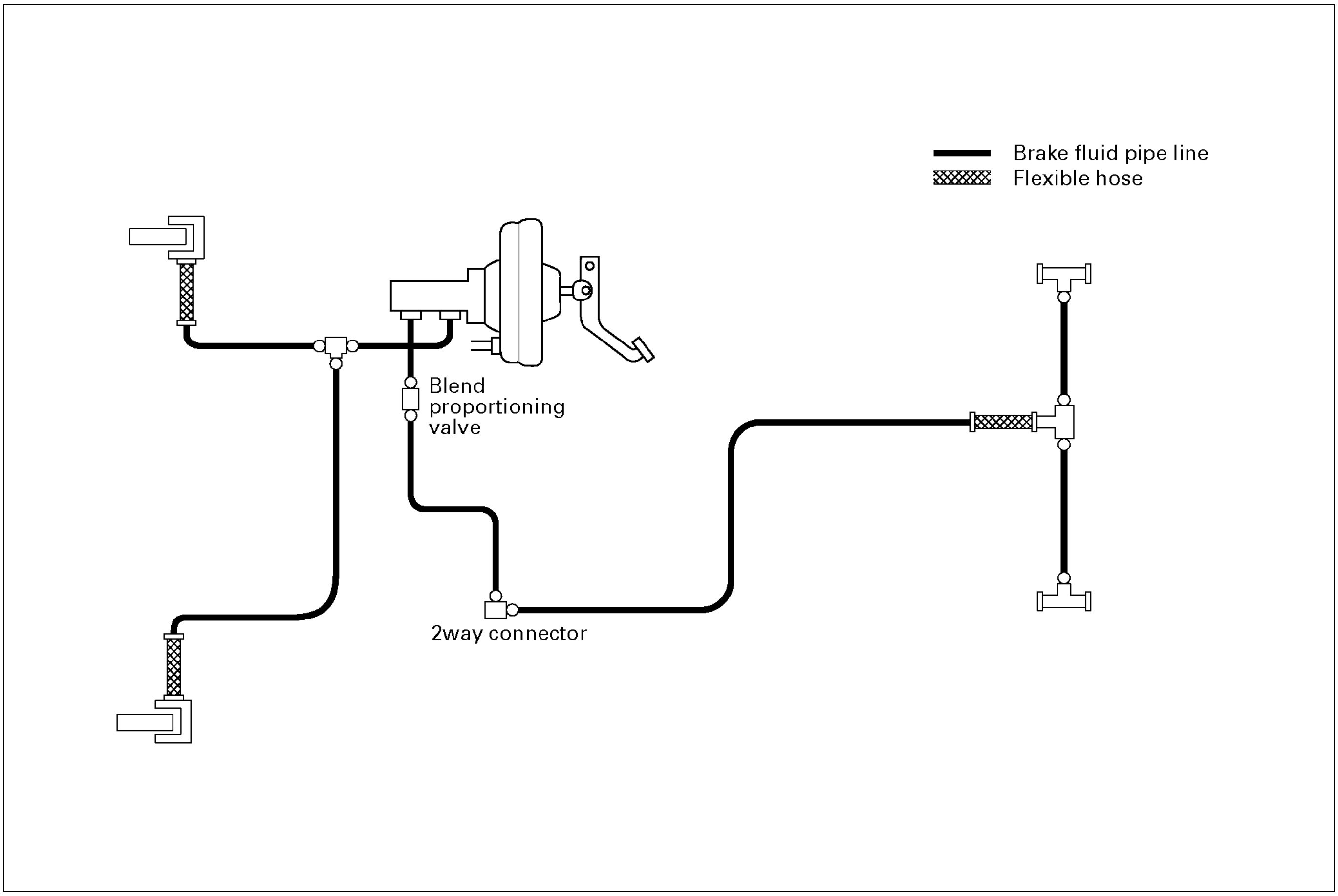
RTW35CMF000101

BLEND PROPORTIONING VALVE

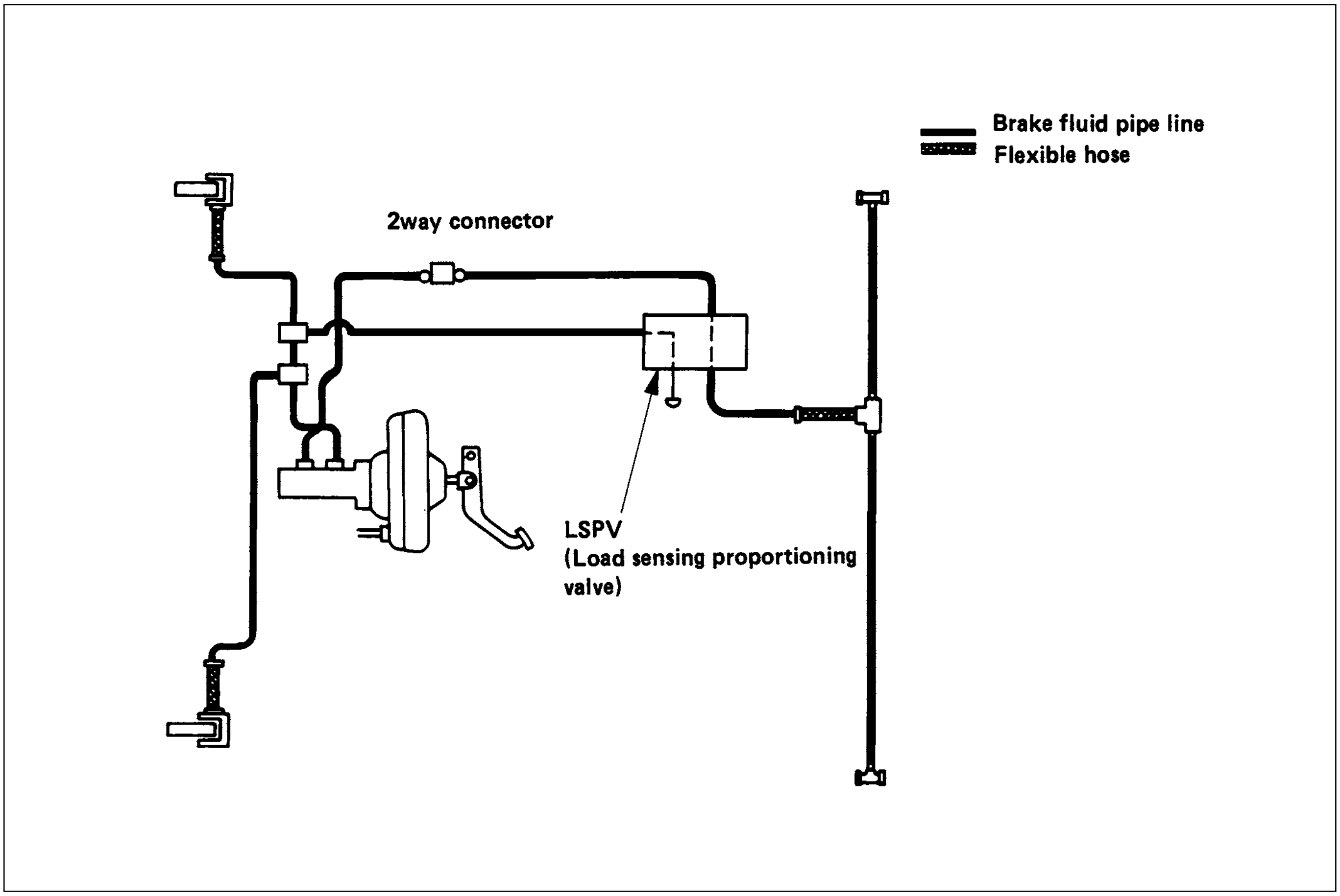


RTW45CMF000301

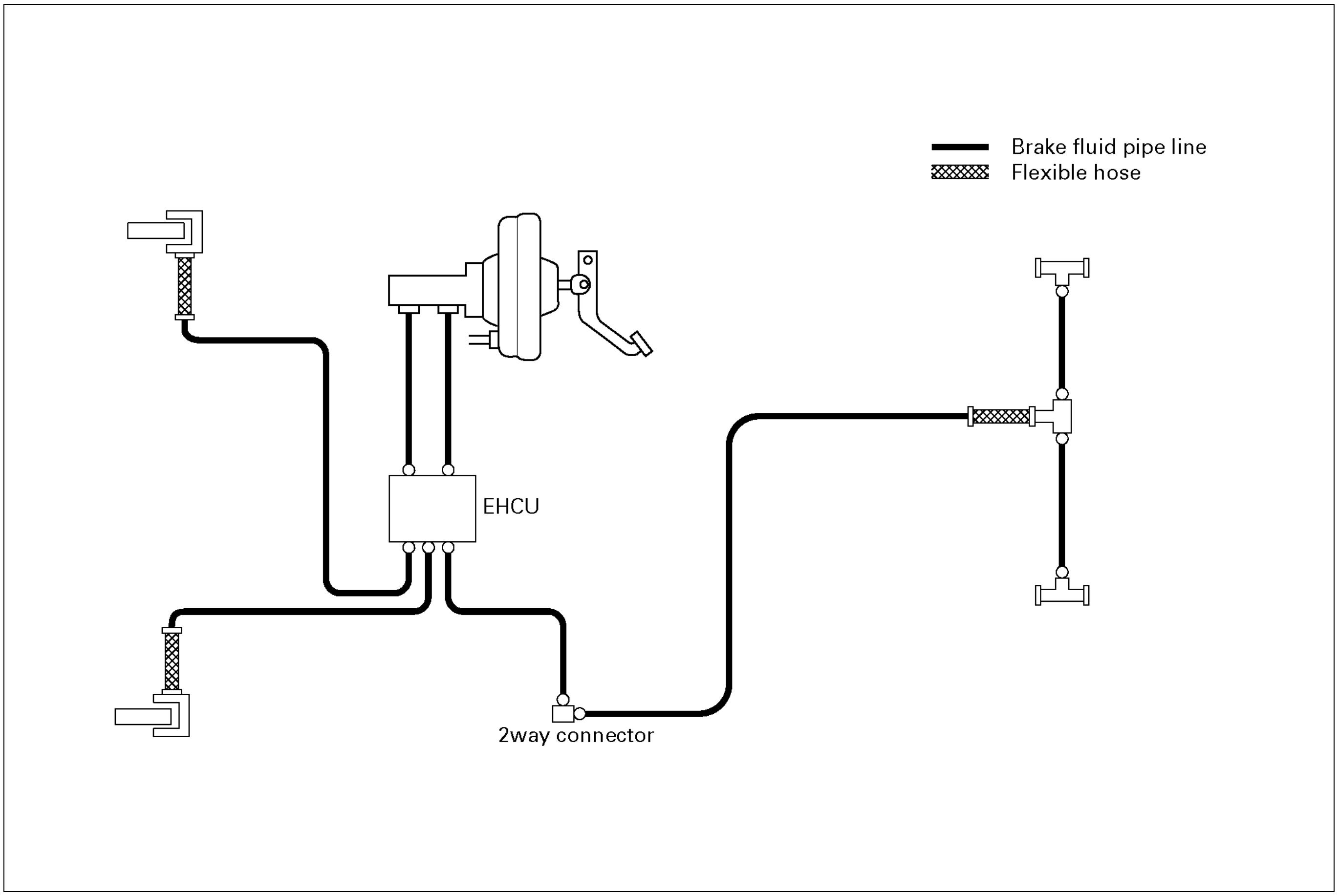
PIPING DIAGRAM (MODEL WITH BLEND PROPORTIONING VALVE)



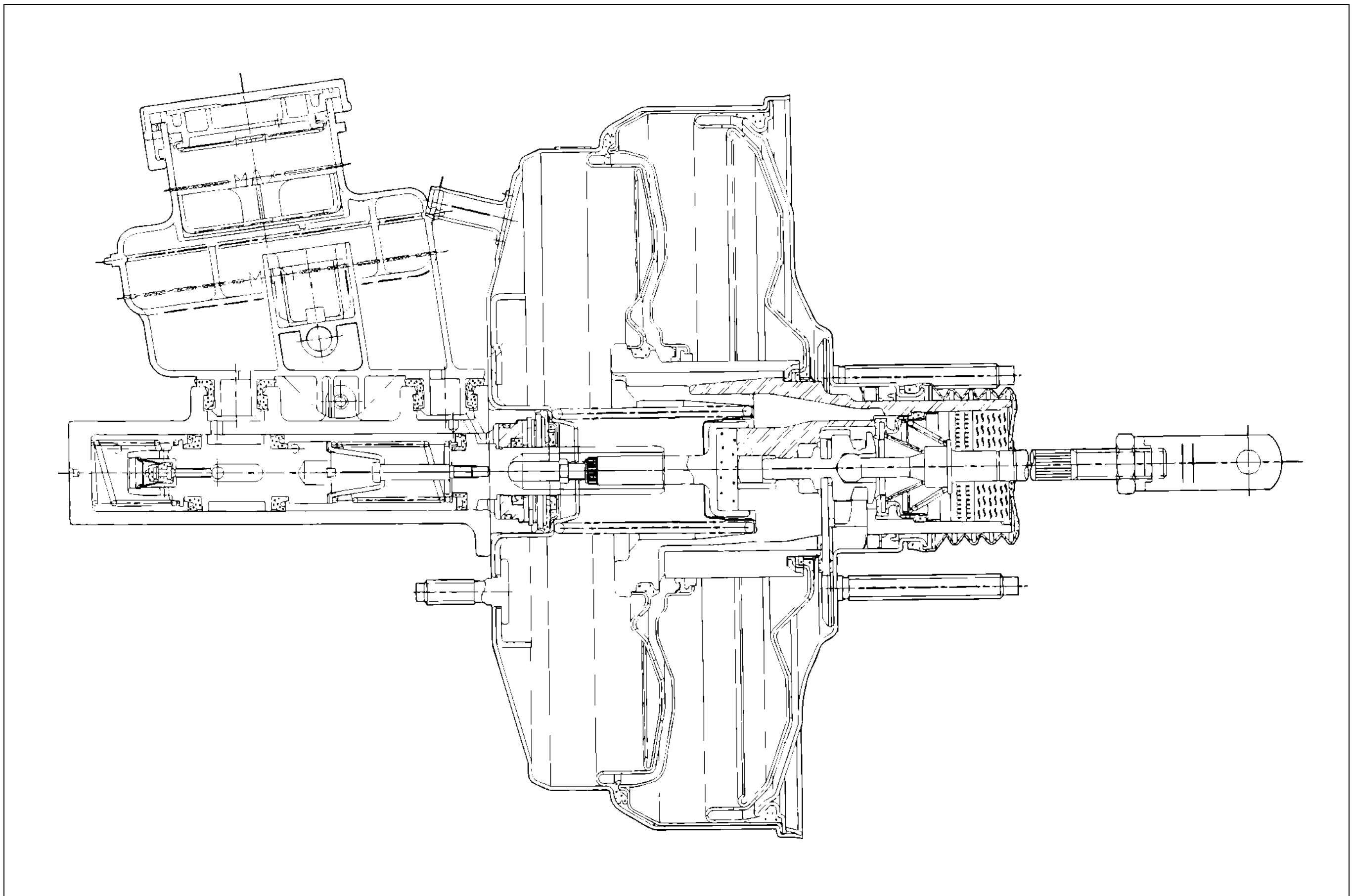
HYDRAULIC LINES (MODEL WITH LOAD SENSING PROPORTIONING VALVE)



HYDRAULIC LINES (MODEL WITH ABS)

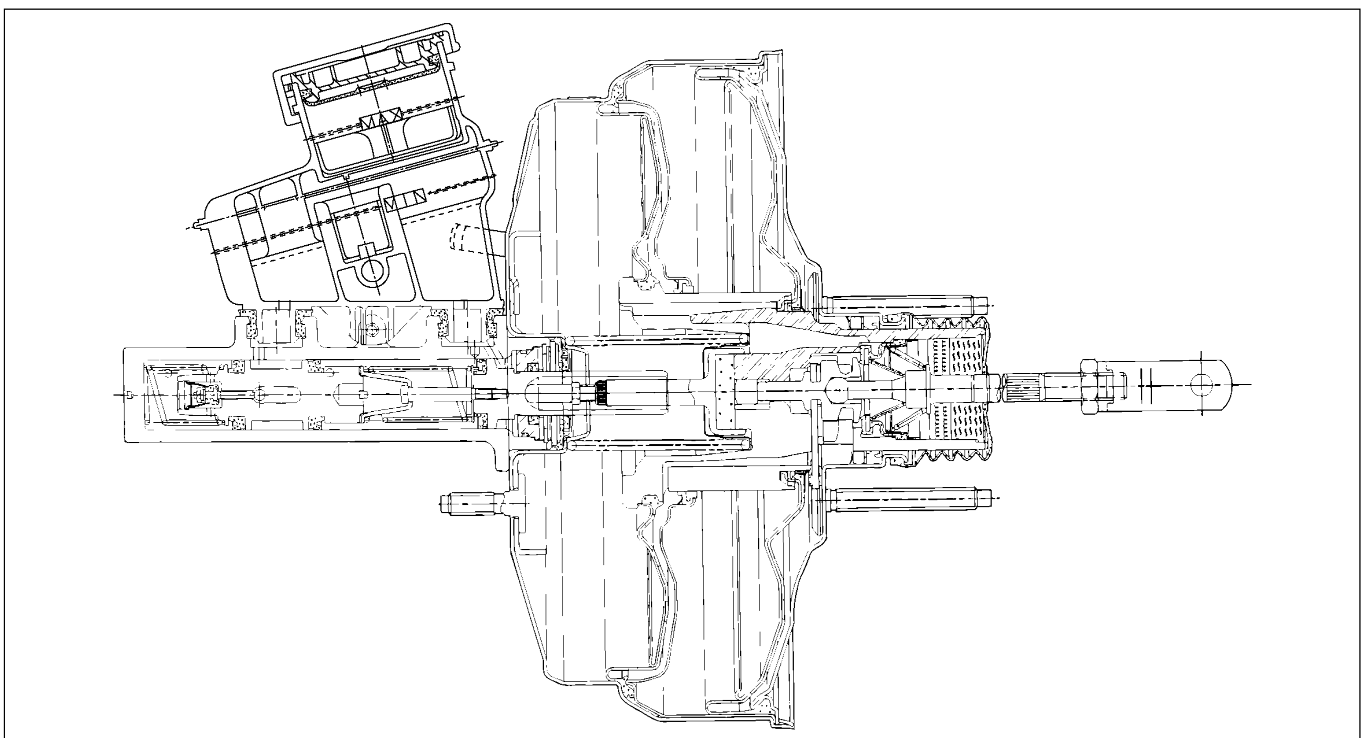


VACUUM SERVO WITH MASTER CYLINDER (RHD)



RTW75CMF000101

VACUUM SERVO WITH MASTER CYLINDER (LHD)



RTW75CMF001801

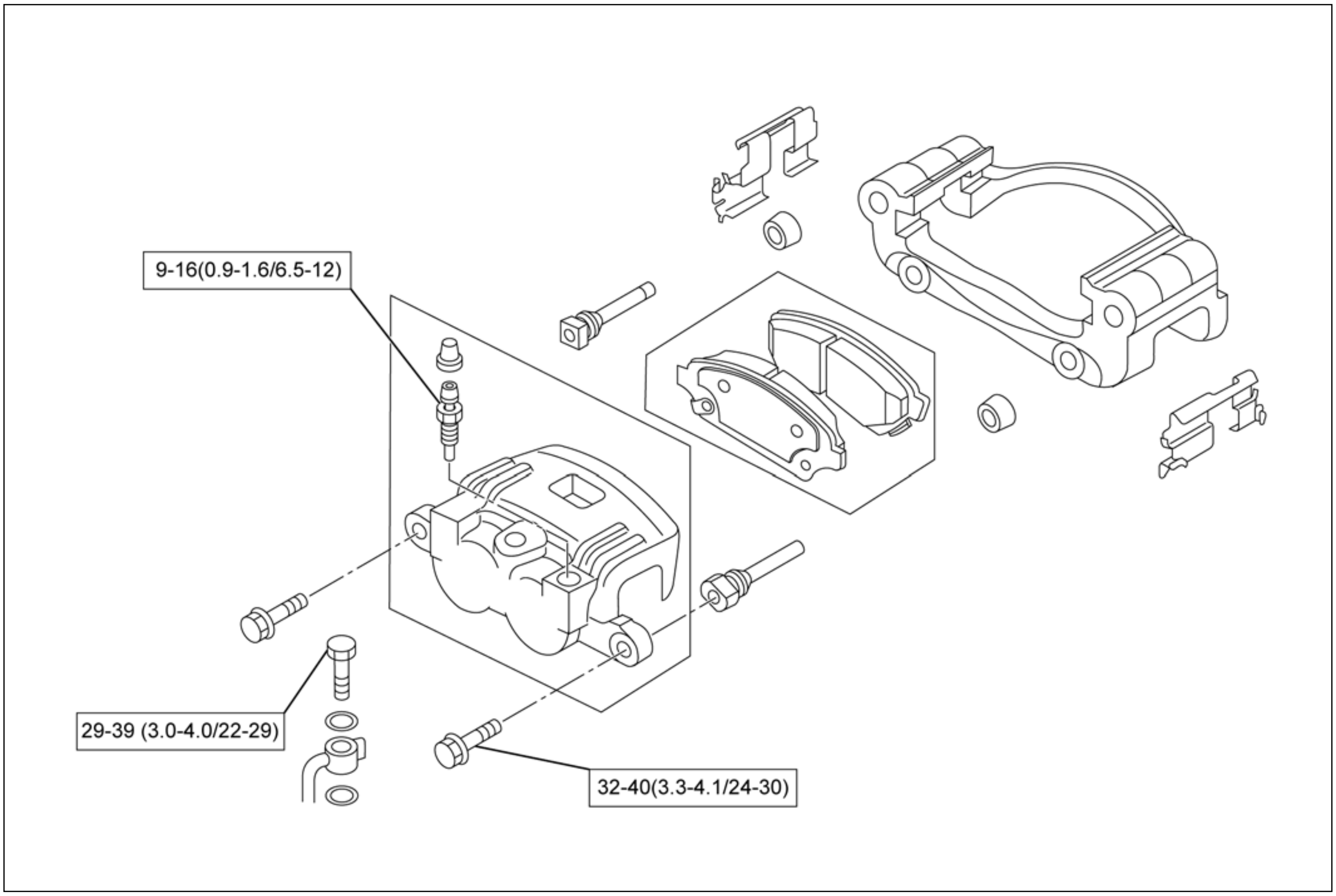
MAIN DATA AND SPECIFICATIONS

FRONT DISC BRAKE	mm (in)	4 × 2	4 × 2 HIGH RIDE 4 × 4
Caliper type		Pin slide	
Disc outside diameter		256 (10.079)	280 (11.024)
Disc thickness		26 (1.024)	27 (1.063)
Piston diameter		42.8 (1.685) × 2	45.5 (1.791) × 2
Adjustment method		Self-adjusting	
REAR DRUM BRAKE	mm (in)	4 × 2	4 × 2 HIGH RIDE 4 × 4
Type		Leading and Trailing	
Drum inside diameter		254 (10.000)	295 (11.614)
Brake lining dimension (Length × Width × Thickness)		244 × 50 × 5 (9.61 × 1.97 × 0.20)	283 × 45 × 5 (11.14 × 1.77 × 0.20)
Adjustment method		Self-adjusting	
WHEEL CYLINDER	mm (in)		
Inside diameter: rear		25.4 (1.000)	23.8 (0.937)
MASTER CYLINDER	mm (in)		
Type		Split	
Bore diameter		25.4 (1.000)	
Piston stroke (Primary + Secondary)		21.8 + 12 (0.86 + 0.47)	
VACUUM SERVO	mm (in)		
Diaphragm diameter		205 (8.071) + 230 (9.055)	
Power cylinder stroke		35 (1.378)	
PEDAL RATIO		3.7	
BALANCE			
Type		Load sensing proportioning valve (without ABS) / Blend proportioning valve (without ABS)/EBD (with ABS)	

TORQUE SPECIFICATIONS

FRONT WHEEL BRAKE

N·m (kgf·m/lb·ft)



RTW55CMF000401

refrigerant container.

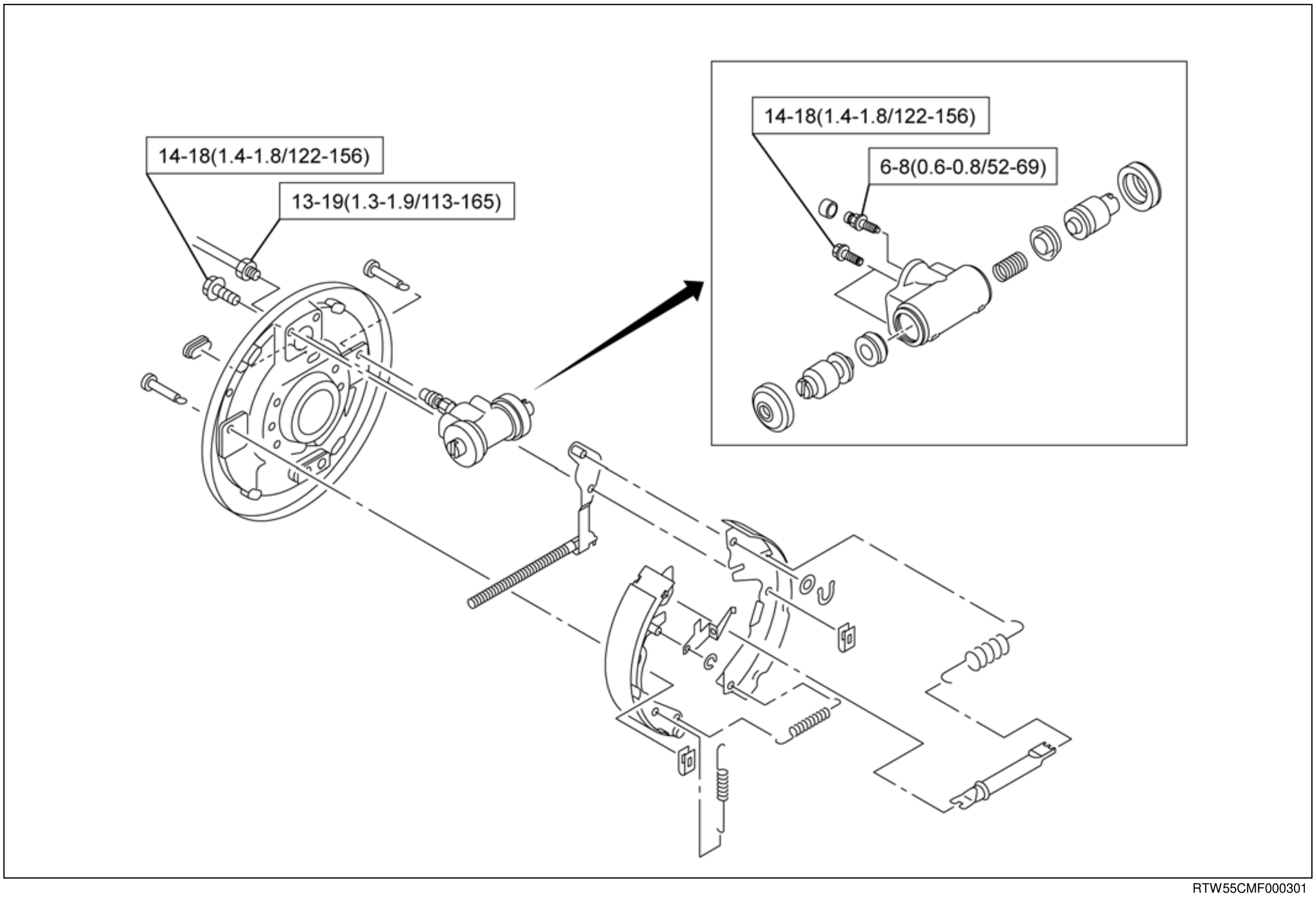
1) Make sure the evacuation process is correctly completed.
2) Connect the center-hose of the manifold gauge to the refrigerant container.
   - Turn the charge valve handle counterclockwise to purge to the charging line and purge any air exiting in the center-hose of the manifold gauge.
3) Open the low-pressure hand valve and charge the refrigerant about 200 g (0.44 lbs.).
   - Make sure the high-pressure hand valve is closed.
   - Avoid charging the refrigerant by turning the refrigerant container upside down.
4) Close the low-pressure hand valve of the manifold gauge.
   - Check to ensure that the degree of pressure does not change.
5) Check the refrigerant leaks by using a HFC-134a leak detector.
   - If a leak occurs, repair the leak connection, and start all over again from the first step of evacuation.
6) If no leaks are found, open the low-pressure hand valve of the manifold gauge. Then continue charging refrigerant to the system.
   - When charging the system becomes difficult:
     (1) Run the engine at Idling and close the all vehicle doors.
     (2) A/C switch is "ON".
     (3) Set the fan control knob (fan switch) to its highest position.
     (4) Set air source selector lever to “RECIRC”

WARNING
BE ABSOLUTELY SURE NOT TO OPEN THE HIGH-PRESSURE HAND VALVE. SHOULD THE HIGH-PRESSURE HAND VALVE BE OPENED, THE HIGH-PRESSURE REFRIGERANT GAS WOULD FLOW BACKWARD, AND THIS MAY CAUSE THE REFRIGERANT CONTAINER TO BURST.

7) When the refrigerant container is emptied, use the following procedure to replace it with a new refrigerant container.
   (1) Close the low-pressure hand valve.
   (2) Raise the needle upward and remove the charge valve.
   (3) Reinstall the charge valve to the new refrigerant container.
   (4) Purge any air existing in the center hose of the manifold gauge.

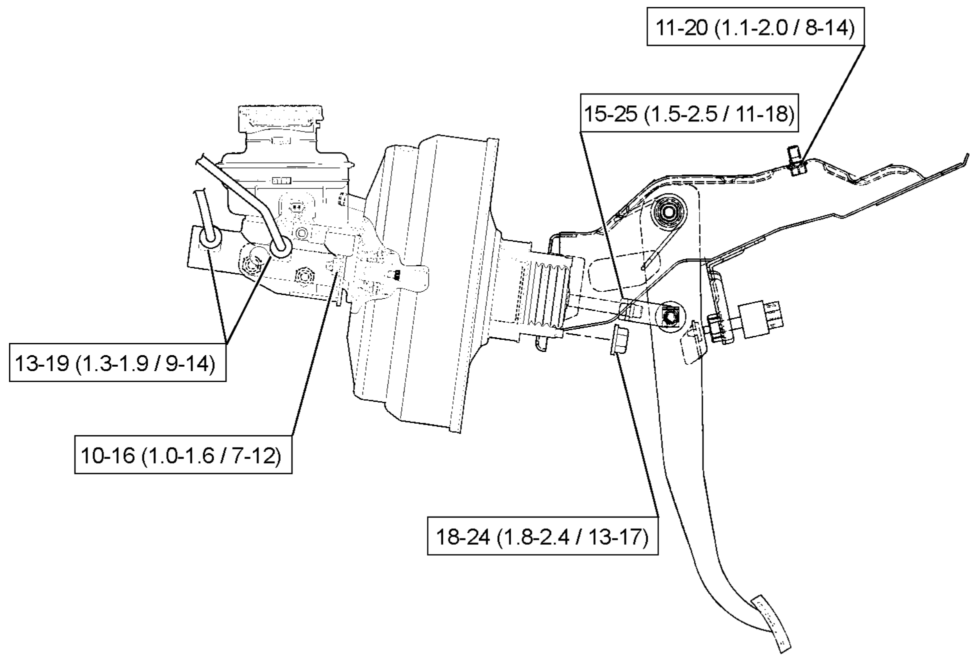
REAR WHEEL DRUM BRAKE

N·m (kgf·m/lb·in)



VACUUM SERVO WITH MASTER CYLINDER AND BRAKE PEDAL

N·m (kgf·m/lb·ft)

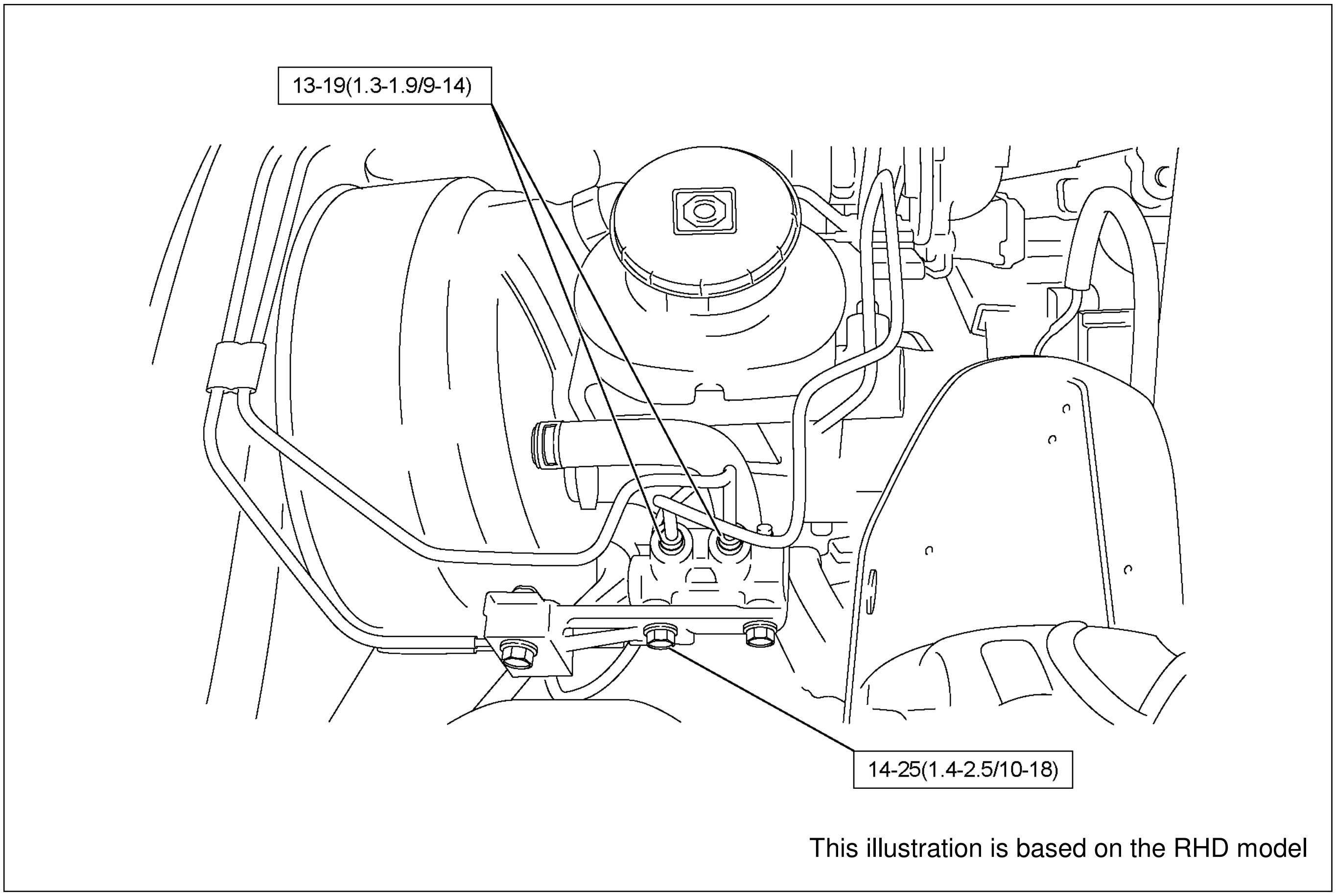


This illustration is based on the RHD model

RTW75CMF000201

BLEND PROPORTIONING VALVE

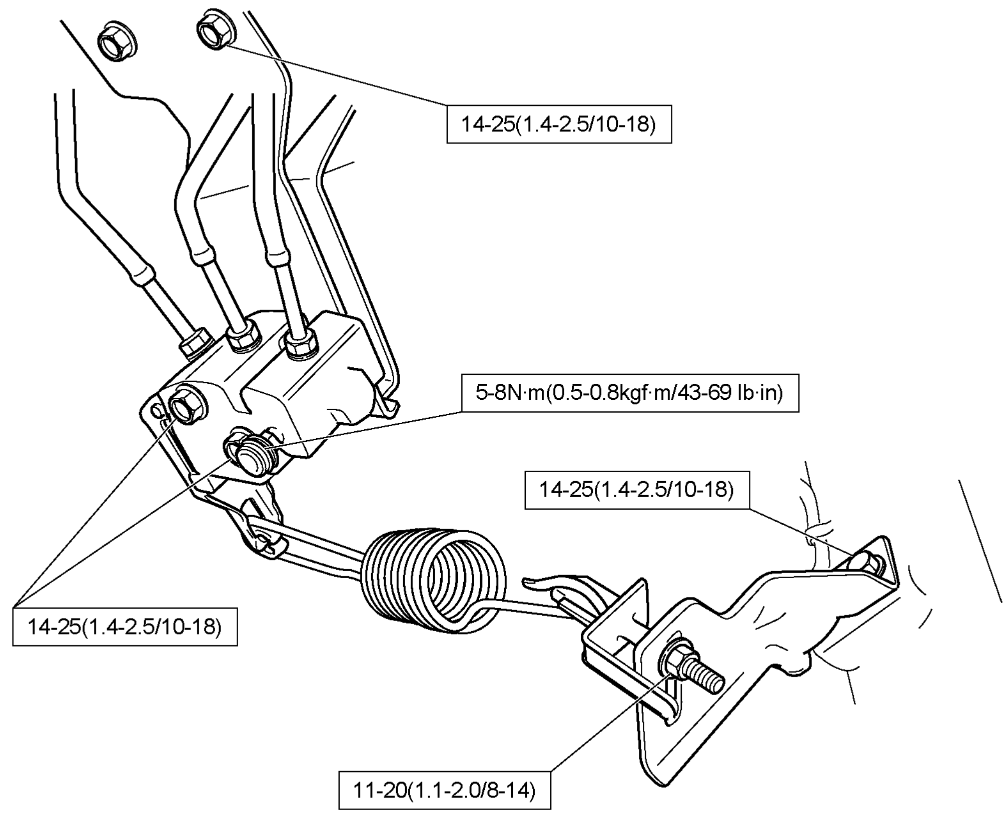
N·m (kgf·m/lb·ft)



RTW75CMF000301

LOAD SENSING PROPORTIONING VALVE (LSPV)

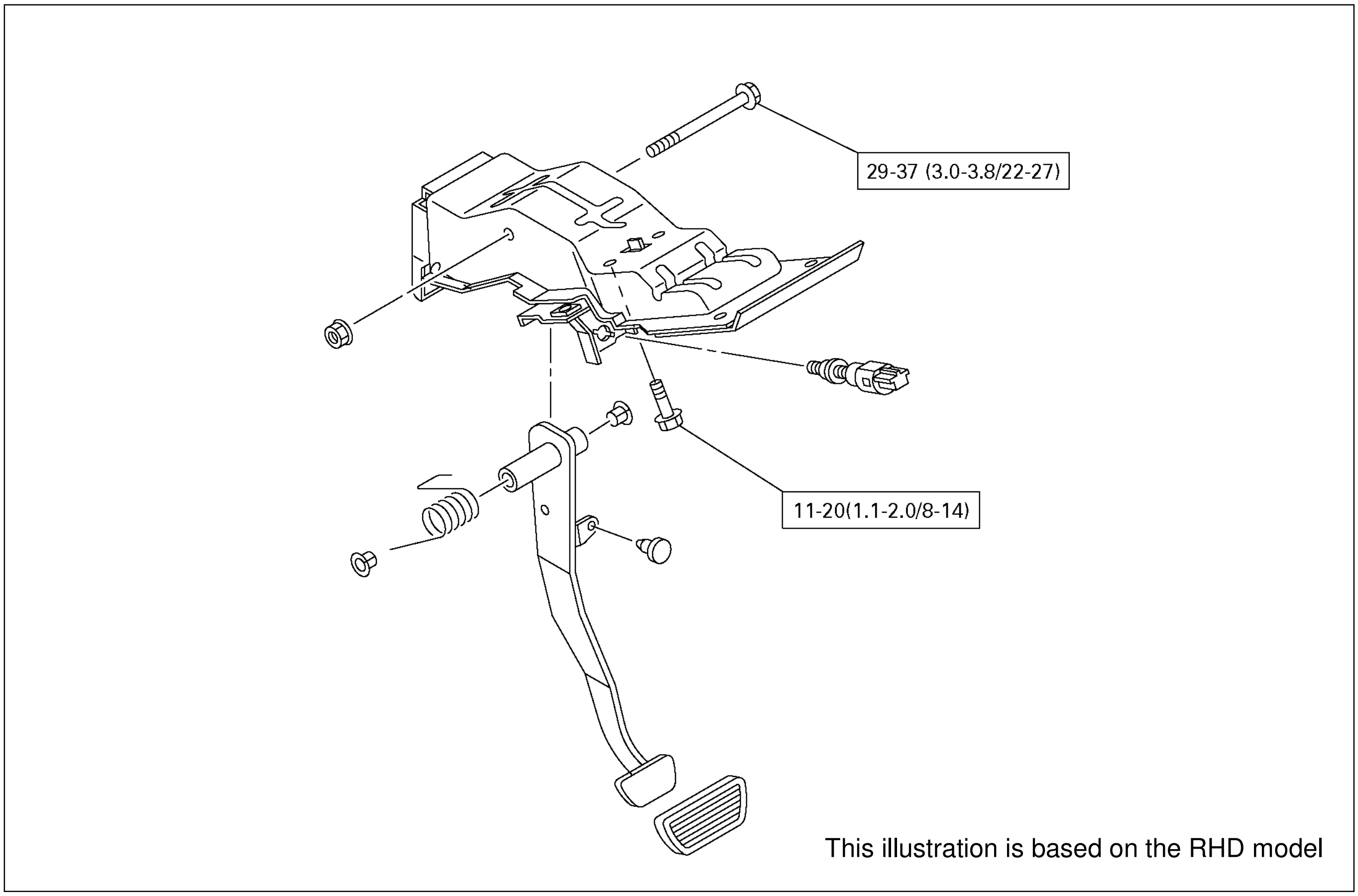
N·m(kgf·m/lb·ft)



RTW35CLF000101

BRAKE PEDAL ASSEMBLY

N·m (kgf·m/lb·ft)



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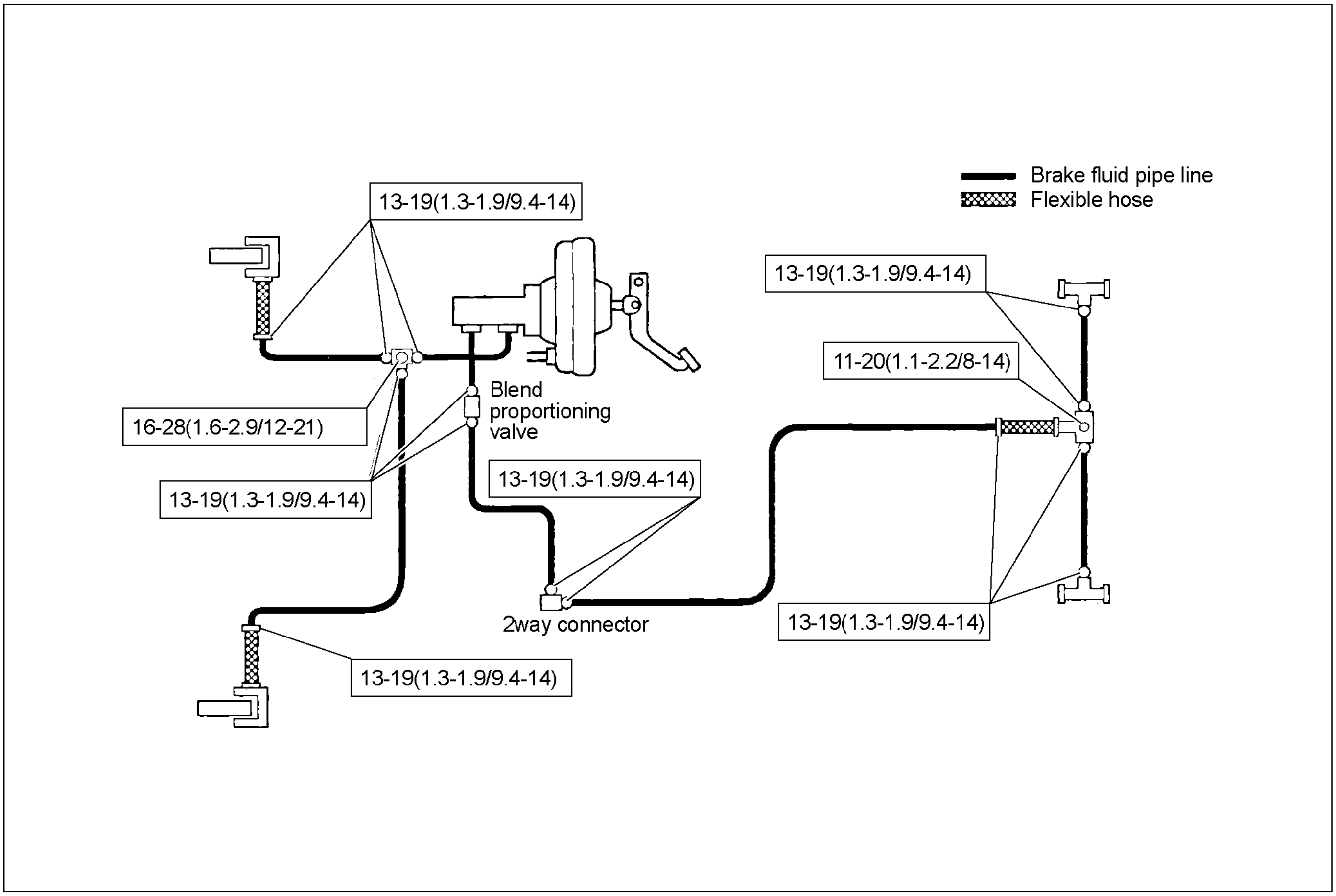
BRAKE LINES (HOSES AND PIPES)
(MODEL WITH BLEND PROPORTIONING VALVE)

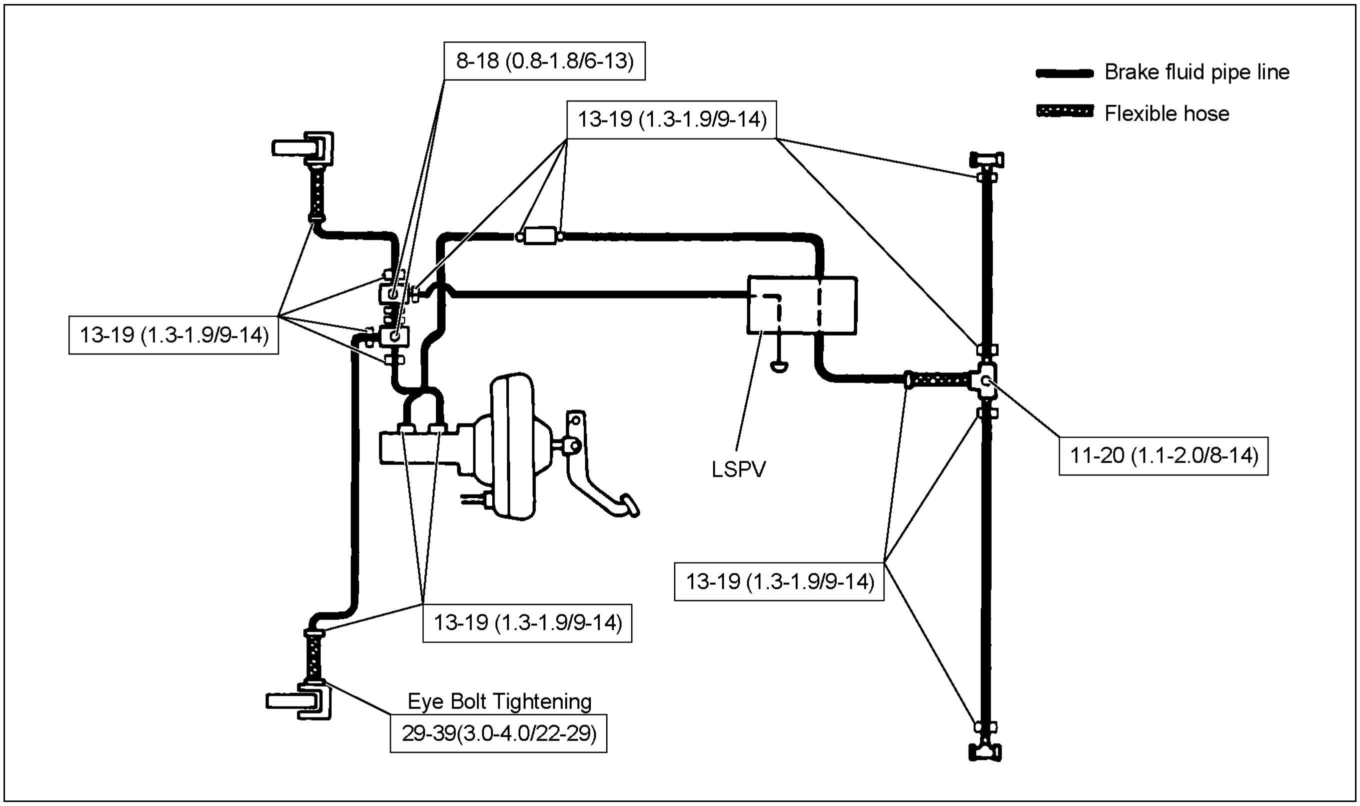
N·m (kgf·m/lb·ft)



RTW75CMF001901

BRAKE LINES (HOSES AND PIPES)
(MODEL WITH LOAD SENSING PROPORTIONING VALVE)

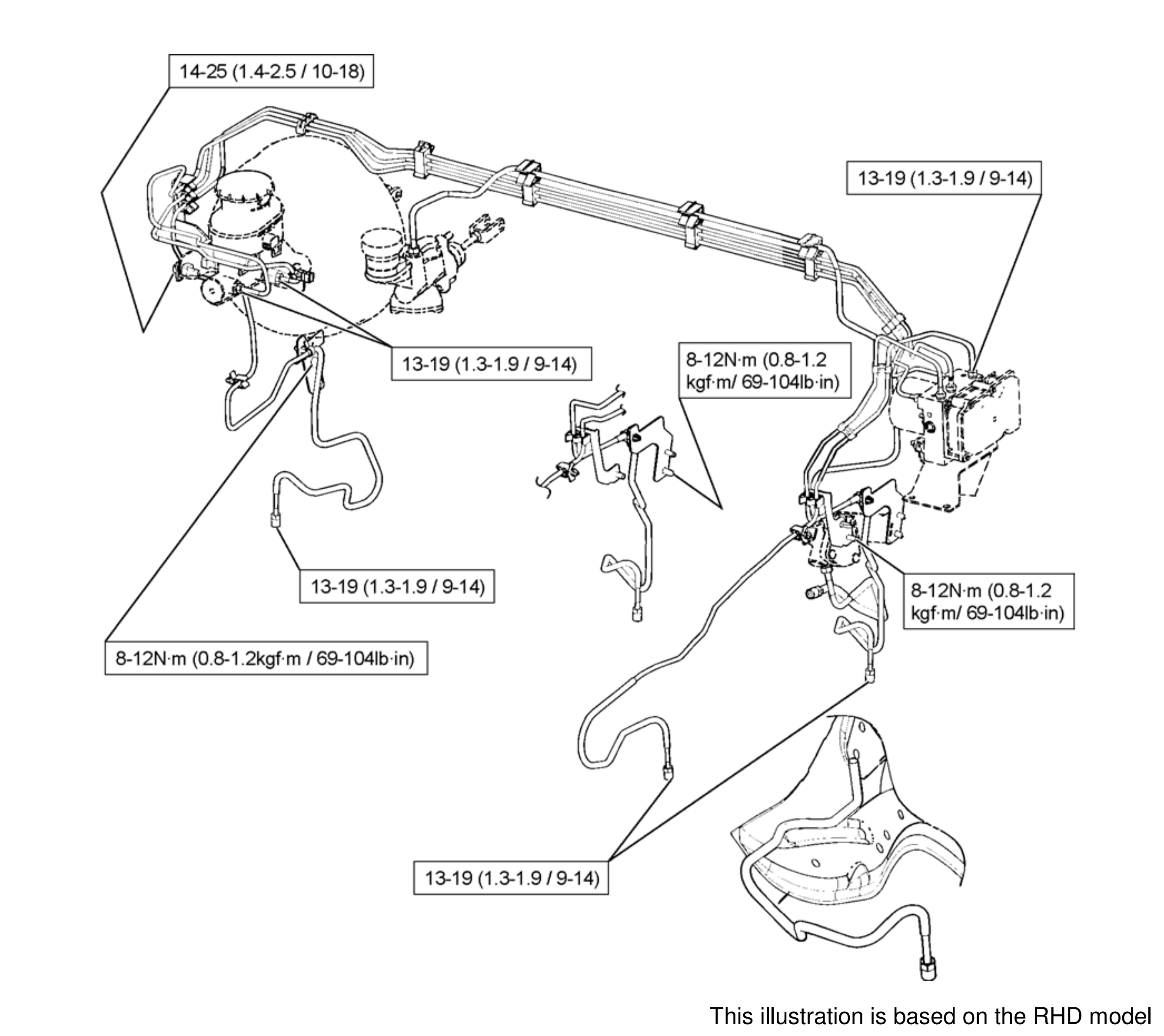
N·m(kgf·m/lb·ft)



RTW65CMF000501

BRAKE LINES (HOSES AND PIPES)
(MODEL WITH ABS)

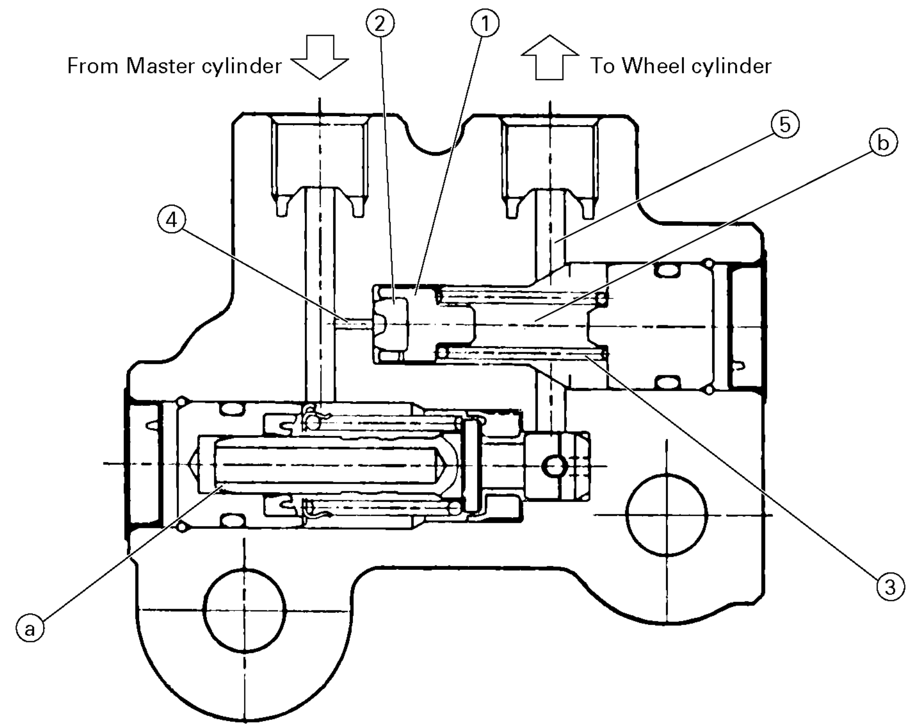
N·m (kgf·m/lb·ft)

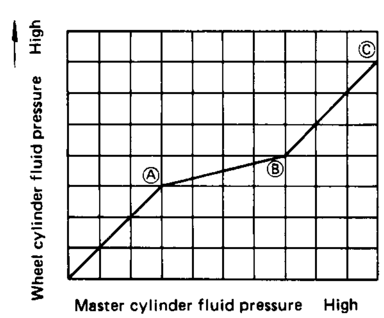


RTW75CLF000301

SERVICING

BLEND PROPORTIONING VALVE (IF SO EQUIPPED)





Structure and Operation

- **Structure**

  Side ⓐ shows P-valve; side ⓑ shows bypass valve.
  Bypass valve seals the routes ④ and ⑤ using the seal ② at the piston ① end.
  In addition, spring ③ presses against the piston ①, and in order to seal out the route ④ and route ⑤ sufficiently, spring ③ presses seal ② against cylinder end surface.
  The left figure is a characteristic curve diagram.

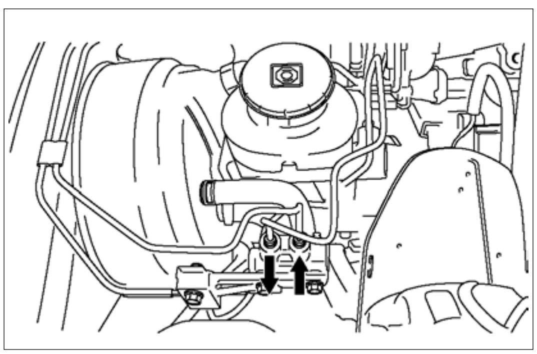
- **Operation**

  The operation of the P-valve by the master cylinder pressure is unchanged up to the brake points Ⓐ and Ⓑ.

  If master cylinder fluid pressure penetrates into the second break point Ⓑ, the fluid pressure pressing against the seal ②, (which isolated route ④ and route ⑤), passing the route ④ of the master cylinder side, overcomes the operating force of the spring ③ + fluid pressure affecting the seal ② of the wheel cylinder, and presses the piston ① to the right side, resulting in the opening of the routes ④ and ⑤, and canceling of the P-valve operation.

  Then, because the master cylinder fluid pressure and the wheel cylinder fluid pressure, up to the point Ⓒ, operate on the identical surface of the seal ②, both have identical ascending ratios.

  However, because of the operation of spring ③ in the wheel cylinder side, wheel cylinder fluid pressure operates to preserve the balance against the master cylinder fluid pressure on the lower level with the difference in pressure resulting from this spring.



RTW75CSH001601

Valve Maintenance

In the case of a fluid leak or other abnormality, the faulty valve should be replaced.
The valve is set up at the engine room.

Note:

The blend proportioning valve is not repairable and must be replaced as a complete assembly.

8) Charge the system to the specified amount and then close the low-pressure hand valve.

Refrigerant Amount g(lbs)

4JA1-T, 4JH1-TC, C24SE	720 (1.59)
4JJ1-TC (Standard Output) 4JJ1-TC (High Output) 4JK1-TC (High Output)	650 (1.43)

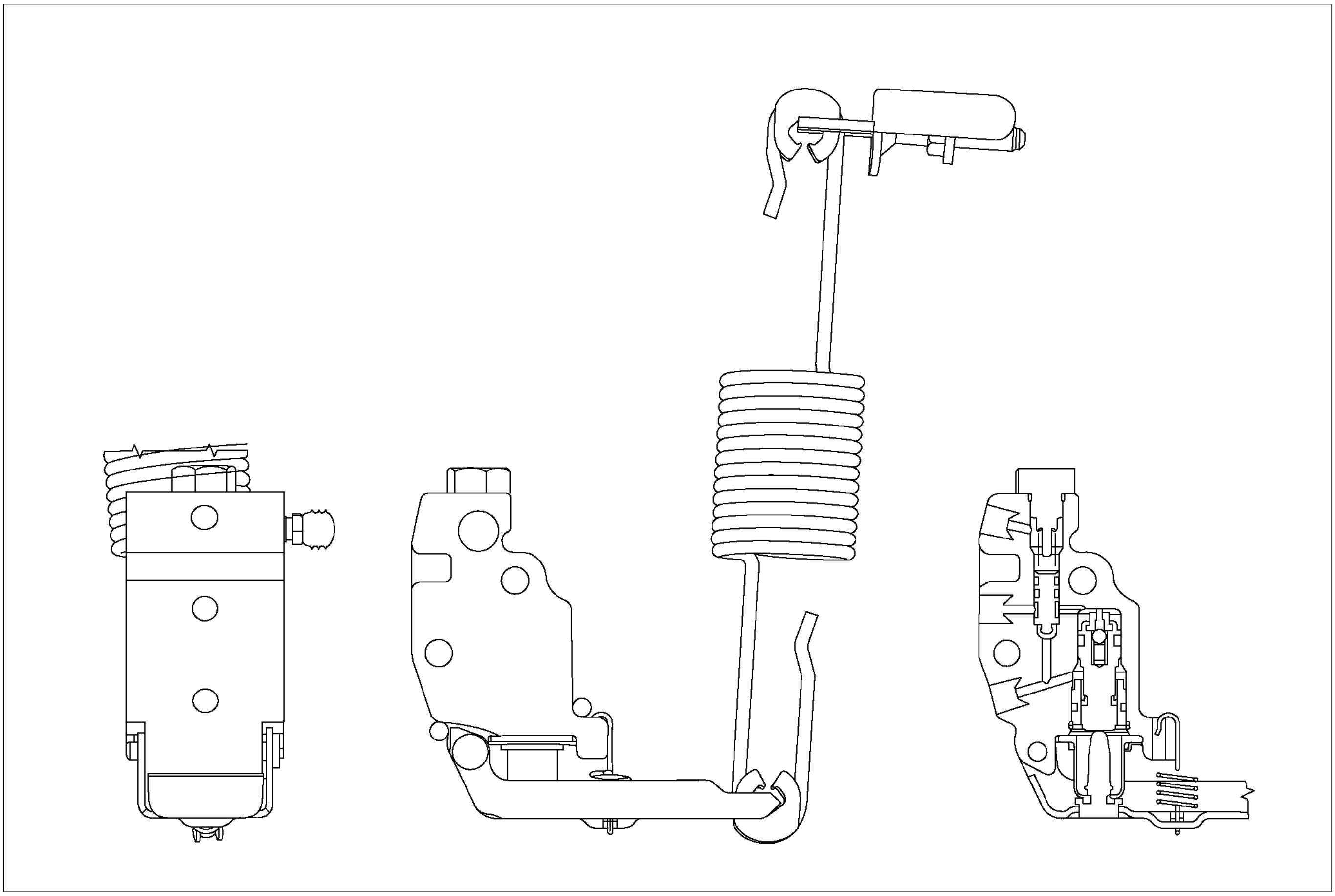
9) Check for refrigerant leaks by using a HFC-134a leak detector.
   - A fully charged system is indicated by the sight glass on the receiver/drier being free of any bubbles (Refer to "Reading Sight Glass").
   - Check the high and low pressure value of the manifold gauge. (Refer to “CHECKING REFRIGERANT SYSTEM WITH MAINFOLD GAUGE” in SERVICE INFORMATION.)

Immediately after charging refrigerant, both high and low pressures are slightly high and to the left of the gauge, but they settle down to the guide pressure valves as shown below:

- Ambient temperature; 30~35°C (86~95°F)
- Guide pressure
  High-pressure side;
  Approx. 1373~1670 kPa (14~17 kg/cm^2 / 199~242 psi)
  Low-pressure side;
  Approx. 127~245 kPa (1.3~2.5 kg/cm^2 / 18~36 psi)

10) Close the low pressure hand valve and charge valve of the refrigerant container.
11) Stop the air conditioning and the engine.
12) Disconnect the high and low pressure hoses from the manifold gauge fittings.

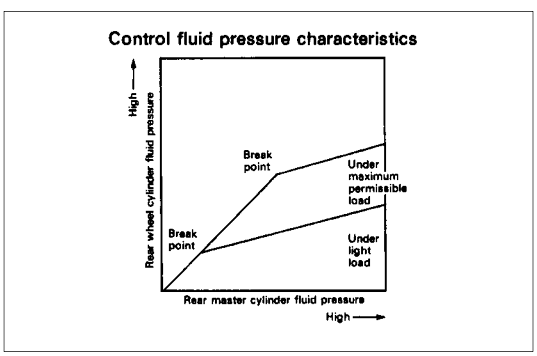
LOAD SENSING PROPORTIONING VALVE (LSPV)



RTW35CMF000101

Structure and Operation

The following is an explanation of the structure and operation of the spring type load sensing device.
This device controls the fluid pressure to the rear brakes in accordance with changes in rear axle load (vertical displacements of the rear axle springs).

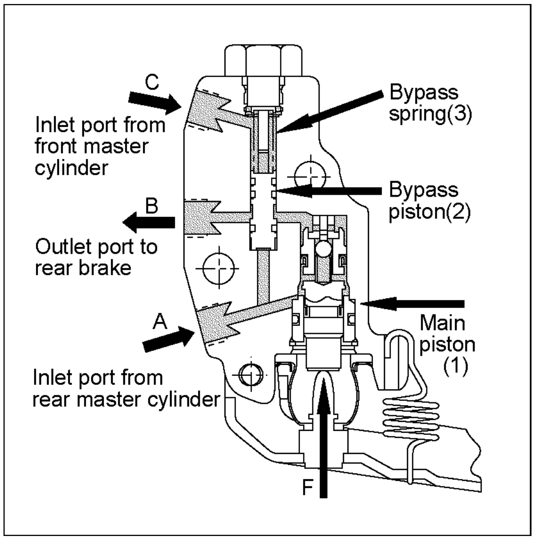


- **Structure**

  This device consists of a load sensing spring and a valve.

  The valve is mounted through a bracket to the frame.

  One end of the load sensing spring is fixed to the valve at the frame and the other end to the rear axle housing through a bracket.



RTW35CSH001001

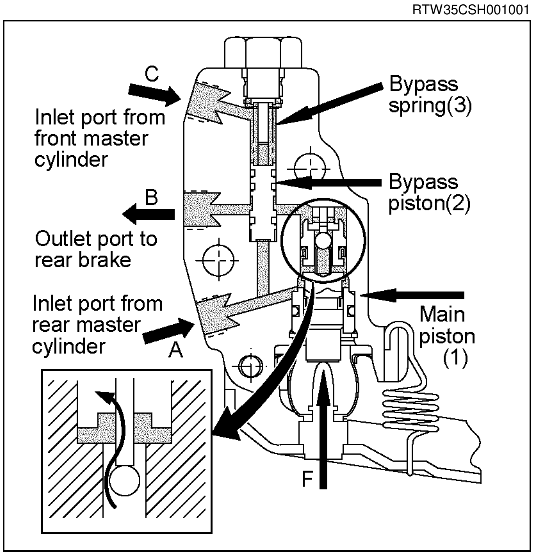
- **Operation**

1) Outline

When the LSPV (Load Sensing Proportioning Valve) detects a change in load weight, the load sensing spring stretches.

Its reaction force is transmitted to the bottom of the load sensing valve to secure an optimum rear wheel cylinder fluid pressure break point in proportion to the actual load weight.

Besides, if the front brake system should fail, the device is designed to prevent the master cylinder fluid pressure from decreasing and to apply it directly to the rear wheel cylinder to obtain a sufficient braking performance.



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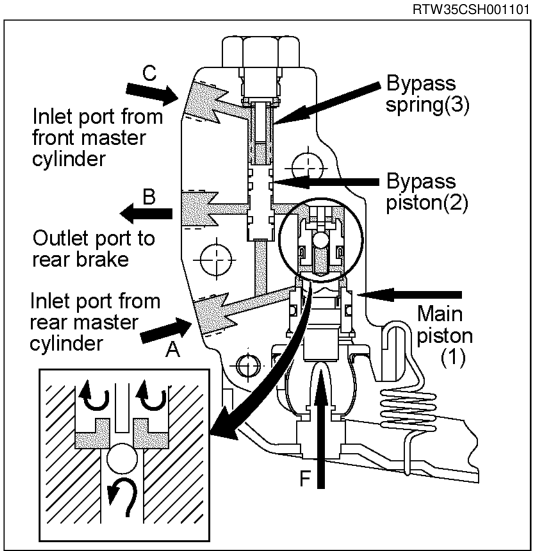
2) Bellow cutting point.

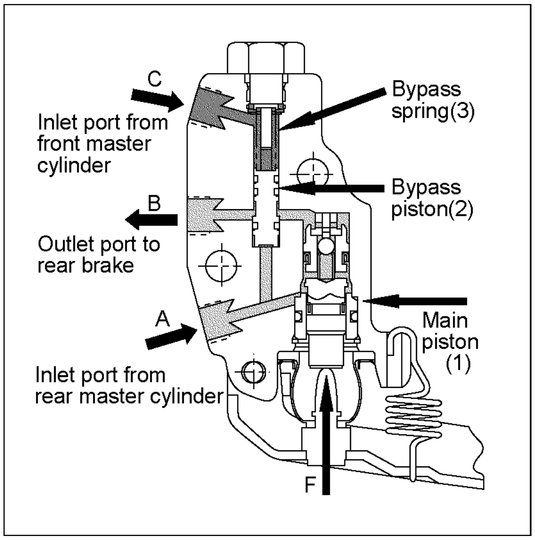
The Force (F) keeps the main piston (1) the rest position. The inlet pressure (A) and outlet pressure (B) are the same as well as the inlet pressure (C) from front master cylinder. The bypass piston (2) is kept on rest position by equilibrium of the pressures (A) and (C) and the bypass spring load (3).



RTW35CSH001201

3) Cutting point.

The cutting point is given by relation between force (F), that is the load applied by suspension of the vehicle and the main piston area (1). The cutting point is achieved when the force generated by hydraulic pressure is upper than the force (F) given by the load suspension. The main piston (1) moves from the rest position closing the valve. In this moment the inlet pressure (A) is upper than the outlet pressure (B). The bypass piston (2) continues on the rest position by equilibrium of (A) and (C) pressure.



RTW35CSH001301

4) Failure on front master cylinder.

In case of failure on front master cylinder the pressure on the inlet port (C) drop to zero. The pressure from inlet port (A) acts on the bypass piston (2) and move it by comprising of bypass spring (3). It makes possible the communication between the inlet port (A) to outlet port (B) through the bypass system. The outlet pressure (B) reaches the inlet pressure (A) and the LSPV is bypassed.

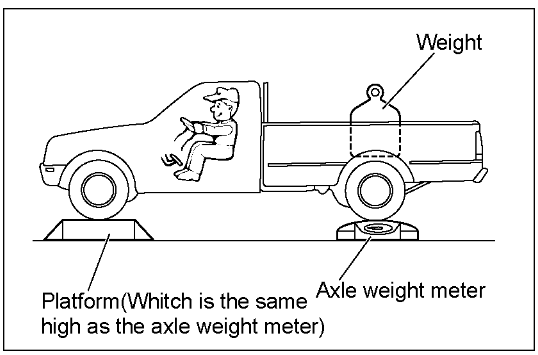
Valve Maintenance

In the case to fluid lead or other a abnormalities, faulty valve should be replaced.

Note:

The load sensing proportioning valve is not repairable and must be replaced as a completed assembly.

LOAD SENSING PROPORTIONING VALVE (LSPV) ADJUSTMENT



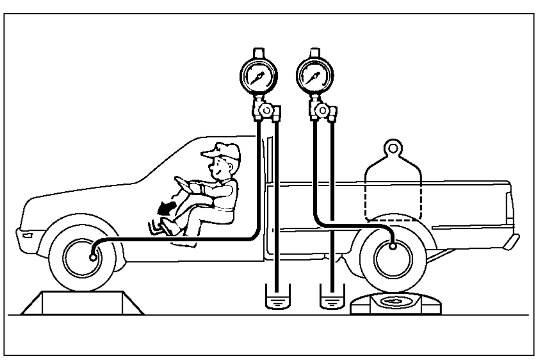
RTW35CSH000301

1. Fluid Pressure Measurement
   1) Rear axle weight adjustment

      With an axle weight meter, adjust the rear axle weight with a person sitting in the driver's seat and a weight loaded in the rear body.

N (kg/lb)

MODEL	Adjustment value
4 × 2	7845 (800/1764)
4 × 2 HIGH RIDE 4 × 4	9316 (950/2095)

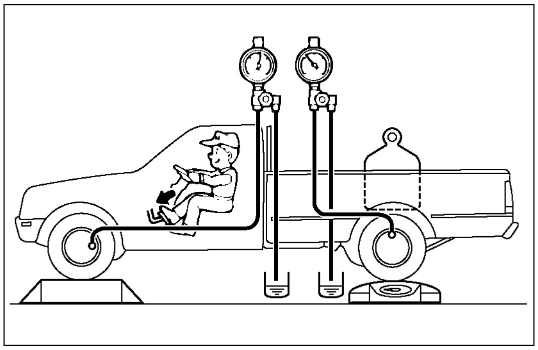


RTW35CSH000101

   2) Installation of a fluid pressure gauge

      Remove the air bleeder of the left hand wheel front and rear brakes. Bleed air out of the fluid pressure gauge with the measurement hose of the fluid pressure gauge installed.

Pressure Tester: Brake oil (Fluid pressure gauge)
5-8840-2190-0



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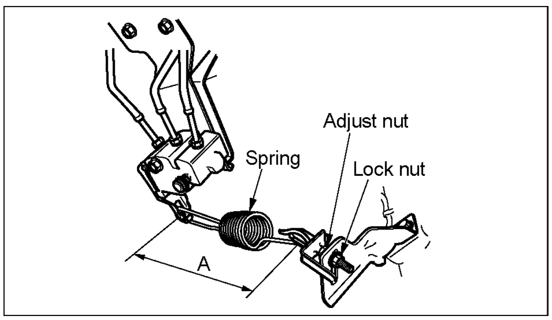
3) Rear wheel cylinder fluid pressure measurement

Step on the brake pedal until the fluid pressure of the front wheel cylinder gets to 9.8Mpa (100kg/cm^2), and check the rear wheel cylinder fluid pressure. (Read the value of the front wheel cylinder fluid pressure 2 seconds after the measurement. When measuring the LSPV fluid pressure, keep the brake pedal pressed down without stepping it down twice or releasing it.)

Rear Wheel Cylinder Fluid Pressure	MPa (kg/cm^2)
2WD	6.77±0.83 (69.0±8.5)
2WD (With High Ride Suspension), 4WD	6.77±0.83 (69.0±8.5)



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2. Oil Pressure Adjustment

1) LSPV spring length adjustment

Loosen the adjust nut of the LSPV spring joint, and adjust the length of the LSPV spring.

When the oil pressure is insufficient, turn the adjust nut clockwise to extend the span “A”. When the oil pressure is too high, turn the adjust nut counterclockwise to reduce the span “A”.

2) After adjustment, tighten the lock nut securely.

Lock Nut Torque	N·m (kgf·m/lb·ft)
11-20 (1.1-2.0/8-14)	

Filling Master Cylinder Reservoir

CAUTION:
Use only specified brake fluid. Do not use any fluid which contains a petroleum base. Do not use a container which has been used for petroleum based fluids or a container which is wet with water. Petroleum based fluid will cause swelling and distortion of rubber parts in the hydraulic brake system. Water mixed with brake fluid lowers the fluid boiling point. Keep all fluid containers capped to prevent contamination.
Always fill the master cylinder reservoir when the engine is cold.
Never allow the brake fluid to come in contact with the painted surfaces.
The master cylinder reservoir must be kept properly filled to ensure adequate reserve and to prevent air and moisture from entering the hydraulic system. However, because of expansion due to heat absorbed from the brakes and the engine, the reservoir must not be overfilled. Thoroughly clean reservoir cap before removal to avoid getting dirt into reservoir. Add fluid as required to bring level to the "MAX" mark on the reservoir tank. Use "DOT 3" Hydraulic Brake Fluid.

Leakage of Brake Fluid

With engine idling, set shift lever in the neutral position and continue to depress brake pedal at a constant pedal application force.
Should the pedal stroke become deeper gradually, leakage from the hydraulic pressure system is possible.
Make sure by visual check that there is no leak.

BLEEDING OF THE BRAKE HYDRAULIC CIRCUIT

If air enters the bake lines, it will cause poor brake action.
Therefore, bleeding should be performed if the brakes have been used with the level of brake fluid in the reservoir excessively low or if brake pipes have been disconnected in the course of brake servicing.
The bleeding operation calls for co-operative action of 2 persons.

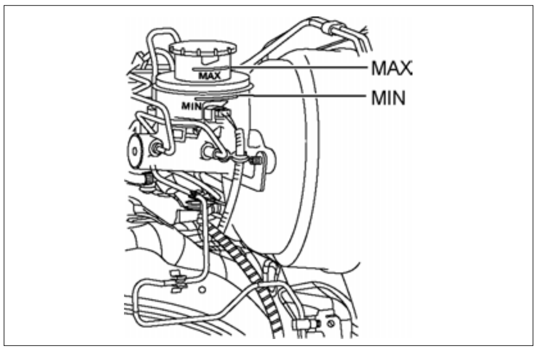
- Set the parking brake firmly while bleeding.
- Perform bleeding operation with ENGINE RUNNING, to prevent damage to push rod seal.
  Make sure exhaust is suitably ventilated.
- Bleed the hydraulic system with the fluid reservoir filled to the specified level.
- Bleed the system starting with the rear wheel cylinder farthest from the master cylinder.

A bleeding operation is necessary to remove air from the hydraulic brake system whenever air is introduced into the hydraulic system. It may be necessary to bleed the hydraulic system at all four brakes if air has been introduced through a low fluid level or by disconnecting brake pipes at the master cylinder. If a brake pipe is disconnected at one wheel, only that wheel cylinder/caliper needs to be bled. If the pipes are disconnected at any fitting located between the master cylinder and brakes, then the brake system served by the disconnected pipe must be bled.

1. Set the parking brake completely, then start the engine.

NOTE:
The vacuum booster will be damaged if the bleeding operation is performed with the engine off.

2. Remove the master cylinder reservoir cap.
3. Fill the master cylinder reservoir with brake fluid. Keep the reservoir at least half full during the air bleeding operation.
4. Always use new brake fluid for replenishment.
5. In replenishing brake fluid, take care that air bubbles do not enter the brake fluid.



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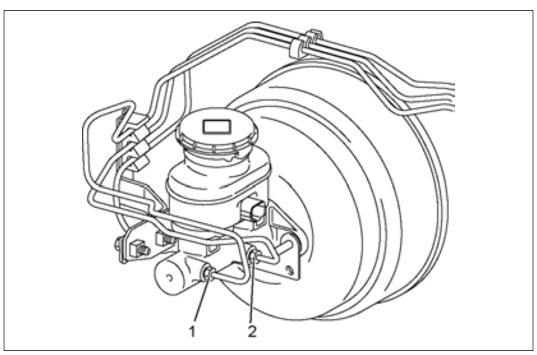
When the master cylinder is replaced or overhauled, first bleed the air from the master cylinder, then from each wheel cylinder and caliper following the procedures described below.

Bleeding the Master Cylinder



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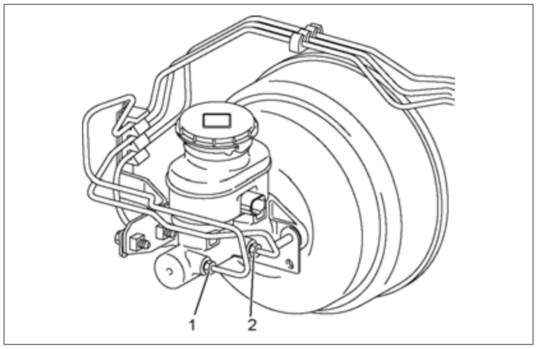
6. Disconnect the rear wheel brake pipe (1) from the master cylinder.
   Check the fluid level and replenish as necessary. If replenished, leave the system for at least one minute.
7. Depress the brake pedal slowly once and hold it depressed.
8. Completely seal the delivery port of the master cylinder with your finger, where the pipe was disconnected, then release the brake pedal slowly.
9. Release your finger from the delivery port when the brake pedal returns completely.
10. Repeat steps 7 through 9 until the brake fluid comes out of the delivery port during step 7.

NOTE: Do not allow the fluid level in the reservoir to go below the half-way mark.

11. Reconnect the brake pipe (1) to the master cylinder and tighten the pipe.
12. Depress the brake pedal slowly once and hold it depressed.
13. Loosen the rear wheel brake pipe (1) at the master cylinder.
14. Retighten the brake pipe, then release the brake pedal slowly.

15.Repeat steps 12 through 14 until no air comes out of the port when the brake pipe is loosened

NOTE: Be very careful not to allow the brake fluid to come in contact with painted surfaces.



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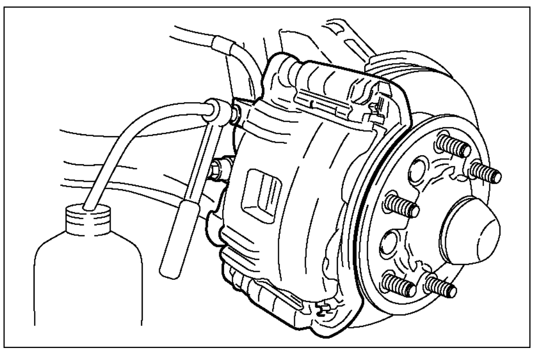
16.Bleed the air from the front wheel brake pipe connection (2) by repeating steps 6 through 15.

Bleeding the Caliper

17.Bleed the air from each wheel in the order listed below:

- Right rear wheel cylinder
- Left rear wheel cylinder
- Left front caliper
- Right front caliper

Conduct air bleeding from the wheels in the above order. If no brake fluid comes out, it suggests that air is mixed in the master cylinder. In this case, bleed air from the master cylinder in accordance with steps 6 through 16, and then bleed air from the caliper or wheel cylinder.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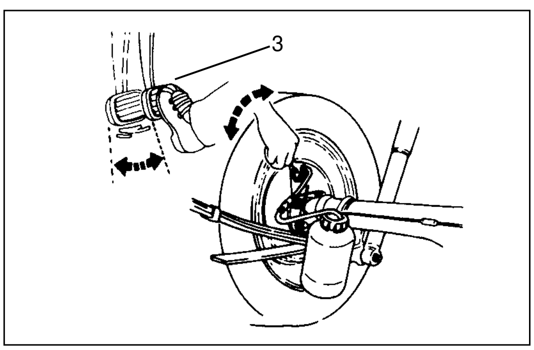
18.Place the proper size box end wrench over the bleeder screw.

19.Cover the bleeder screw with a transparent tube, and submerge the free end of the transparent tube in a transparent container containing brake fluid.



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20.Pump the brake pedal (3) slowly three times (once/sec), then hold it depressed.

21.Loosen the bleeder screw until fluid flows through the tube.

22.Retighten the bleeder screw.

23.Release the brake pedal slowly.

24.Repeat steps 20 through 23 until the air is completely removed.

It may be necessary to repeat the bleeding procedure 10 or more times for front wheels and 15 or more times for rear wheels.

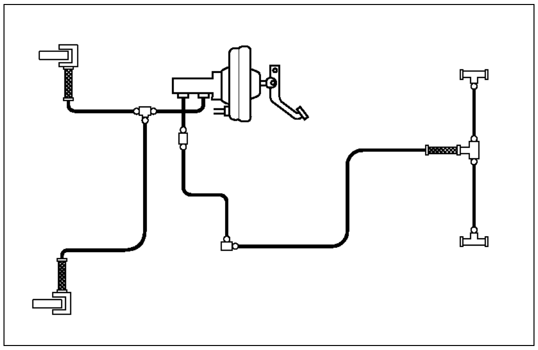
25.Go to the next wheel in the sequence after each wheel is bled.

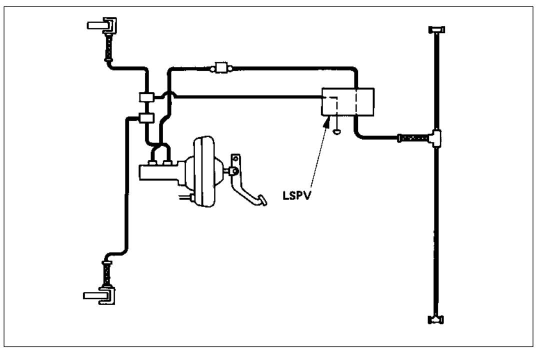
Be sure to monitor reservoir fluid level.

26.Depress the brake pedal to check if you feel “sponginess” after the air has been removed from all wheel cylinders and calipers.

If the pedal feels “spongy” the entire bleeding procedure must be repeated.

27. After the bleeding operation is completed on each individual wheel, check the level of the brake fluid in the reservoir and replenish up to the “MAX" level as necessary.
28. Attach the reservoir cap.
29. Stop the engine.





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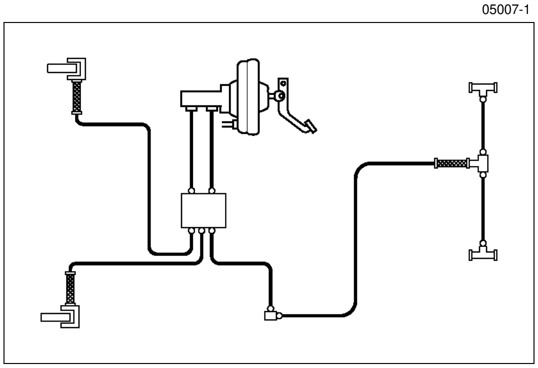
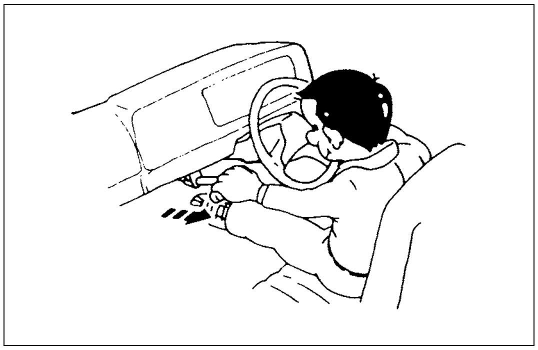


BRAKE LINE (HOSES AND PIPES)

- Inspect all hoses and pipes for wear, bending, chafing, cracks, dents, or any other damage.
  Make necessary correction or replace parts if these abnormal conditions are found through inspection.
- All hoses, pipes and joints can be damaged easily.
  Do not allow the hose to become excessively twisted and bent when working with them, and pay special attention to all the brake lines not to damage them when repairing or replacing other parts (axle, suspension, etc).
- Inspection for leakage should be performed by depressing the brake pedal fully.
  If leakage is apparent at the circumference of joints, retighten or replace these parts.
  This procedure must be performed whenever brake lines are installed.
- After disconnecting the hoses and pipes, cap or tape the openings to prevent entry of foreign material.

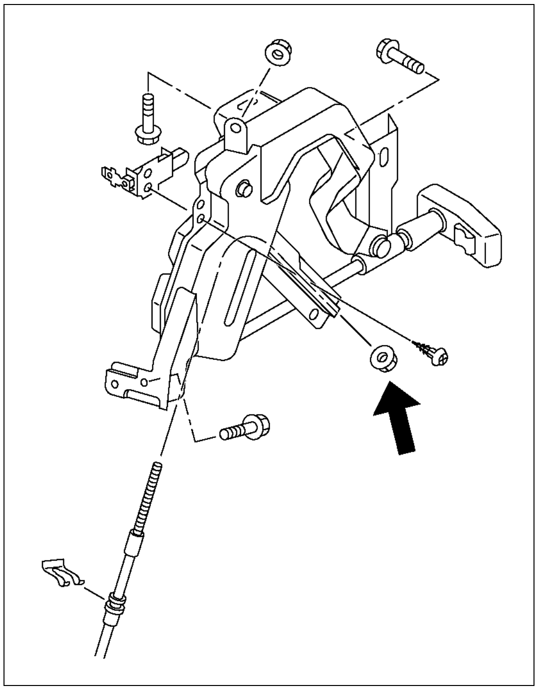
ADJUSTMENT PROCEDURE OF SERVICE AND PARKING BRAKE



Stick type

All brakes are self-adjusting.
Brakes are adjusted by repeated stepping on the brake pedal.
(After stepping on the pedal and releasing it, the rear brake auto-adjuster, produces a clicking sound.
The same operation should be repeated until the sound disappears.)
Take the following steps after overhauling the rear brake assembly.

1. Move the parking brake lever to its fully released position.



311R300007

2. Parking cable must be loosened sufficiently.
   (Loosen the adjust nut and the lock nut.)
3. Repeat stepping on the brake pedal firmly and releasing it until the clicking sound can no longer be heard.
   If the difference between the brake drum inside diameter of the brake shoes is adjusted to be 0.5 mm, the number of times for depressing the brake pedal can be reduced.
4. Remove the drum.
   Measure the brake drum inside diameter and diameter of the brake shoes.

Shoe Clearance	mm (in)
0.25 - 0.40 (0.0098 - 0.0157)	

   If incorrect, check the brake auto-adjusting system.
5. Turn the adjuster nut so that the parking brake lever travels 10 notches when pulled up with a force 30 kg (66 lbs.).
6. Make sure there is no brake drag.

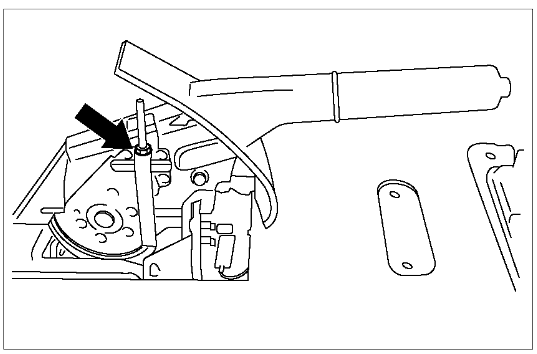
Floor mount type

All brakes are self-adjusting.
Brakes are adjusted by repeated stepping on the brake pedal. (After stepping on the pedal and releasing it, the rear auto-adjuster, in the rear brake, produces a clicking sound.
The same operation should be repeated until the sound disappears.)
Take the following steps after overhauling the rear brake assembly.

1. Move the parking brake lever to its fully released position.
2. Parking cable must be loosened sufficiently.
   (Loosen the adjust nut and the lock nut.)
3. Repeat stepping on the brake pedal firmly, and releasing it until the clicking sound can no longer be heard.
   If the difference between the brake drum inside diameter of the brake shoes is adjusted to be 0.5 mm (0.020 in), the number of times for depressing the brake pedal can be reduced.
4. Remove the drum.
   Measure the brake drum inside diameter and diameter of the brake shoes.

Shoe Clearance	mm (in)
0.25 - 0.40 (0.010 - 0.016)	

If incorrect, check the brake auto-adjusting system.



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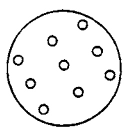
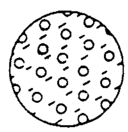
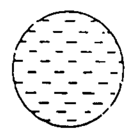
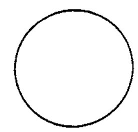
5. Turn the adjuster nut so that the parking brake lever travels 7 notches when pulled up with a force 294N (30 kg / 66 lb).
6. Make sure there is no brake dragging.

Reading Sight Glass

High and low pressure pipe temperature	The high pressure pipe is hot and the low pressure pipe is cold. There is a distinct difference in temperature between them.	The high pressure pipe is warm and the low pressure pipe is cool. There is no great difference in temperature between them.	There is little difference in temperature between the high pressure pipe and the low pressure pipe.	The high pressure pipe is hot and the low pressure pipe is slightly warm. There is a difference in temperature between them.
Sight glass condition	Almost transparent. A flow of bubbles can be seen, but they disappear when the throttle is opened. 	A flow of bubbles always can be seen. It appears sometimes transparent, and sometimes frothy. 	Something like fog faintly can be seen. 	Even at idle with the fan at "HI" (with the window fully open), the bubbles cannot be seen. 
Air conditioning cycle condition	OK	NG (Not enough refrigerant)	NG (Almost no refrigerant)	NG (Too much refrigerant)

The sight glass provides accurate diagnosis only under the following conditions.
If the vehicle can be tested under these conditions, check the sight glass appearance and compare to the chart.

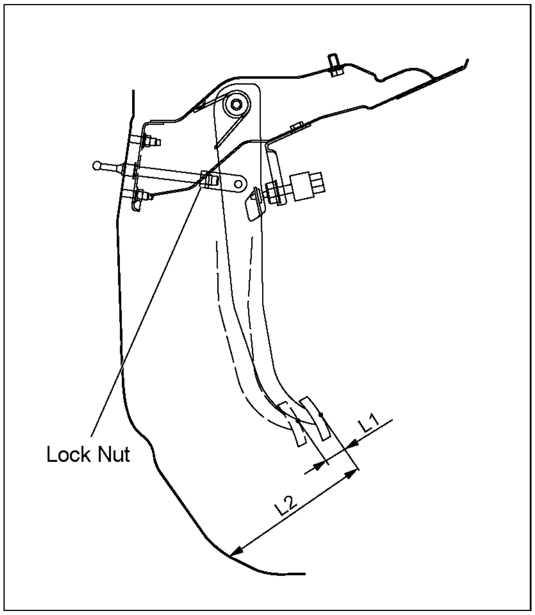
* Engine speed Idling
* A/C switch "ON"
* Blower fan operating at highest speed
* Air source selector lever at "RECIRC"
* Temperature control knob at coldest position
* Ambient temperature below 35°C (95°F) and humidity below 70% (See NOTE 1)
* High side pressure less than 1470 kPa (15 kg/cm^2 / 213 psi) (See NOTE 2)

NOTE 1
If the vehicle cannot be moved to a testing location that meets these specifications, then the sight glass cannot be used for diagnosis. You must discharge and recover the refrigerant, then recharge the system with the specified amount of refrigerant. Then continue checking the system performance.

NOTE 2
If the high side pressure is greater than stated, the sight glass cannot be used for diagnosis. You must discharge and recover the refrigerant, then recharge the system with the specified amount of refrigerant. Then continue checking system performance.

ADJUSTMENT PROCEDURE OF BRAKE PEDAL

The push rod serves as the brake pedal stopper when the pedal is fully released.
Brake pedal height adjustment should be performed as follows.



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Brake Pedal - Height

Measure the brake pedal height after making sure the pedal is fully returned by the pedal return spring.

Note:
Pedal height (L2) must be measured after starting the engine and increasing the revolution several times by stepping on the accelerator pedal.

mm (in)

Pedal free play (L1)	6 - 10 (0.24 - 0.39)	
Height (L2)	M/T	174 - 186 (6.85 - 7.32)
	A/T	176 - 188 (6.93 - 7.40)

Note:
Pedal free play must be measured after turning off the engine and stepping on the brake pedal firmly five times or more.

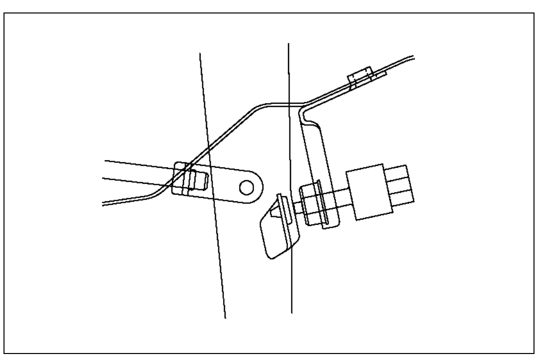
If the measured value deviates from the above range, adjust the brake pedal as follows:

a) Disconnect the stop lamp switch.
b) Loosen the lock nut on the push rod.
c) Adjust the brake pedal to the specified height by rotating the push rod in the appropriate direction.

Lock Nut Torque	N·m (kgf·m/lb·ft)
15 - 25 (1.5 – 2.5 / 11 - 18)	

d) Install the stop lamp switch.

Note:
Pedal height (L_2) must be 57 mm (2.24 in.) or more when applying about 50 kg (110.25 lbs.) of stepping force.


331R300005

How to connect the CLEVICE of the BOOSTER ROD with the PEDAL ARM and how to adjust the PEDAL SW.
After connecting the CLEVIS of the BOOSTER ROD to the PEDAL ARM, adjust the PEDAL SW mounted (PDA) to the PEDAL BRACKET using the procedure explained below.

1. Set the hole of the CLEVIS of the BOOSTER & M/CYL ROD with the hole in the PEDAL ARM.
2. Enter the PIN; PUSH ROD to the PEDAL to the holes from the left side of the PEDAL.
3. Enter and fix the PIN; SNAP PIN FIX to the DITCH of the PIN; PUSH ROD to PEDAL from right side of the PEDAL.
4. Release the LOCK by turning the SWITCH counter-clock-wise.

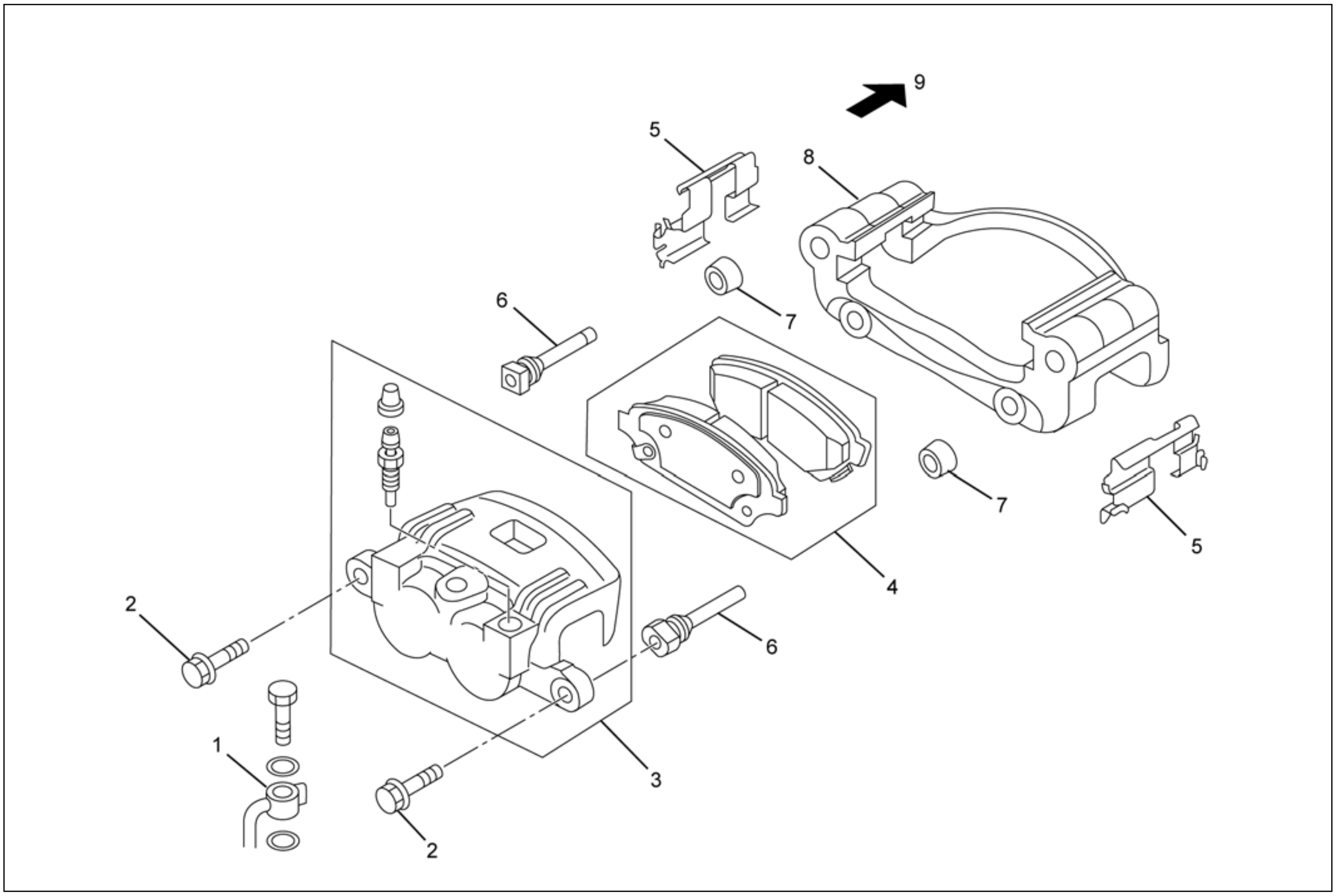
5. Pull the PEDAL ARM a little towards you so that the PEDAL ARM is not pushed in.
6. Holding the PEDAL ARM still with one hand, push in the whole SWITCH with the other hand until the PLUNGER of the SWITCH is pushed in and the SWITCH itself hits the RUBBER of the PEDAL ARM.

   In this condition, turn the SWITCH clock-wise until a “click” sound is heard and lock it.

   By doing this the SWITCH is adjusted at 0.7±0.5 mm (0.028 ± 0.020 in) clearance.

FRONT DISC BRAKE ASSEMBLY

REMOVAL AND INSTALLATION



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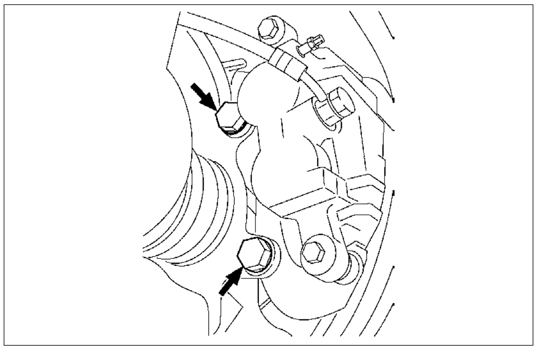
Removal Steps

▲ 1. Brake flexible hose
▲ 2. Lock bolt
3. Caliper assembly
▲ 4. Pad assembly with shim
5. Clip; pad
6. Slide pin
7. Boot
▲ 8. Support bracket
▲ 9. Front hub and disc assembly

Installation Steps

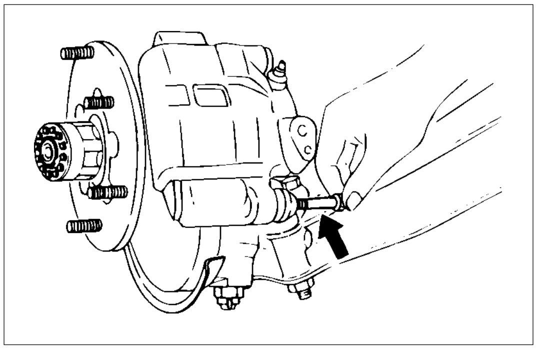
▲ 9. Front hub and disc assembly
▲ 8. Support bracket
▲ 7. Boot
▲ 6. Slide pin
▲ 5. Clip; pad
4. Pad assembly with shim
3. Caliper assembly
▲ 2. Lock bolt
▲ 1. Brake flexible hose


RUW55CSH000101

Important Operations - Removal

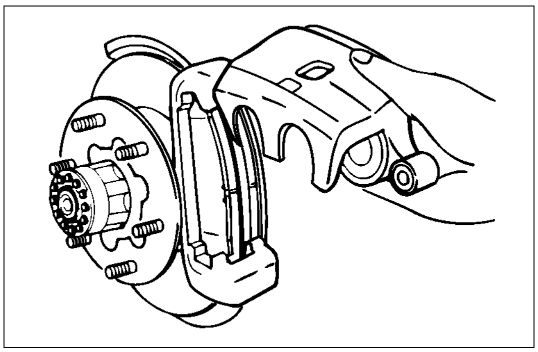
1. Brake Flexible hose

Remove the bolt and gasket and disconnect the brake flexible hose from the caliper.
After disconnecting the flexible hose, cap or tape the openings to prevent entry of foreign material.


RUW55CSH001501

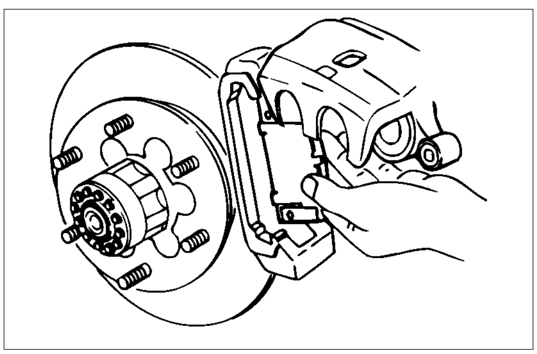
2. Lock Bolt

Remove the lock bolt from the caliper.



4. Pad Assembly with Shim

Rotate the caliper upward.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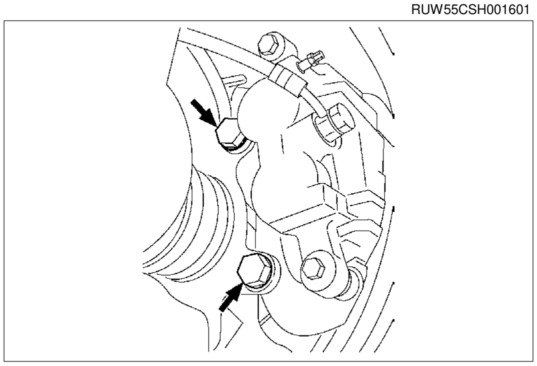
Mark the lining locations if they are to be reinstalled.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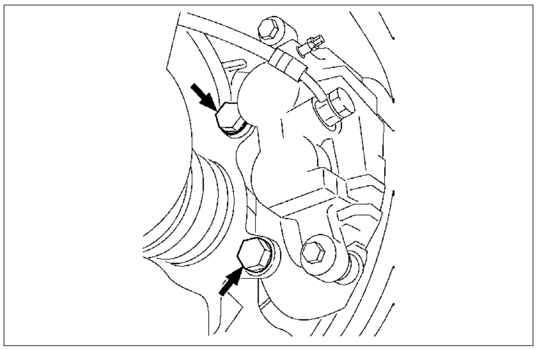
8. Support Bracket

Take care not to damage the brake flexible hose when removing the support bracket.

9. Front Hub and Disc Assembly
For the removal procedure, refer to Section 4C "FRONT WHEEL DRIVE".

Important Operations - Installation

9. Front Hub and Disc Assembly
For the installation procedure, refer to the front hub and disc reassembly procedure in Section 4C "FRONT WHEEL DRIVE".



RUW55CSH000101

8. Support Bracket

Torque	N·m (kgf·m/lb·ft)
206 - 245 (21.0 – 25.0 / 152 - 181)	

Set up the clip and pad before installation of the support bracket.

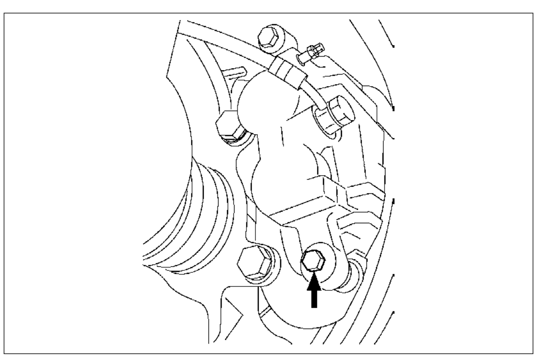
7. Boot

6. Slide Pin

- Be sure to install the boots to the slide pin and the support bracket securely.
- Apply rubber grease to the sliding surface of the slide pin before installation of the slide pin. (Don't use mineral type grease.)

1) Assemble a slide pin boot to a slide pin.
2) Use 0.6g to apply grease to the slide pin entirely as shown bellow.
3) Insert the slide pin to the housing and make sure the boot is also inserted to the housing tightly.

5. Clip; Pad
Install new parts if necessary.



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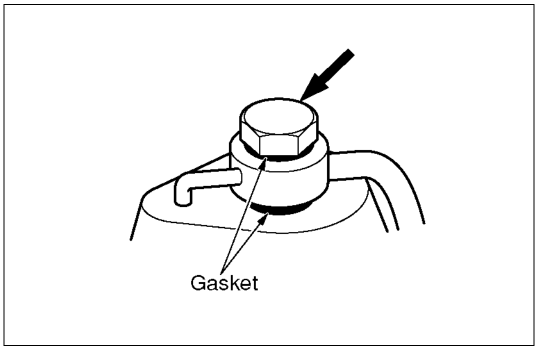
2. Lock Bolt

Torque	N·m (kgf·m/lb·ft)
32 - 40 (3.3 – 4.1 / 24 - 30)	



1. Brake Flexible Hose

Attach the bolt and new gasket

Torque	N·m (kgf·m/lb·ft)
29 -39 (3.0 - 4.0 / 22 - 29)	

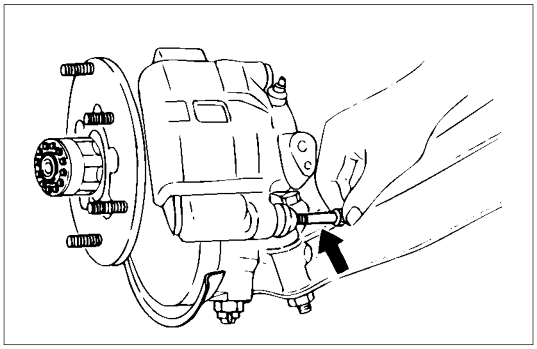
After installation, the bleeding and replenishing procedure must be performed.

Wipe the circumference of the hose clean.

Note:

- **Always use new gaskets.**
- **Be sure to put the hooked edge of the flexible hose end into the anti-rotation cavity.**

REMOVAL AND INSTALLATION OF DISC PAD



RUW55CSH001501

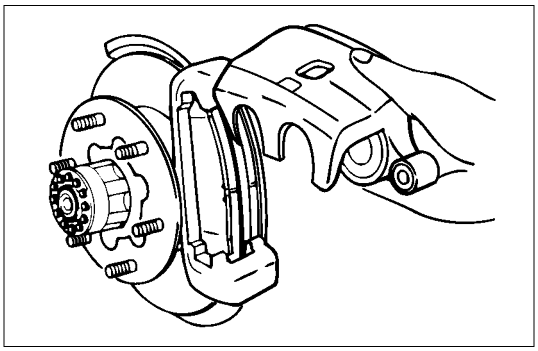
Removal Steps

1. Lock Bolt

Remove the lock bolt from the caliper.

Note:

Don't remove the brake hose from the caliper when replacing pads.

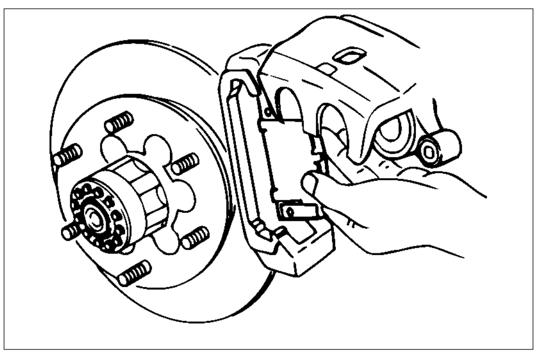


2. Rotate the Caliper Upward

Remove the caliper from the support bracket and move the caliper to the upper link or the frame.

Note:

While caliper is removed from the support bracket, never step on the brake pedal or the piston will protrude rapidly.



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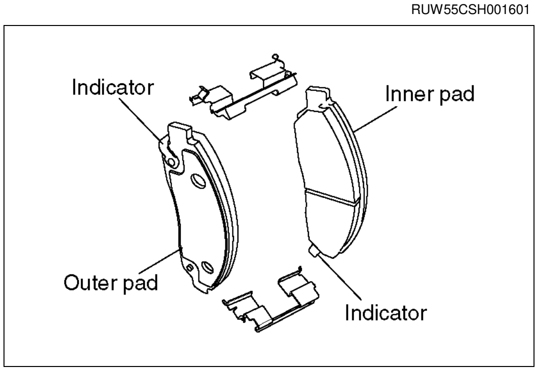
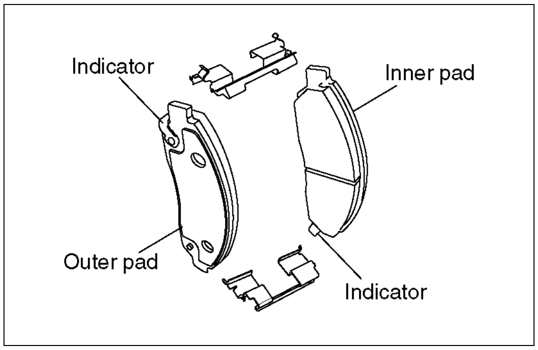
3. Pad Assembly with Shim

Remove the pad assembly with the shim.
Mark the pad locations if they are to be reinstalled.



4. Clip; Pad

Discard the used clip and install a new one.

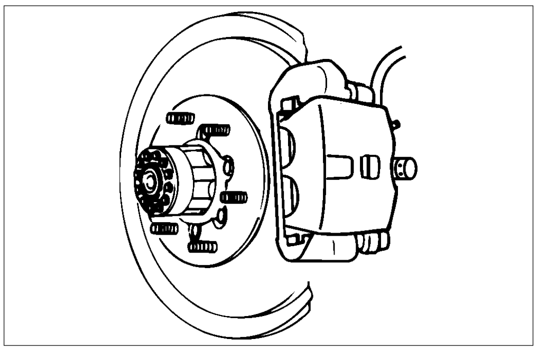


Installation Steps

1. Clip; Pad

2. Pad Assembly with Shim

After attaching the pad assembly with the shim to the support bracket, position the wear indicator to the lower side of the inner pad and position the wear indicator to the upper side of the outer pad.



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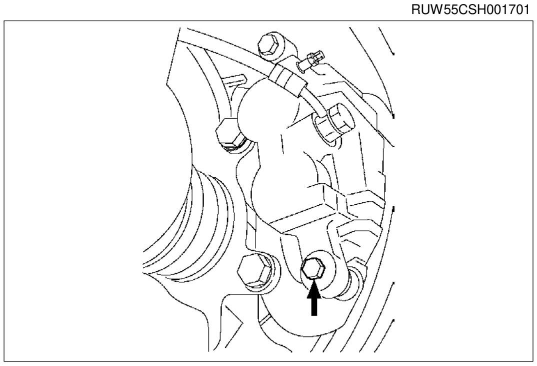
3. Caliper Assembly

Lower the caliper into its original position.
Do not damage the flexible hose by twisting or pulling it.



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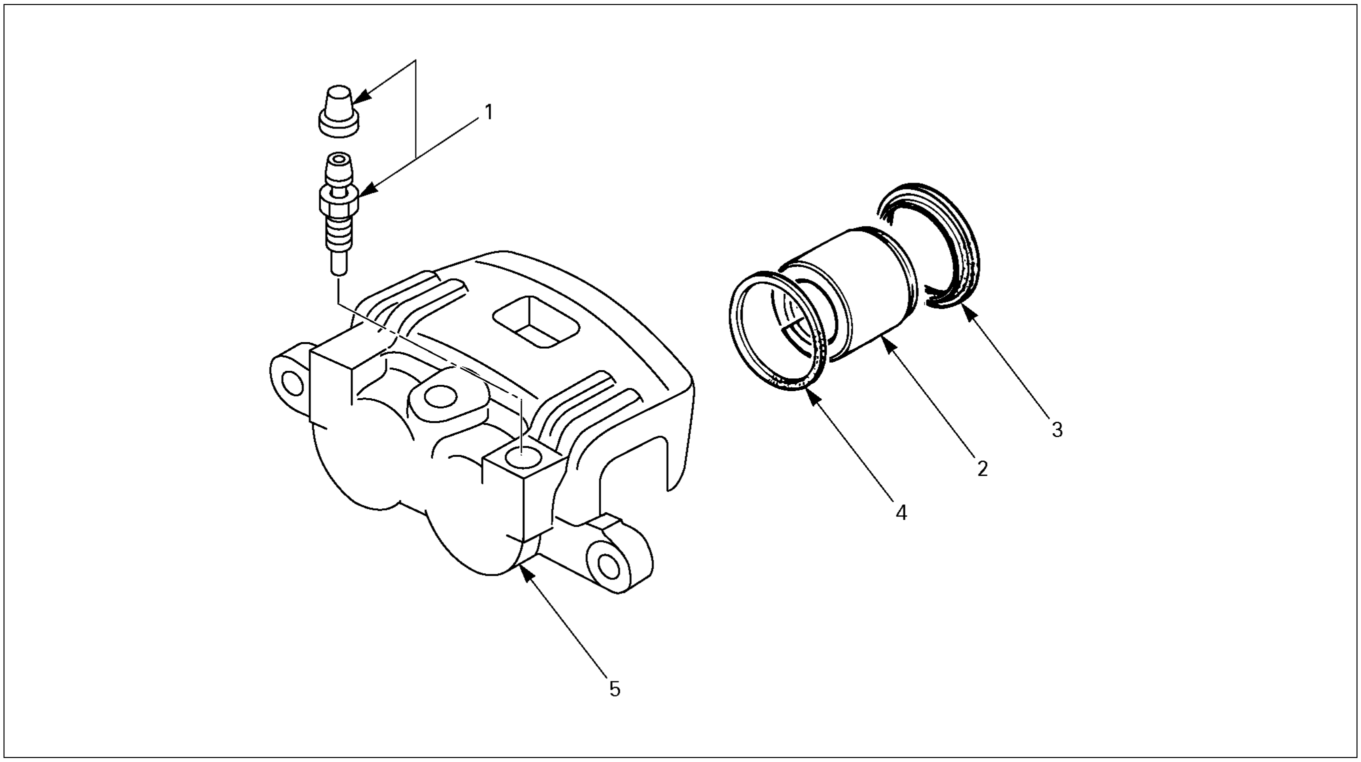
4. Lock Bolt

Attach the lock bolt to the caliper.

Torque	N·m (kgf·m/lb·ft)
32 - 40 (3.3 – 4.1 / 24 - 30)	

DISASSEMBLY

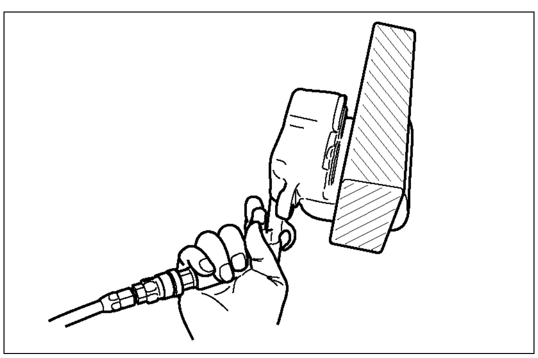
CALIPER ASSEMBLY



Disassembly Steps

1. Bleeder with cap
▲ 2. Piston
3. Dust seal; piston
4. Ring seal
5. Body; caliper

Important Operations



2. Piston (with Ring Seal)

Insert a block of wood into the caliper and force out the piston by blowing compressed air into the caliper at the flexible hose attachment.

This procedure must be done prior to removal of the dust seal.

CAUTION:

Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air.

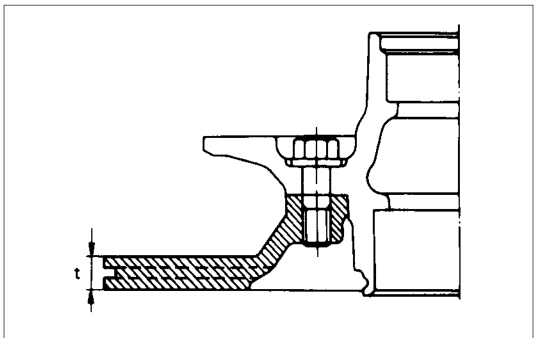
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage or any other abnormal conditions are found through inspection.

- Rotor
- Caliper body
- Cylinder bore
- Piston
- Support bracket
- Lock bolt
- Guide pin

Visual Check

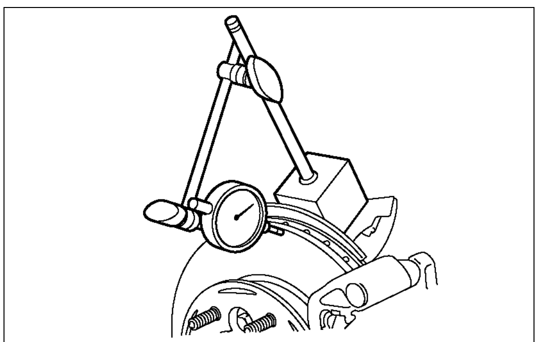
Inspect the following parts for wear, bending, distortion, cracking, corrosion, or other abnormal conditions.



Rotor

- Thickness (t) mm (in)

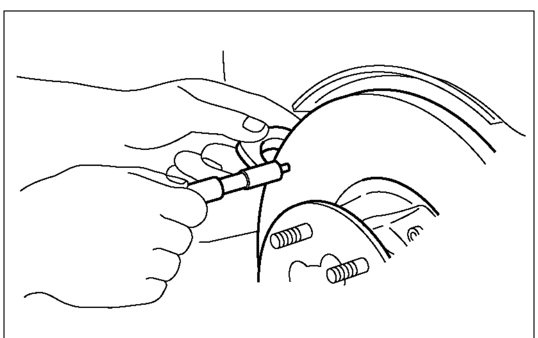
	Standard	Replacement thickness (Discard)
4×2 (Except HIGH RIDE)	26.0 (1.024)	24.6 (0.969)
4×2 (HIGH RIDE) 4×4	27.0 (1.063)	25.6 (1.008)



- Run out

Limit mm (in)
0.075 (0.0029)

Before inspection, adjust the wheel bearing correctly.
Using a dial gauge, measure the run-out at the 10 mm inside position from the rotor out-side edge of the disc pad contact surface.



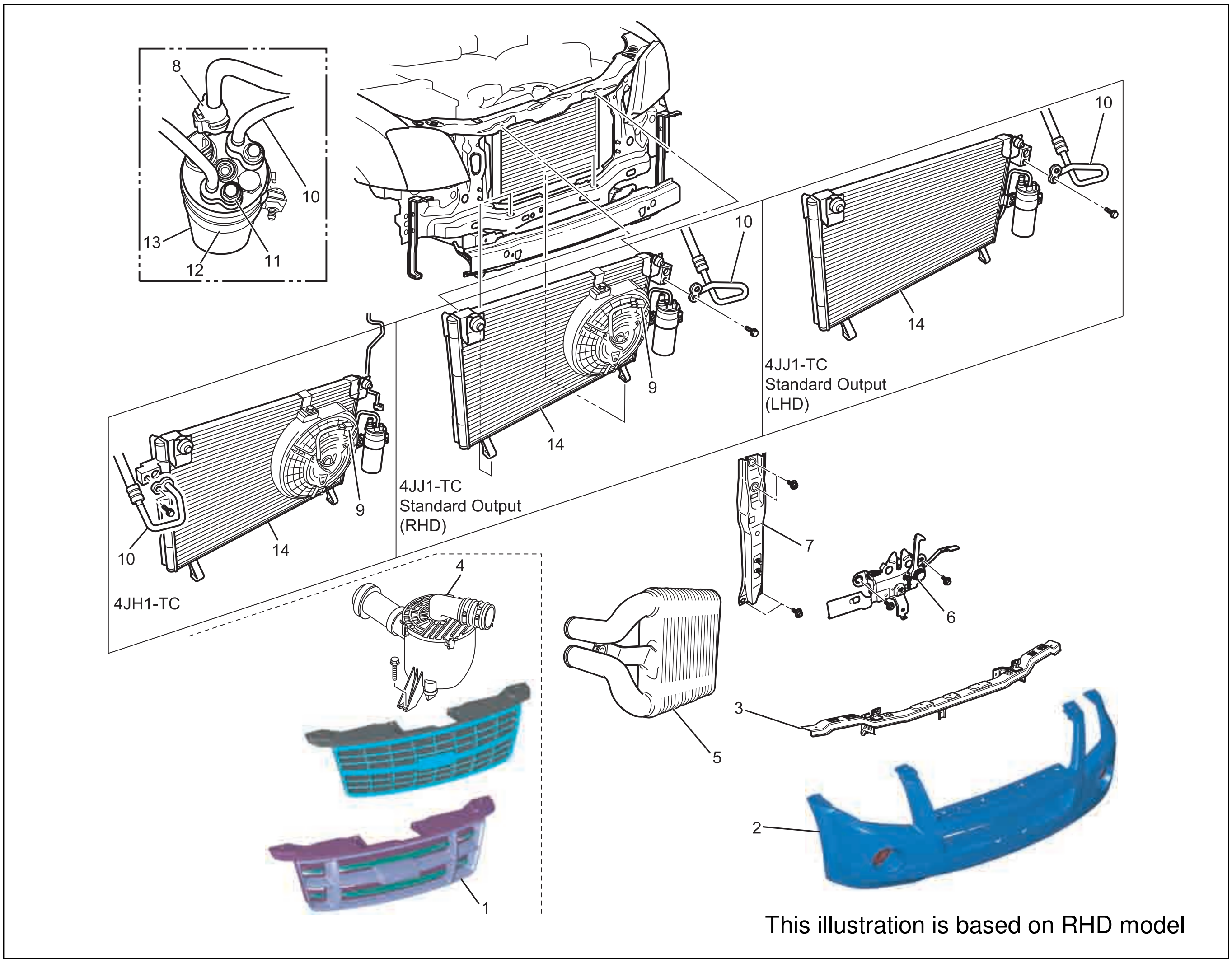
- Parallelism (Total circumferential thickness variation)

Limit mm (in)
0.023 (0.0009)

Contact surface must be within 0.023 mm at the 10 mm inside position from rotor-out side edge.
(Measurement; should be measured at more than 8 positions in circumferential direction.)

CONDENSER

REMOVAL AND INSTALLATION (4JH1-TC, 4JJ1-TC Standard Output)

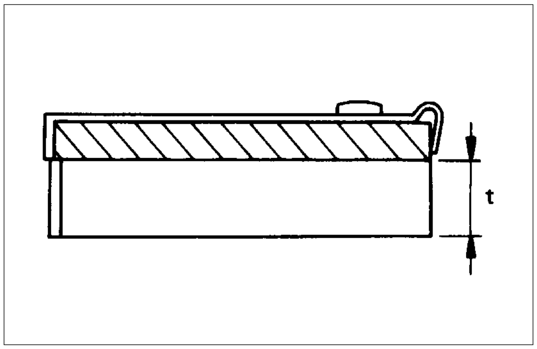


Removal Steps

1. Radiator grille
2. Front bumper fascia
    - Refer to SECTION 2A "FRONT BUMPER"
3. Front bumper impact support assembly
    - Refer to SECTION 2A "FRONT BUMPER"
4. Air cleaner assembly
5. Inter cooler
    - Refer to SECTION 6A "INTER COOLER"
6. Engine hood lock
7. Engine hood front end stay
8. Pressure switch connector
9. Condenser fan connector
10. Refrigerant line
11. Refrigerant line
12. Receiver/drier bracket
13. Receiver/drier
14. Condenser assembly

Installation Steps

14. Condenser assembly
13. Receiver/drier
12. Receiver/drier bracket
11. Refrigerant line
10. Refrigerant line
9. Condenser fan connector
8. Pressure switch connector
7. Engine hood front end stay
6. Engine hood lock
5. Inter cooler
    - Refer to SECTION 6A "INTER COOLER"
4. Air cleaner assembly
3. Front bumper impact support assembly
    - Refer to SECTION 2A "FRONT BUMPER"
2. Front bumper fascia
    - Refer to SECTION 2A "FRONT BUMPER"
1. Radiator grille



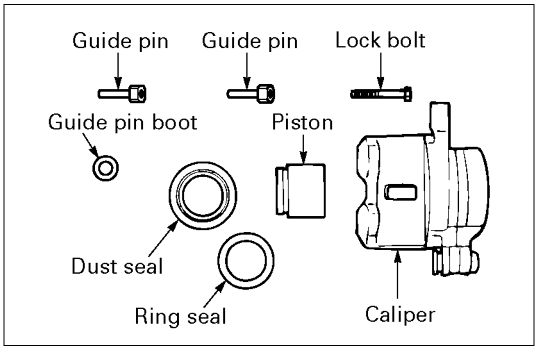
Thickness of Disc Pad

Thickness (t) mm (in)

Standard	Limit
10.0 (0.394)	1.8 (0.071)

Replace the front disc pad whenever the pad wear indicator makes a squeaking noise or when the pad is worn to within 1.8 mm of the shoe table.

All four brake pads should be replaced together.



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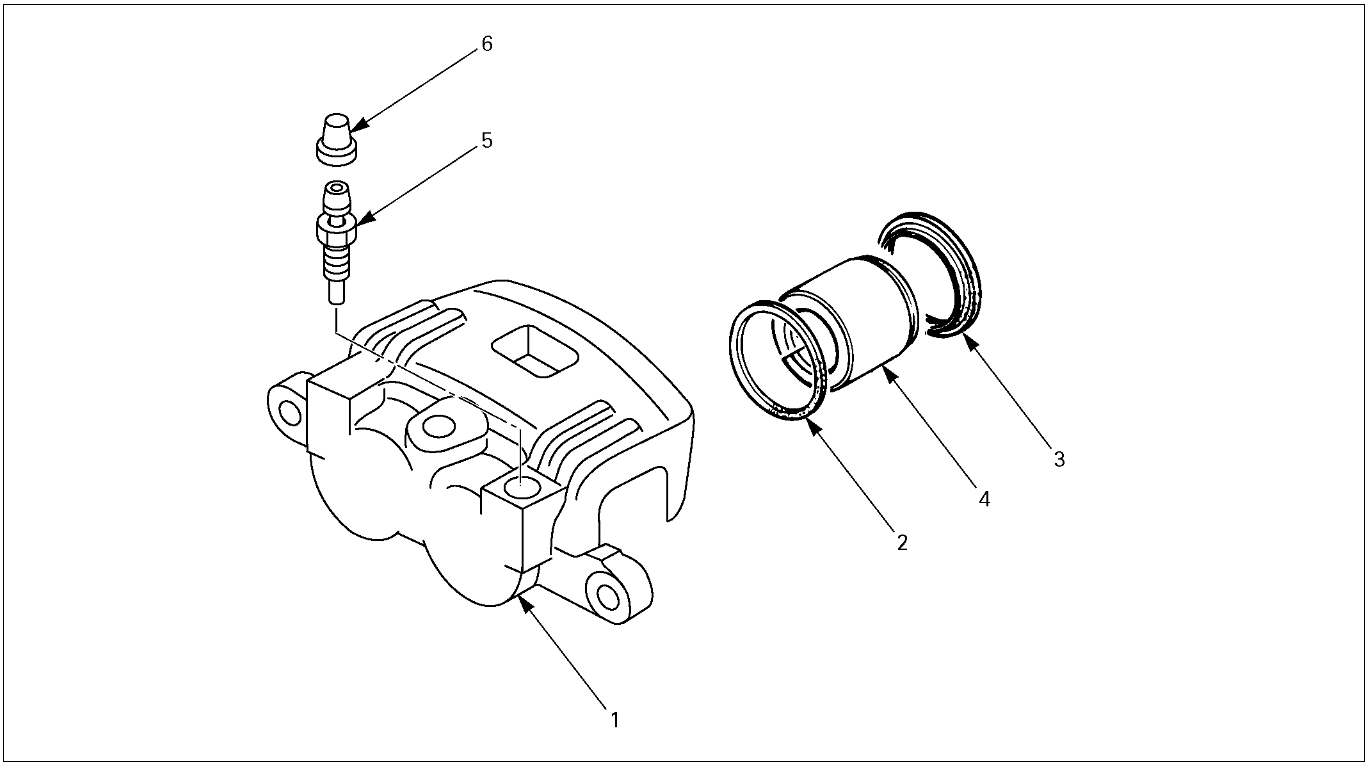
Seal and Boot

The dust seal, dust boot and ring seal should be replaced each time the caliper is overhauled.
Discard these used rubber parts.

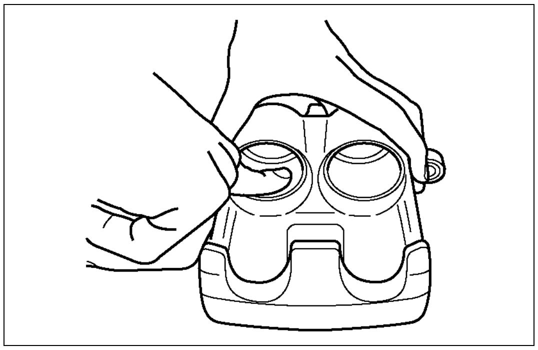
REASSEMBLY

CALIPER ASSEMBLY



Reassembly Steps

▲ 1. Body; caliper
▲ 2. Ring seal
▲ 3. Dust seal; piston
▲ 4. Piston
▲ 5. Bleeder
▲ 6. Cap



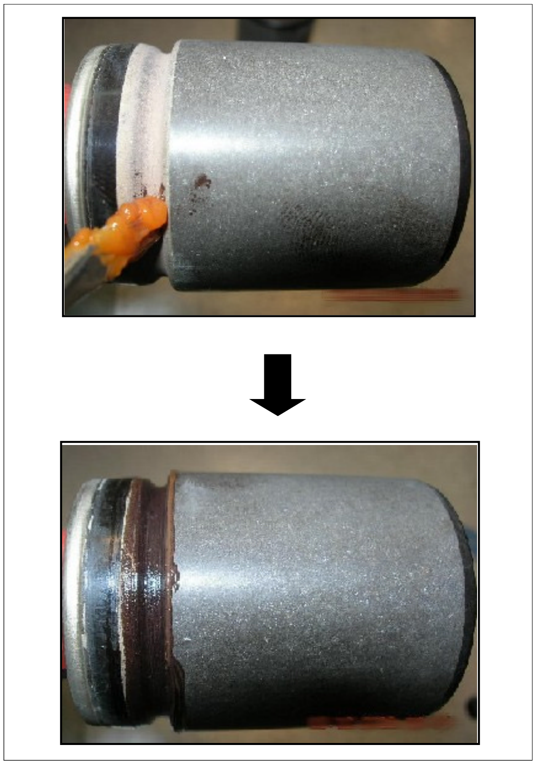
Important Operations

1. Body; Caliper

2. Ring Seal

Apply clean brake fluid to the ring seal and cylinder wall, then insert the ring seal into the cylinder.

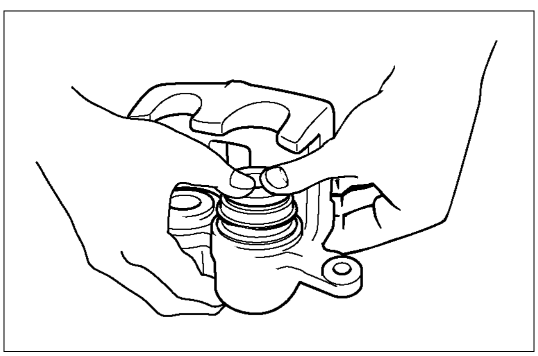
Ensure that the piston ring seal are not twisted in the caliper bore grooves.



3. Dust seal; Piston

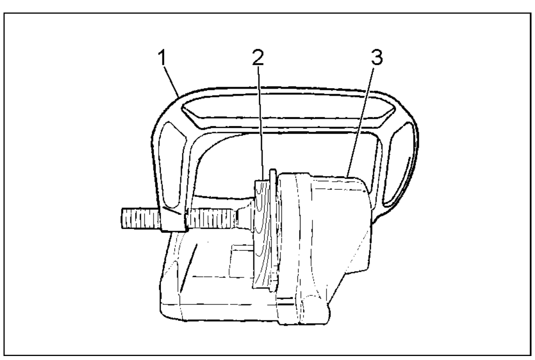
- Apply grease to piston groove and dust seal boot.
  1) Make sure a piston and its groove area are free from dust.
  2) Use 0.5g to apply grease to groove area thoroughly using a brush or finger.
     Make sure color of groove changes as shown bellow after apply grease.

  3) After assembling a dust seal boot to the piston, apply 1.5g to contact area of the piston and the dust seal boot as shown in the picture bellow.



4. Piston

Apply clean brake fluid to the piston, and attach the caliper.
When inserting the piston into the cylinder, use finger pressure only. Do not use a mallet or other impact tool, since damage to the cylinder wall or ring seal can result.
The movement of a caliper piston into a caliper bore should be smooth and even. If a caliper piston is frozen or difficult to move to the bottom, the caliper requires overhaul or replacement.



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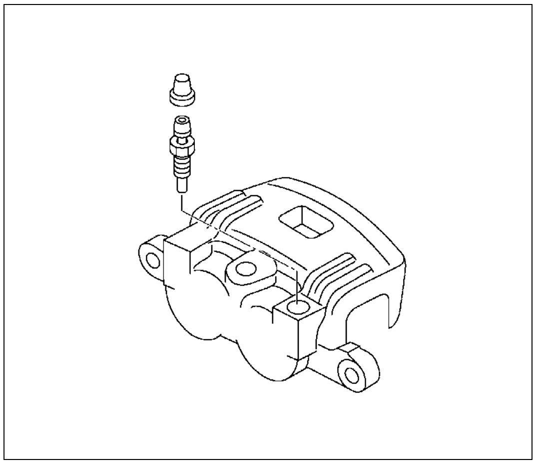
When not entering with a finger, insert a discarded inner brake pad (2) or block of wood in front of the pistons. Using 2 large C-clamps (1) installed over the body of the caliper (3) and against the brake pad or block of wood, slowly move the pistons evenly into the bores.
Insert the dust seal ring into the dust seal.

CAUTION:

Pistons made of plastic material.

Do not hit the piston with a hammer etc. and don't grasp the face of the piston with pliers.



5. Bleeder

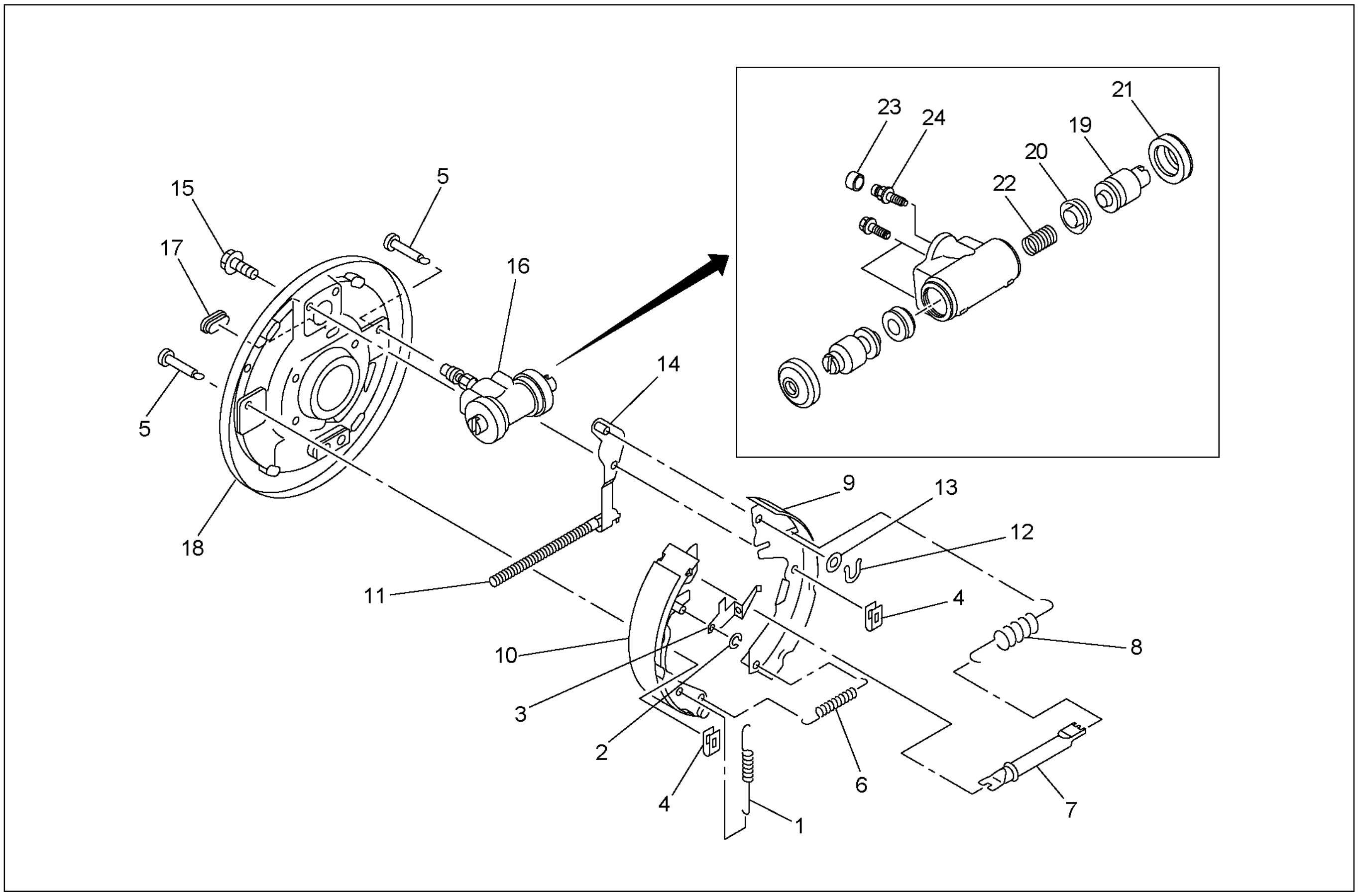
Torque	N·m (kgf·m/lb·ft)
9 – 16 (0.9 – 1.6 / 6.5 – 12)	

6. Cap

REAR DRUM BRAKE ASSEMBLY

DISASSEMBLY

First, disassemble the brake drum. Then disassemble the rear brake assembly.
Refer to the “REAR AXLE” section for the brake drum disassembly procedure.



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MAJOR COMPONENTS

Disassembly Steps

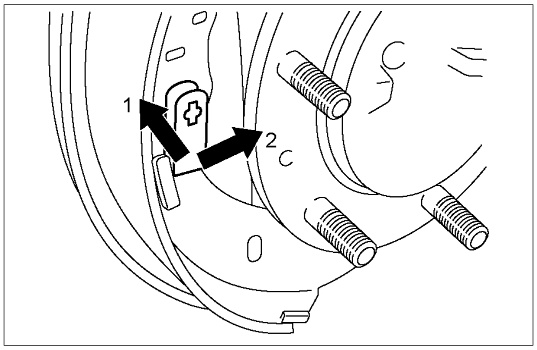
1. Spring; adjuster
2. Ring; Adjuster lever
3. Lever; adjuster
▲ 4. Spring; Shoe hold
5. Pin; Shoe hold
▲ 6. Spring; Shoe to shoe, lower
7. Adjuster assembly
8. Spring; shoe to shoe, upper
9. Shoe; leading
10. Shoe; trailing
11. Spring; lever return
12. Retainer
13. Washer; lever
14. Lever; parking
15. Bolt; wheel cylinder
16. Wheel cylinder assembly
17. Cover
18. Back plate

MINOR COMPONENTS

Disassembly Steps

Wheel Cylinder Assembly

19. Piston assembly
20. Cup; piston
21. Boot; piston
22. Return spring
23. Cap; bleeder
24. Bleeder



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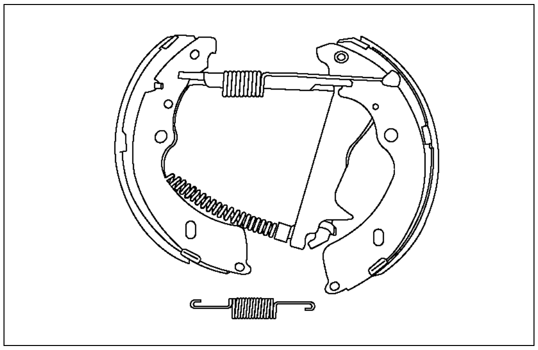
Important Operations

4. Spring; shoe hold

Push the shoe hold spring toward the brake shoe and hold it (1). Rotate the spring to remove it from the shoe hold pin (2).



6. Spring; shoe to shoe, lower

Slide the brake shoes and lower spring toward the ground. Remove the lower spring.

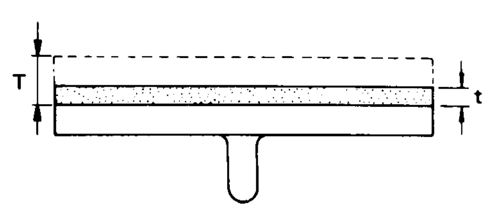
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage or any other abnormal conditions are found through inspection.

- Brake drum
- Back plate
- Brake lining
- Wheel cylinder body
- Piston
- Piston cup
- Return spring

Visual check

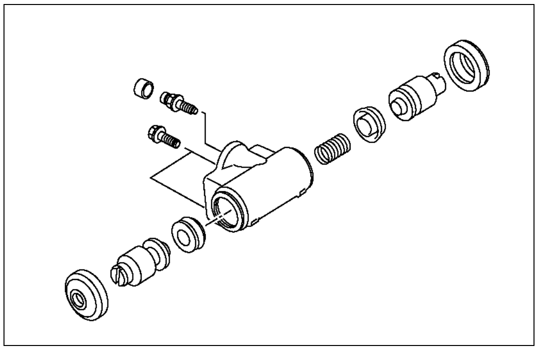
Inspect the following parts for wear scuffs, scratches, corrosion, stains, deterioration, or other abnormal conditions.



Thickness of the Brake Lining

Thickness mm (in)

	standard (T)	Limit (t)
4×2, 4×4	5.0 (0.197)	1.0 (0.039)

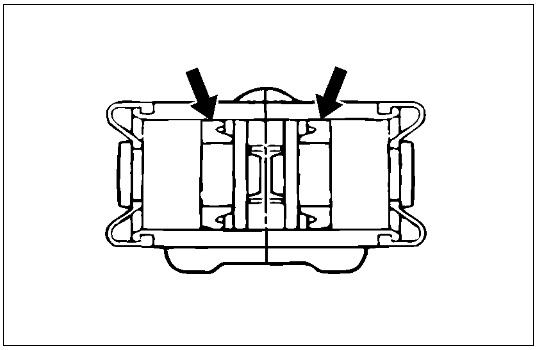


Clean wheel Cylinder Parts

Always use clean brake fluid to clean wheel cylinder parts.

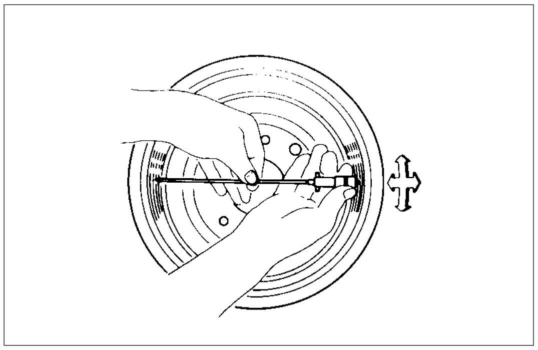
Note:

Do not use mineral based cleaning solvents such as gasoline, kerosene, acetone, paint thinner, or carbon tetrachloride.



Piston Cups

Inspect the piston cups for wear, distortion, fatigue or other abnormal conditions.

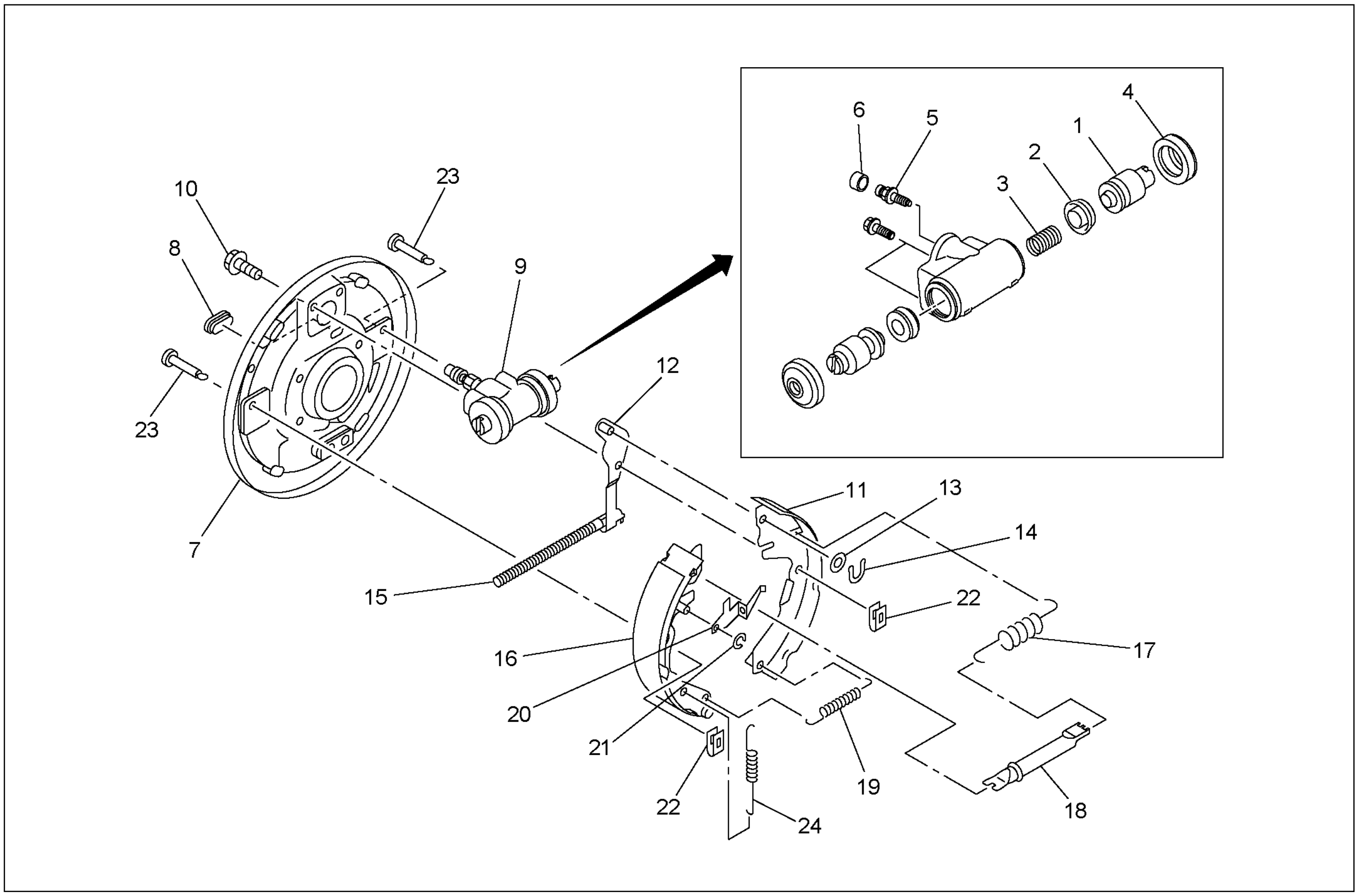


Measuring the Brake Drum

mm (in)

		Standard	Limit
4×2 (Except HIGH RIDE)	Inside diameter	254 (10.000)	255.5 (10.059)
	Run out	0.08 (0.003)	0.15 (0.006)
4×2 (HIGH RIDE) 4×4	Inside diameter	295 (11.614)	296.5 (11.673)
	Run out	0.08 (0.003)	0.15 (0.006)

REASSEMBLY



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MINOR COMPONENTS

Reassembly Steps

Wheel cylinder Assembly

▲ 1. Piston assembly
2. Cup; piston
3. Return spring
4. Boot; piston
▲ 5. Bleeder
6. Cap; bleeder

MAJOR COMPONENTS

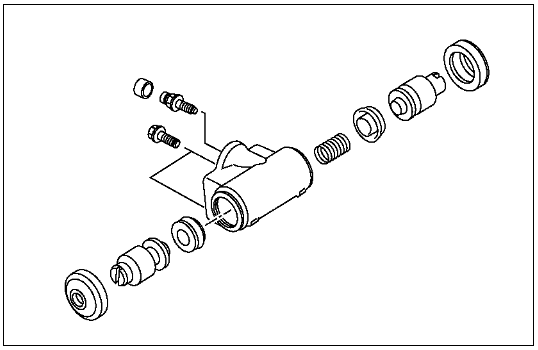
Reassembly Steps

7. Back plate
8. Cover
▲ 9. Wheel cylinder assembly
▲10. Bolt; wheel cylinder
▲11. Shoe; leading
▲12. Lever; parking
▲13. Washer; lever
▲14. Retainer
15. Spring; lever return
▲16. Shoe; trailing
▲17. Spring; shoe to shoe, upper
▲18. Adjuster assembly
19. Spring; shoe to shoe; lower
▲20. Lever; adjuster
▲21. Ring; Adjuster lever
▲22. Spring; shoe hold
▲23. Pin; shoe hold
24. Spring; adjuster

Important Operations

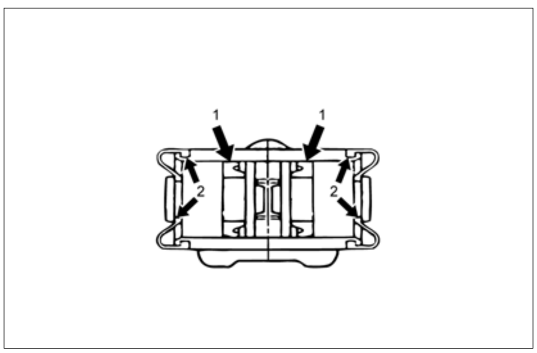
Note:

- Wash the disassembled parts in clean brake fluid.
- Use compressed air to clean the ports.
- Protect the disassembled part surfaces from contamination by dust and other foreign material.
- Before reassembly, check the part surfaces for contamination with dust or other foreign material.
- Be sure to replace the designated parts with new ones.



1. Piston Assembly

Install new piston cups on each piston so that the flared end of the cups are turned to the inboard side of the pistons.
Attach the return spring and the boot to the piston.
Be sure to use new piston cup and boot.



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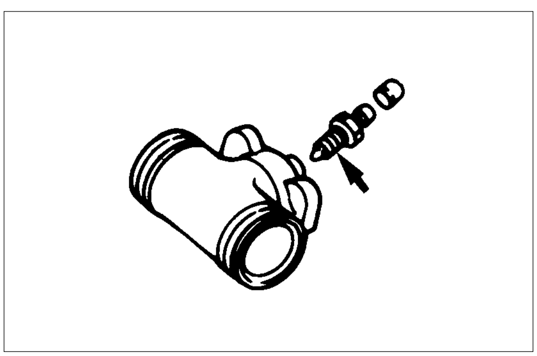
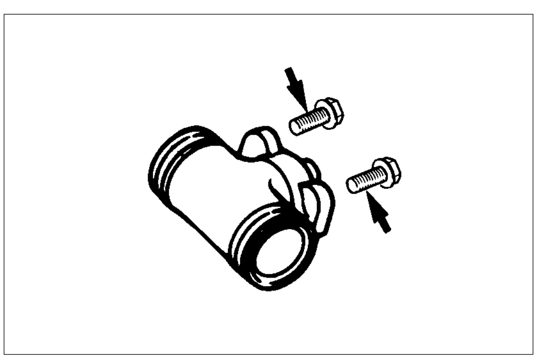
- Apply brake fluid to the pistons and the inner face of the boots.
- Note the direction of piston cup (1).
- Apply rubber grease to the boots (2) as shown in the illustration.



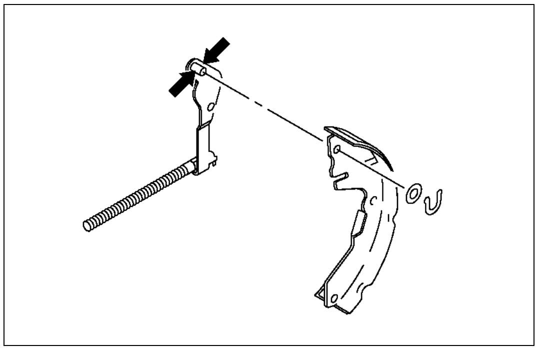
5. Bleeder

Torque	N·m (kgf·m/lb·in)
6 - 8 (0.6 – 0.8 / 52 - 69)	



9. Wheel Cylinder Assembly
10. Bolt; Wheel cylinder

Torque	N·m (kgf·m/lb·in)
14 - 18 (1.4 – 1.8 / 122 - 156)	


308R300008

11.Shoe; leading

- Be sure to use new spring; shoe hold.

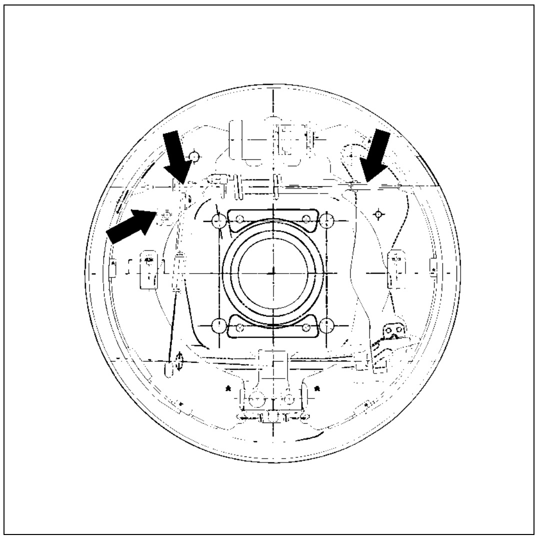
12.Lever; parking

13.Washer; lever

14.Retainer

Install the lever, the washer and the retainer to the leading brake shoe.

- Apply grease to the sliding surfaces of the lever and brake shoe.
- Be sure to use new retainer and washer.


305R300009

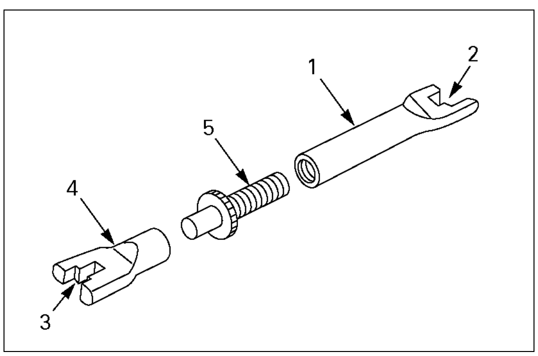
16.Shoe; trailing

- Be sure to use new spring; shoe hold.

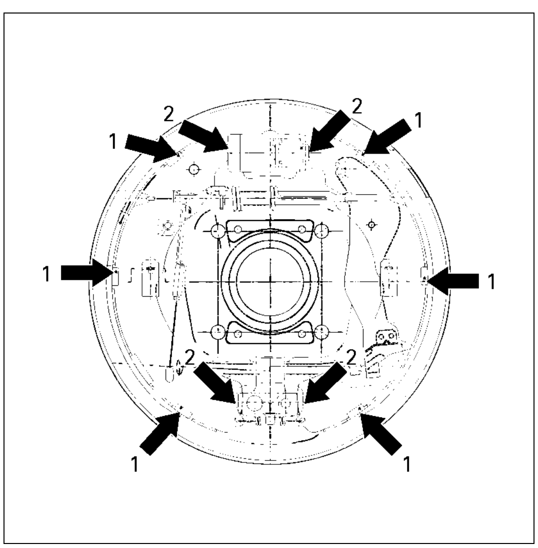
17.Spring; shoe to shoe, upper

18.Adjuster assembly

1. Apply grease to each of the parts shown in the illustration before installing the brake shoe.
   - Lever; adjuster-shoe
   - Adjuster-shoe



2. Clean the adjuster bolt (5) and the adjuster rods (1) (4). Apply grease to the threaded portion of the adjuster bolt.
3. Install the adjuster rod to the adjuster bolt.
4. Apply grease to the adjuster arm ends (2) (3). Set the spring upper to the adjuster arm, then install them to the brake shoe.



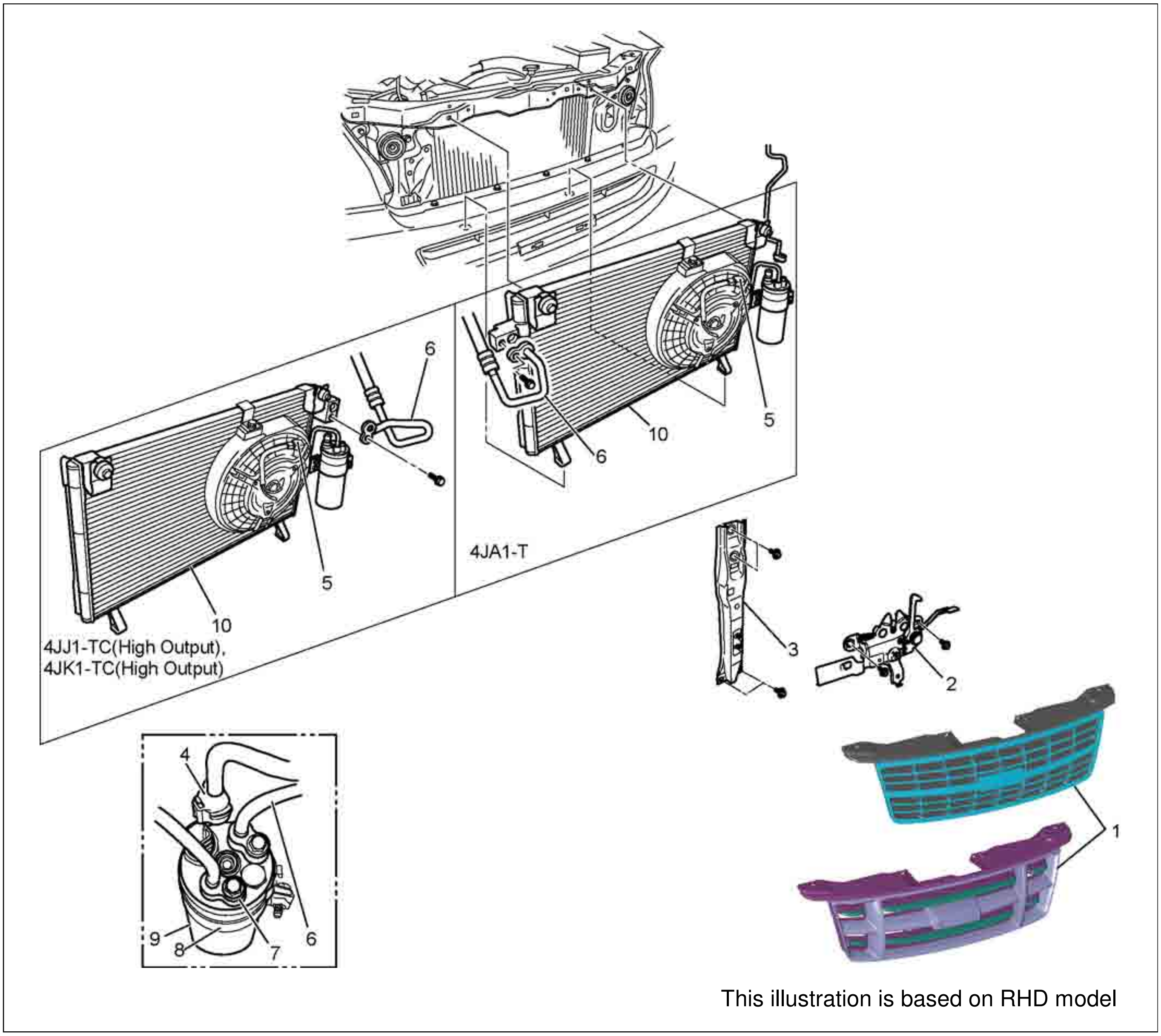
305R300010

5. Before setting the brake shoes, apply grease to the back plate portions (1) contacting the brake shoe edge as shown in the illustration.
6. Apply grease to the wheel cylinder parts contacting the brake shoe (2).
7. Install the brake shoe.

Note:

- Be careful not to damage the wheel cylinder dust cover.
- Do not allow the wheel cylinder piston to fly free.

REMOVAL AND INSTALLATION (4JJ1-TC High Output, 4JK1-TC High Output, 4JA1-T)



RTW710LF001501

Removal Steps

1. Radiator grille
2. Engine hood lock
3. Engine hood front end stay
4. Pressure switch connector
5. Condenser fan connector
6. Refrigerant line
7. Refrigerant line
8. Receiver/drier bracket
9. Receiver/drier
10. Condenser assembly

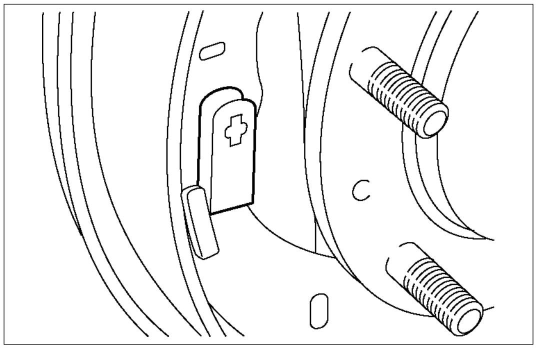
Installation Steps

10. Condenser assembly
9. Receiver/drier
8. Receiver/drier bracket
7. Refrigerant line
6. Refrigerant line
5. Condenser fan connector
4. Pressure switch connector
3. Engine hood front end stay
2. Engine hood lock
1. Radiator grille

20. Lever; adjuster

21. Ring; Adjuster lever

- Apply grease to the lever adjuster sliding surface. Install the lever adjuster and the ring to the shoe; trailing.
- Be sure to use a new ring.

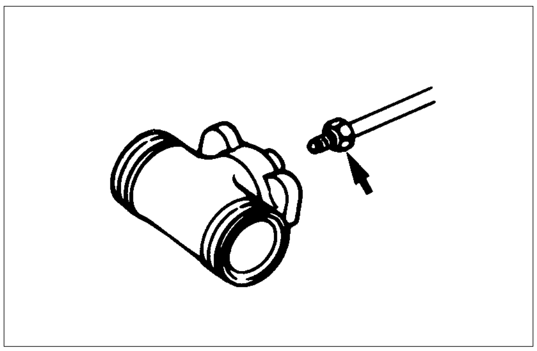


RUW55CSH000501

22. Spring; shoe hold

23. Pin; shoe hold

- Install the brake drum.
- Install the rear wheel.
- If the wheel cylinder has been removed, the brake system must be bled.
- Pump the brake pedal 10 times. Check that there is little or no stroke length variation as the pedal is pumped.
- Adjust the lining clearance.



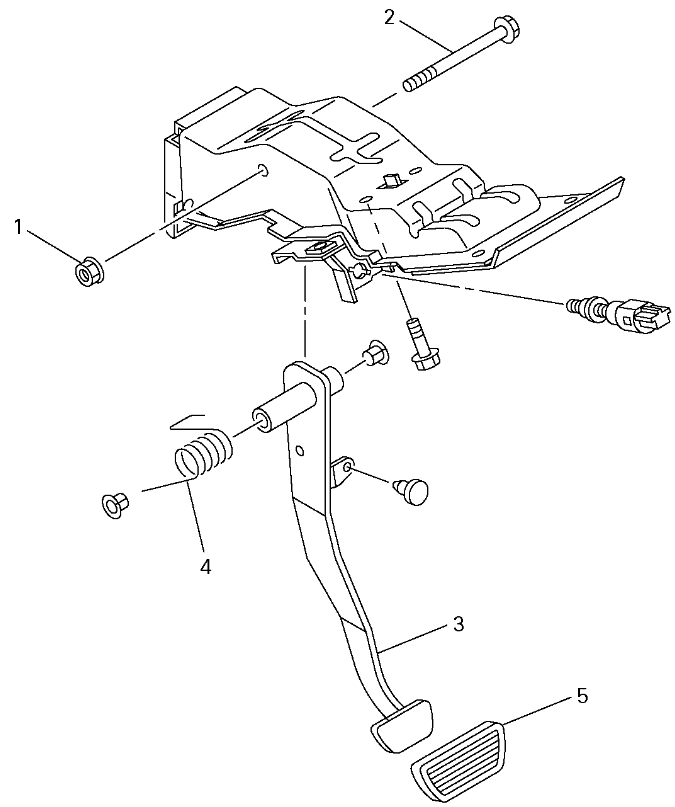
- Brake Line

Torque	N·m (kgf·m/lb·ft)
13 - 19 (1.3 - 1.9 / 9 - 14)	

BRAKE CONTROL

REMOVAL AND INSTALLATION

BRAKE PEDAL ASSEMBLY



This illustration is based on the RHD model

310R300001

Removal Steps

1. Nut; Fulcrum pin
2. Pin; Fulcrum, pedal to bracket
3. Pedal arm
4. Return spring
5. Pedal pad

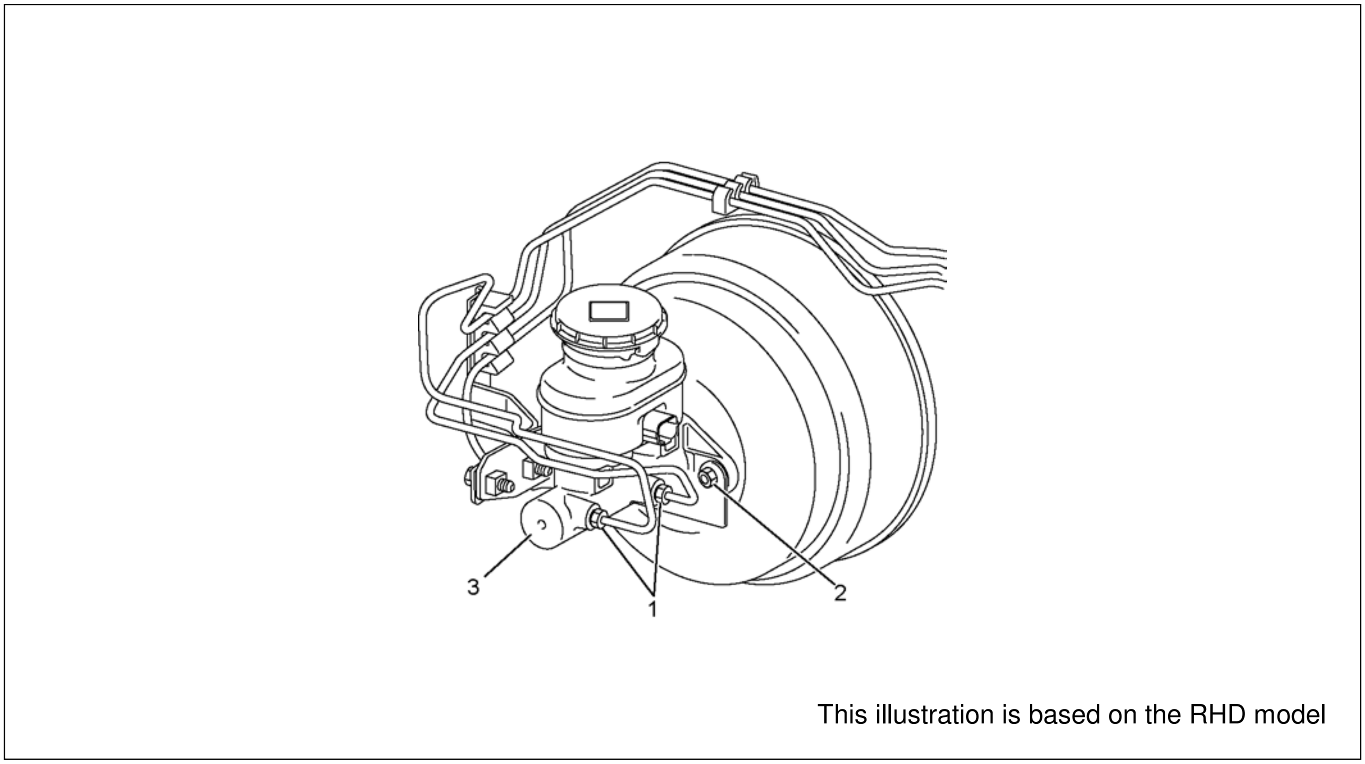
Installation steps

To install, follow the removal procedure in reverse order.
Before installation, apply grease to the entire circumference of the fulcrum pin (2).
Refer to “SERVICING” in this section for adjustment procedure of brake pedal.

MASTER CYLINDER

REMOVAL AND INSTALLATION

MASTER CYLINDER ASSEMBLY



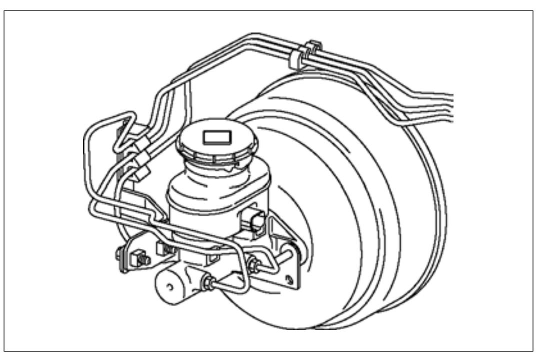
RTW75CMF000901

Removal Steps

▲ 1. Brake line
2. Nut; Master cylinder to vacuum booster
3. Master cylinder assembly

Installation Steps

3. Master cylinder assembly
▲ 2. Nut; Master cylinder to vacuum booster
▲ 1. Brake line



RTW75CSH002701

Important Operation - Removal

1. Brake Line

Be very careful not to spill brake fluid on the painted surface. Damage to the painted surface will result.

Important Operation - Installation

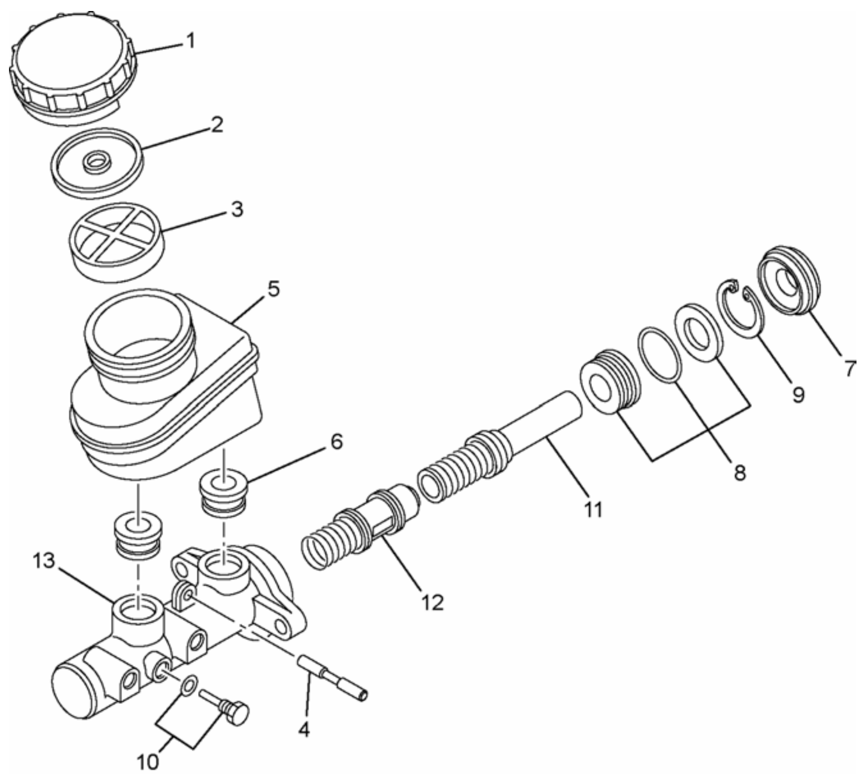
2. Nut; Master Cylinder to Vacuum Booster

Torque	N·m (kgf·m/lb·ft)
10 – 16 (1.0 – 1.6 / 7 – 12)	

1. Brake Line

Torque	N·m (kgf·m/lb·ft)
13 – 19 (1.3 – 1.9 / 9 – 14)	

DISASSEMBLY



RTW75CMF000701

Disassembly Steps

1. Cap
2. Diaphragm
3. Filter
4. Pin
5. Reservoir tank
6. Grommet

▲ 7. Front seal

8. Guide assembly

▲ 9. Snap ring

▲ 10. Stopper bolt and gasket

▲ 11. Primary piston

▲ 12. Secondary piston

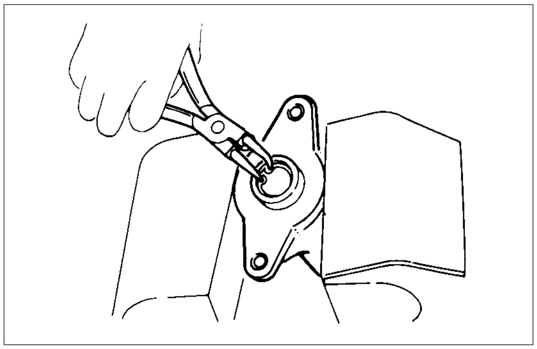
13. Cylinder body

Note:

- Be sure to replace the designated with new ones.
- Wash the disassembled parts in clean brake fluid.
- Use compressed air to clean the ports.
- Do not allow dirt and dust to contaminate the disassembled parts.

Important Operations

When disassembling, inspecting or reassembling the master cylinder assembly, take care not to bring the parts into contact with mineral oil or dust. Wash the piston cups only with brake fluid. Do not use gasoline or other mineral-base cleaning solvents.



7. Front Seal

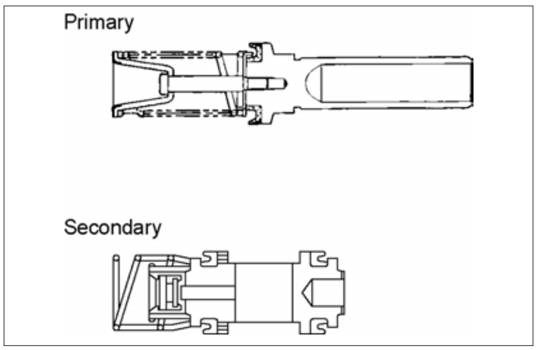
Front seal remain in the vacuum booster side, when removing master cylinder.

9. Snap Ring

Remove the snap ring from the cylinder body with pushing in the primary and secondary pistons.

10.Stopper Bolt and Gasket

Remove the stopper bolt from the cylinder body with pushing in the primary and secondary pistons.



RTW75CSH002201

11.Primary Piston

12.Secondary Piston

Don't remove the spring from the piston.

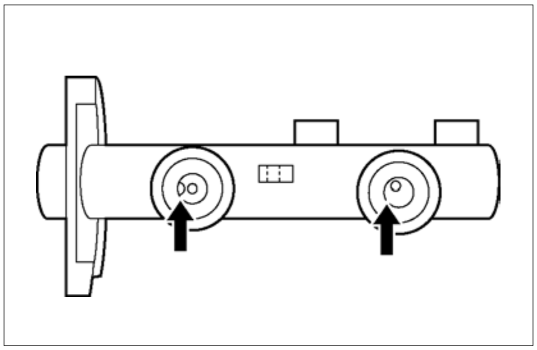
INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear damage or any other abnormal conditions are found through inspection.

- Cylinder body inside face
- Piston
- Piston cup
- Return port, Supply port
- Return spring
- Guide assembly (O-ring, Cup)
- Front seal

Visual Check

Inspect the following parts for wear, distortion, cuts, nicks, corrosion, or other abnormal conditions.

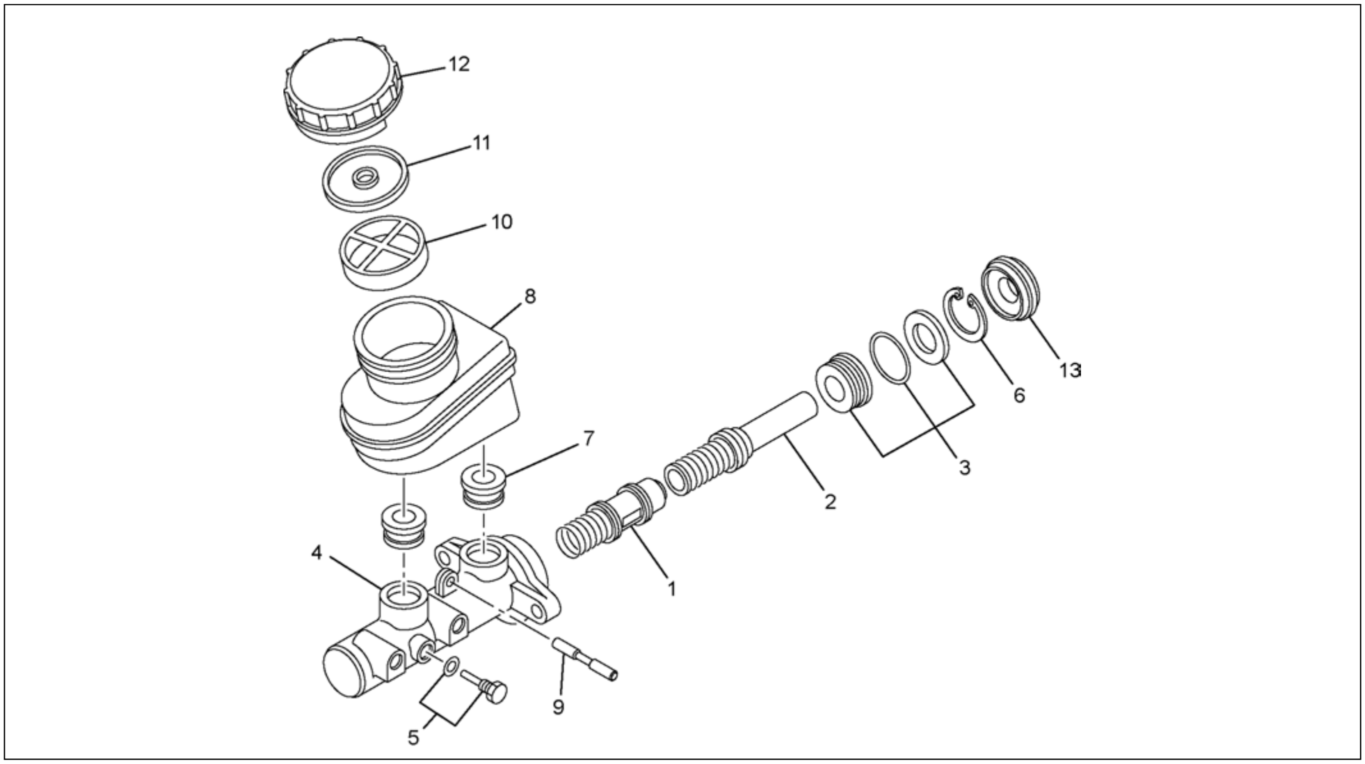


RTW75CSH002401

Return Port

Check the return port for obstructions and if necessary, clean with a tag wire.
Blow away foreign matter with compressed air.

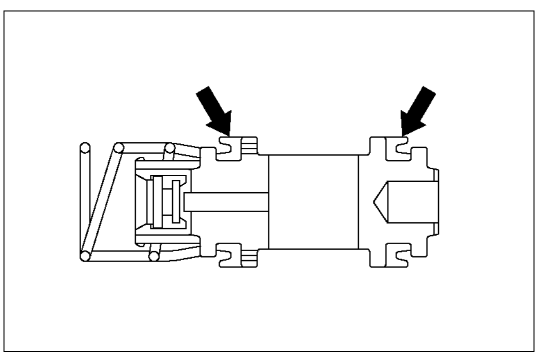
REASSEMBLY



RTW75CMF000801

Reassembly Steps

- ▲ 1. Secondary piston
- ▲ 2. Primary piston
- ▲ 3. Guide assembly
- ▲ 4. Cylinder body
- ▲ 5. Stopper bolt and gasket
- ▲ 6. Snap ring
- ▲ 7. Grommet
- ▲ 8. Reservoir tank
- ▲ 9. Pin
- ▲ 10. Filter
- ▲ 11. Diaphragm
- ▲ 12. Cap
- ▲ 13. Front seal

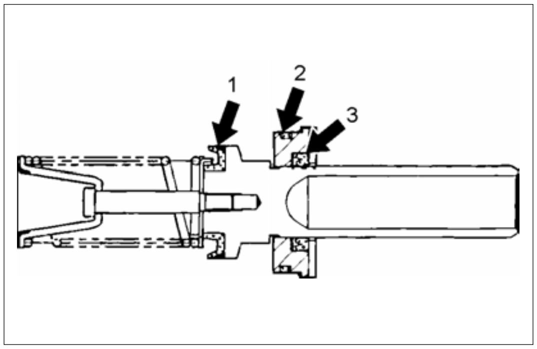


1. Secondary Piston

Lubricate the piston cups on the secondary piston assemblies with brake fluid.

Note:

Be sure to use a new piston.



RTW75CSH002301

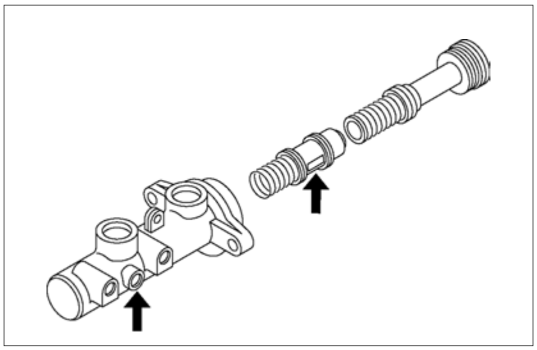
2. Primary Piston

Lubricate the piston cup on the primary piston assemblies with brake fluid (1).

Note:
Be sure to use a new piston.

3. Guide Assembly

Lubricate the O-ring of guide assembly with brake fluid (2) and the cup of guide assembly with rubber grease (3) (0.2 ~ 0.3g).


RTW75CSH002001

4. Cylinder Body

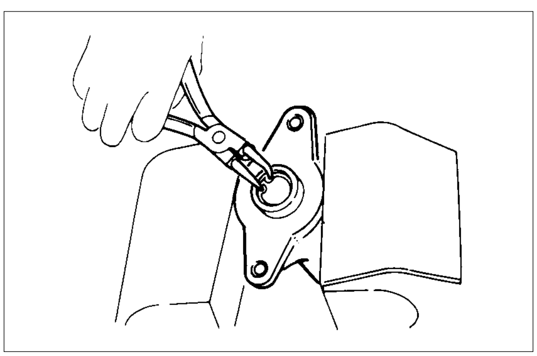
Install the secondary piston and the primary piston to the cylinder body.

Note:
The secondary piston long hole and the cylinder body stopper bolt hole must be aligned at installation.

5. Stopper Bolt and Gasket

Install the stopper bolt to the cylinder body (the piston long hole must be aligned with the cylinder body installation hole). Tighten the bolts to the specified torque.

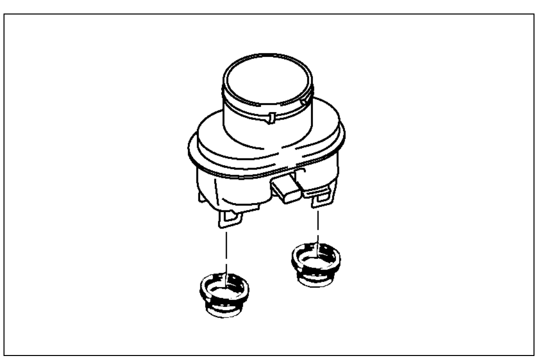
Torque	N·m (kgf·m/lb·in)
2 - 3 (0.2 - 0.3 / 17 - 26)	



6. Snap Ring

Press down on the primary piston and install the snap ring to the cylinder body groove.

Note:
Be sure to use new snap ring.



7. Grommet

1. Install the grommets to the reservoir tank.

Note:
Be sure to use are new grommets.

2. Install the reservoir tank to the cylinder body.

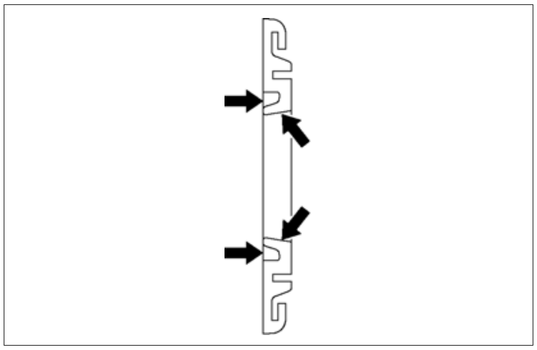
8. Reservoir Tank

9. Pin

10. Filter

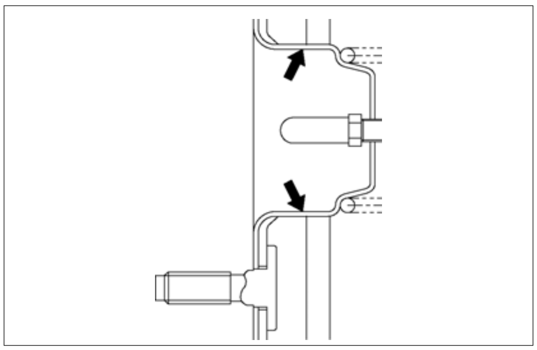
11. Diaphragm

12. Cap


RTW75CSH002501

13. Front Seal

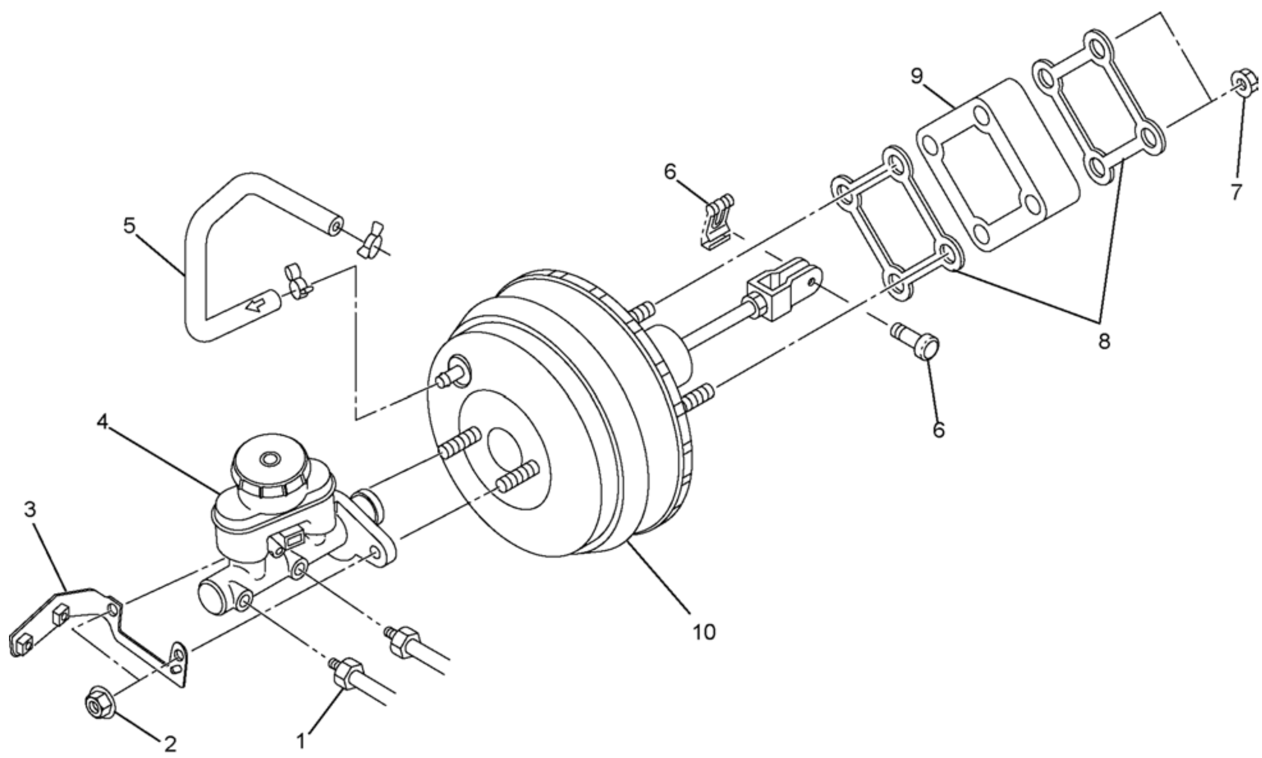
1. Lubricate the front seal with silicon grease (0.3 ~ 0.5g).


RTW75CSH002601

2. Lubricate the front cylinder shell of vacuum booster with silicon grease (0.2g).

VACUUM BOOSTER

REMOVAL AND INSTALLATION



RTW75CMF000501

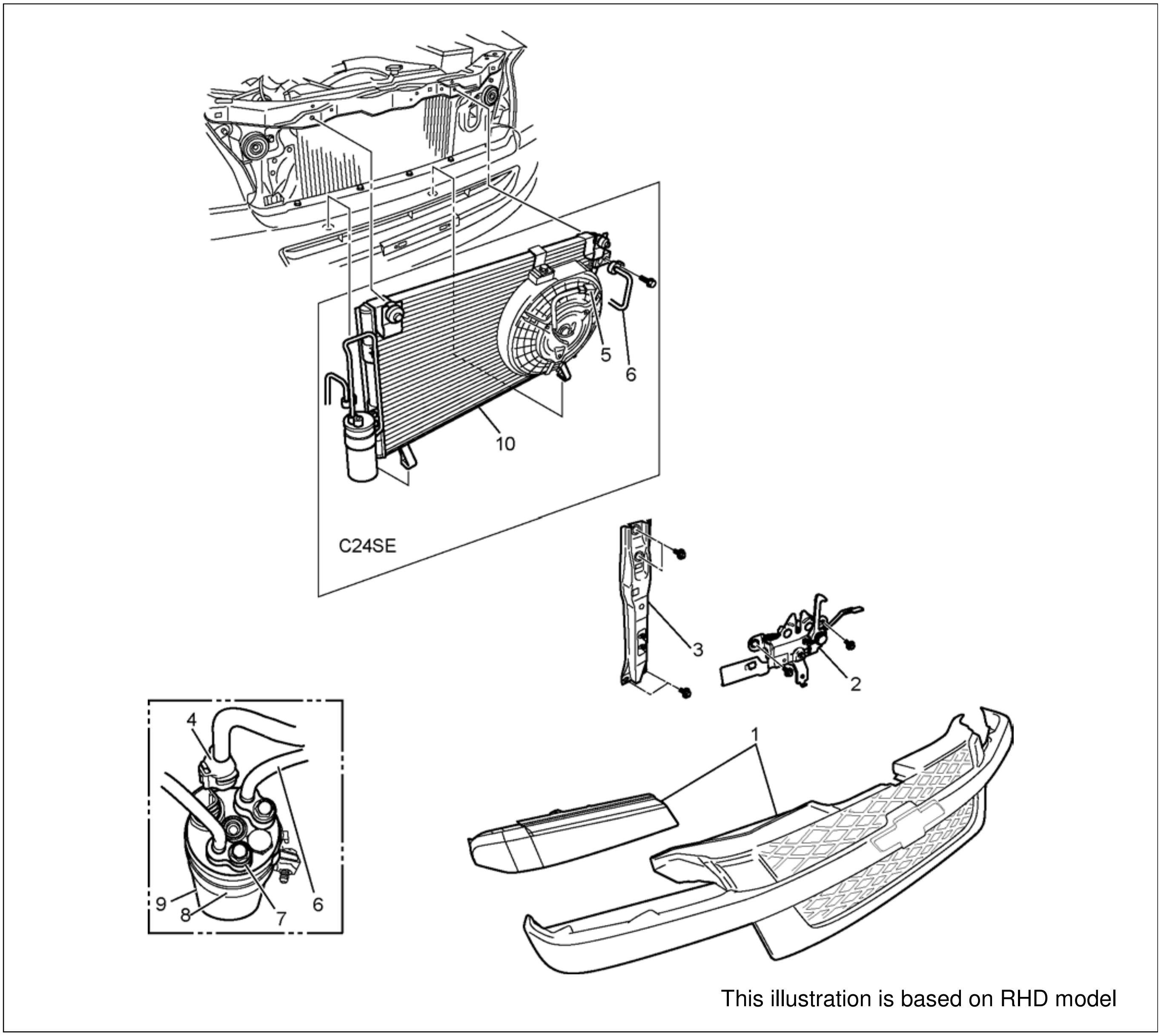
Removal Steps

- ▲ 1. Brake pipe
- ▲ 2. Master cylinder fixing nut
- ▲ 3. Bracket
- ▲ 4. Master cylinder assembly
- 5. Vacuum hose
- 6. Snap pin
- 7. Vacuum booster fixing nut
- 8. Gasket
- 9. Spacer
- 10. Vacuum booster assembly

Installation Steps

- ▲ 10. Vacuum booster assembly
- ▲ 9. Spacer
- ▲ 8. Gasket
- ▲ 7. Vacuum booster fixing nut
- ▲ 6. Snap pin
- ▲ 5. Vacuum hose
- 4. Master cylinder assembly
- 3. Bracket
- 2. Master cylinder fixing nut
- 1. Brake pipe

REMOVAL AND INSTALLATION (C24SE)

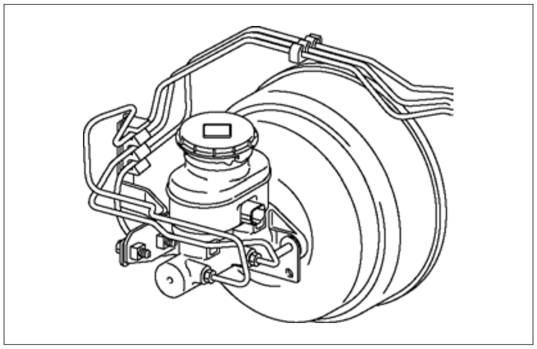


Removal Steps

1. Radiator grille
2. Engine hood lock
3. Engine hood front end stay
4. Triple pressure switch connector
5. Condenser fan connector
6. Refrigerant line
7. Refrigerant line
8. Receiver/drier bracket
9. Receiver/drier
10. Condenser assembly

Installation Steps

10. Condenser assembly
9. Receiver/drier
8. Receiver/drier bracket
7. Refrigerant line
6. Refrigerant line
5. Condenser fan connector
4. Pressure switch connector
3. Engine hood front end stay
2. Engine hood lock
1. Radiator grille


RTW75CSH002701

Important Operation-Removal

1. Brake pipe

When hurdling, be careful not to spill brake fluid over the painted surfaces, as damage to the paint finish will result.

2. Master Cylinder Fixing Nut

3. Bracket

4. Master Cylinder Assembly

NOTE:

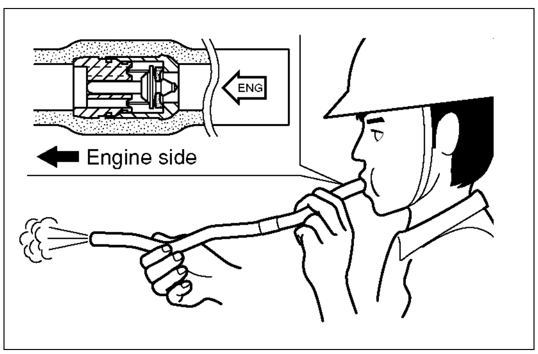
When removing the master cylinder from the vacuum booster, be sure to get rid of the internal negative pressure of the vacuum booster (by, for instance, disconnecting the vacuum hose) in advance.

If any negative pressure remains in the vacuum booster, the piston may possibly come out when the master cylinder is being removed, letting the brake fluid run out.

While removing the master cylinder, do not hold the piston as it can be easily pulled out.

Inspection and Repair

Vacuum Hose (The built in check valve)



360R300002

1) Inspect the check valve, which is installed inside the vacuum hose.
2) Blow air into the hose from the booster side as shown in the illustration. The air should pass freely through the hose.
3) Blow air into the hose from the engine side. The check valve should close to block the passage of air. The vacuum hose and built-in check valve must be replaced as a set if either is found to be defective.

Important Operation-Installation

10. Vacuum Booster Assembly

Note:

- Adjustment of push rod of vacuum booster is not carried out. When vacuum booster is damaged it exchanges for a new article. (Push rod is adjusted)
- Measurement of primary piston position by the side of master cylinder is unnecessary.

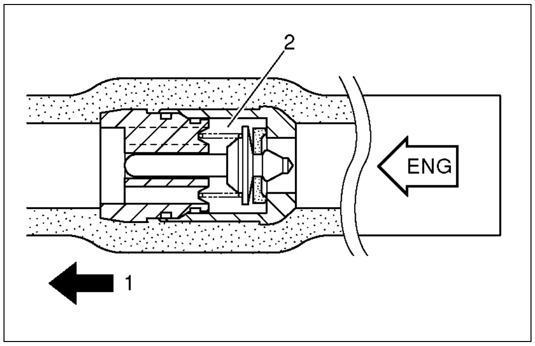
9. Spacer

8. Gasket

7. Vacuum Booster Fixing Nut

6. Snap Pin

Install the vacuum booster assembly to the dash panel and pedal mounting bracket.



360r300003

5. Vacuum Hose

The check valve (2) is built-in to the vacuum hose.

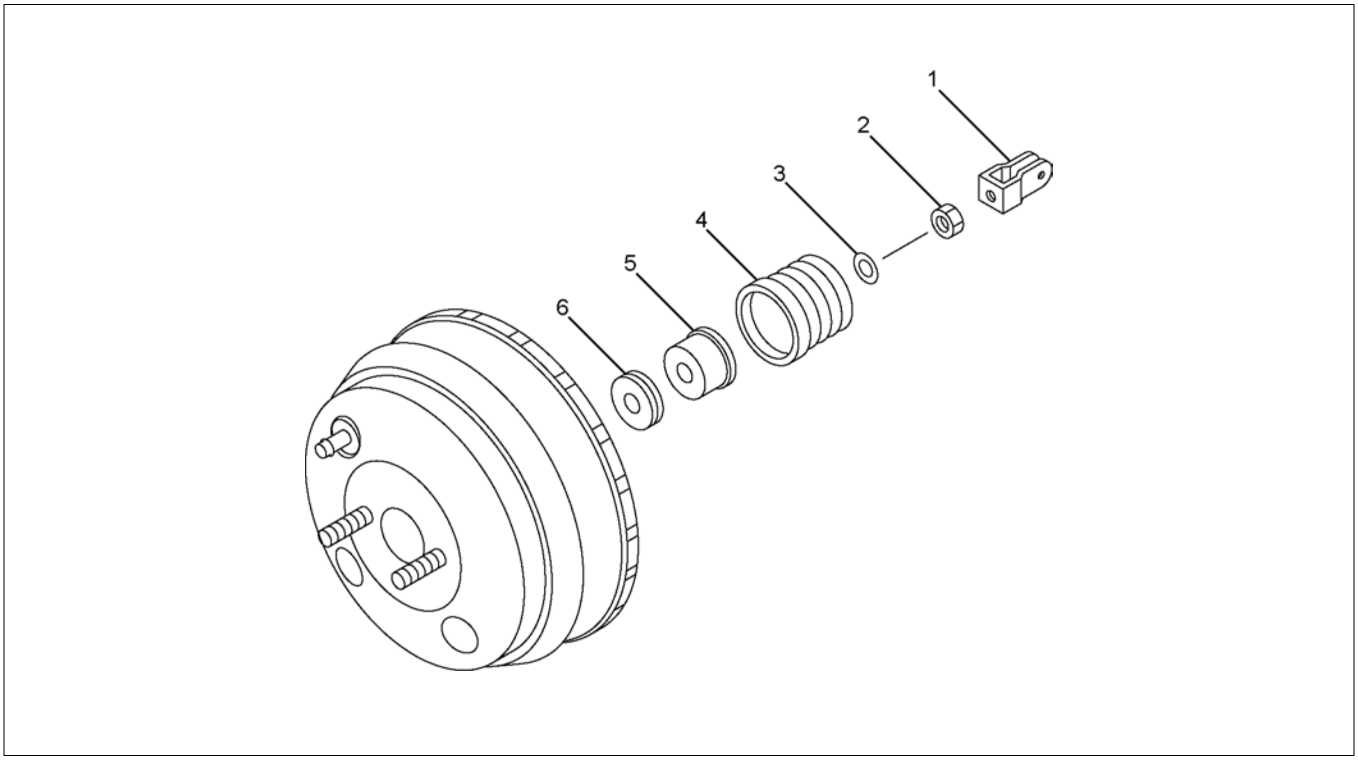
When installing the vacuum hose make sure that the arrow on the hose is facing the engine (1).

Note:

- Do not apply oil to the vacuum hose.
- Installation direction is very important. The booster will not operate if the vacuum hose is installed in the wrong direction.

DISASSEMBLY

VACUUM BOOSTER ASSEMBLY

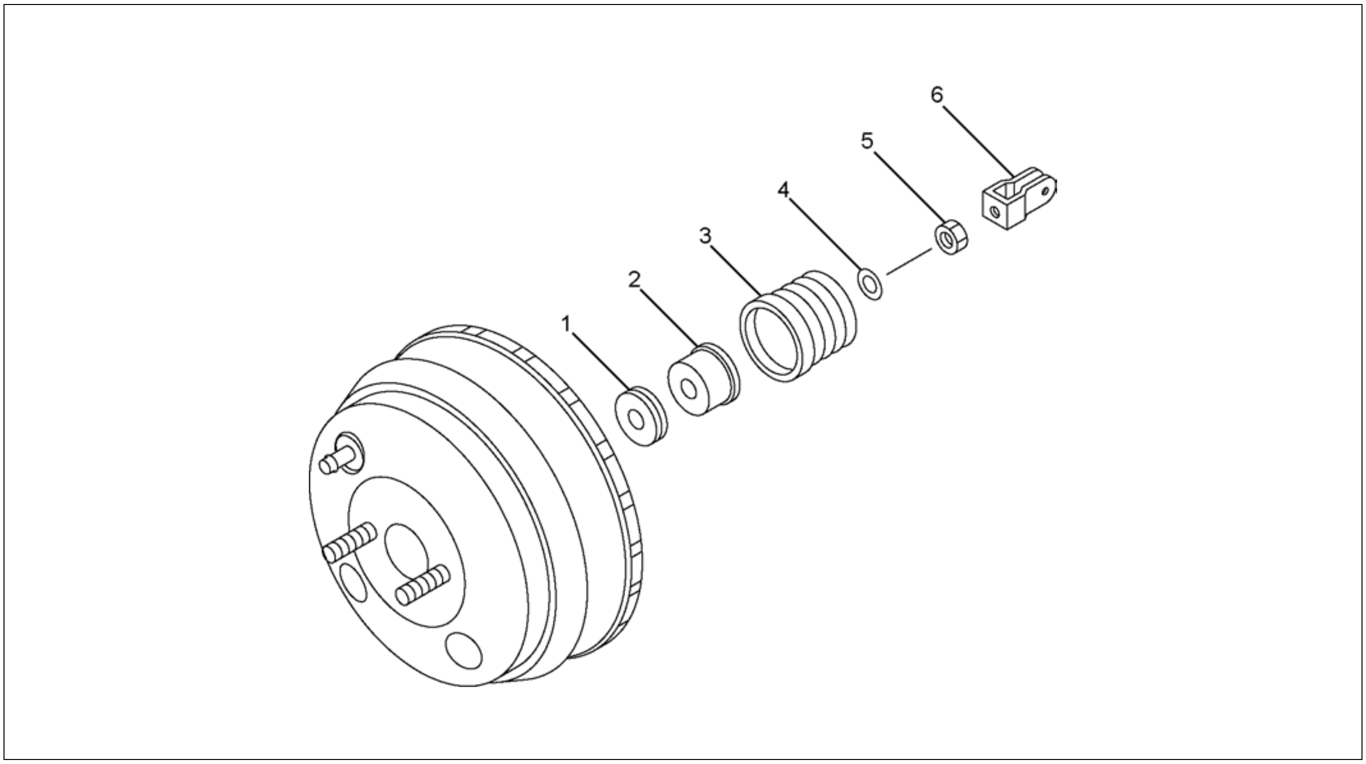


Disassembly Steps

1. Clevis; Yoke
2. Nut; VLV rod
3. Retainer; Guard
4. Guard; VLV body
5. Silencer
6. Filter

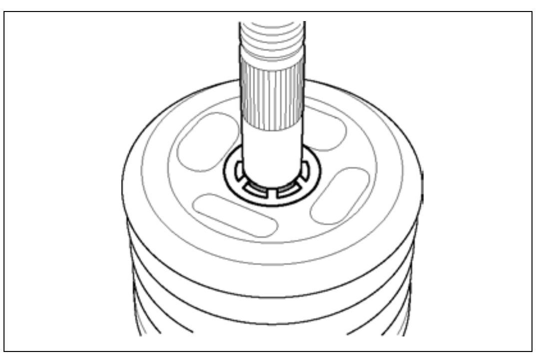
REASSEMBLY

VACUUM BOOSTER ASSEMBLY



Reassembly Steps

1. Filter
2. Silencer
3. Guard; VLV body
▲ 4. Retainer; Guard
▲ 5. Nut; VLV rod
▲ 6. Clevis; Yoke



RTW75CSH002901

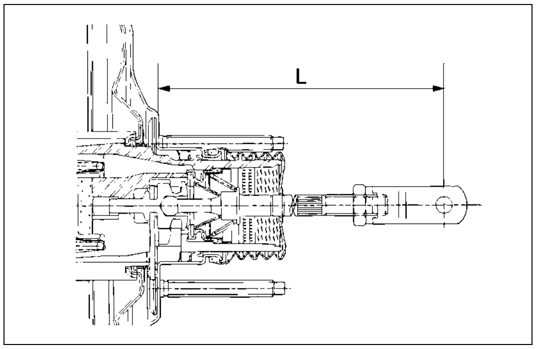
Important Operations

4. Retainer; Guard

Ensure that the lug of the inner surface is fitted into the groove of the ROD.

5. Nut; VLV Rod

Install the nut.



RTW75CSH002801

6. Clevis; Yoke

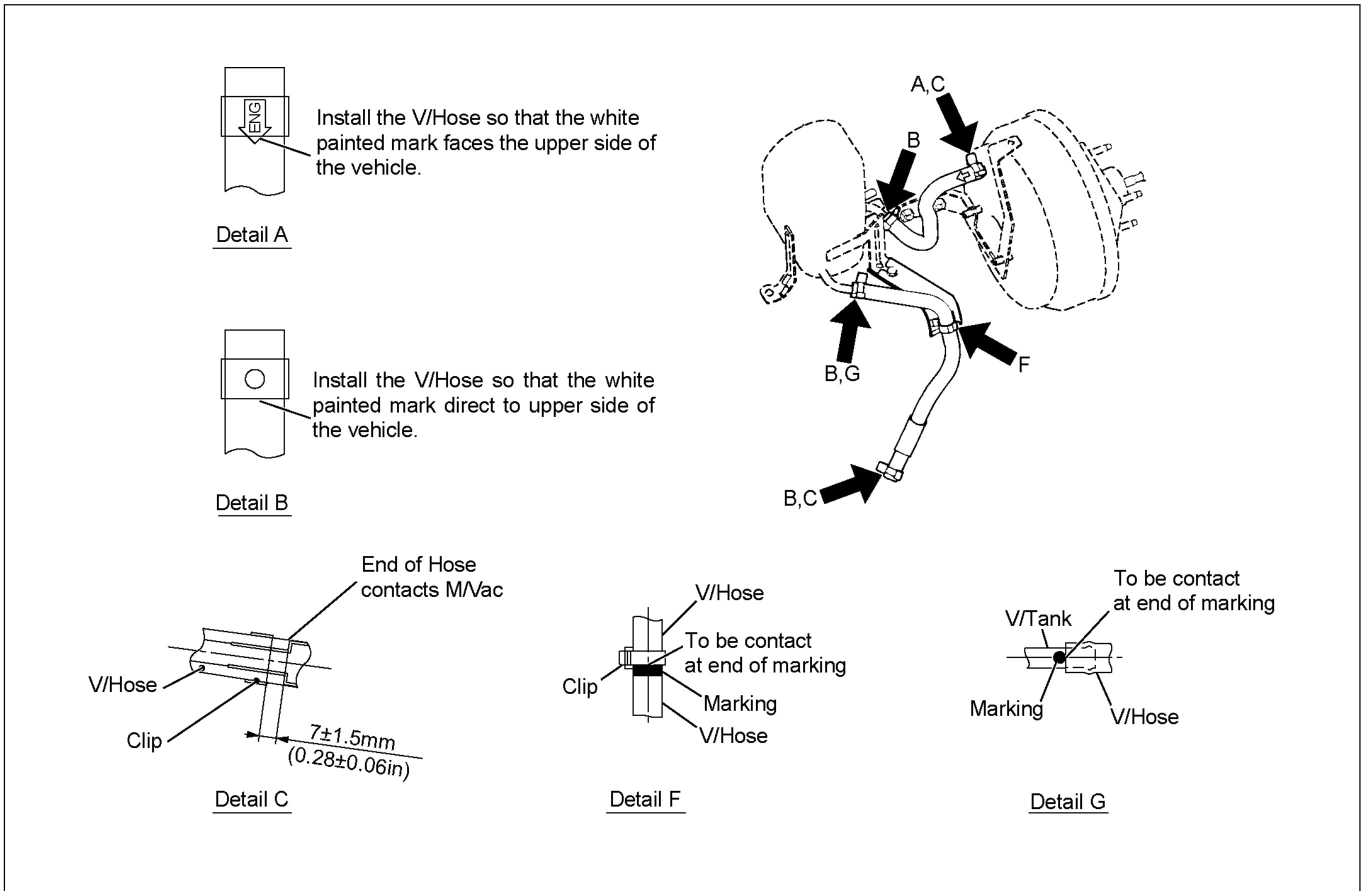
Assemble such that the distance from the rear of the vacuum booster assembly to the center of the clevis yoke hole is within the range of the reference values.

Distance		mm (in)
L	RHD	147.9 - 148.9 (5.823 - 5.862)
	LHD	160.7 - 161.7 (6.327 - 6.366)

Upon assembling the clevis yoke, tighten the nut to the specified torque.

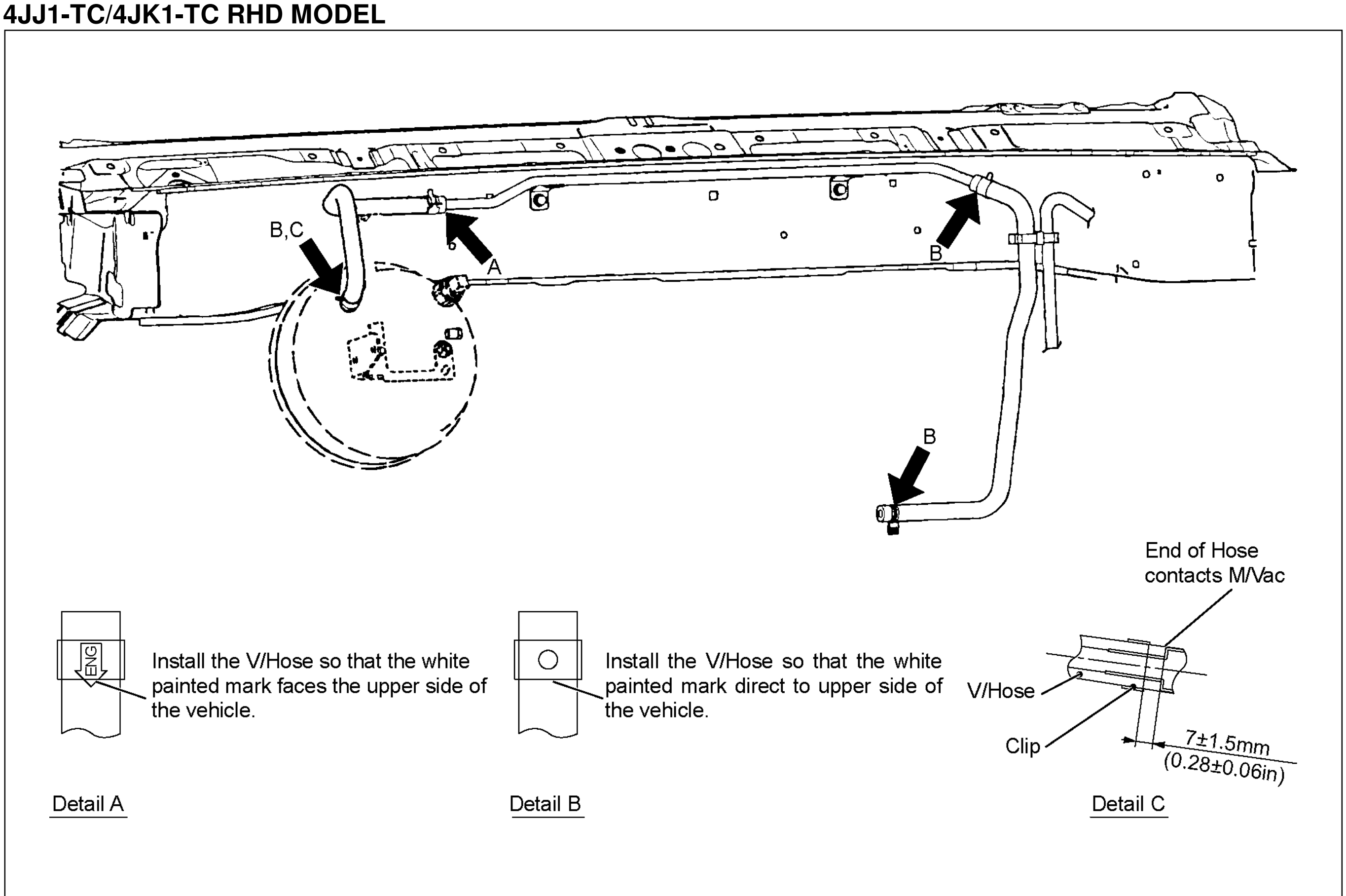
Torque N·m (kgf·m/lb·ft)
15 - 25 (1.5 - 2.5 / 11 - 18)

4JA1-T/4JH1-TC RHD MODEL



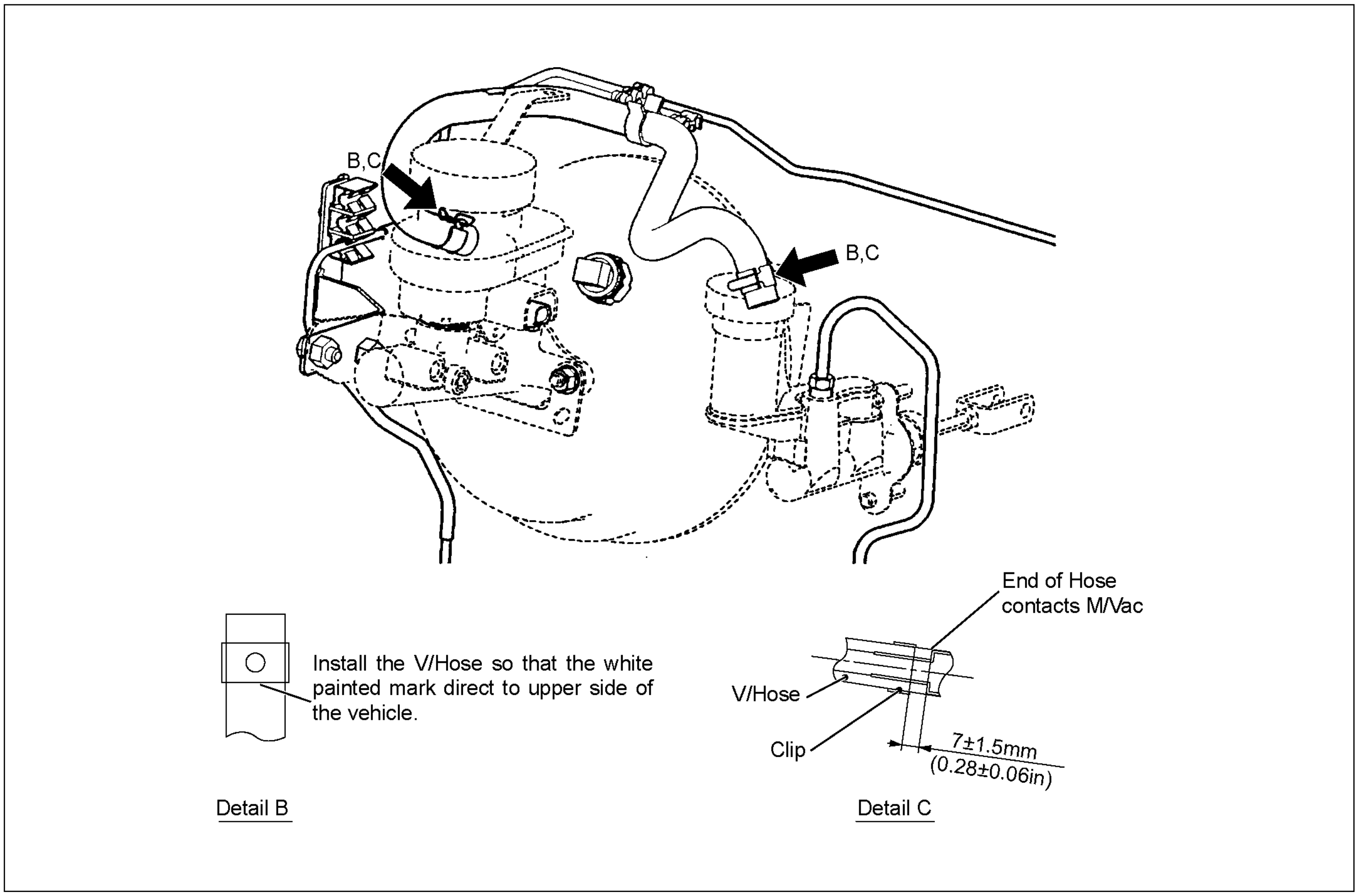
RTW75CMF001101

4JJ1-TC/4JK1-TC RHD MODEL



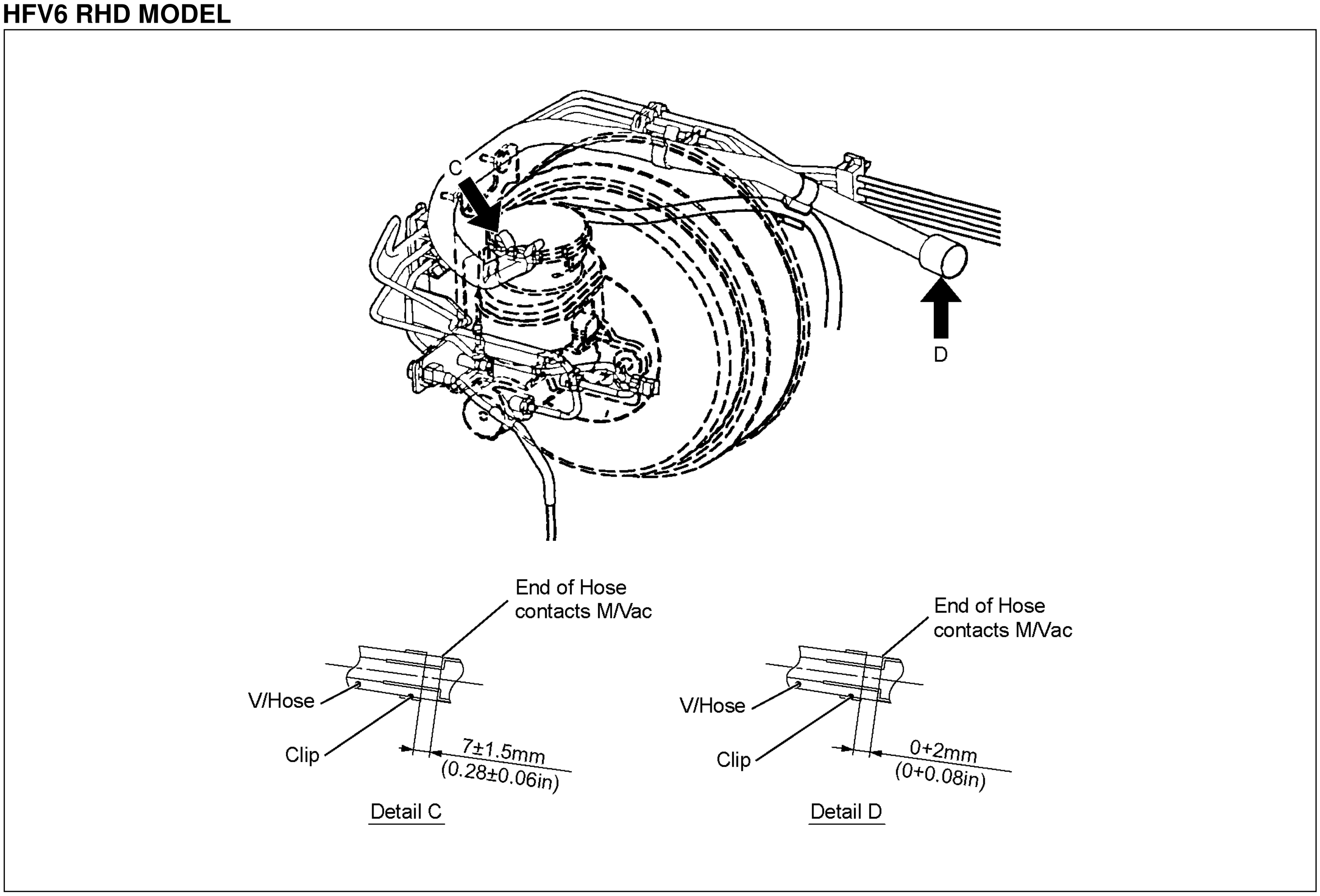
RTW75CMF001301

C24SE RHD MODEL



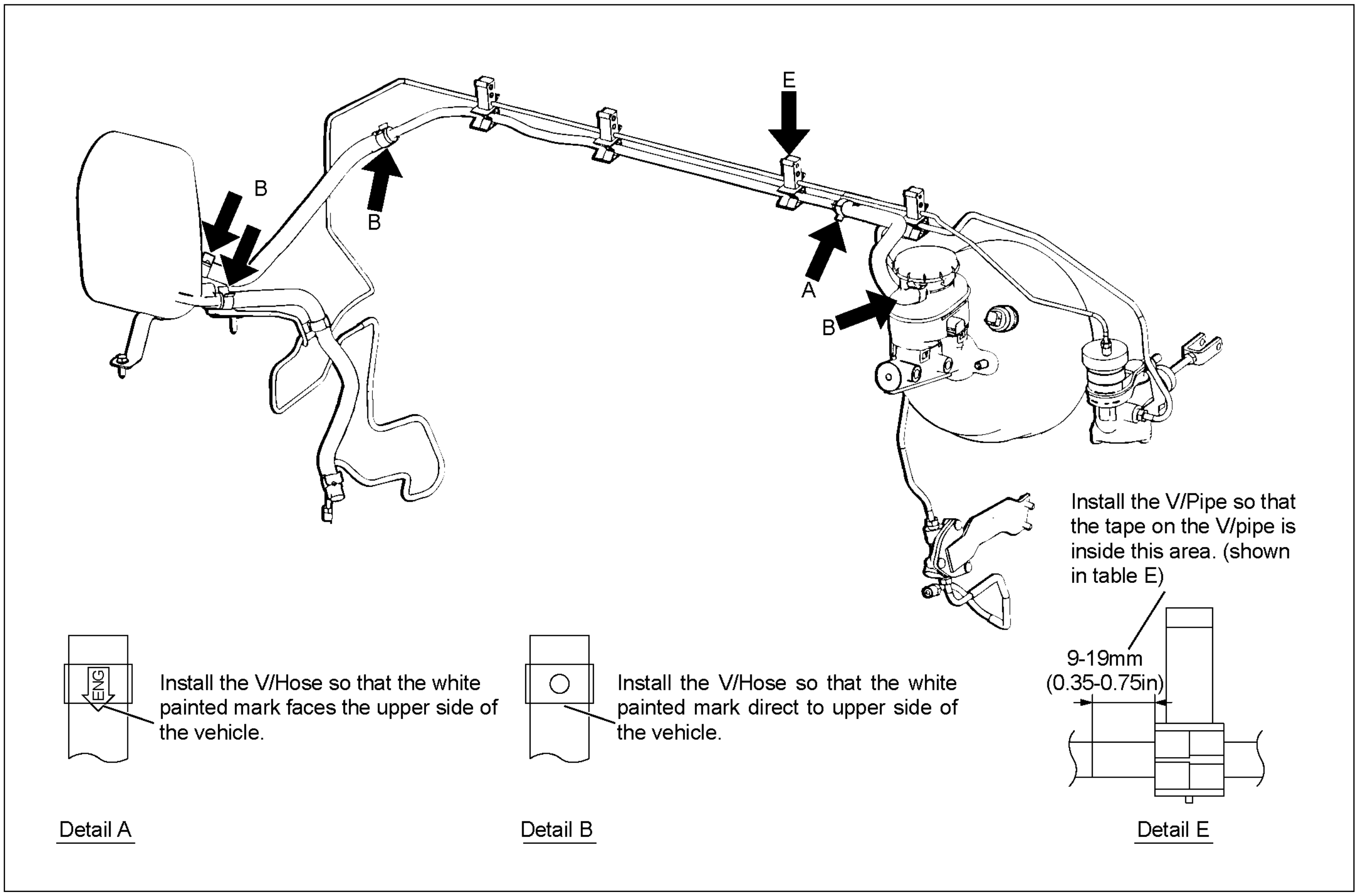
RTW75CMF001401

HFV6 RHD MODEL



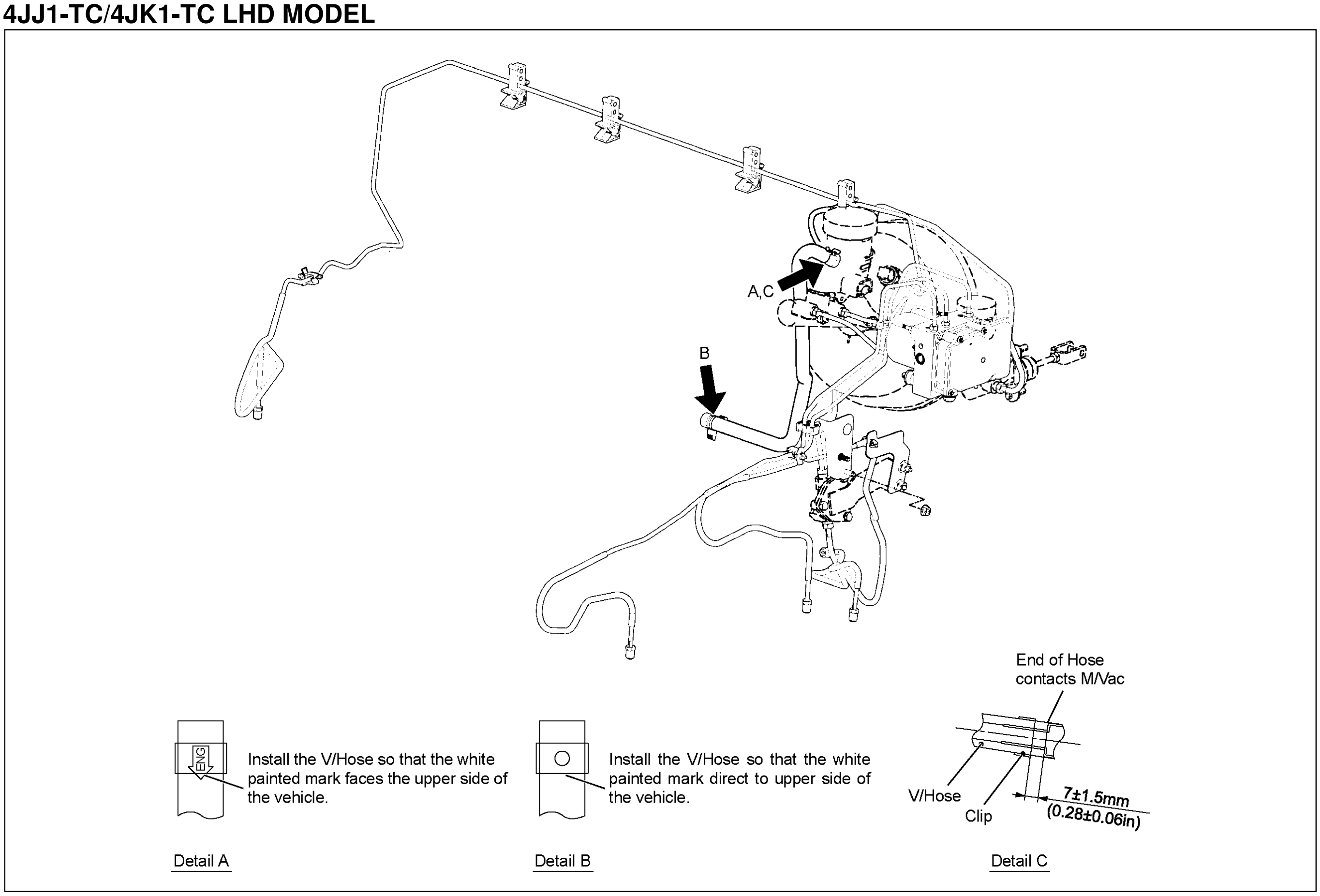
RTW75CMF001601

4JA1-T/4JH1-TC LHD MODEL



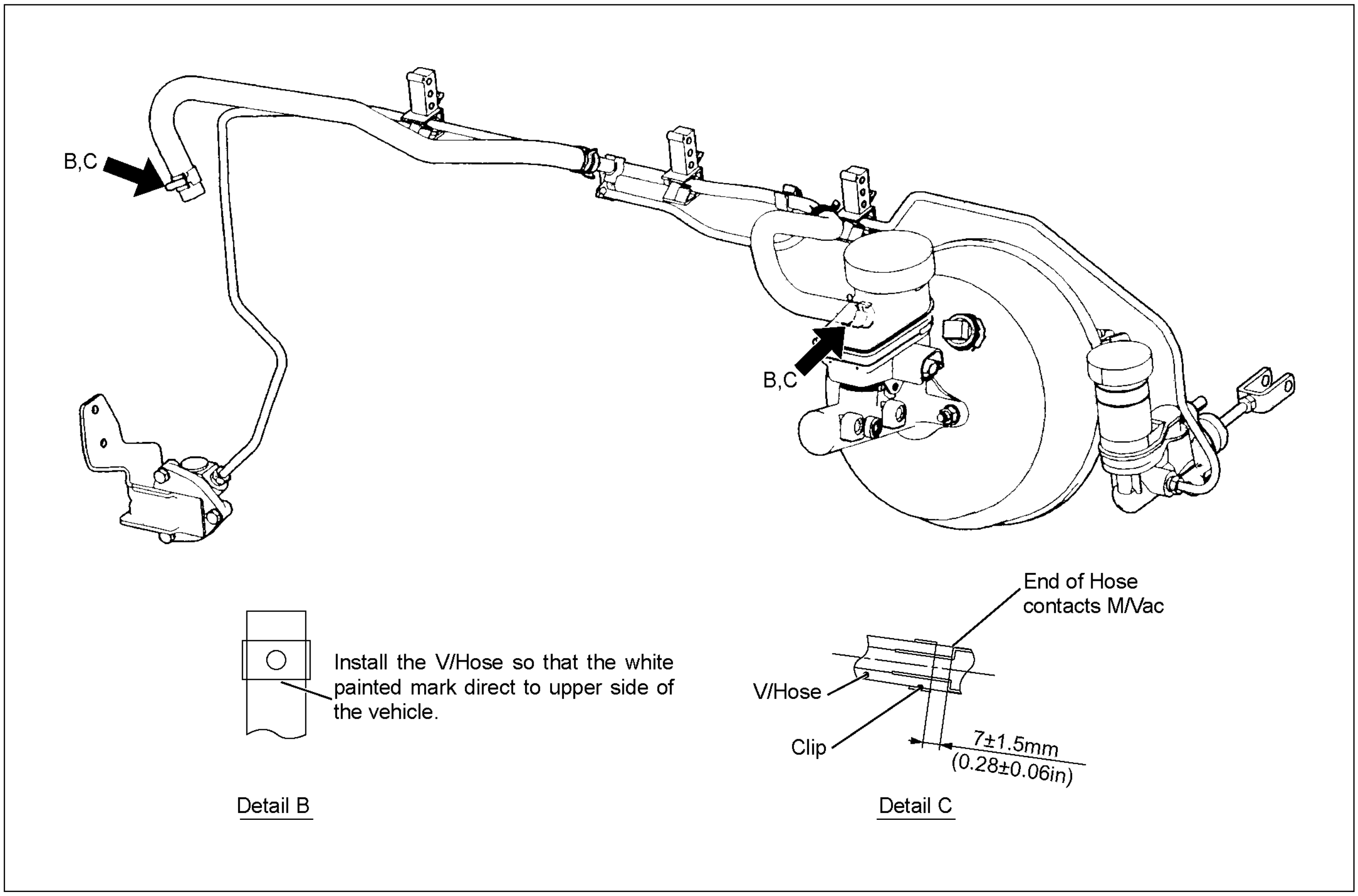
RTW75CMF001201

4JJ1-TC/4JK1-TC LHD MODEL



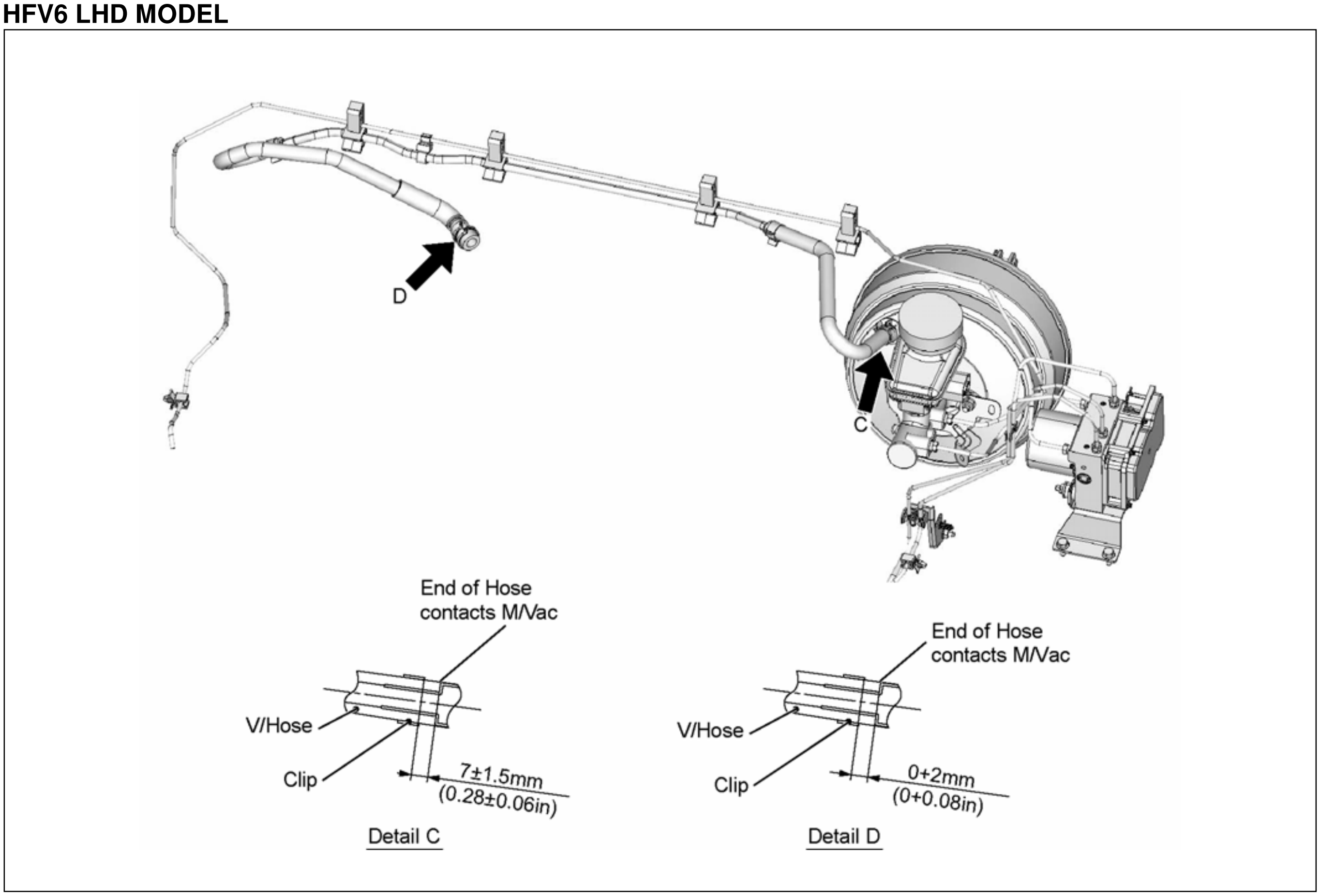
RUW75CLF000201

C24SE LHD MODEL



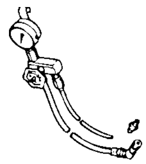
RTW75CMF001501

HFV6 LHD MODEL



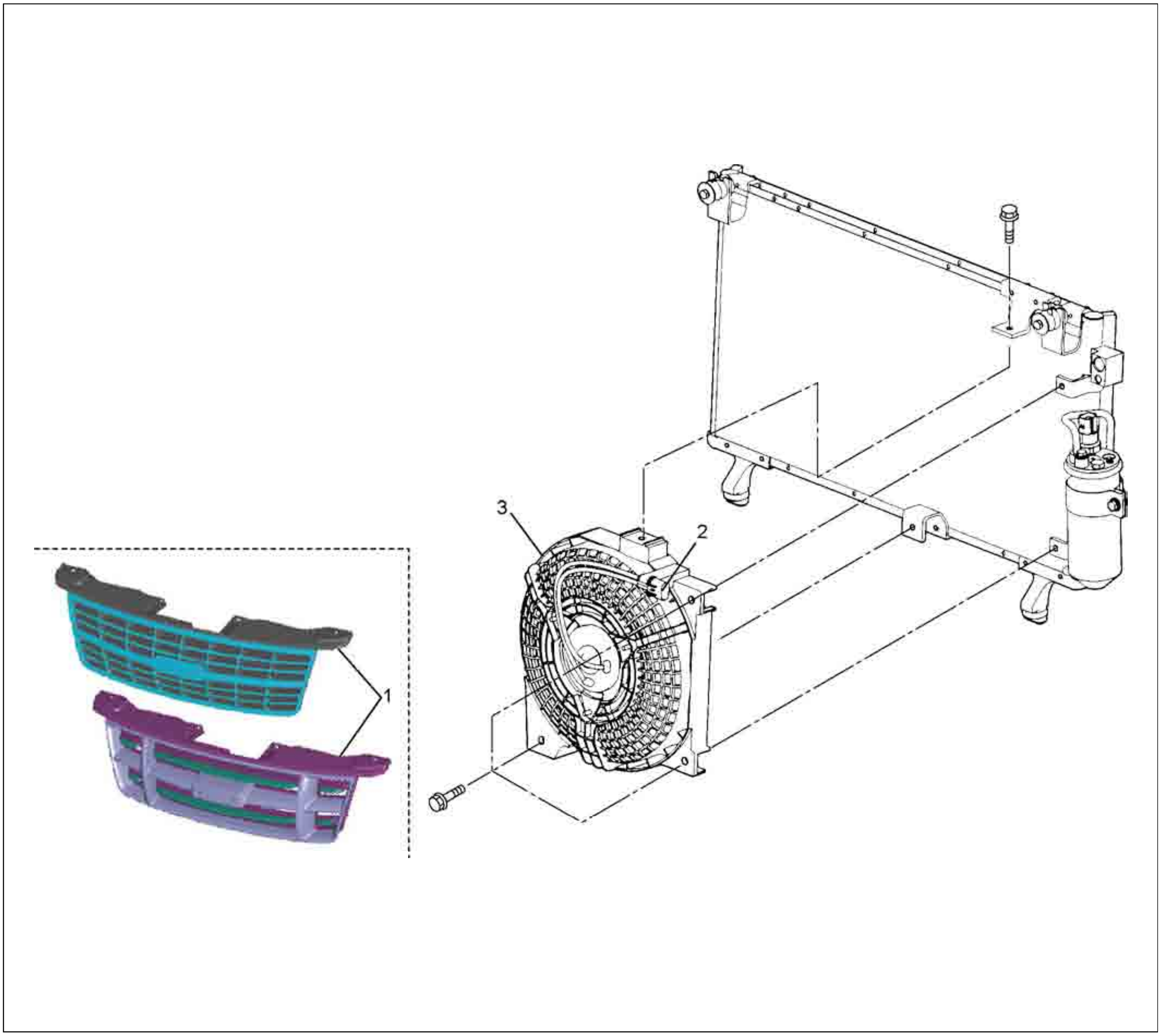
RTW75CMF001701

Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884021900	**5-8840-2190-0** Pressure Tester; Brake Oil

CONDENSER FAN MOTOR

REMOVAL AND INSTALLATION



RTW710MF000701

Removal Steps

1. Radiator grille
2. Fan connector
3. Condenser fan motor

Installation Steps

3. Condenser fan motor
2. Fan connector
1. Radiator grille

SECTION 5D

PARKING BRAKE SYSTEM

TABLE OF CONTENTS

Service Precaution

Service Precaution

WARNING: THIS VEHICLE HAS A SUPPLEMENTAL RESTRAINT SYSTEM (SRS). REFER TO THE SRS COMPONENT AND WIRING LOCATION VIEW IN ORDER TO DETERMINE WHETHER YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING. WHEN YOU ARE PERFORMING SERVICE ON OR NEAR THE SRS COMPONENTS OR THE SRS WIRING, REFER TO THE SRS SERVICE INFORMATION. FAILURE TO FOLLOW WARNINGS COULD RESULT IN POSSIBLE AIR BAG DEPLOYMENT, PERSONAL INJURY, OR OTHERWISE UNNECESSARY SRS SYSTEM REPAIRS.

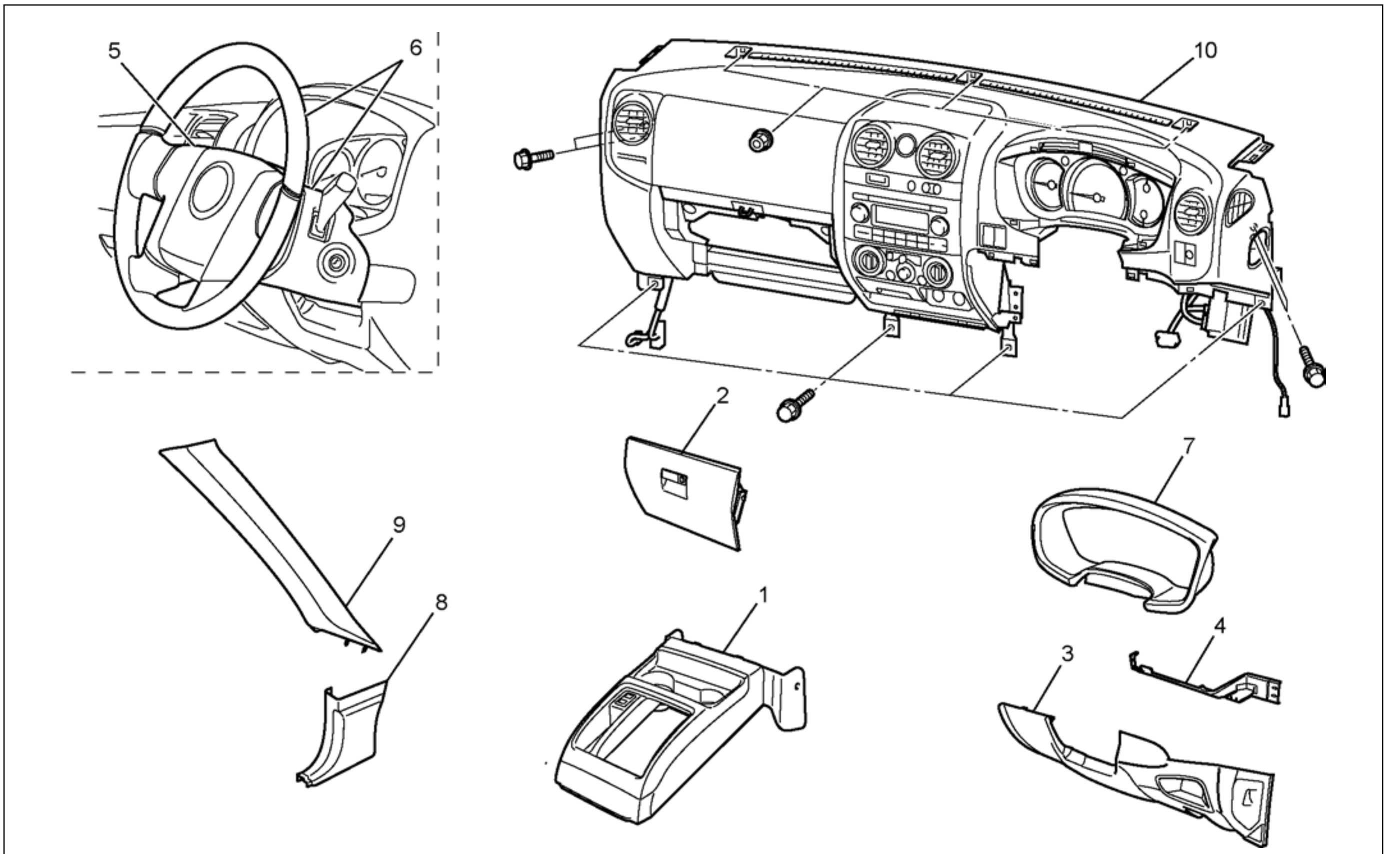
CAUTION: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. ISUZU/GM will call out those fasteners that require a replacement after removal. ISUZU/GM will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

General Description

Pulling up the parking brake lever by hand will set the parking brake. By means of a ratchet type lock, the lever can be held in that position until it is released. The position of the lever is transmitted through cable/lever systems to the rear wheels. These parts are designed to obtain sufficient braking force even when parking on slopes. When the parking brake is set, or when the ignition SW is in the “ON” position, the brake warning light illuminates. The rear wheel parking brake is a leading-trailing brake (mechanical inside expansion type) built in the rear drum brake. Parking brake adjustment is made through the adjusting hole (bored through back plate). Parking brake lever stroke should be adjusted to 8–14 notches with 294N (30 kg / 66 lb) (bench seat) or 6–9 notches with 294N (30 kg / 66 lb) (bucket seat). Refer to “Parking Brake Adjustment” in this section.

Parking Brake Lever

Parking Brake Lever Assembly and Associated Parts (Bench Seat)



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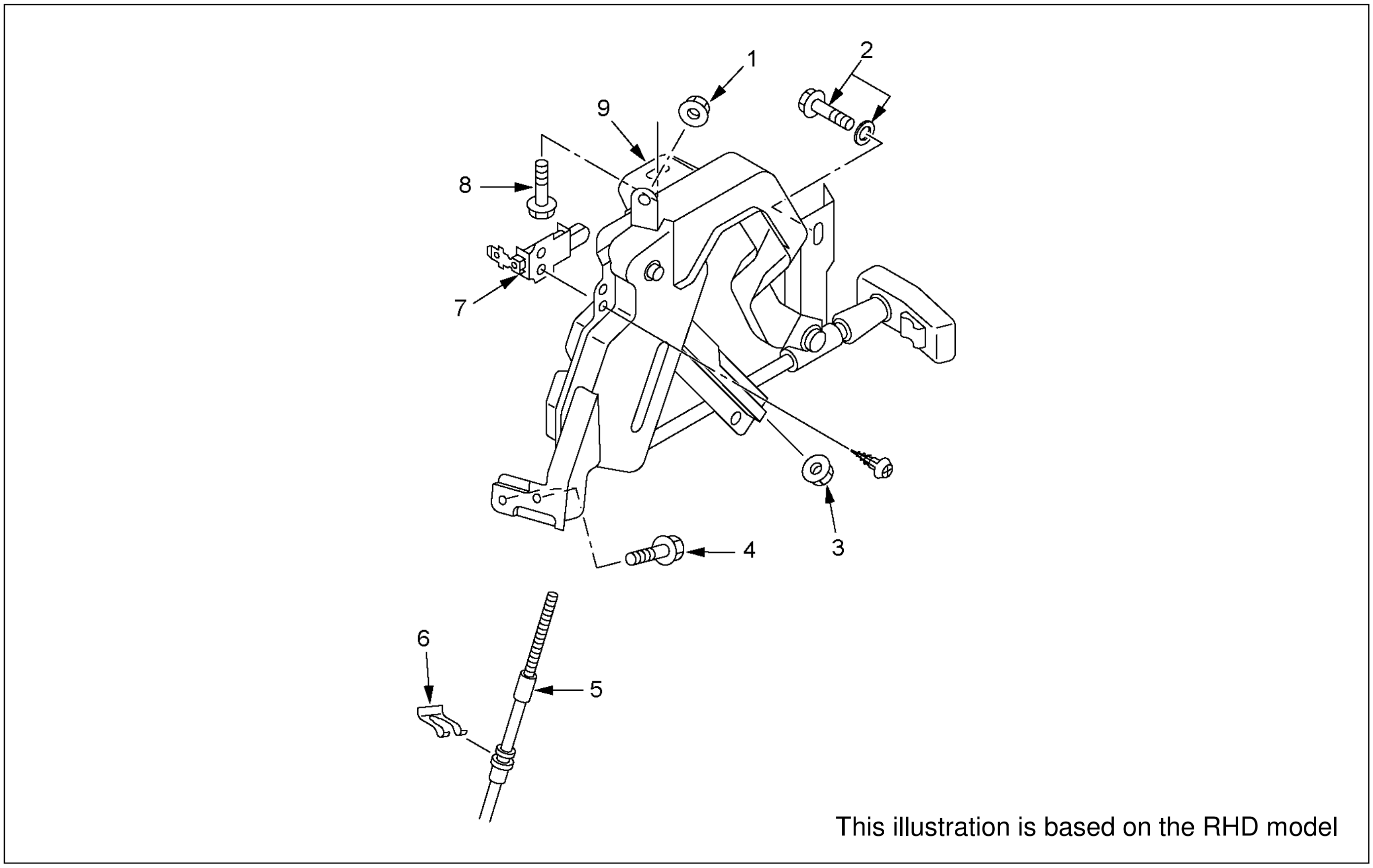
Legend

(1) Front Console Assembly
(2) Glove Box
(3) Instrument Panel Driver Lower Cover Assembly
(4) Driver Knee Bolster Assembly
(5) Driver Air Bag
(6) Steering Wheel/Steering Cowl
(7) Meter Cluster Assembly
(8) Dash Side Trim Cover
(9) Front Pillar Trim Cover
(10) Instrument Panel Assembly & Cross Beam



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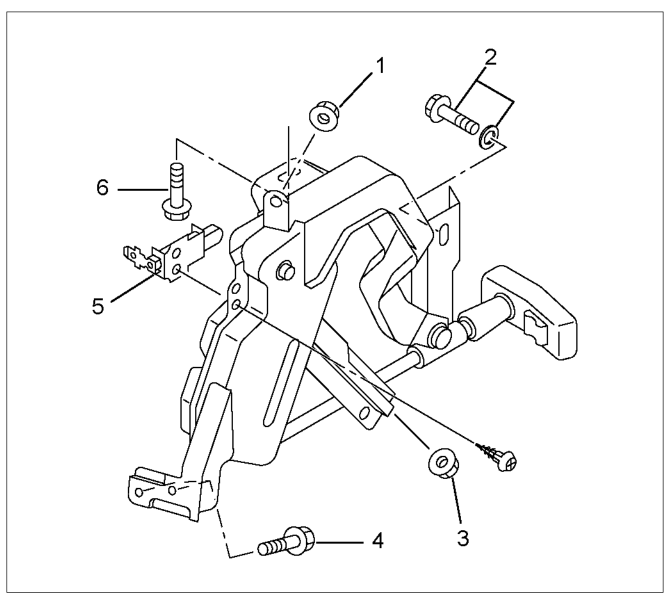
Legend

(1) Nut
(2) Bolt and Washer
(3) Adjust Nut
(4) Bolt
(5) Front Parking Brake Cable
(6) Clip
(7) Switch
(8) Bolt
(9) Parking Lever Assembly

Removal

1. Remove instrument panel assembly & cross beam in legend numbers order.
   Refer to section 10.
2. Bolts (2)(6) are already removed in step 1.
3. Remove adjust nut (3).
4. Pull out clip and take out front parking brake cable from parking lever assembly.
5. Remove bolts (4) and nut (1) and take out parking lever assembly.
6. Remove switch (5).



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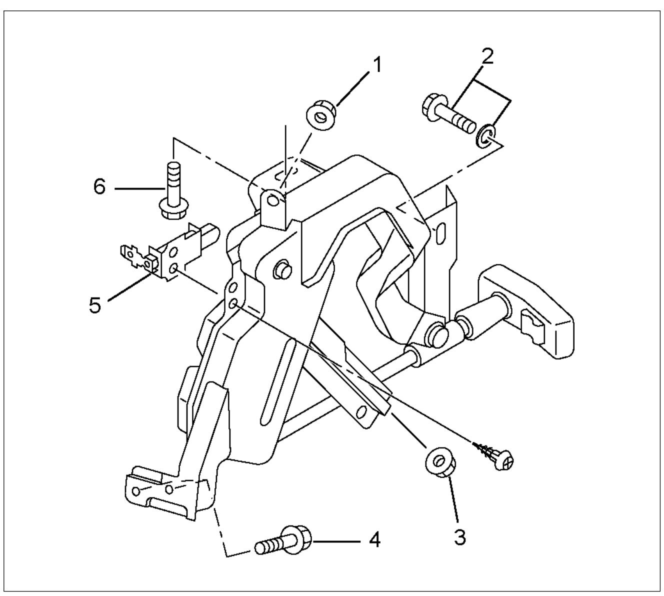
Installation

1. Install switch (5).

   Torque: 1.5 N·m (0.15 kgf·m/13 lb·in)
2. Set parking lever assembly.
3. Install bolts (4) and nut (1) and tighten them to the specified torque.

   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)
4. Set front parking brake cable in parking lever assembly.
5. Drive clip into the outer cable groove of front parking brake cable at the outside of parking lever assembly.
6. Drive adjust nut (3) on the front end of front parking brake cable so that front ends of rear parking brake fit into the rear end (equalizer) of front cable.
7. Install instrument panel assembly & cross beam. Refer to section 10.
8. Install bolts (2)(6) and tighten them to the specified torque.

   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)
9. Install all parts removed. Refer to section 10.
10. When the parking brake cable is replaced, pull the parking brake lever with a force equivalent to operating force: 490 N (50 kg/110 lb), 10 times for conditioning.
11. Adjust nut (3) so that the lever goes through 8–14 notches, when pulled with an operation force of 294 N (30 kg/66 lb) and check brake for no drag.



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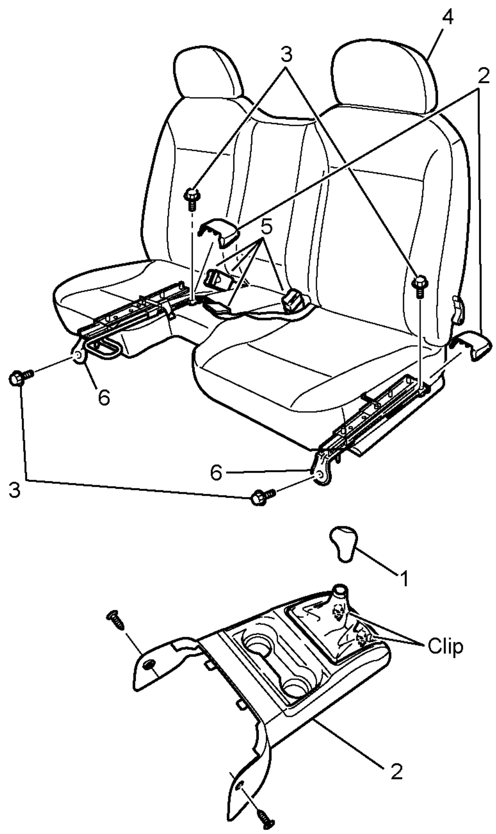
Front Parking Brake Cable

Front Parking Brake Cable and Associated Parts (Bench Seat)



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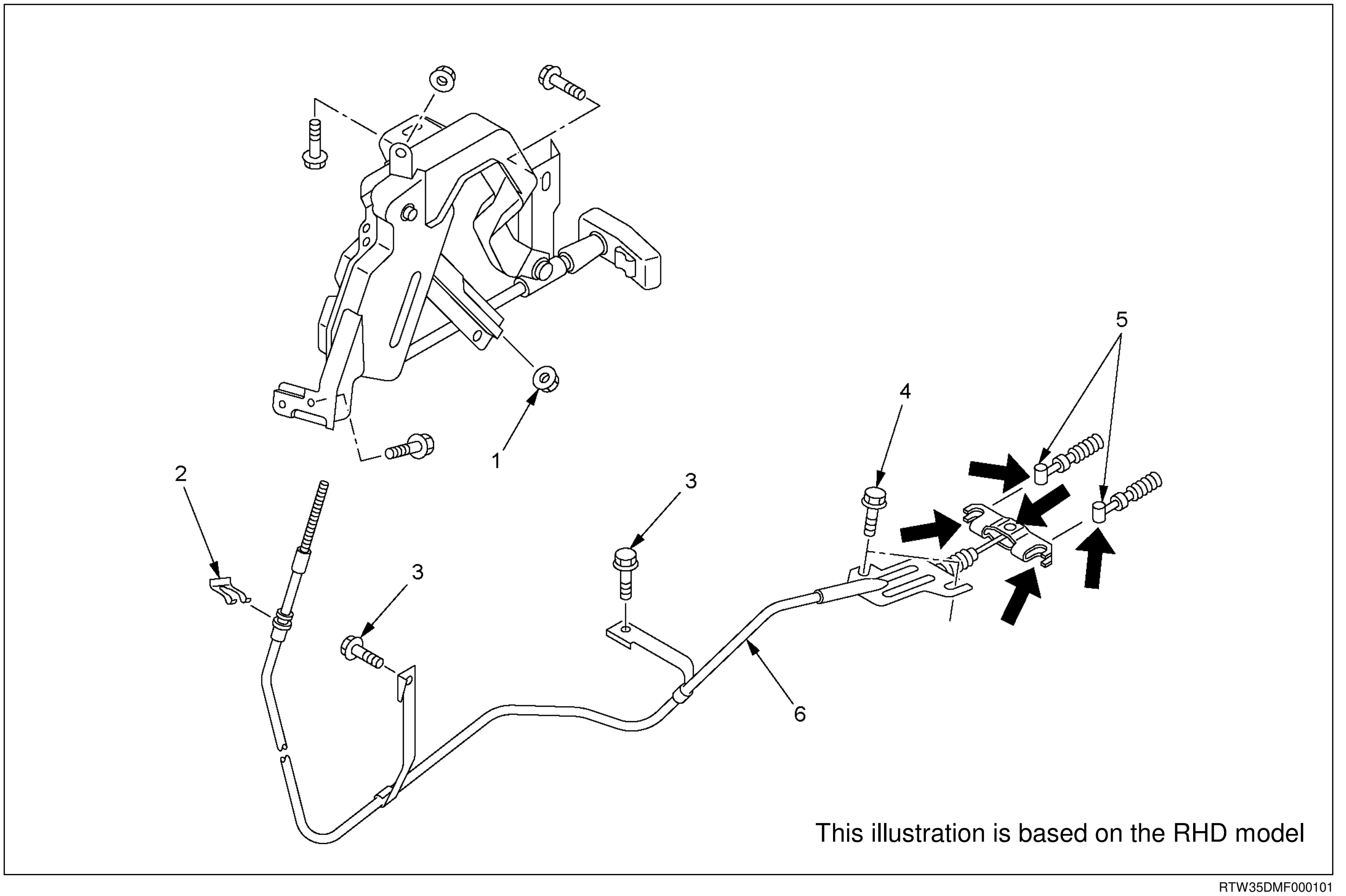
Legend

(1) Shift Knob (manual transmission)
(2) Front Floor Console
(3) Bolt
(4) Seat Assembly
(5) Buckle: side seat and Center Seat Belt
(6) Seat Adjuster



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Legend

(1) Adjust Nut
(2) Clip
(3) Bolt
(4) Bolt
(5) Parking Brake Cable T-end
(6) Front Parking Brake Cable

Removal

1. Remove seat assembly and seat adjuster.
   Refer to section 10.
2. Turn over the carpet so that front parking brake cable appears.
3. Remove adjust nut.
4. Pull out clip and take out front parking brake cable.
5. Remove bolt.
6. Disconnect parking brake cable T-ends from front parking brake cable.
7. Take out front parking brake cable through the floor hole.

Installation

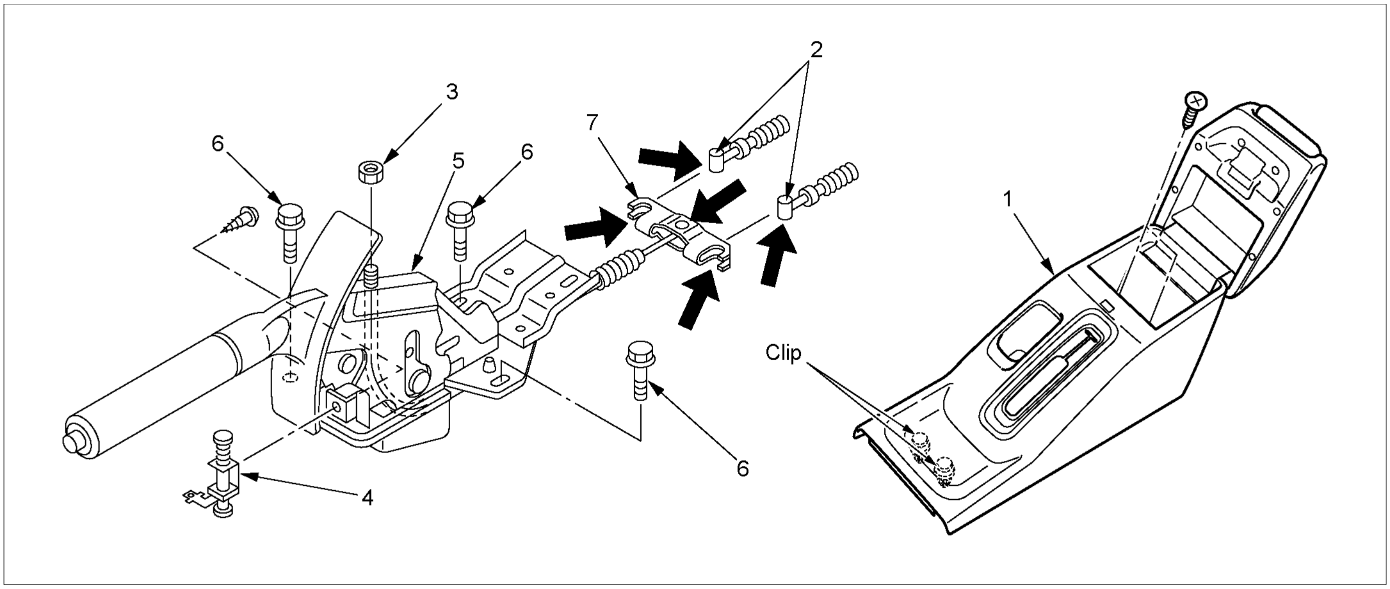
1. Apply grease (multipurpose type grease) to the connecting portion of parking brake cable T-end and front parking brake equalizer (arrow mark).
2. Let rear end (equalizer) of front parking brake cable enter the floor hole and connect it with parking brake rear cable T-end.
3. Set front parking brake cable in the parking lever assembly.
4. Drive clip into the outer cable groove of front parking brake cable at the outside of the parking lever assembly.
5. Install bolt on the floor and tighten to the specified torque.

Torque: 15 N·m (1.5 kgf·m/11 lb·ft)

6. Drive adjust nut on the front end of front parking brake cable so that parking brake cable T-end fits into the rear end (equalizer) of front cable.
7. Fit the carpet on the floor.
8. Install seat adjuster and seat assembly.
   Refer to section 10.
9. Pull parking brake lever with a force equivalent to operating force: 490 N (50 kg/110 lb), 10 times for conditioning.
10. Adjust nut so that parking brake lever goes through 8–14 notches, when pulled with an operation force of 294 N (30 kg/66 lb).
11. Check brake for no drag.

Parking Brake Lever

Parking Brake Lever Assembly and Associated Parts (Bucket Seat)



Legend

(1) Rear Floor Console
(2) Parking Brake Cable T-end
(3) Adjust Nut
(4) Switch
(5) Parking Brake Lever Assembly
(6) Bolt
(7) Equalizer

Removal

1. Remove rear floor console.
   Refer to section 10.
2. Loosen adjust nut.
3. Remove bolt.
4. Remove switch.
5. Disconnect parking brake cable T-end from parking brake lever assembly.
6. Take out parking brake lever assembly.

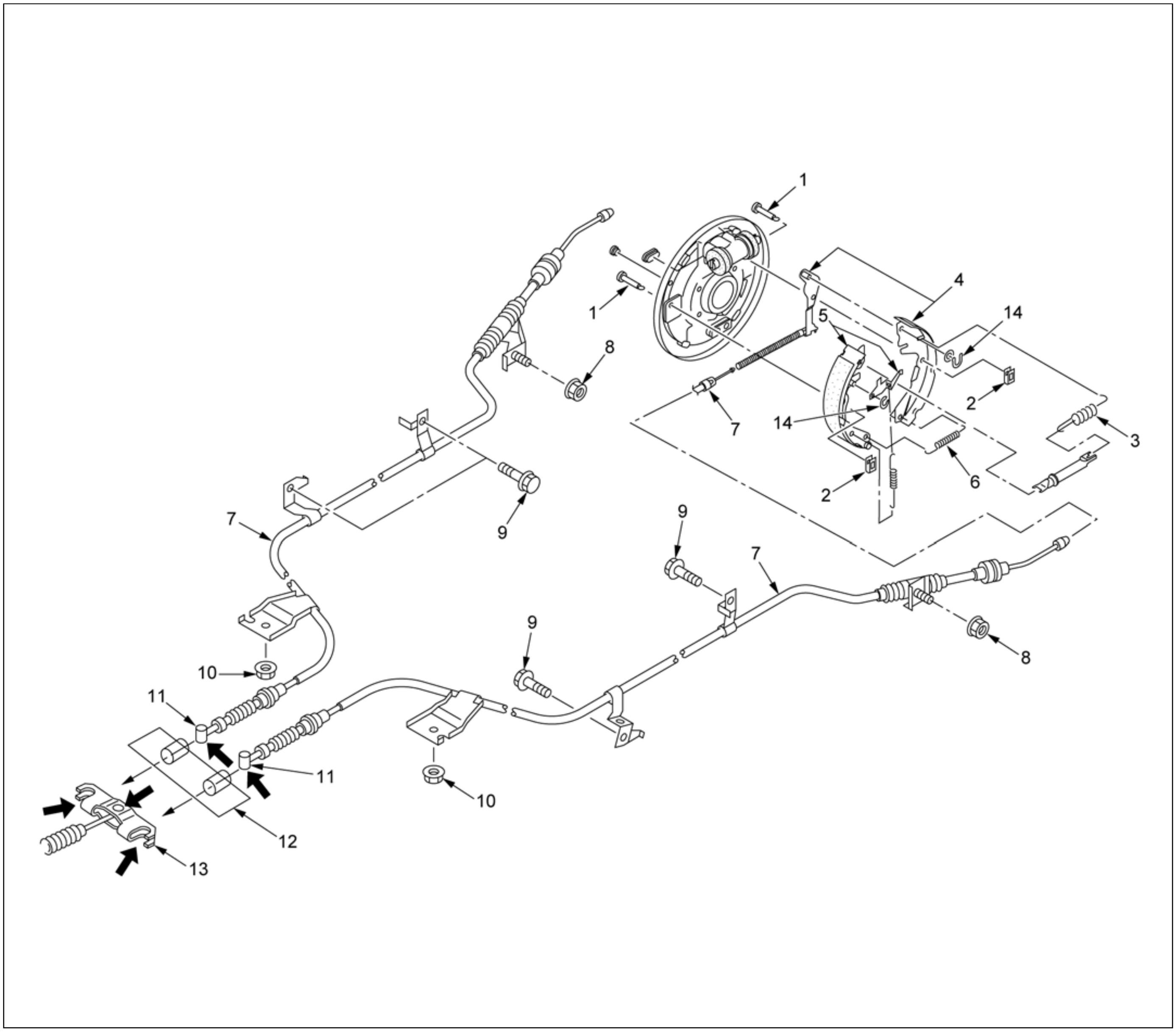
Installation

1. Apply grease (multipurpose type grease) to the connecting portion of parking brake rear cable T-end and parking brake lever equalizer. (arrow mark).
2. Connect parking brake rear cable T-end to equalizer.
3. Install switch.
4. Tighten the parking brake lever fixing bolt to the specified torque.

   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)
5. Drive adjust nut on parking brake assembly so that parking brake cable T-end fits into equalizer.
6. Install rear floor console.
   Refer to section 10.
7. Pull parking brake lever with a force equivalent to operating force: 490 N (50 kg/110 lb), 10 times for conditioning.
8. Adjust nut so that parking brake lever goes through 6–9 notches, when pulled with an operation force of 294 N (30 kg/66 lb).
9. Check brake for no drag.

Parking Brake Rear Cable

Parking Brake Rear Cable and Associated Parts



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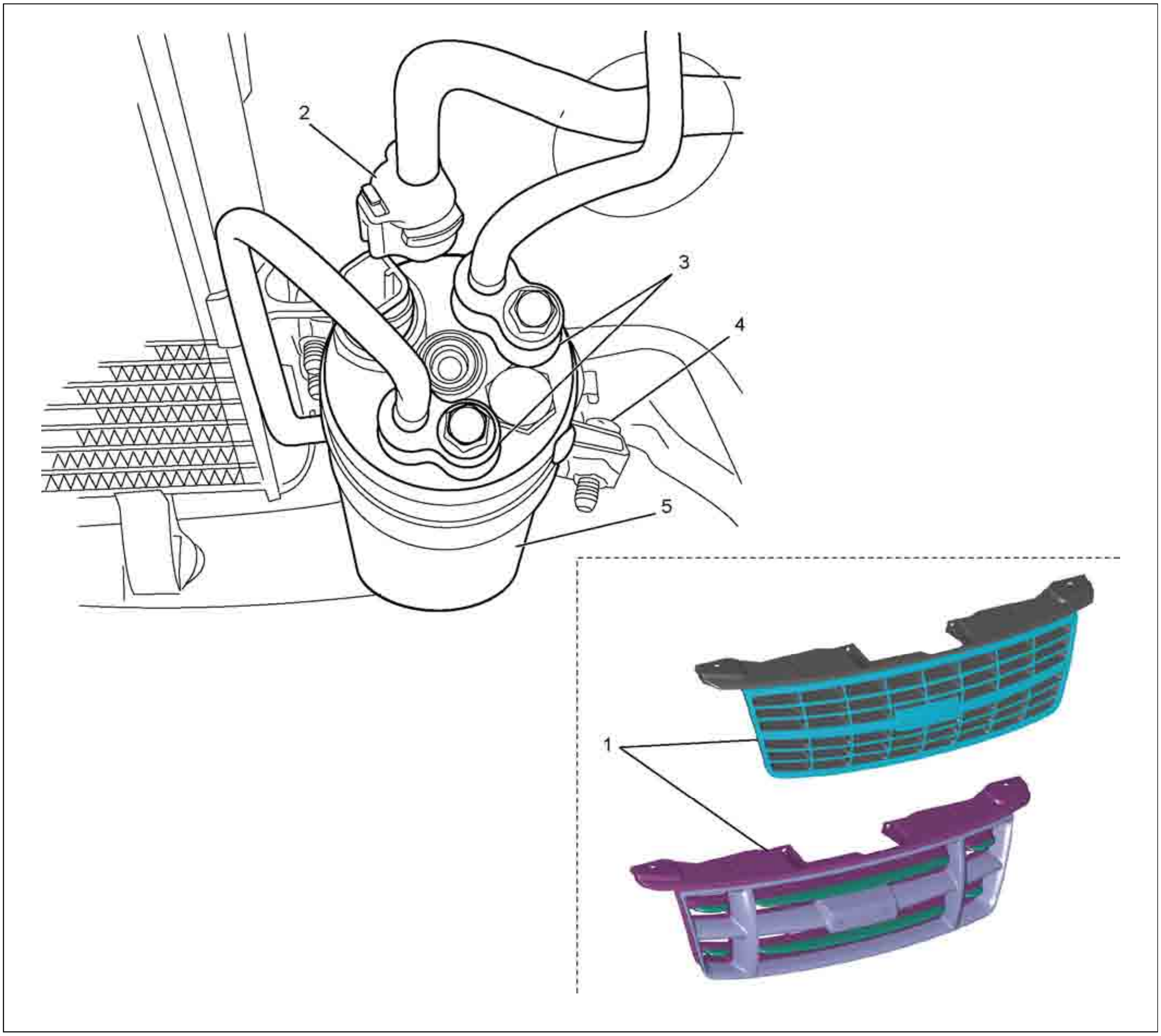
Legend

(1) Tension Pin
(2) Shoe Clamp Spring
(3) Return Spring
(4) Shoe Assembly with Parking Brake Lever
(5) Shoe Assembly with Adjuster Lever
(6) Spring
(7) Parking Brake Rear Cable
(8) Nut
(9) Parking Brake Cable Bolt
(10) Parking Brake Cable Nut
(11) T-end
(12) Outer Cable Retainer
(13) Equalizer
(14) Adjuster Lever Clip

RECEIVER / DRIER

REMOVAL AND INSTALLATION



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Removal Steps

1. Radiator grille
2. Pressure switch connector
3. Refrigerant line
4. Bracket bolt
5. Receiver/drier

Installation Steps

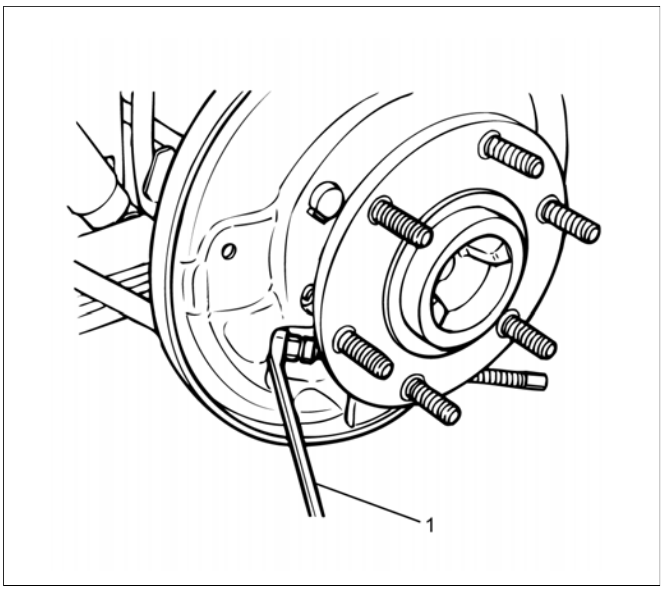
5. Receiver/drier
4. Bracket bolt
3. Refrigerant line
2. Pressure switch connector
1. Radiator grille

Removal

1. Remove wheel and tire.
2. Remove brake drum.
3. Remove tension pin and shoe clamp spring.
4. Remove return spring.
5. Remove shoe assembly with parking brake lever.
6. Remove shoe assembly with adjuster lever and spring.
7. Remove parking brake inner cable from parking brake lever.
8. Use offset box wrench (12 mm hex.) to compress locking lugs on the cable, then remove parking brake outer cable from back plate.

NOTE: Do not twist or bend the cable too much.

A damaged cable will cause poor operation or a cable break down.



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Legend

(1) Offset Box Wrench (12 mm hex)

9. Remove nut to fix the cable on the leaf spring.
10. Take out parking brake rear cable from the back plate.
11. Remove parking brake cable bolt and nut.
12. Disconnect T-end from the equalizer of front cable.

Installation

NOTE: Be sure to use a new shoe clamp spring and a new adjuster lever clip.

1. Apply grease (multipurpose type grease) to the connecting portion of the rear cable and equalizer. (arrow mark).
2. Install parking brake outer cable in back plate and inner cable in parking brake lever.
3. Install return spring.
4. Install shoe clamp spring and tension pin.
5. Install shoe assembly with adjuster lever, shoe assembly with parking brake lever and spring. ---- snap action
6. Install nut and tighten it to the specified torque.

   Torque: 7 N·m (0.7 kgf·m/61 lb·in)
7. Connect T-end with equalizer through outer cable retainer.
8. Install parking brake cable nut and tighten it to the specified torque.

   Torque: 15 N·m (1.5 kgf·m/11 lb·ft)
9. Install parking brake cable bolt and tighten it to the specified torque.

   Torque: 7 N·m (0.7 kgf·m/61 lb·in)
10. Install brake drum.
11. Install wheel and tire.
12. Pull parking brake lever with a force equivalent to operating force: 490 N (50 kg/110 lb), 10 times for conditioning.
13. Adjust parking brake lever adjusting nut so that parking brake lever goes through 6-9 notches (Bucket Seat) or 8–14 notches (Bench Seat), when pulled with an operation force of 294 N (30 kg/66 lb).
14. Check brake for no drag.

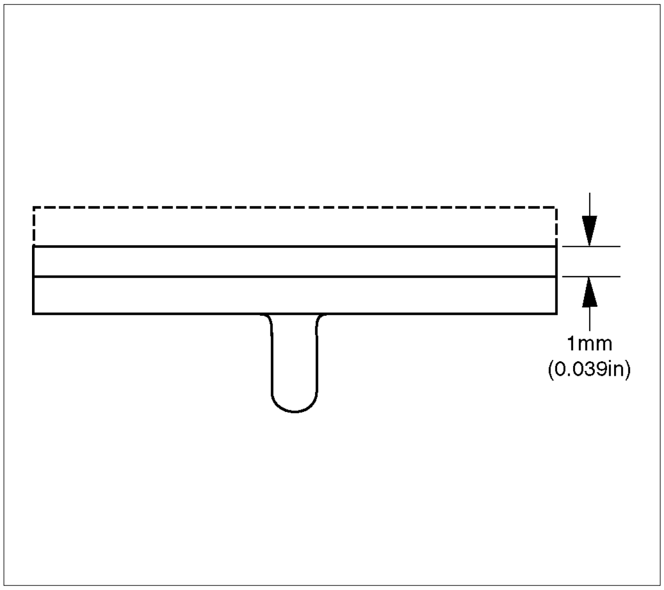
Inspection and Repair

Brake Lining Inspection

Check the shoe assemblies for wear by removing the brake drum.

Replace the shoe assemblies if the lining thickness is less than 1.0 mm (0.039 in).

Minimum limit: 1.0 mm (0.039 in)



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Parking Brake Adjustment

NOTE: All brakes are self-adjusting. Brakes are adjusted by repeated stepping on the brake pedal. (After stepping on the pedal and releasing it, the rear brake auto-adjuster produces a clicking sound. The same operation should be repeated until the sound disappears.)

Take the following steps after overhauling the rear brake assembly.

1. Move the parking brake lever to its fully released position.
2. Parking brake cable must be loosened sufficiently. (Loosen the adjust nut.)
3. Repeat stepping on the brake pedal firmly, and releasing it until the clicking sound can no longer be heard.
   If the difference between the brake drum inside diameter and the brake shoes external diameter is adjusted to be 0.4 mm (0.0157 in), the number of times for depressing the brake pedal can be reduced.
4. Remove the drum. Measure the brake drum inside diameter and the brake shoes external diameter.
   Total shoe clearance: 0.4 mm (0.0157 in)
   If incorrect, readjust the brake shoe clearance.
5. Rotate the adjust nut of hand brake lever until all slack disappears from the cable. Set the adjust nut.
6. After the rear brake shoe/drum gap has been adjusted, perform parking brake cable adjustment.
7. Turn the adjusting nut so that the parking brake lever travels 6–9 notches (Bucket Seat) or 8–14 notches (Bench Seat) when pulled up with a force of 294 N (30 kg/66 lb).
8. Make sure there is no brake dragging.

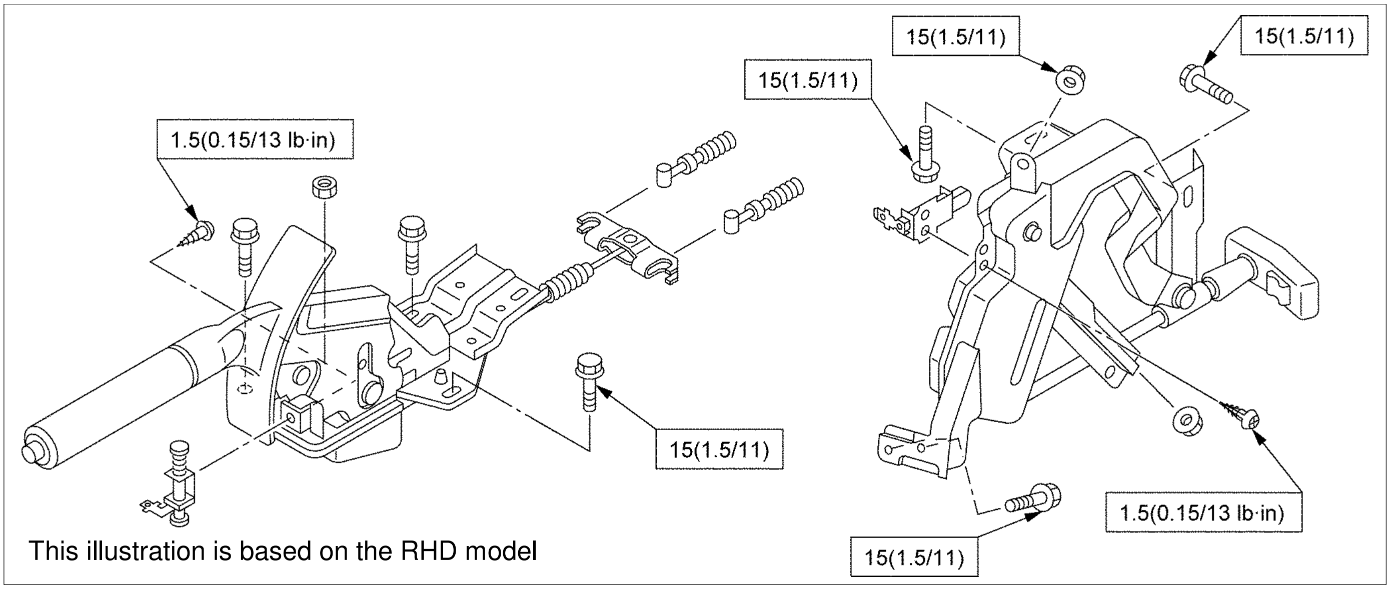
Main Data and Specifications

General Specifications

Type	Leading-Trailing
Drum inside diameter	254 mm (10 in) or 295 mm (11.6 in)
Parking brake lever stroke	6–9 notches; Bucket Seat 8–14 notches; Bench Seat When pulled with a force of 294 N (30 kg/66 lb)

Torque Specifications

N·m (kgf·m/lb·ft)



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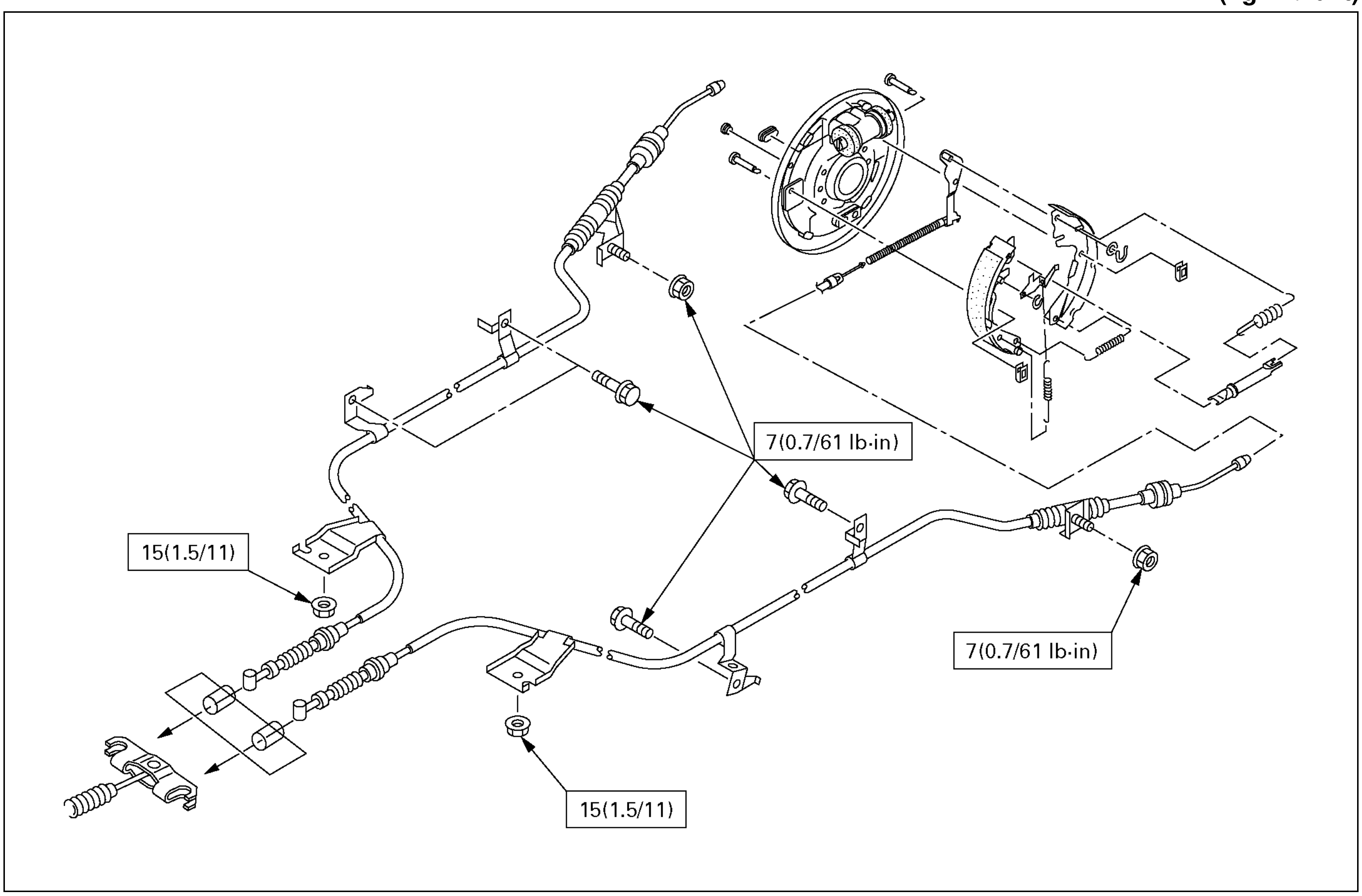
N·m (kgf·m/lb·ft)



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SECTION 6

ENGINE

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ENGINE

4JA1/4JH1 MODELS

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SECTION 6

TROUBLESHOOTING

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Basic Inspection Procedure

Follow the under inspection procedure, when the problem vehicle comes workshop.

Step	Inspection point	Inspection result	YES	NO
1	Check the check engine lamp	Is the check engine lamp turn ON ?	Go to *section 6E "On Board Diagnostic (OBD) System Check"*	Go to *Step 2*
2	The battery fluid level and the gravity	Was the problem found?	Re-charge the battery or replace the battery	Go to *Step 3*
3	The engine coolant capacity	Was the problem found?	Replenish the engine coolant	Go to *Step 4*
4	The engine oil level	Was the problem found?	Replenish the engine oil	Go to *Step 5*
5	The air cleaner element	Was the problem found?	Clean or replace	Go to *Step 6*
6	The piping fixing condition (oil, vacuum and fuel piping)	Was the problem found?	Return normal condition	Go to *Step 7*
7	The drive belt tension and break	Was the problem found?	Re-adjust the tension or replace	Go to *Step 8*
8	Go to *section 6E "On Board Diagnostic (OBD) System Check"*	Was the problem found?	Verify repair	Go to *Step 9*
9	Go to *mechanical troubleshooting chart*	Was the problem found?	Verify repair	—

1. Hard Starting

Inspect the following items before diagnosis.

1. The battery conditions.
   The terminal connection condition.
   The battery charge condition or battery power weakness.
2. The fan belt loosen or broken.
3. The main fuse condition (open or not).
4. Fuel quantity level.

1–1 Starter motor inoperative

Step	Action	Value(s)	Yes	No
1	Check the starter switch. Does the starter switch work?	—	Go to *Step 2*	Repair or replace the starter switch
2	Check the starter relay. Does the starter relay work?	—	Go to *Step 3*	Repair or replace the starter relay
3	Check the magnetic switch. Does the magnetic switch work?	—	Go to *Step 4*	Repair or replace the magnetic switch
4	Check the pinion gear condition on the starter motor. Was the condition normal?	—	Go to *Step 5*	Replace the pinion gear
5	Check the brush wear or brush spring weakness. Was the condition normal?	—	Replace the starter motor assembly	Repair or replace the brush or brush spring

1-2 Starter motor operates but engine does not turn over

Step	Action	Value(s)	Yes	No
1	Check the engine internal seizure. Was the engine seized?	—	Repair or replace seized parts	Check other DTC by Tech 2 and go to indicated DTC

1-3 Engine turn over but does not start engine

Incase of the fuel not being delivered to the injection pump

Step	Action	Value(s)	Yes	No
1	Check clogged, damaged the fuel piping or the connector loosen. Was any problem found?	—	Repair replace problem parts.	Go to *Step 2*
2	Was the over flow valve on the fuel filter closed?	—	Repair replace the over flow valve	Go to *Step 3*
3	Was the fuel filter element clogged?	—	Replace the fuel filter element	Go to *Step 4*
4	Was the fuel line air bled?	—	Go to *Step 5*	Bleed the air
5	Are any DTC stored?	—	Go to *indicated DTC*	Solved

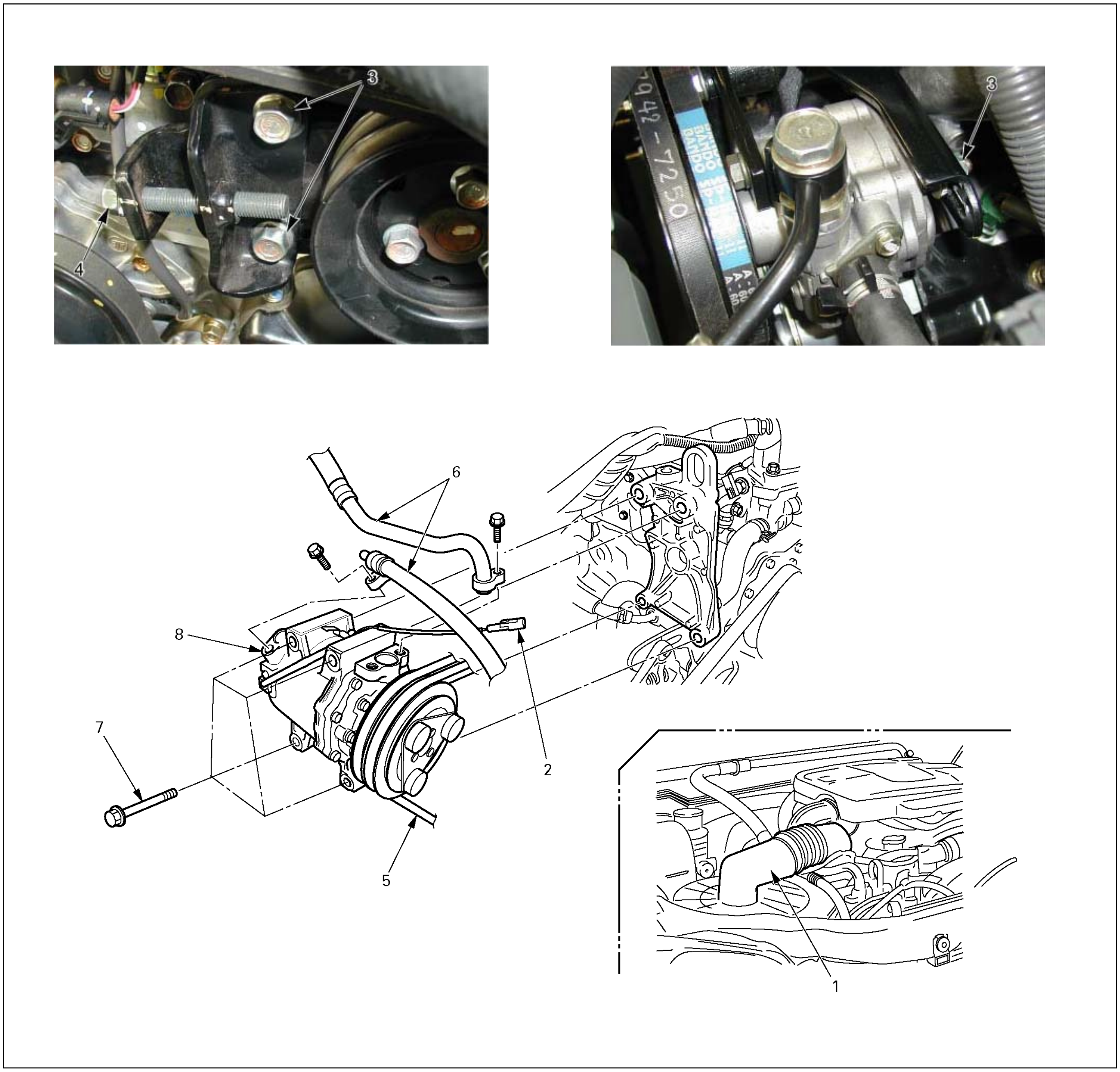
Incase of the fuel is being delivered to the injection pump

Step	Action	Value(s)	Yes	No
1	Was the water contain in the fuel?	—	Replace the fuel	Go to *Step 2*
2	Was the fuel line air bled?	—	Go to *Step 5*	Bleed the air
3	Was the injection spray condition complete?	—	Go to *Step 4*	Replace the injection nozzle
4	Was the injection nozzle injection starting pressure OK?	(See below)	Go to *Step 5*	Replace the injection nozzle
5	Was the injection nozzle sticking?	—	Replace the injection nozzle	Go to *Step 6*
6	Are any DTC stored?	—	Go to *indicated DTC*	Solved

Injection nozzle opening pressure
1st = 19.5 MPa (199 kg/cm^2, 2828 psi)

COMPRESSOR

REMOVAL AND INSTALLATION (4JA1-T, 4JH1-TC)



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Removal Steps

1. Air duct
2. Magnetic clutch harness connector
3. Lock nut
4. Tension adjustment bolt
5. Drive belt
6. Refrigerant line
7. Bolt; compressor to bracket
8. Compressor assembly

Installation Steps

8. Compressor assembly
▲ 7. Bolt; compressor to bracket
▲ 6. Refrigerant line
▲ 5. Drive belt
4. Tension adjustment bolt
3. Lock nut
2. Magnetic clutch harness connector
1. Air duct

2. Unstable Idling

Step	Action	Value(s)	Yes	No
1	Was the fuel line air bled completely?	—	Go to *Step 3*	Bleed the air
2	Was the fuel line leakage or blockage found?	—	Repair or replace relation parts.	Go to *Step 4*
3	Was the water contained in the fuel?	—	Replace the fuel	Go to *Step 5*
4	Was the fuel filter element clogged?	—	Replace the fuel filter element	Go to *Step 6*
5	Was the injection starting pressure or the injection spray condition OK?	(See below)	Go to *Step 7*	Replace the injection nozzle
6	Was the injection nozzle sticking?	See *Step 6*	Replace the injection nozzle	Go to *Step 8*
7	Check the throttle valve condition. Was the idling port clogged in the throttle valve?	—	Repair or replace the throttle valve	Go to *Step 9*
8	Was the valve clearance improper adjusted?	0.4 mm (0.016 in) both intake and exhaust valves	Adjust the valve clearance	Go to *Step 10*
9	Was the compression pressure OK?	3,040 kPa (31 kg/cm^2, 441 psi) at 200rpm	Go to *Step 11*	Readjust the valve clearance or replace the cylinder head gasket or cylinder liner or piston or piston ring or valve and valve seat
10	Are any DTC stored?	—	Go to *indicated DTC*	Solved

Injection nozzle opening pressure
1st = 19.5 MPa (199 kg/cm^2, 2828 psi)

3. Insufficient Power

Step	Action	Value(s)	Yes	No
1	Was the air cleaner element condition OK? (Clogged or not)	—	Go to *Step 2*	Clean or replace the air cleaner element.
2	Was the intake air leakage found from intake system?	—	Repair or replace the intake air system.	Go to *Step 3*
3	Was the fuel filter element condition OK? (Clogged or not)	—	Go to *Step 4*	Clean or replace the fuel filter element.
4	Check the fuel injection pipes. Does the injection pipes have obstruction or any damage?	—	Repair or replace the fuel injection pipes.	Go to *Step 5*
5	Was the water contained in the fuel?	—	Replace the fuel	Go to *Step 6*
6	Was the injection nozzle pressure or spray pattern normal?	—	Go to *Step 7*	Readjust the injection nozzle pressure or replace the nozzle.
7	Was the compression pressure OK?	3.0 MPa (31.0 kg/cm^2, 441 psi) at 200 rpm	Go to *Step 8*	Readjust the valve clearance or replace the cylinder head gasket or cylinder liner or piston or piston ring or valve and valve seat
8	Was the exhaust pipe clogged?	—	Repair or replace the exhaust pipe.	Go to *Step 9*
9	Was the exhaust gas leakage found from exhaust system?	—	Repair or replace the exhaust system.	Go to *Step 10*
10	Was the waste gate control actuator hose broken or cracked?	—	Replace the hose.	Go to *Step 11*
11	Was the waste gate working completely?	—	Go to *Step 12*	Replace the turbocharger assembly.
12	Was turbocharger working completely?	—	Go to *Step 13*	Replace the turbocharger assembly.
13	Are any DTC stored?	—	Go to *indicated DTC*	Solved

4. Excessive Fuel Consumption

Step	Action	Value(s)	Yes	No
1	Was the air cleaner element clogged?	—	Clean or replace the air cleaner element.	Go to *Step 2*
2	Was the air leakage found from the air intake side of the turbocharger?	—	Repair or replace the air intake side of the turbocharger.	Go to *Step 3*
3	Was the turbocharger working completely?	—	Go to *Step 4*	Replace the turbocharger
4	Was there the fuel leakage?	—	Repair or replace the fuel leakage part.	Go to *Step 5*
5	Was the compression pressure OK?	3.0 MPa (31.0 kg/cm^2, 441 psi) at 200 rpm	Go to *Step 6*	Readjust the valve clearance or replace the cylinder head gasket or cylinder liner or piston or piston ring or valve and valve seat
6	Was the injection nozzle pressure or spray pattern normal?	—	Go to *Step 7*	Replace the injection nozzle
7	Are any DTC stored?	—	Go to *indicated DTC*	Solved

5. Excessive Oil Consumption

Step	Action	Value(s)	Yes	No
1	Does the air cleaner element conditon OK? (Clogged or not)	—	Go to *Step 2*	Clean or replace the air cleaner element
2	Does PCV (Positive Crankcase Ventilation) Valve has problem?	—	Repair or replace the relation parts.	Go to *Step 3*
3	Was the oil pressure value more than normal value?	Less than 588 kPa (6.0 kg/cm^2, 85 psi)	Repair or replace the oil relief valve	Go to *Step 4*
4	Inspect the front and rear crankshaft oil seal. Was the oil leakage found?	—	Replace the failure part.	Go to *Step 5*
5	Was the oil leakage found from any gasket?	—	Replace the wrong gasket	Go to *Step 6*
6	Inspect the valve stem seal, the valve stem and the valve guide for worn. Were any worn found?	—	Replace the worn part.	Go to *Step 7*
7	Was the oil leakage found from the turbocharger oil seal?	—	Replace the oil seal.	Go to *Step 8*
8	Was the oil drain pipe of the turbocharger restricted?	—	Repair or replace the oil drain pipe.	Go to *Step 9*
9	Was the oil drain passage in the turbocharger center housing restricted?	—	Clean the center housing	Go to *Step 10*
10	Does turbine wheel has any impact damage?	—	Replace the turbocharger	Go to *Step 11*
11	Are any DTC stored?	—	Go to *indicated DTC*	Solved

6. Overheating

Step	Action	Value(s)	Yes	No
1	Was the engine coolant level OK?	—	Go to *Step 2*	Replenish the coolant
2	Was the water leakage or the radiator restriction found? (Include radiator cap)	—	Repair or replace the leakage part.	Go to *Step 3*
3	Was the fan belt slippage found?	—	Tension or replace the fan belt.	Go to *Step 4*
4	Was the fan clutch working completely?	—	Go to *Step 5*	Replace the fan clutch assembly.
5	Was the oil leakage found from fan clutch?	—	Replace the fan clutch assembly	Go to *Step 6*
6	Was the thermostat working normally?	—	Go to *Step 7*	Replace the thermostat.
7	Was the water pump working OK?	—	Go to *Step 8*	Replace the water pump assembly.
8	Was the restriction by the foreign materials in the cooling system found? For example, clog the water hose between the cylinder body and radiator etc..	—	Clean or replace the clog part.	Go to *Step 9*
9	Was the water leakage found from the sealing cap on the cylinder body?	—	Replace the sealing cap or replace the cylinder body.	Go to *Step 10*
10	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

7. White Exhaust Smoke

Step	Action	Value(s)	Yes	No
1	Was the compression pressure OK?	3.0 MPa (31.0 kg/cm^2, 441 psi) at 200 rpm	Go to *Step 2*	Readjust the valve clearance or replace the cylinder head gasket or cylinder liner or piston or piston ring or valve and relation parts.
2	Was the PCV (Positive Crankcase Ventilation) valve working completely?	—	Go to *Step 3*	Repair or replace the PCV valve.
3	Was the turbocharger working completely?	—	Go to *Step 4*	Replace the turbocharger.
4	Are any DTC stored?	—	Go to *indicated DTC*	Solved

8. Dark Exhaust Smoke

Step	Action	Value(s)	Yes	No
1	Was the air cleaner element normal condition?	—	Go to *Step 2*	Clean or replace the air cleaner element
2	Was the EGR valve sticking?	—	Replace the EGR valve	Go to *Step 3*
3	Was the injection nozzle pressure or the injection spray pattern OK?	—	Go to *Step 4*	Replace the injection nozzle
4	Was the oil leakage found from the turbocharger oil seal?	—	Replace the oil seal	Go to *Step 5*
5	Was the oil drain pipe of the turbocharger restricted?	—	Repair or replace the oil drain pipe	Go to *Step 6*
6	Was restricted the oil drain passage in the turbocharger center housing restricted?	—	Clean the center housing	Go to *Step 7*
7	Does turbine wheel has any impact damage?	—	Replace the turbocharger	Go to *Step 8*
8	Does PCV (Positive Crankcase Ventilation) Valve has problem?	—	Repair or replace the relation parts	Go to *Step 9*
9	Are any DTC stored?	—	Go to *indicated DTC*	Solved

9. Oil Pressure Does Not Rise

Step	Action	Value(s)	Yes	No
1	Was the oil pressure warning lamp working OK?	—	Go to *Step 2*	Replace the oil pressure warning lamp
2	Does the oil filter element clog?	—	Replace the oil filter element	Go to *Step 3*
3	Does the relief valve open?	—	Repair or replace the relief valve	Go to *Step 4*
4	Does the oil strainer clog?	—	Clean or replace the oil strainer	Go to *Step 5*
5	Was the oil pump working OK? (The pump related parts worn etc.)	—	Go to *Step 6*	Repair or replace the oil pump.
6	Was the rocker arm and/or relation parts worn?	—	Replace the rocker arm and/or relation parts	Go to *Step 7*
7	Was the camshaft and/or relation parts worn?	—	Replace the camshaft and/or relation parts	Go to *Step 8*
8	Was the crankshaft and/or relation parts worn?	—	Replace the crankshaft and/or relation parts	Go to *Step 9*
9	Are any DTC stored?	—	Go to *indicated DTC*	Solved

Table of pressure unit

Pressure	kPa (kg/cm^2)	100 (1.0)	980 (10.0)
Resistance	ohm	81	30
Electric current	A	63.5	106.7

10. Abnormal Engine Noise

10–1 Engine knocking

Step	Action	Value(s)	Yes	No
1	Was the injection nozzle pressure or injection spray pattern OK?	—	Go to *Step 2*	Replace the injection nozzle
2	Was the compression pressure OK?	3.0 MPa (31.0 kg/cm², 441 psi) at 200 rpm	Go to *Step 3*	Replace the cylinder head gasket or piston ring
3	Are any DTC stored?	—	Go to *indicated DTC*	Solved

10–2 Gas leakage noise

Step	Action	Value(s)	Yes	No
1	Was the exhaust pipe loose or broken?	—	Retighten or replace the exhaust pipe	Go to *Step 2*
2	Was the exhaust manifold loose?	—	Retighten or replace the exhaust manifold. Or replace the exhaust manifold gasket	Go to *Step 3*
3	Was the injection nozzle loose?	—	Retighten or replace the injection nozzle fixing bolt	Go to *Step 4*
4	Was the cylinder head gasket broken?	—	Replace the cylinder head gasket	Go to *Step 5*
5	Are any DTC stored?	—	Go to *indicated DTC*	Solved

10–3 Continuous noise

Step	Action	Value(s)	Yes	No
1	Was the fan belt tension OK?	9 – 13 mm (0.35 – 0.51 in)	Go to *Step 2*	Adjust the fan belt tension.
2	Was the cooling fan loose?	—	Tighten the cooling fan	Go to *Step 3*
3	Was noise coming from the generator?	—	Repair or replace the generator and/or the vacuum pump	Go to *Step 4*
4	Was noise coming from the water pump?	—	Replace the water pump	Go to *Step 5*
5	Was noise coming from the cylinder head cover?	—	Readjust the valve clearance.	Go to *Step 6*
6	Are any DTC stored?	—	Go to *indicated DTC*	Solved

10-4 Slapping noise

Step	Action	Value(s)	Yes	No
1	Was noise coming from the cylinder head cover?	—	Go to *Step 2*	Go to *Step 4*
2	Were valve clearances correct?	0.4 mm (0.016 in) both intake and exhaust	Adjust the valve clearances	Go to *Step 3*
3	Were the rocker arms damaged?	—	Replace the rocker arms	Go to *Step 4*
4	Was the flywheel fixing bolt loose?	—	Tighten the fixing bolt.	Go to *Step 5*
5	Was noise coming from the cylinder body?	—	Go to *Step 6*	Go to *Step 10*
6	Inspect the crankshaft bearing and/or crankshaft. Was the crankshaft bearing and/or crankshaft worn?	—	Replace the worn parts	Go to *Step 7*
7	Inspect the connecting rod bearing and/or crankpin. Was the connecting rod bearing and/or crankpin worn?	—	Replace the worn parts	Go to *Step 8*
8	Inspect the connecting rod small end bushing and/or piston pin. Was the connecting rod small end bushing and/or piston pin worn?	—	Replace the worn parts	Go to *Step 9*
9	Inspect the piston and/or cylinder liner. Was the piston and/or cylinder liner worn or damaged?	—	Replace the worn or damaged parts	Go to *Step 10*
10	Are any DTC stored?	—	Go to *indicated DTC*	Solved

10-5 Excessive turbocharger noise

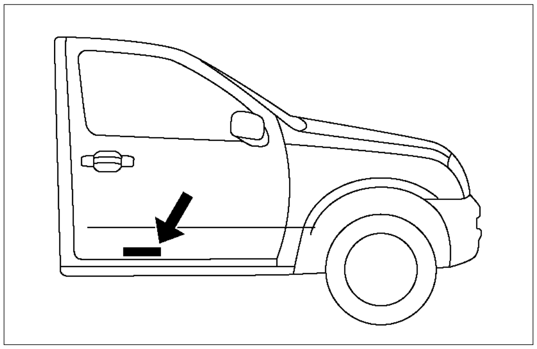
The vibration noise (the air aspiration noise) occurred when turbocharger rotates, it is normal condition of the turbocharger, no necessary any actions.

Step	Action	Value(s)	Yes	No
1	Was the excessive noise coming from the turbocharger?	—	Go to *Step 2*	Go to *Step 10*
2	Inspect the fixing bolts and bands. Was any problem found?	—	Tighten the loose parts	Go to *Step 3*
3	Was the intake or exhaust system gasket damaged?	—	Replace the damaged gasket.	Go to *Step 4*
4	Inspect rotation parts condition. Was the turbine wheel rotation rough?	—	Replace the turbocharger.	Go to *Step 5*
5	Inspect the turbine wheel. Was the turbine wheel rubbing against housing?	—	Replace the turbocharger.	Go to *Step 6*
6	Was the turbine wheel damaged?	—	Replace the turbocharger.	Go to *Step 7*
7	Were there carbon deposits in the turbine or compressor housing?	—	Clean or replace the turbocharger.	Go to *Step 8*
8	Inspect the oil supply condition. Was the oil feed pipe clogged?	—	Repair or replace the oil feed pipe.	Go to *Step 9*
9	Was the turbine shaft bearing worn?	—	Replace the turbocharger.	Go to *Step 10*
10	Are any DTC stored?	—	Go to *indicated DTC*	Solved

11. Rotating Part Wear of Turbocharger

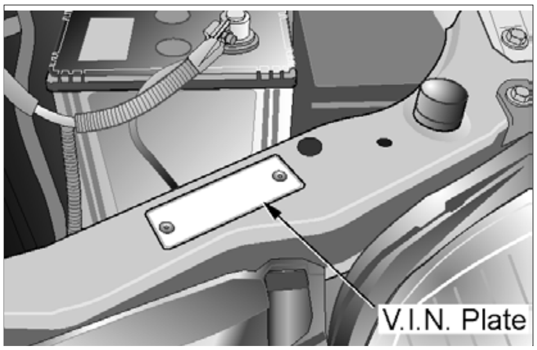
Step	Action	Value(s)	Yes	No
1	Inspect engine oil. Was it contaminated with foreign materials?	—	Replace the engine oil	Go to *Step 2*
2	Was the recommended engine oil grade/viscosity being used?	API CD or ISUZU genuine/ 10W–30	Go to *Step 3*	Replace the engine oil
3	Was the oil feed pipe restricted?	—	Clean or replace the oil feed pipe	Go to *Step 4*
4	Was the oil seal of turbocharger defective?	—	Replace the oil seal	Go to *Step 5*
5	Was the center housing oil drain passage clogged?	—	Clean center housing or replace the turbocharger	Go to *Step 6*
6	Was there oil sludge and/or coking on the turbine shaft?	—	Replace the turbocharger	Go to *Step 7*
7	Are any DTC stored?	—	Go to *indicated DTC*	Solved

IDENTIFICATION



CHASSIS NUMBER

The chassis number is stamped on the right-hand side of the chassis side member under the right door.



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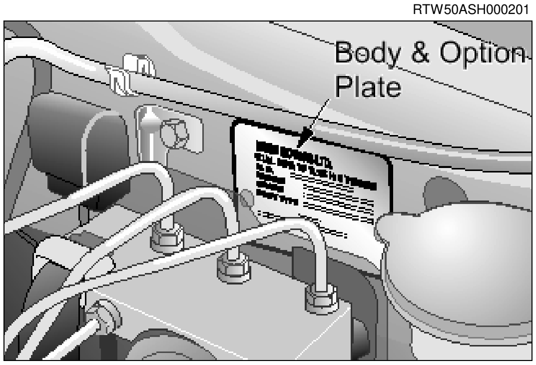
VEHICLE IDENTIFICATION PLATE

The vehicle identification plate is attached to the upper face of the radiator sill in the engine compartment.



BODY AND OPTION IDENTIFICATION PLATE

The body and option plate shows body style, body serial number, paint and trim colour combination, paint number, engine transmissions, axle ratio options and built date. The built date is defined as 'the date of manufacture' by the calendar month and year in which the body shell and power train sub-assemblies are co-joined or moved from the production line.

Important Operations - Installation

7. Bolt; Compressor to Bracket

N·m (kgf·m/lb·ft)

Torque	44 (4.5/33)

6. Refrigerant Line

N·m (kgf·m/lb·in)

Torque	11~19 (1.1/95~1.9/168)

5. Drive Belt

Refer to SECTION 6A “COOLING SYSTEM”.

12. Oil Leakage from Turbocharger

Step	Action	Value(s)	Yes	No
1	Inspect the oil leakage area. Was the oil feed pipe eye bolt loose or the gasket broken?	—	Tighten the eye bolt or replace the gasket.	Go to *Step 2*
2	Were the V band fixing faces tight?	—	Tighten band or replace the turbocharger	Go to *Step 3*
3	Was there oil leakage from the flange of the turbine housing?	—	Replace the turbocharger	Go to *Step 4*
4	Was there oil leakage from the flange of compressor housing?	—	Tighten the bolt and/or hose clamp.	Go to *Step 5*
5	Are any DTC stored?	—	Go to *indicated DTC*	Solved

13. Insufficient Acceleration and/or Lack of Power due to turbocharger

Step	Action	Value(s)	Yes	No
1	Inspect the air or exhaust route. Was the air and/or exhaust gas piping loose?	—	Tighten flange bolts or hose clamp.	Go to *Step 2*
2	Inspect the work of waste gate valve control. Was there rust on the linkage rod or pin of the waste gate valve?	—	Replace the turbocharger	Go to *Step 3*
3	Was air leakage found from the actuator piping?	—	Repair or replace the actuator pipe or hose/	Go to *Step 4*
4	Inspect the inside of the turbocharger. Was the turbine shaft end nut loose?	—	Replace the turbocharger	Go to *Step 5*
5	Were the turbine blades bent?	—	Replace the turbocharger	Go to *Step 6*
6	Was the turbine wheel rubbing against housing?	—	Replace the turbocharger	Go to *Step 7*
7	Are any DTC stored?	—	Go to *indicated DTC*	Solved

14. Battery Charging and Noise Problem

Visual/physical check the following items before diagnosis.
The drive belt tension.
The battery terminals connection condition.
The ground connection condition.
The generator and the battery fastener condition.
The battery fluid level and specific gravity.

14-1 Battery No Charging

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the brush contact condition on the generator. Was there poor contact between the brush and the slip ring?	—	Repair or replace the brush and/or the slip ring.	Go to *Step 3*
3	Inspect the stator coil on the generator. Was there an open circuit or the scorching on the stator coil?	—	Replace the stator coil.	Go to *Step 4*
4	Inspect the rotor coil on the generator. Was there an open circuit or the scorching on the rotor coil?	—	Replace the rotor coil.	Go to *Step 5*
5	Inspect the rectifier on the generator. Was the rectifier defective?	—	Replace the rectifier	Go to *Step 6*
6	Inspect the IC regulator. Was the IC regulator defective?	—	Replace the IC regulator.	Go to *Step 7*
7	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

14-2 Battery Overcharging

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the terminal circuit. Were the B and F terminals shorted?	—	Repair the short circuit.	Go to *Step 3*
3	Check the regulating voltage. Was the IC regulator voltage excessive?	—	Replace the IC regulator.	Go to *Step 4*
4	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

14-3 Battery Under Charging

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the brush contact condition on the generator. Was there intermittent contact between the brush and the slip ring?	—	Repair or replace the brush holder assembly.	Go to *Step 3*
3	Inspect the rotor coil on the generator. Was there a short circuit in the rotor coil?	—	Repair or replace the rotor coil.	Go to *Step 4*
4	Inspect the stator coil on the generator. Was there an open circuit or the short circuit on the stator coil?	—	Repair or replace the stator coil.	Go to *Step 5*
5	Inspect the rectifier on the generator. Was the rectifier defective?	—	Replace the rectifier	Go to *Step 6*
6	Inspect the IC regulator on the generator. Was the IC regulator defective?	—	Replace the IC regulator.	Go to *Step 7*
7	Was the electrical load excessive?	—	Replace more higher capacity generator.	Go to *Step 8*
8	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

14-4 Battery Unstable Charging Current

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the brush contact condition on the generator. Was there poor contact between the brush and the slip ring?	—	Repair or replace the brush and/or the slip ring.	Go to *Step 3*
3	Inspect the rotor coil on the generator. Was there the short circuit or an open circuit in the rotor coil?	—	Repair or replace the rotor coil.	Go to *Step 4*
4	Inspect the stator coil on the generator. Was there an open circuit or the short circuit in the stator coil?	—	Repair or replace the stator coil.	Go to *Step 5*
5	Inspect the connection between the rectifier and stator coil on the generator. Was there a loose connection between the rectifier and stator coil ?	—	Repair the loose connection.	Go to *Step 6*
6	Inspect the IC regulator on the generator. Was the IC regulator defective?	—	Replace the IC regulator.	Go to *Step 7*
7	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

14-5 Charging System Noise

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Was there intermittent noise or continuous noise and that could be identified clearly by increasing and decreasing engine speed?	—	Replace the bearing.	Go to *Step 3*
3	Was there a growling sound and does this sound stop when the connector was disconnected?	—	Replace the stator coil.	Go to *Step 4*
4	Was intermittent sound heard when the generator was running?	—	Replace the brush and/or slip ring.	Go to *Step 5*
5	Was frictional sound heard when generator was running?	—	Clean the slip ring or replace the brush.	Go to *Step 6*
6	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

15. Starter Motor Problem

Visual/physical check the following items before diagnosis.
The battery terminals connection condition.
The ground connection condition.
The starter motor or the battery fastener condition.
The battery fluid level and specific gravity.

15-1 Starter motor pinion engages to ring gear but engine does not turn over

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Check the contact condition between the brush and the commutator. Was the brush and the commutator contact intermittent?	—	Replace the brush or repair the commutator.	Go to *Step 3*
3	Were the brush and the commutator contact faces dirty?	—	Clean contact face	Go to *Step 4*
4	Was the pinion clutch slipped?	—	Replace the pinion clutch	Go to *Step 5*
5	Inspect the armature field coil. Was there an open circuit or a short circuit in the armature field coil?	—	Repair or replace the armature field coil.	Go to *Step 6*
6	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

15-2 Incorrect pinion and ring gear engagement

Step	Action	Value(s)	Yes	No
1	Was "Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the pinion and the ring gear teeth. Were the pinion and/or the ring gear teeth worn or broken?	—	Replace the wron parts.	Go to *Step 3*
3	Inspect the pinion gear return movement. Was the pinion gear return movement incorrect?	—	Adjust or replace the movement parts.	Go to *Step 4*
4	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

15-3 Starter motor continues to run after the starter switch is turned off

Step	Action	Value(s)	Yes	No
1	Was “Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the magnetic switch contact point. Was the contact point seized?	—	Repair or replace the magnetic switch.	Go to *Step 3*
3	Inspect the starter switch. Was the starter switch defective?	—	Replace the starter switch.	Go to *Step 4*
4	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

15-4 Excessive commutator sparking

Step	Action	Value(s)	Yes	No
1	Was “Visual/Physical Check" performed.	—	Go to *Step 2*	Go to *visual/physical check*
2	Inspect the contact condition between the brush and the commutator. Was the brush and the commutator contact intermittent?	—	Replace the brush or repair the commutator.	Go to *Step 3*
3	Was there the slag accumulation on the contact face?	—	Clean the contact face or replace the brush.	Go to *Step 4*
4	Was the brush holder loose?	—	Repair the brush holder	Go to *Step 5*
5	Inspect the commutator. Was there excessive wear or pitting?	—	Repair or replace the commutator.	Go to *Step 6*
6	Was there loose the solder on the commutator?	—	Clean and repair	Go to *Step 7*
7	Inspect the armature shaft. Was the run-out of armature shaft outside the standard value due to worn bearing ?	—	Replace the bearing	Go to *Step 8*
8	Are any DTC stored?	—	Go to *indicated DTC.*	Solved

SECTION 6A

ENGINE MECHANICAL

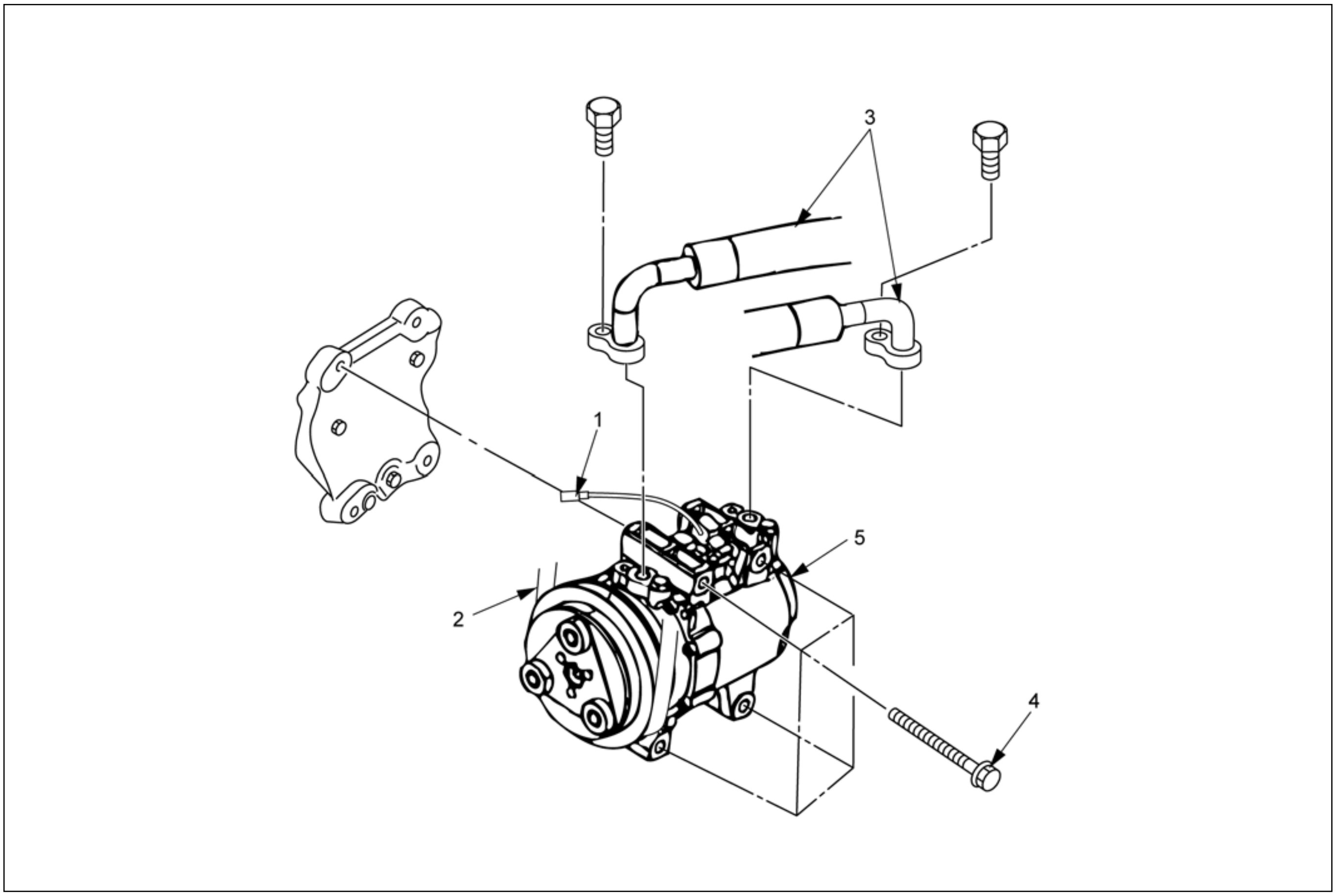
TABLE OF CONTENTS

PAGE

MAIN DATA AND SPECIFICATIONS

Item \ Engine model		4JA1T (L)	4JA1TC
Engine type		Four-cycle, overhead valve, water cooled	
Combustion chamber type		Direct injection	
Cylinder liner type		Dry type, chrome plated	
Timing gear train system		Gear drive	
No. of cylinders-bore × stroke	mm (in)	4 – 93 × 92 (3.66 × 3.62)	
No. of piston rings		Compression ring: 2 / Oil ring: 1	
Total piston displacement	cm^3 (in^3)	2,499 (152.4)	
Compression ratio (to 1)		18.5	
Compression pressure	MPa (kg/cm^2/psi)	3.0 (31.0/441) – 200 rpm	
Engine weight (dry)	kg (lb)	Approximately 239 (527)	
Fuel injection order		1 – 3 – 4 - 2	
Fuel injection timing BTDC	deg	8	-
Specified fuel type		JIS No. 2, DIN/EN590, GB252-1944 Diesel fuel	
Idling speed	rpm	730 ± 25 (A/C Off) 780 ± 25 (A/C ON)	
Valve clearances (At cold): Intake	mm (in)	0.4 (0.016)	
Exhaust	mm (in)	0.4 (0.016)	
Intake valves Open at (BTDC)	deg	24.5	
Close at (ABDC)	deg	55.5	
Exhaust valves Open at (BBDC)	deg	54.0	
Close at (ATDC)	deg	26.0	
Fuel system			
Injection pump type		BOSCH distributor VE type	BOSCH distributor VP44 type
Governor type		Mechanical (Half all speed type)	Electronically controled
Injection nozzle type		Hole with 5 orifices	
Injection nozzle opening pressure	MPa (kg/cm^2/psi)	1st 19.1 (195 / 2,773) 2nd (Reference) 25.5~27.0 (260~275 / 3,702~3,920)	1st 19.0 (194 / 2,755) 2nd (Reference) 34.0~35.5 (347~362 / 4,936~5,154)
Main fuel filter type		Cartridge paper element and water separator	
Lubricating system			
Lubricating method		Pressure circulation	
Specified engine oil (API grade)		ISUZU genuine 10W – 30 (API CD of ACEA B2/B3)	

REMOVAL AND INSTALLATION (4JJ1-TC Standard Output, 4JJ1-TC High Output, 4JK1-TC High Output)



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Removal Steps

1. Magnetic clutch harness connector
2. Drive belt
3. Refrigerant line
4. Bolt; compressor to bracket
5. Compressor assembly

Installation Steps

5. Compressor assembly
▲ 4. Bolt; compressor to bracket
▲ 3. Refrigerant line
▲ 2. Drive belt
1. Magnetic clutch harness connector

Item / Engine model		4JA1T (L)	4JA1TC
Cooling system			
Water pump type		Centrifugal	
Thermostat type		Wax pellet with jiggle valve	
Air cleaner type		Dry paper element	Viscous paper element
Battery type/voltage × No. of units		80D26L × 1	
		95D31L × 1 (OPT)	
Generator capacity	V-A	12 – 60	
		12 – 80	
Starter motor output	V-kW	12 – 2.3	
Turbocharger model		*IHI RHF 4H	
Turbine type		Mixed flow type	
Compressor type		Backward & rake	

*IHI: Ishikawajima-Harima Heavy Industries., Ltd.

MAIN DATA AND SPECIFICATIONS

Item / Engine model		4JH1TC
Engine type		Four-cycle, overhead valve, water cooled
Combustion chamber type		Direct injection
Cylinder liner type		Dry type, chrome plated
Timing gear train system		Gear drive
No. of cylinders-bore × stroke	mm (in)	4 – 95.4 × 104.9 (3.76 × 4.13)
No. of piston rings		Compression ring: 2 / Oil ring: 1
Total piston displacement	liter	2,999
Compression ratio (to 1)		18.3
Compression pressure	MPa (kg/cm^2/psi)	3.0 (31.0/441) – 200 rpm
Engine weight (dry)	kg (lb)	MT: Approximately 249 (549)
		AT: Approximately 236 (520)
Fuel injection order		1 – 3 – 4 - 2
Specified fuel type		JIS No.2, DIN/EN590, GB252-1944 Diesel fuel
Idling speed	rpm	700 ± 25 (A/C OFF)
		800 ± 25 (A/C ON)
Valve clearances (At cold): Intake	mm (in)	0.4 (0.016)
Exhaust	mm (in)	0.4 (0.016)
Intake valves Open at (BTDC)	deg	24.5
Close at (ABDC)	deg	55.5
Exhaust valves Open at (BBDC)	deg	54.0
Close at (ATDC)	deg	26.0
Fuel system		
Injection pump type		BOSCH distributor VP44 type
Injection nozzle type		Hole with 5 orifices
Injection nozzle opening pressure		
	MPa (kg/cm^2/psi)	1st 19.5 (199/2,828)
		2nd (Reference) 34.3~35.8 (350~365/4,980~5,197)
Main fuel filter type		Cartridge paper element and water separator
Lubricating system		
Lubricating method		Pressure circulation
Specified engine oil (API grade)		ISUZU genuine 10W – 30 (API CD of ACEA B2/B3)
Oil pump type		Gear
Oil filter type		Cartridge paper element
Oil capacity	lit (US/UK gal)	6.2 (1.64/1.36) (For 4 × 2)
		7.0 (1.85/1.54) (For 4 × 4)
Oil cooler type		Water cooled

Item \ Engine model	4JH1TC
Cooling system	
Water pump type	Centrifugal
Thermostat type	Wax pellet with jiggle valve
Air cleaner type	Dry paper element (except for Euro3 spec) Viscous paper element (for Euro3 spec)
Battery type/voltage × No. of units	80D26L × 1 95D31L × 1 (OPT) 75D26R × 2 (OPT for EC, MT) 80D26R × 2 (OPT for EC, AT)
Generator capacity V-A	12 – 60/12 – 80
Starter motor output V-kW	12 – 2.3
Turbocharger model	*IHI RHF5
Turbine type	Mixed flow type Radial-inflow
Compressor type	Backward & rake type Radial-outflow

*IHI: Ishikawajima-Harima Heavy Industries., Ltd.

TORQUE SPECIFICATION

STANDARD BOLTS

The torque values given in the following table should be applied whenever a particular torque is not specified.

N·m (kg·m/lb·ft)

<table>
<tr><th rowspan="3">Strength Class / Bolt Identification / Bolt Diameter × Pitch (mm)</th><th rowspan="2">4.8 (4T)</th><th rowspan="2">(7T)</th><th colspan="2">8.8</th><th rowspan="2">9.8 (9T)</th></tr>
<tr><th>Refined</th><th>Non-Refined</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td> No mark</td><td>—</td><td></td><td></td><td></td></tr>
<tr><td>M 6 × 1.0</td><td>5.88 ± 1.96
(0.60 ± 0.20/4.33 ± 1.44)</td><td colspan="3">7.35 ± 2.45
(0.75 ± 0.25/5.43 ± 1.80)</td><td>-</td></tr>
<tr><td>M 8 × 1.25</td><td>12.74 ± 4.90
(1.30 ± 0.50/9.40 ± 3.62)</td><td colspan="3">17.15 ± 5.39
(1.75 ± 0.55/12.66 ± 4.00)</td><td>23.52 ± 6.86
(2.40 ± 0.70/17.36 ± 5.06)</td></tr>
<tr><td>M10 × 1.25</td><td>27.44 ± 6.86
(2.80 ± 0.70/20.25 ± 5.06)</td><td colspan="3">36.75 ± 9.31
(3.75 ± 0.95/27.12 ± 6.87)</td><td>49.98 ± 12.74
(5.10 ± 1.30/36.89 ± 9.40)</td></tr>
<tr><td>M12 × 1.25</td><td>61.25 ± 12.25
(6.25 ± 1.25/45.21 ± 9.04)</td><td colspan="3">75.95 ± 15.19
(7.75 ± 1.55/56.06 ± 11.21)</td><td>94.57 ± 19.11
(9.65 ± 1.95/69.80 ± 14.10)</td></tr>
<tr><td>M14 × 1.5</td><td>95.55 ± 19.11
(9.75 ±1.95/70.52 ± 14.10)</td><td colspan="3">116.13 ± 23.03
(11.85 ± 2.35/85.71 ± 17.00)</td><td>142.10 ± 28.42
(14.50 ± 2.90/104.88 ± 21.00)</td></tr>
<tr><td>M16 × 1.5</td><td>130.34 ± 26.46
(13.30 ± 2.70/96.20 ± 19.53)</td><td colspan="3">169.54 ± 34.30
(17.30 ± 3.50/125.13 ± 25.32)</td><td>199.92 ± 40.18
(20.40 ± 4.10/147.55 ± 29.66)</td></tr>
<tr><td>M18 × 1.5</td><td>188.16 ± 37.24
(19.20 ± 3.80/138.87 ± 27.49)</td><td colspan="3">244.02 ± 49.00
(24.90 ± 5.00/180.10 ± 36.17)</td><td>287.14 ± 57.82
(29.30 ± 5.90/211.93 ± 42.67)</td></tr>
<tr><td>M20 × 1.5</td><td>257.74 ± 51.94
(26.30 ± 5.30/190.23 ± 38.33)</td><td colspan="3">337.12 ± 67.62
(34.40 ± 6.90/248.82 ± 49.41)</td><td>395.92 ± 79.38
(40.40 ± 8.10/292.21 ± 58.59)</td></tr>
<tr><td>M22 × 1.5</td><td>332.22 ± 81.34
(33.90 ± 8.30/245.20 ± 60.03)</td><td colspan="3">453.25 ± 90.65
(46.25 ± 9.25/334.53 ± 66.91)</td><td>530.18 ± 105.84
(54.10 ± 10.80/391.30 ± 78.12)</td></tr>
<tr><td>M24 × 2.0</td><td>448.84 ± 90.16
(45.80 ± 9.20/331.27 ± 66.54)</td><td colspan="3">570.36 ± 140.14
(58.20 ± 14.30/420.96 ± 103.43)</td><td>691.88 ± 138.18
(70.60 ± 14.10/510.65 ± 101.99)</td></tr>
<tr><td>* M10 × 1.5</td><td>26.46 ± 6.86
(2.70 ± 0.70/19.53 ± 5.06)</td><td colspan="3">36.26 ± 8.82
(3.70 ± 0.90/26.76 ± 6.50)</td><td>48.02 ± 11.76
(4.90 ± 1.20/35.44 ±8.68)</td></tr>
<tr><td>* M12 × 1.5</td><td>56.84 ± 11.76
(5.80 ± 1.20/41.95 ± 8.68)</td><td colspan="3">70.56 ± 13.72
(7.20 ± 1.40/52.08 ± 10.13)</td><td>89.18 ± 17.64
(9.10 ± 1.80/65.82 ± 13.02)</td></tr>
<tr><td>* M14 × 2.0</td><td>89.18 ± 17.64
(9.10 ± 1.80/65.82 ± 13.02)</td><td colspan="3">109.76 ± 21.56
(11.20 ± 2.20/81.01 ± 15.91)</td><td>133.28 ± 26.46
(13.60 ± 2.70/98.37 ± 19.53)</td></tr>
<tr><td>* M16 × 2.0</td><td>124.46 ± 24.50
(12.70 ± 2.50/91.86 ± 18.08)</td><td colspan="3">161.70 ± 32.34
(16.50 ± 3.30/119.34 ± 23.87)</td><td>191.10 ± 38.22
(19.50 ± 3.90/141.04 ± 28.21)</td></tr>
</table>

An asterisk (*) indicates that the bolts are used for female threaded parts that are made of soft materials such as casting. Those shown in parentheses in the strength class indicate the classification by the old standard.

FLARE NUTS

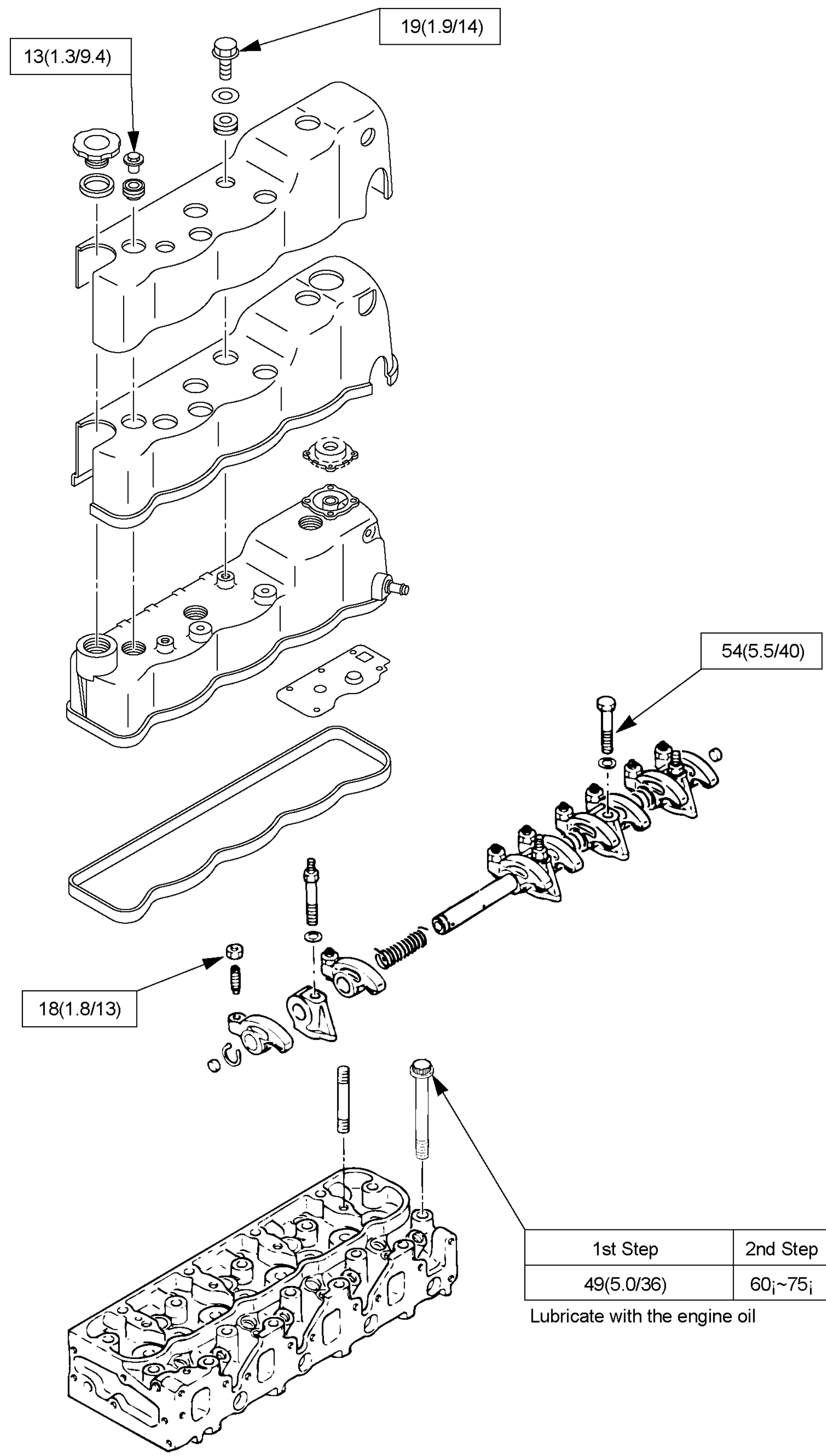
N·m (kg·m/lb·ft)

Pipe diameter mm (in)	Torque	Pipe diameter mm (in)	Torque
4.76 (0.187)	15.2 ± 2.45(1.55 ±0.25/11.2 ± 1.8)	10.00 (0.394)	53.95 ± 4.90(5.50 ± 0.5 /39.7 ± 3.6)
6.35 (0.250)	26.48 ± 2.94(2.70 ± 0.30/19.5 ± 2.1)	12.00 (0.472)	88.29 ± 9.80(9.00 ± 1.0/65.0 ± 7.2)
8.00 (0.315)	44.14 ± 4.90(4.50 ± 0.50/32.5 ± 3.6)	15.00 (0.591)	105.45 ± 12.26(10.75 ± 1.25/77.7 ± 9.0)

SPECIAL PARTS FIXING NUTS AND BOLTS

Cylinder Head Cover, Cylinder Head, and Rocker Arm Shaft Bracket

N·m (kg·m/lb·ft)



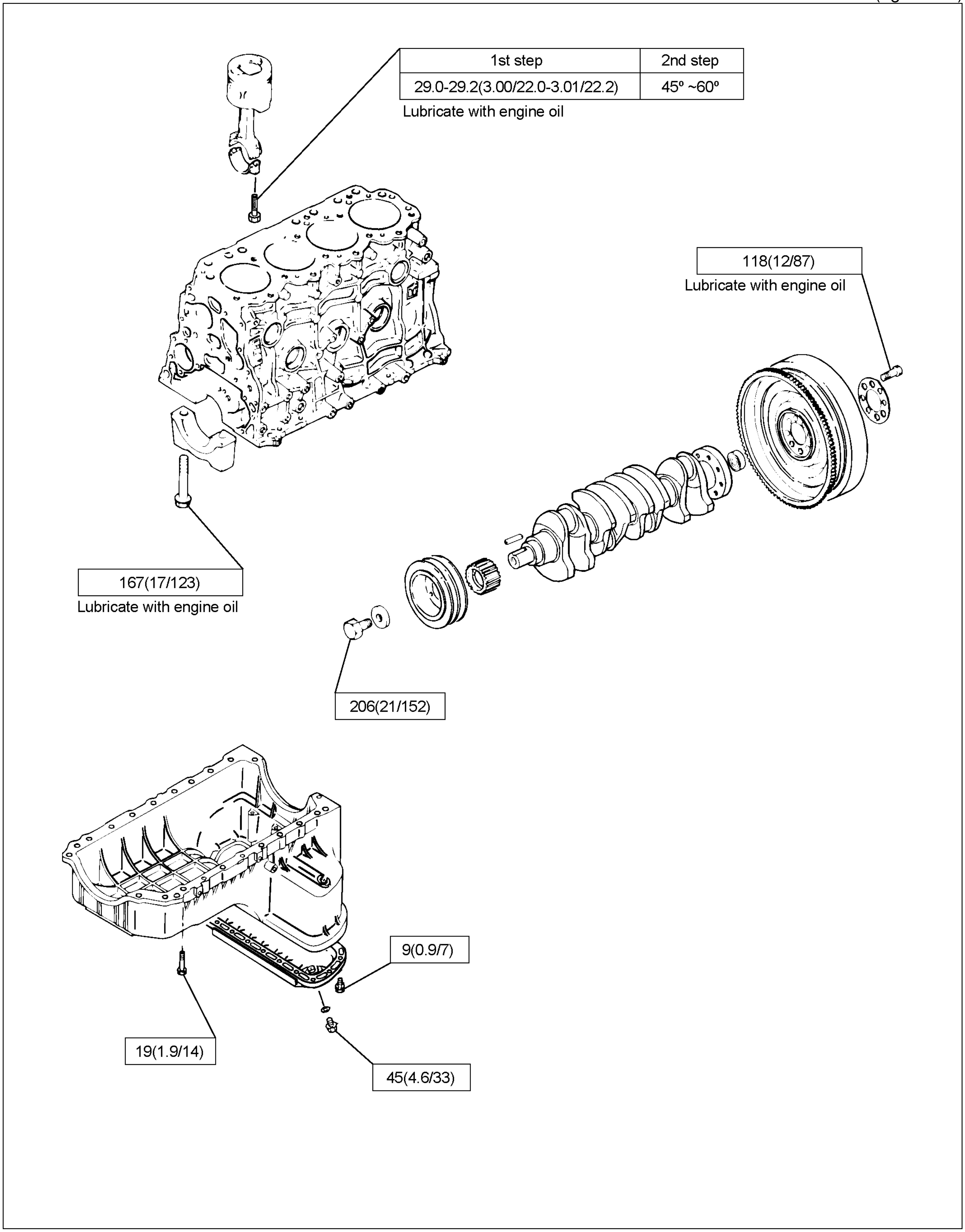
1st Step	2nd Step	3rd Step
49(5.0/36)	60¡~75¡	60¡~75¡

Lubricate with the engine oil

RTW46AXF000501

Crankshaft Bearing Cap, Connecting Rod Bearing Cap, Crankshaft Damper Pulley, Flywheel, and Oil Pan

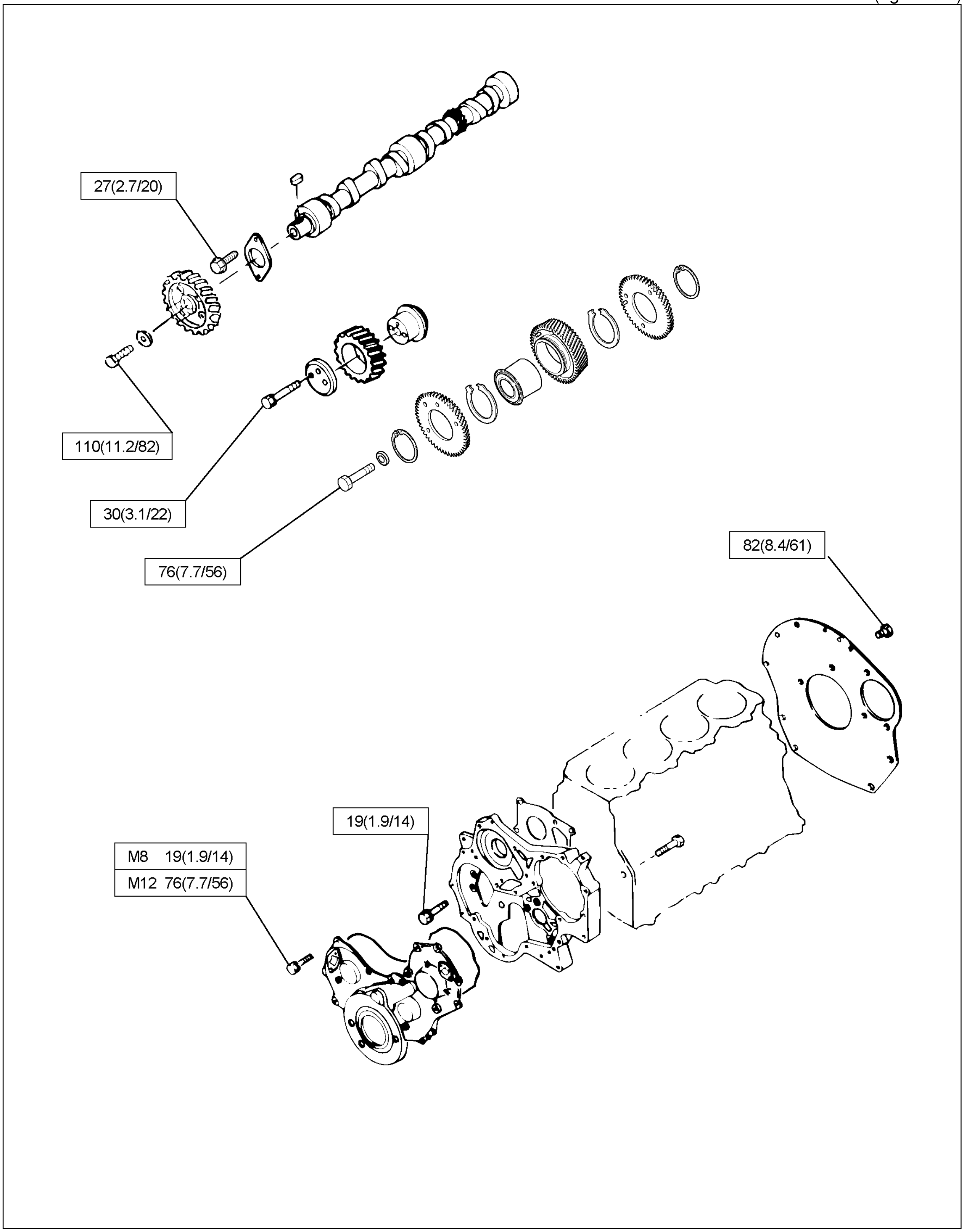
N·m (kg·m/lb·ft)



RTW46AXF001401

Timing Gear Case, Pulley Housing, Timing Gear, and Camshaft

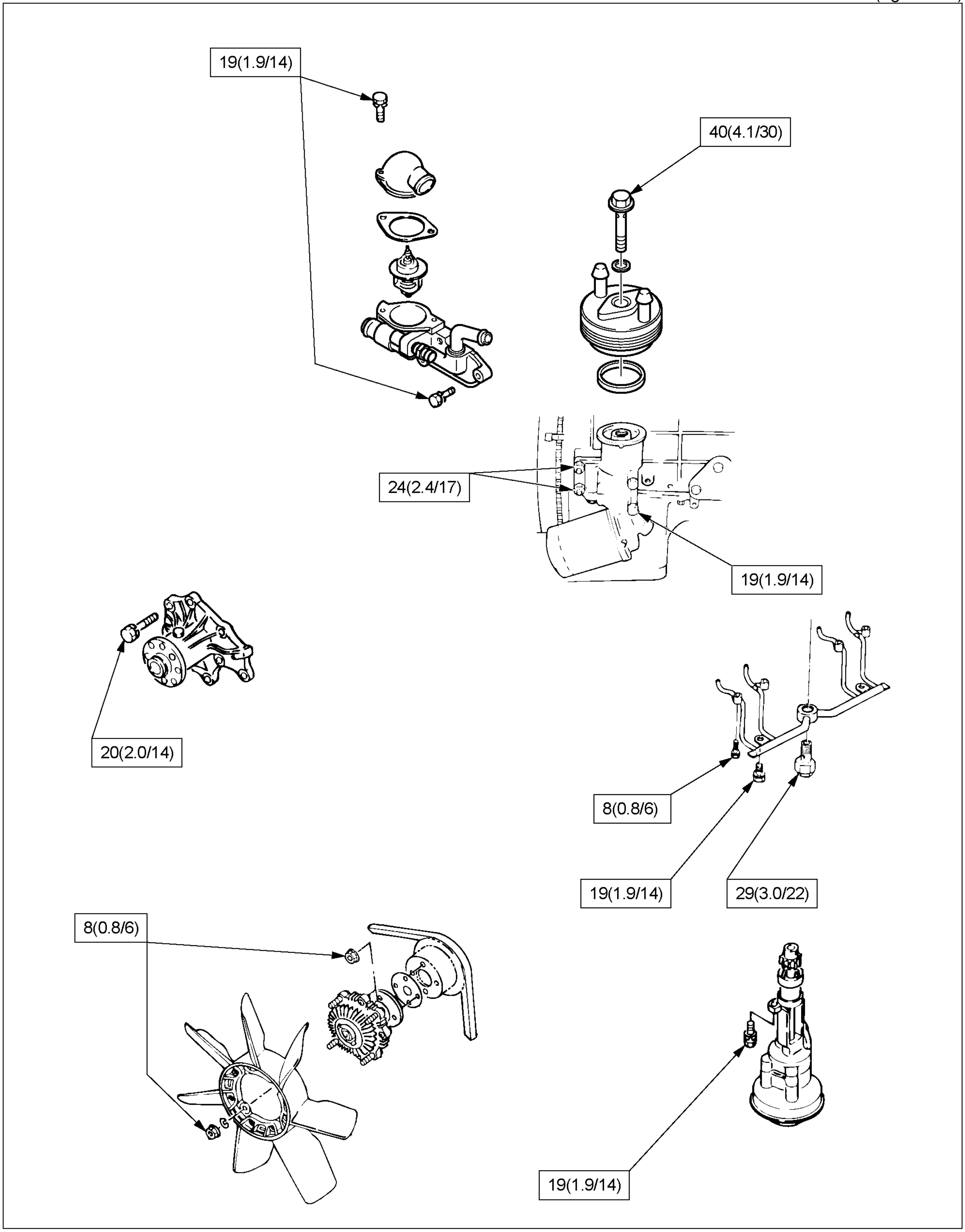
N·m (kg·m/lb·ft)



RTW46AXF000601

Cooling and Lubricating System

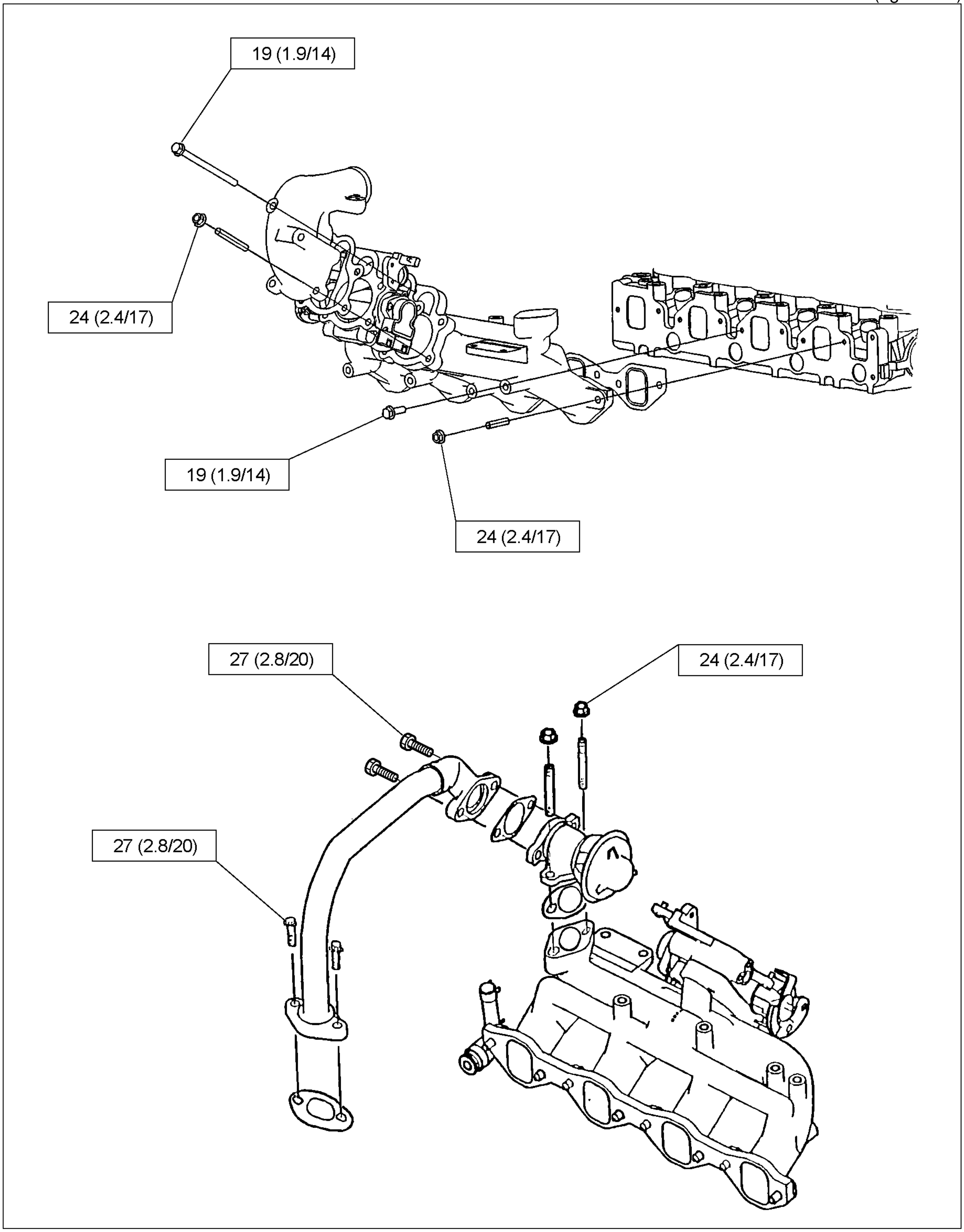
N·m (kg·m/lb·ft)



RTW46AXF000701

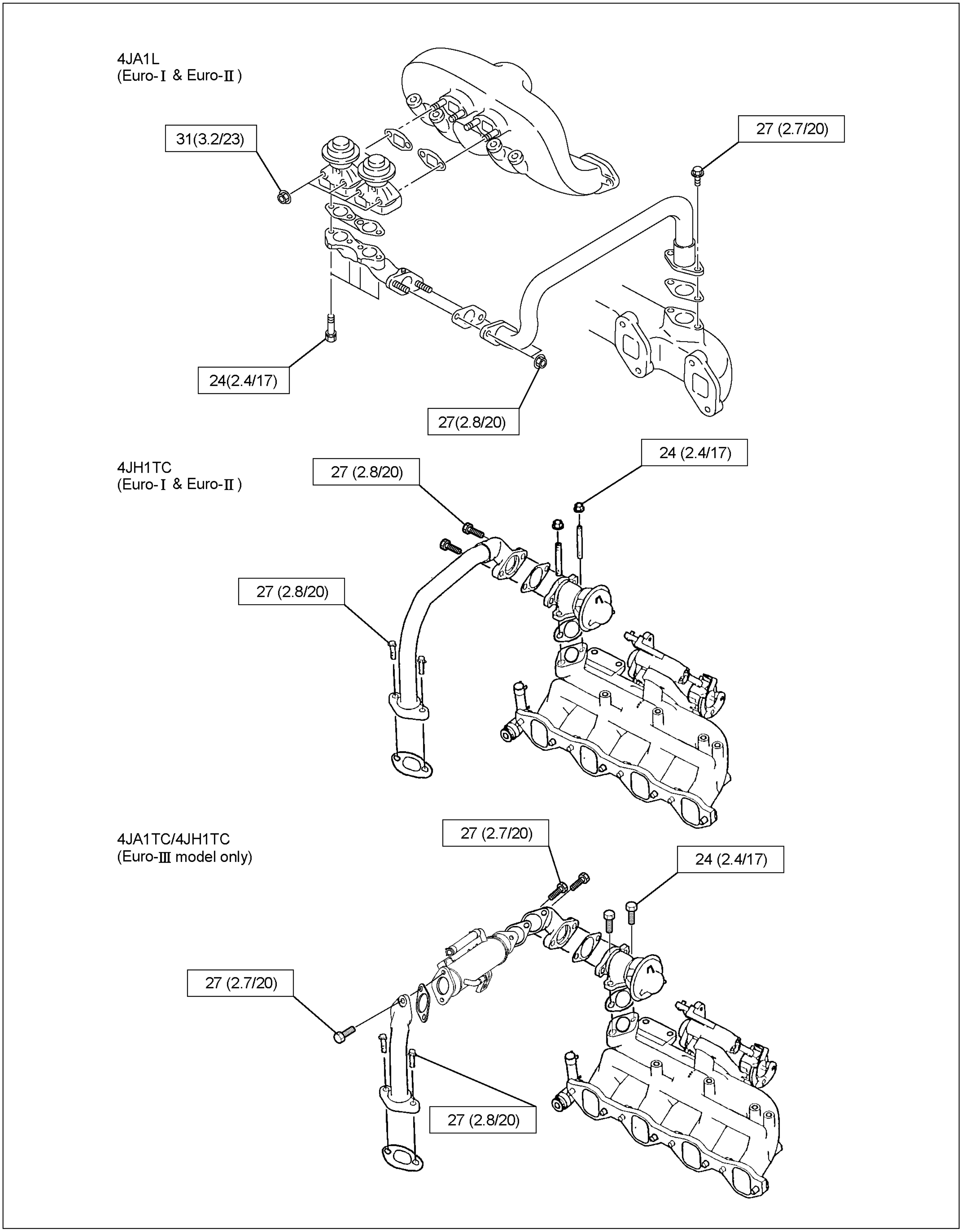
Intake Manifold (4JA1TC / 4JH1TC)

N·m (kg·m/lb·ft)



RTW36AXF000201

EGR Valve, EGR Pipe, EGR Cooler



RTW46AXF000801

Important Operations - Installation

4. Bolt; Compressor to Bracket

N·m (kgf·m/lb·ft)

Torque	44 (4.5/33)

3. Refrigerant Line

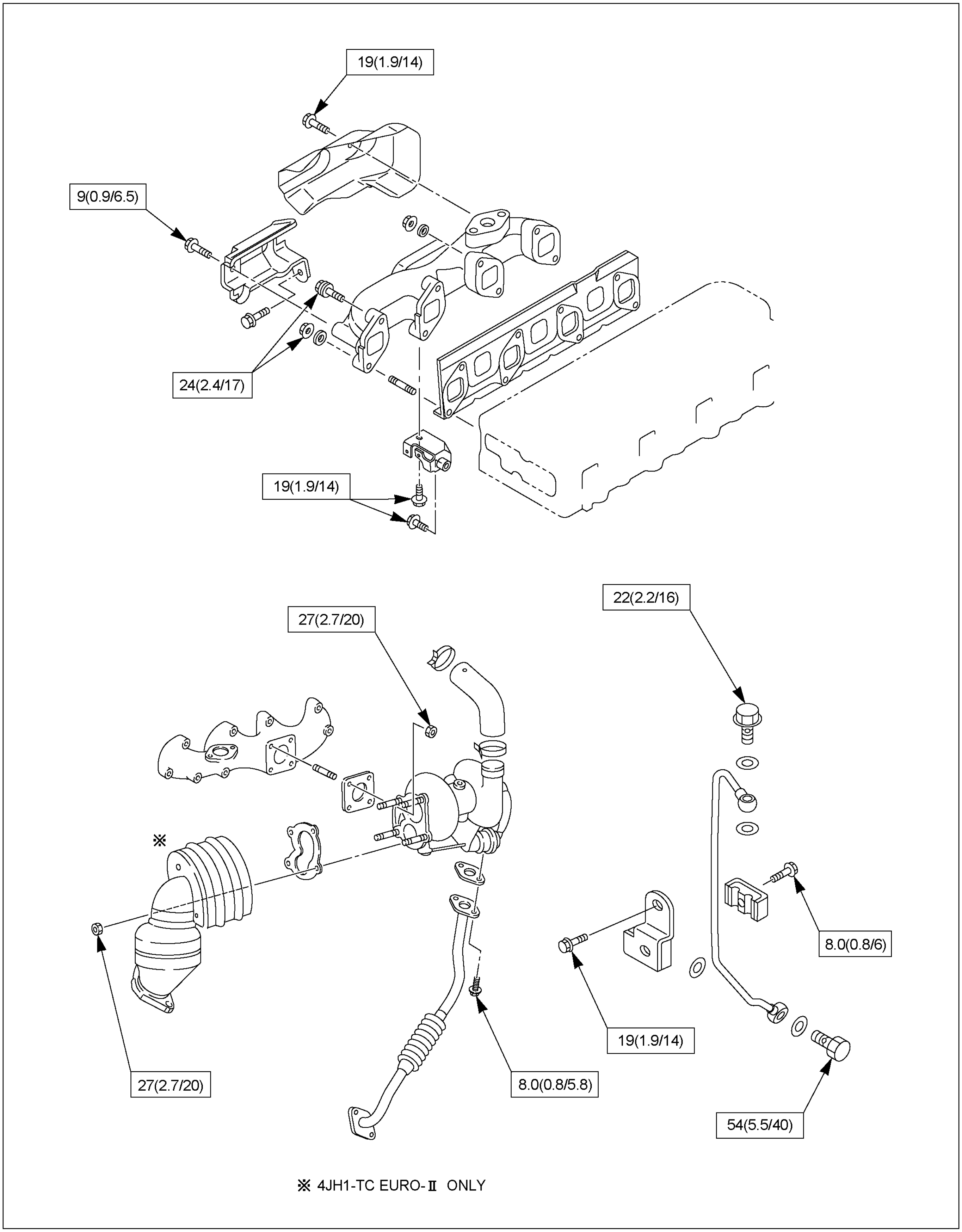
N·m (kgf·m/lb·in)

Torque	11~19 (1.1/95~1.9/168)

2. Drive Belt

Refer to SECTION 6A “INTAKE MANIFOLD”.

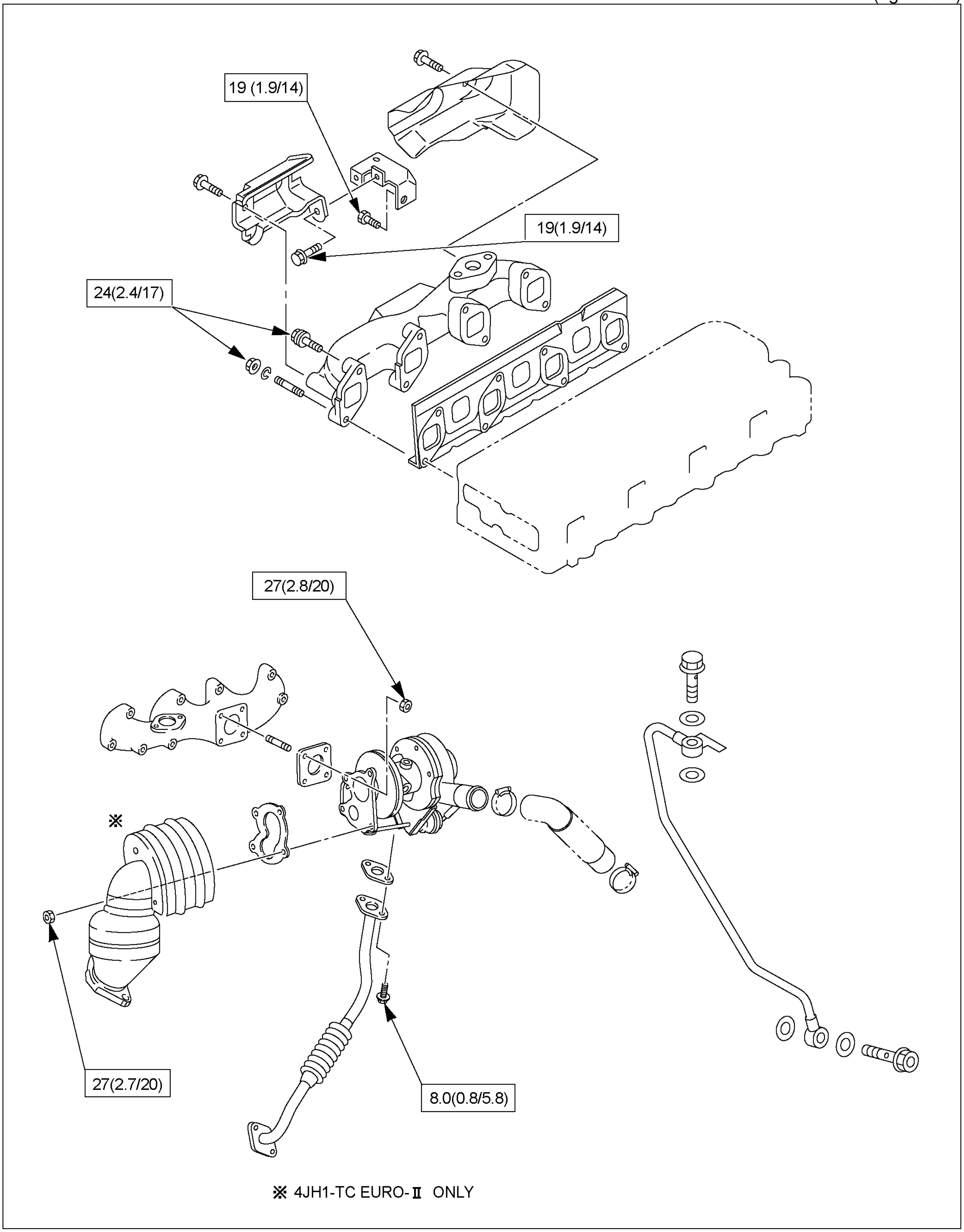
Exhaust Manifold, and Turbocharger (4JA1L)



RTW46AXF000901

Exhaust Manifold, and Turbocharger (4JA1TC/4JH1TC)

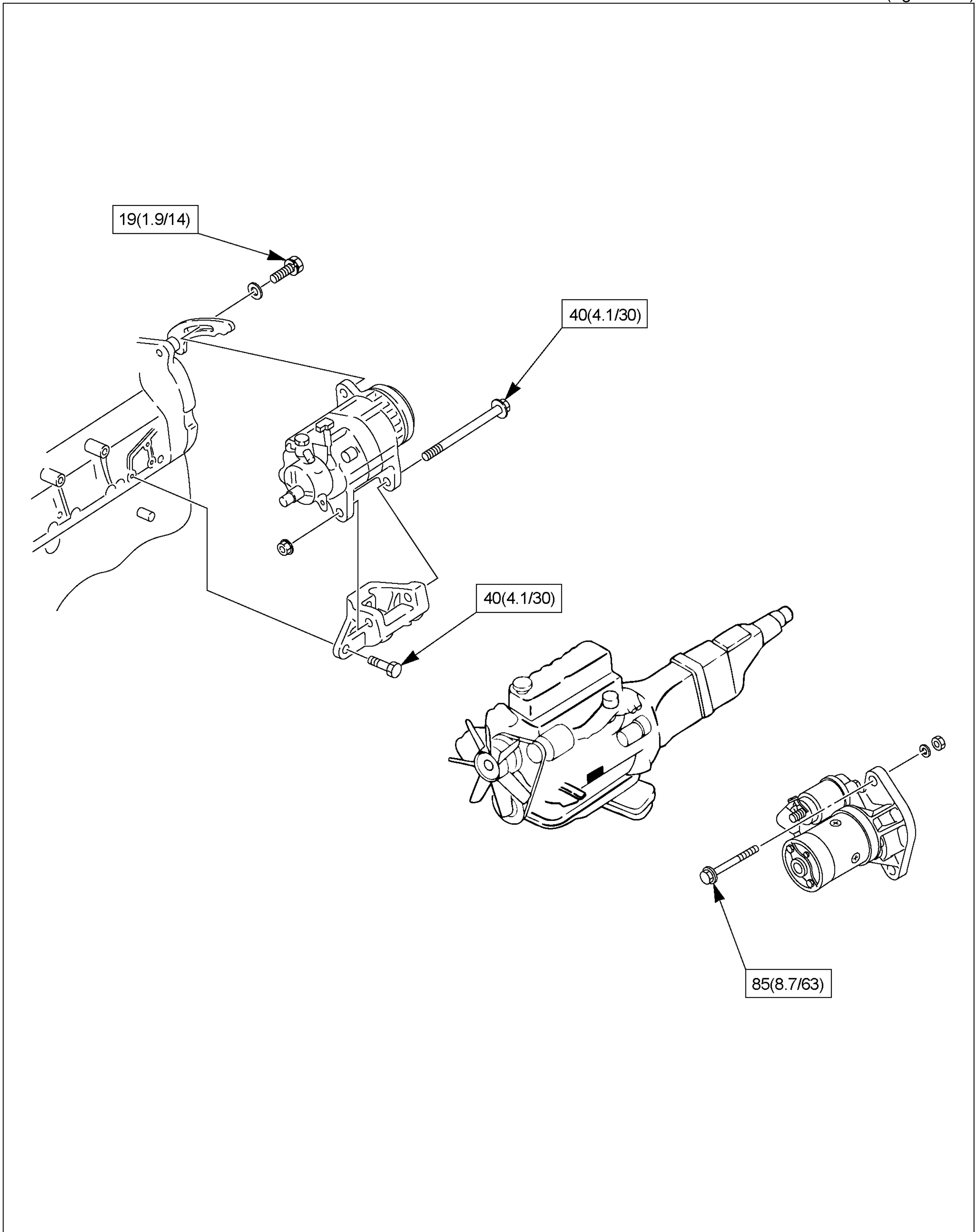
N·m (kg·m/lb·ft)



RTW46AXF001001

Engine Electricals

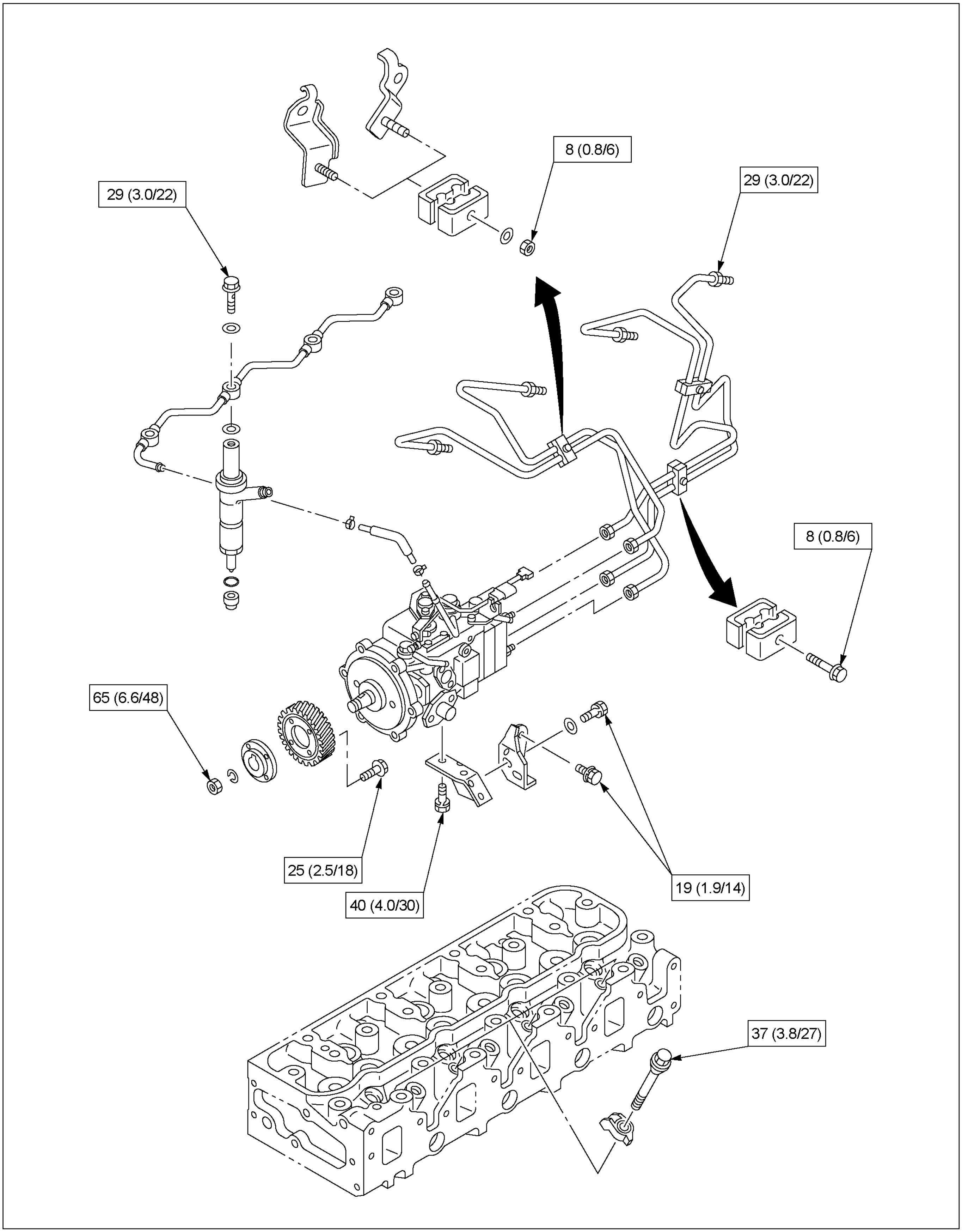
N·m (kg·m/lb·ft)



RTW36AXF000501

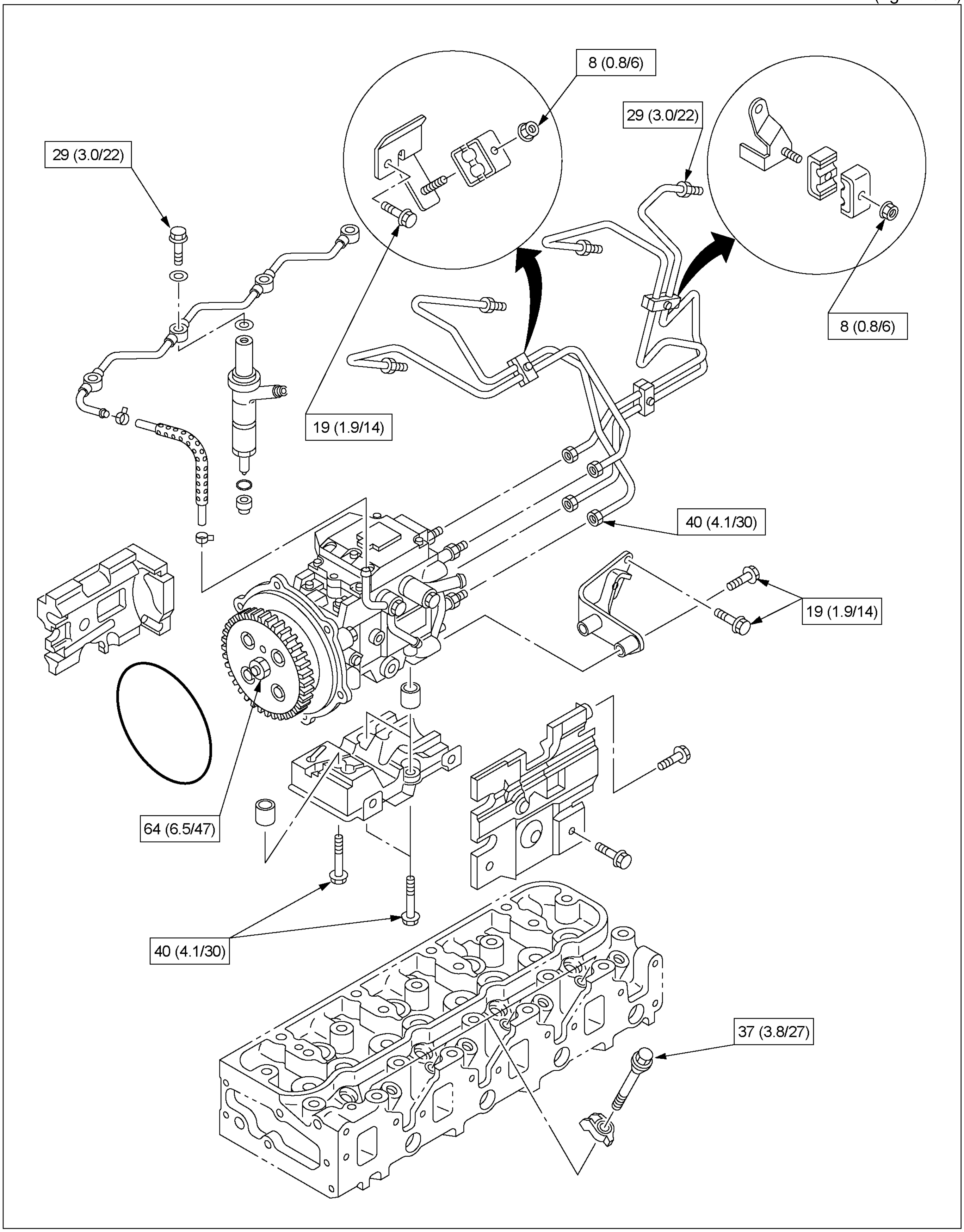
Fuel Injection System (4JA1L)

N·m (kg·m/lb·ft)



Fuel Injection System (4JA1TC)

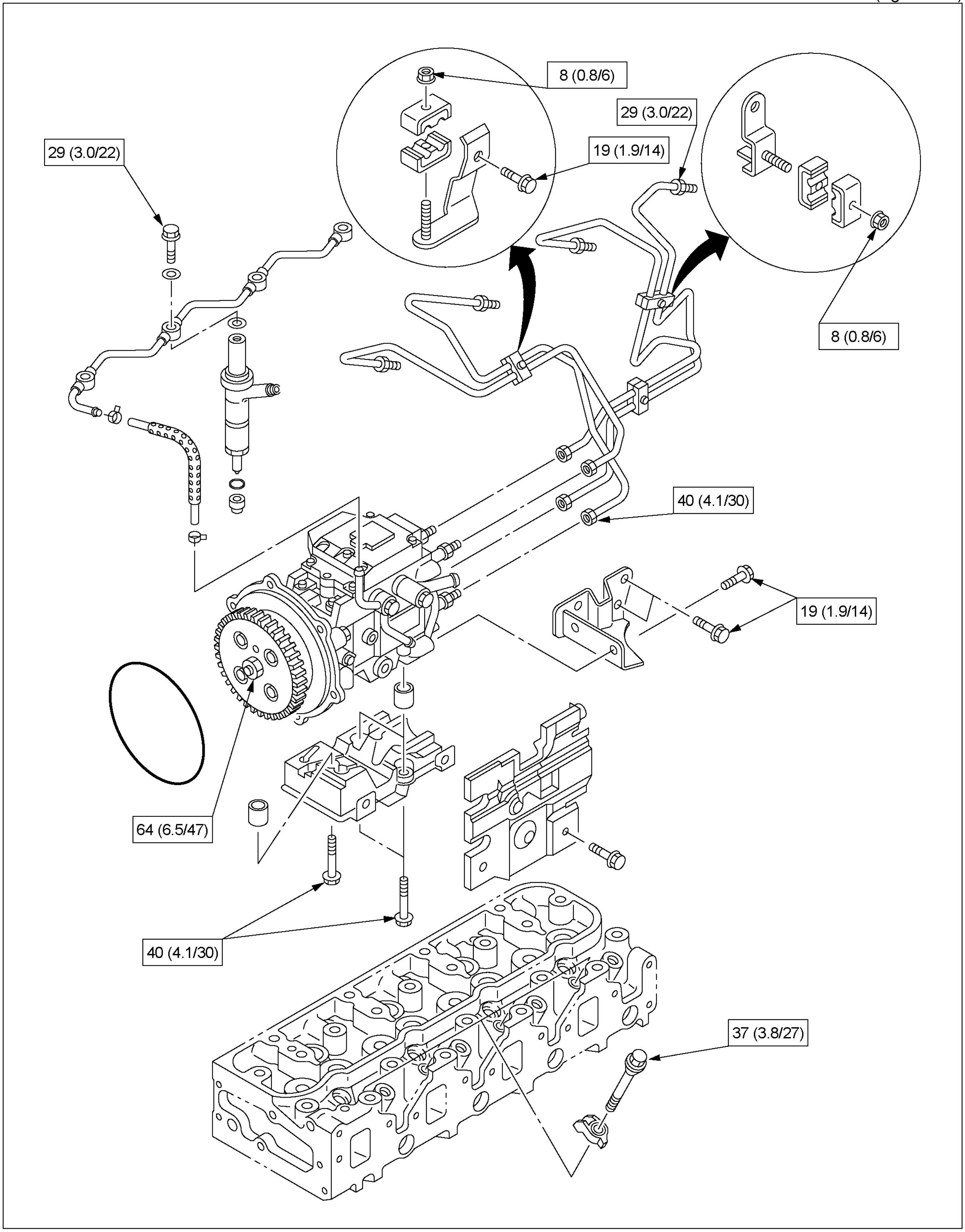
N·m (kg·m/lb·ft)



RTW46AXF001201

Fuel Injection System (4JH1TC)

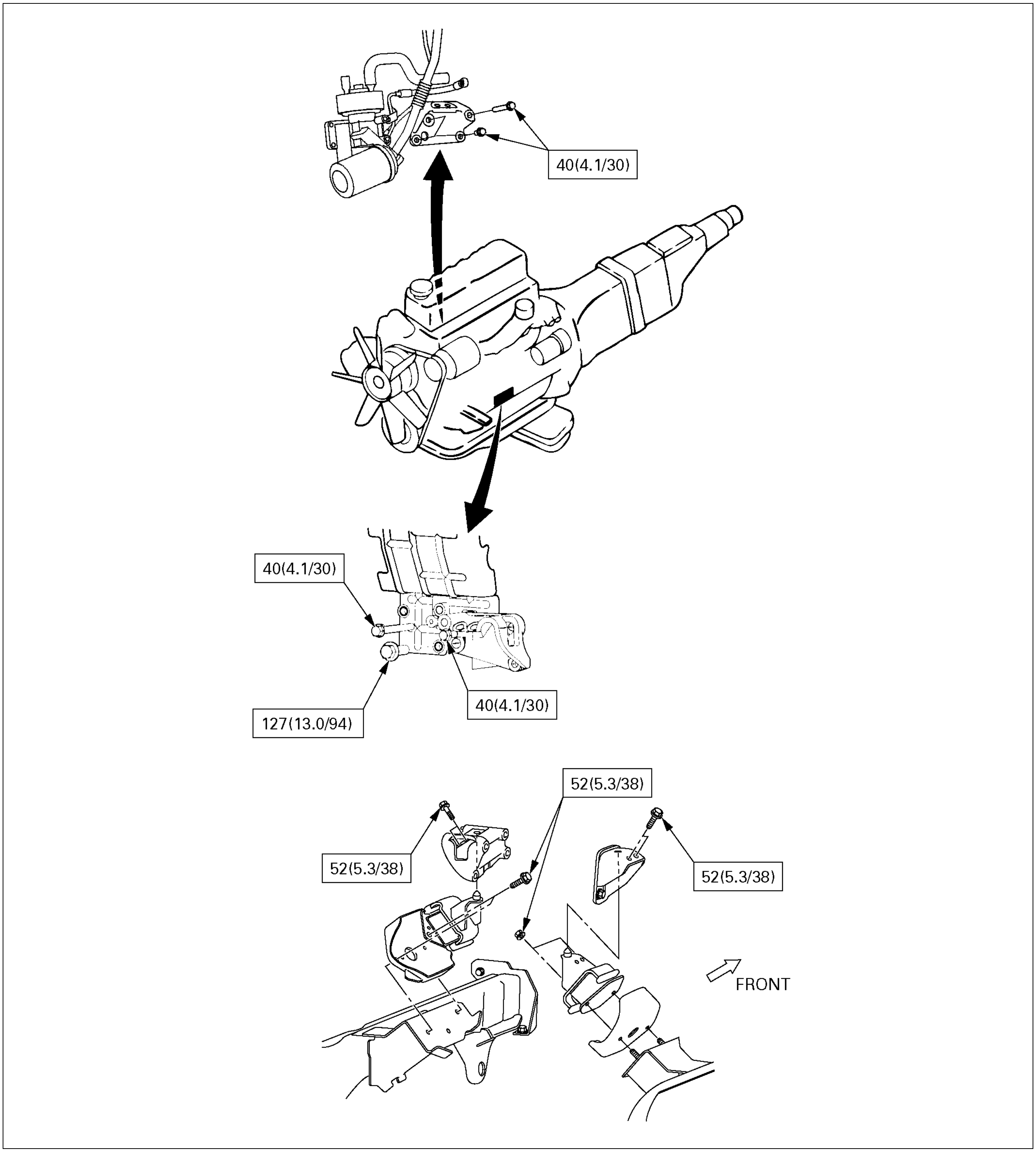
N·m (kg·m/lb·ft)



RTW46AXF001301

Engine Mounting Bracket

N·m (kg·m/lb·ft)



022R300001

RECOMMENDED LIQUID GASKET

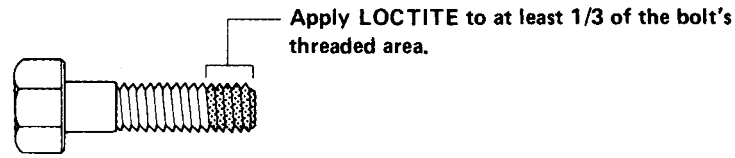
Type	Brand Name	Manufacturer	Remarks
RTV* Silicon Base	ThreeBond 1207B ThreeBond 1207C	Three Bond Three Bond	
Water Base	ThreeBond 1141E ThreeBond 1215	Three Bond Three Bond	
Solvent	ThreeBond 1104 Belco Bond 4 Belco Bond 401 Belco Bond 402	Three Bond Isuzu Isuzu Isuzu	
Anaerobic	LOCTITE 515 LOCTITE 518 LOCTITE 262	Loctite Loctite Loctite	Recommended for transaxle repairs

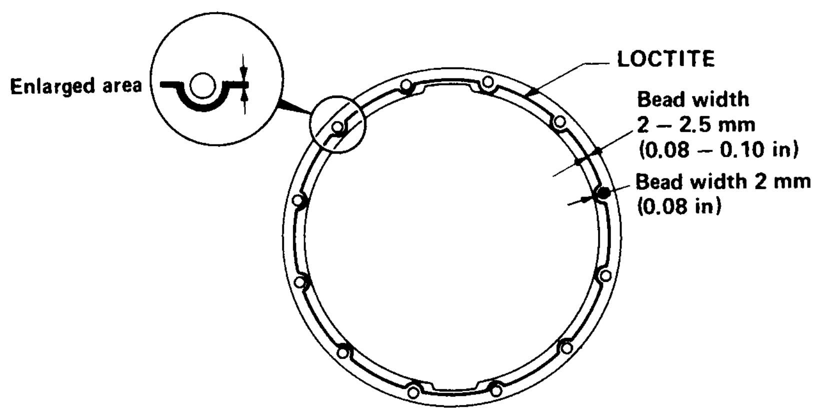
* RTV : Room Temperature Vulcanizer

Note:

1. **It is very important that the liquid gaskets listed above or their exact equivalent be used on the vehicle.**
2. **Be careful to use the specified amount of liquid gasket.**
   Follow the manufacturer's instructions at all times.
3. **Be absolutely sure to remove all lubricants and moisture from the connecting surfaces before applying the liquid gasket.**
   The connecting surfaces must be perfectly dry.
4. **LOCTITE 515 and LOCTITE 518 harden upon contact with a metal surface.**
   Do not apply LOCTITE 515 or LOCTITE 518 between two metal surfaces having a clearance of greater than 0.25 mm (0.01 in). Poor adhesion will result.

LOCTITE APPLICATION PROCEDURE

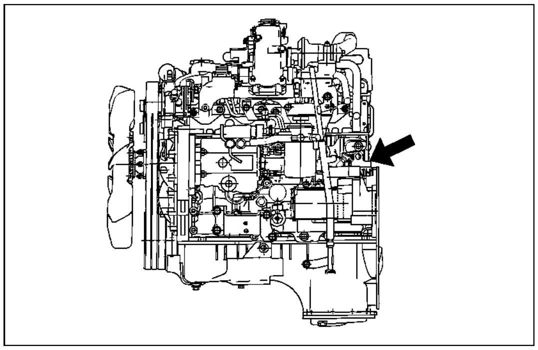
<table>
<tr><th>LOCTITE Type</th><th>LOCTITE Color</th><th>Application Steps</th></tr>
<tr><td>LOCTITE 242</td><td>Blue</td><td rowspan="4">1. Completely remove all lubricant and moisture from the bolts and the female threaded surfaces of the parts to be joined.
The surfaces must be perfectly dry.
2. Apply LOCTITE to the bolts.


3. Tighten the bolts to the specified torque.
4. Wait at least one hour before continuing the installation procedure.</td></tr>
<tr><td>LOCTITE 262</td><td>Red</td></tr>
<tr><td>LOCTITE 270</td><td>Green</td></tr>
<tr><td>LOCTITE 271</td><td>Red</td></tr>
<tr><td>LOCTITE 515</td><td>Violet</td><td>1. Completely remove lubricant and moisture from the connecting surfaces.
The surfaces must be perfectly dry.
2. Apply a 2.0 – 2.5 mm bead of LOCTITE to one of the connecting surfaces.
There must be no gaps in the bead.


3. Tighten the bolts to the specified torque.
4. Let the joined parts set for at least thirty minutes.</td></tr>
</table>

SERVICING

Servicing refers to general maintenance procedures to be performed by qualified service personnel.

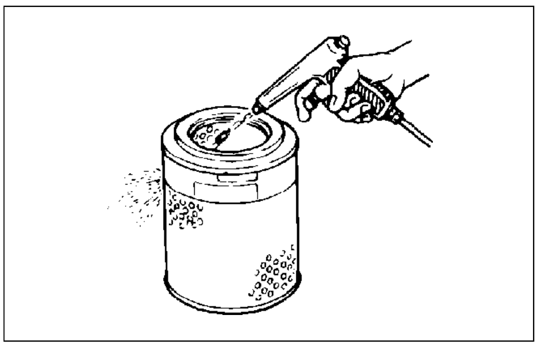

RTW36ASH000401

MODEL IDENTIFICATION

Engine Serial Number

The engine number is stamped on the rear left hand side of the cylinder body.

The engine number is stamped in the plate in front of the engine room as well.


130RY00003

AIR CLEANER

Element cleaning procedures will vary according to the condition of the element.

Dust Fouled Element (Except wet type element)

Rotate the element with your hand while applying compressed air to the inside of the element. This will blow the dust free.

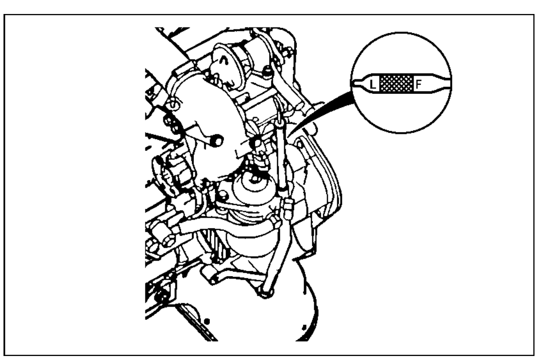
Compressed air pressure	kPa (kg/cm^2 /psi)
392 – 490 (4 – 5/57 – 71)	


6A-6

LUBRICATING SYSTEM

Main Oil Filter (Cartridge Type Paper Element) Replacement Procedure

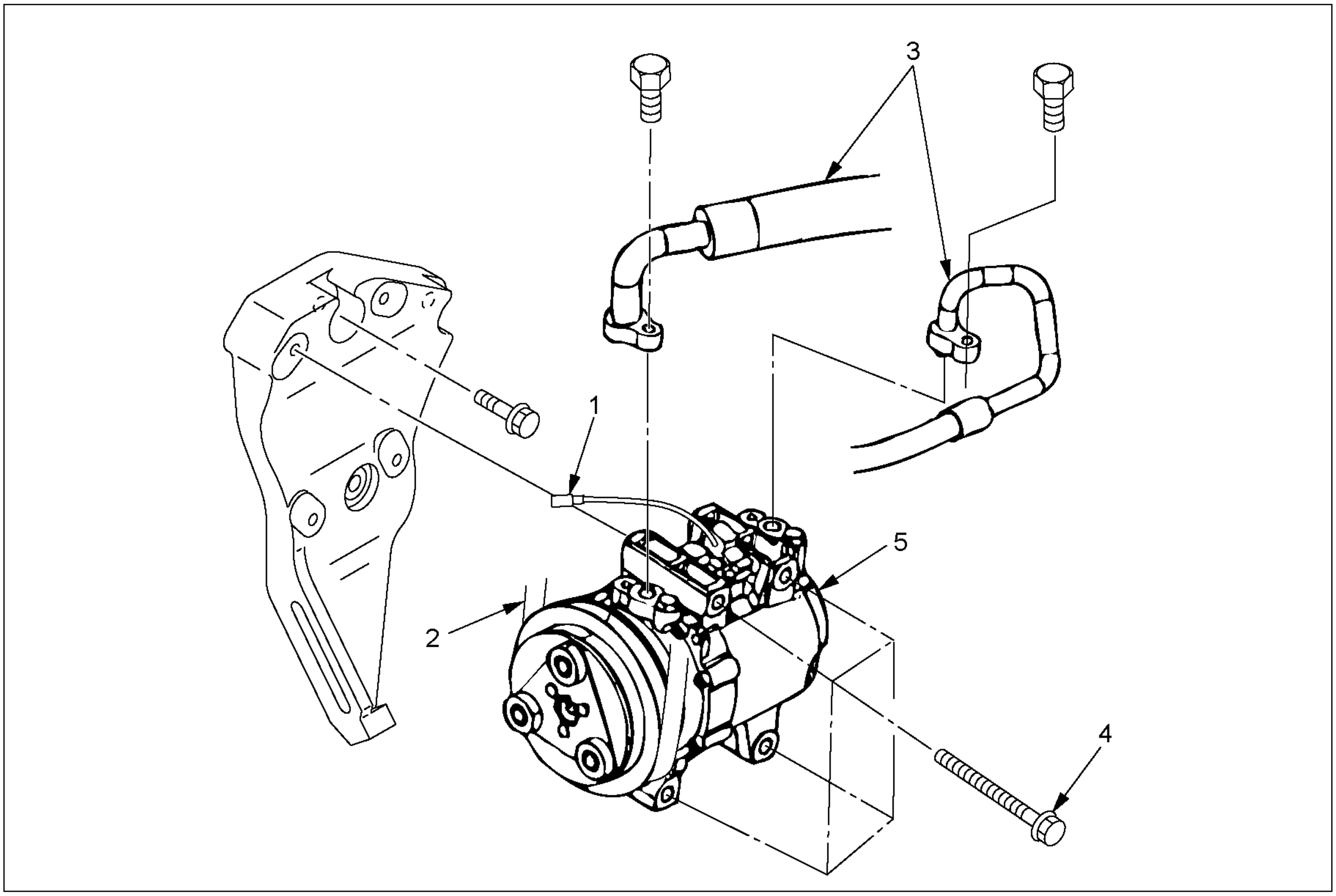
1. Drain the engine oil.
2. Retighten the drain plug.
3. Loosen the used oil filter by turning it counterclockwise with a filter wrench.
   Filter Wrench: 5-8840-0200-0



RTW36ASH000101

4. Clean the oil cooler fitting face. This will allow the new oil filter to seat properly.
5. Apply a light coat of engine oil to the filter O-ring.
6. Turn in the new oil filter until the filter O-ring is fitted against the sealing face.
7. Use the filter wrench to turn in the filter an additional 2/3 turns.
   Filter Wrench: 5-8840-0200-0
8. Check the engine oil level and replenish to the specified level if required.

REMOVAL AND INSTALLATION (C24SE)



RTW310MF000401

Removal Steps

1. Magnetic clutch harness connector
2. Drive belt
3. Refrigerant line
4. Bolt; compressor to bracket
5. Compressor assembly

Installation Steps

5. Compressor assembly
▲ 4. Bolt; compressor to bracket
▲ 3. Refrigerant line
▲ 2. Drive belt
1. Magnetic clutch harness connector

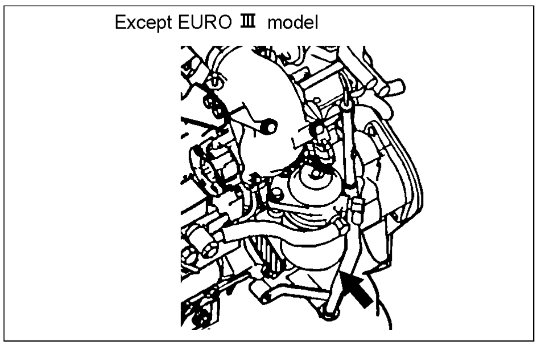
Replenished Engine Oil MAX lit (US/UK gal)

Condition / Model	Engine Dry	With oil filter replacement	Without oil filter replacement
4 × 2 4 × 4 (4JA1L/TC)	6.2 (1.64/1.36)	5.2 ~ 4.2 (1.37 ~ 1.11 / 1.14 ~ 0.92)	4.5 ~ 3.5 (1.19 ~ 0.93 / 0.99 ~ 0.77)
4 × 2 (4JH1TC)	6.2 (1.64/1.36)	5.2 ~ 4.2 (1.37 ~ 1.11 / 1.14 ~ 0.92)	4.5 ~ 3.5 (1.19 ~ 0.93 / 0.99 ~ 0.77)
4 × 4 (4JH1TC)	7.0 (1.85/1.54)	6.2 ~ 5.2 (1.64 ~ 1.37 / 1.36 ~ 1.14)	5.3 ~ 4.3 (1.72 ~ 1.14 / 1.17 ~ 0.95)

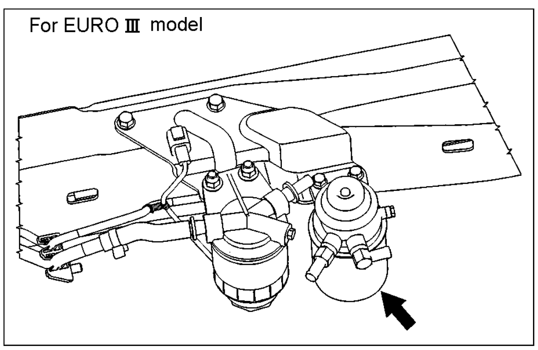
9. Start the engine and check for oil leakage from the main oil filter.

FUEL SYSTEM

Fuel Filter Replacement Procedure



RTW66ASH003201

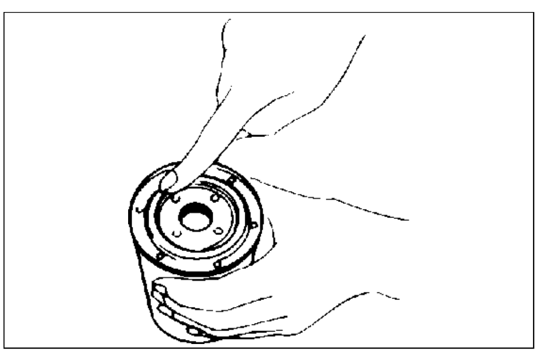


RTW66ASH003301

1. Remove the fuel filter by turning it counterclockwise with a filter wrench.
   Filter Wrench: 5-8840-0253-0 (J-22700)

Note:

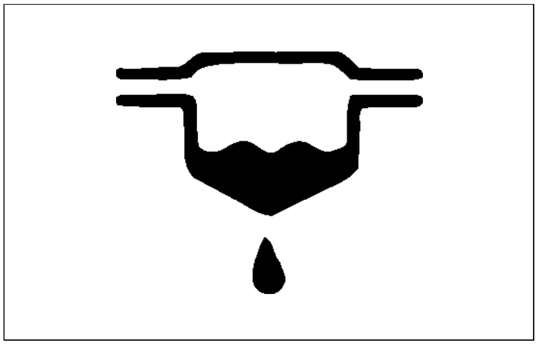
Be careful not to spill the fuel in the filter cartridge.


041RY00009

2. Clean the fuel filter cartridge fitting faces.
   This will allow the new fuel filter to seat properly
3. Apply a light coat of engine oil to the O-ring.
4. Turn in the fuel filter until the sealing face comes in contact with the O-ring.
5. Turn in the fuel filter an additional 2/3 of a turn with a filter wrench.
   Filter Wrench : 5-8840-0253-0 (J-22700)
6. Operate the priming pump until the air discharged completely from fuel system.
7. Start the engine and check for fuel leakage.

Note:

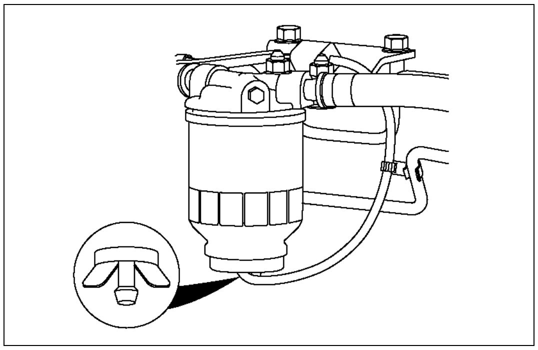
The use of an ISUZU genuine fuel filter is strongly recommended.


041RY00011

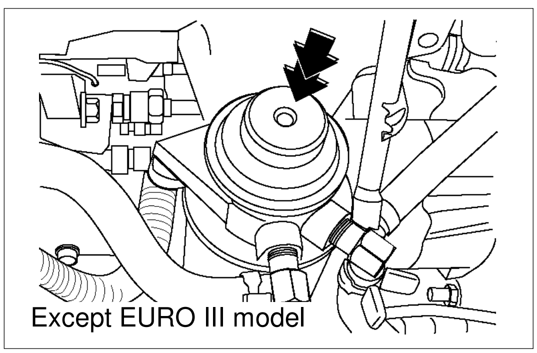
Draining Procedure

The indicator light will come on when the water level in the water separator exceeds the specified level.

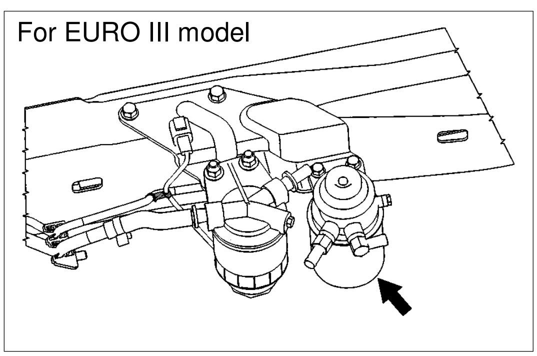
Drain the water and foreign material from the water separator (inside chassis frame) with the following procedure.



1. Place the drain pan under the drain plug.
2. Loosen the drain plug and drain water.
3. After draining the water, tighten the drain plug.
4. Operate the priming pump on the fuel filter several times and check for fuel leakage.
5. Check the water separator indicator light. It should be off.



RTW46ASH002901



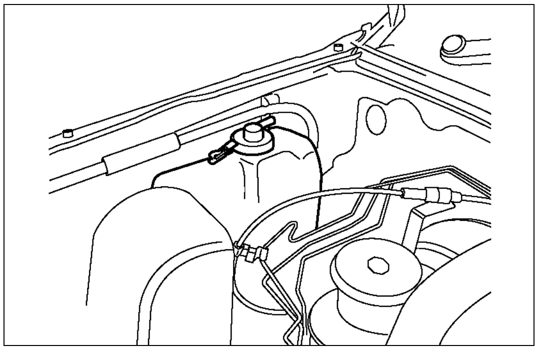
RTW46ASH000501

Air Bleeding

1. Operate the priming pump until strong resistance is felt.
2. Wait 1 minute, and operate the priming pump until strong resistance is felt.
3. Once more wait, and operate the priming pump until strong resistance is felt.
4. Turn the ignition switch to the "ON" position. Wait until the glow indicator lamp turns off.
5. Turn the ignition switch to the "START" position and crank the engine until it starts.
6. If the engine does not start, repeat Step 3 - 5.
7. Allow the engine to idle for 3 minutes to bleed air completely form the fuel system and check for fuel leakage.

Note:

Insufficient air bleeding may cause the Diagnostic Trouble Code (DTC) store or improper engine performance.


111R300001

COOLING SYSTEM

Coolant Level

Check the coolant level and replenish the radiator reserve tank as necessary.

If the coolant level falls below the "MIN" line, carefully check the cooling system for leakage. Then add enough coolant to bring the level up to the "MAX" line.

Engine coolant Filling up procedure

1. Make sure that the engine is cool.

Warning:

When the coolant is heated to a high temperature, be sure not to loosen or remove the rediator cap. Otherwise you might get scalded by hot vapor or boiling water.

To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

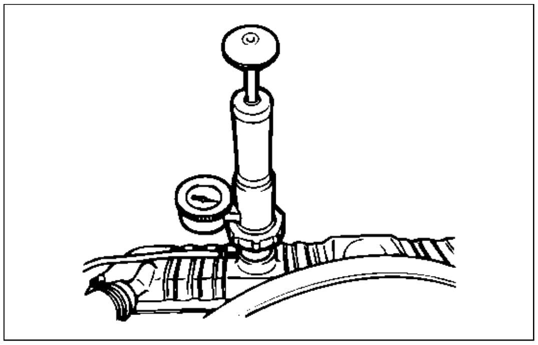
2. Open rediator cap pour coolant up to filler neck
3. Pour coolant into reservoir tank up to "MAX" line
4. Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.
5. After replenish the coolant tighten radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
6. Check to see the thermometer, continuously idling 5 minutes and stop the engine.
7. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hose for leakage.
8. Pour coolant into the reservoir tank up to "MAX" line.

Engine Coolant Total Capacity Lit (U.S / UK gal)

4JA1 / TC	9.4 (2.5 / 2.1)
4JH1TC	M/T: 10.1 (2.7 / 2.2) A/T: 10.0 (2.6 / 2.2)

Mixing Ratio (Anti-Freeze Solution/Water)

50 %

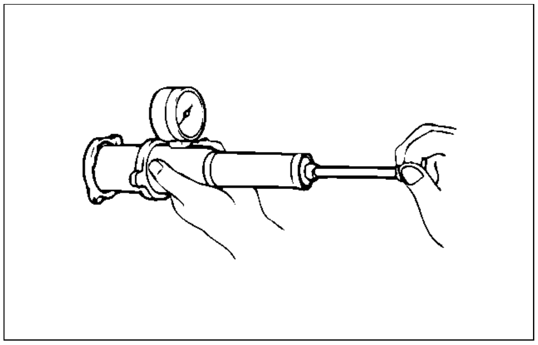


030LX003

Cooling System Inspection

Install a radiator filler cap tester to the radiator. Apply testing pressure to the cooling system to check for leakage. The testing pressure must not exceed the specified pressure.

Testing Pressure	kPa(kg/cm^2 /psi)
150 (1.5/21)	



030LX002

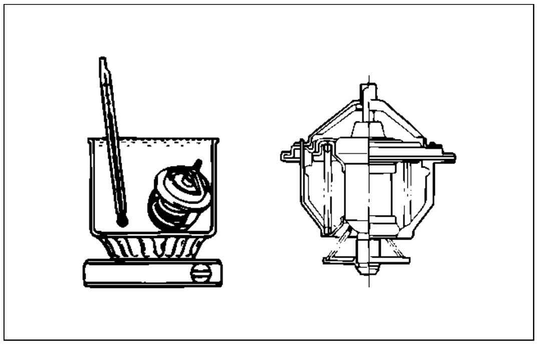
Radiator Cap Inspection

The radiator filler cap is designed to maintain coolant pressure in the cooling system at 103 kPa(1.05 kg/cm^2, 15psi).

Check the radiator filler cap with a radiator filler cap tester. The radiator filler cap must be replaced if it fails to hold the specified pressure during the test procedure.

Radiator Cap Valve Opening Pressure	kPa(kg/cm^2 /psi)
90 – 120 (0.9 – 1.2/13 – 17)	

Negative Valve (Reference)	kPa(kg/cm^2 /psi)
1.9 – 4.9 (0.02 – 0.05/0.28 – 0.71)	



030LX014

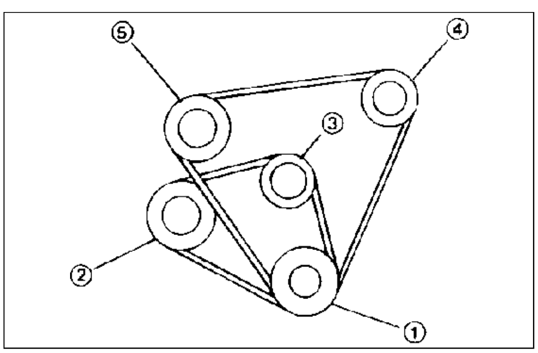
Thermostat Operating Test

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial Opening Temperature	°C (°F)
82 (180)	
Oil Cooler Thermo Valve	°C (°F)
76.5 (170)	
EGR Cooler Thermo Valve	°C (°F)
40 (104)	

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature	°C (°F)
95 (203)	
Oil Cooler Thermo Valve	°C (°F)
90 (194)	
EGR Cooler Thermo Valve	°C (°F)
55 (131)	
Valve Lift at Fully Open position	mm (in)
9.5 (0.37)	
Oil Cooler Thermo Valve	mm (in)
4.5 (0.18)	
EGR Cooler Thermo Valve	mm in)
3.5 (0.14)	

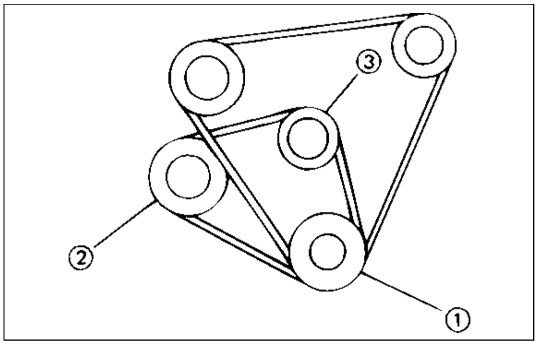


033RY00002

Drive Belt Adjustment

Check drive belts for wear or damage, and replace with new ones as necessary. Check belts for tension, and adjust as necessary.

1 Crankshaft damper pulley
2 Generator pulley
3 Cooling fan pulley
4 Oil pump pulley or idler pulley
5 Compressor pulley or idler pulley



033RY00003

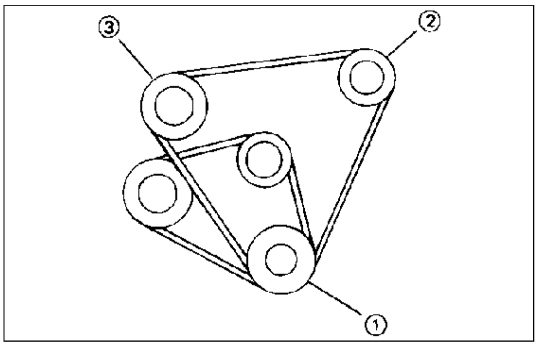
Cooling Fan Pulley Drive Belt

Fan belt tension is adjusted by moving the generator.

Depress the drive belt mid-portion with a 98N (10 kg/22 lb) force.

Cooling Fan Drive Belt Deflection	mm (in)
New belt	4 - 7 (0.16 - 0.28)
Reuse belt	6 - 9 (0.24 - 0.35)

1 Crankshaft damper pulley
2 Generator pulley
3 Cooling fan pulley



033RY00004

A/C Compressor Drive Belt

Compressor belt tension is adjusted by moving the P/S pumppulley.

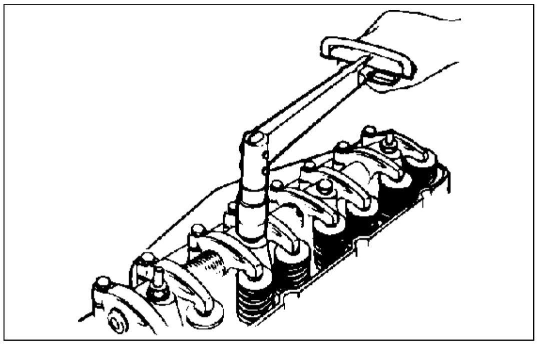
Depress the drive belt mid-portion with a 98N (10 kg/22 lb) force.

A/C Compressor Drive Belt Deflection	mm (in)
New belt	9 - 10 (0.35 - 0.39)
Reuse belt	12 - 13 (0.47 - 0.51)

1 Crankshaft damper pulley
2 P/S pump pulley
2 A/C Compressor pulley

VALVE CLEARANCE ADJUSTMENT

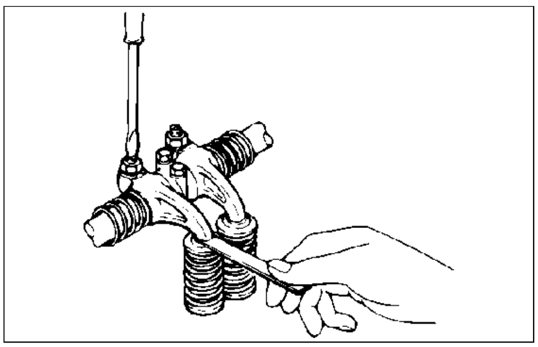
1. Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft damper pulley TDC line is aligned with the timing pointer.



014RY00014

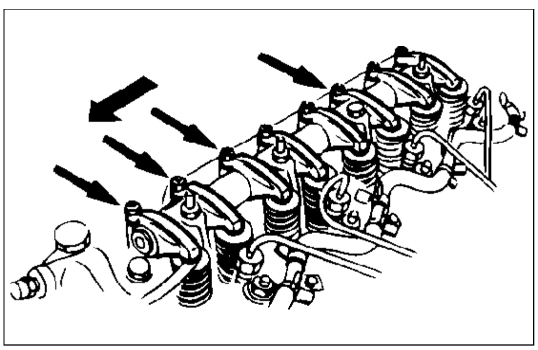
2. Check the rocker arm shaft bracket nuts for looseness.
   Tighten any loose rocker arm shaft bracket nuts before adjusting the valve clearance.

Rocker Arm Shaft Bracket Nut Torque	N·m (kg·m /lb·ft)
54 (5.5/40)	



014RY00015

8. Check for play in the No. 1 intake and exhaust valve push rods.
   If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.
   If the No. 1 cylinder intake and exhaust valve push rods are depressed, the No. 4 piston is at TDC on the compression stroke.

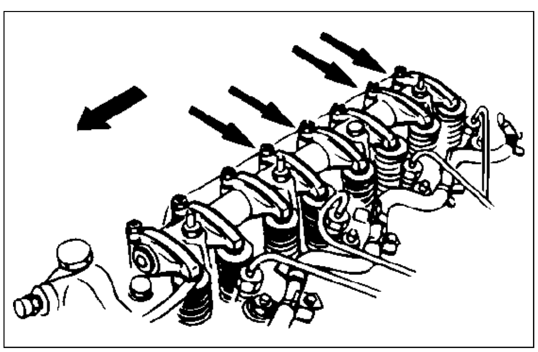


014RY00016

Adjust the No.1 or the No. 4 cylinder valve clearances while their respective cylinders are at TDC on the compression stroke.

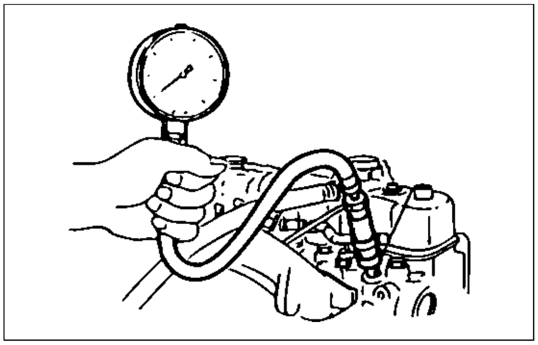
Valve Clearance (At Cold)	mm (in)
0.4 (0.016)	

9. Loosen each valve clearance adjusting screw as shown in the illustration.
10. Insert a feeler gauge of the appropriate thickness between the rocker arm and the valve stem end.



014RY00017

11. Turn the valve clearance adjusting screw until a slight drag can be felt on the feeler gauge.
12. Tighten the lock nut securely.
13. Rotate the crankshaft 360°.
14. Realign the crankshaft damper pulley TDC notched line with the timing pointer.
15. Adjust the clearances for the remaining valves as shown in the illustration.



F06XL056

COMPRESSION PRESSURE MEASUREMENT

1. Start the engine and allow it to idle until the coolant temperature reaches 70 – 80 °C (158 – 176 °F).
2. Remove the following parts.
   - Leak off pipe
   - Injection nozzle holder bracket
   - Injection nozzle holder
3. Install the following parts.
   - Set the adapter and compression gauge (SST) to the No.1 cylinder injection nozzle hole.
   - Injection nozzle holder bracket

Injection nozzle holder bracket Bolt Torque

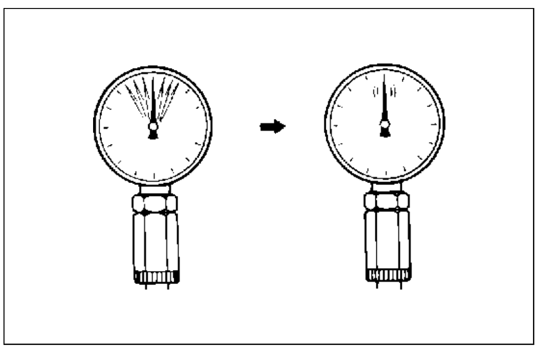
N·m (kg·m /lb·ft)

37 (3.8/27)

Compression Gauge: 5-8840-2675-0

Adapter; Compression Gauge: 5-8531-7001-0

4. Turn the engine over with the starter motor and take the compression gauge reading.



901R100003

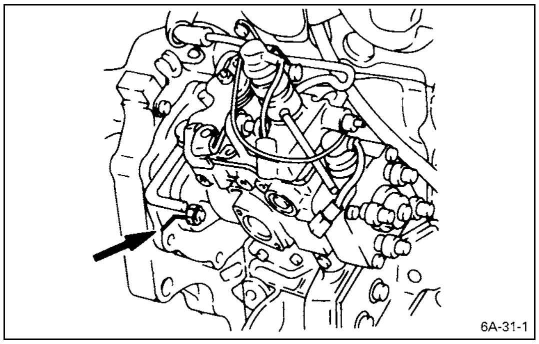
Compression Pressure MPa (kg/cm^2 /psi) at 200 rpm

Standard	Limit
3.0 (31.0/441)	2.1 (21.7/309)

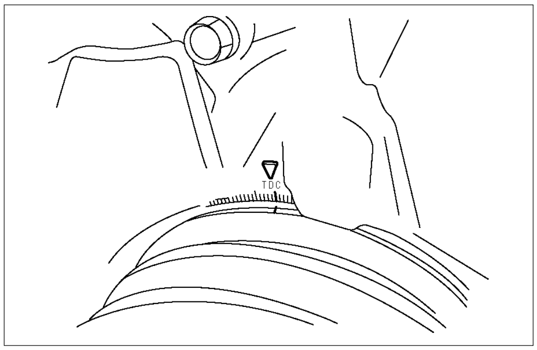
5. Repeat the procedure (Steps 3 and 4) for the remaining cylinders.

   If the measured value is less than the specified limit, refer to “Troubleshooting” in this Manual.

INJECTION TIMING ADJUSTMENT (4JA1T(L) only)


6A-31-1

1. Check that the notched line on the injection pump flange is aligned with the front plate or the timing gear case notched line.



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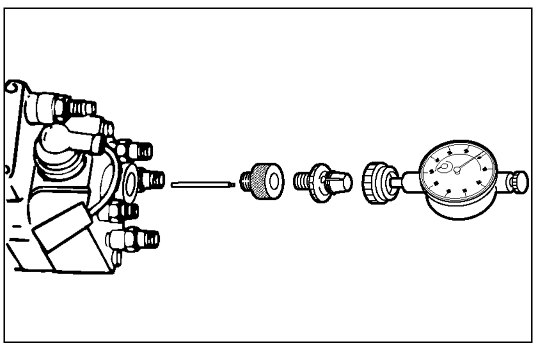
2. Bring the piston in the No. 1 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line is aligned with the timing mark.

Note:

Check for play in the No. 1 intake and exhaust valve push rods.
If the No. 1 cylinder intake and exhaust valve push rods have play, the No. 1 piston is at TDC on the compression stroke.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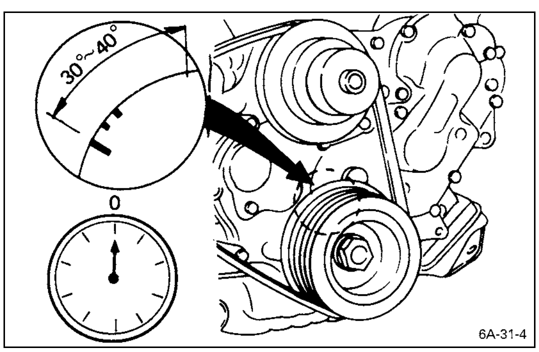
3. Disconnect the injection pipe from the injection pump
4. Remove one bolt from the distributor head.
5. Install the adapter set, togather with static timing gauge.

   The probe of the gauge should be depressed inward approximately 2 mm (0.079 in).

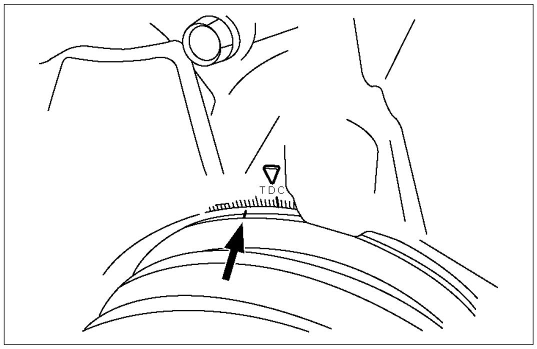
   Static Timing Gauge: 5-8840-0145-0 (J-28827)

   Adapter Set: Static Timing Gauge: 5-8840-2834-0



6A-31-4

6. Rotate the crankshaft to bring the piston in the No. 1 cylinder to a point 30 - 40° BTDC.
7. Set the timing gauge needle to zero.
8. Move the crankshaft pulley slightly in both directions to check that the gauge indication is stable.



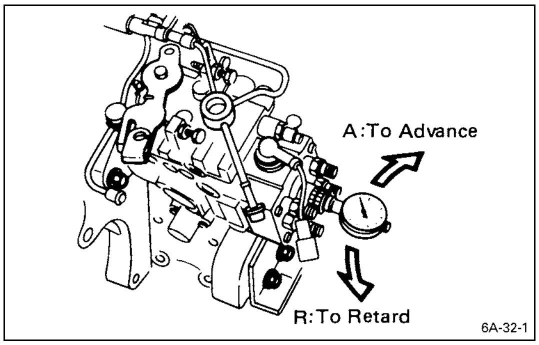
RTW46ASH000701

9. Turn the crankshaft clockwise and read the gauge indication when the crankshaft pulley timing mark (8°) is aligned with the pointer.

Injection Timing : BTDC 8° ± 2°

Standard Reading	mm (in)
0.5 (0.02)	

If the injection timing is outside the specified range, continue with the following steps.



6A-32-1

10. Loosen the injection pump fixing nuts and bracket bolts.
11. Adjust the injection pump setting angle.

When large than standard value	When smaller than standard value
R	A

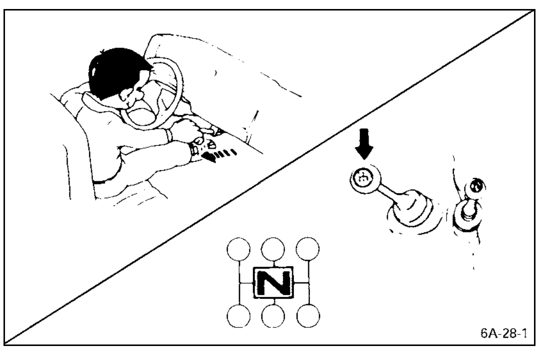
A: Move the injection pump toward the engine.
R: Move the injection pump away from the engine.

12. Install the distributor head bolt.

Distributor head bolt torque	N·m (kg·m /lb·ft)
29 (3.0/22)	

ENGINE CONTROL (4JA1T(L) only)

Idling Speed Adjustment



6A-28-1

1. Set the vehicle parking brake and chock the drive wheels.
2. Place the transmission in neutral.
3. Start the engine and allow it to idle until the coolant temperature reaches 70 - 80°C (158 - 176°F).
4. Disconnect the engine control cable from the control lever.
5. Set a tachometer to the engine.
6. Check the engine idling speed.
   If the engine idling speed is outside the specified range, it must be adjusted.

Engine Idling Speed : 730 ± 25 rpm

Important Operations - Installation

4. Bolt; Compressor to Bracket

N·m (kgf·m/lb·ft)

Torque	44 (4.5/33)

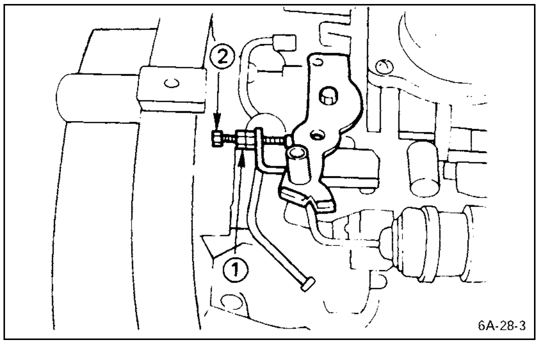
3. Refrigerant Line

N·m (kgf·m/lb·in)

Torque	11~19 (1.1/95~1.9/168)

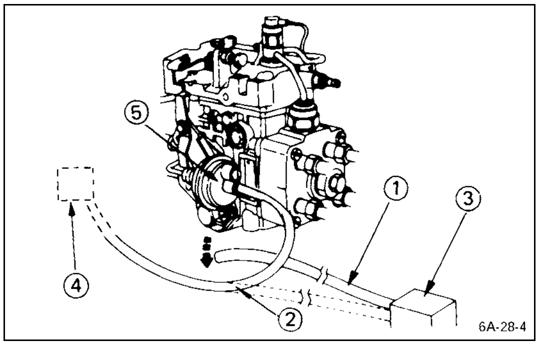
2. Drive Belt

Refer to SECTION 6A "V-BELT TENSION OF ALTERNATER".



Idling Speed Adjustment

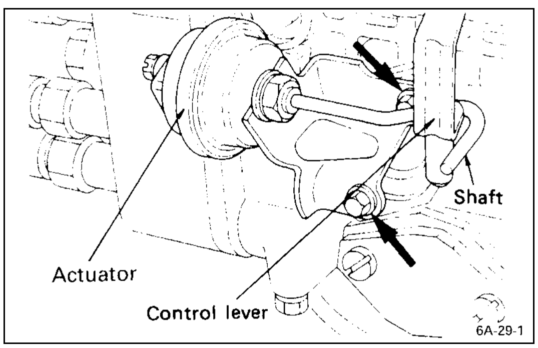
1. Loosen the idling set screw lock nut ① on the injection pump idling set bolt.
2. Adjust the idling speed to the specified range by turning the idling set bolt ②.
3. Lock the engine set nut ① with the idling set bolt lock nut.
4. Check that the idling control cable is tight (free of slack). If required, remove the slack from the cable.



Fast Idling Speed Inspection

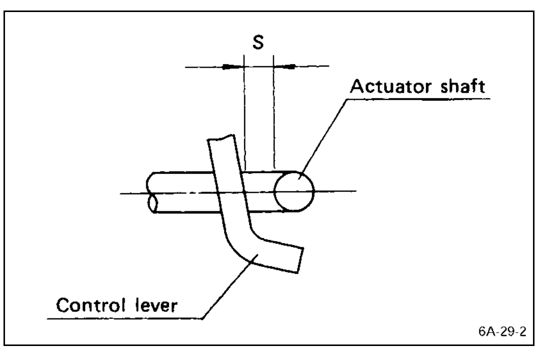
1. Set tachometer to the engine.
2. Disconnect the vacuum hose ① from the fast idle actuator ⑤ on the injection pump.
3. Disconnect the other vacuum hose ② from the vacuum switching valve ③ and connect it to the fast idle actuator ⑤.
   The vacuum line will now be connected directly from the vacuum pump ④ to the fast idle actuator.
4. Check the engine fast idling speed.
   If the engine idling speed is outside the specified range, it must be adjusted.

Fast Idling Speed	rpm
850 ± 25	



Fast Idling Speed Adjustment

1. Loosen the fast idle actuator bracket bolts.

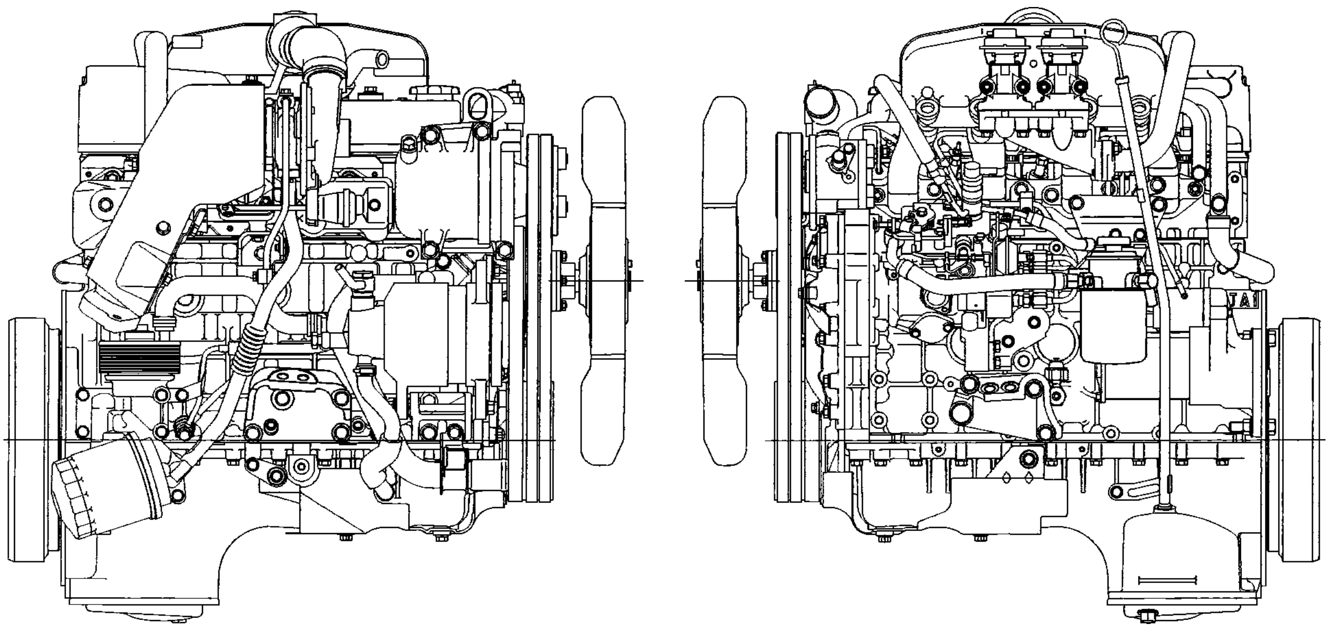


2. Adjust the fast idling speed by moving the actuator bracket, so that the clearance “S” can be 1 ~ 2 mm (0.04 ~ 0.08 in.).
3. Tighten the bracket bolts.

Accelerator Control Cable Adjustment

Refer to Sec. 6H-6 (Accelerator Control)

GENERAL DESCRIPTION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The 4J series automotive diesel engine has special designed combustion chambers in the piston. This design provides superior fuel economy over a wide range of driving conditions.
Auto-thermatic pistons with cast steel struts are used to reduce thermal expansion and resulting engine noise when the engine is cold.
Chrome plated dry type cylinder liners provide the highest durability.
The laminated steel sheet cylinder head gasket is very durable and, to increase the head gasket reliability.
The crankshaft has been tufftrided to provide a longer service life. Because the crankshaft is tufftrided, it cannot be reground.
The 4JA1T(L) engine is equipped with the BOSCH VE-Type distributor injection pump.
The 4JH1TC and 4JA1TC engine is equipped with the BOSCH VP44-Type distributor injection pump.
The engine is turbocharger equipped.

REMOVAL AND INSTALLATION

Read this section carefully before performing any removal and installation procedure. This section gives you important points as well as the order of operation. Be sure that you understand everything in this section before you begin.

Removal

P1010011

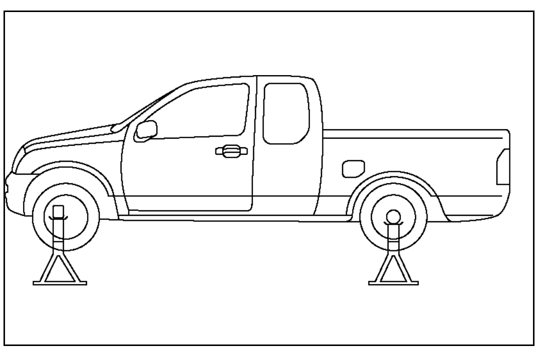
1. Battery

1) Disconnect the battery cable and the grounding cable from the battery terminals.
2) Remove the battery clamp. Take care not to accidentally short the battery with the wrench or some other tool.
3) Remove the battery.
4) Disconnect the battery cable at the starter motor and the ground cable at the cylinder body.

P1010002

2. Engine Hood

Apply setting marks to the engine hood and the engine hood hinges before removing the engine hood. This will facilitate reinstallation of the engine hood to its original position.



F06R300006

3. Supporting the Vehicle

1) Jack up the vehicle.
2) Place chassis stands at the front and the rear of the vehicle.

4. Under cover (for 4x4 model)

5. Rear propeller shaft

1) Remove the propeller shaft flange yoke at the rear differential.
2) Remove the center bearing retainer bolts.
3) Remove the propeller shaft together with the center bearing from the transmission mainshaft spline.

6. Front propeller shaft (for 4x4 model)

Remove the spline yoke flange bolt at the transfer output shaft.

Do not allow the spline yoke to fall away from the front propeller shaft.

If the spline yoke should fall away from the front propeller shaft, align the setting marks on the spline yoke and the propeller shaft to reassemble the two marks. The setting marks are punched circles approx. 3mm (0.12 in) in diameter.

7. Clutch slave cylinder (for M/T model)

8. ATF pipe (for A/T model)

9 Shift control cable (for A/T model)

10. Transmission sensor harness

Remove the vehicle speed sensor connector, inhibitor switch connector (A/T), ATF temperature sensor connector, back up light switch connector (M/T) from transmission.

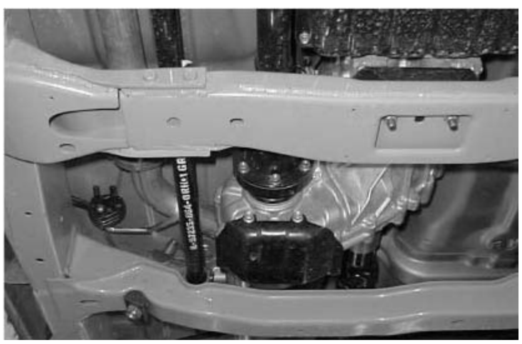
11. Breather hose (for A/T model)

12. Transmission shift lever (for M/T model)

Remove the shift lever from the floor.

13. Transfer shift lever (for 4x4 model)

Remove the shift lever from the floor.



P1010025

14. Transmission member

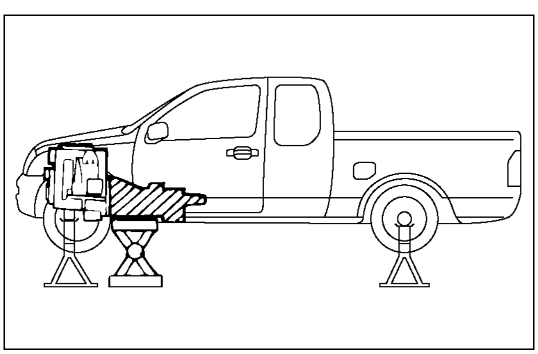
1) Support the transmission with the transmission jack.
2) Remove the transmission member mounting bolts fixing the transmission member to the chassis frame.

15. Torque converter bolt (for A/T model)

1) Remove the under cover under the torque converter housing.
2) Rotate the flywheel by using tire lever or some other tool, and then remove the torque converter bolts.

16. Transmission coupling bolt

1) Support the engine with the garage jack.
2) Use the jack to slightly lower the transmission.
3) Remove the transmission coupling bolts.



F06R300007

17. Transmission (and transfer)

Separate the transmission (and transfer) from the engine.Take care not to damage the transmission, the engine, and their related parts..


P1010009

18. Radiator

1) Drain the engine coolant.
2) Remove the reservoir hose.
3) Remove the upper and lower hose.
4) Remove the fan guide.
5) Remove the radiator.


P1010034

19. Fan

20. Air cleaner

1) Remove the MAF sensor connector (4JA1TC/4JH1TC) from air cleaner duct.
2) Remove the air cleaner duct and the air cleaner box from engine room.
3) Remove the two air ducts from inter cooler (4JA1TC/4JH1TC).

21. Power Steering Pump

Loosen the power steering pump adjust plate bolt, then remove the power steering pump assembly. Place the power steering pump assembly along with piping on the body side.

22. Air conditioner compressor

1) Remove air compressor magnet connector.
2) Remove the air conditioner compressor. Place the air conditioner compressor along with piping on the body side.

23. Engine Control Cable

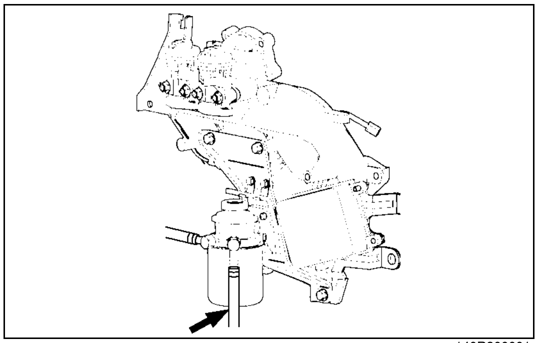
Remove the engine control cable from its bracket (4JA1TC/4JH1TC) or the injection pump (4JA1T(L)).

24. Vacuum Piping

Remove the vacuum pipe from the vacuum pump, the EGR valve, injection pump FICD (4JA1T(L)).

25. Engine Harness

1) Remove following connectors from engine.
   - TPS connector
   - Oil pressure switch connector
   - Thermo switch connector
   - Injection pump connector
   - Engine earth
   - Thermometer unit connector
   - TDC sensor
2) Remove the clips fixing engine harness.



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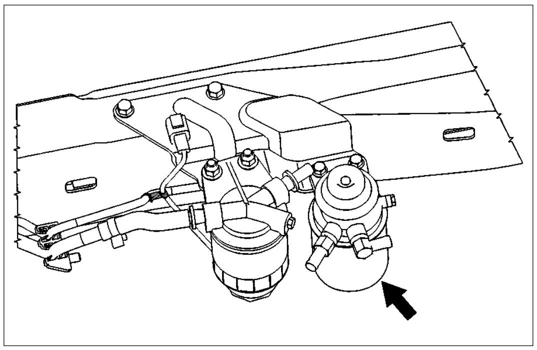
26. Fuel Hose

Remove the fuel hose from the fuel filter (Except EURO III).



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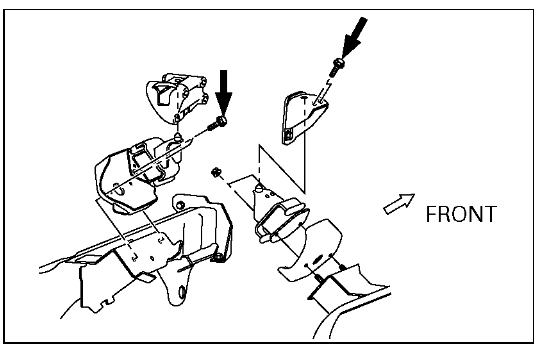
Remove the fuel hose from injection pump (EURO III only).

27. Exhaust Pipe

Remove the front exhaust pipe bolts and separate the exhaust manifold and the front exhaust pipe.

28. Engine Assembly

1) Remove two right side engine foot bolts.
2) Remove two left side engine mount bolts.
3) Use the hoist to lift the engine from the engine compartment.



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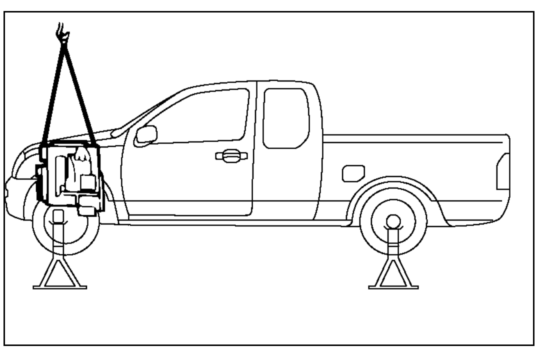


F06R300008

Installation

To reassemble, follow the removal steps in the reverse order.

Coolant Replenishment

Warning:

When the coolant is heated to a high temperature, be sure not to loosen or remove the rediator cap.

Otherwise you might get scalded by hot vapor or boiling water.

To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

1. Open rediator cap pour coolant up to filler neck
2. Pour coolant into reservoir tank up to "MAX" line
3. Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.
4. After replenish the coolant tighten radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
5. Check to see the thermometer, continuously idling 5 minutes and stop the engine.
6. When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the coolant system and reservoir tank hose for leakage.
7. Pour coolant into the reservoir tank up to "MAX" line.

Coolant Capacity lit (US/UK gal)

4JA1 / TC	9.4 (2.5 / 2.1)
4JH1TC	M/T: 10.1 (2.7 / 2.2) A/T: 10.0 (2.6 / 2.2)

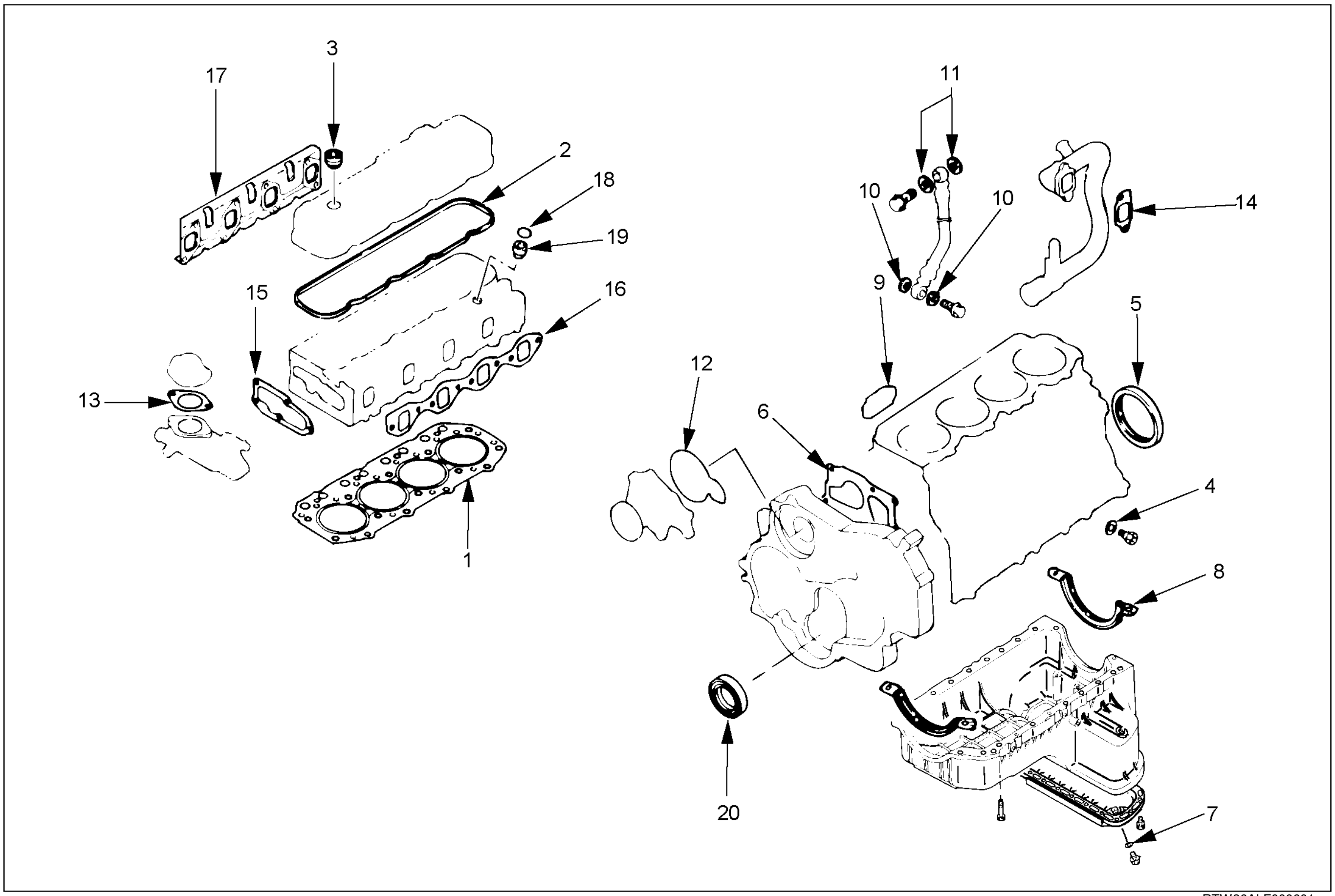
Engine Warm-Up

After completing the required maintenance procedures, start the engine and allow it to idle until it is warm.

Check the following:

1. Engine idling speed.
2. Engine noise level.
3. Engine lubricating system and cooling system. Carefully check for oil and coolant leakage.
4. Clutch engagement.
5. Transmission operation.
6. Indicator warning light operation.

ENGINE REPAIR KIT



RTW36ALF000601

Removal Steps

1. Cylinder head gasket
2. Head cover gasket
3. Head cover cap nut gasket
4. Drain cock gasket
5. Crankshaft rear oil seal
6. Gear case gasket
7. Oil pan drain plug gasket
8. Oil pan gasket
9. Oil filter gasket
10. Joint bolt gasket
11. Vacuum pump gasket
12. Water pump O-ring
13. Water outlet pipe gasket
14. Intake pipe gasket
15. Thermostat housing gasket
16. Intake manifold gasket
17. Exhaust manifold gasket
18. Nozzle holder O-ring
19. Nozzle holder gasket
20. Crankshaft front oil seal

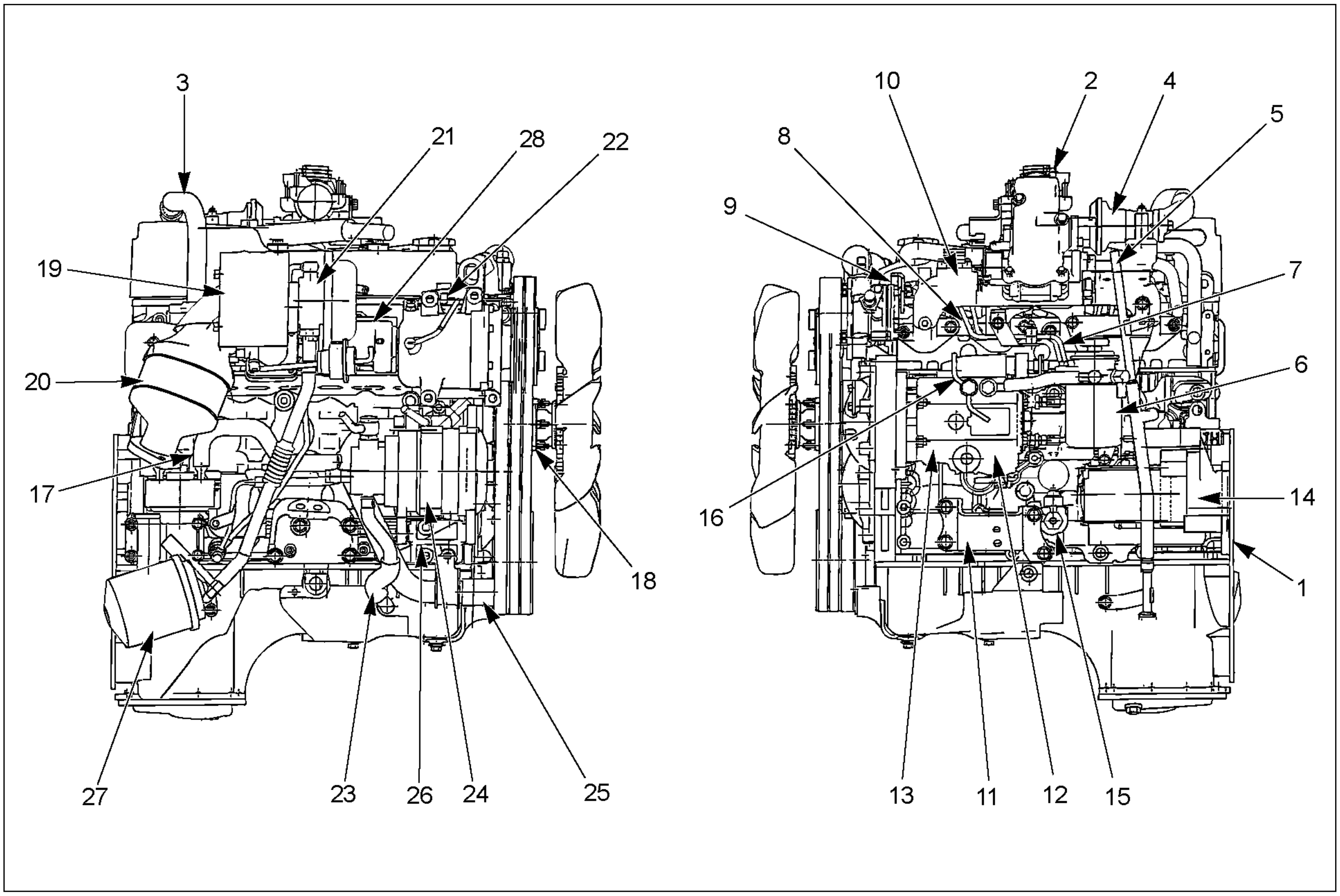
NOTE

Discard all O-rings, gaskets, and seals removed at disassembly and replace them with new ones. Reuse of these parts will result in oil, water, and gas leakage.

ENGINE OVERHAUL

REMOVAL

EXTERNAL PARTS



RTW36AMF000401

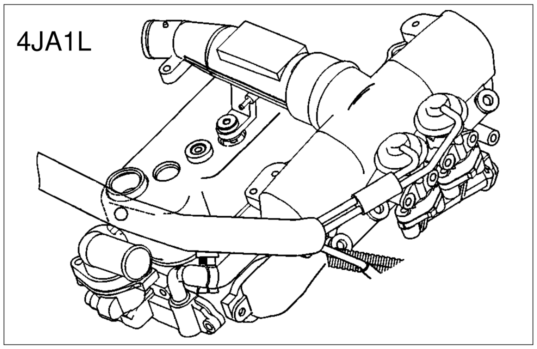
Removal Steps

1. Clutch Assembly or Flex Plate
2. Intake Pipe and Throttle Body
3-1. EGR Pipe
3-2. EGR cooler (EURO III model only)
4. EGR Valve
5. Oil Level Gauge
6. Fuel Filter Assembly (Except EURO III)
7. Fuel Filter Bracket (Except EURO III)
8. Fuel Injection Pipe with Clip
9. Power Steering Oil Pump Bracket
10. Intake Manifold
11. Engine Mounting Bracket and Foot
12. Injection Pump Cover
13. Injection Pump
14. Starter Motor
15. Oil Pressure Warning Switch
16. Fuel Leak Off Pipe
17. Oil Cooler Water Pipe
18. Cooling Fan Pulley
19. Heat Protector
20. Catalytic Converter
21. Turbocharger
22. Compressor Bracket
23. Vacuum Pump Oil Return Hose
24. Generator and Adjusting Plate
25. Water Inlet Pipe
26. Generator Bracket
27. Oil Cooler with Oil Filter
28. Exhaust Manifold

Removal

1. Clutch Assembly or Flex Plate

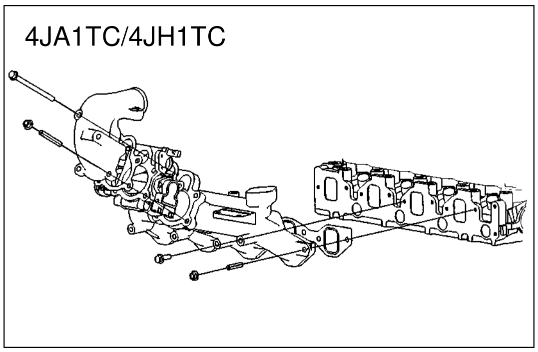
Remove the clutch assembly or the flex plate.



RTW46ASH000801

2. Intake Pipe and Throttle Body (4JA1TC/4JH1TC only)

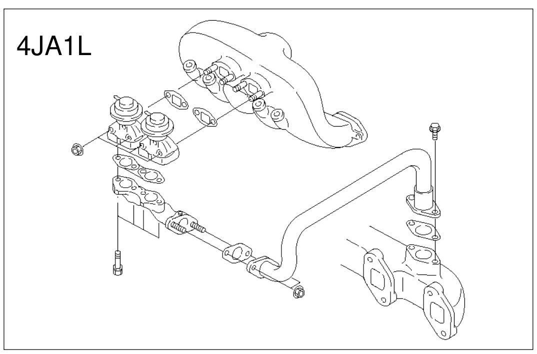
1) Loosen hose clamp between turbocharger and intake duct.
2) Remove the rubber hose.
3) Remove the intake pipe and the throttle body. (4JA1TC/4JH1TC only)



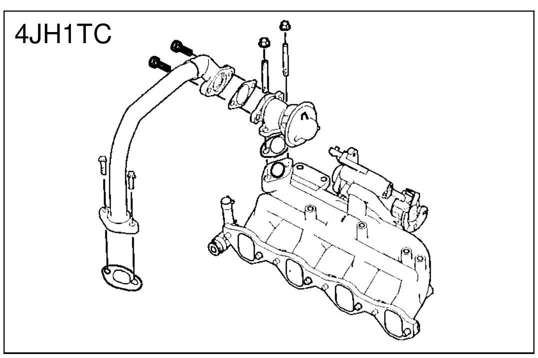
RTW36ASH000201

3-1. EGR Pipe

1) Remove two bolts from the exhaust manifold.
2) Remove two nuts from the EGR valve adapter.
3) Remove the EGR pipe with gaskets.



025R100008



RTW36ASH000301

3-2. EGR Cooler (EURO III model only)

GENERAL REPAIR PROCEDURE

OIL SPECIFICATION

- The HFC-134a system requires a synthetic (PAG) compressor oil.
- Compressor (PAG) oil varies according to compressor model. Be sure to use oil specified for the model of compressor.

Specified Compressor Oil
DH-PR

HANDLING OF OIL

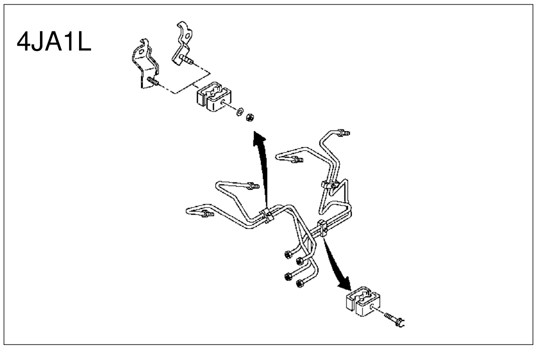
- The oil should be free from moisture, dust, metal powder, etc.
- Do not mix with other oil.
- The water content in the oil increases when exposed to the air. After use, seal oil from air immediately.
- The compressor oil must be stored in steel containers, not in plastic containers.

COMPRESSOR OIL CHECK

The Oil used to lubricate the compressor is circulating with the refrigerant.
Whenever replacing any component of the system or a large amount of gas leakage occurs, add oil to maintain the original amount of. oil.

Oil Capacity

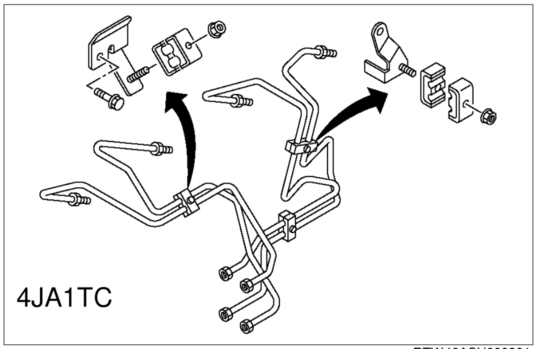
Capacity total in system	CR-14	180 cm^3 (5.07 Imp fl oz)
Compressor (Service parts) charging amount	CR-14	180 cm^3 (5.07 Imp fl oz)



RTW46ASH001001

4. EGR Valve

1) Remove four nuts and remove the EGR valve assembly from the intake manifold.
2) Remove four bolts and remove the adapter from the EGR valve assembly.



RTW46ASH000901

5. Oil Level Gauge

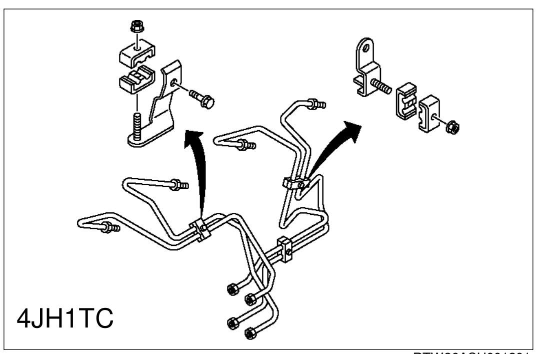
1) Disconnect PCV hose.
2) Remove two bolts and remove the engine oil level gauge.

6. Fuel Filter Assembly (Except EURO III model)

1) Disconnect fuel hose.
2) Remove two bolts and remove the fuel filter.

7. Fuel Filter Bracket (Except EURO III model)

Remove three bolts and remove the fuel filter bracket with leak pipe.



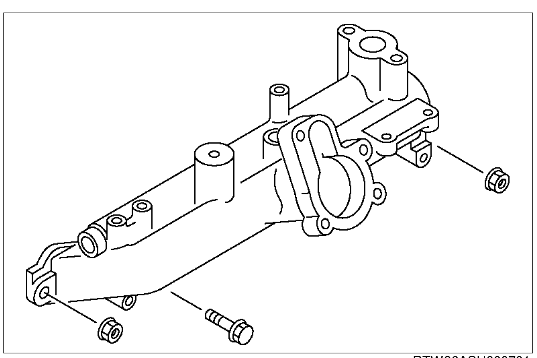
RTW36ASH001201

8. Fuel Injection Pipe with Clip

1) Loosen the injection pipe sleeve nuts at pump side and nozzle side.
   Do not apply excessive force to the injection pipes.
2) Loosen the injection pipe clips.
3) Remove the injection pipe.

NOTE:

Plug the delivery holder ports with the caps to prevent the entry of foreign material.


RTW36ASH000701

9. Power Steering Oil Pump Bracket

10. Intake Manifold

1) Disconnect the PCV hose from the cylinder head cover.
2) Remove the intake manifold with gasket.

11. Engine Mounting Bracket and Foot

12. Injection Pump Cover

13. Injection Pump

Refer to section 6C-19 (Injection Pump)

14. Starter Motor

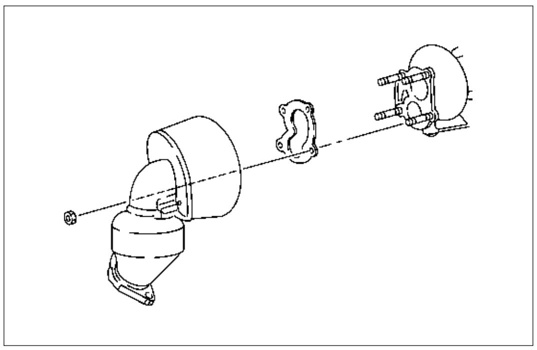
15. Oil Pressure Warning Switch

16. Fuel Leak Off Pipe

17. Oil Cooler Water Pipe

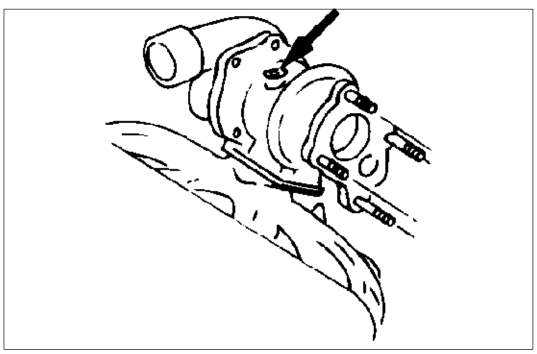
18. Cooling Fan Pulley

19. Heat Protector



027R100007

20. Catalytic Converter



037RY00001

21. Turbocharger

1) Disconnect the water hose between thermostat housing cover and turbocharger.
2) Disconnect the water hose between water inlet pipe and turbocharger.
3) Remove the oil feed pipe.
4) Remove the oil return pipe.
5) Remove the turbocharger and the gasket.

NOTE:

Plug the turbocharger body oil ports and water ports after removing the turbocharger assembly to prevent the entry of foreign material.

22. Compressor Bracket

23. Vacuum Pump Oil Return Hose

24. Generator and Adjusting Plate

25. Water Inlet Pipe

26. Generator Bracket

27. Oil Cooler with Oil Filter

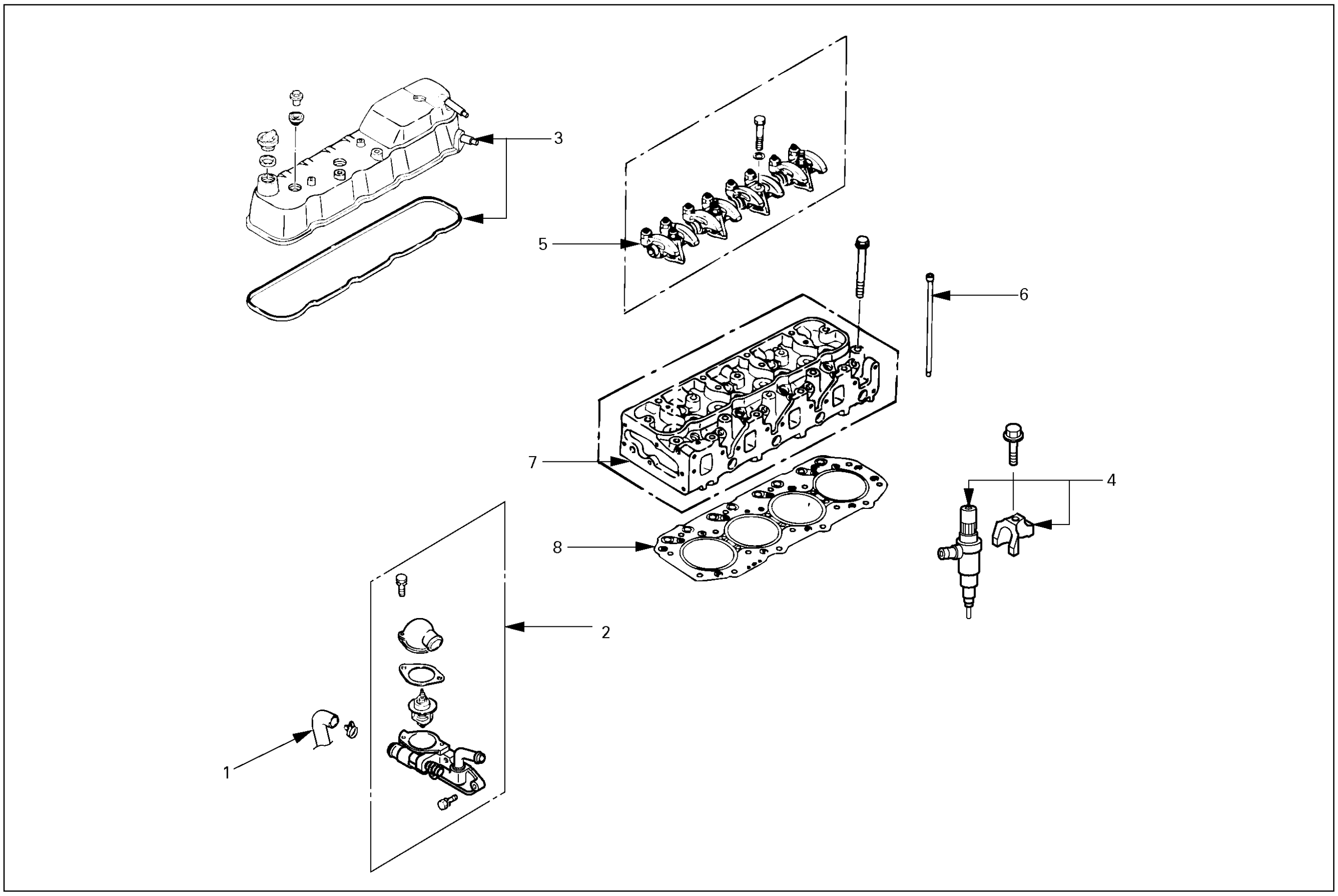
28. Exhaust Manifold

1

DISASSEMBLY

INTERNAL PARTS

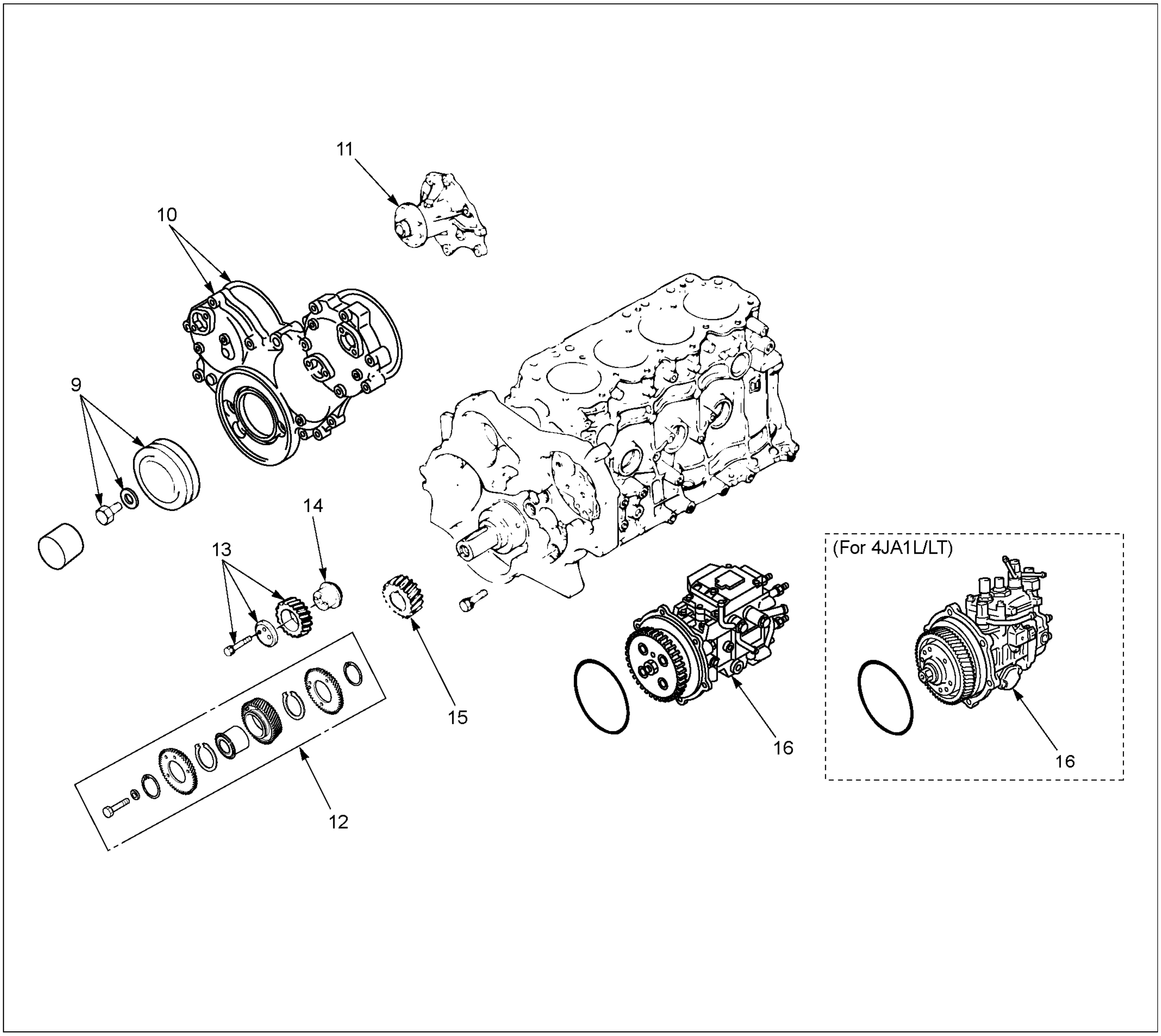
MAJOR COMPONENTS



011R300001

Disassembly Steps-1

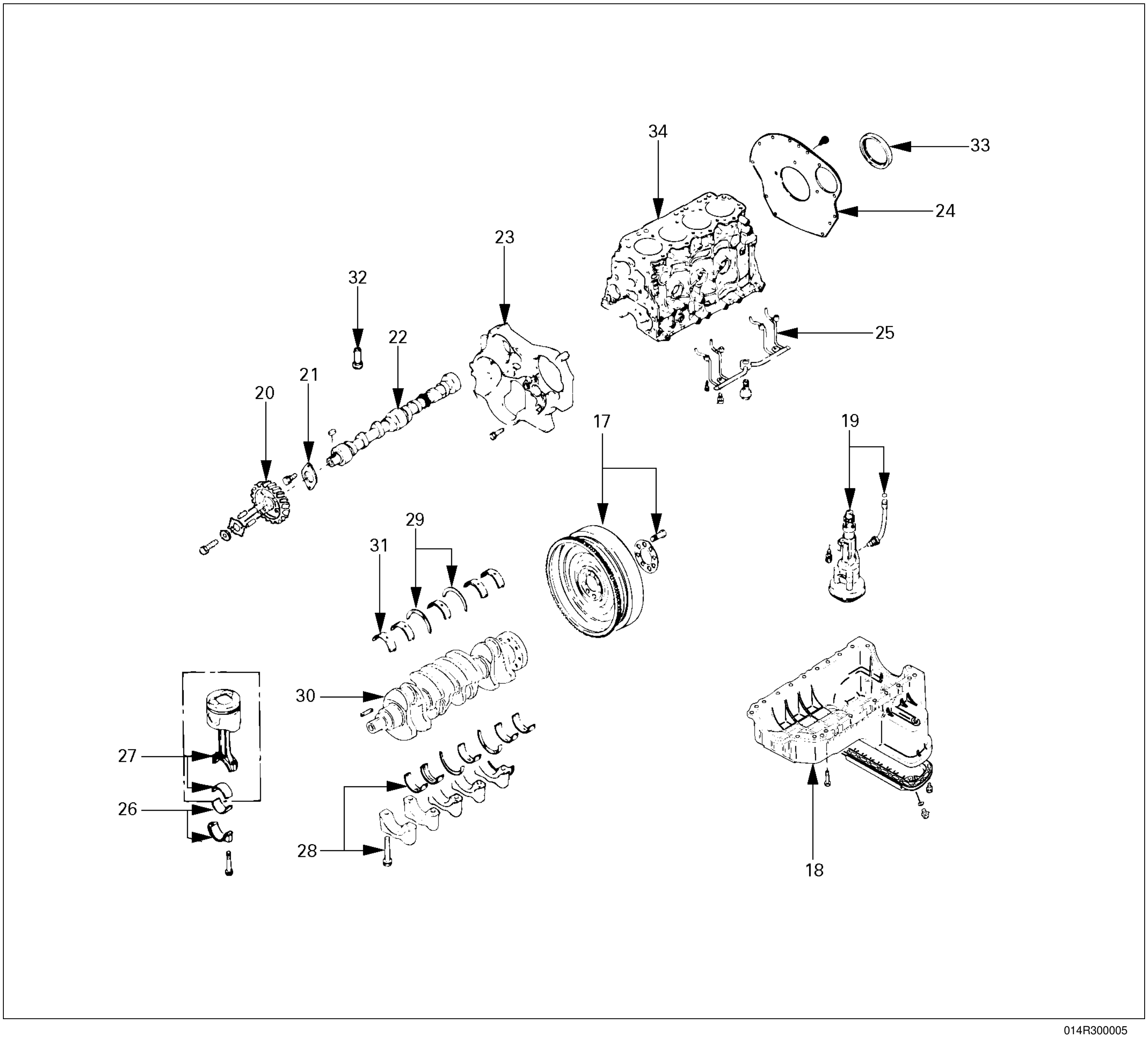
1. Water bypass hose
2. Thermostat housing with thermo switch
3. Cylinder head cover
4. Injection nozzle and bracket
5. Rocker arm shaft and rocker arm
6. Push rod
7. Cylinder head
8. Cylinder head gasket



RTW46ALF000101

Disassembly Steps-2

9. Crankshaft damper pulley
10. Timing gear case cove
11. Water pump
12. Idle gear "B" and shaft
13. Idle gear "A"
14. Idle gear shaft
15. Crankshaft timing gear
16. Injection pump

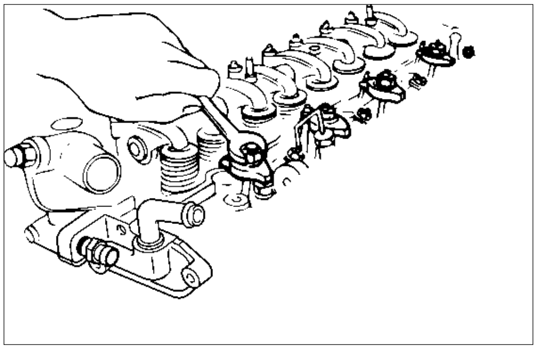


Disassembly Steps-3

17. Flywheel
18. Crank case
19. Oil pump with oil pipe
20. Camshaft timing gear
21. Camshaft thrust plate
22. Camshaft
23. Timing gear case
24. Cylinder body rear plate
25. Piston cooling oil jet
26. Connecting rod bearing cap with lower bearing
27. Piston and connecting rod with upper bearing
28. Crankshaft bearing cap with lower bearing
29. Crankshaft thrust bearing
30. Crankshaft
31. Crankshaft upper bearing
32. Tappet
33. Crankshaft rear oil seal
34. Cylinder body

Disassembly

1. **Water Bypass Hose**
2. **Thermostat Housing with Thermo Switch**
3. **Cylinder Head Cover**
4. **Injection Nozzle and Bracket**



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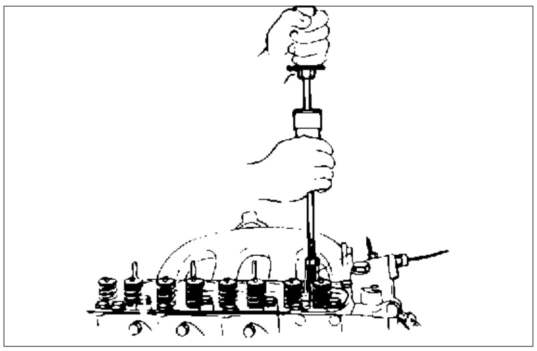
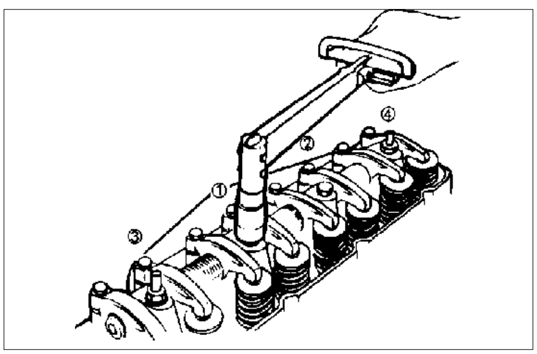
   1. Remove the injection nozzle bracket bolts.



011RY00005

   2. Use the injection nozzle remover and the sliding hammer to remove the injection nozzle together.

Injection Nozzle Remover: 5-8840-2723-0
Sliding Hammer: 5-8840-0019-0



011RY00006

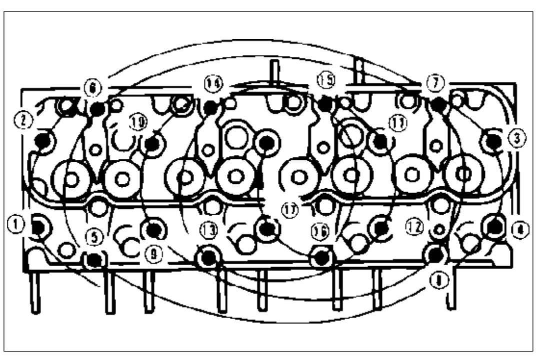
5. **Rocker Arm Shaft and Rocker Arm**

   Loosen the rocker arm shaft bracket bolts in numerical order a little at a time.

Note:

Failure to loosen the rocker arm shaft bracket bolts in numerical order a little at a time will adversely affect the rocker arm shaft.

6. **Push Rod**



011RY00007

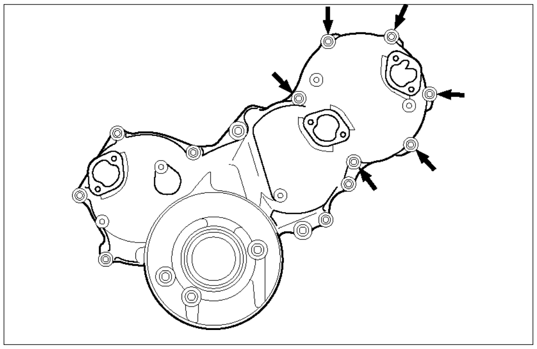
7. **Cylinder Head**

   Loosen the cylinder head bolts in numerical order a little at a time.

Note:

Failure to loosen the cylinder head bolts in numerical order a little at a time will adversely affect the cylinder head lower surface.

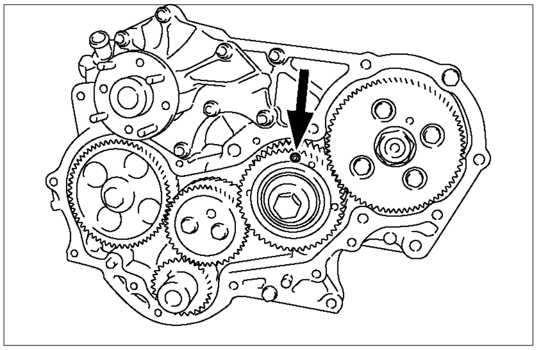
8. **Cylinder Head Gasket**
9. **Crankshaft Damper Pulley**


020L200006

10. Timing Gear Case Cover

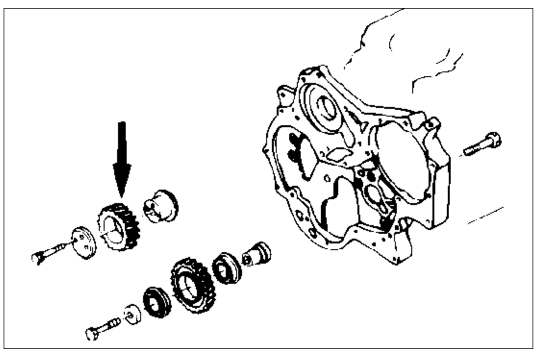
The timing gear case is tightened together with the injection pump at the 6 points indicated by the arrows in the illustration.

11. Water Pump


020L200020

12. Idle Gear B and shaft

Before removing the idle gear B, install bolt (M6,L=30) to the hole marked with an arrow in the illustration to hold the scissor gear in place.

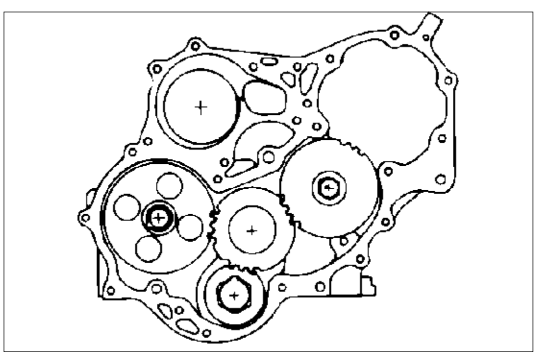

020RY00019

13. Idler Gear "A"

1. Measure the camshaft timing gear backlash and the crankshaft timing gear backlash before removing the idler gear.
2. Measure the idler gear end play before removing the idler gear.

NOTE:

Refer to the following items for details on the backlash and end play measurement procedures.

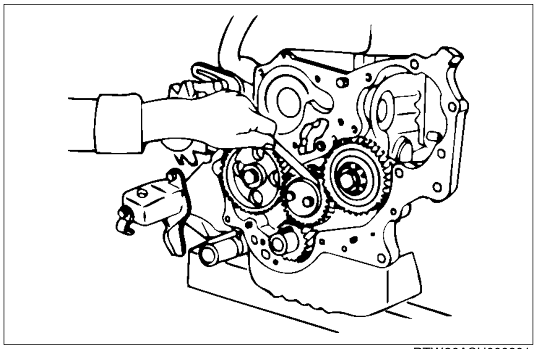

020RY00020

Timing Gear Backlash Measurement

1. Set a dial indicator to the timing gear to measured. Hold both the gear to be checked and the adjusting gear stationary.
2. Move the gear to be checked as far as possible to both the right and the left.
   Take the dial indicator reading.
   If the measured value exceeds the specified limit, the timing gear must be replaced.

Timing Gear Backlash mm (in)

Standard	Limit
0.10 - 0.17 (0.0039 - 0.0067)	0.30 (0.012)


RTW36ASH000801

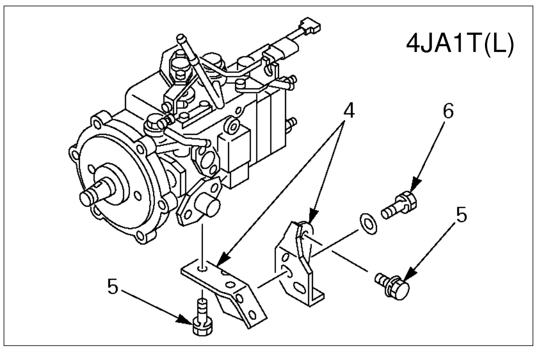
Idler Gear "A" End Play Measurement

Insert a feeler gauge between the idler gear and the thrust collar to measure the gap and determine the idler gear end play.

If the measured value exceeds the specified limit, the thrust collar must be replaced.

Idler Gear End Play mm (in)

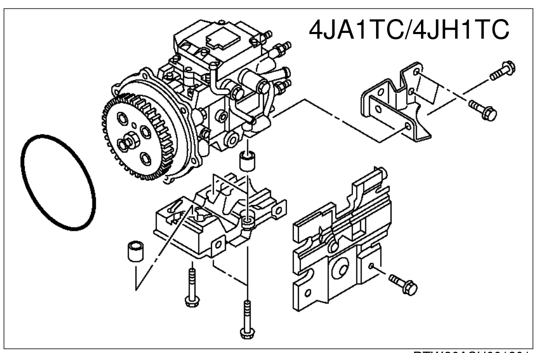
Standard	Limit
0.07 (0.0028)	0.2 (0.0079)



040R300009

14. Idle Gear Shaft

15. Crankshaft Timing Gear



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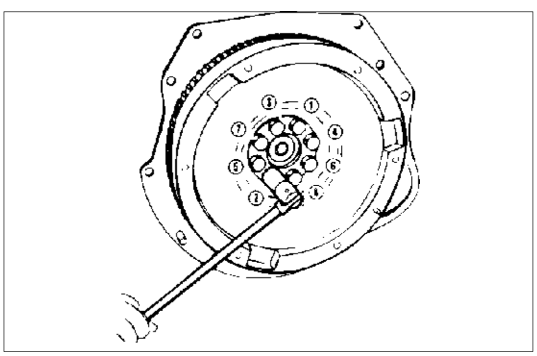
16. Injection Pump

1. Remove the injection pump cover (4JA1TC/4JH1TC only).
2. Remove the injection pump bracket.
3. Pull the injection pump along with the injection pump timing gear free toward the rear of the engine.

NOTE:

Plug the injection pump delivery ports with the caps to prevent the entry of foreign material.


015RY00001

17. Flywheel

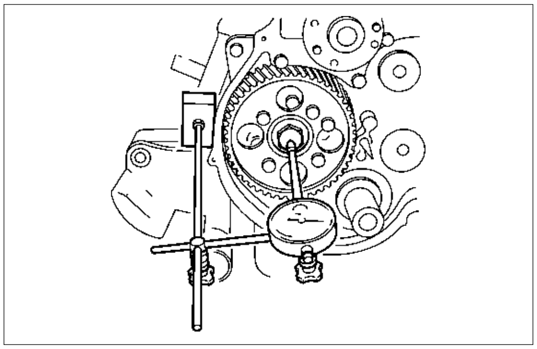
Loosen the flywheel bolts in numerical order a little at a time.

Use the gear stoper to stop the flywheel gear.

Gear stoper: 5-8840-0214-0

18. Crank Case

19. Oil Pump With Oil Pipe

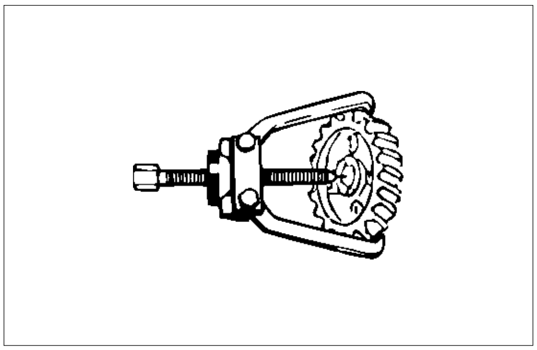

014RT0001

20. Camshaft Timing Gear

1. Use a dial indicator to measure the camshaft end play. This must be done before removing the camshaft gear.
   If the camshaft end play exceeds the specified limit, the thrust plate must be replaced.

Camshaft End Play mm (in)

Standard	Limit
0.050 - 0.114 (0.002 - 0.0044)	0.20 (0.008)


901R100008

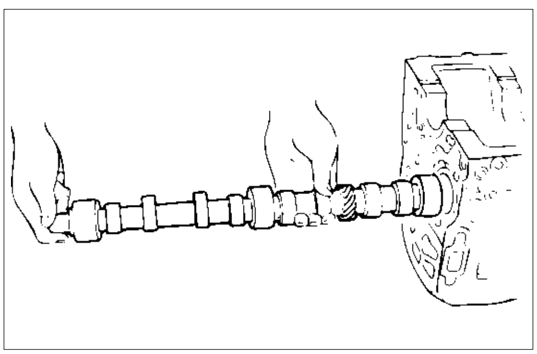
2. Remove the camshaft timing gear bolt from the camshaft.

Note:

Hold the camshaft stationary to prevent the camshaft from turning.

3. Remove the sensor rotor plate.
4. Use the universal puller to pull out the camshaft timing gear.
   Universal Puller: 5-8521-0002-0
5. Remove the thrust plate.

21. Camshaft Thrust Plate

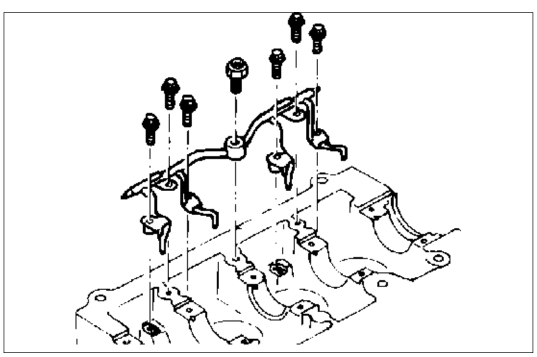

014RY00019

22. Camshaft

Jiggle the camshaft with your hand as you pull it free from the front of the engine.

23. Timing Gear Case

24. Cylinder Body Rear Plate

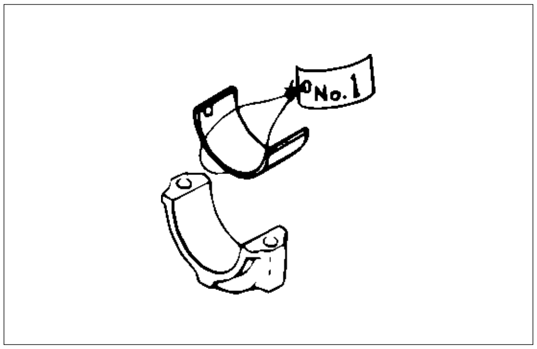

052RY00001

25. Piston Cooling Oil Jet

The oiling jet uses thin steel tubing which is easily bent.

Accidental contact between the oiling jet and the cylinder body, piston, or a tool will damage the oiling jet.

Never attempt to repair a damaged oiling jet. Replace it with a new one.



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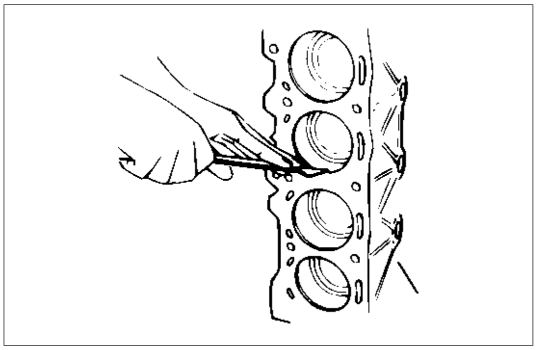
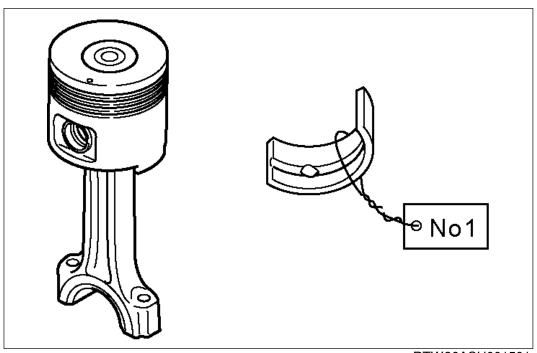
26. Connecting Rod Bearing Cap with Lower Bearing

If the connecting rod lower bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.


015LX018

27. Piston and Connecting Rod with Upper Bearing

1. Remove carbon deposits from the upper portion of the cylinder wall with a scraper before removing the piston and connecting rod.
2. Move the piston to the top of the cylinder and tap it with a hammer grip or a similar object from the connecting rod lower side to drive it out.



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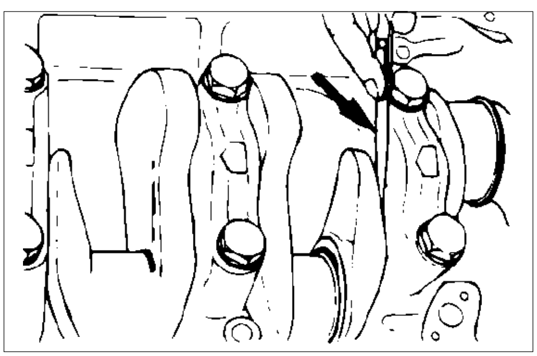
If the connecting rod upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

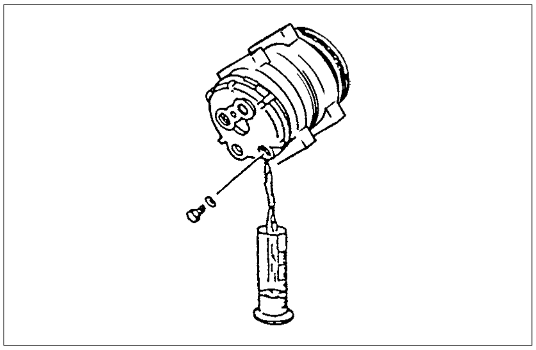

015RY00002

28. Crankshaft Bearing Cap with Lower Bearing

1. Measure the crankshaft end play at the center journal of the crankshaft.
   Do this before removing the crankshaft bearing caps.
   If the measured value exceeds the specified limit, the crankshaft thrust bearing must be replaced.

Crankshaft End Play mm (in)

Standard	Limit
0.10 (0.004)	0.30 (0.012)



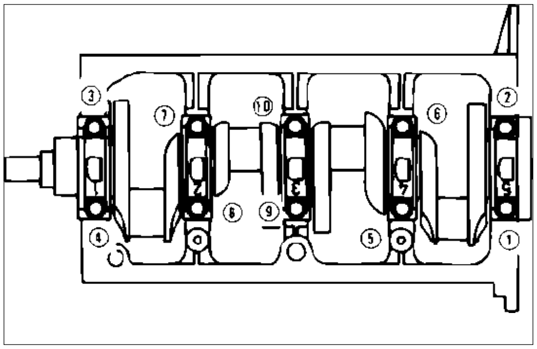
Checking and Adjusting for Used Compressor

(1) Perform Oil return operation.
(Refer to "Oil Return Operation" in this section.)
(2) Discharge refrigerant and remove the compressor.
(3) Drain the compressor oil and measure the extracted oil with a measuring cylinder.
(4) Check the compressor oil for contamination.
(Refer to "Contamination of Compressor Oil" in this section.)
(5) Adjust oil level following the procedure below.

Type	Collected Amount	Charging Amount
CR-14	more than 90 cm^3 (2.53 Imp fl oz)	same as collected amount
	less than 90 cm^3 (2.53 Imp fl oz)	90 cm^3 (2.53 Imp fl oz)

(6) Install the compressor, then evacuate, charge and perform oil return operation.
(7) Check system operation.

When it is impossible to perform oil return operation, the compressor oil should be checked in the following order:
(1) Discharge refrigerant and remove the compressor.
(2) Drain the compressor oil and measure the extracted oil with a measuring cylinder.
(3) Check the oil for contamination.
(4) If more than 90 cm^3 (2.53 Imp fl oz) for CR-14 type is extracted from the compressor, supply same amount of oil to the compressor to be installed.
If the amount of oil extracted is less than 90 cm^3 (2.53 Imp fl oz) for CR-14 type recheck the compressor oil in the following order:
(5) Supply 90 cm^3 (2.53 Imp fl oz) for CR-14 type oil to the compressor and install it onto the vehicle.
(6) Perform oil return operation.
(7) Remove the compressor and recheck the amount of oil.
(8) Adjust the compressor oil.

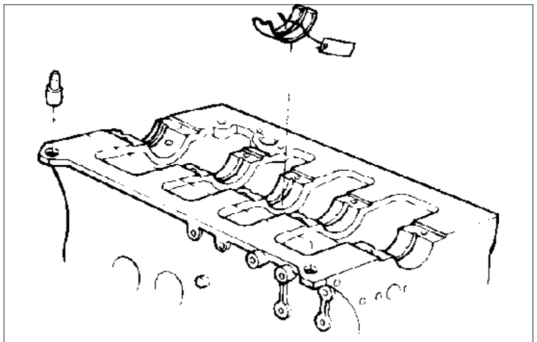


015RY00003

2. Loosen the crankshaft bearing cap bolts in numerical order a little at a time.
   If the crankshaft bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.

29. Crankshaft Thrust Bearing

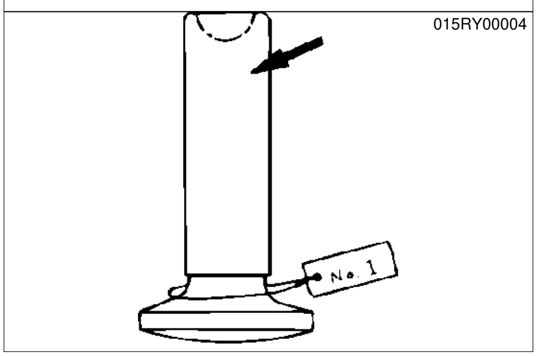
30.Crankshaft



015RY00004

31. Crankshaft Upper Bearing

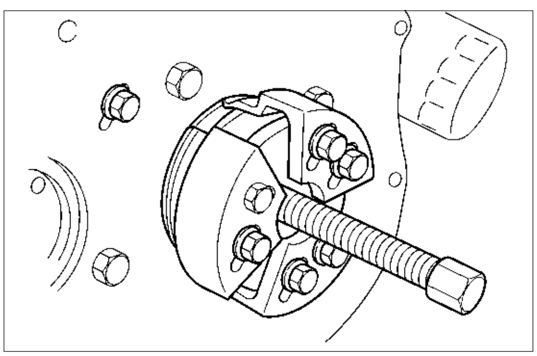
If the crankshaft upper bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



015RY00005

32. Tappet

If the tappets are to be reinstalled, mark their fitting positions by tagging each tappet with the cylinder number from which it was removed.



015LV002

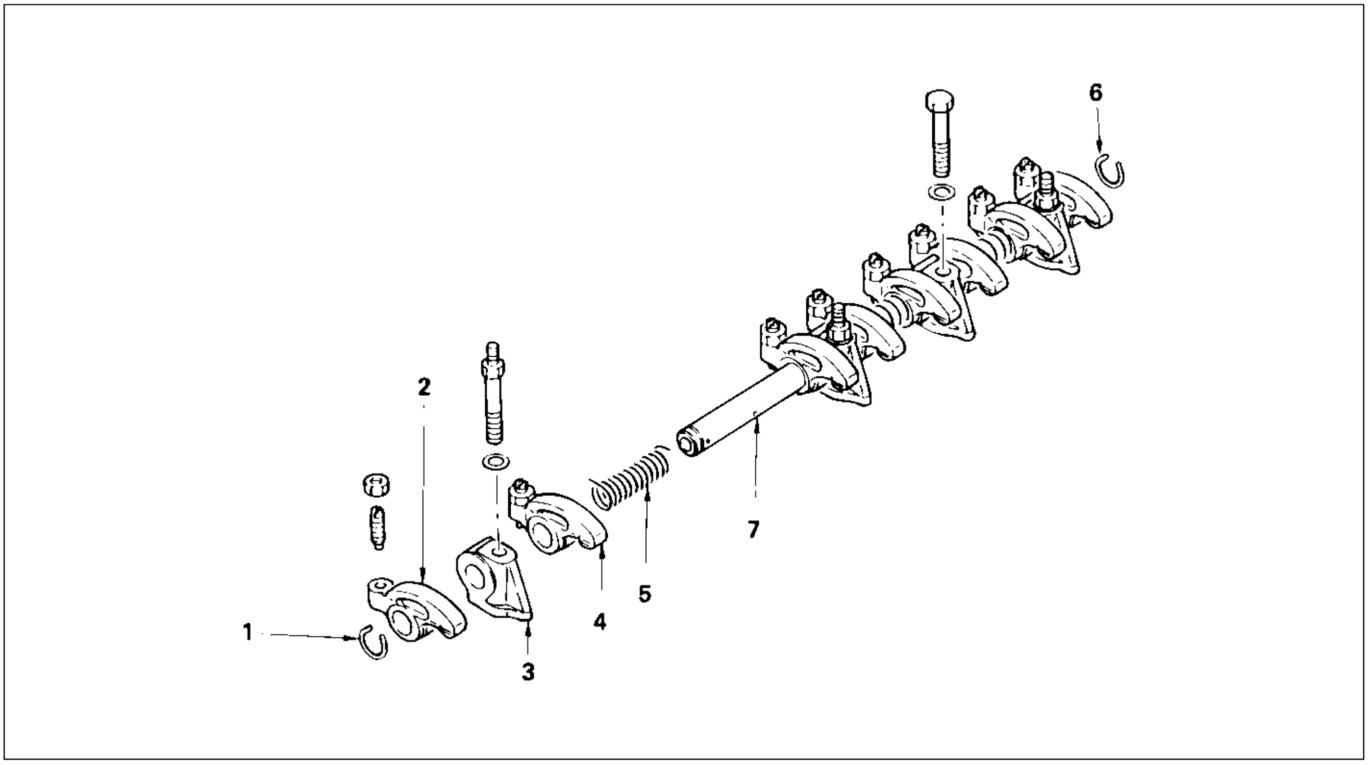
33. Crankshaft Rear Oil Seal

- With the oil seal pushed in deep, install the special tool as shown in the illustration and remove the oil seal.
  Oil Seal Remover: 5-8840-2360-0

34. Cylinder Body

MINOR COMPONENTS

ROCKER ARM SHAFT AND ROCKER ARM

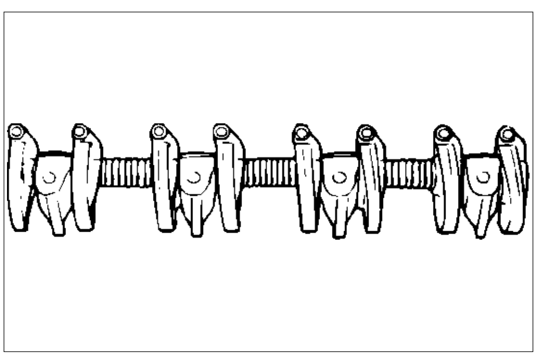


011RY00009

Disassembly Steps

1. Rocker arm shaft snap ring
2. Rocker arm
3. Rocker arm shaft bracket
4. Rocker arm
5. Rocker arm shaft spring
6. Rocker arm shaft snap ring
7. Rocker arm shaft

Disassembly



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1. Rocker Arm Shaft Snap Ring

2. Rocker Arm

3. Rocker Arm Shaft Bracket

1. Use a pair of pliers to remove the snap rings.
2. Remove the rocker arms.
3. Remove the rocker arm shaft brackets.
   If the rocker arms and rocker arm shaft brackets are to be reinstalled, mark their installation positions by tagging each rocker arm and rocker arm shaft bracket with the cylinder number from which it was removed.

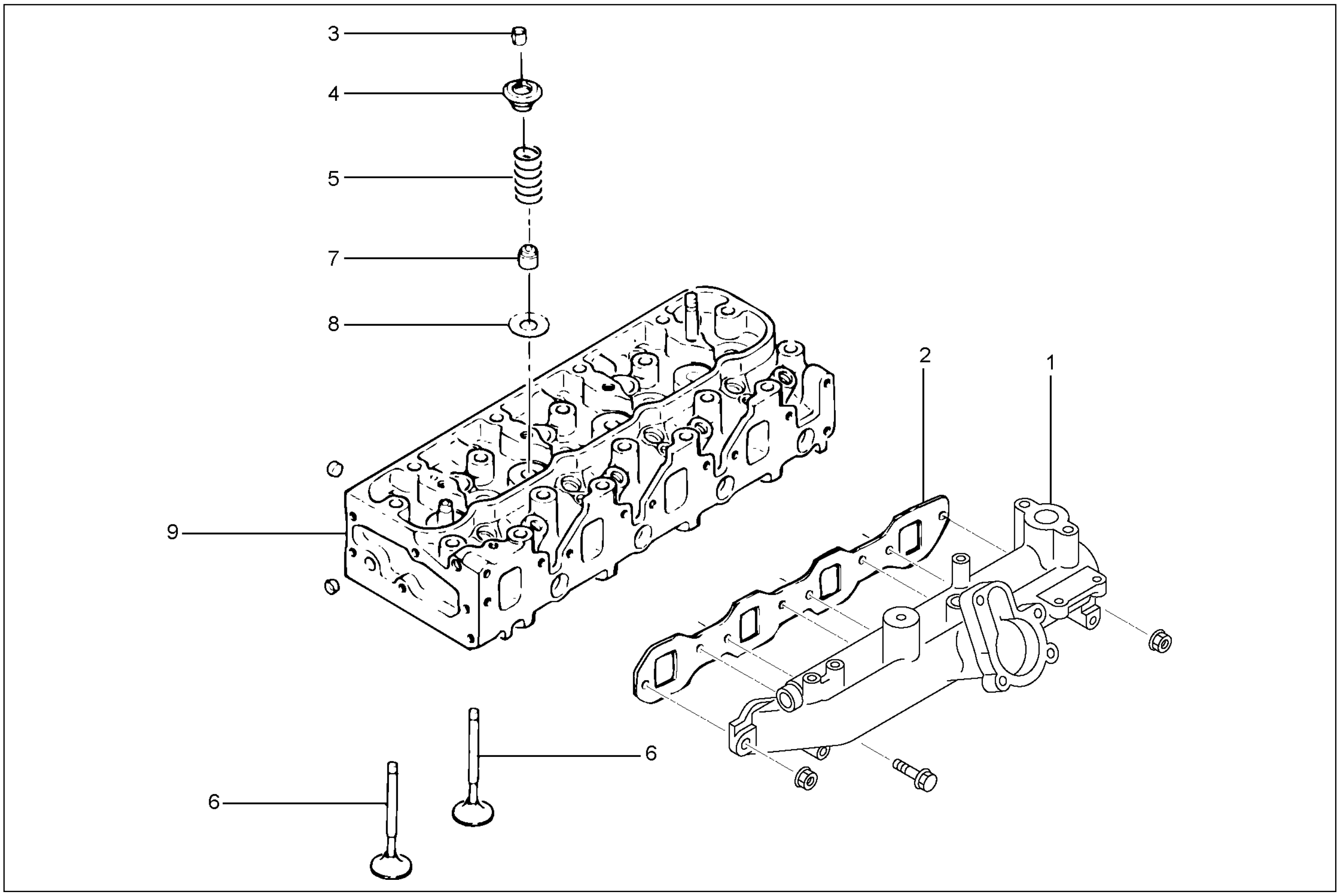
4. Rocker Arm

5. Rocker Arm Shaft Spring

6. Rocker Arm Shaft Snap Ring

7. Rocker Arm Shaft

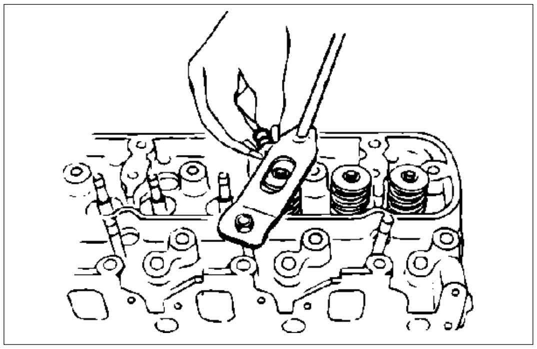
CYLINDER HEAD



RTW46ALF001201

Disassembly Steps

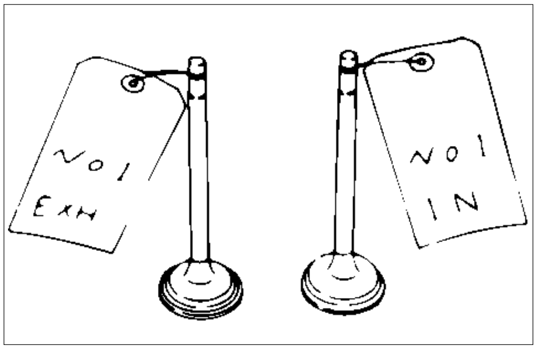
1. Intake manifold
2. Intake manifold gasket
3. Split collar
4. Valve spring upper seat
5. Valve spring
6. Intake and exhaust valve
7. Valve stem oil seal
8. Valve spring lower seat
9. Cylinder head



011RY00011

Disassembly

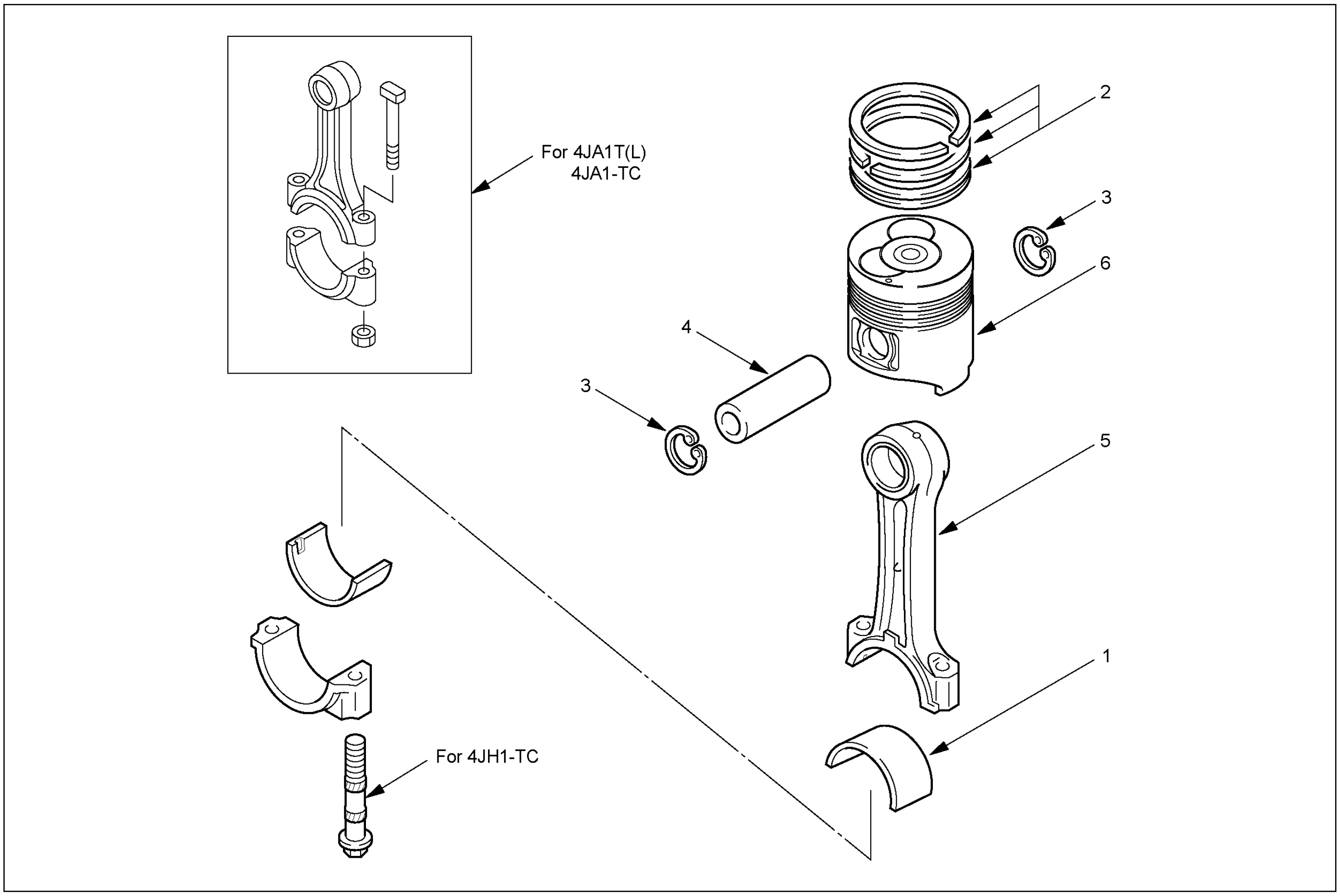
1. **Intake Manifold**
2. **Intake Manifold Gasket**
3. **Split Collar**
   1. Place the cylinder head on a flat wooden surface.
   2. Use the spring compressor to remove the split collars. Do not allow the valve to fall from the cylinder head.
      Spring Compressor: 9-8523-1423-0
4. **Valve Spring Upper Seat**
5. **Valve Spring**



011LX022

6. **Intake and Exhaust Valve**
   If the intake and exhaust valves are to be reinstalled, mark their installation positions by tagging each valve with the cylinder number from which it was removed.
   If the intake and exhaust valves are to be replaced, the valve guides must also be replaced.
7. **Valve Stem Oil Seal**
8. **Valve Spring Lower Seat**
9. **Cylinder Head**

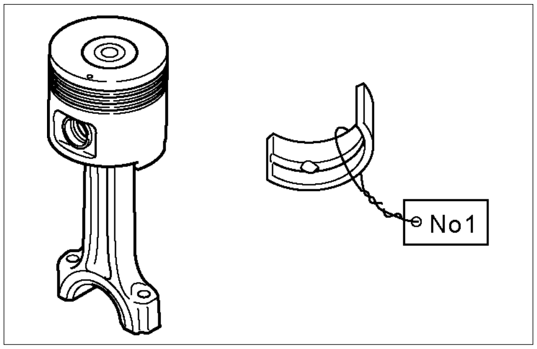
PISTON AND CONNECTING ROD



RTW46ALF000301

Disassembly Steps

1. Connecting rod bearing
2. Piston ring
3. Piston pin snap ring
4. Piston pin
5. Connecting rod
6. Piston

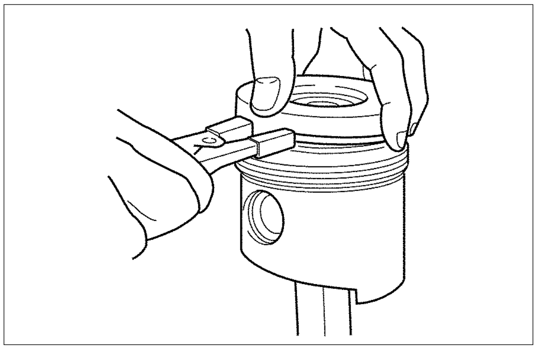


RTW36ASH001501

Disassembly

1. Connecting Rod Bearing

If the connecting rod bearings are to be reinstalled, mark their fitting positions by tagging each bearing with the cylinder number from which it was removed.



015RW041

2. Piston Ring

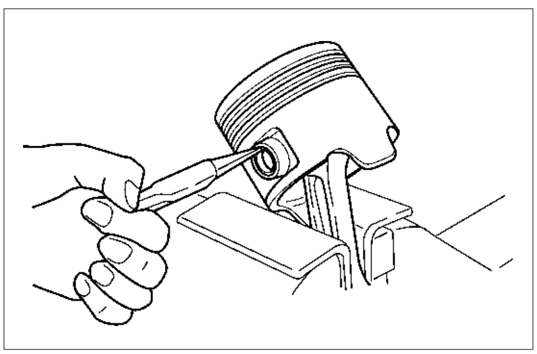
1. Clamp the connecting rod in a vise.

   Take care not to damage the connecting rod.

2. Use a piston ring replacer to remove the piston rings.

   Piston Ring Replacer

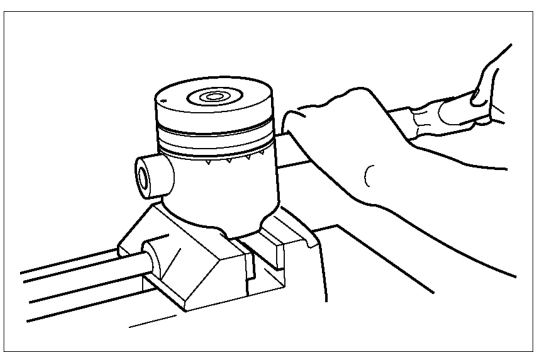
   Do not attempt to use some other tool to remove the piston rings. Piston ring stretching will result in reduced piston ring tension.



F06MV015

3. Piston Pin Snap Ring

Use a pair of pliers to remove the piston pin snap rings.



RTW36ASH001601

4. Piston Pin

5. Connecting Rod

6. Piston

Tap the piston pin out with a hammer and a brass bar.

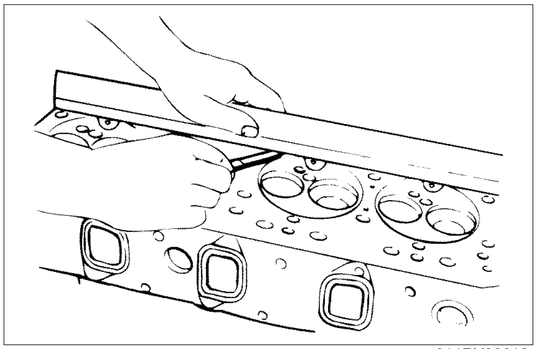
If the pistons and piston pins are to be reinstalled, mark their installation positions by tagging each piston and piston pin with the cylinder number from which it was removed.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

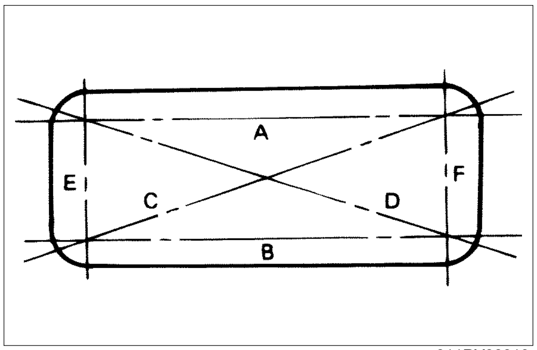
CYLINDER HEAD

Cylinder Head Lower Face Warpage



011RY00012

1. Use a straight edge and a feeler gauge to measure the four sides and the two diagonals of the cylinder head lower face.
2. The cylinder head lower surface warpage is more than the limit, it should be replaced.

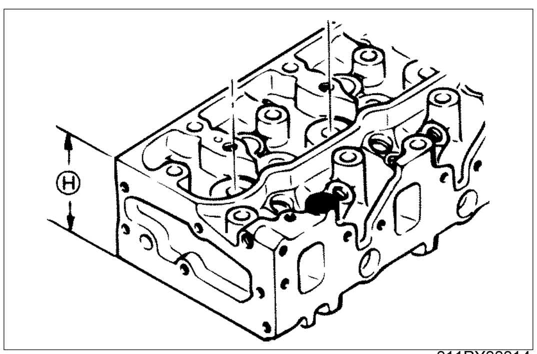


011RY00013

Cylinder Head Lower Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.0079)

NOTE:
The cylinder head lower face cannot be reground.



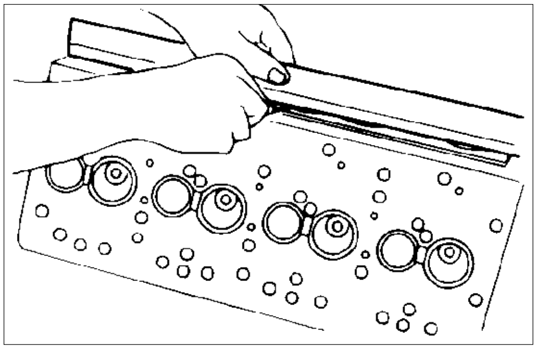
011RY00014

Cylinder Head Height (H) (Reference) mm (in)

Standard
91.95 – 92.05 (3.620 – 3.624)

Positive Crankcase Ventilation (PCV) Valve

1. Remove PCV valve assembly from cylinder head cover.
2. Inspect the diaphragm for broken.
3. Inspect the spring for broken or weaken.
4. If find any abnormal condition, replace the PCV valve assembly.



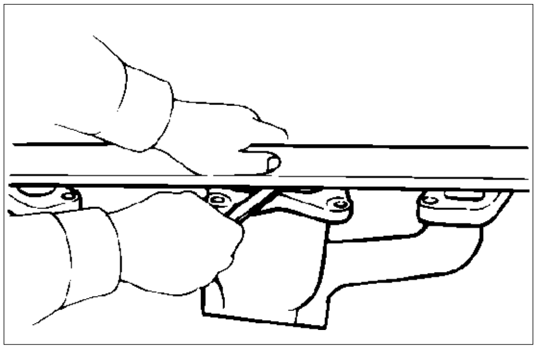
027RY00001

Manifold Fitting Face Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.
Regrind the manifold cylinder head fitting surfaces if the measured values are greater than the specified limit but less than the maximum grinding allowance.
If the measured values exceed the maximum grinding allowance, the cylinder head must be replaced.

Manifold Fitting Face Warpage mm (in)

Standard	Limit	Maximum Grinding Allowance
0.05 (0.002) or less	0.20 (0.008)	0.40 (0.016)



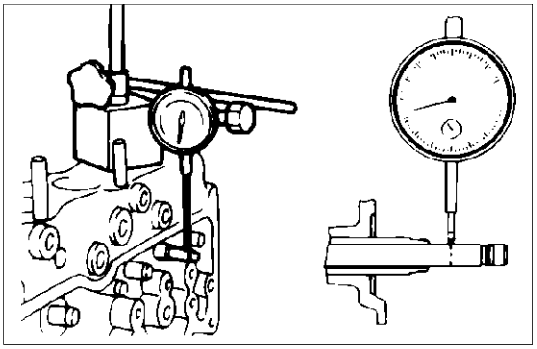
027RY00002

Exhaust Manifold Warpage

Use a straight edge and a feeler gauge to measure the manifold cylinder head fitting face warpage.
If the measured values exceed the specified limit, the manifold must be replaced.

Exhaust Manifold Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.008)



011RY00022

Valve Stem and Valve Guide Clearance

Measuring Method-I

1. With the valve stem inserted in the valve guide, set the dial indicator needle to "0".
2. Move the valve head from side to side.

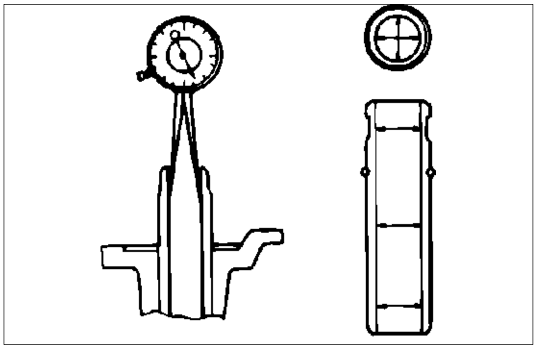
   Read the dial indicator.

   Note the highest dial indication.

   If the measured values exceed the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Clearance mm (in)

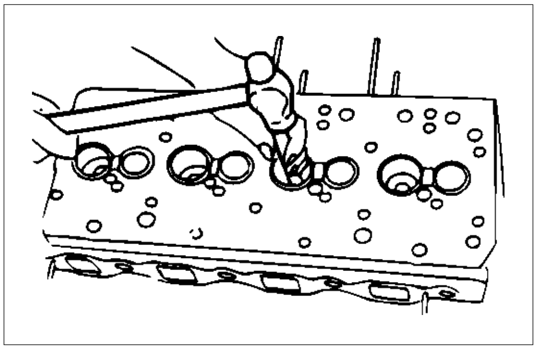
	Standard	Limit
Intake Valve	0.039 - 0.071 (0.0015 - 0.0028)	0.200 (0.008)
Exhaust Valve	0.064 - 0.096 (0.0025 - 0.0038)	0.250 (0.0098)



011RY00023

Measuring Method-II

1. Measure the valve stem outside diameter.
   Refer to the Item "Valve Stem Outside Diameter".
2. Use a caliper calibrator or a telescoping gauge to measure the valve guide inside diameter.

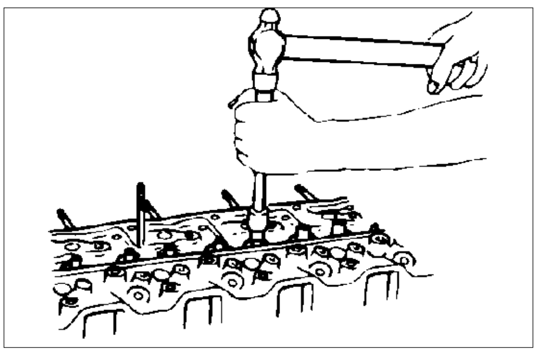


011LX029

Valve Guide Replacement

Valve Guide Removal

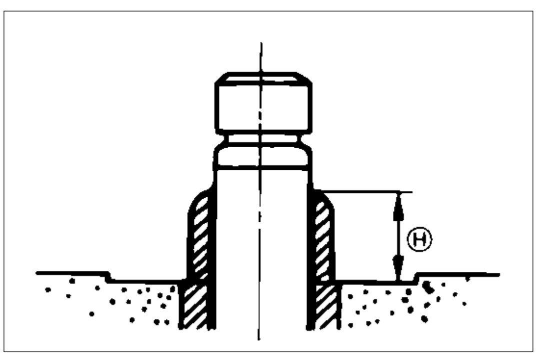
Use a hammer and the valve guide replacer to drive out the valve guide from the cylinder head lower face.
Valve Guide Replacer: 9-8523-1212-0



011RY00024

Valve Guide Installation

1. Apply engine oil to the valve guide outer circumference.
2. Attach the valve guide installer to the valve guide.
3. Use a hammer to drive the valve guide into position from the cylinder head upper face.
   Valve Guide Replacer: 9-8523-1212-0



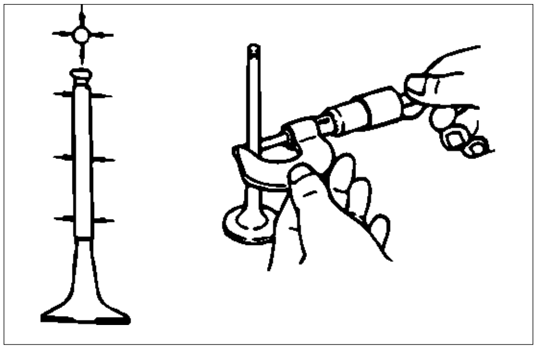
011RY000025

4. Measure the height of the valve guide upper end from the upper face of the cylinder head.

Valve Guide Upper End Height (H) (Reference)	mm (in)
12.8-13.2 (0.50-0.52)	

NOTE:

If the valve guide has been removed, both the valve and the valve guide must be replaced as a set.

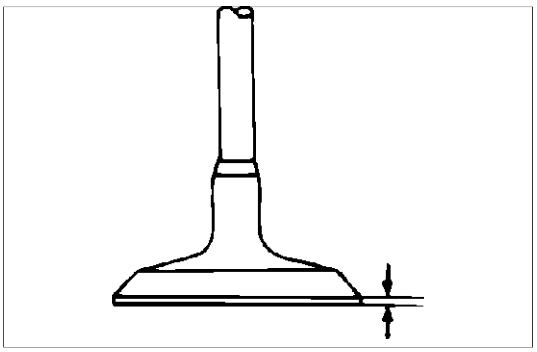

011LX027

Valve Stem Outside Diameter

Measure the valve stem diameter at three points.
If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Valve Stem Outside Diameter mm (in)

	Standard	Limit
Intake Valve	7.946 - 7.961 (0.3128 - 0.3134)	7.880 (0.3102)
Exhaust Valve	7.921 - 7.936 (0.3119 - 0.3124)	7.850 (0.3090)

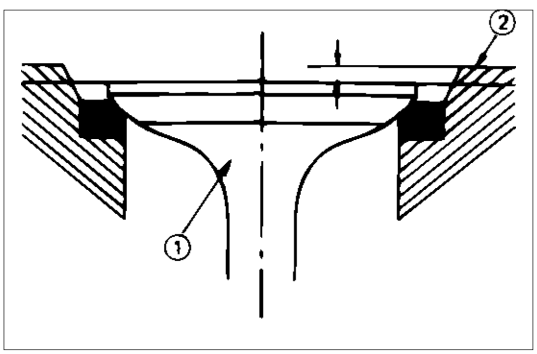

014RY00020

Valve Thickness

Measure the valve thickness.
If the measured value is less than the specified limit, the valve and the valve guide must be replaced as a set.

Intake and Exhaust Valve Thickness mm (in)

		Standard	Limit
4JA1T (L)		1.8 (0.07)	1.5 (0.06)
4JA1TC, 4JH1TC	Inlet	1.34 (0.054)	1.1 (0.045)
	Exhaust	1.36 (0.055)	



014RY00021

Valve Depression

1. Install the valve (1) to the cylinder head (2).
2. Use a depth gauge or a straight edge with steel rule to measure the valve depression from the cylinder head lower surface.
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Depression mm (in)

	Standard	Limit
4JA1T(L)	0.72 (0.029)	1.28 (0.050)
4JA1TC, 4JH1TC	1.17 (0.048)	1.67 (0.068)

Checking and Adjusting for Compressor Replacement

180 cm^3 (5.07 Imp fl oz) of oil is charged in compressor (service parts). So it is necessary to drain the proper amount of oil from the new compressor.

1) Perform oil return operation.
2) Discharge refrigerant and remove the compressor.
3) Drain the compressor oil and measure the extracted oil.
4) Check the compressor oil for contamination.
5) Adjust oil level as required.

Amount of oil drained From used compressor	Draining amount of oil From new compressor
less than 90 cm^3 (2.53 Imp fl oz)	Some as drained amount
more than 90 cm^3 (2.53 Imp fl oz)	90 cm^3 (2.53 Imp fl oz)

6) Evacuate, charge and perform oil return operation.
7) Check system operation.

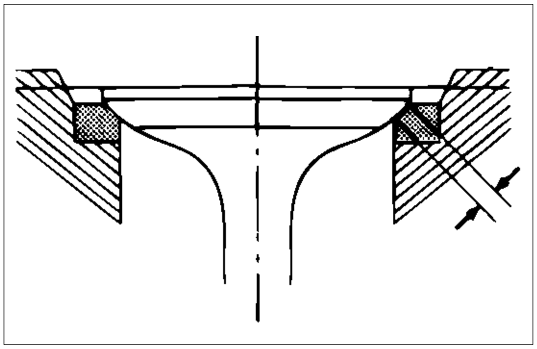
CONTAMINATION OF COMPRESSOR OIL

Unlike engine oil, no cleaning agent is added to the compressor oil. Even is the compressor runs for a long period of time (approximately 1 season), the oil never becomes contaminated as long as there is nothing wrong with the compressor or its method of use.

Inspect the extracted oil for any of the following conditions:

- The capacity of the oil has increased.
- The oil has changed color to red.
- Foreign substances, metal powder, etc., are present in the oil.

If any of these conditions exists, compressor oil is contaminated. Whenever contaminated compressor oil is discovered, the receiver/drier must be replaced.

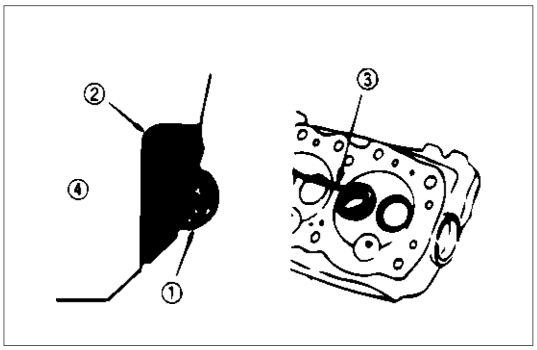

014RY00027

Valve Contact Width

1. Check the valve contact faces for roughness and unevenness. Make smooth the valve contact surfaces.
2. Measure the valve contact width.
   If the measured value exceeds the specified limit, the valve seat insert must be replaced.

Valve Contact Width mm (in)

	Standard	Limit
Intake	1.7 (0.067)	2.2 (0.087)
Exhaust	2.0 (0.079)	2.5 (0.078)

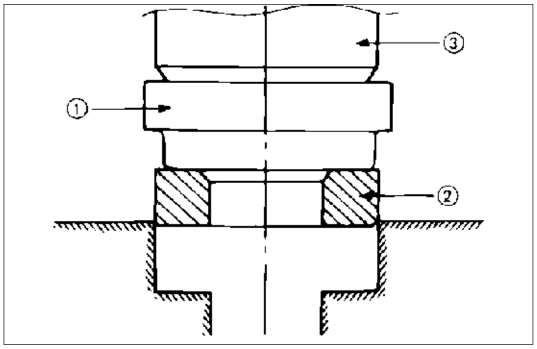


011LX039

Valve Seat Insert Replacement

Valve Seat Insert Removal

1. Arc weld the entire inside circumference (1) of the valve seat insert (2).
2. Allow the valve seat insert to cool for a few minutes.
   This will invite contraction and make removal of the valve seat insert easier.
3. Use a screwdriver (3) to pry the valve seat insert free.
   Take care not to damage the cylinder head (4).
4. Carefully remove carbon and other foreign material from the cylinder head insert bore.



014RY00026

Valve Seat Insert Installation

1. Carefully place the attachment (1) (having a smaller outside diameter than the valve seat insert) on the valve seat insert (2).

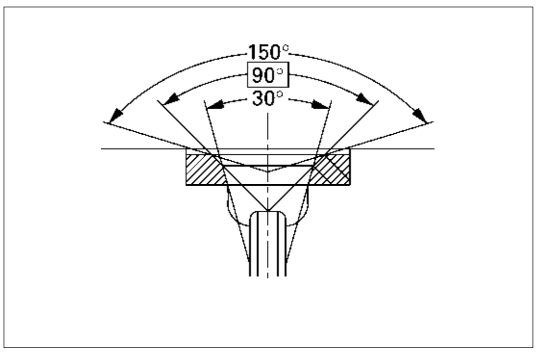
   NOTE:

   The smooth side of the attachment must contact the valve seat insert.

2. Use a bench press (3) to gradually apply pressure to the attachment and press the valve seat insert into place.

   NOTE:

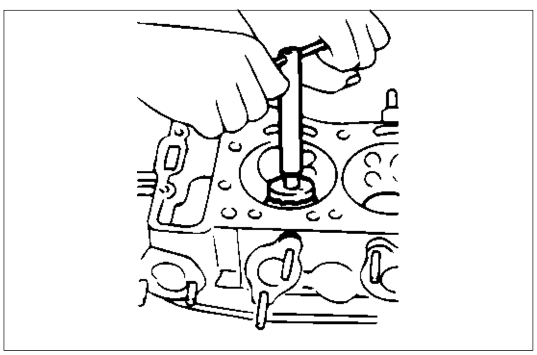
   Do not apply an excessive amount of pressure with the bench press. Damage to the valve seat insert will result.



011LX063

Valve Seat Insert Correction

1. Remove the carbon from the valve seat insert surface.
2. Use a valve cutter (15°, 45°, and 75° blades) to minimize scratches and other rough areas. This will bring the contact width back to the standard value.
   Remove only the scratches and rough areas. Do not cut away too much. Take care not to cut away unblemished areas of the valve seat surface.

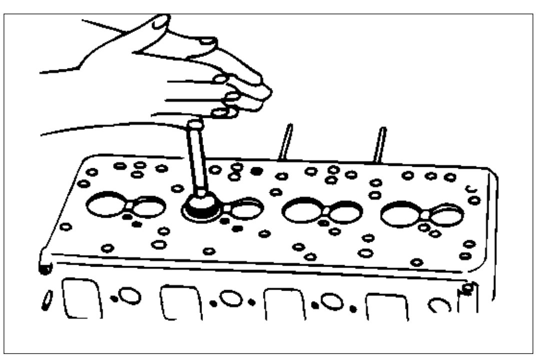

011LX037

Valve Seat Angle	Degree
45	

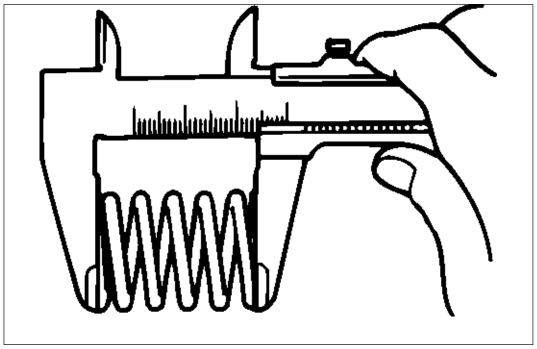
NOTE:

Use an adjustable valve cutter pilot.

Do not allow the valve cutter pilot to wobble inside the valve guide.


011LX038

3. Apply abrasive compound to the valve seat insert surface.
4. Insert the valve into the valve guide.
5. Turn the valve while tapping it to fit the valve seat insert.
6. Check that the valve contact width is correct.
7. Check that the valve seat insert surface is in contact with the entire circumference of the valve.



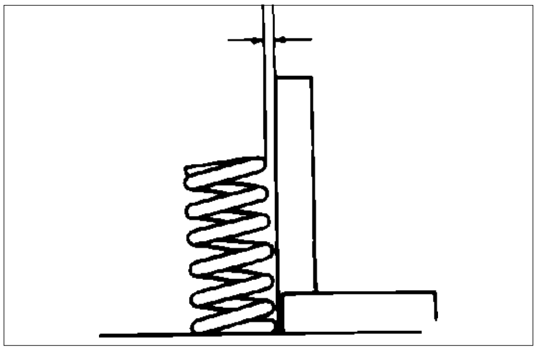
011LX024

Valve Spring Free Height

Use a vernier caliper to measure the valve spring free height.
If the measured value is less than the specified limit, the valve spring must be replaced.

Spring Free Height mm (in)

		Standard	Limit
4JA1T (L) 4JA1TC, 4JH1TC	Single spring	48.0 (1.89)	47.1 (1.85)



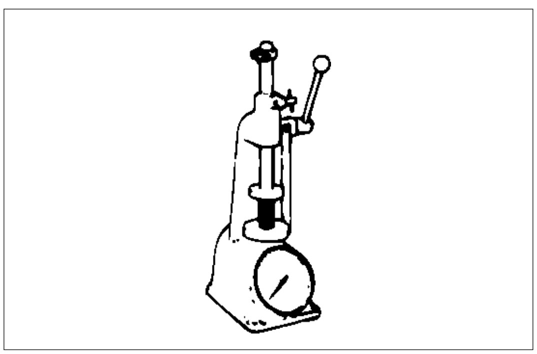
014RY00025

Valve Spring Squareness

Use a surface plate and a square to measure the valve spring squareness.
If the measured value exceeds the specified limit, the valve spring must be replaced.

Spring Squareness mm (in)

		Limit
4JA1T (L) 4JA1TC, 4JH1TC	Single spring	1.7 (0.070)



011LX026

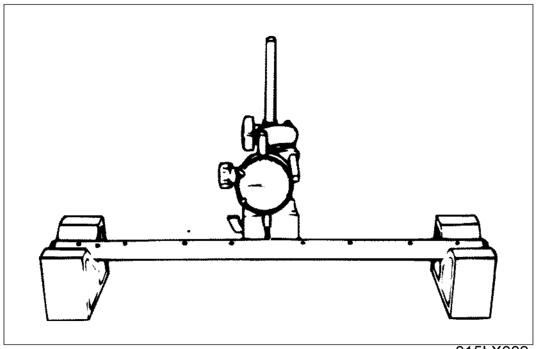
Valve Spring Tension

Use a spring tester to measure the valve spring tension.
If the measured value is less than the specified limit, the valve spring must be replaced.

Valve Spring Tension N (kg/lb)

		Compressed Height	Standard	Limit
4JA1T (L) 4JA1TC, 4JH1TC	Single spring	38.9mm (1.53in)	296.0 (30.2/66.4)	257.7 (26.3/57.9)

ROCKER ARM SHAFT AND ROCKER ARM



015LX008

Rocker Arm Shaft Run-Out

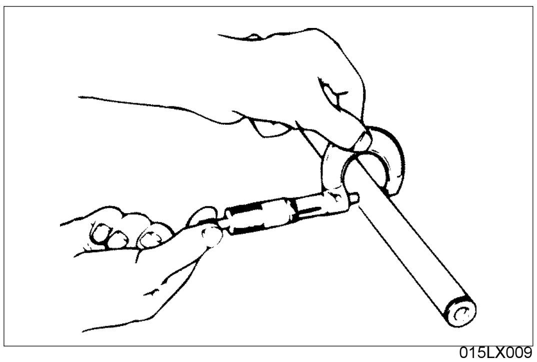
1. Place the rocker arm shaft on a V-block.
2. Use a dial indicator to measure the rocker arm shaft central portion run-out.

   If the run-out is very slight, correct the rocker arm shaft run-out with a bench press. The rocker arm must be at cold condition.

   If the measured rocker arm shaft run-out exceeds the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Run-Out mm (in)
Limit
0.3 (0.012)

Rocker Arm Shaft Outside Diameter

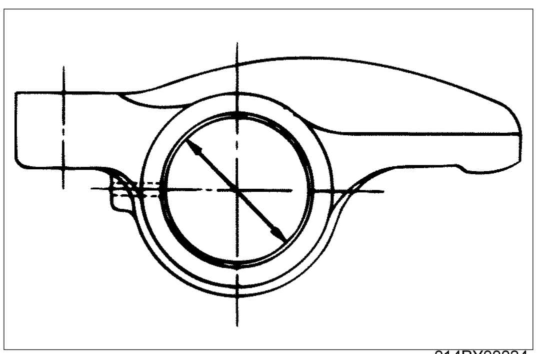


015LX009

Use a micrometer to measure the rocker arm fitting portion outside diameter.
If the measured value is less than the specified limit, the rocker arm shaft must be replaced.

Rocker Arm Shaft Outside Diameter	mm (in)
Standard	Limit
18.98–19.00 (0.747–0.748)	18.90 (0.744)

Rocker Arm Shaft and Rocker Arm Clearance



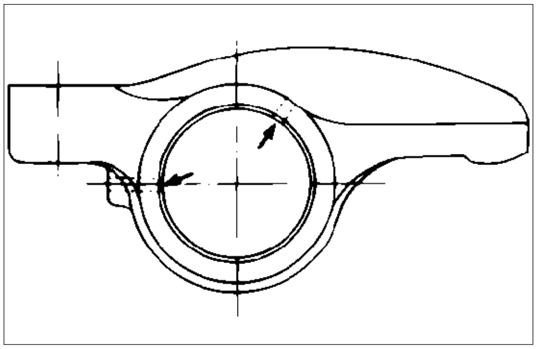
014RY00024

1. Use either a vernier caliper or a dial indicator to measure the rocker arm inside diameter.

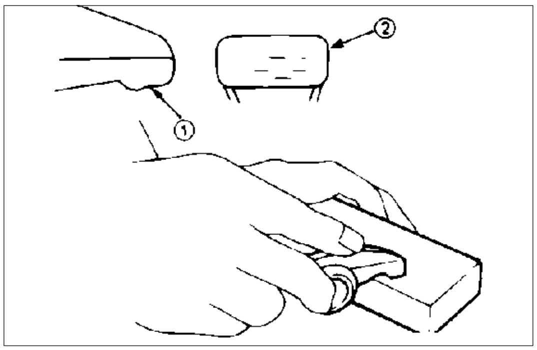
Rocker Arm Inside Diameter	mm (in)
Standard	Limit
19.010–19.030 (0.748–0.749)	19.100 (0.752)

2. Measure the rocker arm shaft outside diameter.
   If the measured value exceeds the specified limit, replace either the rocker arm or the rocker arm shaft.

Rocker Arm Shaft and Rocker Arm Clearance	mm (in)
Standard	Limit
0.01–0.05 (0.0004–0.0020)	0.20 (0.008)


014RY00024

3. Check that the rocker arm oil port is free of obstructions.
   If necessary, use compressed air to clean the rocker arm oil port.



014RY00023

Rocker Arm Correction

Inspect the rocker arm valve stem contact surfaces for step wear (1) and scoring (2).

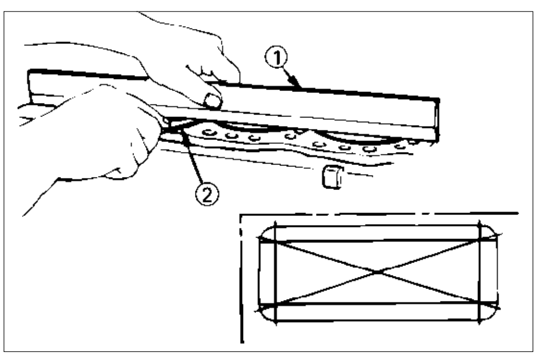
If the contact surfaces have light step wear or scoring, they may be honed with an oil stone.

If the step wear or scoring is severe, the rocker arm must be replaced.

CYLINDER BODY

Cylinder Body Upper Face Warpage

1. Remove the cylinder body dowel.
2. Remove the cylinder liner.
   Refer to "Cylinder Liner Replacement".

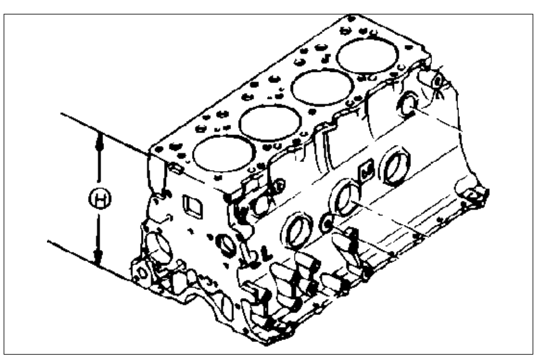


012R100001

3. Use a straight edge (1) and a feeler gauge (2) to measure the four sides and the two diagonals of the cylinder body upper face.
   If the measured values exceeds the limit, the cylinder body must be replaced.

Cylinder Body Upper Face Warpage mm (in)

Standard	Limit
0.05 (0.002) or less	0.20 (0.008)

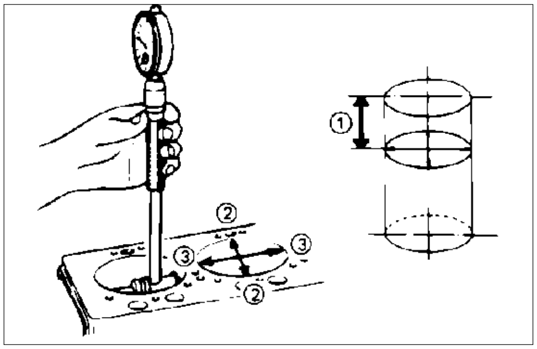


012RY00009

Cylinder Body Height (H) (Reference) mm (in)

Standard
4JA1T(L), 4JA1TC : 244.945-245.055 (9.6435-9.6478)
4JH1TC : 269.945-270.055 (10.6277-10.6320)

4. Reinstall the cylinder liner.
   Refer to "Cylinder Liner Replacement".
5. Reinstall the cylinder body dowel.



012RY00010

Cylinder Liner Bore Measurement

Use a cylinder indicator to measure the cylinder bore at measuring point (1) in the thrust (2-2) and axial (3-3) directions of the crankshaft.

Measuring Point (1): 20 mm (0.79 in)

If the measured value exceeds the specified limit, the cylinder liner must be replaced.

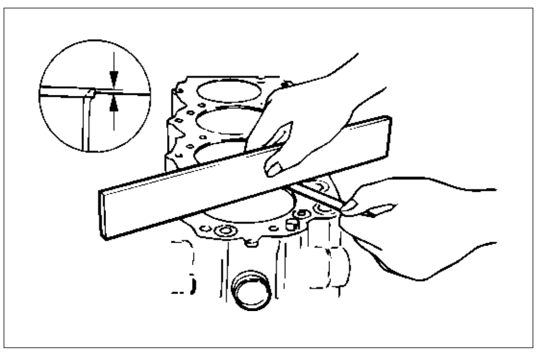
Cylinder Liner Bore mm (in)

	Standard	Limit
4JA1T(L), 4JA1TC	93.00 (3.6614)	93.08 (3.6646)
4JH1TC	95.40 (3.7559)	95.48 (3.7590)

NOTE:

The inside of the dry type cylinder liner is chrome plated. It cannot be rebored or honed.

If the inside of the cylinder liner is scored or scorched, the cylinder liner must be replaced.


012LX016

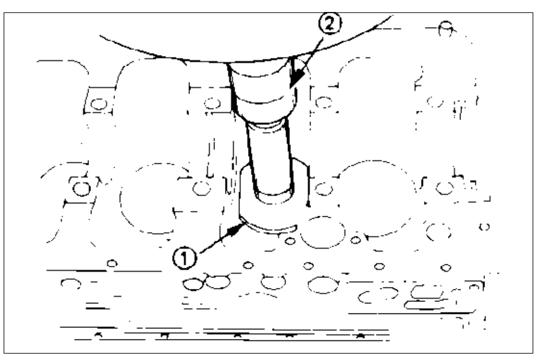
Cylinder Liner Projection Inspection

1. Hold a straight edge along the top edge of the cylinder liner to be measured.
2. Use a feeler gauge to measure each cylinder liner projection.

Cylinder Liner Projection mm (in)

Standard
0-0.1 (0-0.004)

The difference in the cylinder liner projection height between any two adjacent cylinders must not exceed 0.03 mm (0.0012 in).



012RY00012

Cylinder Liner Replacement

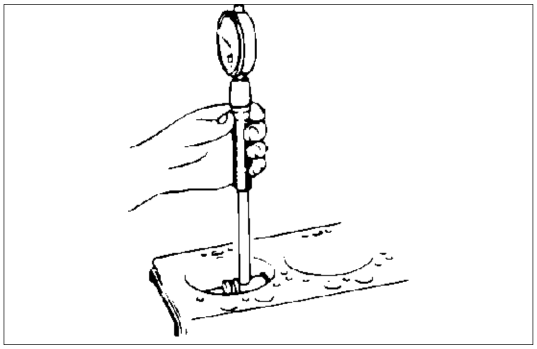
Cylinder Liner Removal

1. Insert the cylinder liner remover (1) into the cylinder body (from the lower side of the cylinder body) until it makes firm contact with the cylinder liner.

   Cylinder Liner Remover : 5-8840-2039-0 (4JA1L/TC)
   : 5-8840-2304-0 (4JH1TC)
2. Use a bench press (2) to slowly force the cylinder liner from the cylinder body.

   NOTE:

   Take care not to damage the cylinder body upper face during the cylinder liner removal procedure.
3. Measure the cylinder body upper face warpage.
   Refer to "Cylinder Body Upper Face Warpage".



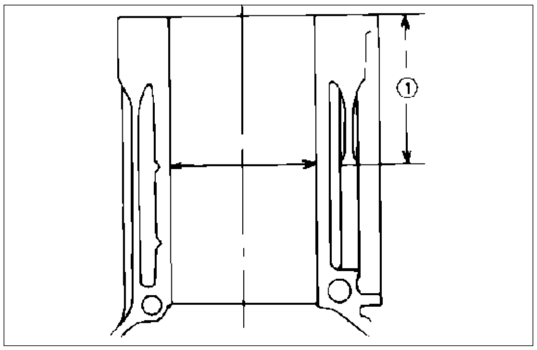
012RY00013

Cylinder Liner Grade Selection

Subtract the average cylinder body bore from the average cylinder liner outside diameter to obtain the fitting interference.

Fitting Interference	mm (in)
Standard	
-0.0010*-0.019 (-0.00004*-0.0007)	

* A minus (-) value indicates that the cylinder body bore is smaller than the liner outside diameter.



012RY00014

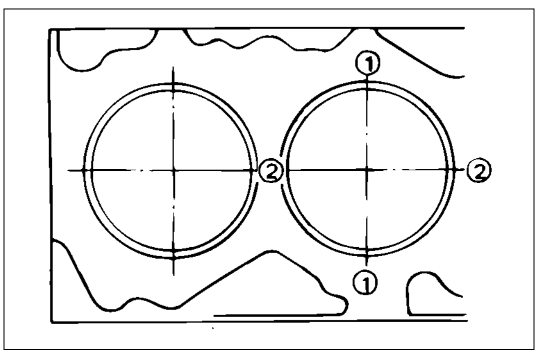
Cylinder Body Bore Measurement

1. Take measurements at measuring point (1) across positions 1-1 and 2-2.

   Measuring Point (1):

   4JA1T(L), 4JA1TC : 13,48,83,118,153 mm (0.51,1.89,3.27,4.65,6.02 in)

   4JH1TC : 18,53,88,123,158 mm (0.71,2.09,3.46,4.84,6.22 in)



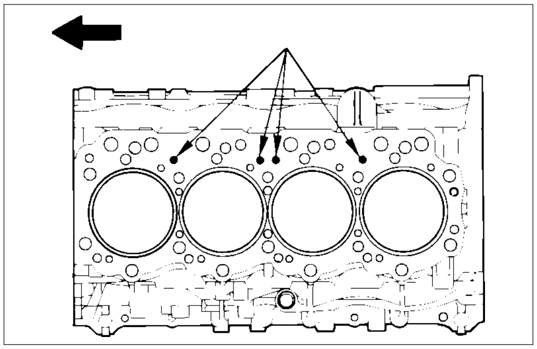
012R300001

Cylinder Liner Grade Selection and Standard Fitting Interference

Accurately measured fitting interference and proper cylinder liner grade selection are extremely important.

If the cylinder liner fitting interference is too small, engine cooling efficiency will be adversely affected.

If the cylinder liner fitting interference is too large, it will be difficult to insert the cylinder liner into the cylinder body.



012RY00022

A mark was stamped on the upper side of the cylinder block during production to indicate the correct liner.

The liner grade (i.e.1.2.3.4) is indicated in metal stamp.

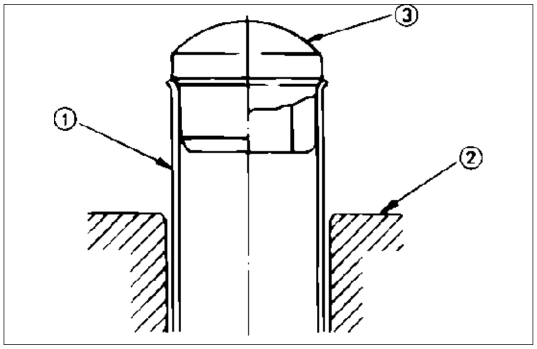
Cylinder Liner Grade

4JA1T (L), 4JA1TC mm (in)

Liner Outside Grade	Cylinder Body Bore Diameter	Liner Outside Diameter	Liner Bore Grade	Service Liner Bore Measurement
1	95.001-95.010 (3.7402-3.7405)	95.011-95.020 (3.7406-3.7409)	AX	93.035-93.050 (3.6628-3.6634)
			CX	93.051-93.066 (3.6634-3.6640)
2	95.011-95.020 (3.7406-3.7409)	95.021-95.030 (3.7410-3.7413)	AX	93.035-93.050 (3.6628-3.6634)
			CX	93.051-93.066 (3.6634-3.6640)
3	95.021-95.030 (3.7410-3.7413)	95.031-95.040 (3.7414-3.7417)	AX	95.035-93.050 (3.6628-3.6634)
			CX	93.051-93.066 (3.6634-3.6640)
4	95.031-95.040 (3.7414-3.7417)	95.041-95.050 (3.7418-3.7421)	AX	93.035-93.050 (3.6628-3.6634)
			CX	93.051-93.066 (3.6634-3.6640)

4JH1TC mm (in)

Liner Outside Grade	Cylinder Body Bore Diameter	Liner Outside Diameter	Liner Bore Grade	Service Liner Bore Measurement
1	97.001-97.010 (3.8189-3.8193)	97.011-97.020 (3.8193-3.8197)	AX	95.435-95.450 (3.7573-3.7579)
			CX	95.451-95.466 (3.7579-3.7585)
2	97.011-97.020 (3.8193-3.8197)	97.021-97.030 (3.8197-3.8200)	AX	95.435-95.450 (3.7573-3.7579)
			CX	95.451-95.466 (3.7579-3.7585)
3	97.021-97.030 (3.8197-3.8200)	97.031-97.040 (3.8200-3.8205)	AX	95.435-95.450 (3.7573-3.7579)
			CX	95.451-95.466 (3.7579-3.7585)
4	97.031-97.040 (3.8200-3.8205)	97.041-97.050 (3.8205-3.8209)	AX	95.435-95.450 (3.7573-3.7579)
			CX	95.451-95.466 (3.7579-3.7585)



012RY00017

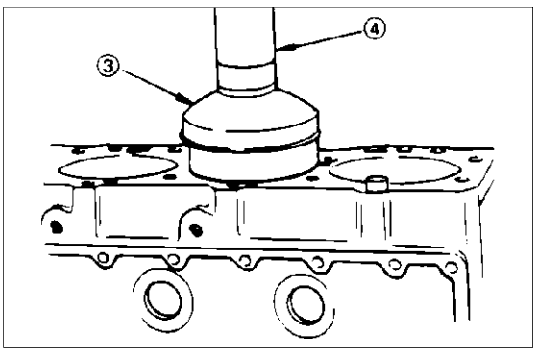
Cylinder Liner Installation

1. Cylinder Liner Installation Using The Special Tool
   1. Use new kerosene or diesel oil to thoroughly clean the cylinder liners and bores.
   2. Use compressed air to blow-dry the cylinder liner and bore surfaces.

NOTE:

All foreign material must be carefully removed from the cylinder liner and the cylinder bore before installation.

3. Insert the cylinder liner (1) into the cylinder body (2) from the top of the cylinder body.



012RY00018

4. Set the cylinder liner installer (3) to the top of the cylinder liner.
   Cylinder Liner Installer : 5-8840-2040-0 (4JA1L/TC)
   : 5-8840-2313-0 (4JH1TC)
5. (3) is directly beneath the bench press shaft center (4).

NOTE:

Check that the cylinder liner is set perpendicular to the bench press and that there is no wobble.

6. Use the bench press to apply a seating force of 4,900 N (500 kg/1,100 lb) to the cylinder liner.
7. Apply a force of 24,500 N (2,500 kg/5,500 lb) to fully seat the cylinder liner.
8. After installing the cylinder liner, measure the cylinder liner projection.
   Refer to "Cylinder Liner Projection Inspection".

Piston Grade Selection

Measure the cylinder liner bore after installing the cylinder liner. Then select the appropriate piston grade for the installed cylinder liner.

1. Measure the cylinder liner bore.
   Refer to "Cylinder Liner Bore Measurement"

Cylinder Liner Bore (Service Part) Grade mm (in)

	Grade	Bore measurement
4JA1T(L) 4JA1TC	AX	93.035-95.050 (3.6628-3.6634)
	CX	93.051-95.066 (3.6634-3.6640)
4JH1TC	AX	95.435-95.450 (3.7573-3.7579)
	CX	95.451-95.466 (3.7579-3.7585)

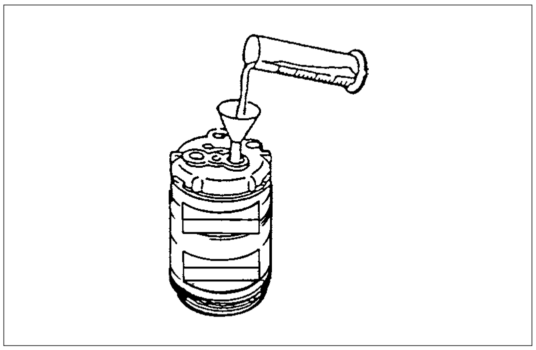
NOTE:
It is most important that the correct piston grade be used. Failure to select the correct piston grade will result in engine failure. Always measure the cylinder bore and select the correct piston grade.

OIL RETURN OPERATION

There is close affinity between the oil and the refrigerant. During normal operation, part of the oil recirculates with the refrigerant in the system.

When checking the amount of oil in the system, or replacing any component of the system, the compressor must be run in advance for oil return operation. The procedure is as follows:

1) Open the all doors and engine hood.
2) Start the engine and A/C switch is "ON" and Set the fan control knob at its highest position.
3) Run the compressor for more than 20 minutes between 800 and 1,000 rpm in order to operate the system.
4) Stop the engine.

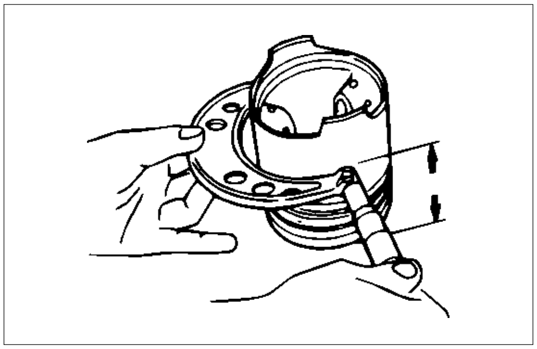


REPLACEMENT OF COMPONENT PARTS

When replacing system component parts, supply the following amount of oil to the component parts to be installed.

Component parts to be installed	Amount of oil
Evaporator	50 cm^3 (1.41 Imp fl oz)
Condenser	30 cm^3 (0.84 Imp fl oz)
Receiver/drier	30 cm^3 (0.84 Imp fl oz)
Refrigerant line (One piece)	10 cm^3 (0.28 Imp fl oz)

Refrigeration oil must be replenished if more than two parts are removed at the same time. After installing these components, check compressor oil.


015LX021

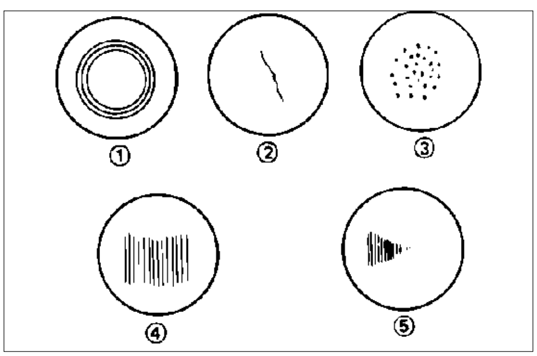
2. Measure the piston diameter.

Piston Measuring Point	mm (in)
4JA1T(L) 4JA1TC	78 (3.07)
4JH1TC	70 (2.76)

Piston Grade (Service Part)		mm (in)
4JA1T(L) 4JA1TC	AX	92.949 - 92.964 (3.6549 - 3.6600)
	CX	92.965 - 92.980 (3.6600 - 3.6606)
4JH1TC	AX	95.359 - 95.374 (3.7542 - 3.7548)
	CX	95.375 - 95.390 (3.7548 - 3.7555)

Cylinder Liner and Piston Clearance	mm (in)
4JA1T(L) 4JA1TC	0.041-0.071 (0.0016-0.0027)
4JH1TC	0.047-0.065 (0.0019-0.0026)

NOTE:
Cylinder liner kit clearances are preset. However, the cylinder liner installation procedure may result in slight decreases in cylinder liner clearances. Always measure the cylinder liner clearance after installation to be sure that it is correct.



014RY00028

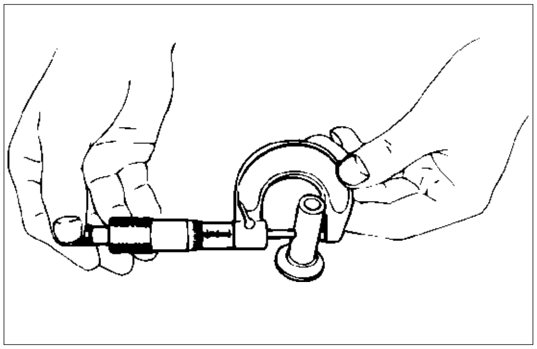
TAPPET AND PUSH ROD

Visually inspect the tappet contact surfaces for pitting, cracking, and other abnormal conditions. The tappet must be replaced if any of these conditions are present.

Refer to the illustration at the left.

1. Normal contact
2. Cracking
3. Pitting
4. Irregular contact Uneven contact
5. Irregular contact One-sided contact

NOTE:
The tappet surfaces are spherical. Do not attempt to grind them with an oil stone or similar tool in an effort to repair the tappet. If the tappet is damaged, it must be replaced.



014RY00029

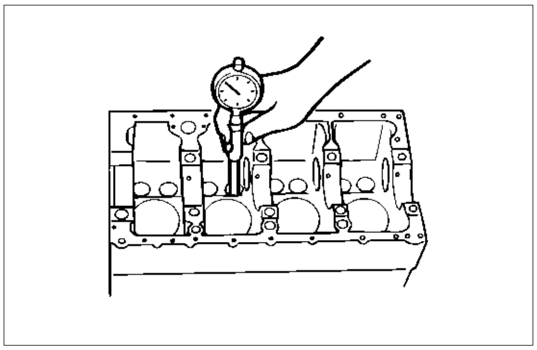
Tappet Outside Diameter

Measure the tappet outside diameter with a micrometer.

If the measured value is less than the specified limit, the tappet must be replaced.

Tappet Outside Diameter mm (in)

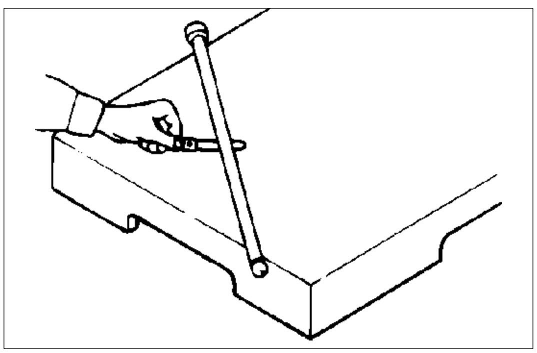
Standard	Limit
12.97 - 12.99 (0.510 - 0.511)	12.95 (0.510)



012LX014

Tappet and Cylinder Body Clearance mm (in)

Standard	Limit
0.01 - 0.046 (0.0004 - 0.0018)	0.10 (0.004)



014RY00031

Push Rod Curvature

1. Lay the push rod on a surface plate.
2. Roll the push rod along the surface plate and measure the push rod curvature with a thickness gauge.

   If the measured value exceeds the specified limit, the push rod must be replaced.

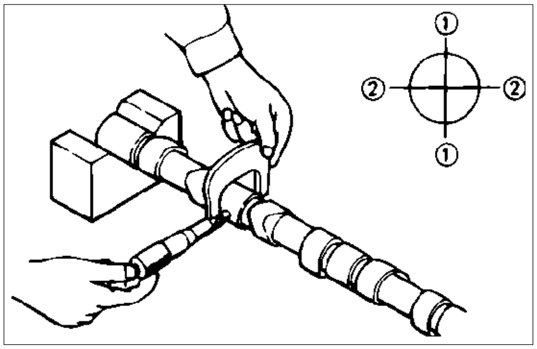
Pushrod Curvature mm (in)

Limit
0.3 (0.012)

3. Visually inspect both ends of the push rod for excessive wear and damage. The push rod must be replaced if these conditions are discovered during inspection.

CAMSHAFT

Visually inspect the journals, the cams, the oil pump drive gear, and the camshaft bearings for excessive wear and damage. The camshaft and the camshaft bearings must be replaced if these conditions are discovered during inspection.



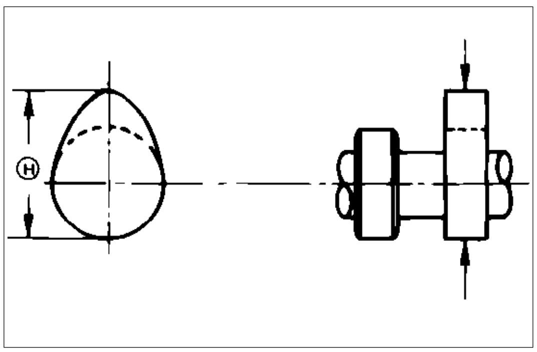
014RY00032

Camshaft Journal Diameter

Use a micrometer to measure each camshaft journal diameter in two directions (1 and 2). If the measured value is less than the specified limit, the camshaft must be replaced.

Camshaft Journal Diameter mm (in)

Standard	Limit
49.945 - 49.975 (1.9663 - 1.9675)	49.60 (1.953)



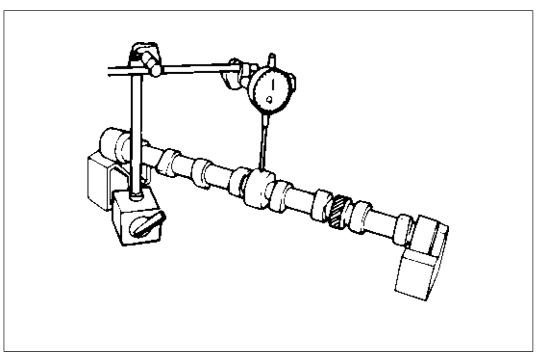
014RY00033

Cam Height

Measure the cam height (H) with a micrometer. If the measured value is less than the specified limit, the camshaft must be replaced.

Cam Height (H) mm (in)

Standard	Limit
42.016 (1.6542)	41.65 (1.640)


014LX092

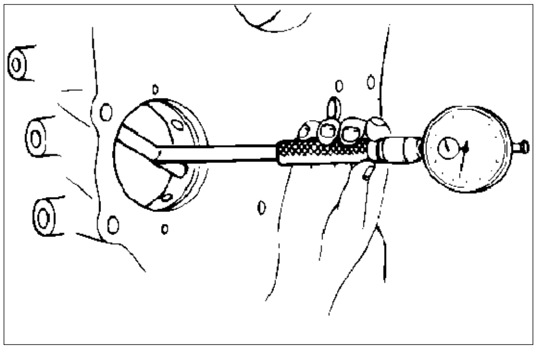
Camshaft Run-Out

1. Mount the camshaft on V-blocks.
2. Measure the run-out with a dial indicator.

   If the measured value exceeds the specified limit, the camshaft must be replaced.

Camshaft Run-Out mm (in)

Standard	Limit
0.02 (0.0008)	0.10 (0.004)



014RY00034

Camshaft and Camshaft Bearing Clearance

Use an inside dial indicator to measure the camshaft bearing inside diameter.

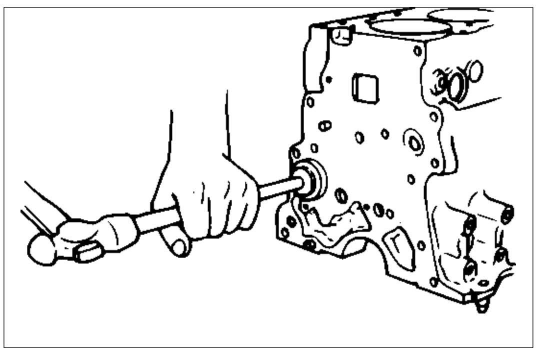
Crankshaft Bearing Inside Diameter mm (in)

Standard	Limit
50.00 - 50.03 (1.968 - 1.970)	50.08 (1.972)

If the clearance between the camshaft bearing inside diameter and the journal exceeds the specified limit, the camshaft bearing must be replaced.

Camshaft Bearing Clearance mm (in)

Standard	Limit
0.055 (0.0022)	0.12 (0.005)



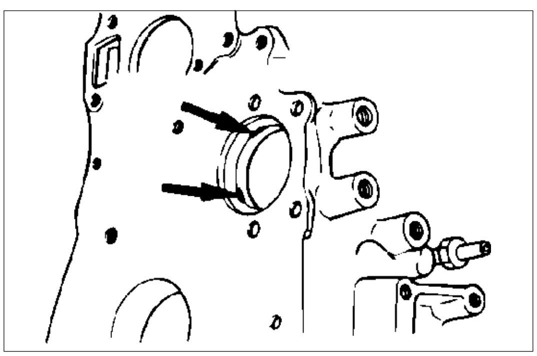
014RY00035

Camshaft Bearing Replacement

Camshaft Bearing Removal

1. Remove the cylinder body plug plate.
2. Use the bearing replacer to remove the camshaft bearing.

Bearing Replacer: 5-8840-2038-0



014RY00036

Camshaft Bearing Installation

1. Align the bearing oil holes with the cylinder body oil holes.
2. Use the replacer to install the camshaft bearing.

Bearing Replacer: 5-8840-2038-0

CRANKSHAFT AND BEARING

Inspect the surface of the crankshaft journals and crankpins for excessive wear and damage.

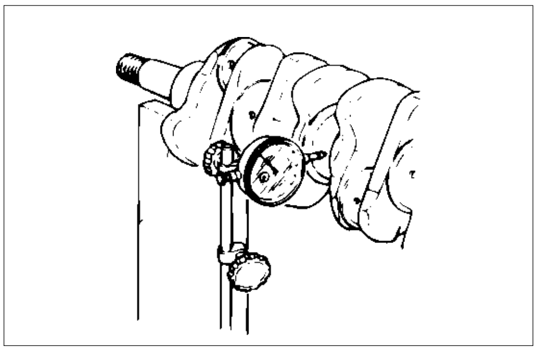
Inspect the oil seal fitting surfaces for excessive wear and damage.

Inspect the oil ports for obstructions.

NOTE:

To increase crankshaft strength, tufftriding (Nitrizing Treatment) has been applied. Because of this, it is not possible to regrind the crankshaft surfaces.

Therefore, under size bearing are not available.



015LX061

Crankshaft Run-Out

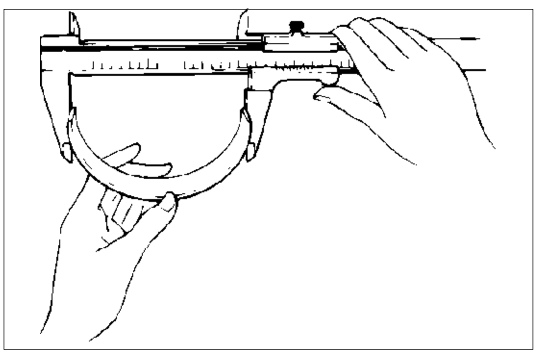
1. Set a dial indicator to the center of the crankshaft journal.
2. Gently turn the crankshaft in the normal direction of rotation.

   Read the dial indicator as you turn the crankshaft.

   If the measured value exceeds the specified limit, the crankshaft must be replaced.

Crankshaft Run-Out mm (in)

Standard	Limit
0.05 (0.002) or less	0.08 (0.003)



015RY00007

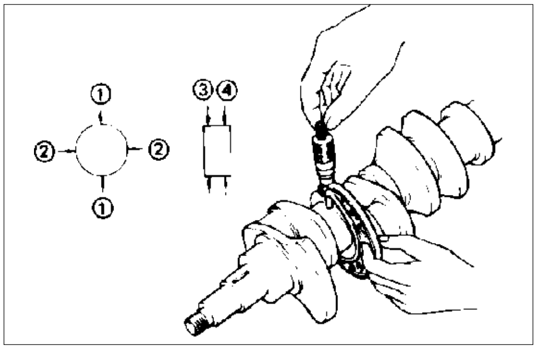
Bearing Spread

Use a vernier caliper to measure the bearing spread.

If the measured value is less than the specified limit, the bearing must be replaced.

Bearing Spread mm (in)

		Limit
Creankshaft Bearing	4JA1T (L), 4JA1TC	64.5 (2.54)
	4JH1TC	74.5 (2.93)
Connecting Rod Bearing		56.5 (2.22)



015RY00008

Crankshaft Journal and Crankpin Diameter

1. Use a micrometer to measure the crankshaft journal diameter across points 1 - 1 and 2 - 2.
2. Use the micrometer to measure the crankshaft journal diameter at the two points (3 and 4).
3. Repeat Steps 1 and 2 to measure the crankpin diameter.

   If the measured values are less than the specified limit, the crankshaft must be replaced.

Crankshaft Journal and Diameter mm (in)

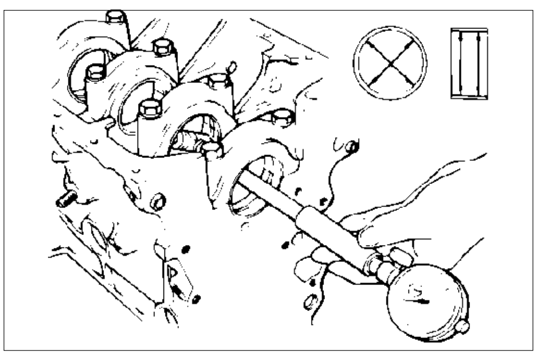
	Standard	Limit
4JA1T (L), 4JA1TC	59.921-59.928 (2.3591-2.3594)	59.91 (2.3586)
4JH1TC	69.917-69.932 (2.7526-2.7532)	69.91(2.7524)

Crankpin Diameter mm (in)

Standard	Limit
52.915 - 52.930 (2.0833 - 2.0839)	52.90 (2.083)

Crankshaft Journal and Crankpin Uneven Wear mm (in)

Standard	Limit
0.05 (0.002) or less	0.08 (0.003)



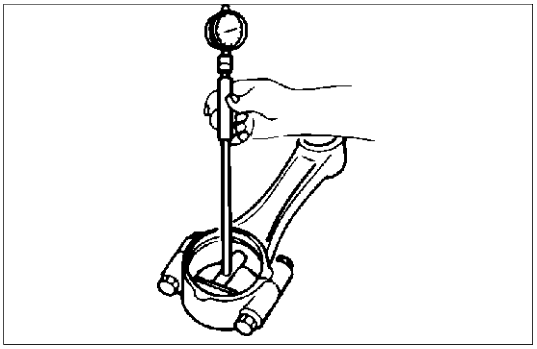
015RY00009

Crankshaft Journal and Crankpin Diameter

If the clearance between the measured bearing inside diameter and the crankshaft journal diameter exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankshaft Journal and Bearing Clearance mm (in)

Standard	Limit
0.032 - 0.077 (0.0013 - 0.0030)	0.110 (0.0043)


015RY00011

Connecting Rod Bearing Inside Diameter

1. Install the bearing to the connecting rod big end.
2. Tighten the bearing cap to the two step of anglar tightening method.

Connecting Rod Bearing Cap Bolt Torque N·m (kg·m/lb ft)

4JA1T (L), 4JA1TC	78-88 (8.0/57 – 9.0/65)
4JH1TC	1st step ; 29.0–29.2 (3.00/22.0–3.01/22.2)
	2nd step ; 45°-60°

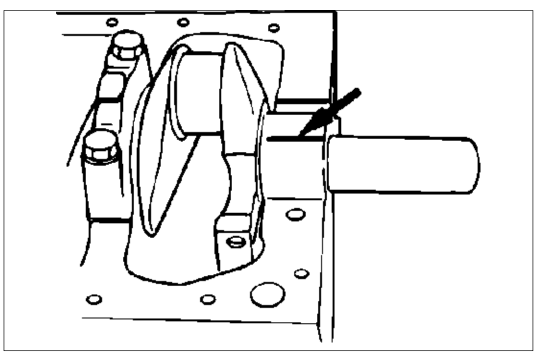
3. Use an inside dial indicator to measure the connecting rod bearing inside diameter.

Crankpin and Bearing Clearance

If the clearance between the measured bearing inside diameter and the crankpin exceeds the specified limit, the bearing and/or the crankshaft must be replaced.

Crankpin and Bearing Clearance mm (in)

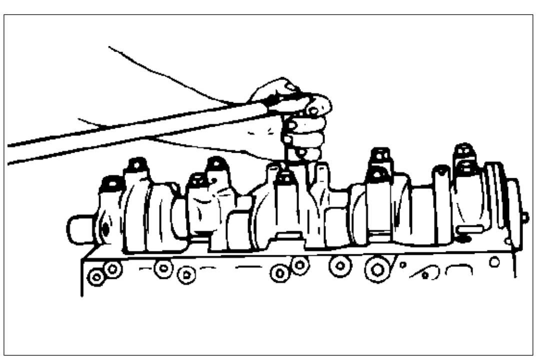
	Standard	Limit
4JA1T (L), 4JA1TC	0.029-0.066 (0.0011-0.0026)	0.100(0.0039)
4JH1TC	0.029-0.083 (0.0011-0.033)	0.100 (0.0039)


015RY00012

Clearance Measurements (With Plastigage)

Crankshaft Journal and Bearing Clearance

1. Clean the cylinder body, the journal bearing fitting surface, the bearing caps, and the bearings.
2. Install the bearings to the cylinder body.
3. Carefully place the crankshaft on the bearings.
4. Rotate the crankshaft approximately 30° to seat the bearing.
5. Place the Plastigage (arrow) over the crankshaft journal across the full width of the bearing.
6. Install the bearing caps with the bearing.


015RY00013

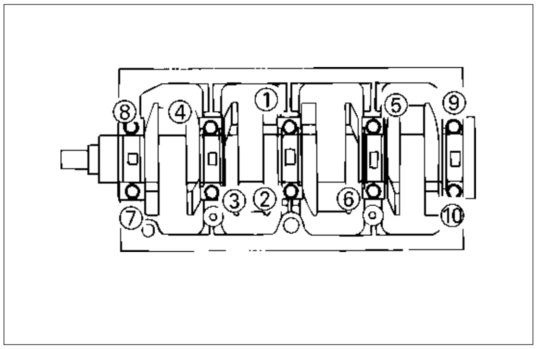
7. Tighten the bearing caps to the specified torque.

Crankshaft Bearing Cap Bolt Torque mm (in)

167 (17/123)

Do not allow the crankshaft to turn during bearing cap installation and tightening.

8. Remove the bearing cap.



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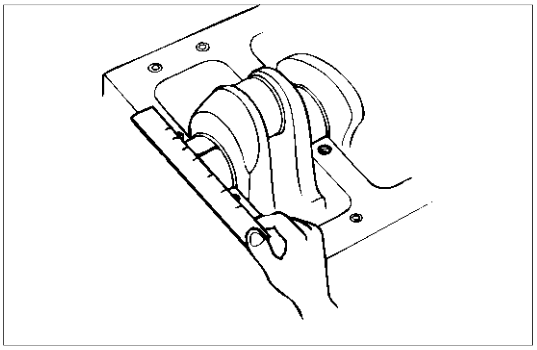


015LX060

9. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

   If the measured value exceeds the limit, perform the following additional steps.

   1. Use a micrometer to measure the crankshaft outside diameter.
   2. Use an inside dial indicator to measure the bearing inside diameter.

      If the crankshaft journal and bearing clearance exceeds the limit, the crankshaft and/or the bearing must be replaced.

Crankshaft Journal and Bearing Clearance mm (in)

Standard	Limit
0.032 - 0.077 (0.0013 - 0.0030)	0.110 (0.0043)

Crankpin and Bearing Clearance

1. Clean the crankshaft, the connecting rod, the bearing cap, and the bearings.
2. Install the bearing to the connecting rod and the bearing cap.

   Do not allow the crankshaft to move when installing the bearing cap.
3. Prevent the connecting rod from moving.
4. Attach the Plastigage to the crankpin.

   Apply engine oil to the Plastigage to keep it from falling.
5. Install the bearing cap and tighten it to the two step of anglar tihtening method.

   Do not allow the connecting rod to move when installing and tightening the bearing cap.

Connecting Rod Bearing Cap Bolt Torque N·m (kg·m/lb ft)

4JA1T (L), 4JA1TC	78-88 (8.0/57 – 9.0/65)
4JH1TC	1st step ; 29.0–29.2 (3.00/22.0–3.01/22.2)
	2nd step ; 45°-60°

6. Remove the bearing cap.
7. Compare the width of the Plastigage attached to either the crankshaft or the bearing against the scale printed on the Plastigage container.

   If the measured value exceeds the specified limit, perform the following additional steps.

   1. Use a micrometer to measure the crankpin outside diameter.
   2. Use an inside dial indicator to measure the bearing inside diameter.

      If the crank pin and bearing clearance exceeds the specified limit, the crankshaft and/or the bearing must be replaced.

Crankpin and Bearing Clearance mm (in)

	Standard	Limit
4JA1T (L), 4JA1TC	0.029-0.066 (0.0011-0.0026)	0.100 (0.0039)
4JH1TC	0.029-0.083 (0.0011-0.0033)	0.100 (0.0039)

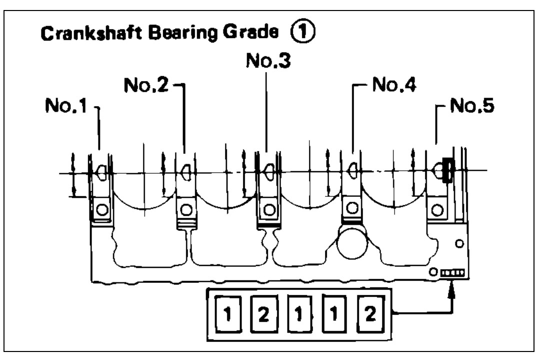
CRANKSHAFT BEARING SELECTION

Crankshaft bearing selection is based on the measured diameters of the crankshaft journals and the bearing inserts.

Match the crankshaft bearing housing grade marks and the crankshaft journal grade marks in the table below to determine the correct crankshaft bearing size.

Crankshaft Bearing Housing Grade Mark Position

Crankshaft bearing housing grade marks 1, 2 or 3 are stamped on the rear right hand side of the cylinder body.

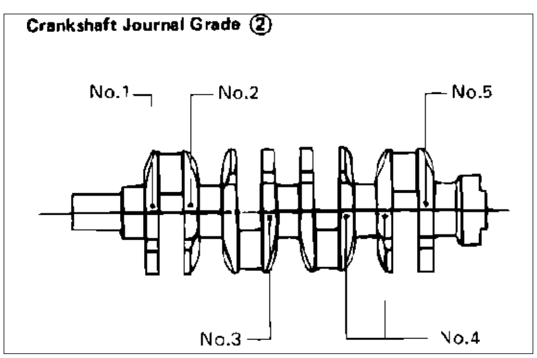


015LX060

Crankshaft Journal Grade Mark Position

The crankshaft journal grade marks (1 or -, 2 or --, 3 or ---) are stamped on each crankshaft journal web.

The crankshaft journal and bearing clearance must be the same for each position after installation of the crankshaft and the crankshaft bearings.



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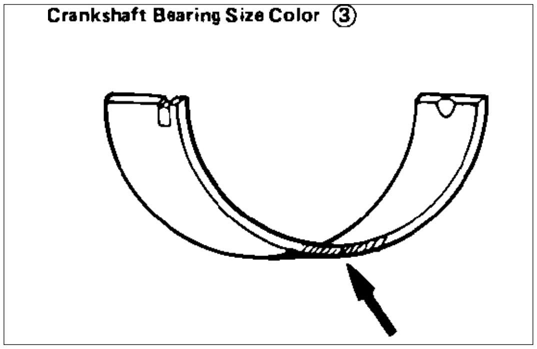
NOTE:

The crankshaft journal mark No. 4 is stamped on crankshaft No. 4 journal web front side or rear side.



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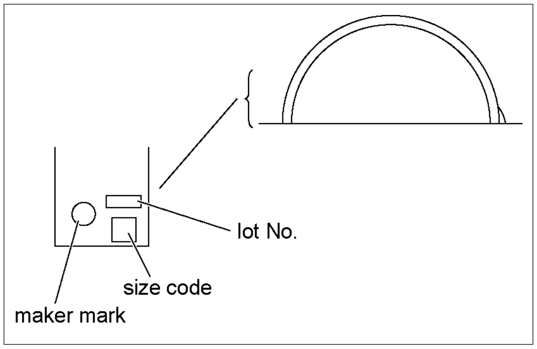

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REFERENCE

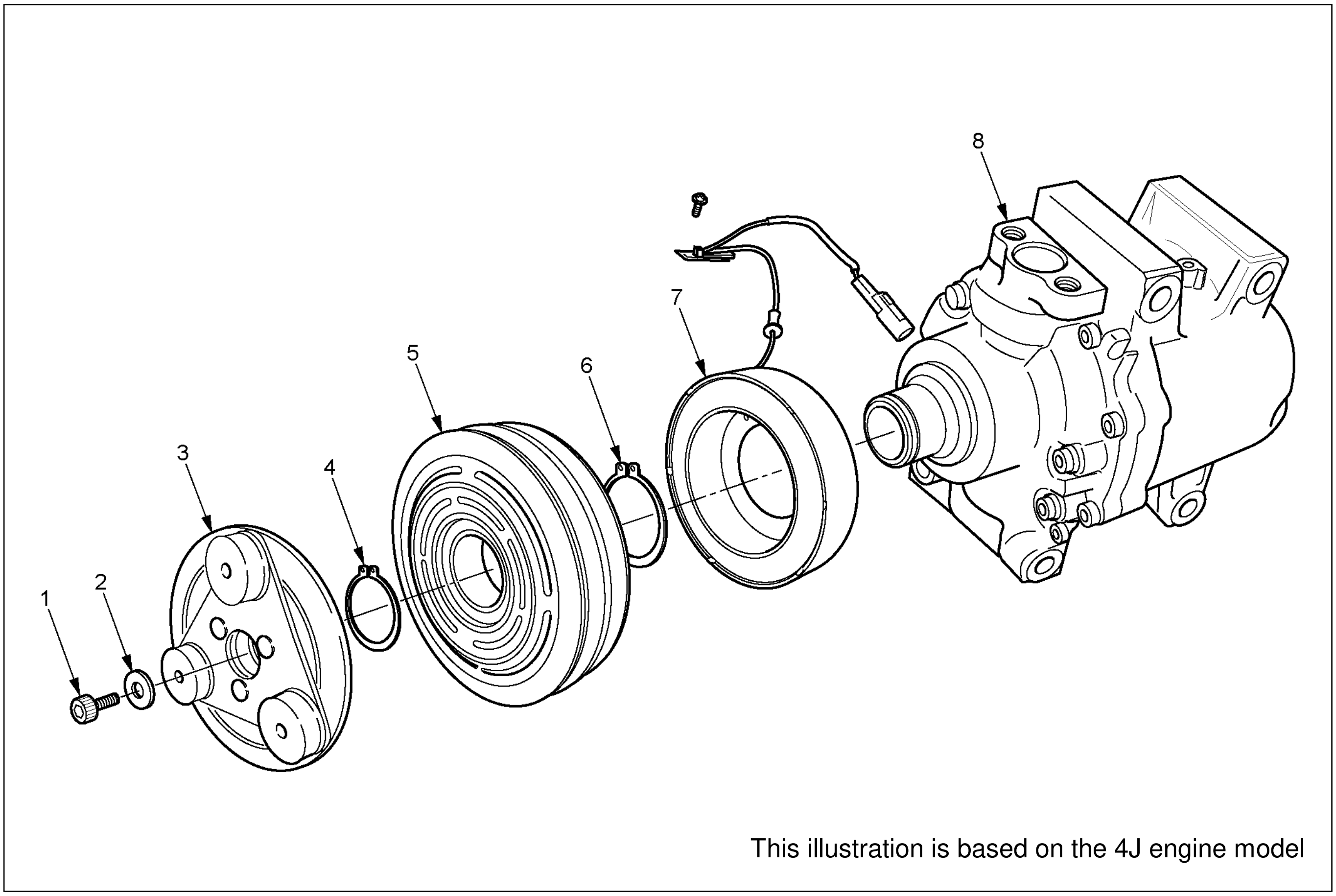
4JA1T(L), 4JA1TC mm (in)

Crankshaft Bearing Housing		Crankshaft Journal		Crankshaft Bearing Size Code
Grade Mark	Diamaeter	Grade Mark	Diamaeter	
1	63.992-64.000 (2.5194-2.5197)	1 or -	59.927-59.932 (2.3593-23.595)	Brown or 4
		2 or - -	59.922-59.927 (2.3591-2.3539)	
		3 or - - -	59.917-59.922 (2.3589-2.3591)	Yellow or 5
2	63.983-63.992 (2.5190-2.5194)	1 or -	59.927-59.932 (2.3593-2.3595)	Black or 2
		2 or - -	59.922-59.927 (2.3591-2.3593)	Blue or 3
		3 or - - -	59.917-59.922 (2.3589-2.3591)	Brown or 4
3	63.975-63.983 (2.5187-2.5190)	1 or -	59.927-59.932 (2.3593-2.3595)	Green or 1
		2 or - -	59.922-59.927 (2.3591-2.3593)	Black or 2
		3 or - - -	59.917-59.922 (2.3598-2.3591)	

4JH1TC mm (in)

Crankshaft Bearing Housing		Crankshaft Journal		Crankshaft Bearing Size Code
Grade Mark	Diamaeter	Grade Mark	Diamaeter	
1	73.992-74.000 (2.9131-2.9134)	1 or -	69.927-69.932 (2.7530-2.7532)	4
		2 or - -	69.922-69.927 (2.7528-2.7530)	
		3 or - - -	69.917-69.922 (2.7556-2.7528)	5
2	73.983-73.992 (2.9127-2.9131)	1 or -	69.927-69.932 (2.7530-2.7532)	2
		2 or - -	69.922-69.927 (2.7528-2.7530)	3
		3 or - - -	69.917-69.922 (2.7556-2.7528)	4
3	73.975-73.983 (2.9124-2.9127)	1 or -	69.927-69.932 (2.7530-2.7532)	1
		2 or - -	69.922-69.927 (2.7528-2.7530)	2
		3 or - - -	69.917-69.922 (2.7526-2.7528)	

DISASSEMBLY

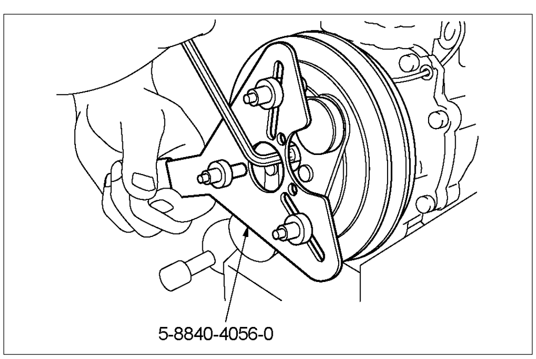


RTW510MF000301

Disassembly Steps

- ▲ 1. Drive plate bolt
- 2. Plain washer
- ▲ 3. Drive plate
- 4. Snap ring
- ▲ 5. Pulley assembly
- ▲ 6. Snap ring
- 7. Field coil
- 8. Compressor

Important Operations - Disassembly



RTW510SH000701

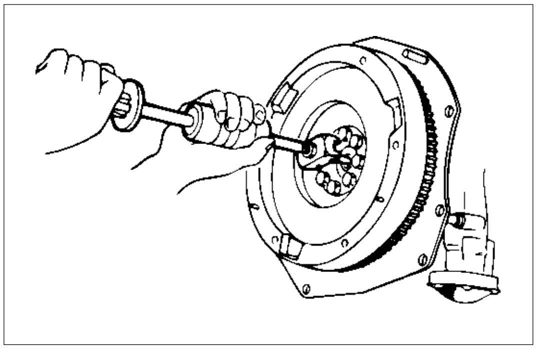
1. Drive Plate Bolt

Using drive plate holder to prevent the drive plate from rotating, then remove the bolt.

Drive Plate Holder: 5-8840-4056-0 (J-37872)

CRANKSHAFT PILOT BEARING

Check the crankshaft pilot bearing for excessive wear and damage and replace it if necessary.



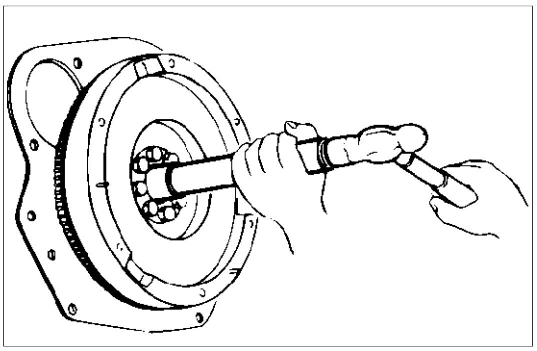
015RY00018

Crankshaft Pilot Bearing Replacement

Crankshaft Pilot Bearing Removal

Use the pilot bearing remover to remove the crankshaft pilot bearing.

Pilot Bearing Remover: 5-8840-2000-0
Sliding Hammer: 5-8840-0019-0



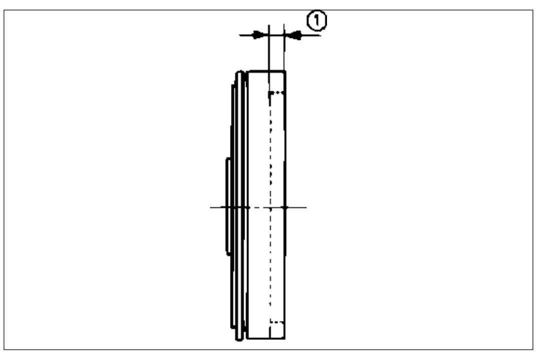
015RY00010

Crankshaft Pilot Bearing Installation

1. Place the crankshaft pilot bearing right angle across the crankshaft bearing installation hole.
2. Tap around the edges of the crankshaft pilot bearing outer races with a brass hammer to drive the bearing into the crankshaft bearing installation hole.

   Pilot Bearing Installer: 5-8522-0024-0

NOTE:
Strike only the crankshaft pilot bearing outer race with the hammer. Do not strike the bearing inner race. Bearing damage and reduced bearing service life will result.



015RY00019

FLYWHEEL AND RING GEAR

Flywheel

1. Inspect the flywheel friction surface for excessive wear and heat cracks.
2. Measure the flywheel friction surface depth.

   If the measured value is within the specified limit, the flywheel may be reground.

   If the measured value exceeds the specified limit, the flywheel must be replaced.

Flywheel Friction Surface Depth (1) mm (in)

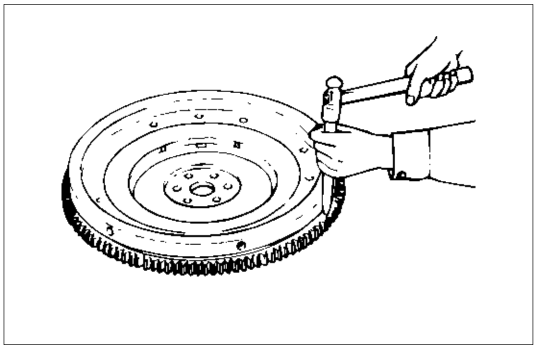
	Standard	Limit
4JA1T (L), 4JA1TC	20 (0.7874)	21 (0.8267)
4JH1TC	18 (0.7087)	19 (0.7480)

Ring Gear

Inspect the ring gear.

If the ring gear teeth are broken or excessively worn, the ring gear must be replaced.

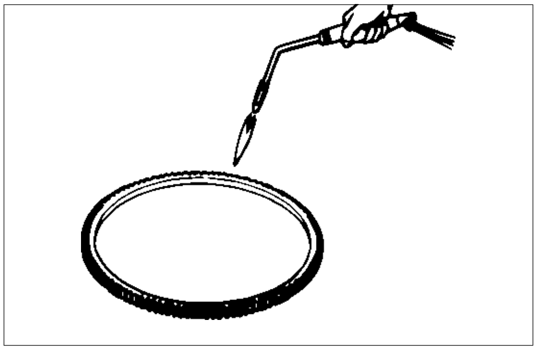
Ring Gear Replacement



020LX008

Ring Gear Removal

Strike around the edges of the ring gear with a hammer and chisel to remove it.



020LX009

Ring Gear Installation

1. Heat the ring gear evenly with a gas burner to invite thermal expansion.

   Do not allow the temperature of the gas burner to exceed 200°C (390°F).

2. Install the ring gear when it is sufficiently heated.

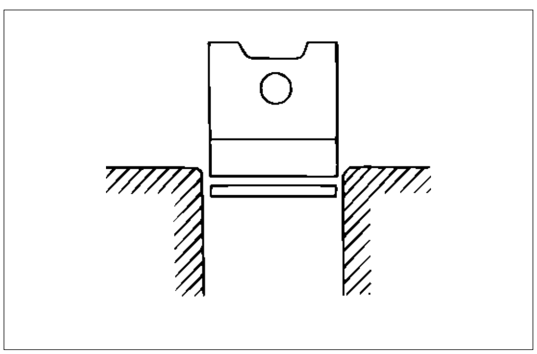
   The ring gear must be installed with the chamfer facing the clutch.

PISTON

Piston Grade Selection and Cylinder Bore Measurement

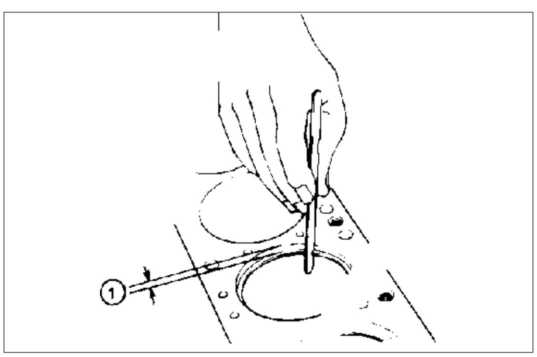
Refer to the Section "Cylinder Body", Item "Cylinder Liner Bore Measurement" for details on piston grade selection and cylinder liner bore measurement.

Piston Ring Gap



015LX023

1. Insert the piston ring horizontally (in the position it would assume if it were installed to the piston) into the cylinder liner.



015RY00020

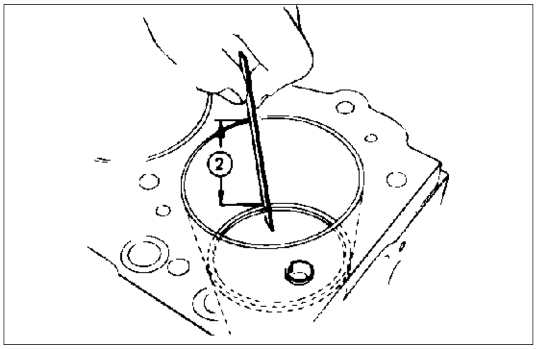
2. Push the piston ring into the cylinder bore until it reaches the measuring point 1 or 2 where the cylinder liner bore is the smallest.

   Do not allow the piston ring to slant to one side or the other. It must be perfectly horizontal.

   Measuring Point 1 10 mm (0.4 in)

   or

   Measuring Point 2 120 mm (4.7 in)



015RY00021

3. Use a feeler gauge to measure the piston ring gap.
   If the measured value exceeds the specified limit, the piston ring must be replaced.

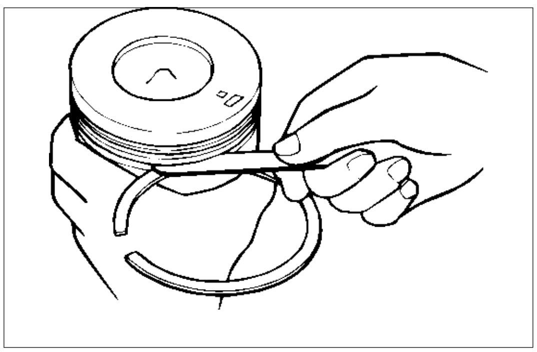
Piston Ring Gap mm (in)

4JA1T (L), 4JA1TC

	Standard	Limit
1st Compression Ring	0.3-0.3 (0.0118-0.0197)	1.5 (0.059)
2nd Compression Ring		
Oil Ring	0.250-0.450 (0.0098-0.0177)	

4JH1TC

	Standard	Limit
1st Compression Ring	0.3-0.5 (0.0118-0.0197)	1.5 (0.059)
2nd Compression Ring		
Oil Ring	0.250-0.450 (0.0098-0.0177)	



015LX025

Piston Ring and Piston Ring Groove Clearance

Use a feeler gauge to measure the clearance between the piston ring and the piston ring groove at several points around the piston.

If the clearance between the piston ring and the piston ring groove exceeds the specified limit, the piston ring must be replaced.

Piston Ring and Piston Ring Groove Clearance mm (in)

4JA1T (L), 4JA1TC

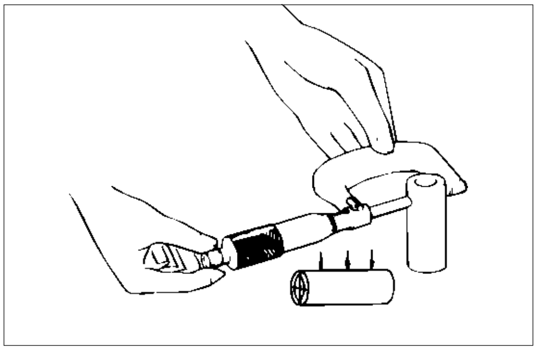
	Standard	Limit
1st Compression Ring	0.09-0.125 (0.0035-0.0049)	0.15 (0.0059)
2nd Compression Ring	0.05-0.085 (0.0020-0.0033)	
Oil Ring	0.03-0.070 (0.0012-0.0028)	

4JH1TC

	Standard	Limit
1st Compression Ring	0.09-0.130 (0.0035-0.0051)	0.15 (0.0059)
2nd Compression Ring	0.05-0.090 (0.0020-0.0035)	
Oil Ring	0.03-0.070 (0.0012-0.0028)	

4. Visually inspect the piston rings.

If a piston ring groove is damaged or distorted, the piston must be replaced.



015LX026

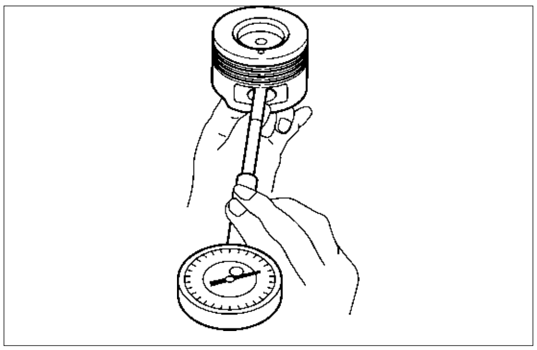
Piston Pin Diameter

Use a micrometer to measure the piston pin diameter at several points.

If the measured value is less than the specified limit, the piston pin must be replaced.

Piston Pin Diameter mm (in)

Standard	Limit
30.995-31.000 (1.2202-1.2204)	30.97 (1.2193)



015RW048

Piston Pin and Piston Clearance

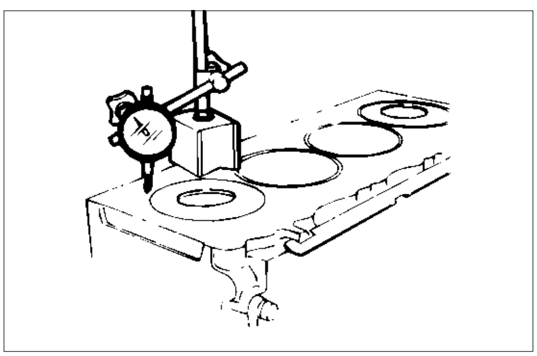
Use and inside dial indicator to measure the piston pin hole (in the piston).

Piston Pin Hole mm (in)

4JA1T (L)	31.002-31.010 (1.2206-1.2208)
4JA1TC, 4JH1TC	31.005-31.013 (1.2207-1.2210)

Piston Pin and Piston Pin Hole Clearance mm (in)

4JA1T (L)	0.002-0.015 (0.00008-0.0006)
4JA1TC, 4JH1TC	0.005-0.018 (0.0002-0.0007)



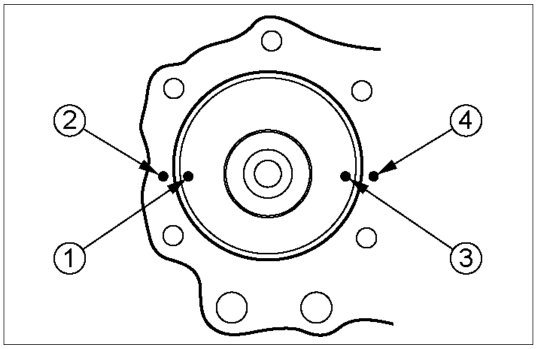
011LX011

CYLINDER HEAD GASKET SELECTION

Cylinder head gasket is determined by the piston head projection from the cylinder body upper surface, in order to improve engine performance.

Three types of gasket are provided by the difference of thickness. Select the adequet one out of three grades of gasket, according to the following procedure.

Before measurement, clear off carbon from the piston head and cylinder body surface and also clean the place where a gasket was installed.



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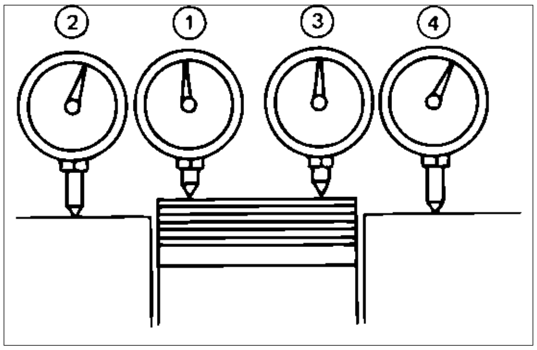
Piston Head Projection Measuring Point

1. Use a dial indicator to measure the piston projection amount.
2. Refer to the illustration for the piston head projection measuring positions.

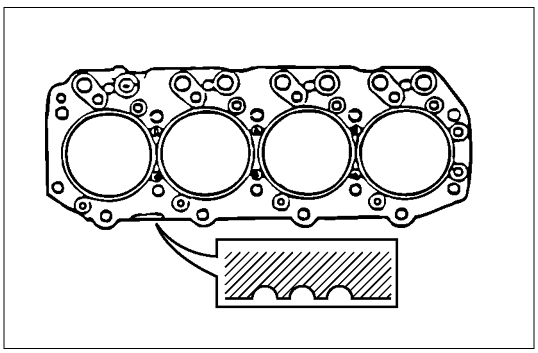
   All measuring positions should be as close as possible to the cylinder liner.



011RY00027

3. Measure the points 1, 2, 3, 4 and obtain two differences 1-2 and 3-4 on each cylinder.

   Calculate the average value of the piston head projection on each cylinder.
4. Obtain the maximum value in the four cylinders.
5. Determine the gasket grade required to the maximum value described above in accordance with the following table.



011RY00030

Cylinder Head Gasket Combination mm (in)

Cylinder Head Gasket Combination

4JA1T (L), 4JA1TC mm (in)

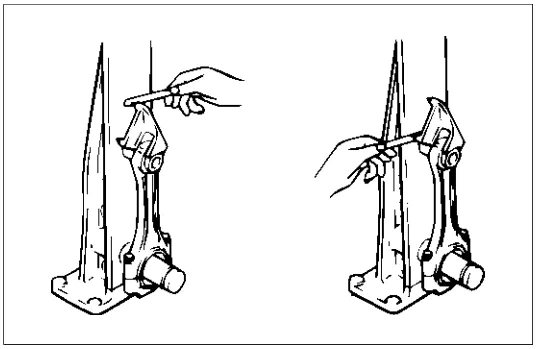
Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
A		0.718-0.773 (0.0283-0.0304)	1.6 (0.0630)
B		0.773-0.819 (0.0304-0.0322)	1.65 (0.0650)
C		0.819-0.874 (0.0322-0.0344)	1.70 (0.0669)

4JH1TC mm (in)

Gasket Grade Mark		Piston Projection	Gasket Thickness (Reference)
A		0.215-0.265 (0.0085-0.0104)	1.3 (0.5118)
B		0.265-0.315 (0.0104-0.0124)	1.35 (0.5315)
C		0.315-0.365 (0.0124-0.0144)	1.4 (0.5512)

NOTE:

Difference of the each piston projection and must be equal or within 0.1 mm (0.004 in).



015LX034

CONNECTING ROD

Connecting Rod Alignment

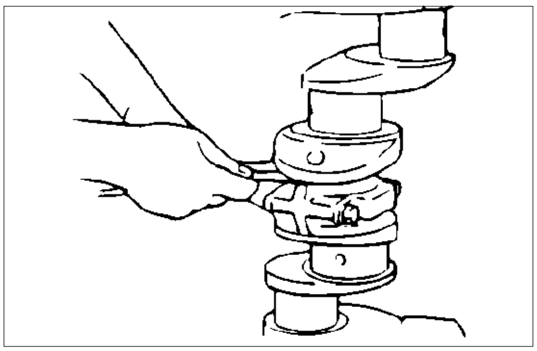
Use a connecting rod aligner to measure the distortion and the parallelism between the connecting rod big end hole and the connecting rod small end hole.

If either the measured distortion or parallelism exceed the specified limit, the connecting rod must be replaced.

Connecting Rod Alignment Per Length of 100 mm (3.94 in)

mm (in)

	Standard	Limit
Distortion	0.08 (0.003) or Less	0.20 (0.008)
Parallelism	0.05 (0.002) or Less	0.15 (0.006)



011RY00029

Connecting Rod Side Face Clearance

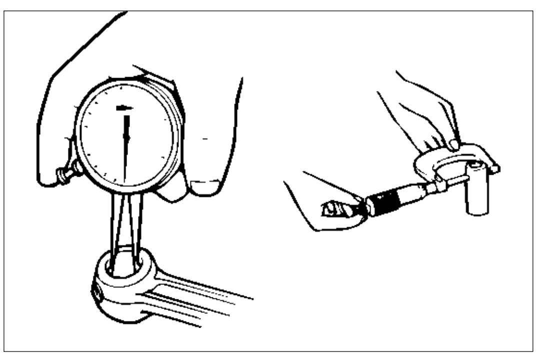
1. Install the connecting rod to the crankpin.
2. Use a feeler gauge to measure the clearance between the connecting rod big end side face and the crankpin side face.

   If the measured value exceeds the specified limit, the connecting rod must be replaced.

Connecting Rod Big End and Crankpin Side Face Clearance

mm (in)

Standard	Limit
0.23 (0.009)	0.35 (0.014)



015LX028

Piston Pin and Connecting Rod Small End Bushing Clearance

Use a caliper calibrator and a dial indicator to measure the piston pin and connecting rod small end bushing clearance.

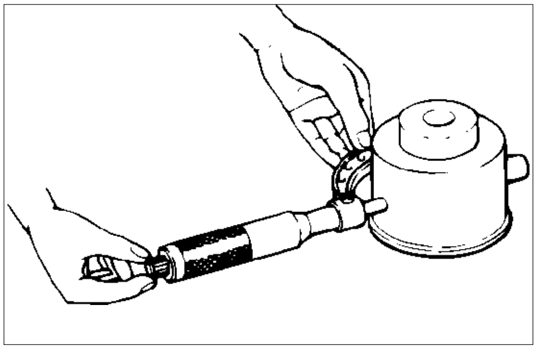
If the clearance between the piston pin and the connecting rod small end bushing exceeds the specified limit, replace the piston pin and/or the connecting rod.

Piston Pin and Connecting Rod Small End Bushing Clearance

mm (in)

	Standard	Limit
4JA1T (L)	0.008-0.020 (0.003-0.0008)	0.050 (0.002)
4JA1TC, 4JH1TC	0.005-0.018 (0.0002-0.0007)	0.050 (0.002)

IDLER GEAR SHAFT AND IDLER GEAR


020RY00025

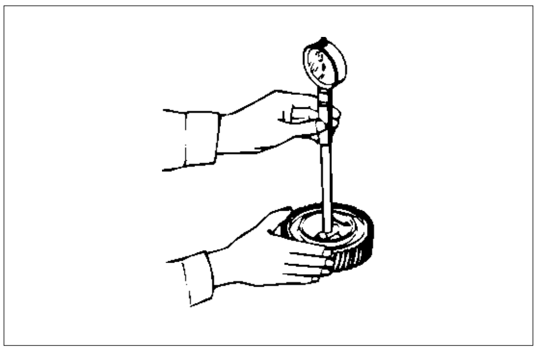
Idler Gear "A" Shaft Outside Diameter

Use a micrometer to measure the idler gear shaft outside diameter.

If the measured value is less than the specified limit, the idler gear shaft must be replaced.

Idler Gear "A" Shaft Outside Diameter mm (in)

Standard	Limit
44.945-44.975 (1.7695-1.7707)	44.845 (1.755)


014LX022

Idler Gear "A" Shaft inside Diameter

1. Use an inside dial indicator or an inside micrometer to measure the idler gear inside diameter.

Idler Gear Inside Diameter mm (in)

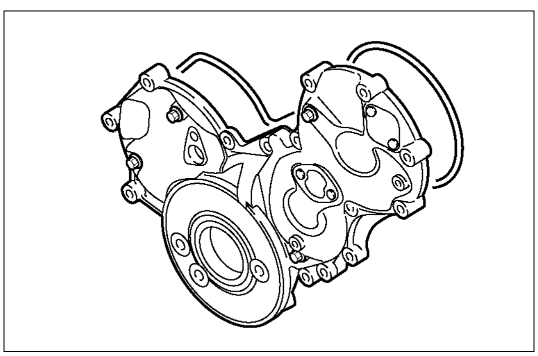
Standard	Limit
45.0-45.03 (1.7717-1.7718)	45.10 (1.7756)

If the clearance between the idler gear shaft outside diameter and the idler gear inside diameter exceeds the limit, the idler gear must be replaced.

Idler Gear Shaft and Idler Gear Clearance mm (in)

Standard	Limit
0.025-0.085 (0.0010-0.0033)	0.200 (0.0079)

TIMING GEAR CASE COVER


020R300004

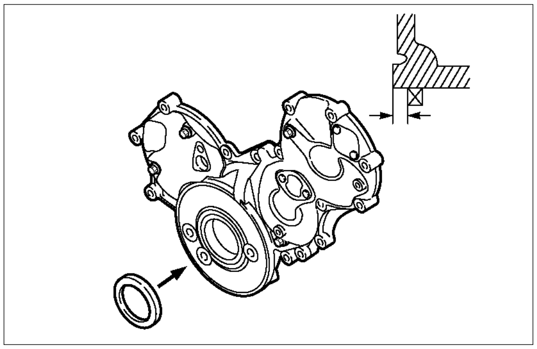
Replace the crankshaft front oil seal if it is excessively worn or damaged.

Crankshaft Front Oil Seal Replacement

Oil Seal Removal

Use a plastic hammer and a screwdriver to tap around the oil seal to free it from the gear case cover.

Take care not to damage the oil seal lip surfaces.



020R300005

Oil Seal Installation

Use the special tool to install the front oil seal.

Front Oil Seal Installer: 5-8840-2361-0

1. With the oil seal attached to the sleeve, insert it into the front end section of the crankshaft.
2. With the oil seal end section attached securely to the crankshaft, tighten up the center bolt until the sleeve hits the front end reference plane of the crankshaft securely.
3. Remove the sleeve.
4. With the seal pressed in, check the dimension of the oil seal section.

Standard Dimension = 1.0 ± 0.03mm

NOTE:

Install the oil seal after assembling the timing pulley housing. The oil seal lip section is applied with oil.

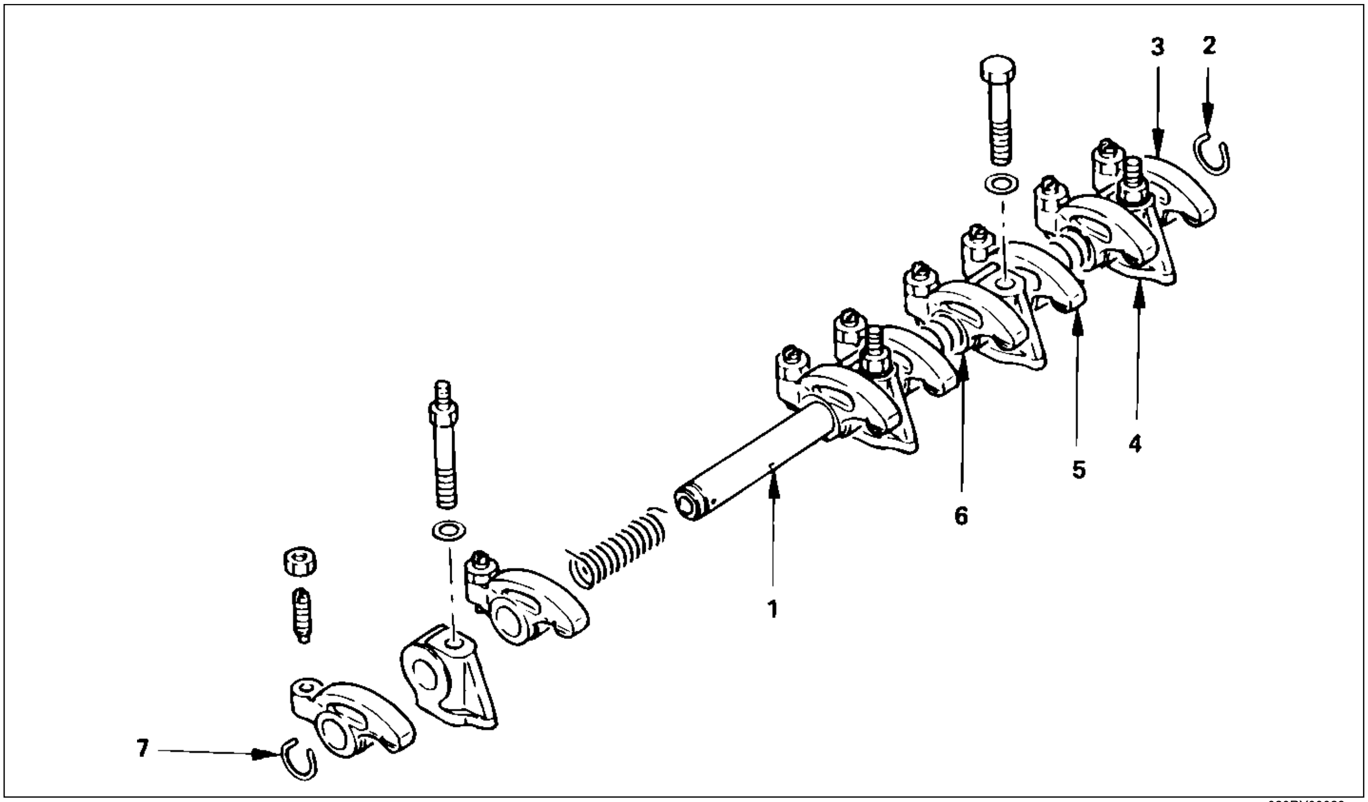
Take notice of the press-in direction of the oil seal.

REASSEMBLY

INTERNAL PARTS

MINOR COMPONENT

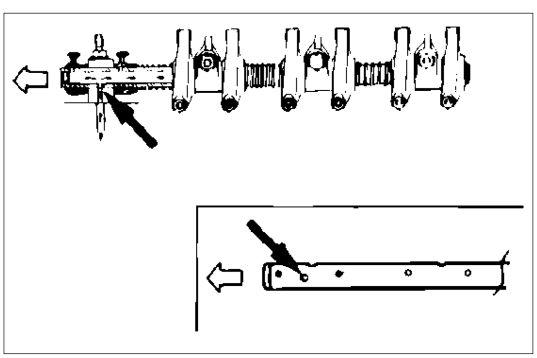
ROCKER ARM SHAFT AND ROCKER ARM



020RY00029

Reassembly Steps

1. Rocker arm shaft
2. Rocker arm shaft snap ring
3. Rocker arm
4. Rocker arm shaft bracket
5. Rocker arm
6. Rocker arm shaft spring
7. Rocker arm shaft snap ring

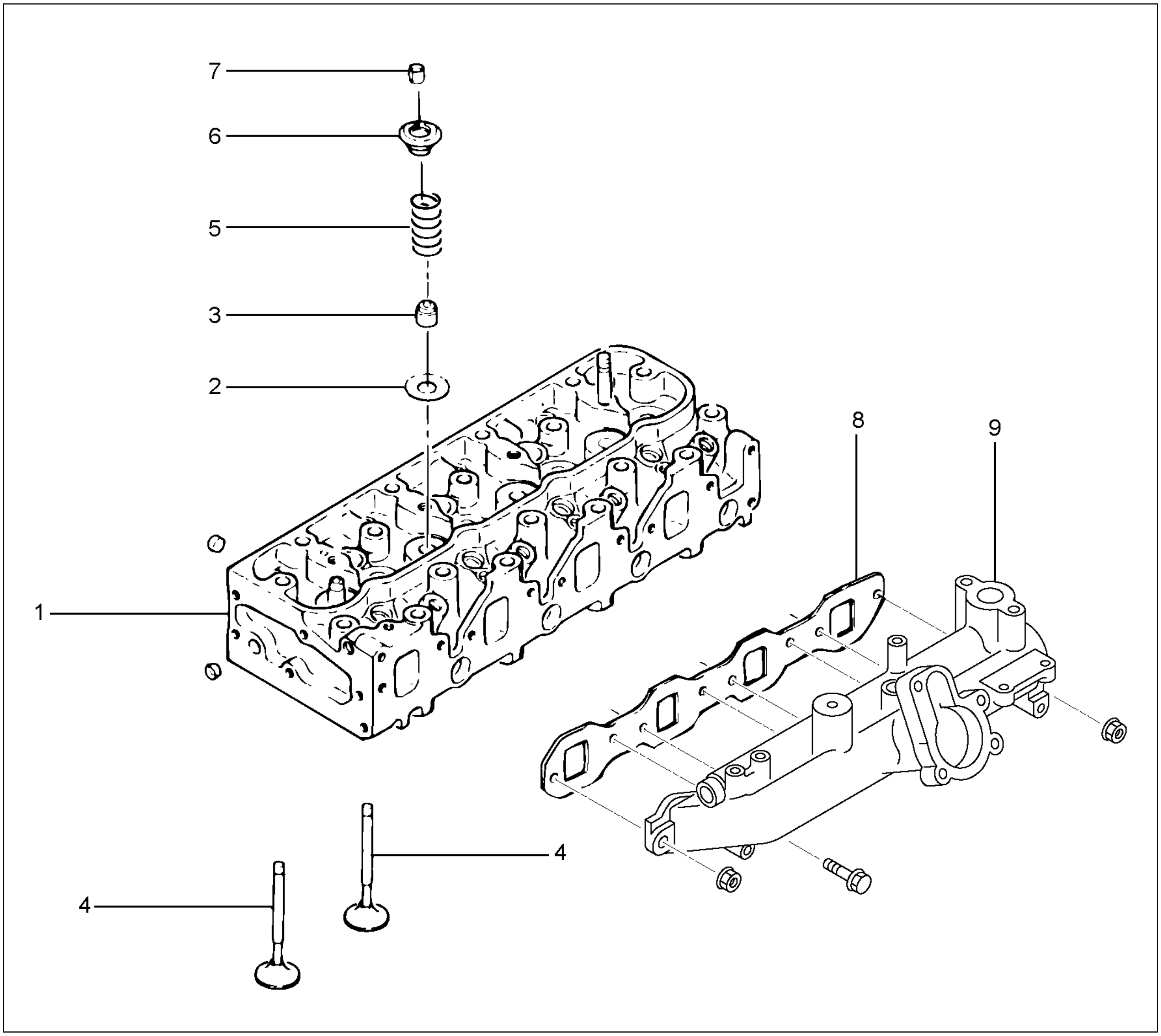


014RY00037

Reassembly

1. **Rocker Arm Shaft**
   1. Position the rocker arm shaft with the large oil hole (4 ϕ) facing the front of the engine.
   2. Install the rocker arm shaft together with the rocker arm, the rocker arm shaft bracket, and the spring.
2. **Rocker Arm Shaft Snap Ring**
3. **Rocker Arm**
4. **Rocker Arm Shaft Bracket**
5. **Rocker Arm**
6. **Rocker Arm Shaft Spring**
7. **Rocker Arm Shaft Snap Ring**

CYLINDER HEAD



RTW46ALF001301

Reassembly Steps

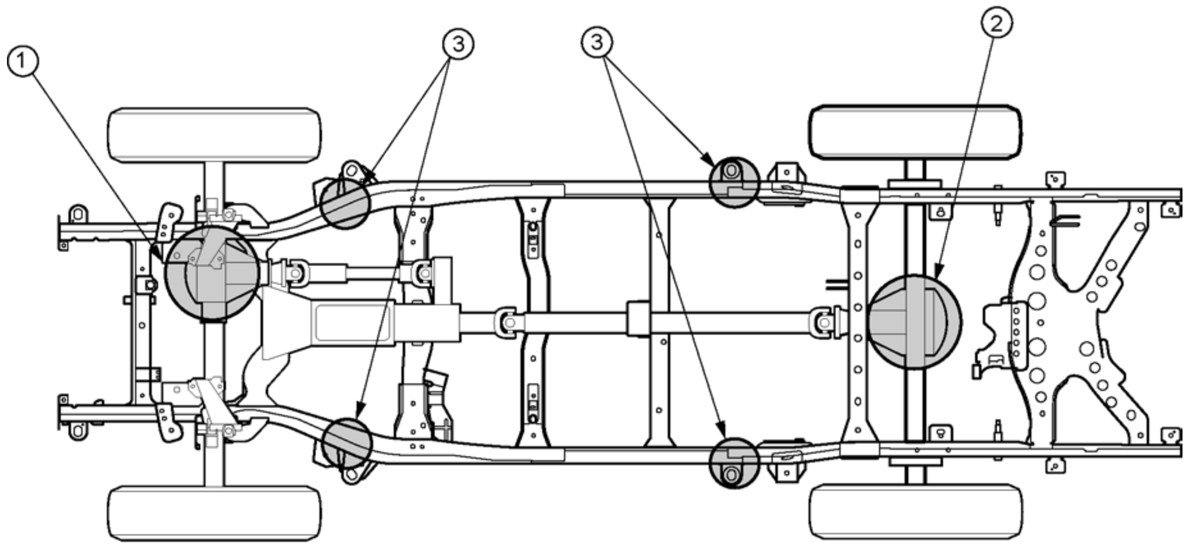
1. Cylinder head
2. Valve spring lower seat
3. Valve stem oil seal
4. Intake and exhaust valve
5. Valve spring
6. Valve spring upper seat
7. Split collar
8. Intake manifold gasket
9. Intake manifold

LIFTING INSTRUCTIONS

If a lifting device other than the original jack is used, it is most important that the device be applied only to the correct lifting points. (See the illustration.) Raising the vehicle from any other point may result in serious damage.

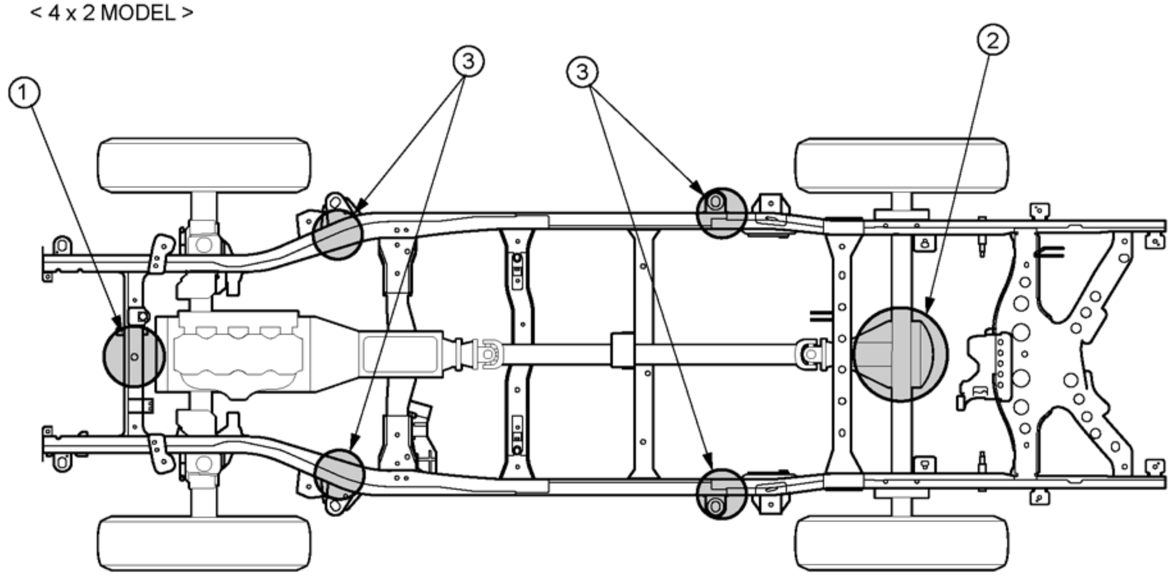
Lifting Points and Supportable Point-Locations

< 4 x 4 MODEL >



1. Front axle center
2. Rear axle center
3. Side frame

< 4 x 2 MODEL >



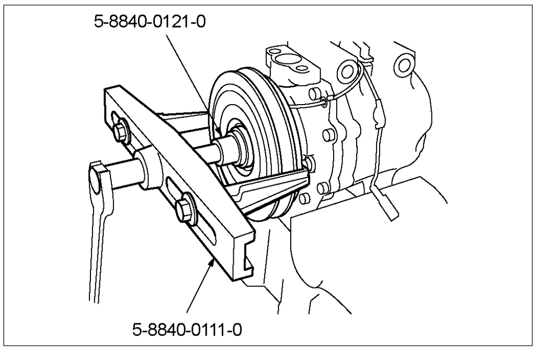
1. 1st cross member center
2. Rear axle center
3. Side frame

RTW50AXF000201

3. Drive Plate

Remove the drive plate.

If the frictional surface shows signs of damage due to excessive heat, the drive plate and pulley should be replaced.



RTW510SH000801

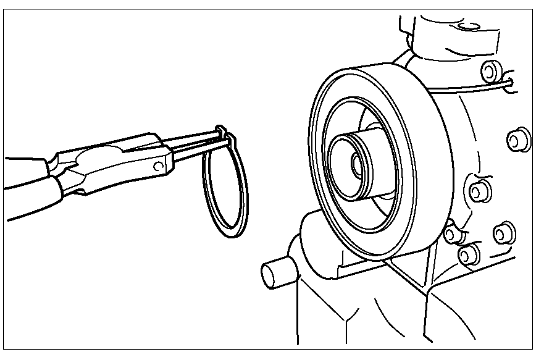
5. Pulley Assembly

Using pulley puller pilot and pulley puller to remove the pulley assembly.

Pulley Puller Pilot: 5-8840-0121-0 (J-33943)

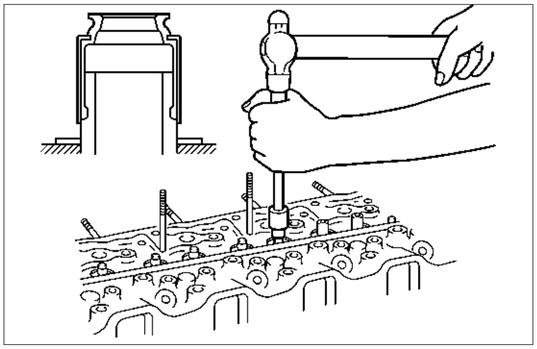
Pulley Puller: 5-8840-0111-0 (J-8433)

Check the appearance of the pulley assembly. If the frictional surface of the pulley shows signs of excessive grooving due to slippage, both the pulley and drive plate should be replaced. The frictional surfaces of the pulley assembly should be cleaned with a suitable solvent before reinstallation.


RTW510SH000901

6. Snap ring

Using snap ring pliers to remove the snap ring.

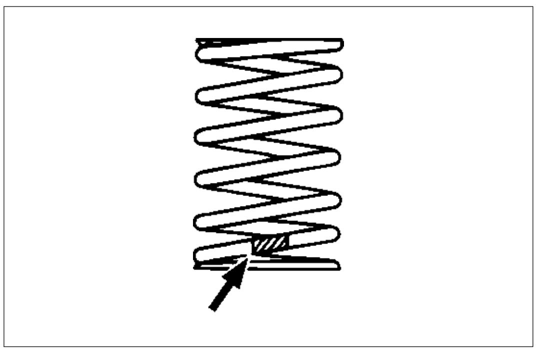


011RW027

Reassembly

1. **Cylinder Head**
2. **Valve Spring Lower Seat**
3. **Valve Stem Oil Seal**
   1. Apply a coat of engine oil to the oil seal inner face.
   2. Use an oil seal installer to install the oil seal to the valve guide.

      Oil Seal Installer: 5-8840-2033-0
4. **Intake and Exhaust Valve**
   1. Apply a coat of engine oil to each valve stem before installation.
   2. Install the intake and exhaust valves.
   3. Turn the cylinder head up to install the valve springs.Take care not to allow the installed valves to fall free.

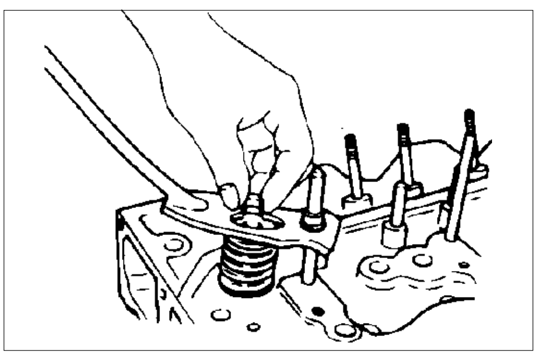


011LX055

5. **Valve Spring**

   Install the valve spring with their fine pitched end (painted) facing down.

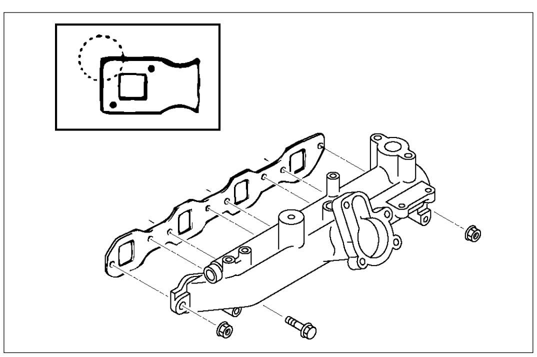
6. **Valve Spring Upper Seat**



014RY00039

7. **Split Collar**
   1. Use the spring compressor to compress the valve spring into position.

      Spring Compressor: 9-8523-1423-0
   2. Install the split collars to the valve stem.
   3. Set the split collars by tapping around the head of the collar with a rubber hammer.



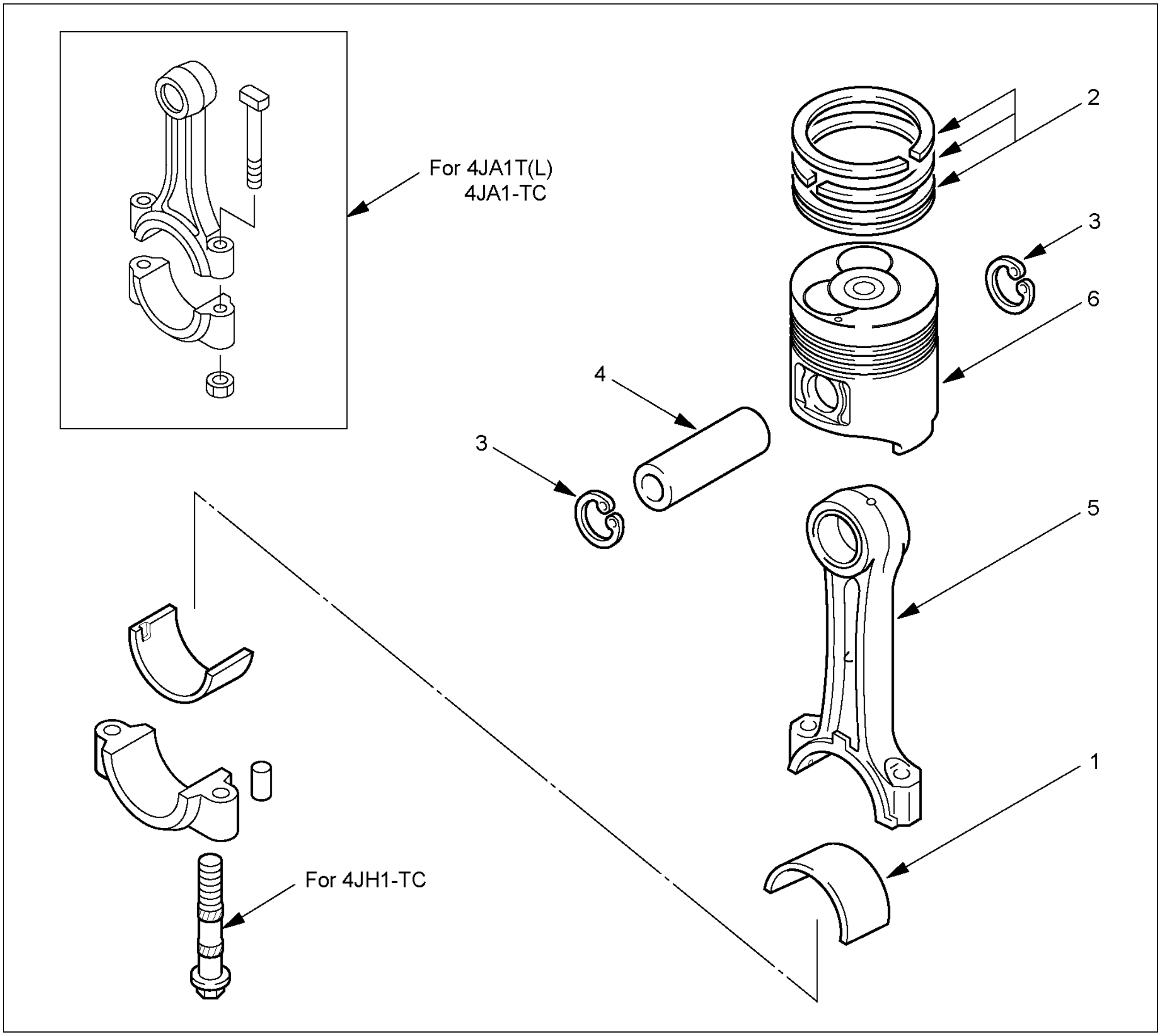
RTW46ASH002301

8. **Intake manifold gasket**
9. **Intake manifold**
   1. Install the manifold gasket with the end having the sharp corners facing the rear of the engine.
   2. Install the intake manifold to the cylinder head.
   3. Tighten the manifold bolt/nuts to the specified torque.

Manifold Bolt/Nut Torque N·m(kg·m/lbft)

Bolt	19 (1.9/14)
Nut	24 (2.4/17)

PISTON AND CONNECTING ROD

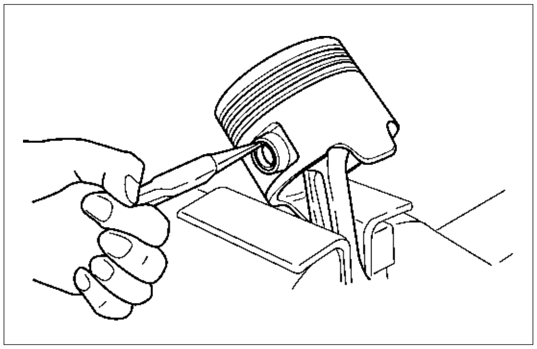


RTW46ALF000301

Reassembly Steps

1. Piston
2. Connecting rod
3. Piston pin snap ring
4. Piston pin
5. Piston pin snap ring
6. Piston ring
7. Connecting rod bearing

Reassembly

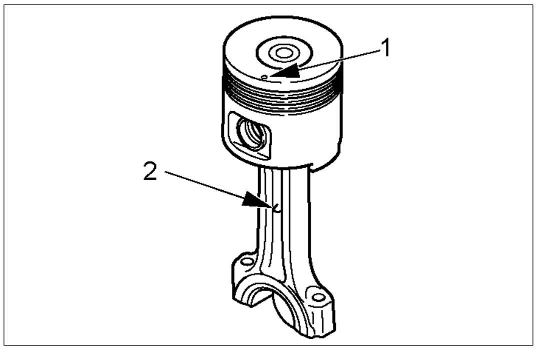


F06MV015

1. Piston

2. Connecting Rod

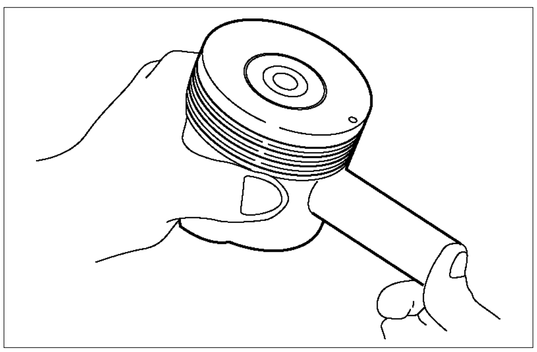
1. Clamp the connecting rod in a vise.Take care not to damage the connecting rod.
2. Use a pair of pliers to install the piston pin snap ring to the piston.



RTW36ASH001801

Install the piston to the connecting rod so that the piston head front mark (1) and the connecting rod mark (2) are facing in the same direction.

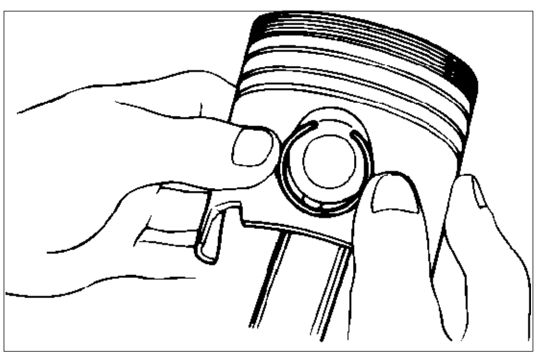
3. Piston Pin Snap Ring



RTW36ASH001901

4. Piston Pin

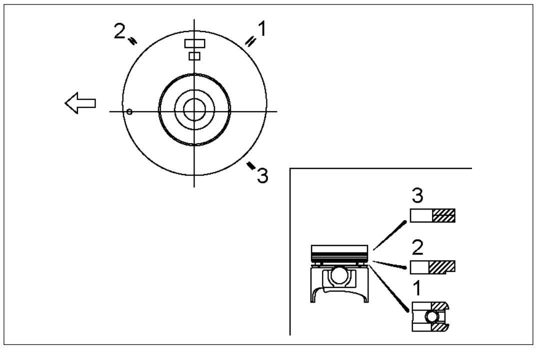
1. Apply a coat of engine oil to the piston pin and the piston pin hole.
2. Use your fingers to force the piston pin into the piston until it makes contact with the snap ring.



015R100001

5. Piston Pin Snap Ring

1. Use your fingers to force the piston pin snap ring into the piston snap ring groove.
2. Check that the connecting rod moves smoothly on the piston pin.



RTW36ASH002001

6. Piston Ring

1. Use a piston ring replacer to install the three piston rings.

   Piston Ring Replacer

   Install the piston rings in the order shown in the illustration.

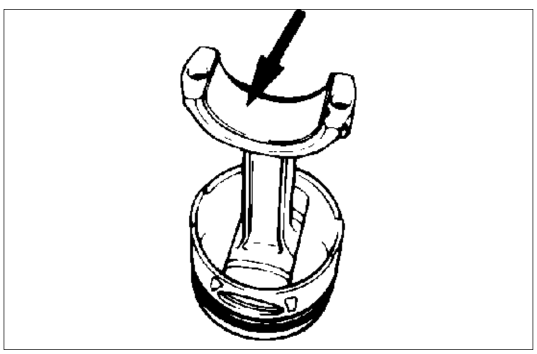
   1. Oil ring
   2. 2nd compression ring
   3. 1st compression ring

NOTE:

Install the compression rings with the stamped side facing up.

Insert the expander coil into the oil ring groove so that there is no gap on either side of the expander coil before installing the oil ring.

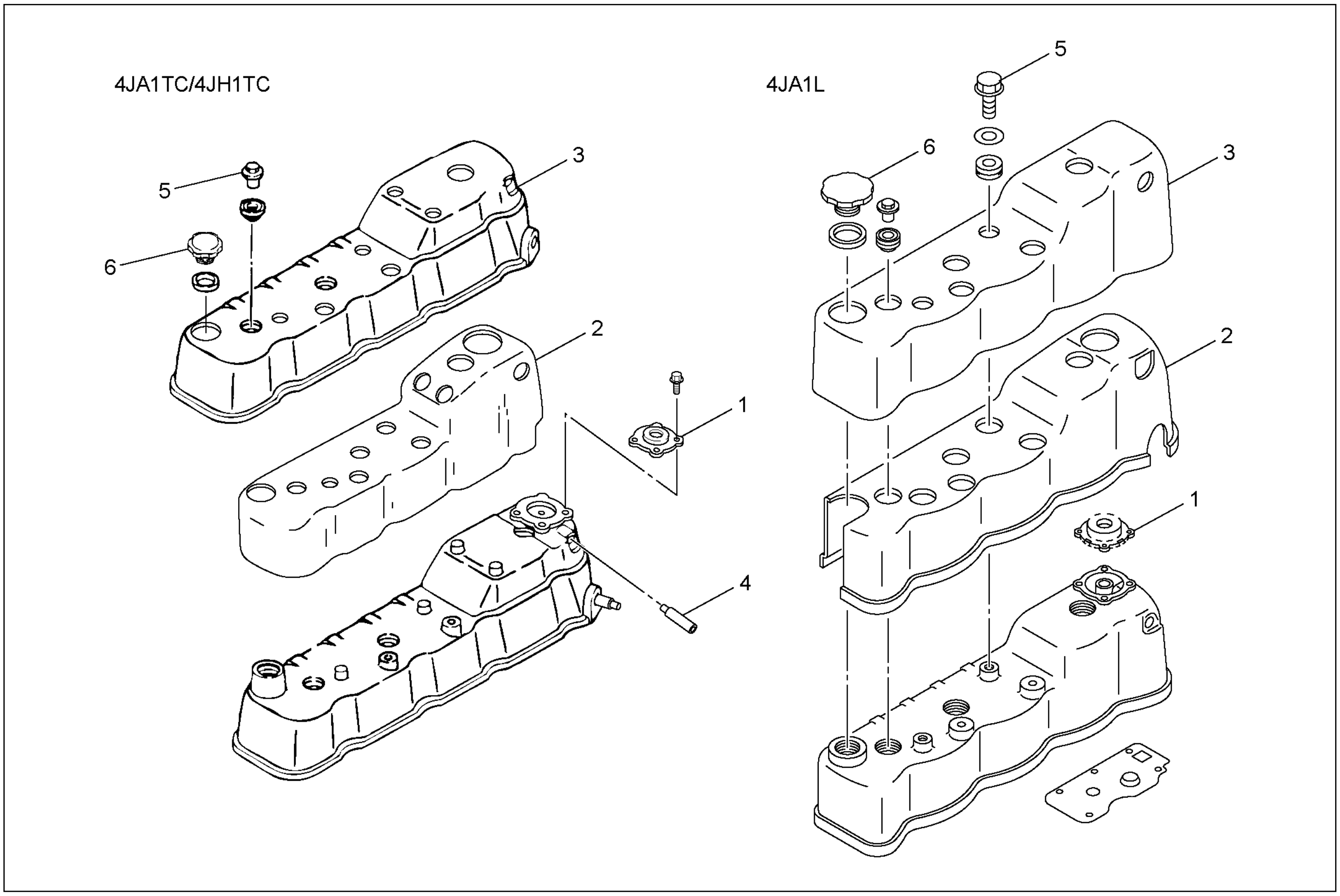
2. Apply engine oil to the piston ring surfaces.
3. Check that the piston rings rotate smoothly in the piston ring grooves


015R100006

7. Connecting Rod Bearing

Carefully wipe any oil or other foreign material from the connecting rod bearing back face and the connecting rod bearing fitting surface.

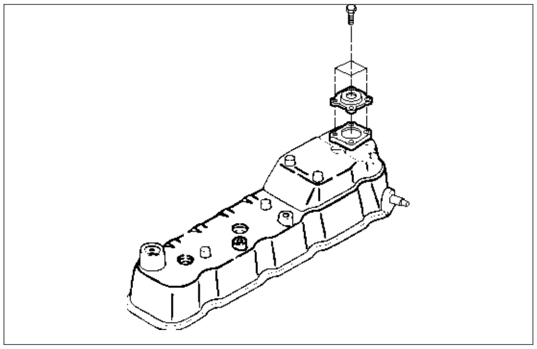
POSITIVE CRANKCASE VENTILATION (PCV) VALVE



RTW46AMF000101

Reassembly Steps

1. Positive Crankcase Ventilation (PCV) Valve
2. Rubber space
3. Cylinder head insulator cover
4. Breather pipe
5. Fixing bolt
6. Oil filler cap

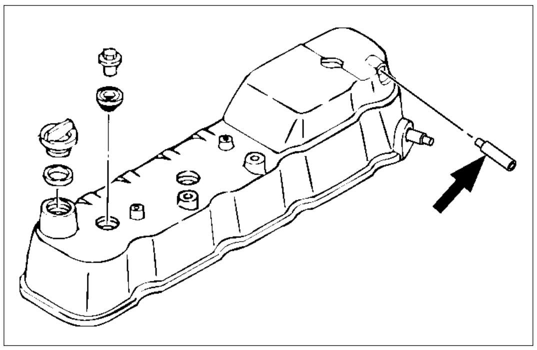

010R100014

Reassembly

1. **PCV Valve**
   Install the PCV valve and tighten the bolts to specified torque.

PCV Valve Bolts Torque	N·m(kg·m/lb in)
2 (0.2/17)	

2. **Rubber Spacer**
3. **Cylinder Head Insulator Cover**

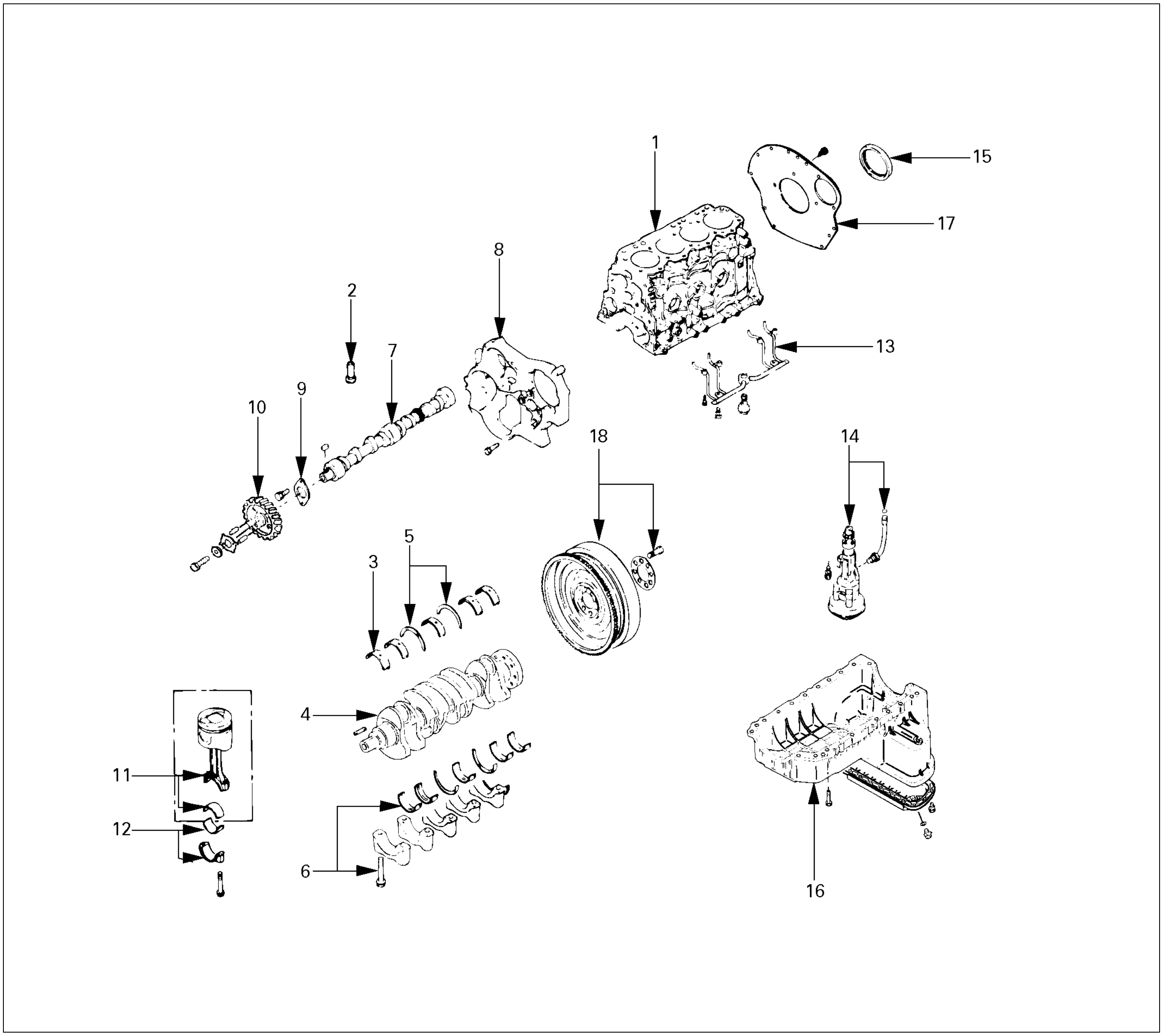

RTW36ASH001401

4. **Breather Hose**
   Apply LOCTITE 262 or equivalent to the new breather pipe.
   Do not reuse the breather pipe.
5. **Fixing Bolt**

Fixing Bolt Torque	N·m(kg·m/lb in)
19 (1.9/14)	

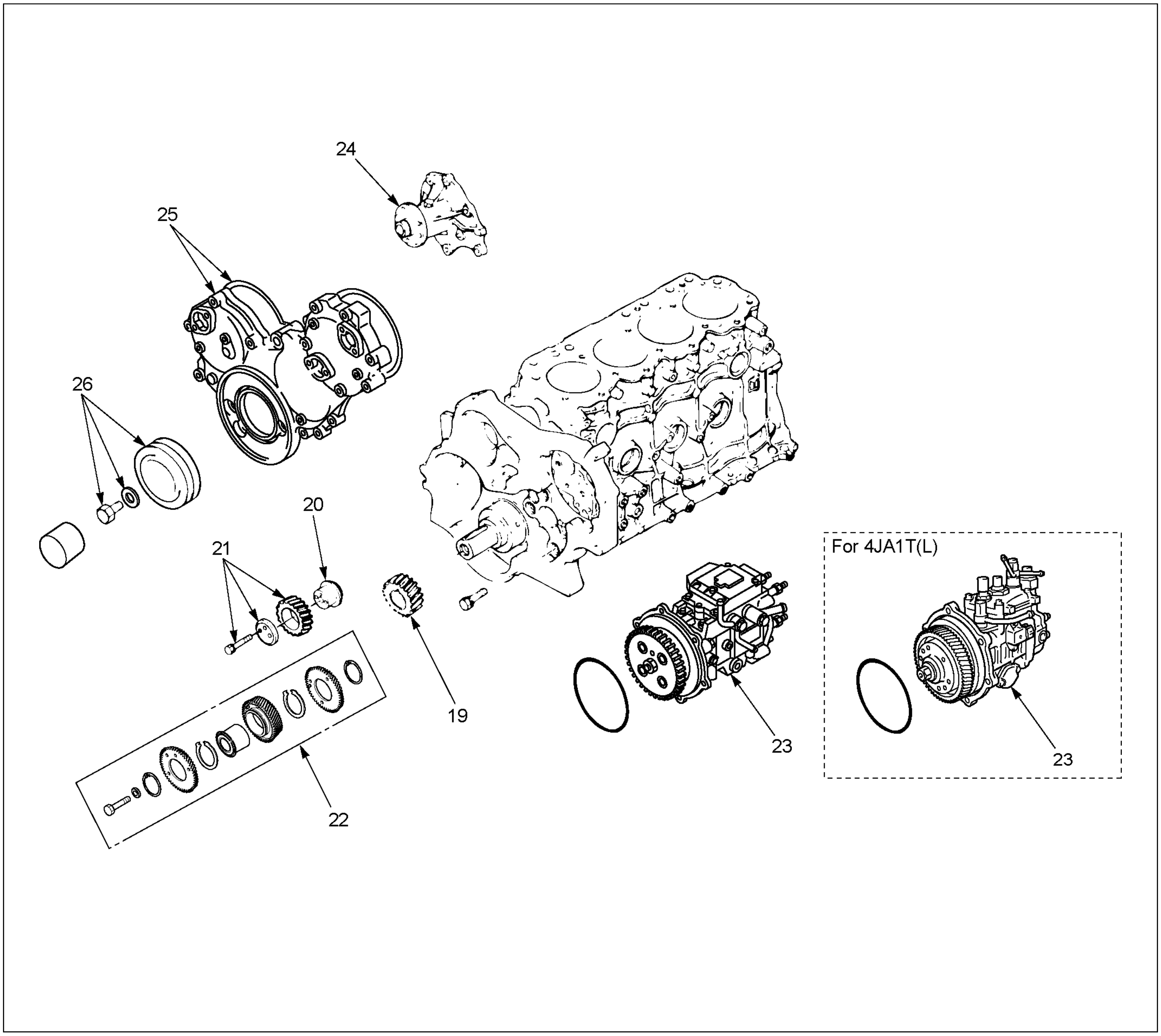
6. **Oil Filler Cap**

MAJOR COMPONENT



Reassembly Steps-1

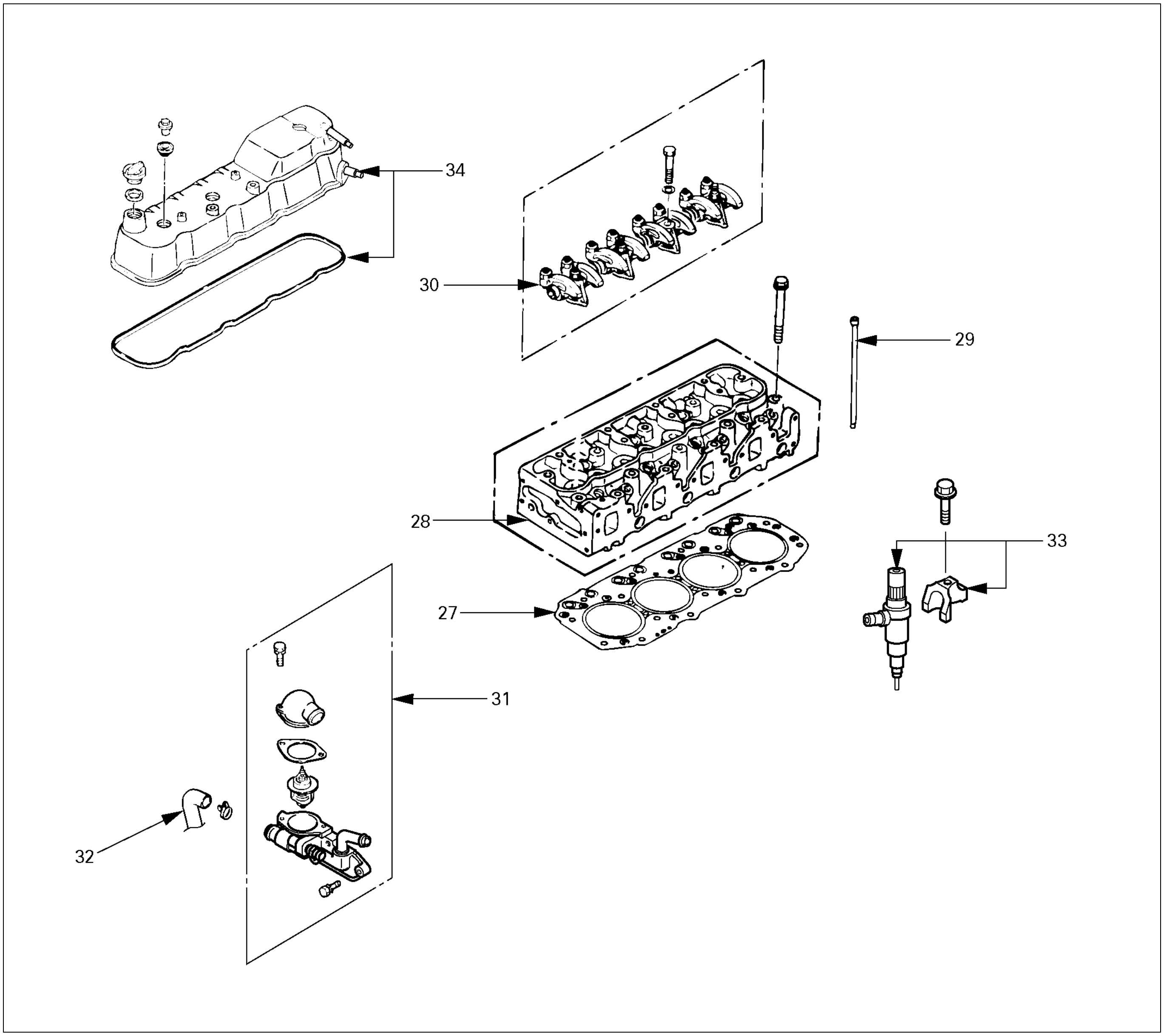
1. Cylinder body
2. Tappet
3. Crankshaft upper bearing
4. Crankshaft
5. Crankshaft thrust bearing
6. Crankshaft bearing cap with lower bearing
7. Camshaft
8. Timing gear case
9. Camshaft thrust plate
10. Camshaft timing gear
11. Piston and connecting rod with upper bearing
12. Connecting rod bearing cap with lower bearing
13. Piston cooling oil pipe
14. Oil pump with oil pipe
15. Crankshaft rear oil seal
16. Crank case
17. Cylinder body rear plate
18. Flywheel



RTW46ALF000501

Reassembly Steps-2

19. Crankshaft timing gear
20. Idler gear shaft
21. Idler gear "A"
22. Idler gear "B" and shaft
23. Injection pump
24. Water pump
25. Timing gear case cover
26. Crankshaft damper pulley

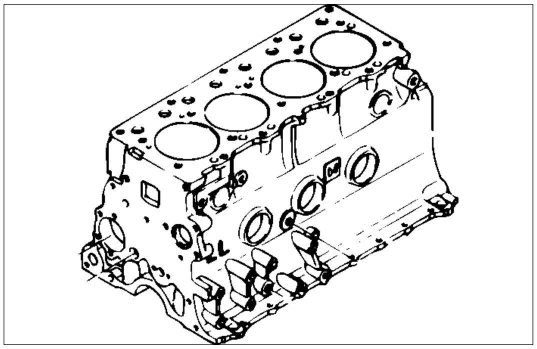


011R300002

Reassembly Steps-3

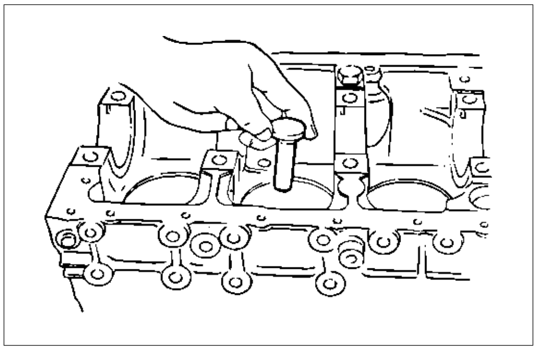
27. Cylinder head gasket
28. Cylinder head
29. Push rod
30. Rocker arm shaft and rocker arm
31. Thermostat housing with thermo switch
32. Water by-pass hose
33. Injection nozzle and bracket
34. Cylinder head cover with gasket

Reassembly


015R100003

1. Cylinder Body

Use compressed air to thoroughly clean the inside and outside surfaces of the cylinder body, the oil holes, and the water jackets.

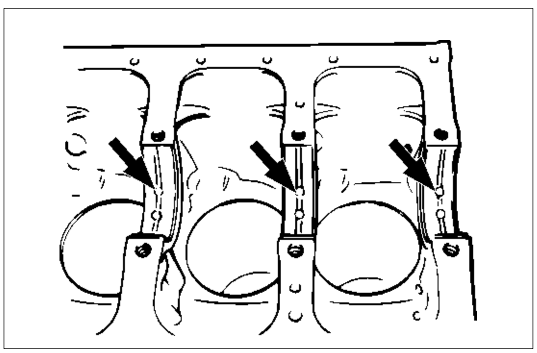

014LX088

2. Tappet

1. Apply a coat of engine oil to the tappet and the cylinder body tappet insert holes.
2. Locate the position mark applied at disassembly (if the tappet is to be reused).

NOTE:

The tappet must be installed before the camshaft installation.


015LX125

3. Crankshaft Upper Bearing

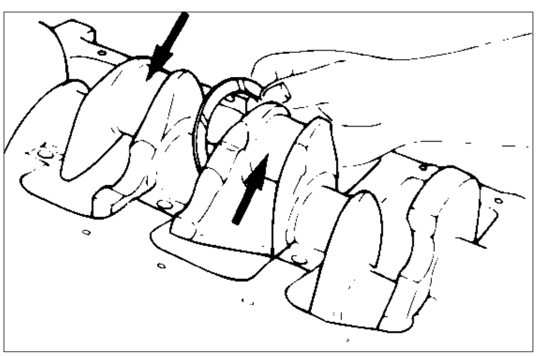
The crankshaft upper bearings have an oil hole and an oil groove. The lower bearings do not.

1. Carefully wipe any foreign material from the upper bearing.

NOTE:

Do not apply engine oil to the bearing back faces and the cylinder body bearing fitting surfaces.

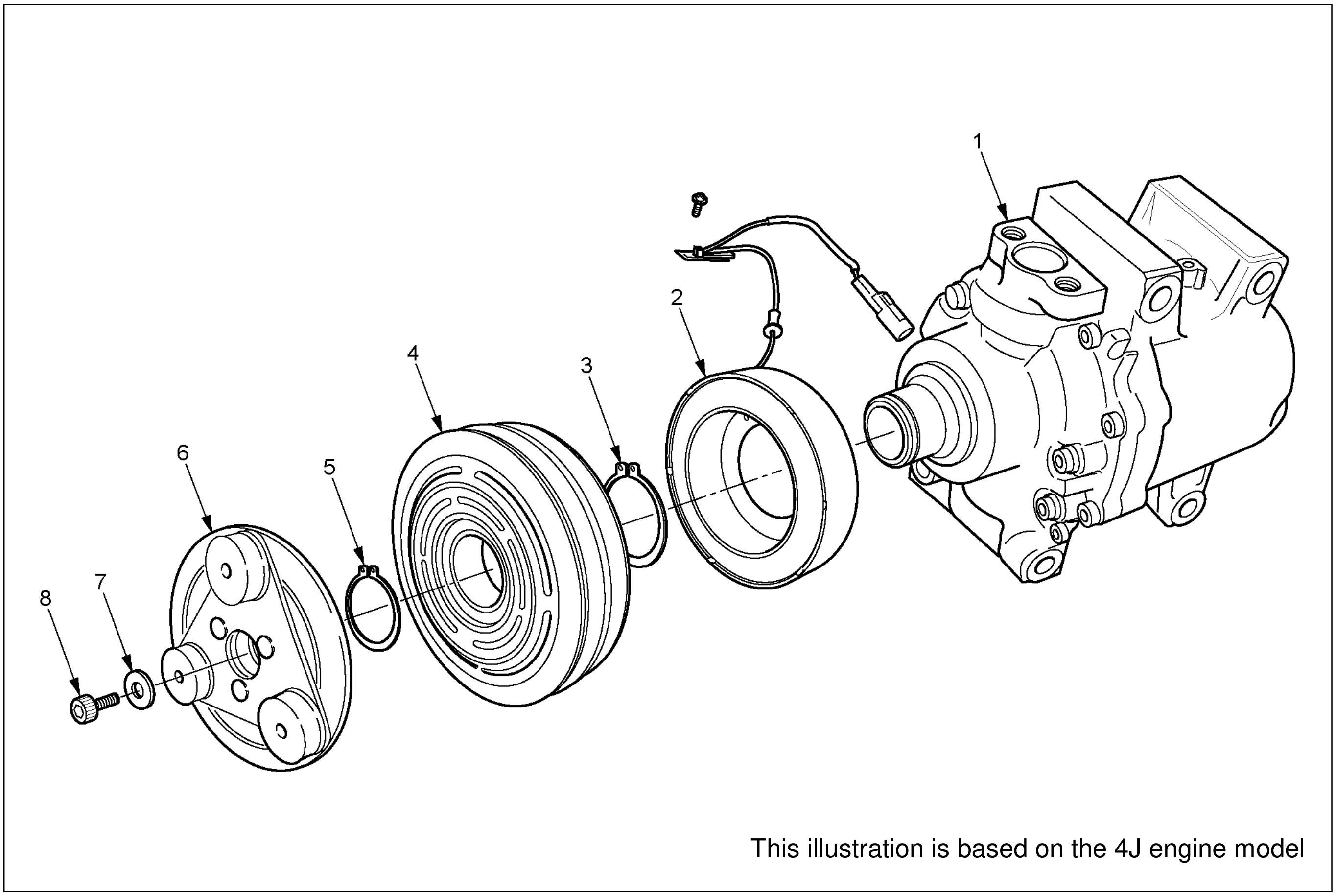
2. Locate the position mark applied at disassembly if the removed upper bearings are to be reused.


015R100004

4. Crankshaft

Apply an ample coat of engine oil to the crankshaft journals and the crankshaft bearing surfaces before installing the crankshaft.

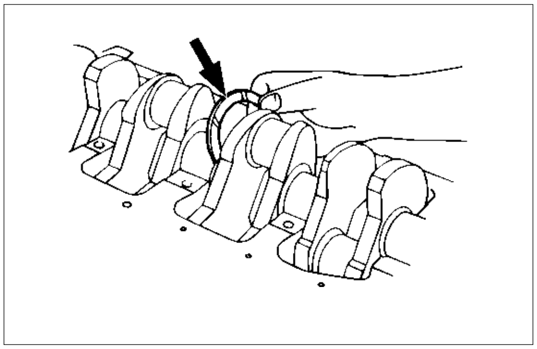
REASSEMBLY



RTW510MF000401

Reassembly Steps

1. Compressor
▲ 2. Field coil
3. Snap ring
▲ 4. Pulley assembly
2. Snap ring
3. Drive plate
7. Plain washer
▲ 8. Drive prate bolt



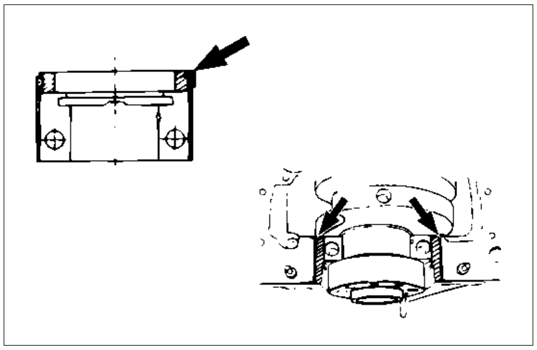
015LX115

5. Crankshaft Thrust Bearing

Apply an ample coat of engine oil to the thrust bearings before installation.

Install the thrust bearings to the crankshaft center journal.

The thrust bearing oil grooves must be facing the sliding faces.



015LX127

6. Crankshaft Bearing Cap With Lower Bearing

Before the crankshaft bearing installation, select the appropriate bearings in accordance with the description in CRANK BEARING SELECTION of INSPECTION AND REPAIR.

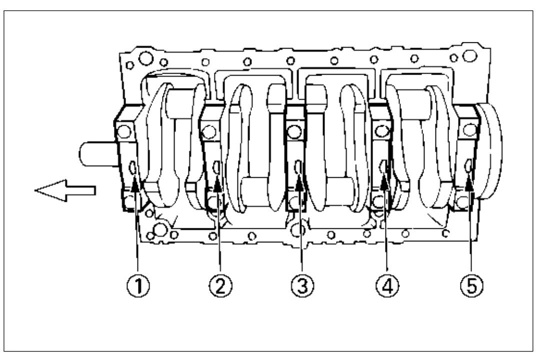
1. Apply the recommended liquid gasket or its equivalent to the No. 5 crankshaft bearing cap cylinder body fitting surfaces at the points shown in the illustration.

NOTE:

Be sure that the bearing cap fitting surface is completely free of oil before applying the liquid gasket. Three bond 1207B Do not allow the liquid gasket to obstruct the cylinder thread holes and bearings.

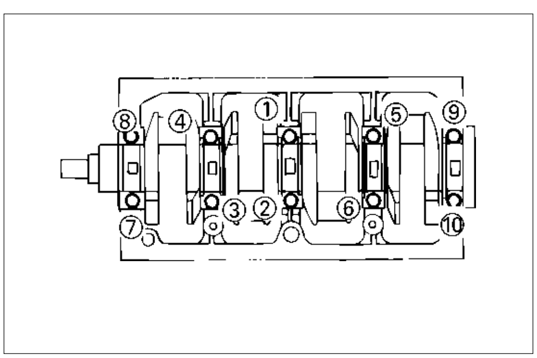
ThreeBond 1207B is a fast-drying liquid gasket.

Tighten the bearing caps immediately after applying the gasket.



015LX128

2. Install the bearing caps with the bearing cap head arrow mark facing the front of the engine.The bearing cap numbers must be facing up.
3. Apply engine oil to the crankshaft bearing cap bolts.

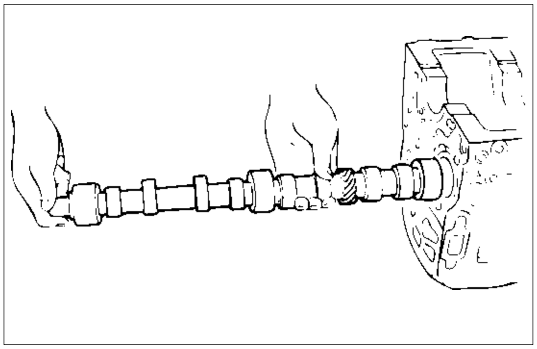


015LX129

4. Tighten the crankshaft bearing cap bolts to the specified torque a little at time in the sequence shown in the illustration.

Crankshaft Bearing Cap Torque	N·m(kg·m/lbft)
167 (17/123)	

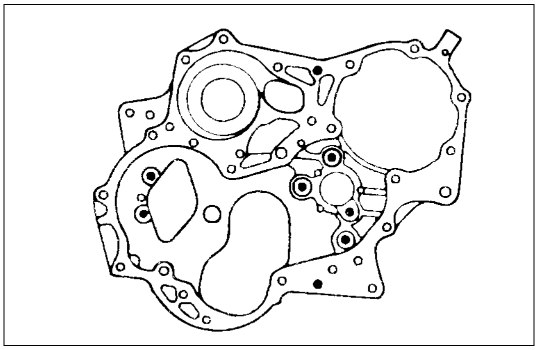
5. Check to see the crankshaft turns smoothly by rotating it manually.



014RY00019

7. Camshaft

1. Apply a coat of engine oil to the camshaft and the camshaft bearings.
2. Install the camshaft to the cylinder body.
   Take care not to damage the camshaft bearings.

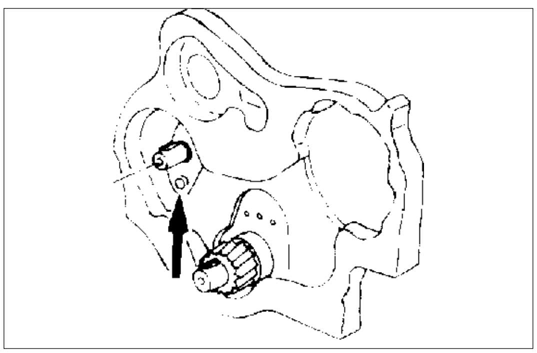


020R300003

8. Timing Gear Case

Tighten the timing gear case with timing gear case gasket to the specified torque.

Timing Gear Case Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

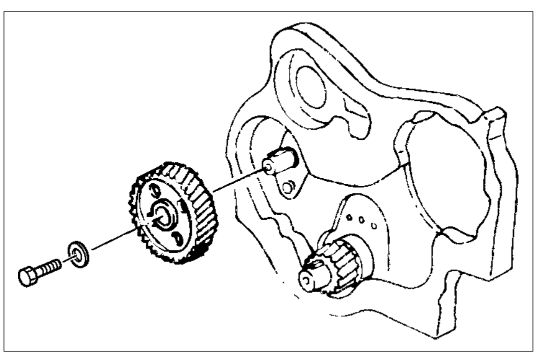


020RY00032

9. Camshaft Thrust Plate

Install the thrust plate to the cylinder body and tighten the thrust plate bolts to the specified torque.

Thrust Plate Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

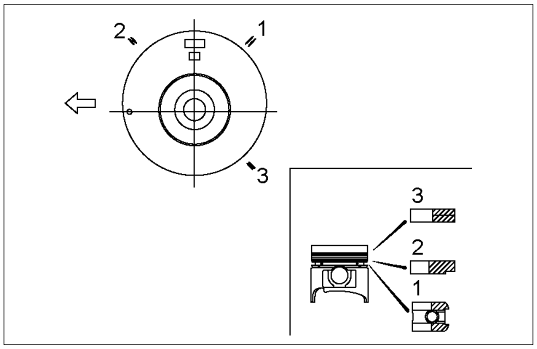


RTW36ASH000901

10. Camshaft Timing Gear

1. Install the camshaft timing gear to the camshaft. The timing gear mark must be facing outward.
2. Tighten the timing gear to the specified torque.

Timing Gear Bolt Torque	N·m(kg·m/lbft)
110 (11.2/82)	

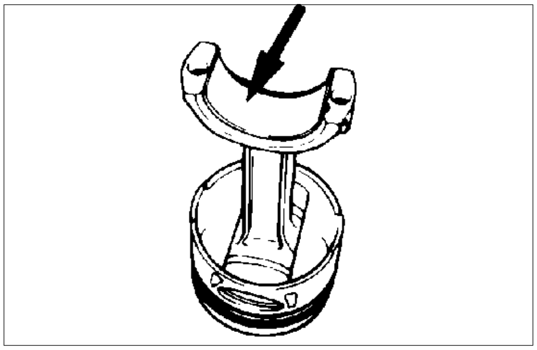


RTW36ASH002001

11. Piston and Connecting Rod with Upper Bearing

12. Connecting Rod Bearing Cap with Lower Bearing

1. Apply a coat of engine oil to the circumference of each piston ring and piston.
2. Position the piston ring gaps as shown in the illustration.
   1. Oil ring
   2. 2nd compression ring
   3. 1st compression ring

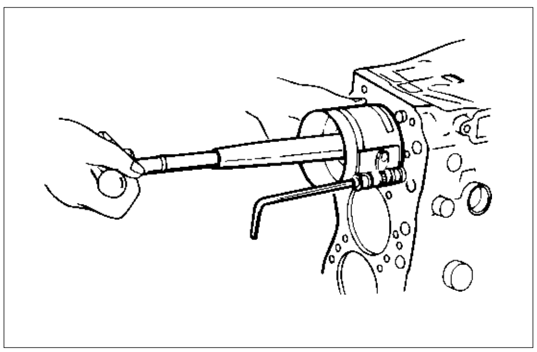

015R100006

3. Apply a coat of molybdenum disulfide grease to the two piston skirts.

   This will facilitate smooth break-in when the engine is first started after reassembly.

4. Apply a coat of engine oil to the upper bearing surfaces.

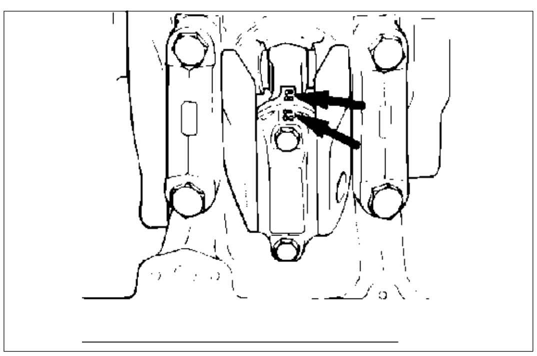
5. Apply a coat of engine oil to the cylinder wall.


015LX096

6. Position the piston head front mark so that it is facing the front of the engine.
7. Use the piston ring compressor to compress the piston rings.

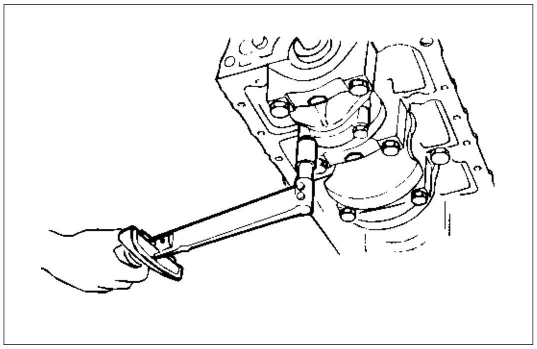
   Piston Ring Compressor: 5-8840-9018-0
8. Use a hammer grip to push the piston in until the connecting rod makes contact with the crankpin.

   At the same time, rotate the crankshaft until the crankpin is at BDC.


015R100007

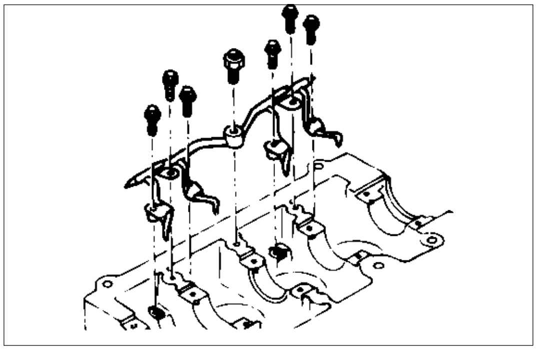
9. Align the bearing cap cylinder number marks and the connecting rod cylinder number marks.

   The cylinder number marks must be turned toward the exhaust manifold.


015LX130

10. Apply a coat of engine oil to the threads and setting faces of each connecting rod cap bolt.
11. Tighten the connecting rod caps to the two step of anglar tigthen method.

Connecting Rod Bearing Cap Bolt Torque	N·m (kg·m/lb ft)
4JA1T (L), 4JA1TC	78-88 (8.0/57 – 9.0/65)
4JH1TC	1st step; 29.0–29.2 (3.00/22.0–3.01/22.2)
	2nd step; 45°-60°


052LX010

13. Piston Cooling Oil Jet

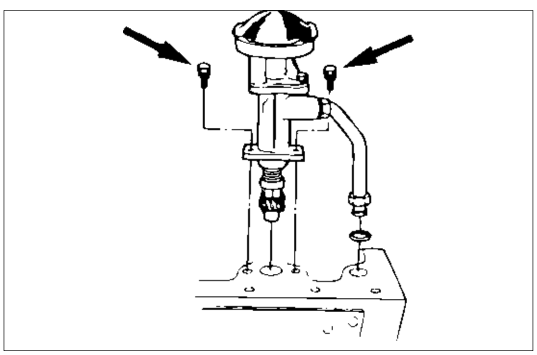
1. Install the piston cooling oil jet to the cylinder body.
2. Tighten the oil jet bolts and relief valve to the specified torque.

Oil Jet Bolt Torque	N·m(kg·m/lb ft)
M8 × 1.25	19 (1.9/14)
M6 × 1.00	8 (0.8/6)

Relief Valve Torque N·m(kg·m/lb ft)
29 (3.0/22)

NOTE:

Check that there is no interference between the piston and the oiling jet by slowly rotating the crankshaft.


051R100004

14. Oil Pump with Oil Pipe

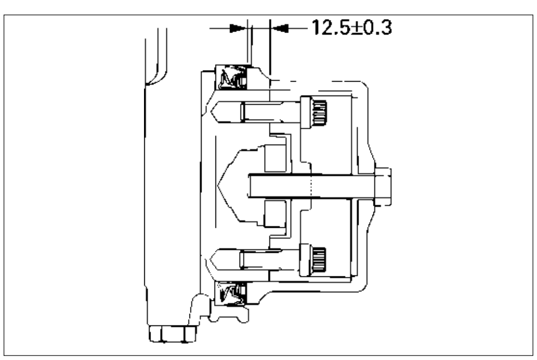
Apply a coat of the molybdenum disul fide and engine oil enough on the pinion gear.

Install the oil pump with the oil pipe and tighten the bolts to the specified torque.

Oil Pump Bolt Torque N·m(kg·m/lb ft)
19 (19/14)

NOTE:

Take care not to damage the O-rings when tightening the oil pipe bolts.

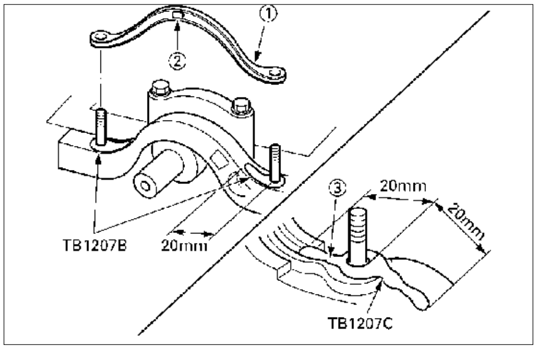


015LX112

15. Crankshaft Rear Oil Seal

Use a oil seal install to install the crankshaft rear oil seal.

Oil Seal Installer: 5-8840-2359-0



013RW012

16. Crank Case

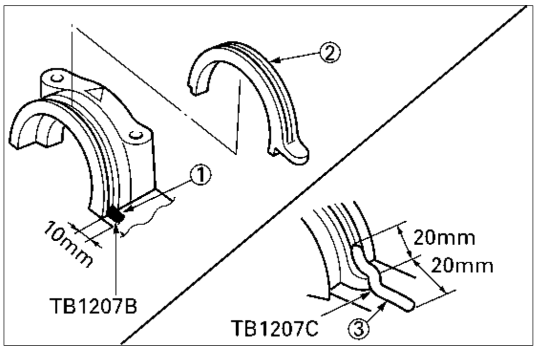
1. Apply the recommended liquid gasket (Three bond 1207B) or its equivalent to arch gasket fitting surface as shown in the illustration.
2. Install the crankcase front gasket (1) to the timing gear case arches.

   The gasket projection (2) must be facing forward.

NOTE:

ThreeBond 1207B is a fast-drying liquid gasket.

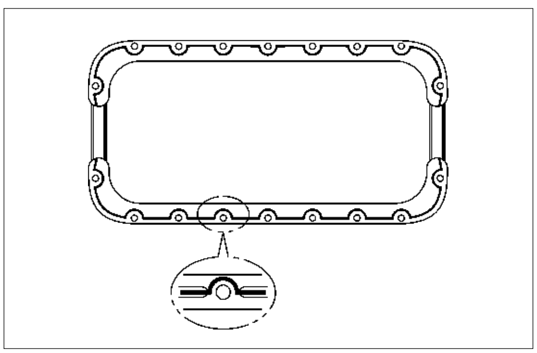
Install the arch packing to the crankcase immediately aftter applying the gasket.



013RW011

3. Install the rear arch gasket (2) to the No. 5 bearing cap. Use your fingers to push the arch gasket into the bearing cap groove.Take care not to scratch the arch gasket outer surface.

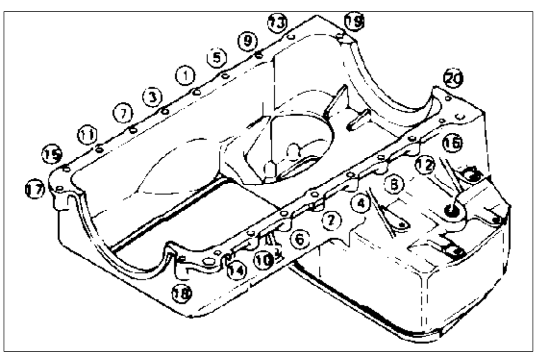
   Also apply the recommended liquid gasket (1207C) or its equivalent to arch gasket fitting area as indicated in the illustration.


013LV003

4. Apply the recommended liquid gasket or its equivalent to groove of the crankcase fitting surface as shown in the illustration.

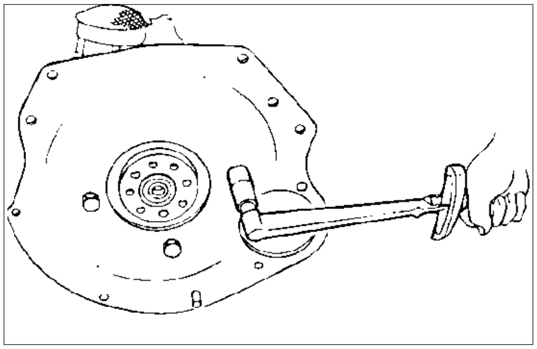
NOTE:

Be sure that the crank case fitting surface is completely free of oil and dust before applying the liquid gasket.


013R100001

5. Install the crank case to the cylinder body.
6. Tighten the crank case bolts to the specified torque a little at a time in the sequence shown in the illustration.

Crank Case Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

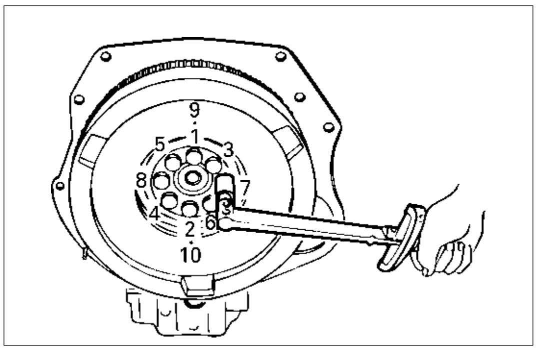


020R100001

17. Cylinder Body Rear Plate

1. Align the rear plate with the cylinder body knock pins.
2. Tighten the rear plate to the specified torque.

Rear Plate Torque	N·m(kg·m/lbft)
82 (8.4/61)	



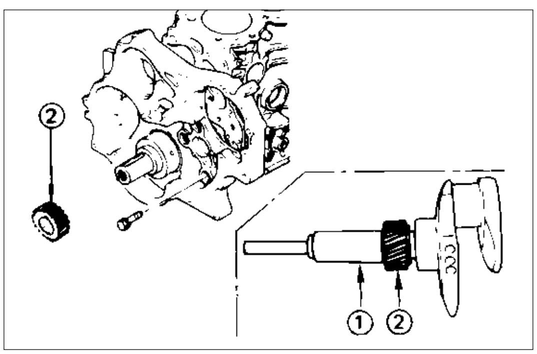
015LX113

18. Flywheel

1. Apply a coat of engine oil to the threads of the flywheel bolts.
2. Align the flywheel with the crankshaft dowel pin.
3. Tighten the flywheel bolts in the numerical order shown in the illustration.

Gear stoper: 5-8840-0214-0

Flywheel Bolt Torque	N·m(kg·m/lbft)
118 (12/87)	



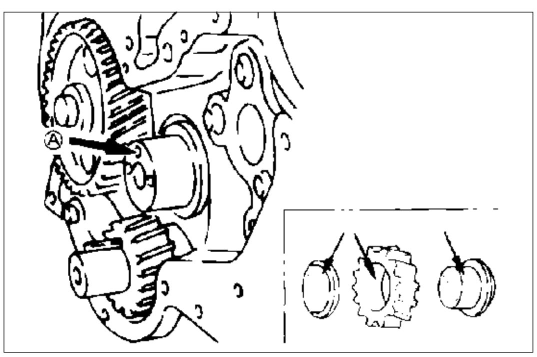
020RY00034

19. Crankshaft Timing Gear

Use the crankshaft timing gear installer (1) to install the crankshaft timing gear (2).

The crankshaft timing gear setting mark must be facing outward.

Crankshaft Timing Gear Installer: 9-8522-0020-0



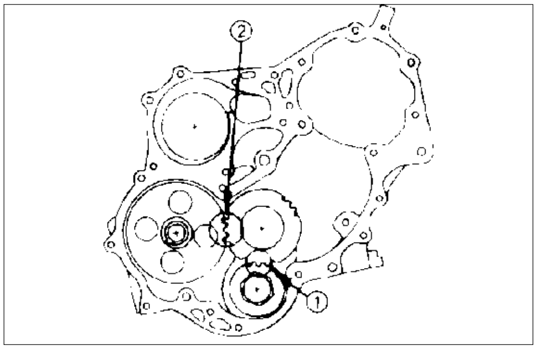
020RY00035

20. Idler Gear Shaft

21. Idler Gear "A"

1. Turn the crankshaft clockwise to set the DTC of the No.1 piston.
2. Apply engine oil to the idler gear and the idler gear shaft.

   The idler gear shaft oil hole (A) must be facing up.
3. Position the idler gear setting marks so that they are facing the front of the engine.

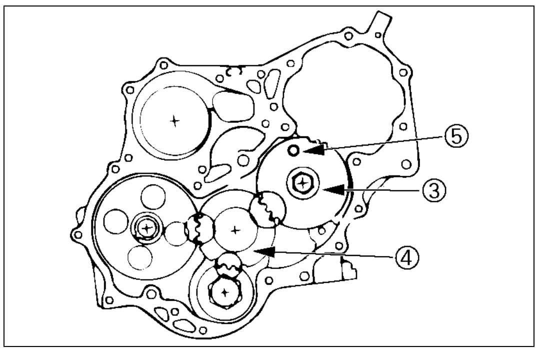


020RY00036

4. Align the idler gear setting mark with the crankshaft timing gear (1) setting mark.
5. Align the idler gear setting mark with the camshaft timing gear (2) setting mark.
6. Install the thrust collar and bolts to the cylinder body through the shaft.

   The thrust collar oil hole must be facing up, and the thrust collar chamfered must be outward.
7. Tighten the idler gear bolt to the specified torque.

Idler Gear "A" Bolt Torque	N·m(kg·m/lbft)
30 (3.1/22)	

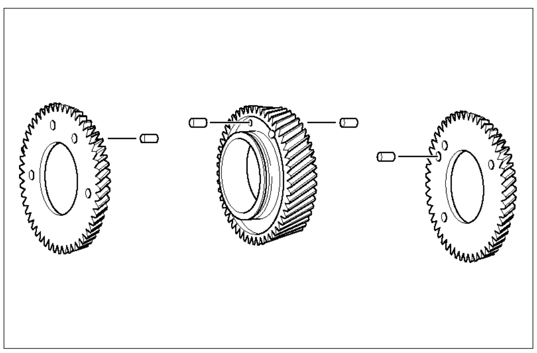


020R300006

22. Idler Gear "B" and Shaft

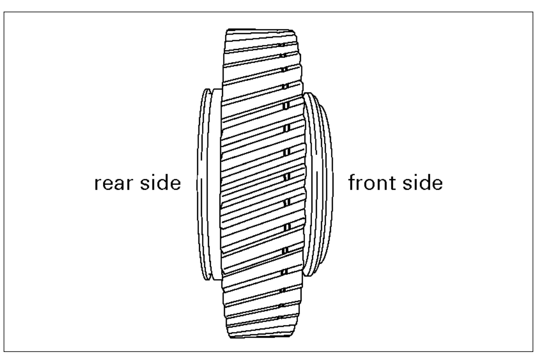
1. Apply engine oil to the idler gear and the idler gear shaft.
2. Align the idler gear "B" (3) setting mark with the idler gear "A" (4) setting mark.
3. Tighten the idler gear bolt to the specified torque.
4. Be sure to remove the lock bolt (5) from idle gear “B”.

Idler Gear "B" Bolt Torque	N·m(kg·m/lbft)
76 (7.7/56)	



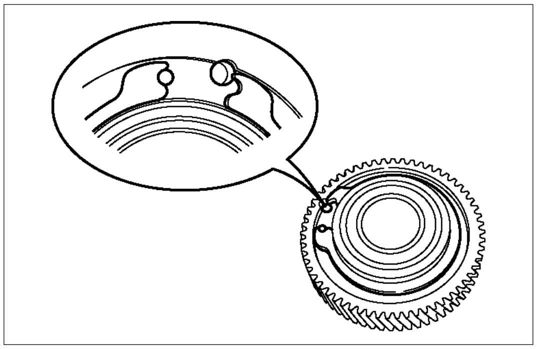
020L200019

5. If the idle gear "B" is disassembled, reassemble in the following procedure.
   1) Drive pins into the main gear, the front gear, and the rear gear.



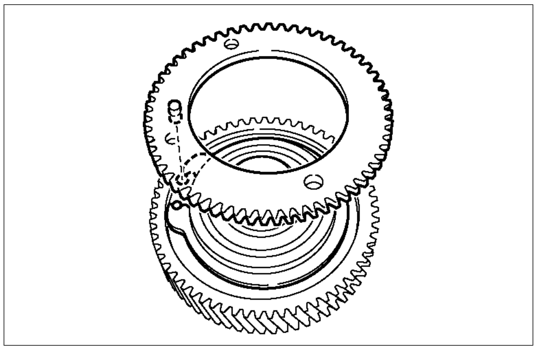
020L200007

   2) Install the main gear bearing from the front side of the main gear (the side with the groove).
   3) Place the main gear in a vise with copper plate so that the rear side of the main gear facing up.



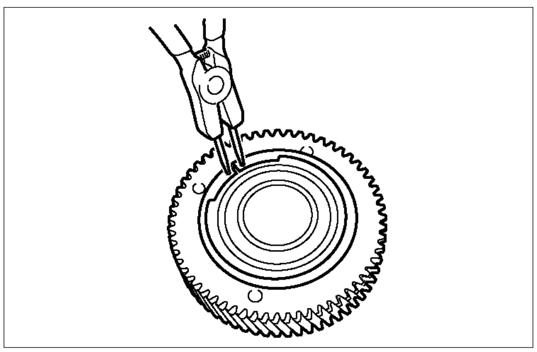
RTW31BSH000101

4) Set the spring as shown in the illustration.



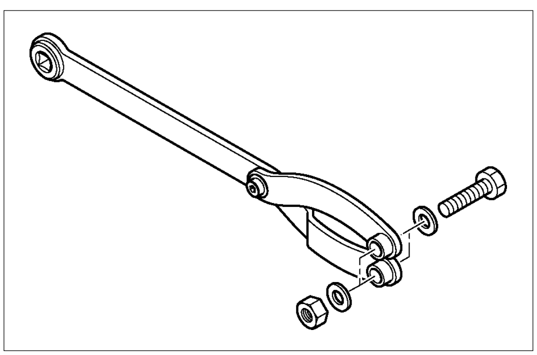
RTW31BSH000201

5) Position the rear gear so that the pin is aligned with the receiving end of the spring.



RTW31BSH000301

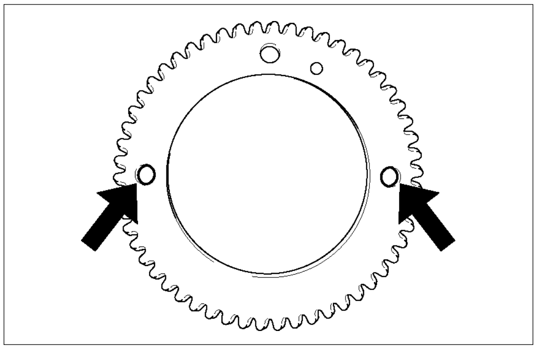
6) Install the snap ring to the main gear groove.



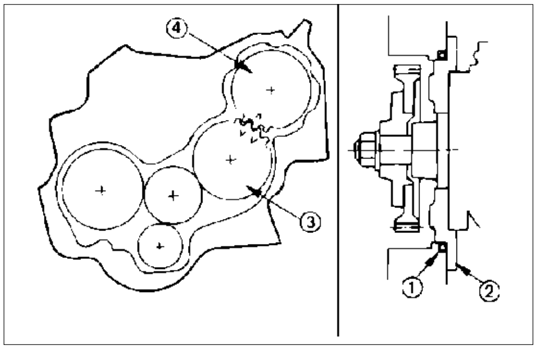
RTW31BSH000501

7) Install suitable bolts, nuts and washers to special tool as shown in the illustration to rotate the scissors gear.

End yoke holder: 5-8840-2447-0


RTW31BSH000401

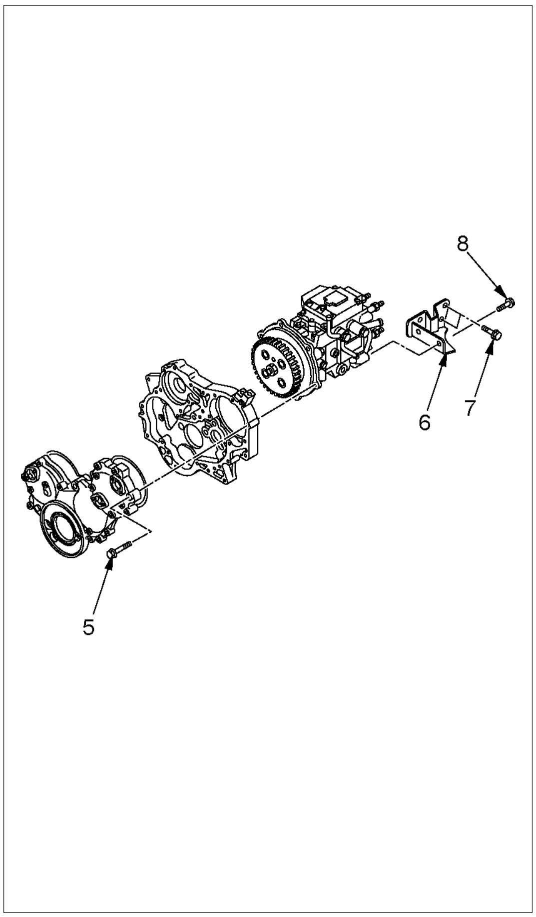
8) Insert the bolts of the special tool into the rear gear setting hole. Rotate the rear gear to mesh the teeth of main gear and rear gear.
9) Insert a lock bolt (M6 × 1 L=30) into scissors gear fixing hole to prevent the scissors gear from turning.
10) Place the main gear in a vise with copper plate so that the front side of the main gear facing up.
11) Repeat steps 4 to 8 to install the front gear.
12) Lock the front gear, the main gear, and the rear gear with lock bolt (inserted at Step 8).



020RY00039

23. Injection Pump

1. Install the O-ring (1) to the injection pump flange (2).
2. Attach the noise insulator rubber to the cylinder body .
3. Install the injection pump to the timing gear case.Align the idler gear "B" (3) mark with the injection pump timing gear (4) mark.



RTW36AMH000101

4JA1TC/4JH1TC:

4. Tighten the injection pump bolts (5) to the specified torque.

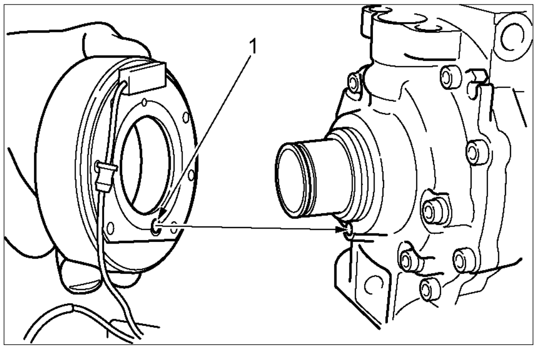
Injection Pump Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

5. Install the injection pump bracket (6) and the bracket bolts (7) and (8) to the cylinder body.
   Temporarily tighten the bracket bolts.
6. Tighten the bracket bolts (7) to the specified torque.
7. Tighten the bracket bolt (8) to the specified torque.

NOTE:
Tighten the bracket bolt (7) first.

Injection Pump Bracket Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

Important Operations - Reassembly

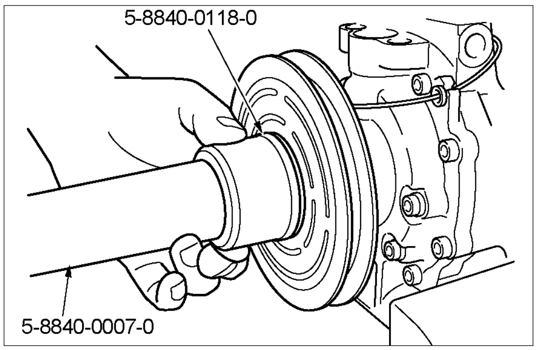


RTW510SH001001

2. Field Coil

Installation field coil.

- Align the located portion (1) of the clutch coil and compressor.



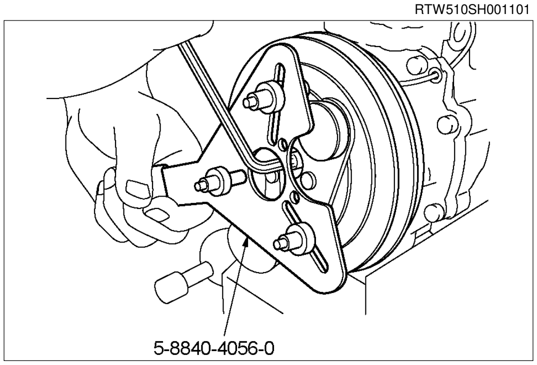
RTW510SH001101

4. Pulley Assembly

Using pulley installer and drive handle to install the pulley assembly.

Pulley Installer: 5-8840-0118-0 (J-33940)

Drive Handle: 5-8840-0007-0 (J-8092)



RTW510SH000701

8. Drive Plate Bolt

Using drive plate holder to prevent the drive plate from rotating.

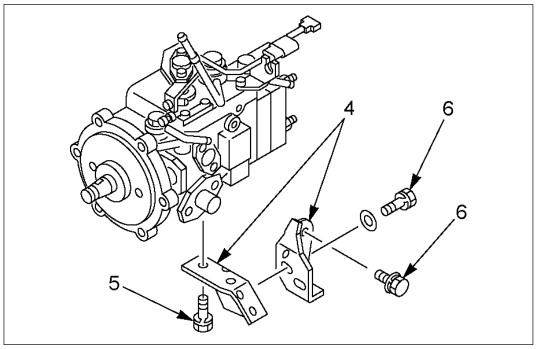
Drive Plate Holder: 5-8840-4056-0 (J-37872)

Tighten the bolt to the specified torque.

N·m (kgf·m/lb·in)

Torque	13 (1.3/113)

After tightening the bolt, check to be sure the pulley rotates smoothly.



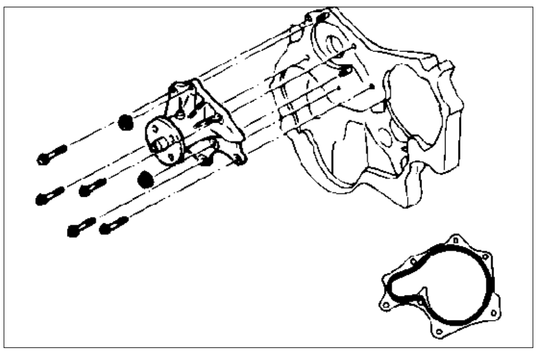
RTW46ASH002201

4JA1T(L):

4. Tighten the injection pump bolts to the specified torque.
5. Install the injection pump bracket (4) and the bracket bolts (5) and (6) to the cylinder body. Temporarily tighten the bracket bolts.
6. Tighten the bracket bolts (5) to the specified torque.
7. Tighten the bracket bolts (6) to the specified torque.

Injection pump Bracket Bolt Torque (6)	N·m(kg·m/lbft)
19 (1.9/14)	

Injection pump Bracket Bolt Torque (5)	N·m(kg·m/lbft)
40 (4.1/30)	

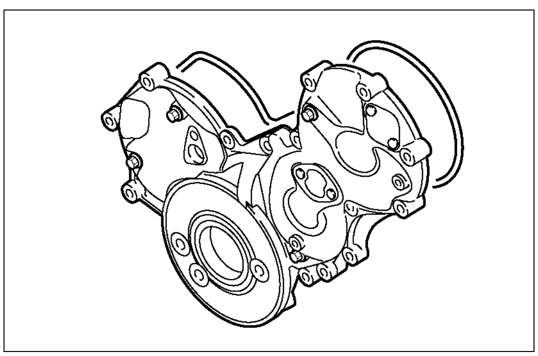


030RY00007

24. Water Pump

1. Apply the recommended liquid gasket or its equivalent to the water pump at the position shown in the illustration.
   Do not apply an excessive amount of liquid gasket.
2. Tighten the water pump bolts to the specified torque.

Water Pump Bolt Torque	N·m(kg·m/lbft)
20 (2.0/14)	

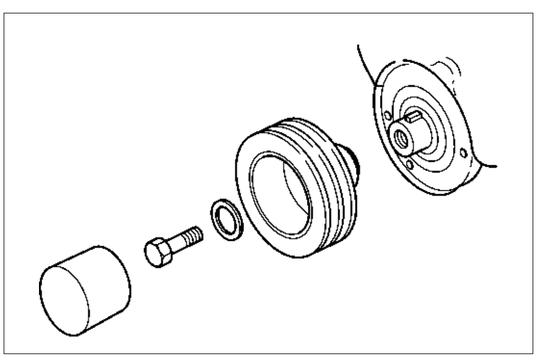


020R300004

25.Timing Gear Case Cover

1. Align the gear case with the timing gear case knock pin and then install the timing gear case cover.
2. Tighten the gear case cover bolts to the specified torque.

Gear Case Cover Bolt Torque	N·m(kg·m/lbft)
M8	19 (1.9/14)
M12	76 (7.7/56)



014R100014

26. Crankshaft Damper Pulley

Tighten the crankshaft damper pulley bolt to the specified torque.

Note:

Hold the flywheel ring gear stationary to prevent the crankshaft from turning when tightening the damper pulley bolt.

Crankshaft Damper Pulley Bolt Torque	N·m(kg·m/lbft)
206 (21/152)	

Take care not to damage the crankshaft damper pulley boss.

27. Cylinder Head Gasket

The cylinder head gasket "TOP" mark must be facing up.

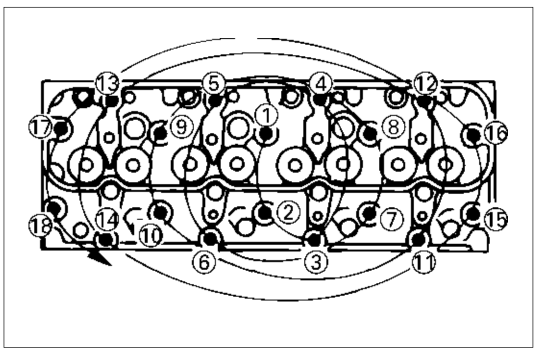
NOTE:

Before the gasket installation, measure the piston head projection and select the appropriate head gasket.

Refer to "INSPECTION AND REPAIR", "Cylinder Head Gasket Selection".

28. Cylinder Head

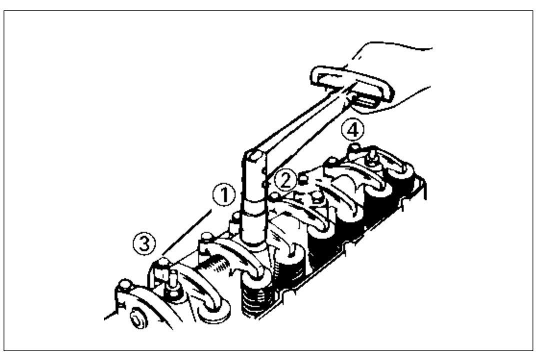
1. Align the cylinder body dowels and the cylinder head dowel holes.
   Carefully place the cylinder head on the cylinder head gasket.
2. Apply a coat of engine oil to the cylinder head bolt threads and setting faces.



011LX073

3. Tighten the cylinder head bolts in three steps of anglar tightening methed.
   Follow the numerical sequence shown in the illustration.

Cylinder Head Bolt Torque	N·m(kg·m/lbft)
1st step	49 (5.0/36)
2nd step	60° - 75°
3rd step	60° - 75°

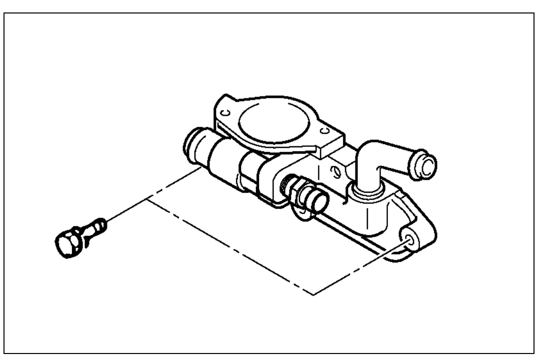


014LX083

30. Rocker Arm Shaft and Rocker Arm

Tighten the rocker arm shaft bracket bolts in the numerical order shown in the illustration.

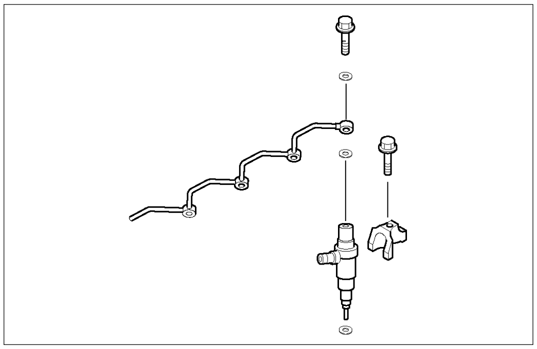
Rocker Arm Shaft Braket Bolt Torque	N·m(kg·m/lbft)
54 (5.5/40)	


031R300002

31. Thermostat Housing

1. Install the thermostat housing.
2. Tighten the thermostat housing bolts to the specified torque.

Thermostat Housing Bolt Torque	N·m(kg·m/lbft)
19 (1.9/14)	

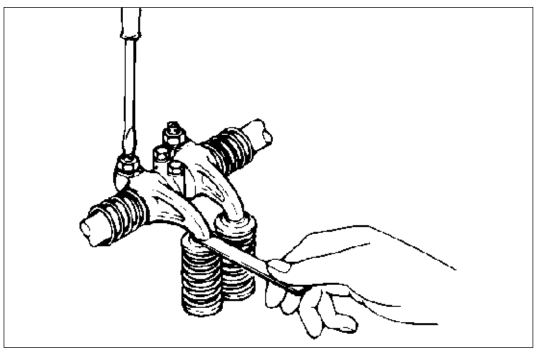


RTW46ASH001201

33. Injection Nozzle Holder

1. Install the injection nozzle gasket and the O-ring to the injection nozzle holder.
   Be sure that the O-ring fits snugly in the injection nozzle groove.
2. Install the nozzle holder toghther with the nozzle holder bracket to the cylinder head.
3. Tighten the nozzle holder bracket bolt to the specified torque.

Injection Nozzle Holder Bracket Bolt Torque	N·m(kg·m/lbft)
37 (3.8/28)	

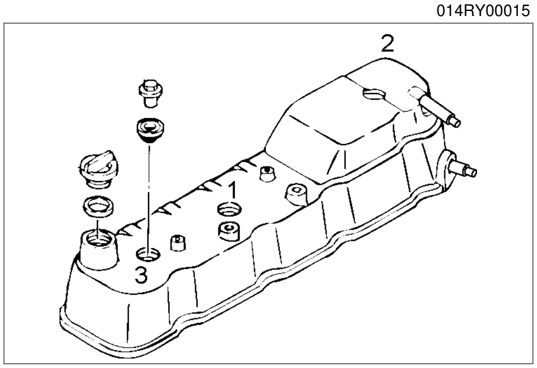


014RY00015

Note on Valve Clearance Adjustment

Valve clearances must be adjusted before the cylinder head cover is reinstalled.Refer to "Valve Clearance Adjustment" in the "Servicing" Section of this manual.

Valve Clearance (At Cold)	mm(in)
0.4 (0.0157)	



RTW46ASH001101

34. Cylinder Head Cover

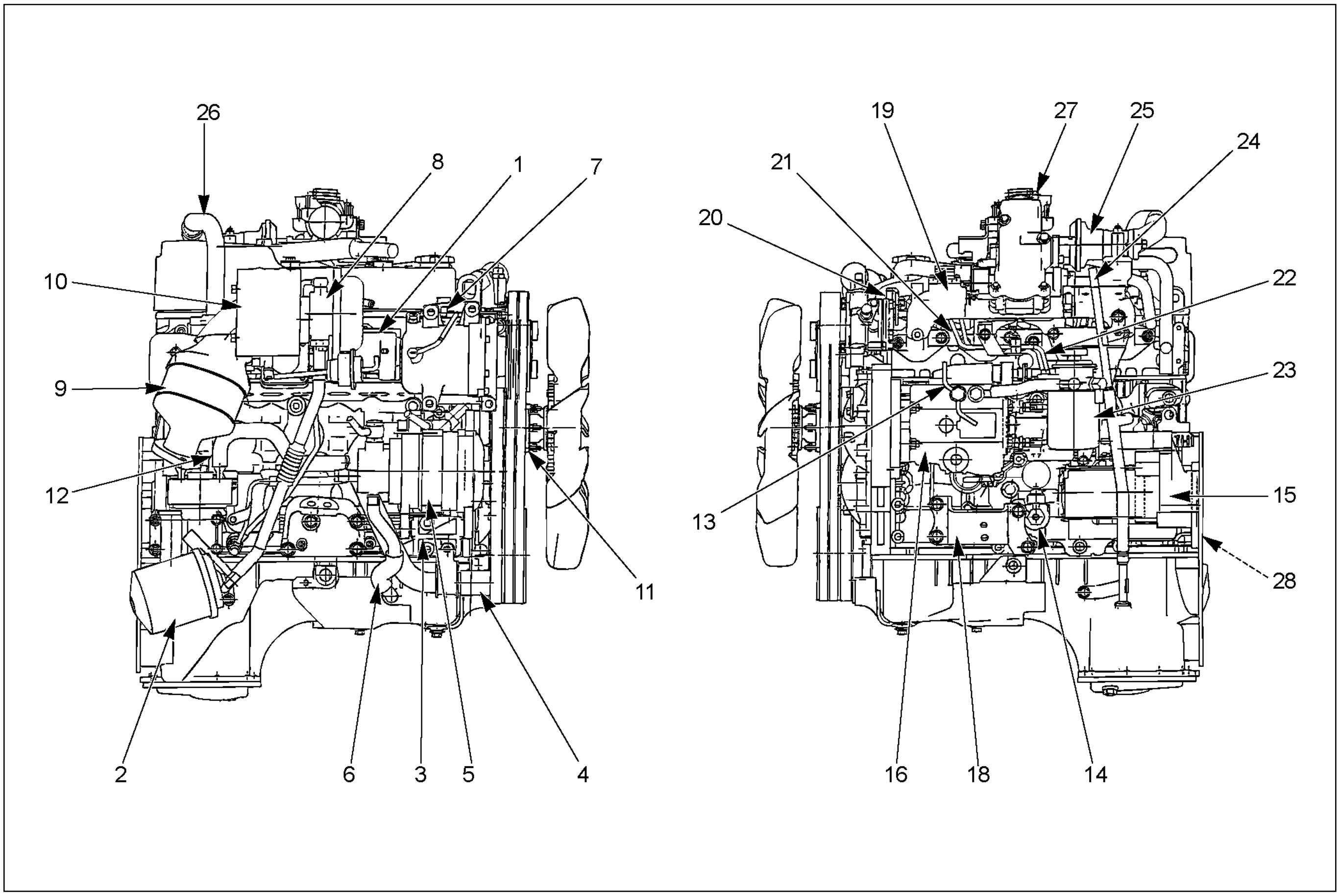
1. Apply engine oil to the rocker arm and the valve spring.
2. Install the cylinder head cover gasket to the head cover. Check to see that the head cover gasket has no loose areas.
3. Tighten the cylinder head cover nuts in the numerical order shown in the illustration.

Cylinder Head Cover Bolt Torque	N·m(kg·m/lbft)
13 (1.3/9.4)	

4. Connect the positive crankcase ventilation (PCV) hose to the cylinder head cover.

INSTALLATION

EXTERNAL PARTS



RTW36AMF000701

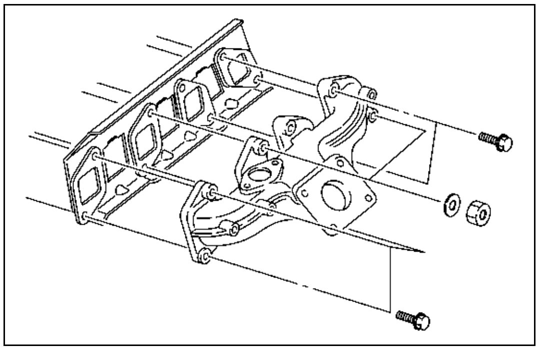
Installation Steps

1. Exhaust Manifold
2. Oil Cooler with Oil Filter
3. Generator Bracket
4. Water Inlet Pipe
5. Generator and Adjusting Plate
6. Vacuum Pump Oil Return Hose
7. Compressor Bracket
8. Turbocharger
9. Catalytic Converter
10. Heat Protector
11. Cooling Fan Pulley
12. Oil Cooler Water Pipe
13. Fuel Leak Off Pipe
14. Oil Pressure Warning Switch
15. Starter Motor
16. Injection Pump
17. Injection Pump Cover
18. Engine Mounting Bracket and Foot
19. Intake Manifold
20. Power Steering Oil Pump Bracket
21. Fuel Injection Pipe with Clip
22. Fuel Filter Bracket (Except EURO III)
23. Fuel Filter Assembly (Except EURO III)
24. Oil Level Gauge
25. EGR Valve

26-1. EGR Pipe

26-2. EGR Cooler (EURO III model only)

27. Intake Pipe and Throttle Body (4JA1TC/4JH1TC only)
28. Clutch Assembly or Flex Plate


027R100003

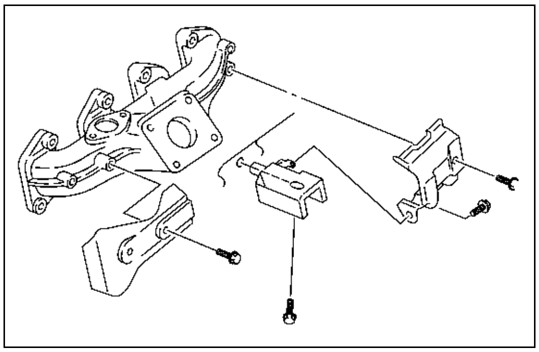
Installation

1. Exhaust Manifold

1) Install the exhaust manifold to the cylinder head with the manifold gasket.
2) Tighten the exhaust manifold bolts and nuts to the specified torque a little at a time.

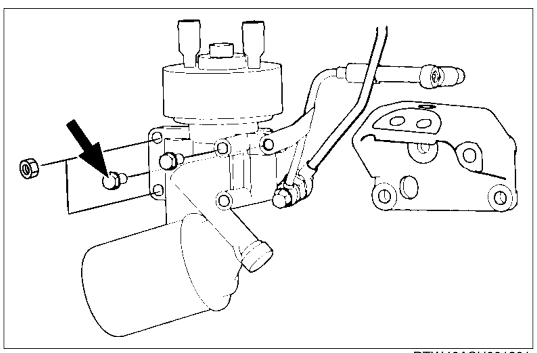
Exhaust Manifold Bolt and Nuts

Torque	N·m(kg·m/lb ft)
24 (2.4/17)	


027R100004

3) Install the exhaust manifold bracket to the manifold and the cylinder body.

Manifold Bracket Bolt Torque	N·m(kg·m/lb ft)
19 (1.9/14)	

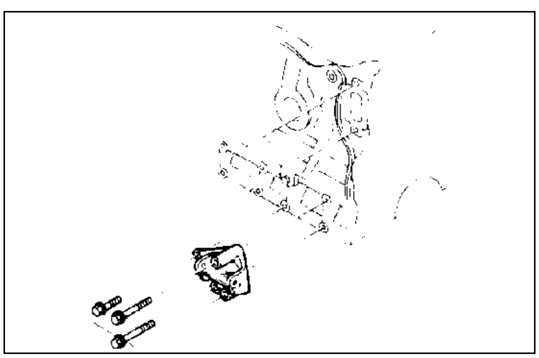

RTW46ASH001301

2. Oil Cooler with Oil Filter

1) Install the O-ring to the oil filter body flange groove.
2) Install the oil filter body to cylinder block and tighten to the specified torque.

Oil Filter Body Bolt and Nut

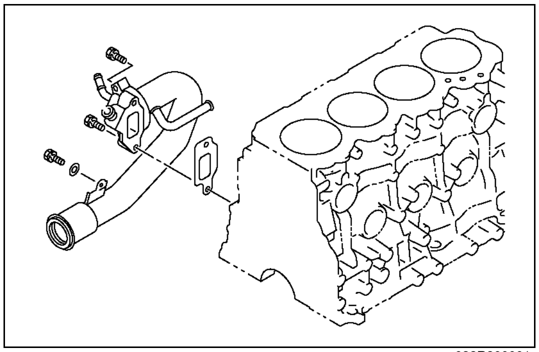
Torque	N·m(kg·m/lb ft)
BOLT 19 (1.9/14) NUT 24 (2.4/17)	


066RY00001

3. Generator Bracket

Install the generator bracket to the cylinder body and tighten the bracket bolts to the specified torque.

Bracket Bolt Torque	N·m(kg·m/lb ft)
40 (4.1/30)	

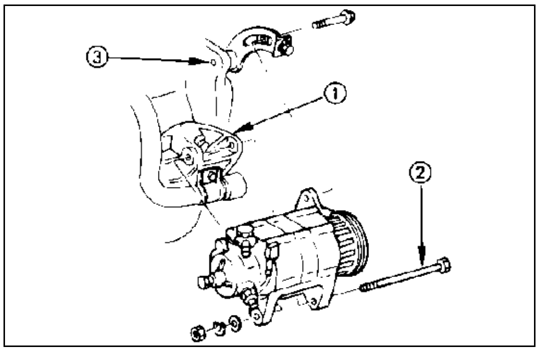


032R300001

4. Water Inlet Pipe

1) Tighten the water inlet pipe bolts to the specified torque.

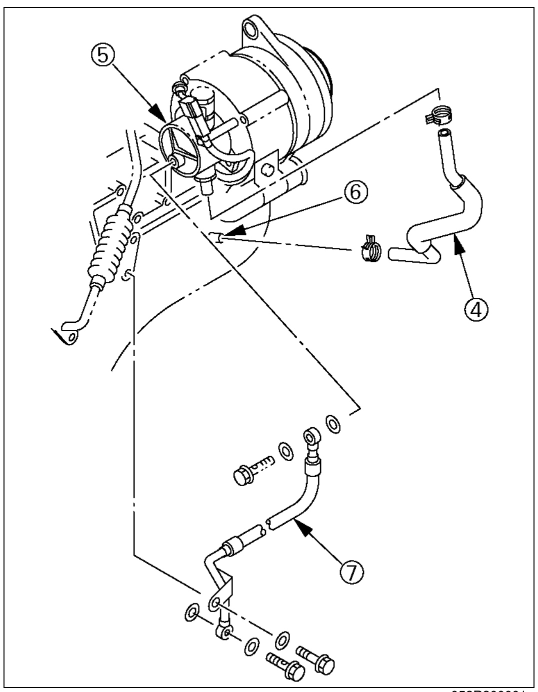
Suction Pipe Bolt Torque	N·m(kg·m/lb ft)
19 (1.9/14)	



066RY00002

5. Generator and Adjusting Plate

1) Install the generator to the bracket (1).
2) Temporarily tighten the generator bolt (2) and adjusting plate bolts (3).
   The bolts will be finally tightened after installation of the cooling fan drive belt.

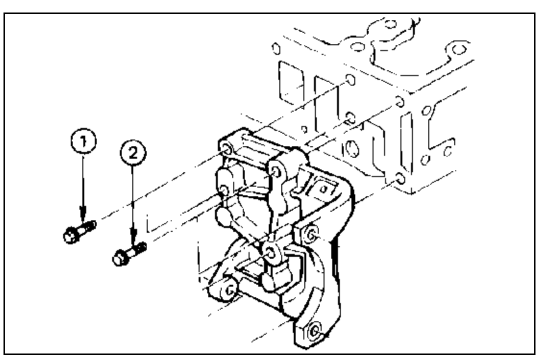


052R300001

3) Connect the vacuum pump rubber hose (4) to the vacuum pump (5), and the oil pan (6).

6. Vacuum Pump Oil Return Hose

Connect the vacuum oil pipe (7) to the vacuum pump, and the cylinder body

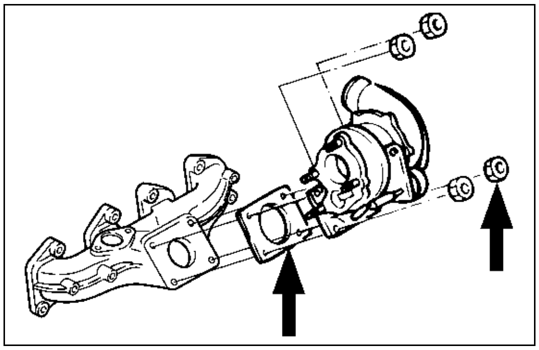


042RY00003

7. Compressor Bracket

1) Install the compressor bracket to the cylinder head.
2) Tighten the bracket bolts to the specified torque.

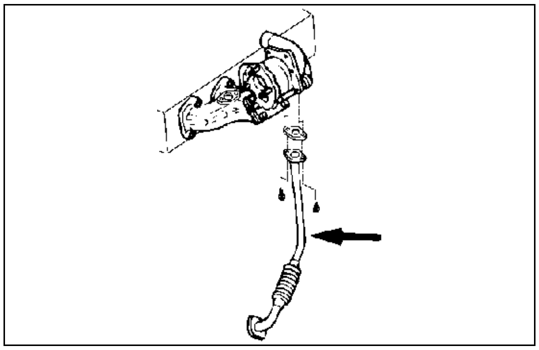
Bracket Bolt Torque	N·m(kg·m/lb ft)
M8×1.25	19 (1.9/14)
M10×1.25	40 (4.1/30)



027R100002

8. Turbocharger

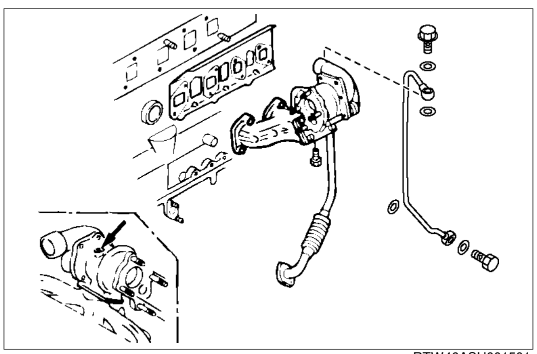
1) Install the turbocharger and the gasket.
2) Temporarily tighten the turbocharger nuts at this time. They will be fully tightened after the installation of the turbocharger oil pipe.
   Always install new nuts and new gasket.



036R100001

3) Install the oil return pipe with gasket to the turbocharger.
4) Tighten the turbocharger oil return pipe to the specified torque.

Bracket Bolt Torque N·m(kg·m/lb ft)
8 (0.8/6)

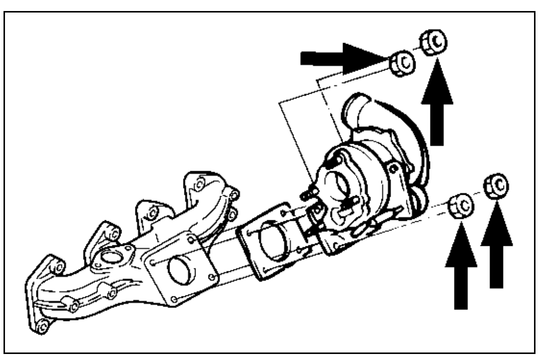


RTW46ASH001501

5) Before installing the oil feed pipe, supply 10 - 20 cc of clean engine oil to the turbocharger center housing through the oil feed opening.
6) Turn the rotating assembly with your hand to thoroughly lubricate the internal parts.
7) Tighten the oil feed pipe to the specified torque.

Turbocharger Oil Feed Pipe Joint

Bolt Torque	N·m(kg·m/lb ft)
M10×1.5	22 (2.25/16)
M14×1.5	54 (5.5/40)



027R100005

8) Tighten the turbocharger nut to the specified torque.

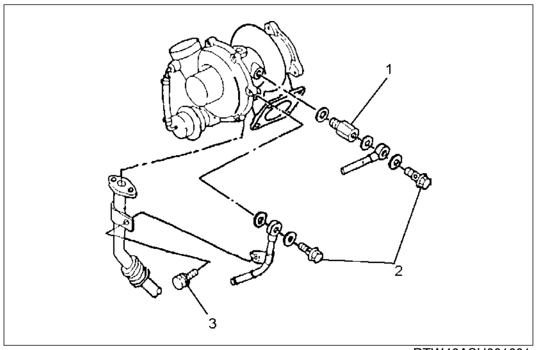
Turbocharger Nut Torque N·m(kg·m/lb ft)
27 (2.7/20)

9) Install the water feed adapter (1) with the gaskets to turbocharger and tighten to the specified torque.

Adapter Torque	N·m(kg·m/lb ft)
39 (4.0/29)	

10) Install the water feed pipe with the gaskets and tighten to the specified torque.

Water Return Pipe Torque	N·m(kg·m/lb ft)
39 (4.0/29)	



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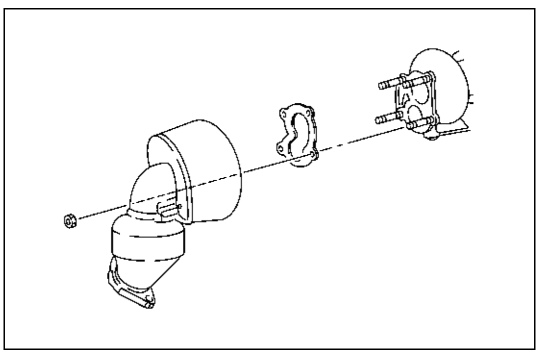
11) Install the water return pipe with the gaskets and tighten to the specified torque.

Water Return Torque	N·m(kg·m/lb ft)
39 (4.0/29)	

12) Clamp the water feed pipe to the oil return pipe of the turbocharger.

Fixing Bolt (3) Torque	N·m(kg·m/lb ft)
8 (0.8/6)	

13) Install the hoses for the water feed and return.


027R100007

9. Catalytic Converter

Install the catalytic converter with gasket and tighten the nut to the specified torque.

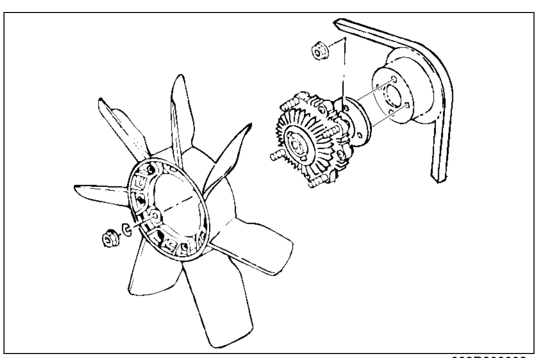
Catalytic converter Nut Torque	N·m(kg·m/lb ft)
27 (2.7/20)	

Do not install the catalytic converter, if drop down it.

10. Heat Protector

Install the heat protector and tighten the bolt to the specified torque.

Heat Protector Bolt Torque	N·m(kg·m/lb ft)
9 (0.9/6.5 lb in)	


033R300002

11. Cooling Fan Pulley

1) Install the cooling fan pulley to the water pump.
2) Tighten the cooling fan pulley nuts to the specified torque.

Pulley Nut Torque	N·m(kg·m/lb ft)
8 (0.8/6)	

12. Oil Cooler Water Pipe

13. Fuel Leak Off Pipe

14. Oil Pressure Warning Switch

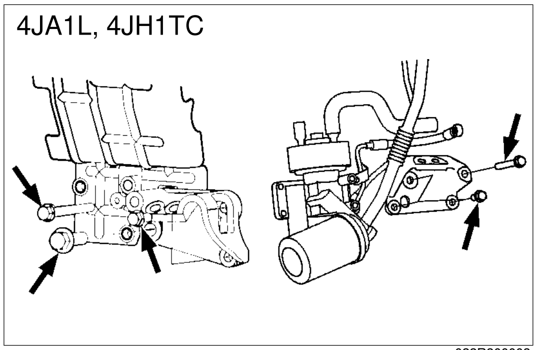
15. Starter Motor

Tighten the starter motor bolts to the specified torque.

Starter Motor Bolt Torque N·m(kg·m/lb ft)
85 (8.7/63)

16. Injection Pump

17. Injection Pump Cover (4JA1TC/4JH1TC only)



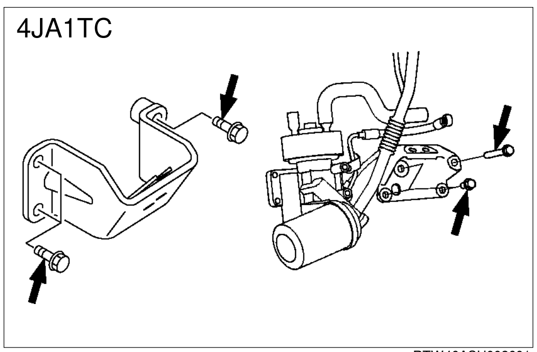
022R300003

18. Engine Foot

Install the engine foot to the cylinder body and tighten the bracket bolts to the specified torque.

Engine Foot Bolt Torque N·m(kg·m/lb ft)

Right Side	M10×1.25	40 (4.1/30)
Left Side	M10×1.25	40 (4.1/30)
	M14×1.50	127 (13/93)



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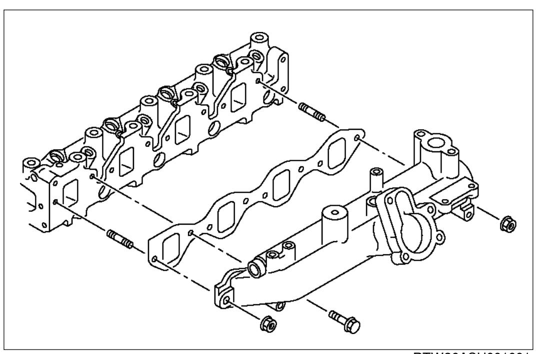
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19. Intake Manifold

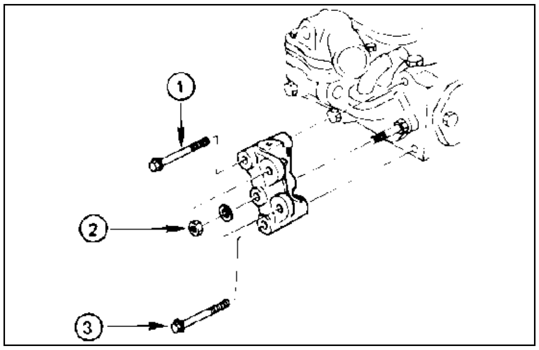
1) Install the manifold gasket to the intake manifold.
2) Connect the intake rubber hose to the intake duct.
3) Tighten the intake manifold bolts and the flange nuts to the specified torque.

Intake Manifold Bolt Torque N·m(kg·m/lb ft)
19 (1.9/14)

Intake Manifold Flange Nut Torque N·m(kg·m/lb ft)
24 (2.4/18)

4) Connect the PCV hose to the cylinder head cover.

5) Install the fan drive belt and adjust the belt tension referring SERVICING of this section



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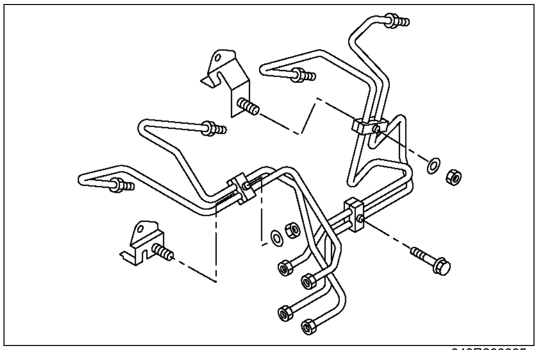


040R300005

20. Power Steering Oil Pump Bracket

Oil Pump Braket Nut and Bolt Torque N·m(kg·m/lb ft)

①	M10×1.25	37 (3.8/28)
② ③	M8×1.25	18 (1.8/13) (Bolt ID:8)

21. Fuel Injection Pipe with Clip

1) Temporarily tighten the injection pipe sleeve nut.
2) Set the clip in the illustrated position.

Note:
Make absolutely sure that the clip is correctly positioned.
An improperly positioned clip will result in injection pipe breakage and fuel pulsing noise.

3) Tighten the injection pipe sleeve nut to the specified torque.

Torque

Injection Pump Side (4JA1TC/4JH1TC) N·m(kg·m/lb ft)

40 (4.1/30)

Injection Pipe Sleeve Nuts N·m(kg·m/lb ft)

29 (3.0/22)

Injection Pipe Clip Nuts N·m(kg·m/lb ft)

8 (0.8/6)

22. Fuel Filter Bracket (Except EURO III model)

Install the fuel filter bracket and tighten fixing bolts to the specified torque.

Fuel Filter Bracket Bolt Torque N·m(kg·m/lb ft)

21 (2.1/15)

23. Fuel Filter Assembly (Except EURO III model)

Install the fuel filter assembly and tighten fixing bolts to the specified torque.

Fuel Filter Assembly Bolt Torque N·m(kg·m/lb ft)

21 (2.1/15)

24. Oil Level Gauge

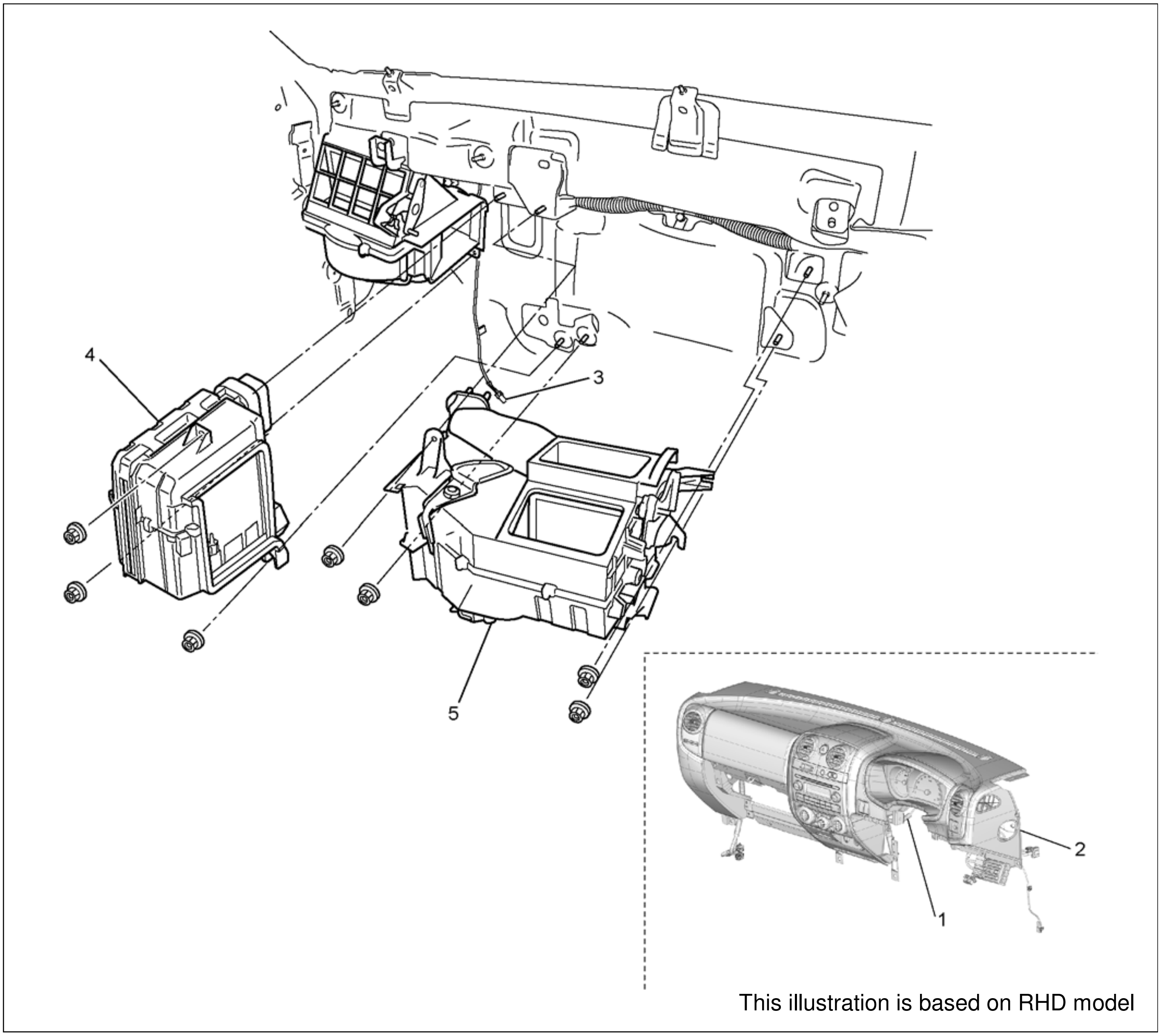
Install the oil level gauge and tighten fixing bolts to the specified torque.

Oil Level Gauge Bolt Torque N·m(kg·m/lb ft)

M8	19 (1.9/14)
M6	8 (0.8/6)

HEATER UNIT

REMOVAL AND INSTALLATION



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Removal Steps

1. Control cable
▲2. Instrument panel assembly and cross beam
3. Electronic thermostat connector
▲4. Evaporator or duct
5. Heater unit

Installation steps

5. Heater unit
4. Evaporator or duct
3. Electronic thermostat connector
▲2. Instrument panel assembly and cross beam
1. Control cable

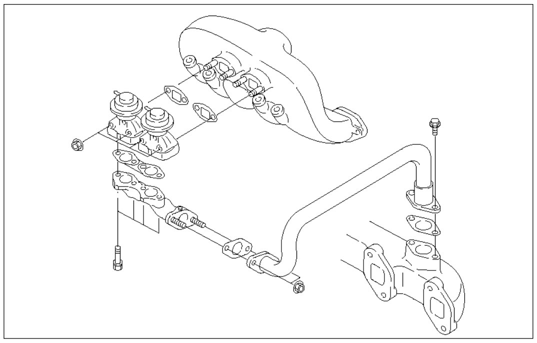
25. EGR Valve

Install the EGR valve assembly to the intake minifold with the two gasket.

Tighten the four nuts to the specified torque.

Nut Tolque	N·m(kg·m/lb ft)
31 (3.1/23)	

Connector the vacuum hose.


025R100008

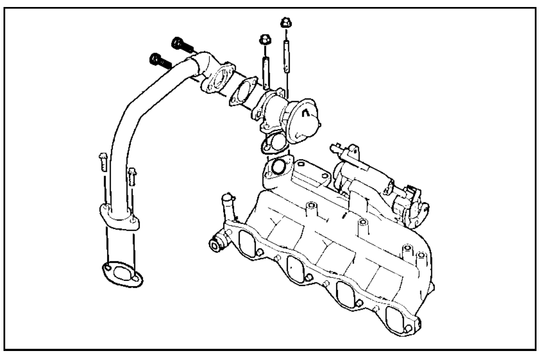
26-1. EGR Pipe

Install the EGR valve adapter with the gasket to the EGR valve assembly and install the EGR pipe with the gasket.

Tighten fixing bolts and nuts to the specified torque.

EGR Valve Adapter Bolts	N·m(kg·m/lb ft)
24 (2.4/17)	

EGR Pipe Bolts and Nuts	N·m(kg·m/lb ft)
27 (2.7/20)	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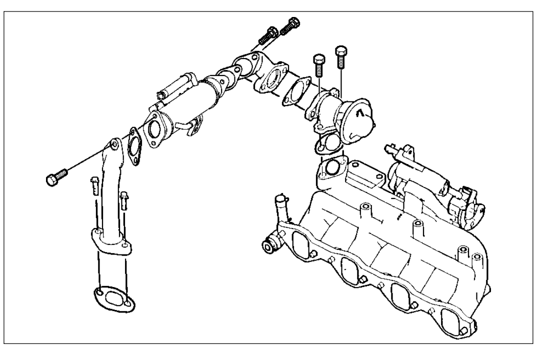
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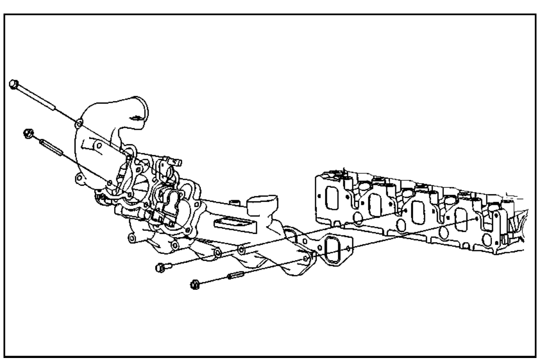
26-2. EGR Cooler (EURO III model only)

Install the EGR valve adapter with the gasket to the EGR valve assembly and install the EGR pipe with the gasket.

Tighten fixing bolts and nuts to the specified torque.

EGR Valve Adapter Bolts	N·m(kg·m/lb ft)
24 (2.4/17)	

EGR Pipe Bolts and Nuts	N·m(kg·m/lb ft)
27 (2.7/20)	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27. Intake Pipe and Throttle Body (4JA1TC/4JH1TC only)

Install the throttle body with the gasket to the intake manifold and install the intake duct with the gasket.

Tighten the two bolts and the two nuts to the specified torque.

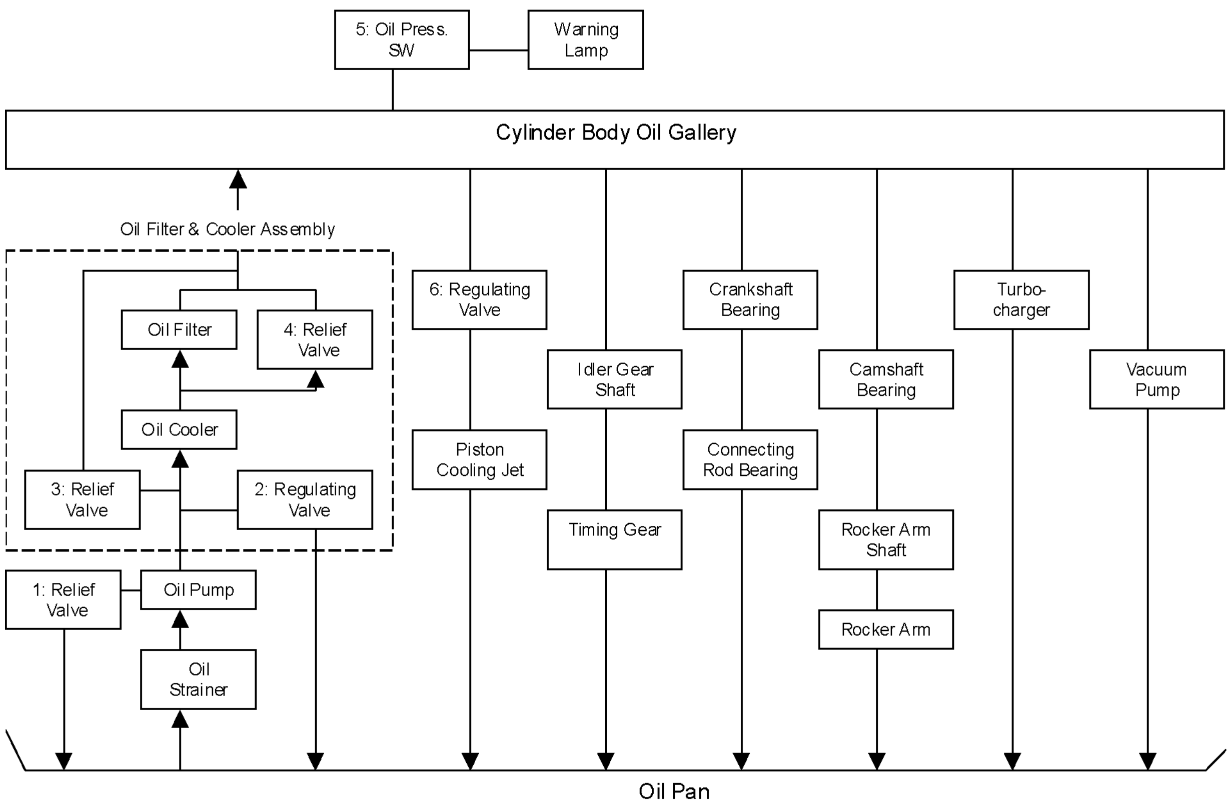
Throttle Body and Intake Duct N·m(kg·m/lb ft)

Bolt	19 (1.9/14)
Nut	24 (2.4/17)

28. Clutch Assembly or Flex Plate

LUBRICATION SYSTEM

LUBRICATING OIL FLOW



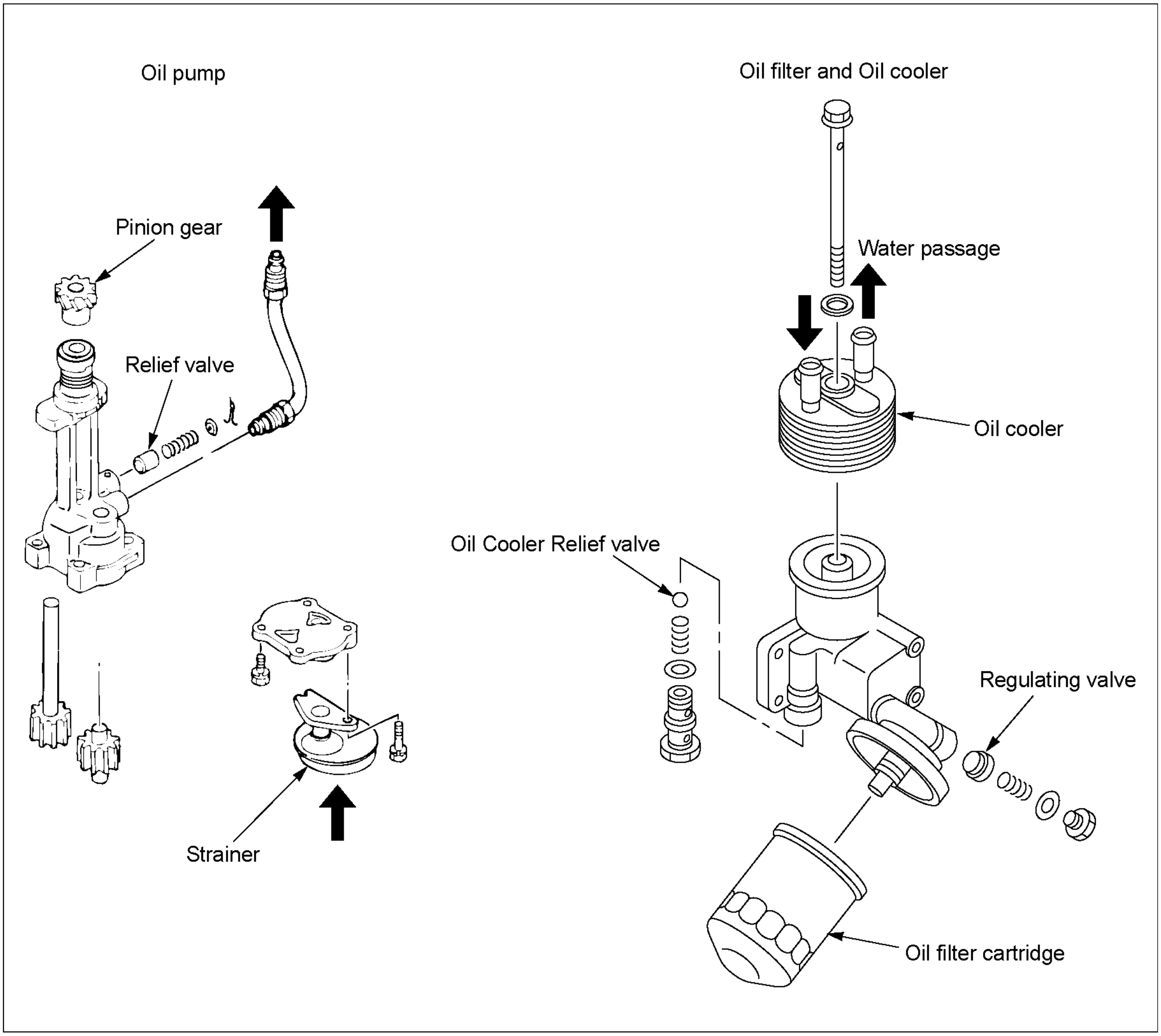
1. Oil Pump Relief Valve Operating Pressure: 6.2 - 7.8 kg/cm^2 (608 – 764 kPa)
2. Regulating Valve Operating Pressure: 5.7 - 6.3 kg/cm^2 (558.6 - 617.4 kPa)
3. Oil Cooler Relief Valve Opening Pressure: 2.8 - 3.4 kg/cm^2 (270 – 330 kPa)
4. Oil Filter Relief Valve Opening Pressure: 0.8 - 1.2 kg/cm^2 (78.4 - 117.6 kPa)
5. Oil Pressure Switch Operating Pressure: 0.3 - 0.5 kg/cm^2 (29.4 - 49.0 kPa)
6. Regulating Valve: 1.8 - 2.2 kg/cm^2 (176 – 216 kPa)

The 4J series engine has a full flow type lubricating system.

Lubricating oil is pumped from the oil pump to the cylinder body oil gallery through the oil cooler and the oil filter. It is then delivered to the vital parts of the engine from the cylinder body oil gallery.

Oiling jets installed on the cylinder body spray engine oil to the piston backside faces to achieve maximum piston cooling effect.

OIL PUMP AND OIL FILTER



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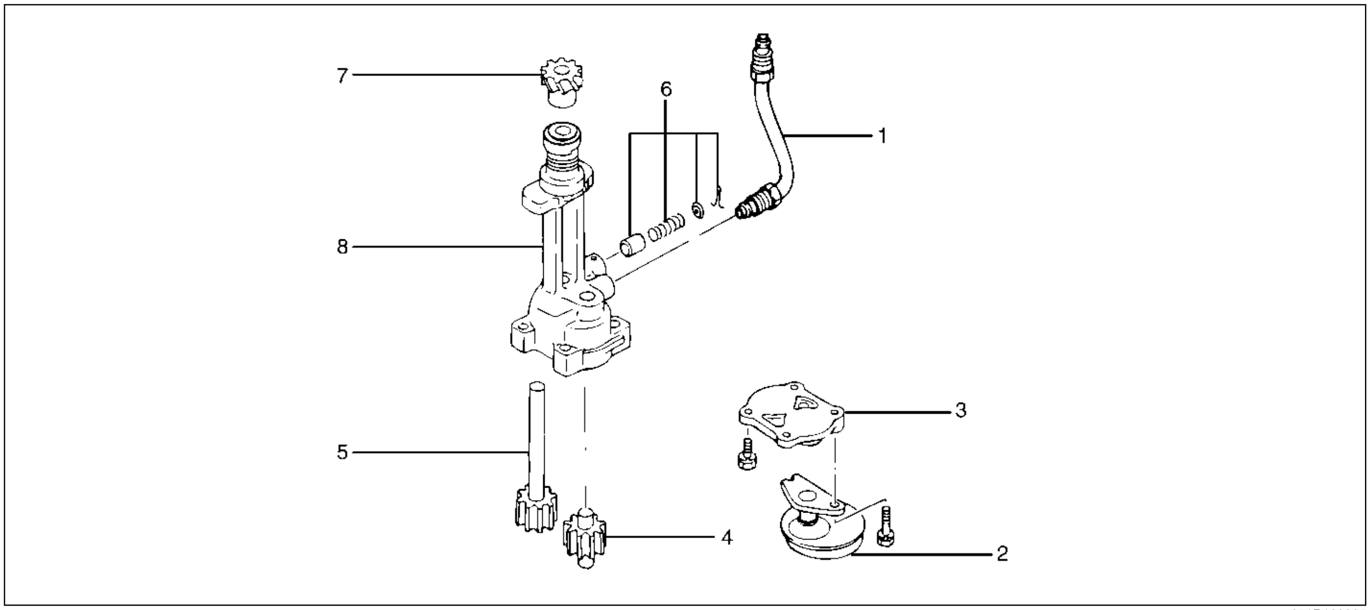
The 4J series engine is equipped with a gear type oil pump.
The oil filter and the water cooled oil cooler integrated a single unit to increase the cooling effect.

OIL PUMP

DISASSEMBLY



051R100005

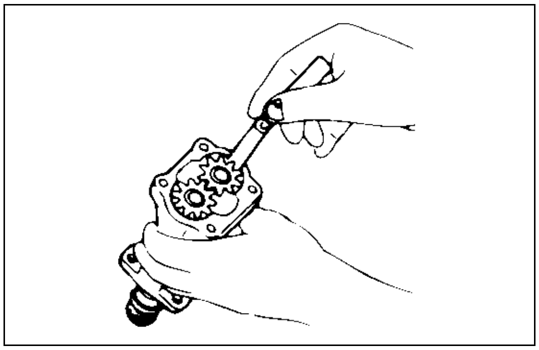
Disassembly Steps

1. Oil pipe
2. Strainer
3. Pump cover
4. Driven gear with bushing
5. Driven gear
6. Relief valve assembly
7. Pinion gear
8. Oil pump body

Disassembly procedure is shown in the illustration above numerical order.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



051RY00001

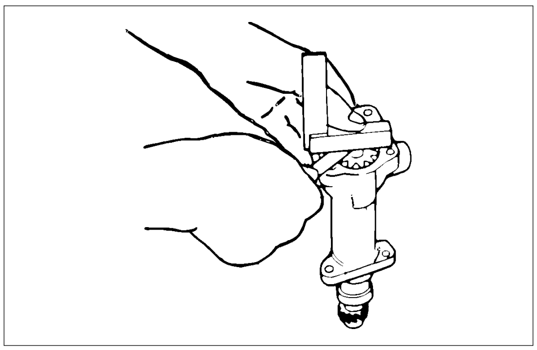
Gear Teeth and Body Inner Wall Clearance

Use a feeler gauge to measure the clearance between the gear teeth and the body inner wall.

If the clearance between the gear teeth and the body inner wall exceeds the specified limit, either the gear or the body must be replaced.

Gear Teeth and Body Inner Wall Clearance mm (in)

Standard	Limit
0.14 (0.0055)	0.20 (0.0079)



RTW46ASH002701

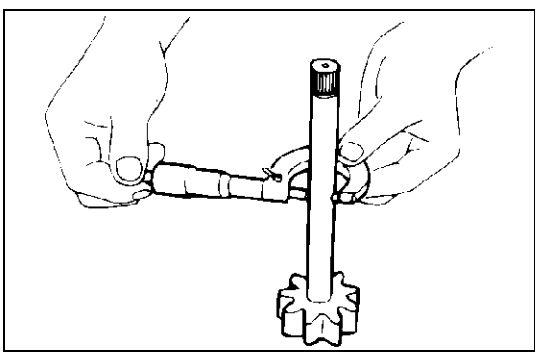
Gear and Body Clearance

Use a feeler gauge to measure the clearance between the body and the gear.

If the clearance between the gear and the body exceeds the specified limit, the body must be replaced.

Gear and Body Clearance mm (in)

Standard	Limit
0.06 (0.024)	0.15 (0.0059)



051RY00003

Drive Shaft and Oil Pump Body Clearance

Use a micrometer to measure the drive shaft outside diameter.

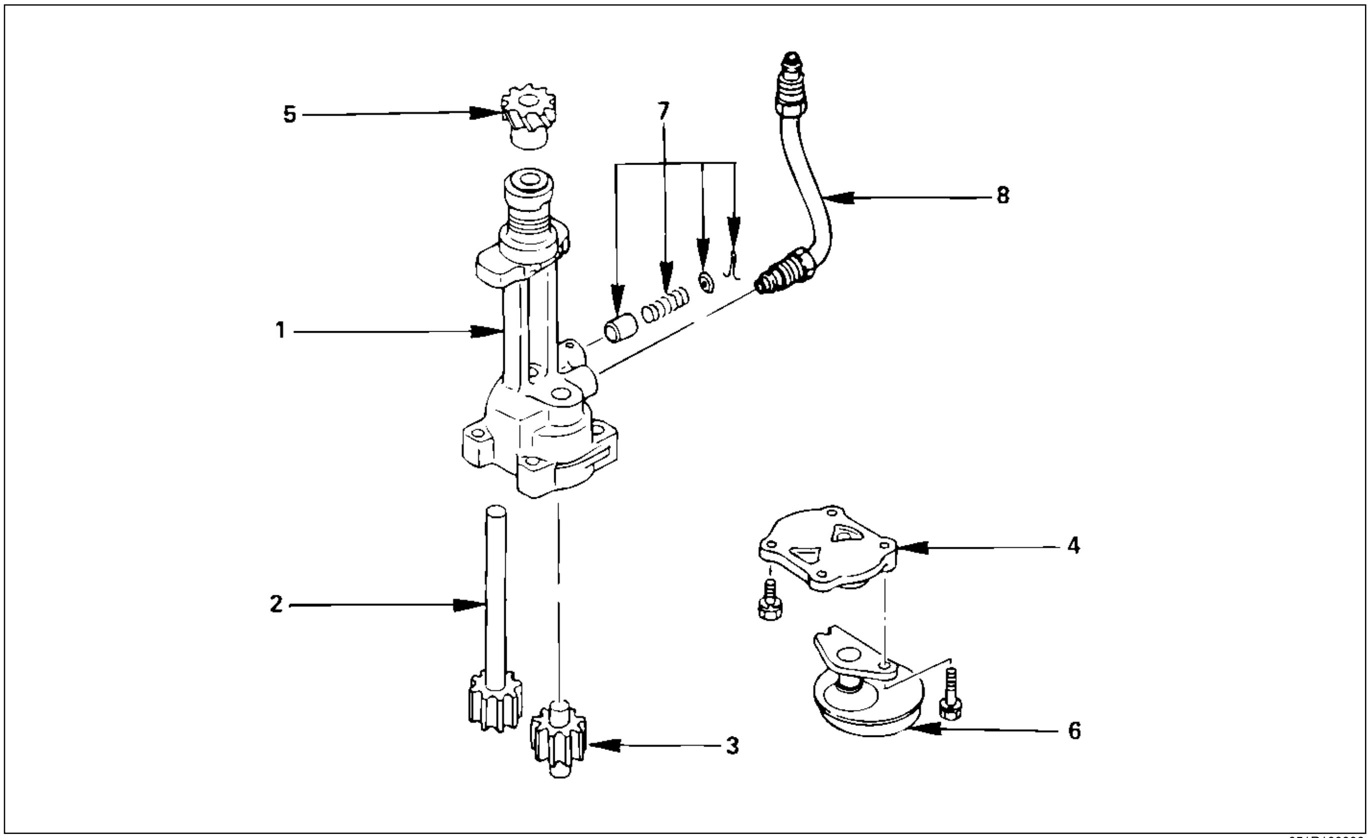
Use an inside dial indicator to measure the pump body inside diameter.

If the clearance between the drive shaft and the oil pump body exceeds the specified limit, the oil pump assembly must be replaced.

Drive Shaft and Oil Pump Body Clearance mm (in)

Standard	Limit
0.04 (0.0016)	0.20 (0.0079)

REASSEMBLY



051R100006

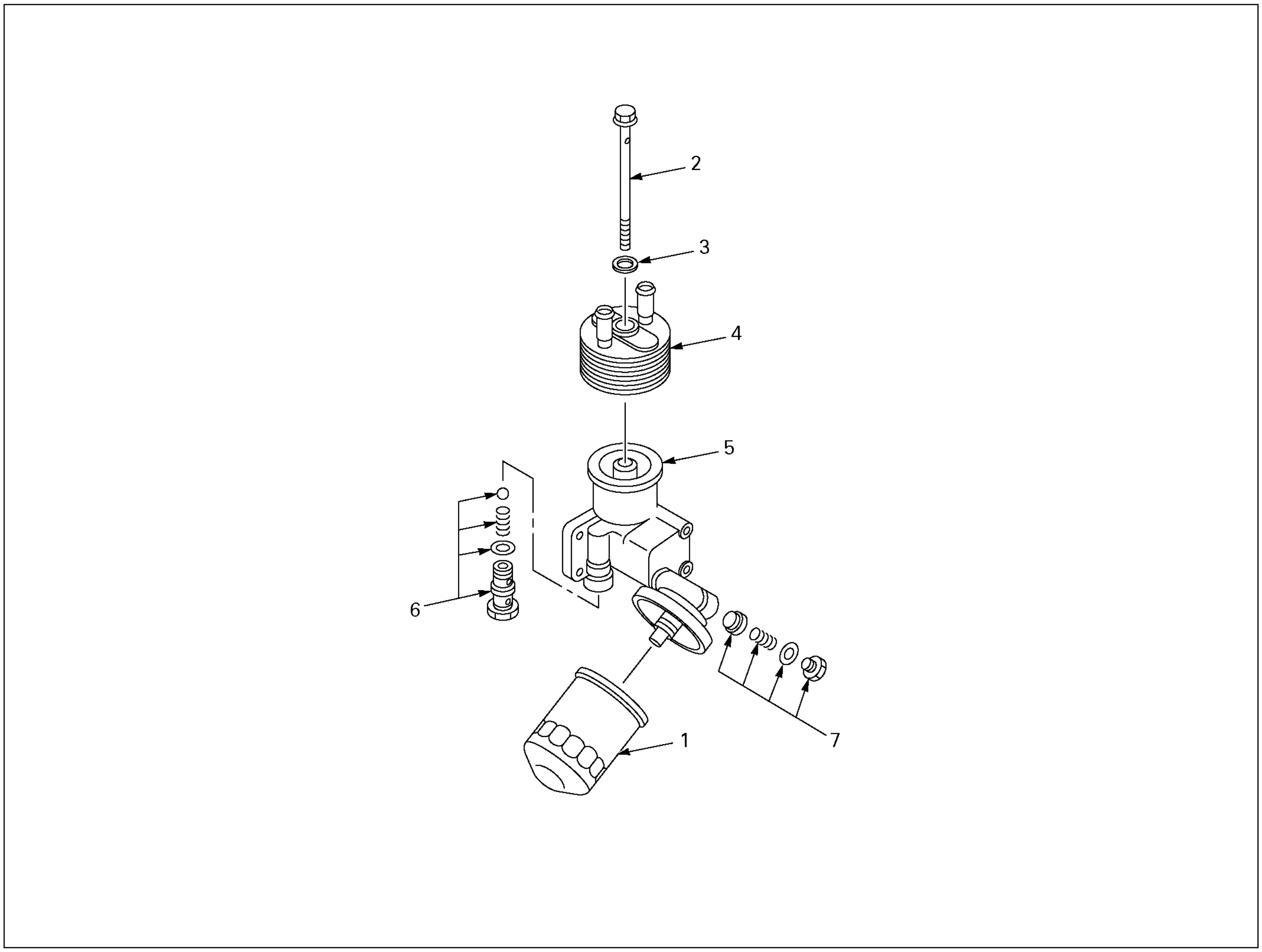
Reassembly Steps

1.	Oil pump body	5.	Pinion gear
2.	Drive gear	6.	Strainer
3.	Driven gear	7.	Relief valve assembly
4.	Pump cover	8.	Oil pipe

Reassembly procedure is shown in the illustration above numerical order.
Pump cover fixing bolts torque: 16 N·m (1.6 kg·m/12 lb ft)

OIL FILTER AND OIL COOLER

DISASSEMBLY



050R300004

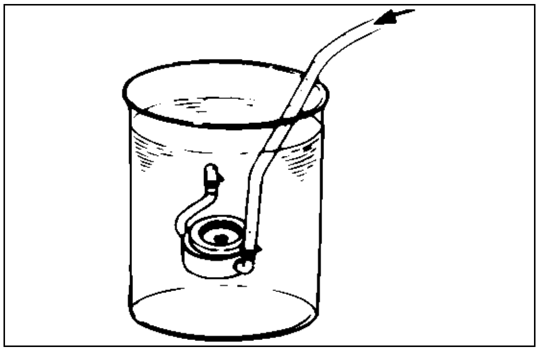
Disassembly Steps

1. Oil filter cartridge
2. Bolt
3. Gasket
4. Oil cooler
5. Body
6. Oil cooler relief valve
7. Regulating valve

Disassembly procedure is shown in the illustration above numerical order.

INSPECTION AND REPAIR

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.


050RY00002

Oil Cooler

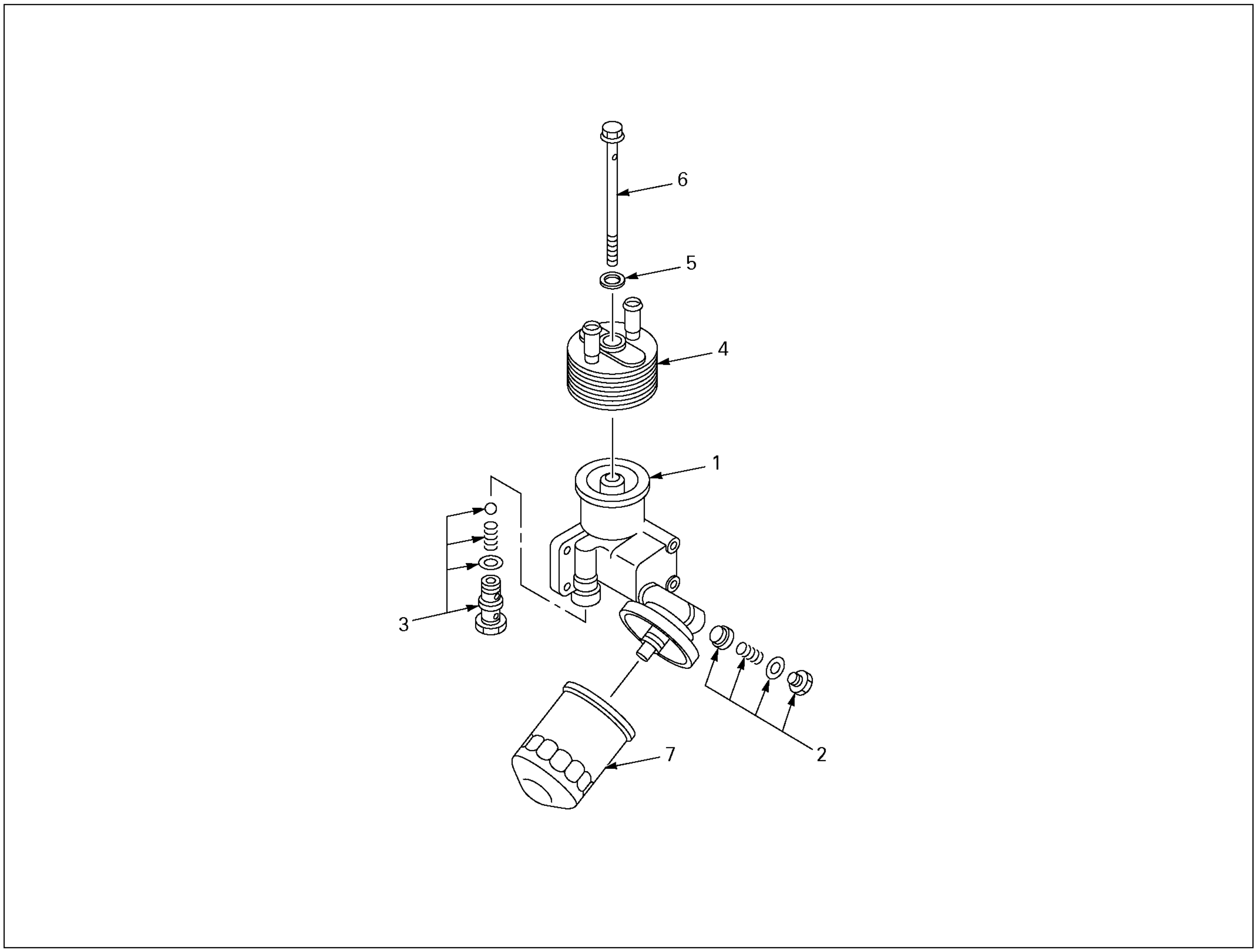
Water Leakage at Water Passage

1. Plug one side of the oil cooler water passage.
2. Submerge the oil cooler in water.
3. Apply compressed air (200kPa (2kg/cm^2 / 28psi)) to the other side of the oil cooler water passage.

If air bubbles rise to the surface, there is water leakage.

Should be replaced oil cooler assembly.

REASSEMBLY

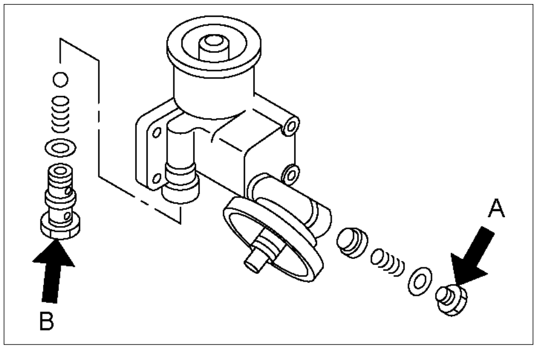


050R300003

Reassembly Steps

1. Body
2. Regulating valve
3. Oil cooler relief valve
4. Oil cooler
5. Gasket
6. Bolt
7. Oil filter cartridge

Reassembly procedure is shown in the illustration above numerical order.



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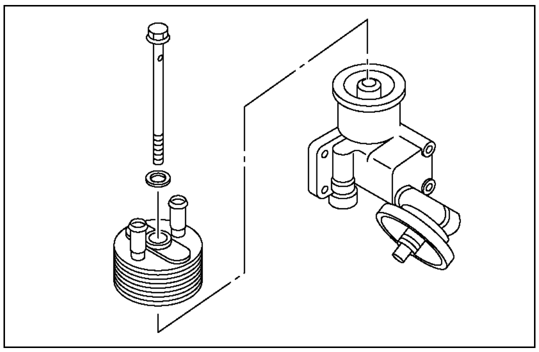
1. **Body**
2. **Oil Filter Safety Valve**
3. **Oil Cooler Safety Valve**

Tighten the oil filter Ⓐ and oil cooler Ⓑ relief valve to the specified torque.

Regulating Valve	N·m(kg·m/lb ft)
Ⓐ	64 (6.5/48)

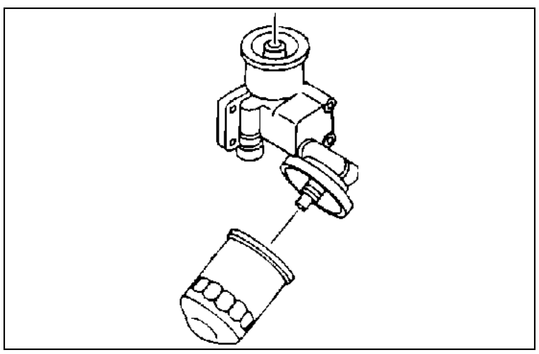


050R300006

4. **Oil Cooler**
5. **Gasket**
6. **Bolt**

Tighten bolt with gasket and oil cooler to the specified torque.

Bolt Torque	N·m(kg·m/lb ft)
40 (4.1/30)	



050RY00004

7. **Oil Filter Cartridge**

1) Apply engine oil to the O-ring.
2) Tighten the oil filter cartridge to the specified torque.

Filter wrench: 5-8840-0201-0

Oil Filter Cartride Torque	N·m(kg·m/lb ft)
18 (1.8/13)	

Important Operations – Removal

2. Instrument Panel Assembly and Cross Beam.

Refer to SECTION 10 “INSTRUMENT PANEL”.

4. Evaporator or Duct

Refer to “EVAPORATOR” or “DUCT” in this section.

Important Operation - Installation

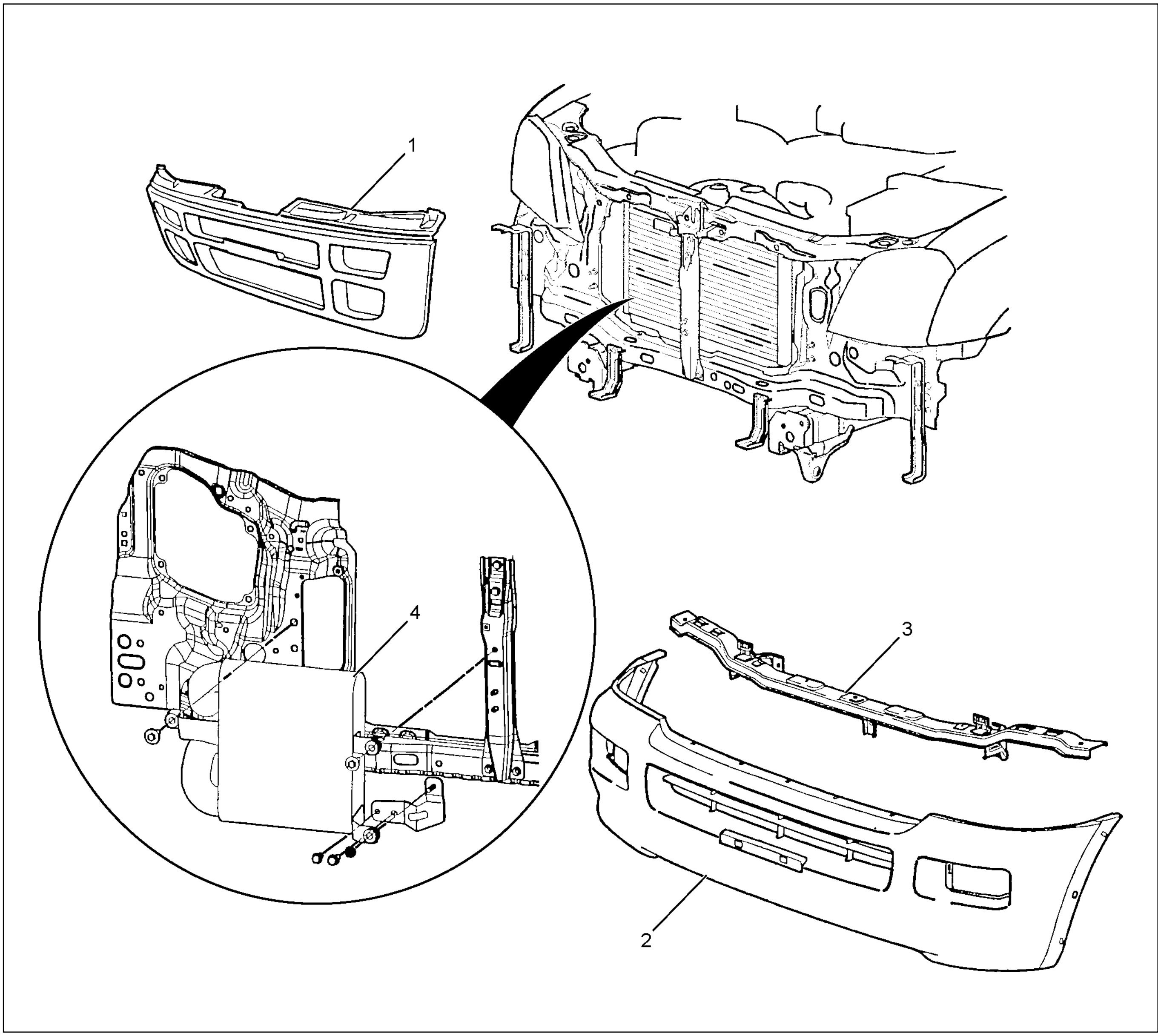
2. Instrument Panel Assembly and Cross Beam

Adjust the heater control cables.

Refer to "CONTROL LEVER ASSEMBLY" in this section.

INTER COOLER

REMOVAL AND INSTALLATION



RTW46ALF001001

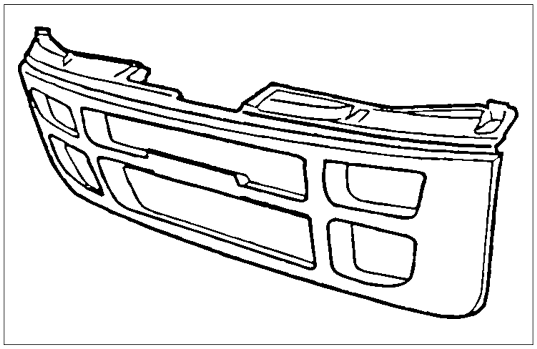
Removal Steps

1. Radiator grille
2. Front bumper fascia
3. Front bumper inpact support assembly
4. Inter cooler

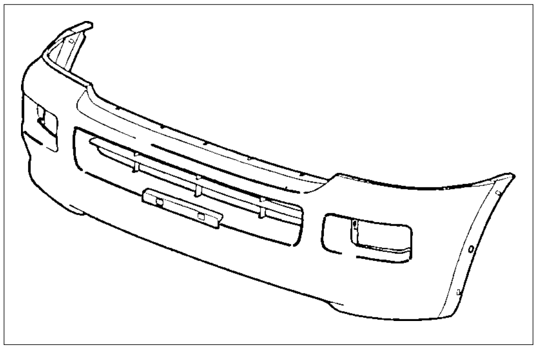
Installation Steps

4. Inter cooler
3. Front bumper inpact support assembly
2. Front bumper fascia
1. Radiator grille

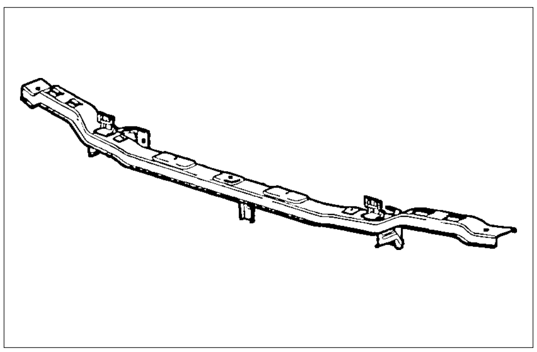
Removal


RTW36ASH000601

1. **Radiator Grille**
   - Refer to removal procedure in Sheet Metal section.


RTW36ASH000501

2. **Front Bumper Fascia**
   - Remove the nine clips and four screws.
   - Disconnect the fog light harness connectors.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3. **Front Bumper Impact Support Assembly**
   - Remove the nut and two bolts.

4. **Inter Cooler**
   - Remove the nut and two bolts.
   - Disconnect the air hose.

Installation

4. **Inter Cooler**
   - Tighten the nut and two bolts.

3. **Front Bumper Impact Support Assembly**
   - Tighten the nut and two bolts.

2. **Front Bumper Fascia**
   - Install the nine clips and four screws.
   - Connect the fog light harness connectors.

1. **Radiator grille**
   - Refer to installation procedure in Sheet Metal section.

SPECIAL TOOLS

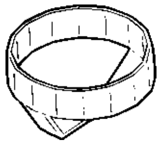
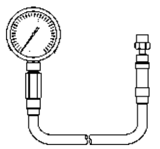
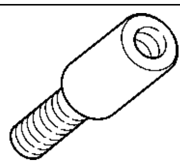
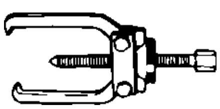
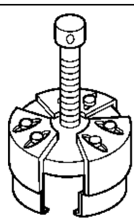
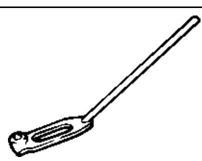
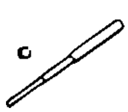
Illustration	Tool Number	Tool Name
	5-8840-0201-0	Filter Wrench
	5-8840-0253-0	Filter Wrench
	5-8840-2675-0	Compression Gauge
	5-8531-7001-0	Adapter; Compression Gauge
	5-8840-2723-0	Nozzle Holder Remover
	5-8840-0019-0	Sliding Hammer
	5-8521-0002-0	Universal Puller
	5-8840-2360-0	Oil Seal Remover
	9-8523-1423-0	Spring Compressor
	9-8523-1212-0	Valve Guide Replacer

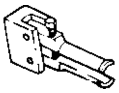
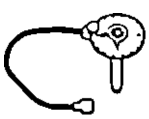
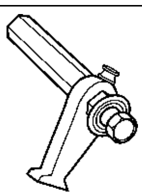
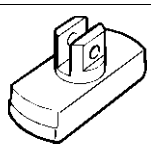
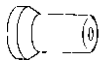
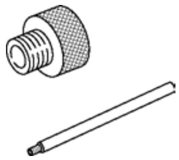
Illustration	Tool Number	Tool Name
	5-8840-2040-0 (4JA1L/TC) 5-8840-2313-0 (4JH1TC)	Cylinder Liner Installer
	5-8840-2038-0	Bearing Replacer; Camshaft
	5-8840-2000-0	Pilot Bearing Remover
	5-8522-0024-0	Pilot Bearing Installer
	5-8840-2033-0	Oil Seal Installer
	5-8840-9018-0	Piston Ring Compressor
	5-8840-2359-0	Oil Seal Installer
	9-8522-0020-0	Crankshaft Timing Gear Installer
	5-8840-0266-0	Angle Gauge
	5-8840-0214-0	Gear Stopper
	5-8840-2039-0 (4JA1L/TC) 5-8840-2304-0 (4JH1TC)	Cylinder Liner Remover

Illustration	Tool Number	Tool Name
	5-8840-2361-0	Front Oil Seal Installer
	5-8840-0145-0	Static Timing Gauge
	5-8840-2834-0	Adapter Set: Static Timing Gauge

SECTION 6B

ENGINE COOLING

TABLE OF CONTENTS

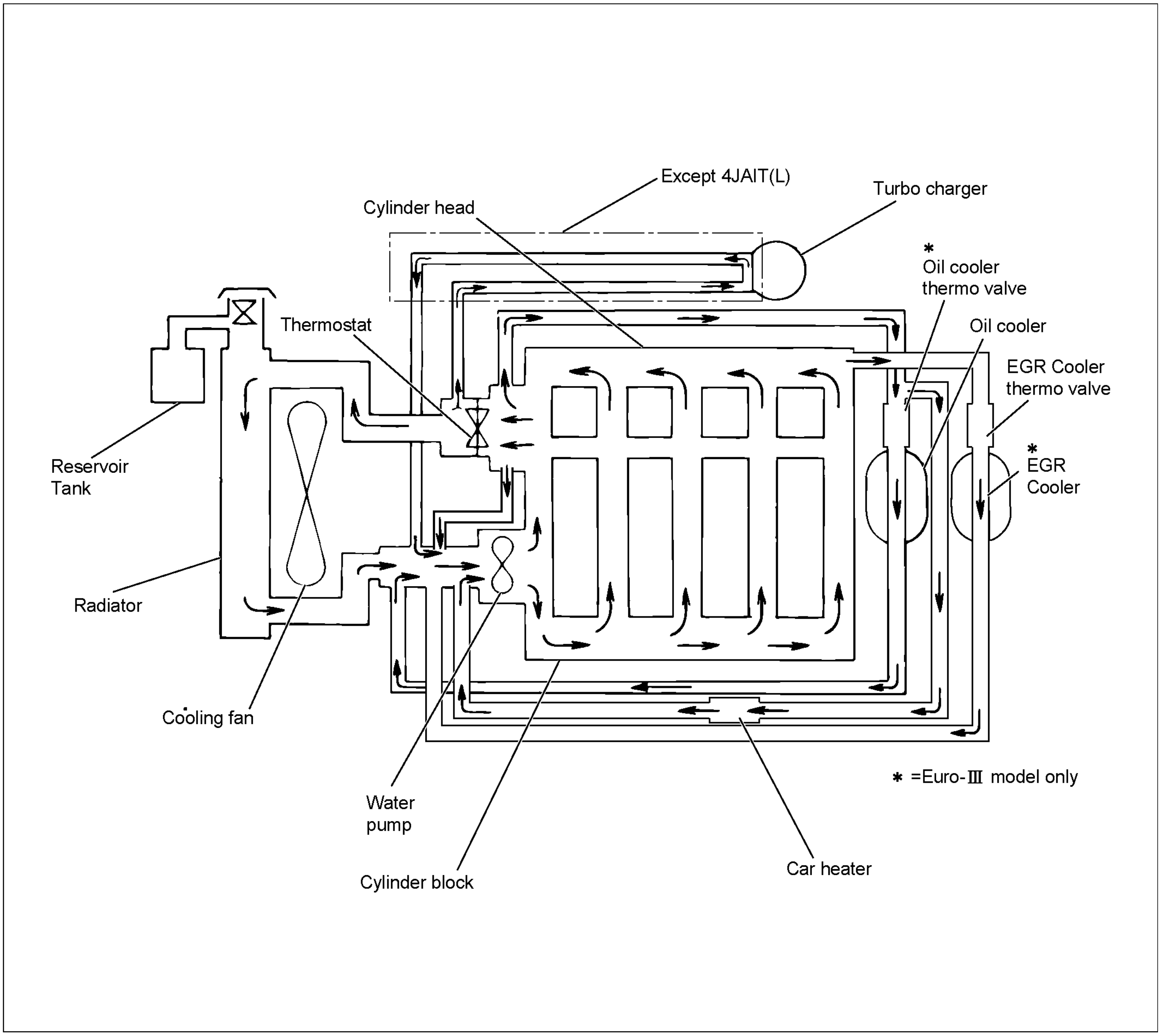
PAGE

MAIN DATA AND SPECIFICATIONS

Item		Description (M/T)	Description (A/T)
Cooling system		Engine coolant forced circulation	
Water pump type		Centrifugal impeller type	
Pump to crankshaft speed ratio	(To 1)	1.2	
Delivery volume	lit (US/UK gal)/min	100 (26.3/22.2)	
Pump speed at 3000 rpm			
Water temperature at 30°C (86°F)			
Pump bearing type		Double row shaft	
Thermostat type		Wax pellet with jiggle valve	
Valve initial opening temperature	°C (°F)	82 (180)	
(Oil cooler thermo valve) (EGR cooler thermo valve)		76.5 (170) 40 (104)	
Valve full opening temperature	°C (°F)	95 (203)	
(Oil cooler thermo valve) (EGR cooler thermo valve)		90 (194) 55 (131)	
Valve lift at fully open position	mm (in)	9.5 (0.37)	
(Oil cooler thermo valve) (EGR cooler thermo valve)		4.5 (0.18) 3.5 (0.14)	
Radiator		Tube type corrugated	
Heat radiation capacity		93.0 kW (79,980 kcal/h)	
Heat radiation area		11.63 m^2 (1.081ft^2)	
Radiator front area		0.28m^2 (0.026 ft^2)	
Radiator dry weight		52 N (5.3 kg/11.7 lb)	53 N (5.4 kg/11.9 lb)
Radiator cap valve opening pressure		93.3 ~ 122.7 kPa (13.5 ~ 17.8 psi)	
Engine coolant capacity		2.4 lit (5.1 U.S pint)	2.3 lit (4.9 U.S pint)
Engine coolant total capacity		10.1 lit (21.3 U.S pint)	10.0 lit (21.1 U.S pint)

GENERAL DESCRIPTION

COOLANT FLOW



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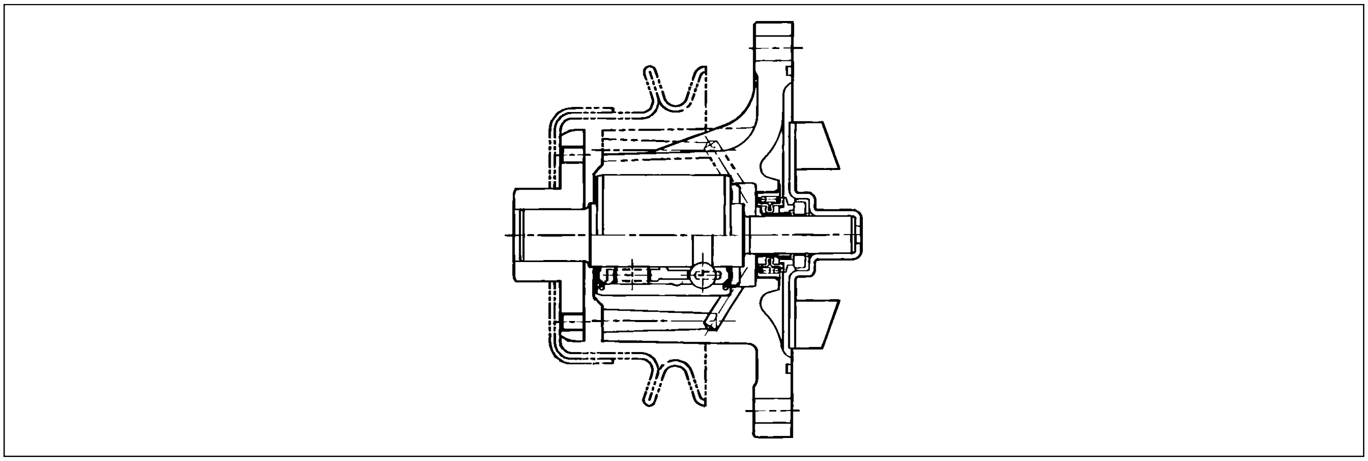
The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.
To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostat through the bypass hose and back to the cylinder body. The coolant does not circulate through the radiator.
When the coolant temperature reaches specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.
The thermostat will be fully open when the coolant temperature reaches specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

WATER PUMP



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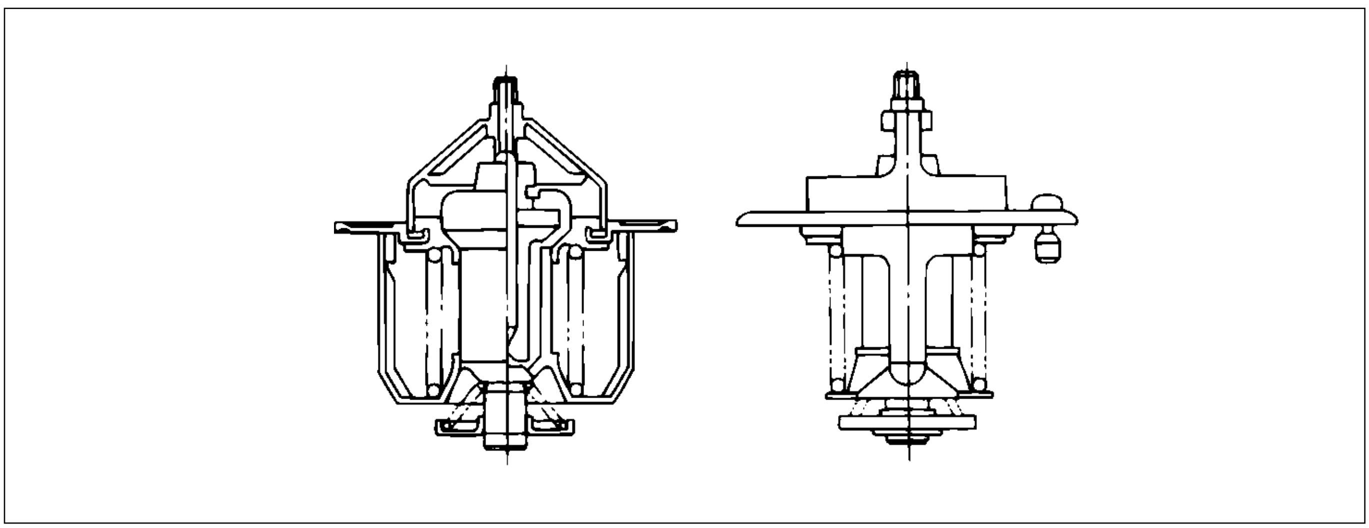
A centrifugal type water pump forcefully circulates the coolant through the cooling system.
The water pump is not disassembled type.

THERMOSTAT



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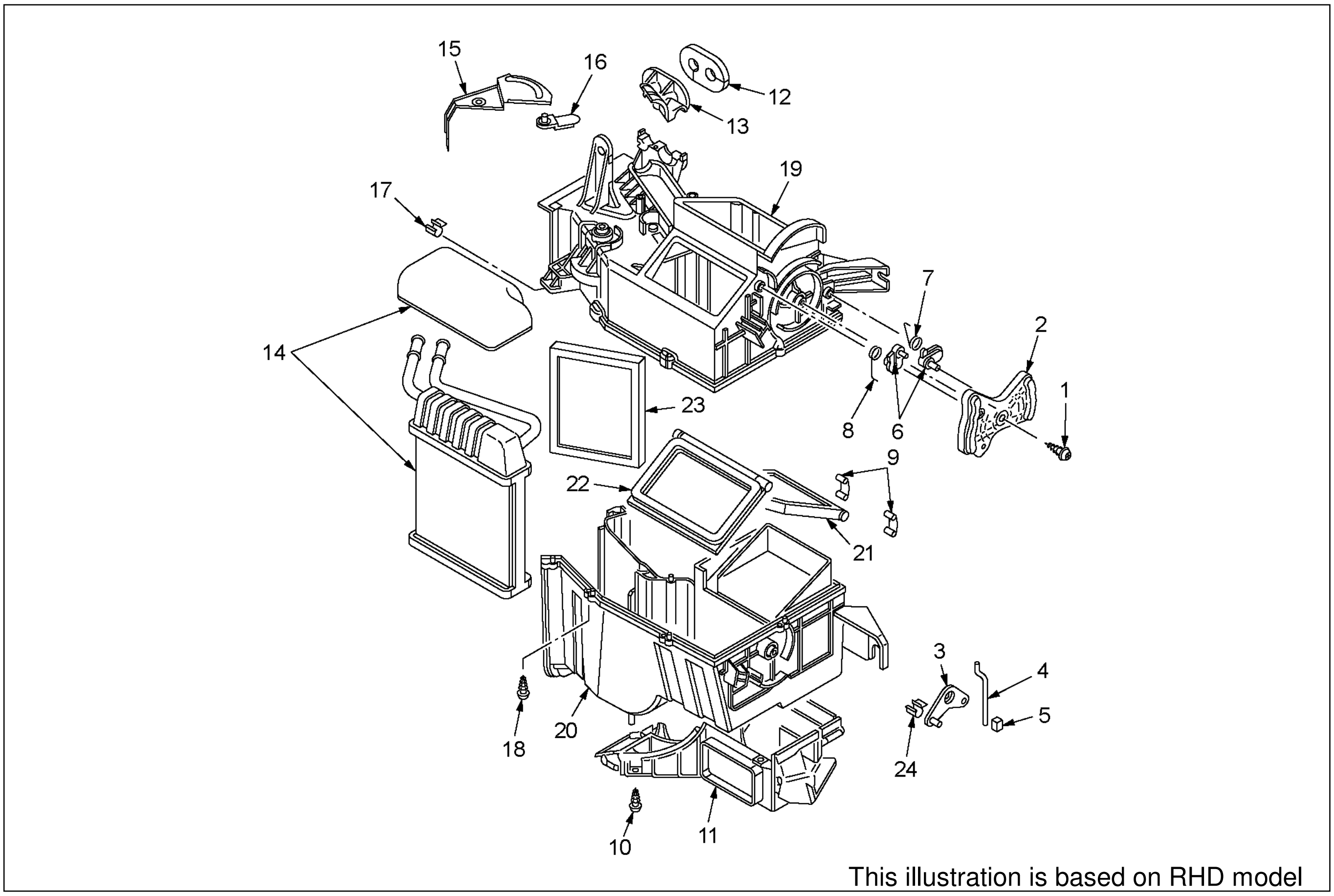
A wax pellet type thermostat is used.
The jiggle valve accelerates engine warm-up.

DISASSEMBLY AND REASSEMBLY

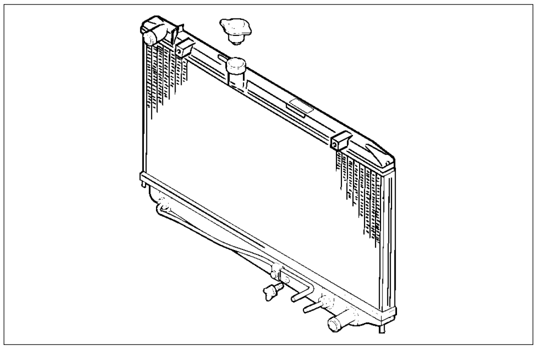


Disassembly Steps

1. Attaching screw
2. Main link-side
3. Sub link-side
4. Mode rod
5. Holder rod
6. Mode lever
7. DEF/FOOT-spring
8. VENT-spring
9. Heater box clip
10. Attaching screws
11. Foot duct
12. FOD H/Pipes seal
13. Heater core clamp
14. Heater core
15. Mix lever (2)
16. Mix lever (1)
17. Control cable clamp
18. Attaching screws
19. Upper case
20. Lower case
21. DEF/FOOT door
22. VENT door
23. Mix door
24. Control cable clamp

Reassembly Steps

24. Control cable clamp
23. Mix door
22. VENT door
21. DEF/FOOT door
20. Lower case
19. Upper case
18. Attaching screws
17. Control cable clamp
16. Mix lever (1)
15. Mix lever (2)
14. Heater core
13. Heater core clamp
12. FOD H/Pipes seal
11. Foot duct
10. Attaching screws
9. Heater box clip
8. VENT-spring
7. DEF/FOOT-spring
6. Mode lever
5. Holder rod
4. Mode rod
3. Sub link-side
2. Main link-side
1. Attaching screw



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Mixing ratio

$$= \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.)} + \text{Water (Lit/gal.)}}$$

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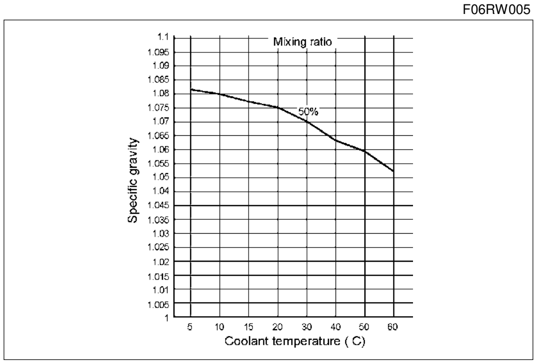

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RADIATOR

The radiator is a tube type with corrugated fins. In order to raise the boiling point of the coolant, the radiator is fitted with a cap in which the valve is operated at 93.3 ~ 122.7 kPa (13.5 ~ 17.8 psi) pressure. (No oil cooler provided for M/T)

Antifreeze Solution

NOTE: Antifreeze solution + Water = Total cooling system capacity.

Total Cooling System Capacity Lit (US / UK gal)

9.4 (2.5/21) 4JA1L/TC

M/T 10.1 (2.7/2.2) 4JH1TC

A/T 10.0 (2.6/2.2) 4JH1TC

See section 0B *MAINTENACE AND LUBRICATION*.

NOTE:

To maintain the corrosion resistance of the aluminum radiator, water and antifreeze must be combined in a 1:1 solution (50% antifreeze and 50% water)

DIAGNOSIS

Engine Cooling Trouble

Symptom	Possible Cause	Action
Engine overheating	Low Engine Coolant level	*Replenish*
	Thermo meter unit faulty	*Replace*
	Faulty thermostat	*Replace*
	Faulty Engine Coolant temperature sensor	*Repair or replace*
	Clogged radiator	*Clean or replace*
	Faulty radiator cap	*Replace*
	Low engine oil level or use of improper engine oil	*Replenish or change oil*
	Clogged exhaust system	*Clean exhaust system or replace faulty parts*
	Faulty Throttle Position sensor	*Replace throttle valve assembly*
	Open or shorted Throttle Position sensor circuit	*Repair or replace*
	Damaged cylinder head gasket	*Replace*
Engine overcooling	Faulty thermostat	*Replace*
Engine slow to warm–up	Faulty thermostat	*Replace*
	Thermo unit faulty	*Replace*

Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant (EC) level should be between the “MIN" and “MAX" lines of reserve tank when the engine is cold. If low, check for leakage and add EC up to the “MAX" line.
There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the EC should also be free from oil.
Replace the EC if excessively dirty.

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1. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.
2. Remove the radiator cap.

WARNING: To avoid the danger of being burned, do not remove the cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure.

3. Disconnect all hoses from the EC reserve tank.
   Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.
4. Refill the cooling system with the EC using a solution that is at least 50 percent antifreeze.

Procedure for filling with coolant (in case of full change)

- Make sure that the engine is cool.
- Open radiator cap pour coolant up to filler neck.
- Pour coolant into reservoir tank up to “MAX" line.
- Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen radiator cap. If the water level is lower, replenish.

WARNING: When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by not vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

- After tightening radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
- Check to see the thermostat has opened through the needle position of water thermometer, conduct a 5–minute idling again and stop the engine.
- When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant is found, check the cooling system and reservoir tank hose for leakage.
- Pour coolant into the reservoir tank up to “MAX" line.

WATER PUMP

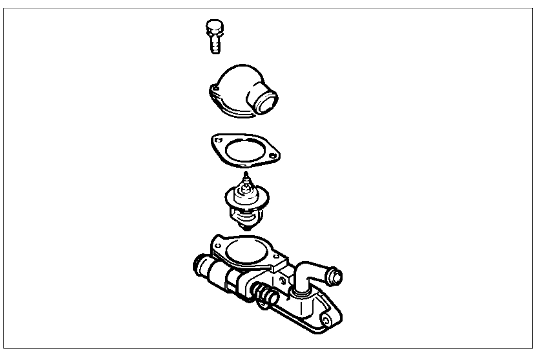
REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

1. Radiator Upper Hose

1) Partially drain the engine coolant.
2) Remove the radiator upper hose.



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2. Water Outlet Pipe

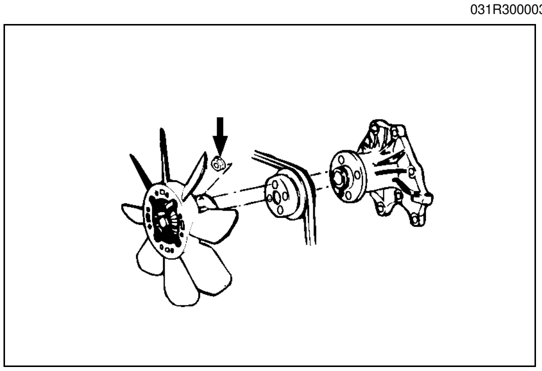
1) Disconnect the turbocharger-cooling pipe from outlet pipe.
2) Loosen the fixing bolt and remove the water outlet bolt.

3. Thermostat

Remove the thermostat from the thermostat housing.

Take care not to damage the thermostat.

4. Upper Fan Shroud



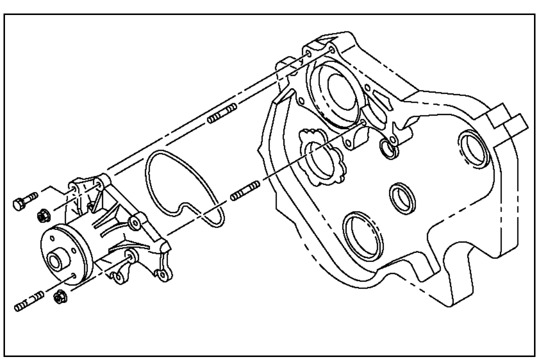
030R300001

5. Fan and Fan Clutch

1) Loosen the fan clutch nuts.
2) Remove the fan together with the fan clutch. Take care not to damage the radiator core.

6. Fan Drive Belt and Pulley

1) Loosen the tension adjust bolt on the generator.
2) Remove the fan drive belt with the fan pulley.



030R300002

7. Water Pump

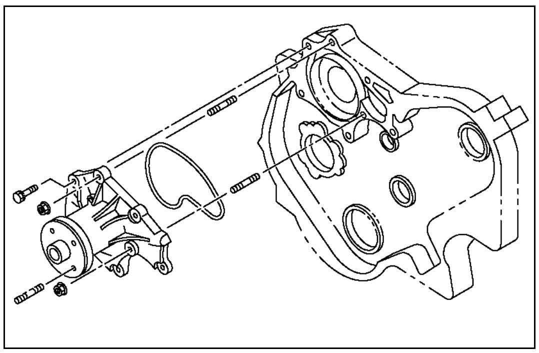
1) Remove the water pump bolts.
2) Remove the water pump.

Inspection and Repair

The water pump is not disassembled type.

Make necessary parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced.

- Cracks in the water pump body
- Coolant leakage from the seal unit
- Excessive radial play or abnormal noise in the fan center when rotate by hand
- Excessive thrust play in the fan center (Standard play: less than 0.2mm)
- Cracks or corrosion in the impeller



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Installation

1. Water Pump

1) Install the water pump with new gasket.

2) Tighten bolts and nuts to specified torque.

Water Pump Bolt/Nut Torque	N·m(kg·m/lb ft)
20 (2.0/14)	

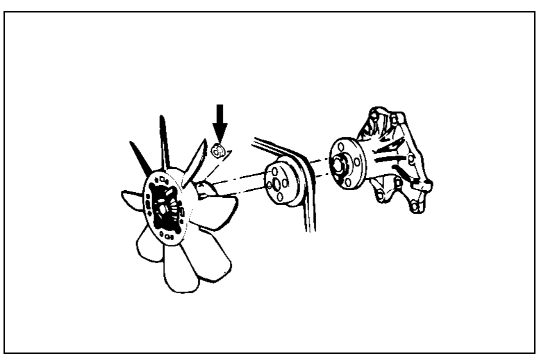
2. Fan Drive Belt and Pulley

1) Install the fan drive belt and fan pulley.

2) Apply tension to the fan drive belt by moving the generator.

3) Apply a force of 98N(10kg/22 lb) to the drive belt mid-portion to check the drive belt deflection.

Fan Drive Belt Deflection	mm (in)
New belt: 4-7(0.16-0.28) Reuse belt: 6-9(0.24-0.35)	



030R300001

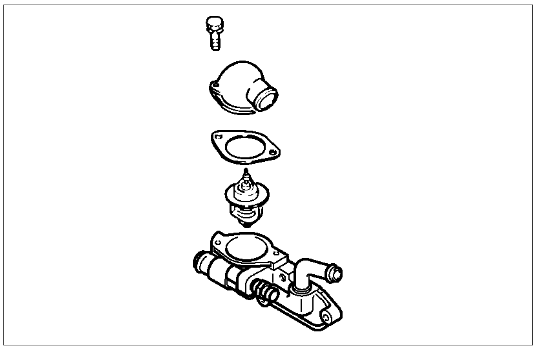
3. Fan and Fan Clutch

1) Install the fan and fan clutch to pulley.

2) Tighten the nuts to specified torque.

Fan Clutch Nut Torque	N·m(kg·m/lb in)
8(0.8/69)	

4. Upper Fan Shroud



031R300003

5. Thermostat

Install the thermostat to the thermostat housing.

6. Water Outlet Pipe

1) Install the water outlet pipe with new gasket to the thermostat housing.
2) Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque	N·m(kg·m/lb ft)
19(1.9/14)	

3) Connect the turbocharger-cooling pipe to outlet pipe.

7. Radiator Upper Hose

1) Connect the radiator upper hose to the water outlet pipe.
2) The knob of clamp shall be dircted to holizonal side.
3) Replenish the engine coolant.

THERMOSTAT

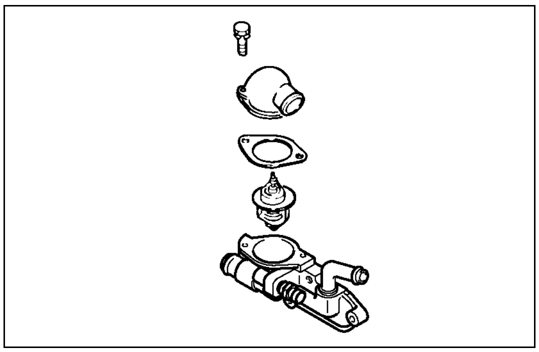
REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

1. Radiator Upper Hose

1) Partially drain the engine coolant.
2) Remove the radiator upper hose.



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2. Water Outlet Pipe

3) Disconnect the turbocharger-cooling pipe from outlet pipe.
4) Loosen the fixing bolt and remove the water outlet bolt.

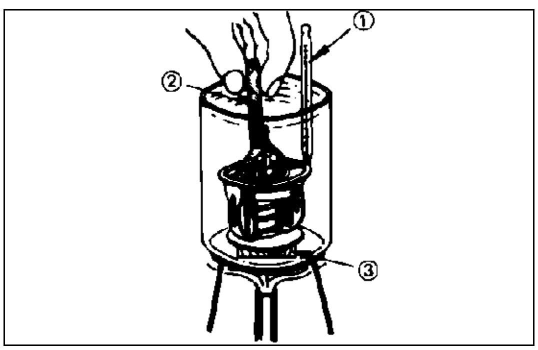
3. Thermostat

Remove the thermostat from the thermostat housing.

Take care not to damage the thermostat.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.



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Operating Test of Thermostat

1. Completely submerge the thermostat in water.
2. Heat the water.
   Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

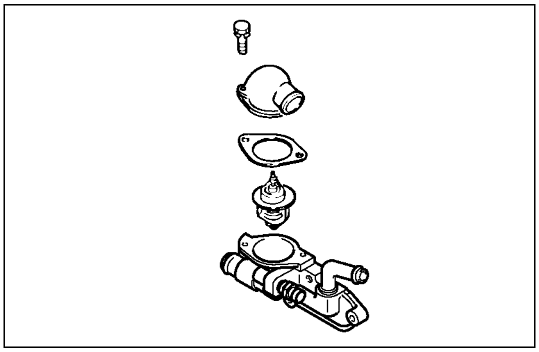
Thermostat Initial Opening Temperature	°C (°F)
82 (180)	

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature	°C (°F)
95 (203)	

Valve Lift At Fully Open Position	mm (in)
9.5 (0.37)	

① Thermometer
② Agitating rod
③ Wooden piece



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Installation

1. Thermostat

Install the thermostat to the thermostat housing.

2. Water Outlet Pipe

3) Install the water outlet pipe with new gasket to the thermostat housing.
4) Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque	N·m(kg·m/lb ft)
19(1.9/14)	

5) Connect the turbocharger-cooling pipe to outlet pipe.

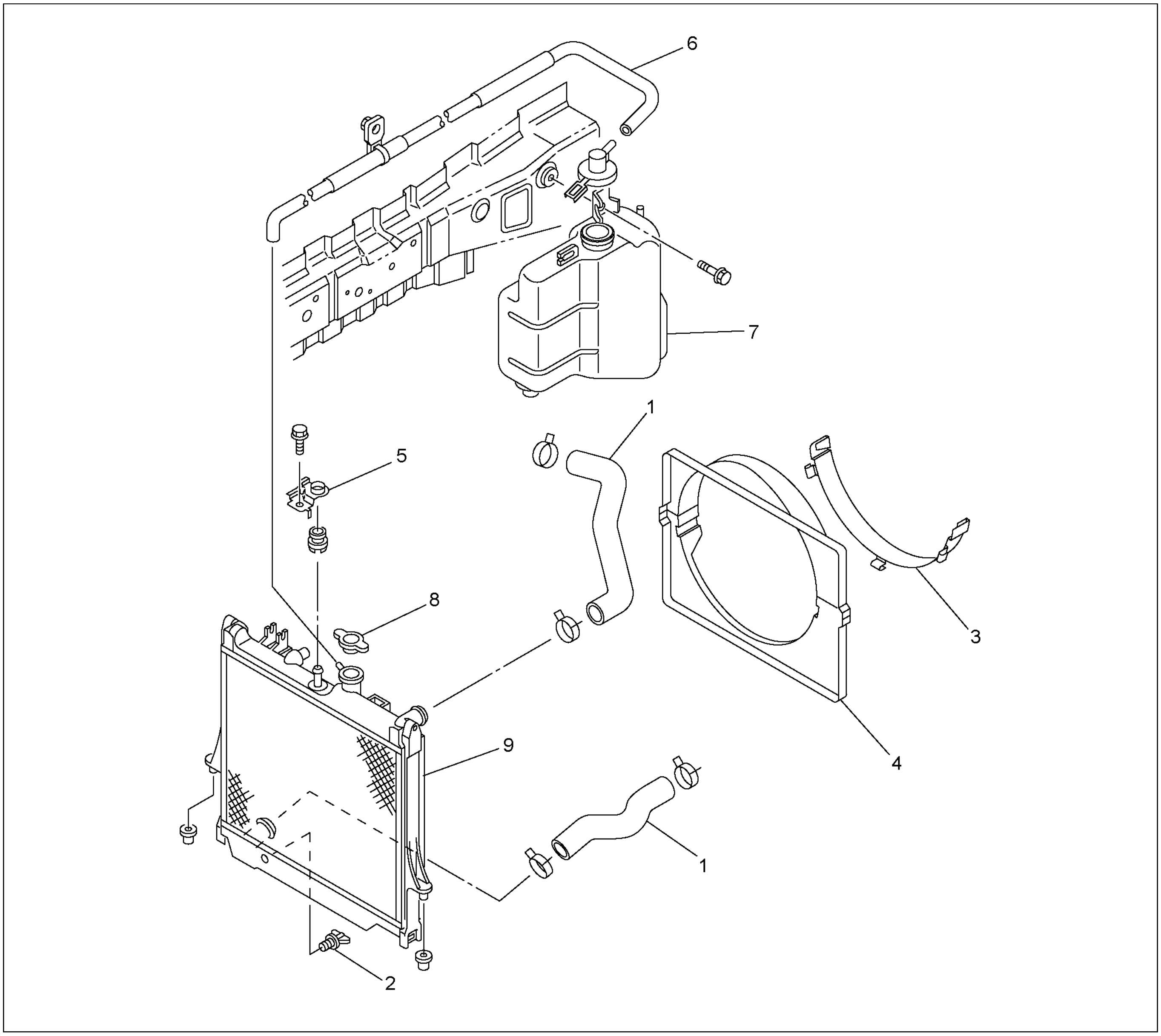
3. Radiator Upper Hose

1) Connect the radiator upper hose to the water outlet pipe.
2) The knob of clamp shall be directed to holizonal side.
3) Replenish the engine coolant.

RADIATOR

REMOVAL AND INSTALLATION

Radiator and Associated Parts



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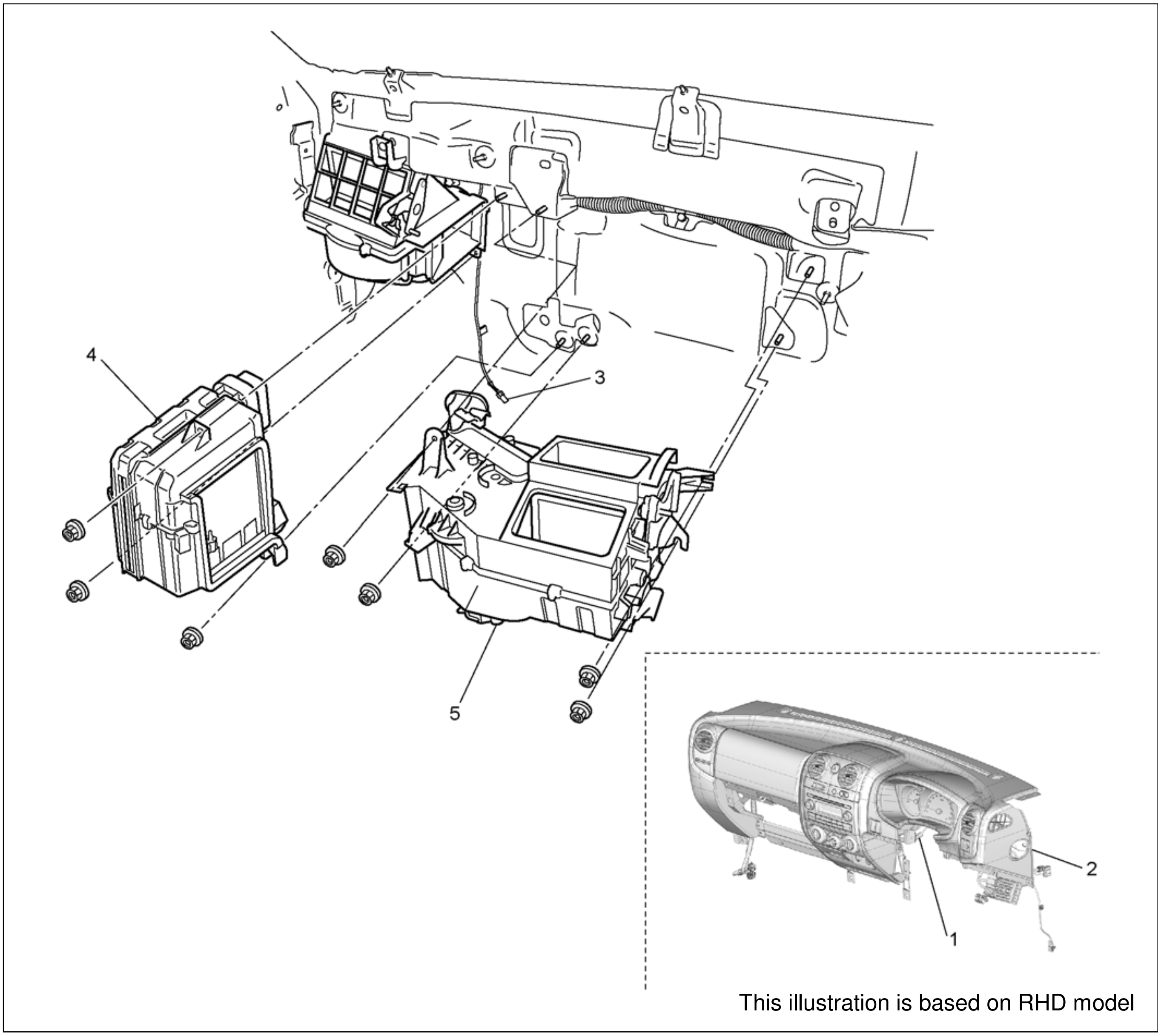
Legend

1. Radiator Hose
2. Drain Plug
3. Fan Guide, Lower
4. Fan Guide
5. Bracket
6. Reserve Tank Hose
7. Reserve Tank
8. Radiator Cap
9. Radiator Assembly

VENT UNIT (WITHOUT HEATER)

REMOVAL AND INSTALLATION



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Removal Steps

1. Control cable
▲2. Instrument panel assembly and cross beam
3. Electronic thermostat connector
▲4. Evaporator or duct
5. Vent unit

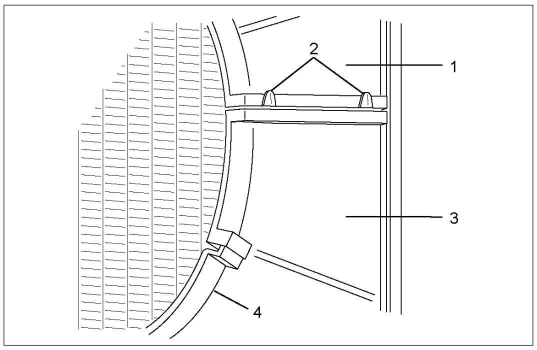
Installation steps

5. Vent unit
4. Evaporator or duct
3. Electronic thermostat connector
▲2. Instrument panel assembly and cross beam
1. Control cable

Removal

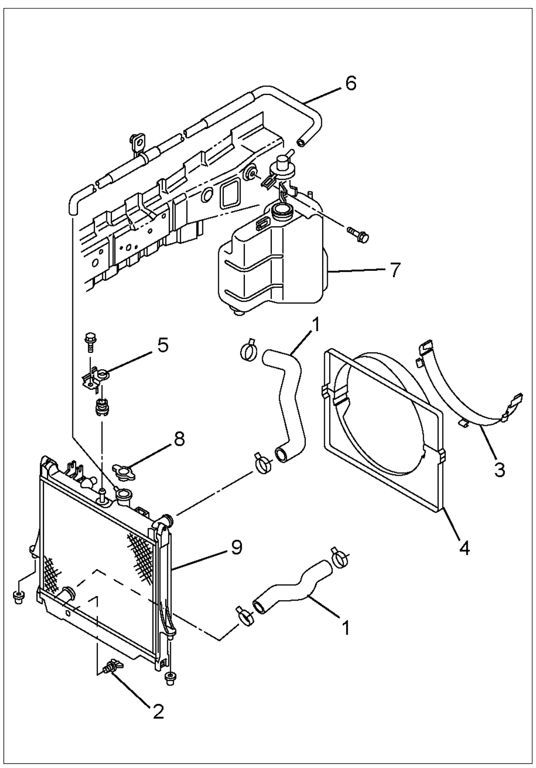
P1010064

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain EC.
3. Disconnect oil cooler hose on automatic transmission (A/T).
4. Disconnect radiator inlet hose and outlet hose from the engine.



PTW46BSH000101

5. Remove fan guide(1), clips(2) on both sides and the bottom lock, then remove lower fan guide(3) with fan shroud(4).
6. Disconnect the reserve tank hose(6) from radiator.



RTW36BMH000101

7. Remove bracket(5).

8. Lift up and remove the radiator assembly with hose, taking care not to damage the radiator core with a fan blade.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

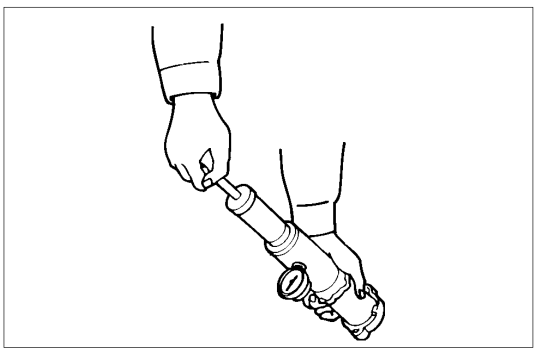
Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.
Replace the cap if the valve opening pressure is outside the standard range.

Valve opening pressure kPa (psi) 93.3 ~ 122.7 (13.5 ~17.8)

Cap tester: 5–8840–0277–0
Adapter: 5–8840–2603–0
Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

Valve opening vacuum kPa (psi) 1.96 ~ 4.91 (0.28 ~ 0.71)



110RS006

Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

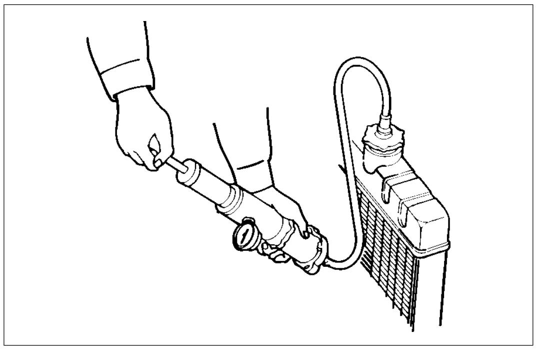
Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (28.5 psi) with a cap tester:

- Leakage from the radiator
- Leakage from the coolant pump
- Leakage from the water hoses

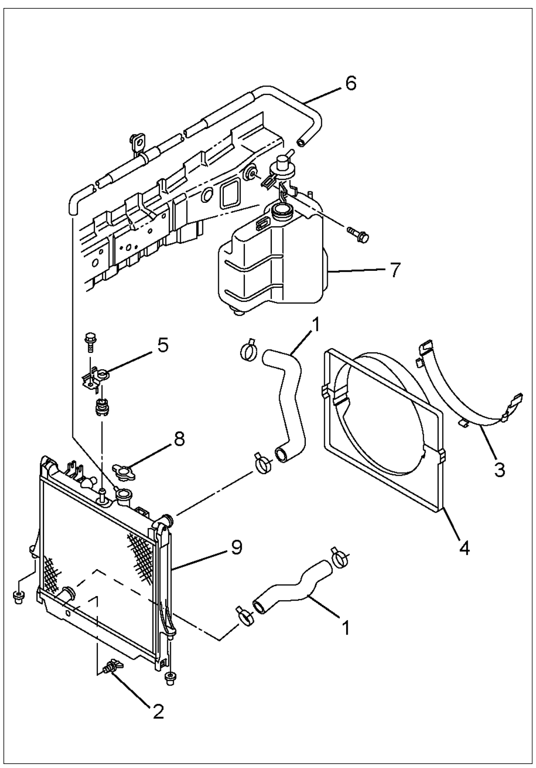


110RS005

- Check the rubber hoses for swelling.

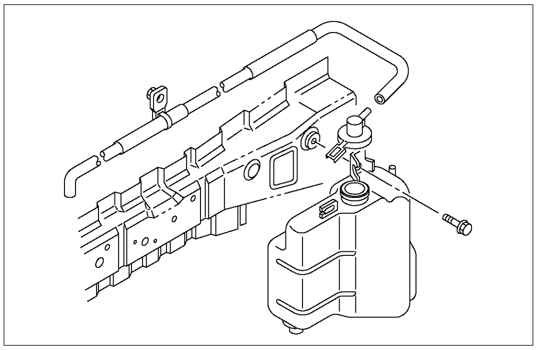
Installation

1. Install radiator assembly (9) with hose, taking care not to damage the radiator core with a fan blade.
2. Support the radiator upper tank with the bracket (5) and secure the radiator.
3. Connect reserve tank hose (6).
4. Install lower fan guide (3).
5. Connect radiator inlet hose and outlet hose (1) to the engine.



RTW36BMH000101

6. Connect oil cooler hose to automatic transmission.
7. Connect battery ground cable.



RTW36BSH000101

8. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.

   Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.

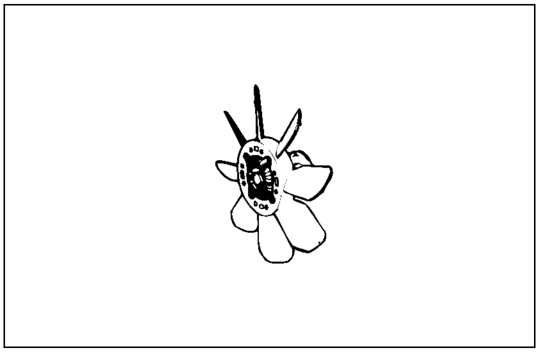
Engine coolant change

Refer to 6B-8 (Draining and Refilling Cooling System).

FAN CLUTCH WITH COOLING FAN

INSPECTION AND REPAIR

Make necessary correction or parts replacement if wear, damage or any other abnormal condition are found through inspection.



033R300001

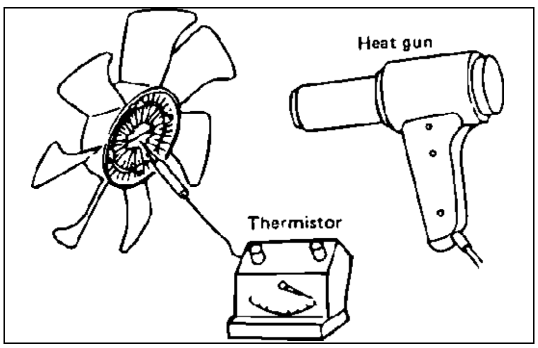
Visually inspect for damage, leak (sillicon grease) or other abnormal conditions.

1. Inspection (on-vehicle)

1) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.

2) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 80°C. Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.

If the fan clutch rotates more readily, however, this indicates that the silicone grease is leaking internally. Replace the fan clutch with a new one.



033RY00011

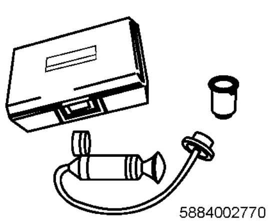
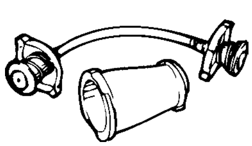
2. Inspection (in unit)

Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 80°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).

If the fan clutch retates more readily at this time, this indicates that the silicone grease is leaking internally.

Replace the fan clutch with a new one.

SPECIAL TOOLS

Illustration	Tool Number	Tool Name
 5884002770	5-8840-0277-0	Cap tester
	5-8840-2663-0	Adapter

SECTION 6C

FUEL SYSTEM

TABLE OF CONTENTS

MAIN DATA AND SPECIFICATIONS

Item	Description		
	4JA1T (L)	4JA1TC	4JH1TC
Injection pump type	Bosch distributor VE type	Bosch distributor VP44 type	
Governor type	Mechanical variable (Half speed oil pressure)	Electrical controled	
Timer type	Oil pressure	Electrical controled	
Fuel feed pump type	Vane with input shaft		
Injection nozzle type	Hole type		
Number of injection nozzle orifices	5		
Injection nozzle orifices			
Inside diameter mm (in)	0.19 (0.0075)	0.17 (0.0067)	0.21 (0.0083)
Injection nozzle designed operating pressure MPa (kg/cm^2) 1st	19.1 (195)	19.0 (194)	19.5 (199)
2nd	25.0 (255)	33.5 (328)	33.8 (331)
Main fuel filter type	Disposable cartridge paper element		

Precautions

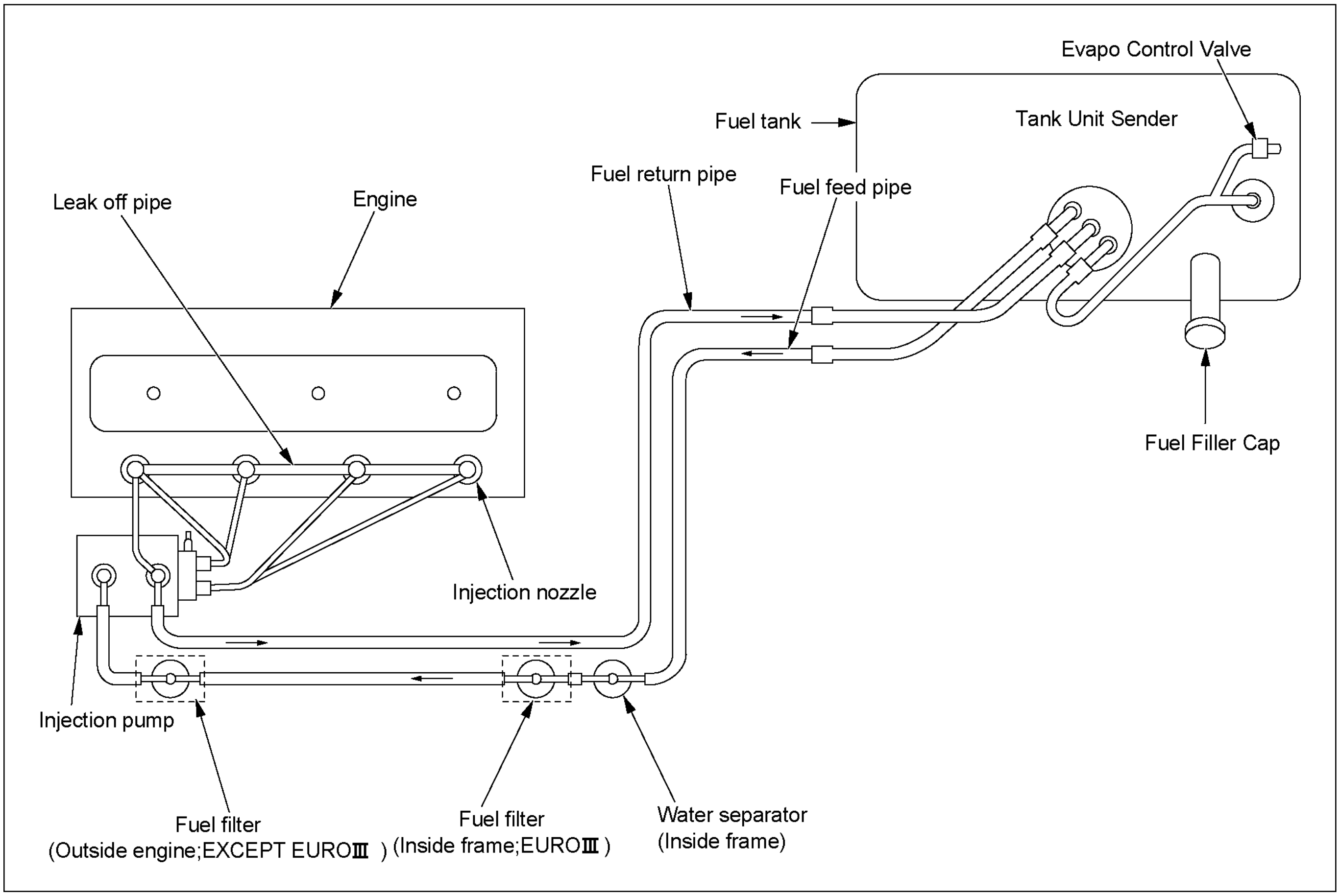
When working on the fuel system, there are several things to keep in mind:

- **Any time the fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.**
- **Always keep a dry chemical (Class B) fire extinguisher near the work area.**
- **Replace all pipes with the same pipe and fittings that were removed.**
- **Clean and inspect “O” rings. Replace if required.**
- **Always relieve the line pressure before servicing any fuel system components.**
- **Do not attempt repairs on the fuel system until you have read the instructions and checked the pictures relating to that repair.**
- **Adhere to all Notices and Cautions.**

NOTE:
Injection nozzle adjustment is possible only on the 4JA1L engine.

GENERAL DESCRIPTION

FUEL FLOW



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The fuel system consists of the fuel tank, the fuel filter, the water separator, the injection pump, and the injection nozzle.
The fuel from the fuel tank passes through the water separator and the fuel filter where water particles and other foreign material are removed from the fuel.
Fuel, fed by the injection pump plunger, is delivered to the injection nozzle in the measured volume at the optimum timing for efficient engine operation.

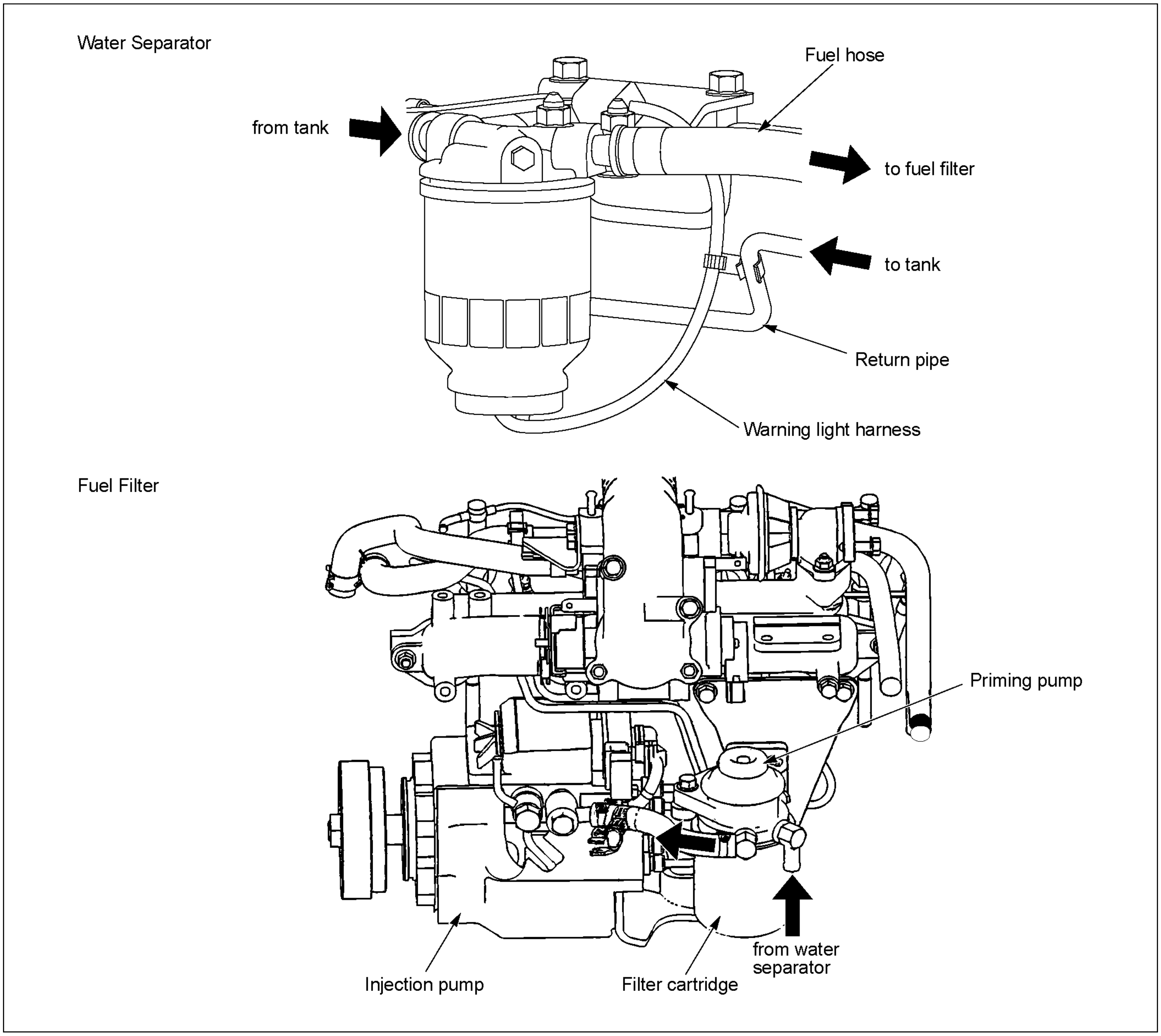
NOTE:

1. **If it find abnormal condition on the fuel injector, refer to section 6E ENGINE DRIVEABILITY AND EMISSIONS.**
2. **Do not contain "Additive for water drain" with fuel.**

FUEL FILTER AND WATER SEPARATOR

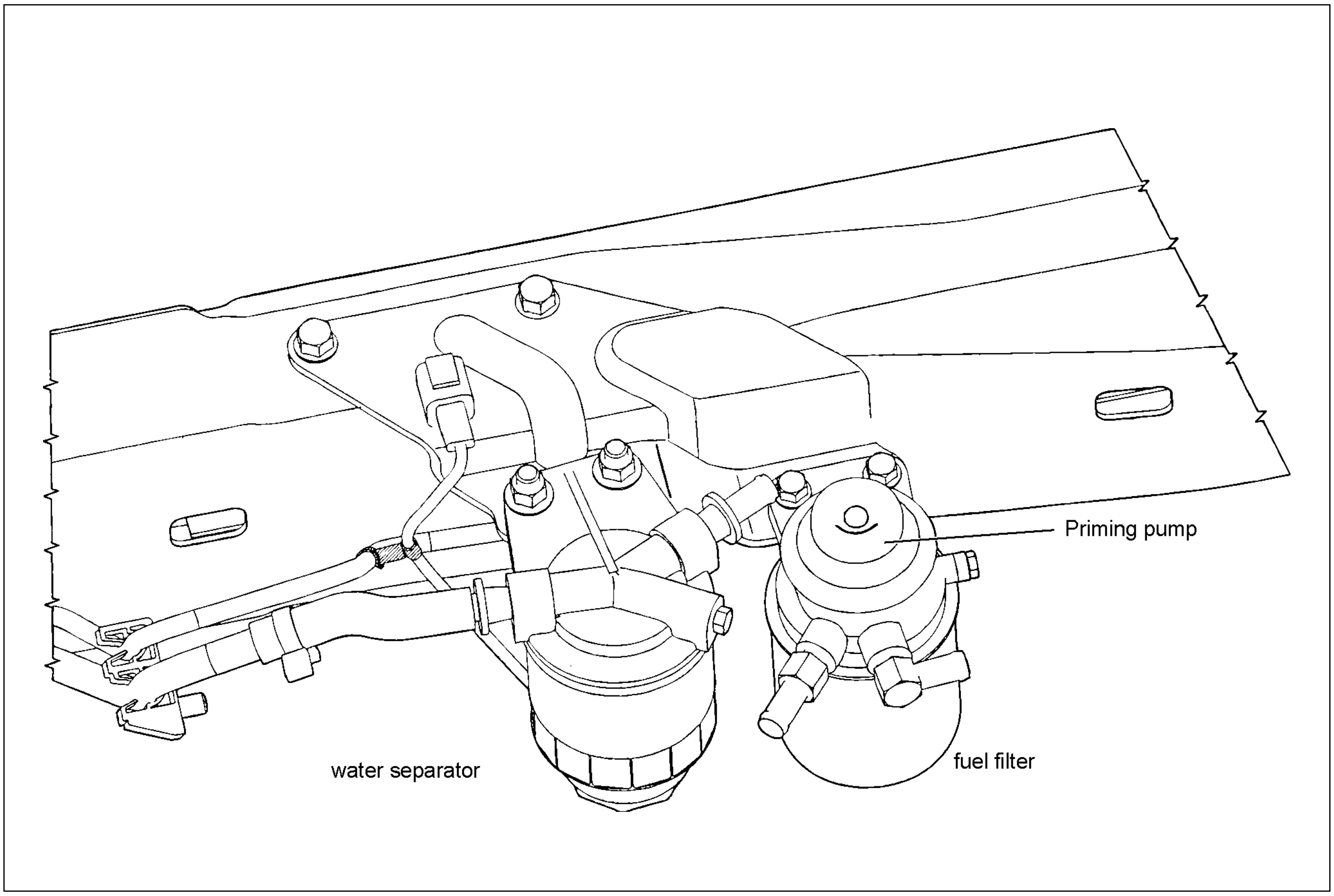
As the inside of the injection pump is lubricated by the fuel which it is pumping, the fuel must be perfectly clean. The fuel filter and the water separator remove water particles and other foreign material from the fuel before it reaches the injection pump.
The water separator has an internal float. When the float reaches the specified level, a warning light comes on to remind you to drain the water from the water separator.
A diaphragm type priming pump is installed at the top of the fuel filter. It is used during the air bleeding procedures.

(Except EURO III model)



RTW36CLF000701

For EURO III model



RTW46AMF000201

Important Operations - Removal

2. Instrument Panel Assembly and Cross Beam.

Refer to SECTION 10 “INSTRUMENT PANEL”.

4. Evaporator or Duct

Refer to “EVAPORATOR” or “DUCT” in this section.

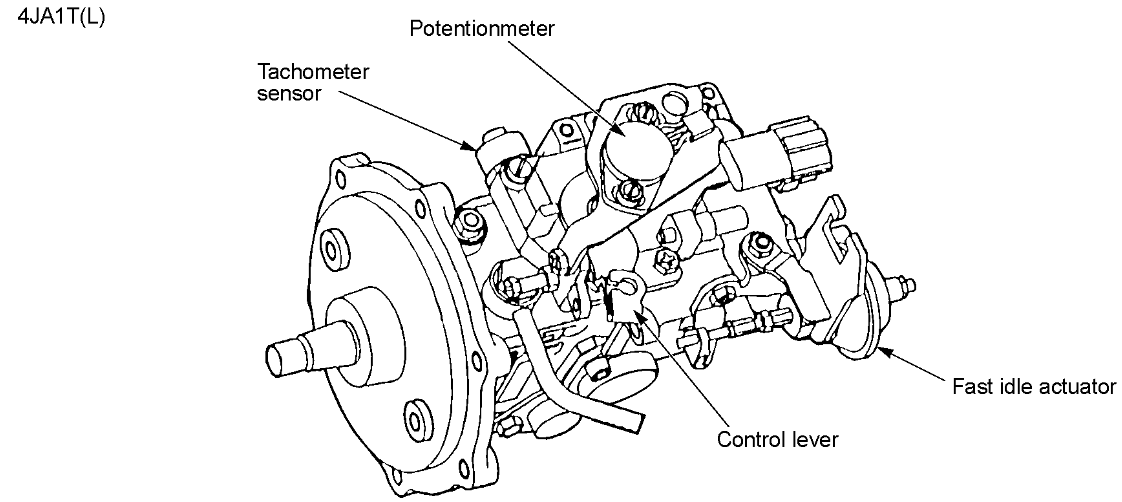
Important Operation - Installation

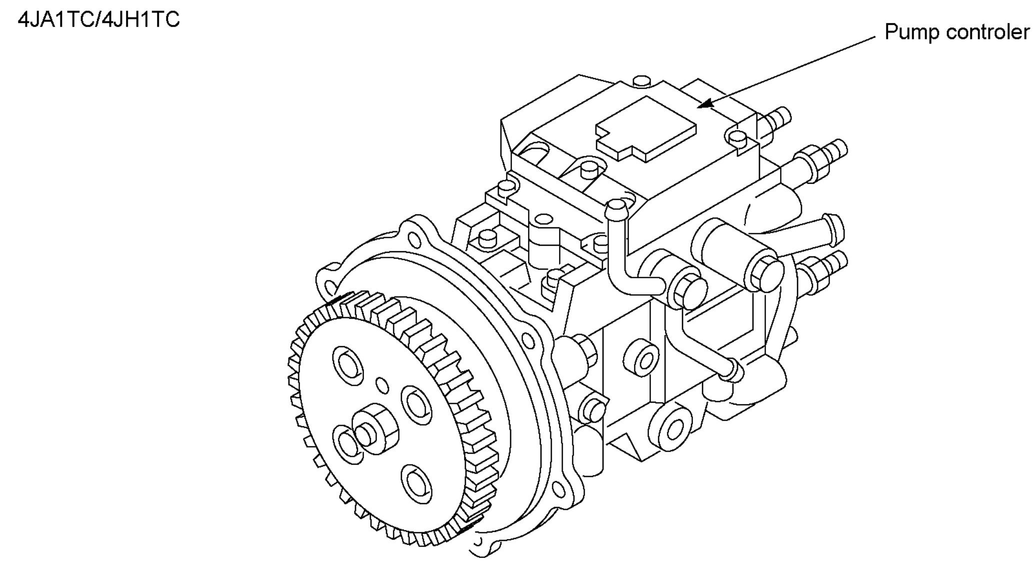
2. Instrument Panel Assembly and Cross Beam

Adjust the heater control cables.

Refer to “CONTROL LEVER ASSEMBLY” in this section.

INJECTION PUMP





RTW46CLF000201

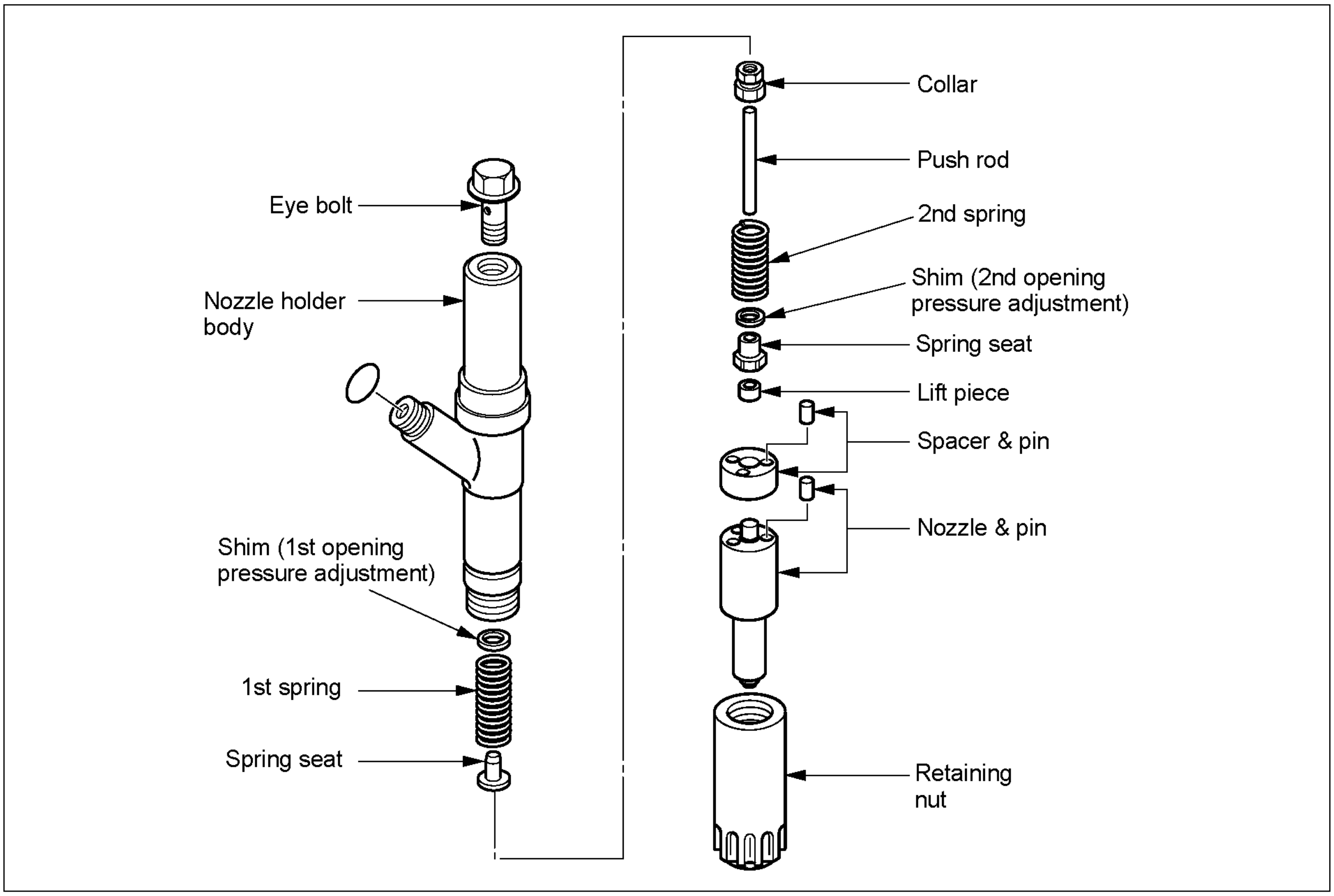
4JA1T(L):

A Bosch Distributor Type Injection Pump is used. A single reciprocating/revolving plunger delivers the fuel uniformly to the injection nozzles, regardless of the number of cylinders.
The governor, the injection timer, and the feed pump are all contained in the injection pump housing. The injection pump is compact, light weight, and provides reliable high-speed operation.
The vacuum-type fast idle actuator increases the engine idling speed to provide the additional power required to operate the air conditioner.
Fast idler diaphragm movement is caused by changes in the negative pressure created by the engine's vacuum pump.
The diaphragm motion is transferred to the injection pump control lever to increase or decrease the idling speed.

4JA1TC/4JH1TC:

The Bosch VP44 injection pump is electronically controlled. The pump controller combine to injection pump.
Signals from the pump controller are sent to the engine control module (ECM). In response to these signals, the ECM selects the optimum fuel injection timing and volume for the existing driving conditions.

INJECTION NOZZLE (4JA1L)



RTW76CMF000301

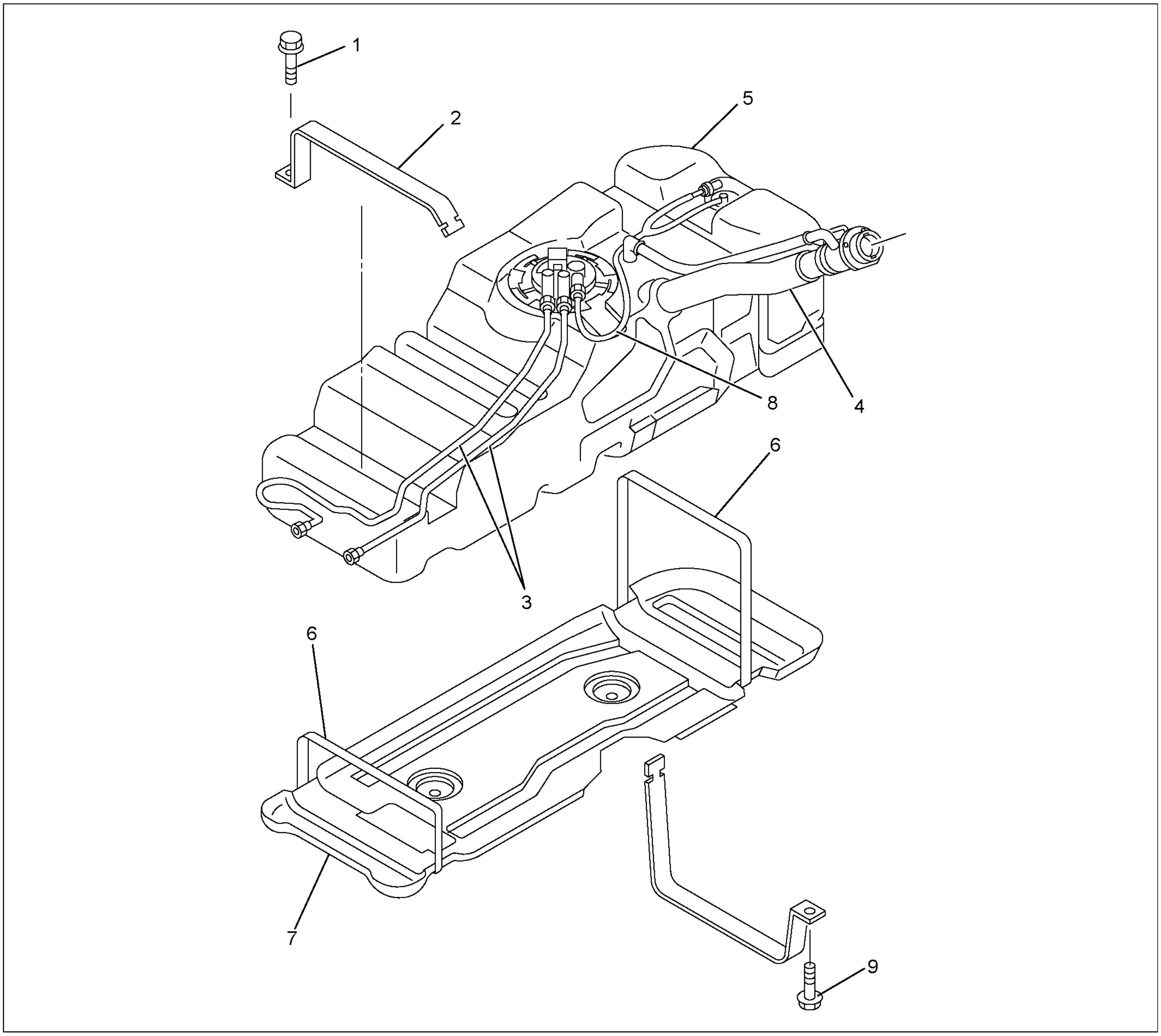
NOTE:

- Injection nozzle adjustment is possible only on the 4JA1L engine.

A hole (with 5 orifices) type injection nozzle. It consists of the nozzle body and the needle valve assembly.
The injection nozzle assembly sprays pressurized fuel from the injection pump into the combustion chamber through the nozzle body injection orifice.

FUEL TANK

Fuel Tank and Associated Parts



RTW46CLF000801

Legend

1. Bolt; Fuel Tank
2. Fuel Tank Band
3. Fuel Tube/Quick Connector
4. Fuel Filler Hose
5. Fuel Tank
6. Under Shield Band (only specified model)
7. Under Shield (only specified model)
8. Evapo Pipe (only specified model)
9. Bolt; Fuel Tank

Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section "Driveability and Emission".

1. Disconnect battery ground cable.
2. Loosen slowly the fuel filler cap.

NOTE: Be careful not to spouting out fuel because of change the pressure in the fuel tank.

NOTE: Cover opening of the filler neck to prevent any dust entering.

3. Jack up the vehicle.
4. Support underneath of the fuel tank with a lifter.
5. Remove the inner liner of the wheel house at rear left side.
6. Remove fixing bolt of the filler neck from the body.
7. Disconnect the quick connector (3) of the fuel tube from the fuel pipe.

NOTE: Cover the quick connector to prevent any dust entering and fuel leakage.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

8. Remove fixing bolt (1) of the tank band and remove the tank band (2).
9. Disconnect the pump and sender connector on the fuel pump and remove the harness from weld clip on the fuel tank.
10. Lower the fuel tank (5).

NOTE: When lower the fuel tank from the vehicle, don't scratch each hose and tube by around other parts.

Installation

1. Raise the fuel tank.

NOTE: When raise the fuel tank to the vehicle, don't scratch each hose and tube by around other parts.

2. Connect the pump and sender connector to the fuel pump and install the harness to weld clip on the tank.

NOTE: The connector must be certainly connected against stopper.

3. Install the tank band and fasten bolt.

Torque	N·m (kg·m / lb ft)
68 (6.9 / 50)	

NOTE: The anchor of the tank band must be certainly installed to guide hole on frame.

4. Connect the quick connector of the fuel tube to the fuel pipe and the evapo tube from evapo joint connector.

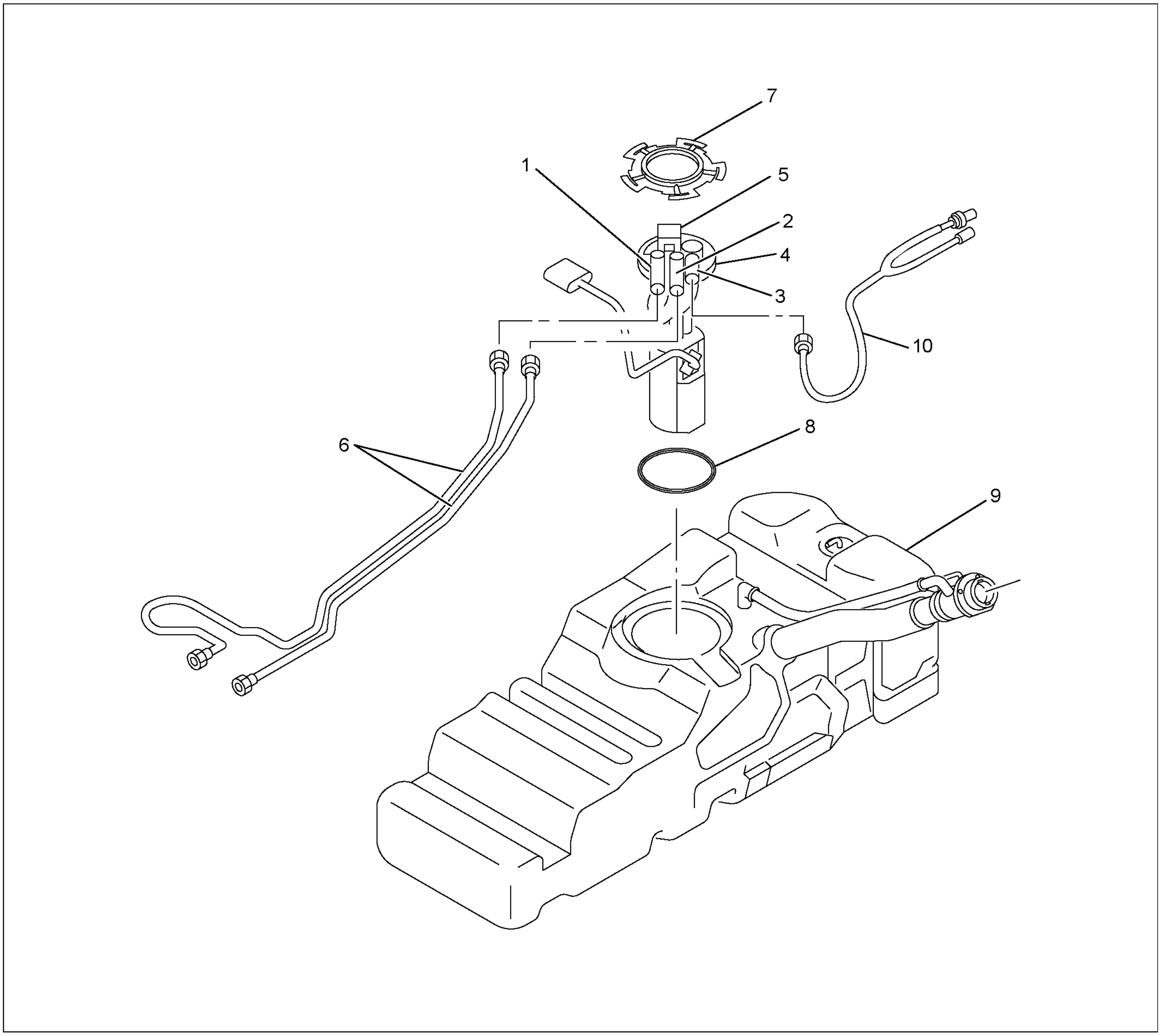
NOTE: Pull off the left checker on the fuel pipe.

NOTE: Refer to "Fuel Tube/Quick Connector Fittings" in this section when performing any repairs.

5. Install the filler neck to the body with bolt.
6. Install the inner liner of the wheel house at rear left side.
7. Remove lifter from the fuel tank.
8. Lower the vehicle.
9. Tigten the filler cap until at least three clicks.
10. Connect the battery ground cable.

FUEL GAUGE UNIT

Fuel Gauge Unit and Associated Parts



RTW46CLF000901

Legend

1. Fuel Feed Port
2. Fuel Return Port
3. Fuel Emission Port
4. Fuel Gauge Unit and Sender Assembly
5. Connector; Fuel Gauge Unit
6. Fuel Tube/Quick Connector
7. Retainer Ring (Fuel Gauge Unit Lock)
8. Seal; Fuel Gauge Unit
9. Fuel Tank Assembly
10. Evapo Tube/Quick Connector

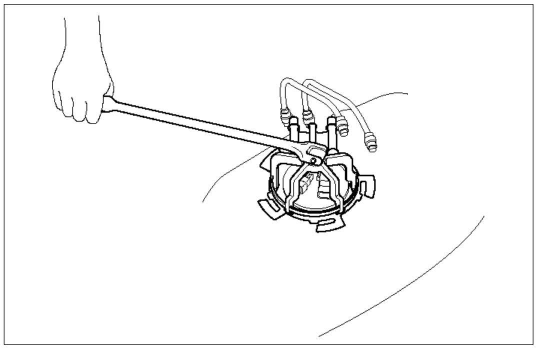
Removal

CAUTION: When repair to the fuel system has been completed, start engine and check the fuel system for loose connection or leakage. For the fuel system diagnosis, see Section “Driveability and Emission".

1. Remove fuel tank assembly (9). Refer to “Fuel Tank Removal" in this section.
2. Disconnect the quick connector (6) of the fuel tube from fuel gauge unit.
3. Disconnect the quick connector (10) of the evapo tube from fuel gauge unit.
3. Remove the retainer ring (7) from the fuel tank with the removal tool 5-8840-2602-0.
4. Remove slowly the fuel gauge unit (4) from the fuel tank as no bend float arm.

NOTE: Cover opening for the fuel gauge unit on fuel tank to prevent any dust entering.

5. Discard fuel gauge unit seal (8) because it cannot be reusable.



140R100035

Installation

1. Clean the seal surface of the fuel tank and the fuel gauge unit.

NOTE: If there is dust on the seal surface, it becomes cause of fuel leak.

2. Install the new fuel gauge unit seal (8) to opening of the fuel tank as along the groove.
3. Install slowly the fuel gauge unit (4) into the fuel tank as no bend float arm.
4. Set flange of the fuel gauge unit on fuel gauge unit seal as mating convexity of the fuel gauge unit and reentrant of the fuel tank.
5. Lock slowly the retainer ring (7) to the fuel tank with the remover tool 5-8840-2602-0.
6. Connect the quick connector (10) of the evapo tube from fuel gauge unit.
7. Connect the quick connector (6) of the fuel tube to to gauge unit.

NOTE: Pull off the left ckecker of the fuel pipe.

NOTE: Refer to “Fuel Tube/Quick Connector Fittings” in this section when performing any repairs.

8. Check leak.

Methed of leak check.

(1) Plug end of quick connector and breather hose (Pull off the breather hose from fuel tank) and tighten fuel filler cap until at least one click are heard.

(2) Apply water soap around the fuel gauge unit seal area.

(3) Pressure air into the fuel tank from end of breather pipe at 5psi (34.3 kPa/2.8kgf/cm^2) over 15 seconds.

(4) Verify no bubbles around the fuel gauge unit seal area.

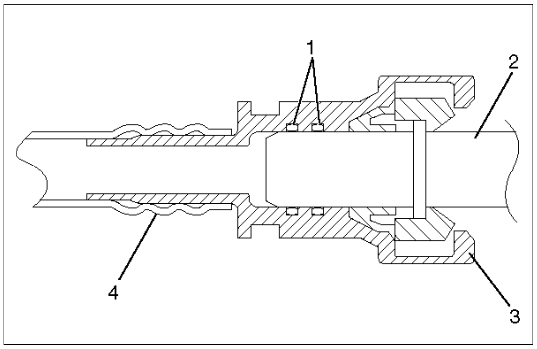
9. Install the fuel tank assembly (9).

NOTE: Refer to “Install the fuel tank” in this section.

FUEL TUBE / QUICK – CONNECTOR FITTINGS

Precautions

- Do not light a match or create a flame.
- Keep flames away from your work area to prevent flammable materials from catching fire.
- Disconnect battery ground cable to prevent electrical shorts.
- Pre-treat piping system or associated parts from thermal damage or from spattering when welding or similar heat-generating work.



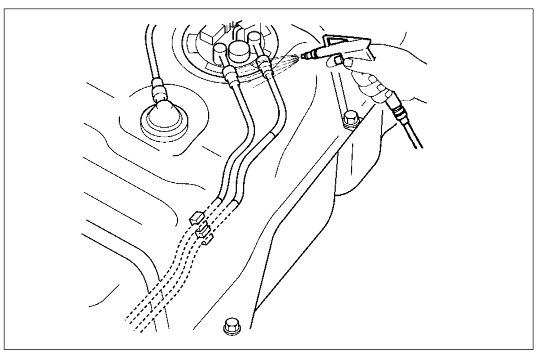
140R100032

Legend

(1) O-ring
(2) Port
(3) Connector
(4) Plastic Tube

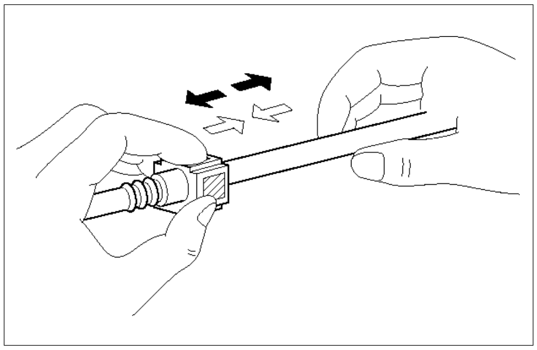
Cautions During Work

Do not expose the assembly to battery electrolyte or do not wipe the assembly with a cloth used to wipe off spilt battery electrolyte.
Piping that has been splattered with battery electrolyte or battery electrolyte soaked cloth that was wiped on the piping cannot be used.


141R100002

Removal

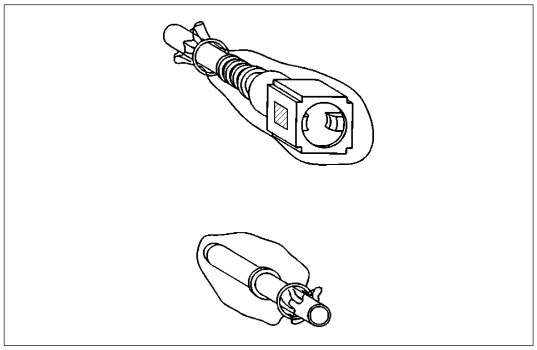
1. Open the fuel cap to relieve the fuel pressure in the tank.
   Use compressed air to remove any dirt on the fuel quick connect fittings prior to disconnecting the fittings.
   When disconnecting the fuel pipe, cover the area with a cloth to prevent fuel from splashing as the fuel pipe may still have some pressure in it.



140R100037

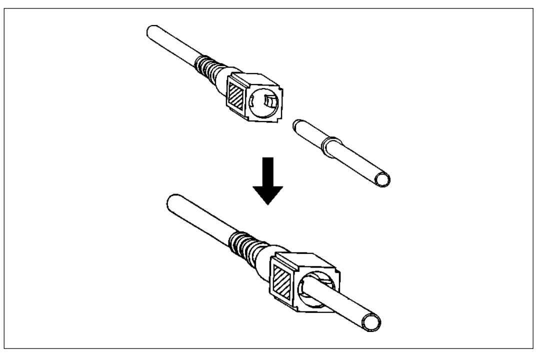
2. For removal of the quick connector, hold the quick connector in one hand, and pull out the connector with the other hand while pressing the square relieve button of the connector, as illustrated.

NOTE: Do not use tools of any kind. Only use bare hands when disconnecting the connector. Use a lubricant (light oil) and/or push and pull the connector until the pipe is disconnected.



140R100028

Cover the connectors that was removed with a plastic bag, to prevent dust or rain water from entering.



140R100036

Reuse of Quick–Connector

- Replace the port and connector if scratch, dent or crack is found.
- Remove any dirt build up on the port when installing the connector. Replace the connector, if there is any forms of rust, dent, scratch.
- After cleaning the port, insert it straight into the connector until it clicks. After it clicks, try pulling at 49N (5kgf) it out to make sure that it is not drawn and is securely locked.

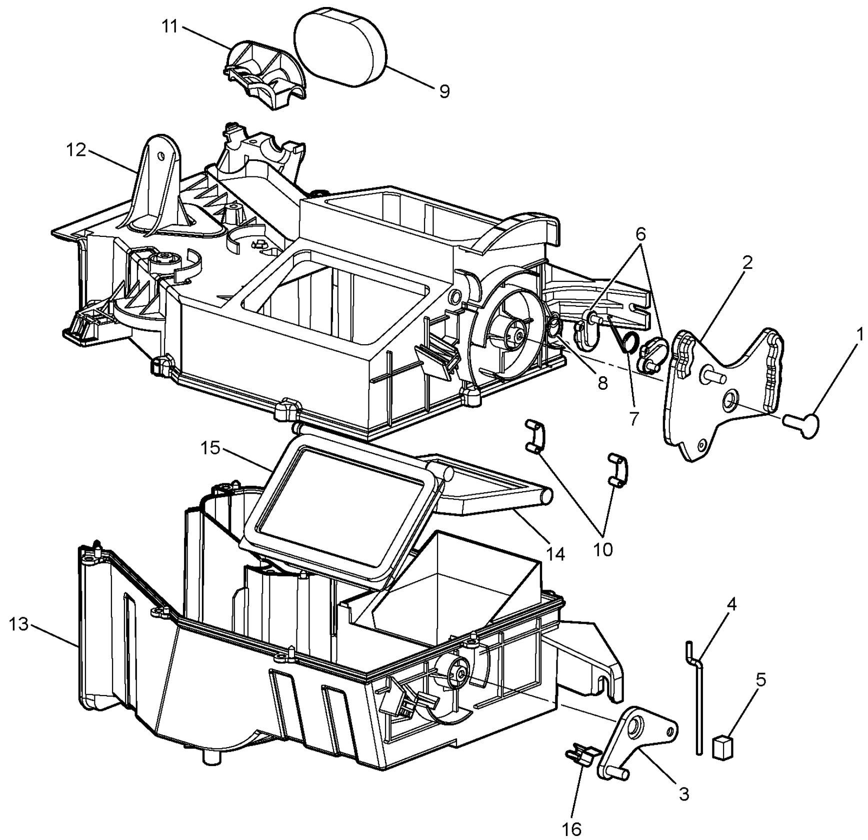
Assembling Advice

By applying engine oil or light oil to the pipe, port makes pipe assembly easier. The pipe assembly should take place immediately after applying oil (to prevent dust from sticking to the pipe surface – which may decrease sealing ability).

Test/Inspection After Assembling

1. Reconnect the battery negative cable.
2. Start the engine and observe the engine idle speed. The presence of dirt in the fuel system may affect the fuel injection system.
3. Check for fuel leakage from the connector.

DISASSEMBLY AND REASSEMBLY



This illustration is based on RHD model

RTW610LF000701

Disassembly Steps

1. Attaching screw
2. Main link-side
3. Sub link-side
4. Mode rod
5. Holder rod
6. Mode lever
7. DEF/FOOT-spring
8. VENT-spring
9. FOD H/pipes seal
10. Heater box clip
11. Heater core clamp
12. Upper case
13. Lower case
14. DEF/FOOT door
15. VENT door
16. Control cable clamp

Reassembly Steps

16. Control cable clamp
15. VENT door
14. DEF/FOOT door
13. Lower case
12. Upper case
11. Heater core clamp
10. Heater box clip
9. FOD H/pipes seal
8. VENT-spring
7. DEF/FOOT-spring
6. Mode lever
5. Holder rod
4. Mode rod
3. Sub link-side
2. Main link-side
1. Attaching screw

FILLER NECK

Removal

1. Remove the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

2. Put a marking the following point as the filler neck assembly is restored.
   - Each joint area of the hose (to restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (to restore axial direction and position of the clamp)
   - Each bolt in the clamp (to restore fasten length of bolt in the clamp)
   - The band clip (to restore position and fasten length of the band clip)

NOTE: Cover end of each hose and pipe to prevent any dust entering.

Installation

1. Align each marking and restore the following point.
   - Each joint area of the hose (Restore axial direction and insertion length of the hose)
   - Each fasten area of the clamp (Restore axial direction and position of the clamp)
   - Each bolt in the clamp (Restore fasten length of bolt in the clamp)

Torque	N·m (kg·m / lb ft)
	2.5 (0.25 / 21.7)

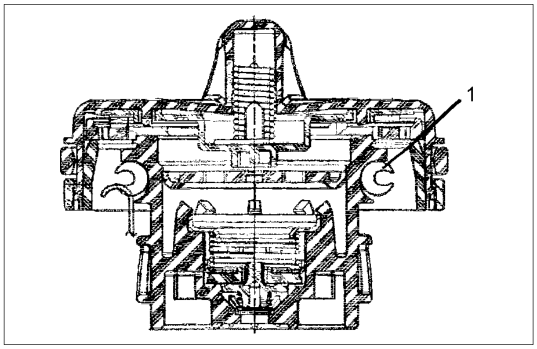
filler neck side except flat deck model.

   - The band clip (Restore position and fasten length of the band clip)

2. Install the fuel tank.

NOTE: Refer to "Fuel Tank" in this section.

FUEL FILLER CAP



RTW46CSH000301

Legend

1. Seal Ring

General Description

A vacuum valve and pressure valve are built into the fuel filler cap which adjusts the fuel pressure in the fuel tank to prevent fuel tank damage.

Inspection

The fuel filler cap must be inspected for seal condition.
The fuel filler cap must be replaced if found defective

CAUTION: A replacement fuel filler cap must be the same as the original. The fuel filler cap valve was designed primarily for this application and must be replaced with the same type or decreased engine performance may occur.

INJECTION PUMP

REMOVAL AND INSTALLATION

Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

1. **Battery**
   Remove the battery from the battery tray.

P1010011

2. **Drive Belt**
   1) Loosen the adjust bolt of the power steering pump pulley.
   2) Remove the drive belt.
3. **Power Steering Pump Assembly**


P1010003

4. **Accelerator Control Cable**
   Disconnect the accelerator cable from the intake throttle.
5. **Vacuum Hose**
   Disconnect the vacuum hose from the EGR valve and the intake throttle.
6. **Fan**

6C-4

7. Power Steering Pump Bracket

8. Throttle Position Sensor Harness Connector (4JA1TC/4JH1TC only)

Disconnect the harness connector from the throttle position sensor.

9. Oil Level Gauge

10. Fuel Pipe

1) Disconnect the fuel hoses from the fuel filter or priming pump.
2) Disconnect the fuel hoses from the injection pump.

6C-5

11. Fuel Filter Assembly (Except EURO III model)

12. Fuel Filter Bracket (Except EURO III model)

13. Leak Off Hose

Disconnect the leak off hose at the injection pump.

14. Injection Pipe Clip

15. Injection Pipe

1) Loosen the injection pipe sleeve nuts at the delivery valve side and the injection nozzle side.

Note:

Do not apply excessive force to the injection pipes.

2) Loosen the injection pipe clip.
3) Remove the injection pipes.

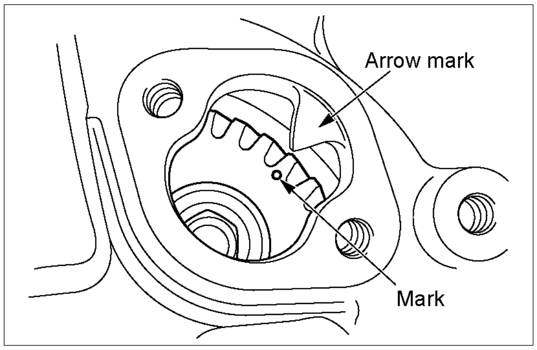
Note:

Plug the delivery holder ports with the caps to prevent the entry of foreign material.

16. Intake Manifold

1) Remove the EGR valve from the intake manifold and EGR pipe.
2) Loosen the intake rubber hoses clip.
3) Loosen the intake manifold bolts and nuts.

17. Injection Pump Cover (4JA1TC/4JH1TC only)



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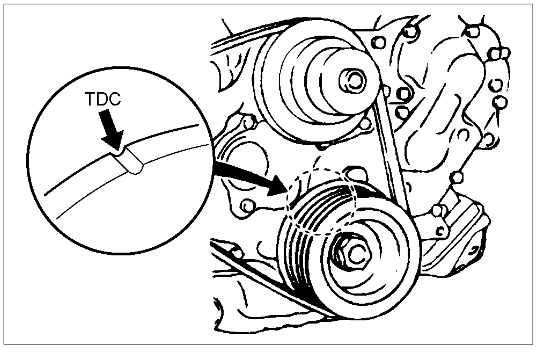

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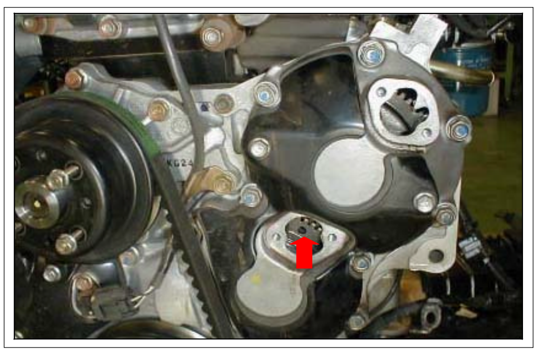

6C-7

18. Timing Check Hole Cover

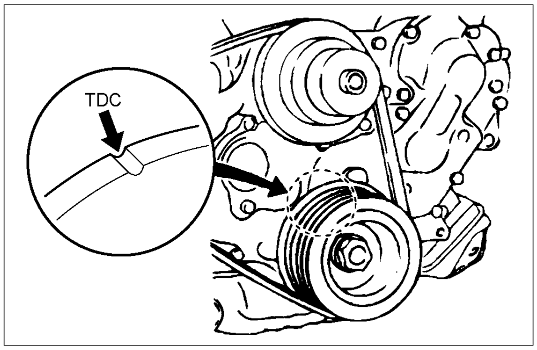
1) Remove the timing check hole cover.
2) For ease in reinstalling the injection pump, align the timing mark on the timing gear case cover by turning the crankshaft using wrench.
   And bring the piston in the No.1 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line aligned with the timing mark.

Note:

If the check hole cover is reinstalled with the lock bolt still in place, the crank pulley will not turn.

3) Insert the lock bolt (M6 x 30) into the scissors gear idle gear “B” fixing hole to prevent the scissors gear from turning.

29. Injection Pump Bracket
20. Injection Pump



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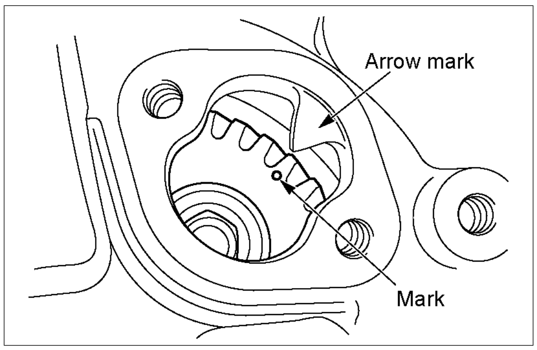

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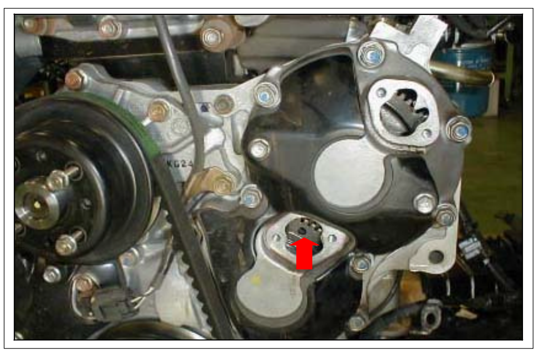


6C-7

Installation

1. Injection Pump

1) Install the injection pump gear (When gear is removed).

Injection Pump Gear Nut	N·m (kg·m/lb ft)
64 (6.5 / 47)	

2) Bring the piston in the No.1 cylinder to TDC on the compression stroke by turning the crankshaft until the crankshaft pulley TDC line aligned with the timing mark.

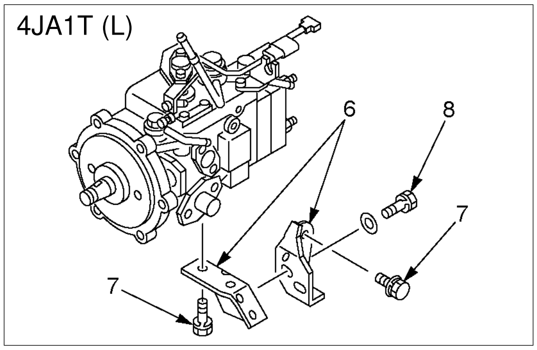
3) Install the injection pump to the timing gear case with align the timing mark on the pump gear to the arrow mark on the timing gear case cover.

4) Check that the setting marks of the injection pump gear and the idler gear B are aligned.

5) Remove the lock bolt (M6 × 30) from the idle gear “B”.

6) Tighten the injection pump fixing bolts to the specified torque.

Injection Pump Bolts Torque	N·m (kg·m/lb ft)
19 (1.9 / 14)	



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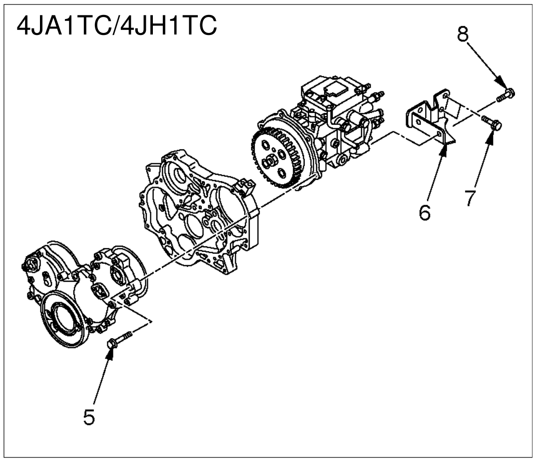

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2. Injection Pump Bracket

1) Install the injection pump bracket (6) and the bracket bolts (7) and (8) to the cylinder body. Temporarily tighten the bracket bolts.

2) Tighten the bracket bolts (7) to the specified torque.

3) Tighten the bracket bolts (8) to the specified torque.

Note:

Tighten the bracket bolt (8) first.

Injection Pump Bracket Torque	N·m(kg·m / lb ft)
(8) 19 (1.9 / 14)	
(7) 40 (4.1 / 30)	

3. Timing Check Hole Cover

Install the timing check hole cover and tighten bolts to the specified torque.

Timing Check Hole Cover Bolts

Torque	N·m(kg·m / lb ft)
8 (0.8 / 69)	

4. Injection Pump Cover (4JA1TC/4JH1TC only)

5. Intake Manifold

1) Install the intake manifold with gasket.

Intake Manifold Bolts

Torque	N·m(kg·m / lb ft)
19 (1.9 / 14)	

Intake Manifold Nuts Torque	N·m(kg·m / lb ft)
24 (2.4 / 17)	

2) Install the EGR valve to the intake manifold and EGR pipe temporarily.

3) Tighten the nuts and bolts to the specified torque

Torque	N·m (kg·m/lb ft)
Nuts	24 (2.4/17)
Bolts	27 (2.8/20)

6. Injection Pipe

Install the injection pipe.

Injection Pipe Torque	N·m(kg·m / lb ft)
29 (3.0 / 22)	
Nozzle Side (4JA1TC/4JH1TC)	N·m(kg·m / lb ft)
29 (3.0 / 22)	
Pump Side (4JA1TC/4JH1TC)	N·m(kg·m / lb ft)
40 (4.1 / 30)	

7. Injection Pipe Clip

Install the injection pipe clip.

Note:

Make absolutely sure that the clip is correctly positioned.

Injection Pipe Clip Torque	N·m(kg·m / lb in)
8 (0.8 / 69)	

8. Leak Off Pipe and Leak Off Hose

Install the leak off pipe to injection nozzle and connect the leak off hose to the injection pump.

9. Fuel Filter Bracket (Except EURO III model)

Install the fuel filter bracket and tighten bolts to the specified torque.

Fuel Filter Bracket Bolts Torque	N·m(kg·m / lb ft)
21 (2.1 / 15)	

10. Fuel Filter Assembly (Except EURO III model)

Install the fuel filter assembly to bracket and tighten bolts to the specified torque.

Fuel Filter Assembly Bolts Torque	N·m(kg·m / lb ft)
21 (2.1 / 15)	

11. Fuel Pipe

1) Connect the fuel hoses to the fuel filter or priming pump.
2) Connect the fuel hoses to the injection pump.

12. Oil Level Gauge

Install the oil level gauge and tighten bolts to the specified torque.

Oil Level Gauge Bolts Torque	N·m(kg·m / lb ft)
M8: 19 (1.9 / 14) M6: 8 (0.8/6 lb in)	

13. Throttle Position Sensor Harness Connector (4JA1TC/4JH1TC only)
Reconnect the harness connector to the throttle position sensor.

14. Power Steering Pump Bracket

15. Fan

16. Vacuum Hose
Connect the vacuum hose to the EGR valve and the intake throttle.

	Euro under	Euro I	Euro II	Euro III
4JA1L	without	with	with	Not used
4JA1TC	Not used	Not used	Not used	With cooler (EGR cooler)
4JH1TC	without	with	with	With (EGR cooler)

17. Accelerator Control Cable
1) Connect the accelerator cable to the injection pump (4JA1T) the intake throttle. (4JA1TC/4JH1TC only)

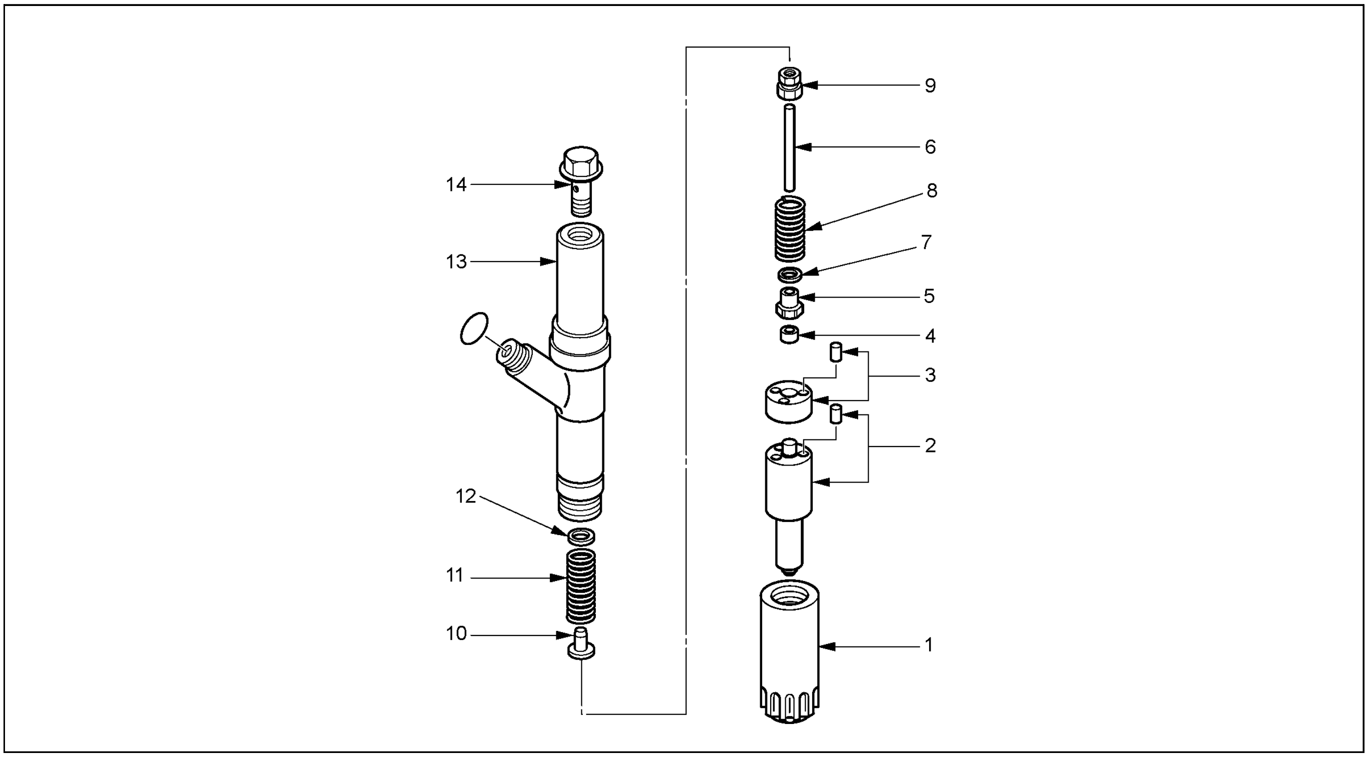
18. Power Steering Pump Assembly

19. Drive Belt
Install the drive belt and adjust the belt tension.

20. Battery

INJECTION NOZZLE (4JA1L)

DISASSEMBLY



RTW76CMF000401

Disassembly Steps

1. Retaining nut
2. Nozzle & pin
3. Spacer & pin
4. Lift Piece
5. Spring seat
6. Push rod
7. Shim (Second nozzle opening pressure adjustment)
8. Second spring
9. Collar
10. Spring seat
11. First spring
12. Shim (First nozzle opening pressure adjustment)
13. Nozzle holder body
14. Eye bolt

Important Operations

Injection nozzle adjustment is possible only on the 4JA1L engine.

The two-spring nozzle holder has been developed to reduce NOx (Nitrogen Oxides) and particulates from direct injection diesel engine exhaust.

Before disassembly remove carbon deposit from nozzle and nozzle holder using a wire brush and wash the outside nozzle holder assembly.

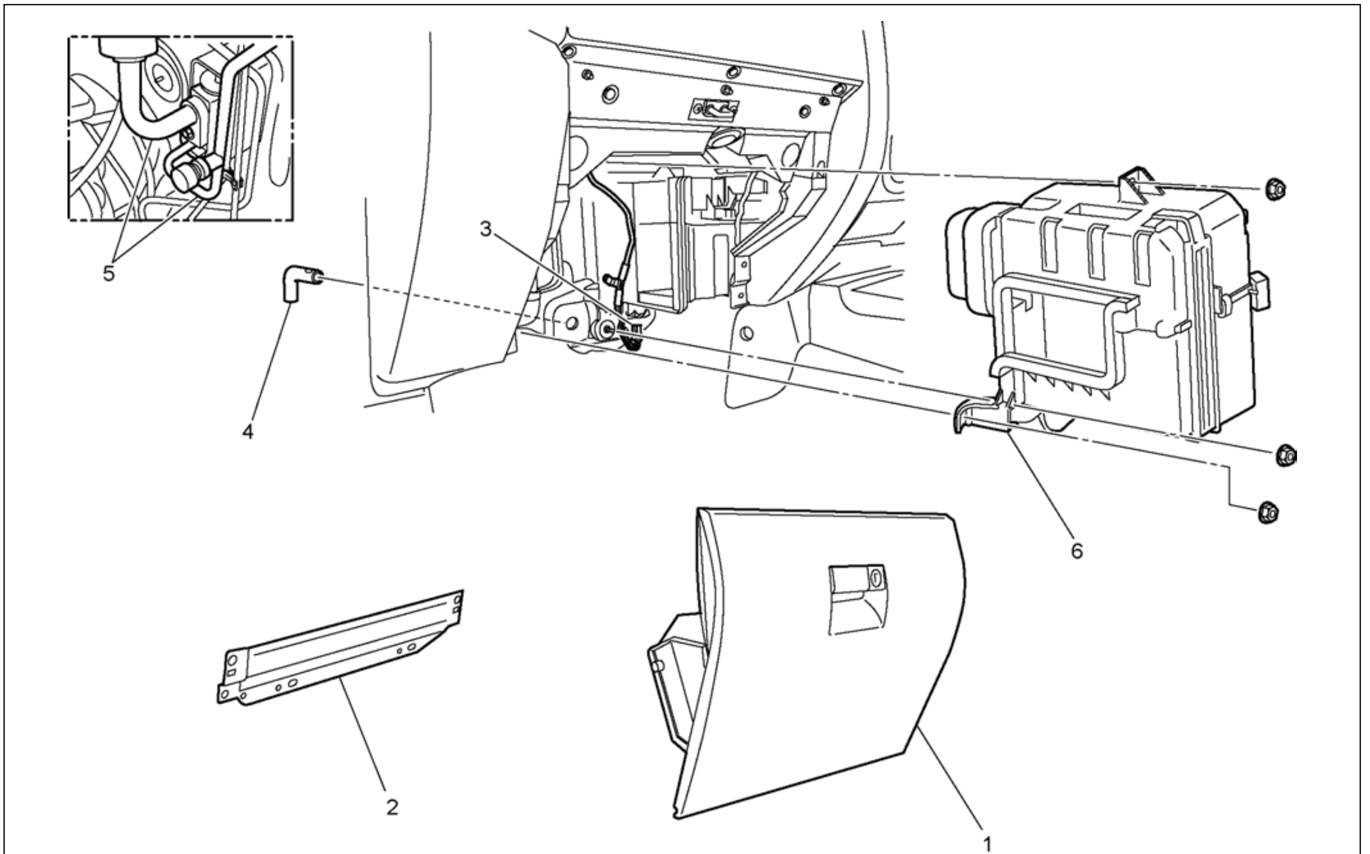
Caution:

Do not touch nozzle holes with the wire brush during cleaning it.

Disassemble the nozzle holder assembly to numerical order.

EVAPORATOR (WITH A/C)

REMOVAL AND INSTALLATION



This illustration is based on RHD model

RTW710LF003001

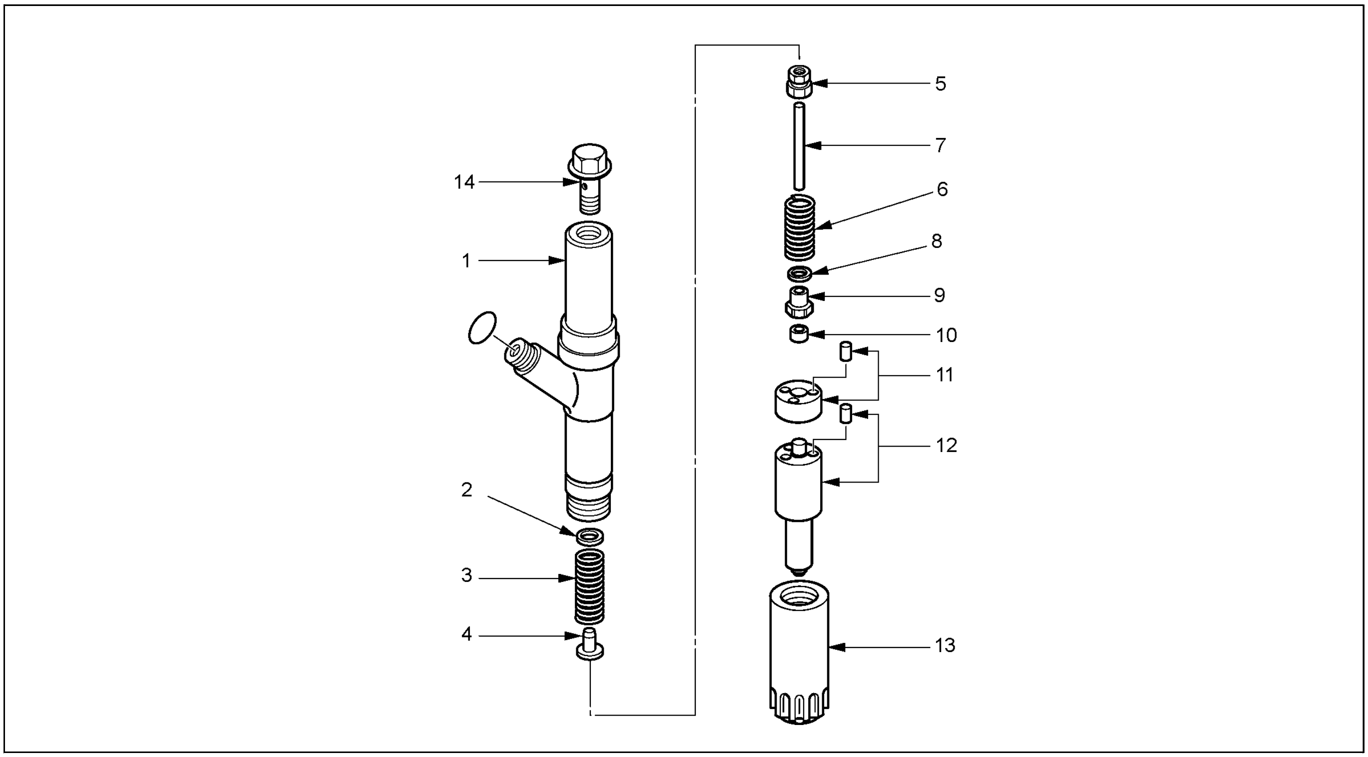
Removal Steps

1. Glove box
2. Passenger lower bracket
3. Electronic thermostat connector
4. Drain hose
5. Refrigerant line
6. Evaporator assembly

Installation Steps

6. Evaporator assembly
5. Refrigerant line
4. Drain hose
3. Electronic thermostat connector
2. Passenger lower bracket
1. Glove box

REASSEMBLY



RTW76CMF000501

Reassembly Steps

1. Nozzle holder body
2. Shim (First opening pressure adjustment)
3. First spring
4. Spring seat
5. Collar
6. Second spring
7. Push rod
8. Shim (Second opening pressure adjustment)
9. Spring seat
10. Lift Piece
11. Spacer & pin
12. Nozzle & pin
13. Retaining nut
14. Eye bolt

Important Operations

The nozzle holder is adjusted as the components are reassembled in the sequence above.

As adjustment of the two-spring nozzle holder is made in hundredths of a millimeter, clean the parts thoroughly in light oil to completely remove any dirt or foreign matter.

REASSEMBLY AND ADJUSTMENT PROCEDURE

1	First nozzle opening pressure adjustment	Adjust the first nozzle opening pressure using the shim.
2	Full needle valve lift confirmation	Confirm the full needle valve lift in accordance with the closed method.
3	Pre-lift confirmation	Confirm pre-lift in accordance with the closed method. **CAUTION:** **If not as specified, replace the nozzle assembly, lift piece, pins and spacer using the nozzle service kit.**
4	Second nozzle opening pressure confirmation	Confirm the second nozzle opening pressure in accordance with the closed method.
5	Second nozzle opening pressure adjustment	Adjust the second nozzle opening pressure using the shim.
6	Final inspection	Confirm the condition of the fuel spray with the nozzle and nozzle holder assembled.

First nozzle opening pressure adjustment

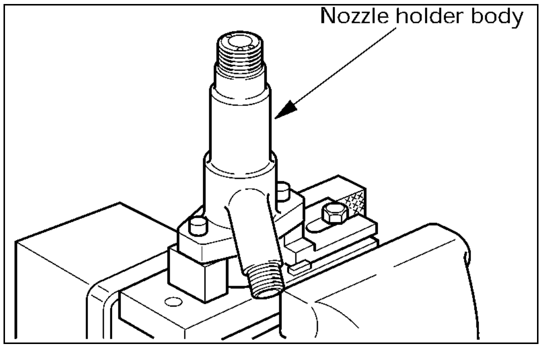
Nozzle needle valve full-lift	0.25 mm (0.0098 in)
Nozzle needle valve pre-lift	0.04 mm(0.0016 in) at 20,000 kPa (2901 psi, 204 kg/cm^2)
Nozzle pressure	
4JA1T(L) 1st Stage	19.1 MPa (2759 psi, 194 kg/cm^2)
2nd Stage	25.5-27.0 MPa (3768-3911 psi, 260-275 kg/cm^2)

NOTE: Only 4JA1L can perform adjustment of a nozzle.

Injection Nozzle Adjustment

First nozzle opening pressure adjustment

1.Clamp the nozzle holder in a vise.



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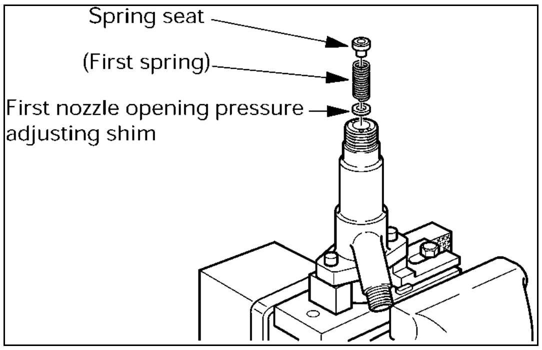
2. Install the shim, first spring and spring seat in the nozzle holder.



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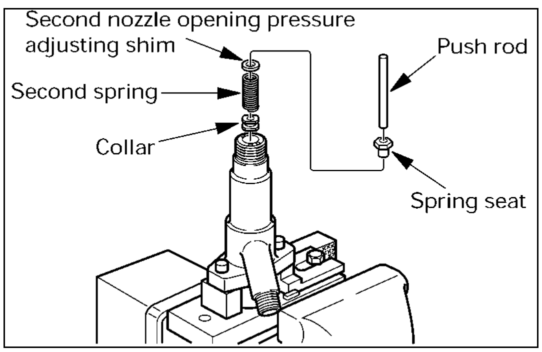
3. Install the collar, second spring, shim, spring seat and pushrod in the nozzle holder.



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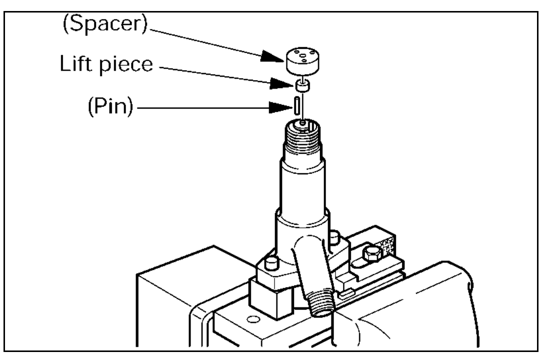
4. Install the pins, lift piece and spacer in the nozzle holder.



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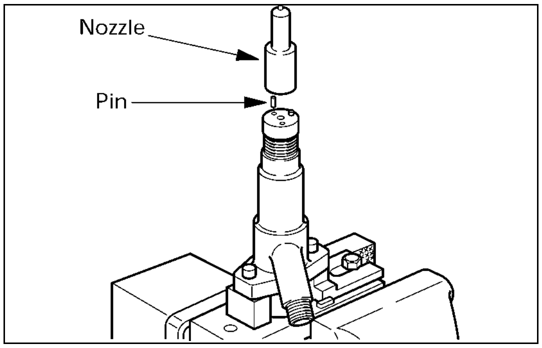

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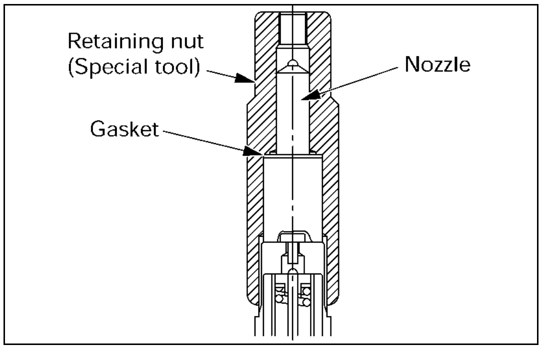
5. Install the pins in the spacer.
6. Install the nozzle on the spacer.



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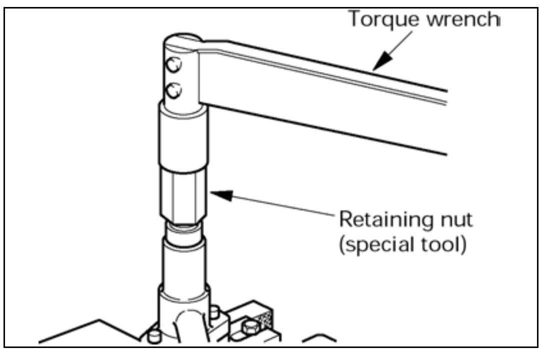
7. Hand-tighten the adjustment retaining nut together with the gasket to the nozzle holder.
   Retaining nut: 157892-3200 (Bosch AS)
   Gasket: 157892-5100 (Bosch AS)
   (Bosch AS = Bosch Automotive Systems Corporation)



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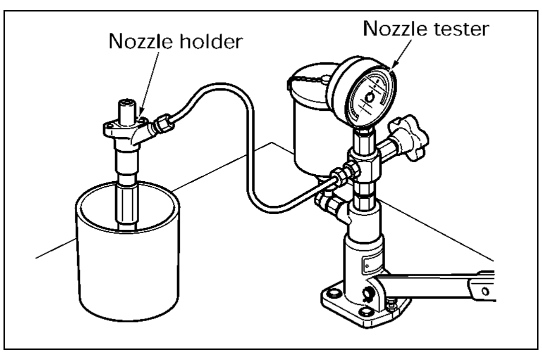
8. Tighten the adjustment retaining nut to the specified torque.
   Torque: 5.1 kg·m (36.9 lb·ft/50 N·m)



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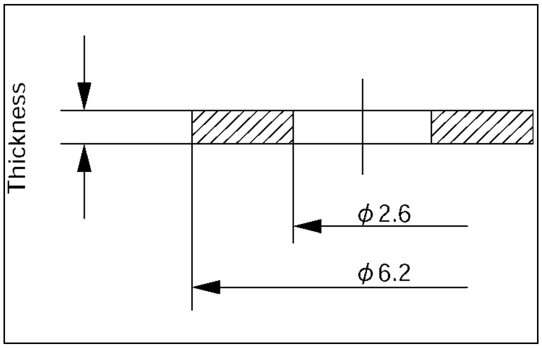
9. Set the nozzle holder to the nozzle tester.
10. Operate the nozzle tester and measure the first nozzle opening pressure.
11. If the first nozzle opening pressure is not as specified, disassemble the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

- **Use a micrometer to measure shim thickness.**



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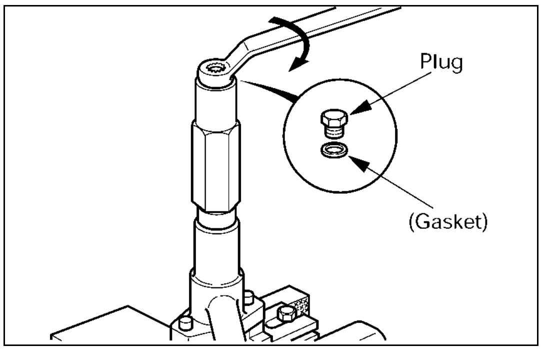
- First nozzle opening pressure adjusting shims

Parts No. (ISUZU)	Thickness (mm)
115349-0420	0.40
115349-0430	0.50
115349-0440	0.52
115349-0450	0.54
115349-0460	0.56
115349-0470	0.58
115349-0480	0.60
115349-0490	0.70



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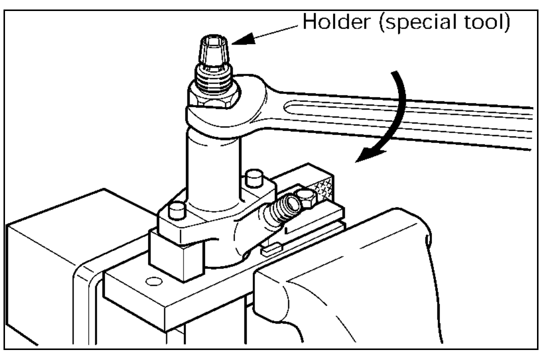
Full needle valve lift confirmation

1. Install the gasket and plug on the adjustment retaining nut.
   Gasket: 026508-1140 (Bosch AS)
   8-9422-7602-0 (ISUZU)
   Plug: 157892-1600 (Bosch AS)



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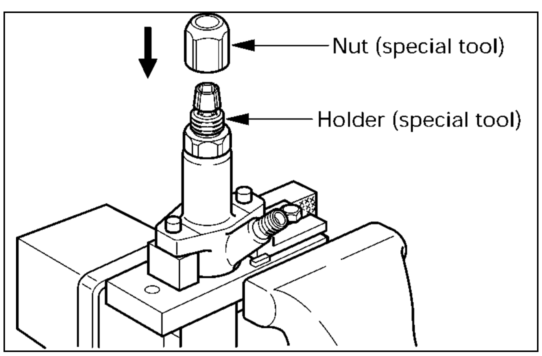
2. Position the nozzle holder with the nozzle facing down and install the dial gauge holder on the nozzle holder.
   Dial gauge holder: 157892-5000 (Bosch AS)



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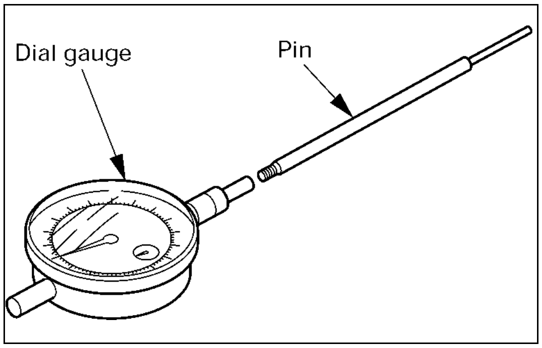
3. Install the nut on the dial gauge holder.
   Nut: 157892-1000 (Bosch AS)



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4. Install the pin to the dial gauge.

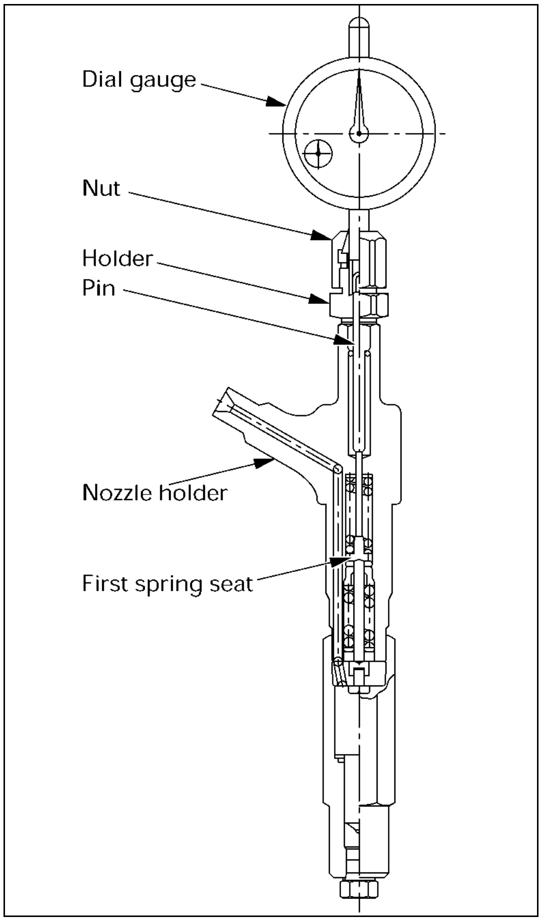
Note:

The lengths of the pins do not include the threaded portions.

Pin (L=100 mm): 157892-5200 (Bosch AS)

Dial gauge: 157954-3800 (Bosch AS)

185317-0150 (ISUZU)



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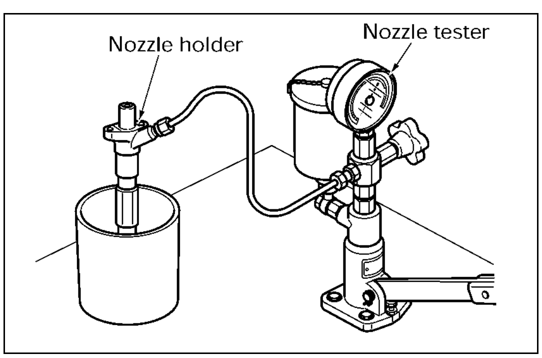
5. Secure the dial gauge to the nozzle holder using the nut so that the pin contacts the tip of the first spring seat.

CAUTION:

- **Secure the dial gauge so that a stroke of 2 mm can be measured.**
- **Do not over-tighten the nut as the dial gauge shaft may jam. (Confirm from the dial gauge that the shaft moves smoothly.)**



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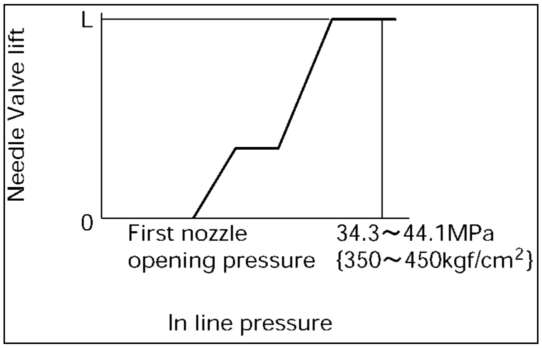
6. Set the nozzle holder to the nozzle tester and put needle to zero on the dial gauge.
7. Operate the nozzle tester to bleed any air from inside the retaining nut and to confirm that no fuel leaks.



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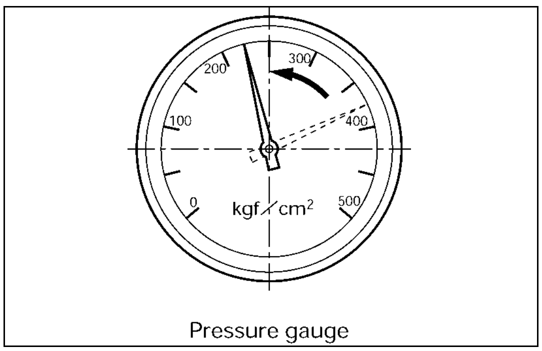
8. Operate the nozzle tester and increase the in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle's needle valve moves through its full lift.
   Record full lift 'L'. (Read dial gauge)

Nozzle Full Lift	mm (in)
0.25 ± 0.02 (0.0098 ± 0.00008)	

Note:

The above operation is used to determine whether the nozzle seat is worn and whether the nozzle assembly is in good condition.



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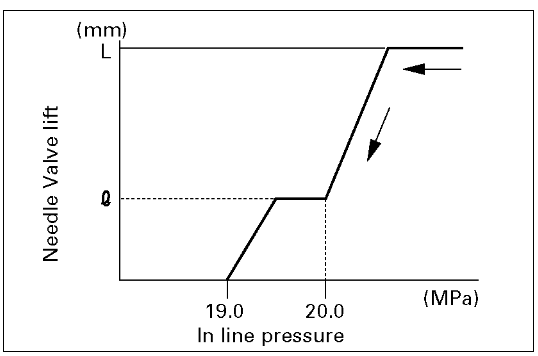

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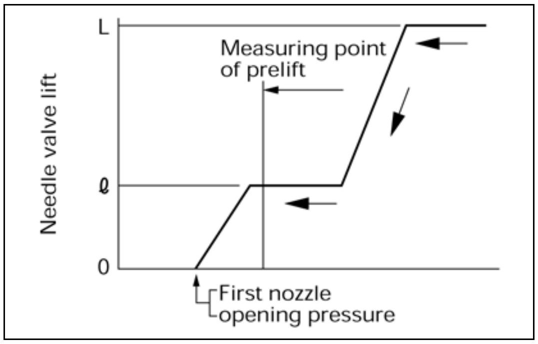
Pre-lift confirmation

1. With the needle valve at full lift, release the nozzle tester handle.

   Note:

   The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.



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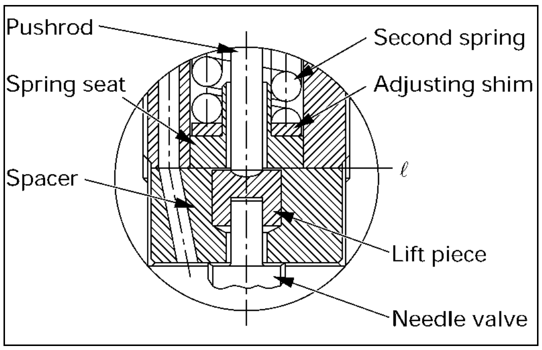
2. Read the needle valve “pre-lift” point from the dial gauge indication (once the needle valve has descended when the second spring has stopped operating).

Pre-lift measuring point:
Read the dial gauge at first nozzle opening pressure +approx 1 MPa (10 kg/cm^2).

Pre-lift mm

	Pressure Mpa (psi/ kg/cm^2)	Lift mm (in)
4JA1T(L)	20.1 (2,858/205)	0.04 (0.0016)

Note:
This point can be found while the pressure is decreasing.



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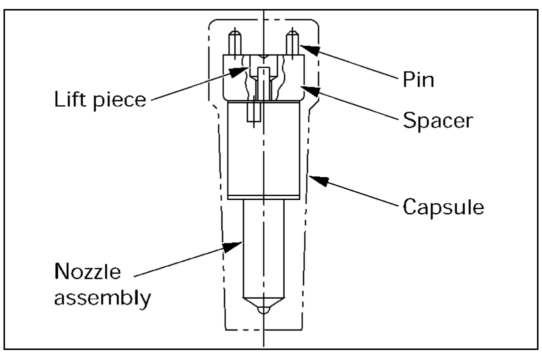
3. Confirm that pre-lift is as specified.



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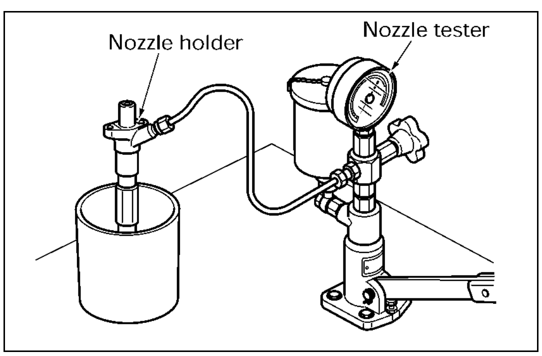
4. If pre-lift is not as specified, replace the pins, lift piece, spacer and nozzle assembly as a set with the service kit.

Service kit

105017-2990 (Bosch AS)
897302-3070 (ISUZU)



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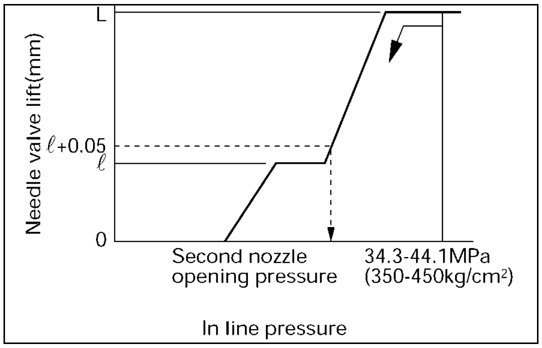
Second nozzle opening pressure confirmation

1. After pre-lift confirmation, operate the nozzle tester to increase in-line pressure to 34.3 - 44.1 MPa (350 - 450 kg/cm^2) so that the nozzle’s needle valve moves through its full lift.



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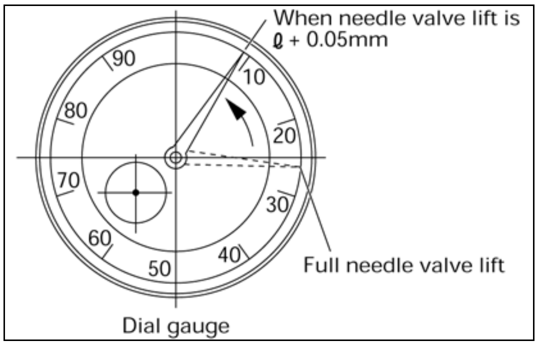
2. Release the nozzle tester handle so that in-line pressure decreases.

Note:

The in-line pressure will decrease and needle valve lift (as indicated on the dial gauge) will also decrease a little.



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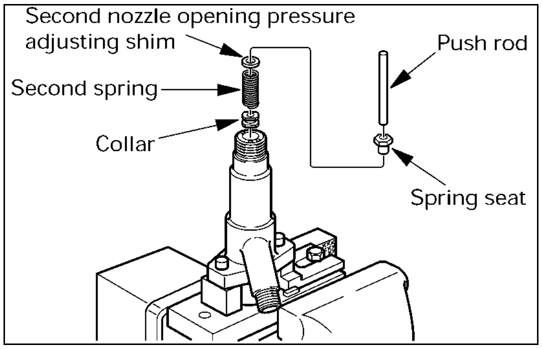
3. Then, read the pressure gauge indication (second nozzle opening pressure) the instant that the dial gauge indicates the specified needle valve lift (usually pre-lift + 0.05 mm).

Second Nozzle Opening Pressure

	Pressure Mpa (psi/ kg/cm^2)	Lift mm (in)
4JA1T(L)	25.5-27.0 (3768-3911/260-275)	0.09 (0.0035)



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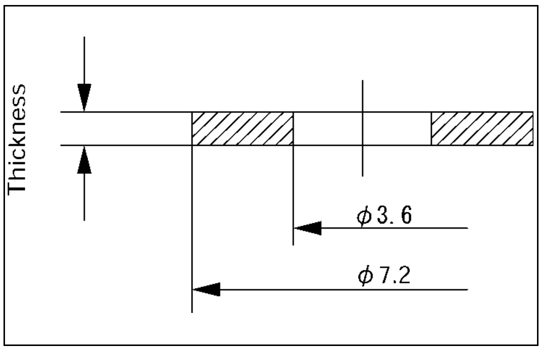
Second nozzle opening pressure adjustment

If the second nozzle opening pressure is not as specified, disassemble the nozzle from the nozzle holder and replace the shim until the pressure is as specified.

CAUTION:

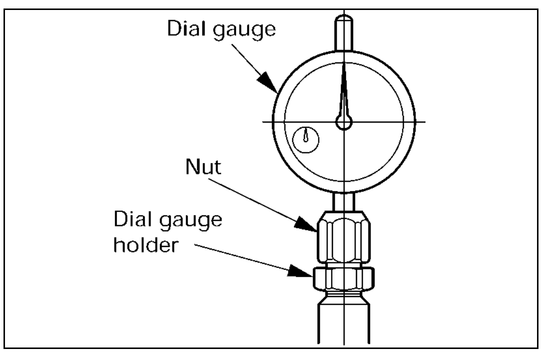
- **Because the second opening pressure changes when the first opening pressure changes, the second opening pressure must be adjusted when the first opening pressure changes.**
- **Use a micrometer to measure shim thickness.**
- **Use some combination of 3 adjusting shims to adjust the pressure.**



040LX009.tif

- Second nozzle opening pressure adjusting shims

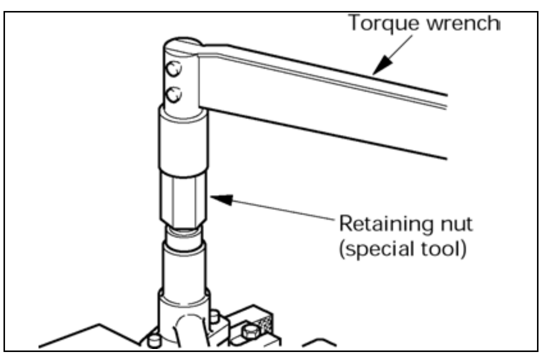
Part No. (ISUZU)	Thickness (mm)	Part No. (ISUZU)	Thickness (mm)
897116-0290	0.10	897116-0380	0.53
897116-0320	0.20	897116-0390	0.54
897116-0330	0.30	897116-0400	0.55
897116-0340	0.40	897116-0410	0.56
897116-0350	0.50	897116-0420	0.57
897116-0360	0.51	897116-0430	0.58
897116-0370	0.52	897116-0440	0.59



040MV028.tif

Final inspection

1. Remove the dial gauge, nut and dial gauge holder.



040MV014-1.tif

2. Remove the adjustment retaining nut and gasket.
3. Install the original retaining nut, confirm that the pins are inserted fully into the nozzle, and then hand-tighten the retaining nut. Then, tighten the original retaining nut to the specified torque.

   Torque: 7.0 kg·m (50.6 lb·ft/69 N·m)